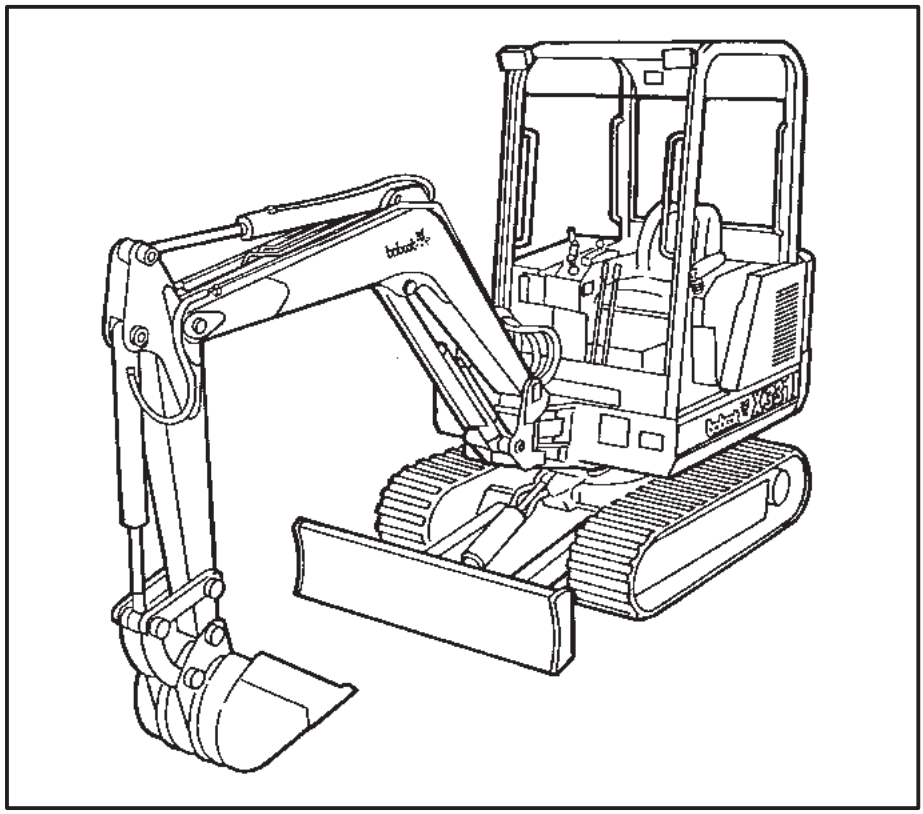
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X 331

Excavator

Service Manual

(S/N 512911001 – 512912999)



MELROE
INGERSOLL-RAND

6724222(2–96)

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.

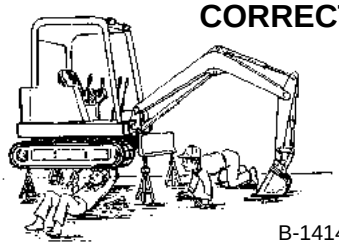
CORRECT



B-10731a

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

CORRECT



B-14148

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

CORRECT



B-14142

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

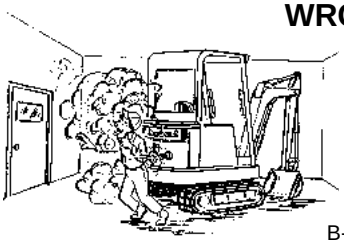
WRONG



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.**

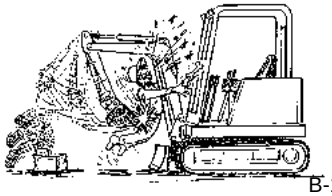
WRONG



B-14141

- **Vent exhaust to outside when engine must be run for service.**
- **Exhaust system must be tightly sealed. Exhaust 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 engine 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 guard 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 performed 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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ALPHABETICAL INDEX

ACCUMULATOR (S/N 12999 & Below) 2–1
ACCUMULATOR (S/N 13001 & Above) 2–1
AIR CLEANER 1–1
AIR CLEANER 7–1
ALTERNATOR 6–1
ARM 4–1
ARM CYLINDER 2–1
AUXILIARY SELECTOR VALVE 2–1

BATTERY 6–1
BLADE 5–1
BLADE CONTROL LEVER AND CABLE 3–1
BLADE CYLINDER 2–1
BOOM 4–1
BOOM CYLINDER 2–1
BOOM PIVOT BUSHING 4–1
BOOM SWING BRACKET 4–1
BOOM SWING CYLINDER 2–1
BUCKET 4–1
BUCKET CYLINDER 2–1
BUCKET TEETH 4–1

CAB 4–1
CAB/CANOPY REAR COVER 4–1
CAB ELECTRICAL 6–1
CENTER SWIVEL JOINT 4–1
COOLING SYSTEM 1–1
COUNTERBALANCE VALVE (S/N 11057–12999) . 4–1
COUNTERWEIGHTS 4–1
CRANKSHAFT AND BEARINGS 7–1
CRANKSHAFT GEAR 7–1
CROSS PORT RELIEF VALVE
(S/N 11001–11056 & S/N 13001 & Above) 4–1
CYLINDER BORE 7–1
CYLINDER HEAD 7–1

DECIMAL & MILLIMETER EQUIVALENTS 8–1

ELECTRICAL SYSTEM 6–1
ENGINE 7–1
ENGINE COMPRESSION 7–1
ENGINE COVER 1–1
ENGINE COVER 4–1
ENGINE FLYWHEEL 7–1
ENGINE LUBRICATION SYSTEM 1–1
ENGINE OIL PRESSURE 7–1
ENGINE OIL SPECIFICATIONS 8–1
ENGINE SPECIFICATIONS 8–1

FAN GUARD 7–1
FINAL DRIVE CASE 1–1
FLOORMAT AND FLOOR PLATE 4–1
FRONT ENGINE COVER 4–1
FUEL CAMSHAFT 7–1
FUEL, COOLANT AND LUBRICANTS 8–1
FUEL INJECTOR NOZZLES 7–1
FUEL INJECTION PUMP 7–1
FUEL LEVEL SENDER 6–1
FUEL SHUT–OFF SOLENOID 7–1
FUEL SYSTEM 1–1

GAUGES 6–1
GAUGE LIGHTS 6–1
GLOW PLUGS 7–1

HEATER AIR FILTER SERVICE 1–1
HYDRAULIC CONTROL VALVE (3–Spool)
(S/N 12999 & Below) 2–1
HYDRAULIC CONTROL VALVE (6–Spool)
(S/N 12999 & Below) 2–1
HYDRAULIC CONTROL VALVE (5–Spool)
(S/N 13001 & Above) 2–1
HYDRAULIC CONTROL VALVE (5–Spool)
(S/N 13001 & Above) 2–1
HYDRAULIC CYLINDER 2–1
HYDRAULIC EXCAVATOR SPECIFICATIONS 8–1
HYDRAULIC FILTER ASSEMBLY 2–1
HYDRAULIC PUMP 2–1
HYDRAULIC RESERVOIR AND FUEL
RESERVOIR 2–1
HYDRAULIC SERVICE INFORMATION
(S/N 11001–12999) 2–1
HYDRAULIC SERVICE INFORMATION
(S/N 13001 & Above) 2–1
HYDRAULIC SYSTEM 1–1
HYDRAULIC SYSTEM TROUBLESHOOTING 2–8

IDLER GEAR AND CAMSHAFT 7–1
INSPECTION COVER (S/N 11001–11999) 4–1
INSTRUMENT PANEL 6–1

JOYSTICK (S/N 12999 & Below) 3–1
JOYSTICK (S/N 13001 & Above) 3–1
JOYSTICK CONTROL CHANGE 2–1

LEFT CONSOLE (S/N 12999 & Below) 3–1
LEFT CONSOLE (S/N 13001 & Above) 3–1
LEFT CONSOLE RELEASE HANDLE
(S/N 13001 & Above) 3–1
LEFT HAND CORNER POST 4–1
LEFT HAND SIDE COVER 4–1
LIFTING AND BLOCKING THE EXCAVATOR 1–1
LUBRICATION OF THE EXCAVATOR 1–1

MAIN RELIEF VALVES (S/N 11001–12999) 2–1
MAIN RELIEF VALVES (Adjustable)
(S/N 13001 & Above) 2–1
MUFFLER 7–1

OIL COOLER 2–1
OIL PUMP 7–1

PISTON AND CONNECTING ROD 7–1
PORT BLOCK 2–1
PORT RELIEF VALVES AND MAIN RELIEF VALVES
(S/N 13001 & Above) 2–1

RADIATOR 7–1
REAR FLOOR PLATE 4–1
RIGHT CONSOLE COVER 3–1
RIGHT CONSOLE 3–1
RIGHT HAND CORNER POST 4–1
RIGHT HAND SIDE COVER 4–1
ROCKER ARM AND SHAFT 7–1
ROPS CANOPY 4–1

SEAT AND SEAT MOUNT 4–1
SERVICE SCHEDULE 1–1
SPARK ARRESTOR MUFFLER 1–1
SPEED CONTROL LEVER 3–1
STARTER 6–1
STEERING LEVER AND PEDALS 3–1
SWING BRACKET BUSHING 4–1
SWING GEAR BOX 4–1
SWING MOTOR 4–1

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ALPHABETICAL INDEX (Cont'd)

SWING MOTOR DRIVE CARRIER
(S/N 13001 & Above) 4–1
SWING MOTOR COVER 4–1

TIMING GEARS 7–1
TIMING GEARCASE COVER 7–1
TOOL BOX 4–1
TRACK DAMAGE IDENTIFICATION 5–1
TRACK FRAME 5–1
TRAVEL MOTOR 5–1
TRANSPORTING THE EXCAVATOR 1–1
TROUBLESHOOTING 6–1
TROUBLESHOOTING 7–1
TWO SPEED SWITCH (S/N 13001 & Above) 2–1
TWO SPEED VALVE (S/N 12999 & Below) 2–1

UPPERSTRUCTURE AND SWING
CIRCLE GEAR 4–1
USING A BOOSTER BATTERY
(JUMP STARTING) 1–1
U.S. TO METRIC CONVERSION 8–1

VALVE CLEARANCE 7–1
VALVE, VALVE SEAT AND GUIDE 7–1

WATER PUMP 7–1

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CONTENTS

SAFETY INSTRUCTIONS iv
SERIAL NUMBER LOCATIONS vi
DELIVERY REPORT vi
HYDRAULIC EXCAVATOR IDENTIFICATION vii
PREVENTIVE MAINTENANCE 1–1
HYDRAULIC SYSTEM 2–1
DRIVE SYSTEM 3–1
UPPER WORKS & SWING SECTION 4–1
MAIN FRAME & TRACKS 5–1
ELECTRICAL SYSTEM 6–1
ENGINE SERVICE 7–1
SPECIFICATIONS 8–1

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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/TOPS/FOGS is in good condition and is not modified.



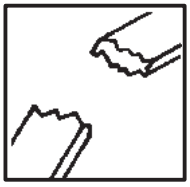
2. Check that ROPS/TOPS mounting hardware is tightened and is Melroe approved.



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



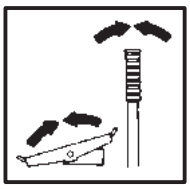
4. Inspect for loose or broken parts or connections.



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



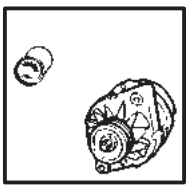
6. Steering levers, control levers and foot pedals must return to neutral. Check that foot pedals lock and control lever locks are in working condition.



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



8. Check the electrical charging system.



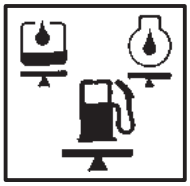
9. Safety treads must in good condition.



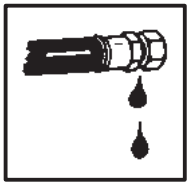
10. Check for correct function of indicator lamps (Optional on some models).



11. Check hydraulic fluid level, engine oil level and fuel supply.



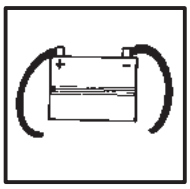
12. Inspect for fuel, oil or hydraulic fluid leaks.



13. Lubricate the excavator.



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 excavator 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 excavator gives operating information as well as routine maintenance and service procedures. It is a part of the excavator and must stay with the machine when it is 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 loader 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.

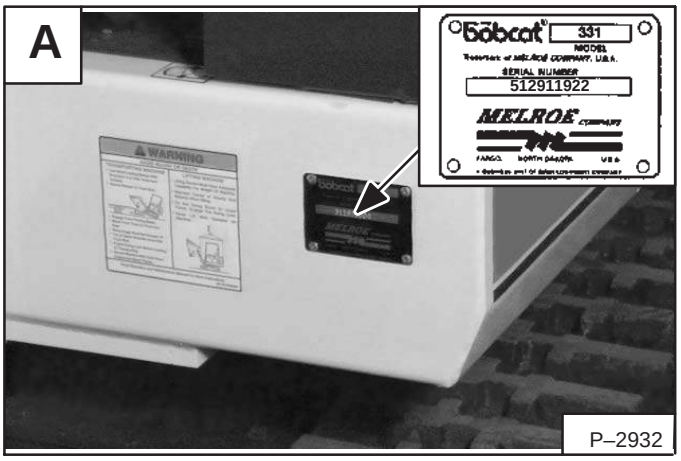
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SERIAL NUMBER LOCATIONS

Always use the serial number of the loader 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.

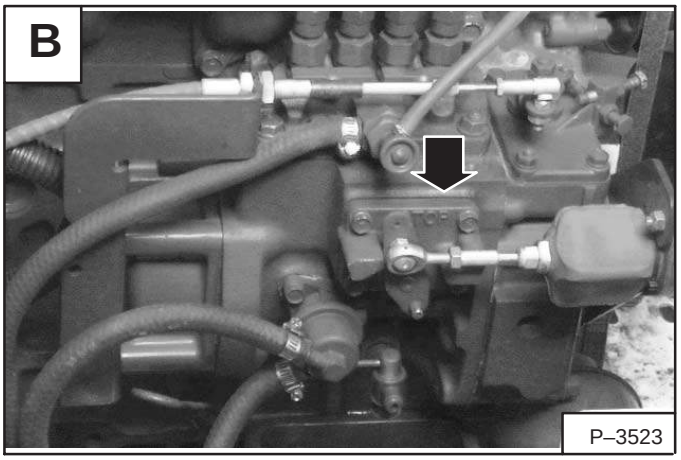
HYDRAULIC EXCAVATOR SERIAL NUMBER

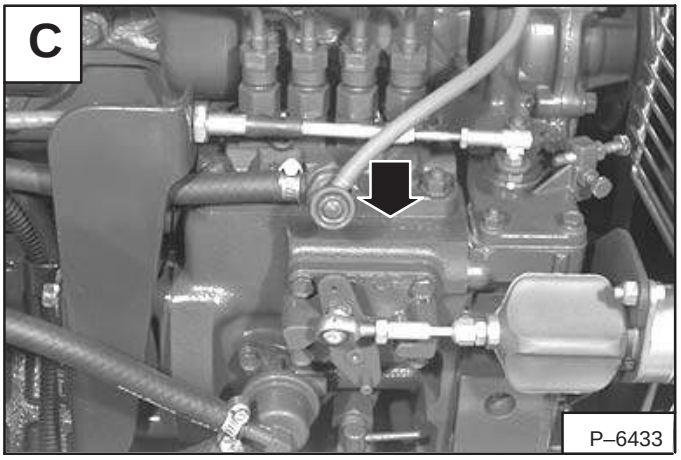
The excavator serial number is on the front of the machine frame, to the left of the boom **[A]**.



ENGINE SERIAL NUMBER

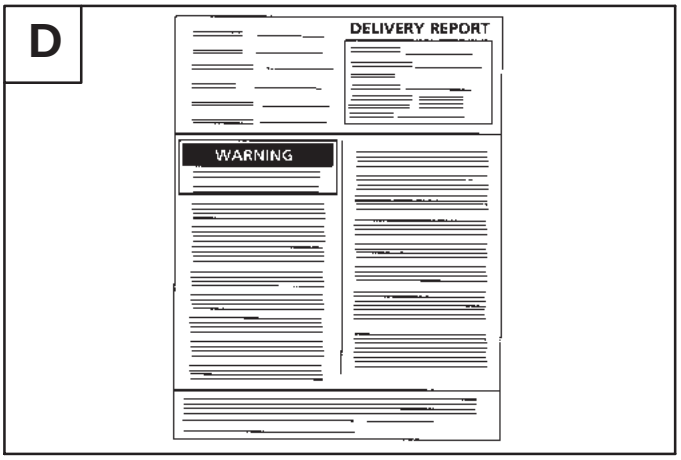
The engine serial number is located on the engine block, near the fuel injection pump (S/N 11001–11999) **[B]** (S/N 12001 & Above) **[C]**.





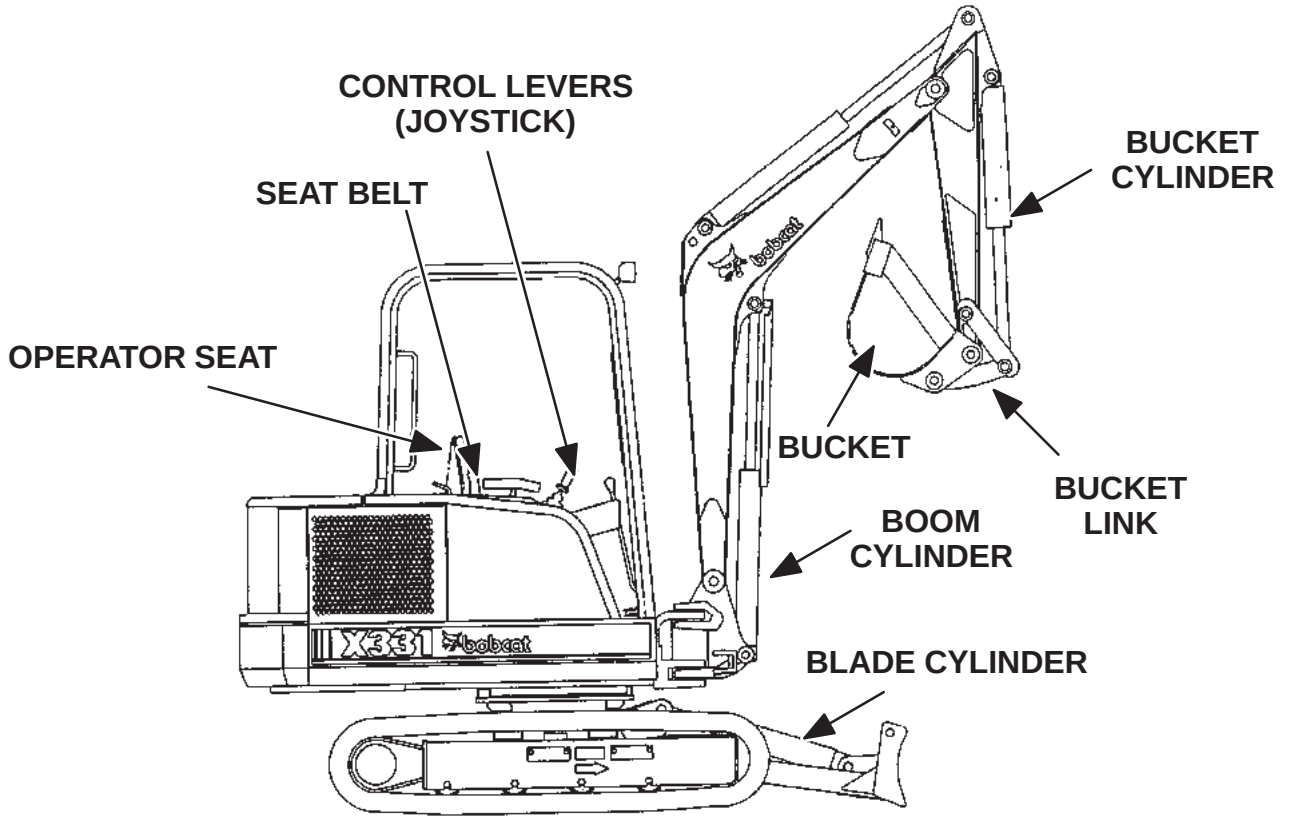
DELIVERY REPORT

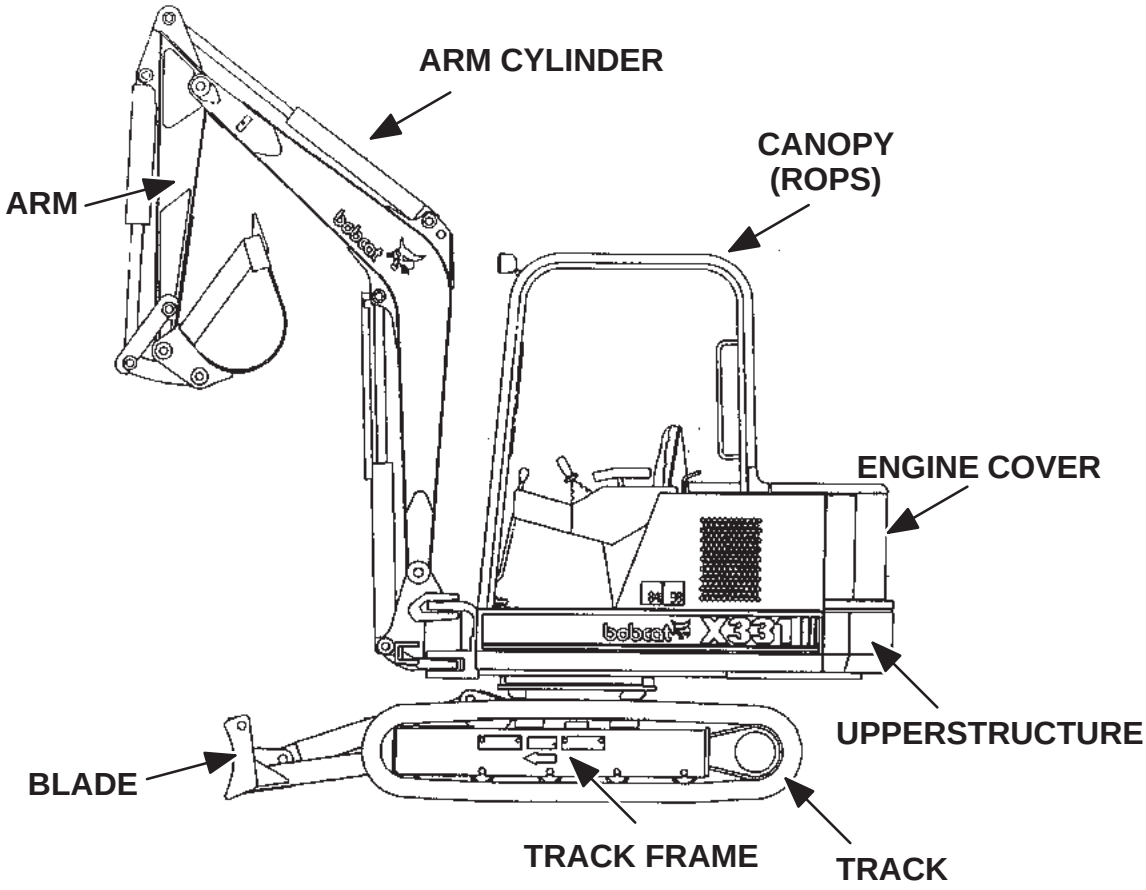
The Delivery Report must be filled out by the dealer and signed by the owner or operator when the Bobcat excavator is delivered. The form contents must be explained to the owner. Make sure it is filled out completely **[D]**.



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HYDRAULIC EXCAVATOR IDENTIFICATION





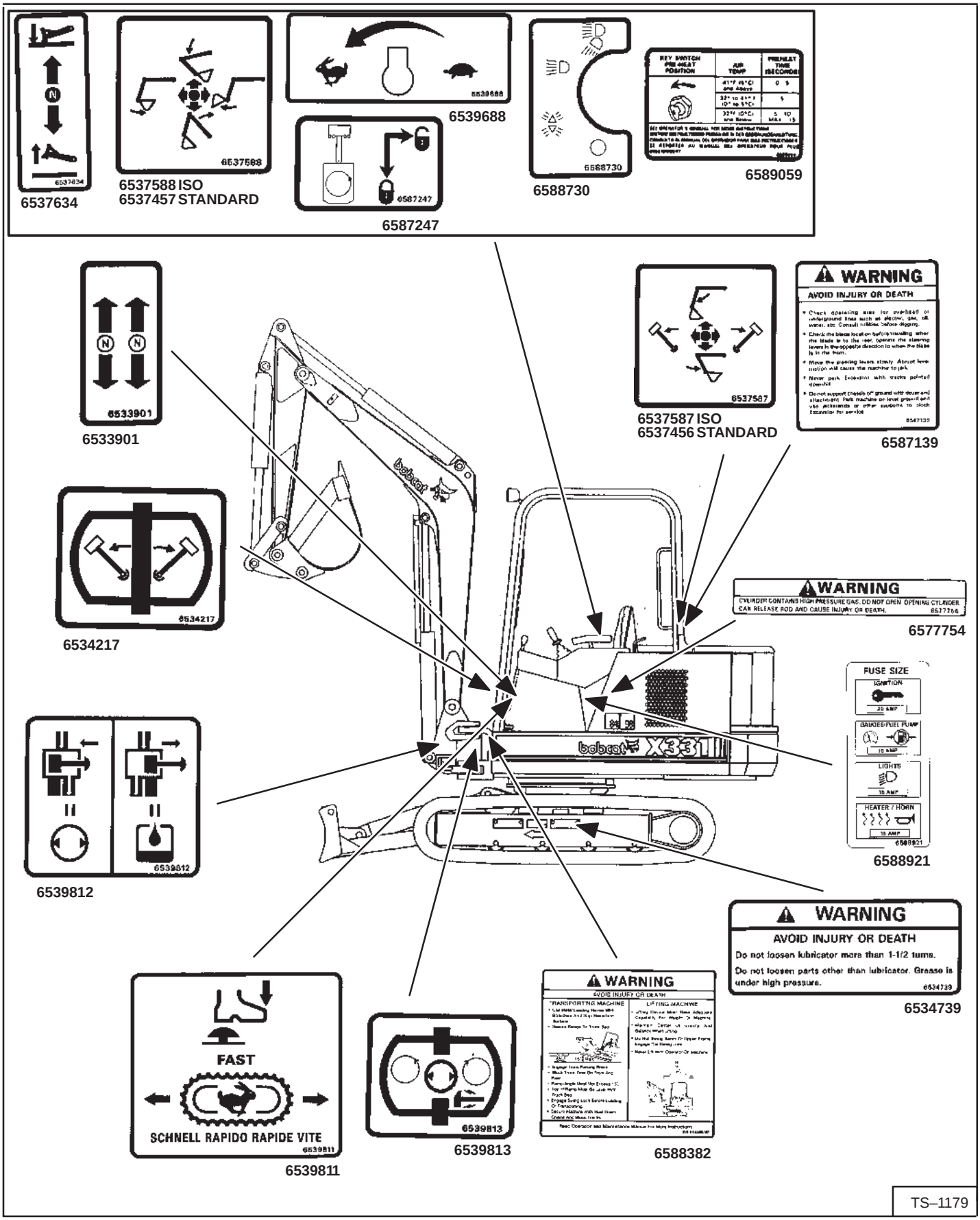
S/N 12001 & Above

TS–1179

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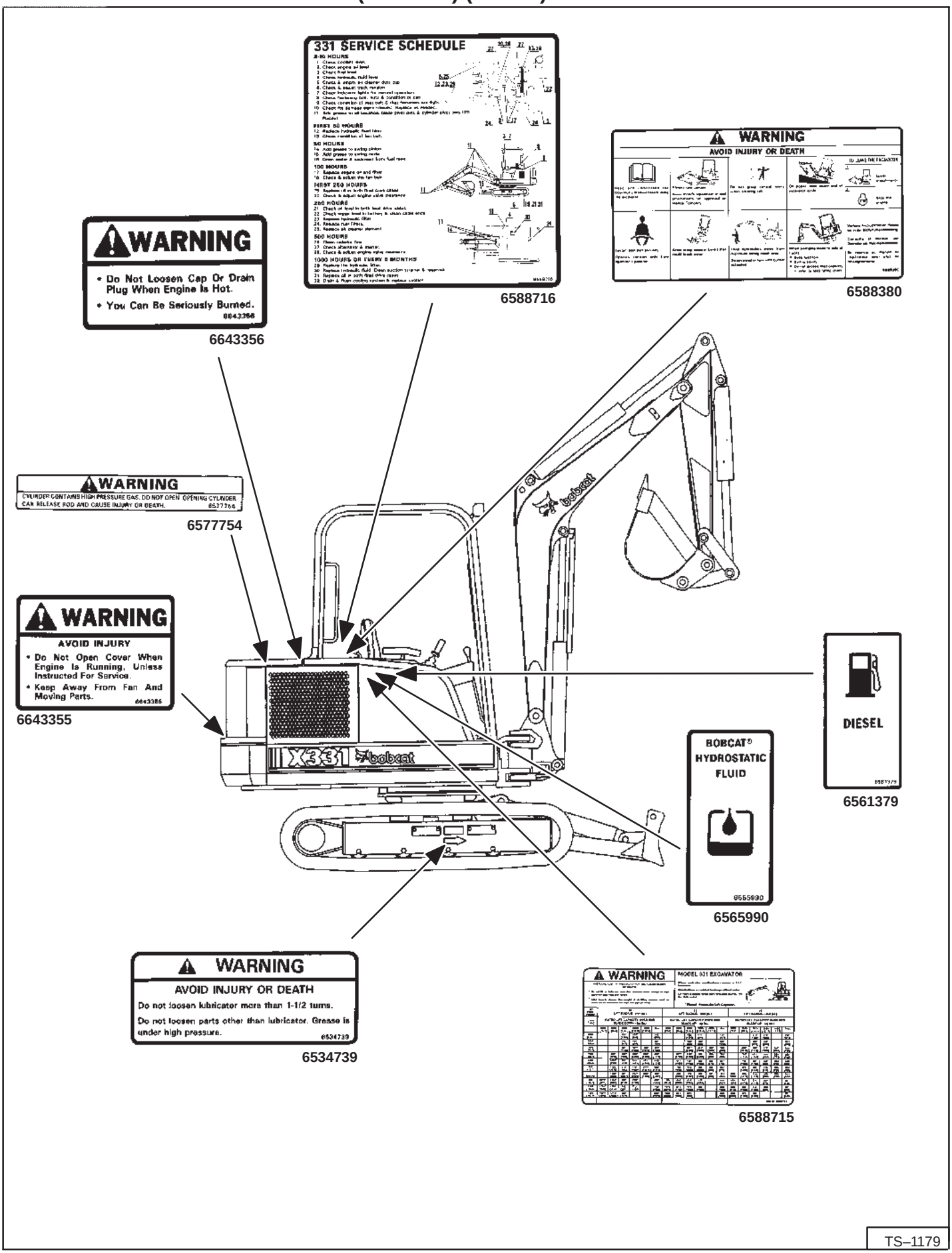
MACHINE SIGNS TRANSLATIONS (DECALS)

Follow the instructions on all the Machine Signs (Decals) that are on the excavator. Replace any damaged machine signs and be sure they are in the correct locations. Machine signs are available from your Bobcat Hydraulic Excavator dealer.



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MACHINE SIGNS TRANSLATIONS (DECALS) (Cont'd)



TS–1179

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PREVENTIVE MAINTENANCE

Page Number

AIR CLEANER
- Servicing the Air Cleaner (S/N 11001–11999) 1–7
- Servicing the Air Cleaner (S/N 12001–12999) 1–8
- Servicing the Air Cleaner (S/N 13001 & Above) 1–10

COOLING SYSTEM
- Coolant Level 1–14
- Coolant Replacement 1–14

ENGINE COVER
- Opening the Cover 1–7

ENGINE LUBRICATION SYSTEM
- Checking Engine Oil 1–13
- Replacing Oil and Filter 1–13

FINAL DRIVE CASE
- Checking Oil Level 1–26
- Draining Final Drive Case 1–26

FUEL SYSTEM
- Filling the Fuel Tank 1–11
- Fuel Filter 1–12
- Fuel Specifications 1–11
- Fuel System Service 1–12
- Removing Air From the Fuel System 1–12

HEATER AIR FILTER SERVICE 1–26

HYDRAULIC SYSTEM
- Checking and Adding Fluid 1–15
- Diagnostic Couplers 1–16
- Hydraulic Reservoir 1–16
- Replacing the Hydraulic Filter (S/N 11001–11999) 1–15
- Replacing the Hydraulic Filter (S/N 12001 & Above) 1–16
- Return Line Filter Service (S/N 12240 & Above) 1–16

LIFTING AND BLOCKING THE EXCAVATOR
- Procedure 1–5

LUBRICATION OF THE EXCAVATOR
- Procedure (S/N 11001–11999) 1–21
- Procedure (S/N 12001 & Above) 1–24

SERVICE SCHEDULE
- Chart (S/N 11001–11999) 1–3
- Chart (S/N 12001 & Above) 1–4

SPARK ARRESTOR MUFFLER
- Cleaning Spark Arrestor Muffler (S/N 11001–11999) 1–19
- Cleaning Spark Arrestor Muffler (S/N 12001 & Above) 1–20

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Page Number

TRANSPORTING THE EXCAVATOR
Procedure 1–6

USING A BOOSTER BATTERY (JUMP STARTING)
Procedure (S/N 11001–11999) 1–17
Procedure (S/N 12001 & Above) 1–18

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SERVICE SCHEDULE (S/N 11001–11999)

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	Replace the filter element only when the red ring shows in the indicator window Check for leaks and damaged components.	■					
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.	■					
Tracks	Check & adjust tension.	■					
All Machinery Pivot Points	Lubricate 20 grease fittings.	■					
Hyd. Fluid, Hoses & Tubelines	Check fluid level & add as needed. Check for damage & leaks. Repair & replace as needed.		■				
Fuel Tank/Fuel Filter	Drain water & sediment from fuel tank/fuel filter.		■				
Swing Circle	Lubricate two grease fittings.		■				
Swing Pinion	Lubricate one grease fitting.		■				
Spark Arrestor Muffler	Clean spark chamber.			■			
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.					■	
Cooling System	Drain, flush & add new coolant to the cooling system.						■
Hydraulic Tank	Change the fluid, clean fill neck strainer.						■
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 100 hours of machine operation do the following procedures:
*** Change oil in final drive case.**

■ Or Every 12 Months.

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SERVICE SCHEDULE (S/N 12001 & Above)

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	Replace the filter element only when the red ring shows in the indicator window Check for leaks and damaged components.	■					
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.	■					
Tracks	Check & adjust tension.	■					
All Machinery Pivot Points	Lubricate 20 grease fittings.	■					
Hyd. Fluid, Hoses & Tubelines	Check fluid level & add as needed. Check for damage & leaks. Repair & replace as needed.		■				
Fuel Tank/Fuel Filter	Drain water & sediment from fuel tank/fuel filter.		■				
Swing Circle	Lubricate two grease fittings.		■				
Swing Pinion	Lubricate one grease fitting.		■				
Spark Arrestor Muffler	Clean spark chamber.			■			
Engine Oil & Filter	Replace oil & filter element.			■			
Alternator/Fan 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.				■		
Cooling System	Clean the radiator fins.					■	
Alternator & Starter	Check the condition.					■	
Cooling System	Drain, flush & add new coolant to the cooling system.						■
Hydraulic Tank	Change the fluid, clean fill neck strainer.						■
Final Drive Case	Change the oil.			**			■
Drain Return Line Filter	Clean Filter with solvent, dry with air pressure.						■
Cab Heater Air Filter	Clean the filter						■

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 100 hours of machine operation do the following procedures:
*** Change oil in final drive case.**

■ Or Every 12 Months.

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⚠ 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–2003–1089

LIFTING AND BLOCKING THE EXCAVATOR

Procedure

Always park the machine on a level surface.

⚠ WARNING

Put jackstands under the blade and track 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

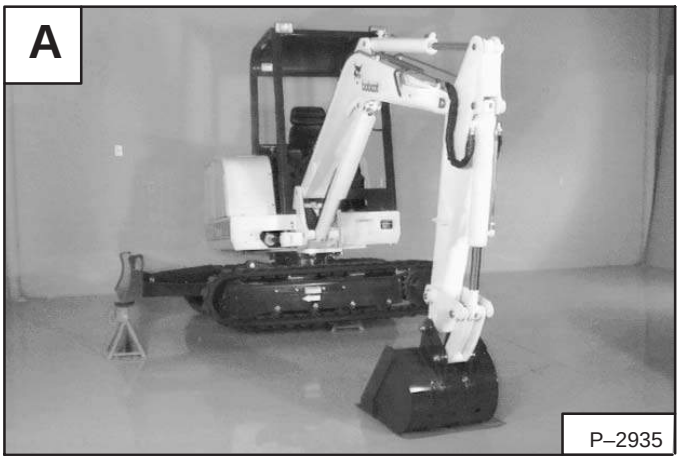
Raise the machine using the boom and arm **[A]**.

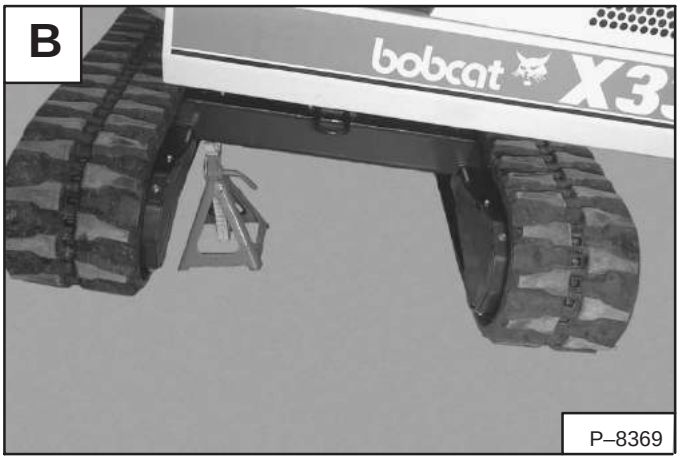
Fully raise the blade and install jackstands under the blade**[A]** and track frame **[B]**.

Lower the boom until all the machine weight is on the jackstands.

Repeat the procedure for the other side.

Stop the engine.





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TRANSPORTING THE EXCAVATOR

Procedure

Make sure the parking brakes on the transport vehicle are engaged and wheels are blocked.

Align the ramps with the center of the transport vehicle. Secure the ramps to the truck bed and be sure ramp angle does not exceed 15 degrees.

Use metal loading ramps and slip resistant surface.

Make sure the ramps are the correct length and width, and can support the weight of the machine.

Determine the direction of the track movement before moving the machine (blade forward). Engage the swing lock pin to lock the upperstructure.

Move the machine forward onto the transport vehicle **[A]**.

Do not change direction of the machine while it is on the ramps.

After loading the machine, position the arm and bucket as shown **[B]**.

Lower the boom.

Stop the engine and remove the key.

Use the following procedure to fasten the Excavator to the transport vehicle:

1. Put blocks under the front and rear of the track shoes.

2. Fasten holddown chains to the front corners of the blade and to the tie down loop at the rear track frame to prevent it from moving when going up or down slopes, or during sudden stops **[C]** & **[D]**.

3. Use chain binders to tighten the chains and then tie the chain binder levers to prevent loosening.

When transporting the machine, observe the rules, motor vehicle laws and vehicle limit ordinances. Use a transport and towing vehicle of adequate length and capacity.

⚠ WARNING

Steel loading ramps are needed to support the weight of the machine when loading onto a transport vehicle. Wood ramps can break and cause personal injury.

W–2058–0887

A



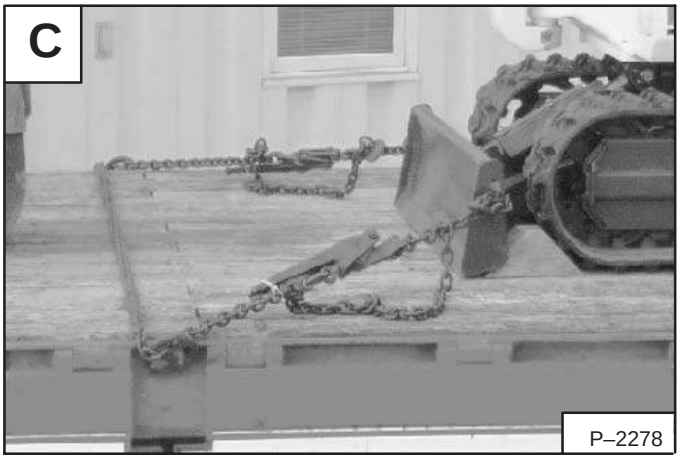
P–8373

B



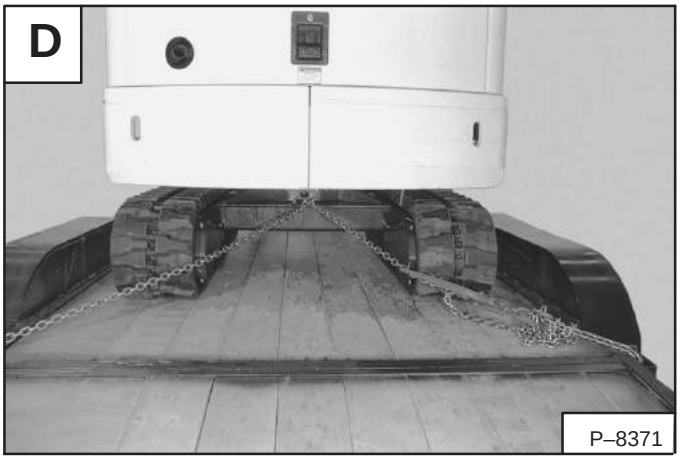
P–8372

C



P–2278

D



P–8371

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ENGINE COVER

Opening the Cover

⚠ WARNING

AVOID INJURY

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

W–2012–0290

Keep the engine cover closed when operating the machine.

W–2141–0189

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

AIR CLEANER

Servicing the Air Cleaner (S/N 11001–11999)

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

Check the air intake hose for damage. Check the air cleaner housing for damage. Be sure all connections are tight.

Replace the large (outer) filter element only when the red ring shows in the window of the condition indicator (Item 1) **[B]**.

NOTE: Push the button on the condition indicator (Item 1), start the engine and operate at full throttle. If the red ring does not show, do not replace the filter element [B].

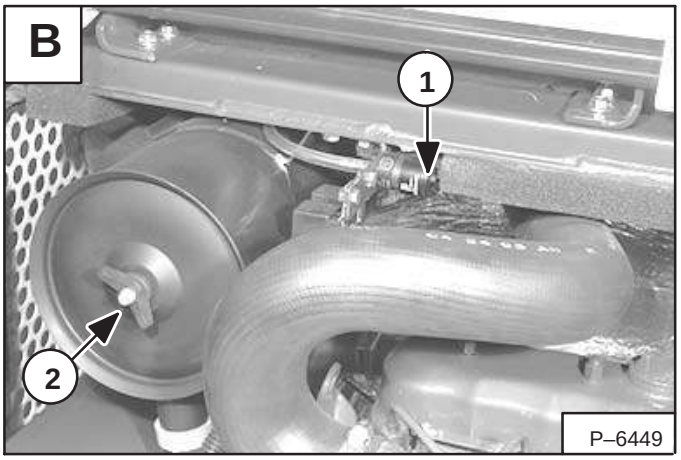
Remove the dust cover wing nut (Item 2) **[B]**.

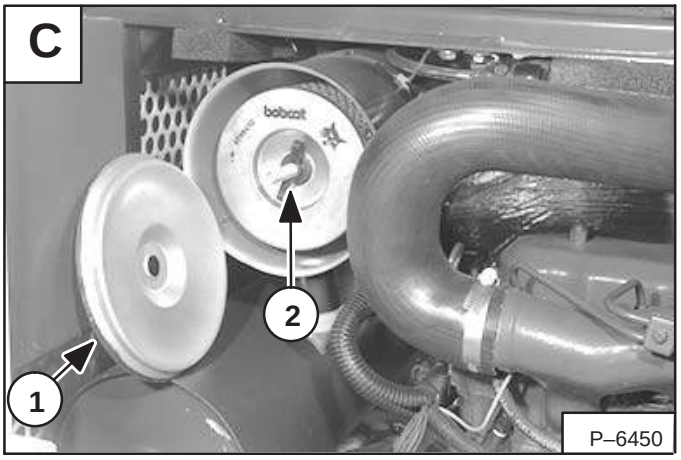
Remove the dust cover (Item 1) **[C]**.

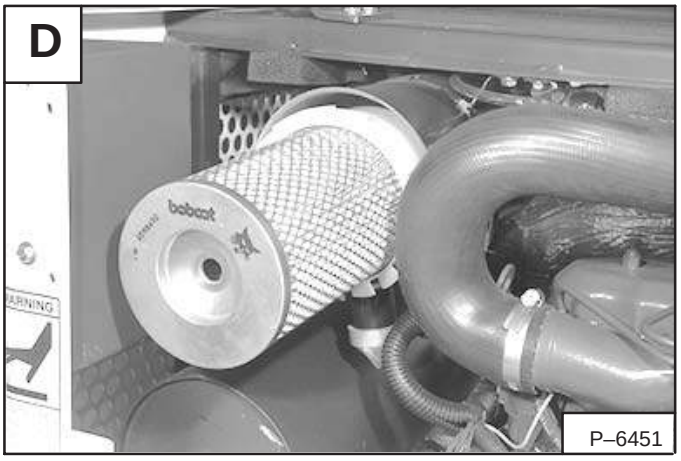
Remove the wing nut (Item 2) **[C]** at the large air filter element.

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









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AIR CLEANER (S/N 11001–11999) (Cont'd)

Servicing the Air Cleaner (Cont'd)

NOTE: Make sure all sealing surfaces are free of dirt and debris.

Install the new filter element and tighten the wing nut. Install the dust cover and tighten the wing nut.

Only replace the inner filter element (Item 1) **[A]** under the following conditions.

- Replace the inner filter element every third time the outer filter element is replaced.

- Replace the inner filter element when the red ring still shows in the condition indicator window after the outer filter element is replaced.

NOTE: After replacing the primary (large) filter element, recheck the condition of the inner filter element by pushing the button on the condition indicator and start the engine. Run the engine at full throttle. If the red ring on the condition indicator shows, replace the inner filter element.

Servicing the Air Cleaner (S/N 12001–12999)

See the Service Schedule Page 1–4 for the correct service interval.

Check the air intake hose for damage. Check the air cleaner housing for damage. Check to make sure all connections are tight.

Replace the large (outer) filter element only when the red ring shows in the window of the condition indicator (Item 1) **[B]**.

NOTE: Push the button on the condition indicator (Item 1) [B] and start the engine. If the red ring does not show, do not replace the filter element.

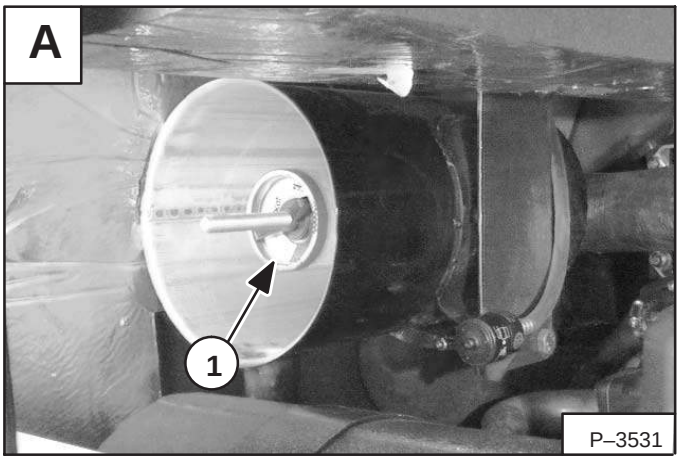
Service the air cleaner as follows:

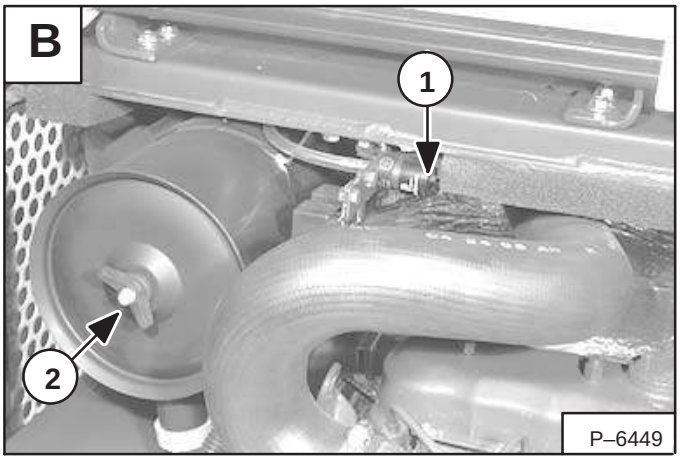
Remove the dust cover wing nut (Item 2) **[B]**.

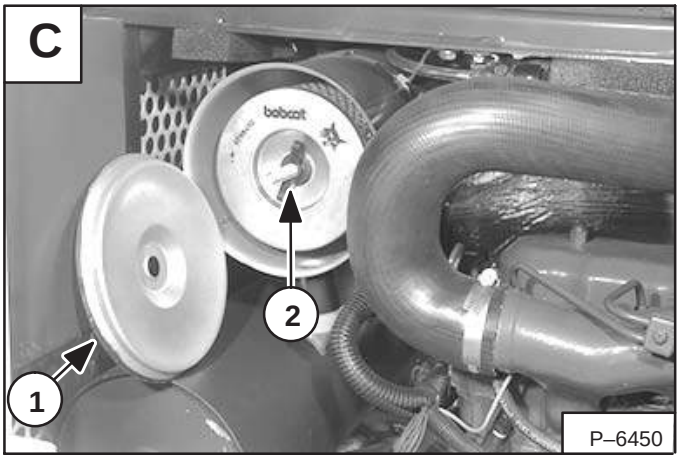
Remove the dust cover (Item 1) **[C]**.

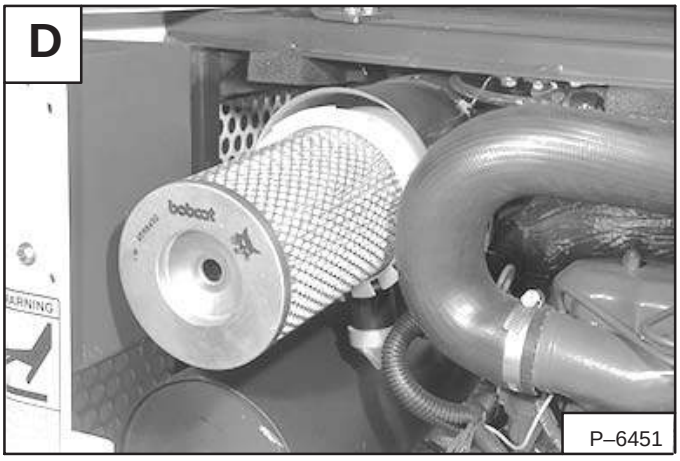
Remove the wing nut (Item 2) **[C]** at the large air filter element.

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









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AIR CLEANER (Cont'd)

Servicing the Air Cleaner (S/N 12001–12999) (Cont'd)

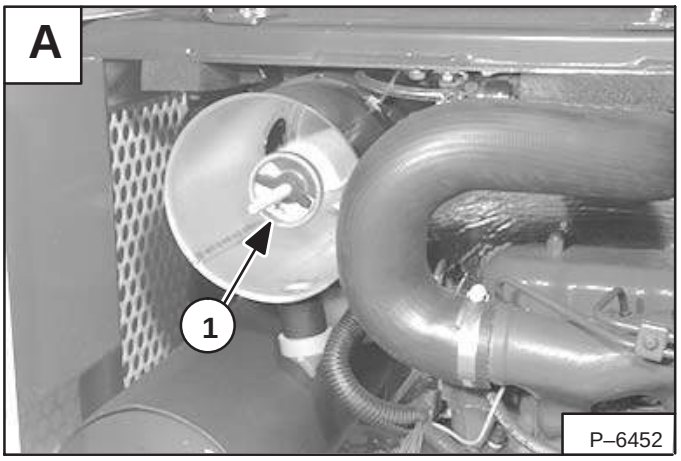
NOTE: Make sure all sealing surfaces are free of dirt and debris.

Install the new filter element and tighten the wing nut. Install the dust cover and tighten the wing nut.

Only replace the inner filter element (Item 1) **[A]** under the following conditions.

- Replace the inner filter element every third time the outer filter element is replaced.
- Replace the inner filter element when the red ring still shows in the condition indicator window after the outer filter element is replaced.

NOTE: After replacing the primary (large) filter element, recheck the condition of the inner filter element by pushing the button on the condition indicator and start the engine. Run the engine at full throttle. If the red ring on the condition indicator shows, replace the inner filter element.



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AIR CLEANER (Cont'd)

Servicing the Air Cleaner (S/N 13001 & Above)

See the Service Schedule Page 1–4 for the correct service interval.

Check the air intake hose for damage. Check the air cleaner housing for damage. Check to make sure all connections are tight.

Replace the large (outer) filter element only when the red ring shows in the window of the condition indicator (Item 1) **[A]**.

NOTE: Push the button on the condition indicator (Item 1) [A] and start the engine. If the red ring does not show, do not replace the filter element.

Service the air cleaner as follows:

Remove the dust cover clamps (Item 2) **[A]**.

Remove the dust cover (Item 3) **[A]**.

Remove the large air filter element (Item 1) **[B]**.

Install the new filter element.

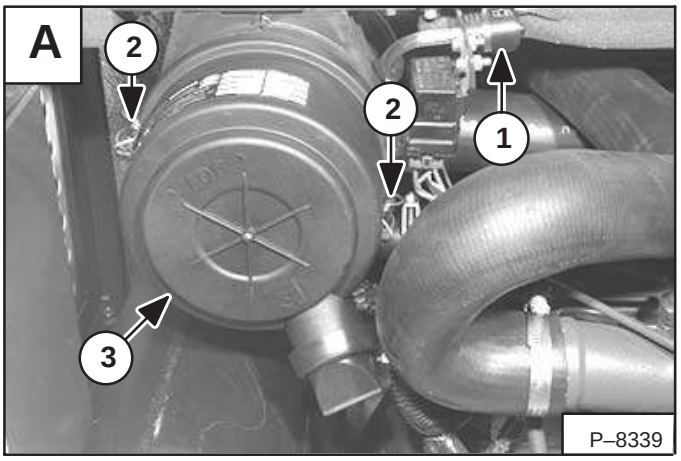
Install the dust cover and latch the two (2) clamps.

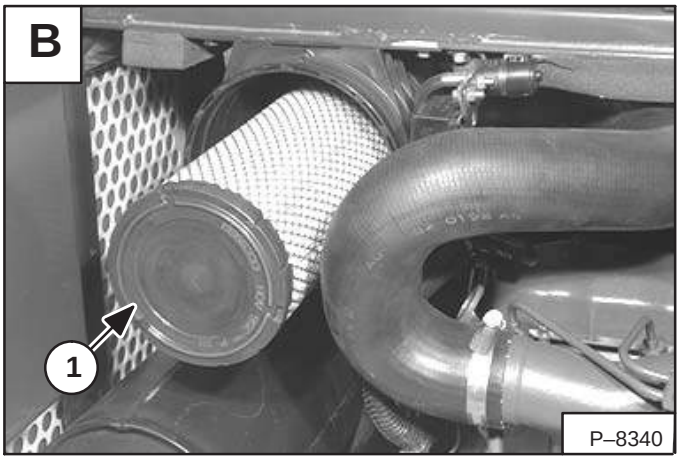
NOTE: Make sure all sealing surfaces are free of dirt and debris.

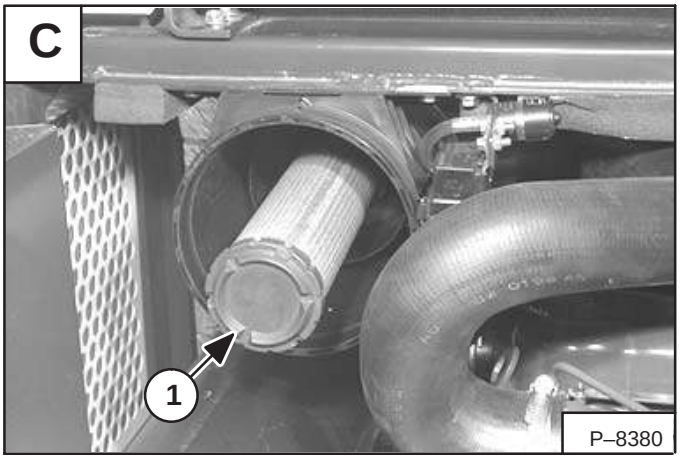
Only replace the inner filter element (Item 1) **[C]** under the following conditions.

- Replace the inner filter element every third time the outer filter element is replaced.
- Replace the inner filter element when the red ring still shows in the condition indicator window after the outer filter element is replaced.

NOTE: After replacing the primary (large) filter element, recheck the condition of the inner filter element by pushing the button on the condition indicator and start the engine. Run the engine at full throttle. If the red ring on the condition indicator shows, replace the inner filter element.







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FUEL SYSTEM

Fuel Specification

Use only clean, high quality diesel fuel, Grade No. 1 or Grade No. 2.

The following is a suggested blending guideline which should prevent fuel gelling problems during cold weather use.

Temp. F° (C°)	No. 2	No.1
+15°(9°)	100%	0%
Down to –20° (–29°)	50%	50%
Below –20° (29°)	0%	100%

For local recommendations, the operator can contact his fuel supplier.

⚠ WARNING

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

W–2063–0887

Filling the Fuel Tank

The fuel level in the tank is indicated by the fuel gauge (Item 1) **[A]** when the ignition switch is ON.

NOTE: When the fuel level reaches the 2.5 gals. (9,3 L.) fuel setting the low fuel light (Item 2) [A] will come ON to alert the operator.

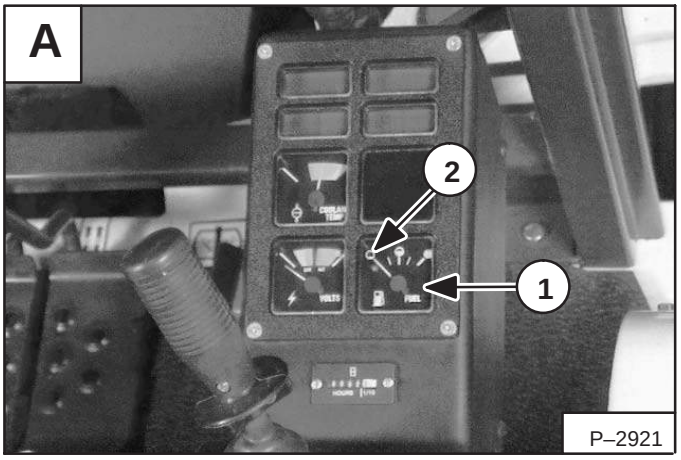
Use the key to unlock the fuel fill door **[B]**.

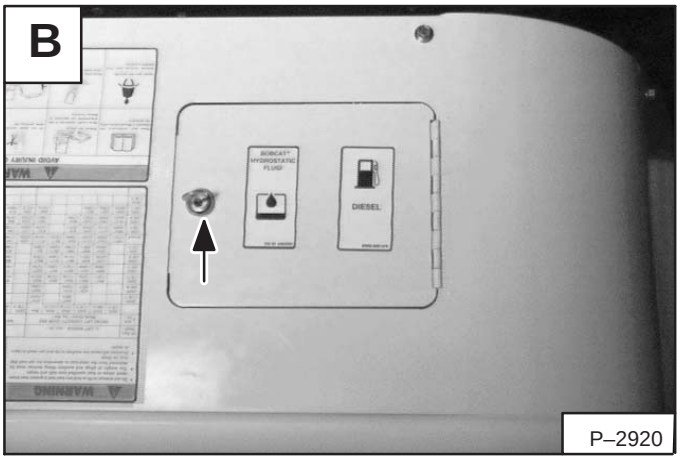
Turn the fill cap to remove it **[C]**.

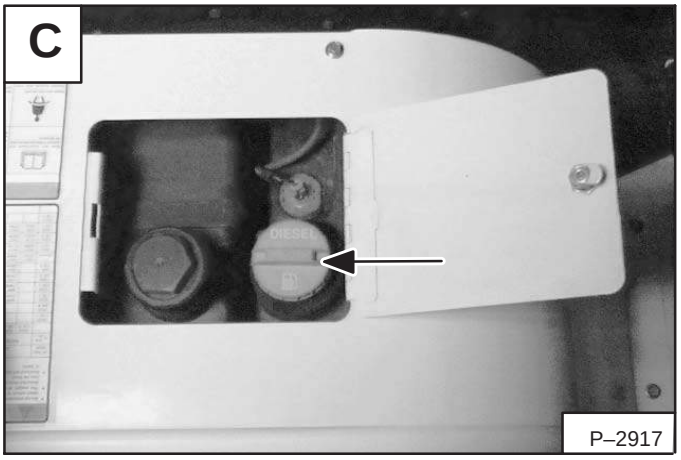
Use a clean, approved safety container to add fuel to the tank.

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

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







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FUEL SYSTEM (Cont'd)

Fuel System Service

See the Service Schedule Page 1–3 or 1–4 for the correct service interval. To remove water and sediment from the fuel tank, turn the upper structure until the fuel tank is centered between the rear tracks.

Open the drain valve (Item 1) **[A]** at the bottom of the fuel tank.

Drain all water and sediment into a container.

See the Service Schedule Page 1–3 or 1–4 for the service interval when to remove the water from the fuel filter.

Loosen the drain (Item 1) **[B]** at the bottom of the filter element to drain any water from the fuel filter.

Tighten the drain when all the water has been removed from the fuel filter.

Fuel Filter

See the Service Schedule Page 1–3 or 1–4 for the service interval when to replace the fuel filter.

Remove the filter element (Item 2) **[B**].

Clean the area around the filter housing. Put oil on the seal of the new filter element. Install the fuel filter and hand tighten.

Remove the air from the fuel filter.

Removing Air from the Fuel System

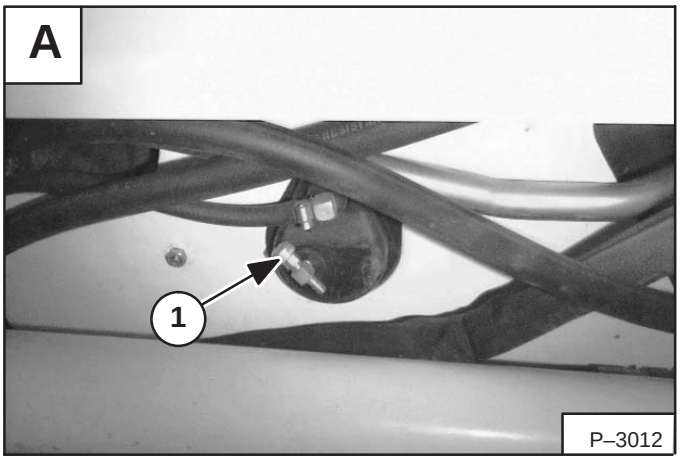
After replacing the fuel filter or when the fuel tank has run out of fuel, the air must be removed from the fuel system prior to starting the engine.

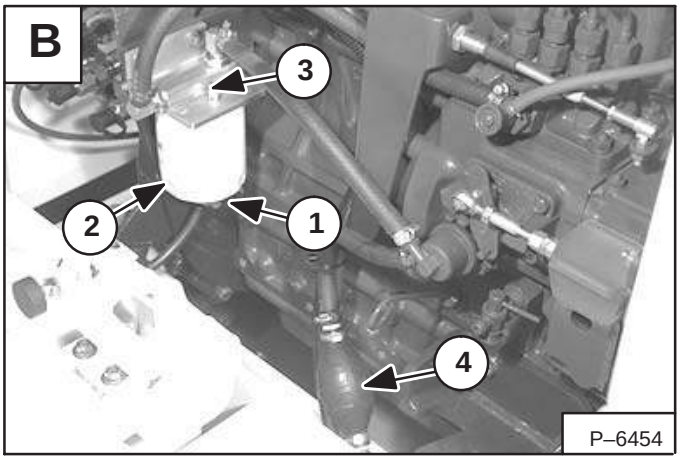
Open the vent (Item 3) **[B]** on the fuel filter housing.

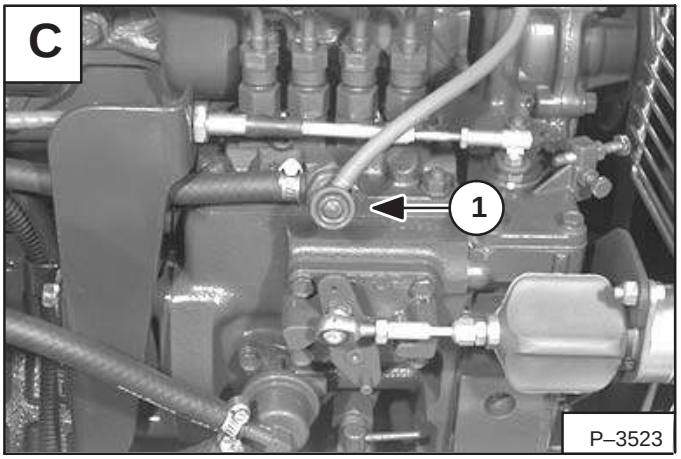
Operate the hand pump (priming bulb) (Item 4) **[B]** until the fuel flows from the vent with no air bubbles.

Tighten the vent plug.

Start the engine. It may be necessary to open the vent (Item 1) **[C]** at the fuel injection pump briefly until the engine runs smooth.







⚠ WARNING

Always clean up spilled fuel of 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

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ENGINE LUBRICATION SYSTEM

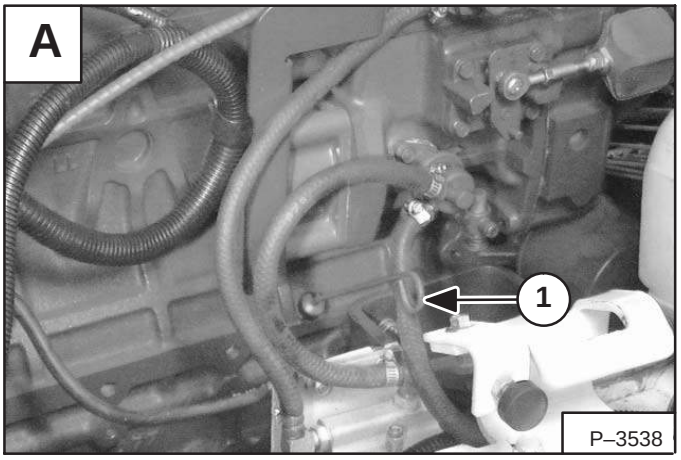
Checking Engine Oil

Check the engine oil every day.

Stop the engine. Open the rear cover. Remove the dipstick (Item 1) **[A]**.

Keep the oil level between the marks on the dipstick.

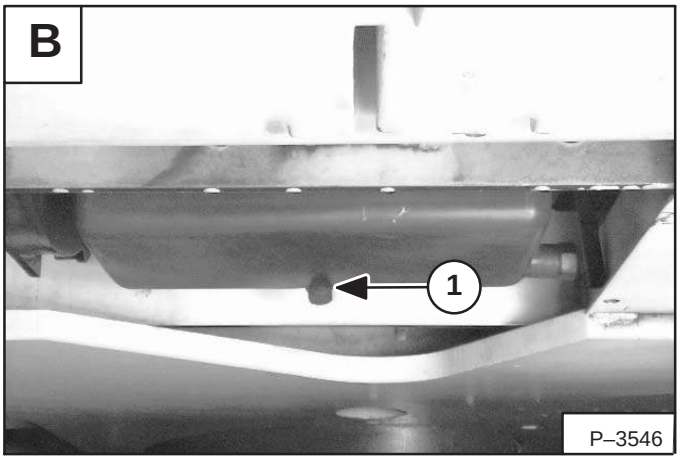
Use a good quality motor oil that meets API Service Classification of CE (See Fuel, Coolant and Lubricants Chart, Section 8).



Replacing Oil and Filter

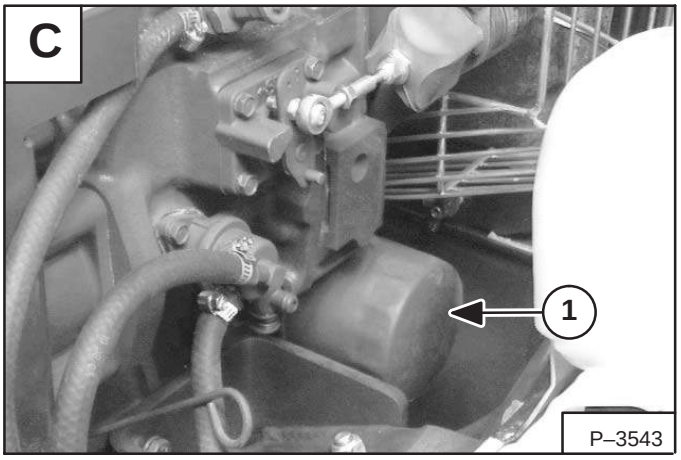
See the Service Schedule Page 1–3 or 1–4 for the service interval for replacing the engine oil and filter.

1. Run the engine until it is at operating temperature. Stop the engine.
2. Open the rear cover.
3. Remove the drain plug (Item 1) **[B]** from the oil pan. Drain the oil into a container.

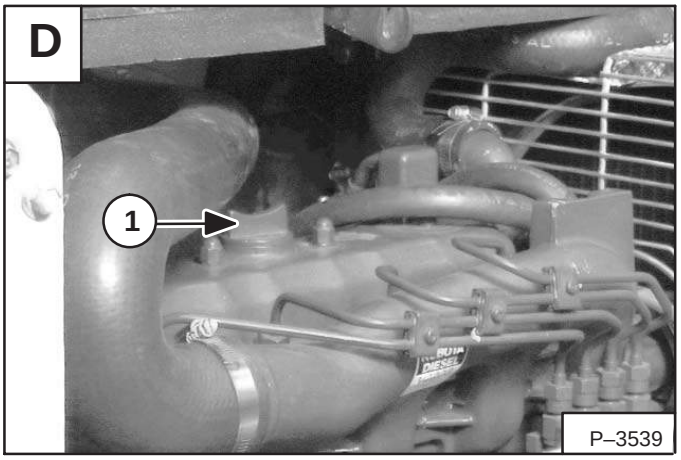


4. Remove the oil filter (Item 1) **[C]**, using a filter wrench.
5. Clean the filter housing surface. Put clean oil on the filter gasket. Install the new filter and hand tighten only.
6. Install and tighten the oil drain plug (Item 1) **[B]**.

NOTE: Use only a Melroe approved oil filter. A non–approved filter may not be of the quality needed to last 250 hrs. of the engine operation, and could cause engine damage. See your parts book or microfiche for the correct part number oil filter.



7. Remove the oil fill cap (Item 1) **[D]**. Put in 7.5 qts. (7,1 l.) of oil into the engine (See Fuel, Coolant and Lubricants Chart, Section 8).
8. Start the engine and let it run for several minutes. Stop the engine. Check for leaks at the oil filter and check the oil level. Add oil as needed if it is not at the top mark on the dipstick.



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COOLING SYSTEM

Coolant Level

Check the cooling system every day to prevent overheating, loss of performance or engine damage.

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

Ethylene Glycol

Add premixed coolant; 50% water and 50% ethylene glycol to the recovery tank if the coolant is low.

Propylene Glycol

Add premixed coolant; 43% water and 57% propylene glycol to the recovery tank if the coolant level is low.

One gallon and one pint of propylene glycol mixed with one gallon of water is the correct mixture of coolant to provide –34°F (–37°C) freeze protection.

Use a refractometer to check the condition of propylene glycol in your cooling system.

See Fuel, Coolant and Lubricants Chart (Section 8).

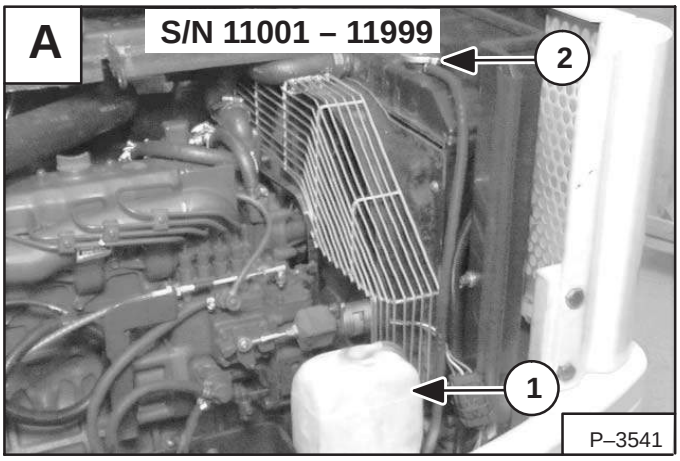
⚠ WARNING

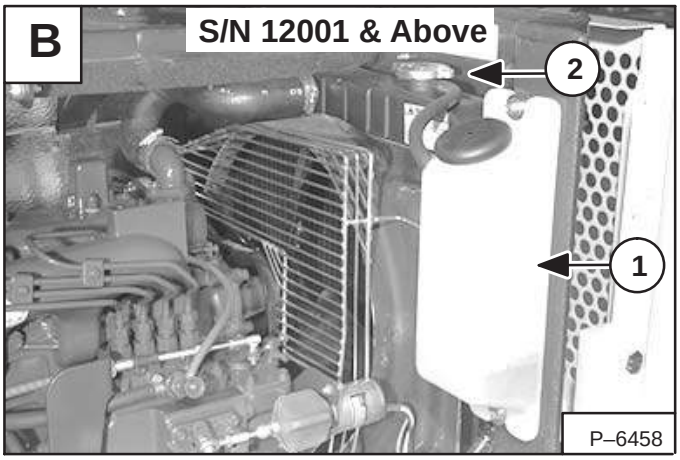
Do not remove radiator cap when the engine is hot. You can be seriously burned.

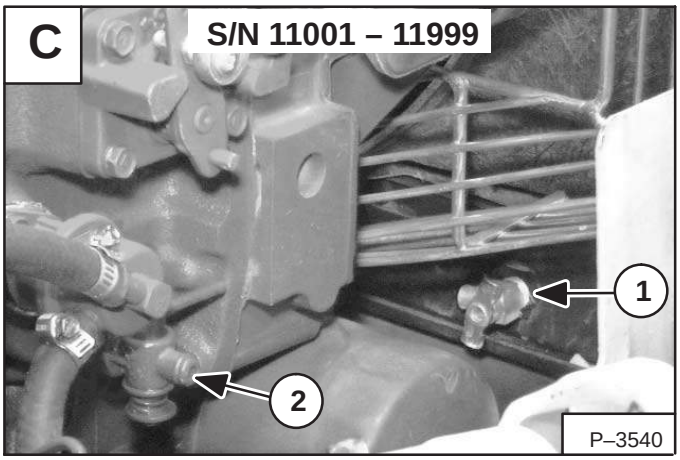
W–2070–1285

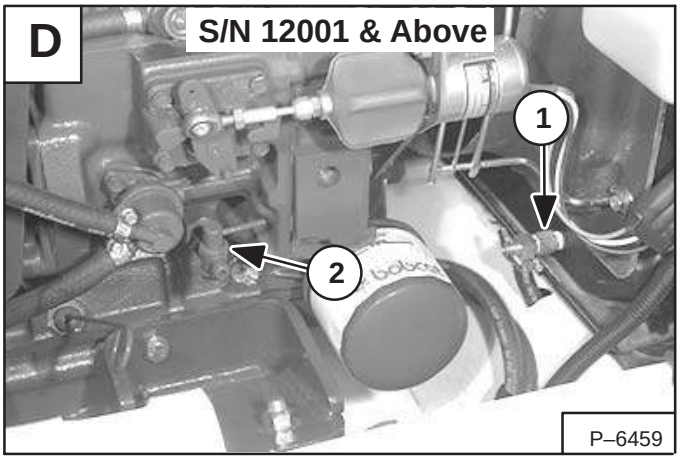
Coolant Replacement

1. Turn the upper structure so there is access to the engine and radiator from between the tracks. Stop the engine.
2. Loosen and remove the radiator cap (Item 2) **[A]** & **[B]**.
3. Open the radiator drain valve (Item 1) **[C]** & **[D]** at the bottom of the radiator. Drain the coolant into a container.
4. Open the engine block drain valve (Item 2) **[C]** & **[D]** and drain the coolant into a container.
5. After all the coolant is removed, close both drain valves.
6. Mix the coolant in a separate container. Fill the radiator with the premixed coolant until it is full. Add coolant to the recovery tank until it is half full.
7. 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).
8. Stop the engine. Check the coolant level and add as needed to bring it up to the filler neck. Install and tighten the radiator cap.









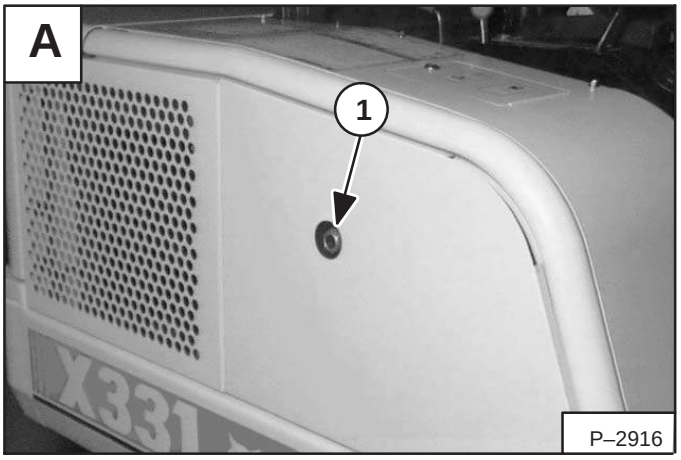
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HYDRAULIC SYSTEM

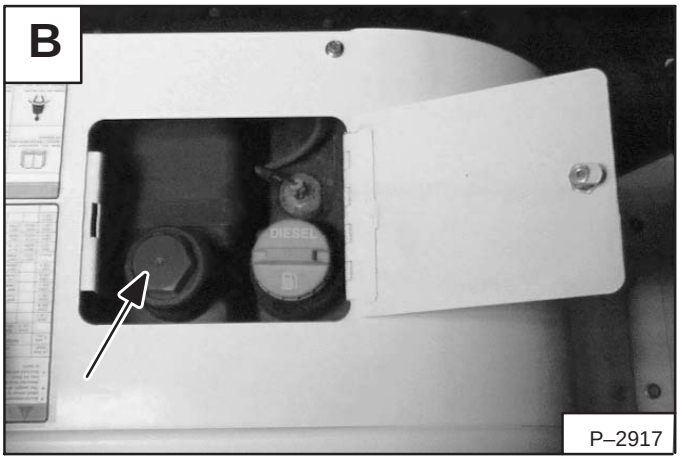
Checking and Adding Fluid

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

1. Put the machine on a flat level surface.
2. Retract the arm and bucket cylinders, put the bucket on the ground and raise the blade. Stop the engine.
3. Check the hydraulic fluid level. It must be visible in the sight gauge (Item 1) **[A]** located on the side of the hydraulic reservoir.



4. If the fluid level is not correct, open the hydraulic tank access door **[B]**.
5. Remove the oil fill cap **[B]**.



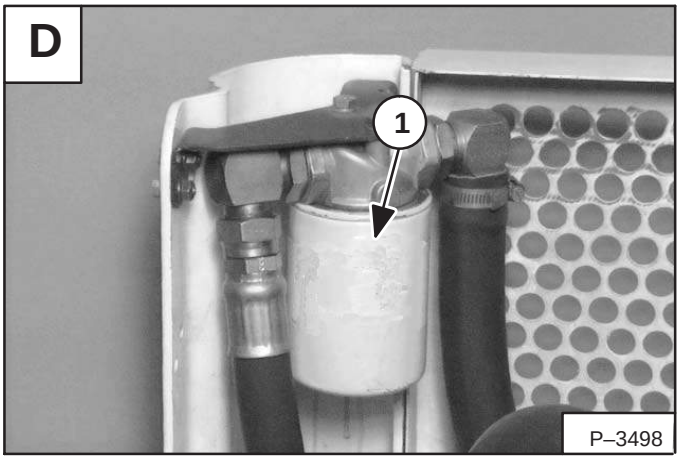
6. Check the condition of the fill strainer **[C]**. The screen must be installed in fill neck when adding oil.
7. Add the correct fluid to the reservoir until it is in the sight gauge (See Fuel, Coolant and Lubricants Chart, Section 8).
8. Install the reservoir cap and lock the access door.



Replacing the Hydraulic Filter (S/N 11001–11999)

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

1. Open the engine cover.
2. Remove the filter element (Item 1) **[D]**.
3. Clean the housing where the filter gasket makes contact.
4. Put clean hydraulic fluid on the gasket. Install the new filter element and hand tighten only.
5. 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 filter for leaks.



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HYDRAULIC SYSTEM (Cont'd)

Replacing the Hydraulic Filter (S/N 12001 & Above)

See the Service Schedule Page 1–4 for the correct service interval.

1. Open the right side cover. (See Page 1–17.)
2. Use a filter wrench and remove the filter element (Item 1) **[A]**.
3. Clean the housing where the filter gasket makes contact.
4. Put clean hydraulic fluid on the gasket. Install the new filter element and hand tighten only.
5. 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 filter for leaks.

Return Line Filter Service (S/N 12240 & Above)

See Service Schedule Page 1–4 for the correct service interval.

1. Open the right side cover. (See Page 1–19.)
2. Remove the filter cartridge (Item 2) **[A]**.
3. Disassemble the cartridge and clean thoroughly.
4. Install the filter cartridge.

Hydraulic Reservoir

See the Service Schedule Page 1–4 for the correct service interval.

1. Move the upperstructure so there is clearance for the reservoir drain between the tracks.
2. Retract the arm and bucket cylinders, lower the bucket to the ground. Stop the engine.
3. Remove and replace the hydraulic filter.
4. Remove the drain plug from the bottom of the reservoir **[B]**.
5. Drain the fluid into a container.
6. Install the drain plug.
7. Add approximately 10.5 gals. (40 L) of fluid to the reservoir (See Fuel, Coolant and Lubricants Charts Section 8).
8. Run the machine through the hydraulic functions. Check the fluid level and add as needed.

⚠ WARNING

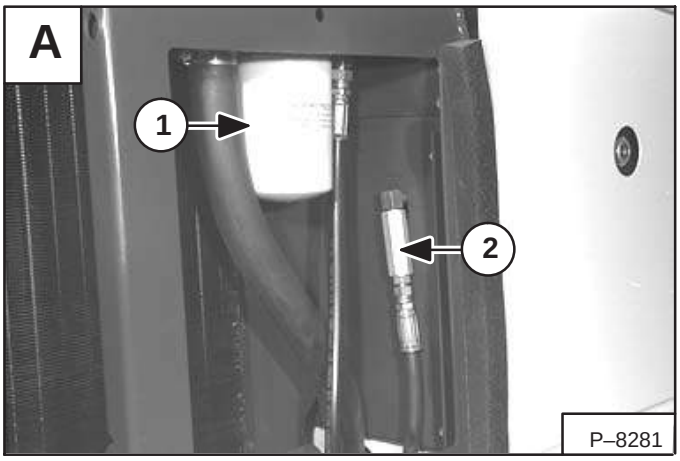
Always clean up spilled fuel or oil. Keep heat, flames, sparks or lighted tobacco away from fuel and oil. Failure to use care around combustibles can cause explosion or fire which can result in injury or death.

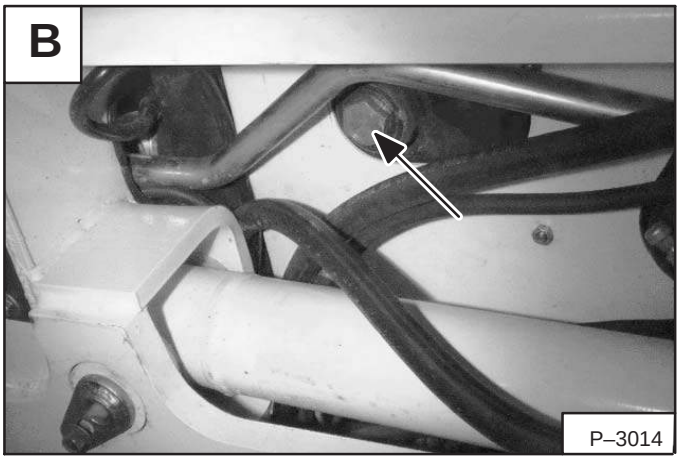
W–2103–1285

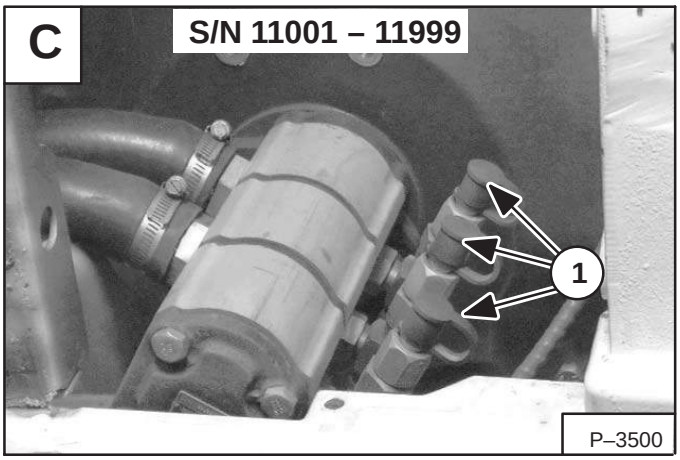
Diagnostic Couplers

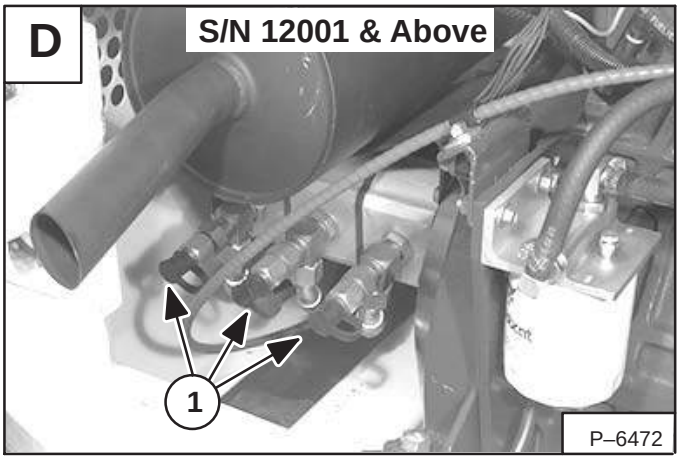
The diagnostic couplers are located on each hydraulic pump (Item 1) **[C]** (S/N 11001–11999) and **[D]** (S/N 12001 & Above).

The couplers can be used to check circuit pressures. (See Page 2–1.)









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USING A BOOSTER BATTERY (Jump Starting)

Procedure (S/N 11001–11999)

IMPORTANT

If jump starting the excavator from a second machine:

When jump starting the excavator from a battery installed in a second machine. Make sure that the second machine is NOT running while using the glow plugs. High voltage spikes from a running machine can burn out the glow plugs.

I–2060–0195

If it is necessary to use a booster battery to start the engine. BE CAREFUL!

Make sure the swing locking lever is in the engaged position.

The key switch must be in the OFF position.

The booster battery must be 12 volt.

Open the engine cover.

Remove the two bolts (Item 1) **[A]** from the inside of the rear engine cover.

Remove the two bolts (Item 1) **[B]** from the side cover.

Remove the side 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) of the machine battery **[C]**.

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 frame (Item 2) **[C]**.

NOTE: See *Cold Temperature Starting Condition*, Operation & Maintenance Manual.

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

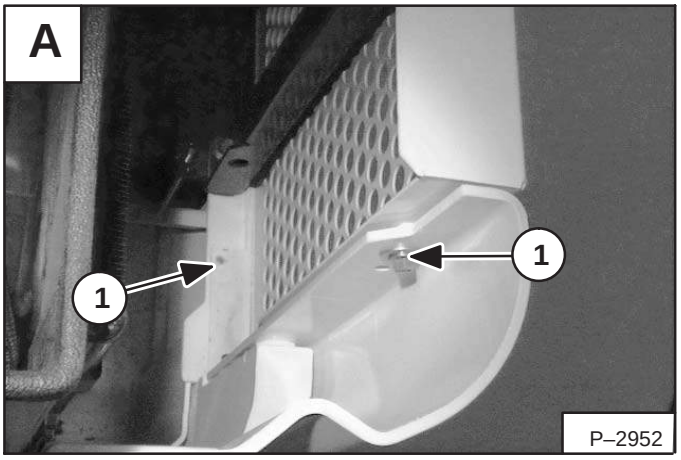
IMPORTANT

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 from the battery.**

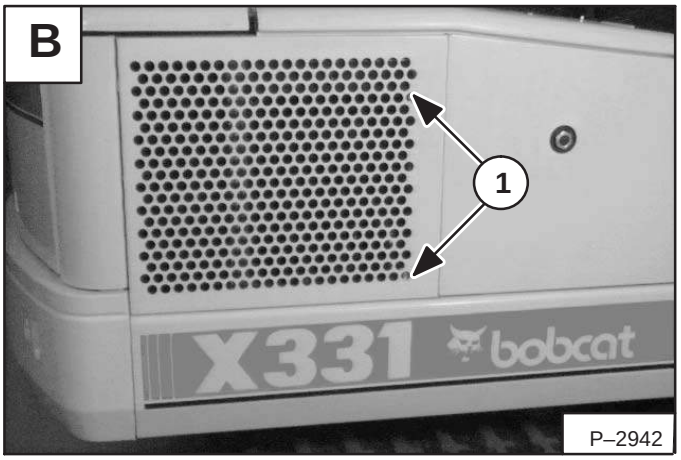
I–2023–1285

A



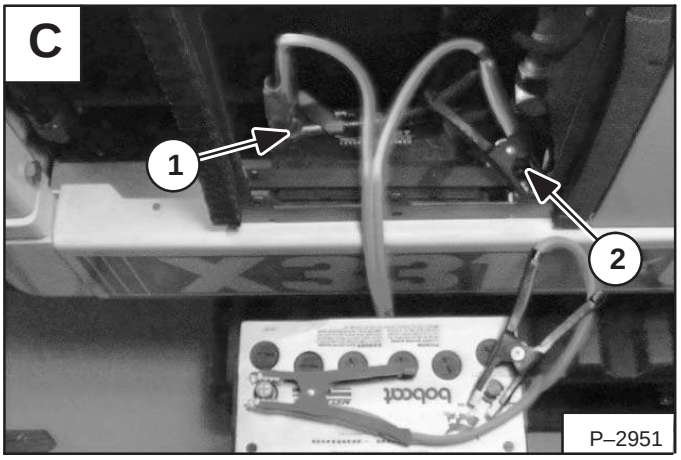
P–2952

B



P–2942

C



P–2951

WARNING

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

Do not jump start or charge a frozen battery. Warm battery to 60ºF. (16ºC.) before connecting or disconnecting cables to battery.

Battery gas can explode and cause serious injury.

W–2066–0490

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USING A BOOSTER BATTERY (Jump Starting) (Cont'd)

Procedure (S/N 12001 & Above)

IMPORTANT

If jump starting the excavator from a second machine:

When jump starting the excavator from a battery installed in a second machine. Make sure that the second machine is NOT running while using the glow plugs. High voltage spikes from a running machine can burn out the glow plugs.

I–2060–0195

If it is necessary to use a booster battery to start the engine. BE CAREFUL!

Make sure the swing lock is in the engaged position.

The key switch must be in the OFF position.

The booster battery must be 12 volt.

Using the ignition key, unlock the two (2) side cover locks (Item 1) **[A]**.

Tilt the top of the side cover out and lift up on the side cover to remove **[B]**.

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) **[C]** 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 frame (Item 2) **[C]**.

NOTE: See *Cold Temperature Starting Procedure*, Operation & Maintenance Manual.

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

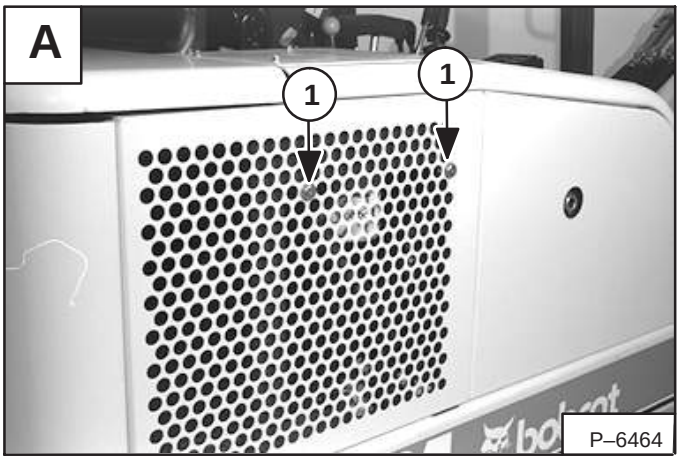
IMPORTANT

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 from the battery.**

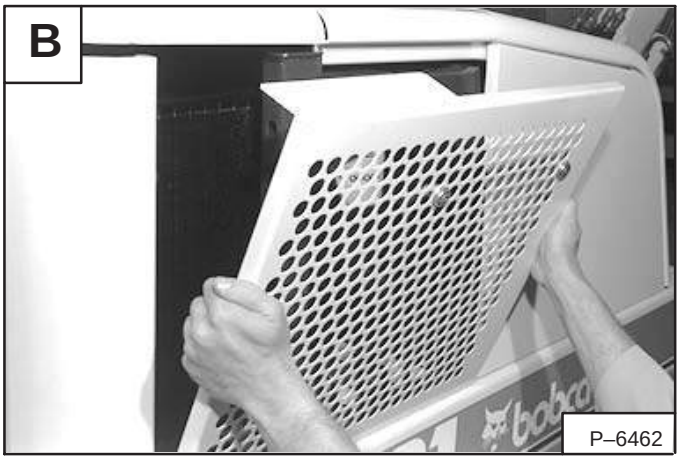
I–2023–1285

A



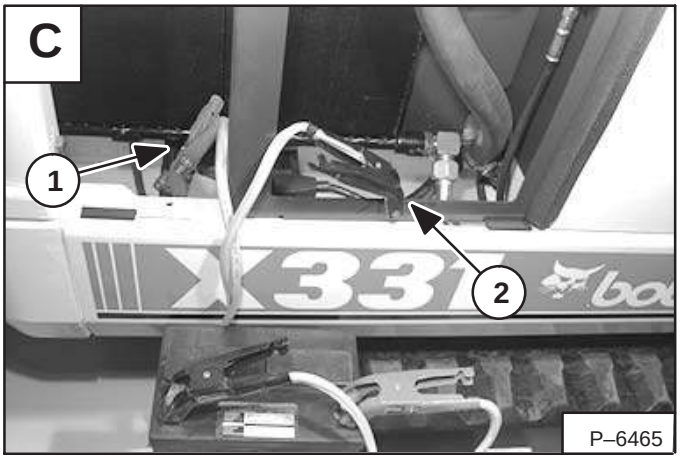
P–6464

B



P–6462

C



P–6465

WARNING

Keep arcs, sparks, flames and lighted tobacco away from batteries. When "jumping" from a 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 or disconnecting cables to battery.

Battery gas can explode and cause serious injury.

W–2066–0490

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SPARK ARRESTOR MUFFLER

Cleaning Spark Arrestor Muffler (S/N 11001–11999)

See the Service Schedule Page 1–3 for the service interval for cleaning the spark arrestor muffler.

Do not operate the excavator with a defective exhaust system.

IMPORTANT

This loader is factory equipped with a U.S.D.A. Forestry Service approved spark arrestor muffler. It is necessary to do maintenance on this spark arrestor muffler to keep it in working condition. The spark arrestor muffler must be serviced by dumping the spark chamber every 100 hours of operation.

If this machine is operated on flammable forest, brush or grass covered land, it must be equipped with a spark arrestor attached to the exhaust system and maintained in working order. Failure to do so will be in violation of California State Law, Section 4442 PRC.

Make reference to local laws and regulations for spark arrestor requirements.

I–2061–0195

Stop the engine. Open the engine cover.

Remove the six bolts from the left side cover (Item 1) **[A]**. Remove the left side cover.

Remove the plug (Item 1) **[B]** from the bottom of the muffler.

⚠ WARNING

When the engine is running during service, the steering levers must be in neutral.

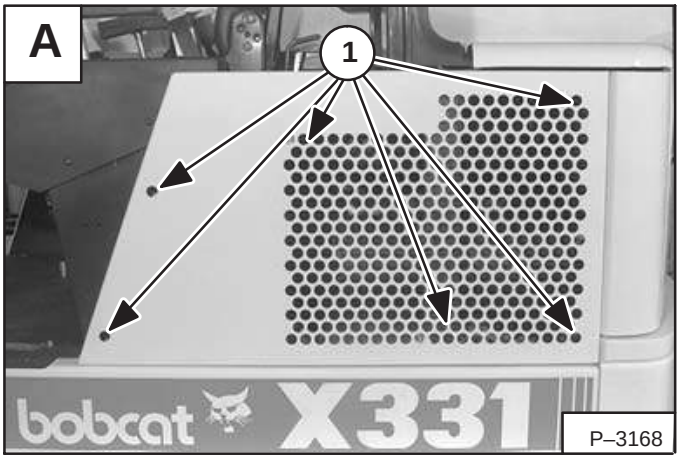
Failure to do so can cause injury or death.

W–2203–0595

Start the engine and run for about 10 seconds while a second person, wearing safety glasses, holds a piece of wood over the outlet of the muffler.

Stop the engine. Install and tighten the plug.

Close the engine cover.



⚠ WARNING

When an engine is running in an enclosed area, fresh air must be added to avoid concentration of exhaust fumes. If the engine is stationary, vent the exhaust outside. Exhaust fumes contain odorless, invisible gases which can kill without warning.

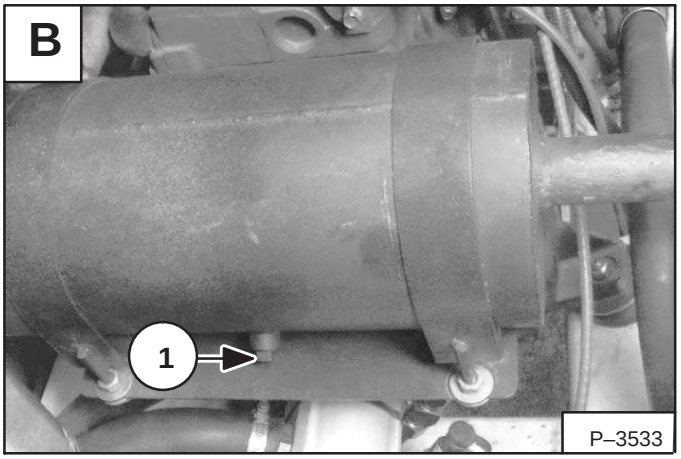
W–2050–1285

Stop engine and allow the muffler to cool before cleaning the spark chamber. Wear safety glasses or goggles. Failure to obey can cause serious injury.

W–2011–1285

Never use machine in atmosphere with explosive dust or gases or where exhaust can contact flammable material. Failure to obey warnings can cause injury or death.

W–2068–1285



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SPARK ARRESTOR MUFFLER (Cont'd)

Cleaning Spark Arrestor Muffler (S/N 12001 & Above)

See the Service Schedule Page 1–4 for the correct service interval.

Do not operate the excavator with a defective exhaust system

IMPORTANT

This excavator is factory equipped with a U.S.D.A. Forestry Service approved spark arrestor muffler. It is necessary to do maintenance on this spark arrestor muffler to keep it in working condition. The spark arrestor muffler must be serviced by dumping the spark chamber every 100 hours of operation.

If this machine is operated on flammable forest, brush or grass covered land, it must be equipped with a spark arrestor attached to the exhaust system and maintained in working order. Failure to do so will be in violation of California State Law, Section 4442 PRC.

Make reference to local laws and regulations for spark arrestor requirements.

I–2061–0195

Stop the engine. Open the engine cover.

Remove the six bolts (Item 1) **[A]** from the left side cover.

Remove the left side cover.

Remove the plug (Item 1) **[B]** from the bottom of the muffler.

⚠ WARNING

When the engine is running during service, the steering levers must be in neutral.

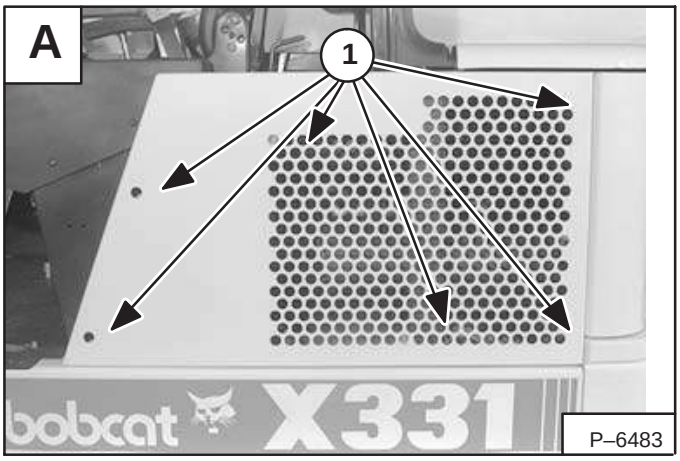
Failure to do so can cause injury or death.

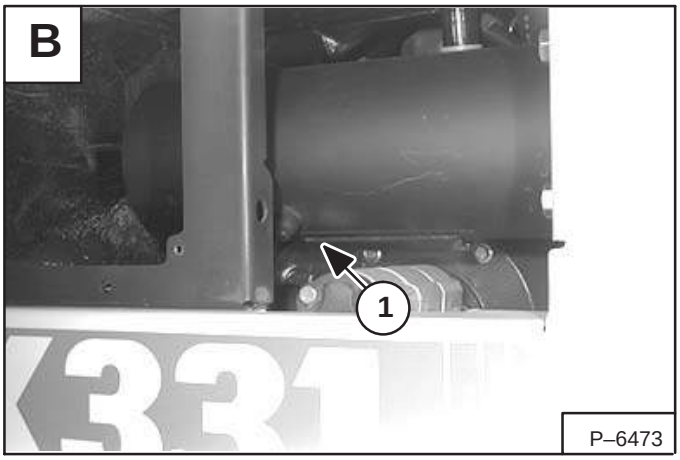
W–2203–0595

Start the engine and run for about 10 seconds while a second person, wearing safety glasses, holds a piece of wood over the outlet of the muffler. (The carbon deposits will be forced out of the muffler plug hole.)

Stop the engine. Install and tighten the plug.

Close the engine cover.





⚠ WARNING

When an engine is running in an enclosed area, fresh air must be added to avoid concentration of exhaust outside. If the engine is stationary, vent the exhaust outside. Exhaust fumes contain odorless, invisible gases which can kill without warning.

W–2050–1285

Stop engine and allow the muffler to cool before cleaning the spark chamber. Wear safety glasses or goggles. Failure to obey can cause serious injury.

W–2011–1285

Never use machine in atmosphere with explosive dust or gases or where exhaust can contact flammable material. Failure to obey warnings can cause injury or death.

W–2068–1285

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LUBRICATION OF THE EXCAVATOR

Procedure (S/N 11001 – 11999)

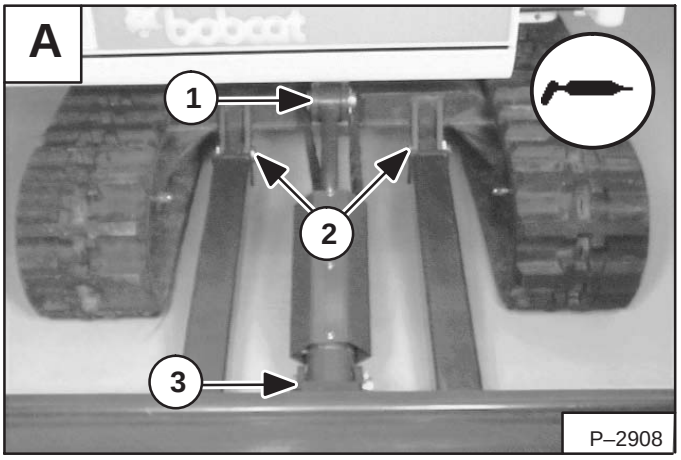
Lubricate the Hydraulic Excavator as specified in the Service Schedule Page 1–3 for the best performance of the machine.

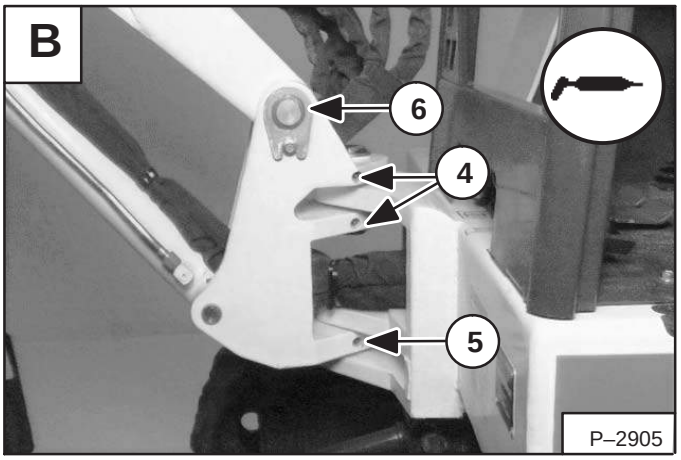
Always use a good quality lithium based multipurpose grease when lubricating the machine. Apply the lubricant until extra grease shows.

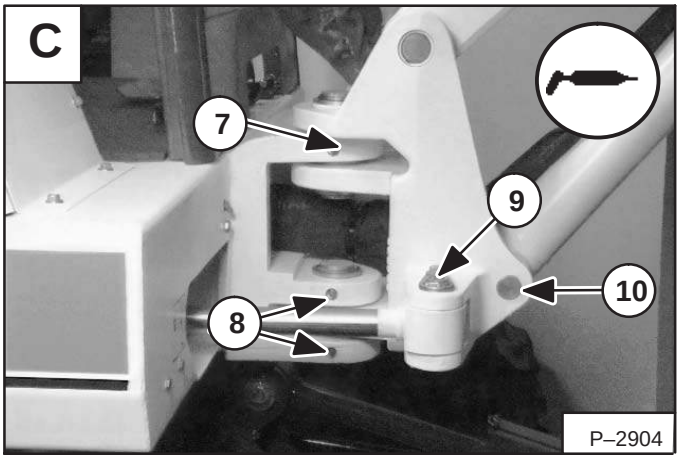
Lubricate the following locations on the Hydraulic Excavator **EVERY 8–10 HOURS:**

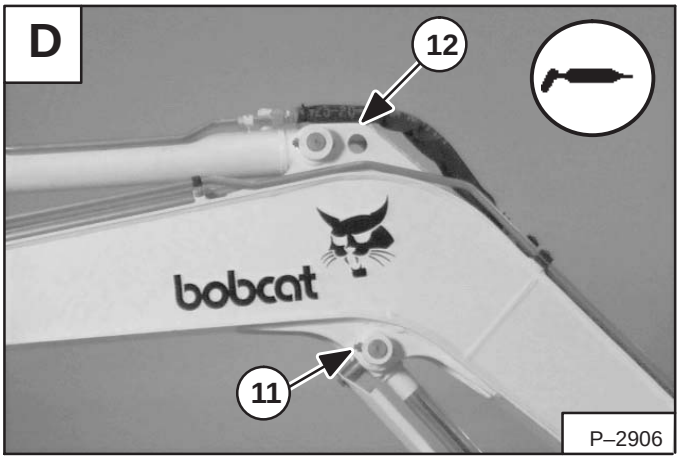
Ref. Description (# of Fittings)

1. Blade Cylinder Rod End (1) **[A]**.
2. Blade Pivots (2) **[A]**.
3. Blade Cylinder Base End (1) **[A]**.
4. Boom Swing Bracket Pivot (2) **[B]**.
5. Boom Swing Bracket (1) **[B]**.
6. Boom Base Pivot (1) **[B]**.
7. Boom Swing Bracket Top Pivot (1) **[C]**.
8. Boom Swing Bracket Pivot (2) **[C]**.
9. Boom Swing Cylinder Rod End (1) **[C]**.
10. Boom Cylinder Base End (1) **[C]**.
11. Boom Cylinder Rod End (1) **[D]**.
12. Arm Cylinder Base End (1) **[D]**.







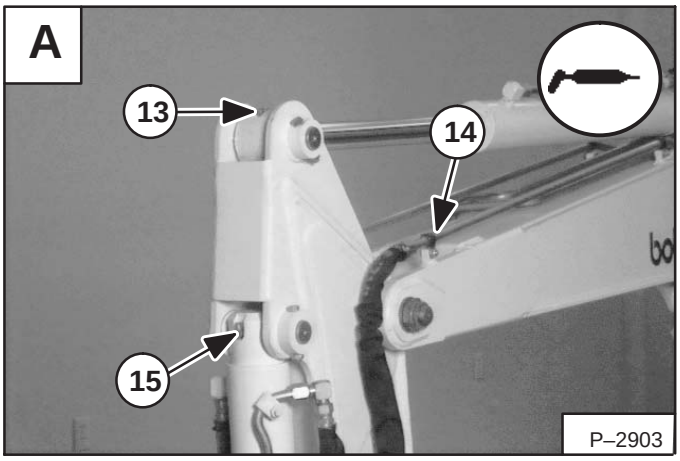


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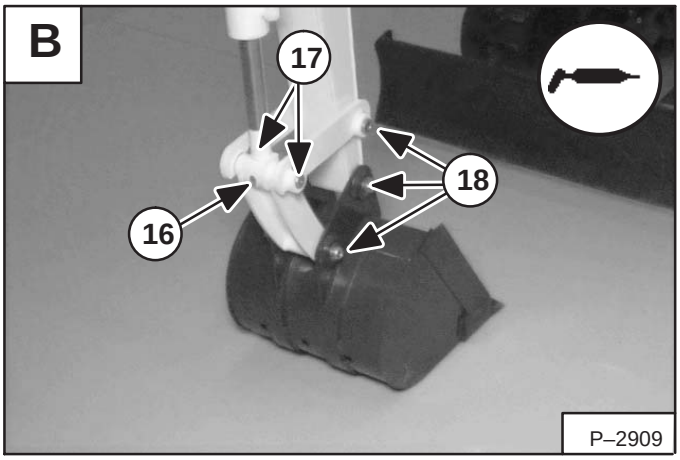
LUBRICATION OF THE EXCAVATOR (Cont'd)

Procedure (S/N 11001–11999) (Cont'd)

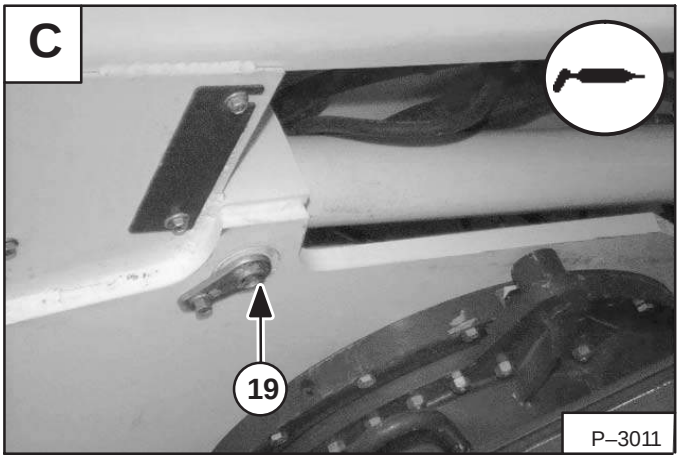
Ref.	Description (# of Fittings)
13.	Arm Cylinder Rod End (1) **[A]**.
14.	Arm Base Pivot (1) **[A]**.
15.	Bucket Cylinder Base End (1) **[A]**.



16.	Bucket Cylinder Rod End (1) **[B]**.
17.	Bucket Link Pivots (2) **[B]**.
18.	Bucket Pivots (4) **[B]**.



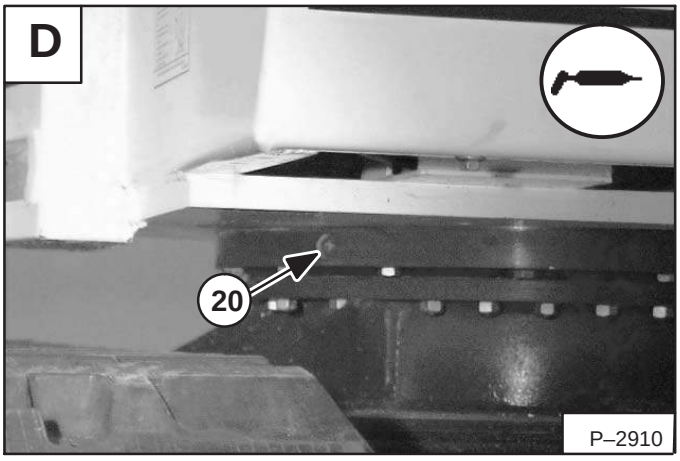
19.	Boom Swing Cylinder Base End (1) **[C]**.



Lubricate the following locations on the Hydraulic Excavator **EVERY 50 HOURS:**

Ref.	Description (# of Fittings)
20.	Swing Circle Ball Bearings (2) **[D]**.

NOTE: Do not over grease the swing circle or damage to the seals could result. Install 4 to 5 pumps of grease from a grease gun into each of the two grease fittings. Rotate the upperstructure 90° and install 4 to 5 pumps of grease into each of the 2 grease fittings.



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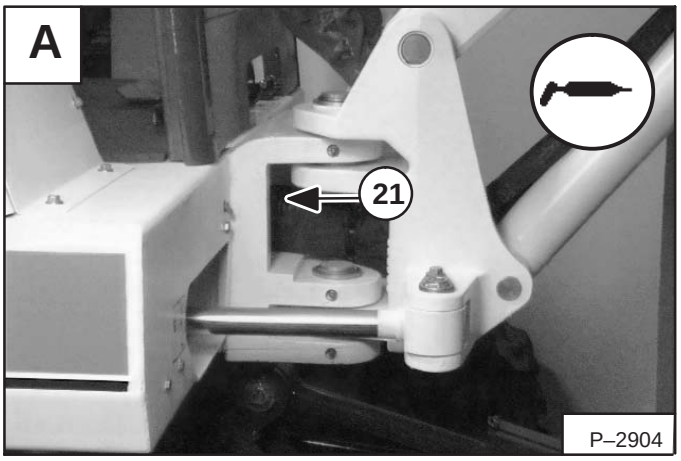
LUBRICATION OF THE EXCAVATOR (Cont'd)

Procedure (S/N 11001–11999) (Cont'd)

Lubricate the following locations on the Excavator **EVERY 50 HOURS: (Cont'd)**

Ref.	Description (# of fittings)
21.	Swing Circle Pinion (1) **[A]**.

NOTE: Install 4 pumps of grease from a grease gun into the grease fitting. Rotate the upper structure 180° and install 4 more pumps of grease into the grease fitting.



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LUBRICATION OF THE HYDRAULIC EXCAVATOR (Cont'd)

Procedure (S/N 12001 & Above)

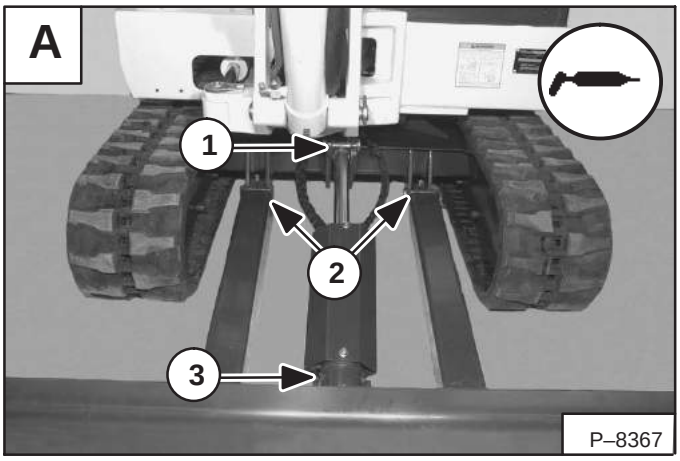
Lubricate the Hydraulic Excavator as specified in the Service Schedule Page 1–4 for the best performance of the machine.

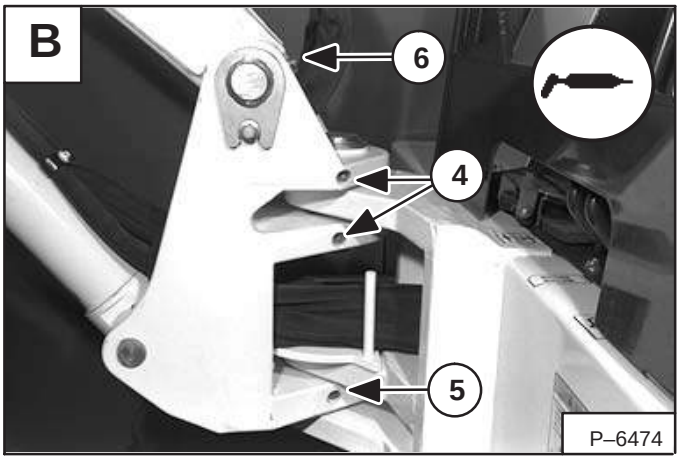
Always use a good quality lithium based multipurpose grease when lubricating the machine. Apply the lubricant until extra grease shows.

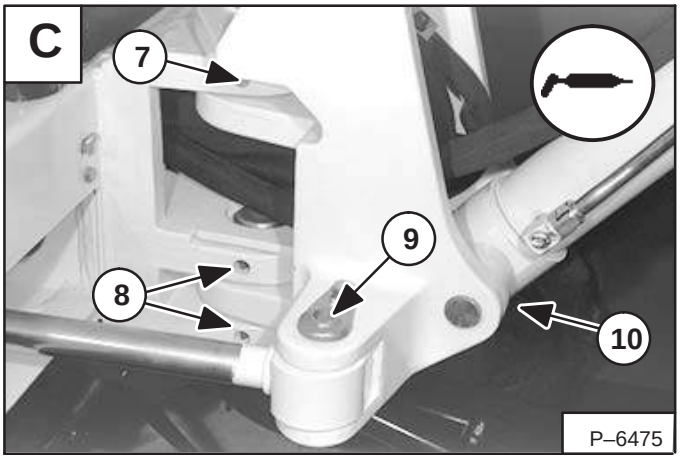
Lubricate the following locations on the Hydraulic Excavator **EVERY 8–10 HOURS:**

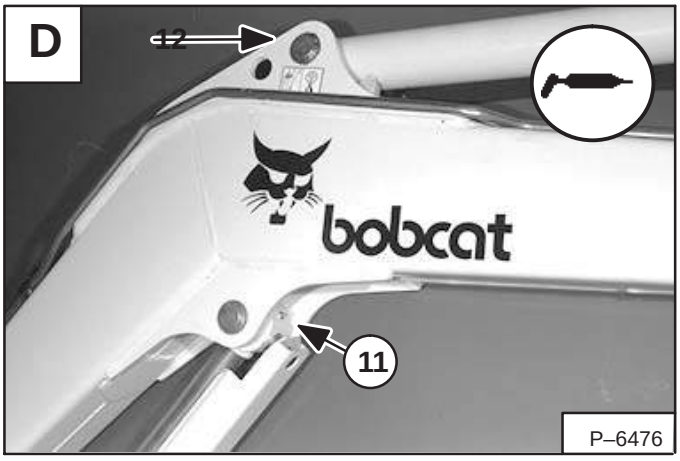
Ref. Description (# of Fittings)

1. Blade Cylinder Rod End (1) **[A]**.
2. Blade Pivots (2) **[A]**.
3. Blade Cylinder Base End (1) **[A]**.
4. Boom Swing Bracket Pivot (2) **[B]**.
5. Boom Swing Bracket (1) **[B]**.
6. Boom Base Pivot (1) **[B]**.
7. Boom Swing Bracket Top Pivot (1) **[C]**.
8. Boom Swing Bracket Pivot (2) **[C]**.
9. Boom Swing Cylinder Rod End (1) **[C]**.
10. Boom Cylinder Base End (1) **[C]**.
11. Boom Cylinder Rod End (1) **[D]**.
12. Arm Cylinder Base End (1) **[D]**.







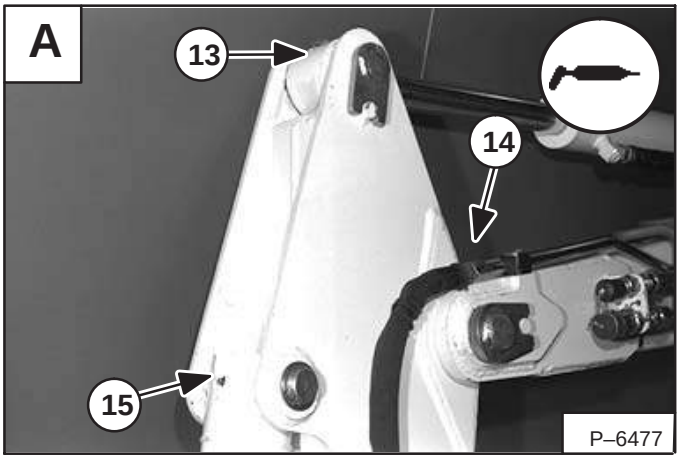


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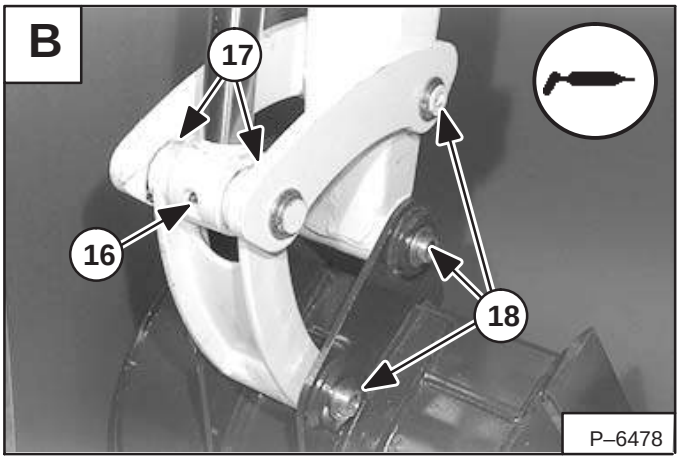
LUBRICATION OF THE HYDRAULIC EXCAVATOR (Cont'd)

Procedure (S/N 12001 & Above) (Cont'd)

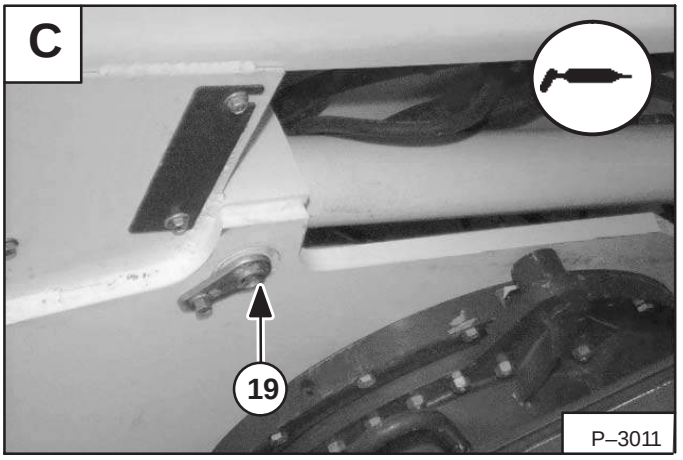
Ref.	Description (# of Fittings)
13.	Arm Cylinder Rod End (1) **[A]**.
14.	Arm Base Pivot (1) **[A]**.
15.	Bucket Cylinder Base End (1) **[A]**.



16.	Bucket Cylinder Rod End (1) **[B]**.
17.	Bucket Link Pivots (2) **[B]**.
18.	Bucket Pivots (3) **[B]**.



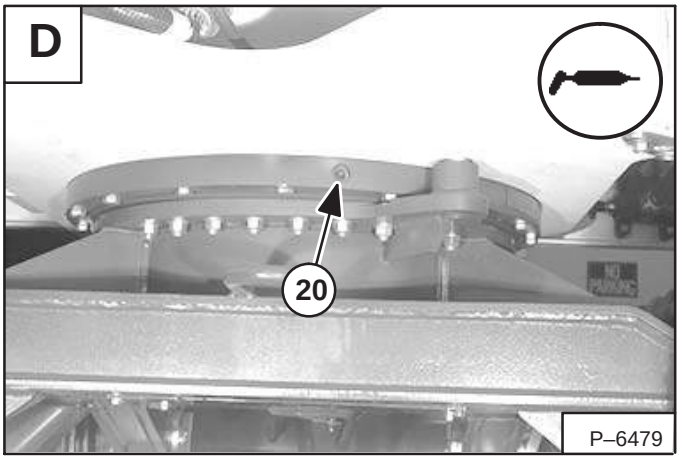
19.	Boom Swing Cylinder Base End (1) **[C]**.



Lubricate the following locations on the Hydraulic Excavator **EVERY 50 HOURS:**

Ref.	Description (# of Fittings)
20.	Swing Circle Ball Bearings (2) **[D]**.

NOTE: Do not over grease the swing circle or damage to the seals could result. Install 4 to 5 pumps of grease from a grease gun into each of the two grease fittings. Rotate the upperstructure 90° and install 4 to 5 pumps of grease into each of the 2 grease fittings.



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LUBRICATION OF THE HYDRAULIC EXCAVATOR (Cont'd)

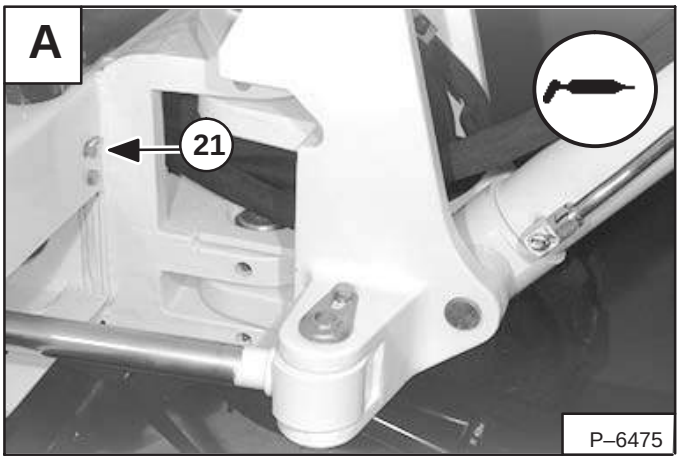
Procedure (S/N 12001 & Above) (Cont'd)

Lubricate the following locations on the Hydraulic Excavator **EVERY 50 HOURS:**

Ref.	Description (# of fittings)

6. Swing Circle Pinion (1) **[A]**.

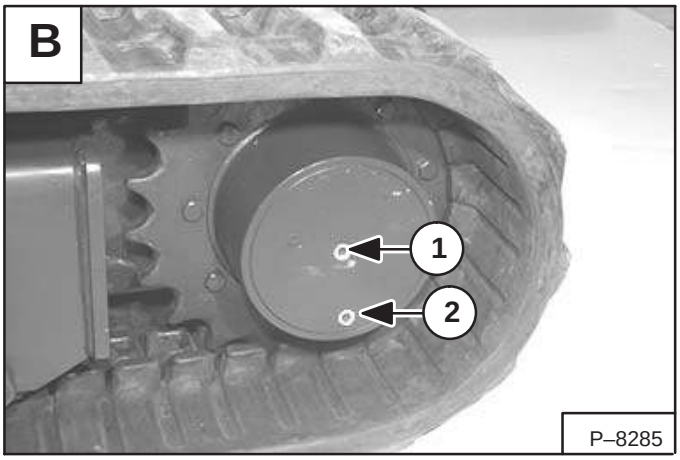
NOTE: Install 4 pumps of grease from a grease gun into the grease fitting. Rotate the upper structure 180° and install 4 more pumps of grease into the grease fitting.



FINAL DRIVE CASE

Checking Oil Level

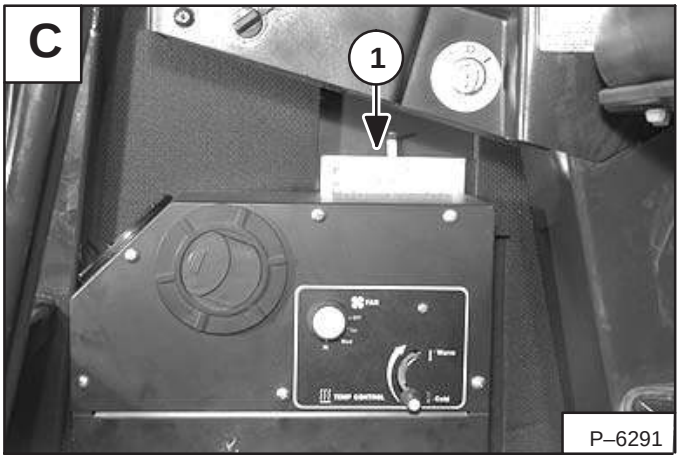
1. Put the machine on a level surface with the plugs positioned as shown in figure **[B]**.
2. Remove the top plug (Item 1) **[B]**. The oil level should be at the bottom edge of the plug hole.
3. Add gear lube 90W through the hole if the oil level is below the hole (See Fuel, Coolant and Lubricant Chart, Section 8).
4. Install and tighten the plug.
5. Repeat the procedure for the other side.



Draining Final Drive Case

See the Service Schedule Page 1–4 for the correct service interval.

1. Put the machine on 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 gear lube is removed, install and tighten the bottom plug (Item 2) **[B]**.
4. Add 0.55 quarts (0,5 L.) of gear lube to the top plug hole (or until the gear lube level is at the bottom edge of the plug hole). Install and tighten the plug.
5. Repeat the procedure for the other side.



HEATER AIR FILTER SERVICE

If equipped with cab option see the Service Schedule Page 1–3 for the correct service interval.

Remove the filter (Item 1) **[C]** from the back of the heater.

Clean the filter element with compressed air.

Install the filter element into the back of the heater.

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HYDRAULIC SECTION

	Page Number
ACCUMULATOR (S/N 12999 & Below)	
Adjustment	2–95
Assembly	2–102
Charging	2–107
Disassembly	2–98
Parts Identification	2–97
Pressure Reducing Valve	2–96
Removal and Installation	2–96
Setting the Safety Relief Valve	2–106
Testing	2–96
ACCUMULATOR (S/N 13001 & Above)	
Parts Identification	2–109
Removal and Installation	2–108
ARM CYLINDER	
Parts Identification	2–130
Removal and Installation (S/N 11001–11999)	2–128
Removal and Installation (S/N 12001 & Above)	2–129
AUXILIARY SELECTOR VALVE	
Disassembly and Assembly	2–110
Removal and Installation (S/N 12999 & Below)	2–110
Removal and Installation (S/N 13001 & Above)	2–110
BLADE CYLINDER	
Parts Identification	2–135
Removal and Installation	2–134
BOOM CYLINDER	
Parts Identification	2–127
Removal and Installation (S/N 11001–11999)	2–125
Removal and Installation (S/N 12001 & Above)	2–126
BOOM SWING CYLINDER	
Parts Identification	2–137
Removal and Installation	2–136
BUCKET CYLINDER	
Parts Identification	2–133
Removal and Installation (S/N 11001–11999)	2–131
Removal and Installation (S/N 12001 & Above)	2–132
HYDRAULIC CONTROL VALVE (3–Spool) (S/N 12999 & Below)	
Assembly	2–49
Blade and Boom Swing Section Disassembly and Assembly	2–52
Description	2–47
Disassembly	2–49
End Cover Disassembly and Assembly	2–55
Housing Swing Section Disassembly and Assembly	2–50
Parts Identification	2–48
Removal and Installation	2–47
HYDRAULIC CONTROL VALVE (6–Spool) (S/N 12999 & Below)	
Assembly	2–33
Auxiliary Section Disassembly and Assembly	2–40
Boom, Bucket and Arm Section Disassembly and Assembly	2–37
Disassembly	2–33
End Cover Disassembly and Assembly	2–45
Left Hand Travel Section Disassembly and Assembly	2–42
Parts Identification	2–32
Removal and Installation	2–31
Right Hand Travel Section Disassembly and Assembly	2–34

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HYDRAULIC SECTION (Cont'd)

	Page Number
HYDRAULIC CONTROL VALVE (5–Spool) (S/N 13001 & Above)	
Boost, Arm, Boom Swing, Blade and Swing Section Assembly	2–94
Arm, Boost and Swing Motor Assembly	2–83
Arm, Boost and Swing Motor Disassembly	2–81
Blade Assembly	2–92
Blade Disassembly	2–90
Boom Swing Assembly	2–87
Boom Swing Disassembly	2–85
Description	2–77
Disassembly	2–79
Inlet Section	2–80
Parts Identification	2–78
Removal and Installation	2–77
HYDRAULIC CONTROL VALVE (5–Spool) (S/N 13001 & Above)	
Left Travel, Right Travel, Boom, Bucket and Auxiliary Assembly	2–69
Boom and Bucket Assembly	2–67
Boom and Bucket Disassembly	2–65
Disassembly	2–59
Left Travel, Right Travel and Auxiliary Assembly	2–63
Left Travel, Right Travel and Auxiliary Disassembly	2–61
Mid Inlet Section Assembly	2–60
Mid Inlet Section Disassembly	2–60
Outlet Sections Assembly	2–60
Outlet Sections Disassembly	2–60
Parts Identification	2–58
Removal and Installation	2–57
HYDRAULIC CYLINDER	
Assembly	2–140
Disassembly	2–138
HYDRAULIC FILTER ASSEMBLY	
Removal and Installation (S/N 11001–11999)	2–124
Removal and Installation (S/N 12001 & Above)	2–124
HYDRAULIC PUMP	
Assembly	2–28
Checking the Hydraulic Pump	2–23
Disassembly	2–26
Parts Identification	2–25
Removal and Installation	2–24
HYDRAULIC RESERVOIR AND FUEL RESERVOIR	
Removal and Installation	2–120
HYDRAULIC SERVICE INFORMATION (S/N 11001–12999)	
Description	2–10
HYDRAULIC SERVICE INFORMATION (S/N 13001 & Above)	
Description	2–17
HYDRAULIC SYSTEM TROUBLESHOOTING	
Troubleshooting the Cylinder Circuit	2–6
Troubleshooting the Hydraulic Circuit	2–5
Troubleshooting the Swing (Slew) Circuit	2–7
Troubleshooting the Travel Circut	2–8
JOYSTICK CONTROL CHANGE	
I.S.O. to Standard Control Pattern (S/N 12999 & Below)	2–145
Standard to I.S.O. Control Pattern (S/N 12999 & Below)	2–145
I.S.O. to Standard Control Pattern (S/N 13001 & Above)	2–146
Standard to I.S.O. Control Pattern (S/N 13001 & Above)	2–146

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Page Number

MAIN RELIEF VALVES (S/N 11001–12999)
- Checking Dual Pressure Relief Valves 2–11
- Checking Single Pressure Relief Valve 2–12
- Description 2–10
- Dual Pressure Relief Valve Adjustment (6–Spool Valve) 2–13
- Single Pressure Relief Valve Adjustment (3–Spool Valve) 2–16

MAIN RELIEF VALVES (Adjustable) (S/N 13001 & Above)
- Adjusting the Main Relief Valves 2–76
- Assembly 2–74
- Checking the Main Relief Valves
  - Testing the Auxiliary and Bucket Circuit Relief Valve 2–19
  - Testing the Blade, Boom Swing, Arm and Boost Circuit Relief Valves 2–17
  - Testing the Boom Circuit Relief Valve 2–22
  - Testing the Left Hand Travel Circuit Relief Valve 2–20
  - Testing the Right Hand Travel Circuit Relief Valve 2–21
  - Testing the 4050 PSI (27925 kPa) Circuit Relief Valve 2–18
- Disassembly 2–75
- Parts Identification 2–73

OIL COOLER
- Removal and Installation (S/N 11001–11999) 2–118
- Removal and Installation (S/N 12001 & Above) 2–119

PORT BLOCK
- Removal and Installation (S/N 12999 & Below) 2–116
- Removal and Installation (S/N 13001 & Above) 2–116

PORT RELIEF VALVES AND MAIN RELIEF VALVES (S/N 13001 & Above)
- Adjustment Procedure (Work Port Relief Valves Only) 2–72
- Assembly 2–72
- Disassembly 2–71
- Parts Identification 2–70
- Port Relief Valve Pressure Setting 2–71

TROUBLESHOOTING
- Chart 2–5

TWO SPEED SWITCH (S/N 13001 & Above)
- Removal and Installation 2–115

TWO SPEED VALVE (S/N 12999 & Below)
- Assembly 2–114
- Disassembly 2–113
- Parts Identification 2–112
- Removal and Installation 2–111

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HYDRAULIC SYSTEM OPERATION

To Be Used With

HYDRAULIC FLOW CHART

(ISO and STANDARD)

For Model

331 EXCAVATOR (S/N 512911001–11056)

Chart # 6724231 (Printed July, 1996)

CHART LEGEND

[1] **OIL COOLER**

[2] **TRAVEL MOTORS**

[3] **CENTER SWIVEL JOINT**

[4] **BLADE CYLINDER**

[5] **#10 MICRON FILTER** (W/25 PSI By–Pass Valve)

[6] **HYDRAULIC PUMPS** ..... Triple Section 3 x 9.1 GPM (34.5 L/min.) @ 2500 RPM

[7] **SUPPLY PORT BLOCK**

[8] **HYDRAULIC RESERVOIR, Cap** (Non–Vented)

[9] **STRAINER**

[10] **HYDRAULIC RESERVOIR** (10.5 Gals. 40 L) (Vented)

[11] **TWO SPEED VALVE**

[12] **SWING MOTOR**

[13] **RETURN PORT BLOCK**

[14] **3–SPOOL CONTROL VALVE**

[15] **MAIN RELIEF VALVE** ..... 2500 PSI (17235 kPa)

[16] **LOAD CHECK VALVE** (Blade Cylinder)

[17] **ONE WAY RESTRICTOR** .082" (Blade Cyl.)

[18] **LOAD CHECK VALVES** (Boom Swing Cylinder)

[19] **BUILD–UP VALVE** .... 200 PSI (1378 kPa)

[20] **BOOM SWING CYLINDER**

[21] **SHUTTLE VALVE**

[22] **PRESSURE REDUCING VALVE** 363 PSI (2500 kPa)

[23] **ACCUMULATOR RELIEF VALVE** .. 507 PSI (3632 kPa)

[24] **CONSOLE LOCK–OUT VALVE**

[25] **L.H. JOYSTICK**

[26] **R.H. JOYSTICK**

[27] **MAIN RELIEF VALVE** – 2 Stage Pressure
Standard Pressure ..... 2500 PSI (17235 kPa)
High Pressure ..... 3000 PSI (20682 kPa)

[28] **MAIN RELIEF VALVE** – 2 Stage Pressure
Standard Pressure ..... 2500 PSI (17235 kPa)
High Pressure ..... 3000 PSI (20682 kPa)

[29] **6–SPOOL CONTROL VALVE**

[30] **PORT RELIEF VALVE** (Boom Cyl.) 2950 PSI (20345 kPa)

[31] **PORT RELIEF VALVE** (Boom Cyl.) 3400 PSI (23448 kPa)

[32] **PORT RELIEF VALVE** (Bucket Cyl.) 3400 PSI (23448 kPa)

[33] **PORT RELIEF VALVE** (Arm Cyl.) 2950 PSI (20345 kPa)

[34] **PORT RELIEF VALVE** (Arm Cyl.) 2950 PSI (20345 kPa)

[35] **ONE WAY RESTRICTOR** .125" (Arm Cyl.)

[36] **ONE WAY RESTRICTOR** .125" (Boom Cyl.)

[37] **BUCKET CYLINDER**

[38] **ARM CYLINDER (Cushion)**

[39] **BOOM CYLINDER (Cushion)**

[40] **AUXILIARY QUICK COUPLERS**

[41] **AUXILIARY SELECTOR VALVE**

[42] **ACCUMULATOR**

[43] **RELIEF VALVE** ..... Swing Motor (2) 2088 PSI (14395 kPa)

[44] **SHUTTLE VALVE**

[45] **HYDRAULIC PUMP TEST PORTS**

[46] **TRAVEL MOTOR SPOOL**

[47] **CASE DRAIN FILTER** (150 Micron)

[48] **CASE DRAIN FILTER** (Optional)
(See Service Letter Dated August 15, 1996)

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For hydraulic breaker operation, when the selector valve **[41]** knob is pulled out (breaker operating position) the left foot pedal works one way only and the fluid flows through the selector valve **[41]**, to the oil cooler **[1]**, to the oil filter **[5]** and back to the supply port block **[7]** with reduced back pressure. When the selector knob is pushed in (2 way flow) the left pedals works both ways and the flow is routed back to the auxiliary section of the 6–spool control valve **[29]**. 2 way flow is used for attachments like the auger.

Fluid from the end cap section of the hydraulic pump **[6]** is forced to the *P1* port of the 3–spool control valve **[14]**. Oil under pressure is also directed to the shuttle valve **[21]** and the 363 PSI pressure reducing valve **[22]** which supplies fluid to the joystick controls **[25]** & **[26]**.

The console lock–out valve **[24]** is located on the left console. When the console is lowered the valve is activated and fluid is allowed to flow to the joysticks **[25]** & **[26]**. When the console is raised the valve is open and the fluid can not flow to the joysticks.

Fluid from the outside hydraulic pump is forced to the *P1* port of the 3–spool control valve **[14]**. When a cylinder reaches the end of the stroke, pressure increases and opens the 2500 PSI relief valve **[15]** and the fluid returns to the oil cooler **[1]**, the oil filter **[5]** and to the supply port block **[7]**. The three sections of this control valve controls house swing, blade and boom swing. The house swing (slew) section controls oil flow to a geroler swing motor **[12]**. The motor contains two 2088 PSI relief valves **[43]**. At full throttle the swing motor can rotate the house frame 9.5 RPM. Motor case drain returns through the return port block **[13]** and return port block filter **[47]** to the reservoir **[10]**.
NOTE: Per the Service Letter Dated August 15, 1996: Some machines may have the 100 mesh screen **[47]** removed and the case drain filter **[48]** installed at the hydraulic reservoir.

The blade section controls fluid flow to the blade cylinder **[4]** and has two (2) load check valves **[16]** which maintain the proper blade height. The blade section has a one way restrictor **[17]** located in the *B* port limiting the *blade raise* speed.

The boom swing section controls oil flow to the boom swing cylinder **[20]** and has two load checks **[18]** for cylinder stability.

A 200 PSI build up valve **[19]** is located on the outlet side of the 3–spool control valve. The valve maintains 200 PSI at idle to charge the accumulator **[42]**. The accumulator stores fluid under pressure to operate the joystick function if the engine stops.

When the 3–spool control valve **[14]** is in neutral the oil flows through the open center to the oil cooler **[1]**, the filter **[5]** and back to the supply port block **[7]**.

Moving a joystick forces fluid to one side of the servo's on either side of a control valve **[14]** & **[29]**. The hydraulic pressure shifts the spool in or out and controls fluid flow for the correct cylinder.

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JOYSTICK FUNCTIONS

ISO CONTROL:

Left Hand:

Joystick pushed forward – Arm out. Oil flows from the joystick *3* port to control valve servo. Oil flows from *A* port of control valve to the rod end of the arm cylinder, retracting the cylinder.

Joystick pulled back – Arm in. Oil flows from the joystick *1* port to control valve servo. Oil flows from the *B* port of control valve to the base end of the arm cylinder, extending the cylinder.

Joystick moved left – Swings the house in the counterclockwise rotation. Oil flows from the joystick *2* port to control valve servo. Oil flows from *A* port of the control valve to the *B* port of the swing motor.

Joystick moved right – Swings the house in clockwise rotation. Oil flows from the joystick *4* port to control valve servo. Oil flows from *B* port of control valve to the *A* port of the swing motor.

Right Hand:

Joystick pushed forward – Boom down. Oil flows from the joystick *1* port to control valve servo. Oil flows from *A* port of control valve to the rod end of boom cylinder, retracting the cylinder.

Joystick pulled back – Boom up. Oil flows from the joystick *3* port to control valve servo. Oil flows from *B* port of control valve to the base end of boom cylinder, extending the cylinder.

Joystick moved right – Opens the bucket. Oil flows from the joystick *2* port to control valve servo. Oil flows from *B* port of control valve to the rod end of the bucket cylinder, retracting the cylinder.

Joystick moved left – Closes the bucket. Oil flows form the joystick *4* port to control valve servo. Oil flows from *A* port of control valve to the base end of the bucket cylinder, extending the cylinder.

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STANDARD CONTROL:

Left Hand:

Joystick pushed forward – Boom down. Oil flows from the joystick *3* port to control valve servo. Oil flows from *A* port of control valve to the rod end of the boom cylinder, retracting the cylinder.

Joystick pulled back – Boom up. Oil flows from the joystick *1* port to control valve servo. Oil flows from the *B* port of control valve to the base end of the boom cylinder, extending the cylinder.

Joystick moved left – Swings the house in the counterclockwise rotation. Oil flows from the joystick *2* port to control valve servo. Oil flows from *A* port of control valve to the *B* port of the swing motor.

Joystick moved right – Swings the house in the clockwise rotation. Oil flows from the joystick *4* port to control valve servo. Oil flows from *B* port of control valve to the *A* port of the swing motor.

Right Hand:

Joystick pushed forward – Arm out. Oil flows from the joystick *1* port to control valve servo. Oil flows from *A* port of control valve to the rod end of boom cylinder, retracting the cylinder.

Joystick pulled back – Arm in. Oil flows from the joystick *3* port to control valve servo. Oil flows from *B* port of control valve to the base end of arm cylinder, extending the cylinder.

Joystick moved right – Opens the bucket. Oil flows from the joystick *2* port to control valve servo.. Oil flows from *B* port of control valve to the rod end of the bucket cylinder, retracting the cylinder.

Joystick moved left – Closes the bucket. Oil flows from the joystick *4* port to control valve servo. Oil flows from *A* port of control valve to the base end of the bucket cylinder, extending the cylinder.

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The two speed track drive motors **[2]** are controlled by a foot pedal operated two speed valve **[11]**. The pedal is normally in the up position for low range 1.5 MPH (2,4 km/hr.). When the foot pedal is pushed down the 363 PSI oil shifts the travel motors into high range 2.9 MPH (4,7 km/hr.). The pedal must be held down for high range. When the foot pedal is released (normal position) the travel motor goes into low range and the oil flows through the two speed valve and back to the reservoir **[10]**.

Forward and Reverse Travel is controlled by the left and right steering lever/foot pedals mechanically actuating the respective 6–spool control valve **[29]** spools. Right hand travel lever/pedal pushed forward – Right track forward: Fluid flows from *A* port of the right hand travel section through the *B* port of the center swivel joint **[3]** and to the *P2* port of the right hand travel motor. Right hand travel lever/pedal pulled back – Right track reverse: Fluid flows from *B* port of right hand travel section through the *D* port of the center swivel joint **[3]** and to the *P1* port of the right hand travel motor.

Left hand travel lever/pedal pushed forward – Left track forward: Fluid flows from *A* port of the left hand travel section through the *A* port of the center swivel joint **[3]** and to the *P1* port of the left hand travel motor. Left hand travel lever/pedal pulled back – Left track reverse: Fluid flows from *B* port of the left hand travel section through the *C* port of the center swivel joint **[3]** and to the *P2* port of the left hand travel motor.

Return oil from the travel motors **[2]** returns through the non pressurized *P* port, through the corresponding center swivel joint **[3]** port and back through the 6–spool control valve **[29]** internally, to the oil cooler **[1]**, to the oil filter **[5]**, and back to the supply port block **[7]**.

Travel motor case drain fluid returns from the travel motor **[2]** ports *T1, T2* to port *H* of the center swivel joint **[3]**, to the return port block **[13]**, through the return port block filter **[47]** and to the reservoir **[10]**.

The blade control lever mechanically controls the 3–spool control valve **[14]** blade spool section. Blade control lever pushed forward lowers the blade: Fluid flows from the *A* port of the 3–spool control valve to the *G* port of the center swivel joint **[3]** to the base end of the blade cylinder **[4]**.

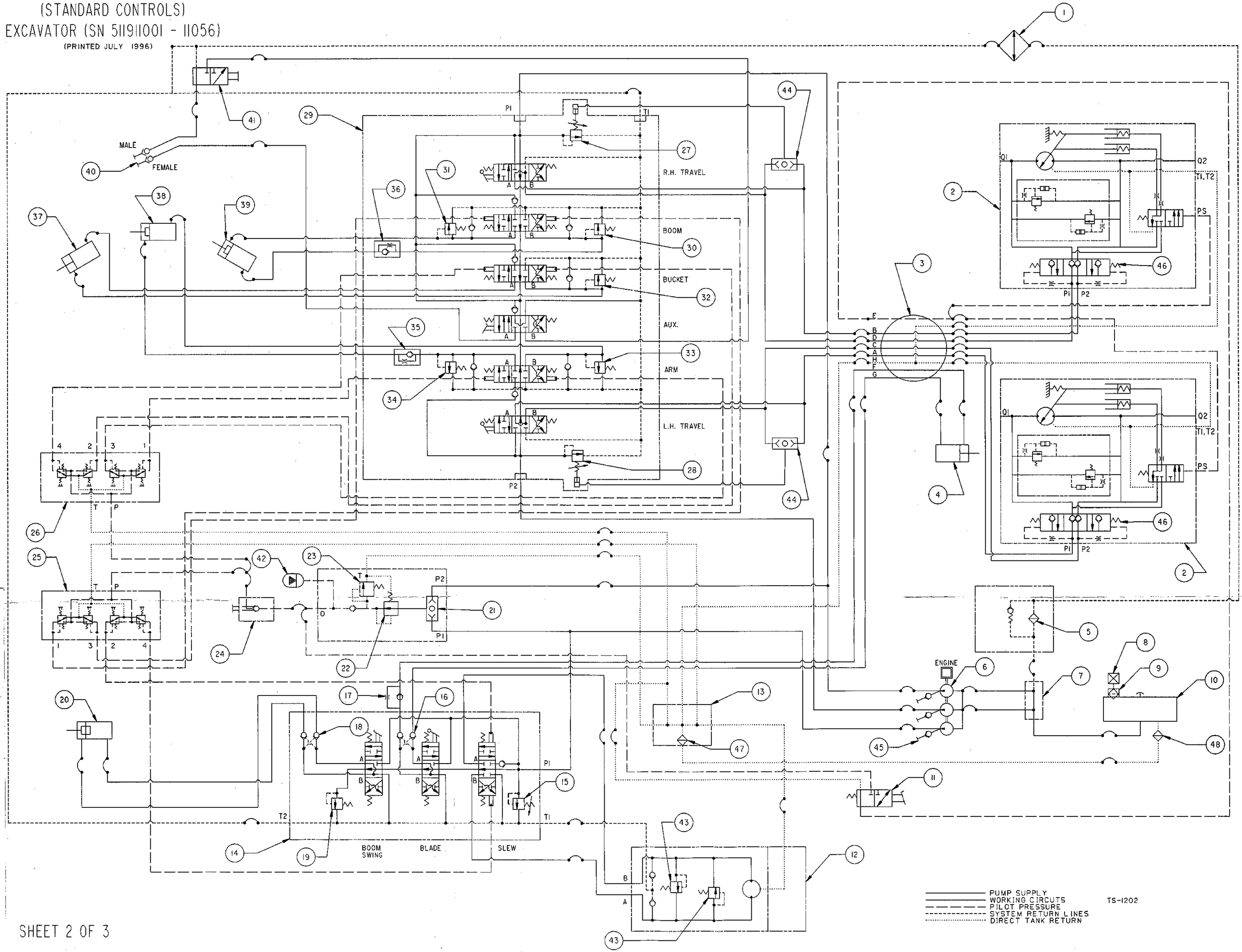
Blade control lever pulled back raises blade: Fluid flows from the *B* port of the 3–spool control valve to the *F* port of the center swivel joint **[3]** to the rod end of the blade cylinder.

The boom swing pedal mechanically controls the boom swing spool section of the 3–spool control valve **[14]**. Right pedal pressure swings the boom to the right by fluid flow from the *A* port to the rod end of the boom swing cylinder **[20]**. Left pedal pressure swings the boom to the left by fluid flow from the *B* port to the base end of the boom swing cylinder **[20]**.

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HYDRAULIC SCHEMATIC (PN 6724231)
(STANDARD CONTROLS)
331 EXCAVATOR (SN 5119111001 - 11056)

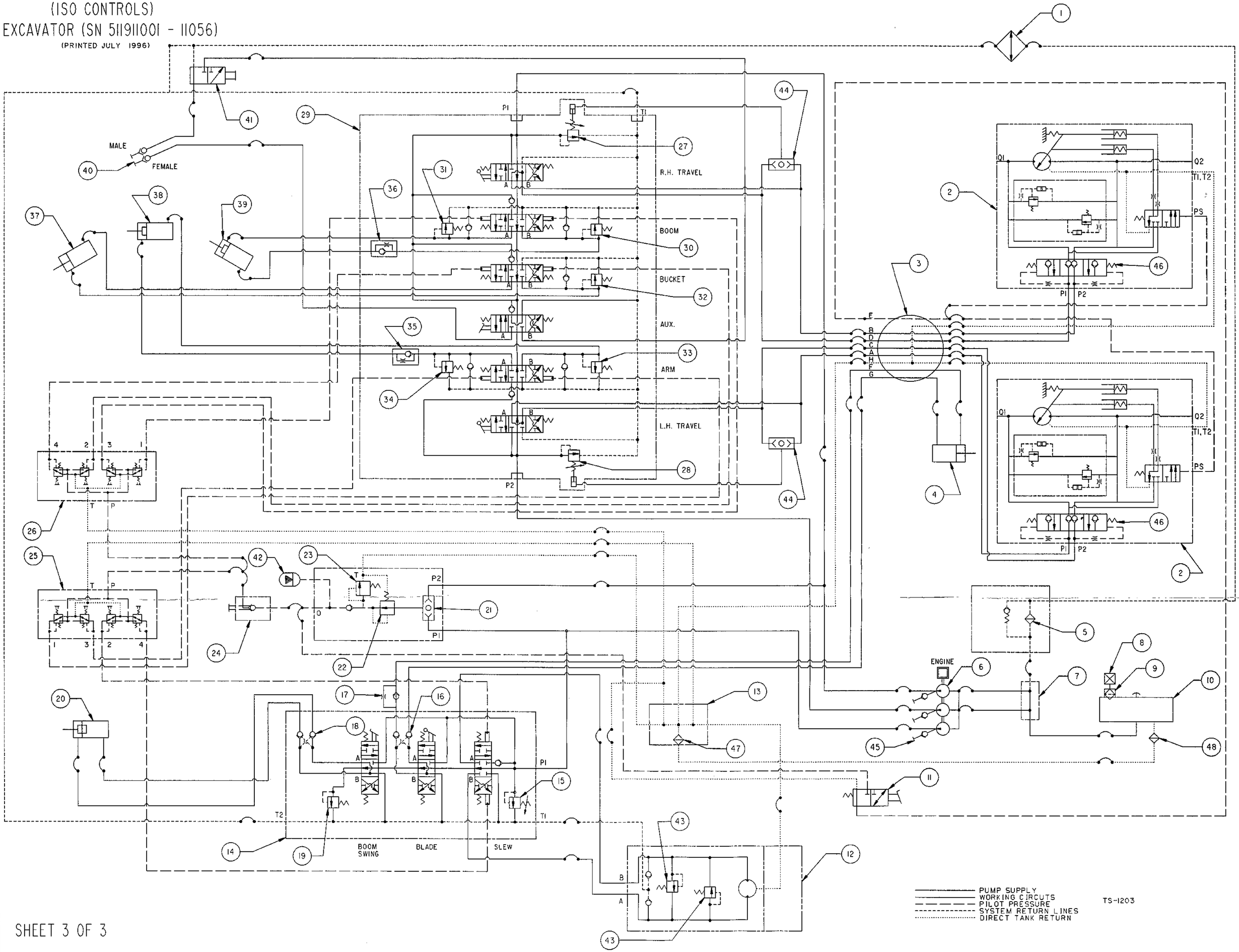
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HYDRAULIC SCHEMATIC (PN 6724231)
(ISO CONTROLS)
331 EXCAVATOR (SN 5119I1001 - 11056)

(PRINTED JULY 1996)



TS-1203

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HYDRAULIC SYSTEM OPERATION

To Be Used With

HYDRAULIC FLOW CHART

(ISO and STANDARD)

For Model

331 EXCAVATOR (S/N 512911057 – 512911999)

Chart # 6724232 (Printed July, 1996)

CHART LEGEND

[1] **OIL COOLER**

[2] **TRAVEL MOTORS**

[3] **CENTER SWIVEL JOINT**

[4] **BLADE CYLINDER**

[5] **#10 MICRON FILTER**
(W/25 PSI By–Pass Valve)

[6] **HYDRAULIC PUMPS**
3 x 9.1 GPM (34.5 L/min.) @ 2500 RPM

[7] **SUPPLY PORT BLOCK**

[8] **HYDRAULIC RESERVOIR, Cap**
(Non–Vented)

[9] **STRAINER**

[10] **HYDRAULIC RESERVOIR** (10.5 Gals. 40 L)
(Vented)

[11] **TWO SPEED VALVE**

[12] **SWING MOTOR**

[13] **RETURN PORT BLOCK**

[14] **3–SPOOL CONTROL VALVE**

[15] **MAIN RELIEF VALVE** ..... 2500 PSI
(17235 kPa)

[16] **LOAD CHECK VALVE** (Blade Cylinder)

[17] **ONE WAY RESTRICTOR** .082" (Blade Cyl.)

[18] **LOAD CHECK VALVES**
(Boom Swing Cylinder)

[19] **BUILD–UP VALVE** .... 200 PSI (1378 kPa)

[20] **BOOM SWING CYLINDER**

[21] **SHUTTLE VALVE**

[22] **PRESSURE REDUCING VALVE** ... 363 PSI
(2500 kPa)

[23] **ACCUMULATOR RELIEF VALVE** .. 507 PSI
(3632 kPa)

[24] **CONSOLE LOCK–OUT VALVE**

[25] **L.H. JOYSTICK**

[26] **R.H. JOYSTICK**

[27] **MAIN RELIEF VALVE** 2 Stage Pressure
Standard Pressure ..... 2500 PSI
(17235 kPa)
High Pressure ..... 3000 PSI
(20682 kPa)

[28] **MAIN RELIEF VALVE** 2 Stage Pressure
Standard Pressure ..... 2500 PSI
(17235 kPa)
High Pressure ..... 3000 PSI
(20682 kPa)

[29] **6–SPOOL CONTROL VALVE**

[30] **PORT RELIEF VALVE** (Boom Cyl.)
2950 PSI (20345 kPa)

[31] **PORT RELIEF VALVE** (Boom Cyl.)
3400 PSI (23448 kPa)

[32] **PORT RELIEF VALVE** (Bucket Cyl.)
3400 PSI (23448 kPa)

[33] **PORT RELIEF VALVE** (Arm Cyl.)
2950 PSI (20345 kPa)

[34] **PORT RELIEF VALVE** (Arm Cyl.)
2950 PSI (20345 kPa)

[35] **ONE WAY RESTRICTOR** .125" (Arm Cyl.)

[36] **ONE WAY RESTRICTOR** .125" (Boom Cyl.)

[37] **BUCKET CYLINDER**

[38] **ARM CYLINDER (Cushion)**

[39] **BOOM CYLINDER (Cushion)**

[40] **AUXILIARY QUICK COUPLERS**

[41] **AUXILIARY SELECTOR VALVE**

[42] **ACCUMULATOR**

[43] **COUNTER BALANCE VALVE**
Swing Motor (2) 2400 PSI (16547 kPa)

[44] **SHUTTLE VALVE**

[45] **HYDRAULIC PUMP TEST PORTS**

[46] **TRAVEL MOTOR SPOOL**

[47] **CASE DRAIN FILTER** (150 Micron)

[48] **CASE DRAIN FILTER** (Optional)
(See Service Letter Dated August 15, 1996)

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FLUID FLOW EXPLANATION

The fluid flows by gravity from the reservoir **[10]** through a supply port block **[7]** to the 3 section hydraulic gear pump **[6]**. The 3 section gear pumps are coupler driven from the engine. Each gear pump section is protected by a relief valve located in the control valve it supplies.

Fluid from the hydraulic pump **[6]** (Engine flywheel end) is forced to the 6–spool hydraulic control valve **[29]** P1 port (Inlet). These control valve sections control R.H. Travel, Boom and Bucket. Oil under pressure is also diverted to the shuttle valve **[21]**.

Fluid from the center section of the hydraulic pump **[6]** is forced to the P2 port of the 6–spool hydraulic control valve **[29]**. These control valve sections control L.H. Travel, Arm and Auxiliary. The two (2) stage pressure, adjustable relief valves **[27]** & **[28]** are located at each end of the 6–spool hydraulic control valve **[29]**.

When the L.H. Travel section and/or the R.H. Travel section is activated in either the forward or reverse travel direction, oil under pressure is diverted to the two (2) stage pressure relief valves **[27]** & **[28]**. The oil pressure shifts the relief valve from standard pressure (2500 PSI – 17235 kPa) to the high pressure (3000 PSI – 20682 kPa). This will allow increased oil pressure to the travel motors **[2]** for increased drive motor torque. As soon as the travel section spools return to neutral, the two (2) stage pressure relief valves mechanically (spring activated) return to the standard pressure (2500 PSI – 20682 kPa).

With all spools in the neutral position the open center control valve allows fluid to flow to the oil cooler **[1]**, to the oil filter **[5]** and to the supply port block **[7]**. When a spool is activated, the fluid flows to the base or rod end of a cylinder **[37],[38],[39]**. The fluid on the other side of the cylinder flows back to the 6–spool hydraulic control valve **[29]**. When a cylinder reaches the end of the stroke, the pressure increases to 2500 PSI and opens the two stage pressure relief valve **[27]** or **[28]**. The fluid then flows through the 6–spool hydraulic control valve **[29]** internally and back to the oil cooler **[1]**, to the oil filter **[5]** and to the supply port block **[7]**.

The 6–spool hydraulic control valve has Port Relief Valves in both ports of the Boom section **[30]** & **[31]**, the Rod end of the Bucket section **[32]** and both ports of the Arm section **[33]** & **[34]**. The boom section has a one way restrictor **[36]** located in the *B* port limiting the *boom down* speed. The arm section has a one way restrictor **[35]** located in the *A* port limiting the *arm in* speed.

The auxiliary spool is hollow, and while in neutral, fluid flows through the center of the spool to the tank port of the valve. When the auxiliary spool is activated, two pump flows are combined to supply 18 GPM to the auxiliary quick couplers **[40]** on the boom. The female coupler is pressure and the male coupler is return. The auxiliary fluid return flows to the selector valve **[41]**.

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For hydraulic breaker operation, when the selector valve **[41]** knob is pulled out (breaker operating position) the left foot pedal works one way only and the fluid flows through the selector valve **[41]**, to the oil cooler **[1]**, to the oil filter **[5]** and back to the supply port block **[7]** with reduced back pressure. When the selector knob is pushed in (2 way flow) the left pedals works both ways and the flow is routed back to the auxiliary section of the 6–spool control valve **[29]**. 2 way flow is used for attachments like the auger.

Fluid from the end cap section of the hydraulic pump **[6]** is forced to the inlet port P1 of the 3–spool control valve **[14]**. Oil under pressure is also directed to the shuttle valve **[21]** and the 363 PSI pressure reducing valve **[22]** which supplies fluid to the joystick controls **[25]** & **[26]**.

The console lock–out valve **[24]** is located on the left console. When the console is lowered the valve is activated and fluid is allowed to flow to the joysticks **[25]** & **[26]**. When the console is raised the valve is open and the fluid can not flow to the joysticks.

Fluid from the outside hydraulic pump is forced to the P1 end of the 3–spool control valve **[14]**. When a cylinder reaches the end of the stroke, pressure increases and opens the 2500 PSI relief valve **[15]** and the fluid returns to the oil cooler **[1]**, the oil filter **[5]** and to the supply port block **[7]**. The three sections of this control valve controls house swing, blade and boom swing. The house swing (slew) section controls oil flow to a geroler swing motor **[12]**. The motor contains two 2400 PSI counter balance valves **[43]**. At full throttle the swing motor can rotate the house frame 9.5 RPM. Motor case drain returns through the port block **[13]** and port block filter **[47]** to the reservoir **[10]**.
NOTE: Per the Service Letter Dated August 15, 1996: Some machines may have the 100 mesh screen **[47]** removed and the case drain filter **[48]** installed at the hydraulic reservoir.

The blade section controls fluid flow to the blade cylinder **[4]** and has two load check valves **[16]** which maintain the proper blade height. The blade section has a one way restrictor **[17]** located in the *B* port limiting the *blade raise* speed.

The boom swing section controls oil flow to the boom swing cylinder **[20]** and has two load checks **[18]** for cylinder stability.

A 200 PSI build up valve **[19]** is located on the outlet side of the 3–spool control valve. The valve maintains 200 PSI at idle to charge the accumulator **[42]**. The accumulator stores fluid under pressure to operate the joystick function if the engine stops.

When the 3–spool control valve **[14]** is in neutral the oil flows through the open center to the oil cooler **[1]**, the filter **[5]** and back to the supply port block **[7]**.

Moving a joystick forces oil to one side of the servo's on either end of the control valve section. The hydraulic pressure shifts the spool in or out and controls fluid flow for the correct cylinder.

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JOYSTICK FUNCTIONS

ISO CONTROL:

Left Hand:

Joystick pushed forward – Arm out. Oil flows from the joystick *3* port to control valve servo. Oil flows from *A* port of control valve to the rod end of the arm cylinder, retracting the cylinder.

Joystick pulled back – Arm in. Oil flows from the joystick *1* port to control valve servo. Oil flows from the *B* port of control valve to the base end of the arm cylinder, extending the cylinder.

Joystick moved left – Swings the house in the counterclockwise rotation. Oil flows from the joystick *2* port to control valve servo. Oil flows from *A* port to control valve to the *P2* port of the swing motor.

Joystick moved right – Swings the house in clockwise rotation. Oil flows from the joystick *4* port to control valve servo. Oil flows from *B* port of control valve to the *P1* port of the swing motor.

Right Hand:

Joystick pushed forward – Boom down. Oil flows from the joystick *1* port to control valve servo. Oil flows from *A* port of control valve to the rod end of boom cylinder, retracting the cylinder.

Joystick pulled back – Boom up. Oil flows from the joystick *3* port to control valve servo. Oil flows from *B* port of control valve to the base end of boom cylinder, extending the cylinder.

Joystick moved right – Opens the bucket. Oil flows from the joystick *2* port to control valve servo. Oil flows from *B* port of control valve to the rod end of the bucket cylinder, retracting the cylinder.

Joystick moved left – Closes the bucket. Oil flows form the joystick *4* port to control valve servo. Oil flows from *A* port of control valve to the base end of the bucket cylinder, extending the cylinder.

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STANDARD CONTROL:

Left Hand:

Joystick pushed forward – Boom down. Oil flows from the joystick *3* port to control valve servo. Oil flows from *A* port of control valve to the rod end of the boom cylinder, retracting the cylinder.

Joystick pulled back – Boom up. Oil flows from the joystick *1* port to control valve servo. Oil flows from the *B* port of control valve to the base end of the boom cylinder, extending the cylinder.

Joystick moved left – Swings the house in the counterclockwise rotation. Oil flows from the joystick *2* port to control valve servo. Oil flows from *A* port of control valve to the *P2* port of the swing motor.

Joystick moved right – Swings the house in the clockwise rotation. Oil flows from the joystick *4* port to control valve servo. Oil flows from *B* port of control valve to the *P1* port of the swing motor.

Right Hand:

Joystick pushed forward – Arm out. Oil flows from the joystick *1* port to control valve servo. Oil flows from *A* port of control valve to the rod end of boom cylinder, retracting the cylinder.

Joystick pulled back – Arm in. Oil flows from the joystick *3* port to control valve servo. Oil flows from *B* port of control valve to the base end of arm cylinder, extending the cylinder.

Joystick moved right – Opens the bucket. Oil flows from the joystick *2* port to control valve servo. Oil flows from *B* port of control valve to the rod end of the bucket cylinder, retracting the cylinder.

Joystick moved left – Closes the bucket. Oil flows from the joystick *4* port to control valve servo. Oil flows from *A* port of control valve to the base end of the bucket cylinder, extending the cylinder.

The two speed track drive motors **[2]** are controlled by a foot pedal operated two speed valve **[11]**. The pedal is normally in the up position for low range 1.5 MPH (2,4 km/hr.). When the foot pedal is pushed down the 363 PSI oil shifts the travel motors into high range 2.9 MPH (4,7 km/hr.). The pedal must be held down for high range. When the foot pedal is released (normal position) the travel motor **[2]** goes into low range and the oil flows through the two speed valve and back to the reservoir **[10].**

Forward and Reverse Travel is controlled by the left and right steering lever/foot pedals mechanically actuating the respective 6–spool control valve **[29]** spools. Right hand travel lever/pedal pushed forward – Right track forward: Fluid flows from *A* port of the right hand travel section through the *B* port of the center swivel joint **[3]** and to the *P2* port of the right hand travel motor **[2]**. Right hand travel lever/pedal pulled back – Right track reverse: Fluid flows from *B* port of right hand travel section through the *D* port of the center swivel joint **[3]** and to the *P1* port of the right hand travel motor **[2]**.

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Left hand travel lever/pedal pushed forward – Left track forward: Fluid flows from *A* port of the left hand travel section through the *A* port of the center swivel joint **[3]** and to the *P1* port of the left hand travel motor **[2]**. Left hand travel lever/pedal pulled back – Left track reverse: Fluid flows from *B* port of the left hand travel section through the *C* port of the center swivel joint **[3]** and to the *P2* port of the left hand travel motor **[2]**.

Return oil from the travel motors **[2]** returns through the non pressurized *P* port, through the corresponding center swivel joint **[3]** port and back through the 6–spool control valve **[29]** internally, to the oil cooler **[1]**, to the oil filter **[5]**, and back to the supply port block **[7]**.

Travel motor case drain fluid returns from the travel motor **[2]** ports *T1, T2* to port *H* of the center swivel joint **[3]**, to the return port block **[13]**, through the return port block filter **[47]**, and to the reservoir **[10]**.

The boom swing pedal mechanically controls the boom swing spool section of the 3–spool control valve **[14]**. Right pedal pressure swings the boom to the right by fluid flow from the *B* port to the base end of the boom swing cylinder **[20]**. Left pedal pressure swings the boom to the left by fluid flow from the *A* port to the rod end of the boom swing cylinder **[20]**.

For S/N 512911057 – 512911137:

The blade control lever mechanically controls the 3–spool control valve **[14]** blade spool section. Blade control lever pushed forward lowers the blade: Fluid flows from the *A* port of the 3–spool control valve **[14]** to the *G* port of the center swivel valve **[3]** to the base end of the blade cylinder **[4]**.

Blade control lever pulled back raises blade: Fluid flows from the *B* port of the 3–spool control valve **[14]** to the *F* port of the center swivel valve **[3]** to the rod end of the blade cylinder **[4]**.

For S/N 512911138 & Above:

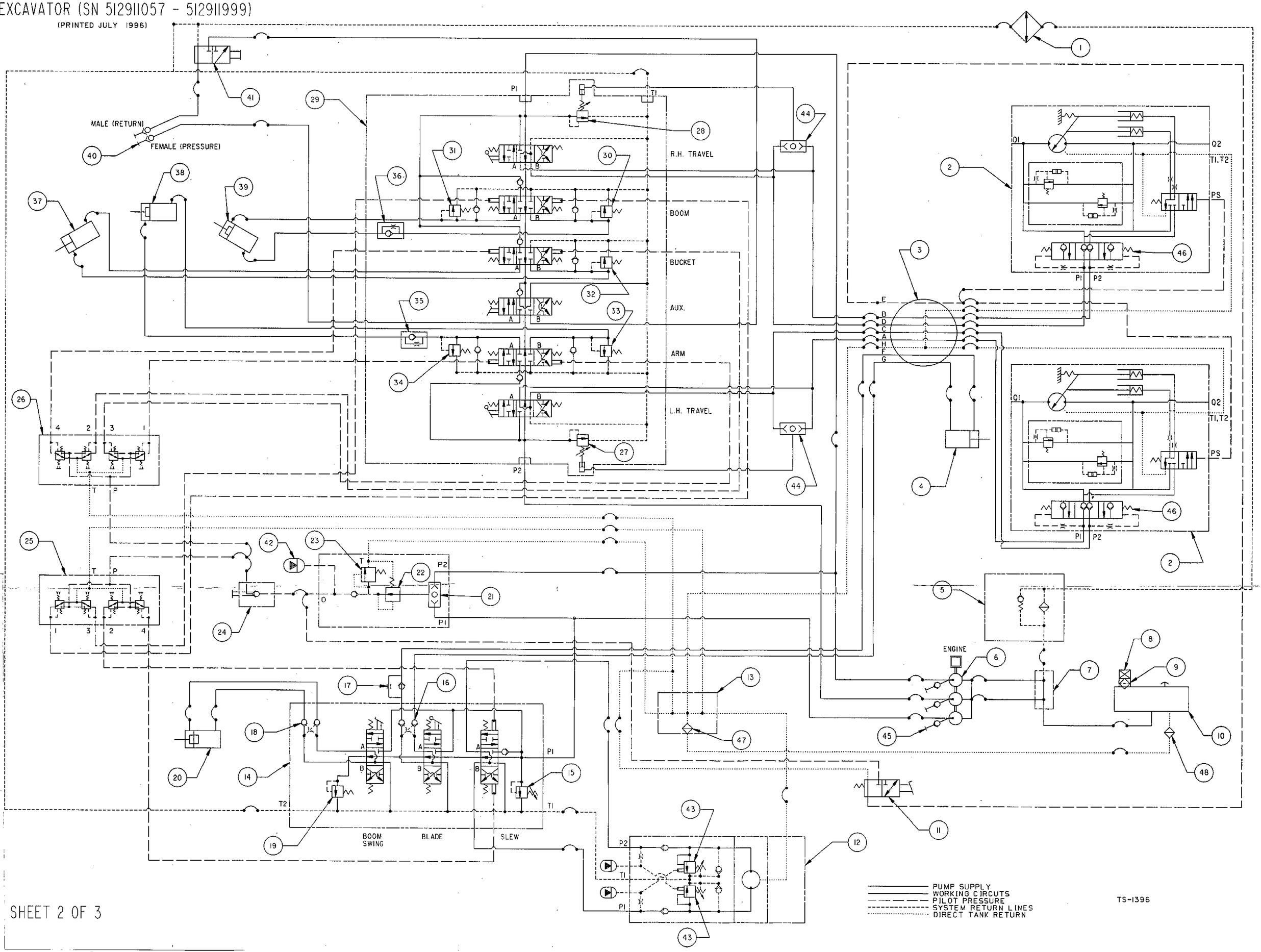
The blade control lever mechanically controls the 3–spool control valve **[14]** blade spool section. Blade control lever pushed forward lowers the blade: Fluid flows from the *A* port of the 3–spool control valve **[14]** to the *F* port of the center swivel valve **[3]** to the base end of the blade cylinder **[4]**.

Blade control lever pulled back raises blade: Fluid flows from the *B* port of the 3–spool control valve **[14]** to the *G* port of the center swivel valve **[3]** to the rod end of the blade cylinder**[4]**.

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HYDRAULIC SCHEMATIC (PN 6724232)
(STANDARD CONTROLS)
EXCAVATOR (SN 5129111057 - 5129111999)

(PRINTED JULY 1996)

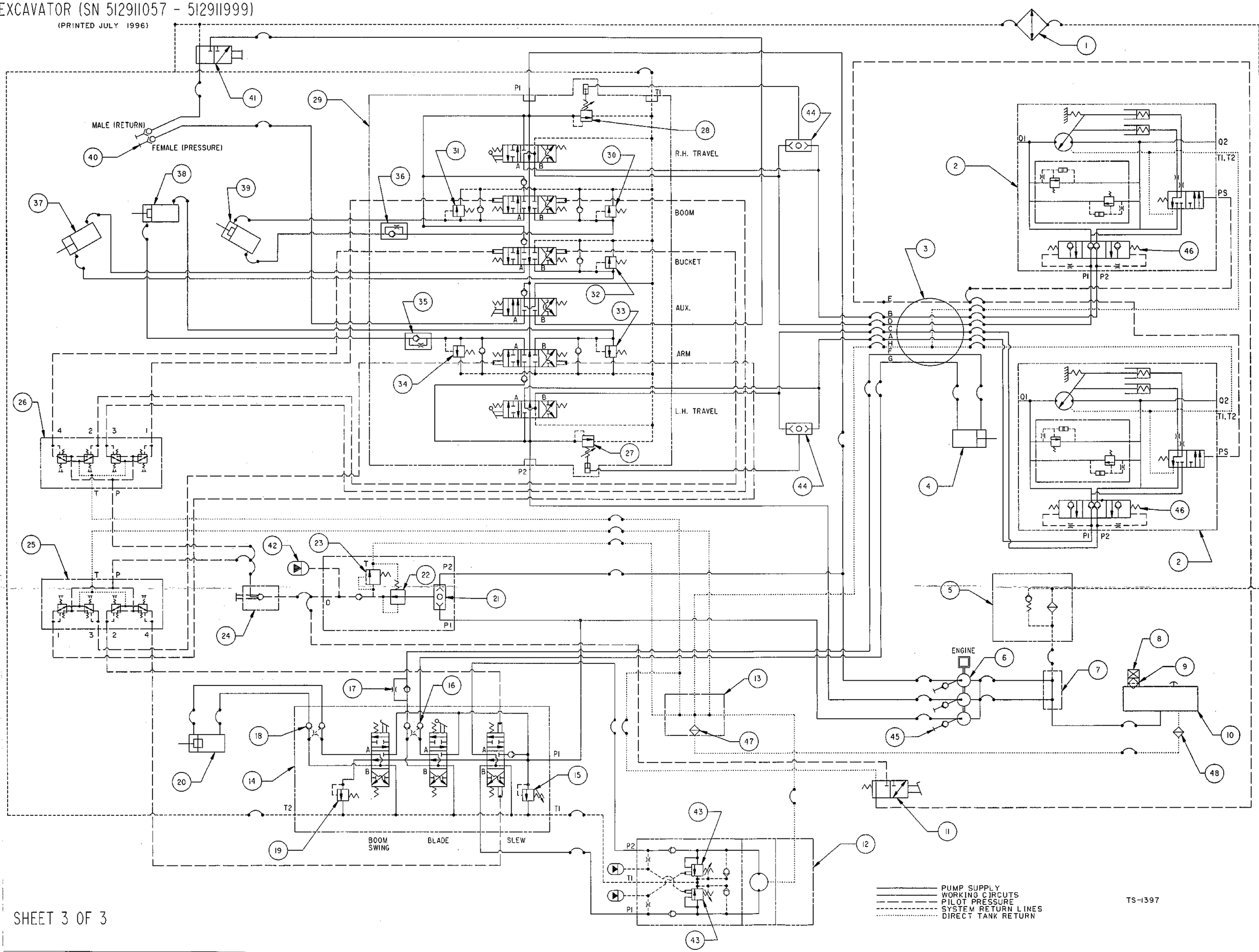


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HYDRAULIC SCHEMATIC (PN 6724232)
(ISO CONTROLS)
331 EXCAVATOR (SN 5129111057 - 5129111999)

(PRINTED JULY 1996)



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HYDRAULIC SYSTEM OPERATION

To Be Used With

HYDRAULIC FLOW CHART

(ISO and STANDARD)

For Model

331 EXCAVATOR (S/N 512912001 – 512912999)

Chart # 6724689 (Printed July, 1996)

CHART LEGEND

[1] **OIL COOLER**

[2] **TRAVEL MOTORS**

[3] **CENTER SWIVEL JOINT**

[4] **BLADE CYLINDER**

[5] **#10 MICRON FILTER**
(W/25 PSI By–Pass Valve)

[6] **HYDRAULIC PUMPS**
3 x 9.1 GPM (34.5 L/min.) @ 2500 RPM

[7] **SUPPLY PORT BLOCK**

[8] **HYDRAULIC RESERVOIR, Cap**
(Non–Vented)

[9] **STRAINER**

[10] **HYDRAULIC RESERVOIR** (10.5 Gals. 40 L)
(Vented)

[11] **TWO SPEED VALVE**

[12] **SWING MOTOR**

[13] **RETURN PORT BLOCK**

[14] **3–SPOOL CONTROL VALVE**

[15] **MAIN RELIEF VALVE** ..... 2500 PSI
(17235 kPa)

[16] **LOAD CHECK VALVE** (Blade Cylinder)

[17] **ONE WAY RESTRICTOR** .082" (Blade Cyl.)

[18] **LOAD CHECK VALVES**
(Boom Swing Cylinder)

[19] **BUILD–UP VALVE** .... 200 PSI (1378 kPa)

[20] **BOOM SWING CYLINDER**

[21] **SHUTTLE VALVE**

[22] **PRESSURE REDUCING VALVE** 363 PSI
(2500 kPa)

[23] **ACCUMULATOR RELIEF VALVE** .. 507 PSI
(3632 kPa)

[24] **CONSOLE LOCK–OUT VALVE**

[25] **L.H. JOYSTICK**

[26] **R.H. JOYSTICK**

[27] **MAIN RELIEF VALVE** – 2 Stage Pressure
Standard Pressure ..... 2500 PSI
(17235 kPa)
High Pressure ..... 3000 PSI
(20682 kPa)

[28] **MAIN RELIEF VALVE** – 2 Stage Pressure
Standard Pressure ..... 2500 PSI
(17235 kPa)
High Pressure ..... 3000 PSI
(20682 kPa)

[29] **6–SPOOL CONTROL VALVE**

[30] **PORT RELIEF VALVE** (Boom Cyl.)
2950 PSI (20345 kPa)

[31] **PORT RELIEF VALVE** (Boom Cyl.)
3400 PSI (23448 kPa)

[32] **PORT RELIEF VALVE** (Bucket Cyl.)
3400 PSI (23448 kPa)

[33] **PORT RELIEF VALVE** (Arm Cyl.)
2950 PSI (20345 kPa)

[34] **PORT RELIEF VALVE** (Arm Cyl.)
2950 PSI (20345 kPa)

[35] **ONE WAY RESTRICTOR** .125" (Arm Cyl.)

[36] **ONE WAY RESTRICTOR** .125" (Boom Cyl.)

[37] **BUCKET CYLINDER**

[38] **ARM CYLINDER (Cushion)**

[39] **BOOM CYLINDER (Cushion)**

[40] **AUXILIARY QUICK COUPLERS**

[41] **AUXILIARY SELECTOR VALVE**

[42] **ACCUMULATOR**

[43] **COUNTER BALANCE VALVE**
Swing Motor (2) 2400 PSI (16547 kPa)

[44] **SHUTTLE VALVE**

[45] **HYDRAULIC PUMP TEST PORTS**

[46] **TRAVEL MOTOR SPOOL**

[47] **RETURN PORT BLOCK DRAIN FILTER**
(S/N 12001 – 12239)

[48] **CASE DRAIN FILTER** (S/N 12240 & Above)

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FLUID FLOW EXPLANATION

The fluid flows by gravity from the reservoir **[10]** through a supply port block **[7]** to the 3 section hydraulic gear pump **[6]**. The 3 section gear pumps are coupler driven from the engine. Each gear pump section is protected by a relief valve located in the control valve it supplies.

Fluid from the hydraulic pump **[6]** (Engine flywheel end) is forced to the 6–spool hydraulic control valve **[29]** *P1* port (Inlet). These control valve sections control R.H. Travel, Boom and Bucket. Oil under pressure is also diverted to the shuttle valve **[21]**.

Fluid from the center section of the hydraulic pump **[6]** is forced to the *P2* port of the 6–spool hydraulic control valve **[29]**. These control valve sections control L.H. Travel, Arm and Auxiliary. The two (2) stage pressure adjustable relief valves **[27]** & **[28]** are located at each end of the 6–spool hydraulic control valve **[29]**.

When the L.H. Travel section and/or the R.H. Travel section is activated in either the forward or reverse travel direction, oil under pressure is diverted to the two (2) stage pressure relief valves **[27]** & **[28]**. The oil pressure shifts the relief valve from standard pressure (2500 PSI – 17235 kPa) to the high pressure (3000 PSI – 20682 kPa). This will allow increased oil pressure to the travel motors **[2]** for increased drive motor torque. As soon as the travel section spools return to neutral, the two (2) stage pressure relief valves, mechanically (spring activated) return to the standard pressure (2500 PSI – 20682 kPa).

With all spools in the neutral position the open center control valve allows fluid to flow to the oil cooler **[1]**, to the oil filter **[5]** and to the supply port block **[7]**. When a spool is activated, the fluid flows to the base or rod end of a cylinder **[37],[38],[39]**. The fluid on the other side of the cylinder flows back to the 6–spool hydraulic control valve **[29]**. When a cylinder reaches the end of the stroke, the pressure increases to 2500 PSI and opens the two stage pressure relief valve **[27]** or **[28]**. The fluid then flows through the 6–spool hydraulic control valve **[29]** internally and back to the oil cooler **[1]**, to the oil filter **[5]** and to the supply port block **[7]**.

The 6–spool hydraulic control valve has Port Relief Valves in both ports of the Boom section **[30]** & **[31]**, the Rod end of the Bucket section **[32]** and both ports of the Arm section **[33]** & **[34]**. The boom section has a one way restrictor **[36]** located in the *B* port limiting the *boom down* speed. The arm section has a one way restrictor **[35]** located in the *A* port limiting the *arm in* speed.

The auxiliary spool is hollow, and while in neutral, fluid flows through the center of the spool to the tank port of the valve. When the auxiliary spool is activated, two pump flows are combined to supply 18 GPM to the auxiliary quick couplers **[40]** on the boom. The female coupler is pressure and the male coupler is return. The auxiliary fluid return flows to the selector valve **[41]**.

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For hydraulic breaker operation, when the selector valve **[41]** knob is pulled out (breaker operating position) the left foot pedal works one way only and the fluid flows through the selector valve **[41]**, to the oil cooler **[1]**, to the oil filter **[5]** and back to the supply port block **[7]** with reduced back pressure. When the selector knob is pushed in (2 way flow) the left pedals works both ways and the flow is routed back to the auxiliary section of the 6–spool control valve **[29]**. 2 way flow is used for attachments like the auger.

Fluid from the end cap section of the hydraulic pump **[6]** is forced to the inlet port P1 of the 3–spool control valve **[14]**. Oil under pressure is also directed to the shuttle valve **[21]** and the 363 PSI pressure reducing valve **[22]** which supplies fluid to the joystick controls **[25]** & **[26]**.

The console lock–out valve **[24]** is located on the left console. When the console is lowered the valve is activated and fluid is allowed to flow to the joysticks **[25]** & **[26]**. When the console is raised the valve is open and the fluid can not flow to the joysticks.

Fluid from the outside hydraulic pump is forced to the P1 end of the 3–spool control valve **[14]**. When a cylinder reaches the end of the stroke, pressure increases and opens the 2500 PSI relief valve **[15]** and the fluid returns to the oil cooler **[1]**, the oil filter **[5]** and to the supply port block **[7]**. The three sections of this control valve controls house swing, blade and boom swing. The house swing (slew) section controls oil flow to a geroler swing motor **[12]**. The motor contains two 2400 PSI counter balance valves **[43]**. At full throttle the swing motor can rotate the house frame 9.5 RPM. For S/N 12001 – 12239 the motor case drain returns through the port block **[13]** and port block filter **[47]** to the reservoir **[10]**. Starting with S/N 12240 & Above, the port block filter **[47]** was removed. The motor case drain returns through the port block **[13]** and the case drain filter **[48]** to the reservoir **[10]**.
NOTE: Per the Service Letter Dated August 15, 1996: Some machines may have the 100 mesh screen **[47]** removed and the case drain filter **[48]** installed at the hydraulic reservoir.

The blade section controls fluid flow to the blade cylinder **[4]** and has two load check valves **[16]** which maintain the proper blade height. The blade section has a one way restrictor **[17]** located in the *B* port limiting the *blade raise* speed.

The boom swing section controls oil flow to the boom swing cylinder **[20]** and has two load checks **[18]** for cylinder stability.

A 200 PSI build up valve **[19]** is located on the outlet side of the 3–spool control valve. The valve maintains 200 PSI at idle to charge the accumulator **[42]**. The accumulator stores fluid under pressure to operate the joystick function if the engine stops.

When the 3–spool control valve **[14]** is in neutral the oil flows through the open center to the oil cooler **[1]**, the filter **[5]** and back to the supply port block **[7]**.

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Moving a joystick forces oil to one side of the servo's on either end of the control valve section. The hydraulic pressure shifts the spool in or out and controls fluid flow for the correct cylinder.

JOYSTICK FUNCTIONS

ISO CONTROL:

Left Hand:

Joystick pushed forward – Arm out. Oil flows from the joystick *3* port to control valve servo. Oil flows from *A* port of control valve to the rod end of the arm cylinder, retracting the cylinder.

Joystick pulled back – Arm in. Oil flows from the joystick *1* port to control valve servo. Oil flows from the *B* port of control valve to the base end of the arm cylinder, extending the cylinder.

Joystick moved left – Swings the house in the counterclockwise rotation. Oil flows from the joystick *2* port to control valve servo. Oil flows from *A* port of the control valve to the *P2* port of the swing motor.

Joystick moved right – Swings the house in clockwise rotation. Oil flows from the joystick *4* port to control valve servo. Oil flows from *B* port of control valve to the *P1* port of the swing motor.

Right Hand:

Joystick pushed forward – Boom down. Oil flows from the joystick *1* port to control valve servo. Oil flows from *A* port of control valve to the rod end of boom cylinder, retracting the cylinder.

Joystick pulled back – Boom up. Oil flows from the joystick *3* port to control valve servo. Oil flows from *B* port of control valve to the base end of boom cylinder, extending the cylinder.

Joystick moved right – Opens the bucket. Oil flows from the joystick *2* port to control valve servo. Oil flows from *B* port of control valve to the rod end of the bucket cylinder, retracting the cylinder.

Joystick moved left – Closes the bucket. Oil flows form the joystick *4* port to control valve servo. Oil flows from *A* port of control valve to the base end of the bucket cylinder, extending the cylinder.

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STANDARD CONTROL:

Left Hand:

Joystick pushed forward – Boom down. Oil flows from the joystick *3* port to control valve servo. Oil flows from *A* port of control valve to the rod end of the boom cylinder, retracting the cylinder.

Joystick pulled back – Boom up. Oil flows from the joystick *1* port to control valve servo. Oil flows from the *B* port of control valve to the base end of the boom cylinder, extending the cylinder.

Joystick moved left – Swings the house in the counterclockwise rotation. Oil flows from the joystick *2* port to control valve servo. Oil flows from *A* port of control valve to the *P2* port of the swing motor.

Joystick moved right – Swings the house in the clockwise rotation. Oil flows from the joystick *4* port to control valve servo. Oil flows from *B* port of control valve to the *P1* port of the swing motor.

Right Hand:

Joystick pushed forward – Arm out. Oil flows from the joystick *1* port to control valve servo. Oil flows from *A* port of control valve to the rod end of boom cylinder, retracting the cylinder.

Joystick pulled back – Arm in. Oil flows from the joystick *3* port to control valve servo. Oil flows from *B* port of control valve to the base end of arm cylinder, extending the cylinder.

Joystick moved right – Opens the bucket. Oil flows from the joystick *2* port to control valve servo. Oil flows from *B* port of control valve to the rod end of the bucket cylinder, retracting the cylinder.

Joystick moved left – Closes the bucket. Oil flows from the joystick *4* port to control valve servo. Oil flows from *A* port of control valve to the base end of the bucket cylinder, extending the cylinder.

The two speed track drive motors **[2]** are controlled by a foot pedal operated two speed valve **[11]**. The pedal is normally in the up position for low range 1.5 MPH (2,4 km/hr.). When the foot pedal is pushed down the 363 PSI oil shifts the travel motors into high range 2.9 MPH (4,7 km/hr.). The pedal must be held down for high range. When the foot pedal is released (normal position) the travel motor goes into low range and the oil flows through the two speed valve and back to the reservoir **[10].**

Forward and Reverse Travel is controlled by the left and right steering lever/foot pedals mechanically actuating the respective 6–spool control valve **[29]** spools. Right hand travel lever/pedal pushed forward – Right track forward: Fluid flows from *A* port of the right hand travel section through the *B* port of the center swivel joint **[3]** and to the *P2* port of the right hand travel motor. Right hand travel lever/pedal pulled back – Right track reverse: Fluid flows from *B* port of right hand travel section through the *D* port of the center swivel joint **[3]** and to the *P1* port of the right hand travel motor.

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Left hand travel lever/pedal pushed forward – Left track forward: Fluid flows from *A* port of the left hand travel section through the *A* port of the center swivel joint **[3]** and to the *P1* port of the left hand travel motor. Left hand travel lever/pedal pulled back – Left track reverse: Fluid flows from *B* port of the left hand travel section through the *C* port of the center swivel joint **[3]** and to the *P2* port of the left hand travel motor.

Return oil from the travel motors **[2]** returns through the non pressurized *P* port, through the corresponding center swivel joint **[3]** port and back through the 6–spool control valve **[29]** internally, to the oil cooler **[1]**, to the oil filter **[5]** and back to the supply port block **[7]**.

Travel motor case drain fluid returns from the travel motor **[2]** ports *T1, T2* to port *H* of the center swivel joint **[3]**, to the return port block **[13]** through the return port block filter **[47]** (S/N 12001–12239) or case drain filter **[48]** (S/N 12240 & Above) to the reservoir **[10]**.

The blade control lever mechanically controls the 3–spool control valve **[14]** blade spool section. Blade control lever pushed forward lowers the blade: Fluid flows from the *A* port of the 3–spool control valve **[14]** to the *G* port of the center swivel valve **[3]** to the base end of the blade cylinder **[4]**.

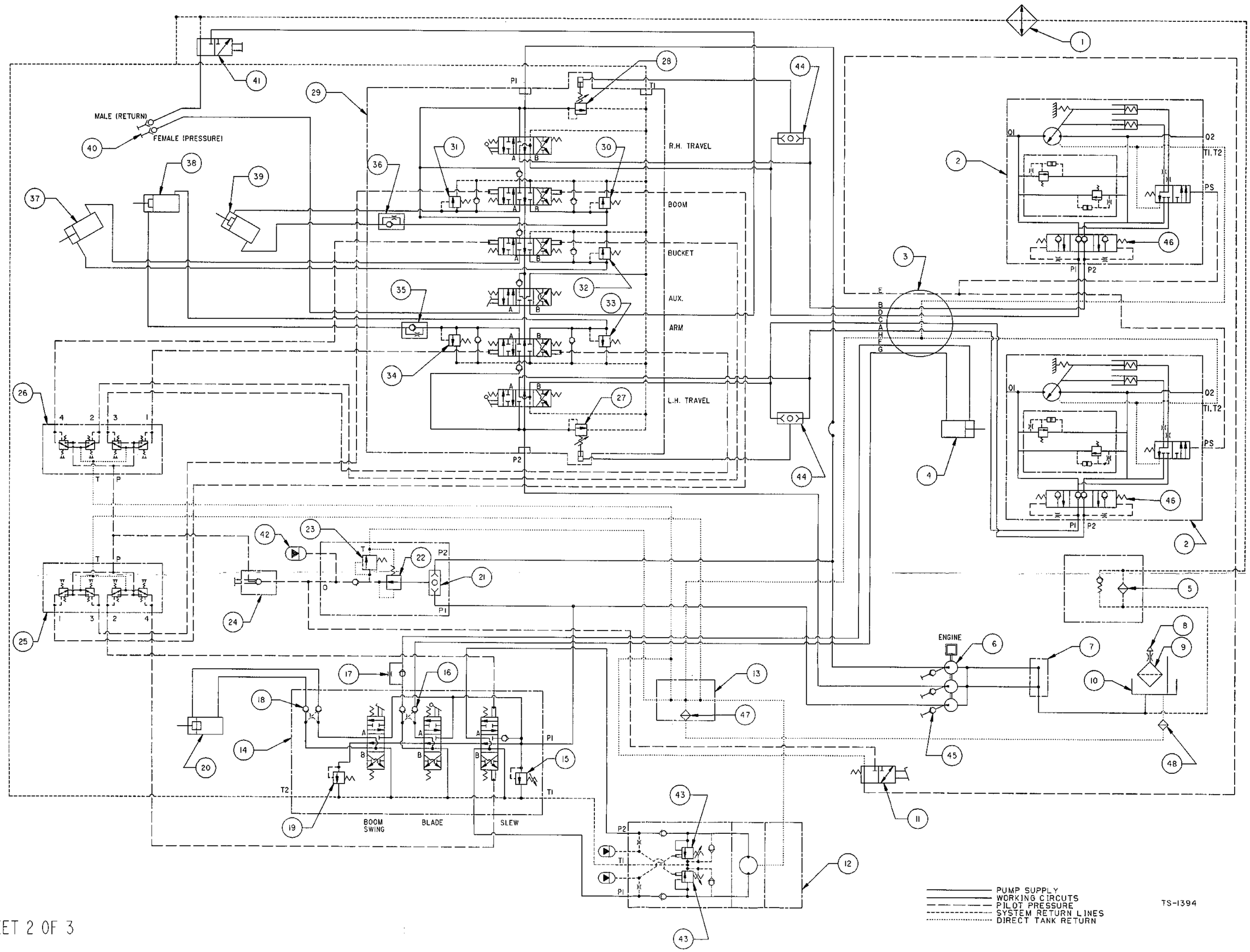
Blade control lever pulled back raises blade: Fluid flows from the *B* port of the 3–spool control valve **[14]** to the *F* port of the center swivel valve **[3]** to the rod end of the blade cylinder **[4]**.

The boom swing pedal mechanically controls the boom swing spool section of the 3–spool control valve **[14]**. Right pedal pressure swings the boom to the right by fluid flow from the *A* port to the rod end of the boom swing cylinder **[20]**. Left pedal pressure swings the boom to the left by fluid flow from the *B* port to the base end of the boom swing cylinder **[20]**.

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HYDRAULIC SCHEMATIC (PN 6724689)
(STANDARD CONTROLS)
331 EXCAVATOR (SN 512912001 - 512912999)

(PRINTED JULY 1996)

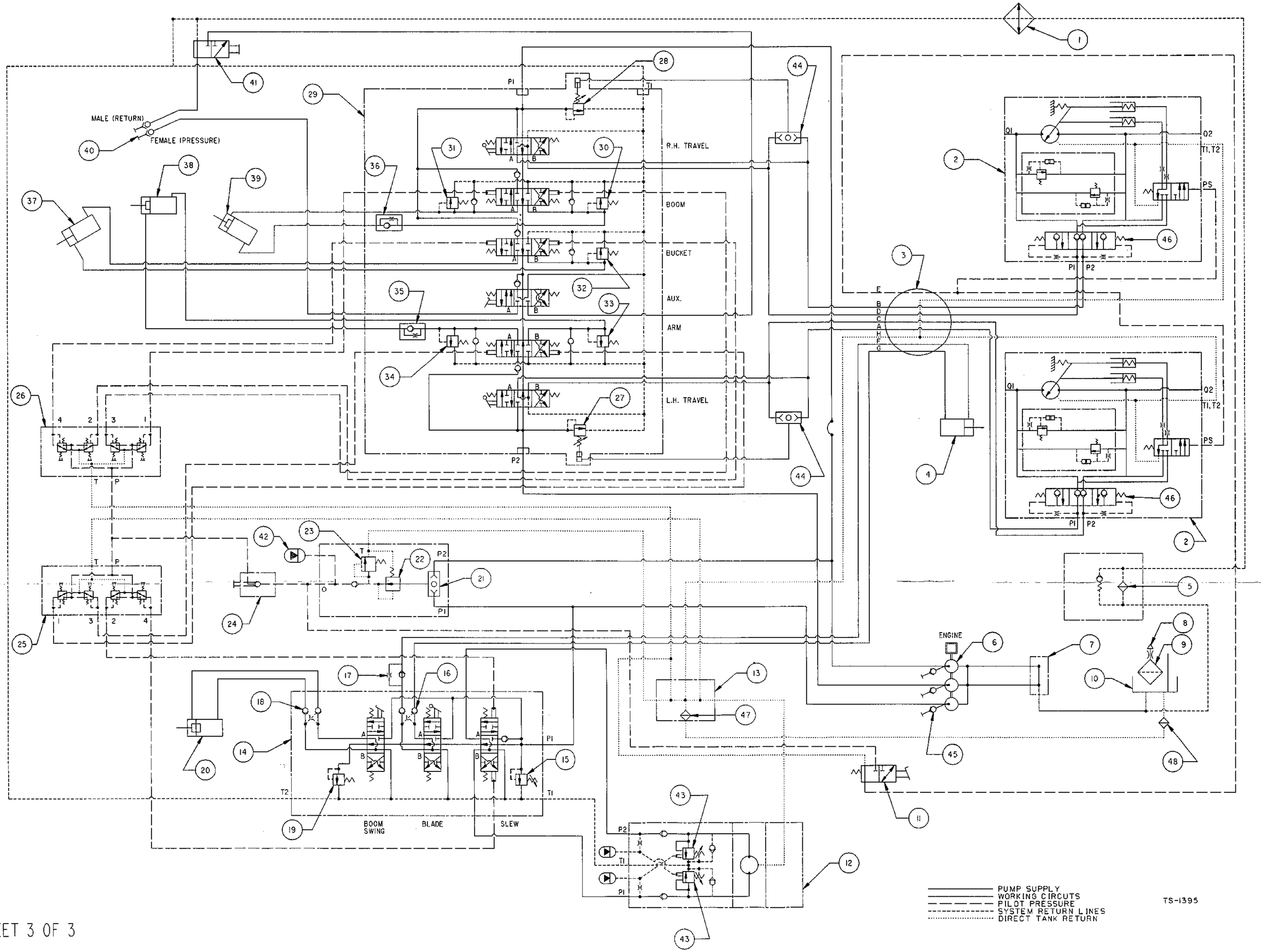


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(ISO CONTROLS)
331 EXCAVATOR (SN 512912001 - 512912999)

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HYDRAULIC SYSTEM OPERATION

To Be Used With

HYDRAULIC FLOW CHART

(ISO and STANDARD)

For Model

331 EXCAVATOR (S/N 512913001 & Above)

Chart # 6724564 (July, 1996)

CHART LEGEND

[1] **OIL COOLER**

[2] **TRAVEL MOTORS**

[3] **CENTER SWIVEL JOINT**

[4] **BLADE CYLINDER**

[5] **#10 MICRON FILTER**
(W/25 PSI By–Pass Valve)

[6] **HYDRAULIC PUMPS**
2 x 7.61 GPM (28.8 L/min.) @ 2500 RPM
1 x 8.87 GPM (33.6 L/min.) @ 2500 RPM
Auxiliary Flow: 16.5 GPM (62,4 L/min.)

[7] **SUPPLY PORT BLOCK**

[8] **HYDRAULIC RESERVOIR PLUG**
(Non–Vented)

[9] **STRAINER** (254 micron)

[10] **HYDRAULIC RESERVOIR** (12.1 Gals. 45.9 L)
(Vented)

[11] **BOOM SWING CYLINDER**

[12] **SWING MOTOR**

[13] **RETURN PORT BLOCK**

[14] **5–SPOOL CONTROL VALVE** 5 Section
Swing Motor, Blade, Boom Offset,
Arm and Boost

[15] **MAIN RELIEF VALVE** ..... number 1
2550 PSI (17582 kPa)

[16] **MAIN RELIEF VALVE** ..... number 2
4050 PSI (27925 kPa)

[17] **CHECK VALVE**

[18] **LOAD CHECK VALVES**
(Boom Swing Cylinder)

[19] **AUXILIARY SELECTOR VALVE**

[20] **ACCUMULATOR** 165 PSI
(1138 kPa) pre charge

[21] **PRESSURE REDUCING VALVE** 325 PSI
(2241 kPa)

[22] **TWO SPEED SOLENOID**

[23] **CONSOLE LOCK–OUT SOLENOID**

[24] **RELIEF VALVE** Swing Motor (2)
1700 PSI (11721 kPa)

[25] **L.H. JOYSTICK**

[26] **R.H. JOYSTICK** (W/Horn Switch)

[27] **MAIN RELIEF VALVE** number 3 & 4
2550 PSI (17582 kPa)

[28] **MAIN RELIEF VALVE** number 5 & 6
3050 PSI (21030 kPa)

[29] **5–SPOOL CONTROL VALVE** 5 Section
R.H. Travel, Boom, Bucket,
Auxiliary and L.H. Travel

[30] **PORT RELIEF VALVE** (Boom Cyl.)
2950 PSI (20340 kPa)

[31] **PORT RELIEF VALVE** (Boom Cyl.)
3400 PSI (23442 kPa)

[32] **PORT RELIEF VALVE** (Arm Cyl.)
2950 PSI (20340 kPa)

[33] **PORT RELIEF VALVE** (Arm Cyl.)
2950 PSI (20340 kPa)

[34] **PORT RELIEF VALVE** (Bucket Cyl.)
3400 PSI (23442 kPa)

[35] **PORT RELIEF VALVE** (Bucket Cyl.)
2950 PSI (20340 kPa)

[36] **PORT RELIEF VALVE** (Blade Cyl.)
3400 PSI (23442 kPa)

[37] **BUCKET CYLINDER**

[38] **ARM CYLINDER (Cushion)**

[39] **BOOM CYLINDER (Cushion)**

[40] **AUXILIARY QUICK COUPLERS**

[41] **HYDRAULIC PUMP TEST PORTS** (Qty. 3)

[42] **TRAVEL MOTOR SPOOL**

[43] **RETURN DRAIN LINE FILTER**
(150 Micron)

[44] **CHECK VALVE** (Qty. 2)

[45] **ORIFICE** .035 (0,89 mm)

[46] **BUILD–UP VALVE**

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FLUID FLOW EXPLANATION

The fluid flows by gravity from the reservoir **[10]** through a supply port block **[7]** to the 3 section hydraulic gear pump **[6]**. The 3 section gear pumps are coupler driven from the engine. Each gear pump section is protected by a relief valve located in the control valve it supplies.

From the hydraulic pump (Engine flywheel end, pump section 1) fluid is forced to the 5–spool hydraulic control valve **[14]** Inlet port. Fluid flows through the 5–spool valve **[14]** power beyond port, through the build–up valve **[46]** and to the second 5–spool valve **[29]** inlet port. With all spools in the neutral position, the open center control valves **[14]** & **[29]** allows the fluid out of the tank port (on 5–spool control valve **[29]**) to the oil cooler **[1]**, to the oil filter **[5]** and back to the supply port block **[7]**.

Fluid from the hydraulic pump (center section, pump section 2) is forced to the mid inlet (port B) of the 5–spool valve **[29]**. These control valve sections operate the left hand travel, bucket and auxiliary.

Fluid from the hydraulic pump (outside section, pump section 3) is forced to the mid inlet port (port A) of the 5–spool valve **[29]**. These control valve sections operate the right hand travel and boom.

The 5–spool control valves **[14]** & **[29]** are composed of series and parallel valve sections.

The slew (house swing) valve section of the 5–spool control valve **[14]** and the left travel and right travel sections of the 5–spool control valve **[29]** are series valves. Return oil from a series valve section flows internally to the next valve section.

The blade, boom swing, arm and boost valve sections of the 5–spool control valve **[14]** and the auxiliary, bucket and boom valve sections of the 5–spool control valve **[29]** are parallel valves. Return oil from a parallel valve section flows to the reservoir.

The slew (house swing) section on 5–spool control valve **[14]** is a series section. When the slew section is activated, fluid flows to the swing motor **[12]** "A" or "B" ports and the return fluid feeds the blade, boom swing, arm and boost section of the 5–spool valve **[14]**. If the swing motor **[12]** cannot turn, the pressure increases to 1700 PSI (11721 kPa) and opens the swing motor relief valves **[24]**. The house rotates at 9.3 RPM at full engine RPM.

When a spool is activated (Blade, Boom Swing or Arm) of the 5–spool control valve **[14]**, the fluid flows to the base or rod end of a cylinder **[4]**, **[11]**, **[38]**. The fluid on the other side of the cylinder flows back to the control valve **[14]** and then to the tank port. When a cylinder reaches the end of the stroke, the pressure increases to 2550 PSI (17582 kPa) and opens the number 1 main relief valve **[15]**.

If either one of the swing motor relief valves **[24]** are activated while a cylinder **[4]**, **[11]**, **[38]** is at the end of its stroke, the pressure increases to 4050 PSI (27925 kPa) and opens the number 2 main relief valve **[16]**.

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If the number 1 main relief valve **[15]** is over relief (by activating the blade, boom swing or arm sections) fluid flow from the engine flywheel pump section (pump section 1) of the hydraulic pump **[6]** to the 5–spool control valve **[29]** is stopped. When the bucket or auxiliary section spool of the 5–spool control valve **[29]** is activated the fluid flows to the bucket cylinder **[27]** rod or base end or the male or female auxiliary couplers **[40]**. Return fluid flows back to the control valve **[29]**. When a cylinder reaches the end of the stroke, the pressure increases to 2550 PSI (17582 kPa) and opens the number 3 main relief valve **[27]**.

When the boom section of the 5–spool hydraulic control valve **[29]** is activated and the boom cylinder**[39]** is at the end of it's stroke, the pressure increases to 2550 PSI (17582 kPa) and opens the number 4 main relief valve **[27]**. When the boom up spool is activated, it also activates the boost section spool. The boom spool travels first to initially start the boom up stroke and is then followed by the boost for 16.5 GPM (62,5 L/min.) to raise the boom.

When either the left or right travel section of the 5–spool control valve is activated and the left or right travel motor **[2]** cannot turn, the pressure increases to 3050 PSI (21030 kPa) and the main relief valves **[28]** (number 5 relief for left hand travel or number 6 for right hand travel) open.

The fluid flows from the hydraulic pump **[6]** (engine flywheel end, pump section 1) through the 5–spool control valves **[14]** to the pressure reducing valve **[21]** for joystick **[25]** & **[26]** operation. The pressure reducing valve **[21]** also charges the accumulator **[20]**. The accumulator **[20]** stores fluid under pressure to operate the joystick function if the engine stops. The build–up valve **[46]**, increases the hydraulic pressure at low engine RPM to increase the hydraulic pressure to the pressure reducing valve **[21]**. This maintains the correct pressure to the joysticks **[25]** & **[26]** for low speed operation.

When the bucket spool is activated, two pump flows (pump section 1 [8.87 GPM] and pump section 2 [7.61 GPM]) are combined to supply 16.5 GPM of flow to the bucket cylinder **[37]**.

When the auxiliary spool is activated, two pump flows (pump sections 1 [8.87 GPM] and 2 [7.61 GPM]) are combined to supply 16.5 GPM flow to the auxiliary quick couplers **[40]** on the boom. The female coupler is pressure and the male coupler is return. The auxiliary fluid return flows through the auxiliary selector valve **[19]**.

For hydraulic breaker operation, when the selector valve **[19]** knob is pulled out (breaker operating position) the left foot pedal works one way only and the fluid flows through the selector valve **[19]**, to the oil cooler **[1]**, to the oil filter **[5]** and back to the supply port block **[7]** with reduced back pressure. When the selector knob **[19]** is pushed in (2 way flow) the left pedals works both ways and the flow is routed back to the auxiliary section of the 5–spool control valve **[29]**. 2 way auxiliary flow is used for attachments like the auger.

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The console lock–out micro–switch is located on the left console. When the console is lowered the lock–out solenoid **[23]** is activated and fluid is allowed to flow to the joysticks **[25]** & **[26]**. When the console is raised the console lock–out solenoid **[23]** is deactivated and fluid cannot flow to the joysticks **[25]** & **[26]**.

Moving a joystick forces oil to one of the servo's on either end of the control valve section. The hydraulic pressure shifts the spool in or out and controls fluid flow to the correct cylinder.

JOYSTICK FUNCTIONS

ISO CONTROL:

Left Hand:

Joystick pushed forward – Arm out. Oil flows from the joystick "1" port to control valve servo. Oil flows from "A" port of control valve to the rod end of the arm cylinder, retracting the cylinder.

Joystick pulled back – Arm in. Oil flows from the joystick "3" port to control valve servo. Oil flows from the "B" port of control valve to the base end of the arm cylinder, extending the cylinder.

Joystick moved left – Swings the house in the counterclockwise rotation. Oil flows from the joystick "4" port to control valve servo. Oil flows from "A" port of the control valve to the "B" port of the swing motor.

Joystick moved right – Swings the house in clockwise rotation. Oil flows from the joystick "2" port to control valve servo. Oil flows from "B" port of control valve to the "A" port of the swing motor.

Right Hand:

Joystick pushed forward – Boom down. Oil flows from the joystick "1" port to control valve servo. Oil flows from "B" port of control valve to the rod end of boom cylinder, retracting the cylinder.

Joystick pulled back – Boom up. Oil flows from the joystick "3" port to control valve servo. Oil flows from "A" port of control valve to the base end of boom cylinder, extending the cylinder.

Joystick moved right – Opens the bucket. Oil flows from the joystick "4" port to control valve servo. Oil flows from "B" port of control valve to the rod end of the bucket cylinder, retracting the cylinder.

Joystick moved left – Closes the bucket. Oil flows form the joystick "2" port to control valve servo. Oil flows from "A" port of control valve to the base end of the bucket cylinder, extending the cylinder.

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STANDARD CONTROL:

Left Hand: **Joystick pushed forward** – Boom down. Oil flows from the joystick "1" port to control valve servo. Oil flows from "B" port of control valve to the rod end of the boom cylinder, retracting the cylinder.

Joystick pulled back – Boom up. Oil flows from the joystick "3" port to control valve servo. Oil flows from the "A" port of control valve to the base end of the boom cylinder, extending the cylinder.

Joystick moved left – Swings the house in the counterclockwise rotation. Oil flows from the joystick "2" port to control valve servo. Oil flows from "A" port of control valve to the "B" port of the swing motor.

Joystick moved right – Swings the house in the clockwise rotation. Oil flows from the joystick "4" port to control valve servo. Oil flows from "B" port of control valve to the "A" port of the swing motor.

Right Hand: **Joystick pushed forward** – Arm out. Oil flows from the joystick "1" port to control valve servo. Oil flows from "A" port of control valve to the rod end of arm cylinder, retracting the cylinder.

Joystick pulled back – Arm in. Oil flows from the joystick "3" port to control valve servo. Oil flows from "B" port of control valve to the base end of the arm cylinder, extending the cylinder.

Joystick moved right – Opens the bucket. Oil flows from the joystick "4" port to control valve servo. Oil flows from "B" port of control valve to the rod end of the bucket cylinder, retracting the cylinder.

Joystick moved left – Closes the bucket. Oil flows from the joystick "2" port to control valve servo. Oil flows from "A" port of control valve to the base end of the bucket cylinder, extending the cylinder.

Forward and Reverse Travel is controlled by the left and right steering lever/foot pedals mechanically actuating the respective 5–spool control valve **[29]** spools. Right hand travel lever/pedal pushed forward – Right track forward: Fluid flows from "B" port of the right hand travel section through the "B" port of the center swivel joint **[3]** and to the "P2" port of the right hand travel motor. Right hand travel lever/pedal pulled back – Right track reverse: Fluid flows from the "A" port of right hand travel section through the "D" port of the center swivel joint **[3]** and to the "P1" port of the right hand travel motor.

Left hand travel lever/pedal pushed forward – Left track forward: Fluid flows from "B" port of left hand travel section through the "A" port of the center swivel joint **[3]** and to the "P1" port of the left hand travel motor. Left hand travel lever/pedal pulled back – Left track reverse: Fluid flows from "A" port of left hand travel section through the "C" port of the center swivel joint **[3]** and to the "P2" port of the left hand travel motor.

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Return oil from the travel motors **[2]** returns through the non pressurized "P" port, the corresponding center swivel joint port and back through the 5–spool control valve **[29]** internally, to the oil cooler **[1]**, to the oil filter **[5]**, and back to the supply port block **[7]**.

Travel motor case drain fluid returns from the travel motor **[2]** ports "T1, T2" to port "H" of the center swivel joint **[3]**, to the return port block **[13]**, to the return drain line filter **[43]** and to the reservoir **[10]**.

The two speed function in the track drive motors **[2]** is controlled by a foot pedal operated two speed solenoid **[22]**. The pedal is normally in the up position for low range 1.35 MPH (2,2 km/hr.); hydraulic fluid flows to each of the drive motors at 7.61 GPM (28,8 L/min.). When the foot pedal is pushed down the two speed solenoid **[22]** is activated and oil flows from the solenoid to the control valve servo on the boost valve section of the 5–spool control valve **[14]**. Oil flows from the "B" port of the boost valve section through the check valves **[45]** to the left and right hand travel valve sections of the 5–spool valve **[29]** for increased oil flow from the hydraulic pump **[6]** (pump section 1). Oil flows from the two speed solenoid **[22]** to the drive motors **[2]** shifting the drive motors **[2]** into high range 2.85 MPH (4,6 Km/hr.); hydraulic fluid flows to each of the drive motors at 12 GPM (45,4 L/min.). The two speed foot pedal must be held down for high range. When the foot pedal is released (normal position) the travel motors **[2]** go into low range, the two speed solenoid **[22]** is deactivated and oil flows through the pressure reducing valve **[21]** to the port block **[13]**, through the filter **[43]** to the reservoir **[10]**.

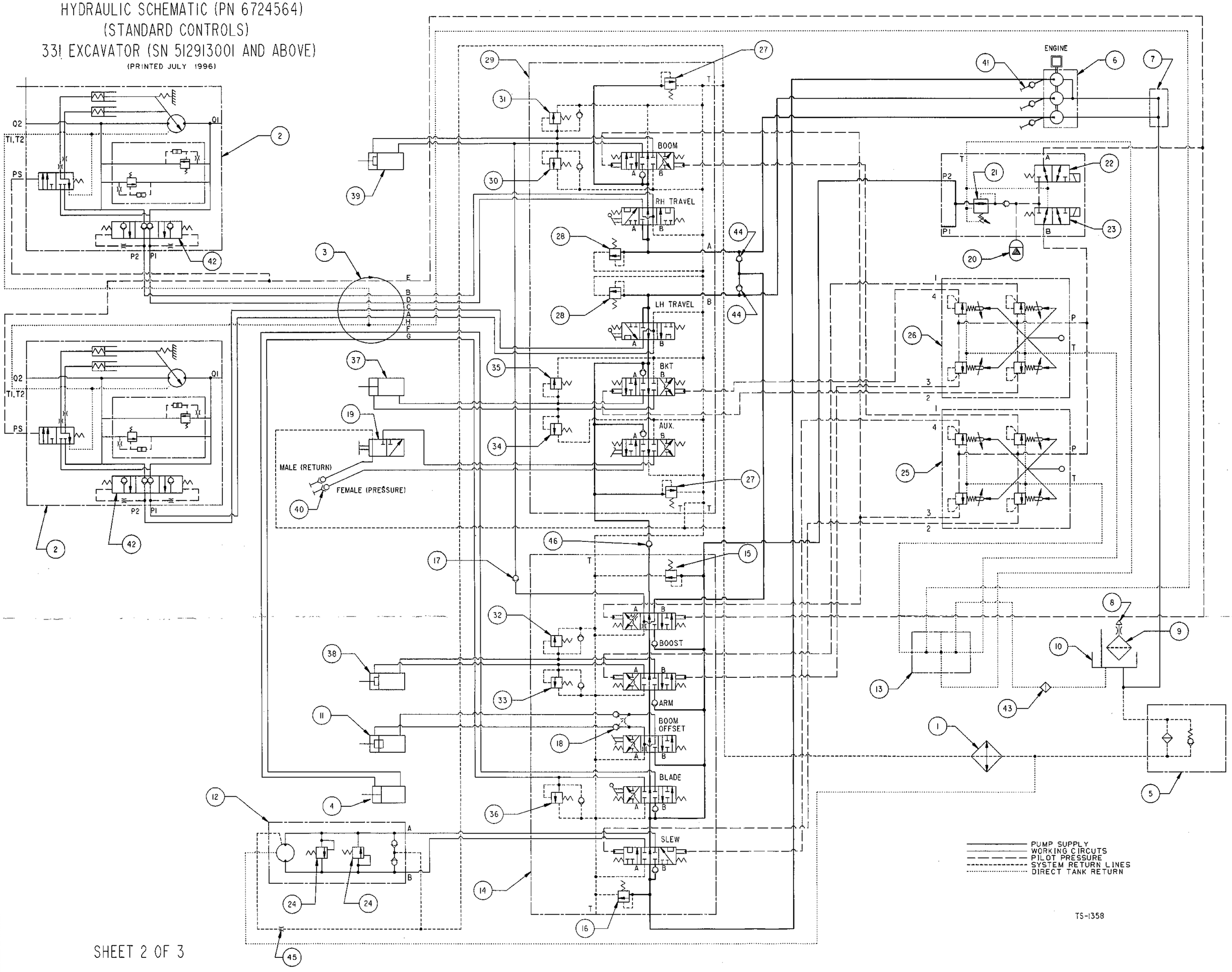
The blade control lever mechanically controls the 5–spool control valve **[14]** blade spool section. Blade control lever pushed forward lowers the blade: Fluid flows from the "A" port of the 5–spool control valve **[29]** to the "G" port of the center swivel valve **[3]** to the base end of the blade cylinder **[4]**.

Blade control lever pulled back raises blade: Fluid flows from the "B" port of the 5–spool control valve to the "F" port of the center swivel valve **[3]** to the rod end of the blade cylinder.

The boom swing pedal mechanically controls the boom swing spool section of the 5–spool control valve **[14]**. Right pedal pressure swings the boom to the right by fluid flow from the "A" port to the rod end of the boom swing cylinder **[11]**. Left pedal pressure swings the boom to the left by fluid flow from the "B" port to the base end of the boom swing cylinder **[11]**.

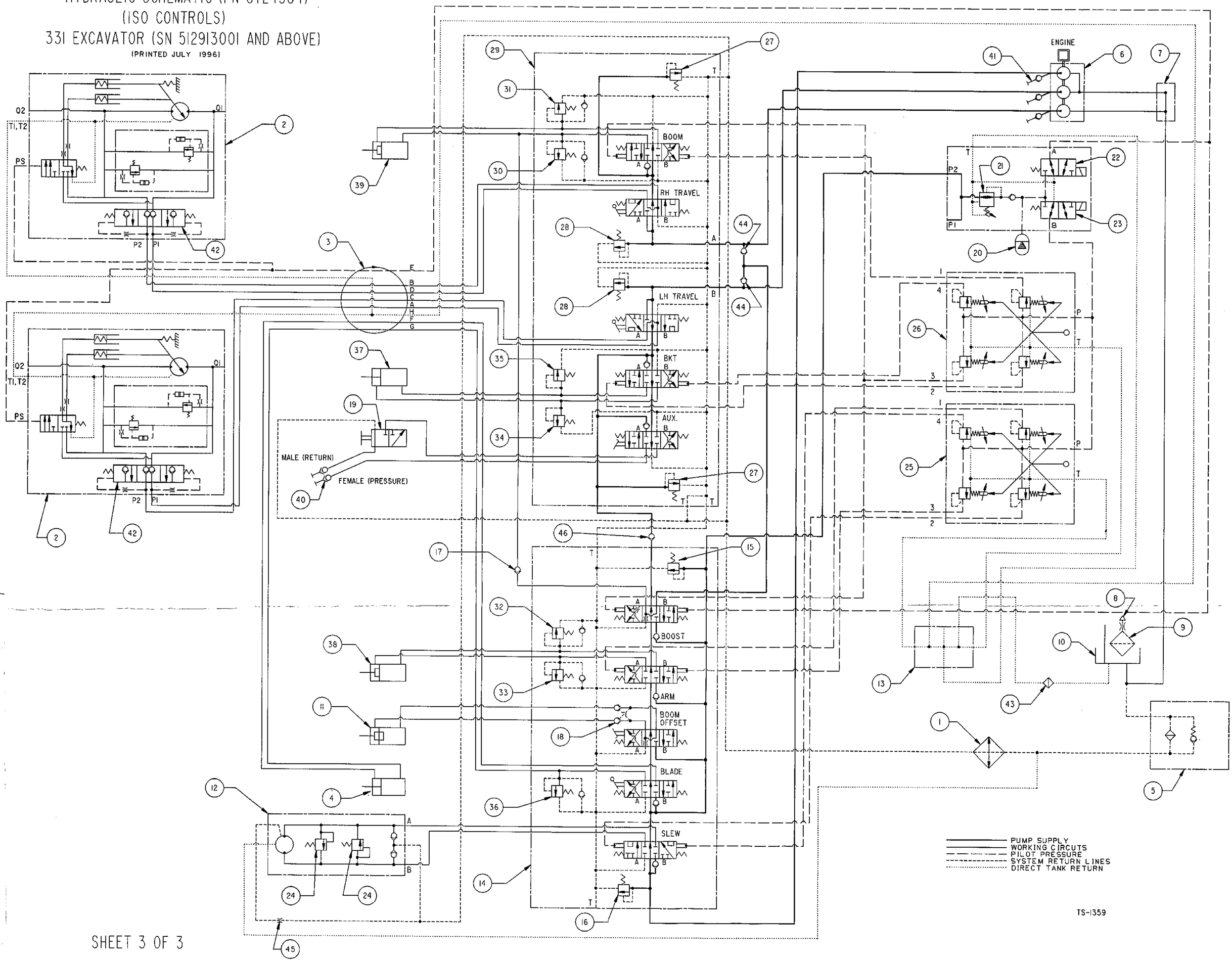
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HYDRAULIC SCHEMATIC (PN 6724564)
(STANDARD CONTROLS)
331 EXCAVATOR (SN 5129130001 AND ABOVE)
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TROUBLESHOOTING THE HYDRAULIC CIRCUIT

PROBLEM	CAUSE	CORRECTION
No hydraulic operation at one or more circuits.	Hydraulic oil level low.	Refill with correct oil.
	Hydraulic pump drive coupling damaged.	Replace.
	Hydraulic pump defective.	Repair or replace.
	Main relief valve defective.	Readjust or replace.
Hydraulic power insufficient to one or more circuits.	Main relief valve pressure setting incorrect.	Readjust or replace.
All hydraulic speed too slow.	Hydraulic oil level or viscosity incorrect.	Fill to correct level. Use correct viscosity oil.
	Engine RPM reduced.	Readjust or replace.
	Control valve linkage defective.	Check, repair or replace.
	Hydraulic pump volume low.	Check repair or replace.
Oil temperature too high.	Oil cooler or radiator fins plugged.	Clean oil cooler external surface.
	Hydraulic oil level low.	Fill to correct level.
	Non recommended hydraulic oil.	Replace.
	Relief valve excessively activated.	Use proper operating procedures.
	One or more relief valves not set correctly.	Readjust or replace.
	Extreme operating conditions. High ambient temperature. (IE: Enclosed structure).	
	Fan belt loose.	Tighten fan belt.

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TROUBLESHOOTING THE CYLINDER CIRCUIT

PROBLEM	CAUSE	CORRECTION
Cylinder inoperable.	Control console raised.	Lower control console.
	Loose fittings or broken hoses.	Repair or replace.
	Low PSI at joystick.	Check, repair or replace pressure reducing valve and or safety valve in pressure reducing valve body.
	Lever linkage incorrectly adjusted.	Readjust.
	Control console lockout switch.	Readjust or replace.
	Cylinder internal leakage excessive.	Repair or replace.
	Joystick manifold pressure reducing valve defective.	Repair or replace.
	Joystick internal leakage excessive.	Repair or replace.
Cylinder for insufficient.	Lever linkage incorrectly adjusted.	Readjust.
	Main relief valve pressure too low.	Readjust or replace.
	Lever linkage incorrectly adjusted.	Readjust.
Cylinder speed too slow.	Cylinder internal leakage excessive.	Repair or replace.
	Joystick manifold solenoid valve defective.	Repair or replace.
	Joystick manifold pressure reducing valve defective.	Repair or replace.
	Control valve internal leakage excessive.	Repair or replace.
	Low tie rod torque on 3 spool & 6 spool control valves.	Tighten tie rods to correct torque.
	Joystick internal leakage excessive.	Repair or replace.
	Low or dirty fluid.	Add or replace the hydraulic fluid.
	Main relief valve malfunctioning.	Readjust or replace.

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TROUBLESHOOTING THE SWING (SLEW) CIRCUIT

PROBLEM	CAUSE	CORRECTION
Swing not operating.	Lower control console.	Lower control console.
	Control console lockout switch incorrectly adjusted or defective.	Readjust or replace.
	Swing lock pin engaged.	Disengage lock pin.
	Joystick manifold pressure reducing valve defective.	Repair or replace.
	Swing motor gear defective.	Repair or replace.
	Joystick internal leakage excessive.	Repair or replace.
	Swing motor defective.	Repair or replace.
Swing force.	Main relief valve set too low..	Readjust or replace.
	Swing motor relief valve pressure too low.	Readjust or replace.
Swing speed too slow.	Pump flow low.	Check, repair or replace.
	Blocked or restricted line to swing motor.	Replace.
	Joystick internal leakage excessive.	Repair or replace.
	Control valve internal leakage excessive.	Repair or replace.
	Swing motor internal leakage excessive.	Repair or replace.
Swing over run excessive.	Control valve spool sticking.	Repair or replace.
	Joystick spool sticking.	Repair or replace.
	Swing motor relief valve set too low.	Repair or replace.
	Swing motor internal leakage excessive.	Repair or replace.
Swing motor seal leakage.	Return line filter plugged.	Inspect, clean or replace.

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TROUBLESHOOTING THE TRAVEL CIRCUIT

PROBLEM	CAUSE	CORRECTION
Travel system inoperable.	Lever linkage incorrectly adjusted.	Readjust.
	Track tension too tight.	Readjust.
	Defective pump.	Check, repair or replace.
	Travel motor counter balance spool sticking.	Repair or replace.
	Travel motor internal leakage excessive.	Repair or replace.
	Travel motor defective.	Repair or replace.
	Travel motor gears defective.	Repair or replace.
	Swivel joint defective.	Repair or replace.
	Main relief valve pressure too low.	Readjust or replace.
Travel power.	Track tension too tight.	Readjust.
	Main relief valve pressure too low.	Readjust or replace.
	Swivel joint leaking.	Repair or replace.
	Travel motor counterbalance spool sticking.	Repair or replace.
Speed too slow.	Lever linkage incorrectly adjusted.	Readjust.
	Swivel joint internal leakage excessive.	Repair or replace.
	Control valve internal leakage excessive.	Repair or replace.
	Low pump pressure.	Check, repair or replace.
	Travel motor internal leakage excessive.	Repair or replace.
Travel motor seal leakage.	Return line filter plugged.	Inspect, clean or replace.

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TROUBLESHOOTING THE TRAVEL CIRCUIT (Cont'd)

PROBLEM	CAUSE	CORRECTION
Machine not running straight.	Lever linkage incorrectly adjusted.	Readjust.
	Track tension not equal.	Readjust.
	Pump output not equal.	Repair or replace.
	Travel motor internal leakage not equal.	Repair or replace.
	Travel motor counter balance spool sticking.	Repair or replace.
	Main relief valve pressure set too low.	Repair or replace.
	Swivel joint internal leakage excessive.	Repair or replace.
	Control valve internal leakage not equal.	Repair or replace.
Machine will not hold on slope or while digging.	Track motor counterbalance valve leakage excessive.	Repair or replace.
	Hose damage.	Replace.
Blade drops while machine is moving.	Lever linkage unaligned.	Readjust.
	Cylinder internal leakage excessive.	Repair or replace.
	Control valve internal leakage excessive.	Repair or replace.
	Swivel joint internal leakage from travel motor pressure circuit into blade cylinder circuit.	Repair or replace.
High/low gear shift inoperative (2–speed).	Lever linkage unaligned.	Readjust.
	Control valve defective.	Replace.
	Low pressure to 2–speed valve.	Readjust.

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HYDRAULIC SERVICE INFORMATION (S/N 11001–12999)

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 main relief valves, five port relief valves, one joystick relief valve and one unloading relief valve in the hydraulic system.

See hydraulic schematic for relief valve locations.

MAIN RELIEF VALVES (S/N 11001–12999)

Description

The hydraulic system has three main relief valves protecting the hydraulic components from high pressure.

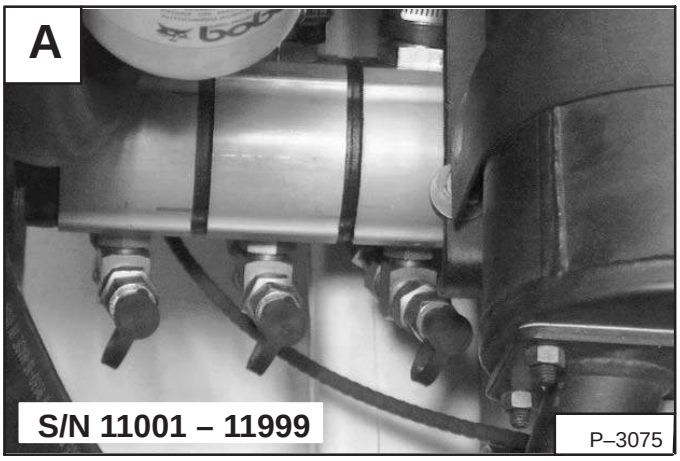
The six spool hydraulic valve uses two, dual pressure relief valves. These relief valves operate at 2450–2500 PSI (16893–17238 kPa) for the boom, arm, bucket and auxiliary functions. When the drive motors are activated, a shuttle valve is used to activate the high pressure side of the two relief valves which increases their pressure setting to 2950–3000 PSI (20340–20685 kPa). As soon as the drive motor levers are returned to neutral, the relief valves return to the standard pressure setting at 2450–2500 PSI (16893–17238 kPa).

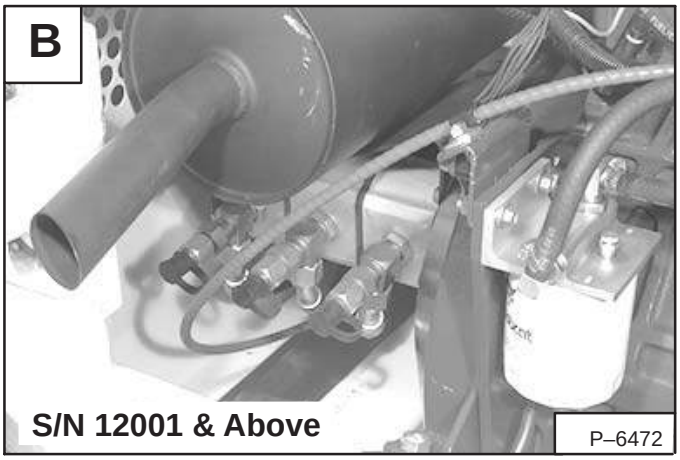
The three spool hydraulic valve uses a single stage relief valve with a constant pressure setting of 2450–2500 PSI (16893–17238 kPa).

The following tools will be needed for the diagnostic coupler check:

MEL1355 – Test Kit
MEL1355–3 – 5000 PSI Gauge
MEL1355–12 – Coupler
MEL1355–4 – Hose

Connect the coupler and the gauge to the hose.





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MAIN RELIEF VALVE (S/N 11001–12999) (Cont'd)

Checking Dual Pressure Relief Valves

Remove the floormat, the floorboards and the rear floorcover. (See Page 4–1.)

To check the high pressure setting on the dual pressure relief valves, the four hoses that go to the left and right hand travel sections must be removed **[A]**. Mark the hoses for ease of assembly.

NOTE: For safety purposes, when doing any testing and/or adjusting of the dual pressure relief valves, make sure that the four travel section hoses are removed from the valve. Plug the hoses and cap the tee fittings with steel caps. This will prevent the excavator from accidently being moved during the pressure tests.

Install steel caps onto the tees and plug the hoses **[B]**.

NOTE: Make sure the swing locking lever is in the engaged (locked) position.

With the engine off, connect the gauge assembly onto the diagnostic coupler on the pump **[C]** & **[D]**.

NOTE: Pump Section 1 (closest to the engine) supplies fluid to the right hand side (P1 inlet port) of the 6–spool valve.
Pump Section 2 (middle section) supplies fluid to the left hand side (P2 inlet port) of the 6–spool valve.
Pump Section 3 (outer section) supplies fluid to the (P1 inlet port) 3–spool valve.

Start the engine.

Run the engine at high idle and warm the hydraulic fluid to 140°F (60°C).

For Pump Section 1 (closest to the engine):

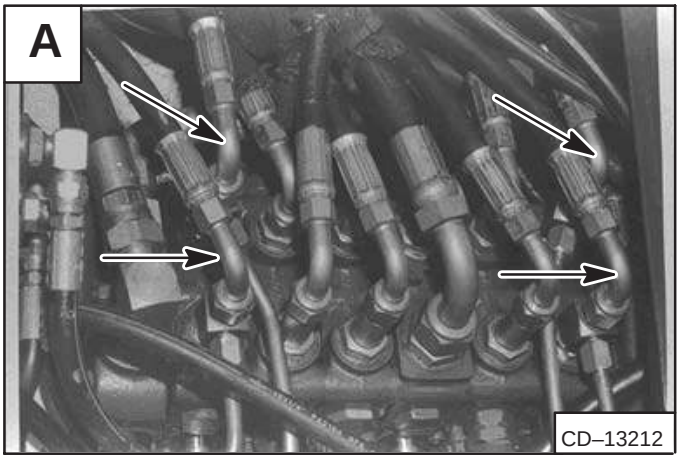
Raise the boom. Curl the bucket until the bucket cylinder is fully extended and continue to apply hydraulic pressure until the relief valve opens. Record the pressure gauge reading. Repeat this five (5) times to get the average pressure reading (this is the right hand side, low pressure setting of the dual pressure relief valve).

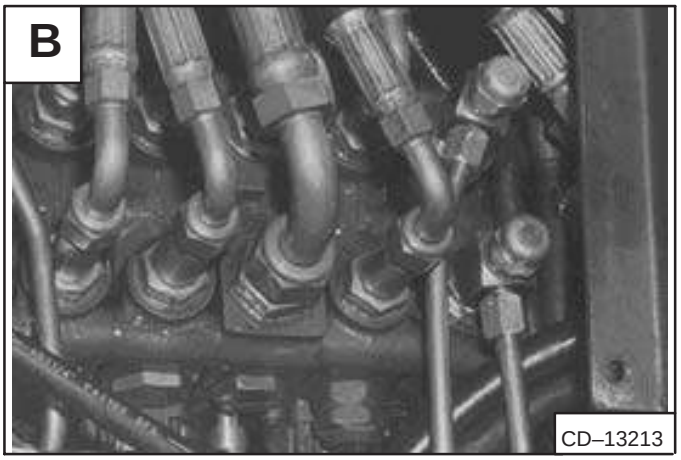
Low pressure setting: 2450–2500 PSI (16893–17238 kPa)

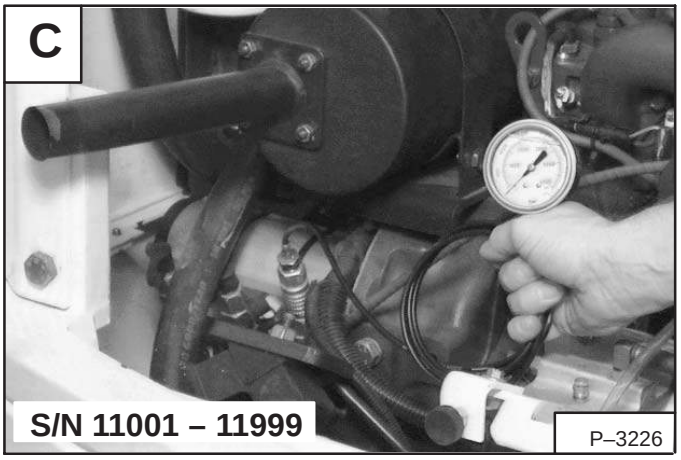
Move the RIGHT HAND travel lever forward and hold in the forward position until the relief valve opens. Record the pressure gauge reading. Repeat this five times to get the average pressure reading (this is the right hand side, high pressure setting of the dual pressure relief valve).

High Pressure Settling: 2950–3000 PSI (20340–20685 kPa).

Stop the engine.









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MAIN RELIEF VALVES (S/N 11001–12999) (Cont'd)

Checking Dual Pressure Relief Valves (Cont'd)

For Pump Section 2 (center pump section):

Move the coupler/pressure gauge assembly onto the diagnostic coupler at the center pump section (Item 1) **[A]** & **[B]**.

Start the engine.

Raise the boom. Move the arm towards the excavator until the arm cylinder is fully extended and the relief valve opens. Record the pressure gauge reading. Repeat this five times to get the average pressure reading (this is the left hand side, low pressure setting, of the dual pressure relief valve).

Low Pressure Setting: 2450–2500 PSI (16893–17238 kPa)

Lower the boom to the ground.

Move the LEFT HAND travel lever forward and hold in the forward position until the pressure relief valve opens. Record the pressure gauge reading. Repeat this five (5) times to get the average pressure reading (this is the left hand side, high pressure setting, of the dual pressure relief valve).

High Pressure Setting: 2950–3000 PSI (20340–20685 kPa)

Checking Single Pressure Relief Valve

For Pump Section 3 (farthest from engine).

Move the coupler/pressure gauge assembly onto the diagnostic coupler at the end of the pump (farthest from the engine) **[C]**, **[D]**.

Start the engine.

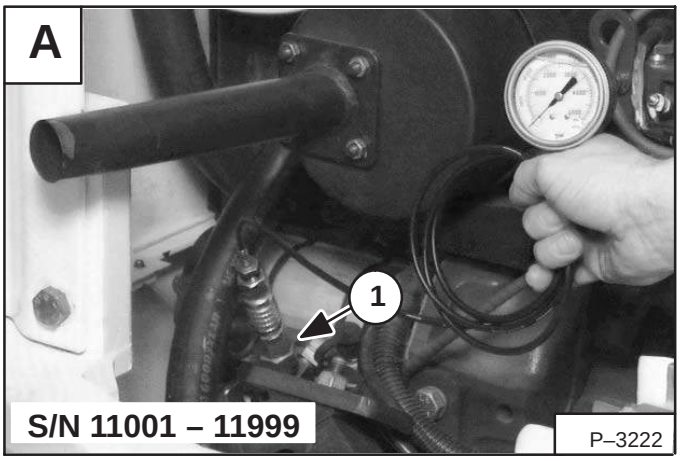
Raise the blade up until the blade cylinder is fully retracted and the relief valve opens. Record the pressure gauge reading. Repeat this five times to get the average pressure reading.

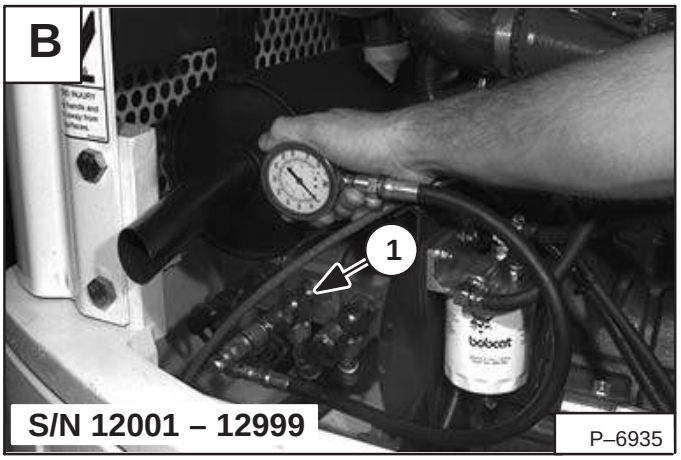
Pressure Setting: 2450–2500 PSI (16893–17238 kPa)

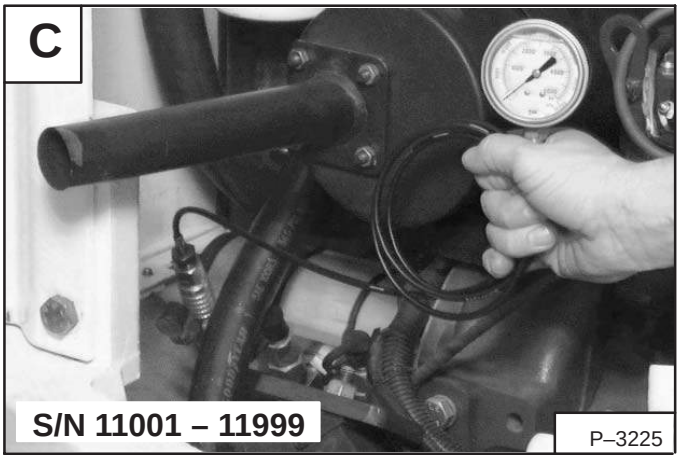
Lower the blade to the ground.

Stop the engine.

For Relief Valve Adjustment procedure. (See Page 2–16.)









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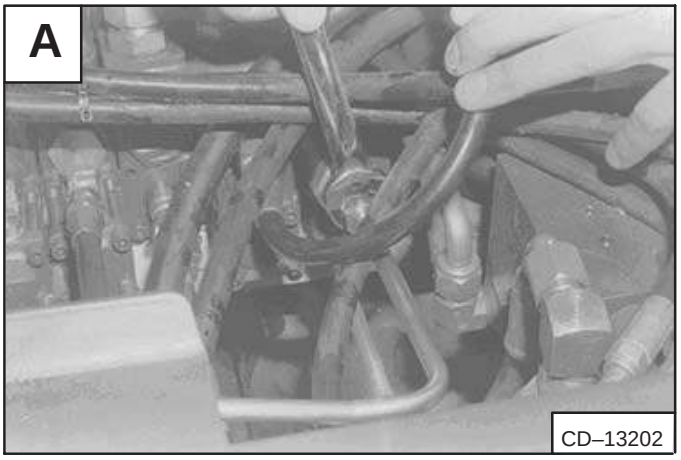
MAIN RELIEF VALVES (S/N 11001–12999) (Cont'd)

Dual Pressure Relief Valve Adjustment (6–Spool Valve)

Remove the tube(s) from the relief valve(s) **[A]**.

Plug the tube(s).

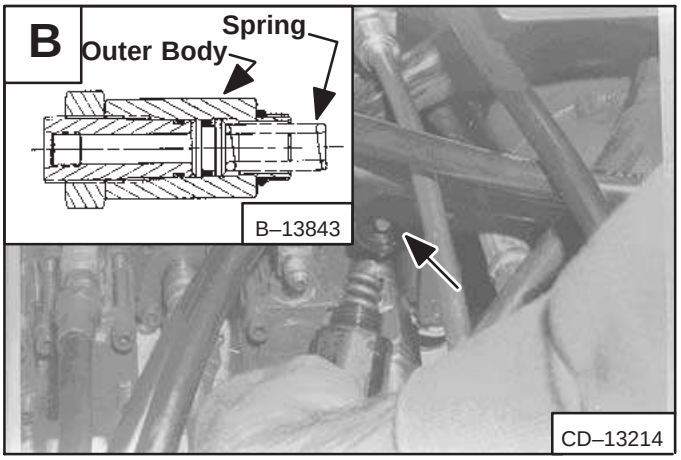
NOTE: Adjust the high pressure relief valve(s) first (if needed) and then adjust the low pressure relief valve(s).



High Pressure Adjustment Procedure (6 Spool Only):

Remove the outer portion of the relief valve body and the spring **[B]**.

NOTE: Make sure that no shims are stuck to the end of the spring when it is removed from the relief valve. If shims are attached, remove them and install them back onto the relief valve poppet.



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**

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MAIN RELIEF VALVES (S/N 11001–12999) (Cont'd)

Dual Pressure Relief Valve Adjustment (6–Spool Valve) (Cont'd)

Add shims to increase the pressure or remove shims to decrease the pressure setting from the relief valve poppet **[A]**.

The following list is the approximate pressure change per shim thickness:

Shim 0.010'' (0,25 mm) thick (896265) = 75 PSI (517 kPa

Shim 0.020'' (0,50 mm) thick (896264) = 200 PSI (1379 kPa)

Shim 0.040'' (1,01 mm) thick (896263) = 300 PSI (2069 kPa)

Check the outer relief body O–ring for damage, replace the O– ring (79K–10) if necessary.

Install the spring and outer portion of the relief valve **[B]**.

Tighten the outer portion of the relief valve to 20 ft.–lbs. (27Nm) torque.

DO NOT overtighten.

Install the tubes onto the adapters.

Install the coupler/pressure gauges onto the pump section closest to the engine for checking the right hand relief valve and onto the center pump section for checking the left hand relief valve. (See Page 2–14.)

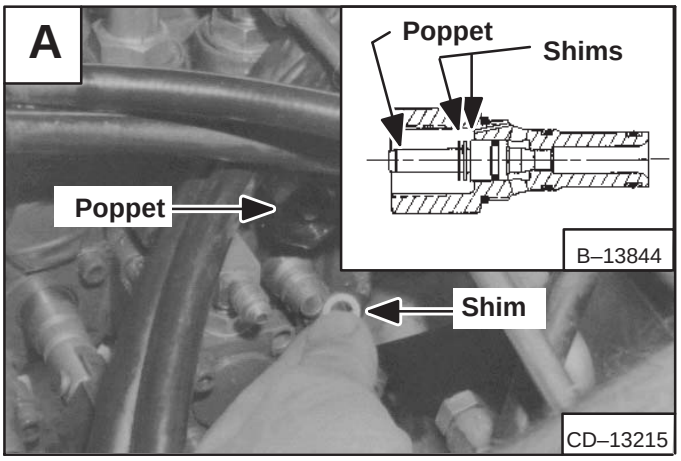
Start the engine and warm the hydraulic fluid to 140°F (60°C).

With the engine running at high idle, retest the high pressure relief settings by pushing the right hand or the left hand travel levers forward and record the pressure gauge readings when the relief valves open. Repeat the check five times to get the average relief valve pressure settings.

If the settings are correct 2950–3000 PSI (20340–20685 kPa), the low pressure settings of the relief valve can now be set. If the pressure settings are not correct, repeat the steps needed to add or remove shims as necessary until pressure settings are correct.

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**





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MAIN RELIEF VALVE (S/N 11001–12999) (Cont'd)

Dual Pressure Relief Valve Adjustment (6–Spool Valve) (Cont'd)

Low Pressure Adjustment Procedure (6 Spool Only):

NOTE: Make sure the high pressure setting(s) are correct before adjusting the low pressure setting(s).

NOTE: If high pressure adjustment was done prior to adjusting low pressure setting, retest the low pressure setting and then adjust the relief valves.

Remove the tube(s) from the relief valve adapter(s) **[A]**. Plug the tube(s).

Install the coupler/pressure gauge onto the pump section (Item 1) **[B]** closest to the engine for checking the right hand relief valve and/or the center (Item 2) **[B]** (S/N 11001–11999 shown) pump section for checking the left hand relief valve.

Start the engine and warm the hydraulic fluid to 140°F (60°C).

Raise the boom.

Run the engine at high idle.

If testing the right hand relief valve, curl the bucket and extend the cylinder until the low pressure relief valve opens and record the pressure reading. Repeat this five times to get the average pressure reading.

If testing the left hand relief valve, extend the arm cylinder until the low pressure relief valve opens and record the pressure reading. Repeat this five times to get the average pressure reading.

Lower the boom to the ground.

Stop the engine.

If relief valve adjustment is required, loosen the relief valve jam nut **[C]**.

Turn the adjusting screw clockwise to increase the pressure or turn the adjusting screw counterclockwise to decrease the pressure **[D]**.

NOTE: Turning the adjusting screw one turn (360°) will change the pressure setting approximately 700 PSI (4827 kPa).

Readjust and retest the low pressure relief valves until pressure settings are correct 2450–2500 PSI (16893–17238 kPa).

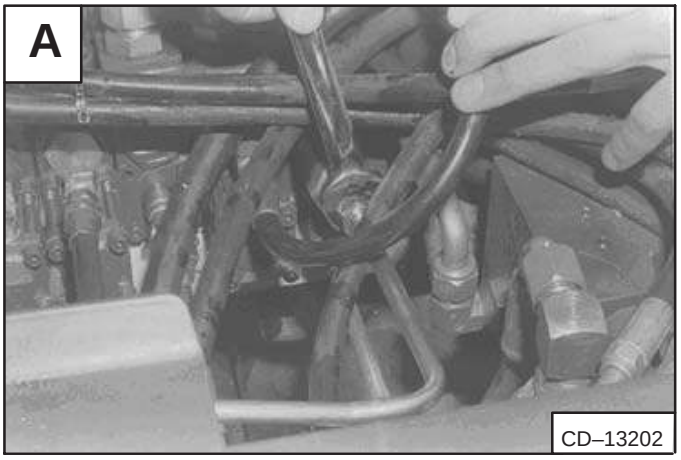
Tighten the jam nut while holding the adjusting screw from turning **[C]**.

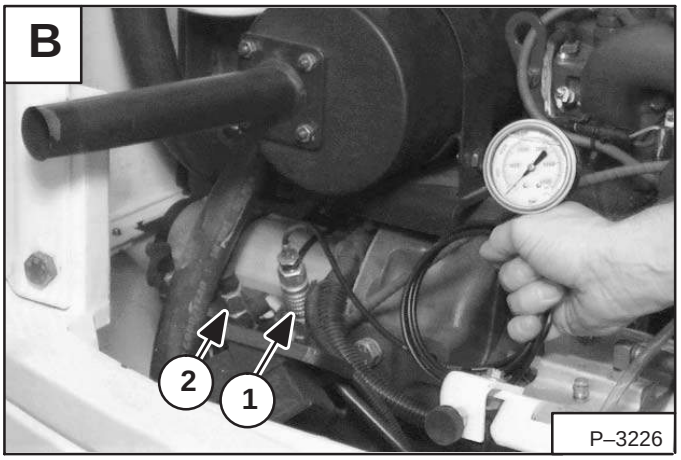
Install the tube(s) **[A]**.

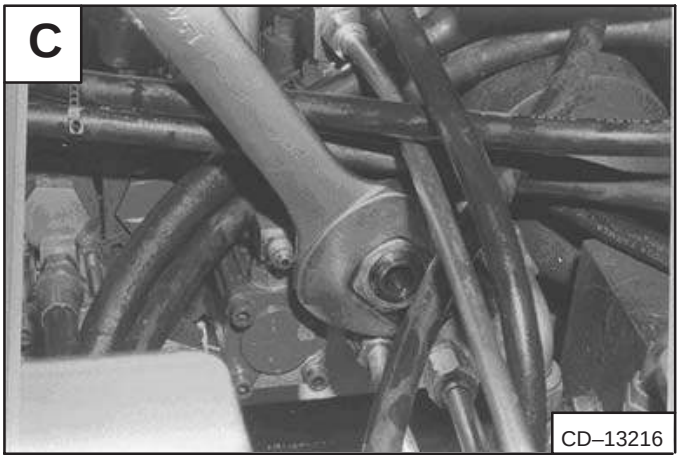
Install the four (4) hoses onto the control valve.

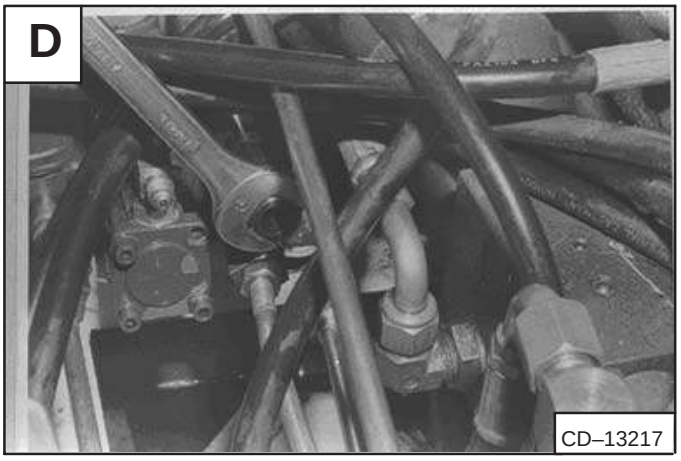
After all the relief valves have been tested and/or adjusted, install the rear floor cover, the rear floorboards and the floormat.

Check the hydraulic fluid reservoir and add fluid as necessary. (See Page 1–16 for the correct procedure.)







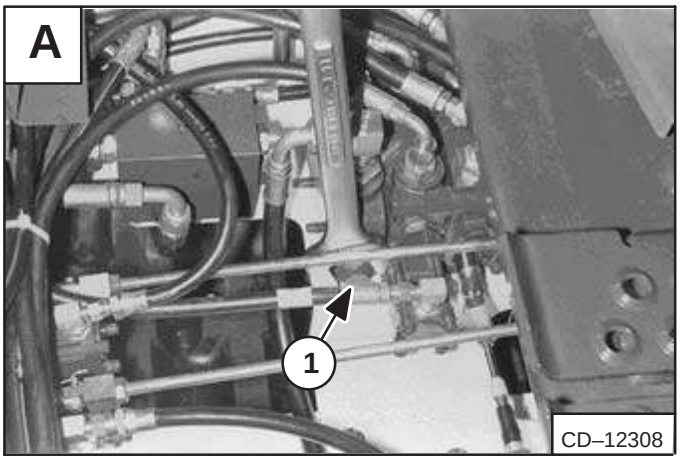


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MAIN RELIEF VALVE (S/N 11001–12999) (Cont'd)

Single Pressure Relief Valve Adjustment (3–Spool Valve)

To adjust the 3 spool valve, main relief valve, loosen the relief valve plug (Item 1) **[A]** & **[B]**.



Remove the plug (Item 1) **[B]** and the spring (Item 2) **[B]**. Make sure no shims are stuck to the end of the spring.

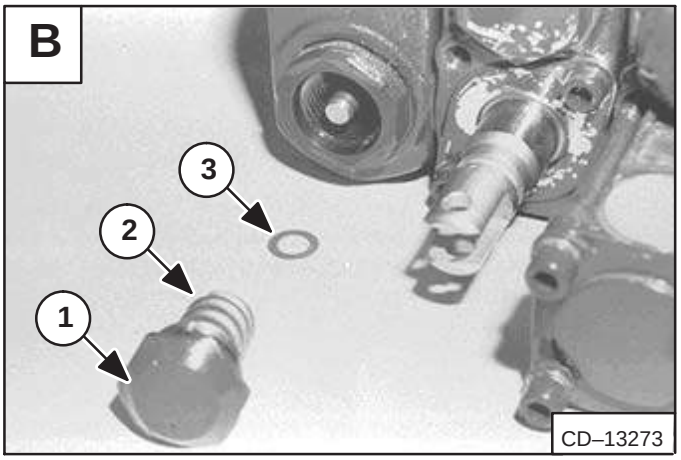
Add shims (Item 3) **[B]** to increase pressure or remove shims (Item 3) **[B]** to decrease the pressure setting.

The following list is the approximate pressure change per shim thickness:

Shim 0.010'' (0,25 mm) thick (896265) = 75 PSI (517 kPa

Shim 0.020'' (0,50 mm) thick (896264) = 200 PSI (1379 kPa)

Shim 0.040'' (1,01 mm) thick (896263) = 300 PSI (2069 kPa)



Check the outer relief body O–ring for damage, replace the O– ring (79K–10) if necessary.

Reinstall the plug. Retest the relief valves to make sure that the pressure settings are correct 2450–2500 PSI (16893–17238 kPa).

After all the relief valves have been tested and/or adjusted, install the rear floor cover, the floorboards and the floormat.

Check the hydraulic fluid reservoir and add fluid as necessary. (See Page 1–16 for the correct procedure.)

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HYDRAULIC SERVICE INFORMATION (S/N 13001 & Above)

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

The hydraulic system has six (6) main relief valves protecting the hydraulic pump sections from high pressure.

The hydraulic pump has three (3) diagnostic couplers for checking each pump section pressure **[A]**.

MAIN RELIEF VALVE (Adjustable) (S/N 13001 & Above)

Checking the Main Relief Valves

The following tools will be needed for the Diagnostic Coupler Check:

MEL1355 – Test Kit
MEL1355–3 – 5000 PSI Gauge
MEL1355–12 – Coupler
MEL1355–4 – Hose

Testing the Blade, Boom Swing, Arm and Boost Circuit Relief Valves

Connect the coupler and gauge from the test kit to the hose.

The main relief valve (Item 1) **[C]** & **[D]** protects the blade, boom swing, arm and boost circuits.

Start the engine. Run the hydraulic functions over relief for 10–20 second intervals to warm the hydraulic oil to operating temperature (160° F). This will take approximately ten (10) minutes.

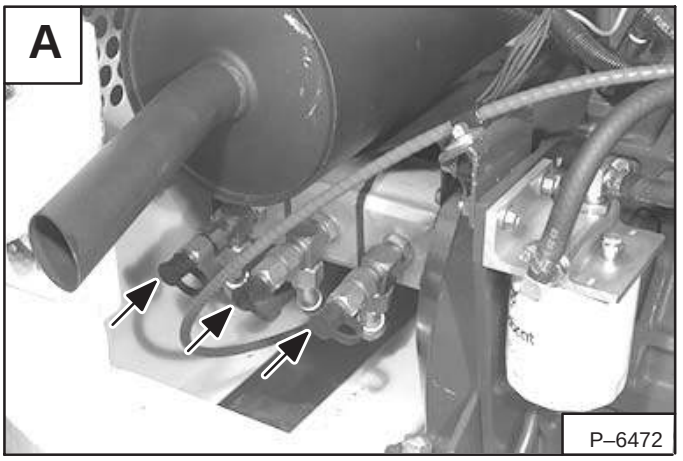
Stop the engine.

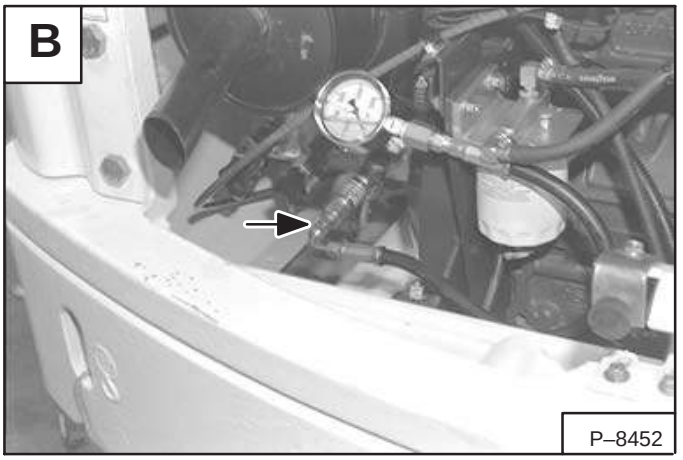
Connect the coupler to the diagnostic coupler on pump section 1 **[B]**.

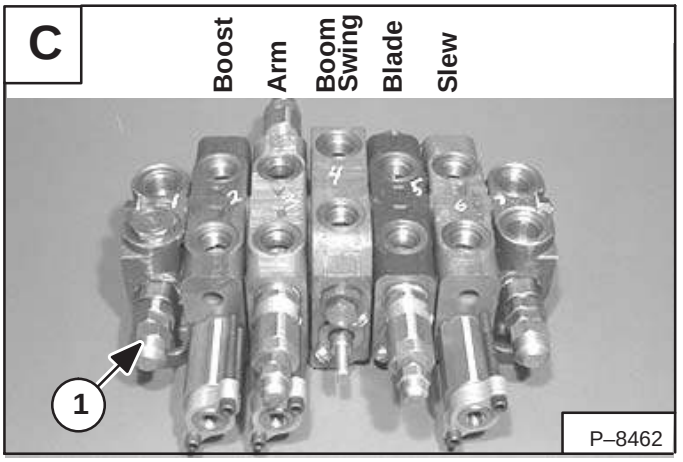
NOTE: Pump section 1 is closest to the engine.

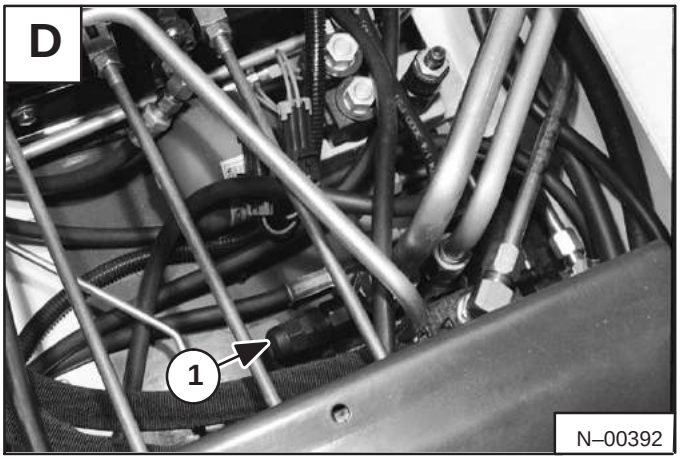
Start the engine and run at high idle.

Engage the blade lever until the blade is fully raised. Continue to engage the blade lever. This will cause the main relief (Item 1) **[C] & [D]** to go over relief. The pressure reading at pump section 1 should read 2550 PSI (17582 KPA). If adjustment is needed see Page 2–76 for adjustment procedure.









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MAIN RELIEF VALVES (Adjustable) (S/N 13001 & Above) (Cont'd)

Checking the Main Relief Valves (Cont'd)

Testing the 4050 PSI (27925 kPa) Circuit Relief

Connect the coupler to the diagnostic coupler on pump section 1 **[A]**.

⚠ WARNING

Control lever must be in locked position anytime the engine is operated during service. Failure to lock controls can cause injury or death.

W–2033–1285

The main relief (Item 1) **[C]** & protects the swing circuit when it is activated with any combination of the blade, boom swing, arm and boost circuits.

Remove the four (4) bolts (Item 1) **[B]** from the front of the access cover. Remove the access cover (Item 2) **[B]**.

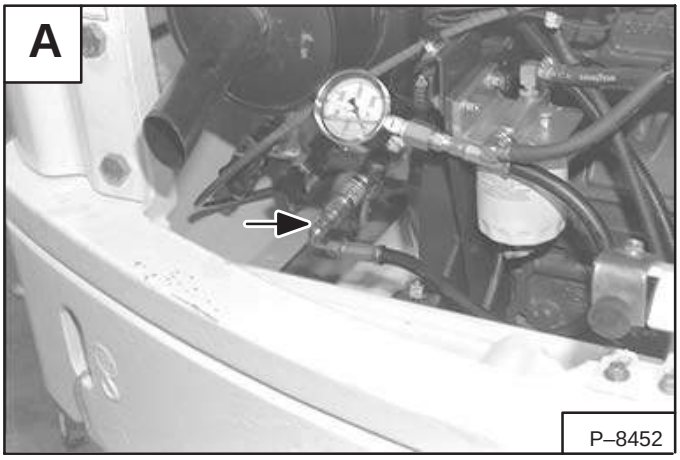
Engage the blade lever until the blade is fully raised. Continue to engage the blade lever.

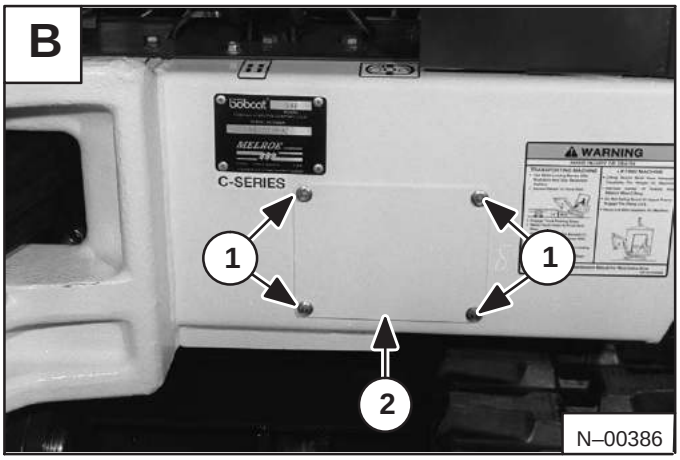
With the swing lock pin engaged and the house locked, engage the swing circuit at the same time. This will cause the main relief (Item 2) **[C]** & to go over relief. The pressure reading at pump section 1 should read 4050 PSI (27925 KPA).

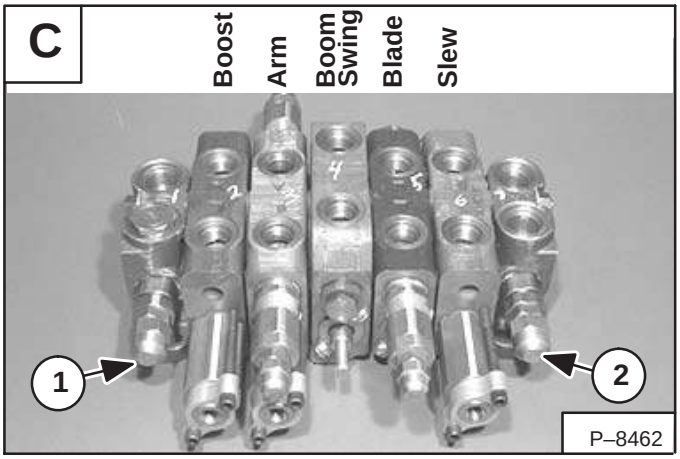
If adjustment is needed see Page 2–76 for adjustment procedure.

NOTE: Access to the main relief valve is made through the access hole in the front of the excavator [D].

Stop the engine.









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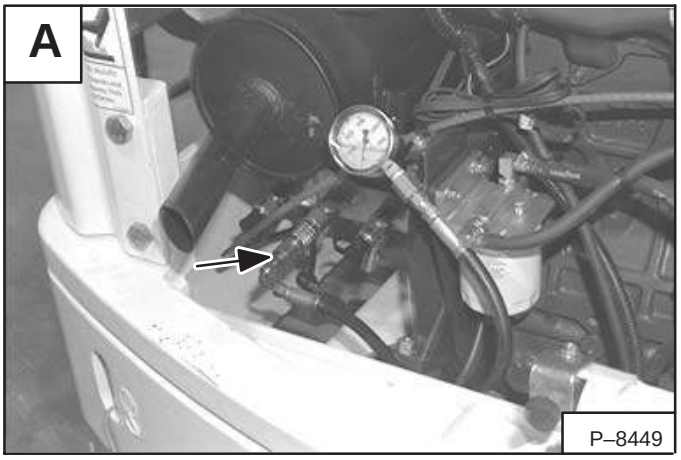
MAIN RELIEF VALVES (Adjustable) (S/N 13001 & Above) (Cont'd)

Checking the Main Relief Valves (Cont'd)

Testing the Auxiliary and Bucket Circuit Relief Valve

Move the test gauge and coupler to pump section 2 **[A]**.

NOTE: The center section of the pump is pump section 2.



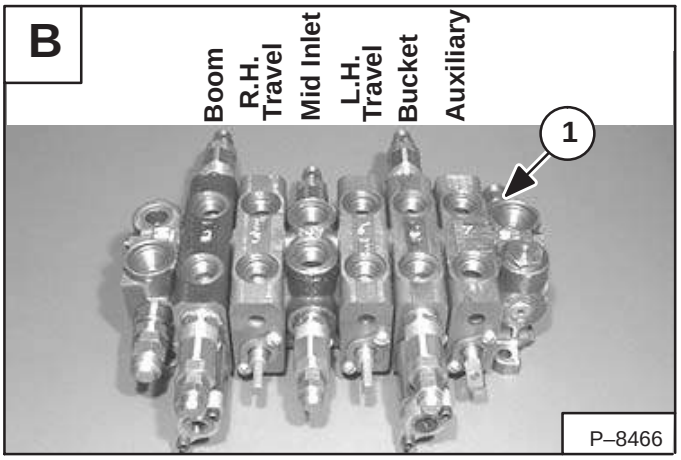
The main relief valve (Item 1) **[B]** & **[C]** protects the auxiliary and bucket circuits.

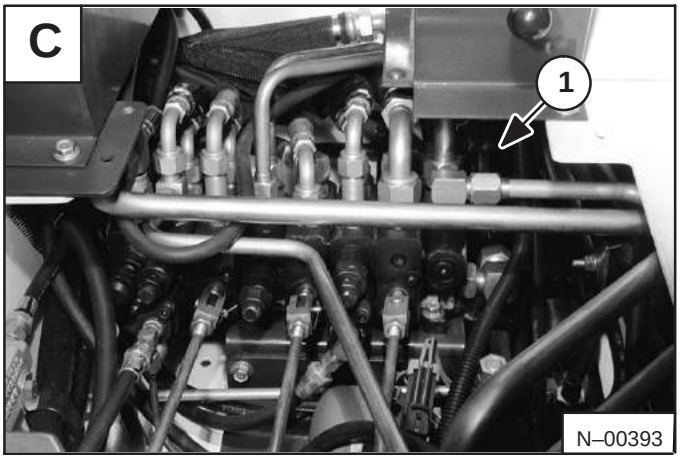
Start the engine and run at high idle.

Engage the blade lever until the blade is completely raised. Continue to engage the blade lever. This will cause relief 1 (shown on Page 2–18) to go over relief reducing the pressure and flow from pump section 1.

Engage the bucket circuit until the bucket is completely extended.

Continue engaging both the blade and bucket circuits at the same time will cause the main relief valve (Item 3) **[B]** & **[C]** to go over relief. The pressure reading at pump section 2 should be 2550 PSI (17582 KPA). If adjustment is needed, see Page 2–76 for adjustment procedure.





NOTE: Turn the upperstructure as shown in [D] to gain access to the main relief valve [B] & [C], from under the excavator.



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MAIN RELIEF VALVES (Adjustable) (S/N 13001 & Above) (Cont'd)

Checking the Main Relief Valves (Cont'd)

Testing the Left Hand Travel Circuit Relief Valve

Lift and block the excavator. (See Page 1–6.)

⚠ WARNING

Put jackstands under the blade and front and rear corners of the under carriage before working under the machine. Failure to block up the machine may allow it to move or fall and result in injury or death.

W–2218–1195

With the test gauge and coupler connected to pump section 2 **[A]**.

NOTE: The center section of the pump is pump section 2.

The main relief valve (Item 1) **[B]** & **[C]** protects the left travel circuit.

Disconnect and plug the hose (Item 2) **[B]** and valve section from the A port of the left travel section.

Start the excavator and run at high idle.

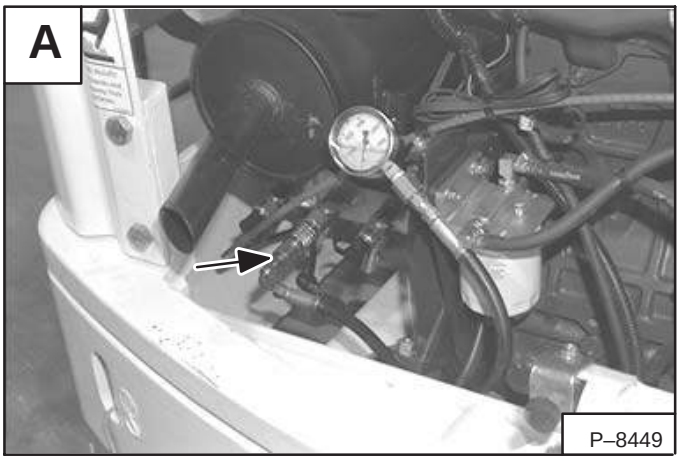
Engage the left travel circuit in the reverse position.

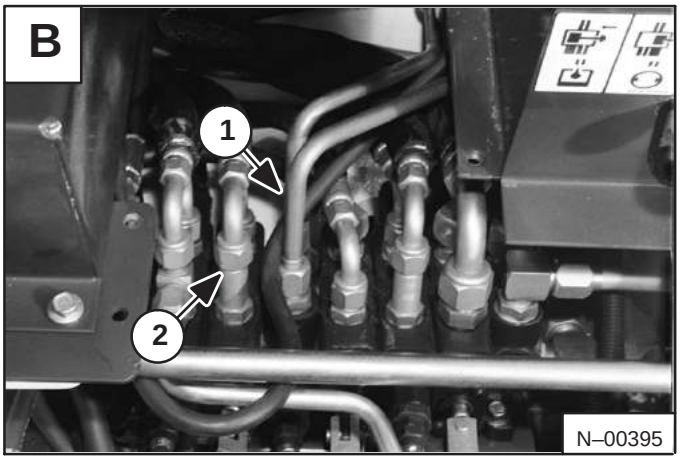
NOTE: Make sure the blade is to the front of the excavator before engaging the travel circuit.

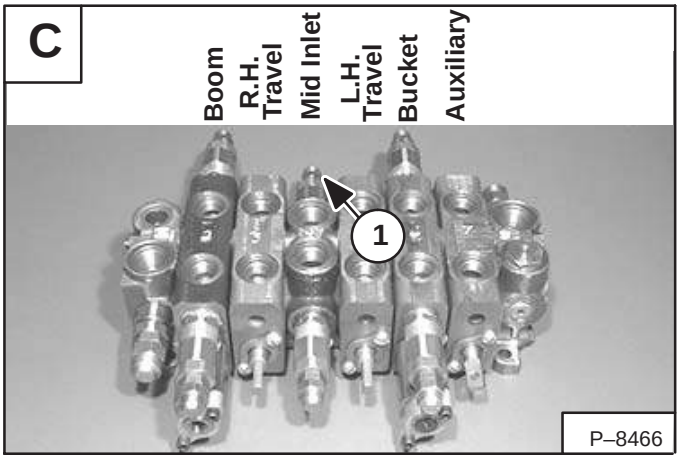
Continue to engage the left travel circuit. This will cause the main relief valve (Item 1) **[B]** & **[C]** to go over relief.

The pressure reading at pump section 2 should be 3050 PSI (21030 kPa). If adjustment is needed See Page 2–76 for adjustment procedure.

NOTE: Turn the upperstructure as shown in [D] to gain access to the main relief valve [B] & [C] from under the excavator.









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MAIN RELIEF VALVES (Adjustable) (S/N 13001 & Above) (Cont'd)

Checking the Main Relief Valves (Cont'd)

Testing the Right Hand Travel Circuit Relief Valve

Lift and block the excavator. (See Page 1–6.)

⚠ WARNING

Put jackstands under the blade and front and rear corners of the under carriage before working under the machine. Failure to block up the machine may allow it to move or fall and result in injury or death.

W–2218–1195

Move the test gauge and coupler to pump section 3 **[A]**.

NOTE: Pump section 3 is farthest away from the engine.

The main relief valve (Item 1) **[C]** & **[D]** protects the right travel circuit.

Remove and plug the hose (Item 1) **[B]** and fitting from the A port of the right travel section.

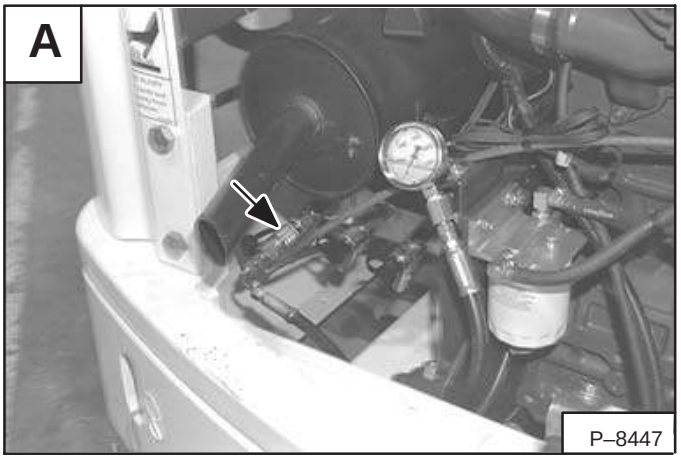
Start the engine and run at high idle.

Engage the right travel section circuit in the reverse position.

NOTE: Make sure the blade is to the front of the excavator before engaging the travel circuit.

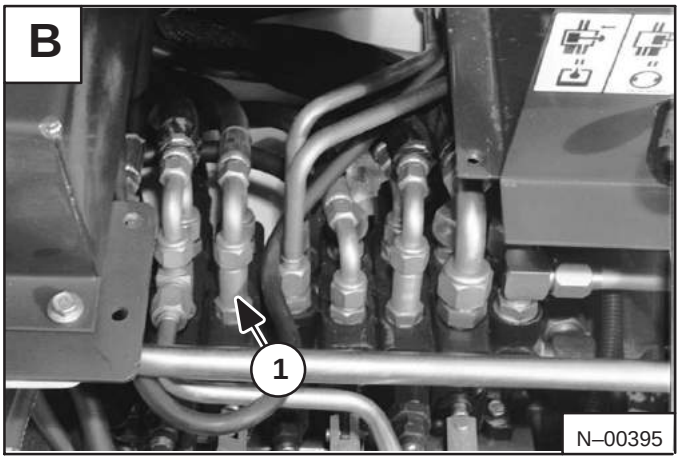
Continue to engage the right travel circuit. This will cause the main relief valve (Item 1) **[C]** & **[D]** to go over relief.

A



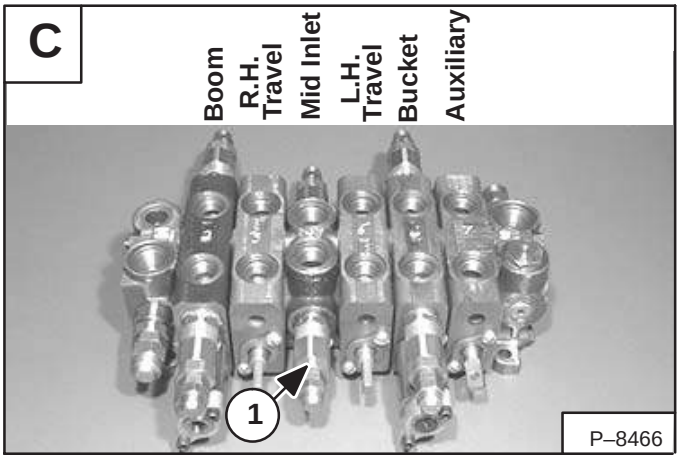
P–8447

B



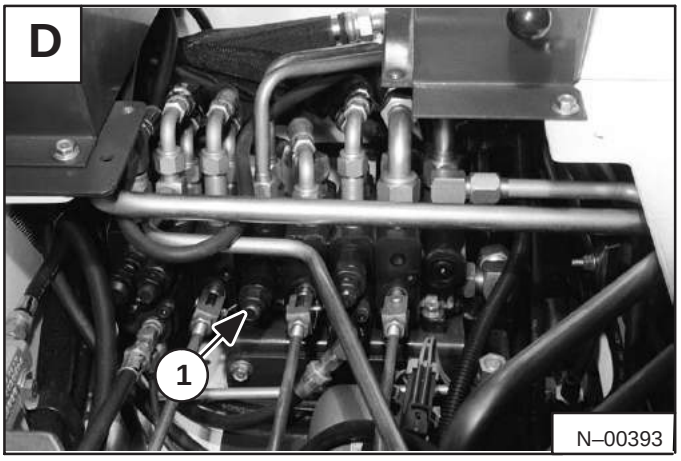
N–00395

C



P–8466

D



N–00393

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MAIN RELIEF VALVES (Adjustable) (S/N 13001 & Above) (Cont'd)

Checking the Main Relief Valves (Cont'd)

The pressure reading at pump section 3 should be 3050 PSI (21030 kPa). If adjustment is needed see Page 2–76 for adjustment procedure.

NOTE: Turn the upperstructure as shown in [A] to gain access to the main relief valve from under the excavator.

When the correct pressure is set, shut off the engine and install the hose on the A port of the right travel section.

Testing the Boom Circuit Relief Valve

The main relief valve (Item 1) **[C]** & **[D]** protects the boom circuit.

Install the test gauge on pump section 3.

NOTE: Pump Section 3 is farthest from the engine.

Disconnect and plug the boom boost pilot pressure tube (Item 1) **[B]** and cap the fitting on the boom section.

This disconnects the boom boost valve from the circuit.

Start the engine and run at high idle.

Engage the boom circuit in the up (lift) direction.

NOTE: Engage the boom circuit in the up (lift) direction only.

Continue to engage the boom circuit. This will cause the main relief valve (Item 1) **[C]** & **[D]** to go over relief. The pressure reading at pump section 3 should be 2550 PSI (17582 kPa). If adjustment is needed see Page 2–76 for adjustment procedure.

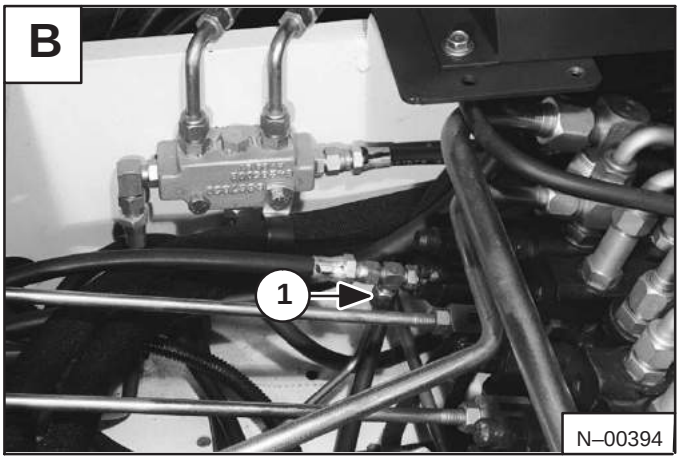
When the correct pressure is set, shut off the engine and install the boost pilot pressure tube (Item 1) **[B]** on the boom valve section.

A



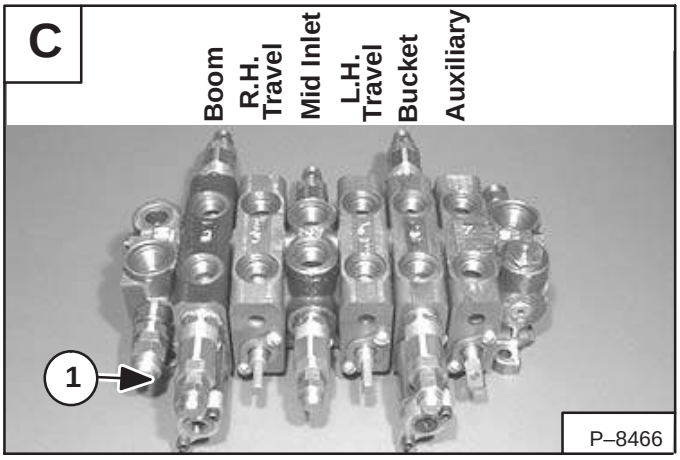
N–00385

B



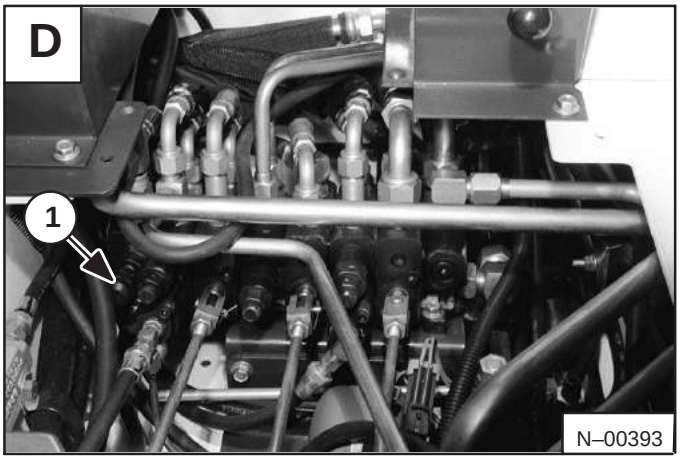
N–00394

C



P–8466

D



N–00393

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HYDRAULIC PUMP

Checking the Hydraulic Pump

The hydraulic pump flow should be as shown in **[A]** for each pump section on a new pump at 2500 RPM.

NOTE: Pump section 1 is closest to the engine.

The following tool will be needed for the hydraulic pump test:

MEL10003 – Hydraulic Tester

Stop the engine.

Raise the engine cover.

Remove the outlet hose from the hydraulic pump section being tested **[B]**.

Connect the hose removed from the pump to the outlet of the tester**[B]**.

Connect the inlet hose of the tester to the pump outlet fitting **[B]**.

NOTE: The tester connections will be the same for each pump section.

NOTE: Open the flow control knob (Item 1) [C] & [D] fully to prevent pump damage. This is a direct pump test. There is no relief valve in the system.

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. Warm the hydraulic fluid to 140F (60C) by turning the restrictor valve until the gauge reads about 1000 PSI (6895 kPa). Do not exceed system pressure.

After the temperature is correct, open the restrictor valve fully.

Record the pump free flow GPM (L/min).

NOTE: The flow should be as shown in chart [A] at 2500 RPM on a new pump, with the flow restrictor open fully.

Close the flow control knob (Item 1) **[C]** & **[D]** slowly to 100 PSI below the relief valve setting 2450–2500 PSI (16893–17238 kPa).

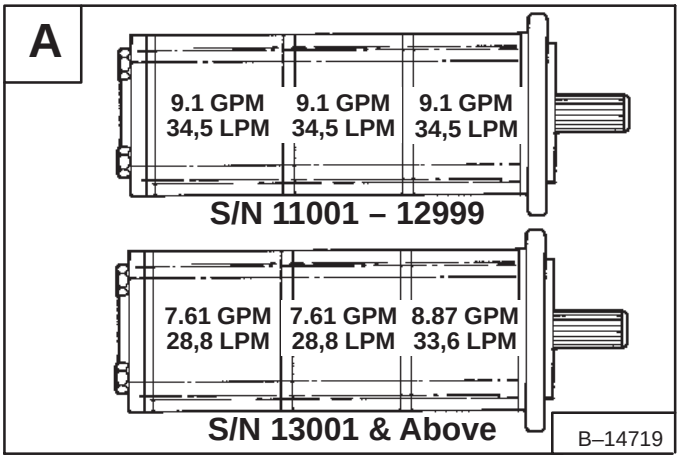
Record the pump high pressure flow GPM (L/min).

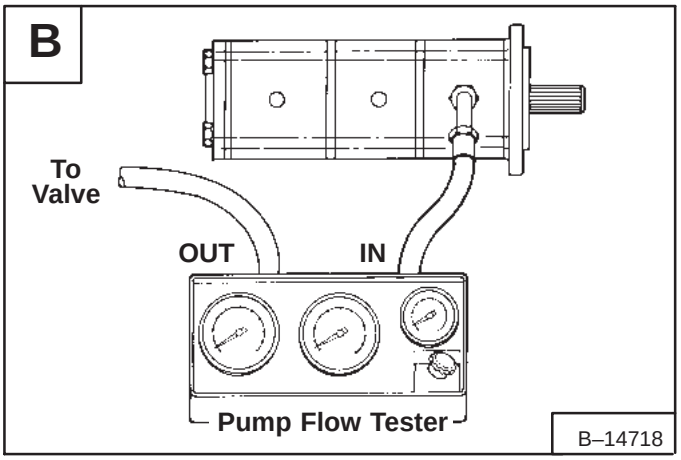
NOTE: The high pressure flow must be at least 80% of free flow.

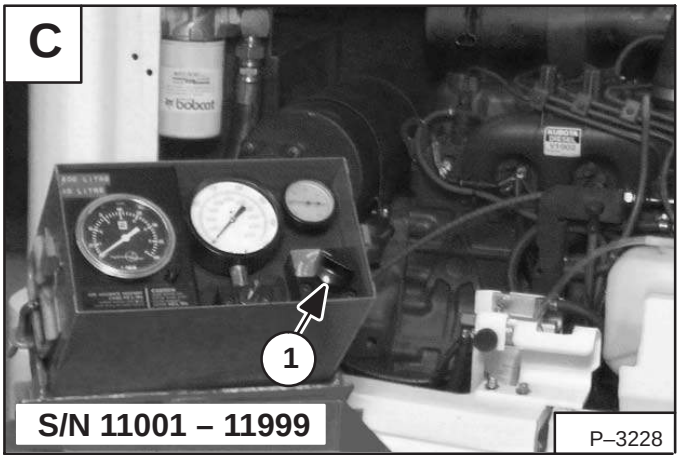
$$\%= \frac{\text{HIGH PRESSURE FLOW (GPM)}}{\text{FREE FLOW (GPM)}} \times 100$$

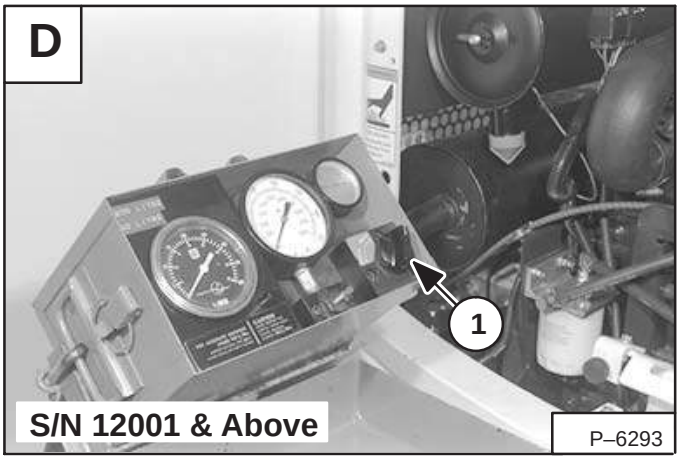
If the high pressure flow is less than 80% of free flow, remove the hydraulic pump for repair or replacement.

Repeat the testing procedure for each pump section









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HYDRAULIC PUMP (Cont'd)

Removal and Installation

NOTE: The photos may appear different but the procedure is the same for all excavators.

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 for correct installation

Drain the hydraulic fluid. (See Page 1–1.)

Remove the left hand side cover. (See Page 4–1.)

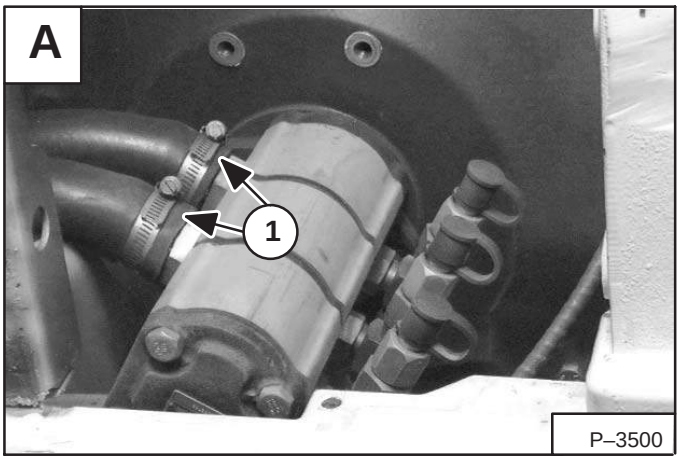
Remove the two inlet hose clamps **[A]**.

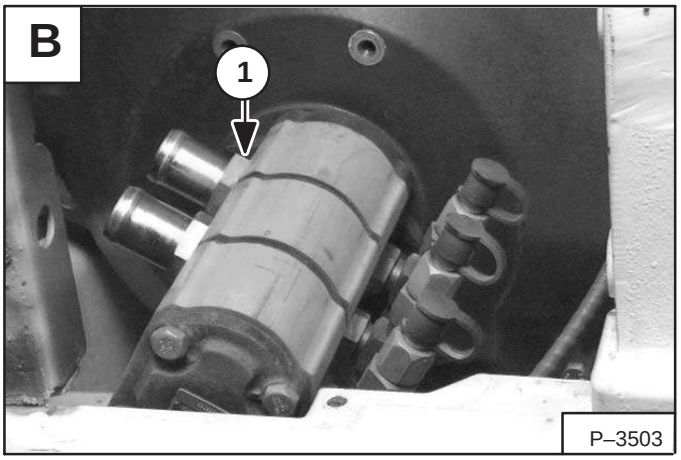
Remove the two inlet hoses from the pump.

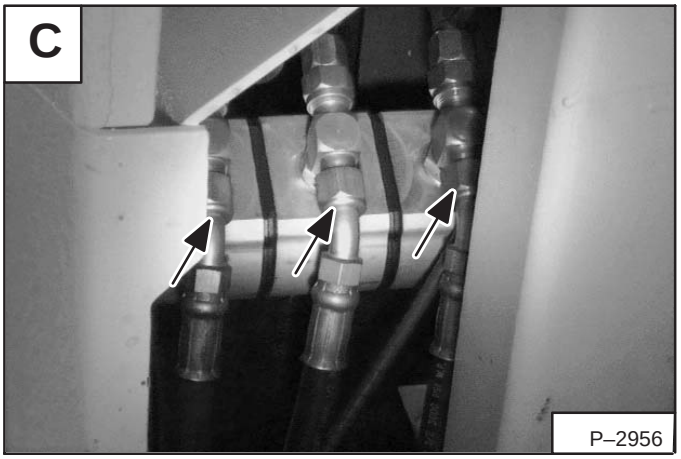
Remove the inner fitting (Item 1) **[B]** from the pump.

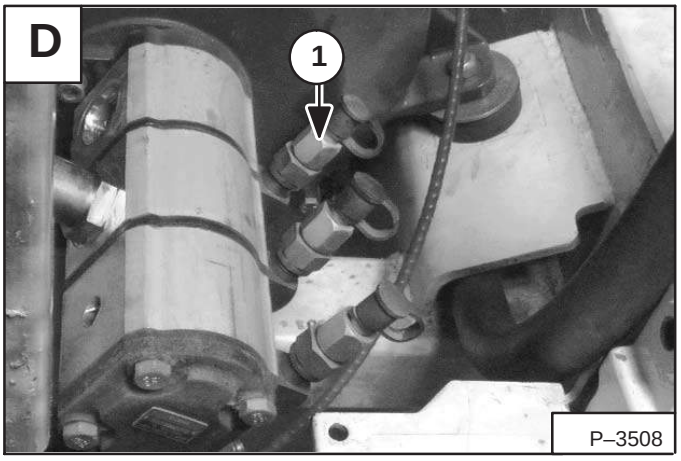
Remove the three pressure hoses from the pump **[C]**.

Remove the inner diagnostic coupler (Item 1) **[D]**, the adapter and the tee from the pump.









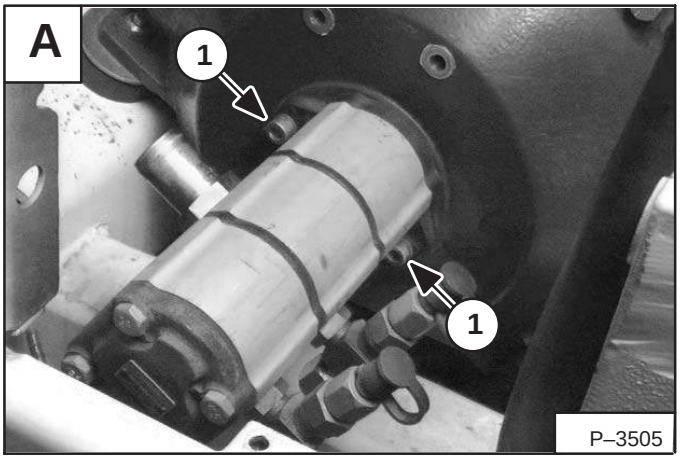
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HYDRAULIC PUMP (Cont'd)

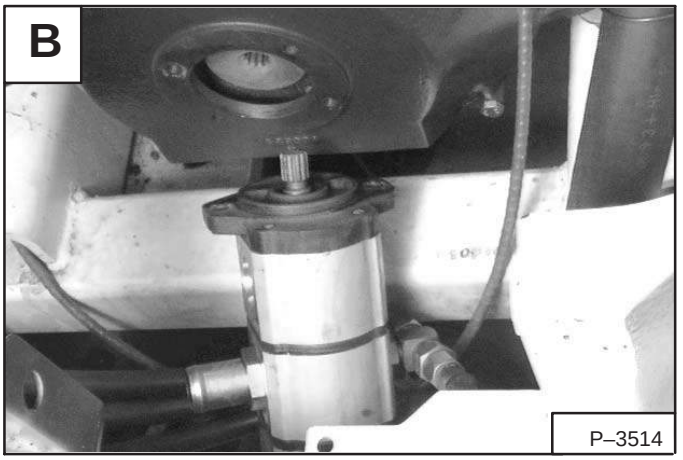
Removal and Installation (Cont'd)

Remove the two bolts (Item 1) **[A]** holding the pump to the housing.

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



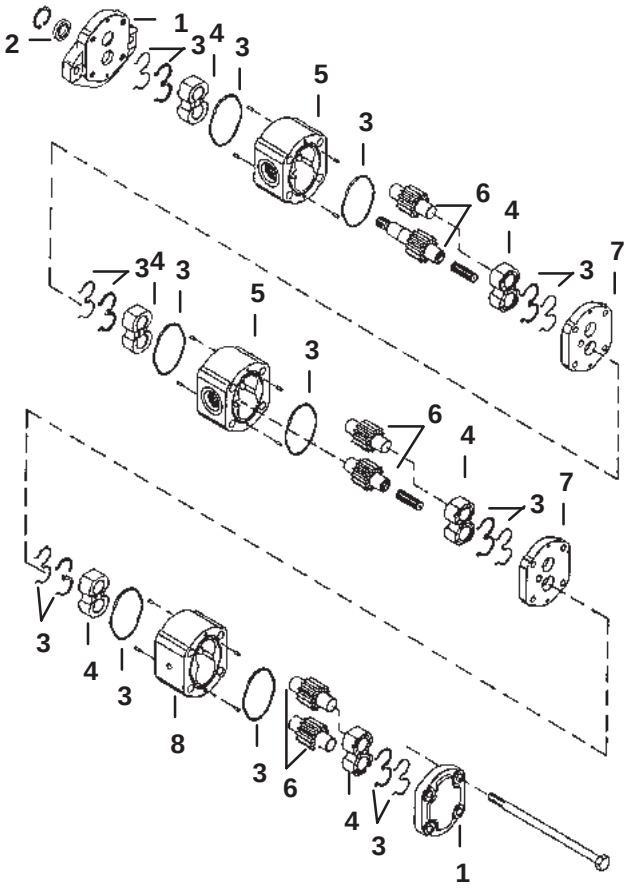
Slide the pump away from the engine and remove **[B]**.



Parts Identification

TRIPLE GEAR PUMP

1. End Cover
2. Shaft Seal
3. Seals
4. Bearings
5. Housing
6. Gears
7. Plate
8. Housing



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HYDRAULIC PUMP (Cont'd)

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

Using a center punch, mark both sides of each separation point (Items 1 – 6) **[A]** on the inlet side of the pump, as shown, with the corresponding separation point number.

Tape the shaft splines (Item 7) **[A]** to ensure that the splines will not damage the oil seal when the shaft is removed.

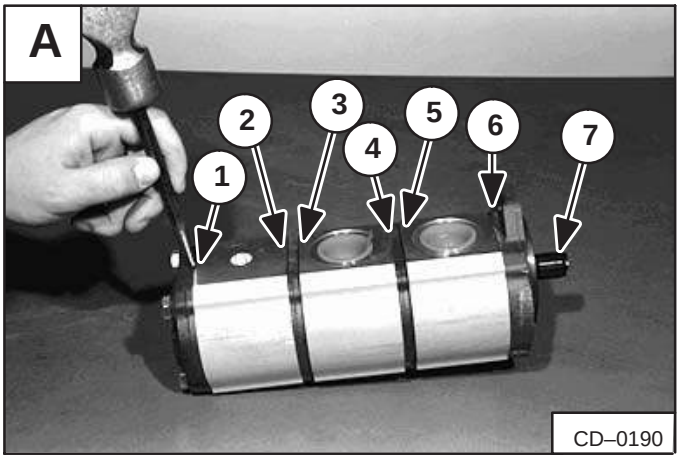
Put the pump, mounting flange down, in a protected jaw vise. Remove the four (4) assembly bolts **[B]**.

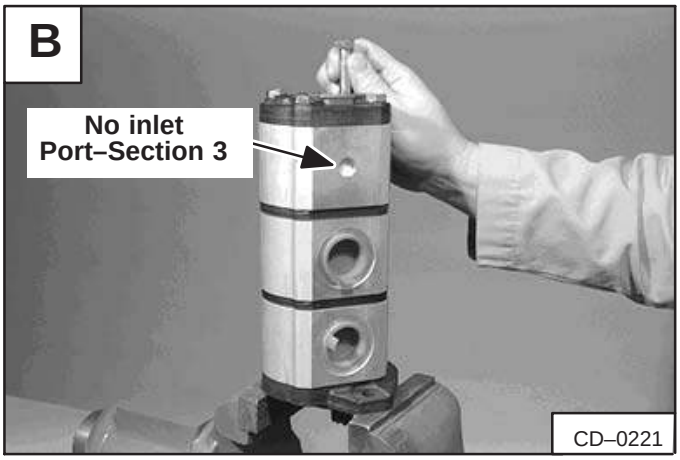
NOTE: The pump has only two inlet ports. The pump section without the inlet port is located in section 3 (end cap section).

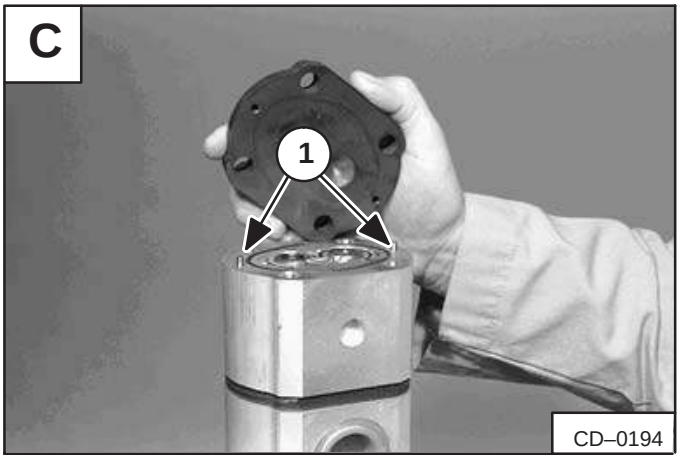
Remove the end cap (or separating plate) and two (2) dowel pins (Item 1) **[C]**.

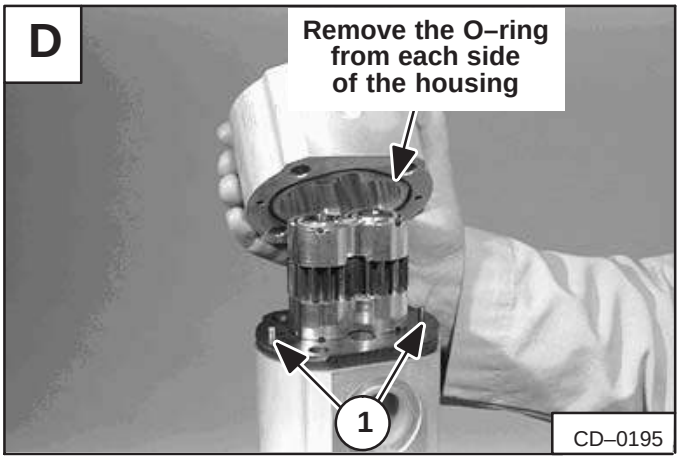
Remove the gear housing and two dowel pins (Item 1) **[D]**.

Remove the O–ring from each end of the gear housing.









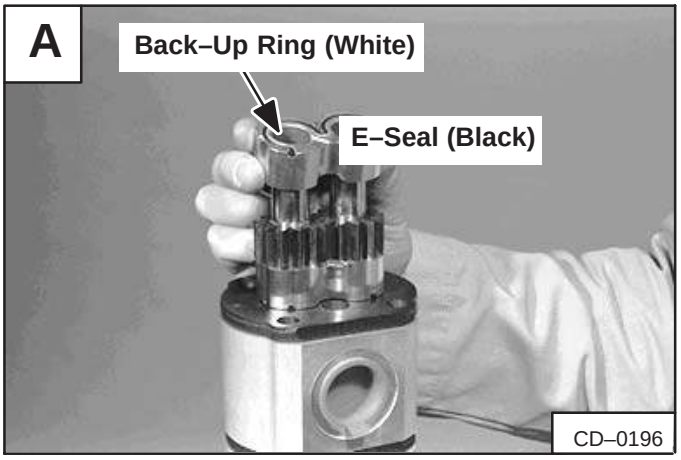
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HYDRAULIC PUMP (Cont'd)

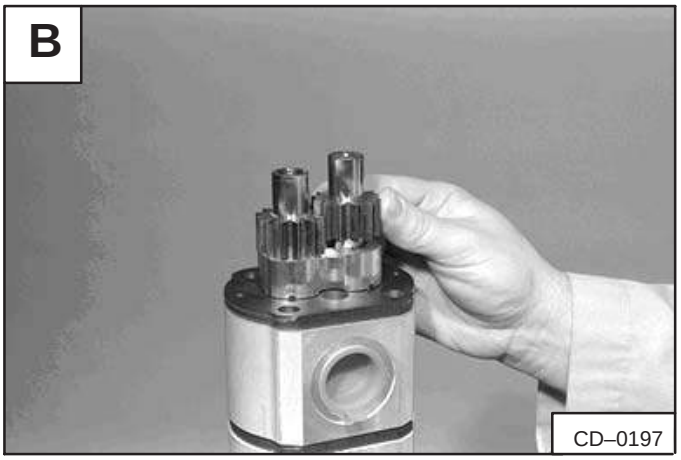
Disassembly (Cont'd)

Remove the upper bearing **[A]**.

Remove the back–up ring and E–seal from the bearing.

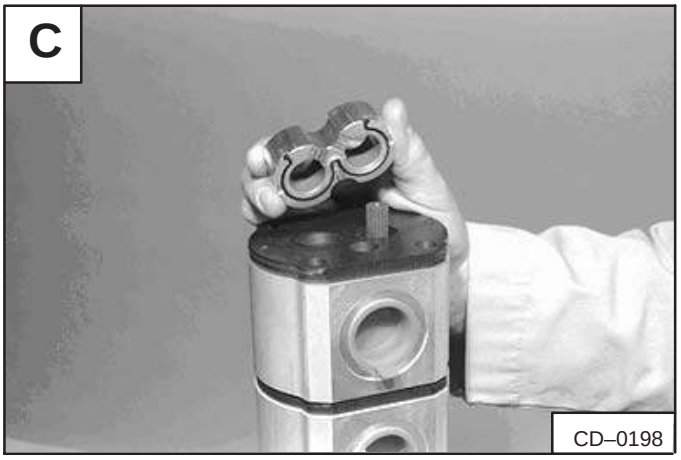


Remove the drive and idler gears **[B]**.



Remove the lower bearing **[C]**.

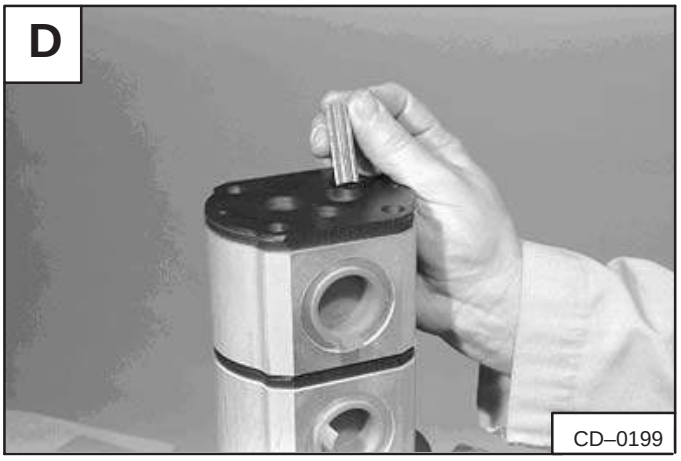
Remove the back–up ring and E–seal from the bearing.



Remove the coupling **[D]**.

Repeat Page 2–26, step **[D]** through Page 2–27, step **[D]** to disassemble each of the remaining pump sections. Keep the parts from each section separate from other sections.

NOTE: The gear housing, two bearings, drive gear and idler gear in each pump section are not serviced separately. These parts are matched sets which are run in at the factory. If any part is damaged, the entire section must be replaced.



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HYDRAULIC PUMP (Cont'd)

Disassembly (Cont'd)

Remove the retaining ring (Item 1) **[A]** from the mounting flange. Remove the oil seal.

Use the correct size driver and install a new oil seal (seal lips to inside of pump) into the mounting flange. Install the retaining ring (Item 1) **[A]**.

Put a small amount of grease to the seal lips.

Assembly

All parts must be clean before assembly. Clean all parts in clean solvent. Use air pressure to dry.

Put a small amount of grease in the E–seal groove of each bearing. Install a new E–seal (Item 1) **[B]** stepped side up, into each E–seal groove. Push each E–seal down into the groove.

Put a small amount of grease on each back–up ring (Item 2) **[B]**. Install the back–up ring into the groove made by the E–seal and bearing. Push the back–up ring down flush with the E–seal.

NOTE: There is a notch (Items 3 & 4) [B] in the center of the back–up ring and E–seal. When installing the back–up ring, make sure that these notches are aligned. If the back–up ring or E–seal is not installed correctly the back–up ring will not be flush with the E–seal.

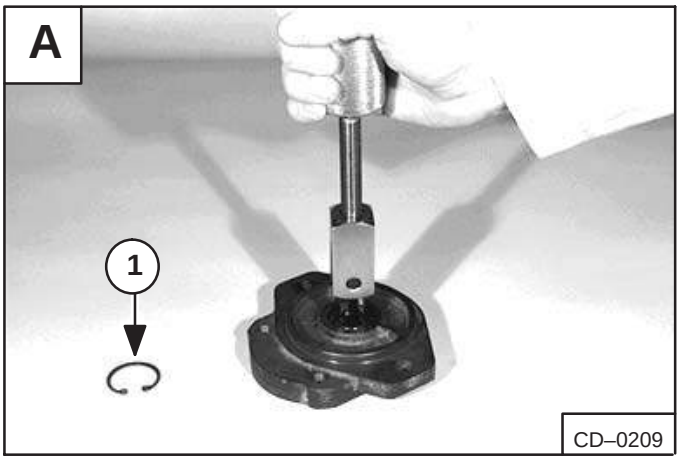
Put the mounting flange, oil seal side down, in a protected jaw vise **[C]**.

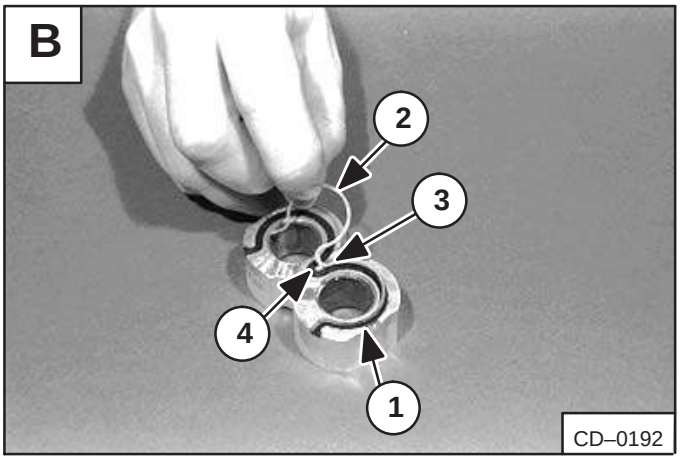
Install two (2) dowel pins (Item 1) **[C]** into the mounting flange (or separating plate).

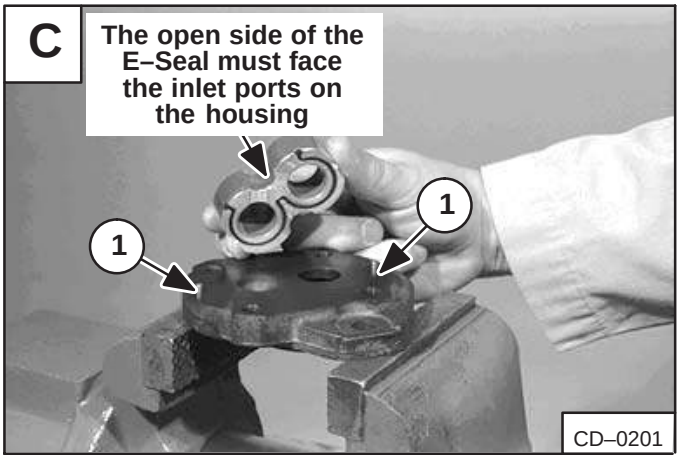
Install the lower bearing, seal side down, on the mounting flange (or separating plate). The open side of the E–seal must point toward the inlet port side (marked side) of the pump **[C]**.

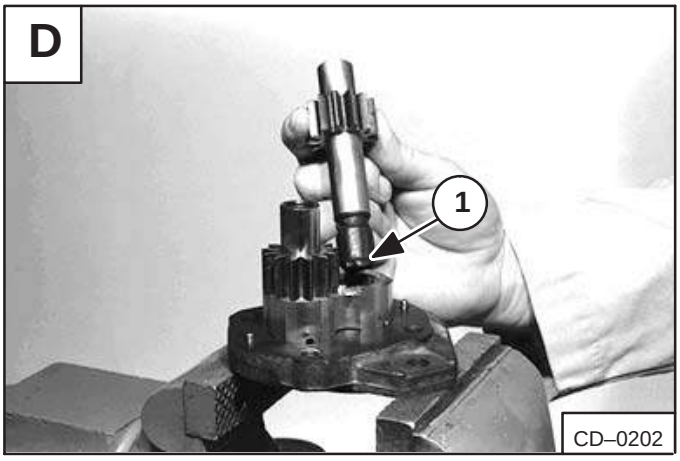
Tape the splined end (Item 1) **[D]** of the drive gear to ensure that the splines will not damage the oil seal during installation.

Apply oil to the drive gear and idler gear and to the side faces of the gears. Install the gears into the lower bearing **[D]**.







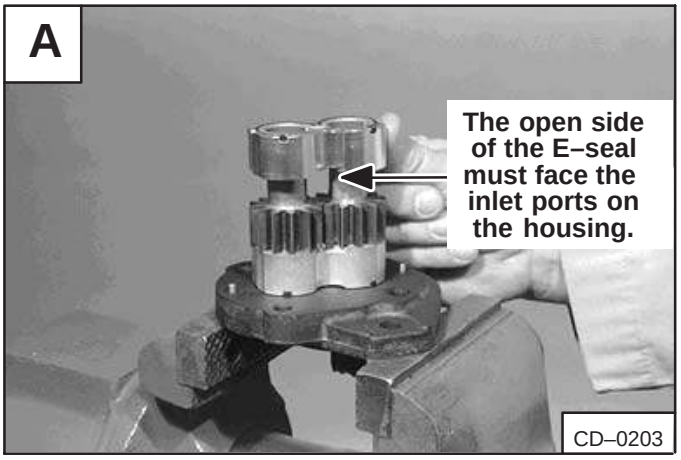


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HYDRAULIC PUMP (Cont'd)

Assembly (Cont'd)

Install the upper bearing, seal side up, on the drive and idler gears. The open side of the E–seal must point toward the inlet port side (marked side) of the pump **[A]**.

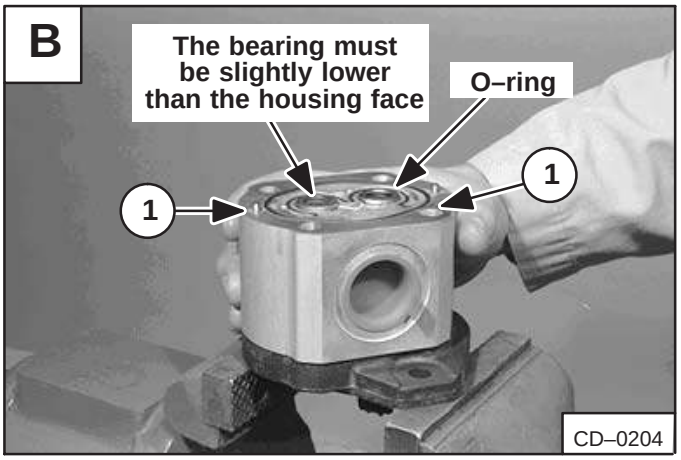


Put a small amount of grease on the O–rings and install a new O–ring on each end of the gear housing.

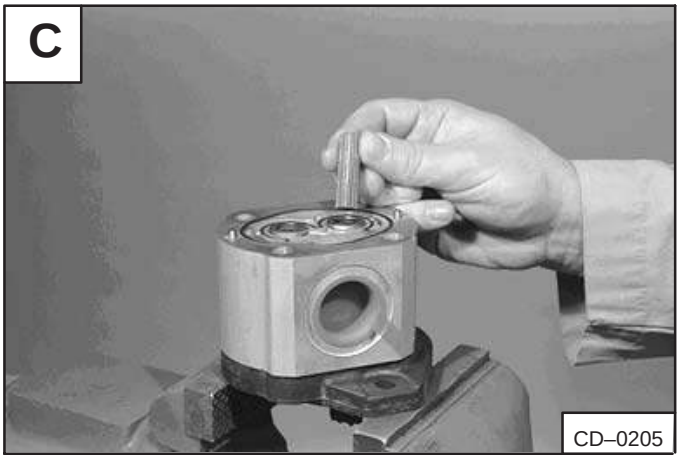
Align the marks made during disassembly on the gear housing and mounting flange (or separating plate). Carefully install the gear housing over the bearings and gears **[B]**.

NOTE: The upper bearing must be slightly lower than the gear housing. If the bearing is higher than the housing, disassemble the pump section to verify that the E–seal, back–up ring, or O–ring have not moved out of position.

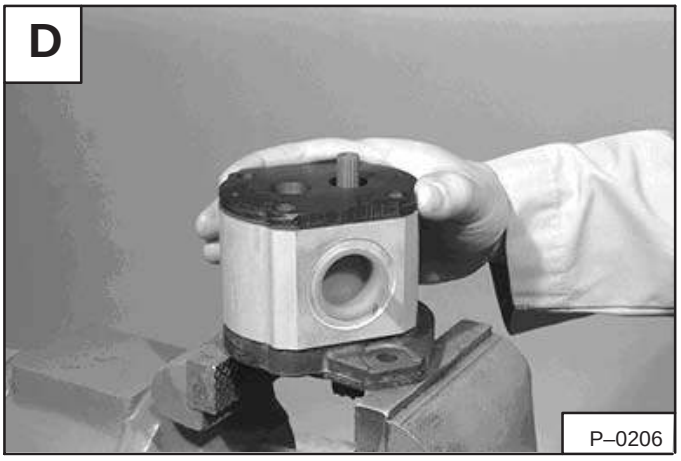
Install two dowel pins (Item 1) **[B]** into the gear housing.



Put oil on the coupling. Install the coupling into the drive gear **[C]**.



Align the marks made during disassembly on the separating plate and gear housing. Install the separating plate **[D]**.



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HYDRAULIC PUMP (Cont'd)

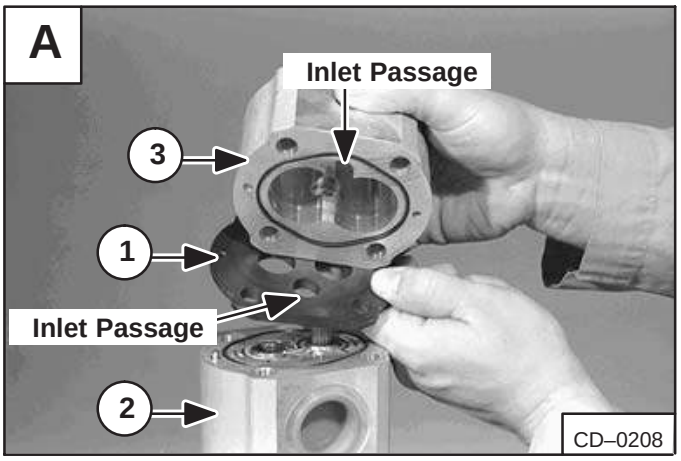
Assembly (Cont'd)

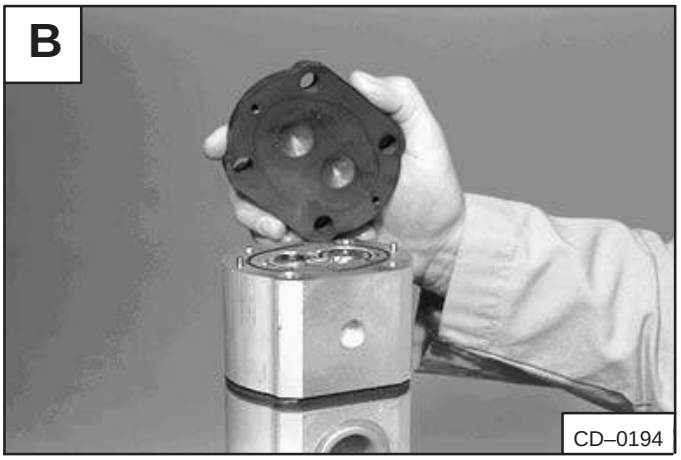
Repeat Page 2–29 step **[B]** through Page 2–30 step **[D]** to assemble pump section 2.

Repeat Page 2–29 step **[B]** through Page 2–30 step **[D]** to assemble pump section 3.

NOTE: When installing pump sections 2 and 3, make sure that the inlet passage is aligned from the section 2 gear housing (Item 2) through the separating plate (Item 1) to the section 3 gear housing (Item 3). Section 3 has no external inlet port and must receive oil flow from the section 2 inlet port [A].

Align the marks made during disassembly on the end cap and gear housing. Install the end cap **[B]**.



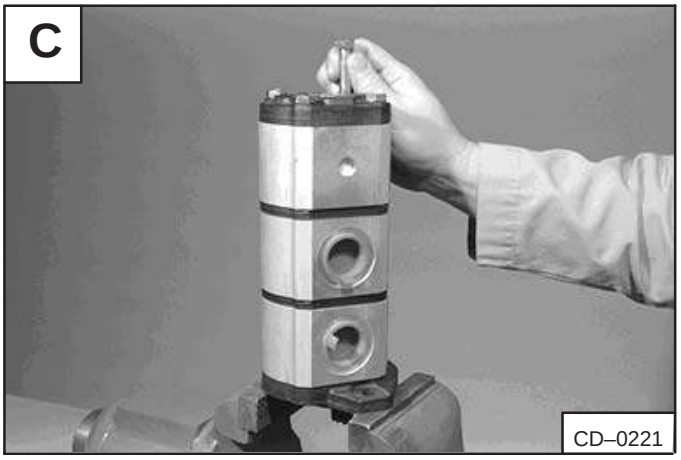


Install the four assembly bolts **[C]**.

Evenly tighten the bolts to a final torque of 50–55 ft.–lbs. (68–75 Nm).

Rotate the input shaft periodically while tightening the bolts to make sure the pump is assembled correctly.

Using a locking plier, rotate the pump shaft to be sure their is no binding.



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HYDRAULIC CONTROL VALVE (6–Spool) (S/N 12999 & Below)

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 floormat. (See Page 4–1.)

Remove the floor plates. (See Page 4–1.).

Remove the seat. (See Page 4–1.)

Remove the swing motor cover. (See Page 4–1.)

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

Mark all the hose and tubes for correct installation.

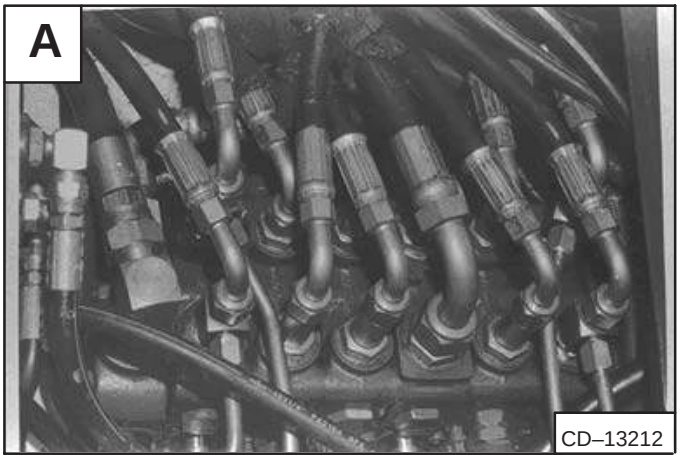
Remove the six (6) tubes that attach to the control valve **[A]**.

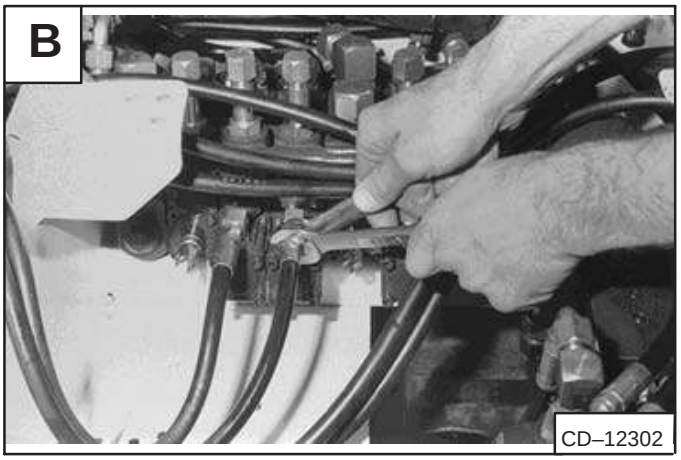
Disconnect the hose from the control valve **[A]**.

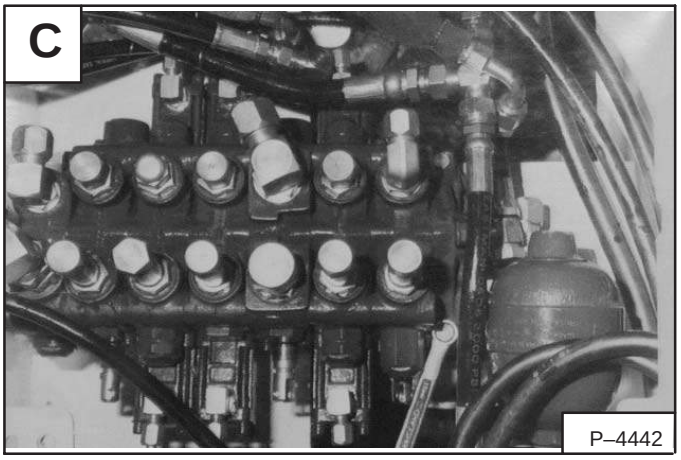
Disconnect the six (6) joystick actuating hoses from the control valve **[B]**.

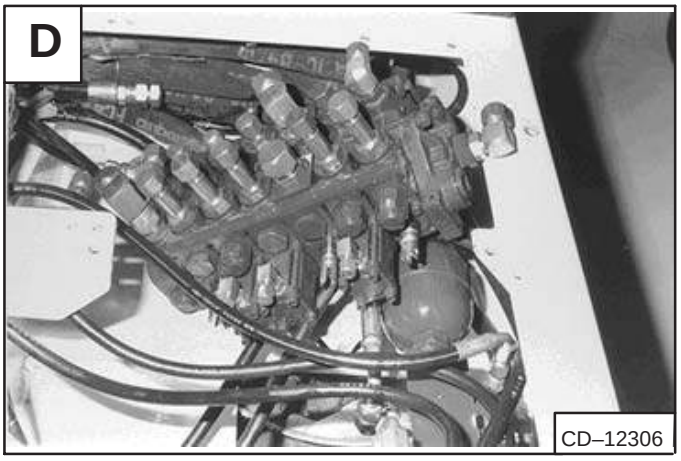
Remove the three (3) mounting bolts from the control valve **[C]**.

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







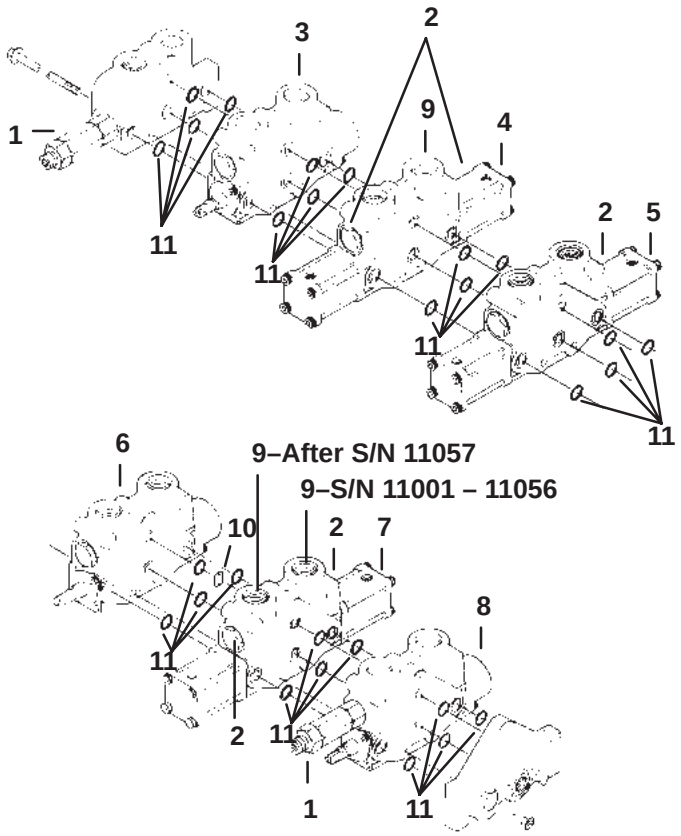


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Parts Identification

CONTROL VALVE ASSEMBLY (6–Spool) (Cont'd)

1. Main Relief Valve
2. Port Relief Valve
3. R.H. Travel Section
4. Boom Section
5. Bucket Section
6. Auxiliary Section
7. Arm Section
8. L.H. Travel Section
9. Restrictor Location
10. Block Off Plate
11. O–rings



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HYDRAULIC CONTROL VALVE (6 Spool) (S/N 12999 & Below) (Cont'd)

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

Mark the valve sections for ease of assembly **[A]**.

Remove the nuts from the valve bolts **[A]**.

Put the valve assembly on its end and remove the end cover from the valve.

Remove the O–rings from the side face of the valve section **[B]**.

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

Remove the block off disc that is located between section 5 (auxiliary) and section 6 (arm) **[C]**.

See the following pages for the disassembly and assembly of the individual valve sections.

Assembly

Clean the side faces of the valve sections and the O–ring glands of any contamination.

Put grease on the O–rings and install the O–rings into the O–ring glands **[B]**.

Install the three bolts through the end cover and put the end cover on its end, with the O–rings facing up.

Install all the valve sections onto the end cover in the order as marked during disassembly.

NOTE: Make sure that the O–rings are correctly seated in the O–ring glands before installing the sections.

Install the block off disc between section 5 (auxiliary) and section 6 (arm) **[C]**.

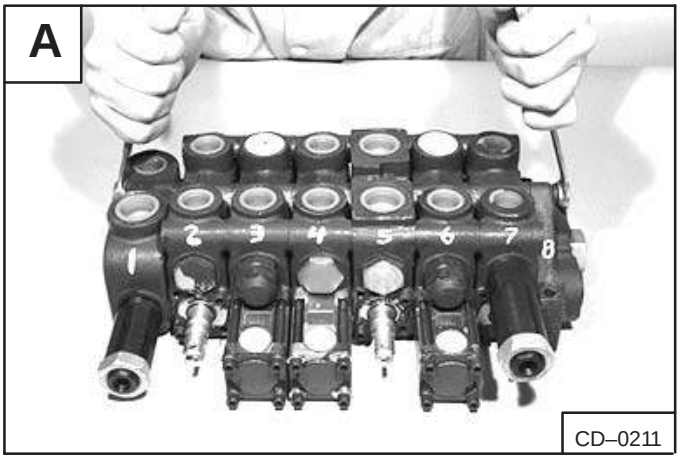
Install the nuts onto the bolts, finger tight.

Set the valve assembly on a flat surface and evenly tighten the nuts to 32 ft.–lbs. (43 Nm) torque **[D]**.

After the nuts are correctly tightened, check the exposed spools to make sure that they move freely in and out of the valve sections.

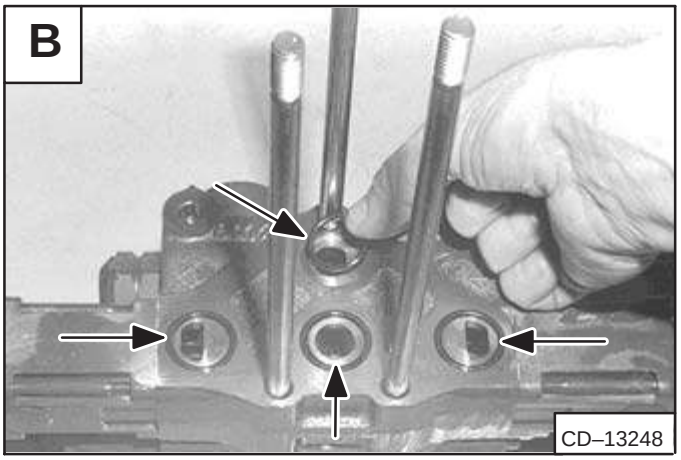
NOTE: If the nuts are not tightened correctly, the spools may not move easily in the housings. Loosen the nuts and retighten.

A



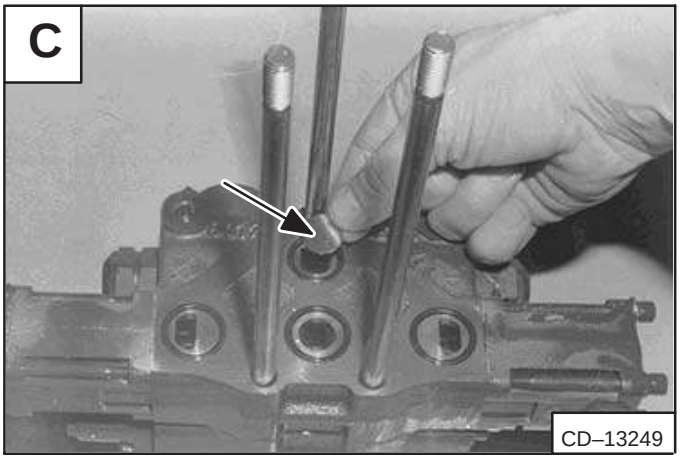
CD–0211

B



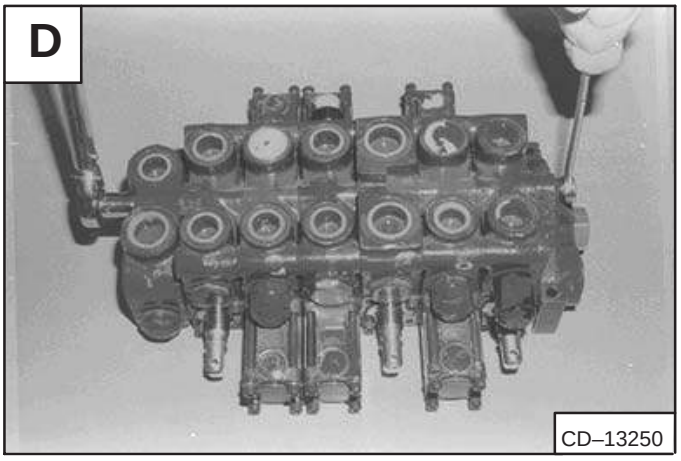
CD–13248

C



CD–13249

D



CD–13250

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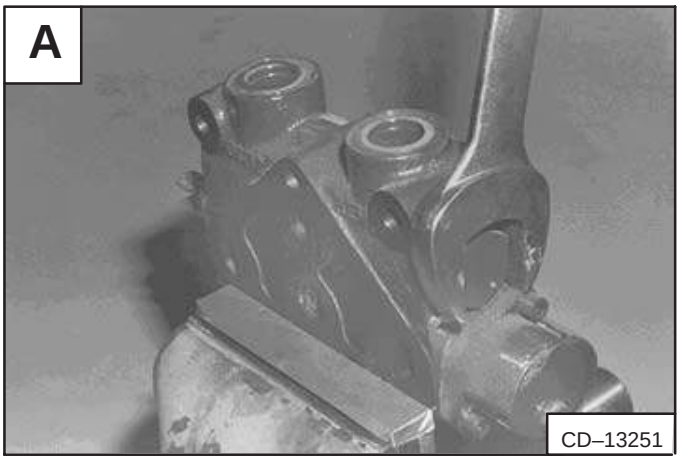
HYDRAULIC CONTROL VALVE (6–Spool) (S/N 12999 & Below) (Cont'd)

Right Hand Travel Section Disassembly and Assembly

Clamp the valve section in a vise with protective jaws **[A]**.

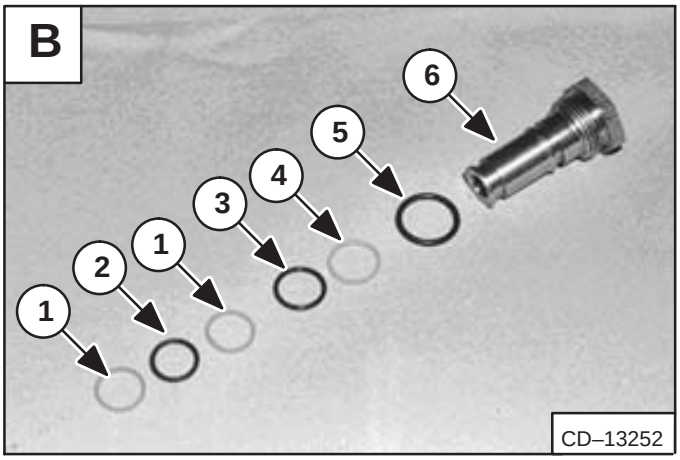
Remove the load check plug from the valve section **[A]**.

Assembly: Tighten the load check plug to 20 ft.–lbs. (28 Nm) torque.



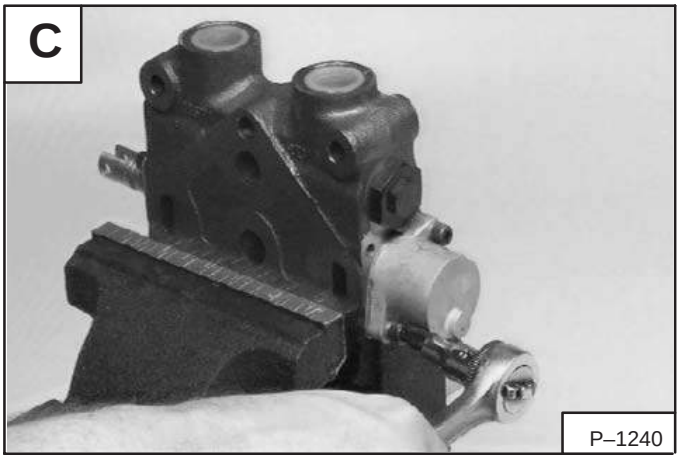
Remove the back–up rings (Item 1) **[B]**, O–ring (Item 2) **[B]**, O–ring (Item 3) **[B]**, back–up ring (Item 4) **[B]** and the O–ring (Item 5) **[B]** from the load check plug (Item 6) **[B]**.

Assembly:The back–up rings can become hard and brittle in dry air conditions. For ease of installing the back–up rings, it is recommended to remove them from the seal kit and put them and a few drops of water into a sealed plastic bag. Leave them in the bag overnight, this will soften the back–up rings and make them easier to install. If time will not permit this, the back–up rings can be put in hot water and allowed to soften for approximately one hour before installation.



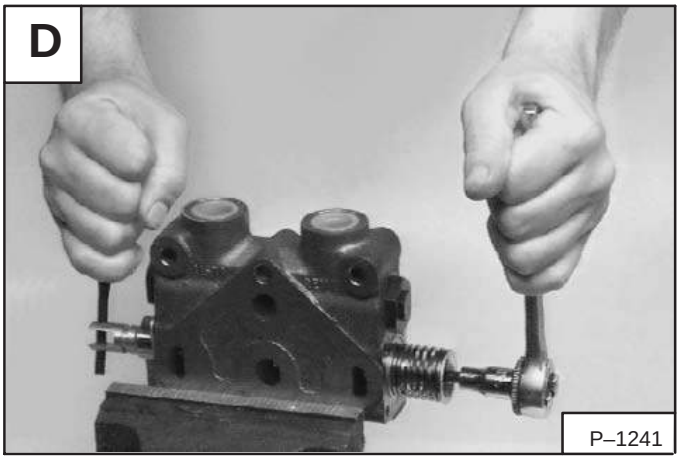
Remove the two (2) bolts and lockwashers and the positioner cover from the valve **[C]**.

Assembly: Tighten the bolts to 10 ft.–lbs. (14 Nm) torque.



Install a rod through the hole in the spool clevis and loosen the spring retainer bolt **[D]**.

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



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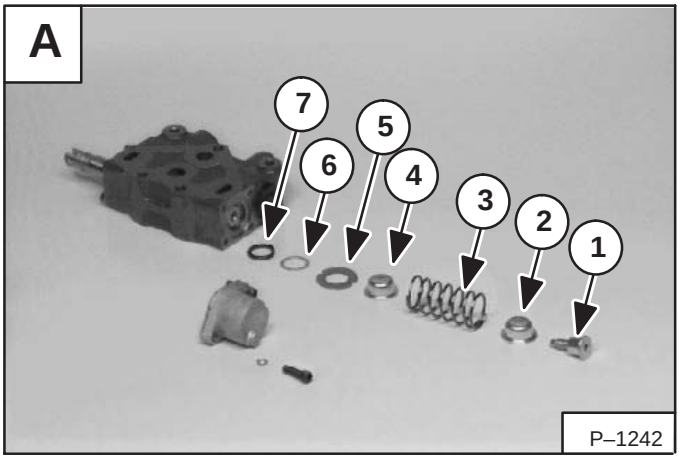
HYDRAULIC CONTROL VALVE (6–Spool) (S/N 12999 & Below) (Cont'd)

Right Hand Travel Section Disassembly and Assembly (Cont'd)

Remove the bolt (Item 1) **[A]**, spring retainer (Item 2) **[A]**, spring (Item 3) **[A]**, spring retainer (Item 4) **[A]**, retainer (Item 5) **[A]**, spool wiper (Item 6) **[A]** and the spool seal (Item 7) **[A]** from the valve.

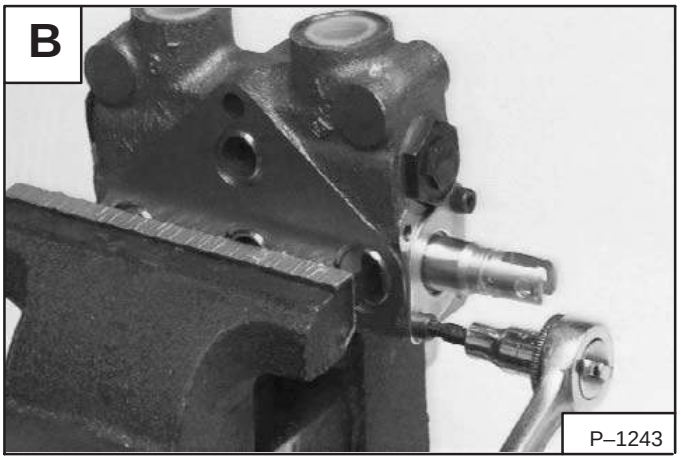
Assembly: Tighten the bolt (Item 1) **[A]** to 10 ft.–lbs. (13 Nm) torque.

NOTE: For ease of removal of the retainer (Item 5) [A], spool wiper (Item 6) [A] and the spool seal (Item 7) [A], push the spool into the valve housing until the spool end is at the inside edge of the spool seal. DO NOT scratch the spool surfaces with any type of tool during seal removal.



Loosen the two (2) bolts from the spool seal cover plate **[B]**.

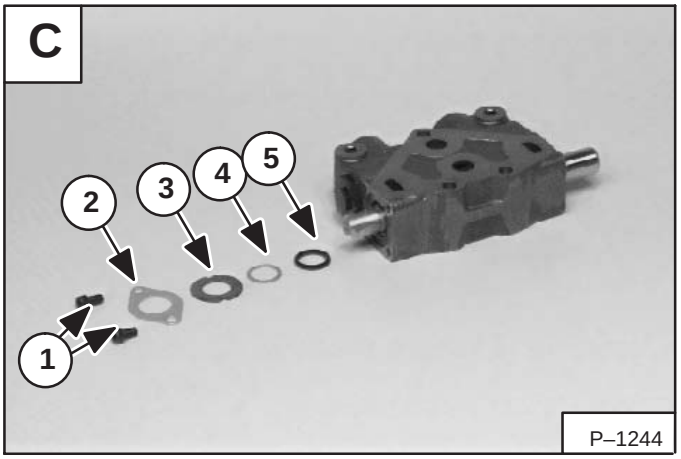
Assembly: Tighten the bolts to 10 ft.–lbs. (13 Nm) torque.



Remove the bolts (Item 1) **[C]**, coverplate (Item 2) **[C]**, retainer (Item 3) **[C]**, spool wiper (Item 4) **[C]** and the spool seal (Item 5) **[C]** from the valve.

NOTE: For ease of removal of the retainer (Item 3) [C], spool wiper (Item 4) [C] and the spool seal (Item 5) [C], push the spool into the valve until the tapered section of the spool is at the inside edge of the spool seal. DO NOT scratch the spool surface with any type of tool during seal removal.

NOTE: The spool and the valve housing are not available separately, they are a matched set. It is not necessary to remove the spool from the housing unless contamination is found in the valve. If the spool is removed, use extreme care not to scratch the spool surface and do not intermix the spool and the housing.



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HYDRAULIC CONTROL VALVE (6–Spool) (S/N 12999 & Below) (Cont'd)

Right Hand Travel Section Disassembly and Assembly (Cont'd)

Spool Wiper and Spool Seal Installation;

NOTE: Spool seal installation tool (MEL1421) is available from OTC Tool and is necessary for correct spool seal installation.

Clean the valve housing seal gland of any contamination.

Put clean oil on the clevis end of the spool surface.

Install the spool seal into the tool, with the open end of the seal facing out **[A]**. Be sure the seal is completely inside the tool.

Put oil on the inner diameter of the seal.

Carefully push the tool (with the spool seal installed) over the end of the spool and into the counterbore of the valve housing **[A]**.

Hold the tool tight against the valve housing and hit the end of the tool with the palm of the hand, driving the seal into the spool seal gland.

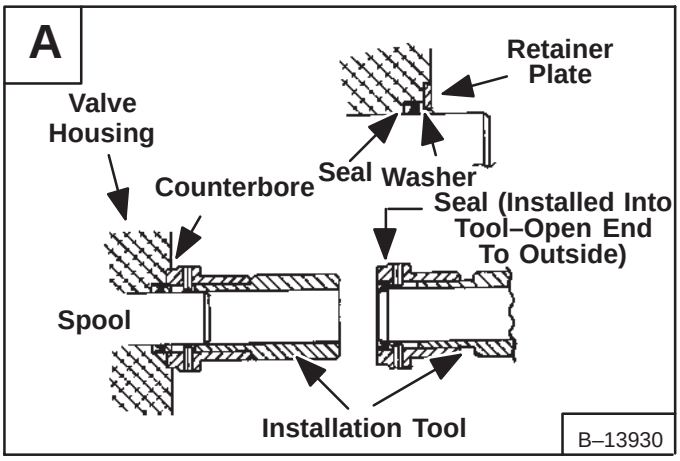
Remove the tool and inspect the spool seal to make sure that the seal is not rolled or twisted.

Put oil on the spool wiper and put it onto the end of the spool with the wiper lip facing out. Put the retainer plate over the wiper lip and push the wiper and retainer plate onto the spool until the retainer plate is flush into the counter bore of the valve housing.

Install the cover plate and bolts.

Repeat this procedure for the positioner end of the spool.

Install the positioner components in reverse order from which they were removed.



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HYDRAULIC CONTROL VALVE (6–Spool) (S/N 12999 & Below) (Cont'd)

Boom, Bucket and Arm Section Disassembly and Assembly

Clamp the valve section in a vise with protective jaws **[A]**.

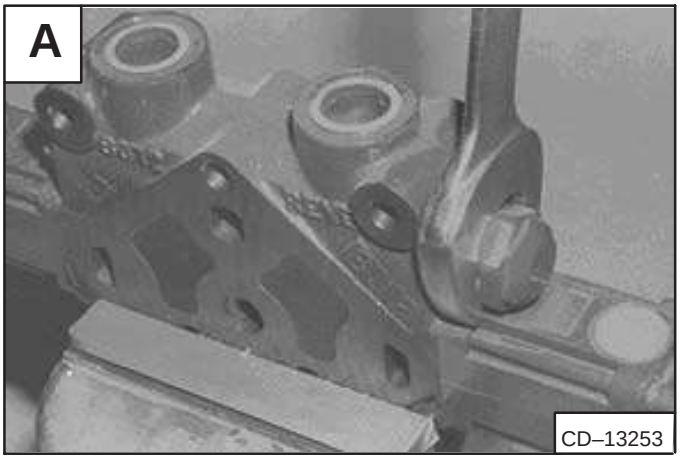
Remove the relief valve assembly from the valve section (For Boom, Bucket and Arm) and/or the load check plug assembly (for bucket only) **[A]**.

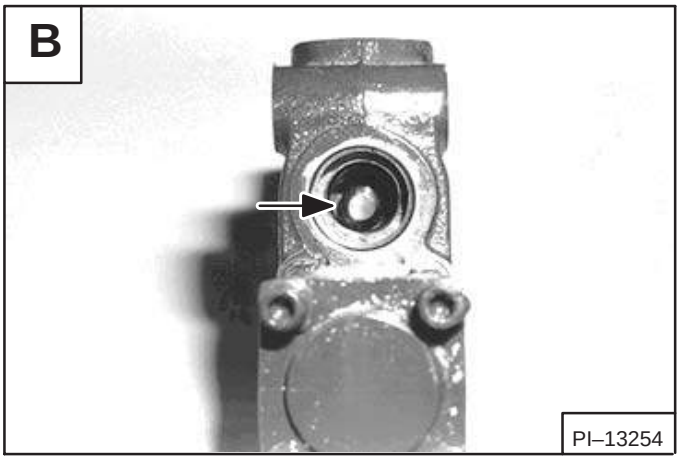
NOTE: Do Not intermix the relief valve assemblies that are of different pressure settings. Mark the end of the valve section and the relief valve to make sure it is installed into the same end of the valve section.

Assembly: Tighten the relief valve and/or the load check plug assembly to 20 ft.–lbs. (27 Nm) torque.

Remove the poppet retainer, spring and the poppet from the relief valve cavity in the end of the valve section **[B]**.

NOTE: Use care when removing the spring, the spring can drop into the spool gland.





Clamp the relief valve into a vise with protective jaws and loosen the end plug **[C]**.

Assembly: Tighten the relief valve plug to 14 ft.–lbs. (19 Nm) torque.

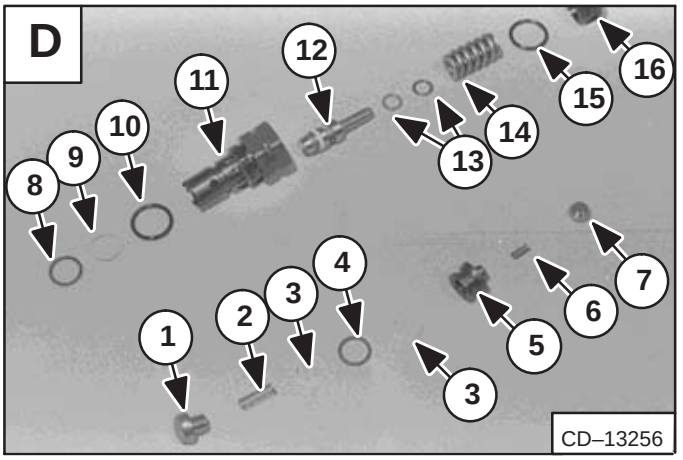
Assembly: Use a heavy weight grease to keep the poppets and springs in position during assembly.



Remove the poppet (Item 1) **[D]**, spring (Item 2) **[D]**, back–up rings (Item 3) **[D]**, O–ring (Item 4) **[D]**, poppet retainer (Item 5) **[D]**, spring (Item 6) **[D]**, poppet (Item 7) **[D]**, O–ring (Item 8) **[D]**, back–up ring (Item 9) **[D]**, O–ring (Item 10) **[D]**, relief housing (Item 11) **[D]**, relief poppet (Item 12) **[D]**, shims (Item 13) **[D]**, spring (Item 14) **[D]**, O–ring (Item 15) **[D]** and end plug (Item 16) **[D]**.

NOTE: Check the poppets (Item 1, 7 & 12) [D] for surface wear and indentations. If the poppet wear is excessive, order a new relief valve assembly from Melroe Parts Operations. The seal on the relief poppet (Item 12) [D] is not available separately. If the seal is damaged, order a new relief valve assembly.

Assembly: The back–up rings can become hard and brittle in dry air conditions. For ease of installing the back–up rings, it is recommended to remove them from the seal kit and put them and a few drops of water into a sealed plastic bag. Leave them in the bag overnight, this will soften the back–up rings and make them easier to install for ease of installation. If time will not permit this, the back–up rings can be put in hot water and allowed to soften for approximately one hour before installation.



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HYDRAULIC CONTROL VALVE (6–Spool) (S/N 12999 & Below) (Cont'd)

Boom, Bucket and Arm Section Disassembly and Assembly (Cont'd)

Load check plug assembly

Remove the poppet (Item 1) **[A]**, spring (Item 2) **[A]**, back–up washer (Item 3) **[A]**, O–ring (Item 4) **[A]**, O–ring (Item 5) **[A]**, back–up washer (Item 6) **[A],** O–ring (Item 7) **[A]** from the load check plug.

NOTE: Check the poppet (Item 1) [A] for surface wear and indentations. If the poppet wear is excessive, order a new load check relief valve assembly from Melroe Parts Operation.

Assembly: The back–up rings can become hard and brittle in dry air conditions. For ease of installing the back–up rings, it is recommended to remove them from the seal kit and put them and a few drops of water into a sealed plastic bag. Leave them in the bag overnight, this will soften the back–up rings and make them easier to install. If time will not permit this, the back–up rings can be put in hot water and allowed to soften for approximately one hour before installation.

Clamp the valve section in a vise with protective jaws **[B]**.

Loosen the four bolts from the positioner cover **[B]**.

Assembly: Tighten the bolts to 4–6 ft.–lbs. (6–8 Nm) torque.

Remove the bolts (Item 1) **[C]**, lockwashers (Item 2) **[C]**, washers (Item 3) **[C]**, positioner cover (Item 4) **[C]** and seal (Item 5) **[C]** from the valve section.

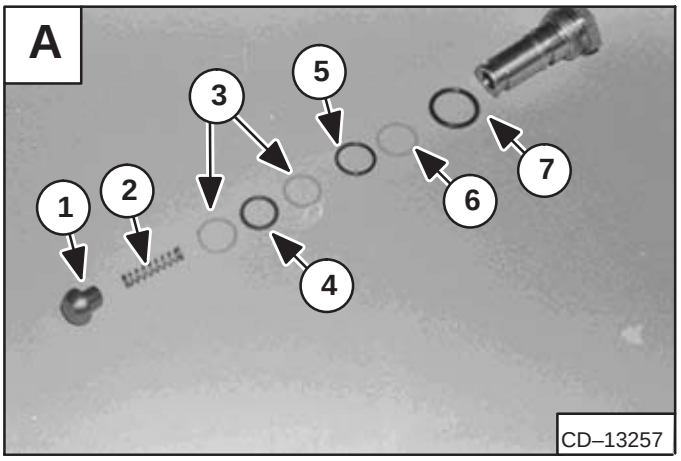
Remove the four bolts, lockwashers, washers and the positioner cover from the opposite end of the valve section.

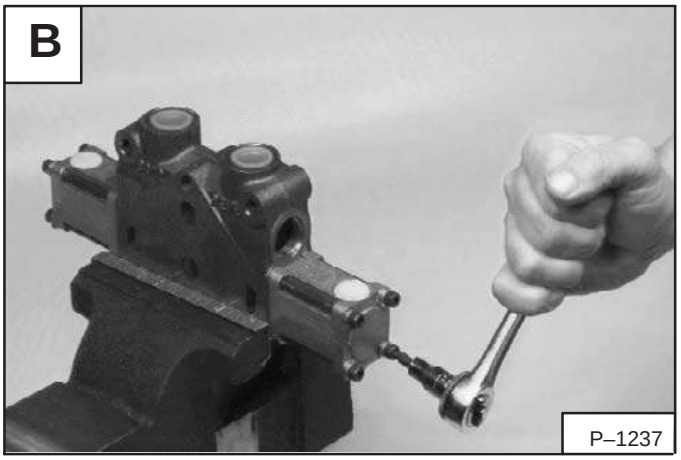
Assembly: Tighten the bolts to 4–6 ft.–lbs. (6–8 Nm) torque.

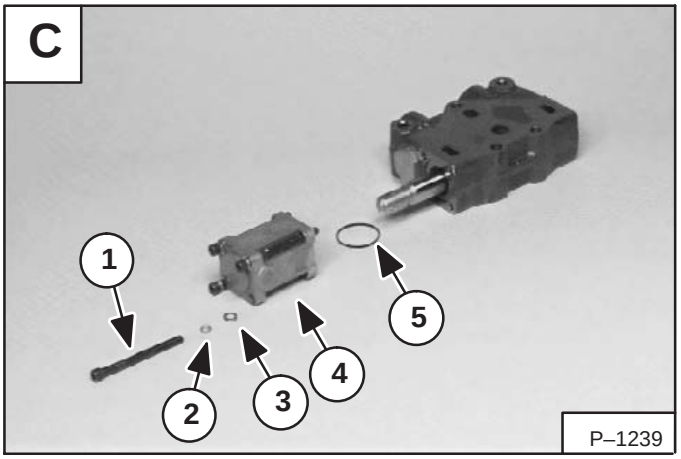
Install a rod through the clevis end of the spool and loosen the bolt in the opposite end of the spool **[D]**.

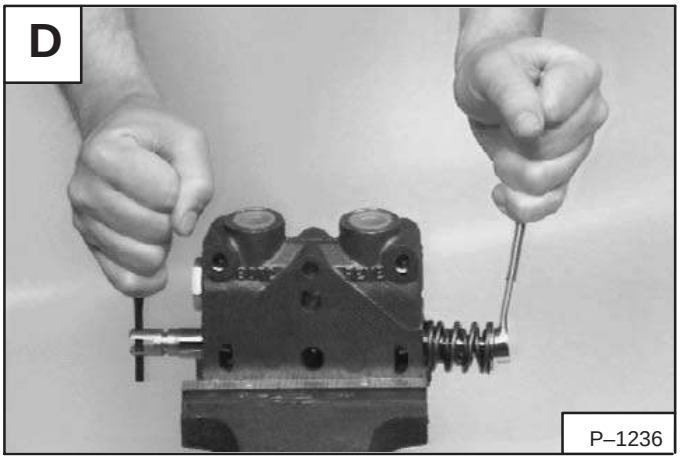
Do Not grip the spool with any type of tool.

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









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HYDRAULIC CONTROL VALVE (6–Spool) (S/N 12999 & Below) (Cont'd)

Boom, Bucket and Arm Section Disassembly and Assembly (Cont'd)

Remove the bolt (Item 1) **[A]**, washer (Item 2) **[A]**, spacer (Item 3) **[A]**, spring (Item 4) **[A]**, spring (Item 5) **[A]**, spring retainer (Item 6) **[A]** and the seal (Item 7) **[A]** from the valve section.

Assembly: Put LOCTITE #272 on the threads of the bolt (Item 1) **[A]** and tighten the bolt to 10–12 ft.–lbs. (14–16 Nm) torque.

Check the seal cavity in the valve housing for contamination and clean as necessary.

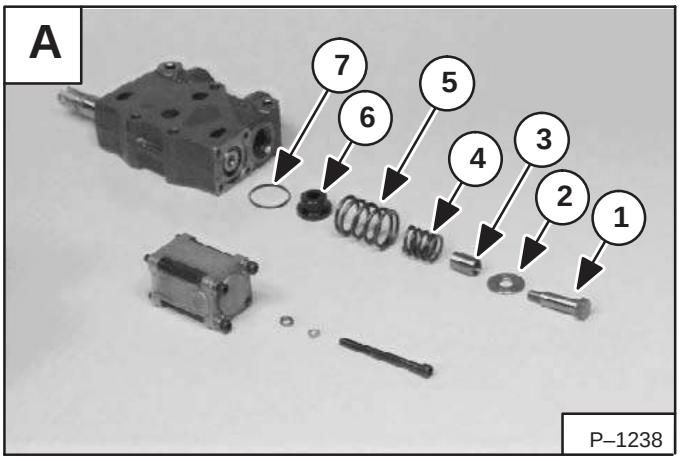
NOTE: The spool and the valve housing are not available separately, they are a matched set. It is not necessary to remove the spool from the housing unless contamination is found in the valve. If the spool is removed, use extreme care not to scratch the spool surface and do not intermix the spool and housing.

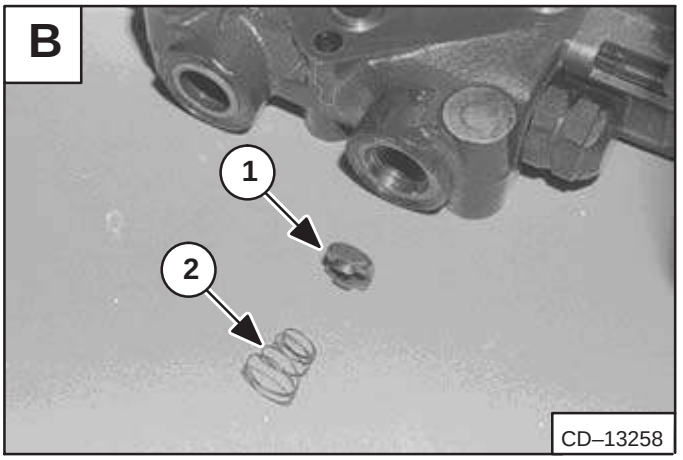
Clean the valve housing seal cavities of any contamination.

Put oil on the seals and assemble in reverse order.

The boom and arm assembly use a one way restrictor (Item 1) **[B]** and spring (Item 2) **[B]** installed in the B port (rear port) of the valve section.

Check the restrictor orifice (0.125 inch) for contamination and install.





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HYDRAULIC CONTROL VALVE (6–Spool) (S/N 12999 & Below) (Cont'd)

Auxiliary Section Disassembly and Assembly

Remove the bolt (Item 1) **[A]**, spring retainer (Item 2) **[A]**, spring (Item 3) **[A]**, spring retainer (Item 4) **[A]**, retainer (Item 5) **[A]**, spool wiper (Item 6) **[A]** and the spool seal (Item 7) **[A]** from the valve.

Assembly: Tighten the bolt (Item 1) **[A]** to 10 ft.–lbs. (13Nm) torque.

NOTE: For ease of removal of the retainer (Item 5) [A], spool wiper (Item 6) [A] and the spool seal (Item 7) [A], push the spool into the valve housing until the spool end is to the inside edge of the seal. Do Not scratch the spool surfaces with any type of tool during seal removal.

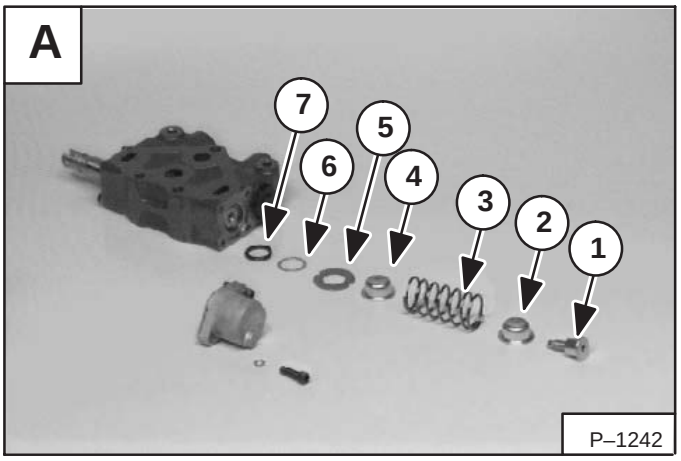
Loosen the two (2) bolts from the spool seal cover plate **[B]**.

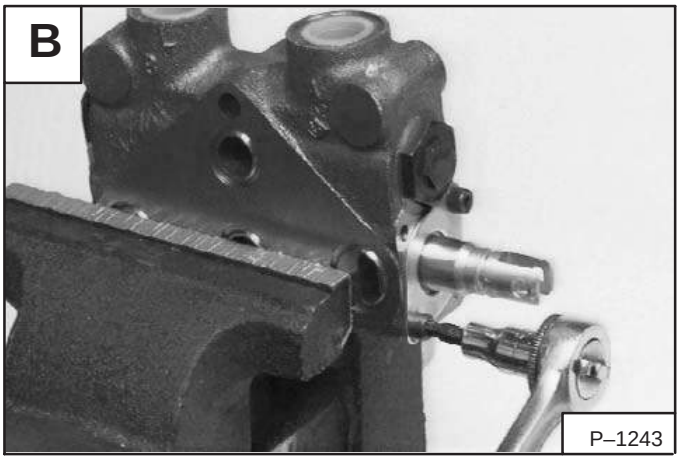
Assembly: Tighten the bolts to 10 ft.–lbs. (13 Nm) torque.

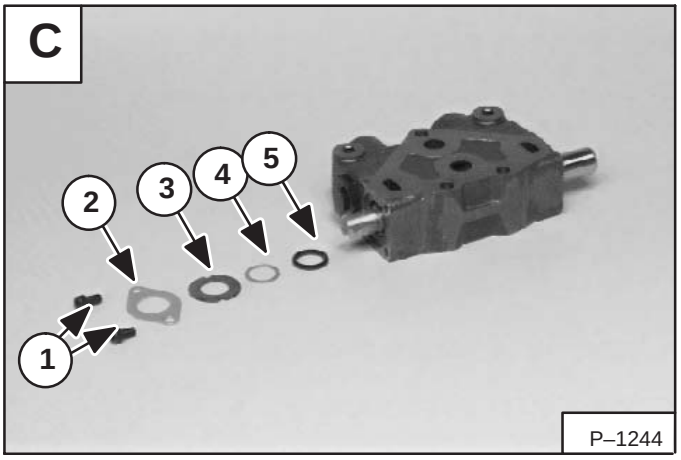
Remove the bolts (Item 1) **[C]**, cover plate (Item 2) **[C]**, retainer (Item 3) **[C]**, spool wiper (Item 4) **[C]** and the spool seal (Item 5) **[C]** from the valve.

NOTE: For ease of removal of the retainer (Item 3) [C], spool wiper (Item 4) [C] and the spool seal (Item 5) [C], push the spool into the valve until the tapered section of the spool is at the inside edge of the seal. Do Not scratch the spool surface with any type of tool during seal removal.

NOTE: The spool and the valve housing are not available separately, they are a matched set. It is not necessary to remove the spool from the housing unless contamination is found in the valve, If the spool is removed, use extreme care not to scratch the spool surface and do not intermix the spool and the housing.







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HYDRAULIC CONTROL VALVE (6–Spool) (S/N 12999 & Below) (Cont'd)

Auxiliary Section Disassembly and Assembly (Cont'd)

Spool Seal and Spool Wiper Installation

NOTE: Spool seal installation tool (MEL1421) is available from OTC Tool and is necessary for correct spool seal installation.

Clean the valve housing seal gland of any contamination.

Put clean oil on the clevis end of the spool surface.

Install the spool seal into the tool, with the open end of the seal facing out **[D]**. Be sure the seal is completely inside the tool.

Put oil on the inner diameter of the seal.

Carefully push the tool (with the spool seal installed) over the end of the spool and into the counterbore of the valve housing **[D]**. Hold the tool tight against the valve housing and hit the end of the tool with the palm of the hand, driving the seal into the spool seal gland.

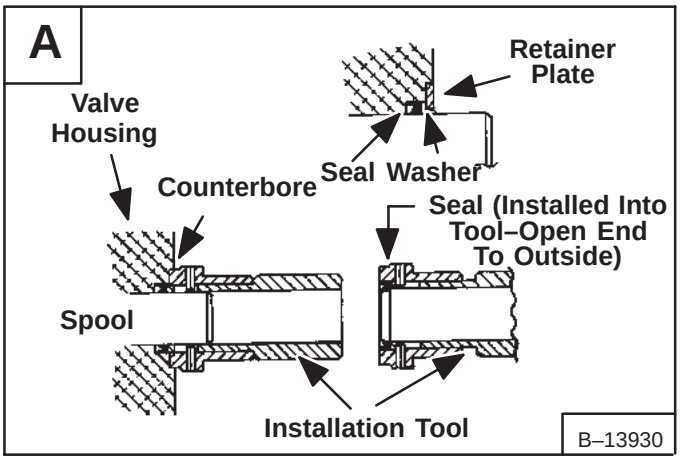
Remove the tool and inspect the spool seal to make sure that the seal is not rolled or twisted.

Put oil on the spool wiper and put it onto the end of the spool with the wiper lip facing out. Put the retainer plate over the wiper lip and push the wiper and retainer plate onto the spool until the retainer plate is flush into the counter bore of the valve housing.

Install the cover plate and bolts.

Repeat this procedure for the positioner end of the spool.

Install the positioner components in reverse order from which they were removed.



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HYDRAULIC CONTROL VALVE (6–Spool) (S/N 12999 & Below) (Cont'd)

Left Hand Travel Section Disassembly and Assembly

Clamp the valve section in a vise with protective jaws **[A]**.

Remove the relief valve from the spool end of the valve section and/or the load check plug from the positioner end of the valve section **[A]**.

Assembly: Tighten the relief valve and/or the load check plug to 20 ft.–lbs. (27 Nm) torque.

Clamp the relief valve into a vise with protective jaws and loosen the end plug **[B]**.

Assembly: Tighten the relief valve plug to 14 ft.–lbs. (19 Nm) torque.

Remove the back–up rings (Item 1) **[C]**, O–ring (Item 2) **[C]**, O–ring (Item 3) **[C]**, back–up ring (Item 4) **[C]**, O–ring (Item 5) **[C]**, relief housing (Item 6) **[C]**, relief poppet (Item 7) **[C]**, shims (Item 8) **[C]**, spring (Item 9) **[C]**, O– ring (Item 10) **[C]**, back–up ring (Item 11) **[C]**, O–ring (Item 12) **[C]**, piston (Item 13) **[C]**, O–ring (Item 14) **[C]**, back–up ring (Item 15) **[C]**, adjusting screw (Item 16) **[C]** and the jam nut (Item 17) **[C]**.

NOTE: Check the relief poppet (Item 7) [C] for surface wear and indentation. If damage is found, order a new relief valve assembly from Melroe Parts Operations. The seal on the relief poppet (Item 7) [C] is not available separately. If the seal is damaged, order a new relief valve assembly from Melroe parts.

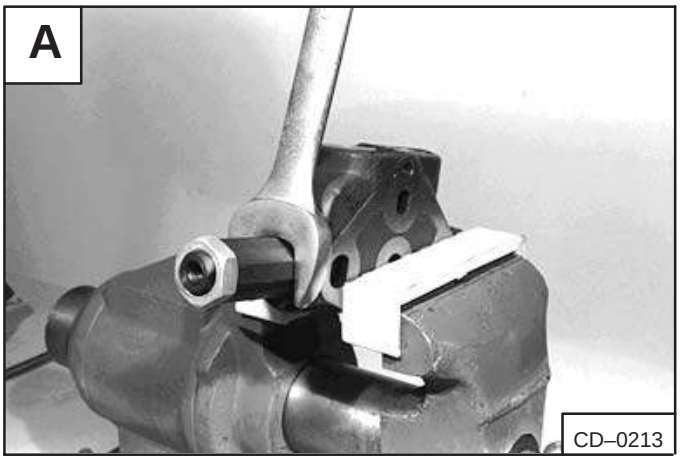
Assembly: The back–up rings can become hard and brittle in dry air conditions. For ease of installing the back–up rings, it is recommended to remove them from the seal kit and put them and a few drops of water into a sealed plastic bag. Leave them in the bag overnight, this will soften the back–up rings and make them easier to install. If time will not permit this, the back–up rings can be put in hot water and allowed to soften for approximately one hour before installation.

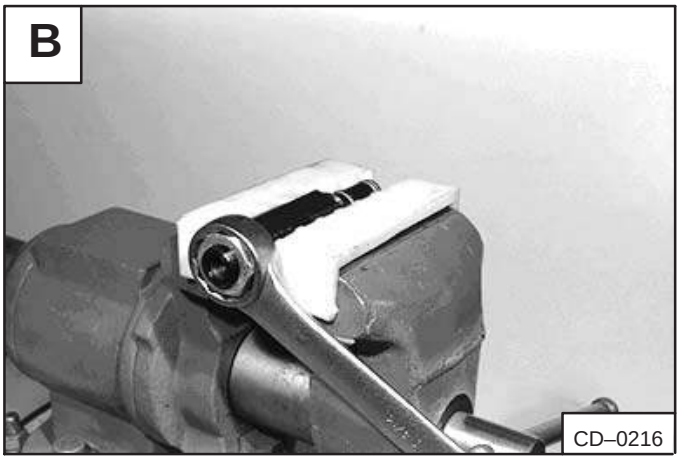
NOTE: The relief valve pressure setting must be checked and/or readjusted after the valve assembly has been reassembled. See Page 2–11 for information on testing and setting the relief pressure.

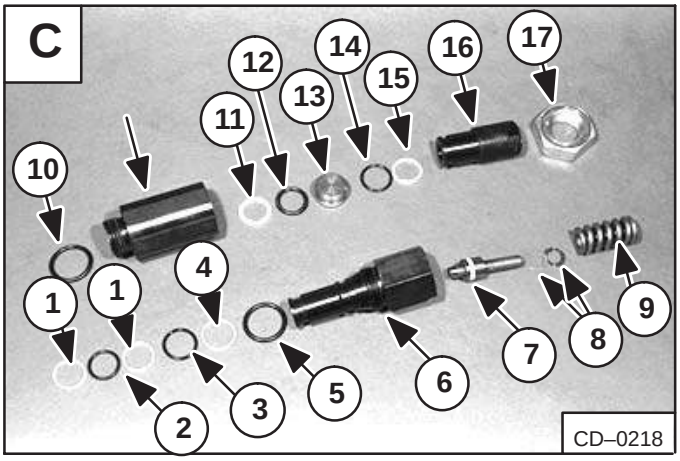
From the load check plug, remove the poppet (Item 1) **[D]**, spring (Item 2) **[D]**, back–up washer (Item 3) **[D]**, O–ring (Item 4) **[D]**, O–ring (Item 5) **[D]**, back–up washer (Item 6) **[D]**, O–ring (Item 7) **[D]** from the check plug housing (Item 8) **[D]**.

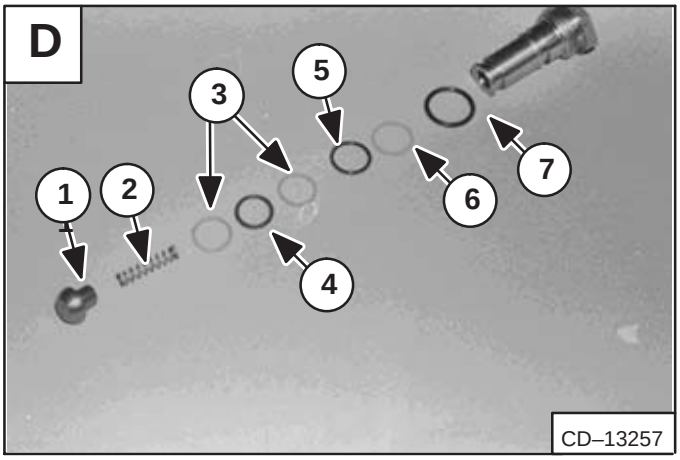
Assembly: Use a heavy grease on the poppet and spring to hold in correct position during assembly.

NOTE: Check the poppet (Item 1) [D] for surface wear and indentations. If damage is found, order a new load check plug assembly from Melroe Parts Operations.









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HYDRAULIC CONTROL VALVE (6–Spool) (S/N 12999 & Below) (Cont'd)

Left Hand Travel Section Disassembly and Assembly (Cont'd)

Clamp the valve section in a vise with protective jaws.

Remove the two (2) bolts (Item 1) **[A]**, lockwashers (Item 2) **[A]**, and the positioner cover (Item 3) **[A]**.

Assembly: Tighten the bolts to 10 ft.–lbs. (13 Nm) torque.

Install a rod through the hole in the spool clevis and remove the spring retainer bolt (Item 4) **[A]**, spring retainer (Item 5) **[A]**, spring (Item 6) **[A]**, spring retainer (Item 7) **[A]**, retainer (Item 8) **[A]**, spool wiper (Item 9) **[A]** and the spool seal (Item 10) **[A]**.

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

Assembly: Tighten the bolt (Item 4) to 10 ft.–lbs. (13 Nm) torque.

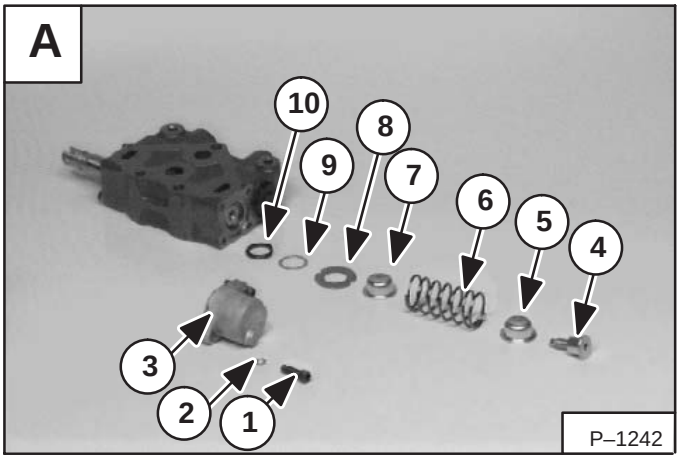
NOTE: For ease of removal of the retainer (Item 8) [A], spool wiper (Item 9) [A] and the spool seal (Item 10) [A], push the spool into the valve housing until the spool end is at the inside edge of the seal. Do Not scratch the spool surface with any type of tool during seal removal.

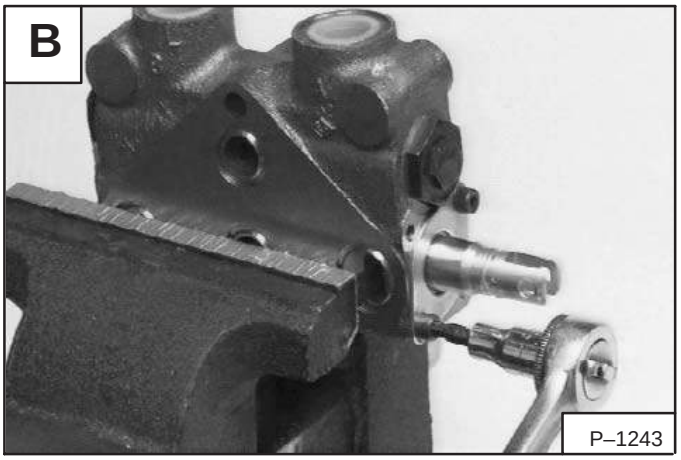
Loosen the two (2) bolts from the spool seal coverplate **[B]**.

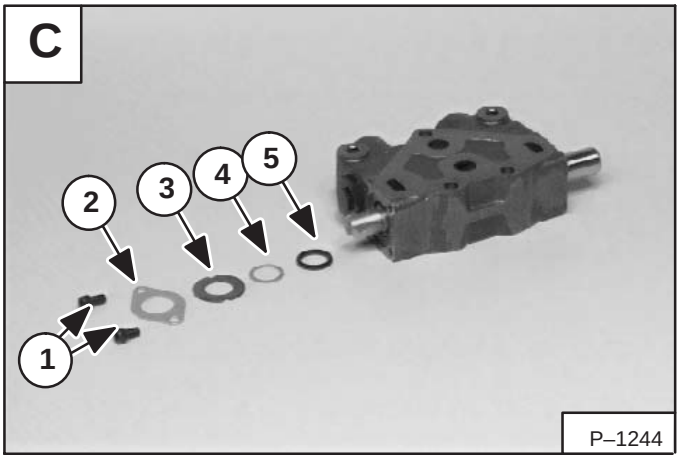
Assembly: Tighten the bolt to 10 ft.–lbs. (13 Nm) torque. Remove the bolts (Item 1) **[C]**, cover plate (Item 2) **[C]**, retainer (Item 3) **[C]** spool wiper (Item 4) **[C]** and the spool seal (Item 5) **[C]** from the valve.

NOTE: The spool and the valve housing are not available separately, they are a matched set. It is not necessary to remove the spool from the housing unless contamination is found in the valve. If the spool is removed, use extreme care not to scratch the spool surface and do not intermix the spool and the housing.

NOTE: The spool and the valve housing are not available separately, they are a matched set. It is not necessary to remove the spool from the housing unless contamination is found in the valve. If the spool is removed, use extreme care not to scratch the spool surface and do not intermix the spool and the housing.







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HYDRAULIC CONTROL VALVE (6–Spool) (S/N 12999 & Below) (Cont'd)

Left Hand Travel Section Disassembly and Assembly (Cont'd)

Spool Seal and Spool Wiper Installation

NOTE: Spool seal installation tool (MEL1421) is available from OTC Tool and is necessary for correct spool seal installation.

Clean the valve housing seal gland of any contamination.

Put clean oil on the clevis end of the spool surface.

Install the spool seal into the tool, with the open end of the seal facing out **[D]**. Be sure the seal is completely inside the tool.

Put oil on the inner diameter of the seal.

Carefully push the tool (with the spool seal installed) over the end of the spool and into the counterbore of the valve housing **[D]**. Hold the tool tight against the valve housing and hit the end of the tool with the palm of the hand, driving the seal into the spool seal gland.

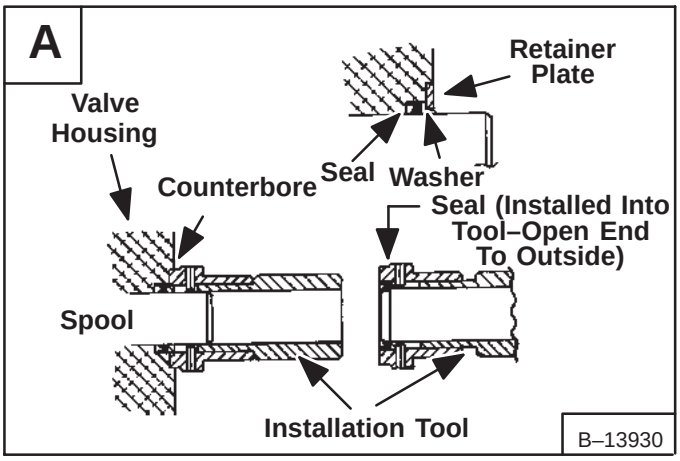
Remove the tool and inspect the spool seal to make sure that the seal is not rolled or twisted.

Put oil on the spool wiper and put it onto the end of the spool with the wiper lip facing out. Put the retainer plate over the wiper lip and push the wiper and retainer plate onto the spool until the retainer plate is flush into the counter bore of the valve housing.

Install the cover plate and bolts.

Repeat this procedure for the positioner end of the spool.

Install the positioner components in reverse order from which they were removed.



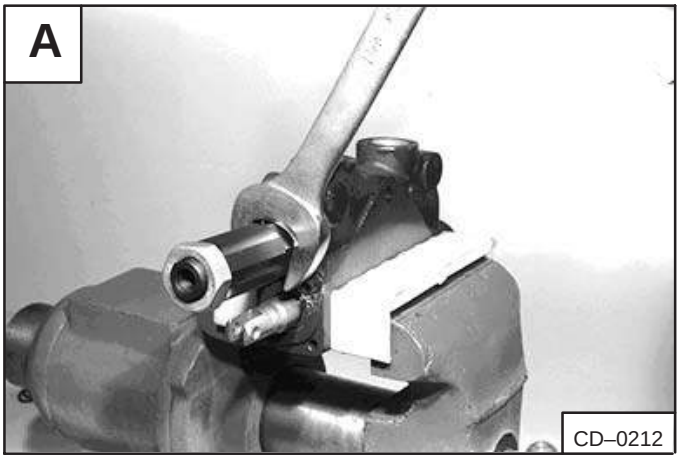
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HYDRAULIC CONTROL VALVE (6–Spool) (S/N 12999 & Below) (Cont'd)

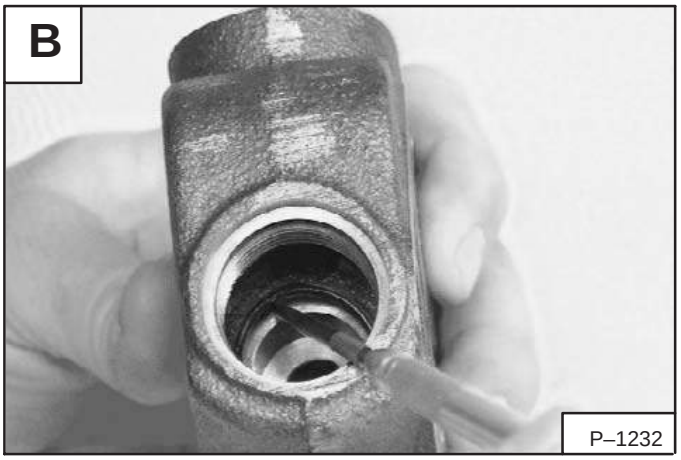
End Cover Disassembly and Assembly

Clamp the end cover in a vise with protective jaws **[A]**.

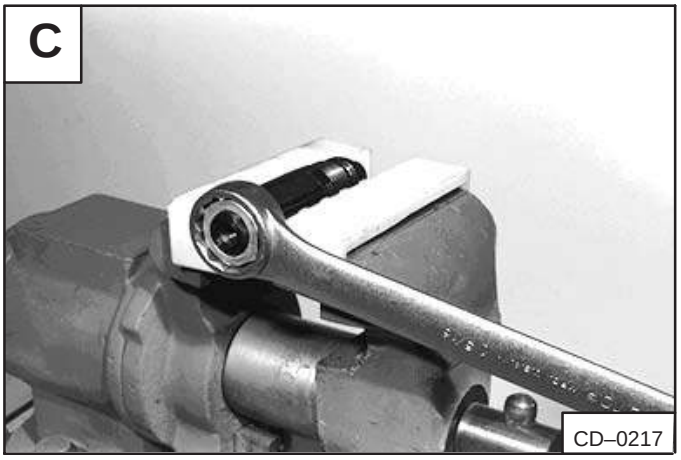
Remove the relief valve from the end cover **[A]**.



The relief valve quad ring usually remains inside the end cover cavity when the relief valve is removed. Remove the quad ring from the end cover **[B]**.



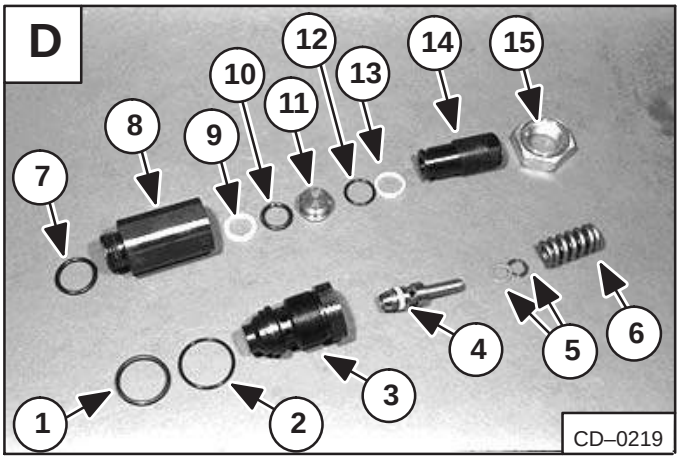
Clamp the relief valve housing in a vise and loosen the end plug **[C]**.



Remove the quad ring (Item 1) **[D]**, O–ring (Item 2) **[D]**, relief housing (Item 3) **[D]**, poppet assembly (Item 4) **[D]**, shims (Item 5) **[D]**, spring (Item 6) **[D]**, O–ring (Item 7) **[D]**, housing (Item 8) **[D]**, back–up ring (Item 9) **[D]**, O–ring (Item 10) **[D]**, piston (Item 11) **[D]**, O–ring (Item 12) **[D]**, back–up ring (Item 13) **[D]**, adjusting screw (Item 14) **[D]**, and the jam nut (Item 15) **[D]**.

NOTE: The poppet (Item 4) [D] has an O–ring and a back–up ring which are not available separately If these components are damaged, order a new relief valve assembly from Melroe Parts Operations.

NOTE: NOTE:The relief valve pressure setting must be checked and/or readjusted after the valve assembly has been reassembled. See Page 2–13 for information on testing and setting the relief pressure.



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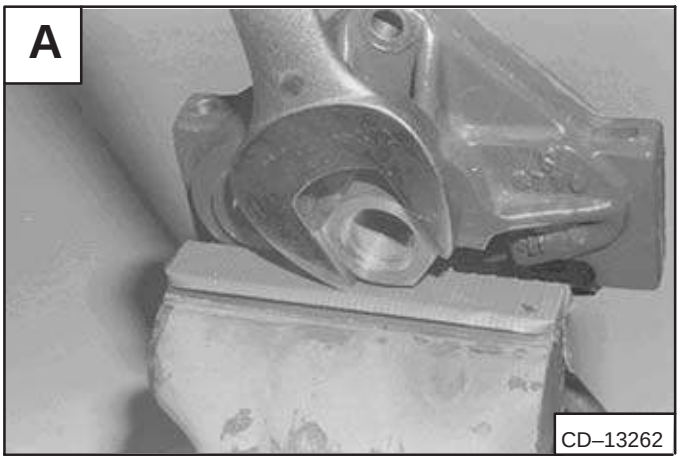
HYDRAULIC CONTROL VALVE (6–Spool) (S/N 12999 & Below) (Cont'd)

End Cover Disassembly and Assembly (Cont'd)

Clamp the end cover in a vise with protective jaws **[A]**.

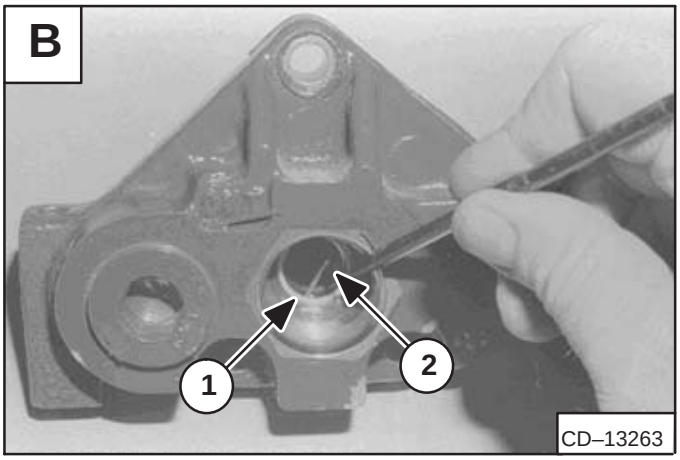
Remove the power beyond sleeve from the end cover **[A]**.

Assembly: Tighten the power beyond sleeve to 20 ft.–lbs. (27 Nm) torque.

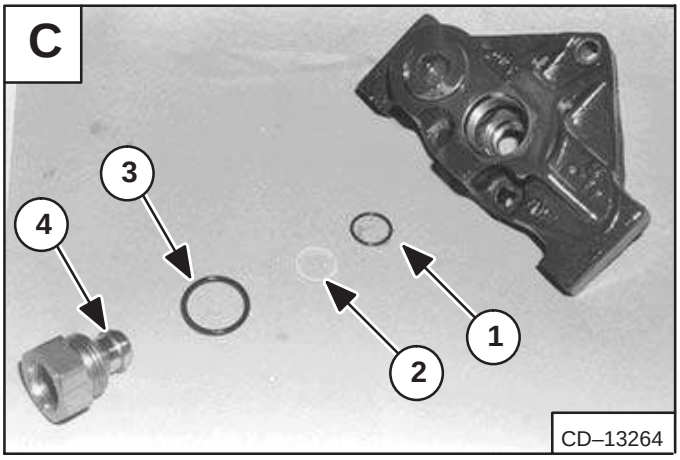


Remove the back–up ring (Item 1) **[B]** & **[C]** and the O–ring (Item 2) **[B]** & **[C]** from the end cover cavity.

NOTE: These parts remain inside the end cover housing when the power beyond sleeve is removed.



Remove the O–ring (Item 1) **[C]**, back–up washer (Item 2) **[C]**, O–ring (Item 3) **[C]** from the power beyond sleeve (Item 4) **[C]**.



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HYDRAULIC CONTROL VALVE (3–Spool) (S/N 12999 & Below)

Description

The 3–spool control valve contains two valves, a 2450–2500 PSI (16893–17238 kPa) main Relief valve and a 200 PSI Pressure Build–up valve.

The 200 PSI build–up is used for charging the accumulator.

After engine start–up, the pressure builds in the system to charge an accumulator and at 200 PSI (1379 kPa) the Pressure Build–up valve opens and allows excess oil to return to tank.

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 floormat. (See Page 4–1.)

Remove the floor plate. (See Page 4–1.)

Remove the control lever mounting plate. (See Page 3–1.)

Mark all hoses for correct installation.

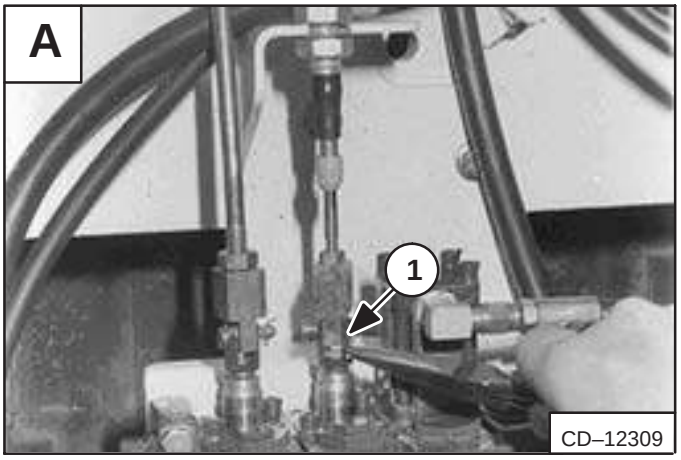
Remove the cotter pin (Item 1) **[A]** and linkage pin from both spools.

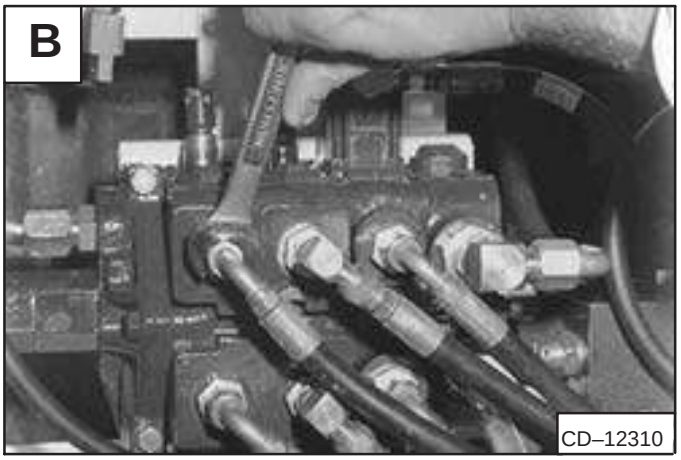
Remove the hoses from the control valve **[B]**.

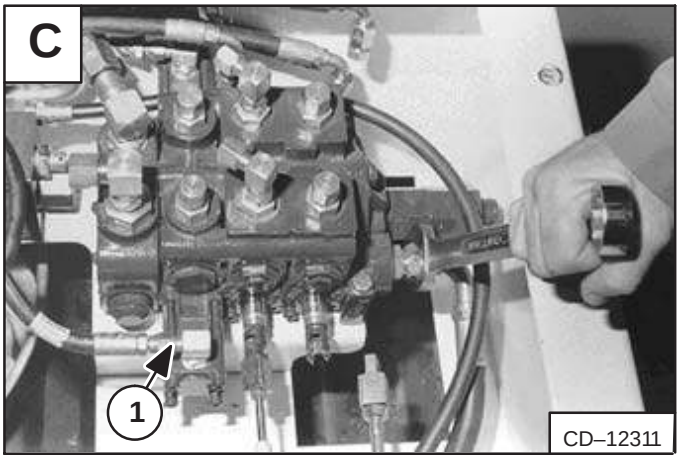
Remove the joystick control hoses (Item 1) **[C]** and inlet and outlet hoses from the control valve.

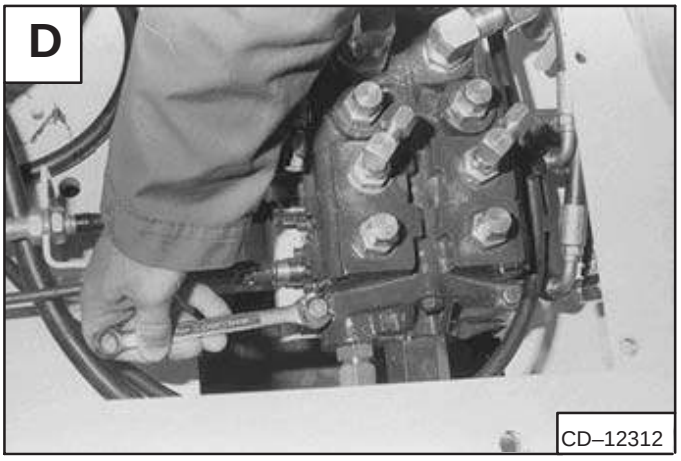
Remove the three mounting bolts from the control valve **[D]**.

Remove the control valve.







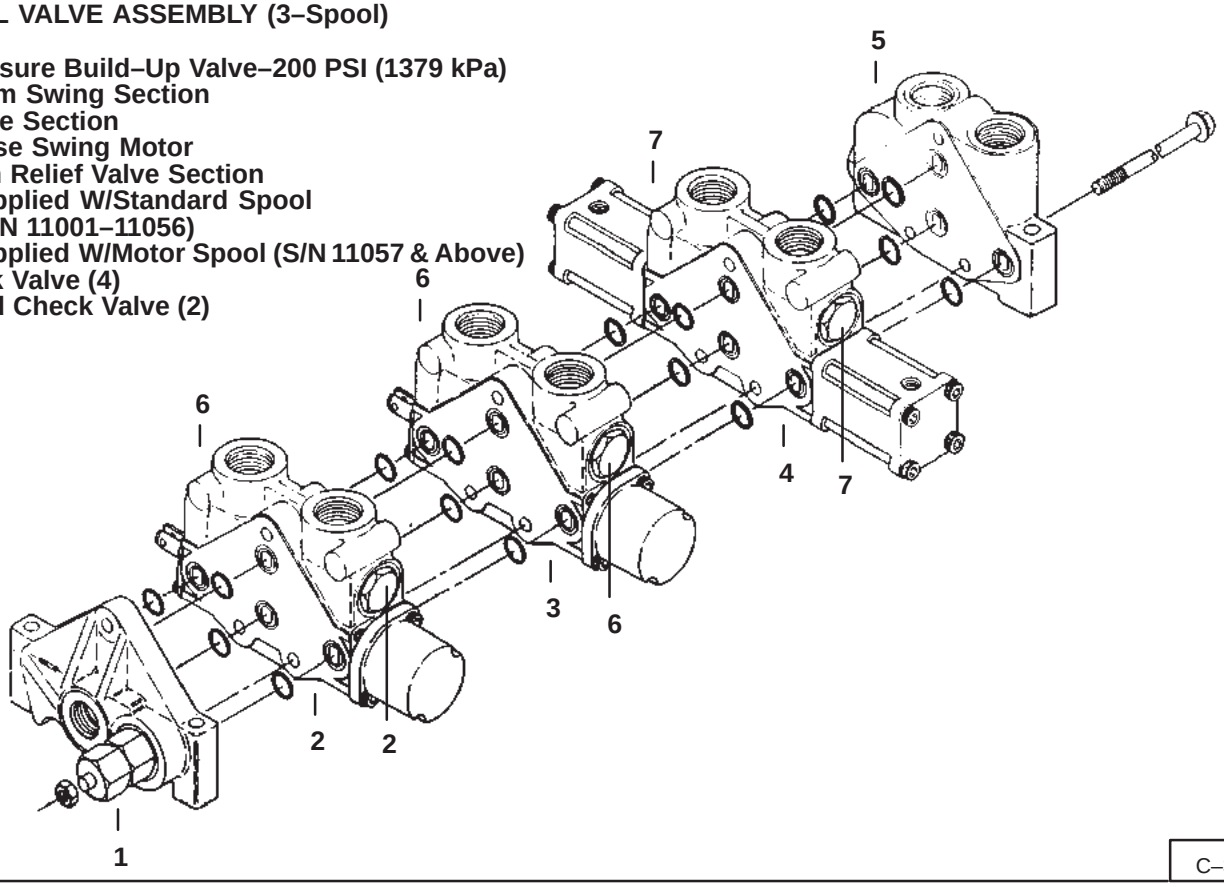


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Parts Identification

CONTROL VALVE ASSEMBLY (3–Spool)

1. Pressure Build–Up Valve–200 PSI (1379 kPa)
2. Boom Swing Section
3. Blade Section
4. House Swing Motor
5. Main Relief Valve Section
   Supplied W/Standard Spool (S/N 11001–11056)
   Supplied W/Motor Spool (S/N 11057 & Above)
6. Lock Valve (4)
7. Load Check Valve (2)



C–3295

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HYDRAULIC CONTROL VALVE (3–Spool) (S/N 12999 & Below) (Cont'd)

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

Mark the valve sections for ease of assembly **[A]**.

Remove the nuts from the valve bolts **[A]**.

Put the valve assembly on its end and remove the end cover from the valve bolts **[B]**.

Remove the O–rings from the side face of the valve section **[C]**.

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

Remove the remaining valve section and O–rings.

See the following pages for the disassembly and assembly of the individual valve sections.

Assembly

Clean the side faces of the valve sections and the O–ring glands of any contamination.

Put grease on the O–rings and install the O–rings into the O–ring glands.

Install the three bolts through the end cover and put the end cover on its end, with the O–rings facing up.

Install all the valve sections onto the end cover in the order as marked during disassembly.

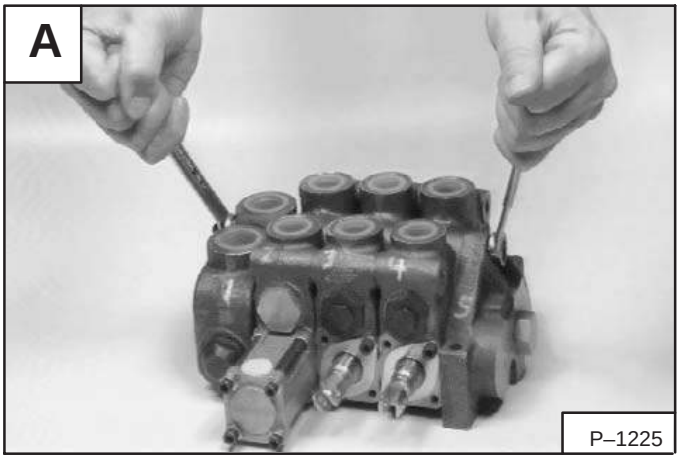
NOTE: Make sure that the O–rings are correctly seated in the O–ring glands before installing the sections.

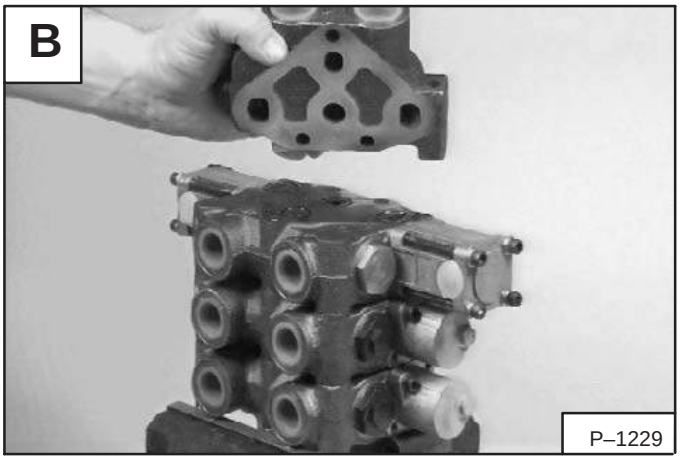
Install the nuts onto the through bolts fingertight.

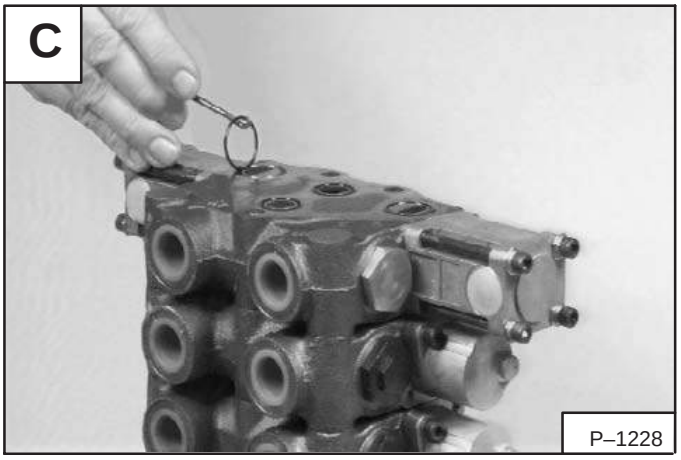
Set the valve assembly on a flat surface and evenly tighten the nuts to 32 ft.–lbs. (43 Nm) torque **[D]**.

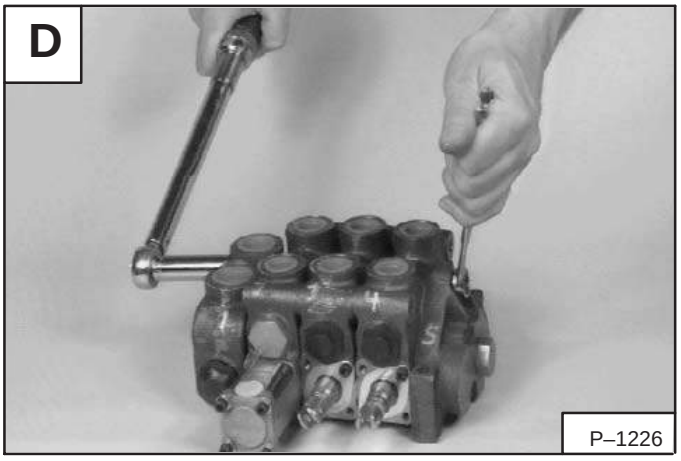
After the nuts are tightened to the correct torque, check the exposed spools to make sure that they move freely in and out of the valve sections.

NOTE: If the nuts are not tightened correctly, the spools may not move easily in the housings. Loosen the nuts and retorque.









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HYDRAULIC CONTROL VALVE (3–Spool) (S/N 12999 & Below) (Cont'd)

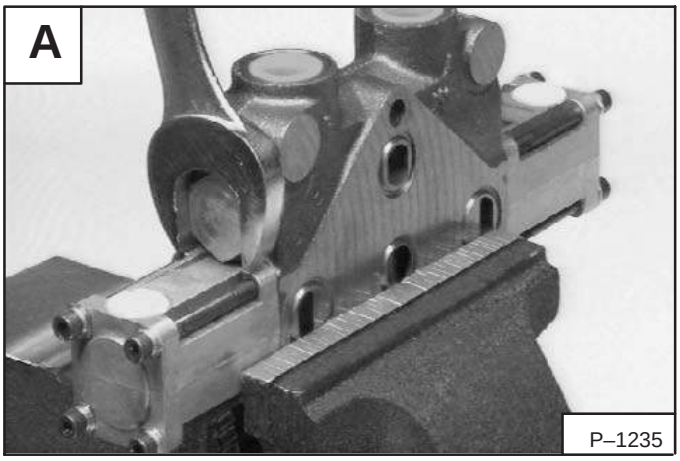
Housing Swing Section Disassembly and Assembly

Clamp the valve section in a vise with protective jaws **[A]**.

Remove the load check plug from the valve section **[A]**.

Assembly: Tighten the load check plug to 20 ft.–lbs. (27 Nm) torque.

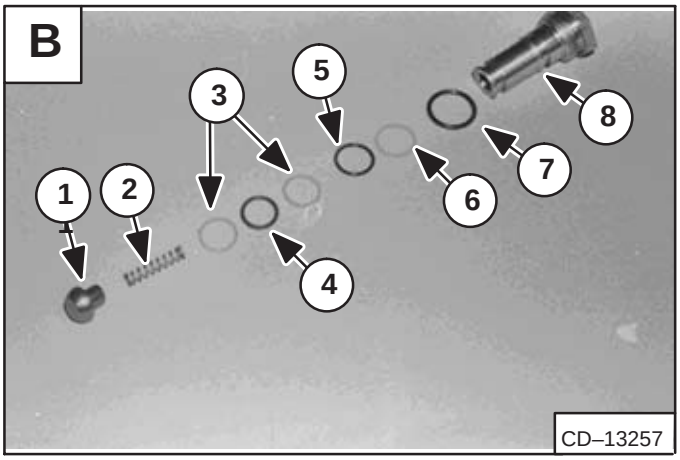
Assembly: Use a heavy grease on the poppet and spring to hold in correct position during assembly.



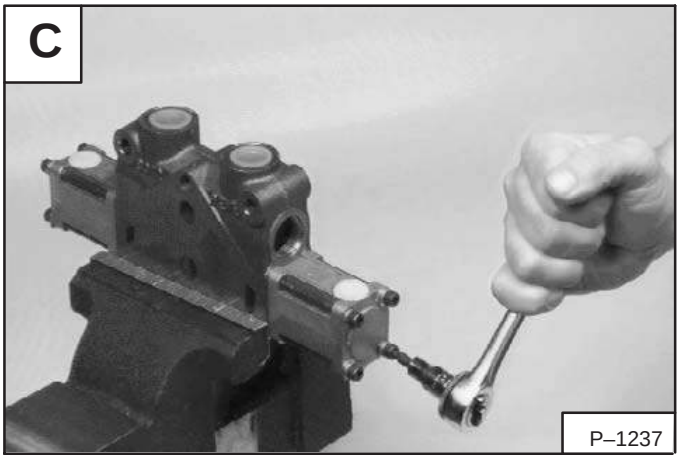
Remove the poppet (Item 1) **[B]**, spring (Item 2) **[B]**, back–up washer (Item 3) **[B]**, O–ring (Item 4) **[B]**, O–ring (Item 5) **[B]**, back–up washer (Item 6) **[B]** and O–ring (Item 7) **[B]** from the load check plug (Item 8) **[B]**.

NOTE: Check the poppet (Item 1) [B] for surface wear and indentation. If the poppet wear is excessive, order a complete load check plug assembly from Melroe Parts Operations.

Assembly: The back–up rings can become hard and brittle in dry air conditions. For ease of installing the back–up rings, it is recommended to remove them from the seal kit and put them and a few drops of water into a sealed plastic bag. Leave them in the bag overnight, this will soften the back–up rings and make them easier to install. If time will not permit this, the back–up rings can be put in hot water and allowed to soften for approximately one hour before installation.



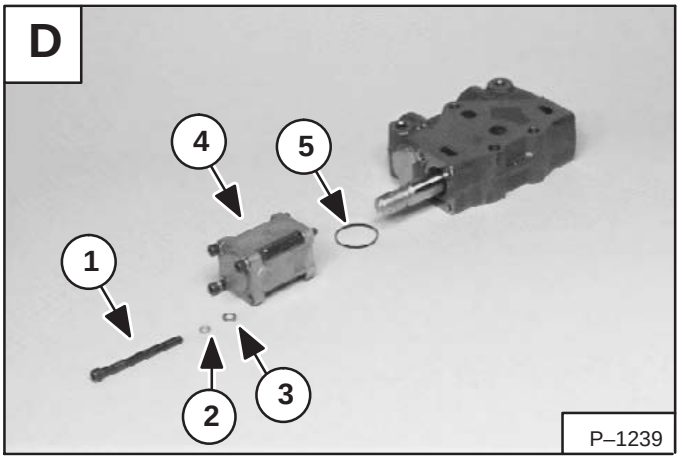
Loosen the four (4) bolts from the positioner cover **[C]**.



Remove the bolts (Item 1) **[D]**, lock washers (Item 2) **[D]**, washers (Item 3) **[D]**, positioner cover (Item 4) **[D]** and seal (Item 5) **[D]** from the valve.

Remove the four bolts, lockwashers, washers and the position cover from the opposite end of the valve section.

Assembly: Tighten the bolts to 4–6 ft.–lbs. (6–8 Nm) torque.



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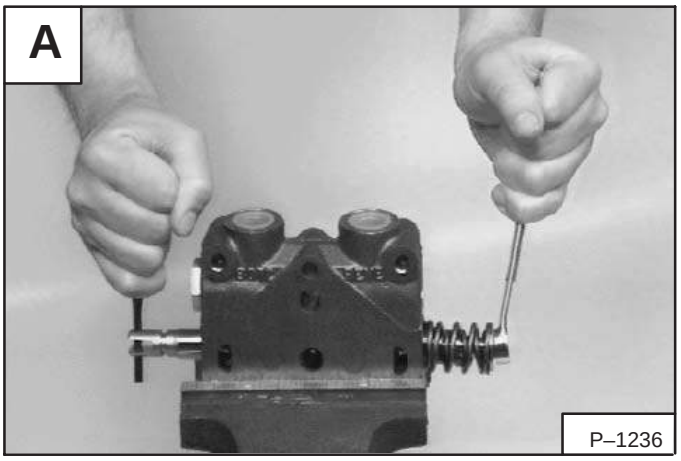
HYDRAULIC CONTROL VALVE (3–Spool) (S/N 12999 & Below) (Cont'd)

Housing Swing Section Disassembly and Assembly (Cont'd)

Install a rod through the clevis end of the spool and loosen the bolt in the opposite end of the spool **[A]**.

Do Not grip the spool with any type of tool.

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



Remove the bolt (Item 1) **[B]**, washer (Item 2) **[B]**, spacer (Item 3) **[B]**, spring (Item 4) **[B]**, spring (Item 5) **[B]** spring retainer (Item 6) **[B]** and the seal (Item 7) **[B]** from the valve section.

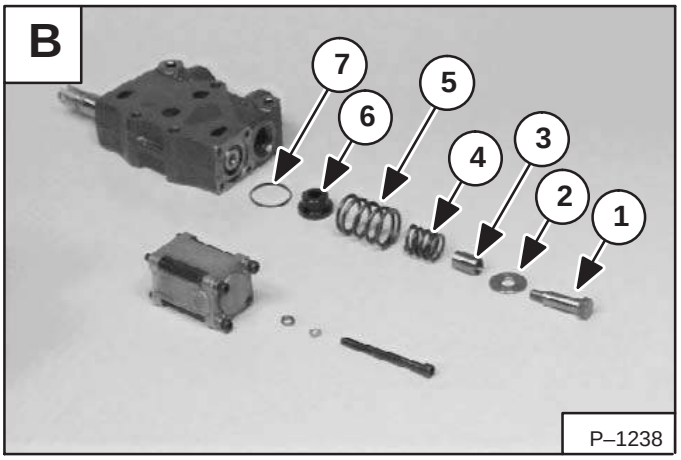
Assembly: Put LOCTITE #242 on the threads of the bolt (Item 1) **[B]** and tighten the bolts to 10–12 ft.–lbs. (14–16 Nm) torque.

Check the seal cavity in the valve housing for contamination and clean as necessary.

NOTE: The spool and the valve housing are not available separately, they are a matched set. It is not necessary to remove the spool from the housing unless contamination is found in the valve. If the spool is removed, use extreme care not to scratch the spool surface and do not intermix the spool and housings.

Clean the valve housing seal cavities of any contamination.

Put oil on the seals and assemble in reverse order.



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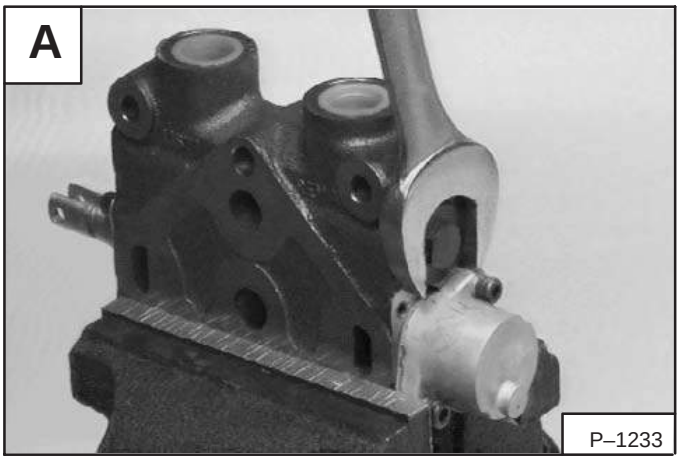
HYDRAULIC CONTROL VALVE (3–Spool) (S/N 12999 & Below) (Cont'd)

Blade and Boom Swing Section Disassembly and Assembly

Clamp the valve section in a vise with protective jaws **[A]**.

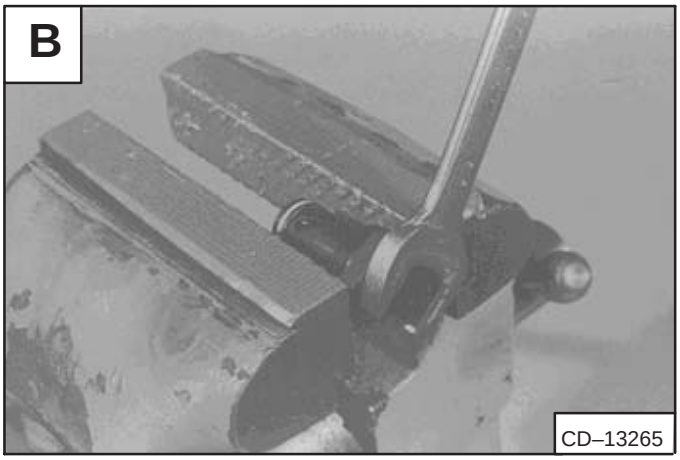
Remove the check valve assembly from the valve section **[A]**.

Assembly: Tighten the check valve assembly to 20 ft.–lbs. (28 Nm) torque.



Clamp the check valve in a vise with protective jaws and loosen the check valves **[B]**.

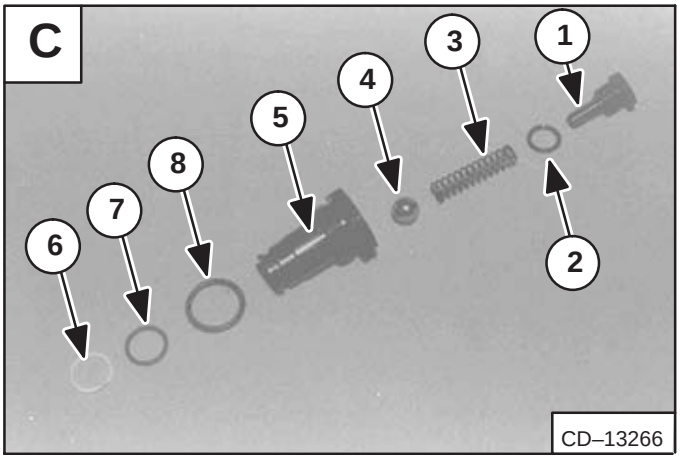
Assembly: Tighten the check valve to 14 ft.–lbs. (62 Nm) torque.



Remove the check valve (Item 1) **[C]**, O–ring (Item 2) **[C]**, spring (Item 3) **[C]** and ball (Item 4) **[C]** from the check valve plug (Item 5) **[C]**.

Remove the back–up ring (Item 6) **[C]**, O–ring (Item 7) **[C]** and the O– ring (Item 8) **[C]** from the check valve plug (Item 5) **[C]**.

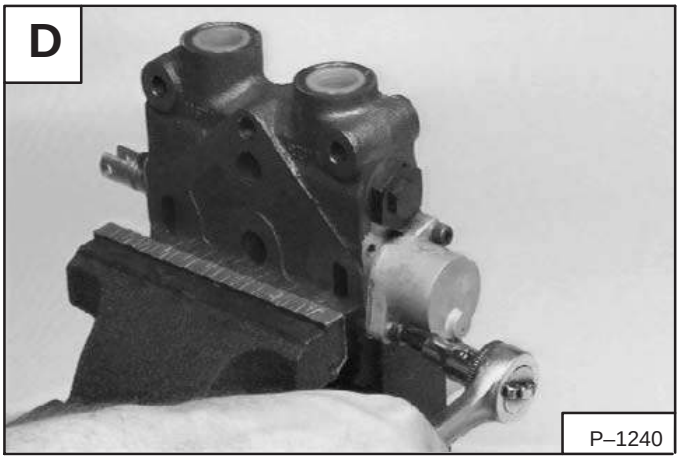
Clean and inspect all the parts. If any of the check valve assemblies parts are damaged, order a new check valve assembly from Melroe Parts Operation.



Assembly: The back–up rings can become hard and brittle in dry air conditions. For ease of installing the back–up rings, it is recommended to remove them from the seal kit and put them and a few drops of water into a sealed plastic bag. Leave them in the bag overnight, this will soften the back–up rings and make them easier to install. If time will not permit this, the back–up rings can be put in hot water and allowed to soften for approximately one hour before installation.

Remove two bolts and lockwashers and the positioner cover **[D]**.

Assembly: Tighten the bolts to 10 ft.–lbs. (14 Nm) torque.



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HYDRAULIC CONTROL VALVE (3–Spool) (S/N 12999 & Below) (Cont'd)

Blade and Boom Swing Section Disassembly and Assembly (Cont'd)

Install a rod through the hole in the spool clevis and loosen the spring retainer bolt.

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

Assembly: Tighten the bolt (Item 1) **[A]** to 10 ft.–lbs. (13 Nm) torque.

Remove the bolt (Item 1) **[A]**, spring retainer (Item 2) **[A]**, spring (Item 3) **[A]**, spring retainer (Item 4) **[A]**, retainer (Item 5) **[A]**, spool wiper (Item 6) **[A]**, and the spool seal (Item 7) **[A]** from the valve.

NOTE: For ease of removal of the retainer (Item 5) [A], spool wiper (Item 6) [A] and the spool seal (Item 7) [A], push the spool into the valve housing until the spool end is at the inside edge of the seal. Do Not scratch the spool surface with any type of tool during seal removal.

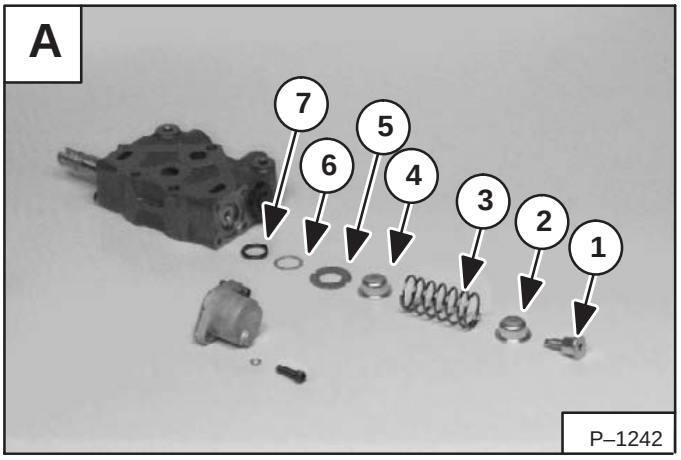
Loosen the two bolts from the spool seal cover plate **[B]**.

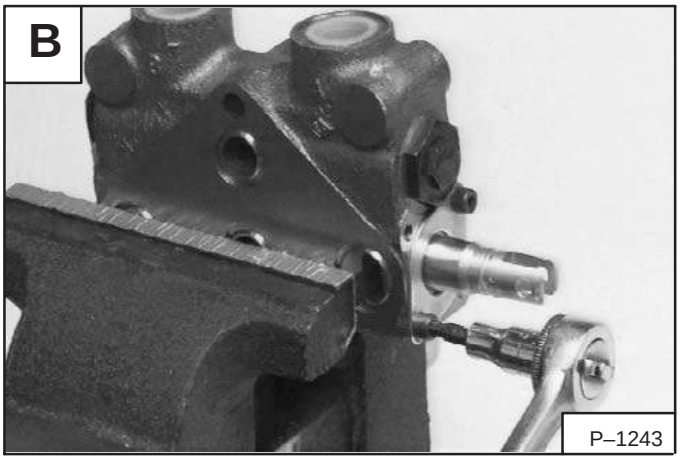
Assembly: Tighten the bolts to 10ft.–lbs. (13 Nm) torque.

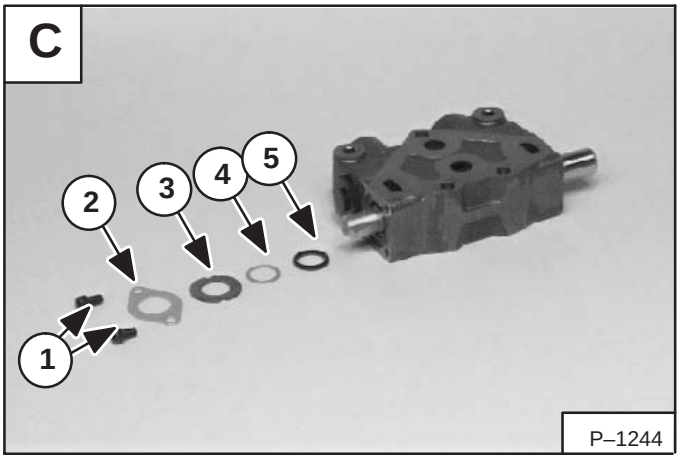
Remove the bolts (Item 1) **[C]**, cover plate (Item 2) **[C]**, retainer (Item 3) **[C]**, spool wiper (Item 4) **[C]** and the spool seal (Item 5) **[C]** from the valve.

NOTE: The spool and the valve housing are not available separately, they are a matched set. It is not necessary to remove the spool from the housing unless contamination is found in the valve. If the spool is removed, use extreme care not to scratch the spool surface and do not intermix the spool and the housing.

NOTE: For ease of removal of the retainer (Item 3) [C], spool wiper (Item 4) [C] and the spool seal (Item 5) [C], push the spool into the valve until the tapered section of the spool is at the inside edge of the seal. Do Not scratch the spool surface with any type of tool during seal removal.







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HYDRAULIC CONTROL VALVE (3–Spool) (S/N 12999 & Below) (Cont'd)

Blade and Boom Swing Section Disassembly and Assembly (Cont'd)

Spool Seal and Spool Wiper Installation.

NOTE: Spool seal installation tool (MEL1421) is available from OTC Tool and is necessary for correct spool seal installation.

Clean the valve housing seal gland of any contamination.

Put clean oil on the clevis end of the spool surface.

Install the spool seal into the tool, with the open end of the seal facing out **[D]**. Be sure the seal is completely inside the tool.

Put oil on the inner diameter of the seal.

Carefully push the tool (with the spool seal installed) over the end of the spool and into the counterbore of the valve housing **[D]**. Hold the tool tight against the valve housing and hit the end of the tool with the palm of the hand, driving the seal into the spool seal gland.

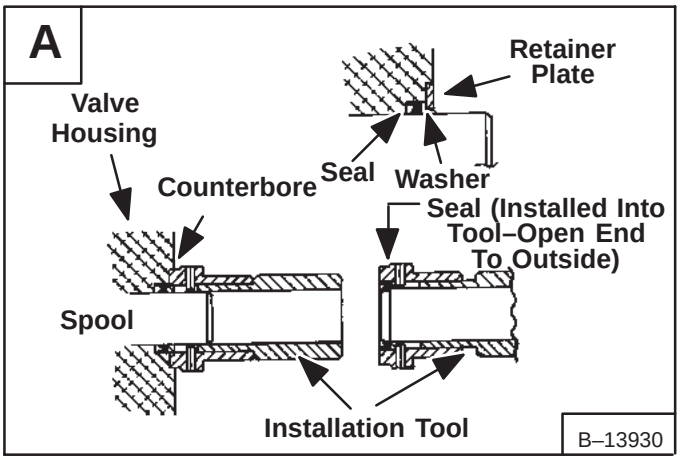
Remove the tool and inspect the spool seal to make sure that the seal is not rolled or twisted.

Put oil on the spool wiper and put it onto the end of the spool with the wiper lip facing out. Put the retainer plate over the wiper lip and push the wiper and retainer plate onto the spool until the retainer plate is flush into the counter bore of the valve housing.

Install the cover plate and bolts.

Repeat this procedure for the positioner end of the spool.

Install the positioner components in reverse order from which they were removed.



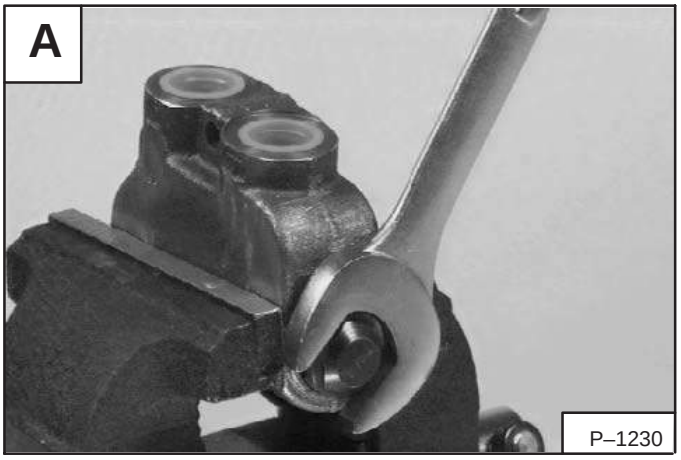
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HYDRAULIC CONTROL VALVE (3–Spool) (S/N 12999 & Below) (Cont'd)

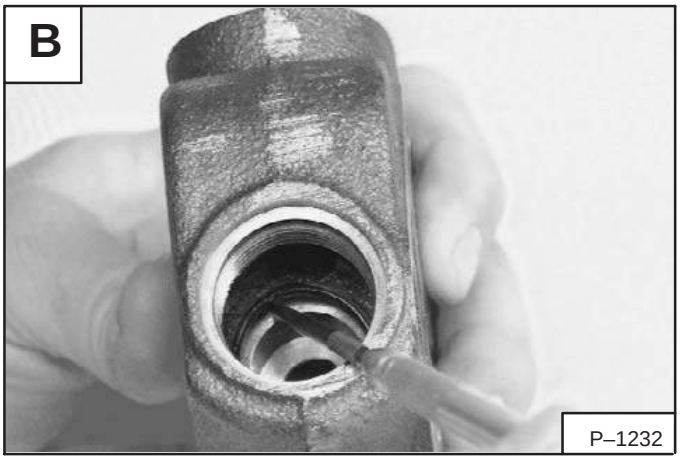
End Cover Disassembly and Assembly

Clamp the end cover in a vise with protective jaws **[A]**.

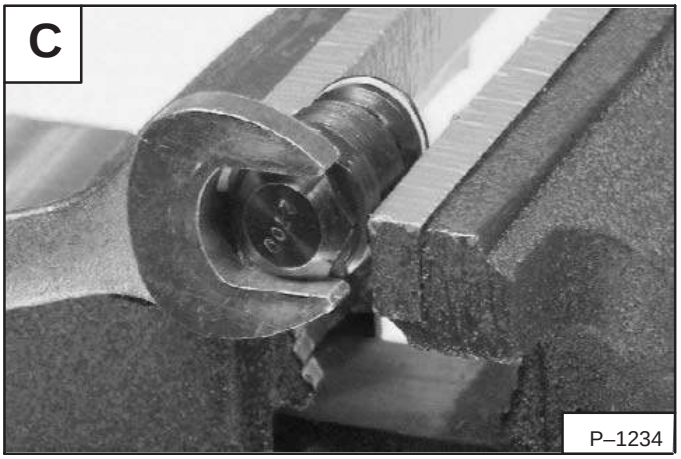
Remove the relief valve from the end cover **[A]**.



The relief valve O–ring and back–up ring usually remain inside the end cover cavity when the relief valve is removed. Remove the O–ring and back–up ring from the end cover **[B]**.



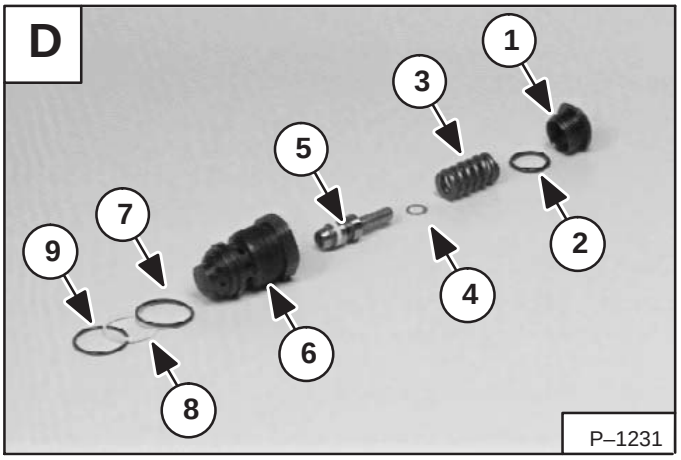
Clamp the relief valve housing in a vise and loosen the end plug **[C]**.



Remove the end plug (Item 1) **[D]**, O–ring (Item 2) **[D]**, spring (Item 3) **[D]**, shim(s) (Item 4) **[D]**, poppet assembly (Item 5) **[D]**, relief housing (Item 6) **[D]**, O–ring (Item 7) **[D]**, back–up washer (Item 8) **[D]** and the O–ring (Item 9) **[D]**.

NOTE: The poppet (Item 5) [D] has an O–ring and a back–up ring which are not available separately. If these components are damaged, order a new relief valve assembly from Melroe Parts Operations.

NOTE: The relief valve pressure setting must be checked and/or readjusted after the valve assembly has been reassembled. See Page 2–16 for information on testing and setting the relief pressure.



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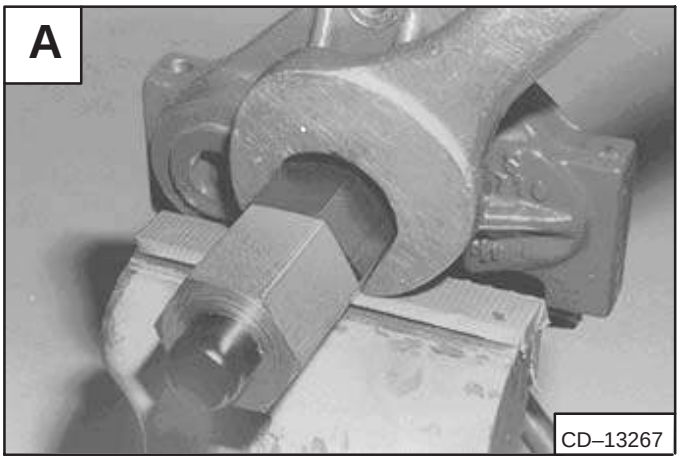
HYDRAULIC CONTROL VALVE (3–Spool) (S/N 12999 & Below) (Cont'd)

End Cover Disassembly and Assembly (Cont'd)

Clamp the end cover in a vise with protective jaws **[A]**.

Remove the pressure build–up valve assembly from the end cover **[A]**.

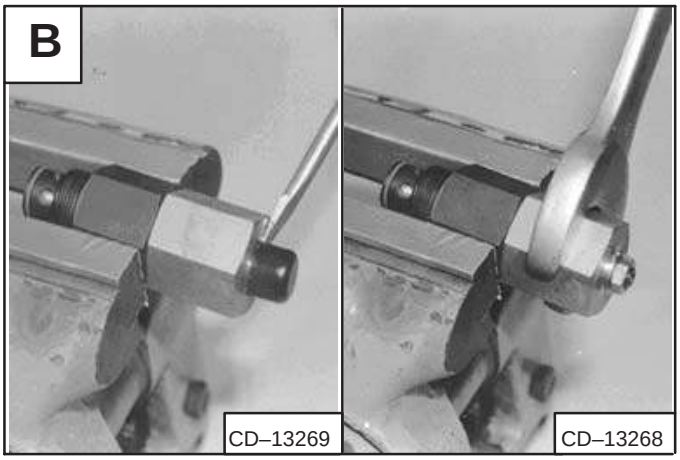
Assembly: Tighten the pressure build–up valve to 18–22 ft.–lbs. (24–30 Nm) torque.



Pry the cap loose from the end of the pressure build–up valve assembly **[B]**.

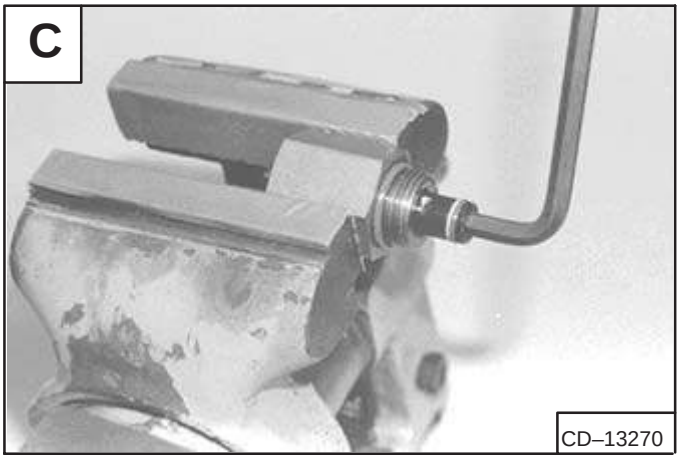
Clamp the pressure build–up valve in a vise and loosen the end plug **[B]**.

Assembly: Tighten the plug to 18–22 ft.–lbs. (24–30 Nm) torque.



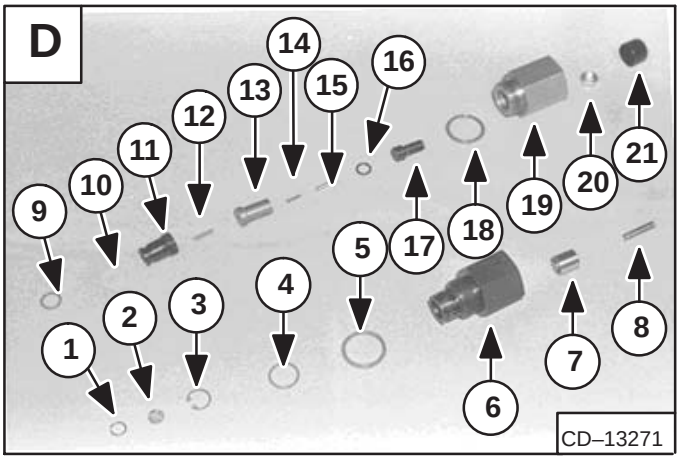
Clamp the end plug into the vise and loosen the poppet seat **[C]**.

Assembly: Put LOCTITE #242 on the threads of the poppet seat and tighten to 4–6 ft.–lbs. (6–8 Nm) torque. Do not allow LOCTITE to contact any of the components during assembly of the poppet seat.



Remove the snap ring (Item 1) **[D]**, screen (Item 2) **[D]**, snap ring (Item 3) **[D]**, O–ring (Item 4) **[D]**, O–ring (Item 5) **[D]**, housing (Item 6) **[D]**, poppet (Item 7) **[D]**, spring (Item 8) **[D]**, O–ring (Item 9) **[D]**, back–up ring (Item 10) **[D]**, poppet seat (Item 11) **[D]**, poppet (Item 12) **[D]**, poppet retainer (Item 13) **[D]**, spring (Item 14) **[D]**, pin (Item 15) **[D]**, O–ring (Item 16) **[D]**, pressure adjusting screw (Item 17) **[D]**, O–ring (Item 18) **[D]**, end plug (Item 19) **[D]**, jam nut (Item 20) **[D]** and cap (Item 21) **[D]**.

NOTE: The pressure build–up valve must be readjusted after the valve has been reassembled. See Page 2–96 for adjustment procedure.



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HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above)

Left Travel, Right Travel, Boom, Bucket and Auxiliary

The 5 Spool hydraulic control valve has two main relief pressure valves that operate at 2550 PSI and are located on each outlet section. There are two main relief pressure valves that operate at 3550 PSI that are located on the inlet section. The boom and bucket valve sections have work port relief valves. The boom rod end and bucket base end (spool end) are set at 2950 PSI. The boom base end and bucket rod end are set at 3400 PSI.

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 floor mat. (See Page 4–1.)

Remove the floor plate. (See Page 4–1.)

Remove the seat. (See Page 4–1.)

Remove the swing motor cover. (See Page 4–1.)

Remove the left control console mount bolts. (See Page 3–1.)

Reposition the console to gain clearance for control valve removal.

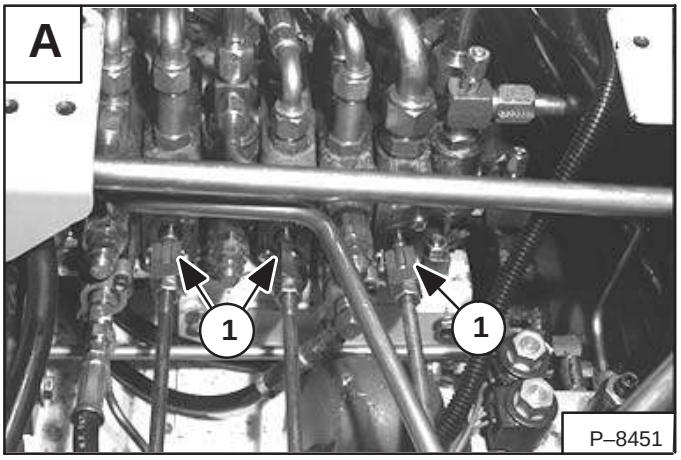
Mark the tubes and hoses for ease of installation.

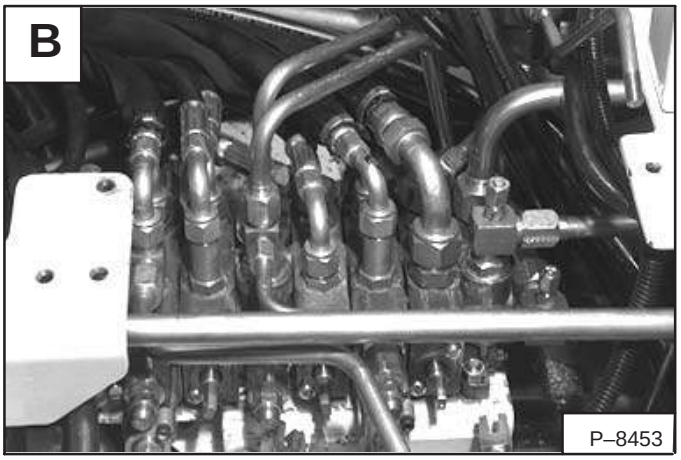
Remove the cotter pins and clevis pins (Item 1) **[A]** from the right travel, left travel and auxiliary valve section linkages.

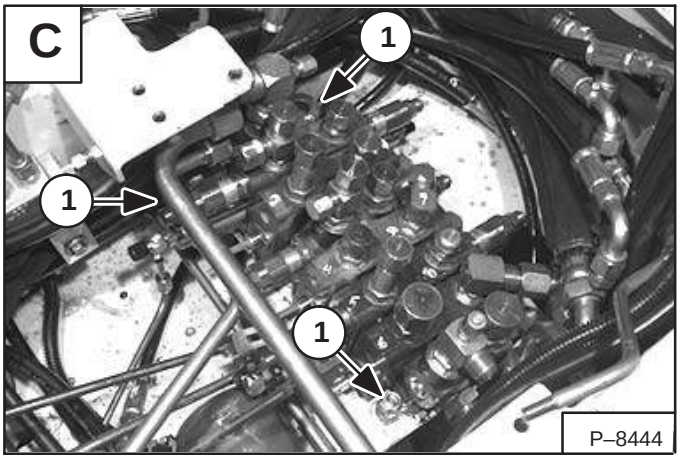
Remove the tubes and hoses **[B]**.

Remove the three (3) mounting bolts (Item 1) **[C]** from the control valve.

Remove the control valve from the excavator **[D]**.









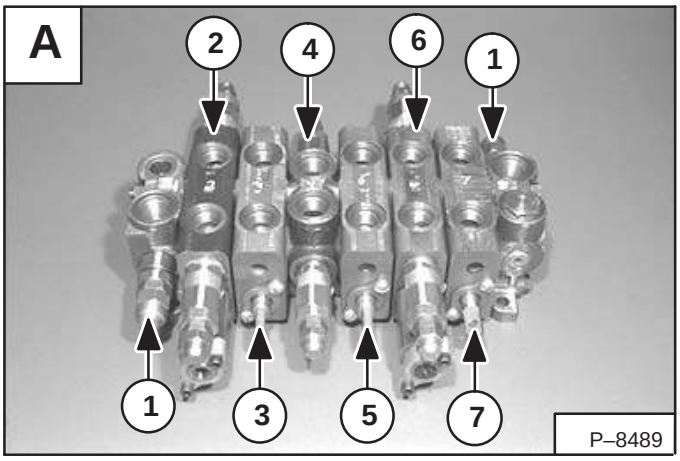
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HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

Left Travel, Right Travel, Boom, Bucket and Auxiliary (Cont'd)

The Husco 5 Spool control valve has eight different sections:

The Outlet Section (Item 1) **[A]**.
The Boom Section (Item 2) **[A]**.
The Right Hand Travel Section (Item 3) **[A]**.
The Inlet Section (Item 4) **[A]**.
The Left Hand Travel Section (Item 5) **[A]**.
The Bucket Section (Item 6) **[A]**.
The Auxiliary Section (Item 7) **[A]**.



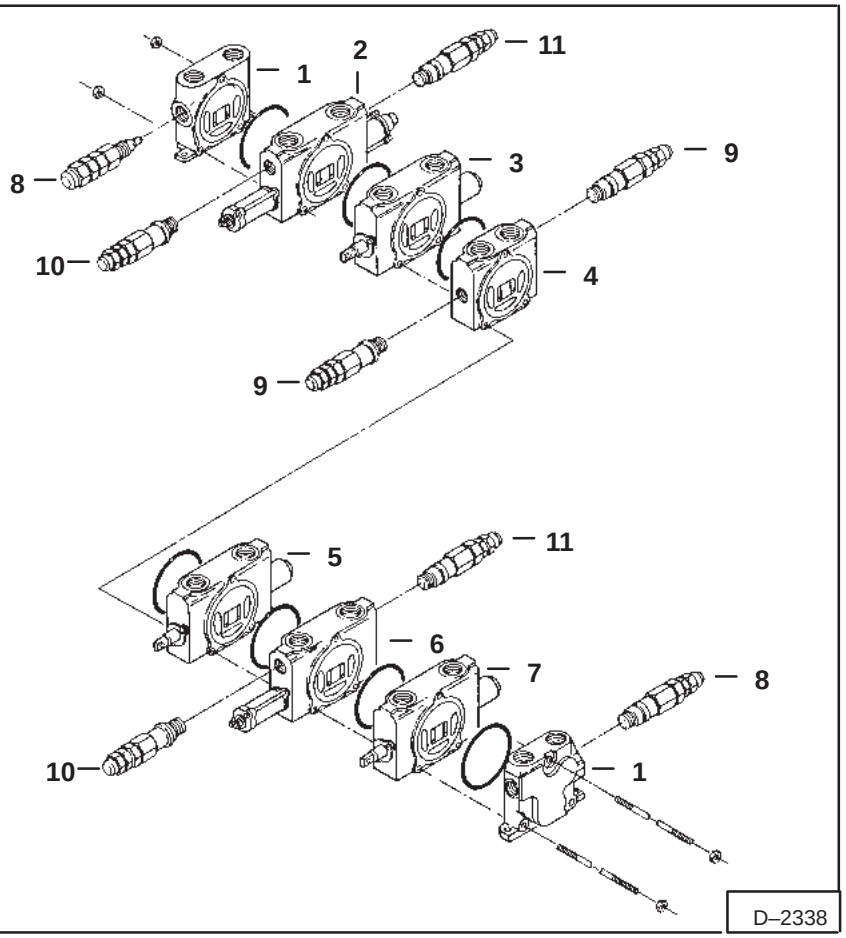
The two (2) outlet sections and inlet section have main relief valves. The boom and bucket sections have work port relief valves.

Parts Identification

CONTROL VALVE (5–Spool)

Left Travel, Right Travel, Boom, Bucket and Auxiliary

1. **Outlet**
2. **Boom**
3. **Right Hand Travel**
4. **Inlet**
5. **Left Hand Travel**
6. **Bucket**
7. **Auxiliary**
8. **Main Relief Valves 2550 PSI (17582 kPa)**
9. **Main Relief Valves 3550 PSI (24477 kPa)**
10. **Port Relief Valves 2950 PSI (20340 kPa)**
11. **Port Relief Valves 3400 PSI (23443 kPa)**



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HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

Left Travel, Right Travel, Boom, Bucket and Auxiliary (Cont'd)

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

Clean the control valve assembly with a solvent.

Disassembly

Remove all the fittings from the control valve before disassembling the valve. Install new O–rings onto the fittings before reusing them.

Mark the valve sections for ease of assembly.

Remove the nuts from the three (3) tie rods (Item 1) **[A]**.

Remove the outlet valve section from the valve assembly **[B]**.

Continue to remove all the valve sections **[C]**. Keep the valve sections in the correct order for ease of assembly.

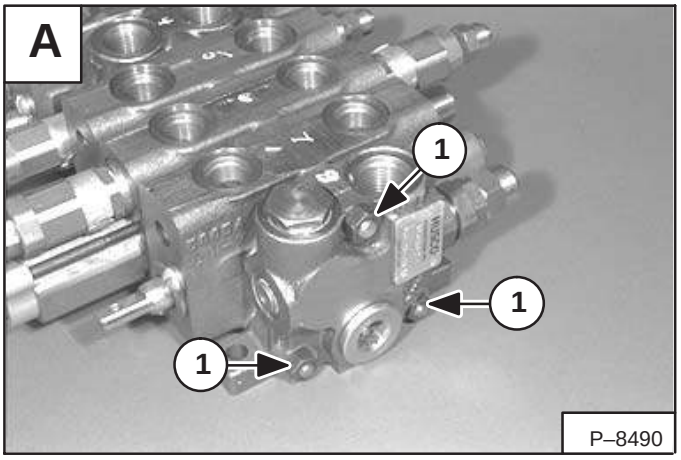
Remove the O–ring (Item 1) **[D]**, spring (Item 2) **[D]** and the load check valve (Item 3) **[D]** from the valve body.

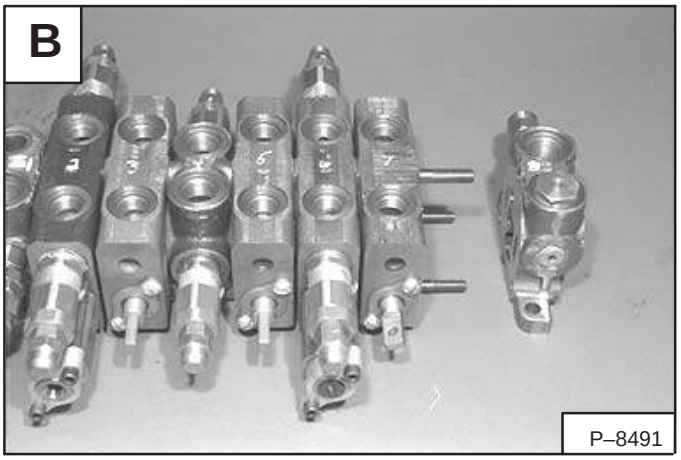
NOTE: There is no spring and load check valve in the, mid inlet valve section or outlet sections.

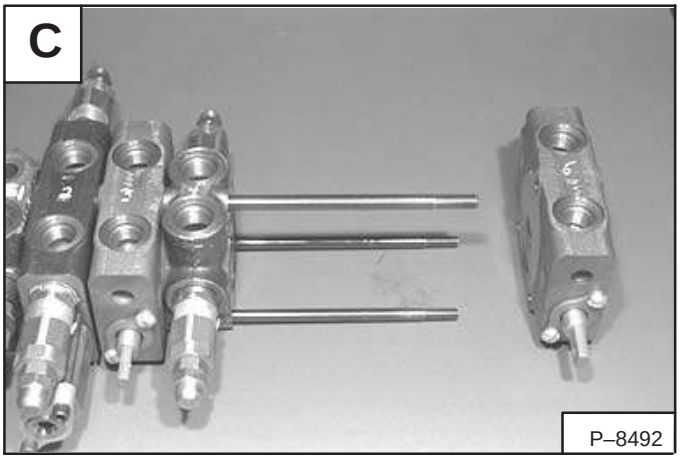
If only the valve section O–rings need replacing, clean and dry the side faces of the sections and the O–ring glands.

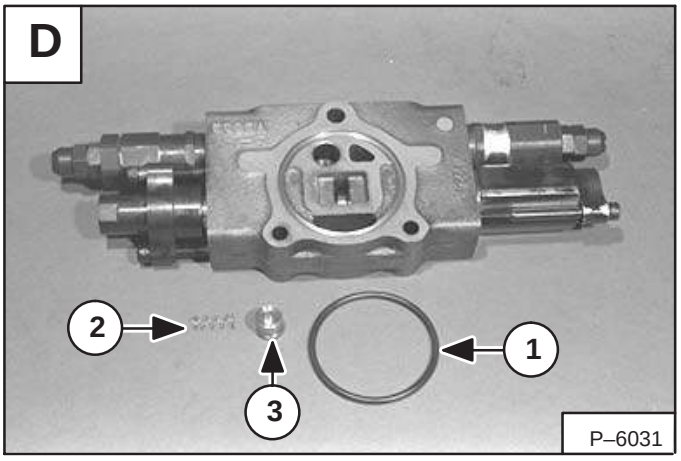
Install new O–rings and reassemble the valve.

See Page 2–69 for tightening torque.









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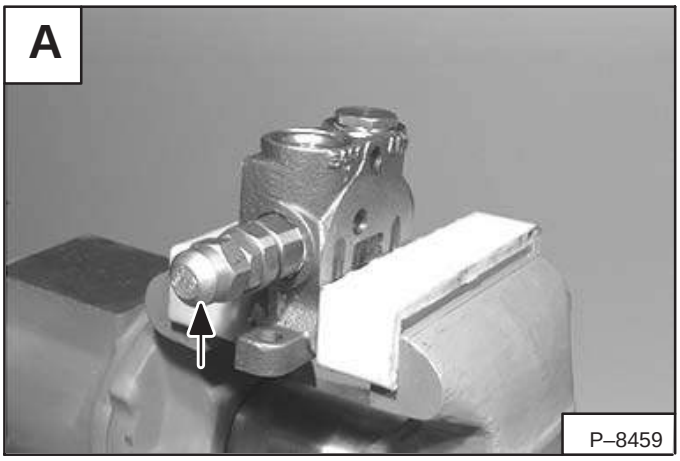
HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

Left Travel, Right Travel, Boom, Bucket and Auxiliary (Cont'd)

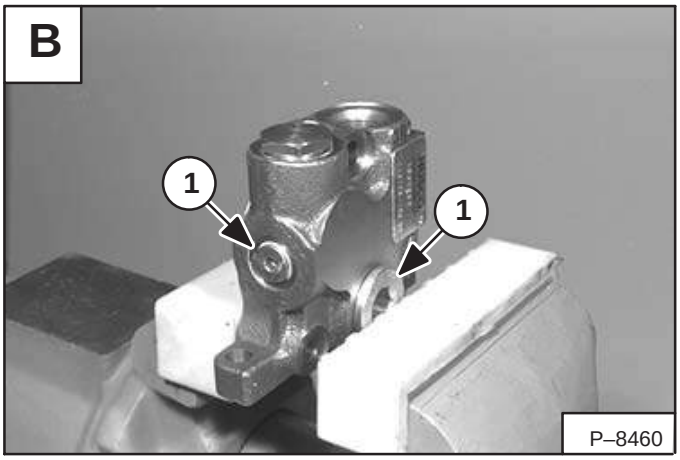
Outlet Sections Disassembly

Put the valve section in a vise with protective jaws.

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



Remove the plugs (Item 1) **[B]** from the inlet section.



Remove the O–rings (Item 1) **[C]** from the plugs.

Outlet Sections Assembly

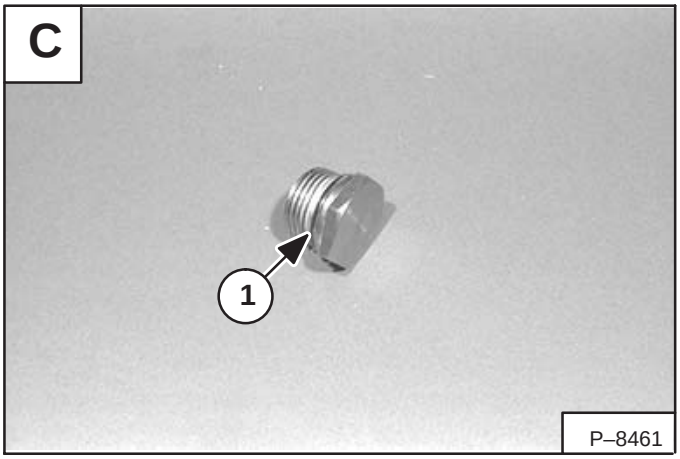
Oil and install new O–rings on the plugs.

Clean the valve section in solvent and dry.

Install the plugs in the inlet section.

Install the main pressure relief valve into the valve section. Tighten to 43–53 ft.–lbs. (57–71 Nm) of torque.

NOTE: If the main pressure relief valve is disassembled the relief pressure setting must be reset. See Page 2–73 for main relief valve repair.

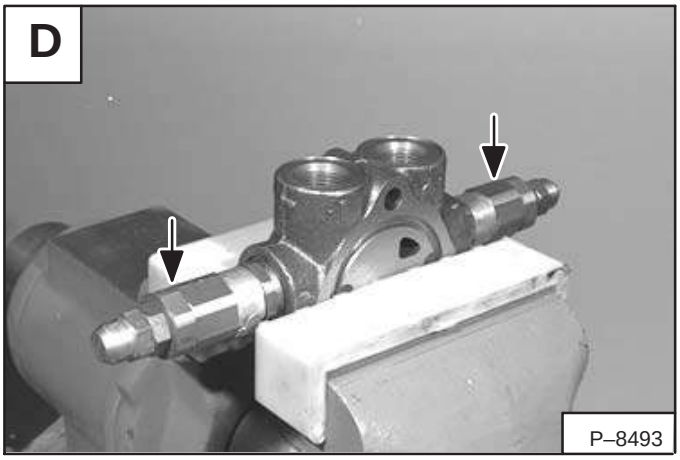


Mid Inlet Section Disassembly

Put the valve section in a vise with protective jaws.

Remove the main reliefs from both ends of the section **[D]**.

NOTE: The main reliefs for the inlet section are the same as the work port relief valves with the only difference being a higher relief pressure.



Mid Inlet Section Assembly

Clean the valve section in solvent and dry with compressed air.

Install the main relief valves on both ends of the valve section. Tighten to 30–36 ft.–lbs. (40–48 Nm) of torque.

NOTE: If the relief valve is disassembled the relief pressure setting must be reset. See page 2–70 for main relief valve repair.

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HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

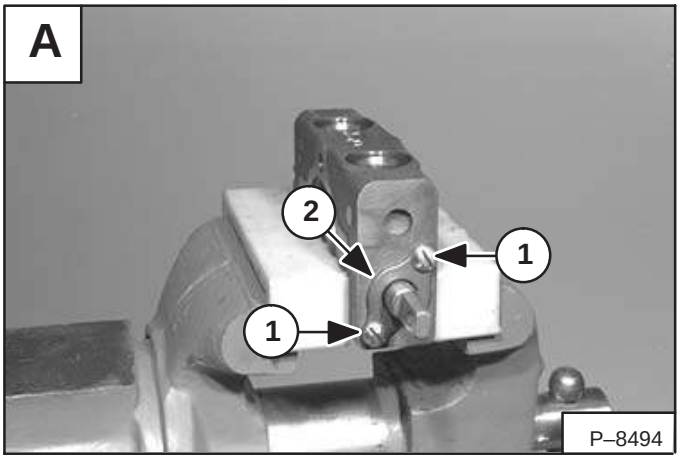
Left Travel, Right Travel, Boom, Bucket and Auxiliary (Cont'd)

Left Travel, Right Travel and Auxiliary Disassembly

Put the valve section in a vise with protective jaws.

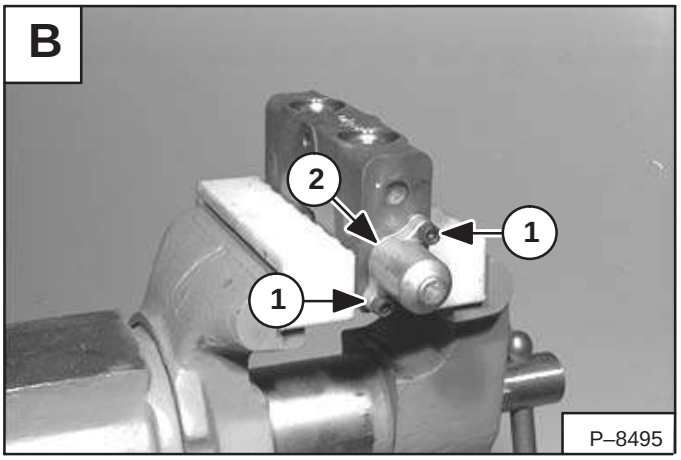
Remove the two (2) screws (Item 1) **[A]** from the retaining plate on the actuating end of the spool.

Remove the retaining plate (Item 2) **[A]**.



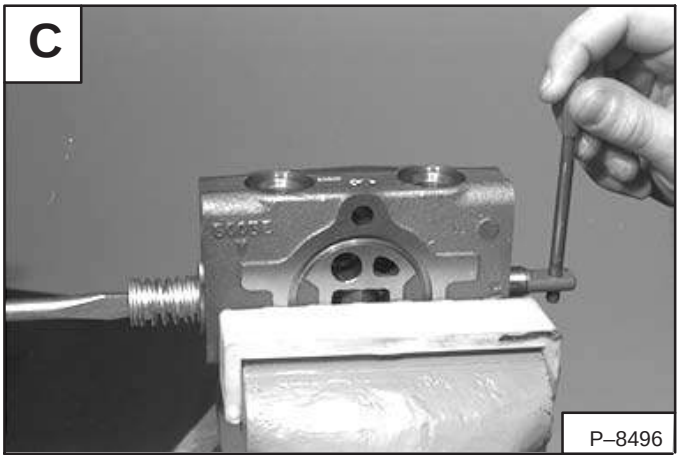
Remove the two (2) screws (Item 1) **[B]** from the end cap.

Remove the end cap (Item 2) **[B]**.

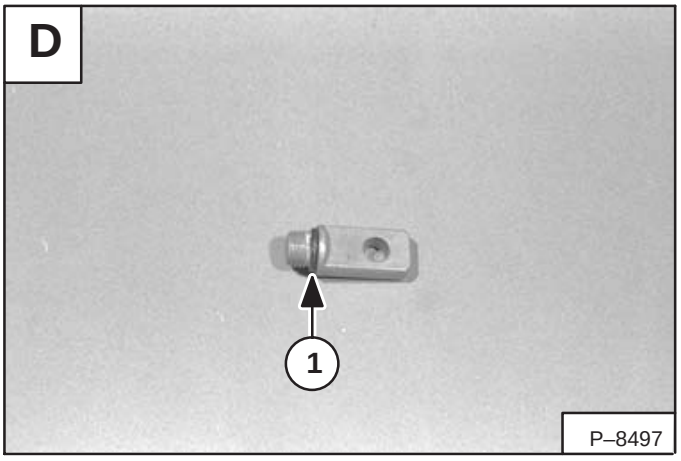


Insert a pin in hole in the actuating end of the spool. Remove the yoke from the spool by holding the pin and turning the spring retaining bolt **[C]**.

NOTE: Only the left and right travel sections have a removable yoke. The auxiliary section yoke is a machined part of the spool.



Remove the O–ring (Item 1) **[D]** from the yoke.



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HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

Left Travel, Right Travel, Boom, Bucket and Auxiliary (Cont'd)

Left Travel, Right Travel and Auxiliary Disassembly (Cont'd)

Slide the spool out far enough to insert a pin in hole in the spool. Loosen the spring retaining screw from the end of the spool **[A]**.

NOTE: To remove the spring retaining screw on the auxiliary section, insert a pin in the hole of the actuating end of the spool and hold the pin while removing the screw.

Do not use any type of tool to grip the finished surface of the spool; the spool will be damaged.

NOTE: The spring is under pressure, use care when removing the spring retaining screw.

The spool and housing are not serviced separately. The spool does not need to be removed from the housing except to clean oil passages if contamination is found.

If the spool is removed, use care not to scratch the spool surface and do not intermix the spools and the housings.

The spool can be removed from either direction of the valve after the seals have been removed.

Remove the spring retaining bolt (Item 1) **[B]**, spring retainer (Item 2) **[B]**, spring (Item 3) **[B]**, spring retainer (Item 2) **[B]** and the plate (Item 4) **[B]**. Remove the O–ring (Item 5) **[B]** from the retaining bolt (Item 1) **[B]**.

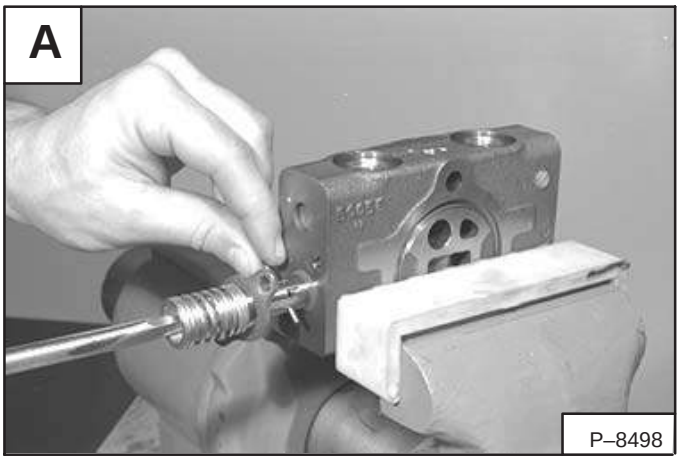
Remove the wiper from the spool (both ends) **[C]**.

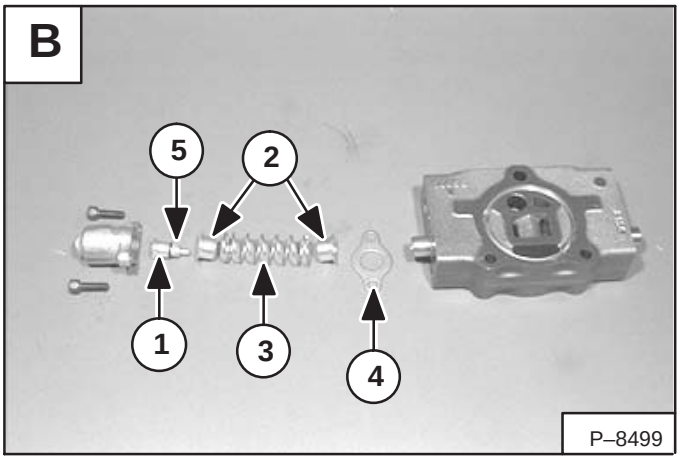
Pull the spool into the housing far enough to remove the spool O–ring from the bore in the valve section **[D]**.

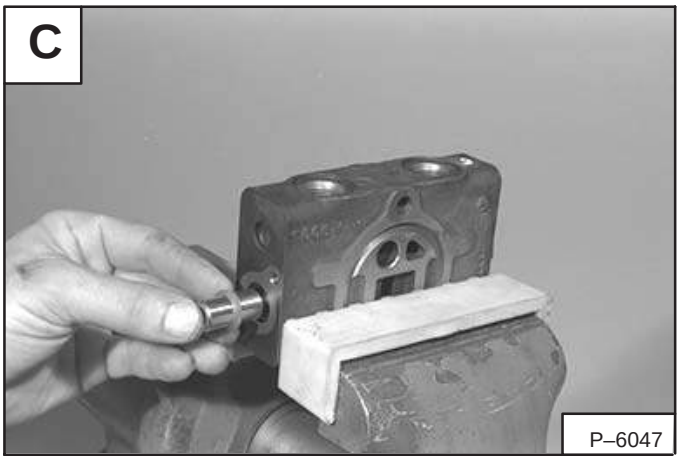
Use a brass tool to remove the O–ring. Do not scratch the bore of the valve section while removing the O–ring or leakage may occur.

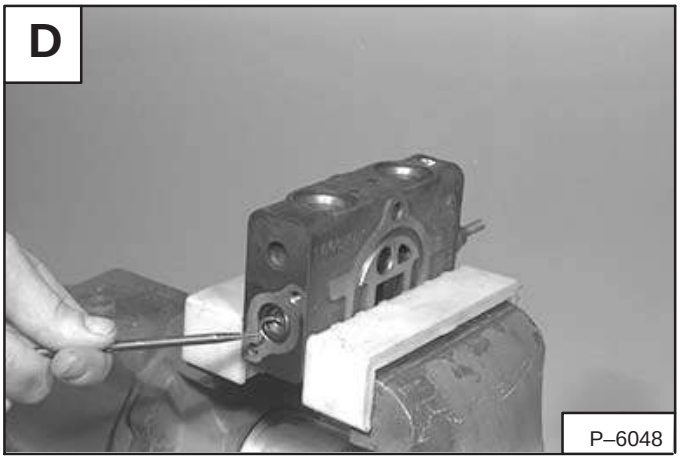
Push the other end of the spool into the housing and remove the O–ring from the opposite end.

Check the O–ring glands for contamination and clean as necessary.









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HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

Left Travel, Right Travel, Boom, Bucket and Auxiliary (Cont'd)

Left Travel, Right Travel and Auxiliary Assembly

Install a new O–ring into the bore of the valve section by pinching the O–ring and inserting it into the O–ring gland **[A]**.

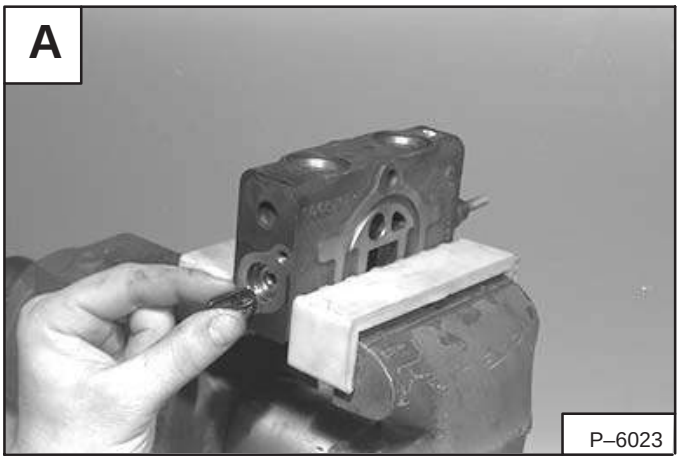
Use a brass tool and position the O–ring firmly into the O–ring gland.

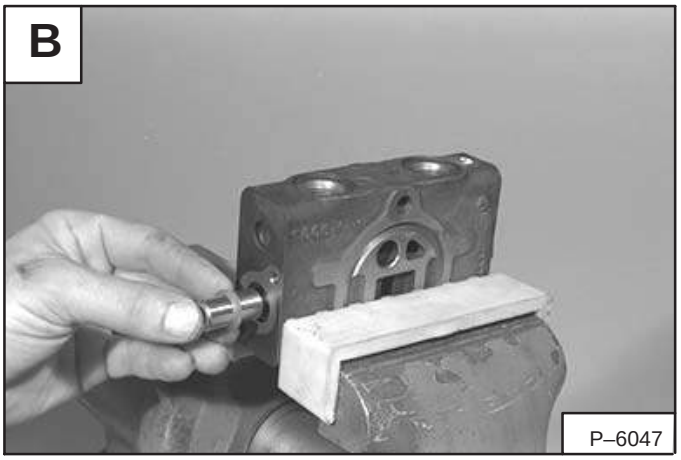
Apply oil to the O–ring.

Slowly rotate the spool and push it through the O–ring. Then pull the spool through the valve section far enough to gain access to the spool O–ring gland on the opposite end of the valve.

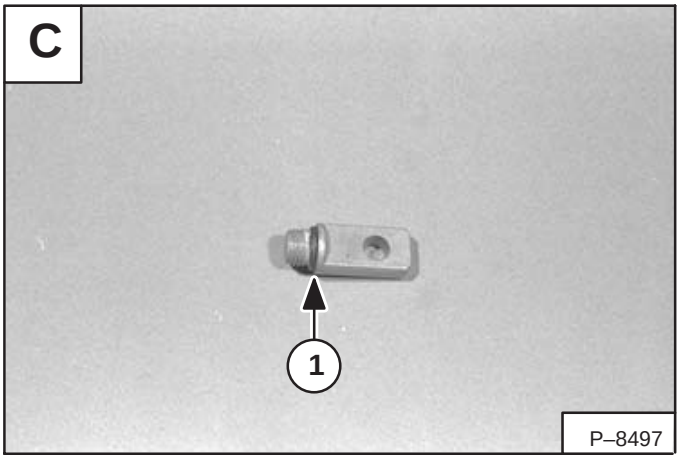
Repeat the steps for installing the spool O–rings.

Install the wiper on both ends of the spool **[B]**. Use finger pressure to seat the wiper into the bore of the valve.



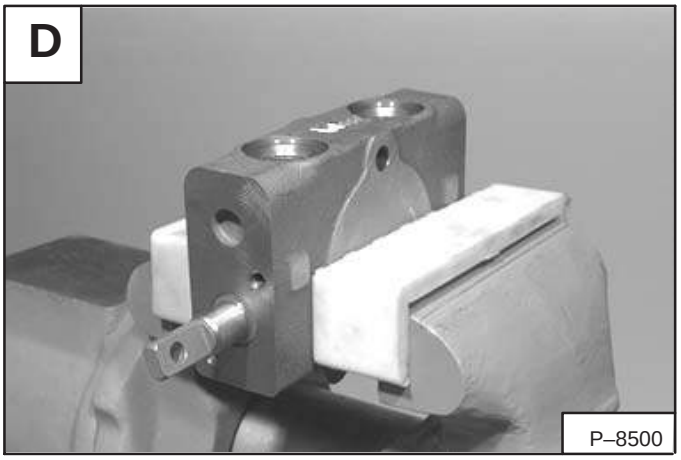


Oil and install a new O–ring (Item 1) **[C]** on the yoke.



Install the yoke on the left and right travel section spools **[D]**.

NOTE: Only the left and right travel sections have a removable yoke. The auxiliary yoke is a machined part of the spool.



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HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

Left Travel, Right Travel, Boom, Bucket and Auxiliary (Cont'd)

Left Travel, Right Travel and Auxiliary Assembly (Cont'd)

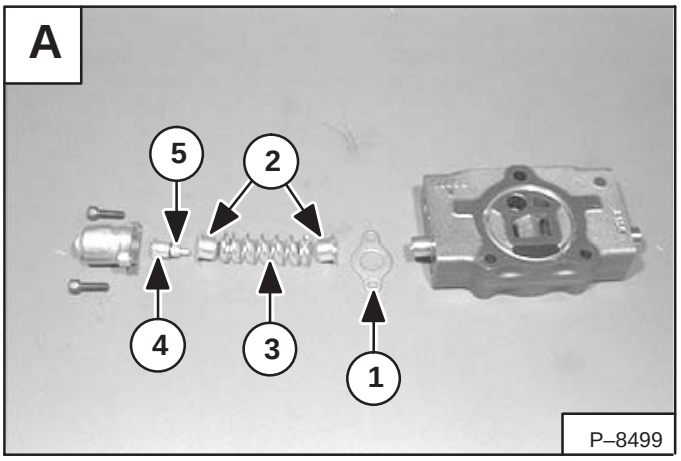
Install the plate (Item 1) **[A]** over the spool.

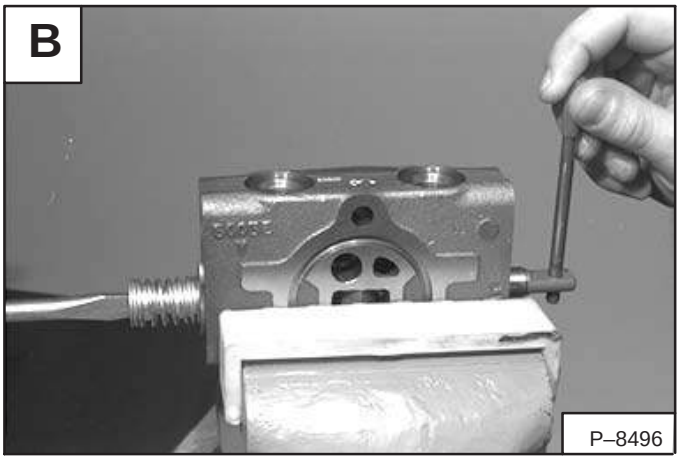
Oil and install a new O–ring (Item 5) **[A]** on the spring retaining bolt (Item 4) **[A]**.

Install the spring seat (Item 2) **[A]**, spring (Item 3) **[A]**, and outer spring seat (Item 2) **[A]** on the spool.

Apply thread adhesive (LOCTITE #271) to the spring retainer bolt (Item 4) **[A]** threads.

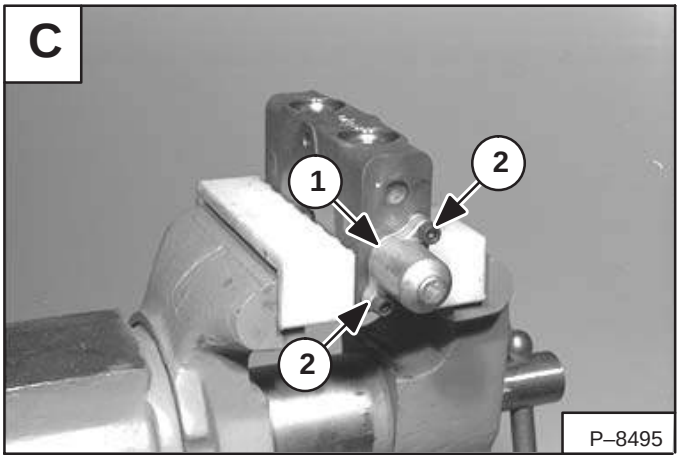
Insert a pin through the hole in the spool and tighten the spring retaining bolt **[B]**. Tighten the spring retaining bolt to 6–8 ft.–lbs. (8–10 Nm) of torque.





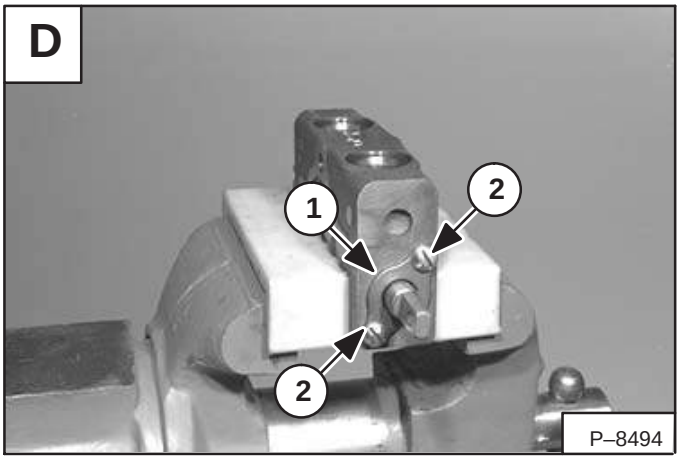
Install the end cap (Item 1) **[C]** over the spring and install the two (2) screws (Item 2) **[C]**.

Tighten the screws (Item 2) **[C]** to 6–8 ft.–lbs. (8–10 Nm) of torque.



Install the retainer plate (Item 1) **[D]** and the two (2) screws (Item 2) **[D]**.

Tighten the screws to 3–5 ft.–lbs. (4–6 Nm) of torque.



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HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

Left Travel, Right Travel, Boom, Bucket and Auxiliary (Cont'd)

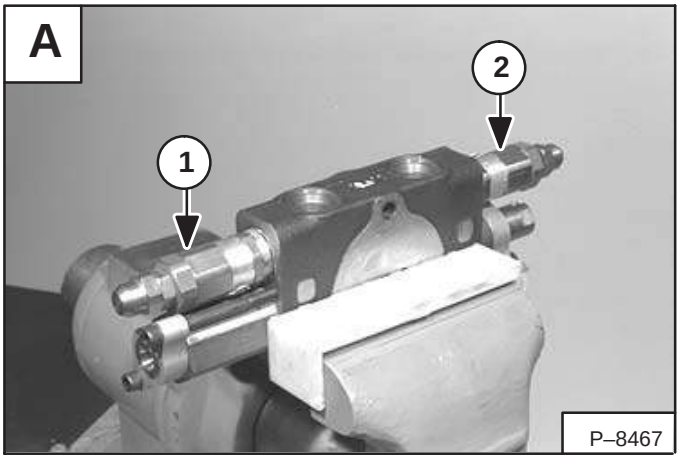
Boom and Bucket Disassembly

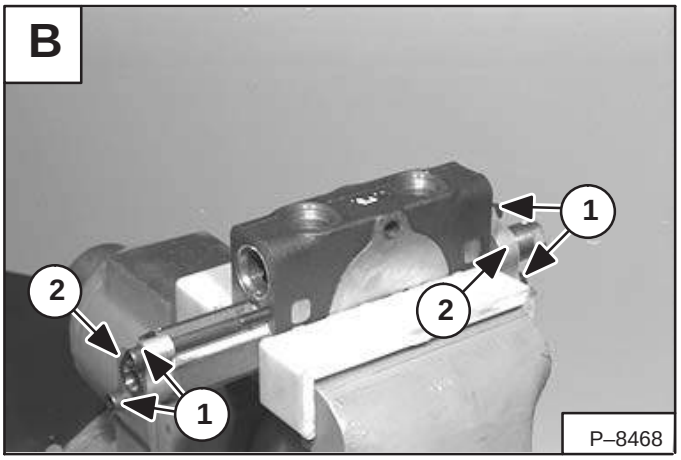
Put the valve section in a vise with protective jaws.

Remove the work port relief valve from both ends of the valve section **[A]**.

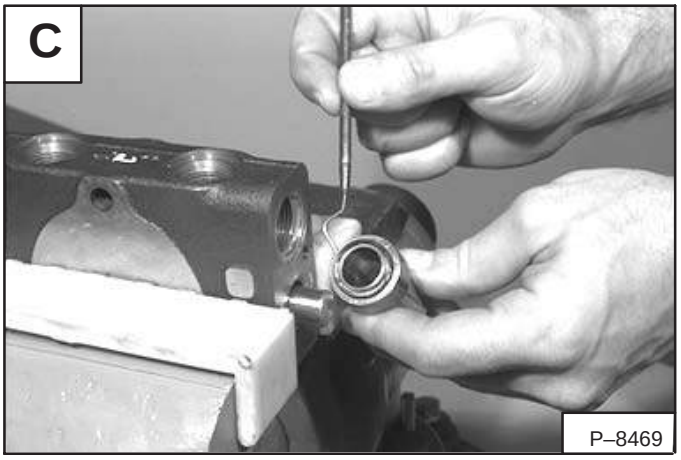
NOTE: The 2950 PSI (20340 kPa) (Item 1) [A] relief valve is located in the front of the valve section and the 3400 PSI (23443 kPa) (Item 2) [A] relief valve is located in the rear of the valve section.

Remove the four (4) screws (Item 1) **[B]** and retaining plates (Item 2) **[B]** from both end covers.

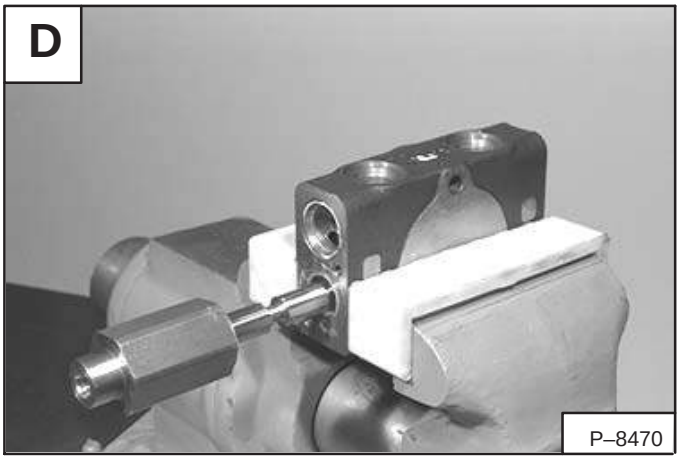




Remove the end cover from the end of the valve. Remove the O–ring **[C]**.



Remove the end cover and spool from the valve section **[D]**.



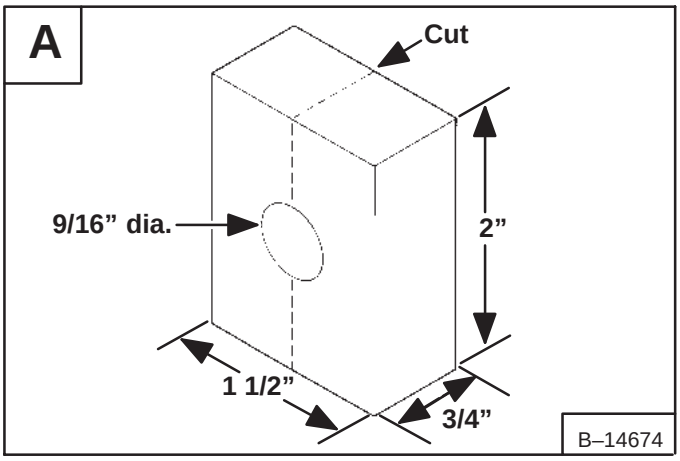
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HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

Left Travel, Right Travel, Boom, Bucket and Auxiliary (Cont'd)

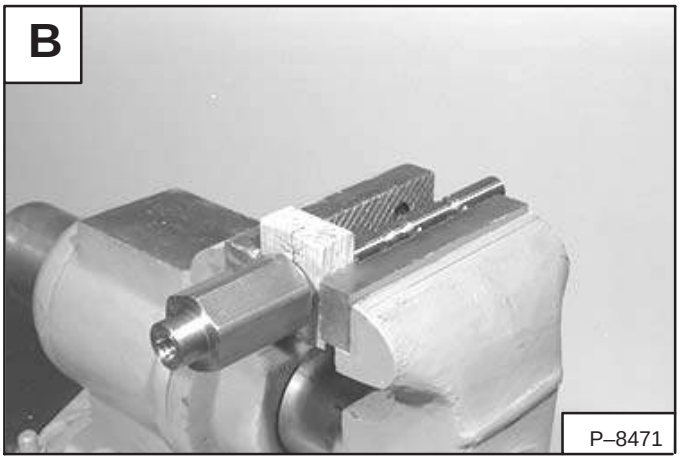
Boom and Bucket Disassembly (Cont'd)

To remove the end cover from the spool, a holding fixture will have to be made from a 3/4" thick x 1 1/2" wide x 2" long (19 mm thick x 38 mm wide x 50 mm long) piece of hardwood. Drill a 9/16" (14 mm) hole in the center of the hardwood block. Cut the block lengthwise **[A]**.

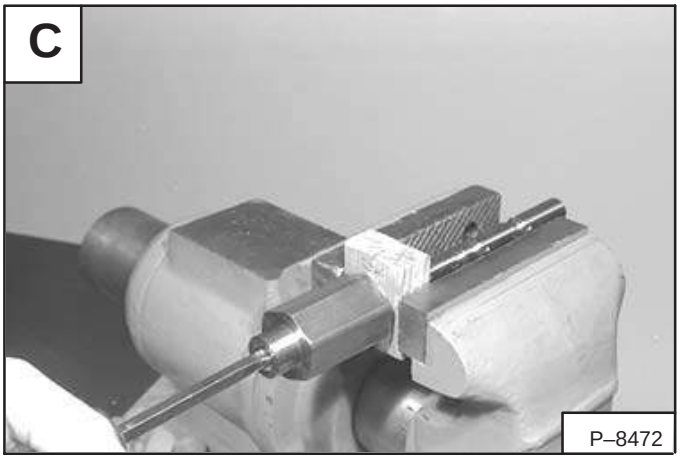


Place both halves of the hardwood block around the spool, next to the end cover. Clamp the blocks in a vise **[B]**.

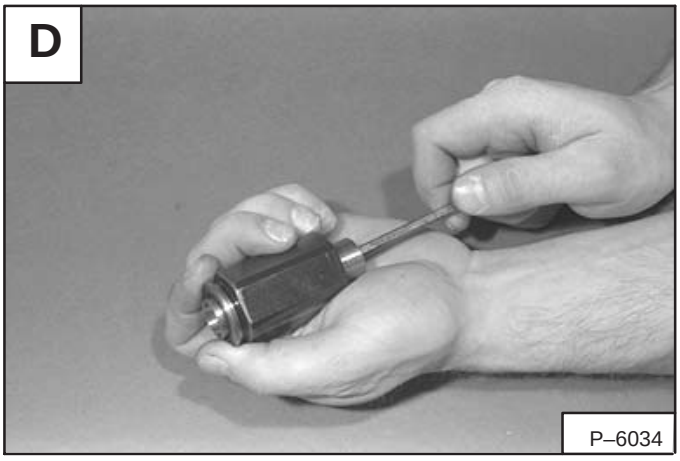
NOTE: Do not use anything other than hardwood blocks to grip the spool, or the spool will be damaged.



Remove the end cover from the spool **[C]**. Use care not to scratch the spool, as the spool and housing are not serviceable separately.



Remove the retainer from the end cover by pushing on the bolt head **[D]**.



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HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

Left Travel, Right Travel, Boom, Bucket and Auxiliary (Cont'd)

Boom and Bucket Disassembly (Cont'd)

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

Remove the spring seat (Item 3) **[A]**, the inner spring (Item 4) **[A]**, the outer spring (Item 5) **[A]** and the second spring seat (Item 3) **[A]**.

Boom and Bucket Assembly

Clean parts in solvent and dry.

Oil and install new O–rings (Item 1) **[A]** on the retainer (Item 2) **[A]**.

Apply thread adhesive (LOCTITE #271) to the spring retaining bolt (Item 6) **[A]**.

Install the spring seat (Item 3) **[A]**, the outer spring (Item 5) **[A]**, the inner spring (Item 4) **[A]**, inner spring seat (Item 3) **[A]**, the bolt (Item 6) **[A]** and the retainer (Item 2) **[A]** into end cover.

Clamp the spool in a vise using the hardwood fixture used for disassembly **[B]**.

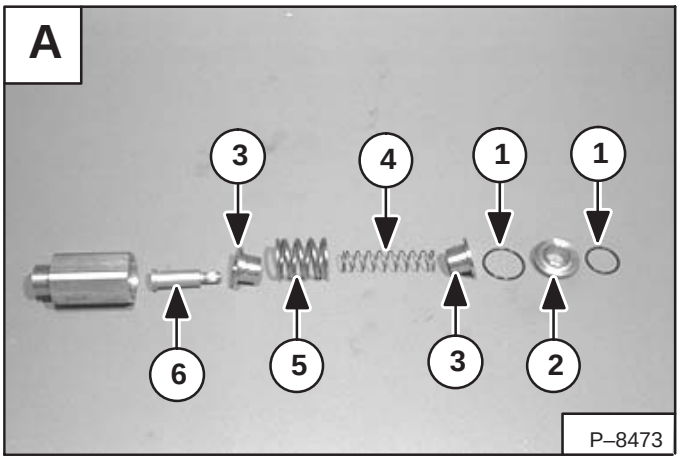
Install the end cover on the spool **[C]**.

Tighten the spring retaining bolt to 6–8 ft.–lbs. (8–10 Nm) of torque.

Install the end cover retaining plate (Item 1) **[D]** and screws (Item 2) **[D]** on the end cover.

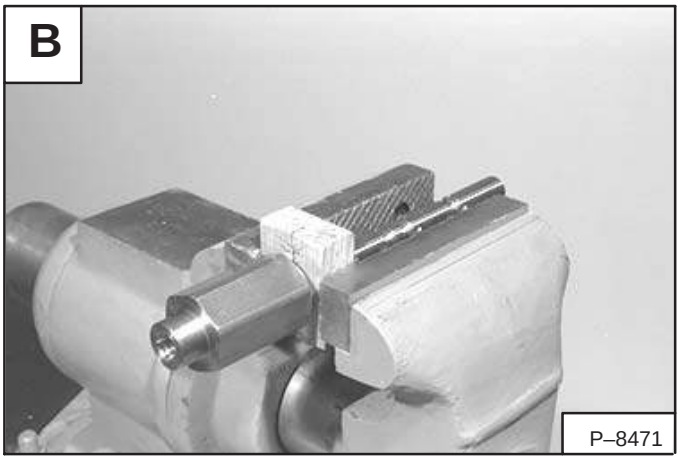
Tighten the screws to 6–9 ft.–lbs. (8–10 Nm) of torque.

A



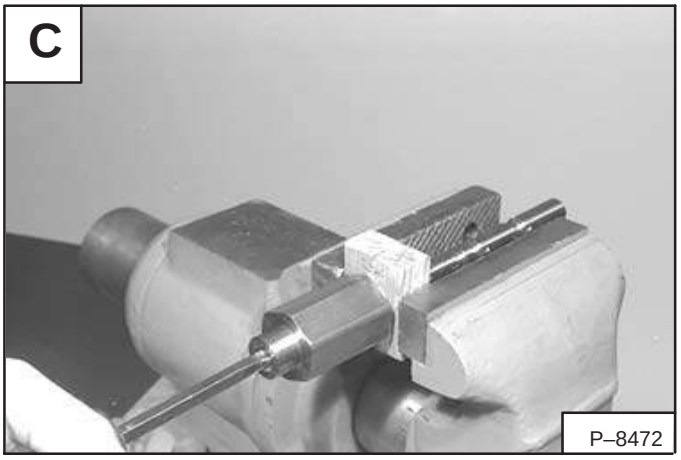
P–8473

B



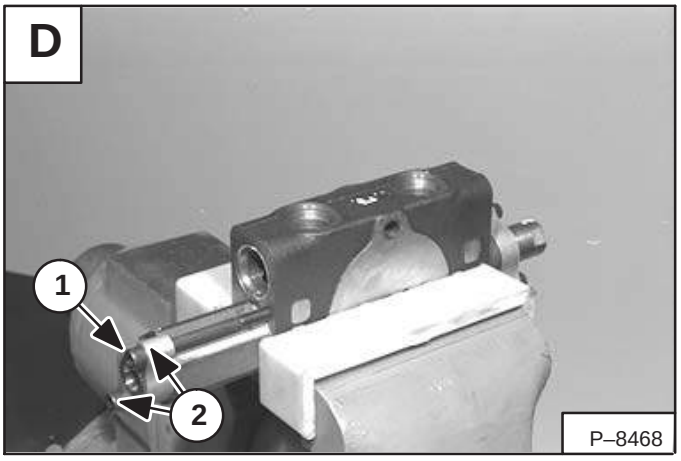
P–8471

C



P–8472

D



P–8468

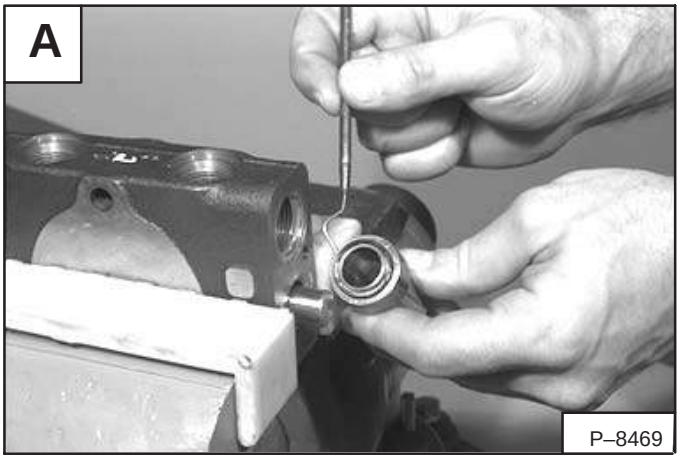
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HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

Left Travel, Right Travel, Boom, Bucket and Auxiliary (Cont'd)

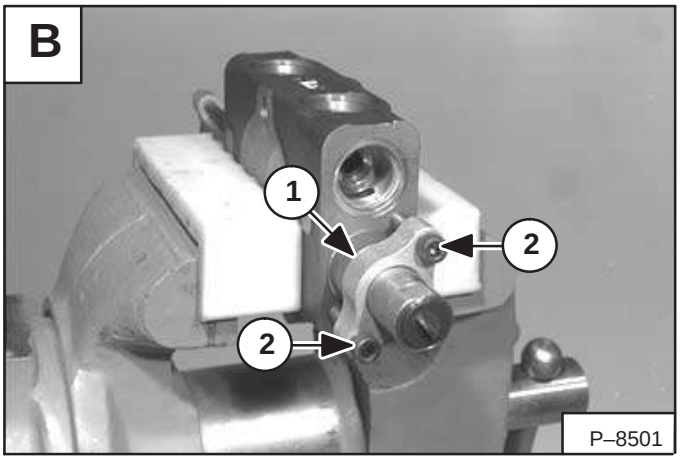
Boom and Bucket Assembly (Cont'd)

Oil and install a new O–ring on the end cover of the valve section **[A]**.

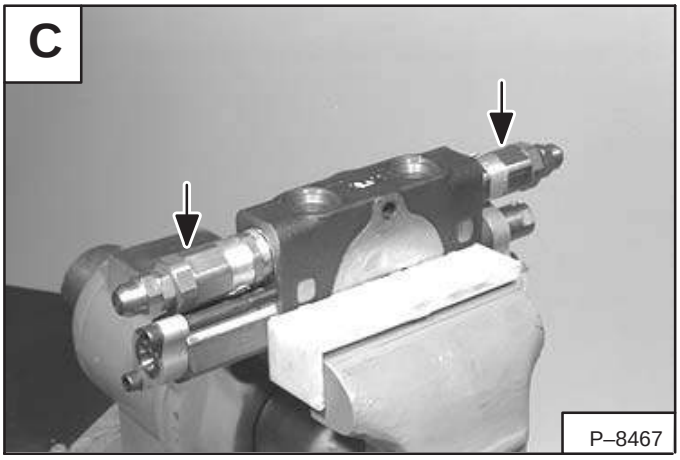


Install the end cover, the end cover retaining plate (Item 1) **[B]** and the screws (Item 2) **[B]**.

Tighten the screws to 6–9 ft.–lbs. (8–10 Nm) of torque.



Install the port relief valves on the valve section. Tighten to 30–36 ft.–lbs. (40–48 Nm) of torque **[C]**.



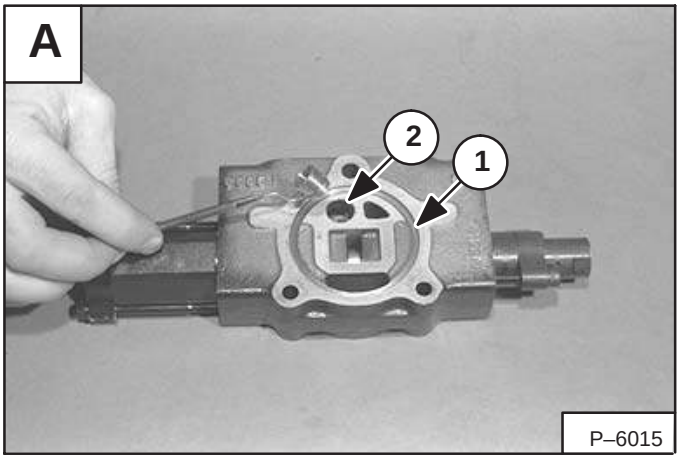
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HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

Left Travel, Right Travel, Boom, Bucket and Auxiliary (Cont'd)

Assembly

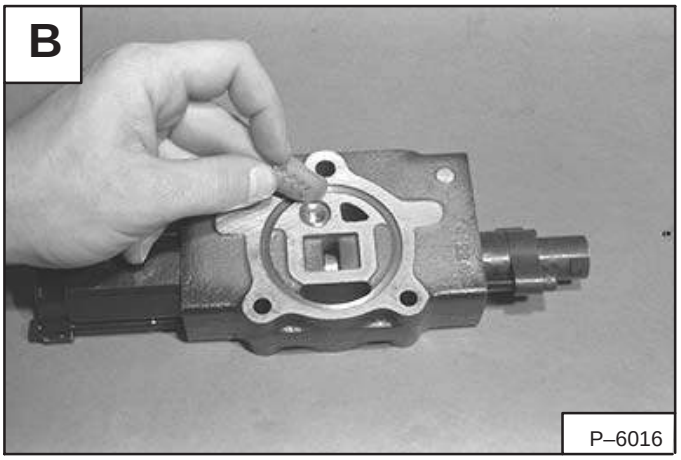
Put grease on the new O–rings and install the O–rings (Item 1) **[A]** on the face of the valve sections. Oil and install the poppet (Item 2) **[A]** in the bore on the face of the valve section.



Install the spring in the poppet **[B]**.

Install the nuts on the short threaded end of the tie rods, with at least two (2) threads extending past the nut.

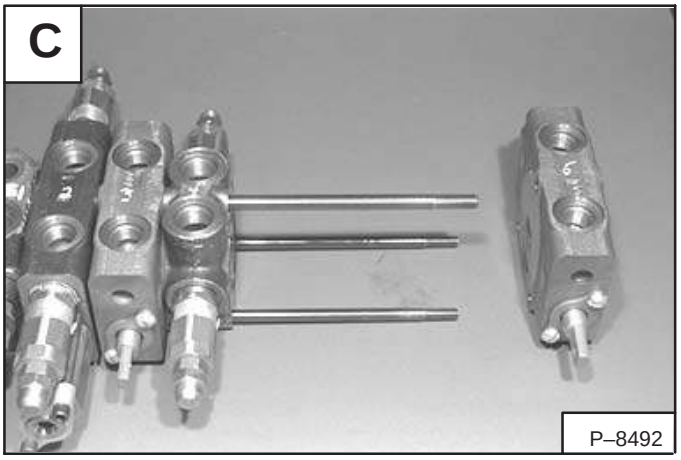
Install the tie rods through the outlet section. Check each valve section for location marks. Make sure that the valve sections are installed in the correct order.



Install the valve sections on the tie rods **[C]**.

Install the three (3) nuts on the tie rods, finger tighten only at this time.

Be sure the valve is flat on the bench by pressing down on the inlet sections so the mounting feet on the end sections are aligned.



Tighten the tie rod nuts to 10 ft.–lbs. (13 Nm) of torque in a crisscross manner**[D]**.

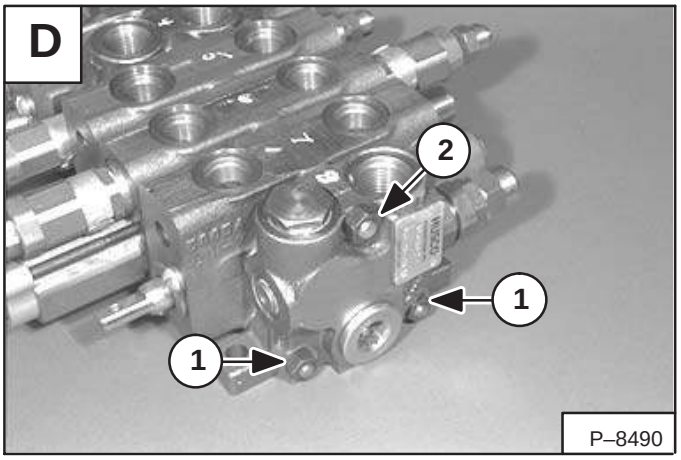
Tighten the two (2) 5/16" diameter tie rod nuts (Item 1) **[D]** to 14 ft.–lbs. (19 Nm) of torque.

Tighten the one (1) 3/8" diameter tie rod nuts (Item 2) **[D]** to 33 ft.–lbs. (45Nm) of torque.

The valve must not have any spacing between the valve sections and the spools must be free when pushed in and released.

The spools must not stick, if the spools do stick, loosen the tie rod nuts and tighten per above information.

Recheck the mounting feet for level settings.

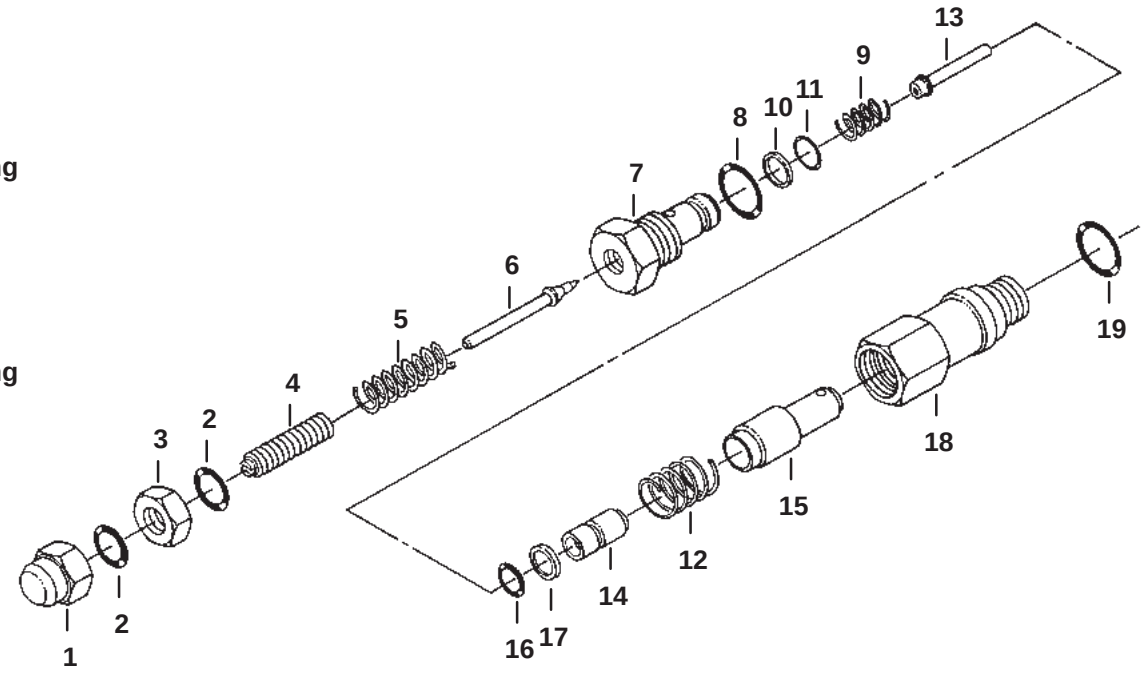


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PORT RELIEF VALVES AND MAIN RELIEF VALVES (S/N 13001 & Above)

Parts Identification

1. Nut
2. O–ring
3. Nut
4. Screw
5. Spring
6. Poppet
7. Housing
8. O–ring
9. Spring
10. Back–up Ring
11. O–ring
12. Spring
13. Poppet
14. Poppet
15. Sleeve
16. O–ring
17. Back–up Ring
18. Housing
19. O–ring



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PORT RELIEF VALVES AND MAIN RELIEF VALVES (S/N 13001 & Above) (Cont'd)

Port Relief Valve Pressure Setting

Boom relief set at:
(Rod End) Front . . . . . 2950 PSI (20340 kPa)
(Base End) Rear . . . . . 3400 PSI (23443 kPa)

Bucket Relief set at:
(Rod End) Rear . . . . . 3400 PSI (23443 kPa)
(Base End) Front . . . . . 2950 PSI (20340 kPa)

Arm Relief set at:
(Rod End) Rear . . . . . 2950 PSI (20340 kPa)
(Base End) Front . . . . . 2950 PSI (20340 kPa)

Blade Relief set at:
(Rod End) Front . . . . . 3400 PSI (23443 kPa)
(Base End) Rear . . . . . None

Main Relief Valve Pressure Setting:

Inlet Section set at:
(Rod End) Front . . . . . 3550 PSI (24477 kPa)
(Base End) Rear . . . . . 3550 PSI (24477 kPa)

NOTE: The main relief pressure setting is measured at the hydraulic pump.

Disassembly

Remove the end cap (Item 1) **[B]** and the O–ring (Item 2) **[B]** from the adjusting screw (Item 5) **[B]**. Remove the jam nut (Item 3) **[B]** and the O–ring (Item 4) **[B]** from the adjusting screw (Item 5) **[B]**.

Remove the adjusting screw (Item 5) **[B]**, spring (Item 6) **[B]** and poppet (Item 7) **[B]** from the housing (Item 8) **[B]**.

Remove the housing (Item 8) **[B]**. Remove the O–rings (Item 9) **[B]** and back–up ring (Item 10) **[B]** from the housing.

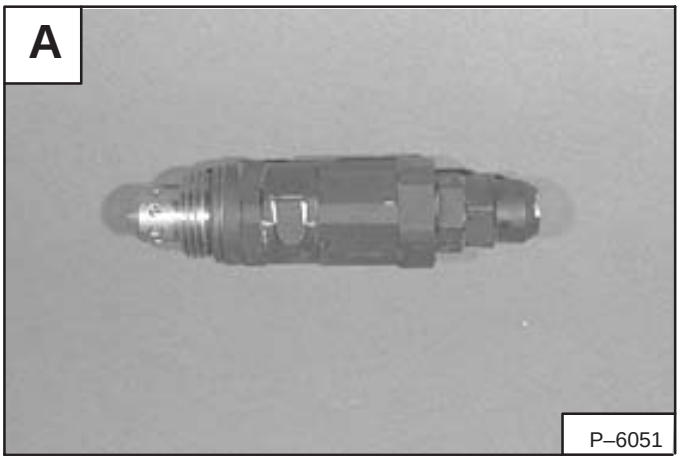
Remove the spring (Item 11) **[B]**, poppet (Item 12) **[B]**, pilot pressure poppet (Item 13) **[B]**. Remove the O–ring (Item 14) **[B]** and back–up ring (Item 15) **[B]** from the poppet.

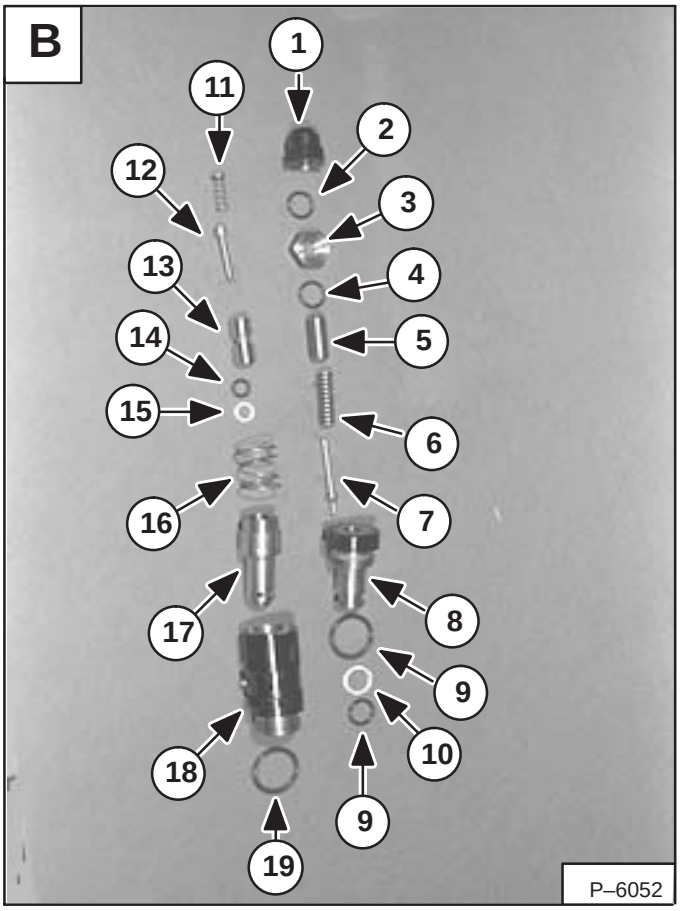
Remove the spring (Item 16) **[B]** and sleeve (Item 17) **[B]** from the housing (Item 18) **[B]**.

Remove the O–ring (Item 19) **[B]** from the housing (Item 18) **[B]**.

Clean all parts in solvent and dry.

Inspect the poppet for scratches or wear at the pilot point. If damage is found, order a new port relief valve assembly from Melroe Parts.





⚠ 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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PORT RELIEF VALVES AND MAIN RELIEF VALVES (S/N 13001 & Above) (Cont'd)

Assembly

Put oil on the O–rings and the back–up rings and install. Be careful not to over stretch these parts during installation.

Put oil on the sleeve (Item 17) **[A]** and insert it into the housing (Item 18) **[A]**.

Install the spring (Item 16) **[A]** into the housing (Item 18) **[A]** and on the sleeve (Item 17) **[A]**.

Install the poppet (Item 13) **[A]**.

Install the pilot pressure poppet (Item 12) **[A]** into the poppet (Item 13) **[A]**. Install the spring (Item 11) **[A]** on the pilot pressure poppet (Item 12) **[A]**.

Install the housing (Item 8) **[A]** on the housing (Item 18) **[A]**. Tighten to 30–36 ft.–lbs. (40 – 48 Nm) of torque.

Insert the poppet (Item 7) **[A]** and the spring (Item 6) **[A]** into the housing (Item 8) **[A]**.

Install the adjusting screw (Item 5) **[A]** into the housing (Item 8) **[A]**.

Install the lock nut (Item 3) **[A]** on the adjusting screw (Item 5) **[A]**. Tighten to 6–8 ft.–lbs. (8–10 Nm) of torque.

Install the end cap (Item 1) **[A]** on the adjusting screw (Item 5) **[A]**. Tighten to 6–8 ft.–lbs. (8–10 Nm) of torque.

Adjustment Procedure (Work Port Relief Valves Only)

A portable hydraulic hand pump will be used to test the work port relief valves. The hand pump must have clean hydraulic fluid that is compatible with the Melroe hydraulic fluid or use SAE 10W–30 motor oil.

Install the hand pump hose and a pressure gauge (minimum of 5000 PSI) into the valve section work port in which the port relief valve is located **[B]**. Pressurize this section with the hand pump until the port relief valve opens and make a note of the pressure reading.

If the port relief pressure setting needs to be adjusted, release the hand pump pressure valve.

Remove the end cap nut.

Loosen the lock nut (Item 1) **[B]**.

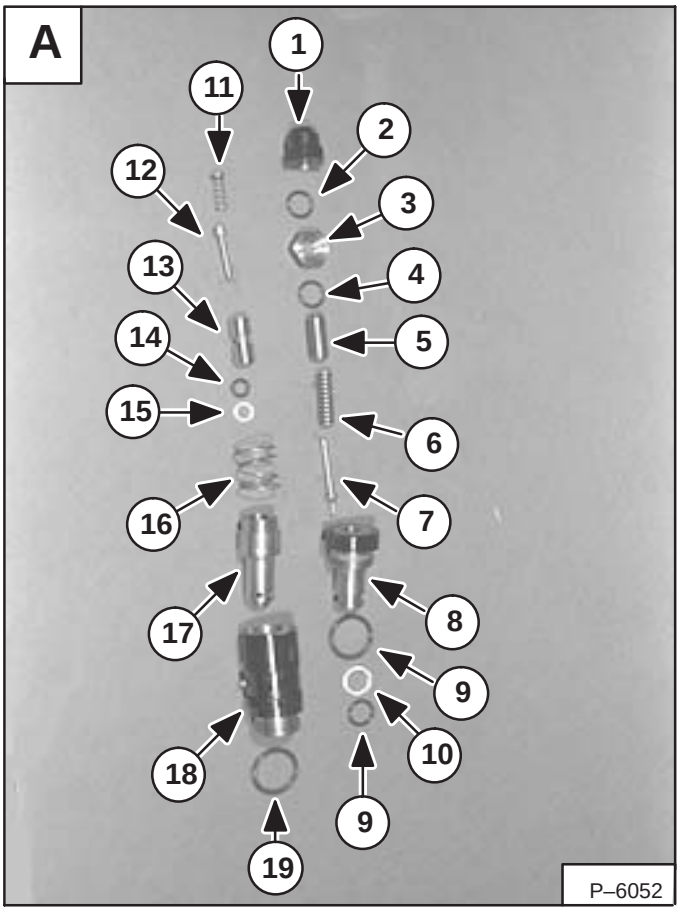
Turn the adjusting screw (Item 2) **[B]** clockwise to increase the pressure and counter clockwise to reduce the pressure.

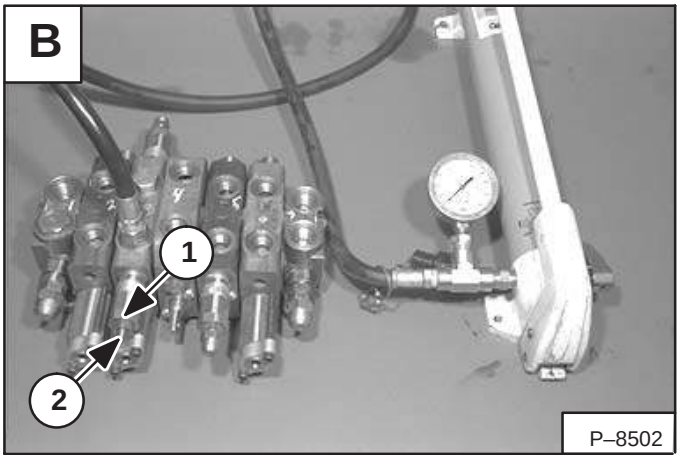
NOTE: 1/8 turn is approximately 100 PSI (690 kPa) and 1/4 turn is approximately 250 PSI (1724 kPa) when the correct pressure setting is obtained, tighten the locknut while holding the adjustment screw from turning.

Adjust the port relief valve until the correct setting is obtained. (See previous page for the port relief pressures.)

Install the end cap.

NOTE: The valve is shown out of the excavator for photo clarity.





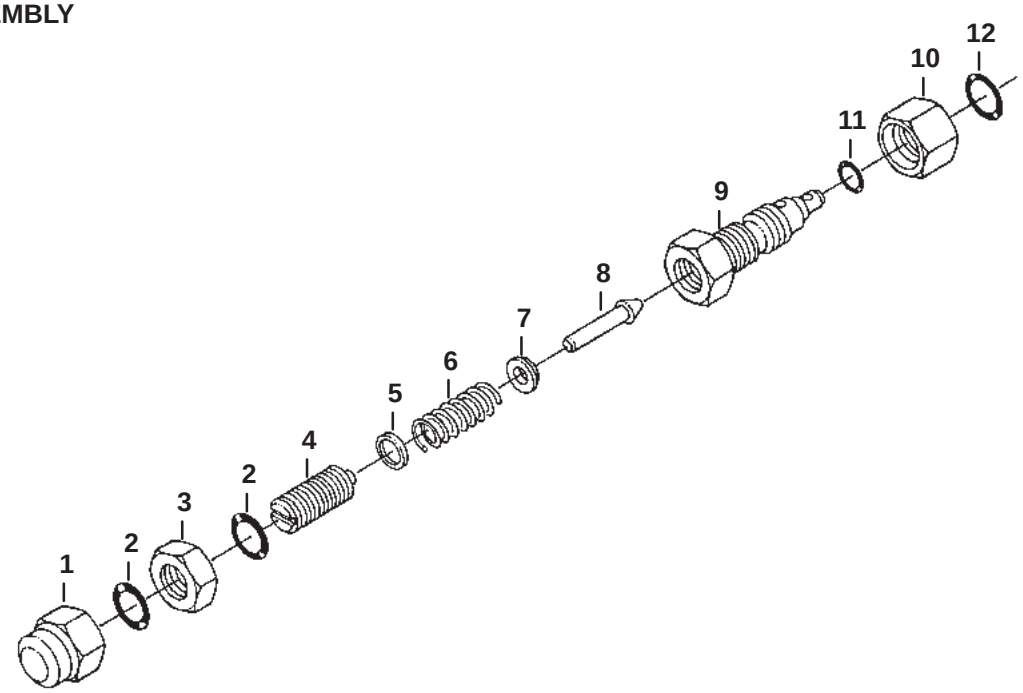
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MAIN RELIEF VALVES (Adjustable) (S/N 13001 & Above)

Parts Identification

RELIEF VALVE ASSEMBLY

1. Nut
2. O–ring
3. Nut
4. Screw
5. Shim
6. Spring
7. Stop
8. Poppet
9. Housing
10. Nut
11. O–ring
12. O–ring



C–3361

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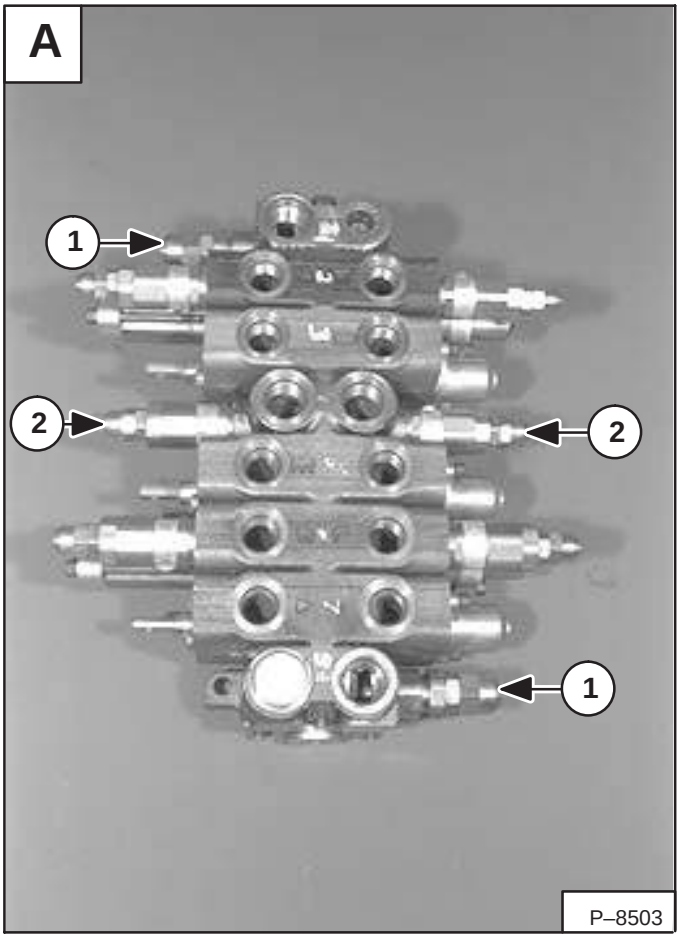
MAIN RELIEF VALVES (Adjustable) (S/N 13001 & Above) (Cont'd)

Assembly

Main Relief Valve pressure setting at the hydraulic pump:

Outlet Section Main Relief Valves (Item 1) **[A]** 2550 PSI (17582 kPa)

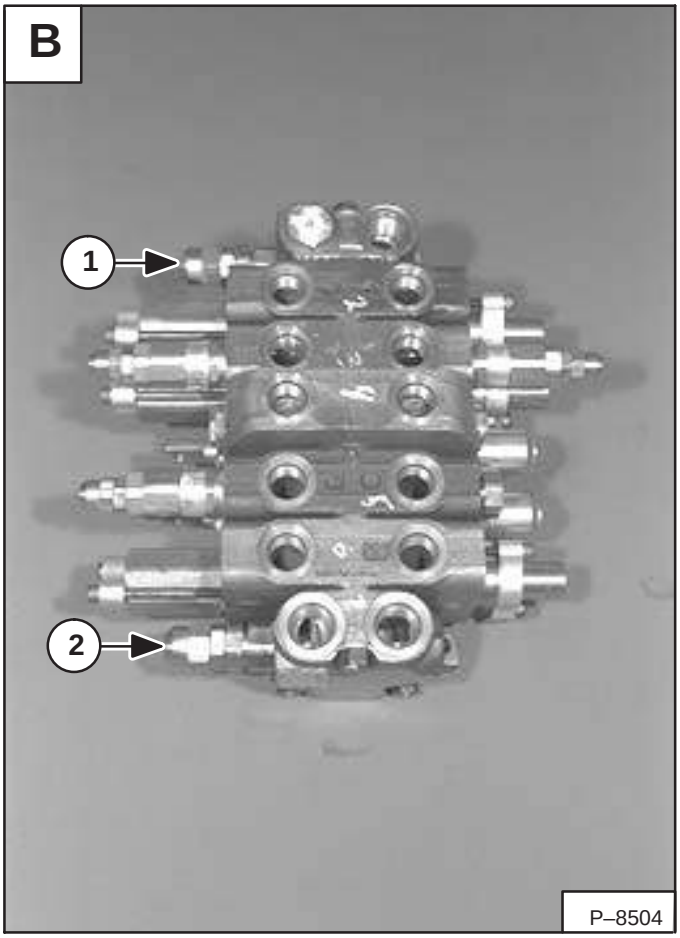
Mid Inlet Section Main Relief Valves (Item 2) **[A]** 3550 PSI (24477 kPa)



Inlet Section Main Relief Valve (Item 1) **[B]** 2550 PSI (17582 kPa)

Inlet Section Main Relief Valve (Item 2) **[B]** 4050 PSI (27925 kPa)

NOTE: All main relief pressure setting are measured from the hydraulic pump.



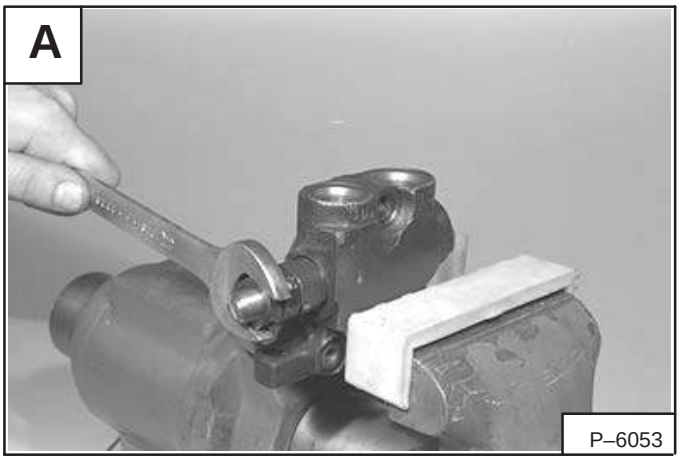
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MAIN RELIEF VALVES (Adjustable) (S/N 13001 & Above) (Cont'd)

NOTE: For Center Inlet Section Main Relief Valves. (See Page 2–70.)

Disassembly

Remove the main relief valve from the valve assembly **[A]**. If valve assembly is not being disassembled, plug the main relief cavity to avoid contamination.



Remove the end cap (Item 1) **[B]**, O–ring (Item 2) **[B]**, locknut (Item 3) **[B]** and O–ring (Item 4) **[B]** from the adjusting screw (Item 5) **[B]**.

Remove the adjusting screw (Item 5) **[B]**, shim (Item 6) **[B]**, spring (Item 7) **[B]**, spring stop (Item 8) **[B]** and poppet (Item 9) **[B]** from the housing (Item 10) **[B]**.

Remove the nut (Item 11) **[B]** and the O–ring (Item 12) **[B]** from the housing.

Remove the O–ring (Item 13) **[B]** from the nut.

Assembly

Put oil on the O–rings and install. Be careful not to over stretch these parts during installation.

Install the nut (Item 11) **[B]** on the housing (Item 10) **[B]**.

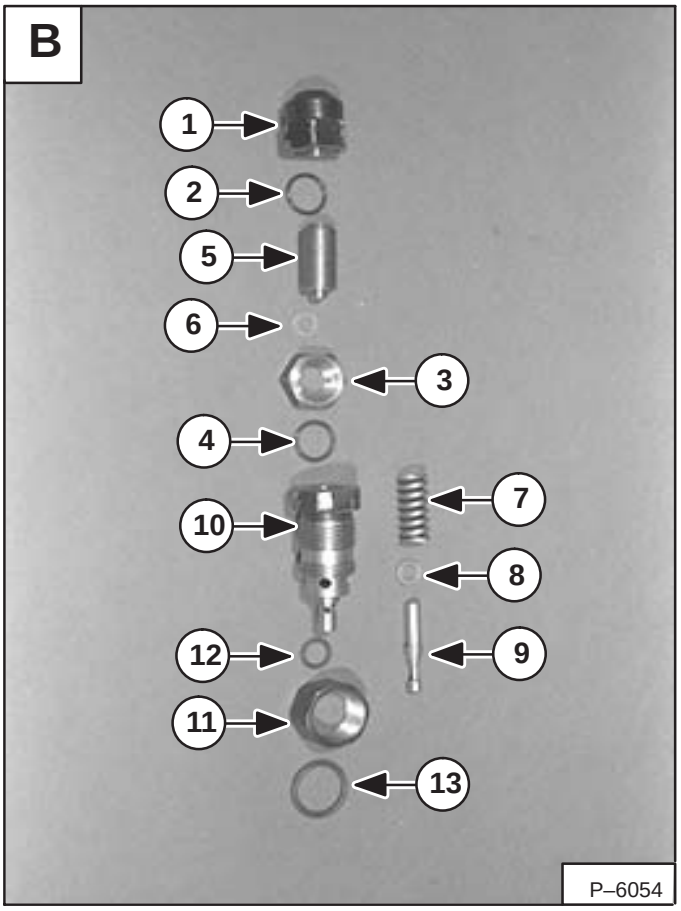
Install the poppet (Item 9) **[B]**, spring stop (Item 8) **[B]**, spring (Item 7) **[B]** and shim (Item 6) **[B]** into the housing.

Install the adjusting screw (Item 5) **[B]** into the housing (Item 10) **[B]**.

Install the lock nut (Item 3) **[B]** and end cap (Item 1) **[B]** on the adjusting screw (Item 5) **[B]**. Tighten to 16–20 ft.–lbs. (21–26 Nm) of torque.

Install the main relief valve in the inlet valve assembly. Tighten to 43–53 ft.–lbs (57–71 Nm) of torque.

The relief pressure setting must be reset.



⚠ 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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MAIN RELIEF VALVES (Adjustable) (S/N 13001 & Above) (Cont'd)

Adjusting the Main Relief Valves

Install the control valve into the excavator.

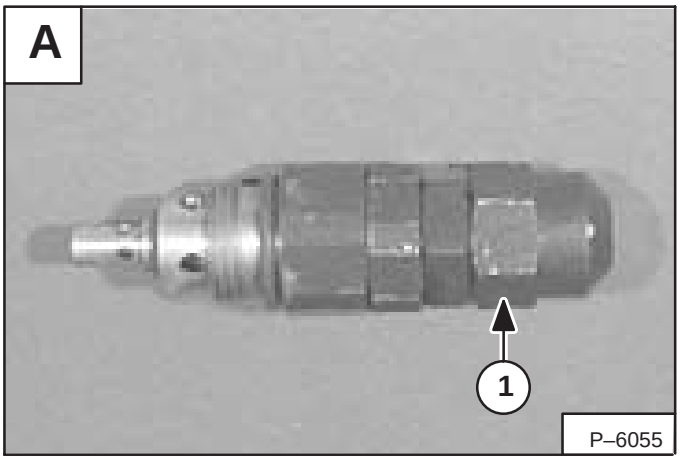
Install all hoses and tubelines.

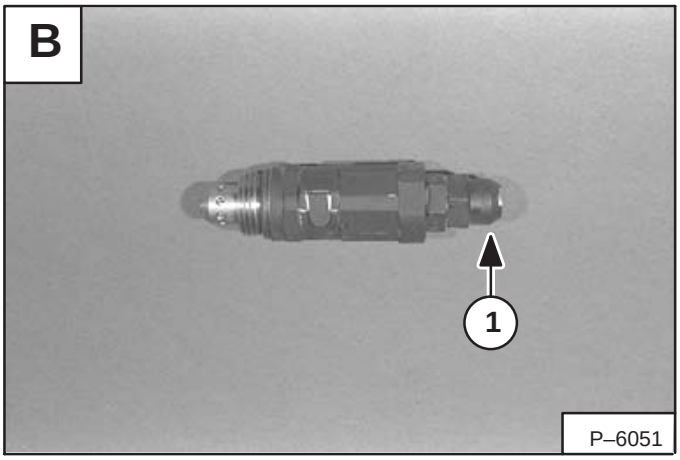
Install all the control linkages.

Test the relief valve pressure setting per information on Page 2–17.

If the relief valves need to be adjusted do the following:

Remove the end cap (Item 1) **[A]** & **[B]**.





Loosen the lock nut (Item 1) **[C]**.

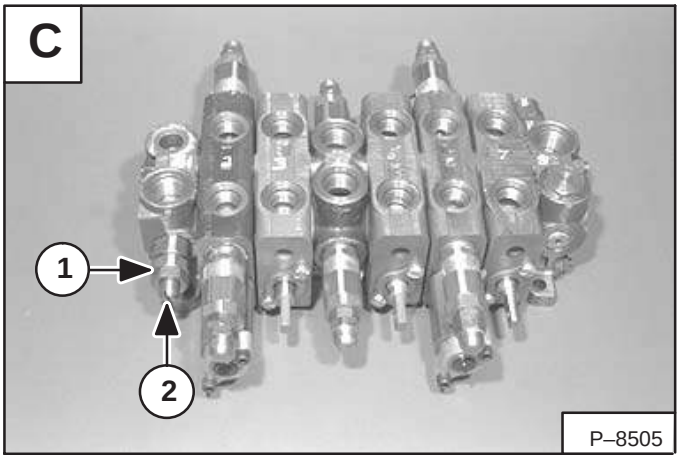
Turn the adjustment screw (Item 2) **[C]** clockwise to increase the pressure and counterclockwise to reduce the pressure.

When the correct pressure setting is obtained, tighten the lock nut while holding the adjusting screw from turning.

Adjust the main relief valve until the correct setting is obtained. (See Page 2–74 for main relief valve pressures.)

Install the end cap.

NOTE: The valve is shown out of the excavator for photo clarity.



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HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above)

Boost, Arm, Boom Swing, Blade and Swing Section

Description

The 5 spool hydraulic control valve has two main relief valves. One operates at 4050 PSI, the second operates at 2550 PSI. The blade section has one work port relief valve that operates at 3400 PSI. The arm section has two work port relief valves that operate at 2950 PSI.

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 floor mat. (See Page 4–6.)

Remove the floor plate. (See Page 4–6.)

Remove the control lever mounting plate. (See Page 3–36.)

Mark all hoses and tubes for correct installation.

Remove the bolt and tube clamps (Item 1) **[A]**.

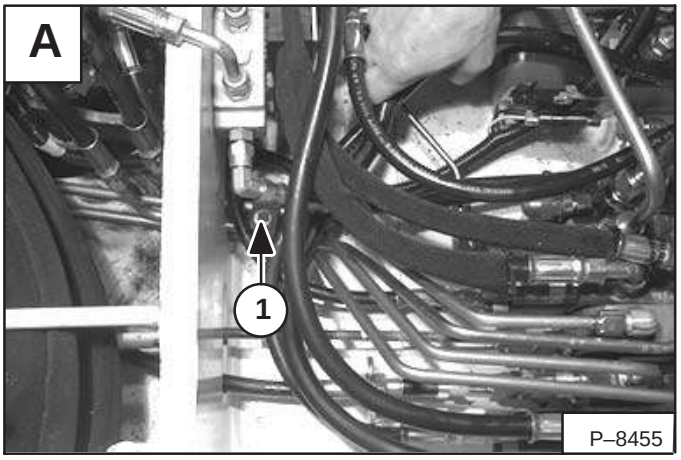
NOTE: This will allow the tubes to be moved after removing the tubes from the control valve providing clearance for valve removal.

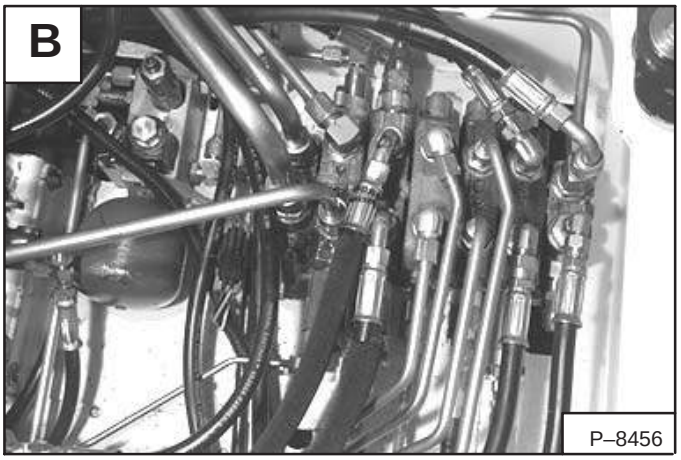
Remove the hoses and tubes from the control valve **[B]**.

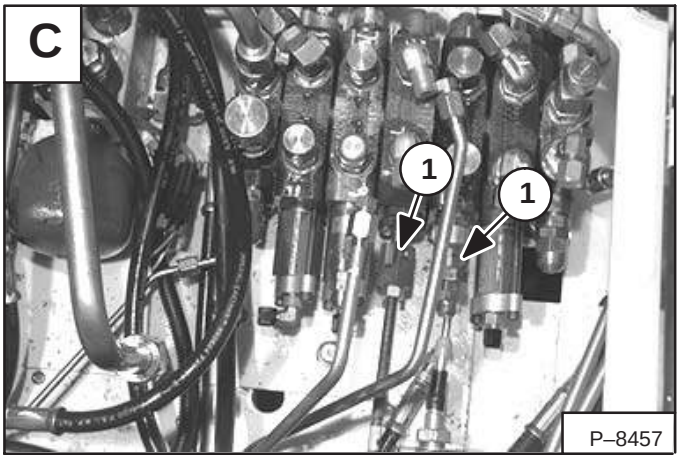
Remove the cotter pins (Item 1) **[C]** and linkage pins from the boom swing and blade valve section linkages.

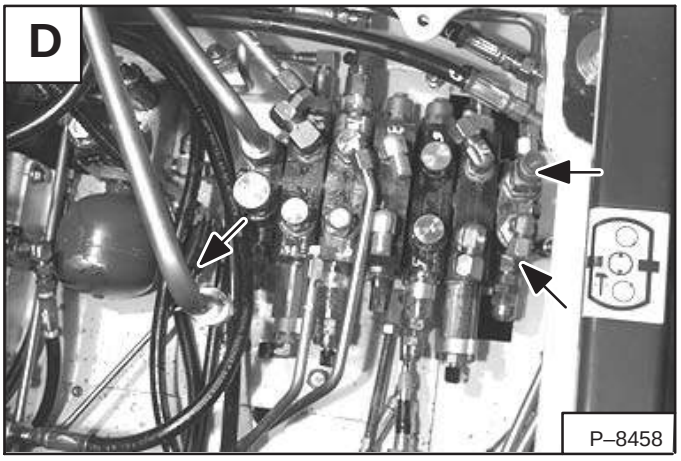
Remove the three (3) mounting bolts from the control valve **[D]**.

Remove the valve from the excavator.









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HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

Boost, Arm, Boom Swing, Blade and Swing Section (Cont'd)

Parts Identification

The Husco five spool control valve has seven different sections:

The inlet section (Item 1) **[A]**.

The boost section (Item 2) **[A]**.

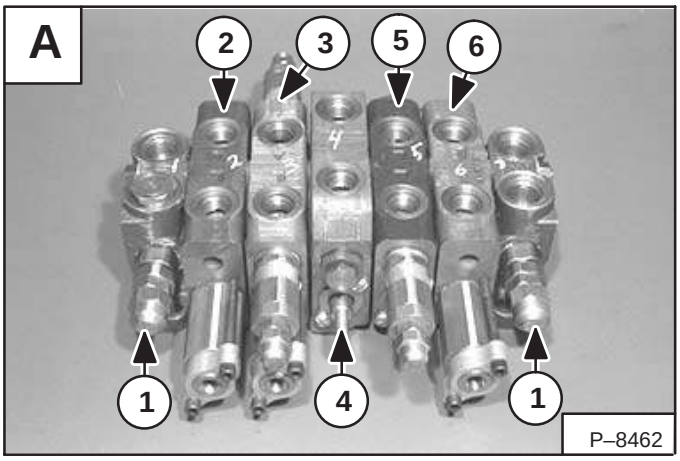
The arm section (Item 3) **[A]**.

The boom swing section (Item 4) **[A]**.

The blade section (Item 5) **[A]**.

The swing section (Item 6) **[A]**.

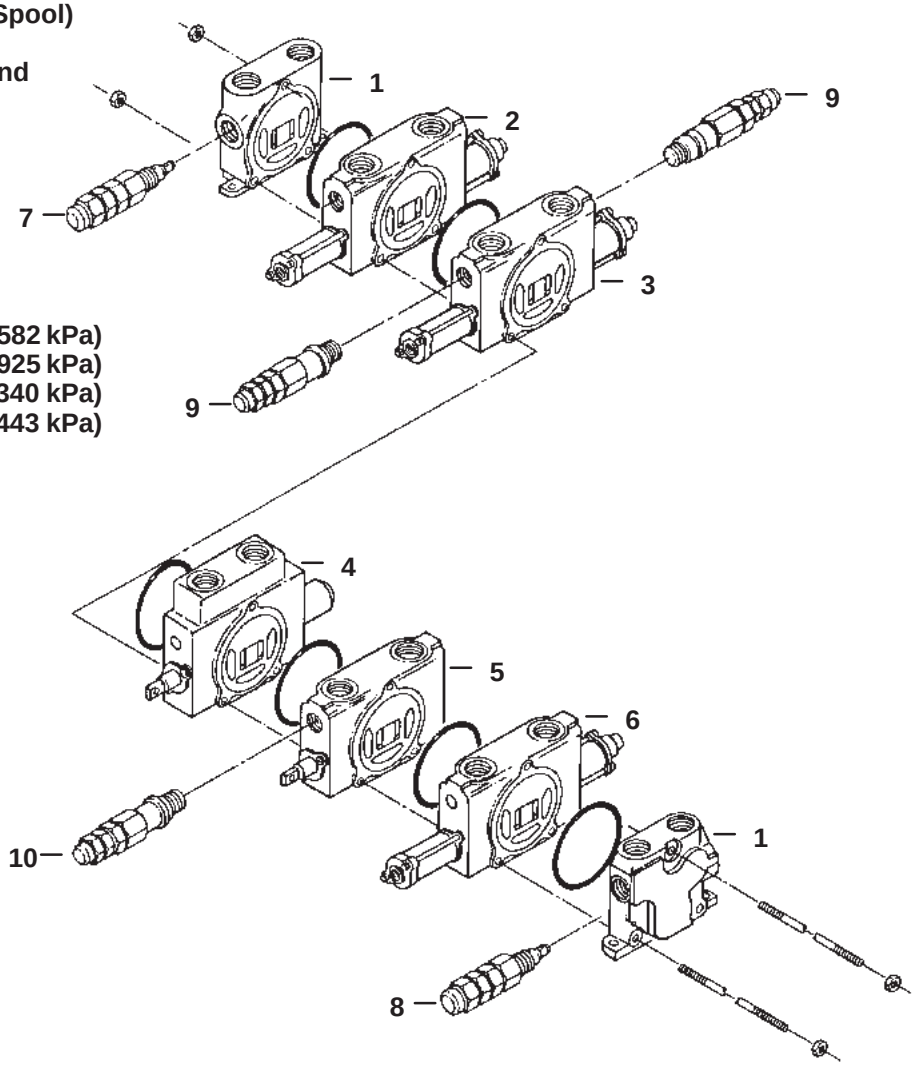
Each of the two (2) inlet sections on the valve have a main relief valve. The arm and blade sections have 3 work port relief valves.



CONTROL VALVE ASSEMBLY (5–Spool)

Boost, Arm, Boom Swing, Blade and Swing Section

1. **Inlet**
2. **Boost**
3. **Arm**
4. **Boom Swing**
5. **Blade**
6. **Swing**
7. **Main Relief Valve 2550 PSI (17582 kPa)**
8. **Main Relief Valve 4050 PSI (27925 kPa)**
9. **Port Relief Valve 2950 PSI (20340 kPa)**
10. **Port Relief Valve 3400 PSI (23443 kPa)**



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HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

Boost, Arm, Boom Swing, Blade and Swing Section (Cont'd)

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

Clean the control valve assembly with a solvent.

Disassembly

Remove all the fittings from the control valve before disassembling the valve. Install new O–rings onto the fittings before reusing them.

Mark the section for ease of assembly.

Remove the nuts from the three (3) tie rods **[A]**.

Remove the inlet valve section from the valve assembly **[B]**.

Continue to remove all the valve sections **[C]**. Keep the valve sections in the correct order for ease of assembly.

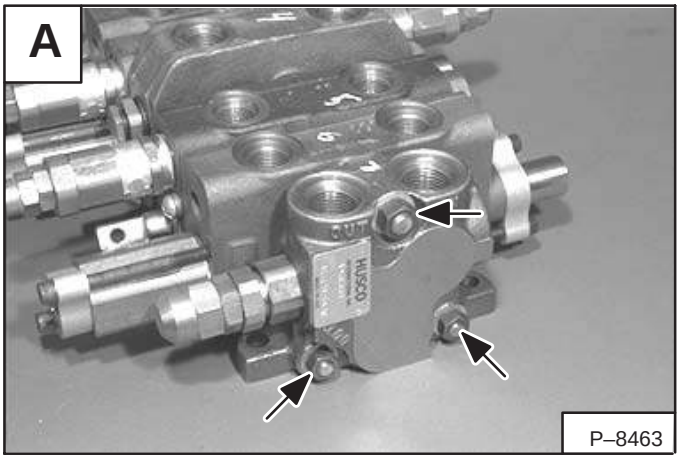
Remove the O–ring (Item 1) **[D]**, spring (Item 2) **[D]** and the load check valve (Item 3) **[D]** from the valve body.

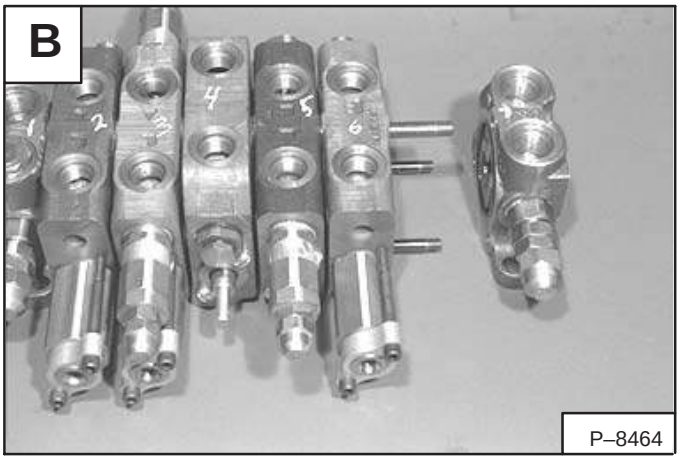
NOTE: There is no spring and load check valve in the boom swing valve section.

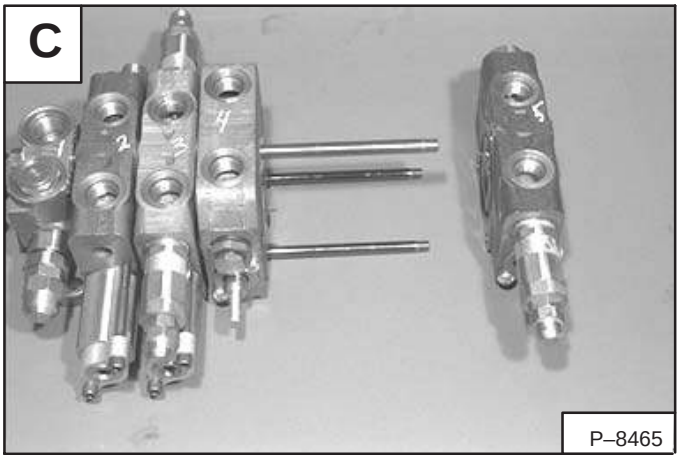
If only the valve section O–rings need replacing, clean and dry the side faces of the sections and the O–ring glands.

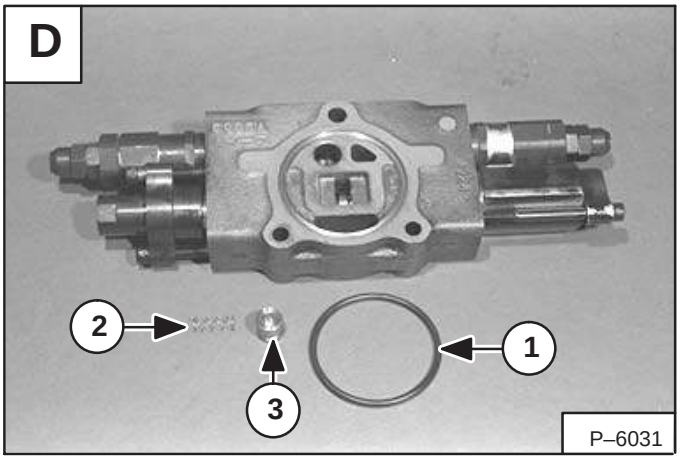
Install new O–rings and reassemble the valve.

See Page 2–94 for tightening torque.









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HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

Boost, Arm, Boom Swing, Blade and Swing Section (Cont'd)

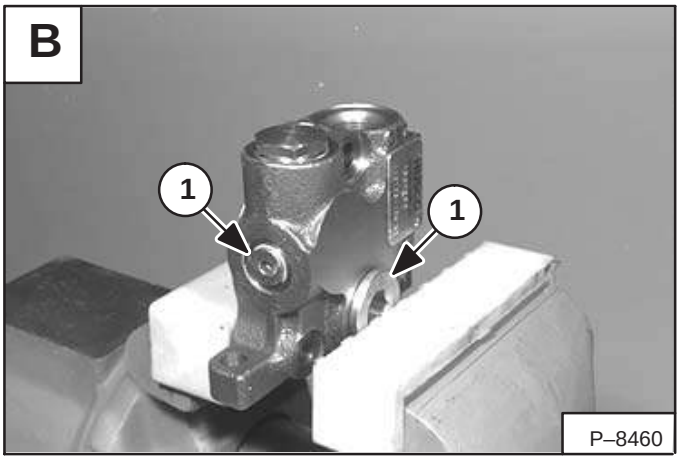
Inlet Section

Put the valve section in a vise with protective jaws.

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



Remove the plugs (Item 1) **[B]** from the inlet section (if equipped).



Remove the O–rings (Item 2) **[C]** from the plugs.

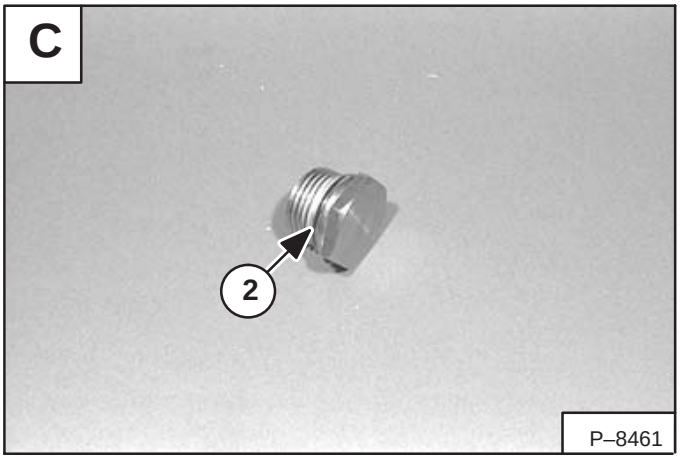
Clean the valve section in solvent and dry.

Install the main pressure relief valve into the valve section. Tighten to 43–53 ft.–lbs. (57–71 Nm) of torque.

Oil and install new O–rings on the plugs.

Install the plugs in the inlet section.

NOTE: If the main pressure relief valve is disassembled the relief pressure setting must be reset. See Page 2–73 for main relief valve repair.



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HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

Boost, Arm, Boom Swing, Blade and Swing Section (Cont'd)

Arm, Boost and Swing Motor Disassembly

Put the valve section in a vise with protective jaws.

Remove the work port relief valve from both ends of the valve section **[A]**.

NOTE: Only the arm section is equipped with work port relief valves.

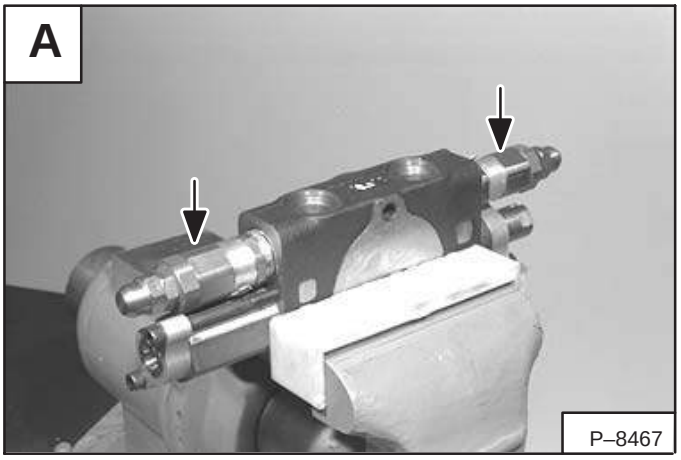
Installation: Tighten the port relief valve to 30–36 ft.–lbs. (40–48 Nm) of torque.

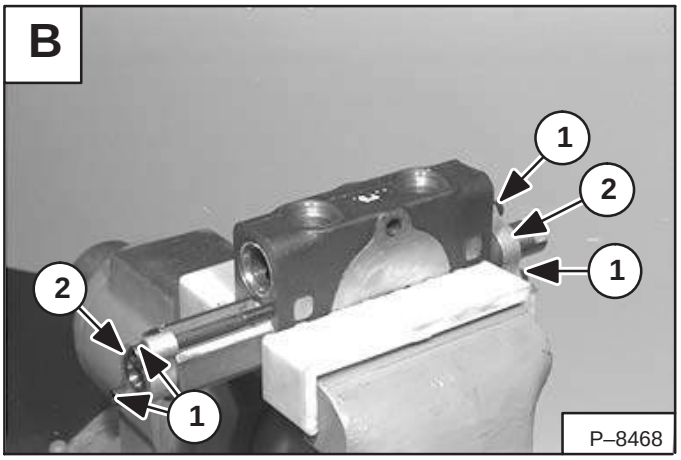
NOTE: If the relief valve is disassembled the relief pressure setting must be reset. See Page 2–70 for port relief valve repair.

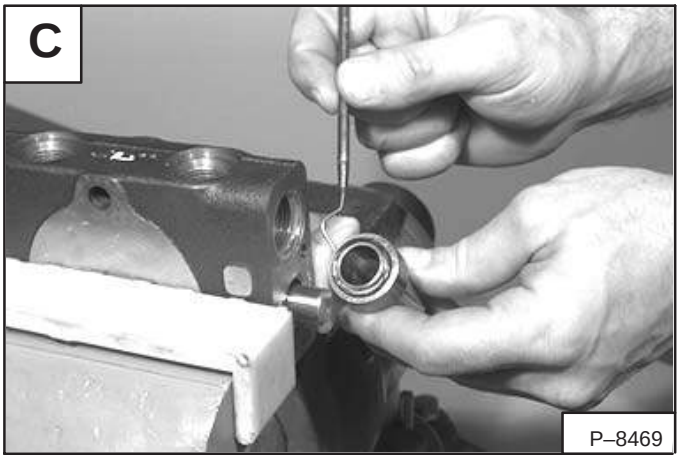
Remove the four (4) screws (Item 1) **[B]** and retaining plates (Item 2) **[B]** from both end covers.

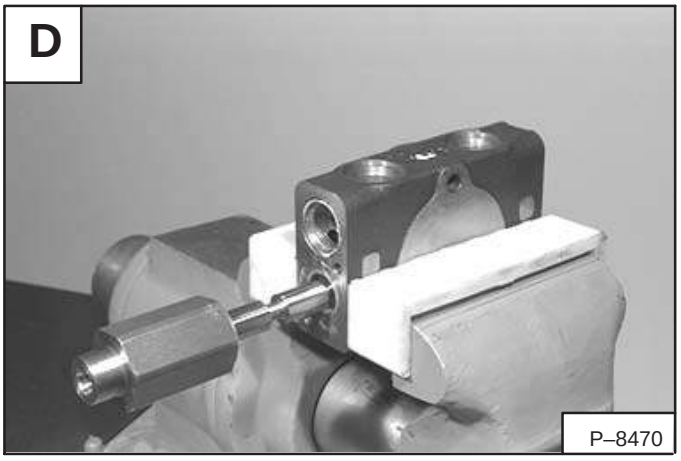
Remove the end cover from the end of the valve. Remove the O–ring **[C]**.

Remove the end cover and spool from the valve section **[D]**.









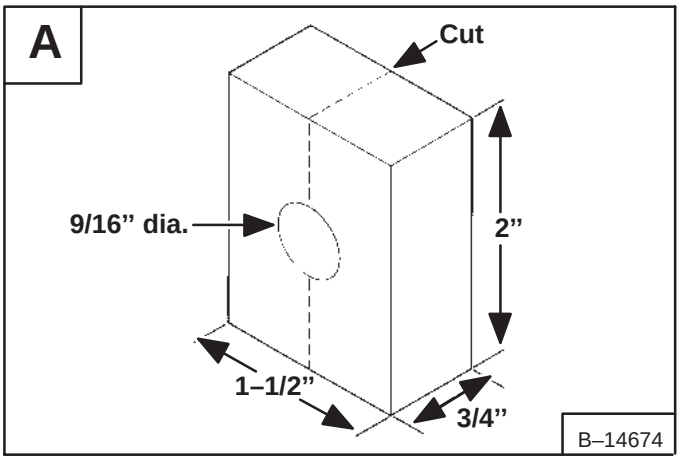
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HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

Boost, Arm, Boom Swing, Blade and Swing Section (Cont'd)

Arm, Boost and Swing Motor Disassembly (Cont'd)

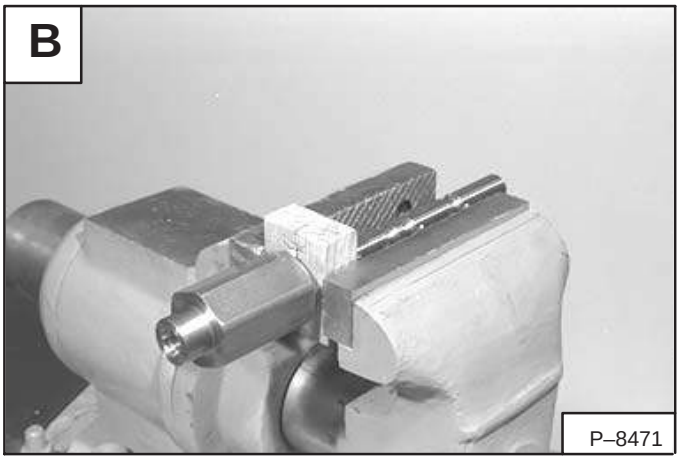
To remove the end cover from the spool, a holding fixture will have to be made from a 3/4'' thick X 1–1/2'' wide X 2'' long (19 mm thick X 38 mm wide X 50 mm long) piece of hardwood. Drill a 9/16'' (14 mm) hole in the center of the hardwood block. Cut the block length wise **[A]**.



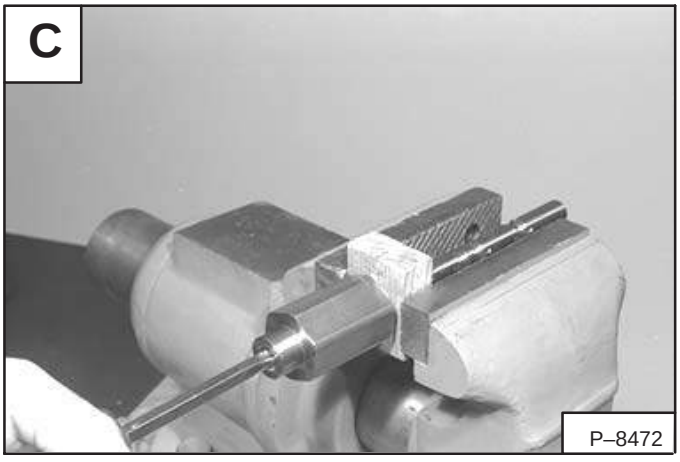
Place both halves of the hardwood block around the spool, next to the end cover.

Clamp the blocks in a vise **[B]**.

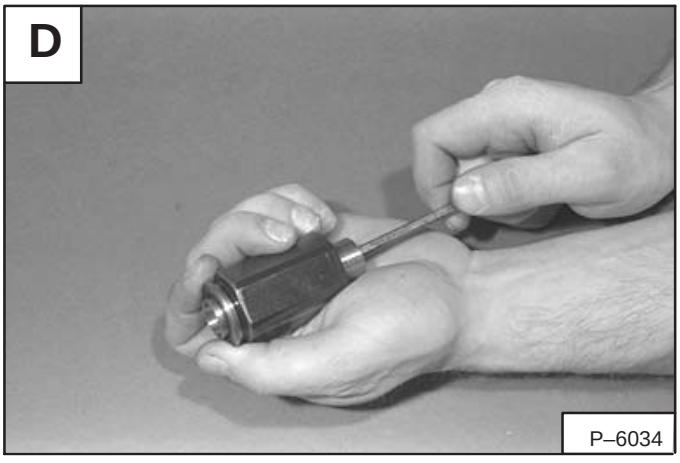
NOTE: Do not use anything other than hardwood blocks to grip the spool, or the spool will be damaged.



Remove the end cover from the spool **[C]**. Use care not to scratch the spool, as the spool and housing are not serviceable separately.



Remove the retainer from the end cover by pushing on the bolt head **[D]**.



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HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

Boost, Arm, Boom Swing, Blade and Swing Section (Cont'd)

Arm, Boost and Swing Motor Disassembly (Cont'd)

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

Remove the spring seat (Item 3) **[A]**, the inner spring (Item 4) **[A]**, the outer spring (Item 5) **[A]** and the second spring seat (Item 3) **[A]**.

Arm, Boost and Swing Motor Assembly

Clean parts in solvent and dry.

Oil and install new O–rings (Item 1) **[A]** on the retainer (Item 2) **[A]**.

Apply thread adhesive (LOCTITE #271) to the spring retaining bolt (Item 6) **[A]**.

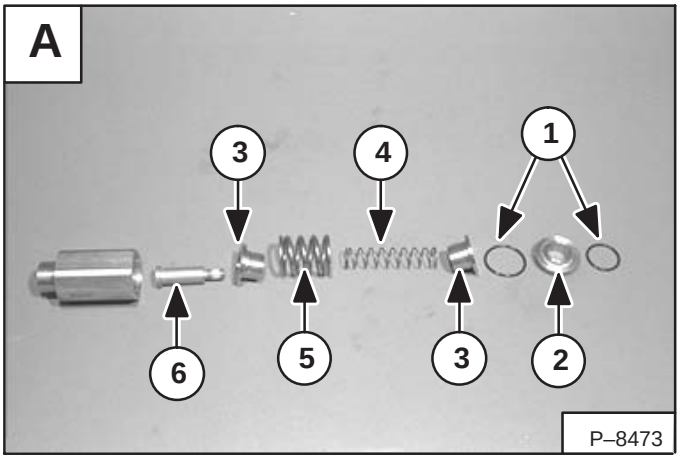
Install the spring seat (Item 3) **[A]**, the outer spring (Item 5) **[A]**, the inner spring (Item 4) **[A]**, inner spring seat (Item 3) **[A]**, the bolt (Item 6) **[A]** and the retainer (Item 2) **[A]** into the end cover.

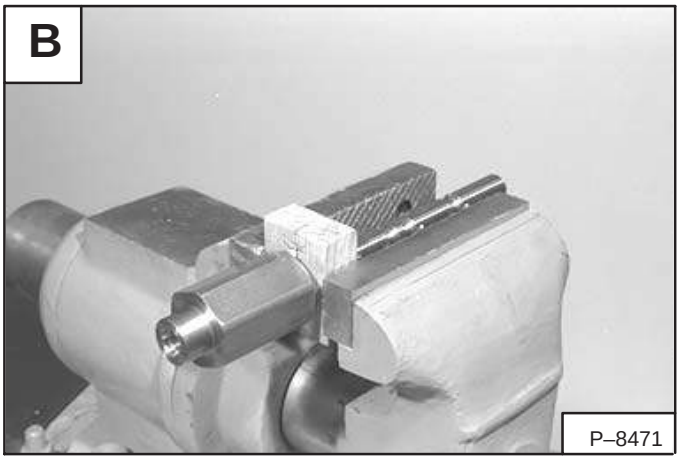
Clamp the spool in a vise using the hardwood fixture used for disassembly **[B]**.

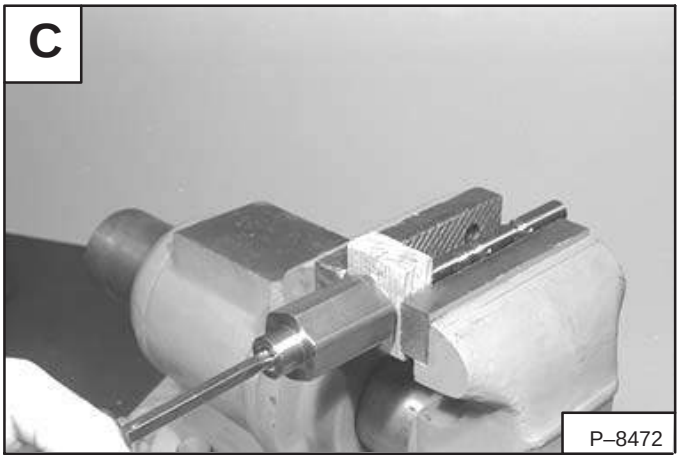
Install the end cover on the spool **[C]**.

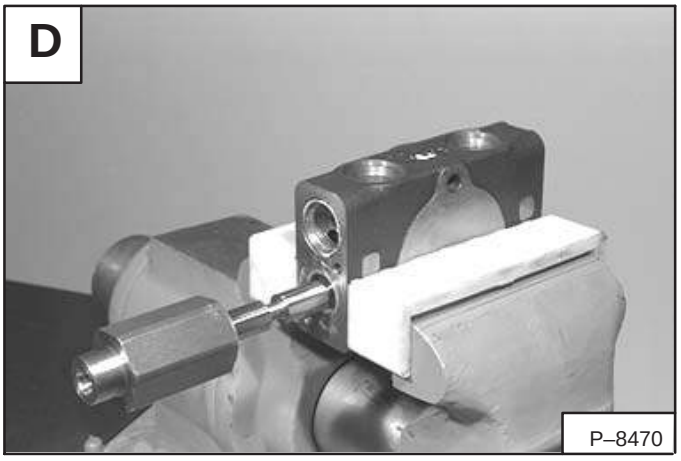
Tighten the spring retaining bolt to 6–8 ft.–lbs. (8–10 Nm) of torque.

Install the end cover and spool in the valve section **[D]**.









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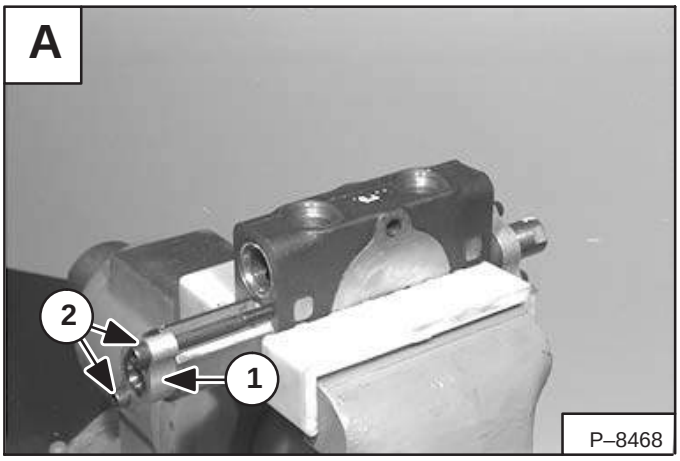
HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

Boost, Arm, Boom Swing, Blade and Swing Section (Cont'd)

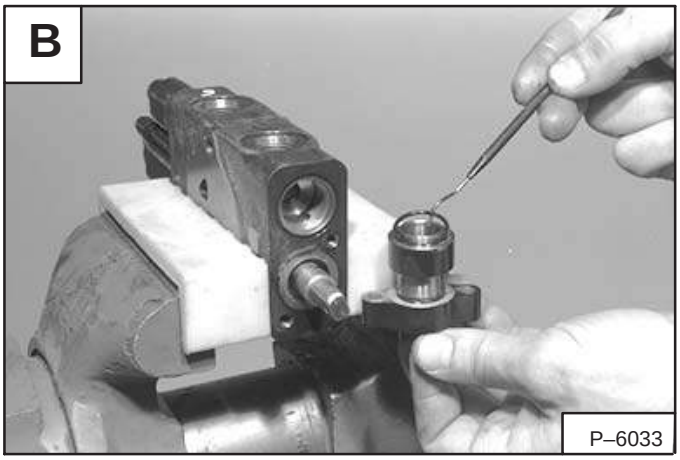
Arm, Boost and Swing Motor Assembly (Cont'd)

Install the end cover retaining plate (Item 1) **[A]** and screws (Item 2) **[A]** on the end cover.

Tighten the screws to 6–9 ft.–lbs. (8–10 Nm) of torque.

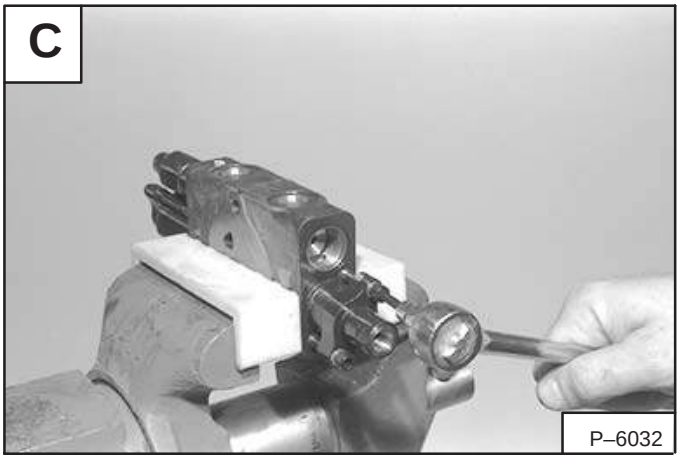


Oil and install a new O–ring on the end cover for the end of the valve section **[B]**.



Install the end cover, the end cover retaining plate and the screws **[C]**.

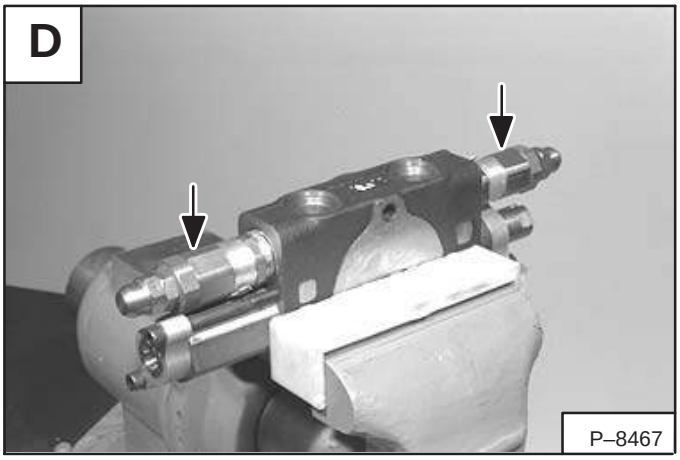
Tighten the screws to 6–9 ft.–lbs. (8–10 Nm) torque.



Install the port relief valves on the valve section.

Tighten to 30–36 ft.–lbs. (40–48 Nm) of torque.

NOTE: Only the arm section is equipped with two (2) work port reliefs.



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HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

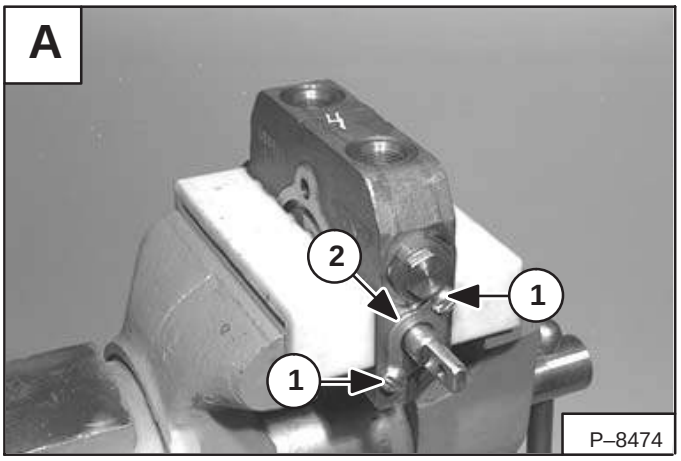
Boost, Arm, Boom Swing, Blade and Swing Section (Cont'd)

Boom Swing Disassembly

Put the valve section in a vise with protective jaws.

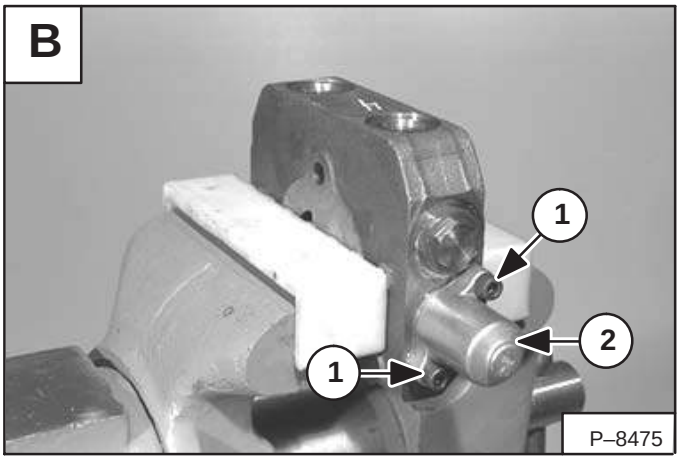
Remove the two (2) screws (Item 1) **[A]** holding the plate (Item 2) **[A]** to the valve section.

Remove the plate.



Remove the two (2) screws (Item 1) **[B]** holding the end cover (Item 2) **[B]** to the valve section.

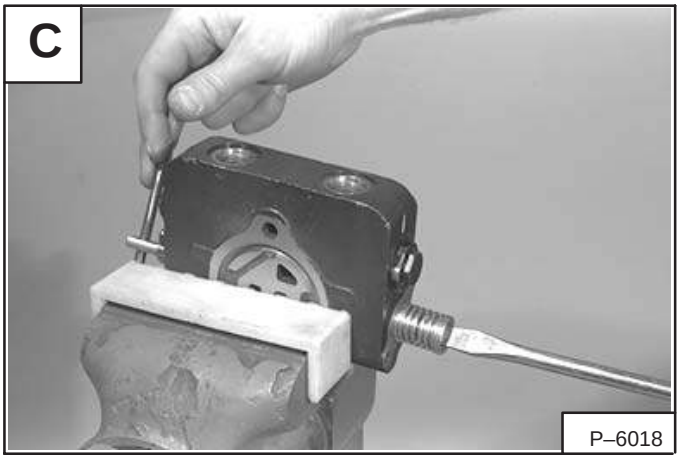
Remove end cover.



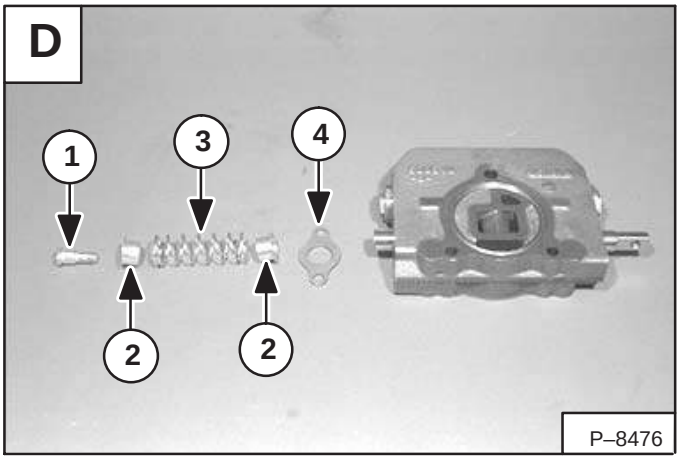
Insert a pin into the hole in the actuating end of the spool to prevent the spool from turning. Remove the spring retaining screw from the spool **[C]**.

NOTE: The spring is under pressure, use care when removing the spring retaining screw.

Do not use any type of tool to grip the finished surface of the spool; the spool will be damaged.



Remove the spring retainer screw (Item 1) **[D]**, outer spring seat (Item 2) **[D]**, spring (Item 3) **[D]** and the inner spring seat (Item 2) **[D]** from the spool. Remove the plate (Item 4) **[D]** from the valve section.



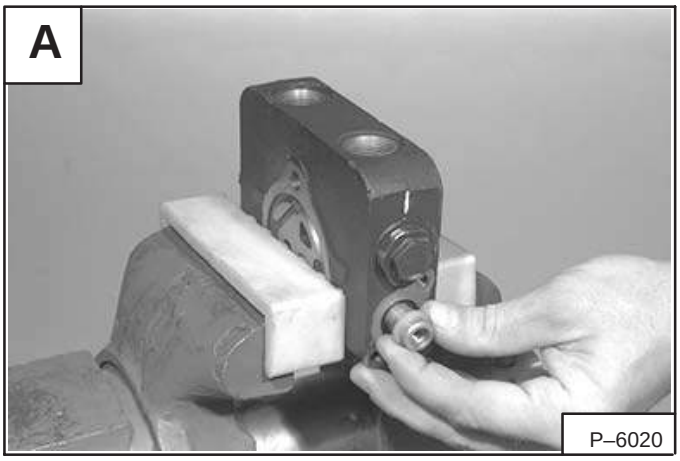
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HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

Boost, Arm, Boom Swing, Blade and Swing Section (Cont'd)

Boom Swing Disassembly (Cont'd)

Remove the wiper from both ends of the spool **[A]**.

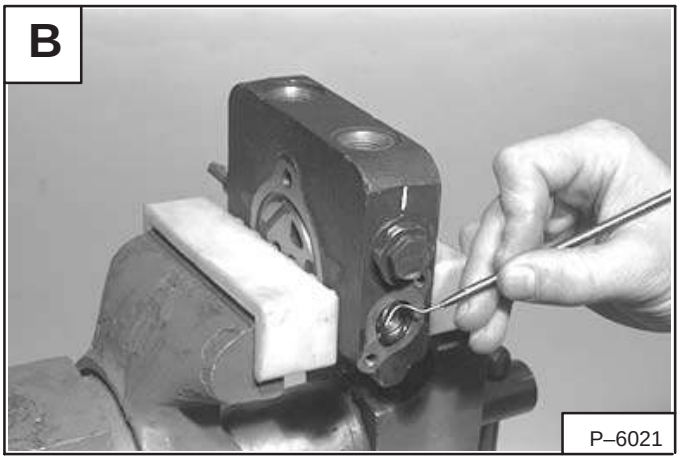


Pull the spool into the housing far enough to remove the O–ring from the spool bore in the valve section. Use a brass tool to remove the O–ring **[B]**. Do not scratch the bore of the valve section while removing the O–ring; leakage may occur.

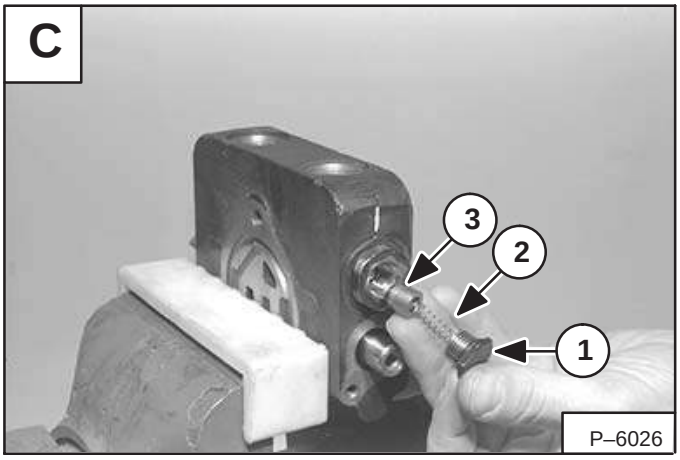
Repeat this procedure for the opposite side of the spool.

Check the O–ring gland for contamination and clean as necessary.

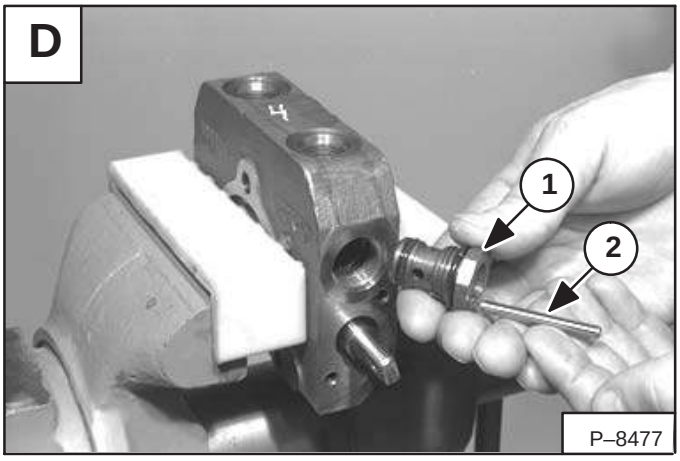
The spool and the housing are not serviceable separately. The spool does not need to be removed from the housing except to clean the oil passages if contamination is found. If the spool is removed use care not to scratch the spool surface and do not intermix the spool and housings.



Remove the plug (Item 1) **[C]**, spring (Item 2) **[C]** and poppet (Item 3) **[C]** from both ends of the valve section.



Remove the housing (Item 1) **[D]** and pin (Item 2) **[D]** from the actuating end of the valve section.



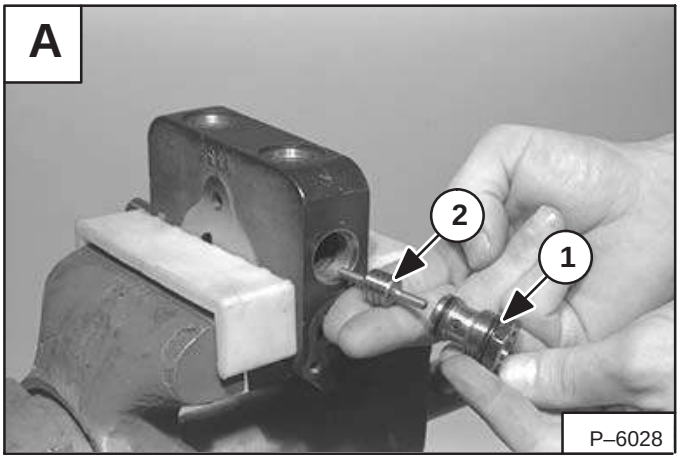
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HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

Boost, Arm, Boom Swing, Blade and Swing Section (Cont'd)

Boom Swing Disassembly (Cont'd)

Remove the housing (Item 1) **[A]** and the spool (Item 2) **[A]** from the rear of the valve section.



Remove the O–rings and the back–up rings from the housing and plug **[B]** & **[C]**.

Boom Swing Assembly

Clean all parts in solvent and dry.

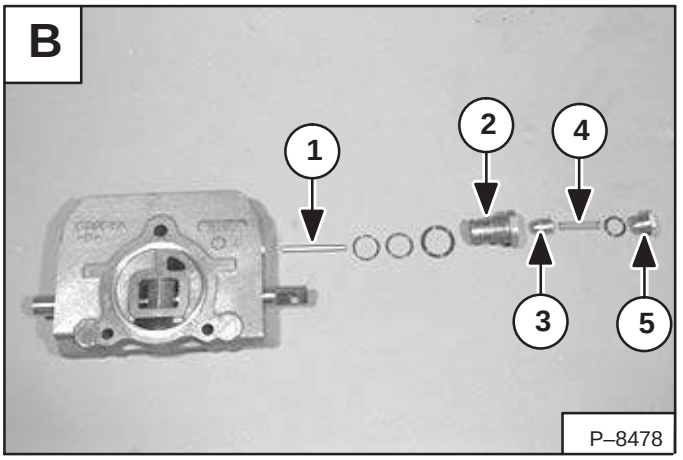
Install the new O–rings and back–up rings on both of the housings and on both of the plugs. Apply oil to the O–rings.

Install the pin (Item 1) **[B]** and the housing (Item 2) **[B]** into the actuating end of the valve.

Install the poppet (Item 3) **[B]**, the spring (Item 4) **[B]** and the plug (Item 5) **[B]**.

Tighten the housing (Item 2) **[B]** to 43–53 ft.–lbs. (58–71 Nm) of torque.

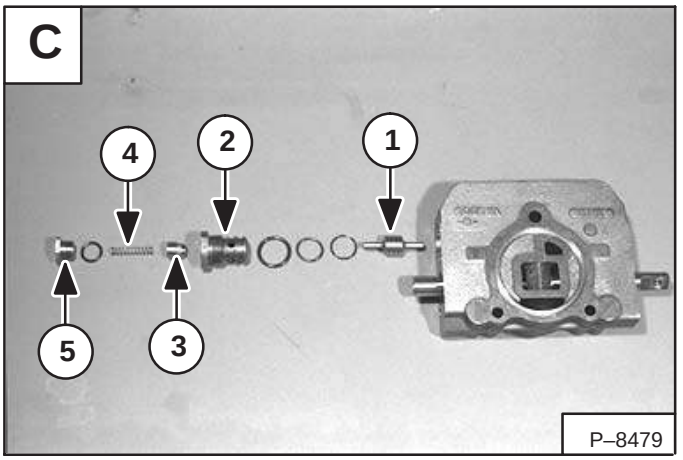
Tighten the plug (Item 5) to 15 ft.–lbs. (20 Nm) of torque.



Install the spool (Item 1) **[C]** and the housing (Item 2) **[C]** in the valve. Tighten the housings to 43–53 ft.–lbs. (58–71 Nm) of torque.

Install the poppet (Item 3) **[C]**, spring (Item 4) **[C]** and the plug (Item 5) **[C]**.

Tighten the plug (Item 5) **[C]** to 15 ft.–lbs. (20 Nm) of torque.



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HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

Boost, Arm, Boom Swing, Blade and Swing Section (Cont'd)

Boom Swing Assembly (Cont'd)

Clean all parts with solvent and dry.

Install new O–rings by pinching the O–ring and inserting it into the O–ring gland. Use a brass tool to position the O–ring firmly into the O–ring gland **[A]**.

Put oil on the O–ring and slowly rotate the spool while pushing it through the valve section. Pull the spool far enough into the housing to install a new O–ring on the opposite end of the spool. Repeat the above steps for installing the spool O–ring.

Install the wiper on both ends of the spool **[B]**.

Use finger pressure to seat the wiper into the bore of the valve.

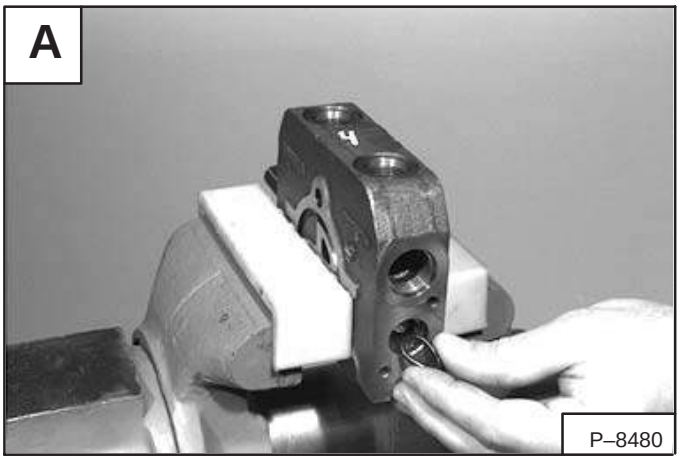
Install the plate and the two (2) screws on the actuating end of the spool **[C]**.

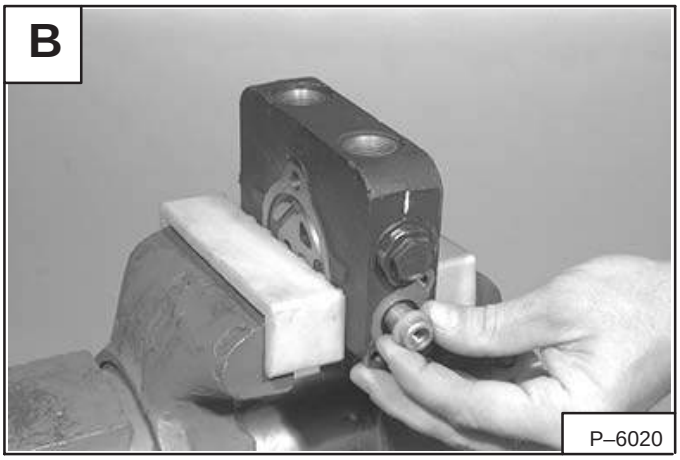
Tighten the screws to 3–5 ft.–lbs. (4–6 Nm) torque.

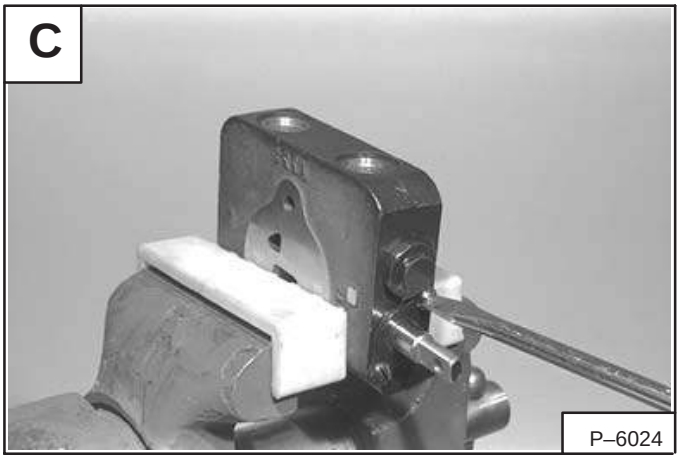
Apply thread adhesive (LOCTITE #271) to the spring retaining screw (Item 4) **[D]**.

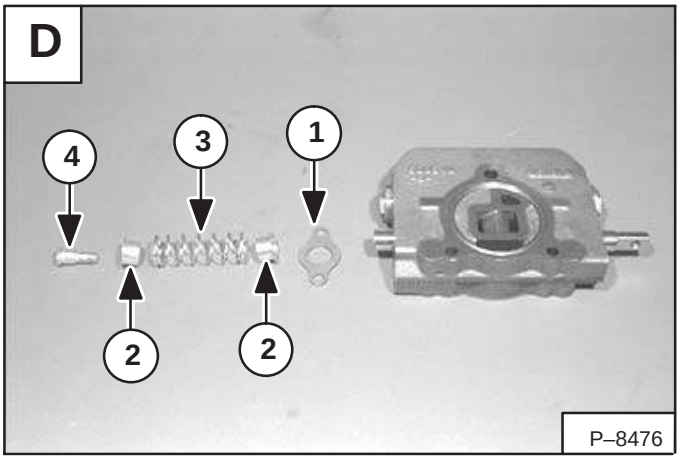
Slide the plate (Item 1) **[D]** over the spool, install the inner spring seat (Item 2) **[D]** on the end of the spool.

Install the spring (Item 3) **[D]** on the spool. Install the outer spring seat (Item 2) **[D]** and the retaining screw (Item 4) **[D]**.









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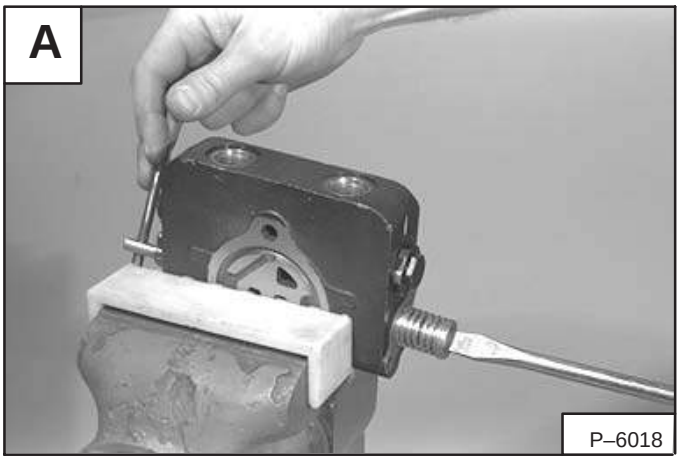
HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

Boost, Arm, Boom Swing, Blade and Swing Section (Cont'd)

Boom Swing Assembly (Cont'd)

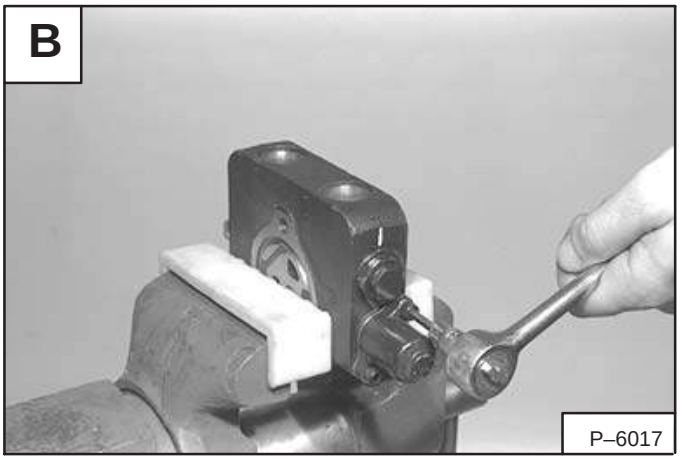
Insert a pin in the hole in the actuating end of the spool to prevent the spool from turning **[A]**.

Tighten the retainer screw to 6–8 ft.–lbs. (8–10 Nm) torque.



Install the end cover over the spring and install the two (2) screws **[B]**.

Tighten the screws to 6–8 ft.–lbs. (8–10 Nm) torque.



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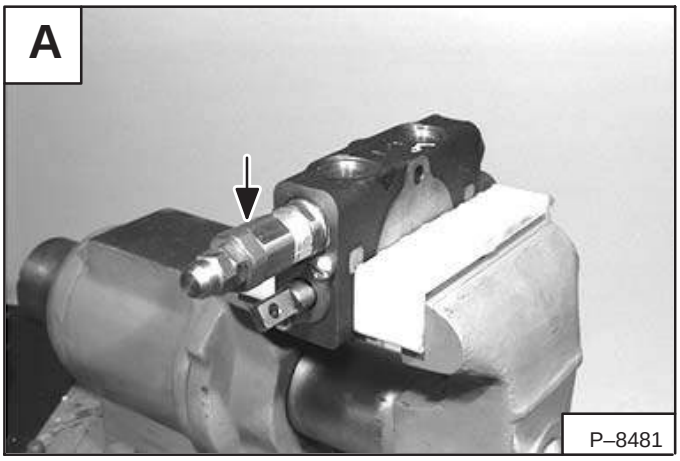
HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

Boost, Arm, Boom Swing, Blade and Swing Section (Cont'd)

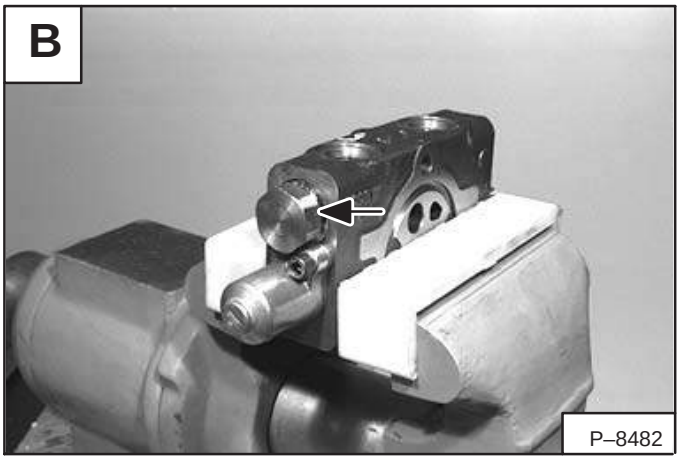
Blade Disassembly

Use a vise with protective jaws and clamp the valve section.

Remove the port relief valve from the actuating end of the valve section **[A]**.



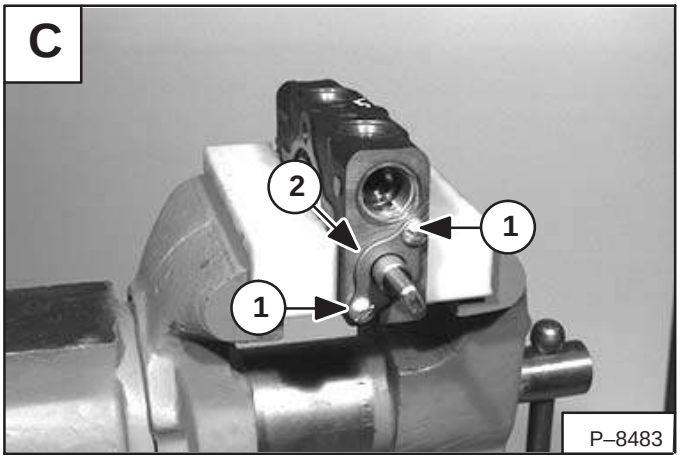
Remove the plug from the rear of the valve section **[B]**.



Put the valve section in a vise with protective jaws.

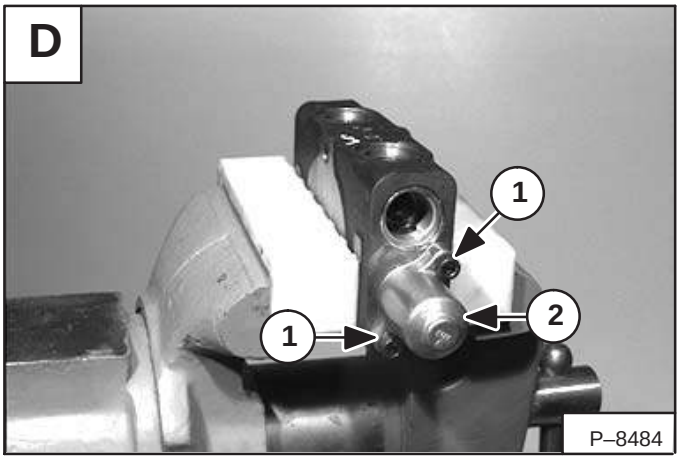
Remove the two (2) screws (Item 1) **[C]** from the retaining plate on the actuating end of the spool.

Remove the retaining plate (Item 2) **[C]**.



Remove the two (2) screws (Item 1) **[D]** from the end cap.

Remove the end cap (Item 2) **[D]**.



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HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

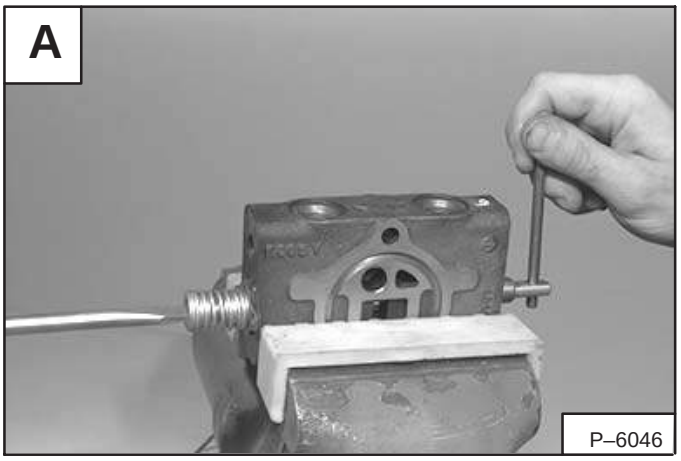
Boost, Arm, Boom Swing, Blade and Swing Section (Cont'd)

Blade Disassembly (Cont'd)

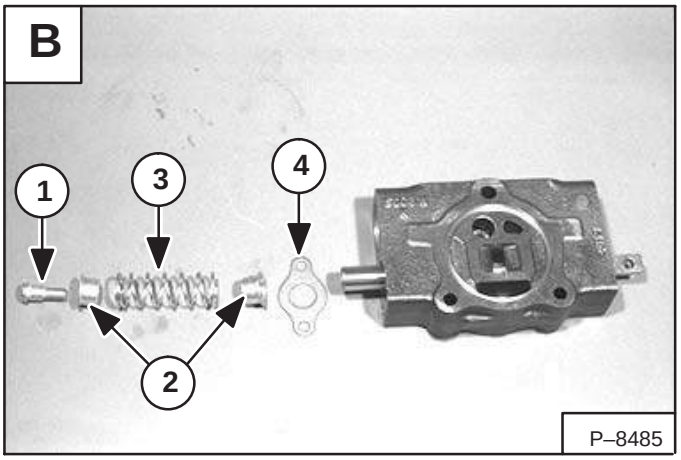
Insert a pin into the hole in the actuating end of the spool to retain the spool from turning.

Remove the spring retaining screw from the end of the spool **[A]**.

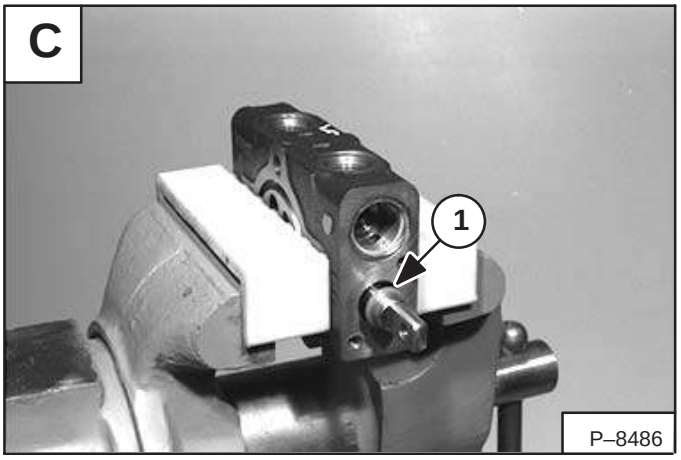
NOTE: The spring is under pressure, use care when removing the spring retaining screw.



Remove the spring retaining screw (Item 1) **[B]**, the spring retainer (Item 2) **[B]**, the spring (Item 3) **[B]**, the spring retainer (Item 2) **[B]** and the plate (Item 4) **[B]**.



Remove the wiper (Item 1) **[C]** from both ends of the spool.

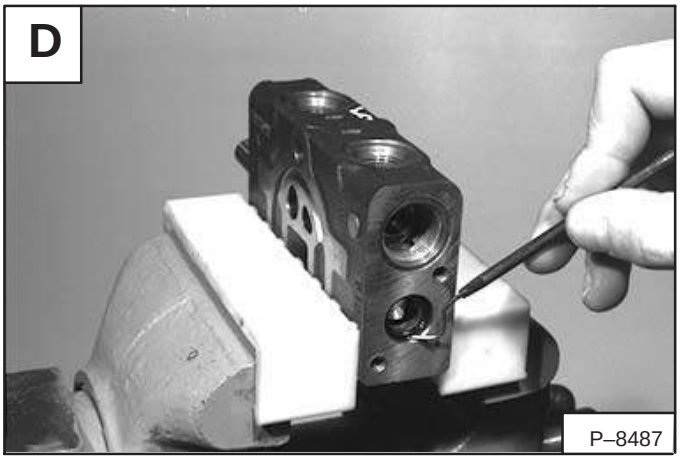


Pull the spool into the housing far enough to remove the spool O–ring from the bore in the valve section **[D]**.

Use a brass tool to remove the O–ring. Do not scratch the bore of the valve section while removing the O–ring or leakage may occur.

Push the other end of the spool into the housing and remove the O–ring from the opposite end.

Check the O–ring gland for contamination and clean as necessary.



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HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

Boost, Arm, Boom Swing, Blade and Swing Section (Cont'd)

Blade Assembly

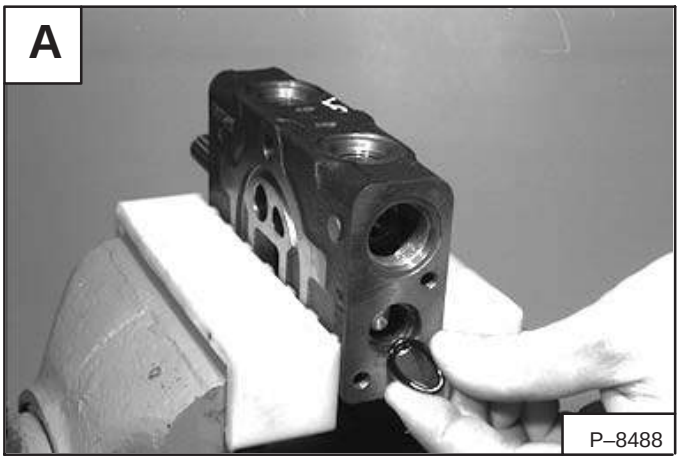
Install a new O–ring into the bore of the valve section by pinching the O–ring and inserting it into the O–ring gland **[A]**.

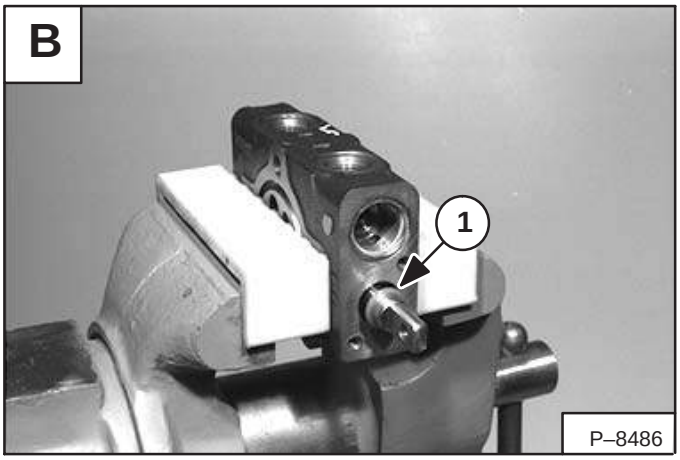
Use a brass tool and position the O–ring firmly into the O–ring gland.

Apply oil to the O–ring.

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

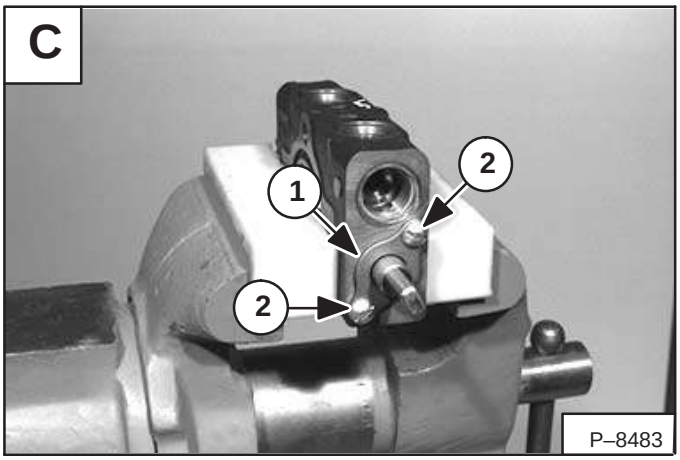
Install the wiper (Item 1) **[B]** on both ends of the spool. Use finger pressure to seat the wiper into the bore of the valve.





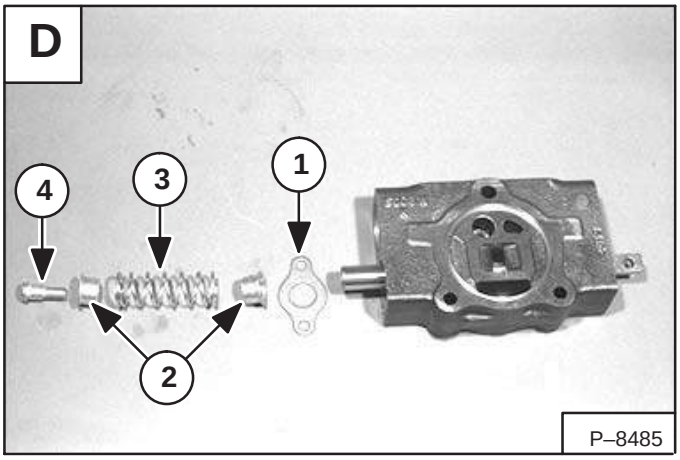
Install the retainer plate (Item 1) **[C]** and the two (2) screws (Item 2) **[C]**.

Tighten the screws to 3–5 ft.–lbs. (4–6 Nm) of torque.



Install the retaining plate (Item 1) **[D]**, the spring seat (Item 2) **[D]**, the spring (Item 3) **[D]** and the outer spring seat (Item 2) **[D]** on the end of the spool.

Apply thread adhesive (LOCTITE #271) to the threads of the retaining bolt (Item 4) **[D]**.



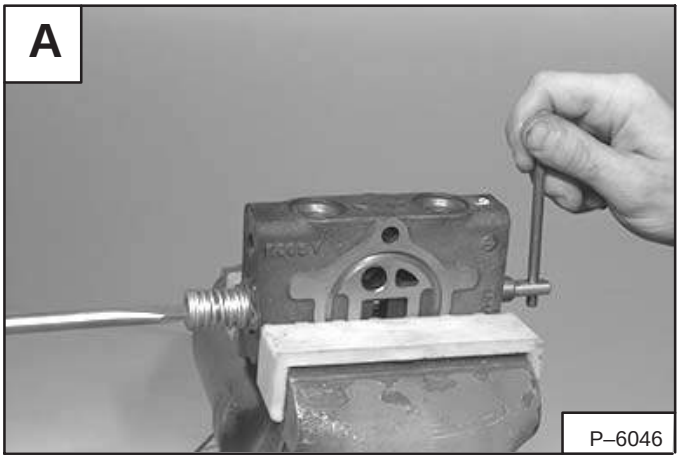
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HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

Boost, Arm, Boom Swing, Blade and Swing Section (Cont'd)

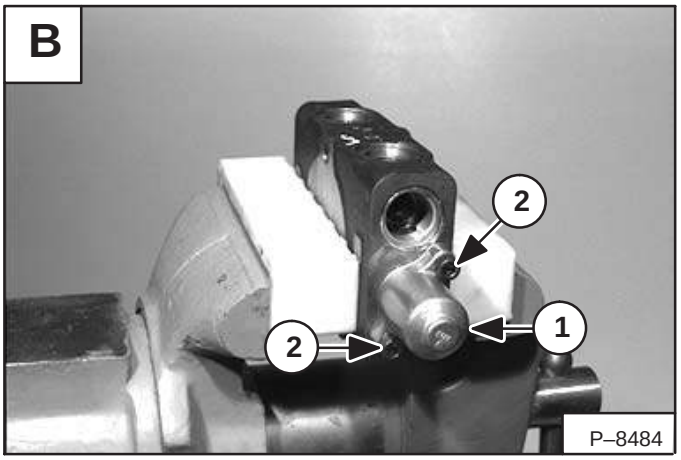
Blade Assembly (Cont'd)

Insert a pin through the hole in the spool and tighten the spring retaining bolt to 6–8 ft.–lbs. (8–10 Nm) of torque **[A]**.



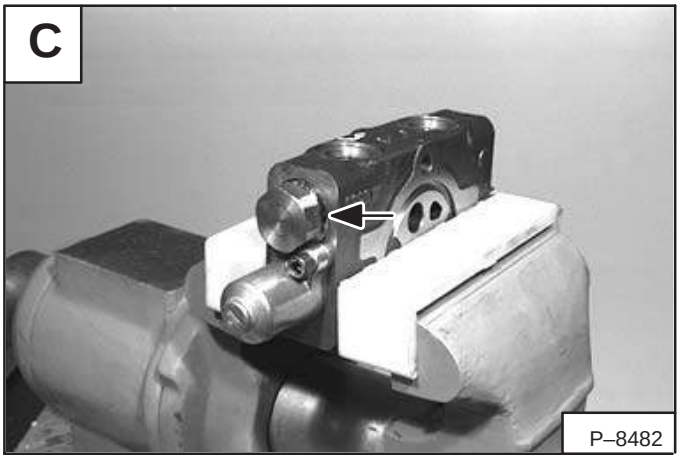
Install the end cap (Item 1) **[B]** over the spring and install the two (2) screws (Item 2) **[B]**.

Tighten the screws to 6–8 ft.–lbs. (8–10 Nm) of torque.



Install the plug on the rear of the valve section **[C]**.

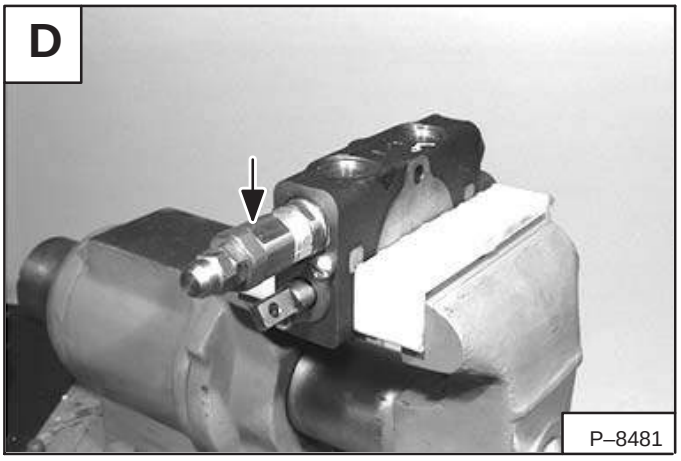
Tighten the plug to 30–36 ft.–lbs. (40–48 Nm) of torque.



Install the work port relief valve on the actuating end of the valve section **[D]**.

Tighten the work port relief valve to 30–36 ft.–lbs. (40–48 Nm) of torque.

NOTE: If the relief valve is disassembled the relief pressure setting must be reset. See Page 2–70 for port relief valve repair.



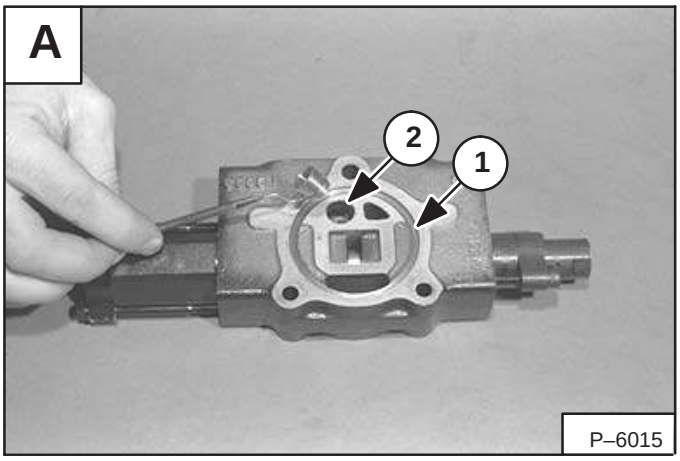
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HYDRAULIC CONTROL VALVE (5–Spool) HUSCO VALVE (S/N 13001 & Above) (Cont'd)

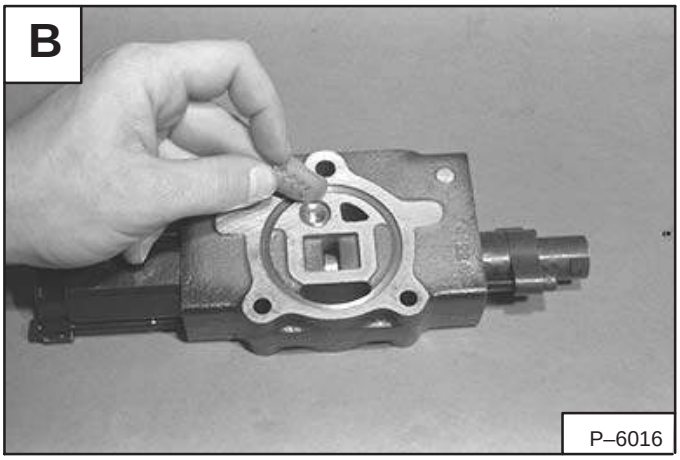
Boost, Arm, Boom Swing, Blade and Swing Section (Cont'd)

Assembly

Put grease on the new O–rings and install the O–rings on the face of the valve sections (Item 1) **[A]**. Install the poppet into the bore on the face of the valve section (Item 2) **[A]**.



Install the spring into the poppet **[B]**.



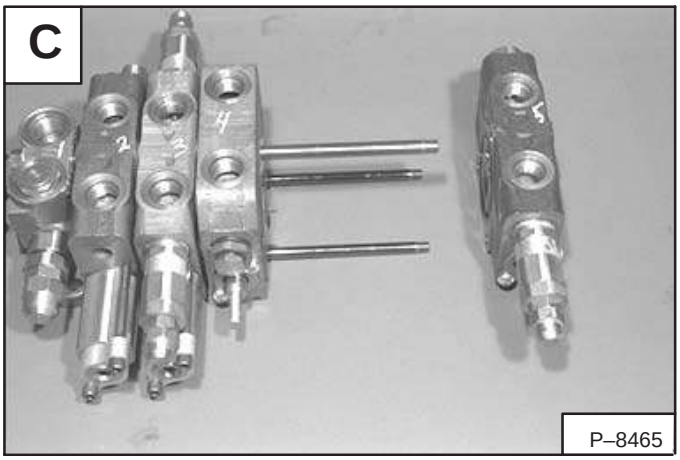
Install the nuts onto the short threaded end of the tie rods with at least two threads extending past the nut.

Install the tie rods through the inlet section. Check each valve section for location marks. Make sure that the valve sections are installed in the correct order.

Install the valve sections on the tie rods **[C]**.

Install the three (3) nuts on the tie rods, finger tighten only at this time.

Be sure the valve is flat on the bench by pressing down on the inlet sections so the mounting feet of the the end sections are aligned.



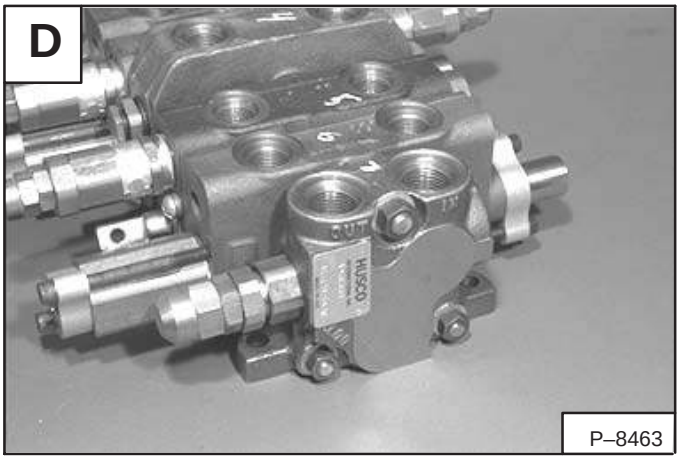
Tighten the tie rod nuts to 10 ft.–lbs (13 Nm) of torque in a crisscross pattern **[D]**.

Tighten the two (2) 5/16'' dia. tie rods to 14 ft.–lbs. (19 Nm). Tighten the one (1) 3/8'' dia. tie rod nut to 33 ft.–lbs. (45 Nm).

The valve must not have any spacing between the valve sections and the spools must be free when pushed in and released.

The spools must not stick, if the spools do stick, loosen the tie rod nuts and tighten per above information.

Recheck the mounting feet for level settings.



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ACCUMULATOR (S/N 12999 & Below)

Adjustment

The pressure build–up valve is set at 200 PSI (1379 kPa).

The pressure build–up valves function is to create 200 PSI (1379 kPa) back pressure in order to charge the accumulator.

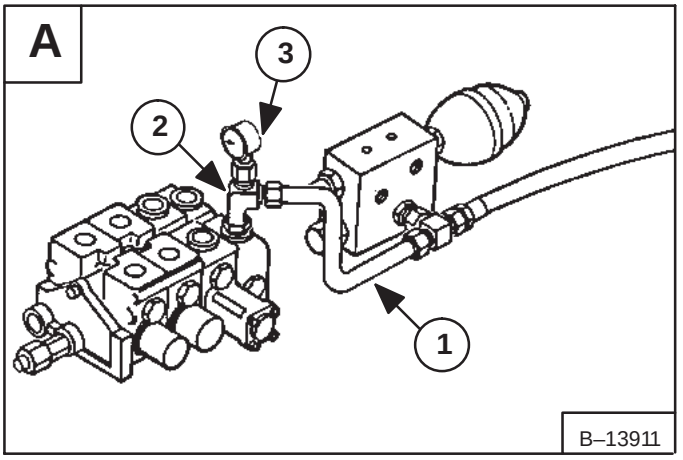
To test the pressure build–up valves pressure setting, disconnect the inlet tube (Item 1) **[A]** from the elbow on the 3–spool control valve. Remove the elbow from the valve. Install a tee (Item 2) **[A]** (21K–7) into the valve and reinstall the inlet tube (Item 1) **[A]** onto the tee.

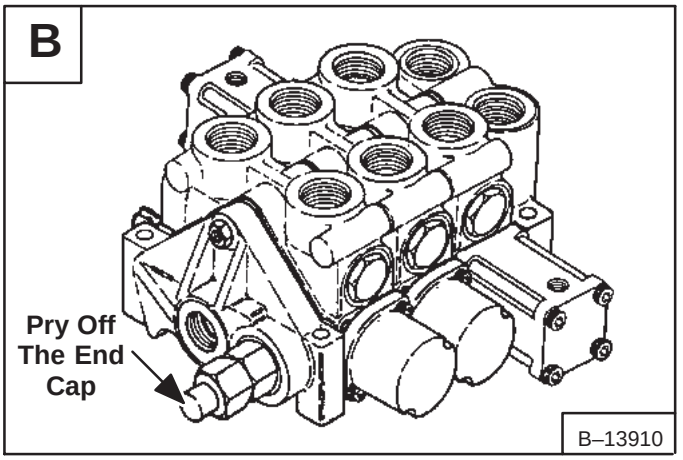
Install a *pressure gauge (Item 3) **[A]** onto the tee.

Start the excavator.

Warm the hydraulic fluid to 140°F. (60°C.).

Run the engine at high idle and record the pressure gauge reading. If the build–up valve needs to be reset, pry off the end cap from the build–up valve **[B]**.





Loosen the adjusting screw jam nut **[C]**.

Turn the adjusting screw clockwise to increase the pressure or counterclockwise to decrease the pressure **[C]**.

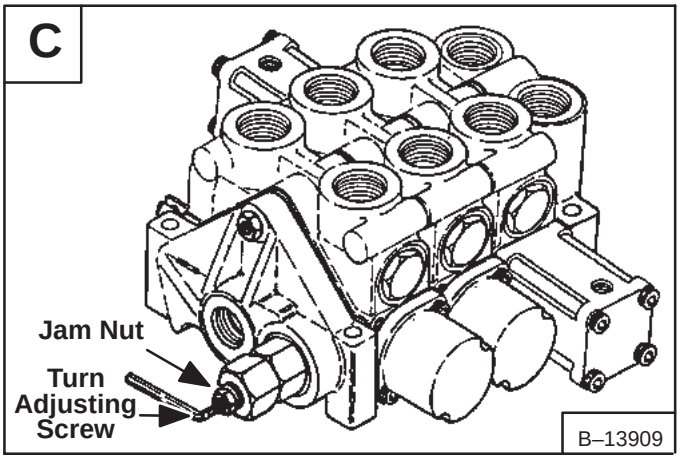
When the pressure gauge reading is correct, tighten the jam nut while holding the adjusting screw from turning.

Stop the engine.

Remove the pressure gauge and the tee.

Reinstall the elbow, previously removed, and install the tube on the elbow.

*5000 PSI (34475 kPa) Minimum.



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ACCUMULATOR (S/N 12999 & Below) (Cont'd)

Pressure Reducing Valve

The pressure reducing valve body contains two valves, the pressure reducing valve and a safety relief valve.

The valve body is connected to the accumulator.

The pressure reducing valve maintains approximately 360 PSI (2482 kPa) to supply low pressure hydraulic flow to the joysticks.

The accumulator provides short term reserve pressure for joystick function with engine off.

Testing

Remove the boom pilot line (Item 1) **[A]** from the front of the boom valve section.

Start the excavator and warm the hydraulic oil to operating temperature.

Install a 500 PSI (3448 kPa) gauge on the pilot line **[B]**.

Activate the boom down circuit and record the pressure.

The pressure reading should be approximately 300 PSI (2482 kPa).

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.

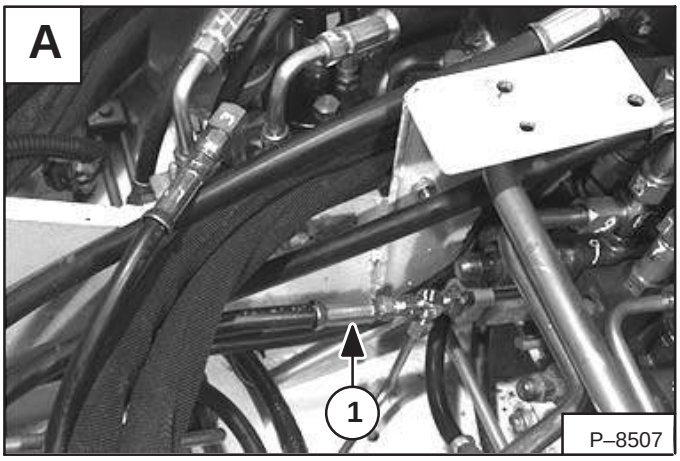
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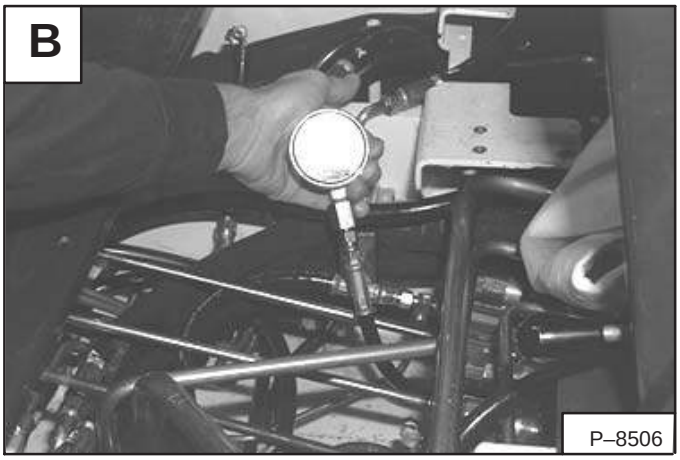
Remove the center floor panel. (See Page 4–6.)

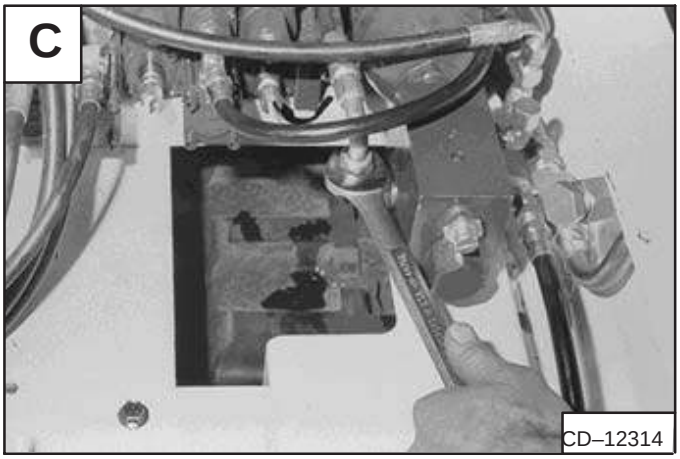
Mark the hoses for correct installation.

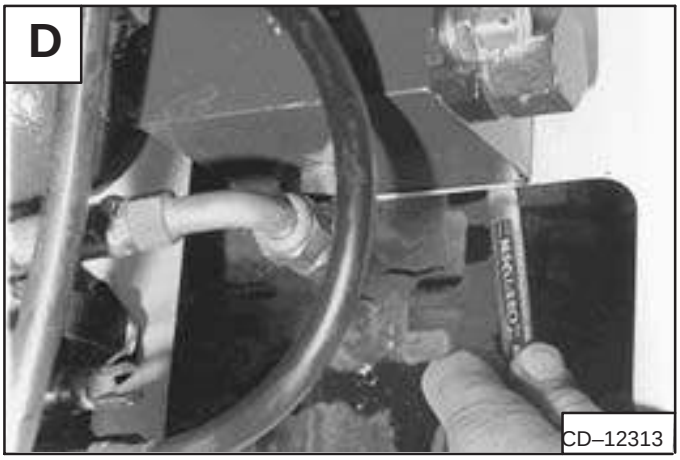
Remove the hoses and tubes from the reducing valve **[C]**.

Remove the two mounting bolts from under the swing frame **[D]**.







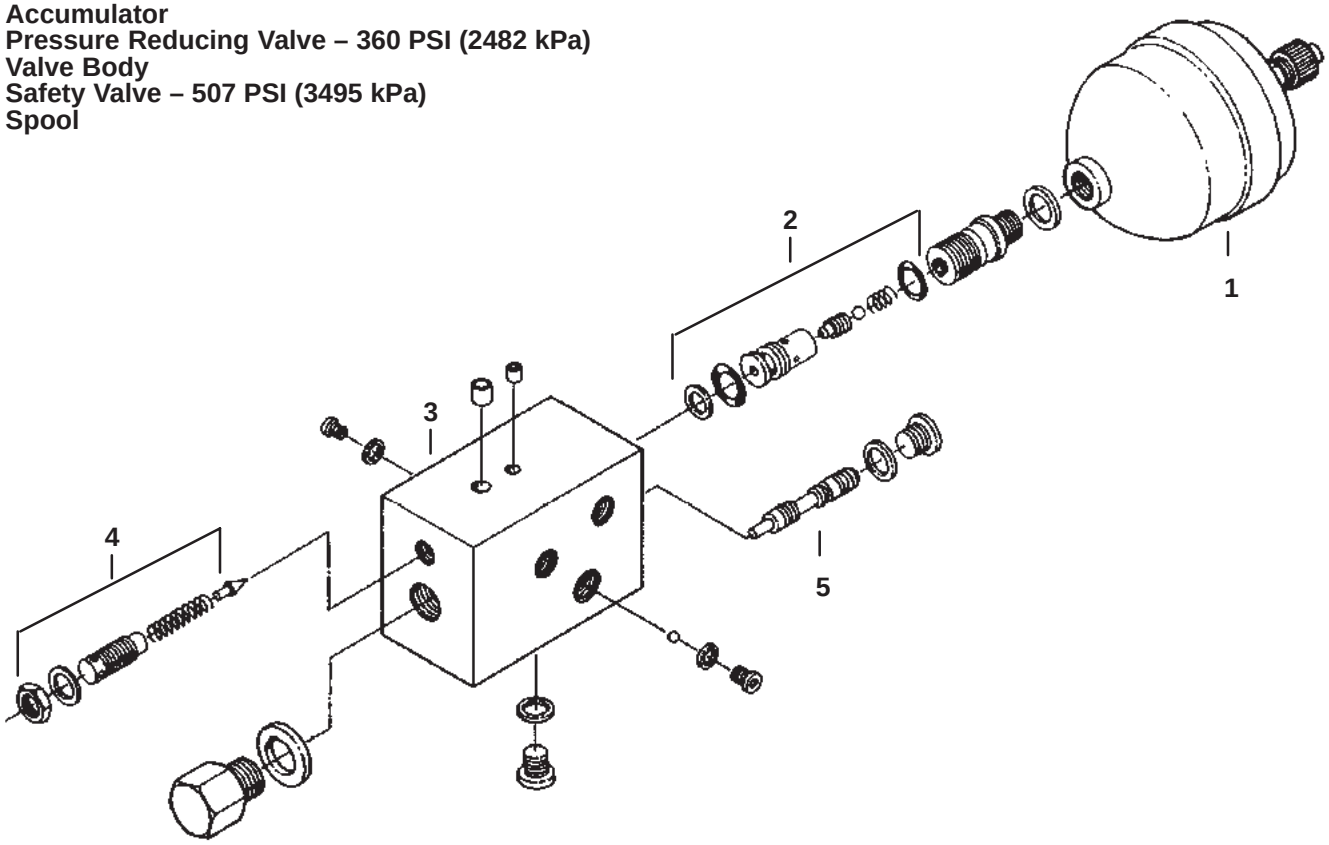


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ACCUMULATOR (S/N 12999 & Below) (Cont'd)

Parts Identification

1. Accumulator
2. Pressure Reducing Valve – 360 PSI (2482 kPa)
3. Valve Body
4. Safety Valve – 507 PSI (3495 kPa)
5. Spool



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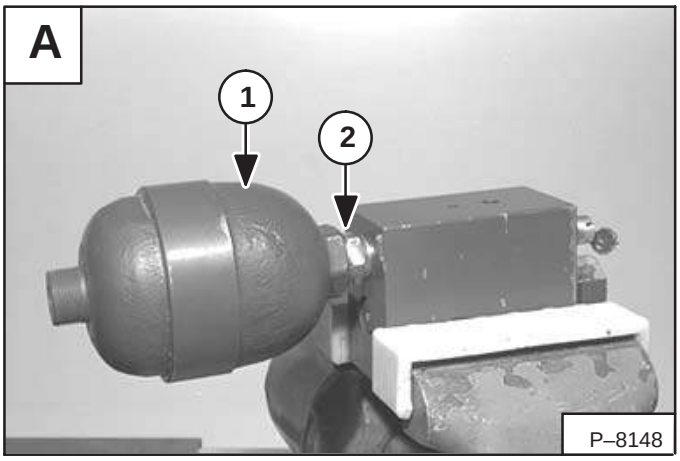
ACCUMULATOR (S/N 12999 & Below) (Cont'd)

Disassembly

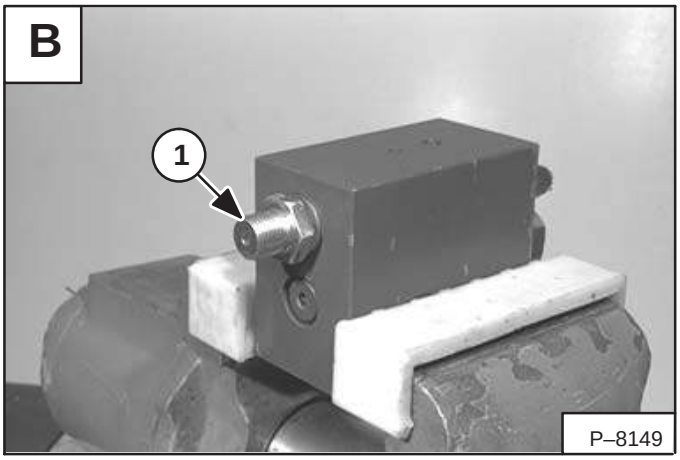
Use a vise with protective jaws and clamp the valve body.

Remove the accumulator (Item 1) **[A]** and seal (Item 2) **[A]**.

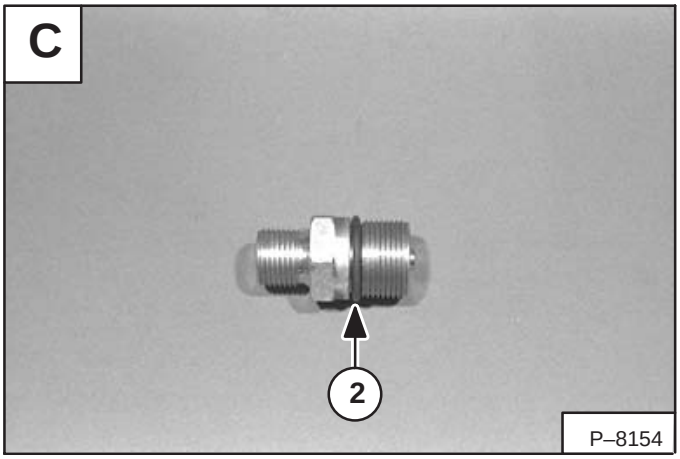
NOTE: The accumulator does not need to be discharged before removal.



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

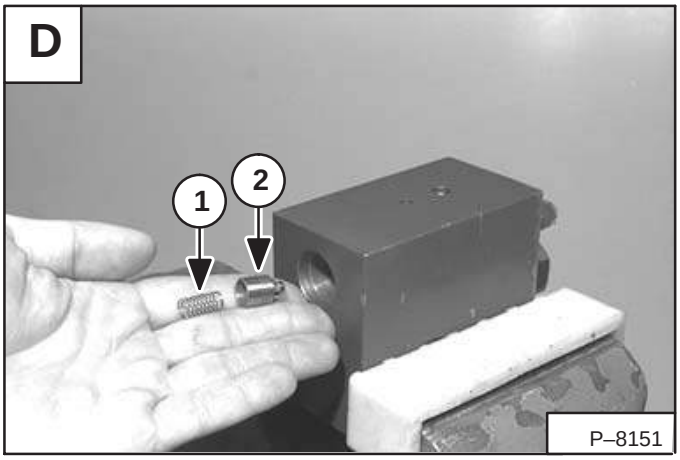


Remove the O–ring (Item 1) **[C]** from the adapter.



Remove the spring (Item 1) **[D]** and seat (Item 2) **[D]** from the spool.

NOTE: Use care when removing the seat and spool so as not to scratch the polished surfaces. Scratches in the polished surface will cause internal leakage.

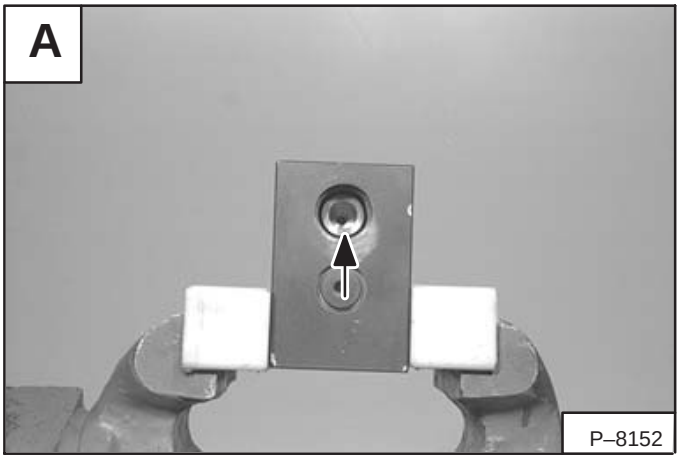


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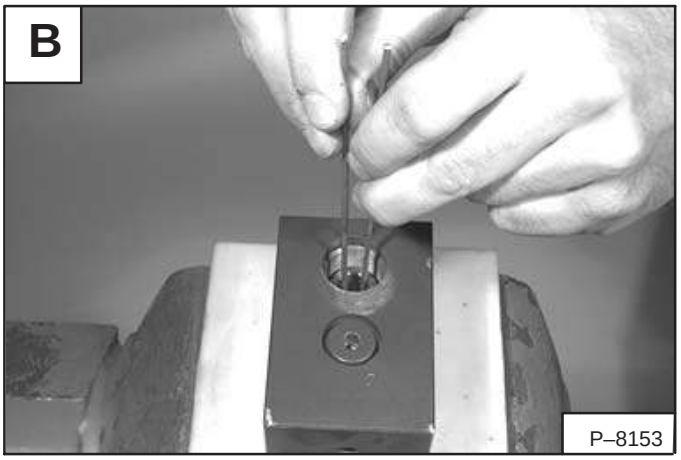
ACCUMULATOR (S/N 12999 & Below) (Cont'd)

Disassembly (Cont'd)

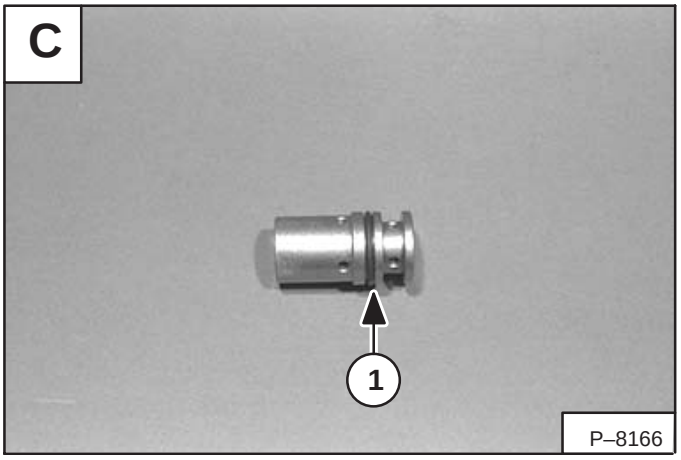
Using two (2) pieces of .090 inch wire, with a 90° bend on the end, remove the spool by inserting the wires through the center orifice and engaging two (2) of the ports **[A]**.



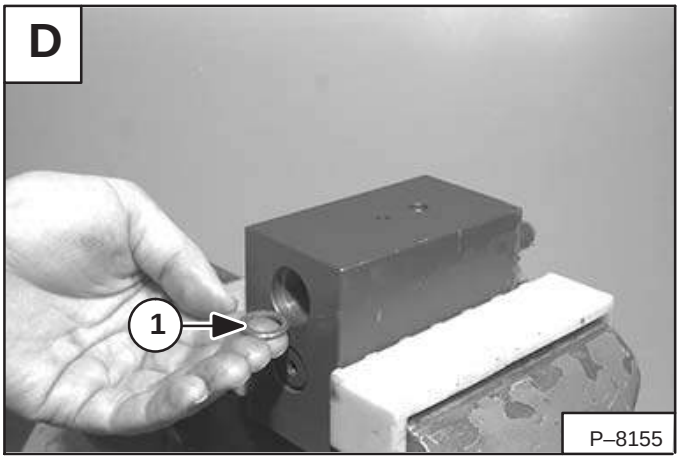
Remove the spool by pulling straight up on the wires **[B]**.



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



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



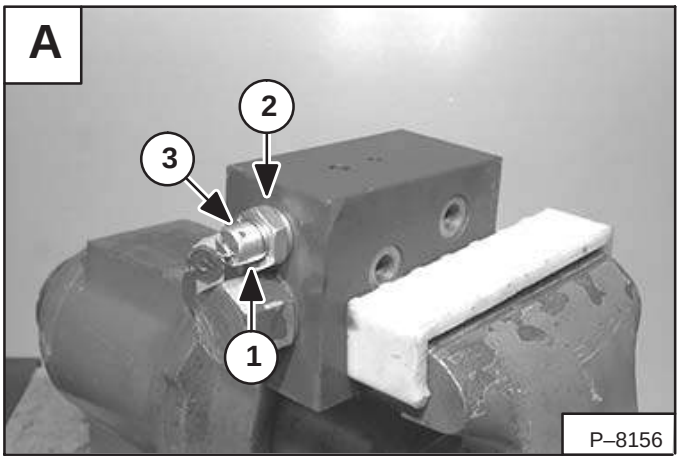
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ACCUMULATOR (S/N 12999 & Below) (Cont'd)

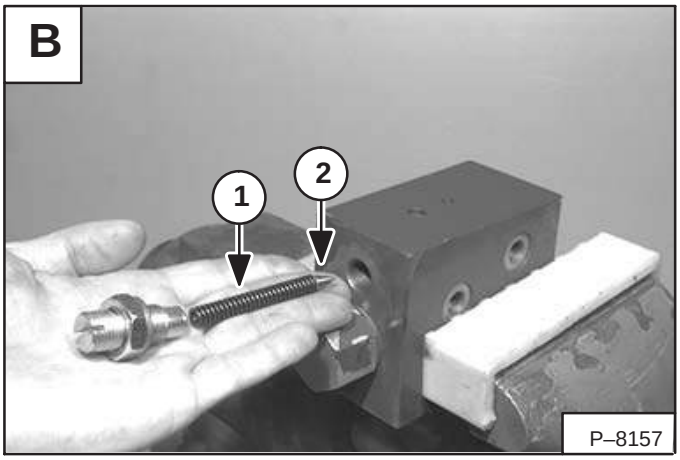
Disassembly (Cont'd)

Cut and remove the wire seal (Item 1) **[A]**. Loosen the locknut (Item 2) **[A]** and remove the adjusting screw (Item 3) **[A]**.

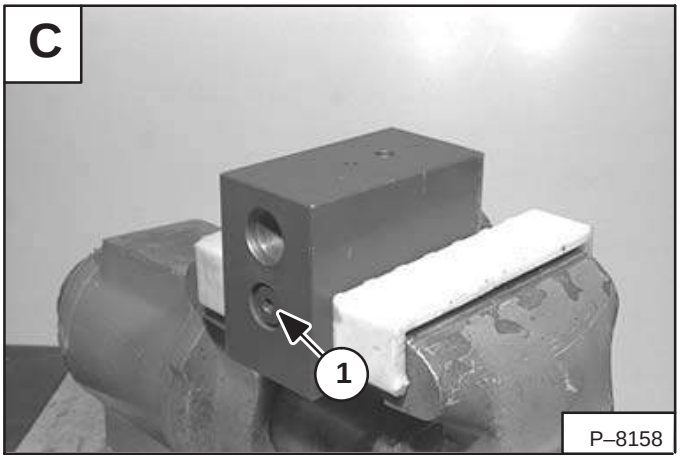
NOTE: The safety relief valve must be reset to the correct pressure setting if it is removed from the valve body.



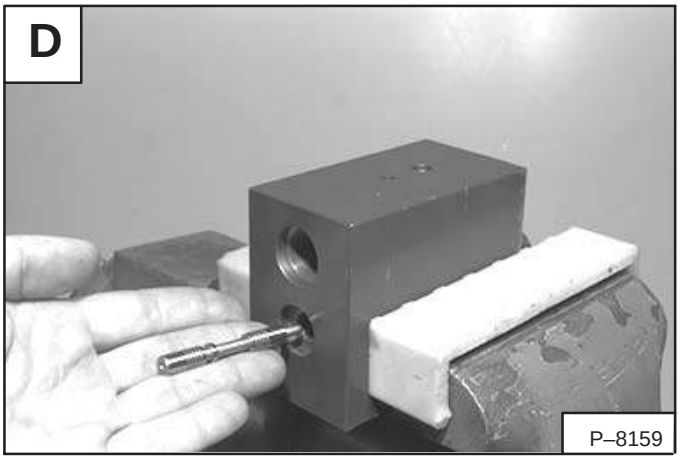
Remove the spring (Item 1) **[B]** and valve (Item 2) **[B]**.



Remove the plug (Item 1) **[C]** and copper washer from the accumulator end of the valve body.



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

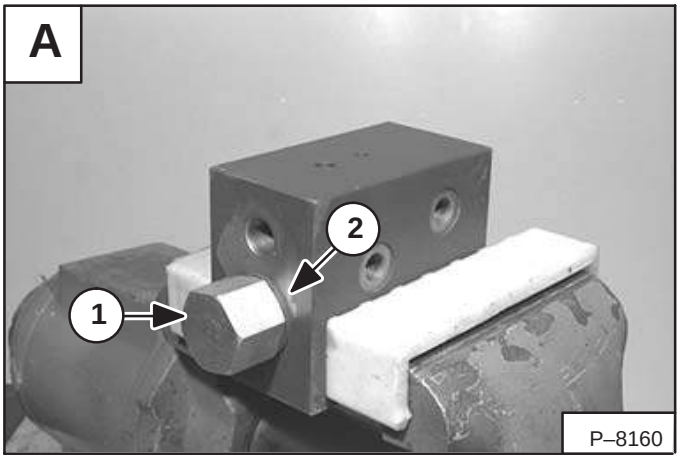


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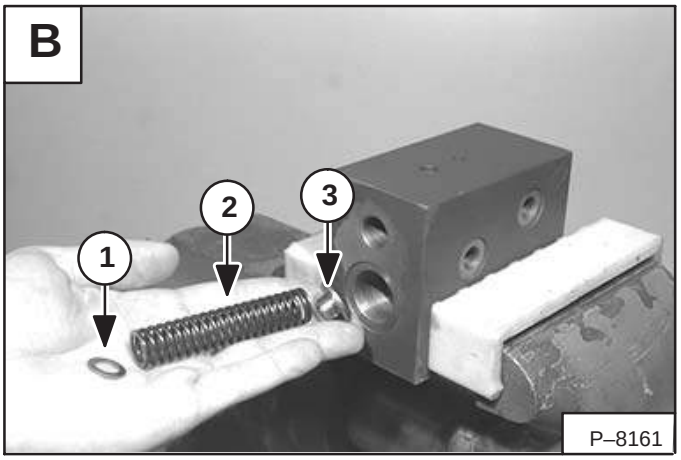
ACCUMULATOR (S/N 12999 & Below) (Cont'd)

Disassembly (Cont'd)

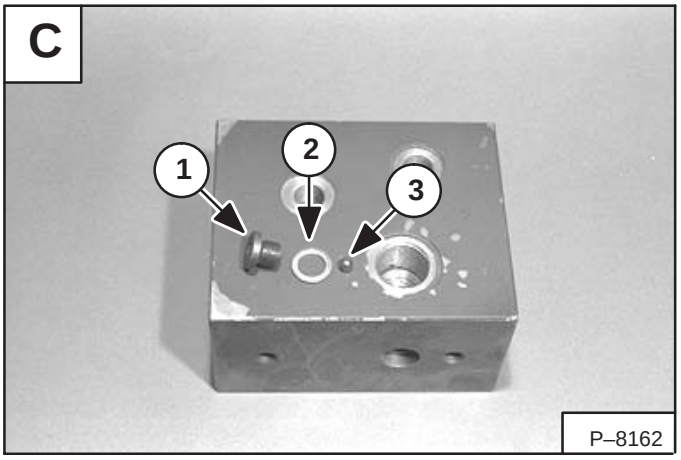
Remove the plug (Item 1) **[A]** and washer (Item 2) **[A]** from the adjustment end of the valve body.



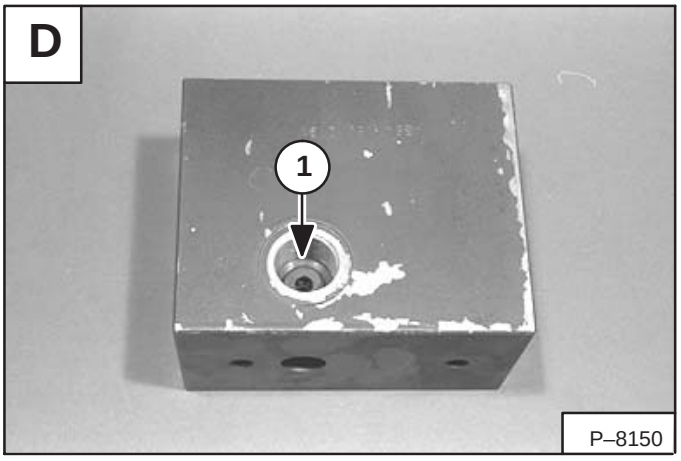
Remove the shim (Item 1) **[B]**, spring (Item 2) **[B]**, and spring seat (Item 3) **[B]** from the valve body.



Remove the plug (Item 1) **[C]**, washer (Item 2) **[C]**, and check ball (Item 3) **[C]** from one side of the valve body.



Remove the plug (Item 1) **[D]** and washer from the opposite side of the valve body.

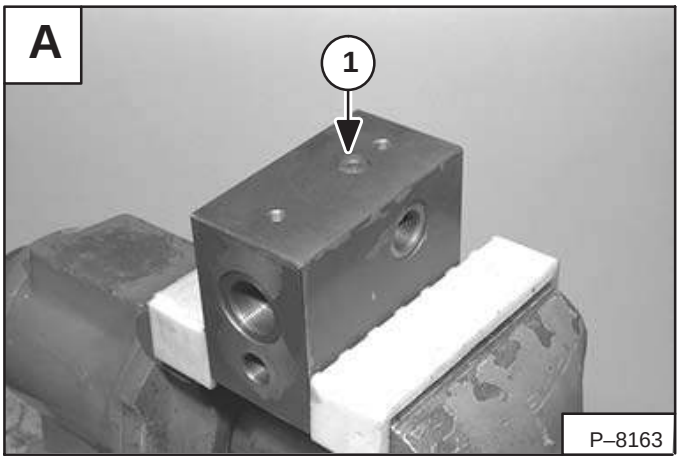


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ACCUMULATOR (S/N 12999 & Below) (Cont'd)

Disassembly (Cont'd)

Remove the plug (Item 1) **[A]** and washer from the bottom of the valve body.



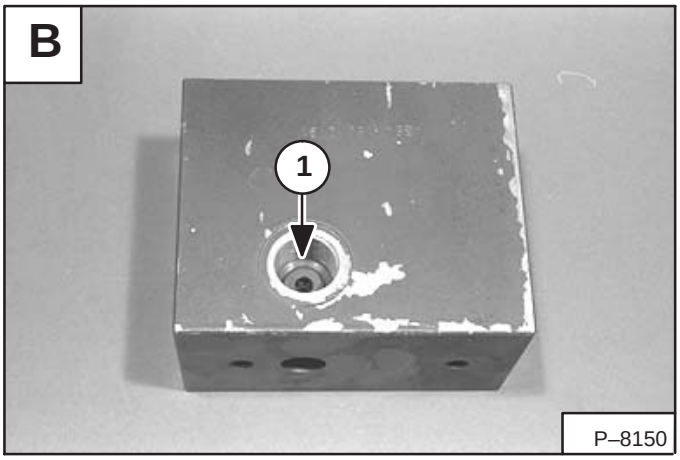
Assembly

Prior to assembly:

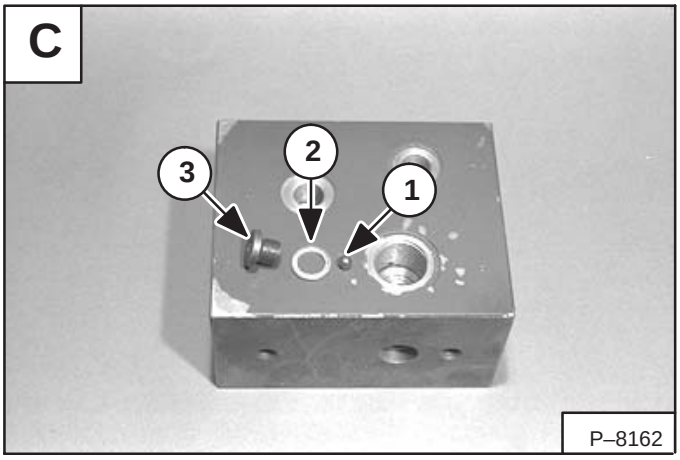
Clean all parts in solvent and dry with compressed air.
Inspect all valves, seats and spools for wear.

Install the bottom plug (Item 1) **[A]** and a new washer in the bottom of the valve body.

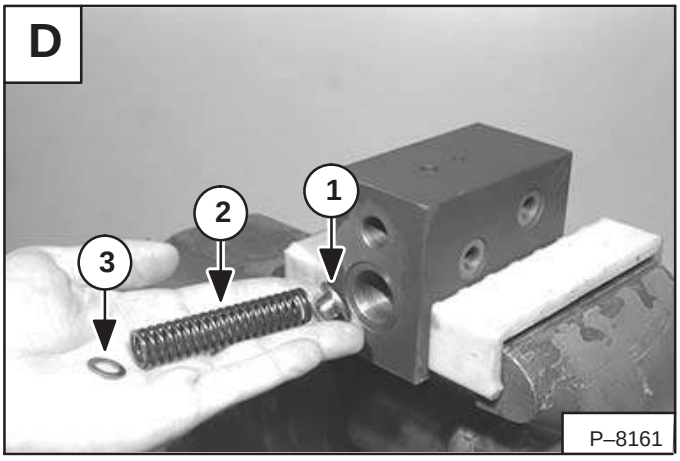
Install the side plug (Item 1) **[B]** and a new washer in the side of the valve body.



Install the check ball (Item 1) **[C]** into the valve body. Install a new washer (Item 2) **[C]** and plug (Item 3) **[C]** into the valve body.



Install the spring seat (Item 1) **[D]** , spring (Item 2) **[D]**, and spring shim (Item 3) **[D]** into the valve body.

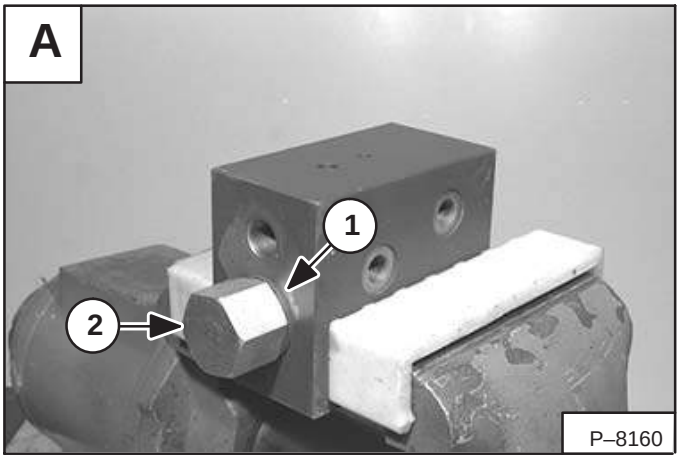


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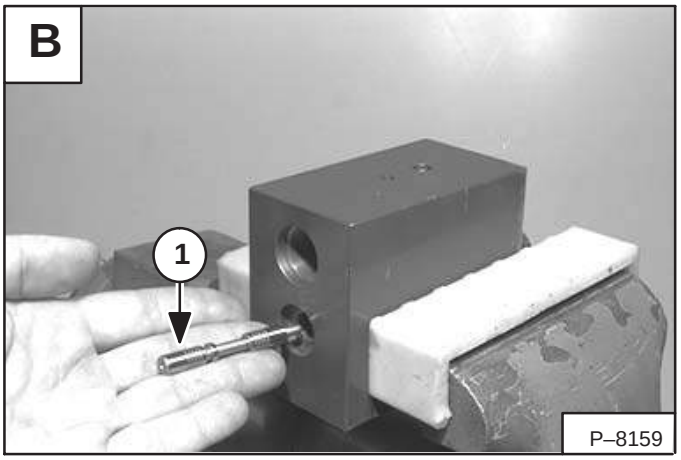
ACCUMULATOR (S/N 12999 & Below) (Cont'd)

Assembly (Cont'd)

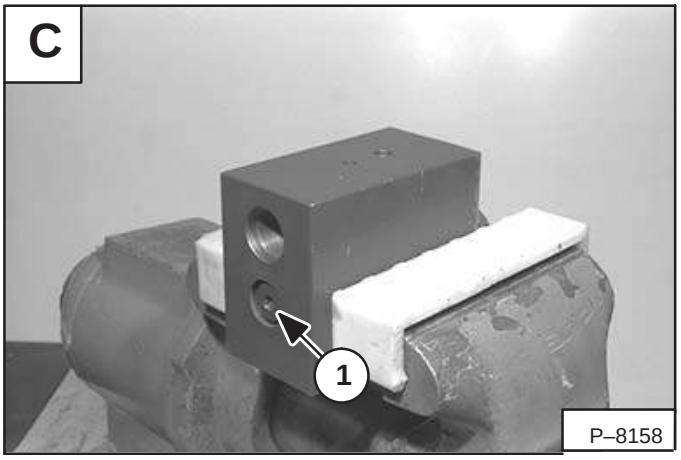
Install the washer (Item 1) **[A]** and plug (Item 2) **[A]** on the valve body.



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

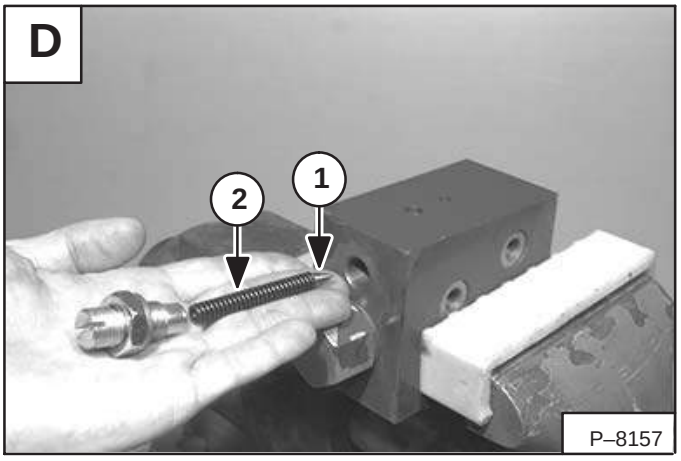


Install a new copper washer and plug (Item 1) **[C]** in the valve body.



Dip the valve (Item 1) **[D]** in clean hydraulic fluid. Install the valve (Item 1) **[D]** and spring (Item 2) **[D]** in the valve body.

NOTE: The safety relief valve must be reset to the correct pressure setting before the accumulator valve can be put back in service. See page 2–106 for adjustment procedure.

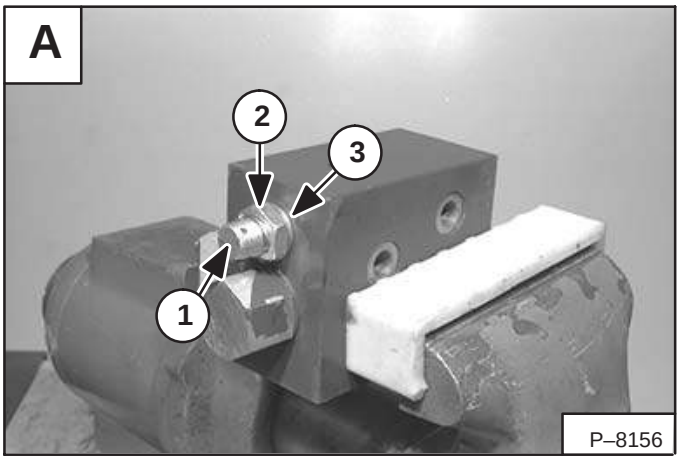


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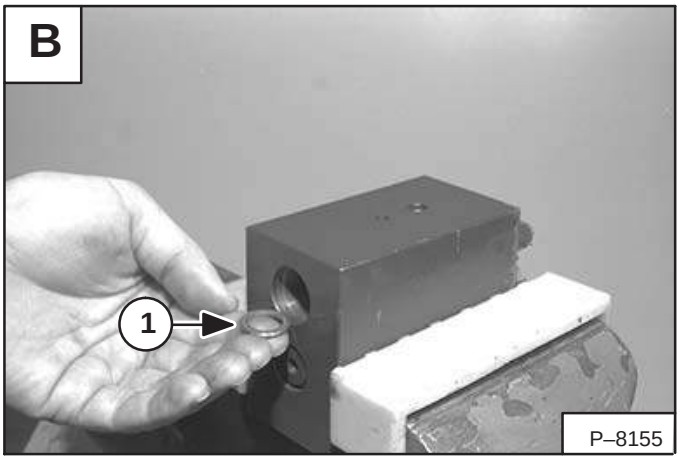
ACCUMULATOR (S/N 12999 & Below) (Cont'd)

Assembly (Cont'd)

Install the adjustment screw (Item 1) **[A]**, locknut (Item 2) **[A]**, and washer (Item 3) **[A]** in the valve body.

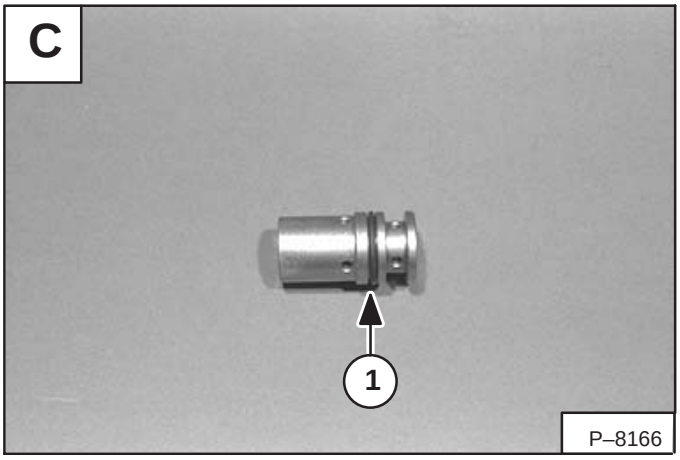


Install a new washer (Item 1) **[B]** in the valve body.

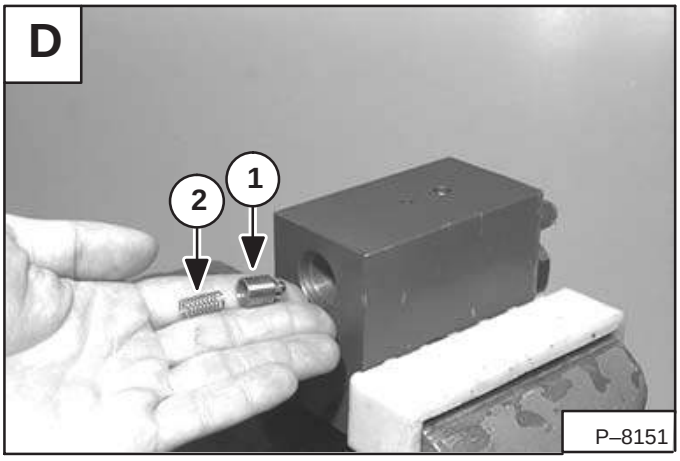


Oil and install a new O–ring (Item 1) **[C]** on the spool.

Dip the spool in clean hydraulic fluid and install in the valve body.



Dip the seat in oil and install the seat (Item 1) **[D]** in the spool. Install the spring (Item 2) **[D]** in the seat (Item 1) **[D]**.

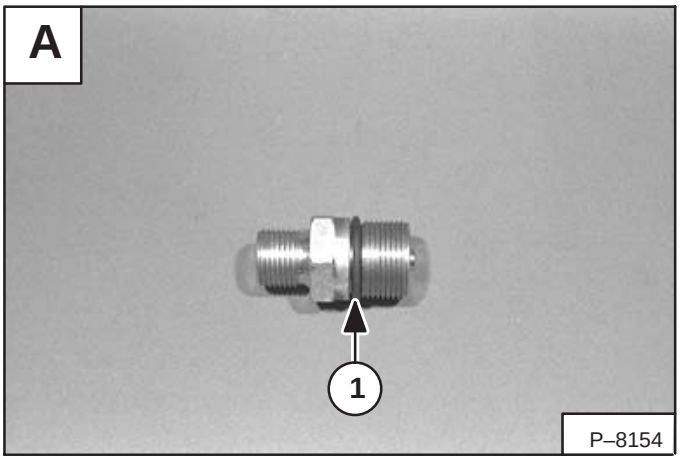


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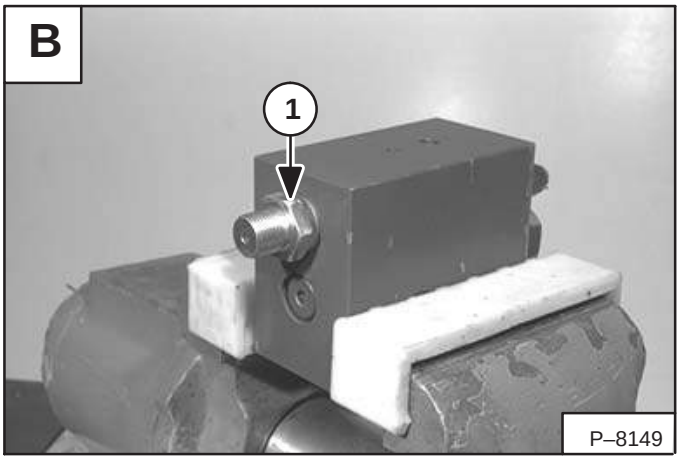
ACCUMULATOR (S/N 12999 & Below) (Cont'd)

Assembly (Cont'd)

Use care when installing the O–ring so the threads do not cut the O–ring. Apply oil to the new O–ring (Item 1) **[A]** and install the O–ring (Item 1) **[A]** on the adapter.

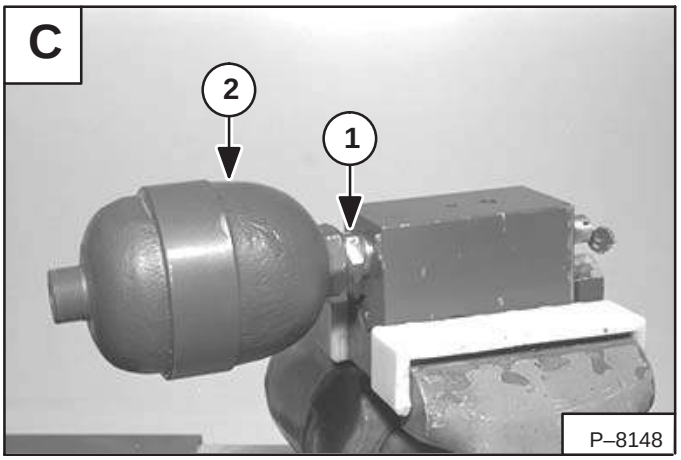


Install the adapter (Item 1) **[B]** in the valve body.



Install the seal (Item 1) **[C]** and accumulator (Item 2) **[C]** on the adaptor.

NOTE: The accumulator pressure should be checked before putting the accumulator valve back in service. See page 2–107 for the procedure.



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ACCUMULATOR (S/N 12999 & Below) (Cont'd)

Setting the Safety Relief Valve

⚠ 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

Remove the tubeline from either the P1 or P2 port (Item 1) **[A]**.

Install a 5000 PSI gauge (Item 1) **[B]** between the joystick and pressure reducing valve.

Remove the tank return line and install a clear line leading to a drain pan in its place.

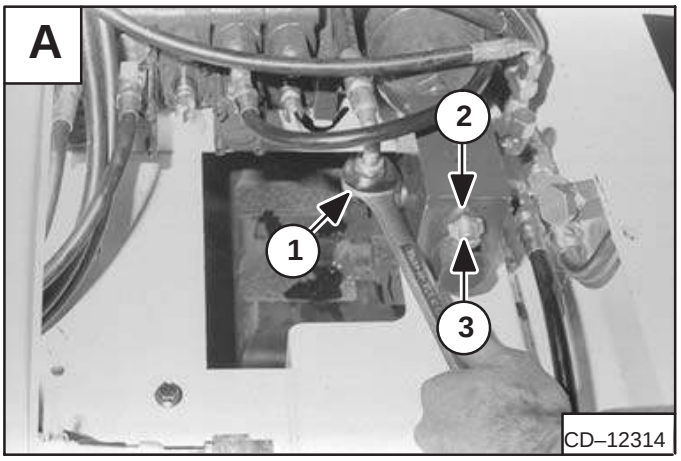
Start the excavator and run at low idle. If the gauge doesn't read 1450 psi, advance the engine idle speed until 1450 PSI is reached.

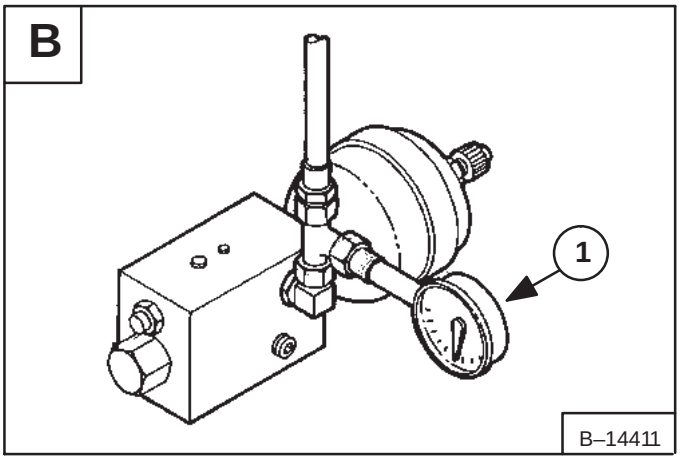
Loosen the locknut (Item 2) **[A]**, and turn the adjustment screw (Item 3) **[A]** counterclockwise until hydraulic fluid starts to leak out the tank return line (clear line installed previously).

Slowly turn the adjustment screw (Item 3) **[A]** clockwise until the flow out the tank return line stops.

Remove the gauge and install the fittings, tubes, and hoses previously removed.

Turn the adjustment screw an additional 3/4 of a turn clockwise and tighten the locknut.





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ACCUMULATOR (S/N 12999 & Below) (Cont'd)

Charging

The Hydraulic accumulator provides 200 PSI (kPa). Short term reserve pressure for joystick function with the engine off.

The following tool will be needed to test and service the accumulator. MEL1435 accumulator servicing and test kit.

Remove the pressure reducing valve and accumulator from the excavator. (See Page 2–96.)

Install the accumulator into a vise with protective jaws.

Remove the protective cover from the accumulator **[A]**.

Install the hand wheel/bleed screw/gauge assembly (Item 1) **[B]** on the accumulator.

NOTE: Before installing the gauge assembly on the accumulator, ensure the hand wheel is open and the bleed screw is closed.

Install the nitrogen bottle adapter (Item 2) **[B]** to the gauge assembly (Item 1) **[B]** with the hose (Item 3) **[B]**.

Open the nitrogen bottle.

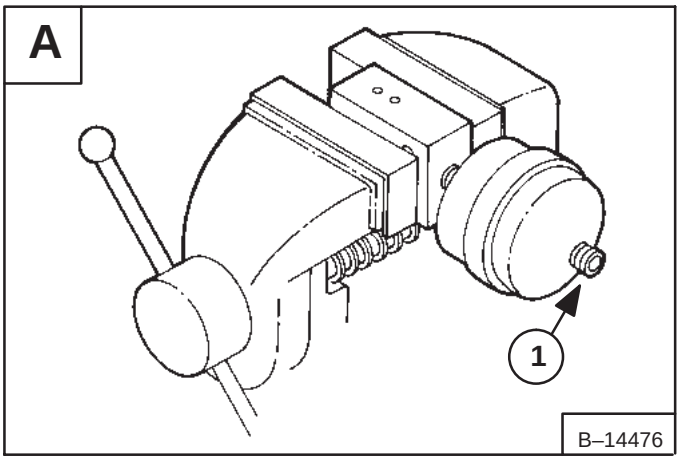
Slowly close the hand wheel (Item 4) **[B]** until the correct pressure is reached. Increase the pressure until its slightly higher than needed. Close the nitrogen bottle.

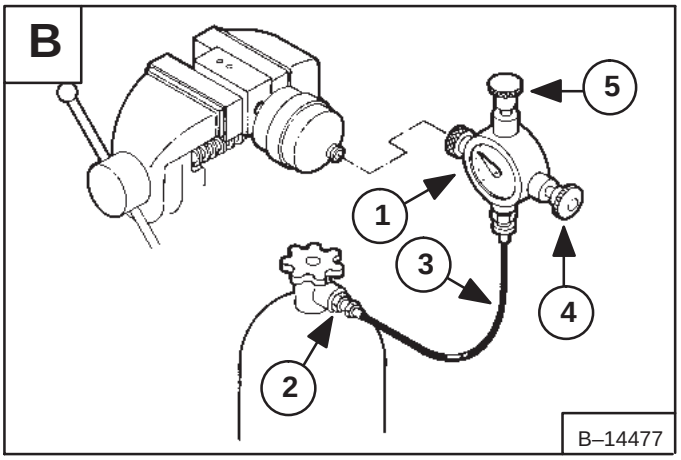
Bleed off the excess pressure by opening and closing the bleed screw (Item 5) **[B]**.

Recheck the pressure after allowing the accumulator to stabilize for five (5) min.

Bleed off or add more nitrogen into the excavator.

NOTE: Use only nitrogen for charging the accumulator to prevent explosions and fire hazard.





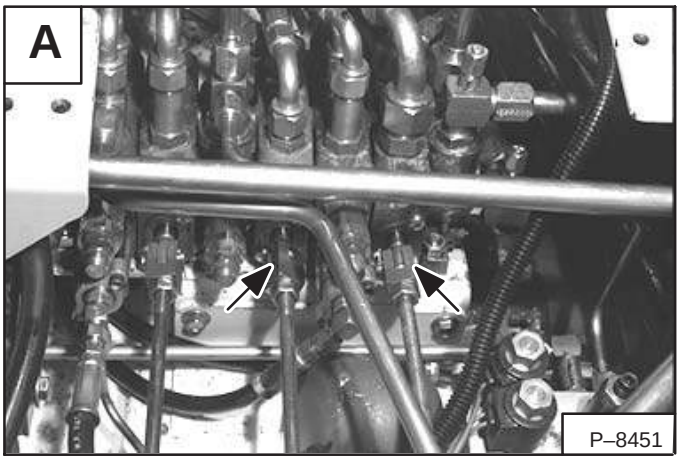
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ACCUMULATOR (S/N 13001 & Above)

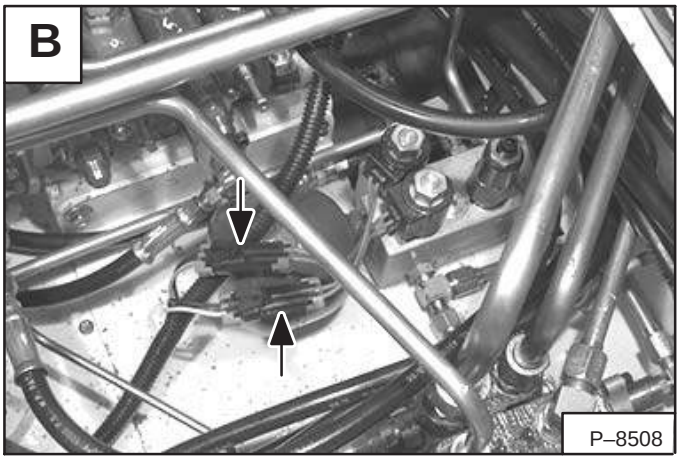
Removal and Installation

Remove the center floor panel. (See Page 4–1.)

Remove the control rods from the auxiliary and left travel valve sections **[A]**.

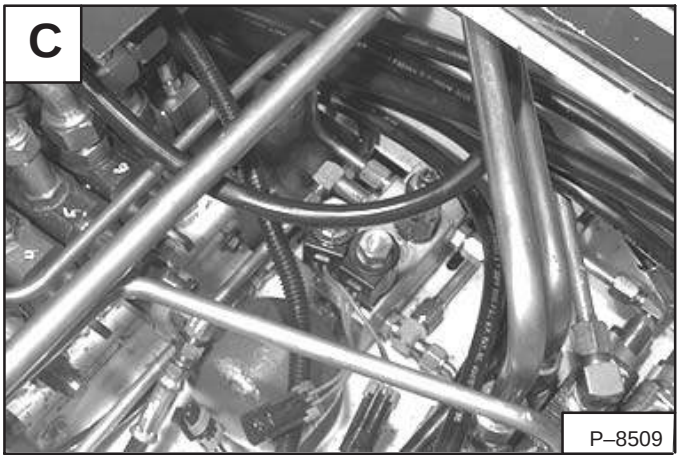


Disconnect the two (2) coils from the wire harness **[B]**.

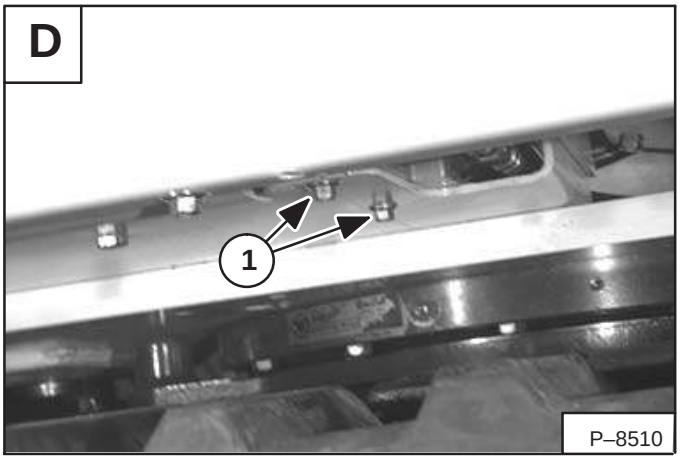


Mark the hoses for correct installation.

Remove the hoses and tubelines **[C]**.



Remove the two (2) mounting bolts (Item 1) **[D]** from under the swing frame.

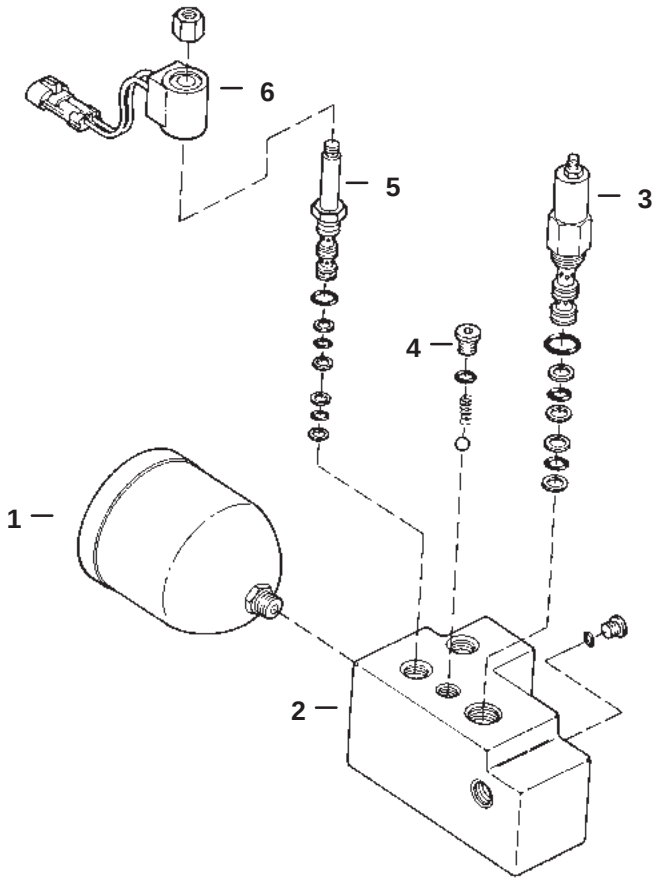


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ACCUMULATOR (S/N 13001 & Above) (Cont'd)

Parts Identification

1. Accumulator
2. Valve Body
3. Relief Valve
4. Check Valve
5. Spool
6. Coil



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AUXILIARY SELECTOR VALVE

Removal and Installation (S/N 12999 & Below)

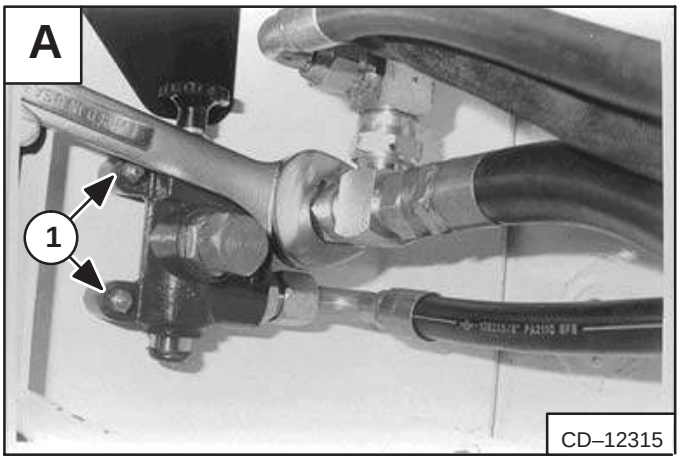
The selector valve is used to switch the auxiliary circuit flow from two way flow to the couplers to one way flow (reduced back pressure to tank for breaker operation).

The selector valve is located under the right front corner of the machine near the boom swing cylinder.

Mark the hoses before removal for correct installation.

Remove the hoses and tubes from the selector valve **[A]**.

Remove the mounting bolts (Item 1) **[A]** to remove the selector valve.



Removal and Installation (S/N 13001 & Above)

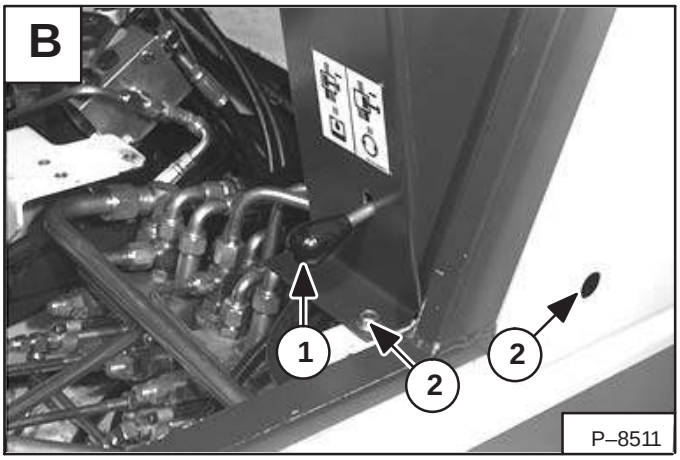
The selector valve is located under the left console.

Remove the seat. (See page 4–1.)

Remove the auxiliary control knob (Item 1) **[B]**.

Remove the four (4) bolts (Item 2) **[B]** from the left console.

Position the console towards the center of the cab.



Remove the tubes and hoses from the selector valve to remove the selector valve from the excavator **[C]**.

Disassembly and Assembly

Remove the snap rings (Item 1) **[D]**.

Push the knob in until the rear seal (Item 2) **[D]** is exposed. Remove the rear seal.

Remove the spool from the valve body. Remove the front seal (Item 3) **[D]** from the spool.

To prevent cutting the new seal on sharp edges, wrap the spool in 3 or 4 layers of glossy paper. Leave the front seal groove exposed.

Install the new seal over the paper and into the front seal groove.

Put clean grease on the new seal. Remove the paper and install the spool in the body.

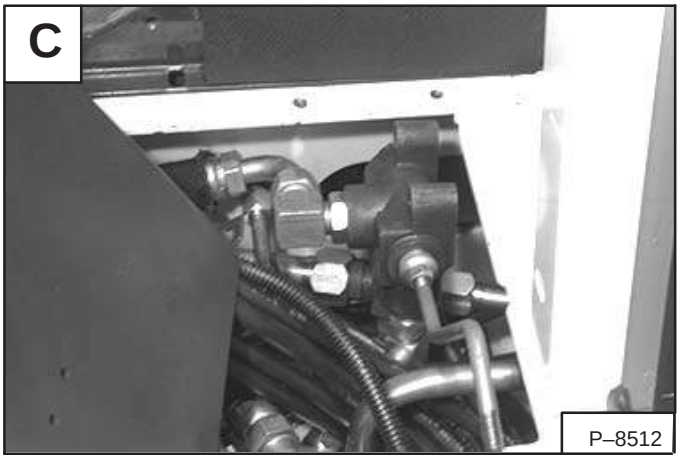
With a rotating action, push the spool until the front seal is in the body and the rear seal groove is exposed.

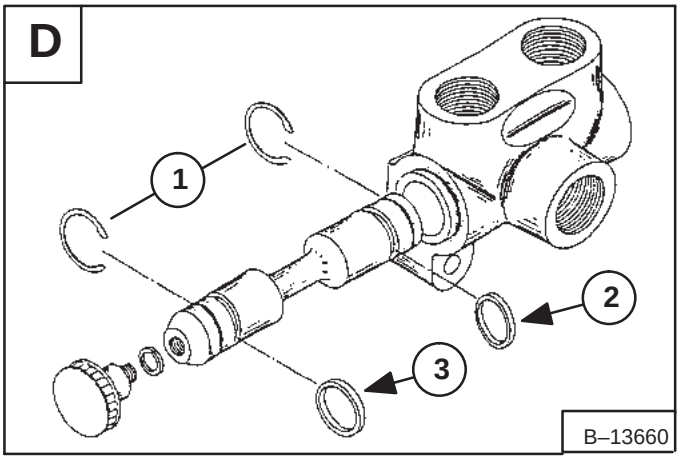
Install the rear seal in the groove.

Put clean grease on the rear seal.

Install the rear snap ring and pull the spool toward the front until it stops.

Install the front snap ring.





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TWO SPEED VALVE (S/N 12999 & Below)

Removal and Installation

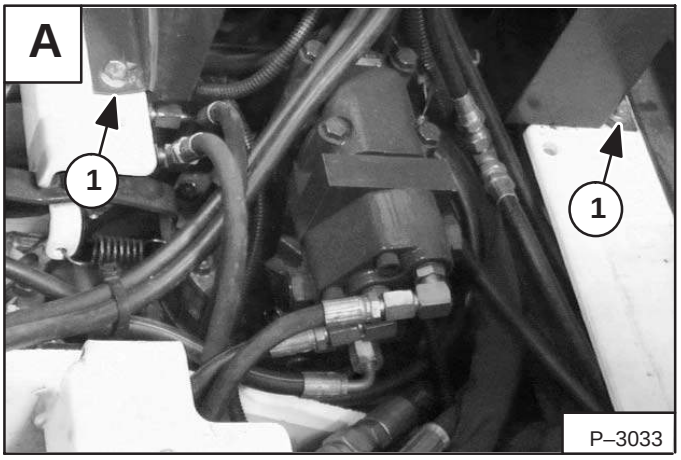
Remove the floormat. (See Page 4–1.)

Remove the floor plate. (See Page 4–1.)

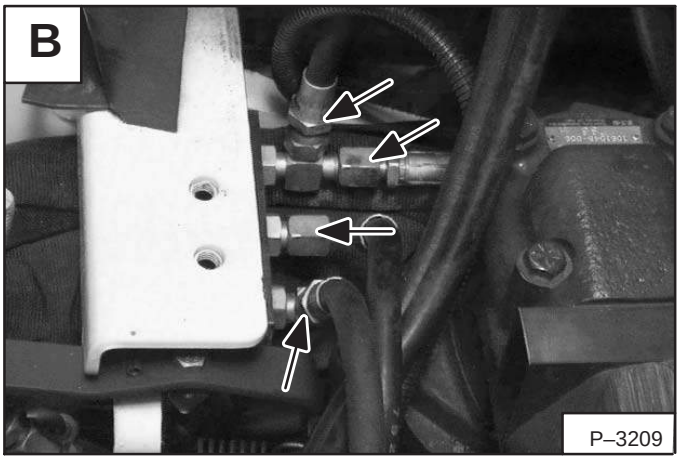
Remove the swing motor cover. (See Page 4–1.)

Loosen the four R.H. console mounting bolts (Item 1) **[A]** and slide the console forward.

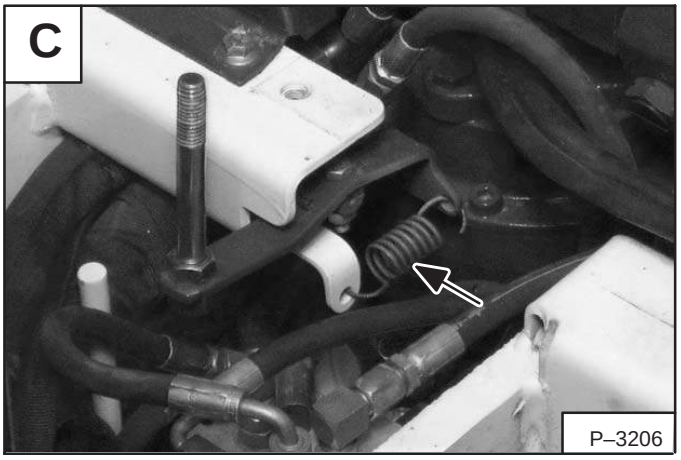
Mark the hoses before removal for correct installation.



Remove the hoses from the fittings **[B]**.

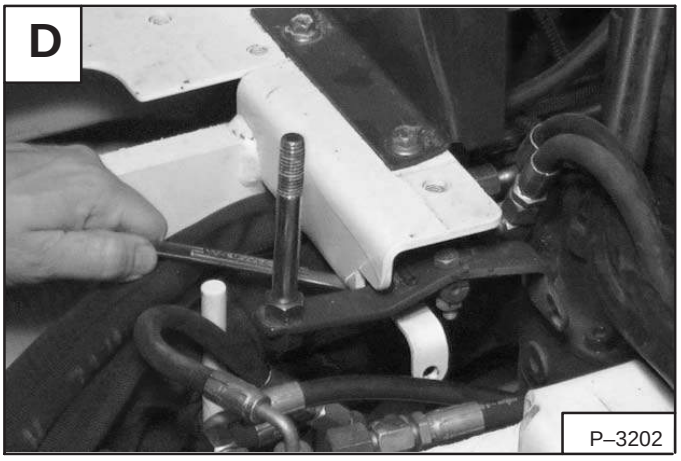


Remove the spring from the lever and bracket **[C]**.



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

Remove the two speed valve.

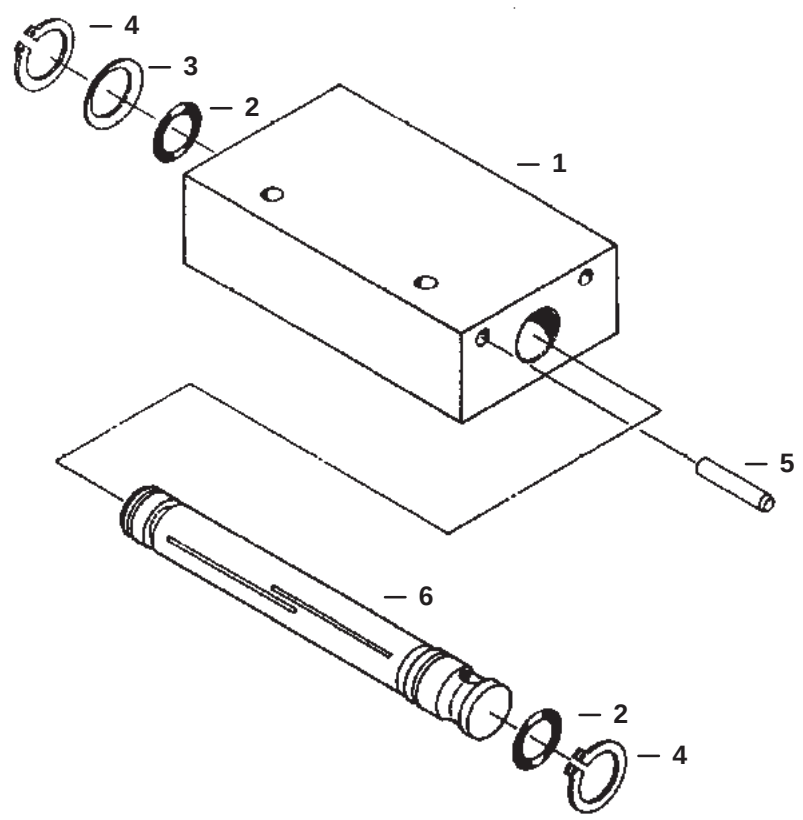


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TWO SPEED VALVE (S/N 12999 & Below) (Cont'd)

Parts Identification

1. Body
2. O–ring
3. Washer
4. Snap Ring
5. Pin
6. Spool



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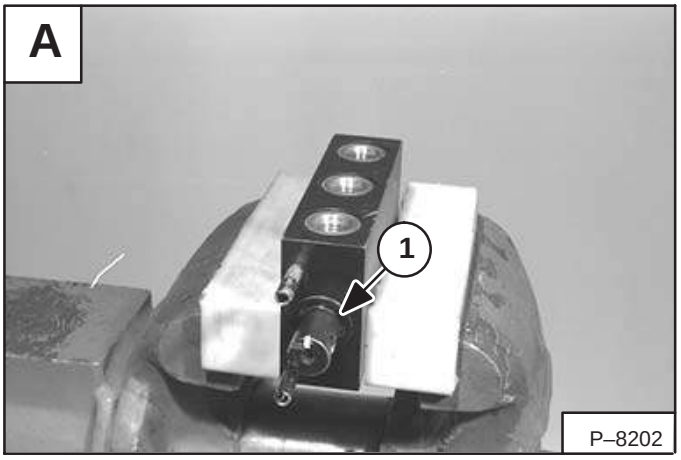
TWO SPEED VALVE (S/N 12999 & Below) (Cont'd)

Disassembly

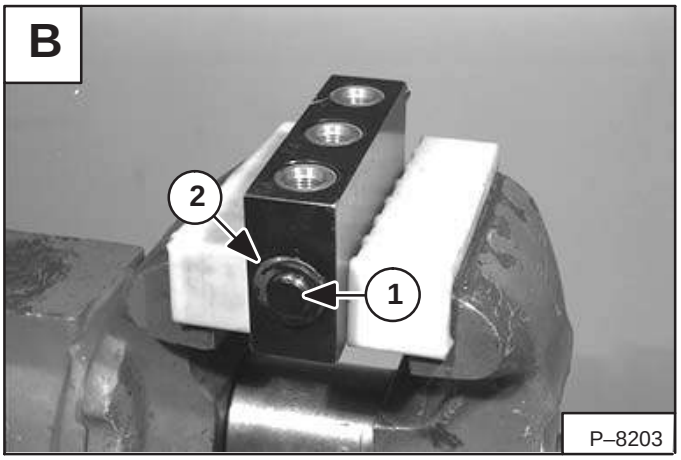
Clamp the valve in a vise that has protective jaws.

The end of the spool is marked with a notch to show the proper spool to valve body alignment. The notch must point up to the ports in the valve body **[A]**.

Remove the snap ring (Item 1) **[A]** from the front of the spool.

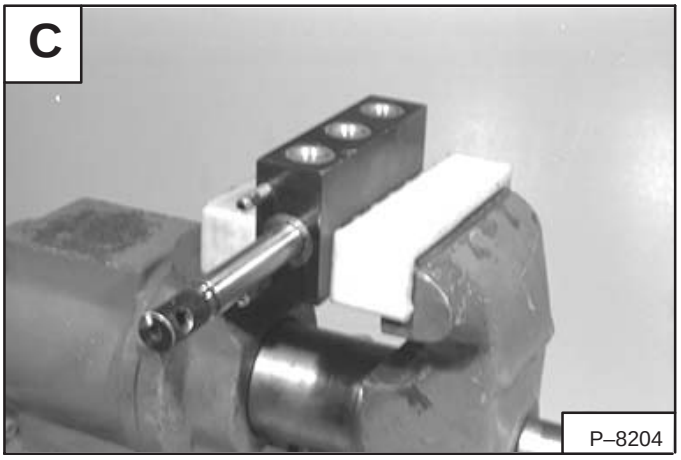


Remove the snap ring (Item 1) **[B]** and washer (Item 2) **[B]** from the rear of the spool.

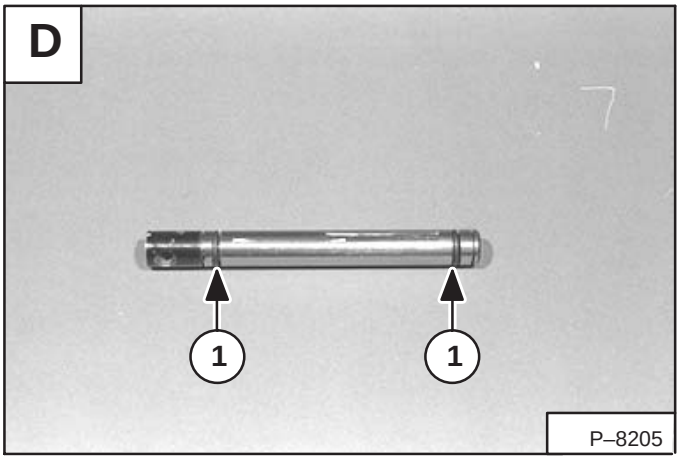


Pull the spool out the front of the valve body **[C]**.

NOTE: Use care not to scratch or damage the spool. Scratches in the spool can cause internal leakage.



Remove the two (2) O–rings (Item 1) **[D]** from the spool.



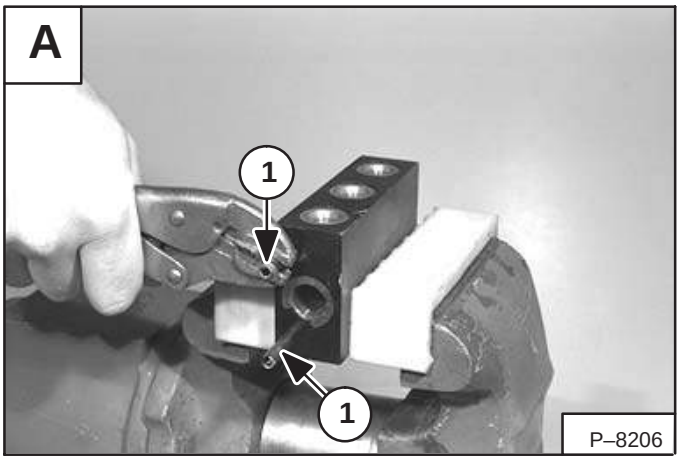
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TWO SPEED VALVE (S/N 12999 & Below) (Cont'd)

Disassembly (Cont'd)

Use a locking plier to compress the roll pins (Item 1) **[A]**. Pull the roll pins (Item 1) **[A]** from the valve body.

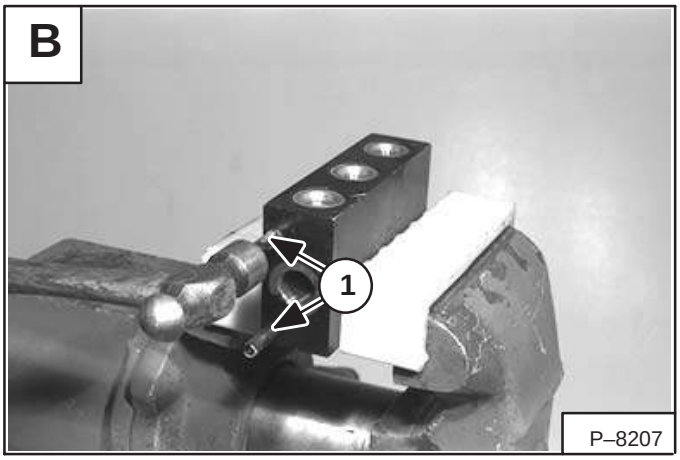
NOTE: Remove the roll pins (Item 1) [A] only if they have been damaged.



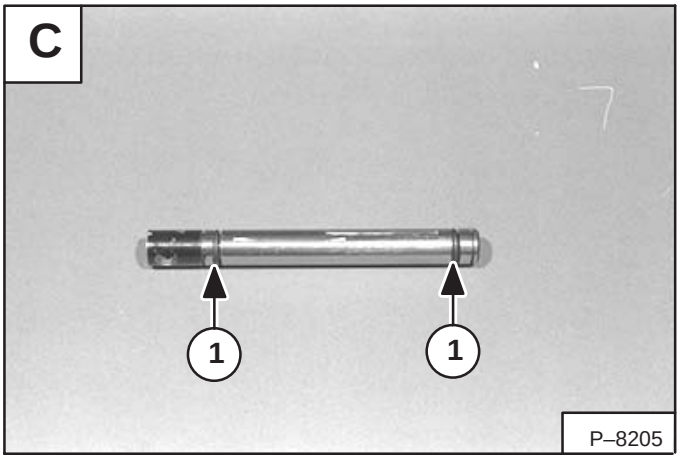
Assembly

Clean all parts in solvent and dry with compressed air.

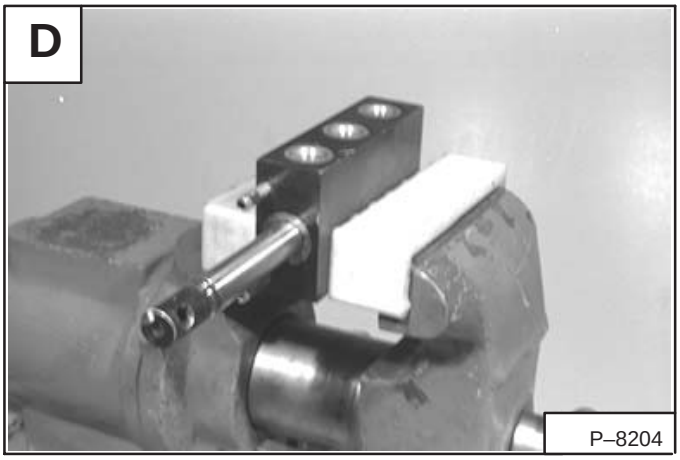
If the roll pins need replacing, tap the two (2) roll pins (Item 1) **[B]** in the valve body.



Oil and install the two (2) new O–rings (Item 1) **[C]** on the spool.



Apply clean hydraulic fluid to the spool and install the spool in the valve body **[D]**.

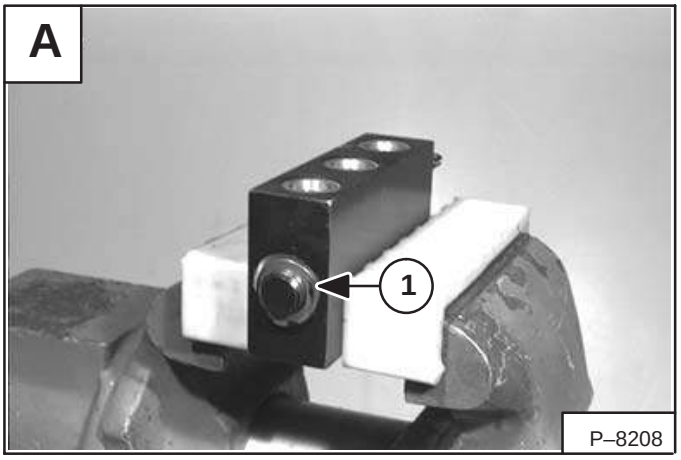


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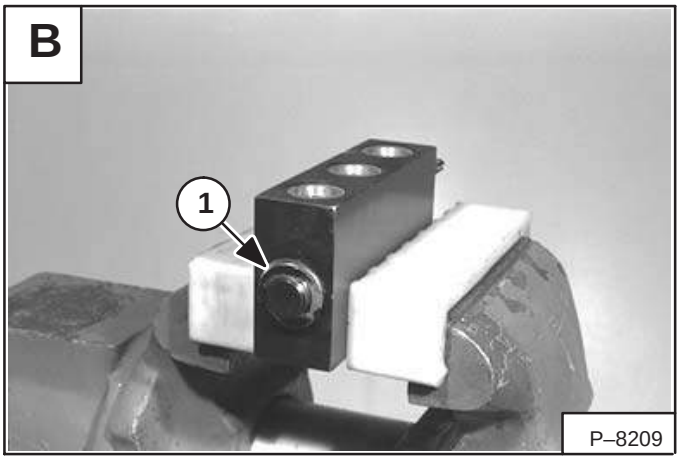
TWO SPEED VALVE (S/N 12999 & Below) (Cont'd)

Assembly (Cont'd)

Install the washer (Item 1) **[A]** on the spool.

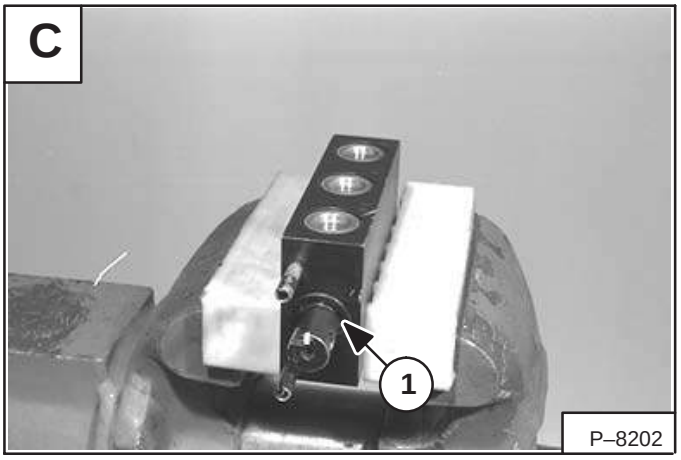


Install the snap ring (Item 1) **[B]** on the rear snap ring groove of the spool.



Install the snap ring (Item 1) **[C]** on the front snap ring groove of the spool.

NOTE: Make sure the notch in the spool points up to the port openings, as shown [C].



TWO SPEED SWITCH (S/N 13001 & Above)

Removal and Installation

Remove the floor mat. (See Page 4–1.)

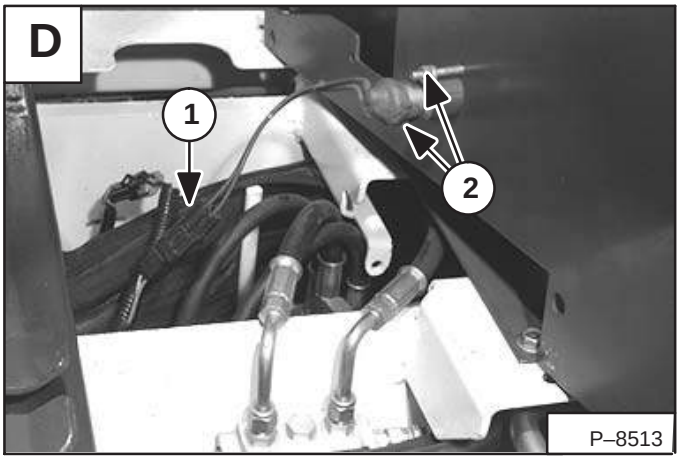
Remove the floor plate. (See Page 4–1.)

Unplug the two speed switch (Item 1) **[D]** from the wire harness.

Remove the two (2) mounting nuts and bolts (Item 2) **[D]** from the floor plate.

Remove the two speed switch from the floor plate.

NOTE: The electric two speed switch is not serviceable. If the switch is not operating correctly, discard and replace with a new two speed switch.



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PORT BLOCK

Removal and Installation (S/N 12999 & Below)

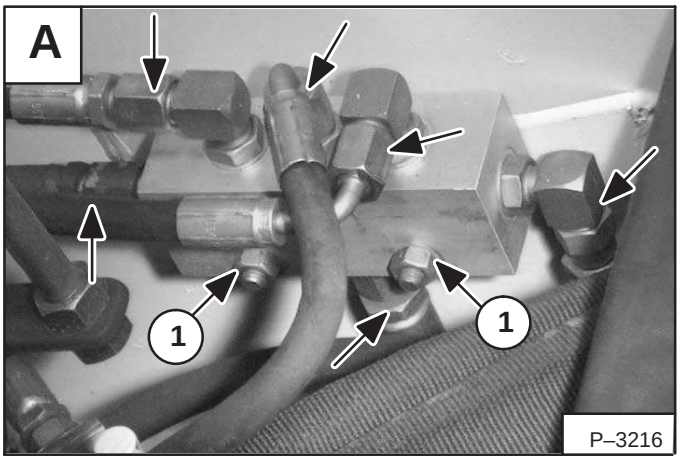
Remove the floormat. (See Page 4–1.)

Remove the floor plate. (See Page 4–1.)

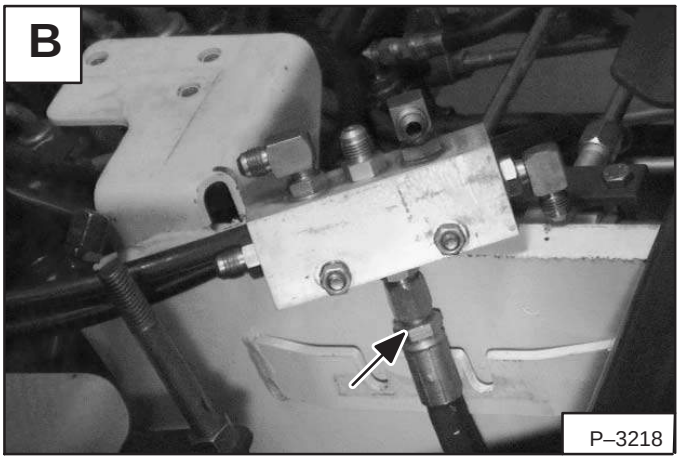
Mark the hoses before removal for correct installation.

Remove the hoses from the port block **[A]**.

Loosen the mounting bolts (Item 1) **[A]**.

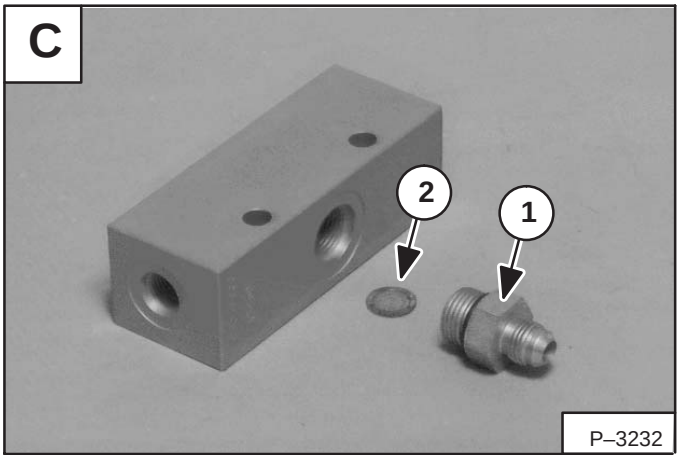


Remove the port block and the lower hose **[B]**.



Remove the bottom fitting (Item 1) **[C]** on the port block and remove the screen filter (Item 2) **[C]**. Clean the screen with solvent and reinstall.

The washer surface of the filter must be toward fitting.



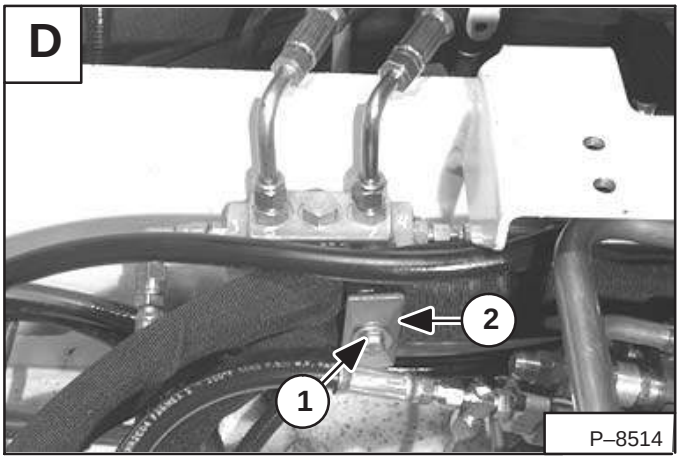
Removal and Installation (S/N 13001 & Above)

Remove the floor mat. (See Page 4–1.)

Remove the floor plate. (See Page 4–1.)

Mark the hoses and tubes before removal for correct installation.

Remove the mount bolt (Item 1) **[D]** and hose clamps (Item 2) **[D]** from the port block.

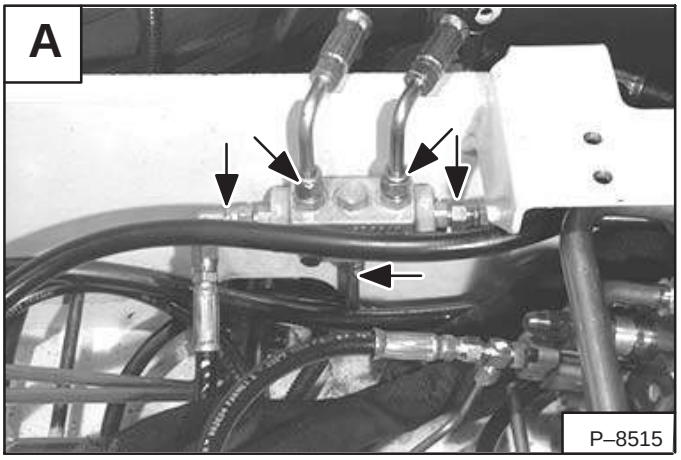


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Port Block (Cont'd)

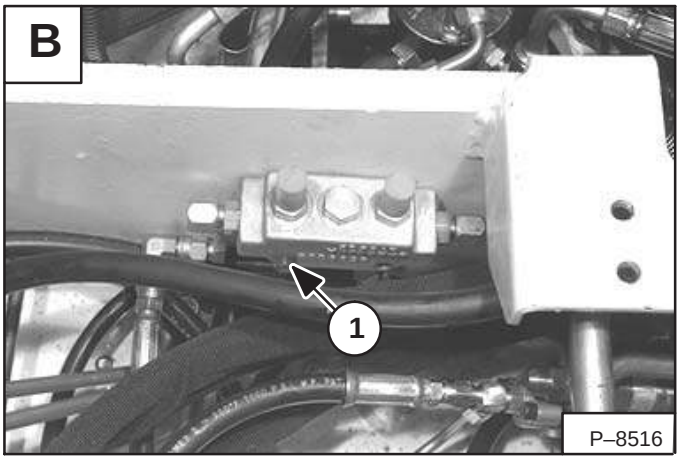
Removal and Installation (S/N 13001 & Above) (Cont'd)

Remove the hoses and tubes from the port block.



Remove the second mount bolt (Item 1) **[B]** from the port block.

Remove the port block from the excavator.



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OIL COOLER

Removal and Installation (S/N 11001 – 11999)

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 right hand side cover. (See Page 4–1.)

Remove the right hand corner post. (See Page 4–1.)

Remove the fluid from the hydraulic reservoir.

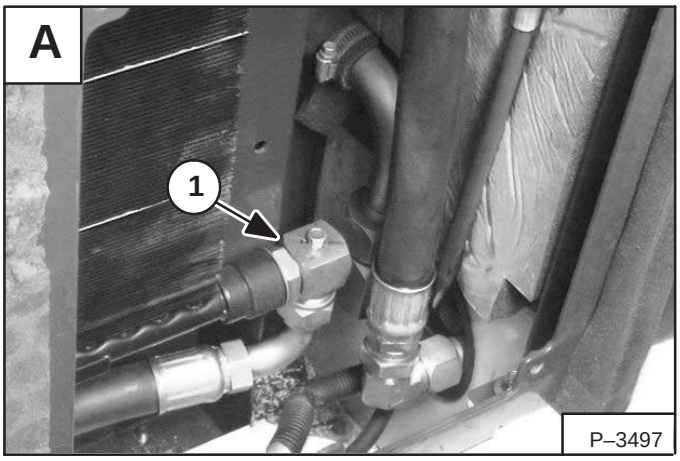
Remove the tube (Item 1) **[A]** from the elbow on the oil cooler.

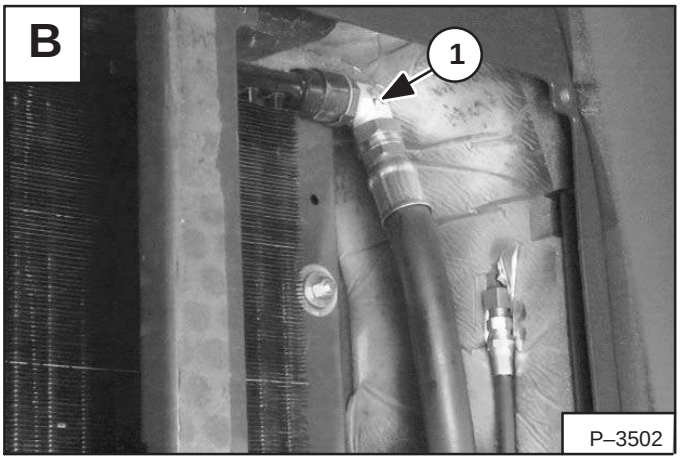
Remove the hose (Item 1) **[B]** from the elbow on the oil cooler.

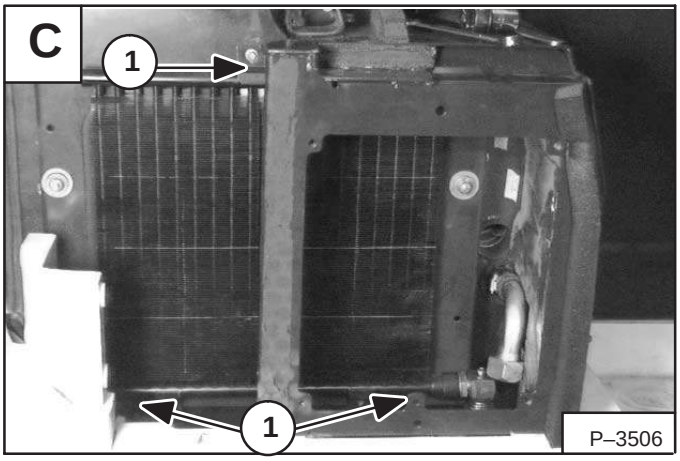
Remove the four (4) oil cooler mounting bolts (Item 1) **[C]**.

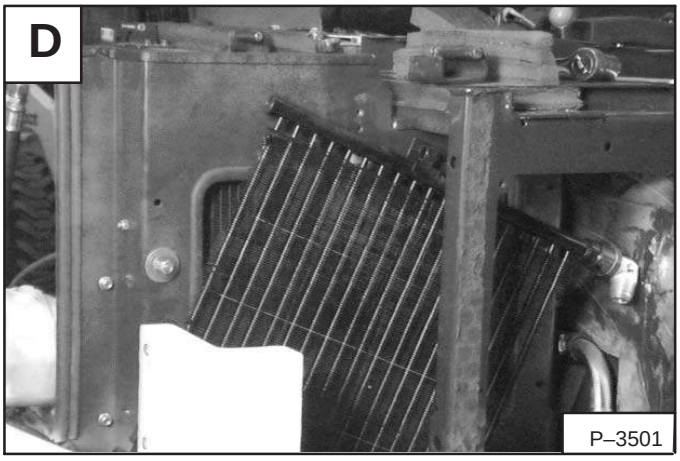
Remove the oil cooler **[D]**.

NOTE: Do not damage the radiator fins when removing the oil cooler.









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OIL COOLER

Removal and Installation (S/N 12001 & Above)

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 right hand side cover. (See Page 4–1.)

Remove the right hand corner post. (See Page 4–1.)

Remove the right hand counterweight. (See Page 4–1.)

Remove the fluid from the hydraulic reservoir.

Remove the tube (Item 1) **[A]** from the elbow on the oil cooler.

Remove the hose (Item 1) **[B]** from the filter mount.

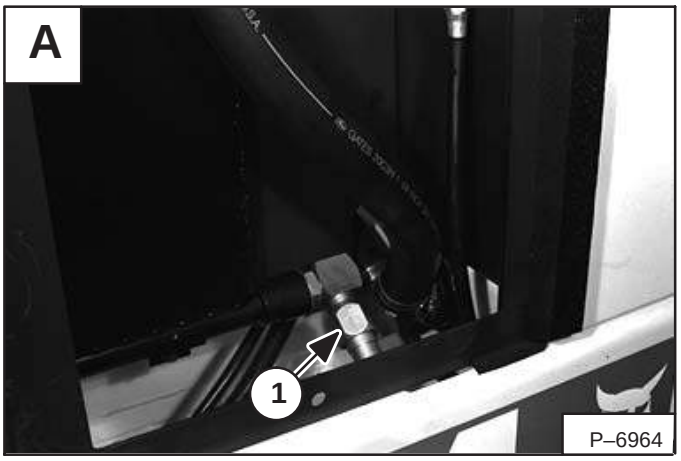
Remove the filter mount bolts (Item 2) **[B]**.

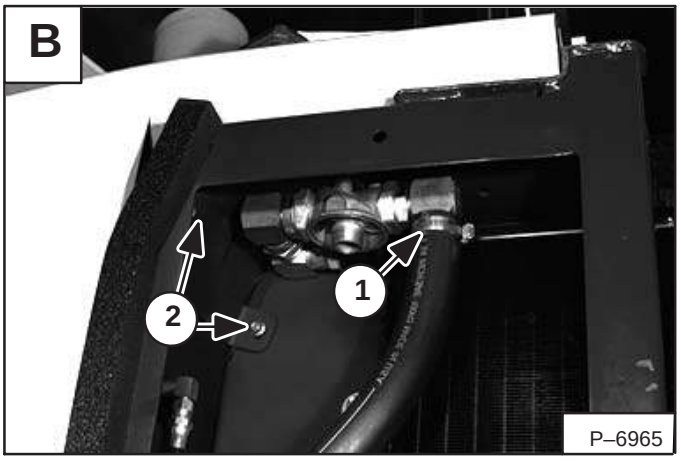
Remove the filter mount, from the oil cooler.

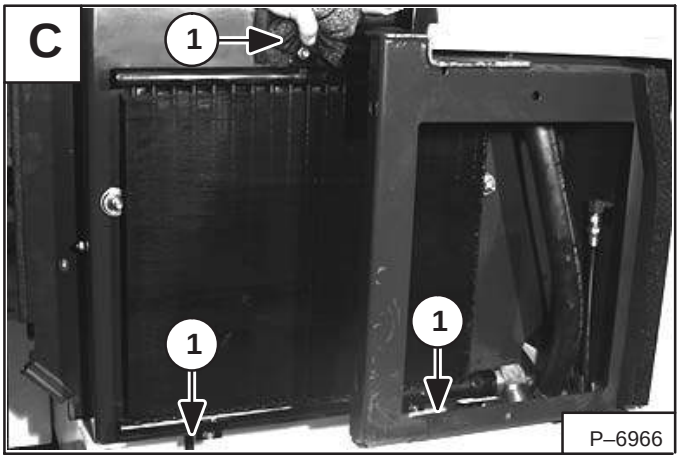
Remove the three (3) oil cooler mounting bolts (Item 1) **[C]**.

Remove the oil cooler.

NOTE: Do not damage the radiator fins when removing the oil cooler.







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HYDRAULIC RESERVOIR AND FUEL RESERVOIR

Removal and Installation

IMPORTANT

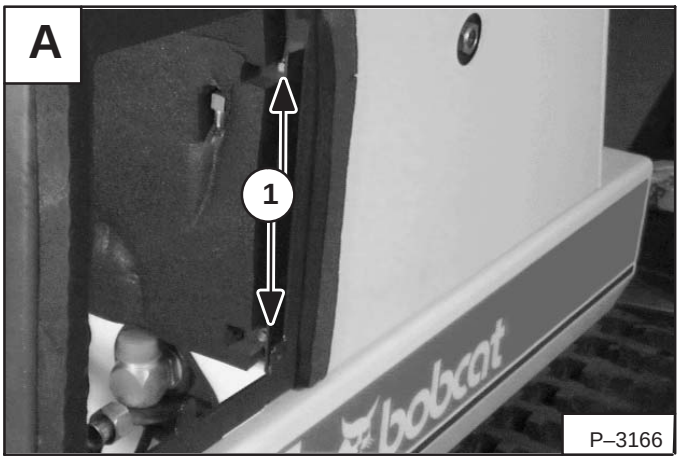
When making repairs on hydrostatic and hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.

I–2003–0284

Turn the upperstructure to have access to the bottom of the hydraulic and fuel tanks from between the track.

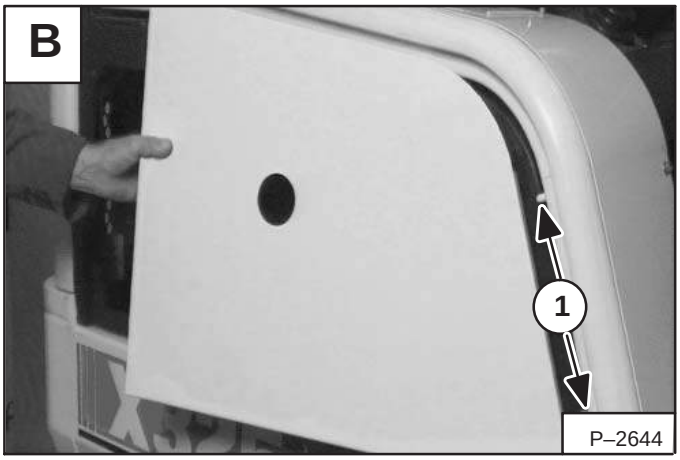
Remove the right side cover. (See Page 4–1.)

Remove the two bolts (Item 1) **[A]** from the rear of the right front side cover.



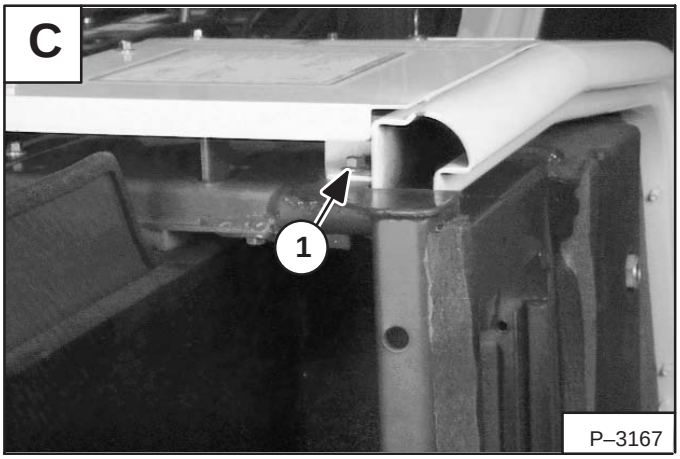
Pull out on the side cover until the rear edge clears the front engine cover **[B]**.

Pull the side cover to the rear until the cover slides out of the front mounting pins (Item 1) **[B]**.



Remove the bolt (Item 1) **[C]** from the top cover.

Installation: Tighten the bolt to 30–37 ft.–lbs. (40–50 Nm) torque.



Remove the bolt (Item 1) **[D]** from the side of the top cover.

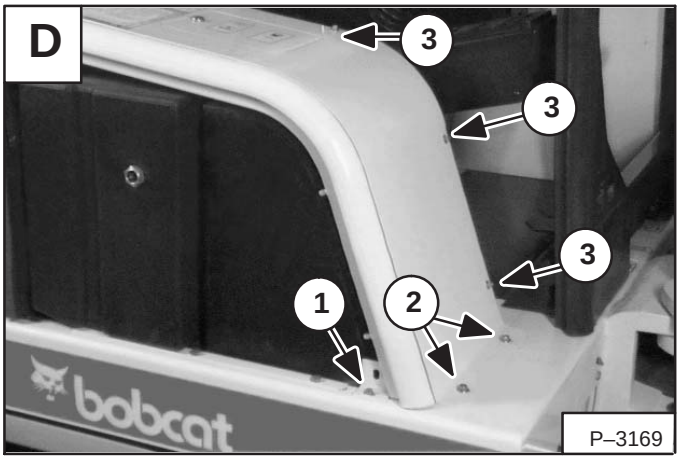
Installation: Tighten the bolt to 30–37 ft.–lbs. (40–50 Nm) torque.

Remove the two front bolts (Item 2) **[D]** from the top cover.

Installation: Tighten the bolts to 30–37 ft.–lbs. (40–50 Nm) torque.

Remove the right (8) top bolts (Item 3) **[D]** from the top cover.

Installation: Tighten the bolts to 15–18 ft.–lbs. (20–25 Nm) torque.



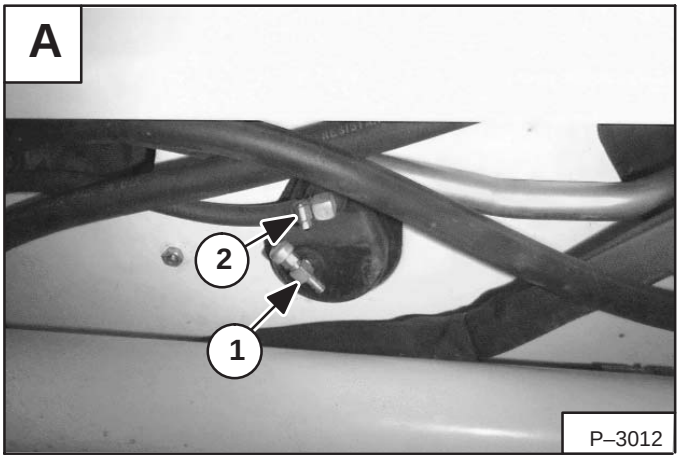
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HYDRAULIC RESERVOIR AND FUEL RESERVOIR (Cont'd)

Removal and Installation (Cont'd)

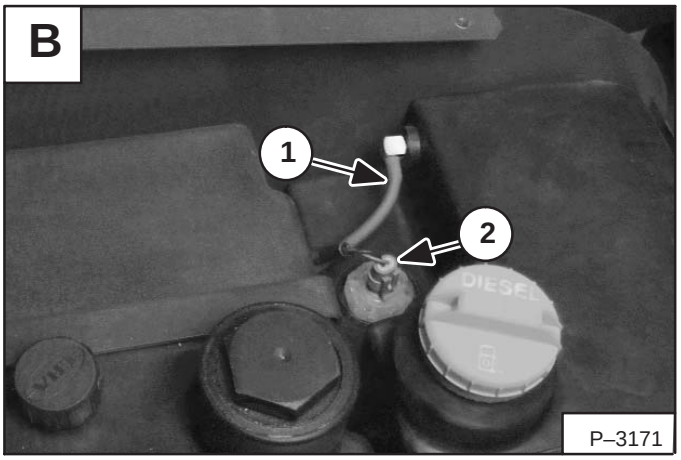
Slowly open the fuel tank drain valve (Item 1) **[A]** and drain the fuel into a container.

Loosen the hose clamp (Item 2) **[A]** and remove the fuel hose.



Remove the return fuel hose (Item 1) **[B]** from the top of the fuel tank.

Disconnect the fuel sender harness connector (Item 2) **[B]**.

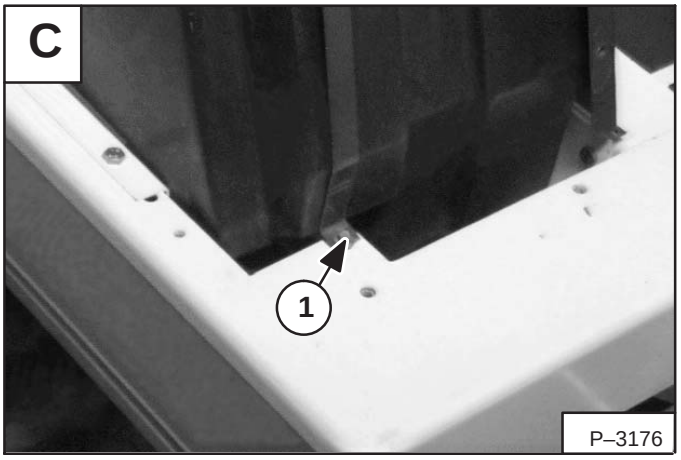


Remove the bolt (Item 1) **[C]** from the fuel tank retainer strap.

Bend the strap upwards slightly and remove the fuel tank.

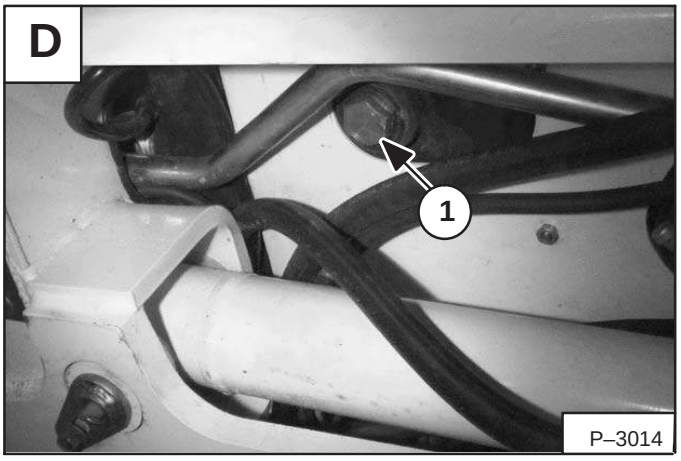
NOTE: The foam pieces between the fuel tank and the frame must be reinstalled during assembly.

Installation: Tighten the bolt to 15–18 ft.–lbs. (20–25 Nm) torque.



Remove the battery. (See Page 6–1.)

Drain the hydraulic tank by removing the plug (Item 1) **[D]** from the bottom of the tank. Drain the fuel into a container, approximately 10.5 gals. (40 L).



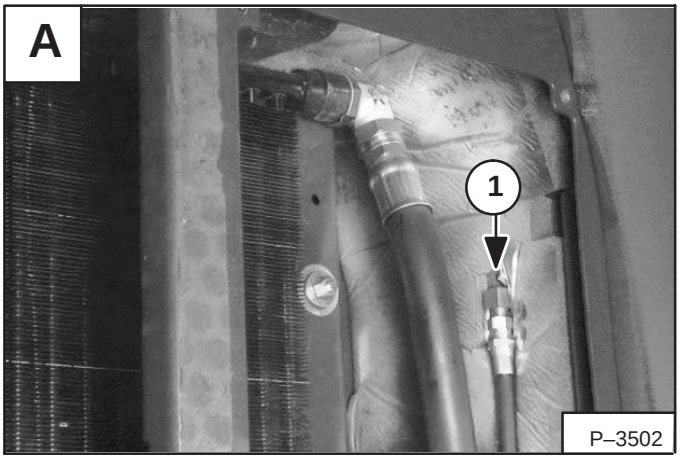
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HYDRAULIC RESERVOIR AND FUEL RESERVOIR (Cont'd)

Removal and Installation (Cont'd)

The following two (2) steps are for S/N 11001–11999 only:

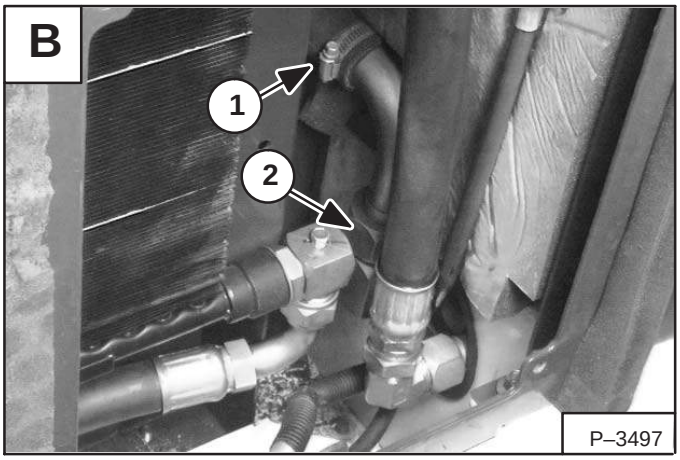
Remove the hydraulic return hose (Item 1) **[A]** from the rear of the hydraulic tank.



Loosen the hose clamp (Item 1) **[B]** form the elbow.

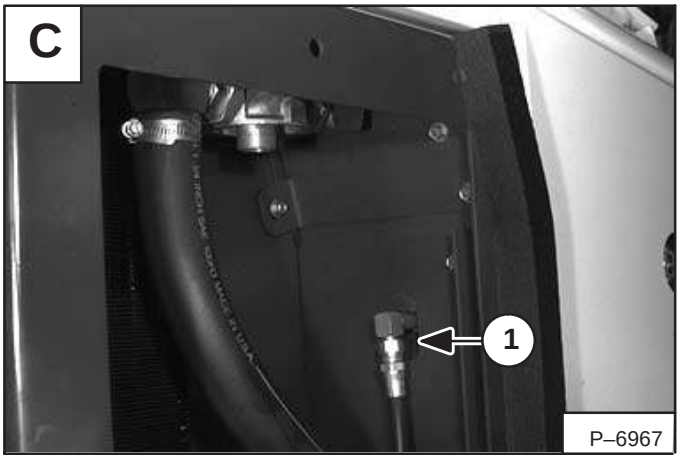
Loosen the nut (Item 2) **[B]** on the elbow.

When the nut is remove and the elbow is loose, turn the elbow up (180°) and out of the way.



The following two (2) steps are for S/N 12001 & Above only:

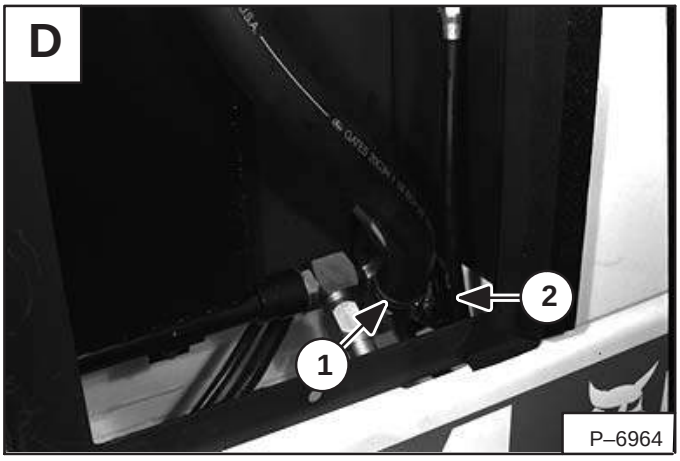
Remove the hydraulic return hose (Item 1) **[C]** from the rear of the hydraulic tank.



Loosen the hose clamp (Item 1) **[D]** from the elbow.

Loosen the nut (Item 2) **[D]** on the elbow.

When the nut is removed and the elbow is loose, turn the elbow (180°) and out of the way.



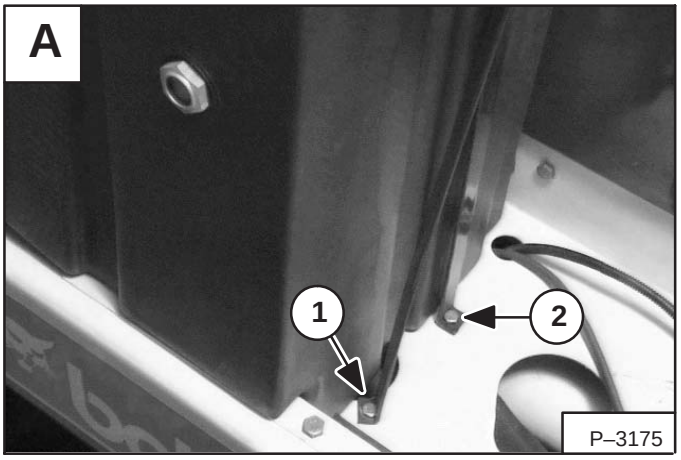
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HYDRAULIC RESERVOIR AND FUEL RESERVOIR (Cont'd)

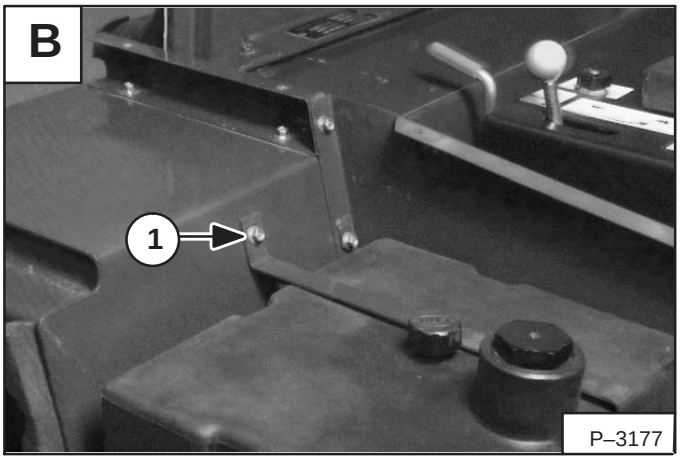
Removal and Installation (Cont'd)

Remove the bolt (Item 1) **[A]** and nut from the front tank retainer strap.

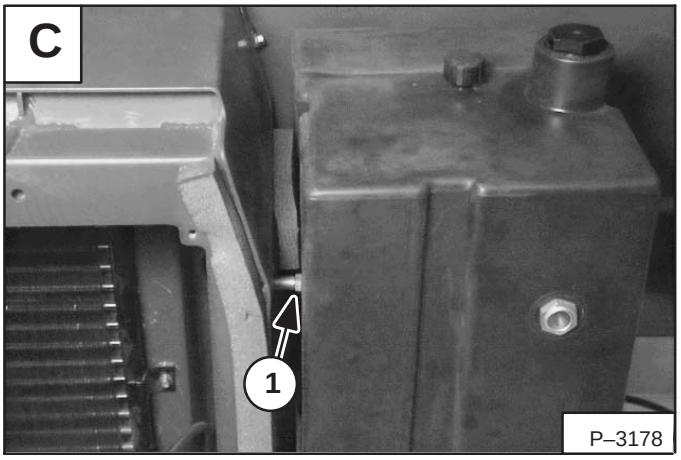
Remove the bolt (Item 2) **[A]** and nut from the hydraulic tank retainer strap.



Remove the bolt (Item 1) **[B]** from the back of the tank retainer strap.



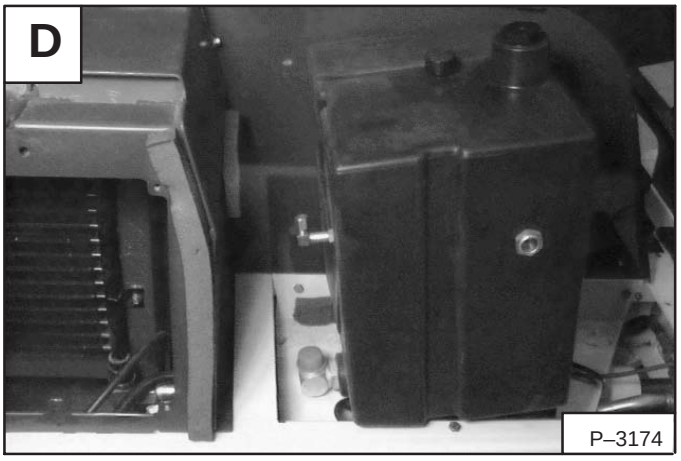
Loosen the jam nut (Item 1) **[C]** on the top elbow on the hydraulic tank and then rotate the elbow up (180°) so the elbow points upwards.



Tilt the top of the tank to the rear and pull forward on the bottom of the tank **[D]**.

Remove the tank.

NOTE: The foam pieces between the hydraulic tank and the frame must be reinstalled during assembly.



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HYDRAULIC FILTER ASSEMBLY

Removal and Installation (S/N 11001–11999)

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.

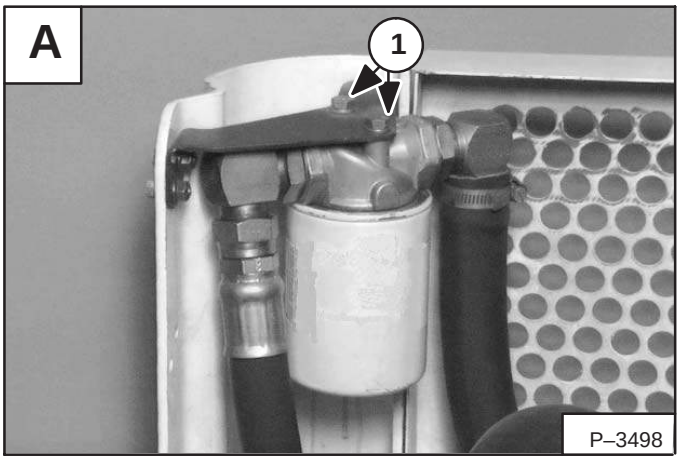
I–2003–0284

Raise the engine cover.

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

Install plugs into the hoses and tighten. If hoses are lowered without plugs installed, hydraulic fluid will start draining from hydraulic tank.

Remove the mounting bolts (Item 1) **[A]** from the filter assembly.



Removal and Installation (S/N 12001 & Above)

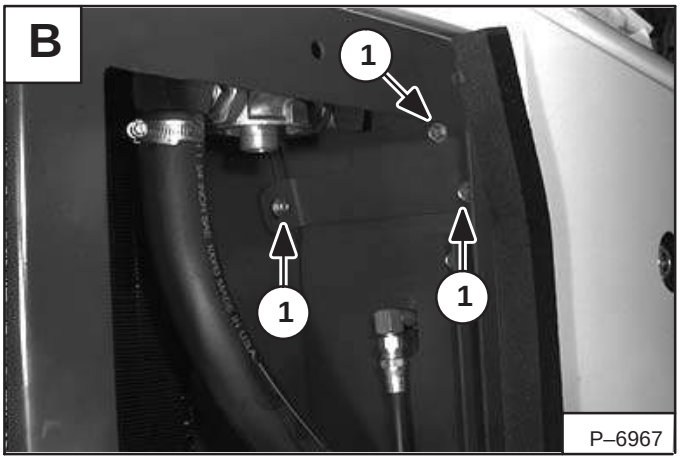
Remove the right side cover. (See Page 4–1.)

Remove the filter. (See Page 1–1.)

Remove the outlet hoses from the filter **[B]**.

Install a plug into the hose and tighten.

Remove the mounting bolts (Item 1) **[B]** from the filter assembly.



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BOOM CYLINDER

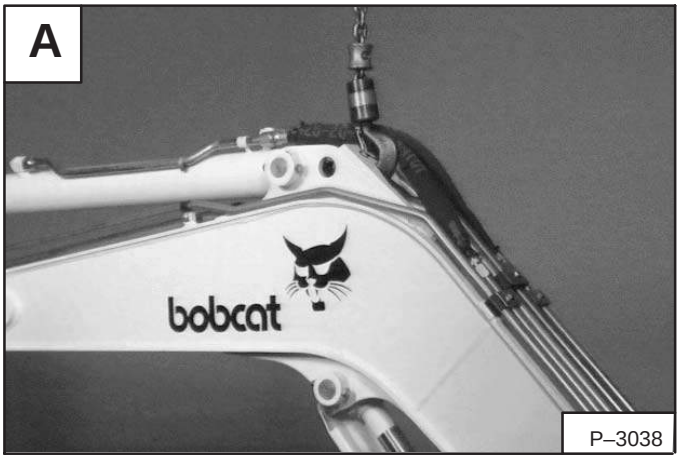
Removal and Installation (S/N 11001–11999)

See Page 2–138 for cylinder repair procedure.

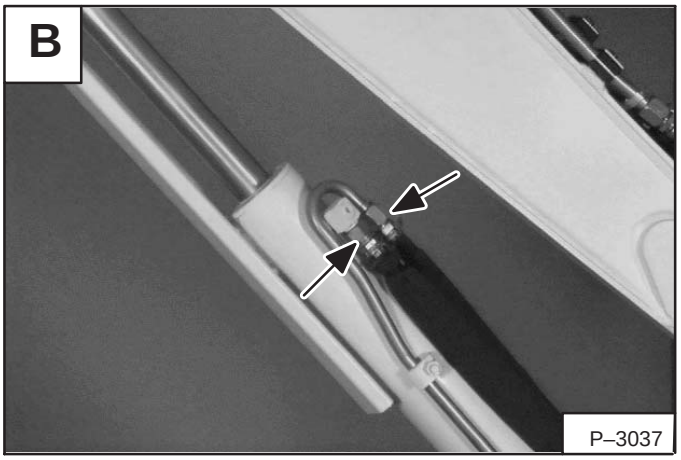
Put the bucket on the floor. Stop the engine.

Move the hydraulic control to release the hydraulic pressure.

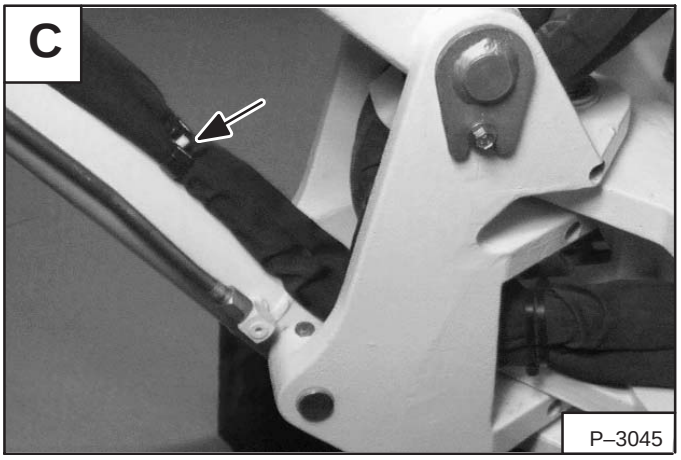
Fasten a chain hoist to the boom **[A]**.



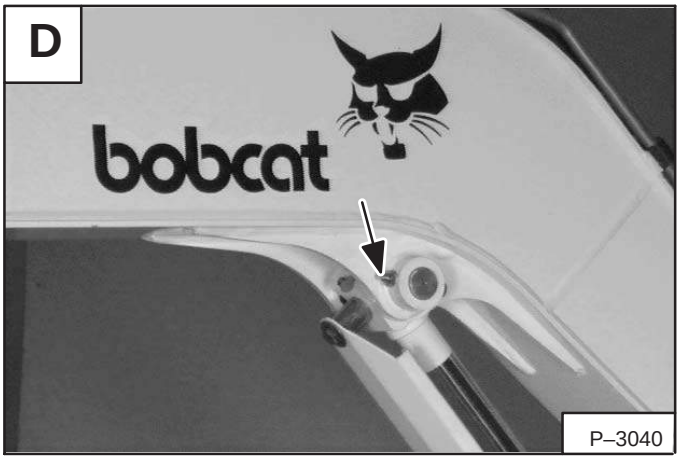
Disconnect the two hoses from the boom cylinder **[B]**.



Remove the nut from the hose clamp **[C]**.



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



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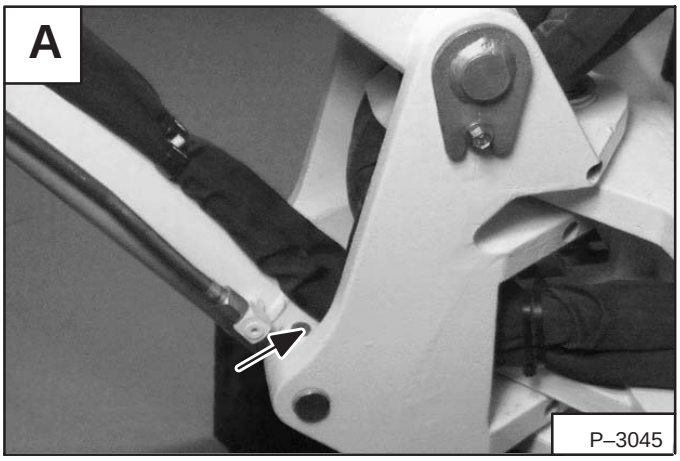
BOOM CYLINDER (Cont'd)

Removal and Installation (S/N 11001–11999) (Cont'd)

Remove the retaining bolt and nut from the base end pin **[A]**.

Remove the cylinder base end pin.

Remove the boom cylinder.



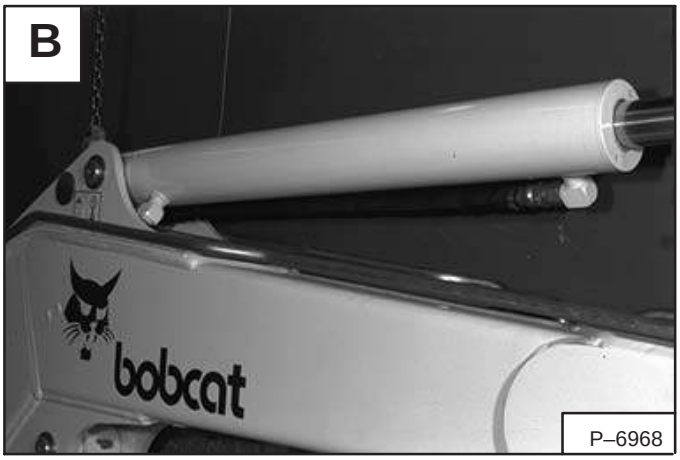
Removal and Installation (S/N 12001 & Above)

See Page 2–138 for cylinder repair procedure.

Put the bucket on the floor. Stop the engine.

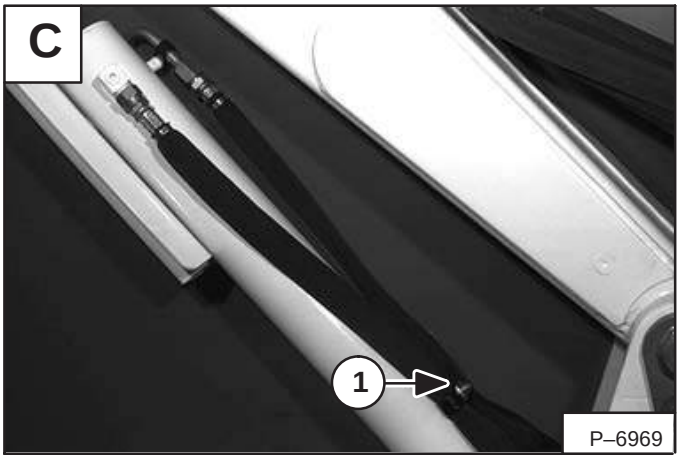
Move the hydraulic control to release the hydraulic pressure.

Fasten a chain hoist to the boom **[B]**.



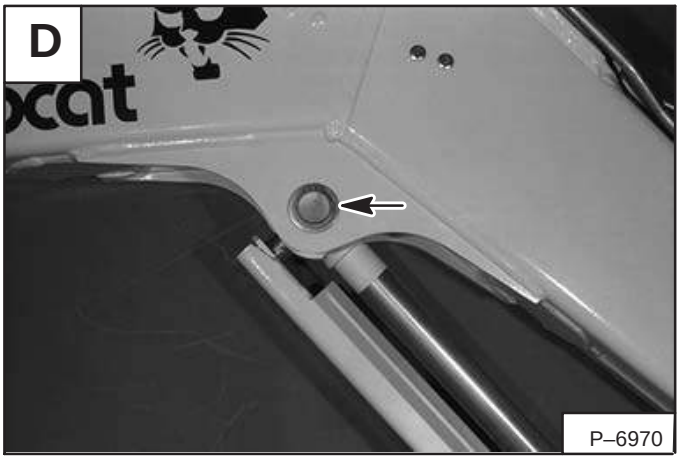
Disconnect the two hoses from the boom cylinder **[C]**.

Remove the bolt from the hose clamp (Item 1) **[C]**.



Remove the snap ring and washer from the cylinder rod end pin **[D]**.

Remove the cylinder rod end pin.



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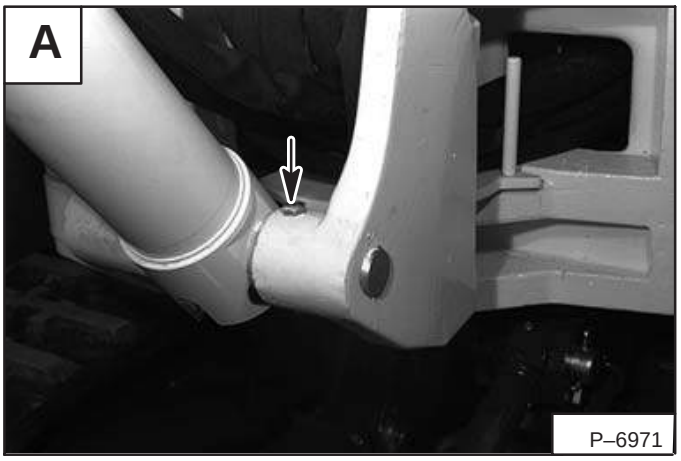
BOOM CYLINDER (Cont'd)

Removal and Installation (S/N 12001 & Above) (Cont'd)

Remove the retaining bolt and nut from the base end pin **[A]**.

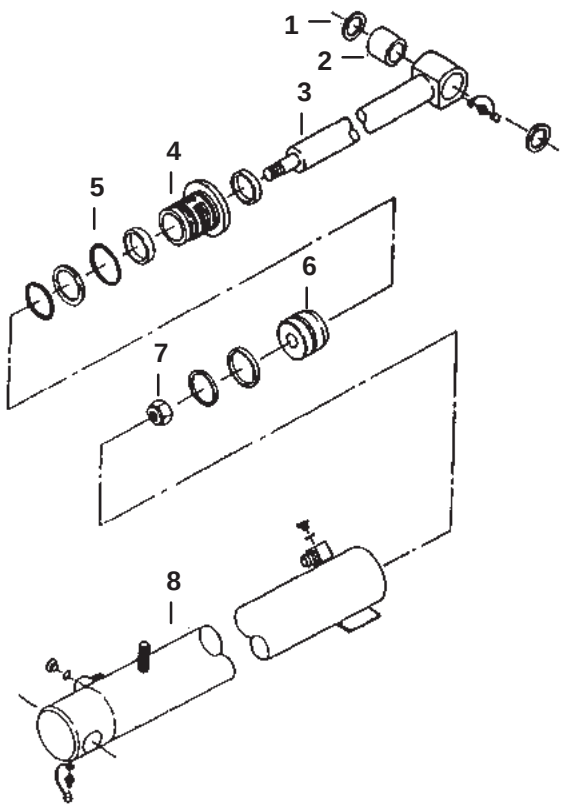
Remove the cylinder base end pin.

Remove the boom cylinder.



Parts Identification

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



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ARM CYLINDER

Removal and Installation (S/N 11001–11999)

See Page 2–138 for cylinder repair procedure.

Put the bucket on the floor. Stop the engine.

Support the boom with a chain hoist.

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

Fasten a chain hoist to the boom **[A]**.

Disconnect the two hoses (Item 1) **[B]** from the arm cylinder.

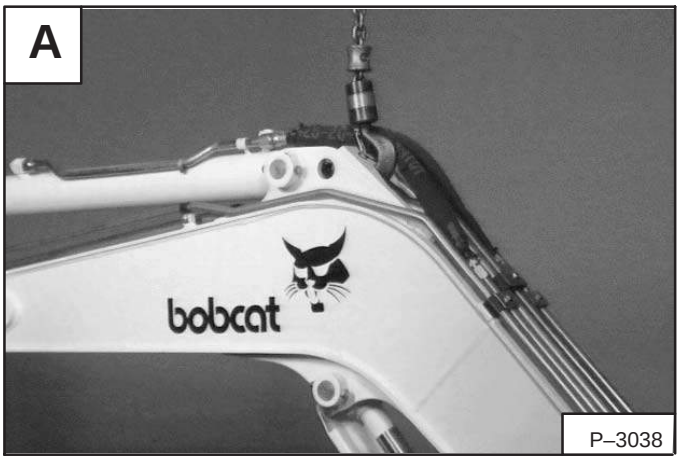
Remove the retainer bolt (Item 2) **[B]** and nut from the cylinder base end pin.

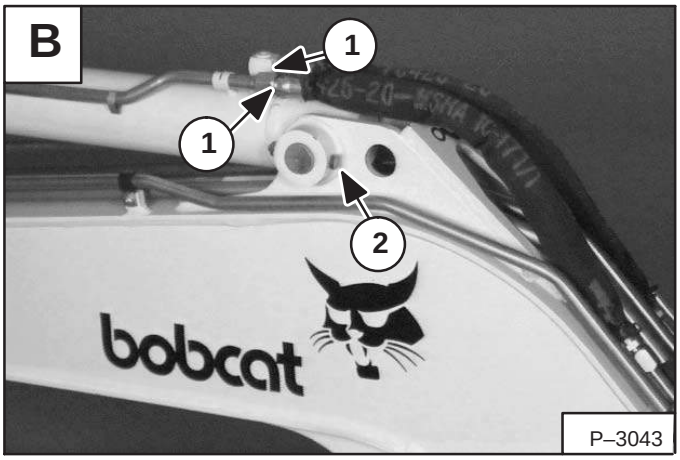
Remove the cylinder base end pin.

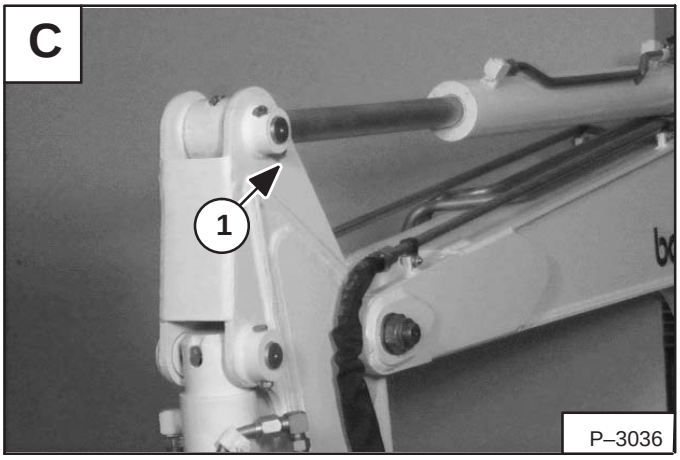
Remove the retainer bolt (Item 1) **[C]** and nut from the cylinder rod end pin.

Remove the cylinder rod end pin.

Remove the cylinder from the arm.







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ARM CYLINDER (Cont'd)

Removal and Installation (S/N 12001 & Above)

See Page 2–138 for cylinder repair procedure.

Put the bucket on the floor. Stop the engine.

Support the boom with a chain hoist.

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

Fasten a chain hoist (Item 1) **[A]** to the boom.

Disconnect the two hoses (Item 2) **[A]** from the arm cylinder.

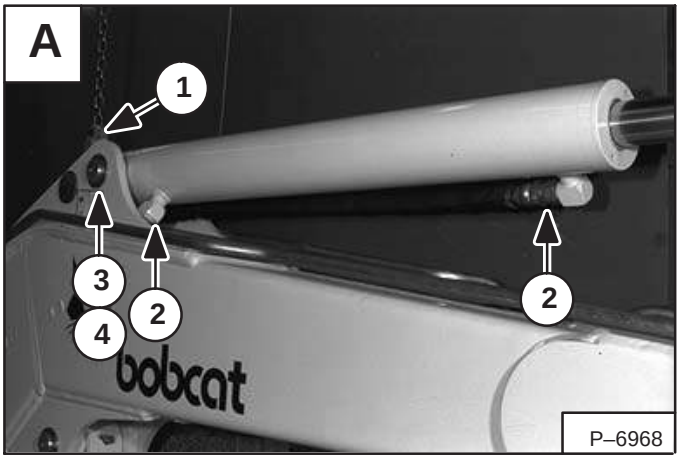
Remove the snap ring (Item 3) **[A]** and washer (Item 4) **[A]** from the cylinder base end pin.

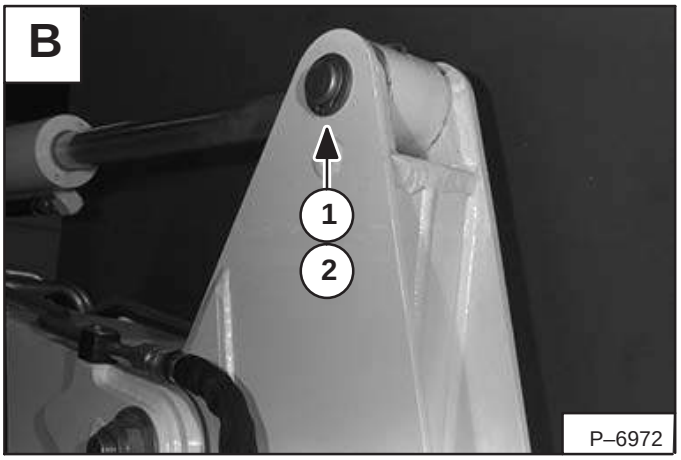
Remove the cylinder base end pin.

Remove the snap ring (Item 1) **[B]** and washer (Item 2) **[B]** from the cylinder rod end pin.

Remove the cylinder rod end pin.

Remove the cylinder from the arm.



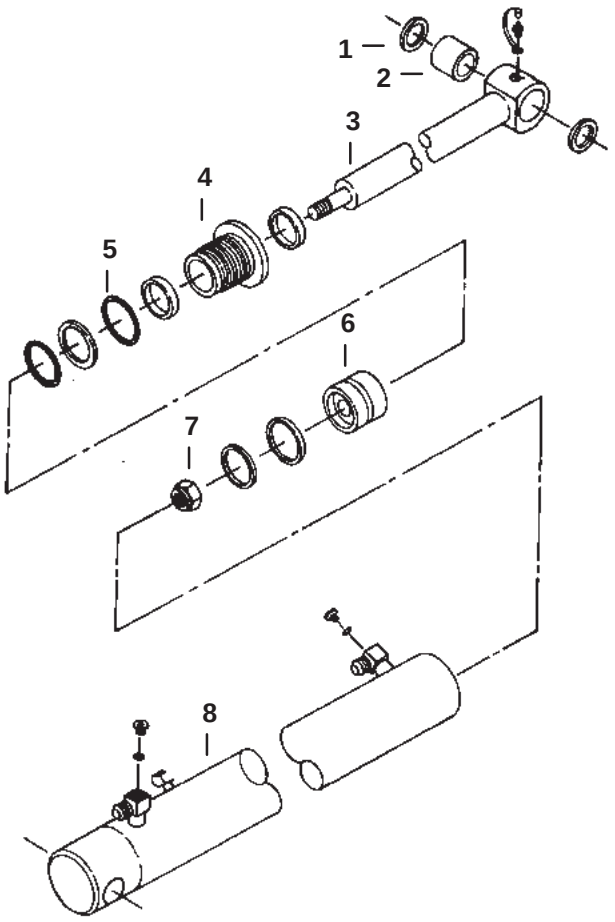


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ARM CYLINDER (Cont'd)

Parts Identification

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



C–3283

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BUCKET CYLINDER

Removal and Installation (S/N 11001–11999)

See Page 2–138 for cylinder repair procedure.

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

Fasten a chain hoist to the arm **[A]**.

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

Remove the cylinder rod end pin.

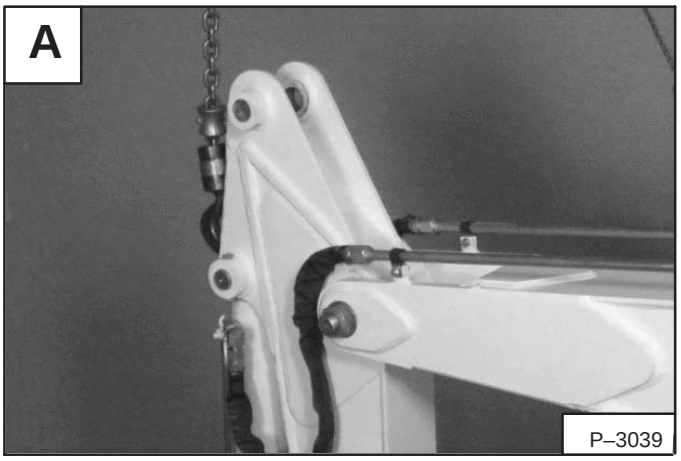
NOTE: Shim (Item 2) [B] must be reinstalled in between cylinder rod and bucket links.

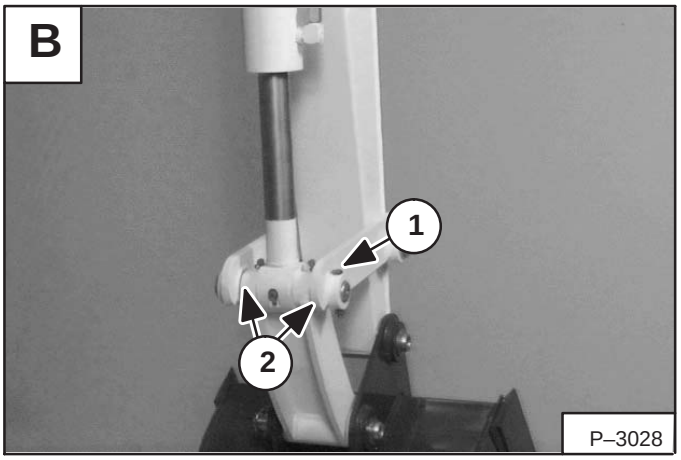
Remove the two (2) hoses (Item 1) **[C]** from the bucket cylinder.

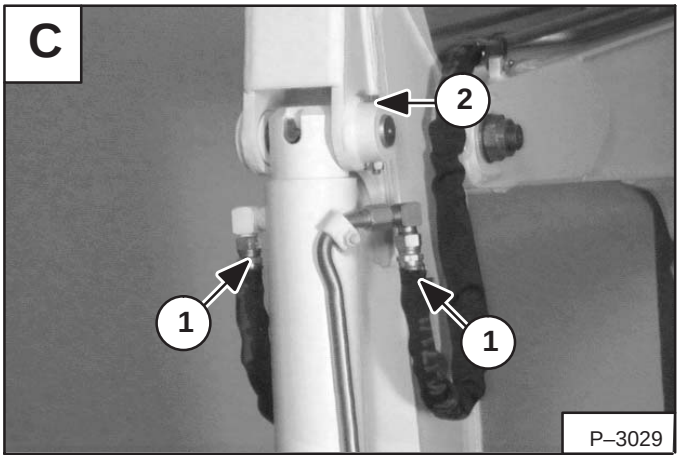
Remove the retainer bolt (Item 2) **[C]** and nut from the cylinder base end pin.

Remove the cylinder base end pin.

Remove the bucket cylinder.







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BUCKET CYLINDER (Cont'd)

Removal and Installation (S/N 12001 & Above)

See Page 2–138 for cylinder repair procedure.

Put the bucket on the floor. Stop the engine.

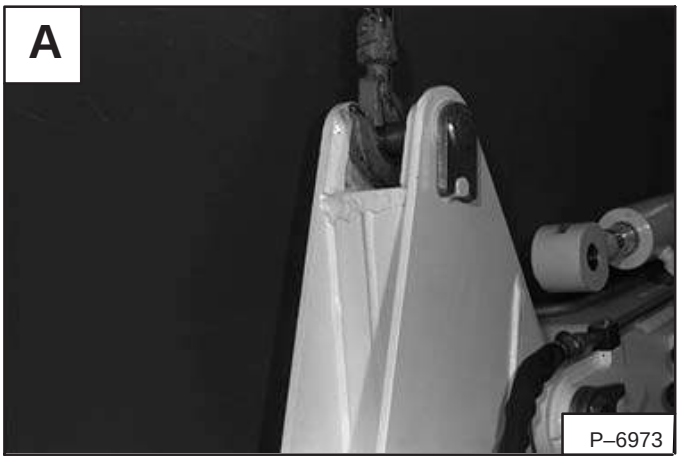
Move the hydraulic controls to release the hydraulic pressure.

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.

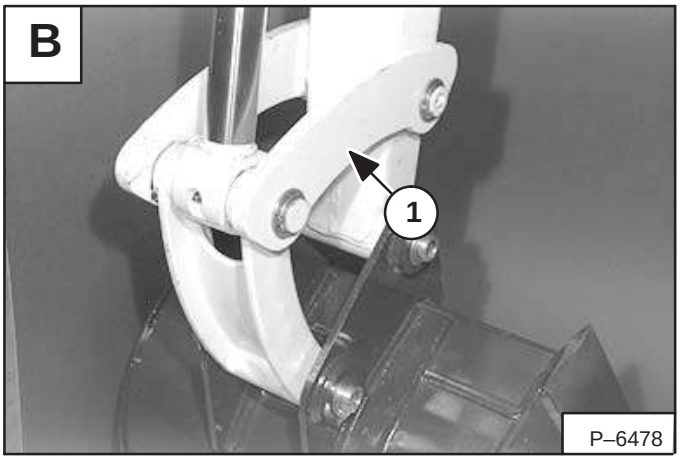
I–2003–0284

Fasten a chain hoist to the arm **[A]**.



Remove the snap rings and washers from the cylinder rod end pin link (Item 1) **[B]**.

Remove the cylinder rod end pin link (Item 1) **[B]**.



Remove the cylinder rod end pin from the cylinder and arm **[C]**.

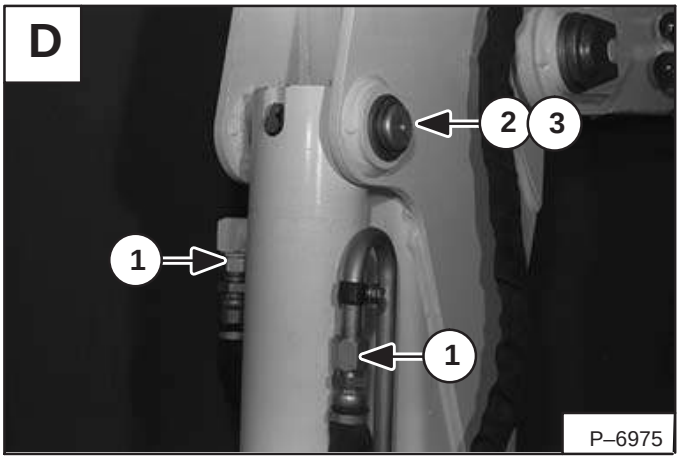


Remove the two (2) hoses (Item 1) **[D]** from the bucket cylinder.

Remove the snap ring (Item 2) **[D]** and washer (Item 3) **[D]** from the cylinder base end pin.

Remove the cylinder base end pin.

Remove the bucket cylinder.

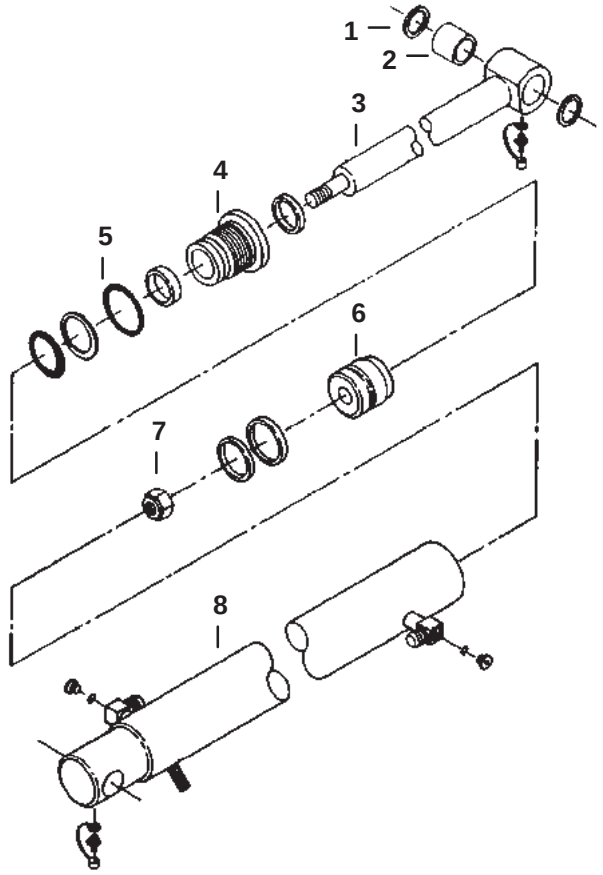


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BUCKET CYLINDER (Cont'd)

Parts Identification

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



C–3286

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BLADE CYLINDER

Removal and Installation

See Page 2–138 for cylinder repair procedure.

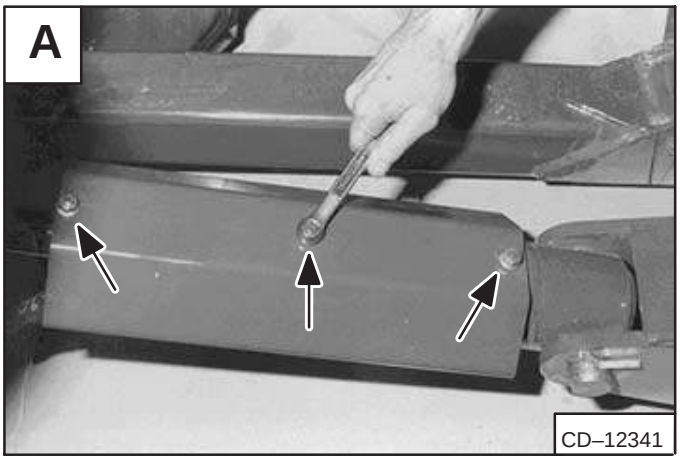
IMPORTANT

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.

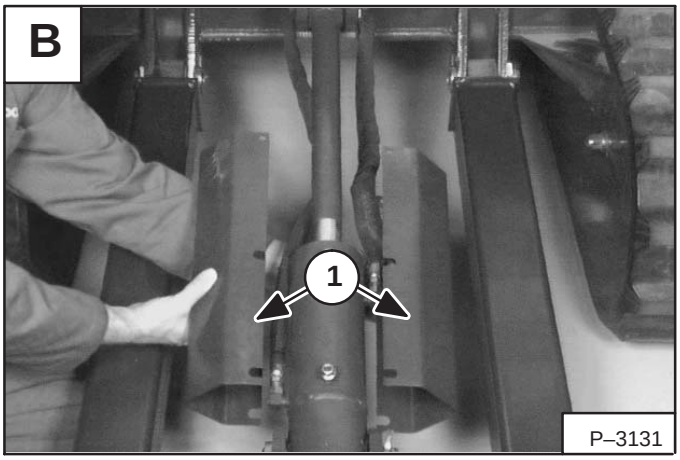
I–2003–0284

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

Loosen the six (6) nuts on the cylinder guard **[A]**.



Remove the two guards (Item 1) **[B]**.

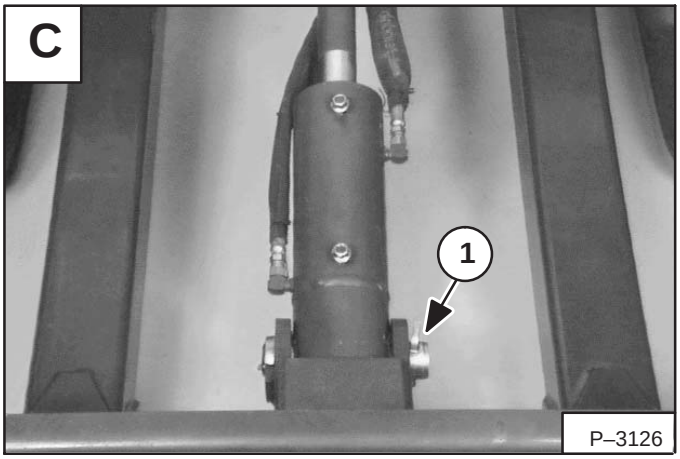


Remove the two (2) hoses from the blade cylinder **[C]**.

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

Remove the base end pin from the blade cylinder.

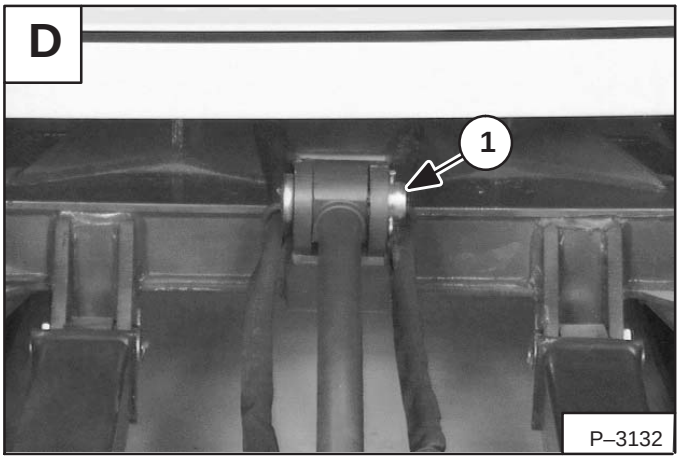
Lower the base end to the floor.



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

Remove the pin.

Remove the cylinder.

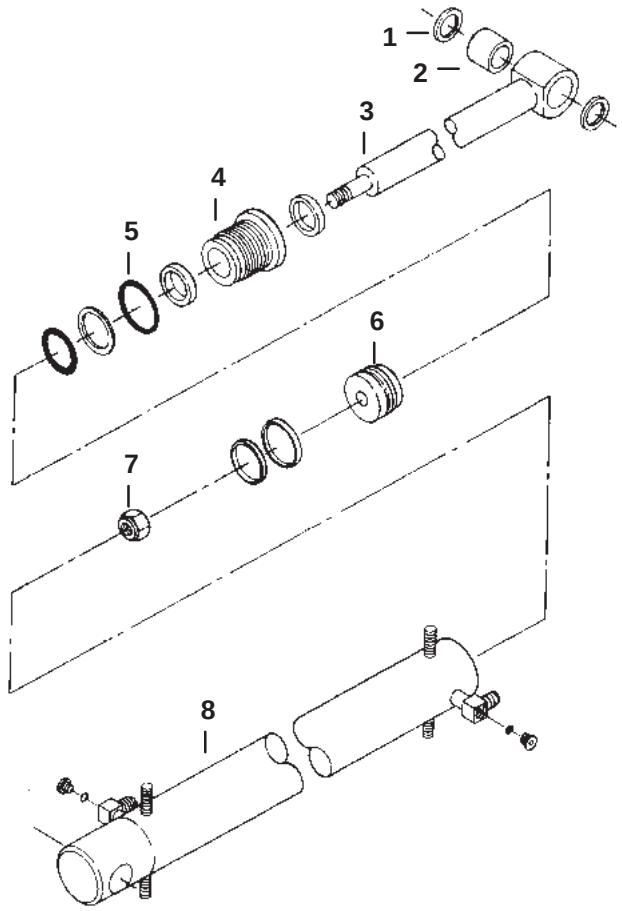


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BLADE CYLINDER (Cont'd)

Parts Identification

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



C–3284

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BOOM SWING CYLINDER

Removal and Installation

See Page 2–138 for cylinder repair procedure.

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

Put the bucket and the blade on the ground and stop the engine. Move the blade lever both directions to release hydraulic pressure.

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

Remove the pin.

Remove the spacers (Item 2) **[A]** from the edges of the boom swing cylinder rod end (if equipped).

Installation: Install spacers as needed to align the rod end of the cylinder to the boom swing bracket.

Pivot the cylinder to the right.

Reach through the cylinder access hole in the front of the upperstructure and remove the cylinder rod end hose.

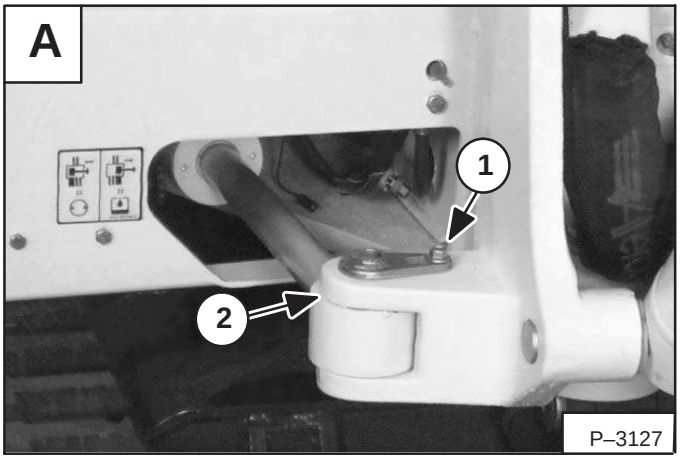
Remove the bolt (Item 1) **[B]** from the cylinder base end pin from under the right side of the upperstructure.

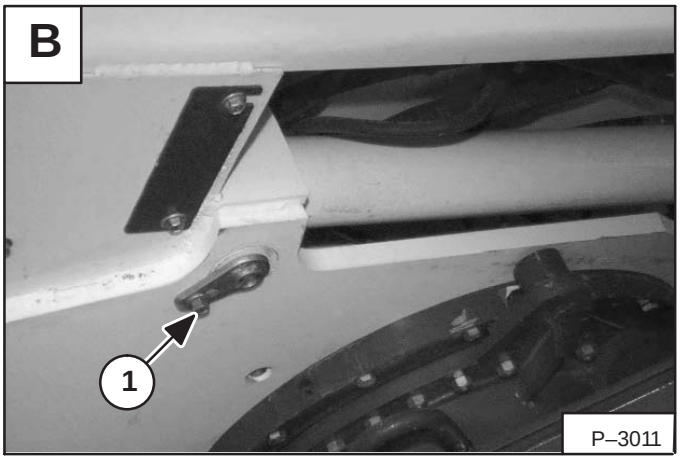
Remove the pin.

Slide the cylinder forward through the access hole until the cylinder base end hose can be reached through the access hole.

Have a second person hold the cylinder rod end stationary and remove the hose from the cylinder base end.

Remove the cylinder.



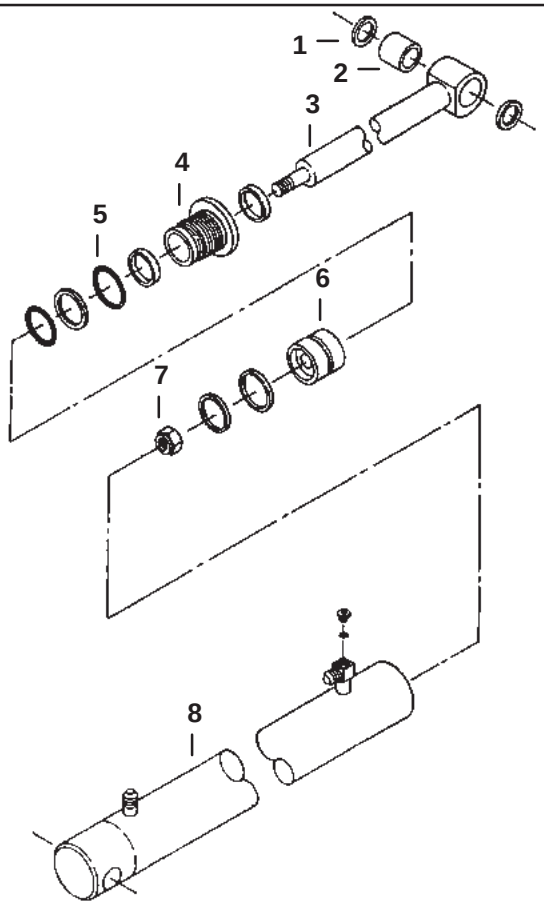


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BOOM SWING CYLINDER (Cont'd)

Parts Identification

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



C–3287

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HYDRAULIC CYLINDER

Disassembly

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

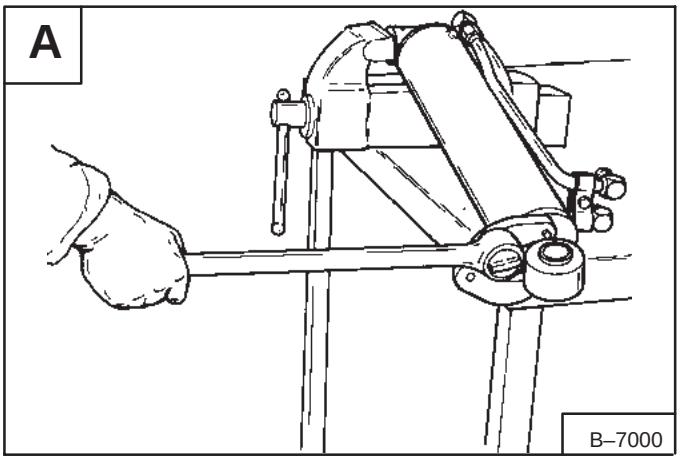
The following tools will be needed to disassemble and assemble the cylinders:

1. MEL1075 – Adjustable Gland Nut Wrench
2. MEL1074 – O–Ring Seal Hook
3. MEL1396 – Seal Installation Tool
4. MEL1033 – Rod Seal Installation Tool

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

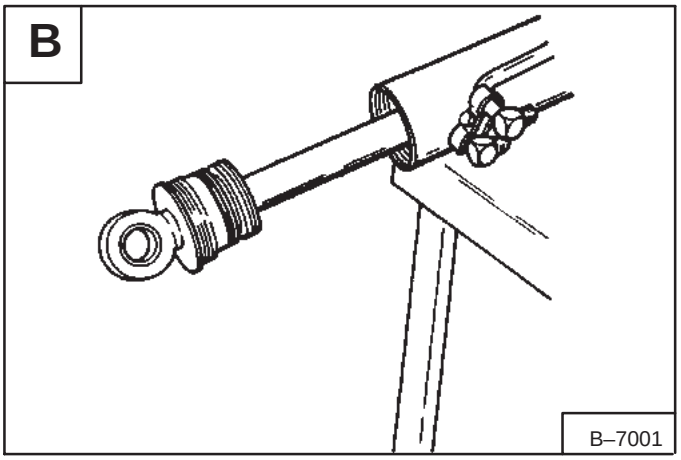
Use the adjustable gland nut wrench to loosen the head **[A]**.



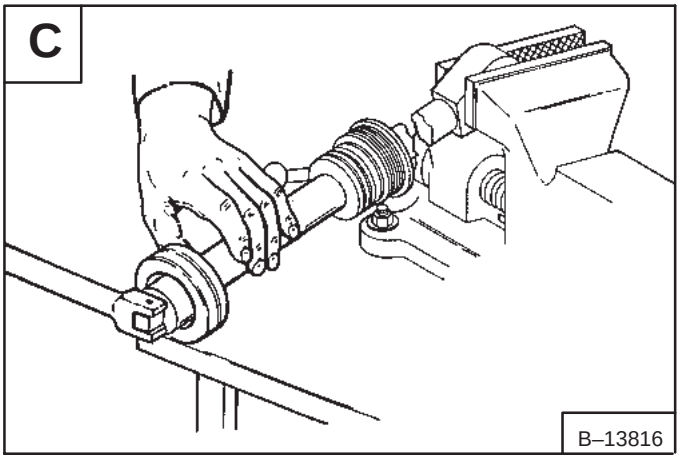
Remove the rod assembly from the cylinder case **[B]**.

Remove the cylinder case from the vise.

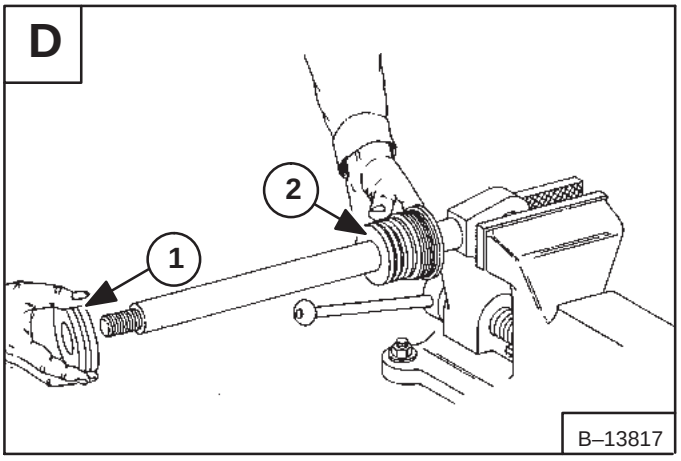
Put the rod end in the vise.



Loosen the nut from the piston end of the rod **[C]**.



Remove the piston (Item 1) **[D]** and head (Item 2) **[D]**.

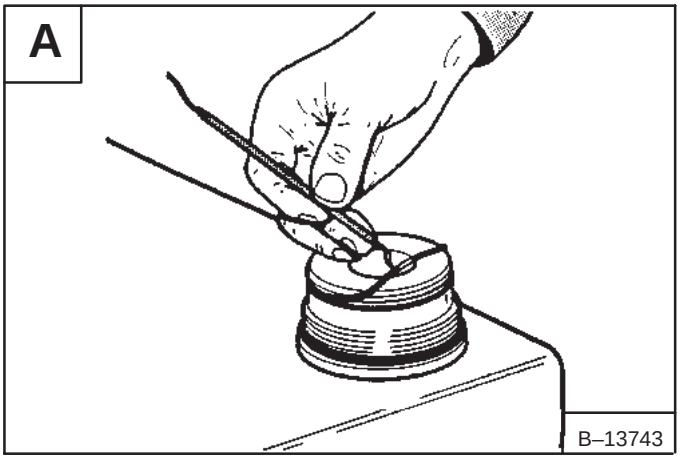


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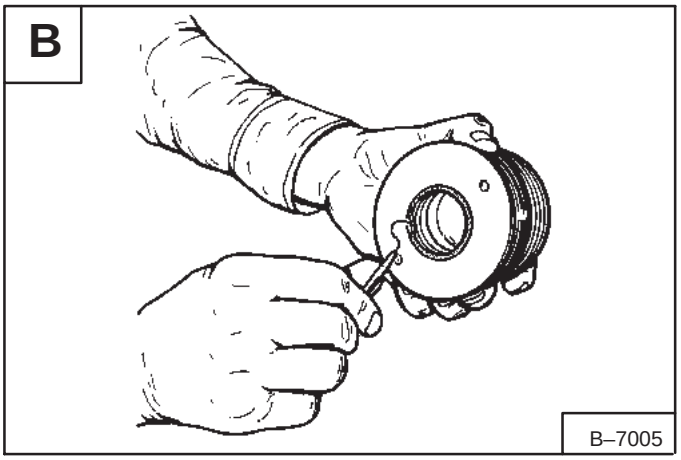
HYDRAULIC CYLINDER (Cont'd)

Disassembly (Cont'd)

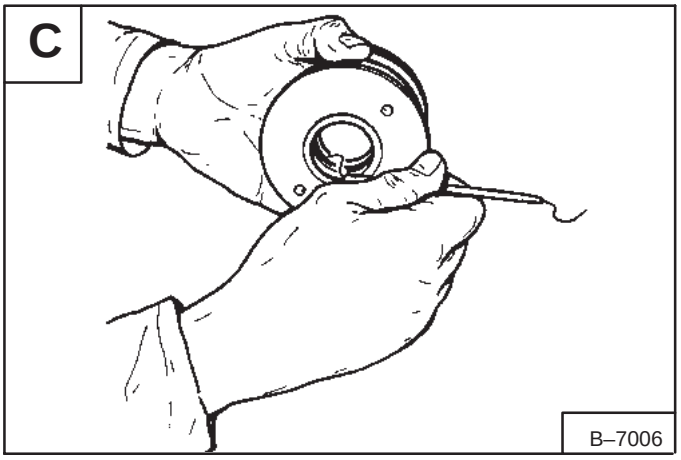
Remove the O–ring and back–up washer from the head with seal hook **[A]**.



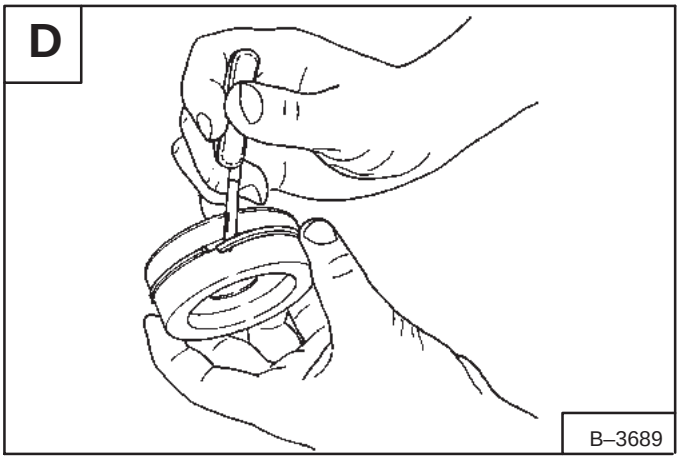
Remove the wiper seal **[B]**.



Remove the oil seal from the head **[C]**.



Cut the old teflon seal and remove the seal from the piston **[D]**.

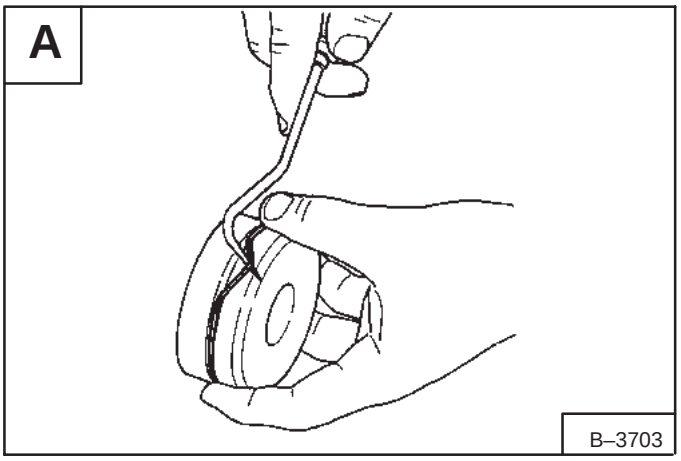


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HYDRAULIC CYLINDER (Cont'd)

Disassembly (Cont'd)

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



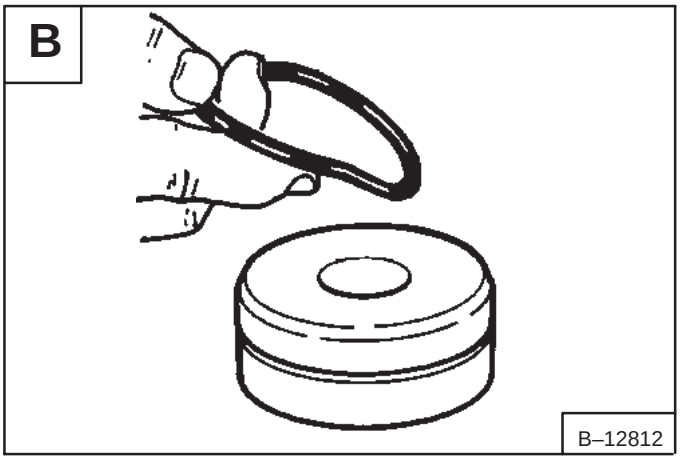
Wash the cylinder parts in solvent and air dry them.

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.

Assembly

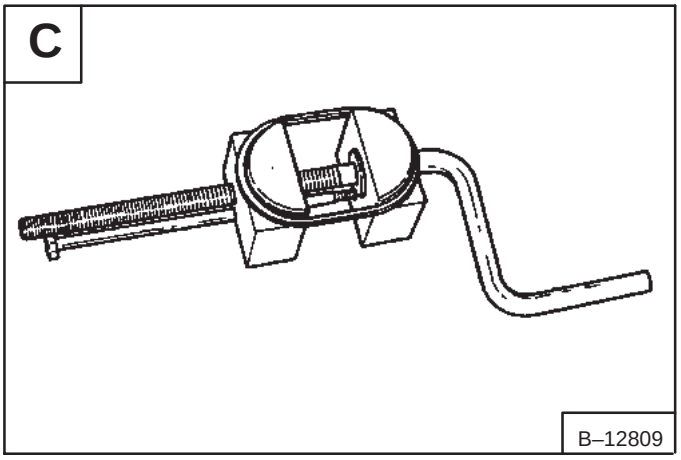
Install the O–ring on the piston **[B]**.



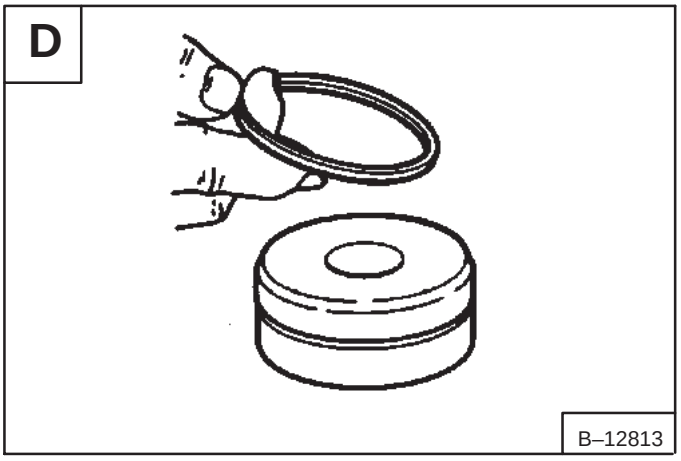
NOTE: Do not overstretch the seal.

Install the seal on the tool and stretch it until it fits the piston **[C]**.

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



Install the seal on the piston **[D]**.



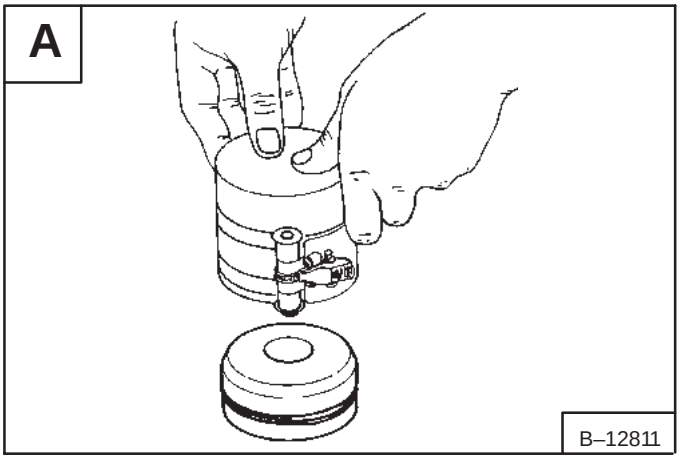
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HYDRAULIC CYLINDER (Cont'd)

Assembly (Cont'd)

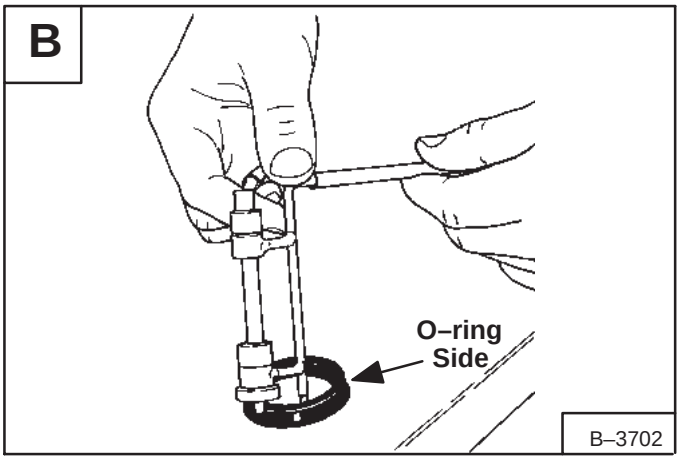
Use a ring compressor to compress the seal to the correct size **[A]**.

Leave the piston in the ring compressor for three minutes.

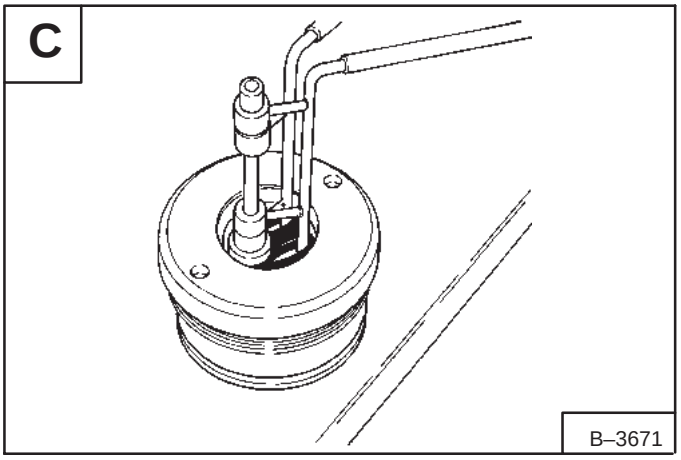


Install the oil seal on the rod seal tool **[B]**.

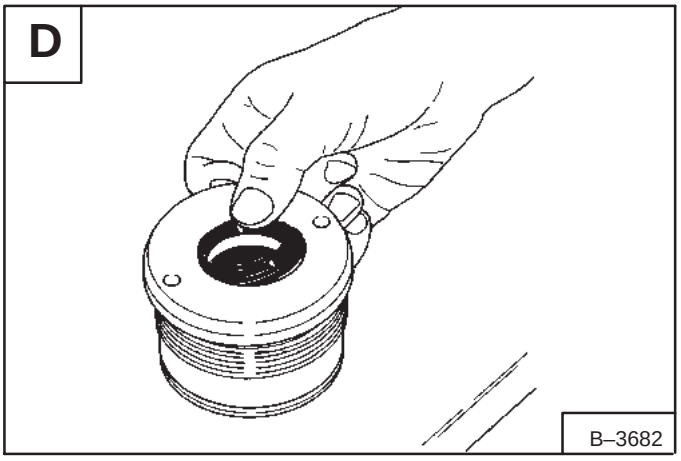
NOTE: The O–ring side of the oil seal goes toward the inside of the cylinder.



Install the oil seal in the head **[C]**.



Install the wiper seal with the lip toward the outside of the head **[D]**.

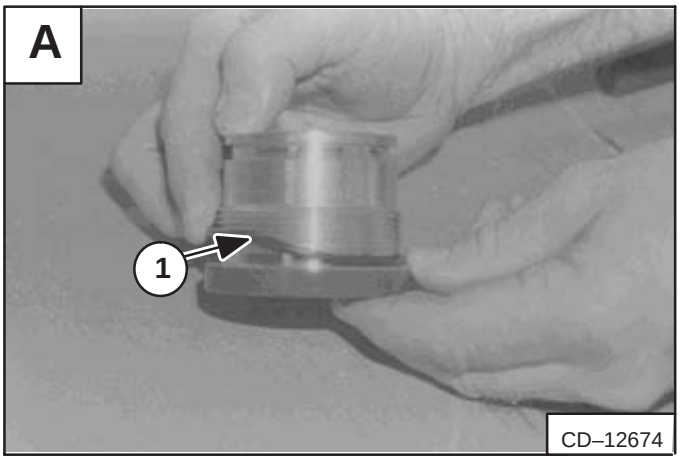


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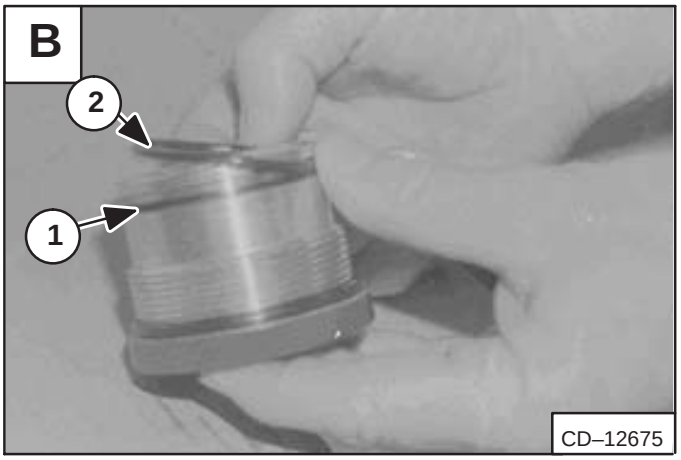
HYDRAULIC CYLINDER (Cont'd)

Assembly (Cont'd)

Install the O–ring (Item 1) **[A]** onto the head.



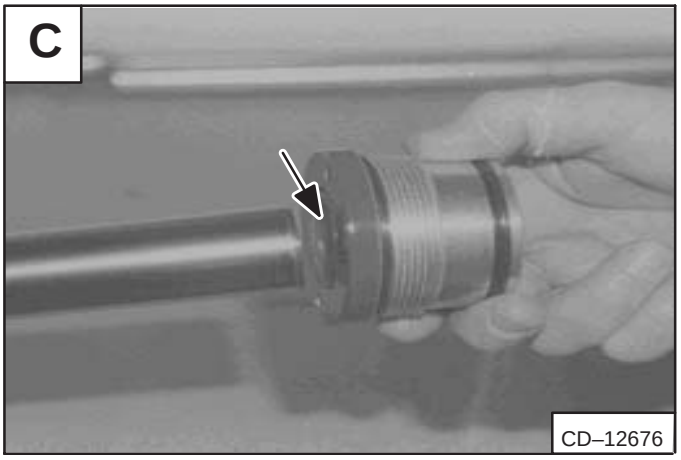
Install the back–up washer (Item 1) **[B]** and O–ring (Item 2) **[B]** onto the head.



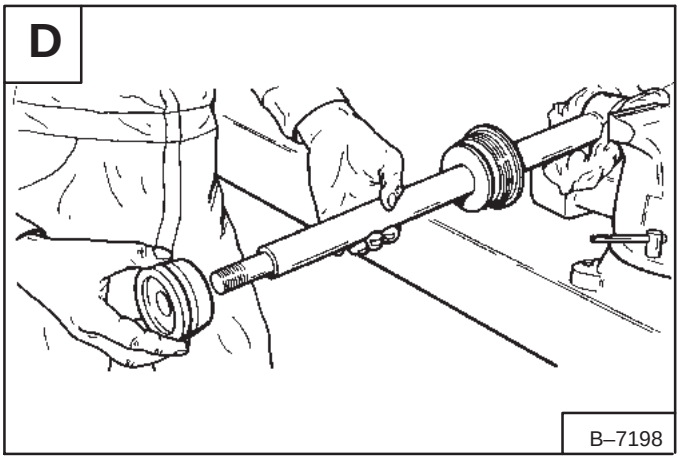
Apply grease to the inside of the head and to the lips of the seals.

Inspect the beveled edge of the rod for nicks or sharp edges **[C]**. Remove these with a file prior to installing the gland on the rod or damage to the seals may occur.

Install the head on the rod **[C]**.



Install the piston on the rod **[D]**.



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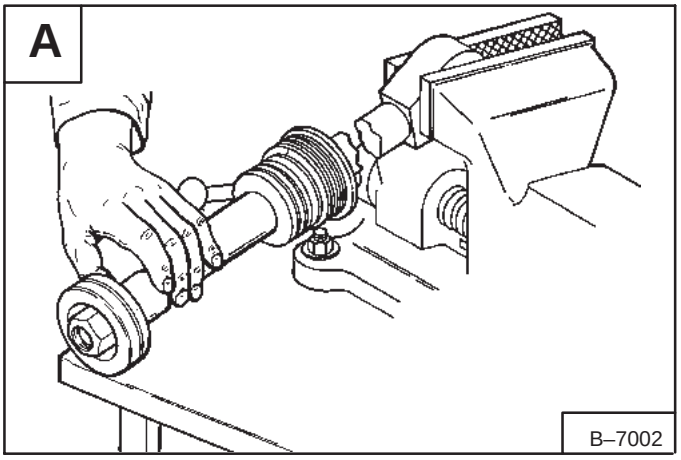
HYDRAULIC CYLINDER (Cont'd)

Assembly (Cont'd)

Lubricate the threads and install the nut **[A]**.

Tighten the nut to the following torque.

CYLINDER	TORQUE
BOOM, ARM, BLADE & BOOM SWING	425–525 ft.–lbs. (576–712 Nm)
BUCKET	800–900 ft.–lbs. (1085–1221 Nm0')

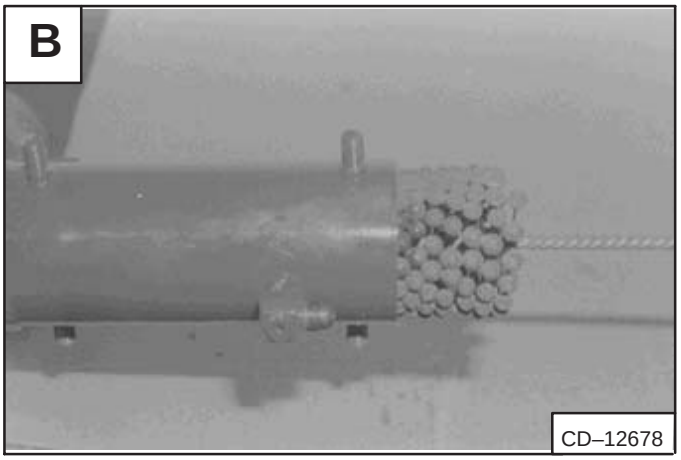


Inspect the inside of the cylinder case for nicks and scratches. If the cylinder case has minor scuffing the cylinder case can be honed **[B]**. Use a flexible hone and lubricate with oil during the honing process.

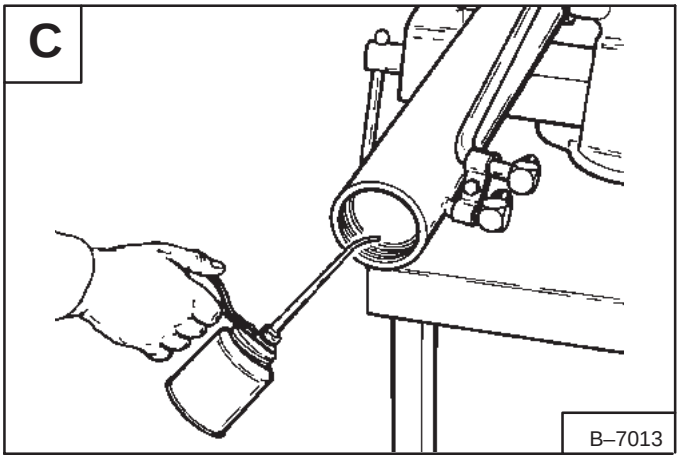
Thoroughly wash the inside of the cylinder case after honing process.

The following hones can be ordered from OTC Service Tools:

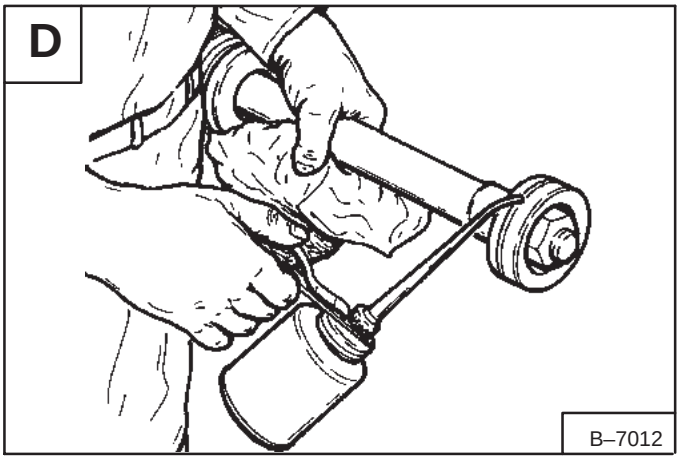
MEL1418 – 2"
OEM–6275 – 2–3/4"–3"
OEM–6270 – 3"–3–1/2"
OEM–6271 – 3–1/2"–4"



Put oil on the seal surface of the cylinder case **[C]**.



Put oil on the Teflon seal on the piston **[D]**.

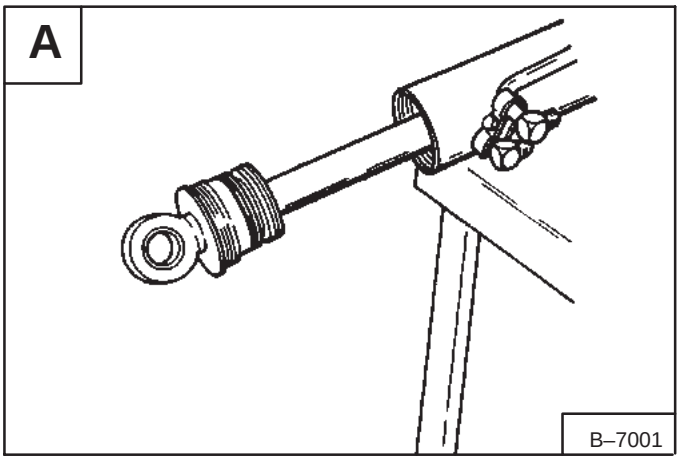


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HYDRAULIC CYLINDER (Cont'd)

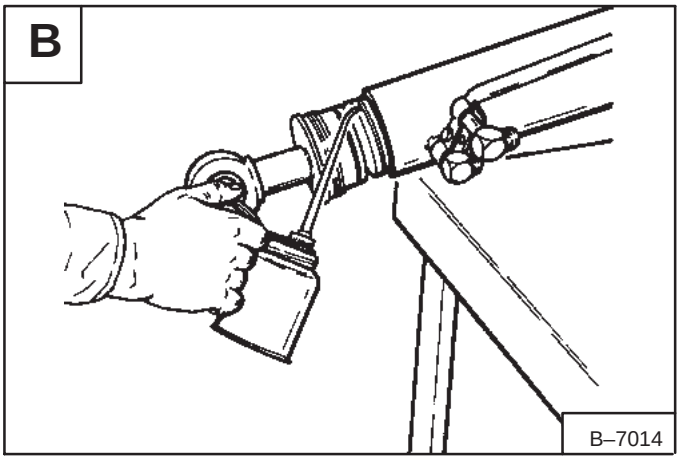
Assembly (Cont'd)

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



Put oil on the seals on the head **[B]**.

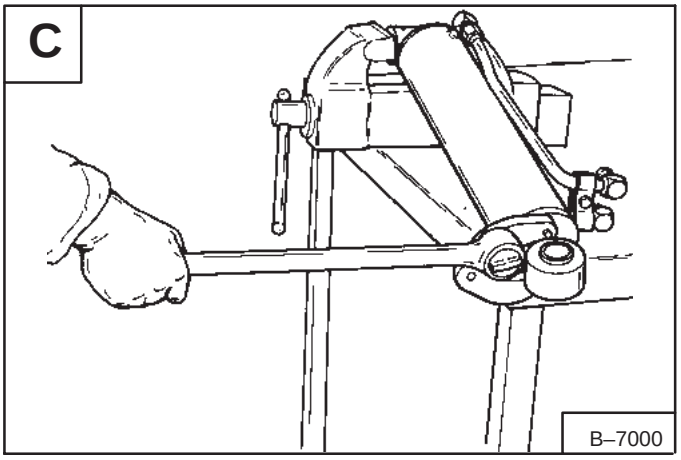
Put oil on the threads of the head.



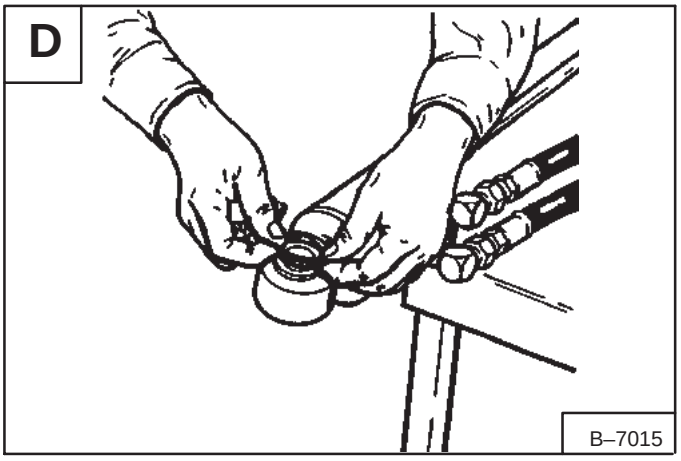
Use the adjustable gland nut wrench to tighten the head **[C]**.

NOTE: Tighten gland until it is flush with the end of the cylinder case.

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



Replace the seal on the rod end (if so equipped) if it shows signs of wear or damage **[D]**.



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JOYSTICK CONTROL CHANGE

Rotate the upperstructure so that it is 90° to the excavator tracks.

Remove the center floor panel. (See Service Manual.)

NOTE: Remove the center floor panel to access the front of the control valve (hoses 1 and 2).

NOTE: Access the rear of the control valve from under the left side of the upperstructure (hoses 3 and 4).

ISO to STANDARD Control Pattern (S/N 12999 & Below)

Mark the hoses as shown **[A]**.

Remove hoses (Items 1 & 2) **[A]** and change their position on the control valves as shown in **[B]**.

Remove hoses (Items 3 & 4) **[A]** and change their position on the control valves as shown in **[B]**.

The Right Hand Joystick will now control the arm (arm out and arm in) and the bucket curl.

The Left Hand Joystick will not control the boom (boom up and boom down) and the upperstructure swing.

DO NOT change any of the hoses on the top of the control valve to the work cylinders. Change only the hoses that connect the joysticks to the control valve spools.

Clean the existing decals on the control consoles with soap and water and let dry.

Install the STANDARD control pattern decals (P/N 6589843 for RH console and P/N 6589842 for LH console) on top of the existing control pattern decals.

STANDARD to ISO Control Pattern (S/N 12999 & Below)

Mark the hoses as shown **[B]**.

Remove hoses (Items 1 & 2) **[B]** and change their position on the control valves as shown in **[A]**.

Remove hoses (Items 3 & 4) **[B]** and change their position on the control valves as shown in **[A]**.

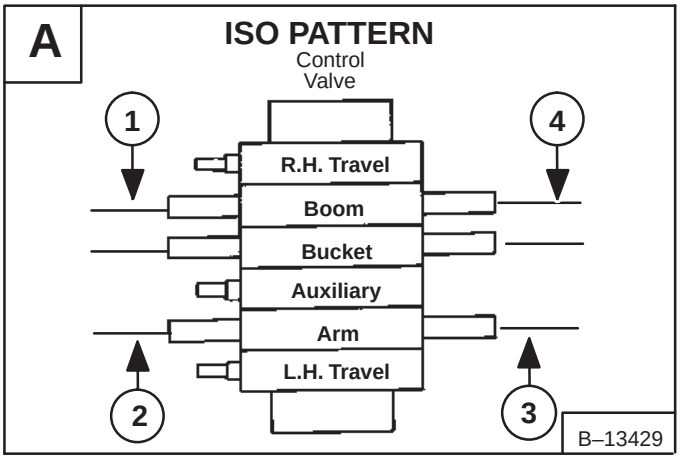
The Right Hand Joystick will now control the boom (boom up and boom down) and the bucket curl.

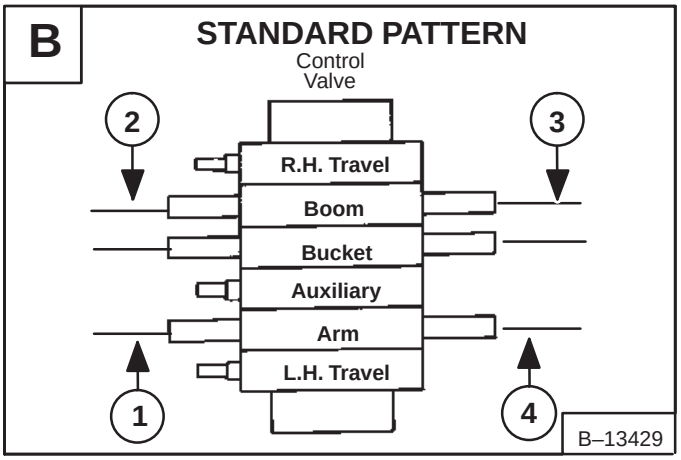
The Left Hand Joystick will now control the arm (arm out and arm in) and the upperstructure swing.

DO NOT change any of the hoses on the top of the control valve to the work cylinders. Change only the hoses that connect the joysticks to the control valve spools.

Clean the existing decals on the control consoles with soap and water and let dry.

Install the ISO control pattern decals (P/N 6589740 for RH console and P/N 6589741 for LH console) on top of the existing control pattern decals.





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JOYSTICK CONTROL CHANGE (Cont'd)

Rotate the upperstructure so that it is 90° to the excavator tracks.

Remove the center floor panel. (See Service Manual.)

NOTE: Remove the center floor panel to access the front of the control valve (hoses 1 and 2).

NOTE: Access the rear of the control valve from under the left side of the upperstructure (hoses 3 and 4).

ISO to STANDARD Control Pattern (S/N 13001 & Above)

Mark the hoses as shown **[A]**.

Remove hoses (Items 1 & 2) **[A]** from the end of the control valve and change their position on the control valves as shown in **[B]**.

Remove hoses (Item 3 & 4) **[A]** from the end of the control valve and change their position on the control valves as shown in **[B]**.

The Right Hand Joystick will now control the arm (arm out and arm in) and the bucket curl.

The Left Hand Joystick will not control the boom (boom up and boom down) and the upperstructure swing.

DO NOT change any of the hoses on the top of the control valve to the work cylinders. Change only the hoses that connect the joysticks to the control valve spools.

Clean the existing decals on the control consoles with soap and water and let dry.

Install the STANDARD control pattern decals (P/N 6589843 for RH console and P/N 6589842 for LH console) on top of the existing control pattern decals.

STANDARD to ISO Control Pattern (S/N 13001 & Above)

Mark the hoses as shown **[B]**.

Remove hoses (Item 1 & 2) **[B]** from the end of the control valve and change their position on the control valves as shown in **[A]**.

Remove hoses (Item 3 & 4) **[B]** from the end of the control valve and change their position on the control valves as shown in **[A]**.

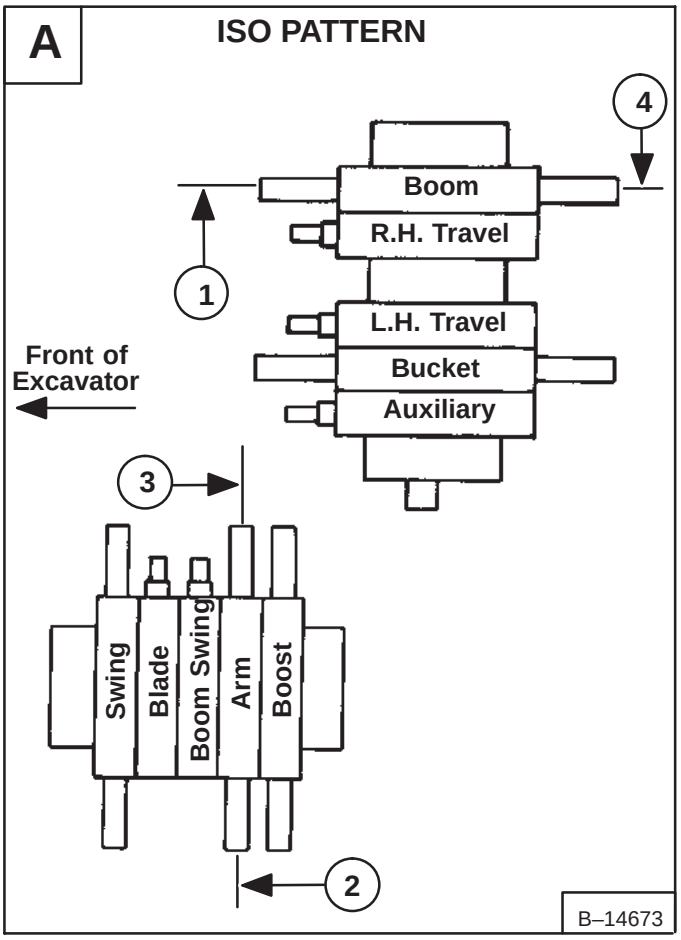
The Right Hand Joystick will now control the boom (boom up and boom down) and the bucket curl.

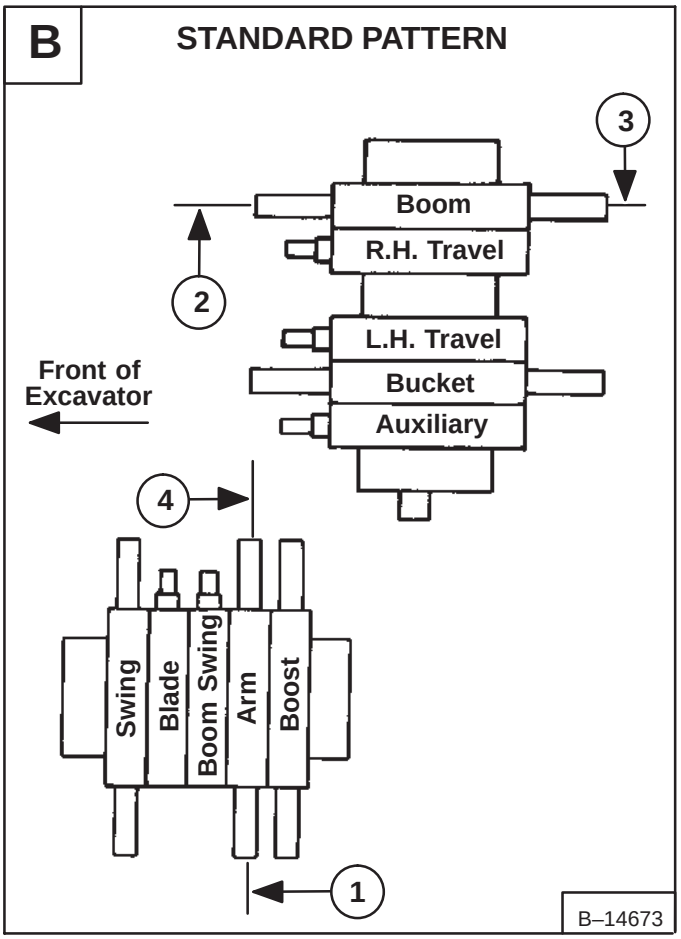
The Left Hand Joystick will now control the arm (arm out and arm in) and the upperstructure swing.

DO NOT change any of the hoses on the top of the control valve to the work cylinders. Change only the hoses that connect the joysticks to the control valve spools.

Clean the existing decals on the control consoles with soap and water and let dry.

Install the ISO control pattern decals (P/N 6589740 for RH console and P/N 6589741 for LH console) on top of the existing control pattern decals.





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DRIVE SECTION

Page Number

BLADE CONTROL LEVER AND CABLE
Removal and Installation 3–35

LEFT CONSOLE RELEASE HANDLE (S/N 13001 & Above)
Adjustment 3–9
Removal and Installation 3–8

LEFT CONSOLE (S/N 12999 & Below)
Cylinder Removal and Installation 3–3
Lockout Valve Removal and Installation 3–3
Removal and Installation 3–4

LEFT CONSOLE (S/N 13001 & Above)
Cylinder Removal and Installation 3–6
Control Lock Micro–Switch Removal and Installation 3–5
Removal and Installation 3–6

JOYSTICK (S/N 12999 & Below)
Disassembly and Assembly 3–12
Parts Identification 3–11
Removal and Installation 3–10

JOYSTICK (S/N 13001 & Above)
Assembly 3–21
Disassembly 3–18
Parts Identification 3–17
Removal and Installation 3–16
Troubleshooting 3–26

RIGHT CONSOLE
Removal and Installation (S/N 12999 & Below) 3–27
Removal and Installation (S/N 13001 & Above) 3–30

RIGHT CONSOLE COVER
Removal and Installation 3–32

SPEED CONTROL LEVER
High Idle Adjustment 3–34
Low Idle Adjustment 3–34
Removal and Installation 3–34

STEERING LEVER AND PEDALS
Adjusting Linkage Rods 3–37
Removal and Installation 3–36

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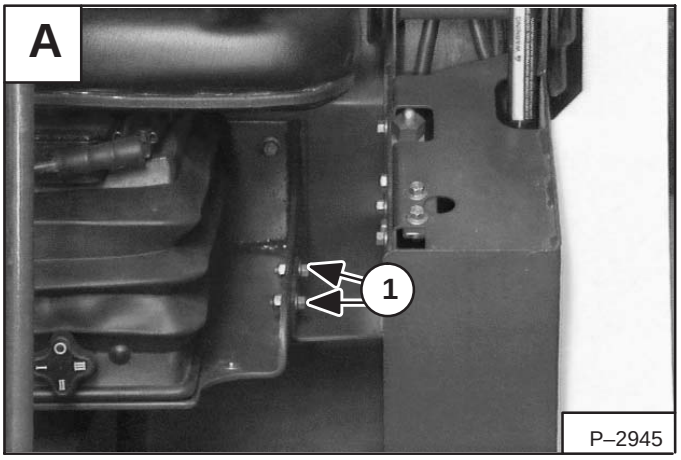
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LEFT CONSOLE (S/N 12999 & Below)

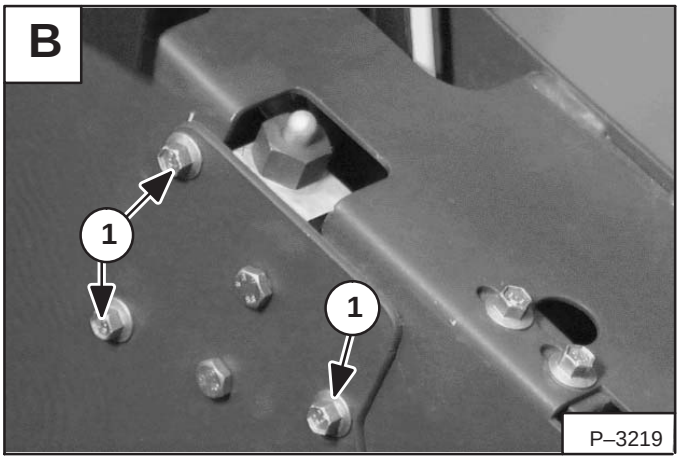
Lockout Valve Removal and Installation

Raise the control console.

Remove the two (2) mounting bolts (Item 1) **[A]** from the left hand seat support bracket.



Remove the three (3) bolts (Item 1) **[B]** from the support bracket.



Lift up and out on the bracket and remove the lock out valve **[C]**.

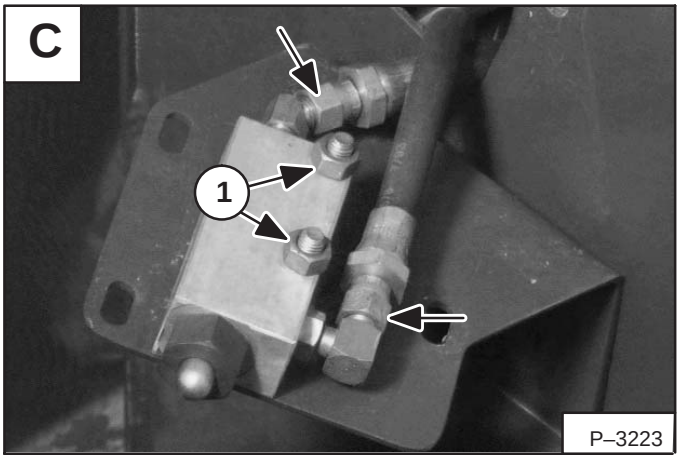
Mark the hoses for correct installation.

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

Remove the nuts (Item 1) **[C]** from the mounting bolts.

Remove the lockout valve.

Installation: Use mounting plate slots to adjust lockout valve plunger to fully depressed position when console is in lowered position.



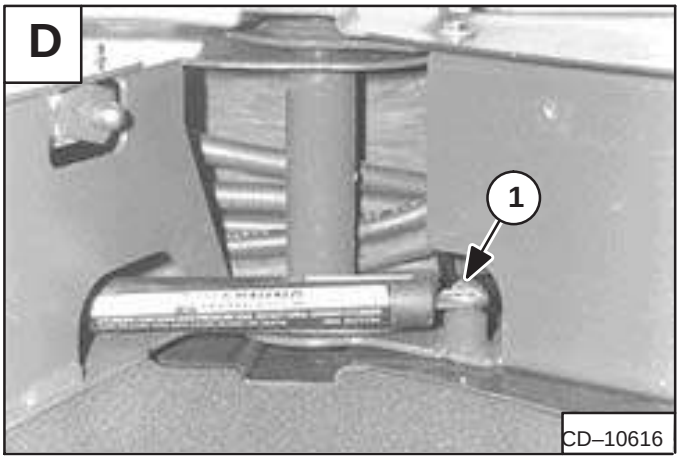
Cylinder Removal and Installation

Remove the cotter pins (Item 1) **[D]** from the base end and rod end of the cylinder. Remove the cylinder from the mounting pins and remove the cylinder.

⚠ WARNING

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

W–2113–0288



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LEFT CONSOLE (S/N 12999 & Below) (Cont'd)

Removal and Installation

Lower the boom and blade to the ground.

Stop the engine.

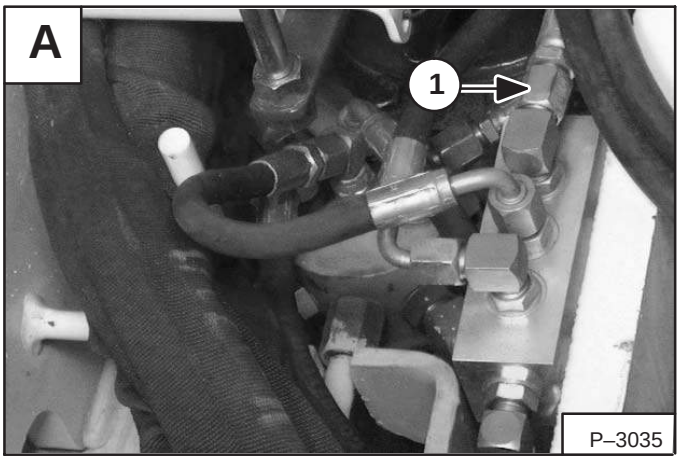
Remove the floormat and floor plate. (See Page 4–1.)

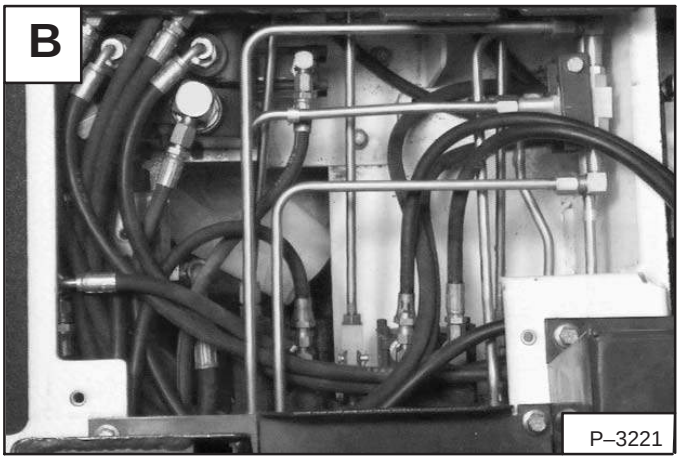
Remove the swing motor cover and the rear floor plate. (See Page 4–1.)

Remove the left console drain hose (Item 1) **[A]** from the drain block.

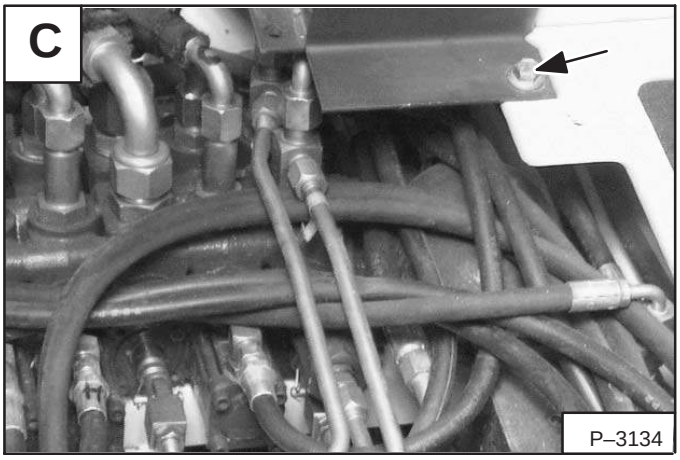
Mark the hoses for correct installation.

Remove the joystick control lever hoses from the 6–spool and the 3–spool control valves (2 hoses each control valve) **[B]**.



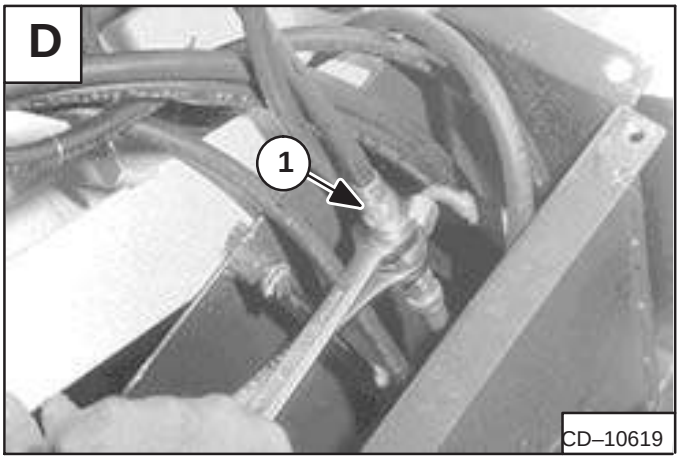


Remove the left console mounting bolts **[C]**.



Remove the right console hose (Item 1) **[D]** from the left console tee fitting.

Remove the left console.



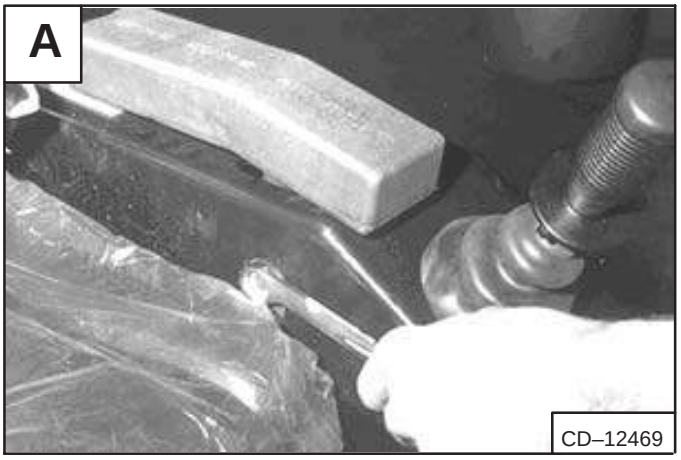
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LEFT CONSOLE (S/N 13001 & Above)

Control Lock Micro–Switch Removal and Installation

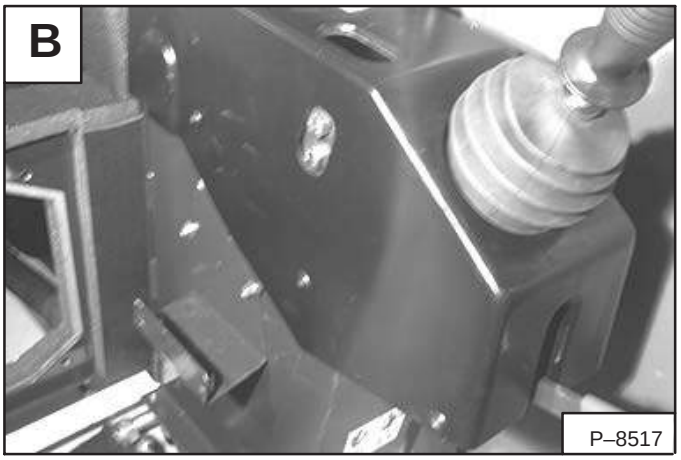
Loosen the two bolts (Item 1) **[A]** holding the arm rest.

Remove the arm rest.



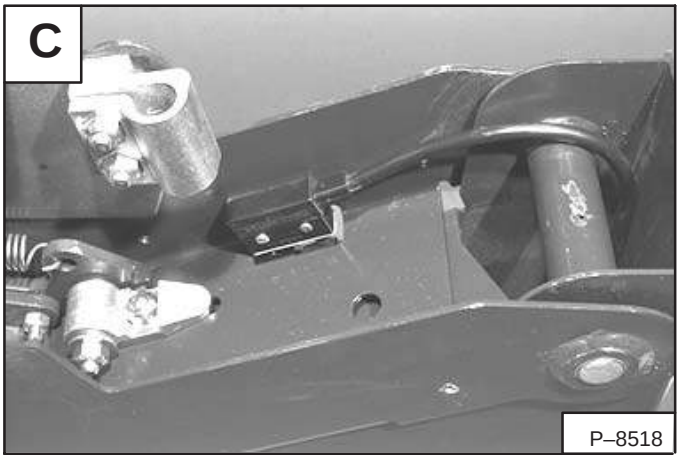
Remove the six (6) screws holding the console cover **[B]**.

Remove the control console cover.

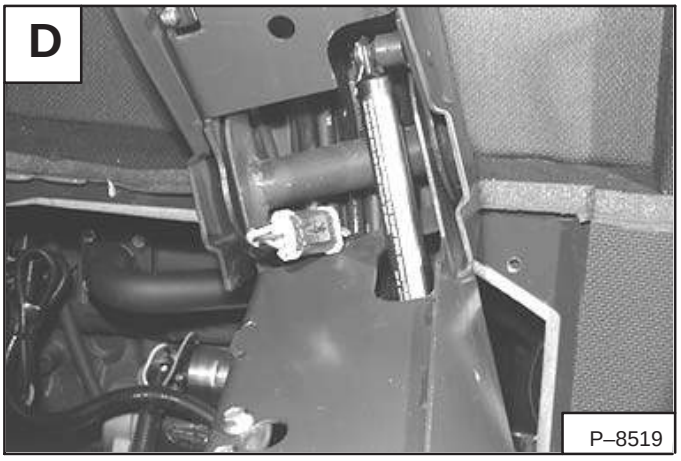


Remove the two (2) screws (Item 1) **[C]** and nuts from the micro–switch (Item 2) **[C]**.

NOTE: The joystick and hoses are removed for photo clarity.



Disconnect the plug (Item 1) **[D]** from the wire harness and remove the micro–switch.

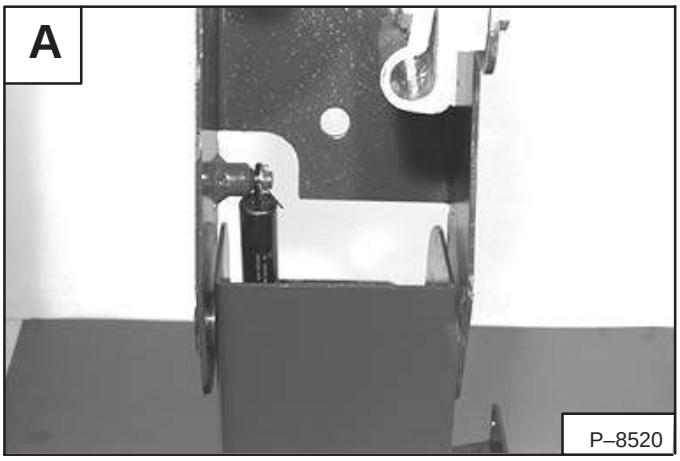


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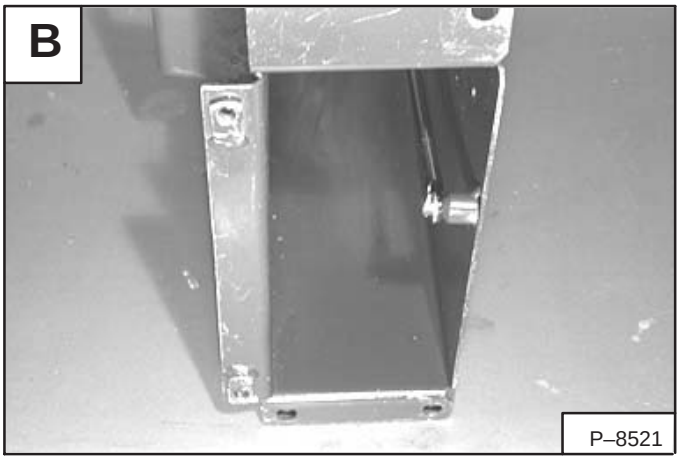
LEFT CONSOLE (S/N 13001 & Above) (Cont'd)

Cylinder Removal and Installation

Remove the cotter pin (Item 1) **[A]** the washer (Item 2) **[A]** and remove the base end of the cylinder.



Remove the cotter pin (Item 1) **[B]** the washer (Item 2) **[B]** and the rod end of the cylinder and remove from the machine.



NOTE: The console is removed for photo clarity.

⚠ WARNING

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

W–2113–0288

Removal and Installation

Mark the hoses for correct installation.

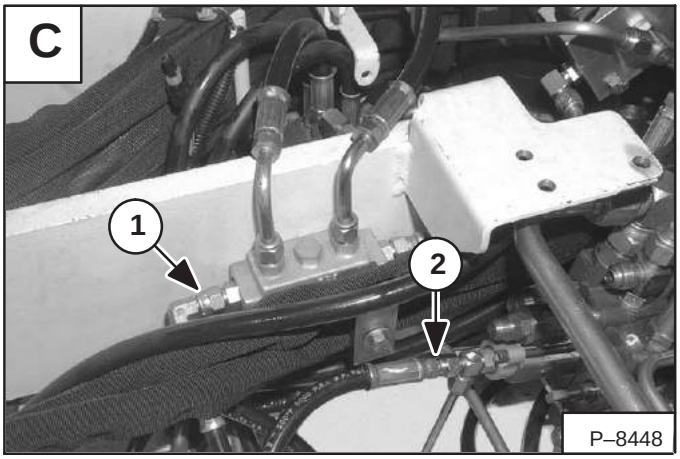
IMPORTANT

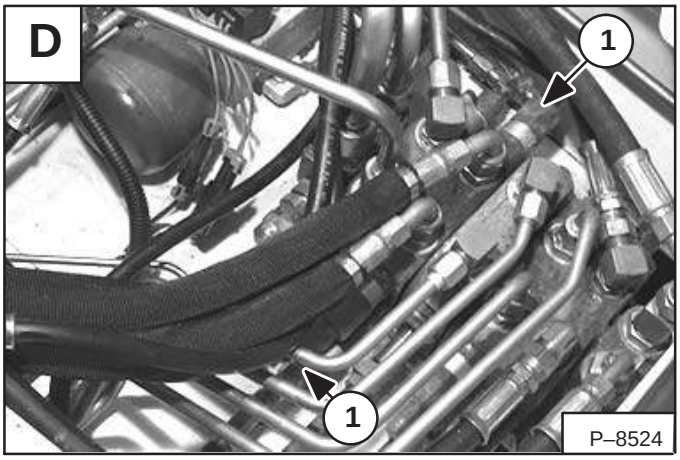
When making repairs on hydrostatic and hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.

I–2003–0284

Remove the joystick control lever hose (Item 1) **[C]** from the port block.

Remove the joystick control lever hose (Item 2) **[C]** from the valve (Boom Section) for Standard control pattern or (Item 1) **[D]** for ISO control pattern (Arm Section).



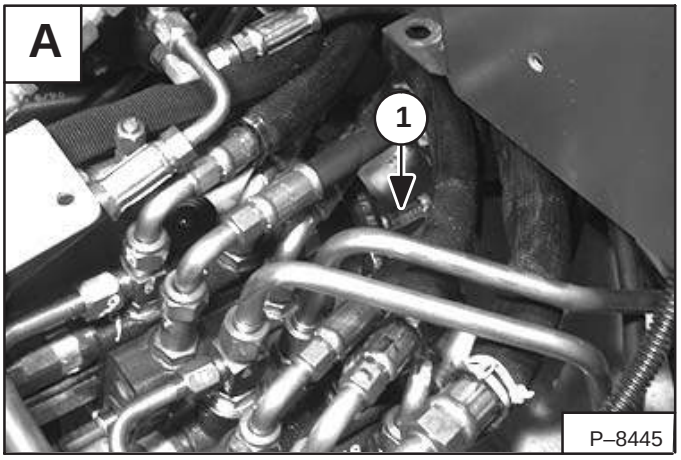


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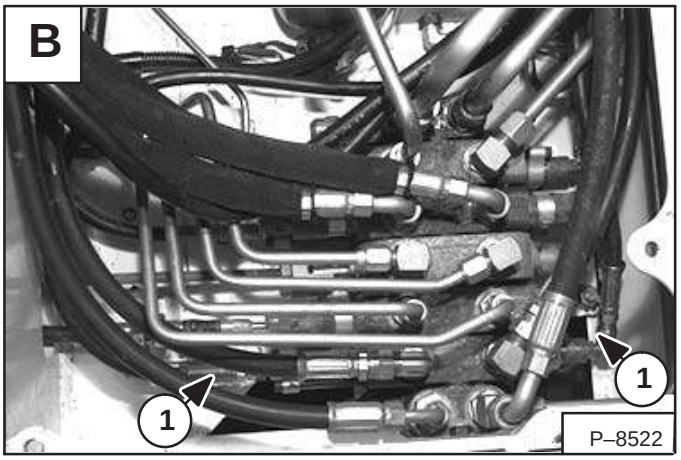
LEFT CONSOLE (S/N 13001 & Above) (Cont'd)

Removal and Installation (Cont'd)

Remove the joystick control lever hose (Item 1) **[A]** from the rear of the valve (Boom Section).

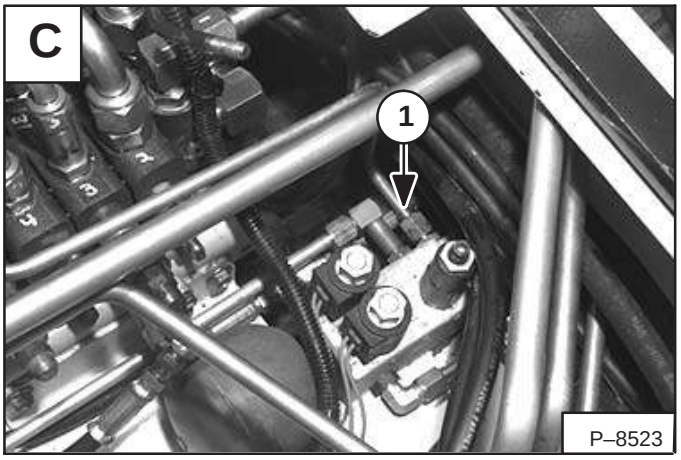


Remove the joystick control lever hoses (Item 1) **[B]** from the valve (Swing Section).



Remove the joystick control lever hose (Item 1) **[C]** from the accumulator.

Remove the console.



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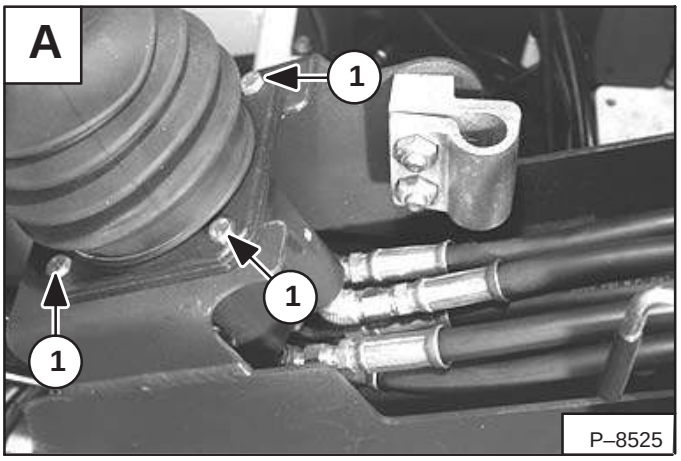
LEFT CONSOLE RELEASE HANDLE (S/N 13001 & Above)

Removal and Installation

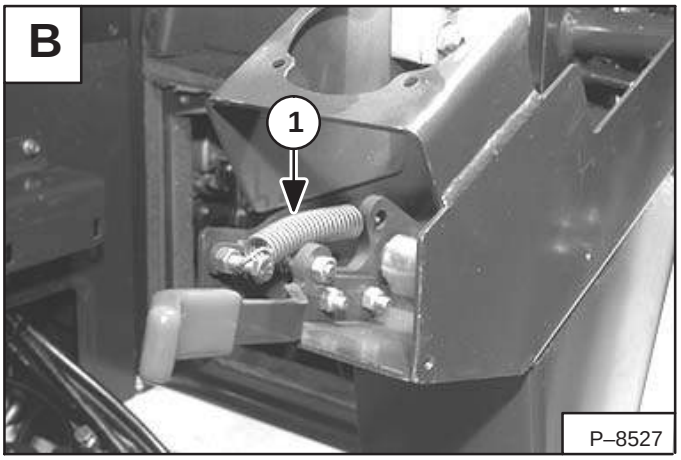
Remove the arm rest and console cover. (See Page 3–10.)

NOTE: The joystick is removed for photo clarity.

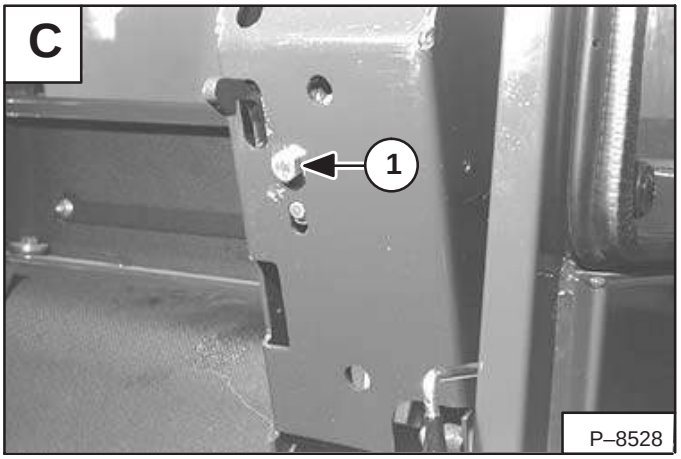
Remove the four (4) joystick mounting bolts (Item 1) **[A]** to gain clearance for removal of the release handle.



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

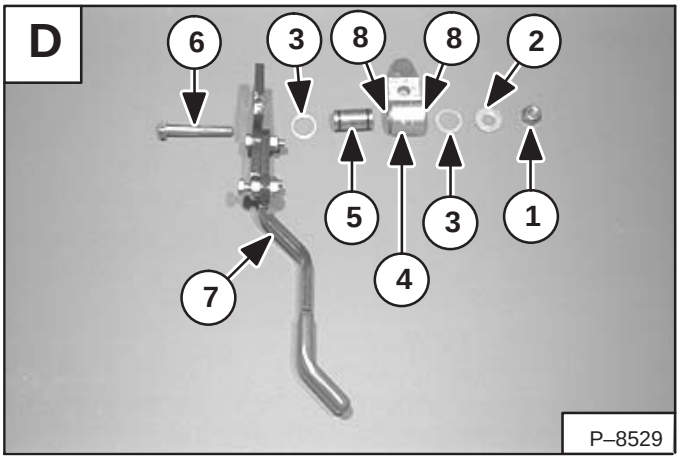


Remove the bolt (Item 1) **[C]** from the handle mount.



Remove the nut (Item 1) **[D]**, the washer (Item 2) **[D]**, the thrust washers (Item 3) **[D]**, the mount (Item 4) **[D]**, the sleeve (Item 5) **[D]** and the bolt (Item 6) **[D]** from the handle (Item 7) **[D]**.

NOTE: Remove the bushing (Item 8) [D] from the mount (Item 4) [D].

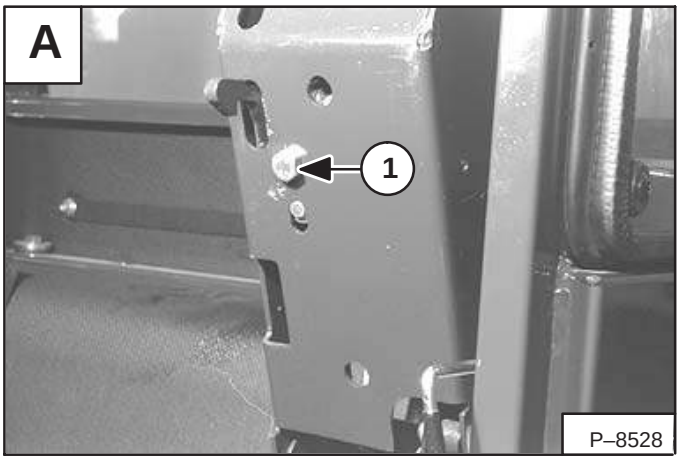


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LEFT CONSOLE RELEASE HANDLE (S/N 13001 & Above) (Cont'd)

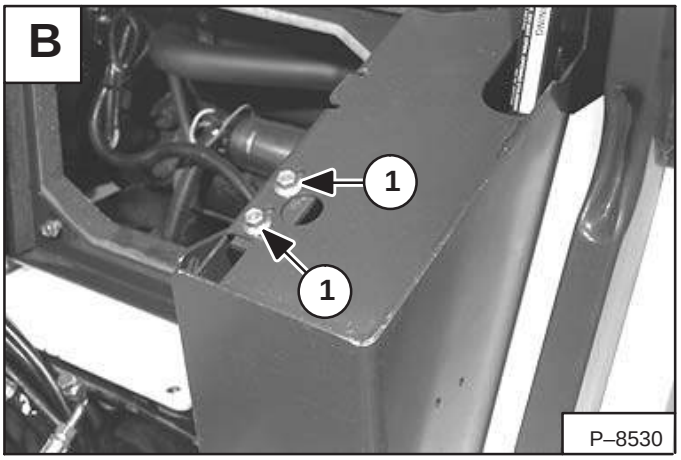
Adjustment

Loosen the bolt (Item 1) **[A]** and slide the lever to adjust.



Latch plate adjustment.

Loosen the two (2) bolts (Item 1) **[B]** and slide the plate to adjust.



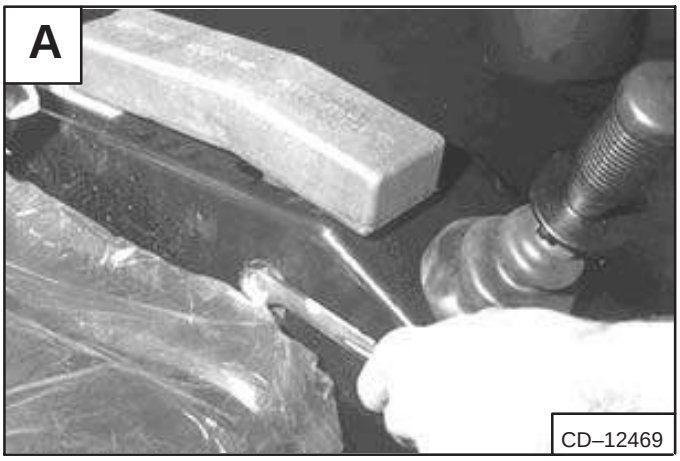
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JOYSTICK (S/N 12999 & Below)

Removal and Installation

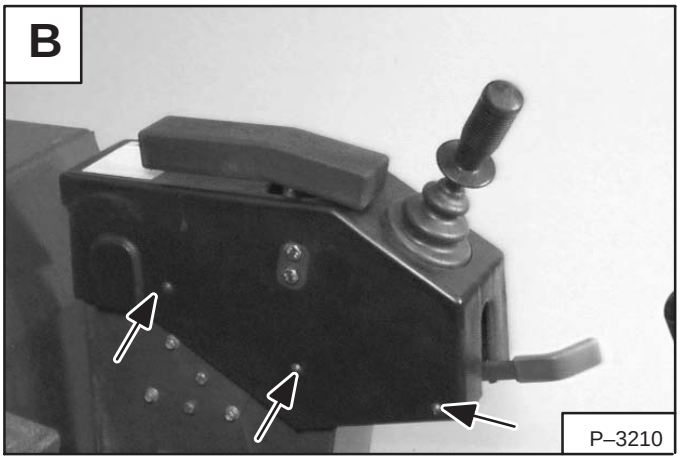
Loosen the two bolts (Item 1) **[A]** holding the arm rest.

Remove the arm rest.



Remove the six (6) screws holding the console cover **[B]**.

Remove the control console cover.

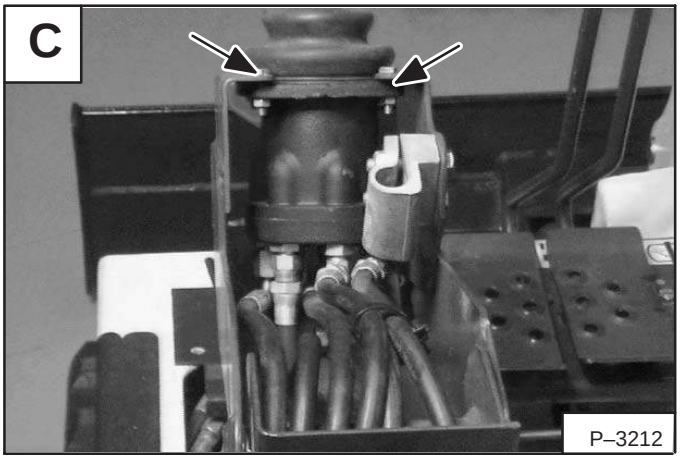


NOTE: Mark the hoses locations for correct installation.

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

Remove the four (4) bolts and nuts from the joystick flange **[C]**.

Remove the joystick.



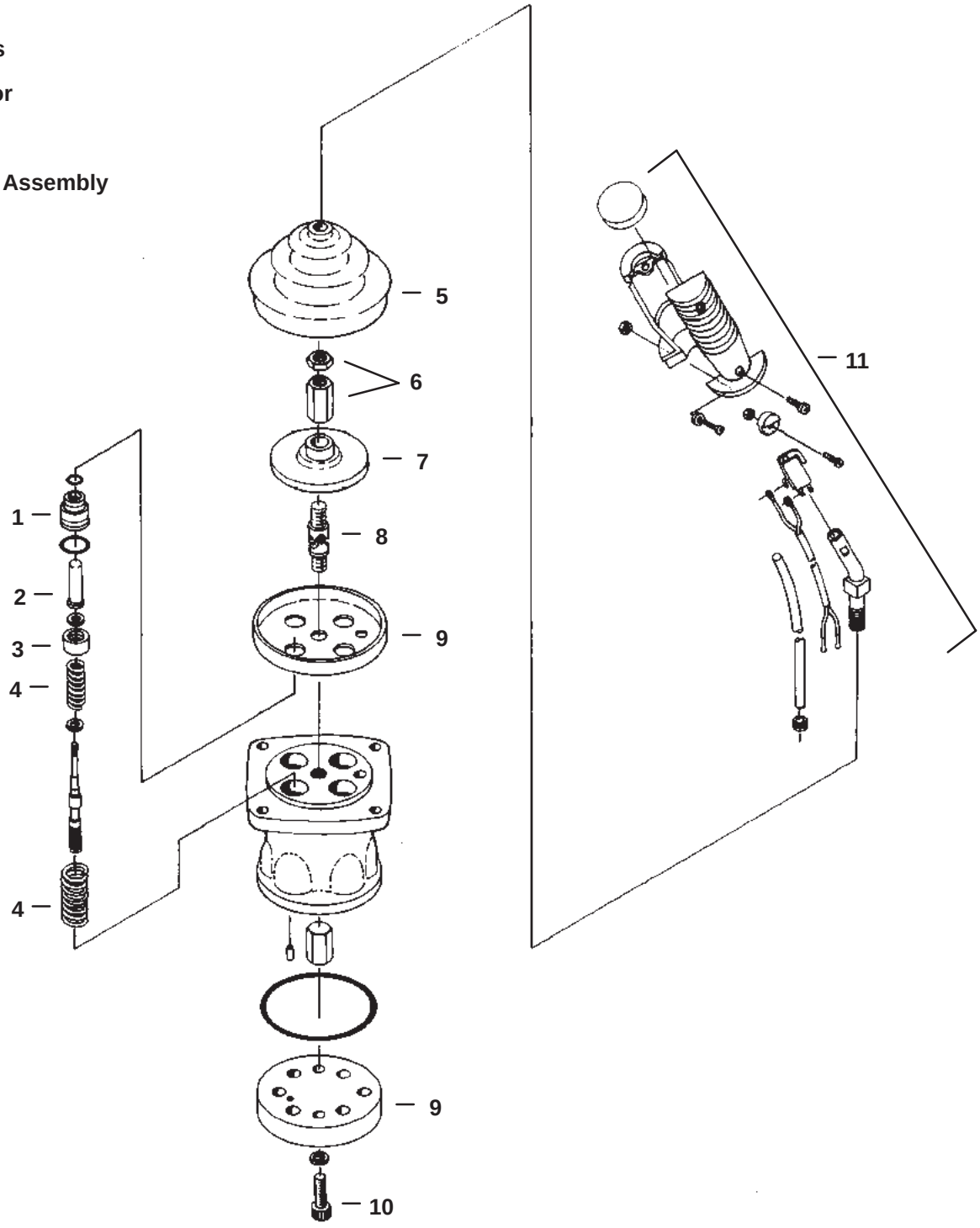
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Parts Identification

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



D–1972

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JOYSTICK (S/N 12999 & Below) (Cont'd)

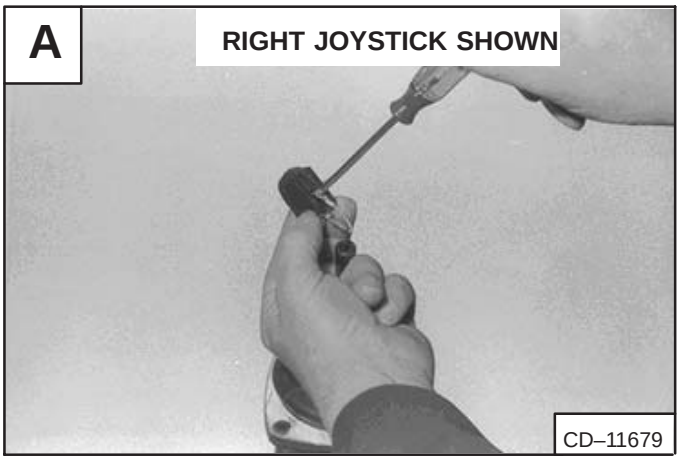
Disassembly and Assembly

NOTE: The right joystick is equipped with a horn button. The valve body disassembly and assembly procedure is the same for both joysticks.

Remove the cap from the joystick **[A]**.

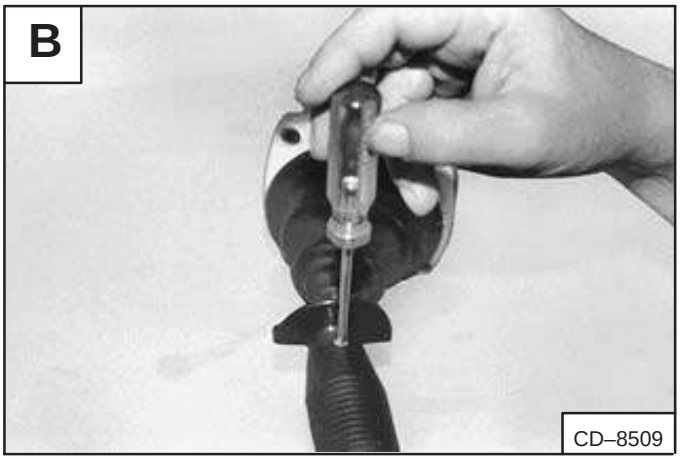
Right Joystick Only: Remove the horn wires from the cap **[A]**.

NOTE: Mark the wires for correct installation.

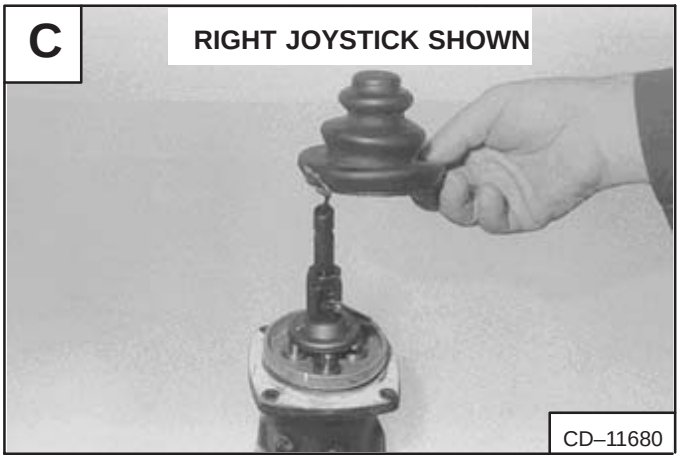


Remove the screws from the handle **[B]**.

Remove the handle.



Remove the rubber boot from the joystick **[C]**.



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JOYSTICK (S/N 12999 & Below) (Cont'd)

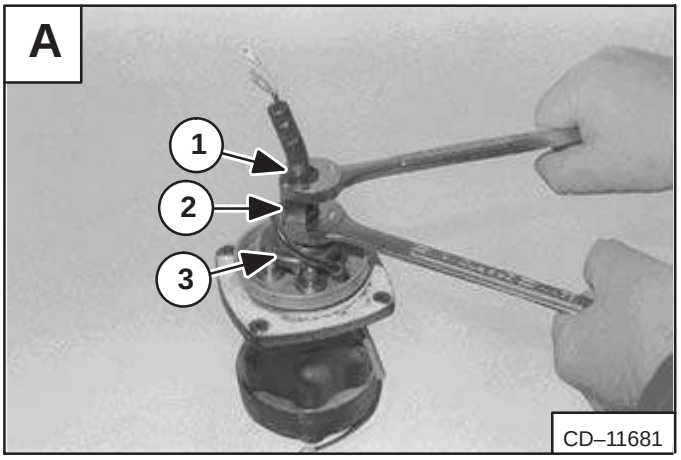
Disassembly and Assembly (Cont'd)

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]**.

NOTE: To test the joystick for correct rod disc adjustment. Blow air at 10 PSI (69 kPa) 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. Adjust the rod disc upward until the air flow stops. Tighten the adjustment nut to 43 in.–lbs. (5 Nm) torque.



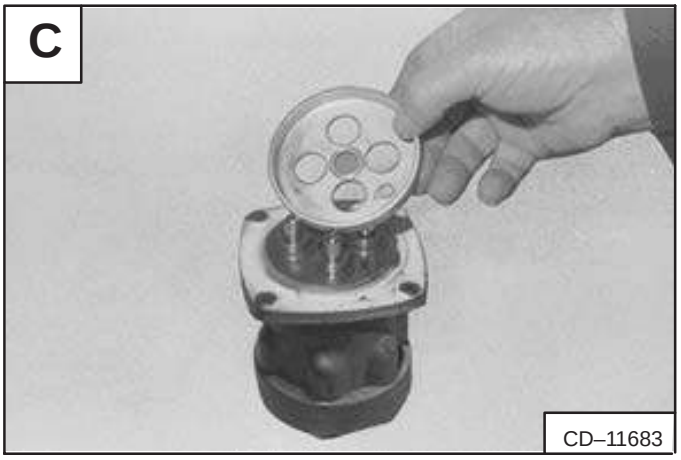
Remove the joint **[B]**.

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

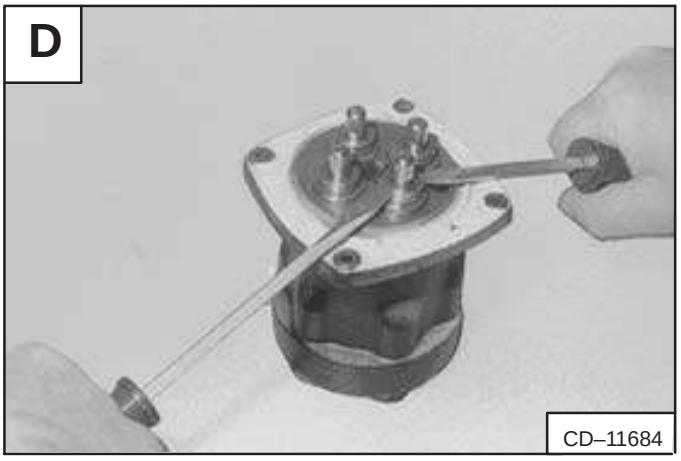


Remove the plate **[C]**.

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



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



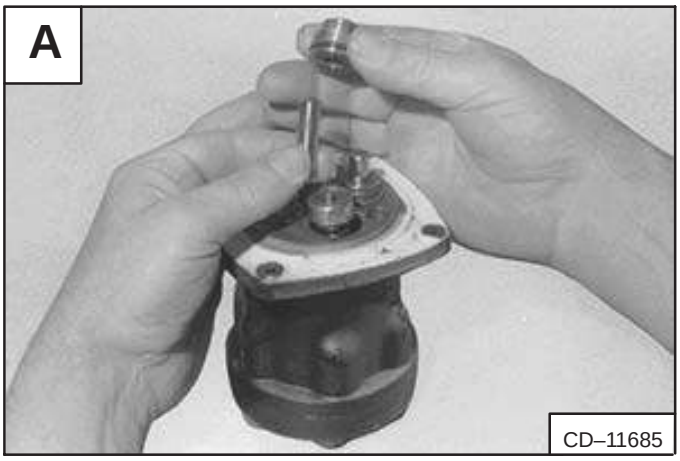
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JOYSTICK (S/N 12999 & Below) (Cont'd)

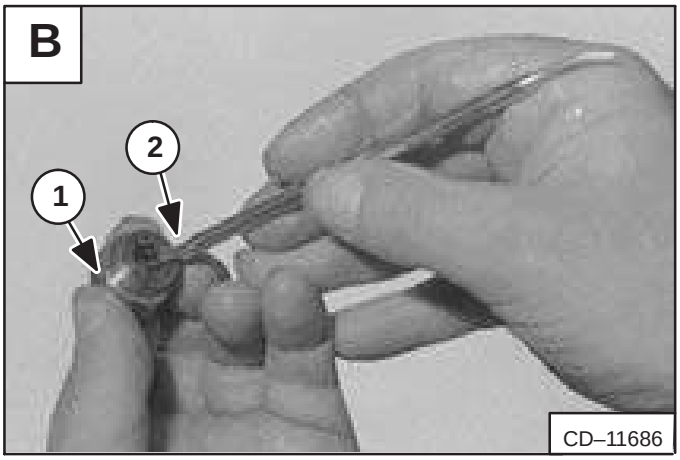
Disassembly and Assembly (Cont'd)

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

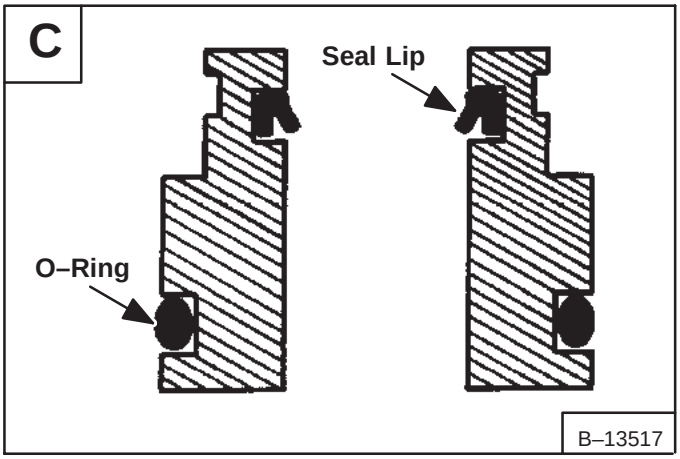
Check the push rod crown for wear.



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

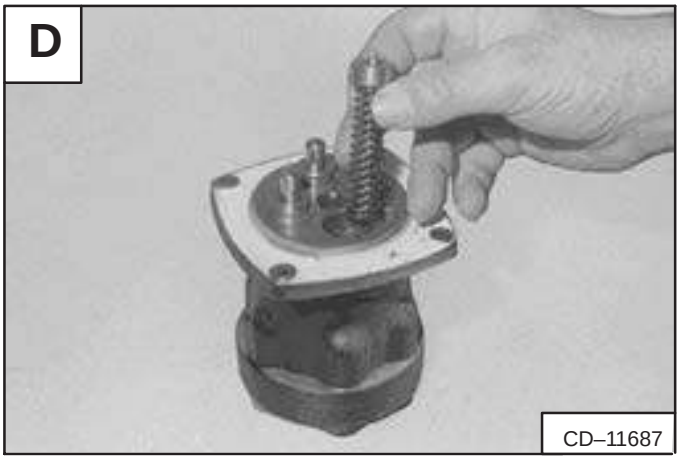


Installation: Be sure the seal lip is toward the valve body **[C]**.



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

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

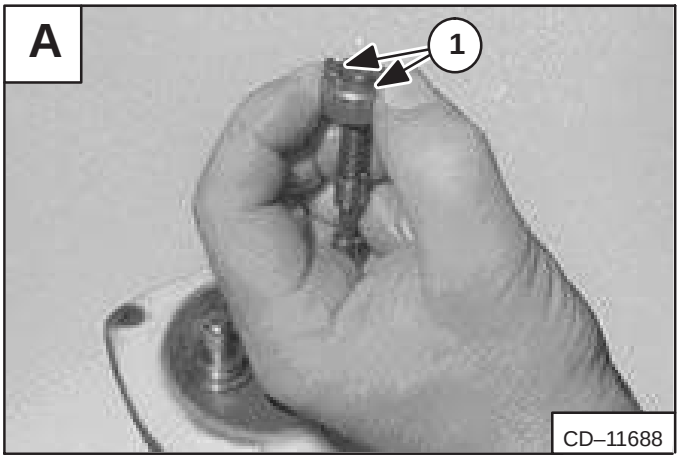


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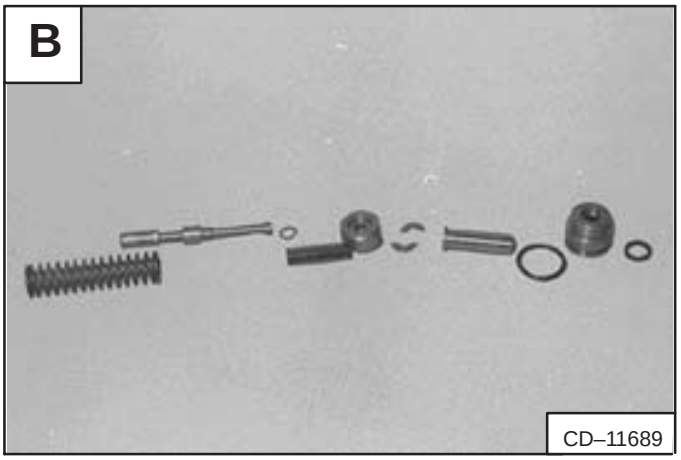
JOYSTICK (S/N 12999 & Below) (Cont'd)

Disassembly and Assembly (Cont'd)

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

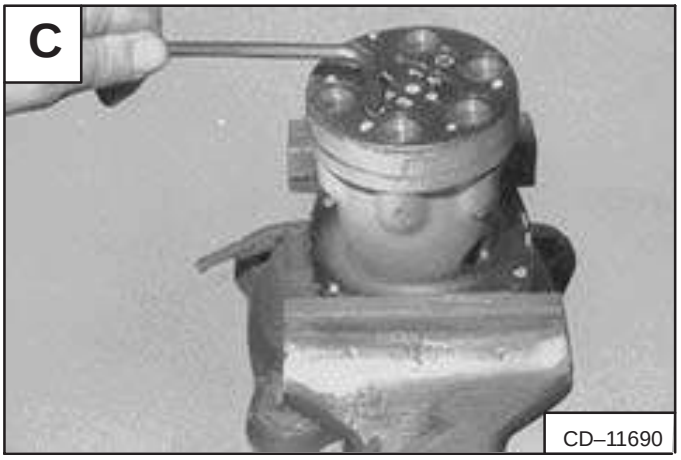


Remove spring seat, spring and washers from the spool **[B]**.



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

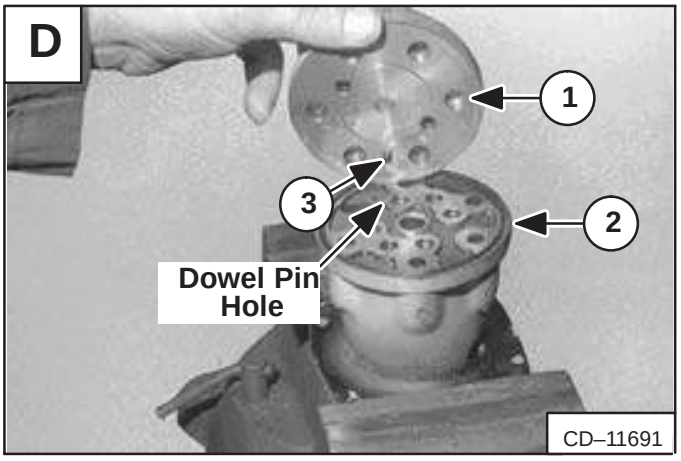
Installation: Tighten the bolts to 26 in.–lbs. (3 Nm) torque.



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.



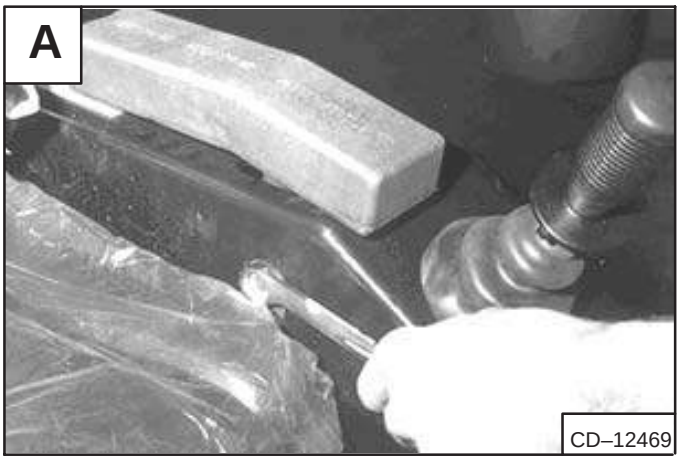
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JOYSTICK (S/N 13001 & Above)

Removal and Installation

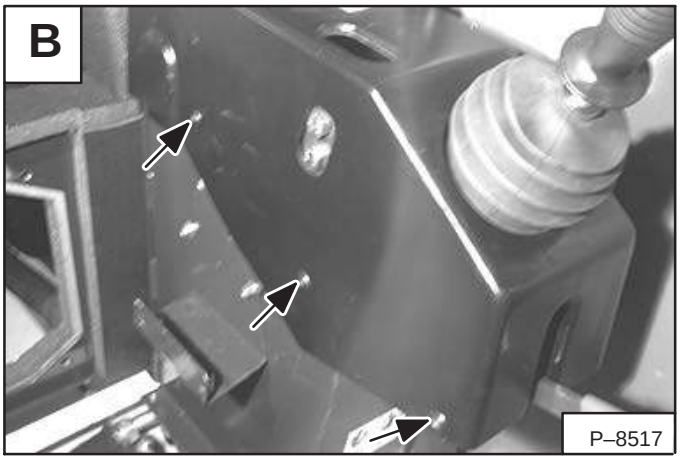
Loosen the two (2) bolts (Item 1) **[A]** holding the arm rest.

Remove the arm rest.



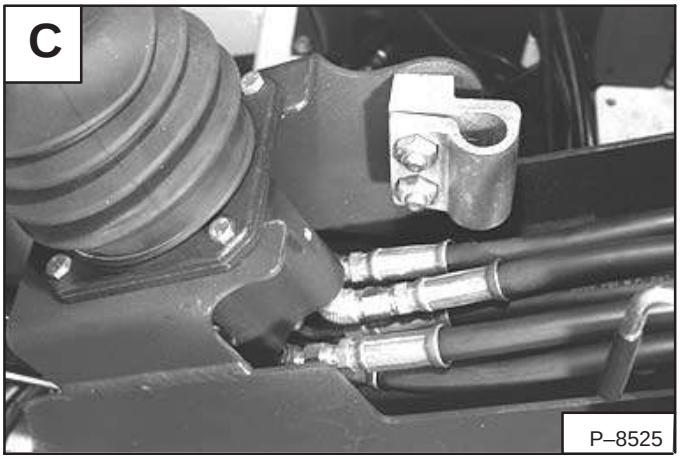
Remove the six (6) screws holding the console cover **[B]**.

Remove the control console cover.



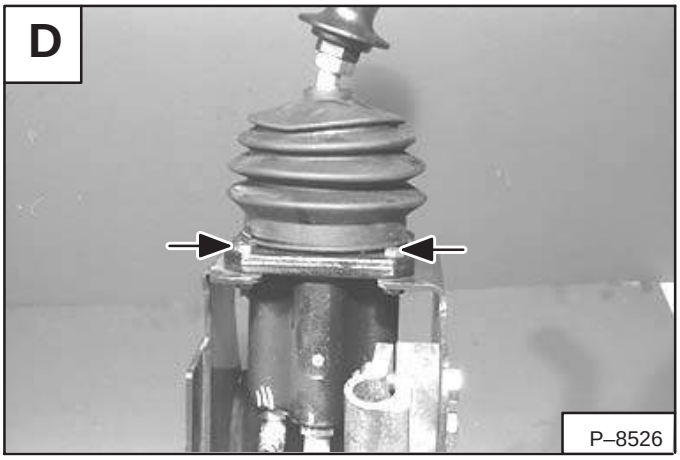
Remove the hoses from the joystick **[C]**.

NOTE: Mark the hoses locations for correct installation.



Remove the four (4) bolts and nuts from the joystick flange **[D]**.

Remove the joystick.



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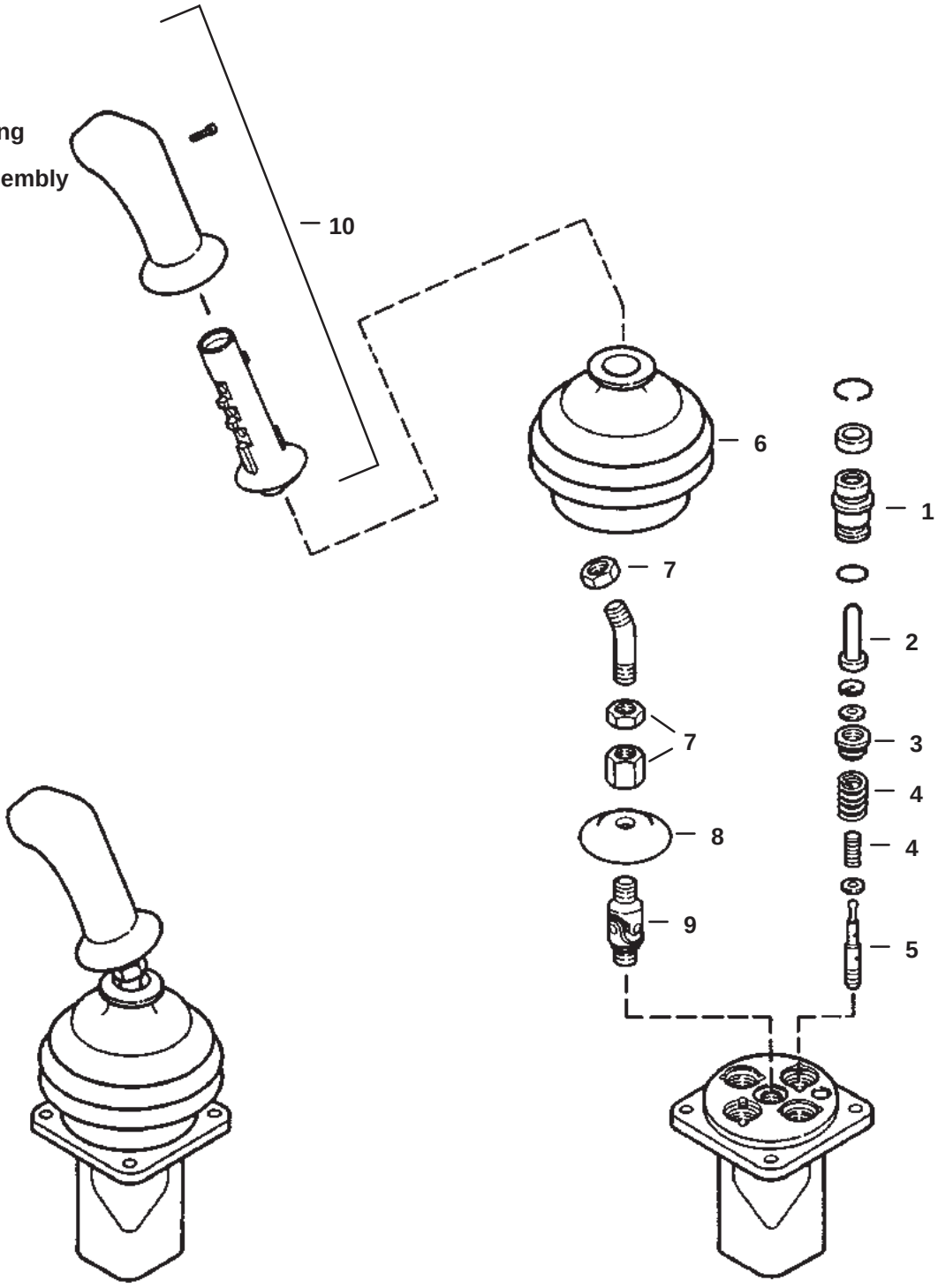
JOYSTICK (S/N 13001 & Above)

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. Rod
6. Boot
7. Nut
8. Selector Ring
9. Joint
10. Handle Assembly



B–14600

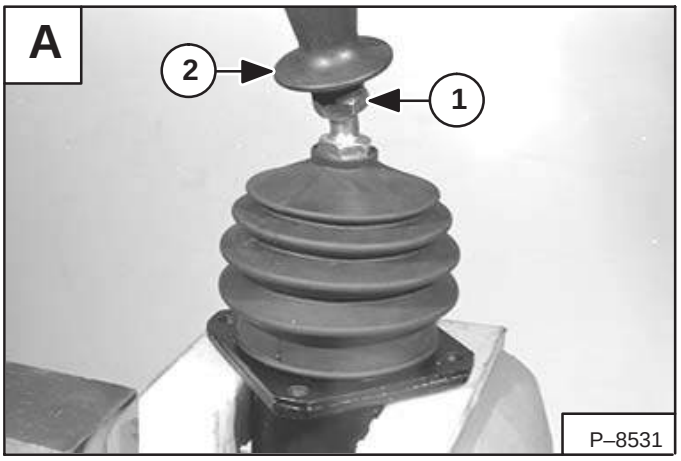
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JOYSTICK (S/N 13001 & Above) (Cont'd)

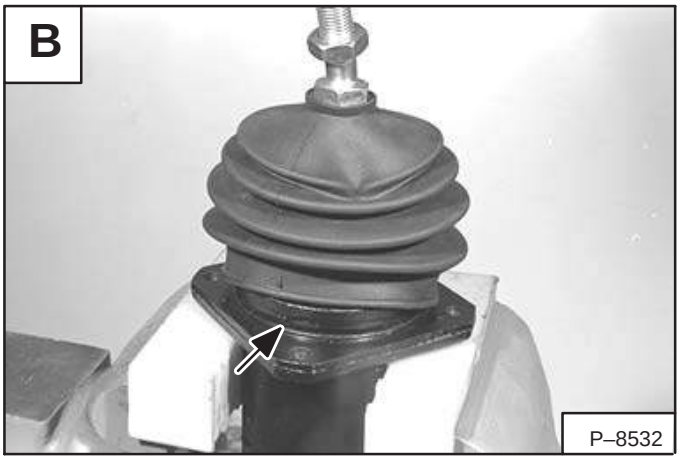
Disassembly

Clamp the joystick in a vise with padded jaws.

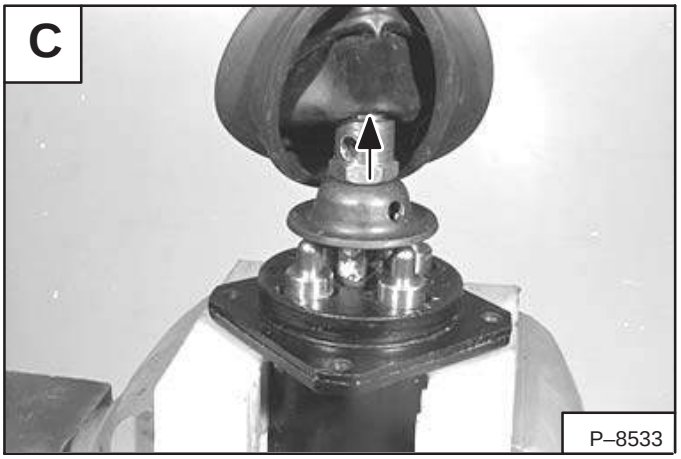
Loosen the handle locknut (Item 1) **[A]** and remove the handle (Item 2) **[A]**.



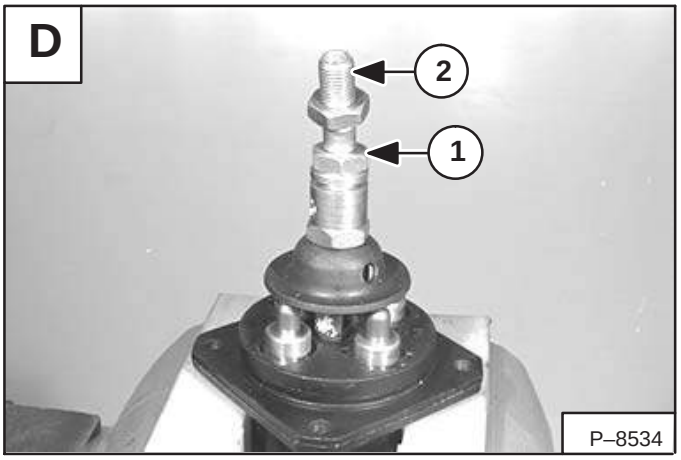
Remove the dust boot from the groove on the joystick valve **[B]**.



Pull the dust boot up and remove the boot lip from the top groove **[C]**. Remove the dust boot.



Loosen the lever locknut locknut (Item 1) **[D]** and remove the lever (Item 2) **[D]**.



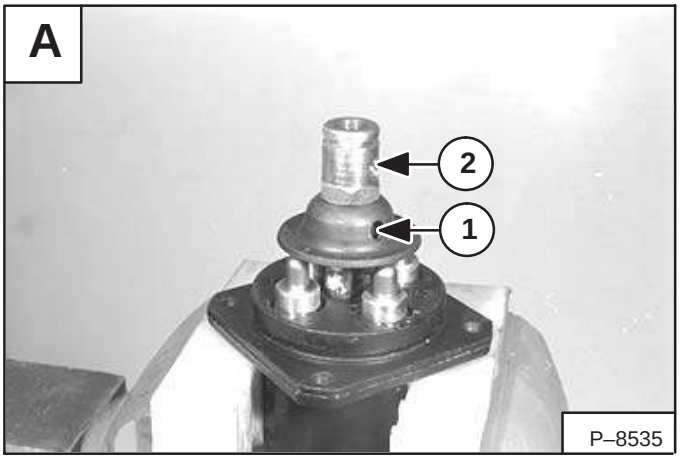
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JOYSTICK (S/N 13001 & Above) (Cont'd)

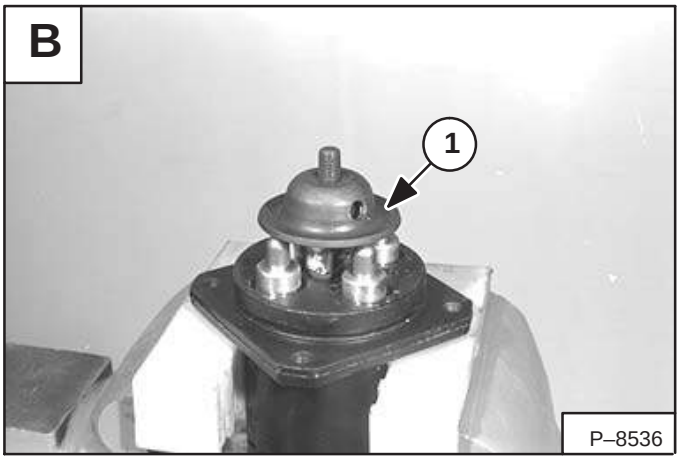
Disassembly (Cont'd)

Insert a drift in the selector ring hole (Item 1) **[A]** and loosen the coupler (Item 2) **[A]**.

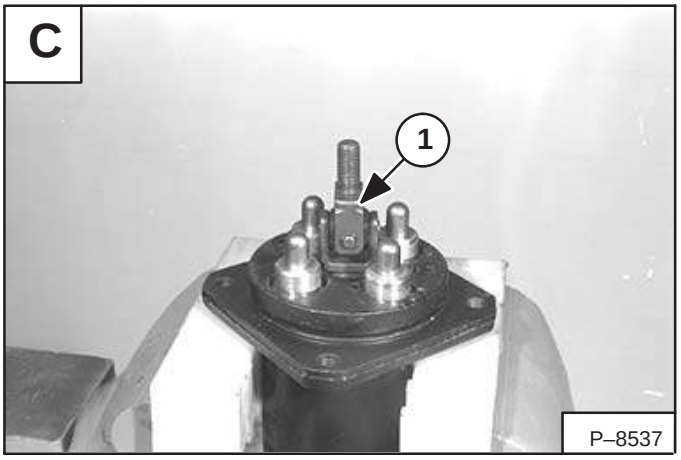
Remove the coupler.



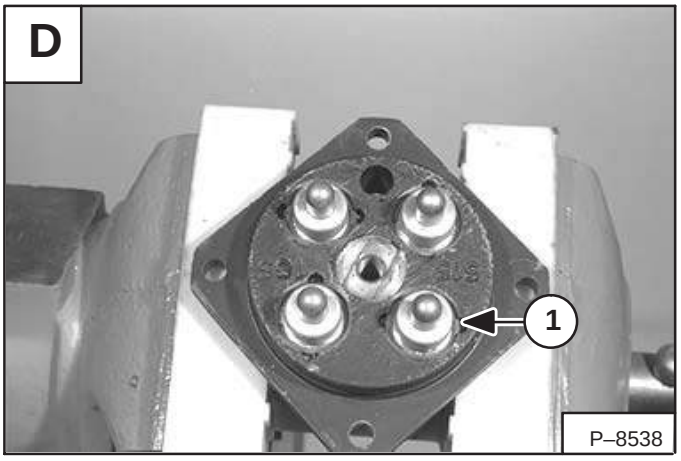
Remove the selector ring (Item 1) **[B]**.



Remove the swivel joint (Item 1) **[C]**.



Remove the plunger snap ring (Item 1) **[D]**.



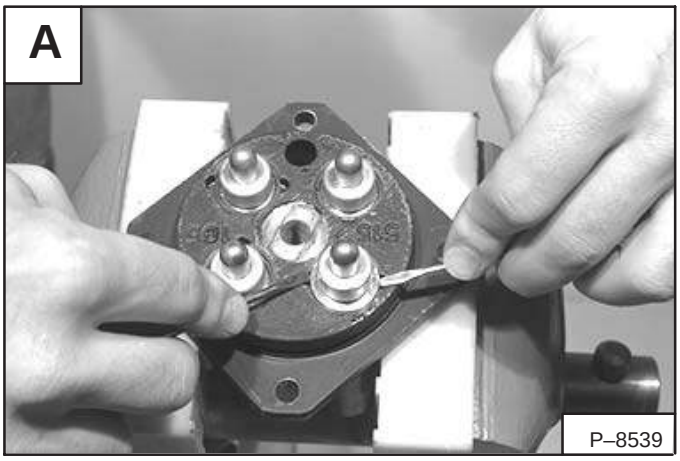
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JOYSTICK (S/N 13001 & Above) (Cont'd)

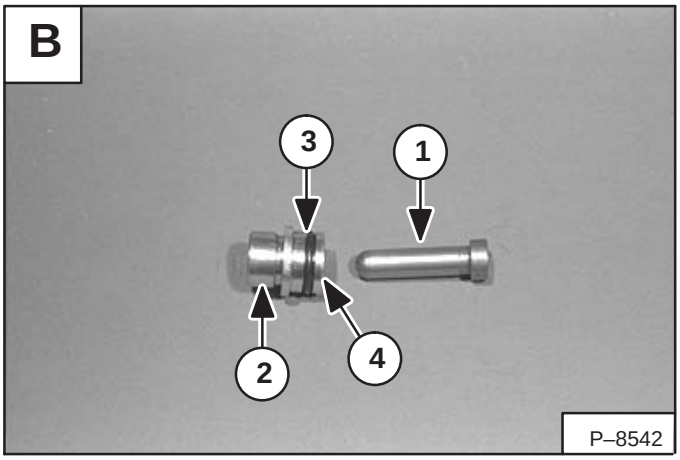
Disassembly (Cont'd)

Remove the plunger by prying on the edges with two (2) small flat blade screwdrivers **[A]**.

NOTE: Install the plungers in the same bore from which they are removed.

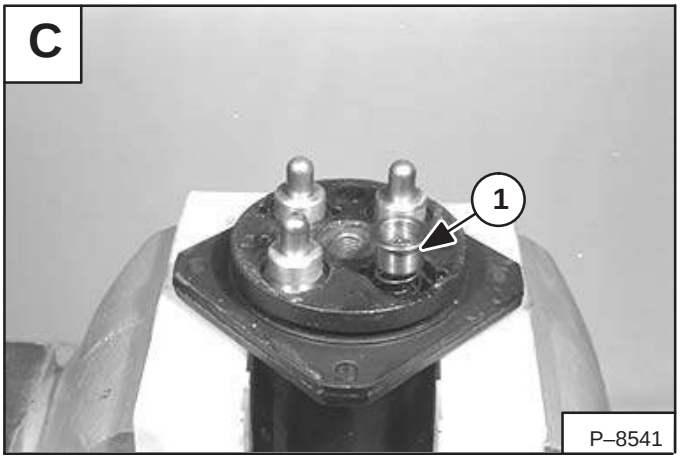


Remove the push rod (Item 1) **[B]** from the plug (Item 2) **[B]**. Remove the O–ring (Item 3) **[B]** from the outside of the plug (Item 2) **[B]** and the seal (Item 4) **[B]** from the inside of the plug (Item 2) **[B]**.

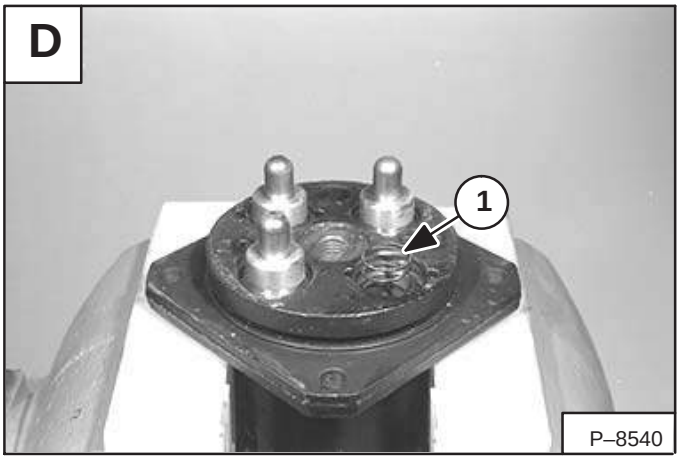


Remove the spool assembly (Item 1) **[C]**.

NOTE: Install the spool assembly in the same bore from which they are removed.



Remove the centering spring (Item 1) **[D]** from the joystick body.

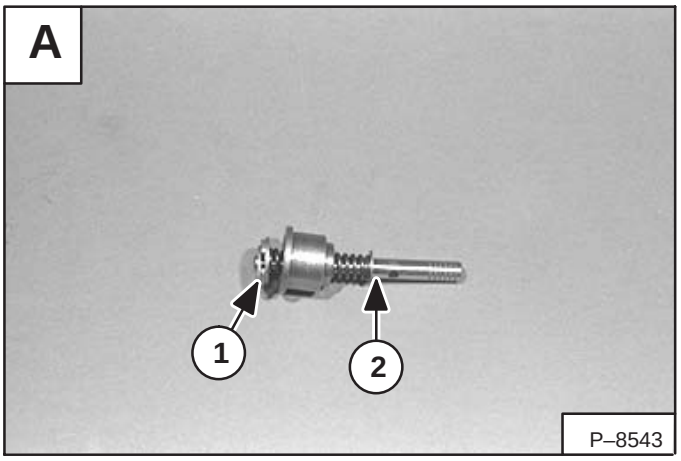


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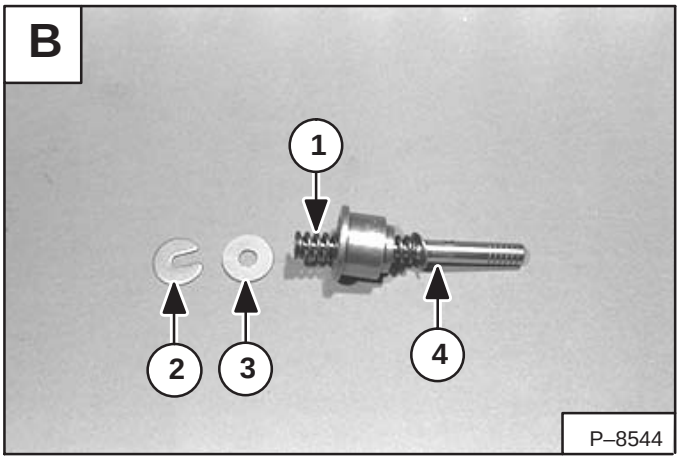
JOYSTICK (S/N 13001 & Above) (Cont'd)

Disassembly (Cont'd)

Remove the two (2) shims (Item 1) **[A]** from the end of the spool (Item 2) **[A]**.

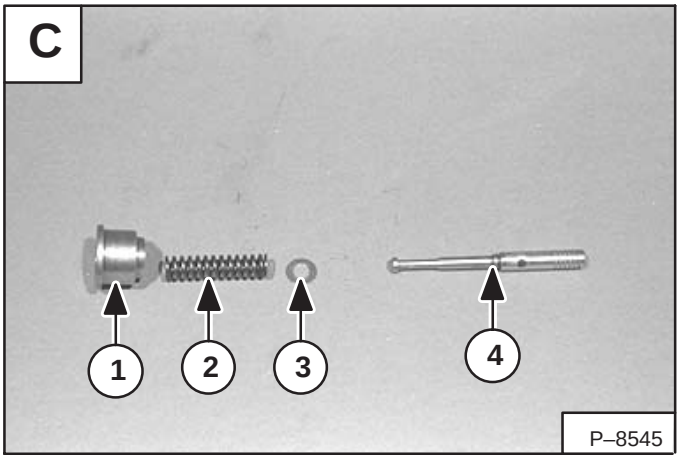


Compress the spring (Item 1) **[B]** and remove the C–clip (Item 2) **[B]** and washer (Item 3) **[B]** from the end of the spool (Item 4) **[B]**.



Remove the spring seat (Item 1) **[C]**, the spring (Item 2) **[C]** and washer (Item 3) **[C]** from the spool (Item 4) **[C]**.

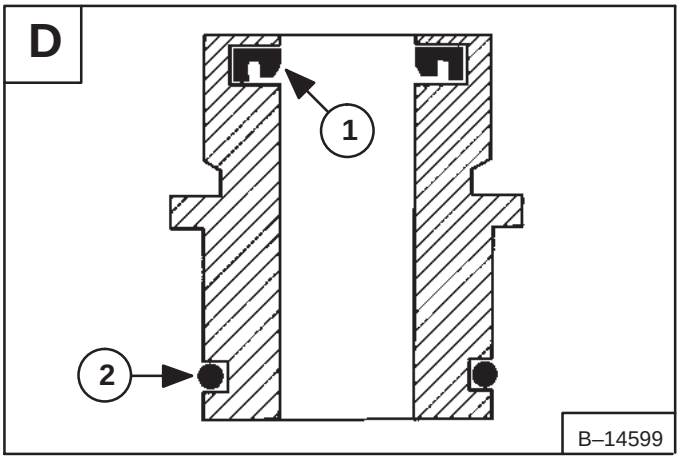
Repeat steps 2–D through 4–C for the remaining three (3) plunger/spool assembly.



Assembly

Clean all parts in solvent and dry with compressed air. Inspect the push rod crown for wear. Replace all components showing excessive wear.

Oil and Install a new seal (Item 1) **[D]** in the plug. Be sure the seal lip is toward the valve body. Oil and install a new O–ring (Item 2) **[D]** on the plug.

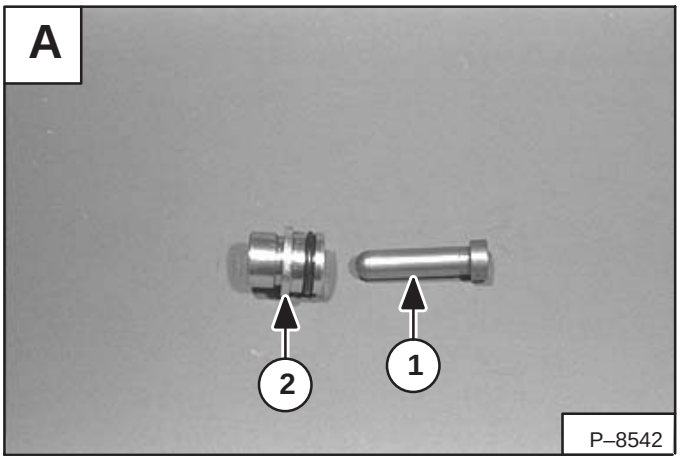


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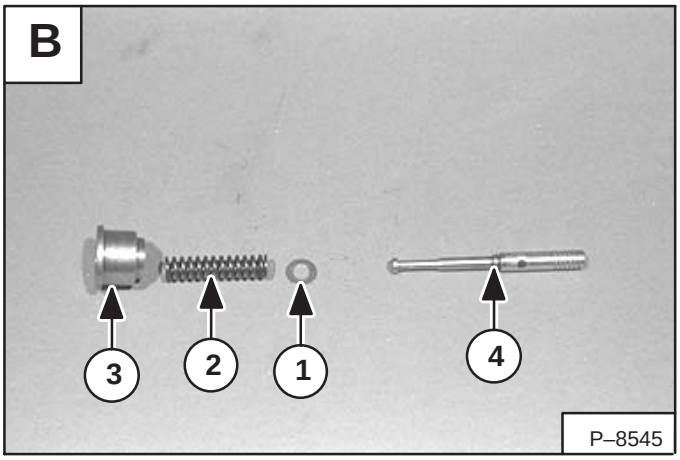
JOYSTICK (S/N 13001 & Above) (Cont'd)

Assembly (Cont'd)

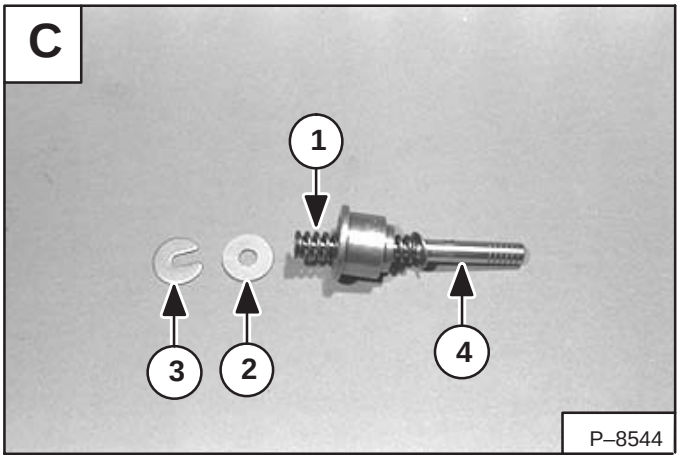
Install the push rod (Item 1) **[A]** in the plug (Item 2) **[A]**.



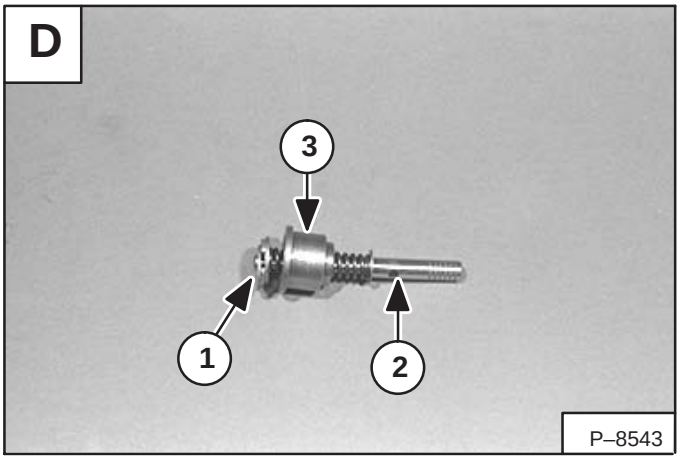
Install the washer (Item 1) **[B]**, spring (Item 2) **[B]** and the spring seat (Item 3) **[B]** on the spool (Item 4) **[B]**.



Compress the spring (Item 1) **[C]** and install the washer (Item 2) **[C]** and C–clip (Item 3) **[C]** on the end of the spool (Item 4) **[C]**.



Install the two (2) shims (Item 1) **[D]** on the end of the spool (Item 2) **[D]**. Slide the spring seat (Item 3) **[D]** to the end of the spool (Item 2) **[D]** to retain the shims (Item 1) **[D]** in place.

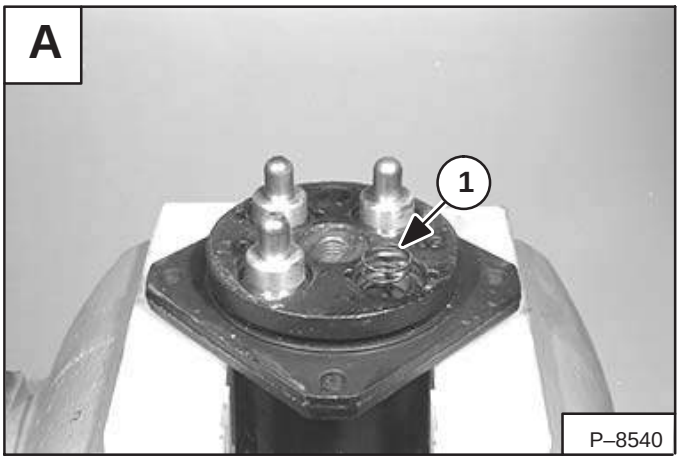


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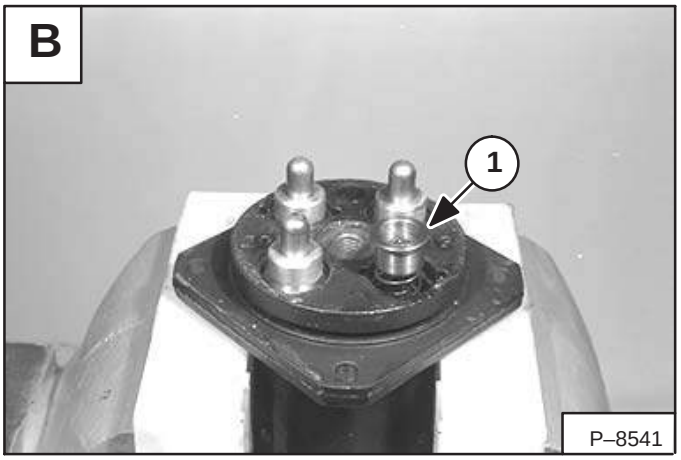
JOYSTICK (S/N 13001 & Above) (Cont'd)

Assembly (Cont'd)

Install the centering spring (Item 1) **[A]** in the joystick body.

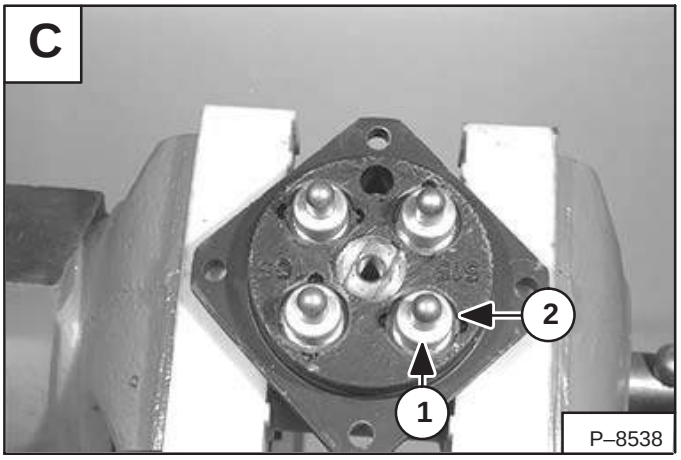


Dip the spool assembly in clean hydraulic oil and install the spool assembly in the port which it was previously removed **[B]**.



Install the plunger (Item 1) **[C]** in the valve body. Install the plunger snap ring (Item 2) **[C]** in the snap ring groove.

Repeat steps 3–19D through 3–23C for the remaining three (3) plunger/spool assembly.

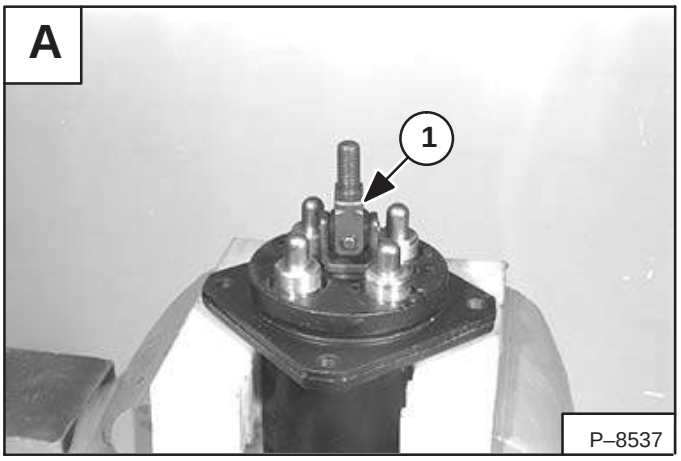


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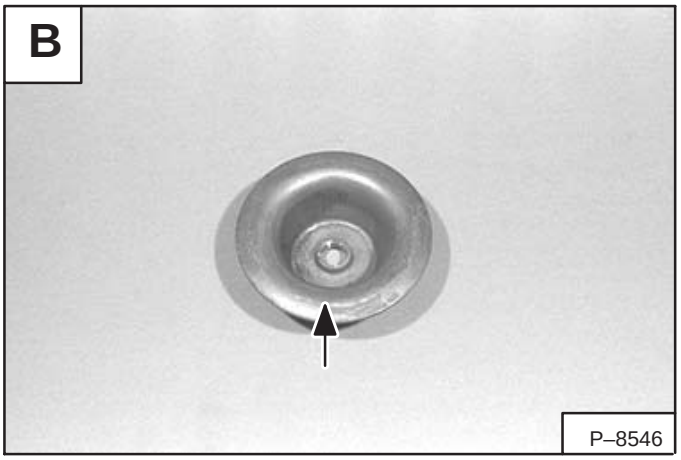
JOYSTICK (S/N 13001 & Above) (Cont'd)

Assembly (Cont'd)

Apply thread lock (LOCTITE #542) to the swivel joint threads, and install the swivel joint (Item 1) **[A]** in the joystick valve body. Tighten to 5 ft.–lbs. (7 Nm) of torque. Lubricate the swivel joint after installation.

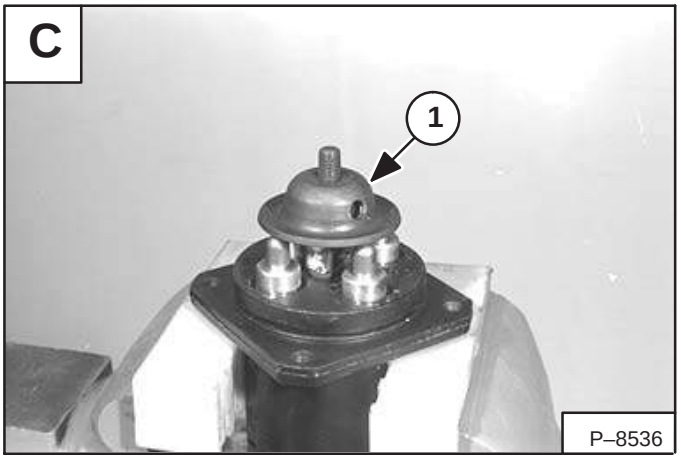


Grease the bottom plate of the selector ring **[B]**.

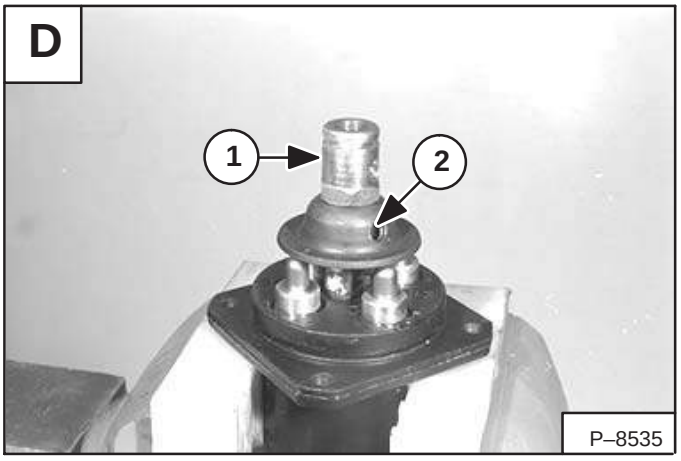


Install the selector ring (Item 1) **[C]**.

Tighten the selector ring until it makes slight contact with all four (4) push rods.



Install the coupler (Item 1) **[D]** on the end of the swivel joint. Insert a drift in the hole in the selector ring (Item 2) **[D]** and tighten the coupler to 5 ft.–lbs. (7 Nm) of torque.



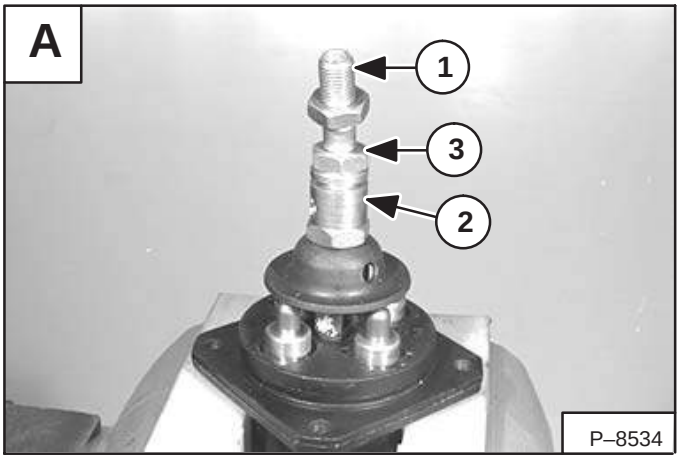
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JOYSTICK (S/N 13001 & Above) (Cont'd)

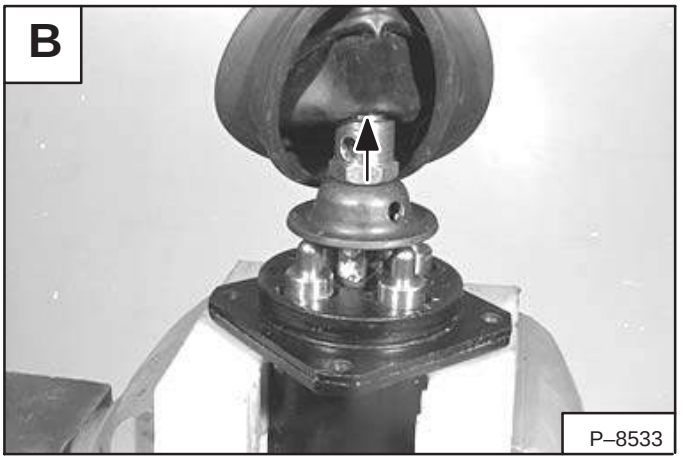
Assembly (Cont'd)

Install the lever (Item 1) **[A]**, in the coupler (Item 2) **[A]**.

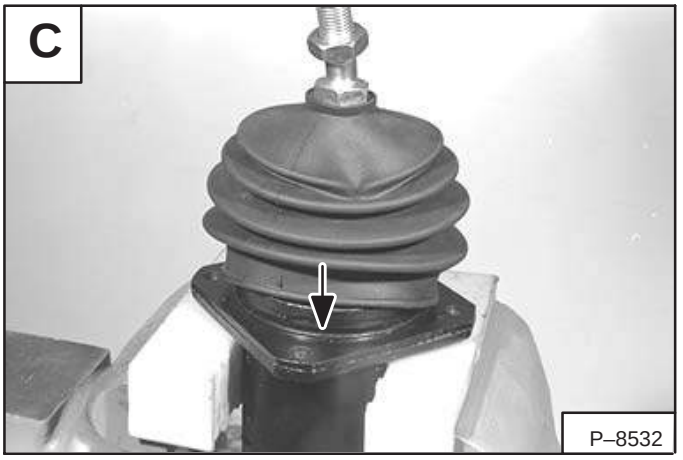
Tighten the locknut (Item 3) **[A]** making sure the lever (Item 1) **[A]** is orientated toward port number two.



Install the dust boot over the lever until the top lip on the dust boot engages the top groove on the coupler **[B]**.

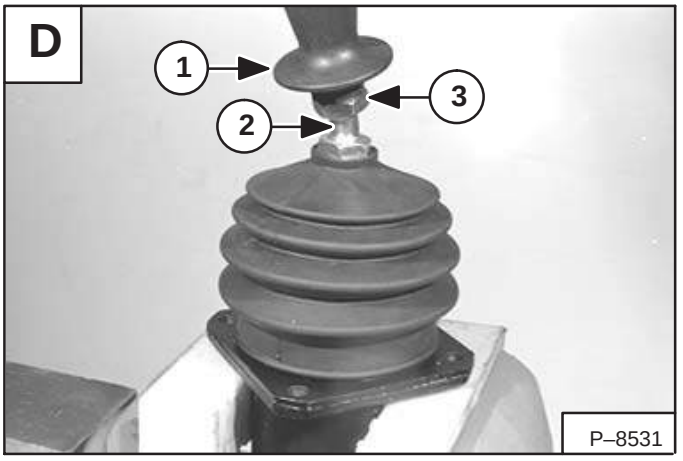


Install the bottom lip of the dust boot in the groove on the joystick valve body **[C]**.



Install the handle (Item 1) **[D]** on the lever (Item 2) **[D]**.

Tighten the handle locknut (Item 3) **[D]**.



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JOYSTICK (S/N 13001 & Above) (Cont'd)

Troubleshooting

To test a joystick that has a circuit that sticks, remove the pilot line from the valve section of the sticking circuit.

Install a 500 PSI (3448 kPa) gauge on the pilot line **[A]**.

Start the excavator, and warm the hydraulic oil to operating temperature.

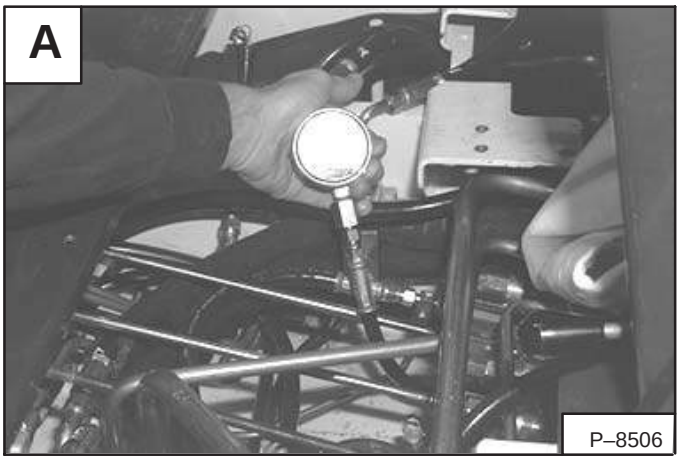
Engage the circuit to be tested and record the operating pressure.

The operating pressure should be approximately 300 PSI (2482 kPa).

If the pressure is low, check the other joystick pilot lines for correct operating pressure.

If the operating pressure is correct, check the valve section spool for proper operation. If the operating pressure is incorrect, remove the pressure reducing valve, clean, install and retest.

If the pressure is still incorrect replace the pressure reducing valve. (See Page 2–1.)



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RIGHT CONSOLE

Removal and Installation (S/N 12999 & Below)

Disconnect the negative cable from the battery. (See Page 6–1.)

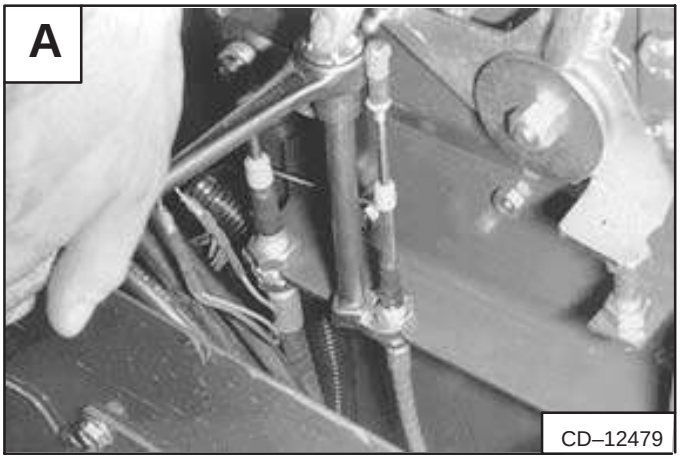
Remove the seat. (See Page 4–1.)

Remove the swing motor cover. (See Page 4–1.)

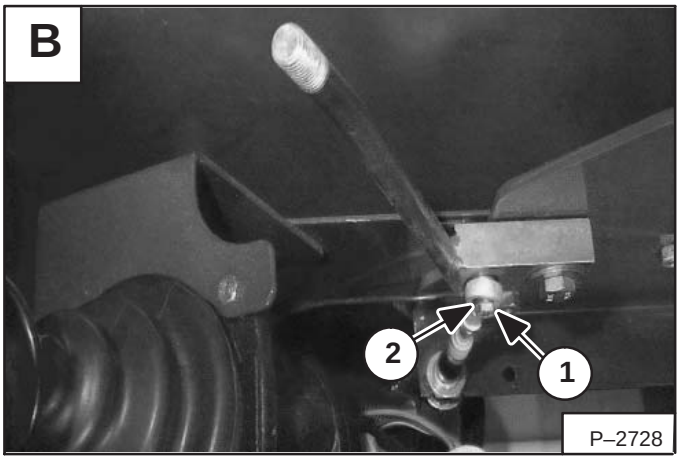
Remove the right console cover. (See Page 3–1.)

Remove the ball joint (Item 1) **[A]** from the speed control lever.

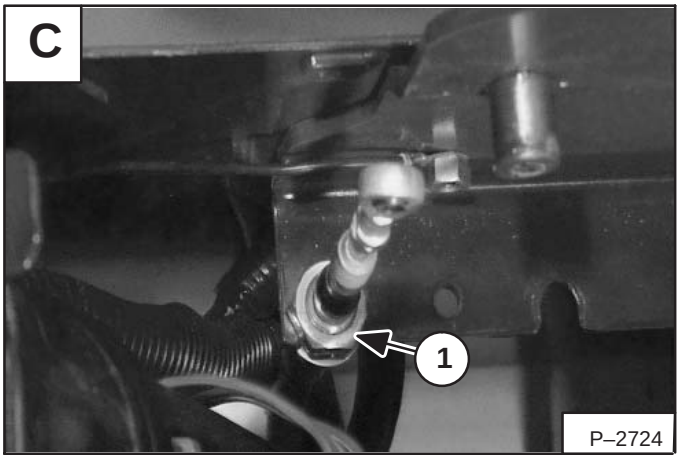
Loosen the jam nut (Item 2) **[A]** on speed control cable.



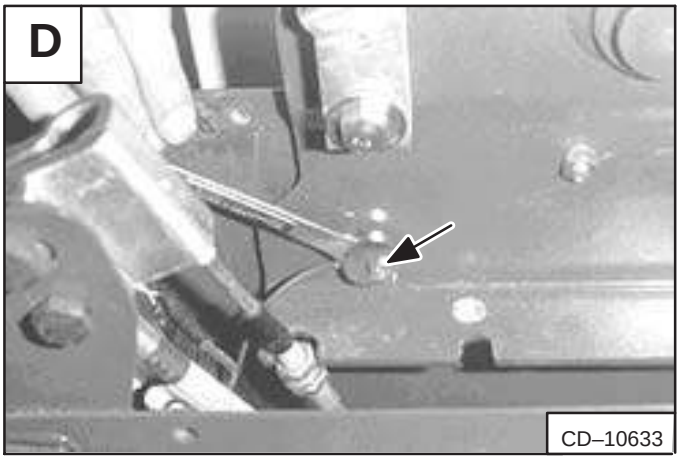
Remove the bolt (Item 1) **[B]** and the spacer (Item 2) **[B]** from the blade cable.



Loosen the jam nut (Item 1) **[C]** from the blade cable.



Remove the ground cable from the console **[D]**.

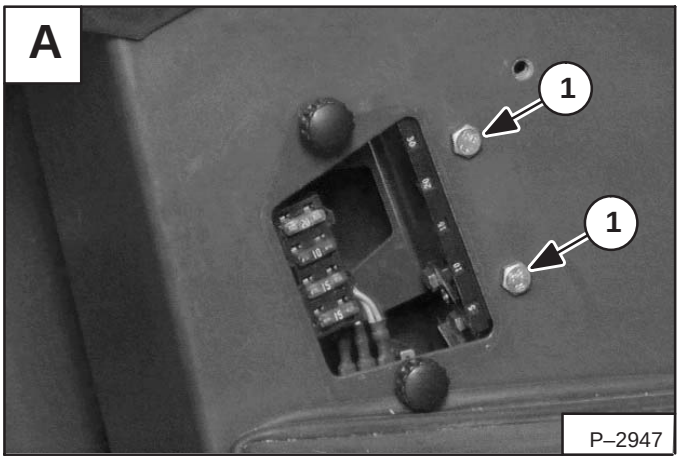


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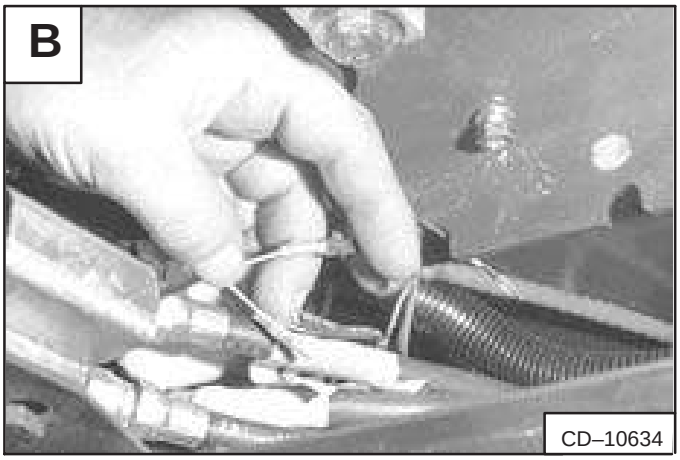
RIGHT CONSOLE (Cont'd)

Removal and Installation (S/N 12999 & Below) (Cont'd)

Remove the two bolts (Item 1) **[A]** holding the fuse panel to the console.

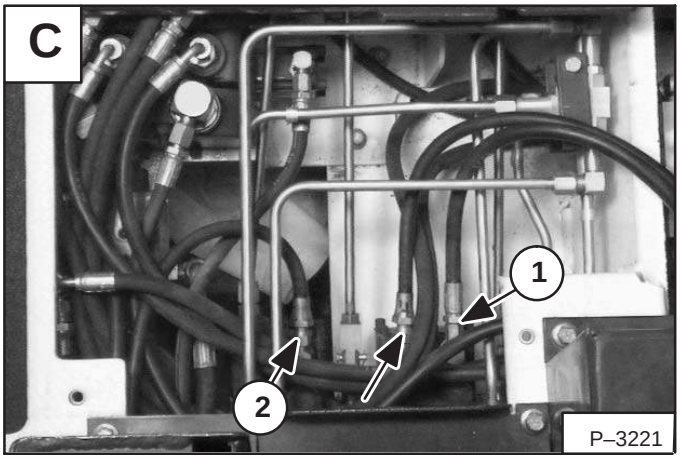


Disconnect the horn wires at the joystick **[B]**.



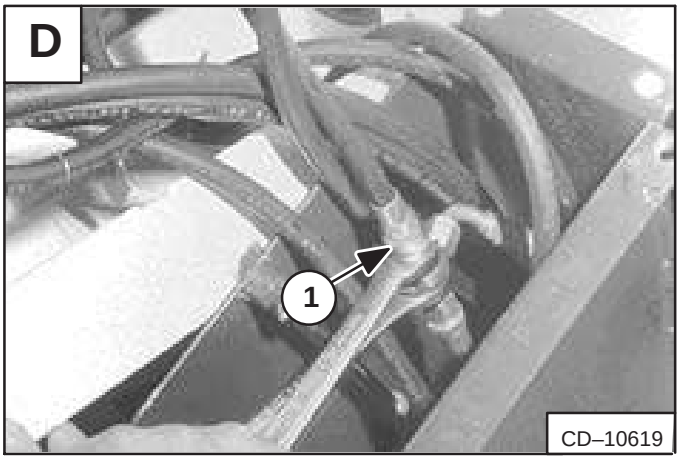
Remove the four (4) hoses that go from the joystick to activate the six (6) spool control valve **[C]**.

NOTE: Remove hose identified as (Item 1) [C] for ISO control pattern and remove hose identified as (Item 2) [C] for Standard Control Pattern.



Remove the right hand joystick supply hose (Item 1) **[D]** from under the left hand control console.

NOTE: The three left hand console mounting bolts must be removed so that the left console can be tipped to allow access from under the console to remove the supply hose.

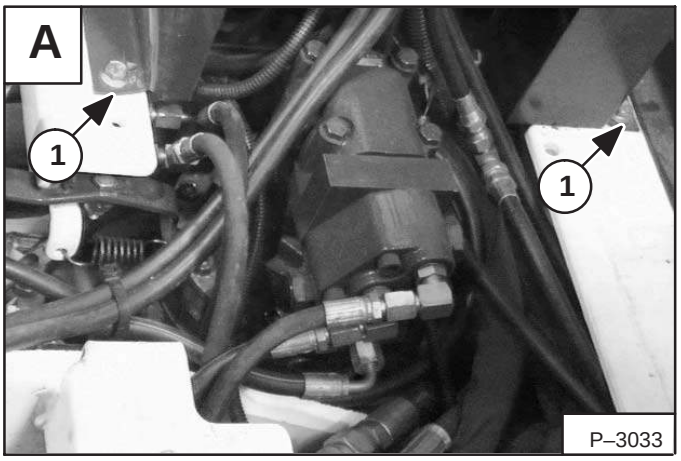


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RIGHT CONSOLE (Cont'd)

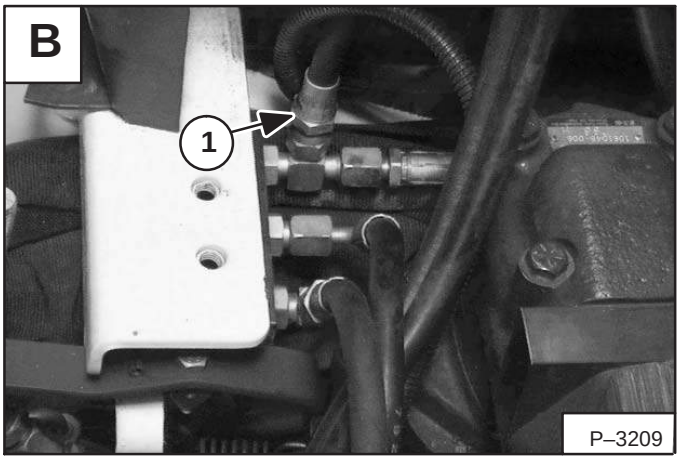
Removal and Installation (S/N 12999 & Below) (Cont'd)

Remove the four (4) bolts (Item 1) **[A]** from the bottom of the right hand console.



Slide the console forward. Remove the joystick drain hose (Item 1) **[B]** from the two speed valve fitting.

Connect a chain hoist to the control console and remove the console.

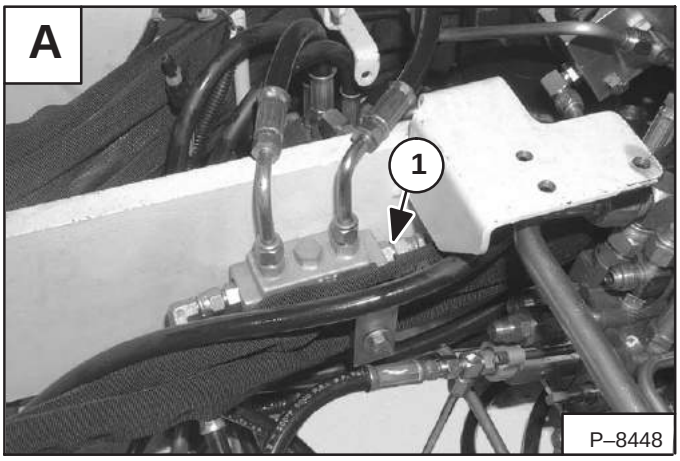


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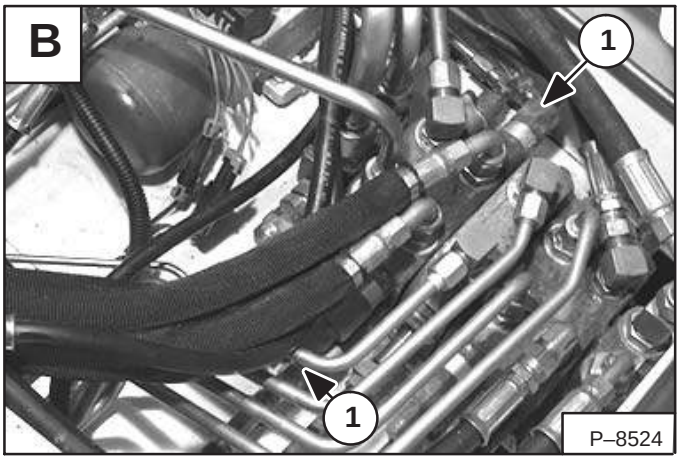
RIGHT CONSOLE (Cont'd)

Removal and Installation (S/N 13001 & Above)

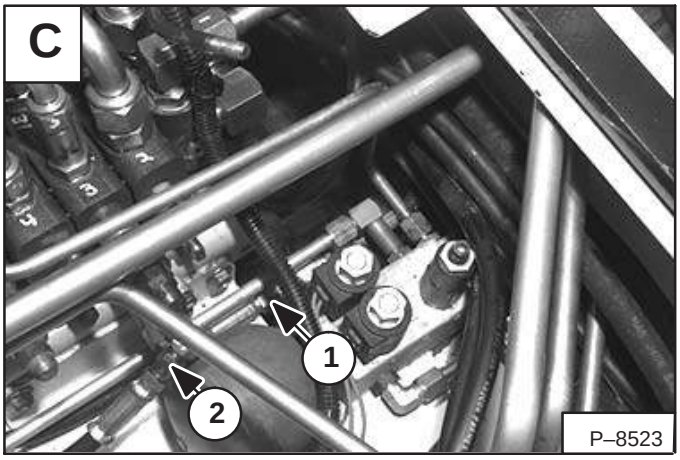
Remove the joystick control lever hose (Item 1) **[A]** from the port block.



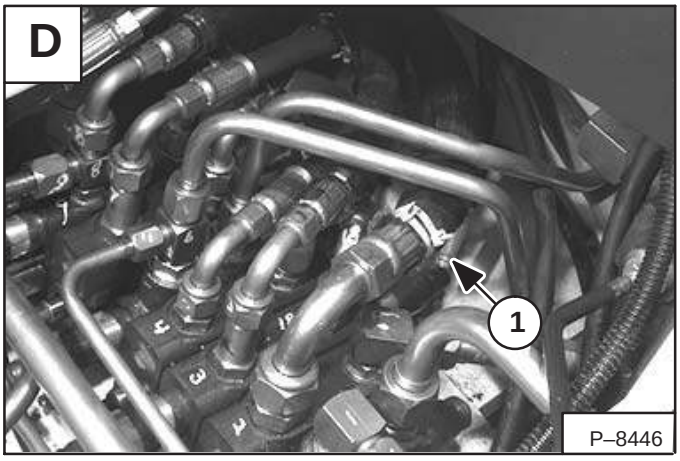
Remove the joystick control lever hose (Item 1) **[B]** from the front and rear of the valve (Arm Section) for Standard control pattern or (Item 1) **[C]** for ISO control pattern (Bucket Section).



Remove the joystick control lever hose (Item 2) **[C]** from the accumulator.



Remove the joystick control lever hose (Item 1) **[D]** from the valve (Bucket Section).

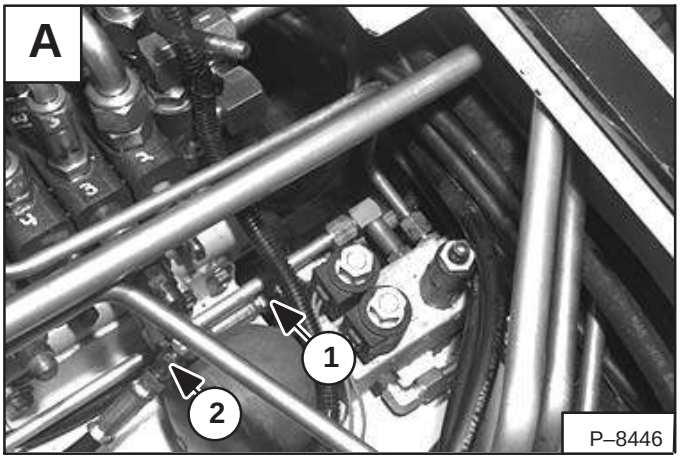


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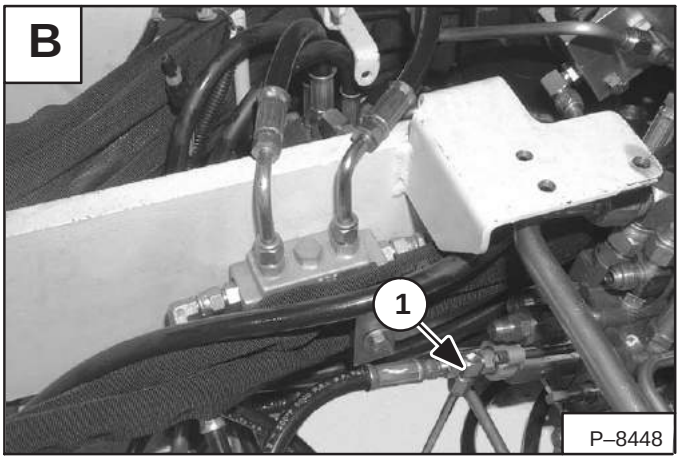
RIGHT CONSOLE (Cont'd)

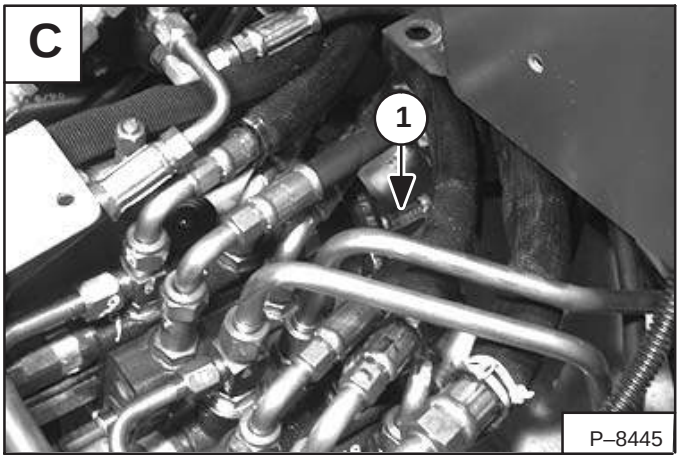
Removal and Installation (S/N 13001 & Above) (Cont'd)

Remove the joystick control lever hose (Item 1) **[A]** from the accumulator and the joystick control lever hose (Item 2) **[A]** from the valve (Bucket Section) for Standard control pattern.

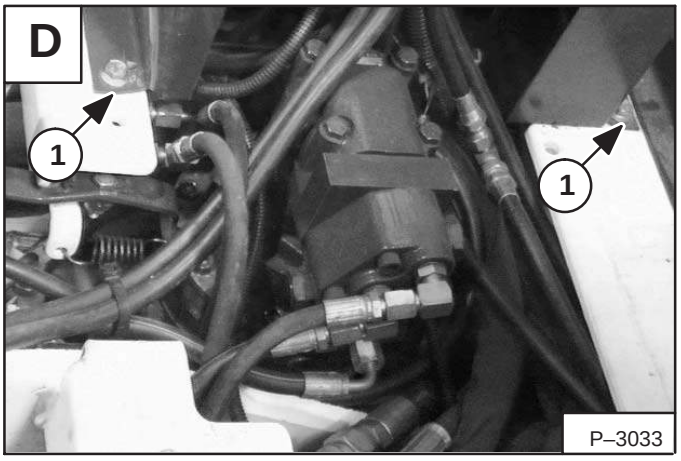


Remove the joystick control lever hose (Item 1) **[B]** and (Item 1) **[C]** from the valve (Boom Section) for ISO control pattern.





Remove the four (4) bolts (Item 1) **[D]** from the bottom of the right hand console and remove.

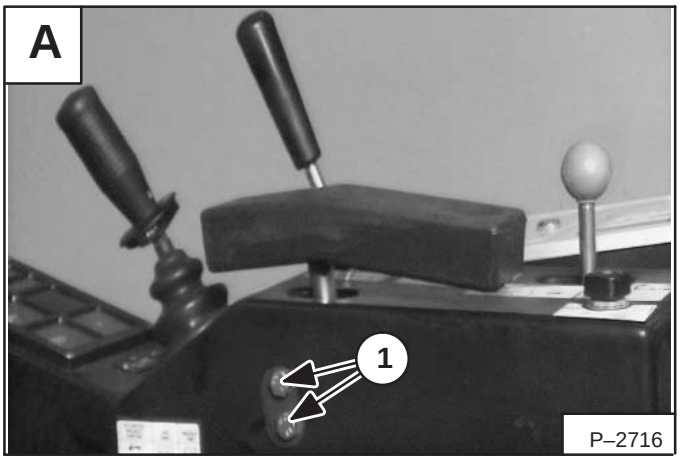


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RIGHT CONSOLE COVER

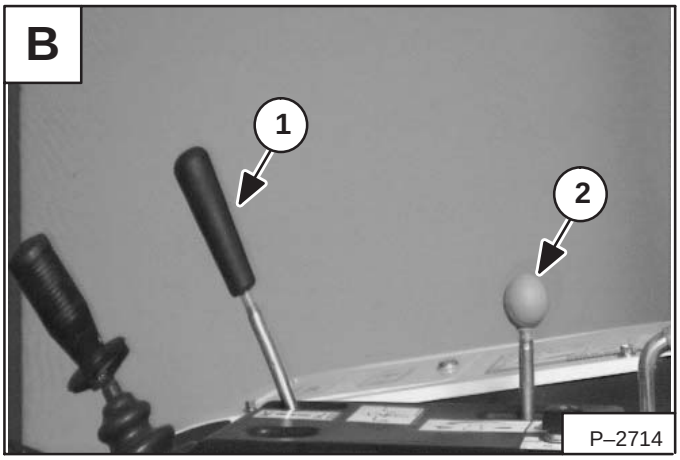
Removal and Installation

Loosen the two bolts (Item 1) **[A]** to remove the arm rest.



Remove the blade knob (Item 1) **[B]** and speed control knob (Item 2) **[B]**.

Remove the mounting screws from the console cover.

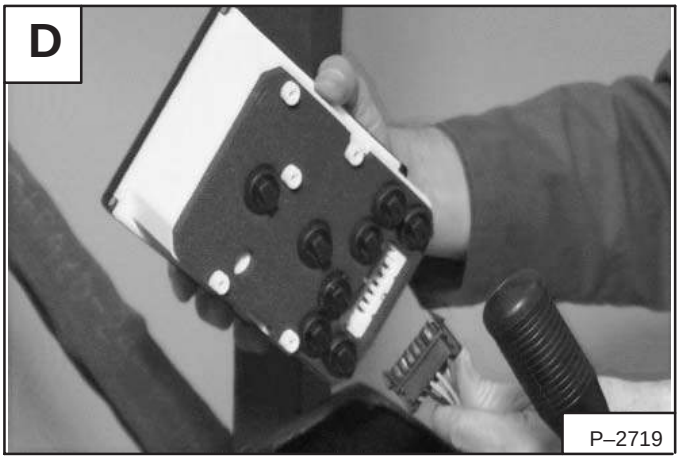


Remove the four (4) instrument panel mounting screws **[C]**.

Remove the instrument panel.



Remove the wire harness from the instrument panel socket **[D]**.



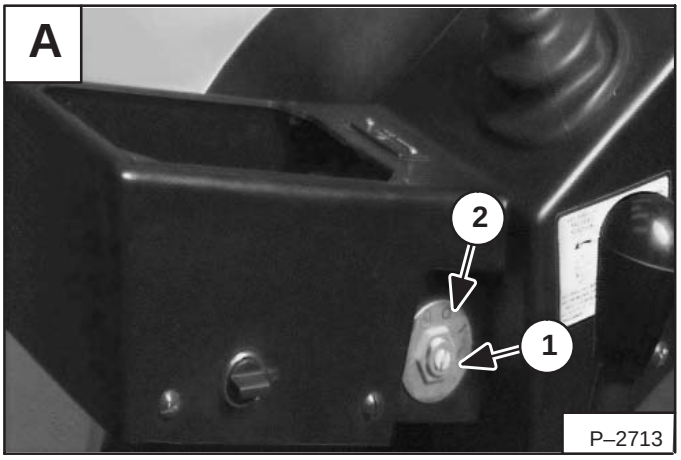
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RIGHT CONSOLE COVER (Cont'd)

Removal and Installation (Cont'd)

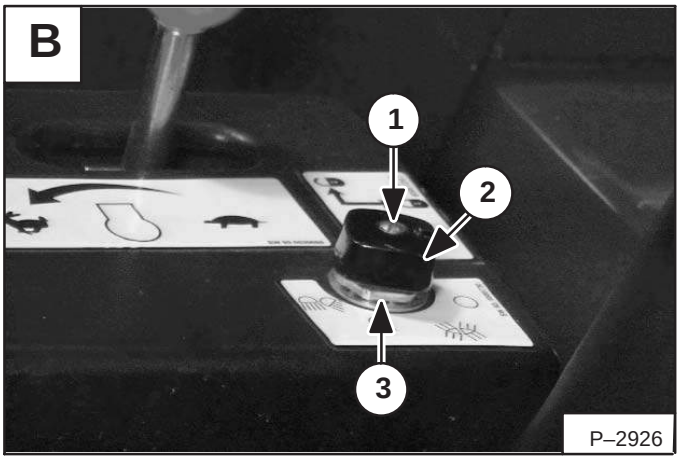
Remove the nut (Item 1) **[A]** and the switch face plate (Item 2) **[A]** from the ignition switch.

Push the ignition switch into the console.



Remove the screw (Item 1) **[B]** from the light switch knob.

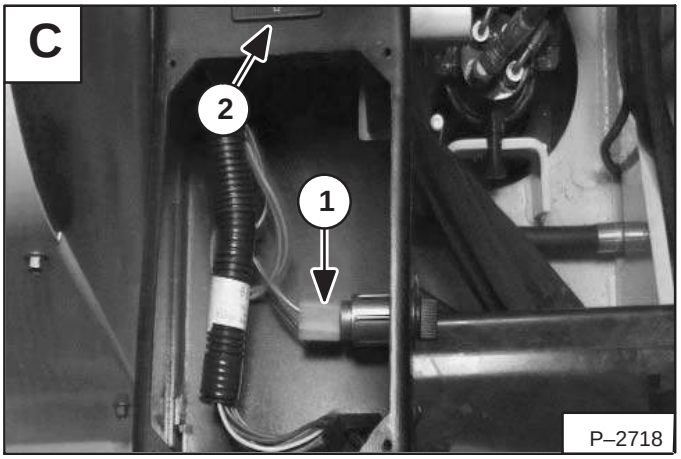
Remove the knob (Item 2) **[B]** and remove the nut (Item 3) **[B]**. Push the light switch down into the console.



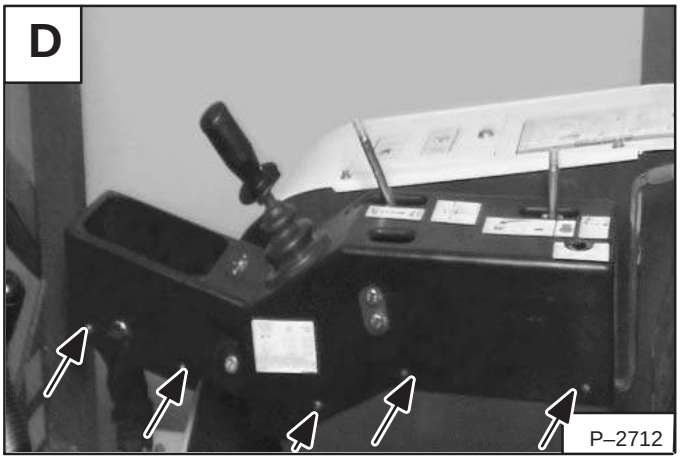
Remove the harness connector (Item 1) **[C]** from the auxiliary power plug.

Remove the wires from the hourmeter (Item 2) **[C]**.

NOTE: The orange wires go to the right hand hourmeter terminal and the yellow wire to the left hand side.



Remove the ten (10) screws from the console cover. Remove the console cover **[D]**.



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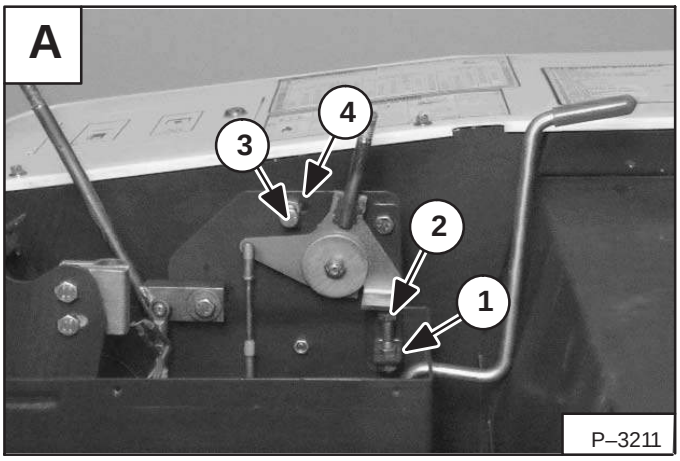
SPEED CONTROL LEVER

Low Idle Adjustment

In low idle position, the speed control lever should stop against the lever stop bolt when the engine speed is reduced to 1000 RPM.

To adjust low idle, start the engine and loosen the jam nut (Item 1) **[A]** and move the speed control lever to 1000 RPM.

Turn the idle bolt (Item 2) **[A]** to touch the speed control lever and tighten the jam nut. (When the low idle speed has been set to 1000 RPM, the low idle adjustment screw on the engine should touch the speed control lever).

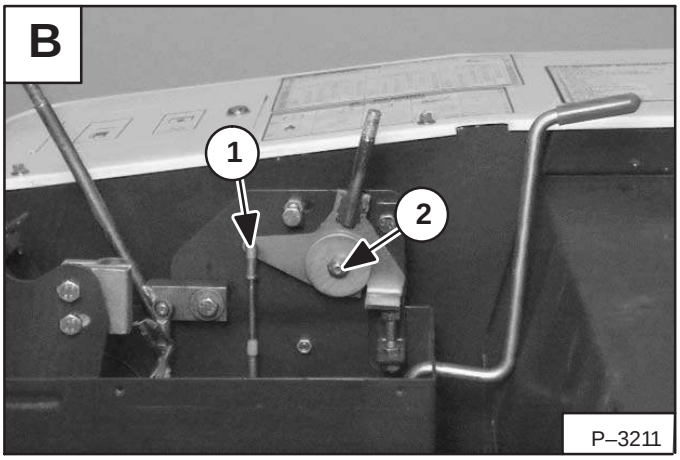


High Idle Adjustment

In high idle position the speed control lever should stop against the bolt (Item 3) **[A]** and the high idle screw on the fuel injection pump at the same time.

To adjust high idle, loosen the jam nut (Item 4) **[A]** and move the lever so the lever touches the stop screw on the fuel injection pump.

Move the stop bolt (Item 3) **[A]** to touch the lever and tighten the jam nut (Item 4) **[A]**.



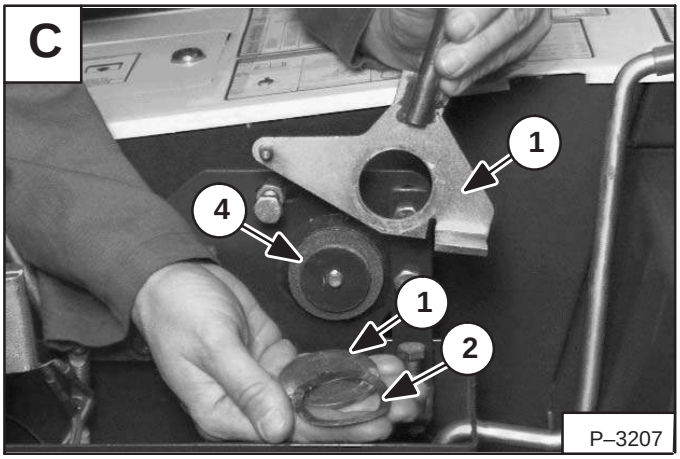
Removal and Installation

Disconnect the speed control cable ball joint (Item 1) **[B]** from the lever.

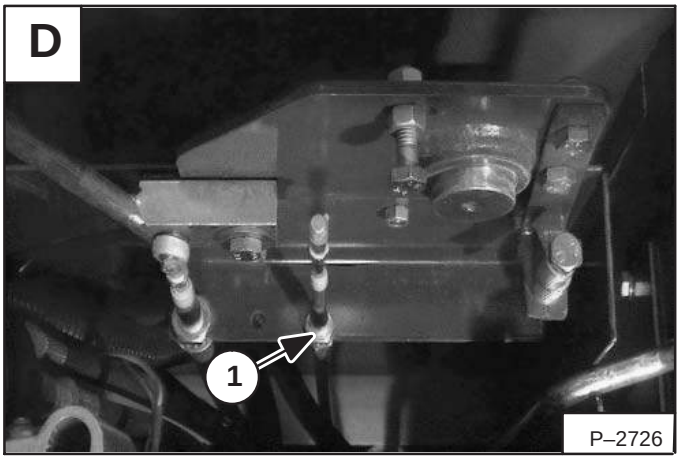
Remove the lock nut (Item 2) **[B]** from the lever.

Installation: Tighten the nut (Item 2) **[B]** to allow lever movement with 15 lbs. pressure.

Remove the flat washer (Item 1) **[C]**, the wave washer (Item 2) **[C]**, the lever (Item 3) **[C]** and the friction washer (Item 4) **[C]**.



Loosen the locknut (Item 1) **[D]** to remove the speed control cable from the right console.



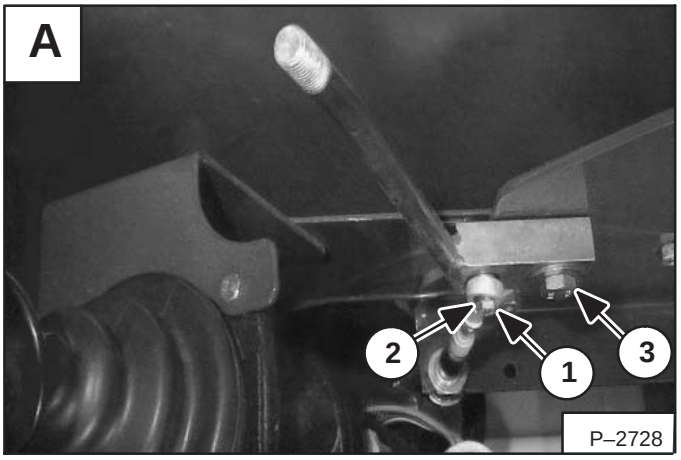
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BLADE CONTROL LEVER AND CABLE

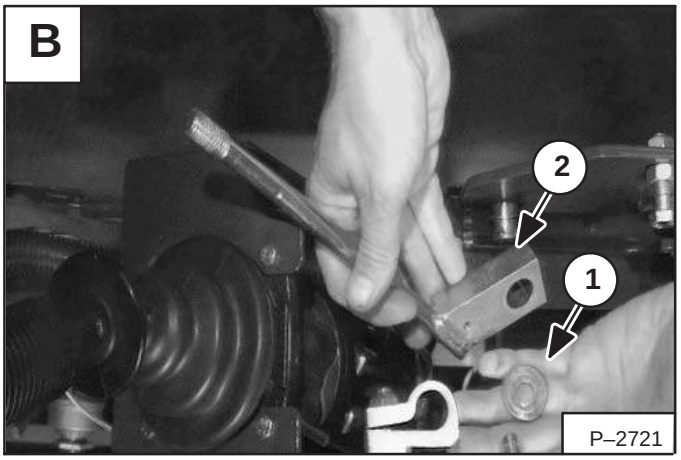
Removal and Installation

Remove the bolt (Item 1) **[A]** and the spacer (Item 2) **[A]** from the blade cable ball joint.

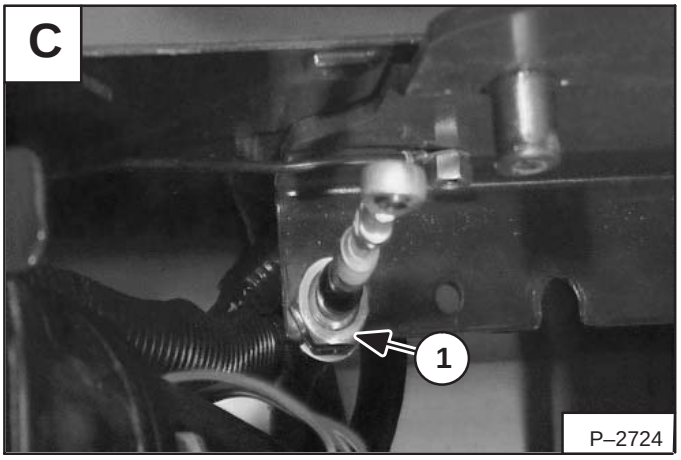
Remove the bolt (Item 3) **[A]** from the blade lever.



Remove the washer (Item 1) **[B]** and the blade lever (Item 2) **[B]**.



Loosen the jam nut (Item 1) **[C]** on the blade cable and remove the blade cable.



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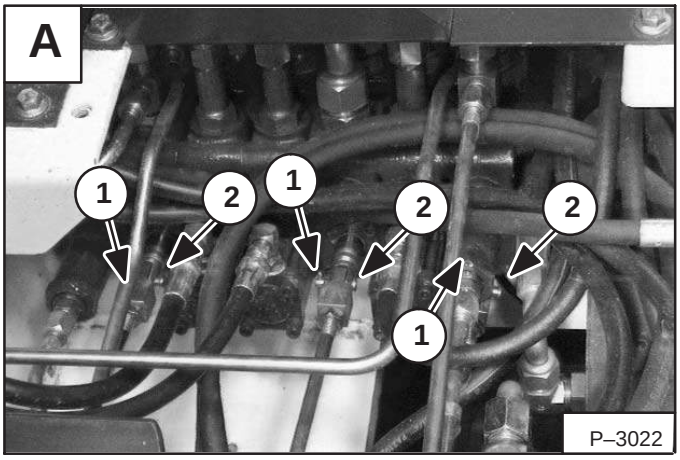
STEERING LEVERS AND PEDALS

Removal and Installation

Remove the floormat. (See Page 4–1.)

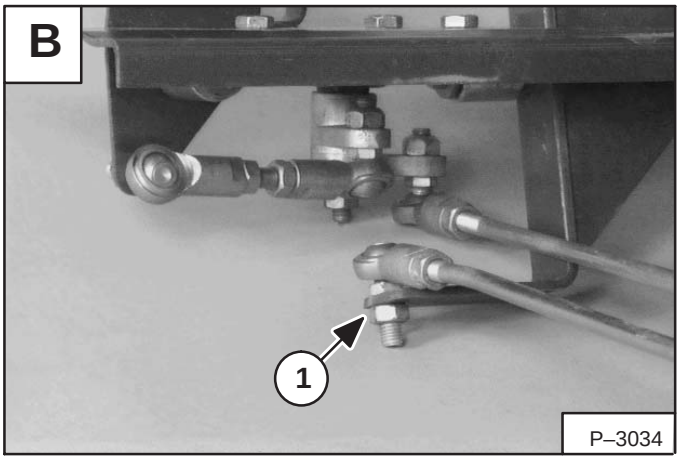
Remove the floor plate. (See Page 4–1.)

Remove the three cotter pins (Item 1) **[A]** and the three clevis pins (Item 2) **[A]**.

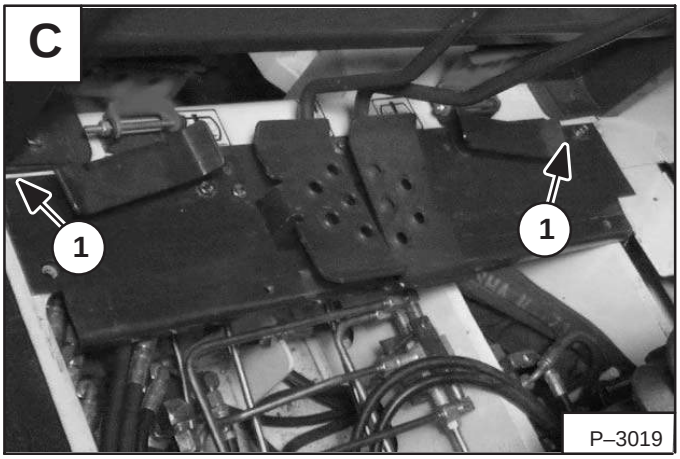


Remove the nut (Item 1) **[B]** from the travel lever ball joint (left hand).

Remove the rod.



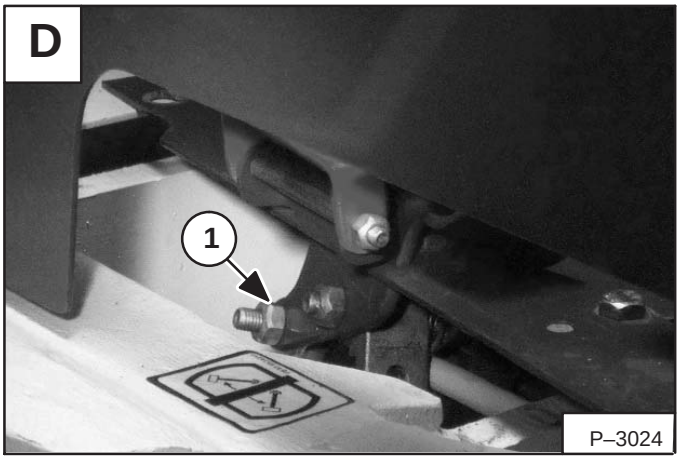
Remove the two (2) front floor plate mounting bolts (Item 1) **[C]**.



Slide the floor plate to the rear as far as possible.

Remove the ball joint nut (Item 1) **[D]** from the boom swing pedal.

Lift up, and move forward with the lever and pedal assembly until the actuating rods clear the hydraulic tubes. Remove the lever and pedal assembly.



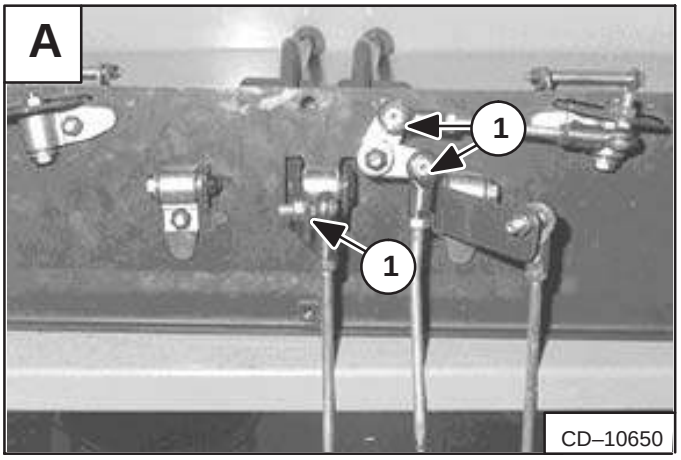
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STEERING LEVERS AND PEDALS (Cont'd)

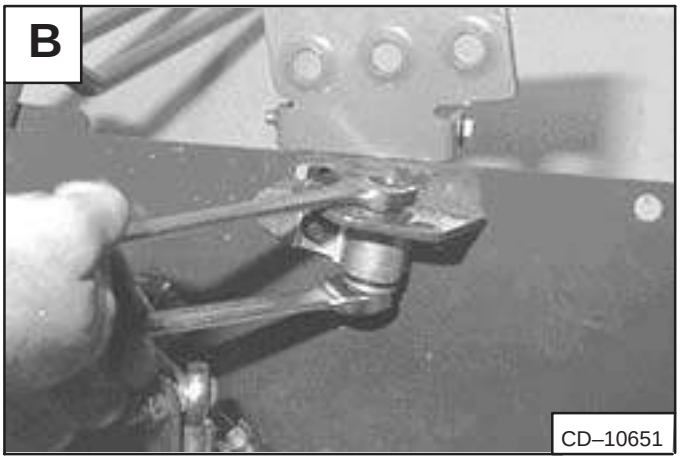
Removal and Installation (Cont'd)

NOTE: Before removing linkage rods, mark the locations of the rods and the orientation of the ball joints.

Remove the nuts (Item 1) **[A]** from the linkage ball joints.

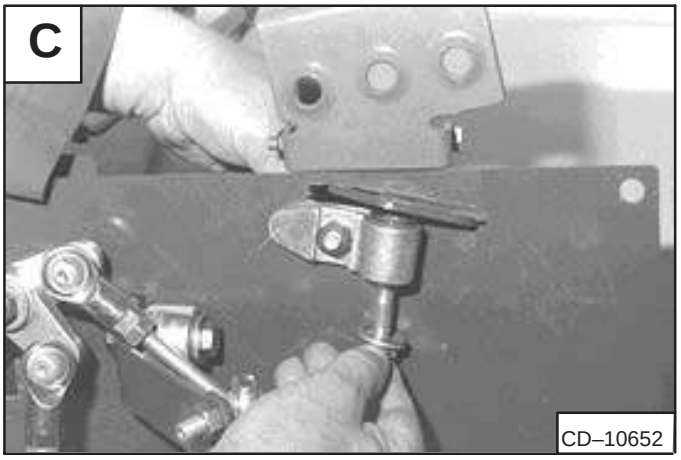


Remove the nut and bolt from the pivot mounts **[B]**.



Remove the pivot bolt and the two washers from the pedal mount **[C]**.

NOTE: Install the washers in the same location during assembly of all pivot mounts.



Remove the pivot sleeve and the O–rings **[D]**.

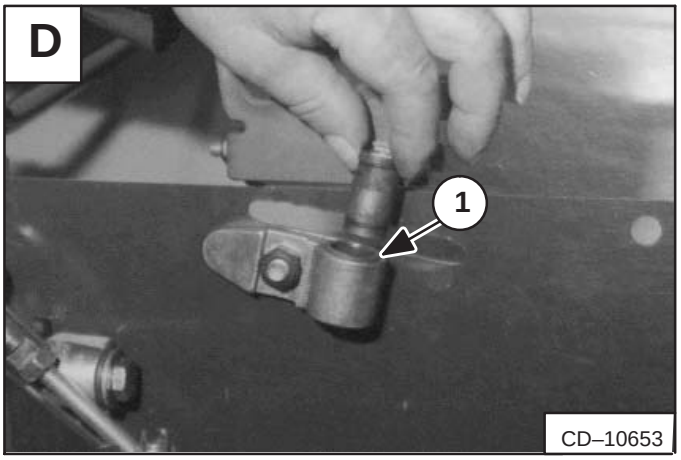
Bushings (Item 1) **[D]** are pressed into the pivot mounts. If new bushings are needed, lightly tap the new bushings into the pivot mount to avoid distortion.

NOTE: Put oil on the O–rings during assembly.

Adjusting Linkage Rods

Adjust the linkage rods so the travel levers are positioned even with each other.

Make sure the spools will move full stroke in both directions.



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UPPER WORKS AND SWING SECTION

	Page Number
ARM	
Removal and Installation (S/N 11001–11999)	4–16
Removal and Installation (S/N 12001 & Above)	4–16
BOOM	
Removal and Installation	4–17
BOOM PIVOT BUSHING	
Bushing Installation	4–22
Bushing Removal	4–22
BOOM SWING BRACKET	
Hose Installation	4–20
Removal and Installation	4–18
BUCKET	
Removal and Installation	4–15
BUCKET TEETH	
Removal and Installation	4–15
CAB	
Door Removal and Installation	4–82
Door Window Removal and Installation	4–83
Front Lower Window Removal and Installation	4–82
Front Upper Window Removal and Installation	4–82
Front Window Removal and Installation	4–81
Left Hand Side Window Removal and Installation	4–83
Rear Window Removal and Installation	4–86
Right Hand Side Window Removal and Installation	4–84
Right Hand Window Assembly Removal and Installation	4–85
Removal and Installation	4–77
CAB/CANOPY REAR COVER	
Installation	4–87
Removal	4–87
CENTER SWIVEL JOINT	
Assembly	4–72
Disassembly	4–71
Parts Identification	4–70
Removal and Installation (S/N 12999 & Below)	4–68
Removal and Installation (S/N 13001 & Above)	4–69
COUNTERBALANCE VALVE (S/N 11057–12999)	
Assembly	4–37
Disassembly	4–37
Description	4–36
Removal and Installation	4–36
COUNTERWEIGHTS	
Removal and Installation	4–13
CROSS PORT RELIEF VALVE (S/N 11001–11056 & S/N 13001 & Above)	
Assembly	4–34
Disassembly	4–32
Description	4–35
Testing	4–35
ENGINE COVER	
Removal and Installation (S/N 11001–11999)	4–3
Removal and Installation (S/N 12001 & Above)	4–3
FLOORMAT AND FLOOR PLATE	
Removal and Installation	4–6
FRONT ENGINE COVER	
Removal and Installation	4–14

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	Page Number
INSPECTION COVER (S/N 11001–11999)	
Removal and Installation	4–9
LEFT HAND CORNER POST	
Removal and Installation	4–12
LEFT HAND SIDE COVER	
Removal and Installation (S/N 11001–11999)	4–10
Removal and Installation (S/N 12001 & Above)	4–10
REAR FLOOR PLATE	
Removal and Installation	4–8
RIGHT HAND CORNER POST	
Removal and Installation	4–12
RIGHT HAND SIDE COVER	
Removal and Installation (S/N 11001–11999)	4–11
Removal and Installation (S/N 12001 & Above)	4–11
ROPS CANOPY	
Removal and Installation	4–75
SEAT AND SEAT MOUNT	
Removal and Installation	4–5
SWING BRACKET BUSHING	
Bushing Installation	4–21
Bushing Removal	4–21
SWING GEAR BOX	
Assembly (S/N 11001–12999)	4–46
Disassembly (S/N 11001–12999)	4–40
Parts Identification (S/N 11001–12999)	4–39
SWING MOTOR	
Assembly (S/N 11001–12999)	4–28
Disassembly (S/N 11001–12999)	4–25
Removal and Installation (S/N 11001–11056)	4–23
Removal and Installation (S/N 11057–12999)	4–24
Removal and Installation (S/N 13001 & Above)	4–56
SWING MOTOR DRIVE CARRIER (S/N 13001 & Above)	
Assembly	4–59
Disassembly	4–58
Parts Identification	4–57
Removal and Installation	4–57
SWING MOTOR COVER	
Removal and Installation	4–8
TOOL BOX	
Removal and Installation (S/N 11001–11999)	4–9
Removal and Installation (S/N 12001 & Above)	4–9
UPPERSTRUCTURE AND SWING CIRCLE GEAR	
Alignment Pins (Not Threaded)	4–67
Removal and Installation	4–63
Swing Bearing Installation	4–65
Swing Bearing Removal	4–64

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ENGINE COVER

Removal and Installation (S/N 11001–11999)

Open the engine cover **[A].**



Hold the engine cover open.

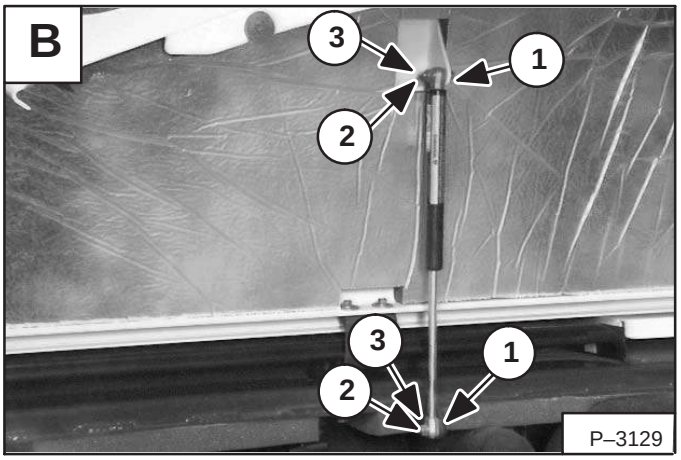
Remove the bolts (Item 1) **[B]**, nuts (Item 2) **[B]** and the spacers (Item 3) **[B]** inside the gas spring ball joint.

Remove the gas spring.

⚠ WARNING

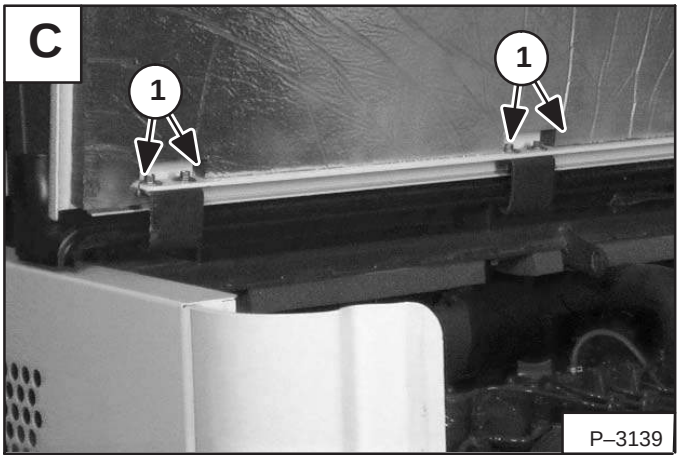
Cylinder contains high pressure gas. Do not open. Opening cylinder can release rod and cause injury or death.

W–2113–0288



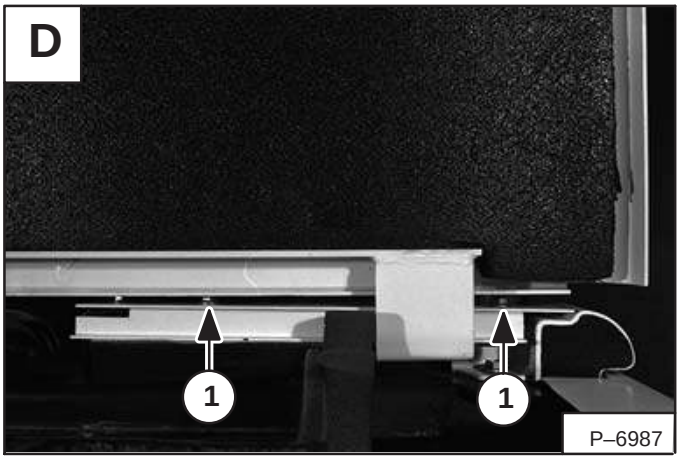
Remove the six bolts (Item 1) **[C]** and washers from the hood hinges.

Remove the engine cover.



Removal and Installation (S/N 12001 & Above)

Remove the two (2) bolts (Item1) **[D]** attaching the bracket to the cover. This will allow the bracket to be repositioned for the cover removal.

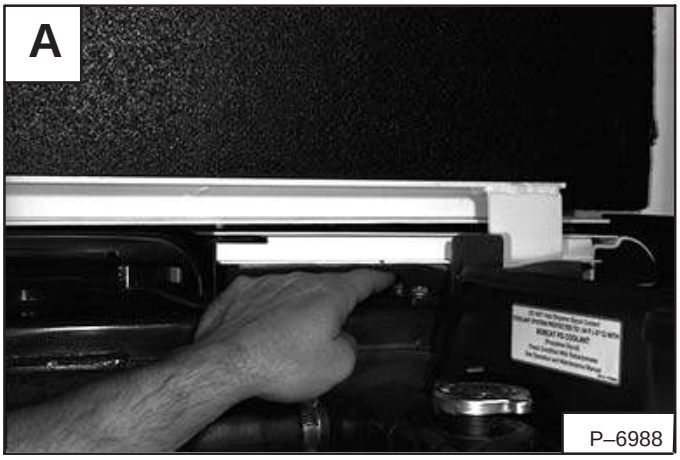


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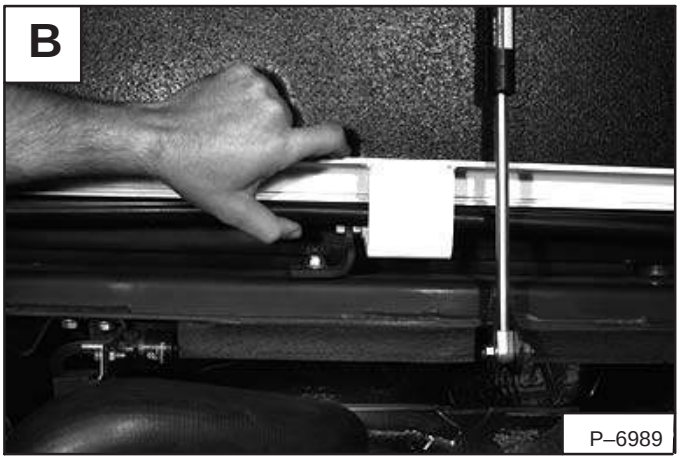
ENGINE COVER (Cont'd)

Removal and Installation (S/N 12001 & Above) (Cont'd)

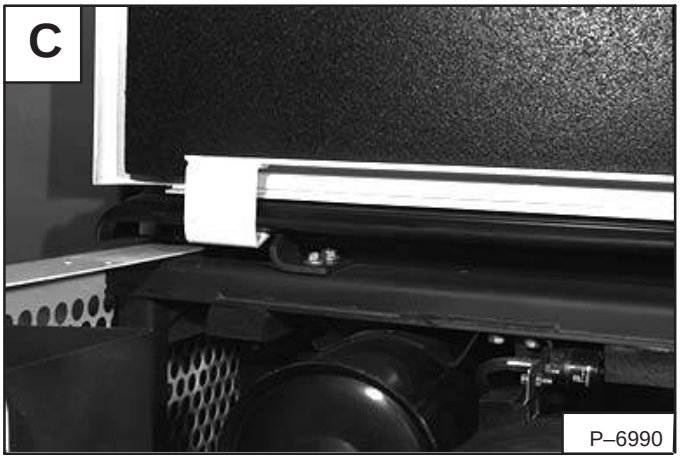
Remove the two (2) bolts from the the angle mount on the right hinge **[A]**.



Remove the nut from the hinge bolt on the center hinge **[B]**.



Remove the two (2) bolts from the angle mount on the left hinge. **[C]**.



⚠ WARNING

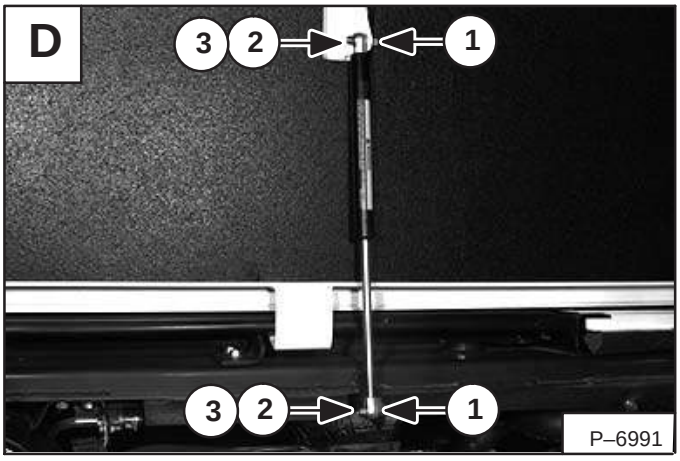
Cylinder contains high pressure gas. Do not open. Opening cylinder can release rod and cause injury or death.

W–2113–0288

Remove the bolts (Item 1) **[D]**, nuts Item 2) **[D]** and the spacers (Item 3) **[D]** inside the gas spring ball joint.

Remove the gas spring.

With the help of a second person, slide the engine cover to the right and remove from the excavator.



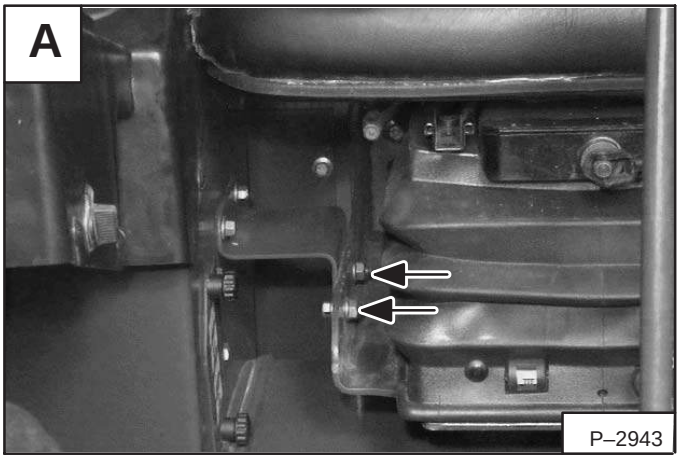
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SEAT AND SEAT MOUNT

Removal and Installation

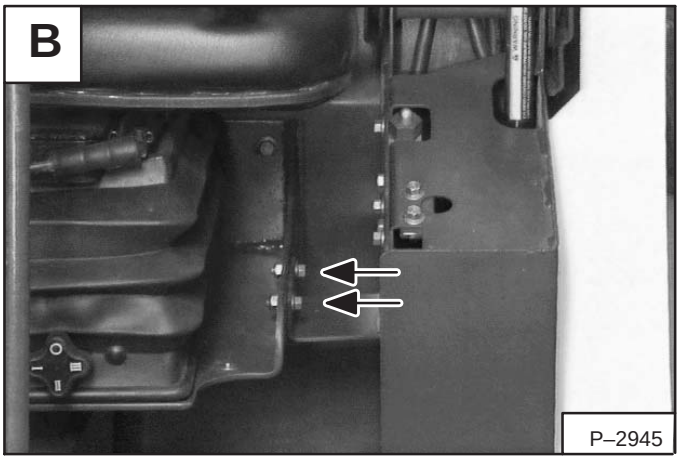
Remove the two bolts and nuts from the right hand seat support bracket **[A]**.

Installation: Tighten the nuts to 15–18 ft.–lbs. (20–25 Nm) torque.



Remove the two bolts and nuts from the left hand seat support bracket **[B]**.

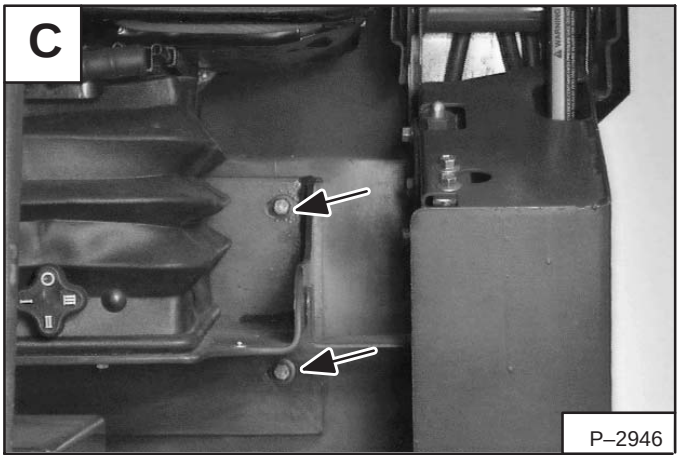
Installation: Tighten the nuts to 15–18 ft.–lbs. (20–25 Nm) torque.



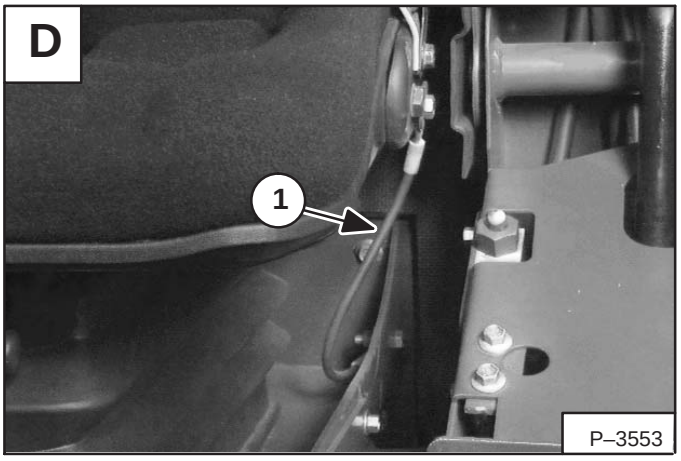
Remove the four (4) bolts holding the seat mount to the front engine cover **[C]**.

Installation: Tighten the bolts to 30–36 ft.–lbs. (40–50 Nm) torque.

Remove the seat and the seat mount.



Installation: Be sure the cable (Item 1) **[D]** is connected to the seat and the seat mount bolt.

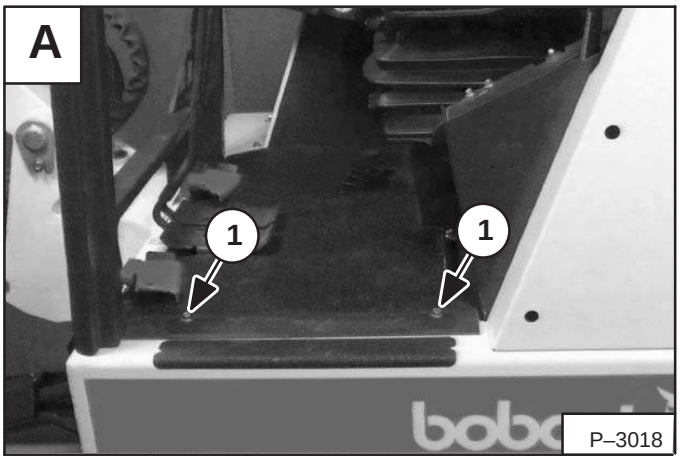


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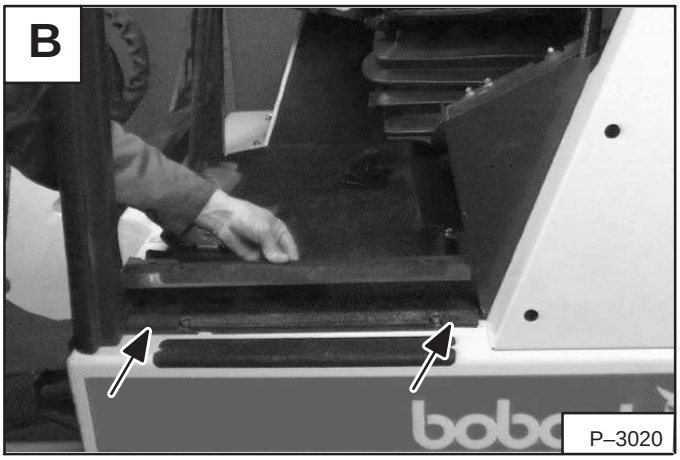
FLOORMAT AND FLOOR PLATE

Removal and Installation

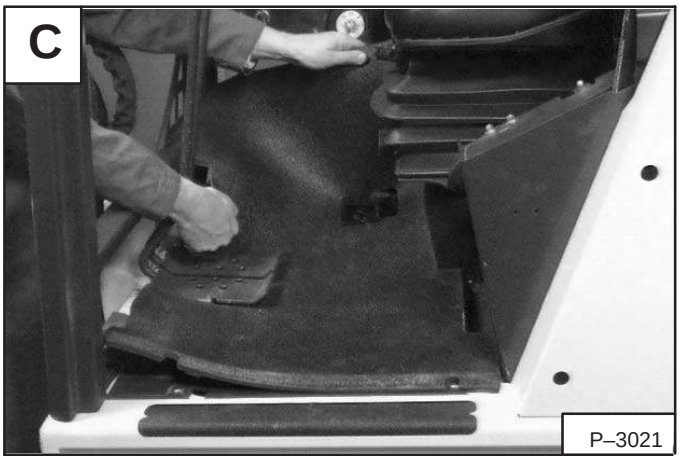
Remove the two bolts (Item 1) **[A]** from the retainer plate.



Remove the retainer plate and the two (2) spacers **[B]**.



Remove the floormat **[C]**.



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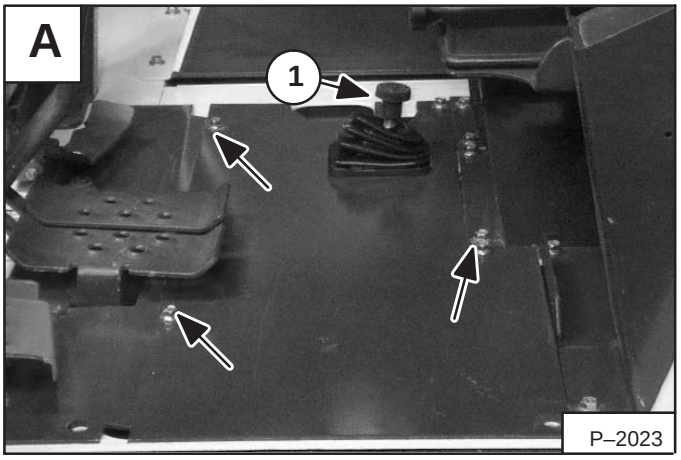
FLOORMAT AND FLOOR PLATE (Cont'd)

Removal and Installation (Cont'd)

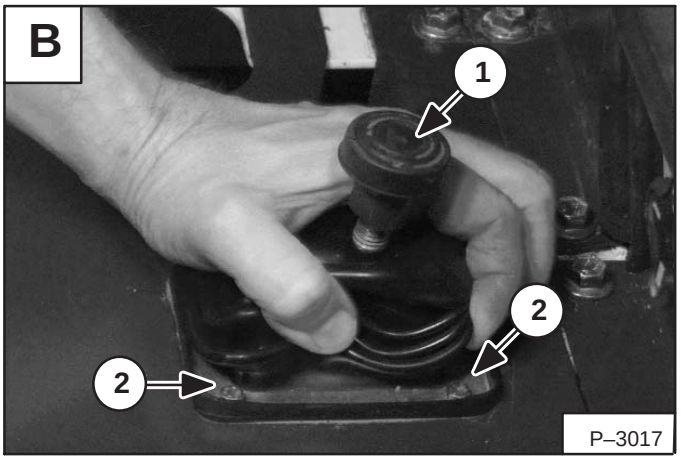
For S/N 12999 & Below:

Remove the two speed pedal knob (Item 1) **[A]**. (The knob is threaded onto the shaft.)

Remove the three bolts from the floor plate **[A]**.

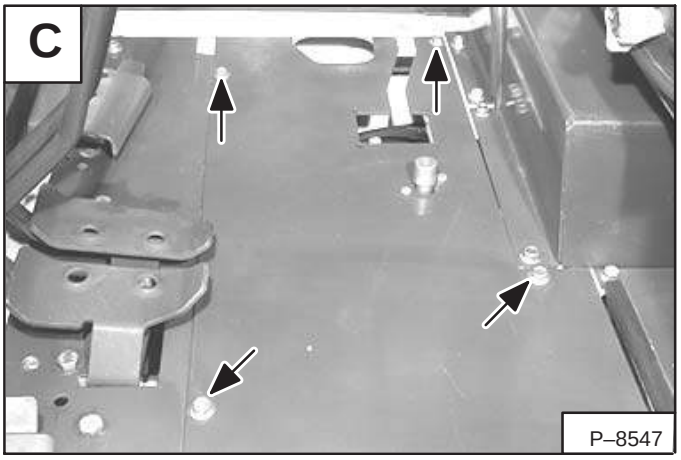


Remove the two speed pedal boot by removing the knob (Item 1) **[B]** and remove the four screws (Item 2) **[B]**.



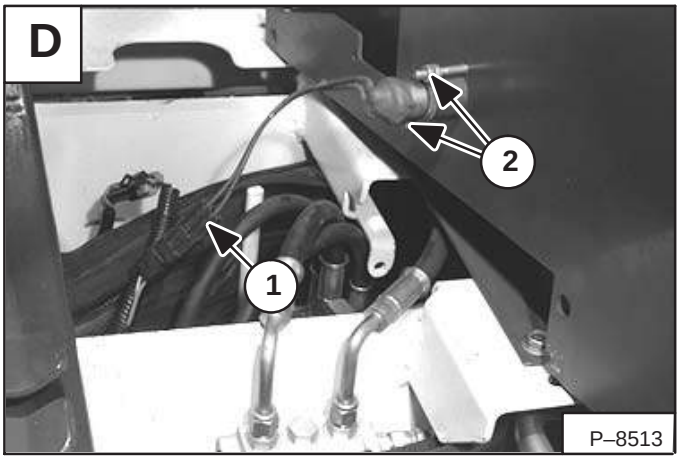
For S/N 13001 & Above:

Remove the four (4) bolts from the floor plate **[C]**.



Unplug the two speed switch (Item 1) **[D]** from the wiring harness.

Remove the two nuts and bolts (Item 2) **[D]** from the two speed switch. Remove the switch.

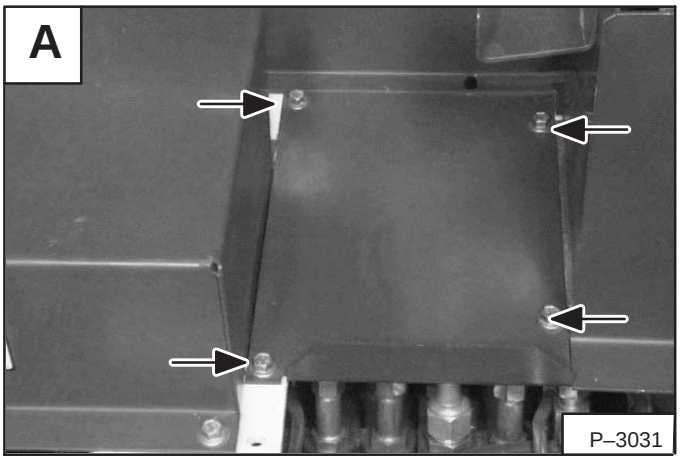


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REAR FLOOR PLATE

Removal and Installation

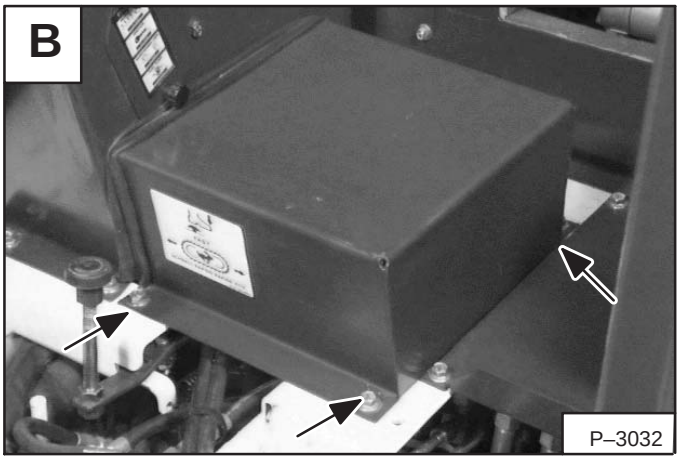
Remove the four bolts from the rear floor plate **[A]**.



SWING MOTOR COVER

Removal and Installation

Remove the four bolts from the swing motor cover **[B]**.



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INSPECTION COVER (S/N 11001–11999)

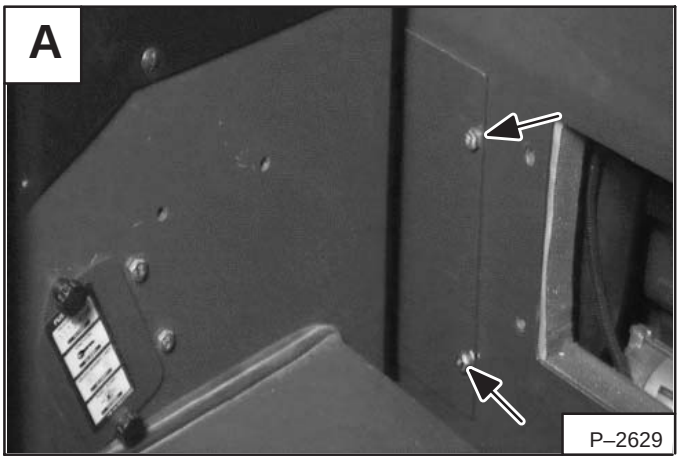
Removal and Installation

Remove the seat and mounting frame. (See Page 4–5.)

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

Remove the inspection cover.

There is no inspection cover for S/N 12001 & Above excavators. The seat opening was enlarged on later models.



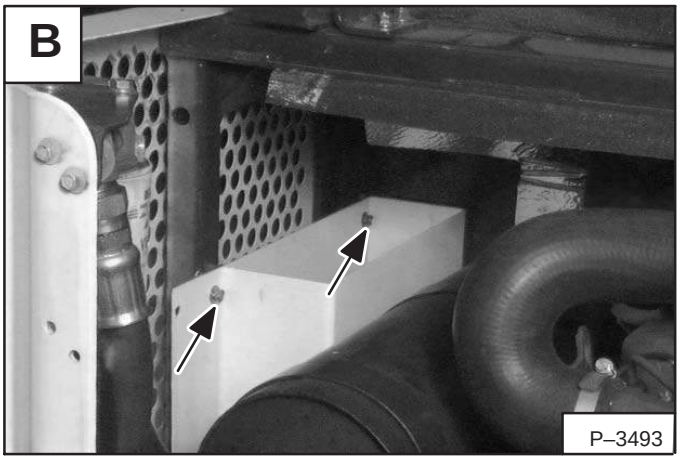
TOOL BOX

Removal and Installation (S/N 11001–11999)

Open the engine cover.

Remove the two bolts from the tool box **[B]**.

Remove the tool box.



Removal and Installation (S/N 12001 & Above)

Open the engine cover.

Remove the two (2) bolts from the tool box **[C]**.

Remove the tool box.

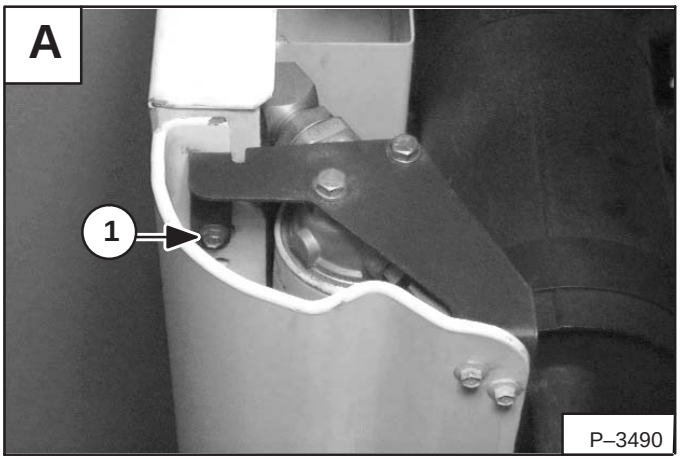


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LEFT HAND SIDE COVER

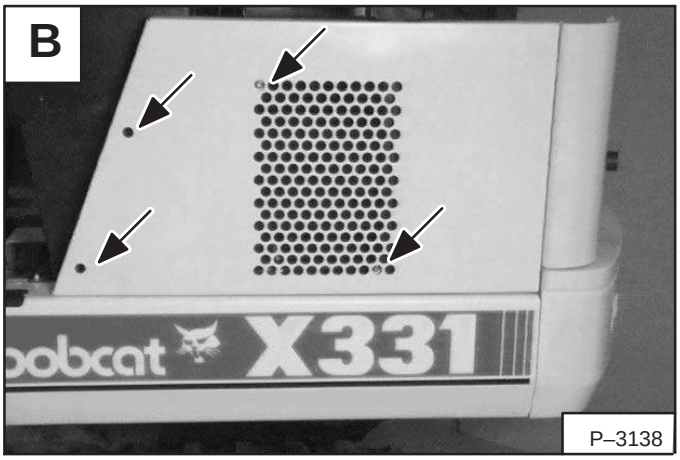
Removal and Installation (S/N 11001–11999)

Remove the two bolts from the side cover **[A]**.



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

Remove the side cover.



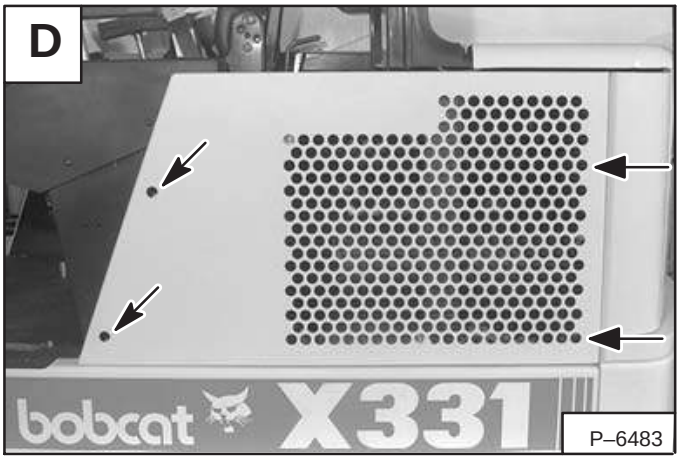
Removal & Installation (S/N 12001 & Above)

Remove the two (2) bolts from the side cover **[C]**.



Remove the four (4) bolts from the side cover **[D]**.

Remove the side cover.

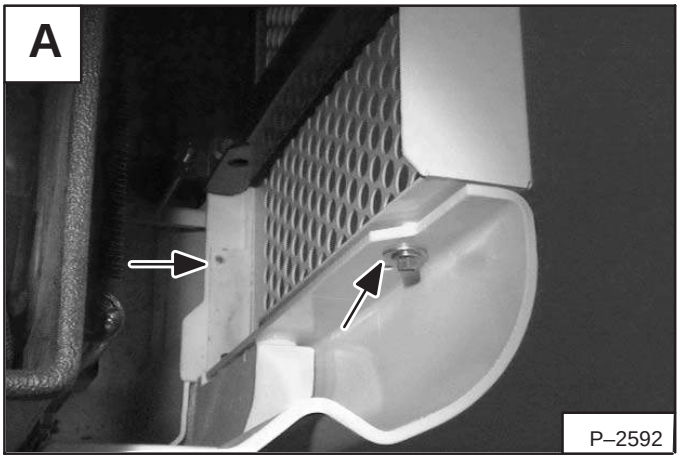


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RIGHT HAND SIDE COVER

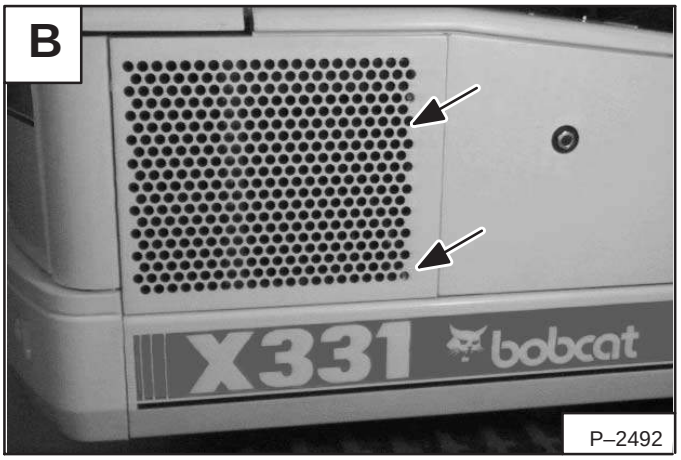
Removal and Installation (S/N 11001–11999)

Remove the two bolts from the side cover **[A]**.



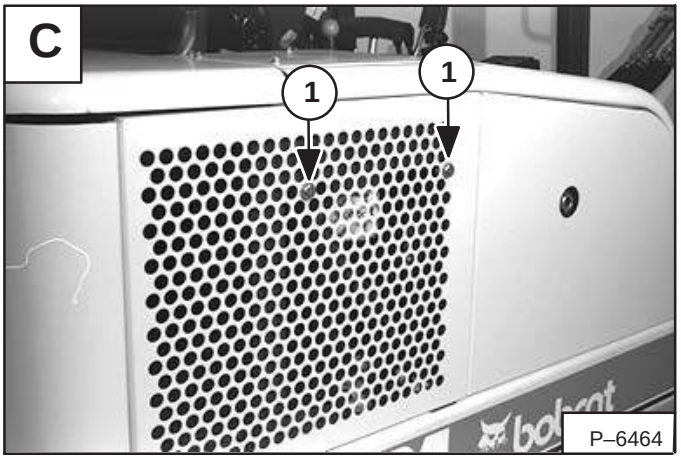
Remove the two bolts from the side cover **[B]**.

Remove the side cover.



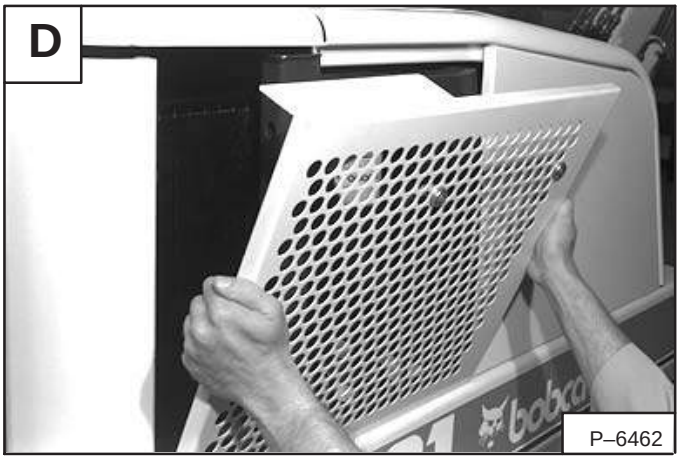
Removal and Installation (S/N 12001 & Above)

Using the ignition key, unlock the two (2) side cover locks (Item 1) **[C]**.



Tilt the top of the side cover out and lift up on the side cover to remove **[D]**

Remove the side cover,



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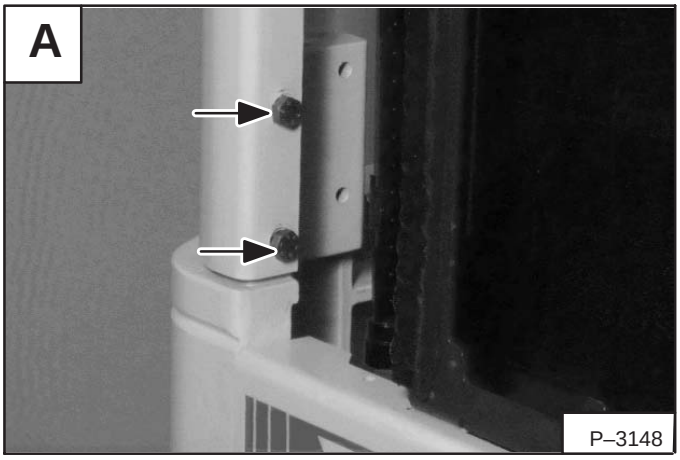
RIGHT HAND CORNER POST

Removal and Installation

Remove the right hand side cover. (See Page 4–11.)

Remove the two bolts from the inside of the corner post **[A]**.

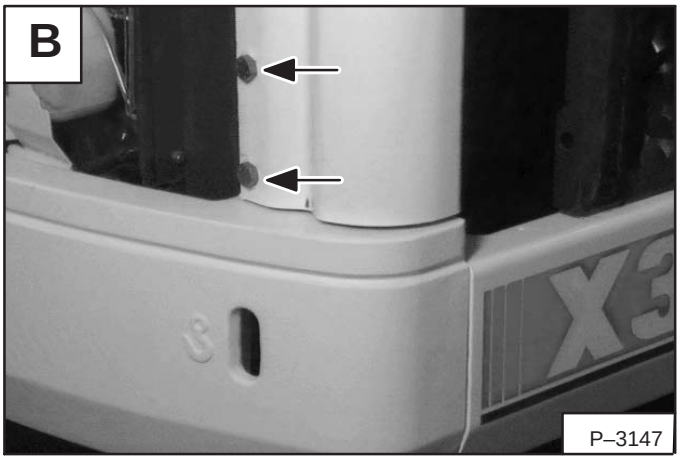
Installation: Tighten the bolts to 125–140 ft.–lbs. (170–190 Nm) torque.



Remove the two bolts from the outside of the corner post **[B]**.

Installation: Tighten the bolts to 125–140 ft.–lbs. (170–190 Nm) torque.

Remove the corner post.



LEFT HAND CORNER POST

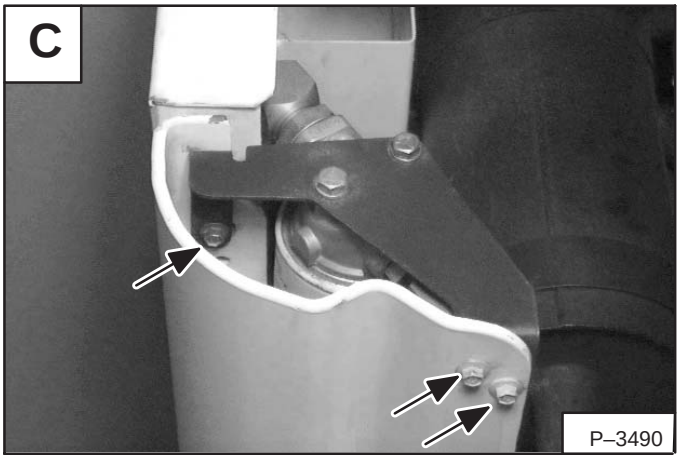
Removal and Installation

Remove the left hand side cover. (See Page 4–10.)

Remove the bolts from the hydraulic filter mounting bracket **[C]** (S/N 11001–11999).

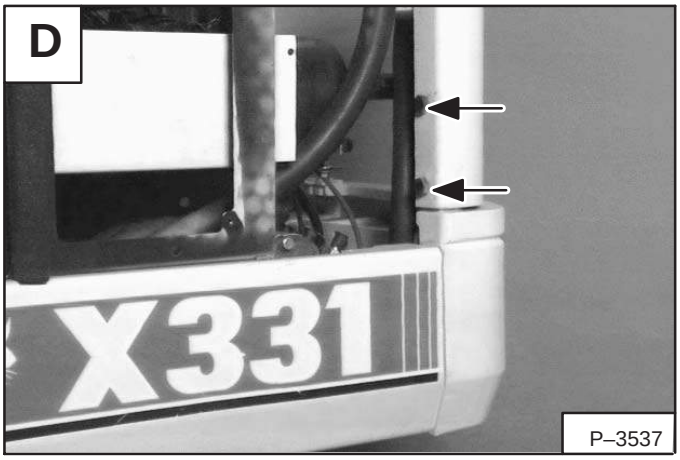
Move the hydraulic filter assembly off to the side.

For S/N 12001 & Above, remove the tool box. (See Page 4–9.)



Remove the two (2) bolts from the outside of the corner post **[D]**.

Installation: Tighten the bolts to 125–140 ft.–lbs. (170–190 Nm) torque.



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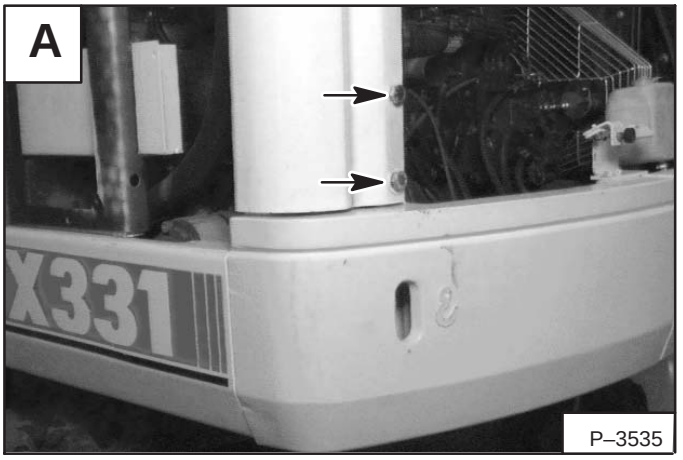
LEFT HAND CORNER POST (Cont'd)

Removal and Installation (Cont'd)

Remove the two bolts from the outside of the corner post.

Installation: Tighten the bolts to 125–140 ft.–lbs. (170–190 Nm) torque.

Remove the corner post.



COUNTERWEIGHTS

Removal and Installation

NOTE: The procedure below is for the right hand counterweight. The procedure is identical for the left hand counterweight.

For the Right Hand Counterweight:

Remove the right side cover. (See Page 4–11.)

For the Left Hand Counterweight:

Remove the left side cover. (See Page 4–10.)

The counterweight will need to be removed with a chain and a hoist. The left hand counterweight weights approximately 235 lbs. (106.5 kg), the right hand counterweight weights approximately 225 lbs. (102 kg).

Drill a 5/16'' (8,6 mm) hole into the counterweight at the dimensions shown **[B]** & **[C]**. Tap the hole to 3/8 inch UNC (10 mm).

Bolt a chain to the hole and attach the opposite end of the chain to the counterweight lift hole. Install a chain hoist and apply a slight amount of lifting force.

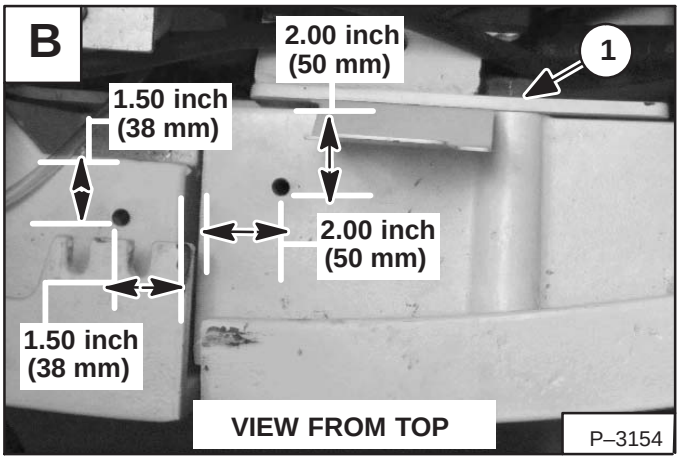
Remove the two bolts from the inside edge of the side frame **[D]**.

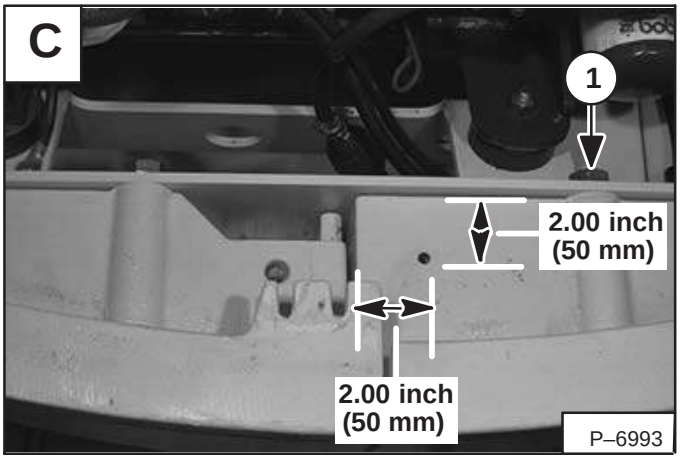
Installation: Tighten the bolts to 235–265 ft.–lbs. (320–360 Nm) torque.

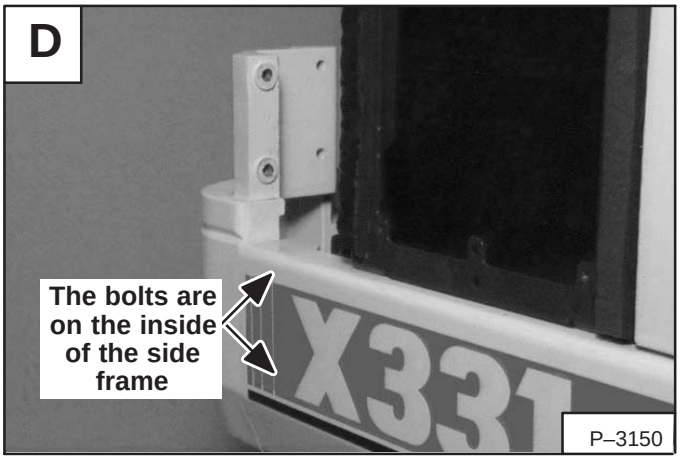
Remove the two bolts (Item 1) from the inside rear edge of the excavator frame **[B]** & **[C]**.

Installation: Tighten the bolts to 235–265 ft.–lbs. (320–360 Nm) torque.

NOTE: On excavator S/N 12001 & Above the left counterweight has a hole cast in to it to use as a lift point.







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FRONT ENGINE COVER

Removal and Installation

Remove the engine cover. (See Page 4–3.)

Remove the cab/canopy. (See Pages 4–77 & 4–75.)

Remove the right side cover. (See Page 4–11.)

Remove the left side cover. (See Page 4–10.)

Remove the battery. (See Page 6–1.)

Remove the fuel/hydraulic tanks. (See Page 2–1.)

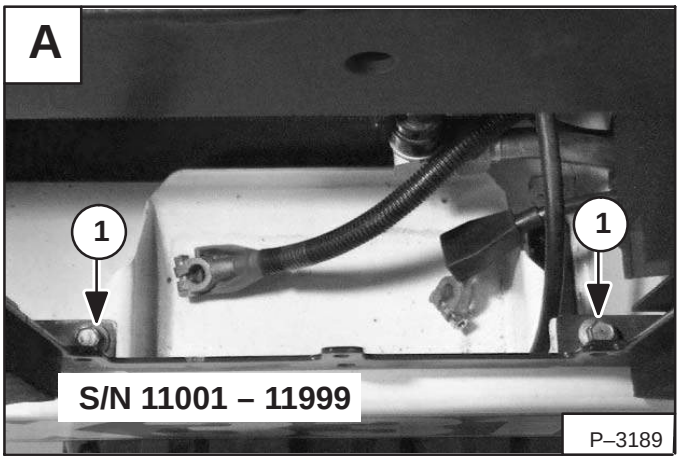
Remove the seat and seat mount. (See Page 4–5.)

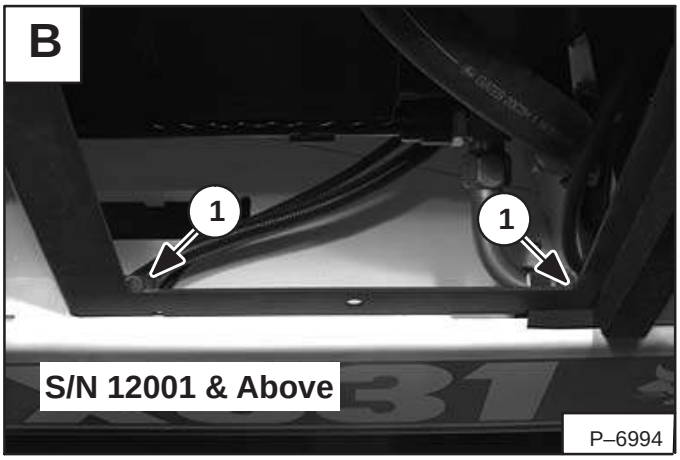
Remove the corner posts. (See Page 4–12.)

Remove the air cleaner. (See Page 7–1.)

Remove the four bolts (Item 1) **[A]** & **[B]** and nuts (2 on each side) from the sides of the engine cover.

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





Use a chain and hoist and remove the front engine cover **[C]**.

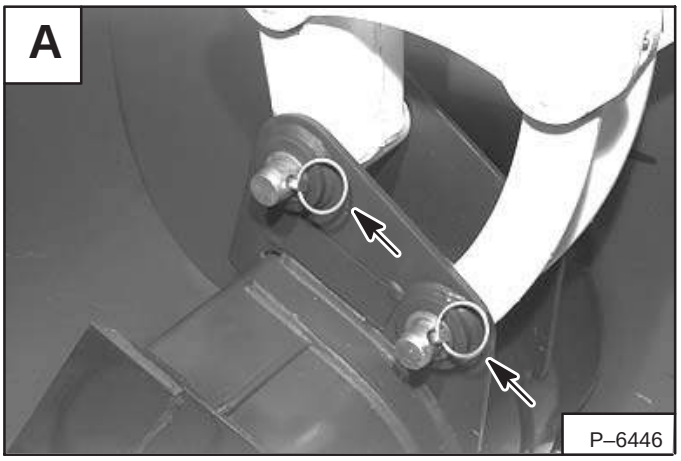


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BUCKET

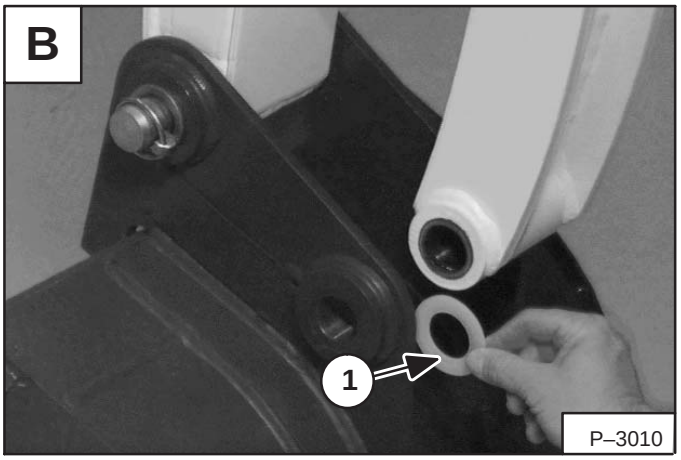
Removal and Installation

Remove the retainer clips from the bucket pins **[A]**.



Remove the bucket pins and plastic spacers (Item 1) **[B]**.

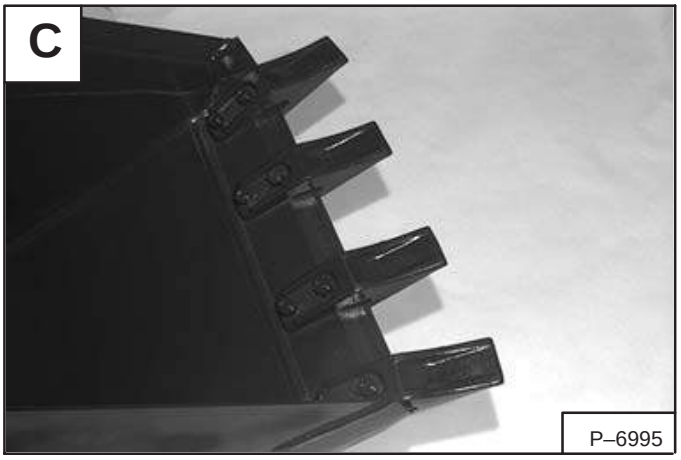
NOTE: Install the spacers in the same location during assembly.



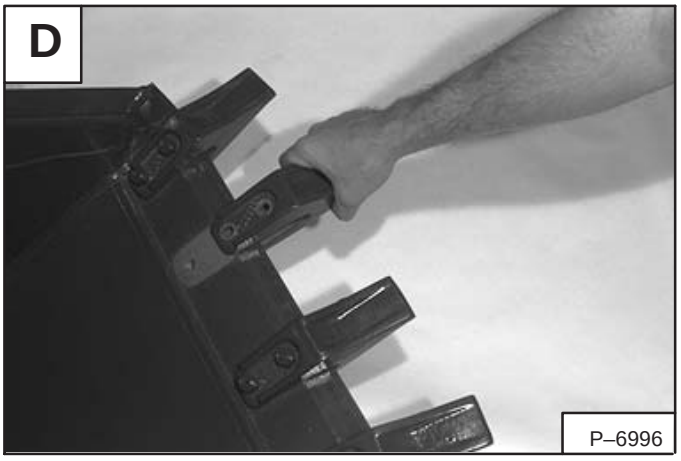
BUCKET TEETH

Removal and Installation

Remove the nuts and bolts from the bucket teeth **[C]**.



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



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ARM

Removal and Installation (S/N 11001–11999)

Remove the arm cylinder. (See Page 2–1.)

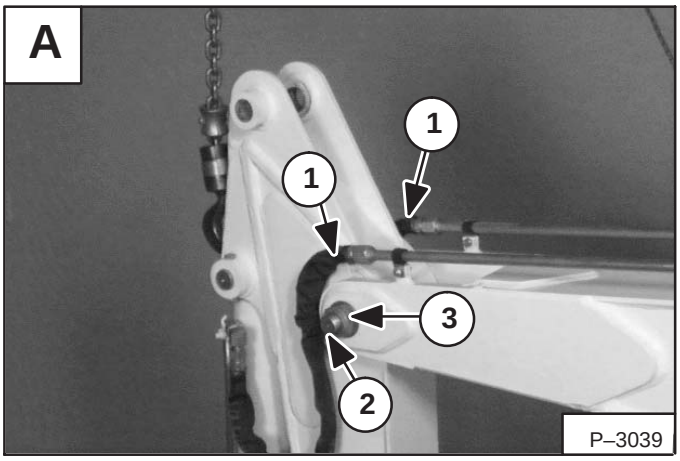
Support the arm with a chain hoist **[A]**.

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

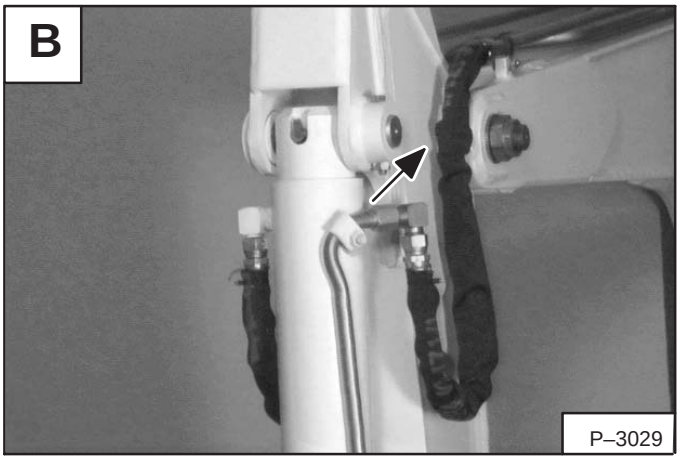
Remove the nut (Item 2) and the washer (Item 3) from the boom mounting pin **[A]**.

Remove the pivot pin.

Installation: Tighten the lock nut until it is seated firmly against the boom but do not overtighten and deflect the boom mounting plates. The arm must pivot freely.



Remove the shims between arm and the boom **[B]**.



Removal and Installation (S/N 12001 & Above)

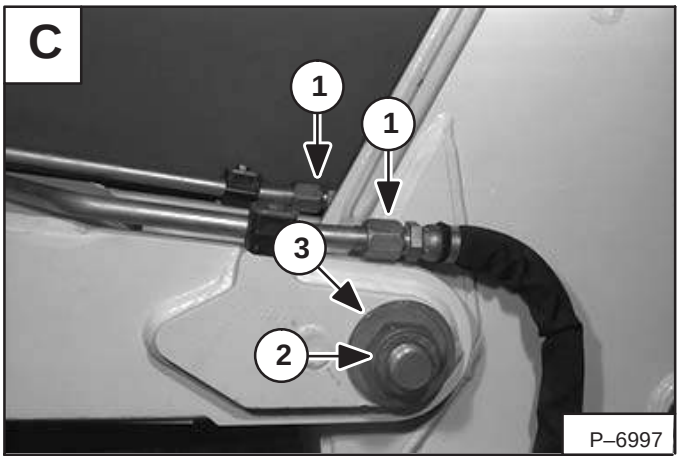
Remove the arm cylinder. (See Page 2–1.)

Support the arm with a chain hoist.

Disconnect the bucket cylinder hoses (Item 1) **[C]**.

Remove the nut (Item 2) **[C]** and the washer (Item 3) **[C]** from the boom mounting pin.

Installation: Tighten the lock nut until it is seated firmly against the boom but do not over tighten and deflect the boom mounting plates. The arm must pivot freely.



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BOOM

Removal and Installation

Remove the arm. (See Page 4–16.)

Install a chain hoist onto the boom lift hole **[A]**.

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 boom cylinder. (See Page 2–1.)

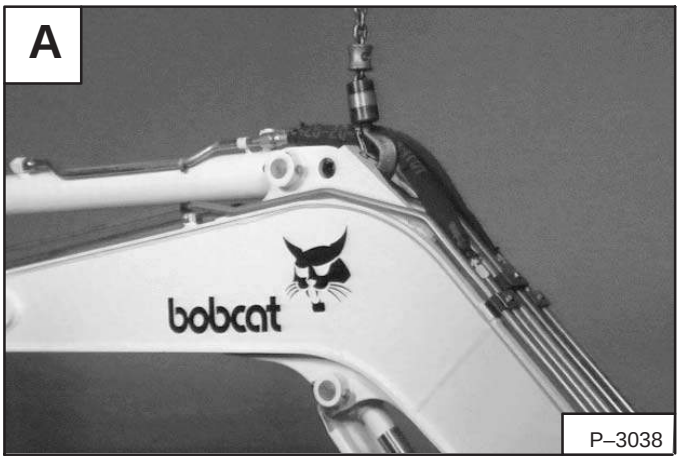
Mark hoses for correct installation.

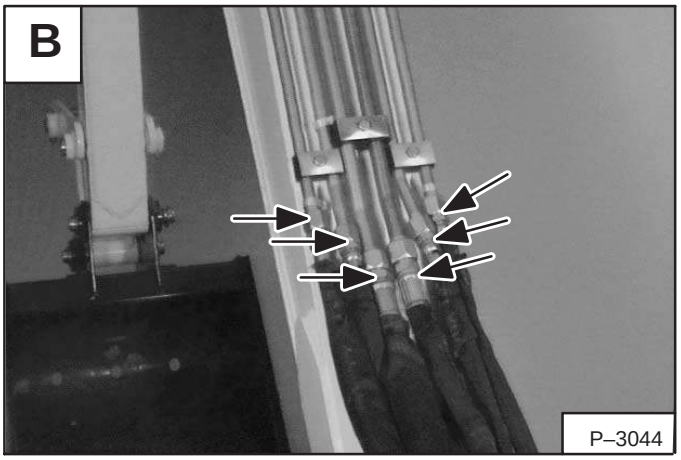
Remove the six (6) hoses from the tubes on the boom **[B]**.

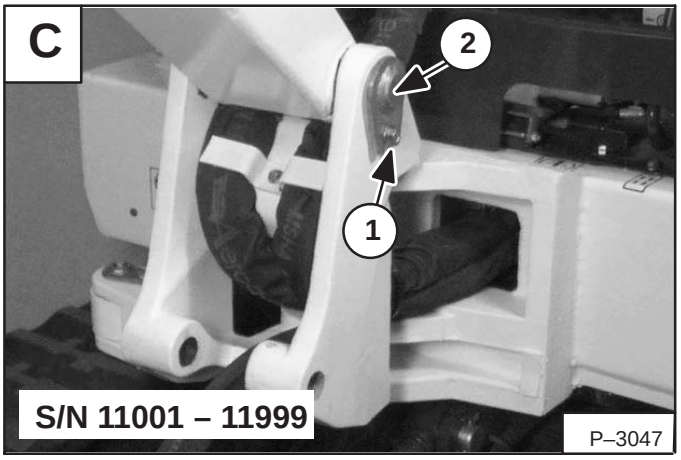
Remove the bolt (Item 1) **[C]** & **[D]** and the spacer.

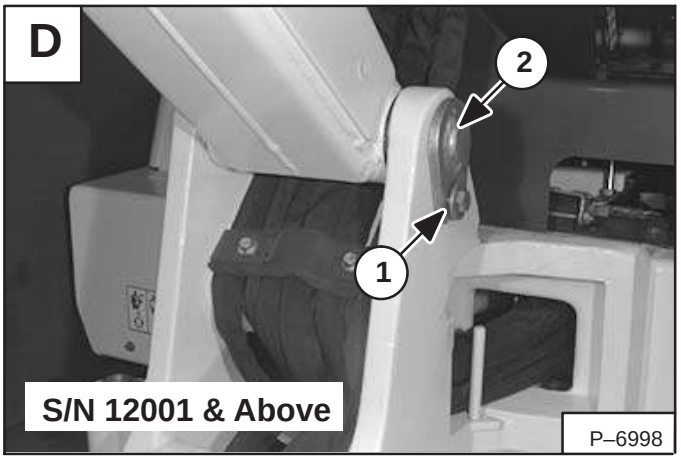
With the boom supported with the chain hoist, remove the boom pin (Item 2) **[C]** & **[D]**.

Remove the boom.









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BOOM SWING BRACKET

Removal and Installation

Remove the arm. (See Page 4–16.)

Remove the boom. (See Page 4–17.)

Remove the bolt (Item 1) **[A]** from the swing bracket hose clamp.

Remove the clamp.

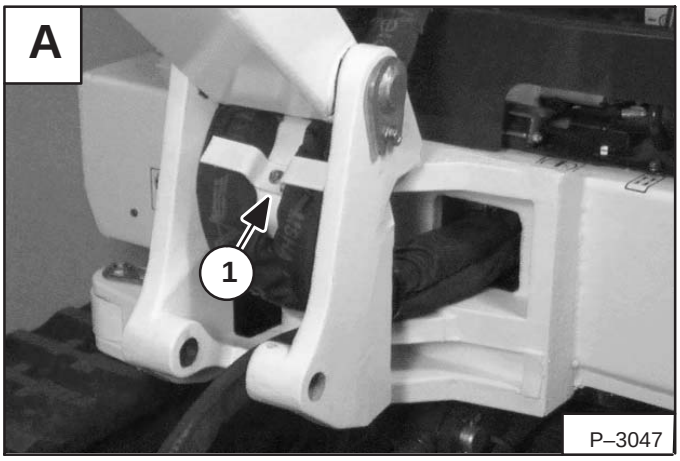
NOTE: When the hoses have been removed from the clamped position, these hoses must be measured for correct clamped length and position. (See Page 4–20.)

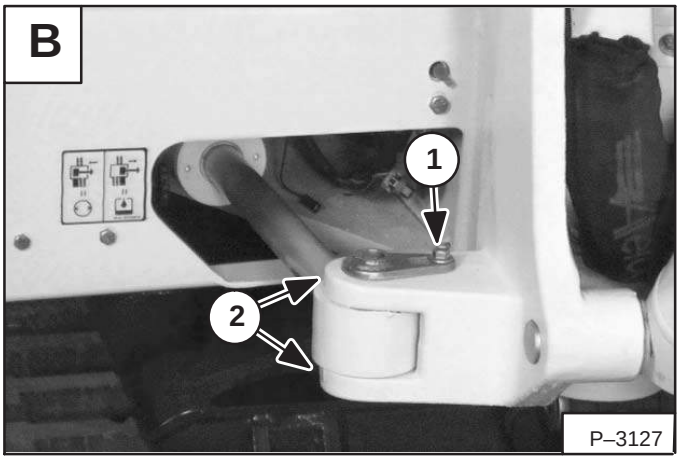
Remove the bolt (Item 1) **[B]**, the washer and the nut from the boom swing cylinder pin.

Remove the pin.

Remove the spacers (Item 2) **[B]** from the edges of the boom swing cylinder rod end (if equipped).

Installation: Install spacers as needed to align the rod end of the cylinder to the boom swing bracket.



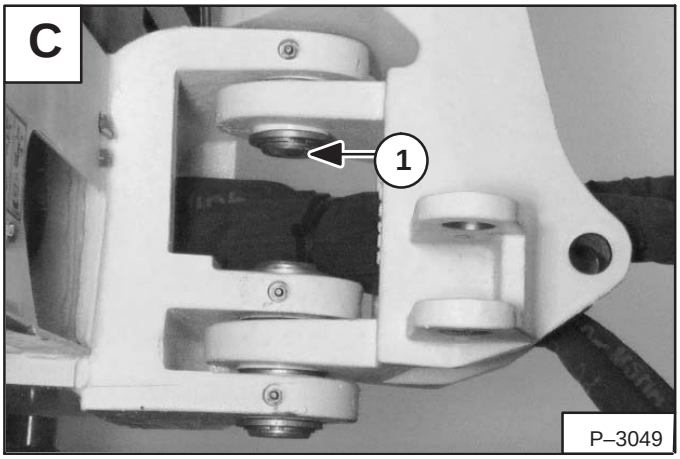


Remove the snap ring (Item 1) **[C]** and washer from the lower end of the top swing bracket pivot pin.

IMPORTANT

Do Not use a porta–power to press out the swing bracket pivot pins without the lower pin being supported. Excess pressure can cause the swing bracket casting to crack.

I–2092–1195

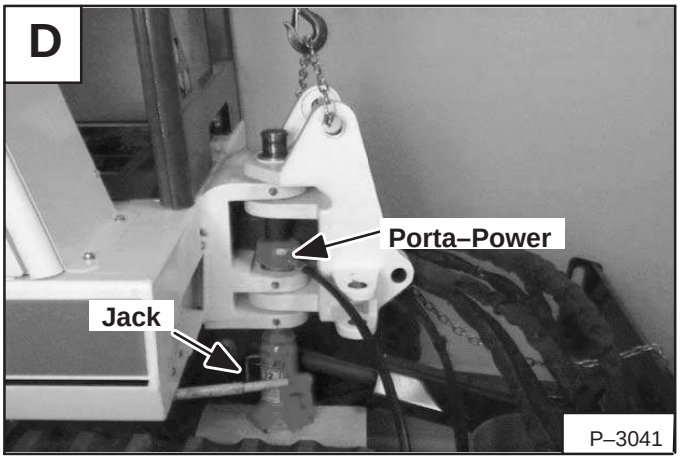


To remove the top pin, try to tap the pin up and out of the swing bracket.

Do not use excessive force.

If the pin will not move by tapping; install a jack under the lower swing bracket pin to support the swing bracket casting.

Install a porta–power between the two pins and press the top pin out **[D]**.



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BOOM SWING BRACKET (Cont'd)

Removal and Installation (Cont'd)

Remove the snap ring (Item 1) **[A]** from the top of the bottom swing bracket pivot pin.

IMPORTANT

Support the bottom of the swing bracket when removing the pins. Excess pressure can cause the swing bracket casting to crack.

I–2093–1195

Install a jack and a spacer tube under the upperstructure swing bracket to support the casting **[B]**. The spacer tube must be large enough to allow the pin to be driven into the center of the spacer for pin removal.

Use a large punch and drive the bottom swing bracket pin out **[B]**.

NOTE: Do Not use a porta–power to press out the bottom pin because the top casting cannot be supported and possible damage to the casting could occur.

Remove the two (2) spacers (Items 1 & 2) **[C]** from the swing bracket.

NOTE: The bottom spacer (Item 1) [C] is always 0.18 inch (4,5 mm) thick. The top spacer (Item 2) [C] varies in thickness: 0.22, 0.24, 0.26 inch (5,5, 6,0, 6,5 mm) thick.

Inspect the bushings for damage, replace bushing if necessary. (See Pages 4–21 & 4–22.)

Install the bottom spacer (Item 1) **[C]**, (P/N 6588093), 0.18" (4,5 mm thick) between the bottom of the boom swing bracket and the upperstructure mount.

Align the boom swing bracket and install the lower pin. Install the washer and the snap ring (Item 1) **[A]**.

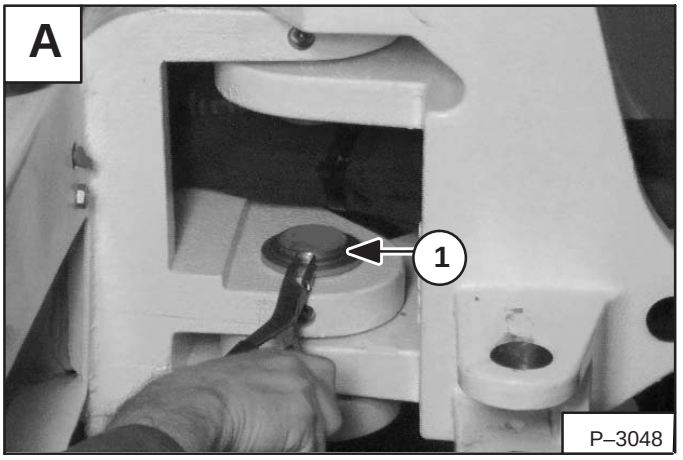
Lift up on the boom swing bracket.

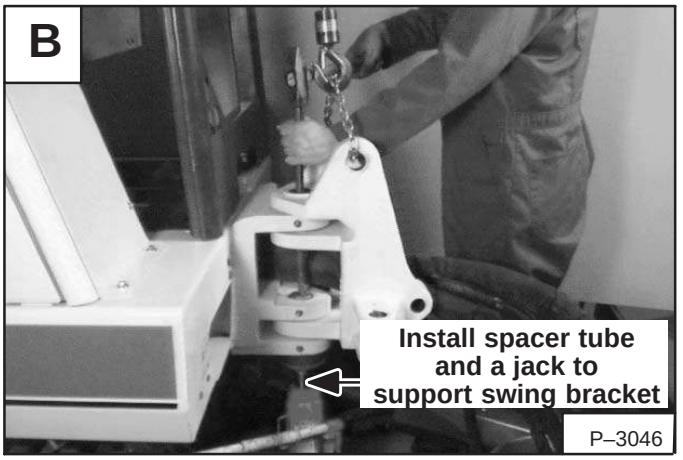
Measure the distance between the boom swing bracket and the upperstructure **[D]**.

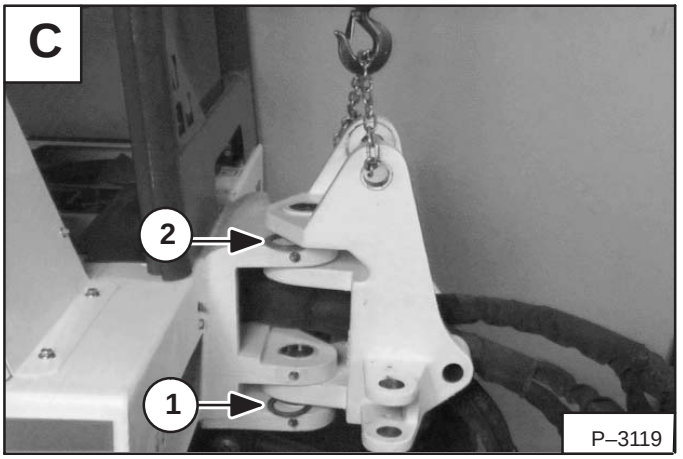
Install the appropriate spacer:

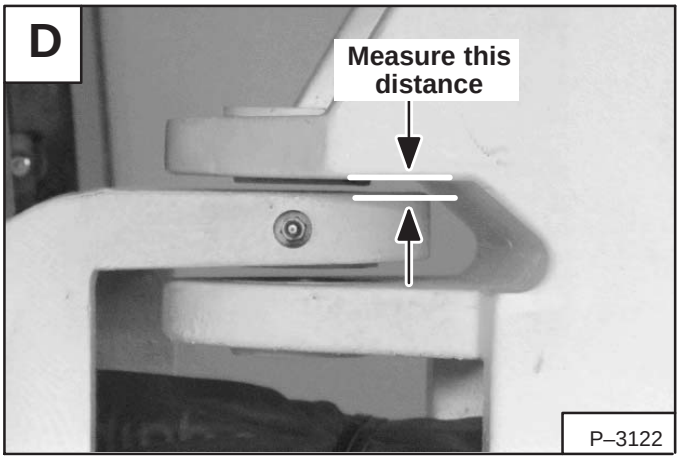
P/N 6588099 =0 .22" (5,5 mm) thick
P/N 6588121 = 0.24" (6,0 mm) thick
P/N 6588122 = 0.26" (6,5 mm) thick

Install the top pin, washer and snap ring.









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BOOM SWING BRACKET (Cont'd)

Hose Installation

IMPORTANT

Hoses must be correctly positioned when routed through the swing bracket and must be clamped to the correct length to avoid hose stretch and abrasion.

I–2111–0496

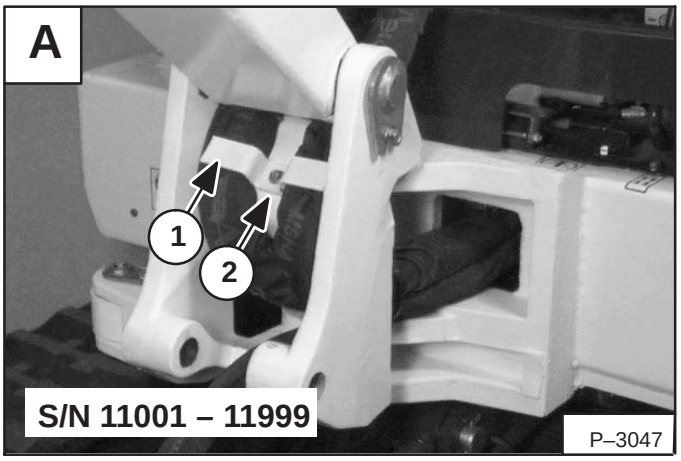
Route the hoses through the boom swing bracket as shown **[A]** & **[B]**.

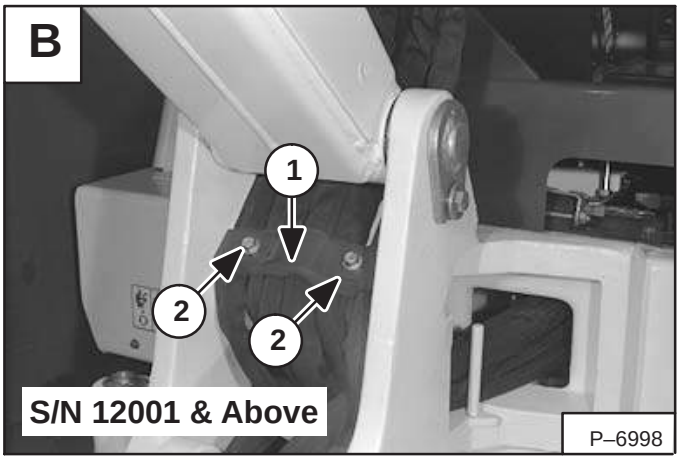
Install the hoses and install the hose clamp (Item 1) **[A]** & **[B]** and the bolt (Item 2). Do not tighten the bolt (Item 2) **[A]** & **[B]** at this time.

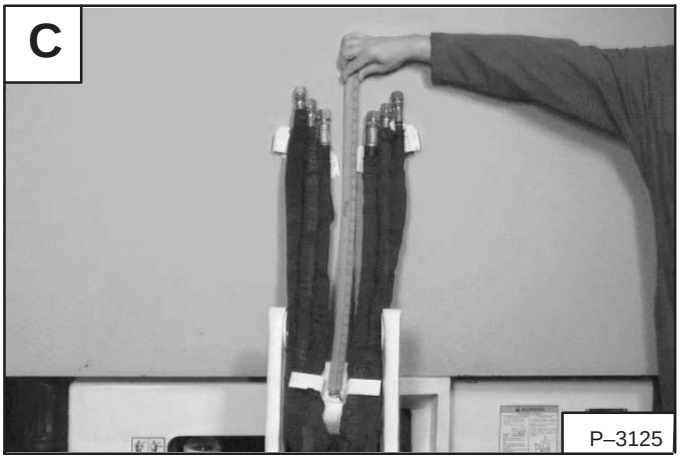
Measure the length of the hoses from the center line of the clamp to the end of each hose **[C]**

Bucket Cylinder Rod End Hose – 29–1/2'' (750 mm)
Arm Cylinder Rod End Hose – 28–1/2'' (724 mm)
Auxiliary Hoses (Qty. 2) – 27'' (686 mm)
Arm Cylinder Base End Hose – 28–1/2'' (724 mm)
Bucket Cylinder Base End Hose – 29–1/2'' (750 mm)

When hoses are all at the correct length, tighten the clamp bolt (Item 2) **[A]** & **[B]**.







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SWING BRACKET BUSHING

Bushing Removal

IMPORTANT

Do Not point (hammer) on the boom swing bracket. Excess pressure can cause the casting to crack.

I–2095–1195

The following parts will be needed for removal and installation of the boom swing bracket bushings:

1. Bolt – 3/4 x 6 inch or (16 x 160 mm) long
2. Nut – 3/4 inch or (16 mm)
3. Washer – 7/8 I.D. x 1.931 – 1.875 O.D. x 3/8 inch thick or (22 I.D. x 49 – 48 O.D. x 10 mm thick)
4. Washer – 7/8 I.D. x 2.69 – 2.62 O.D. x 3/8 inch thick or (22 I.D. x 68 – 65 O.D. x 10 mm thick)
5. Washer – 7/8 I.D. x 4 – 4–1/4 O.D. x 1/2 inch thick or (22 I.D. x 102 – 108 O.D. x 13 mm thick)
6. Spacer – 3–3/16 – 3–1/4 I.D. x 3–3/4 – 4 O.D. x 1–1/2 inch thick or (81 – 82 I.D. x 95 – 100 O.D. x 38 mm thick)

Install the spacer (Item 6) **[A]** and washer (Item 5) **[A]** over the flanged end of the bushing.

The spacer (Item 6) **[A]** must be centered over the bushing to avoid contact between the bushing and the spacer during removal.

Install the washer (Item 4) **[A]** onto the opposite end of the bushing. This washer must be centered on the bushing and must not contact the casting.

Install the bolt (Item 1) **[A]** and the nut (Item 2) **[A]** through the washers and the spacer.

Tighten the bolt and nut to remove the bushing from the casting.

Bushing Installation

Apply a film of grease to the outer diameter of the bushing and to the inner diameter of the casting.

Center the bushing on the casting hole.

NOTE: Make sure that the bushing is centered into the casting hole and that it starts into the hole evenly and squarely.

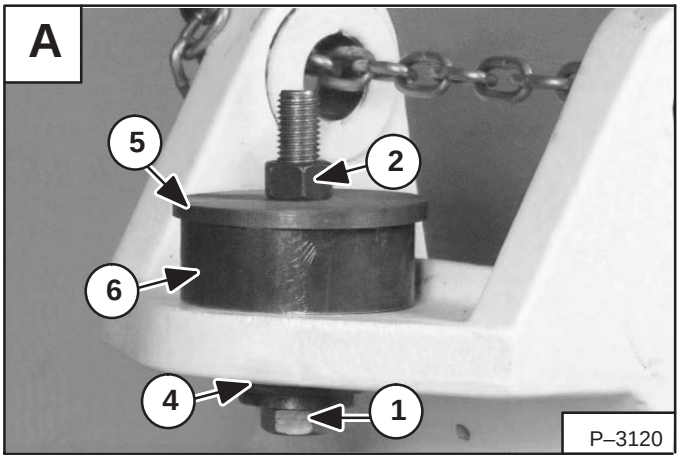
Put the washers (Item 3 & 4) **[B]** over the flanged end of the bushing.

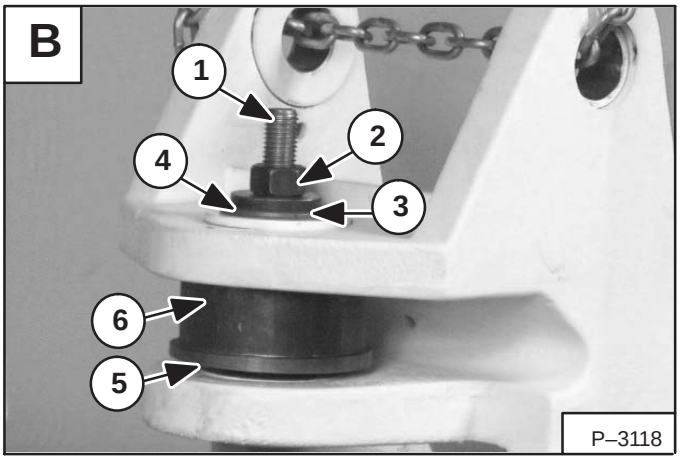
Put the spacer (Item 6) **[B]** and the washer (Item 5) **[B]** over the bushing hole casting. Center the spacer and the washer over the bushing hole.

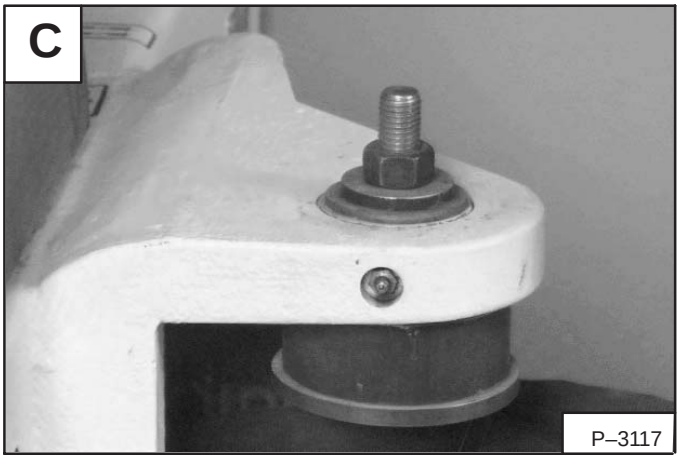
Install the bolt (Item 1) **[B]** through the washers, the spacer and the bushing. Install nut (Item 2) **[B]**.

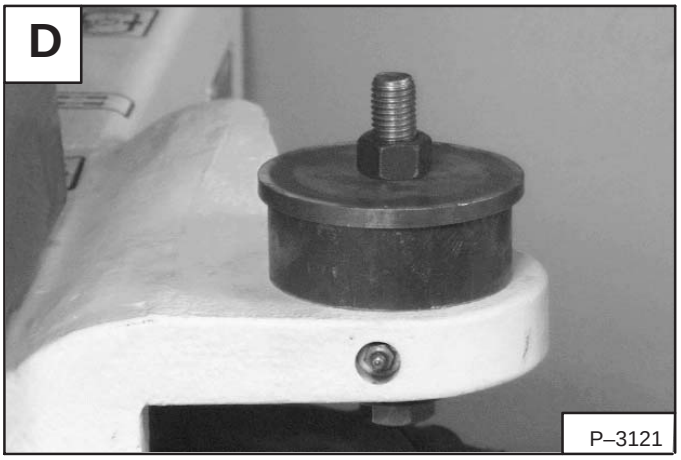
Tighten the bolt and nut until the bushing is seated in the casting.

The same procedure is used to remove and install the bushings into the frame casting **[C]** & **[D]**.









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BOOM PIVOT BUSHING

Bushing Removal

IMPORTANT

Do Not pound (hammer) out the boom pivot bushings. Excess pressure cab cause the casting to crack.

I–2110–0496

See Page 4–21 for parts needed for removal and installation of the boom pivot bushings.

Install the spacer (Item 6) **[A]** and washer (Item 5) **[A]** over the flanged end of the bushing.

The spacer (Item 6) **[A]** must be centered over the bushing to avoid contact between the bushing and the spacer during removal.

Install the washer (Item 3) **[A]** onto the opposite end of the bushing. This washer must be centered on the bushing and must not contact the casting.

Install the bolt (Item 1) **[A]** and the nut (Item 2) **[A]** through the washers and the spacer.

Tighten the bolt and nut to remove the bushing from the casting.

Bushing Installation

Apply a film of grease to the outer diameter of the bushing and to the inner diameter of the casting.

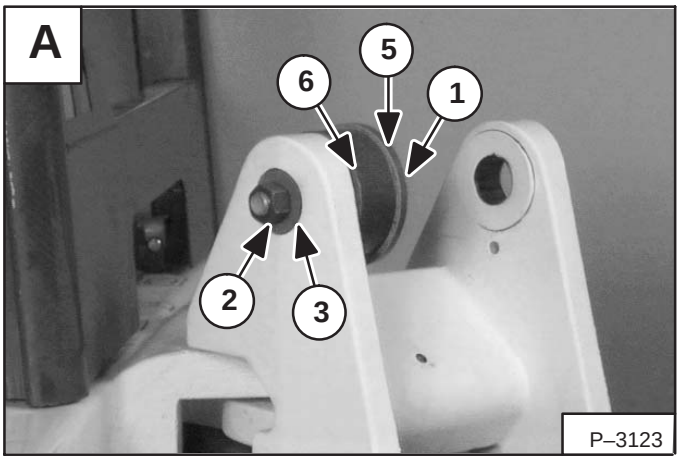
Center the bushing to the casting hole.

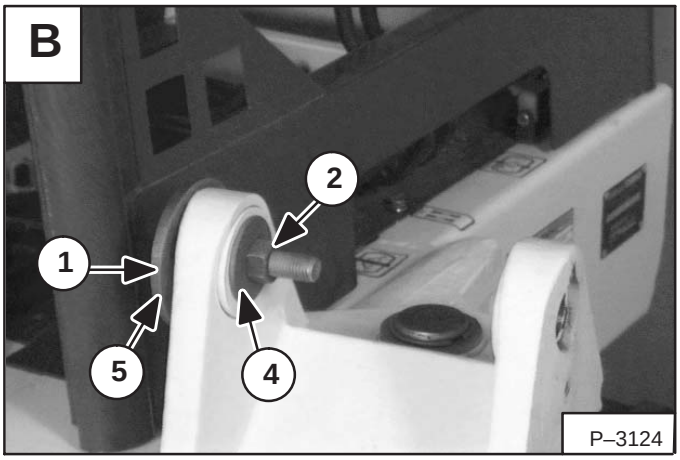
NOTE: Make sure that the bushing is centered in the casting hole and that it starts into the hole evenly and squarely. Install the washer (Item 4) over the flanged end of the bushing [B].

Install the washer (Item 5) **[B]** on the outside of the casting. Center the washer over the bushing hole.

Install the bolt (Item 1) **[B]** and the nut (Item 2) **[B]** through the washers and the bushing.

Tighten the bolt and nut until the bushing is seated in the casting.





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SWING MOTOR

Removal and Installation (S/N 11001–11056)

Remove the seat and swing motor cover. (See Pages 4–5 & 4–8.)

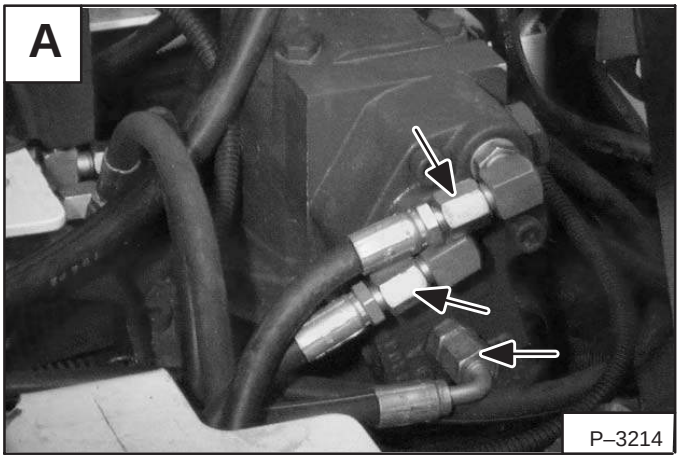
IMPORTANT

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.

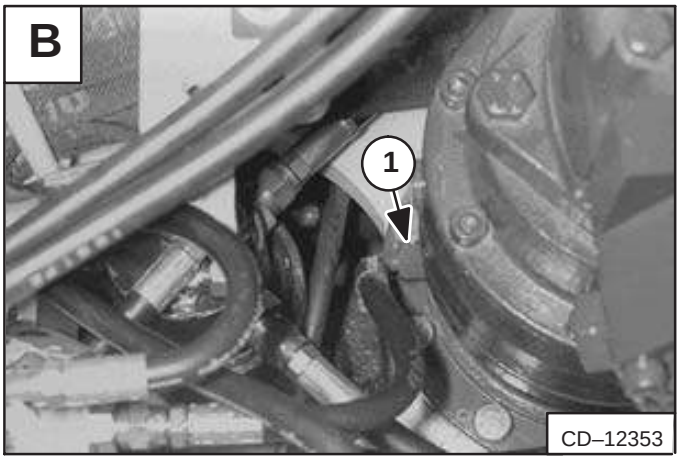
I–2003–0284

Mark the hoses for correct installation.

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



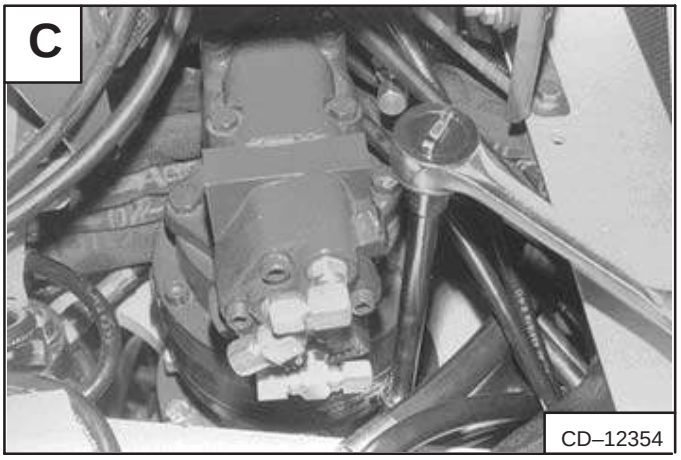
Remove the swing motor drain hose (Item 1) **[B]**.



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

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

Remove the swing motor and gear box assembly **[C]**.



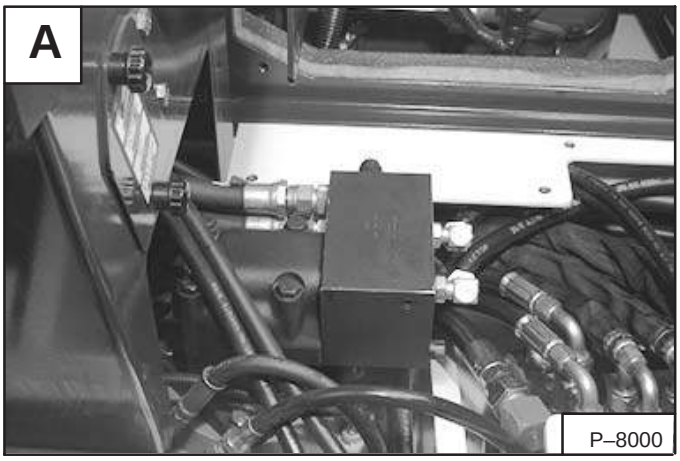
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SWING MOTOR (Cont'd)

Removal and Installation (S/N 11057–12999)

Mark the hoses for correct installation.

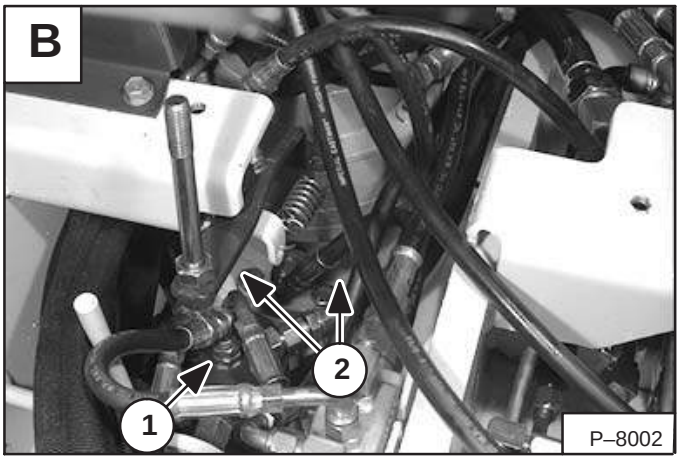
Remove the five (5) hoses from the swing motor **[A]**.



Remove the swing motor drain hose (Item 1) **[B]**.

Remove the mounting bolts (Item 2) **[B]** from the swing motor.

Remove the swing motor and gear box assembly.



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SWING MOTOR (Cont'd)

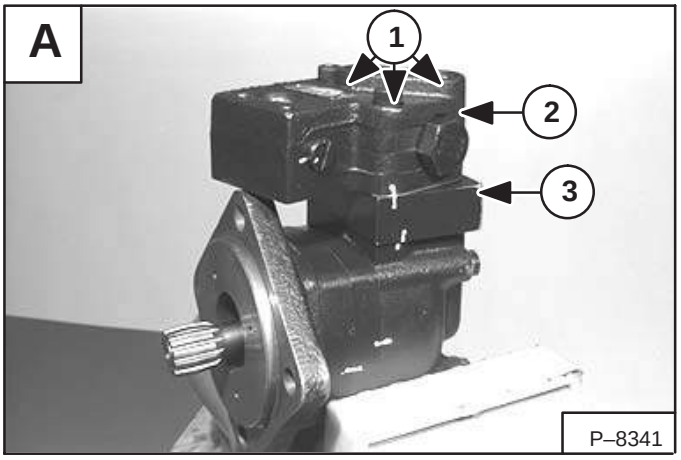
Disassembly (S/N 11001–12999)

Prior to disassembly:

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

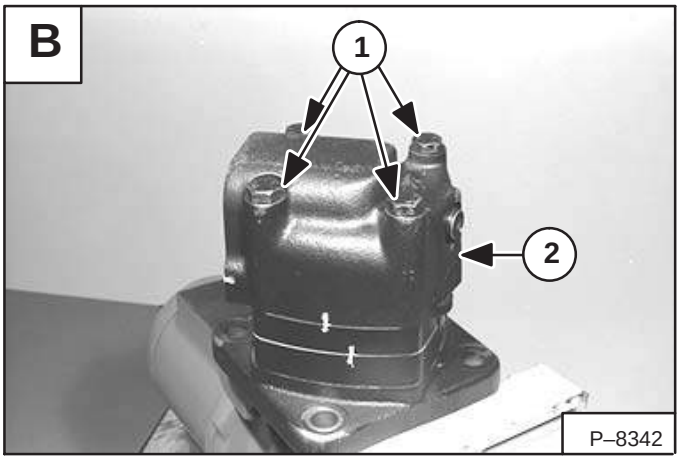
Clamp the swing motor assembly in the vise with padded jaws and mark the housing for ease of assembly **[A]**.

Remove the three (3) bolts (Item 1) **[A]** and lift the cross port relief valve (Item 2) **[A]** and block (Item 3) **[A]** from the swing motor.

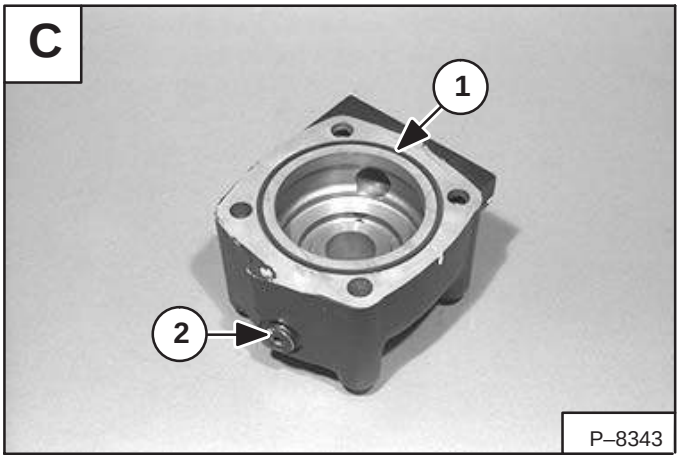


Remove the four (4) bolts (Item 1) **[B]** and lift off the housing (Item 2) **[B]**.

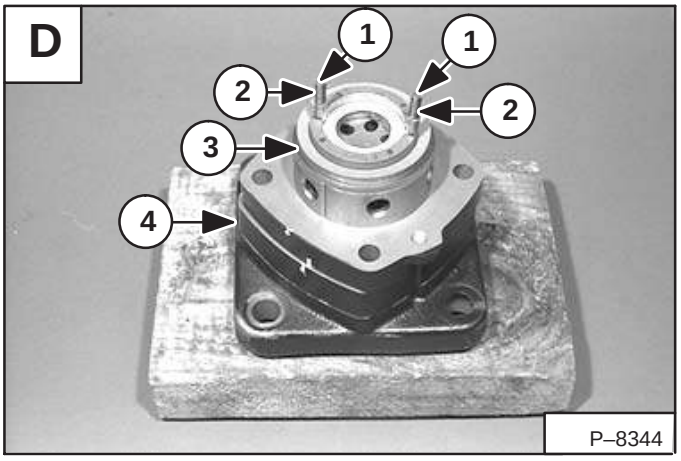
NOTE: Take care not to lose inner parts.



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



Remove the springs (Item 1) **[D]** the pins (Item 2) **[D]** and the balance plate (Item 3) **[D]** from the swing motor (Item 4) **[D]**.

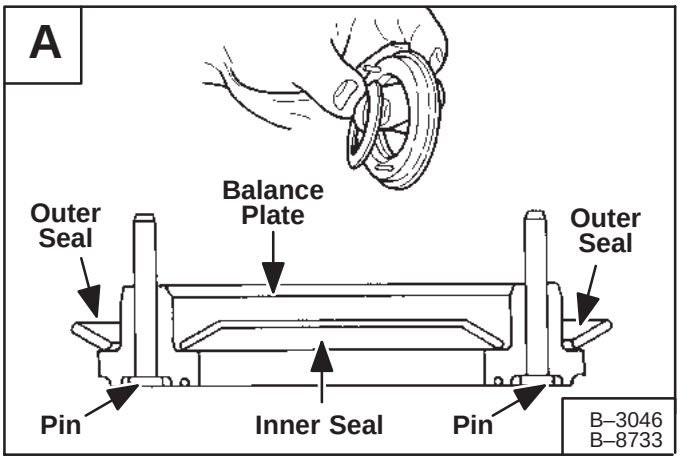


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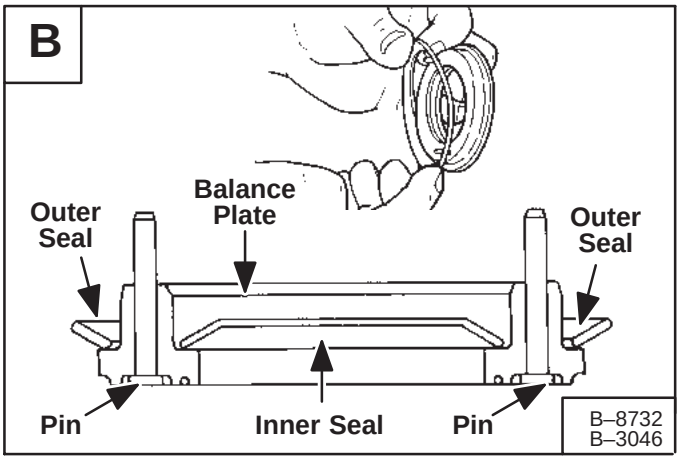
SWING MOTOR (Cont'd)

Disassembly (S/N 11001–12999) (Cont'd)

Remove the inner seal, from the balance plate **[A]**.

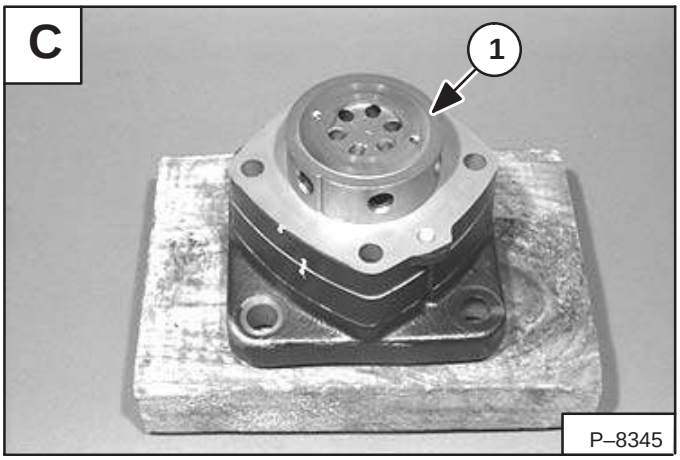


Remove the outer seal from the balance plate **[B]**.

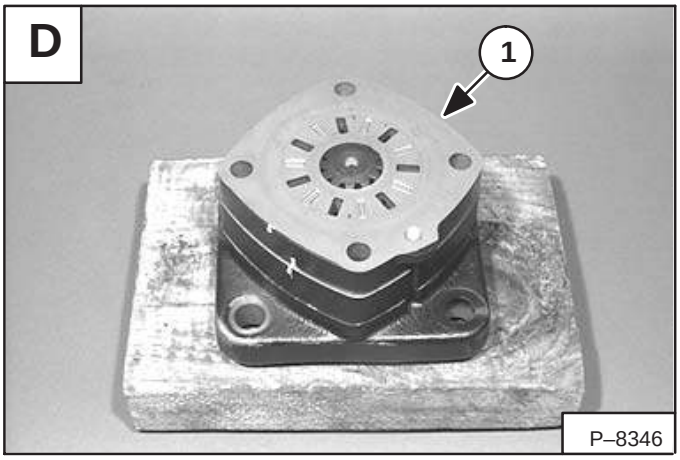


Remove the valve (Item 1) **[C]** from the valve plate.

NOTE: See assembly procedure Page 4–29 for timing the motor when installing the valve, valve drive and geroler.



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

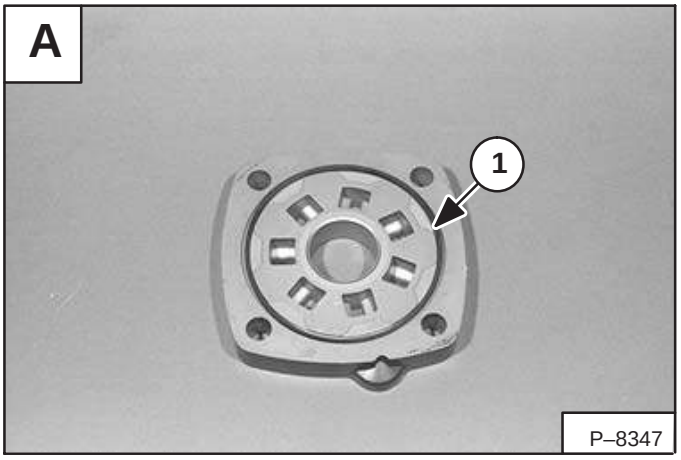


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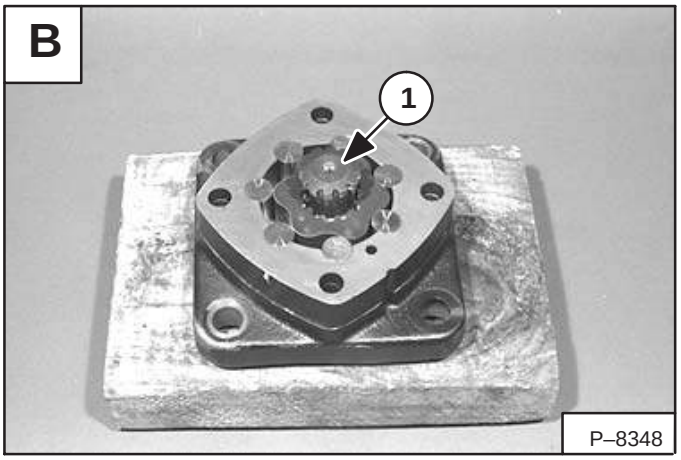
SWING MOTOR (Cont'd)

Disassembly (S/N 11001–12999) (Cont'd)

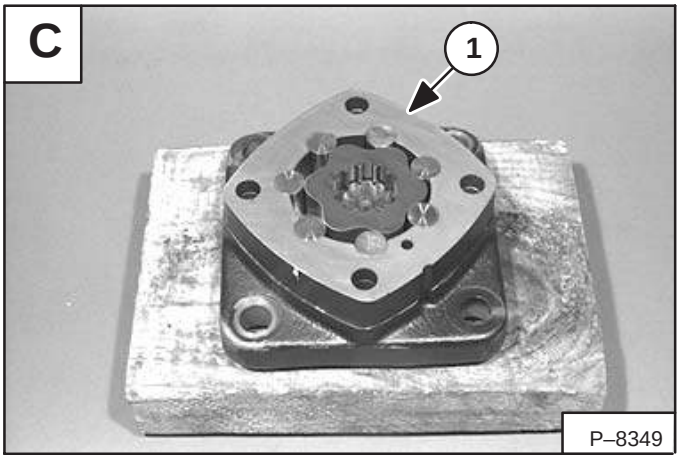
Remove the large O–ring (Item 1) **[A]** from the valve plate.



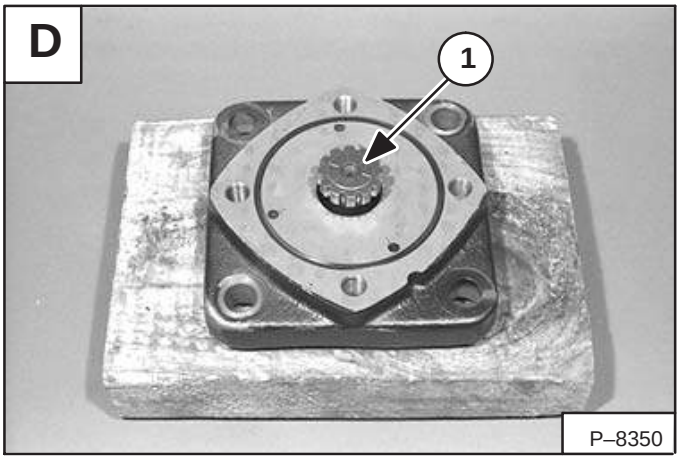
Remove the valve drive (Item 1) **[B]**.



Remove the geroler (Item 1) **[C]**.



Remove the drive shaft (Item 1) **[D]**.

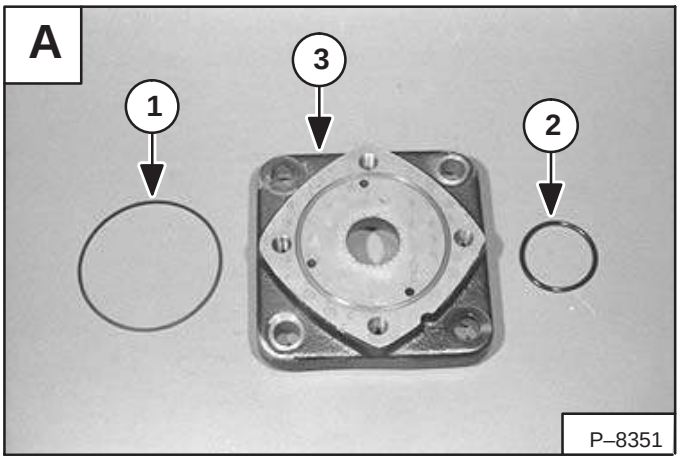


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SWING MOTOR (Cont'd)

Disassembly (S/N 11001–12999) (Cont'd)

Remove the large O–ring (Item 1) **[A]** and the small O–ring (Item 2) **[A]** from the housing (Item 3) **[A]**.



Assembly (S/N 11001–12999)

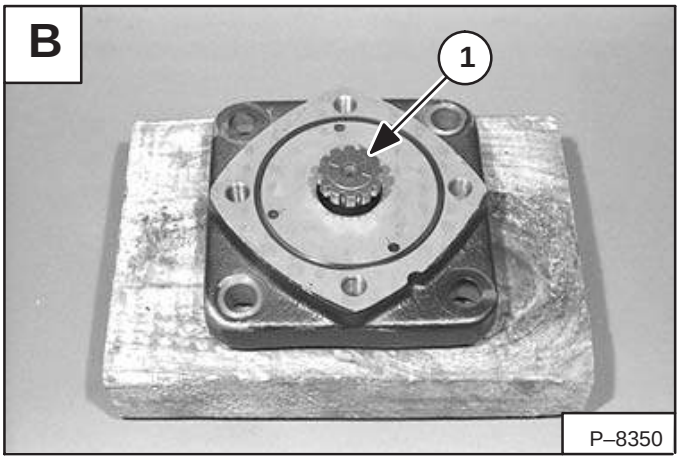
Prior to assembly:

Clean all parts with oil and dry with compressed air.

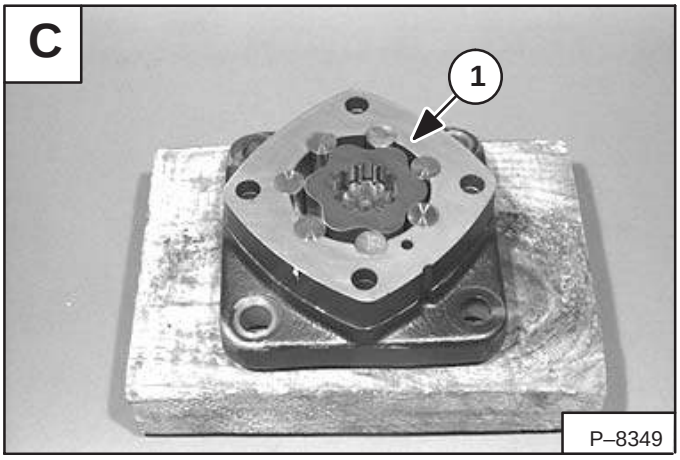
Put grease on O–rings.

Install a new large O–ring (Item 1) **[A]** and a new small O–ring (Item 2) **[A]** in the housing (Item 3) **[A]**.

Install the drive shaft (Item 1) **[B]** into the housing.



Install the geroler (Item 1) **[C]** on the wear plate, engaging the teeth of the drive shaft.



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SWING MOTOR (Cont'd)

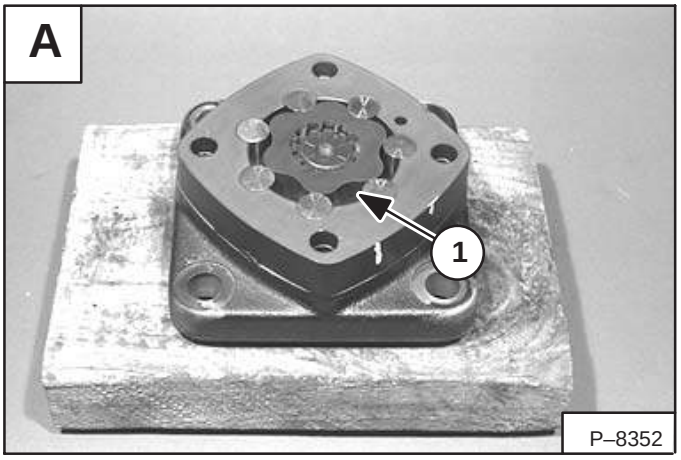
Assembly (S/N 11001–12999) (Cont'd)

Timing the hydraulic motor.

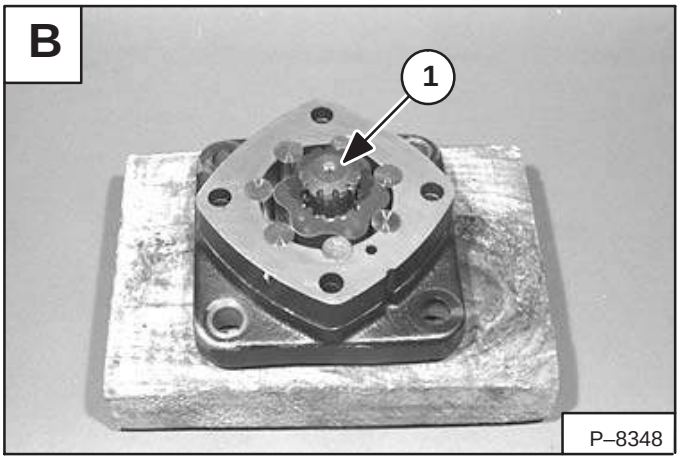
The timing of the motor controls the direction of rotation of the drive shaft. The timing parts are as follows:

1. Geroler assembly
2. Valve drive
3. Valve plate
4. Valve

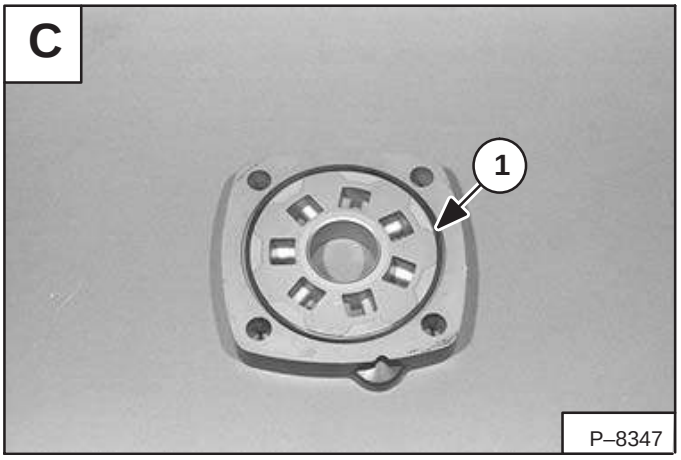
Find the largest opening in the geroler assembly (Item 1) **[A]**. Mark the outside of the geroler at this point.



Install the valve drive (Item 1) **[B]**.

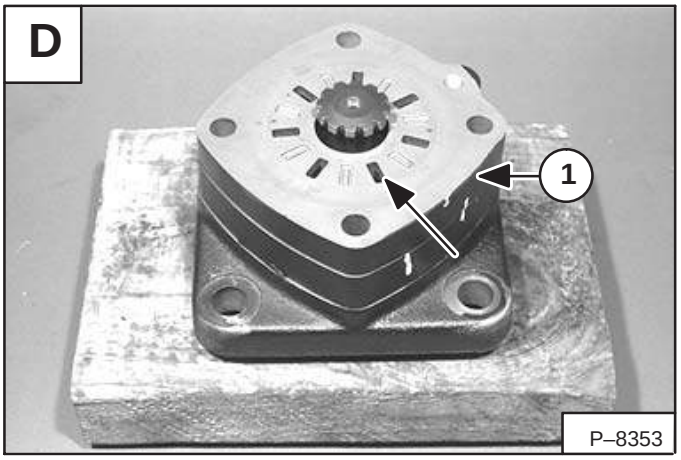


Install a new O–ring (Item 1) **[C]** on the valve plate.



Make sure one of the parts on the valve plate is aligned with the largest opening (marked earlier) of the geroler **[D]**.

Install the valve plate (Item 1) **[D]**.

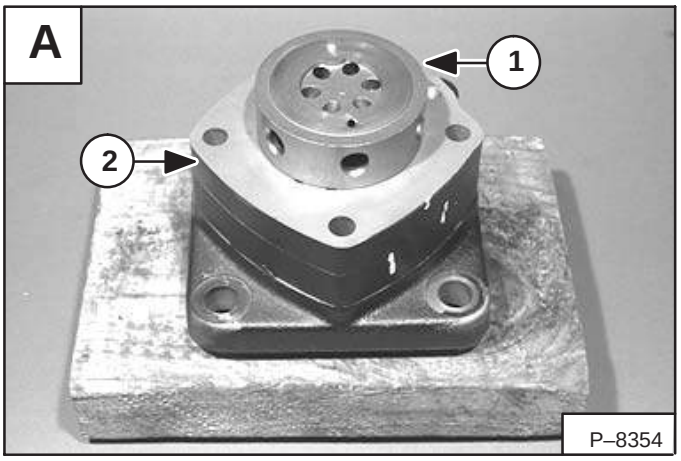


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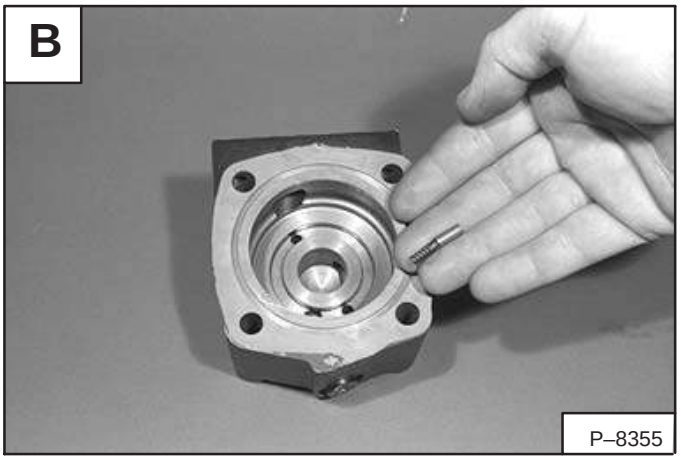
SWING MOTOR (Cont'd)

Assembly (S/N 11001–12999) (Cont'd)

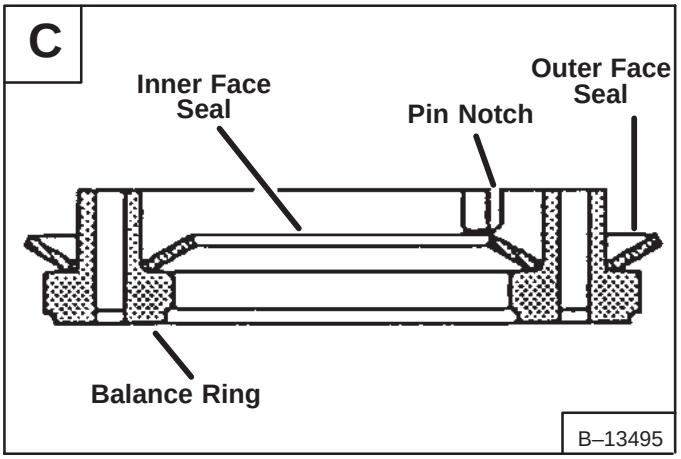
Install the valve (Item 1) **[A]** on the valve plate (Item 2) **[A]**. Align one of the side ports with the mark on the geroler housing. Turn the valve clockwise a small amount until the teeth on the valve engage.



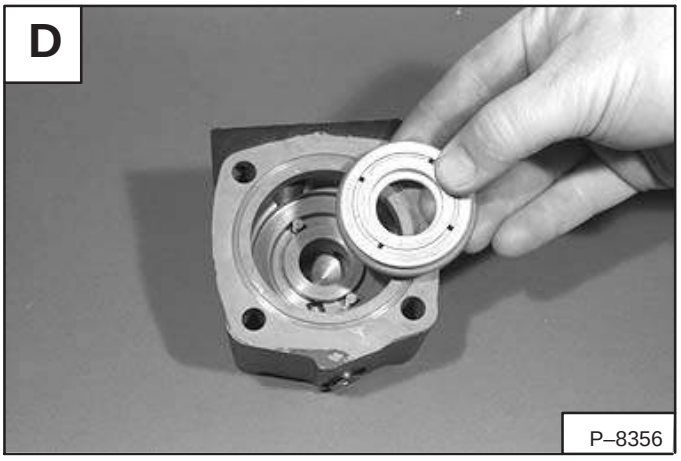
Install the two (2) springs and pins in the valve housing **[B]**.



Install the inner and outer seals on the balance ring as shown **[C]**.



Install the balance ring in the valve housing, and engage the alignment pins.

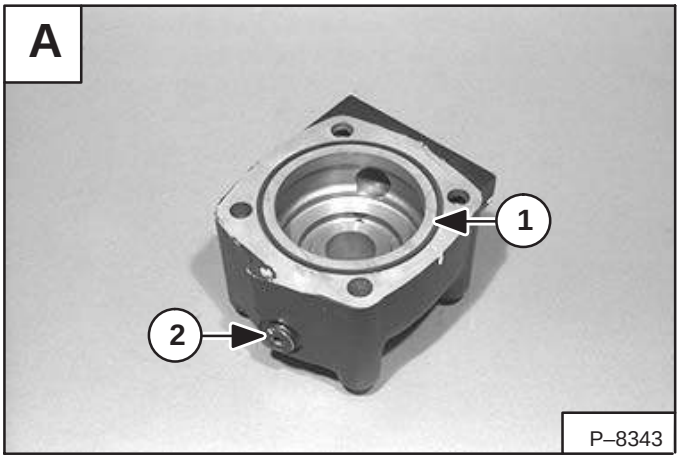


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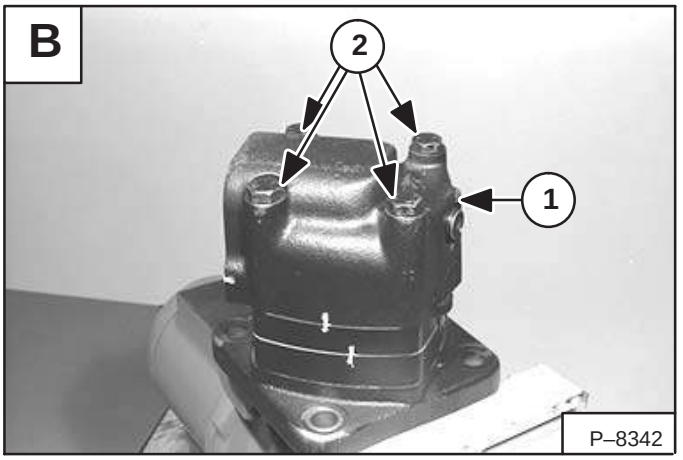
SWING MOTOR (Cont'd)

Assembly (S/N 11001–12999) (Cont'd)

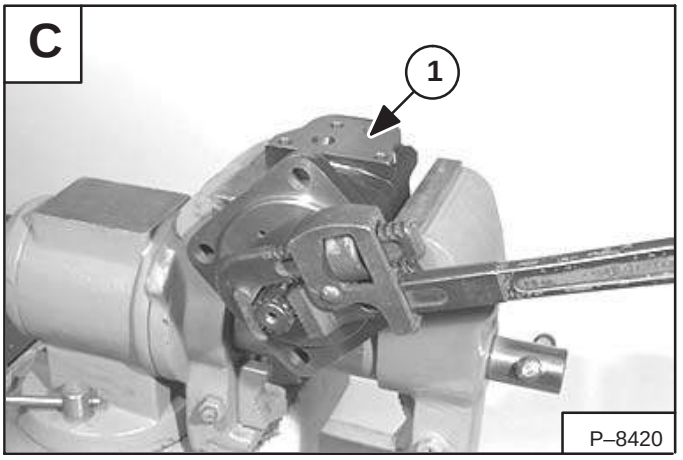
Install a new O–ring on the housing (Item 1) **[A]**. Install a new O–ring on the plug (Item 2) **[A]** and Install in the housing.



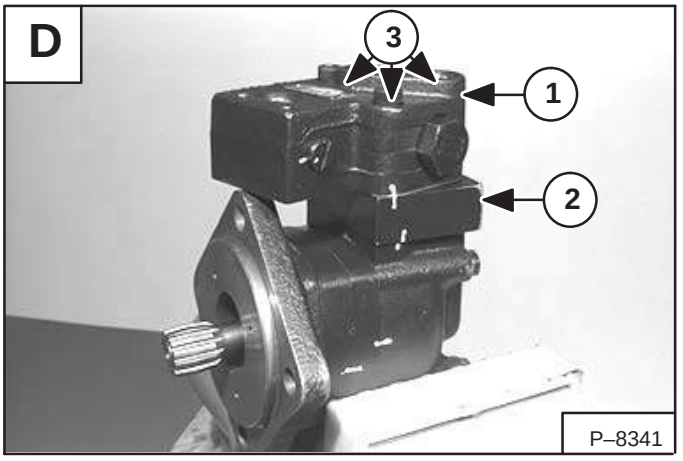
Install the housing (Item 1) **[B]** on the assembly and install the four (4) bolts (Item 2) **[B]** and tighten to 37 ft.–lbs. (50 Nm) of torque.



NOTE: To ensure that the timing of the swing motor is correct, put the swing motor in a vise and use a pipe wrench to turn the shaft clockwise, there should be suction in the port hole (Item 1) [C].



Clamp the swing motor assembly in a vise with padded jaws, align the marks and install the cross port relief valve (Item 1) **[D]** and block (Item 2) **[D]** onto the swing motor, install the three (3) bolts (Item 3) **[D]** and tighten to 200 in.–lbs. (23 Nm) of torque.



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CROSS PORT RELIEF VALVE (S/N 11001–11056 S/N 13001 & Above)

Disassembly

Prior to disassembly:

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

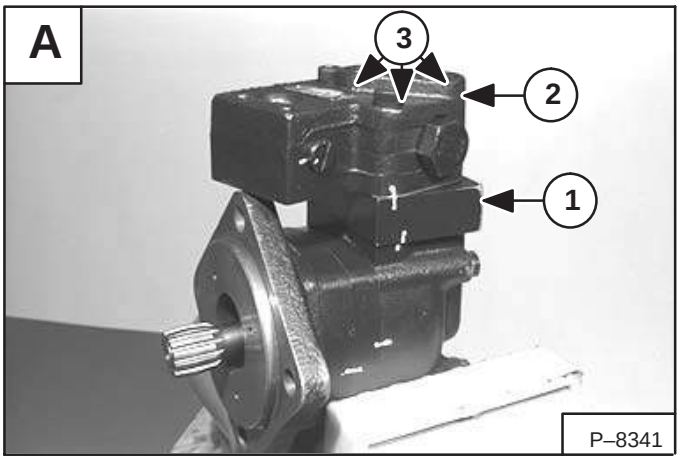
Clamp the swing motor assembly in a vise with padded jaws and mark the housing for ease of assembly **[A]**.

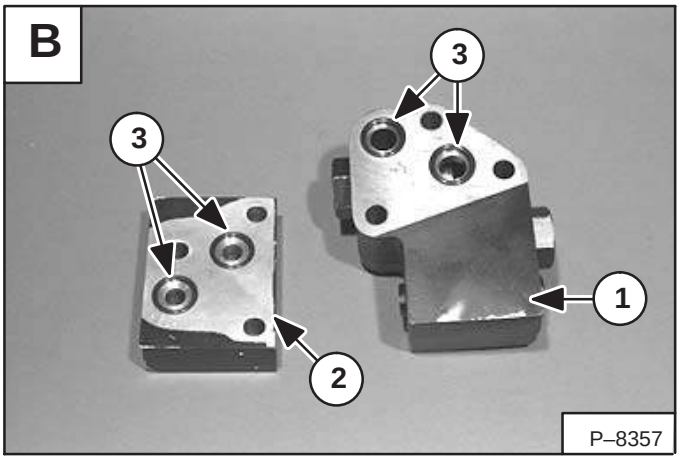
Remove the three (3) bolts (Item 1) **[A]** and lift the cross port relief valve (Item 2) **[A]** and block (Item 3) **[A]** from the swing motor.

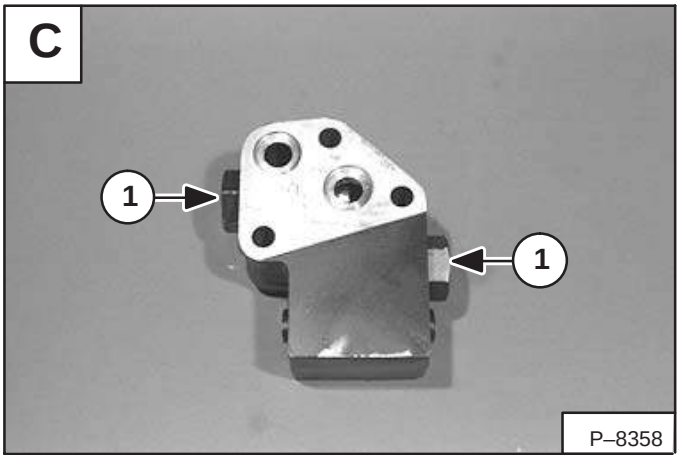
Separate the cross port relief valve (Item 1) **[B]** from the block (Item 2) **[B]** and remove the four (4) O–rings (Item 3) **[B]**.

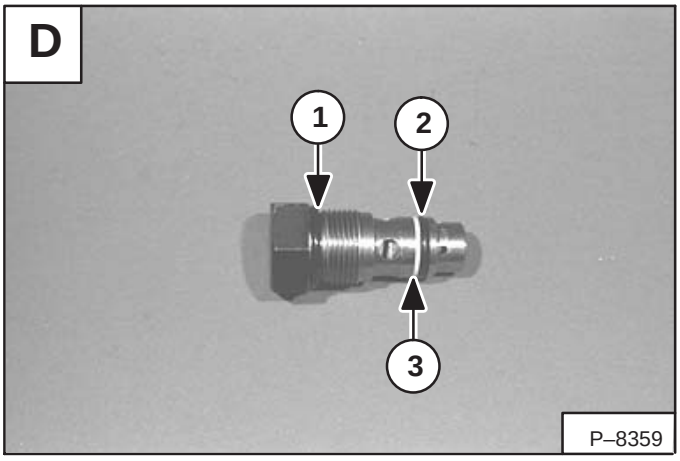
Remove the two (2) relief valves (Item 1) **[C]** from the cross port relief valve.

Remove the large O–ring (Item 1) **[D]** the small O–ring (Item 2) **[D]** and the back–up washer (Item 3) **[D]** from the relief valve.







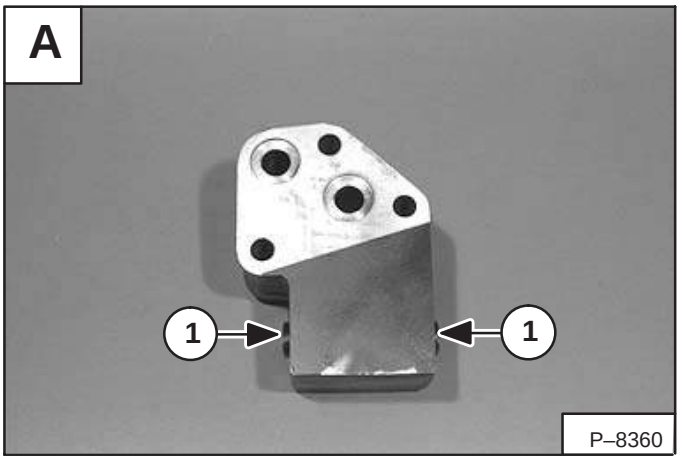


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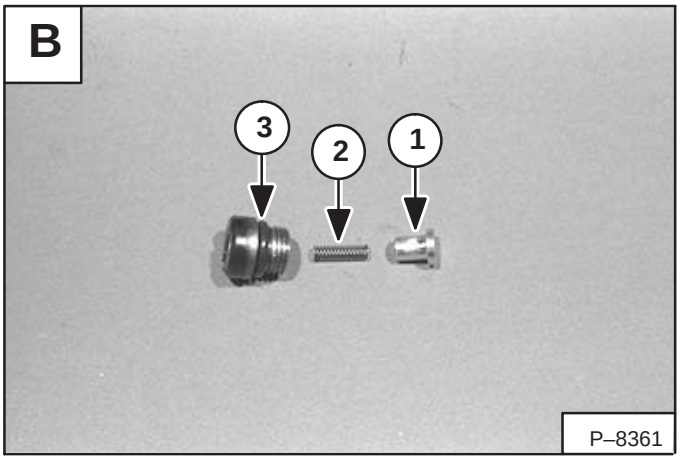
CROSS PORT RELIEF VALVE (S/N 11001–11056 S/N 13001 & Above) (Cont'd)

Disassembly (Cont'd)

Remove the two (2) plugs (Item 1) **[A]** from the cross port relief valve.



Remove the plunger (Item 1) **[B]** the spring (Item 2) **[B]** and the O–ring (Item 3) **[B]** from the plug.



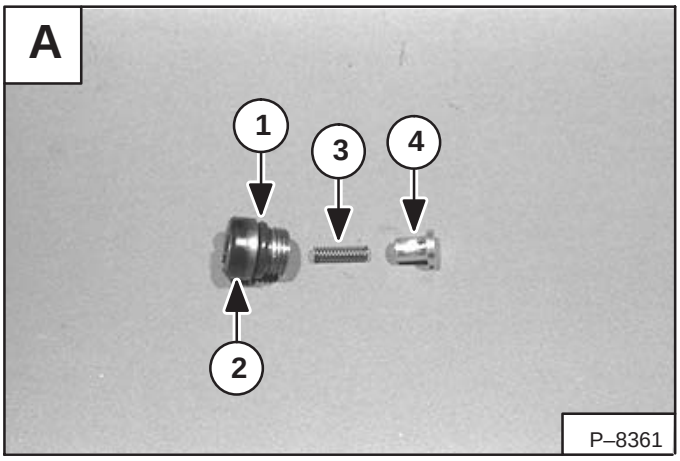
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CROSS PORT RELIEF VALVE (S/N 11001–11056 S/N 13001 & Above) (Cont'd)

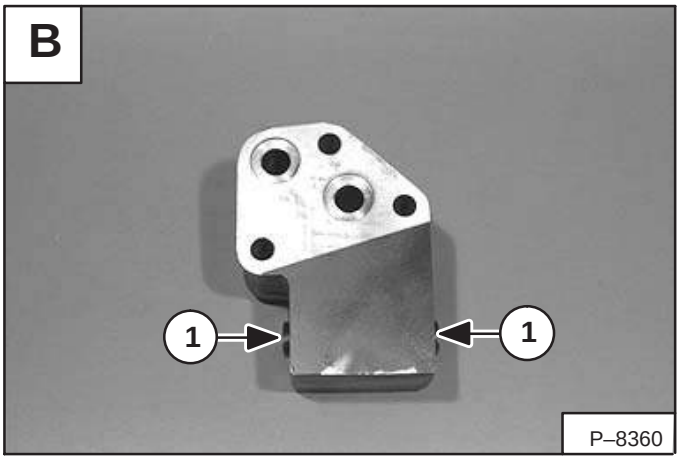
Assembly

Prior to assembly:
Clean all parts with oil and dry with compressed air.
Put grease on O–rings.

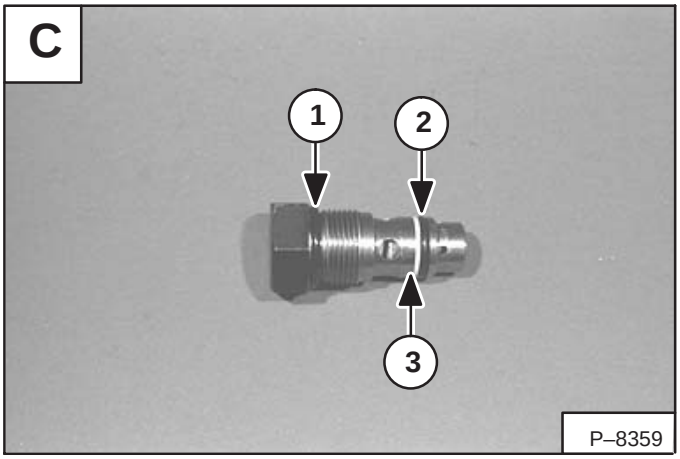
Install a new O–ring (Item 1) **[A]** on the plug (Item 2) **[A]** and install the spring (Item 3) **[A]** and plunger (Item 4) **[A]**.



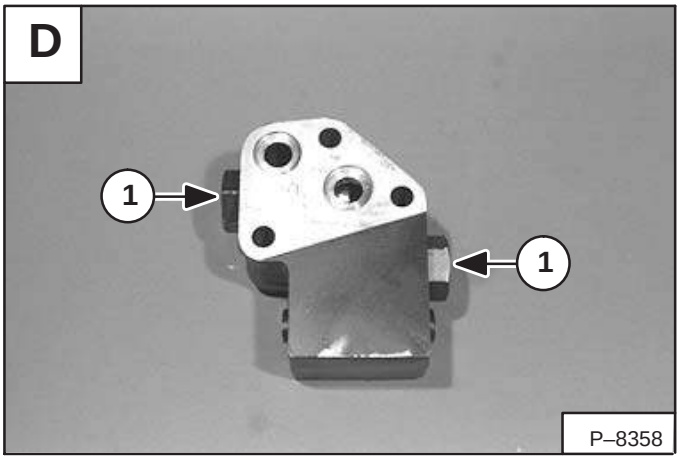
Install the two (2) plugs (Item 1) **[B]** in the cross port relief valve and tighten.



Install a new large O–ring (Item 1) **[C]** the small O–ring (Item 2) **[C]** and the back–up washer (Item 3) **[C]** on the relief valve.



Install the two (2) relief valves (Item 1) **[D]** into the cross port relief valve and tighten.

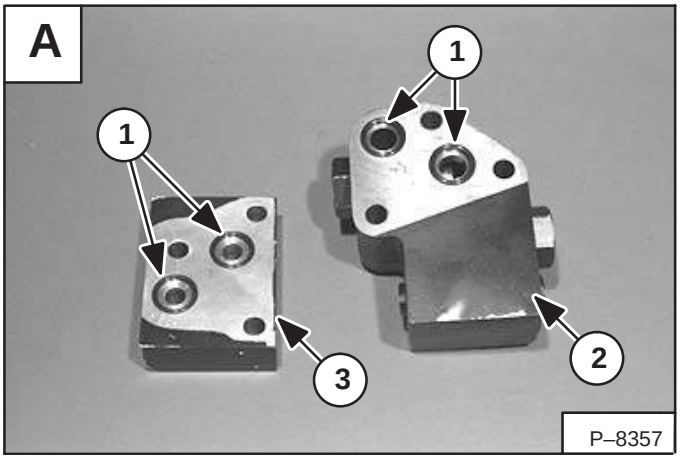


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CROSS PORT RELIEF VALVE (S/N 11001–11056 S/N 13001 & Above) (Cont'd)

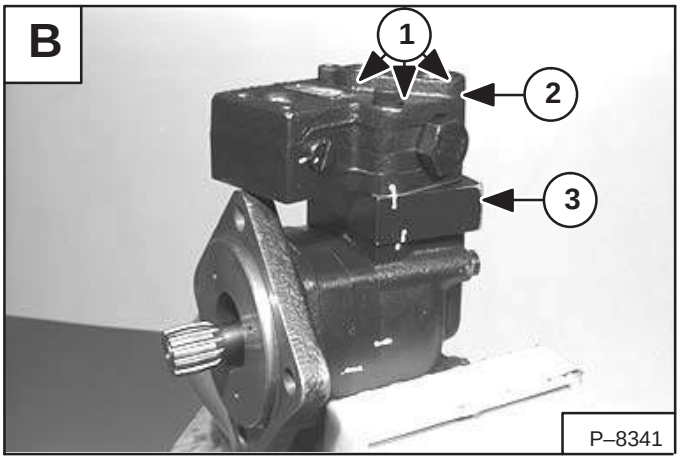
Assembly (Cont'd)

Install new O–rings (Item 1) **[A]** on the cross port relief valve (Item 2) **[A]** and on the block (Item 3) **[A]**.



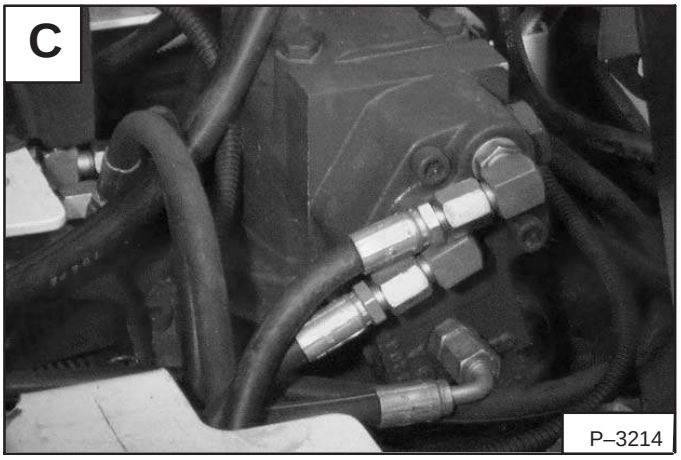
Clamp the swing motor assembly in a vise with padded jaws and align the marks on the housing with the marks on the swing motor and block **[B]**.

Install the three (3) bolts (Item 1) **[B]** through the cross port relief (Item 2) **[B]** and the block (Item 3) **[B]** and tighten to the swing motor. Tighten the bolts to 200 in.–lbs. (23 Nm) of torque.



Description

The cross port relief valve used on the swing motor has two (2) relief valves mounted on either side of the valve body **[C]**. These valves work with the accumulator hoses to dampen the swing stop, preventing damage to the swing motor. The relief valves also prevent the upperstructure from independent movement, or creeping, until the swing circuit is engaged.

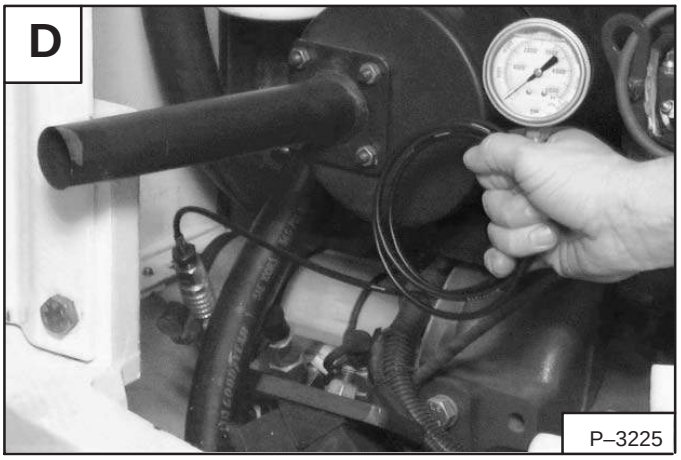


Testing

Connect a 5000 PSI gauge to the number three (3) pump section **[D]**. Warm the excavator up to operating temperature.

With the swing lock engaged, actuate the swing circuit in one direction. Record the pressure. Activate the swing circuit in the opposite direction. Record the pressure.

The cross port relief valves are factory set at 1650 PSI (11379 kPa) and are non–adjustable. If the valves do not function correctly, remove, clean, install and retest. If the valves do not function correctly after cleaning, replace the relief valves.



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COUNTERBALANCE VALVE (S/N 11057–12999)

Description

The counterbalance valve used on the swing motor has two (2) check valve on the bottom of the valve housing and two (2) counterbalance valves on the end of the valve housing.

The counterbalance valves work with the accumulator hoses to dampen the swing stop, preventing damage to the swing motor.

The check valves prevent the house from the independent movement, or creeping until the swing circuit is engaged.

The counterbalance valves **[A]** are adjustable by loosening the locknut and turning the adjustment screw. The adjustment screw has a range of three (3) full turns.

The check valves are factory set, and only the O–rings and back–up rings are replaceable. If the check valves don't function correctly after replacing the back up rings and O–rings the check valve must be replaced.

Removal and Installation

IMPORTANT

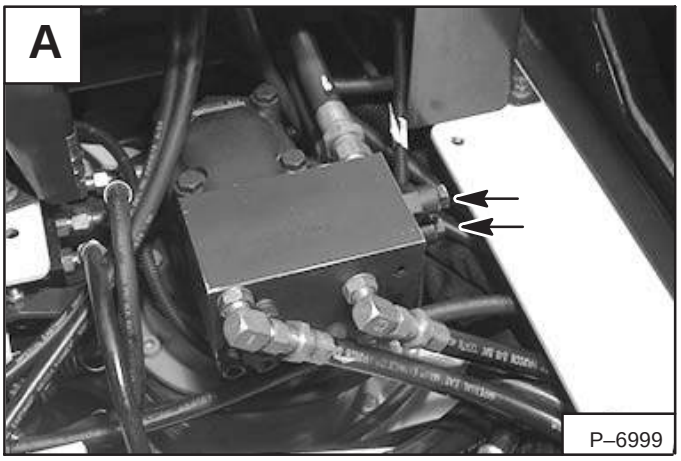
When making repairs on hydrostatic and hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.

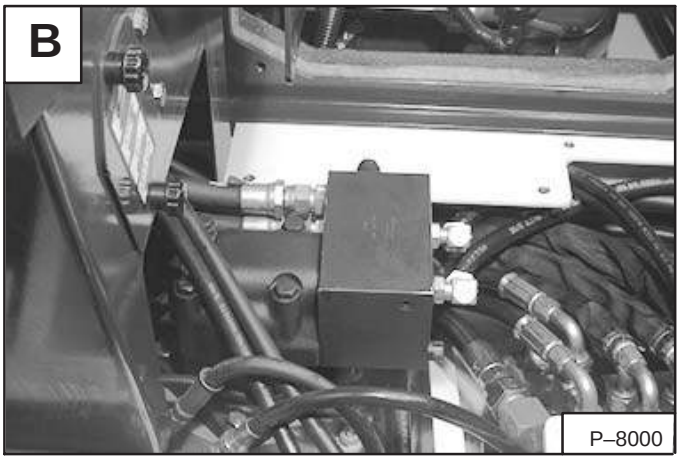
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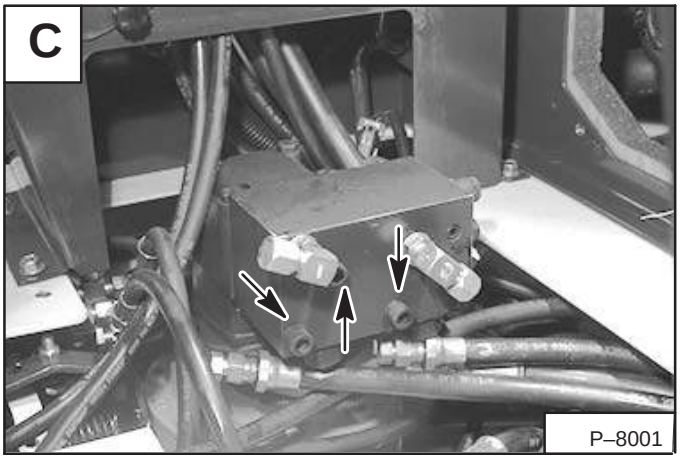
Mark the hoses for correct installation.

Remove the five (5) hoses from the counterbalance valve **[B]**.

Remove the three (3) mount bolts from the valve **[C]**.







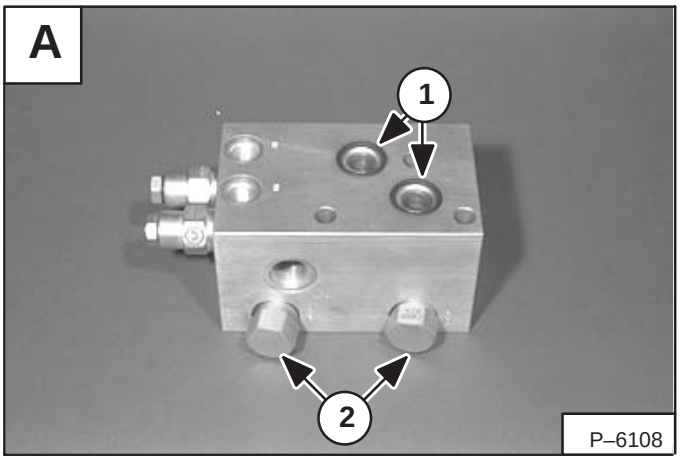
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COUNTERBALANCE VALVE (S/N 11057–12999) (Cont'd)

Disassembly

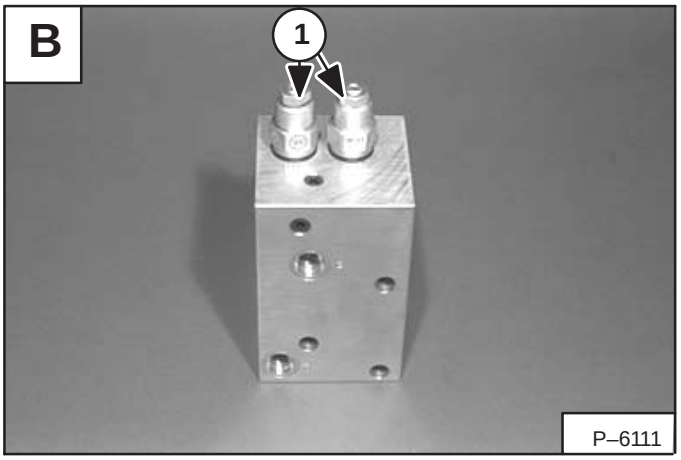
Remove the O–rings (Item 1) **[A]** from the face of the valve body.

Remove the two (2) check valves (Item 2) **[A]** from the bottom of the valve body.



Remove the two (2) counterbalance valves (Item 1) **[B]** from the end of the valve.

Clean the valve body check valves and counterbalance valves in solvent and dry with compressed air. When cleaning the check vales use a piece of plastic tubing to manually operate the inner workings of the valve. This will flush the valve clean.

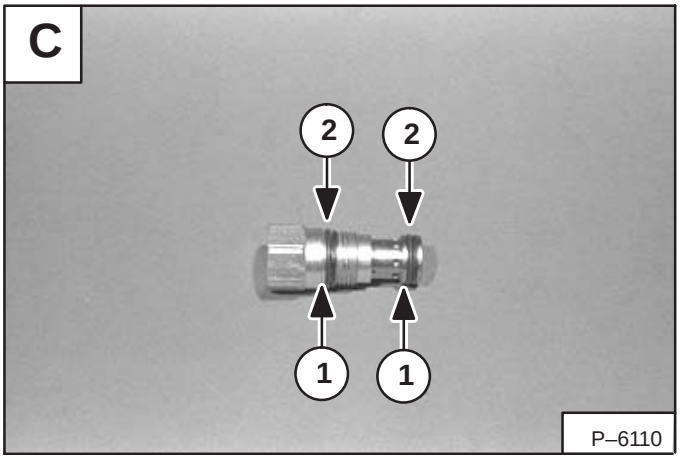


Assembly

Oil and install new O–rings (Item 1) **[C]**. and back–up rings (Item 2) **[C]** on the check valves.

Dip the valve in clean hydraulic oil before installing.

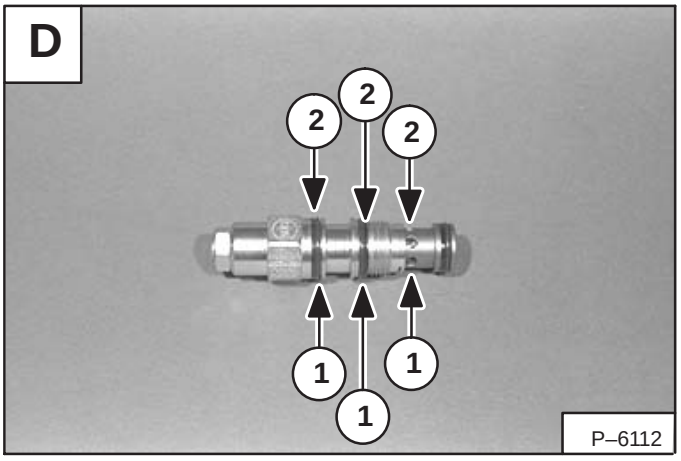
Install the check valves in the valve body. Tighten to 30–35 ft.–lbs. (40–47 Nm) of torque.



Oil and install new O–rings (Item 1) **[D]** and back–up rings (Item 2) **[D]** on the counterbalance valves.

Dip the valve in clean hydraulic oil before installing.

Install the counterbalance valves in the valve body. Tighten to 33–37 ft.–lbs. (Nm) of torque.

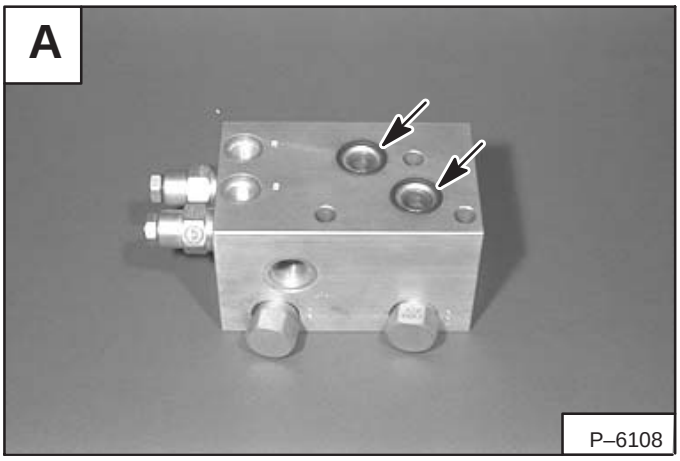


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COUNTERBALANCE VALVE (S/N 11057–12999) (Cont'd)

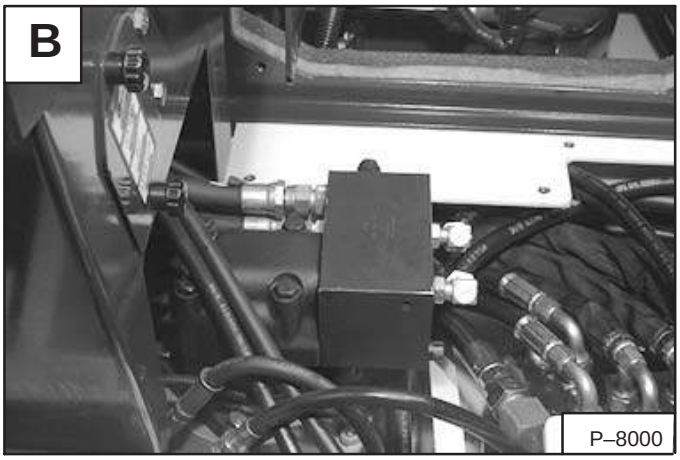
Assembly (Cont'd)

Oil and install new O–rings on the face of the valve body **[A]**.



Install the valve body on the swing motor with three (3) bolts **[B]**. Tighten to 33–37 ft.–lbs. (Nm) of torque.

Install the five (5) lines on the valve body **[B]**.



Testing and adjusting of counterbalance valves.

The following tools will be needed for the counterbalance valve check.

MEL1335 – Test Kit
MEL1355–3 – 5000 PSI Gauge
MEL1355–12 – Coupler
MEL1355–4 – Hose

Connect the coupler and the gauge from the tool kit to the hose.

Install the coupler onto the third pump **[C]**.

NOTE: The pump closest to the engine is pump one.



Start the engine and run at full RPM.

Warm the hydraulic fluid to 140°F (60°C).

Center the upperstructure with the track frame, lower swing lock handle into the engaged *Locked* position.

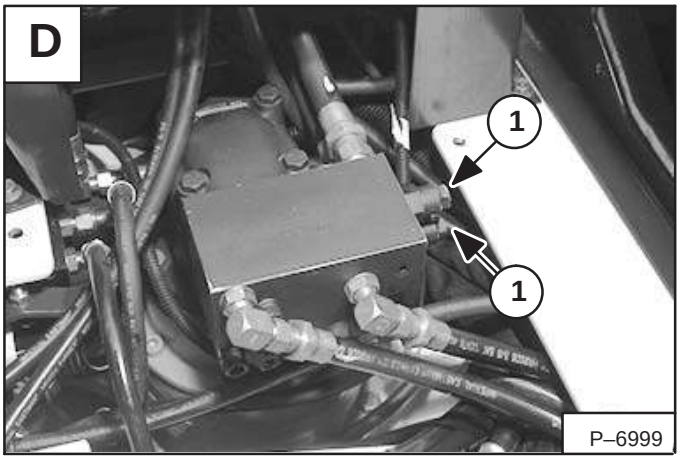
Move the left hand joystick control lever to the right and record the pressure gauge reading when the counterbalance valve opens.

Repeat this test procedure to get an accurate reading for the top valve.

To test the bottom valve repeat the above procedure by moving the left hand joystick control lever to the left.

The correct pressure setting for the counterbalance valve is 2088 PSI (14395 kPa) at pump section three.

If adjustment is needed, loosen the lock nut (Item 1) **[D]** and turn the adjusting screw clockwise to increase pressure.



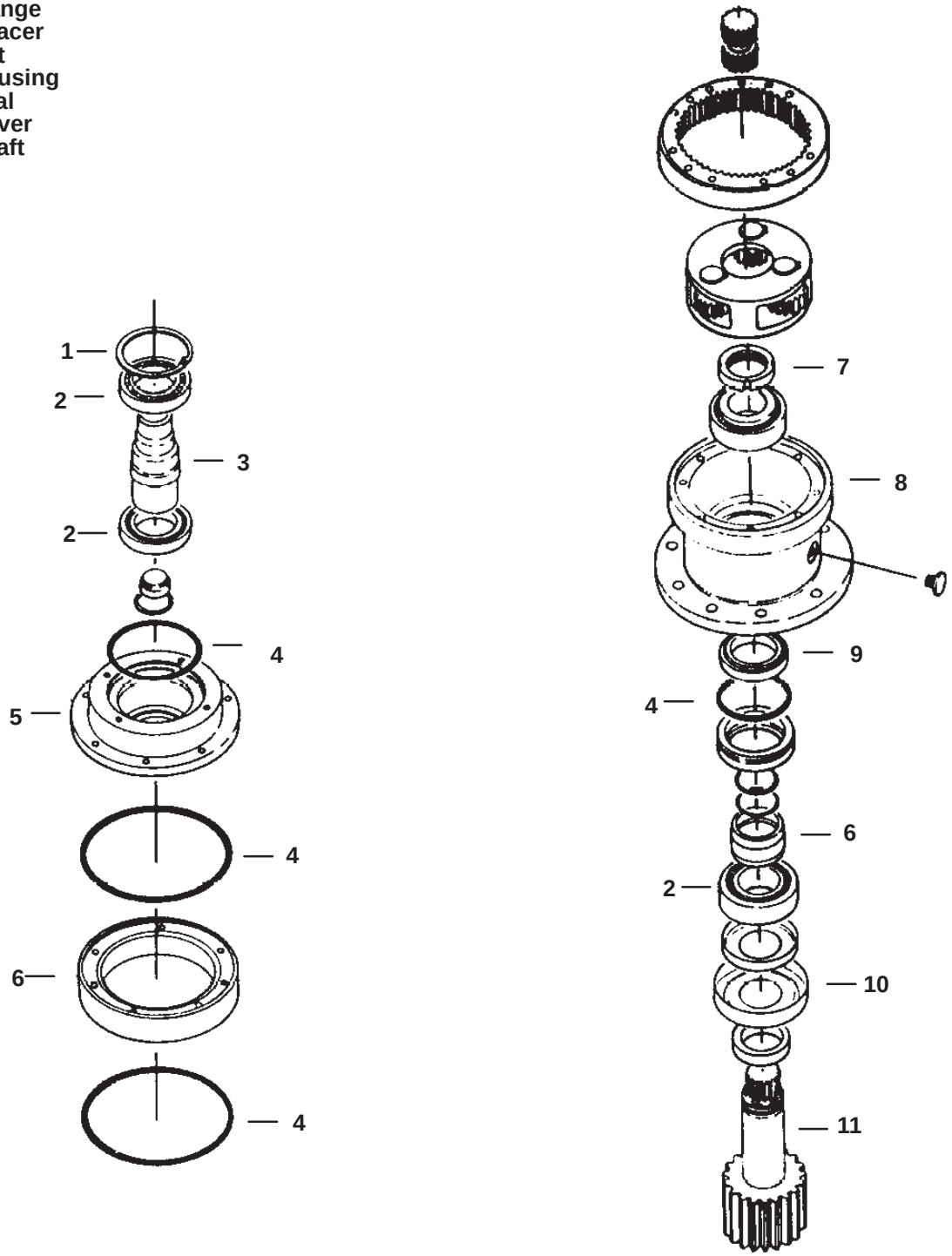
NOTE: 1/4 turn is approximately 100 PSI.

Tighten the lock nut and retest.

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SWING GEAR BOX

1. Snap Ring
2. Bearing
3. Coupling
4. O–ring
5. Flange
6. Spacer
7. Nut
8. Housing
9. Seal
10. Cover
11. Shaft



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SWING GEAR BOX (Cont'd)

Disassembly (S/N 11001–12999)

The following procedure contains information for the repair of the gear box. The photos used may appear different than the unit you are repairing, but the procedure is the same.

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

Drain the lubrication oil from the gear box case by removing one of the side plugs. Turn the case on its side and drain the oil out of the drain hole.

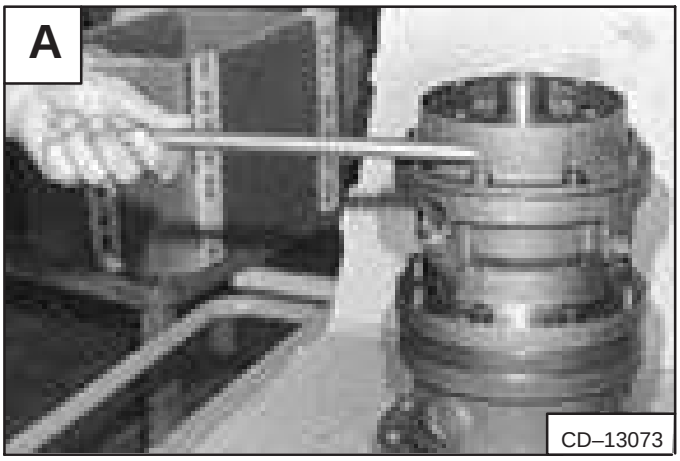
Make an alignment mark down the side of the gear box for correct assembly.

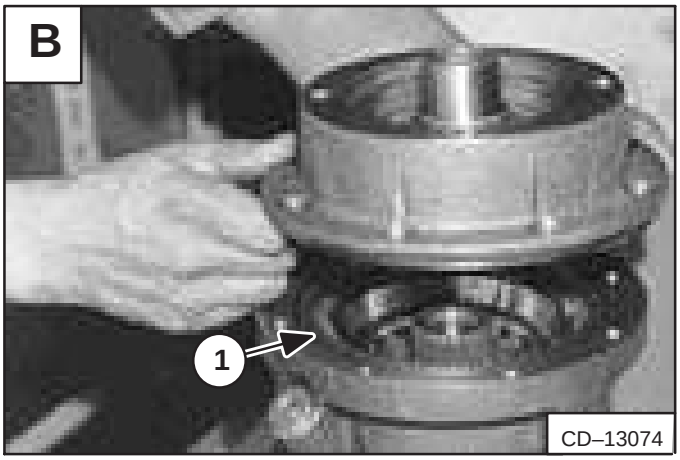
Remove the eight (8) bolts from the top housing flange **[A]**.

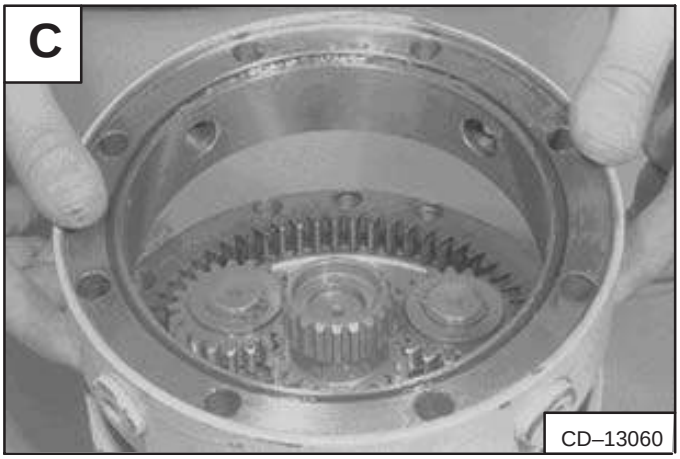
Remove top housing flange assembly **[B]**.

Remove the O–ring (Item 1) **[B]** from the mating housing face.

Remove the center spacer ring from the top of the lower housing **[C]**.





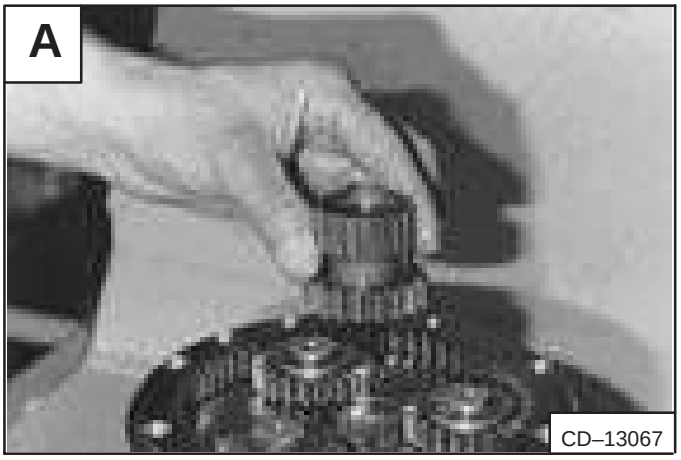


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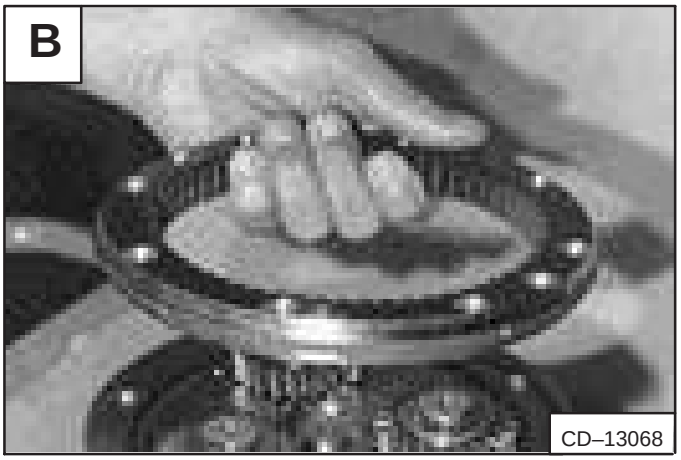
SWING GEAR BOX (Cont'd)

Disassembly (S/N 11001–12999) (Cont'd)

Remove the sun gear from the lower housing **[A]**.

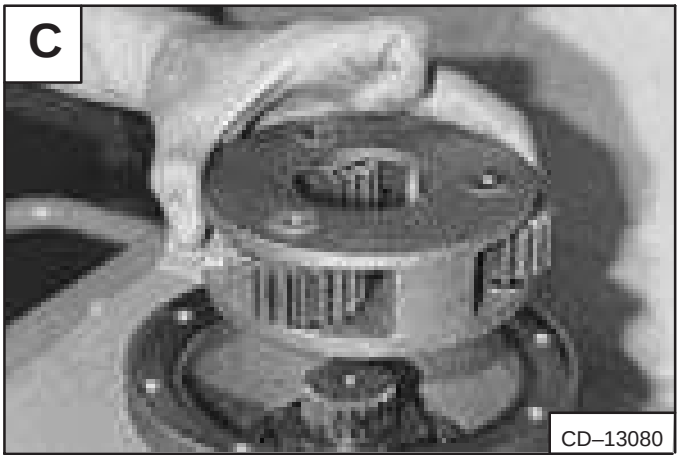


Remove the ring gear spacer from the top of the lower housing **[B]**.



Remove the planetary gear assembly from the lower housing **[C]**.

NOTE: The planetary gear assembly components are not serviceable separately. If any of these parts are damaged, a complete planetary gear assembly must be ordered from Melroe Parts Operation.



The bearing retainer nut is staked to the output shaft. To allow for easier removal of the nut, use a wedge shaped chisel inserted into the groove in the output shaft. Drive the chisel into the shaft groove to displace the metal from the factory stake in the bearing retainer nut **[D]**.



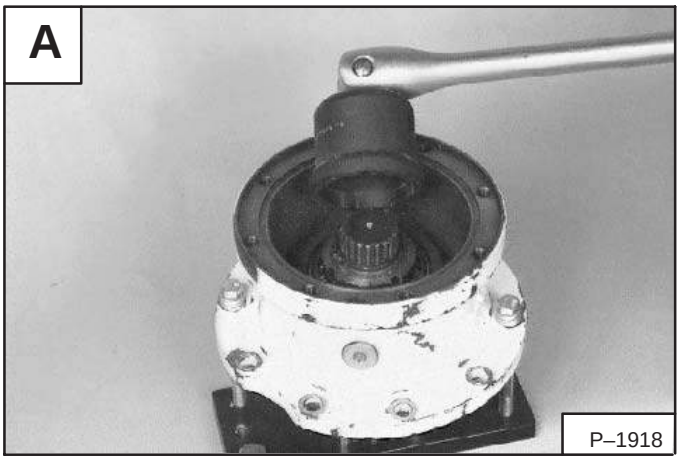
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SWING GEAR BOX (Cont'd)

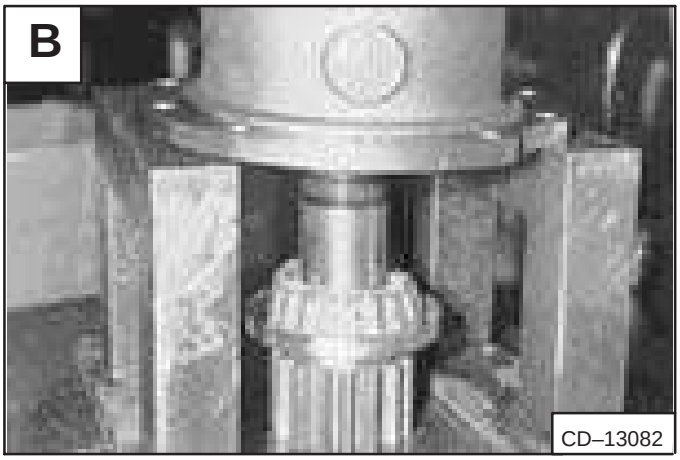
Disassembly (S/N 11001–12999) (Cont'd)

Use bearing nut removal tool (MEL1417) and remove the bearing nut from the output shaft **[A]**.

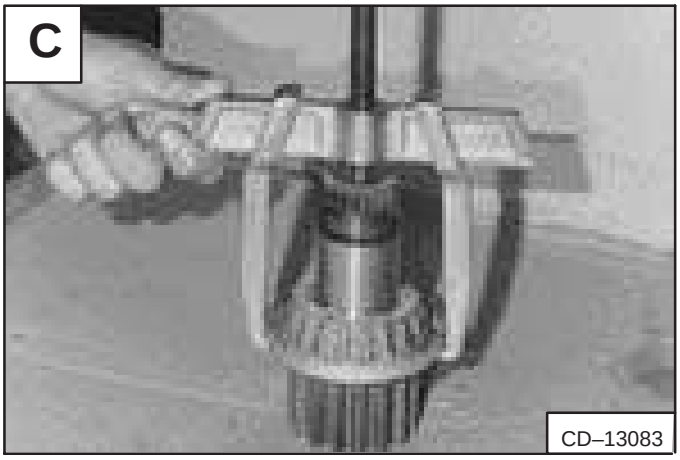
Use shaft retainer tool (MEL1419) to hold the gear end of the shaft from rotating while removing the bearing nut. Fasten the housing to the shaft retaining tool and fasten the shaft retaining tool to a stationary bench.



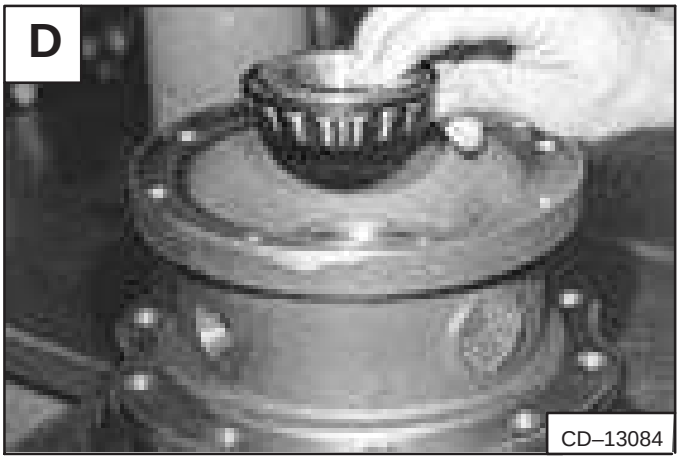
Press the output shaft from the lower housing **[B]**.



Use a two jaw puller and remove the dust cap, dust cup and the tapered bearing cone from the output shaft **[C]**.



Remove the tapered bearing cone from the lower housing **[D]**.

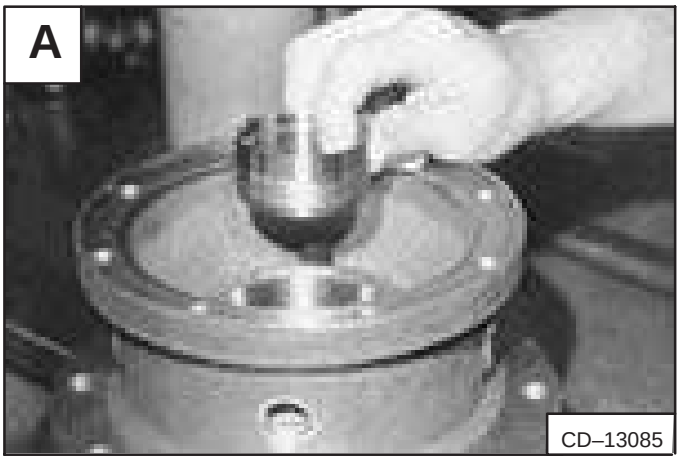


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SWING GEAR BOX (Cont'd)

Disassembly (S/N 11001–12999) (Cont'd)

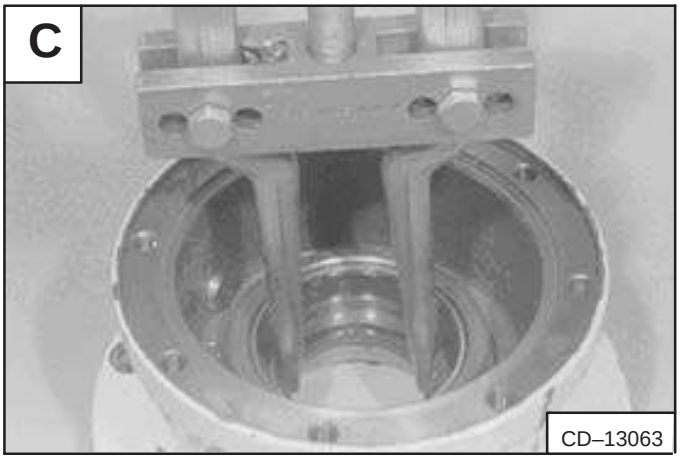
Remove the bearing spacer from the lower housing **[A]**.



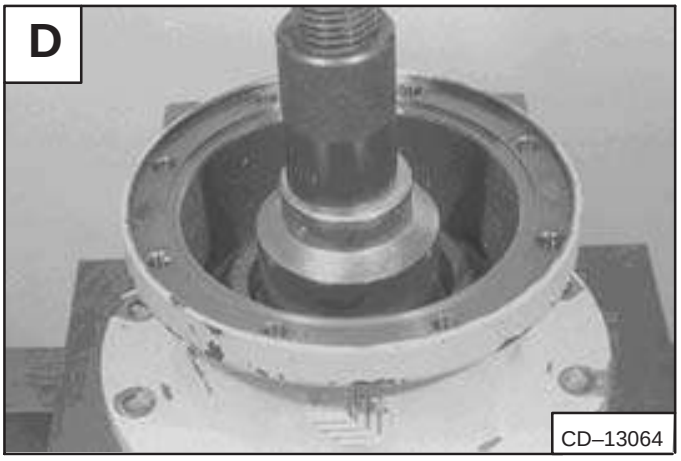
Remove the two O–rings from the internal diameter of the bearing spacer **[B]**.



Use an internal puller to remove the lower bearing cup from the lower housing **[C]**.



Use a press to remove the opposite side tapered bearing cup and the seal retainer **[D]**.

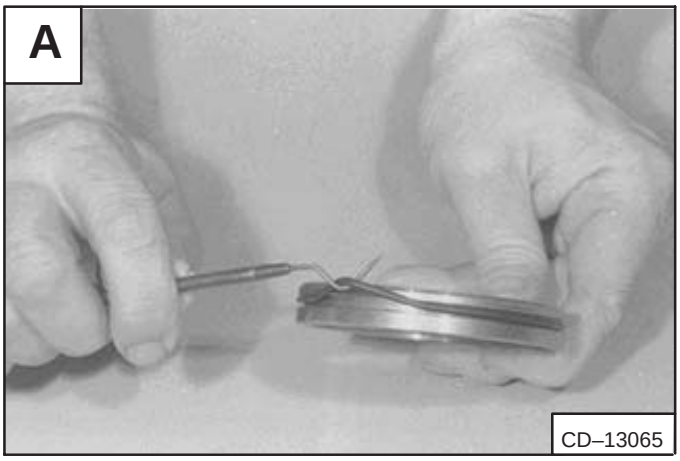


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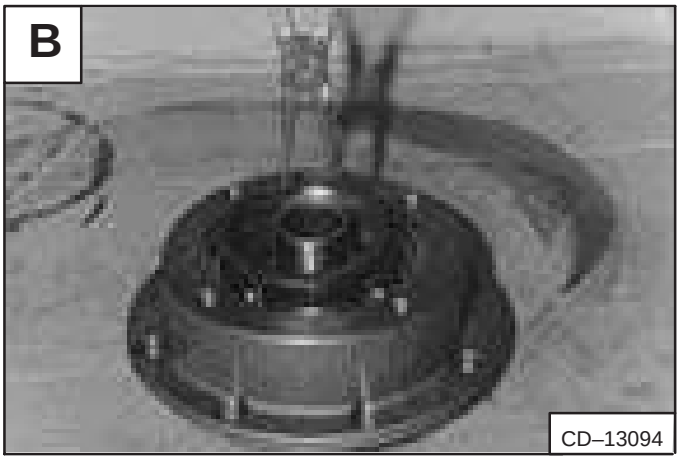
SWING GEAR BOX (Cont'd)

Disassembly (S/N 11001–12999) (Cont'd)

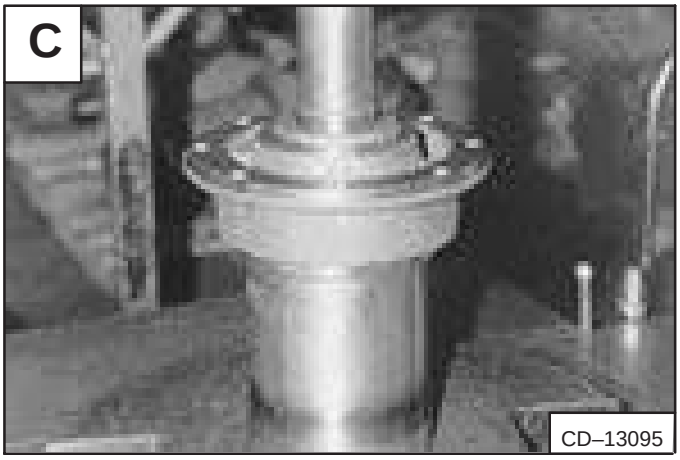
Remove the O–ring from the outer diameter of the seal retainer and remove the seal from the inner diameter of the seal retainer **[A]**.



Remove the snap ring from the top housing flange **[B]**.



Use a press to remove the input shaft and bearings from the top housing flange **[C]**.



Remove the seal from the top housing flange **[D]**.

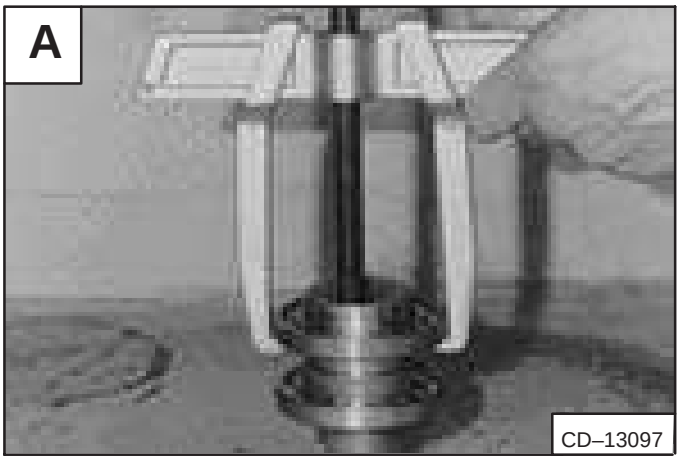


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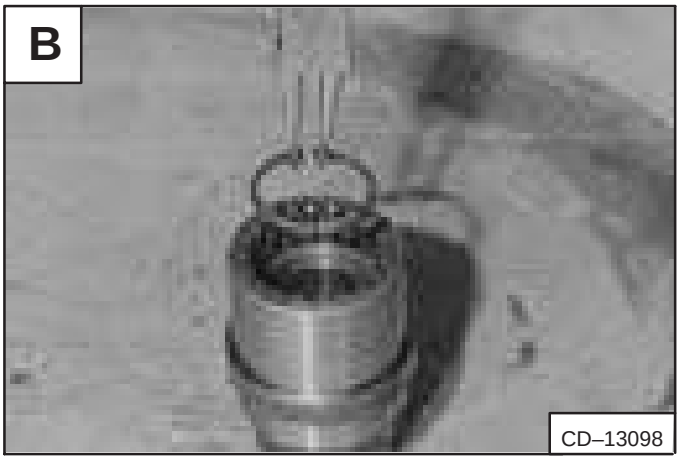
SWING GEAR BOX (Cont'd)

Disassembly (S/N 11001–12999) (Cont'd)

Use a two jaw bearing puller to remove the two bearings from the input shaft **[A]**.



Remove the snap ring from the internal diameter of the input shaft **[B]**.



Remove the plug from the input shaft **[C]**.



Remove the O–ring from the internal diameter of the input shaft **[D]**.

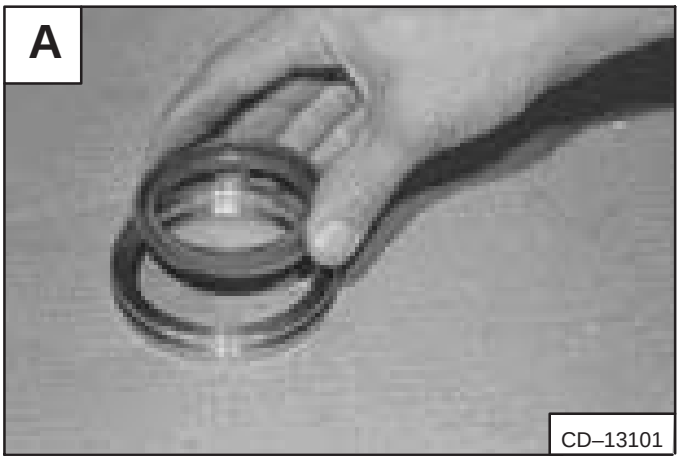


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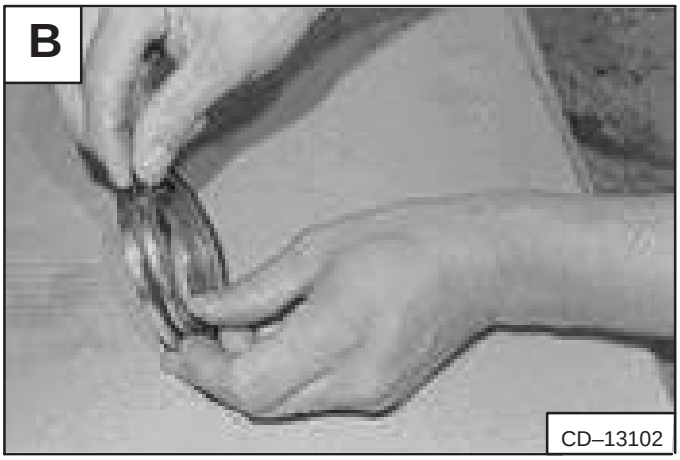
SWING GEAR BOX (Cont'd)

Assembly (S/N 11001–12999)

Install the seal into the output spacer ring **[A]**.



Put petroleum jelly on the O–ring and install the O–ring onto the outer diameter of the output spacer ring **[B]**.



Put the output spacer ring assembly into the lower housing **[C]**. Push the spacer ring in until it is flush with the internal shoulder of the housing.

NOTE: The seal side of the spacer ring assembly contacts the internal shoulder of the housing.



Install the outer bearing cup into the lower housing **[D]**.

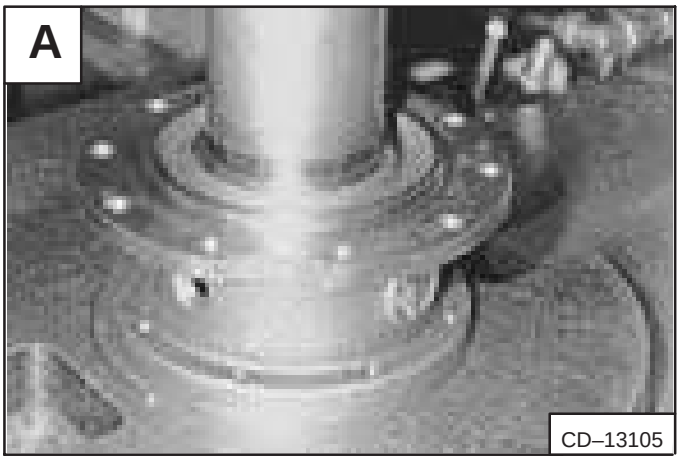


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SWING GEAR BOX (Cont'd)

Assembly (S/N 11001–12999) (Cont'd)

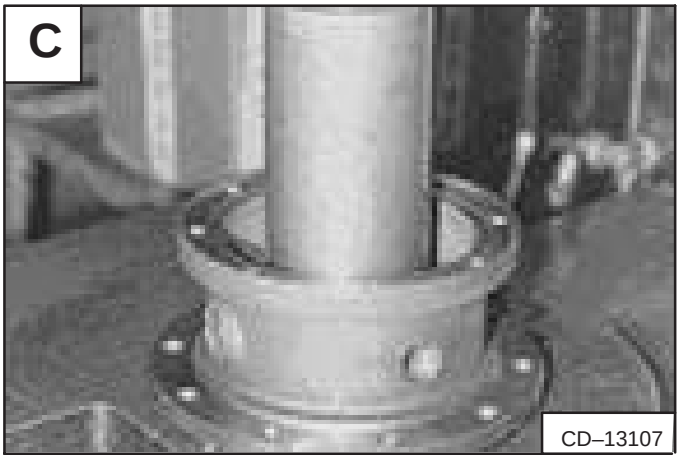
Press the outer bearing cup into the lower housing until it is flush with the spacer ring **[A]**



Turn the lower housing over and install the inner bearing cup into the lower housing **[B]**



Press the inner bearing cup into the lower housing until it is flush with the flange **[C]**.



Put the outer bearing cone on a support tube that contacts only the inner bearing race **[D]**.

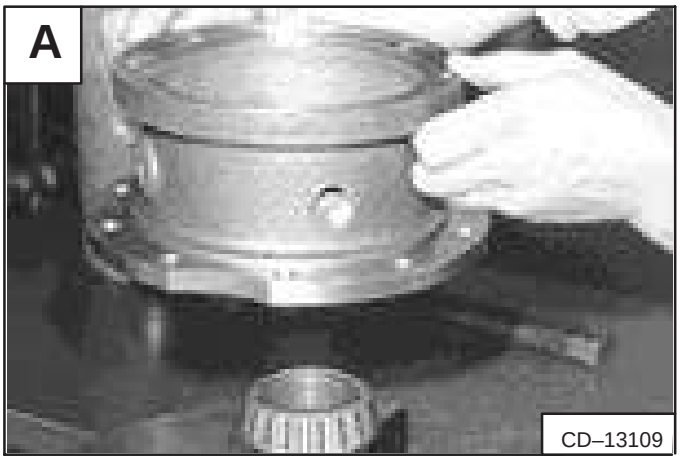


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SWING GEAR BOX (Cont'd)

Assembly (S/N 11001–12999) (Cont'd)

Put the lower housing on the bearing **[A]**.



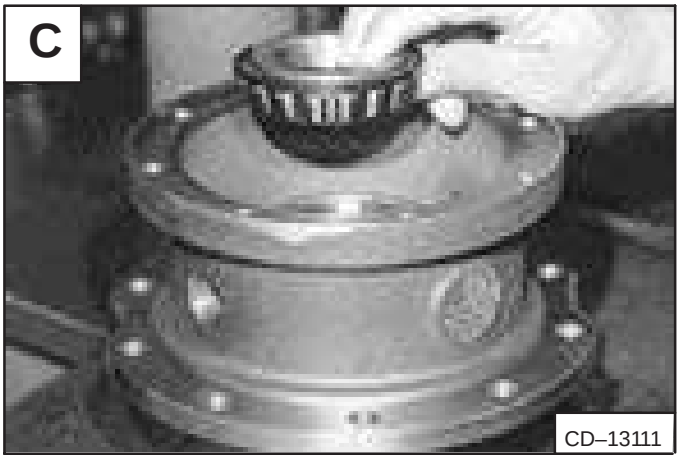
Do not install the O–rings into the bearing spacer at this time. They will be installed later.

Install the bearing spacer into the lower housing **[B]**.

NOTE: The O–ring end of the bearing spacer will face up.



Install the inner bearing cone into the top of the lower housing **[C]**.



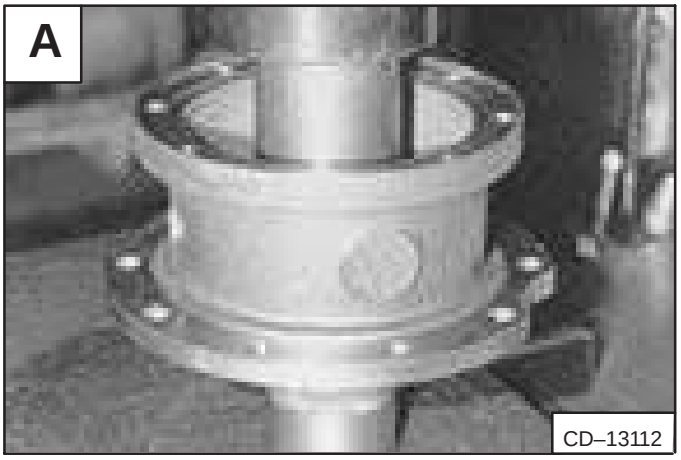
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SWING GEAR BOX (Cont'd)

Assembly (S/N 11001–12999) (Cont'd)

Press down on the top bearing cone using 1100 lbs. (500 Kg) of pressure **[A]**.

Manually rotate the lower housing to determine the smoothness and rotational resistance of the lower housing.

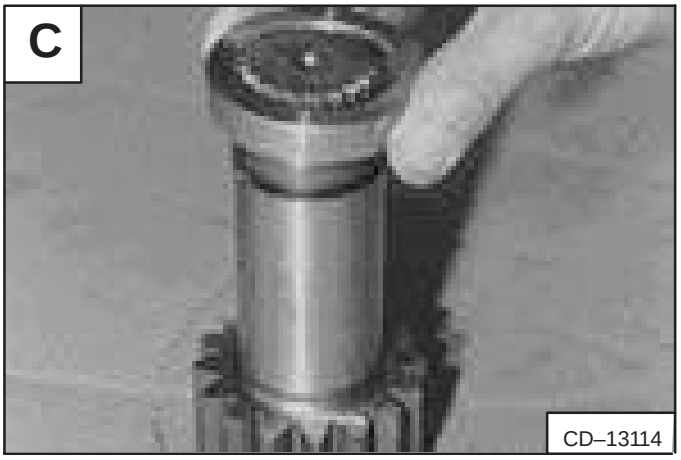


If the rotation of the lower housing is difficult, install 0.039'' (0,1 mm) shim(s) (Melroe P/N 13EM–4561) between the bearing spacer ring and the bearing cone **[B]**.

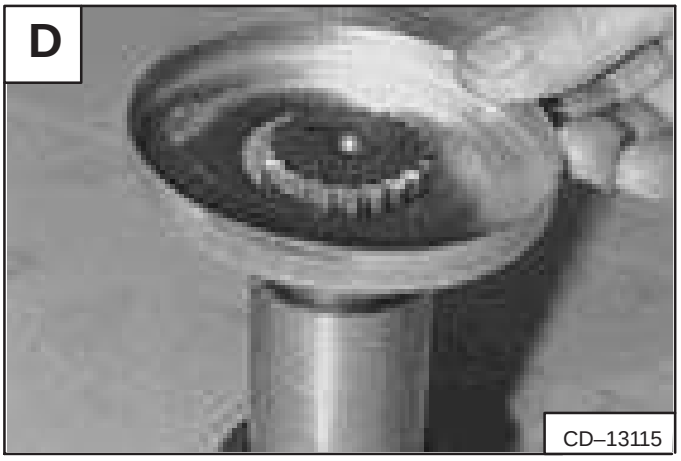
If the lower housing rotates too easily, remove the bearing spacer ring and lap the end of the spacer ring until rotational resistance is adequate **[B]**.



Install the spacer on the output shaft **[C]**.



Install the outer dust cap on the output shaft **[D]**.

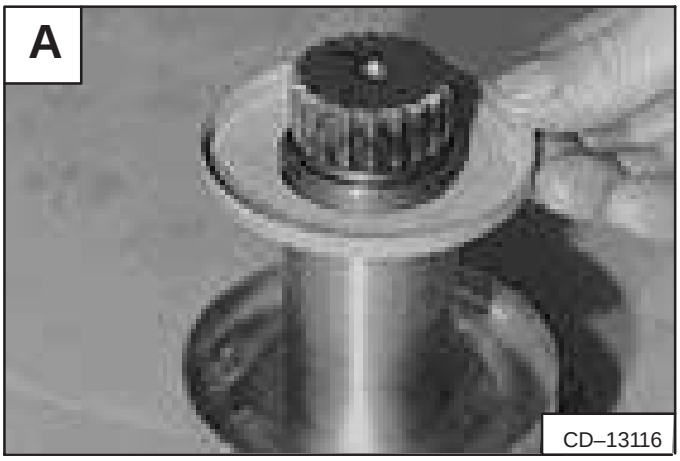


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SWING GEAR BOX (Cont'd)

Assembly (S/N 11001–12999) (Cont'd)

Install the inner dust cup on the output shaft **[A]**.



Fill the inner dust cup with a quality bearing grease **[B]**.



Pack the bearing cone with a quality bearing grease and install the outer bearing cone on the output shaft **[C]**.



Install the bearing spacer (and any bearing shims, if needed) on the output shaft **[D]**.

The O–ring end of the spacer ring faces up.



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SWING GEAR BOX (Cont'd)

Assembly (S/N 11001–12999) (Cont'd)

Put petroleum jelly on the two O–rings. Carefully install the two O–rings over the threaded shaft and down to the bearing spacer.

Use a tool with a curved smooth end to push the O–rings into the bearing spacer **[A]**.



Put a quality bearing grease on the two bearing cups.

Install the lower housing on the output shaft **[B]**.



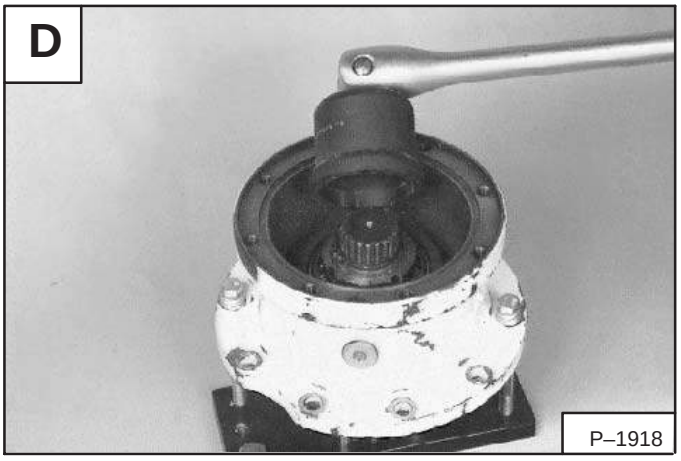
Pack the bearing cone with a quality grease and install the inner bearing cone on the output shaft and down on the bearing cup **[C]**.



Install the bearing nut on the output shaft **[D]**.

Use bearing nut tool (MEL1417) and tighten the bearing nut to 325–400 ft.–lbs. (450–550 Nm) torque.

Use the shaft retainer tool (MEL1419) to hold the gear end of the shaft from rotating while installing the bearing nut. Fasten the housing to the shaft retainer tool and fasten the shaft retainer tool to a stationary bench.

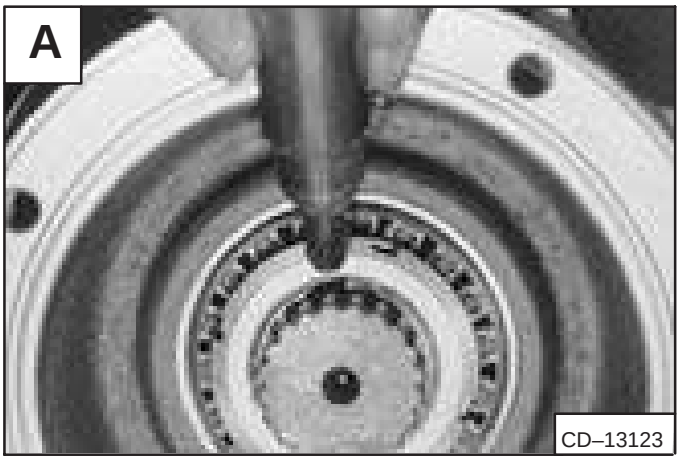


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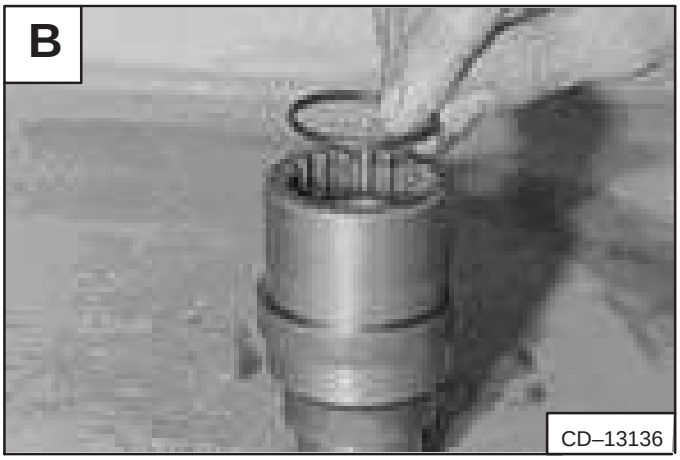
SWING GEAR BOX (Cont'd)

Assembly (S/N 11001–12999) (Cont'd)

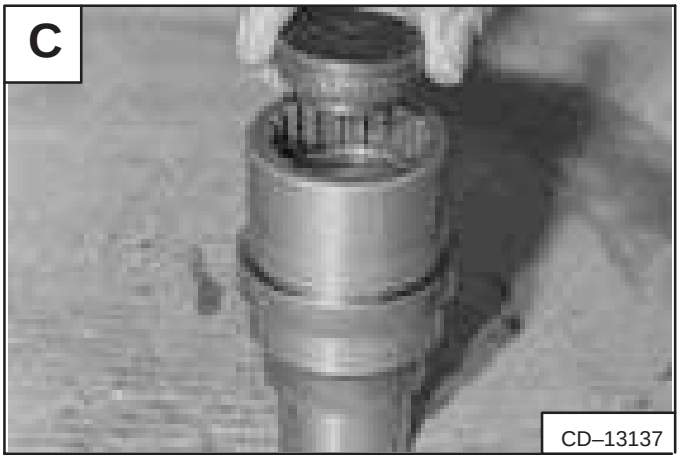
Use a center punch to stake the bearing nut to the output shaft to prevent the nut from loosening **[A]**.



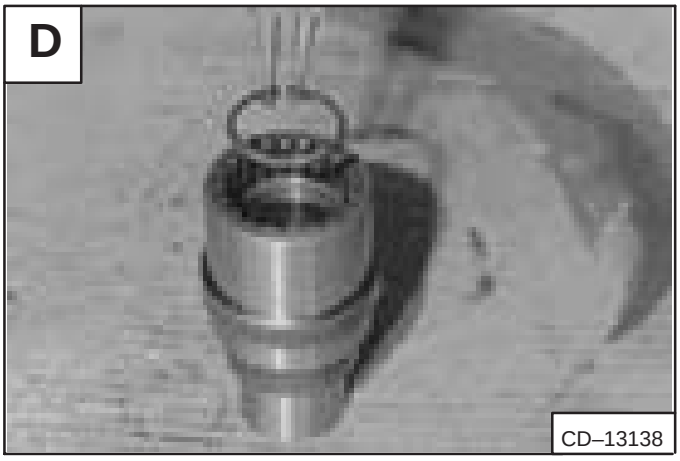
Put petroleum jelly on the O–ring and install the O–ring into the input shaft **[B]**.



Install the plug in the internal diameter of the input shaft **[C]**.



Install the snap ring in the input shaft **[D]**.

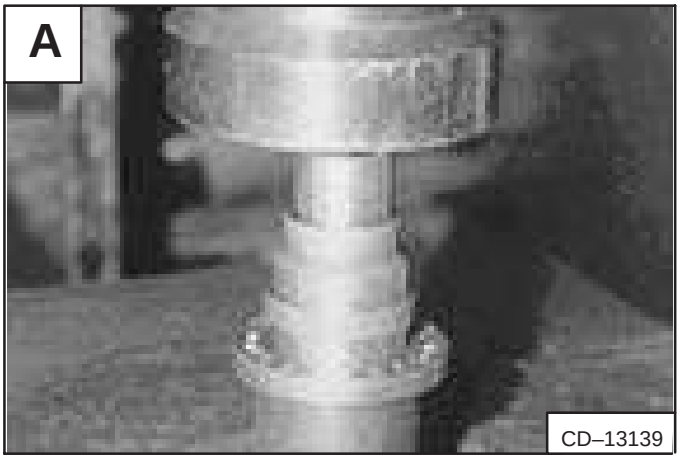


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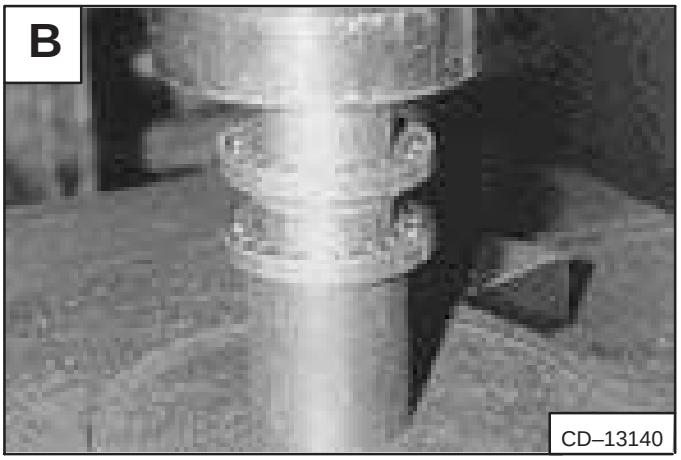
SWING GEAR BOX (Cont'd)

Assembly (S/N 11001–12999) (Cont'd)

Press the input shaft into the new bearing **[A]**.



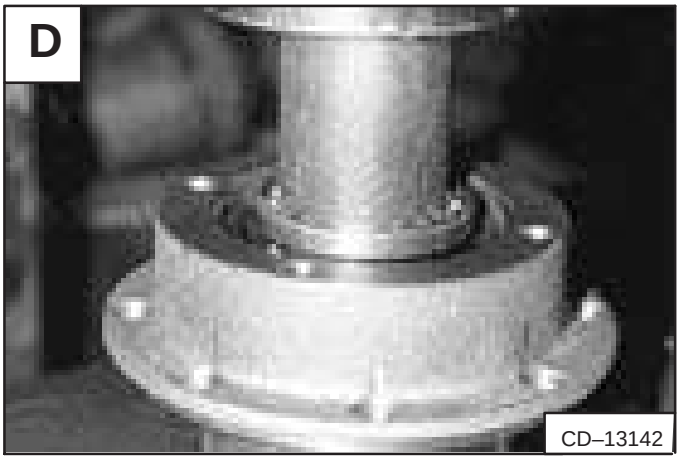
Turn the input shaft over and press the input shaft into the second new bearing **[B]**.



Put petroleum jelly on the internal and external surfaces of the new seal and install the seal into the top housing flange **[C]**.



Press the input shaft assembly into the top housing flange **[D]**.

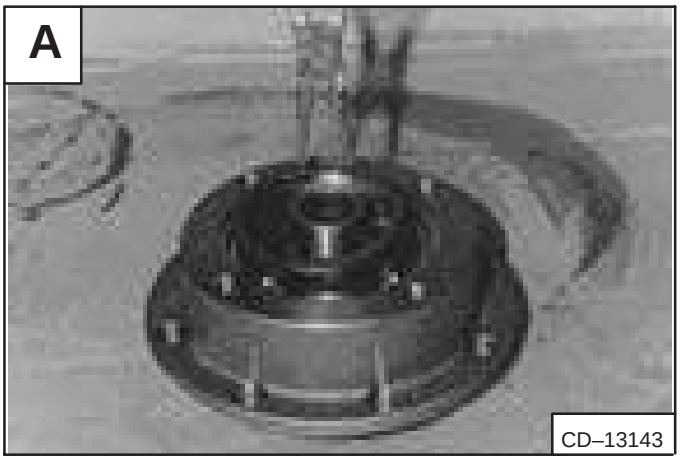


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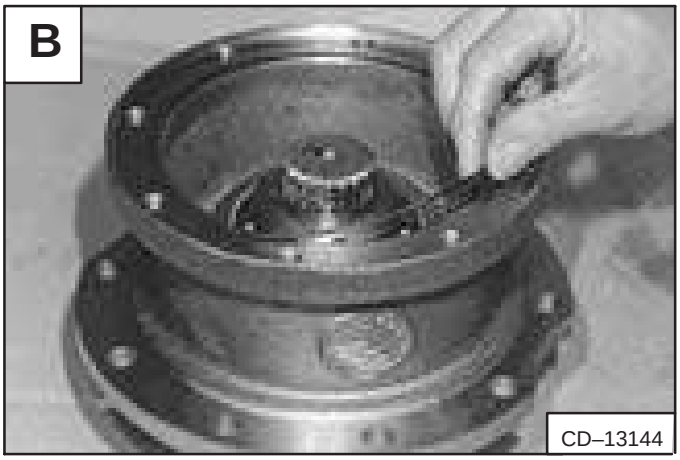
SWING GEAR BOX (Cont'd)

Assembly (S/N 11001–12999) (Cont'd)

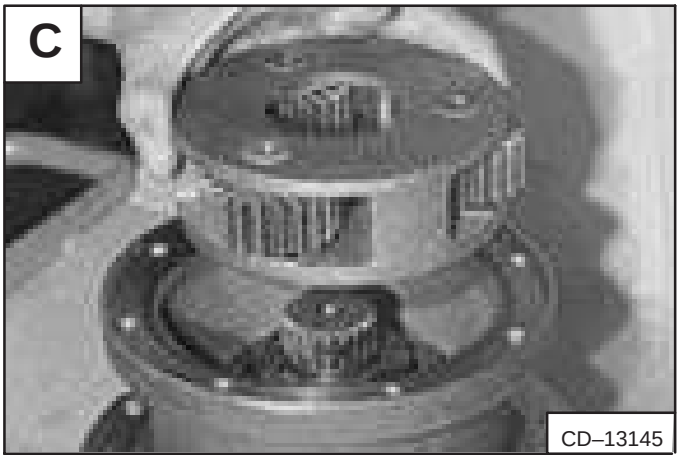
Install the snap ring into the top housing flange to retain the input shaft **[A]**.



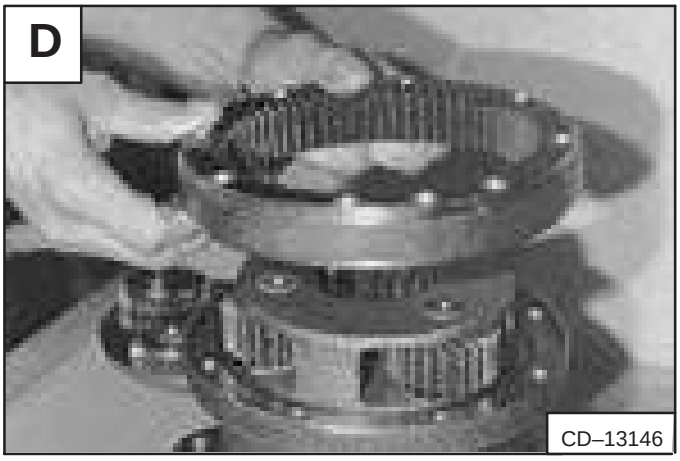
Put petroleum jelly on the O–ring and install the O–ring into the lower housing.



Install the planetary gear assembly into the lower housing **[C]**.



Install the ring gear spacer on the top of the housing and onto the planetary gears **[D]**.

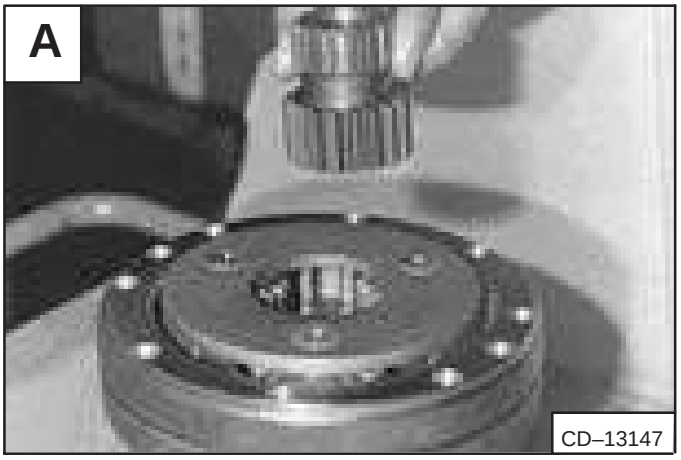


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SWING GEAR BOX (Cont'd)

Assembly (S/N 11001 2999) (Cont'd)

Install the sun gear into the planetary gears **[A]**.

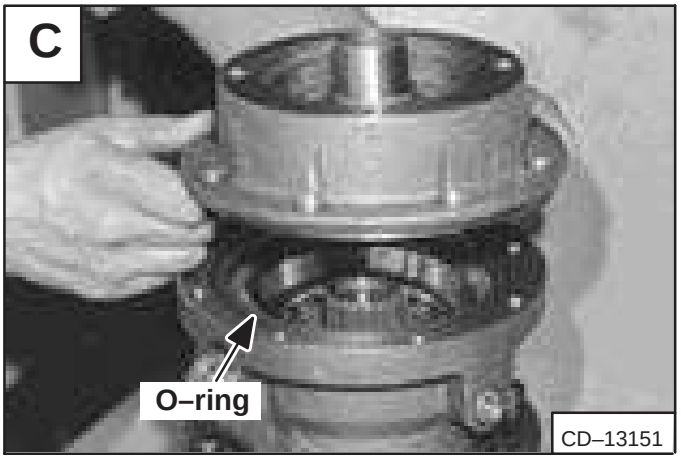


Put petroleum jelly on the O–rings and install the O–ring into the center spacer.

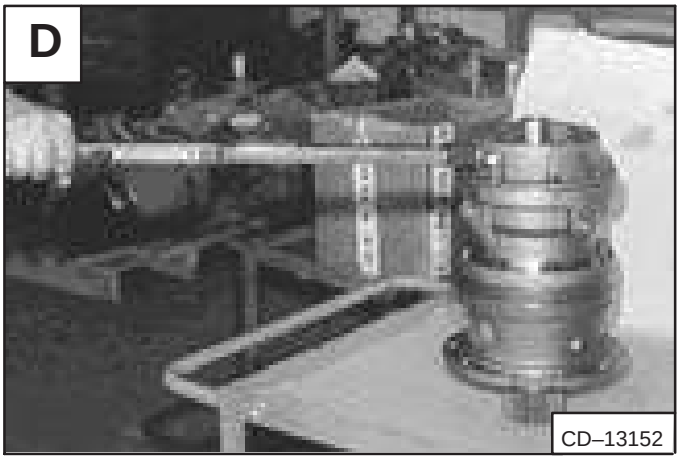
Install the center spacer onto the lower housing and align the bolt holes **[B]**.



Install the top housing onto the gear box **[C]**.



Install the eight (8) bolts into the top housing **[D]**. Tighten the bolts to 27–37 ft.–lbs. (40–50 Nm) torque.



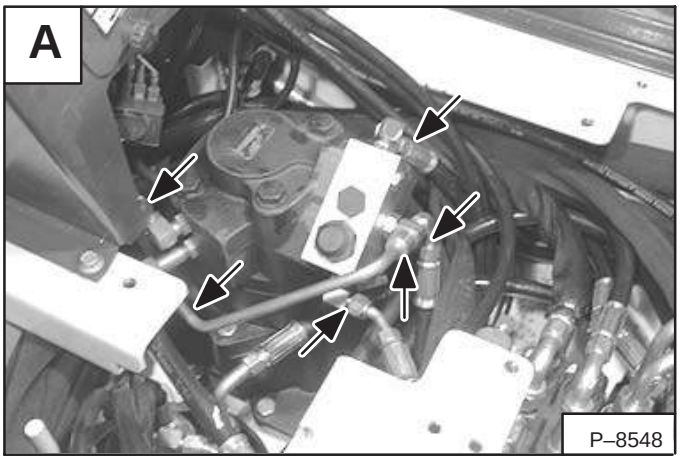
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SWING MOTOR

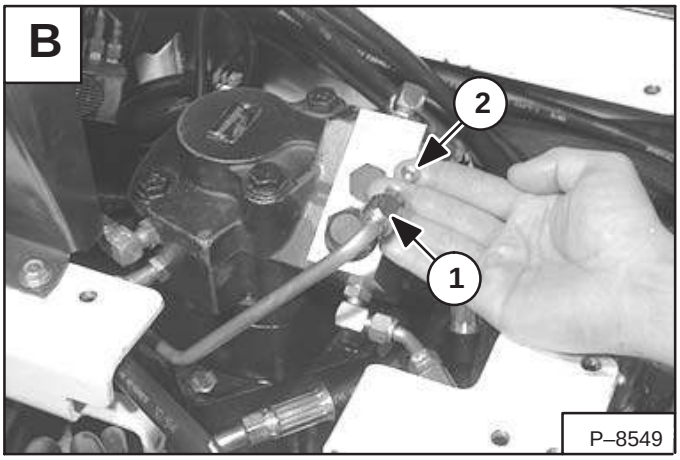
Removal and Installation (S/N 13001 & Above)

Mark the hoses and tubes for correct installation.

Remove the tubes and hoses from the swing motor **[A]**.



NOTE: Use care when removing the tube (Item 1) [B] not to lose the orifice (Item 2) [B] that is installed in the end of the tube.



Remove the four bolts (Item 1) **[C]** from the cross port relief valve. Remove the cross port relief valve (Item 2) **[C]**.

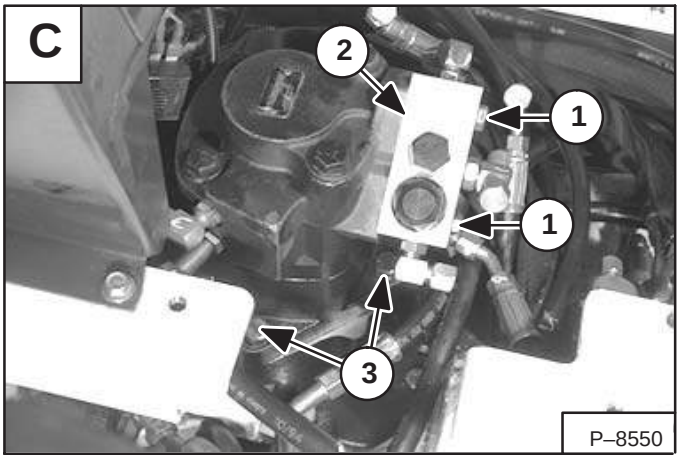
Remove the four (4) bolts (Item 3) **[C]** from the swing motor. Remove the swing motor.

Some machines have used bolts that are Grade 8,8 material and the later machines have used bolts that are Grade 10,9 material on the swing motor. Check the markings on the bolt head to determine the correct tightening torque.

Apply thread adhesive (LOCTITE #242) to the bolt threads.

Tighten the bolts to the following torque:

Grade 8,8 . . . . . 48–55 ft.–lbs. (65–75 Nm)
Grade 10,9 . . . . . 74–81 ft.–lbs. (100–110 Nm)



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SWING MOTOR DRIVE CARRIER (S/N 13001 & Above)

Removal and Installation

Mark and remove the eight (8) drive carrier mounting bolts.

NOTE: It is necessary to mark the mounting bolts as the bolts are not all the same length. The bolts must be installed in the original positions.

Install two 12 mm bolts in the threaded holes (Item 1) **[B]** in the drive carrier. Tighten the bolts down to push the drive carrier off of the two alignment pins.

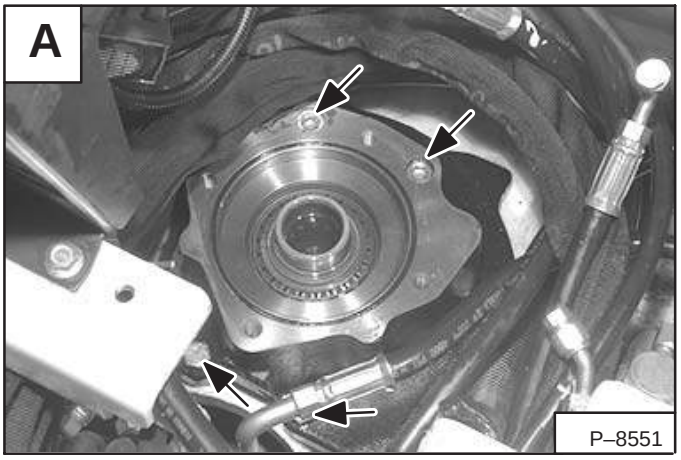
Remove the drive carrier from the excavator.

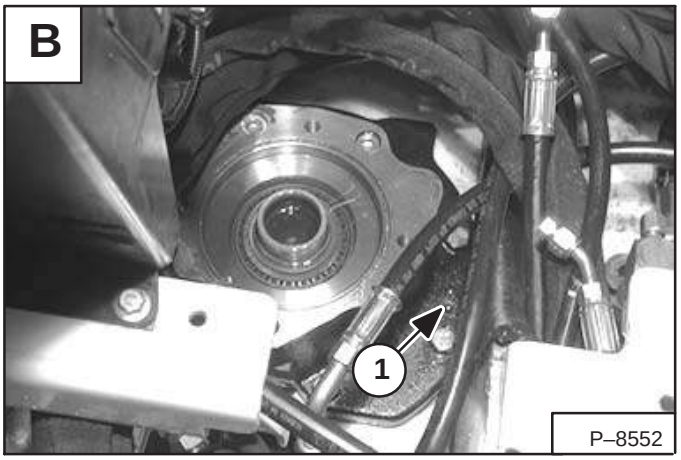
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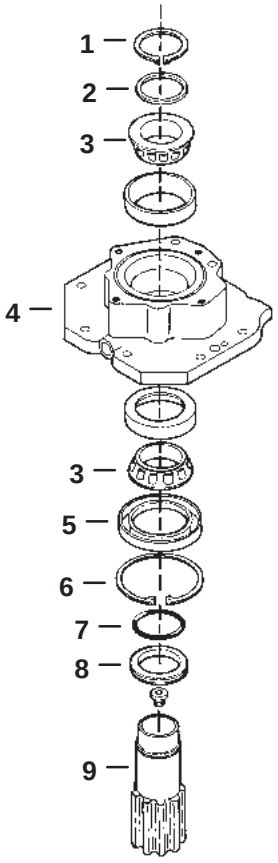




Parts Identification

SWING MOTOR DRIVE CARRIER

1. **Snap Ring**
2. **Spacer**
3. **Bearing**
4. **Housing**
5. **Seal**
6. **Snap Ring**
7. **O–ring**
8. **Spacer**
9. **Shaft**



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SWING MOTOR DRIVE CARRIER (S/N 13001 & Above) (Cont'd)

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.

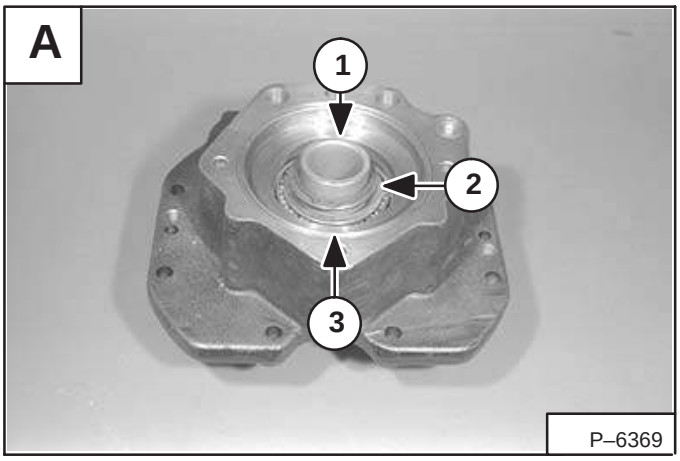
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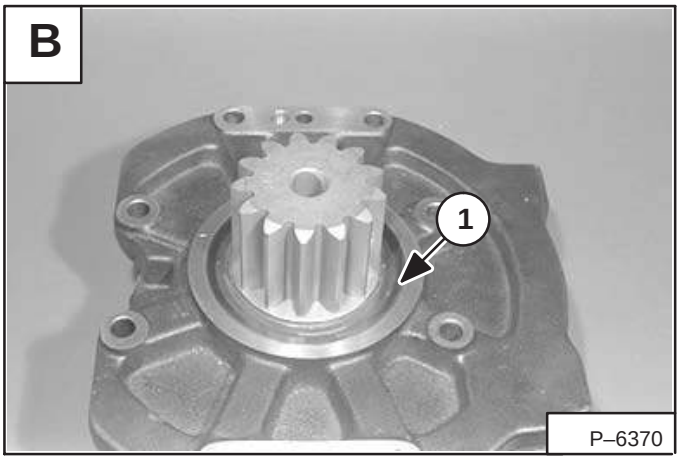
Drain the lubrication oil from the assembly by removing the drain plug, located in the bottom of the swing drive shaft (Item 1) **[A]**.

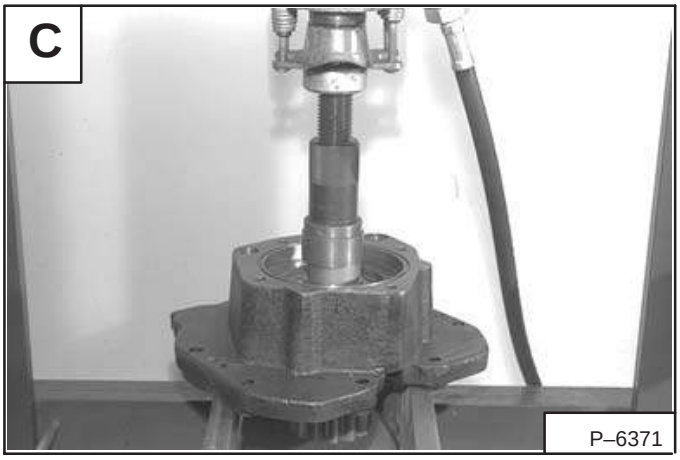
Remove the snap ring (Item 2) **[A]** and the spacer (Item 3) **[A]** from the top of the drive shaft.

Remove the snap ring (Item 1) **[B]** from the bottom of the carrier.

Press the drive shaft out the bottom of the carrier to remove the top bearing and bottom seal **[C]**.





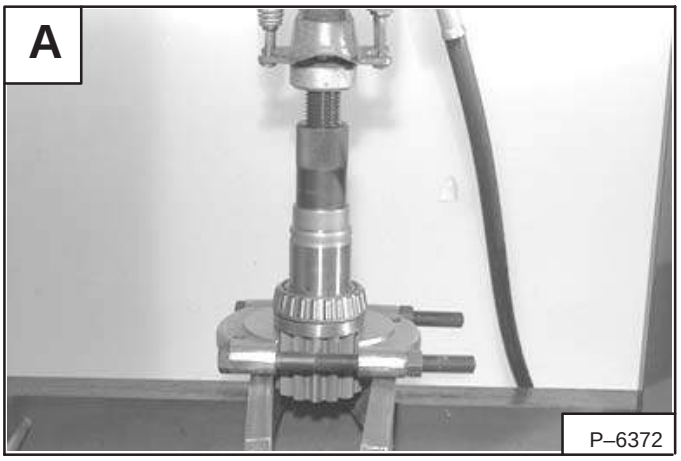


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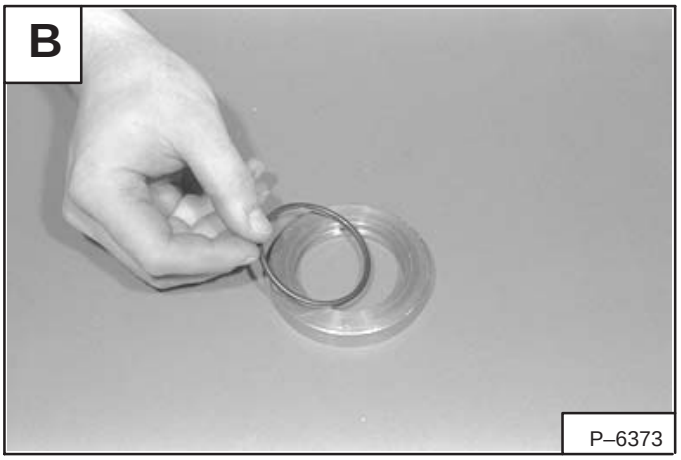
SWING MOTOR DRIVE CARRIER (S/N 13001 & Above) (Cont'd)

Disassembly (Cont'd)

Remove the bottom bearing and spacer by supporting the spacer and pressing the shaft through it **[A]**.

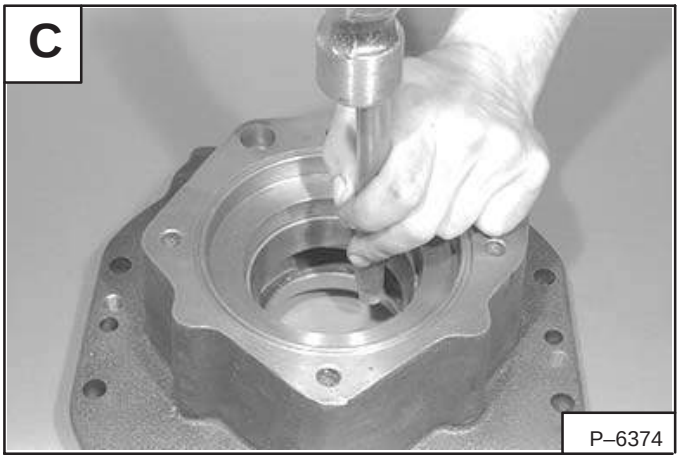


Remove the O–ring located inside the spacer **[B]**.



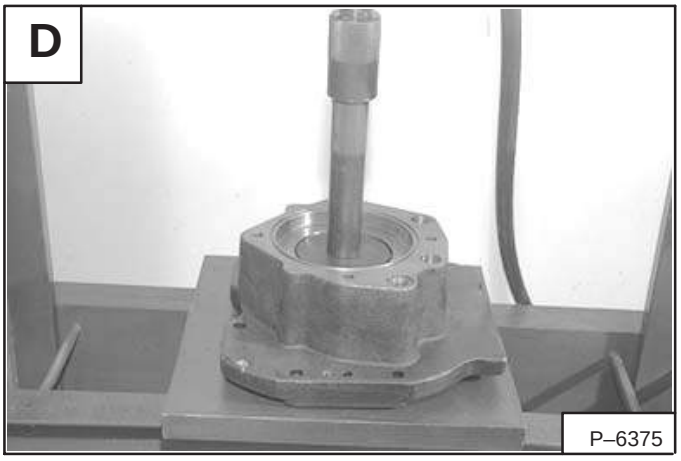
Using a hammer and brass punch, remove the bearing cups from the top and bottom of the carrier **[C]**.

Clean all parts in solvent and dry with compressed air.



Assembly

Apply a light film of grease to the outside of the new bearing cups, and press the top and bottom cups into the carrier **[D]**.

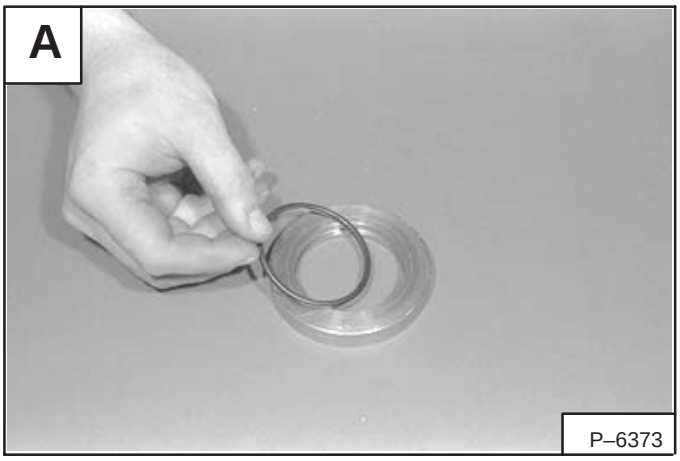


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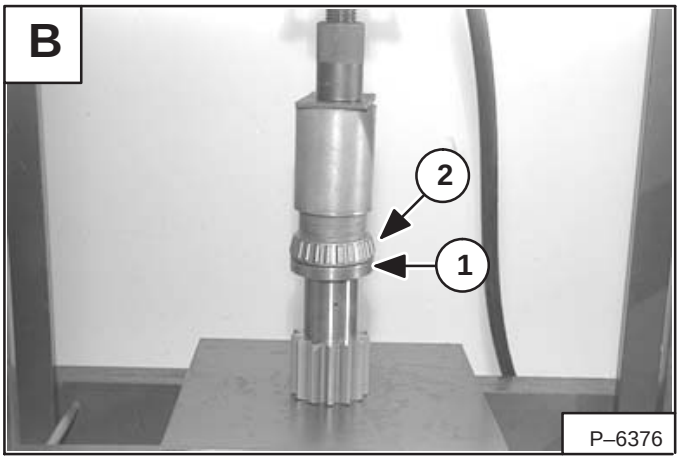
SWING MOTOR DRIVE CARRIER (S/N 13001 & Above) (Cont'd)

Assembly (Cont'd)

Oil and install a new O–ring inside the spacer **[A]**.

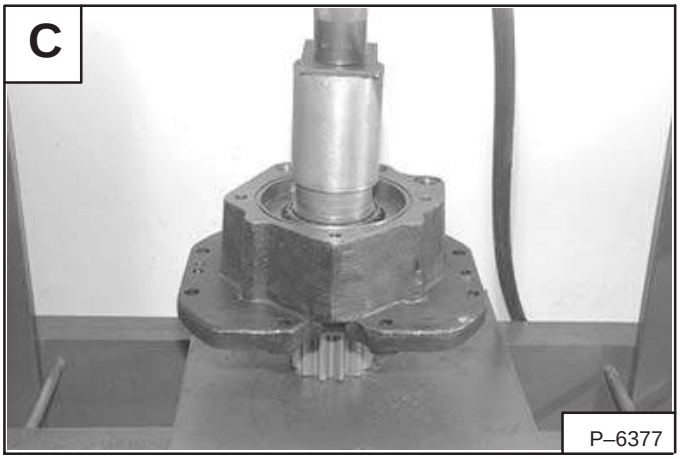


Press the spacer (Item 1) **[B]** and a new bearing (Item 2) **[B]** on to the drive shaft.

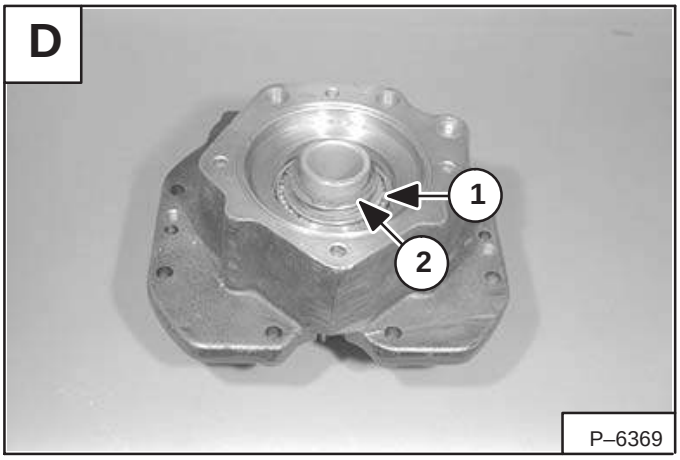


Install the drive shaft with the spacer and the new bearing installed, through the bottom of the carrier.

Press a new bearing on the top of the drive shaft **[C]**.



Install the washer (Item 1) **[D]** and the snap ring (Item 2) **[D]** on the drive shaft.



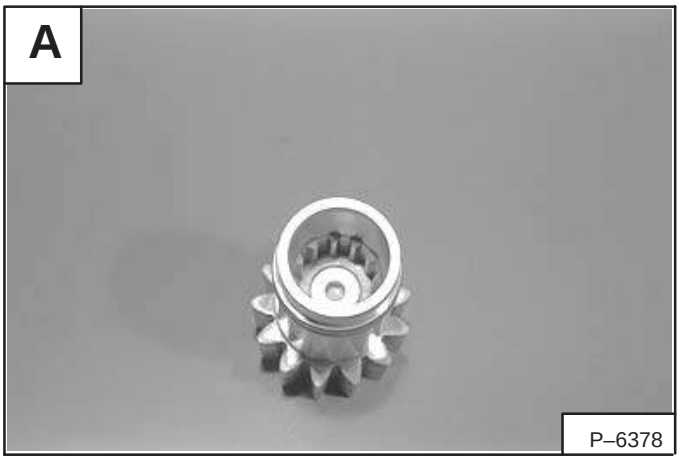
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SWING MOTOR DRIVE CARRIER (S/N 13001 & Above) (Cont'd)

Assembly (Cont'd)

Oil and install a new O–ring on the drain plug.

Install the plug in the bottom of the drive shaft **[A]**.

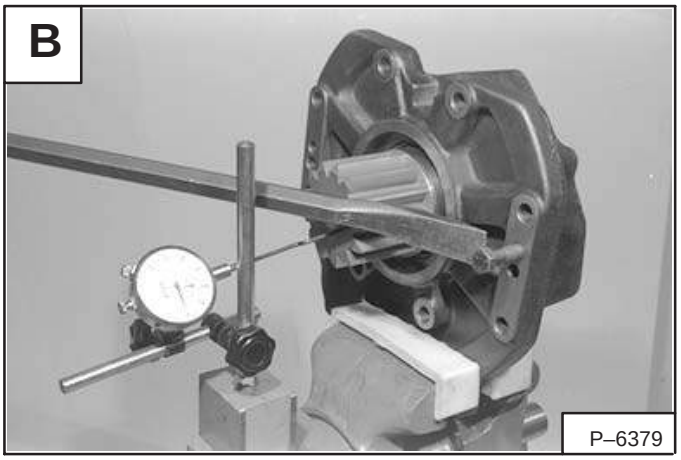


Clamp the carrier in a vise that has padded jaws. Thread a bolt in the threaded hole in the carrier flange. Setup a dial indicator so the end play of the drive shaft can be checked, by placing a pry bar under the head of the installed bolt and across the end of the drive shaft **[B]**.

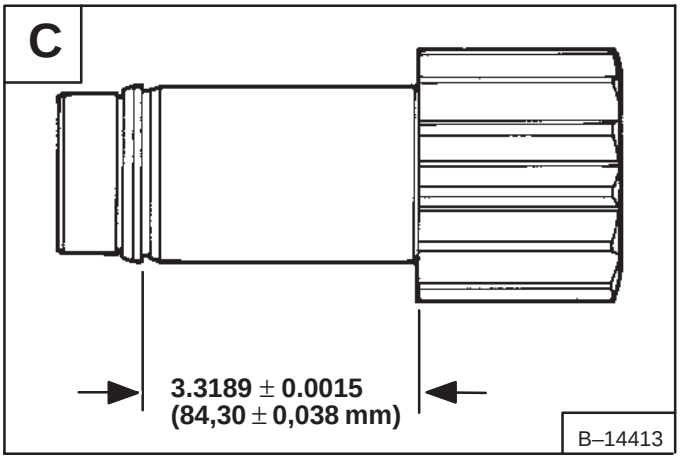
End play should not be more than .009'' (.229 mm) and the shaft should rotate smoothly.

If the end play is greater than .009'' (.229 mm) the carrier assembly has to be disassembled and the following components checked;

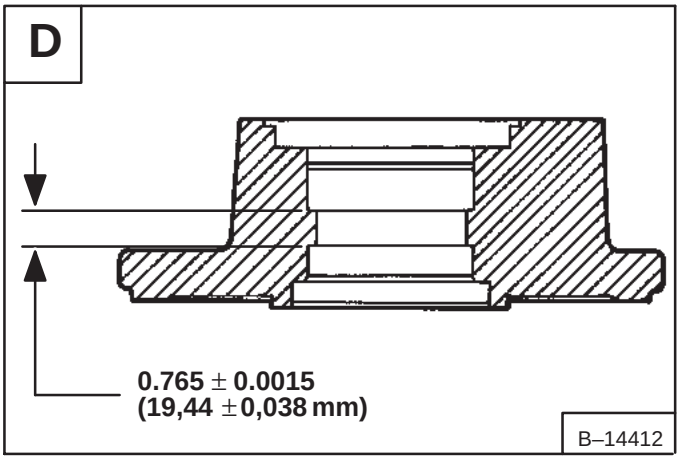
Snap Ring . . . . . .078" ±.002" (1.98 ± .05 mm)
Washer . . . . . .178" ± .001'' (4.52 ± .03 mm)
Spacer . . . . . .472" ± .002'' (12.0 ± .05 mm)



Length of drive shaft from top of snap ring groove to top of spline section 3.3189" ± .0015" (84.3 ± .038 mm) **[C]**.



Top bearing cup seat to bottom bearing cup seat .765'' ± .0015'' (19.44 ± .038 mm) **[D]**.



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SWING MOTOR DRIVE CARRIER (S/N 13001 & Above) (Cont'd)

Assembly (Cont'd)

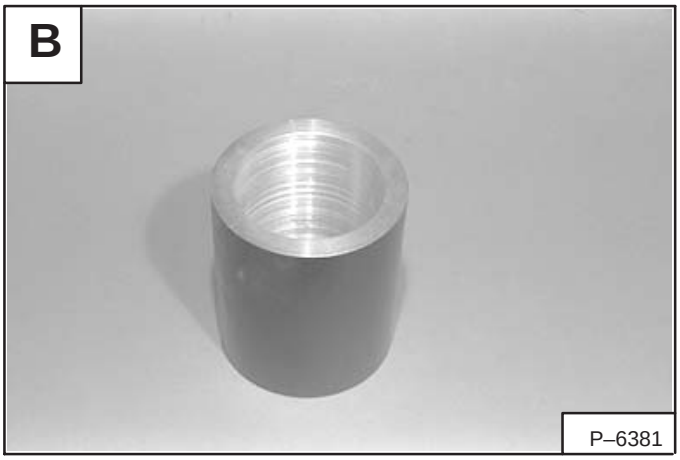
Install the seal in the bottom of the carrier **[A]**.



A seal installation tool can be made locally **[B]**.

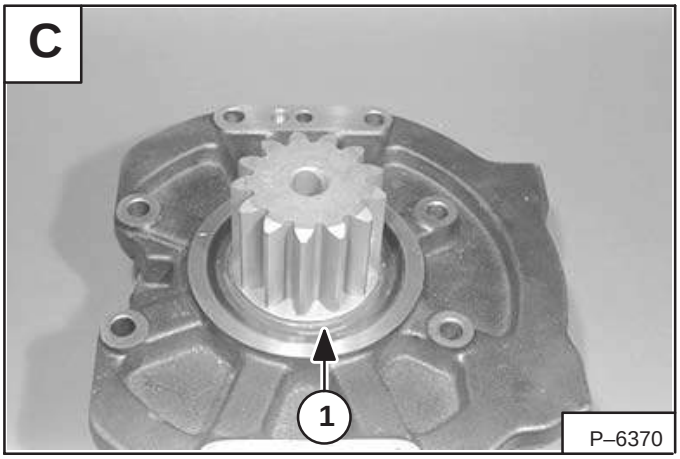
Dimensions of the seal installation tool:

I.D.	3.250" (82,55 mm)
O.D.	4.0" (101,6 mm)
Height	5.0 " (127 mm)



Install the bottom snap ring (Item 1) **[C]**.

After the drive assembly has been installed in the excavator, fill the carrier with enough hydraulic fluid to cover the top bearing, before installing the swing motor.



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UPPERSTRUCTURE AND SWING CIRCLE GEAR

Removal and Installation

This section involves the removal and installation of the complete upperstructure from the track frame.

Remove the floormat. (See Page 4–6.)

Remove the floor plate. (See Page 4–6.)

Fasten the lifting fixture sling to the lifting holes at the left and right side at the rear of the upperstructure and the lift eye on the boom **[A]** & **[B]**.



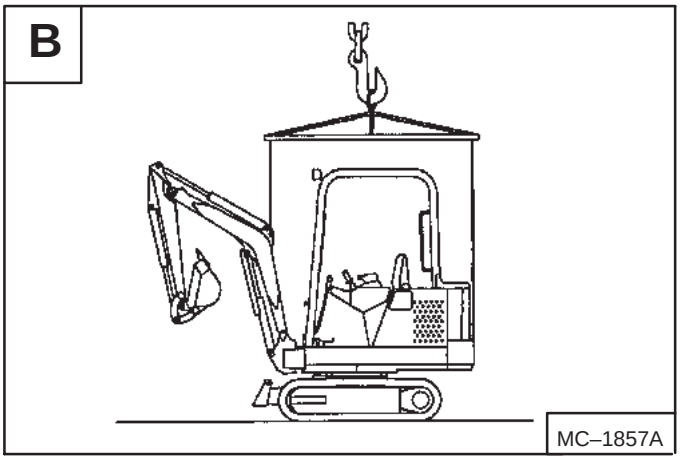
The boom must be in full raised position and centered to the front of the excavator. **[B]**.

⚠ WARNING

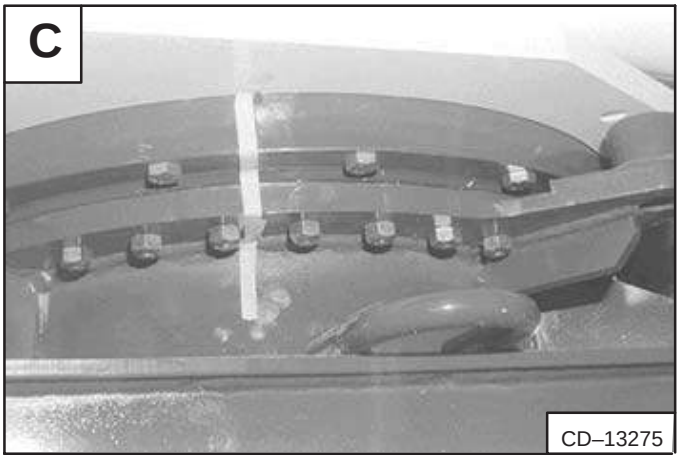
AVOID INJURY OR DEATH

- **Use a lifting fixture with sufficient capacity for the weight of the excavator plus any added attachments.**
- **Maintain center of gravity and balance when lifting.**
- **Never lift with operator on machine.**

W–2170–0195

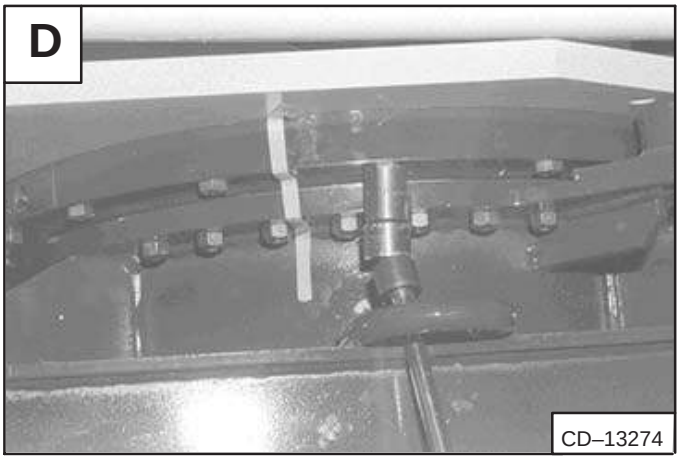


Mark the upperstructure to the swing bearing and to the track frame for assembly **[C]**.



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. Remove this bolt and continue the above procedure.

NOTE: For disassembly safety a minimum of four evenly spaced bolts must remain installed, to be removed later.



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UPPERSTRUCTURE AND SWING CIRCLE GEAR (Cont'd)

Removal and Installation (Cont'd)

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.

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Mark the eight hoses and fittings on the top portion of the swivel for correct installation **[A]**. Remove the hoses from the swivel joint.

Remove the swivel joint stop bolt (Item 1) **[A]** and nut.

Apply a small amount of lifting pressure to the upperstructure with the lift sling. Remove the four remaining bolts holding the upperstructure to the swing bearing.

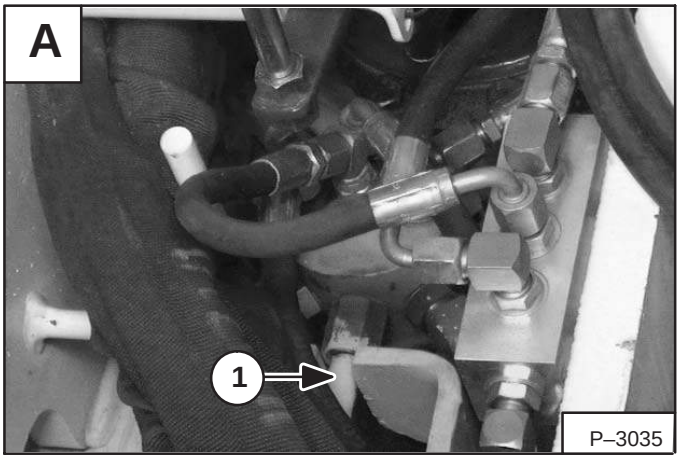
Lift the upperstructure off of the swing bearing. Put the upperstructure on suitable supporting stands or blocks **[B]**.

Swing Bearing Removal

Install a c–clamp or other suitable retainer to prevent the swing bearing from turning while being removed **[C]**.

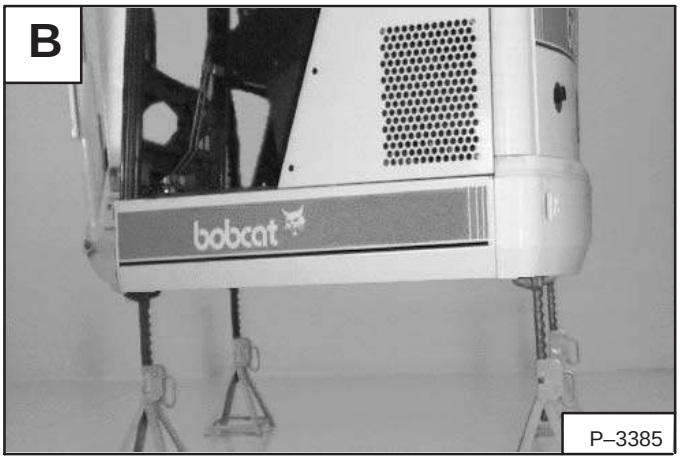
Remove the 24 bolts and nuts that hold the swing bearing to the track frame **[D]**.

A



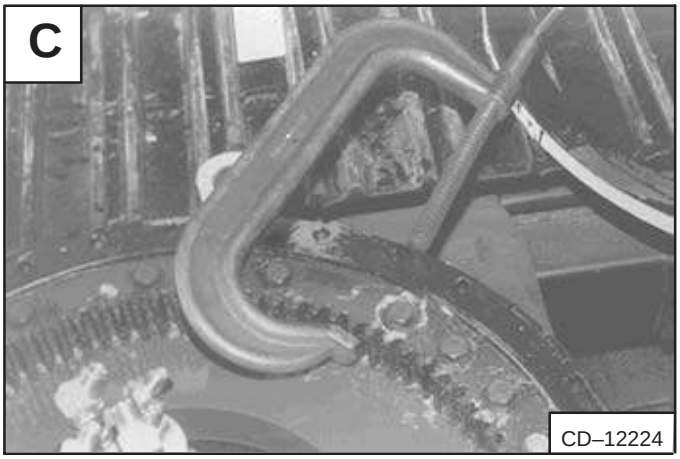
P–3035

B



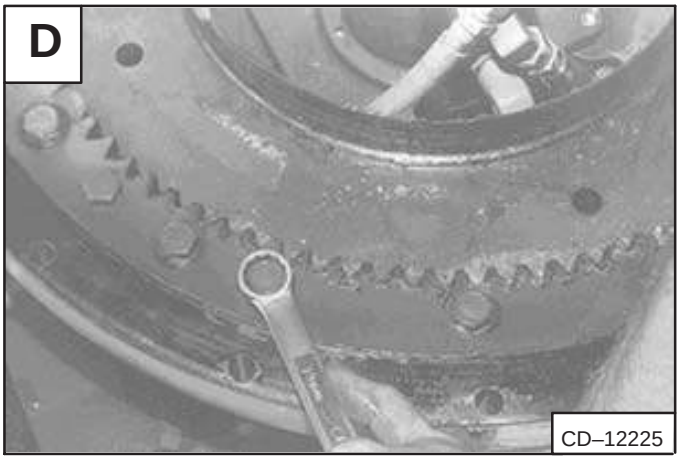
P–3385

C



CD–12224

D

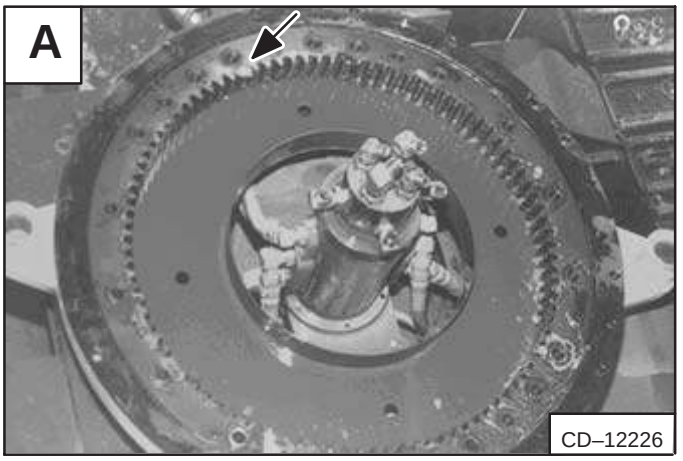


CD–12225

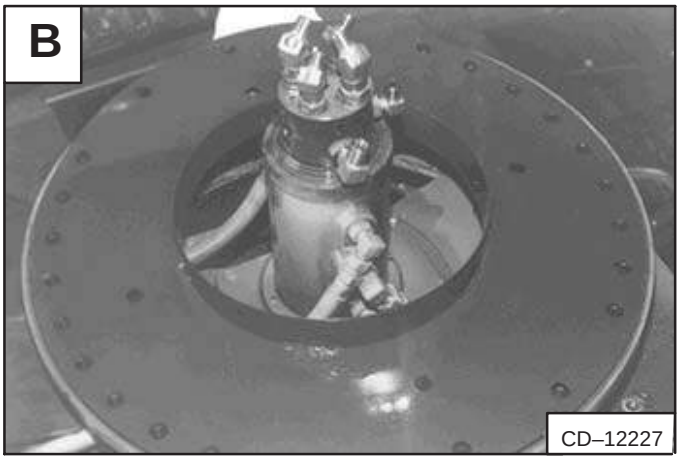
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Swing Bearing Removal (Cont'd)

Mark the top surface of the swing bearing for ease of assembly. Remove the swing bearing from the track frame **[A]**.



Remove the grease cover from the track frame. Clean and inspect the grease cover for damage **[B]**. Replace if necessary.

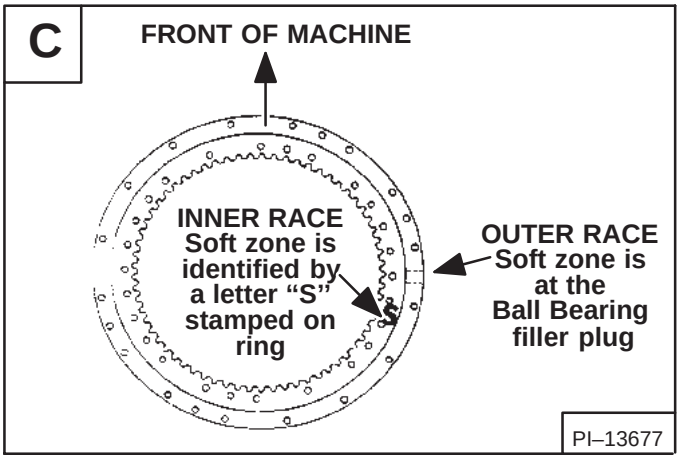


Swing Bearing Installation

If reusing the existing swing bearing, use top side and edge aligning marks to put the swing bearing in the correct location. If a new swing bearing is being installed, find the soft zone area **[C]**.

Install the swing bearing so that the soft zone is at either the L.H. or R.H. side of the excavator.

NOTE: DO NOT put the soft zone to the front or rear of excavator.



Install the 24 bolts and lock nuts **[D]**.

Tighten the nuts to 73–81 ft.–lbs. (100–110 Nm) torque.



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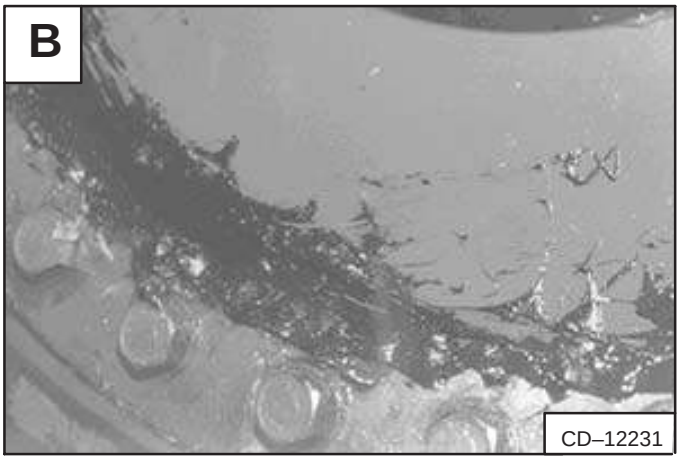
UPPERSTRUCTURE AND SWING CIRCLE GEAR (Cont'd)

Swing Bearing Installation (Cont'd)

Use a tap (12 mm) in the holes in the upperstructure to remove any dried thread lock or burrs **[A]**.

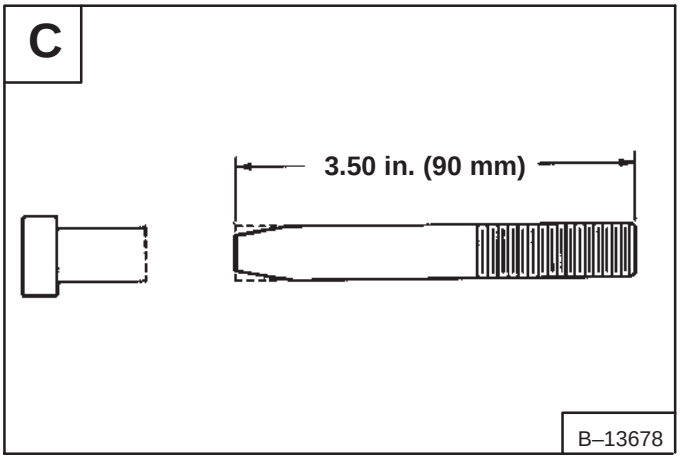


Put lubriplate grease or equivalent on the swing bearing gear **[B]**.



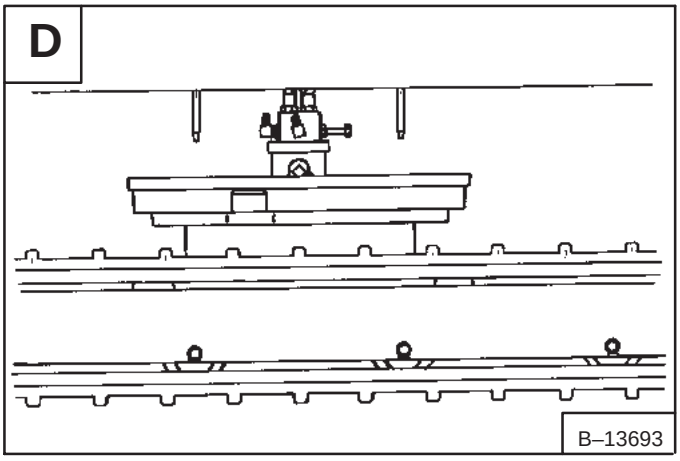
Make three alignment pins by using M12 x 110 mm (P/N 7GM–12110) long bolts. Cut the head off of these bolts at 3.50 in. (90 mm), then taper this end of the bolts **[C]**.

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.



Install the upperstructure onto the swing bearing using the alignment marks and the alignment pins **[D]**.

Make sure 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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UPPERSTRUCTURE AND SWING CIRCLE GEAR (Cont'd)

Swing Bearing Installation (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 correctly align the upperstructure for correct swing motor gear to swing bearing ring gear clearance.

Tighten these three tapered bolts to 60 ft.–lbs. (81 Nm) torque.

Remove the three, 3.50'' (90 mm) alignment pins from the upperstructure.

These headless pins can be removed from the bottom.

Apply thread adhesive (LOCTITE 242) to the swivel joint stop bolt.

Install the swivel joint stop bolt and nut into the swivel joint.
Install the nut completely onto the bolt threads then tighten the bolt to 110–125 ft.–lbs. (150–170 Nm) torque.

Install the hoses and fittings that were removed earlier. Start the engine and run at idle to rotate the upperstructure to install and tighten the bolts.

Apply liquid adhesive (LOCTITE 242) to the threads of the bolts. Install the bolts into all holes (except the three with the alignment bolts installed). Tighten these bolts to 73–81 ft.–lbs. (100–110 Nm) torque.

Remove the three alignment bolts (P/N 6535902). Install the three remaining bolts. Tighten these bolts to 73–81 ft.–lbs. (100–110 Nm) torque.

Check the backlash between the gears by moving the frame back and forth at several points throughout 360° of frame rotation. There must be some backlash present.

Install the floor plate and floormat.

Check the hydraulic fluid level and add as necessary.

Alignment Pins (Not Threaded)

If the upperstructure is being replaced, use the special alignment pins (P/N 6586495) in the holes provided in the upperstructure **[B]** & **[C]**.

Remove any paint from the three alignment pin holes.

Use a chain hoist to lower the upperstructure onto the swing bearing.

Align the bolt holes in the upperstructure with the holes in the bearing.

Install an alignment pin into the upperstructure and put the upperstructure on the bearing to allow the pin to be put into the swing bearing gear teeth. Pull the upperstructure to set the pin firmly into the bearing teeth.

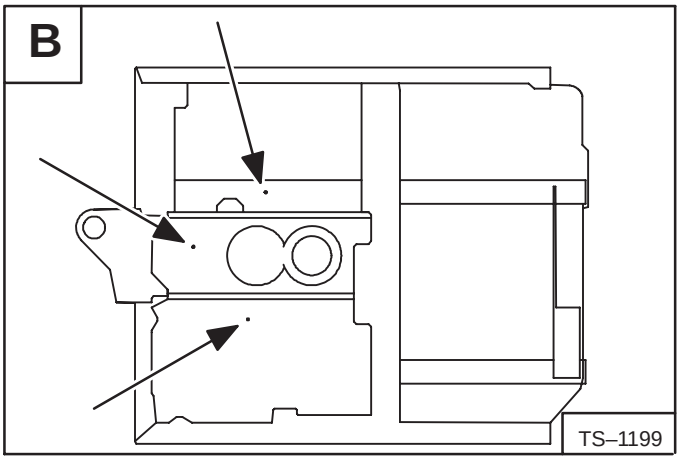
Install the next alignment pin into the upperstructure and into the bearing gear teeth. Pull the upperstructure to set the second pin into the bearing teeth.

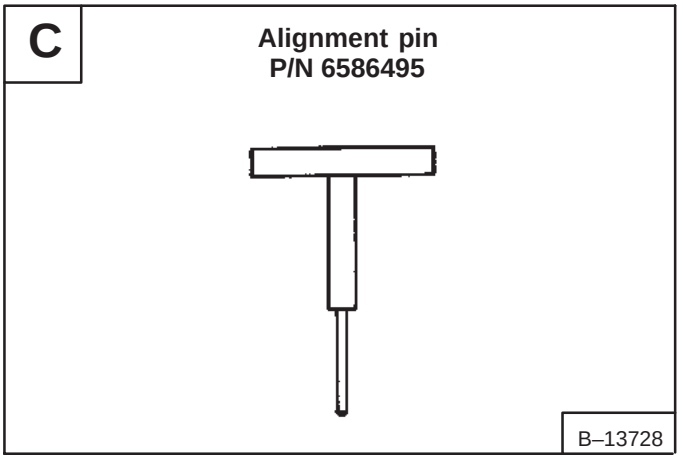
Install the third alignment pin, this will align the bearing to the upperstructure for correct swing motor to bearing teeth engagement.

Apply liquid adhesive (LOCTITE 242) to the bolt threads. Rotate the upperstructure to install the bolts.

Tighten the bolts to 73–81 ft.–lbs. (100–110 Nm) torque.







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CENTER SWIVEL JOINT

Removal and Installation (S/N 12999 & Below)

Through Bottom Access Cover.

Lower blade and boom to the ground.

Stop the engine.

⚠ WARNING

Put jackstands under the blade and front and rear corners of the under carriage before working under the machine. Failure to block up the machine may allow it to move or fall and result in injury or death.

Remove two and loosen two bolts (Item 1) **[A]** from the access cover (Item 2). Remove the access plate (Item 2) **[A]** from the bottom of the under carriage. The plate mounting holes have slots so that the plate can be easily removed.

Installation: Tighten the bolts to 30–37 ft.–lbs. (40–50 Nm) torque.

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 or tag the hoses and fittings for correct installation **[B]**.

Remove the bottom 8 hoses from the swivel joint **[B]**.

Remove the floormat and floor panels. (See Page 4–6.)

Mark or tag the hoses and fittings for correct installation **[C]** & **[D]**.

Remove the top eight hoses from the swivel joint from the top side **[C]**.

Remove the jam nut and the swivel joint stop bolt (Item 1) **[C]**.

Installation: Apply liquid adhesive (LOCTITE 242) to the swivel joint stop bolt and install the jam nut and the bolt into the swivel joint. Tighten the nut completely onto the bolt threads. Tighten the bolt to 110–125 ft.–lbs. (150–175 Nm) torque.

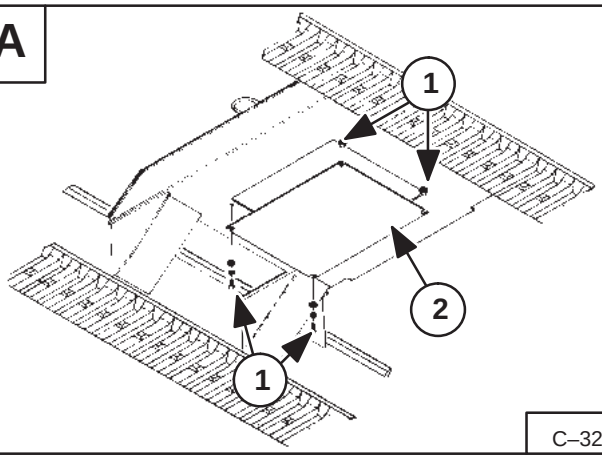
Remove the four bolts (Item 1) **[D]** holding the swivel joint to the track frame.

Installation: Tighten the bolts to 48–55 ft.–lbs. (65–75 Nm) torque. Use LocTite 242 on the bolt threads.

Rotate the swivel joint 90 degrees **[D]**. Lower the swivel joint out the bottom of under carriage.

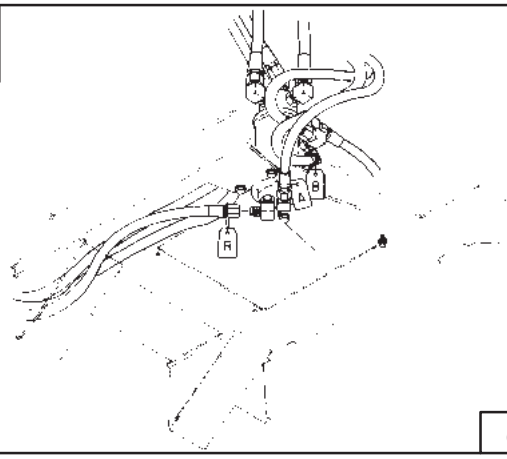
Inspect the fitting O–rings for damage and replace as necessary.

A



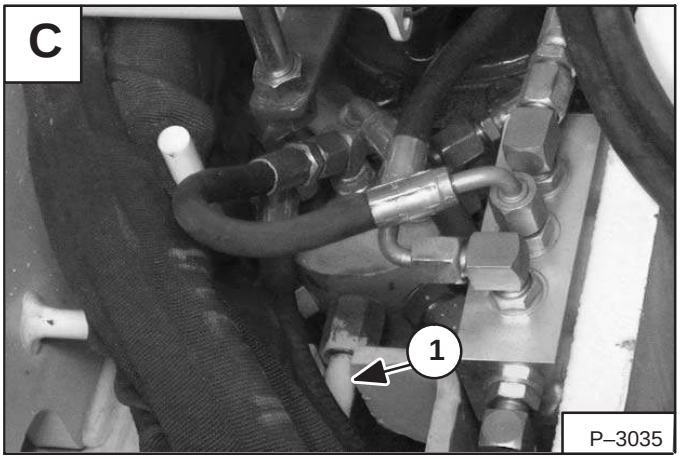
C–3299

B



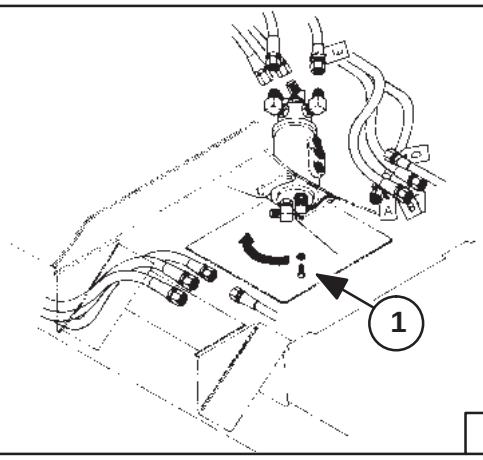
C–3300

C



P–3035

D



C–3301

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CENTER SWIVEL JOINT (Cont'd)

Removal and Installation (S/N 13001 & Above)

Remove the floor mat and floor plate. (See Page 4–6.)

Remove the swing motor cover. (See Page 4–8.)

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 ease of installation.

Remove the hoses from the center swivel joint **[A]**.

Remove the jam nut and swivel joint stop bolt (Item 1) **[A]**.

Installation: Apply thread lock (LOCTITE #242) to the swivel joint stop bolt and install the jam nut and the bolt in the swivel joint. Tighten the nut completely on the bolt threads. Tighten the bolt to 110–125 ft.–lbs. (150–175 Nm) of torque.

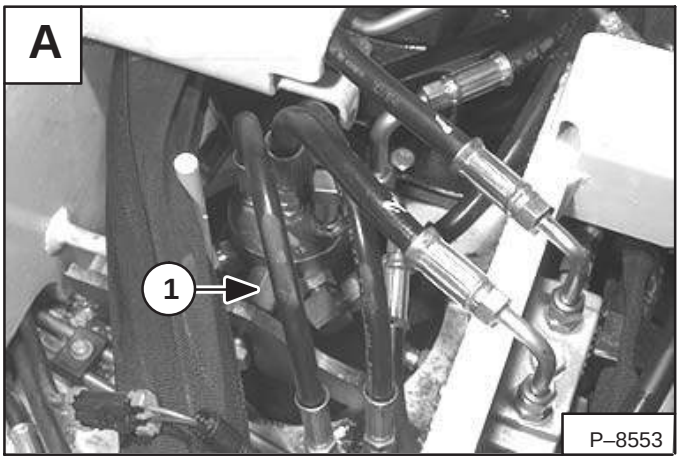
Remove the access plate from the bottom of the undercarriage **[B]**.

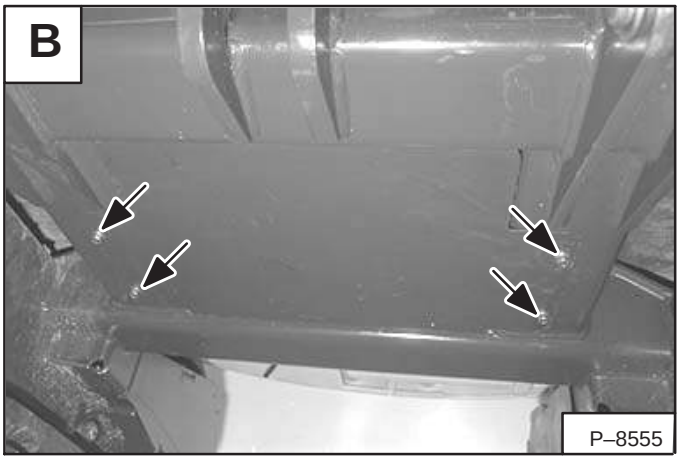
Mark the hoses for ease of installation.

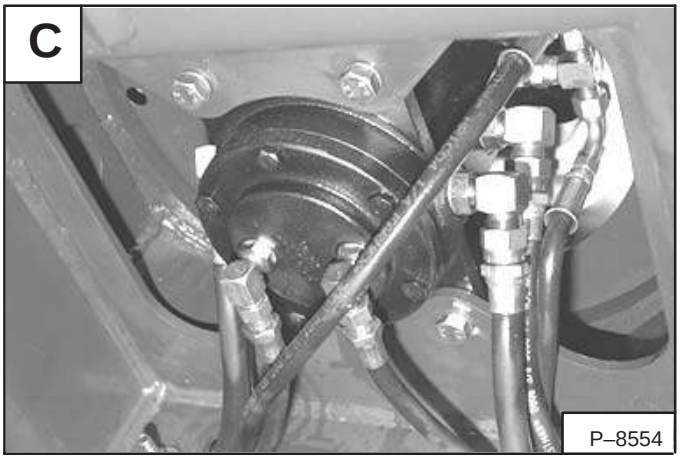
Remove the hoses from the swivel joint **[C]**. Remove the four (4) mount bolts from the swivel joint **[C]**.

Installation: Apply thread lock (LOCTITE #242) to the mount bolts and tighten to 48–55 ft.–lbs. (65–75 Nm) of torque.

Lower the swivel joint through the bottom of the undercarriage.





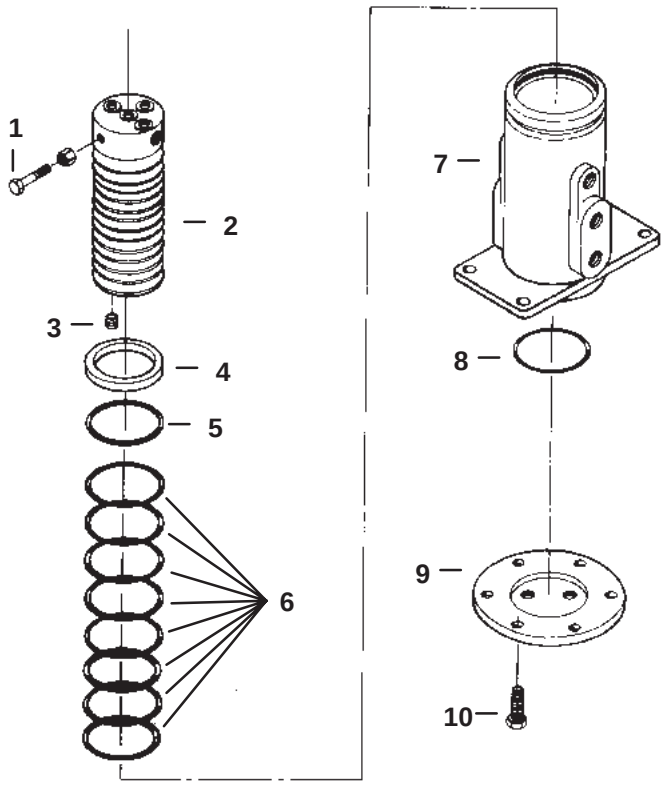


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Parts Identification

SWIVEL JOINT

1. Bolt
2. Rotor
3. Plug
4. Seal
5. Seal
6. Seal
7. Body
8. O–Ring
9. Cover
10. Bolt



D–2250

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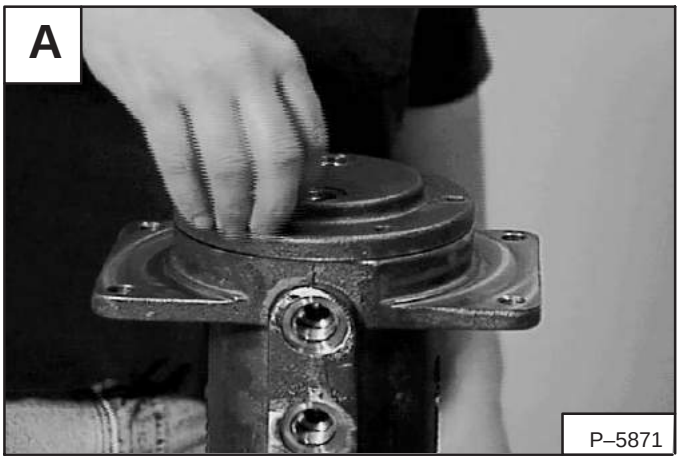
CENTER SWIVEL JOINT (Cont'd)

The swivel joint is a rotary hydraulic swivel, under pressure, to the travel motors and the blade.

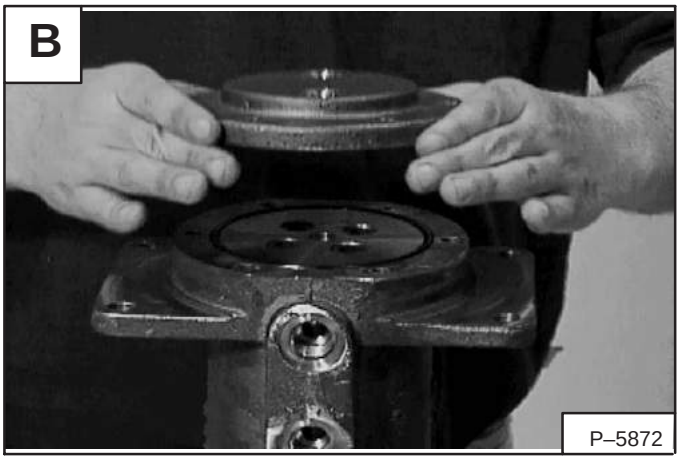
Disassembly

Mark the cover and body for ease of assembly.

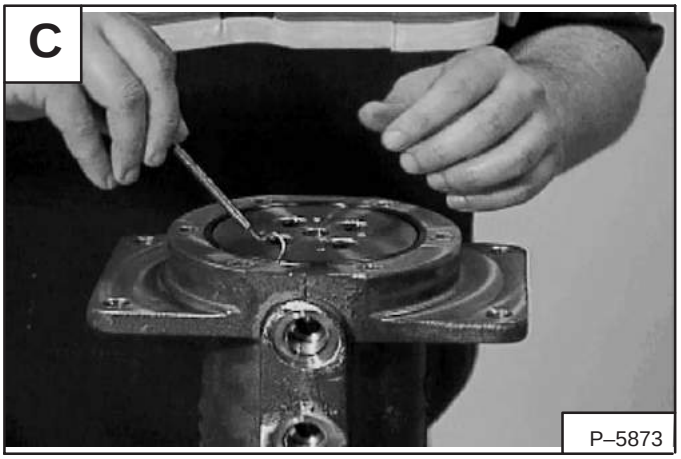
Remove the six (6) bolts from the cover **[A]**.



Remove the cover **[B]**.



Remove the O–ring from the O–ring groove **[C]**.

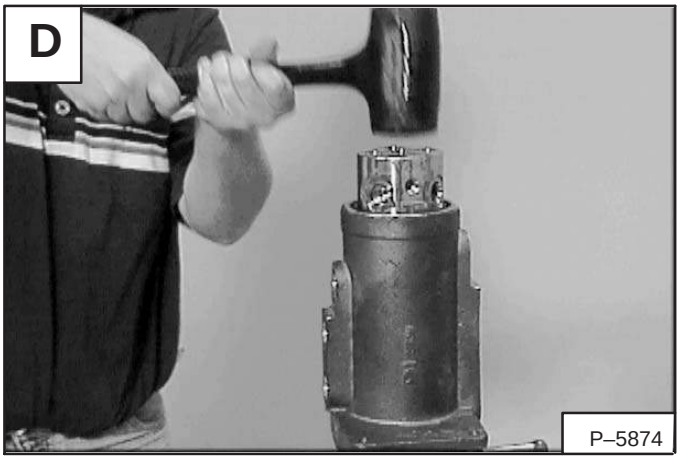


Clamp the swivel joint, base end down in a vise, and drive the rotor out of the body with a soft faced hammer **[D]**.

Remove all the O–rings and glide rings from the rotor.

Clean the rotor with solvent and dry with compressed air.

NOTE: Use care not to scratch the rotor surface as damage to the finished surface could cause internal leakage.



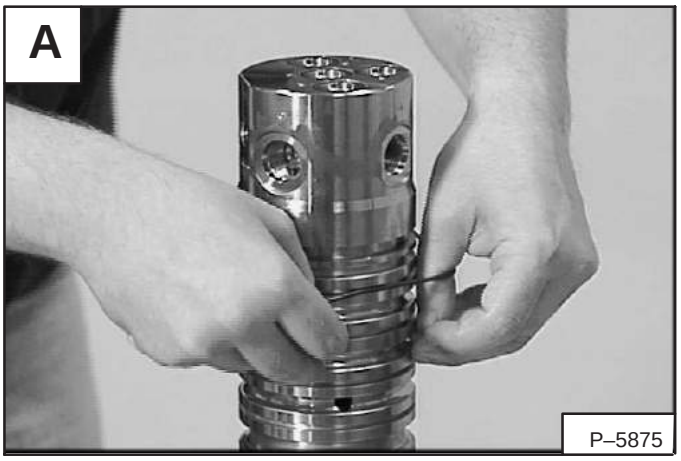
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CENTER SWIVEL JOINT (Cont'd)

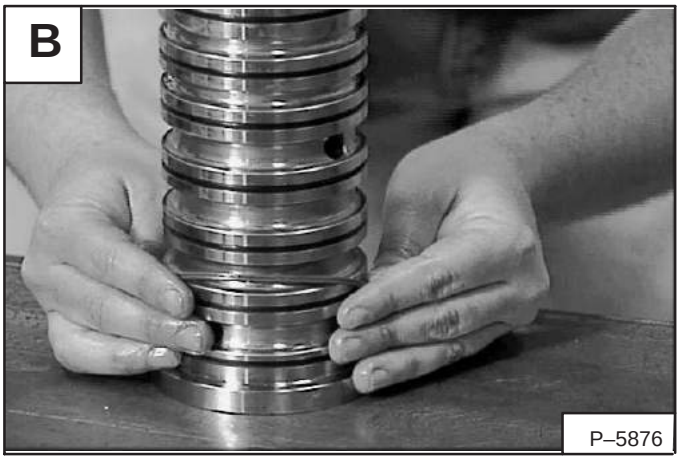
Assembly

Install new O–rings on the rotor **[A]**.

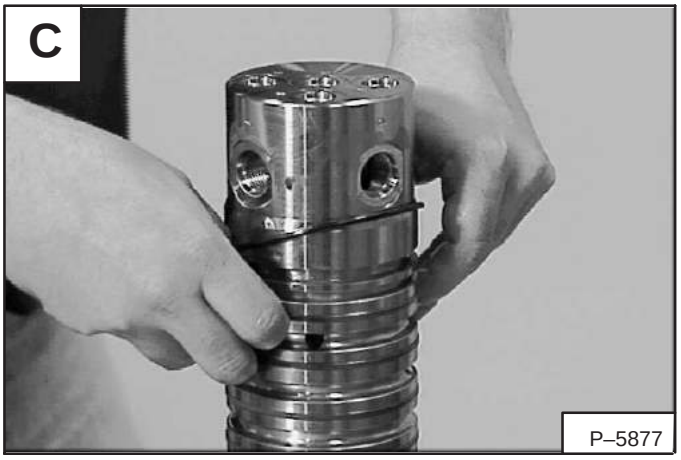
Heat the glide rings and crown seal in hydraulic oil for three (3) minutes at 130° F (54° C).



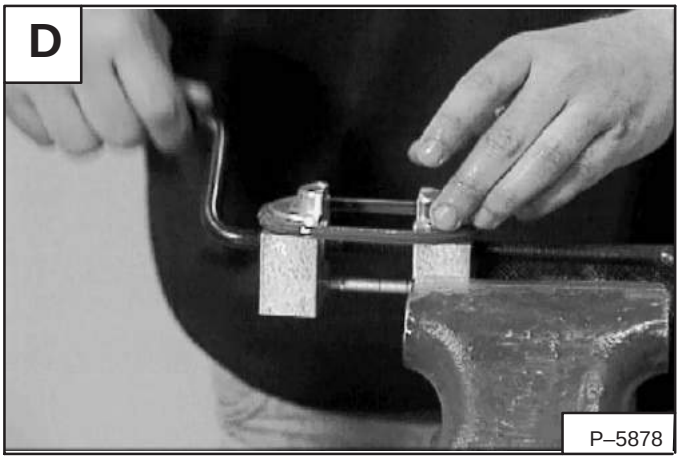
Stretch the heated glide rings to 4" (101,6 mm) and install on the rotor **[B]**.



Install the crown seal O–ring **[C]**.



Stretch the heated crown seal to 4.5" (114,3 mm) **[D]**.



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CENTER SWIVEL JOINT (Cont'd)

Assembly (Cont'd)

Work the crown seal on the rotor and down to the top groove **[A]**.



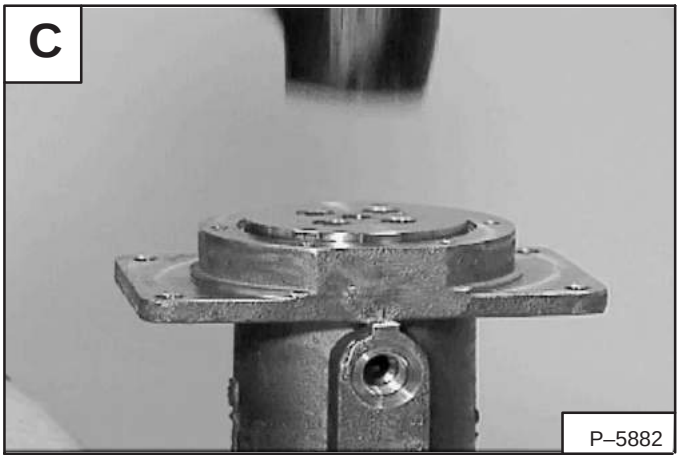
Press the wiper seal in the body **[B]**

Lubricate the inside of the body and the rotor with hydraulic oil or light grease.

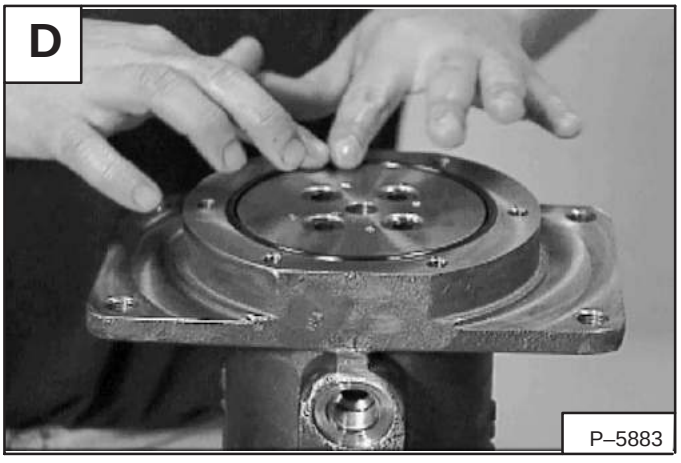
Slide the rotor in the body.



Seat the rotor using a soft faced hammer **[C]**.



Install a new O–ring in the groove on the bottom of the body **[D]**.

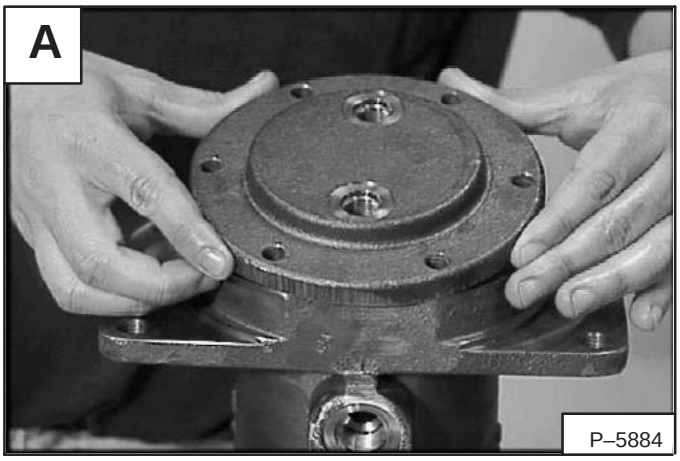


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CENTER SWIVEL JOINT (Cont'd)

Assembly (Cont'd)

Install the cover on the body **[A]**.



Apply thread lock (LOCKTITE #242) to the bolt threads, and install the cover bolts. Tighten to 18 ft.–lbs. (24 Nm) of torque.



Check the breakaway torque of the swivel joint **[C].**

The breakaway torque of the swivel joint is 50–90 ft.–lbs. (68–122 Nm).



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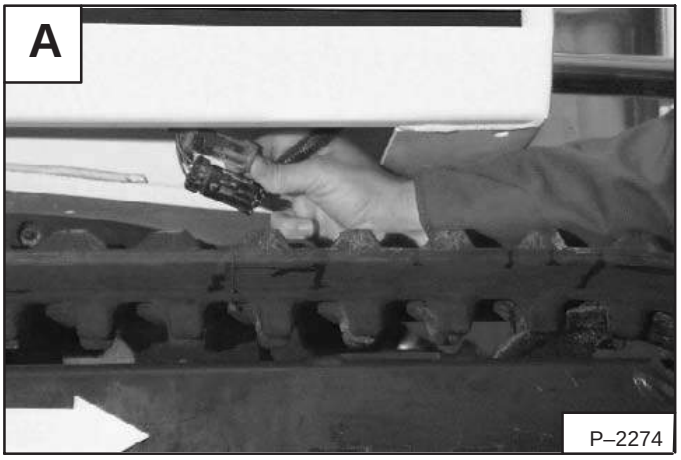
ROPS CANOPY

Removal and Installation

Disconnect the battery negative (–) cable. (See Page 6–1.)

Remove the floor plate. (See Page 4–6.)

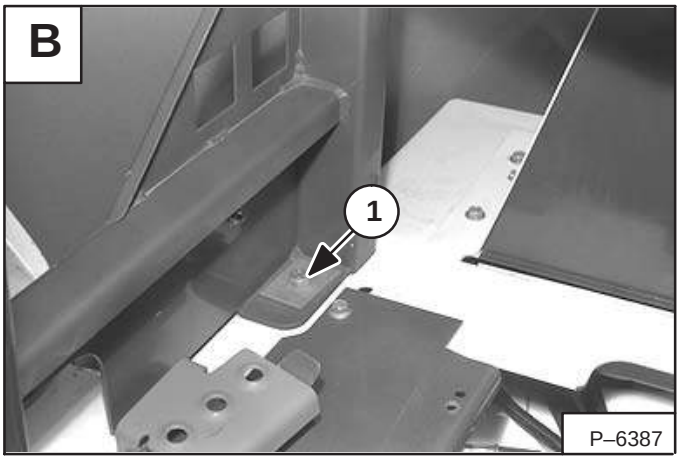
Disconnect the canopy harness from the main harness **[A]**. The harness connectors are under the right hand upperstructure, near the boom swing cylinder.



Remove the bolt (Item 1) **[B]**, the nut and the three spacers from both front corners of the canopy.

NOTE: One of the plates goes between the canopy mount and the top of the upperstructure.

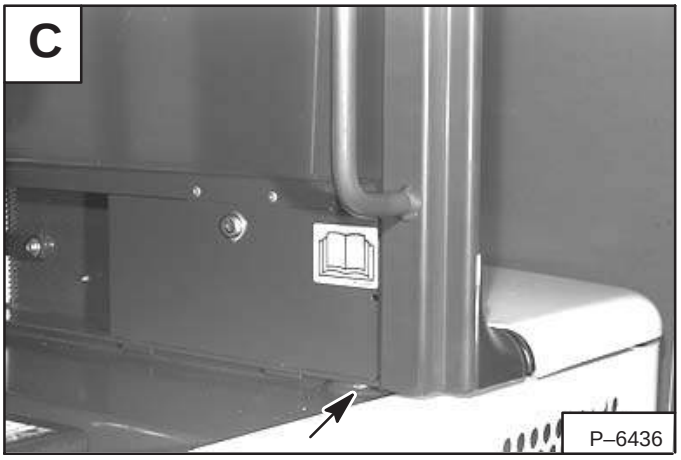
Installation: Tighten the bolts to 48–55 ft.–lbs. (65–75 Nm) torque.



Unlock and remove the storage compartment **[C]**.

Remove the bolt and the spacer from both the rear corners of the canopy **[C]**.

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



Install a lifting sling to the canopy and use a lifting device of sufficient capacity and lift the canopy up a few inches **[D]**.



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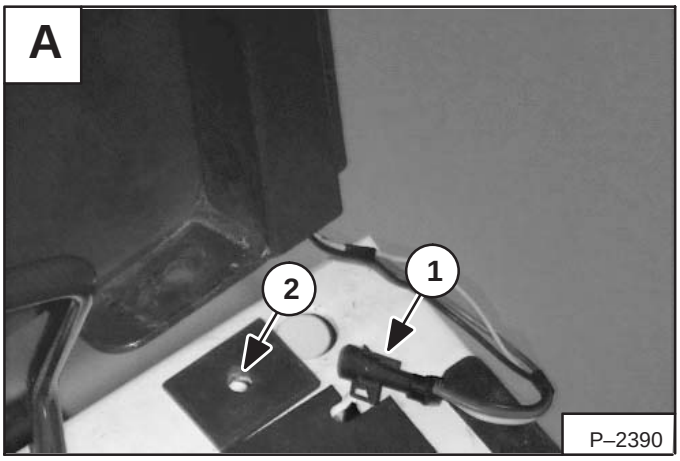
ROPS CANOPY (Cont'd)

Removal and Installation (Cont'd)

With canopy lifted up a few inches, pull the canopy harness (Item 1) **[A]** up and out of right hand front upperstructure access hole.

Remove the third plate (Item 2) **[A]** that is between the bottom of the canopy mount and the top of the upperstructure.

Remove the canopy from the excavator.



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CAB

Removal and Installation

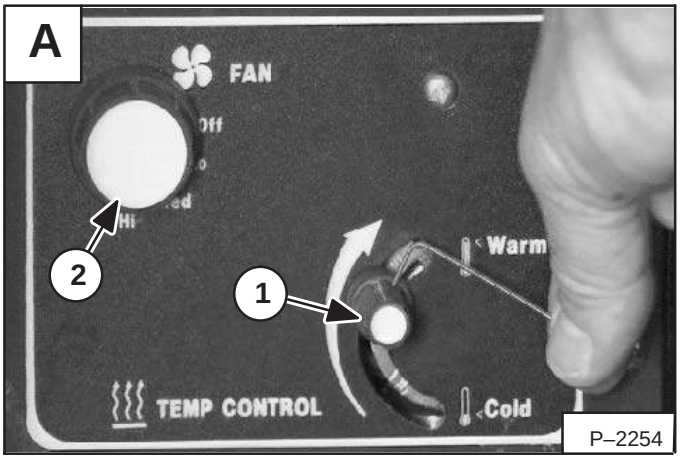
Disconnect the battery negative (–) cable. (See Page 6–1.)

Remove the floor plate. (See Page 4–6.)

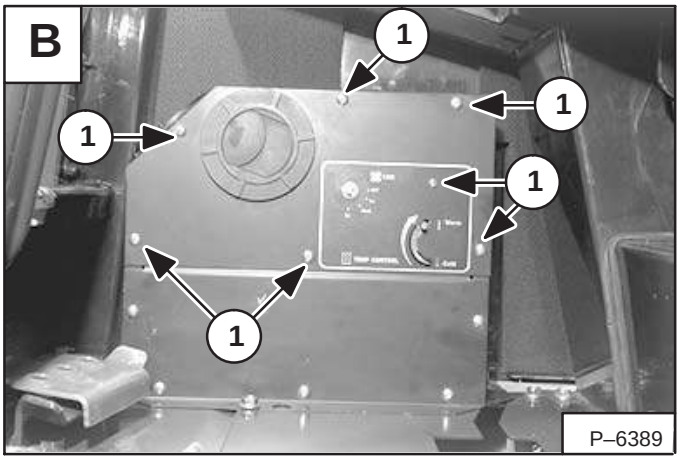
Drain the radiator. (See Page 1–1.)

Loosen the set screw on the heat control knob and remove the knob (Item 1) **[A]**.

Remove the fan switch knob (Item 2) **[A]** by pulling out on the knob.

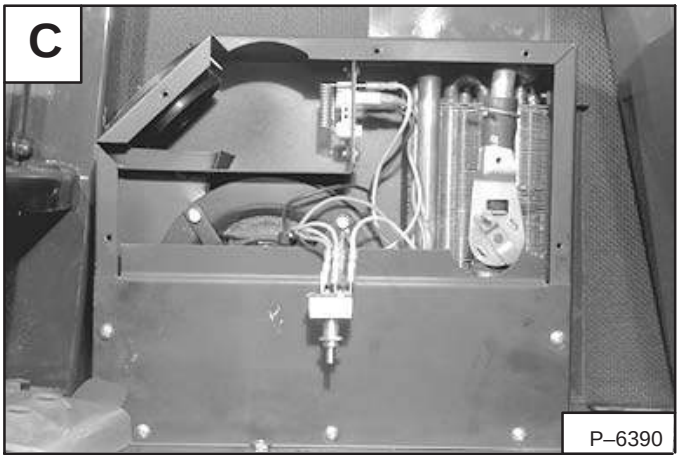


Remove the seven (7) screws (Item 1) **[B]** from the top half of the heater cover plate.

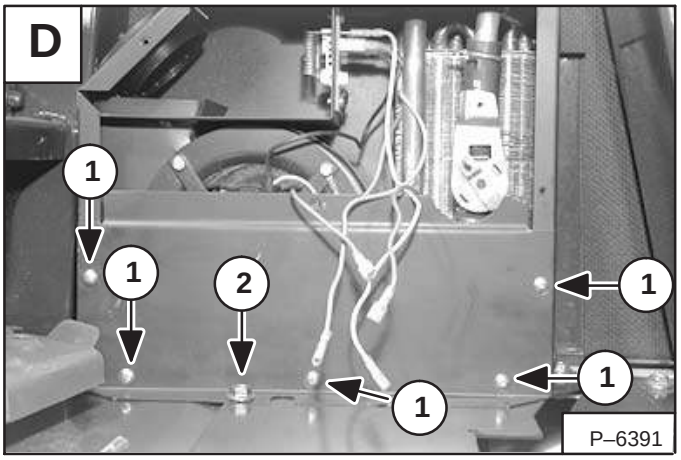


Remove the front cover and mark the electrical wires going to the heater switch **[C]**.

Remove the wires from the heater switch.



Remove the five (5) screws (Item 1) **[D]** and the bolt (Item 2) **[D]** from the lower half of the heater cover plate.



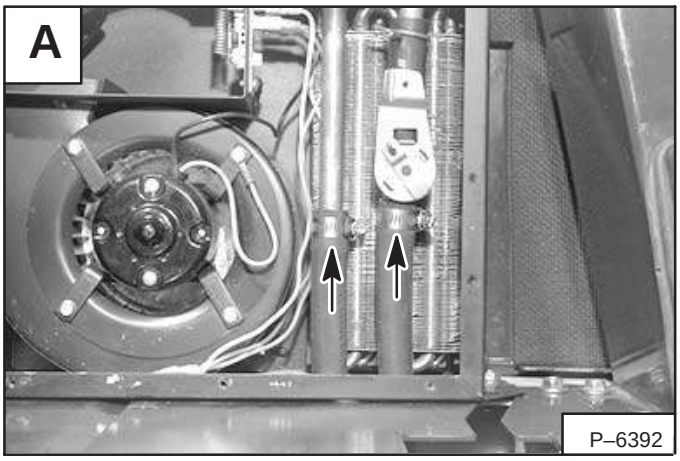
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CAB (Cont'd)

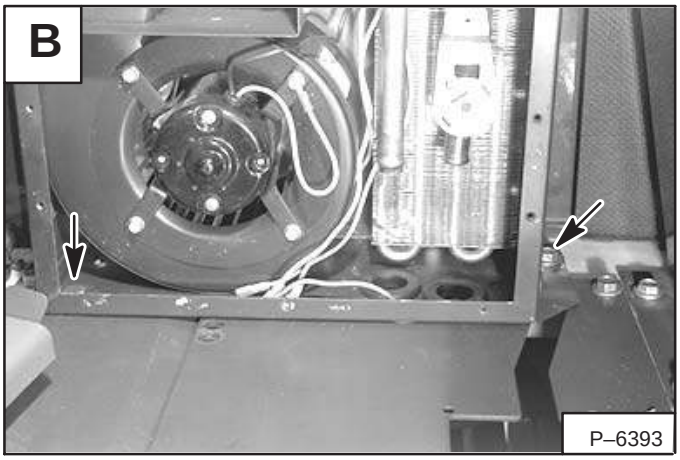
Removal and Installation (Cont'd)

Mark the locations of the two (2) heater hoses (inlet & outlet) for correct installation.

Loosen the two heater hose clamps and remove the heater hoses from the heater core **[A]**.

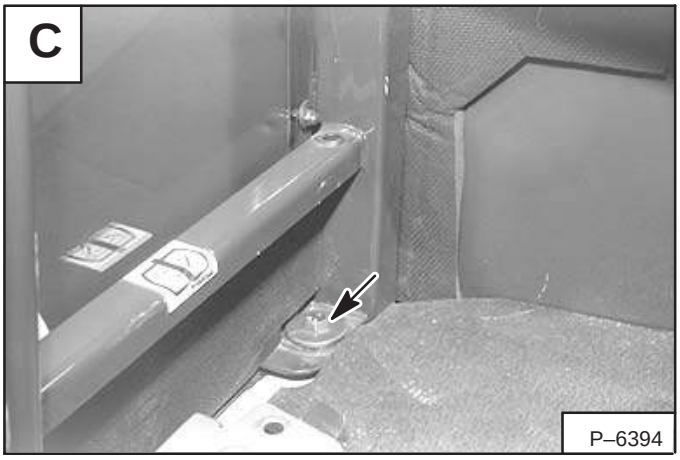


Remove the two bolts from the base of the heater and remove the heater **[B]**.



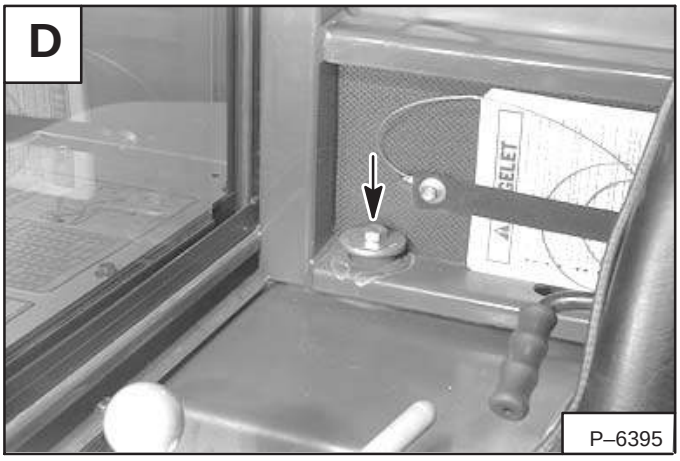
Remove the bolt, washer, plate and nut from both front cab mounts **[C]**.

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



Remove the bolt and the washer from left rear cab mount **[D]**.

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



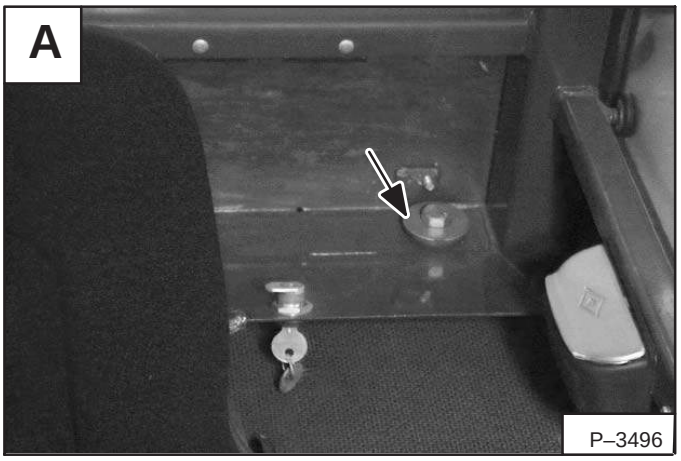
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CAB (Cont'd)

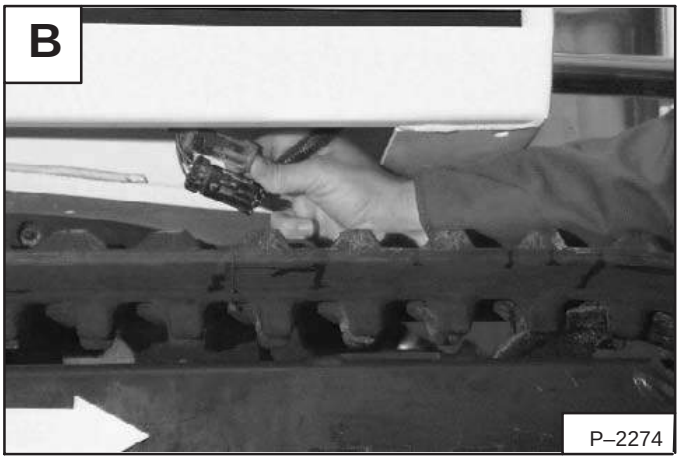
Removal and Installation (Cont'd)

Remove the bolt and washer from the right rear cab mount **[A]**.

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



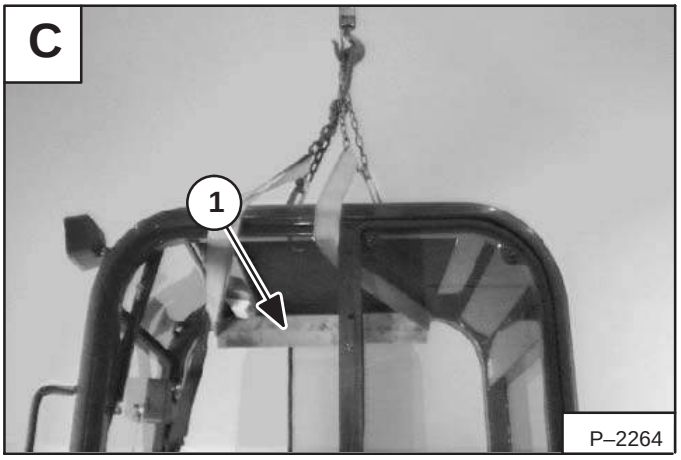
Disconnect the cab harness from the main harness **[B]**. The harness connectors are under the right hand upperstructure, near the boom swing cylinder.



TWO PIECE RIGHT SIDE WINDOW.

Open the right hand windows so that one lifting strap can be installed to the front of the window opening and a second lifting strap can be installed to the rear of the window opening **[C]**.

Install a 2 inch x 8 inch board (Item 1) **[C]** of sufficient length to spread the lifting straps so that they do not contact the right window.



Install a lifting device of sufficient capacity to the sling and lift the cab up a few inches **[D]**.



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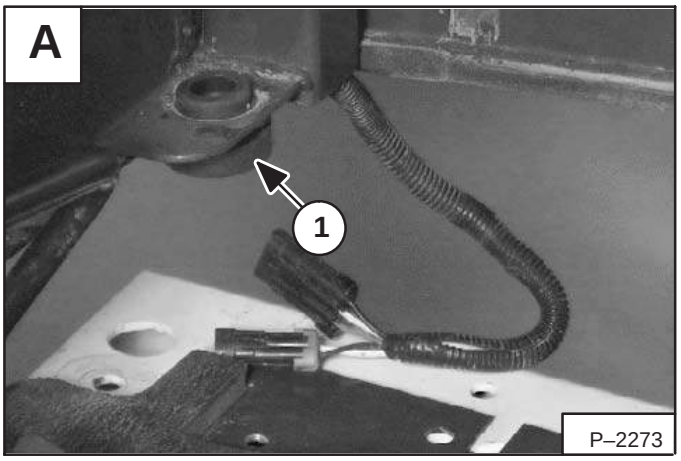
CAB (Cont'd)

Removal and Installation (Cont'd)

With the cab lifted off the upperstructure a few inches, the cab mounts (Item 1) **[A]** can be removed from the four (4) cab corners.

Remove the cab wire harness through the access hole in the right hand front corner of the upperstructure **[A]**.

Remove the cab.



THREE PIECE RIGHT WINDOW.

Install the lifting eyes on the cab **[B]**.

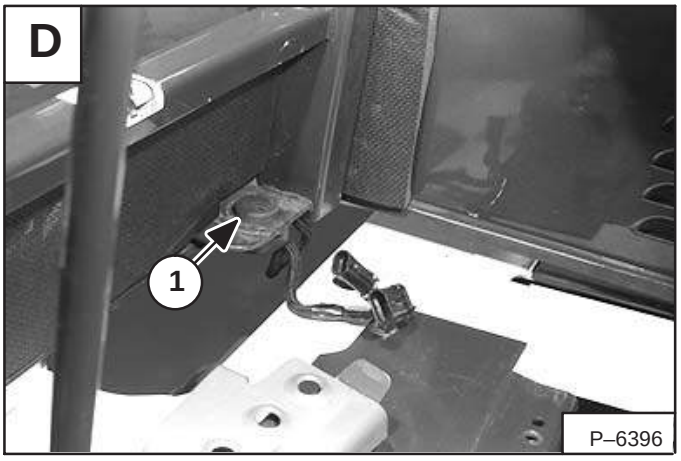


Install a lifting device of sufficient capacity to the lifting eyes and lift the cab up a few inches **[C]**.



With the cab lifted off of the upperstructure a few inches, the cab mounts (Item 1) **[D]** can be removed from the four (4) cab corners.

Remove the cab wire harness through the access hole in the right hand front corner of the upperstructure **[D]**.

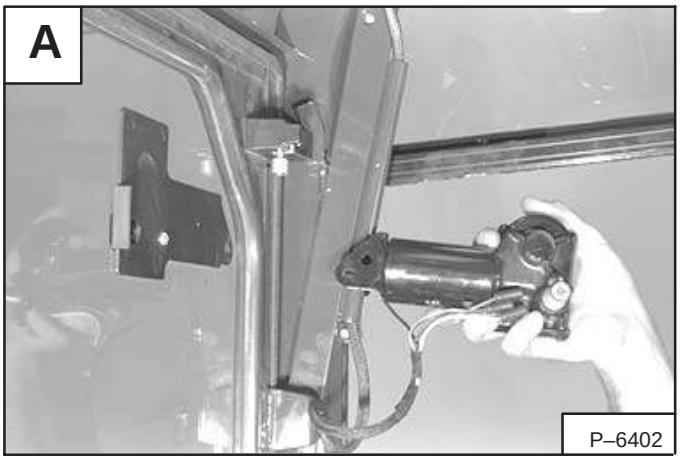


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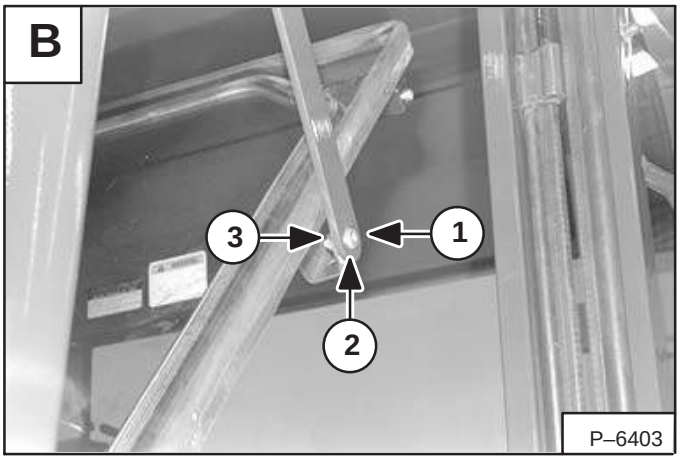
CAB (Cont'd)

Front Window Removal and Installation

Remove the wiper motor from the window. Mark the wires for ease of assembly, and remove the wires from the wiper motor **[A]**.



Remove the mounting screw (Item 1) **[B]**, bushing (Item 2) **[B]** and nut (Item 3) **[B]** from the two (2) window pivots.

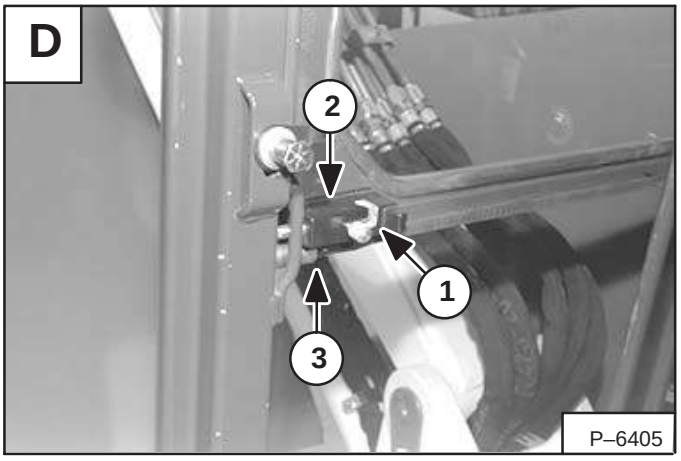


With the help of a second person, use the window handles to hold the window in position and remove the two (2) lower latches by removing the two (2) screws and washers on each side of the window frame **[C]**



Remove the latch (Item 1) **[D]**, spacer (Item 2) **[D]** and the roller (Item 3) **[D]** from both sides.

Remove the front window and frame assembly.



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Front Lower Window Removal and Installation

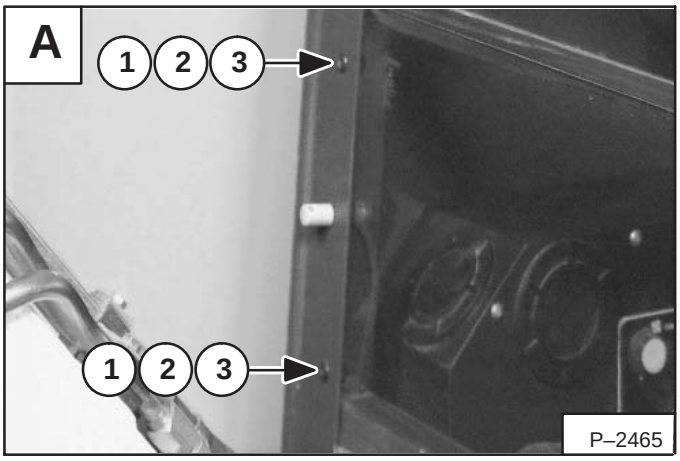
Remove the mounting screws (Item 1) **[A]**, washers (Item 2) **[A]**, grommets (Item 3) **[A]** and the nuts from the lower glass.

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

Remove the glass.

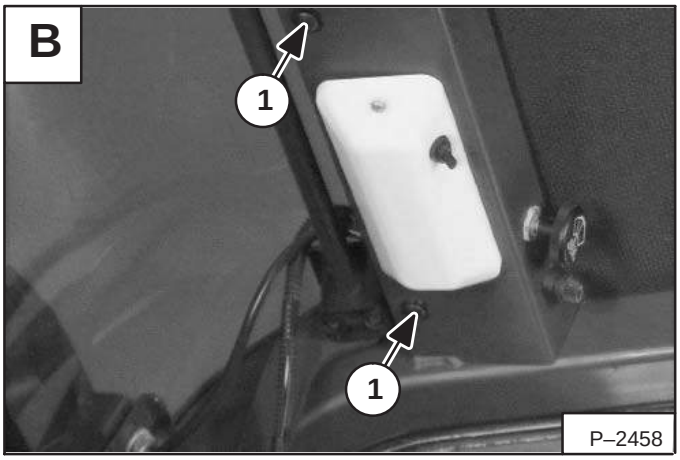
Remove the gasket from the cab frame.

When installing the window, use a new window gasket seal.



Front Upper Window Removal and Installation

Remove the mounting screws (Item 1) **[B]** from the upper cab console to access the window mounting nuts.



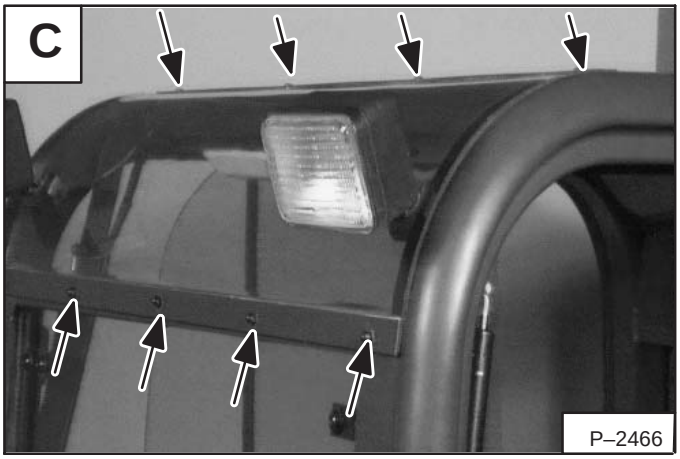
Remove the mounting screws, retainer straps and nuts **[C]**.

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

Remove the window.

Remove the gasket from the cab frame.

When installing the window, use a new window gasket seal.



Door Removal and Installation

The door can be removed from the cab by slowly swinging the door back and forth while lifting up on the door **[D]**.

NOTE: When installing the door; the top hinge is bolted to the door. Align the top hinge first and then position the bottom hinge. Hold up on the door and slowly rock the door back and forth until the hinges are engaged about 3/4" (19 mm). Then rock the door back and forth until the door weight moves the door hinges to full engagement.



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Door Window Removal and Installation

The glass is held in position with mounting screws (Item 1) **[A]**, washers (Item 2) **[A]**, grommets (Item 3) **[A]** and nuts.

Open the door and remove the glass edge seal.

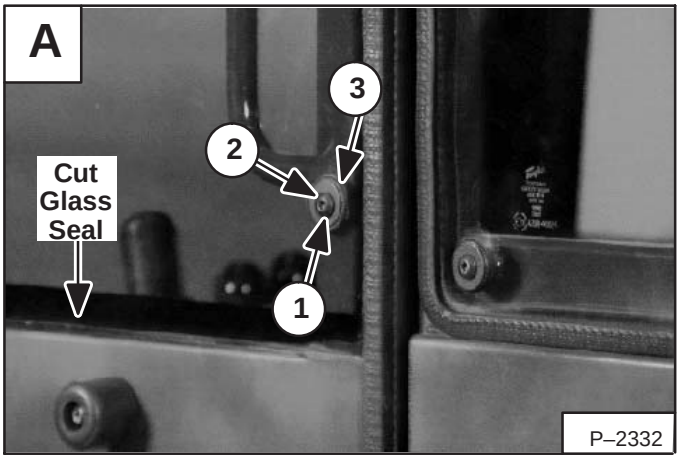
Close the door.

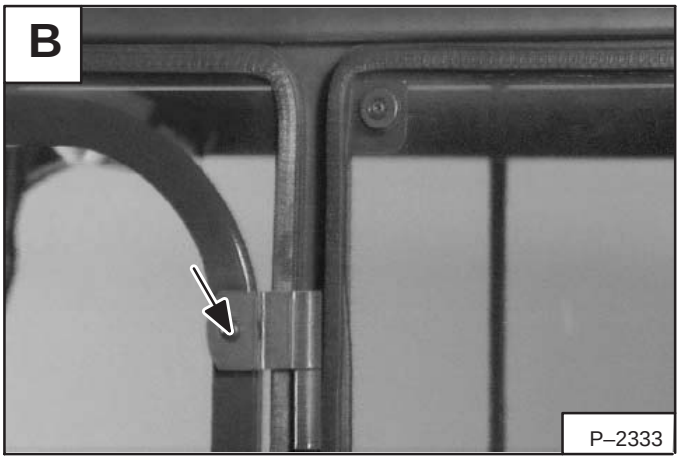
Use a knife to cut the glass sealer at the center of the door **[A]**.

NOTE: When removing the top door window the top door hinge is bolted to the glass. Make sure that the door is closed so when the hinge is removed, the door is held in its proper position.

Hold the glass in position and remove the mounting screws from the glass **[B]**. Remove the glass

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





Left Hand Side Window Removal and Installation

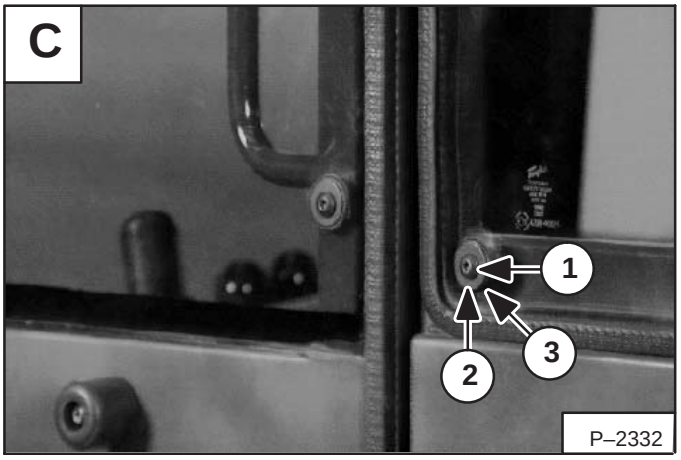
The window is held in position with mounting screws (Item 1) **[C]**, washers (Item 2) **[C]** and grommets (Item 3) **[C]**.

Hold the window in position and remove the mounting screws (Item 1) **[C]**.

Remove the window.

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

Remove the window edge seal.



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CAB (Cont'd)

Right Hand Side Window Removal and Installation

TWO PIECE SIDE WINDOW.

To remove the right hand side glass, the lower window felt channel and the rubber bumper strip must be removed.

Unlatch the outer window and open the window slightly.

Lift upwards on the felt channel and the rubber bumper strip until they contact the edge of the glass.

Slide the glass open while pulling the felt channel and the rubber bumper strip in the same direction as the glass is being opened. Slide the glass open fully.

Grasp the glass and slide it backwards to the slightly open position.

While holding the glass up, pull the felt channel and the rubber bumper out of the window channel.

Lower the glass into the channel and tilt the top edge of the window outwards and lift the glass up and out.

Installation: Set the glass into the lower channel and tilt the top of the glass inwards. Lift up on the glass until it is seated in the upper window channel.

Hold the glass up and insert the rubber bumper strip into the window channel. With the help of a blunt tool, slide the rubber channel under the glass. Insert the felt channel into the window channel, with the edge of the felt channel flush with the edge of the glass. Lift the glass upwards and slide the glass into the felt channel. With the help of a blunt tool, slide the glass and the felt channel back to the closed window position. Continue this process until the felt channel is fully engaged into the window channel.

NOTE: The outer glass must be removed before inner glass can be removed.

Use the same procedure to remove the inner glass.

THREE PIECE SIDE WINDOW.

To remove the right hand side glass, the top window felt channel and the rubber bumper strip must be removed.

Unlatch the outer window and open the window slightly.

Remove the rubber bumper strip **[C]**.

Pull down on the felt channel **[D].**

Slide the glass open while pulling the felt channel in the same direction as the glass in being opened.

Slide the glass open fully.

Grasp the glass and slide it backwards to the slightly open position.

Pull the felt channel out of the window channel.









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CAB (Cont'd)

Right Hand Side Window Removal and Installation (Cont'd)

THREE PIECE SIDE WINDOW.

Lift the glass up into the window channel and tilt the bottom edge out. Lower the glass from the cab **[A]**.

NOTE: The outer glass must be removed before inner glass can be removed.

Use the same procedure to remove the inner glass.

Installation: Tilt the top of the glass inward and up into the window channel. Lower the glass onto the window track.

With the window in the open position, slide the window felt channel into the window frame and onto the window. Slide the window back and forth while working the window felt into the window frame **[B]**.

Use a blunt tool to fully seat the window channel felt.

Install the rubber bumper strip at the front of the window frame.

Right Hand Window Assembly Removal and Installation

To remove the right hand window assembly, remove the two pieces of window (See Below). Carefully pry out the window frame from the cab assembly.

NOTE: If the window frame is to be used, use care to remove the frame. The window frame is aluminum and can easily be damaged.

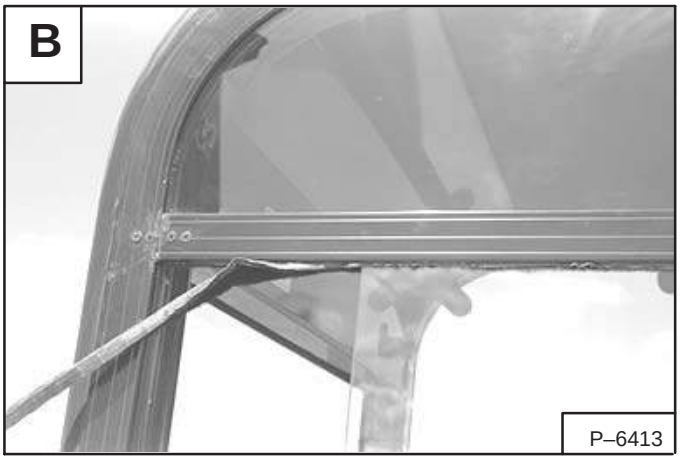
To install the window frame, clean the cab frame opening of any dust, dirt, grease or existing urethane window sealant.

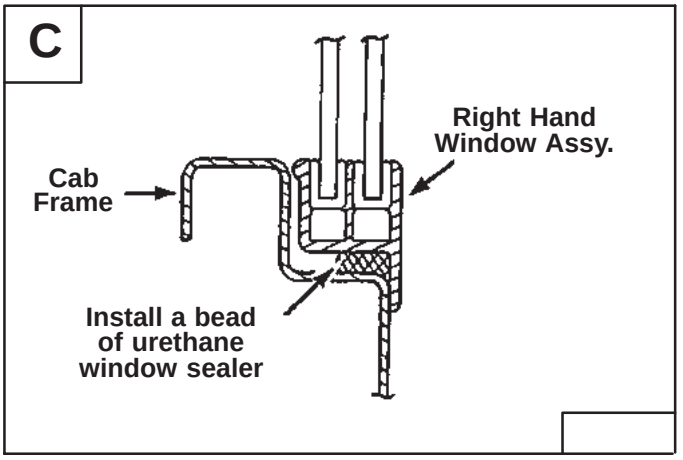
Put a bead of urethane window sealant (P/N 6654148) on the window frame assembly as shown **[C]**.

Install the window assembly into the opening and press into position.

Let the sealant set–up (per the recommendation on the sealant instructions on the tube) before moving the excavator.







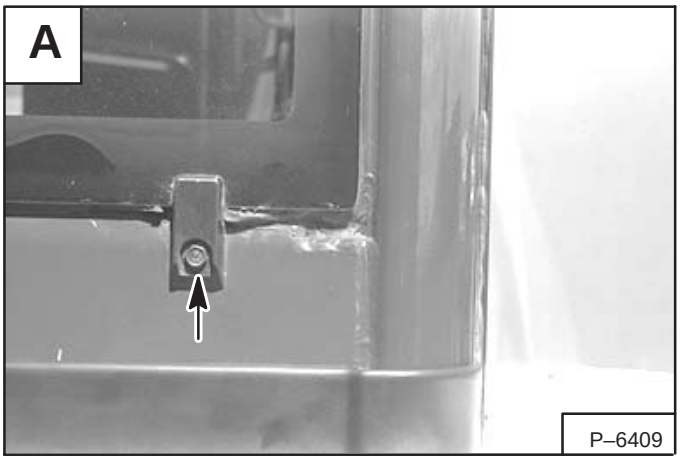
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CAB (Cont'd)

Rear Window Removal and Installation

Remove the four (4) clamps **[A]**.

Hold the window in position while cutting the abrasive.



Insert the cut wire through the adhesive at the corner of the window. Pull the wire around the window perimeter to cut the adhesive **[B]**.

Installation: Install the adhesive tape to the outer perimeter of the window. Put the window into the window opening and press the window into position.

Install the four window retaining clamps.



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CAB/CANOPY REAR COVER

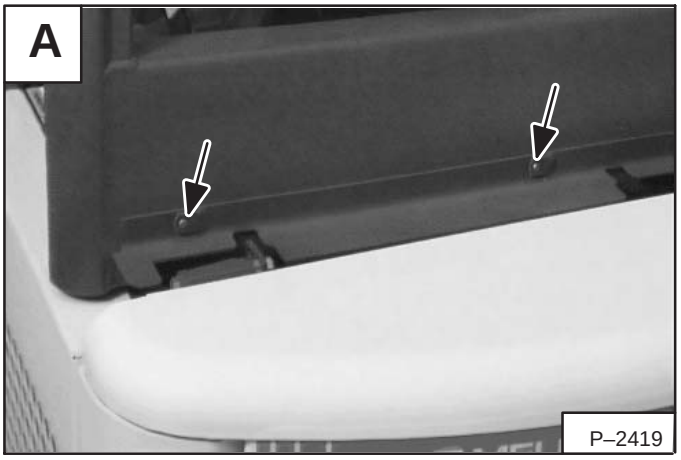
Removal

The plastic cover is attached to the cab and canopy with an adhesive.

To remove the cover, start at one end of the cover and use two putty knives and slowly pry out on the cover to separate the adhesive from the cover and the cab.

Remove the three bolts that hold the support to the cab/canopy **[A]**.

Installation: Tighten the bolts to 14–18 ft.–lbs. (20–25 Nm) torque.



Installation

Clean the back surface of the plastic cover.

Install the adhesive tape (P/N 6665212) on the back, top surface of the cover **[B]**.

Leave approximately a 1/8'' (3 mm) gap between the adhesive tape and the outer edges of the cover.

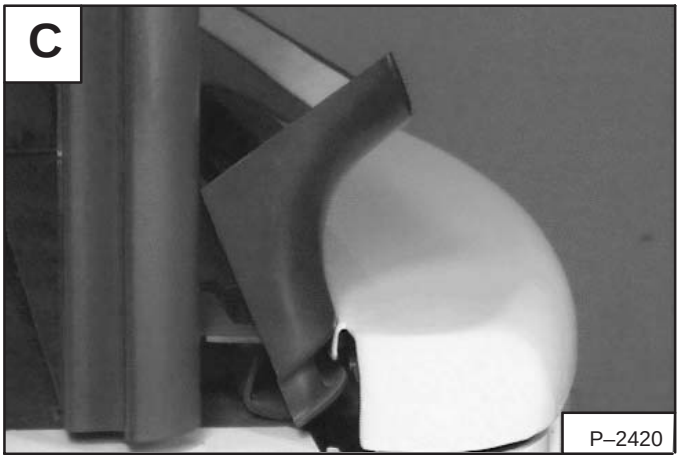
NOTE: Leave the protective film on the one side of the adhesive tape at this time.



With the engine cover closed, tip the plastic cover so that the drip rail will slide under the top lip of the engine cover.

Roll the cover towards the cab/canopy until the drip rail is fully engaged **[C]**.

Test fit the cover to the cab and determine the best fit.



Tip the cover back and remove the protective film from the tape and install the cover on the cab/canopy **[D]**.

Firmly press the top edge of the cover into the cab/canopy so that the adhesive has a complete bond **[D]**.



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MAIN FRAME AND TRACKS

	Page Number
BLADE	
Removal and Installation	5–3
TRACK	
Adjustment (S/N 512912999 & Below)	5–5
Adjustment (S/N 512913001 & Above)	5–6
Rubber Track Clearance	5–4
Rubber Track Removal And Installation	5–7
Steel Track Clearance	5–5
Steel Track Removal And Installation	5–9
Track Lug Height	5–3
Track Tension Adjustment	5–4
TRACK DAMAGE IDENTIFICATION	
Abrasion of Embedded Metals	5–69
Abrasion of the Track Roller Side	5–75
Cracks And Cuts On The Lug Side Rubber	5–74
Cracks Of The Lug Side Rubber Due To Fatigue	5–73
Cuts On The Edges Of Track Roller Side	5–76
Cuts On The Lug Side Rubber	5–72
Cutting Of Steel Cords	5–68
Lug Abrasion	5–74
Separation Of Embedded Metals	5–70
Separation Of Embedded Metals Due To Corrosion	5–71
TRACK FRAME	
Disassembly And Assembly (S/N 512912999 & Below)	5–11
Disassembly And Assembly (S/N 512913001 & Above)	5–12
TRAVEL MOTOR (S/N 512911001–512913404)	
Assembly	5–33
Disassembly	5–18
Parts Identification	5–17
Removal And Installation	5–15
Testing	5–14
TRAVEL MOTOR (S/N 512913405 & Above)	
Assembly	5–57
Disassembly	5–48
Parts Identification	5–47

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BLADE

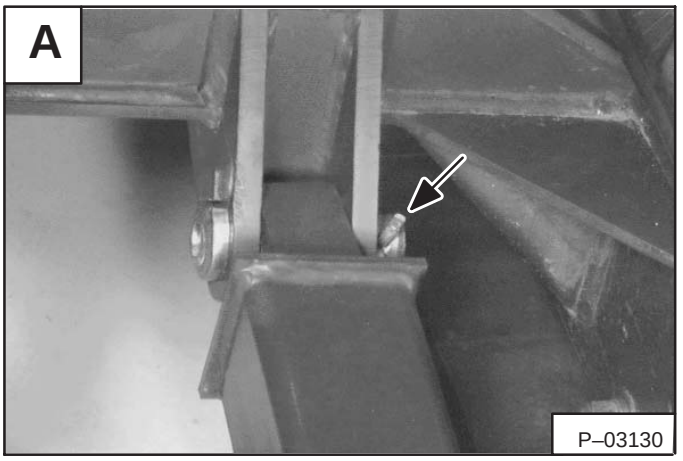
Removal and Installation

Lower the blade to the ground.

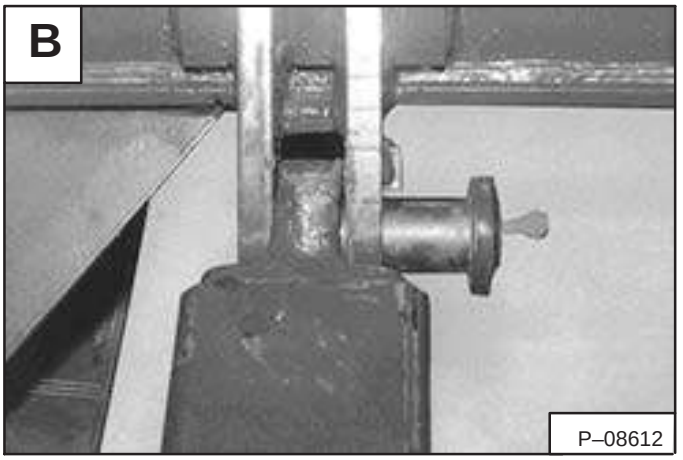
Disconnect the blade cylinder hoses. (See Page 2–1.)

Remove the cylinder. (See Page 2–1.)

Remove the cotter pin from the blade arm pivot pins (both sides) **[A]**.



Remove the blade arm pivot pins **[B]**.



TRACK

Track Lug Height

Rubber Track

The lug height of a new rubber track (Bridgestone or Spencer) is .9843" (25 mm).

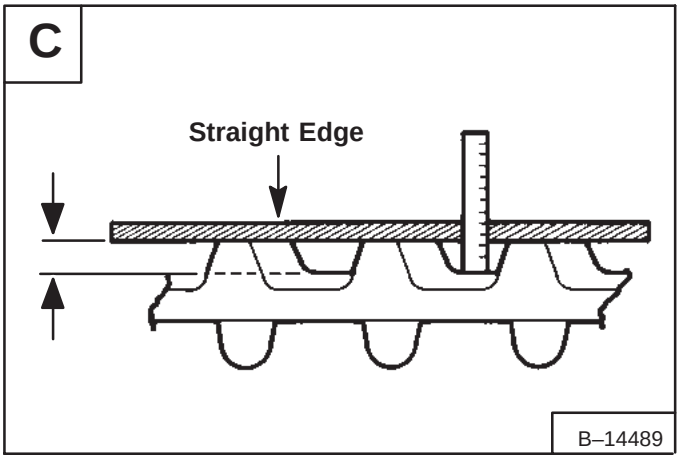
To find the percentage of wear on a excavator track, measure the height of the lug by placing a straight edge across the top of three (3) lugs and measure the distance from the base of the track to the bottom of the straight edge **[C]**.

Divide this measurement by the new track height and multiply by 100. This will give the percentage of track lug left.

Example: lug height .7874" (20 mm)

$$\frac{.7874}{.9843} \times 100 = 80$$

80% of the track lug is remaining with 20% wear on the track lugs.



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TRACK (Cont'd)

Track Tension Adjustment

NOTE: The wear of the pins and bushings on the undercarriage vary with the working conditions and the different types of soil conditions. It is necessary to inspect track tension to maintain the correct tension. See Service Schedule (Page 1–3) for the correct service interval.

Raise the machine using the boom and arm **[A]**.

Raise the blade and install jackstands under the blade and track frame **[A]** & **[B]**. Lower the boom until all machine weight is on the jackstands.

Stop the engine.

⚠ WARNING

AVOID INJURY OR DEATH

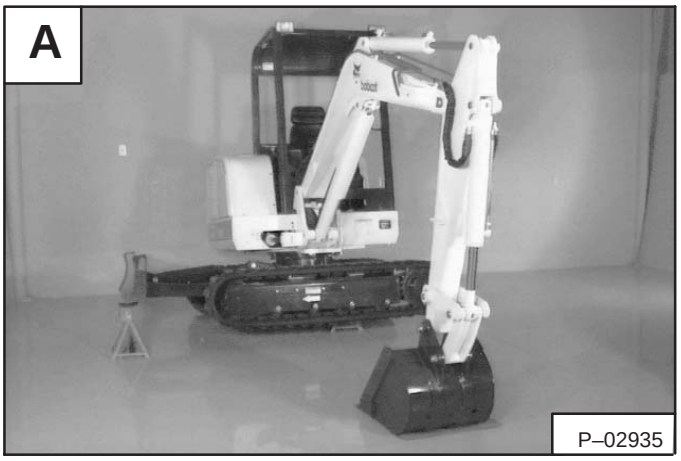
Keep fingers and hands out of pinch points when checking the track tension.

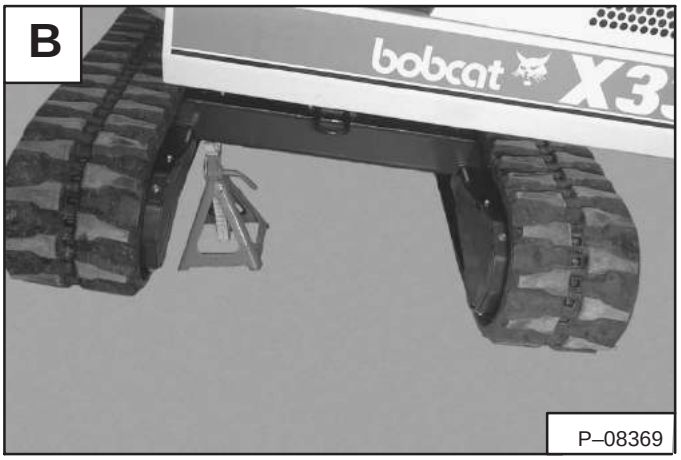
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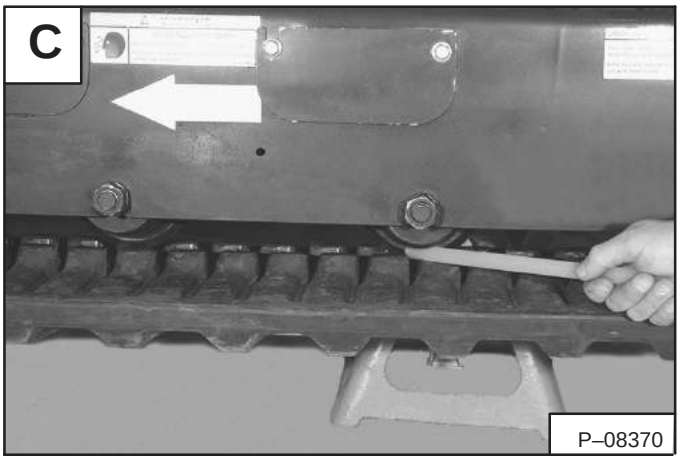
Rubber Track Clearance

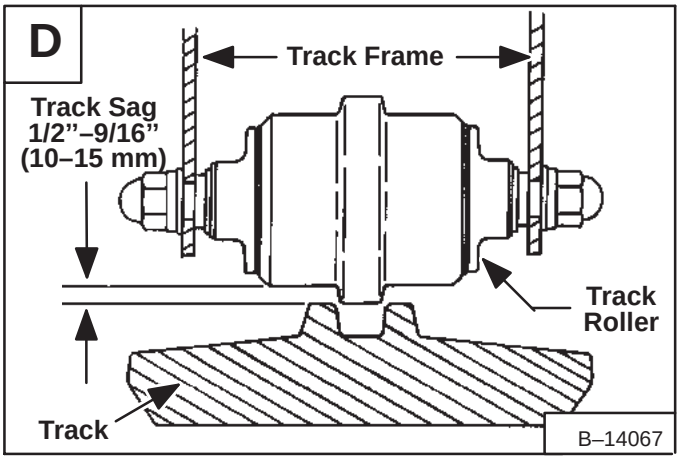
Measure the rubber track sag at either middle track roller **[C]**. Do Not get fingers into pinch points between the track and the track roller. Use a bolt or a dowel of the appropriate size to check the gap between the contact edge of the roller and top edge of the track guide lug **[C]** & **[D]**.

Rubber Track Clearance . . . . . 1/2"–9/16" (10–15 mm)









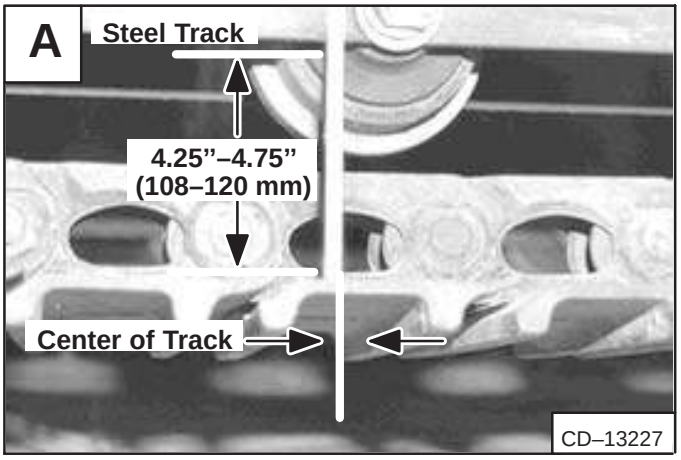
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TRACK (Cont'd)

Steel Track Clearance

Measure the steel track sag at the center of the track, between the lower edge of the track frame and the top surface of the track **[A]**.

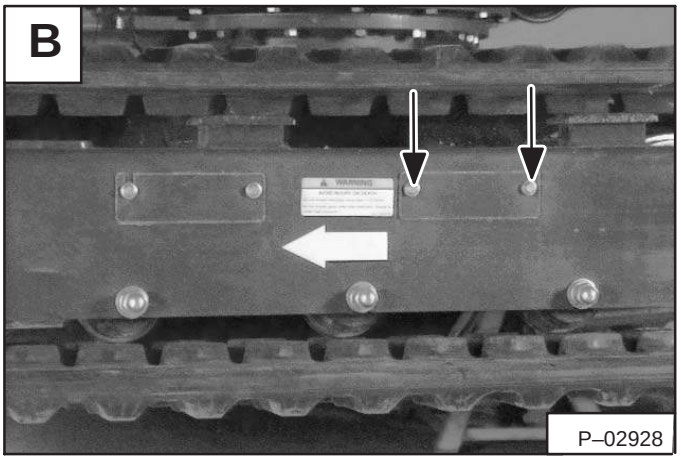
Steel Track Clearance . . 4.25" – 4.75" (108–120 mm)



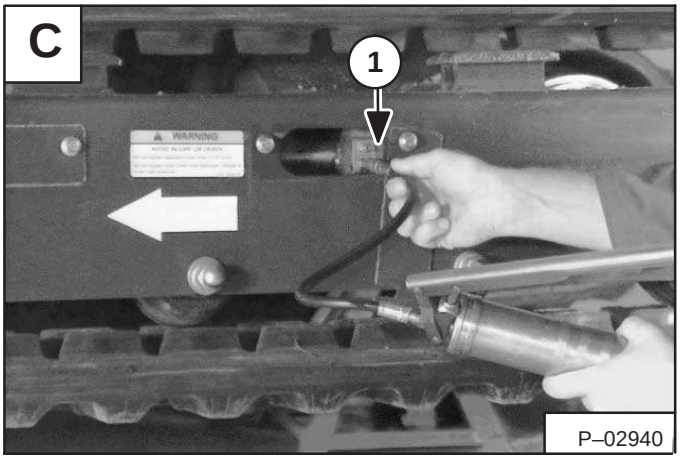
Adjustment (S/N 512912999 & Below)

To adjust the track tension do the following:

Loosen the two bolts from the cover **[B]**. Pivot the cover down.



Add grease to the fitting (Item 1) **[C]** until the track tension is correct.

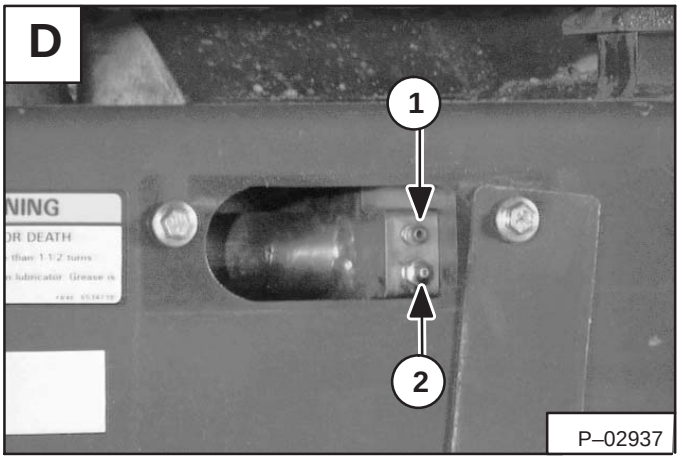


Loosen the bleed fitting (Item 1) **[D]** to release tension from the track.

NOTE: Do not loosen the grease fitting (Item 2) [D].

Repeat the procedure for the other side.

NOTE: Left hand side track frame grease fitting and bleed fitting are shown in photo [D]. For right hand side track frame, the grease fitting (Item 2) [D] will be on the top and the bleed fitting (Item 1) [D] will be on the bottom.



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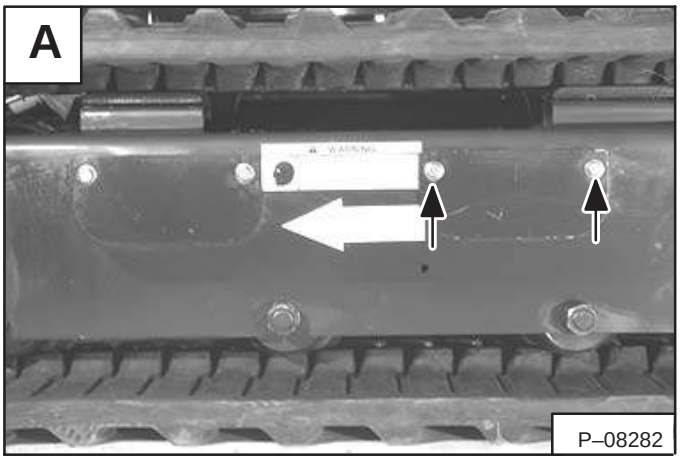
TRACK (Cont'd)

Adjustment (S/N 512913001 & Above)

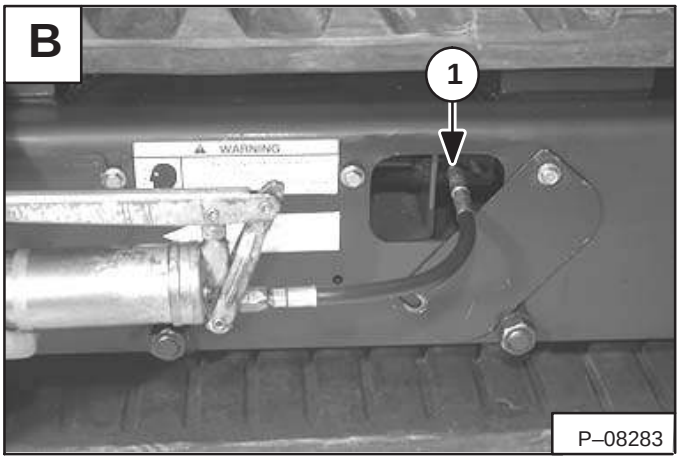
To adjust the track tension do the following:

Loosen the two bolts from the cover **[A]**.

Pivot the cover down.



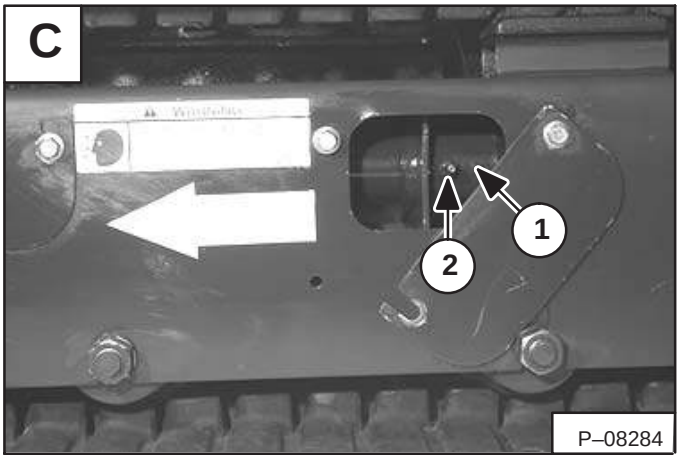
Add grease to the fitting (Item 1) **[B]** until the track tension is correct.



Loosen the bleed fitting (Item 1) **[C]** to release tension from the track.

NOTE: Do not loosen the grease fitting (Item 2) [C].

Repeat the procedure for the other side.



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TRACK (Cont'd)

Rubber Track Removal and Installation

Lift and block both sides of the machine as follows:

Raise the blade fully.

Use the boom and arm to lift the blade end of the machine up about 3 inches (75 mm) and install jackstands under the blade **[A]**.

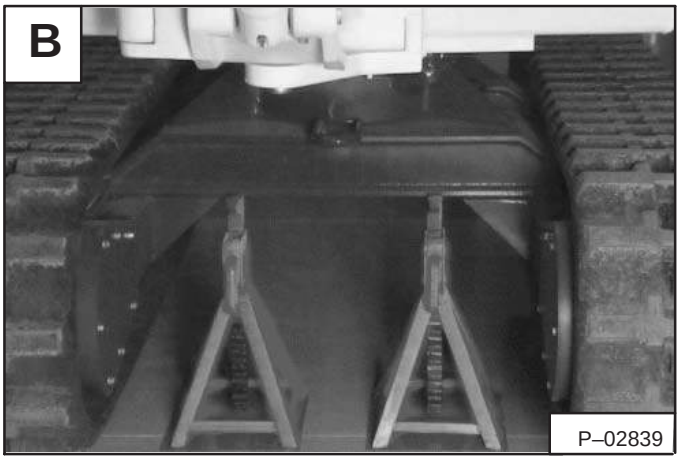


Swing the upperstructure 180° and use the boom and arm to slowly lift the opposite end of the undercarriage about 3 inches (75 mm) and install jackstands under the undercarriage **[B]**.

⚠ WARNING

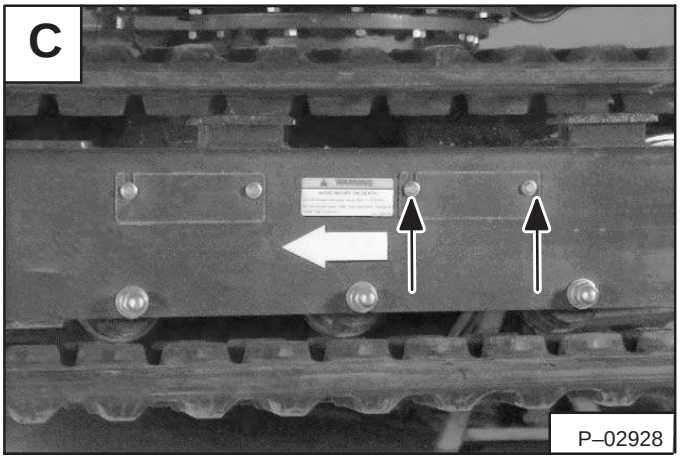
AVOID INJURY OR DEATH

Put jackstands under the blade and rear corners of the under carriage before working under the machine. Failure to block up the machine may allow it to move or fall and result in injury or death.



Stop the engine.

Loosen the two bolts from the cover **[C]**. Pivot the cover downwards.

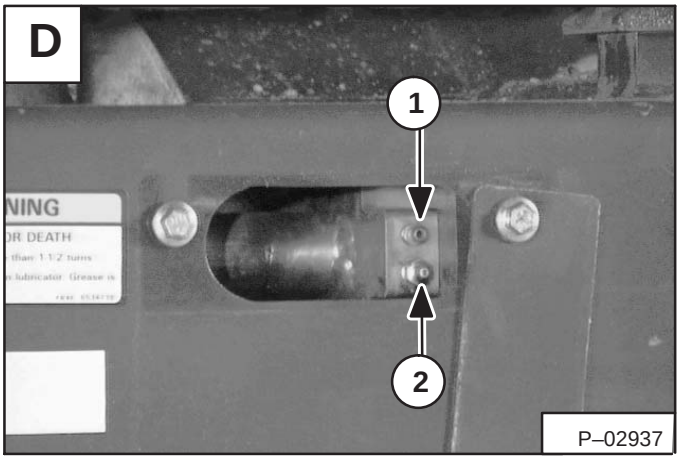


S/N 512912999 & Below

Loosen the bleed fitting (Item 1) **[D]** (a maximum of 1–1/2 turns) to release the tension from the grease spring.

NOTE: Do not loosen the grease fitting (Item 2) [D].

NOTE: The left hand side track frame grease fitting and bleed fitting are shown in Fig. [D]. For the right hand side track frame, the grease fitting (Item 2) [D] will be on top and the bleed fitting (Item 1) [D] will be on the bottom.



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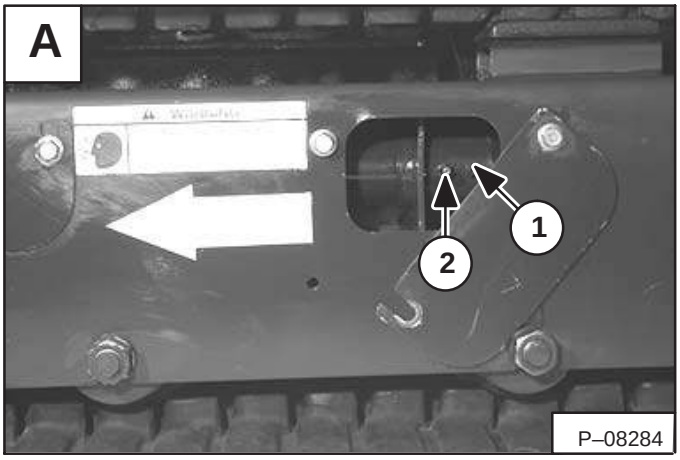
TRACK (Cont'd)

Rubber Track Removal and Installation (Cont'd)

S/N 512913001 & Above

Loosen the bleed fitting (Item 1) **[A]** (a maximum of 1 1/2 turns) to release the tension from the grease spring.

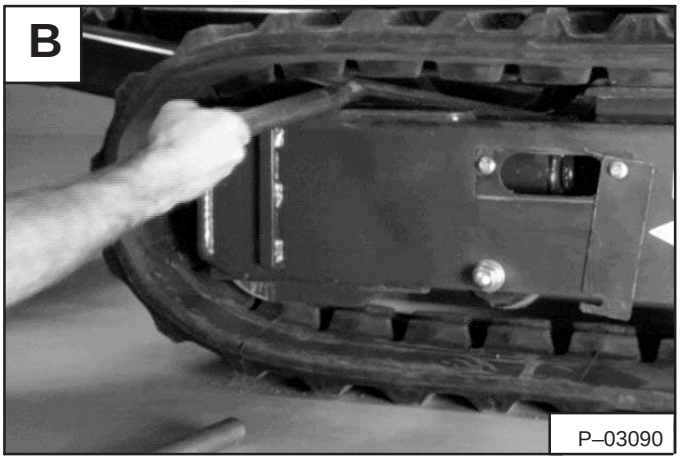
NOTE: Do not loosen the grease fitting (Item 2) [A].



Start the engine.

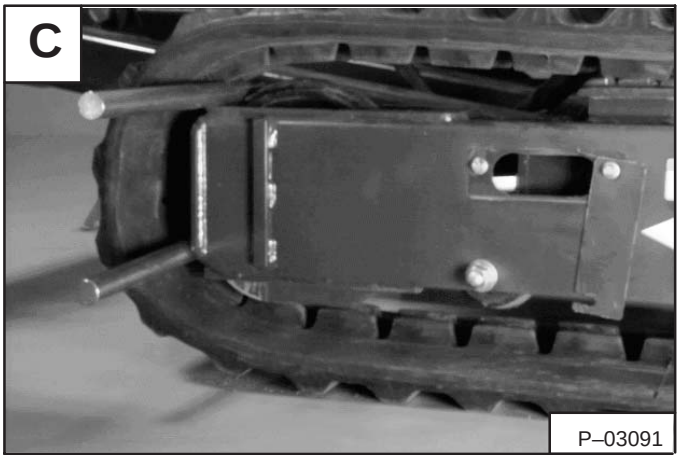
Slowly turn the track in the forward direction.

Insert a steel rod or pipe (Approximately 1–1/4 inch (30 mm) diameter) between the track and the idler wheel **[B]**.



Insert a second steel rod or pipe, at a distance of two lugs from the first, between the track and the idler wheel **[C]**. Continue to turn the track until the first pipe contacts the track frame.

Stop the engine.



Insert a pry bar between the track and the idler wheel and pry out on the track until the track slides off the idler wheel **[D]**.

Remove the track.

To install the rubber track:

Put the track over the drive sprocket lugs.

Put the front of the track onto the front idler wheel.

See Page 5–4 for adding grease to the grease spring and for checking track tension.



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TRACK (Cont'd)

Steel Track Removal and Installation

With the excavator raised and the bleed fitting loosened start the excavator. (See Page 5–5.) Slowly turn the track. This will force more grease out of the grease spring.

Stop the engine.

⚠ WARNING

AVOID INJURY

Keep fingers and hands out of pinch points when removing the track.

W–2173–0195

The track can be removed either as a complete assembly or by removing a connecting pin and separating the track.

To remove the track as a compete assembly, install a pry bar between the track and the front idler wheel and pry out on the track **[A]**.

Installation: Put the track over the drive sprocket lugs. Then position the front of the track over the front idler wheel.

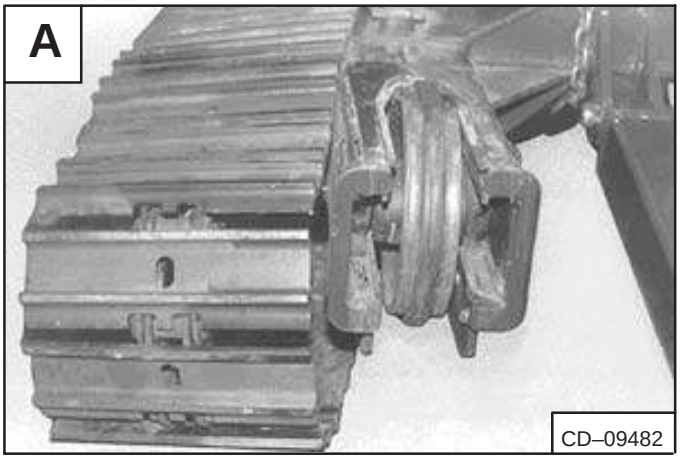
See Page 5–4 for adding grease to the grease spring and for checking track sag.

To remove the track by removing a connecting pin:

There is no master link or master connecting pin with this track. The connecting pins have a stepped diameter **[B]**. The smaller diameter is a slip fit into the tracks connecting links and the larger diameter is a press fit.

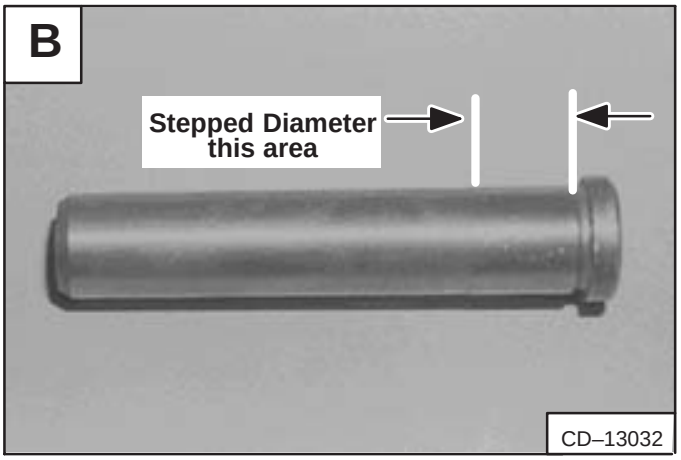
To remove a connecting pin, hold a heavy steel block on the connecting link near the pin being removed. Use a heavy hammer and a punch to drive out the connecting pin.

A



CD–09482

B



CD–13032

⚠ 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.**

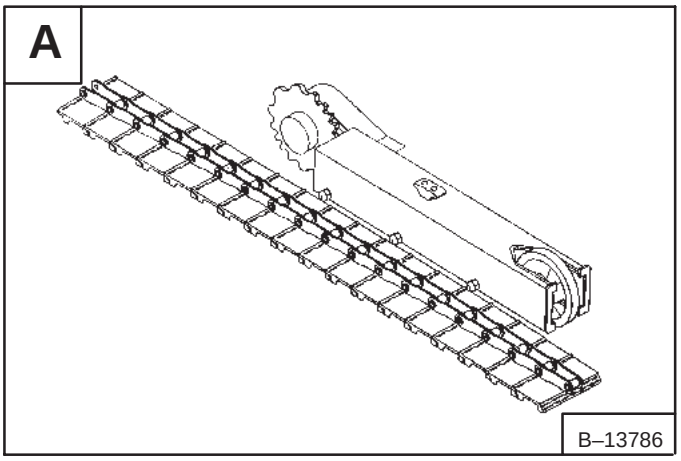
W–2019–1285

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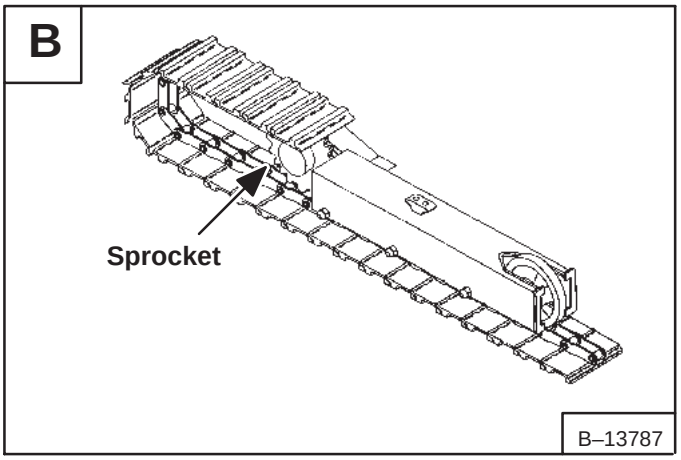
TRACK (Cont'd)

Steel Track Removal and Installation (Cont'd)

Installation: Put the steel track under the track frame so the front end of the track extends approximately three links in front of idler wheel **[A]**.



Pull the opposite end of the track up and forward and put the end links of the steel track onto the sprocket **[B]**.



With the help of a second person, start the excavator and run the engine at low idle. Make sure that the swing locking lever is in the locked position. Use the travel lever (on which side the track is being installed) to slowly turn the drive motor in the forward direction. Hold the end of the track up as the drive motor slowly moves the track forward. Guide the end of the track over the top of the guide block and up to the front idler wheel **[C]**.

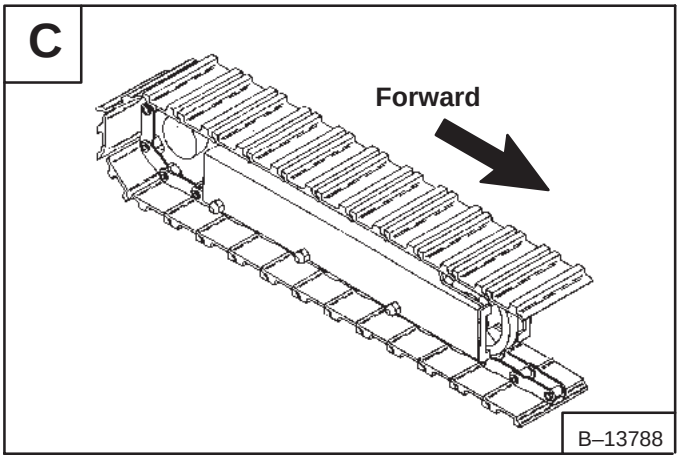
Stop the engine.

⚠ WARNING

AVOID INJURY OR DEATH

Drive motor must be operated slowly to avoid any sudden movements that could cause injury or death.

W–2174–0195

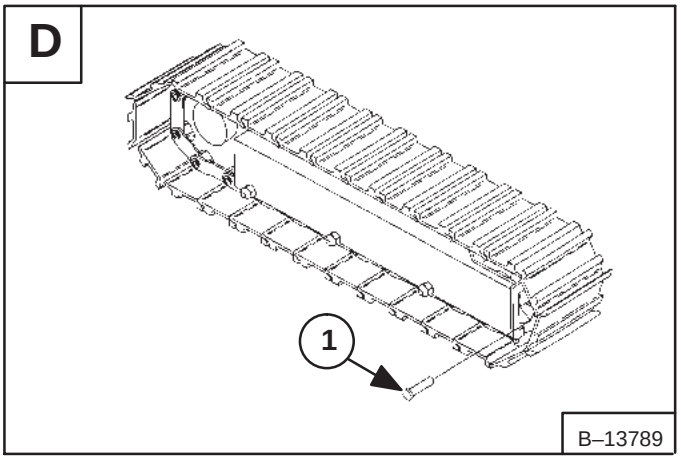


Put the two ends of the track together and use a drift pin to hold the links together.

Insert the connecting link pin (Item 1) **[D]** into the track link hole. Tap the end of the pin until the press fit diameter contacts the connecting link hole.

Hold a heavy steel block on the back side of the track connecting link and use a heavy hammer to drive the connecting link pin to the track link until the head of the pin is flush with the track link.

See Page 5–5 for adding grease to the grease spring and for checking track sag.



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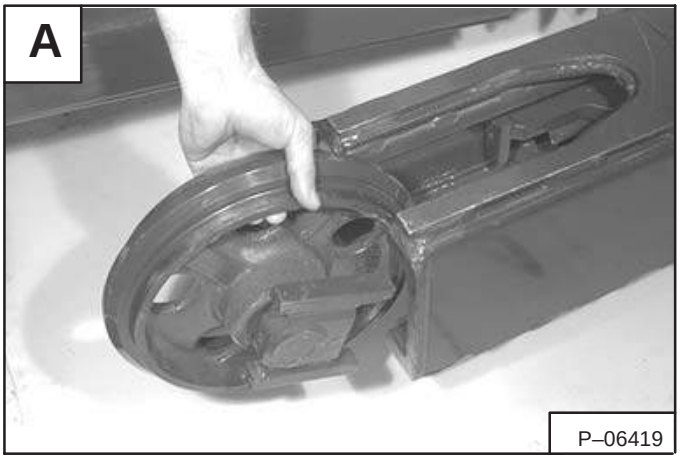
TRACK FRAME

Disassembly and Assembly (S/N 512912999 & Below)

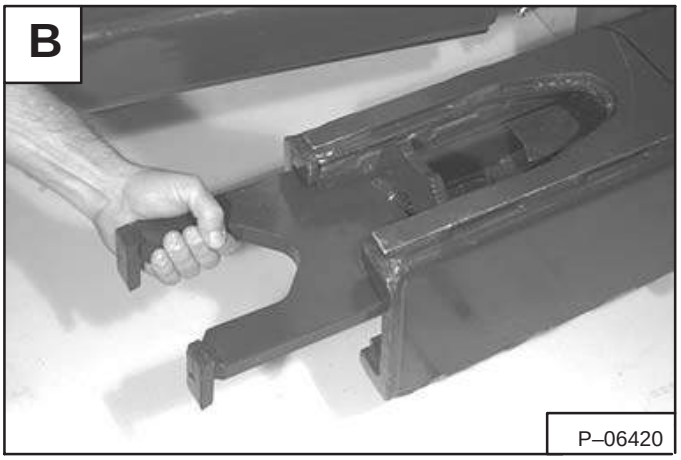
Use the following procedure to remove the different parts from the track frame:

Remove the track. (See Page 5–7.)

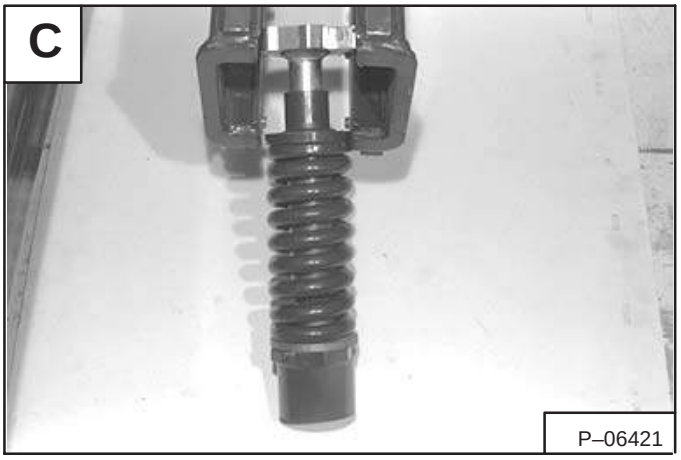
Slide the front track idler out of the track frame to remove it **[A]**.



Remove the sliding plate **[B]**.



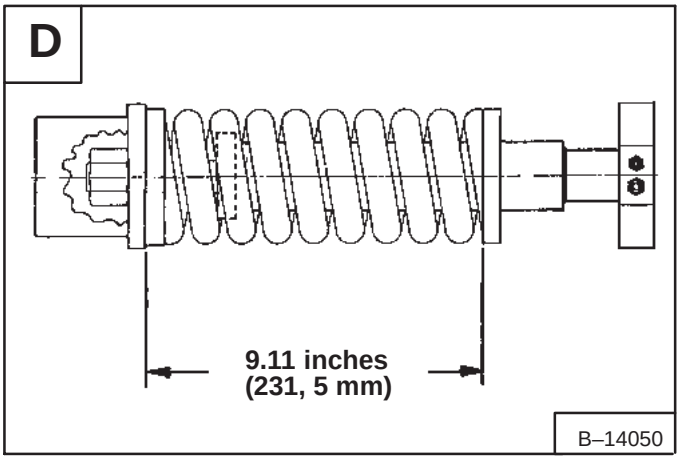
Slide the recoil spring cylinder forward and remove it from the track frame **[C]**.



If the recoil spring is disassembled or whenever the recoil spring is removed from the track frame, check and adjust the recoil spring to 9.11 inches (231,5 mm) **[D]**.

NOTE: If the adjusting nut is removed or if adjustment is needed, Apply thread sealant liquid adhesive (LOCTITE #242) to the nut.

NOTE: If grease spring is disassembled, it may be necessary to install the grease spring cylinder assembly into a press and compress the spring slightly to start the adjusting nut.



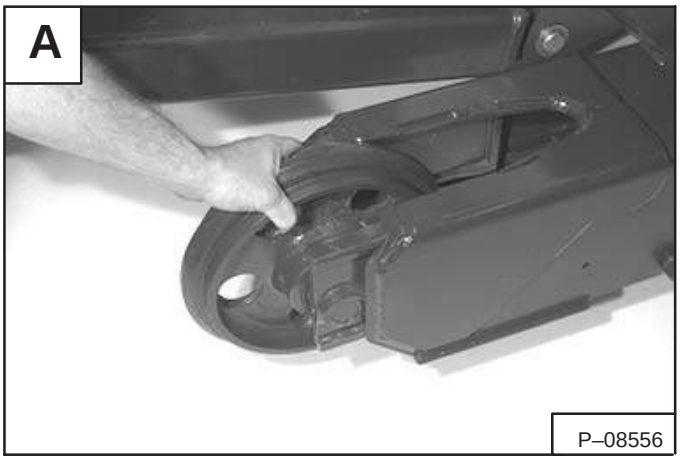
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Disassembly and Assembly (S/N 512913001 & Above)

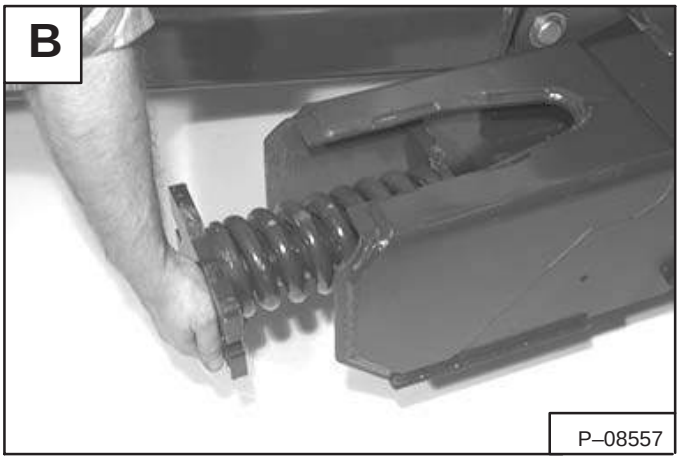
Use the following procedure to remove the different parts from the track frame.

Remove the track. (See Page 5–7.)

To remove, slide the front track idler out of the track frame **[A]**.



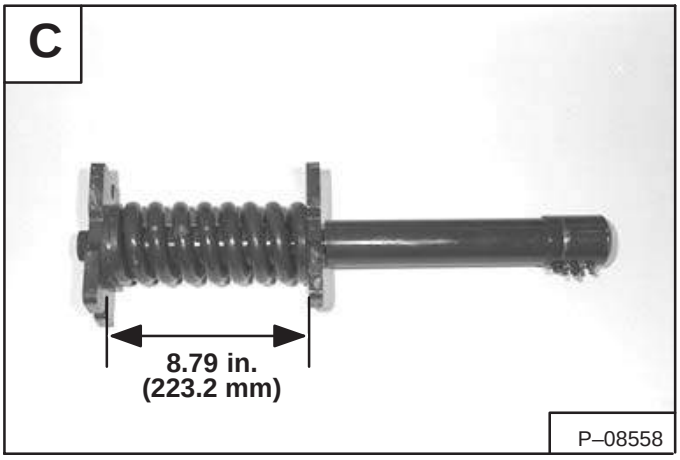
Remove the recoil spring **[B]**.



If the recoil spring is disassembled or whenever the recoil spring is removed from the track frame, check that the recoil spring is compressed to 8.79 inches (223.2 mm) **[C]**.

NOTE: The recoil spring is not adjustable. If it does not meet the required measurement order a new component.

NOTE: If grease spring is disassembled, it may be necessary to install the grease spring cylinder assembly in a press and compress the spring slightly to start the bolt.



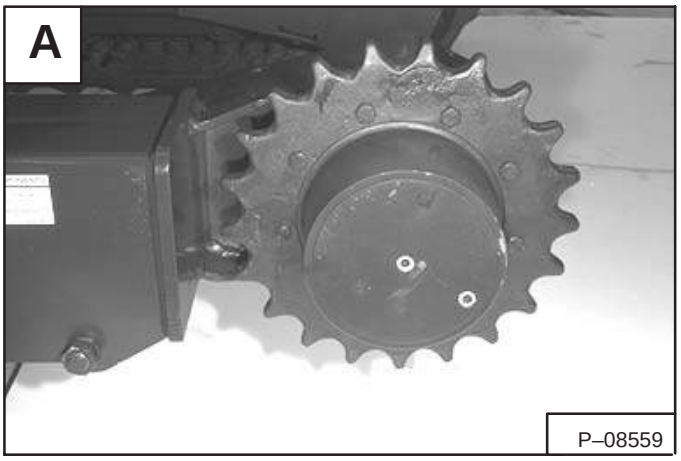
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Disassembly and Assembly (S/N 151293001 & Above) (Cont'd)

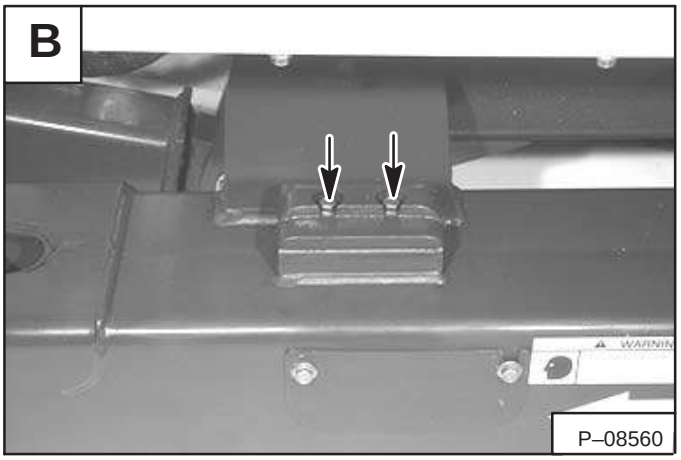
Remove the drive sprocket bolts **[A]**.

Installation: Put liquid adhesive (LOCTITE #242) on the bolts and tighten to 80 ft.–lbs. (108 Nm) torque.

Remove the drive sprocket from the drive motor and planetary gear assembly.

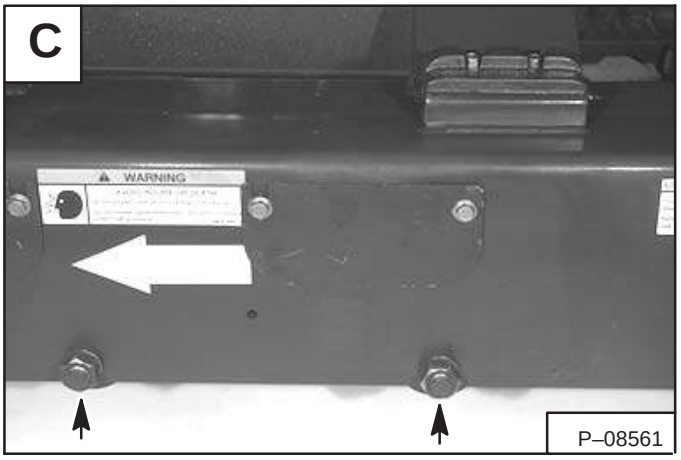


Remove the guide block bolts **[B]**.

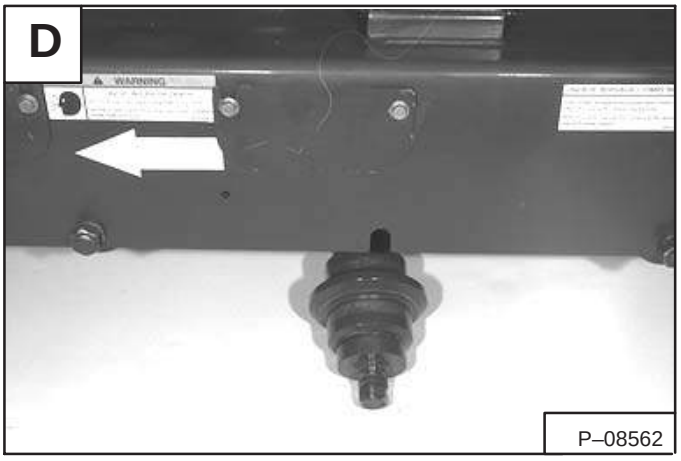


Loosen the nuts on the track roller on both sides of the track frame **[C]**.

Installation: Tighten the nuts to 125–140 ft.–lbs. (170–190 Nm) torque.



Remove the track roller **[D]**.



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TRAVEL MOTOR

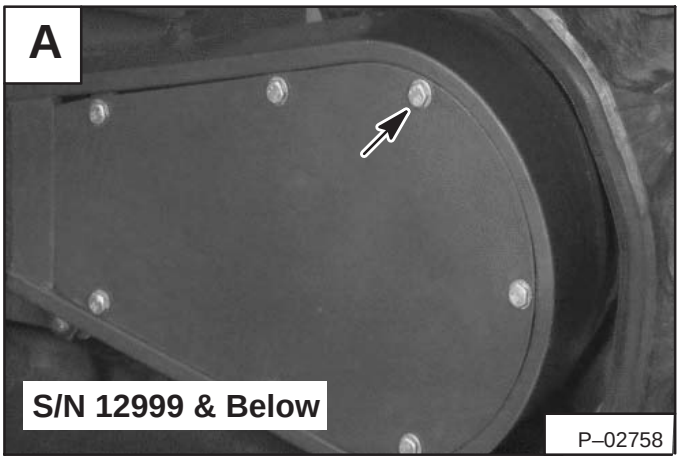
Testing

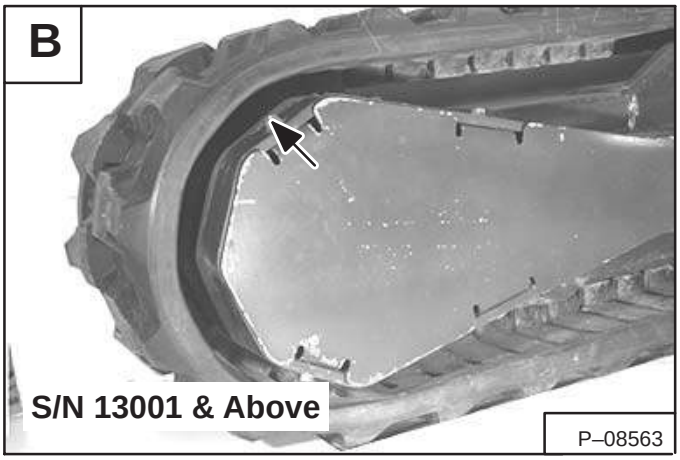
Lift and block the side of the track frame where the drive motor will be tested.

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

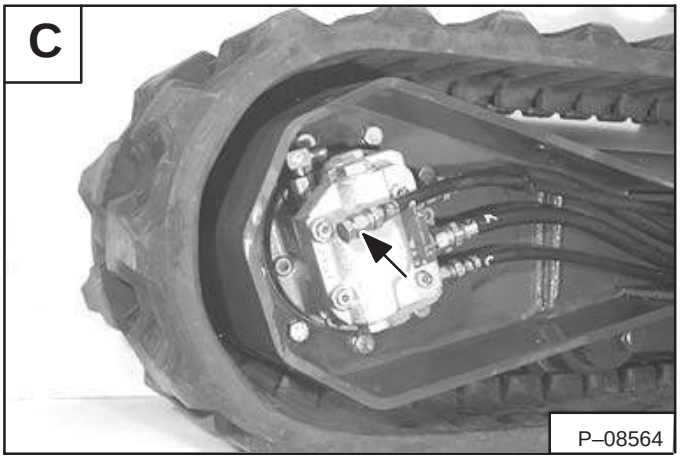
Installation: Tighten the bolts to 15–18 ft.– lbs. (20–25 Nm) of torque.

Remove the cover.

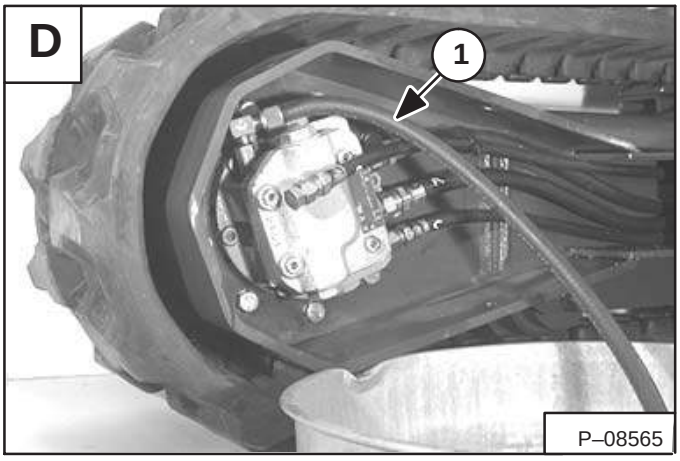




Remove and plug the case drain return line **[C]**.



Install a drain line (Item 1) **[D]** onto the final drive case drain port with the unattached end going to a empty drain pan.



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TRAVEL MOTOR (Cont'd)

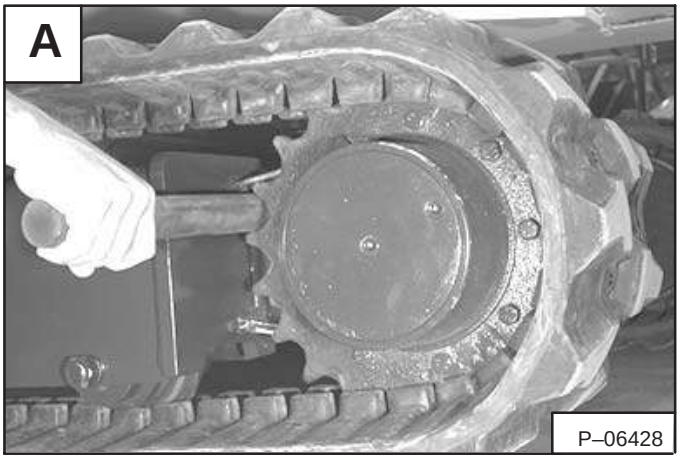
Testing (Cont'd)

Using a 1–1/2 inch solid bar placed through the drive sprocket, and into the track frame **[A]** run the final drive control lever for one minute at high idle.

Measure the amount of hydraulic oil in the drain pan.

Normal case drain is .09 GPM (0,35 LPM).

Service limit is .26 GPM (1,0 LPM)



Removal and Installation

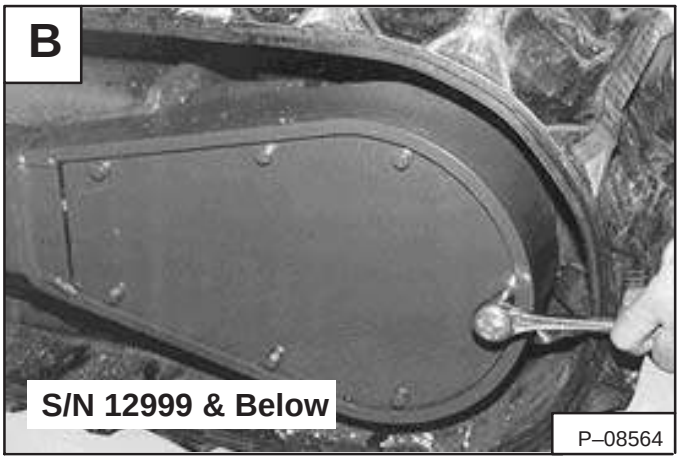
Remove the bolts from the track frame cover **[B]** & **[C]**.

Installation: Tighten the bolts to 20–25 ft.–lbs. (27–34 Nm) torque.

Remove the cover.

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

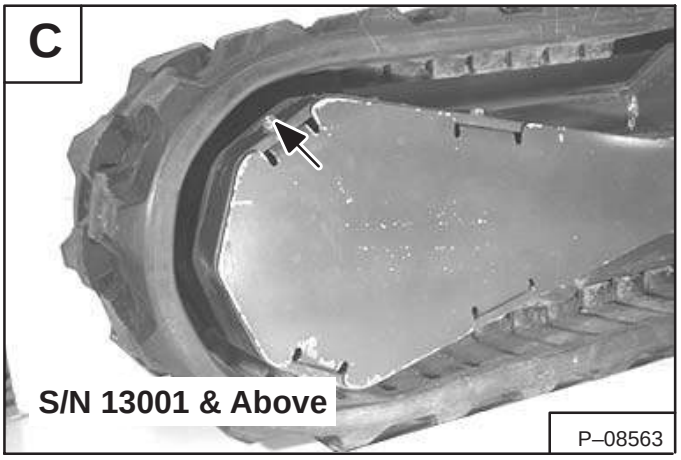
Release the track tension and remove the track. (See Page 5–7.)



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.

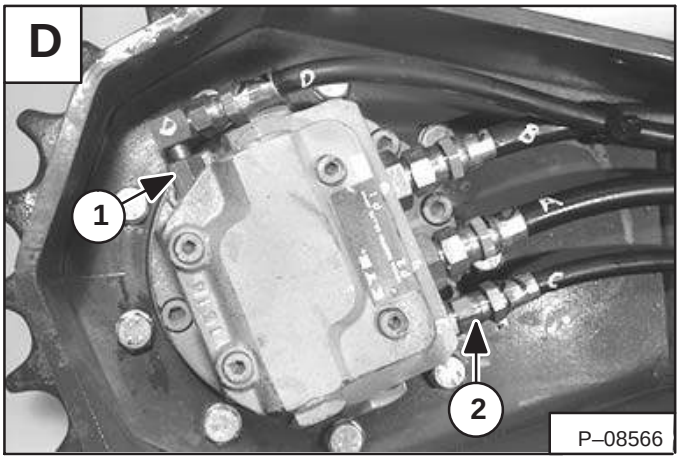
I–2003–0284



Mark the hoses for correct installation.

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

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



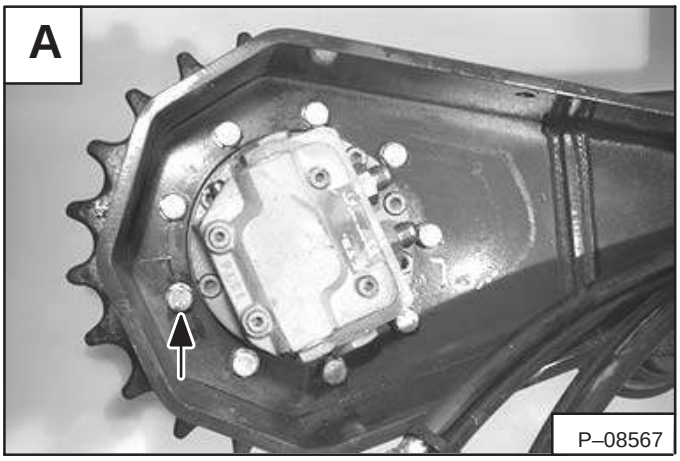
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TRAVEL MOTOR (Cont'd)

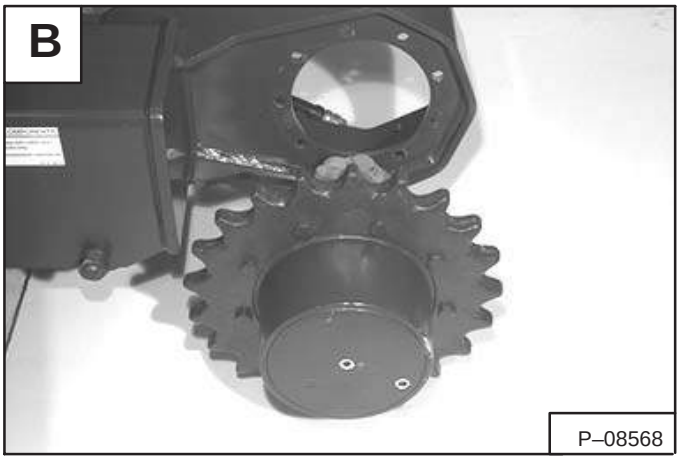
Removal and Installation (Cont'd)

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

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



Remove the motor assembly from the track frame **[B]**.

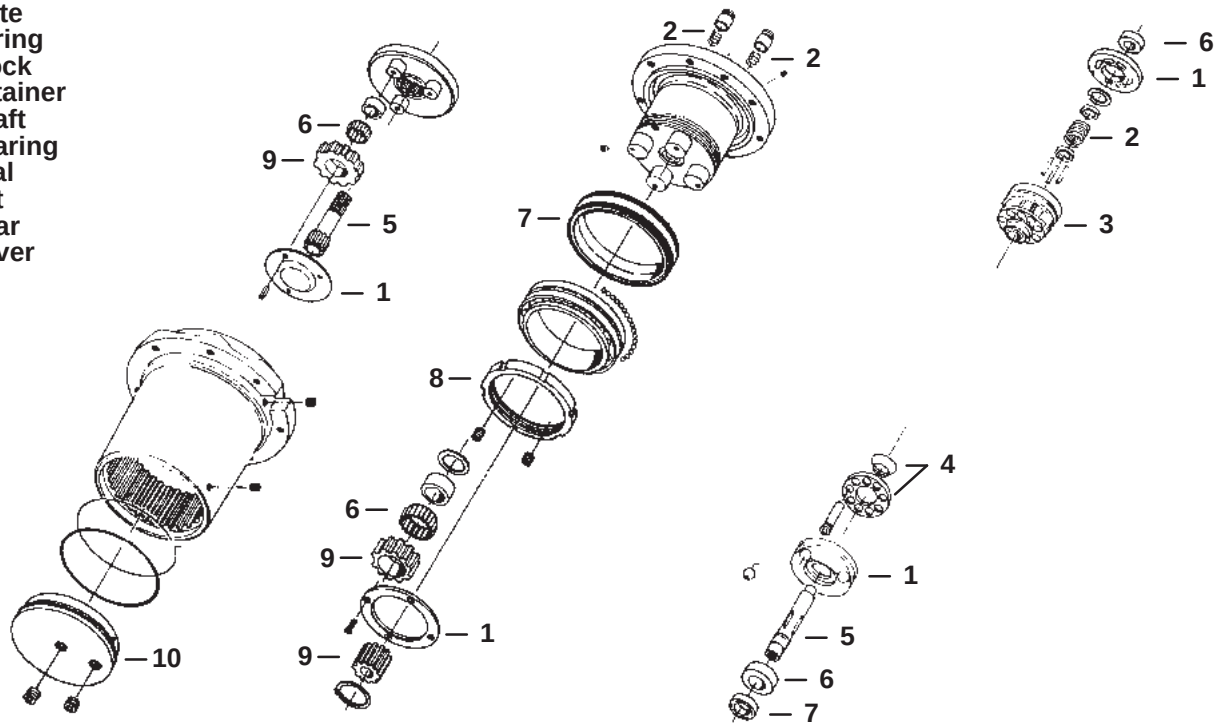


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Parts Identification

TRAVEL MOTOR

1. Plate
2. Spring
3. Block
4. Retainer
5. Shaft
6. Bearing
7. Seal
8. Nut
9. Gear
10. Cover



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TRAVEL MOTOR (S/N 512911001–512913404) (Cont'd)

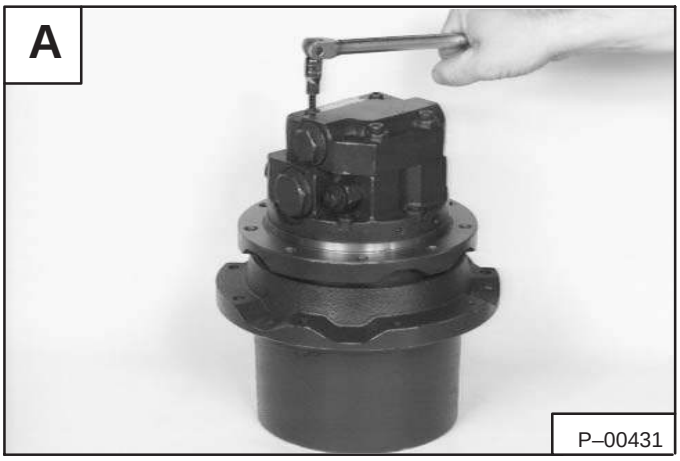
Disassembly

IMPORTANT

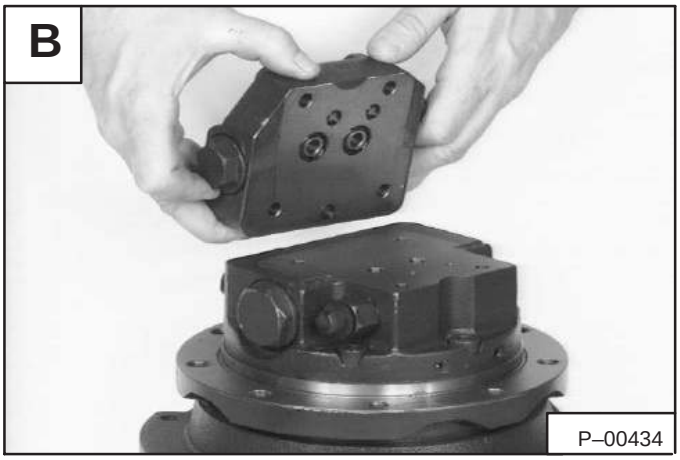
When making repairs on hydrostatic and hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.

I–2003–0284

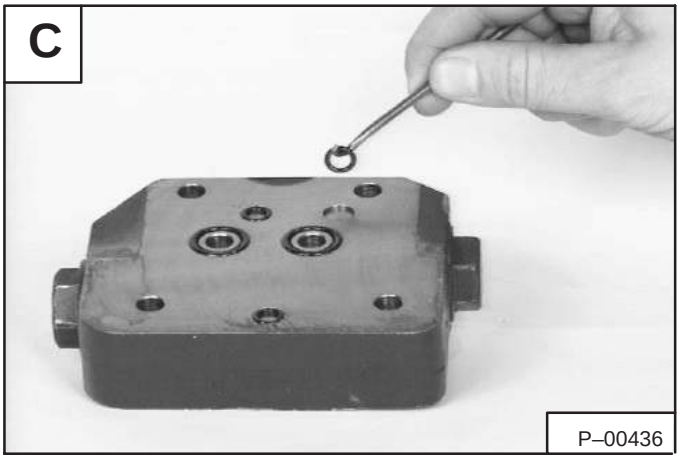
Remove the four bolts from the relief block assembly **[A]**.



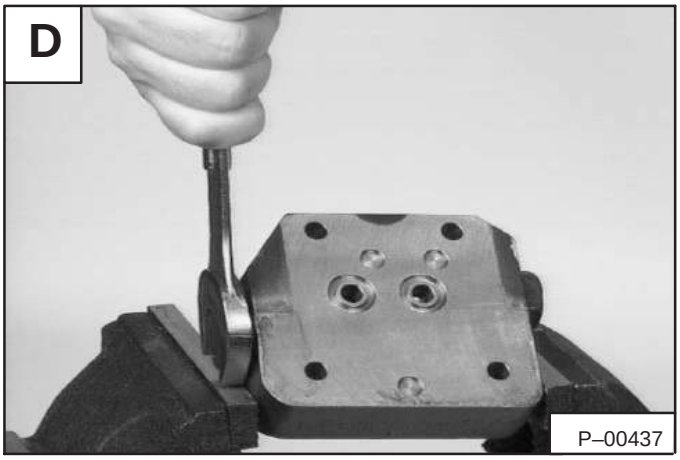
Remove the relief valve assembly from the drive motor **[B]**.



Remove the five O–rings from the relief valve assembly **[C]**.



Clamp the relief valve assembly in a vise and remove the two relief valves **[D]**.

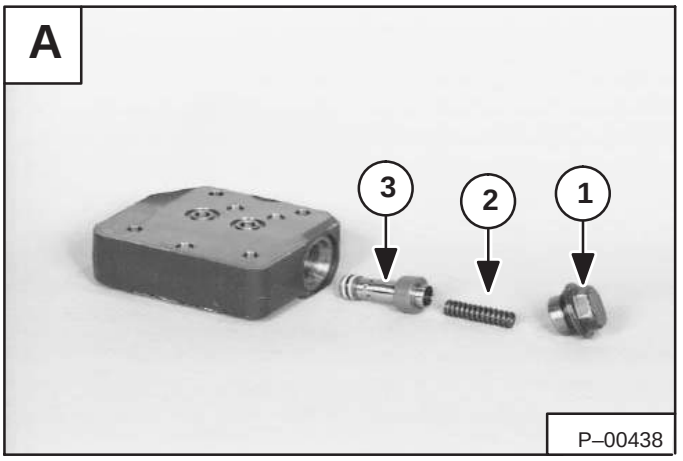


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TRAVEL MOTOR (S/N 512911001–512913404) (Cont'd)

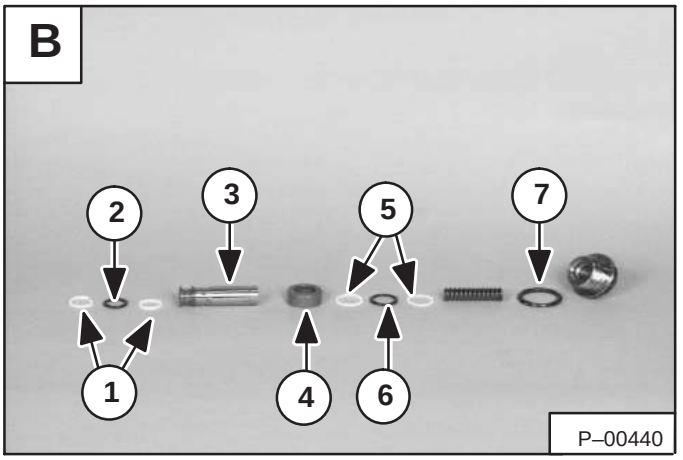
Disassembly (Cont'd)

Remove the plug (Item 1) **[A]**, spring (Item 2) **[A]** and the relief assembly (Item 3) **[A]** from each end of the valve block.

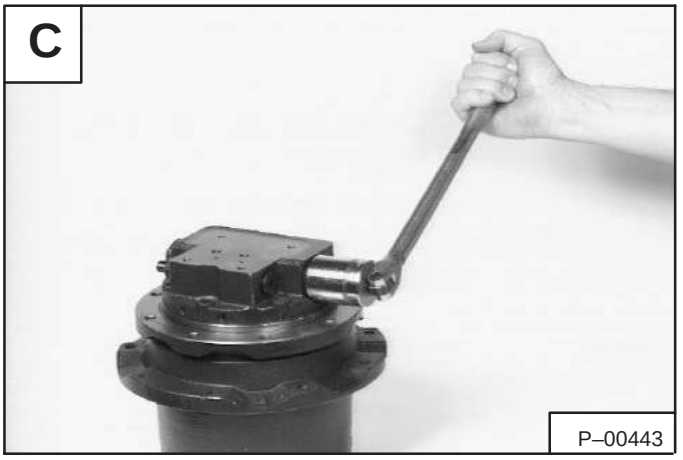


Remove the two back–up rings (Item 1) **[B]** and O–ring (Item 2) **[B]** from the spool (Item 3) **[B]**. Slowly turn the piston (Item 4) **[B]** and remove it from the spool (Item 3) **[B]**. Remove the two back–up rings (Item 5) **[B]** and the O–ring (Item 6) **[B]** from the inner diameter of the piston (Item 4) **[B]**. Remove the O–ring (Item 7) **[B]** from the plug.

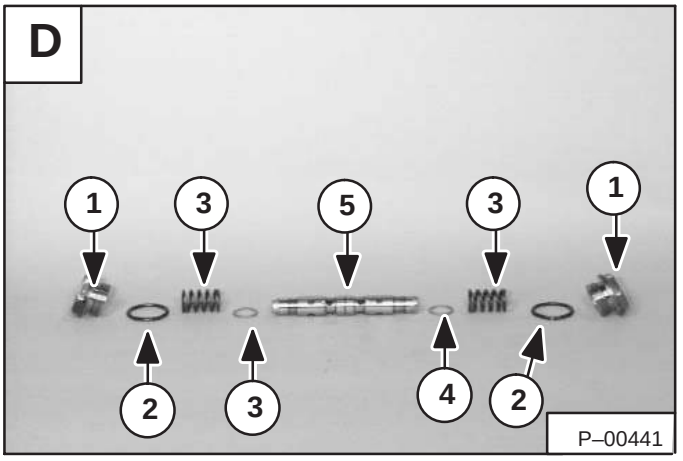
NOTE: Check the poppet movement inside the spool (Item 3) [B]. The poppet must move freely. The poppet cannot be removed from the spool. If poppet is lodged or damage a new relief valve will need to be ordered.



Loosen the two plugs from each end of the valve body **[C]**.



Remove the plugs (Item 1) **[D]** and remove the O–ring (Item 2) **[D]** from the plug. Remove the springs (Item 3) **[D]**, retaining washers (Item 4) **[D]** and slowly turn the spool (Item 5) **[D]** and remove it from the valve body.



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TRAVEL MOTOR (S/N 512911001–512913404) (Cont'd)

Disassembly (Cont'd)

To disassemble the spool, insert a hardened dowel pin thru the hole in the spool gland and use a vise with protective jaws to hold the spool **[A]**.

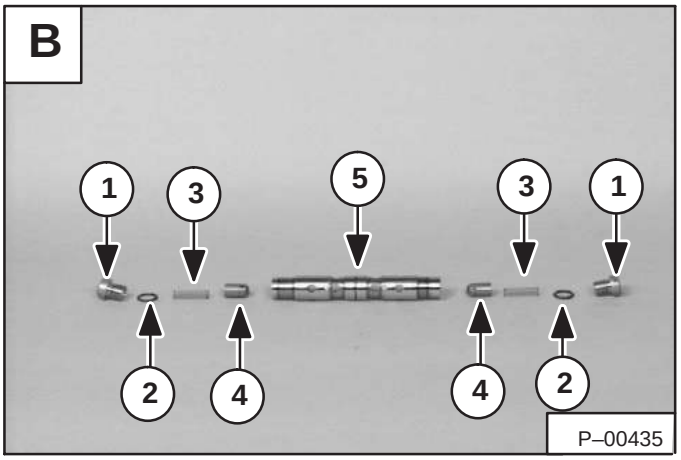
Remove the two end plugs from the spool **[A]**.

NOTE: Do Not use any type of clamp tool on the spool. The spool must be replaced if there are scratches or other damage.



Disassemble the spool by removing the O–rings (Item 2) **[B]** from the end plugs (Item 1) **[B]**. Remove the springs (Item 3) **[B]** and the poppets (Item 4) **[B]** from the spool (Item 5) **[B]**.

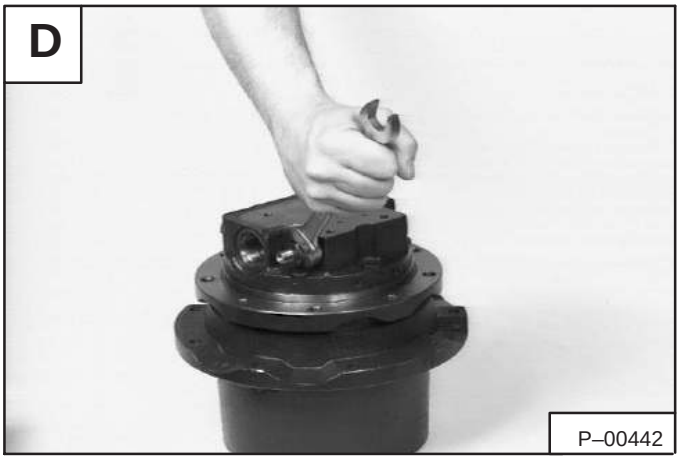
Use solvent to clean; dry all spool components.



Loosen the plug from the end of the valve body **[C]**.



Loosen the adapter from the opposite end of the valve body **[D]**.



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TRAVEL MOTOR (S/N 512911001–512913404) (Cont'd)

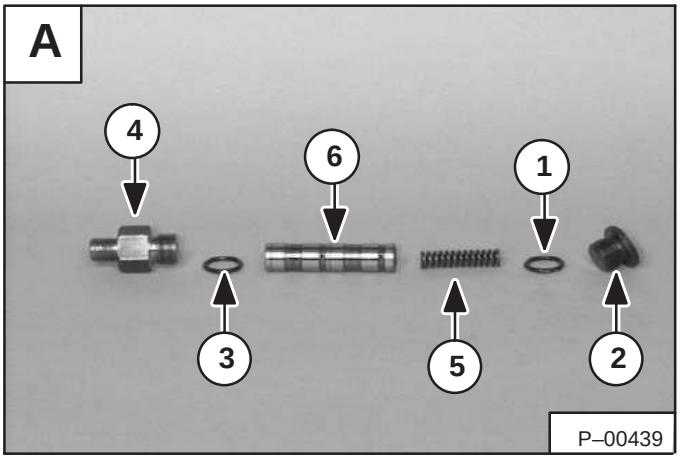
Disassembly (Cont'd)

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

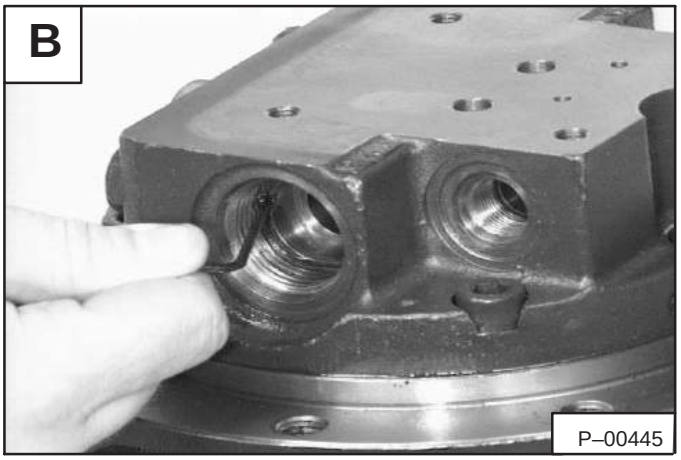
Remove the O–ring (Item 3) **[A]** from the end of the adapter (Item 4) **[A]**.

Remove the spring (Item 5) **[A]** and the spool (Item 6) **[A]**.

Use solvent to clean; dry all components.



Remove the orifice from each end of the internal diameter of the spool body **[B]**.

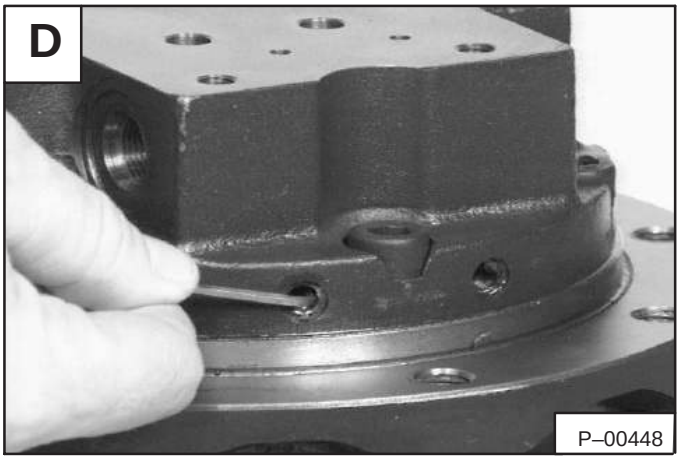


Remove the two plugs from the edge face of the valve body **[C]**.



Remove the two orifice plugs from each of these plug holes **[D]**. (Total of four orifice.)

NOTE: Do not intermix these orifice plugs with orifice plugs removed from different locations on the travel motor.



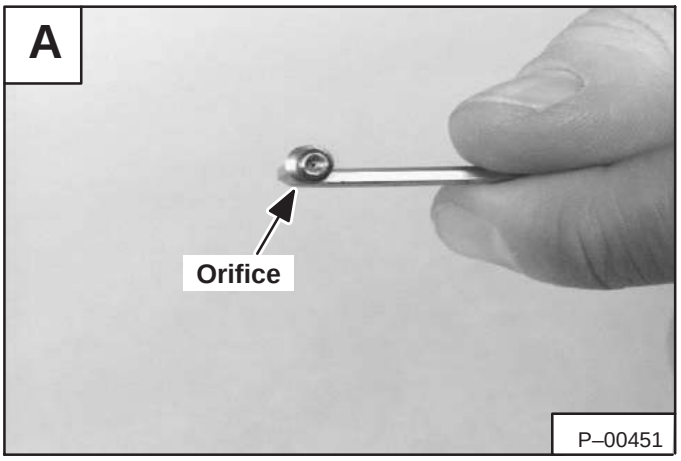
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TRAVEL MOTOR (S/N 512911001–512913404) (Cont'd)

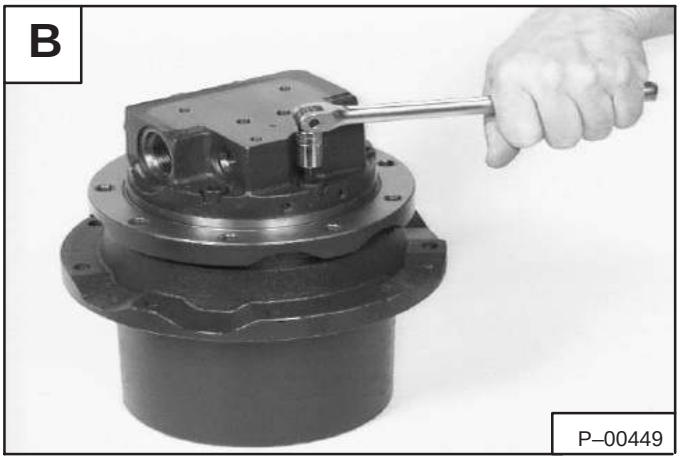
Disassembly (Cont'd)

Inspect the orifice in the center of each plug for contamination **[A]**.

If orifice is plugged, clean with an appropriate sized oxy/acetylene torch tip cleaner or replace if necessary.

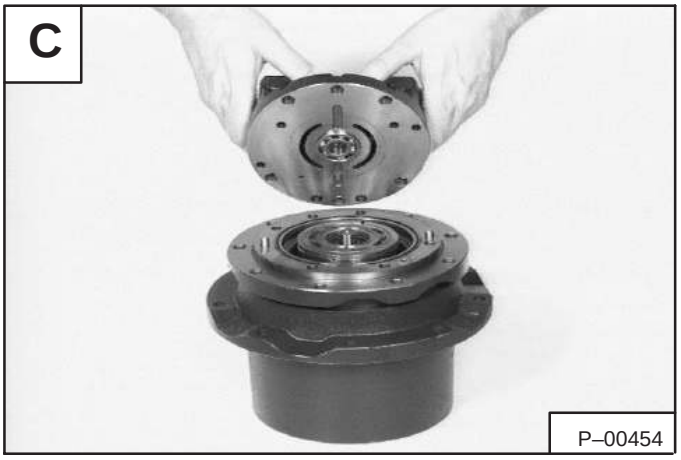


Remove the six bolts holding the valve body to the drive motor **[B]**.

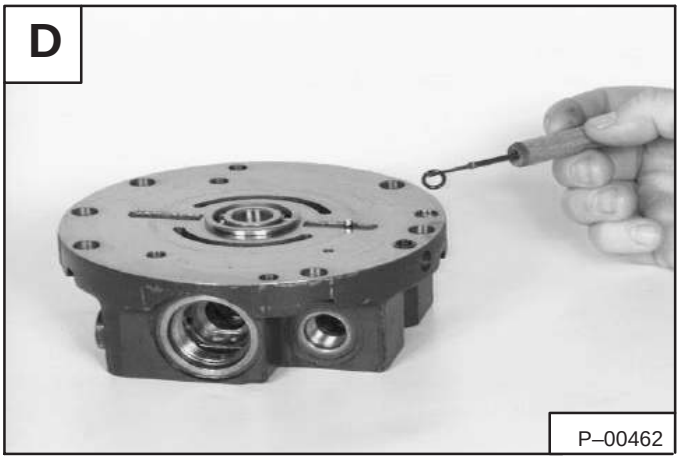


Lift the valve body off of the drive motor **[C]**.

If the valve body is stuck to the drive motor, lightly tap the edge of the valve body with a plastic hammer to loosen.



Remove the two O–rings from the valve body face **[D]**.



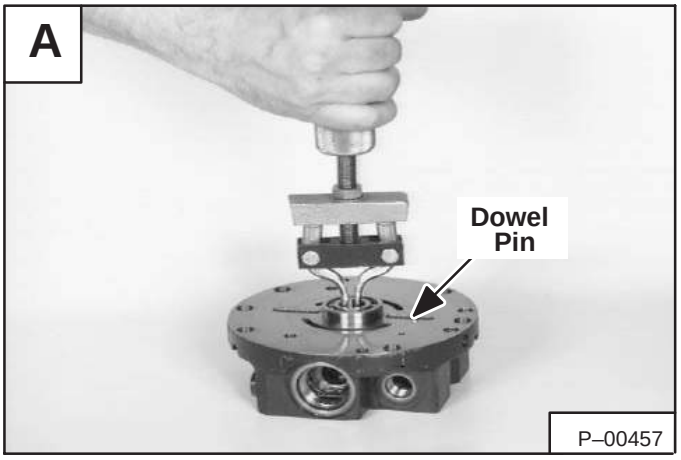
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TRAVEL MOTOR (S/N 512911001–512913404) (Cont'd)

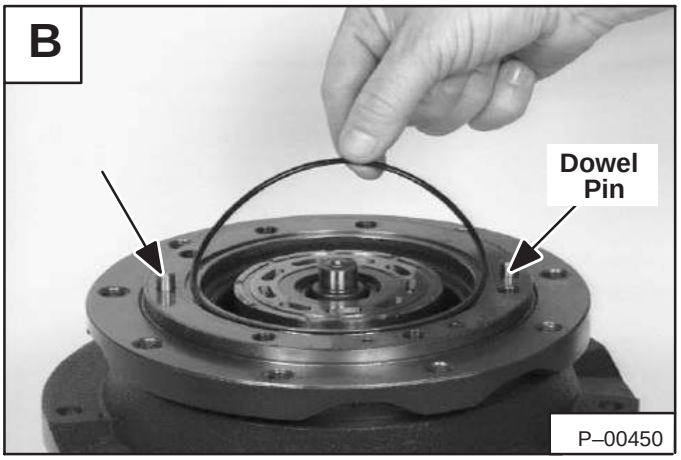
Disassembly (Cont'd)

Remove the bearing from the valve body with a slide hammer type puller **[A]**.

NOTE: The dowel pin in the face of the valve body is staked to the valve body. Do Not remove the dowel pin unless it is damaged.

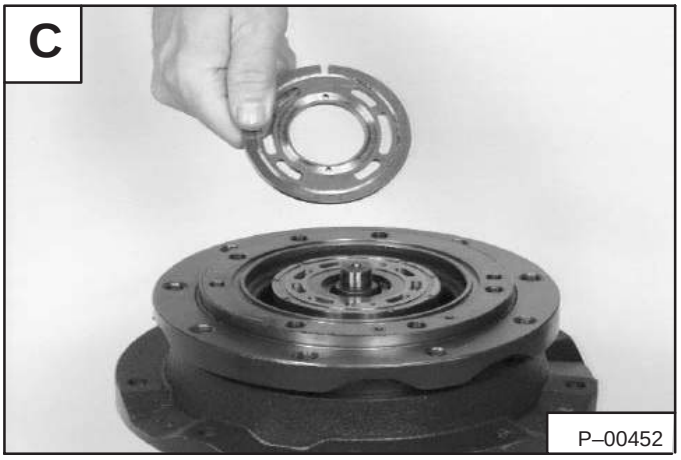


Remove the O–ring and the two dowel pins **[B]**.

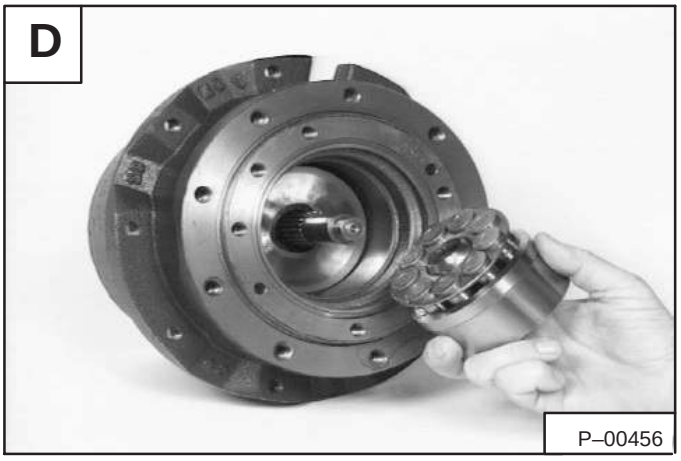


Remove the valve plate from the rotating group **[C]**.

NOTE: The bronze side of the valve plate goes toward the rotating group.



Remove the rotating group from the drive motor hub **[D]**.

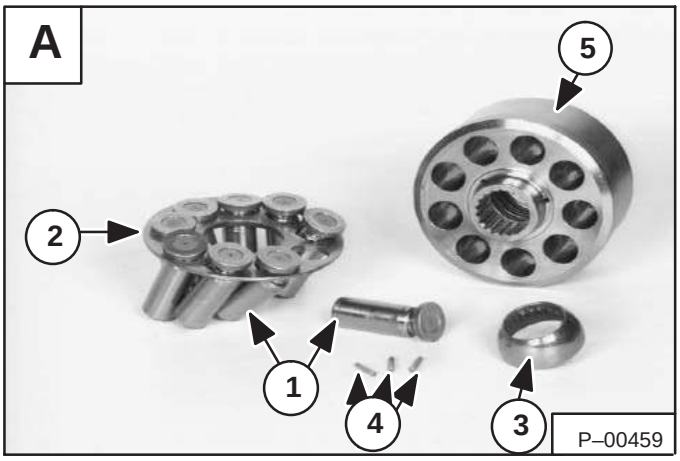


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TRAVEL MOTOR (S/N 512911001–512913404) (Cont'd)

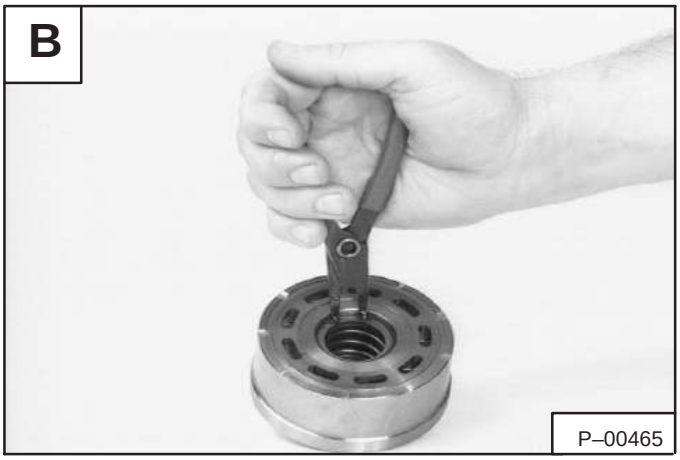
Disassembly (Cont'd)

Disassemble the rotating group by removing the pistons (Item 1) **[A]**, piston retainer (Item 2) **[A]**, conical spacer (Item 3) **[A]** and the three pins (Item 4) **[A]** from the piston housing (Item 5) **[A]**.

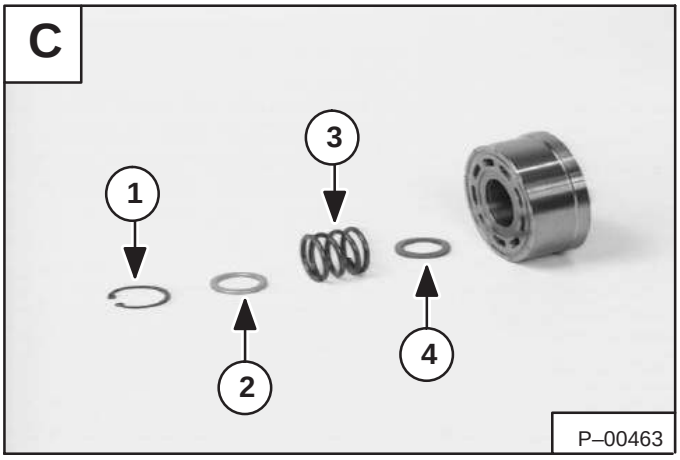


Turn the piston housing over and remove the snap ring from the housing **[B]**.

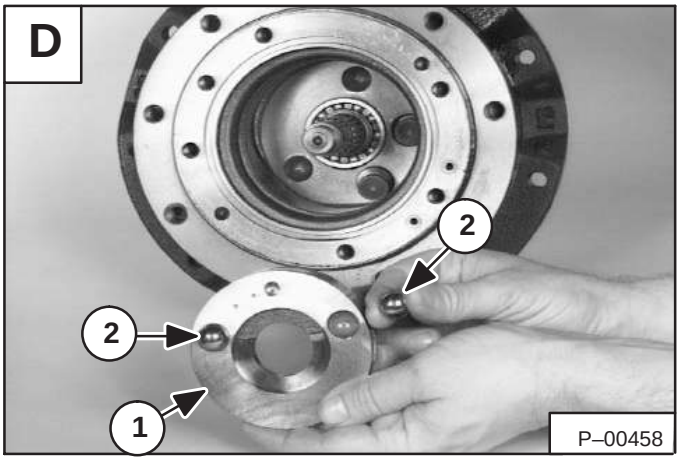
NOTE: The spring inside the piston housing is under pressure. Use care when removing the snap ring from the piston housing.



Remove the snap ring (Item 1) **[C]**, collar (Item 2) **[C]**, spring (Item 3) **[C]** and the collar (Item 4) **[C]** from the piston housing.



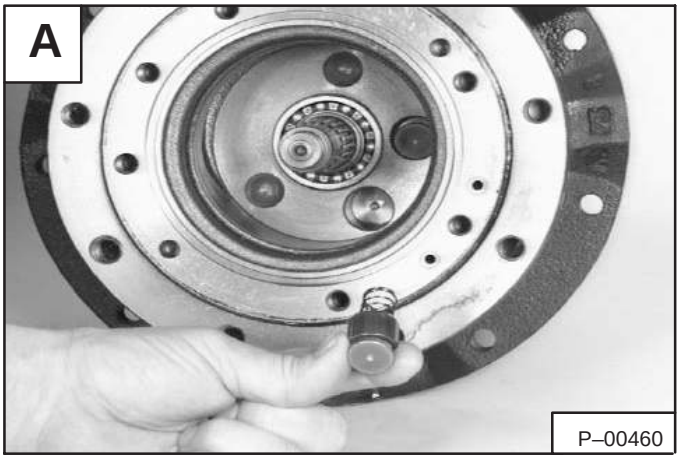
Remove the swash plate (Item 1) **[D]** and the two steel balls (Item 2) **[D]** from the drive motor hub.



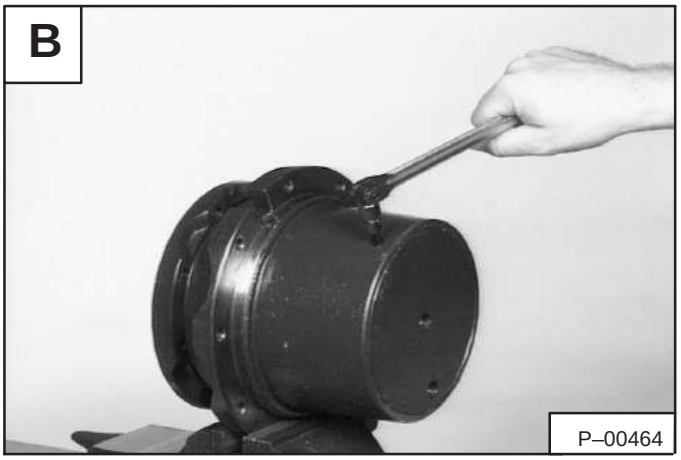
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Disassembly (Cont'd)

Remove the two pistons and springs from the drive motor hub **[A]**.



Clamp the housing flange into a vise and remove the plug from the side of the housing **[B]**.

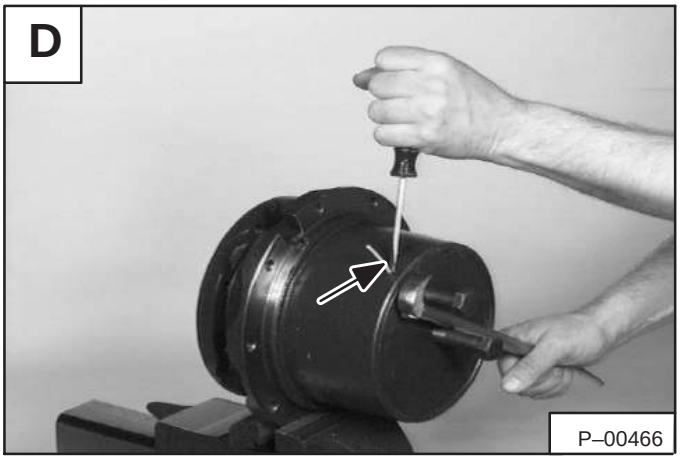


If the drive motor lube oil has not already been drained, do so now.

Remove the two plugs from the cover of the drive motor housing **[C]**. Drain the fluid into a container. Dispose of this fluid properly.



Install two bolts (PT 3/8 metric threads) into the plug holes in the cover. Install a flat blade screw driver tip into the hole in the side of the housing and use a bar to turn the end cover. Turn the end cover until the lock wire starts to come out of the housing hole **[D]**.

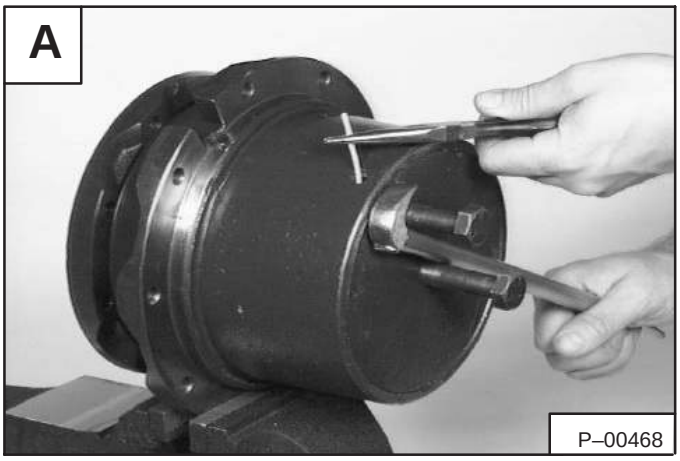


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TRAVEL MOTOR (S/N 512911001–512913404) (Cont'd)

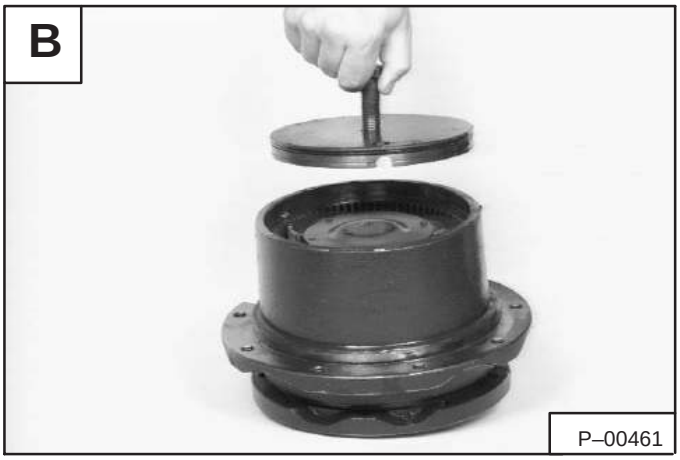
Disassembly (Cont'd)

Pull the lock wire out while turning the end cover until the wire is completely removed from the housing **[A]**.

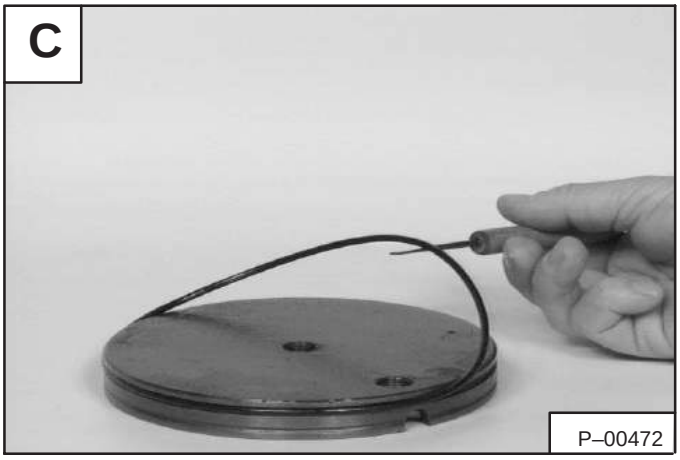


Remove the drive motor from the vise and set on a flat surface.

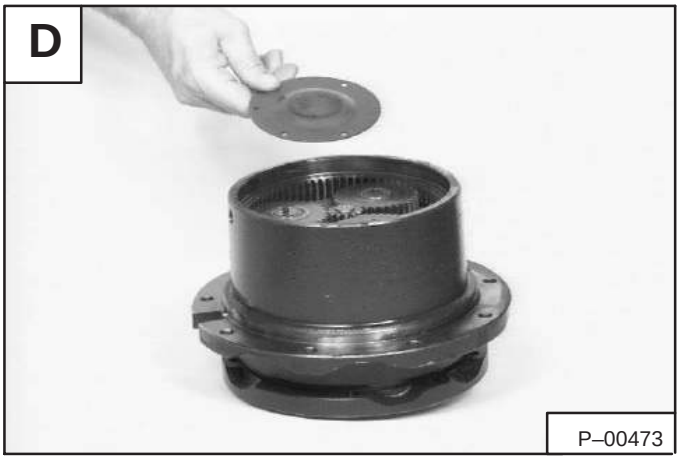
Remove the end cover from the drive motor housing **[B]**.



Remove the O–ring from the edge of the cover **[C]**.



Remove the thrust plate from the planetary assembly **[D].**

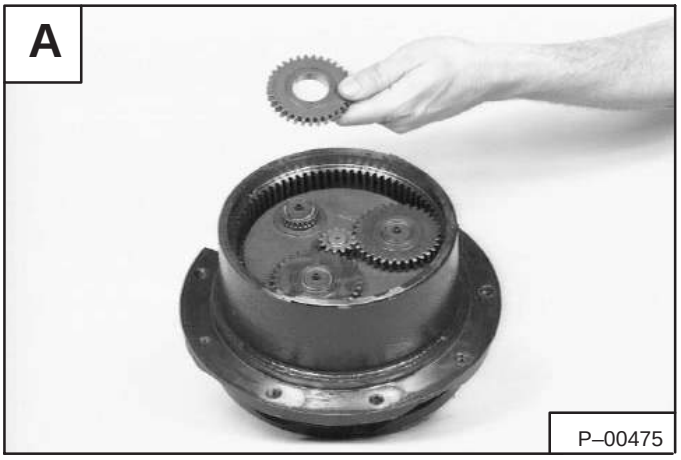


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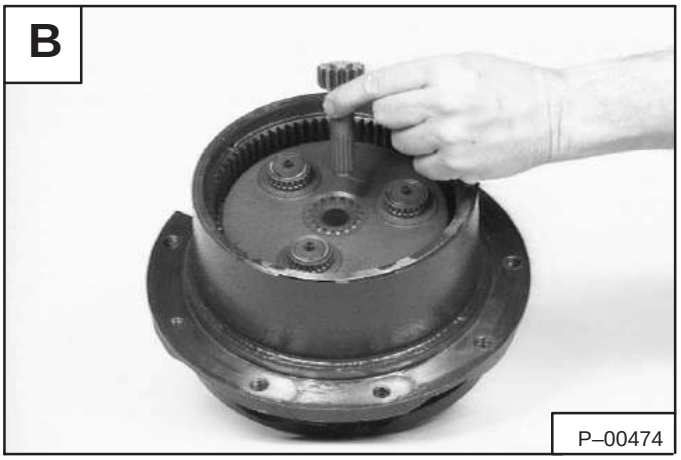
TRAVEL MOTOR (S/N 512911001–512913404) (Cont'd)

Disassembly (Cont'd)

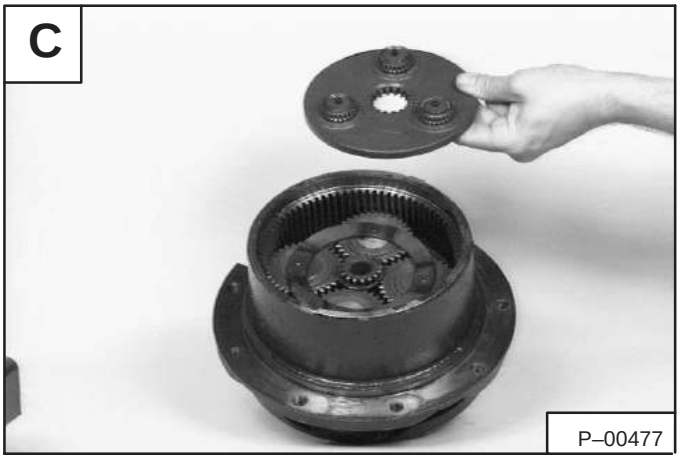
Remove the three planetary gears from the planetary holder **[A]**.



Remove the drive gear shaft from the housing **[B]**.

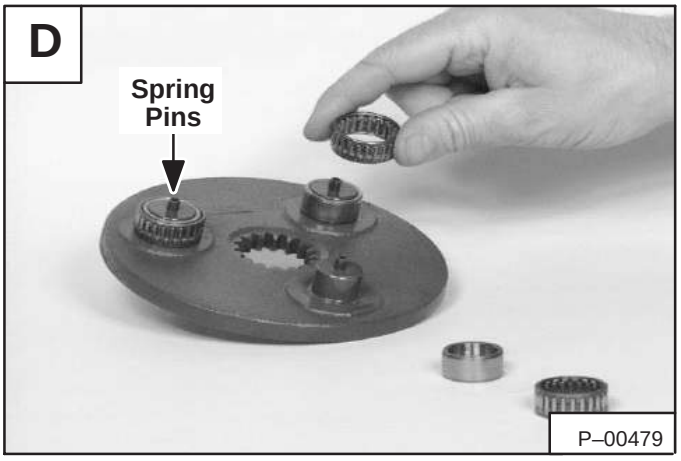


Remove the planetary holder from the housing **[C]**.



Remove the three needle bearings and bearing races from the holder **[D]**.

NOTE: The spring pins do not need to be removed or replaced unless damaged.



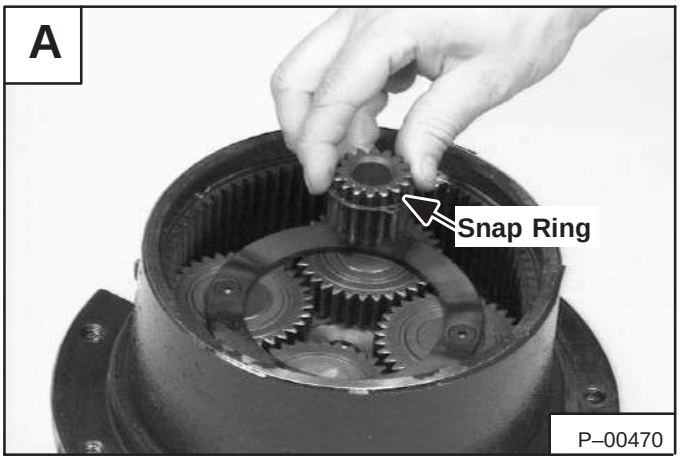
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TRAVEL MOTOR (S/N 512911001–512913404) (Cont'd)

Disassembly (Cont'd)

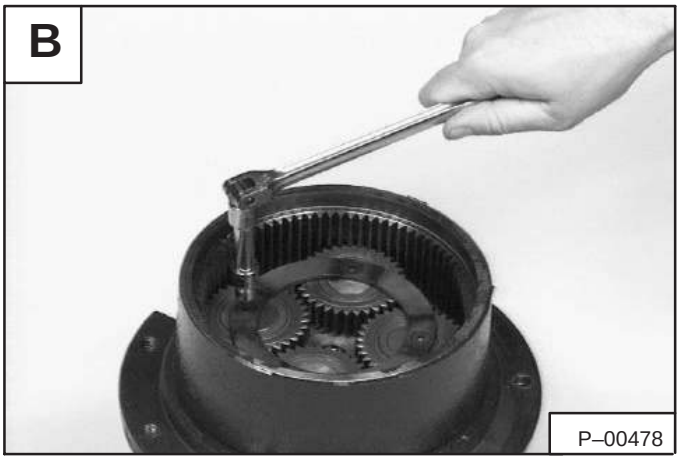
Remove the drive gear from the center of the planetary gears **[A]**.

NOTE: The snap ring does not need to be removed from the gear unless it is damaged.

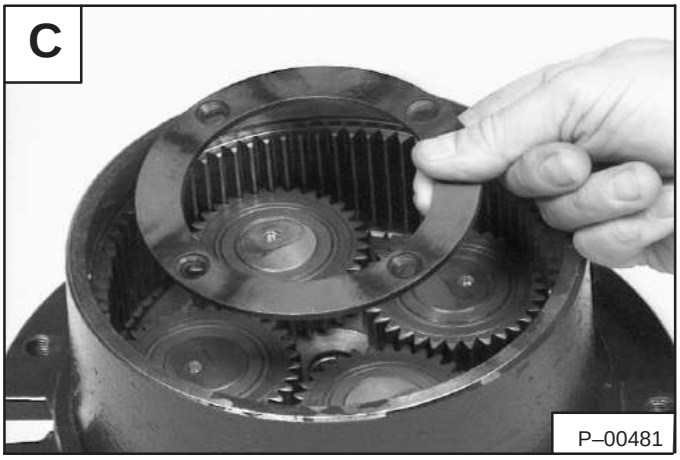


Remove the four screws holding the retaining ring to the inner planetary **[B]**.

NOTE: These screws have been coated with thread lock adhesive and may be difficult to remove. Use a torch and lightly heat the head of the screw to remove the screw. The heat will soften the thread lock adhesive to allow easier removal of these screws.



Remove the retaining ring **[C]**.



Remove the four gears, needle bearings, bearing races and the thrust washers **[D]**.



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TRAVEL MOTOR (S/N 512911001–512913404) (Cont'd)

Disassembly (Cont'd)

Remove the plug from the notched area in the travel motor flange **[A]**.



Remove the 131 or 132 steel balls that retain the drive motor housing to the drive motor hub **[B]** & **[C]**.

The balls must be removed thru the plug hole. Use solvent to flush oil off of the steel balls and the mating surfaces of the bearing and housing.

Use a magnet to remove the exposed steel balls from the plug hole. Use short bursts of compressed air to force the first few steel balls to the plug hole and remove these with the magnet. Continue this process until no more balls will appear at the plug hole.

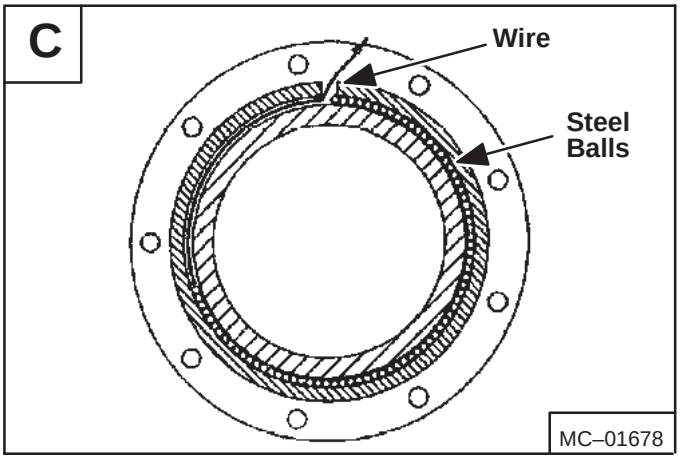
NOTE: Use care with the following process not to allow the wire to become lodged or to break off inside the motor.



Use a length of 16 gauge mechanics wire and bend a tight, closed loop at one end of the wire. Insert the wire into the plug hole and carefully push the wire around the diameter of the bearing to force the steel balls to the hole.

Remove the exposed balls with a magnet and continue this process until all 132 balls are removed and the end of the wire is visible thru the hole. Carefully remove the wire, DO NOT break the wire off inside the housing when removing the wire **[C]**.

NOTE: If balls seem to be lodged in the housing, it may be necessary to use a press or a three jaw puller to center the ball bearing groove into the center of the plug hole.



Use a three jaw puller to remove the travel motor housing **[D]**.

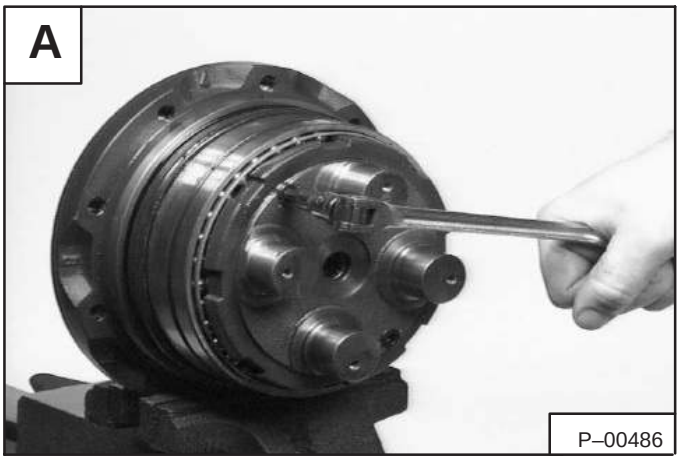


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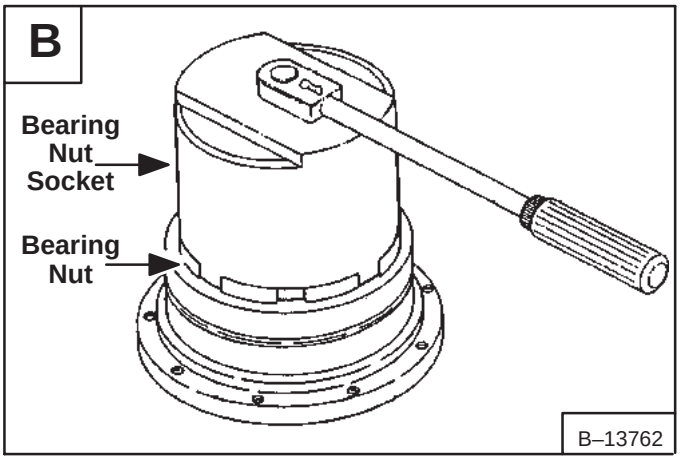
TRAVEL MOTOR (S/N 512911001–512913404) (Cont'd)

Disassembly (Cont'd)

Remove the three set screws that retain the bearing nut from turning **[A]**.

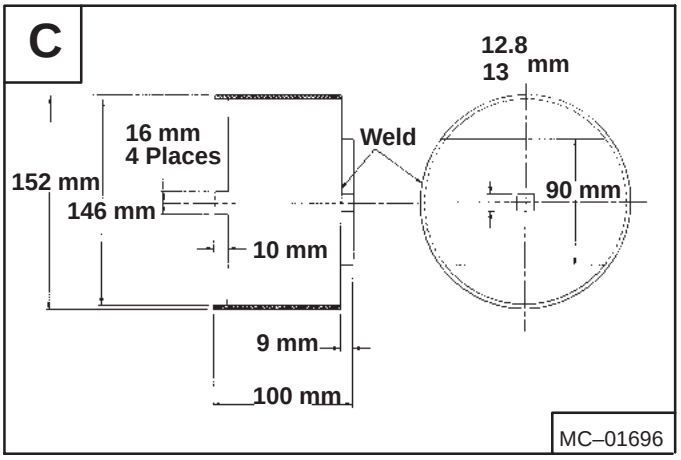


Use the bearing nut socket **[C]**, to remove the bearing nut from the drive motor hub **[B]**.



Bearing nut socket dimensions **[C]**.

This tool can be made at a local machine shop.



Carefully remove the double race bearing from the hub **[D]**.

NOTE: The inner and outer races of this bearing are not permanently retained to each other. If not lifted off as an assembly, the races will separate and the steel balls will come loose.



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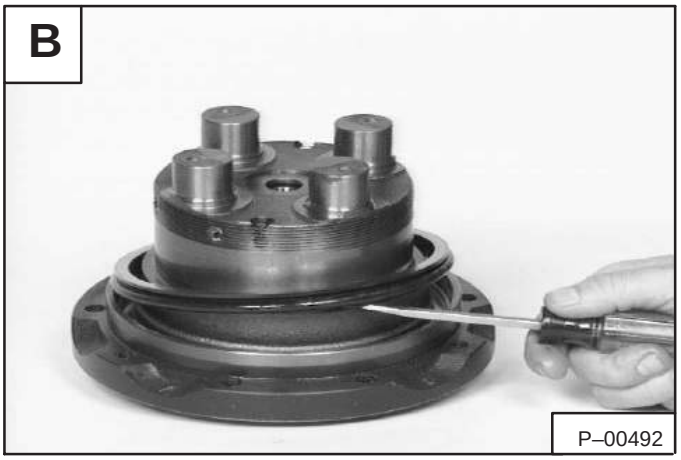
TRAVEL MOTOR (S/N 512911001–512913404) (Cont'd)

Disassembly (Cont'd)

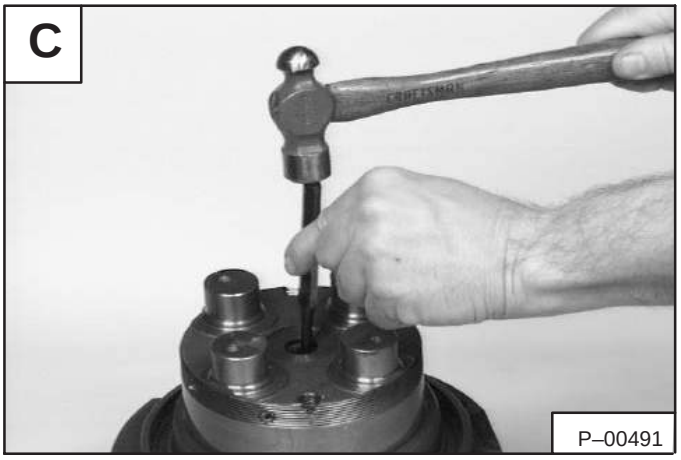
Remove the top half of the floating seal from the hub **[A]**.



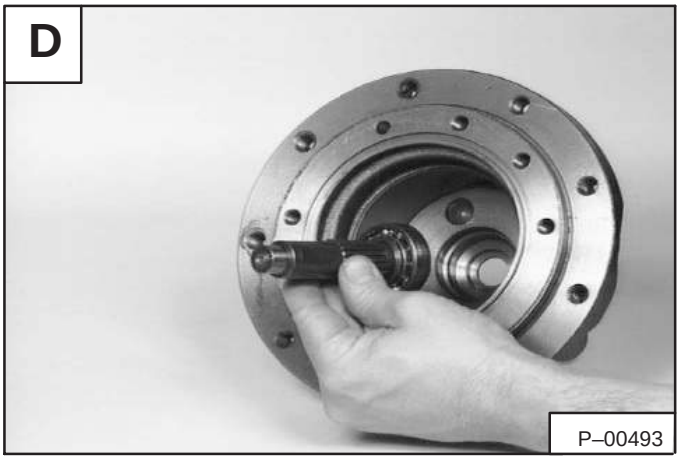
Pry the lower half of the floating seal from the hub **[B]**.



Use a punch to tap the rotating group drive shaft and bearing out of the hub **[C]**.



Remove the drive shaft and bearing from the hub **[D]**.



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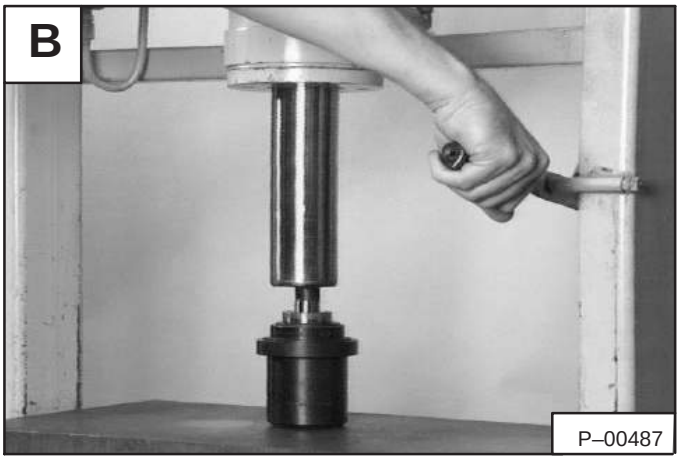
TRAVEL MOTOR (S/N 512911001–512913404) (Cont'd)

Disassembly (Cont'd)

Remove the seal from the hub **[A]**.



Use a press to press the drive shaft out of the bearing **[B].**



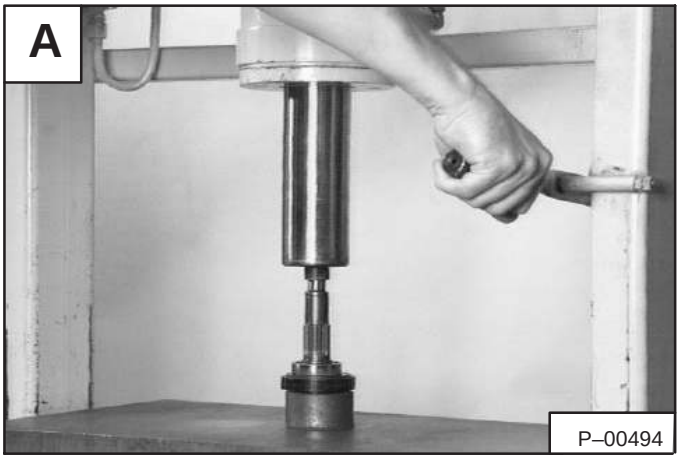
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TRAVEL MOTOR (S/N 512911001–512913404) (Cont'd)

Assembly

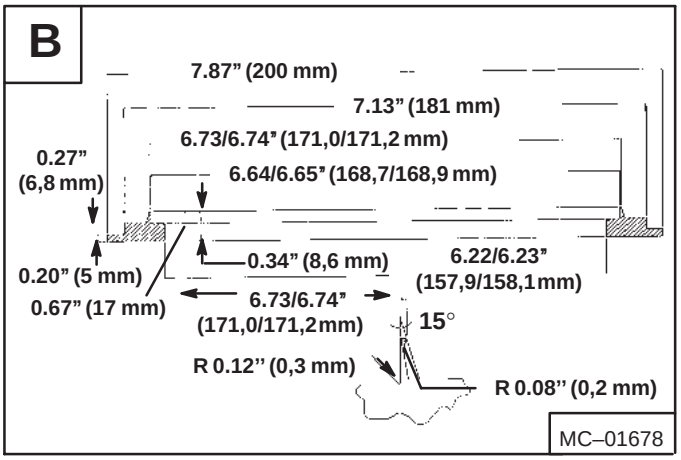
Install a new bearing onto the rotating group drive shaft **[A]**.

NOTE: Use a press tube that contacts the inner bearing race.



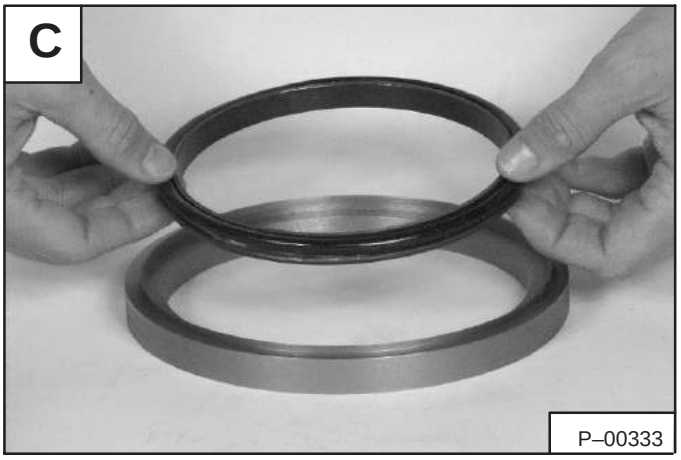
Floating seal installation tool **[B]**.

This tool can be made by a local machine shop or can be purchased from OTC Tool (MEL1412).



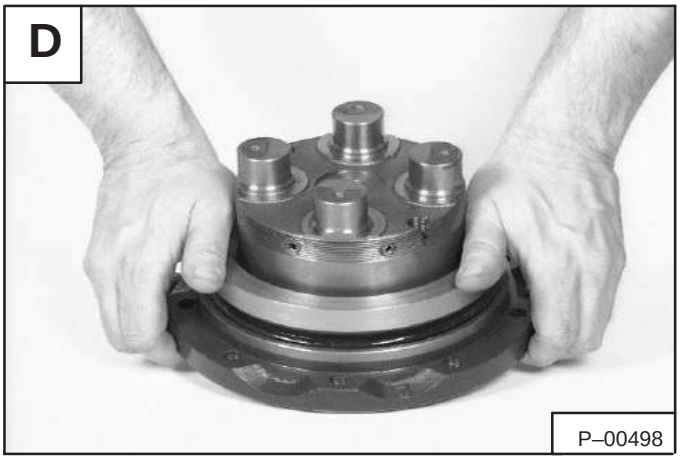
Put grease on the floating seal O–ring and on the floating seal surface of the drive motor hub.

Install the floating seal into the installation tool **[C]**.



Turn the seal and installation tool over and set it in place in the hub **[D]**.

Using both hands, evenly press down on the installation tool to insert the floating seal into the hub **[D]**.



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TRAVEL MOTOR (S/N 512911001–512913404) (Cont'd)

Assembly (Cont'd)

Apply grease to the O–ring of the other half of the floating seal.

Install the top half of the floating seal onto the previously installed floating seal half **[A]**.

NOTE: The O–ring of this half of the floating seal faces upwards.



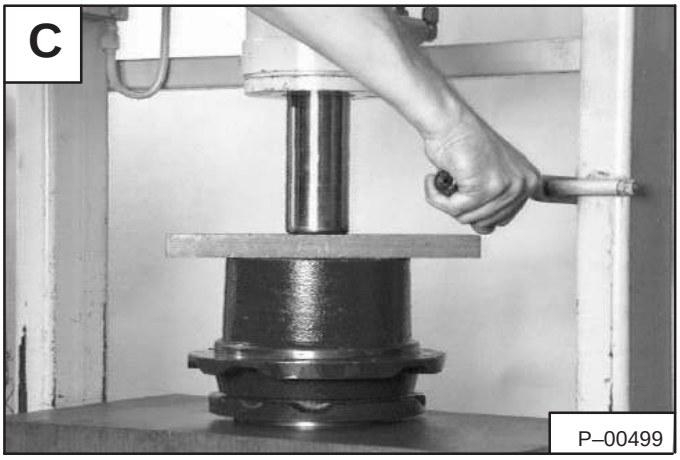
Carefully install a new double roller bearing onto the hub **[B]**.

Install the bearing nut onto the bearing, tighten the nut so that the bearing is seated against the hub but not tight. The bearing nut will be tightened more in a later step.



Press the drive motor housing onto the hub **[C]**.

NOTE: Make sure that the housing is positioned over the bearing and the top half floating seal.



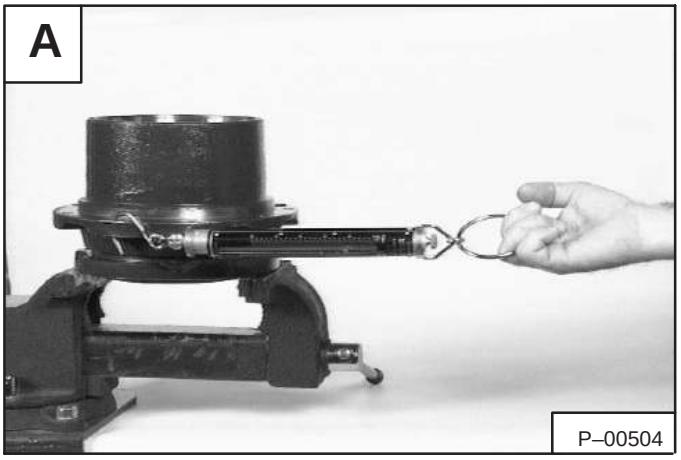
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TRAVEL MOTOR (S/N 512911001–512913404) (Cont'd)

Assembly (Cont'd)

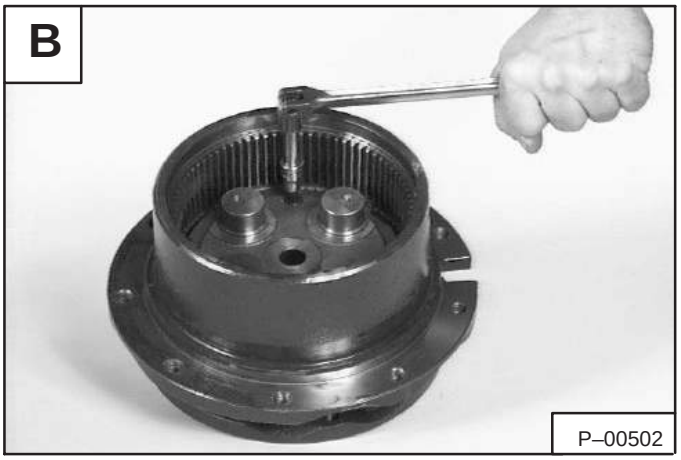
Use a spring scale to check the housing start up load **[A]**:

Use the bearing nut socket to tighten the bearing nut until there is 10–15 ft.–lbs. (1.5–2.0 kgf) force need for housing start up load.

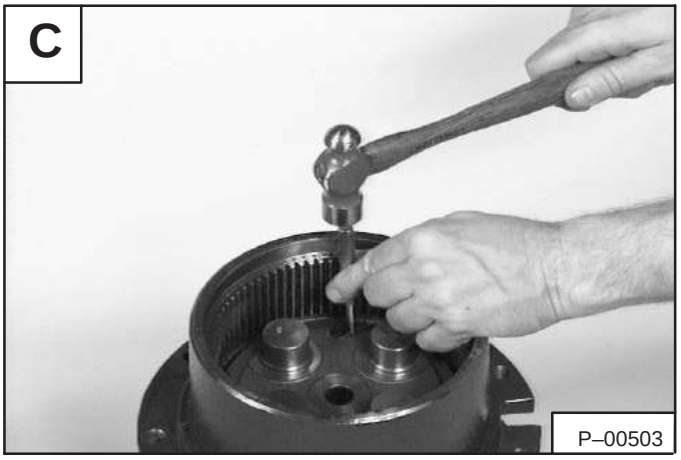


After the correct start up load has been set, install the three set screws to retain the bearing nut **[B]**.

Tighten the set screws to 21–29 ft.–lbs. (29–39 Nm) torque.

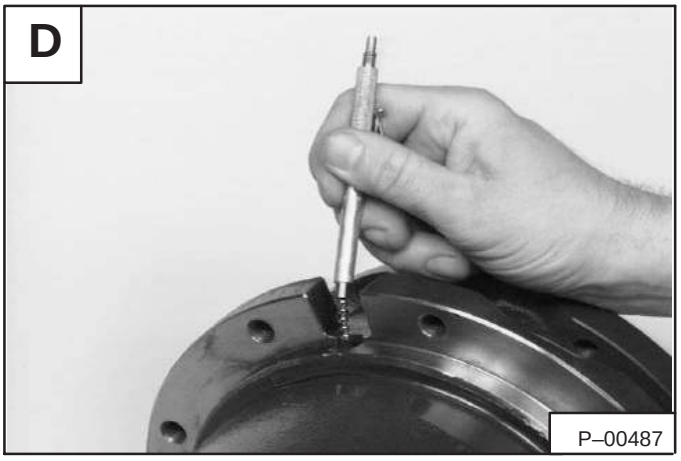


Use a center punch to stake the hub to the set screw so that the set screws will not come loose **[C]**.



Turn the motor on its side and install the 132 steel balls into the housing hole **[D]**.

NOTE: Make sure the hub ball grooves are centered to the bearing groove. If not, either use a 3 jaw puller or a press to align the ball grooves.



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TRAVEL MOTOR (S/N 512911001–512913404) (Cont'd)

Assembly (Cont'd)

Clean the screw threads of any dried on thread locking compound and inspect the screws. Replace screws if any damage is found.

Put liquid adhesive (LOCTITE #242) on the treads of the screw. Install the four screws thru the retainer ring **[A]**.

Tighten the screws to 3–6 ft.–lbs. (4–8 Nm) torque.



Install the snap ring onto the drive gear (if previously removed) and install the drive gear into the center of the planetary gears **[B]**.

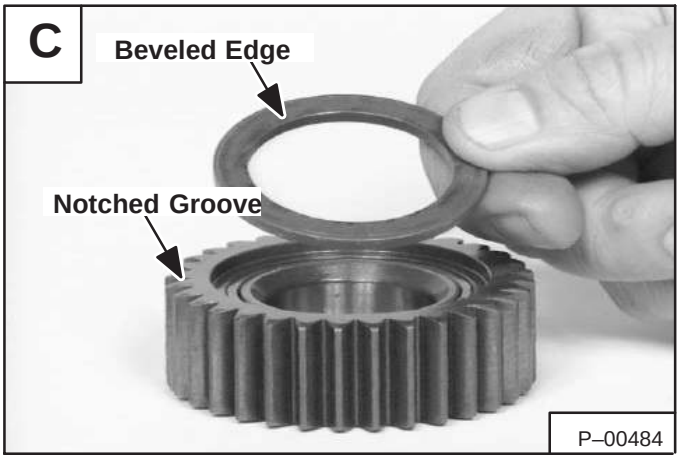
NOTE: The gear must be installed with the narrow section of the gear up (when viewed using the snap ring as the dividing line).



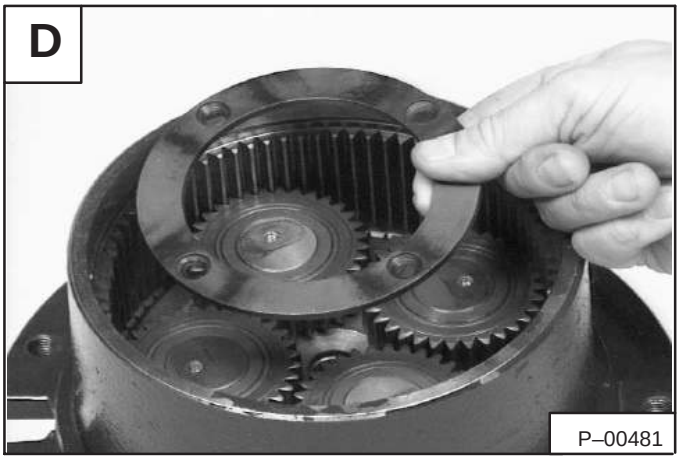
Put a small amount of petroleum jelly on the thrust washer. Install the thrust washer into the notched groove in the side of the gear and the beveled edge of the thrust washer will face up as viewed in **[C]**.

Turn the gear assemblies over and install them onto the pinion stub shafts on the hub. The beveled edge of the thrust washer must match up to the beveled edge of the stub shaft at the hub face and the thrust washers must remain seated in the notched groove of the gear.

If installed correctly, the top face of the gear will be slightly lower than the top face of the stub shaft.



Install retaining ring on the top of the stub shafts **[D]**.



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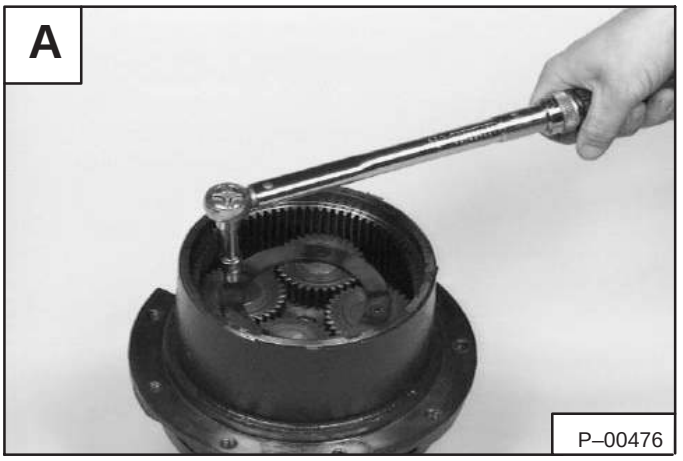
TRAVEL MOTOR (S/N 512911001–512913404) (Cont'd)

Assembly (Cont'd)

Clean the screw threads of any dried on thread locking compound and inspect the screws. Replace screws if any damage is found.

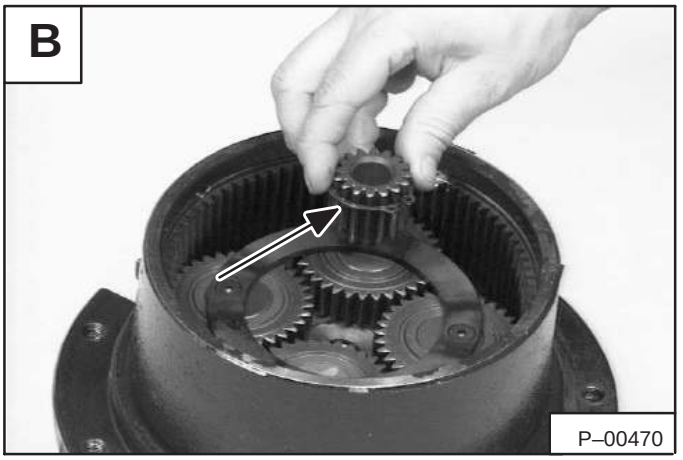
Put liquid adhesive (LOCTITE #242) on the threads of the screws. Install the four screws thru the retainer ring **[A]**.

Tighten the screws to 36–72 ft.–lbs. (4,1–8,1 Nm) torque.

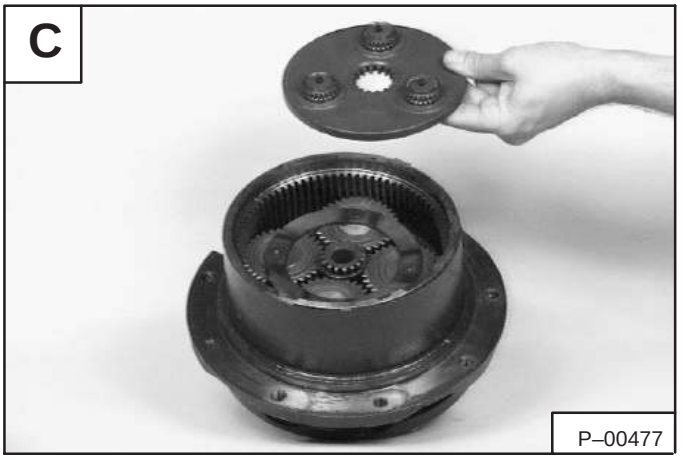


Install the snap ring onto the drive gear (if previously removed) and install the drive gear into the center of the planetary gears **[B]**.

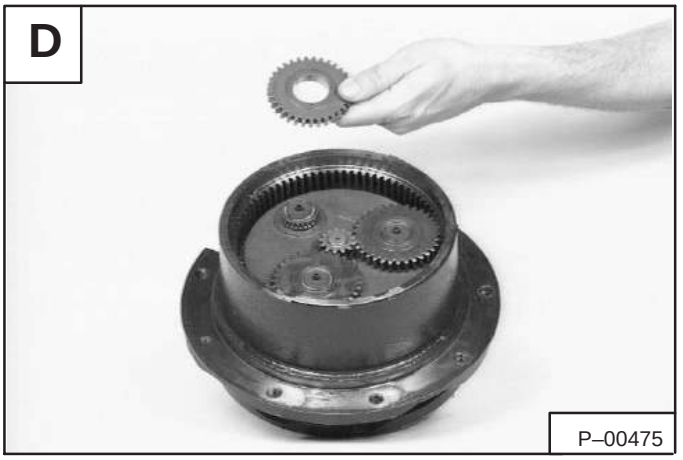
NOTE: The gear must be installed with the narrow section of the gear upwards (when viewed using the snap ring as the dividing line).



Install new spring pins into the stub shafts (if the spring pins were removed) and install the planetary holder onto the drive gear **[C]**.



Install the bearing race onto the stub shafts. Put a small mount of petroleum jelly on the needle bearings and install over the bearing races. Install the planetary gears over needle bearings **[D]**.

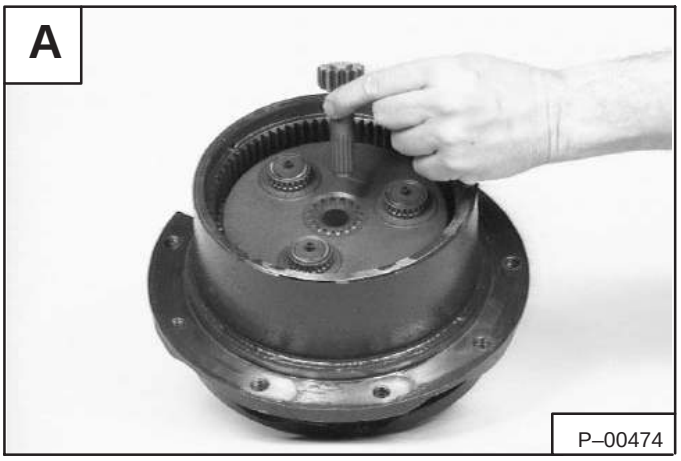


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TRAVEL MOTOR (S/N 512911001–512913404) (Cont'd)

Assembly (Cont'd)

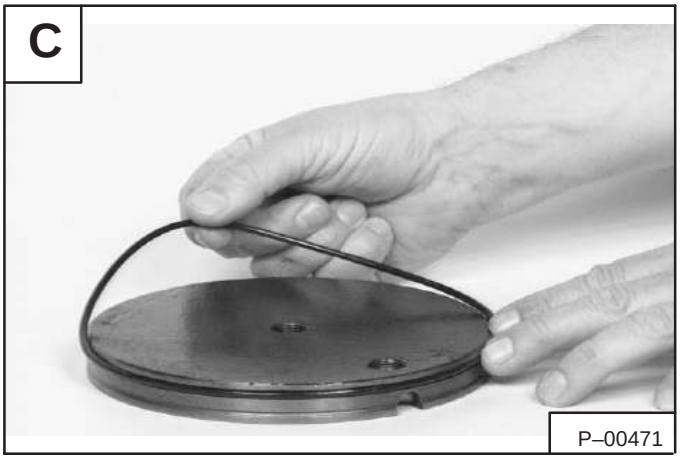
Install the drive shaft into the planetary gears **[A]**.



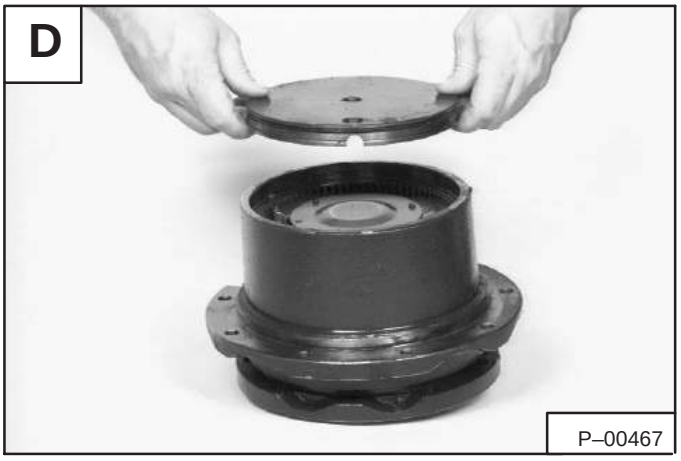
Put the four holes in the thrust plate over the spring pins in the stub shafts **[B]**.



Put petroleum jelly and install a new O–ring onto the end cover **[C]**.



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



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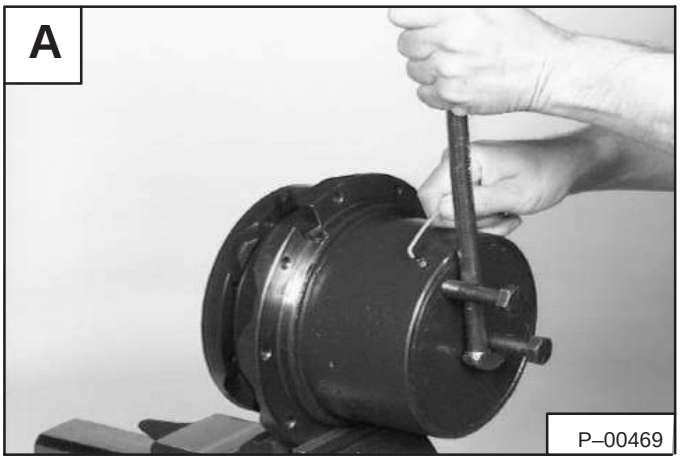
TRAVEL MOTOR (S/N 512911001–512913404) (Cont'd)

Assembly (Cont'd)

Clamp the drive motor in a vise and install two bolts (3/8 PT thread) into the end cover **[A]**.

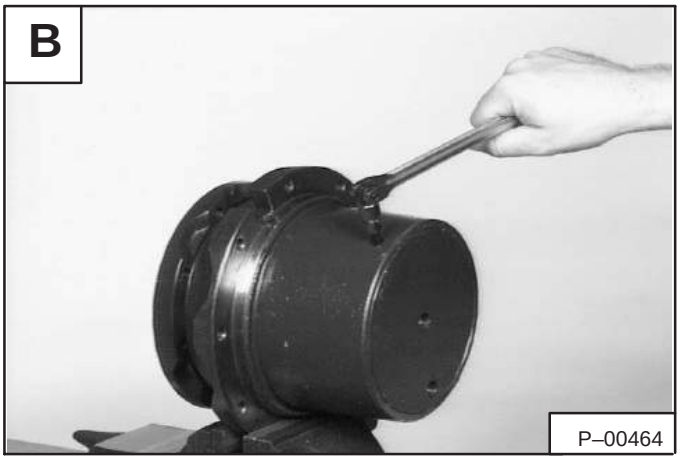
Bend a 1/4 inch hook in the end of the lock wire. Insert the hook end of the lock wire into the hole in the side of the motor and into the slot on the edge of the end cover.

Turn the end cover with a bar and insert the lock wire into the hole as it moves around the end cover **[A]**.



Install the plug into the lock wire hole **[B]**.

Tighten the plug to 72–96 in.–lbs. (8,1–10,8 Nm) torque.



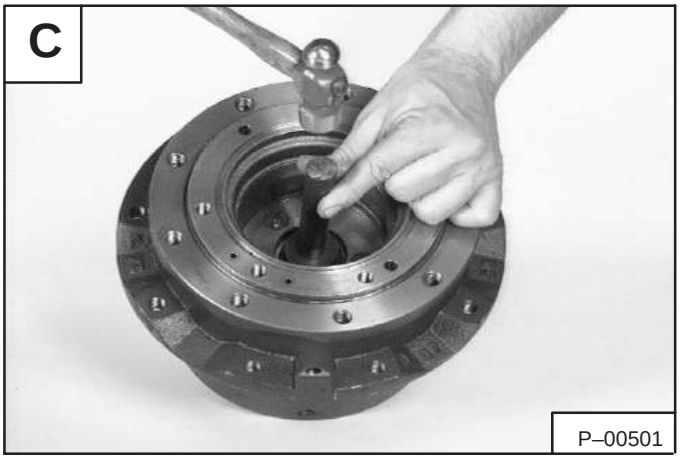
Remove the drive motor from the vise.

Set the motor on the end cover on a flat surface.

Put a small amount of petroleum jelly on the outer diameter of the seal and install the seal into the drive motor **[C]**.

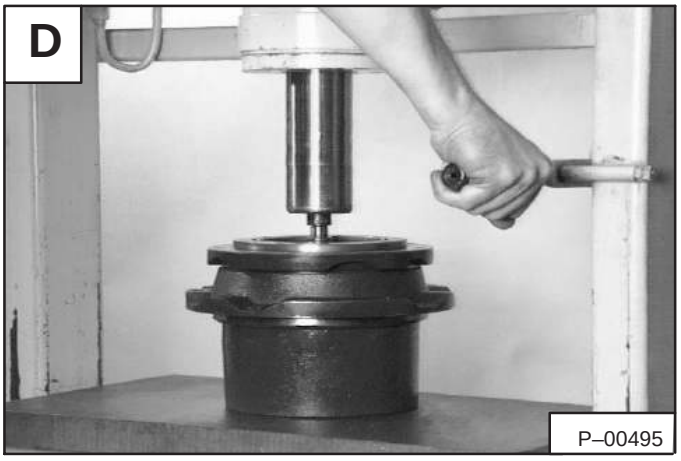
NOTE: The lip side of the seal faces up as viewed in [C].

Put a small amount of petroleum jelly on the seal lips.



Put a small amount of petroleum jelly on the end of the rotating group drive shaft and press the shaft and bearing into the hub **[D]**.

NOTE: Make sure that the end of the shaft is aligned thru the center of the seal prior to pressing the shaft in place.



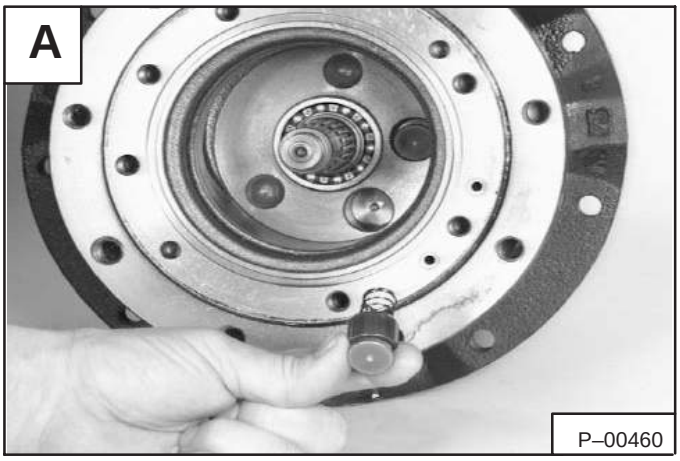
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TRAVEL MOTOR (S/N 512911001–512913404) (Cont'd)

Assembly (Cont'd)

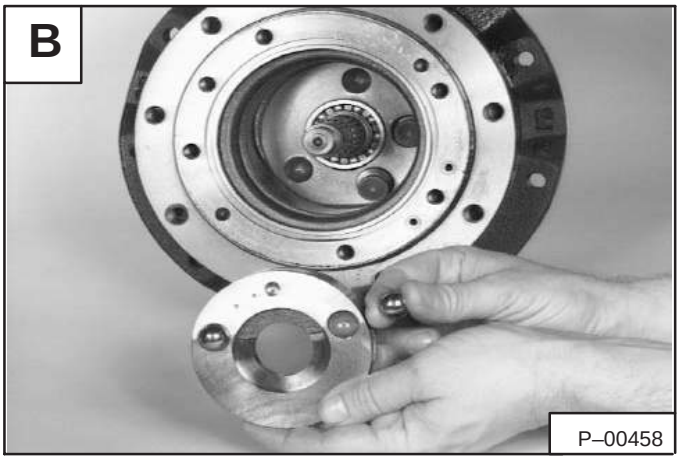
Put oil on the piston holes in the motor hub and on the piston side and face.

Install the piston and the spring into the piston holes **[A]**.



Put a small amount of petroleum jelly on the steel balls **[B]**.

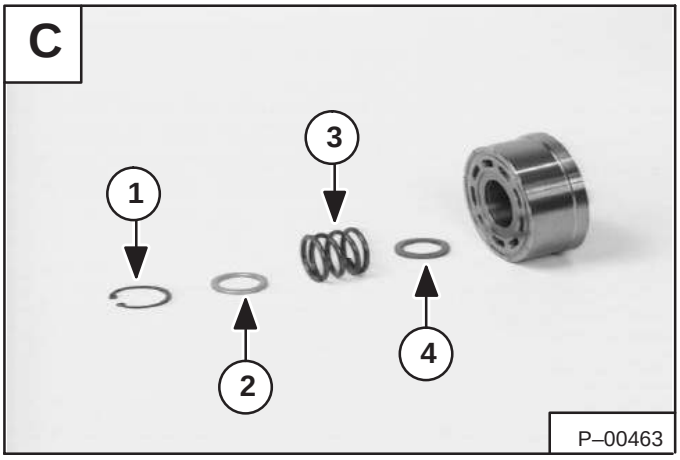
Install the steel balls into the swash plate and install the swash plate into the drive motor hub **[B]**. Rock the swash plate back and forth to check for binding and to make sure the pistons and springs move freely under the swash plate.



Install the collar (Item 4) **[C]**, spring (Item 3) **[C]**, collar (Item 2) **[C]** and the snap ring (Item 1) **[C]** into the piston housing.

Use a press with a press tube that fits loosely inside the snap ring but will contact the collar.

Compress the collar and spring down into the housing and install the snap ring.

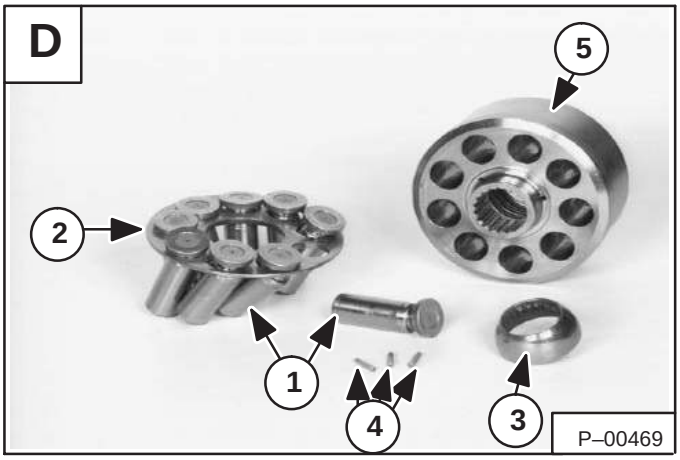


Put petroleum jelly on the three pins (Item 4) **[D]** and insert the three pins into the holes in the piston housing (Item 5) **[D]**.

Install the conical spacer (Item 3) **[D]** on top of the pins (Item 4) **[D]** and piston housing (Item 5) **[D]**.

Install the pistons (Item 1) **[D]** into the piston retainer (Item 2) **[D]**.

Put oil in the piston holes in the piston housing (Item 5) **[D]** and insert the pistons into the piston housing.



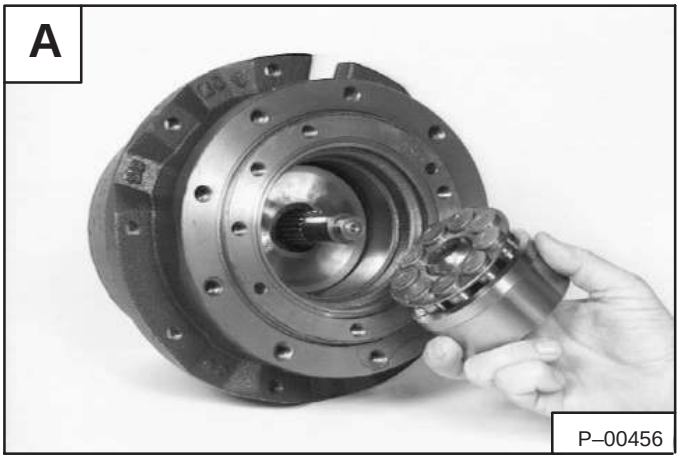
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TRAVEL MOTOR (S/N 512911001–512913404) (Cont'd)

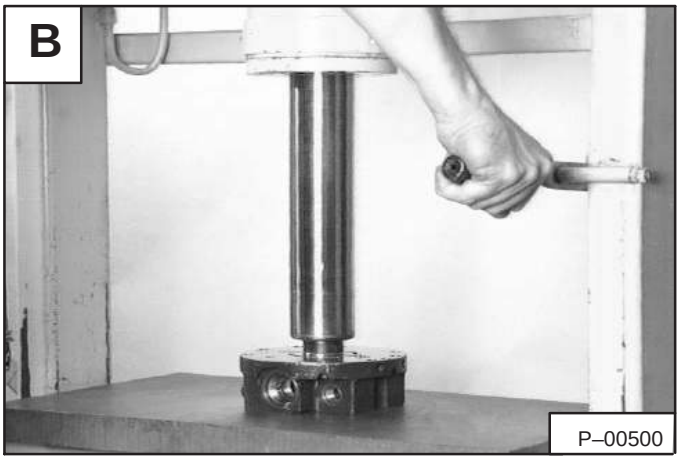
Assembly (Cont'd)

Put oil on the face of the swash plate and on the pistons.

Install the rotating group into the drive motor **[A]**.

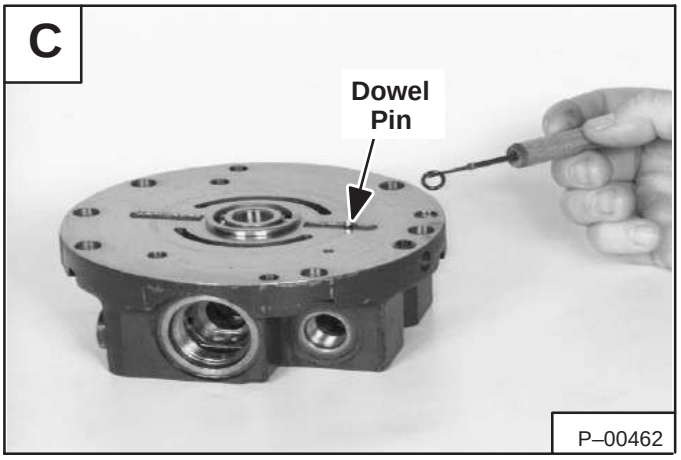


Press a new bearing into the valve body **[B]**. Use a press tube that contacts the external bearing race only.



Install the new O–rings into the valve body **[C]**.

NOTE: If a new valve body is being used or if the locating dowel pin was removed, install a new dowel pin and use a center punch to stake the valve body to the dowel pin.

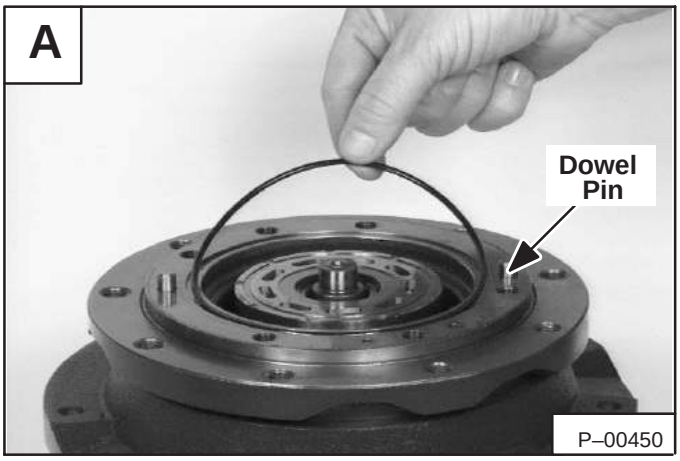


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TRAVEL MOTOR (S/N 512911001–512913404) (Cont'd)

Assembly (Cont'd)

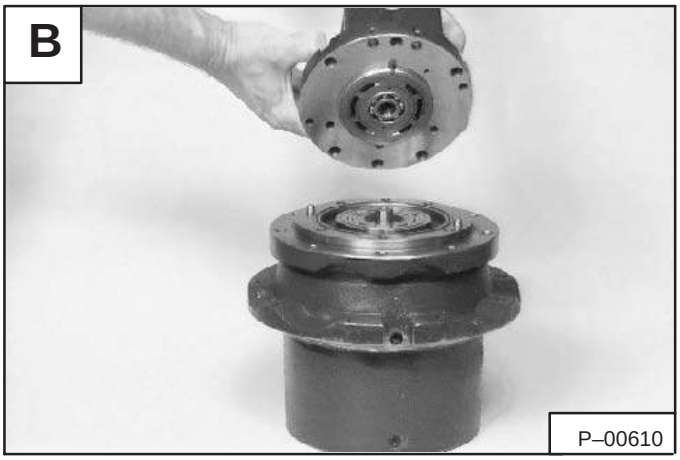
Install a new O–ring onto the motor hub and install the two dowel pins **[A]**.



Put petroleum jelly on the valve plate (steel side) and install the valve plate on the valve body.

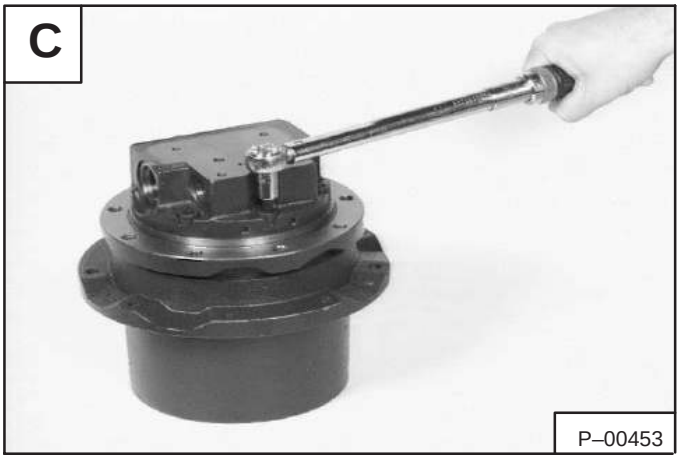
The notch in the valve plate will line up with the locating dowel pin and the bronze side of the valve plate must be facing out from the valve body.

Install the valve body onto the travel motor **[B]**.



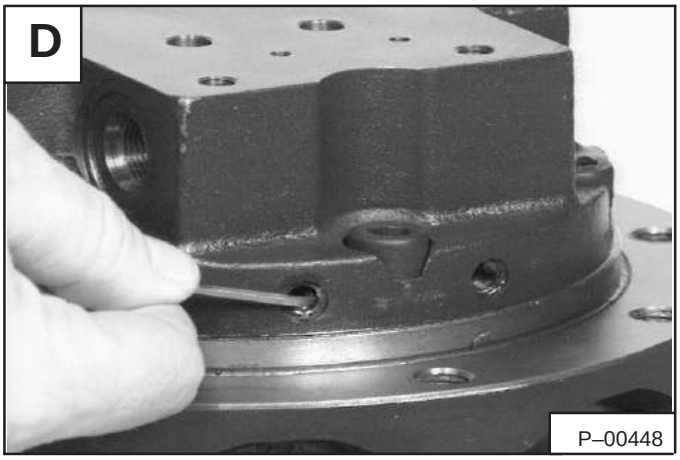
Install the six bolts into the valve body **[C]**.

Tighten the bolts to 43–50 ft.–lbs. (58–68 Nm) torque.



Install the plugs with orifices into the side of the valve body **[D]**.

Tighten the plugs to 18–24 in.–lbs. (2,0–3,7 Nm) torque.



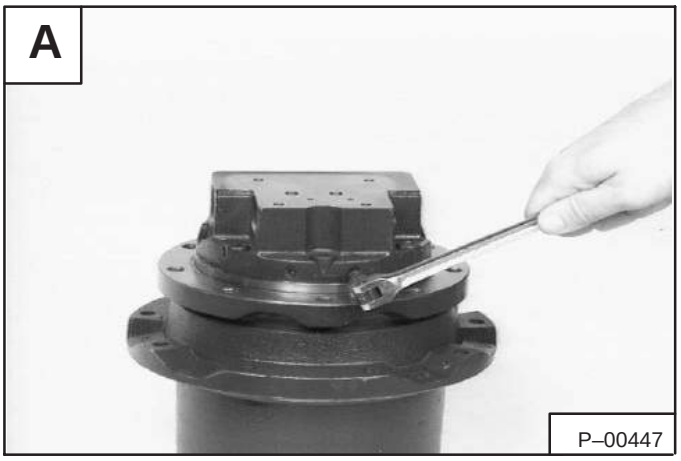
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TRAVEL MOTOR (S/N 512911001–512913404) (Cont'd)

Assembly (Cont'd)

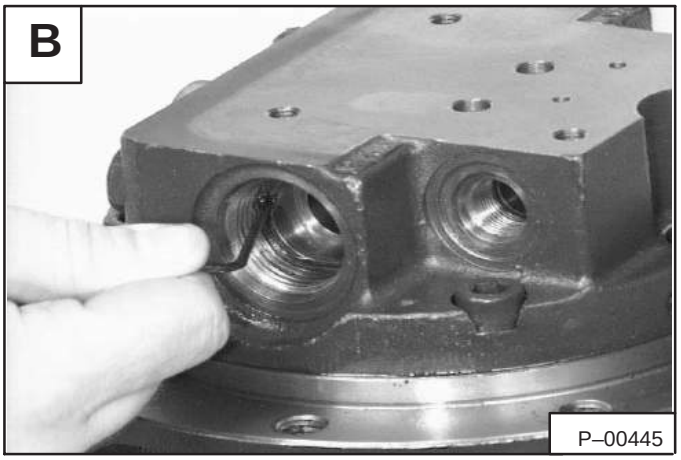
Install the plugs into the orifice ports **[A]**.

Tighten the plugs to 78–96 in.–lbs. (9–10 Nm) torque.



Install the plugs with orifices into both ends of the valve body **[B]**.

Tighten the plugs to 18–24 in.–lbs. (2,0–3,7 Nm) torque.

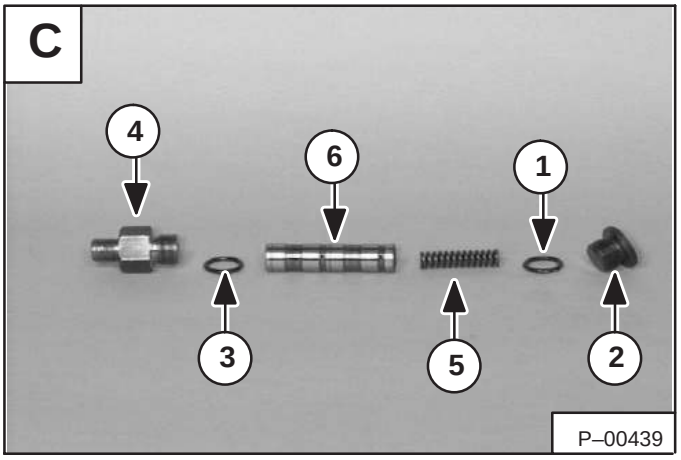


Install new O–rings (Items 1 & 3) **[C]** onto the plug (Item 2) **[C]** and the adapter (Item 4) **[C]**.

Install the adapter (Item 4) **[C]** into the valve body.

Tighten the adapter to 36–43 ft.–lbs. (49–58 Nm) torque.

Put oil on the spool (Item 6) **[C]** and install the spool (Item 6) **[C]** and the spring (Item 5) **[C]**.



Install the plug into the valve body **[D]**.

Tighten the plug to 36–43 ft.–lbs. (49–58 Nm) torque.



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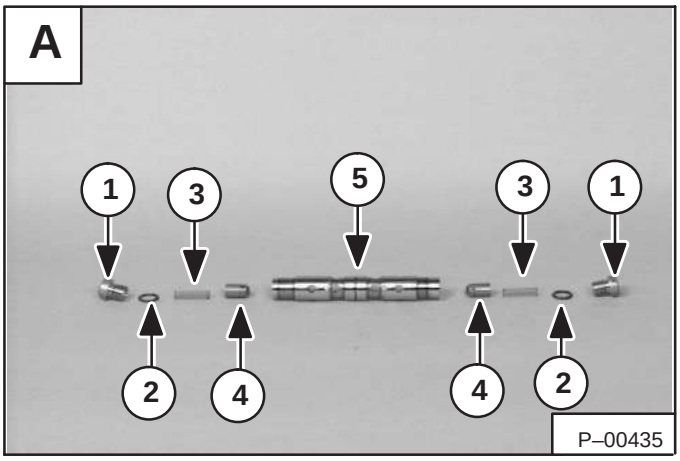
TRAVEL MOTOR (S/N 512911001–512913404) (Cont'd)

Assembly (Cont'd)

Install new O–ring (Item 2) **[A]** on the plugs (Item 1) **[A]**. Put oil on the poppets (Item 4) **[A]** and install the poppets (Item 4) **[A]** and the springs (Item 3) **[A]** into the spool (Item 5) **[A]**

Install the plugs (Item 1) **[A]** into the spool (Item 5) **[A]**.

Tighten the plugs to 21–25 ft.–lbs. (29–33 Nm) torque.



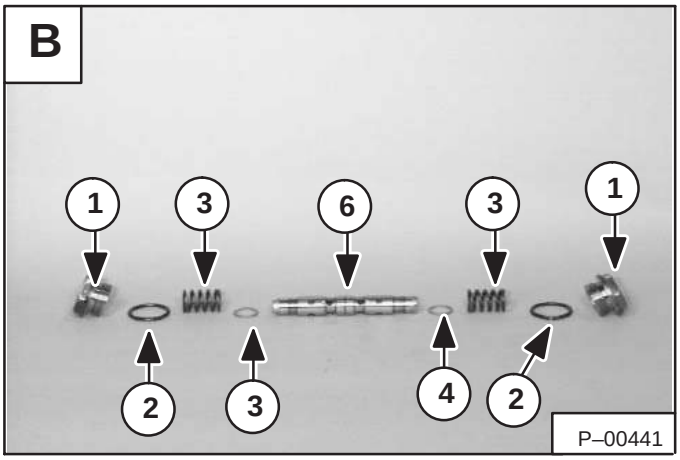
Install new O–rings (Item 2) **[B]** on plugs (Item 1) **[B]**.

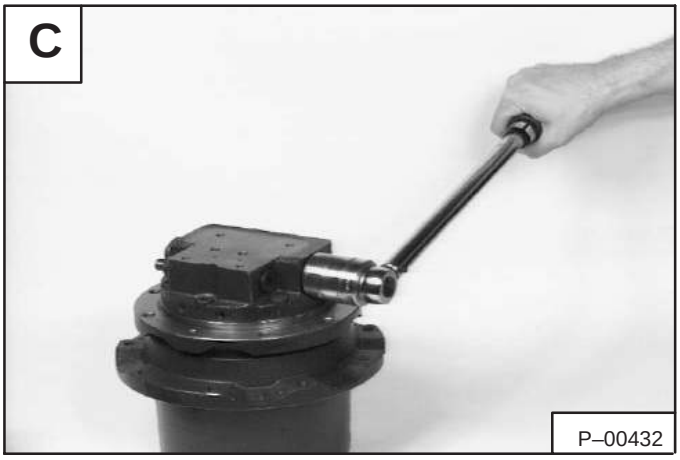
Put oil on the spool (Item 5) **[B]** and install the spool into the valve body.

Install the washers (Item 4) **[B]** on the ends of the spool (Item 6) **[B]** and install the springs (Item 3) **[B]** over the ends of the spool Item 6) **[B]**.

Install the plugs (Item 1) **[B]** into the valve body **[C]**.

Tighten the plugs to 152–180 ft.–lbs. (206–245 Nm) torque.



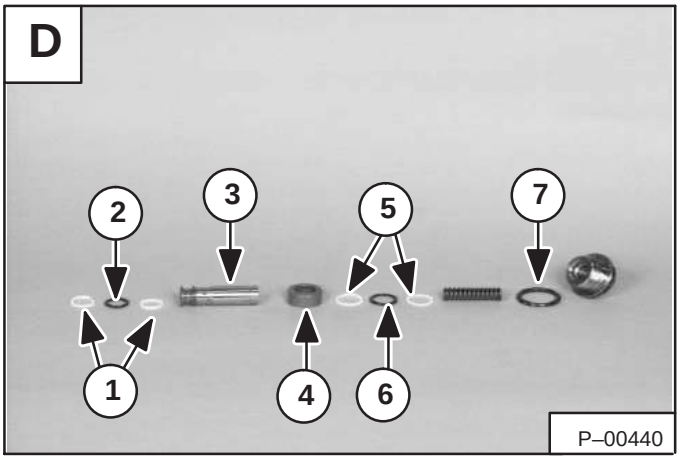


Install new back–up washers (Item 5) **[D]** and O–ring (Item 6) **[D]** into the piston (Item 4) **[D]**.

Install new back–up washers (Item 1) **[D]** and O–ring (Item 2) **[D]** on the spool (Item 3) **[D]**.

Put oil on the spool (Item 3) **[D]** and on the inside diameter of the piston (Item 4) **[D]**.

Install the piston (Item 4) **[D]** on the spool (Item 3) **[D]**.



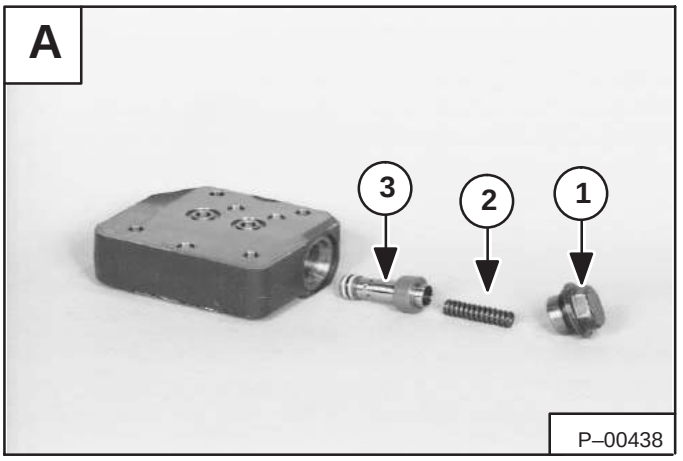
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TRAVEL MOTOR (S/N 512911001–512913404) (Cont'd)

Assembly (Cont'd)

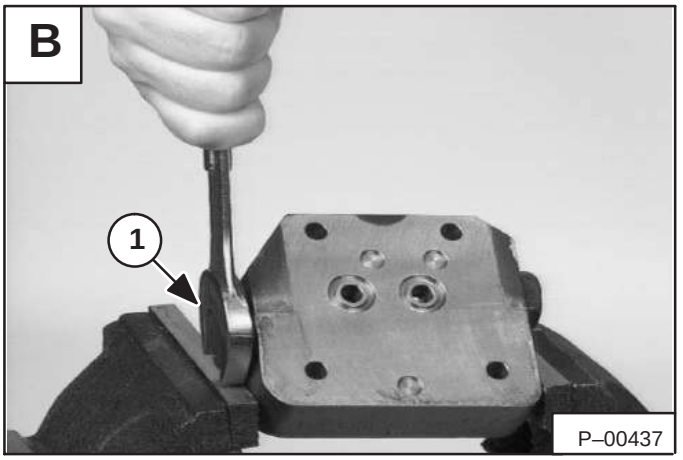
Put oil on the spool and piston (Item 3) **[A]**. Install the spool and piston (Item 3) **[A]** into the valve body (both ends).

Install the spring (Item 2) **[A]** into the end of the spool.

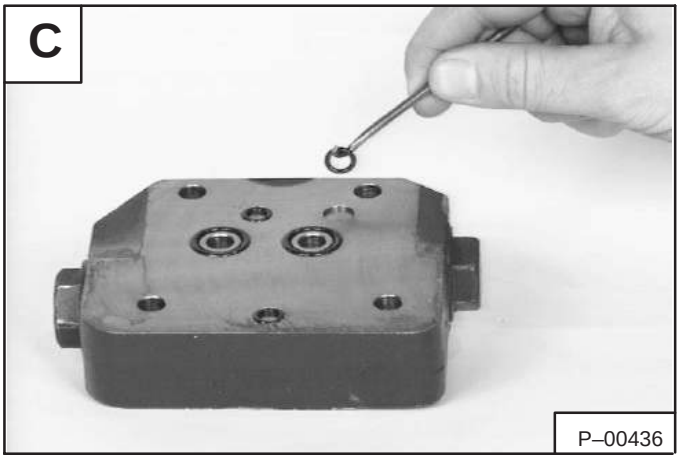


Install a new O–ring on the plug (Item 1) **[A]** & **[B]** and install the plug into the valve body.

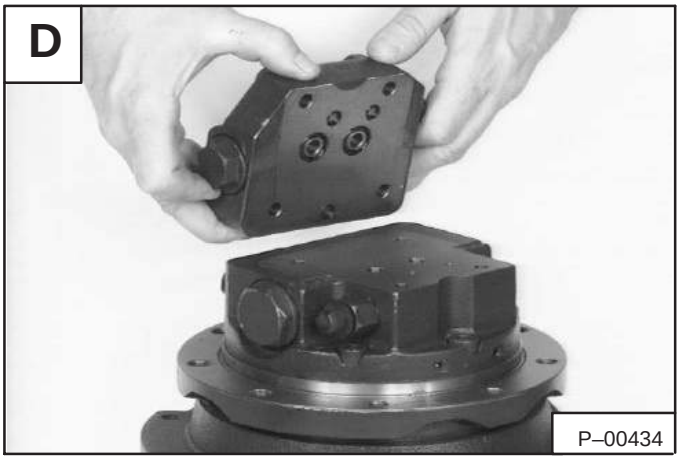
Tighten the plugs to 173–180 ft.–lbs. (235–245 Nm) torque.



Install the three new small O–rings and the two large O–rings into the valve body **[C]**.



Install the valve body **[D]**.

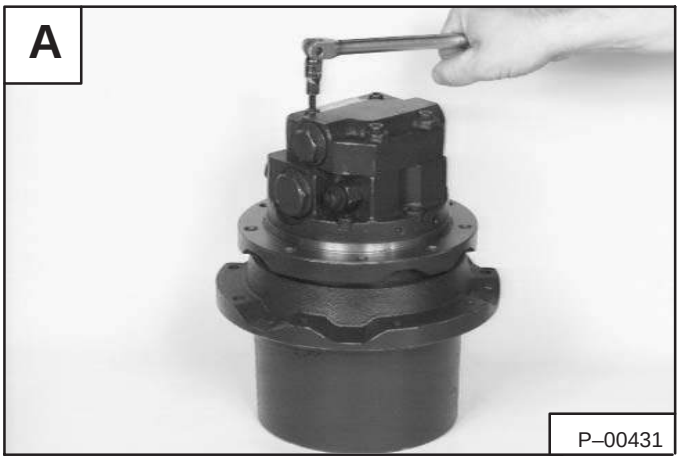


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Assembly (Cont'd)

Install the four bolts into the valve body **[A]**.

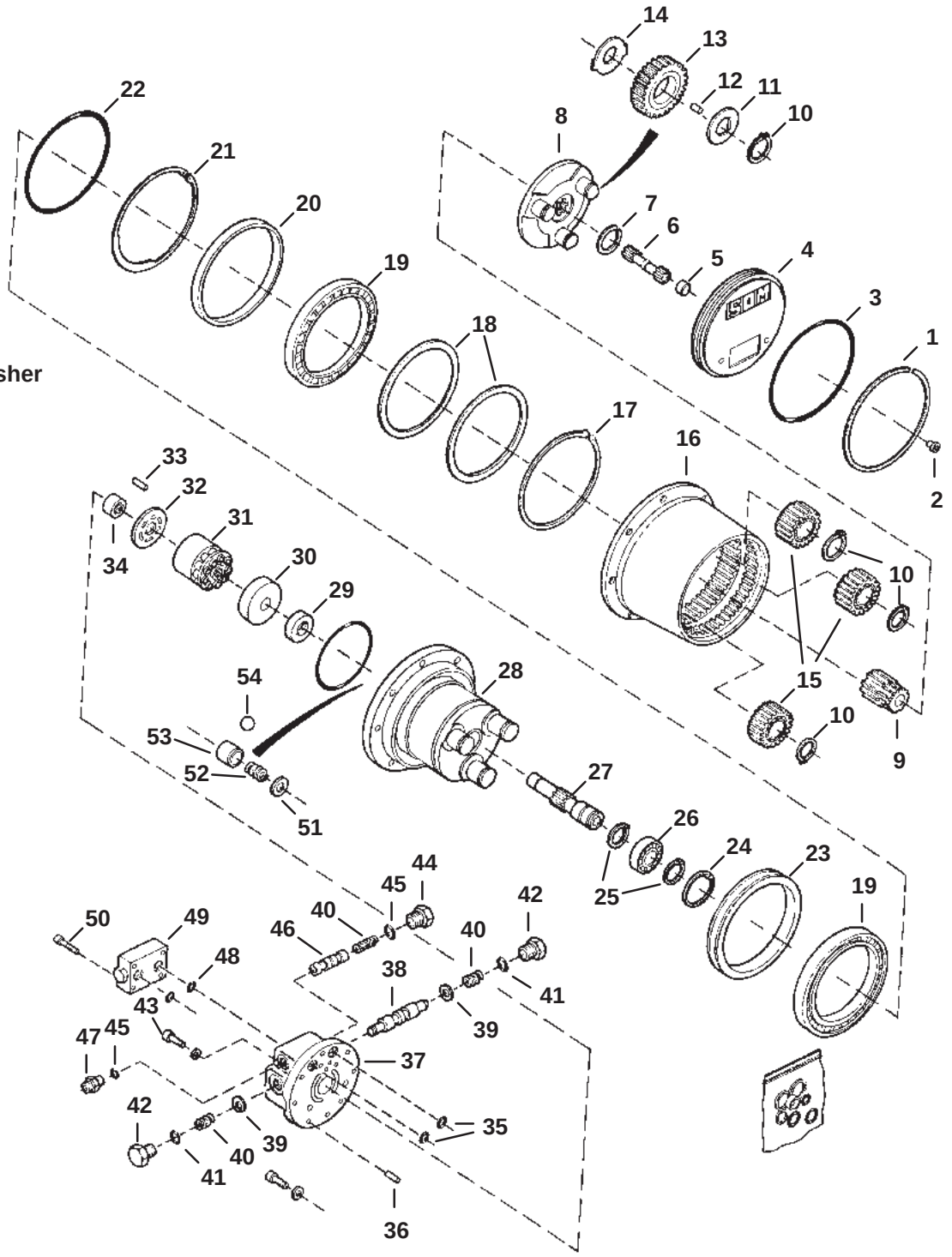
Tighten the bolts to 20–23 ft.–lbs. (27–31 Nm) torque.



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TRAVEL MOTOR (S/N 512913405 & Above)

Parts Identification



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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

The following tool will need to be ordered from OTC Tool to reassemble the travel motor:

MEL1519 for torque ring and seal ring assembly.

Disassembly

Remove the drain plugs (Item 1) **[A]** from the end cover.

Drain the oil into a container.

Remove the internal snap ring from the travel motor case **[B]**.

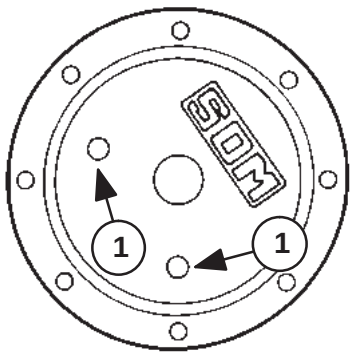
To remove the cover, install two threaded pins in the drain holes and lift the cover off **[C]**.

Air pressure may also be used to remove the cover.

Screw the adapter in a drain hole and apply 8–11 psi **[D]**.

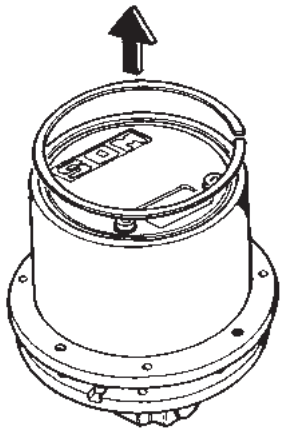
NOTE: Do not use excess pressure or seal damage may result.

A



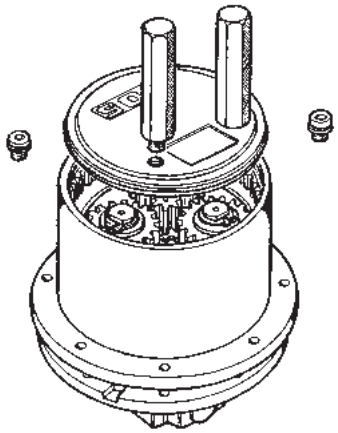
B–14497

B



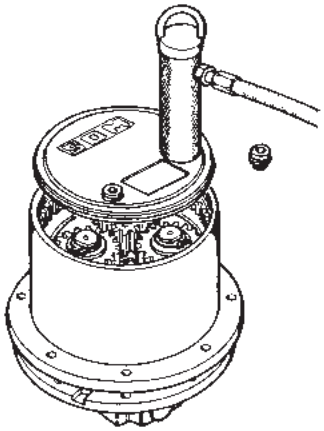
B–14729

C



B–14730

D



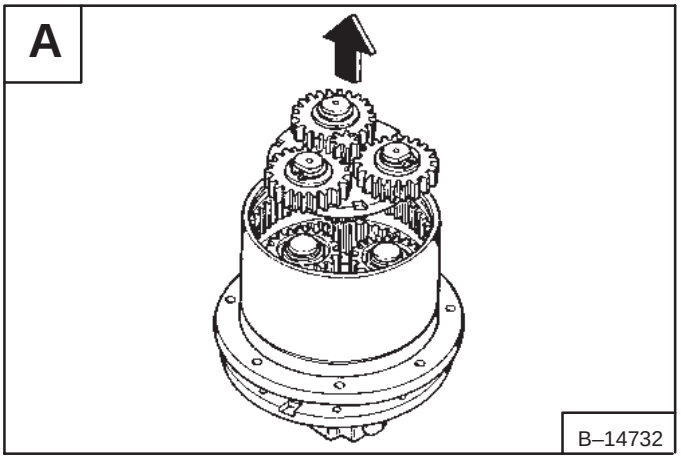
B–14731

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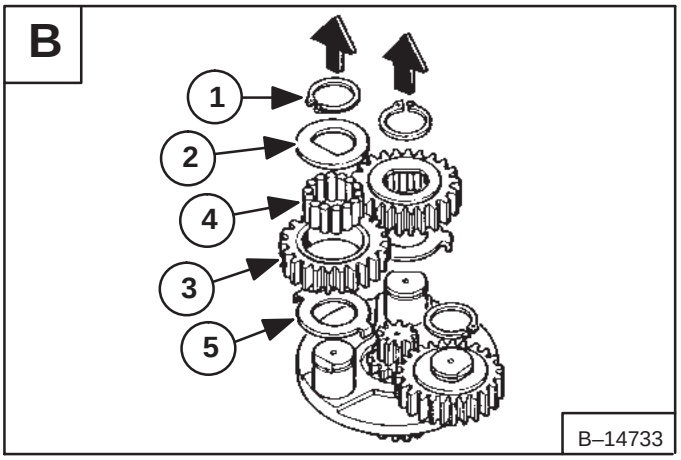
TRAVEL MOTOR (S/N 512913405 & Above) (Cont'd)

Disassembly (Cont'd)

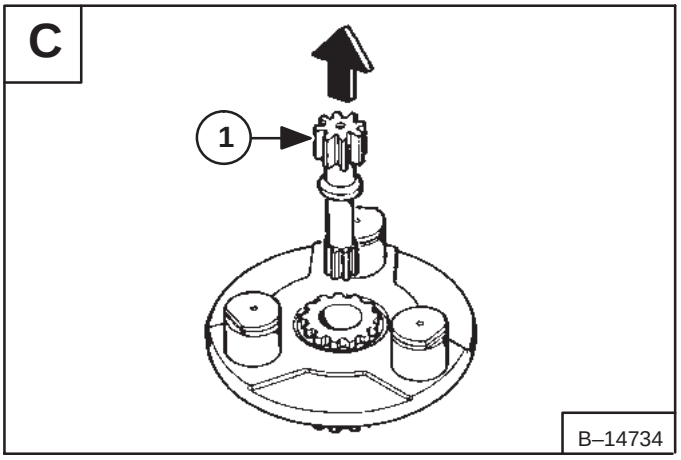
Remove the planetary carrier **[A]**.



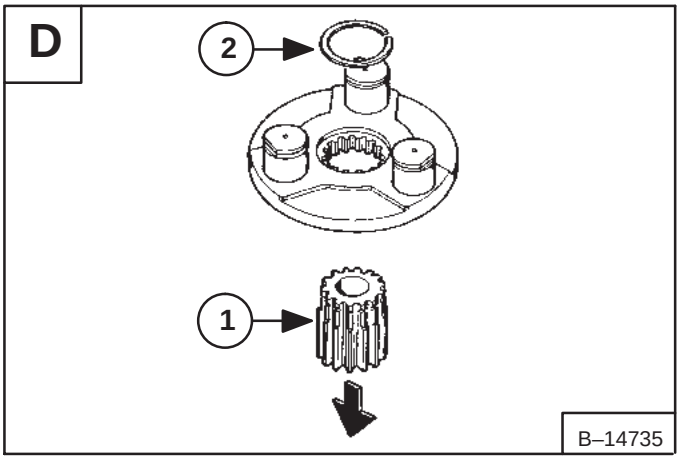
Remove the snap rings (Item 1) **[B]**, the anti–rotation washers (Item 2) **[B]**, the gears (Item 3) **[B]**, the bearings (Item 4) **[B]** and the bottom thrust washers (Item 5) **[B]** from the planetary carrier assembly.



Remove the sun gear (Item 1) **[C]** from the carrier.



Remove the sun gear (Item 1) **[D]** from the planetary carrier, by removing the snap ring (Item 2) **[D]** and pushing the sun gear (Item 1) **[D]** out of the carrier.

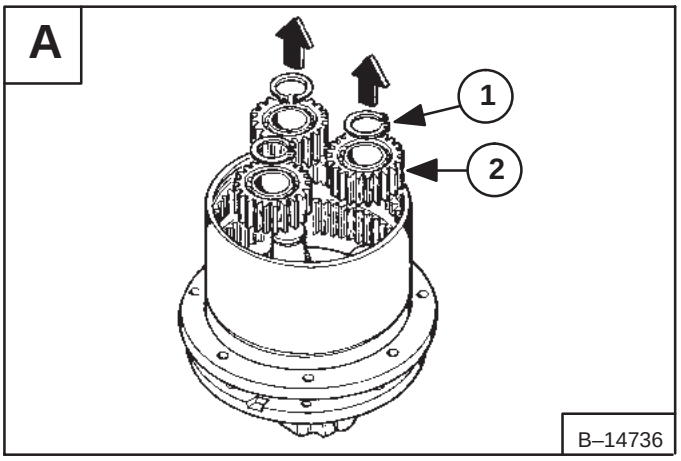


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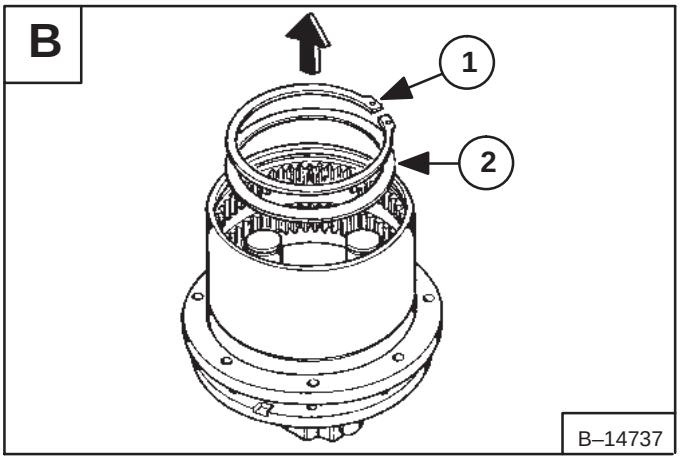
331ServiceManual#87742251#S/N512911001-512912999-MainFrameAndTracksSectionPart1of4

Disassembly (Cont'd)

Remove the snap rings (Item 1) **[A]** and the gears/bearings (Item 2) **[A]**.



Remove the external snap ring (Item 1) **[B]** and the shim(s) (Item 2) **[B]**.



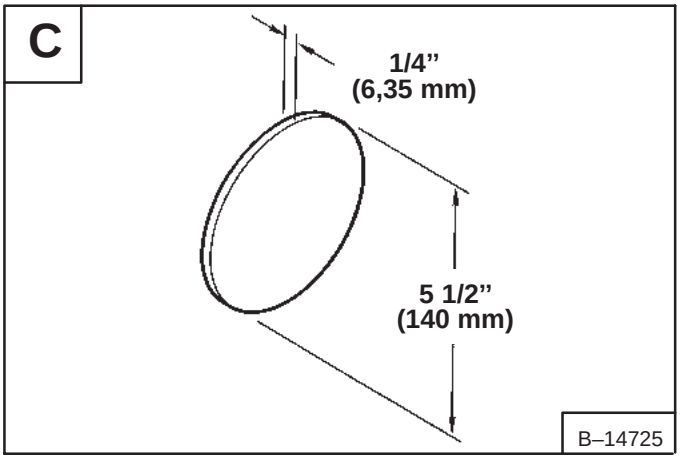
Before the ring gear can be pulled from the hub, a plate must be placed on the three pins of the planetary carrier.

The plate will provide support for the three jaw puller.

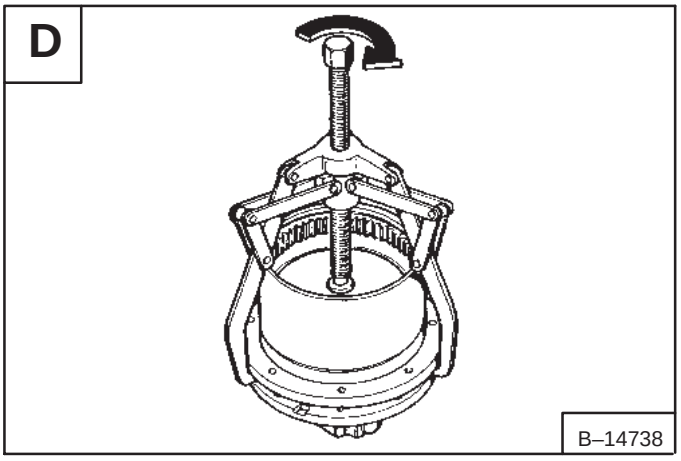
Fabricate or obtain the plate **[C]** locally.

The dimensions of the plate are as follows:

Diameter . . . . . 5–1/2 inches (140 mm)
Thickness . . . . . 1/4 inch (6.35 mm)



Using a three jaw puller, separate the hub and the ring gear assembly.



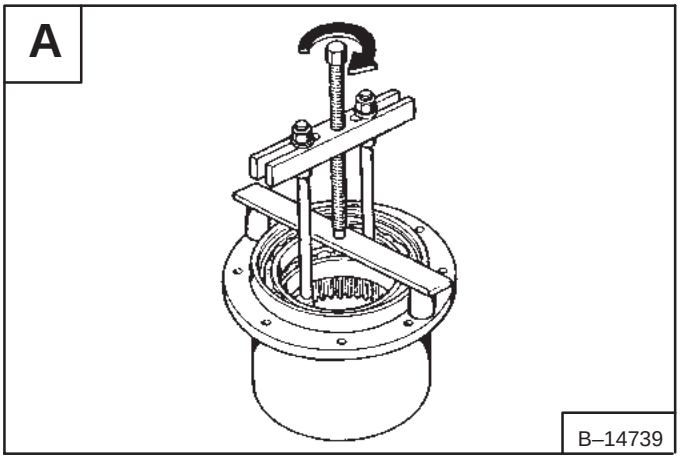
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TRAVEL MOTOR (S/N 512913405 & Above) (Cont'd)

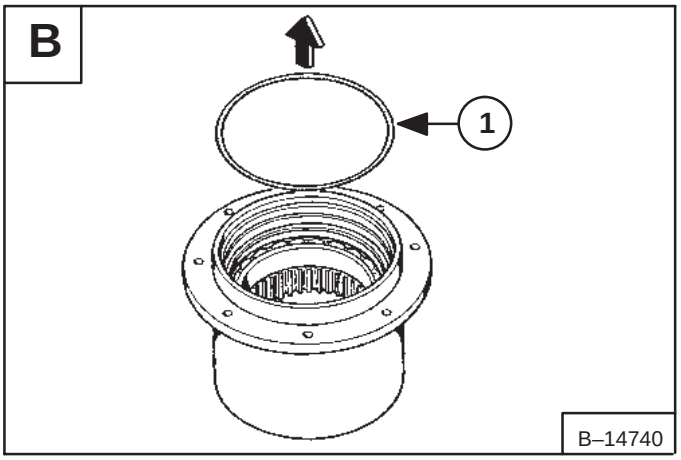
Disassembly (Cont'd)

Remove the ball bearing from the ring gear **[A]**.

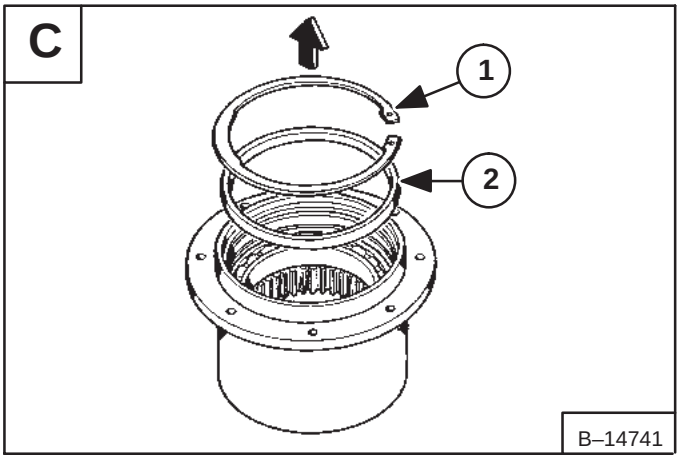
NOTE: Do not damage the top surface of the bearing as it is lapped (polished) to mate with the front seal ring.



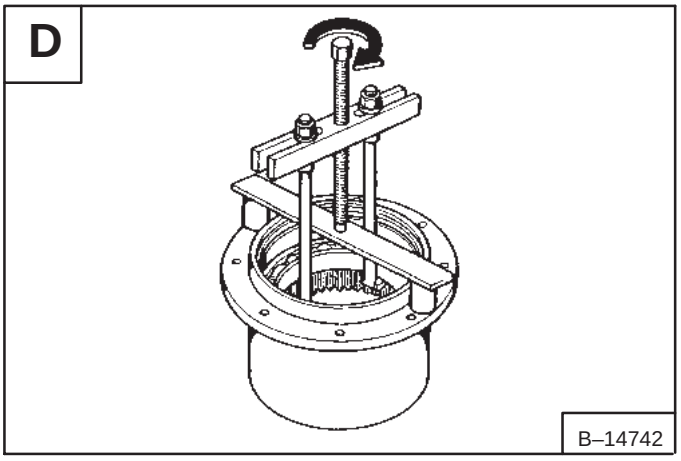
Remove the O–ring (Item 1) **[B]** from the ring gear.



Remove the internal snap ring (Item 1) **[C]** and spacer (Item 2) **[C]**.



Remove the second bearing from the ring gear **[D]**.

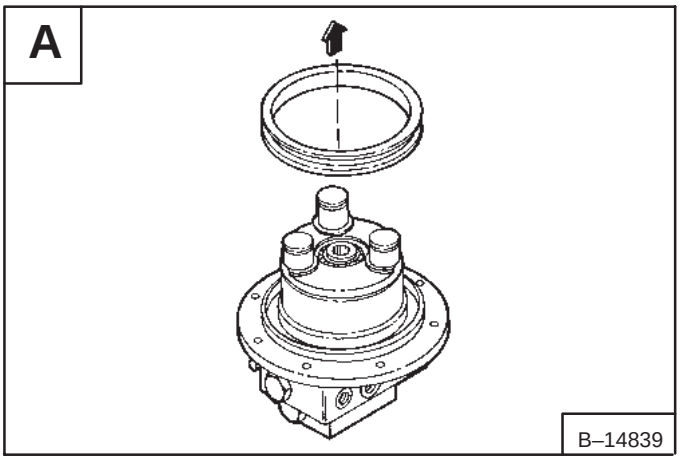


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TRAVEL MOTOR (S/N 512913405 & Above) (Cont'd)

Disassembly (Cont'd)

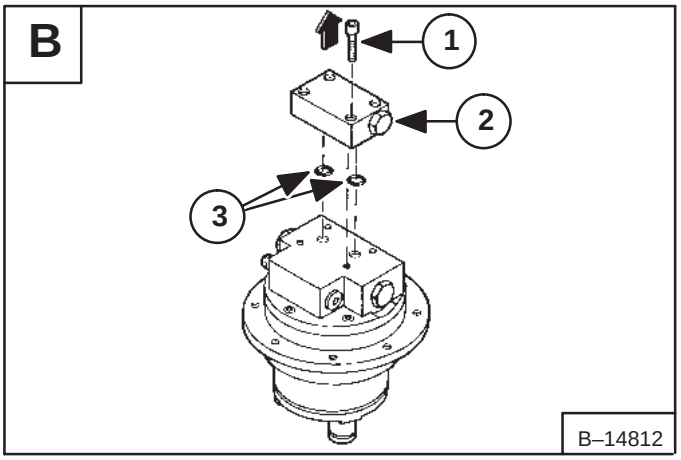
Remove the front seal ring from the motor hub **[A]**.



Remove the four screws (Item 1) **[B]** from the relief valve block (Item 2) **[B]**.

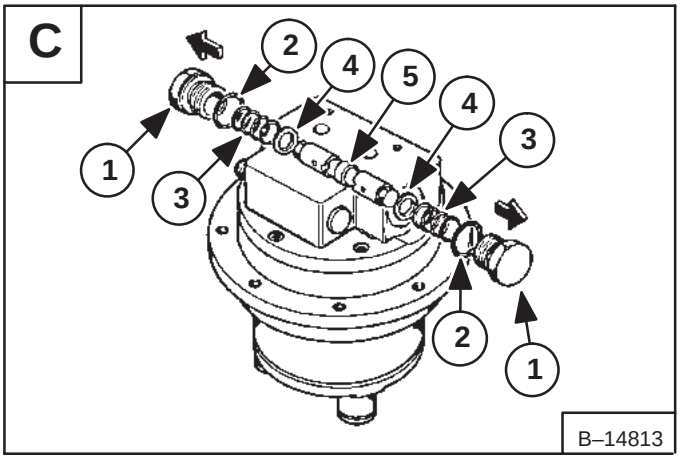
Remove the two o–rings (Item 3) **[B]**.

NOTE: The relief valve block assembly (Item 2) [B] and the relief valves are not serviceable. If any of these parts are damaged, order a new relief valve block assembly from Melroe Parts.



Remove the two plugs (Item 1) **[C]**, the O–rings (Item 2) **[C]**, the springs (Item 3) **[C]** and the washers (Item 4) **[C]** from both ends of the spool.

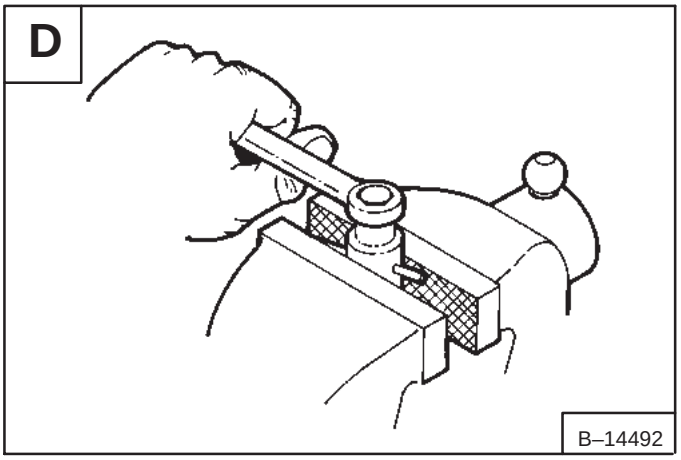
Remove the spool (Item 5) **[C]**.



To disassemble the spool, insert a hardened pin through the hole in the spool and use a vise with protective jaws to hold the spool **[D]**.

NOTE: Do not use any type of tool to grip the spool or damage to the spool will result.

Remove the two end plugs from both ends of the spool **[D]**.

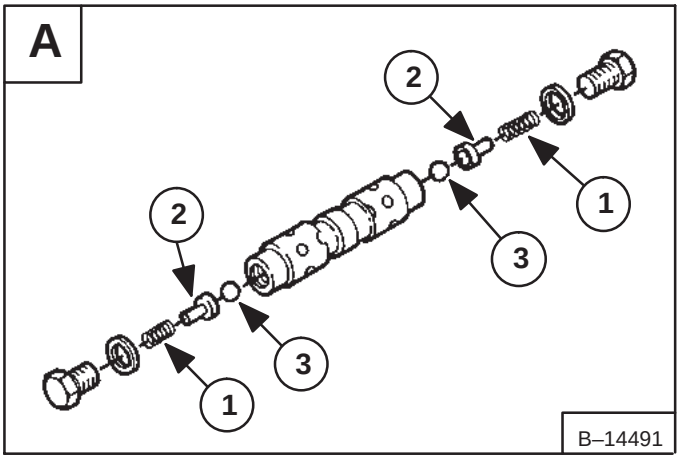


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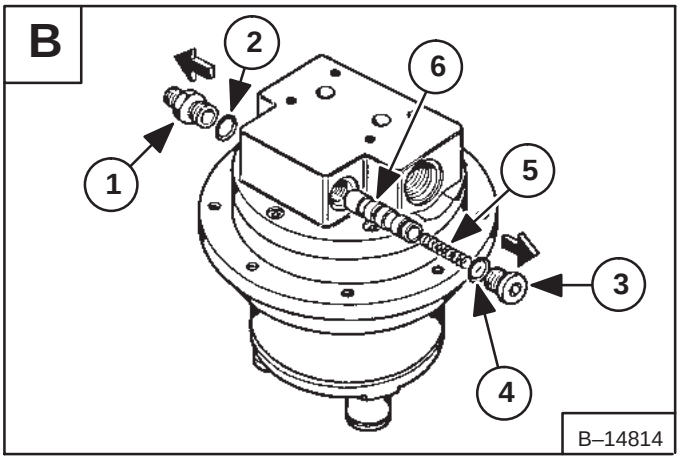
TRAVEL MOTOR (S/N 512913405 & Above) (Cont'd)

Disassembly (Cont'd)

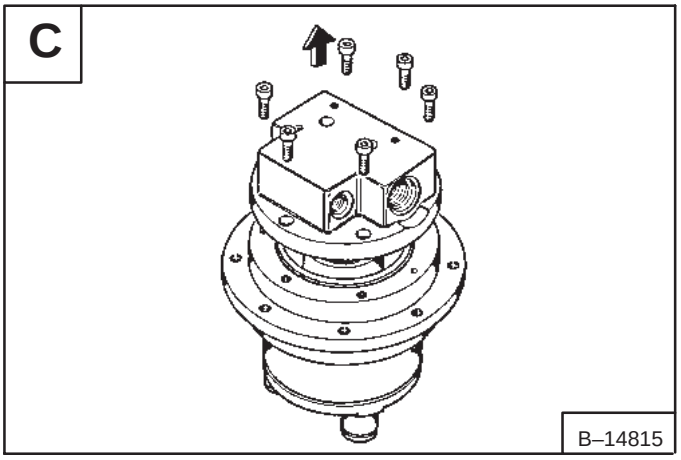
Remove the spring (Item 1) **[A]**, the poppet (Item 2) **[A]** and the check ball (Item 3) **[A]** from both ends of the spool.



Remove the fitting (Item 1) **[B]** and the O–ring (Item 2) **[B]**. Remove the plug (Item 3) **[B]**, the O–ring (Item 4) **[B]**, the spring (Item 5) **[B]** and the two speed spool (Item 6) **[B]**.

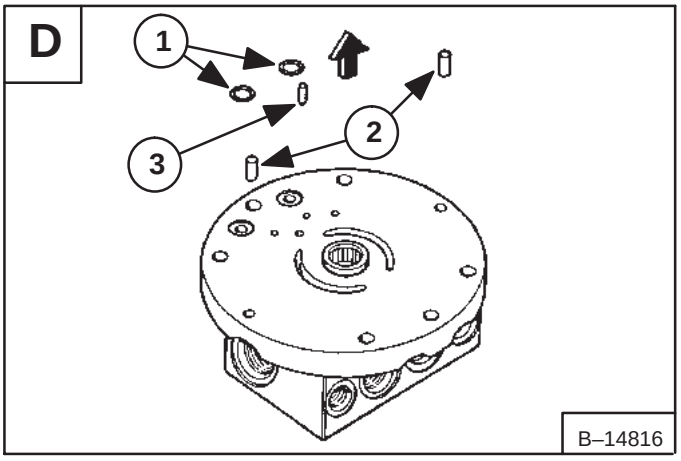


Remove the six bolts and motor cover **[C]**.



Remove the two O–rings (Item 1) **[D]** and the two dowel pins (Item 2) **[D]**.

Remove the alignment pin (Item 3) **[D]**.

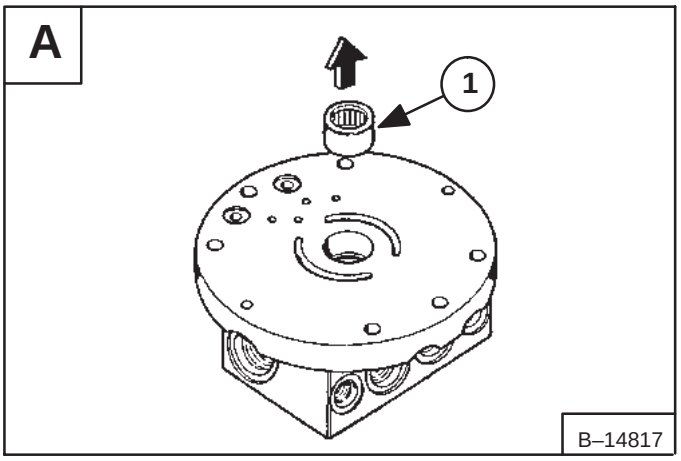


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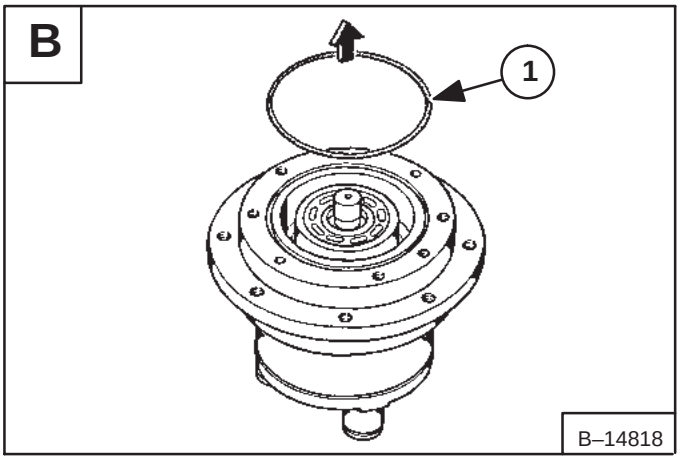
TRAVEL MOTOR (S/N 512913405 & Above) (Cont'd)

Disassembly (Cont'd)

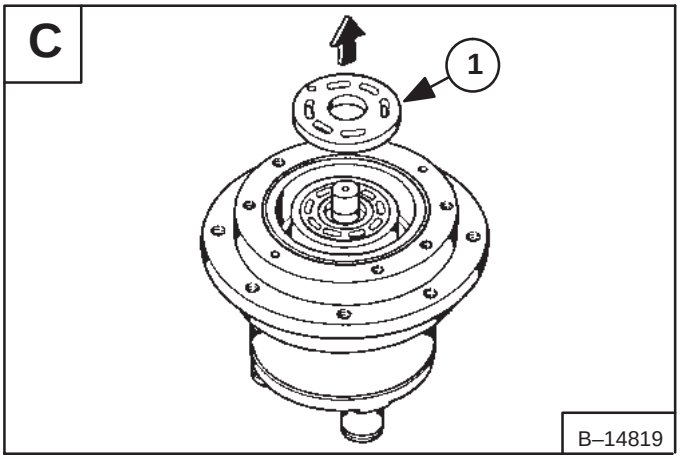
Remove the bearing (Item 1) **[A]** with a bearing puller.



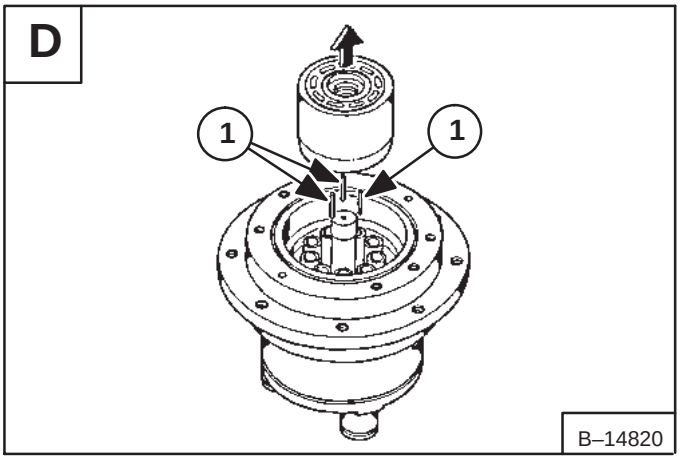
Remove the O–ring (Item 1) **[B]** from the motor.



Remove the bronze valve plate (Item 1) **[C]**.



Remove the rotating block and the three dowel pins (Item 1) **[D]**.

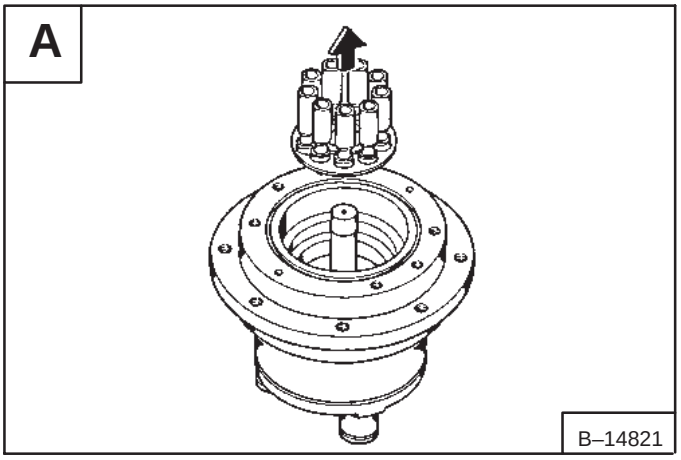


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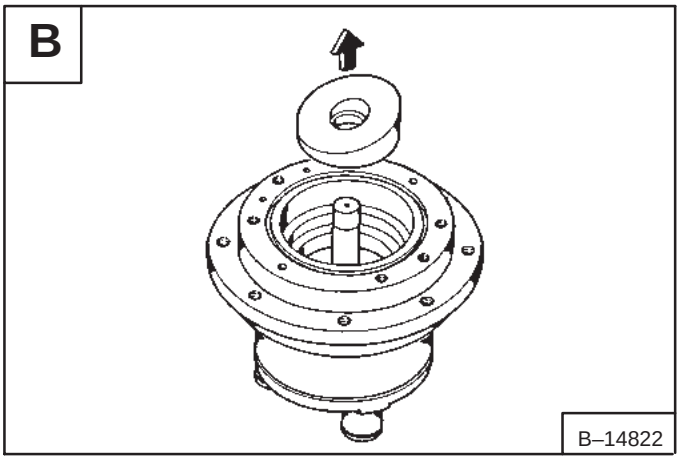
TRAVEL MOTOR (S/N 512913405 & Above) (Cont'd)

Disassembly (Cont'd)

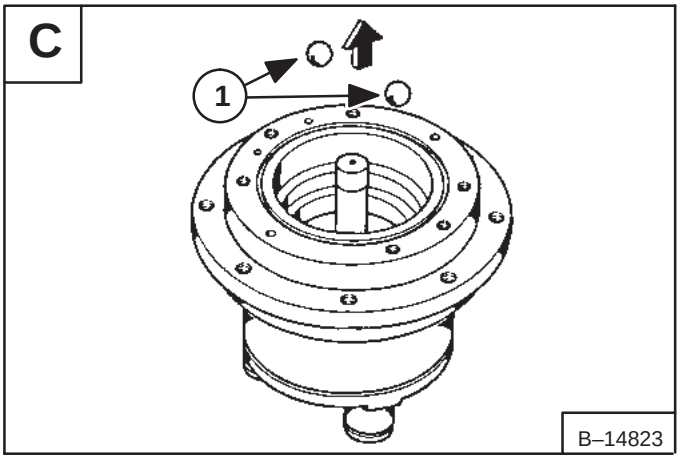
Remove the piston assembly **[A]**.



Remove the swash plate **[B]**.

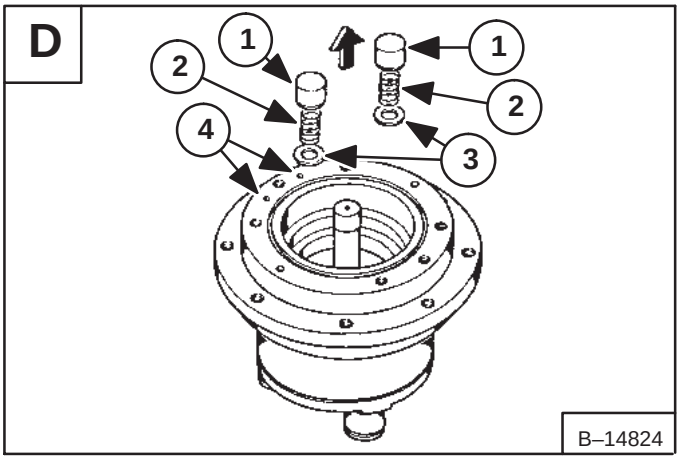


Remove the two balls (Item 1) **[C]**.



Remove the two displacement control pistons (Item 1) **[D]**, the springs (Item 2) **[D]** and the washers (Item 3) **[D]**.

NOTE: To ease removal of the pistons, apply low air pressure to the oil holes (Item 4) [D].



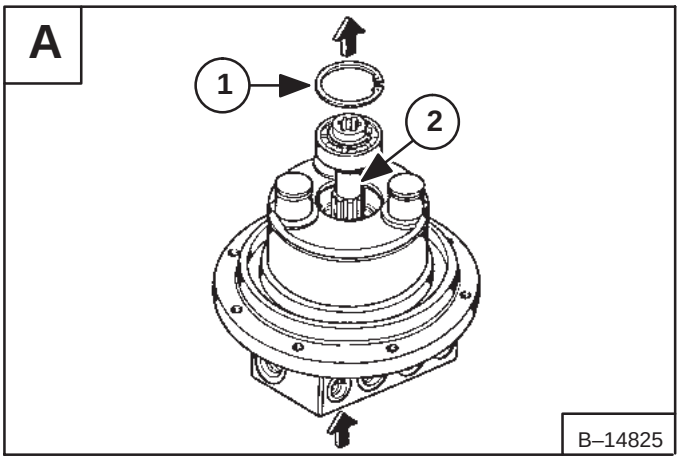
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TRAVEL MOTOR (S/N 512913405 & Above) (Cont'd)

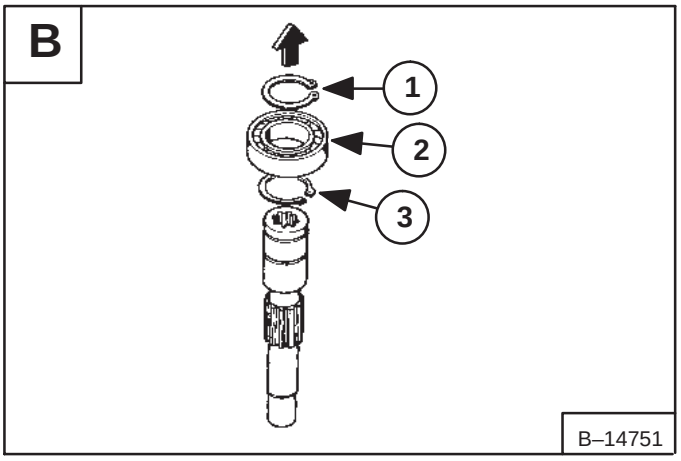
Disassembly (Cont'd)

Remove the internal snap ring (Item 1) **[A]** that retain the bearing/drive shaft to the hub.

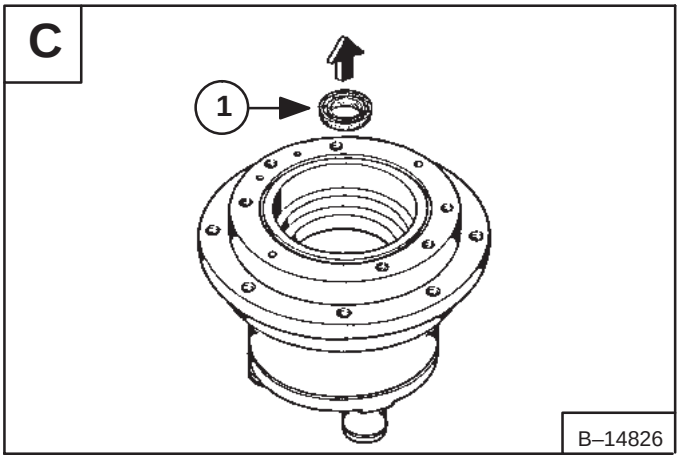
Push the drive shaft (Item 2) **[A]** from the bottom to remove the shaft from the hub.



Remove the snap ring (Item 1) **[B]**, the bearing (Item 2) **[B]** and the second snap ring (Item 3) **[B]** from the drive shaft.



Remove the seal (Item 1) **[C]** from the hub.



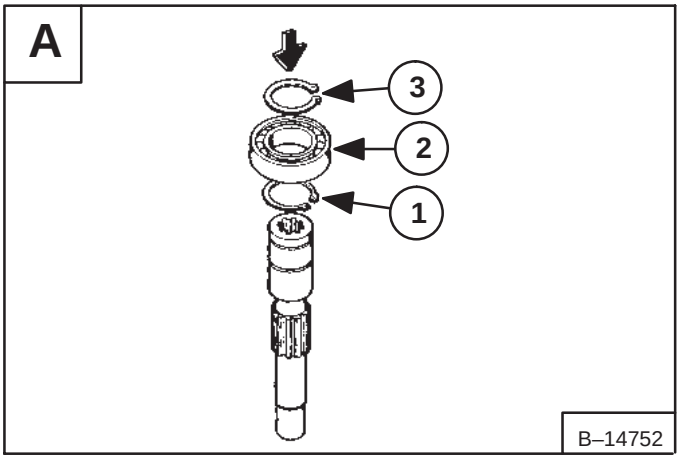
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TRAVEL MOTOR (S/N 512913405 & Above) (Cont'd)

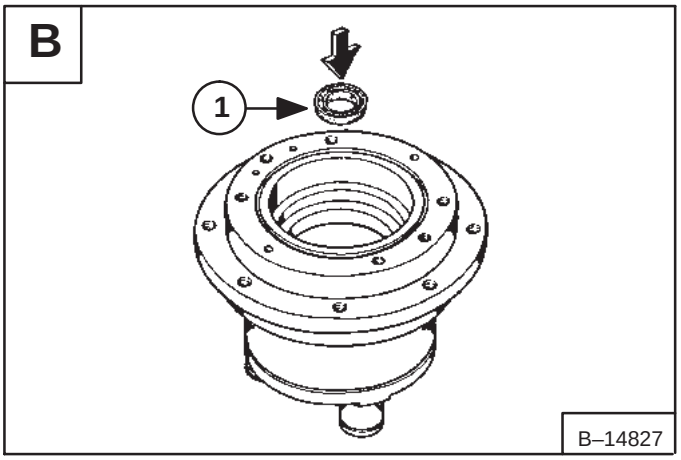
Assembly

Clean all parts in solvent and dry with compressed air. Inspect all parts and replace any that are damaged. If any of the planetary gears are damaged, replace all the planetary gears and sun gear from the planetary assembly that is damaged. One damaged gear can cause a microscopic fatigue crack in mating teeth and cause premature failure after servicing. Apply oil to all O–rings (as noted) and light grease to the ball and roller bearings before installation.

Install the lower snap ring (Item 1) **[A]**, the bearing (Item 2) **[A]** and the top snap ring (Item 3) **[A]** on the drive shaft.



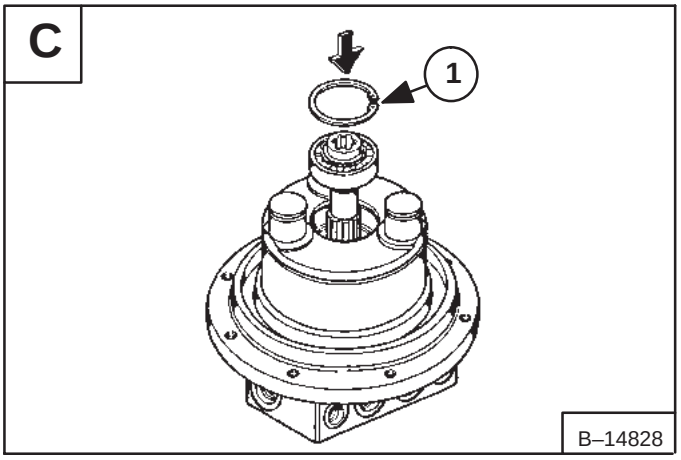
Apply oil to the inside diameter of the oil seal and install the oil seal (Item 1) **[B]** in the hub.



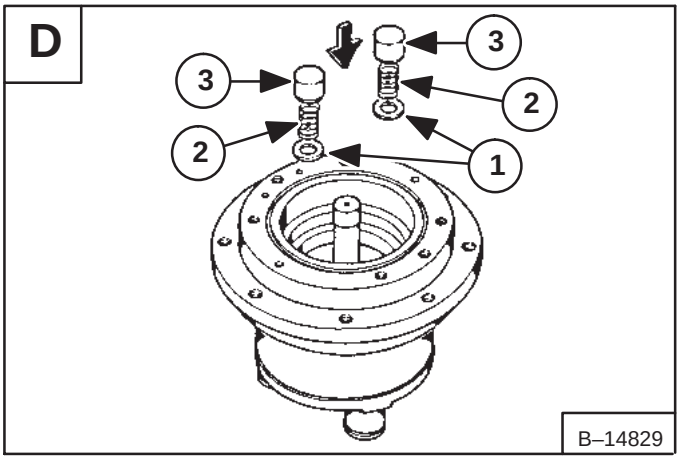
Install the drive shaft in the hub **[C]**.

NOTE: Make sure the bearing is seated in the hub.

Install the internal snap ring (Item 1) **[C]**.



Install the two washers (Item 1) **[D]** and the springs (Item 2) **[D]**. Apply oil on the displacement control pistons (Item 3) **[D]** and install the pistons in the piston bore.

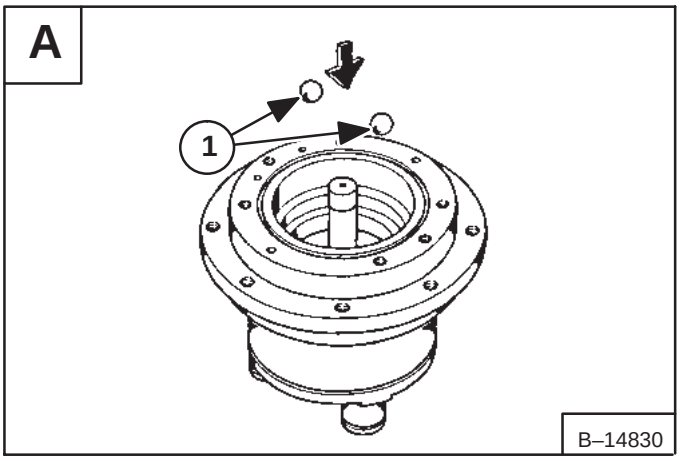


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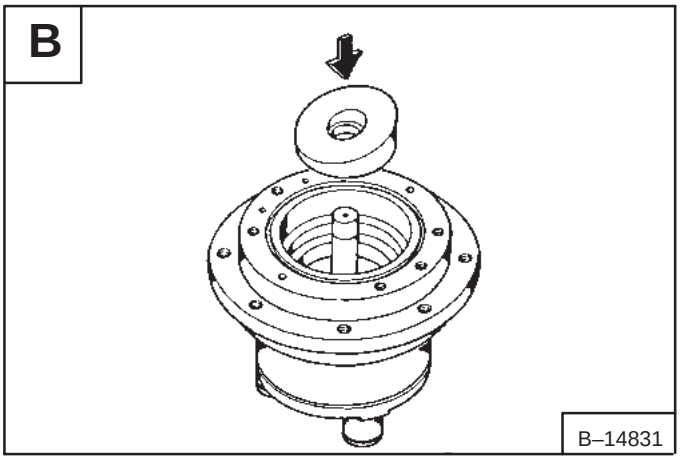
TRAVEL MOTOR (S/N 512913405 & Above) (Cont'd)

Assembly (Cont'd)

Install the two balls (Item 1) **[A]** in the motor housing.

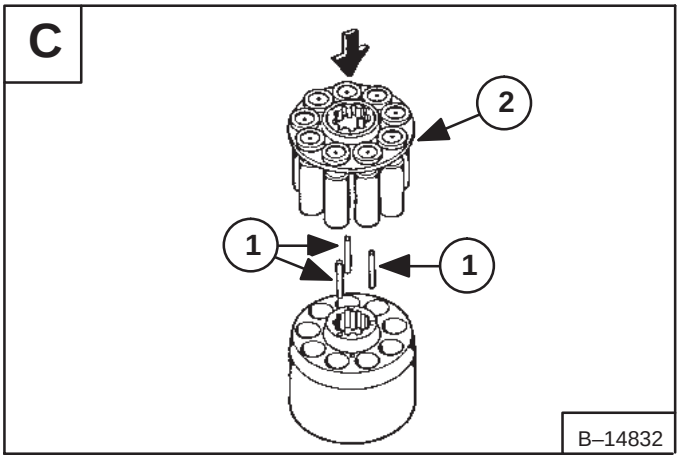


Install the swash plate in the motor housing **[B]**.



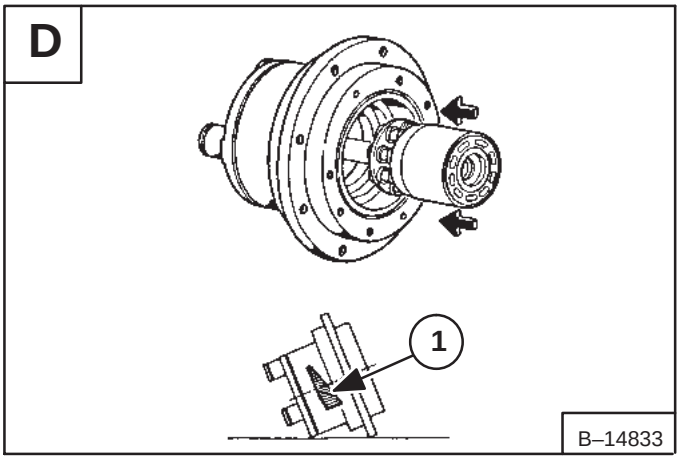
Install the three dowel pins (Item 1) **[C]** in the rotatating block.

Apply oil to the piston assembly (Item 2) **[C]** and install the piston assembly in the rotating block.



Tip the motor housing on its side **[D]**. Make sure the thick side of the swash plate (Item 1) **[D]** is to the bottom.

Install the rotating block assembly in the motor housing **[D]**.

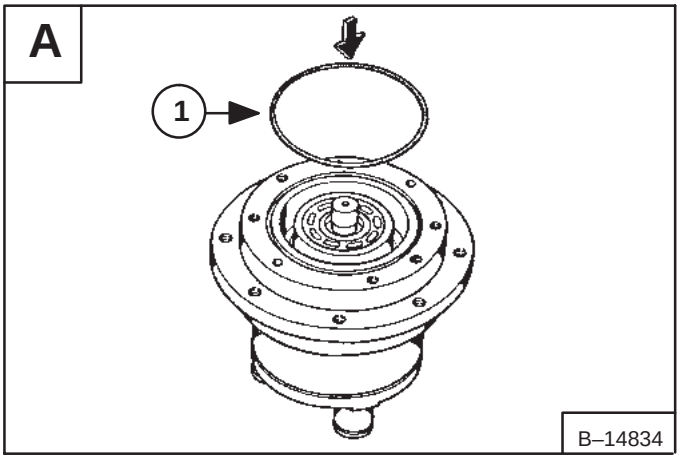


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TRAVEL MOTOR (S/N 512913405 & Above) (Cont'd)

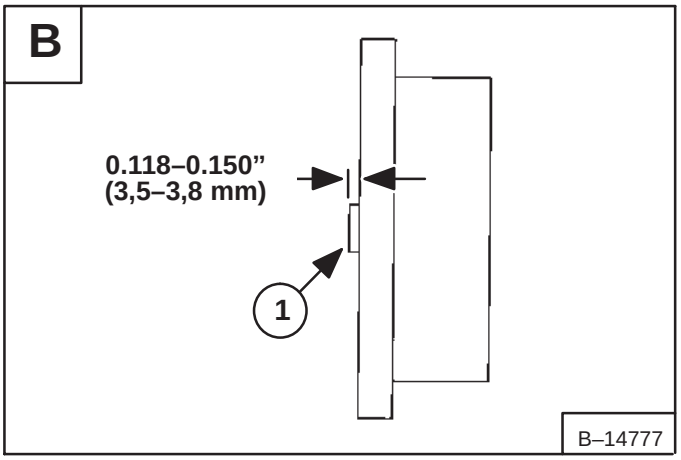
Assembly (Cont'd)

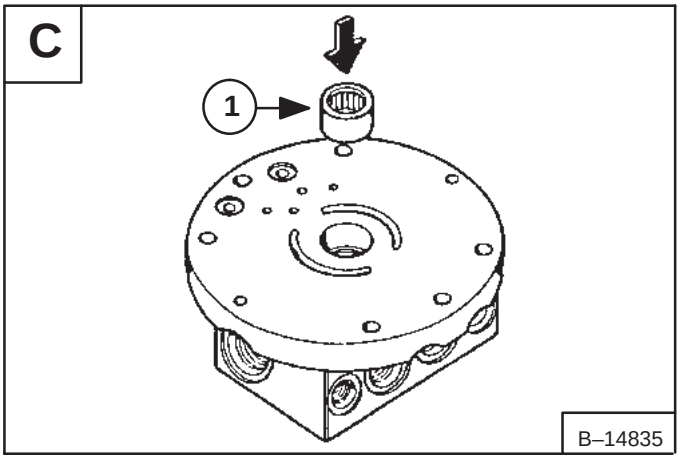
Apply oil to and install the O–ring (Item 1) **[A]** on the motor housing.



Press the bearing (Item 1) **[B]** & **[C]** in the motor cover.

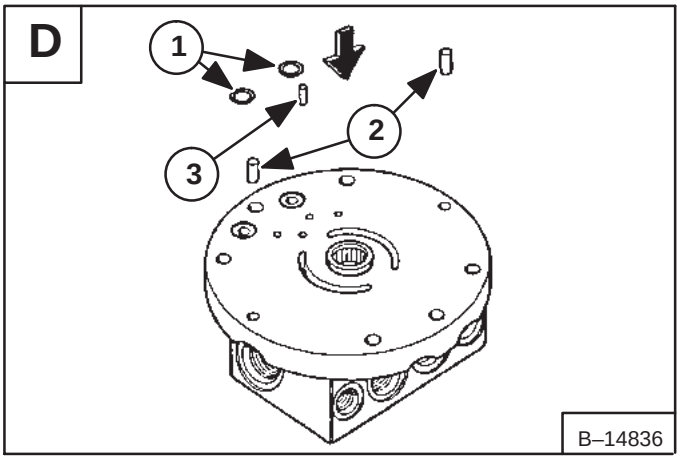
The bearing (Item 1) **[B]** must extend from the face of the motor cover .118 – .150 inch (3, 5–3,8 mm).





Apply oil to the two O–rings (Item 1) **[D]** and install the O–rings on the motor cover.

Install the two alignment pins (Item 2) **[D]** and the valve plate pin (Item 3) **[D]** on the motor cover.

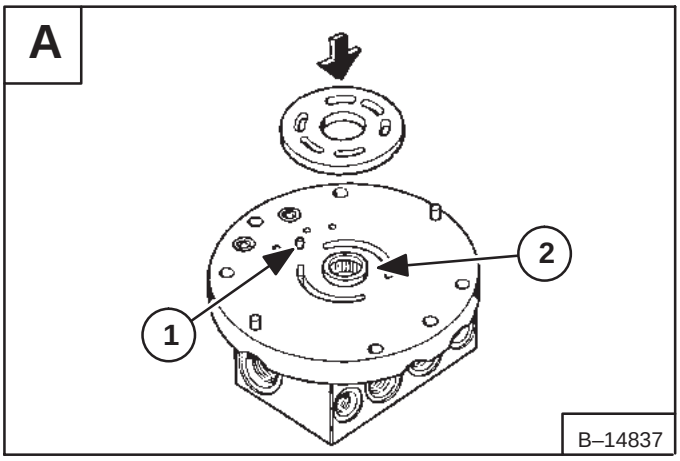


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TRAVEL MOTOR (S/N 512913405 & Above) (Cont'd)

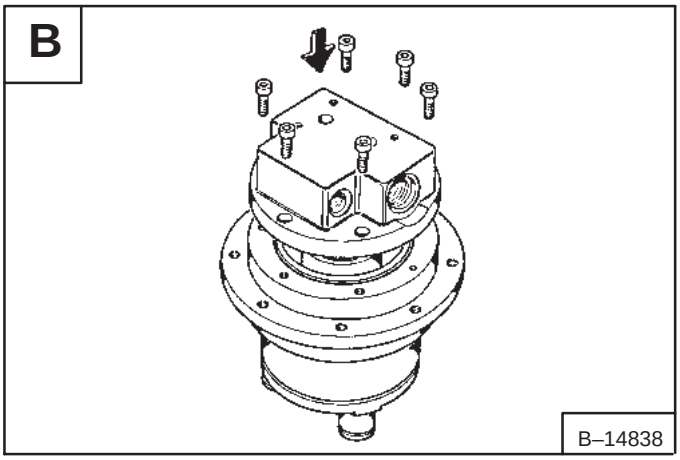
Assembly (Cont'd)

Apply light grease to the valve plate. Install the valve plate on the motor cover, over the valve plate alignment pin (Item 1) **[A]**.



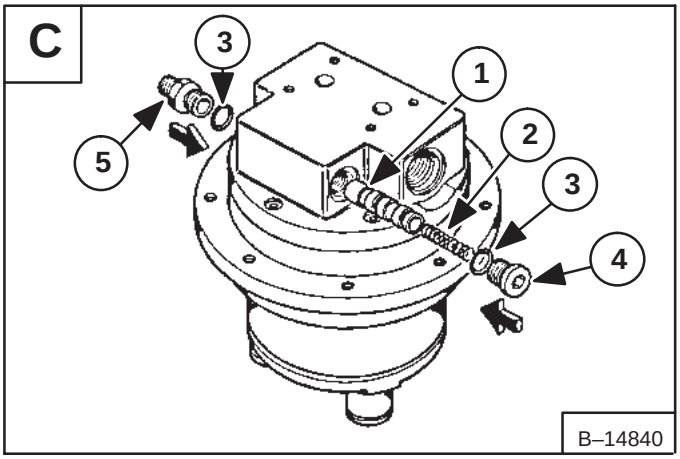
Lubricate the bearing (Item 2) **[A]** with oil and install the motor cover on the hub with six bolts **[B]**.

Tighten the bolts in a criss–cross manner to 18–22 ft.–lbs. (25–30 Nm) torque.



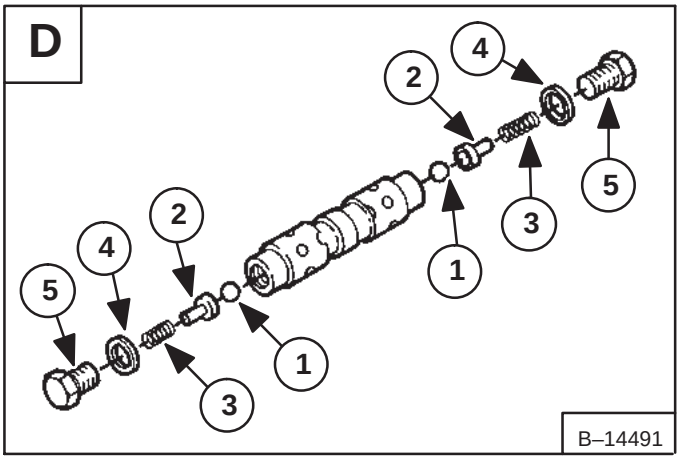
Apply oil to and install the two speed spool (Item 1) **[C]** and the spring (Item 2) **[C]**.

Apply oil to and install the O–rings (Item 3) **[C]** on the plug (Item 4) **[C]** and the adapter (Item 5) **[C]**. Install the plug (Item 4) **[C]** and the adapter (Item 5) **[C]**.



Install the check ball (Item 1) **[D]**, the poppet (Item 2) **[D]** and the spring (Item 3) **[D]** in both ends of the spool.

Apply oil and install the new O–rings (Item 4) **[D]** on the plugs (Item 5) **[D]**.



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TRAVEL MOTOR (S/N 512913405 & Above) (Cont'd)

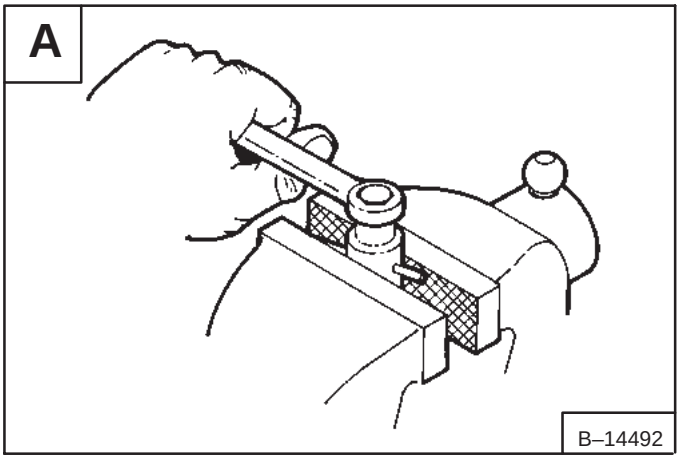
Assembly (Cont'd)

To assemble the spool, insert a hardened pin through the hole in the spool and use a vise with protective jaws to hold the spool **[A]**.

NOTE: Do not use any type of tool to grip the spool or damage to the spool will result.

Install the two plugs in both ends of the spool **[A]**.

Tighten the plugs to 18–22 ft.–lbs. (25–30 Nm) torque.

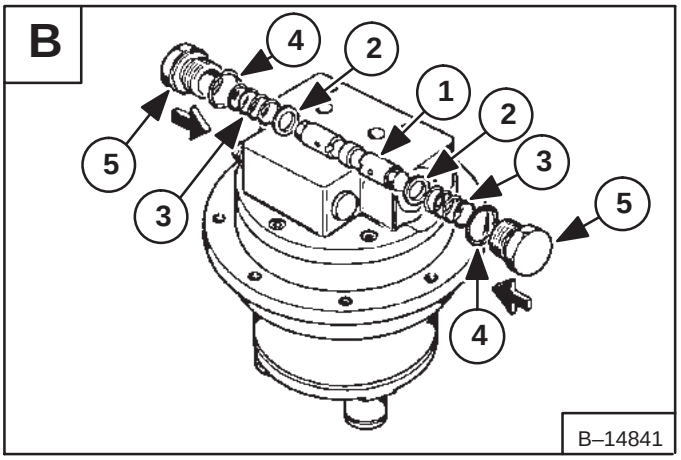


Apply oil to and install the spool (Item 1) **[B]** in the motor cover.

Install the washers (Item 2) **[B]** and the springs (Item 3) **[B]** on both ends of the spool (Item 1) **[B]**.

Apply oil to and install new O–rings (Item 4) **[B]** on the plugs (Item 5) **[B]**.

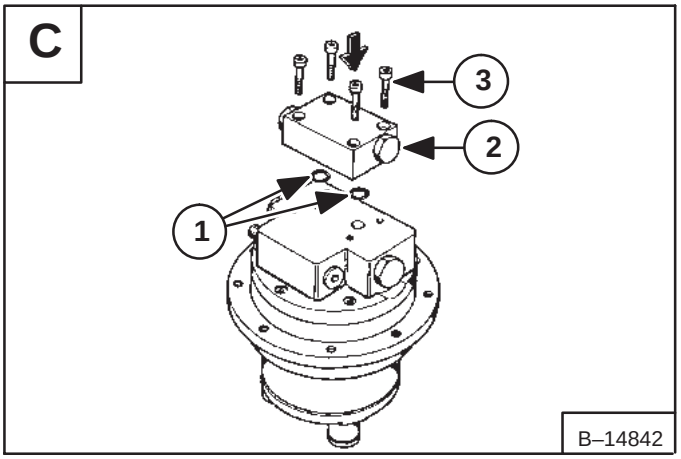
Install the plugs (Item 5) **[B]** on the motor cover.



Apply oil to and install the two O–rings (Item 1) **[C]**.

Install the relief valve block assembly (Item 2) **[C]** and the four bolts (Item 3) **[C]**. Tighten the bolts to 18–21 ft.–lbs. (25–28 Nm) torque.

NOTE: The relief valve block assembly (Item 2) [C] and the relief valves are not serviceable. If any of these parts are damaged, order a new relief valve block assembly from Melroe Parts.



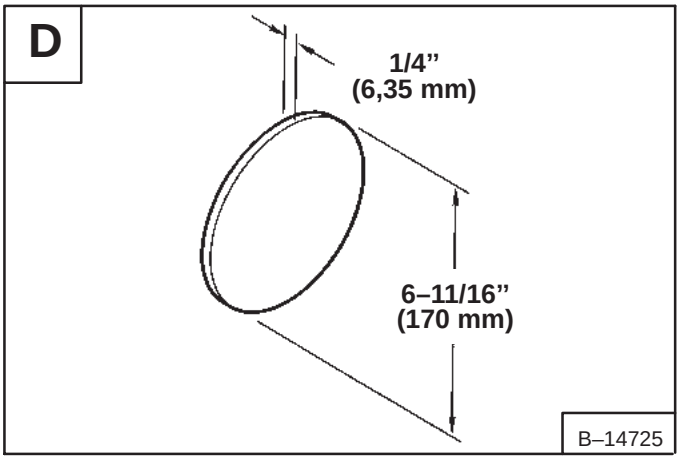
To install the bearings, a bearing installation tool will be needed.

This tool is placed on the top of the bearing inner and outer race and a press is used to seat the bearings.

Fabricate or obtain the tool locally **[D]**.

The dimensions are as follows:

Diameter . . . . . 6–11/16 inches (170 mm)
Thickness . . . . . 1/4 inch (6,35 mm)



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TRAVEL MOTOR (S/N 512913405 & Above) (Cont'd)

Assembly (Cont'd)

Lubricate the outer edge of the bearing and press the bearing (Item 1) **[A]** in the housing, using the bearing installation tool.

NOTE: If either the top or bottom bearing has been replaced, measure the thickness of the old and new bearing. If the difference is greater than ± .002 inch (0,05 mm) add or subtract shims to match the new bearing thickness to the old bearing thickness.

If shims are needed, order the appropriate shim(s) from Melroe Parts:

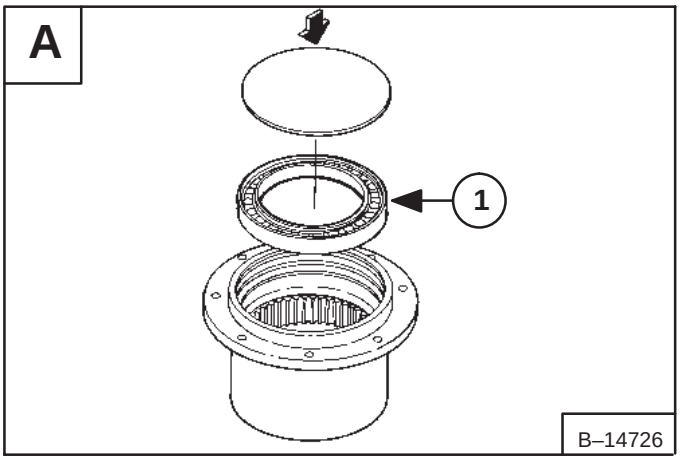
P/N 6669119 – .0079 inch (0,2 mm)
P/N 6669120 – .0118 inch (0,3 mm)
P/N 6669121 – .0157 inch (0,4 mm)
P/N 6669122 – .0354 inch (0,9 mm)
P/N 6669123 – .0374 inch (0,95 mm)

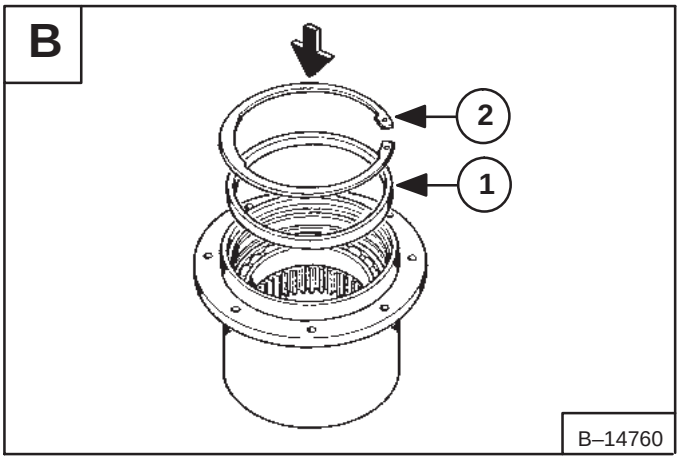
Install the spacer (Item 1) **[B]** and the internal snap ring (Item 2) **[B]**.

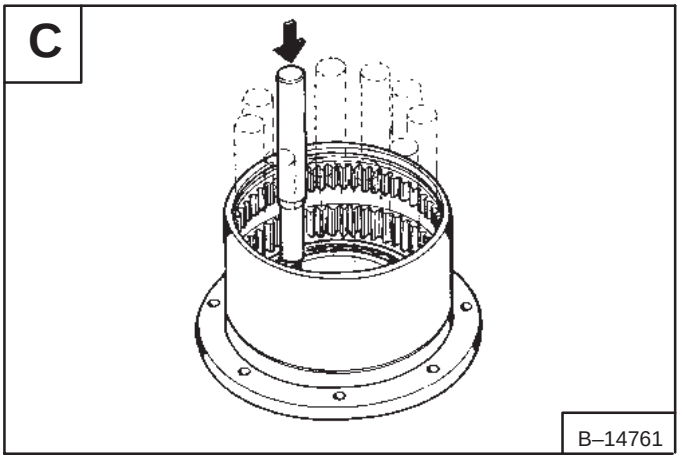
Invert the ring gear, and using a brass drift, seat the bearing against the spacer **[C]**.

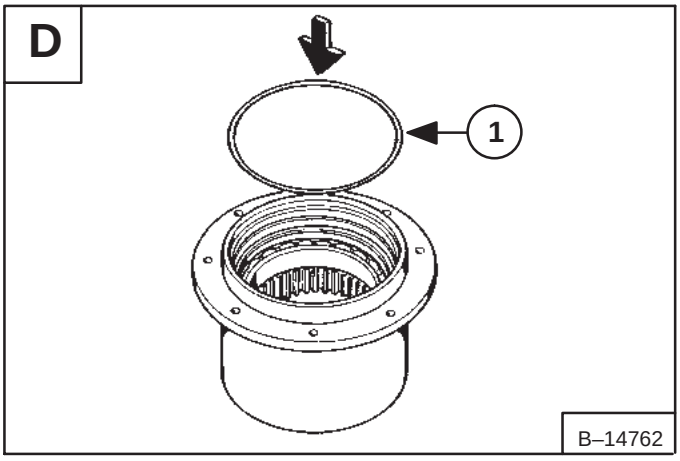
Apply oil to and install the O–ring (Item 1) **[D]**.

NOTE: Make sure the O–ring (Item 1) [D] is correctly installed in the housing so it is not damaged when the second bearing is installed.







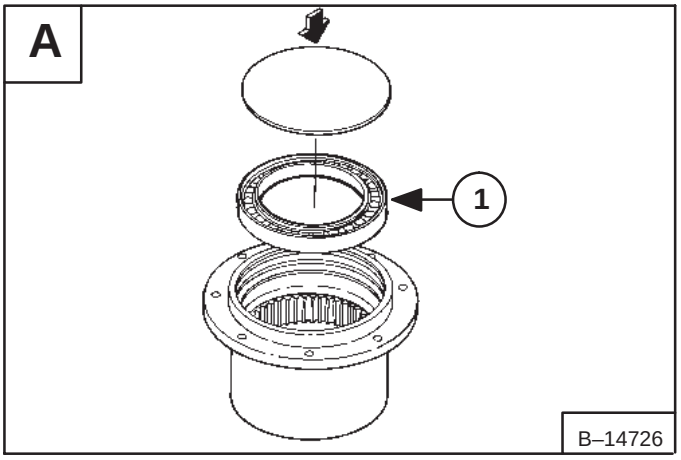


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TRAVEL MOTOR (S/N 512913405 & Above) (Cont'd)

Assembly (Cont'd)

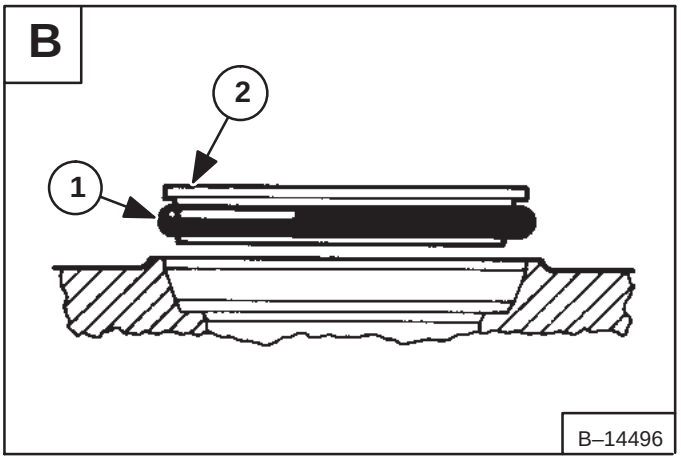
Lubricate the outer edge of the second bearing and press the bearing in the housing **[A]**.



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

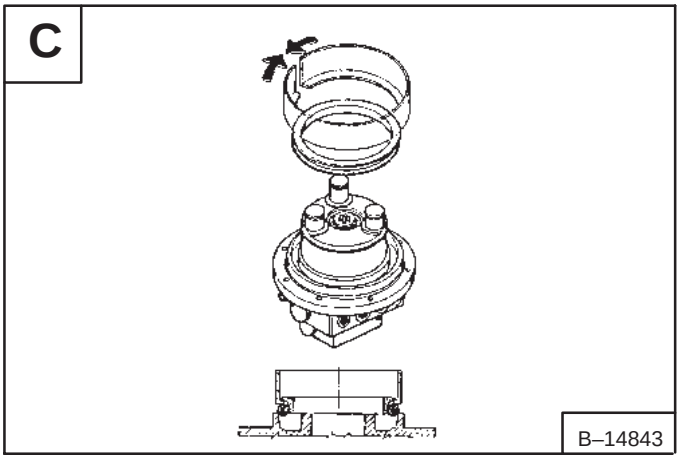
NOTE: Inspect the seal ring for burrs before installing the O–ring. Install the O–ring making sure it is not twisted. To remove any twists, gently pull a section of the O–ring and let it snap back.

The O–ring, seal ring and motor assembly must be clean and free of any dust, oil film or foreign matter.



Install the seal seating tool (MEL1519) on the seal ring and O–ring assembly **[C]**.

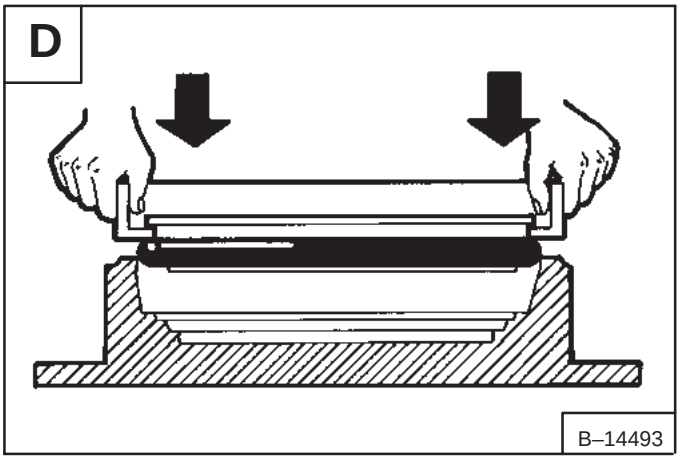
The O–ring and seal ring assembly has to be lubricated with alcohol, so the O–ring will slip past the housing retaining ring and seal uniformly in the motor housing radius **[C]**.



Dip the O–ring and seal ring assembly in a pan of alcohol.

Shake off the excess alcohol and install the seal ring assembly on the motor **[D]**.

Use firm even pressure on the installation tool (MEL1519) to *pop* the O–ring into the motor housing.



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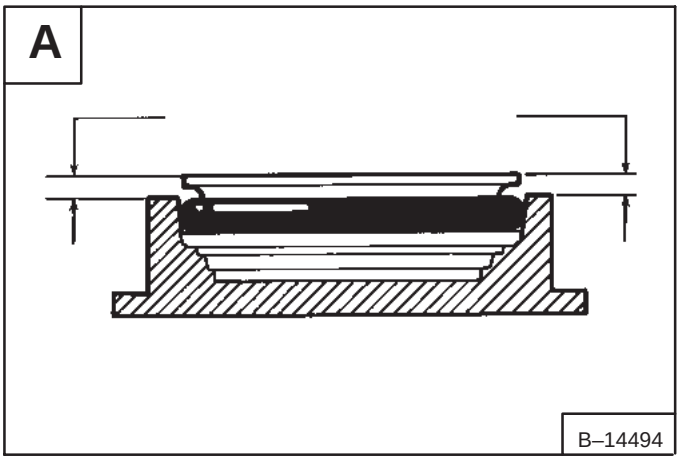
TRAVEL MOTOR (S/N 512913405 & Above) (Cont'd)

Assembly (Cont'd)

After the seal ring is installed, check the stand out height **[A]** in four places, 90° apart.

The stand out height is .30 ± .02 inch (7,62 ± 0,5 mm).

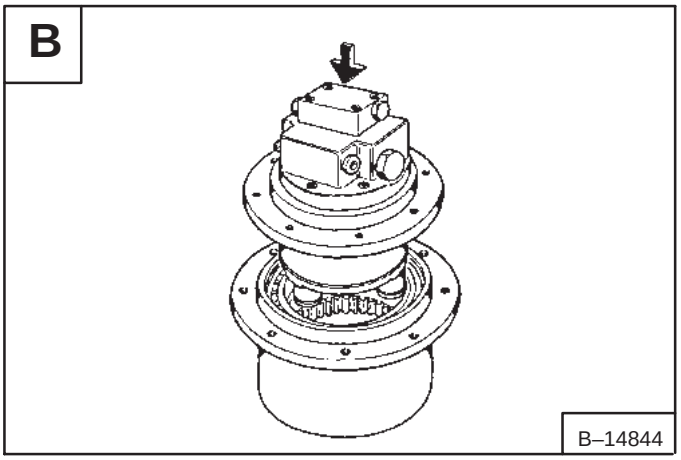
NOTE: If the seal ring does not meet the height specifications inspect the O–ring for twists or obvious bulges.



Apply a light film of oil to the seal ring and lapped face of the bearing.

NOTE: Do not get any oil on the rubber O–ring.

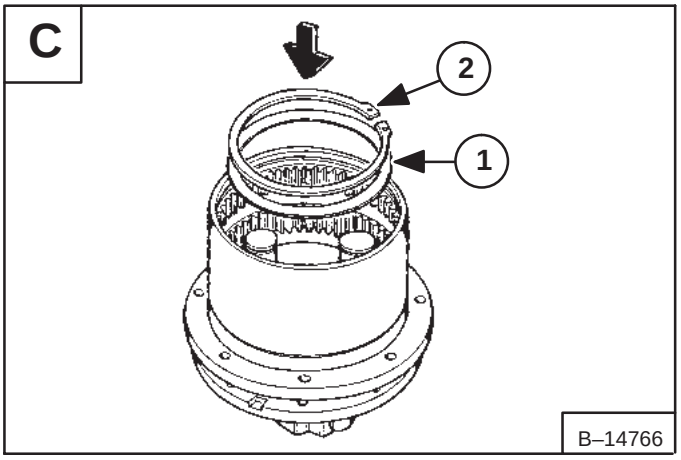
Press the reduction unit and motor assembly in the bearings **[B]**. The inner bearing may move deeper into the housing as the motor assembly is pressed into the housing. If this happens, tap the inner bearing down to its original position using a brass drift.



Install the shim(s) (Item 1) **[C]** and external snap ring (Item 2) **[C]** in the motor reduction unit.

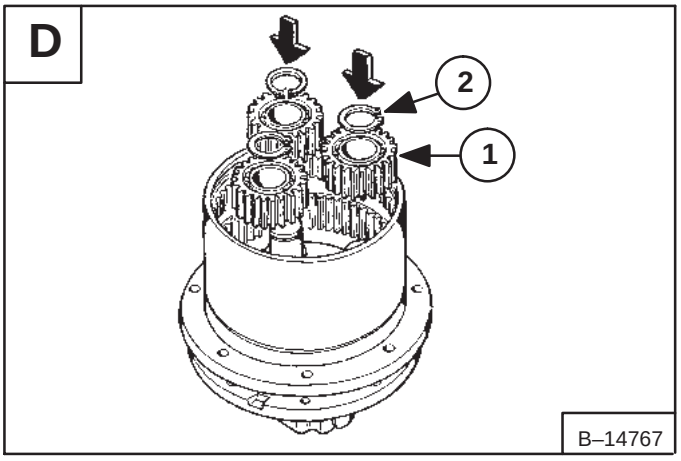
The shim(s) (Item 1) **[C]** are used to remove any end play between the ring gear and reduction unit.

The snap ring (Item 2) **[C]** must be snug against the shim(s) (Item 1) **[C]** and fully seated in the snap ring groove.



Install the planetary gears/bearings (Item 1) **[D]** and snap rings (Item 2) **[D]**.

NOTE: The second stage planetary gears/bearings must be installed with the bearing race flare facing down to match the shoulder on the pins.



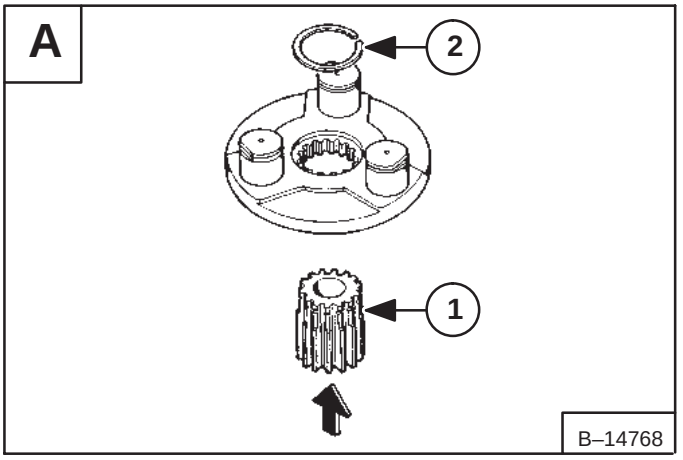
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TRAVEL MOTOR (S/N 512913405 & Above) (Cont'd)

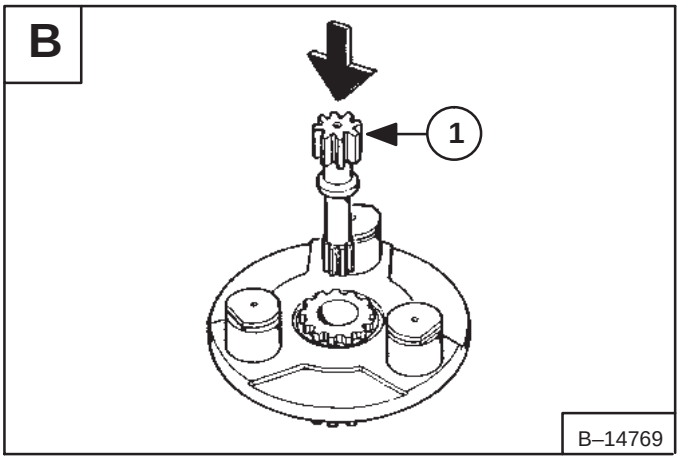
Assembly (Cont'd)

Install the sun gear (Item 1) **[A]** to the outer planetary carrier.

Install the snap ring (Item 2) **[A]** on the sun gear (Item 1) **[A]**.

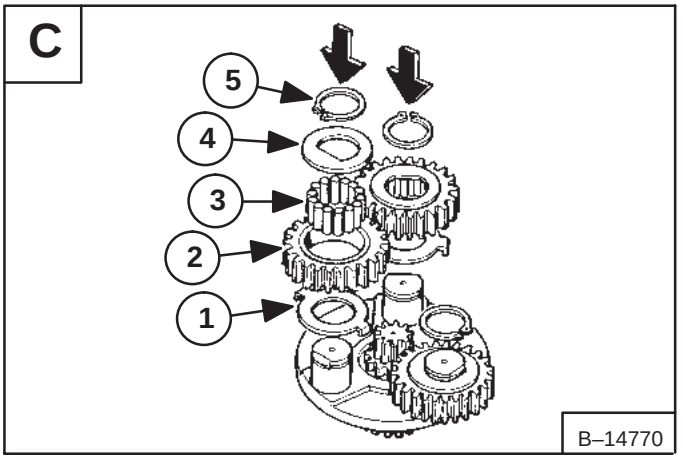


Install the sun gear (Item 1) **[B]**.

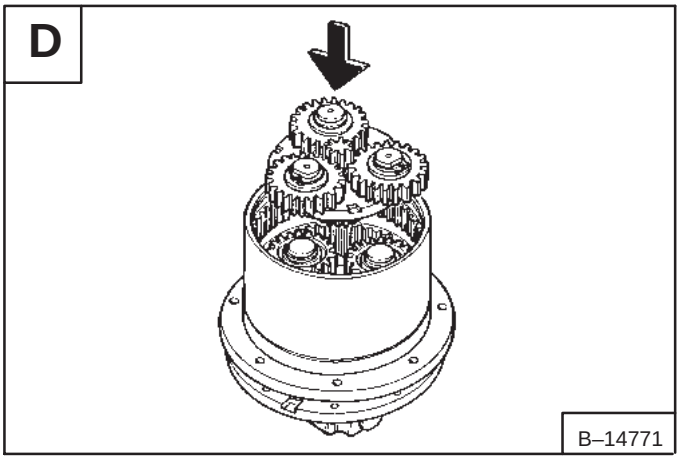


Install the thrust washers (Item 1) **[C]**, the planetary gears (Item 2) **[C]**, the bearings (Item 3) **[C]**, the anti–rotation washers (Item 4) **[C]** and the external snap rings (Item 5) **[C]**.

Install the snap rings (Item 5) **[C]** so the opening of the snap ring is towards the outside.



Install the planetary assembly in the hub **[D]**.



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TRAVEL MOTOR (S/N 512913405 & Above) (Cont'd)

Assembly (Cont'd)

Inspect the cover bushing (Item 1) **[A]** for wear.

If the bushing (Item 1) **[A]** needs to be replaced, a hole will need to drilled in the center of the bushing.

Using a number 3 drill bit, drill a hole in the bushing. Do Not drill into the cover. Thread the hole using a 1/4 x 28 inch NF tap.

Install a 1/4 x 28 inch bolt (Item 2) **[A]** in the bushing and pull the bushing out of the cover.

Install the new bushing in the cover with the bevel down.

The clearance between the cover bushing and the sun gear must be 0.016–0.024 inch (0,4–0,6 mm).

Place a 1/2 inch (13 mm) long piece of 1/16 inch (1,5 mm) solder (Item 1) **[B]** on the sun gear.

Seat the cover in the hub.

Remove the cover and measure the solder.

If the clearance between the sun gear and cover bushing does not meet specifications, order the appropriate shim(s) from Melroe Parts.

Shim Thickness	MEL Part Number
0.020 inch (0,5 mm)	6669597
0.030 inch (0,76 mm)	6669598
0.050 inch (1,27 mm)	6669699

Remove the bushing.

Install the correct shim under the bushing and install the bushing.

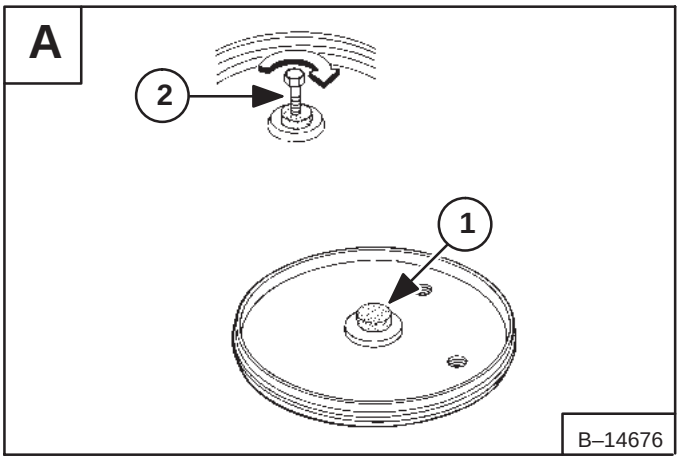
NOTE: Make sure there are no burrs on the bushing face from bushing removal.

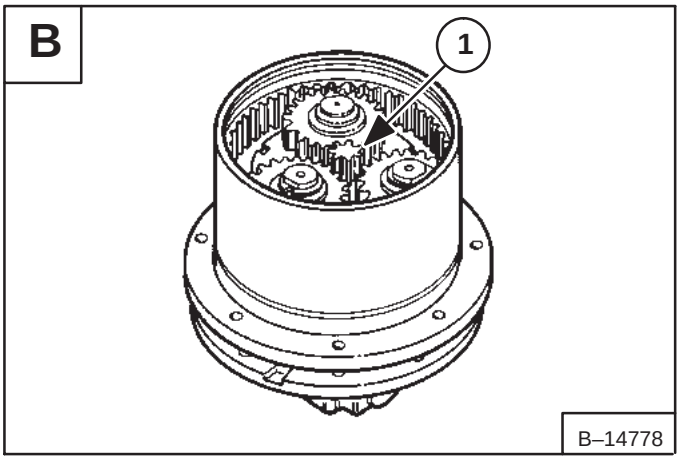
Repeat the procedure for checking clearance between the sun gear and cover bushing.

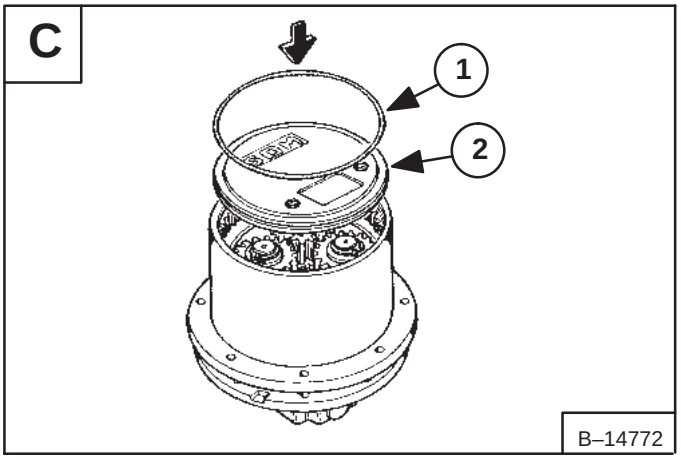
Apply oil to and install the O–ring (Item 1) **[C]** on the cover.

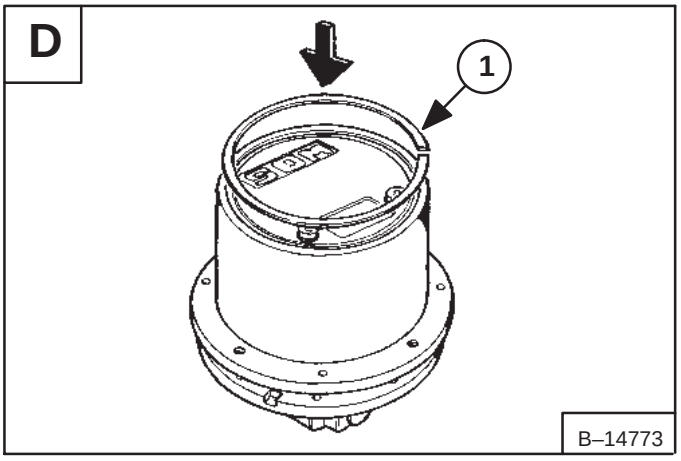
Install the cover (Item 2) **[C]** on the hub.

Install the snap ring (Item 1) **[D]** securing the cover to the travel motor.









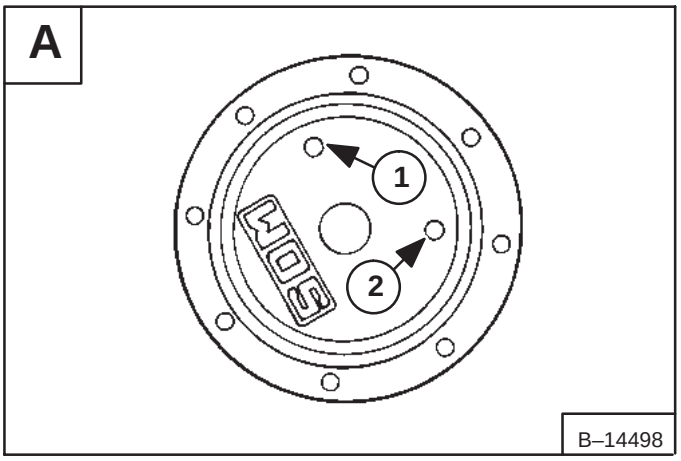
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TRAVEL MOTOR (S/N 512913405 & Above) (Cont'd)

Assembly (Cont'd)

Add .55 quarts (0,5 L) of gear lube 90W to the top plug hole (Item 1) **[A]** until the gear lube is at the bottom of the plug hole (Item 2) **[A]**.

Install and tighten the two plugs.



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TRACK DAMAGE IDENTIFICATION

Cutting Of Steel Cords

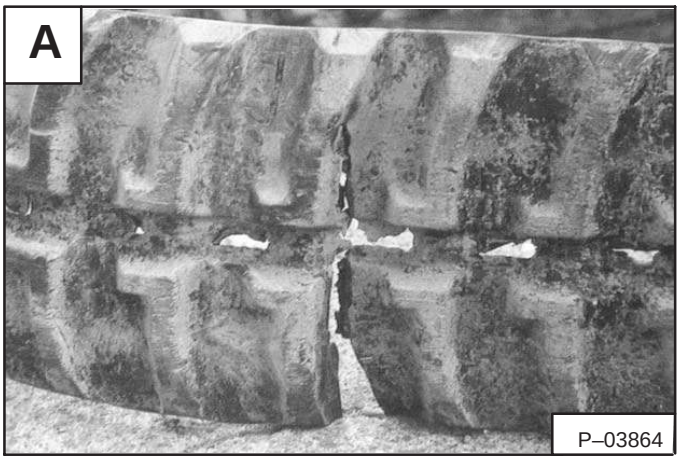
The following pages show photos and illustrations of track damage and the probable cause of the damage. It is intended to be used for identifying the reason for track damage and how to avoid future track damage.

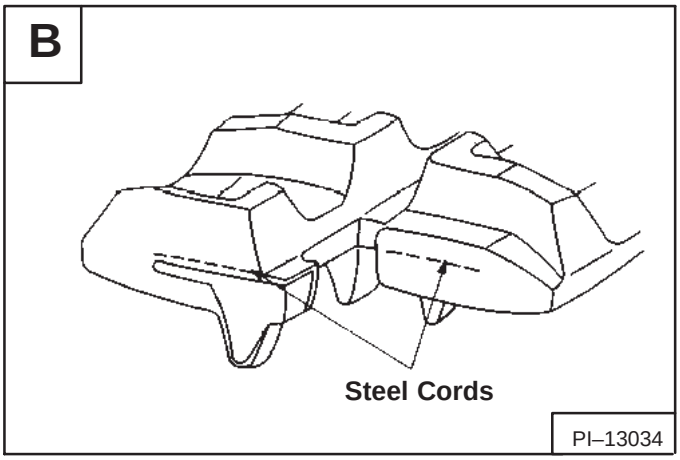
Damage:

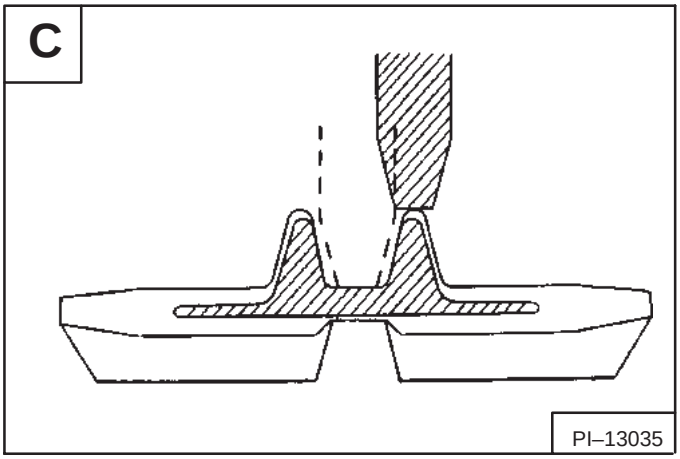
Embedded steel cords are cut off **[A]** & **[B]**.

Replacement:

Replacement is required **[A]** & **[B]**.







Causes of the damage:

When applied to rubber tracks under the following circumstances, tension in excess of the breaking strength of the embedded steel cords causes steel cords to be cut:

When the rubber track is detracking, the idler or sprocket rides on the projections of the embedded metal **[C]**.

When the rubber track is detracted, projections of rubber tracks get stuck between the frame of the undercarriage.

The rubber track is clogged with stones or foreign obstacles.

Furthermore, when moisture invades through a cut on the lug side rubber surface, the embedded steel cords will corrode. The deterioration of the design strength may lead to the breaking off of the steel cords.

Prevention:

The following preventions should be taken to minimize the risk of this damage:

Periodical checking on site of the recommended track tension. (See Page 5–4.)

Avoiding quick turns on bumpy and rocky fields.

Drive carefully to avoid having stones and other articles clog the rubber tracks.

Driving over sharp objects should be avoided. If this is impossible, do not make turns while driving over sharp objects.

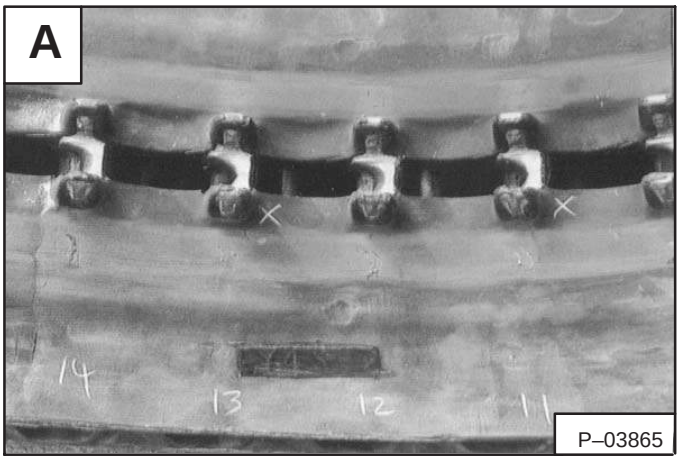
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TRACK DAMAGE IDENTIFICATION (Cont'd)

Abrasion Of Embedded Metals

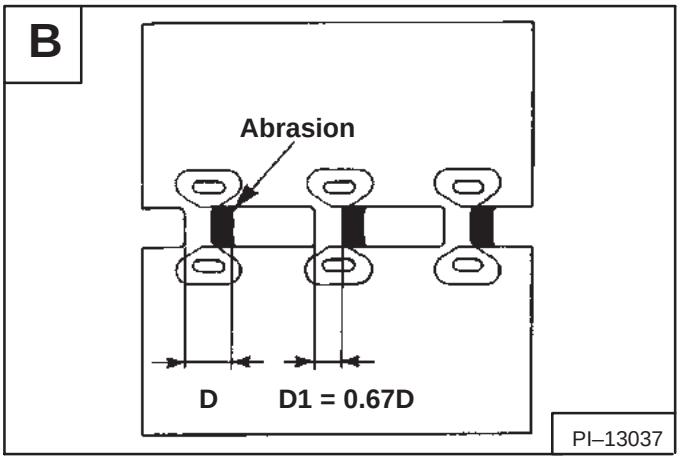
Damage:

In proportion to the service time, embedded metals will gradually wear away by friction **[A]**.



Replacement:

Replacement is required when the width of the embedded metals (D1) becomes 67% of their original width (D) **[B]**.



Causes of the damage:

When the track rollers, sprockets and idler gears roll over the embedded metals, abrasion of embedded metals is inevitable. The following cases sometimes accelerate their abrasion:

Rubber tracks are driven with an extraordinary heavy load on them.

Rubber tracks are used on sandy fields.

Prevention:

As long as rubber tracks are used under normal operating conditions, abnormal abrasion is unlikely to occur. The level of abrasion should be carefully checked when the machines are used for dozing which generate a heavy load for rubber tracks, and when they are operated under a sandy field condition for a long time.

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TRACK DAMAGE IDENTIFICATION (Cont'd)

Separation Of Embedded Metals

Damage:

Extraordinary outer forces applied to embedded metals cause their separation from the rubber track's body **[A]**.

Replacement:

Even a partial separation of embedded metals requires replacement of the track.

Causes of the damage:

Embedded metals are adhered between the steel cords and the rubber body. The following cases generate external forces greater than the adhesion strength, causing separation of the embedded metals:

When the idler continually rides on the projections of embedded metals, the embedded metals will eventually peel off **[B]**.

When a rubber track is detracted, it becomes stuck between the guide or the undercarriage frame, causing the separation of embedded metals **[C]**.

Abnormally worn sprockets as shown will pull embedded metals out **[D]**.

Prevention:

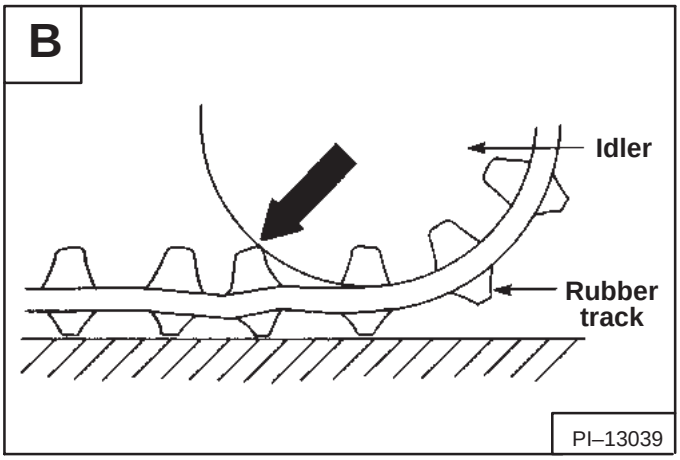
Similar to the prevention against the cutting of the steel cords:

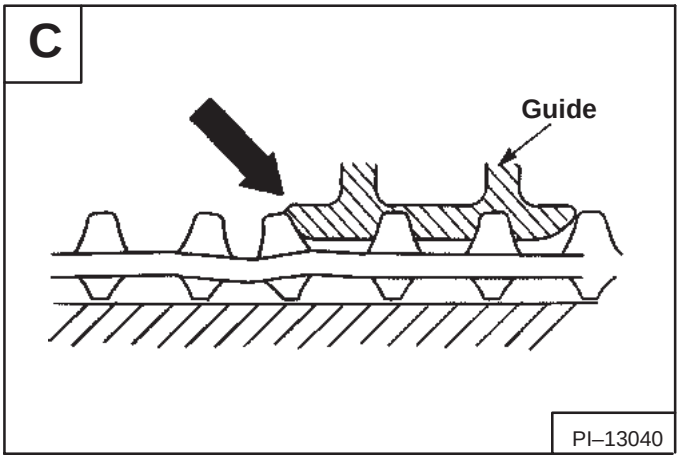
Recommended track tension should be periodically checked. (See Page 5–4.)

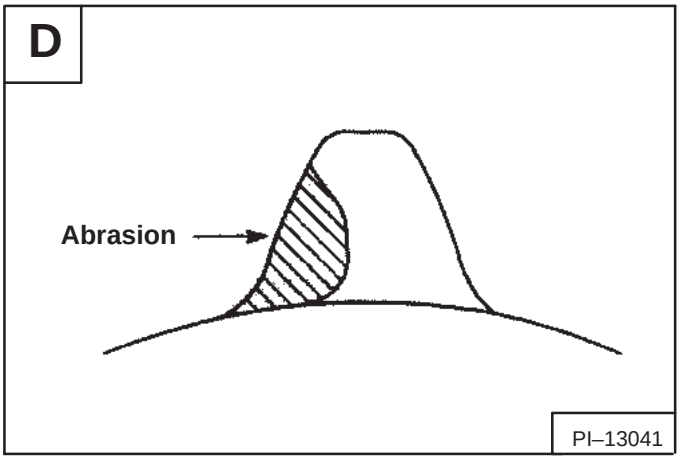
Quick turns on bumpy and rocky fields should be avoided.

If abnormal wear of sprockets is observed, they should be immediately replaced.









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TRACK DAMAGE IDENTIFICATION (Cont'd)

Separation Of Embedded Metals Due To Corrosion

Damage:

Due to corrosion of embedded metals, the adhesion to the rubber body deteriorates, resulting in complete separation **[A]**.

Replacement:

Even a partial separation of embedded metals requires a rubber track replacement.

Causes of the damage:

Embedded metals are bonded to the rubber body. The following operating conditions cause embedded metals to corrode, causing deterioration of the bonding, and finally resulting in separation of the embedded metals from the rubber body **[B]**.

Excessively salty fields, like the sea shore.

Strong acidic or alkali soil conditions

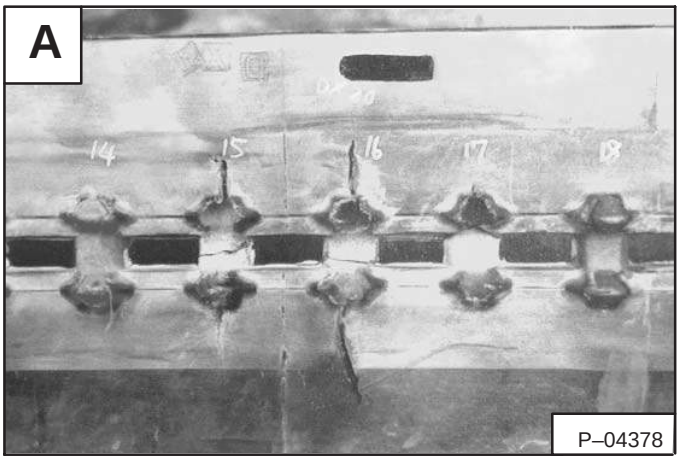
Compost spread grounds

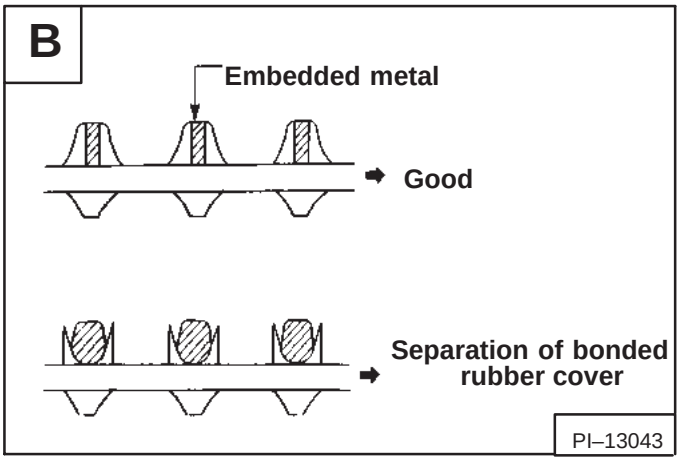
On tracks that are out of adjustment, the track rollers, idlers and sprockets will gradually wear the rubber surface at track roller side, causing exposure of the embedded metals. Consequently the embedded metals will corrode resulting in their separation from the rubber body.

Prevention:

If rubber tracks are used under such field conditions as described under (Causes of the damage), they should be washed with plenty of water. After being completely dried, they should be stored correctly.

When the bonded rubber cover is separated from the embedded metal projections and the metals in the rubber body become loose, it is time to consider replacement of the rubber track.





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TRACK DAMAGE IDENTIFICATION (Cont'd)

Cuts On The Lug Side Rubber

Damage:

Cuts on the lug side rubber often occurs as one of the most typical failure modes **[A]**

Replacement:

When a cut on the lug side rubber reaches the embedded steel cords, it should be immediately repaired with cold vulcanization rubber.

Causes of the damage:

When rubber tracks drive over projections or sharp stones in the fields, the concentrated forces applied cause cuts on the lug side rubber surface. In case of making turns on projections, the lug side rubber surface will have an even higher chance to be cut. If the cuts run through the embedded steel cords, it might result in the steel cords' breakage due to their corrosion. It is highly recommended to repair the cuts with cold vulcanization rubber as soon as they are observed **[B]**.

Prevention:

Machine operators are requested to drive with great attention to the ground's surface especially in terrains of the following type:

Construction sites

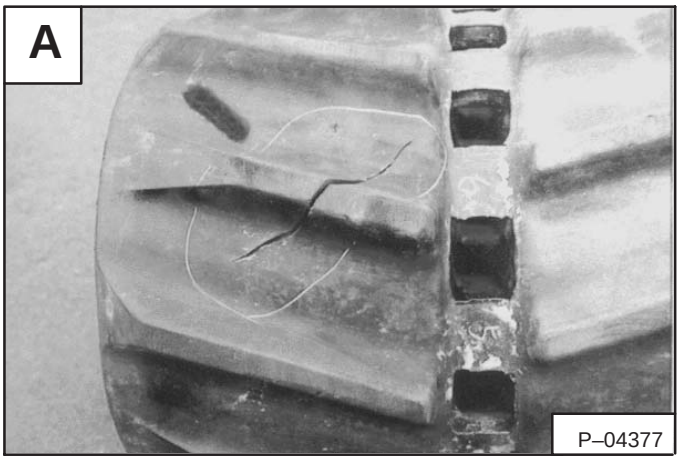
Demolition sites

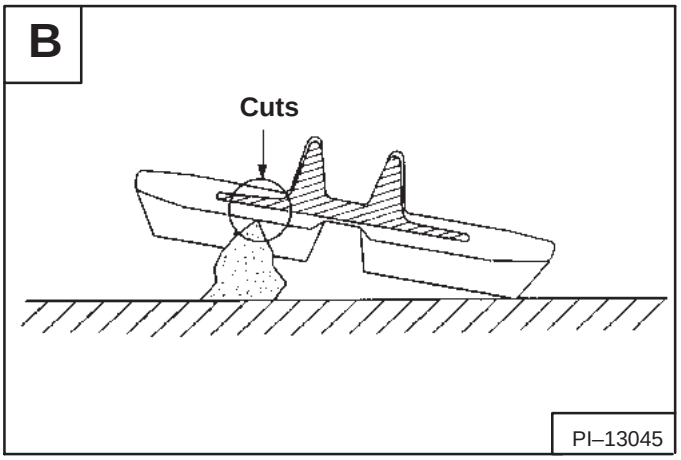
Paths covered with rocks and wood

Concrete ridges

Stumpy fields

When operating on terrains as mentioned above, high speed, quick turns and overloading should be avoided.





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TRACK DAMAGE IDENTIFICATION (Cont'd)

Cracks Of The Lug Side Rubber Due To Fatigue

Damage:

Small cracks around the root of the lug as a result from operation fatigue **[A]** & **[B]**.

Replacement:

When the cracks reach so deep that they expose the steel cords, track replacement is required.

Causes of the damage:

Because of wound stress applied to rubber tracks around the undercarriage parts during operation, the fatigue especially causes cracks on the lug side rubber surface. Once the cracks occur, they gradually deteriorate with even small external cracks. Also when operating near seashores or under cold temperatures, rubber tracks are more likely to suffer from ozone cracks.

Prevention:

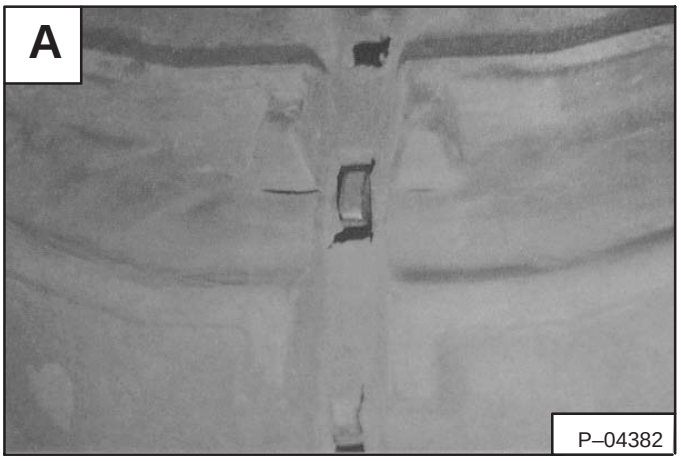
Rubber tracks are designed with special rubber compounds to prevent cracks due to fatigue. However, external injuries on the lug side rubber sometimes cause more chance of cracking. Machine operators should observe soil conditions when driving, so as not to cause external injuries to the lug side rubber. In order to minimize the occurrence of ozone cracks, attention should be paid to the following instructions for maintenance:

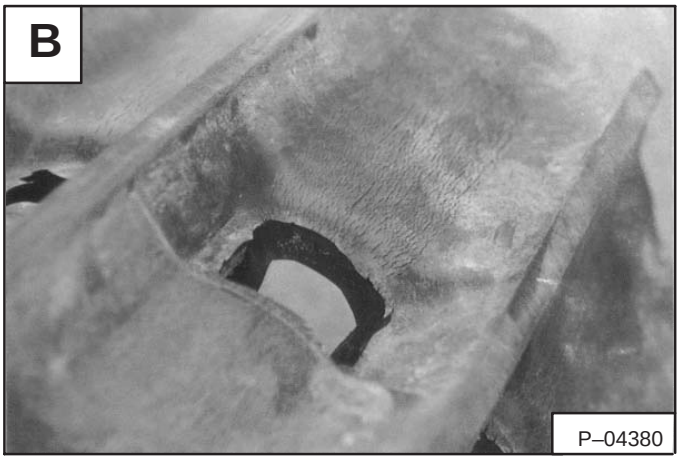
Avoid exposing stored tracks to direct sun light.

Avoid exposing stored tracks to direct rain and snow fall.

Store tracks in well ventilated warehouses.

Use the tracks at least once a month.





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TRACK DAMAGE IDENTIFICATION (Cont'd)

Lug Abrasion

Damage:

As its service time proceeds, the lug side inevitably undergoes abrasion **[A]** & **[B]**.

Replacement:

No replacement is required.

Causes of the damage:

Lug abrasion is more or less inevitable. Even if lug abrasion is proceeding, the rubber track can be used. However, as the traction performance deteriorates accordingly, it is highly recommended to replace the abraded tracks with new ones when the lug height becomes less than 5 mm.

Prevention:

In order to prevent the rubber track from abnormal or premature abrasion, following operating conditions should be avoided:

Making quick and repeated turns on concrete and asphalt roads

Driving up and down hilly paths with slippage

Making frequent turns on paths covered with rocks and wood

Cracks And Cuts On The Lug Side Rubber

Damage:

Sometimes cracks and cuts on the lug side rubber at the edges of the embedded metals can be observed **[A]**.

Replacement:

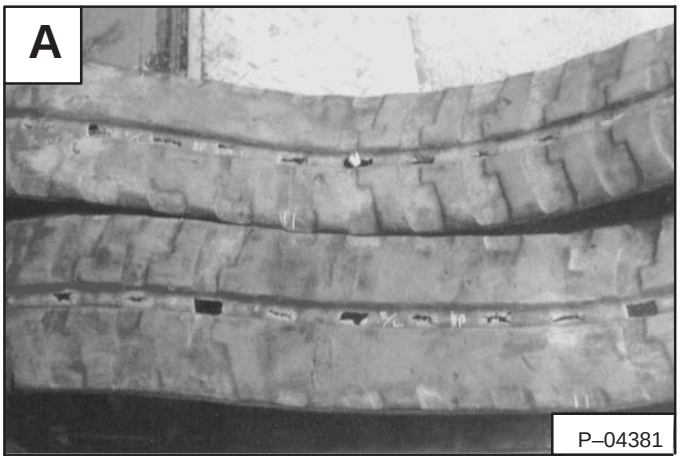
Basically, no replacement is required unless the cuts on the lug side rubber are discovered all around the edges of the embedded metals, as this will result in a complete cut off.

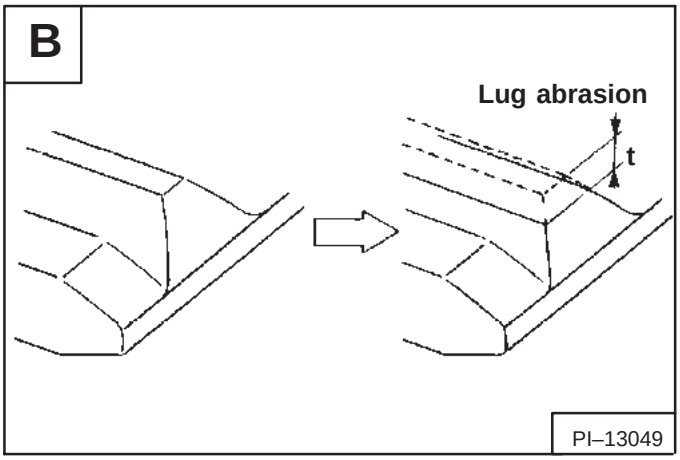
Causes of the damage:

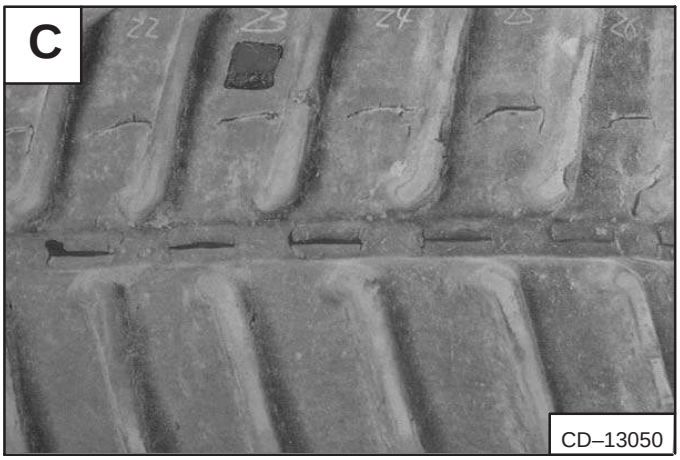
When rubber tracks drive over sharp projections, intensive stress is applied to the lug side rubber surface, especially at the edges of embedded metals, causing cracks and cuts in the area around the embedded metals **[D]**.

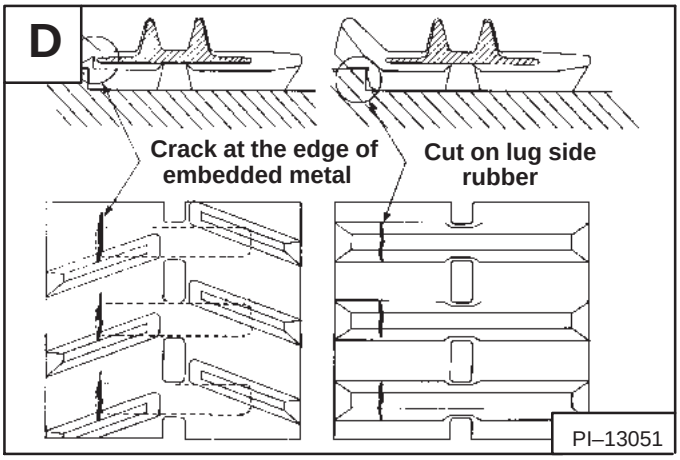
Prevention:

To avoid extensive stress applied to the lug root where metals are embedded, machine operators are requested to avoid driving over stumps and ridges.









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TRACK DAMAGE IDENTIFICATION (Cont'd)

Abrasion Of The Track Roller Side

Damage:

The rubber surface on which track rollers run is gradually abraded. It will end in the exposure of the embedded metals **[A]**.

Replacement:

It is recommended to replace the rubber track when more than half of the embedded metals are completely exposed.

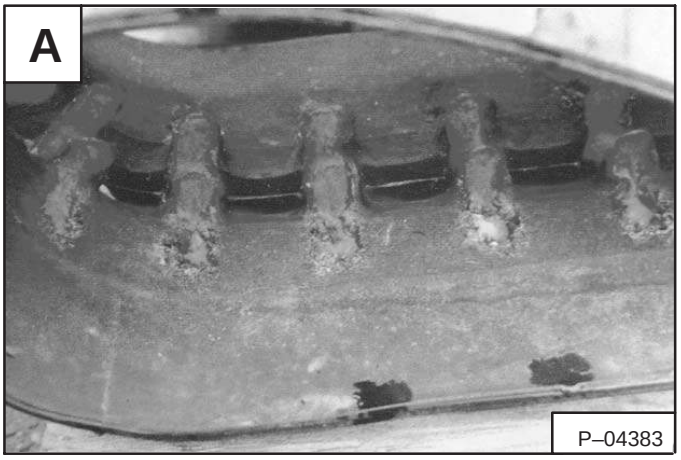
Causes of the damage:

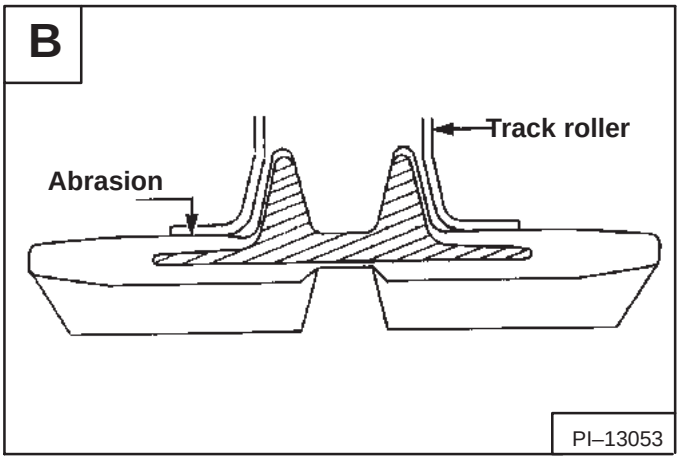
The abrasion of the track roller side rubber surface occurs because of sand and gravel being clogged between the rubber and the outside surface of the track rollers. The stress pushes the sand and gravel against the side of the rubber track to cause the abrasion **[B]**.

The level of abrasion is highly dependent on terrain conditions. A higher level of abrasion will occur when the rubber tracks are operated in fields covered with many stones and gravel. Small stones hardened with mud, stuck to the track rollers increase the abrasion level. After an extended period of abrasion, it will be more likely for exposed embedded metals to catch moisture through the inside steel cords, which can cause breakage of steel cords and separation of the metals from the rubber body.

Prevention:

After operation in wet fields containing many small stones, wash off the mud that is stuck to the track rollers completely. When operating on gravel paths and stony grounds, machines should be driven slowly and the turning radius should be big enough to prevent stones and gravel from getting stuck to the track roller side rubber.





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TRACK DAMAGE IDENTIFICATION (Cont'd)

Cuts On The Edges Of Track Roller Side

Damage:

Both edges of a rubber track have no special reinforcements. It sometimes occurs during operation that they are cut or torn off **[A]** & **[B]**.

Replacement:

In such case, the rubber track does not have to be replaced.

Causes of the damage:

This damage is caused by objects on the field or by interference with the machine frame.

In case of damage by objects on the operating ground:

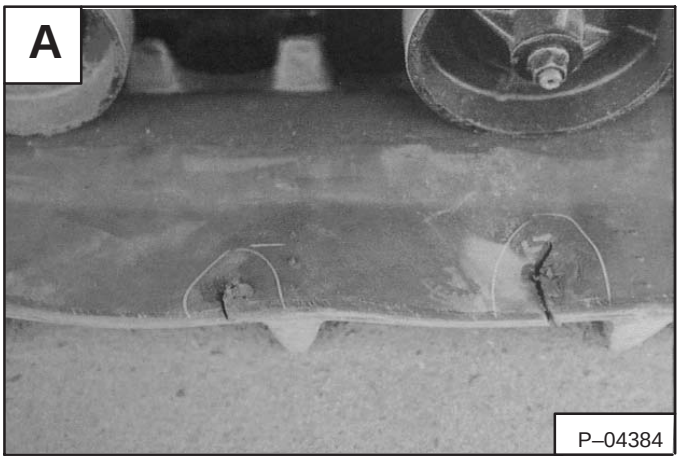
The edges of rubber track are often deformed largely due to a bumpy ground surface, stones and other objects, which cause extensive stress on the edges resulting in the damage. Especially, when a machine drives over concrete ridges, this type of damage easily occurs **[C]**.

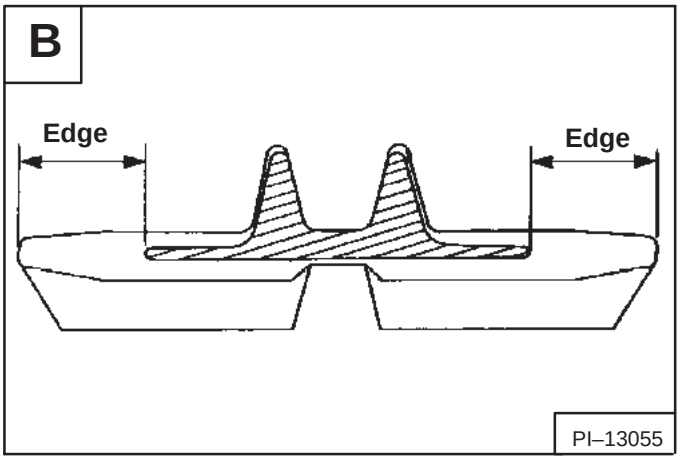
In case of damage by interference with the machine frame

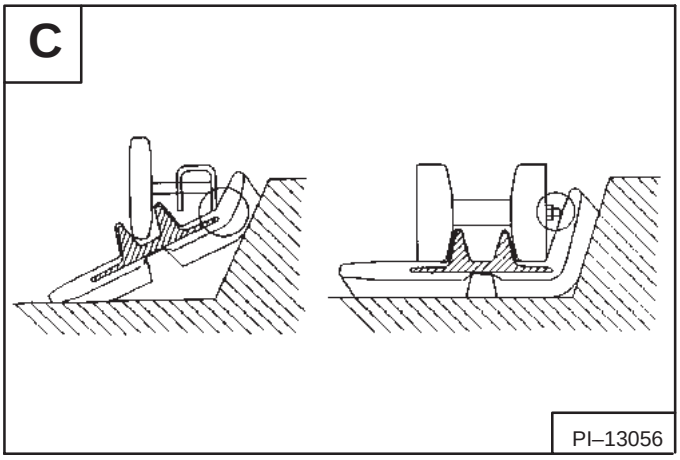
If a machine continues operating with rubber tracks being detracted, the rubber tracks may get caught up in the machine frame or undercarriage parts resulting in damage. Furthermore, when a machine travels along side slopes, the rubber tracks are deformed so much that they come into contact with the machine frame and undercarriage parts, which causes cutting, gouging and rubbing of rubber tracks in the end **[D]**.

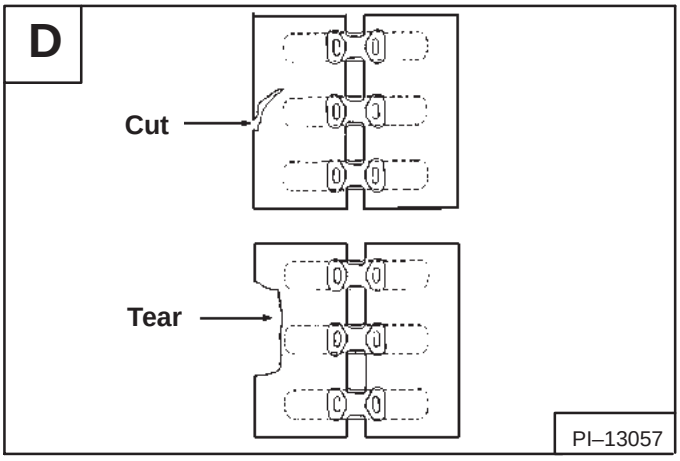
Prevention:

When traveling, a machine operator should be careful not to drive over any projections on the ground. He should also prevent rubber tracks from coming into contact with concrete walls, ditches and ridges. If rubber tracks are detracked, the machine should be stopped immediately for retracking.









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ELECTRICAL SYSTEM

	Page Number
ALTERNATOR	
Assembly	6–11
Belt Adjustment	6–8
Disassembly and Inspection	6–9
Parts Identification	6–9
Rectifier Continuity (Diode) Test	6–10
Removal and Installation	6–8
Rotor Continuity Test	6–10
Rotor Ground Test	6–10
Stator Continuity Test	6–9
Stator Ground Test	6–9
BATTERY	
Check the Battery	6–5
Removal and Installation (S/N 11001–11999)	6–5
Removal and Installation (S/N 12001 & Above)	6–6
CAB ELECTRICAL	
Cab Option	6–18
ELECTRICAL SYSTEM	
Description	6–3
Electrical System Service	6–4
Fuses	6–4
Fuse Arrangement	6–4
FUEL LEVEL SENDER	
Checking	6–16
Removal and Installation	6–16
GAUGES	
Removal and Installation	6–17
GAUGE LIGHTS	
Removal and Installation	6–18
INSTRUMENT PANEL	
Removal and Installation	6–17
STARTER	
Cleaning and Inspection	6–14
Disassembly and Assembly	6–13
Removal and Installation	6–12
Parts Identification	6–15
TROUBLESHOOTING	
Chart	6–3

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WIRE LEGEND

NO,s.	COLOR	GAUGE
1A	Red	10
1A1	Red	10
1B	Red	10
1C	Red	14
1C1	Red	14
1D	Red	10
1D1	Red	10
1E	Red	12
2DA	Red/White	14
10A	Black	16
10B	Black	14
10C	Black	14
10E	Black	16
10F	Black	12
10J	Black	16
10T	Black	16
12DR	Orange	16
12E	Orange	16
12H	Orange	14
12S	Orange	12
12Y	Orange	16
14E	Grren/White	16
14F	Lt. Green	16
14R	Green/White	16
19C	Red/White	12
19L	Red/White	16
19S	Red/White	16
19SS	Red/White	16
19W	Red/White	16
20	Black	16
20R	Black	16
21R	White	16
21RC	White	16
21S	White/Green	14
22	Purple	16
23FA	Red/Blue	16
23FB	White/Blue	14
23FP	White/Black	14
28	Lt. Blue/Black	16
28A	Lt. Blue/Black	16
28B	Lt. Blue/Orange	14
28G	Lt. Blue/Black	16
30F	Black	16
31PP	Yellow/Green	16
31PS	Yellow/Green	16
31PR	Yellow/Green	16
35H	Yellow/Brown	16
36	Purple	16
36T	Purple/White	16
36TF	Purple/White	16
36TJ	Purple/White	16
36TS	Purple/White	16

WIRE LEGEND (Cont'd)

NO,s.	COLOR	GAUGE
37E	Yellow	16
42A	Dk. Blue	16
42FR	Dk. Blue	16
46	Brown	16
49D	Gray	16
60C	Black	16
60WA	Black	16
64	Orange/Blue	16
64A	Orange/Blue	16
65	Orange/White	16

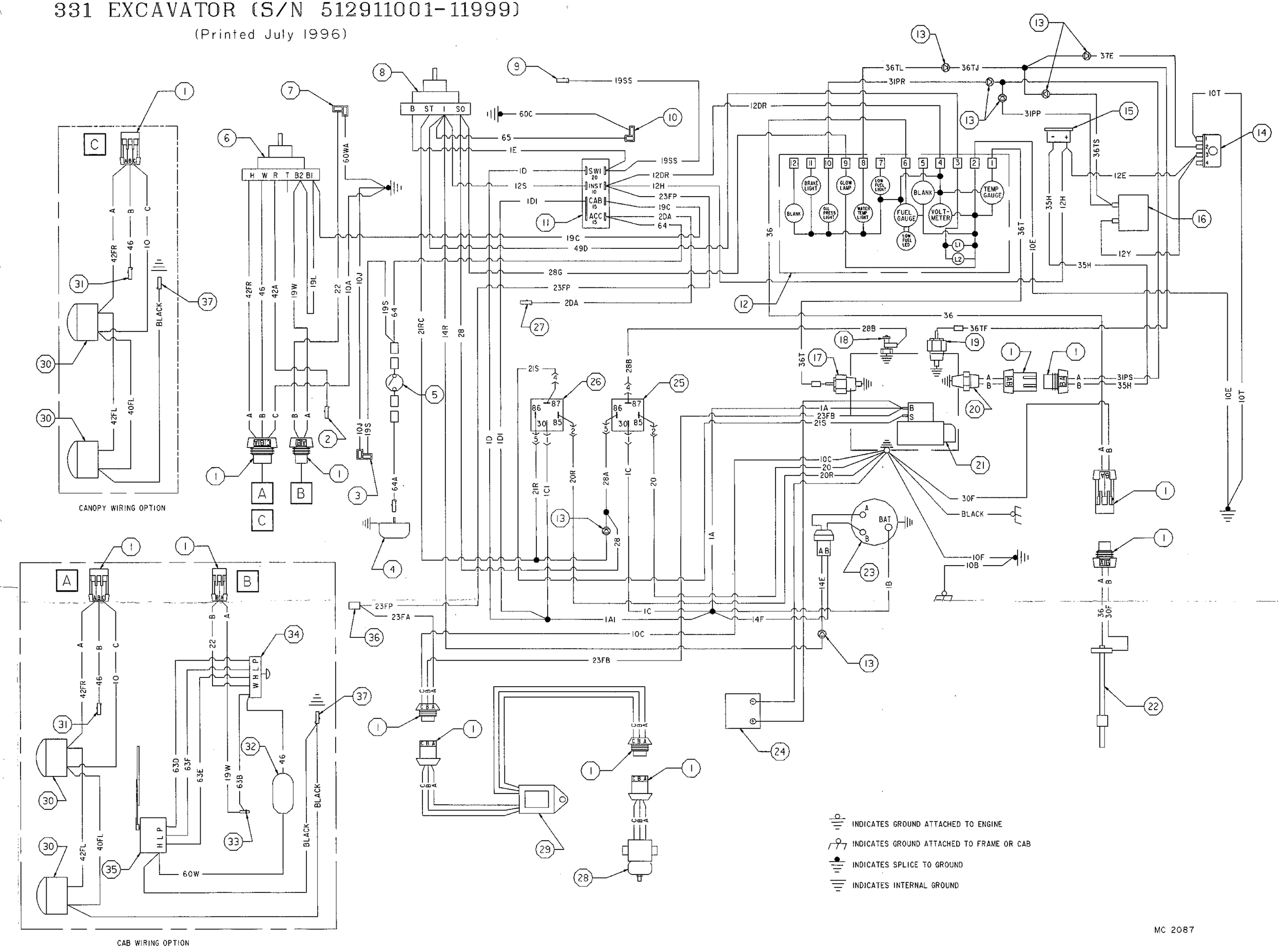
PARTS LEGEND

[1] Harness Connector
[2] Auxiliary Light Connector
[3] Accessory Socket Connector
[4] Horn
[5] Horn Switch
[6] Light Switch
[7] Windshield Washer Connector
[8] Ignition Switch
[9] Radio Memory Connector
[10] Radio Connector
[11] Fuse Block
[12] Instrument Panel
[13] Diode
[14] Timer
[15] Hourmeter
[16] Buzzer
[17] Coolant Temperature Sender
[18] Glow Plugs
[19] Temperature Switch
[20] Oil Pressure Switch
[21] Starter
[22] Fuel Sender
[23] Alternator
[24] Battery
[25] Pre–Heat Relay
[26] Starter Relay
[27] Cab Heater Relay
[28] Fuel Shut–off Solenoid
[29] Solenoid Timer
[30] Lights (Opt.)
[31] Warning Light Connector (Positive)
[32] Dome Light (Opt.)
[33] Cab Fuse
[34] Switch (Opt.)
[35] Wiper Motor (Opt.)
[36] Fuel Pump Connector
[37] Warning Light Ground Connector

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WIRING SCHEMATIC (P/N 6724223) Sheet 1 Of 2
331 EXCAVATOR (S/N 512911001-11999)

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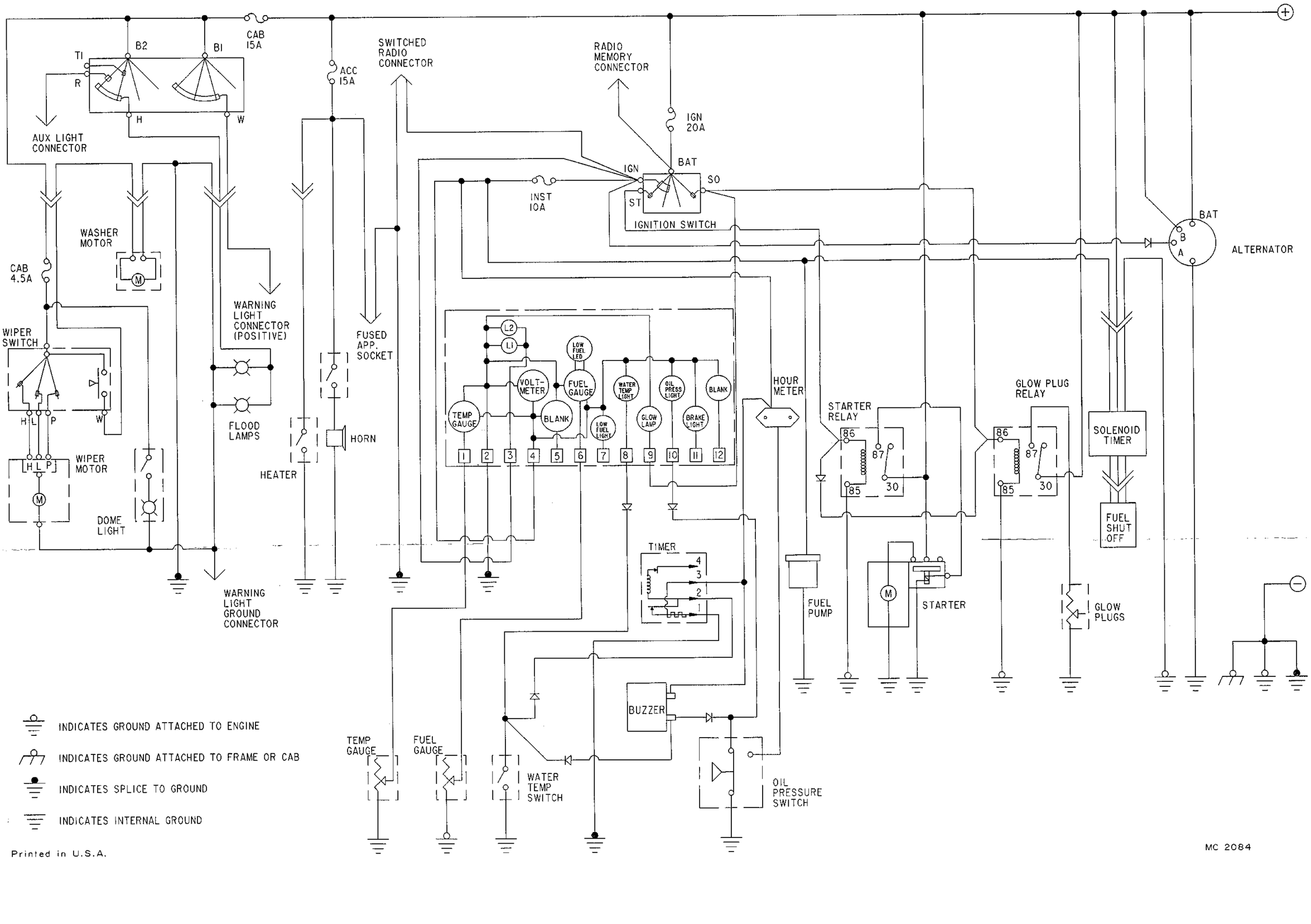


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WIRING SCHEMATIC (P/N 6724223) Sheet 2 Of 2
331 EXCAVATOR (S/N 512911001 - 11999)

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WIRE LEGEND

NO,s.	COLOR	GAUGE
1AS	Red	12
1A1	Red	12
1D	Red	10
1D1	Red	10
1E	Red	12
2DA	Red/White	14
10	Black	16
10A	Black	16
10B	Black	14
10E	Black	16
10J	Black	16
10T	Black	16
12DR	Orange	16
12E	Orange	16
12H	Orange	14
12S	Orange	12
12Y	Orange	16
14R	Green/White	16
19C	Red/White	12
19L	Red/White	16
19S	Red/White	16
19SS	Red/White	16
19W	Red/White	16
21RC	White	16
22	Purple	16
23FA	Red/Blue	16
28	Lt. Blue/Black	16
28G	Lt. Blue/Black	16
30F	Black	16
31PP	Yellow/Green	16
31PS	Yellow/Green	16
31PR	Yellow/Green	16
35H	Yellow/Brown	16
36	Purple	16
36T	Purple/White	16
36TF	Purple/White	16
36TL	Purple/White	16
36TS	Purple/White	16
37E	Purple/White	16
40FL	Black	16
42A	Dk. Blue	16
42FL	Dk. Blue	16
42FR	Dk. Blue	16
46	Brown	16
49D	Gray	16
60W	Black	16
63B	Orange/Black	16
63D	Yellow	16
63E	Red/Black	16
63F	Green	16
64	Orange/Blue	16
64A	Orange/Blue	16
65	Orange/White	16

PARTS LEGEND

[1] Harness Connector
[2] Auxiliary Light Connector
[3] Accessory Socket Connector
[4] Horn
[5] Horn Switch
[6] Light Switch
[7] Ignition Switch
[8] Fuse Block
[9] Cab Heater Connector
[10] Instrument-Panel
[11] Diode
[12] Hourmeter
[13] Timer
[14] Buzzer
[15] Console Connector
[16] Fuel Sender
[17] Lights (Opt.)
[18] Warning Light Connector (Positive)
[19] Wiper Motor (Opt.)
[20] Cab Fuse
[21] Dome Light (Opt.)
[22] Warning Light Ground Connector
[23] Switch (Opt.)

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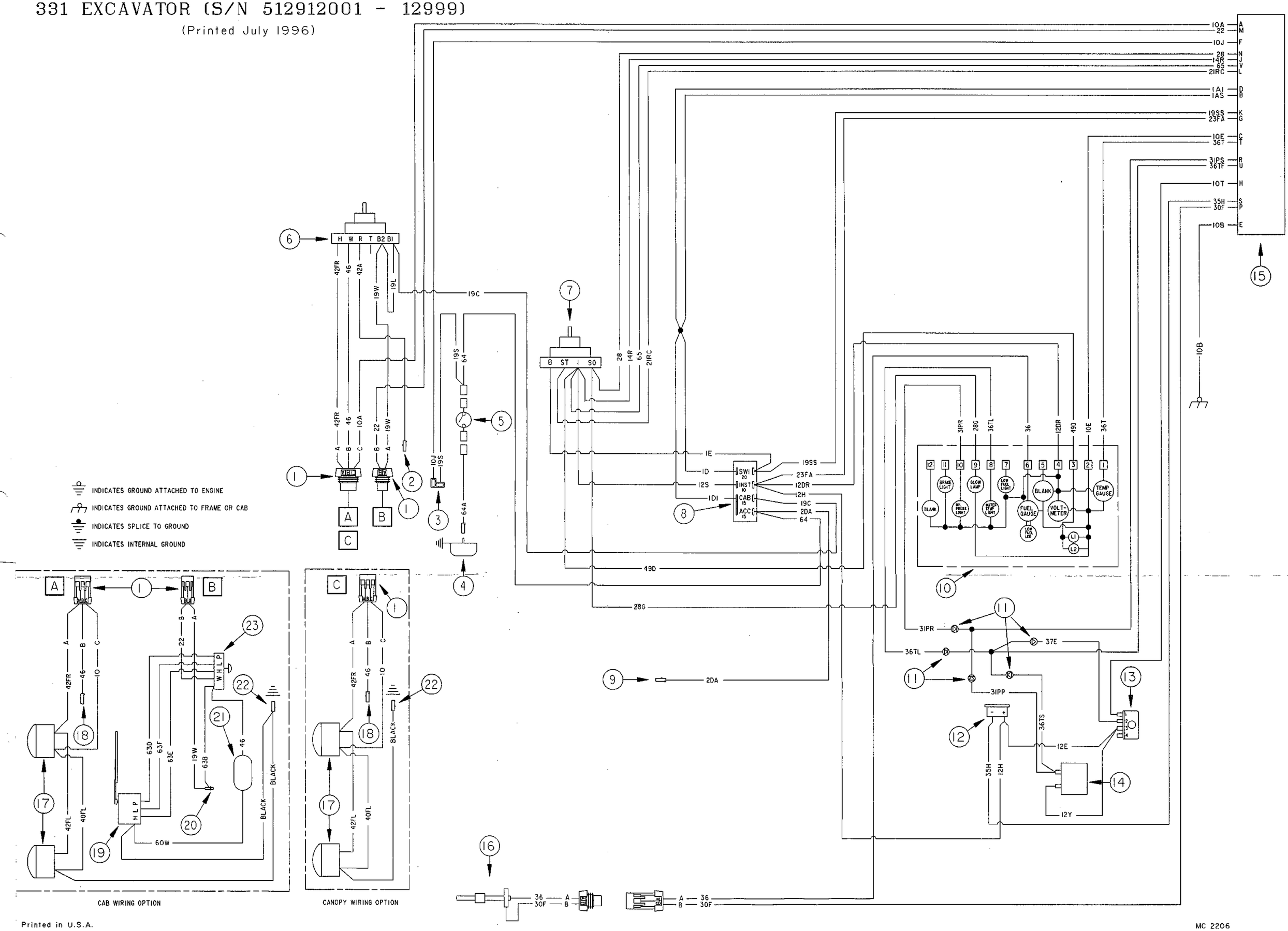
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WIRING SCHEMATIC (P/N 6724486) Sheet 1 Of 3

325 EXCAVATOR (S/N 514011001 - 12999)

331 EXCAVATOR (S/N 512912001 - 12999)

(Printed July 1996)



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WIRE LEGEND

NO,s.	COLOR	GAUGE
1A	Red	10
1AS	Red	12
1A1	Red	12
1B	Red	10
1C	Red	14
1C1	Red	14
10A	Black	16
10B	Black	14
10C	Black	14
10E	Black	16
10F	Black	12
10J	Black	16
10T	Black	16
14E	Green/White	16
14F	Lt. Green	16
14R	Green/White	16
19SS	Red/White	16
20	Black	16
20R	Black	16
21R	White	16
21RC	White	16
21S	White/Green	14
22	Purple	16
23FA	Red/Blue	16
23FB	White/Blue	14
28	Lt. Blue/Black	16
28A	Lt. Blue/Black	16
28B	Lt. Blue/Orange	14
30F	Black	16
31PS	Yellow/Green	16
35H	Yellow/Brown	16
36T	Purple/White	16
36TF	Purple/White	16
60C	Black	16
60WA	Black	16
65	Orange/White	16

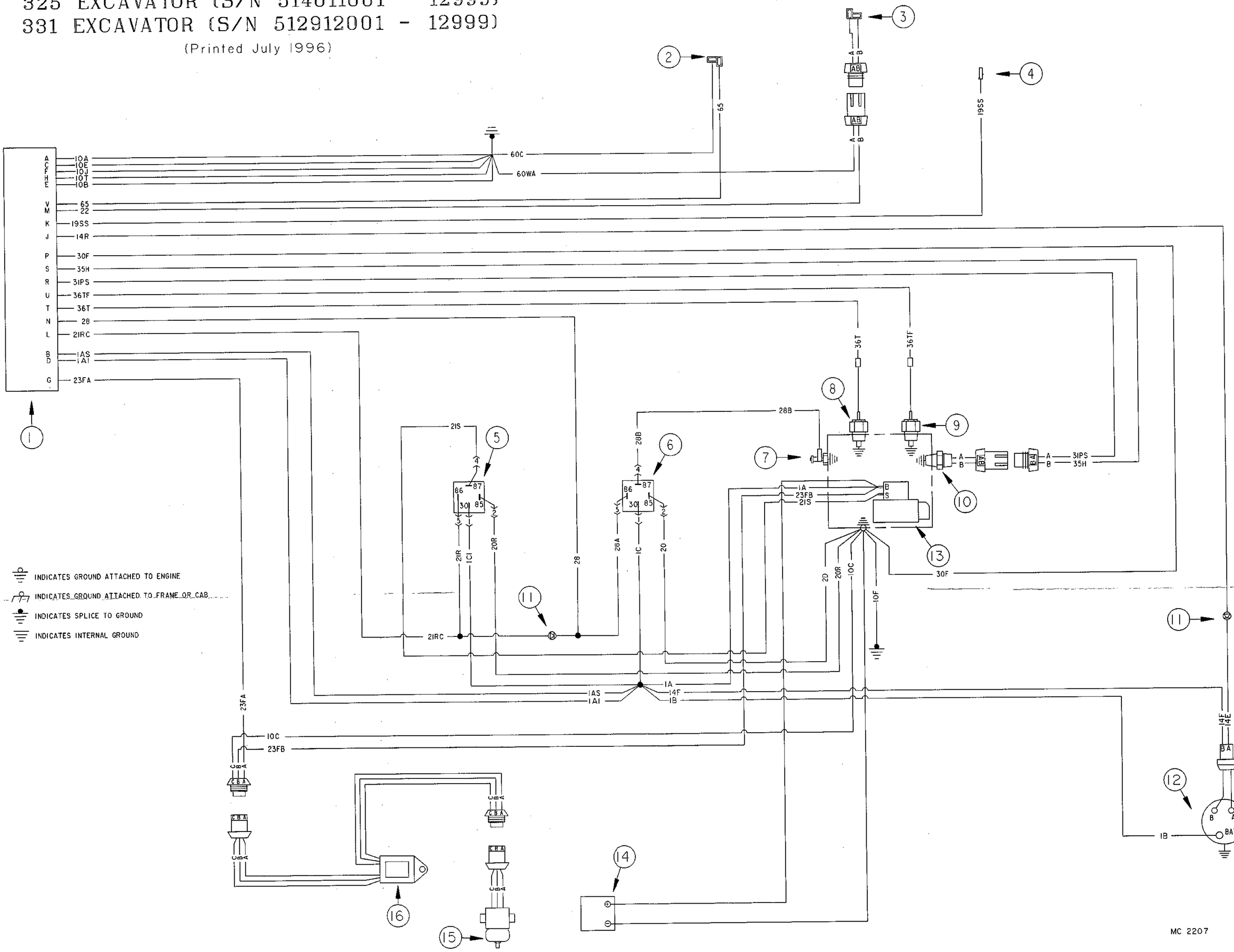
PARTS LEGEND

[1] Engine Connector
[2] Radio Connector
[3] Washer Connector
[4] Radio Memory Connector
[5] Starter Relay
[6] Pre–Heat Relay
[7] Glow Plugs
[8] Coolant Temperature Sender
[9] Temperature Switch
[10] Oil Pressure Switch
[11] Diode
[12] Alternator
[13] Starter
[14] Battery
[15] Fuel Shut–off Solenoid
[16] Solenoid Timer

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WIRING SCHEMATIC (P/N 6724486) Sheet 2 Of 3
325 EXCAVATOR (S/N 514011001 - 12999)
331 EXCAVATOR (S/N 512912001 - 12999)

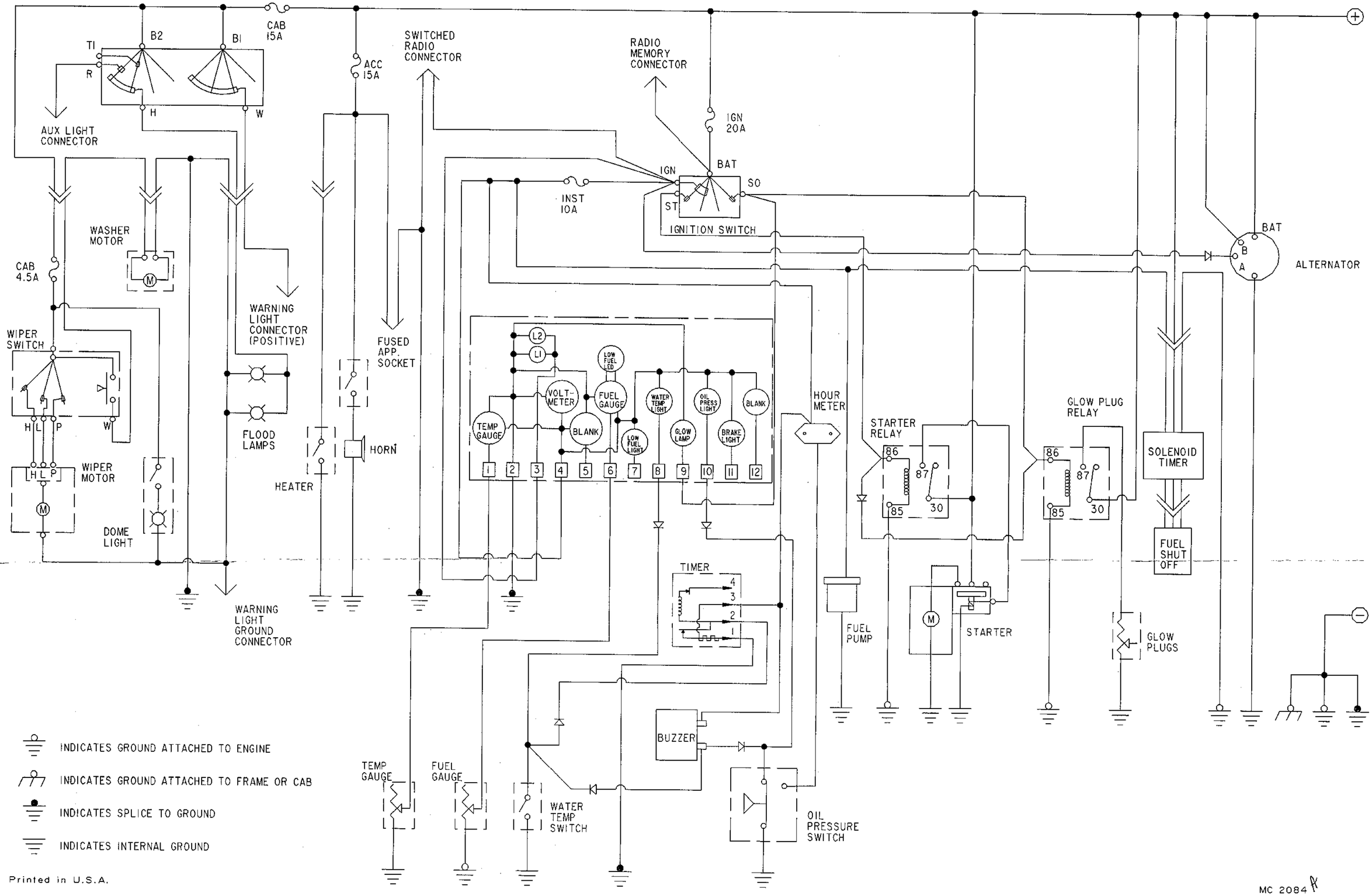
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WIRING SCHEMATIC (P/N 6724486) Sheet 3 Of 3
325 EXCAVATOR (S/N 514011001 - 12999)
331 EXCAVATOR (S/N 512912001 - 12999)

(Printed July 1996)



INDICATES GROUND ATTACHED TO ENGINE

INDICATES GROUND ATTACHED TO FRAME OR CAB

INDICATES SPLICE TO GROUND

INDICATES INTERNAL GROUND

Printed in U.S.A.

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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.

⚠ 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 manual 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, 5
Alternator will not charge.	1, 2, 5
Starter will not turn the engine.	2, 3, 4, 6, 7, 8, 9

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 ground connection is not making a good contact.
5. The alternator is damaged.
6. The engine is locked.
7. The starter is damaged.
8. The wiring or the solenoid is damaged.
9. Check the fuses.

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 (with integral regulator) and a battery.
2. The starting circuit has a starter motor, solenoid and starter switch for starting the engine.

Fuses protect the electrical system from an overload. The reason for the overload must be found before starting the engine.

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ELECTRICAL SYSTEM (Cont'd)

Fuses

The fuses protect the electrical system from damage. To replace the fuse(s), loosen the knobs (Item 1) **[A]** and remove the cover.

Replace the fuse(s) with the same type and capacity.

NOTE: Before replacing any fuse, find and fix the problem that caused the fuse to blow. Make sure the key switch is in the OFF position before replacing the fuse.

Fuse Arrangement [B]

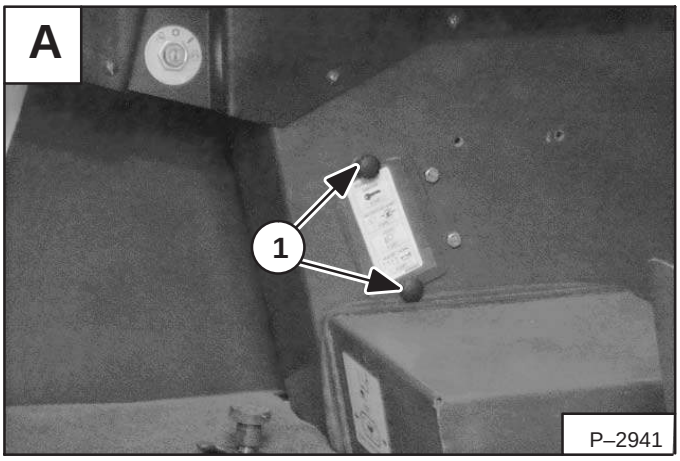
Ref.	Fuse Capacity

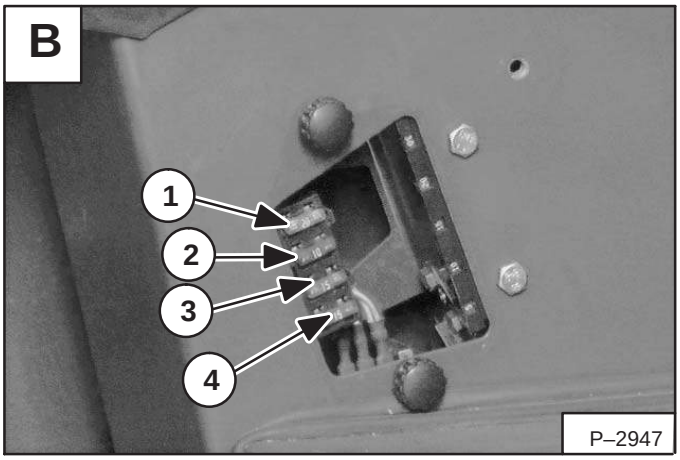
1. 20 Amp.: This fuse supplies power to the ignition switch.
2. 10 Amp.: This fuse supplies power to the dash panel, the hourmeter and the fuel pump.
3. 5 Amp.: This fuse supplies power to the light switch.
4. 15 Amp.: This fuse supplies power to the horn and the heater (if equipped).

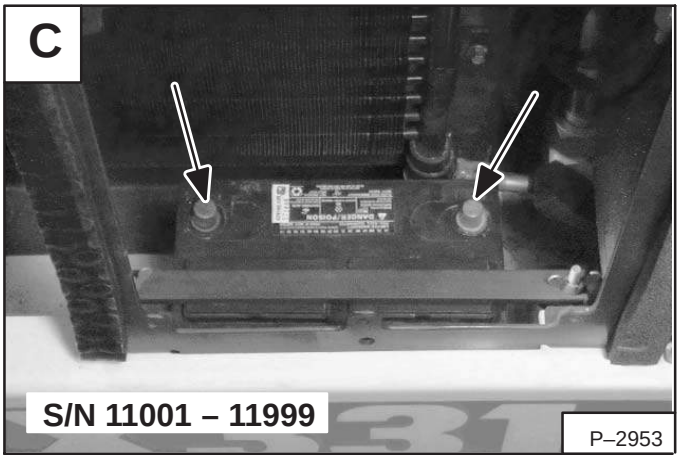
Electrical System Service

Use the following procedure to service the electrical system:

1. Check that the battery cable ends are clean and tight. Remove any acid or corrosion from the battery cable ends with baking soda and water solution. Cover the battery terminals with grease to prevent corrosion **[C]** & **[D]**.
2. Check the electrolyte level in the battery (if applicable, factory installed batteries are maintenance free). Add distilled water as needed. (See Battery Manual P/N 6566047 for additional information).
3. Check the alternator belt for wear and correct tension.
4. Check that all wire connections are tight.









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BATTERY

Check the Battery

⚠ WARNING

Batteries contain acid which burns eyes and skin on contact. Wear goggles and protective clothing 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.

W–2065–1286

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 (S/N 11001–11999)

Open the engine cover **[A]**.

Remove the two bolts (Item 1) **[B]** from inside the right hand side of the engine cover.

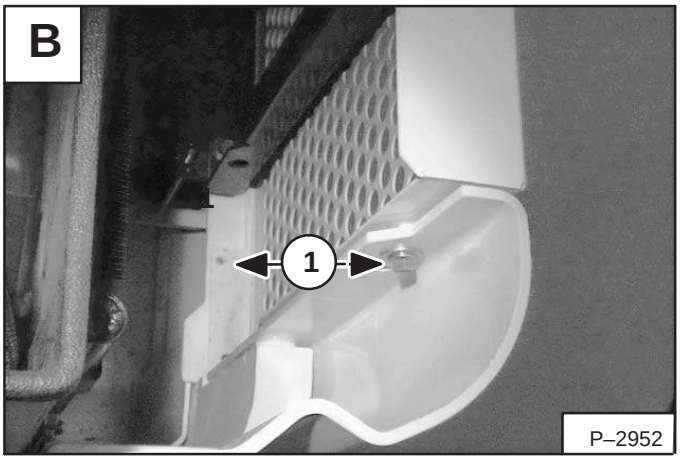
Remove the two bolts from the right side cover **[C]**.

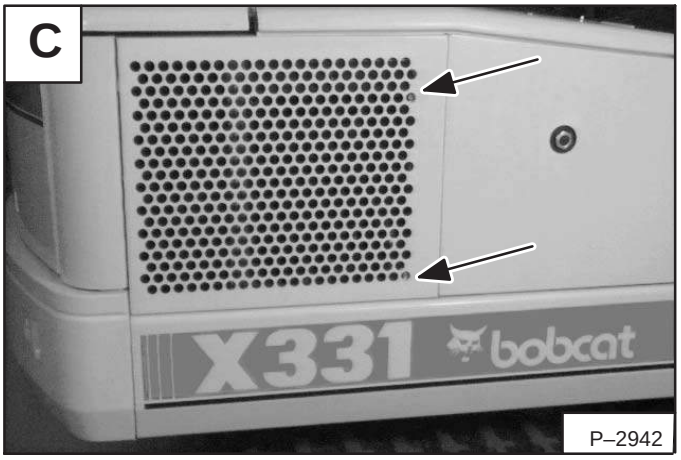
Remove the right side cover.

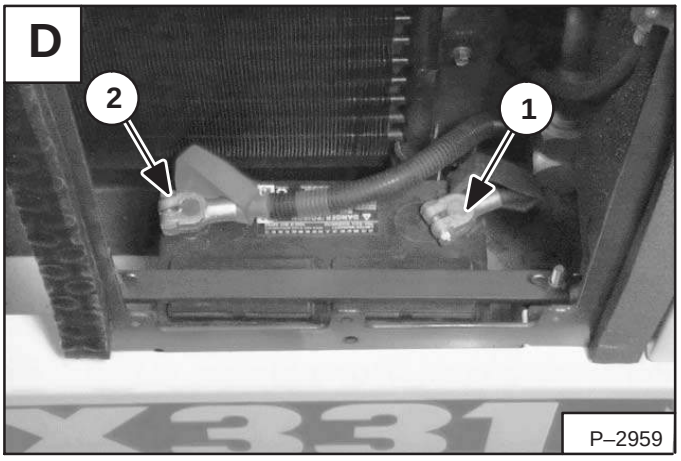
Disconnect the negative (–) cable (Item 1) **[D]** first.

Disconnect the positive (+) cable (Item 2) **[D]**.







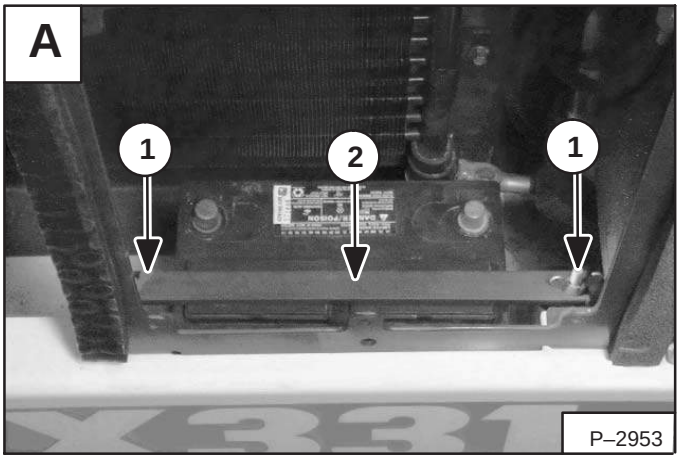


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BATTERY (Cont'd)

Removal and Installation (S/N 11001–11999) (Cont'd)

Remove the wing nuts (Item 1) **[A]** and the battery hold down clamp (Item 2) **[A]**.

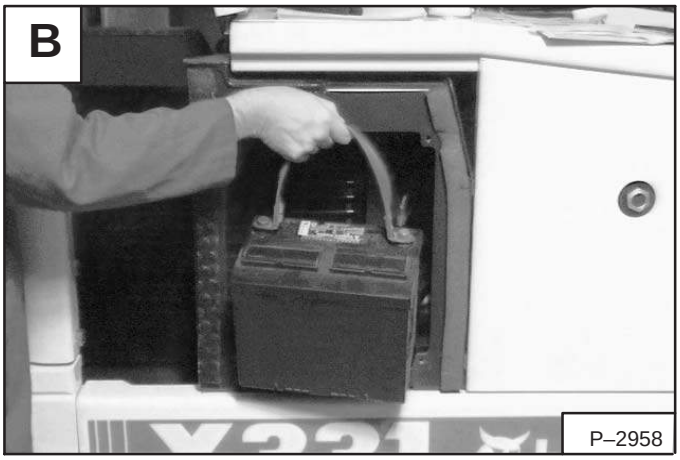


Use a battery removal strap to remove the battery from the excavator **[B]**.

Always clean the terminals and the cable ends, even when installing a new battery.

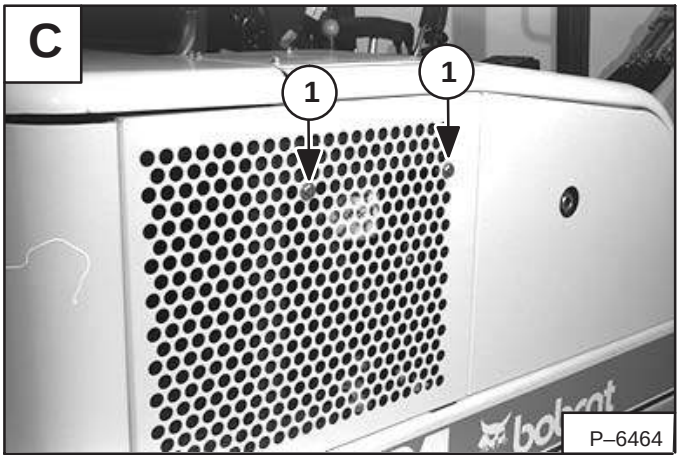
Reverse the procedure for battery installation.

NOTE: If the battery cables are removed for any reason, disconnect the negative (–) cable first and when installing the battery cables, make the last connection the negative (–) cable to the battery.

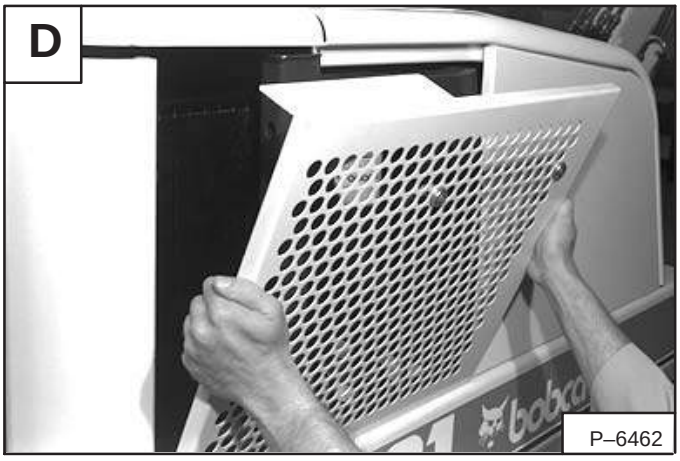


Removal & Installation (S/N 12001 & Above)

Using the ignition key, unlock the two (2) sides cover locks (Item 1) **[C]**.



Tilt the top of the side cover out and lift up on the side cover to remove **[D]**.



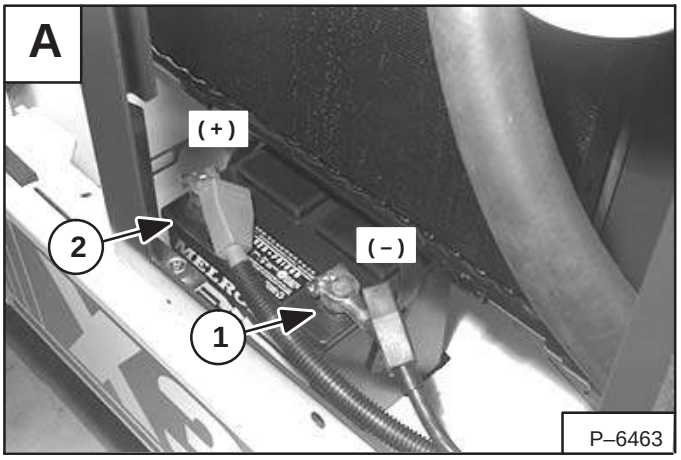
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BATTERY (Cont'd)

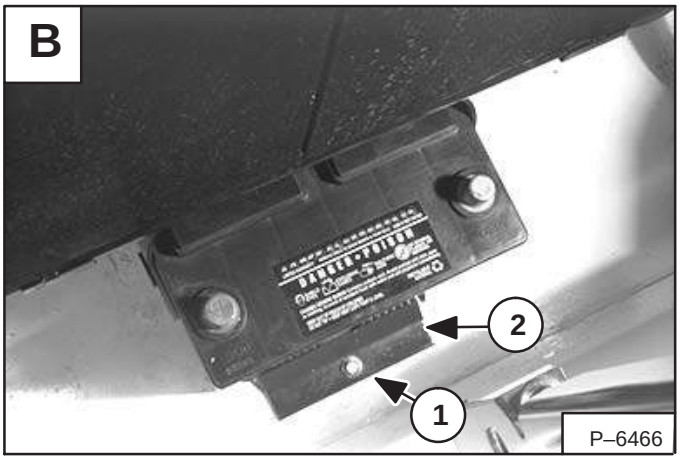
Removal and Installation (S/N 12001 & Above) (Cont'd)

Disconnect the negative (–) cable (Item 1) **[A]** first.

Disconnect the positive (+) cable (Item 2) **[A]**.



Remove the bolt (Item 1) **[B]** and remove the hold down clamp (Item 2) **[B]**.



Remove the battery from the compartment **[C]**. Always clean the terminals and the cable ends, even when installing a new battery.

Install the battery. Install the hold down clamp and tighten the bolt.

Connect the battery cables. Connect the negative (–) cable (Item 1) **[A]** last to prevent sparks at the terminal.



⚠ WARNING

Batteries contain acid which burns eyes and skin on contact. Wear goggles and protective clothing 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.

W–2065–1286

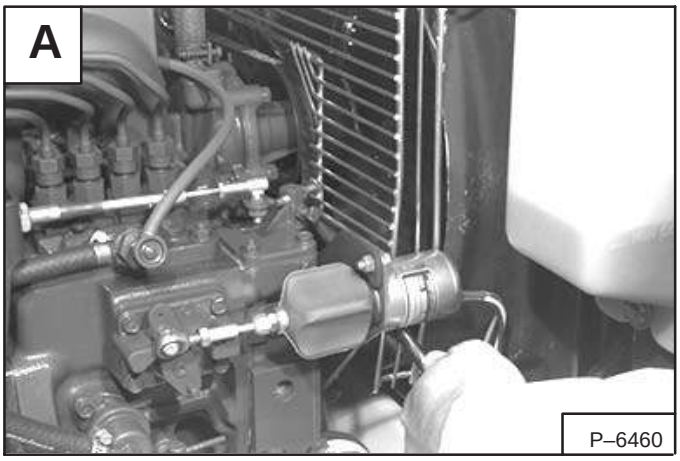
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ALTERNATOR

Belt Adjustment

Stop the engine. Open the engine cover.

The belt should deflect about 1/2'' (13 mm) when pressed between the water pump pulley and crankshaft pulley with approximately 13 lbs. (58 N) force **[A]**.

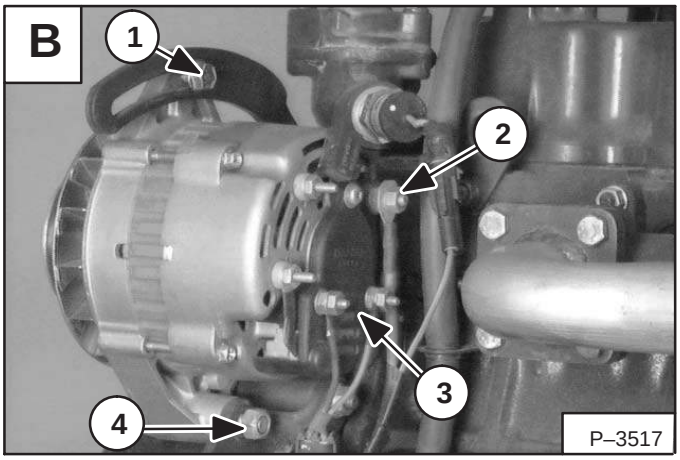


If the tension is not correct, loosen the alternator mounting bolt (Item 4) **[B]**.

Loosen the adjustment bolt (Item 1) **[B]**.

Move the alternator until the belt tension is correct. 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

NOTE: Some of the photos used in this procedure show the engine cover removed. This was done for clarity and easy identification of the parts.

Open the engine cover.

Disconnect the negative (–) battery cable. (See Page 6–5.)

Remove the air cleaner for access to the alternator bolts and wiring from the engine side (S/N 11001–11999 only). (See Page 7–1.)

Remove the seat and seat mount Page 4–1 and the access plate Page 4–1 for access to the alternator bolts and wiring from the operator area.

Remove the wire (Item 2) **[B]** going to the battery terminal of the alternator.

Disconnect the harness connector (Item 3) **[B]** from the alternator.

Remove the adjusting bolt (Item 1) **[B]**.

Remove the mounting bolt (Item 4) **[B]**.

Remove the alternator.

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ALTERNATOR (Cont'd)

Parts Identification

Disassemble the alternator (See Parts Identification) **[A]**.

Disassembly and Inspection

Remove the regulator cover and regulator.

Remove the four bolts holding halves together.

Pry the halves apart (use a press if needed).

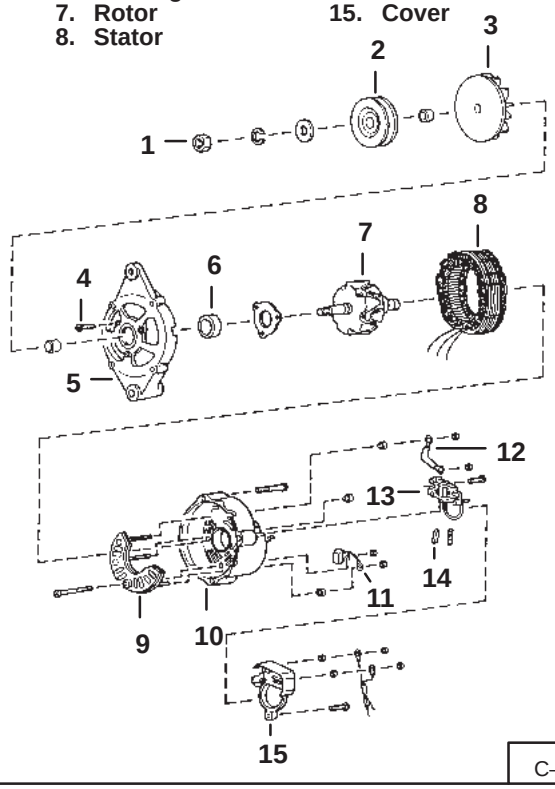
Use a soft jaw vise to hold rotor while removing pulley nut.

Remove front case half from the rotor while removing pulley nut.

Unsolder the stator leads from the rectifier. Remove the stator.

A

1. Nut
2. Pulley
3. Fan
4. Bolt
5. Case Half (Front)
6. Bearing
7. Rotor
8. Stator
9. Rectifier (Diode)
10. Case Half (Rear)
11. Condenser Assy.
12. Bolt
13. Regulator
14. Brush
15. Cover



C–3312

Stator Continuity Test

Use an ohmmeter to test the stator.

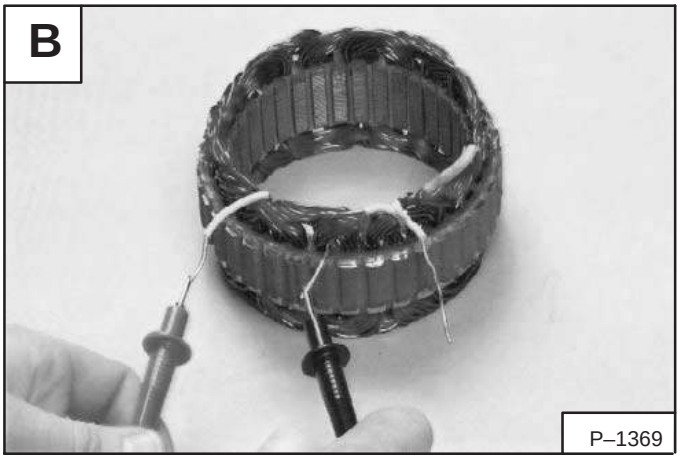
Touch the probes to two of the bare stator wires **[B]**.

Move one of the probes to the third wire.

The readings should be the same.

If there is no continuity, replace the stator.

B



P–1369

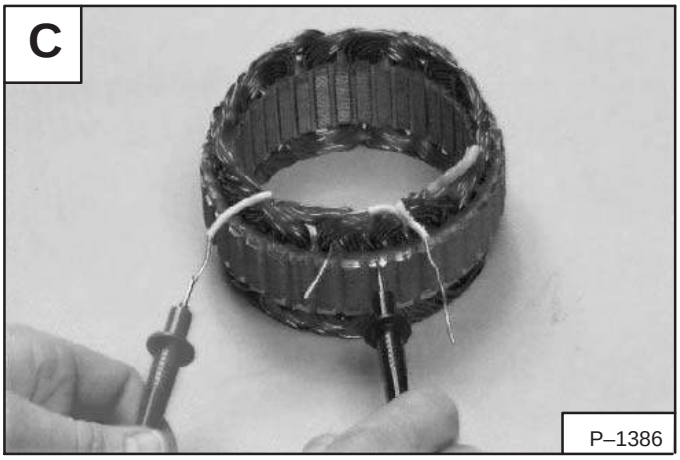
Stator Ground Test

Touch one probe to a bare stator lead and the other probe to the bare metal surface of the stator **[C]**.

There should be no continuity.

Replace the stator if there is continuity.

C



P–1386

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ALTERNATOR (Cont'd)

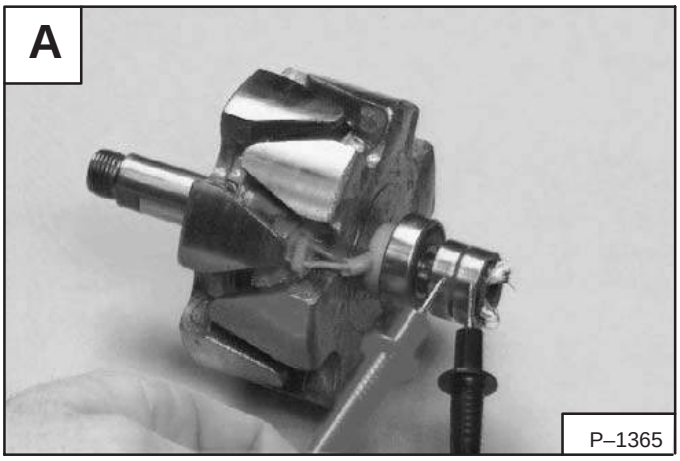
Disassembly and Inspection (Cont'd)

Rotor Continuity Test

Touch the probes to the slip rings **[A]**.

The ohmmeter should read between 3.065 – 33.85 ohms.

If there is no continuity replace the rotor.

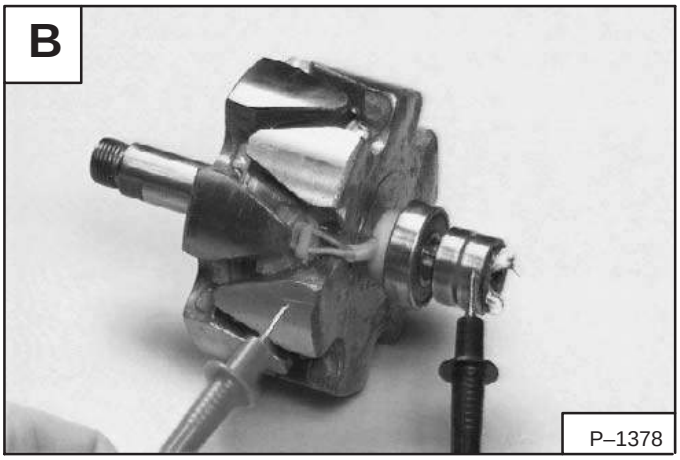


Rotor Ground Test

Touch one probe to one of the slip rings and the other probe to the rotor shaft **[B]**.

There should be no continuity.

Replace the rotor if there is continuity.



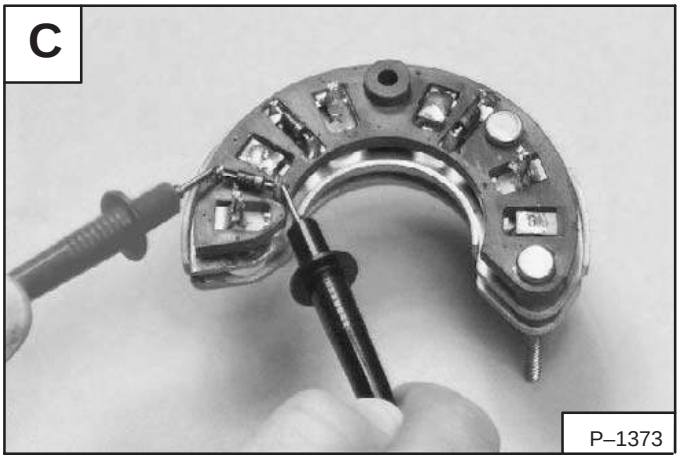
Rectifier Continuity (Diode) Test

NOTE: In the diode tests there should be continuity in one direction only. If the diode being tested shows no continuity or continuity in both directions, replace the rectifier assembly.

Touch the probes to the terminal of each diode and read the meter **[C]**.

Reverse the probes to check the diode in the other direction.

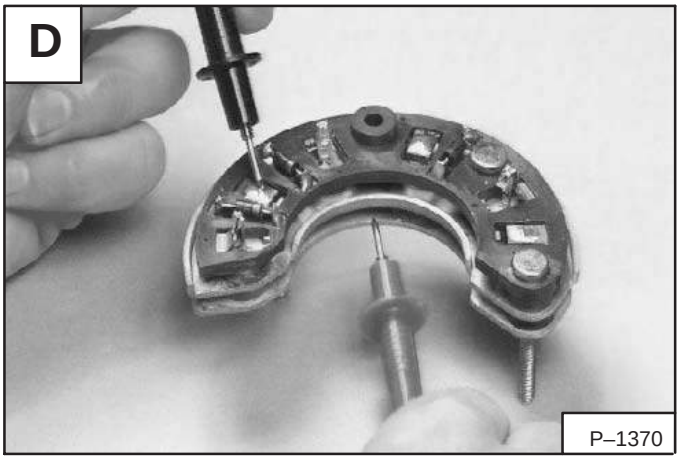
There should be continuity in one direction only.



Touch one probe to the diode and the other probe to the connected heatsink and read the meter **[D]**.

Reverse the probes to check the diode in the other direction.

There should be continuity in one direction only.



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ALTERNATOR (Cont'd)

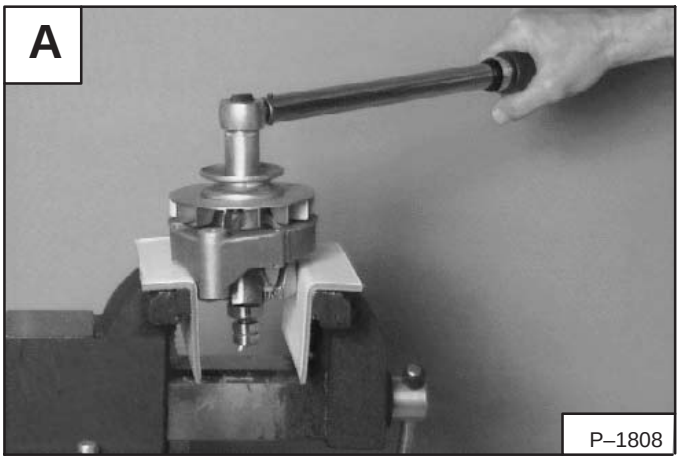
Assembly

Reverse the order of disassembly.

Do not assemble the rear case half.

Place the rotor in soft jaws when tightening the shaft nut. Tighten to 50 ft.–lbs. (68 Nm) torque **[A]**.

Install the rear case half and the remaining parts.



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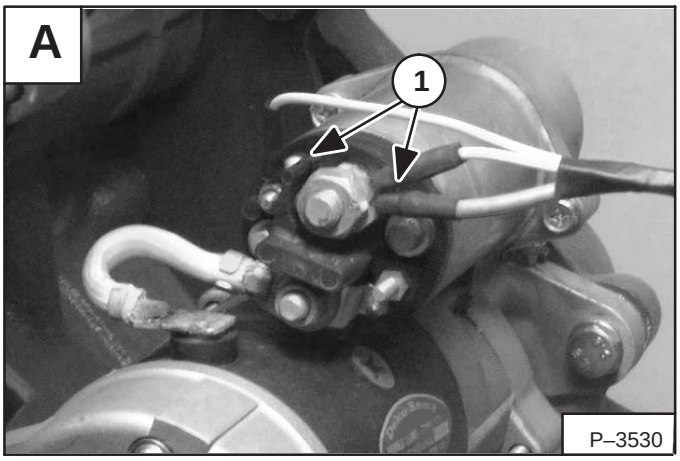
STARTER

Removal and Installation

Remove the operator seat and seat mount to get access to the starter. (See Page 4–1.)

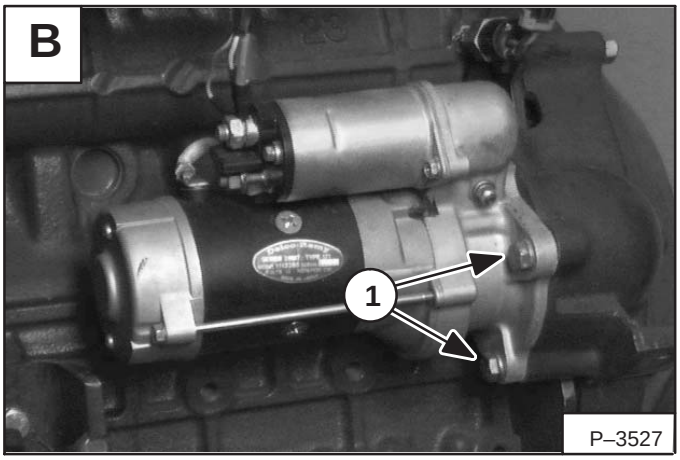
Disconnect the negative (–) cable from the battery. (See Page 6–5.)

Disconnect the wires (Item 1) **[A]** from the starter.



Remove the three mounting bolts (Item 1) **[B]** from the starter.

Remove the starter from the bell housing.



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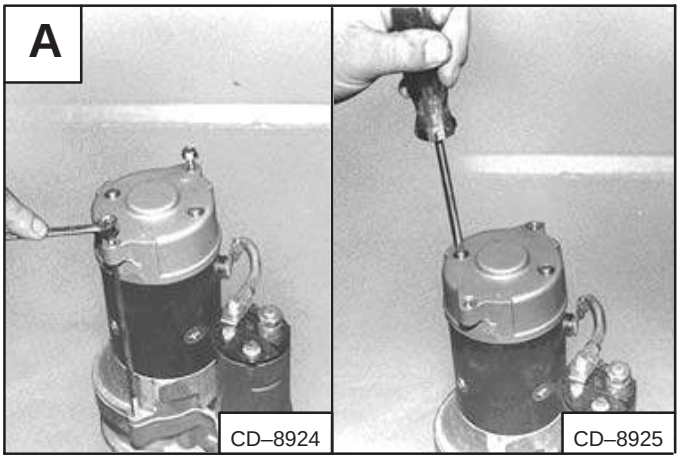
STARTER (Cont'd)

Disassembly and Assembly

Refer to the Parts Identification. (See Page 6–15.)

Remove the starter thru bolts **[A]**.

Remove the end cap screws **[A]**.



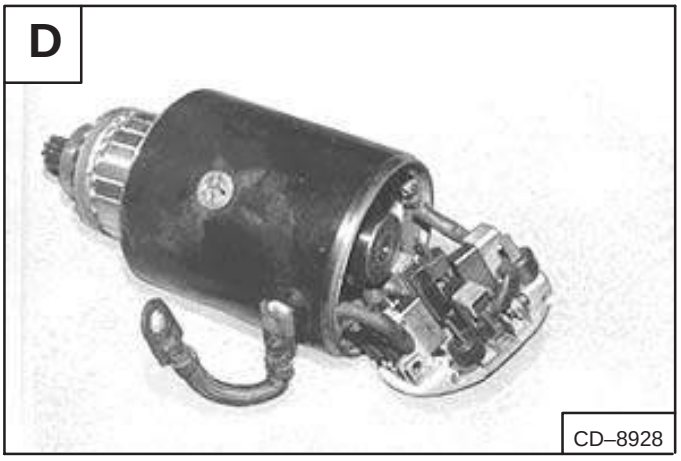
Remove the starter end cap **[B]**.



Remove the starter housing/armature assembly from the reduction gear drive **[C]**.



Remove the armature and brushes from the starter housing **[D]**.

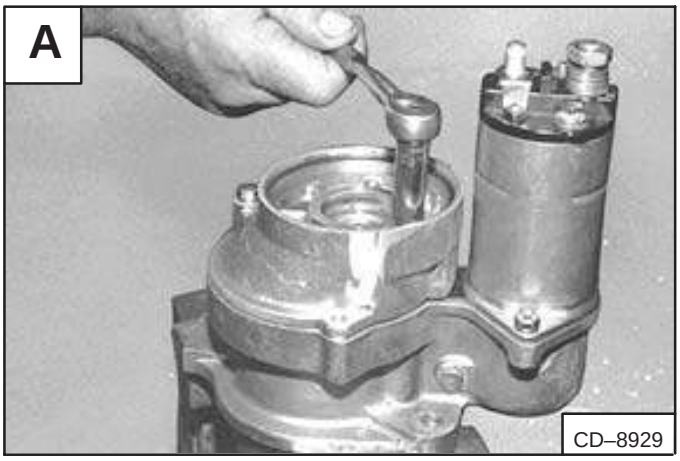


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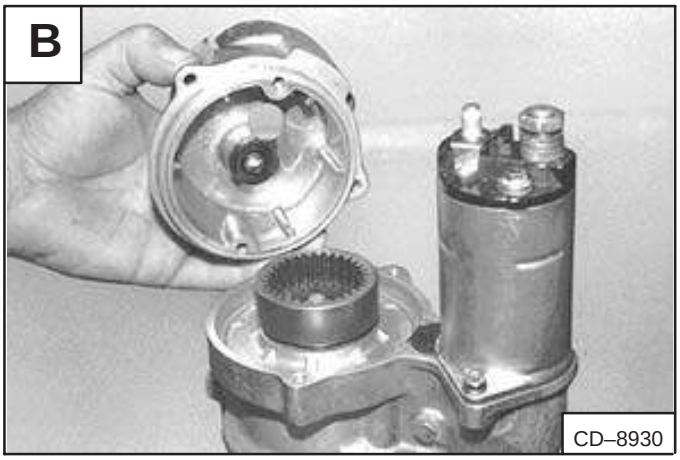
STARTER (Cont'd)

Disassembly and Assembly (Cont'd)

Remove the bolts from the reduction gear housing **[A]**.



Remove the reduction gear housing **[B]**.



Cleaning and Inspection

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.

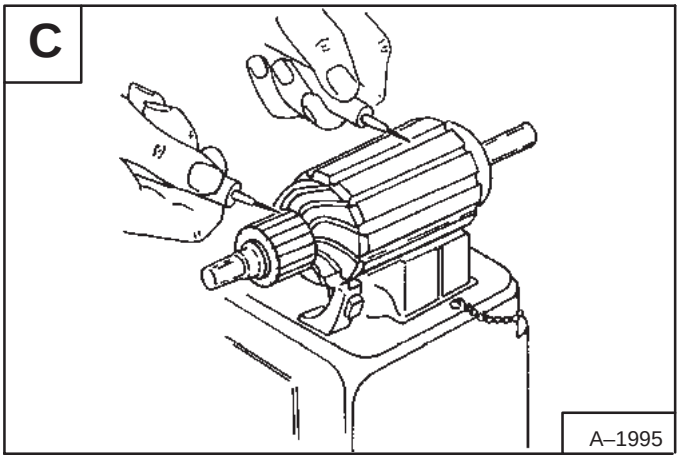
Check the following items:

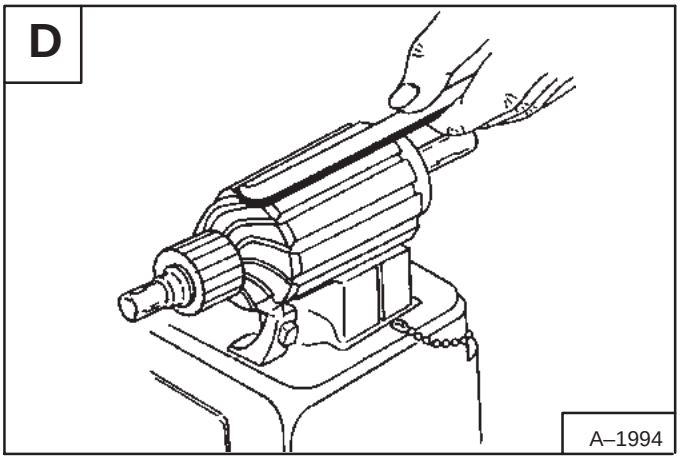
Armature
- Broken or burned insulation.
- Loose connections at commutator.
- Open or grounded circuits **[C]** & **[D]**.
- Worn shaft or bearings.
- Rough commutator.

Brush Holders
- Broken springs.
- Broken insulation.
- Spring tension.

Field Coils
- Broken or burned insulation.
- Electrical continuity.
- Brush connections.

Drive Gear
- Worn teeth.
- Tooth engagement.



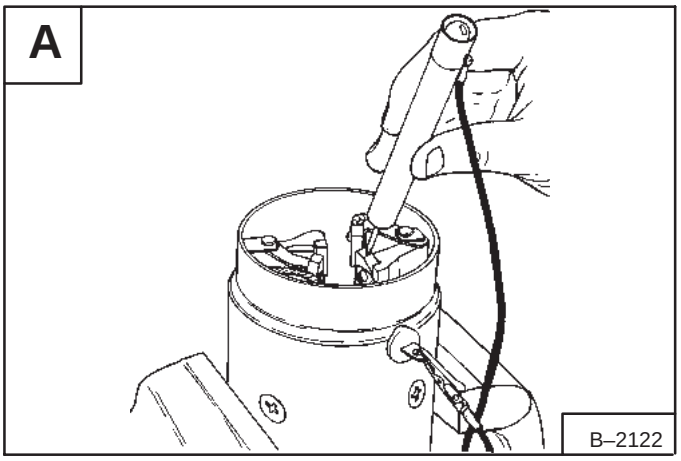


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STARTER (Cont'd)

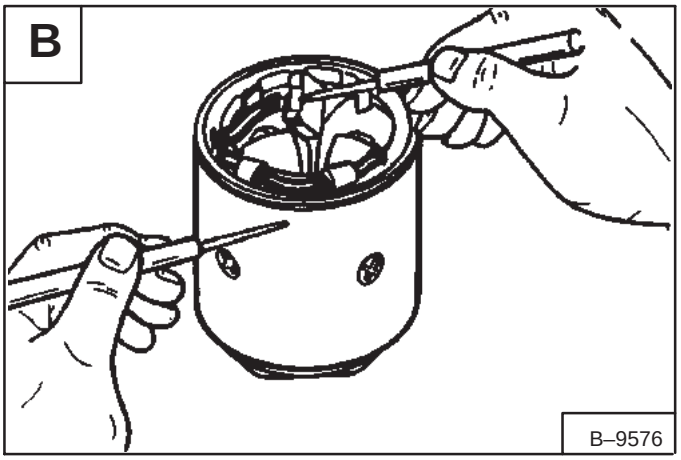
Cleaning and Inspection (Cont'd)

Field Coils:
Broken or burned insulation
Electrical continuity **[A]**.
Brush connections



Drive Gear:
Worn teeth
Tooth engagement (drive gear must engage ring gear by 1/2 the depth of the ring gear tooth)

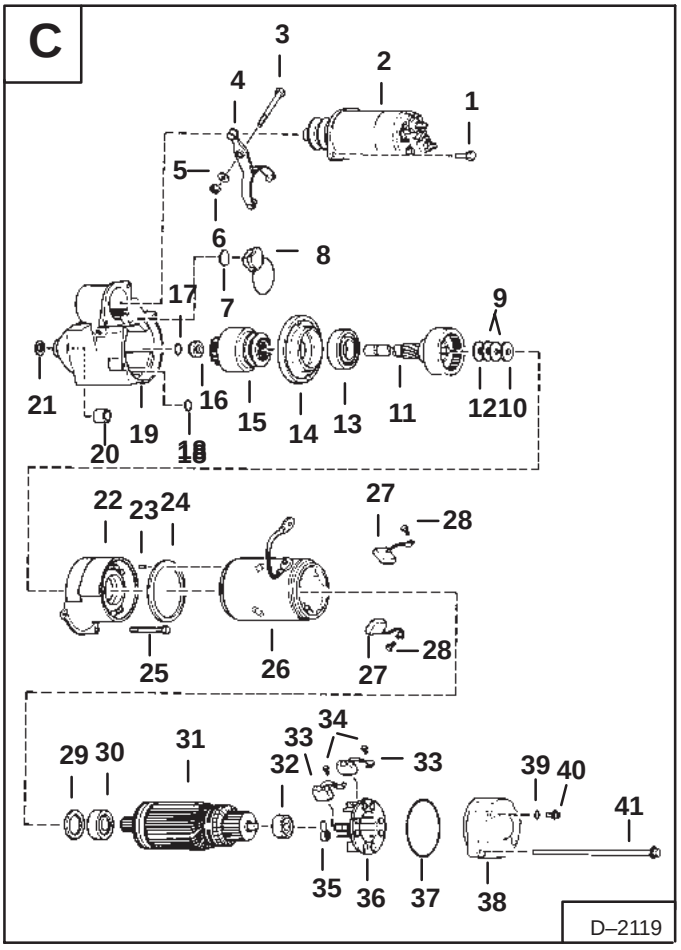
To test for ground, use a test light and touch one probe to the body and the other probe to the field winding end of the brush. The lamp should not light **[B]**.



Part Identification

Disassemble and assemble the starter as shown in Fig. **[C]**.

Ref.	Description	Ref.	Description
1.	SCREW	21.	WASHER
2.	SOLENOID	22.	SUPPORT
3.	BOLT	23.	PIN
4.	LEVER	24.	GASKET
5.	WASHER	25.	BOLT
6.	NUT	26.	FRAME
7.	WASHER	27.	BRUSH
8.	PLUG	28.	SCREW
9.	WASHER	29.	SPACER
10.	WASHER	30.	BEARING
11.	DRIVE SHAFT	31.	ARMATURE
12.	WASHER	32.	BEARING
13.	SUPPORT	33.	BRUSH
14.	SUPPORT	34.	SCREW
15.	DRIVE	35.	SPRING
16.	STOP	36.	BRUSH HOLDER
17.	RING	37.	O–RING
18.	RING	38.	FRAME
19.	HOUSING DRIVE	39.	WASHER
20.	BUSHING	40.	SCREW
		41.	BOLT



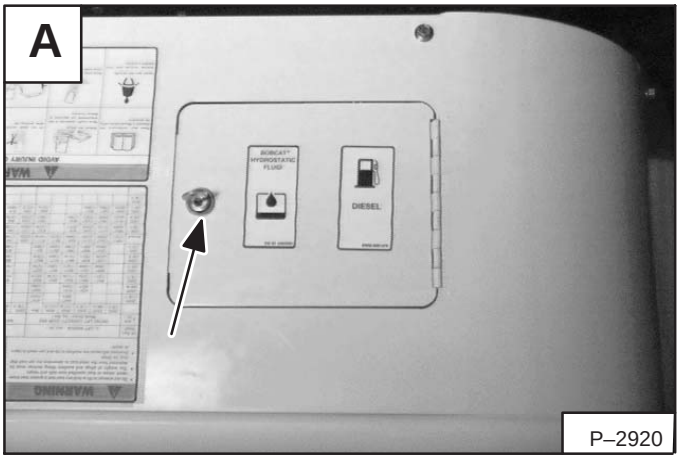
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FUEL LEVEL SENDER

Removal and Installation

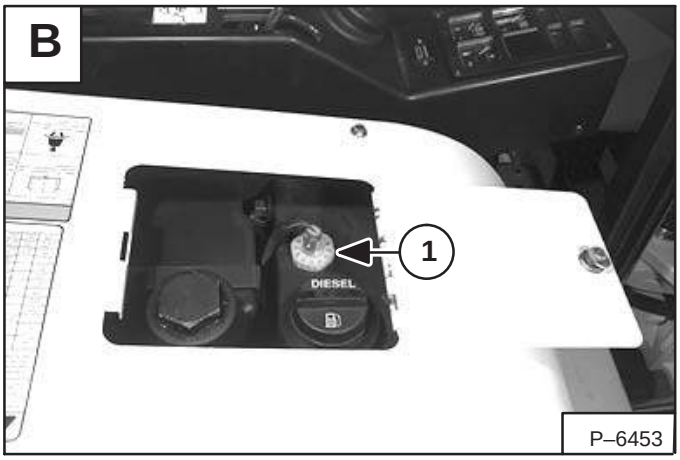
Remove the negative battery cable. (See Page 6–5.)

Open the locking fuel cover **[A]**.



Disconnect the harness connector (Item 1) **[B]** form the fuel sender.

Remove the fuel sender **[A]**. The sender threads into the tank, use a wrench to remove the sender.



Checking

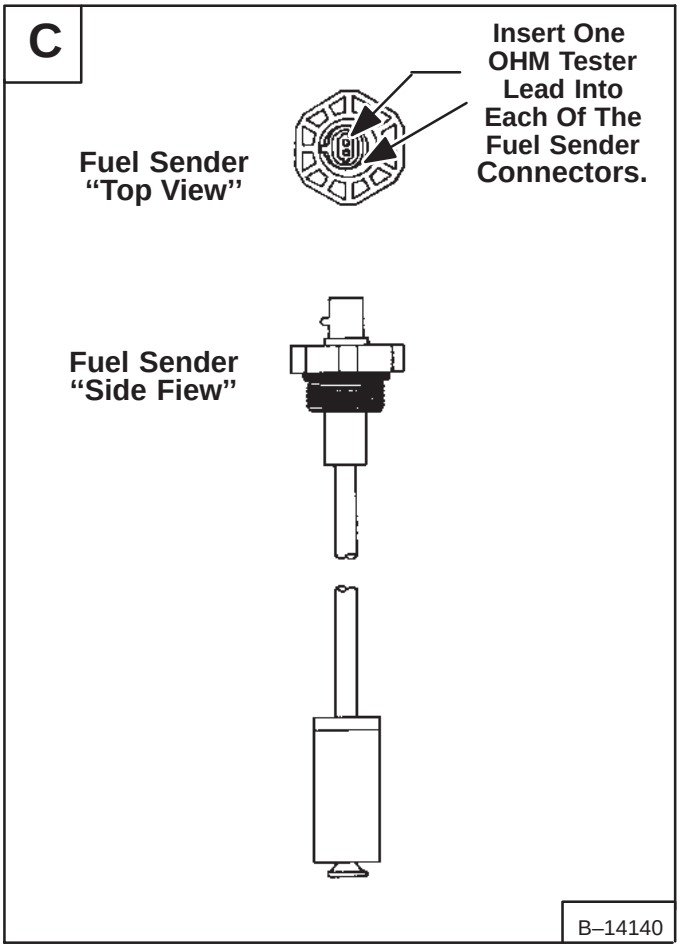
Use an ohmmeter to check the resistance of the fuel sender.

Insert one of the ohm tester leads into each of the fuel senders electrical connectors in the end of the fuel sender **[C]**.

With the fuel sender in the position shown **[C]**, read the ohms in the empty position. Slide the float upwards and the ohm reading will decrease. See resistance chart below.

The resistance should read as follows:

FULL: 15–35 Ohms.
HALF: 82–97 Ohms.
EMPTY: 230–250 Ohms.



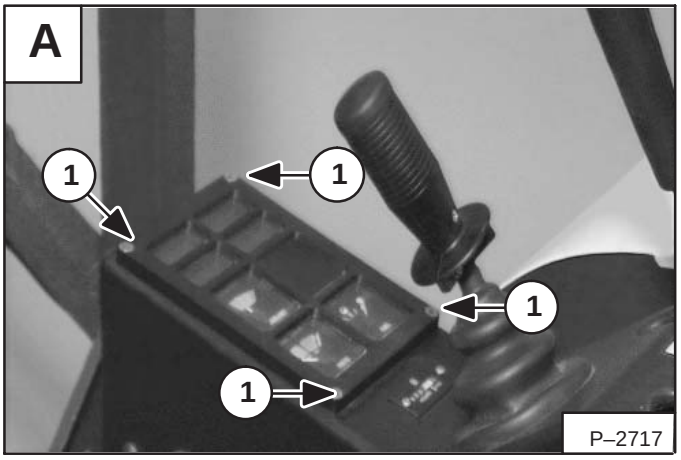
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INSTRUMENT PANEL

Removal and Installation

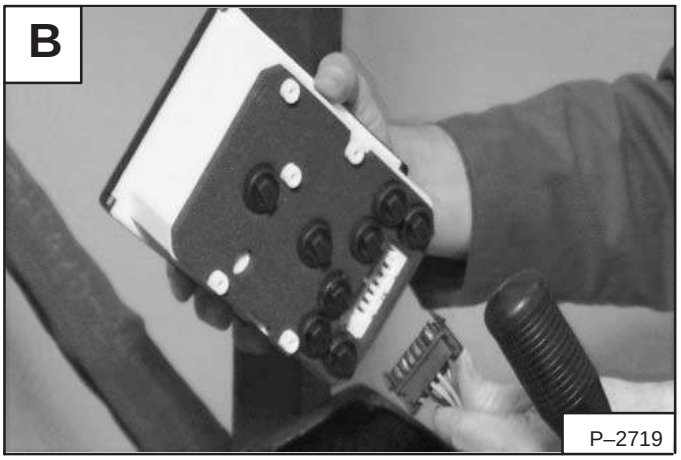
Remove the four (4) mounting screws (Item 1) **[A]** from the instrument panel.

Lift the instrument panel.



Unplug the wire harness from the instrument panel socket **[B]**.

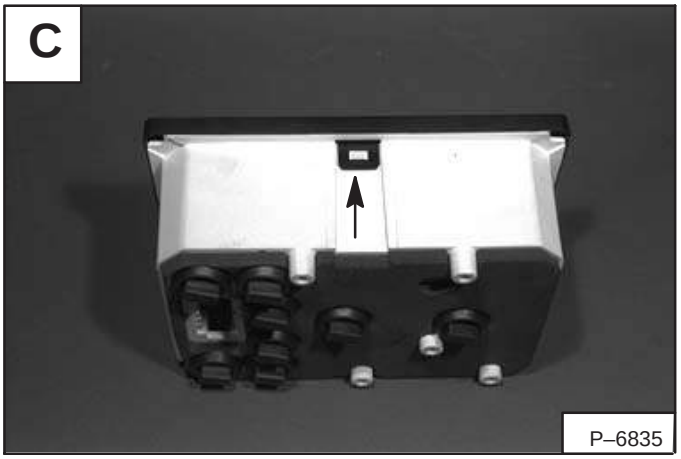
Refer to the Operation & Maintenance Manual for the Instrument Panel Operation.



GAUGES

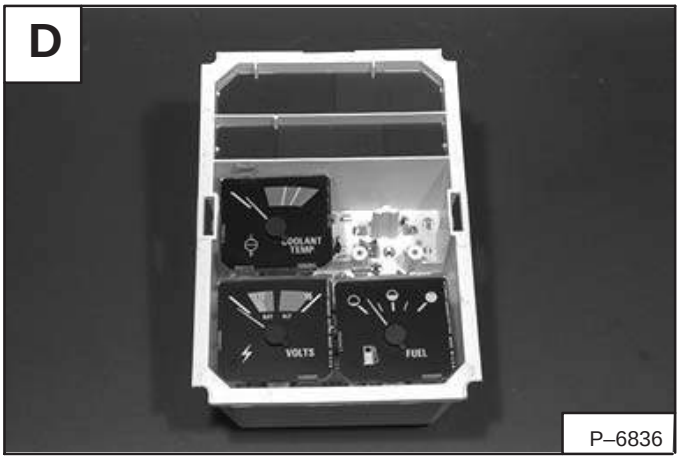
Removal and Installation

Remove the instrument panel cover by lifting out and up on the two (2) side tabs **[C]**.



Remove the gauge by pulling straight up on the gauge tab **[D]**.

Installation: Push the gauge in the instrument panel until fully seated.

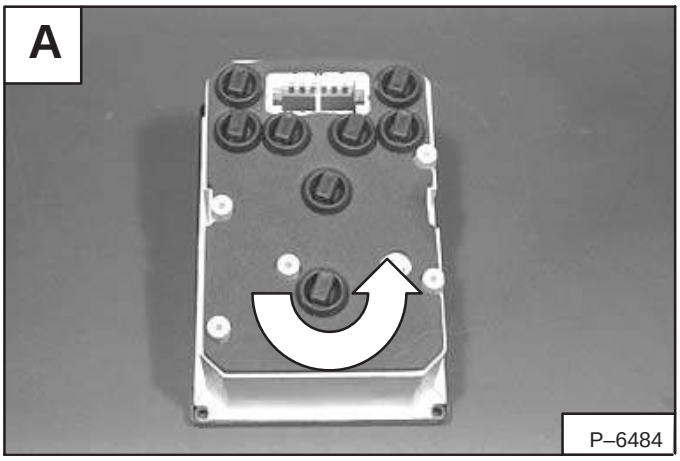


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GAUGE LIGHTS

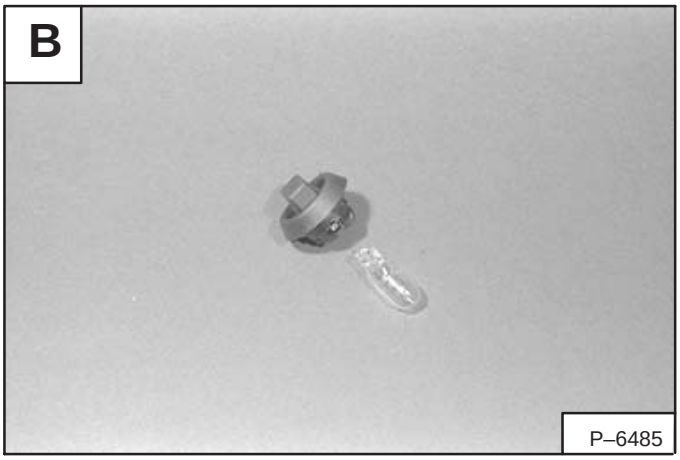
Removal and Installation

Turn the bulb socket counter clockwise and pull out **[A]**.



Remove the bulb from the socket and replace with a serviceable bulb **[B]**.

Install the bulb socket into the back of the instrument panel and turn clockwise to lock into place.

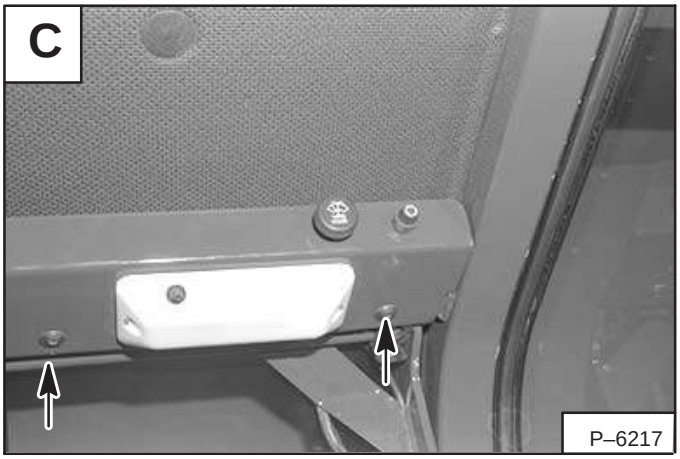


CAB ELECTRICAL

Cab Option

Remove the negative (–) cable from the battery. (See Page 6–5.)

Remove the four (4) screws from the cab overhead console **[C]**.

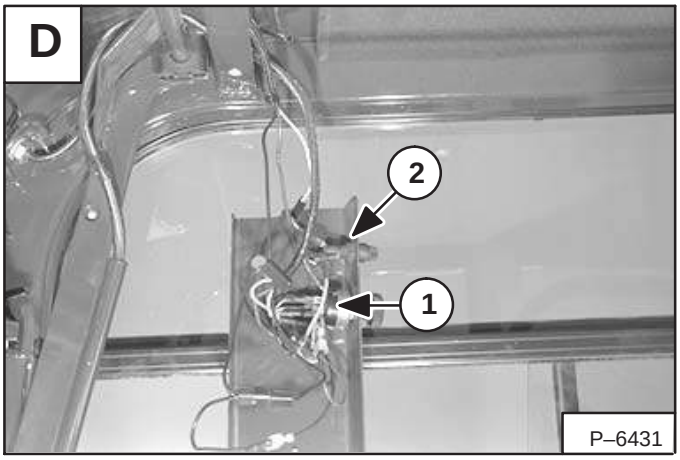


Lower the console down.

Mark the wires for ease of installation.

Remove the wires from the wiper/washer switch (Item 1) **[D]** and remove the switch.

Remove the wires from the fuse holder (Item 2) **[D]** and remove the fuse holder.



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ENGINE SERVICE

Page Number

AIR CLEANER
- Removal and Installation (S/N 11001–11999) 7–18
- Removal and Installation (S/N 12001–12999) 7–18
- Removal and Installation (S/N 13001–Above) 7–20

CRANKSHAFT AND BEARINGS
- Removal and Installation 7–45
- Servicing the Crankshaft and Bearings 7–46

CRANKSHAFT GEAR
- Removal and Installation 7–39

CYLINDER BORE
- Checking the Cylinder Bore 7–50

CYLINDER HEAD
- Disassembly and Assembly 7–26
- Removal and Installation 7–25
- Servicing the Cylinder Head 7–27
- Top Clearance 7–27

ENGINE
- Removal and Installation 7–21

ENGINE COMPRESSION
- Checking 7–4

ENGINE FLYWHEEL
- Flywheel Ring Gear 7–24
- Removal and Installation 7–24

ENGINE OIL PRESSURE
- Checking Engine Oil Pressure 7–40
- Relief Valve 7–40

FAN GUARD
- Removal and Installation (S/N 11001–11999) 7–13
- Removal and Installation (S/N 12001 & Above) 7–13

FUEL CAMSHAFT
- Governor 7–38
- Removal and Installation 7–38

FUEL INJECTOR NOZZLES
- Checking the Injector Nozzles 7–12
- Removal and Installation 7–11

FUEL INJECTION PUMP
- Checking the Injection Pump 7–7
- Removal and Installation 7–7
- Timing the Injection Pump 7–9

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	Page Number
FUEL SHUT–OFF SOLENOID	
Adjustment	7–6
Removal and Installation	7–6
Timer Module Removal and Installation	7–6
GLOW PLUGS	
Checking the Glow Plug	7–5
Removal and Installation	7–5
IDLER GEAR AND CAMSHAFT	
Removal and Installation	7–34
Servicing the Camshaft	7–35
Servicing the Idler Gear and Shaft	7–36
MUFFLER	
Removal and Installation (S/N 11001–11999)	7–17
Removal and Installation (S/N 12001 & Above)	7–17
OIL PUMP	
Checking Engine Oil Pressure	7–40
Oil Pump Service	7–39
Relief Valve	7–40
Removal and Installation	7–39
PISTON AND CONNECTING ROD	
Connecting Rod Alignment	7–44
Removal and Installation	7–41
Servicing the Piston and Connecting Rod	7–42
RADIATOR	
Removal and Installation (S/N 11001–11999)	7–14
Removal and Installation (S/N 12001 & Above)	7–15
ROCKER ARM AND SHAFT	
Checking	7–31
TIMING GEARS	
Checking Backlash	7–37
TIMING GEARCASE COVER	
Removal and Installation	7–32
TROUBLESHOOTING	
Chart	7–3
VALVE CLEARANCE	
Adjustment	7–4
VALVE, VALVE SEAT AND GUIDE	
Checking the Valve Guide	7–28
Reconditioning the Valve and Valve Seat	7–29
Valve Spring	7–30
WATER PUMP	
Disassembly and Assembly	7–51
Removal and Installation	7–51

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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.

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, 21, 22, 24, 25, 26, 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, 12, 13, 15, 16, 17, 19, 20, 21, 23, 24, 25, 27, 28, 29
Black exhaust.	10, 12, 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. Plugged breather pipe.
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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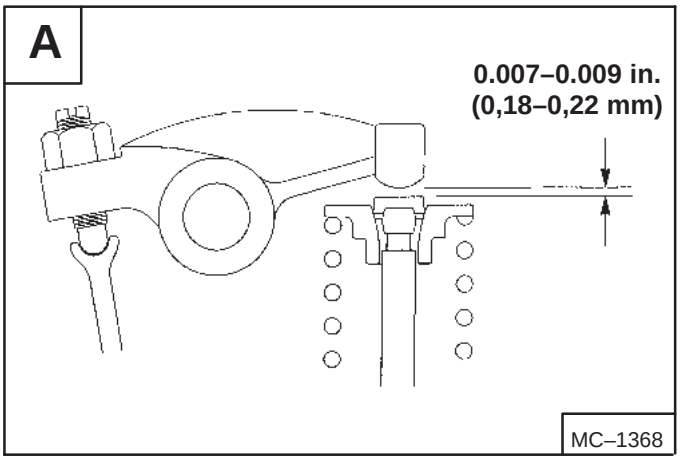
VALVE CLEARANCE

Adjustment

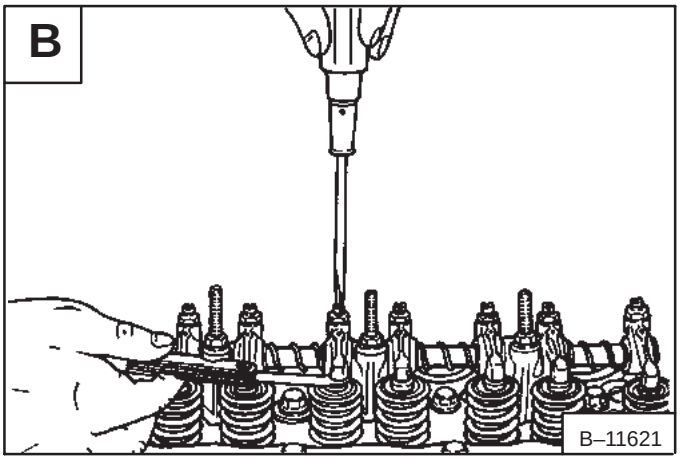
Adjust the valve clearance with the engine stopped and cold.

The correct valve clearance is 0.007–0.0087 inch (0,18–0,22 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]**.



ENGINE COMPRESSION

Checking

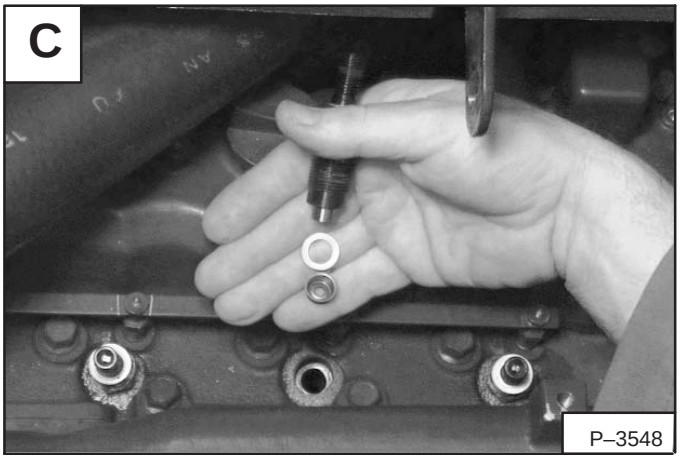
The tools listed will be needed to do the following procedure:

MEL10630 – Engine Compression Kit
MEL1352 – Compression Adapter (Glow Plug)

The engine must be at operating temperature.

Remove the glow plugs. (See Page 7–5.)

Install the correct compression adapter into the cylinder head **[C]**.



Connect the compression gauge **[D]**.

Make sure the throttle is fully backward (engine idle).

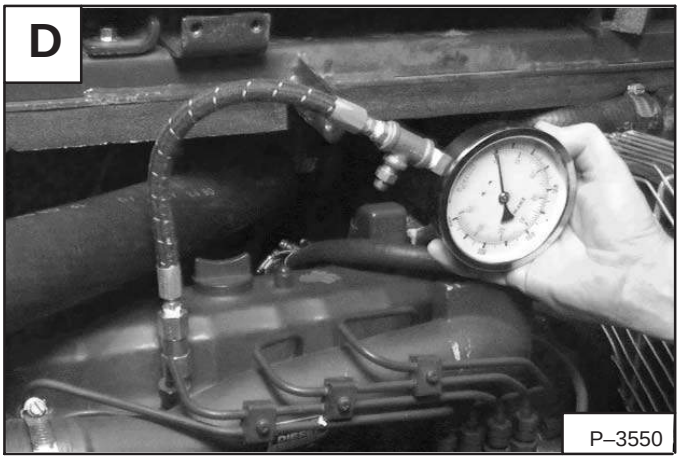
Disconnect the fuel stop solenoid.

Crank the engine with the starter at 200–300 RPM.

Compression Pressure 512–540 PSI (3530–3720 kPa)
Allowable Limit (minimum) . . . . . 370 PSI (2550 kPa)

No more than 10% variance among cylinders.

Connect the fuel stop solenoid.



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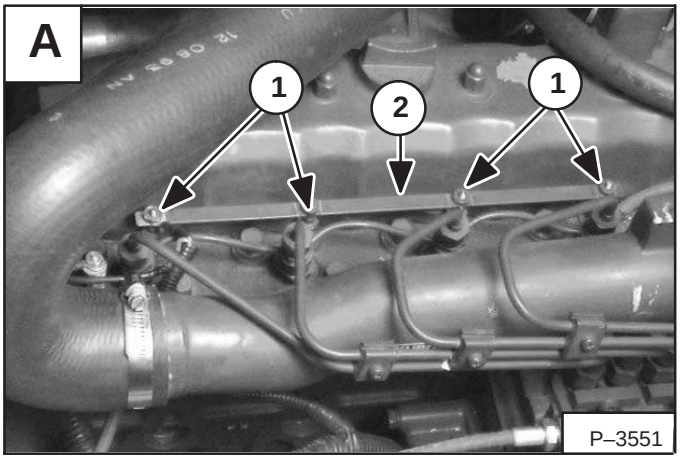
GLOW PLUGS

Removal and Installation

Disconnect the negative (–) cable from the battery.

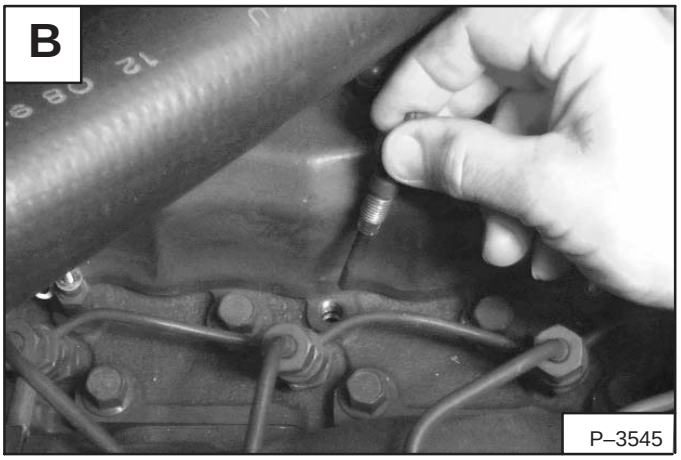
Remove the nuts (Item 1) **[A]** from the glow plugs.

Remove the glow plug connecting strap (Item 2) **[A]**.



Loosen and remove the glow plug **[B]**.

Installation: Tighten the glow plug 15–18 ft.–lbs. (20–24 Nm) torque.



Checking the Glow Plug

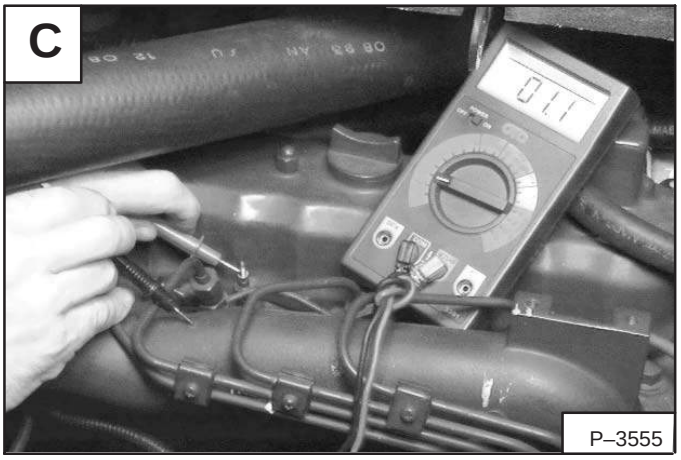
Disconnect the glow plug cable and connecting strap.

Use an ohmmeter to check the glow plugs.

Touch one probe to the end of the glow plug and the other probe to the body of glow plug.

The reading must be between –8 ohms. If the resistance is infinite, the coil of the glow plug is broken.

Repeat the procedure for each glow plug.



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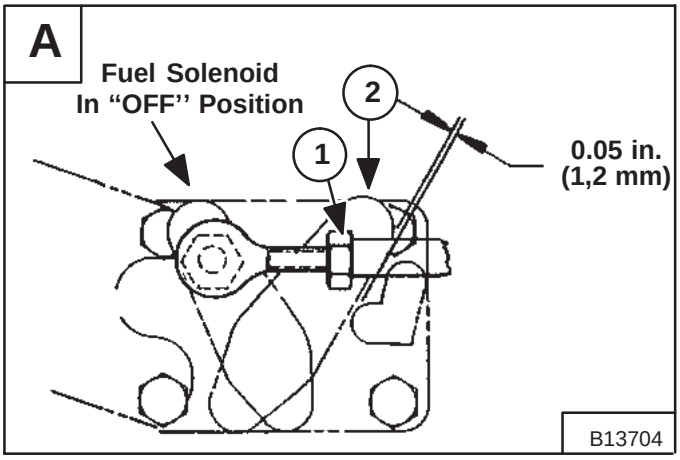
FUEL SHUT–OFF SOLENOID

Adjustment

Stop the engine.

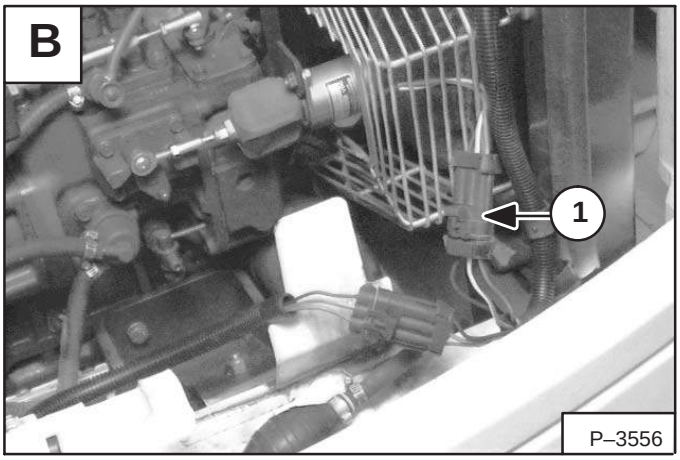
Raise the engine cover.

Loosen the jam nut (Item 1) **[A]** and rotate the solenoid shaft to adjust the linkage for a maximum distance of 0.05 inch (1,2 mm) between the lever (Item 2) **[A]** and the stop when the solenoid plunger is seated.



Removal and Installation

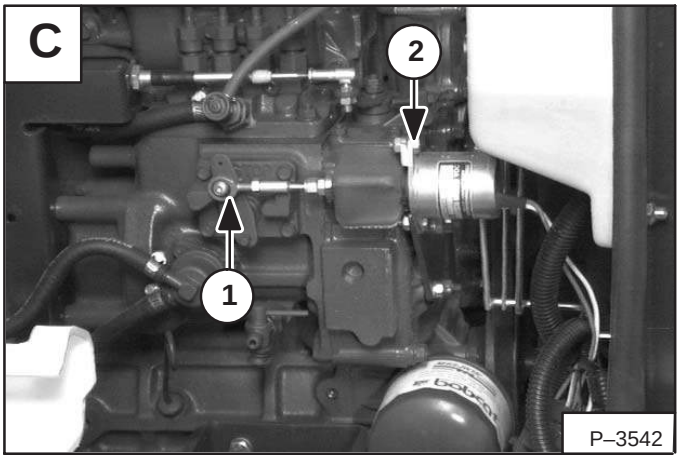
Disconnect the wire from the solenoid (Item 1) **[B]**.



Remove the nuts (Item 1) **[C]** from the ball joint.

Remove the bolts and nuts (Item 2) **[C]** from the solenoid.

Remove the solenoid.



Timer Module Removal and Installation

The timer modules' function is to provide pull in current to the fuel solenoid for only a short duration. This provides longer fuel solenoid service life and also allows for more starter cranking power.

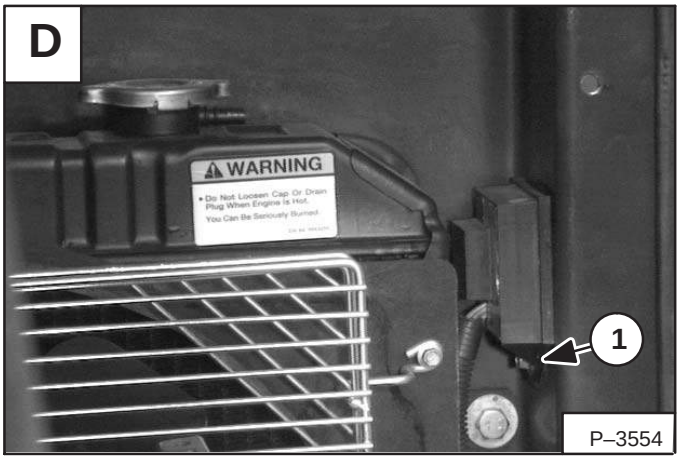
Remove the radiator over flow bottle (S/N 12001 & Above)

Disconnect the wire from the timer module **[D]**.

Remove the bolt (Item 1) **[D]** and nut.

Remove the neoprene washer from between the timer module and radiator frame.

Remove the timer module.



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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.

⚠ 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. Wear safety goggles. If fluid enters skin or eyes, get immediate medical attention.

W–2074–1285

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 a high pressure fuel line from the injection pump. Loosen the other end of the same fuel line so it can be turned away from the fitting.

Connect the adopter fuel line (Item 1) **[A]** to the fitting and connect the pressure gauge (Item 2) **[A]**.

Turn the flywheel to increase the pressure. If the pressure can not reach the allowable limit, replace the injection pump assembly.

Fuel Tightness of Pump Element
Allowable Limit . . . . . 2133 PSI (14707 kPa)

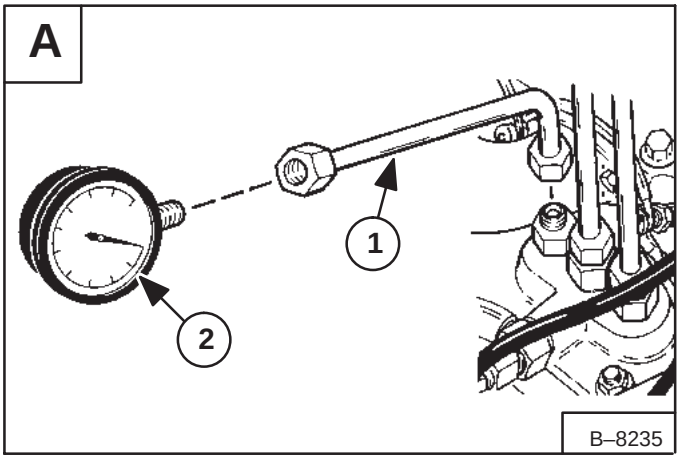
Measure the time needed to decrease the pressure from 2133 PSI to 1990 PSI (14707 kPa to 13721 kPa). If the measurement is less than the allowable limit, replace the delivery valve.

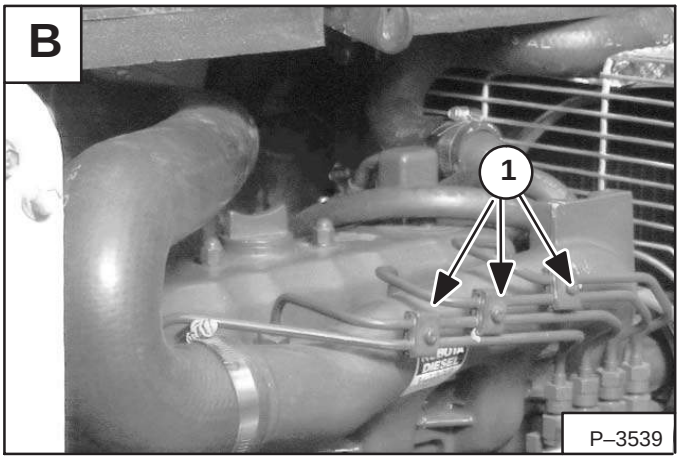
Fuel Tightness of Delivery Valve
Allowable Limit . . . . . 5 seconds

Removal and Installation

Clean around the injection pump.

Loosen the fuel line clamps (Item 1) **[B]**.





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FUEL INJECTION PUMP (Cont'd)

Removal and Installation (Cont'd)

Disconnect the high pressure fuel lines (Item 1) **[A]** from the fuel injectors and fuel injection pump.

IMPORTANT

Do not bend the high pressure fuel injection tubes when removing or installing them.

I–2029–0289

Disconnect the throttle linkage cable ball joint (Item 1) **[B]** from the injection pump.

Loosen the jam nuts (Item 2) **[B]** from the bracket to remove the throttle cable.

Disconnect the fuel inlet hose (Item 3) **[B]** and return hose (Item 4) **[B]**.

Remove the four injection pump mounting nuts.

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.

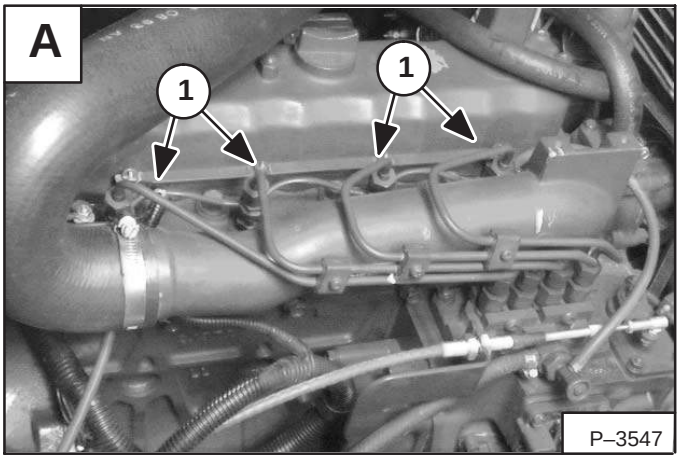
NOTE: Make sure the same number shims are installed under the injection pump. The shims are used for engine timing.

IMPORTANT

Do not attempt to maintain or adjust unless you are trained and have the correct equipment.

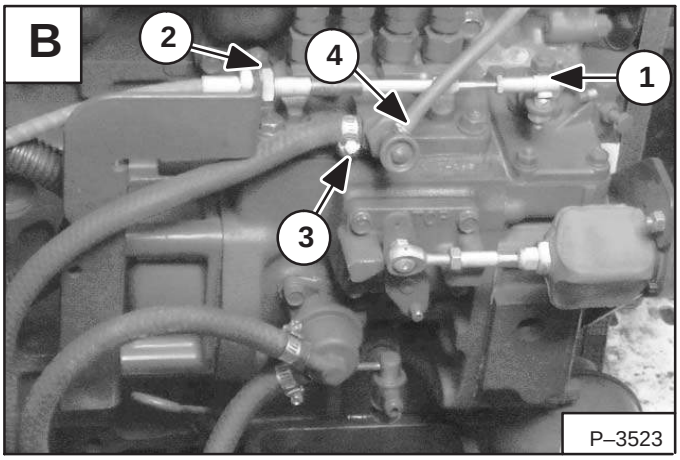
I–2028–0189

A



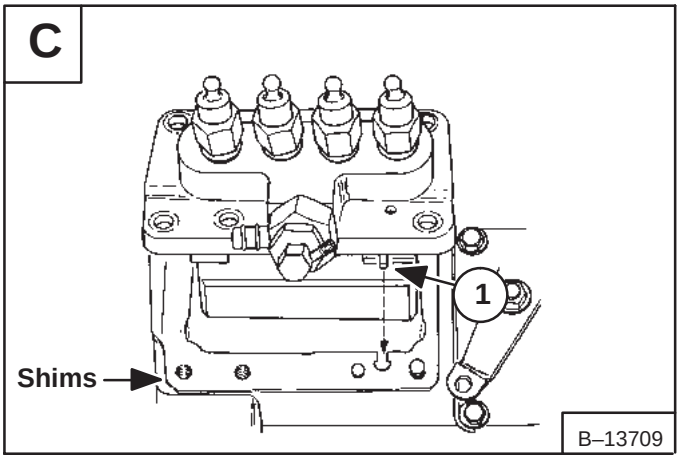
P–3547

B



P–3523

C



B–13709

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FUEL INJECTION PUMP (Cont'd)

Timing the Injection Pump

NOTE: S/N 12269 & Below Excavators, the flywheel was marked at 19° B.T.D.C. and 22 1/2° B.T.D.C. See Page 7–10 for flywheel mark modification before timing the injection pump.

Timing the injection pump is done by changing the number of shims between the injection pump and engine block.

Remove the number one cylinder high pressure line from the injection pump.

Disconnect the fuel shut–off linkage (Item 1) **[A]** from the injection pump.

Turn the fuel supply lever to the ON position. Install a short plastic tube in the fitting of the number one cylinder port. Point the tube up (vertical) **[B]**.

Turn the engine counter clockwise until fuel flows out of the injection pumps number 1 cylinder nozzle. (Install a tool on the crankshaft at the front of the engine to turn the engine).

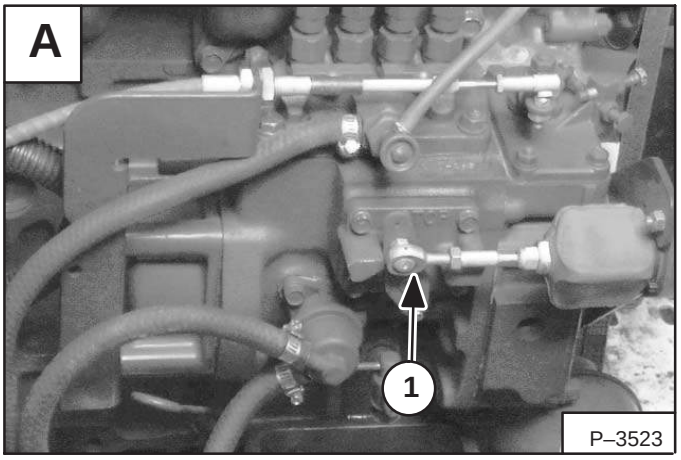
NOTE: The fuel must flow out of the nozzle for 1 firing cycle before timing can be attempted.

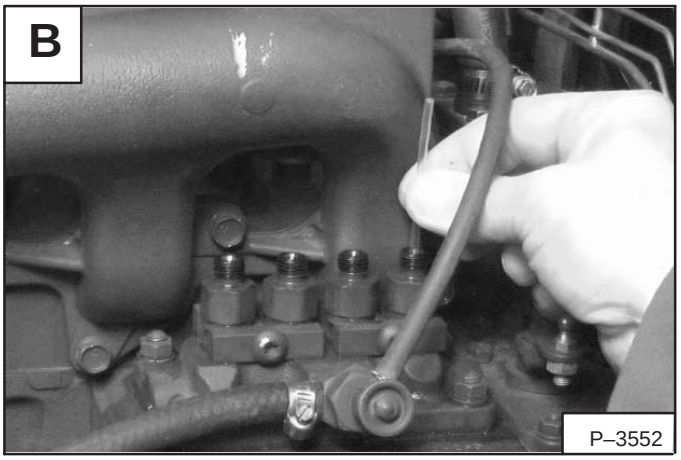
Continue to turn the engine slowly (for approximately 1–3/4 turns after fuel stops flowing from the injection pump nozzle), until the 17° B.T.D.C. mark on the side of the flywheel is at the bottom edge of the timing hole (Item 1) **[C]** in the flywheel housing.

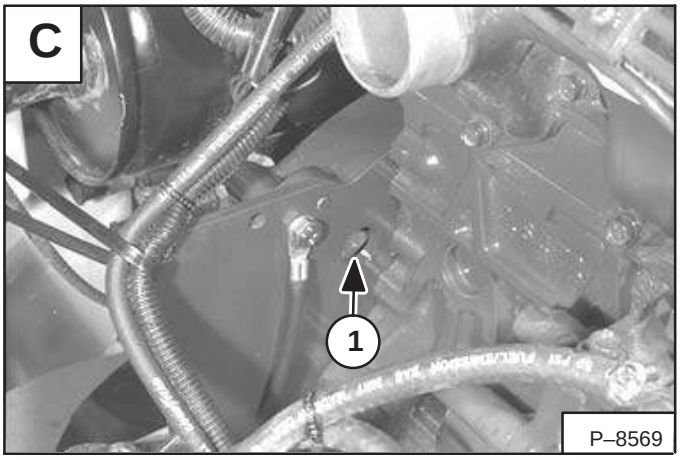
Slowly turn the engine counterclockwise: as soon as fuel starts to flow at the top of the injection pump nozzle stop turning the engine.

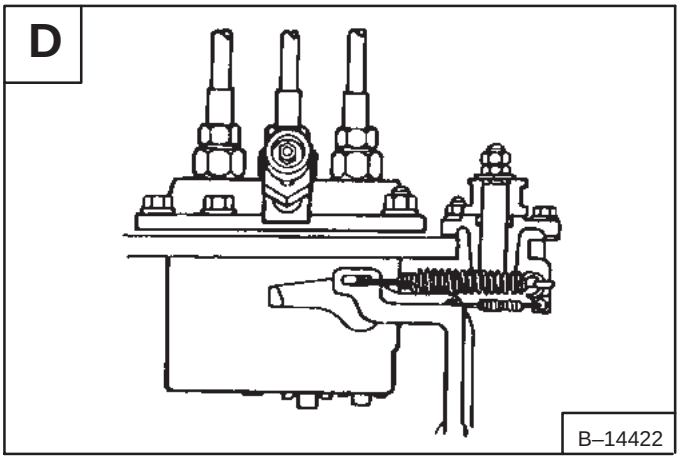
The correct engine timing for all Kubota D2203 engines is 17° B.T.D.C. . Add or subtract shims (Item 1) **[D]** to time the engine to 17° B.T.D.C. the engine is correctly timed when the 17° B.T.D.C. mark on the flywheel is aligned with the notch in the timing hole **[C]**.

NOTE: Adding or reducing the shim thickness by 0.05 mm retards or advances the injection timing by 0.5°.









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FUEL INJECTION PUMP (Cont'd)

Timing the Injection Pump (Cont'd)

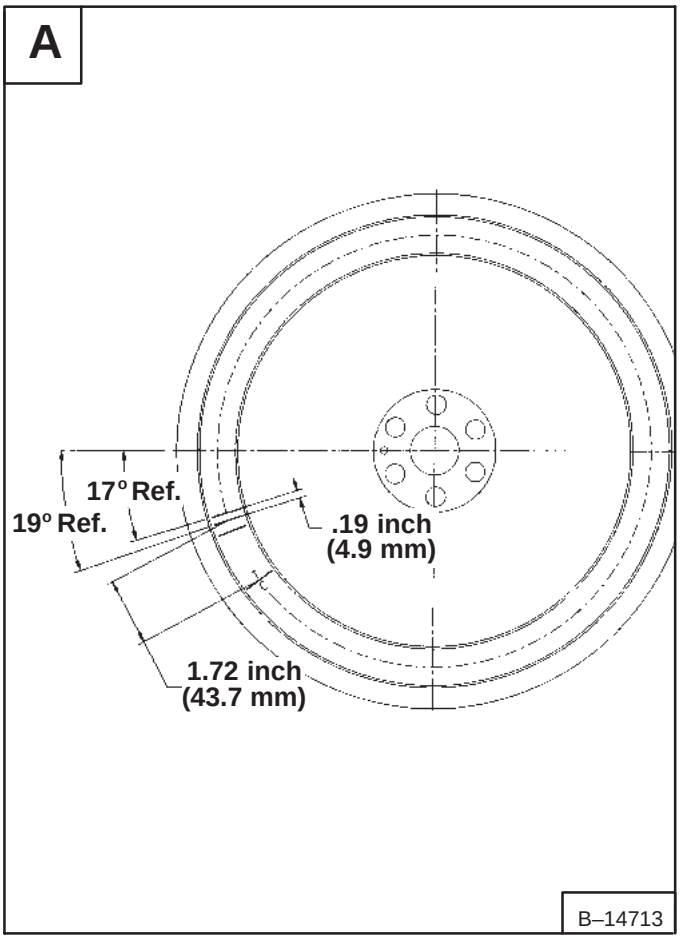
For (S/N 12269 & Below)

The flywheel marks on Excavator S/N 12269 & Below are stamped at 19° B.T.D.C. and 22–1/2° B.T.D.C. Before timing the injection pump on the above S/N Excavators the flywheel timing mark must be modified.

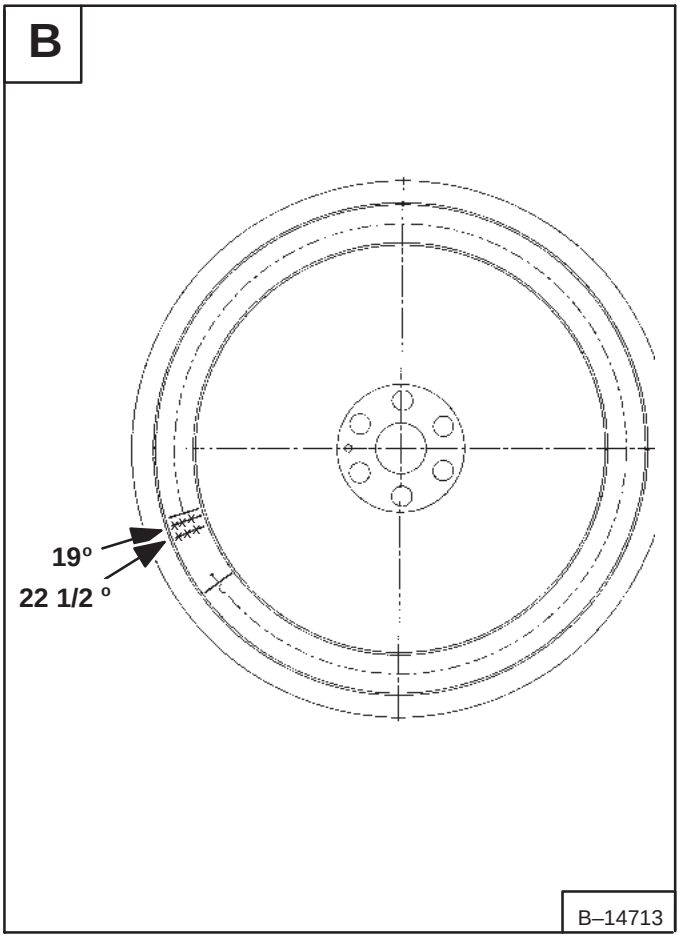
Remove the flywheel. (See Page 7–24.)

Use the 19° B.T.D.C. mark as the locating line for adding the new timing mark locations.

Add the 17° B.T.D.C. and T.D.C. marks to the dimensions shown **[A]**.



Use a chisel or a marking stamp and cross out the existing 19° B.T.D.C. and 22–1/2° marks as shown **[B]**.



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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. Wear safety goggles. If fluid enters skin or eyes, get immediate medical attention.

W–2074–1285

Some problems caused by faulty injector nozzles:

- The engine is hard to start or will not start.
- Rough engine operation at idle.
- The engine will not have full power.
- 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

Disconnect the high pressure fuel lines from the fuel injectors **[A]**.

Disconnect the fuel lines form the fuel injection pump.

Remove the high pressure fuel lines.

Disconnect the fuel return hose (Item 1) **[B]**.

Remove the retainer nut from the top of the fuel injectors.

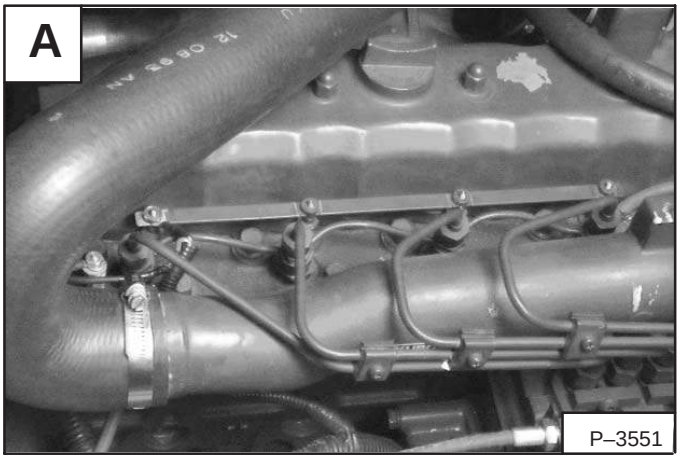
Remove the fuel return pipe (Item 2) **[B]**.

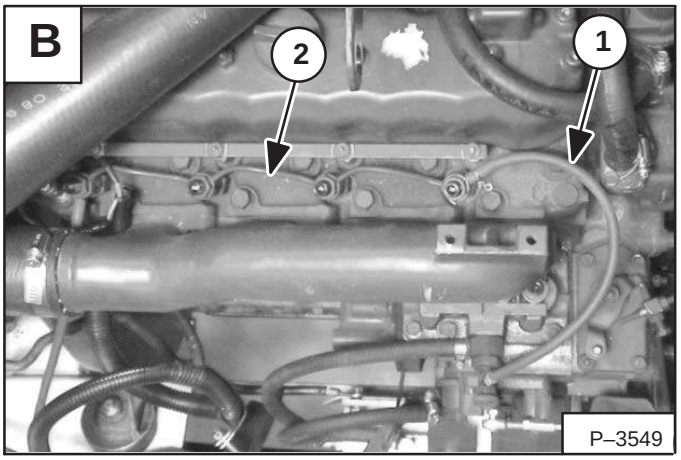
Loosen the injector nozzle.

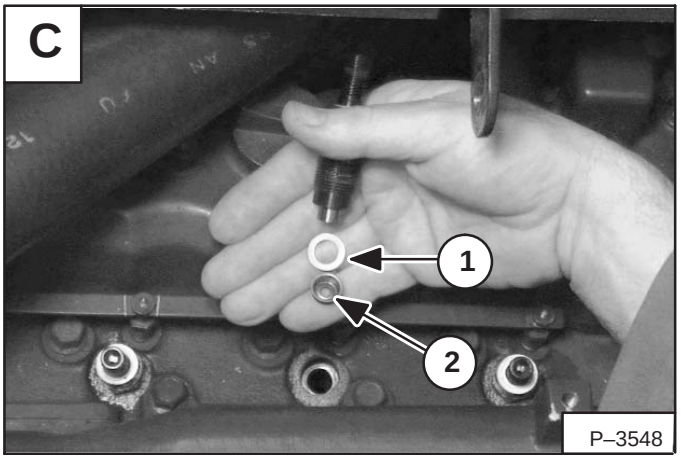
Installation: Tighten the injector nozzle to 36–51 ft.–lbs. (40–69 Nm) torque.

Remove the injector nozzle from the cylinder head **[C]**.

NOTE: Be sure to replace the copper washer (Item 1) [C] and nozzle cap (Item 2) [C] anytime new or used fuel injectors are installed.







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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

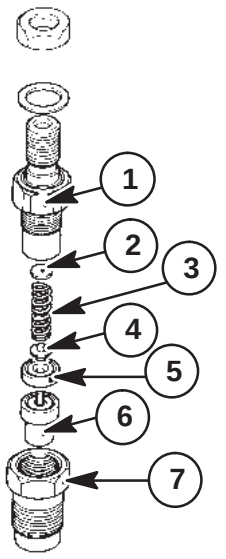
Disassemble and clean the injector nozzle.

The nozzle release pressure can be adjusted by adding or removing spacer(s) from the top of the nozzle spring (Item 3) **[A]**.

Each spacer will change the release pressure by about 142 PSI (980 kPa).

Fuel Injection Pressure . . . . . 1991–2133 PSI (13728–14707 kPa)

A



(1) Nozzle Holder
(2) Adjusting Washer
(3) Nozzle Spring
(4) Push Rod
(5) Distance Piece
(6) Nozzle Piece
(7) Nozzle Retaining Nut

PI–9981

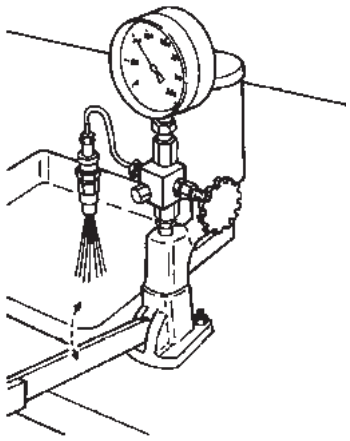
Assemble the injector nozzle. Connect the nozzle to the tester with the nozzle down **[B]**.

Operate the hand lever at a slow rate and record the opening pressure. If the pressure is not correct, disassemble the nozzle and add or remove the spacer (Item 2) **[A]** as needed.

When the injector nozzle is assembled, tighten the nozzle body to 43–58 ft.–lbs. (59–79 Nm) torque.

Check for inside leakage. Operate the hand lever until the pressure 1850 PSI (12755 kPa). Keep the nozzle under this pressure for 10 seconds, check to see if fuel leaks from the nozzle. If fuel leaks, replace the nozzle.

B

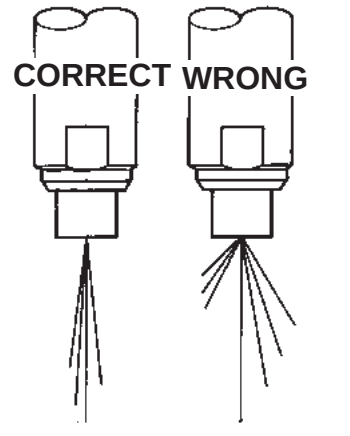


A–2513

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 injector has an even flow coming from the nozzle.

C



A–2621

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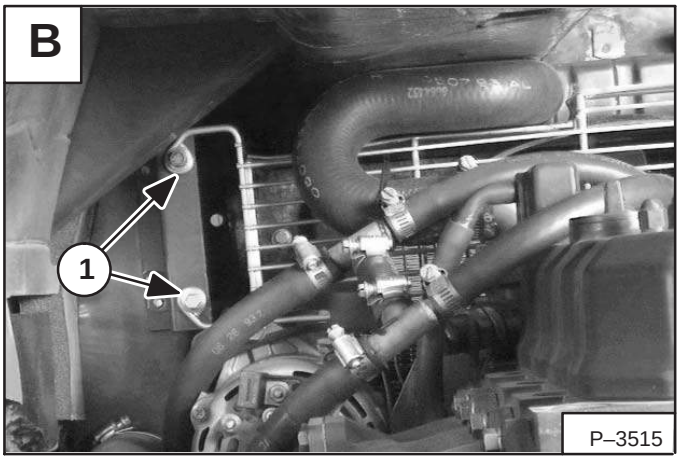
FAN GUARD

Removal and Installation (S/N 11001–11999)

Open the engine cover **[A]**.

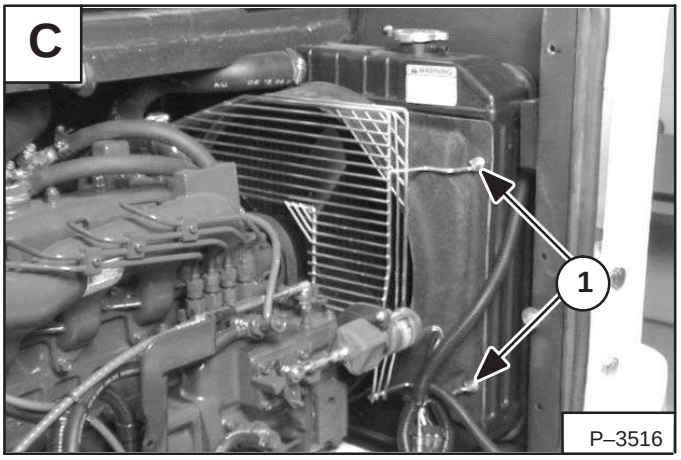


Remove the two bolts (Item 1) **[B]** and nuts.



Remove the two bolts (Item 1) **[C]**.

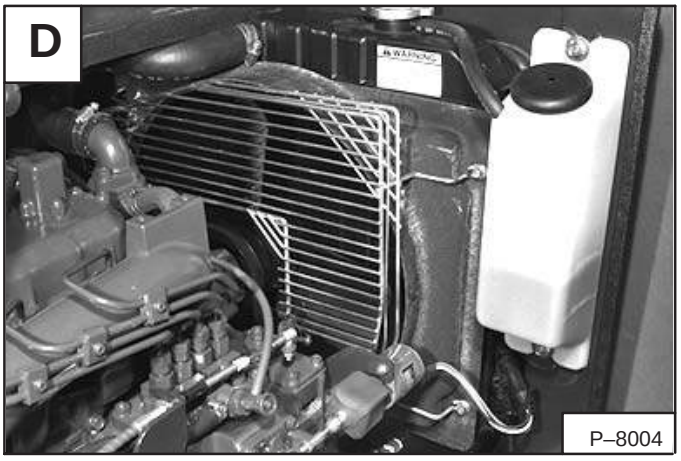
Remove the fan guard.



Removal and Installation (S/N 12001 & Above)

Remove the three (3) bolts **[D]**.

Remove the fan guard.



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RADIATOR

Removal and Installation (S/N 11001 – 11999)

Remove the fan guard. (See Page 7–13.)

Remove the oil cooler. (See Page 2–1.)

⚠ WARNING

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

W–2070–1285

Loosen the radiator cap.

Open the radiator drain valve (Item 1) **[A]** at the bottom of the radiator.

Drain all coolant into a container.

Loosen the top radiator hose clamp (Item 1) **[B]**. Remove the radiator hose from the radiator.

Disconnect the lower radiator hose.

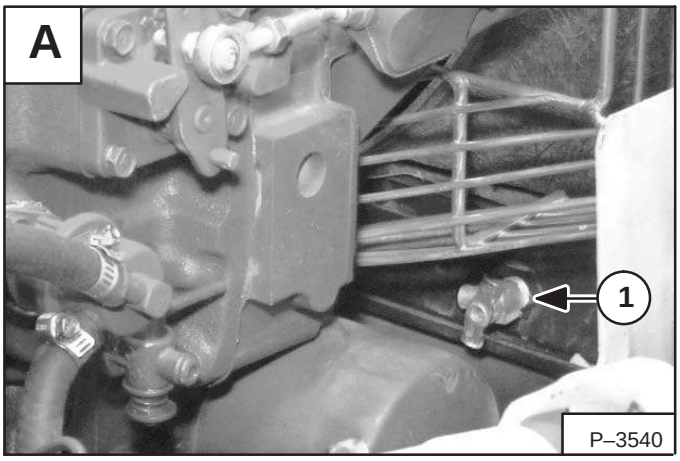
Remove the timer module (Item 1) **[C]**.

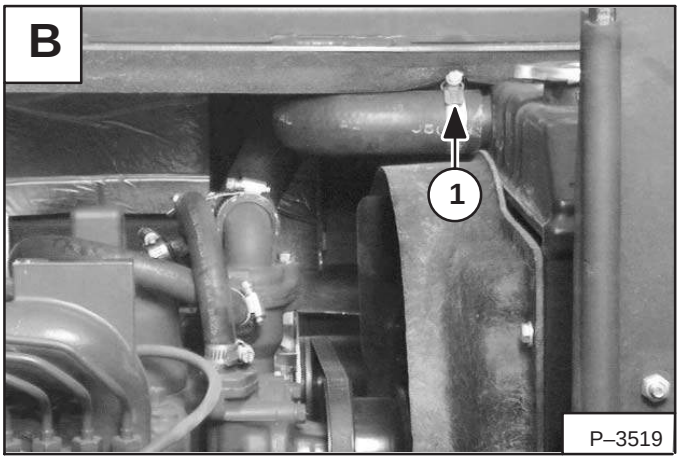
Disconnect the air cleaner intake hose that is attached to the radiator support.

Remove the fan from the water pump hub.

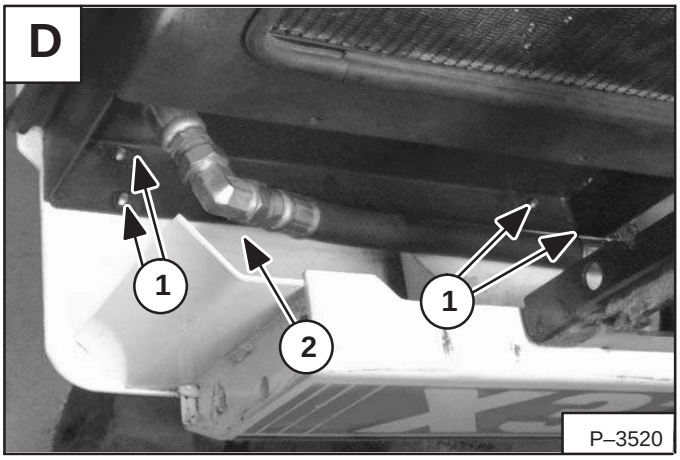
Remove the four bolts (Item 1) **[D]** from the radiator support.

Disconnect the hose (Item 2) **[D]** from the oil filter.







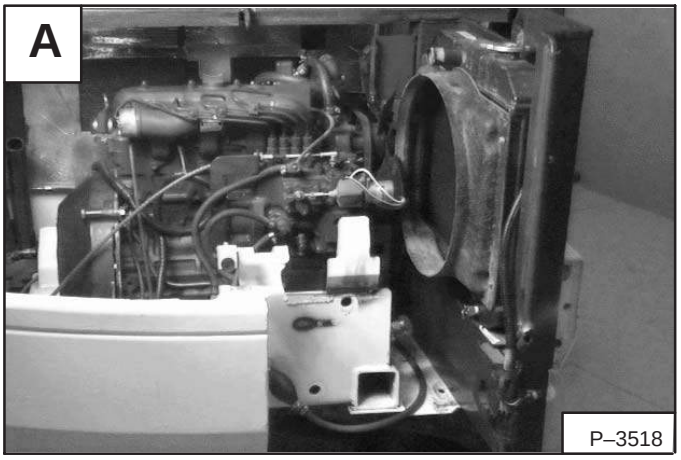


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RADIATOR (Cont'd)

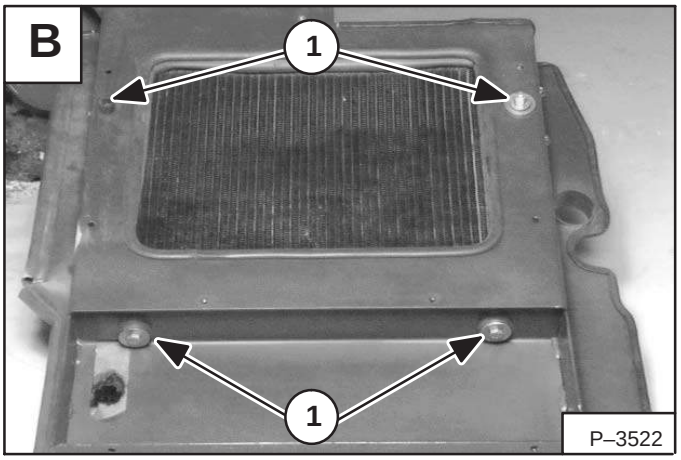
Removal and Installation (S/N 11001–11999) (Cont'd)

Move the radiator and support to the right and pull the radiator and support out of the rear of the excavator **[A]**.



Remove the four radiator mounting bolts (Item 1) **[B]**, washers, and rubber mounts and nuts.

Remove the radiator.



Removal and Installation (12001 & Above)

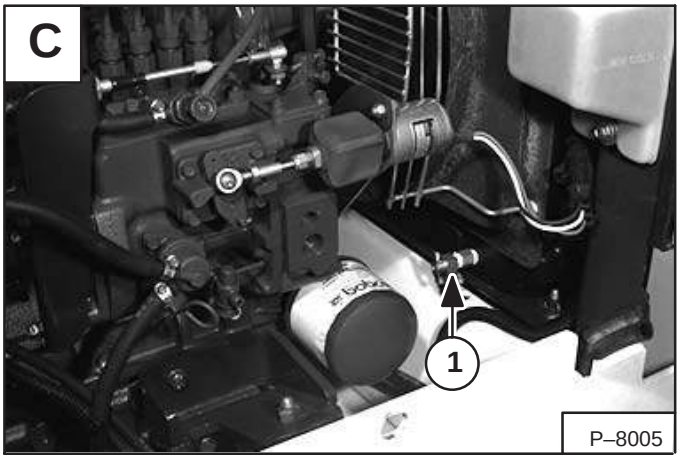
Remove the fan guard. (See Page 7–13.)

Remove the oil cooler. (See Page 2–1.)

⚠ WARNING

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

W–2070–1285



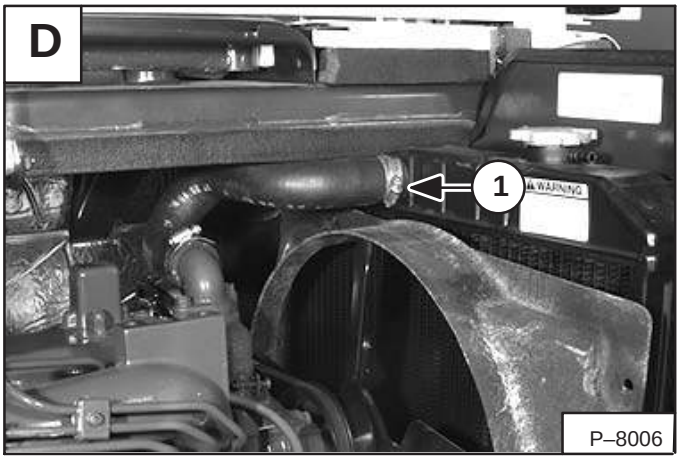
Open the radiator drain valve (Item 1) **[C]** at the bottom of the radiator.

Drain all coolant into a container.

Loosen the top radiator hose clamp (Item 1) **[D]**.

Remove the radiator hose from the radiator.

Disconnect the lower radiator hose.



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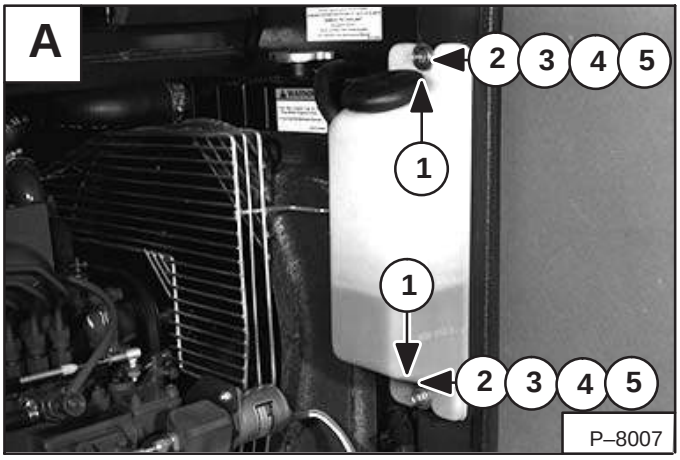
RADIATOR (Cont'd)

Removal and Installation (S/N 12001 & Above) (Cont'd)

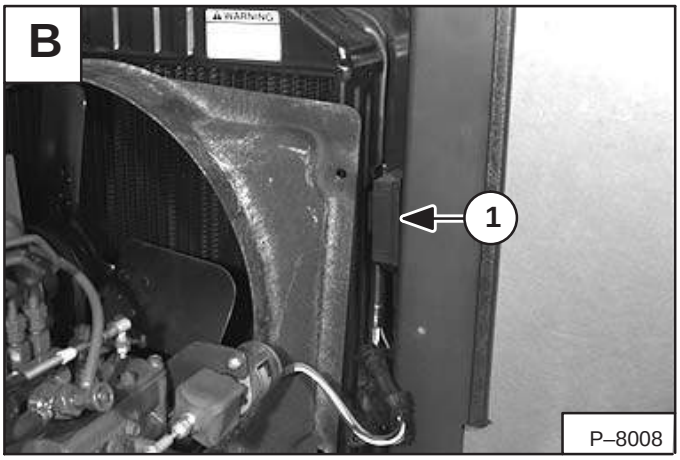
Remove the top bolt (Item 1) **[A]**, washer (Item 2) **[A]**, spacer (Item 3) **[A]**, lock washer (Item 4) **[A]** and nut (Item 5) **[A]** from the radiator overflow tank.

Loosen the bottom overflow tank mounting bolt (Item 1) **[A]**, washer (Item 2) **[A]**, spacer (Item 3) **[A]**, lock washer (Item 4) **[A]** and nut (Item 5) **[A]**.

Remove the over flow tank.

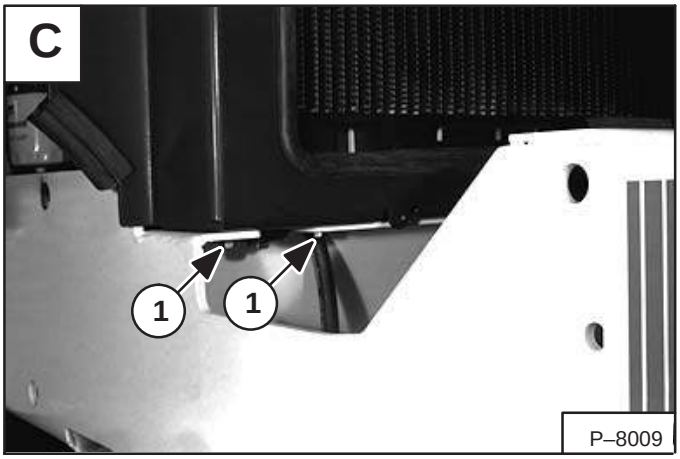


Remove the timer module (Item 1) **[B]**.

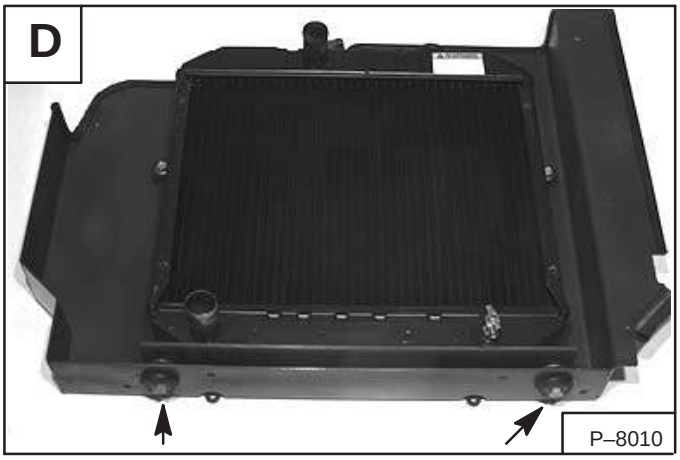


Remove the four (4) bolts (Item 1) **[C]** from the radiator support.

Move the radiator and support to the right and pull the radiator and support out the rear of the excavator.



Remove the two (2) radiator mounting bolts, washers, rubber mounts and nuts **[D]**.



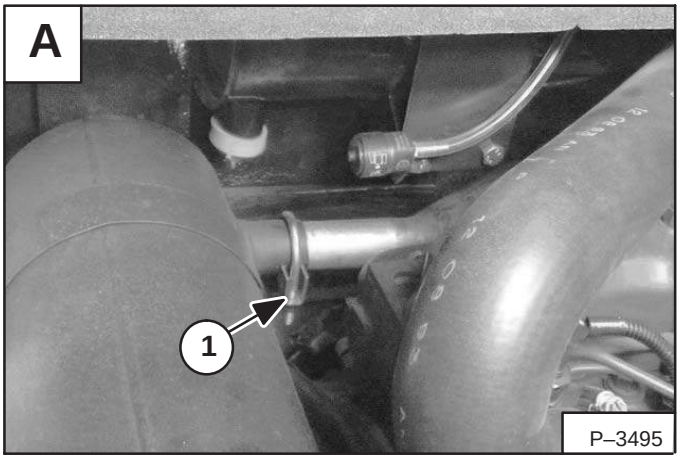
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MUFFLER

Removal and Installation (S/N 11001–11999)

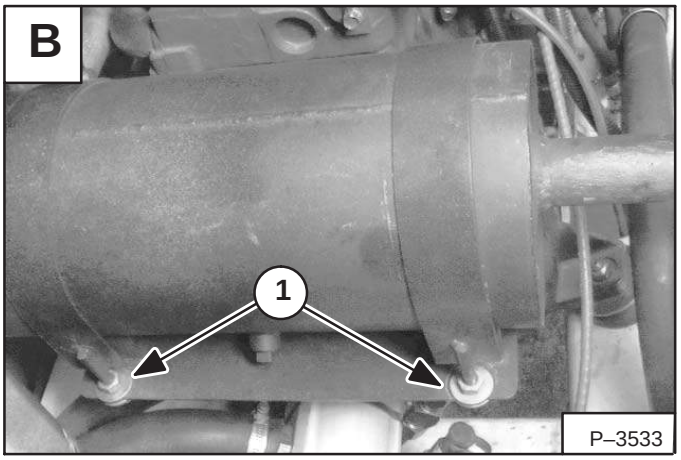
Remove the tool box. (See Page 4–1.)

Remove the exhaust pipe clamp (Item 1) **[A]**.



Loosen the nuts (Item 1) **[B]** from the two muffler clamps.

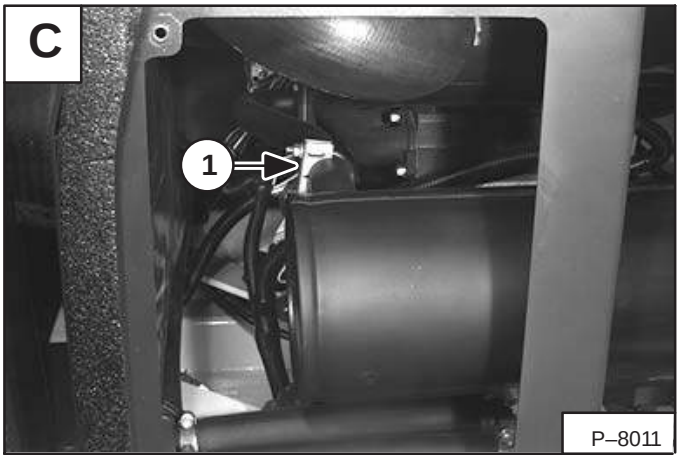
Remove the muffler from the engine.



Removal and Installation (S/N 12001 & Above)

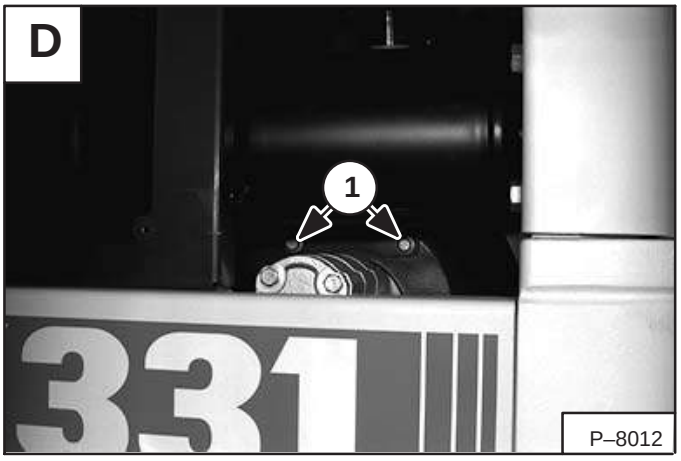
Remove the left side cover. (See Page 4–1.)

Remove the exhaust pipe clamp (Item 1) **[C]**.



Remove the two (2) bolts from the muffler mount **[D]**.

Remove the muffler from the engine.



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AIR CLEANER

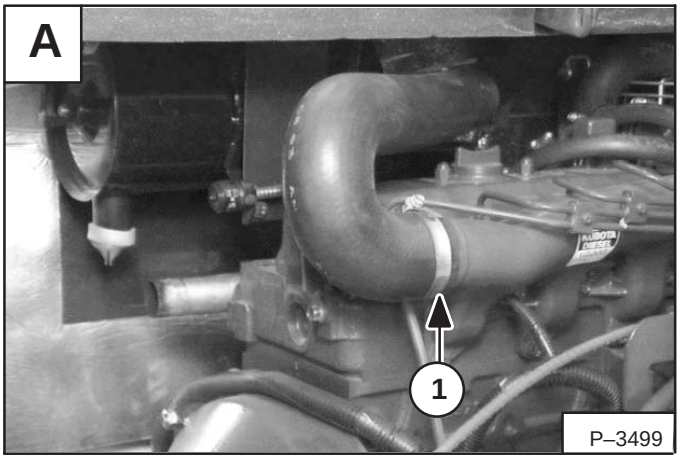
Removal and Installation (S/N 11001–11999)

Raise the engine cover.

Loosen the hose clamp (Item 1) **[A]** on the air intake hose.

Remove the hose from the intake manifold.

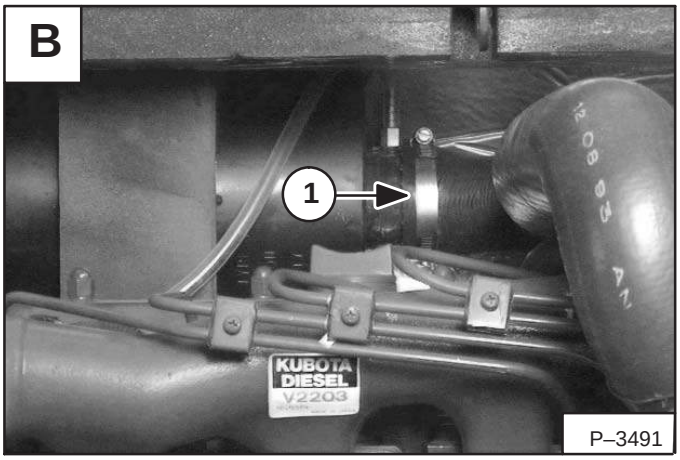
NOTE: Plug the air intake hole to keep contamination out of into the engine.



Loosen the hose clamp (Item 1) **[B]** on the air cleaner.

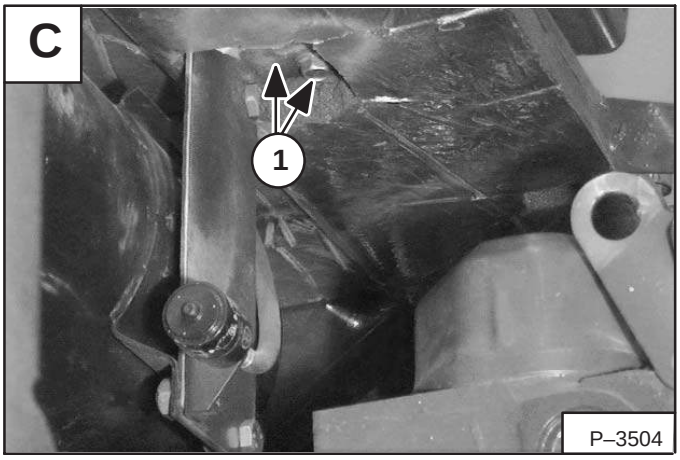
Remove the hose.

Disconnect the air intake hose (which comes from the radiator support) from the air cleaner.



Remove the two mounting bolts (Item 1) **[C]** from the air cleaner mounting bracket.

Remove the air cleaner housing.



Removal and Installation (S/N 12001–12999)

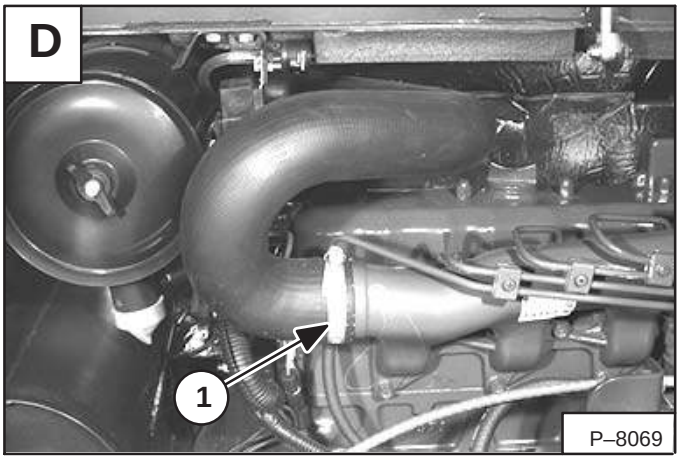
Raise the engine cover.

Remove the left side cover. (See Page 4–1.)

Loosen the hose clamp (Item 1) **[D]** on the side intake hose.

Remove the hose from the intake manifold.

NOTE: Plug the air intake hole to keep contamination out of the engine.



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AIR CLEANER (Cont'd)

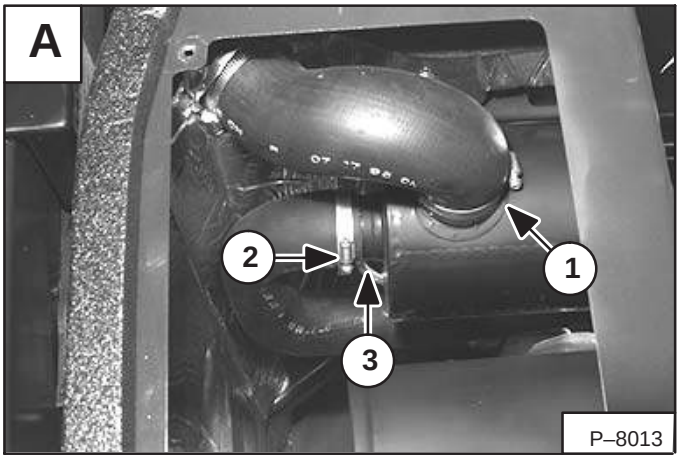
Removal and Installation (S/N 12001 & 12999) (Cont'd)

Loosen the hose clamp (Item 1) **[A]** on the air cleaner.

Remove the hose.

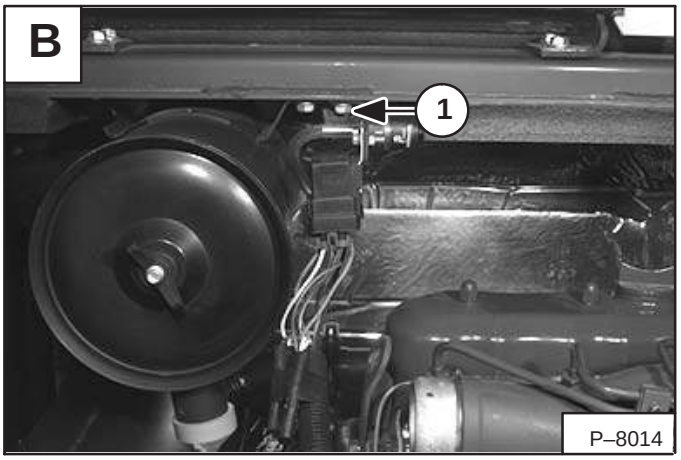
Loosen the hose clamp (Item 2) **[A]** on the air intake hose. Remove the hose from the air cleaner.

Remove the air indicator hose (Item 3) **[A]** from the air cleaner.



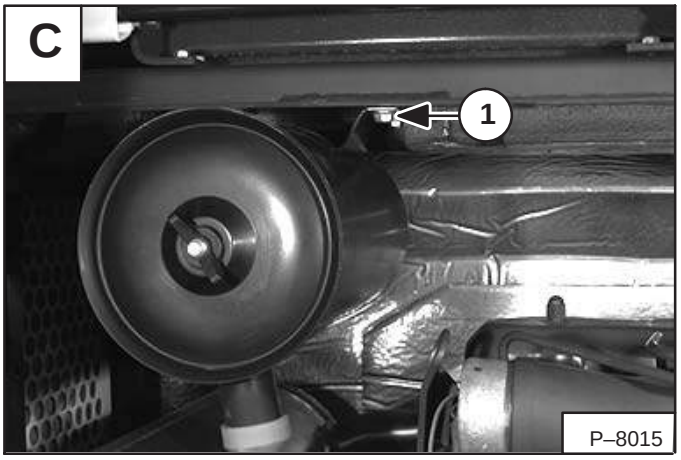
Remove the one (1) bolt (Item 1) **[B]** from the relay/air indicator mount.

Reposition the mount out of the way.



Remove the three (3) air cleaner mount bolts (Item 2) **[C]**.

Remove the air cleaner housing from the excavator.



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AIR CLEANER (Cont'd)

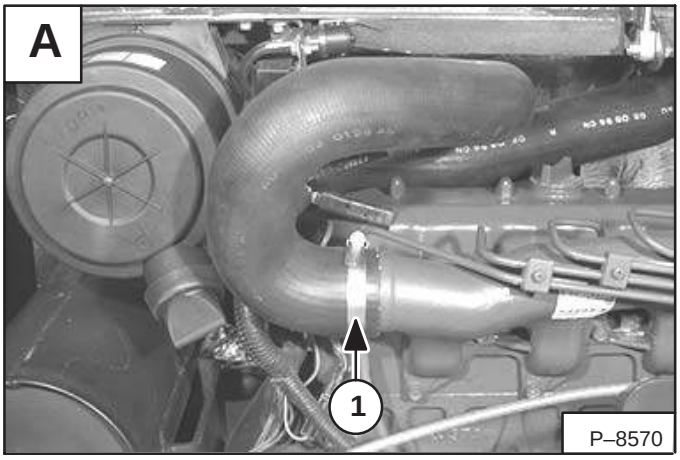
Removal and Installation (S/N 13001 & Above)

Raise the engine cover.

Loosen the hose clamp (Item 1) **[A]** on the air intake hose.

Remove the hose from the intake manifold.

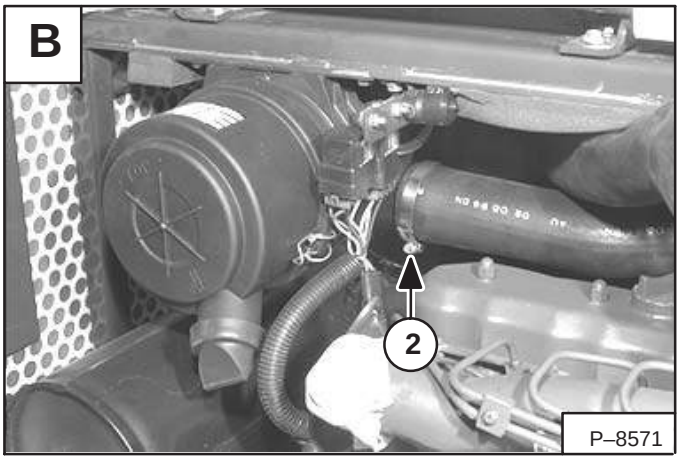
NOTE: Plug the air intake hole to keep contamination out of the engine.



Loosen the hose clamp (Item 1) **[B]** on the air cleaner.

Remove the hose.

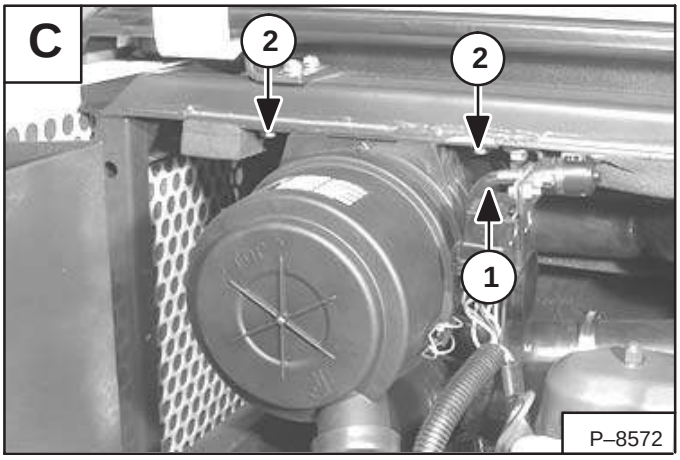
Disconnect the air intake hose (on the rear) of the air cleaner.



Remove the clear tube (Item 1) **[C]** from the air cleaner indicator.

Remove the two (2) mounting bolts (Item 2) **[C]** from the air cleaner mounting bracket.

Remove the air cleaner.



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ENGINE

Removal and Installation

Remove the engine cover. (See Page 4–1.)

Remove the right side cover. (See Page 4–1.)

Remove the left side cove.r (See Page 4–1.)

Remove the left corner post. (See Page 4–1.)

Remove the right corner post. (See Page 4–1.)

Remove the battery ground cable. (See Page 6–1.)

Remove the air cleaner. (See Page 7–18.)

Remove the muffler. (See Page 7–17.)

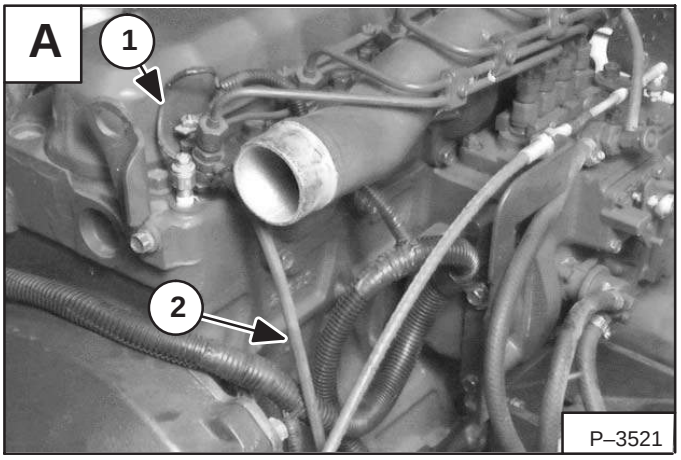
Remove the hydraulic pump. (See Page 2–1.)

Remove the fan guard. (See Page 7–13.)

Remove the seat and the seat mount. (See Page 4–1.)

Remove the wire (Item 1) **[A]** from the glow plugs.

Remove the fuel return hose (Item 2) **[A]**.

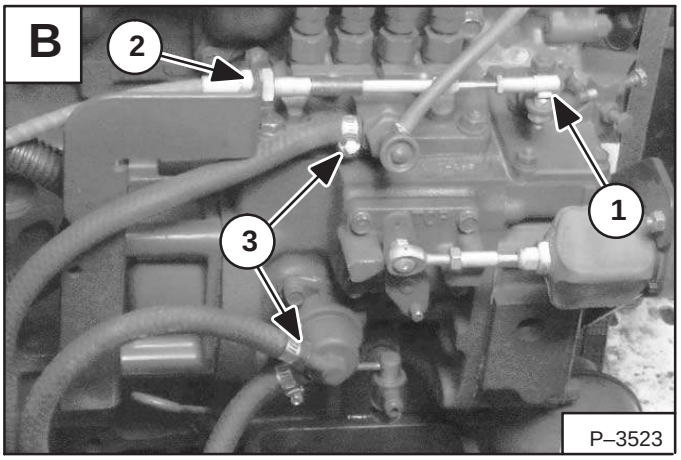


Remove the speed control cable ball joint (Item 1) **[B]**.

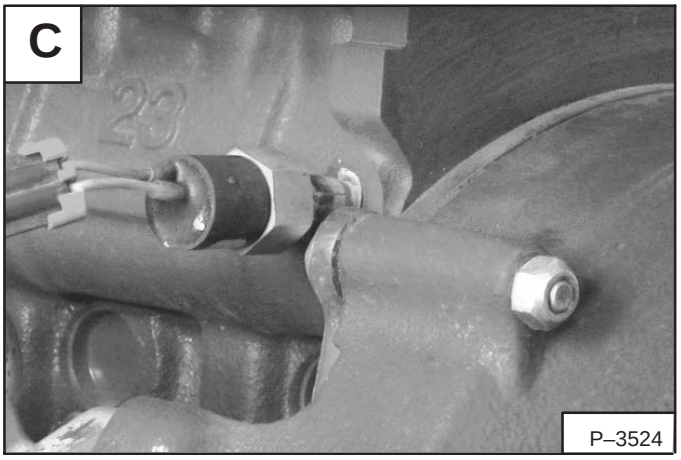
Loosen the jam nut (Item 2) **[B]** and move the speed control cable out of the way.

Loosen the clamp (Item 3) **[B]** on the fuel lines.

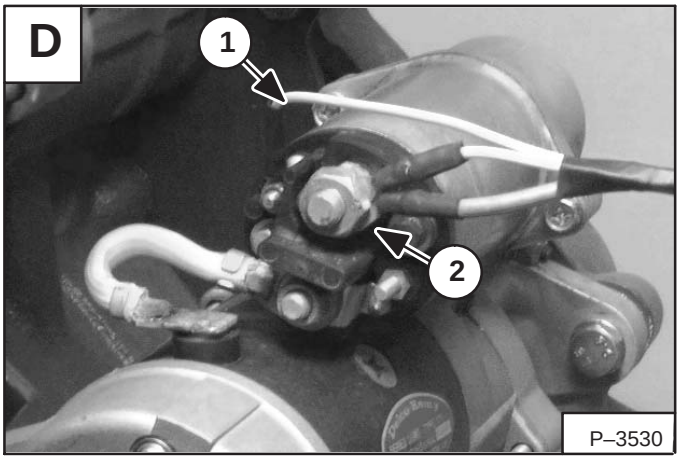
Disconnect and plug the fuel lines.



Disconnect the wires from the oil sender **[C]**.



Remove the starter wires (Item 1) **[D]** and the battery cable (Item 2) **[D]**.



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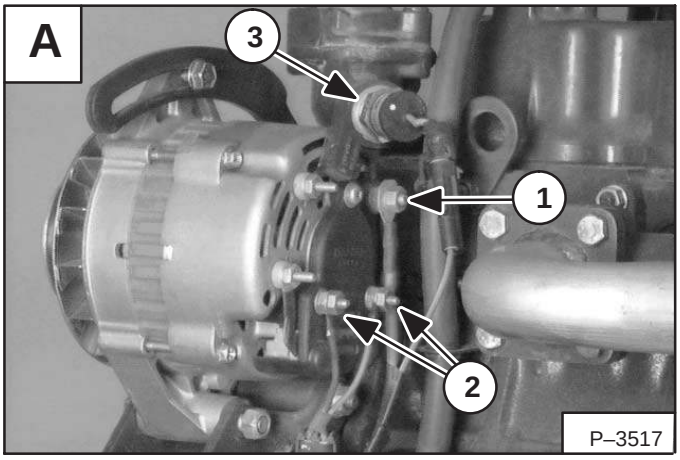
ENGINE (Cont'd)

Removal and Installation (Cont'd)

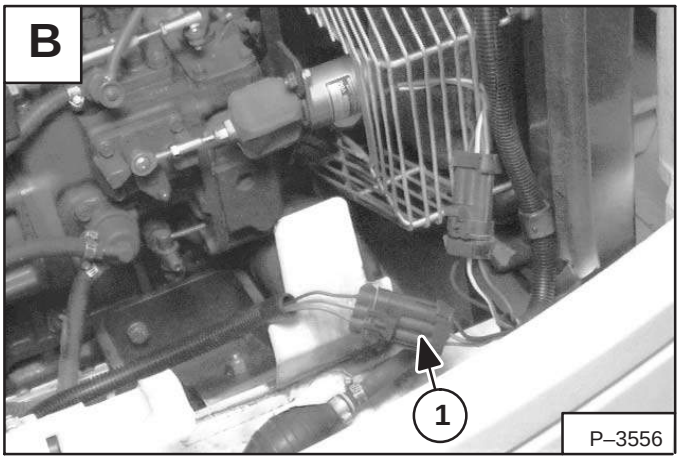
Remove the wire (Item 1) **[A]** from the alternator.

Disconnect the alternator harness connector (Item 2) **[A]**.

Disconnect the water temperature sender connector (Item 3) **[A]**.



Disconnect the fuel shut–off solenoid harness connector (Item 1) **[B]**.

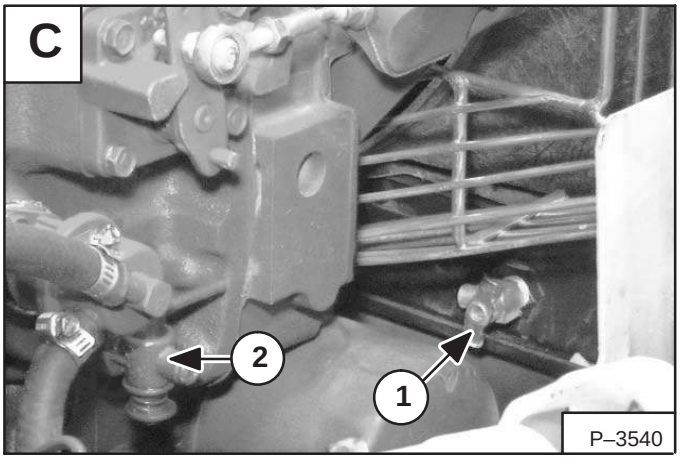


Loosen the radiator cap.

Open the radiator drain valve (Item 1) **[C]** at the bottom of the radiator.

Drain all coolant into a container.

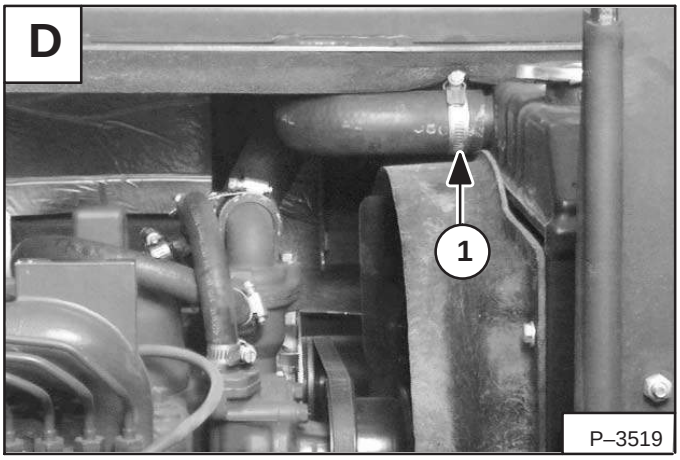
Open the engine block drain (Item 2) **[C]** and drain the coolant from the engine block into a container.



Remove the top radiator hose clamp (Item 1) **[D]**.

Remove the hose from the radiator.

Disconnect the lower radiator hose.

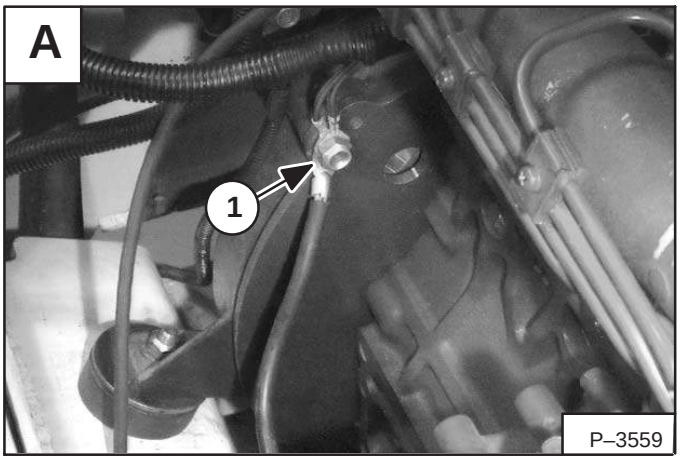


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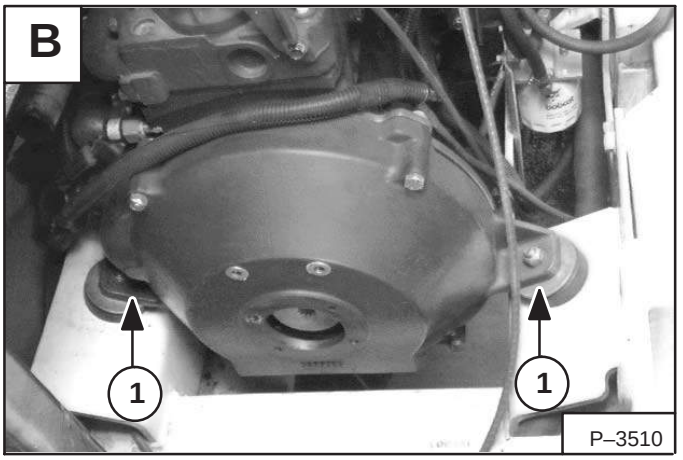
ENGINE (Cont'd)

Removal and Installation (Cont'd)

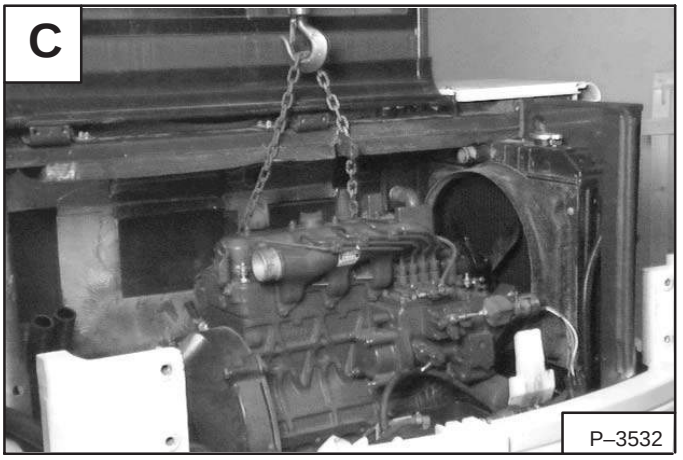
Disconnect the ground wire and harness ground wires from the bolt (Item 1) **[A]**.



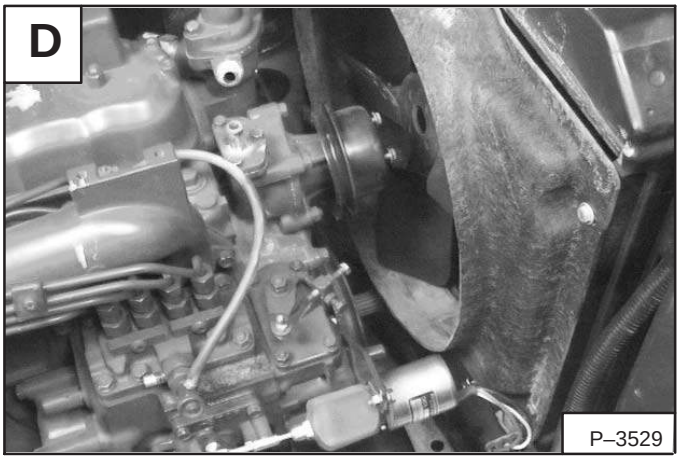
Remove the nuts and bolts (Item 1) **[B]** from all four engine mounts.



Connect a chain to the two engine lift eyes **[C]**.



Start to lift the engine, be sure the fan clears the radiator shroud **[D]**.



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ENGINE FLYWHEEL

Removal and Installation

Open the engine cover.

Remove the left hand corner post. (See Page 4–1.)

Remove the hydraulic filter. (See Page 2–1.)

Remove the tool box. (See Page 4–1.)

Remove the hydraulic pump. (See Page 2–1.)

Remove the muffler. (See Page 7–17.)

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

Remove the bolts (Item 2) **[A]** from the engine mounts.

Remove the flywheel housing.

Installation: Tighten the flywheel housing bolts to 30–37 ft.–lbs. (40–50 Nm) torque.

Remove the three bolts (Item 1) from the hydraulic pump coupler **[B]**.

Remove the coupler.

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

Remove the six bolts (Item 1) **[C]** from the flywheel.

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.**

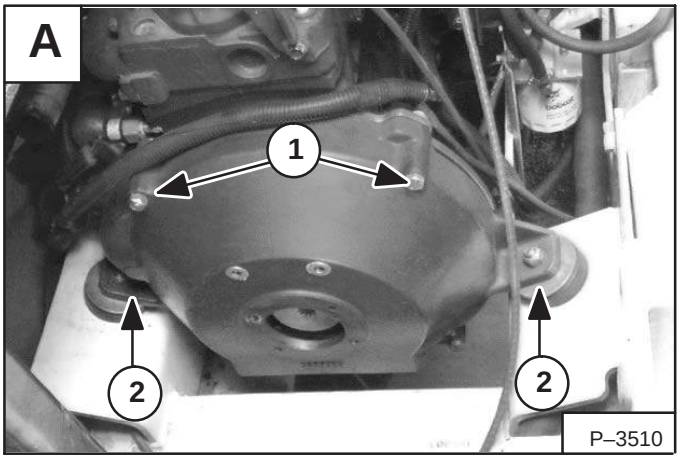
W–2019–1285

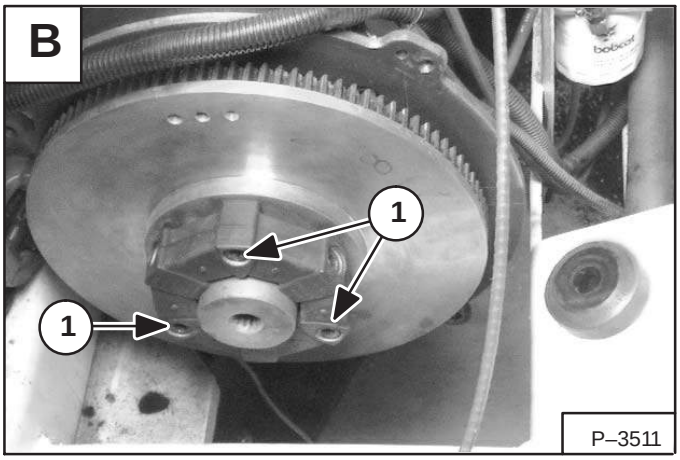
The ring gear on the flywheel is an interference fit. Heat the ring gear enough to expand it and hit it with a hammer, evenly to remove it.

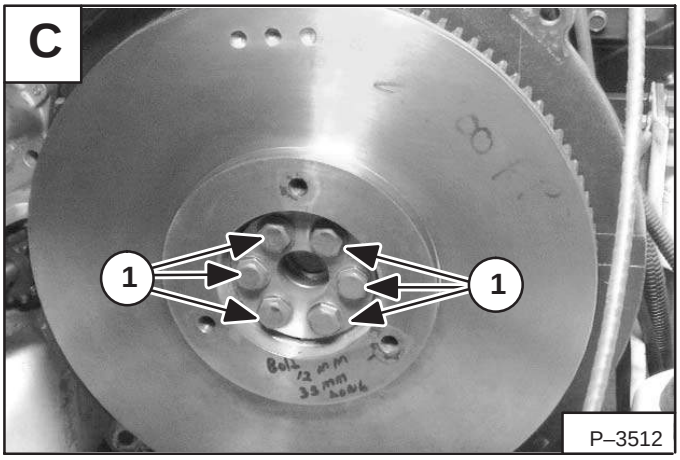
Clean the outer surface of the flywheel to give a smooth fit.

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.





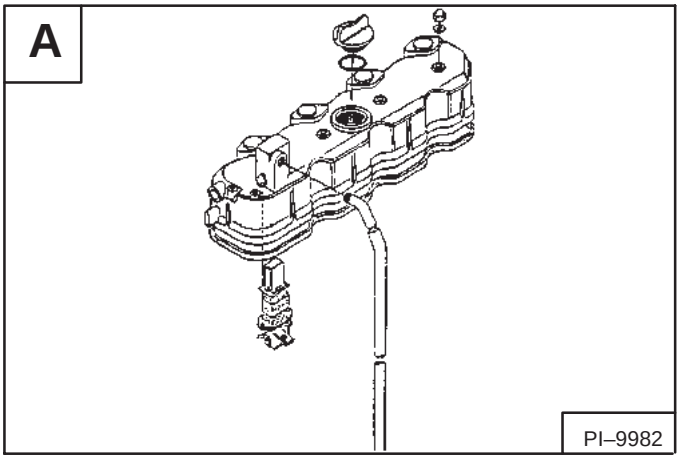


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CYLINDER HEAD

Removal and Installation

Remove the nuts from the valve cover and remove the valve cover and gasket **[A]**.



Remove the fuel injector nozzles. (See Page 7–11.)

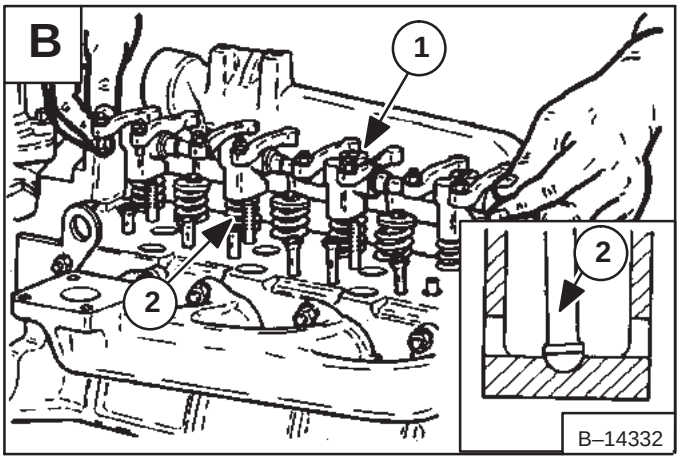
Remove the glow plugs. (See Page 7–5.)

Remove the alternator. (See Page 6–1.)

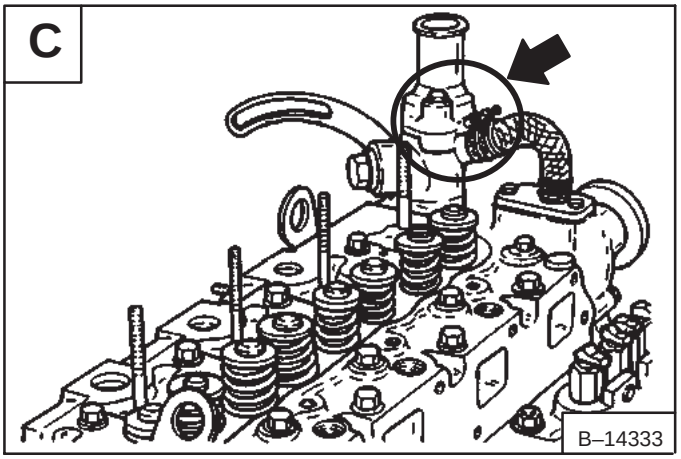
Remove the rocker arm and shaft assembly (Item 1) **[B]**.

Remove the push rods (Item 2) **[B]**.

Remove the intake and exhaust manifolds.



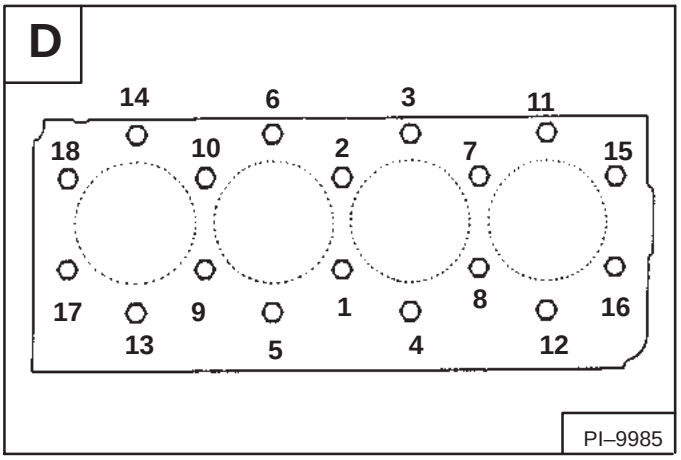
Remove the water return hose **[C]**.



Remove the cylinder head bolts in order of #18 to #1 **[D]**.

Installation: Put oil on the bolt threads. Tighten the bolts in the correct sequence to 68–72 ft.–lbs. (93–98 Nm) torque.

NOTE: Re–tighten the cylinder head bolts in the correct sequence after the engine has been run for 30 minutes.



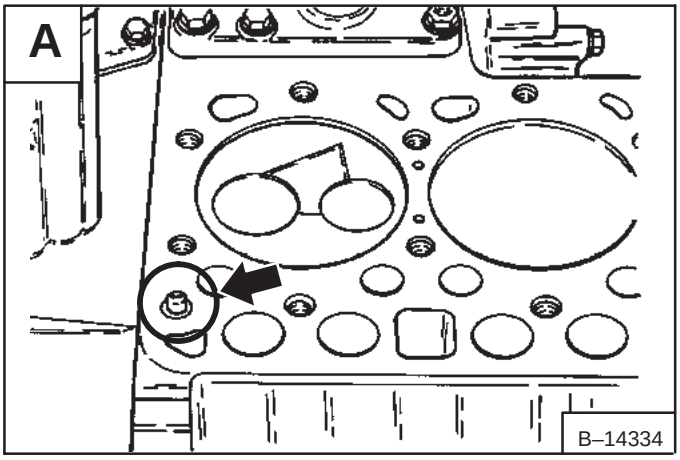
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CYLINDER HEAD (Cont'd)

Removal and Installation (Cont'd)

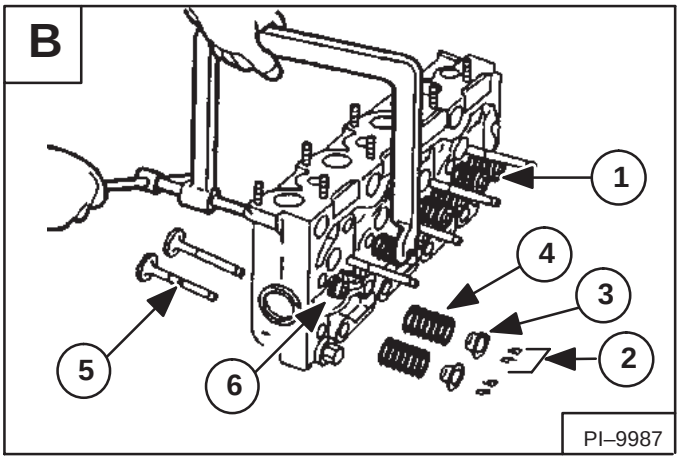
Remove the cylinder head from the engine block.

Installation: Always use new head gasket and new O–ring. Make sure the O–ring is seated over the dowel **[A]**.



Disassembly and Assembly

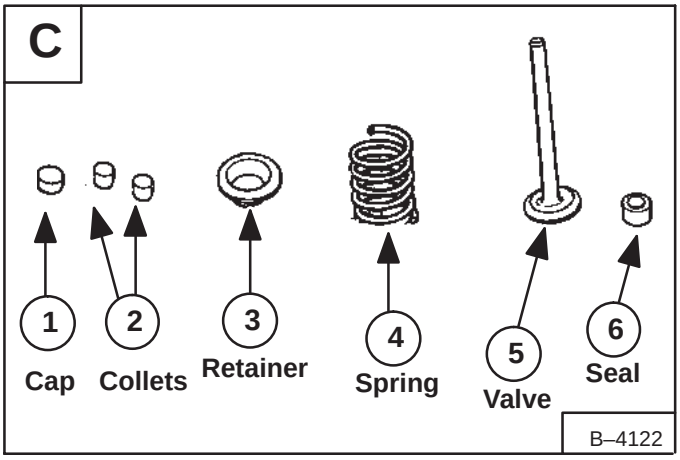
Use a valve spring compressor to compress the valve spring **[B]**.



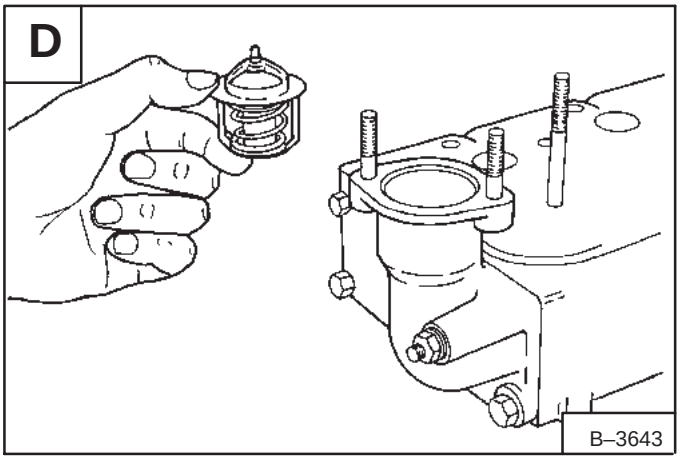
Remove the valve cap (Item 1) **[B]** & **[C]** and valve spring collet (Item 2) **[B]** & **[C]**.

Remove the valve spring retainer (Item 3) **[B]** & **[C]** and the spring (Item 4) **[B]** & **[C]**.

Remove the seal (Item 6) **[B]** & **[C]** and the valve (Item 5) **[B]** & **[C]**.



Remove the thermostat housing. Remove the thermostat from the cylinder head **[D]**.



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CYLINDER HEAD (Cont'd)

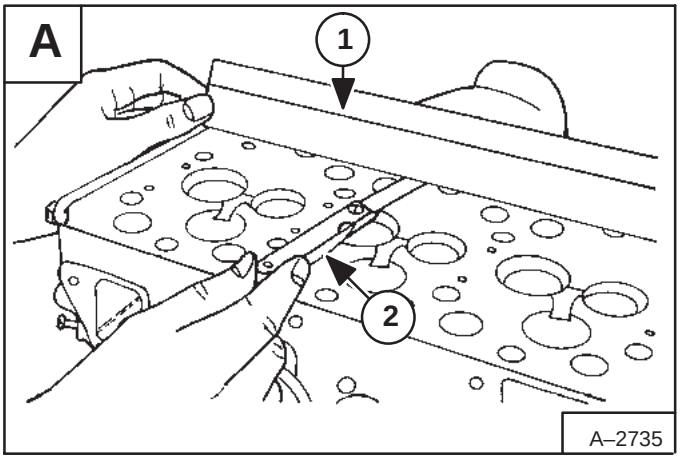
Servicing the Cylinder Head

Clean the surface of the cylinder head.

Put a straight edge (Item 1) **[A]** on the cylinder head.

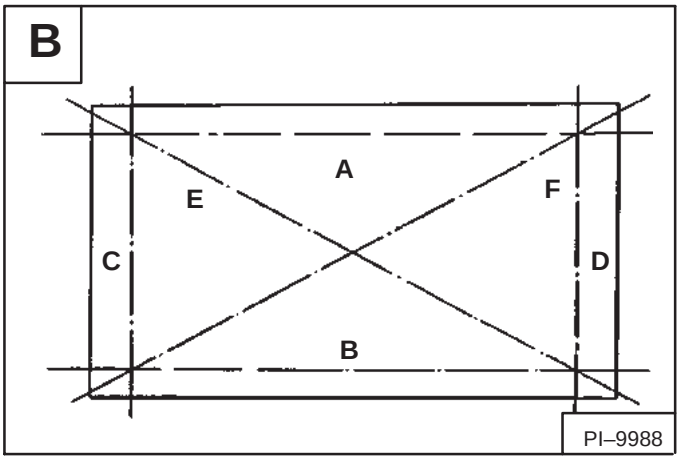
NOTE: Do not put the straight edge across combustion chambers.

Put a feeler gauge (Item 2) **[A]** between the straight edge and the surface of the cylinder head.



Put the straight edge on the cylinder head's four sides and two diagonal as shown in figure **[B]**.

The maximum distortion of the head surface is ± 0.002 inch (± 0,05 mm). If the measurement exceeds the specification, replace the cylinder head.

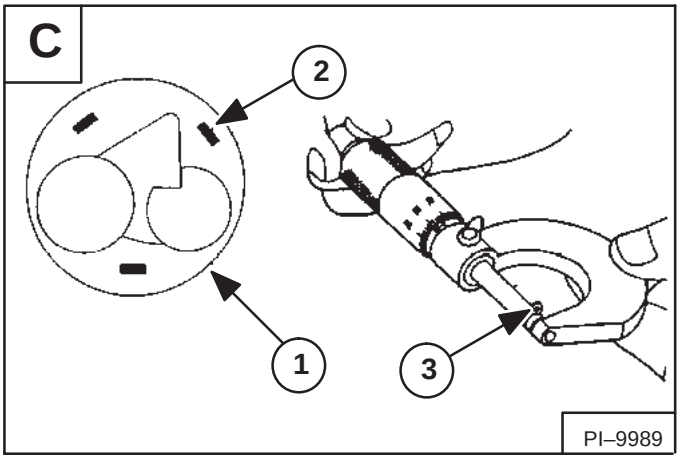


Top Clearance

Install the cylinder head gasket. Put the piston (Item 1) **[C]** being checked at T.D.C.

Put 3 pieces of 0.06 inch (1,5 mm) diameter solder (Item 2) **[C]** on the top of the piston. Use grease to hold them in position.

NOTE: Put the solder in position so they do not touch the valves.



Turn the piston to bottom dead center.

Install the cylinder head and tighten to the correct torque in the correct sequence. (See Page 7–25.)

Turn the crankshaft until the piston exceeds T.D.C. Remove the cylinder head.

Remove the solder wire (Item 3) **[C]** and measure it.

If the measurement exceeds the specifications, check the oil clearance of the crank pin journal or the piston pin.

Top Clearance . . . . . 0.022–0.028 inch (0,55–0,7 mm)

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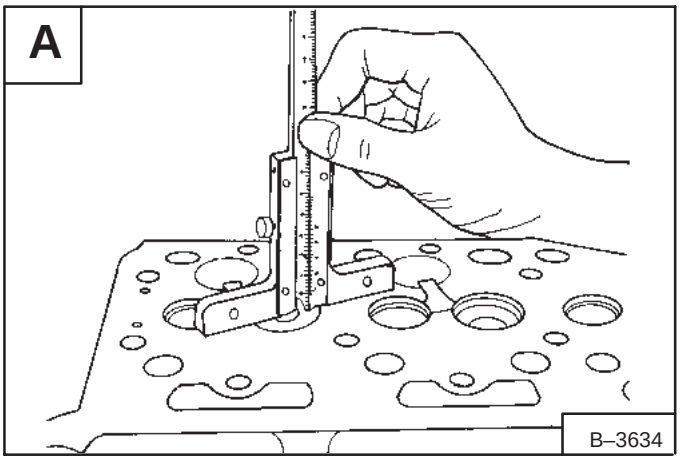
VALVE, VALVE SEAT AND GUIDE

Checking the Valve Guide

Remove the valve and spring from the cylinder head. (See Page 7–26.)

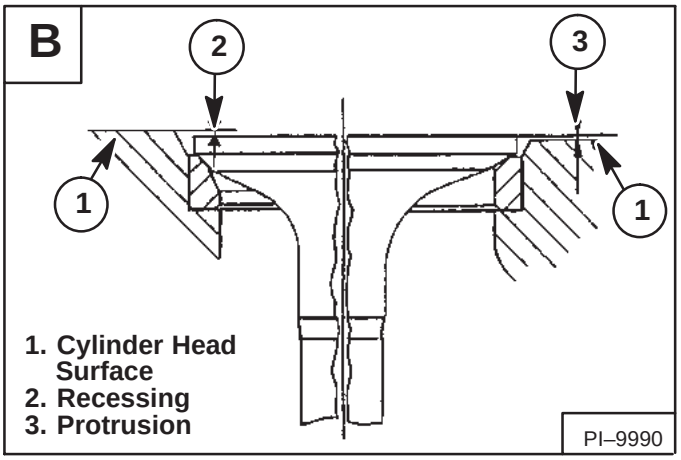
Clean the valve seat and combustion chamber.

Install the valve into the guide. Measure the valve recessing or protrusion with a depth gauge **[A]**.



If the measurement exceeds the allowable limit, replace the valve or cylinder head **[B]**.

Protrusion . . . . . 0.002” (0,5mm)
Recessing . . . . . 0.006” (0,15 mm)
Allowable Limit (Recessing) . . . . . 0.016” (0,4 mm)



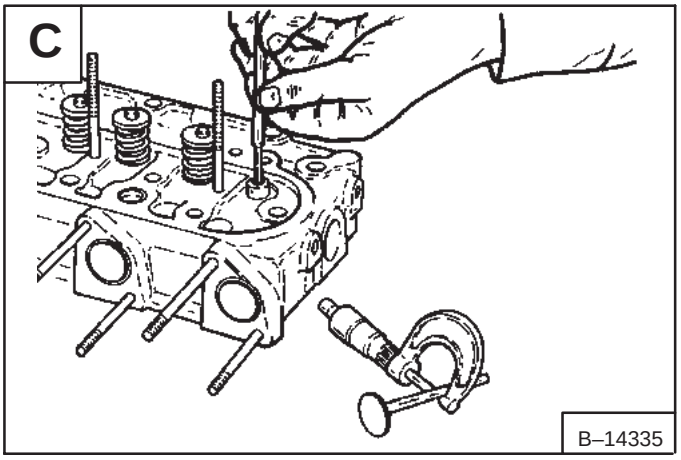
Remove the carbon from the valve guide.

Measure the valve stem O.D. **[C]**.

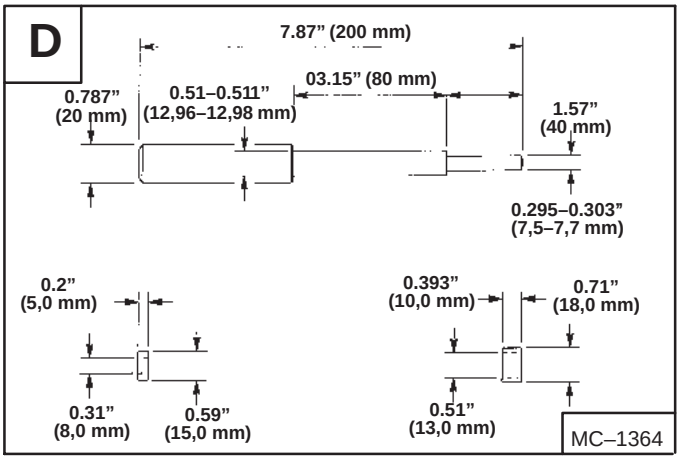
Measure the valve guide I.D. **[C]**.

Calculate the clearance. If the clearance exceeds the allowable limit, replace the valve and/or valve guide.

Valve Guide I.D. . . . . 0.3156–0.3161” (8,015–8,03 mm)
Valve Stem O.D. . . . . 0.3134–03140” (7,96–7,98 mm)
Clearance Between Valve Stem and Guide . . . . . 0.0016–0.0028” (0,04–0,07 mm)
Allowable Limit . . . . . 0.004” (0,1 mm)



To remove and replace the valve guide, make the driver tool as shown in figure **[D]**.



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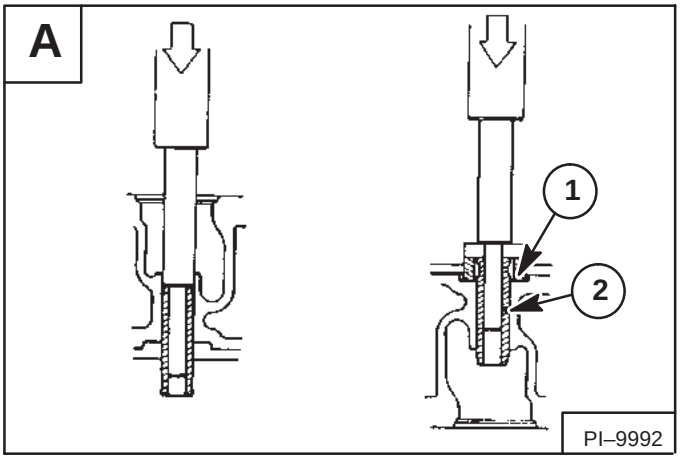
VALVE, VALVE SEAT AND GUIDE (Cont'd)

Checking the Valve Guide (Cont'd)

Press the used valve guide out of the cylinder head using the special driver tool **[A]**.

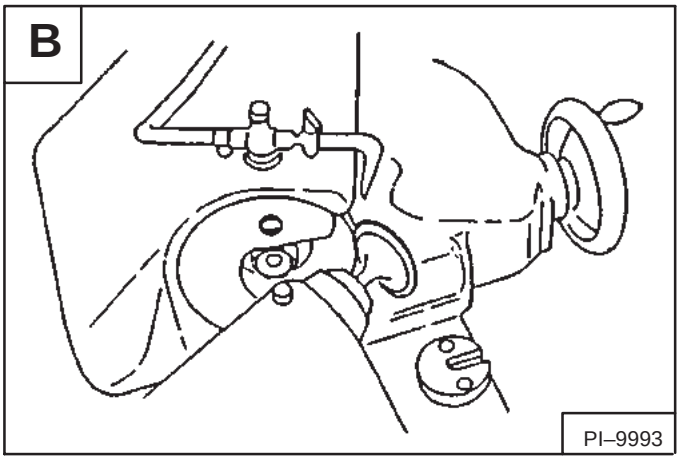
Put oil on the outside diameter of the new valve guide. Press the new valve guide into the cylinder head from the top side. Use the special driver tools (Items 1 & 2) **[A]**, press the new guide until the tool contacts the cylinder head.

Ream the valve guide to the correct specifications.

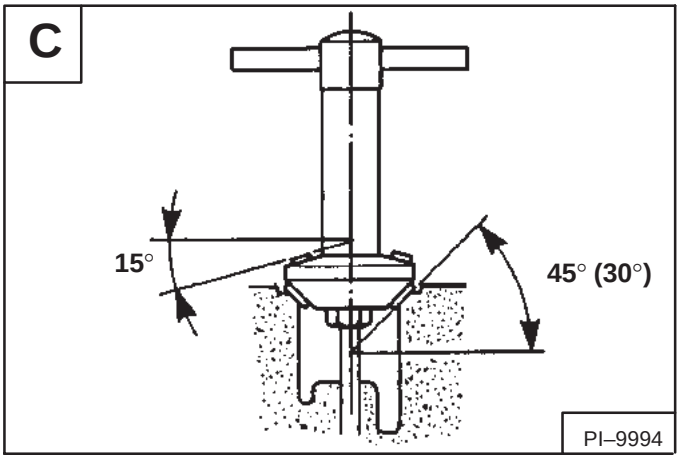


Reconditioning the Valve and Valve Seat

Grind the valve face to the correct angle using a valve refacer **[B]**.



Grind the valve seat surface in the cylinder head to the correct angle **[C]**.

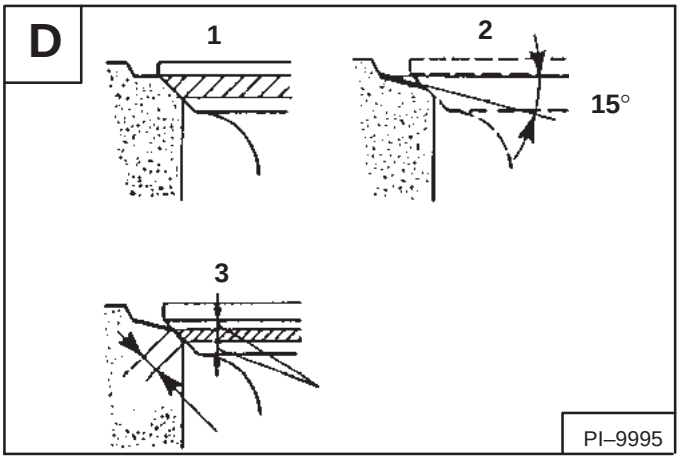


Check the seat surface and valve face (Item 1) **[D]**.

If the seat surface is too wide, use a 15 degree cutter (Item 2) **[D]** to get the correct width (Item 3) **[D]**.

Valve Seat Width
Intake . . . . . 0.084 inch (2,12 mm)
Exhaust . . . . . 0.084 inch (2,12 mm)

Valve Seat & Face Angle
Intake . . . . . 60°
Exhaust . . . . . 45°



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VALVE, VALVE SEAT AND GUIDE (Cont'd)

Valve Spring

Measure the length of the valve spring. If the measurement is less than the allowable limit, replace the spring **[A]**.

Free Length . . . . . 1.642–1.661 inch (41,7–42,2 mm)
Allowable Limit . . . . . 1.622 inch (41,2 mm)

Put the spring on a flat surface, place a square on the side of the spring **[A]**.

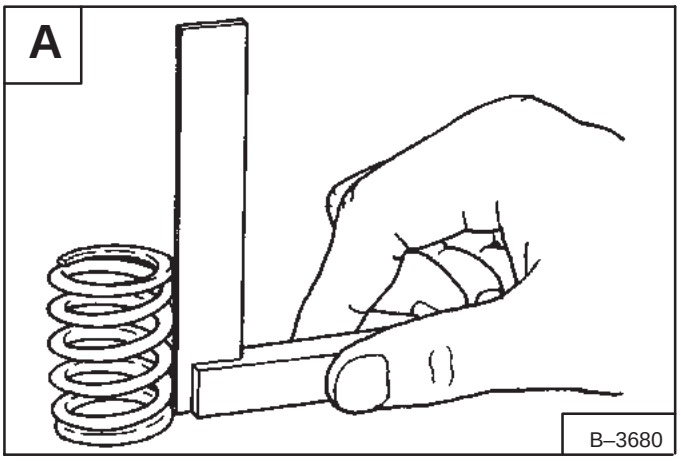
Rotate the spring and measure the maximum tilt. If the measurement excess the allowable limit, replace the spring.

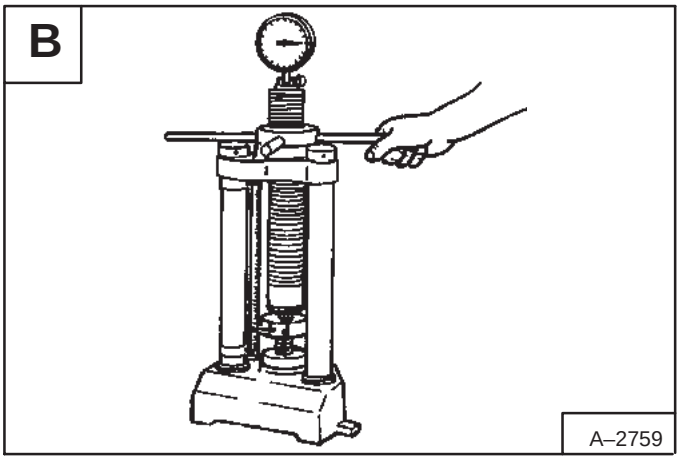
Tilt . . . . . 0.04 inch (1,0 mm)

Put the spring on a tester and compress to specified length **[B]**.

Read the compressed load on the gauge. If the measurement exceeds allowable limit, replace the spring.

Setting Length . . . . . 1.378 inch (35,0 mm)
Setting Load . . . . . 26.4 lbs. (117,6 N)
Allowable Limit . . . . . 22.5 lbs. (100,0 N)





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ROCKER ARM AND SHAFT

Checking

Measure the rocker arm I.D. (Item 1) **[A]** with an inside micrometer.

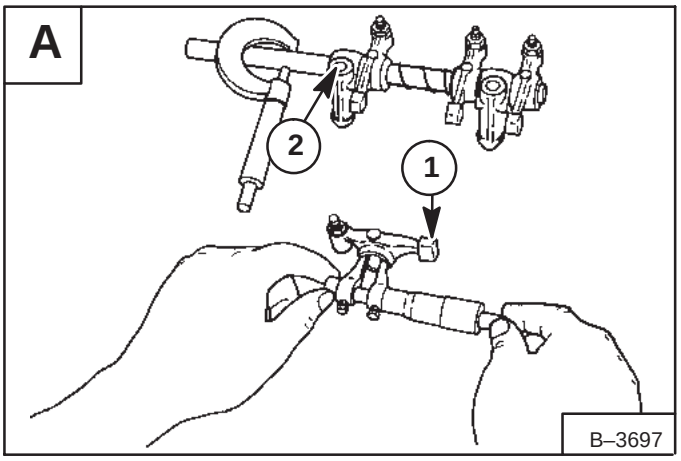
Measure the rocker arm shaft O.D. (Item 2) **[A]** with an outside micrometer.

If the clearance exceeds the allowable limit, replace the bushing.

If the clearance still exceeds the allowable limit after the bushing is replace, replace the rocker arm shaft.

Oil Clearance Between Rocker Arm
& Shaft . . . . . 0.006–0.0018 inch (0,016–0,045 mm)
Allowable Limit . . . . . 0.006 inch (0,15 mm)

Rocker Arm Shaft O.D. . . . . 0.550–0551 inch
(13,97–13,98 mm)
Rocker Arm I.D. . . . . 0.5512–0.5529 inch
(14,0–14,02 mm)



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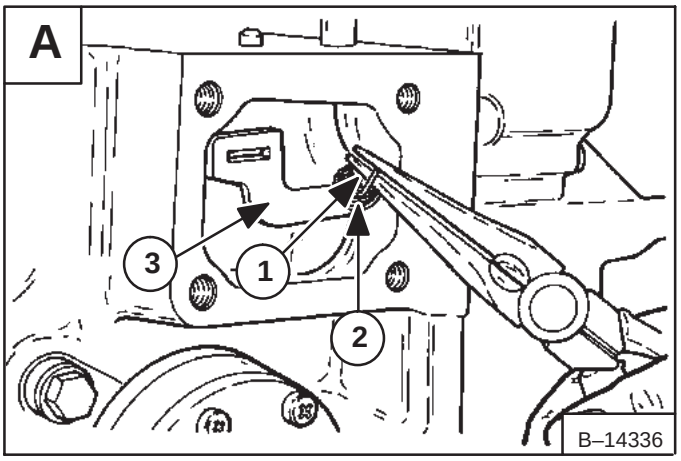
TIMING GEARCASE COVER

Removal and Installation

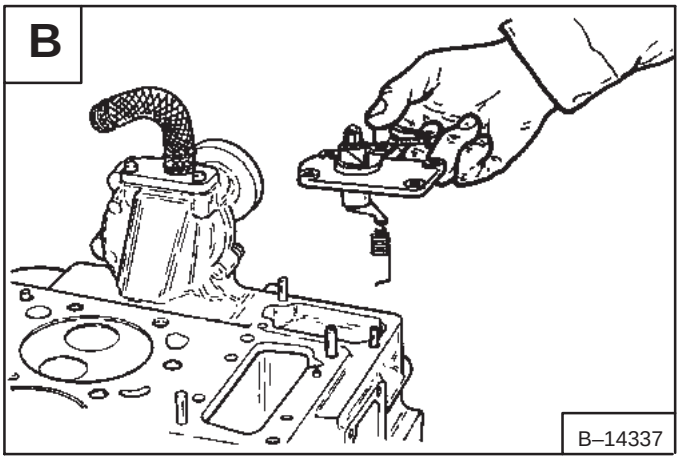
Remove the fuel injection pump. (See Page 7–7.)

Remove the cylinder head, rocker arms and push rods. (See Page 7–25.)

Disconnect the two governor springs (Items 1 & 2) **[A]** from the fork lever (Item 3) **[A]**.

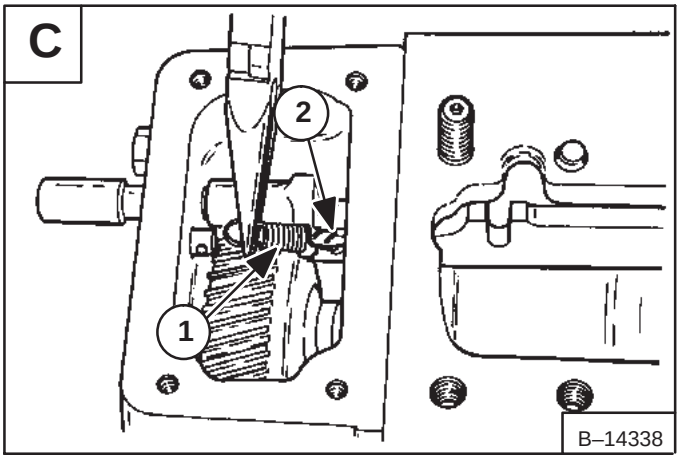


Remove the speed control plate with the governor springs **[B]**.



Remove the start spring (Item 1) **[C]** from the fork lever (Item 2) **[C]**.

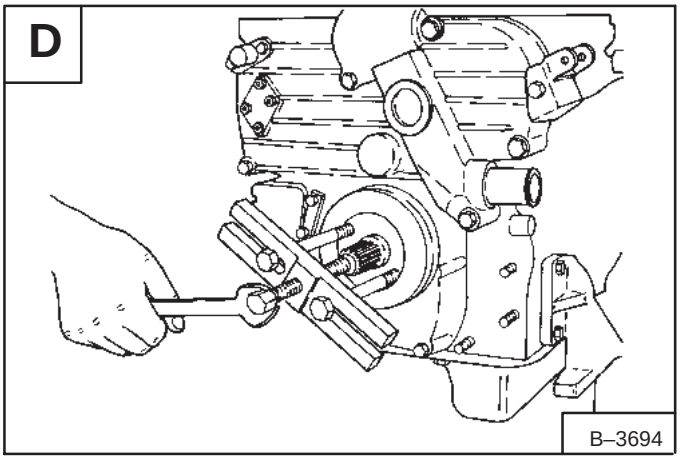
Installation: Be careful; do not drop the spring into the gearcase.



Remove the crankshaft pulley nut.

Installation: Tighten the nut to 101–116 ft.–lbs. (137–157 Nm) torque.

Use a puller and remove the crankshaft pulley **[D]**.



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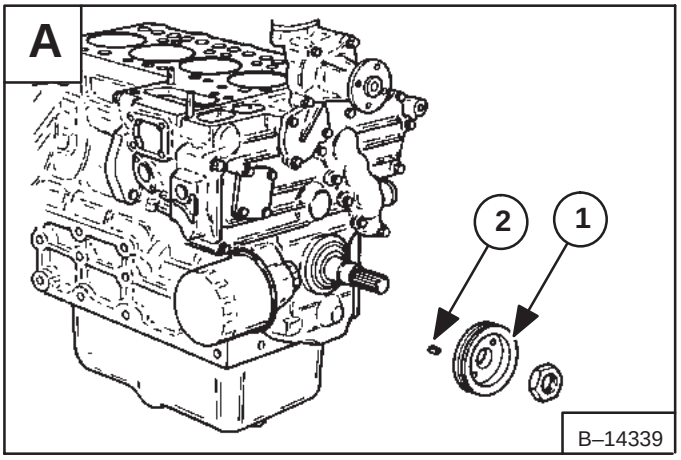
TIMING GEARCASE COVER (Cont'd)

Removal and Installation (Cont'd)

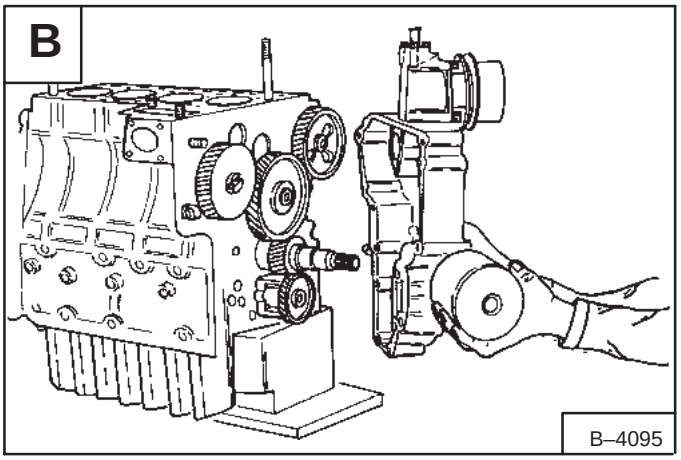
Remove the crankshaft pulley (Item 1) **[A]** and key (Item 2) **[A]**.

Remove the bolts from the timing gearcase cover.

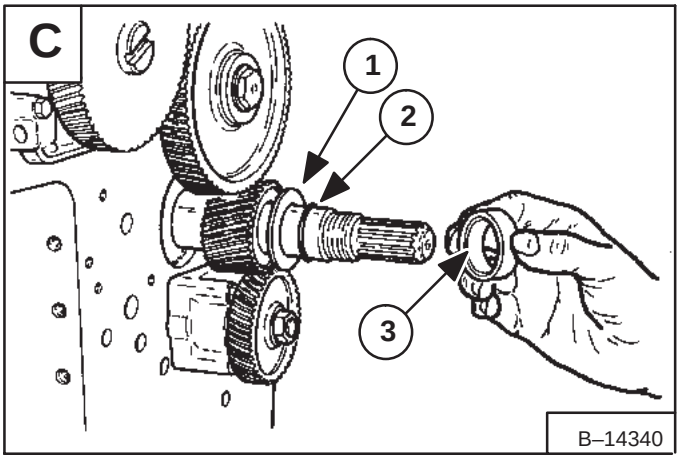
Installation: Tighten the bolts to 13–15 ft.–lbs. (18–20 Nm) torque.



Remove the timing gearcase cover **[B]**.

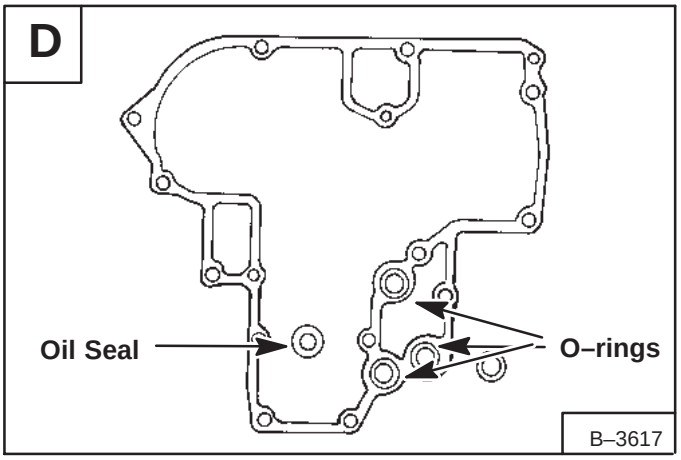


Remove the crankshaft oil slinger (Item 1) **[C]**, O–ring (Item 2) **[C]** and collar (Item 3) **[C]**.



Installation: Install new O–rings and oil seal into the timing gearcase cover **[D]**.

NOTE: When a new timing gearcase cover is installed, to establish the *correct position* of the injection pump fuel rack stop before removing it from the old timing gearcase cover, the distance from the machined surface of the gearcase (gasket surface) to the end of the stop should be measured. The stop should then be installed in the new gearcase and set to the same distance that was previously measured. Do not try to test operate the engine to establish if it has enough power. The adjustment must be set by a qualified service personnel for the injection pump.



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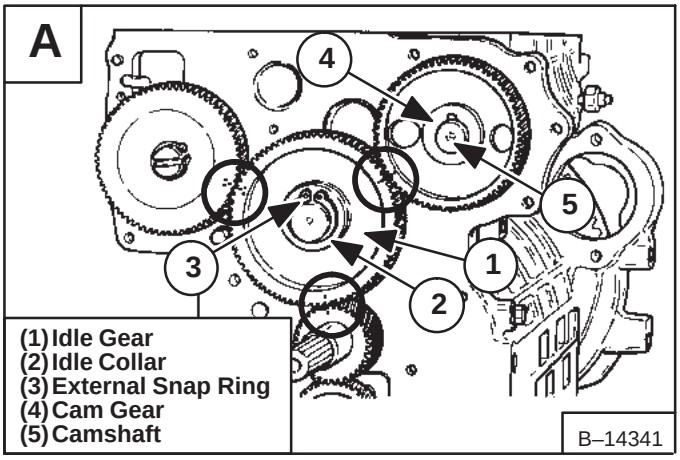
IDLER GEAR AND CAMSHAFT

Removal and Installation

Remove the timing gearcase cover. (See Page 7–32.)

Remove the snap ring (Item 3) **[A]** from the idler gear shaft (Item 1) **[A]**.

Installation: Make sure the timing marks are in correct alignment when installing the timing gears **[A]**.



Remove the idler gear (Item 1) **[B]**.

Remove the idler gear collar (Item 2) **[B]**.

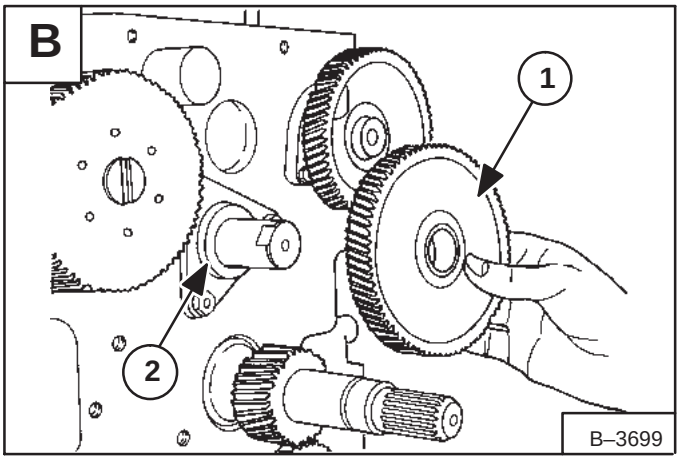
Remove the idler gear shaft mounting bolts.

Installation: Tighten the mounting bolts to 17–20 ft.–lbs. (23–27 Nm) torque.

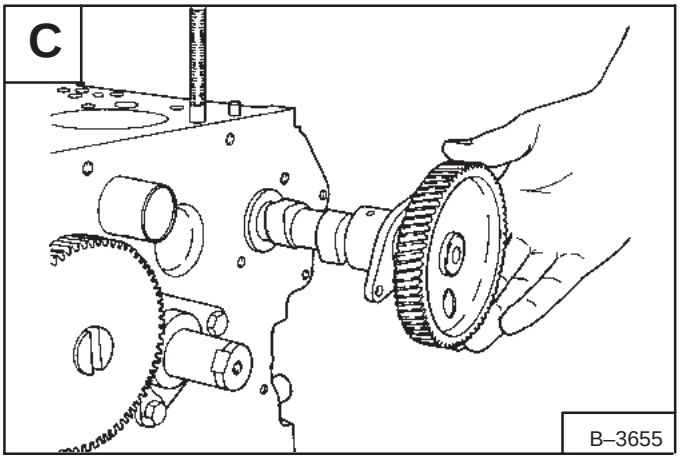
Align the holes on the camshaft gear with the camshaft retainer plate bolts.

Remove the bolts.

Installation: Tighten the camshaft retainer bolts to 17–20 ft.–lbs. (23–27 Nm) torque.

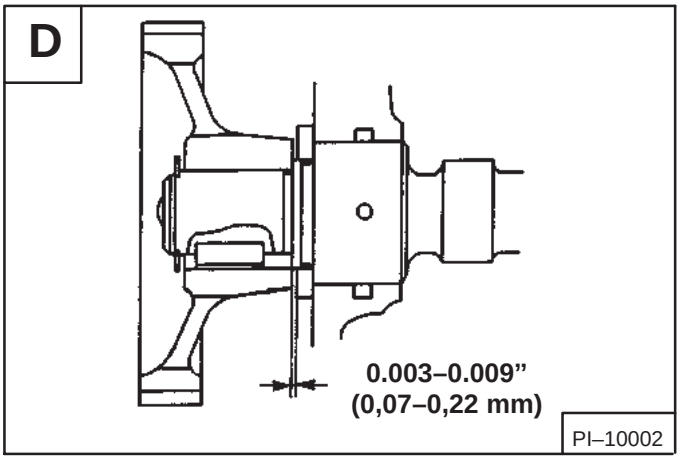


Remove the camshaft from the engine block **[C]**.



Installation: Check the camshaft end play, if the clearance exceeds the allowable limit, replace the camshaft retainer plate **[D]**.

Camshaft End Play . 0.003–0.009 inch (0,07–0,22 mm)
Allowable Limit . . . . . 0.012 inch (0,3 mm)

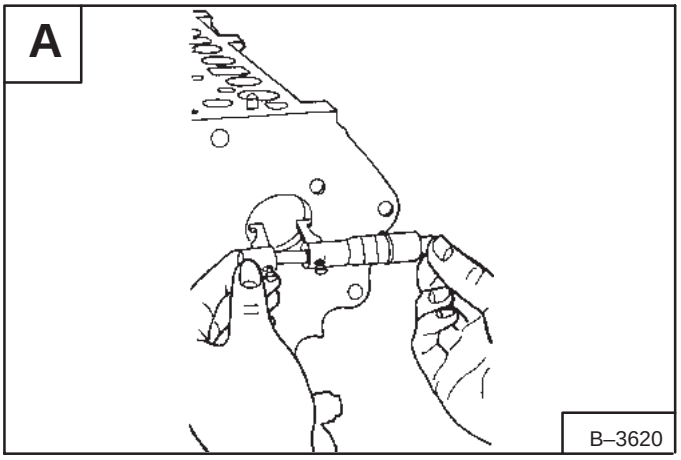


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IDLER GEAR AND CAMSHAFT (Cont'd)

Servicing the Camshaft

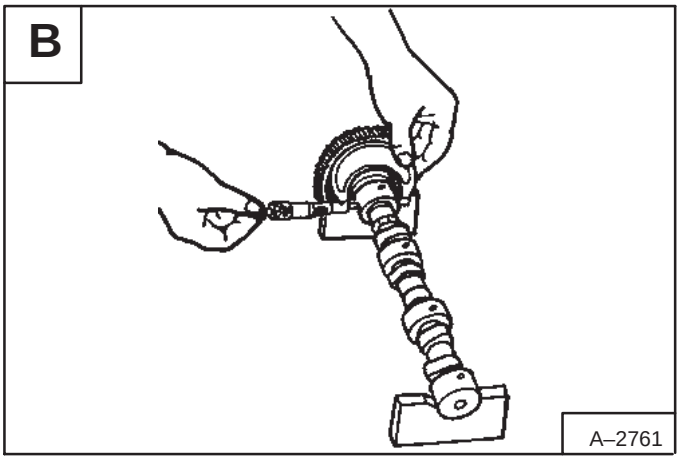
Measure the camshaft bearing in the engine block **[A]**.



Measure the camshaft journal **[B]**.

Calculate the oil clearance. If the clearance exceeds the allowable limit, replace the camshaft.

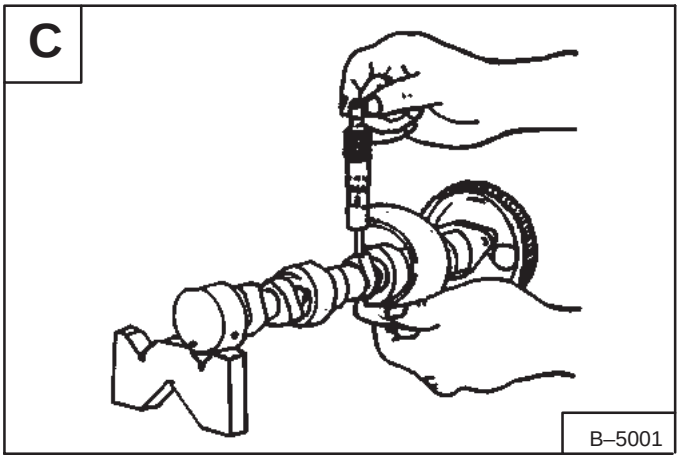
Bearing I.D. . . . . 1.575–1.576 inch (40,0–40,03 mm)
Journal O.D. . . . . 1.572–1.573 inch (39,93–39,95 mm)
Oil Clearance of Camshaft
Journal . . . . . 0.002–0.004 inch (0,05–0,09 mm)
Allowable Limit . . . . . 0.006 inch (0,15 mm)



Measure the cam lobes at their highest point **[C]**.

If the measurement is less than the allowable limit, replace the camshaft.

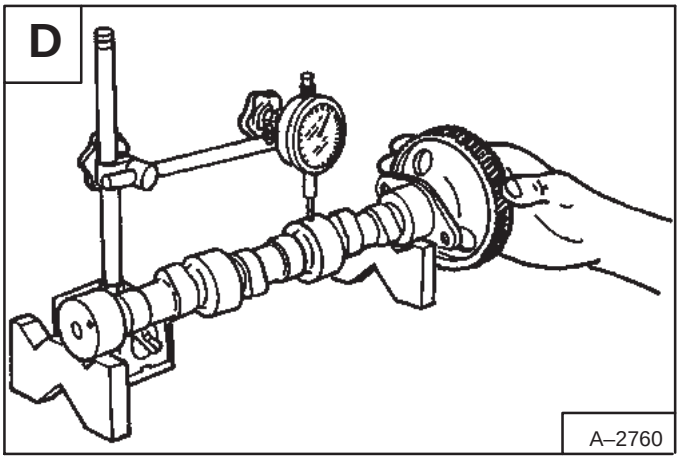
Cam Lob Height . . . . . 1.318 inch (33,47 mm)
Allowable Limit . . . . . 1.316 inch (33,42 mm)



Put the camshaft in V–blocks. Install a dial indicator **[D]**.

Turn the camshaft at a slow rate. If the misalignment exceeds the allowable limit, replace the camshaft.

Camshaft Alignment Allowable Limit . . . . . 0.004 inch (0,01 mm)



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IDLER GEAR AND CAMSHAFT (Cont'd)

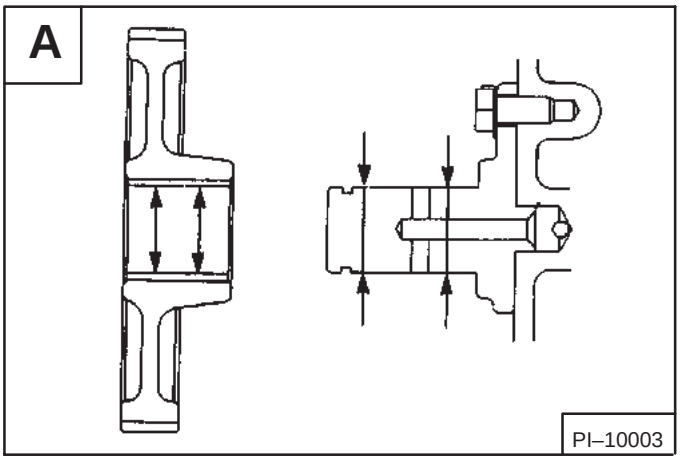
Servicing the Idler Gear and Shaft

Measure the O.D. of the idler gear shaft **[A]**.

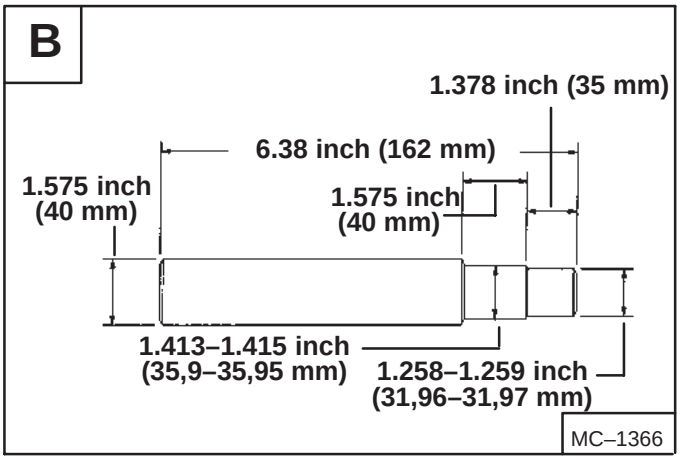
Measure the I.D. of the idler gear bushing **[A]**.

If the clearance exceeds the allowable limit, replace the bushing.

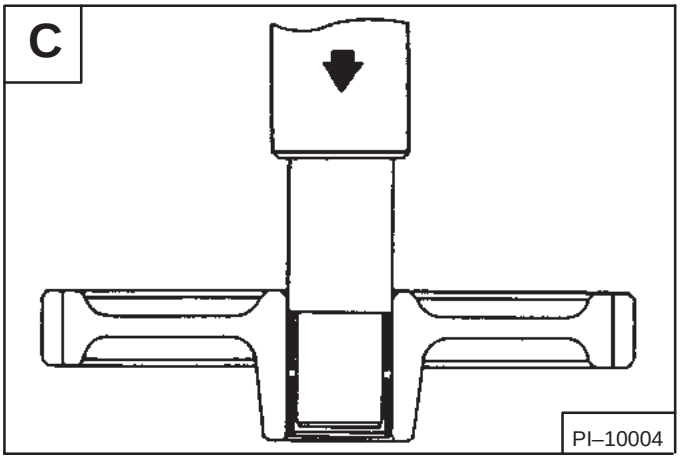
Idler Gear Shaft O.D. . . . . 1.258–1.259 inch (31,96–31,97 mm)
Idler Gear Bushing I.D. . . . . 1.259–1.261 inch (32,0–32,03 mm)
Clearance between Idler Shaft & Gear Bushing . . . 0.001–0.003 inch (0,025–0,07 mm)
Allowable Limit . . . . . 0.004 inch (0,1 mm)



To replace the idler gear bushing, make a driver tool as shown in figure **[B]**.



Use a press and special driver tool, to remove the old bushing and install the new bushing **[C]**.



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TIMING GEARS

Checking Backlash

When the gears are installed, check the backlash of the gears.

Install a dial indicator **[A]**.

Hold one gear while turning the other gear **[A]**.

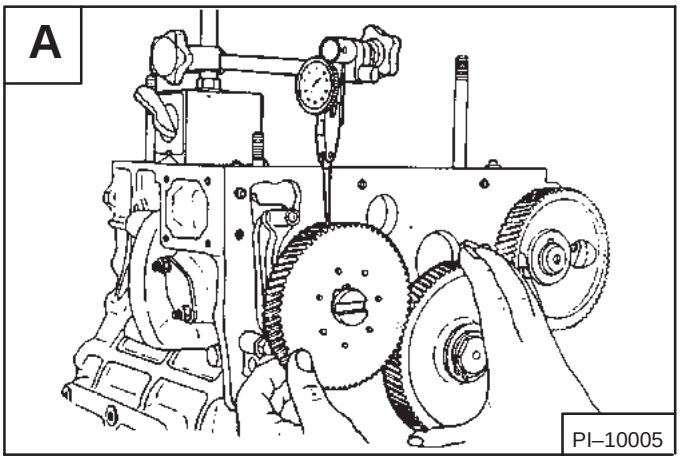
If the backlash exceeds the allowable limit, check the oil clearance of the shaft and gear. If the oil clearance is correct, replace the gear.

Crank Gear & Idler Gear . . . . . 0.002–0.004 inch (0,042–0,10)
Allowable Limit . . . . . –.006 inch (0,15 mm)

Cam Gear & Idler Gear . . . . . 0.002–0.005 inch (0,042–0,12 mm)
Allowable Limit . . . . . 0.006 inch (0,15 mm)

Injection Pump Gear & Idler Gear . . . 0.002–0.005 inch (0,042–0,115 mm)
Allowable Limit . . . . . 0.006 inch (0,15 mm)

Oil Pump Gear & Idler . . . . . 0.002–0.004 inch (0,042–0,109 mm)
Allowable Limit . . . . . 0.006 inch (0,15 mm)



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FUEL CAMSHAFT

Removal and Installation

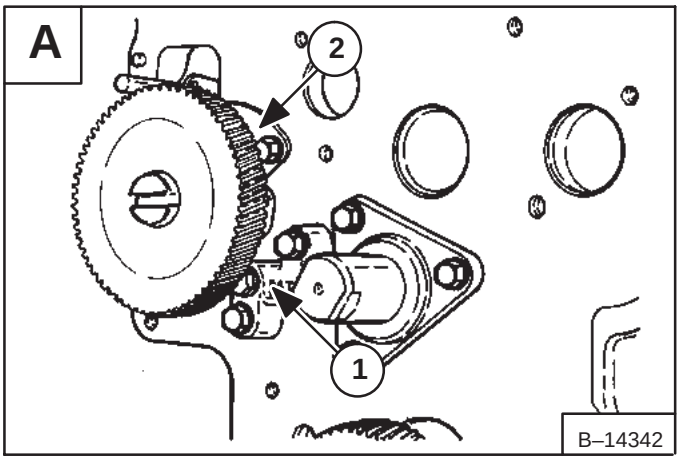
Remove the timing gearcase cover. (See Page 7–32.)

Remove the idler gear. (See Page 7–34.)

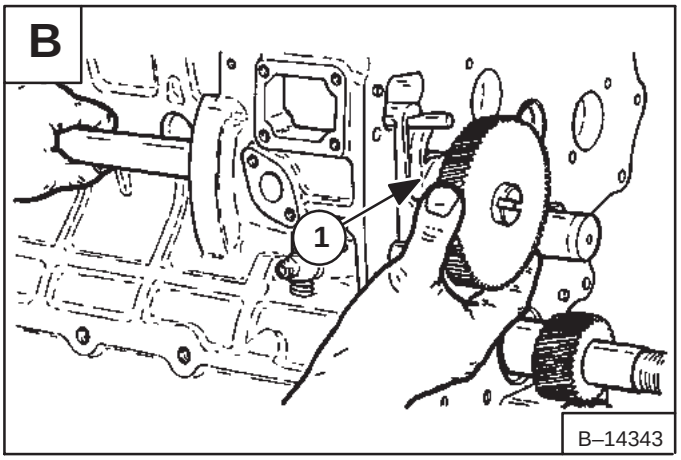
Remove the bolt (Item 1) **[A]** from the retainer plate (Item 2) **[A]**.

Installation: Tighten the bolt to 60–72 in.–lbs. (6,8–8,1 Nm) torque.

Remove the fuel camshaft retainer plate (Item 2) **[A]**.



Remove the fuel camshaft and fork lever assembly (Item 1) **[B]** at the same time.

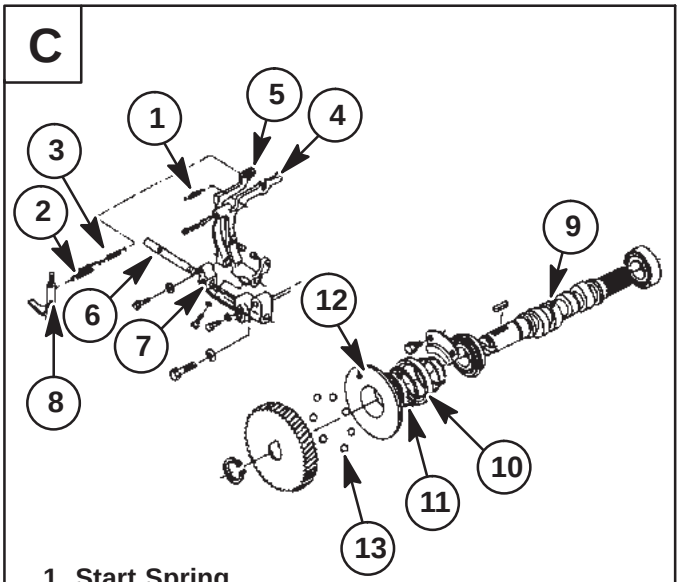


Governor

The governor serves to keep the engine speed constant by automatically adjusting the amount of fuel supplied to the engine according to changes in the load.

Disassemble and assemble the governor and fuel camshaft as shown in figure **[C]**.

Check all the parts for wear or damage and replace as needed.



1. Start Spring
2. Governor Spring
3. Governor Spring
4. Fork Lever
5. Fork Lever
6. Fork Lever Shaft
7. Fork Lever Holder
8. Governor Lever
9. Fuel Camshaft
10. Governor Ball Case
11. Steel Balls
12. Governor Sleeve
13. Steel Ball

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CRANKSHAFT GEAR

Removal and Installation

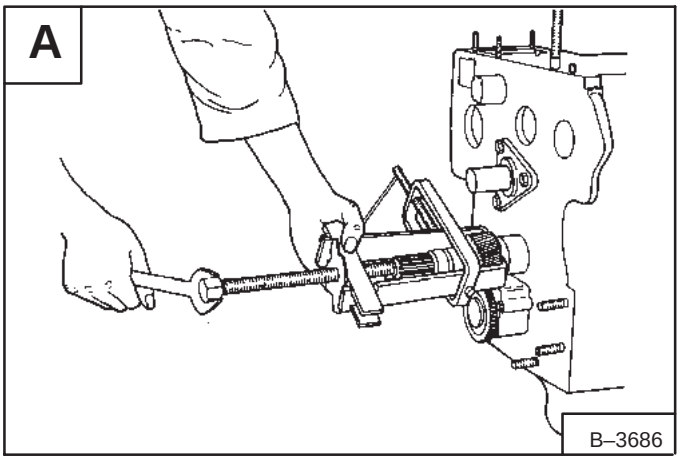
Remove the timing gearcase cover. (See Page 7–32.)

Remove the idler gear. (See Page 7–34.)

Remove the crankshaft gear with a puller **[A]**.

Remove the crankshaft key.

Installation: Install the crankshaft key. Heat the crankshaft gear to 176°F (80°C) and fit it on the crankshaft.



OIL PUMP

Removal and Installation

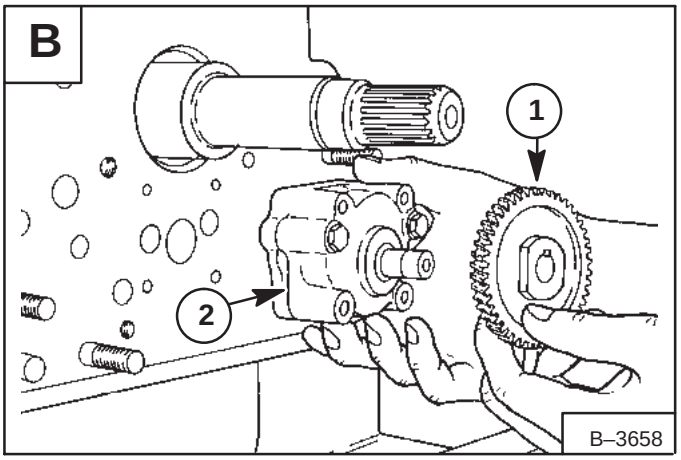
Remove the timing gearcase cover. (See Page 7–32.)

Remove the crankshaft gear.

Remove the nut from the oil pump shaft. Use a puller to remove the oil pump gear (Item 1) **[B]**.

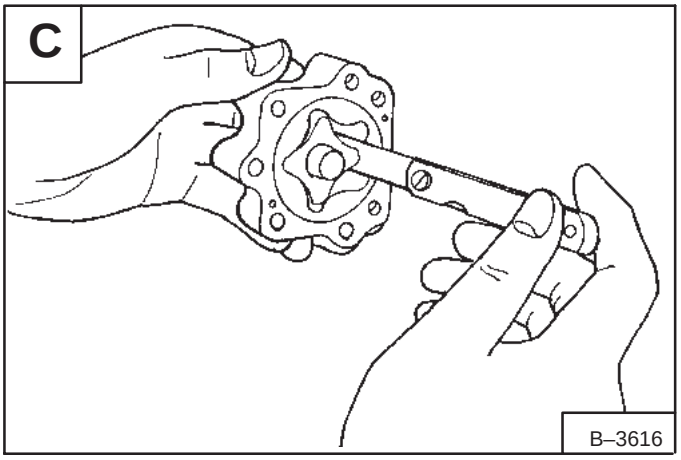
Remove the oil pump mounting bolts. Remove the oil pump (Item 2) **[B]**.

Installation: Tighten the oil pump mounting bolts to 60–72 in.–lbs. (6,9–8,1 Nm) torque.



Oil Pump Service

Measure the clearance between the lobes of the inner rotor and outer rotor **[C]**.

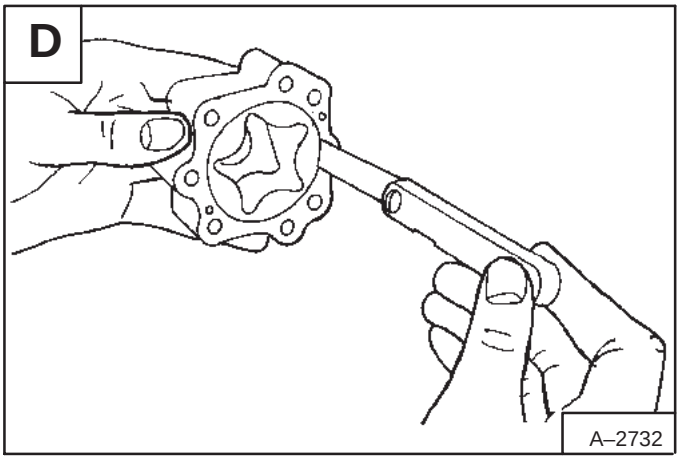


Measure the clearance between the outer rotor and pump body **[D]**.

If the clearance exceeds the allowable limit, replace the oil pump.

Clearance Between Inner & Outer Rotor . . . . 0.0012–0.006 inch (0,10–0,16 mm)

Clearance Between Outer Rotor & Body . . . . . 0.004–0.008 inch (0,11–0,19 mm)



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OIL PUMP (Cont'd)

Oil Pump Service (Cont'd)

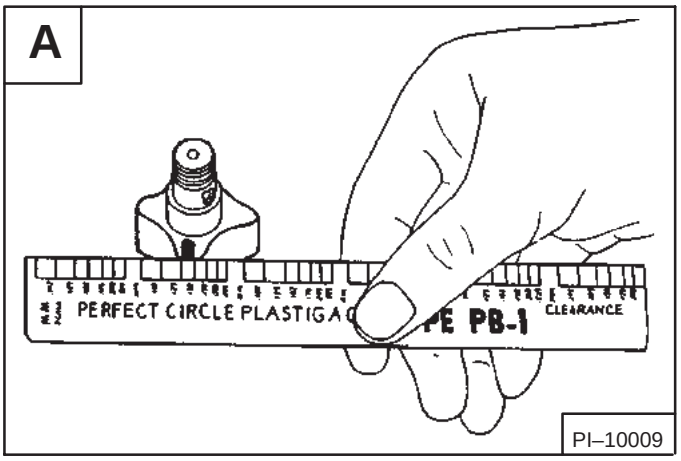
Put a piece of press gauge on the rotor face **[A]**.

Install the cover and tighten the bolts.

Remove the cover carefully. Measure the width of the press gauge **[A]**.

If the clearance exceeds the allowable limit replace the oil pump.

End Clearance . . . . . 0.004–0.006 inch (0,11–0,15 mm)



ENGINE COMPRESSION

Checking Engine Oil Pressure

Remove the oil pressure sensor.

Install a pressure gauge **[B]**.

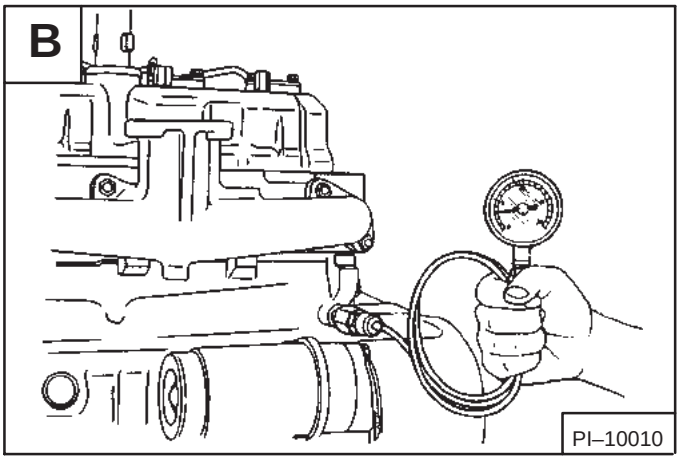
Start the engine and run until it is at operating temperature.

If the oil pressure is less than the allowable limit, check the following items:

* Engine Oil Level Low
* Oil Pump Defective
* Oil Galley Plugged
* Oil Strainer Plugged
* Excessive Clearance at the Rod & Main Bearings
* Relief Valve Stuck

At Idle Speed Allowable Limit . . . . . 7 PSI (49 kPa)

At Rated Speed . . . . . 43–65 PSI (294–441 kPa)
Allowable Limit . . . . . 36 PSI (245 kPa)

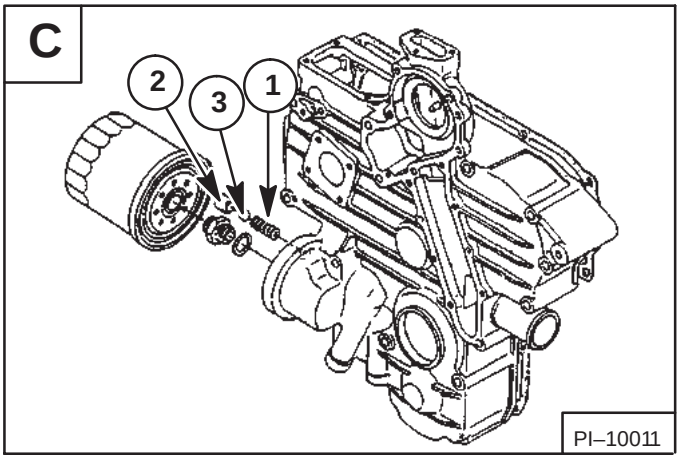


Relief Valve

The relief valve prevents damage of the lubricating system due to high pressure. This relief valve is a ball type.

Remove the valve seat (Item 2) **[C]**, Ball (Item 3) **[C]** and spring (Item 1) **[C]**.

Check the parts for wear or damage and replace as needed.



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PISTON AND CONNECTING ROD

Removal and Installation

Remove the cylinder head. (See Page 7–25.)

Remove the top edge from the cylinder bore with a ridge reamer.

Remove the oil pan.

Remove the oil pump strainer (Item 1) **[A]**.

Turn the flywheel and put a pair of connecting rods at bottom dead center.

Remove the connecting rod bolts.

Installation: Tighten the connecting rod bolts to the following torque:

W/O Flange Bolt . . . . . 27–30 ft.–lbs. (37–41 Nm)
W/Flange Bolt . . . . . 33–36 ft.–lbs. (45–49 Nm)

Remove the rod cap and bearing **[B]**.

Use a hammer handle and push the piston/connecting rod assembly out of the cylinder bore **[B]**.

NOTE: Make sure the pistons are marked so they will be returned to the same cylinder bore.

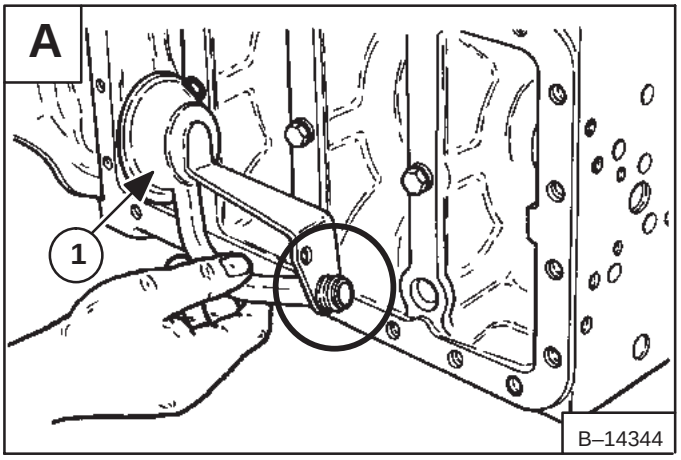
Installation: Make sure the marks on the connecting rod and bearing are aligned when installing the bearing cap **[C]**.

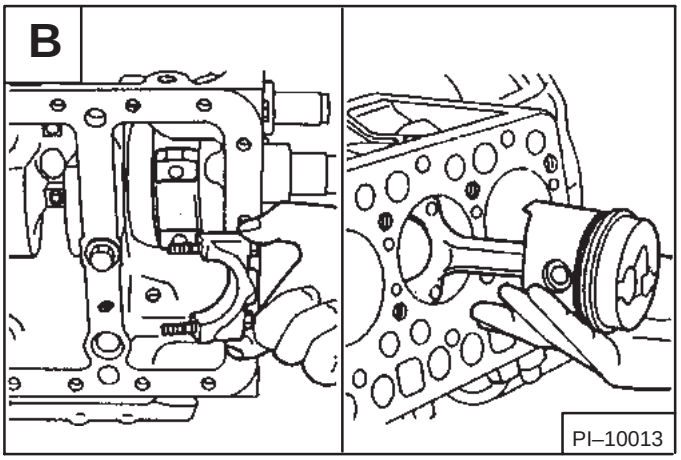
Repeat the procedure to remove the other piston/connecting rod assemblies from the engine block.

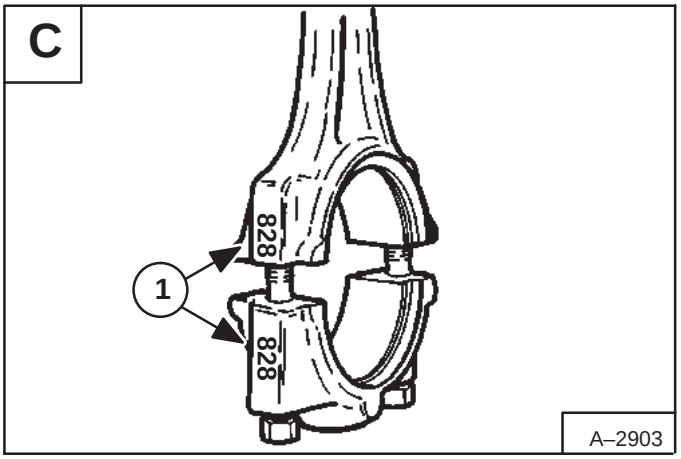
Remove the piston rings **[D]**.

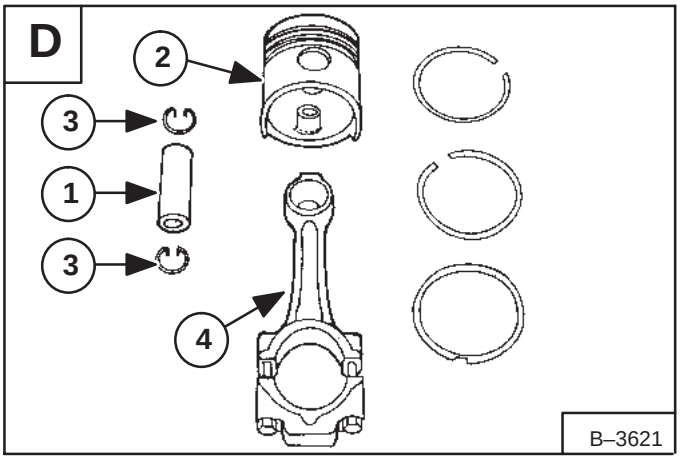
Remove the snap ring (Item 3) **[D]** and piston pin (Item 1) **[D]**.

Separate the piston (Item 2) **[D]** from the connecting rod (Item 4) **[D]**.







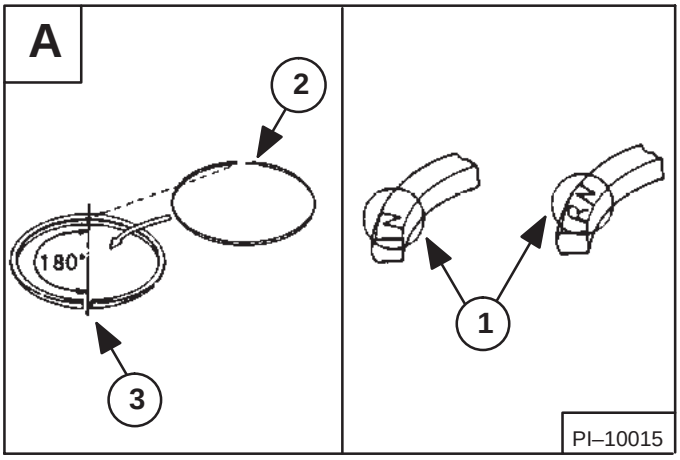


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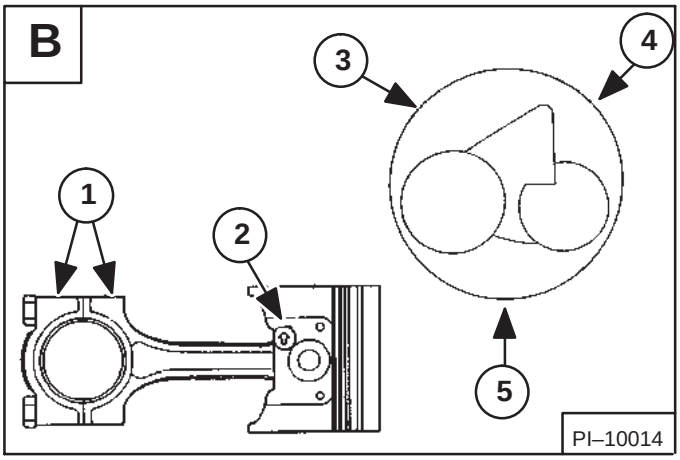
PISTON AND CONNECTING ROD (Cont'd)

Removal and Installation (Cont'd)

Installation: When installing new rings, assemble the ring so the mark (Item 1) **[A]** near the gap faces the top of the piston. When installing the oil ring, place the expander joint (Item 2) **[A]** on the opposite side of the oil ring gap (Item 3) **[A]**.



Installation: When reassembling, align the marks (Item 1) on the connecting rod and piston (Item 2) **[B]**. Heat the piston to 176–212°F. (80–100°C.) and tap the piston pin into position. Place the piston rings so that there are gaps every 120 degrees (Items 3, 4 & 5) **[B]** with no gap facing the piston pin in the cylinder.

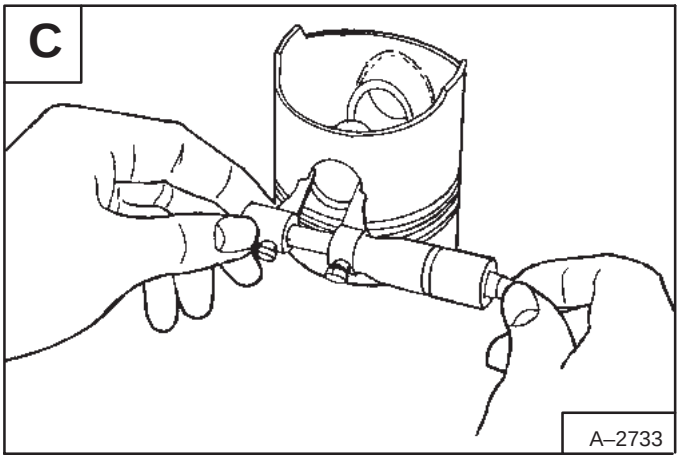


Servicing the Piston and Connecting Rod

Measure the I.D. of the piston pin bore in both horizontal and vertical directions **[C]**.

If the measurement exceeds the allowable limit, replace the piston.

Piston Pin Bore I.D. . . . . 0.984–0.985 inch (25,0–25,013 mm)
Allowable Limit . . . . . 0.986 inch (25,05 mm)

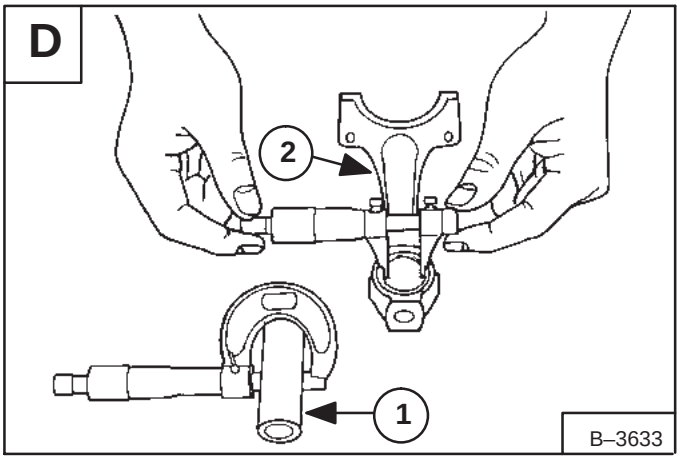


Measure the O.D. of the piston pin (Item 1) **[D]**.

Measure the I.D. of the connecting rod small end (Item 2) **[D]**.

Calculate the oil clearance. If the clearance exceeds the allowable limit, replace the bushing. If it still exceeds the specifications, replace the piston pin.

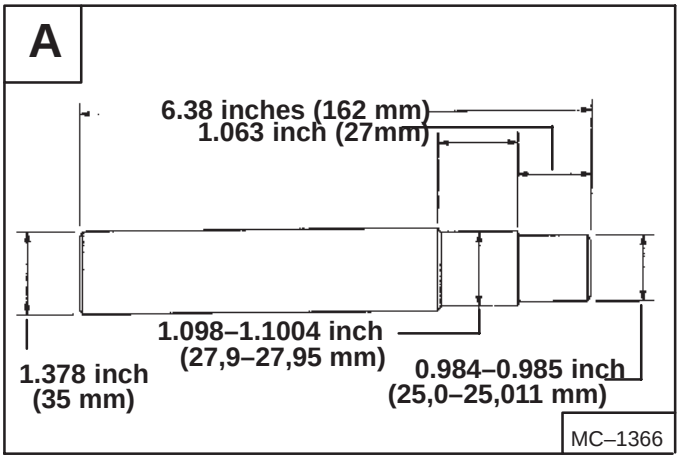
Piston Pin O.D. . . 0.984–0.985 inch (25,0–25,011 mm)
Bushing I.D. . . . . 0.985–0.986 inch (25,03–25,04 mm)
Oil Clearance between Piston Pin & Bushing . . . 0.0006–0.0015 inch (0,014–0,038 mm)
Allowable Limit . . . . . 0.006 inch (0,15 mm)
Service Replacement Part . . . . . 0.0006–0.003 inch (0,015–0.07 mm)



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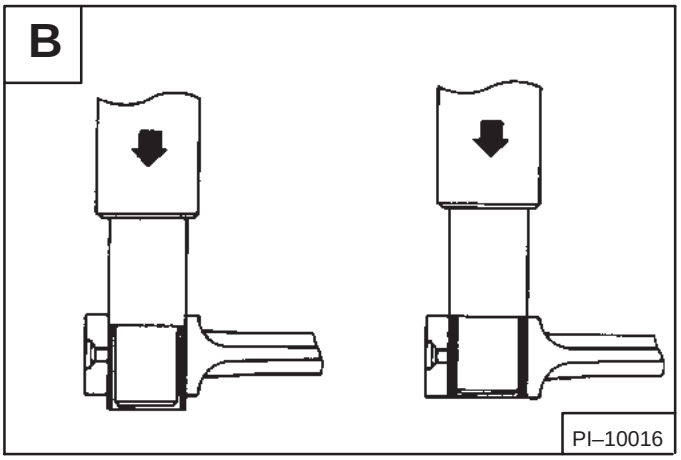
Servicing the Piston and Connecting Rod (Cont'd)

To replace the connecting rod small end bushing, make a driver tool as shown in figure **[A]**.



Use a press and special driver tool to remove the small end bushing **[B]**.

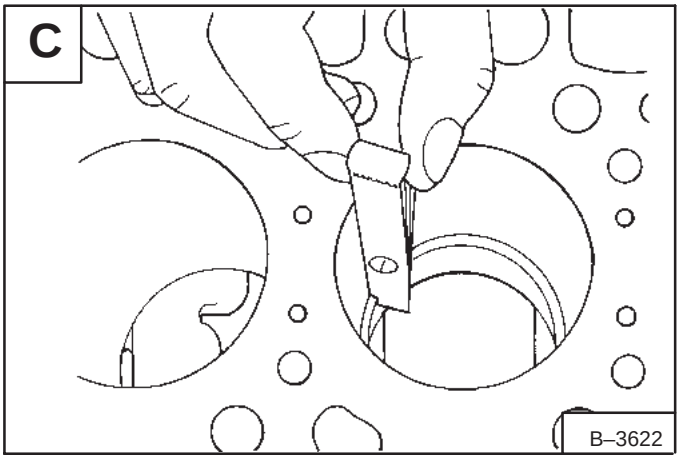
Installation: Clean the small end bushing and bore. Put oil on the bushing and press into the connecting rod until it is flush **[B]**.



Install a new piston ring into the lower part of the cylinder bore. Measure the ring gap with a feeler gauge **[C]**.

If the gap exceeds the allowable limit, replace the cylinder liner.

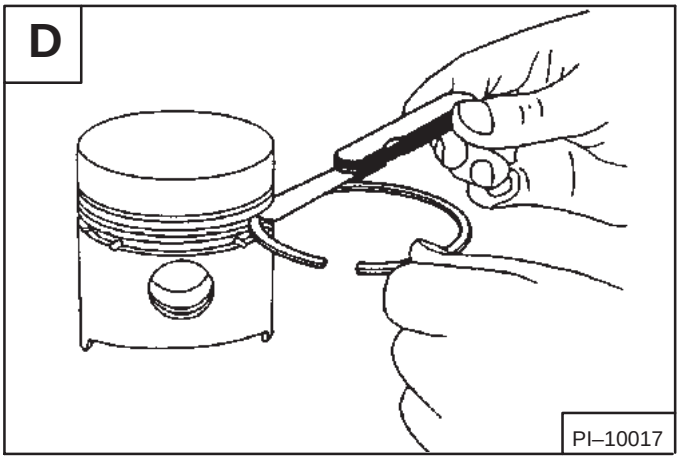
Compression Ring Gap . . . . . 0.012–0.018 inch (0,3–0,5 mm)
Oil Ring Gap . . . . . 0.010–0.018 inch (0,25–0,45 mm)
Allowable Limit . . . . . 0.05 inch (1,25 mm)



Remove the carbon from the ring grooves. Measure the clearance between the ring and groove with a feeler gauge **[D]**.

If the clearance exceeds the allowable limit, replace the piston.

Compression Ring . . . . . 0.008 inch (0,2 mm)
Oil Ring . . . . . 0.006 inch (0,15 mm)



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PISTON AND CONNECTING ROD (Cont'd)

Connecting Rod Alignment

NOTE: The small end bushing is the basis of this check, check the bushing for wear before doing this check.

Install the piston pin into the connecting rod.

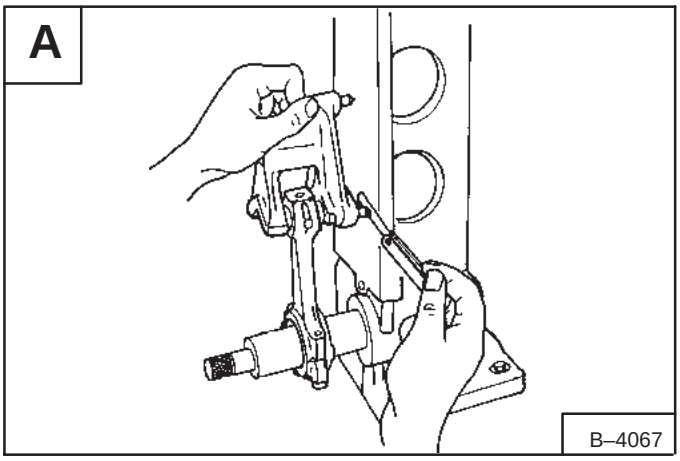
Install the connecting rod on an alignment tool.

Put the gauge over the piston pin and move it against the face plate.

If the gauge does not fit squarely against the face plate, measure the space between the gauge and face plate **[A]**.

If the measurement exceeds the allowable limit, replace the connecting rod.

Rod Alignment . . . . . 0.002 inch (0,05 mm)



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CRANKSHAFT AND BEARINGS

Removal and Installation

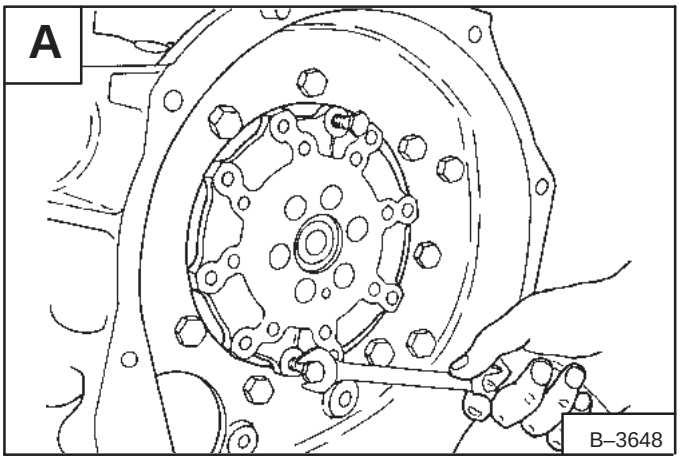
Remove the piston and connecting rod assemblies. (See Page 7–41.)

Remove the engine flywheel. (See Page 7–24.)

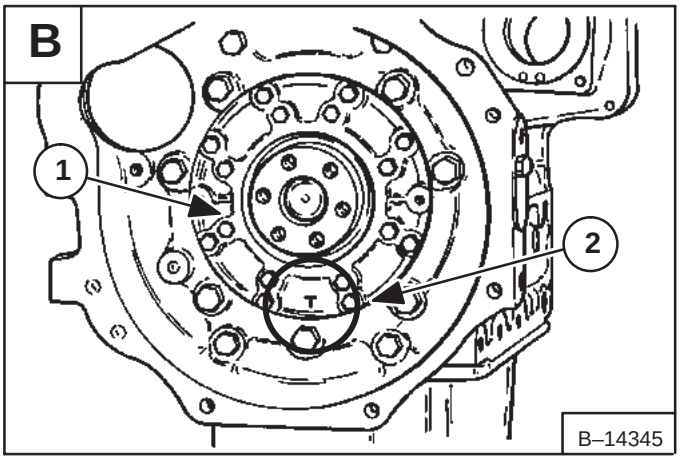
Remove the bolts which fasten the bearing case cover to the block.

Installation: Tighten the bearing case cover bolts to 13–15 ft.–lbs. (18–21 Nm) torque.

Install two bolts into the bearing case cover and pull the cover out **[A]**.



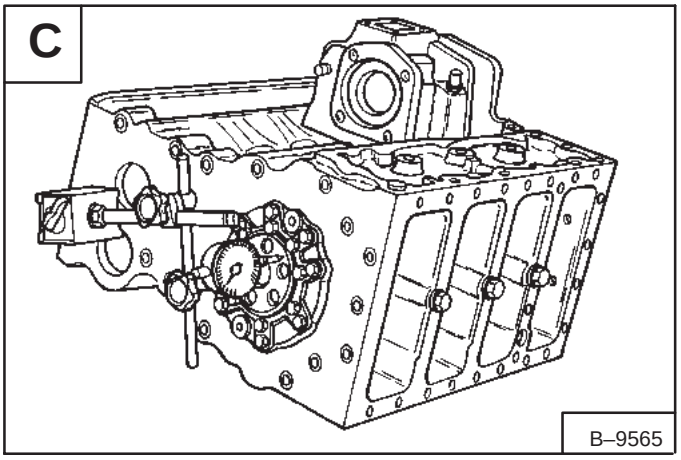
Installation: When installing the cover (Item 1) **[B]**, make sure the casting mark (Item 2) **[B]** is in the down position.



Before removing the crankshaft/main bearings, check the end play. Install a dial indicator. Measure the end play by moving the crankshaft back and forth **[C]**.

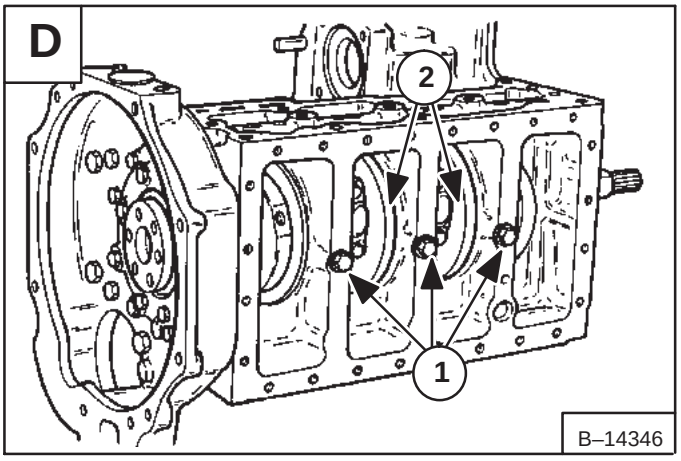
If the measurement exceeds the allowable limit, replace the thrust washers.

End Play . . . . . 0.006–0.012 inch (0,15–0,31 mm)
Allowable Limit . . . . . 0.020 inch (0,5 mm)



Remove the main bearing case bolt (Item 1) **[D]**.

Installation: Align the bearing case hole (Item 2) **[D]** with the hole in the block. Put oil on the bolt threads and tighten to 51–54 ft.–lbs. (69–73 Nm) torque.



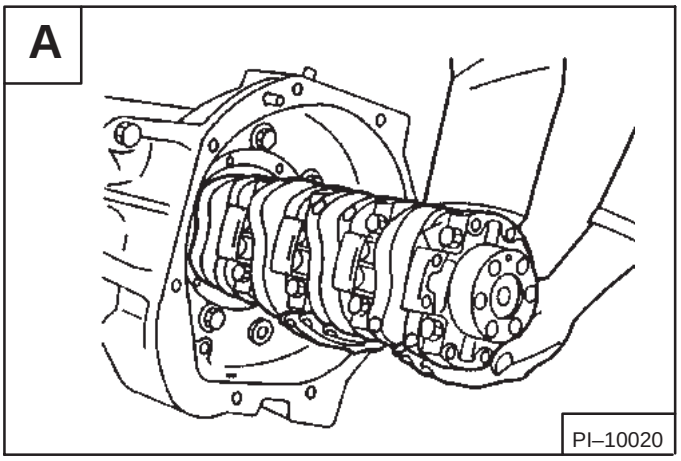
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CRANKSHAFT AND BEARINGS (Cont'd)

Removal and Installation (Cont'd)

Remove the crankshaft/main bearing assembly from the engine block **[A]**.

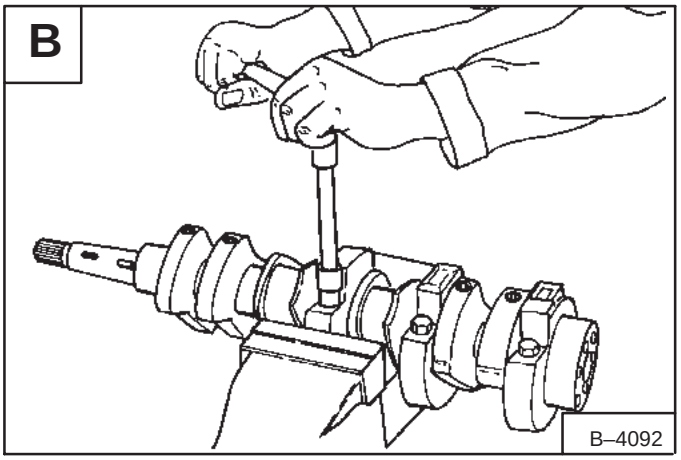
Mark the bearing case halves for correct installation.



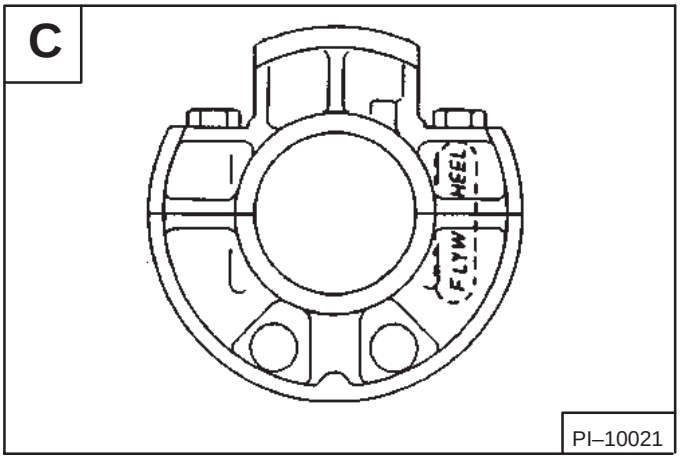
Remove the two bearing case bolts **[B]**.

Remove the bearing case and bearing.

Installation: Tighten the bearing case bolts to 34–38 ft.–lbs. (46–52 Nm) torque.



Installation: When installing the main bearing case assemblies, face the mark FLYWHEEL inch to the flywheel side of the engine block **[C]**. Be sure the thrust washers with its oil grooves face outward.



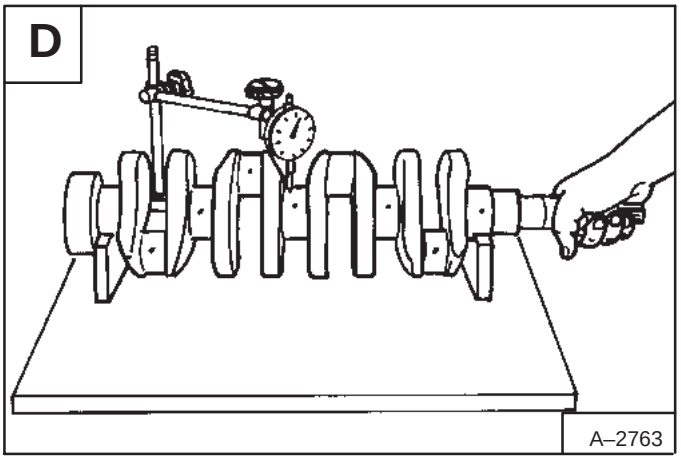
Servicing the Crankshaft and Bearings

Put the crankshaft on V–blocks. Install a dial indicator on the center journal **[D]**.

Turn the crankshaft at a slow rate.

If the misalignment exceeds the allowable limit, replace the crankshaft.

Alignment . . . . . 0.0008 inch (0,02 mm)



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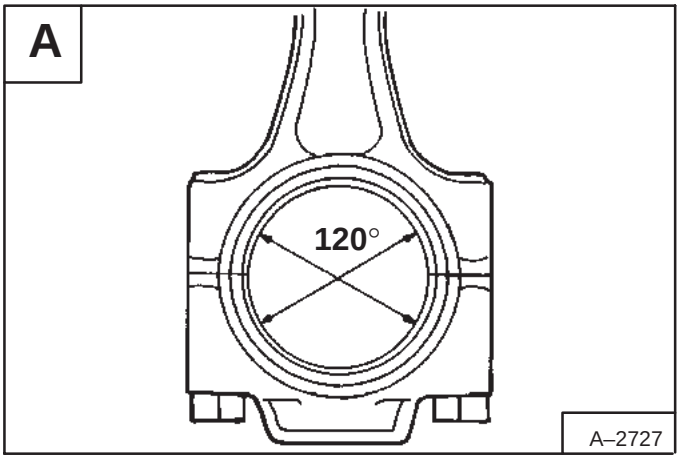
CRANKSHAFT AND BEARINGS (Cont'd)

Servicing the Crankshaft and Bearings (Cont'd)

Tighten the connecting rod cap bolts as follows:

W/O Flange Bolt . . . . . 27–30 ft.–lbs. (37–41 Nm)
W/Flange Bolt . . . . . 33–36 ft.–lbs. (45–49 Nm)

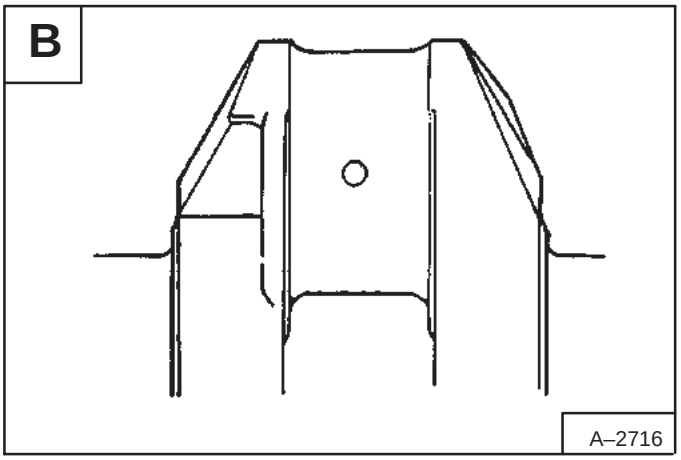
Measure the crankpin bearing I.D. **[A]**.



Measure the crankpin O.D. **[B]**.

Calculate the oil clearance.

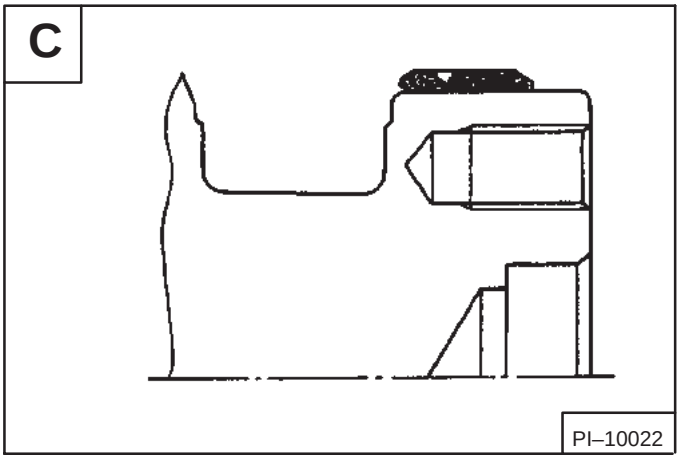
Crankpin Bearing I.D. . . . . 1.850–1.852 inch (47,0–47,05 mm)
Crankpin O.D. . . 1.849–1.850 inch (49,96–46,98 mm)
Oil Clearance . . 0.0009–0.003 inch (0,025–0,087 mm)



Check the wear on the crankshaft sleeve **[C]**.

If the wear exceeds the allowable limit or the seal leaks oil, replace the sleeve.

Wear of Sleeve . . . . . 0.004 inch (0,1 mm)



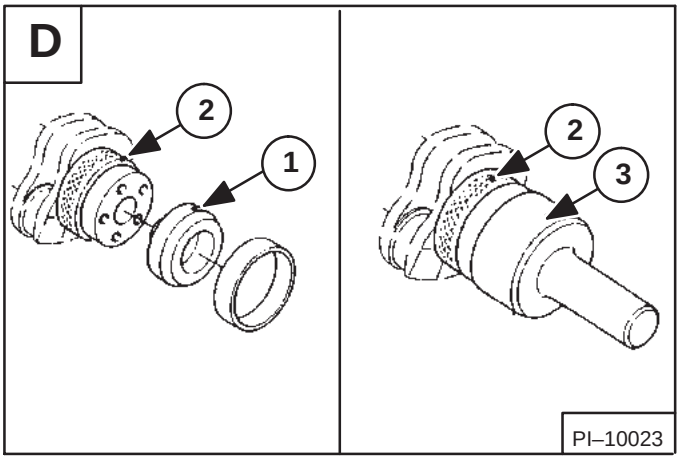
The special tool set will be needed to replace the crankshaft sleeve.

Remove the sleeve.

Install the sleeve guide (Item 1) **[D]** and stop (Item 2) **[D]**.

Heat the sleeve to about 300°F (150°C). Install the sleeve on the crankshaft using the special driver tool (Item 3) **[D]**.

NOTE: The sleeve is installed with the larger chamfered surface to the front of the crankshaft (Item 1) [C].

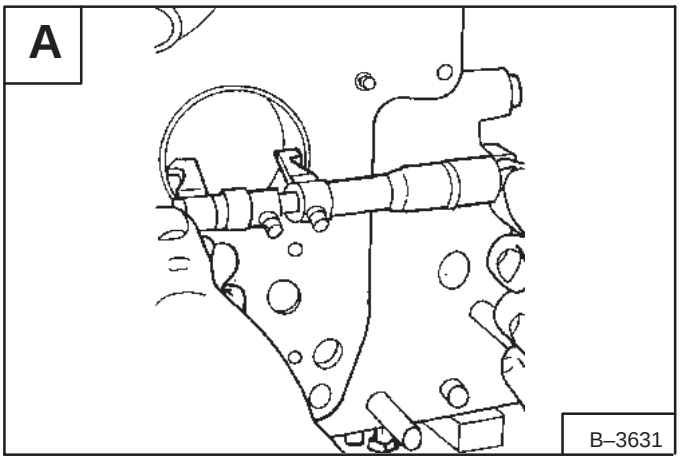


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CRANKSHAFT AND BEARINGS (Cont'd)

Servicing the Crankshaft and Bearings (Cont'd)

Measure the I.D. of the No. 1 crankshaft bearing **[A]**.

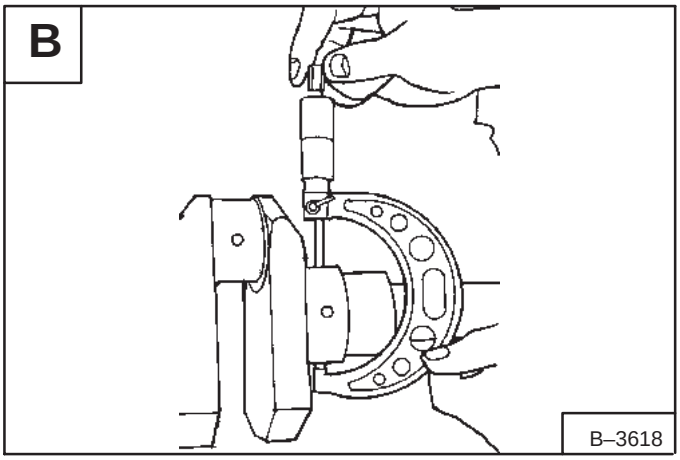


Measure the O.D. of the crankshaft journal **[B]**.

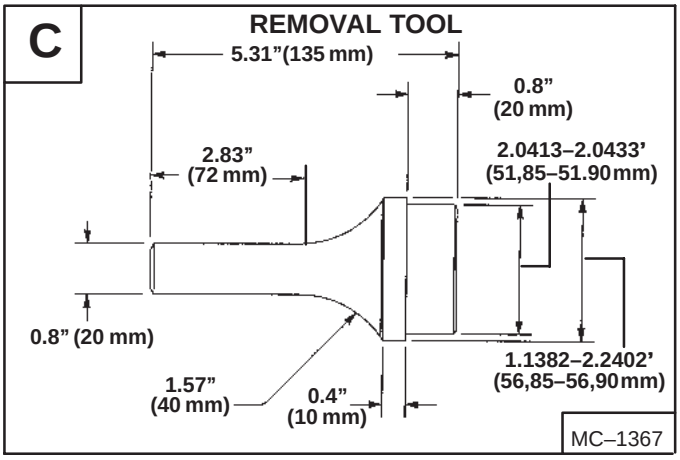
Calculate the oil clearance.

If the clearance exceeds the allowable limit, replace the crankshaft bearing.

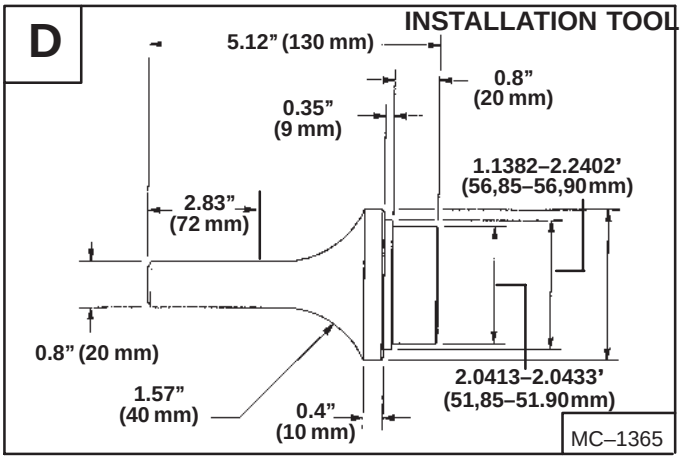
Bearing I.D. . . . . 2.046–0.049 inch (51,98–52,04 mm)
Journal O.D. . . . . 2.044–2.045 inch (51,92–51,94 mm)
Oil Clearance . . . . . 0.002–0.005 inch (0,04–0,12 mm)
Allowable Limit . . . . . 0.008 inch (0,2 mm)



To remove the front bearing make the tool as shown in figure **[C]**.



To install the front bearing make the tool as shown in figure **[D]**.

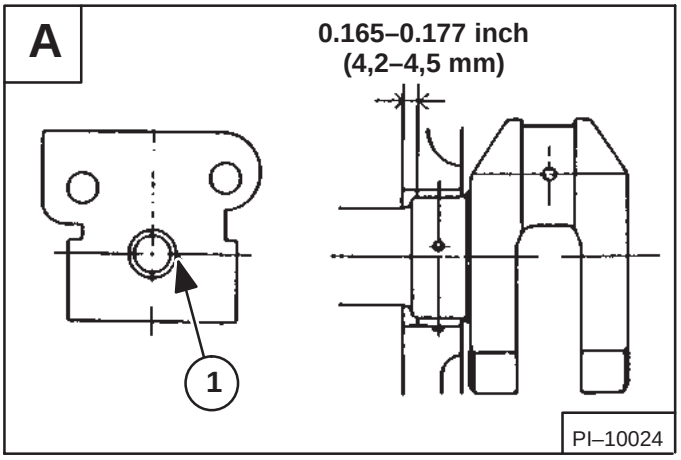


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Servicing the Crankshaft and Bearings (Cont'd)

Remove the front bearing (Item 1) **[A]** with the special removal tool.

Installation: Clean the new bearing and bore, put oil on them. Install the new bearing with the installation driver tool **[A]**.



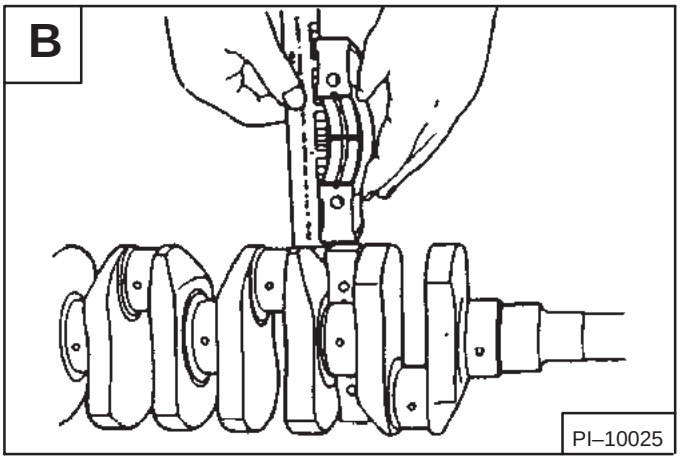
Clean the crankshaft journal and bearing. Put a strip of press gauge on the center journal.

Install the main bearing case halves and tighten the bolts. Remove the bearing case halves.

Measure the flattened press gauge **[B]**.

If the clearance exceeds the allowable limit, replace the crankshaft bearing.

Crankshaft Journal O.D. . . . . 2.044–2.045 inch (51,92–51,94 mm)
Bearing I.D. . . . . 2.046–2.048 inch (51,98–52,03 mm)
Oil Clearance . . . . . 0.002–0.004 inch (0,04–0,10 mm)
Allowable Limit . . . . . 0.008 inch (0,2 mm)

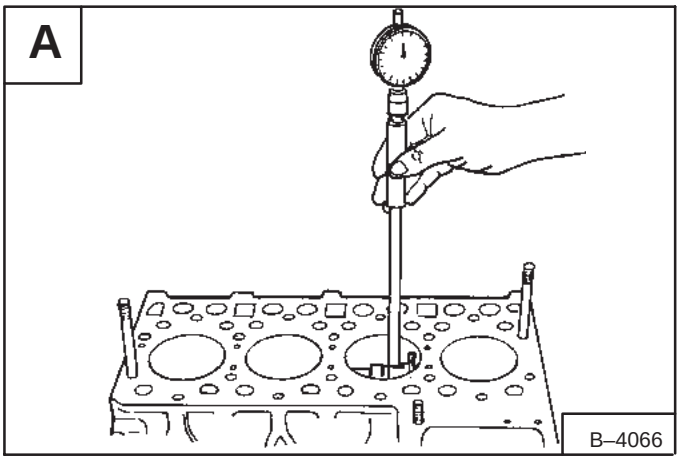


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CYLINDER BORE

Checking the Cylinder Bore

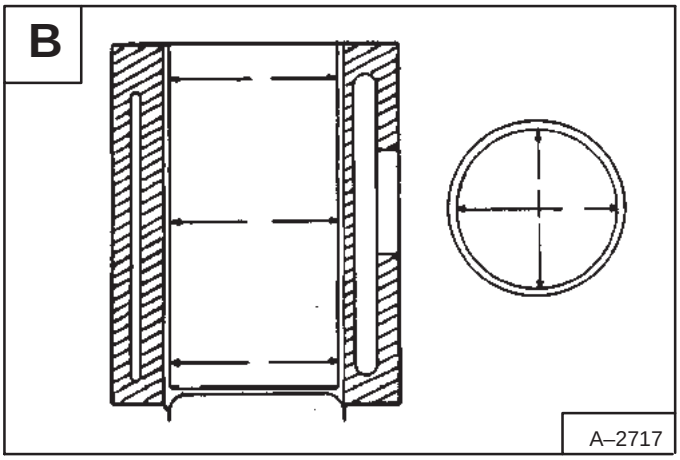
Use a gauge to check the inside measurement of the cylinder bore **[A]**.



Measure the six points as shown in figure **[B]** to find the maximum wear.

The specifications is 3.425–3.426 inch (87,0–87,02 mm). The wear limit is +0.006 inch (+0,15 mm).

If the cylinder bore is not within specifications, re–bore the cylinder for oversize piston.



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WATER PUMP

Removal and Installation

Drain the cooling system.

Remove the radiator. (See Page 7–14.)

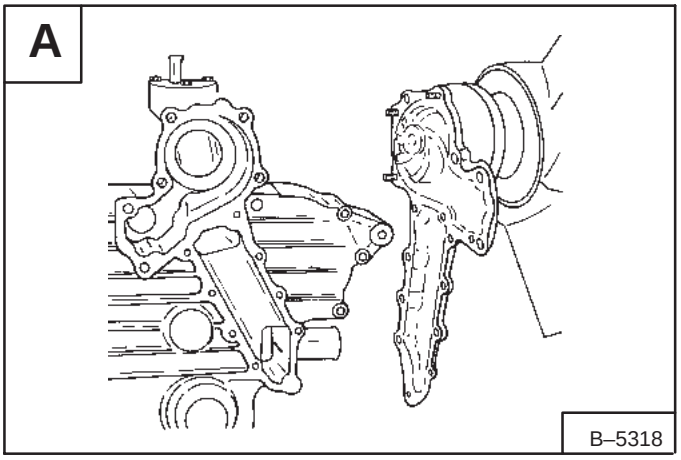
Remove the alternator belt.

Remove the fan.

Remove the water pump bolts.

Remove the water pump **[A]**.

Installation: Always use a new gasket when installing the water pump.



Disassembly and Assembly

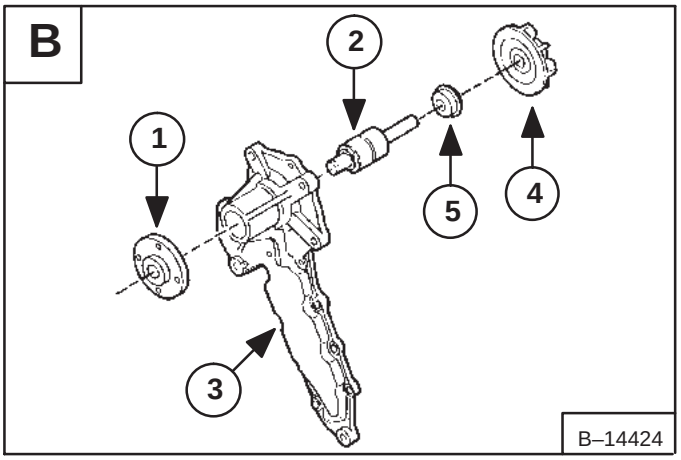
Put the water pump (Item 3) **[B]** in a vise.

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

Drive the shaft (Item 2) **[B]** out of the impeller (Item 4) **[B]** side of the water pump **[B]**.

Remove the seal (Item 5) **[B]**.

Install a new seal (Item 5) **[B]** when assembling the water pump.



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SPECIFICATIONS

Page Number

DECIMAL & MILLIMETER EQUIVALENTS
- Chart 8–15

ENGINE SPECIFICATIONS
- Camshaft 8–11
- Crankshaft 8–12
- Crankshaft Re–Grind Data 8–13
- Connecting Rods 8–11
- Cylinders 8–11
- Cylinder Head 8–10
- Engine Bolt Torque 8–12
- Fuel Injection Nozzles 8–10
- Fuel Injection Pump 8–10
- Oil Pump 8–11
- Pistons 8–11
- Piston Rings 8–11
- Rocker Arms 8–10
- Tappet 8–11
- Thermostat 8–12
- Timing Gear 8–12
- Torque for General Metric Bolts 8–13
- Valves 8–10
- Valve Springs 8–10
- Valve Timing 8–10

ENGINE OIL SPECIFICATIONS
- Description 8–14

FUEL, COOLANT AND LUBRICANTS
- Chart 8–14

HYDRAULIC EXCAVATOR SPECIFICATIONS
- Brakes 8–6
- Capacities 8–6
- Cylinder Cycle Time 8–6
- Digging Force 8–6
- Drive System 8–6
- Electrical 8–5
- Engine 8–5
- Hydraulic Cylinders 8–6
- Hydraulic System (S/N 11001–12999) 8–6
- Hydraulic System (S/N 13001 & Above) 8–9
- Lifting Capacity (S/N 11001–12999) 8–5
- Lifting Capacity (S/N 13001 & Above) 8–8
- Machine Dimensions (S/N 11001–11999) 8–3
- Machine Dimensions (S/N 12001 & 12999) 8–4
- Machine Dimensions (S/N 13001 & Above) 8–7
- Operation & Performance 8–5
- Refill Capacities 8–6
- Std. Strack Shoes 8–6
- Swing System 8–6
- Track 8–6
- Undercarriage 8–6

U.S. TO METRIC CONVERSION
- Chart 8–15

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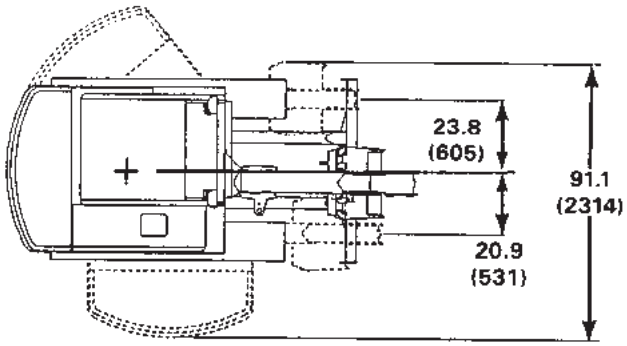


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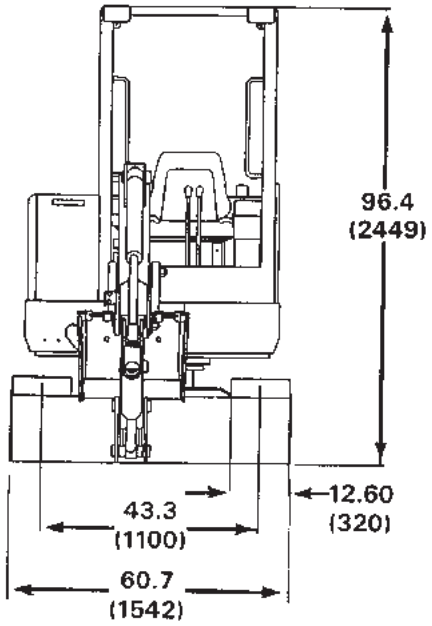
EXCAVATOR SPECIFICATIONS

Machine Dimensions (S/N 11001–11999)

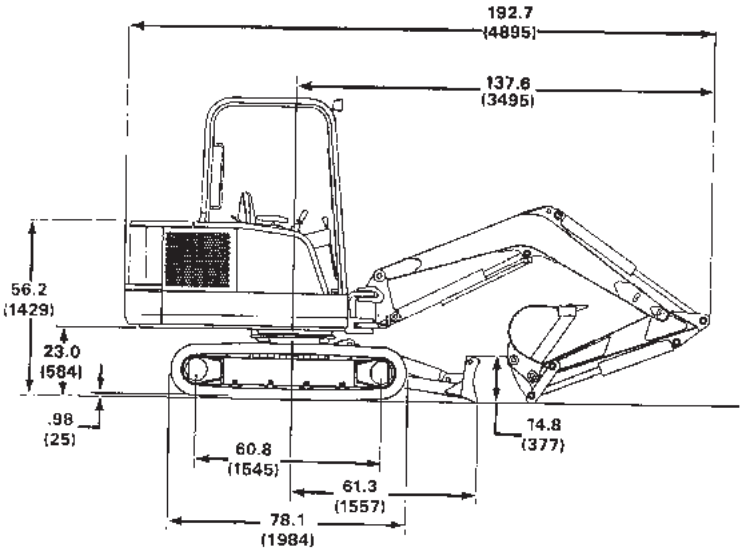
- All dimensions are shown in inches. Respective metric dimensions are given in millimeters enclosed by parentheses.
- Where applicable, specifications conform to SAE standards. Specifications are subject to change without notice.



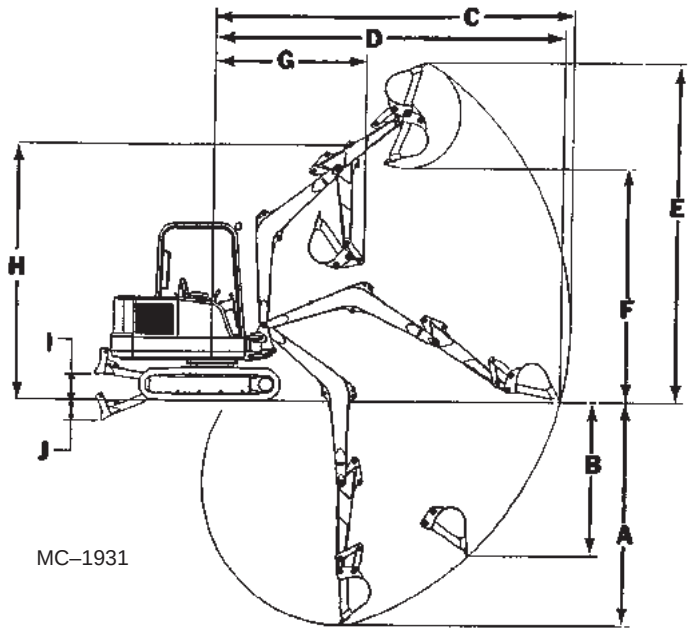
MC–1934



MC–1932



MC–1933



MC–1931

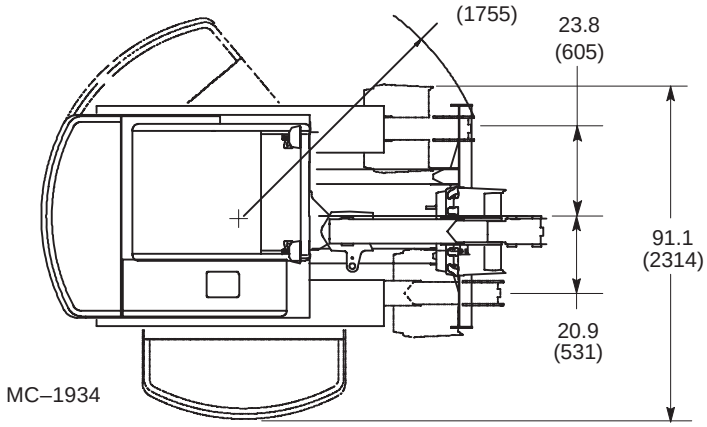
		Inches (mm)
A	Max. digging depth	120.1 (3050)
B	Max. vertical wall depth	56.3 (1429)
C	Max. digging reach	195.4 (4964)
D	Max. digging reach at ground level	190.5 (4840)
E	Max. digging height	186.1 (4726)
F	Max. dumping height	126.0 (3200)
G	Max. Work Equip. Radius W/Boom at max. height & arm retracted	82.2 (2089)
H	Max. height of Min. swing radius	140.2 (3561)
I	Max. lift above ground (blade)	14.1 (358)
J	Max. drop below ground blade	11.0 (280)

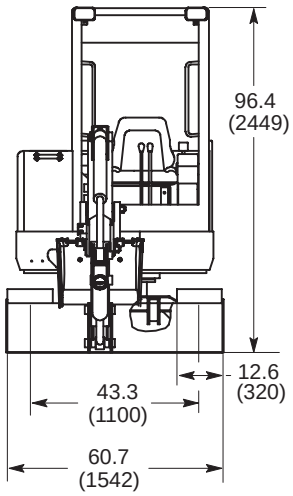
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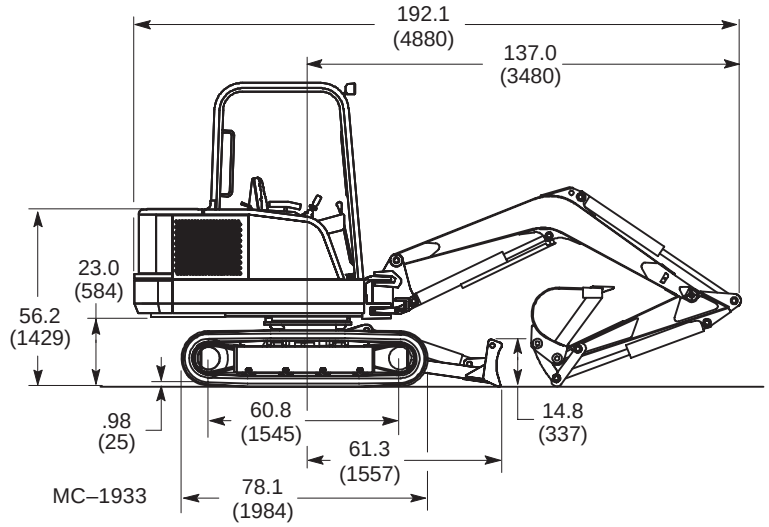
EXCAVATOR SPECIFICATIONS

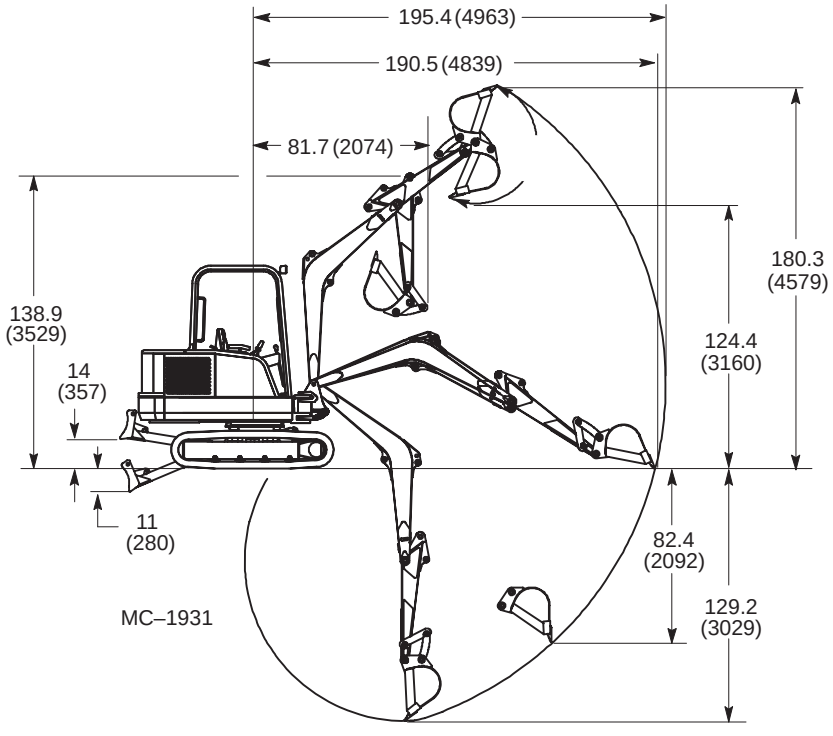
Machine Dimensions (S/N 12001 & Above)

- 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.









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HYDRAULIC EXCAVATOR SPECIFICATIONS (Cont'd)

Lifting Capacity

⚠ WARNING

OVERLOAD CAN TIP THE EXCAVATOR AND CAUSE INJURY OR DEATH

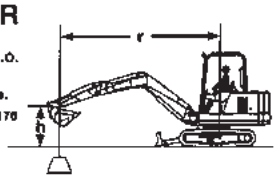
* Do not lift or hold any load that exceeds these ratings at their specified load radii and height.
* Total load is shown. The weight of all lifting devices must be deducted to determine the load that can be lifted.

MODEL 331 EXCAVATOR

Where applicable specifications conform to I.S.O. Standards.

Specifications are subject to change without notice.

Lift Point is bucket hinge point W/bucket 80.0 kg (176 lbs.) fully curled.



* Rated Hydraulic Lift Capacity

LIFT POINT HEIGHT	(r) LIFT RADIUS - mm (in.)						(r) LIFT RADIUS - mm (in.)						(r) LIFT RADIUS - mm (in.)					
h mm (in.)	RATED LIFT CAPACITY OVER END BLADE DOWN - kg (lb.)						RATED LIFT CAPACITY OVER END BLADE UP - kg (lb.)						RATED LIFT CAPACITY OVER SIDE BLADE UP - kg (lb.)					
	2000 (78.7)	2500 (98.4)	3000 (118.1)	3500 (137.8)	4000 (157.5)	Max.	2000 (78.7)	2500 (98.4)	3000 (118.1)	3500 (137.8)	4000 (157.5)	Max.	2000 (78.7)	2500 (98.4)	3000 (118.1)	3500 (137.8)	4000 (157.5)	Max.
3000 (118.1)			552* (1218)	430* (948)		442* (974)			552* (1218)	414* (914)		434* (957)			572* (1262)	415* (922)		442* (974)
2500 (98.4)			402* (887)	434* (957)		481* (1061)			402* (887)	416* (922)		462* (1018)			399* (879)	426* (940)		371 (818)
2000 (78.7)			521* (1146)	497* (1096)	485* (1070)	497* (1096)			501* (1105)	474* (1044)	466* (1027)	378 (833)		552* (1216)	509* (1122)	477* (1053)	442* (974)	344 (758)
1500 (59.1)		909* (1784)	839* (1409)	560* (1235)	529* (1166)	533* (1175)		781* (1723)	616* (1357)	456 (1005)	396 (870)	364 (803)		785* (1731)	631* (1392)	449 (990)	350 (773)	320 (705)
1000 (39.4)		1058* (2332)	762* (1679)	635* (1401)	572* (1262)	560* (1235)		647 (1868)	722* (1592)	490 (1080)	395 (870)	357 (788)		725 (1599)	541 (1193)	432 (953)	344 (758)	310 (683)
500 (19.7)		1186* (2875)	872* (1923)	710* (1566)	616* (1357)	596* (1314)		796 (1755)	612 (1350)	480 (1058)	386 (858)	367 (810)		677 (1493)	520 (1148)	415 (915)	330 (728)	310 (683)
Ground		1308* (2880)	951* (2097)	782* (1679)	659* (1453)	635* (1401)		837 (1845)	618 (1357)	490 (1080)	391 (863)	371 (818)	905 (1995)	670 (1478)	514 (1133)	405 (893)	333 (735)	313 (690)
-500 (-19.7)	1819* (4011)	1334* (2941)	994* (2192)	789* (1740)		687* (1514)	1184 (2610)	840 (1853)	619 (1365)	476 (1050)		418 (923)	905 (1995)	667 (1470)	514 (1133)	388 (878)		337 (743)
-1000 (-39.4)	1784* (3932)	1275* (2819)	905* (2201)	773* (1705)		742* (1636)	1078 (2378)	813 (1793)	619 (1365)	497 (1095)		456 (1006)	963 (2123)	680 (1500)	514 (1133)	408 (900)		391 (863)
-1500 (-59.1)	1661* (3663)	1215* (2680)	866* (1914)			805* (1775)	1201 (2648)	874 (1926)	576 (1268)			568 (1298)	932 (2055)	677 (1493)	524 (1155)			381 (840)

SW 93 6588715

OPERATIONS & PERFORMANCE

	331
Weights	
Operating Weight	
(W/Canopy & Rubber Track)	7127 lbs. (3236 kg)
(W/Canopy & Steel Track)	7283 lbs. (3307 kg)
(W/Cab & Rubber Track)	7385 lbs. (3354 kg)
(W/Cab & Steel Track)	7543 lbs. (3426 kg)
Travel Speed	
Low Range	1.24 MPH (2,0 km/hr.)
High Range	2.30 MPH (3,7 km/hr.)
Controls	
Vehicle	Two Hand Levers/Foot Pedals
Function	Two joystick levers control boom, bucket, arm and swing. Separate lever controls blade. Left foot pedal controls auxiliary hydraulics. Right foot pedal controls boom swing.
ENGINE	
Make	Kubota
Model	V2203–TU–B
Fuel	Diesel
Horsepower	40 HP (29,9 kW) @ 2400 RPM
Displacement	134 cu. in. (2197 cu. cm.)
Maximum Torque	102.5 ft–lbs. (139 Nm) @ 1600 RPM
Maximum Governed RPM – Full Load	2400 RPM
No Load	2550 RPM
Low Idle Speed	1125 – 1175 RPM
Number of Cylinders	Four
Bore/Stroke	3.43/3.64 (87/92,5)
Cooling System	Liquid
Lubrication System	Pressure
Filter	Cartridge Type – Full Flow
Starter	12 Volt, (1.4 Kw) Reduction Drive
Alternator	12 volt, 50 Amp.
Battery	12 Volt, 400 Cold Crank Amps. at 0°F (–18°C) 75 min. reserve capacity at 25 Amps

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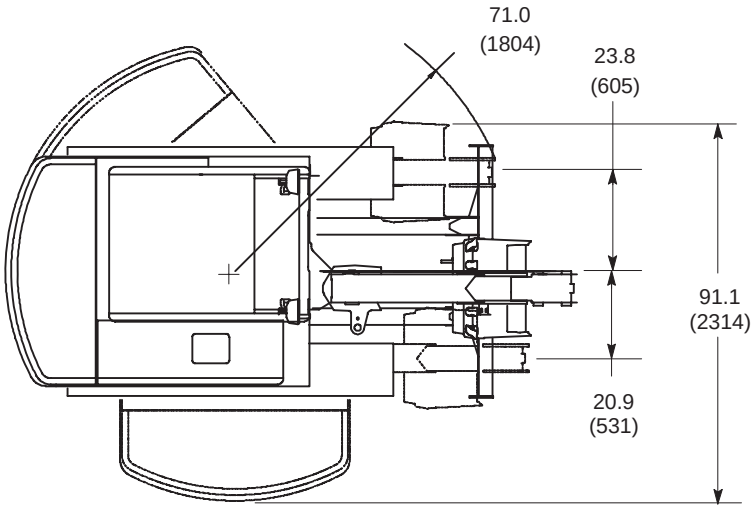
HYDRAULIC EXCAVATOR SPECIFICATIONS (Cont'd)	331		
HYDRAULIC SYSTEM			
Number of Pumps	Three		
Type	Triple Section Gear Pump		
Capacity	3 x 9.1 GPM (34,5 L/min.)		
System Relief Setting			
Implement Circuits	2500 PSI (17235 kPa)		
Travel Circuits	3000 PSI (29685 kPa)		
Swing Circuits	2088 PSI (14395 kPa)		
Auxiliary Flow	18.2 GPM (69.0 L/min.)		
Control Valve(s)	6 Spool & 3 Spool		
Drive Motors	Two Axial Piston		
Swing Motor	Orbit Motor		
Hydraulic Function Time			
Bucket	Curl 4.7 Sec.	Dump 3.0 Sec	
. Arm	Retract 4.8 Sec.	Extend 3.2 Sec.	
Boom	Raise 5.0 Sec.	Lower 6.8 Sec.	
Boom Swing	Left 4.2 Sec.	Right 3.3 Sec.	
Blade	Raise 1.50 Sec.	Lower 2.3 Sec.	
SWING SYSTEM			
Swing Drive	Orbit Motor Connected to a Planetary Drive		
Swing Circle	Single Row Shear Type Ball Bearings with Internal Gear Built into Swing Circle		
Swing Speed	9.5 RPM		
HYDRAULIC CYLINDERS	**Bore Dia. in. (mm)**	**Rod Dia in. (mm)**	**Stroke in. (mm)**
Boom (cushion up)	3.25 (83)	1.75 (44)	25.31 (643)
Dipperstick (cushion retract, extend)	3.00 (76)	1.75 (44)	23.62 (600)
Bucket	3.25 (83)	2.00 (51)	19.69 (500)
Boom swing (cushion left and right)	3.00 (76)	1.50 (38)	20.67 (525)
Blade	3.50 (89)	1.75 (44)	4.92 (125)
DRIVE SYSTEM			
Final Drive	Each Track is Driven by a Hydrostatic Axial Piston Motor		
Type of Reduction	Two Stage Planetary Gear Reduction 41.9:1		
Max. Drawbar Pull	7100 lbs. (3227 kg)		
Gradability	30°		
BRAKES			
Travel			
Service	Hydraulic Lock on Motor		
Parking	Hydraulic Lock on Motor		
Swing			
Service	Hydraulic Lock on Motor		
Holding	Pin Lock		
UNDERCARRIAGE			
Type	Crawler–Tractor Design Undercarriage. Sealed Track Rollers with Reinforced Box–Section Track Roller Frame. Grease Type Track Adjusters with Shock Absorbing Recoil Springs.		
STD TRACK SHOES			
Type	Rubber		
Width	12.6" (320 mm)		
No. of Shoes	1		
No. of Track Rollers	4 each		
Ground Pressure	4.63 PSI (31.9 kPa)		
REFILL CAPACITIES			
Fuel Tank	14.4 gal. (54,5 L)		
Radiator	4.0 gal. (15,1 L)		
Engine Oil & Filter	7.5 qts. (7,1 L)		
Hydraulic Reservoir	10.6 gal. (40 L)		
DIGGING FORCE			
Dipperstick	3600 lbf. (16013 N)		
Bucket	7000 lbf. (31136 N)		

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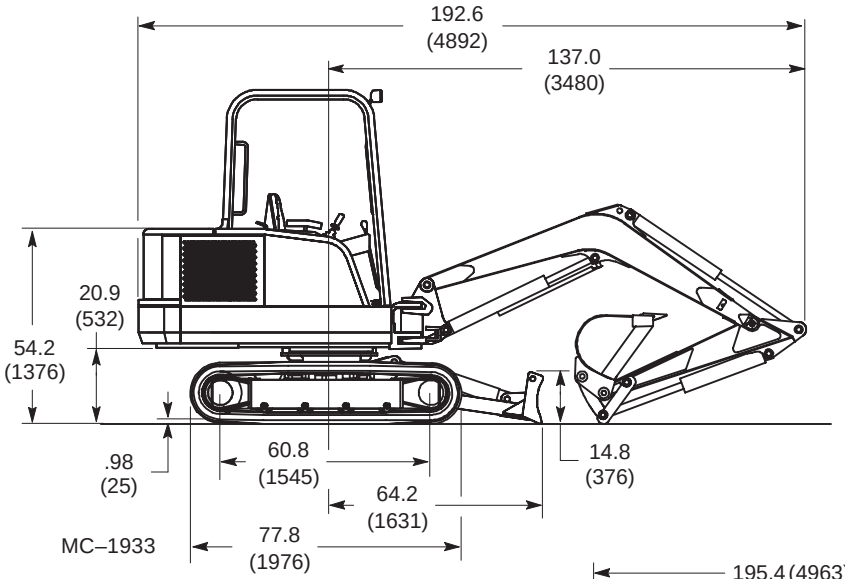
HYDRAULIC EXCAVATOR SPECIFICATIONS

Machine Dimensions (S/N 13001 & Above)

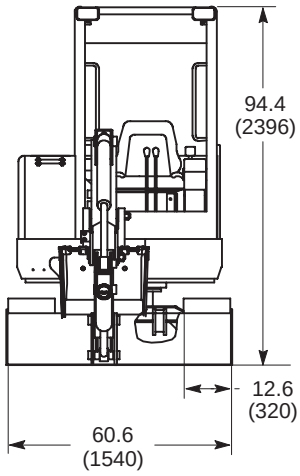
- All dimensions are shown in inches. Respective metric dimensions are given in millimeters enclosed by parentheses.
- Where applicable, specifications conform to SAE standards. Specifications are subject to change without notice.



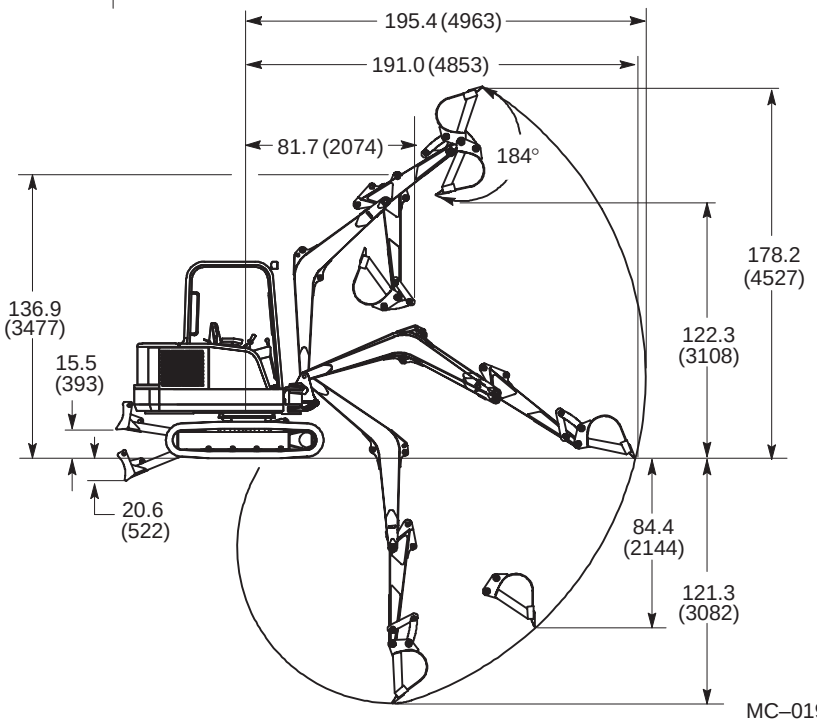
MC–01934



MC–1933



MC–01932



MC–01931

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HYDRAULIC EXCAVATOR SPECIFICATIONS (Cont'd)

Lifting Capacity

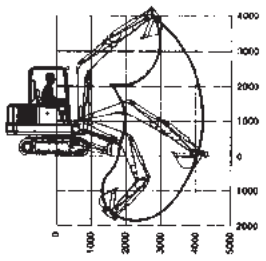
⚠ WARNING

OVERLOAD CAN TIP THE EXCAVATOR AND CAUSE INJURY OR DEATH

- Do not lift or hold any load that exceeds these ratings at their specified load radii and height.
- Total rated load is shown. The weight of all lifting devices must be deducted to determine the net load that can be lifted.

Where applicable specifications conform to ISO Standards.
Specifications are subject to change without notice.
Lift Point is bucket hinge point with standard bucket attached and bucket cylinder fully extended.

MELROE MODEL 331 EXCAVATOR



BOOM LENGTH 2400 mm (94.5 in.)
ARM LENGTH 1200 mm (47.2 in.)
COUNTERWEIGHT 208.5 kg (459 lbs.)
STANDARD BUCKET 609 mm (24.0 in.) 80.0 kg (176 lbs.)

CIRCUIT PRESSURES
WORKING- 17.2 BAR (2500 psi)
HOLDING- 20.3 bar (2950 psi)

LIFT POINT HEIGHT	RATED LIFT CAPACITY OVER END BLADE DOWN - kg (lb.)						RATED LIFT CAPACITY OVER END BLADE UP - kg (lb.)						RATED LIFT CAPACITY OVER SIDE BLADE UP - kg (lb.)					
mm (in.)	LIFT RADIUS - mm (in.)						LIFT RADIUS - mm (in.)						LIFT RADIUS - mm (in.)					
	2000 (78.7)	2500 (98.4)	3000 (118.1)	3500 (137.8)	4000 (157.5)	Max.	2000 (78.7)	2500 (98.4)	3000 (118.1)	3500 (137.8)	4000 (157.5)	Max.	2000 (78.7)	2500 (98.4)	3000 (118.1)	3500 (137.8)	4000 (157.5)	Max.
3000 (118.1)			552* (1218)	430* (948)		442* (974)			552* (1218)	414* (914)		434* (957)			572* (1262)	418* (922)		442* (974)
2500 (98.4)			402* (887)	434* (957)		481* (1061)			402* (887)	418* (922)		462* (1018)			395* (870)	426* (940)		371 (818)
2000 (78.7)			521* (1148)	497* (1096)	485* (1070)	497* (1096)			501* (1105)	474* (1044)	466* (1027)	378 (833)		552* (1218)	509* (1122)	477* (1053)	442* (974)	344 (758)
1500 (59.1)		809* (1784)	639* (1409)	560* (1235)	529* (1166)	533* (1175)		781* (1723)	616* (1357)	456* (1005)	395 (870)	364 (803)		785* (1731)	631* (1392)	449* (990)	350 (773)	320 (705)
1000 (39.4)		1058* (2332)	762* (1679)	635* (1401)	572* (1262)	560* (1235)		847 (1868)	722* (1592)	490 (1080)	395 (870)	357 (788)		725 (1598)	541 (1193)	432 (953)	344 (758)	310 (683)
500 (19.7)		1168* (2575)	872* (1923)	710* (1566)	616* (1357)	596* (1314)		796 (1755)	612 (1350)	480 (1058)	388 (855)	367 (810)		677 (1493)	520 (1148)	415 (915)	330 (728)	310 (683)
Ground		1306* (2880)	951* (2097)	762* (1697)	659* (1453)	635* (1401)		837 (1845)	618 (1357)	490 (1080)	391 (863)	371 (818)	905 (1995)	670 (1478)	514 (1133)	405 (893)	333 (735)	313 (690)
-500 (-19.7)	1819* (4011)	1334* (2941)	994* (2192)	789* (1740)		687* (1514)	1184 (2610)	840 (1853)	619 (1365)	476 (1050)		418 (923)	905 (1995)	667 (1470)	514 (1133)	398 (878)		337 (743)
-1000 (-39.4)	1784* (3932)	1278* (2819)	998* (2201)	773* (1705)		742* (1636)	1078 (2378)	813 (1793)	619 (1365)	497 (1095)		456 (1005)	963 (2123)	680 (1500)	514 (1133)	408 (900)		391 (863)
-1500 (-59.1)	1661* (3663)	1215* (2680)	868* (1914)			805* (1775)	1201 (2648)	874 (1928)	575 (1268)			588 (1296)	932 (2055)	677 (1493)	524 (1155)			381 (840)

* Rated Hydraulic Lift Capacity

SW 94 6589745

SPECIFICATIONS

	331
WEIGHTS	
Operating Weight (Includes Standard Equipment and 20" Bucket) – W/Rubber Tracks	6960 lbs (3157 kg)
W/Steel Tracks	7118 (3229 kg)
Travel Speed	
Lo	1.1 MPH (1,8 km/hr.)
High	3.2 MPH (5,1 km/hr.)
CONTROLS	
Vehicle	Two Hand or Foot Levers
Excavator Functions	Two hydraulic joysticks control boom, arm, bucket and cab swing. Two foot pedals control boom swing and Aux. Hyd. The blade is controlled by a separate lever.
ENGINE	
Make	Kubota
Model	V2203–E
Fuel	Diesel
Horsepower	40 HP (29.9 Kw) @ 2400 RPM
Maximum Governed RPM (Full Load)	2400 RPM
Torque	102.5 ft.–lbs. (139 Nm) @ 1600 RPM
No. of Cylinders	Four
Displacement	134 cu.–in. (2.1 L)
Bore x Stroke	3.42" (87 mm) x 3.64" (92,4 mm)
Lubrication	Forced
Filter	Cartridge Type – Full Flow
Air Cleaner	Dry replaceable paper cartridge
ELECTRICAL	
Starter	12 Volt (2,7 kW) Reduction Drive
Alternator	12 Volt, 50 Amps.
Battery	12 Volt, 500 Cold Crank Amps. @ –18° C (0° F) 75 minute reserve capacity

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HYDRAULIC EXCAVATOR SPECIFICATIONS (Cont'd)	331		
HYDRAULIC SYSTEM			
Number of Pumps	Three		
Type	Triple Section Gear Pump		
Capacity	1 x 8.9 GPM (33,6 LPM) 2 x 7.6 GPM (28.8 LPM)		
System Relief Settings			
Implement Circuits	2700 PSI (18617 kPa), 2800 PSI (19306 kPa), 2850 PSI (19651 kPa), 4100 PSI (28270 kPa)		
Travel Circuits (S/N 13001–13404)	3050 PSI (21030 kPa)		
(S/N13405 & Above)	3700 PSI (25512 kPa)		
Swing Circuits	1700 PSI (11721 kPa)		
Auxiliary Flow	16.5 GPM (62.4 L/min.)		
Control Valve(s)	5 Spool Parallel & Series		
Drive Motors	Two Axial Piston		
Swing Motor	Orbit Motor		
CYLINDER CYCLE TIME			
Bucket	Curl 2.5 Sec.	Dump 1.8 Sec.	
Arm	Retract 4.1 Sec.	Extend 4.9 Sec.	
Boom	Raise 3.7 Sec.	Lower 4.8 Sec.	
Boom Swing	Left 4.3 Sec.	Right 3.4 Sec.	
Blade	Raise 2.0 Sec.	Lower 2.1 Sec.	
SWING SYSTEM			
Swing Drive	Orbit Motor Connected to a Direct Drive		
Swing Circle	Single Row Shear Type Ball Bearings with Internal Gear Built into Swing Circle		
Swing Speed	9.3 RPM		
HYDRAULIC CYLINDERS	**Bore Dia. in. (mm)**	**Rod Dia in. (mm)**	**Stroke in. (mm)**
Boom (cushion up)	3.25 (83)	1.75 (44)	25.31 (643)
Dipperstick (cushion retract, extend)	3.00 (76)	1.75 (44)	23.62 (600)
Bucket	3.25 (83)	2.00 (51)	19.69 (500)
Boom swing (cushion left and right)	3.00 (76)	1.50 (38)	20.67 (525)
Blade	3.50 (89)	1.75 (44)	7.28 (185)
DRIVE SYSTEM			
Final Drive	Each Track is Driven by a Hydrostatic Axial Piston Motor		
Type of Reduction	Two Stage Planetary Gear Reduction 41.9:1		
Max. Drawbar Pull	7100 lbs. (3227 kg)		
Gradability	30°		
BRAKES			
Travel			
Service	Hydraulic Lock on Motor		
Parking	Hydraulic Lock on Motor		
Swing			
Service	Hydraulic Lock on Motor		
Holding	Pin Lock		
UNDERCARRIAGE			
Type	Crawler–Tractor Design Undercarriage. Sealed Track Rollers with Reinforced Box–Section Track Roller Frame. Grease Type Track Adjusters with Shock Absorbing Recoil Springs.		
STD TRACK SHOES			
Type	Rubber		
Width	12.6" (320 mm)		
No. of Shoes	1		
No. of Track Rollers	4 each		
Ground Pressure	4.52 PSI (31.2 kPa)		
REFILL CAPACITIES			
Fuel Tank	14.4 gal. (54,5 L)		
Radiator	4.0 gal. (15,1 L)		
Engine Oil & Filter	7.5 qts. (7,1 L)		
Hydraulic Reservoir	10.6 gal. (40 L)		
DIGGING FORCE			
Arm	3600 lbf. (16013 N)		
Bucket	7000 lbf. (31136 N)		

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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	1990–2133 PSI (13721–14707 kPa)
Fuel Tightness Nozzle Seat	Dry Nozzle at 1849 PSI (12749 kPa)

Fuel Injection Pump

Fuel Tightness Plunger	10 sec: initial pressure 2133–1990 PSI (14707–13721 kPa)
Limit Permitted	5 seconds
Injection Timing	17 – 19 degrees B.T.D.C.
High Idle	2550 – 2600 RPM
Low Idle	1125 – 1175 RPM

Cylinder Head

Cylinder Head Surface Distortion	0.002 (0,05) Max.
Thickness of Gasket (Used)	0.0453–0.0492 (1,15–1,25)
(New)	0.0512–0.0551 (1,3–1,4)
Top Clearance (Piston to Head)	0.0217–0.0276 (0,55–0,70)
Compression	512–540 PSI (3530–3720 kPa)
Allowable Limit	370 PSI (2550 kPa)
Difference Between Cylinders	10%

Valves

Valve Seat Width	0.0835 (2,12)
O.D. of Valve Stems	0.3134–0.31420(7,96–7,98)
I.D. of Valve Guides	0.3156–0.3161 (8,016–8,03)
Clearance Between Valve Stem & Guide	0.0016–0.0026 (0,04–0,07)
Allowable Limit	0.0039 (0,1)
Valve Clearance (Cold)	0.007–0.0087 (0,18–0,22)
Valve Recessing (Protrusion)	0.002 (0,05)
(Recess)	0.06 (0,15)
Valve Seat Angle (Int.)	60 degrees
Valve Seat Angle (Exh.)	45 degrees

Valve Springs

Free Length	1.64–1.66 (41,7–42,2)
Allowable Limit	1.62 (41,2)
Fitted Length	1.378 (35,0)
Compress to Fitted Length	26.4 lbs. (117,6 N)
Allowable Limit	22.5 lbs. (100,0 N)
Inclination Allowable Limit	0.039 (1,0)

Valve Timing

Intake Valve (Open)	12 degrees B.T.D.C.
(Close)	36 degrees A.T.D.C.
Exhaust Valve (Open)	60 degrees B.T.D.C.
(Close)	12 degrees A.T.D.C.

Rocker Arms

O.D. of Rocker Arm Shaft	0.5501–0.5506 (13,97–13,99)
I.D. of Rocker Arm Bushings	0.5512–0.5519(14,0–14,02)
Clearance Between Rocker Arm & Bushing	0.0006–0.0018 (0,02–0,06)
Allowable Limit	0.006 (0,15)

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All dimensions are given in inches. Respective metric dimensions are given in millimeters enclosed by parentheses.

Camshaft

Journal O.D.	1.5720–1.5728 (39.934–39,95)
Bearing I.D.	1.5748–1.5758 (40,0–40,025)
Oil Clearance	0.002–0.0036 (0,05–0,091)
Allowable Limit	0.006 (0,15)
Alignment Allowable Limit	0.0034(0,01)
Cam Lobe Height	1.318 (33,47)
Allowable Limit	1.316 (33,42)
End Clearance	0.0028–0.0087 (0,07–0,22)
Allowable Limit	0.012 (0,3)

Tappet

Clearance Between Tappet & Guide	0.0008–0.0024 (0,02–0,061)
Tappet O.D.	0.9433–0.9441 (23,959–23,98)
Tappet Guide I.D.	0.9449–0.9457 (24,0–24,021)

Cylinders

Cylinder Bore I.D.	3.425–3.426 (87,00–87,022)
Allowable Limit	+0.006 (+0,15)

Piston Rings

Ring Gap (Top & 2nd Ring)	0.012–0.018 (0,3–0,45)
Limit Permitted	0.05 (1,25)
Ring Gap (Oil Ring)	0.010–0.018 (0,25–0,45)
Limit Permitted	0.05 (1,25)
Side Clearance of Ring Groove:	
Top Ring	Zero Clearance
Second Ring	0.0037–0.0047 (0,094–0,12)
Oil RIng	0.0008–0.002 (0,02–0,051)

Pistons

Piston Pin Bore	0.9843–0.9848 (25,0–25.014)
Limit Permitted	0.9862 (25,05)

Connecting Rod

Piston Pin O.D.	0.9843–0.9847 (25,0–25,011)
Small End Bushing I.D.	0.9852–0.9858 (25,025–25,04)
Clearance Between Piston Pin & Small End Bushing	0.0006–0.0015 (0,015–0,038)
Service Replacement Part	0.0006–0.003 (0,015–0,07 mm)
Connecting Rod Alignment Limit Permitted	0.002 (0,05)

Oil Pump

Oil Pressure Rated RPM	43–64 PSI (294–441 kPa)
Limited Permitted	36 PSI (248 kPa)
Idle Speed	14 PSI (98 kPa)
Limit Permitted	7 PSI (49 kPa)
Clearance Between Inner Rotor & Outer Rotor	0.0039–0.0063 (0,1–0,16)
Outer Rotor & Pump Body	0.0043–0.0075 (0,11–0,19)
End Clearance Between Inner Rotor & Cover	0.0041–0.0059 (0,103–0,15)

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All dimensions are given in inches. Respective metric dimensions are given in millimeters enclosed by parentheses.

Crankshaft

Crankshaft Alignment Limit Permitted	0.0008 (0,02)
Oil Clearance Between Journal & Bearing #1	0.0016–0.0046 (0,04–0,117)
Limit Permitted	0.008 (0,2)
Journal O.D. #1	2.0441–2.0449 (51,921[51,94)
Bearing I.D. #1	2.0465–2.0488 (51,98–52,04)
Oil Clearance Between Journal & Bearing #2	0.0016–0.0041 (0,04–0,104)
Limit Permitted	0.008 (0,2)
Journal O.D. #2	2.0441–2.0449 (51,92–51,94)
Bearing I.D. #2	2.0465–2.0482 (51,98–52,02)
Oil Clearance Between Crank Pin & Bearing	0.0009–0.0034 (0,023–0,086)
Limit Permitted	0.008 (0,2)
Crank Pin O.D.	1.8488–1.8494 (46,96–46,97)
Crank Pin Bearing I.D.	1.8504–1.8522 (47,0–47,05)
Crankshaft Side Clearance	0.0059–0.0122 (0,15–0,31)
Limit Permitted	0.020 (0,5)

Timing Gear

Timing Gear Backlash	
Crank Gear – Idle Gear	0.0016–0.0044 (0,041–0,112)
Idle Gear – Cam Gear	0.0016–0.0045 (0,041–0,114)
Idle Gear – Injection Pump Gear	0.0016–0.0046 (0,041–0,117)
Idle Gear – Oil Pump Gear	0.0016–0.0043 (0,041–0,109)
Limit Permitted	0.006 (0,15)
Clearance Between Idle Gear Shaft & Idle Gear Bushing	0.001–0.0026 (0,025–0,066)
Limit Permitted	0.004 (0,10)
Idler Gear Side Clearance Idler Gear	0.008–0.020 (0,2–0,51)

Thermostat

Valve Opening Temperature	157–163°F (70–73°C)
Valve Fully Open	185°F (85°C)

Engine Bolt Torque	Ft.–Lbs.	Nm
Camshaft Retainer Plate Bolts	17–20	23–27
* Connecting Rod Bolts W/O Flange	27–30	37–41
W/Flange	33–36	45–49
Crankshaft Nut	101–116	137–157
* Cylinder Head Bolts	67–72	91–98
Drain Plug	30–36	39–49
* Flywheel Bolts	83–90	113–122
Fuel Camshaft Retainer Bolts	5–6	6,8–8,1
Fuel Injection Tubeline Fittings	11–19	13–26
Glow Plugs	15–18	20–25
* Idler Gear Shaft Bolts	17–20	23–27
Injection Nozzles	36–51	49–69
Injection Pump Mounting Bolts	17–20	23–27
Injector Nozzle Body	43–58	59–79
* Main Bearing Bolts	51–54	69–73
* Main Bearing Case Bolts	34–38	46–52
Oil Switch	11–15	15–20
Rear Bearing Case Cover Bolts	13–15	18–20
Timing Gearcase Cover Bolts	13–17	18–23

* Lightly Oiled Threads

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ENGINE SPECIFICATIONS (Cont'd)

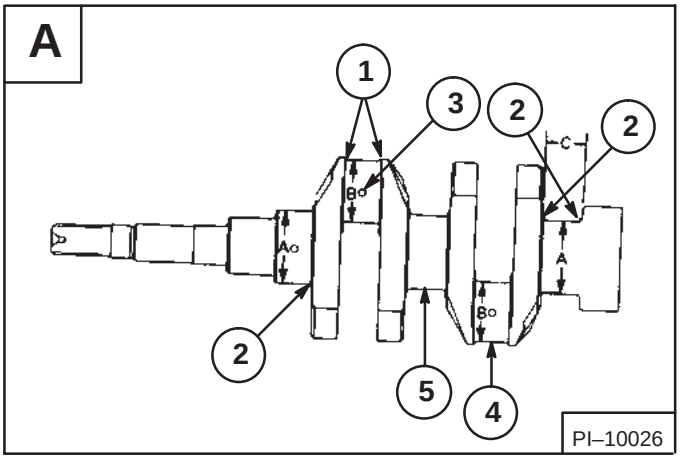
Crankshaft Re–Grind Data

If the standard size bearing cannot be used due to excessive wear of the crankpin and crank journal use undersize or oversize bearings.

For undersize or oversize bearing use, follow the precautions noted below.

Grind the crankpin and journal with a wheel which has specified round corner and width without shoulder **[A]**.

1. 0.1299–0.1457" (3,3–3,7 mm)
2. 0.1102–0.1260" (2,8–3,2 mm)
3. Be sure to chamfer the oil hole circumference to 0.04–0.06" (1,0–1,5 mm) radius with and oil stone.
4. The crankpin must be fine finished to higher than (0,4–5).
5. The crank journal must be fine–finished to higher than (0,4–5).
6. The crank journal side surface must be fine–finished to higher than (1,6–5).



SIZE	CODE NO.	NAME OF BEARING	BEARING MARK	CRANKSHAFT PROCESSING DIM.	
–0.008 inch (0,2 mm)	17331–2391–1	Crankshaft Bearing 1 0.008 inch minus (0,2 minus)	020 US	A	2.0363–2.037 inches (51,721–51,74 mm)
–0.008 inch (0,2 mm)	17331–2393–1	Crankshaft Bearing 2 0.008 inch minus (0,2 minus)	020 US		
–0.016 inch (0,4 mm)	17331–2392–1	Crankshaft Bearing 1 0.016 inch minus (0,4 minus)	040 US		2.0284–2.0291 inches (51,521–51,54 mm)
–0.016 inch (0,4 mm)	17331–2394–1	Crank shaft Bearing 2 0.016 inch minus (0,4 minus)	040 US		
–0.008 inch (0,2 mm)	17331–2297–1	Crank Pin Bearing 0.008 inch minus (0,2 minus)	020 US	B	1.8409–1.8415 inch (46,759–46,775 mm)
–0.016 inch (0,4 mm)	17331–2298–1	Crank Pin Bearing 0.016 inch minus (0,4 minus)	040 US		1.8330–1.8337 inch (46,559–46,575 mm)
+0.008 inch (+0,2 mm)	15221–2395–1	Thrust Bearing 1 – 0.008 inch plus (0,2 mm plus)	020 OS	C	1.8330–1.8337 inch (46,559–46,575 mm)
	19202–2397–1	Thrust Bearing 2 – 0.008 inch plus (0,2 mm plus)			
+0.016 inch (+0,4 mm)	15221–2396–1	Thrust Bearing 1 – 0.016 inch plus(0,4 mm plus)	040 OS		1.0315–1.0335 inch (26,20–25,25 mm)
	19202–2398–1	Thrust Bearing 2 – 0.016 inch plus (0,4 mm plus)			

Torque For General Metric Bolts

Nominal Diameter	Grade Unit	Standard Screw and Bolt			Special Screw and Bolt		
		N m	kfg m	ft lbs	N m	kgf m	ft lbs
M6		7.9 to 9.3	0.80 to 0.95	5.8 to 6.9	9.8 to 11.3	1.00 to 1.15	7.23 to 8.32
M8		17.7 to 20.6	1.8 to 2.1	13.0 to 15.2	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
M10		39.2 to 45.1	4.0 to 4.6	28.9 to 33.3	48.1 to 55.9	4.9 to 5.7	35.4 to 41.2
M12		62.8 to 72.6	6.4 to 7.4	46.3 to 53.5	77.5 to 90.2	7.9 to 9.2	57.1 to 66.5

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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	7.5 qts. (7,1 L)
Fuel Tank	Diesel Fuel	No. 1 No. 2	14.4 gals (54,5 L)
Cooling System	50/50 Water & Anti–Freeze	50/50 Water & Anti–Freeze	6.3 qts. (6,0 L)
Hydraulic Tank	6563328*		Tank Cap. 10.5 gals (40,0 L) System Capacity 17.6 gals. (66,6 L)
Final Drive Case (each)	90W Gear		0.55 qts. (0,5 L)

ENGINE OIL SPECIFICATIONS

Description

When fuel sulphur content is less than 0.5% change the engine oil and filter as shown in the Service Schedule (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

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.

Use oil of the correct SAE viscosity for expected temperature conditions.

*Anti–Freeze Solution

Ethylene Glycol

Add premixed coolant; 50% water and 50% ethylene glycol to the recovery tank if the coolant level is low.

Propylene Glycol

Add premixed coolant; 43% water and 57% propylene glycol to the recover tank if the coolant level is low.

One gallon and one pint of propylene glycol mixed with one gallon of water is the correct mixture of coolant to provide a –34°F (–37°C) freeze protection.

Use a refractometer to check the condition of propylene glycol in you cooling system.

Effective January 1995 all Excavators will be changed from ethylene glycol to propylene glycol.

Propylene glycol is enviromentally safer whil providing equivilent or superior protection.

Propylene glycol install in new machines and from Melroe Parts Sales colored purple for identification.

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DECIMAL AND MILLIMETER EQUIVALENTS

FRACTIONS	DECIMALS	MM
1/64	0.015625	0.397
1/32	0.03125	0.794
3/64	0.046875	1.191
1/16	0.0625	1.588
5/64	0.078125	1.984
3/32	0.09375	2.381
7/64	0.109375	2.778
1/8	0.1250	3.175
9/64	0.140625	3.572
5/32	0.15625	3.969
11/64	0.171875	4.366
3/16	0.1876	4.762
13/64	0.203125	5.159
7/32	0.21875	5.556
15/64	0.234375	5.953
1/4	0.2500	6.350
17/64	0.265625	6.747
9/32	0.28125	7.144
19/64	0.296875	7.541
5/16	0.3125	7.938
21/64	0.328125	8.334
11/32	0.34375	8.731
23/64	0.359375	9.128
3/8	0.3750	9.525
25/64	0.390625	9.922
13/32	0.40625	10.319
27/64	0.421875	10.716
7/16	0.4375	11.112
29/64	0.453125	11.509
15/32	0.46875	11.906
31/64	0.484375	12.303
1/2	0.5000	12.700

FRACTIONS	DECIMALS	MM
33/64	0.515625	13.097
17/32	0.53125	13.494
35/64	0.546875	13.891
9/16	0.5625	14.288
37/64	0.578125	14.684
19/32	0.59375	15.081
39/64	0.609375	15.478
5/8	0.6250	15.875
41/64	0.640625	16.272
21/32	0.65625	16.669
43/64	0.671875	17.066
11/16	0.6875	17.462
45/64	0.703125	17.859
23/32	0.71875	18.256
47/64	0.734375	18.653
3/4	0.7500	19.050
49/64	0.765625	19.447
25/32	0.78125	19.844
51/64	0.796875	20.241
13/16	0.8125	20.638
53/64	0.828125	21.034
27/32	0.84375	21.431
55/64	0.859375	21.828
7/8	0.8750	22.225
57/64	0.890625	22.622
29/32	0.90625	23.019
59/64	0.921875	23.416
15/16	0.9375	23.812
61/64	0.953125	24.209
31/32	0.96875	24.606
63/64	0.984375	25.003
1	1.000	25.400

1 mm = 0.03937”

0.001” = 0.0254 mm

U.S. TO METRIC CONVERSION

	TO CONVERT	INTO	MULTIPLY BY
LINEAR MEASUREMENT	Miles	Kilometers	1.609
	Yards	Meters	0.9144
	Feet	Meters	0.3048
	Feet	Centimeters	30.48
	Inches	Meters	0.0254
	Inches	Centimeters	2.54
	Inches	Millimeters	25.4
AREA	Square Miles	Square Kilometers	2.59
	Square Feet	Square Meters	0.0929
	Square Inches	Square Centimeters	6.452
	Acre	Hectare	0.4047
VOLUME	Cubic Yards	Cubic Meters	0.7646
	Cubic Feet	Cubic Meters	0.02832
	Cubic Inches	Cubic Centimeters	16.39
WEIGHT	Tons (Short)	Metric Tons	0.9078
	Pounds	Kilograms	0.4536
	Ounces (Avdp.)	Grams	28.3495
PRESSURE	Pounds/Sq. In.	Kilopascal	6.895
WORK	Foot–Pounds	Newton–Metre	1.356
LIQUID VOLUME	Quarts	Liters	0.9463
	Gallons	Liters	3.785
LIQUID FLOW	Gallons/Minute	Liters/Minute	3.785
TEMPERATURE	Fahrenheit	Celsius	1.Subtract 32° 2. Multiply by 5/9

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331–1
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22 May 1996
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SERVICE MANUAL REVISION

ROUTE TO ATTENTION

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SERVICE MANAGER	☒
SALES MANAGER	☐

AFFECTING:

Product BOBCAT EXCAVATOR

Model 331 (S/N 512911001 & Above)

Manual No. 6724222 (2–96)

NOTICE **Insert This Sheet With The Appropriate Manual For Future Reference.**

The following page is a revision to the 331 Excavator Service Manual P/N 6724222 (2–96).

Take out and put in the following revised page:

TAKE OUT	PUT IN
Cover 6724222 (2–96)	Cover 6724222 (2–96)

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TAKE OUT	PUT IN
Hydraulic Schematic For Models 331 Excavator (S/N 512911001–11056) (Standard & ISO) Chart #6724231 (Printed April 1996)	Hydraulic Schematic For Models 331 Excavator (S/N 512911001–11056) (Standard & ISO) Chart #6724231 (Printed July 1996)
Hydraulic Schematic For Models 331 Excavator (S/N 512911057 & Above) (Standard & ISO) Chart #6724232 (Printed April 1996)	Hydraulic Schematic For Models 331 Excavator (S/N 512911057) (Standard & ISO) Chart #6724232 (Printed July 1996)
	Hydraulic Schematic For Models 331 Excavator (S/N 512912001–12999) (Standard & ISO) Chart #6724689 (Printed July 1996)
Hydraulic Schematic For Models 331 Excavator (S/N 512913001 & Above) (Standard & ISO) Chart #6724564 (Printed April 1996)	Hydraulic Schematic For Models 331 Excavator (S/N 512913001 & Above) (Standard & ISO) Chart #6724564 (Printed July 1996)
	Electrical Schematic For Models 331 Excavator (S/N 512911001–11999) Chart #6724223 (Printed July 1996)
	Electrical Schematic For Models 331 Excavator (S/N 512912001–12999) Chart #6724486 (Printed July 1996)
	Electrical Schematic For Models 331 Excavator (S/N 512913001 & Above) Chart #6724585 (Printed July 1996)

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TAKE OUT	PUT IN
Hydraulic Schematic For Models 331 Excavator (S/N 512913001 & Above) (Standard & ISO) Chart #6724564 (Printed July 1996)	Hydraulic Schematic For Models 331 Excavator (S/N 512913001 & Above) (Standard & ISO) Chart #6724564 (Printed April 1997)

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Manual No. 6724222 (2–96)

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The following page is a revision to the 331 Excavator Service Manual P/N 6724222 (2–96) Revised (7–96).

Put in the added page as follows:

TAKE OUT	PUT IN
Contents Page 5–1	Contents Page 5–1 (Revised July 1997)
5–17 thru 5–56	5–17 thru 5–56 (Revised July 1997)
	5–57 thru 5–76 (Added July 1997)

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Product BOBCAT EXCAVATOR

Model 331 (S/N 512911001–512912999)

Manual No. 6724222 (2–96)

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Put in the added page as follows:

TAKE OUT	PUT IN
Cover (S/N 512911001 & Above) 6724222 (2–96)	Cover (S/N 512911001–512912999) 6724222 (2–96)
v, vi	v (Revised Mar. 98), vi
2–145, 2–146	2–145, 2–146 (Revised Mar. 98)
4–55 Thru 4–58	4–55 Thru 4–58 (Revised Mar. 98)
7–3, 7–4	7–3, 7–4 (Revised Mar. 98)
8–3 Thru 8–10	8–3 Thru 8–10 (Revised Mar. 98)

REMOVE Wiring Schematic (P/N 6724585)
(S/N 13001 & Above)
Sheet 1 Of 3 Thru Sheet 3 Of 3.

REMOVE Hydraulic Schematic (P/N 6724564)
(S/N 13001 & Above)
Sheet 1 Of 3 Thru Sheet 3 Of 3

See the NEW 331 (S/N 512913001 & Above) Service Manual (P/N 6900464 (2–98) for the new Hydraulic and Wiring Schematics.

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