SMTD20MEX09/1E

SERVICE MANUAL

TD-20M

EXTRA

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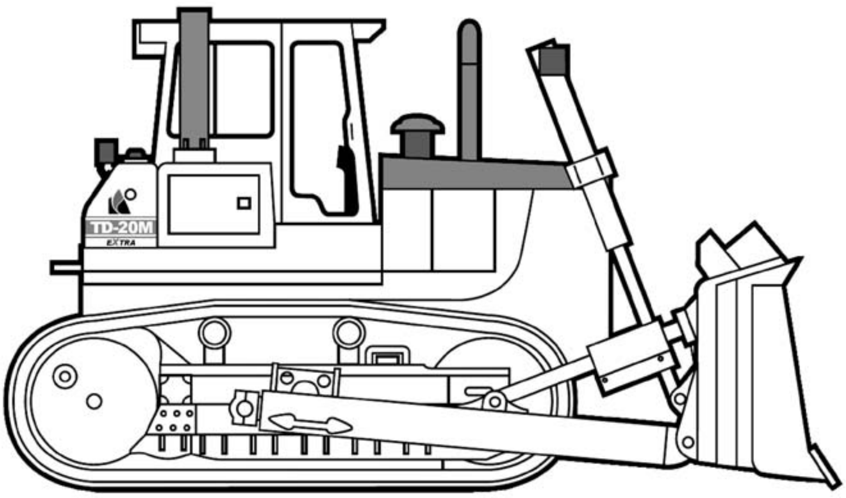

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DUE TO THIS CONTINUOUS PROGRAM OF RESEARCH AND DEVELOPMENT, PERIODIC REVISIONS MAY BE MADE TO THIS PUBLICATION. IT IS RECOMMENDED THAT CUSTOMERS CONTACT THEIR DISTRIBUTOR FOR INFORMATION ON LATEST REVISION.

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INTRODUCTION

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SAFETY PRECAUTIONS

1. GENERAL

The instructions contained in this service manual are for information and guidance of service personnel who are responsible for overhaul and repair of the machine.

Due to a continuous program of research and development, some procedures, specifications and parts may be altered in a constant effort to improve this machine. Some illustrations are of a general application of this model and may not show your machine and component parts accurately in all details.

It is our policy to improve our products whenever it is possible and practical to do so. We reserve the right to make changes or add improvements at any time without incurring any obligation to install such changes on products sold previously.

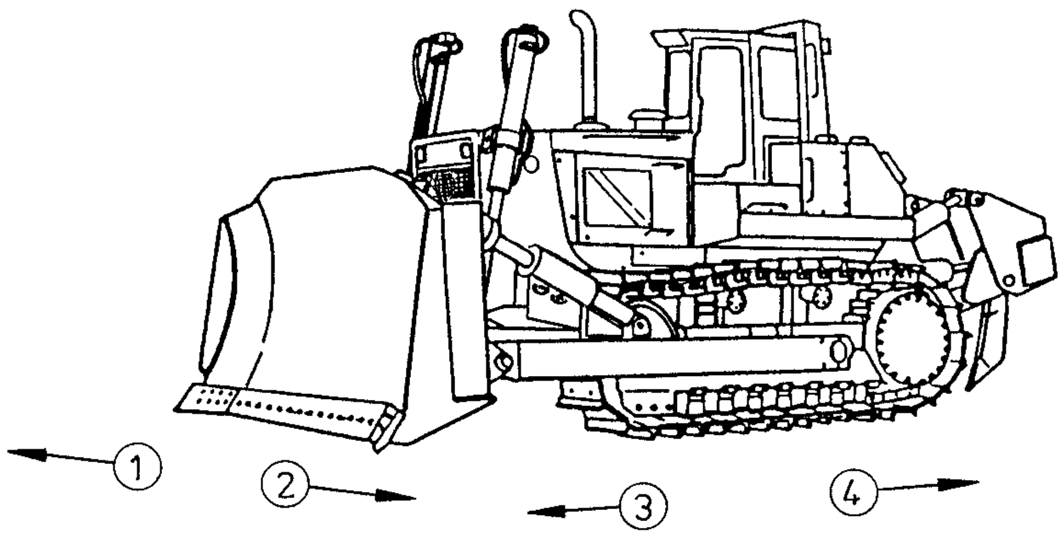


Fig. 1.1. TD-20M EXTRA Crawler Tractor with Cab

1. Right Hand Side of the Machine
2. Left Hand Side of the Machine
3. Front of the Machine
4. Rear of the Machine

Throughout this manual there will be two types of cross references. One type is to a heading in another section. The other is to a heading within the same section. Unless it is otherwise stated, references will be to the same section. Refer to the section contents page at the beginning of the individual sections for specific page numbers.

Throughout this manual the use of the terms “Left”, “Right”, “Front” and “Rear” must be understood to avoid confusion when following instructions. “Left" and “Right" indicate the left and right sides of the machine when facing forward in the operator's seat, refer to Fig. 1.1.

INTRODUCTION

SAFETY PRECAUTIONS

Throughout this manual the following warning symbols and notes are used to warn the persons against danger.

DANGER! This sign and the text in bold letters used throughout this Manual indicates an emergency, which, if not avoided, will result in serious injury or death. This sign calls your attention to a most serious danger.

WARNING! This sign and the text in bold letters used throughout this Manual indicates an emergency, which, if not avoided, may result in injury or death.

CAUTION: This sign and the text in bold letters used throughout this Manual indicates an emergency, which, if not avoided, may result in minor injury.

Besides above, two words are used thorougout the manual related to possible damage of machine units, its functioning or facilitating the maintenance, beneficiary influence on machine operation and period to overhaul.

IMPORTANT: *This sign and text in italics is used throughout this manual to call your attention to key problems for machine operation. Failure to follow such instructions may result in damage of the machine and heavy material losses.*

NOTE: *This sign and text in italics is used throughout this manual to call your attention to important function having influence on the right functioning of the machine or for informational purposes.*

WORK SAFETY – FOLLOW THESE RULES

This symbol and text with bold letters is used throughout this manual to call your attention to instructions concerning your personal safety. Observe and follow these instructions. Be certain anyone operating and servicing this machine is aware of these rules. Failure to follow these rules may result in injury or death.

WARNING: The machine can only be operated and serviced by a person who is familiar with OPERATOR'S MANUAL and SERVICE MANUAL, knows operation of the machine and its mechanisms, experienced and properly licensed to operate such machines.

The instructions and information given in this section do not cover all you ought to know to operate the machine safely. Detailed instructions regarding operational safety appear in the following sections of this manual. Carefully observe and follow all instructions provided in this manual.

Human error is an important factor in most equipment-related injuries. Haste, carelessness and lack of training are the primary causes of injuries.

Most operating injuries occur because of excessive speed, loss of control, failure to observe warning signs, slipping or falling while entering for dismounting, a lack piles on roadways, lack of a ROPS or seat belt, or not watching in the direction of travel.

SAFETY PRECAUTIONS

Most maintenance injuries occur during welding or when using hammers or wrenches. The most common faults are improper work position, a slipped tool, missed aim, a broken tool, flying chips and no welding hood.

Think before you act. A careful operator or maintenance man is the best insurance against an accident.

Always wear proper safety equipment. Avoid wearing jewelry and loose fitting clothing; they could catch on moving parts, which could result in serious injury or death. Hard hat, sturdy rough-soled work shoes or safety shoes, ear protectors, reflective clothing, safety glasses and heavy gloves may be required. Consult your employer for specific safety equipment requirements.

Each job site and application may have personal safety requirements. Carefully evaluate your particular application and machine for equipment such as heater and defroster, all windshield wipers, warning lights, side view and rearview mirrors, back-up alarms, fire extinguisher, rotating beacons and additional lights. If in doubt, contact your distributor.

It is recommended that the machine be equipped with a fully charged fire extinguisher and the first aid kit. All personnel should be instructed in fire extinguisher proper usage. Recharge immediately after use.

The fire extinguisher is to be mounted in the operator's cab at the RH side of the operator's seat. Refer to OPERATOR'S MANUAL for the fire extinguisher location.

The fire extinguisher is to be secured in its holder to prevent its displacement while the machine is in motion. In case of fire the fire extinguisher is easy to get hold off. The fire extinguisher plate provides you with how to use (put into operation) the extinguisher and its designation.
The operator is to be trained and familiar how to operate the fire extinguisher.

Electrical system is 24-volt negative ground.
Each machine is equipped with a booster receptacle that is to be used during the engine start up with a booster battery. When the use of the booster receptacle socket is impossible in out-of-normal situations, follow the precautions given below to prevent chances of injury or damage to electrical circuits.

1. Turn the electrical master switch to the OFF position.
2. Attach one end of jumper cable to the positive terminal (+) of booster battery and other end to the positive terminal of machine battery.
3. Attach one end of second cable to the negative terminal (-) of booster battery and other end to the machine's ground terminal away from the battery.
4. To remove cables, reverse above sequence exactly to avoid sparks near the battery.

A frozen battery can explode when the booster cables are attached. NEVER check battery charge by placing a metal object across the battery posts. The sparks could cause an explosion. Use a voltmeter or areometer for checking.

Every machine is factory equipped with a safety belt mounted to the operator's seat.

INTRODUCTION

SAFETY PRECAUTIONS

2. BEFORE STARTING THE ENGINE

Never start the engine indoors unless proper exhaust ventilation is provided to remove deadly exhaust gases. Once the engine is operating, move the machine outdoors as soon as possible. Exhaust gases are dangerous and can cause unconscious-ness and death.

Always place the drive train neutral lock lever in locked position, drive train control lever in neutral position and apply the parking brake before starting the engine.

The operator must be alert, physically fit and free from the influences of alcohol, drugs or medications that might affect his eyesight, hearing, reactions or judgment.

Observe and know the use of alternate exits from the operator compartment.

Safety must always be the operator's most important concern. He must refuse to operate when he knows it is unsafe and consult his supervisor when safety is in doubt.

Do not jump onto or of the machine. When mounting or leaving the machine always use two feet and one hand or one foot and two hands to ensure contact with machine steps, holders or rails.

Do not use controls or hoses as hand holds when climbing on or off the machine. Hoses and controls can move and do not provide solid support. Movement of the controls may cause inadvertent and unexpected movement of the machine or its equipment.

Follow all machine-mounted safety signs before starting, operating, maintaining or servicing the machine.

Be sure the area of the operator's compartment, all mounting steps and grab handles are free of oil, grease, loose objects, ice and mud to lessen the possibility of slipping. Remove or secure all maintenance and personal items so they will not interfere with the operator or jam the controls.

Perform a visual check of the machine before starting the engine. Look for such things as improper fluid levels, oil leaks, and loose, damaged or missing parts. Do not start the engine until any unsafe conditions are corrected. Secure all caps and filler plugs.

Know and understand the traffic flow patterns of your job and obey flagman, signs and signals.

Before entering the operator's compartment, clear the immediate area surrounding the machine of personnel and obstructions. Walk completely around the machine. After entering the operator's compartment, sound the horn to clear the immediate area of the machine.

Check work area for hazardous conditions. Due to the danger of fire and explosion, never check or fill the fuel tank or the batteries near the burning or smoking materials, open fire or spark conditions due to fire hazard or explosion.

SAFETY PRECAUTIONS

3. OPERATION

Check the work area for hazardous conditions. Be alert for soft ground conditions, especially when working on slopes, near drop-offs or excavations or fill material, which could lead to sudden land collapse and tipping of the machine.

At night and at times of poor visibility, carefully check the work area before moving in with the machine. Use all lights provided.

Keep the windshield, windows and mirrors (if equipped) clean.

Before starting the engine, be sure you understand all control functions. Check all controls, including the brakes, decelerator, steering and transmission. Check all gauges, warning lights and safety devices. Correct any malfunctions.

Only one person, the operator, should be permitted to ride on the machine when it is in operation.

Perform an operational check of the machine in a safe area before putting it to work.

Keep operating controls, hands and shoes free of grease, water and mud to insure positive control functions.

Because the machine is ROPS equipped, for your personal protection, wear your seat belt.
Before driving the machine, adjust the seat and fasten the seat belt. Adjust the seat belt to fit snugly and flow around the hips to lessen the chance and severity of injury in the event of an accident.
Never wear the seat belt across the abdomen.

Check overhead clearance carefully before operating the machine in areas with low overhead clearance, such as guy wires, power lines, bridges, low-hanging tree branches and building entrances or exits. These overhead obstructions could cause an accident.

After starting the engine, but before moving the machine, warn nearby personnel by giving a couple of short horn blasts.

During the brake lock test, be sure that there are no people in the immediate area of the machine, and that the same is free from obstacles. As the brakes do not brake the machine, stop the machine operation immediately and remove the cause of the defect.

Be sure that the rear screen is securely fastened to the ROPS structure before operating the winch. Operating without correctly installed screen could result in serious injuries. Operate the winch from the driver’s seat only. Always engage the parking brake before winching, if the machine is stopped. Use caution when installing or removing cable from the winch. Keep all persons clear of a cable under tension. Never use a cable that is damaged. Failure to follow these instructions could result in serious injuries.

Never mix gasoline, gasohol and/or alcohol with diesel fuel. This practice creates an extreme fire hazard and under certain conditions an explosion, which could result in personal injury or death.

Do not smoke when refueling or servicing the machine. A fire could result.

Never place gasoline or diesel fuel in open pan.

INTRODUCTION

SAFETY PRECAUTIONS

Never remove the fuel tank filler caps or refill the fuel tanks while the engine is running or hot or when the machine is indoors. Fumes are dangerous, a spark or flame could result in a fire or explosion.

Observe instruments and warning lights frequently. Report any defects or unusual noises in machine during operation. Be alert to the location of other personnel. Do not operate if exposed personnel enter the immediate work area. Warn all ground persons to leave the area of the machine.

On machines equipped with a suction fan or a reversible fan in the suction position, periodically check the engine exhaust system for leaks. Exhaust gases are dangerous to the operator.

Do not operate the machine in a condition of extreme fatigue or illness.

Be sure that the rear screen is securely fastened to the ROPS structure.

Be sure chains or cables and their anchor points are strong enough to handle the expected load. Inspect carefully chains and cables for flaws before using them.
Always wear gloves when handling cables and chains. Avoid looping or knotting a cable or chain.
Do not pull with a kinked chain or cable as excessively high stress in bent area may cause chain or cable failure. Cables or chains for towing or winching should be fastened to attachment points designed to this purpose only.
Be sure the attachment pins are securely inserted immediately before pulling with the chain or cable.
Stand clear of chains or cables under load.

Keep engine exhaust system and exhaust manifold clear of combustible material for your personal protection.

Know the locations of underground cables, water mains, gas lines, etc. A ruptured gas line or cut electrical cable could result in personal injury or death.

When leaving the machine unattended for any length of time, make sure the blade is completely lowered, the engine is stopped, the parking brake is applied, and the electrical master switch is in the “off” position and drive train neutral lock lever is in locked position. If the machine is equipped with a cab make sure that the cab door is locked.

Before operating the machine read and know the Operator’s Manual and ALL SAFETY GRAPHICS.

The roll-over protective structure (ROPS) provides the operator’s protection in the event of machine rollover or upset. This structure is designed to bend during rollover to protect the operator from sudden impact loads.

When operating the machine, look in the intended direction of travel and the immediate machine operational area to be sure personnel or allied equipment does not interfere with the machine work pattern.

Never try to get on or off the machine while it is moving. A serious injury or death could result.

Never shift the transmission into neutral (N) when traveling downhill. The machine may go out of control and a rollover could result or the transmission, torque converter or engine could be damaged when the transmission is again placed in gear. Always put the transmission in low gear before starting downhill. Use the decelerator and brake pedal to slow the machine.

SAFETY PRECAUTIONS

Avoid side hill travel whenever possible. Drive straight up and down the slope. If the machine starts slipping sideways on a grade, turn downhill immediately.

If possible avoid crossing obstacles such as ridges, rocks or logs. If you can't avoid them, reduce speed and ease over the obstacle at an angle.

A machine's weight and the vibration it creates can cause the edge of a high wall to collapse. Keep your machine away from the edges of banks and excavations. If it is not possible to avoid turn the machine front towards the bank edge or excavation.

Travel slowly in congested areas or on rough ground, slopes or near drop-offs or on snow, ice or slippery surfaces.

Maintain a safe distance between your machine and other vehicles according to the condition of the road and load.

Never hold the hydraulic controls in their extreme position after the equipment has reached its maximum travel. This could cause overheating of the hydraulic system.

Do not adjust the seat position while the machine is in motion. A loss of control may result. Completely stop the machine, apply and lock the parking brake and then adjust the seat.

Never use the blade as a brake except in an emergency.

Carry the blade low for maximum stability and visibility.

Where noise exposure during machine exploitation or after repair operations exceeds levels defined by proper health and safety authorities and applicable standards wear authorized ear protective equipment.

4. MAINTENANCE

Servicemen and their helpers only are allowed to remain at operator' s post while maintaining or repairing the machine.
Authorized personnel only is allowed to control, maintain or repair a machine.

Do not hurry. Haste could result in accident.

Load things into the machine from the ground level before mounting the machine.

Loosen the radiator cap slowly to relieve all pressure in the system and use caution when removing the caps.

Pressurized Reservoir; loosen the filler cap slowly to relieve reservoir pressure to prevent possible injury. Always vent the hydraulic system before working on any hydraulic component. Have all equipment resting on the ground or blocked before removing any hydraulic component.

Have all equipment resting on the ground and relieve all hydraulic system pressure by moving control lever in various directions before removing any hydraulic component.

Never work beneath the blade and/ or ripper without proper blocking. Improper blocking could result in serious injuries.

When service or maintenance requires access to areas that cannot be reached from the ground, use a ladder or platform. If such ladders or platforms are not available, use the machine hand holds and steps provided. Perform all service or maintenance carefully.

SAFETY PRECAUTIONS

Do not attempt to make repairs that you do not understand. Consult your distributor. Use only approved parts for repairs and maintenance. Failure to do so could compromise your personal safety and machine performance and reliability.

Use only approved parts for repairs and maintenance show in your parts catalog. Failure to do so could compromise your personal safety and machine performance and reliability.

Never align holes with fingers or hands. Use a proper aligning tool.

Be sure all used tools are in good condition. Do not use tools which are worn, bent or have mushroomed heads. Use the proper tool for the job. Remove sharp edges and burrs from reworked parts.

For field service, move machine to level ground if possible and blocks the tracks. If work is absolutely necessary on an incline, block the machine and its attachments securely. Move the machine to level ground as soon as possible.

Before working on the machine, turn OFF the electrical system master switch and remove the starting switch key so no one will start it unexpectedly.

Do not carry loose objects in pockets that might catch on the machine or fall unnoticed into open compartments.

Before working on any part of the engine or electrical system, disconnect the battery ground cable. Tag the cable and all controls to alert personnel that work is in progress.

When it is necessary to make any checks or adjustments with the engine operating, always use two people. One trained person must be in the operator's seat to safeguard the second person making the checks or adjustment.

As an added precaution, when making checks or adjustments with the engine operating, apply the parking brake.

Never stand on the tracks or near the blade while the engine is operating.

If the engine is running and the side doors are open or removed be careful of rotating parts such as the fan and belts that can cause serious injury.

Do not clean or lubricate the machine subassemblies while the engine is operating. The parts in motion when contacted can cause personal injury.

Use a non-toxic, nonflammable commercial solvent for cleaning parts, unless otherwise specified. Never use gasoline, diesel fuel, kerosene or other flammable solvents for cleaning part.

Excessive or repeated skin contact with sealant or solvents may cause skin irritation. In case of skin contact, remove sealant or solvent promptly by washing with soap and water. Follow the manufacturer’s advice whenever cleaning agents or other chemicals are used.

Lower blade and ripper before making hydraulic adjustments. To prevent personal injury, be sure no personnel are standing in the way of the blade and/or ripper when it is being lowered.
Never allow anyone to walk under or be near unblocked raised equipment.

Provide proper ventilation when operating in a closed building to avoid danger of exhaust gases. Exhaust gases are dangerous and can cause unconsciousness and death.

SAFETY PRECAUTIONS

Hydraulic fluid escaping under pressure from a very small hole can be almost invisible, yet have sufficient force to penetrate the skin. Use a piece of cardboard or wood to search for suspected leaks. Do not use hands. If injured by escaping fluid, see a doctor at once. Serious infection or reaction can occur if proper medical treatment is not administered immediately.

When welding, wear proper protective equipment such as a helmet, dark safety glasses, protective glasses near welding. DO NOT look at the arc without proper eye protection.

Wear proper protective equipment such as goggles or safety glasses with side shields, hard hat, safety shoes and heavy gloves when metal or other particles are apt to fly or fall.

Lift and handle all heavy parts with a lifting device of proper capacity. Be sure parts are secured by proper slings and hooks. Use lifting eyes if provided. Warn people in the area to stand clear.

Do not attempt to repair the ROPS protective structure after an accident. Repaired structures do not provide the original strength and protection. Contact your distributor for information on structure replacement. Do not cut, drill, weld, grind the ROPS protective structure as all these operations have a detrimental effect on its structure and safety.

When using compressed air for cleaning parts, wear goggles or safety glasses with side shields. Use an air nozzle, which limits the pressure to 200 [kPa].

Do not use an open flame to check for leaks or fluid levels anywhere around the machine.

Keep work area clean and dry. Remove oil and water spills immediately.

Do not pile up oily or greasy rags. They are a fire hazard. Store them in an approved, closed metal container.

Use a soft iron or nonferrous hammer to install or remove ripper point. It is dangerous to hammer on the point. Wear safety glasses with side shields or goggles to reduce the chances of injury.

Batteries give off a highly inflammable gas. Never allow sparks or open flame near the batteries.
A fire or explosion could occur. Do not charge batteries in a closed area. Provide proper ventilation to guard against accidental explosion of an accumulation of the explosive gas given off in the charging process. When installing batteries be sure the electrical master switch is locked in the OFF position. Be sure to connect the positive cable to the positive terminal and the negative (ground) cable to the negative terminal.

Never mix gasoline, gasohol or alcohol with diesel fuel. This creates an extreme fire or explosion hazard, which could result in personal injury or death.

Do not use bleach, color dye or solvents on the seat belt webbing. This may cause a severe loss of tensile strength. This could cause the webbing to break resulting in personal injury. It is recommended that the seat belt be cleaned only with warm water and mild detergent.

5. WHEN PARKING

If parking on or near traffic lanes cannot be avoided, provide appropriate flags, barriers, flares and warning signals. Also provide advance-warning signals in the traffic lane for approaching traffic.
Park the machine in a non-operating and non-traffic area. Park machine on level ground whenever possible. If you must park on a slope, park at right angles to the slope. Apply and lock the brake pedal.

Never leave the machine unattended with the engine running.

INTRODUCTION

SAFETY PRECAUTIONS

When leaving the machine unattended, slowly lower the hydraulic equipment to the ground and place drive train neutral lock lever in locked position, shut off the engine, apply and lock the parking brake. Relieve any pressure in the hydraulic system by moving the controls in all directions. Turn off the electrical system master switch. Take the keys out both from the electrical system master switch and the starter switch. Always lock up machine when leaving it unattended, including any anti-vandalism attachments.

Do not jump off the machine.

When operating in bad weather and storm lightening is nearby, dismount and seek shelter away from the machine. Lightening will be attracted to the machine and can cause serious injury or death.

When the machine is to be loaded onto a transport truck and trailer do so carefully. Load only when the trailer is level. The steel track shoes will slide easily on the trailer. When the machine is properly positioned tie it securely with a rope and block with wooden pieces so it cannot move on the trailer. For more detailed information refer to OPERATOR"S MANUAL.

Keep your head, body, legs, hand, fingers away from the blade and ripper when they are in a raised position.

Do not allow the hydraulic system to support the mounted equipment without its proper blocking when leaving the machine unattended, to eliminate the possibility of an expected drop of the blade or ripper.

SERVICE INFORMATION

6. SERIAL NUMBERS

For complete description and location of the machine serial number, the blade serial number, the ripper serial number and the engine serial number, refer to SECTION 1, INTRODUCTION in OPERATOR'S MANUAL.

All other components having serial numbers are each equipped with a separate stamped serial number plate.

Use machine serial numbers when requesting information or ordering parts and proper numbers from PARTS CATALOGUE.

7. INSPECTION AND REPAIR

Bearings

Inspect for evidence of overheating, cracks, scores, pitting and general wear and replace if necessary. Serviceable bearings must be cleaned, soaked in fresh lube and wrapped in grease proof material.

Gasket and Seals

Always use new gaskets and seals during assembly and installation. Use extreme caution to avoid damage to seals or gaskets during these operations. Use sleeves or tape when seals have to be passed over threads or splines. Pack lip type seals with fresh grease prior to installation. Felt dust seals must be soaked in light clean oil before assembly.
DO NOT roll an O-ring during installation. To correctly install, position at one point and using a blunt tool, stretch into position. DO NOT stretch any more than is required for proper installation.

SERVICE INFORMATION

Gears and Splines and Welds or Castings

Check splines with their mating parts for wear. Check gears and splines for pitting, burrs, broken or missing teeth. Burrs can be removed with a fine stone, but care must be taken so that only burr is removed and gear or spline profile is not changed. Check all weld for cracks, twisting and misalignment. Check castings for cracks and distortion.

Piping and Hoses

Check all fittings for leaks and thread damage. Check steel piping for cracks and chafing. Check hoses for chafing, twisting or perishing, etc.

Relief Valves

Before commencing work on hydraulic system, check that relief valves are opening at their correct pressures. Pressures are listed and information on how to check and adjust pressures in HYDRAULIC section.

Lubrication

During assembly, running or wear surfaces must be coated with specified lube. Refer to OPERATOR'S MANUAL. Use sufficient lube to prevent seizing, scoring or excessive wear on initial operation. Failure to provide starting lube may result in serious damage.

8. ELECTRONIC CIRCUITS PROTECTION DURING WELDING AT THE MACHINE

Welding on a Vehicle With an Electronic Controlled Fuel System and CMCV One Lever Controlled Drive System.

The welding at the engine or engine installed components is not recommended.
However, if a welding within the machine is unavoidable, proceed as follows:

- Disconnect both the negative (-) and positive (+) battery cables from the battery.
- Disconnect both the ECM connector at the engine LH side and the CMCV connector within the operator pod LH column. To do it, remove the left armrest, unscrew and remove the cover plate with a module, disconnect the connectors for the module power leads.
- Do not connect the welder ground cable to the ECM cooling plate or ECM itself.
- Attach the welder ground cable no more than 0.6 [m] away from the part being welded.

LOCTITE USAGE

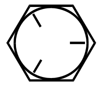
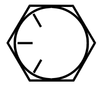
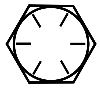
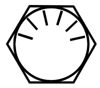
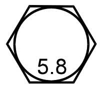
9. LOCTITE USAGE

Type and application places of LOCTITE are showed in specific places of Service Manual.

For surface preparation, application, setting time before placing in operation, removal and application in low temperature refer to directions for use of LOCTITE.

STANDARD TORQUES

10. BOLT IDENTIFICATION CHART

Type / Class	Description	Head Marking
Type 5 Inch Thread	Three radial lines on top and none on side of head. Medium carbon steel quenched and tempered.	
Type 5.2 Inch Thread	Three radial lines on top and none on side of head. Low carbon boron steel quenched and tempered.	
Type 8 Inch Thread	Six radial lines on top and none on side of head. Medium carbon or carbon alloy steel quenched and tempered.	
Type 8.2 Inch Thread	Six radial lines on top and none on side of head. Low carbon boron steel quenched and tempered.	
Class 5.8 Metric Thread	Marked on top or side of head. Low or medium carbon steel.	
Class 8.8 Metric Thread	Marked on top or side of head. Medium carbon or carbon alloy or low carbon boron steel quenched and tempered.	
Class 10.9 Metric Thread	Marked on top or side of head. Medium carbon or carbon alloy or low carbon boron steel quenched and tempered.	

11. TORQUE VALUES FOR STANDARD FASTENERS

The following charts provide tightening torque for general purpose applications using original equipment standard hardware as listed in the PARTS CATALOGUE for the machine involved. DO NOT SUBSTITUTE.

Special torques and applications which are nonstandard are listed separately on a SPECIAL NUT AND BOLT TORQUE charts in further Sections of the manual.

A torque value to a tolerance of ± 10 [%] of the chart value should be achieved for a satisfactory applications.

Torque Values for Standard English Fasteners

Original equipment standard hardware is defined as Type 8, coarse thread bolts and nuts and thru hardened flat washers (Rockwell “C” 38-45), all phosphate coated and assembled without supplemental lubrication (as received) condition. The torques shown below also apply to the following: phosphate coated bolts used in tapped holes in steel or gray iron; phosphate coated bolts used with phosphate coated prevailing torque nuts (nuts with distorted threads or plastic inserts); phosphate coated bolts used with copper plated weld nuts.
Markings on bolt heads or nuts indicate material grade ONLY and are NOT to be used to determine required torque.

STANDARD TORQUES

GENERAL APPLICATION TORQUES	
Nominal Thread [in]	Standard Torque [Nm]
1/4	10
5/16	21
3/8	38
7/16	60
1/2	92
9/16	130
5/8	180
3/4	325
7/8	520
1	780
1 1/8	1110
1 1/4	1565
1 3/8	2050
1 1/2	2720
1 3/4	3380
2	5080

Torque Values for Standard Metric Fasteners

Original equipment standard hardware is defined as coarse thread metric class 10.9 bolts and class 10.0 nuts and thru hardened flat washers (Rockwell “C” 38-45), all phosphate coated and assembled without supplemental lubrication (as received) condition. The torques shown below apply to phosphate coated bolts designed for 60 % yield strength.

The torques shown below also apply to the following: phosphate coated bolts used in tapped holes in steel or gray iron; phosphate coated bolts used with phosphate coated prevailing torque nuts (nuts with distorted threads or plastic inserts), phosphate coated bolts used with copper plated weld nuts.

Markings on bolt heads or nuts indicate material grade ONLY and are NOT to be used to determine required torque.

GENERAL APPLICATION TORQUES	
Nominal Thread [mm]	Standard Torque [Nm]
6	10
7	16
8	23
10	46
12	80
14	125
16	200
18	275
20	385
22	530
24	670
27	980
30	1330
33	1790
36	2325
39	3010

INTRODUCTION

STANDARD TORQUES

12. SPLIT FLANGE CONNECTIONS

The following chart provides the tightening torques for split flange connections used in hydraulic systems. Flanges and fitting shoulders should fit squarely. Install all bolts, finger tight, then torque evenly. Over torquing bolts will damage the flanges and/or bolts, which may cause leakage.

Flange Size [in]*	Bolt Size [in]	Bolt Torque Newton Meter [Nm]
1/2	5/16	20 to 24
3/4	3/8	30 to 37
1	3/8	37 to 47
1-1/4	7/16	47 to 61
1-1/2	1/2	62 to 79
2	1/2	75 to 88
2-1/2	1/2	107 to 123
3	5/8	187 to 203
3-1/2	5/8	159 to 180

(*) – Inside diameter of hydraulic tube or hose fitting

13. HYDRAULIC TUBES AND FITTINGS

The torque figures are recommended for plain, cadmium or zinc plated fittings, dry or wet installations. Swivel nuts either swaged or brazed. These torques are not recommended for tube with wall thickness of 0.9 [mm] or less.

Size	Tubing O.D. [in]	Thread size [in]	Torque values for 37 [°] flared fittings [Nm]	Torque values for O-ring boss plugs, locknuts and 37 [°] JIC flared fittings [Nm]
4	1/4	7/16–20	12–16	8–14
5	5/16	1/2 –20	16–20	14–20
6	3/8	9/16–18	29–33	20–27
8	1/2	3/4 –16	47–54	34–42
10	5/8	7/8–14	72–79	47–54
12	3/4	1-1/16–12	104–111	81–95
14	7/8	1-3/16–12	122–138	95–109
16	1	1-5/16–12	149–163	108–122
20	1–1/4	1-5/8–12	190–204	129–156
24	1–1/2	1-7/8–12	217–237	163–190
32	2	2-1/2–12	305–325	339–407

STANDARD TORQUES

14. HOSE CLAMPS

The following chart provides the tightening torques for hose clamps used in all rubber applications (radiator, air cleaner, operating lever boots, hydraulic system, etc.).

Clamp Type and Size	TORQUE ± 0.6 [Nm]	
	Radiator, Air Cleaner, Boots, Etc. [Nm]	Hydraulic System [Nm]
"T" Bolt (Any Diameter)	6.2 to 7.3	—
Worm Drive - 1-3/4 in Open Diameter and Under	2.2 to 3.3	4.5 to 5.6
Worm Drive - Over 1-3/4 in Open Diameter	4.5 to 5.6	—
Worm Drive - All "Ultra-Title"	10.7 to 11.8	4.5 to 5.6

15. TORQUE VALUES FOR AIR CONDITIONING TUBES AND FITTINGS

SWAGED 45 [°] CONNECTIONS

SIZE	THREAD SIZE [in]	TORQUE VALUES FOR MATERIALS [Nm]			
		STEEL-STEEL	BRONZE –STEEL	COPPER-STEEL	ALUMINUM-STEEL
1/4	7/16–20	16 – 23	15 – 20	15 – 20	12 – 18
3/8	5/8–18	27 – 33	23 – 38	23 – 38	20 – 25
1/2	3/4–16	47 – 54	38 – 46	38 – 46	28 – 36
5/8	7/8–14	61 – 68	45 – 53	45 – 53	34 – 42
3/4	1-1/16–12	72 – 80	49 – 57	49 – 57	45 – 53
3/4	1-1/16–14	72 – 80	49 – 57	49 – 57	45 – 53

16. TORQUE VALUES FOR AIR CONDITIONING O-RING CONNECTIONS

SIZE	THREAD SIZE [in]	TORQUE VALUES FOR MATERIALS [Nm]
		STEEL-STEEL
1/4	7/16–20	15 – 25
3/8	5/8–18	27 – 33
1/2	3/4–16	40 – 48
5/8	7/8–14	47 – 54
3/4	1-1/16–12	54 – 61
3/4	1-1/16–14	54 – 61

SECTION 5

STEERING

STEERING

CONTENTS

GENERAL

STEERING

GENERAL

1. DESCRIPTION

The machine is equipped with a steering system consisting of a steering drive located in the rear main frame and a two speed steering valve mounted on the rear main frame cover. Brake pedal cable and drive train control valve hydraulically operate the steering valve. Oil pressure from the drive train control valve is directed to the steering valve to operate the steering drive unit.

For further detailed information on the hydraulically controlled steering system refer to SECTION 7, DRIVE TRAIN; SECTION 7C TRANSMISSION and SECTION 7E, STEERING DRIVE.

SECTION 6

COOLING SYSTEM

COOLING SYSTEM

CONTENTS

1. DESCRIPTION

Four cooling systems are used on this machine. First system cools the air, after compressing in engine turbocharging system, second system cools engine coolant, third system cools drive train oil, fourth system is used for cooling oil in fan drive system. All four systems use the modular radiator, which is mounted in front part of the machine. Air flow through the radiators is provided by the hydraulically driven suction fan.

Engine Cooling Systems

Engine intake system is equipped in air-to-air heat exchanger [charge air cooler (CAC)] to reduce intake manifold temperature. The CAC system includes air ducting from the turbocharger compressor outlet to the CAC air inlet, and from the CAC air outlet to the engine intake manifold.

The engine cooling system used on this machine is a closed, deaerated with separate auxiliary tank. Pressure type system permits operation at extreme angle without loss of coolant through the overflow tube. The cooling system also permits operation at higher engine temperatures without boiling.

For detailed information on the engine cooling system components, refer to the Engine Operation and Maintenance Manual QSC8.3 and QSL9 Engine, Bulletin No 4021518; Troubleshooting and Repair Manual ISC, ISC^{e,} QSC8.3, ISL and QSL9 Engines, Bulletin 4021418 and Troubleshooting Repair Manual QSC Engines, CM850 Electronic Control System, Bulletin No.4021416.

Drive Train Oil Cooling System

The drive train cooling system uses an oil to air heat transfer type oil cooler, to cool the oil used in the drive train components: transmission, torque converter and steering drive.

Fan Drive Hydraulic Motor Oil Cooling System

The fan drive oil cooling system uses an oil to air heat transfer type oil cooler, to cool the oil used in the fan drive hydraulic system.

2. OPERATION

Engine Cooling Systems

Intake Air Cooling (Refer to Fig. 6.1)

Intake air after passing thru the screen air filter and air filter elements is sucked into the turbocharger (14). Compressed and heated air from the turbocharger is directed to the charge air cooler (CAC) (1) (heat exchanger). CAC outlet is connected to engine intake elbow (15). Tubes (12, 16) are connected with special vibration resistant hump hoses (13). The hot air enters to the cooler (1) and flows through horizontally arranged channels. Heat is dissipated to the air being forced past the outside of the cooler by suction fan, driven by the hydraulic motor.

Engine Cooling System (Refer to Fig. 6.1)

The engine block mounted, belt driven coolant pump, draws coolant from bottom of the radiator and forces it through engine oil cooler chamber to lower coolant manifold in engine block. From there, the coolant is pumped into engine cylinder block where it cools the cylinder liners. Next, the coolant flows to the cylinders head, through its channels and to upper coolant manifold in engine block. The thermostat controls the coolant flow from the upper coolant manifold and engine cooling intensity.

If the engine is cold, thermostat prevents coolant flow through the radiator. Coolant flows in internal drilled channel in the engine block and head back to coolant pump. When opening temperature of thermostat is achieved, internal by-pass channel closes. Hot coolant flows to top of the radiator then through radiator (8) to bottom. Air flowing through the radiator core channels carries away heat to the atmosphere. The flow of the air is forced by the sucked type fan, driven by the hydraulic motor.
The radiator (8), engine cylinders head are vented to auxiliary tank (4) with the vent hoses (5) and (6), respectively.

The hose (10) between auxiliary tank (4) and tube (11) is designed to filling system. The auxiliary tank has an automotive type radiator cap with a built in pressure-vacuum relief valve. The valve allows excess air and vapor to escape trough an overflow hose (3). Coolant filter is incorporated in parallel between upper and bottom coolant manifold. Cab heater element is incorporated in parallel between upper coolant manifold and suction side of coolant pump.

Drive Train Oil Cooling System (Refer to Fig. 6.1)

The oil used in drive train system is directed to the oil cooler (2) thru the inlet hose (17) as it leaves the torque converter. The heat from the oil is dissipated to the air being forced past the outside of the core channels by the sucked type fan, driven by the hydraulic motor. The oil is then directed to the lubrication purpose of transmission with the hose (9).

Hydraulic Motor Fan Drive Oil Cooling System (Refer to Fig. 6.1)

Torque converter mounted and driven hydraulic oil pump is pumping oil to the fan drive hydraulic motor, then oil is directed to the oil cooler (18) thru the hose (19). The heat from the oil is dissipated to the air being forced past the outside of the cooler channels by the hydraulically driven suction type fan. The oil is then directed to the hydraulic oil tank thru the hose (20).
Hydraulic motor speed is controlled by the three sensors located in the engine intake air system, engine cooling system and drive train system.

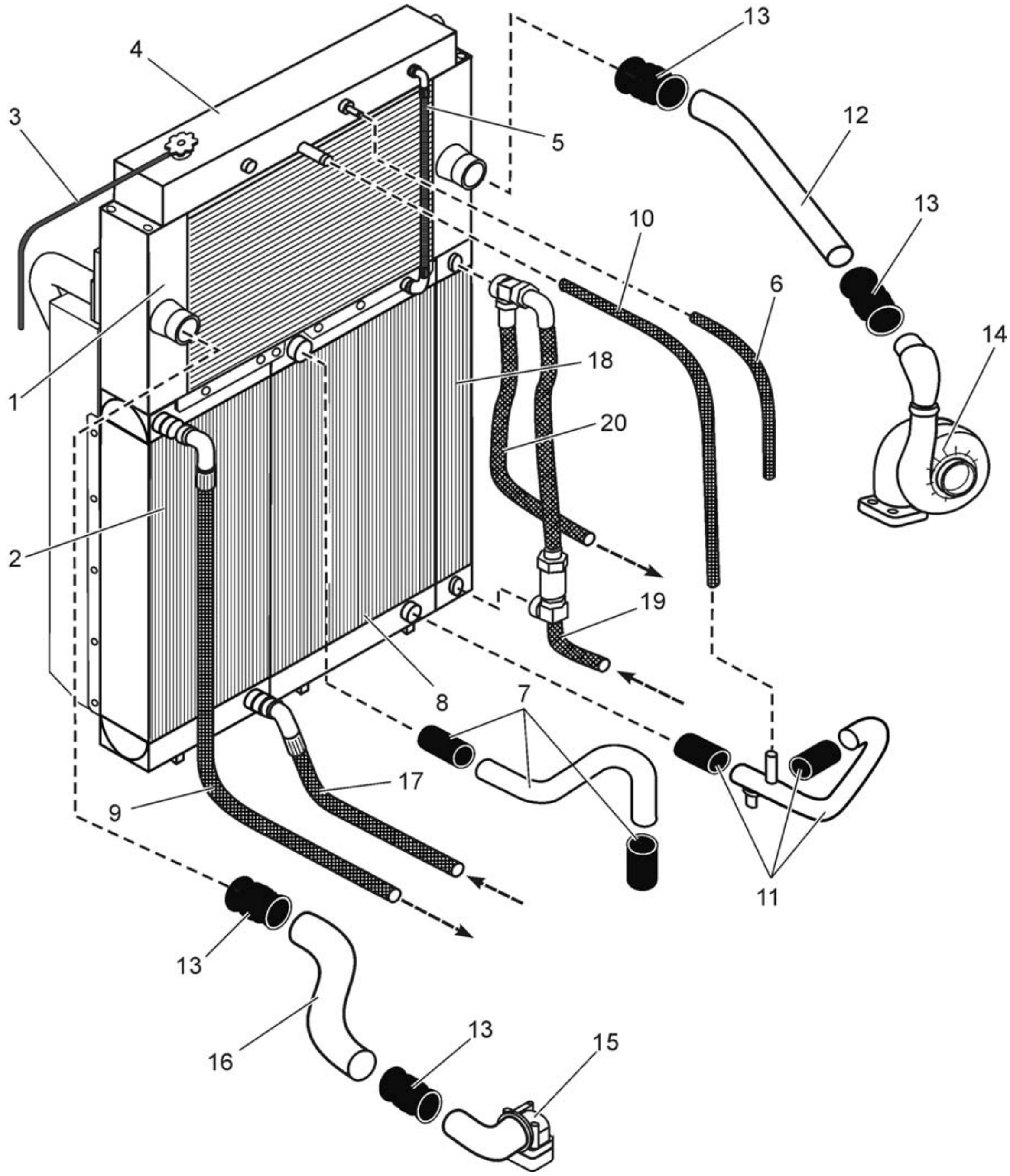


Fig. 6.1. Cooling Systems Connections

1. Charge Air Cooler (CAC)
2. Drive Train Oil Cooler
3. Overflow Hose
4. Auxiliary Tank
5. Radiator Vent Hose
6. Engine Vent Hose
7. Coolant Tube (inlet)
8. Engine Radiator
9. Oil Hose (outlet)
10. Cooling System Fill Hose
11. Coolant Tube (outlet)
12. Air Tube (inlet)
13. Hump Hose
14. Turbocharger
15. Air Inlet Elbow
16. Air Tube (outlet)
17. Oil Hose (inlet)
18. Hydraulic Motor Oil Cooler
19. Oil Hose (inlet)
20. Oil Hose (outlet)

3. SPECIFICATIONS

Engine Cooling System

Capacity . . . . 50 [l]
Coolant pump type . . . . Centrifugal
Standard thermostat range . . . . 82 to 93 [°C]
Minimum recommended coolant temperature . . . . 70 [° C]
Maximum allowable top tank temperature . . . . 107 [°C]
Minimum recommended pressure cap . . . . 50 [kPa]

Engine radiator:

Type . . . . coolant to air
Core . . . . replaceable, with air fins and horizontally arranged flat channels
Test pressure . . . . 200 [kPa]

Charge Air Cooler

Type . . . . air to air
Core . . . . replaceable, with air fins and vertically arranged flat channels
Test pressure . . . . 300 [kPa]
Maximum allowable pressure drop across CAC and piping . . . . 20 [kPa]

Drive Train Oil Cooler

Type . . . . oil to air
Core . . . . replaceable, with air fins and vertically arranged flat channels
Test pressure . . . . 1500 [kPa]

Fan Drive Oil Cooler

Type . . . . oil to air
Core . . . . replaceable, with air fins and vertically arranged flat channels
Test pressure . . . . 1500 [kPa]

Special Nut and Bolt Torque Data:

Radiator bracket mounting bolts. . . . . 50-60 [Nm]
Fan mounting bolt. . . . . 38-42 [Nm]

(Torques given are for bolts and nuts lubricated with SAE-30 engine oil.)

NOTE: *Except for the special torque shown, all bolts and nuts are to be given a standard torque. Refer to "STANDARD TORQUES " in Section 1, "INTRODUCTION."*

4. SERVICE DIAGNOSIS

Engine cooling system

COMPLAINT	
PROBABLE CAUSE	REMARKS
Engine Power Output Low	
1. Engine overloaded	Review operating instructions in the Operator's Manual
2. Air leak between the turbocharger and intake manifold	Check the CAC system piping connections for leakage. Replace damaged parts
3. CAC restricted	Inspect the air cooler for internal restrictions /clogging
4. Fan blades damaged	Replace fan
5. Fan drive system problem	Refer to Section 10
Overheating Due to Restricted Air Flow	
1. Clogged radiator	Flush with steam for external clogging
2. Fan blades damaged	Replace fan
3. Fan shroud damaged	Repair or replace fan shroud
4. Fan drive system problem	Refer to Section 10
Overheating Due to Poor Circulation	
1. Low coolant level	Fill cooling system to proper level. Refer to Operator's Manual
2. Tank cap not securely tightened to seal the pressure system	Remove radiator cap and inspect. Replace cap if gasket is worn. Tighten radiator cap to maintain pressure in system
3. Pressure relief valve on tank cap is faulty. Cooling system pressure escaping	Replace cap. Do not repair or replace any relief valve parts
4. Faulty thermostat	Check thermostat for operation. Replace if faulty. Refer to Troubleshooting and Repair Manual QSC8.3 Engines
5. Restriction in radiator core	Make a cooling system pressure test. Flush the cooling system chemically. Refer to Troubleshooting and Repair Manual QSC8.3 Engines
6. Coolant pump problem	Make a cooling system pressure test. Remove coolant pump and recondition. Refer to Troubleshooting and Repair Manual QSC8.3 Engines
Coolant to Engine Oil Internal Leakage	
1. Cylinder head warped	Replace cylinder head and gasket. Torque head bolts as specified in the Troubleshooting and Repair Manual QSC8.3 Engines
2. Engine oil cooler cracked	Remove oil cooler, perform pressure test. Refer to Troubleshooting and Repair Manual QSC8.3 Engines

COMPLAINT	
PROBABLE CAUSE	REMARKS
External Leakage	
1. Defective connections in cooling system	Check or replace defective hoses and clamps as required
2. Radiator leaks	Remove the radiator. Repair or replace as necessary. Make a pressure test
3. Defective coolant pump seal	Inspect the coolant pump body for indication of coolant leakage at the weep hole. Remove pump, replace defective parts. Refer to Troubleshooting and Repair Manual QSC8.3 Engines
4. Cylinder head cracked or warped	Replace cylinder head and gasket. Torque head bolts as specified in Troubleshooting and Repair Manual QSC8.3 Engines
5. Cylinder block cracked or porous	Repair or replace defective block. Refer to Troubleshooting and Repair Manual QSC8.3 Engines
Engine Runs Cold	
1. Extremely cold weather	Cover radiator
2. Coolant temperature gauge or sensor faulty	Replace sensor or temperature gauge
3. Thermostat inoperative	Replace. Refer to Troubleshooting and Repair Manual QSC8.3 Engines

Drive Train Cooling System

COMPLAINT	
PROBABLE CAUSE	REMARKS
Drive Train Oil Overheating	
1. Operating too long in low efficiency ranges	Review operating instructions in the Operator's Manual
2. Clogged radiator	Flush with steam for external clogging
3. Oil temperature gauge or sensor faulty	Replace sensor or temperature gauge
4. Fan drive system problem	Refer to Section 10
5. Drive train problem	Refer to Section 7

5. REMOVAL

1. Position machine in place which makes it possible to use lifting device for lifting of disassembled assembles.

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

2. Turn electrical master switch to the "OFF" position.
3. Disassemble the aspirator tube (2, Fig. 6.2) between the air precleaner and muffler. Loosen the clamp and remove the air precleaner (1).

4. Remove the exhaust tube assy (6).
5. Remove bolts and disassemble side enclosures (5) on both sides.
6. Remove bolts (3). Use lifting device, remove the hood assy (4).
7. Attach a suitable lifting device to the crankcase guard, remove the hardware and lower the guard on the ground to get access to the bottom radiator mounting points.

WARNING! This procedure requires extreme caution. Use suitable blocking equipment while under confines of machine.

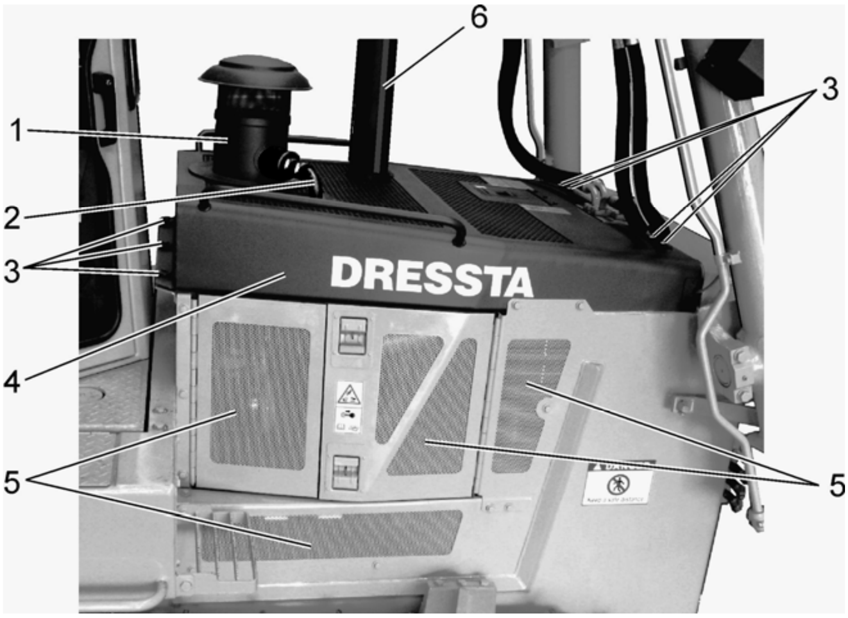


Fig. 6.2. Hood and Engine Enclosure

1. Air Precleaner
2. Aspirator Tube
3. Bolts
4. Hood Assy
5. Side Enclosures
6. Exhaust Tube Assy

8. Drain coolant from cooling system. Refer to Operator's Manual.
9. Disconnect wire harness connector from the coolant level switches (2, Fig. 6.3), and secure it to frame.
10. Loosen the clamps and remove air tubes (1 and 6) from the cooler and engine connections.

IMPORTANT: *Disconnected lines must be capped with the correct size plastic caps or clean corks. Openings must never be plugged with rags. This practice could easily introduce dirt or lint in to critical components of the system.*

11. Loosen the clamp and remove engine vent hose (5) from the auxiliary tank and attach it to engine.
12. Loosen the clamp and remove coolant fill hose (4) from the auxiliary tank.
13. Loosen the clamps and remove coolant tube (3) between the radiator and engine outlet.
14. Remove hydraulic hoses (1 and 2, Fig. 6.4) from drive train oil cooler. Secure hoses in an upright position to frame.

NOTE: *Small quantity of oil from drive train oil cooler should be drained to the suitable container.*

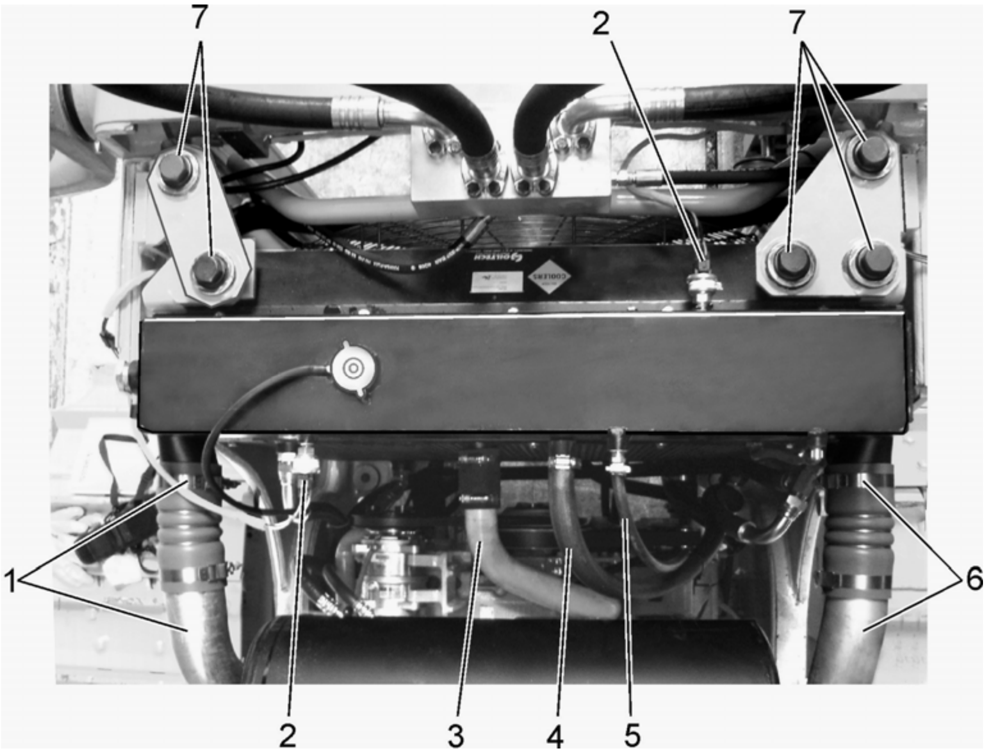


Fig. 6.3. Radiators Assy Connections (top view)

1. Air Tube (CAC outlet)
2. Coolant Level Switch
3. Coolant Tube (inlet)
4. Coolant Fill Hose
5. Engine Vent Hose
6. Air Tube (CAC inlet)
7. Bolts

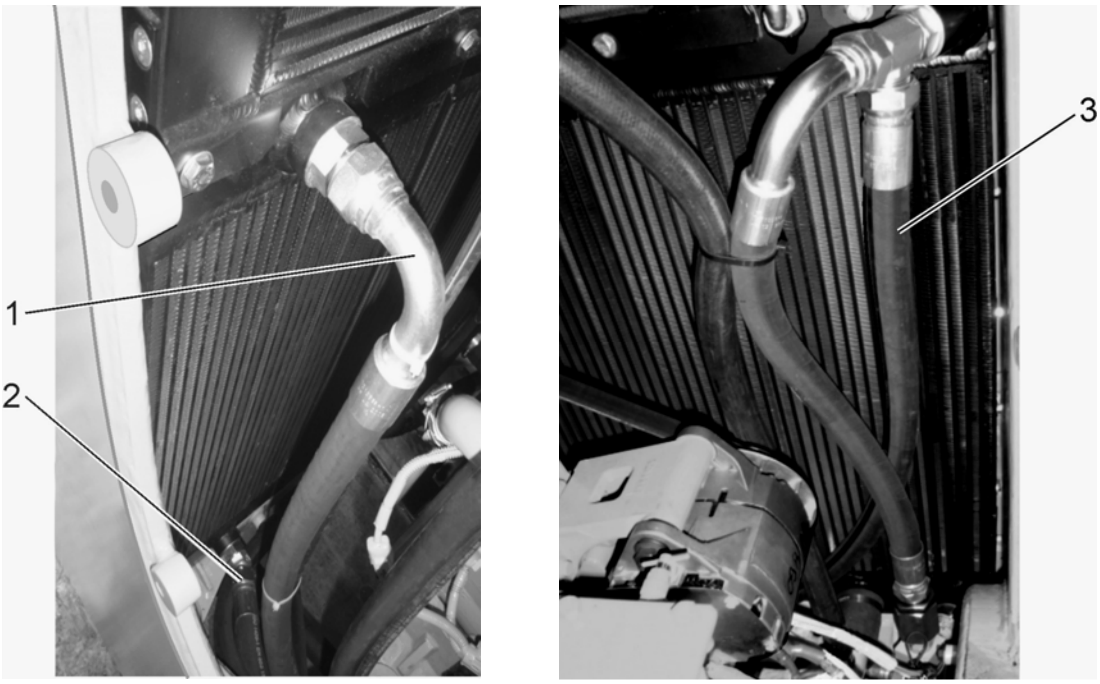


Fig. 6.4. Radiators Assy Connections (LH and RH)

1. Hydraulic Hose (outlet)
2. Hydraulic Hose (inlet)
3. Hydraulic Hose (outlet)

15. Remove hose (3) from fan drive hydraulic motor oil cooler. Secure hose in an upright position to frame.
16. Remove bolts securing front radiator door, and swing them open.
17. Tag and remove hydraulic hoses (1, 3 and 4, Fig. 6.5) from fan drive hydraulic motor. Secure hose in an upright position to frame.
18. Remove hose (2, Fig. 6.6) from fan drive hydraulic motor oil cooler. Secure hose in an upright position to frame.

NOTE: *Small quantity of oil from fan drive hydraulic motor oil cooler should be drained to the suitable container.*

19. Loosen the clamp and remove tube (1) from the engine radiator.
20. Use the slings to lift the radiator. Wrap the slings around the radiator bottom plate and sag.

IMPORTANT: *Do not use the hydraulic motor bracket for radiator assy hoisting.*

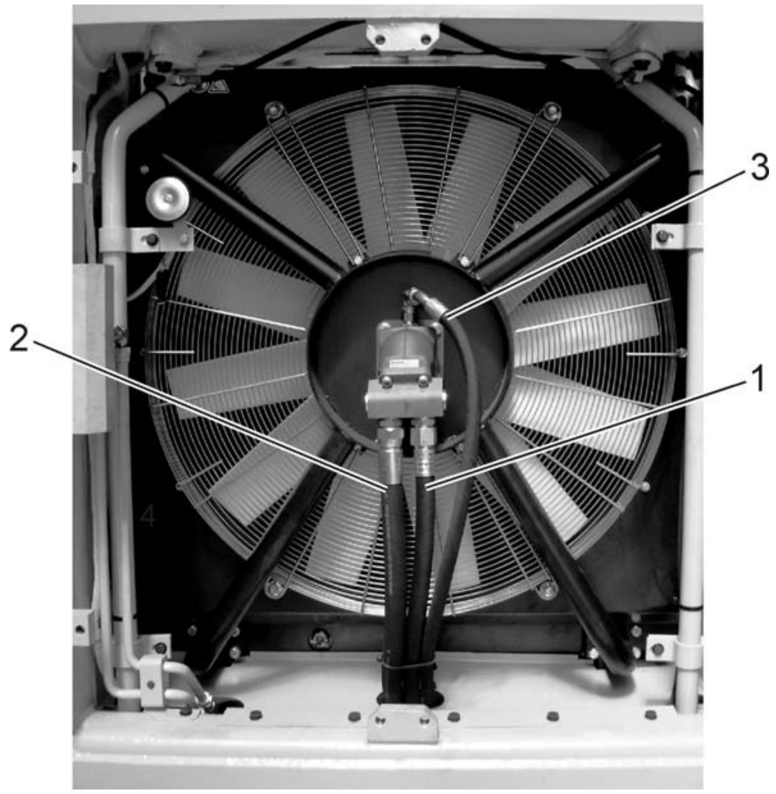


Fig. 6.5. Fan Drive Hydraulic Motor Disassembly Points

1. Hydraulic Hose (inlet)
2. Hydraulic Hose (outlet)
3. Hydraulic Hose (drain)

COOLING SYSTEM

21. Unscrew bolts (7, Fig. 6.3) securing radiator assy to upper brackets.
22. Unscrew bolts (3, Fig. 6.6) securing radiator assy to beam (4) at the bottom.
23. Carefully hoist the radiator assy up and over frame. Position assy on the hydraulic motor bracket, using suitable height wooden pads.

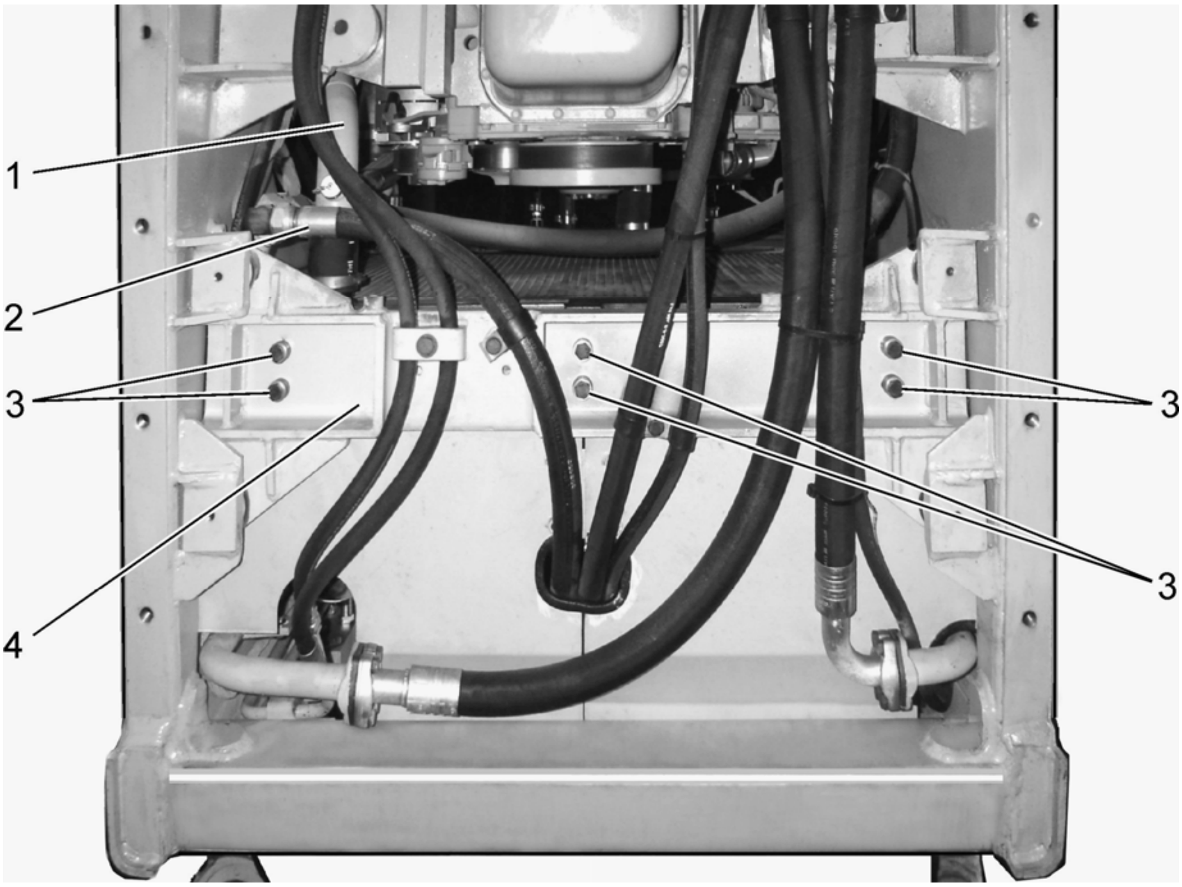


Fig. 6.6. Radiator Assy Disassembly Points (bottom view)

1. Coolant Tube (outlet)
2. Hydraulic Hose (inlet)
3. Bolts
4. Beam

6. DISASSEMBLY (refer to Fig. 6.7)

NOTE: *If any problem occurs with the particular element (core) of the radiator assy, it is possible to remove a single core required repairing without disassembly of all elements.*

Charge air cooler removing

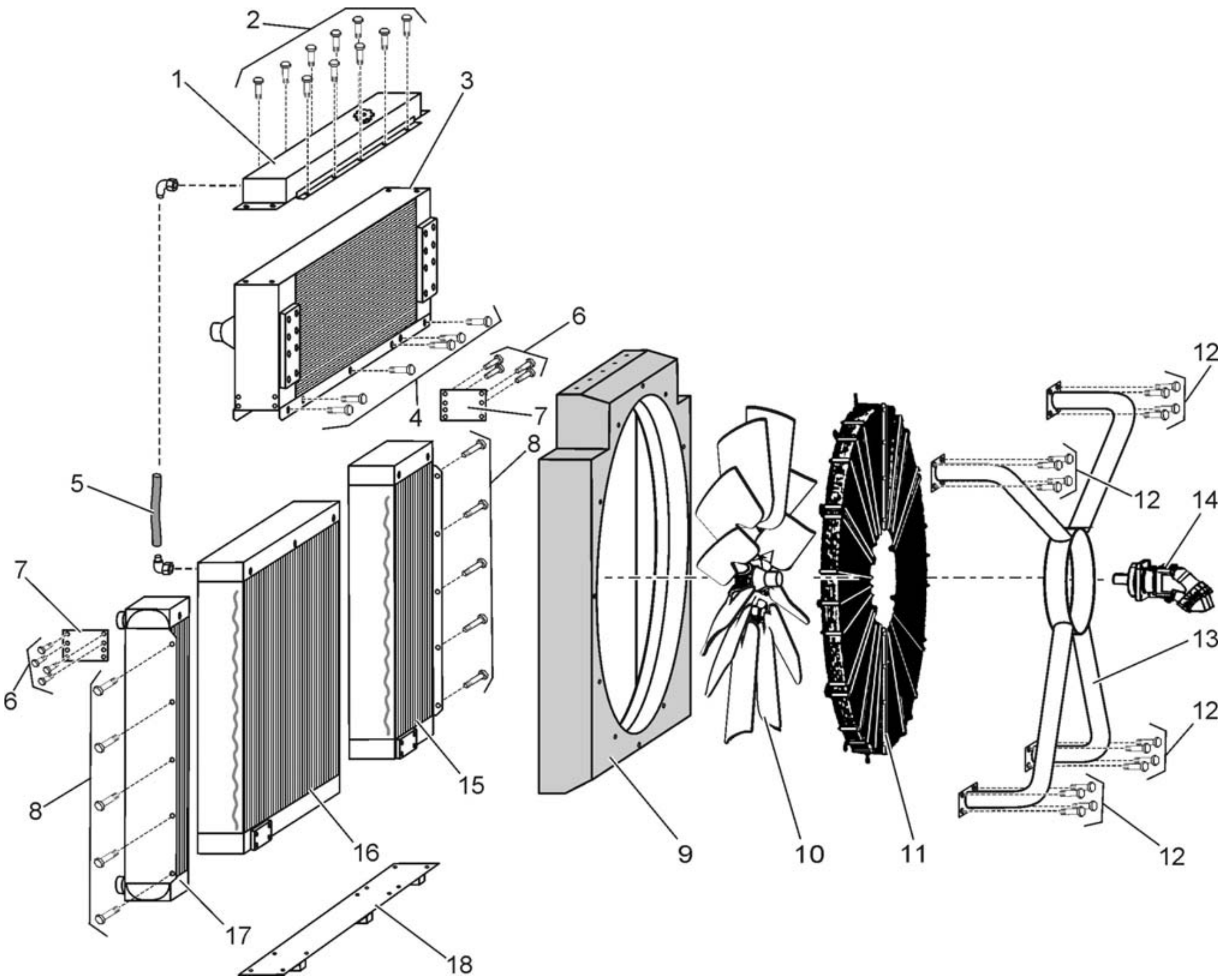


Fig. 6.7. Radiators Assy Exploded View

1. Auxiliary Tank	7. Plate	13. Hydraulic Motor Bracket
2. Bolts	8. Bolts	14. Hydraulic Motor
3. Charge Air Cooler	9. Fan Shroud	15. Drive Train Oil Cooler
4. Bolts	10. Fan	16. Engine Radiator
5. Vent Hose	11. Fan Guard	17. Fan Drive Oil Cooler
6. Bolts	12. Bolts	18. Bottom Plate

1. Position radiator assy vertically on the bottom plate (18).
2. Remove vent hose (5) between auxiliary tank (1) and engine radiator.
3. Remove bolts securing fan guard (11) to fan shroud (9).
4. Remove bolts (12) securing hydraulic motor bracket (13) to the radiators assy. Remove bracket with hydraulic motor (14), fan guard (11) and fan (10).

5. Remove bolts (2 and 8) securing fan shroud (9) to radiators assy and remove it.
6. Remove bolts (4) securing air cooler to the coolers (15, 17) and to radiator (16) in the bottom.
7. Remove bolts (6) securing air cooler to the plate (7). Remove air cooler (3) with auxiliary tank (1).

NOTE: *To remove other elements (cores) of the radiator assy, follow the procedure described above.*

7. INSPECTION AND REPAIR

1. Examine of cores for damage. Straighten bent fins if possible to avoid air flow restrictions. Clean cores outside with compressed air or water with additives no aggressive for aluminum. The direction of cleaning stream should be parallel to the fins in order to avoid damage.
2. Inspect top and bottom of a particular cooler and radiator for cracks.
3. Inspect all hoses for cracks or rupture and install new when in doubt.
4. Inspect the radiator cap.
5. Perform pressure test of a particular cooler and radiator if necessary.
6. Check and repair fan shroud and fan guard for cracks.
7. Check fan for cracks and other damage. Do not repair. Replace for new one.

NOTE: *Elements (cores) of the radiator assy, are mounted (welded) and have to be replaced by new if unrepairable.*

NOTE: *Elements (cores) of the radiator assy, are made of aluminum, any repair required is to be done in experienced workshop.*

8. REASSEMBLE (Refer to Fig. 6.7)

Charge air cooler mounting

1. Position cooler (3) with auxiliary tank (1) on place, install bolts (6) securing air cooler to the plate (7).
2. Install bolts (4) securing air cooler to the coolers (15 ,17) and radiator 16 in the bottom.
3. Position the fan shroud, install bolts (2 and 8) securing fan shroud (9) to radiator assy.
4. Position the hydraulic motor bracket (13) with fan (10) fan guard (11) and hydraulic motor (14). Install the bolts (12).
5. Install bolts securing fan guard (11) to fan shroud (9).
6. Install vent hose (5) between auxiliary tank (1) and engine radiator (16).

NOTE: *Tighten all bolts with care. Apply standard torques values for aluminum.*

9. INSTALLATION

NOTE: *Before mounting radiator assy remove bolts and washers (1, Fig. 6.8) and inspect rubber shock absorber (2) of radiator beam (3) for wear.*

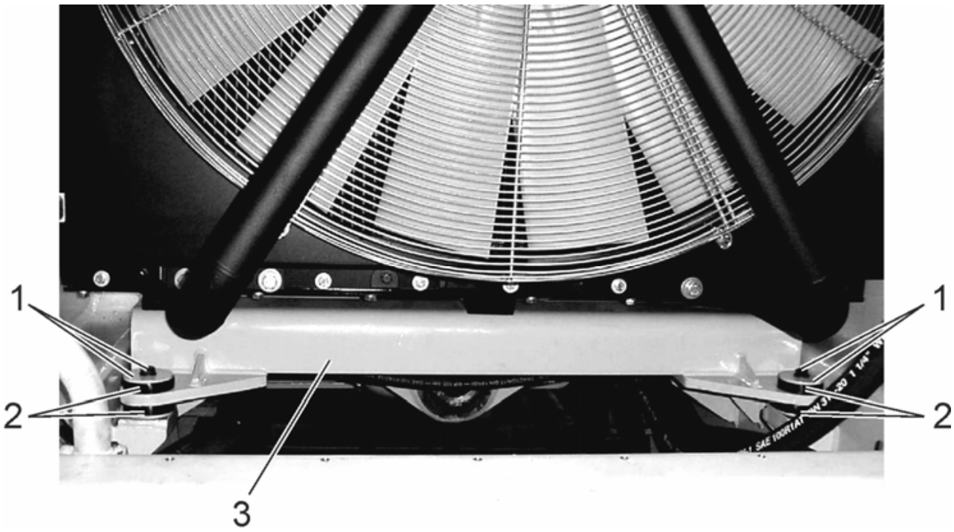


Fig. 6.8. Radiator Assy Lower Bracket (front view)

1. Bolts and Washer
2. Rubber Shock Absorber
3. Radiator Beam Assy (bracket)

1. Use the slings to lift the radiator assy. Wrap the slings around the radiator bottom plate and carefully hoist the radiator assy up and over frame. Position radiator assy on the beam (1, Fig. 6.6) and install bolts (3) securing radiator assy to beam (4) at the bottom initially.

IMPORTANT: *Do not use the hydraulic motor bracket for radiator assy hoisting.*

2. Install bolts (7, Fig. 6.3) securing radiator assy to upper brackets. Tighten all bolts securing the radiator assy to the beam and brackets starting from bottom. Remove lifting slings.
3. Install tube (1, Fig. 6.6) to the engine radiator and tighten the clamp.
4. Reinstall hydraulic hose (2) to fan drive hydraulic motor oil cooler.
5. Reinstall hydraulic hoses (1, 3 and 4, Fig. 6.5) to the fan drive hydraulic motor.
6. Reinstall hydraulic hose (3, Fig. 6.4) to the fan drive hydraulic motor oil cooler.
7. Reinstall hydraulic hoses (1 and 2) to the drive train oil cooler.
8. Reinstall coolant tube (3, Fig. 6.3) between the radiator and engine outlet. Tighten the clamps.
9. Reinstall coolant fill hose (4) to the auxiliary tank. Tighten the clamp.
10. Reinstall engine vent hose (5) to the auxiliary tank. Tighten the clamp.
11. Reinstall air tubes (1 and 6) to the cooler and engine connections. Tighten the clamps.
12. Reconnect wire harness connector to the coolant level switches (2).
13. Refill cooling system with the coolant. Refer to Operator's Manual.

COOLING SYSTEM

14. Start the engine. After reaching operating temperatures, check all disconnected previously lines: cooling, and hydraulic systems for leaks. Stop the engine. Check the coolant level, drive train oil level and hydraulic oil level as described in Operator's Manual.

WARNING! Before working on the machine be sure to turn master switch "OFF" and take the key out to prevent accidental starting.

15 Attach a suitable lifting device to the crankcase guard. Lift the guard and install the bolts.

WARNING! This procedure requires extreme caution. Use suitable blocking equipment while under confines of machine.

16. Close front radiator door, install the bolts.
17. Use lifting device, install the hood assembly (4, Fig. 6.2). Install bolts (3).
18. Reinstall side enclosures (5) on both sides.
19. Reinstall the exhaust tube assy (6).
20. Reinstall the air precleaner (1) and aspirator tube (2) between the air precleaner and muffler. Tighten the clamps.

SECTION 7

DRIVE TRAIN

DRIVE TRAIN

CONTENTS

SERVICE /SPECIAL TOOLS

1. SERVICE /SPECIAL TOOLS

DESCRIPTION	TOOL NUMBER
Digital Optical Tachometer	3377462
Test Pressure Gauges Kit	910-50-0005

GENERAL

2. DESCRIPTION

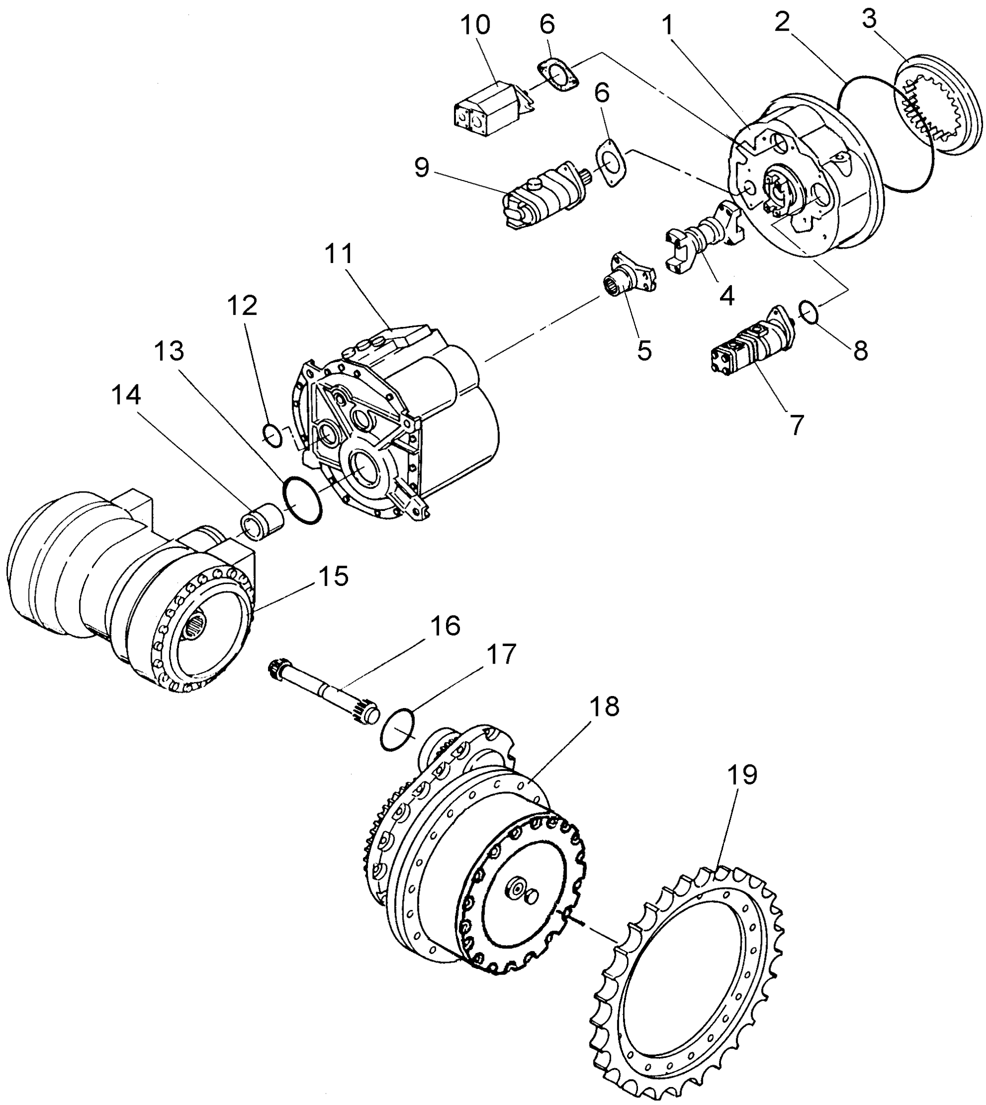


Fig. 7.1. Drive Line

1. Torque Converter
2. O-Ring
3. Drive Ring
4. Drive Shaft
5. Input Yoke
6. Gasket
7. Equipment Pump
8. O-Ring
9. Charge and Scavenge Pump
10. Fan Drive Pump
11. Transmission
12. O-Ring
13. O-Ring
14. Drive Pinion Sleeve
15. Two Speed Steering Drive
16. Output Shaft
17. O-Ring
18. Final Drive
19. Drive Sprocket

DRIVE TRAIN

GENERAL

Power from the engine is transmitted through a flywheel drive ring (3) to the torque converter (1). Drive shaft (4) couples the output flange of the torque converter with input yoke (5) of transmission (11). The converter delivers torque according to the variation in load on the oil used as the medium, and transmits the power to the transmission (11). When the transmission is engaged, power is transmitted from the output shaft of the transmission to the pinion shaft of steering drive (15), and by steering drive clutches to the steering drive output shaft (16), then through final drives (18) and sprockets (19) to the tracks.

3. DRIVE TRAIN MAIN COMPONENTS

The torque converter (1, Fig. 7.1) contains a single stage, single phase, three element converter assembly and a drive gear to drive the drive train charge and scavenge pump, the equipment pump and the fan drive pump. The torque converter main function is to multiply engine torque.

The transmission (11) is designed to provide high speed shifting by use of hydraulically actuated clutch packs. It has three forward and three reverse speeds. Gears are mounted on four shafts: directional (input) shaft, range (output) shaft, countershaft and reverse idler shaft.

The steering drive (15) is a unit constructed into a housing similar to a transmission. This design affords ease of assembly and service. The machine is equipped with the two speed steering drive.
The two speed steering drive contains one low range clutch pack, one high range clutch pack, one brake clutch pack and a planetary on each side of the machine. The low and high range clutch packs are hydraulically applied and spring released whereas the brake clutch packs are spring applied and hydraulically released. An inner planetary provides the reduction in speed for the low range. If a hydraulic failure occurs or the engine is stopped, the steering drive will automatically apply the brakes.

The final drive (18) consist of a set of spur gears and a planetary on each side at the rear of the machine. Power is transmitted from the steering drive to each of the final drives. Double reduction in the final drive is accomplished by a pinion to bullgear arrangement for the first reduction and a planetary set for the final reduction.

OPERATION

4. DRIVE TRAIN SYSTEM VALVES

Drive Train Control Valve (12, Fig.'s 7.2 and 7.3)

The drive train control valve is a manually controlled direction, range and steering control valve. The valve is used to direct main oil pressure to the transmission range selector valve for transmission control and to the steering control valve for range and steering control. A hydraulic detent holds the control lever in the desired transmission direction.
When the lock lever is moved to the unlocked position main pressure from the charge pump enters the drive train control valve at the “M” port and is distributed to the direction and steering spools of this valve. When the control lever is in the centered “neutral” position, oil is active at the selected steering ports but is blocked at the direction spools.

OPERATION

When the control lever is moved forward, the pivot ring depresses the Forward direction spool, directing oil to the “F” port at the bottom of the valve. The “F” pressure is also directed internally to the base of the Reverse spool which pushes the Reverse spool up to the pivot ring. This action creates a hydraulic detent holding the lever forward.

When pulling the control lever to neutral or reverse, the pivot ring pushes down on the Reverse spool which displaces the hydraulic detent oil. At the same time the Forward spool follows the pivot ring up and mid way through its stroke the forward pressure is cut off as well as the reverse hydraulic detent, allowing the valve to go into neutral. If the lever is pulled all the way to reverse the same sequence of events happens for the reverse hydraulic detent.

Steering is accomplished in two ways: by moving the control lever to the left or right or by shifting the HI-LO speed range switches. The two steering methods can be used together and in any combination.

When the machine is started with both speed range switches in LO-LO positions both tracks are in LO-LO. With the lever pushed to forward the machine travels in FWD, LO-LO (both tracks in LO-LO). Initial movement of the lever to the right drops right LO clutch steering pressure causing the right steering clutch to be in a neutral condition. The neutral condition is indicated by a “feel point” or effort increase in the control lever movement. Further movement of the lever further decreases pressure at the right brake, which if moved to the end of the lever stroke will result in a pivot turn to the right. By shifting both range switches to their upper position both tracks shift up to HI-HI (both tracks in HI-HI). If traveling in HI-HI and the lever is pulled to the right the following occurs. The initial lever movement lowers signal pressure causing a sequence valve to automatically shift the right track from HI to LO. With further lever travel to the right the right LO track will go to the neutral condition as indicated by the “feel point” as discussed earlier. Further lever movement will result in a pivot turn. As the lever is moved back to the upright position the LO clutch engages and then up into HI.

With the lever pushed to forward and both speed range switches in LO-LO positions the machine travels in FWD, LO-LO (both tracks in LO-LO). By shifting the right switch to HI position, the right track shifts up to HI. Both machine tracks are engaged, while the right track features the higher speed and, as a result, the machine will make a gradual turn to the left. To cause the machine to make a gradual turn to the right proceed in similar manner by controlling the left hand track power. The machine will make a gradual turn so long as one of the speed range switches gets reactivated. Each speed range switch steering results in full power turns. Then the machine will revert to straight travel in a range it was engaged in prior to the gradual turn activation.

A transmission gear is selected by pushing the drive train control lever up-shift and down-shift buttons.

For a complete Machine Speed and Direction Changes description and operation, refer to OPERATOR’S MANUAL.

Two Speed Steering Valve (Fig.’s 7.4, 7.5 and 7.6)

The two speed steering valve contains three valves. Two of them: upper LC, RC, FB and lower HI-LO are mounted above rear main frame cover and one - manifold J under this cover.

The upper valve consists of three basic sections: LC left clutch section, RC right clutch section and the FB foot brake section.

The LC and RC clutch sections control the flow of oil to the clutch packs to drive each track individually. Both of the sections contain a metering spools which are each held in the rear drive position by pilot pressure CL and CR respectively from the drive train control valve.

OPERATION

The FB foot break section, contains one spool which is held in the drive position by a return spring. When in this position, oil pressure from the LC and RC sections enters the foot brake section FB it evenly split into two separate circuits, one for the LB brake clutch pack and one for the RB brake clutch pack of steering drive SD. When the foot brake is applied, the spool in this section moves forward and begins to dissipate the oil pressure to both brake clutch packs simultaneously.

The lower valve consist of two sections LH and RH. Each of section contains HI-LO spool, which is controlled by solenoid valve SOL and a sequence valve SEQ. These two pairs of valves SOL and SEQ are placed in one housing of HI-LO valve. This HI-LO valve housing is bolted to the back of the lower steering valve housing.

Each of sections performs two functions: shifts the HI-LO range spool to HI position when the solenoid valve SOL is actuated making a high range track speed, and shifts HI-LO range spool from high to low when solenoid valve is off making a low range track speed.

In case one HI-LO range spool is shifted a gradual turn is making. The left and right steering pilot pressures enter the HI-LO valve and remains unique to their individual left or right side. The steering pilot pressure first enters the sequence valve SEQ. When the steering pilot pressure is above 1370 [kPa], the pilot pressure connects to the solenoid valve SOL. When pilot pressure enters the solenoid SOL, it may send pilot pressure to the HI-LO spool when the solenoid SOL is energized and it causes, the HI-LO spool shifts to the high position.

The purpose of the sequence valve SEQ is to automatically downshift the HI-LO spool from High to Low when the main oil pressure decreases from the full pressure of 1860 [kPa] to below 1370 [kPa]. When the sequence valve SEQ shifts, it disconnects the pilot pressure to the solenoid valve so that causes the HI-LO spool moves to the Low position.

When the right speed range switch of the drive train control lever is in its upper position (HI) and the left range switch in its lower (LO) position (Fig. 7.5) the drive train electronic controller (EC) chooses the correct solenoid setting to result in the gradual left turn. The EC controller upshifts or downshifts range of appropriate track to complete the turn.

When the control lever is moved to the right pivot position (Fig. 7.6), the CR pilot pressure drive train control valve decreases. This dropping pilot pressure activates the metering spool, moving it forward. The oil pressure to RC and RB clutch is cut off. These right clutches are now connected to the drain and dozer is pivoting turn right.

When the both rocker switches are in its upper positions (HI) both solenoids SOL are energized. Both solenoids direct pilot oil to both HI-LO spools causing the HI - LO spools to shift to HI position. Main oil pressure from the metering spools by HI LO spools sections is directed to both the HI range clutches ports.

The manifold J covers one spool and spring. The purpose of this manifold is to automatically shift off the low range clutches when the main oil pressure decays from the full pressure of 1860 [kPa] to below 860 [kPa].

Switching Valve (10, Fig.'s 7.2 and 7.3)

The switching valve provides a pressure connection for the main low pressure and clutch low oil pressure warning light switch, allowing enters either "M" - main pressure to the switch, when the drive train control lever is in the neutral position, or "PC" – gear clutch pressure when the drive train control lever is in the forward or reverse position.

Gear Shifting Valve (11, Fig.'s 7.2 and 7.3)

Gear shifting valve is an electronically controlled transmission gears valve. The valve housing contains two solenoids: one for the second gear (11A) and the other one – for the third gear (11B). When the machine is started both solenoids are de-energized and drive begins in the default condition of transmission that is in the first gear position. When the up-shift control button is pressed once the second gear solenoid is energized and the second gear is selected. With pressed up-shift button once again the third gear is selected (the third gear solenoid is energized).

OPERATION

Drive Train Lock Solenoid Valve (17, Fig.'s 7.2 and 7.3)

The drive train lock solenoid valve blocks flow to the drive train control valve when the drive train lock lever is in the lock position, and allows flow to drive train control valve when the drive train lock lever is in the unlock position. The drive train lock solenoid valve contains normally closed solenoid valve. When starting the machine the lock lever is in the lock position and the solenoid valve is deenergized. The oil under main pressure enters the lock solenoid valve. The normally closed solenoid valve blocks the flow. In this condition the drive train control valve and transmission is not operational. When the lock lever is moved to the unlocked position, an electric switch is closed sending power to the solenoid valve. The energized solenoid valve opens and directs flow to the drive train control valve. The drive train control valve and transmission is now operational.

Priority Valve (18, Fig.'s 7.2 and 7.3)

The purpose of the priority valve is to maintain a steady pressure to the transmission and steering valve. Transmission pump flow enters the priority valve. The regulated pressure branches off and is connected to the drive train lock solenoid valve. When the priority pressure of 1890 [kPa] setting is met, the valve opens and flow continues on to the pressure regulator valve mounted on the transmission.

The Pressure Regulator Valve, the Rate of Rise Valve and the Range Selector Valve are described in a separate section. For a complete description and operation, refer to SECTION 7C.

HYDRAULIC OIL FLOW

5. TRANSMISSION SYSTEM OIL FLOW (Refer to Fig.'s 7.2 and 7.3)

The rear part of main frame (9) is the common oil reservoir for torque converter, transmission and steering drive. When the engine is running, oil is flowing from the bottom of the main frame (9), through suction strainer (2) and onto the rear charge element (3) of drive train charge and scavenge pump.

The charge element (3) of drive train charge and scavenge pump delivers oil flow through hydraulic damper (22), pressure oil filter (5) and priority valve (18) to the M port of pressure regulator valve (15) and to steering control valve by line (19). This charge pump element delivers also oil flow through unlocked drive train lock solenoid valve (17) to drive train control valve (12). Oil from the pressure regulator valve (15) M port is directed through two internal passages in transmission manifold to rate of rise valve (14) and through one passage to P port of range selector valve (13). Oil from the pressure regulator valve (15) M port is also directed by hoses to gear shifting valve (11) and switching valve (10).

The main pressurized oil directed to drive train control valve (12) enters the M port and can be directed out to either the F or R port. When shift of valve occurs the oil is directed out of one of these ports, by hose to range selector valve (13) to shift the valve directional spool and switch spool. These spools are visible in lower part of valve (13).

The main pressurized oil is directed to rate of rise valve (14) by P, P1 ports of range selector valve (13) and is passed onto the FR and PC ports of range selector valve (13).

DRIVE TRAIN

HYDRAULIC OIL FLOW

Rate of rise valve (14) supplies oil first to the FR port of the range selector valve (13) and then to the PC port of range selector valve (13).

The pressurized oil entering the FR port of range selector valve (13) is directed either to the FC port or RC port and onto the transmission (1) forward or reverse clutch pack. The pressurized oil entering also the PC port of range selector valve (13) is directed either to the 1C, 2C or 3C port and onto the transmission first, second or third speed clutch pack. A transmission speed gear is selected by gear shifting valve (11) controlled by suitable buttons of drive train control valve lever.

For a more complete description and operation of the main regulator valve, the rate of rise valve, the range selector valve and the drive train control valve, refer to SECTION 7C.

Legend for Fig.'s 7.2 and 7.3

1 Transmission
2. Suction Strainer
3. Drive Train Charge Pump
4. Drive Train Scavenge Pump
5. Pressure Filter
5A. Drive Train Oil Pressure Filter Warning Light
6. Torque Converter
6A. Drive Train System Oil Temperature Gauge
7. Oil Cooler
8. Suction Strainer
9. Main Frame
10. Switching Valve
10A. Low Transmission Main Pressure and Low Speed Clutch Oil Pressure Warning Light
11. Gear Shifting Valve
11A. 2nd Gear Solenoid Valve
11B. 3rd Gear Solenoid Valve
12. Drive Train Control Valve
12A. Gear and Range Display
13. Range Selector Valve
14. Rate of Rise Valve
15. Pressure Regulator Valve
16. Pressure Diagnostic Center
17. Drive Train Lock Solenoid Valve
18. Priority Valve
19. To Steering Control Valve
20. To Steering Drive Lubricating
21. To Lower Steering Valve
22. Hydraulic Damper
23. Drive Train Electronic Controller
24. Engine RPM Sensor
25. Transmission Input Shaft RPM Sensor
26. FWD&RWD Travel Pressure Switch
27. Ripper Shank Pin Control System Connection
28. Breather
29. Gear Presetting Mode Switch (WB)
30. Auto Downshift Mode Switch (WO)

HYDRAULIC OIL FLOW

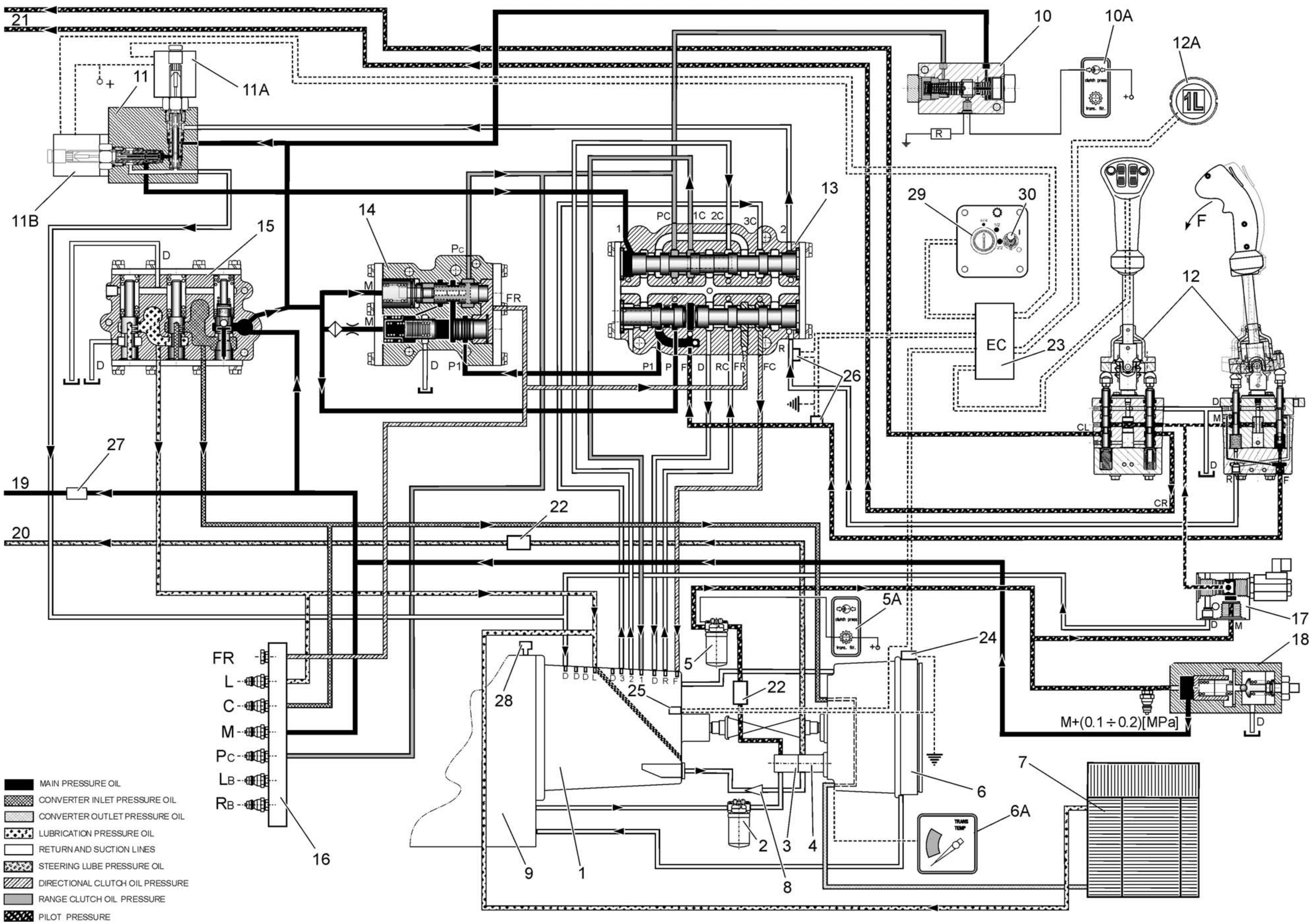


Fig. 7.2. Drive Train Hydraulic Oil Flow with Trans First Forward - TWO SPEED STEERING DRIVE

HYDRAULIC OIL FLOW

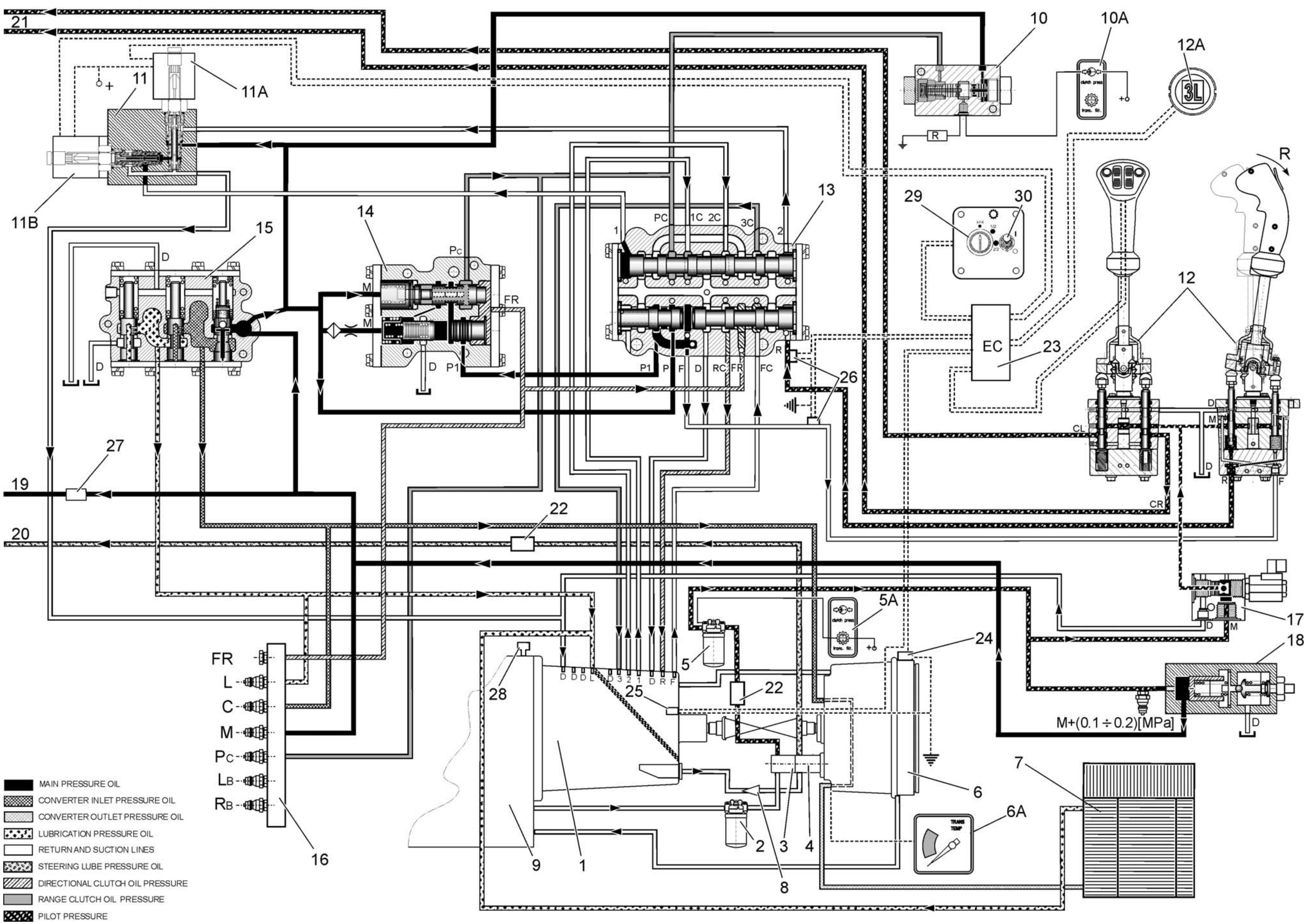


Fig. 7.3. Drive Train Hydraulic Oil Flow with Trans Third Reverse - TWO SPEED STEERING DRIVE

HYDRAULIC OIL FLOW

6. TORQUE CONVERTER AND LUBRICATION OIL FLOW (Refer to Fig.'s 7.2 and 7.3)

Pressurized oil from the C port of middle torque converter section pressure regulator valve (15) is directed by hose to the inlet port of torque converter (6). After the pressurized oil is used for torque multiplication, it exits the torque converter at the outlet port and is directed by hose to the inlet port of oil cooler (7), which is located in one radiator assy.

The cooled oil from the outlet port of oil cooler (7) is regulated by the third lubrication spool in pressure regulator valve (15) and then directed to the transmission (1) for lubrication purpose.

Cooler outlet oil travels into the transmission clutches for clutches cooling and shafts lubrication.

This oil after cooling and lubrication of transmission collects in the transmission sump. From the bottom of transmission (1) is then scavenged by hose through an in-line oil strainer (8A) and onto the scavenge element (4) of drive train charge and scavenge pump. From the scavenge pump element (4) of drive train pump outlet the oil is delivered through hydraulic damper (22) to the steering drive by line (20, Fig.'s 7.2 and 7.3) for internal lubrication purpose. Then oil eventually drains back into the bottom of the main frame (9).

Leakage of oil from the torque converter (6) is gravity drained by hose from engine flywheel housing back to the main frame (9). For a more complete description and operation of the torque converter, refer to SECTION 7B, TORQUE CONVERTER.

7. STEERING SYSTEM OIL FLOW Refer to Fig.'s 7.4 to 7.6)

Pressurized oil M enters the inlet port of steering valve and is available for steering and braking. The pressurized oil at inlet port of steering valve housing in neutral position of spools allows pressurized oil from steering valve through the steering valve manifold and onto the drive and brake clutch packs in steering drive.

This steering drive M oil pressure operates within the range 1790 – 1930 [kPa]. The drive clutch packs are actuated on a range of 690 – 1930 [kPa] and the brake clutch packs are released on a range 620 – 1930 [kPa]. When the pressure is dissipated below 690 [kPa], the drive clutch packs release and then the brake clutch packs begin to engage.

When the engine is running and both HI-LO speed range switches are in LO position, oil pressure is directed to both the low range clutch packs and the brake clutch packs. When the low range clutch packs are engaged, it locks the sun gears of the inner planetary to the stationary steering drive housing. When the drive train control lever is moved forward (rearward) power from the pinion shaft, transmitted through the bevel gear and ring gears, turns the planet gears which are forced to walk around the locked sun gears. This action causes the planet gears to rotate the planet carrier output shafts and sprocket drives.

When both the HI-LO speed range switches are toggled into HI position, oil pressure is directed to both the high range clutch packs and the brake clutch packs. When the high range clutch pack is engaged, the low range sun gear is unlocked, planets are rotating free. Power to the tracks is transmitted from the pinion shaft to the bevel gear, through the engaged drive clutch packs to the output shafts and on to the sprocket drives.

When the foot brake is applied, oil pressure to both brake clutch packs is released. As the pressure drops, springs engage both brakes simultaneously. However, the oil pressure to the drive clutch packs is not released and the torque converter does the slipping, the foot brake will hold the machine stationary with the transmission in second or third gear but not in first gear at higher RPM.

To make a left gradual turn, shift the right speed range switch to its upper (HI) position and shift the left speed range switch in its lower (LO) position during machine is moving forward or rearward. The electronic controller will select the left track to low range and the right track to high range.

DRIVE TRAIN

HYDRAULIC OIL FLOW

Power to the left track is transmitted from the pinion shaft to the bevel gear, thru the inner planetary, to the output shaft and out to the sprocket drive. Power to the right track is transmitted from the pinion shaft to the bevel gear and from high range clutch directly to the output shaft and sprocket drive. A right gradual turn is the opposite.

To make a left pivot turn, shift the drive train control lever in the full left position during machine is moving forward or rearward. The left track is stationary. Power to the right track is transmitted from the pinion shaft to the bevel gear, thru or without inner planetary to the output shaft and out to the sprocket drive. A right pivot turn is the opposite.

The two speed steering drive consists of two drive circuits for each side of the machine. The following describes the operation of both sides.

STARTING AND HIGH-LOW RANGE STRAIGHT TRAVEL (Fig. 7.4).

When the dozer is started with both speed range switches in LO-LO positions, both tracks are in low speed range. Main pressure M from the transmission pressure regulator valve enters the upper valve clutches section LC and RC inlet ports, around the metering spools and on to the HI-LO sections. Here the oil is divided in two circuits, one to the foot brake FB and one to the HI-LO spools. At the foot brake FB released, the oil enters the inlet port around the foot brake spool and out to disengage the brake clutch packs LB and RB. The lower valve contains two HI – LO spools, one for each side of the machine. These spools are controlled by the high-low solenoids SOL. At the HI-LO spools in the LO position, the oil is directed by steering manifold J shifted by M oil pressure to the right to engage the LO drive clutch packs.

When both speed range switches are in HI-HI positions, both left and right high-low range solenoids SOL are energized. Both solenoids direct pilot oil to both HI-LO spools causing the HI-LO spools to shift to HI range. Oil pressure from the both clutch sections enters the spool bores and is directed out to the high range clutches.

GRADUAL TURN LEFT (Fig. 7.5).

When the drive train control lever is in drive position with the left speed range switch in its lower (LO) position and the right speed range switch in its upper (HI) position, the left side steering drive is working as described above, but on the right side high-low range solenoid SOL is energized. The solenoid direct pilot oil pressure to left side of HI-LO spool causing the HI-LO spool to shift to HI range. Oil pressure from the RC clutch section enters the spool bores and is directed out the HI range port. In this way the right LO clutch pack is released and the right HI clutch pack is engaged. The machine gradually turns left.

PIVOT TURN RIGHT (Fig. 7.6)

When the drive train control lever is in drive position and it is slowly moved to the pivot position the metering spool in rear side of this clutch section of the valve begins to meter the main pressure to the drain annulus, thereby reducing the pressure at the RC clutch annulus which is connected to both the LO drive and RB brake clutch packs. As the pressure is reduced, the drive clutch pack releases first and next the brake clutch pack begins to engage. When the drive train control lever is moved completely to the right pivot position, the pilot pressure CR is dropping down and activates the metering spool, moving it forward and stops the main oil flow. Then all the pressure is completely dissipated to the drain annulus, from the right side of the drive and brake clutches. Machine is in a right brake condition. The machine pivots turn right.

For a more complete description and operation of the steering valve and the steering drive, refer to SECTION 7E.

HYDRAULIC OIL FLOW

Legend for Fig.'s 7.5, 7.6 and 7.7.

M	- Main Pressure
CR	- Brake Clutch (Right) Pilot Pressure
CL	- Brake Clutch (Left) Pilot Pressure
LC	- Left Clutch Section
RC	- Right Clutch Section
HI-LO	- High-Low Range Section
SOL	- HI-LO Range Solenoid
SEQ	- Sequence Valve
FB	- Foot Brake Section
EC (23)	- Drive Train Electronic Controller
J	- Steering Manifold
SD	- Steering Drive
L	- Lubricating Pressure
RB	- Right Brake Pressure
LB	- Left Brake Pressure

DRIVE TRAIN

HYDRAULIC OIL FLOW

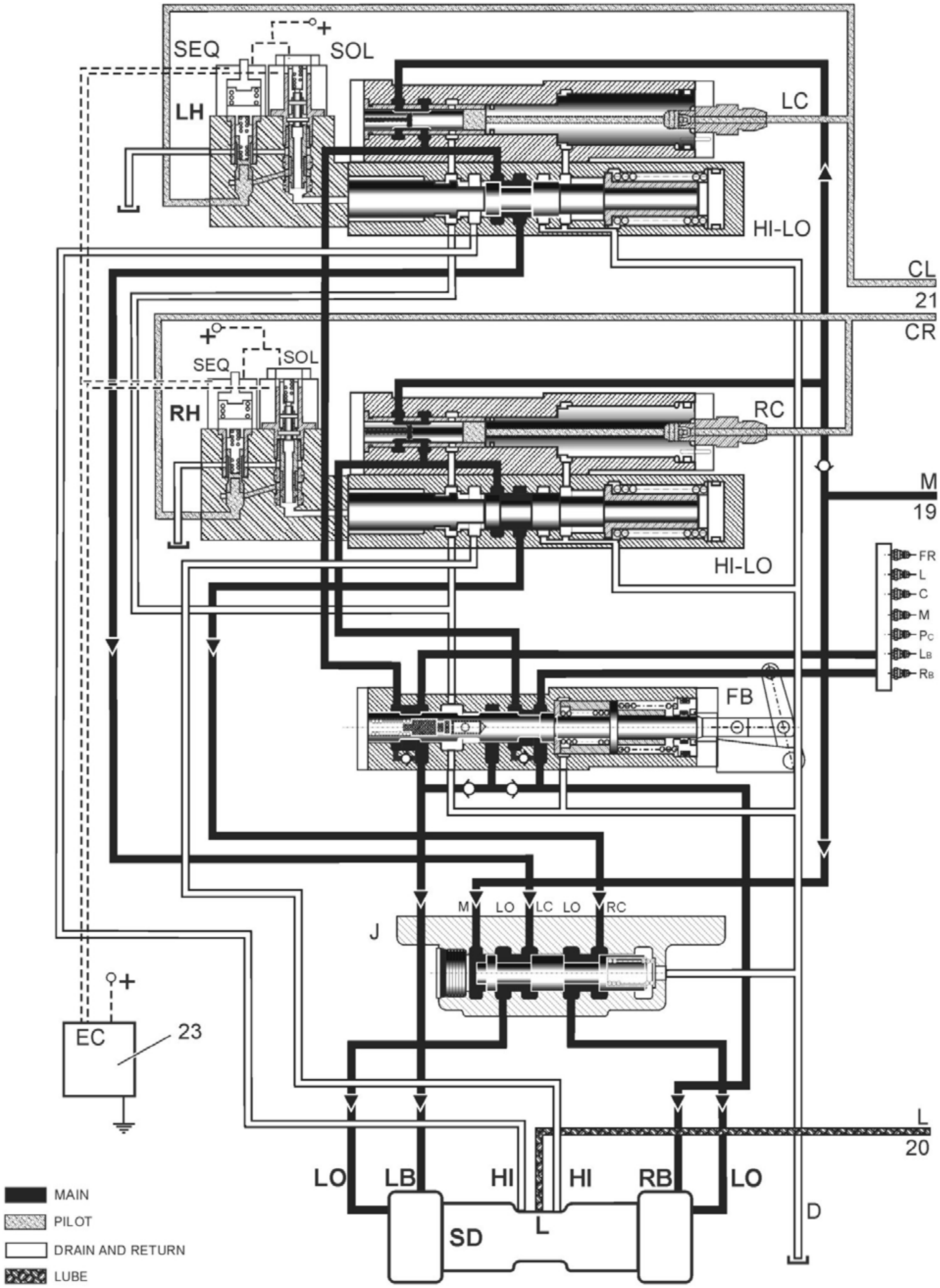


Fig. 7.4. Starting and HI-LO Range Straight Travel

TWO SPEED STEERING DRIVE

HYDRAULIC OIL FLOW

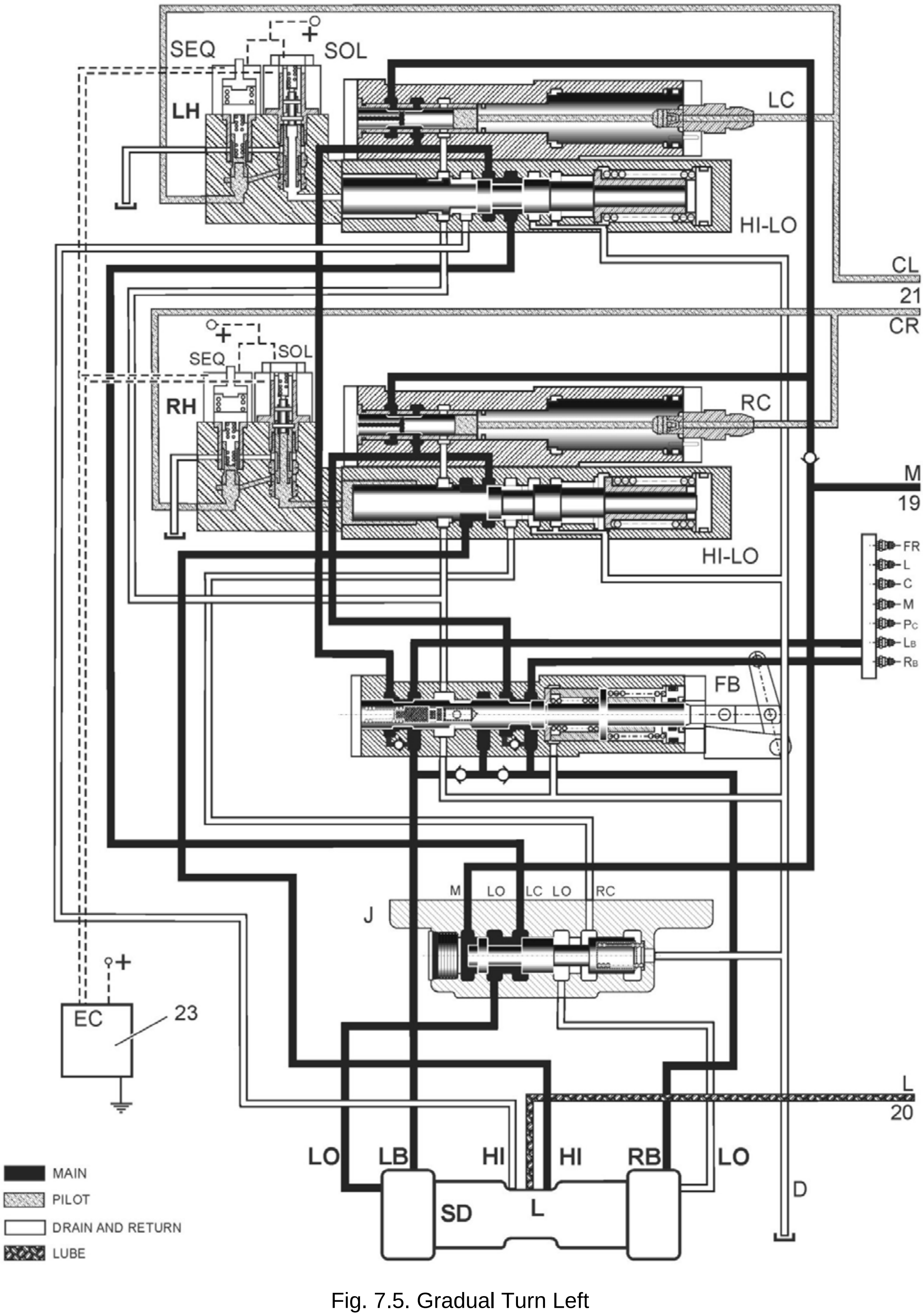


Fig. 7.5. Gradual Turn Left
TWO SPEED STEERING DRIVE

DRIVE TRAIN

HYDRAULIC OIL FLOW

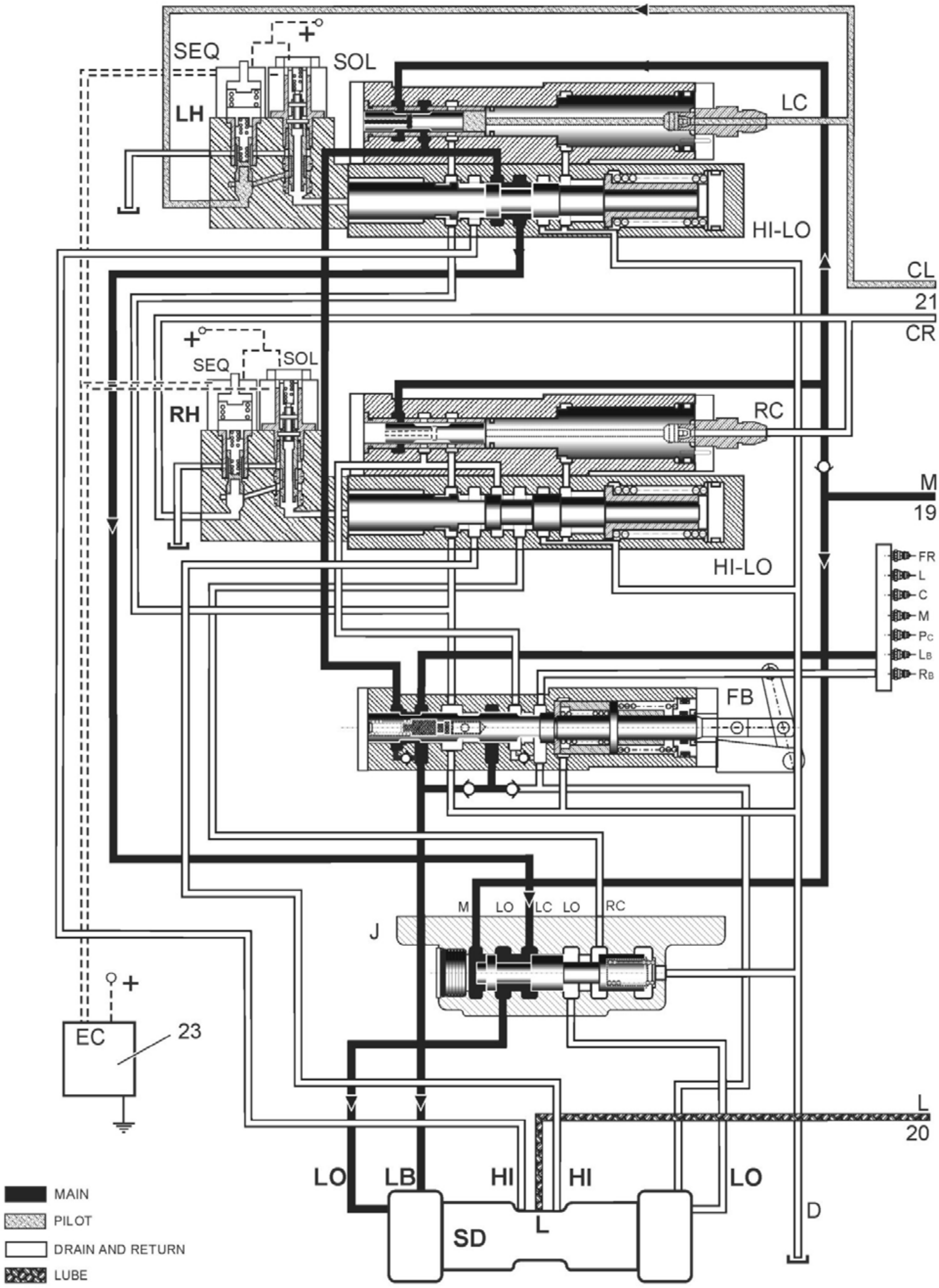


Fig. 7.6. Pivot Turn Right

TWO SPEED STEERING DRIVE

SERVICE DIAGNOSIS

8. TROUBLE SHOOTING

COMPLAINT	
PROBABLE CAUSE	**REMEDY**
Main Low Pressure and Clutch Low Oil Pressure Warning Light Glows Red (Drive Train Control Lever in Neutral, Engine Run, Oil Worm)	
1. Low main pressure	Refer to DIAGNOSTIC CHART in Par. 10, below
2. Pressure switch malfunction	Check and replace switch
3. Switching valve malfunction	Check valve. Repair or replace
Clutch Low Oil Pressure Warning Light Glows Red (Drive Train Control Lever in Forward or Reverse, Engine Run, Oil Worm)	
1. Low pressure at gear	Refer to DIAGNOSTIC CHART in Par. 10, below
No Gear/Direction Engagement	
1. Low main and/or gear pressure	Refer to "Main Low Pressure and/or Clutch Low Oil Pressure Warning Light Glows Red" above
High Torque Converter Oil Temperature (Gauge on Instrument Panel)	
1. Low main frame oil level	Check according to OPERATOR'S MANUAL
2. Temperature gauge or sensor malfunction	Replace gauge or sensor
3. Operating too long in low efficiency ranges	Review operating instructions in OPERATOR'S MANUAL
4. Clogged oil cooler	Clean according to OPERATOR'S MANUAL
5. Clogged drive train suction strainer	Remove and clean
6. Leakage on suction line	Check suction line for tightness
7. Transmission problem	Check transmission temperature and clutches oil pressure. Refer to DIAGNOSTIC CHART in Par. 10, below
8. Torque converter oil leakage excessive	Refer to SECTION 7B, TORQUE CONVERTER
9. Clogged or restricted torque converter oil line (T.C. oil pressure O.K.)	Clean and check for correct routing
10. Steering drive or brake clutches damaged	Refer to DIAGNOSTIC CHART in Par. 10, below
Loss of Power under Load	
1. Low oil level	Check oil level in rear frame and fill as necessary
2. Engine not up to rated performance	Perform stall speed test. Refer to Par. 11
3. Low transmission clutches oil pressures	Check oil pressures. Refer to Par. 10, TRANSMISSION AND TORQUE CONVERTER OIL PRESSURE TEST
4. Transmission oil level too high	Check operation and condition of scavenge circuit
5. Slipping clutch packs in transmission and/or steering drive	Refer to Par. 12, DRIVE TRAIN CLUTCH TEST
6. Excessive torque converter oil leakage	Refer to SECTION 7B, TORQUE CONVERTER

DRIVE TRAIN

SERVICE DIAGNOSIS

COMPLAINT	
PROBABLE CAUSE	**REMEDY**
Slow or Erratic Transmission Clutch Engagement	
1. Low transmission oil pressures	Check oil pressures. Refer to Par. 10, TRANSMISSION AND TORQUE CONVERTER OIL PRESSURE TEST
2. Rate of rise valve malfunction	Check valve and screen under valve. Install new valve gasket
3. Range selector valve malfunction	Check valve. Repair or replace
No 2nd and/or 3rd Gear Engagement	
1. Electrical or electronic system malfunction	Refer to SECTION 8, ELECTRICAL
No Operation in Presetting or Auto-Downshift Gear Mode	
1. Electrical or electronic system malfunction	Refer to SECTION 8, ELECTRICAL

9. SPECIFICATIONS

Charge and Scavenge Pump

Type . . . . gear, dual element
Capacities @ 2200 engine [RPM]:
Front (scavenge) section . . . . 176 [l/min]
Rear (charge) section . . . . 137 [l/min]

Transmission Test Oil Pressures

Main oil pressure (M) . . . . 1790 – 1930 [kPa]
Torque converter inlet oil pressure (C) . . . . 660 - 860 [kPa]
Lubrication oil pressure (L) . . . . 310 - 450 [kPa]
Transmission forward and reverse clutch oil pressures (FR):
In neutral . . . . 0 [kPa]
In gear . . . . Main (M) minus 0 – 70 [kPa]
Transmission first, second and third speed clutch oil pressures:
In neutral . . . . 0 [kPa]
In gear . . . . Main (M) minus 100 – 170 [kPa]

Steering Test Oil Pressures

Main oil pressure (M) . . . . 1790 – 1930 [kPa]
Right or left drive clutch . . . . Main (M) minus 0 – 34 [kPa]
Right or left brake clutch . . . . Main (M) minus 0 – 34 [kPa]
Steering pilot pressure (Priority valve) . . . . Main (M) plus (100 - 200) [kPa]

Torque Converter

Stall Speed:
Converter only . . . . 1800 – 2000 [RPM]
Converter and hydraulic . . . . 1620 – 1820 [RPM]

SERVICE DIAGNOSIS

10. TRANSMISSION AND TORQUE CONVERTER OIL PRESSURE TEST (Refer to Fig. 7.7)

WARNING! Be sure the area around the machine is clear of personnel and obstructions as the vehicle may move during these tests. If the machine starts to move, fully depress the decelerator pedal and shift the drive train control lever to NEUTRAL.

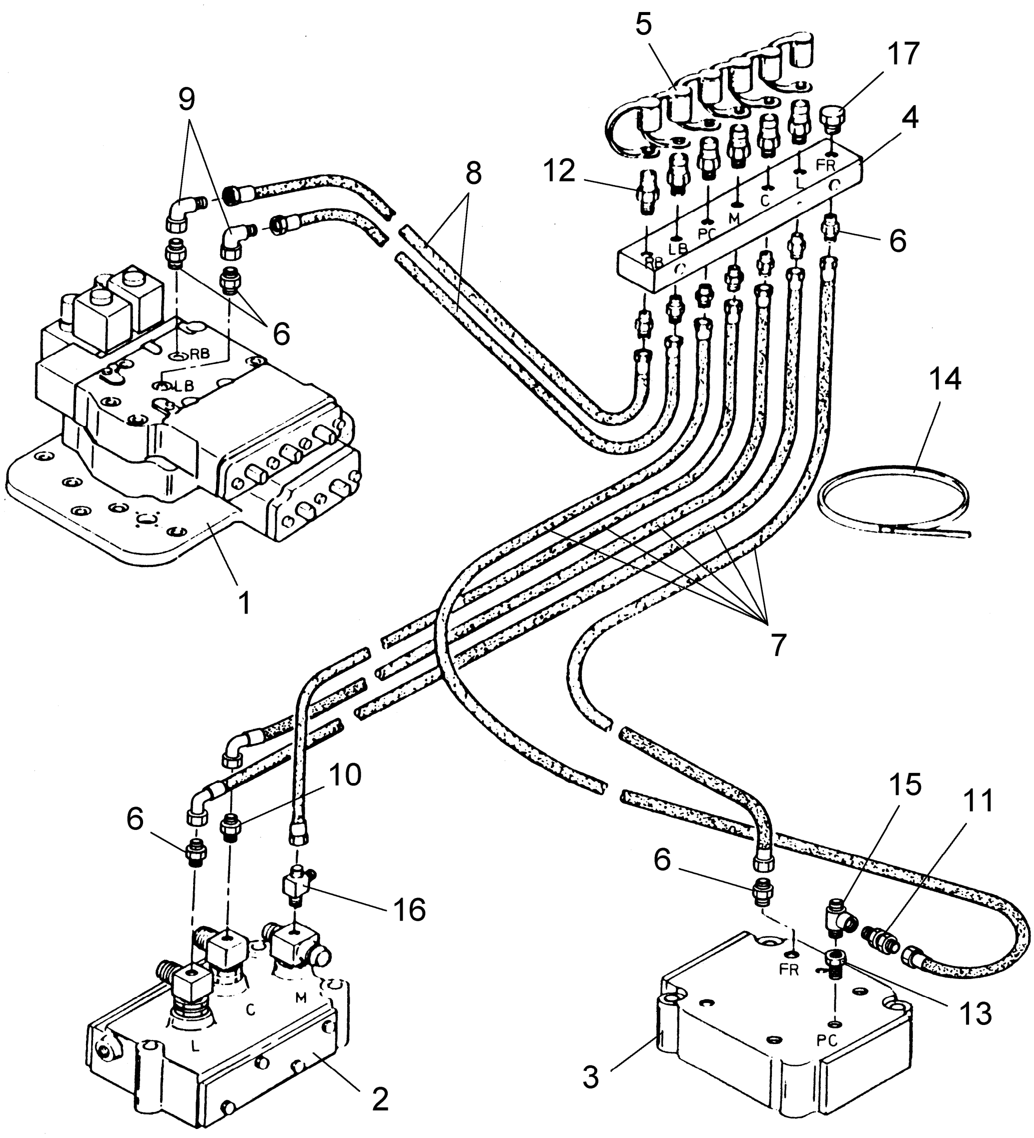


Fig. 7.7. Pressure Gauge Connect Points

1. Two Speed Steering Valve
2. Pressure Regulator Valve
3. Range Selector Valve
4. Junction Block
5. Protective Cap
6. Connector
7. Hoses
8. Hoses
9. Elbows
10. Connector
11. Connector
12. Quick Disconnect
13. Reducer Connector
14. Strap
15. Tee
16. Tee
17. Plug

1. Open the door at the left hand side of the platform. Remove the protective covers from quick disconnect fittings and connect the Test Pressure Gauges Kit (refer to SERVICE /SPECIAL TOOLS) to the pressure regulator valve (quick disc. fittings M, C and L) and range selector valve (quick disc. and plug fittings PC and FR) ports shown in Fig. 7.7.

DRIVE TRAIN

SERVICE DIAGNOSIS

NOTE: *Tag each test gauge to avoid confusion when performing these checks.*

NOTE: *The following pressure checks should be performed with the engine running at full throttle and oil at operating temperature. To obtain operating temperature, shift to third forward with the foot brake applied until the temperature gauge pointer reaches the high side. Then shift to neutral until the temperature gauge pointer drops to the midpoint. Repeat this procedure until the midpoint will be in green range.*

Transmission and Torque Converter Test Oil Pressure Chart

GEAR RANGE	TEST PORT DESCRIPTION (All readings are given in [kPa])				
	MAIN (M)	TORQUE CONV. (C)	LUBE (L)(*)	RANGE CLUTCH (PC)	DIRECT CLUTCH (FR)
Neutral	1790 - 1930	660 - 860	310 - 450	0	0
Forward First	1790 - 1930	660 - 860	310- 450	M minus 100 - 170	M minus 0 - 70
Forward Second	1790 - 1930	660 - 860	310 - 450	M minus 100 - 170	M minus 0 - 70
Forward Third	1790 - 1930	660 - 860	310 - 450	M minus 100 - 170	M minus 0 - 70
Reverse First	1790 - 1930	660 - 860	310 - 450	M minus 100 - 170	M minus 0 - 70
Reverse Second	1790 - 1930	660 - 860	310 - 450	M minus 100 - 170	M minus 0 - 70
Reverse Third	1790 - 1930	660 - 860	310 - 450	M minus 100 - 170	M minus 0 - 70

NOTE: *With the engine running at low idle the M, PC and FR pressure readings are slightly less than those shown in the above chart. However C and L pressure readings are much lower than those shown in the above chart with the same conditions.*

(*) ***IMPORTANT:*** *Additionally measure the L pressure with the engine running at low idle. Never operate the machine, if the L pressure reading is 0.0 [kPa].*

WARNING! Be sure the area around the machine is clear of personnel and obstructions as the vehicle may move during these tests. If the machine starts to move, fully depress the decelerator pedal and shift the drive train control lever to NEUTRAL.

2. With the drive train control lever in neutral, brake pedal is applied and the engine running at high idle, observe the readings of the pressure test gauges. The readings should be the pressures as shown in the above chart. Fully depress the decelerator pedal.

   With the engine running at low idle, steering in low (high) range, shift the drive train lock lever to its unlocked position and the drive train control lever into transmission forward first and slowly release the decelerator pedal, machine is moving. With the engine running at high idle, shift the transmission through second and third forward gear, steering both low and high range, machine stands still. Observe the readings of the pressure test gauges. The readings should be the pressures as shown in the above chart. Oil pressures should increase and decrease rapidly when engaging and disengaging clutch packs. Fully depress the decelerator pedal and shift the transmission in neutral.

   Repeat this step for each transmission reverse gear range.

SERVICE DIAGNOSIS

3. Shift the drive train control lever into neutral and move the drive train lock lever to ON position. Place the engine speed control lever in the low idle position and stop the engine.
4. If the readings are within these ranges with the oil at operating temperature, proceed with STEERING SYSTEM OIL PRESSURE CHECK, Par. 13 in this Section.
5. If the readings are not within these ranges with the oil at operating temperature, refer to the following diagnostic chart.

Transmission and Torque Converter Diagnostic Chart

PROBLEM	PROBABLE CAUSE
1. Low main oil pressure	a. Low oil level in rear frame. Refer to OPERATOR'S MANUAL. b. Clogged suction strainer. Refer to OPERATOR'S MANUAL. c. Leaking pump inlet lines. d. Fatigued or broken main spool springs in regulator valve. e. Incorrect number of shims at main spool in pressure regulator valve. Each shim changes the pressure by approximately 35 [kPa]. DO NOT use more than a total three shims. f. Safety check ball or spring in pressure regulator valve malfunction. g. Steering system leaking. Perform STEERING SYSTEM SUPPLY PRESSURE TEST described in this Section. h. Defective rear section of pump.
2. High main oil pressure	a. Main regulator spool stuck. b. Incorrect priority valve adjustment after repairing or replacement.
3. Low torque converter oil pressure	a. Low main oil pressure. Refer to problem 1 above. b. Clogged suction strainer. Refer to OPERATOR'S MANUAL. c. Leaking pump inlet lines. d. Stuck converter spool in pressure regulator valve. e. Fatigued or broken converter spool spring in pressure regulator valve. f. Incorrect number of shims at converter spool in pressure regulator valve. Each shim changes the pressure by approximately 25 [kPa]. DO NOT use more than a total three shims. g. Internal leak in converter. Check sleeve hub and output shaft seal rings. h. Defective rear section of pump.
4. High torque converter oil pressure.	a. Restricted or blocked oil passage or line. b. Restricted oil cooler.
5. Low transmission lubrication oil pressure.	a. Low torque converter oil pressure. Refer to problem 3 above. b. Fatigued or broken lubrication spool spring in pressure regulator valve. c. Stuck lubrication spool in pressure regulator valve. d. Incorrect number of shims at lube spool in pressure regulator valve. Each shim changes the pressure by approximately 7 [kPa]. DO NOT use more than a total three shims.

SERVICE DIAGNOSIS

PROBLEM	PROBABLE CAUSE
6. Low or zero, each (FR) directional and (PC) range clutch oil pressure.	a. Low main oil pressure. Refer to problem 1 above. b. No or low signal oil pressure from drive train control valve. Tee in a 3000 [kPa] test pressure gauge at the **F** or **R** port on the range selector valve and check for oil pressure. If low, repair or replace the drive train control valve. c. Stuck switch spool in range selector valve. d. Rate of rise valve damaged. e. Screen under rate of rise valve clogged. f. Leaking manifold seal ring between F and R gear on input shaft. Perform “Five Penny” Test described in this Section.
7. Low or zero pressure at both 2nd and 1st or 1st and 3rd	a. Leaking manifold seal ring gear on output shaft (between 2 and 1 or 1 and 3). Check manifold and seal rings condition; refer to SECTION 7C, TRANSMISSION. Perform “Five Penny” Test described in this Section.
8. Low or zero one of F or R clutch pressure	a. No or low signal oil pressure from drive train control valve. Tee in a 3000 [kPa] test pressure gauge at the F or R port on the range selector valve and check for oil pressure. b. Range selector valve directional spool damaged. c. Leaking one of manifold outside seal gear (F, R) on input shaft. Perform Five Penny Test described in this Section. d. Leaking one of directional clutch pack. Perform Five Penny Test described in this Section.
9. Low or zero one of 1st, 2nd or 3rd clutch pressure	a. Faulty solenoid valve on gear shifting valve (2nd or 3rd). b. Range selector valve range spool damaged. c. Leaking one of outside manifold seals on output shaft (for 2nd or 3rd gear only). Check manifold and seal rings condition; refer to SECTION 7C, TRANSMISSION. Perform “Five Penny” Test described in this Section.

11. TORQUE CONVERTER STALL SPEED CHECK

WARNING! Be sure the area around the machine is clear of personnel and obstructions as the machine may move during this test. If the machine starts to move, fully depress the decelerator pedal and shift the transmission to NEUTRAL.

IMPORTANT: *Do not hold the machine in a stall condition for more than ten seconds.*

1. Use the Digital Optical Tachometer (refer to SERVICE /SPECIAL TOOLS in this Section).
2. With the engine speed at full throttle and the foot brake applied, oil at operating temperature, shift the transmission into third forward and record the stall speed RPM.
3. If the stall speed meets specifications, proceed with Par. 12, DRIVE TRAIN CLUTCH TEST.
4. If the stall speed does not meet specifications, refer to the following chart.

Torque Converter Stall Speed Chart

PROBLEM	PROBABLE CAUSE
1. Stall speed too high	a. Engine injection pump defective or improperly adjusted. b. Refer to Par. 12, DRIVE TRAIN CLUTCH TEST.
2. Stall speed too low	a. Too low engine power. Refer to ENGINE REPAIR MANUAL.

SERVICE DIAGNOSIS

12. DRIVE TRAIN CLUTCHES TEST

NOTE: *Before performing the drive train clutches test, the drive train oil pressures should be checked. Refer to Par. 10, TRANSMISSION AND TORQUE CONVERTER OIL PRESSURE TEST and to Par. 13, STEERING SYSTEM OIL PRESSURE CHECK in this Section.*

WARNING! Be sure the area around the machine is clear of personnel and obstructions as the machine may move during this test. If the machine starts to move, fully depress the decelerator pedal and shift the transmission to NEUTRAL.

IMPORTANT: *Do not hold the machine in a stall condition for more than ten seconds.*

1. Apply the brake pedal and lock it. Remove the front center floor plate in the operator's platform.
2. Start the engine. Depress the decelerator pedal to decrease the engine speed. Move the drive train lock lever to the OFF position. Place the engine speed control lever in the high idle position.
3. Shift the drive train control lever into forward second gear range with the steering drive in the high range, gradually release the decelerator pedal and check for drive shaft rotation. Check the same in low range clutch engagement position with the engine running at high idle, shift the transmission into forward third gear range and again, check for drive shaft and final drive sprocket rotation.
4. Fully depress the decelerator pedal and shift the transmission into reverse third gear range. Gradually release the decelerator pedal and again, check for drive shaft and final drive sprocket rotation.
5. Fully depress the decelerator pedal and shift transmission into neutral. Move the drive train lock lever to the ON position. Place the engine speed control lever in the low idle position and release the decelerator pedal. Stop the engine.
6. If the drive shaft and final drive sprocket did NOT rotate, the operational condition of the drive train clutches is satisfactory, with the possible exception of a slipping first gear range clutch in the transmission.
7. If the drive shaft and/or final drive sprocket did rotate, refer to the following diagnostic chart.
8. Reinstall the front center floor plate in the operator's platform.

Drive Train Clutch Diagnostic Chart

PROBLEM	PROBABLE CAUSE
1. Final drive sprocket stationary and drive shaft turns in all transmission gear ranges in LO or HI range	Slipping both directional clutches in transmission. Slipping LO or HI drive clutches in steering drive.
2. Final drive sprocket stationary and drive shaft turns in forward and reverse second gear range only	Slipping second gear range clutch in transmission.
3. Final drive sprocket stationary and drive shaft turns in forward and reverse third gear ranges	Slipping third gear range clutch in transmission.
4. Final drive sprocket stationary and drive shaft turns in forward third gear range but not in reverse third	Slipping forward directional clutch in transmission.
5. Final drive sprocket stationary and drive shaft turns in reverse third gear range but not in forward third	Slipping reverse directional clutch in transmission.
6. Final drive sprocket rotates	Slipping brake clutch in steering drive.

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SERVICE DIAGNOSIS

13. STEERING SYSTEM OIL PRESSURE CHECK

1. Stop the engine and open the door at the left hand side of the platform.
2. Connect the Test Pressure Gauges Kit (refer to SERVICE /SPECIAL TOOLS in this Section) to right and left brake quick disconnect fittings (RB and LB, Fig. 7.7) on the diagnostic center and to the RC and LC test ports (1 and 3, Fig. 7.8) on the steering valve. Tag each test gauge with the corresponding description to avoid confusion when performing these checks.

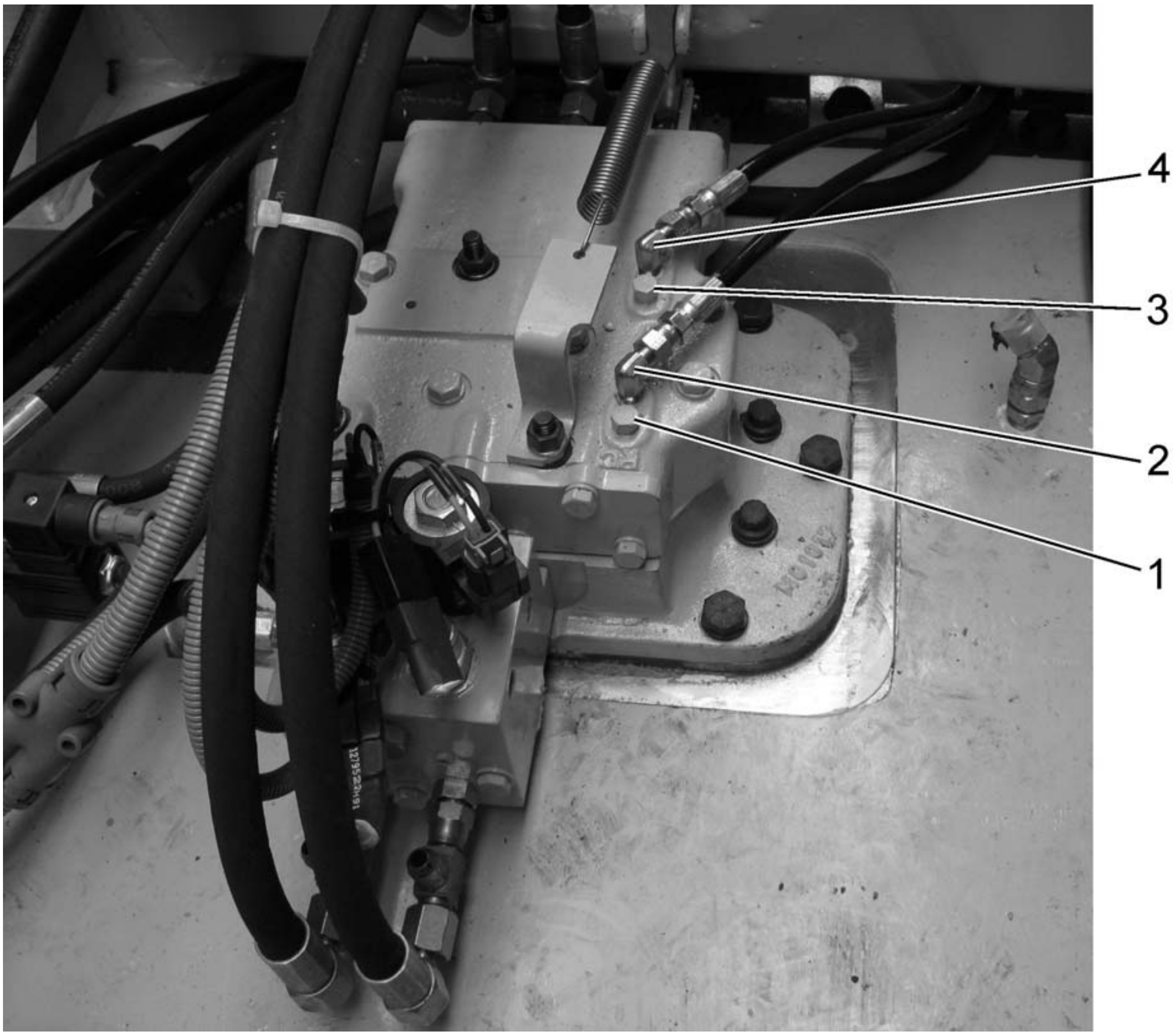


Fig. 7.8. Pressure Gauge Connect Points

1. Right Clutch (RC)
2. Right Brake (RB)
3. Left Clutch (LC)
4. Left Brake (LB)

NOTE: *The following pressure checks should be performed with the engine running at full throttle and oil at operating temperature. To obtain operating temperature shift to third forward with the foot brake applied until the temperature gauge pointer reaches the high side. Then shift to neutral until the temperature gauge pointer drops to the midpoint. Repeat this procedure until the midpoint will be in green range.*

3. Run the engine at full throttle and check the gauge readings with those in the following chart.

SERVICE DIAGNOSIS

Steering System Test Oil Pressure Chart

DRIVE TRAIN CONTROL LEVER OR BUTTONS POSITIONS AND BRAKE PEDAL POSITIONS	TEST PORT DESCRIPTION				
	MAIN [kPa]	LH CLUTCH [kPa]	LH BRAKE [kPa]	RH CLUTCH [kPa]	RH BRAKE [kPa]
1. Both tracks in low range clutch engagement (both LO/HI range switches in their lower position). Control lever in neutral.	1790 - 1930	Main minus 0 – 34	Main minus 0 – 34	Main minus 0 – 34	Main minus 0 – 34
2. Both tracks in high range clutch engagement (both LO/HI range switches in their upper position). Control lever in neutral.	1790 - 1930	Main minus 0 – 34	Main minus 0 – 34	Main minus 0 – 34	Main minus 0 - 34
3. Left track in low range clutch engagement and right track in pivot or brake (both LO/HI range switches in their lower position). Control lever fully shifted to the right.	1790 - 1930	Main minus 0 – 34	Main minus 0 – 34	0 (%)	0 (%)
4. Left track in low range clutch engagement and right track at feel point (both LO/HI range switches in their lower position). Initial movement of the control lever to the right.	1790 - 1930	Main minus 0 - 34	Main minus 0 - 34	590 – 760 (%)	590 - 760 (%)
5. Left track in pivot or brake and right track in low range clutch engagement (both LO/HI range switches in their lower position). Control lever fully shifted to the left.	1790 - 1930	0 (%)	0 (%)	Main minus 0 – 34	Main minus 0 – 34
6. Left track at feel point and right track in low range clutch engagement (both LO/HI range switches in their lower position). Initial movement of the control lever to the left.	1790 - 1930	590 - 760 (%)	590 - 760 (%)	Main minus 0 – 34	Main minus 0 - 34
7. Both tracks in low range clutch engagement (both LO/HI range switches in their lower position). Control lever in neutral and foot brake pedal fully applied.	1790 - 1930	Main minus 0 – 34	0 (#)	Main minus 0 – 34	0 (#)
8. Both tracks in low range clutch engagement (both LO/HI range switches in their lower position). Control lever in neutral and foot brake pedal at feel point.	1790 - 1930	Main minus 0 - 34	450 - 520	Main minus 0 – 34	450 - 520

(%) - Oil pressure drop should be gradual with control lever movement.
(#) - Oil pressure drop should be gradual with brake pedal movement.

DRIVE TRAIN

SERVICE DIAGNOSIS

Steering Drive Diagnostic Chart

PROBLEM	PROBABLE CAUSE
1. No clutch and brake pressures.	a. Low main pressure. Refer to “Transmission and Torque Converter Diagnostic Chart” above.
2. Low or zero right or left clutch pressure with HI-LO switches in low range.	a. RH or LH low range clutch hose in rear main frame leaking. b. Steering valve gasket leaking. c. RH or LH low range piston seal ring leaking.
3. Low or zero right or left clutch and brake pressure with HI-LO switches in low and high range.	a. RH or LH metering spool in upper steering valve seized. b. Steering valve gasket leaking.
4. Low or zero right or left clutch pressure with HI-LO switches in high range.	a. RH or LH solenoid valve or sequence valve faulty. b. RH or LH high range clutch hose in rear frame leaking. c. Steering valve gasket leaking. d. High range seal ring on gear hub leaking. e. High range piston seal rings leaking.
5. Low or zero right or left brake pressure.	a. RH or LH brake clutch hose in rear main frame leaking. b. Brake piston seal ring leaking.

14. STEERING SYSTEM FUNCTIONAL CHECK

Before performing the steering system function check, the steering valve pressures must be checked. Refer to Paragraph 13, STEERING SYSTEM OIL PRESSURE CHECK.

With the Test Pressure Gauges Kit (refer to SERVICE /SPECIAL TOOLS in this Section) still connected to right and left brake quick disconnect fittings on the diagnostic center and to the RC and LC test ports on the steering valve (Refer to Step 2, in Paragraph 13 of this Section) and machine on level and hard ground start the engine. Set the engine speed at low idle, engage the transmission in third forward and proceed as follows:

Brake Release and Engagement Pressure Check

1. Hold the drive train control lever fully shifted to the left in the LH brake position.
2. Increase the engine speed until the RH track begins to creep.
3. Apply the foot brake slowly and record the RB brake clutch pressure (gauge connected to RB on the diagnostic center) when the track stops creeping.
4. Slowly release the foot brake and record the RB brake clutch pressure (gauge connected to RB on the diagnostic center) when the track begins to creep.
5. Repeat steps 1 through 4 for the LB brake clutch by actuating the foot brake with the drive train control lever fully shifted to the right in the RH brake position and record the LB brake clutch pressure (gauge connected to LB on the diagnostic center).
6. The pressures obtained should be between 550 – 690 [kPa].

15. TRANSMISSION “FIVE PENNY” DIAGNOSTIC TEST

This test is designed to assist in the diagnosis of a problem with the machine transmission and to help determine if the transmission needs to be removed and disassembled or if the problem is in the hydraulic components which are external to the transmission assembly.

If there is complaint of low pressure or slippage in the transmission, pressure test should be performed and pressures of all circuits must be recorded for future comparisons; refer to TRANSMISSION AND TORQUE CONVERTER OIL PRESSURE TEST in this Section. If the pressure test shows that there is low pressure in one or more circuits, then “Five Penny” Test may be done.

“Five Penny” Test Procedure

1. Remove the range selector valve; refer to RANGE SELECTOR VALVE in TRANSMISSION, SECTION 7C.

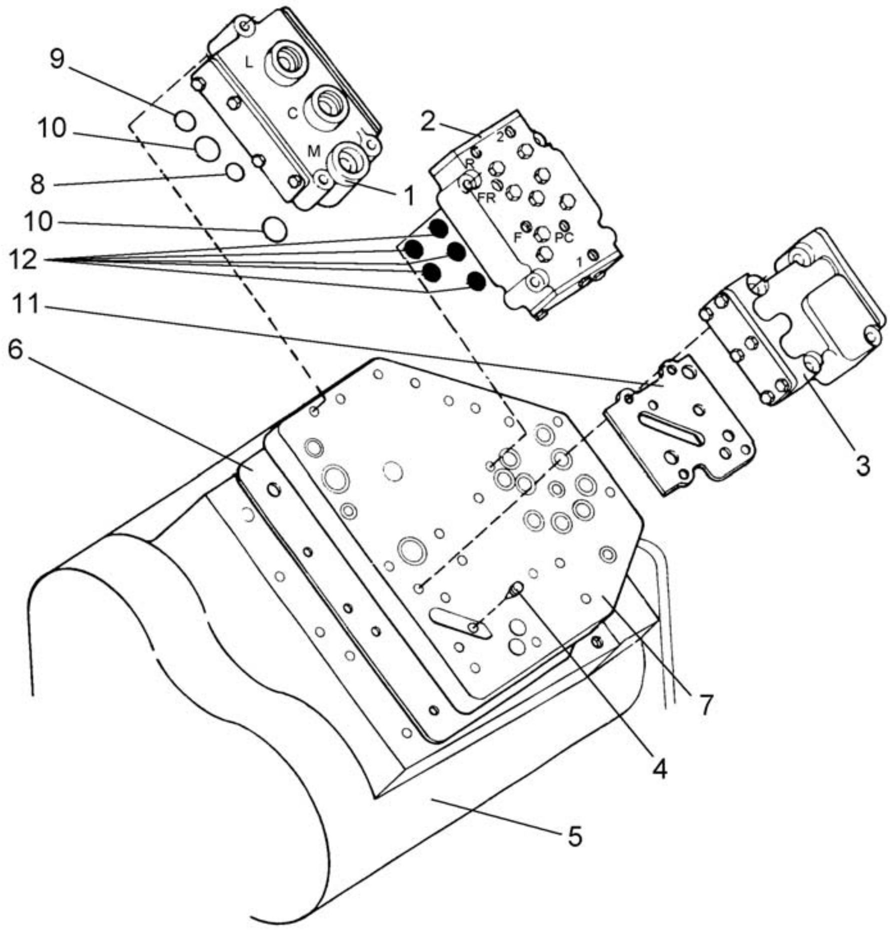


Fig. 7.9. Pennies (Disks) Placing on the Underside of the Range Selector Valve

1. Pressure Regulator Valve
2. Range Selector Valve
3. Rate of Rise Valve
4. Orifice Strainer
5. Transmission Assy
6. Manifold Gasket
7. Transmission Manifold
8. O-Ring
9. O-Ring
10. O-Ring
11. Rate of Rise Valve Gasket
12. Penny Coins (or Small Disks ϕ 21.3 [mm] dia. and 2 [mm] thick)

SERVICE DIAGNOSIS

2. Use pennies (or small metal disks having ϕ 21.3 [mm] and 2 [mm] in diameter and thickness respectively) (12, Fig. 7.9) and place them over the ports for FC, RC, 1C, 2C, 3C on the underside of the range selector valve (2) (the US penny will just fit inside transmission manifold (7) ports O-rings, so they will be held in place). Reinstall the valve and tighten it down, with coins (or metal disks) in place. This effectively shuts off any flow to the clutch packs so no clutch engagement is possible, but the lube flow is not interrupted, so there is no danger of damage to the transmission during this test.
3. Start the engine and take all drive train pressures again. The pressures should be taken in all ranges and in both directions; refer to TRANSMISSION AND TORQUE CONVERTER OIL PRESSURE TEST in this Section. Shut off the engine.
4. If the pressures which were low on the first test are NOW correct, the problem is internal to the transmission and it will have to be removed and repaired (for more details refer to Transmission and Torque Converter Diagnostic Chart in this Section).
5. If the pressures are still low, the problem is outside of transmission, probably in the transmission valves.
6. Remove the pennies or metal disks; reinstall the range selector valve with O-rings, refer to RANGE SELECTOR VALVE in TRANSMISSION, SECTION 7C.

16. STEERING SYSTEM LEAKAGE TEST

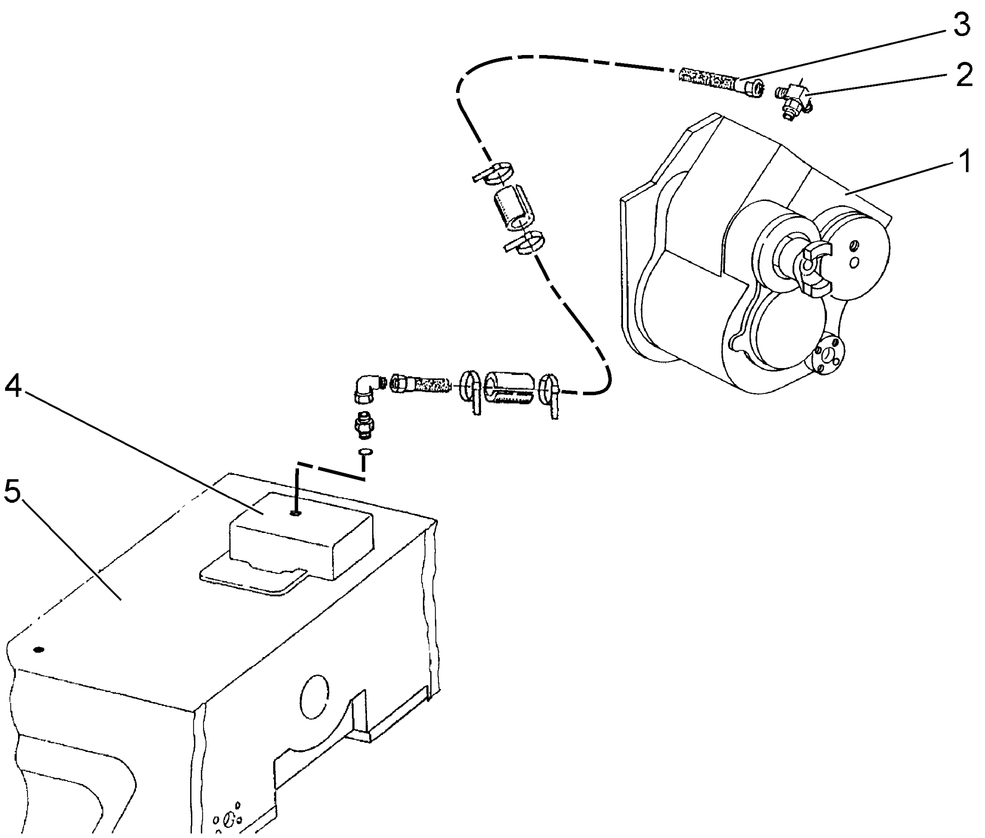


Fig. 7.10. Steering System Supply Pressure Test

1. Transmission
2. Hydraulic Tee
3. Steering Valve Supply Hose
4. Steering Valve
5. Rear Main Frame

SERVICE DIAGNOSIS

1. If main pressure M, supplying the steering valve, is low, disconnect supply hose (3, Fig. 7.10) from the pressure regulator valve and plug the tee (2), to ensure that the M pressure is not connected to any leakage in the steering system.
2. Start the engine and take the M main pressure again. Refer to TRANSMISSION AND TORQUE CONVERTER OIL PRESSURE TEST in this Section. Shut off the engine.
3. If the pressures is correct with the steering valve blocked and incorrect with the steering valve connected, then the steering system needs to be further checked. Refer to STEERING SYSTEM OIL PRESSURE CHECK in this Section.
4. Remove plug from the tee (2) and reconnect supply hose (3) to the pressure regulator valve.

17. PRIORITY VALVE PRESSURE CHECK AND ADJUSTMENT PROCEDURE

The priority valve is located at the machine L.H. side, under the drive train system filter, behind the diagnostic center (see Fig. 7.11).

The valve is not under normal diagnostic procedure. In case of valve repair or replacement check the pressure and adjust it if needed. Refer to procedures described below.

Fig. 7.11. Priority Valve Pressure Gauge Connect Point

1. Priority Valve
2. Quick Disconnect Fitting
3. Priority Valve Pressure Regulator

DRIVE TRAIN

SERVICE DIAGNOSIS

Priority Valve Pressure Check

The check is to be carried out at the engine high idle speed.

1. Remove the protective cap from quick disconnect fitting (2, Fig. 7.11) mounted in the elbow at the pressure filter base.
2. Connect the pressure gauge (refer to SERVICE /SPECIAL TOOLS in this Section) to the quick disconnect fitting (2).
3. Check the "M" pressure at the diagnostic center of the drive system, refer to **Transmission And Torque Converter Test Oil Pressure Chart** in SECTION 7, DRIVE TRAIN.
4. Check the priority valve pressure. The pressure gauge is to register "M" + 0.2 [MPa].
5. If the pressure taken is outside the specifications, the priority valve pressure regulator (3) calls for adjustment. Refer to **Priority Valve Pressure Adjustment Procedure** below.
6. Disconnect the pressure gauge and restore the protective cap.

Priority Valve Pressure Adjustment Procedure

The check is to be carried out at the engine maximum RPM.

1. Connect the pressure gauge and check priority valve pressure as described in **Priority Valve Pressure Check** above.
2. To adjust priority valve pressure regulator (2, Fig.7.12), loosen the counter nut (4) and turn the adjusting screw (3) in to increase pressure or out to decrease pressure (refer to **Priority Valve Pressure Check** procedure above).
3. Tighten the counter nut (4) to the pressure regulator (2) after adjustment. Recheck the priority valve pressure and disconnect the pressure gauge.

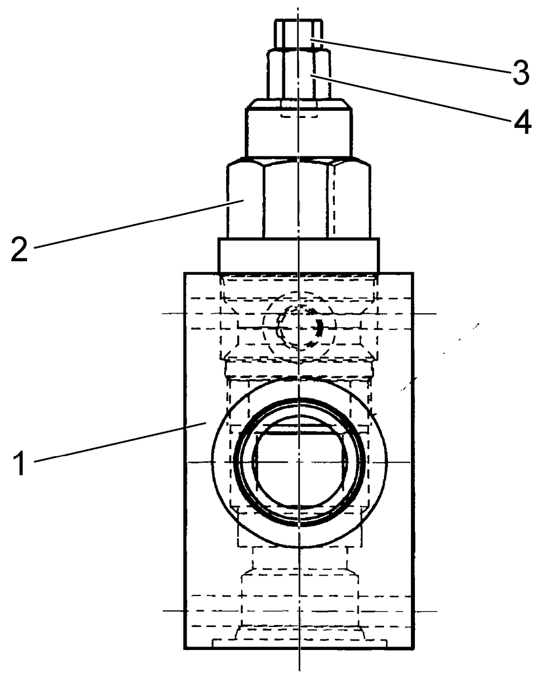


Fig. 7.12. Pressure Gauge Connect Point

1. Priority Valve
2. Priority Valve Pressure Regulator
3. Adjusting Screw
4. Counter Nut

SECTION 7B

HYDRAULIC TORQUE CONVERTER

HYDRAULIC TORQUE CONVERTER

CONTENTS

SERVICE /SPECIAL TOOLS

1. SERVICE /SPECIAL TOOLS

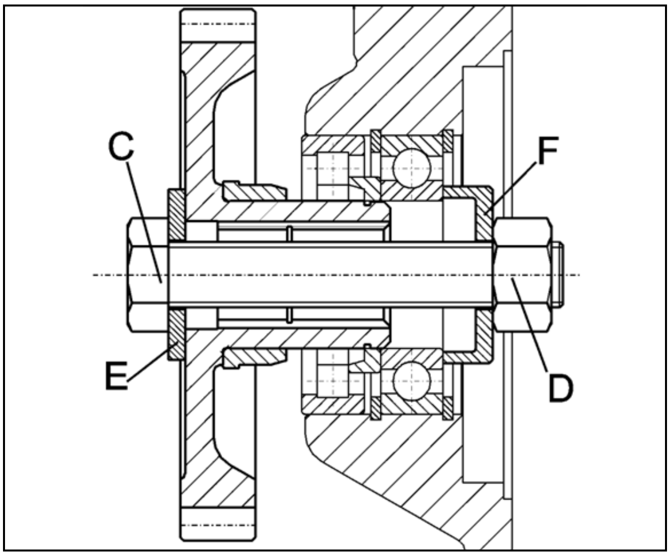
TOOL FOR DRIVE GEAR MOUNTING

C – Bolt M20 x 120
601-35-1225-3-01
30100R1

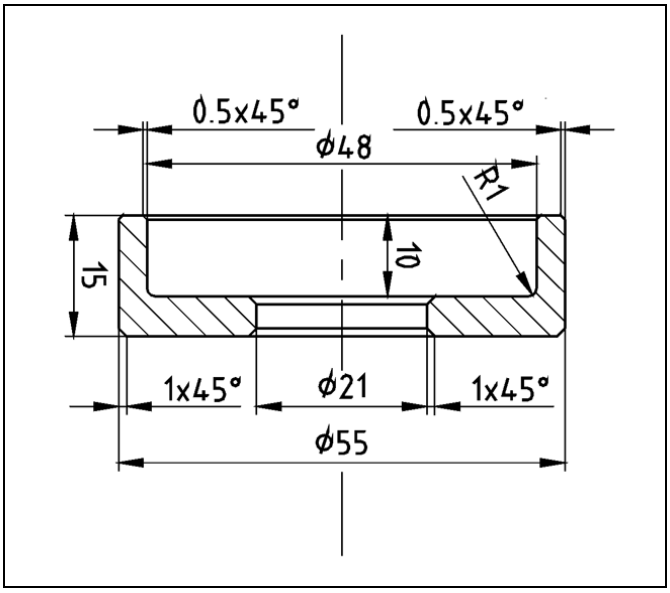
D – Nut M20-6-A
603-01-1223-0-01

E – Round Washer 21
612-42-1000-0-01

F – Special Washer (per Drawing)



SPECIAL WASHER
(R1 = 1.0 [mm])



GENERAL

2. DESCRIPTION AND OPERATION (Refer to Fig.'s 7B.1 and 7B.2)

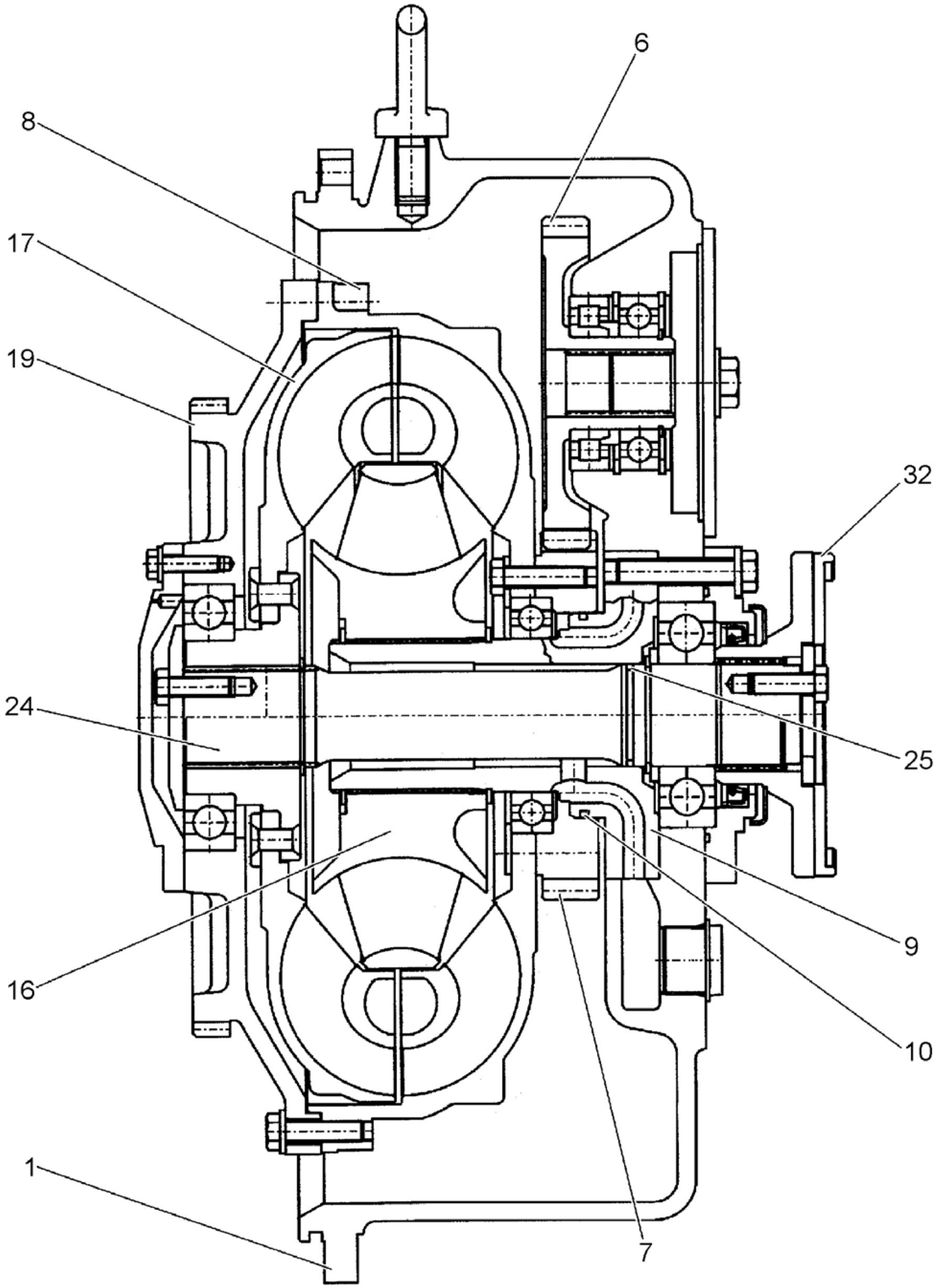


Fig. 7B.1. Cross Section View of Torque Converter

GENERAL

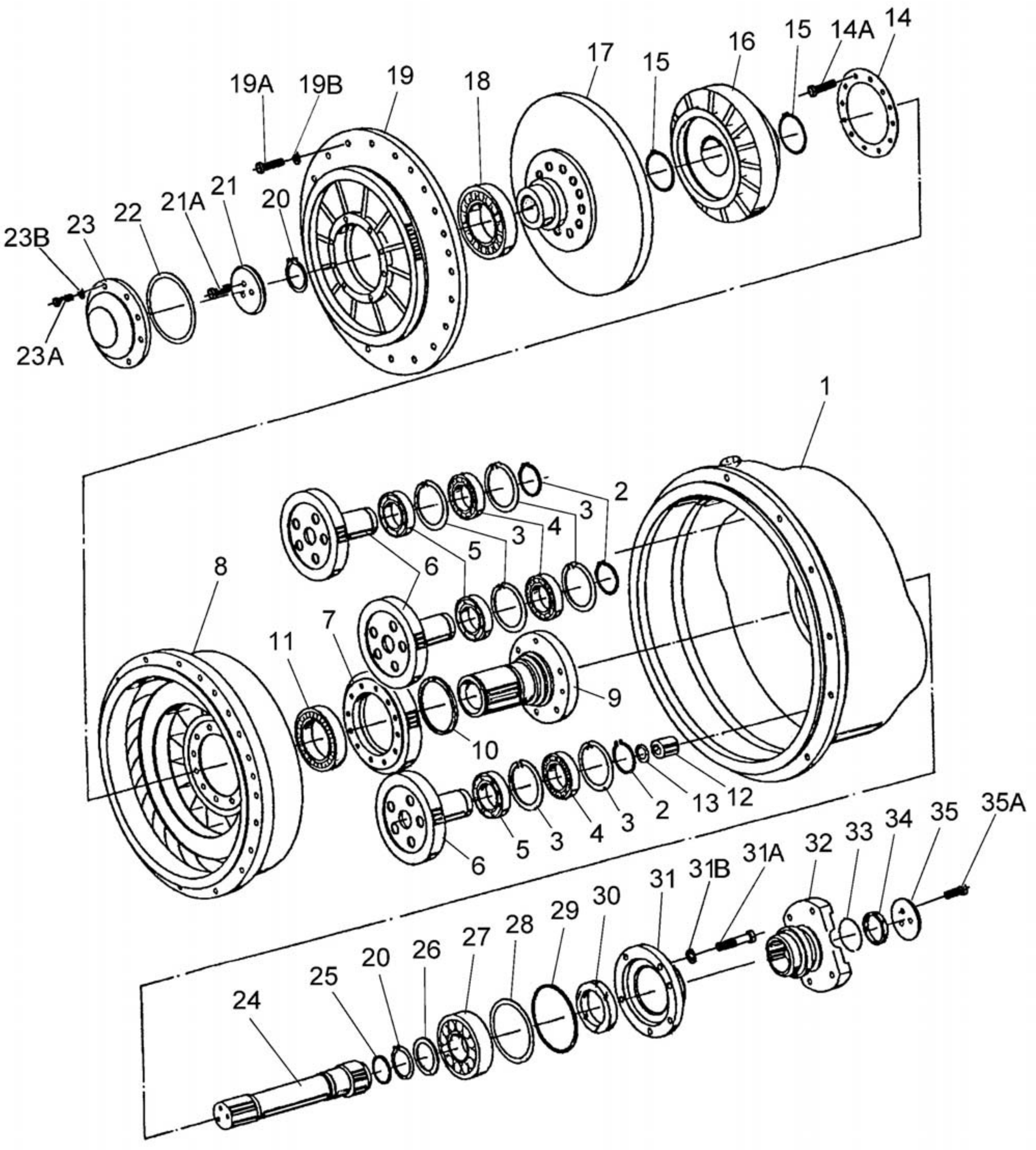


Fig. 7B.2. Exploded View of Torque Converter

GENERAL

Legend for Fig.'s 7B.1 and 7B.2

1. Converter Housing	12. Sleeve Spacer	20. Retaining Ring	29. Seal Ring
2. Retaining Ring	13. Retaining Ring	21. Retaining Plate	30. Seal Ring
3. Retaining Ring	14. Thrust Washer	22. Shim	31. Rear Cover
4. Ball Bearing	14A.Bolt	23. Housing Cover	31A.Bolt
5. Roller Bearing	15. Retaining Ring	23A.Bolt	31B.Washer
6. Driven Gear	16. Stator	23B.Washer	32. Output Flange
7. Drive Gear	17. Turbine Assy	24. Output Shaft	33. Thrust Ring
8. Impeller	18. Ball Bearing	25. Seal Ring	34. O-ring
9. Ground Sleeve Hub	19. Drive Housing	26. Washer	35. Retaining Plate
10. Seal Ring	19A.Bolt	27. Ball Bearing	35A.Bolt
11. Ball Bearing	19B.Washer	28. Shim	

This machine is equipped with a single stage, single phase torque converter, bolted directly to the engine flywheel housing. The torque converter automatically varies the output required at the tracks to meet the changing load requirements of the tractor. Engine power is transferred by the converter with little change in torque when the load is light. When a heavy load is encountered, the torque multiplication becomes greater, but with a resulting loss of machine speed. It is important to note that the converter does not increase engine horsepower, but does increase the amount of torque available at the tracks.

Converter housing (1) is flange-mounted to the machine engine. Engine power is transferred through drive housing (19) driven by the engine flywheel. Impeller (8) with drive gear (7) is bolted to drive housing (19). Gear (7) drives gear pumps through driven gears (6) that supply oil to machine hydraulic systems. Turbine assy (17) is splined to the output shaft (24) on one hand and there is the output flange (32) splined to the output shaft on the other hand. Between the impeller and turbine assy the stator (16) is mounted splined to the stationary ground sleeve hub (9). There is no direct mechanical connection between the impeller and turbine or stator.

Engine turns bladed impeller (8) bolted to drive housing (19). At the same time external gear pump is powered from the engine and supplies oil to impeller blades. The impeller draws fluid from the opening surrounding the hub and ejects it from its blades at high velocity. The turbine (17) is positioned opposite the impeller and its blades receive the full impact of this velocity. Oil exits from the turbine in the opposite direction of rotation from that of the impeller. The turbine divides the oil flow between converter discharge passage as one oil stream, while the other oil stream impacts stator (16) blades, giving additional torque, charging the turbine (17). The curved blades of the stator re-directs the flow back to the impeller in the same direction as the impeller is moving, completing the cycle. This constant gain in energy of impeller flow oil and stator reaction torque increase the energy received by the turbine with the result of torque multiplication at output shaft (24) and output flange (32) of the torque converter.

Torque multiplication is determined by the speed of the turbine in relation to the impeller. A fluid thrown at a paddle will strike it with more force if the paddle is stationary than it will if the paddle is moving in the same direction as the fluid. Similarly, when the turbine (17) is rotating as fast as the impeller (8), the oil passes easily through the turbine applying little or no force to the blades. As the output shaft slows down, the fluid strikes the turbine blades with more force. The maximum striking force of the fluid is reached when the turbine is stopped. This occurs in the machine when the output shaft is stalled by a heavy load.

Seal ring (10) at oil inlet and seal ring (25) at oil outlet, respectively separate oil high pressure chamber from the other torque converter work volume. These seal rings and their condition are crucial to torque converter leakage rate and consequently, torque converter loss rate and its efficiency.

3. SPECIFICATIONS

Torque converter weight . . . . 130 [kG]
Torque converter admissible leakage rate . . . . 2 - 8 [lpm]
Torque converter stall speed:
Converter only . . . . 1800 – 2000 [RPM]
Converter and hydraulic . . . . 1620 – 1820 [RPM]

Special Bolt Torque Data

Housing cover to drive housing bolts . . . . 21 – 25 [Nm]
Output flange with retaining plate to output shaft bolts . . . . 41 – 51 [Nm]
Drive housing to impeller bolts . . . . 48 – 58 [Nm]
Drive gear to impeller bolts . . . . 48 – 58 [Nm]
Rear cover and ground sleeve hub to converter housing bolts . . . . 72 – 88 [Nm]
Universal joint mounting bolts . . . . 110 [Nm]
Torque converter to flywheel housing mounting bolts . . . . 75 [Nm]

4. SERVICE DIAGNOSIS

COMPLAINT	
PROBABLE CAUSE	**REMEDY**
Loss of Oil from Torque Converter	
Leaking connections	Operate the engine at part throttle and inspect all lines and connections for leaks. Tighten or replace parts as necessary.
Leaking torque converter a). at rear b). at front or through cranking motor	Check all bolts, nuts and gasket joints while the system is under pressure. Replace parts if necessary. Replace leaking broken seal ring at rear cover or O-ring at output flange. Replace O-ring at housing or cranking motor.
Grinding or Scraping Noise Inside Converter Housing	
Bearing failure allowing the turbine or impeller blades to strike the fixed stator	Replace bearings, turbine, impeller and stator as necessary.
High Torque Converter Oil Temperature (Gauge on Instrument Panel)	
See SERVICE DIAGNOSIS in SECTION 7	
Loss of Power	
See SERVICE DIAGNOSIS in SECTION 7	

GENERAL

5. TORQUE CONVERTER INTERNAL LEAKAGE TEST (Refer to Fig. 7B.3)

NOTE: *The following oil leakage check should be performed with the engine running at full throttle and oil at operating temperature. To obtain operating temperature, shift to third forward with the foot brake applied until the temperature gauge pointer reaches the high side. Then shift to neutral until the temperature gauge pointer stops. Repeat this procedure until the moment that the gauge pointer, on dropping, stops at the green zone.*

1. Shift the drive train lock lever to the lower position.

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

2. Remove the transmission case guard from the bottom of the machine.

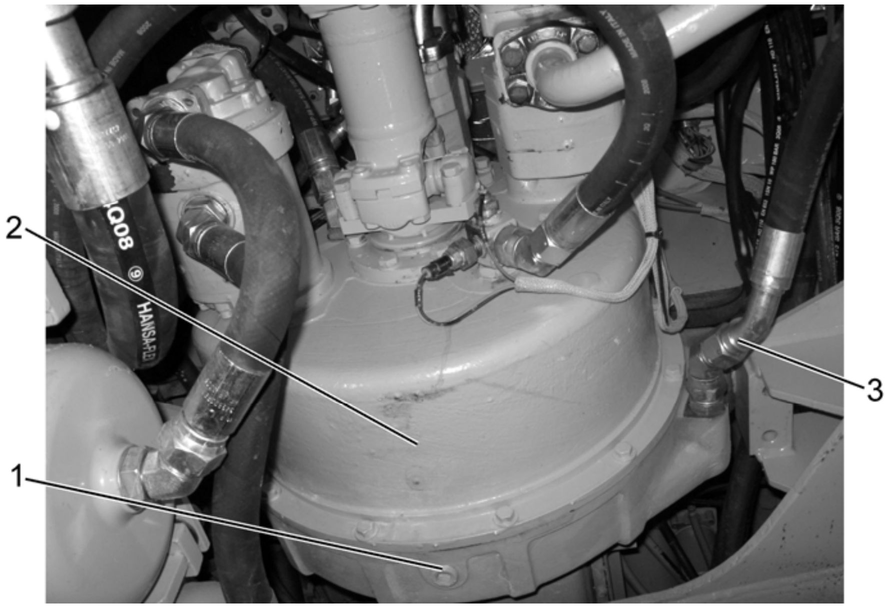


Fig. 7B.3. Drain Hose End Disconnecting (Bottom View)

1. Engine Flywheel Housing
2. Torque Converter
3. Torque Converter Drain Hose

3. Disconnect the torque converter drain hose end (3) from the engine flywheel housing (1). Cap the hole of the hose end (3).
4. Take the disconnected hose end (3). Connect new hose to the flywheel housing hole and put it in a separate container. Turn the electric master switch ON and start the engine.
5. Operate the engine at full throttle and be filling the container for 30 seconds, omitting the initial, stronger oil flow-out.

GENERAL

6. Stop the engine and turn the electric master switch OFF.
7. If the torque converter is not removed from machine disconnect the hose from flywheel housing, remove the plug and reconnect the drain hose end (3) to the engine flywheel housing (1). Reinstall transmission case guard to the bottom of the machine.
8. Carry out a measurement of the drained oil.
   A. If volume of oil is less than 4 [l] (8 [l], per minute), the internal leakage of torque converter is allowable.
   B. If volume of oil is more than 4 [l] (8 [l], per minute), the internal leakage of torque converter exceed the limit. The torque converter should be removed from the machine and repaired as described below.

TORQUE CONVERTER

6. REMOVAL

IMPORTANT: *Before removing the torque converter perform diagnostics of failures according to the description in Paragraph 4 in this SECTION, and check for oil leaks according to Paragraph 5 in this SECTION, so as to be sure that the disassembly torque converter is advisable.*

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

IMPORTANT: *Disconnected hydraulic lines must be capped with the correct size plastic caps. If these caps are not available, tape or clean rubber corks may be used. Hydraulic openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components of the machine. Also tag all disconnected lines to facilitate correct and easier installation.*

1. Remove the transmission case guard from the bottom of the machine. Drain the equipment hydraulic reservoir as described in the OPERATOR'S MANUAL.
2. Remove the ROPS/FOPS structure (if equipped), cab and platform. Refer to SECTION 13 for this procedure.
3. Disconnect the breather hose (5, Fig. 7B.4) from the torque converter (2).
4. Remove the equipment pump (4). Refer to SECTION 10A for removing procedure.
5. Remove the charge and scavenge pump (1). Refer to SECTION 7C for this procedure.
6. Remove the fan drive pump (3). Refer to SECTION 10A for this procedure.
7. Disconnect hose (6) from the torque converter (2).

TORQUE CONVERTER

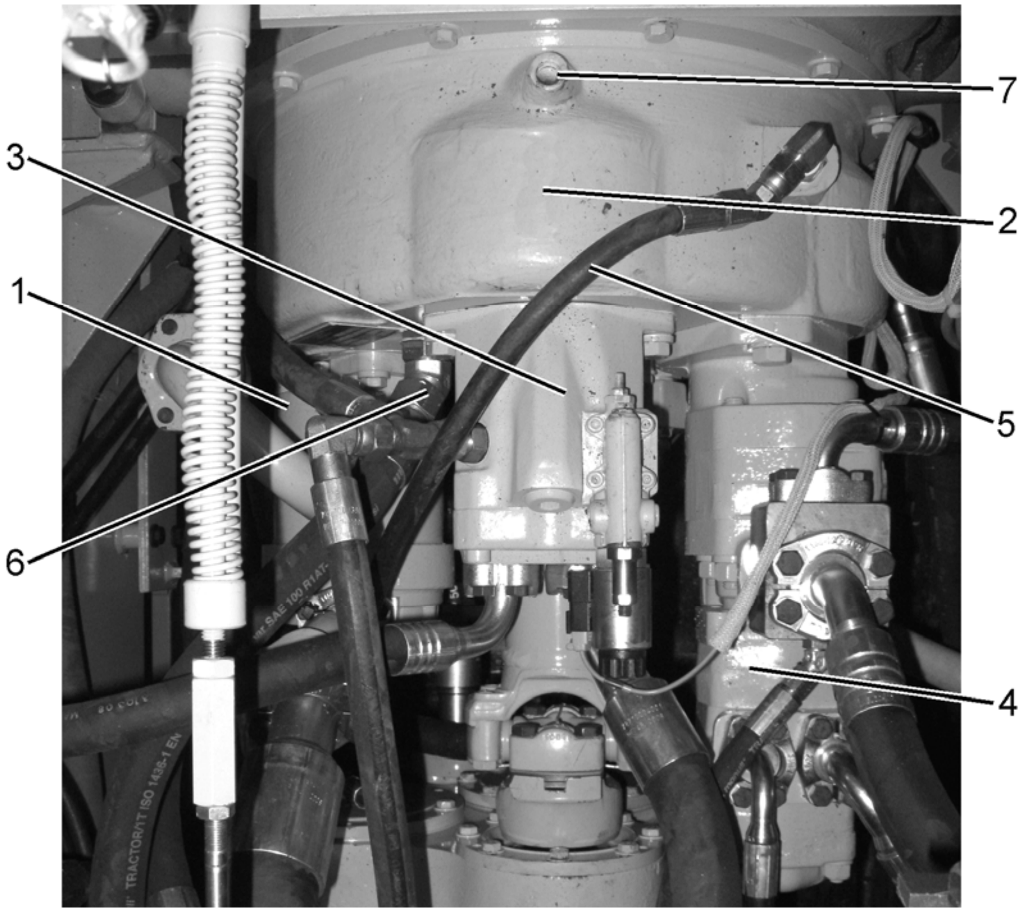


Fig. 7B.4. Upper Torque Converter Disconnecting Points

1. Charge and Scavenge Pump
2. Torque Converter
3. Fan Drive Pump
4. Hydraulic Equipment Pump
5. Torque Converter Breather Hose
6. Pressure Regulator Valve to Torque Converter Hose
7. Eyebolt Hole

8. Disconnect the electrical harness (5, Fig. 7B.5) from the torque converter oil temperature sensors (3). Disconnect the oil cooler hose (7) from torque converter tee connector. Remove the tee connector with torque converter oil temperature sensors (3) from the torque converter (2).
9. Disconnect torque converter drain hose (8) from the flywheel housing.

NOTE: *Before removing the universal joint, wire the bearing cap to prevent bearings from falling off the spider trunnion.*

10. Remove the universal joint (4) between the torque converter and transmission:
    a. Unscrew four bolts connecting the joint to the torque converter flange.
    b. Unscrew four bolts connecting the joint to the transmission flange.

TORQUE CONVERTER

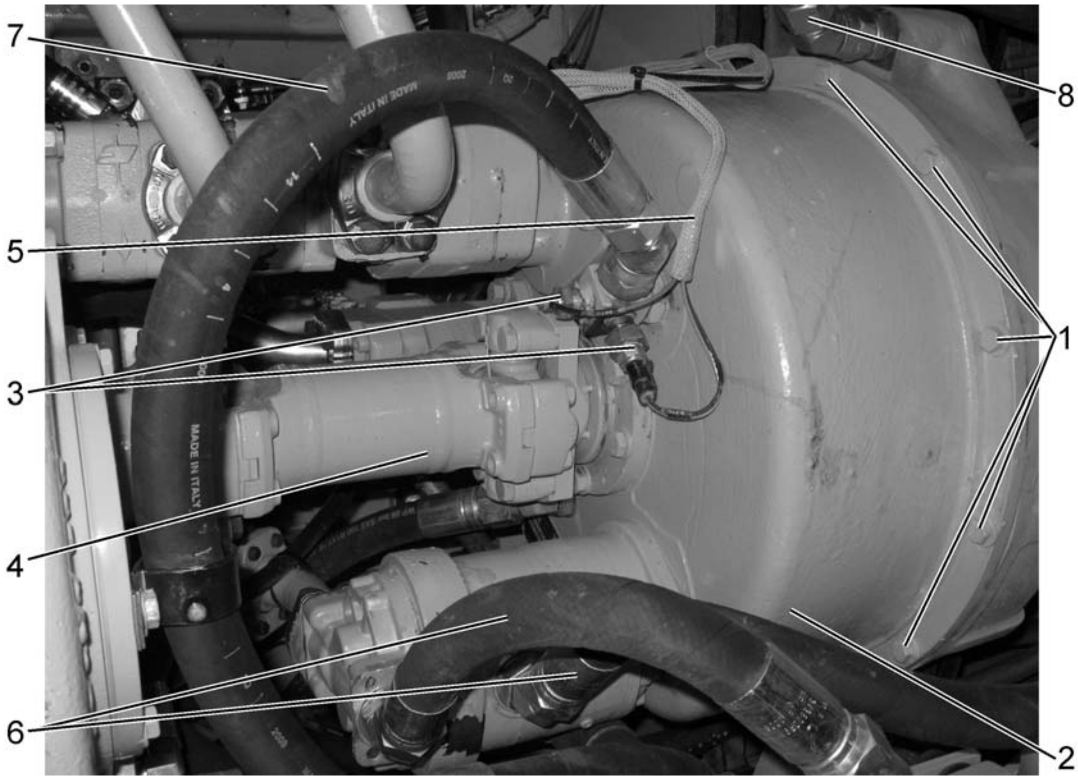


Fig. 7B.5. Lower Torque Converter Disconnecting Points

1. Mounting Bolts
2. Torque Converter
3. Torque Converter Oil Temperature Sensors
4. Universal Joint
5. Electrical Harness
6. Charge and Scavenge Pump Outlet Hoses
7. Oil Cooler Hose
8. Torque Converter Drain Hose

11. Install the eyebolt M16 in the threaded hole (7, Fig. 7B.4) located in the top of the torque converter housing. Attach a hoist to the eyebolt in the torque converter. Place a sling tension on the hoist and remove the torque converter mounting bolts (1, Fig. 7B.5). Move the converter back to clear the flywheel housing and take up the torque converter.

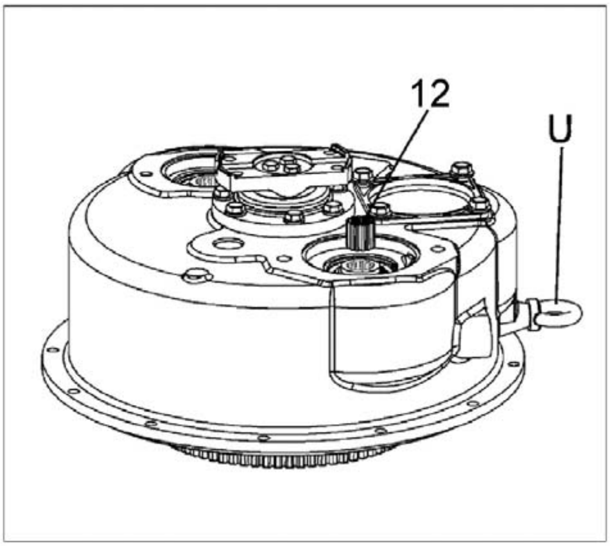
NOTE: *Cover the opening at the flywheel housing to prevent dirt and dust from entering.*

12. Remove the O-ring from the converter housing flange.

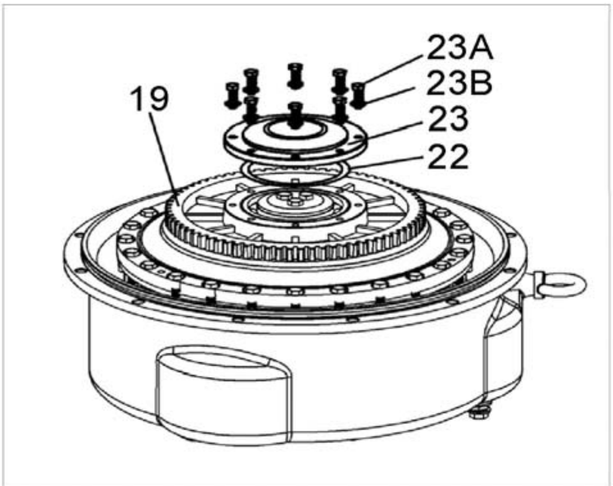
TORQUE CONVERTER

7. DISASSEMBLY

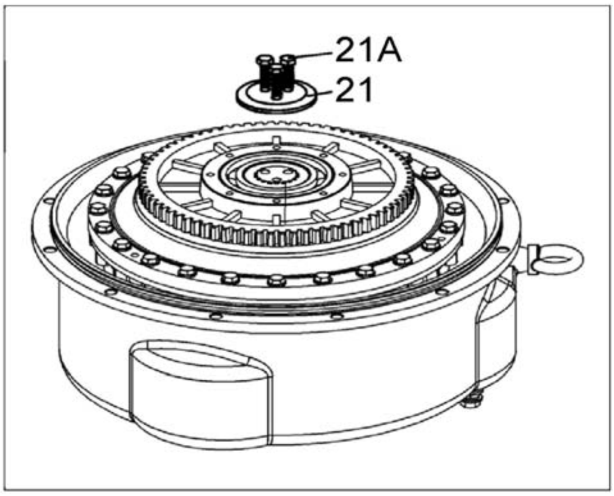
1. Remove spacer sleeve (12) from the torque converter and protect it, then thoroughly clean the outside of the converter housing.



2. Place the torque converter on a bench so the drive housing (19) is up. Remove bolts (23A) with washers (23B). Remove housing cover (23) with shims pack (22). Keep the shims with the cover.

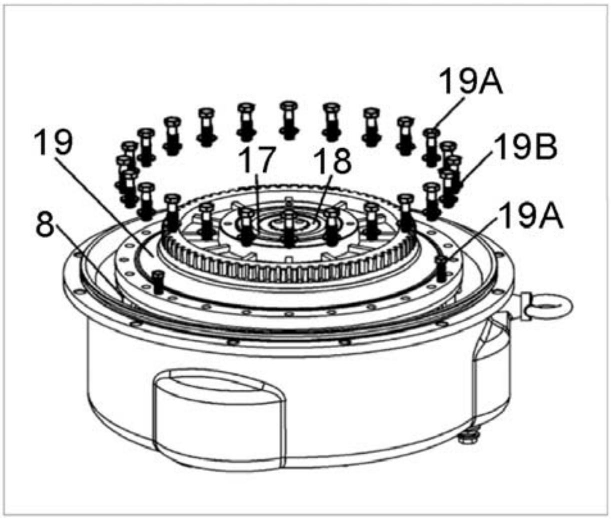


3. Remove bolts (21A), then remove retaining plate (21).

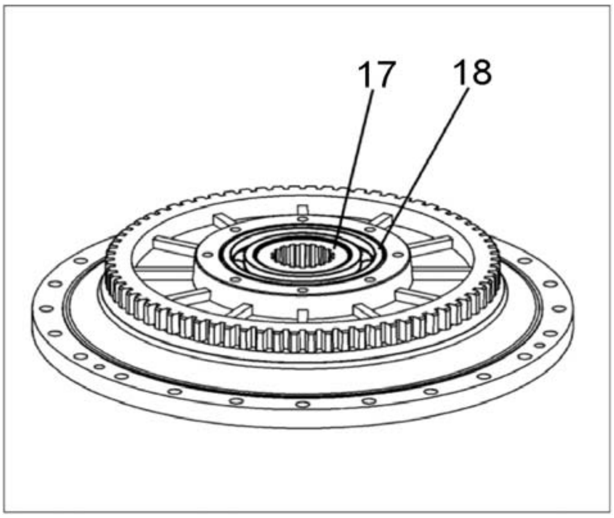


TORQUE CONVERTER

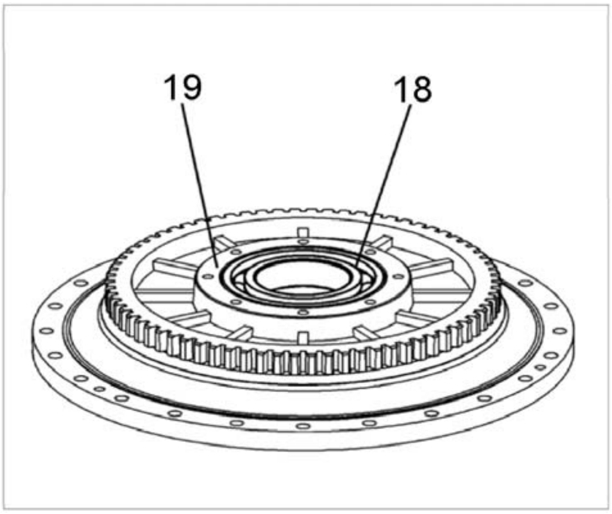
4. Mark the impeller (8) position in relation to drive housing (19) to keep the position of rotational parts after reassembly. Remove bolts (19A) with washers (19B) securing housing (19) to impeller (8). Screw three bolts (19A) into three threaded holes facing each other in the housing flange. Screw the bolts in a regular way until the housing (19) clears the impeller flange. Remove the housing (19) with ball bearing (18) and turbine assy (17).



5. Drive turbine assy (17) out the ball bearing (18) using 50 to 75 [mm] dia. driver.

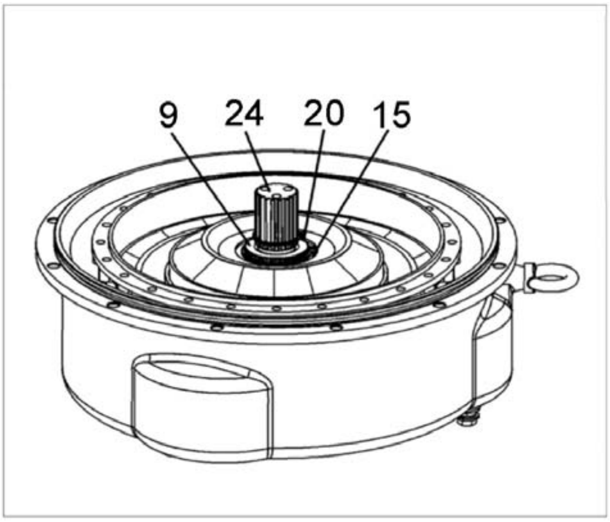


6. Press ball bearing (18) out of drive housing (19) using 110 to 117 [mm] dia. driver supporting it against the bearing (18) outer race.

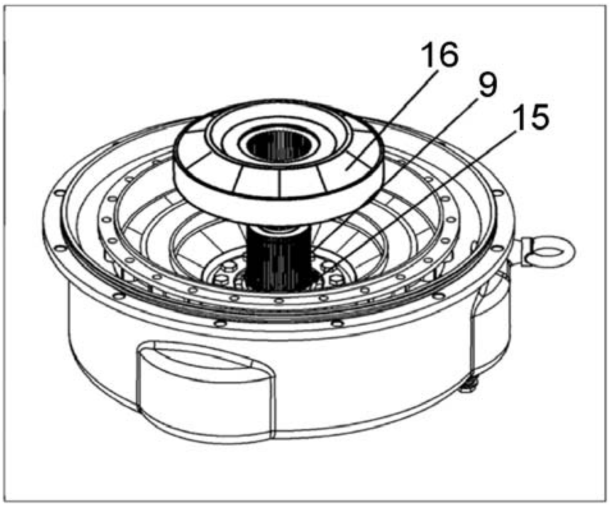


TORQUE CONVERTER

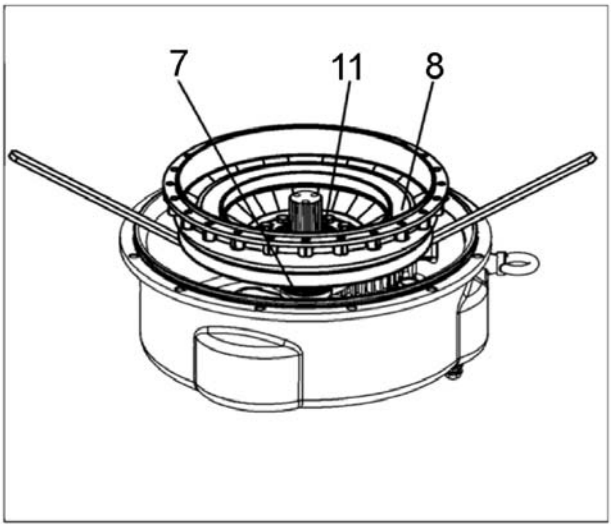
7. Remove the retaining ring (20) from the output shaft (24) and retaining ring (15) from ground sleeve hub (9).



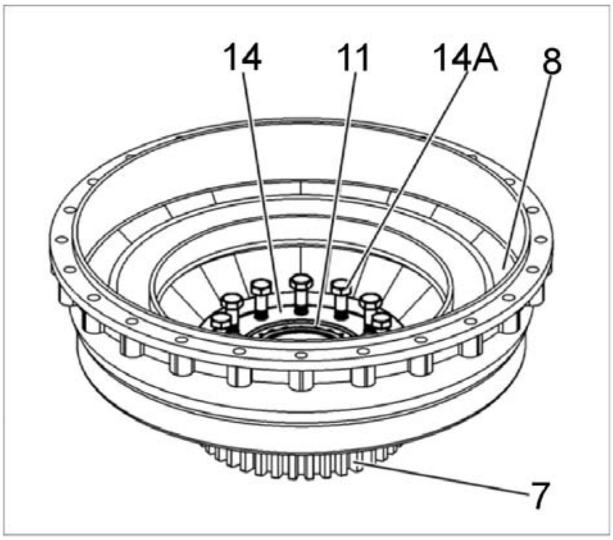
8. Remove stator (16) from ground sleeve hub (9), then lift retaining ring (15) out of ground sleeve hub (9).



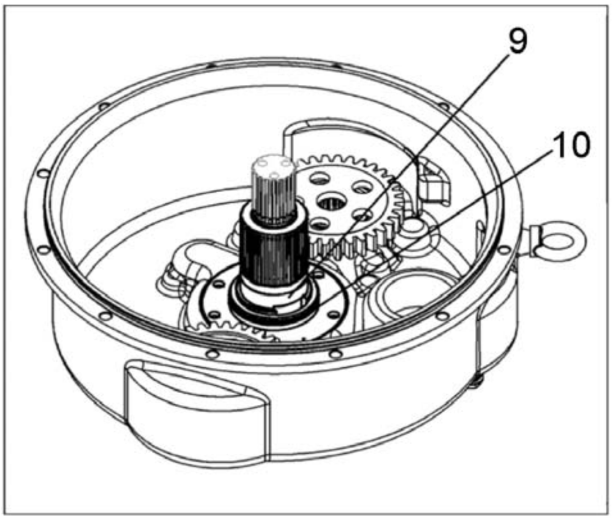
9. Remove impeller (8) with bearing (11) and drive gear (7) using two levers.



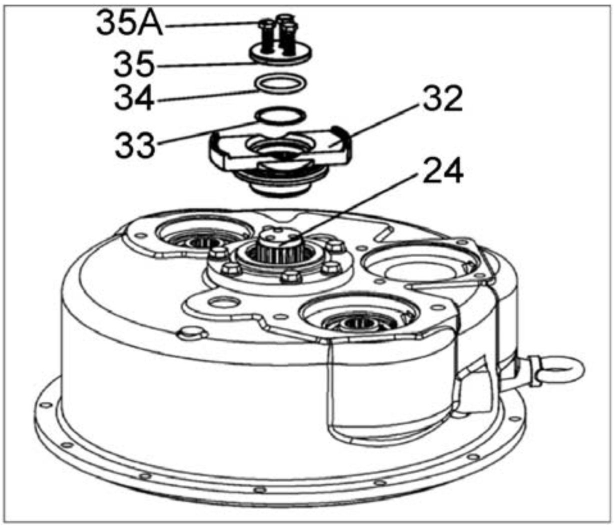
10. Remove bolts (14A) securing impeller (8) to the drive gear (7). Remove thrust washer (14). Tap the drive gear (7) and bearing (11) out of the impeller (8). Press ball bearing (11) out of drive gear (7) using 90 to 99 [mm] dia. driver supporting it against the bearing (11) outer race.



11. Remove seal ring (10) from ground sleeve hub (9).

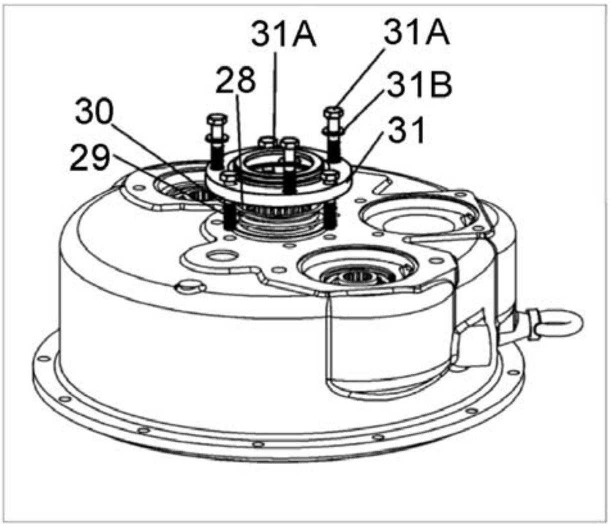


12. Turn the housing (1) over. Remove bolts (35A), retaining plate (35), O-ring (34) and thrust ring (33). Slide the output flange (32) from output shaft (24).

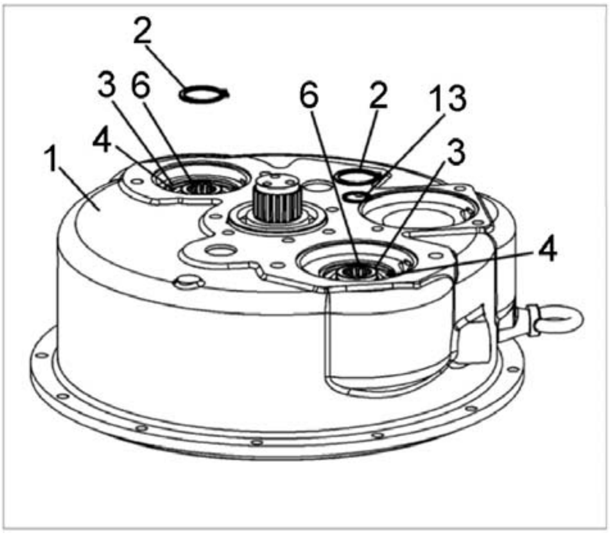


TORQUE CONVERTER

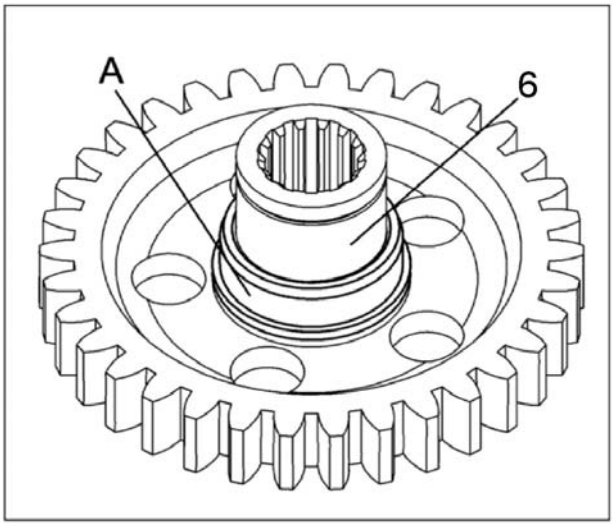
13. Remove bolts (31A) with washers (31B) securing cover (31) to housing (1). Screw three bolts (31A) into three threaded holes facing each other in the cover (31). Screw the bolts in a regular way to remove the rear cover (31). Remove seal ring (29). Press seal ring (30) out of rear cover (31) using 70 to 77 [mm] dia. driver. Remove shims (28) and keep with cover (31) to facilitate proper installation.



14. Remove retaining rings (2) from driven gears (6) and retaining ring (13) from driven gear (6) inside part. Drive the gears (6) out of ball bearings (4) using a suitable driver. Remove outer retaining rings (3) from housing bores.

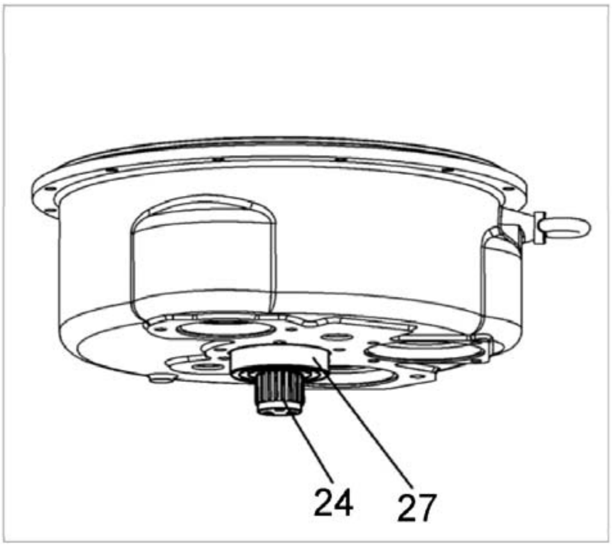


15. Bearing outer races shall remain in converter housing (1). If needed remove rings and bearing (5) outer races from converter housing. If bearing (5) replacement is necessary, remove inner races (A) from gears (6) with a suitable puller.

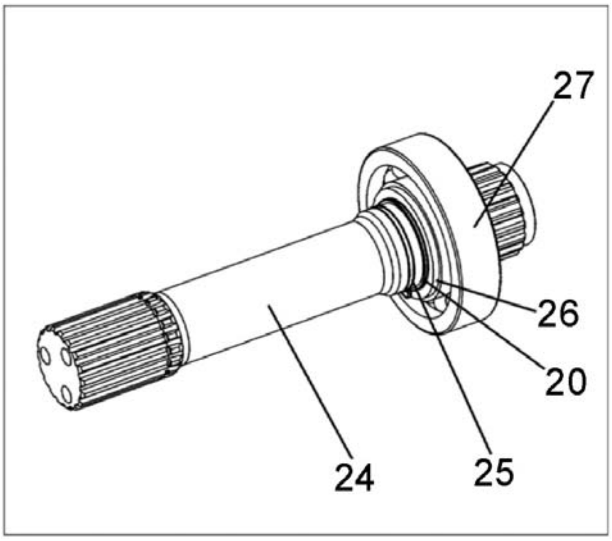


TORQUE CONVERTER

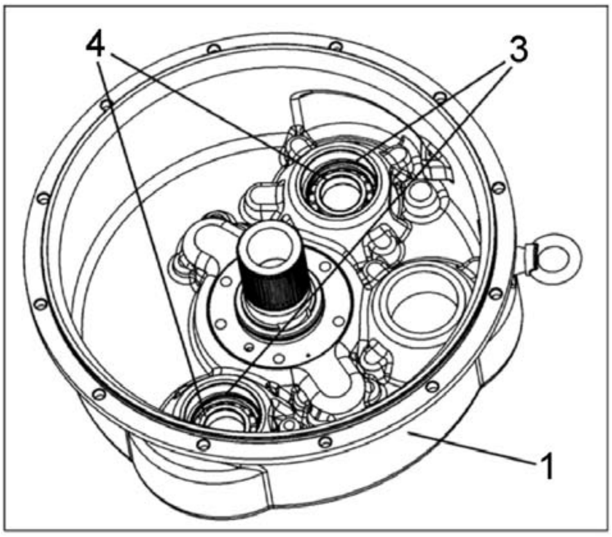
16. Turn the converter housing (1) over with its output or rear side down. Working from inside housing (1), tap on the end of shaft (24) with a hammer and a block of wood until bearing (27) is free.



17. Remove seal ring (25), retaining ring (20) and washer (26) from shaft (24). Tap the shaft (24) out of ball bearing (27) with a hammer and soft metal driver.

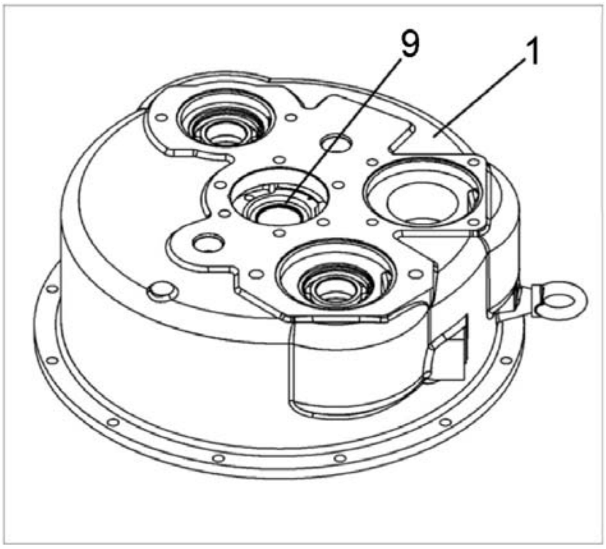


18. Remove inner retaining rings (3) from housing (1) bores. Remove bearings (4) from housing (1) using 75 to 84 [mm] dia. driver supporting it against the bearing (4) outer race.

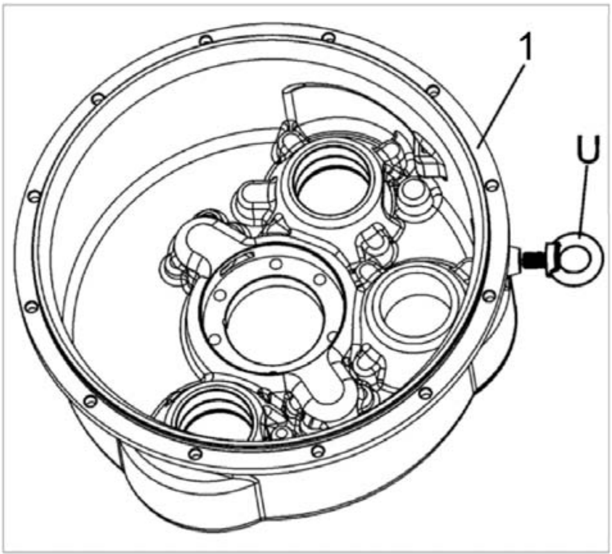


TORQUE CONVERTER

19. Turn converter housing (1) with its output or rear side up. Remove ground sleeve hub (9) from converter housing (1) using suitable driver and hammer.



20. If converter housing (1) needs to be replaced or repaired, unscrew eyebolt (U).



8. INSPECTION AND REPAIR

1. Wash all components thoroughly in a suitable solvent after the torque converter has been disassembled. Dry thoroughly with compressed air or a clean cloth. Clean thoroughly all sealing surfaces that were coated with LOCTITE for assembly purposes. Use caution so the metal surface remains undamaged. Check all the oil passages for lack of passage obstructions with compressed air.

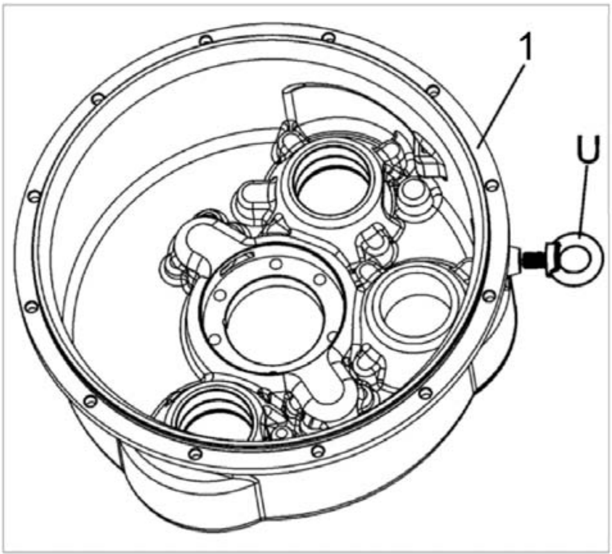
IMPORTANT: *Do not spin dry bearings with compressed air.*

2. Inspect all bearings condition. Replace all bearings that do not rotate freely or show excessive clearance.
3. It is recommended that new O-rings, gaskets and oil seals be installed whenever the torque converter is disassembled for service. Replace definitely teflon seal ring (10) at the converter input and seal ring (25) at the converter output when excessive oil leakage occurs during the test.
4. Inspect all splined connections for excessive clearance caused by wear surfaces, surface dents, burrs or other damages and replace if necessary.
5. Replace all gears that tooth are worn excessively or damage. Mating gear surfaces may show increased smoothness but any gear spalling is not allowable.
6. Check thoroughly all bearings shaft journals and bores where bearings are seated to ensure that there are no worn out spots due to rotation of inner bearing race on its shaft or bearing outer race in its bore. If the check reveals that either the bearing rotates on its shaft journals or it rotates in its bore it is seated in, both the bearing and its mating part must be replaced.
7. Check turbine assy (17) riveted joints. If any rivet loose exists the entire turbine assy must be replaced.
8. Inspect the blades of impeller (8), stator (16) and turbine assy (17) for mechanical damage. If the blades are excessively worn or damaged, the entire assembly must be replaced.
9. Inspect thoroughly drive gear (7) inner bore that mates with seal ring (10). Any inner bore of ground sleeve hub (9) signs of rubbing are not allowable. Drive gear (7) inner bore and seal ring (10) contact surface shall not be grooved.
10. Inspect ground sleeve hub (9) bore wear interacting with seal ring (25). The hub must be replaced if it is grooved by the seal ring. If any contact signs are visible on the hub surface with both drive gear (7) bore surface and shaft (24), the hub must be replaced.
11. Output flange (32) shall not be grooved by seal ring (30) while contact surface smoothing and darkening are admissible.
12. Replace the converter housing (1) if cracks, thread stripping or bearing bores damages occurs.

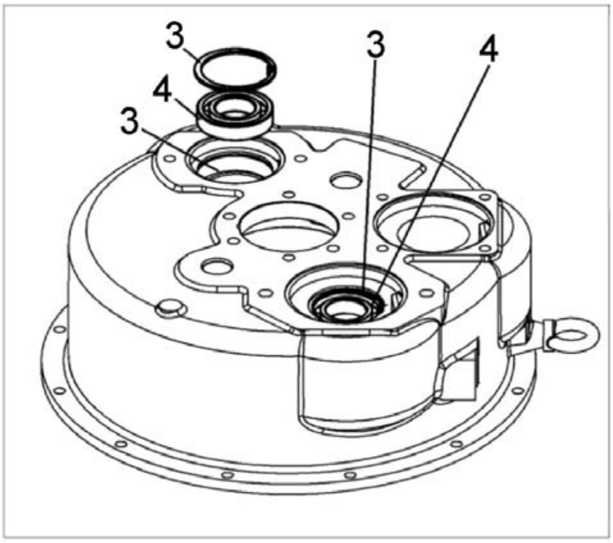
TORQUE CONVERTER

9. REASSEMBLY

1. Screw eyebolt (U) into converter housing (1).

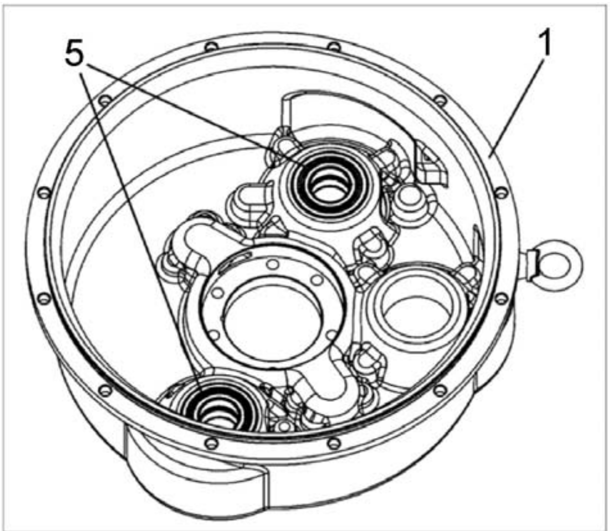


2. Place the converter housing on a bench with its output or rear side up. Install retaining rings (3) into housing bores. Using the 75 to 84 [mm] dia. driver against the outer race of ball bearing (4), tap the bearing until it bottoms on the ring (3). Repeat this procedure for the remaining bearings.



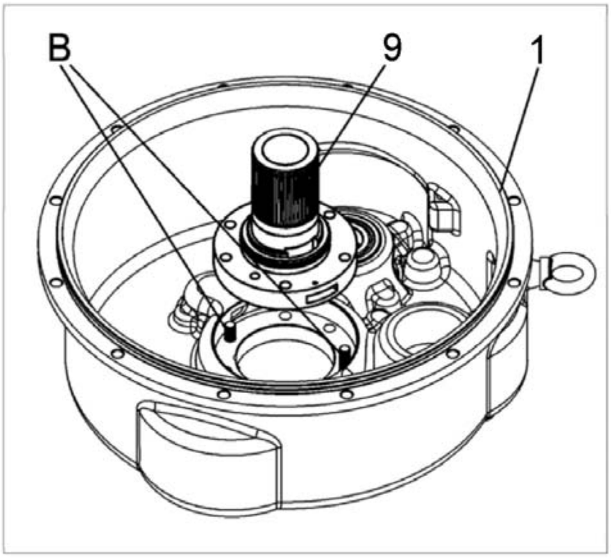
3. Turn converter housing (1) over. Install angle rings and outer bearing races with rollers of roller bearings (5) in the pump seats.

NOTE: *The complete bearing always must be press with its angle ring inward, until it bottoms on the retaining ring. This installation procedure ensures bearing's races (inner and outer) will not be out of alignment with each other.*

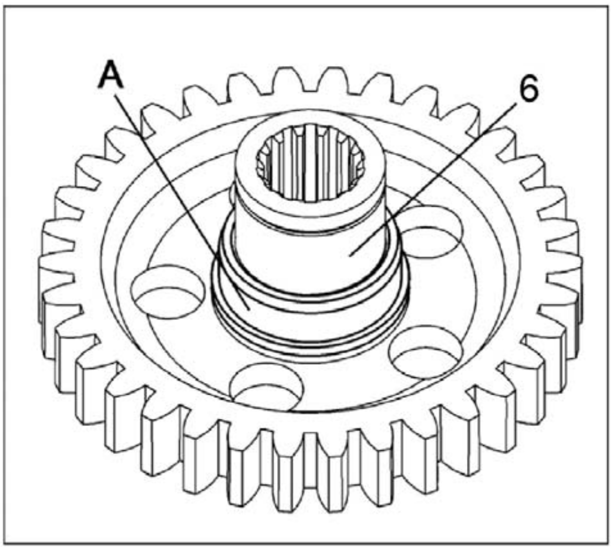


TORQUE CONVERTER

4. Clean and degrease surfaces both ground sleeve hub (9) flange and hub seat in converter housing (1). Apply LOCTITE 510 to ground sleeve hub (9) and install it in a way that the hub flange openings line up with their counterparts in converter housing (1). To ensure the correct hub installation insert two M12 aligning studs (B) 30 [mm] length into ground sleeve hub to eliminate the existing clearance.

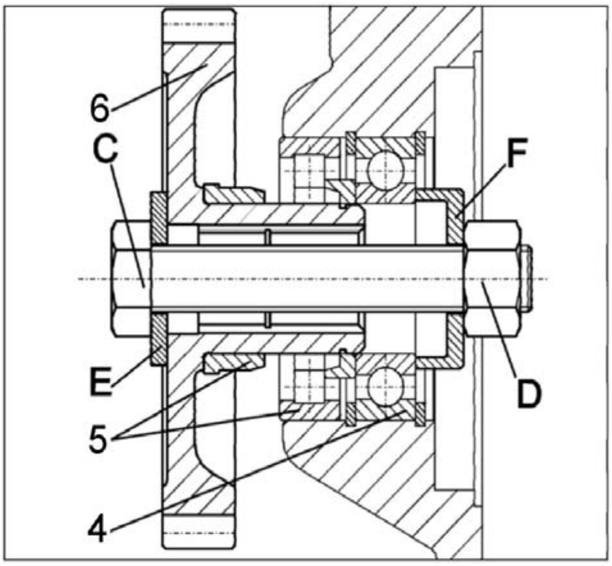


5. Install if removed rings and bearing (5) outer races to the converter housing. If not removed bearing outer races shall remain in converter housing (1). If removed press bearing inner races (A) on driven gears (6) hubs with the larger outer diameter pointed towards the gear, until it bottoms.



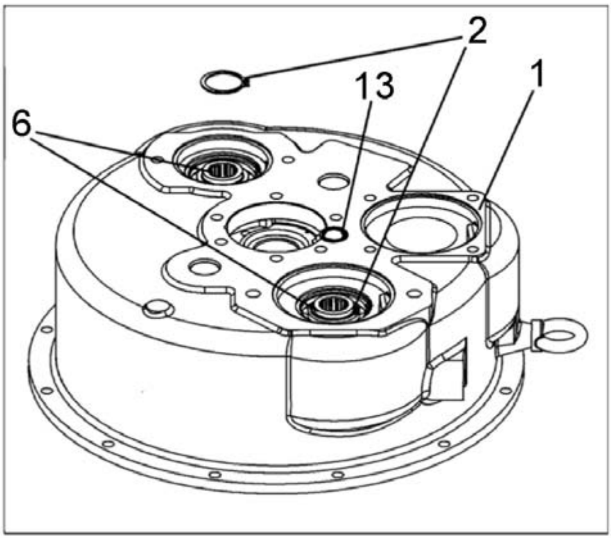
6. Install gears (6) into ball bearing (4) and (5) seats. Press the gears in until the retaining ring groove in the gear hub appears.

NOTE: *For this operation use a driven gear pusher set (see Service / Special Tools in this Section) which consists of M20 x 120 bolt (C) nut (D), washer (E) and special (F) thrust washer with nest. The thrust washer shall support against ball bearing's (4) inner race.*

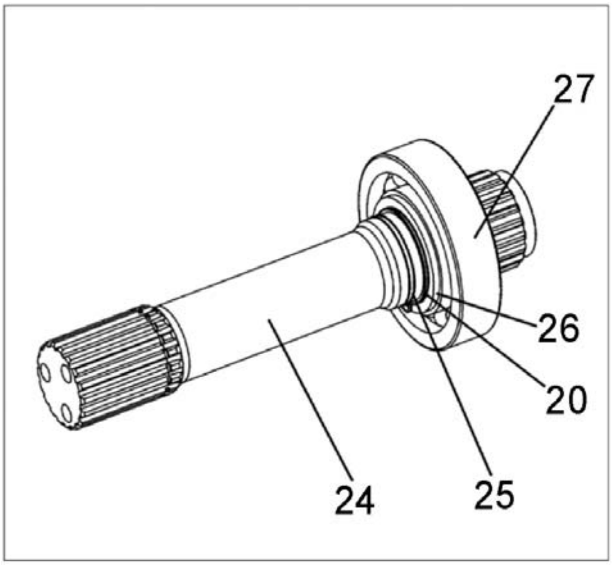


TORQUE CONVERTER

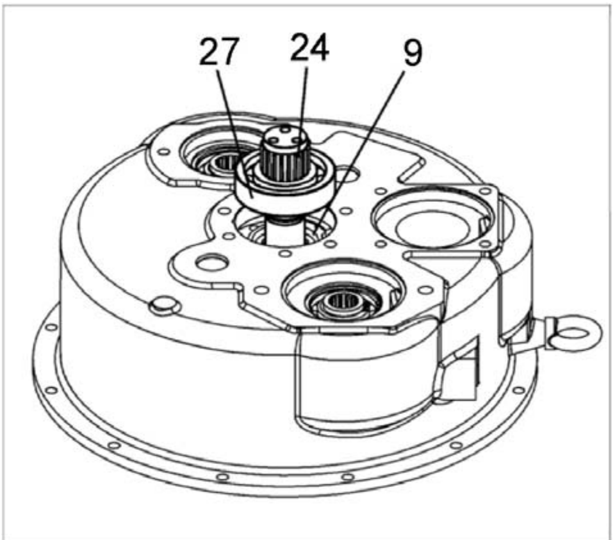
7. Turn converter housing (1) over with its rear side up. Install retaining rings (2) onto driven gears (6) hubs. Install retaining ring (13) inside the hub of the right driven gear (6).



8. Install retaining ring (20) and washer (26) on output shaft (24). Press the output end of shaft (24) into bearing (27) until the bearing seats against the washer (26) and retaining ring (20) Install seal ring (25).

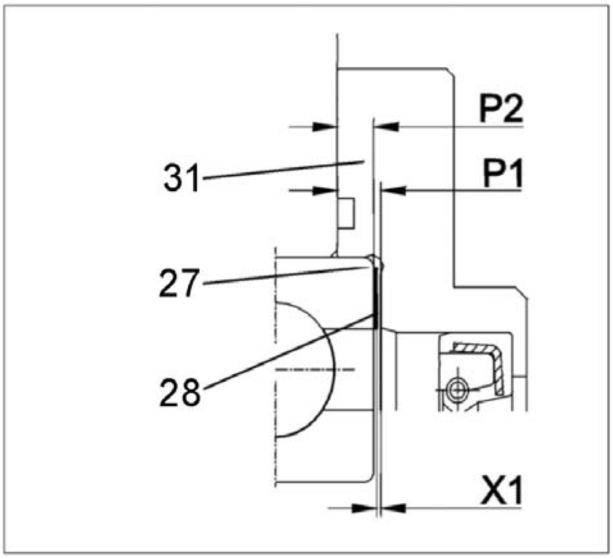


9. Insert shaft (24) into ground sleeve hub (9) from the output end of housing (1). Seat the bearing (27) inside the housing using a suitable driver until the outer race of bearing (27) bottoms the hub (9). Apply LOCTITE #603 (LOCTITE #608 is acceptable) on outside the surface of the bearing.

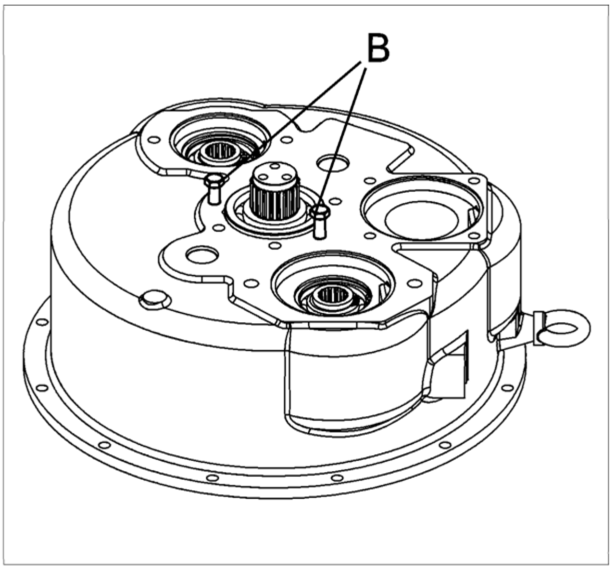


TORQUE CONVERTER

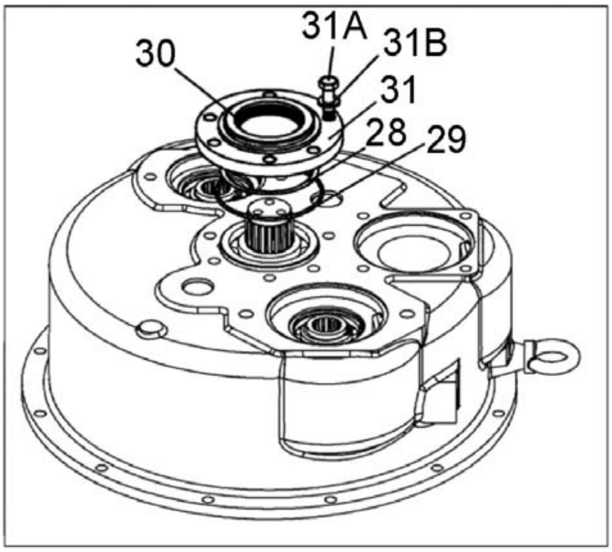
10. Measure the (P1) distance of the bore chamber at rear cover (31). Measure the (P2) distance of ball bearing face to housing contacting face (1). Select shims pack thickness (28) so the (X1) gap between the bearing and rear cover obtains the amount of 0.05 - 0.1 [mm]. Using virgin lead to measure the appropriate distance is acceptable too.



11. Remove bolts (B) securing hub.

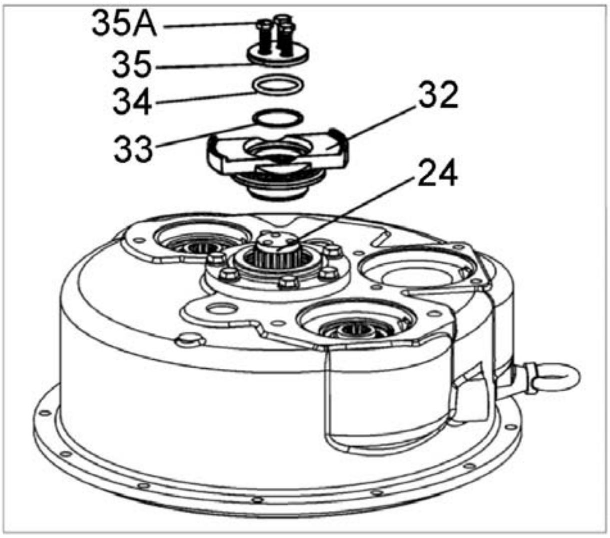


12. Press seal ring (30) into rear cover (31) until it is 1-2 [mm] out of cover outer flange. The seal lip should face toward the converter when the rear cover (31) is installed. Next, install the selected shim pack (28) and seal ring (29) in the cover groove. Install cover (31) and secure it with bolts (31A) and washers (31B), using LOCTITE 262. Torque the bolts to 72 - 88 [Nm].

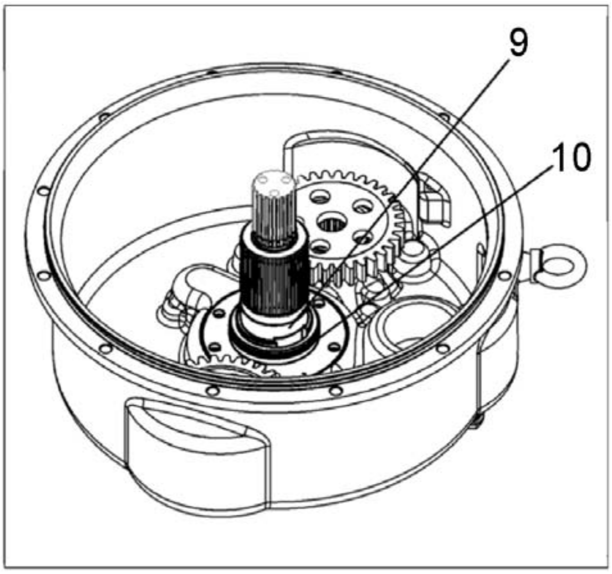


TORQUE CONVERTER

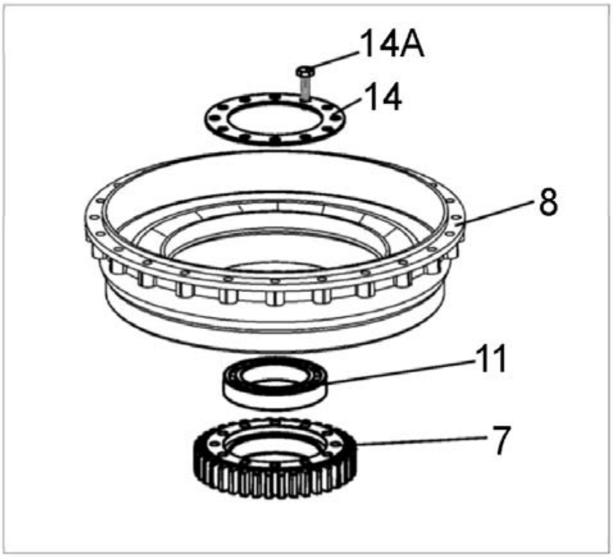
13. Install output flange (32), thrust ring (33), O-ring (34) and retaining plate (35) onto shaft end (24). Secure with the bolts (35A) using LOCTITE 262. Torque the bolts to 41 - 51 [Nm].



14. Turn converter housing (1) over with the gear up. Install seal ring (10) in the groove of ground sleeve hub (9). Coat the seal ring lightly with oil.

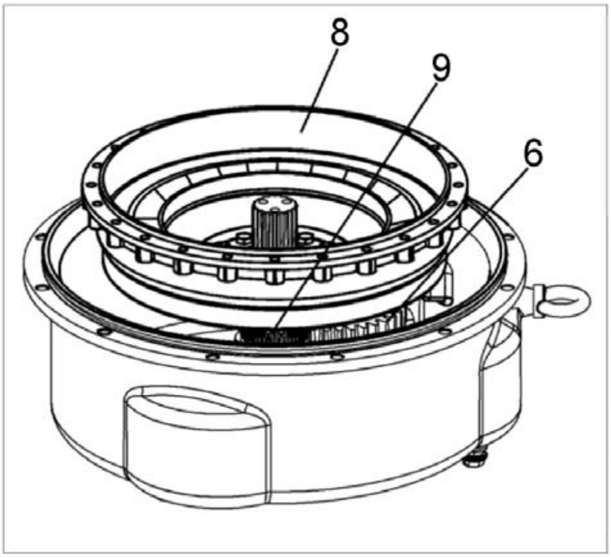


15. Press ball bearing (11) into drive gear (7). Secure impeller (8) to drive gear (7) with the bolts (14A) and thrust washer (14). Apply LOCTITE 262 to the bolts and torque to 48 – 58 [Nm].

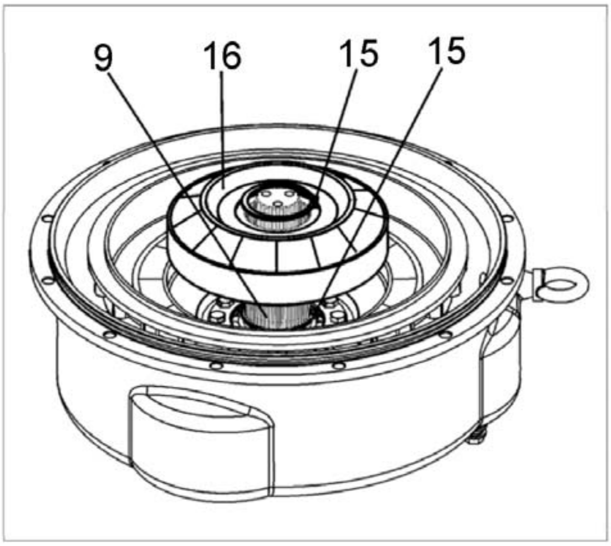


16. Lower the assembly with impeller (8) into housing (1), sliding the assembly onto ground sleeve hub (9). As the assembly is lowered into housing (1), drive gear (7) will mesh with driven gears (6).

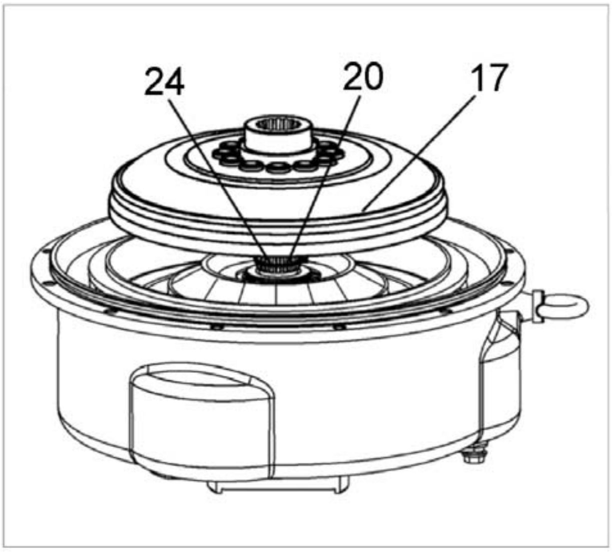
IMPORTANT: *If at any point when contact is made, the resistance appears, rotate the assembly holding up the impeller lightly. Use caution when the assembly passes over the seal ring (10).*



17. Install retaining ring (15) into ground sleeve hub (9) groove. Install stator (16) on the hub, secure with retaining ring (15).

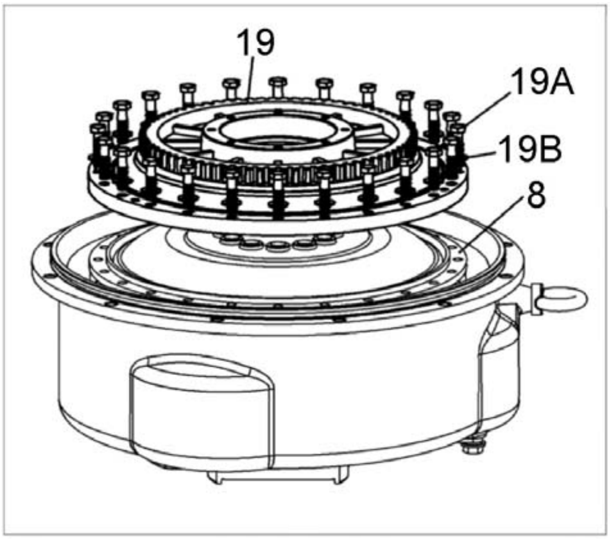


18. Install retaining ring (20) in the groove of output shaft (24). Install turbine assy (17) on the shaft end.

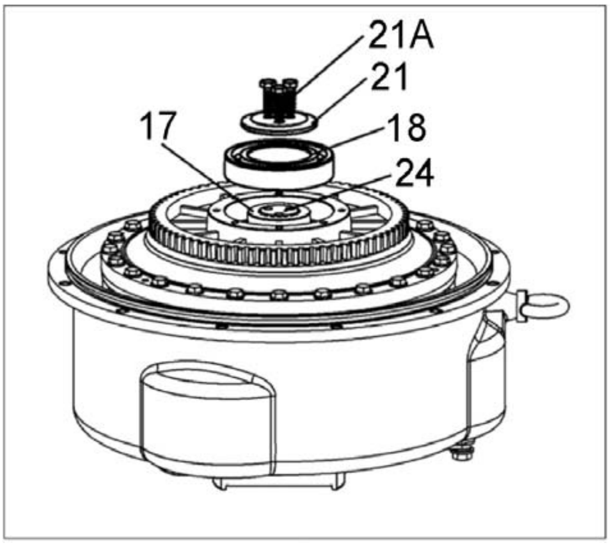


TORQUE CONVERTER

19. Position properly drive housing (19) in relation to impeller (8) according to signs made during disassembly. Secure the housing to the impeller with bolts (19A) and washers (19B). Apply LOCTITE 243 to the bolts and torque to 48 - 58 [Nm].

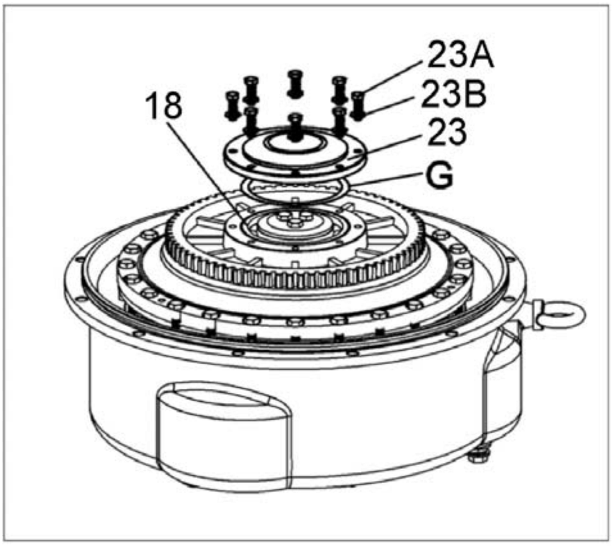


20. Press ball bearing (18) on hub of turbine assy (17). Position retaining plate (21) on the ball bearing (18) and secure the plate to shaft (24) with bolts (21A). Apply LOCTITE 262 to the bolts. Torque the bolts to 41 - 51 [Nm]. Ball bearing (18) should bottom the turbine (17) hub while threading the bolts.

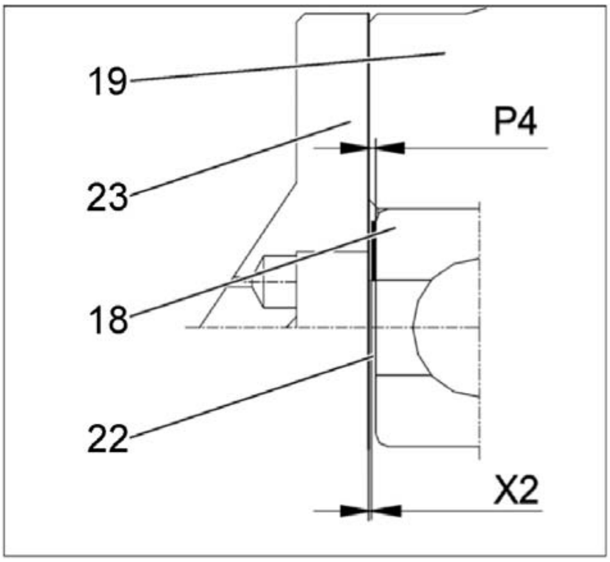


21. Place washer (G) of minimum thickness of 2 [mm] onto ball bearing (18). Install housing cover (23) on ball bearing (18) and torque the cover to drive housing (19) with bolts (23A) and washers (23B) to 21 – 25 [Nm].

NOTE: *Be sure bearing outer race (18) bottoms the bore chamber of drive housing (19).*

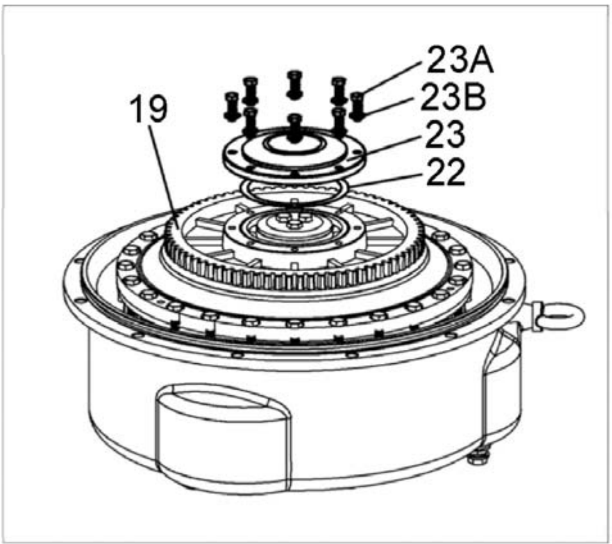


22. Remove cover (23) and washer (G). Measure the (P4) distance between ball bearing face (18) and drive housing (19) faying face. Select shims pack (22) thickness so the (X2) gap between bearing (18) and cover (23) obtains the amount of 0.05 to 0.1 [mm]. Using virgin lead to measure the appropriate distance is acceptable too.

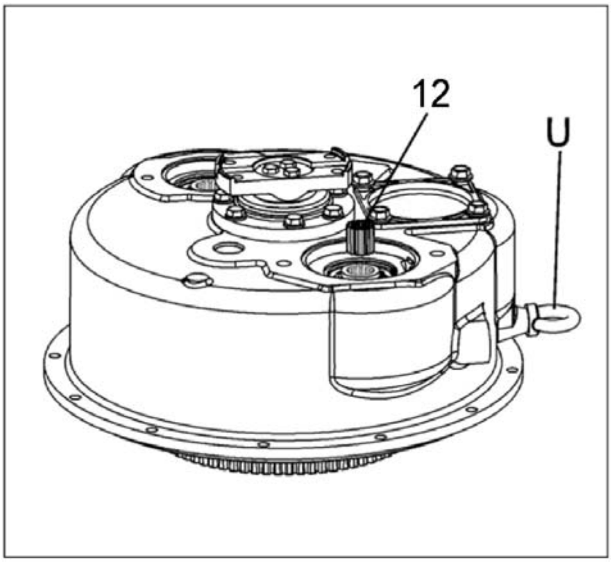


23. Install shims pack (22) on the top of bearing (18). Install housing cover (23) and secure with the bolts (23A) and washers (23B). Apply LOCTITE 262 to the bolts and torque to 21 - 25 [Nm].

NOTE: *Use caution the shims forming the pack be centrally placed on the bearing and none of them will not get between the housing cover and the drive housing.*



24. Insert spacer sleeve (12) into driven gear (6) hub and secure it against the slip from. Leave eyebolt (U) with torque converter for machine installation.



TORQUE CONVERTER

10. INSTALLATION

IMPORTANT: *All gaskets and any collapsed hoses or damaged connections must be replaced with new. Whenever a sealing ring is required at a disconnected line, it is recommended that a new sealing ring be installed.*

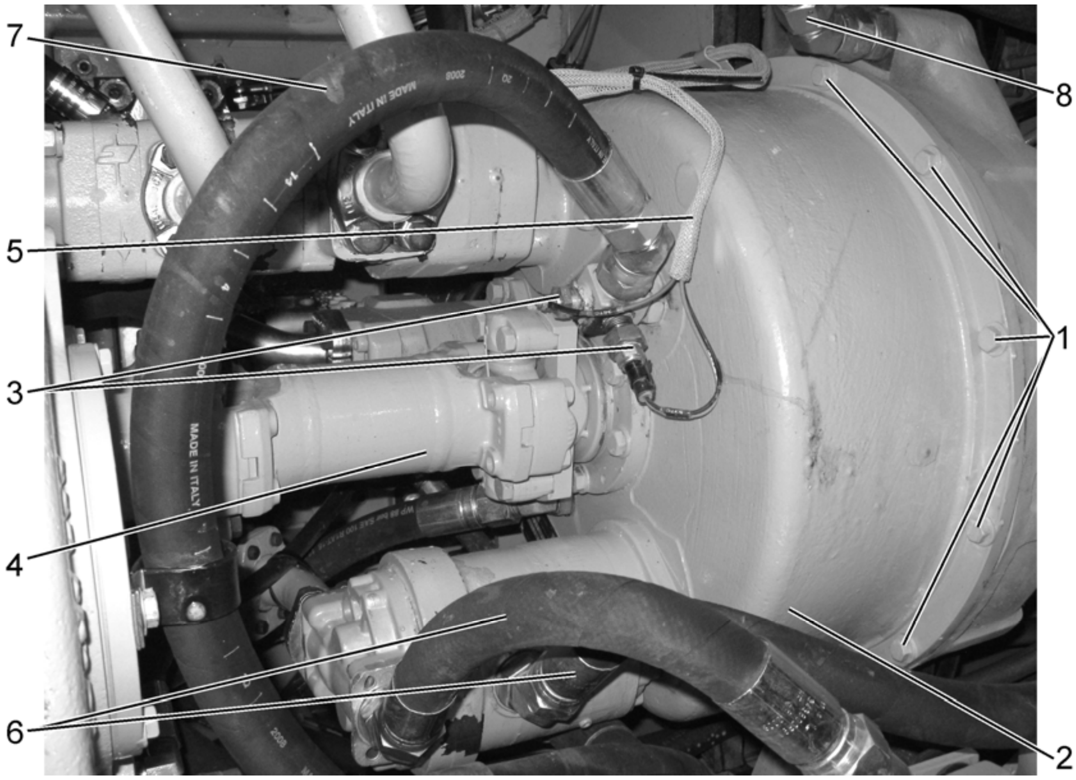


Fig. 7B.6. Lower Torque Converter Reconnecting Points

1. Mounting Bolts
2. Torque Converter
3. Torque Converter Oil Temperature Sensors
4. Universal Joint
5. Electrical Harness
6. Charge and Scavenge Pump Outlet Hoses
7. Oil Cooler Hose
8. Torque Converter Drain Hose

1. Thoroughly clean the mating surfaces of the torque converter housing and the engine flywheel housing. Install a new O-ring on the converter housing flange.
2. Install of 100 to 130 [mm] two aligning studs at 10 and 2 o'clock positions in flywheel housing. Fasten the hoist and raise the torque converter into position on the aligning studs. Move the torque converter toward the engine until the torque converter drive housing gear meshes with the drive gear in the flywheel housing. Secure the torque converter to the flywheel housing. Torque the bolts (1, Fig. 7B.6) with washers to 75 [Nm] and unscrew eyebolt (U).

IMPORTANT: *As the converter housing enters the flywheel housing, be sure the O-ring is properly seated in the groove of the converter housing.*

TORQUE CONVERTER

WARNING! Remove the wire used to keep the bearings from falling from the spider trunnions. If installing a new spider and bearing assembly, remove the soft iron strap attached to the bearing caps. This will eliminate the possibility of the straps or wire breaking loose from the caps and causing personal injury when the engine is running.

3. Install the universal joint (4) between torque converter and transmission. Torque the mounting bolts to 110 [Nm].

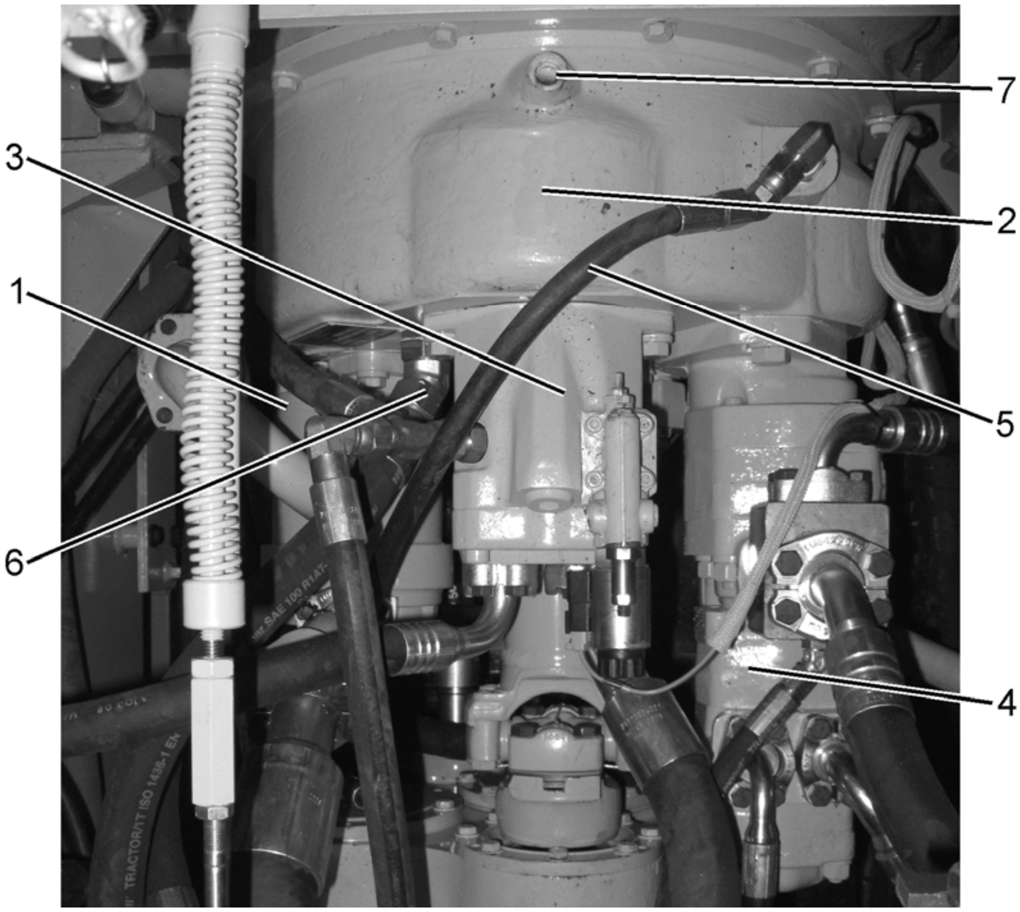


Fig. 7B.7. Upper Torque Converter Reconnecting Points

1. Charge and Scavenge Pump
2. Torque Converter
3. Fan Drive Pump
4. Hydraulic Equipment Pump
5. Torque Converter Breather Hose
6. Pressure Regulator Valve to Torque Converter Hose
7. Eyebolt Hole

4. Connect torque converter drain hose (8) to the flywheel housing.
5. Install the tee connector with the oil temperature sensors (3) to the torque converter (2). Connect oil cooler hose (7) to the tee connector. Connect the electrical harness (5) to the torque converter oil temperature sensors (3).
6. Connect hose (6, Fig. 7B.7) to the torque converter (2).
7. Install the fan drive pump (3). Refer to SECTION 10A for this procedure.
8. Install the charge and scavenge pump (1). Refer to SECTION 7C for this procedure.

TORQUE CONVERTER

9. Install the equipment pump (4). Refer to SECTION 10A for this procedure.
10. Connect the breather hose (5) to the torque converter (2).
11. Install the platform, cab and ROPS/FOPS structure (if equipped). Refer to SECTION 13 for this procedure.
12. Fill the equipment hydraulic reservoir as described in the OPERATOR'S MANUAL.
13. Start the engine and visually check hoses and connections for leakage.

NOTE: *It is recommended that the transmission oil filter be serviced after the first 50 hours of operation. Refer to the OPERATOR’S MANUAL for procedure. Thereafter, service the filter at the normal scheduled interval.*

14. Install the center floor plate and transmission case guard.

SECTION 7C

TRANSMISSION

TRANSMISSION

CONTENTS

SERVICE/SPECIAL TOOLS

GENERAL

TRANSMISSION

PRESSURE REGULATOR VALVE

RANGE SELECTOR VALVE

RATE OF RISE VALVE

DRIVE TRAIN CONTROL VALVE

CHARGE AND SCAVENGE PUMP

TRANSMISSION

GEAR SHIFTING VALVE

PRIORITY VALVE

DRIVE TRAIN LOCK SOLENOID VALVE

TRANSMISSION

SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS

DESCRIPTION	TOOL NUMBER
Directional clutch shaft (input shaft) eyebolt	1/2“-13
Range clutch shaft (output shaft) eyebolt	1/2“-13
Countershaft eyebolt	1/2“-13

GENERAL

2. DESCRIPTION

The transmission is designed to provide gears shifting by using hydraulic actuated clutches. It has three forward and three reverse speeds. The transmission is bolted to the front of the rear part main frame, and is coupled to the torque converter by a drive shaft with a universal joint on each end. The drive shaft rotates the transmission input shaft. The transmission also contains an output shaft, a counter shaft and a reverse idler shaft.

Directional Clutch Shaft (Input Shaft)

The directional (input) shaft rotates on two tapered roller bearings. The shaft consists of forward and reverse drive gears, which ride on caged roller bearings and are welded to the dual hydraulic clutch pack assembly.

Countershaft

The countershaft rotates on two tapered roller bearings. The shaft consists of forward and reverse driven gears and first speed driver gear. The reverse driven gear is splined to the rear of the shaft and held in place by retaining rings. It is in constant mesh with the reverse idler gear and the second speed driven gear. The forward driven gear is splined to the center of the shaft and held in place by retaining rings. It is in constant mesh with the forward drive gear and the third speed driven gear. The first speed driver gear is splined to the front of the shaft and held in place by retaining rings. It is in constant mesh with the first speed driven gear.

Reverse Idler Shaft

The reverse idler shaft is bolted to the transmission cover in a fixed position. The shaft consists of a reverse idler gear which rides on two tapered roller bearings and is in constant mesh with the reverse driver gear and the reverse driven gear.

Range Clutch Shaft (Output Shaft)

The range (output) shaft rotates on two tapered roller bearings. The shaft consists of first, second and third speed driven gears which ride on caged roller bearings. The second speed driven gear is welded to the single hydraulic clutch pack assembly. The first and third speed driven gears are welded to the dual hydraulic clutch pack assembly.

Pressure Regulator Valve

The pressure regulator valve (1, Fig. 7C.1) contains three spools. The main spool limits the pressure at output side of the charge pump to 1790 - 1930 [kPa]. The oil at this pressure is used for clutch pack engagement. Excess oil from the main spool is channeled to the converter spool, then to the lubrication spool.
The converter spool limits the pressure in the torque converter inlet to 660 - 860 [kPa]. Oil leaving the converter is directed to the oil cooler. From the cooler, the oil is directed back to the lubrication spool in the pressure regulator valve. This oil and the excess oil dumped by the converter spool is used to lubricate the transmission. The lube oil pressure is limited to 310 - 450 [kPa]. Excess lube oil is dumped into the transmission sump. It should be noted that lube pressure will be lower in gear than it is in neutral.

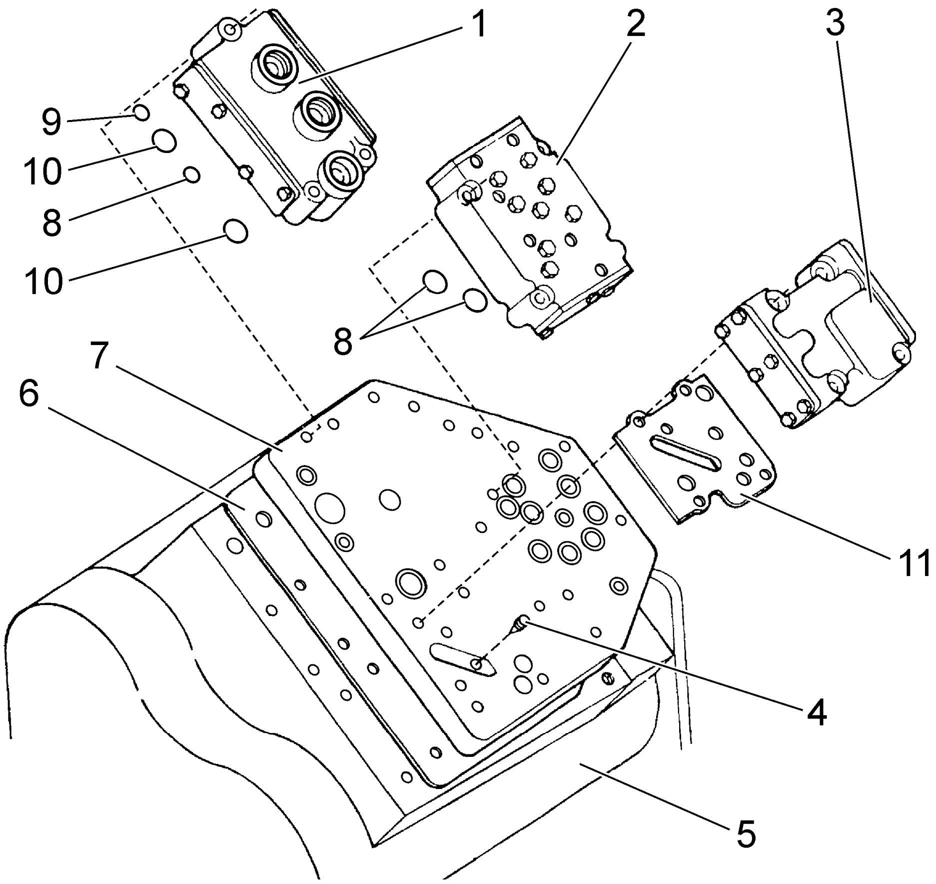


Fig. 7C.1. Transmission and Valves Location

1. Pressure Regulator Valve	5. Transmission Assy	9. O-Ring
2. Range Selector Valve	6. Manifold Gasket	10. O-ring
3. Rate of Rise Valve	7. Valves Manifold	11. Rate of Rise Valve Gasket
4. Orifice Strainer	8. O-Ring	

Range Selector Valve

This valve (2, Fig. 7C.1) consists of one switch spool, one directional selector spools and two range selector spools which are hydraulically controlled. In "forward", oil pressure is exerted between the switch spool and directional selector spool, causing the short switch spool to compress the spring and the long directional selector spool to remain in place. In "reverse", oil pressure is exerted on the end of the long directional selector spool, causing both spools to move against the spring. In "first or second" (transmission gears), oil pressure is applied against one of the range selector spools causing it to compress the spring. In "third", no oil pressure is applied and the range selector spools are held in place by the spring. When the spools are shifted, oil pressure from the rate of rise valve (3) enters the range selector valve and exits through openings not covered by the spool and on to the transmission to engage the clutch packs: one directional and one range clutch pack.

Rate of Rise Valve

Rate of rise valve (3, Fig. 7C.1) sequences the flow and regulates the pressure of the oil to the directional and range clutch packs during shifting. When a directional or gear range shift occurs, oil from the range selector valve (2) enters the rate of rise valve and is first directed to the directional clutch pack. When this clutch pack is full, the pressure rises and opens the sequence spool to allow the range clutch packs to fill while the pressure to the directional clutch pack remains the same. When the range clutch pack is full, the pressure in all the packs begins to raise evenly. Because the pressure in the directional clutch pack is greater, it fully engage before the range clutch pack, allowing any slippage to occur only in the latter. This deleted engagement time is created by modulating piston and allows a smooth shift without shock.

3. SPECIFICATIONS

Transmission

Type . . . . Power Shift
Number of forward speed 3
Number of reverse speed 3

Directional Clutch Shaft (Input Shaft)

Shaft end play . . . . 0.13 - 0.25 [mm]

Reverse clutch pack

Number of friction discs (internally splined clutch plates) 6
Number of separator plates (externally splined clutch plates) 5
Thickness of friction disc . . . . 2.46 - 2.61 [mm]
Thickness of separator plate . . . . 2.06 - 2.16 [mm]

Forward clutch pack:

Number of friction discs (internally splined clutch plates) 6
Number of separator plates (externally splined clutch plates) 5
Thickness of friction disc . . . . 2.46 - 2.61 [mm]
Thickness of separator plate . . . . 2.06 - 2.16 [mm]

GENERAL

Range Clutch Shaft

Shaft end play . . . . 0.13 - 0.25 [mm]

First speed clutch pack:

Number of friction discs (internally splined clutch plates) 7

Number of separator plates (externally splined clutch plates) 6

Thickness of friction disc . . . . 2.76 - 2.92 [mm]

Thickness of separator plate . . . . 2.23 - 2.33 [mm]

Second speed clutch pack:

Number of friction discs (internally splined clutch plates) 9

Number of separator plates (externally splined clutch plates) 8

Thickness of friction disc . . . . 2.76 - 2.92 [mm]

Thickness of separator plate . . . . 2.23 - 2.33 [mm]

Third speed clutch pack:

Number of friction discs (internally splined clutch plates) 7

Number of separator plates (externally splined clutch plates) 6

Thickness of friction disc . . . . 2.76 - 2.92 [mm]

Thickness of separator plate . . . . 2.23 - 2.33 [mm]

Countershaft

Countershaft end play . . . . 0.13 - 0.25 [mm]

Special Bolt and Nut Torque Data

Universal joint mounting bolts . . . . .110 [Nm]

Pressure regulator valve mounting bolts . . . . 42 - 50 [Nm]

Range selector valve mounting bolts . . . . 32 [Nm]

Transmission mounting bolts . . . . 920 [Nm]

Transmission cover to housing mounting bolts . . . . 92 [Nm]

Reverse idler shaft mounting bolt . . . . 325 ± 10% [Nm]

Rate of rise valve end cover bolts . . . . 26 - 28 [Nm]

Range selector valve end cover bolts . . . . 26 - 28 [Nm]

Pressure regulator valve end cover bolts . . . . 26 - 28 [Nm]

NOTE: *Except for the special torques shown, all bolts and nuts are to be given a standard torque. Refer to SECTION 1.*

Springs

SPRING	Free Length [mm]	Test Length [mm]	Test Load [N]	Total Number of Coils
Pressure Regulator Valve:				
Torque Converter Spool Spring	71,5	50.8	278 - 300	14
Lube Spool Spring	81.6	50.8	96 – 109	19
Main Spool Ball Spring	21.1	15.4	75 – 83	9
Main Spool Inner Spring	49.8	35.1	193 - 207	12.5
Main Spool Outer Spring	76.5	52.5	380 - 398	13.5
Rate of Rise Valve:				
Piston Spring (Inner)	88.0	71.1	160 - 178	17.5
Piston Spring (Outer):	46.3	31.7	160 - 178	6
Reducing Spring	45.0	19	245 - 262	5.5
Sequence Spool Spring	71.1	25	36	8
Range Selector Valve:				
Clutch Selector Spool Spring	48.7	35.5	249	13
Range Selector Spool Spring	48.7	35.5	249	13
Transmission:				
Range Clutch Pack Springs	52.2	41.9	200 – 218	11.5
Directional Clutch Pack Springs	40.7	32.3	84 – 92	9.5

TRANSMISSION

4. REMOVAL

NOTE: *It is required that Paragraph 8, TROUBLE SHOOTING in SECTION 7 be reviewed and the pressure checks in Paragraph 10, TRANSMISSION AND TORQUE CONVERTER OIL PRESSURE TEST be taken before removing the transmission. In this manner, hydraulic malfunctions can be pinpointed and corrected at time of teardown.*

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

IMPORTANT: *When disconnecting hydraulic lines for any reason, they should be properly capped with the correct size plastic cap. If these caps are not available, tape or clean rubber corks may be used. Hydraulic openings must never be plugged with rags. This practice could easily introduce dirt or lint into critical hydraulic components of the machine. Tag all disconnected oil lines to facilitate easier installation.*

NOTE: *It is possible to remove the transmission without removing the range selector valve and pressure regulator valve. In this case tag the hoses of drive train control valve, diagnostic center, steering valve and gear shifting valve, and disconnect these hoses from pressure regulator valve and range selector valve.*

1. Drain the main frame as described in the OPERATOR'S MANUAL.
2. Remove the transmission case guard from bottom of machine.
3. Remove the ROPS, cab and platform. Refer to SECTION 13, SUPERSTRUCTURE.
4. Disconnect suction strainer to pump hose (10, Fig. 7C.2) and suction strainer hose (3) from the suction strainer.
5. Disconnect the electrical harness wires from the travel pressure switches located on the range selector valve (2). Disconnect electric wire from the transmission input shaft RPM sensor (8) located on the transmission housing. Remove pressure switches and RPM sensor (8).
6. Disconnect drive train lock solenoid valve and gear shifting valve drain hoses from the housing of transmission (12).
7. Disconnect supply hose (5) from the pressure regulator valve (11). Disconnect torque converter supply hose (9) from the pressure regulator valve (11).
8. Disconnect the torque converter breather hose (2, Fig. 7C.3) from the transmission.
9. Remove the hardware securing the range selector valve (2, Fig. 7C.2) and pressure regulator valve (11) to the manifold (13) located on the transmission (12). Tie the valves (with hoses still attached) up out of the way.
10. Disconnect the transmission scavenge hose (3, Fig. 7C.3) from the transmission (1).

NOTE: *Before removing the universal joint, wire or tape the bearing caps to prevent them from falling off the spider trunnions.*

11. Remove the universal joint (7, Fig. 7C.2) from between the torque converter and transmission.
    a. Unscrew four bolts connecting the joint to the torque converter output flange.
    b. Unscrew four bolts connecting the joint to the transmission drive yoke.

TRANSMISSION

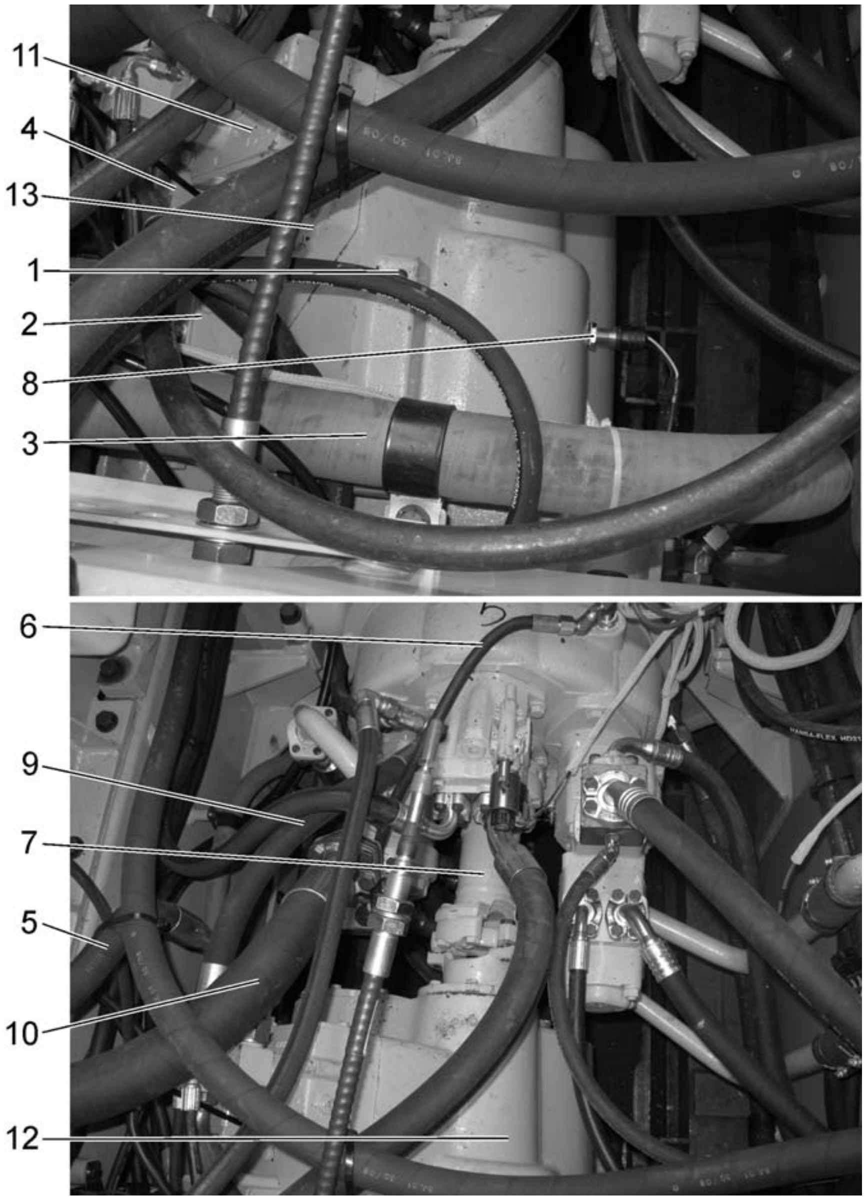


Fig. 7C.2. Transmission Disconnecting Points (Top View)

1. Eyebolt Hole
2. Range Selector Valve
3. Suction Strainer Hose
4. Rate of Rise Valve
5. Pressure Regulator Valve Supply Hose
6. Breather Hose
7. Universal Joint
8. Trans Input Shaft RPM Sensor
9. TC Supply Hose
10. Suction Strainer to Pump Hose
11. Pressure Regulator Valve
12. Transmission
13. Valves Manifold

12. Install the eyebolt in the threaded hole (1) 5/8”-11UNC-2B located in the top of the transmission housing.
13. Attach a suitable hoist and sling with a lift hook to the eyebolt threaded into transmission body. Remove slack from hoist so that will support transmission when transmission mounting bolts are removed.
14. Remove suction hose (4, Fig. 7C.3) from main frame (5) and three bolts securing transmission to main frame. Move transmission forward to free output shaft from steering drive. Lift the transmission up of the machine. Remove and discard O-rings (26 and 27, Fig. 7C.5).

NOTE: *Cover the opening in the main frame to prevent dirt and dust from entering.*

TRANSMISSION

Fig. 7C.3. Transmission Disconnecting Points (Bottom View)

1. Transmission
2. TC Breather Hose
3. Transmission Scavenge Hose
4. Suction Hose
5. Rear Main Frame

15. Position the transmission assembly on a stand so that transmission housing is up as shown on Fig. 7C.4. If not already done, unscrew the hardware securing the range selector valve (2, Fig. 7C.1) and pressure regulator valve (1) to the manifold (7) located on the transmission (5). Remove the valves. Discard O-rings.(8, 9 and 10).
16. Remove the rate of rise valve (3) with gasket (11).
17. Remove the orifice strainer (4).
18. Remove the valves manifold (1, Fig. 7C.4) and manifold gasket (2) from the transmission.

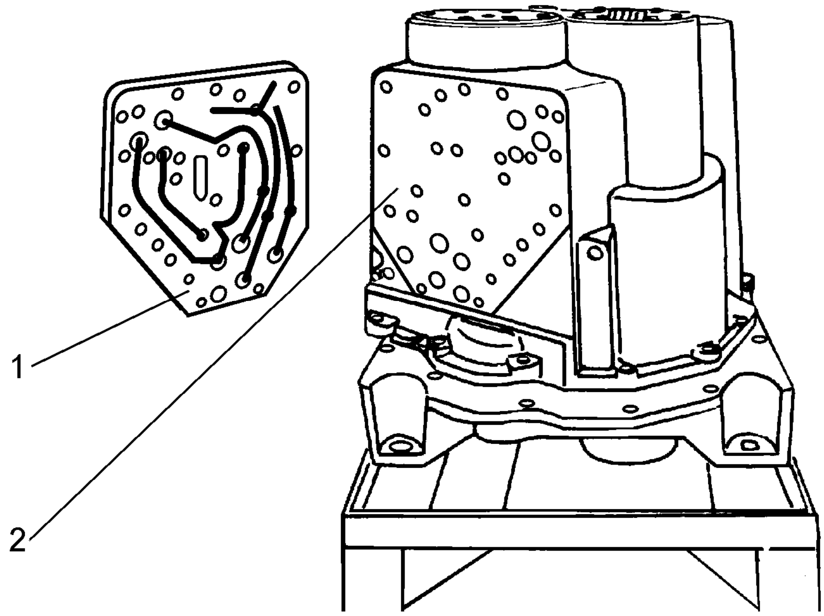


Fig. 7C.4. Removing the Transmission Manifold

1. Valves Manifold
2. Manifold Gasket

TRANSMISSION

5. DISASSEMBLY

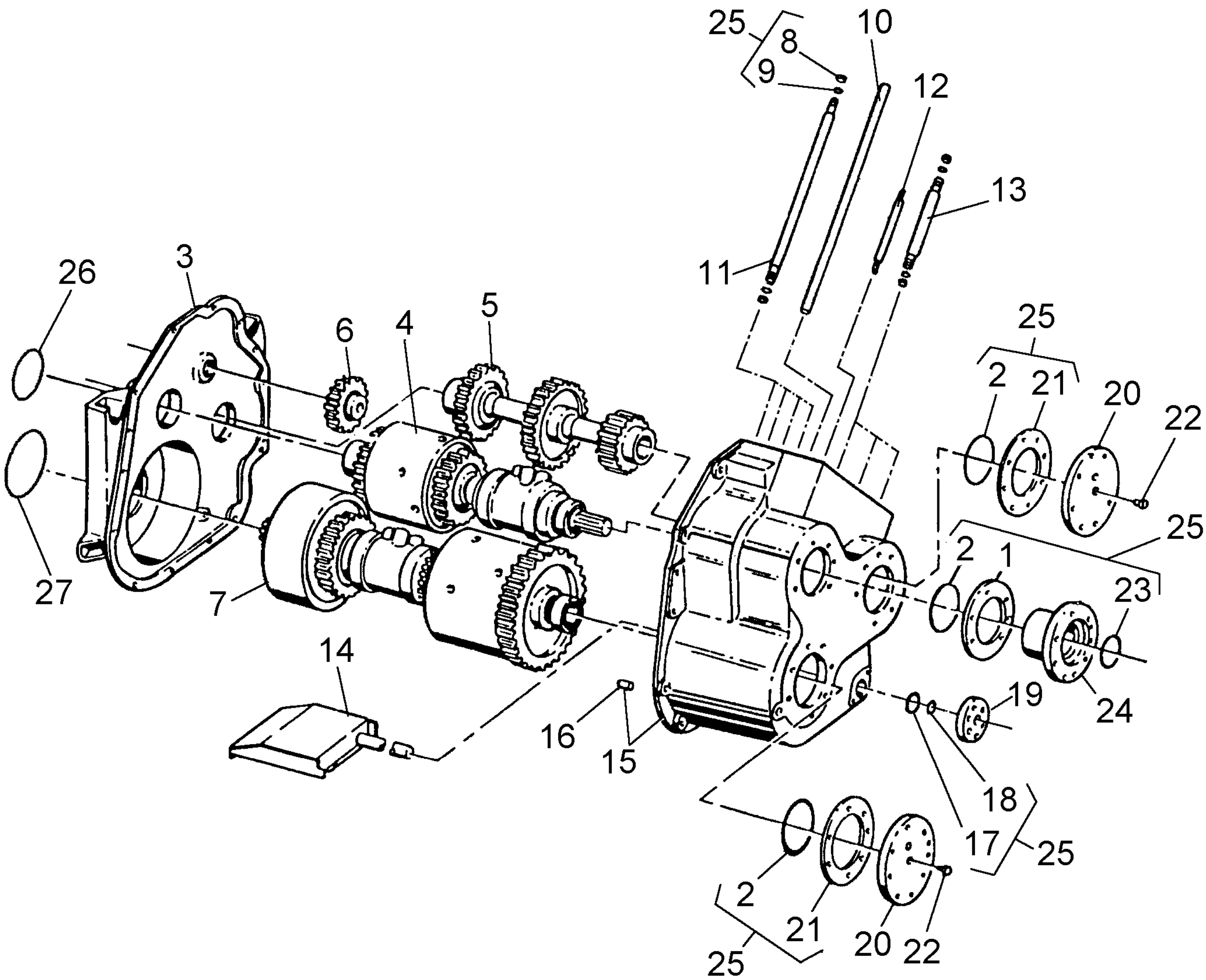


Fig. 7C.5. Exploded View of Transmission

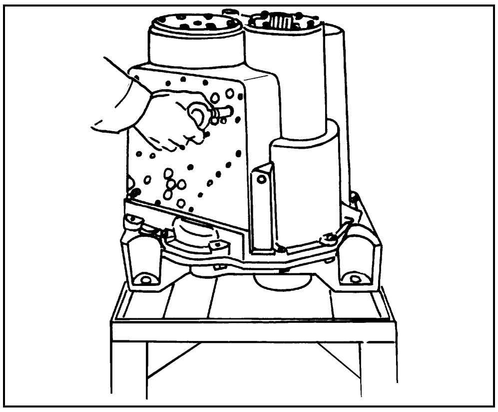
1. Shim
2. O-Ring
3. Cover Assy
4. Directional Clutch Shaft
5. Countershaft
6. Reverse Idler Gear
7. Range Clutch Shaft
8. O-Ring
9. Seal Ring
10. Manifold-Long Support
11. Supply-Long Tube
12. Manifold-Short Support
13. Supply-Short Tube
14. Transmission Strainer
15. Housing Assy
16. Dowel Pin
17. O-Ring
18. O-Ring
19. Flange, Strainer
20. Shaft Cover
21. Shim
22. Drain Plug
23. Oil Seal
24. Input Cover
25. Service Kit
26. O-Ring
27. O-Ring

TRANSMISSION

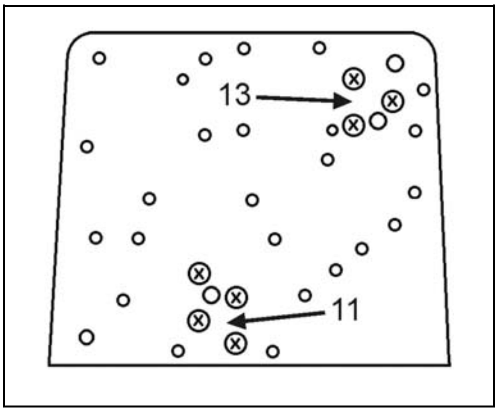
TRANSMISSION

Transmission Case and Cover (Refer to Fig. 7C.5)

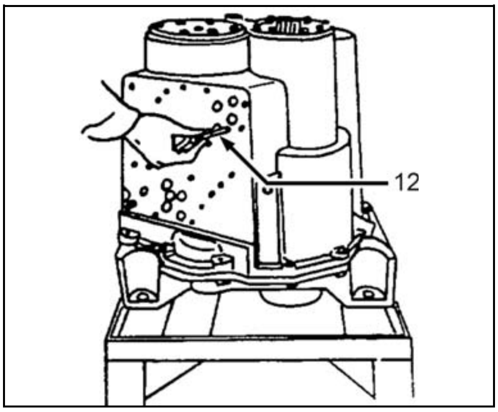
1. If not already done, remove drive yoke from the splined input shaft (4).
2. Remove the short tubes (13) from the transmission housing by inserting an eyebolt (threaded shaft smaller than tube ID) into the end of the tube, cock it to the side and pull out. Repeat for the long tubes (11). Remove and discard tube O-rings (8) and seal rings (9).



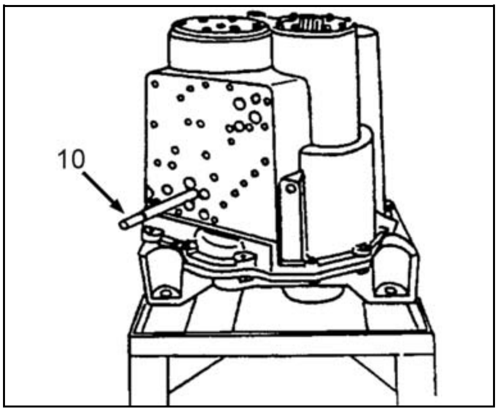
NOTE: *Tubes need not be pulled completely out of case, thus avoiding damage to inner O-rings (8) and seal rings (9) on the ends of the tubes.*



3. Unthread and remove the manifold-short support stud (12).



4. Remove manifold-long support tube (10).



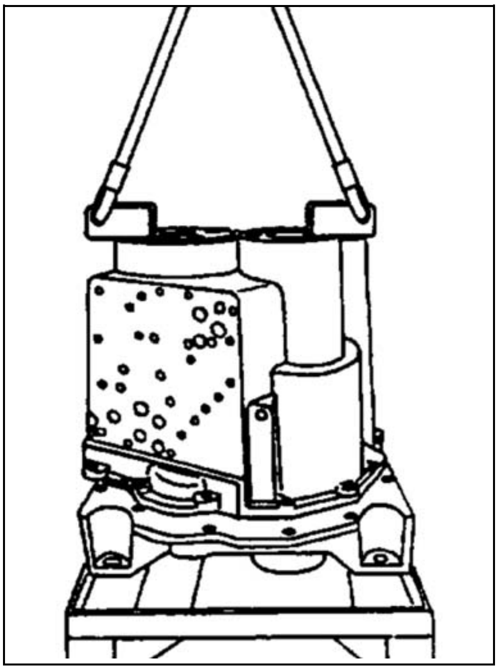
TRANSMISSION

5. Remove and tag the shaft cover (20) from the countershaft opening. Remove the shims (21) and keep with the cover for proper installation. Remove and discard O-ring (2) from cover.
6. Remove and tag the cover (20) from the range shaft opening. Remove the shims (21) and keep with the cover for proper installation. Remove and discard O-ring (2) from cover.

NOTE: *There are three 3/8 NC puller holes provided in the countershaft cover to aid in removal.*

NOTE: *The cover and shims are the same type as used on the countershaft and range shaft opening and can easily become intermixed.*

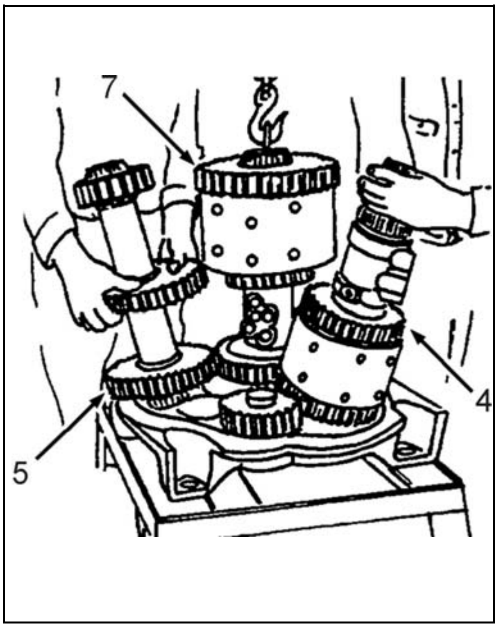
7. Remove cover (24) from the directional clutch shaft opening. Remove the shims (1) and keep with the cover. Remove oil seal (23) from the input cover. Remove and discard O-ring (2) from cover.



8. Remove the flange (19) from housing (15). Remove O-rings (17 and 18) from the flange and discard.
9. Remove the bolts and washers securing cover (3) to housing (15). Attach a hoist to the housing (15) and lift straight up and off.

NOTE: *If the transmission housing and cover will not separate easily, tap along the seam with a soft mallet until the cover is free of the housing dowel pins.*

10. Remove the two nuts and washers securing the transmission strainer (14) to housing (15). Remove the strainer.
11. Install an eyebolt in the end of range clutch shaft (7) and hoist it up far enough to allow removal of the countershaft (5) and the directional shaft (4).



TRANSMISSION

Reverse Idler Shaft (Refer to Fig. 7C.6)

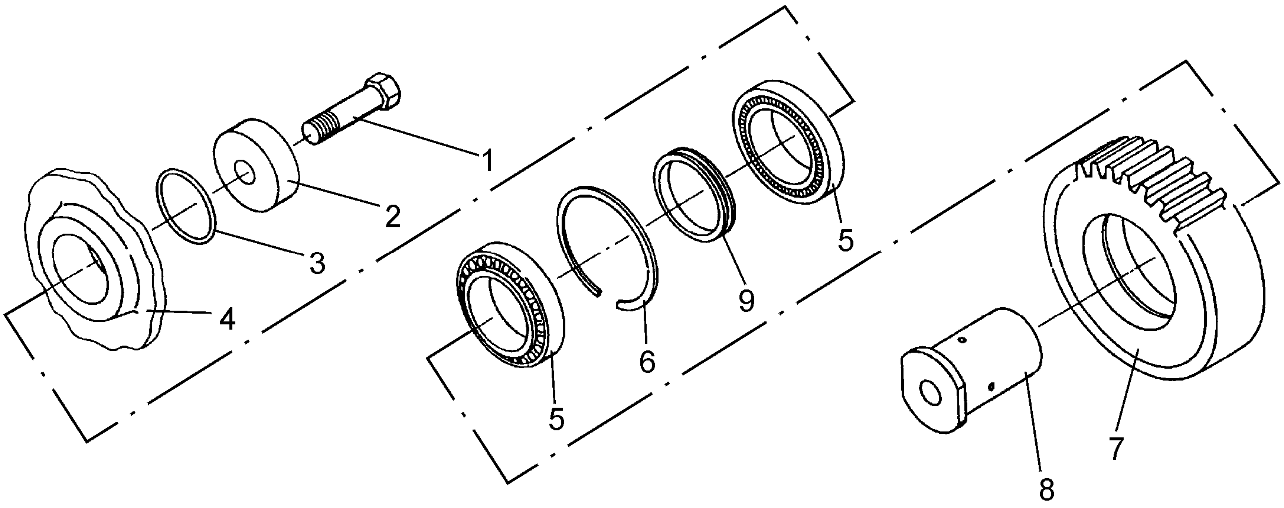
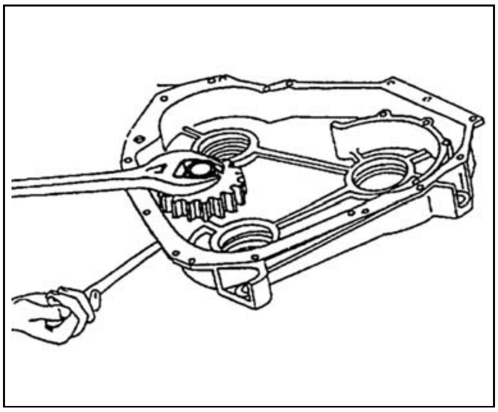


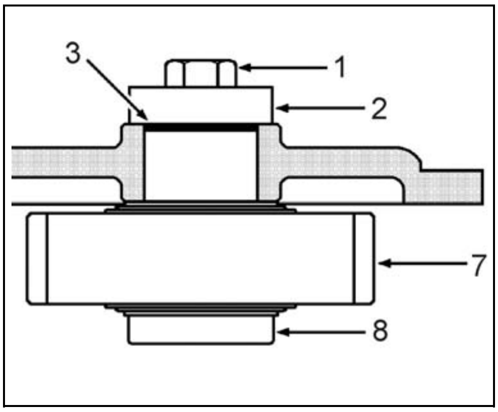
Fig. 7C.6. Reverse Idler Shaft

1. Bolt	4. Cover Assy	7. Reverse Idler Gear
2. Plate	5. Tapered Roller Bearing	8. Reverse Idler Gear Shaft
3. O-Ring	6. Retaining Ring	9. Bearing Cone Spacer

12. Remove the bolt (1) securing plate (2).

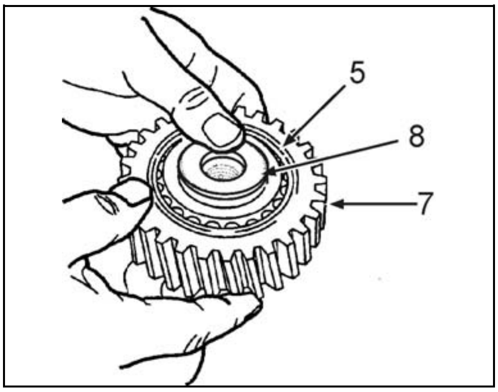


13. Remove plate (2) and O-ring (3). Tap the reverse idler shaft (8) from the cover (4).

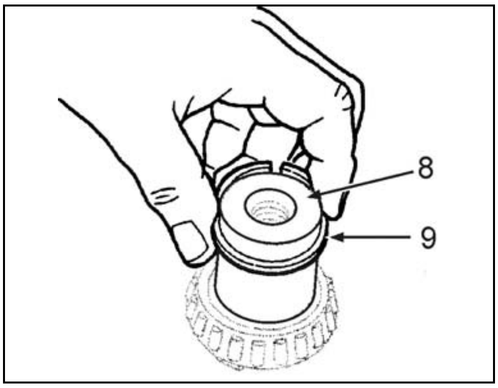


TRANSMISSION

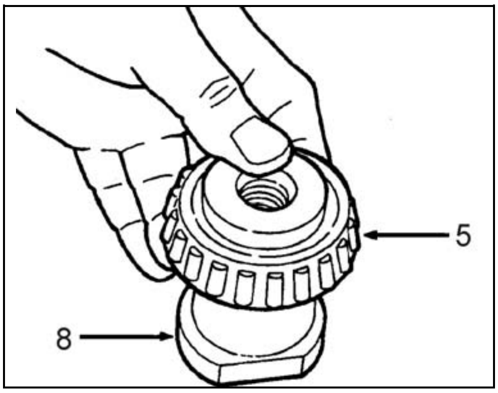
14. Place the shaft assembly in a press so the shaft (8) points up and the gear (7) supports the assembly. Using a suitable driver, press the shaft out of the gear. One bearing cone (5) will be pressed off with the gear.



15. Remove the spacer (9) from shaft (8).

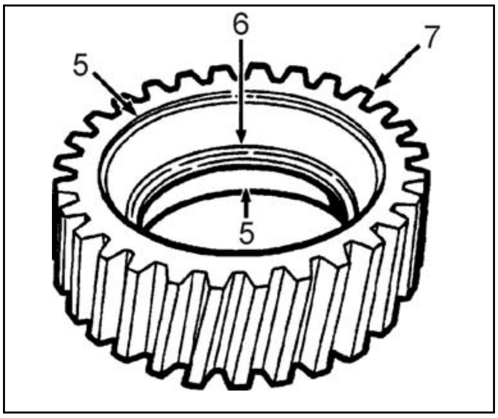


16. If bearing or shaft replacement is necessary, press bearing cone (5) off shaft (8).



17. If bearing (5) or gear (7) replacement is necessary remove the bearing cups from both ends of the gear. Remove bearing retaining ring (6) if necessary.

NOTE: *An internal retaining ring (6) separates the two cups inside gear (7).*



TRANSMISSION

Countershaft (Refer to Fig. 7C.7)

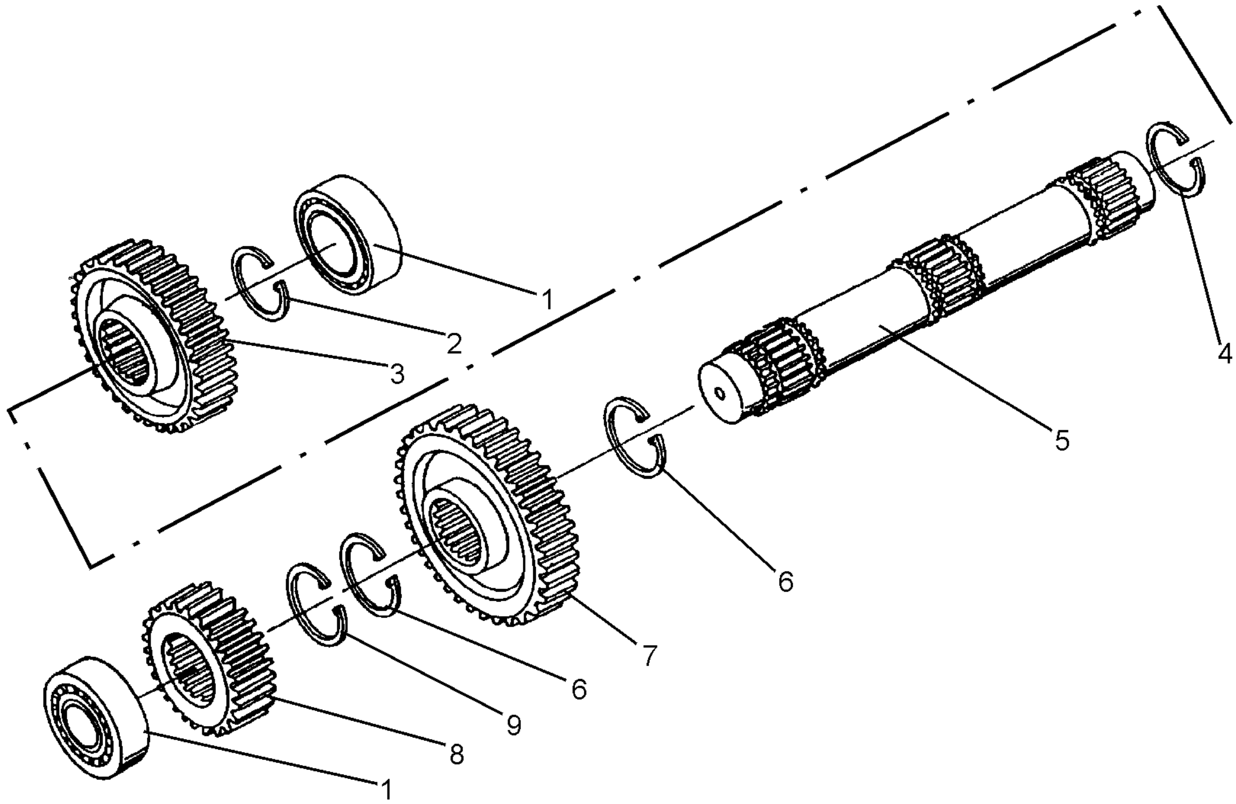


Fig. 7C.7. Exploded View of Countershaft

1. Tapered Roller Bearing
2. Retaining Ring
3. Reverse Idler Gear
4. Retaining Ring
5. Countershaft
6. Retaining Ring
7. Forward Driven Gear
8. First Drive Gear
9. Retaining Ring

NOTE: *The cup for bearing (1) was removed with the countershaft cover (20, Fig. 7C.5) during the complete transmission tear down. If bearing replacement is necessary, remove bearing cup (1) from the cover.*

18. Remove the retaining ring (2) from groove in countershaft (5). Support the countershaft (5) in a press under idler gear (3) and press the countershaft (5) from idler gear (3) and bearing cone (1).
19. Disassemble component parts in the order (4, 6, 7, 6, 1, 8, 9) using a press.

NOTE: *The cup for bearing (1) was removed with cover (3, Fig. 7C.5) during the complete transmission tear down. If bearing replacement is necessary, remove bearing cup (1) from the cover.*

TRANSMISSION

Directional Clutch Shaft (Refer to Fig. 7C.8)

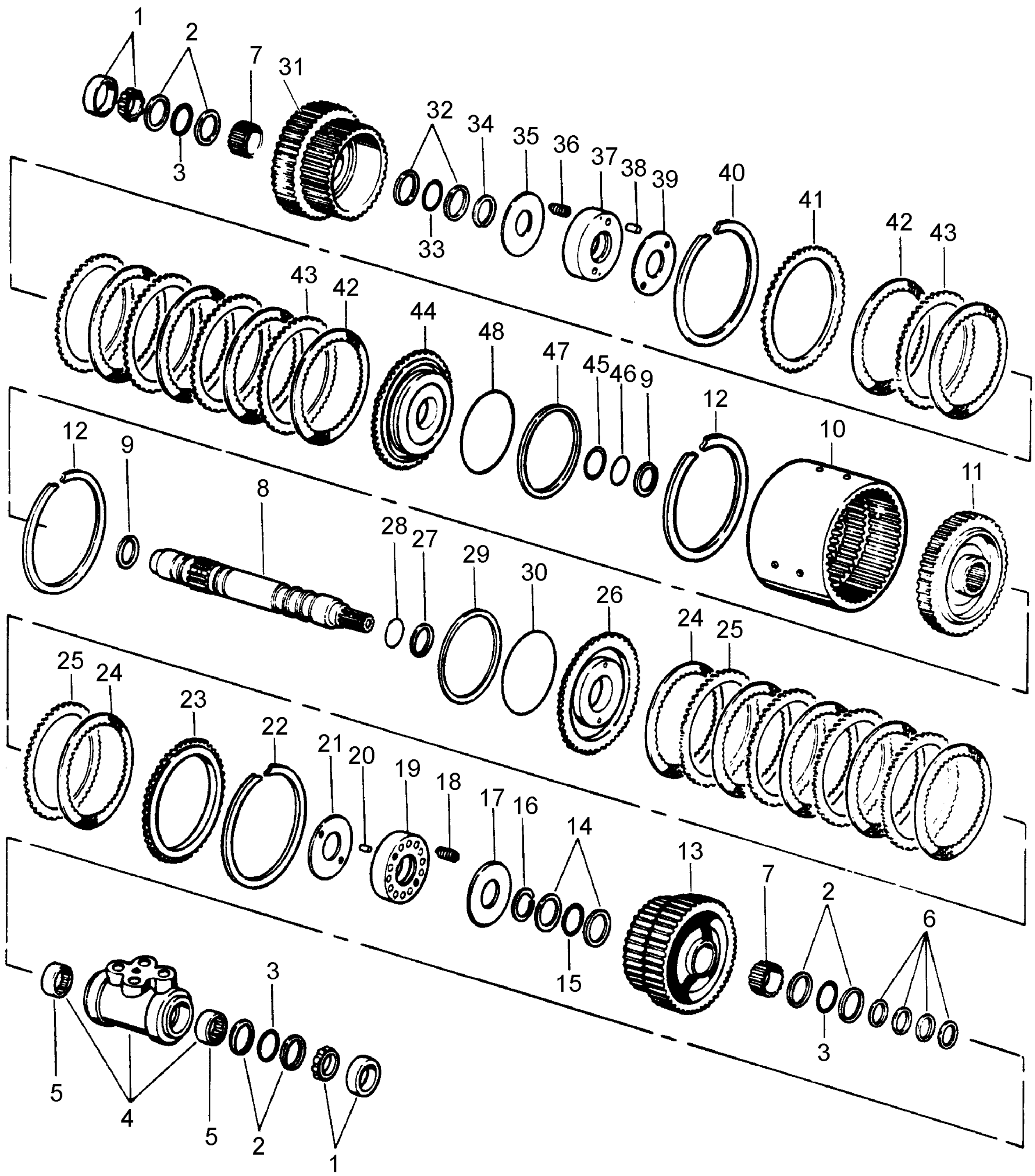


Fig. 7C.8. Exploded View of Directional Clutch Shaft

TRANSMISSION

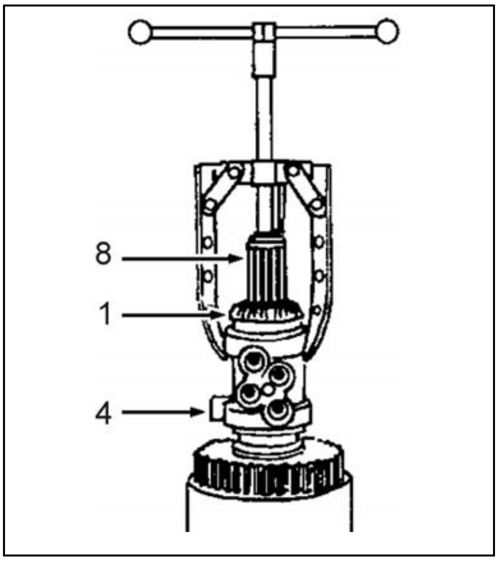
Legend for Fig. 7C.8. Exploded View of Directional Clutch Shaft

1. Tapered Roller Bearing
2. Thrust Washer
3. Thrust Bearing
4. Manifold Assy
5. Roller Bearing
6. Shaft Seal Ring
7. Roller Bearing
8. Input Shaft Assy
9. Retaining Ring
10. Clutch Drum
11. Clutch Hub
12. Retaining Ring
13. Forward Drive Gear
14. Thrust Washer
15. Thrust Bearing
16. Retaining Ring
17. Spring Retainer Plate
18. Piston Springs
19. Lube Sleeve Assy
20. Guide Pins
21. Spring Retainer Plate
22. Retaining Ring
23. Clutch Support Plate
24. Friction Disc
25. Separator Plate
26. Forward Clutch Piston
27. Seal Ring
28. O-Ring
29. Seal Ring
30. O-Ring
31. Reverse Drive Gear
32. Thrust Washer
33. Thrust Bearing
34. Retaining Ring
35. Springs Plate
36. Piston Springs
37. Lube Sleeve Assy
38. Guide Pins
39. Springs Plate
40. Retaining Ring
41. Clutch Support Plate
42. Friction Disc
43. Separator Plate
44. Reverse Clutch Piston
45. Seal Ring
46. O-Ring
47. Seal Ring
48. O-Ring

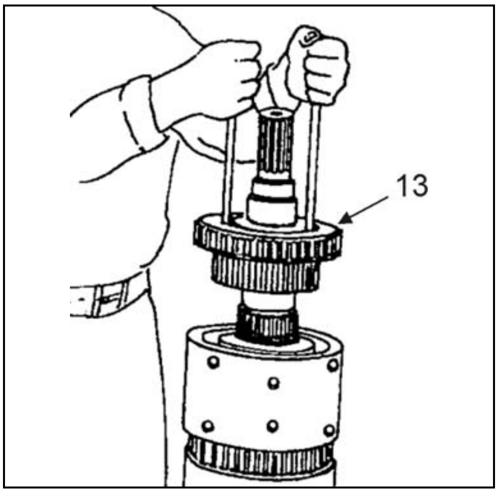
NOTE: *Bearing cup (1) was removed with cover (24, Fig. 7C.5). If bearing replacement is necessary, remove bearing cup (1) from the cover.*

20. Place the input (directional) clutch shaft in a suitable stand so that the oil manifold (4) is up. Install a gear puller to manifold. Remove manifold (4), bearing cone (1) and thrust bearing parts (2, 3, 2) from the shaft (8).
21. Remove and discard seal rings (6) from clutch shaft. Remove the thrust bearing parts (2, 3, 2) from the clutch shaft.

NOTE: *Remove bearings (5) from manifold (4) only if necessary.*

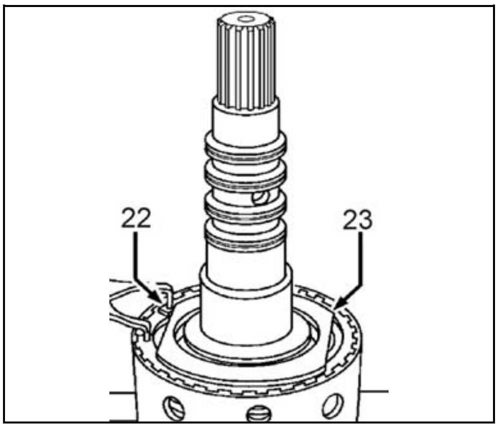


22. Install two bolts in the forward drive gear (13) and remove from the clutch shaft. Remove the thrust bearing parts (14,15,14) and roller bearing (7) from the clutch shaft.



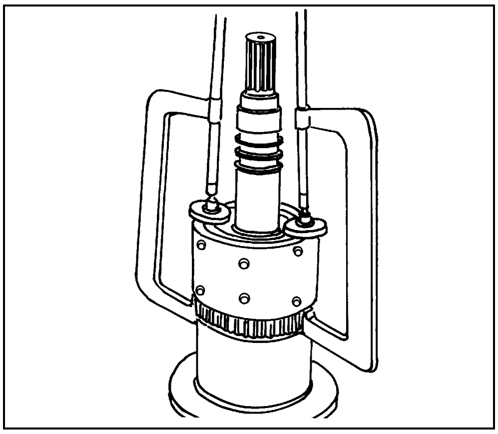
TRANSMISSION

23. Using retaining ring pliers, remove the retaining ring (22) from drum (10). Carefully screw two 3/8" bolts to hole in the support plate (23), not to damage the friction disc (24) and remove support plate from drum (10). If the bolts are not available use two screwdrivers for removing the support plate.
24. Remove friction discs (24) and separator plates (25) out of drum (10).



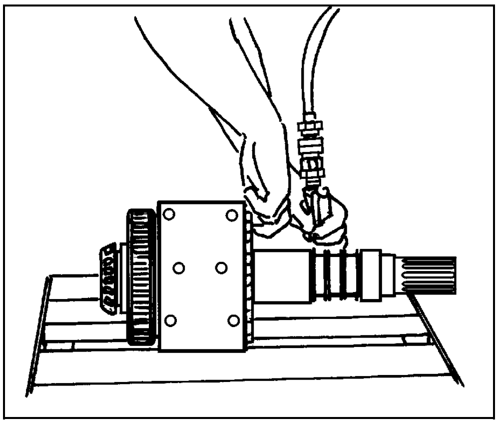
25. Compress the piston return springs (18) by pressing down on the spring retainer plate (17) with C clamps and remove retaining ring (16).
26. Disassemble component parts (17 through 21) in the numerical order from the clutch shaft.

WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme caution when disassembling.



27. Lay the shaft on its side and apply compressed air in port closest to the clutch pack to remove piston (26). Remove seal ring (29) and O-ring (30) from piston (26).

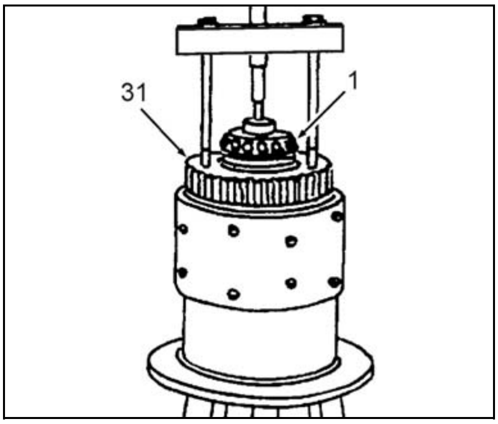
NOTE: *Wear eye protection when using air under pressure. Limit the air pressure to 200 [kPa].*



28. Place the shaft in the stand so that reverse drive gear (31) is up. Remove cone of bearing (1) with gear (31) and thrust bearing parts (2, 3, 2) using the gear as the puller.

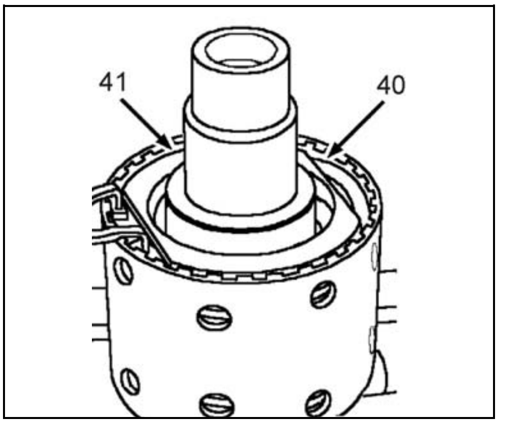
NOTE: *Bearing cup (1) was removed with rear housing cover (3, Fig. 7C.5). If bearing replacement is necessary, remove bearing cup (1) from the cover.*

29. Remove the thrust bearing parts (32, 33, 32) and roller bearing (7) form the clutch shaft.

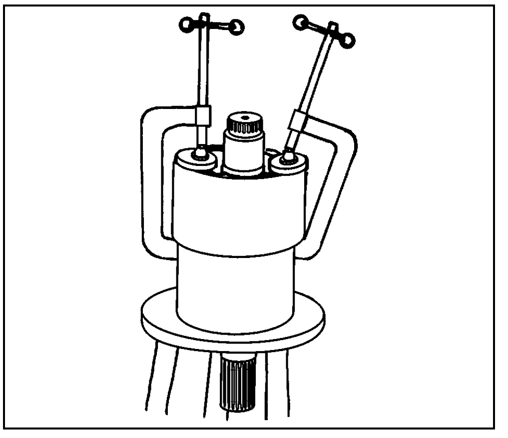


TRANSMISSION

30. Using retaining ring pliers, remove the retaining ring (40) from drum (10). Carefully screw two 3/8” bolts to hole in the support plate (41), not to damage the friction disc (42) and remove support plate from drum (10). If the bolts are not available use two screwdrivers for removing the support plate.
31. Remove friction discs (42) and separator plates (43) out of drum (10).

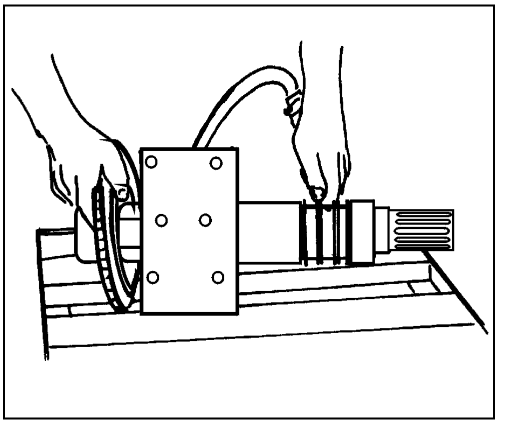


32. Compress the piston return springs (36) by pressing down on the springs plate (35) with C clamps and remove retaining ring (34).
33. Disassemble component parts (35 through 39) in numerical order from the clutch shaft.



WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme caution when disassembling.

34. Lay the shaft on its side and apply compressed air in the center port to remove piston (44). Remove seal ring (47) and O-ring (48) from piston (44).

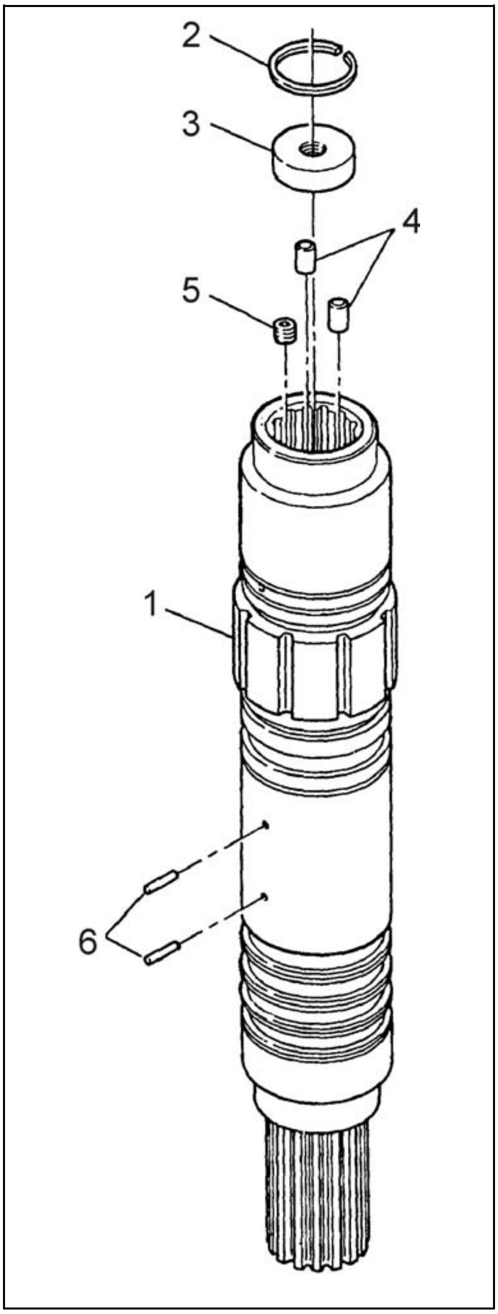


NOTE: *Wear eye protection when using air under pressure. Limit the air pressure to 200 [kPa].*

35. Remove one of retaining rings (12) and press the hub (11) with shaft (8) off the drum (10). The second retaining ring (12) need not be removed unless replacement is necessary.
36. Remove one of retaining rings (9) and press hub (11) off the shaft (8). Remove seal rings (45 and 27) and O-rings (46 and 28) from hub (11). Second retaining ring (9) from shaft need not be removed unless replacement is necessary.

TRANSMISSION

37. Disassemble component parts (2 through 6) in reference number order.



1. Input Shaft
2. Retaining Ring
3. Shaft Adapter
4. Dowel Pin
5. Metering Plug
6. Spring Pin

TRANSMISSION

TRANSMISSION

Range Clutch Shaft (Refer to Fig. 7C.9)

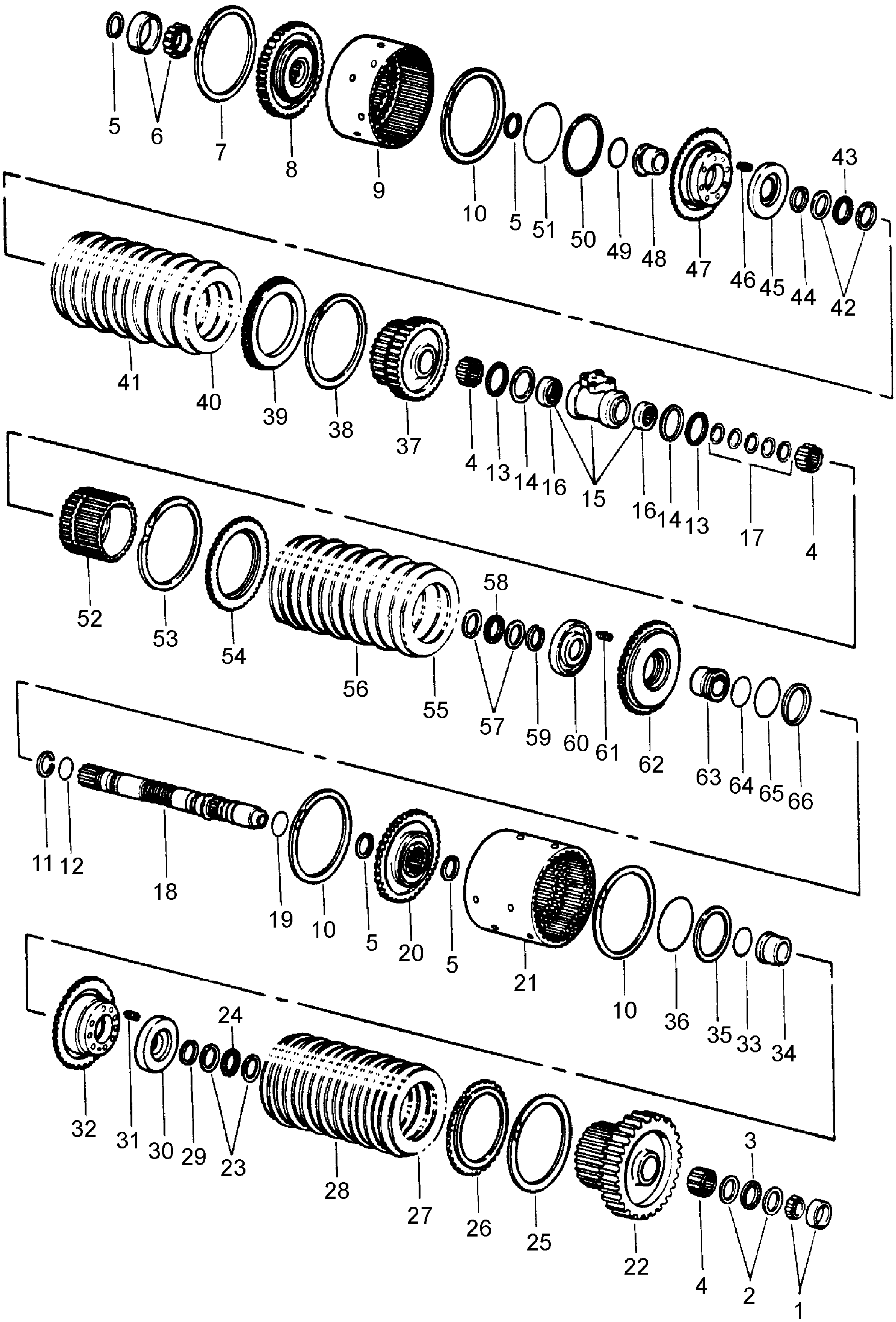
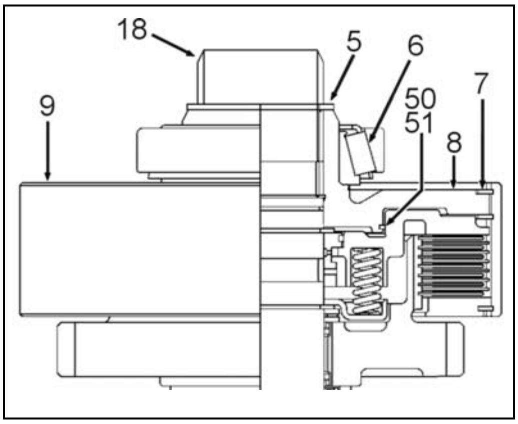


Fig. 7C.9. Exploded View of Range Clutch Shaft

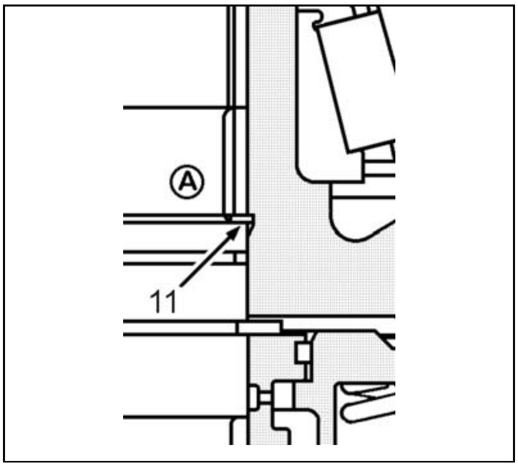
Legend for Fig. 7C.9. Exploded View of Range Clutch Shaft

1. Tapered Roller Bearing
2. Thrust Washer
3. Thrust Bearing
4. Roller Bearing
5. Retaining Ring
6. Tapered Roller Bearing
7. Retaining Ring
8. Second Clutch Hub
9. Second Clutch Drum
10. Retaining Ring
11. Retaining Ring
12. O-Ring
13. Thrust Bearing
14. Thrust Washer
15. Clutch Manifold Assy
16. Roller Bearing
17. Shaft Seal Ring
18. Output Shaft Assy
19. Seal Ring
20. First and Third Hub
21. First and Third Drum
22. First Clutch Gear
23. Thrust Washer
24. Thrust Bearing
25. Retaining Ring
26. Clutch Support Plate
27. Friction Disc
28. Separator Plate
29. Retaining Ring
30. Spring Retainer Plate
31. Piston Return Spring
32. First Clutch Piston
33. O-Ring
34. Lube Sleeve
35. Seal Ring
36. O-Ring
37. Second Clutch Gear
38. Retaining Ring
39. Clutch Support Plate
40. Friction Disc
41. Separator Plate
42. Thrust Washer
43. Thrust Bearing
44. Retaining Ring
45. Spring Retainer Plate
46. Piston Return Spring
47. Second Clutch Piston
48. Lube Sleeve
49. O-Ring
50. Seal Ring
51. O-Ring
52. Third Clutch Gear
53. Retaining Ring
54. Clutch Support Plate
55. Friction Disc
56. Separator Plate
57. Thrust Washer
58. Thrust Bearing
59. Retaining Ring
60. Spring Retainer Plate
61. Piston Return Spring
62. Third Clutch Piston
63. Lube Sleeve
64. O-Ring
65. O-Ring
66. Seal Ring

38. Place the range shaft in a suitable stand so that the second speed clutch pack is facing up. Remove the retaining ring (5) securing the second clutch hub (8) to the shaft (18). Remove the retaining ring (7) securing the second clutch hub to the drum (9).



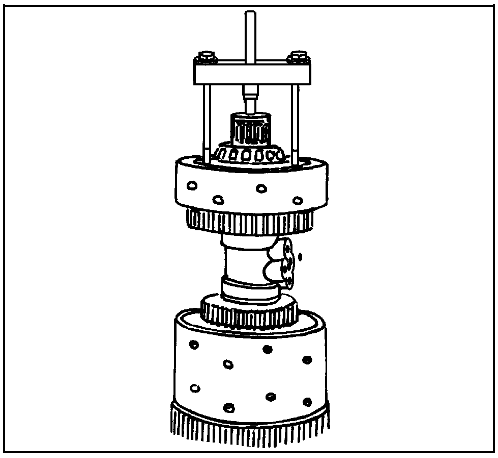
NOTE: *There is internal retaining ring (11) mounted in the hub that is used for hub placement. As the hub is being pulled from the shaft, the retaining ring will ride down the hubs beveled surface (A) and remain with the shaft.*



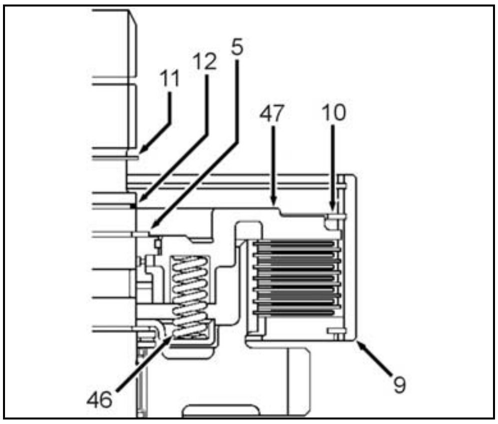
TRANSMISSION

39. Install a puller arrangement to the hub (8) and remove with bearing cone (6). Remove and discard seal ring (50) and O-ring (51) from hub (8).

NOTE: *The cup for the tapered roller bearing cone (6) was removed with cover (3, Fig. 7C.5) during the complete transmission tear down. If bearing replacement is necessary, remove bearing cup (6) from the cover and the cone from the hub.*

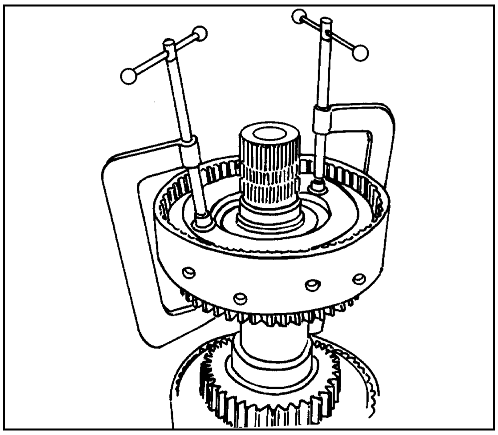


40. Remove the retaining ring (11) and O-ring (12) from the shaft. Remove the retaining ring (10) from the drum (9).



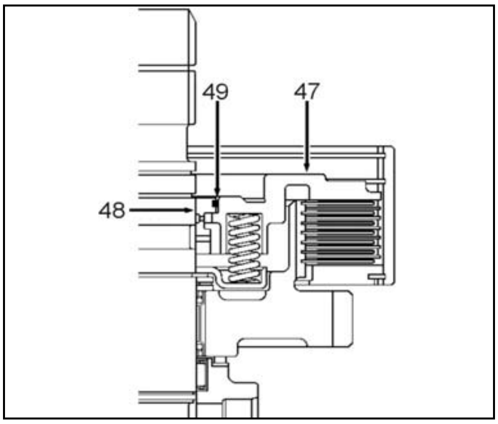
41. Compress the piston return springs (46) by pressing down on the piston (47) with C clamps and remove retaining ring (5). Slowly release the C clamps.

WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme caution when disassembling.



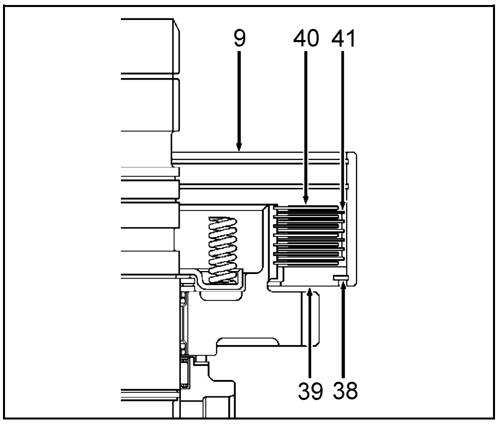
42. Remove second clutch piston (47) with lube sleeve (48). Separate the parts and discard O-ring (49).

NOTE: *It is possible to remove parts (48, 49, 47, 41, 40, 39, 38) as an assembly by lifting drum (9) off the output shaft (18). In this case set the assembly on a bench and disassemble component parts in the sequence indicated.*

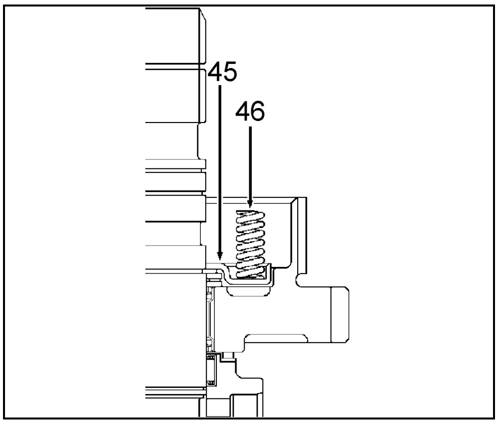


TRANSMISSION

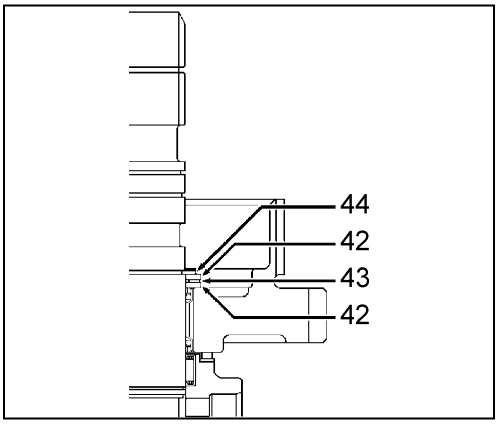
43. Remove the drum (9) with seven friction discs (40) and six separator plates (41). Using retaining ring pliers, remove the retaining ring (38) from drum (9). Carefully screw two 3/8” bolts to hole in the support plate (39), not to damage the friction disc (40) and remove support plate from drum (9). If the bolts are not available use two screwdrivers for removing the support plate. Separate friction discs and separator plates from the drum.



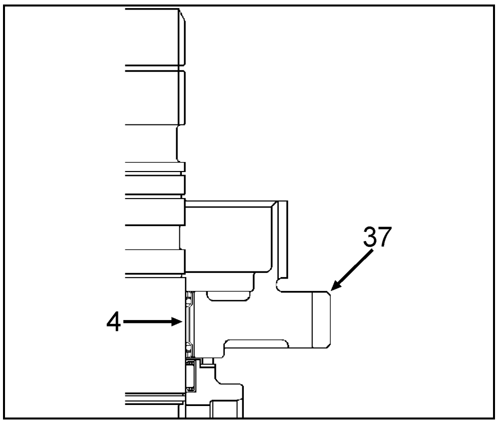
44. Remove the eight piston return springs (46) and spring retainer plate (45).



45. Remove the retaining ring (44) and thrust bearing parts (42, 43, 42).

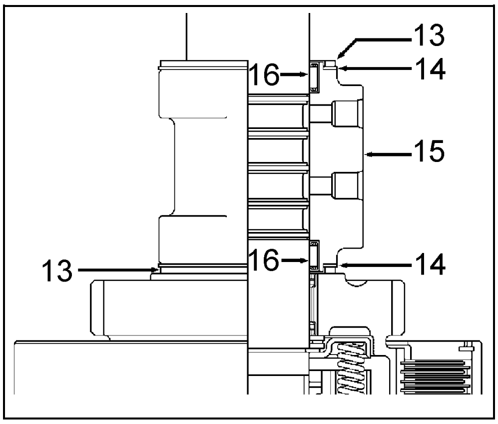


46. Remove the second clutch gear (37) and roller bearing (4).

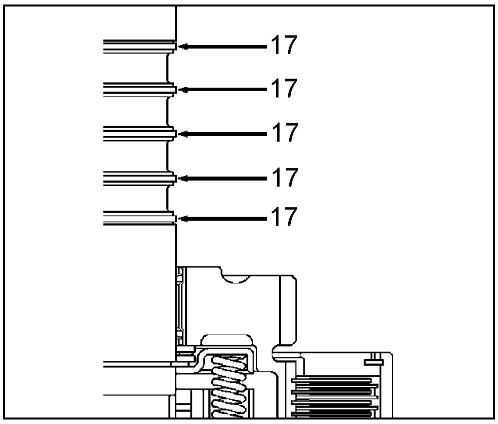


TRANSMISSION

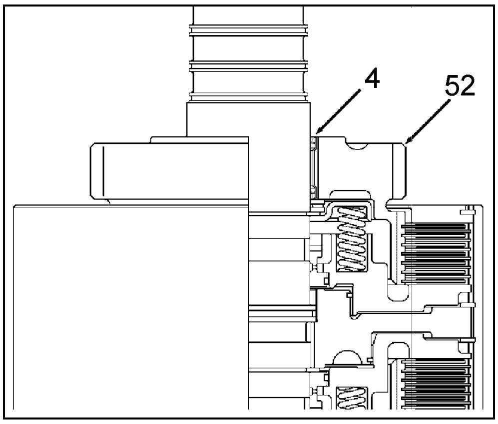
47. Remove the thrust bearing (13) and thrust washer (14) from the clutch manifold (15).
48. Remove the clutch manifold (15) with the roller bearings (16). Remove bearings (16) if needed.
49. Remove the bottom thrust bearing (13) and thrust washer (14) from the clutch manifold (15).



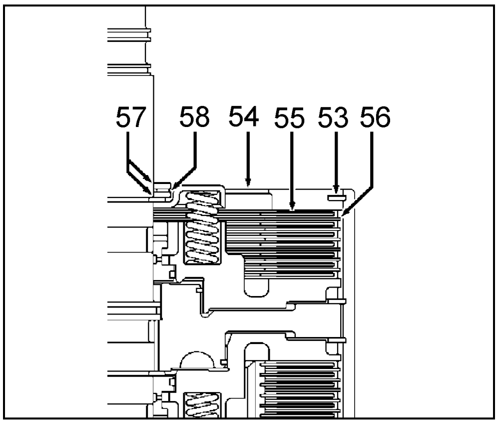
50. Remove and discard the shaft to manifold seal rings (17).



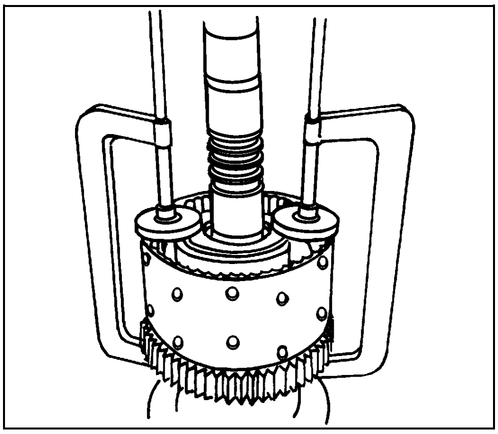
51. Remove the third clutch gear (52) and roller bearing (4).



52. Remove the thrust bearing parts (57, 58, 57). Using retaining ring pliers, remove the retaining ring (53) from drum (21). Carefully screw two 3/8” bolts to hole in the support plate (54), not to damage the friction disc (55) and remove support plate from drum (21). If the bolts are not available use two screwdrivers for removing the support plate. Remove the seven friction discs (55) and six separator plates (56).

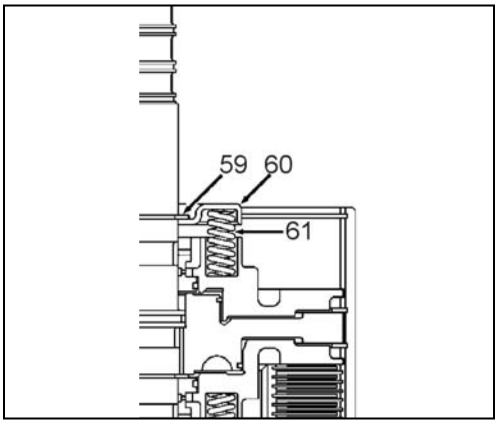


53. Position two C clamps to the piston spring retainer plate (60). Compress the return springs with C clamps.

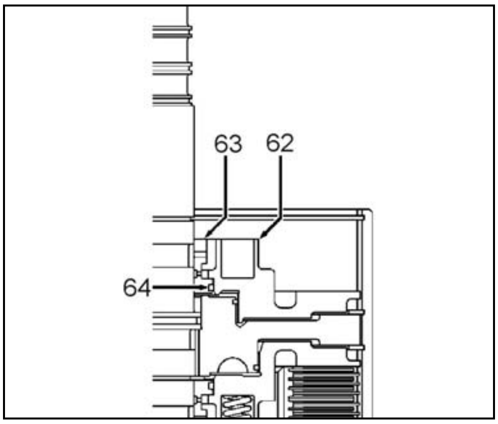


WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme caution when disassembling.

54. Remove the retaining ring (59), then slowly let off the C clamps to release return springs tension. Remove the retainer plate (60) and six springs (61).

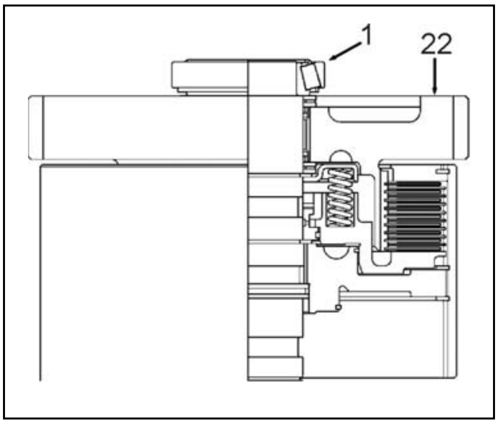


55. Lay the shaft on its side and remove the third clutch piston (62) and the lube sleeve (63) from the shaft. Remove and discard O-ring (64) from the lube sleeve.



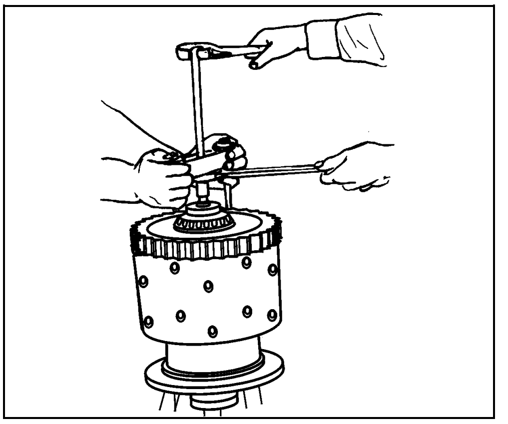
56. Place the shaft in the stand so that first clutch gear (22) is up. Install a puller to the first clutch gear.

NOTE: *The cup for the roller bearing cone (1) was removed with range shaft cover (20, Fig.7C.5) during the complete transmission tear down. If bearing replacement is necessary, remove the bearing cup (1) from the cover.*

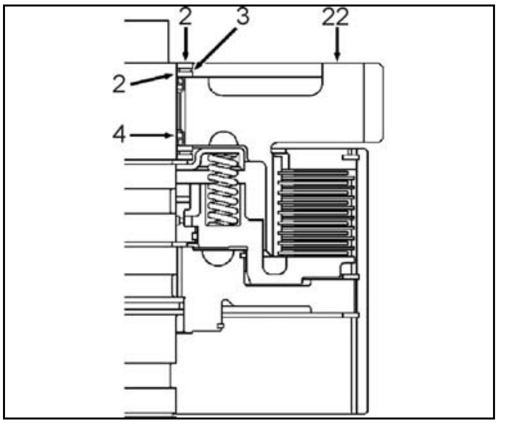


TRANSMISSION

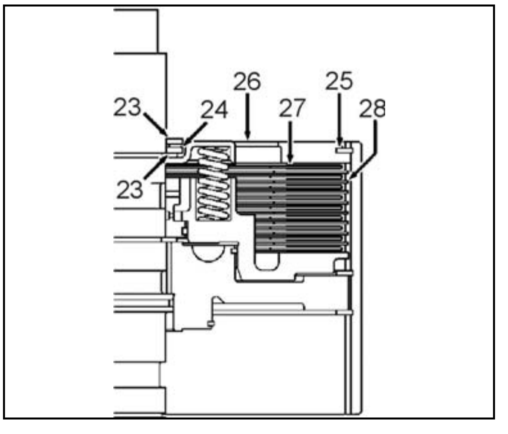
57. Draw up on puller until the roller bearing cone (1) with the gear is free from the shaft. Remove the bearing and puller.



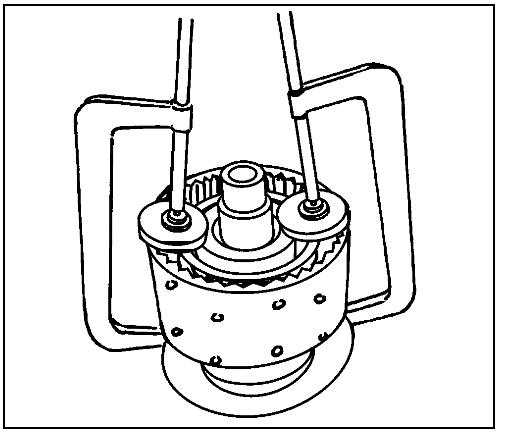
58. Remove the thrust bearing parts (2, 3, 2) from the gear. Remove the first clutch gear (22) and roller bearing (4).



59. Remove the thrust bearing parts (23, 24, 23). Using retaining ring pliers, remove the retaining ring (25) from drum (21). Carefully screw two 3/8" bolts to hole in the support plate (26), not to damage the friction disc (27) and remove support plate from drum (21). If the bolts are not available use two screwdrivers for removing the support plate. Remove the nine friction discs (27) and the eight separator plates (28).



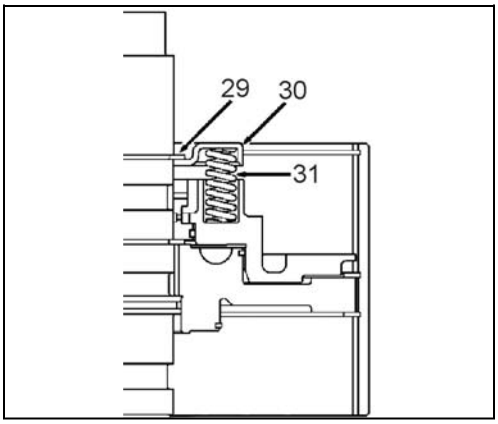
60. Position two C clamps to the piston spring retainer plate (30). Compress the return springs with C clamps.



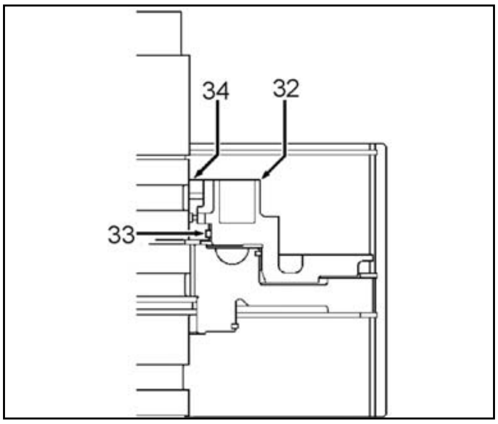
WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme caution when disassembling.

TRANSMISSION

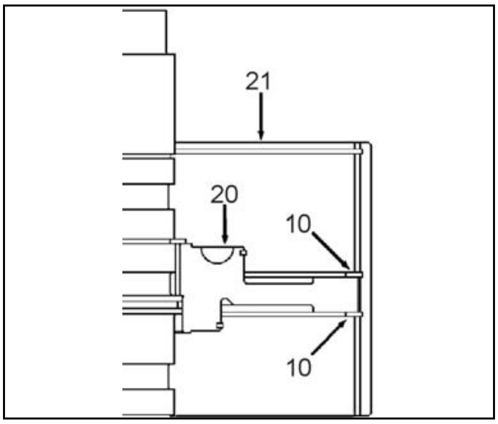
61. Remove the retaining ring (29), then slowly let off the C clamps to release return springs tension. Remove the retainer plate (30) and eight springs (31).



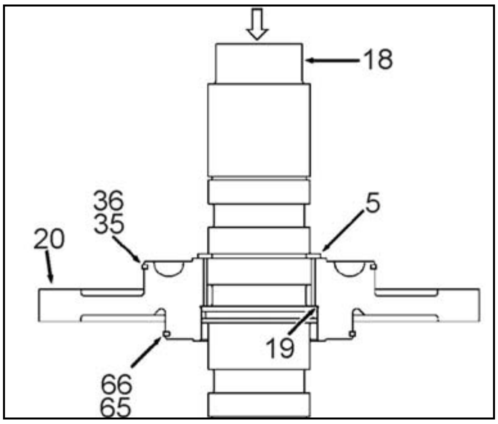
62. Remove the first clutch piston (32) and the lube sleeve (34) from the shaft. Remove and discard O-ring (33) from the lube sleeve.



63. Remove one of the retaining rings (10) and lift the shaft (18) with hub (20) out of drum (21). The second retaining ring (10) need not be removed from drum (21) unless replacement is necessary.



64. Remove the seal rings (35 and 66) and O-rings (36 and 65) from each side of the hub (20). Remove the retaining rings (5) and press the hub off the shaft (18). Remove the seal ring (19) from the shaft.

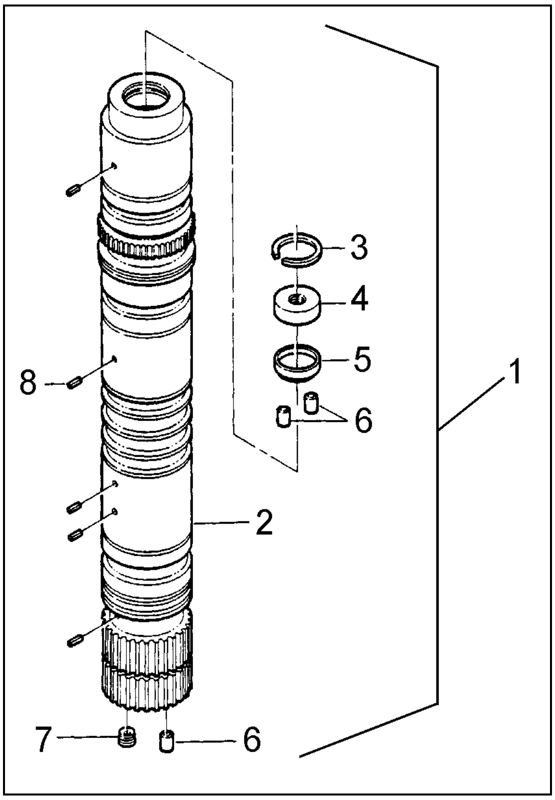


TRANSMISSION

TRANSMISSION

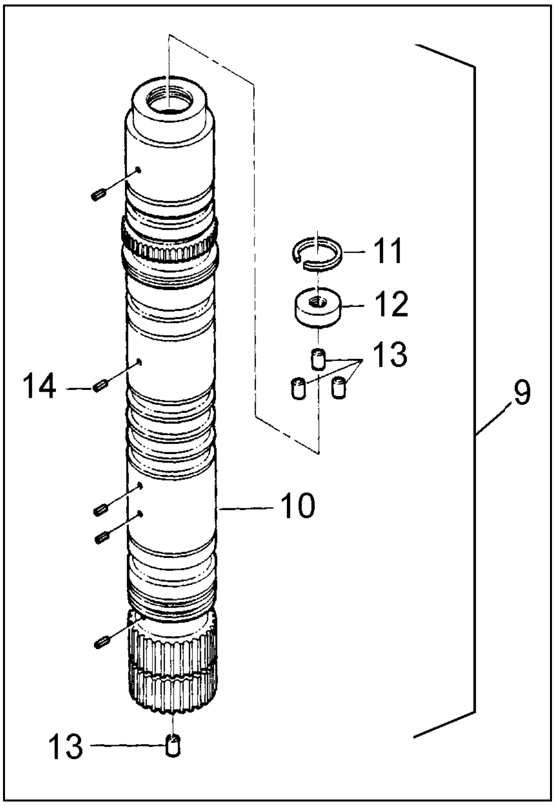
65. Disassemble alternatively range (output) shaft (1) component parts (3 through 8) from shaft (2).

1. Output Shaft Assy
2. Shaft
3. Retaining Ring
4. Shaft Adapter
5. Cup Plug
6. Dowel Pin
7. Metering Plug
8. Spring Pin



65A. or disassemble range (output) shaft (9) component parts (11 through 14) from shaft (10).

9. Output Shaft Assy
10. Shaft
11. Retaining Ring
12. Shaft Adapter
13. Dowel Pin
14. Spring Pin



TRANSMISSION

6. INSPECTION AND REPAIR

1. It is recommended that new O-rings be installed whenever the transmission is disassembled for service.
2. Wash all parts thoroughly in a suitable solvent. Dry thoroughly with compressed air or a clean cloth.

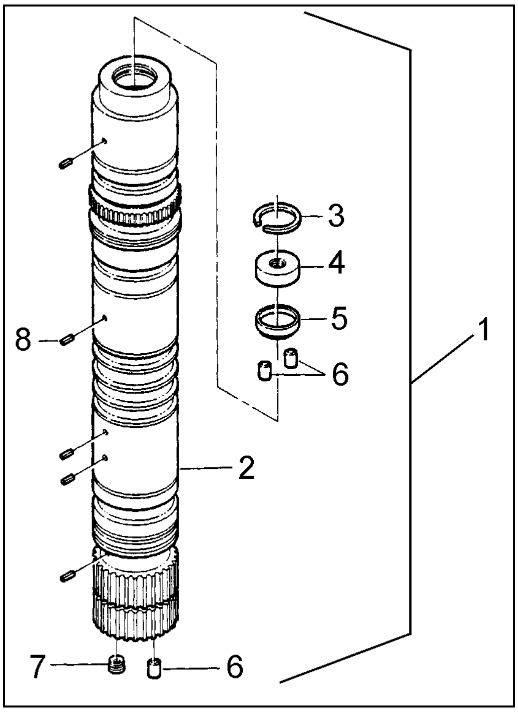
NOTE: *Do not spin dry bearings with compressed air.*

3. Inspect bearings for excessive wear or damage and replace if necessary. Reusable bearings should be soaked in clean oil and wrapped with clean paper until ready for reassembly.
4. Inspect the gears for worn, chipped or broken teeth. Replace if wear is excessive or teeth are damaged.
5. Inspect the splines on the shafts for wear. Replace shafts if wear is excessive. Slight burrs can be smoothed down with a stone.
6. Flush all oil passages of the input and output shafts. Be sure all lube holes are clean and free of obstruction.
7. Inspect the clutch plates for excessive wear or warpage and replace if necessary.
8. Using an oil stone, remove any burrs that might damage sealing surfaces or increase wear to close tolerance parts.
9. Check the compression springs for damage and fatigue. If they do not fall within the tolerances given in Paragraph 2, SPECIFICATIONS, they must be replaced.
10. Flush and clean all oil lines and the oil cooler to assure a clean hydraulic system.

7. REASSEMBLY

Range Clutch Shaft (Refer to Fig. 7C.9)

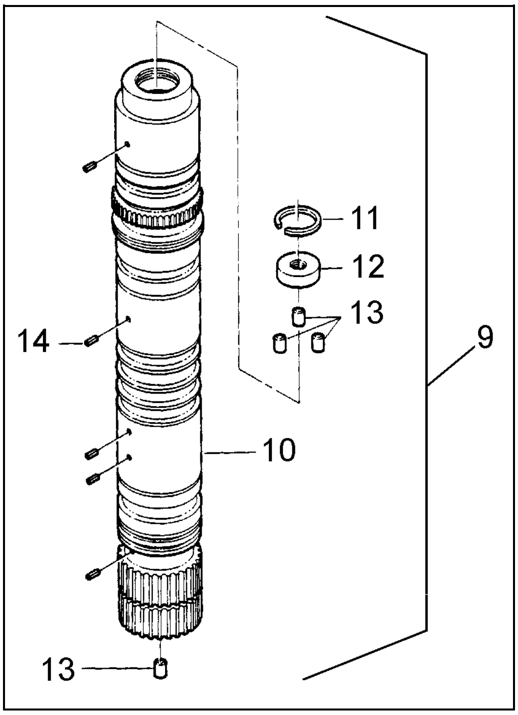
1. If removed, reassemble alternatively range (output) shaft (1) component parts (3 through 8) to shaft (2) in reverse numerical sequence



1. Output Shaft Assy
2. Shaft
3. Retaining Ring
4. Shaft Adapter
5. Cup Plug
6. Dowel Pin
7. Metering Plug
8. Spring Pin

NOTE: *Press in five spring pins (8) to shaft (2) holes down to depth 1.3 [mm] from shaft surface. Do not damage the surface during process.*

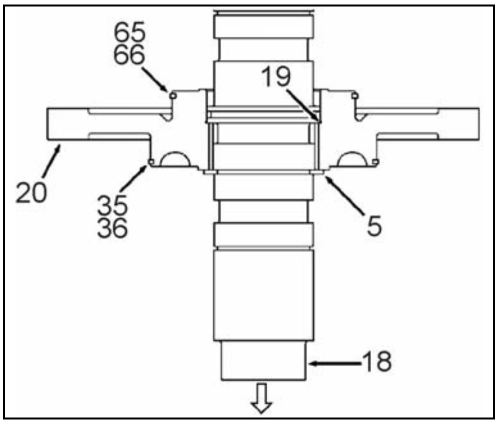
1A. Or reassemble range (output) shaft (9) component parts (11 through 14) to shaft (10) in reverse numerical sequence.



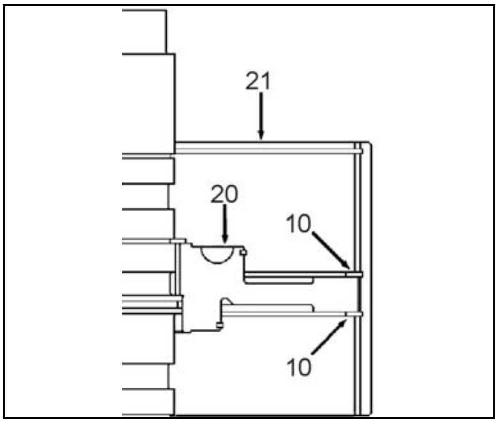
9. Output Shaft Assy
10. Shaft
11. Retaining Ring
12. Shaft Adapter
13. Dowel Pin
14. Spring Pin

NOTE: *Press in five spring pins (14) to shaft holes (10) down to depth 1.3 [mm] from shaft surface. Do not damage the surface during process.*

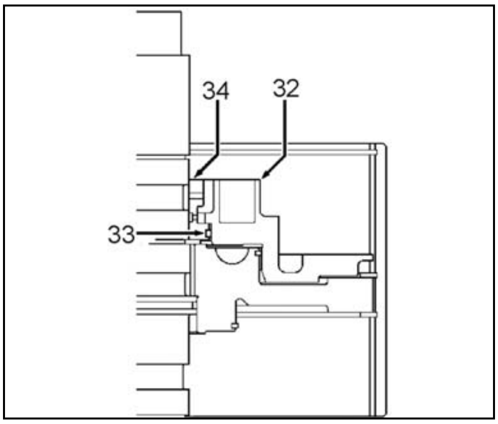
2. Heat the hub (20 to 200 [°C]. Install seal ring (19) to the clutch shaft (18). Press the clutch shaft into the hub until it bottoms against its stop. After the hub has cooled, install the O-rings (36 and 65) and seal rings (35 and 66) on each side of the hub (20). Install the retaining rings (5).



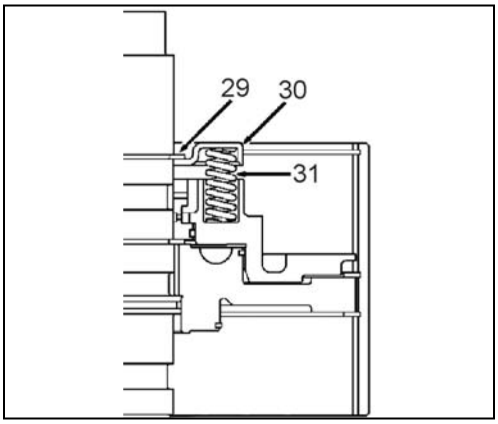
3. If removed, install one retaining ring (10) inside the drum (21). Mount the drum on the hub (20) and clutch shaft and secure with the remaining retaining ring (10).



4. Install a new O-ring (33) to the lube sleeve (34) and insert on the clutch shaft up against the hub. Install the first speed piston (32) over the sleeve being careful not to damage the hub and sleeve seal.

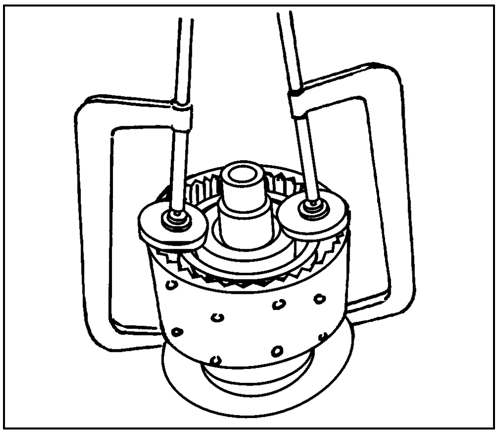


5. Install the eight piston return springs (31) into the pockets of the piston and cap with the retainer plate (30).



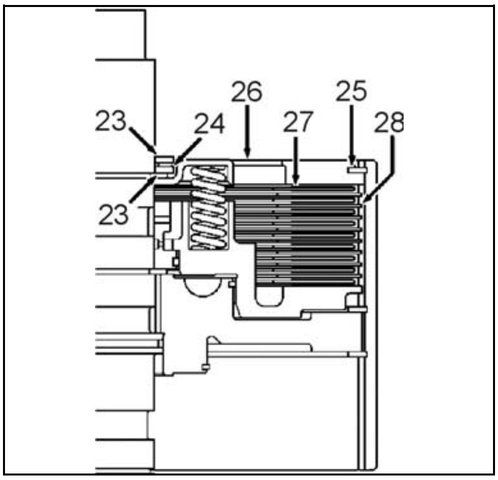
TRANSMISSION

6. Using two C clamps, compress the retainer plate and secure with the retaining ring (29). Remove the clamps.



WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme caution when assembling.

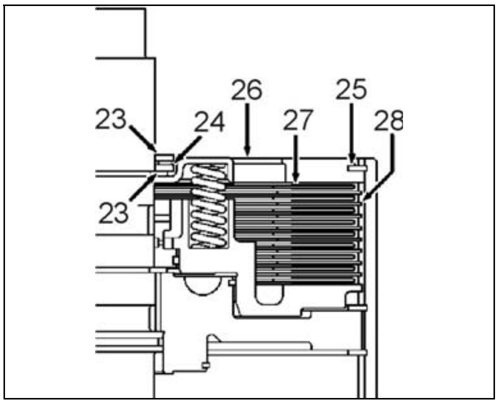
7. Alternately install one internally splined friction disc (27) and one externally splined separator plate (28), ending with an internally splined friction disc, into the drum (21).



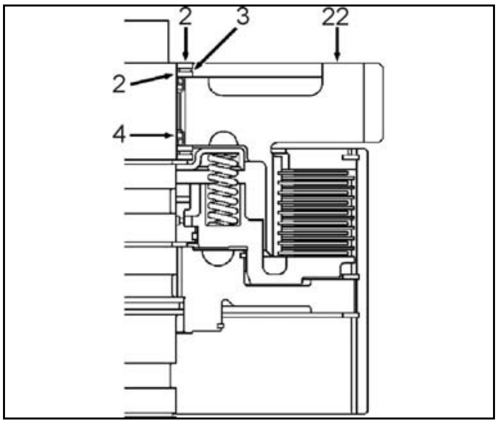
NOTE: *The internally splined friction discs must be thoroughly oiled (with same oil as used in the transmission) prior to assembling in the drum. Because the facing is porous and absorbs oil, a light oiling may be not sufficient. Whenever possible, the discs must be soaked, for at least two minutes, in a container of clean transmission oil. If facilities are not available for soaking, a heavy oiling on both surfaces may be sufficient*

8. Install the support plate (26) in the drum (21).

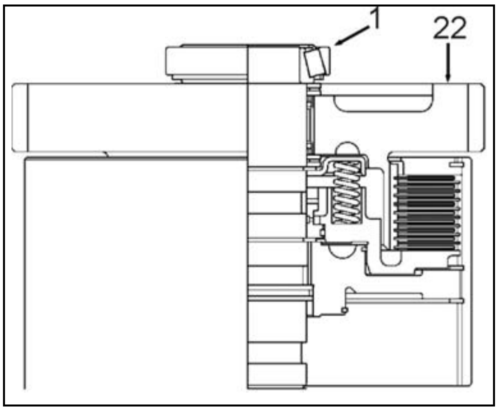
9. Using ring pliers, clamp the retaining ring (25) and install it in the drum (21). Carefully let off the pliers until retaining ring seats in the groove in the drum. Install the thrust bearing parts (23, 24, 23) on the clutch shaft (18).



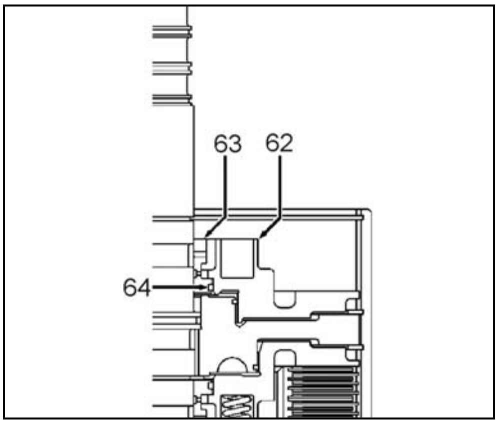
10. Install the roller bearing (4) onto the clutch shaft. Position the first clutch gear (22) over the end of the shaft. Be sure all the internally splined discs are aligned in drum (21) and that the gear meshes with all the discs and sits squarely on the roller bearing (4). Install the thrust bearing parts (2, 3, 2).



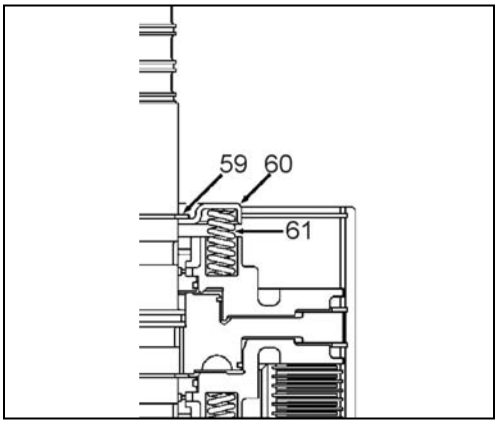
11. Heat the bearing cone (1) to 120 [°C] for 45 minutes and install on the shaft until it bottoms. To assure that the cone is seated, keep pressure against the cone until it cools down.



12. Turn the shaft assembly over in the stand so that the splined end is up. Install a new O-ring (64) to the lube sleeve (63) and insert on the clutch shaft against the hub. Install the third clutch piston (62) into hub being careful not damage the hub and sleeve seal.

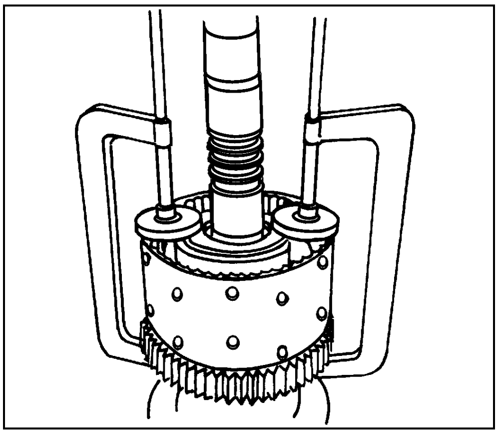


13. Install the six piston return springs (61) into the pockets of the piston (62) and cap with the retainer plate (60).



14. Using two C clamps, compress the retainer plate and secure with the retaining ring (59). Remove the clamps.

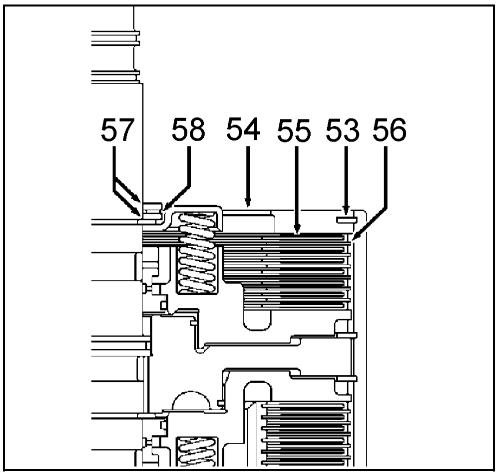
WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme caution when assembling.



TRANSMISSION

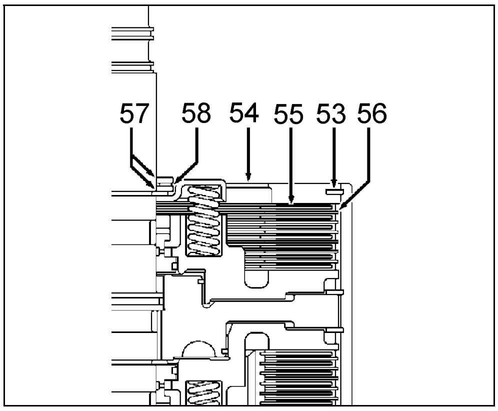
15. Alternately install one internally splined friction disc (55) and one externally splined separator plate (56), ending with an internally splined friction disc, into the drum (21).

NOTE: *The internally splined friction discs must be thoroughly oiled (with same oil as used in the transmission) prior to assembling in the drum. Because the facing is porous and absorbs oil, a light oiling may be not sufficient. Whenever possible, the discs must be soaked, for at least two minutes, in a container of clean transmission oil. If facilities are not available for soaking, a heavy oiling on both surfaces may be sufficient*.

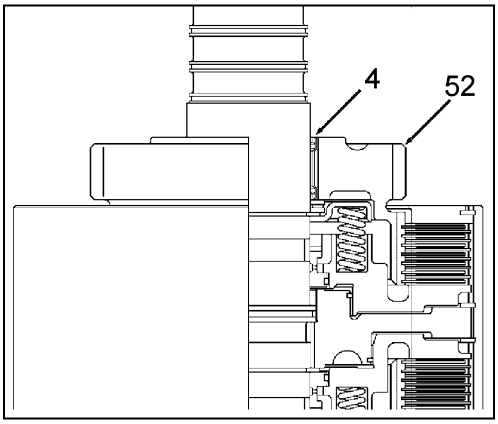


16. Install the support plate (54) in the drum (21).

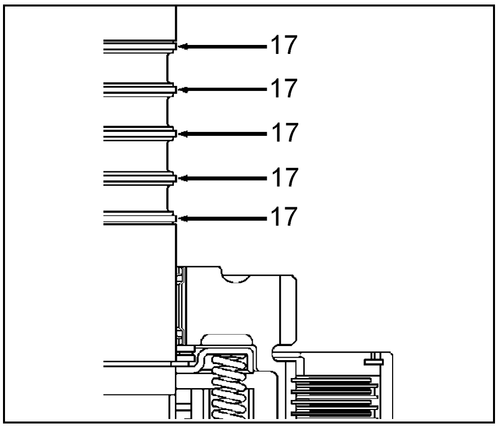
17. Using ring pliers, clamp the retaining ring (53) and install it in the drum (21). Carefully let off the pliers until retaining ring seats in the groove in the drum. Install the thrust bearing parts (57, 58, 57) to the clutch shaft (18).



18. Install the roller bearing (4) onto the clutch shaft. Position the third clutch gear (52) over the end of the shaft. Be sure all the internally splined discs (55) are aligned in drum (21) and that the gear meshes with all the discs and sits squarely on the roller bearing (4).



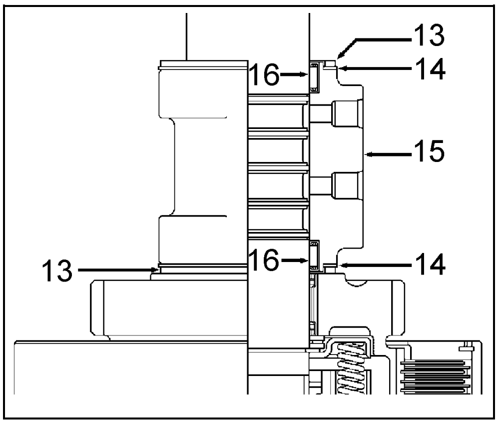
19. Install new manifold seal rings (17) to the clutch shaft.



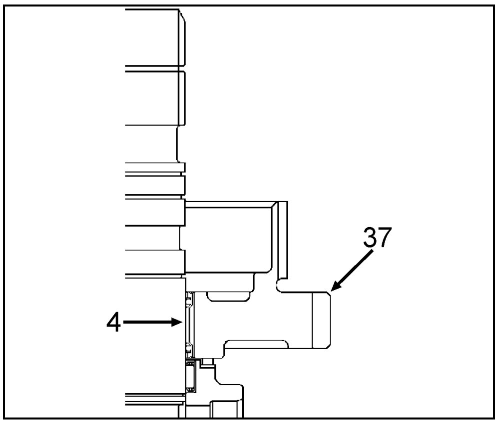
20. Install the thrust bearing parts (13 and 14) to the clutch shaft against the third clutch gear.

NOTE: *If bearings (16) were replaced from the clutch manifold (15), press in the new bearings 0 ÷ 0.25 [mm] below face.*

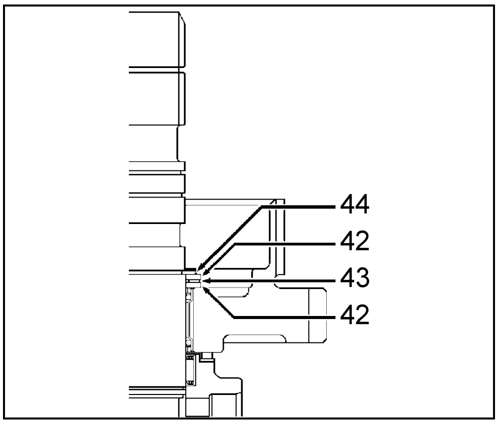
21. Install the clutch manifold (15) onto the clutch shaft being careful not to damage the shaft seals.
22. Install the thrust bearing parts (14 and 13) to the clutch shaft against the clutch manifold.



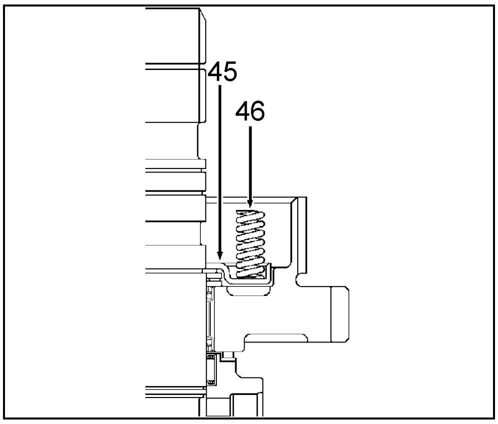
23. Install the roller bearing (4) onto the clutch shaft. Install the second clutch gear (37) onto bearing.



24. Install the thrust bearing parts (42, 43, 42) and secure with the retaining ring (44).

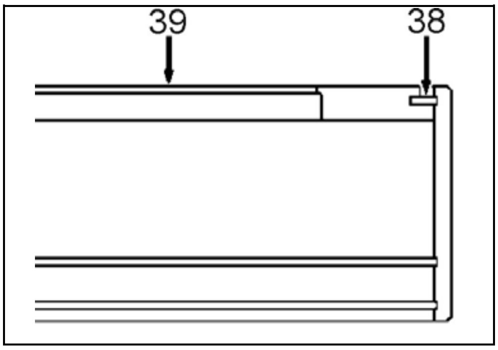


25. Install the spring retainer plate (45). Equally space the eight piston return springs (46) around the cup.



TRANSMISSION

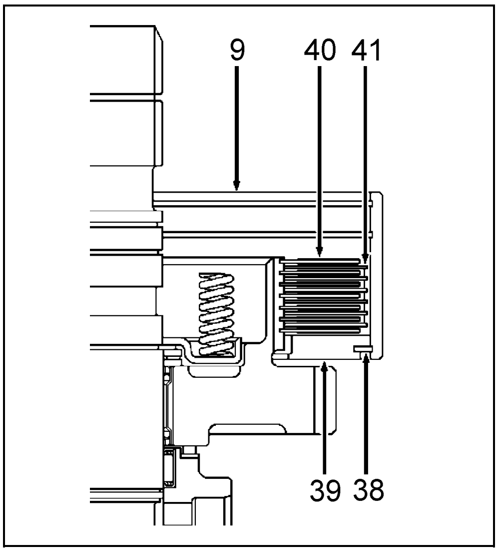
26. Install the support plate (39) and retaining ring (38) as follows.



27. Install the support plate (39) in the drum (9).

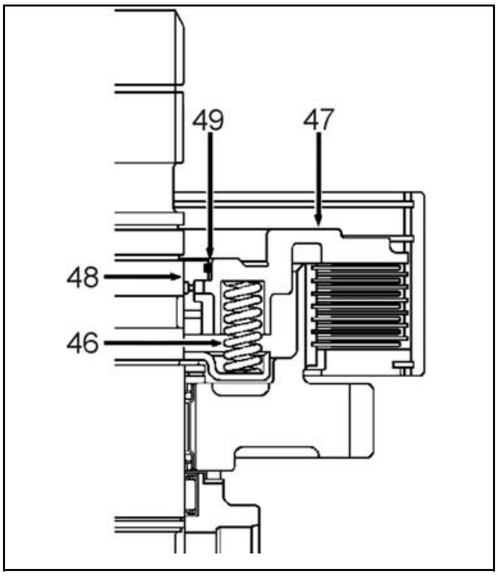
28. Using ring pliers, clamp the retaining ring (38) and install it in the drum (9). Carefully let off the pliers until retaining ring seats in the groove in the drum (9). Install the drum and support plate to the clutch shaft.

29. Alternately install one internally splined friction disc (40) and one externally splined separator plate (41), ending with an internally splined friction disc, into the drum (9).

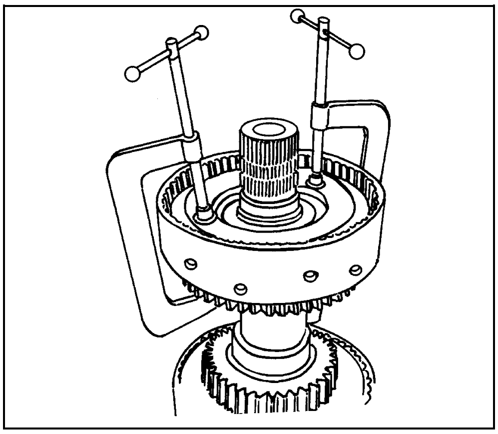


NOTE: *The internally splined friction discs must be thoroughly oiled (with same oil as used in the transmission) prior to assembling in the drum. Because the facing is porous and absorbs oil, a light oiling may be not sufficient. Whenever possible, the discs must be soaked, for at least two minutes, in a container of clean transmission oil. If facilities are not available for soaking, a heavy oiling on both surfaces may be sufficient*.

30. Install the second clutch piston (47) over the return springs (46) into the drum with lube sleeve (48). Install a new O-ring (49) to the lube sleeve (48) and position between the shaft and piston being careful not to damage the O-ring.

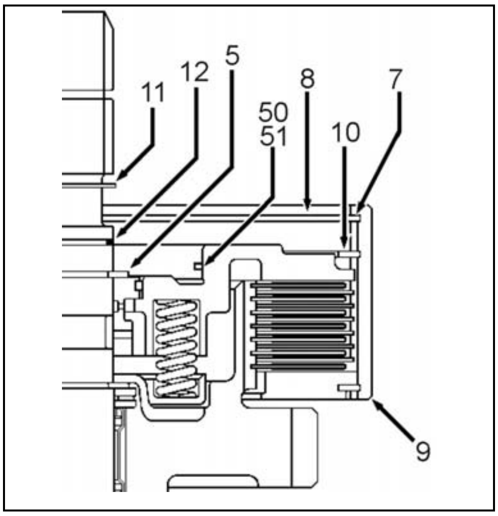


31. Using two C clamps, compress the second clutch piston (47) and secure with the retaining ring (5). Remove the clamps.



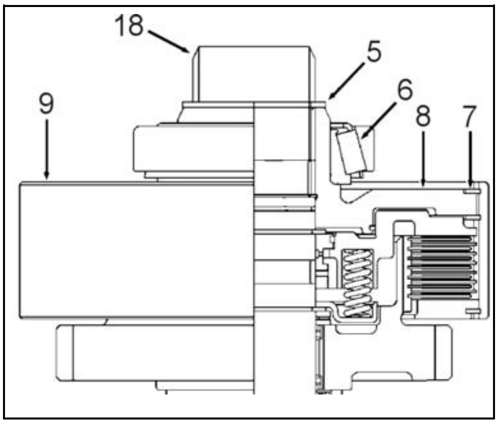
WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme caution when assembling.

32. Install O-ring (12) and internal retaining ring (11) to the clutch shaft. Install a new O-ring (51) and seal ring (50) to the second clutch hub (8). Install the hub into drum (9) being careful not to damage the seals. Secure with the retaining rings (5 and 7).



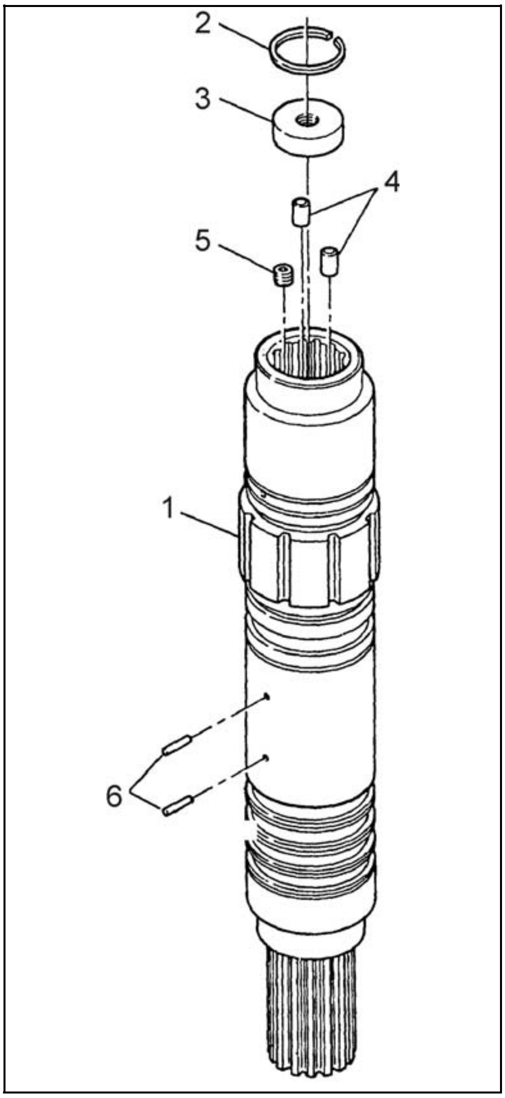
33. If bearing cone (6) was removed, heat new bearing cone to 120 [°C] for 45 minutes and install on hub (8) until it bottoms. To assure cone is properly seated on hub (8), keep pressure against the cone until it cools down.

NOTE: *If bearings were replaced, press new bearing cup (6) in cover (3, Fig. 7C.5), and press new bearing cup (1) in cover (20, Fig. 7C.5).*



Directional Clutch Shaft (Refer to Fig. 7C.8)

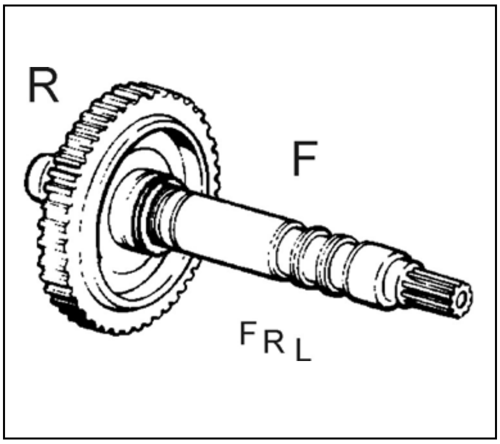
34. Reassemble component parts (2 through 6) in reverse sequence.



1. Input Shaft
2. Retaining Ring
3. Shaft Adapter
4. Dowel Pin
5. Metering Plug
6. Spring Pin

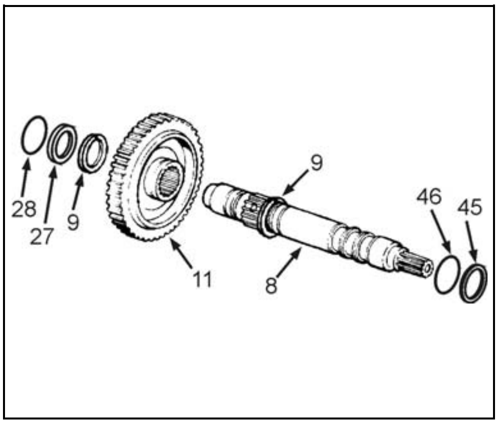
NOTE: *Press in two spring pins (6) to shaft holes (1) down to depth 1.3 [mm] from shaft surface. Do not damage the surface during process.*

NOTE: *When assembling the hub to the shaft, the porting between the two parts is critical. Align the porting accordingly.*

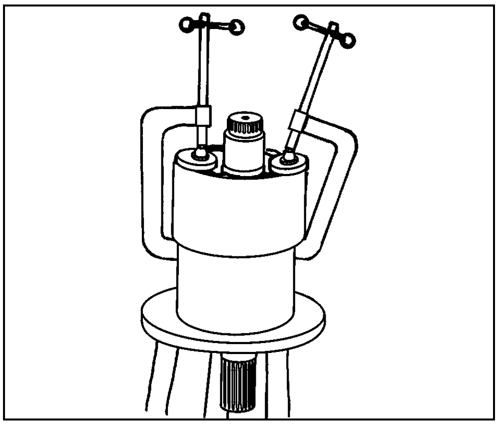


R – REVERSE
F – FORWARD
L – LUBE

TRANSMISSION



35. If removed, install one retaining ring (9) to the clutch shaft (8). Heat the hub (11) to 200 [°C] and press it on the shaft until it bottoms on retaining ring (9). Reinstall the second retaining ring (9). After the hub has cooled, install the O-rings (46 and 28) and seal rings (45 and 28) on each side of the hub (11) respectively.
36. If retaining ring (12) was removed, install the ring inside the drum (10). Position the drum (10) on the hub and clutch shaft and secure with the remaining retaining ring (12).



37. Place the shaft in a suitable stand so that the splined end is down. Install a new seal ring (47) and O-ring (48) on the reverse piston (44) and install the piston in the drum (10) being careful not to damage the piston rings.
38. Reassemble component parts (35 through 39) on the shaft in reverse sequence. Compress the springs (36) and secure with the retaining ring (34).

WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme caution when assembling.

39. Alternately install one internally splined friction disc (42) and one externally splined separator plate (43), ending with an internally splined friction disc, into the drum (10).

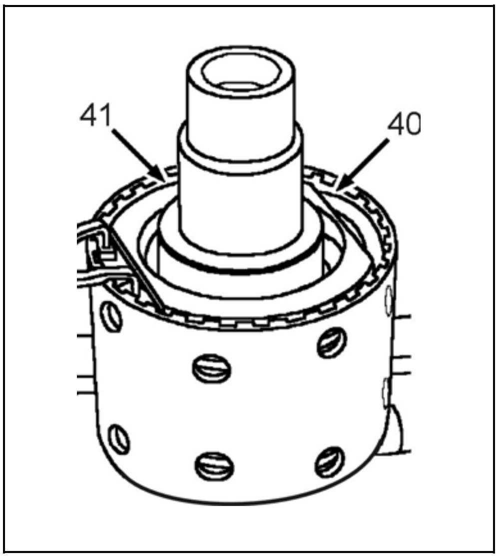
NOTE: *The internally splined friction discs must be thoroughly oiled (with same oil as used in the transmission) prior to assembling in the drum. Because the facing is porous and absorbs oil, a light oiling may be not sufficient. Whenever possible, the discs must be soaked, for at least two minutes, in a container of clean transmission oil. If facilities are not available for soaking, a heavy oiling on both surfaces may be sufficient.*

40. Install the support plate (41) in the drum (10).

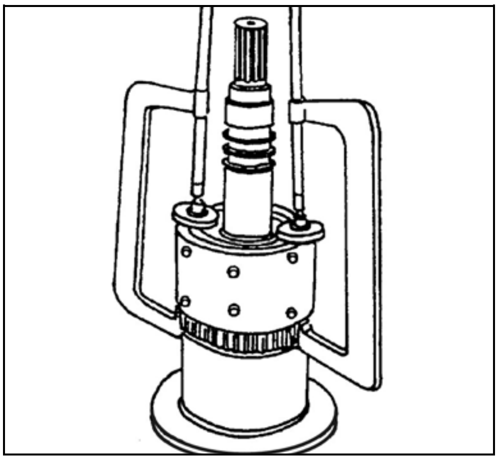
41. Using ring pliers, clamp the retaining ring (40) and install it in the drum (10). Carefully let off the pliers until retaining ring seats in the groove in the drum (10).

TRANSMISSION

42. Install the thrust bearing parts (32, 33, 32) and roller bearing (7) on the clutch shaft (8). Position the reverse drive gear (31) over the end of the shaft. Be sure all the internally splined discs (42) are aligned in drum (10) and that the gear meshes with all the discs and sits squarely on the roller bearing.
43. Reassemble the thrust bearing parts (2, 3, 2). Heat the bearing cone (1) to 80 – 100 [°C] for 45 minutes and install on the shaft until it bottoms. To assure cone is seated, keep pressure against the cone until it cools down.



44. Turn the shaft assembly over in the stand so that the splined end is up. Install new O-ring (30) and seal ring (29) on the forward piston (26) and install the piston into drum (10) being careful not to damage the seals.
45. Reassemble component parts (17 through 21) in reverse sequence. Compress springs (18) and install retaining ring (16).



WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme caution when assembling.

46. Alternately install one internally splined friction disc (24) and one externally splined separator plate (25), ending with an internally splined friction disc, into the drum (10).

NOTE: *The internally splined friction discs must be thoroughly oiled (with same oil as used in the transmission) prior to assembling in the drum. Because the facing is porous and absorbs oil, a light oiling may be not sufficient. Whenever possible, the discs must be soaked, for at least two minutes, in a container of clean transmission oil. If facilities are not available for soaking, a heavy oiling on both surfaces may be sufficient.*

TRANSMISSION

47. Install the support plate (23) in the drum (10)

48. Using ring pliers, clamp the retaining ring (22) and install it in the drum (10). Carefully let off the pliers until retaining ring seats in the groove in the drum (10).

49. Install the thrust bearing parts (14, 15, 14) on the clutch shaft. Position the forward drive gear (13) over the end of the shaft. Install roller bearing (7) in the bore of gear (13). Be sure all the internally splined discs (24) are aligned in drum (10) and that the gear meshes with all the discs and sits squarely on the roller bearing. Install the thrust bearing parts (2, 3, 2).

50. Install new shaft seals (6) to the grooves on the shaft. Install the oil manifold (4) onto the shaft being careful not to damage the seals.

NOTE: *If bearings (5) were replaced from the clutch manifold (4), press in the new bearings 0 ÷ 0.25 [mm] below face.*

51. Install the thrust bearing parts (2, 3, 2).

52. Heat bearing cone (1) to 120 [°C] for 45 minutes and install on the shaft until it bottoms. To assure cone is seated, keep pressure against the cone until it cools down a few seconds.

NOTE: *If bearings were replaced, press new bearing cup (1) in cover (3, Fig. 7C.5), and press new bearing cup (1) in cover (24, Fig. 7C.5).*

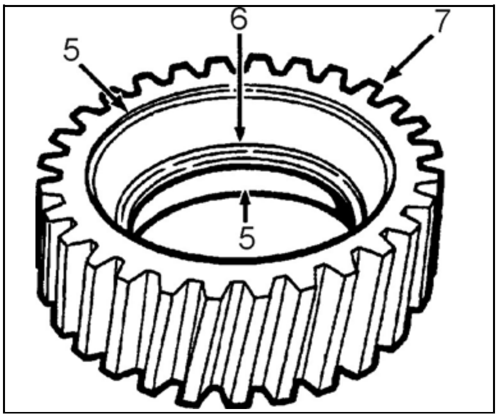
Countershaft (Refer to Fig. 7C.7)

53. Reassemble component parts in sequence (9, 8, 6, 7, 6, 4, 3, 2).
54. Heat bearing cones (1) to 120 [°C] for 45 minutes and install on the shaft until it bottoms. To assure cones are seated, keep pressure against the cones until they cool down a few seconds.

NOTE: *If bearings were replaced, press new bearing cup (1) in cover (3, Fig. 7C.5), and press new bearing cup (1) in cover (20, Fig. 7C.5).*

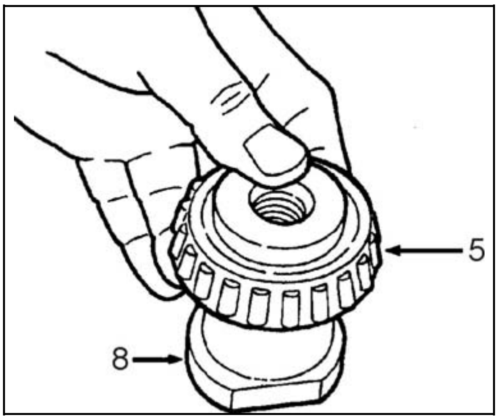
Reverse Idler Shaft (Refer to Fig. 7C.6)

55. If bearings or gear were replaced, check that retaining ring (6) is properly seated in the groove inside gear (7) and press one bearing cup (5) in the gear bore until it bottoms on ring (6). Turn the gear over and press the second bearing cup (5) in the gear bore until it bottoms on ring (6).



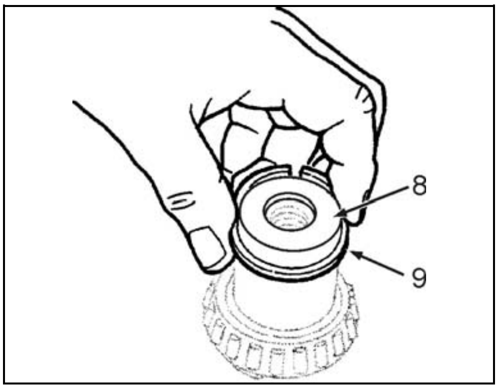
NOTE: *An internal retaining ring (6) separates the two cups inside gear (7).*

56. If bearing or shaft was replaced, heat bearing cone (5) to 120 [°C] for 45 minutes and install on shaft (8) until it bottoms. To assure cone is seated, keep pressure against the cone until it cools a few seconds.

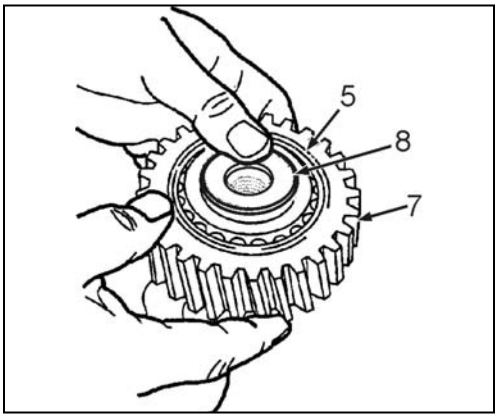


TRANSMISSION

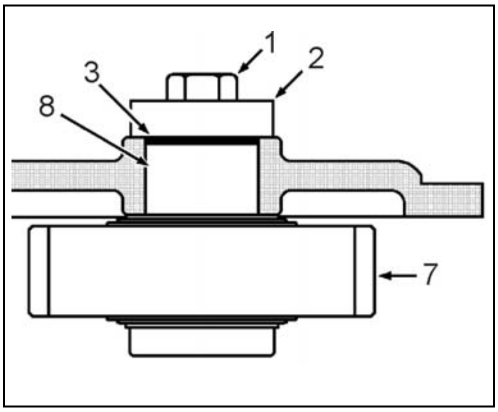
57. Install spacer (9) on the shaft (8).



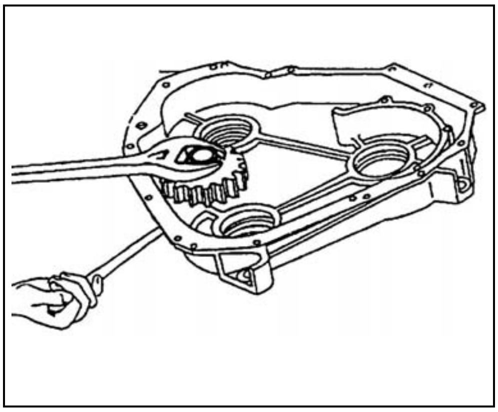
58. Insert the shaft (8) through gear (7). Heat bearing cone (5) to 120 [°C] for 45 minutes and install on shaft (8) until it bottoms against spacer (9). To assure cone is seated, keep pressure against the cone until it cools a few seconds.



59. Insert the shaft into the transmission cover. Install O-ring (3) and plate (2) on the outside of the transmission cover and secure with the bolt (1).

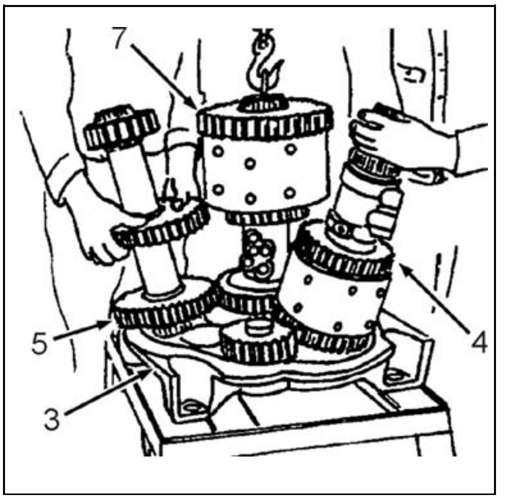


60. Torque the bolt to 325 ± 10% [Nm].

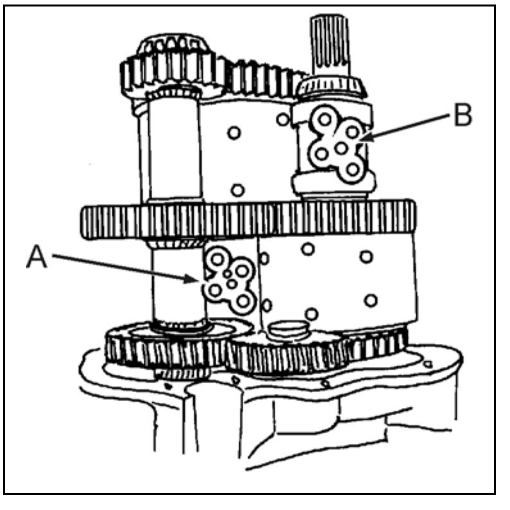


Transmission Case and Cover (Refer to Fig. 7C.5)

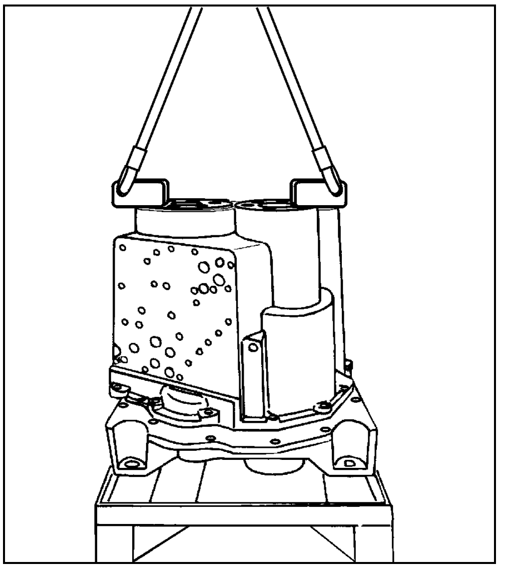
61. Position cover (3) on the work stand. Attach a hoist to range clutch shaft (7) and lower the shaft on cover (3). Do not set the shaft all the way down.
62. Install shafts (4 and 5) on cover (3) and lower shaft (7) all the way down. Remove the hoist and eyebolt.



63. Turn manifold (A) so that the ports are aimed between the countershaft and the input shaft. Turn manifold (B) so that the ports are aimed in the same direction.
64. Install sump pipe spacers on the studs in housing (15). Install transmission strainer (14) on the studs and secure with the two nuts and washers.



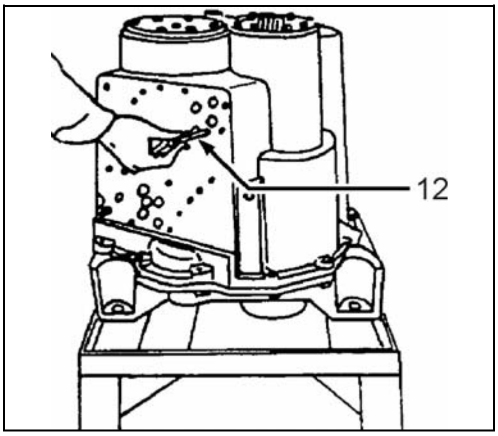
65. Apply LOCTITE #515 to the mating surfaces of cover (3) and housing (15) according to the instructions on the container. Hoist the housing (15) and lower it over the shafts until dowel pins (16) enter cover (3). Secure with bolts and washers previously removed. Torque the bolts to 92 [Nm].



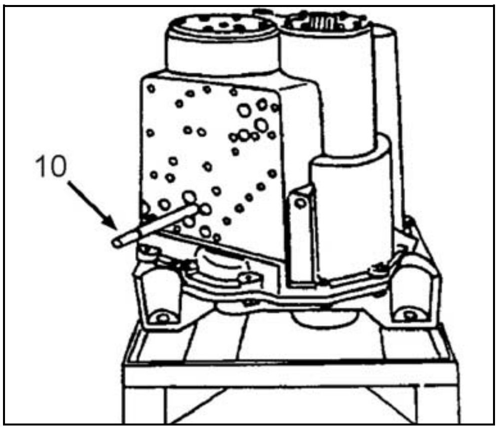
TRANSMISSION

66. Insert manifold-short support (12) through the opening in housing (15) and thread it into the manifold of directional clutch shaft (4).

NOTE: *The directional clutch shaft can be rotated to enhance positive thread engagement into the clutch shaft manifold.*



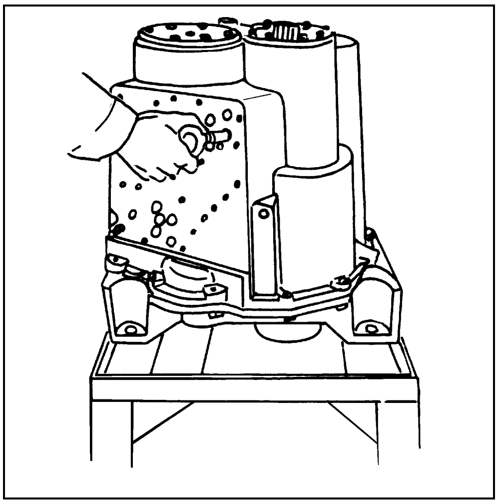
67. Insert manifold-long support (10) through the opening in housing (15) and into the manifold of range clutch shaft (7).



68. Install new seal rings (9) on tubes (11 and 13). Install the O-rings (8) over seal rings. Insert tubes (11 and 13) through the openings in housing (15). Using an eyebolt in the end of the tubes, insert them into the manifolds.

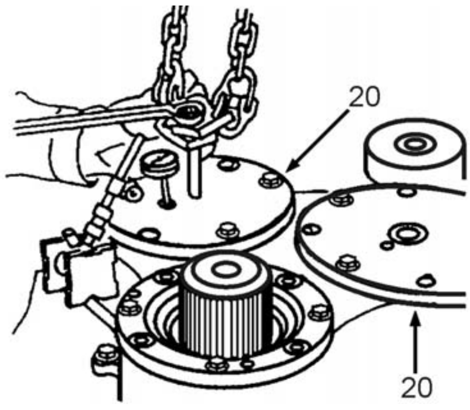
NOTE: *Do not pull the tubes all the way out once the first set of seal rings have passed through the housing (15). The inside edge of the holes will damage the seal rings.*

69. Install new O-rings (17 and 18) on flange (19) and secure the flange to housing (15) with the two bolts previously removed.
70. Install new O-rings (2) on covers (20 and 24). Install oil seal (23) in input cover (24).

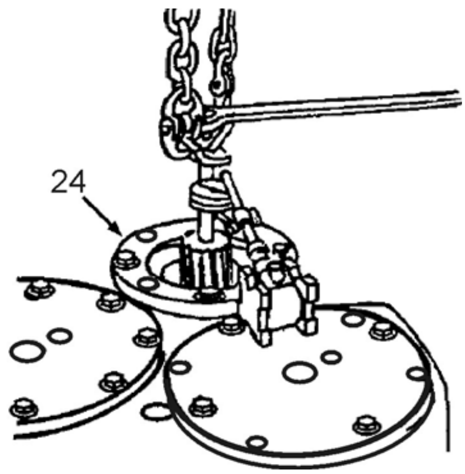


TRANSMISSION

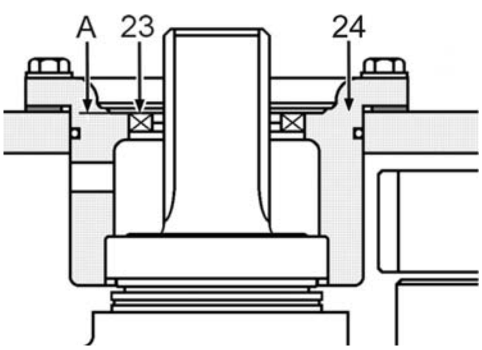
71. If a new transmission housing or cover has been installed or any shaft, bearing or gears replaced, it will be necessary to check the end play of the shafts. If it was not necessary to replace any of these parts, using the original shims will result in the proper end play.
72. To check the countershaft (shown) or range clutch shaft end play, secure the covers (20) with the original shim packs (21) to the housing (15) using standard torque. Remove plugs (22) from shaft covers (20). Install a hoist by threading the bolt into the shaft. Mount a dial indicator on the housing, place the indicator pointer on the end of the shaft and set the indicator at zero. Raise the hoist until the transmission begins to raise and take a reading. Add or subtract shims to obtain the proper end play, refer to Paragraph 3, SPECIFICATIONS in this Section. To regulate end play, shims (21) must be used. The thickness of the shims available are: 0.5 [mm], 0.12 [mm] and 0.18 [mm].
73. Install the proper amount of shims (21) and secure covers (20) to housing (15).Torque the bolts to 38 [Nm]. Install plugs (22) in shaft covers (20).



74. To check the directional clutch shaft end play, secure the cover (24) with the original shim packs (1) to the housing (15) using standard torque. Install a hoist by threading the bolt into the shaft. Mount a dial indicator on the housing, place the indicator pointer on the end of the shaft and set the indicator at zero. Raise the hoist until the transmission begins to raise and take a reading. Add or subtract shims to obtain the proper end play, refer to Paragraph 3, SPECIFICATIONS in this Section. To regulate end play, shims (1) must be used. The thickness of the shims available are: 0.5 [mm], 0.12 [mm] and 0.18 [mm].
75. Install the proper amount of shims (1) and secure the cover (24) to housing (15).Torque the bolts to 38 [Nm].



76. Install oil seal (23) in input cover (24) flush with the edge (A) of the cover and install drive yoke.



TRANSMISSION

8. INSTALLATION

1. Be sure the mating surfaces of the valves manifold and housing are clean and free of any old gasket material. Install the manifold (1) with new gasket (2) as shown in Fig. 7C.4. Install the orifice strainer (4, Fig. 7C.1).
2. Be sure the mating surfaces of the rate of rise valve and valves manifold are clean and free of any old gasket material. Install the rate of rise valve (3) with new gasket (11).
3. Remove the covering from the rear main frame opening.
4. Be sure the new O-rings (26 and 27, Fig. 7C.5) are properly seated. Position the transmission nearby the machine and attach the hoist to the eyebolt in the housing. Raise the transmission, place it into position and move it back toward the main frame, being sure the output shaft splines with the steering drive pinion shaft sleeve. Secure the transmission to the main frame with the hardware previously removed. Torque the transmission bolts to 920 [Nm]. Install suction hose (4, Fig. 7C.3) to main frame (5).
5. Remove the hoisting equipment. Remove the lifting eye from the top of the transmission.
6. Install the transmission universal joint (7, Fig. 7C.2) between the torque converter and transmission (12). Secure the universal joint to the drive yoke and to the torque converter output flange. Torque the bolts to 110 [Nm].

WARNING! Remove the wire or tape used to keep the bearings from falling from the spider trunnions. If installing a new spider and bearing assembly, remove the soft iron strap attached to the bearing caps. This will eliminate the possibility of the straps or wire breaking loose from the caps and causing personal injury when the engine is running.

7. Reconnect the transmission scavenge hose (3, Fig. 7C.3) to the transmission (1).
8. Reconnect the torque converter breather hose (2) to the transmission (1).
9. Be sure the mating surfaces of the range selector valve (2, Fig.7C.2), pressure regulator valve (11) and transmission manifold (13) are clean. Reinstall the valves (with hoses still attached) with new mounting O-rings (8, 9 and 10, Fig. 7C.1) on the transmission manifold (7).
10. Reconnect pressure supply hose (5, Fig. 7C.2) to the pressure regulator valve (11). Reconnect torque converter supply hose (9) to the pressure regulator valve (11).
11. Reconnect drive train lock solenoid valve and gear shifting valve drain hoses to the housing of transmission (12).
12. Install RPM sensor (8) into the transmission housing. Carefully screw the sensor (8) in as far as it will go and until it just touches sensor gear. Undo the sensor ¾ turns and lock it with a lock nut. Install FWD and RWD travel pressure switches to the range selector valve (2). Reconnect the electrical harness wires to the travel pressure switches and RPM sensor (8).
13. Install suction strainer to pump hose (10) and suction strainer hose (3) to the suction strainer.
14. Install the ROPS, cab and platform, refer to SECTION 13, SUPERSTRUCTURE.
15. Refill the main frame and as described in the OPERATOR'S MANUAL. Start the engine. Check for leakage. If the main and range clutch oil warning lamp is lighting, make inspection and repair.
16. Check the oil pressures in the transmission as described in SECTION 7, Paragraph 10, TRANSMISSION AND TORQUE CONVERTER OIL PRESSURE TEST.
17. Install the front center floor plate and the transmission case guard.
18. Check the rear frame oil level and add oil if necessary.
19. After first 50 hours of operation, disassemble and clean the suction filter. Change the pressure filter.

PRESSURE REGULATOR VALVE

9. REMOVAL AND DISASSEMBLY (Refer to Fig. 7C.10 and 7C.11)

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

IMPORTANT: *When disconnecting hydraulic lines for any reason, they should be properly capped with the correct size plastic cap. If these caps are not available, tape or clean rubber corks may be used. Hydraulic openings must never be plugged with rags. This practice could easily introduce dirt or lint into critical hydraulic components of the machine. Tag all disconnected oil lines to facilitate easier installation.*

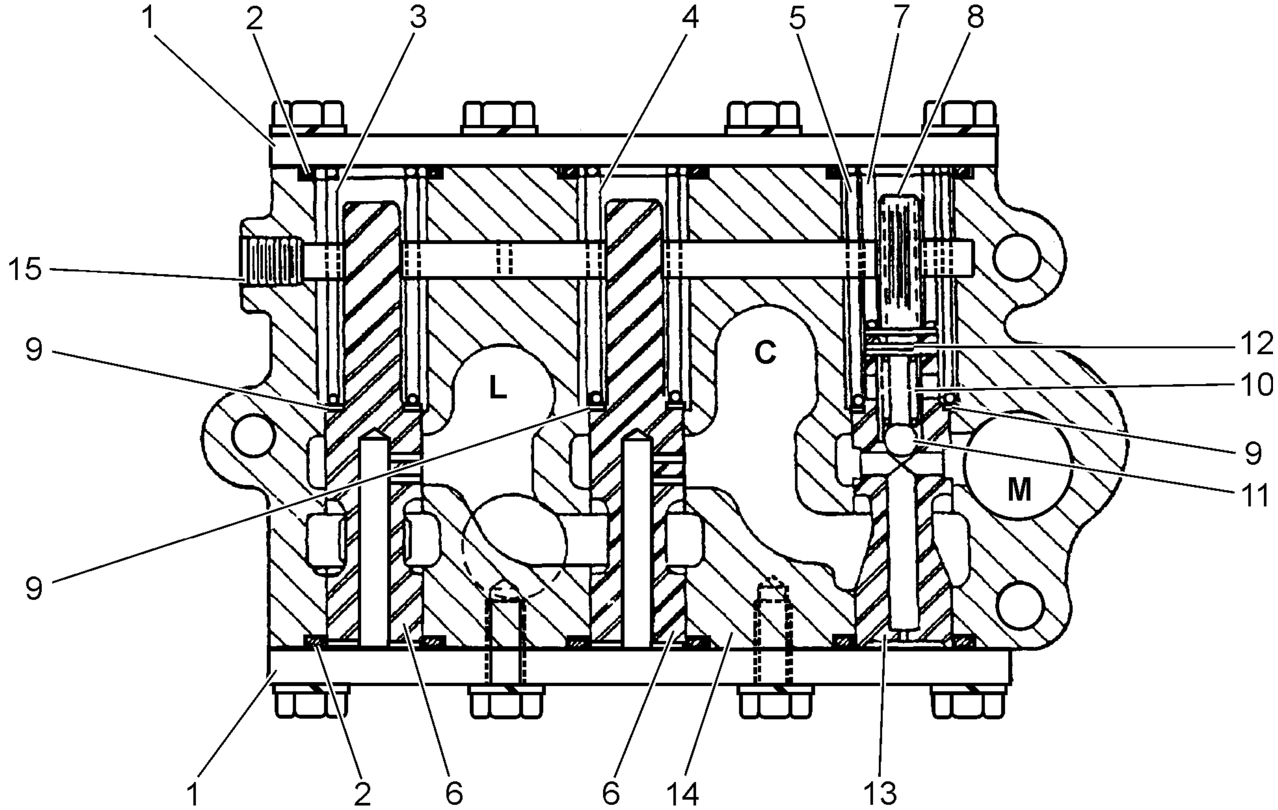


Fig. 7C.10. Cross Section of Pressure Regulator Valve

1. End Cover
2. O-Ring
3. Lube Spool Spring
4. Torque Converter Spool Spring
5. Main Spool Outer Spring
6. Lube or Torque Converter Spool
7. Main Spool Inner Spring
8. Spring Guide Pin
9. Shim
10. Ball Spring
11. Check Ball
12. Spring Pin
13. Main Spool
14. Valve Housing
15. Port Plug

PRESSURE REGULATOR VALVE

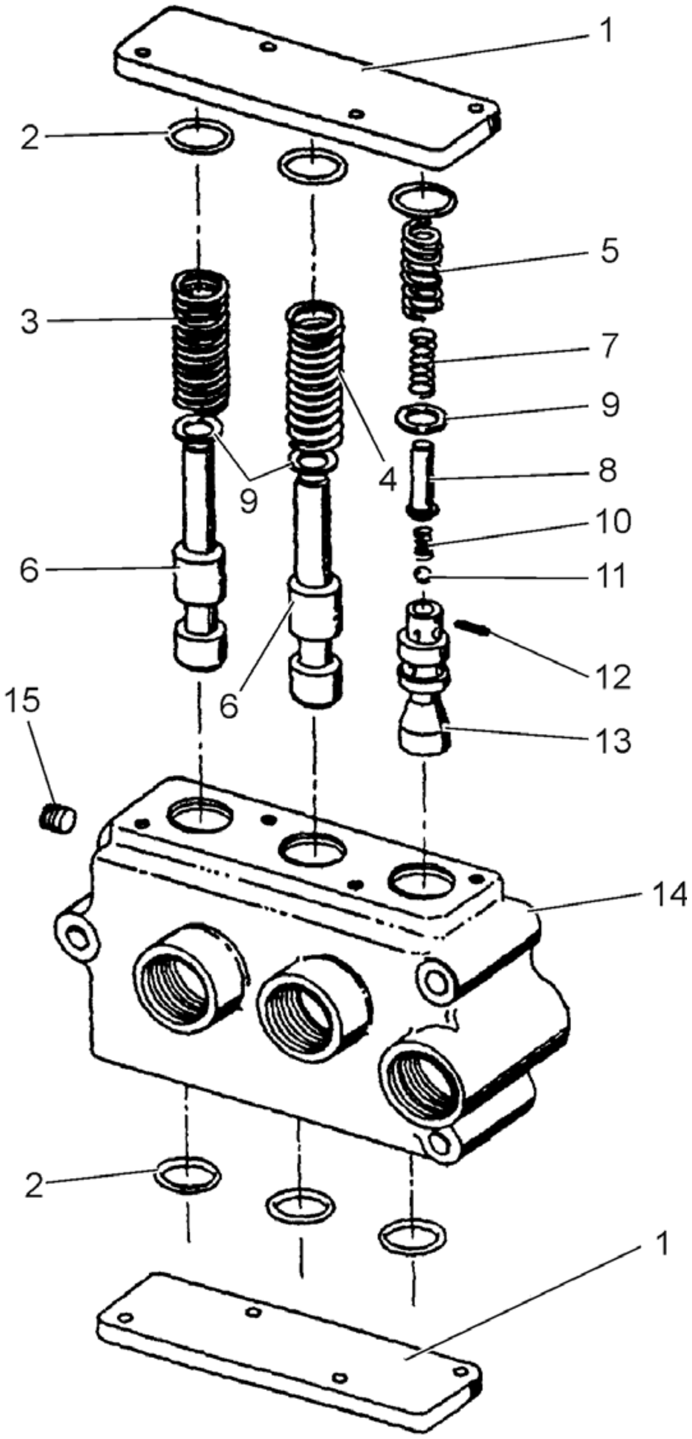


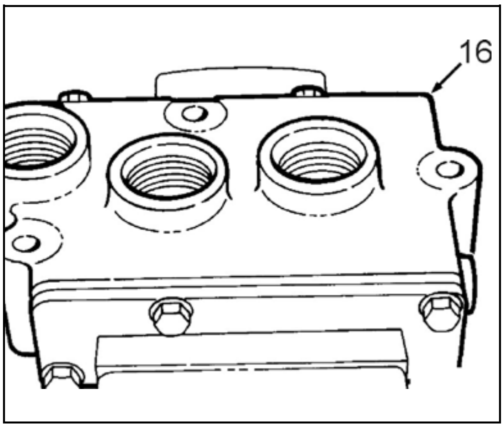
Fig. 7C.11. Exploded View of Pressure Regulator Valve

1. End Cover
2. O-Ring
3. Lube Spool Spring
4. Torque Converter Spool Spring
5. Main Spool Outer Spring
6. Lube or Torque Converter Spool
7. Main Spool Inner Spring
8. Spring Guide Pin
9. Shim
10. Ball Spring
11. Check Ball
12. Spring Pin
13. Main Spool
14. Valve Housing
15. Port Plug

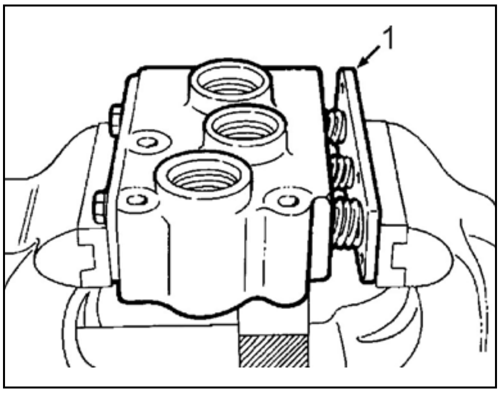
PRESSURE REGULATOR VALVE

1. Remove floor mat (cab equipped machines). Remove the bolts securing the center floor plate between seat and instrument panel and remove the plate.
2. Disconnect the hoses at pressure regulator valve and tag them.
3. Remove the bolts and washers securing the valve to top of the transmission housing. Remove the valve assembly and mounting O-rings.

4. Position the valve housing (16) into a vise, supporting the valve as necessary.

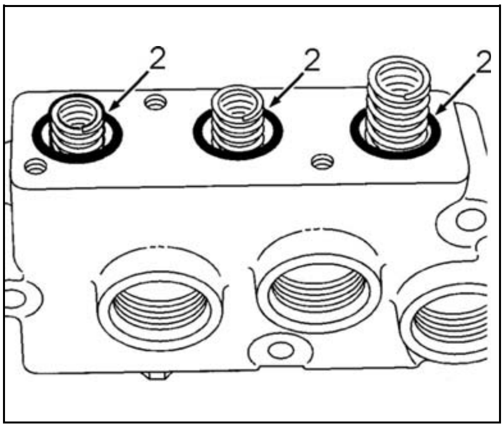


5. Remove the bolts and lock washers from the end cover (1). Slowly back off vise allowing springs to decompress.

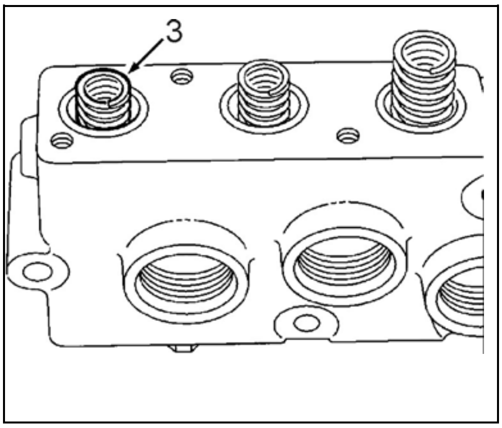


WARNING! Spring loaded assembly. Covers must be held to relieve spring pressure. Use extreme care when disassembling.

6. Remove the O-rings (2) from the valve housing and discard.

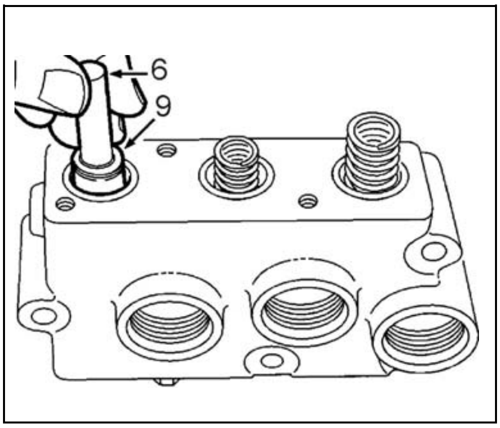


7. Remove the lube spool spring (3). Identify the spring for ease of testing and assembly.

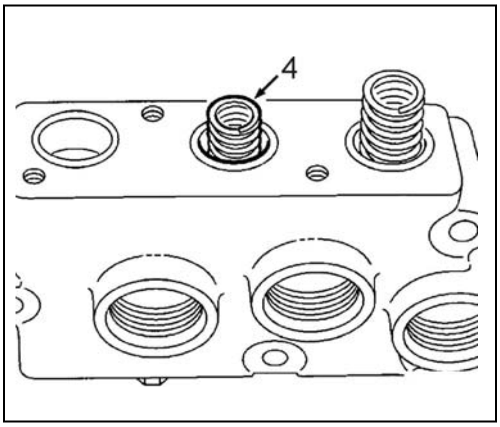


8. Remove the lube spool (6) with the spring shims (9). Keep the removed amount of shims with the spool.

NOTE: *Both the lube and converter spools (6) are interchangeable. Do not switch the spools in each others housing bore.*

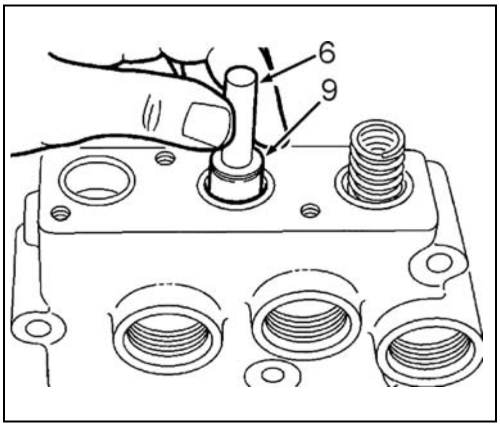


9. Remove the converter spool spring (4). Identify the spring for ease of testing and assembly.



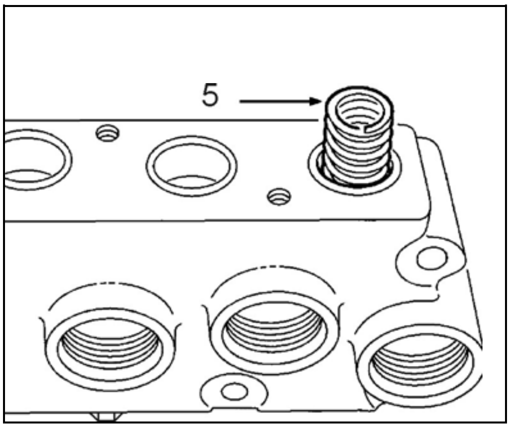
10. Remove the converter spool (6) with the spring shims (9). Keep the removed amount of shims with the spool.

NOTE: *Both the lube and converter spools (6) are interchangeable. Do not switch the spools in each others housing bore.*

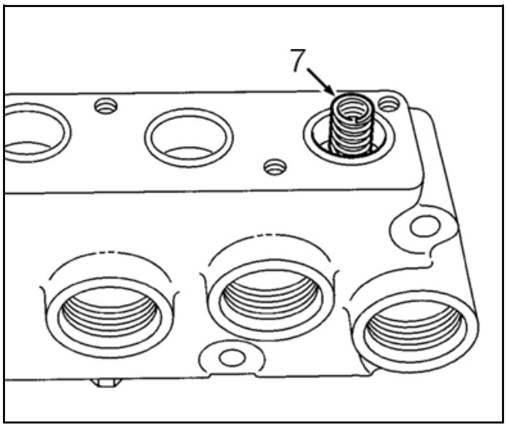


PRESSURE REGULATOR VALVE

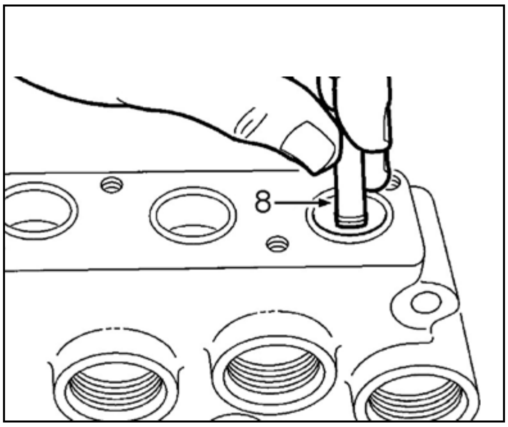
11. Remove the main spool outer spring (5). Identify the spring for ease of testing and assembly.



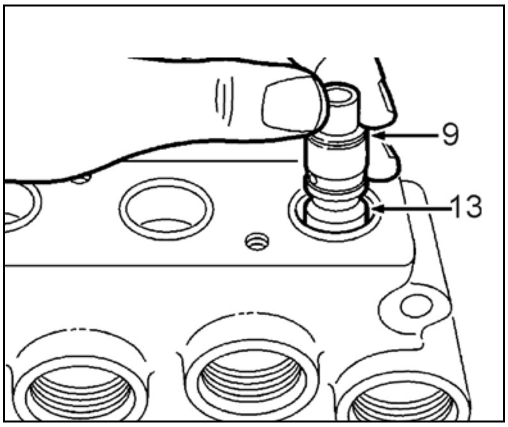
12. Remove the main spool inner spring (7). Identify the spring for ease of testing and assembly.



13. Remove the spring guide pin (8).



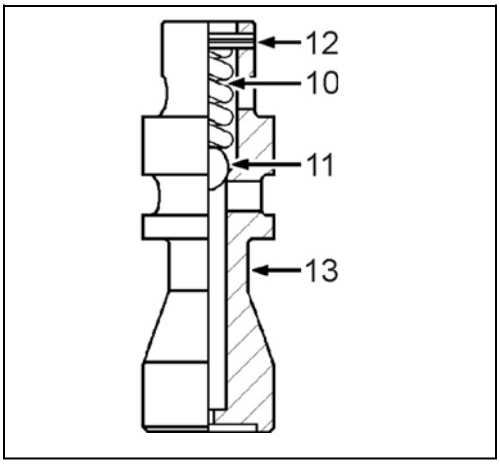
14. Remove the main spool assembly (13) with the spring shims (9). Keep the removed amount of shims with the spool.
15. Remove the remaining end cover (1) and discard the O-rings (2).
16. If necessary, remove port plug (15) from the valve housing (14).



17. If necessary, disassemble the main spool as follows;

Rest the assembly on a block of wood. Using a pin drift, drive the spring pin (12) from the spool (13) allowing the pin drift to retain the spring (10). Carefully remove the pin drift allowing the check ball spring to decompress. Remove the spring and check ball (11).

WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme care when assembling.



10. INSPECTION AND REPAIR

1. It is recommended that all new O-rings be installed upon reassembly of the valve.
2. Clean all parts in a suitable solvent and blow dry with compressed air. Be sure all oil passages in the valve housing and spools are clean and free of obstructions.
3. Inspect the parts for excessive wear and replace if necessary.
4. Inspect the condition of the springs. If they are damaged or do not fall within the specifications shown in Paragraph 3, SPECIFICATIONS, they must be replaced.

TRANSMISSION

PRESSURE REGULATOR VALVE

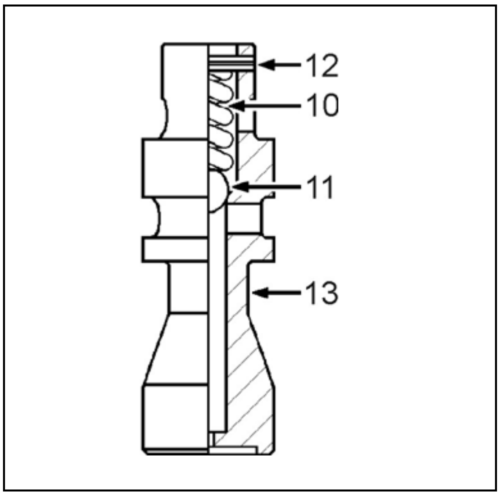
11. REASSEMBLY AND INSTALLATION (Refer to Fig. 7C.10 and 7C.11)

NOTE: *Lubricate the spools and valve bores with transmission oil upon reassembly*.

NOTE: *Be sure springs are assembled in the correct bore of the valve and the same amount of shims are installed as were removed from each bore.*

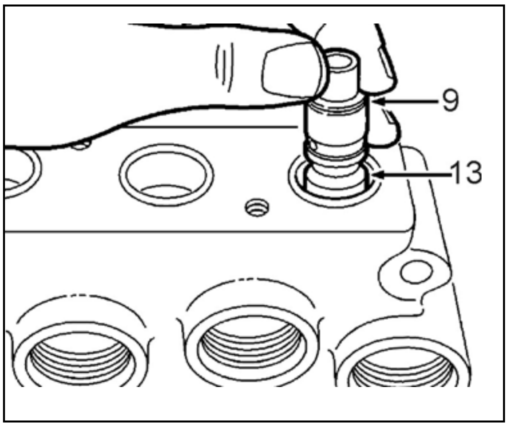
1. Reassemble the main spool as follows;

   Install the check ball (11) and the check ball spring (10) into the spool (13). Compress the spring and secure with the spring pin (12).



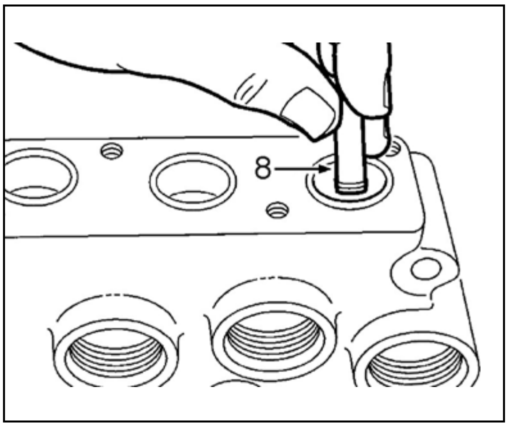
WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme care when disassembling.

2. Apply LOCTITE Pipe Sealant #569 to plug (15) and install in the valve housing (14) if removed.
3. Install new O-rings (2) into the bottom of the housing and bolt the bottom end cover (1) in place.
4. Install the main spool assembly (13) with the same amount of shims (9) that were removed.



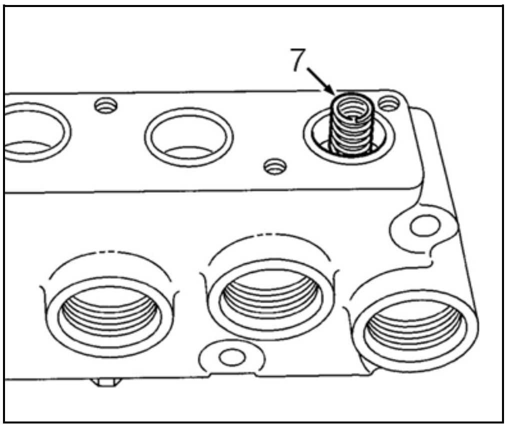
NOTE: *A total quantity of 3 shims can used under the spool spring. Each shim that is added or removed will raise or lower the main pressure by 35 [kPa].*

5. Install the spring guide pin (8) in the housing bore.

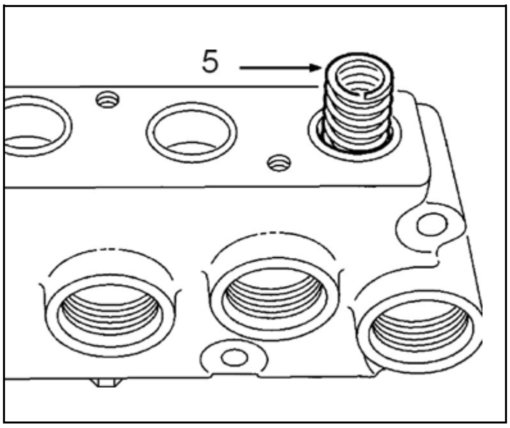


PRESSURE REGULATOR VALVE

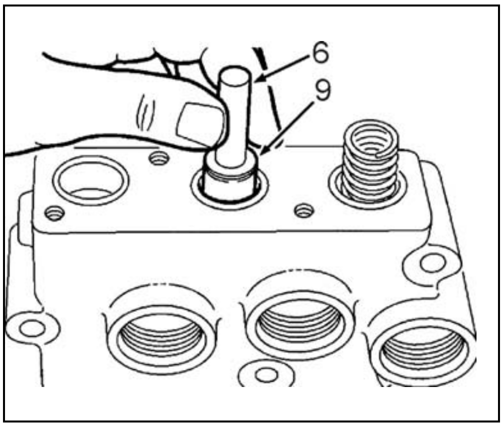
6. Install the main spool inner spring (7).



7. Install the main spool outer spring (5).



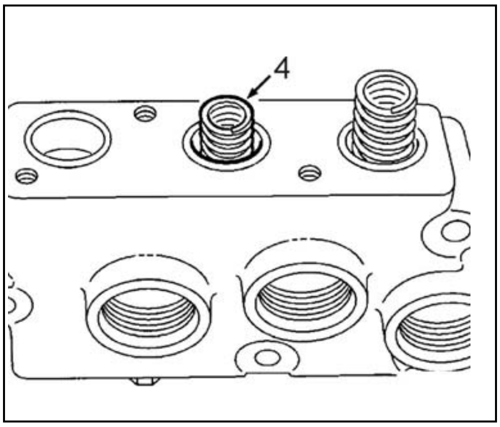
8. Install the converter spool (6) with the spring shims (9) that were removed with the spool.



NOTE: *A total quantity of 3 shims can used under the spool spring. Each shim that is added or removed will raise or lower the converter pressure by* 25 [kPa].

NOTE: *Both the lube and converter spools (6) are interchangeable. Do not switch the spools in each others housing bore.*

9. Install the converter spool spring (4).

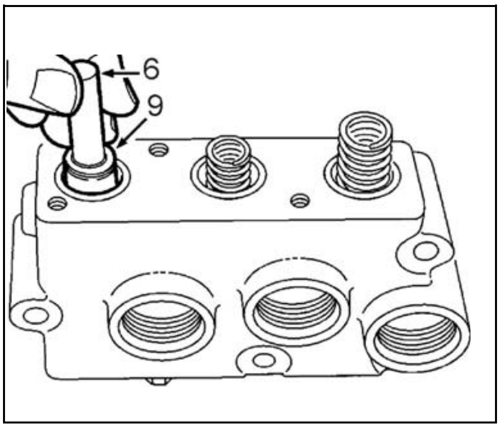


PRESSURE REGULATOR VALVE

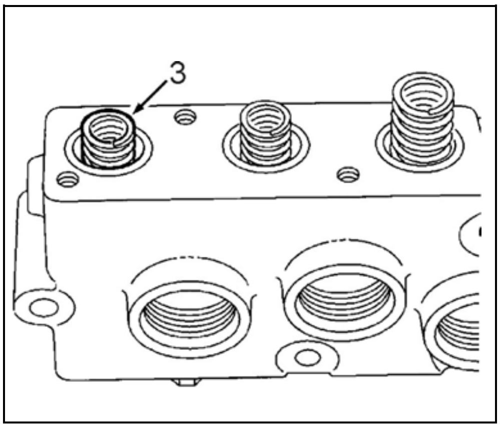
10. Install the lube spool (6) with the spring shims (9) that were removed with the spool.

NOTE: *A total quantity of 3 shims can used under the spool spring. Each shim that is added or removed will raise or lower the lube pressure by* 7 [kPa].

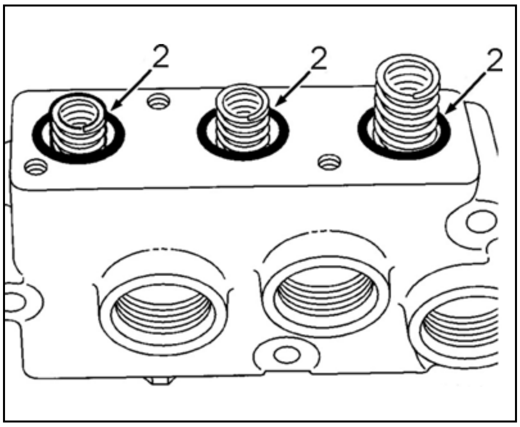
NOTE: *Both the lube and converter spools (6) are interchangeable. Do not switch the spools in each others housing bore.*



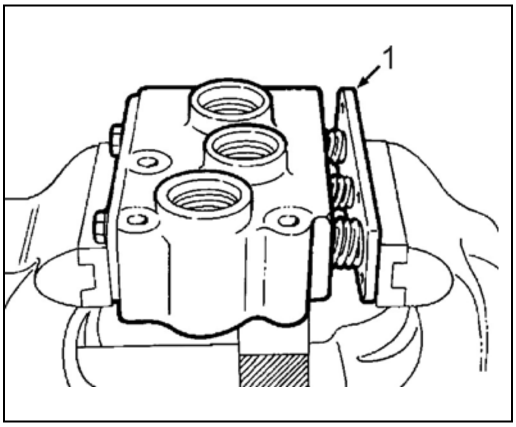
11. Install the lube spool spring (3).



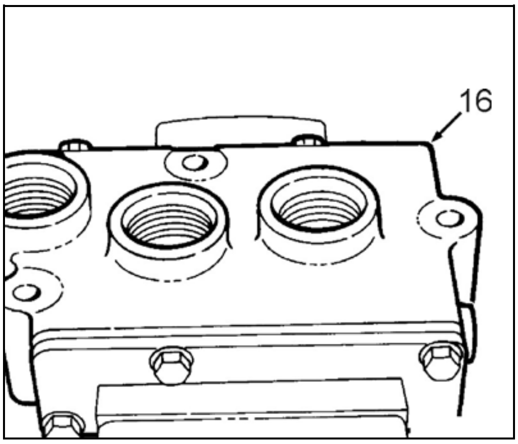
12. Install the new O-rings (2) into the housing grooves.



13. Position the valve housing and the top end cover (2) in the vise.



14. Slowly close the vise and install the mounting hardware to the cover (1). Tighten the bolts securing both covers (1) to a torque 26 - 28 [Nm].



WARNING! Spring loaded assembly. Covers must be held to relieve spring pressure. Use extreme care when assembling.

15. Position the valve and O-rings on top of the transmission housing and secure with bolts and washers. Torque the bolts to 42 - 50 [Nm].
16. Reconnect the hoses at the pressure regulator valve.
17. Check the oil level in the main frame as described in the OPERATOR'S MANUAL.

IMPORTANT! *As soon as the engine starts, observe the transmission main and range clutch oil pressure warning lamp on the dash. If lights, immediately turn off engine.*

18. Start the engine. Check for leaks. Check oil pressures as described in Paragraph 10, TRANSMISSION AND TORQUE CONVERTER OIL PRESSSURE TEST in SECTION 7.
19. Install the center floor plate between seat and instrument panel. Install the floor mat, if cab equipped.
20. Check oil level in rear main frame as described in OPERATOR’S MANUAL.

RANGE SELECTOR VALVE

12. REMOVAL AND DISASSEMBLY (Refer to Fig. 7C.12 and 7C.13)

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

IMPORTANT: *When disconnecting hydraulic lines for any reason, they should be properly capped with the correct size plastic cap. If these caps are not available, tape or clean rubber corks may be used. Hydraulic openings must never be plugged with rags. This practice could easily introduce dirt or lint into critical hydraulic components of the machine. Tag all disconnected oil lines to facilitate easier installation.*

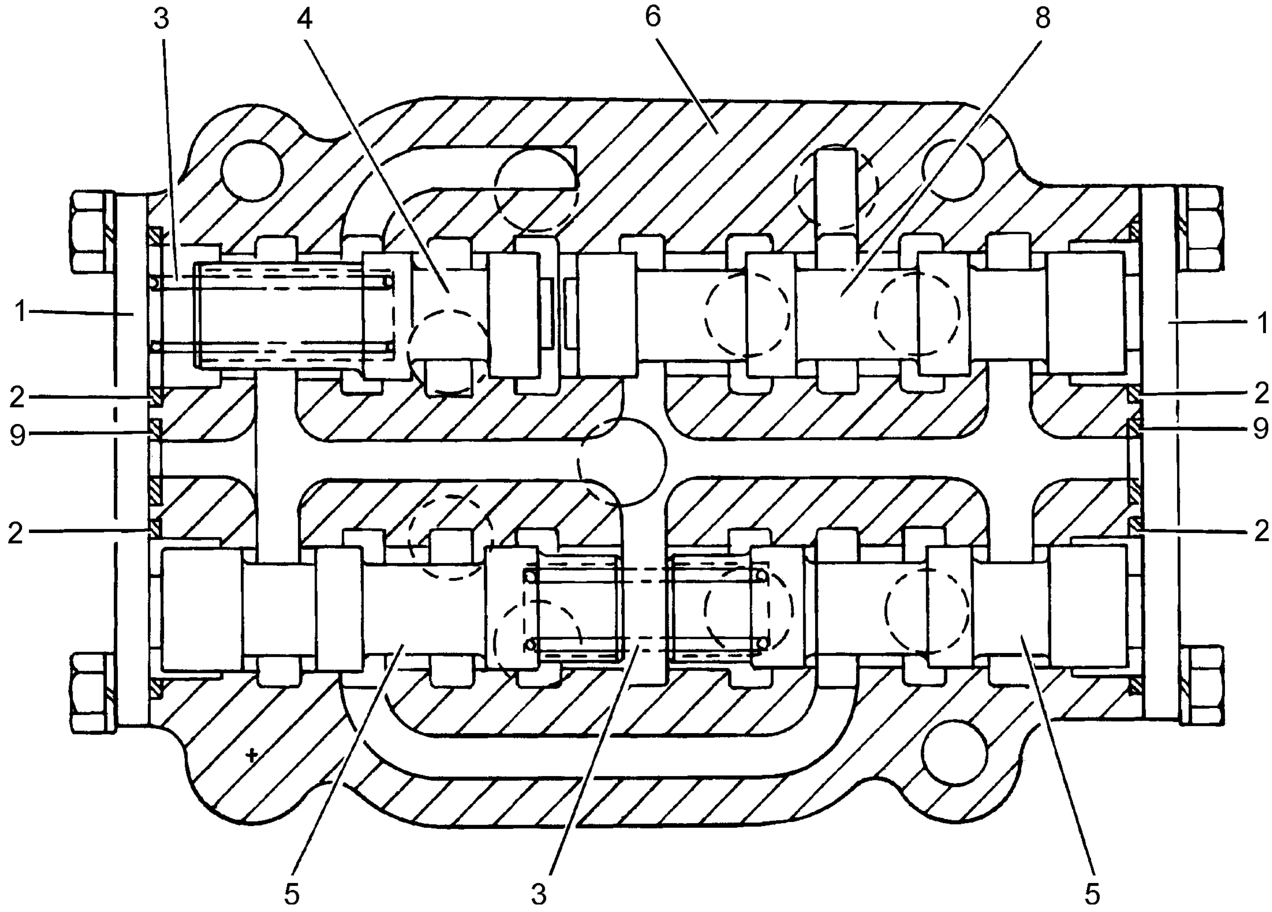


Fig. 7C.12. Cross Section of Range Selector Valve

1. End Cover
2. O-Ring
3. Return Spring
4. Switch Spool
5. Range Selector Spool
6. Valve Housing
8. Directional Spool
9. O-Ring

RANGE SELECTOR VALVE

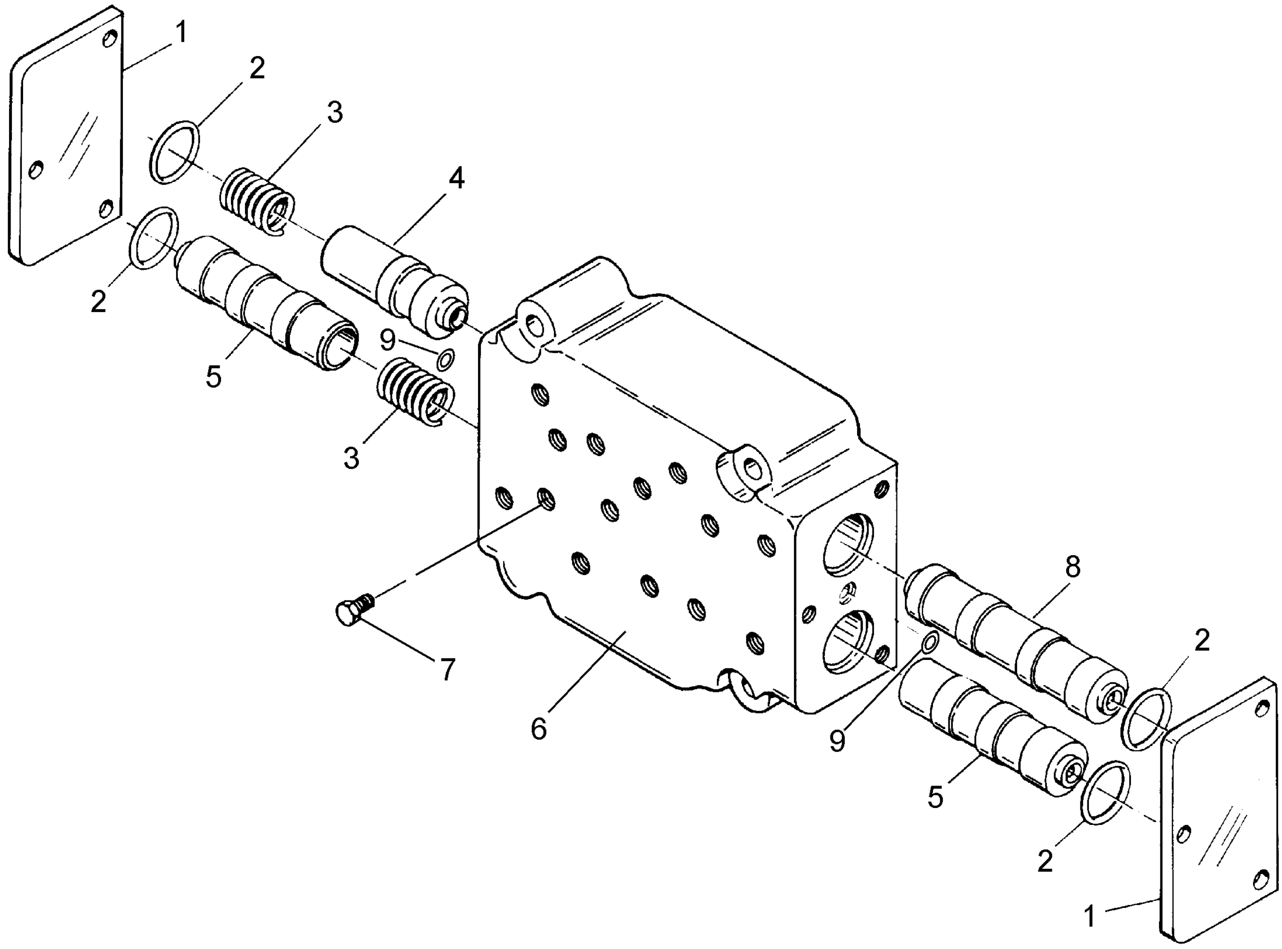


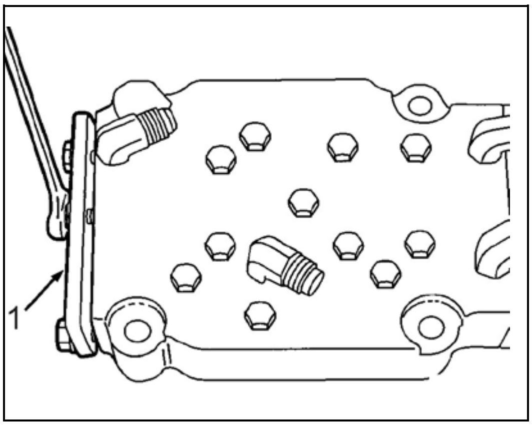
Fig. 7C.13. Exploded View of Range Selector Valve

1. End Cover
2. O-Ring
3. Return Spring
4. Switch Spool
5. Range Selector Spool
6. Valve Housing
7. Port Plug
8. Directional Selector Spool
9. O-Ring

1. Remove floor mat (cab equipped machines). Remove the bolts securing the center floor plate between seat and instrument panel and remove the plate.
2. Disconnect the hoses at range selector valve and tag them.
3. Remove the bolts and washers securing the valve assembly to the top of the transmission housing. Remove the valve assembly and mounting O-rings.

RANGE SELECTOR VALVE

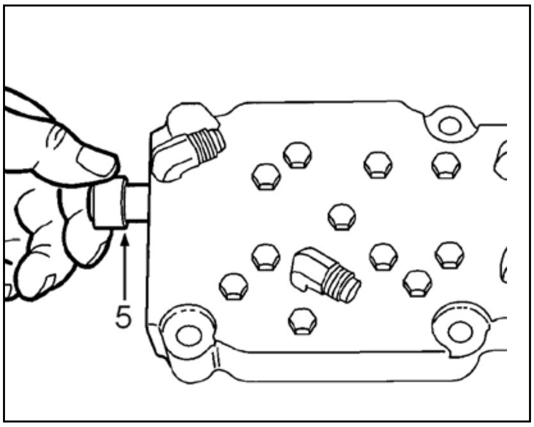
4. Slowly loosen the end cover (1) bolts until all the spring tension is relieved. Remove the end cover.



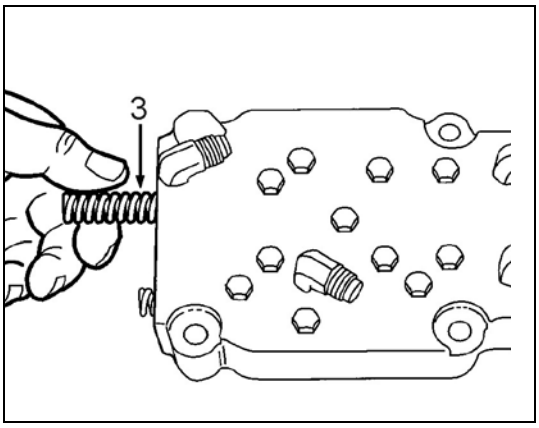
WARNING! Spring loaded assembly. Covers must be held to relieve spring pressure. Use extreme care when disassembling.

5. Remove the range selector spool (5) from the housing.

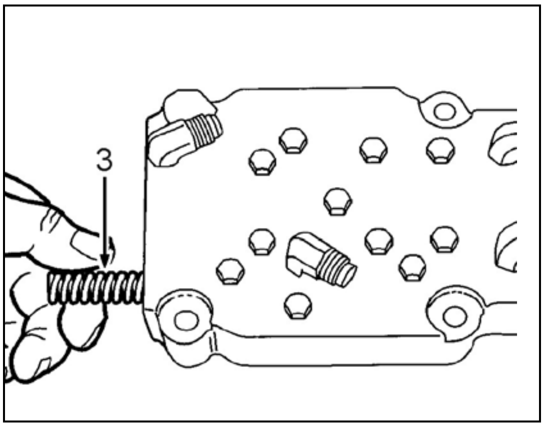
NOTE: *The spool is to be kept with the housing bore side that it was removed from.*



6. Remove the range spool return spring (3) from the housing bore.

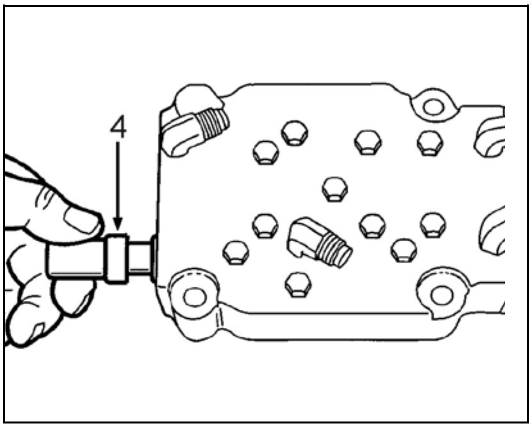


7. Remove the switch spool return spring (3) from the housing bore.

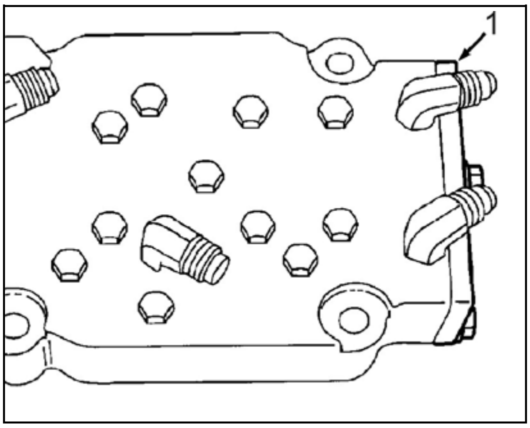


8. Remove the switch spool (4) from the housing bore.

NOTE: *The spool is to be kept with the housing bore side that it was removed from.*

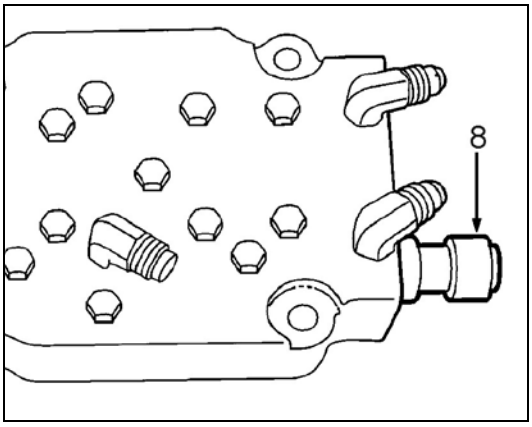


9. Remove the remaining end cover (1).



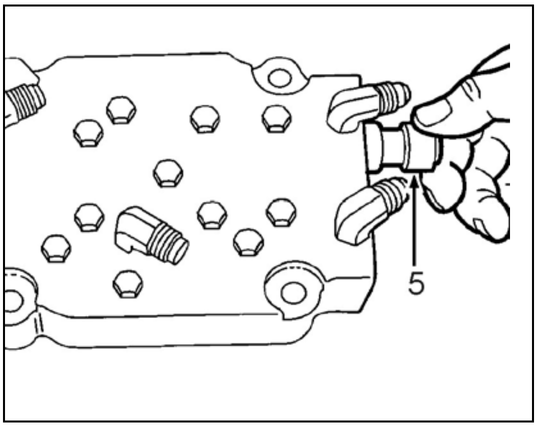
10. Remove the directional selector spool (8) from the housing.

NOTE: *The spool is to be kept with the housing bore side that it was removed from.*



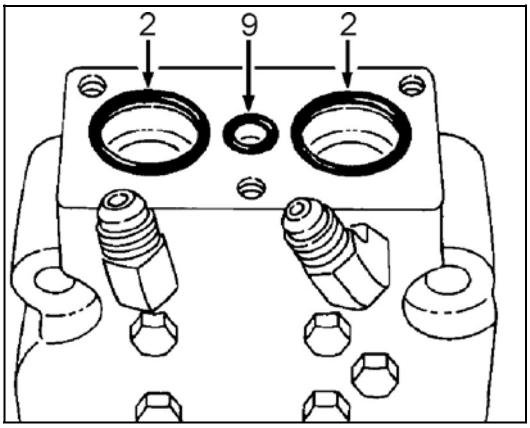
11. Remove the remaining range selector spool (5) from housing bore.

NOTE: *The spool is to be kept with the housing bore side that it was removed from.*



RANGE SELECTOR VALVE

12. Remove the large (2) and small (9) O-rings from each end of the housing. Discard the O-rings and replace with new.



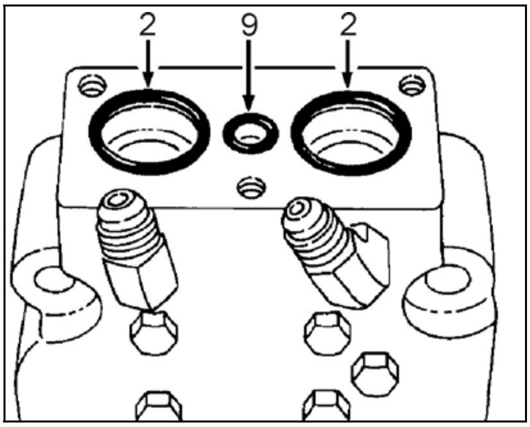
13. INSPECTION AND REPAIR

1. It is recommended that all new O-rings be installed upon reassembly of the valve.
2. Clean all parts in a suitable solvent and blow dry with compressed air. Be sure all the oil passages in the valve housing are clean and free of obstructions.
3. Inspect the parts for excessive wear and replace if necessary.
4. Inspect the condition of the springs. If they are damaged or do not fall within the specifications shown in Paragraph 3, SPECIFICATIONS, they must be replaced.

14. REASSEMBLY AND INSTALLATION (Refer to Fig. 7C.12 and 7C.13)

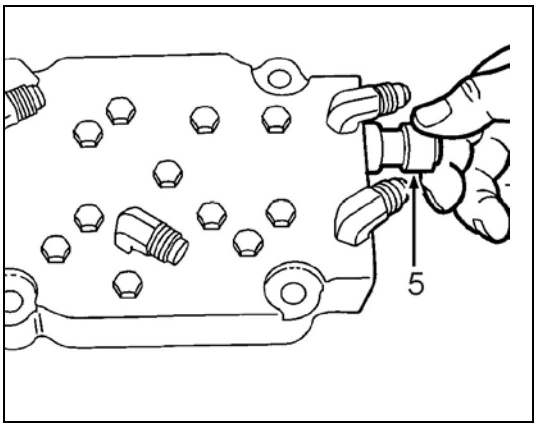
NOTE: *Lubricate the spools and valve bores with transmission oil upon reassembly.*

1. Coat the new large (2) and small (9) O-rings with amber grease and install in the counter bores in each end of the housing.

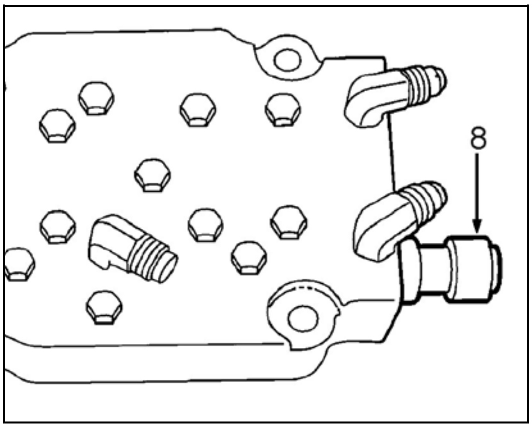


RANGE SELECTOR VALVE

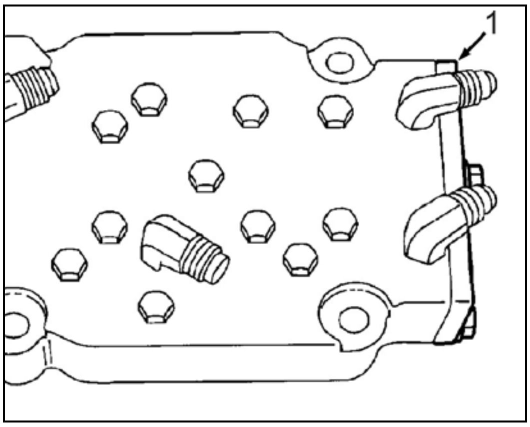
2. Install the range selector spool (5) into its housing bore.



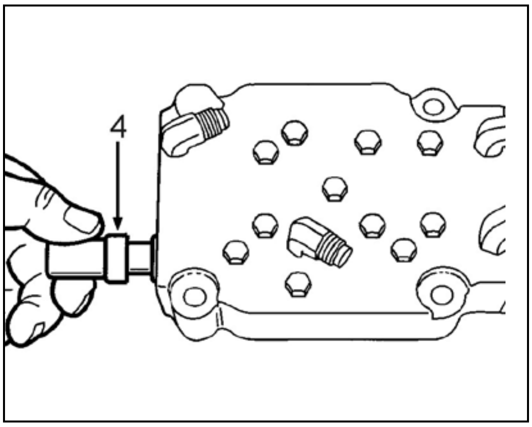
3. Install the directional selector spool (8) into its housing bore.



4. Install the end cover (1) and secure with the hardware.



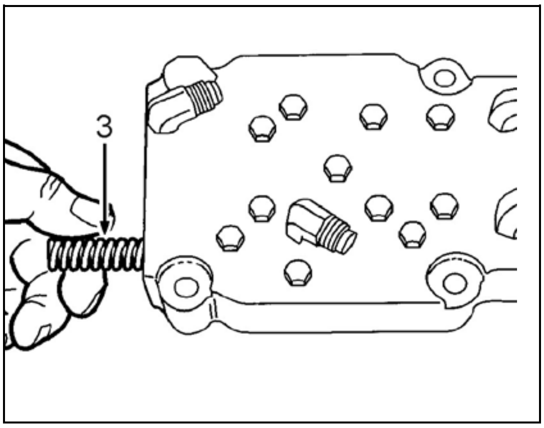
5. Install the switch spool (4) into its housing bore.



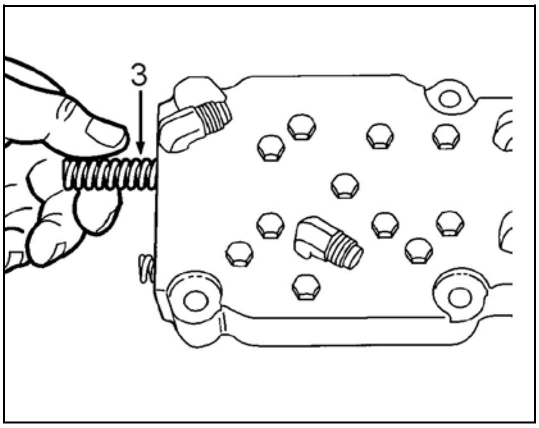
TRANSMISSION

RANGE SELECTOR VALVE

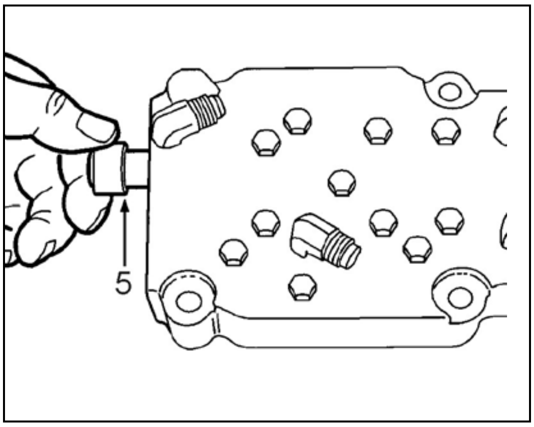
6. Install the switch spool return spring (3) into the spool.



7. Install the range spool return spring (3) into the spool.

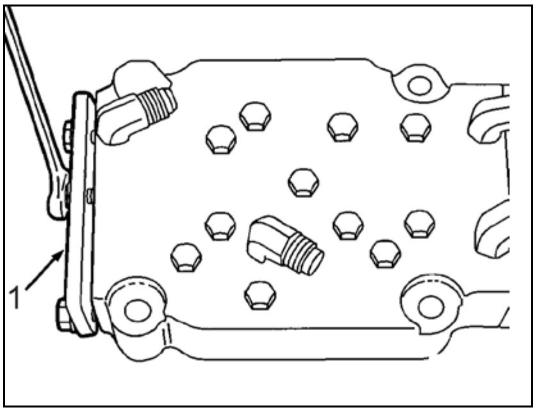


8. Install the remaining range selector spool (5) into its housing bore.



9. Install the end cover (1) and secure with hardware. Torque the bolts to 26 - 28 [Nm].

WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme care when assembling.



RANGE SELECTOR VALVE

10. Position the valve and O-rings on top of the transmission housing and secure with bolts and washers. Torque the bolts to 32 [Nm].
11. Reconnect the hoses at the range selector valve.
12. Check the oil level in the main frame as described in the OPERATOR'S MANUAL.

IMPORTANT! *As soon as the engine starts, observe the transmission main and range clutch oil pressure warning lamp on the dash. If lights, immediately turn off engine.*

13. Start the engine. Check for leaks. Check oil pressures as described in Paragraph 10, TRANSMISSION AND TORQUE CONVERTER OIL PRESSSURE TEST in SECTION 7.
14. Install the center floor plate between seat and instrument panel. Install the floor mat, if cab equipped.

RATE OF RISE VALVE

15. REMOVAL AND DISASSEMBLY (Refer to Fig. 7C.14 and 7C.15)

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

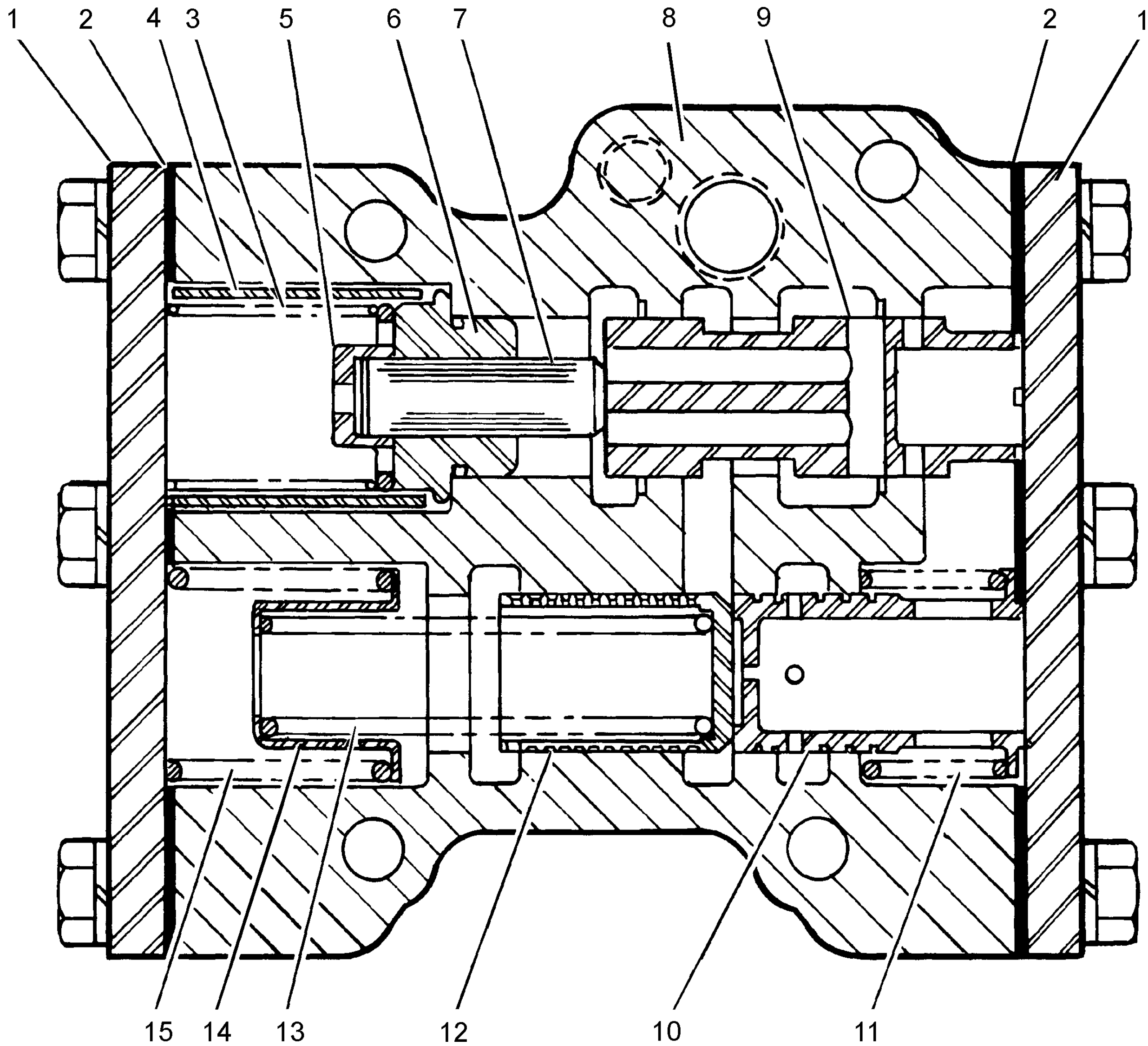


Fig. 7C.14. Cross Section of Rate of Rise Valve

1. End Cover
2. Gasket
3. Sequence Spool Spring
4. Spring Spacer
5. Sequence Valve Disc
6. Sequence Valve Spacer
7. Dowel Pin
8. Valve Housing
9. Sequence Valve Spool
10. Reducing Spool
11. Reducing Spring
12. Modulating Piston
13. Inner Piston Spring
14. Spring Retainer
15. Outer Piston Spring

RATE OF RISE VALVE

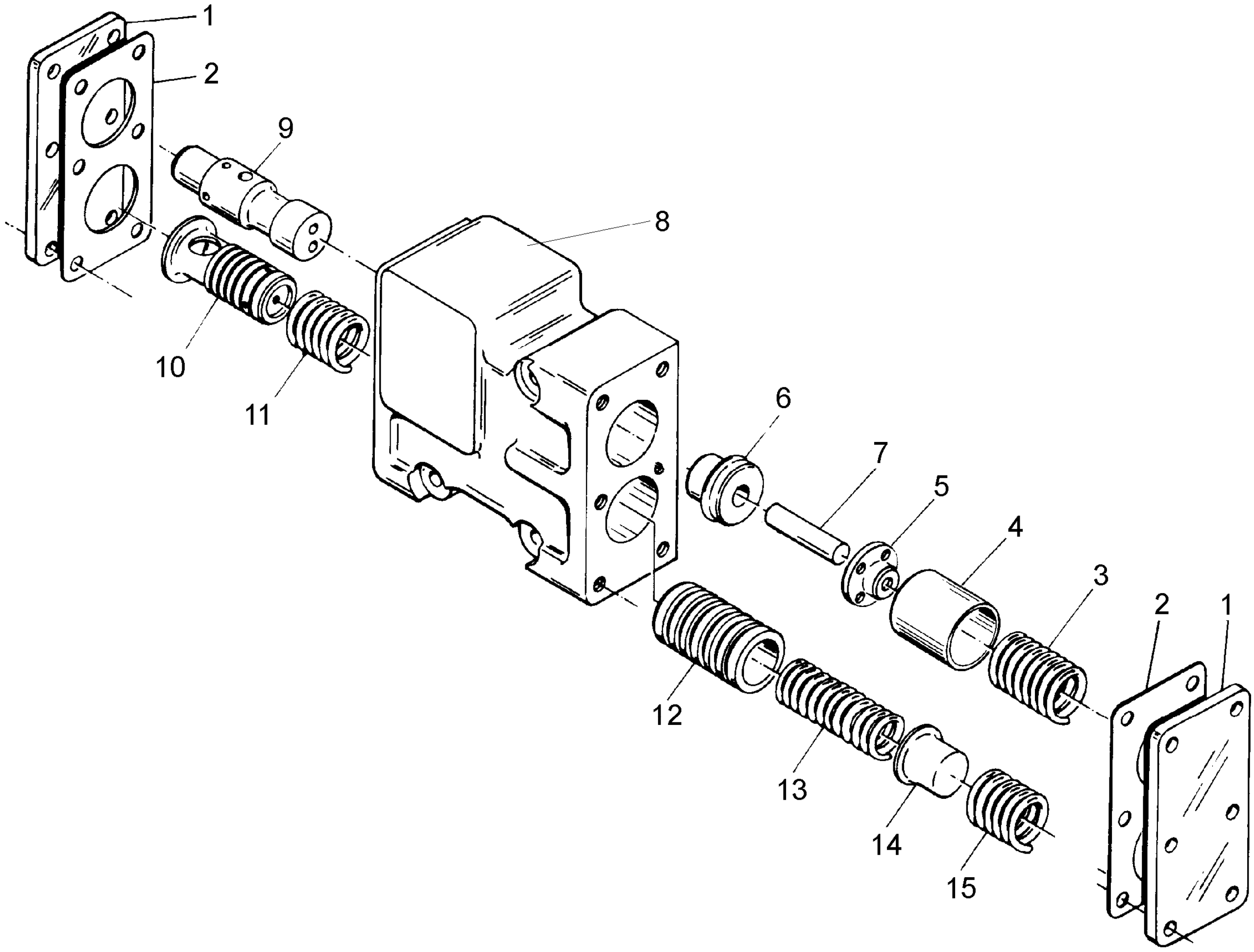


Fig. 7C.15. Exploded View of Rate of Rise Valve

1. End Cover
2. Gasket
3. Sequence Spool Spring
4. Spring Spacer
5. Sequence Valve Disc
6. Sequence Valve Spacer
7. Dowel Pin
8. Valve Housing
9. Sequence Valve Spool
10. Reducing Spool
11. Reducing Spring
12. Modulating Piston
13. Inner Piston Spring
14. Spring Retainer
15. Outer Piston Spring

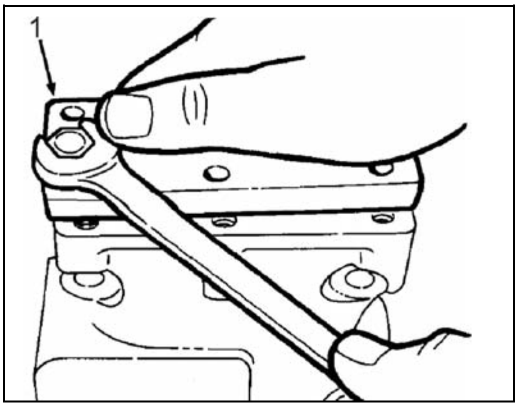
1. Remove floor mat (cab equipped machines). Remove the bolts securing the center floor plate between seat and instrument panel and remove the plate.
2. Disconnect the hoses at rate of rise valve and tag them.
3. Remove the bolts and washers securing the valve assembly to the top of the transmission housing. Remove the valve assembly and gasket. Discard the gasket.

TRANSMISSION

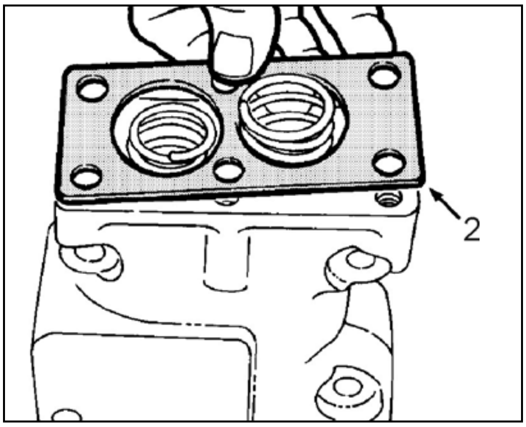
RATE OF RISE VALVE

4. While holding down on the end cover (1), slowly let off the mounting bolts until all the spring tension is released. Then remove the cover.

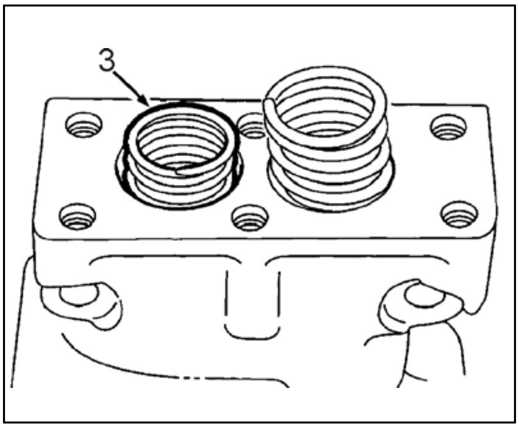
WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme care when disassembling.



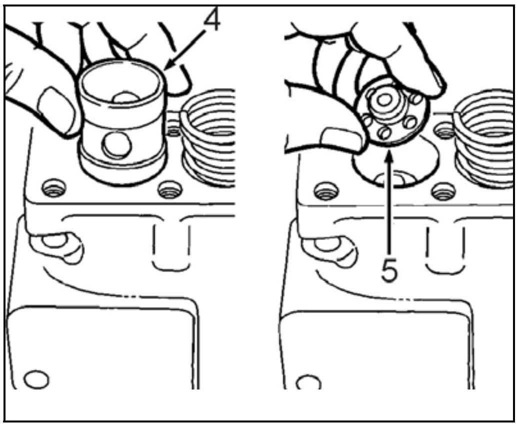
5. Remove and discard the end cover gasket (2).



6. Remove the sequence spool spring (3) from the housing bore.



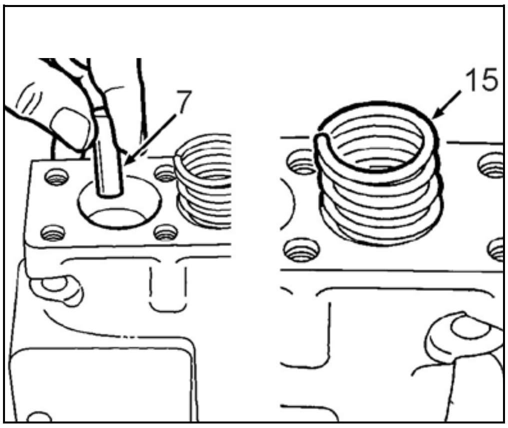
7. Remove the spring spacer (4) from the housing bore.
8. Remove the sequence valve disc (5) from the housing bore.



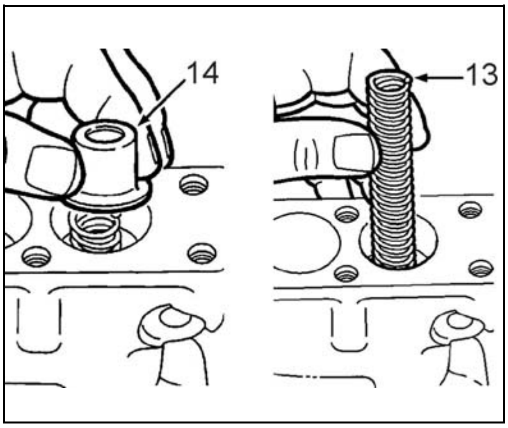
RATE OF RISE VALVE

9. Remove the dowel pin (7) from the housing bore.
10. Remove the outer piston spring (15) from the housing bore.

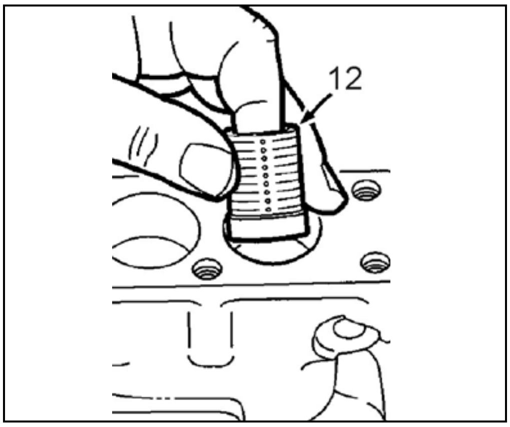
NOTE: *The spool is to be kept with the housing bore side that it was removed from.*



11. Remove the spring retainer (14) from the housing bore.
12. Remove the inner piston spring (13) from the housing bore.

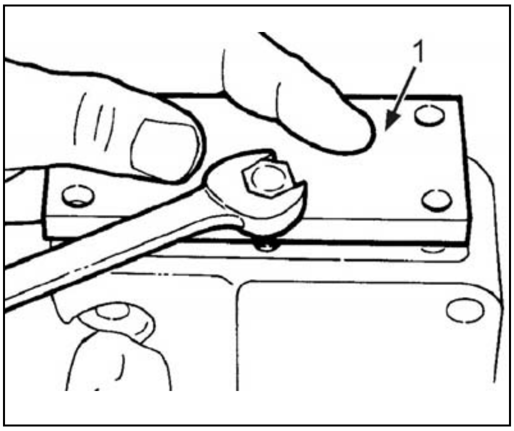


13. Remove the modulating piston (12) from the housing bore.



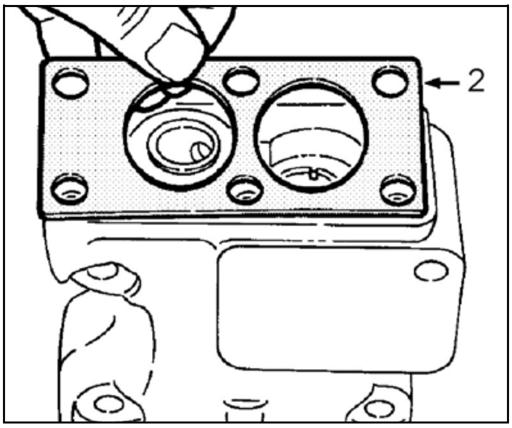
14. Slowly remove the end cover (1) hardware until all the spring tension is released. Remove the cover.

WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme care when disassembling.



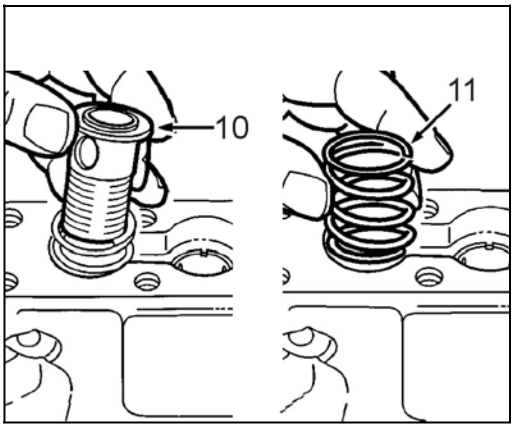
RATE OF RISE VALVE

15. Remove and discard the end cover gasket (2).

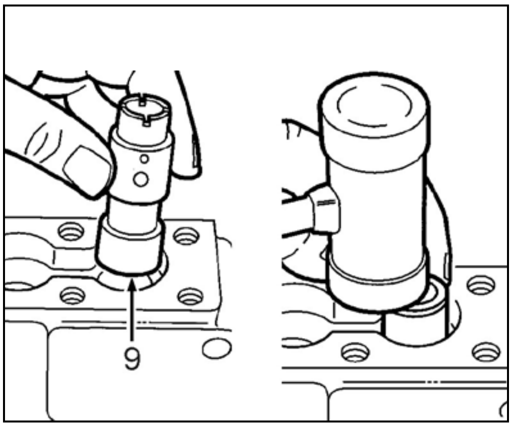


16. Remove the reducing spool (10) from the housing bore.
17. Remove the reducing spool spring (11) from the housing bore.

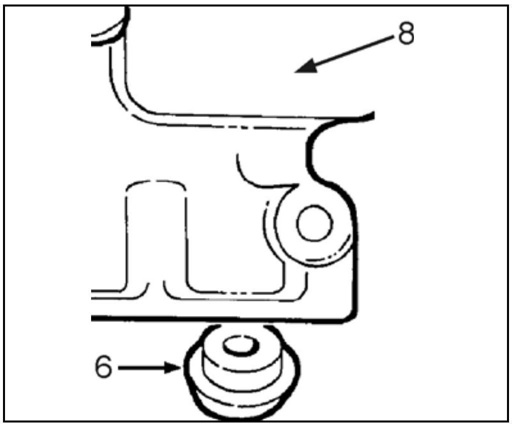
NOTE: *The spool is to be kept with the housing bore side that it was removed from.*



18. Remove the sequence valve spool (9) from the housing bore.
19. Using a wooden dowel pin, insert into the housing bore up against the sequence spool spacer. Gently tap on dowel to dislodge the spacer from the housing.



20. Remove the sequence spool spacer (6) from the housing (8).



16. INSPECTION AND REPAIR

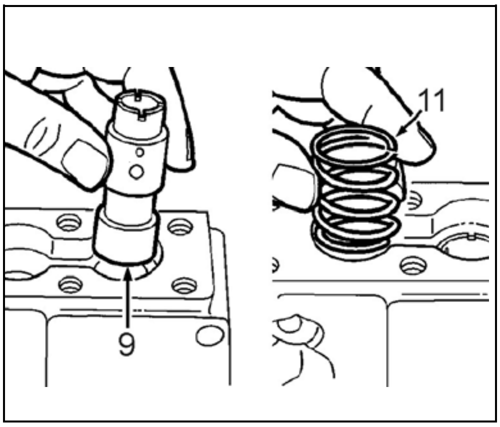
1. Clean all parts in a suitable solvent and blow dry with compressed air. Be sure all the oil passages in the valve housing are clean and free of obstructions.
2. Inspect the parts for excessive wear and replace if necessary.
3. Inspect the condition of the springs. If they are damaged or do not fall within the specifications shown in Paragraph 3, SPECIFICATIONS, they must be replaced.

17. REASSEMBLY AND INSTALLATION (Refer to Fig. 7C.14 and 7C.15)

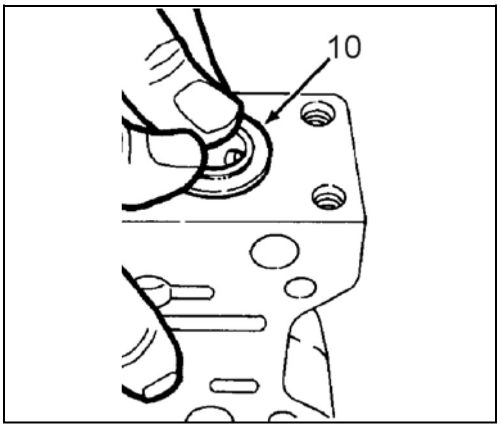
NOTE: *Lubricate the spools and valve bores with transmission oil upon reassembly.*

NOTE: *Springs (11) and (15) appear to be identical, however they are different. Intermixing will result in loss of range clutch pressure and loss of directional pressure.*

1. Install the sequence valve spool (9) into housing bore.
2. Install reducing spool spring (11) into housing bore.

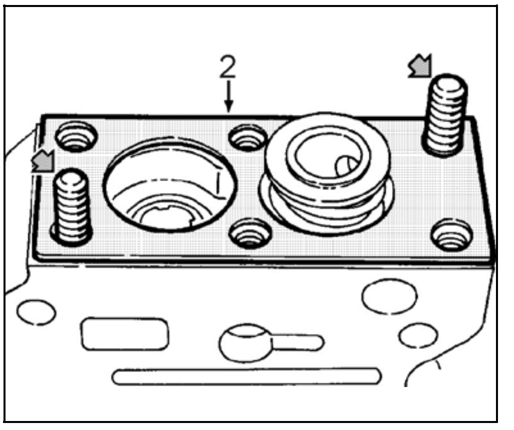


3. Seat the reducing spool (10) in the housing bore.



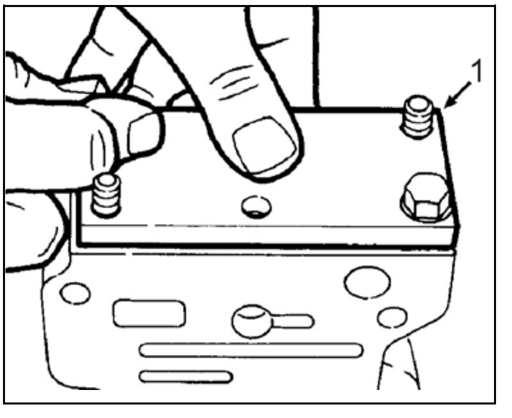
RATE OF RISE VALVE

4. Insert the aligning studs to the housing. Install a new end cover gasket (2) to the housing.

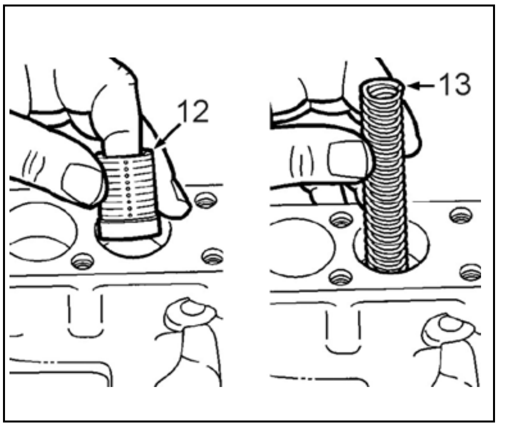


5. Install the end cover (1) over the aligning studs and secure with four bolts. Remove the aligning studs and install the remaining bolts.

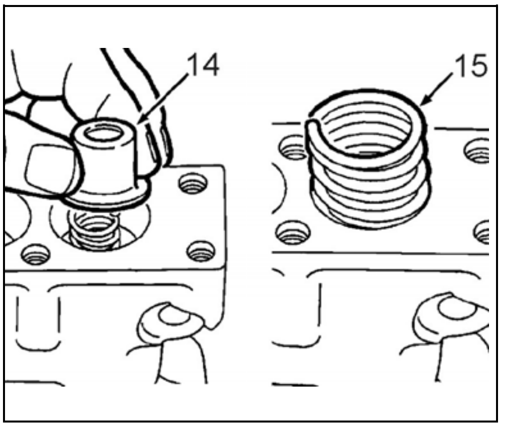
WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme care when assembling.



6. Install the modulating piston (12) into the housing bore.
7. Install the inner piston spring (13) into the modulating piston in the housing bore.

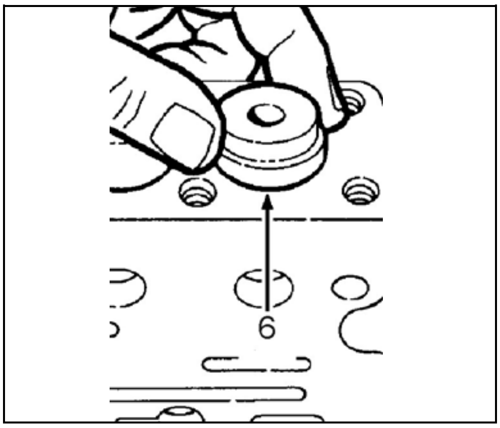


8. Install the spring retainer (14) over the spring.1
9. Install the outer piston spring (15) over the retainer.

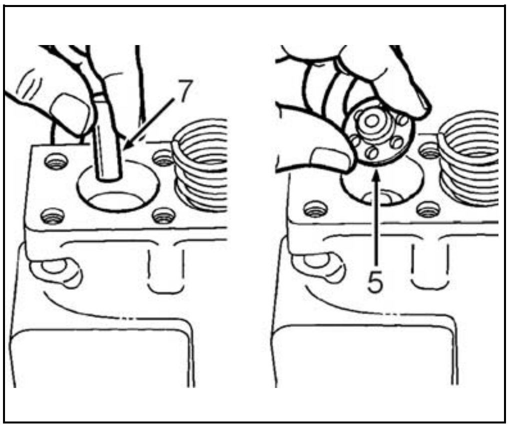


RATE OF RISE VALVE

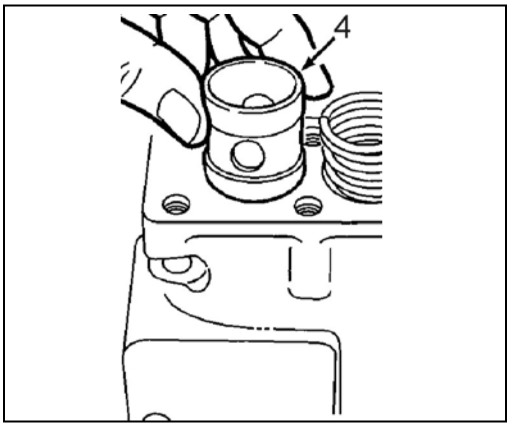
10. Squarely seat the sequence valve spacer (6) into the housing bore.



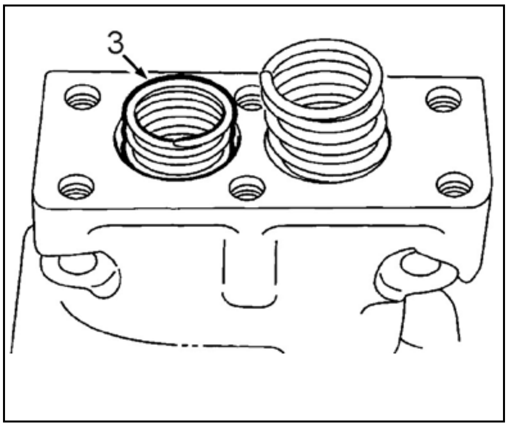
11. Install the dowel pin (7) in the housing bore into the sequence spool spacer.
12. Install the sequence valve disc (5) on the dowel pin.



13. Install the spring spacer (4).

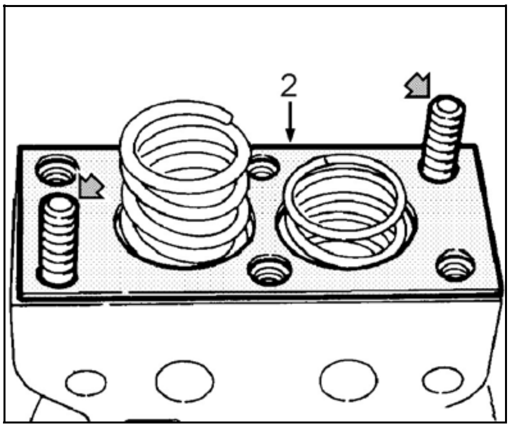


14. Install the sequence spool spring (3) inside the spring spacer.



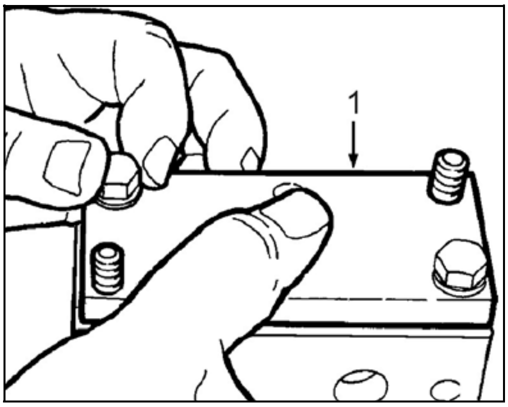
RATE OF RISE VALVE

15. Insert the aligning studs to the housing. Install a new end cover gasket (2) to the housing.



16. Install the end cover (1) over the aligning studs and secure with four bolts. Remove the aligning studs and install the remaining bolts. Tighten the bolts securing covers (1) to a torque of 26 to 28 [Nm].

WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme care when assembling.



17. Position the valve with new gasket on top of the transmission housing and secure with bolts and washers. Torque the bolts to 32 [Nm].
18. Reconnect the hoses at the range selector valve.
19. Check the oil level in the rear main frame as described in the OPERATOR'S MANUAL.

IMPORTANT! As soon as the engine starts, observe the transmission main and range clutch oil pressure warning lamp on the instrument panel. If lights, immediately turn off engine.

20. Start the engine. Check for leaks. Check oil pressures as described in Paragraph 10, TRANSMISSION AND TORQUE CONVERTER OIL PRESSSURE TEST in SECTION 7.
21. Install the center floor plate between seat and instrument panel. Install the floor mat, if cab equipped.

DRIVE TRAIN CONTROL VALVE

18. REMOVAL

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

IMPORTANT: *When disconnecting hydraulic lines for any reason, they should be properly capped with correct size plastic cap. If these caps are not available, tape or clean rubber corks may be used. Hydraulic openings must never be plugged with rags. This practice could easily introduce dirt or lint into critical hydraulic components of machine. Tag all disconnect oil lines to facilitate easier installation.*

1. Unscrew bolts (4, Fig. 7C.16) and remove L.H. enclosure (3) with L.H. door.
2. Unscrew bolts (2) and remove access cover (1) in order to obtain access to mounting points of the drive train control valve.
3. Disconnect the electrical wire (5, Fig. 7C.17) from the filter base. Unscrew bolts (2) fastening filter base to the filter bracket (3) and allow the filter (4) to be supported by the hoses.

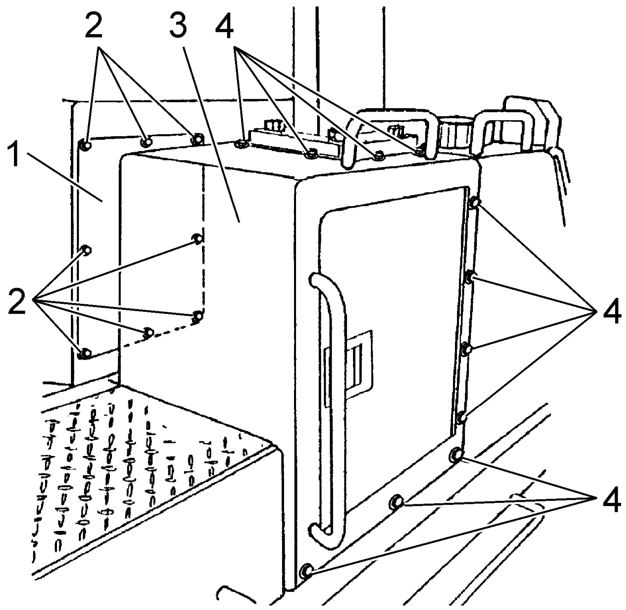


Fig. 7C.16. Disassembly Access Cover to Drive Train Control Valve

1. Access Cover
2. Bolts
3. L.H. Enclosure
4. Bolts

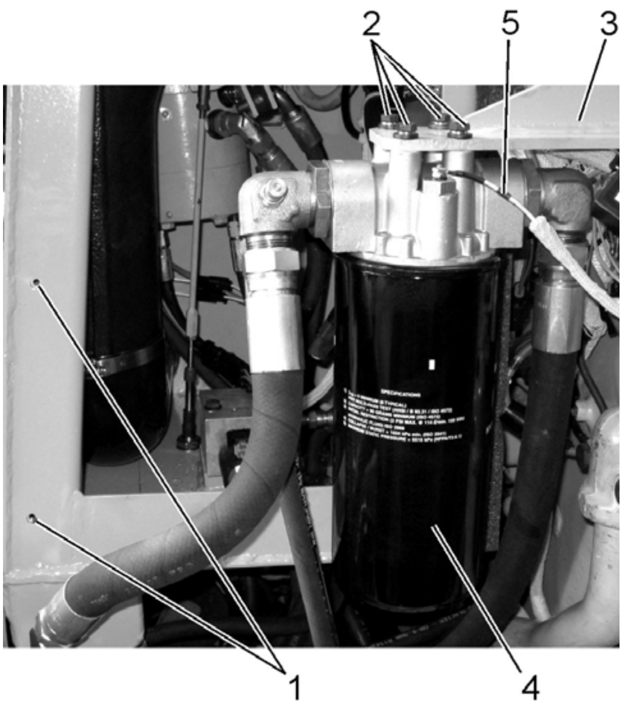


Fig. 7C.17. Drive Train Pressure Filters Removal

1. Access Cover Bolts (Removed)
2. Bracket Mounting Bolts
3. Filter Bracket
4. Filter
5. Electrical wire

4. Disconnect drive train control lever harness (3, Fig. 7C.19).
5. Remove the screws (2, Fig. 7C.18) and remove cover (1).
6. Remove two stiffener plates and unscrew control lever (5) with attached boot and electrical harness.

TRANSMISSION

DRIVE TRAIN CONTROL VALVE

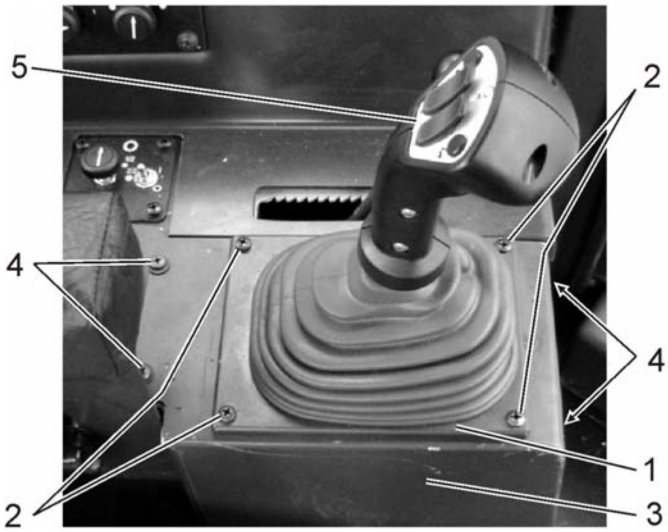


Fig. 7C.18. Disassembly Console
to Access Drive Train Control Valve

1. Cover
2. Screws
3. Valve Console
4. Screws
5. Control Lever

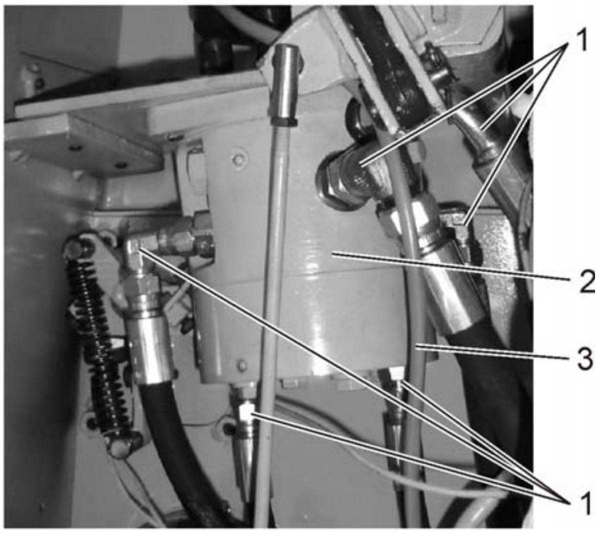


Fig. 7C.19. Drive Train Control Valve
Disconnecting Points

1. Hoses
2. Drive Train Control Valve
3. Control Lever Harness

7. Unscrew four mounting screws (4) securing valve console (3) to the platform and remove console (3) out of the platform.
8. Disconnect and tag all hoses (1, Fig. 7C.19) connected to the drive train control valve (2).
9. Unscrew four mounting bolts (1, Fig. 7C.20) securing valve bracket (2) to the platform and remove the valve with bracket from the platform. Unscrew three mounting bolts (3) securing drive train control valve (4) to valve bracket (2) and remove the bracket (2) out of the valve (4).

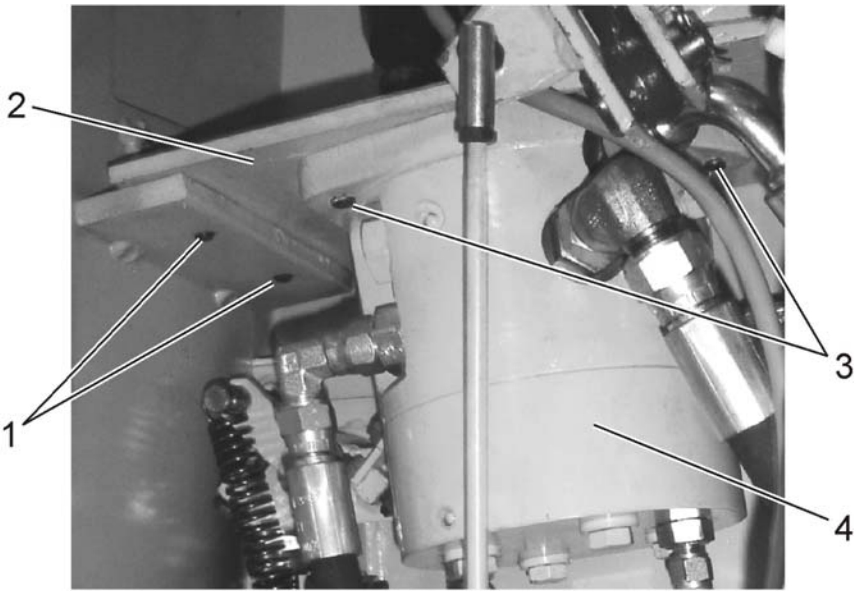


Fig. 7C.20. Drive Train Control Valve Disconnecting Points

1. Mounting Bolts
2. Valve Bracket
3. Mounting Bolts
4. Drive Train Control Valve

DRIVE TRAIN CONTROL VALVE

19. DISASSEMBLY (Refer to Fig.'s 7C.21 and 7C.22)

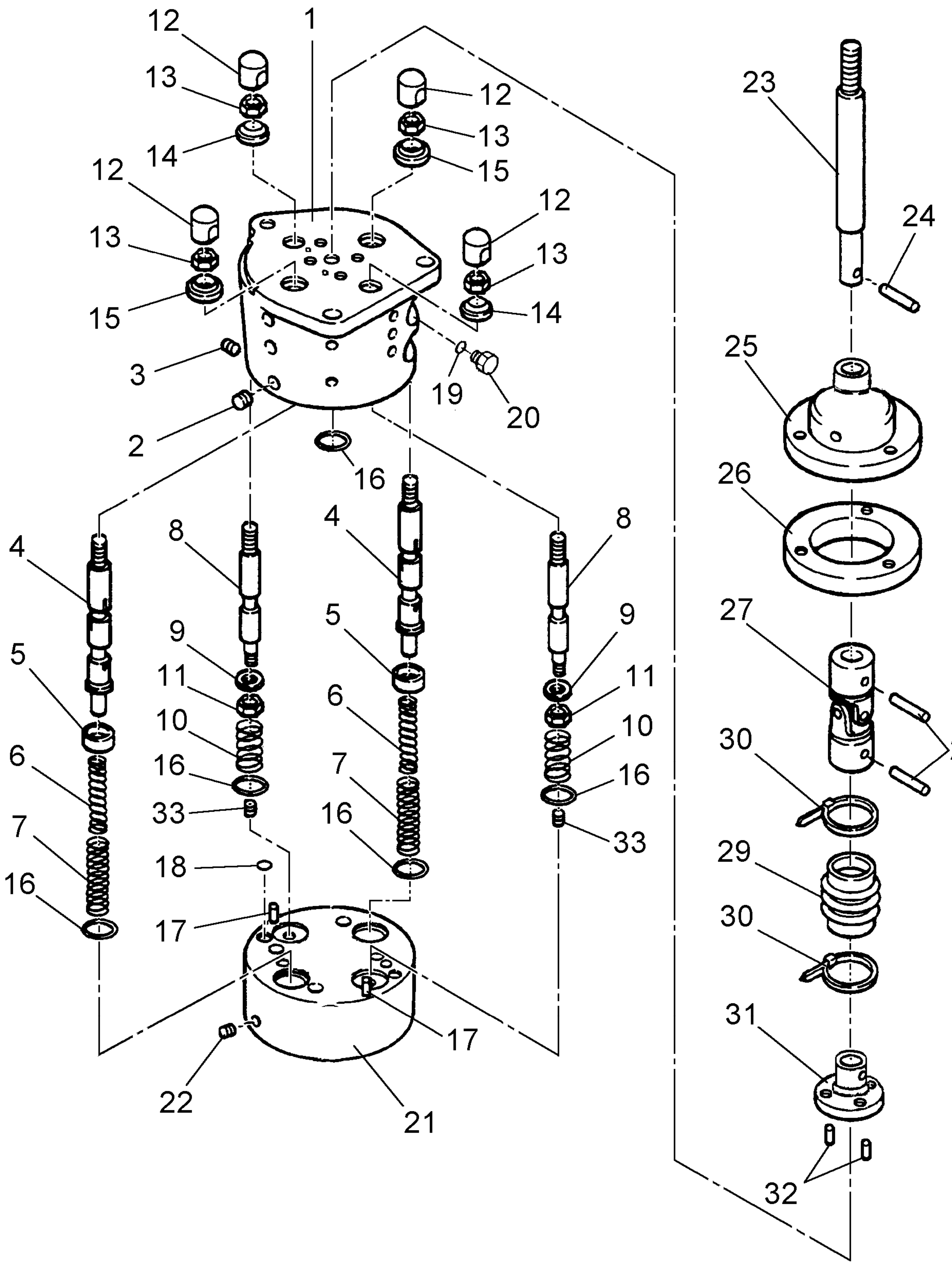


Fig. 7C.21. Exploded View of Drive Train Control Valve

TRANSMISSION

DRIVE TRAIN CONTROL VALVE

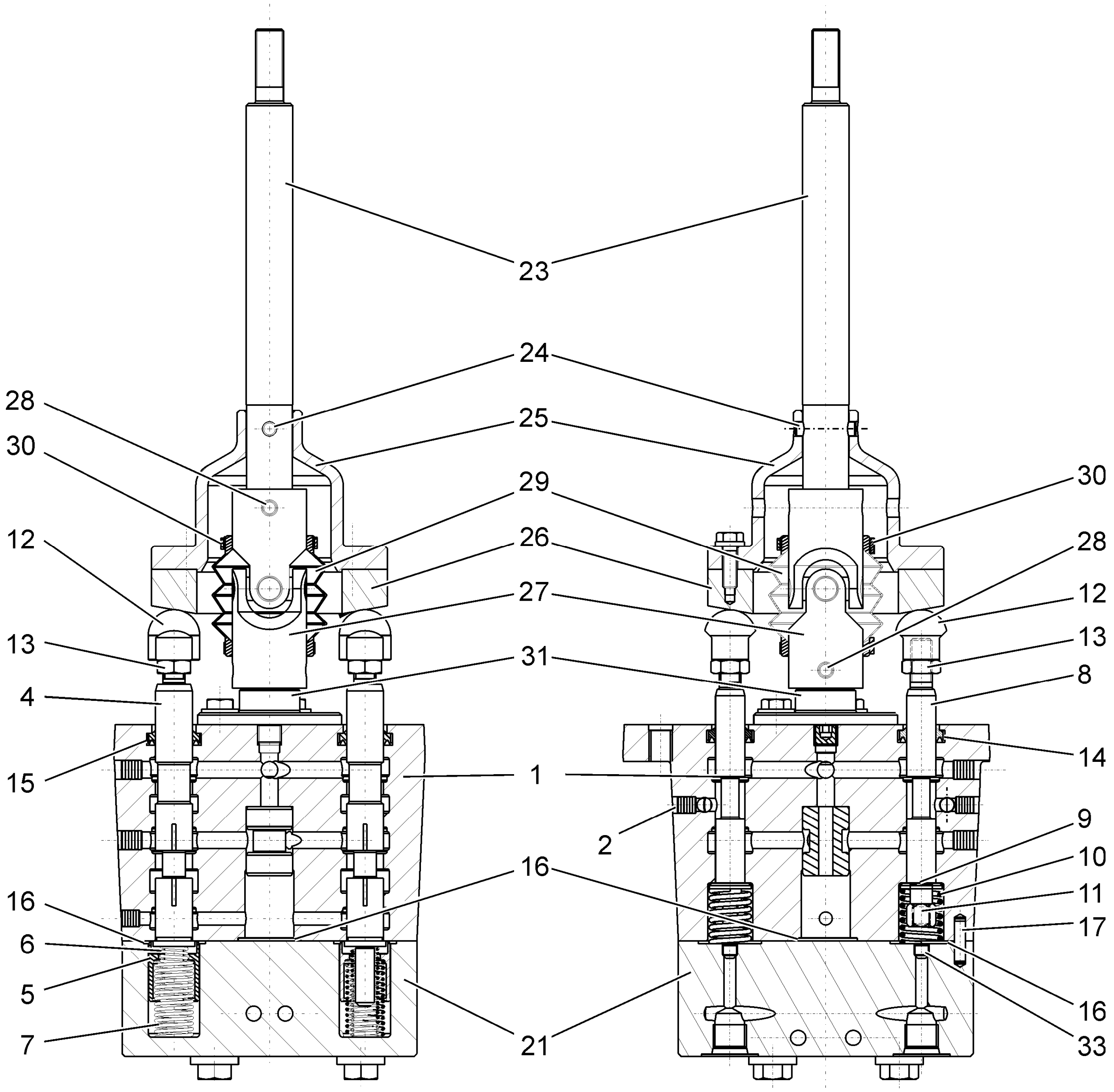
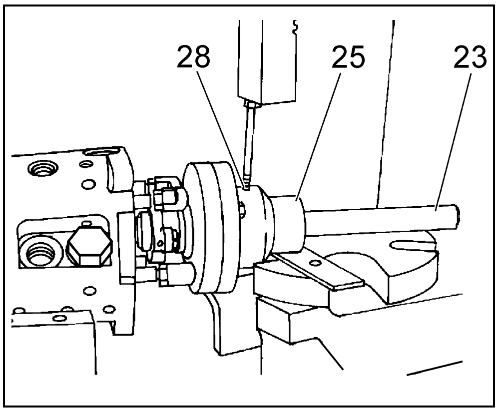


Fig. 7C.22. Cross Section View of Drive Train Control Valve

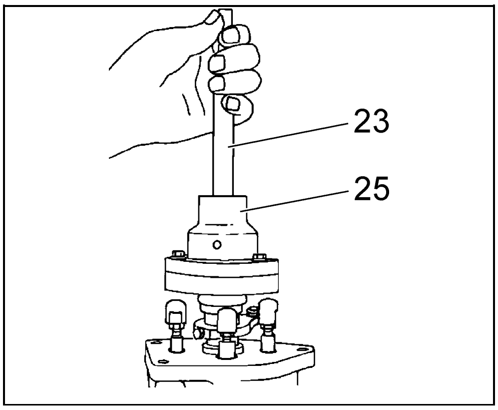
Legend for Fig. 7C.21 and Fig. 7C.22

1. Housing Assy	10. Directional Spool Spring	19. O-Ring	28. Dowel Pin
2. Port Plug	11. Stop Nut	20. Plug	29. Universal Joint Boot
3. Port Plug	12. Rocker End	21. Bottom Cover	30. Strip
4. Steering Spool	13. Jam Nut	22. Port Plug	31. Joint Base
5. Guide Sleeve	14. Seal Ring	23. Lever	32. Dowel Pin
6. Inner Spring	15. Seal Ring	24. Dowel Pin	33. Orifice Plug
7. Outer Spring	16. O-Ring	25. Joint Housing	
8. Directional Spool	17. Dowel Pin	26. Pivot Ring	
9. Thrust Washer	18. O-Ring	27. Universal Joint	

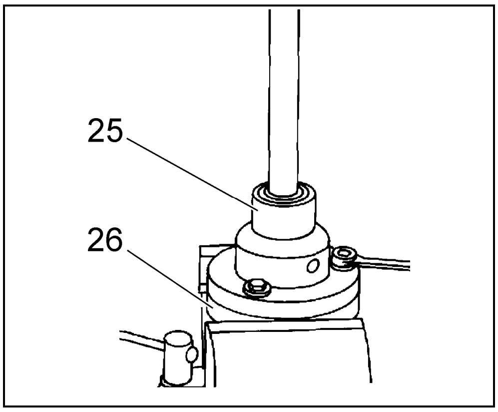
1. Position the valve in press with the hole in the joint housing (25) aligned with the dowel pin (28) in the lever (23). Apply the press and drive the pin out clearing the housing with lever.



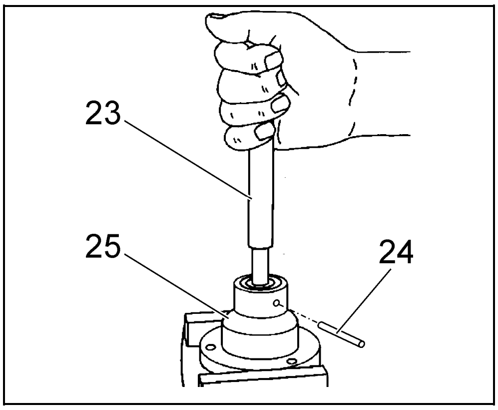
2. Remove the lever (23) with the joint housing (25) from the valve.



3. Position the assembly in a vise. Remove the hardware and separate the housing (25) from the pivot ring (26).

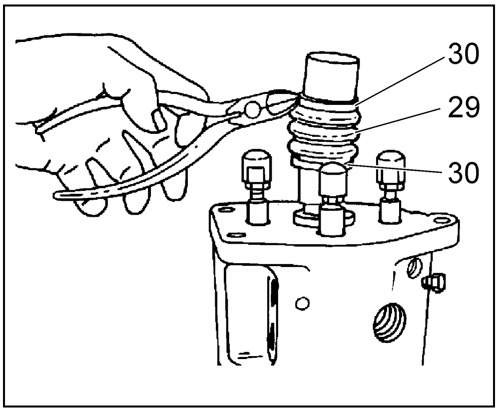


4. Drive the dowel pin (24) out from the housing (25). Remove the lever (23) from the joint housing (25).

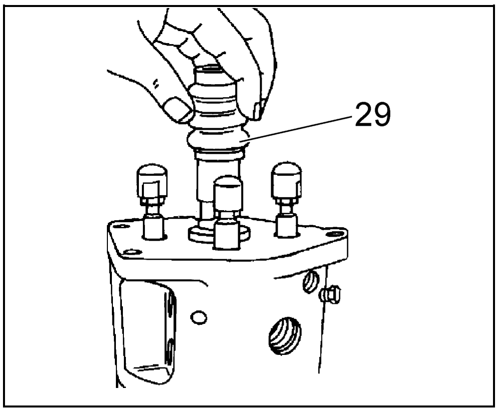


DRIVE TRAIN CONTROL VALVE

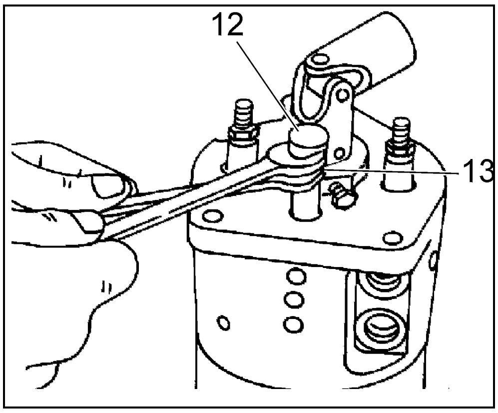
5. Cut and remove the tie straps (30) from the joint boot (29).



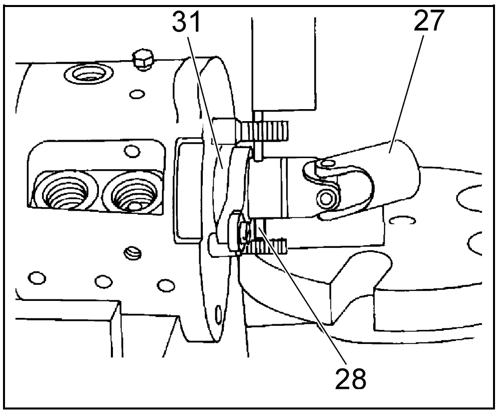
6. Remove the boot (29) from the universal joint.



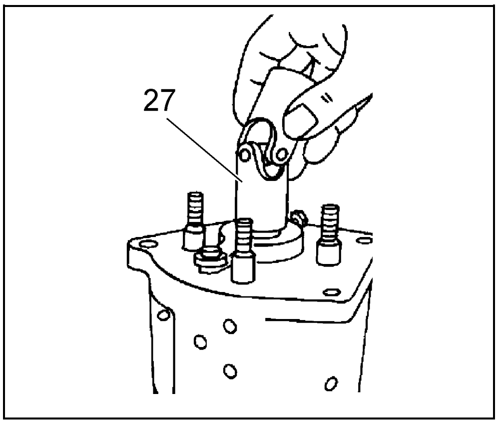
7. Remove the spool rocker end (12) and jam nut (13) from each spool.



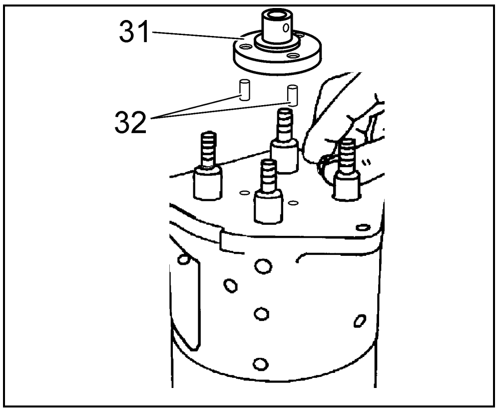
8. Position the assembly in a vise. Remove the dowel pin (28) connecting the universal joint (27) to the joint base (31).



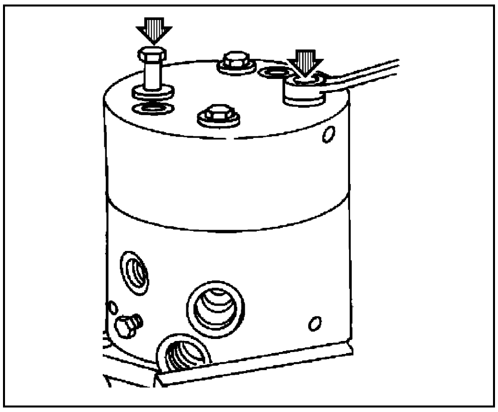
9. Remove the universal joint (27).



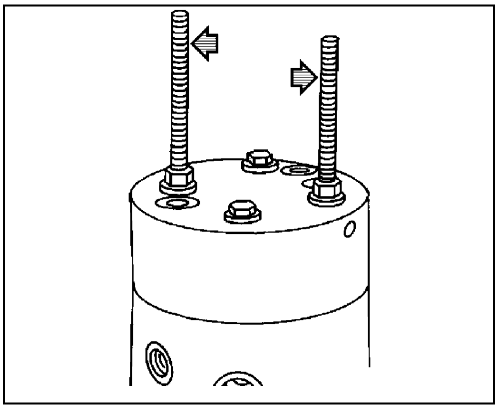
10. Unscrew four bolts and remove the joint base (31). If required, remove two dowels pins (32) from the base (31).



11. Turn the valve over and remove the two opposite side mounting bolts.

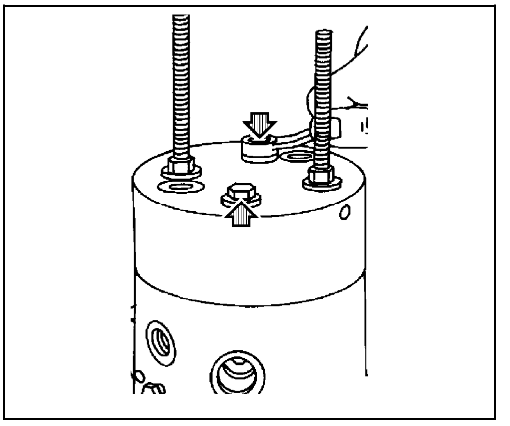


12. Install two threaded rods with washers and nuts to the vacated mounting holes.



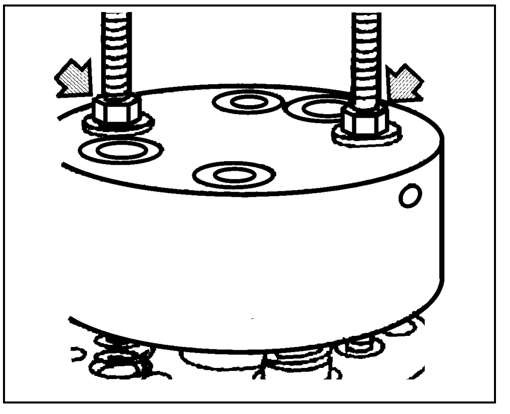
DRIVE TRAIN CONTROL VALVE

13. Remove remaining two mounting bolts.

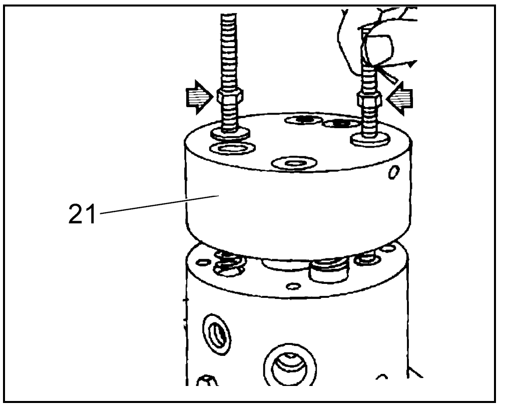


14. Let off each nut until all spring tension is relieved.

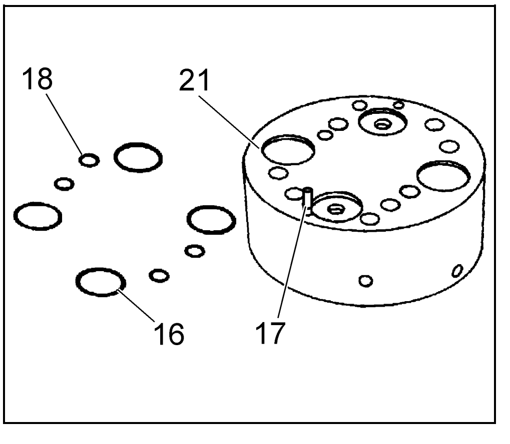
WARNING! Spring loaded assembly. Cover must be held to relieve spring pressure. Use extreme care when disassembling.



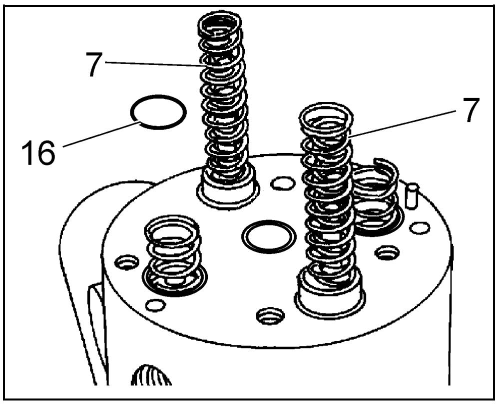
15. Remove the threaded rods and the bottom cover (21) from the valve.



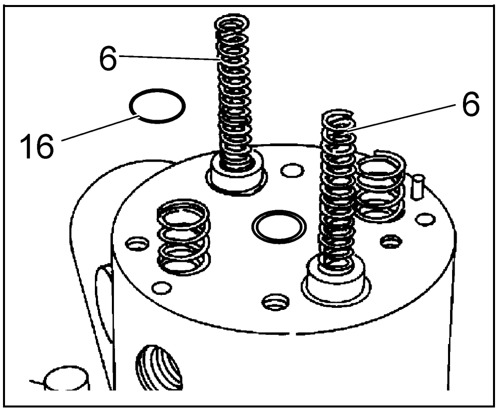
16. Remove and discard the O-rings (16 and 18) from the bottom cover (21). If necessary, remove dowel pin (17).



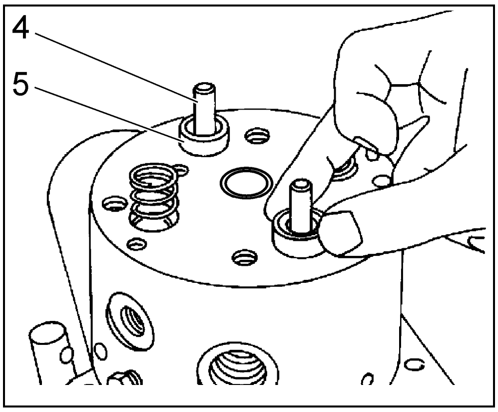
17. Remove and discard O-ring (16) from the valve housing. Remove the outer springs (7).



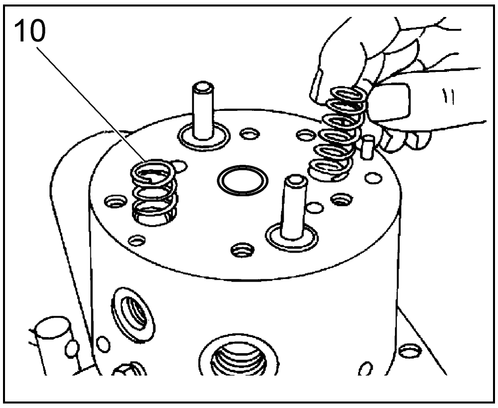
18. Remove the inner springs (6).



19. Remove the guide sleeve (5) from each steering spool (4).

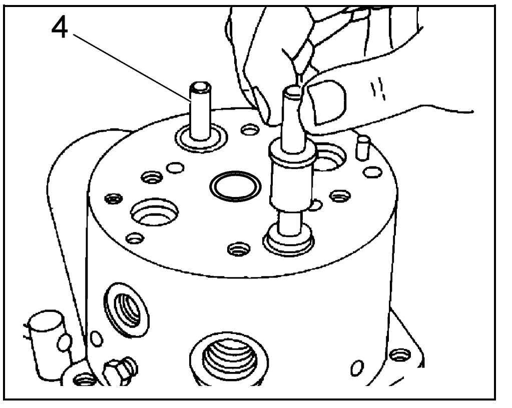


20. Remove the directional spool springs (10) at each directional spool in the valve housing.

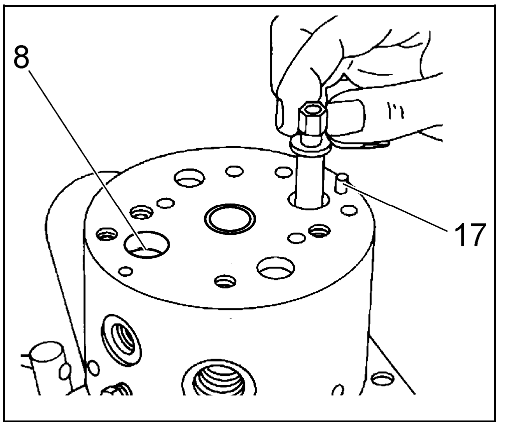


DRIVE TRAIN CONTROL VALVE

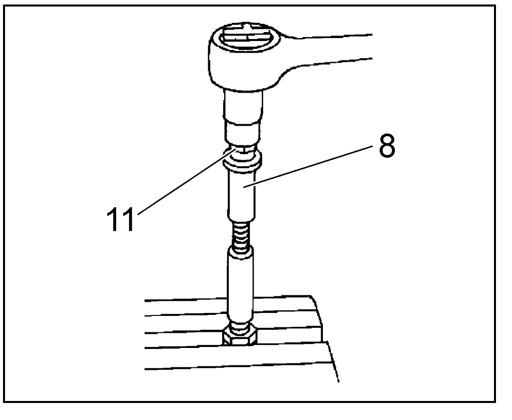
21. Remove the two steering spools (4) from the valve housing.



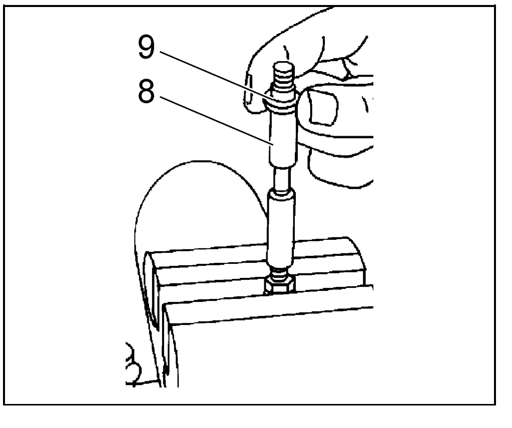
22. From under the valve housing, push the directional spool (8) up and out of the valve body. Repeat for remaining spool. If necessary, remove dowel pin (17).



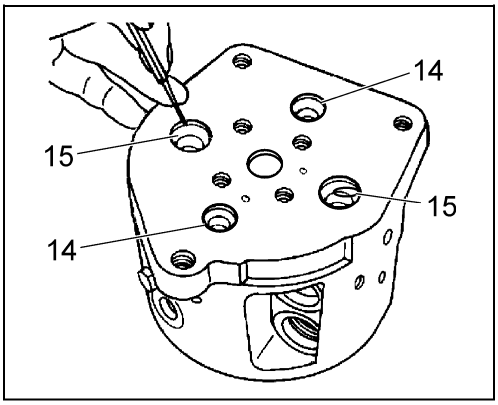
23. Install two 3/8"NC nuts on the directional spool (8) and position in a vise. Remove the loctited stop nut (11) from the spool. Repeat for remaining spool.



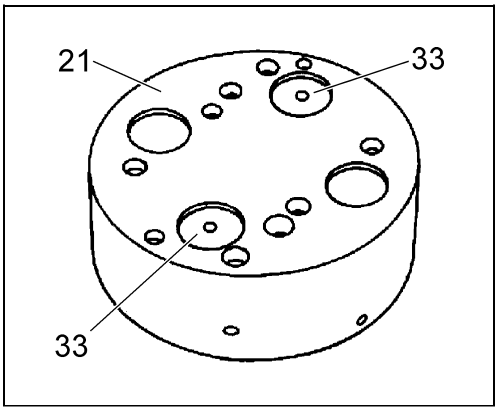
24. Remove the thrust washer (9) from the spool (8). Repeat for remaining spool.



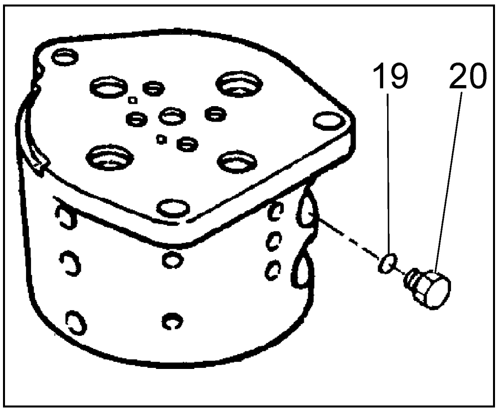
25. Remove and discard seal rings (14 and 15) from the valve housing.



26. Remove the orifice plugs (33) from the bottom cover (21).



27. Remove two plugs (20) with O-rings (19), if necessary.



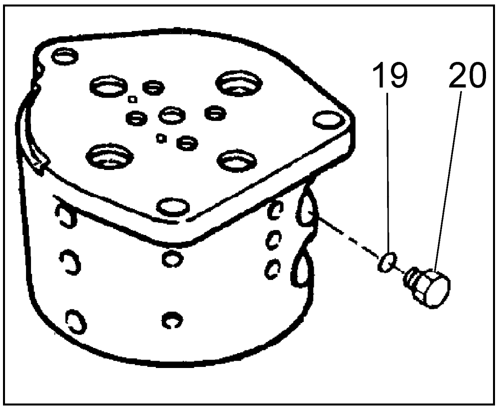
20. INSPECTION AND REPAIR

1. Clean all parts in a suitable cleaning solvent and blow dry with compressed air. Be sure all the oil passages in the valve spools and valve body are clean and free of obstructions.
2. Inspect the parts for excessive wear or scratches and replace if necessary.
3. All the sealing rings must be replaced.
4. Clean threads with a stiff brush and solvent. Check for damage.
5. Inspect the condition of the springs. If they are wore or damaged, they must be replaced.
6. Inspect the pivot ring and spool rocker ends for excessive wear or scratches and replace if necessary.

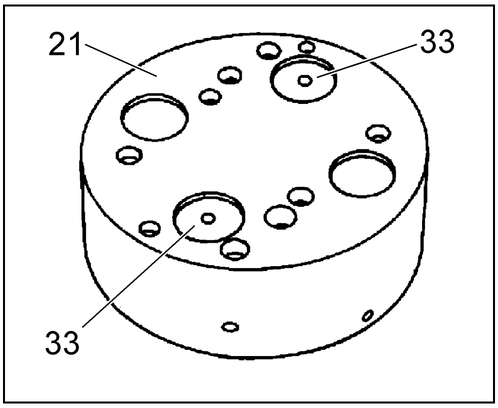
21. REASSEMBLY (Refer to Fig.'s 7C.21 and 7C.22)

IMPORTANT: *Sealing rings should be lubricated with petroleum jelly for ease of assembly. The valve spools and theirs bores should also be lightly lubricated.*

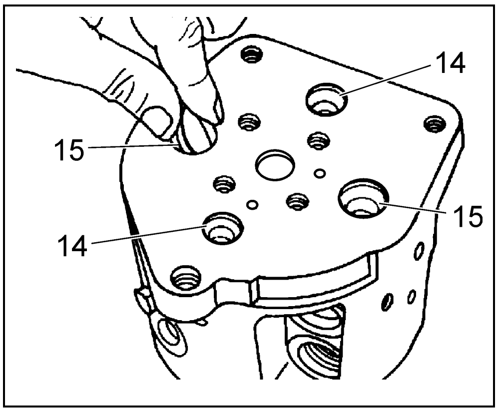
1. Install two plugs (20) with O-rings (19), if removed.



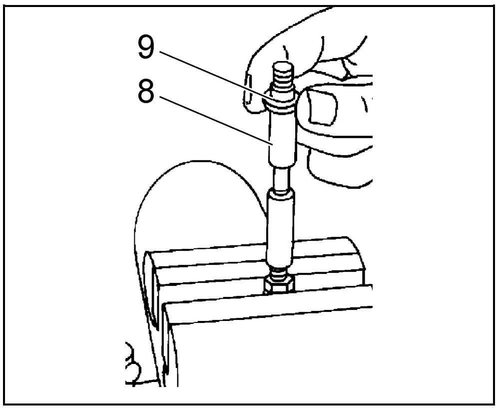
2. Install the orifice plugs (33) into the bottom cover (21). Torque the plugs to 2.7 [Nm].



3. Install new seal rings (14 and 15), with the U cup portion facing down, to the spool bores in the valve housing.

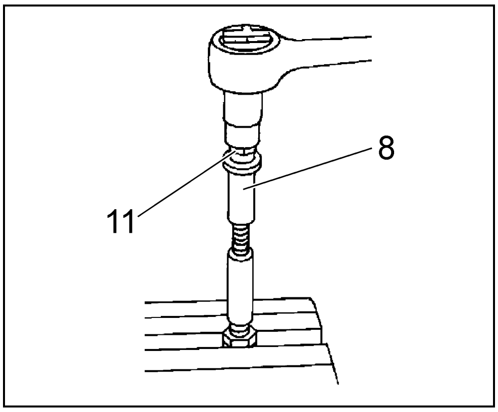


4. With the directional spool nutted in a vise, install the thrust washer (9).

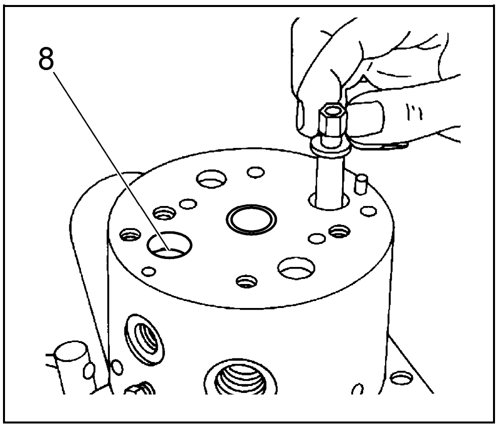


5. Apply LOCTITE #242 to the nut threads, and install the stop nut s (11). Torque the nuts to 22 [Nm].

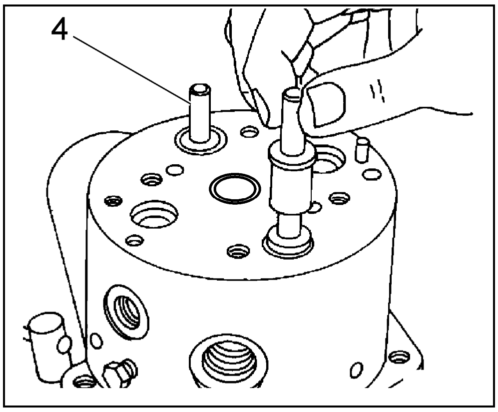
Repeat Step 4 through 5 for remaining spool.



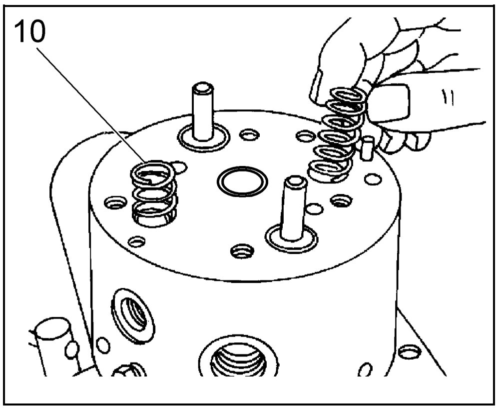
6. Install the directional spool (8) into the valve housing using a slight turning motion to aid the spool pass through the seal ring. Repeat for remaining spool. If removed, install dowel pin (17).



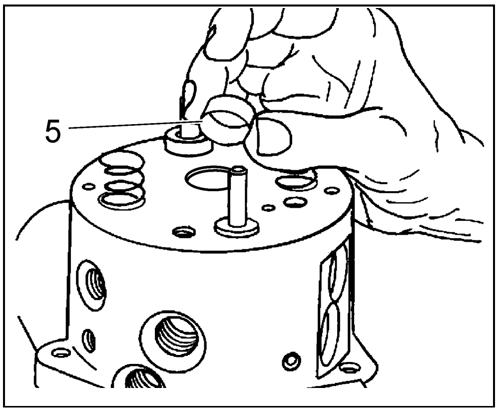
7. Install the steering spool (4) into the valve housing using a slight turning motion to aid the spool pass through the seal ring. Repeat for remaining spool.



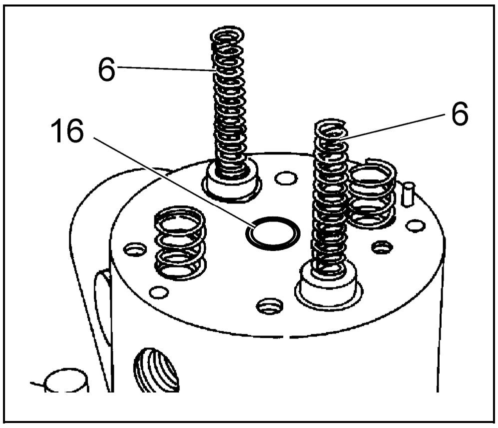
8. Install the directional spool springs (10) in the recessed bores.



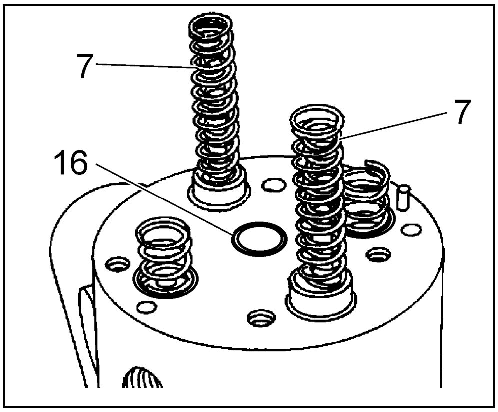
9. Install the guide sleeves (5) over the steering spools with the recessed area towards the valve housing.



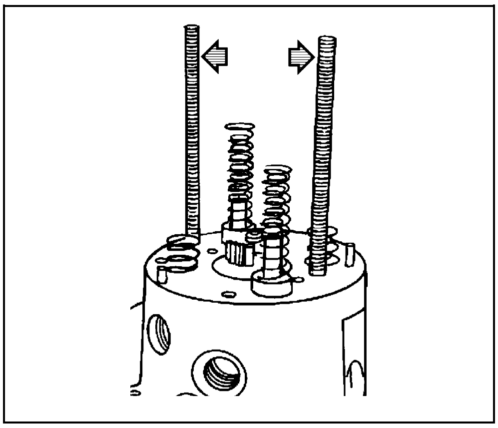
10. Install O-ring (16) into valve housing. Install the inner springs (6) to the steering spools.



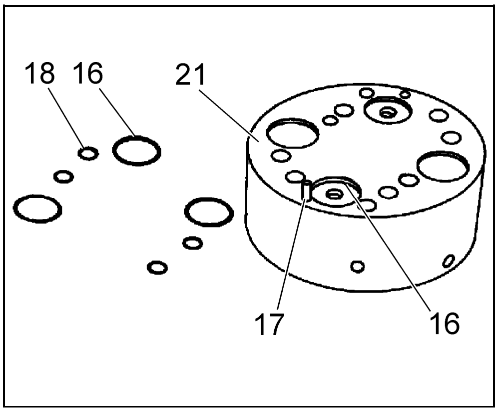
11. Install the outer springs (7) to the steering spools.



12. Install two threaded rods to valve housing.

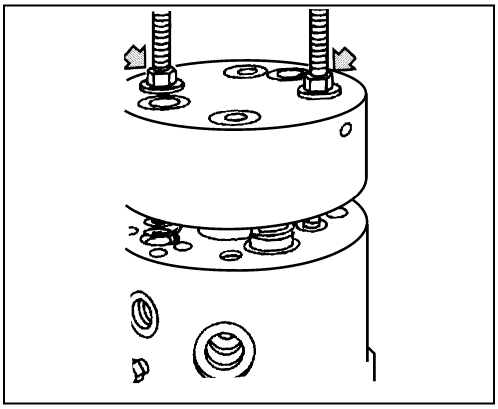


13. Install new O-rings (16 and 18) to the bottom cover (21). If removed, install dowel pin (17).

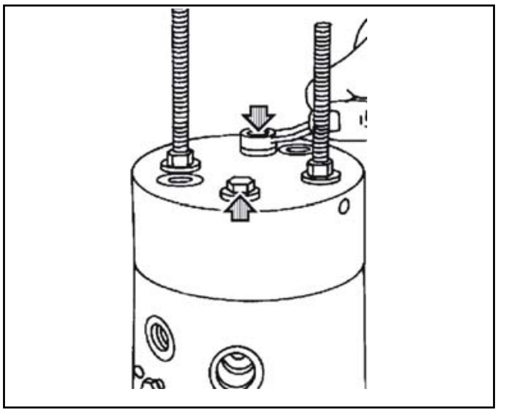


14. Position the bottom cover (21) over the threaded rods, with the offset dowel pin holes to the dowel pins (17). Draw down equally on the nuts until the cover is flush.

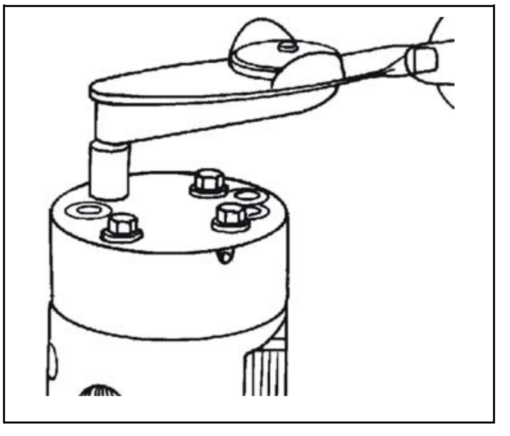
NOTE: *Be careful not to bind the cover to the dowel pin.*



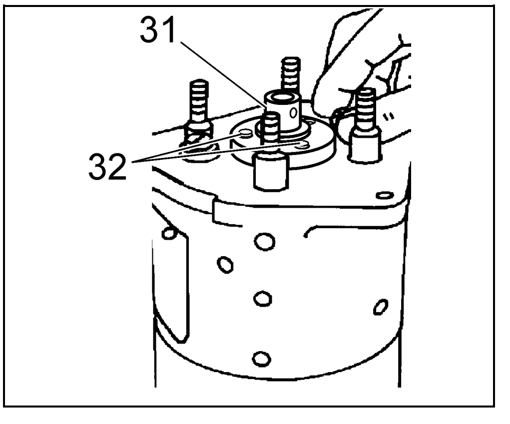
15. Install two mounting bolts at the open holes. Remove the threaded rods and install the remaining bolts.



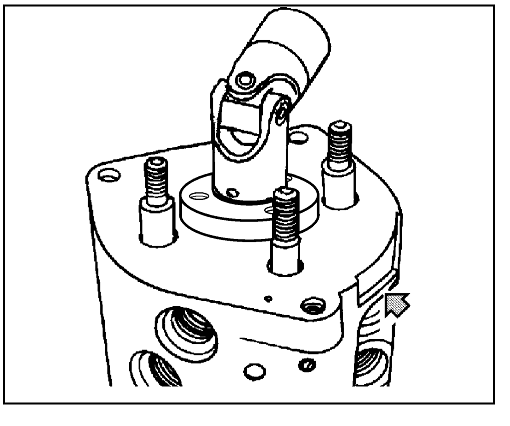
16. Torque the mounting bolts to 38 [Nm].



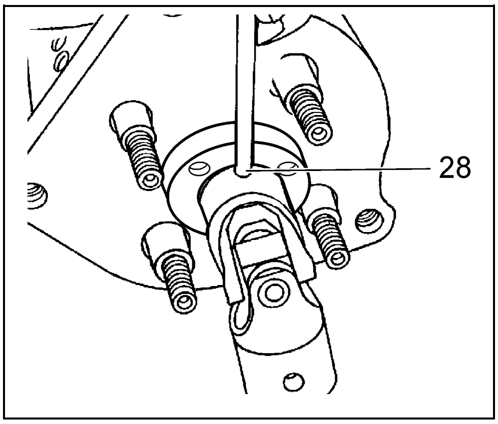
17. If removed, install two dowel pins (32). Install joint base (31) to the valve housing, aligning the base dowel pins with the offset recess in the valve housing. Torque the bolts to 11 [Nm].



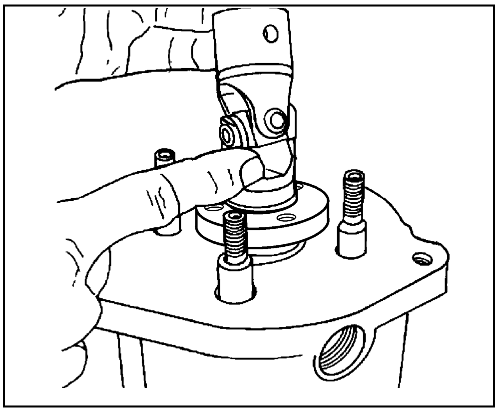
18. Slide the universal joint (27) over the joint base (31).



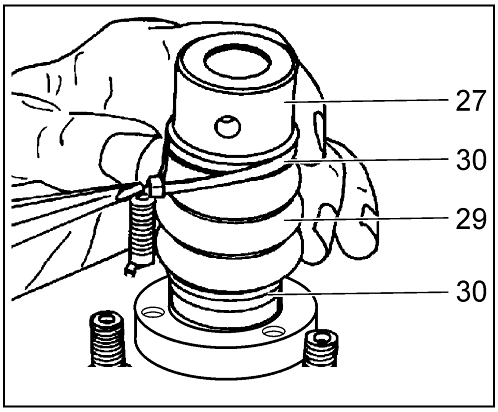
19. Drive the dowel pin (28) in making sure it is countersunk at each end.



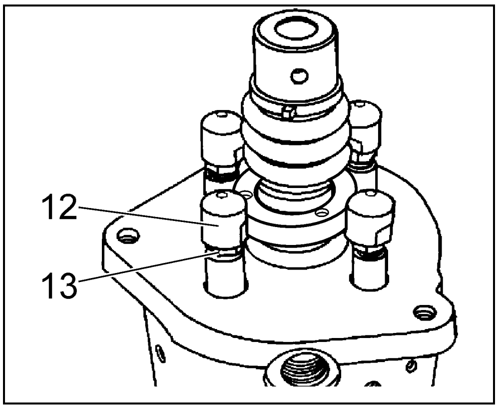
20. Apply a generous amount of grease (refer to OPERATOR'S MANUAL) to the universal joint.



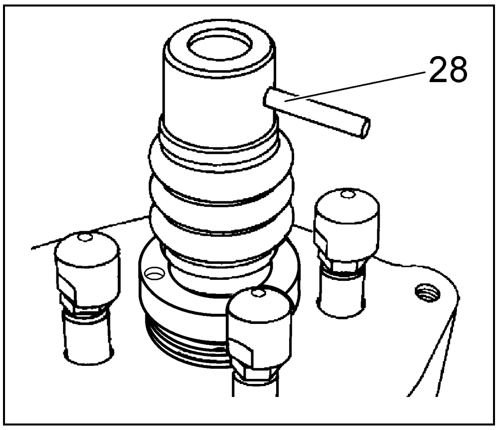
21. Install the boot (29) over the universal joint (27) and secure with the tie straps (30).



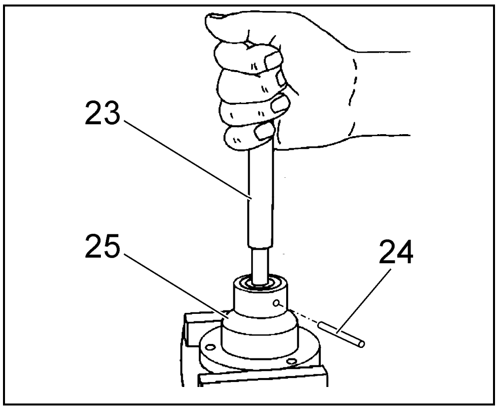
22. Install the jam nuts (13) and the spool rocker ends (12) to each spool.



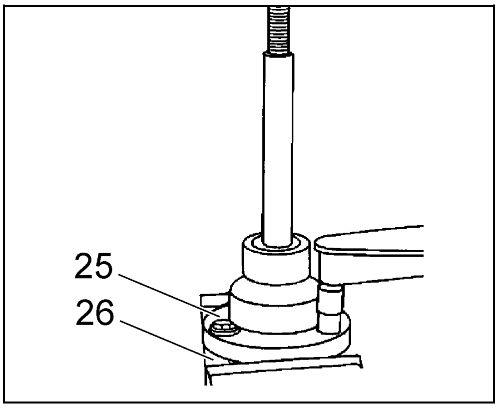
23. Start the dowel pin (28) into the universal joint.



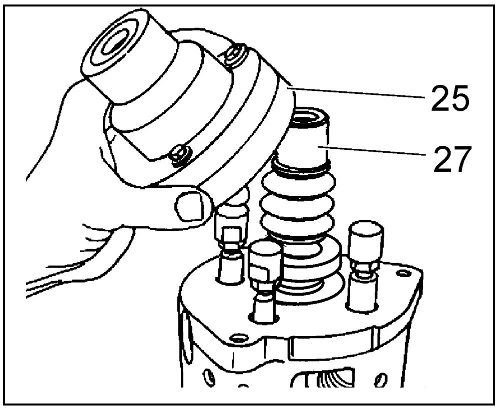
24. Install the lever (23) into the housing (25) and align with the dowel pin (24). Drive the pin into the housing so that it completely clears the housing.



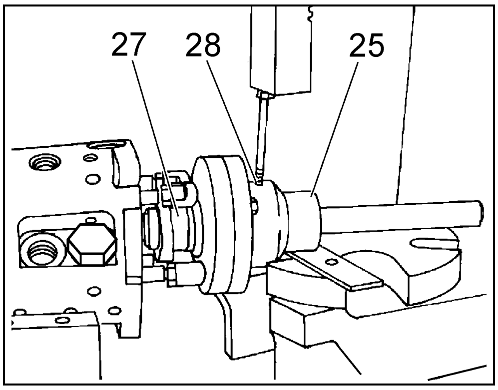
25. Attach the joint housing (25) to the pivot ring (26) and torque the bolts to 11 [Nm].



26. Install the joint housing (25) over the universal joint (27) and align the dowel pin opening in the universal joint with the opening in the joint housing.

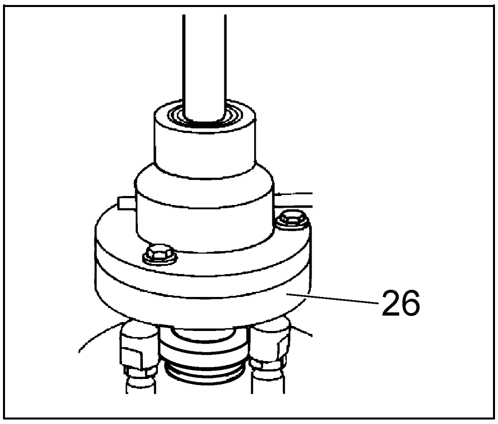


27. Drive the pin (28) into joint housing (25) to join the housing with the universal joint (27) so that it completely clears the housing (25).

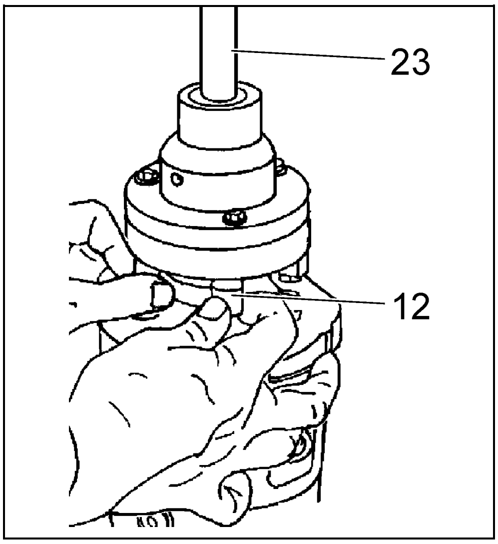


Drive Train Control Valve Adjustment

28. Apply a generous amount of grease (refer to OPERATOR'S MANUAL) to the pivot ring (26) surface.

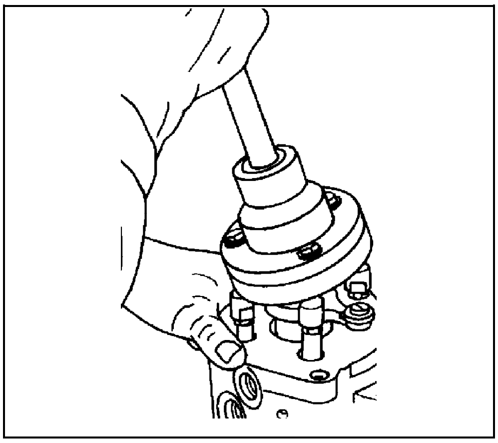


29. Run all four spool rocker ends (12) up against the pivot ring until the lever (23) is vertical with no free play between the pivot ring surface and rocker ends.

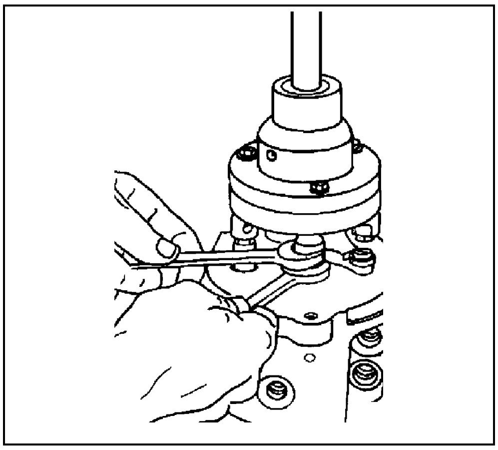


DRIVE TRAIN CONTROL VALVE

30. Move the lever fully in all directions to seat the steering and directional spools against their springs. Recheck for free play between the pivot ring and rocker ends and correct as necessary.



31. Tighten the jam nuts to the spool rocker ends. Torque the nuts to 32 – 37 [Nm].



22. PRESSURE TEST

Drive train control valve pressure test. (Refer to Fig's. 7.1 and 7.2 in SECTION 7)

1. Install drive train control valve in the platform console as described in steps 1 to 6, Paragraph 23, INSTALLATION in this Section.
2. Install Pressure Test Kit gauges (refer to SERVICE /SPECIAL TOOLS in Section 7, DRIVE TRAIN) in respective pressure lines.
3. Apply parking brake. Start the engine.
4. "FWD - RWD" pressure test.
   a. Shift the drive train control lever from neutral (N) to forward (FWD) position. The hydraulic detent is to hold the lever within 7 [°] ÷ 9 [°]; this hydraulic detent must be operational within 3 [°] ÷ 5 [°]. The "F" test point pressure must be M-0.07 [MPa] and 'R" test point pressure must be 0.0 [MPa]. Shift the lever back to the neutral position; the hydraulic detent must release the lever within 3.5 [°] ÷ 6.5 [°].

   b. Repeat this procedure for the rearward (RWD) drive train control lever position. The pressures must be the same respectively.

   c. The pressures in test points "F" and "R" must be 0.0 [MPa] for control lever in neutral (N) position.
5. Left and right steering pressure test (starting from neutral (N) position).
   a. The pressures in test points "CR" and "CL" must be M-0.07 [MPa] for drive train control lever in neutral (N) position.

   b. Gradually shift the lever from neutral (N) position to the right (RH) direction.

      - with the lever being shifted from 1.6 ± 1 [°] to 5.0 ± 1 [°] initially, the "CR" test point pressure in should be dropping gradually from M-0.07 [MPa] to 0.63 [MPa], followed by the pressure gradually drop to 0.35 [MPa] with lever shifted from 5.0 ± 1 [°] to 10.0 ± 1 [°].
      - finally the "CR" point pressure should be dropped gradually to 0.0 [MPa] with lever at the right extreme position. During this procedure the "CL" test point pressure must be M-0.07 [MPa].

   c. Repeat this procedure for left (LH) direction. The "CL" point pressures should be identical as for RH direction respectively.
6. If the pressures are outside specified above, control valve should be repaired or replaced.
7. Shut off the engine and, in case of successful test pressure results, continue installation as described in Paragraph 23, INSTALLATION in this Section.

TRANSMISSION

DRIVE TRAIN CONTROL VALVE

23. INSTALLATION

1. Install drive train control valve (4, Fig. 7C.20) into the valve bracket (2) and secure with three mounting bolts (3).
2. Put the valve bracket (2) with drive train control valve mounted into position, and install the assembly to the platform with four bolts (1).
3. Reconnect all hoses (1, Fig. 7C.19) to the drive train control valve (2).
4. Install valve console (3, Fig. 7C.18) into platform and secure with screws (4).
5. Turn on control lever (5) with attached boot and electrical harness. Install two stiffener plates along with control lever.
6. Reinstall cover (1) and secure with screws (2).
7. Reconnect control lever harness (3, Fig. 7C.19).

WARNING! Be sure the area around the machine is clear of personnel and obstructions as the vehicle may move during these test. If the machine starts to move, fully depress the decelerator pedal and shift the drive train control lever to NEUTRAL.

8. Install filter (4, Fig. 7C.17) to the filter bracket (3) and secure with bolts (2). Reconnect the electrical wire (5) to the filter base.
9. Apply parking brake. Start the engine. Move the drive train control lever through all the lever positions and check connections for leaks.
10. Install access cover (1, Fig. 7C.16) and secure with bolts (2).
11. Reinstall L.H. enclosure (3) on the left hand side and secure with bolts (4).
12. Check the oil level in the rear main frame as described in the OPERATOR"S MANUAL, add oil if required.

CHARGE AND SCAVENGE PUMP

24. REMOVAL

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

IMPORTANT: *When disconnecting hydraulic lines for any reason, they should be properly capped with the correct size plastic cap. If these caps are not available, tape or clean rubber corks may be used. Hydraulic openings must never be plugged with rags. This practice could easily introduce dirt or lint into critical hydraulic components of the machine. Tag all disconnected oil lines to facilitate easier installation.*

1. Remove floor mat (cab equipped machines) and center floor plate from between operator's seat and instrument panel.
2. Remove the transmission case guard from the bottom of the machine.
3. Drain rear main frame as described in the OPERATOR'S MANUAL.
4. Disconnect brake control cable (7, Fig. 7C.23).
5. Disconnect breather hose (6) and supply hose (2) from the torque converter.
6. Disconnect tube (3) and hose (1) from the top of charge and scavenge pump (4).

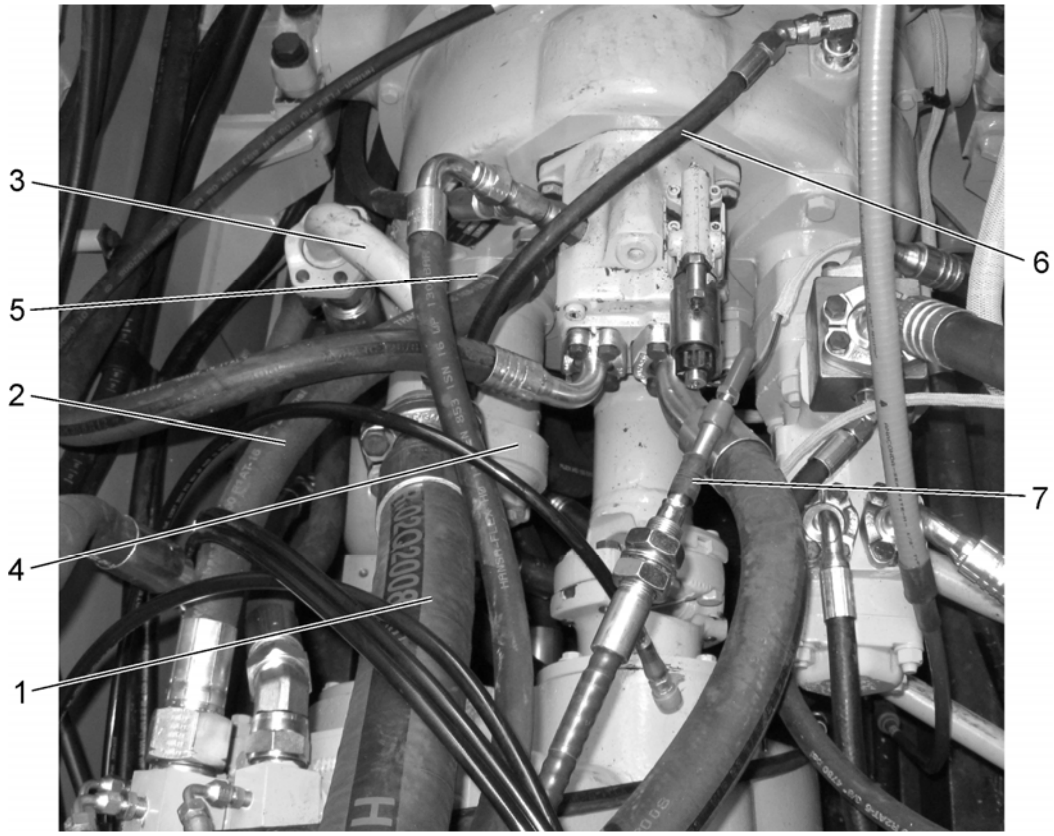


Fig. 7C.23. Charge and Scavenge Pump Disconnect Points (Top View)

1. Charge Suction Hose
2. TC Supply Hose
3. Scavenge Suction Tube
4. Charge and Scavenge Pump
5. Pump Bolt
6. TC Breather Hose
7. Brake Control Cable (Disconnected)

CHARGE AND SCAVENGE PUMP

7. Disconnect the scavenge pump hose (2, Fig. 7C.24) and charge pump hose (3) from the bottom of charge and scavenge pump (1).
8. Take up the slack in the hoist of pump and unscrew two mounting bolts (5, Fig. 7C.23). Pull the pump free of the torque converter and get it out of the machine. When removing the pump, be careful not to lose the splined sleeve between the pump drive shaft and the drive gear inside the torque converter. Remove and discard the pump mounting O-ring.

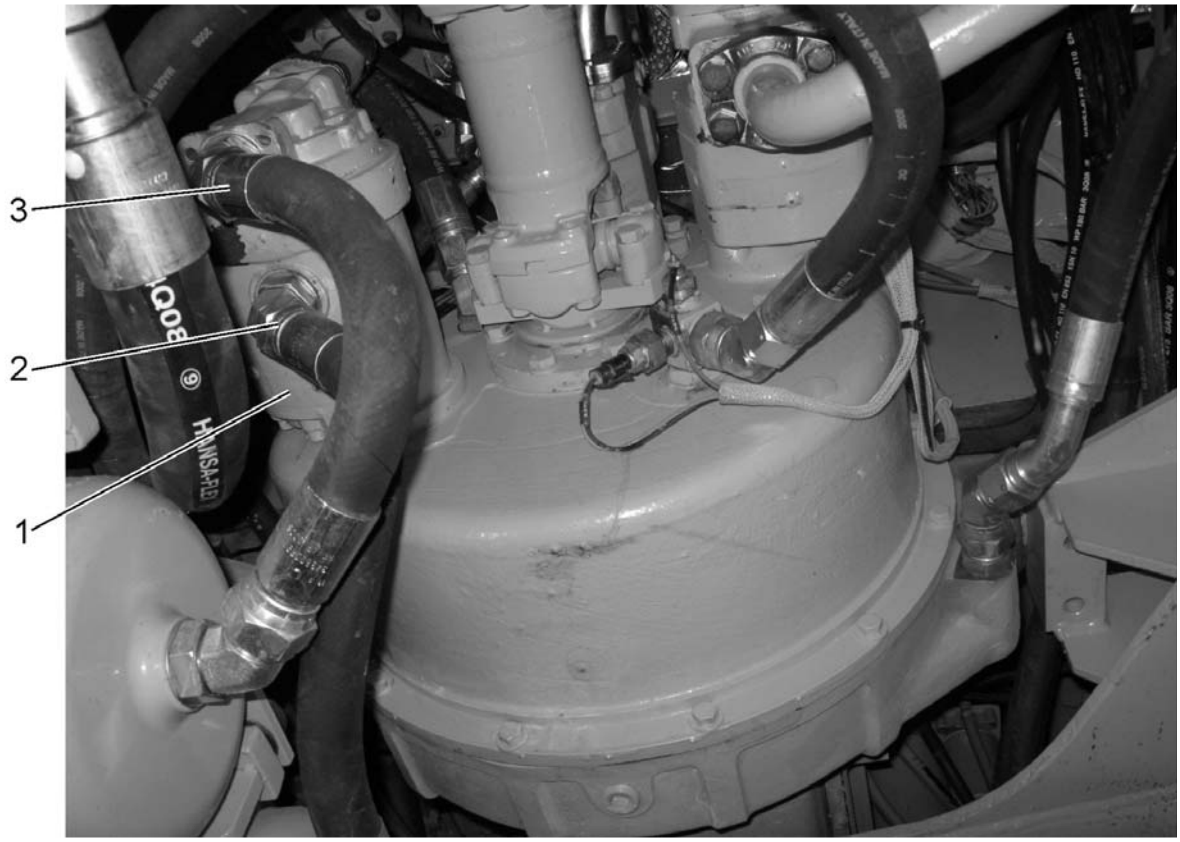


Fig. 7C.24. Charge and Scavenge Pump Disconnect Points (Bottom View)

1. Charge and Scavenge Pump
2. Scavenge Pump Hose
3. Charge Pump Hose

25. DISASSEMBLY (Refer to Fig. 7C.25)

Troubleshooting procedures should be followed per instructions as described in SECTION 10A. PUMPS.

1. Clean the exterior of the pump with solvent before beginning disassembly.
2. Position the pump on the work bench so that the drive shaft is pointing up. Index mark the five pump sections to retain relationship during reassembly.
3. Remove mounting nuts (5) and washers (2) from studs (4).
4. Remove flange (7) as shown in Fig. 7C.26. Parts (9 and 10) should come off with the flange.
5. Remove seals (9 and 10) from flange (7).

CHARGE AND SCAVENGE PUMP

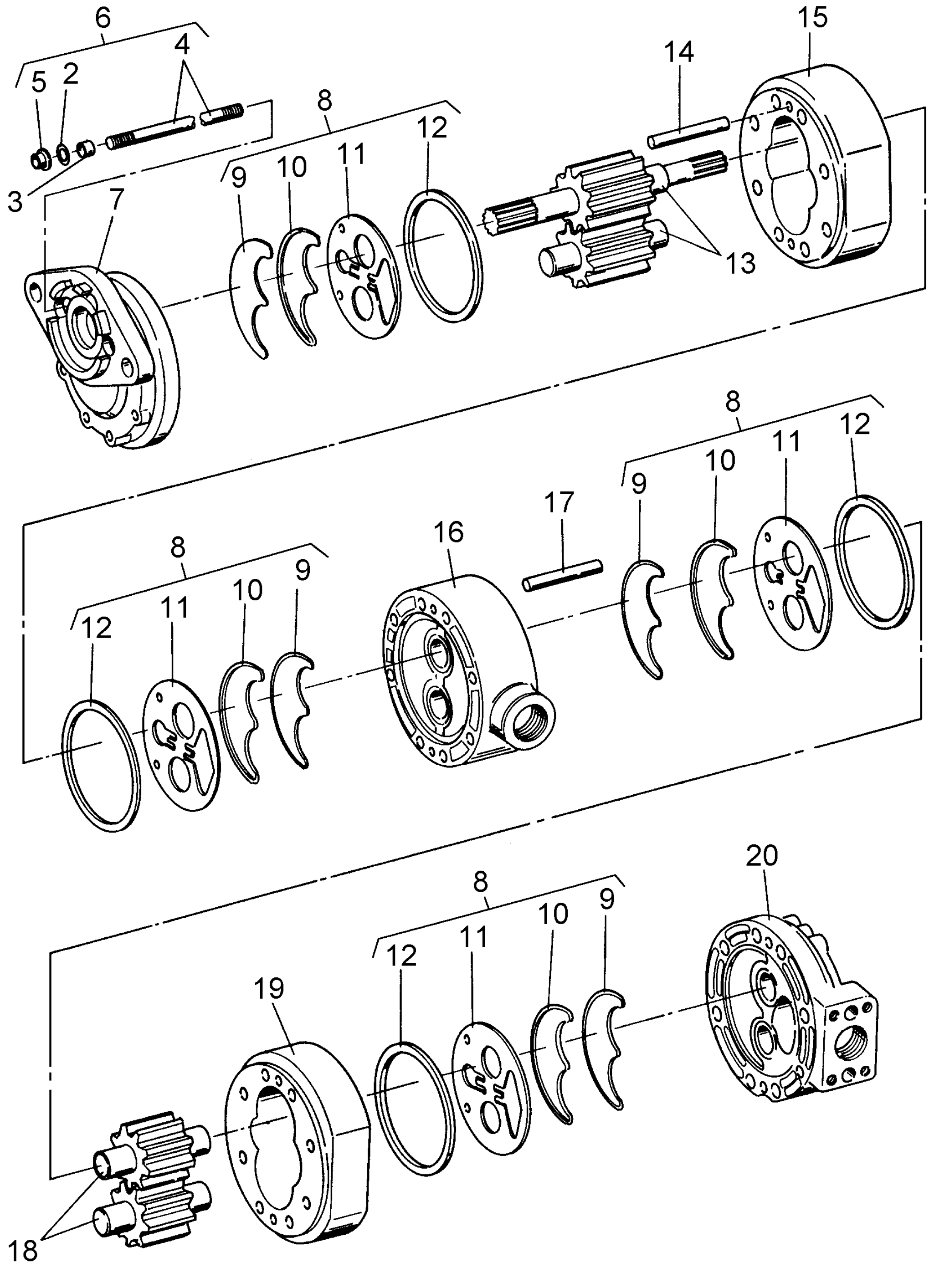


Fig. 7C.25. Exploded View of Charge and Scavenge Pump

2. Washer	9. Seal	16. Inlet and Outlet Front Section
3. Tube Sleeve	10. Seal	17. Rear Dowel Pin
4. Tie Rod Stud	11. Wear Plate	18. Rear Gear Set
5. Nut	12. O-Ring	19. Rear Gear Section
6. Stud Kit	13. Front Gear Set	20. Inlet and Outlet Rear Section
7. Flange	14. Dowel Pin	
8. Service Kit	15. Front Gear Section	

CHARGE AND SCAVENGE PUMP

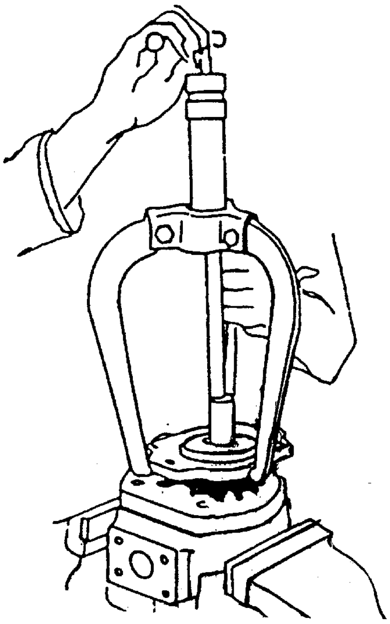


Fig. 7C.26. Removing Mounting Flange

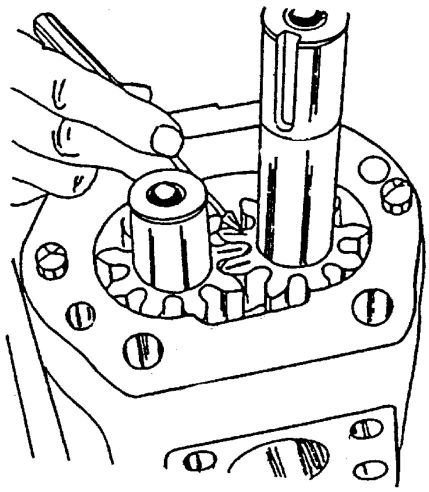


Fig. 7C.27. Index Marking Gears

6. Remove wear plate (11) and O-ring (12).
7. Index mark the teeth of gears (13) as shown in Fig. 7C.27 to retain the original mesh so that the same wear pattern will be re-established if the original gears are installed. Remove the front gears set (13) from front gear section (15).
8. Remove front gear section (15). Remove and discard O-ring (12) and wear plate (11). If necessary, remove dowel pin (14).
9. Lift off inlet and outlet front section (16). Parts (9, 10, 17) should come off with the section.
10. Remove seals (9 and 10) from inlet and outlet front section (16). Rear dowel pins (17) need not be removed. Section stud sleeves (3) need not be removed.
11. Remove wear plate (11) and O-ring (12).
12. Index mark the teeth of gears (18) to obtain the original mesh so that the same wear pattern will be re-established if the original gears are installed. Remove the gears from rear gear section (19).
13. Remove rear gear section (19), O-ring (12) and wear plate (11).
14. Remove seals (9 and 10) from inlet and outlet rear section (20).
15. Remove the studs from inlet and outlet rear section (20).

26. INSPECTION AND REPAIR

1. Discard all seals, O-rings and wear plates and replace with new ones during reassembly.
2. Wash all parts thoroughly in a suitable solvent. Dry thoroughly with compressed air.
3. Inspect the edges of gear teeth and faces for scoring or roughness. If possible, remove roughness or scoring with an oil stone. Also inspect the gear hubs for excessive wear at the bearing surfaces.

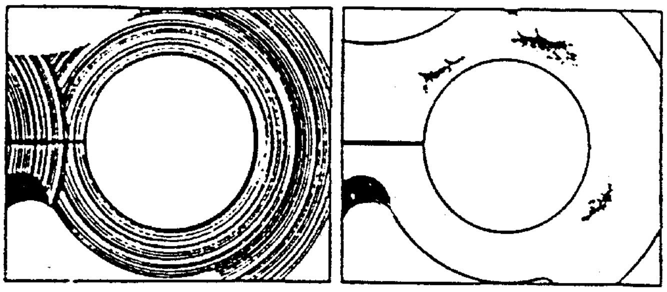


Fig. 7C.28. Pump Wear Plate Wear

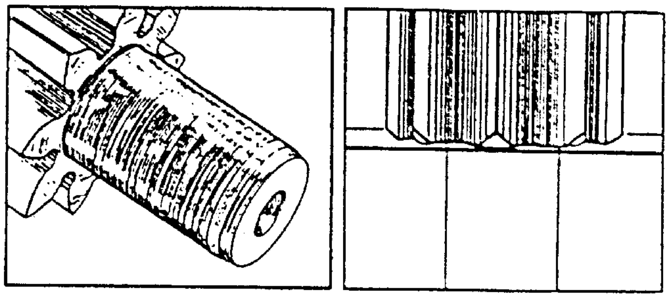


Fig. 7C.29. Pump Gears Wear

4. Discard wear plates that have score marks , heavy wear pattern or show erosion marks indicating cavitation or aerated oil condition. Refer to Fig. 7C.28.
5. Gear assemblies (refer to Fig. 7C.29) should be discarded if :
   a. shaft journals show excessive wear or pitting,
   b. gear teeth show excessive wear,
   c. gear face scored or cracked,
   d. drive shaft splines or key ways distorted or badly worn

NOTE: *Gears assemblies must be replaced in pairs.*

5. Remove any roughness from the machined surfaces of flange (7), sections (15 and 19) and section (16 and 20) with an oil stone. If roughness is excessive, the components should be replaced.
6. Rewash all parts that were smoothed with an oil stone and dry thoroughly.

27. REASSEMBLY (Refer to Fig. 7C.25)

1. Install seals (9 and 10) in the groove in inlet and outer rear section (20).
2. Place O-ring (12) around wear plate (11) and install on inlet and outlet rear section (20). Wear plate (11) must be installed so that the bronze side with the slots will face toward gears (18) and that the port holes are aligned.
3. Install rear gear section (19) on inlet and outlet rear section (20) so that the index marks on the section line up with the matching marks on the section. Install gears (18) aligning the index marks on the gear teeth.
4. Check that section stud sleeves (3) are installed in the stud hole in inlet and outlet front section (16). Install seals (9 and 10) in the grooves on both sides of in inlet and outlet front section (16).
5. Place O-ring (12) around wear plate (11) and install on rear gear section (19). Wear plate (11) must be installed so that the bronze side with the slots will face toward gears (18) and that the port holes are aligned.

NOTE: *The wear plate may require chassis grease on the underside to keep it in place during assembly.*

6. Install inlet and outlet front section (16) on rear gear section (19) so the index marks on the two sections line.
7. Insert studs (4), course threads first, through the holes in sections (16 and 19) and thread them into inlet and outlet rear section (20) until 84 [mm] of the stud remains. The distance is measured from the top end of studs (4) to the upper surface of inlet and outlet front section (16).
8. Place O-ring (12) around wear plate (11) and install on inlet and outlet front section (16). Wear plate (11) must be installed so that the bronze side with the slots will face toward gears (13) and that the port holes are aligned.
9. Install front gear section (15) on inlet and outlet front section (16) so the index marks on the two sections line up. Install the drive gear of gear set (13) in the front gear section (15) being sure it splines with the drive gear of gear set (18). Install the driven gear of gear set (13) aligning the index marks on the gear teeth.
10. Install seals (9 and 10) in the groove in flange (7).
11. Place O-ring (12) around wear plate (11) and install on flange (7). Wear plate (11) must be installed so that the bronze side with the slots will face toward gears (13) and that the port holes are aligned.

NOTE: *The wear plate may require chassis grease on the underside to keep it in place during assembly.*

12. Install flange (7) on front gear section (15) so the index marks on the flange and section line up.
13. Install washers (2) and nuts (5) on studs (4). Torque the nuts to 30 - 35 [Nm].

28. INSTALLATION

1. Be sure the splined sleeve is still installed in the drive gear inside the torque converter.
2. Position the charge and scavenge pump (4, Fig. 7C.23) with new mounting O-ring on the torque converter flange. Using bolts (5) secure the pump to torque converter.
3. Reconnect the scavenge pump hose (2, Fig. 7C.24) and charge pump hose (3) to the bottom of pump (1).
4. Reconnect tube (3, Fig. 7C.23) and hose (1) to the top of pump (4).
5. Reconnect breather hose (6) and supply hose (2) to the torque converter.
6. Reconnect brake control cable (7).
7. Refill the main frame as described in the OPERATOR'S MANUAL.
8. Start the engine as described in OPRATOR'S MANUAL and check for leaks.
9. Check the rear main frame oil level as described in the OPERATOR'S MANUAL and add if necessary.
10. Stop the engine and install the floor plate and the transmission case guard to the bottom of machine.

GEAR SHIFTING VALVE

29. REMOVAL

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

IMPORTANT: *Disconnected hydraulic lines must be properly capped with the correct size plastic cap. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Remove all dirt accumulation from the main frame cover. Tag disconnected lines to facilitate faster and correct installation.*

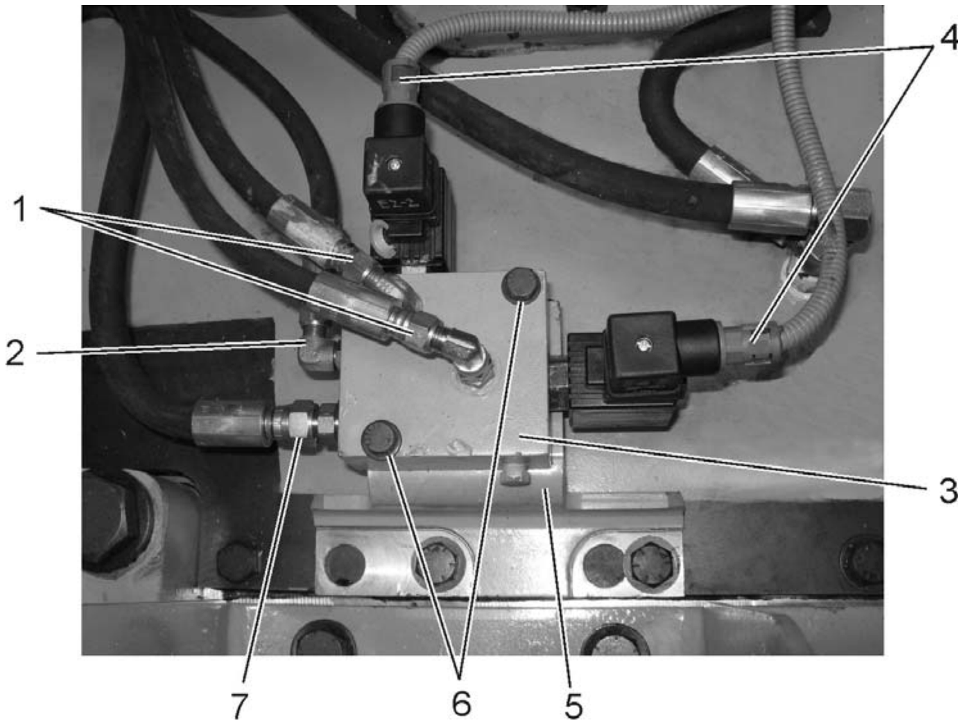


Fig. 7C.30. Gear Shifting Valve Disconnect Points

1. Control Hoses
2. Drain Hose
3. Gear Shifting Valve Assy
4. Wiring Harnesses
5. Bracket
6. Bolts
7. Pressure Supply Hose

1. Turn electrical master switch to OFF position and take it out.
2. Unscrew bolts (5, Fig.7E.1) securing rear plate (3) and remove the plate from the machine.
3. Disconnect wiring harnesses (4, Fig. 7C.30) at two solenoid valves.
4. Disconnect two control hoses (1).
5. Unscrew two bolts (6) and separate gear shifting valve (3) from the bracket (5).
6. Disconnect drain hose (2) and pressure supply hose (7) and remove the valve out of machine.

TRANSMISSION

GEAR SHIFTING VALVE

30. DISASSEMBLY (Refer to Fig. 7C.31)

1. Unscrew the solenoid coils from the solenoid valves (1 and 2). Remove the solenoid valve (1 and 2) bodies from the valve housing (3). Remove and discard the valve seal kit and replace with new.
2. Remove plugs (4), if necessary.

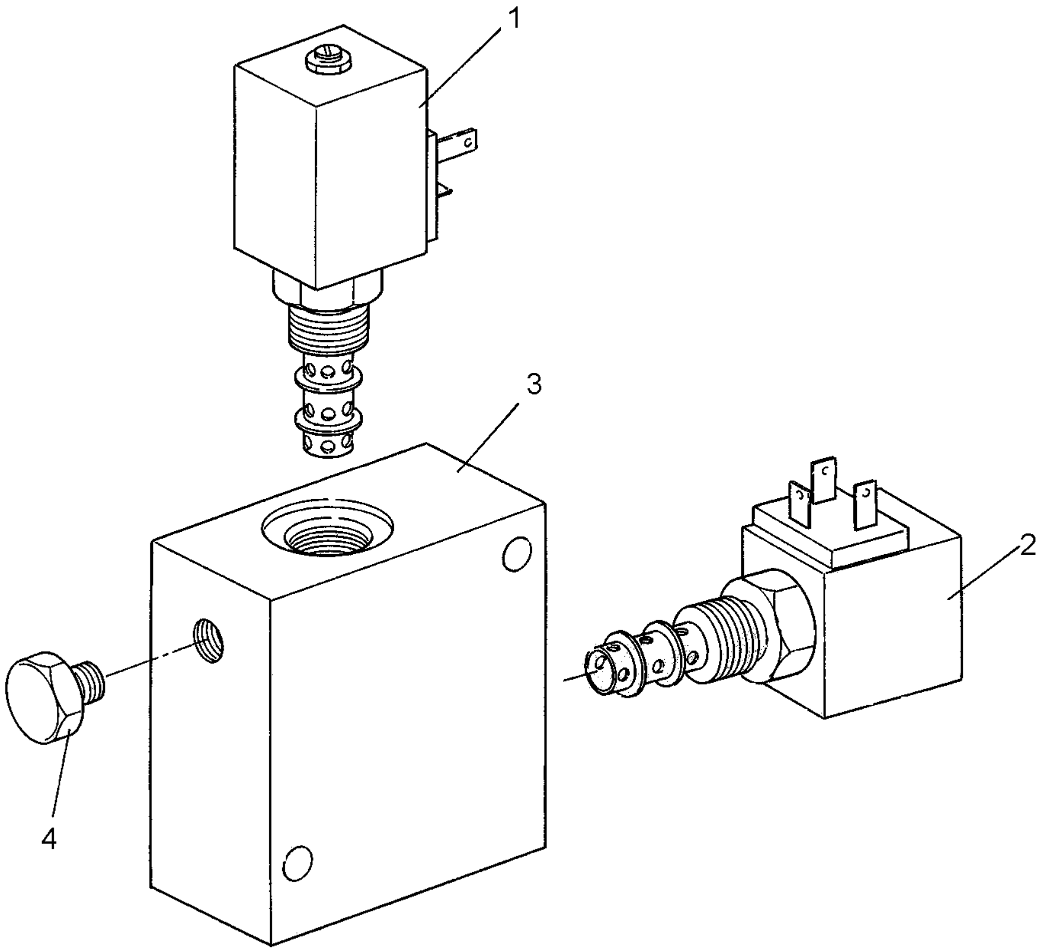


Fig. 7C.31. Exploded View of Gear Shifting Valve

1. Solenoid Valve 3rd Gear
2. Solenoid Valve 2nd Gear
3. Valve Housing
4. Plug

31. INSPECTION AND REPAIR

1. It is recommended that all new O-rings and seal rings be installed upon reassembly of the valve.
2. Clean all parts in a suitable solvent and blow dry with compressed air. Be sure all oil passages in the valve bodies and spools are free of obstructions.
3. Inspect parts for excessive wear and replace if necessary.
4. Clean threads with a stiff brush and solvent. Check for damage.

32. REASSEMBLY (Refer to Fig. 7C.31)

1. Apply LOCTITE PIPE SEALANT to the threads of plug (4) and install it, if removed.
2. Install a new seal kit to the solenoid valve (1 and 2) bodies. Install the solenoid valves bodies to the valve housing (3). Torque the solenoid valve (1 and 2) bodies to 20.5 • 22.5 [Nm]. Install the solenoid coils on valve bodies and torque them to 4.3 • 4.8 [Nm].

33. INSTALLATION

1. Temporarily secure the gear shifting valve (3, Fig. 7C.30) to the valve bracket (5). Reconnect the pressure supply hose (7) and drain hose (2) to the valve and then install the gear shifting valve (3) to the bracket (5) with two mounting bolts (6).
2. Reconnect two control hoses (1) to the valve housing.
3. Reconnect two wiring harnesses (4) to the solenoids.
4. Start the engine and operate drive train control lever. Check for leaks and functioning.
5. Reinstall the rear plate (3, Fig. 7E.1).

TRANSMISSION

PRIORITY VALVE

34. REMOVAL AND DISASSEMBLY

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

IMPORTANT: *Disconnected hydraulic lines must be properly capped with the correct size plastic cap. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Remove all dirt accumulation from the main frame cover. Tag disconnected lines to facilitate faster and correct installation.*

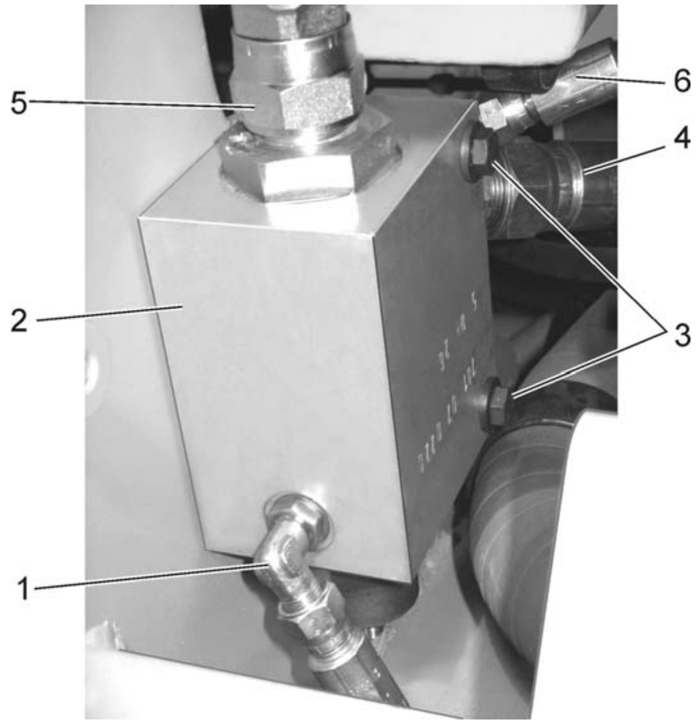


Fig. 7C.32. Priority Valve Disconnect Points

1. Drain Hose
2. Priority Valve
3. Mounting Bolt
4. Priority Valve to Transmission Hose
5. Pressure Supply Hose
6. Priority Valve to Switching Valve Hose

1. Turn electrical master switch to OFF position and take it out.
2. Open LH filter compartment door.
3. Disconnect supply hose (5, Fig. 7C.32) from the priority valve (2).
4. Unscrew two bolts (3) and separate priority valve (2) from LH fender bracket.
5. Disconnect drain hose (1), and priority valve to transmission hose (4) from the priority valve (2).
6. Remove the valve from the machine and unscrew attached hydraulic connectors, if necessary.
7. Remove the pressure regulator (1 Fig. 7C.33) from the valve housing (2). Remove and discard the valve seal kit and replace with new.

PRIORITY VALVE

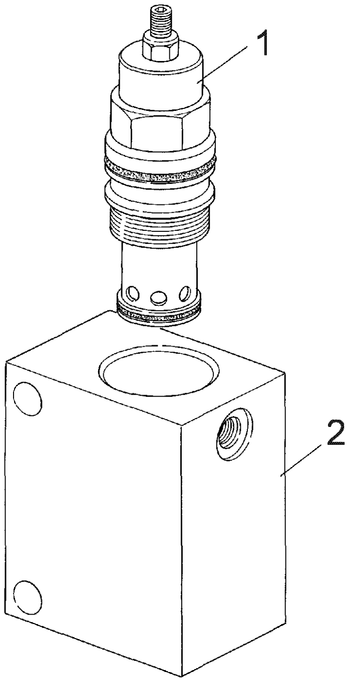


Fig. 7C.33. Exploded View of Priority Valve

1. Pressure Regulator
2. Valve Housing

35. INSPECTION AND REPAIR

1. It is recommended that all new seal rings be installed upon reassembly of the valve.
2. Clean all parts in a suitable solvent and blow dry with compressed air. Be sure all oil passages in the valve housing and regulator are free of obstructions.
3. Inspect parts for excessive wear and replace if necessary.
4. Clean threads with a stiff brush and solvent. Check for damage.

36. REASSEMBLY AND INSTALLATION

1. Install a new seal kit to the pressure regulator body (1, Fig. 7C.33).
2. Install the pressure regulator body into the valve housing (2). Torque the regulator body (1) to 465 ÷ 500 [Nm].
3. Reconnect the priority valve to transmission hose (4, Fig. 7C.32), and drain hose (1) to the valve (2).
4. Secure the priority valve (2) to the LH fender bracket with two mounting bolts (3) and support bar.
5. Reconnect remaining pressure supply hose (5) to the valve (2).
6. Start the engine and operate with drive train control lever. Check for leaks and functioning.
7. Check the priority valve pressure and adjust, if necessary. Refer to PRIORITY VALVE PRESSURE CHECK AND ADJUSTMENT PROCEDURE in SECTION 7, DRIVE TRAIN.
8. Shut off the engine and close LH filter compartment door.

DRIVE TRAIN LOCK SOLENOID VALVE

37. REMOVAL AND DISASSEMBLY

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

IMPORTANT: *Disconnected hydraulic lines must be properly capped with the correct size plastic cap. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Remove all dirt accumulation from the main frame cover. Tag disconnected lines to facilitate faster and correct installation.*

1. Unscrew bolts (4, Fig. 7C.34) and remove L.H. enclosure (3) with L.H. door.
2. Unscrew bolts (2) and remove access cover (1) in order to obtain access to mounting points of the drive train lock solenoid valve.
3. Disconnect the electrical wire (5, Fig. 7C.35) from the filter base. Unscrew bolts (2) fastening filter base to the filter bracket (3) and allow the filter (4) to be supported by the hoses.

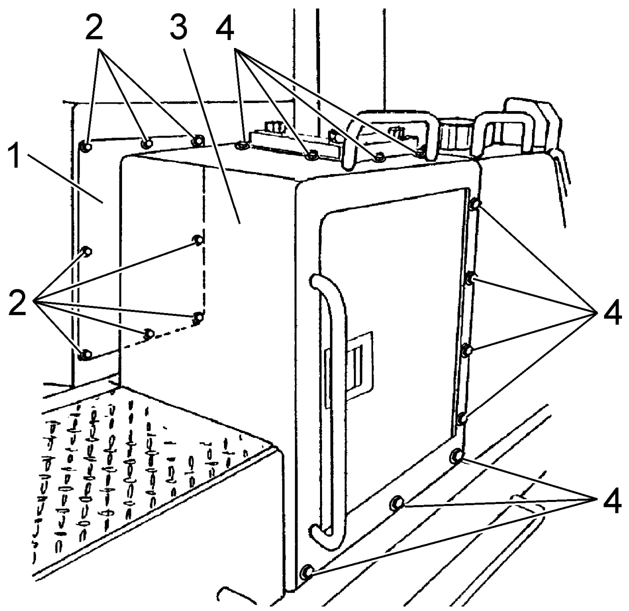


Fig. 7C.34. Disassembly Access Cover to Drive Train Control Valve

1. Access Cover
2. Bolts
3. L.H. Enclosure
4. Bolts

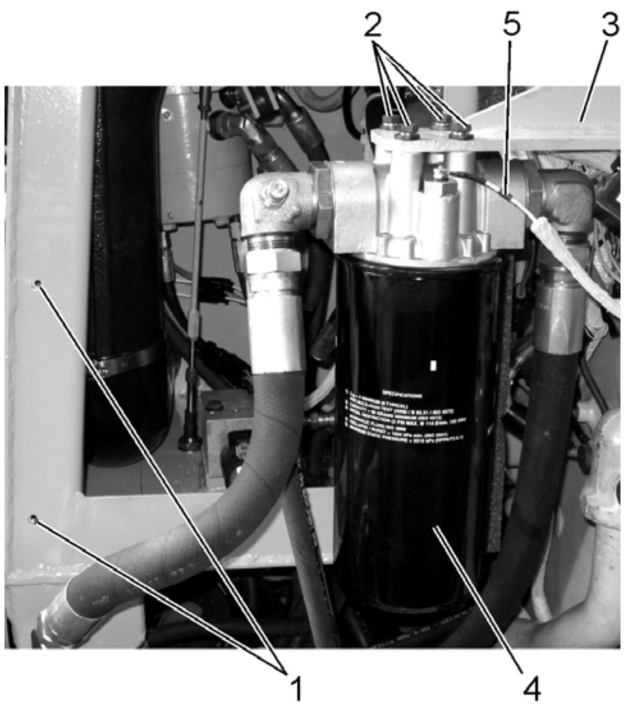


Fig. 7C.35. Drive Train Pressure Filters Removal

1. Access Cover Bolts (Removed)
2. Filter Mounting Bolts
3. Filter Bracket
4. Filter
5. Electrical wire

DRIVE TRAIN LOCK SOLENOID VALVE

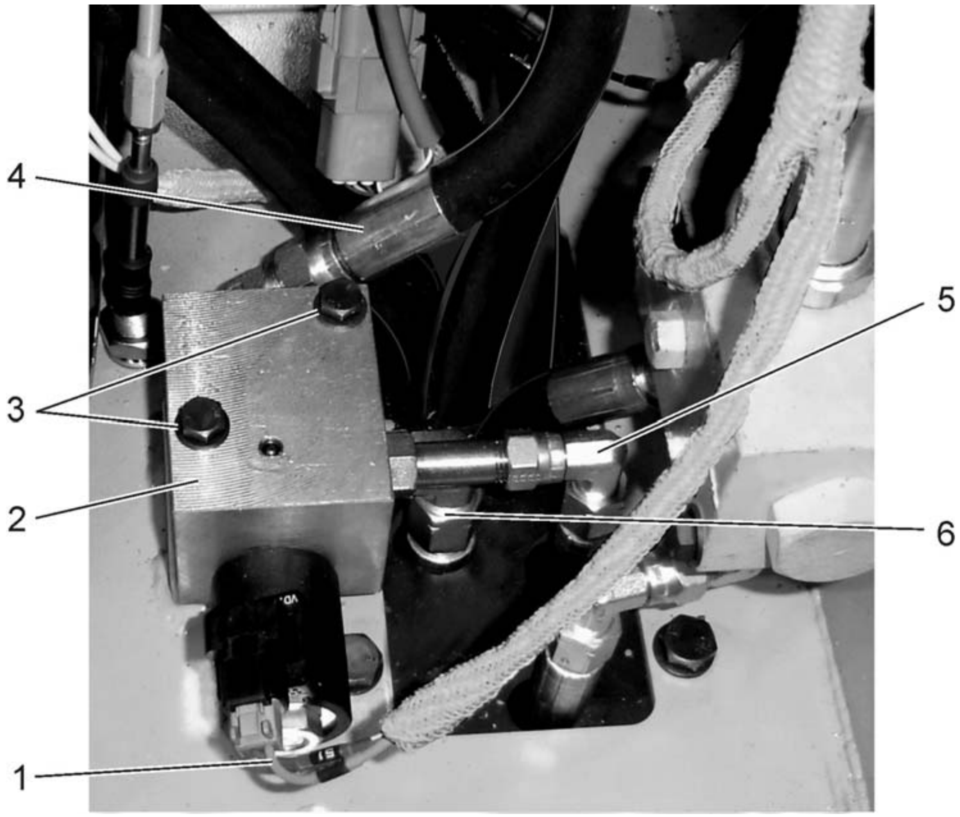


Fig. 7C.36. Drive Train Lock Solenoid Valve Disconnect Points

1. Harness
2. Drive Train Lock Solenoid Valve
3. Mounting Bolts
4. Solenoid Lock Valve to Drive Train Control Valve Hose
5. Drain Hose
6. Pressure Supply Hose

4. Disconnect drive train lock solenoid valve harness (1, Fig. 7C.36).
5. Disconnect drain hose (5), supply hose (6) and lock solenoid valve to drive train control valve hose (4) at the lock solenoid valve (2).
6. Unscrew two bolts (3) and separate solenoid lock valve (2) from LH fender.
7. Remove the valve from the machine and unscrew attached hydraulic connectors, if necessary.
8. Unscrew the solenoid coil from the lock solenoid valve (2). Remove the solenoid valve cartridge (4, Fig.7C.37) from the valve manifold (1). Remove and discard the valve seal kit and replace with new.
9. Remove plug (5), if necessary.

TRANSMISSION

DRIVE TRAIN LOCK SOLENOID VALVE

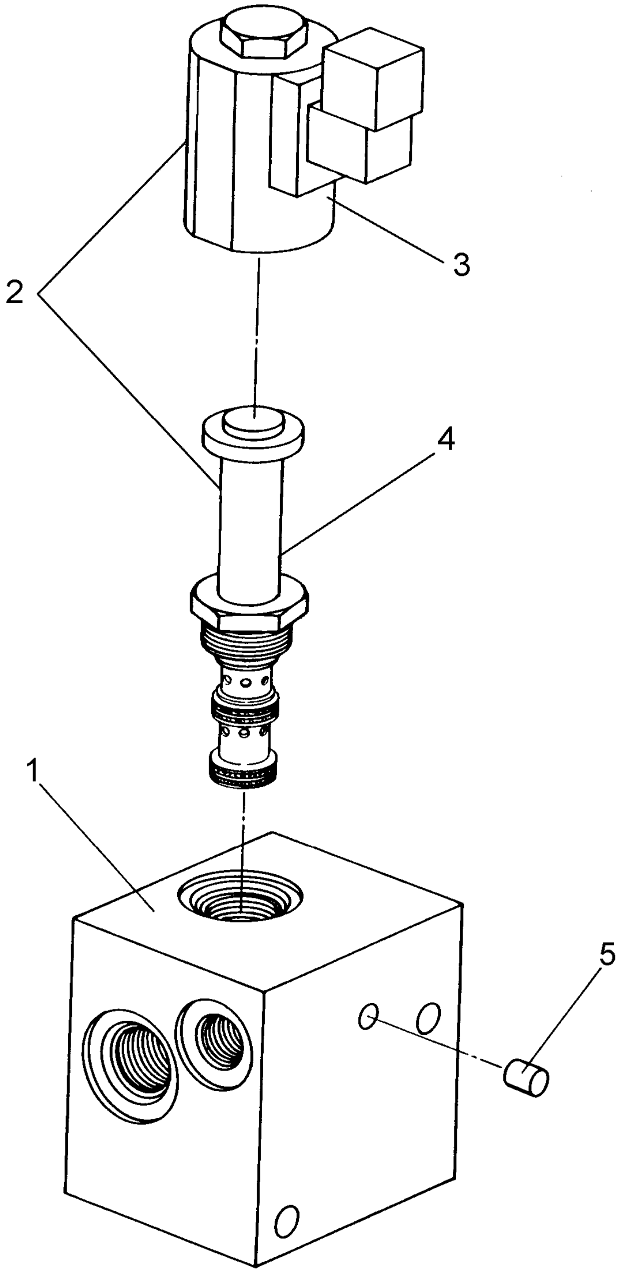


Fig. 7C.37. Explode View of Drive Train Lock Solenoid Valve

1. Manifold
2. Solenoid Valve
3. Solenoid Valve
4. Valve Cartridge
5. Port Plug

38. INSPECTION AND REPAIR

1. It is recommended that all new seal rings be installed upon reassembly of the valve.
2. Clean all parts in a suitable solvent and blow dry with compressed air. Be sure all oil passages in the valve manifold and valve cartridge are free of obstructions.
3. Inspect parts for excessive wear and replace if necessary.
4. Clean threads with a stiff brush and solvent. Check for damage.

39. REASSEMBLY AND INSTALLATION

1. Apply LOCTITE PIPE SEALANT to the threads of plug (5, Fig. 7C.37) and install, if removed.
2. Install a new seal kit to the solenoid valve cartridge (4). Install valve cartridge to the valve manifold (1). Torque the cartridge to 20.5 ÷ 22.5 [Nm]. Install the solenoid coil on valve cartridge and torque the nut to 5.4 ÷ 8.1 [Nm].
3. Secure the lock solenoid valve (2, Fig. 7C.36) to the LH fender with two mounting bolts (3).
4. Reconnect hose (4), pressure supply hose (6) and drain hose (5) to the lock solenoid valve (2).
5. Reconnect lock solenoid valve harness (1) to the valve (2).

WARNING! Be sure the area around the machine is clear of personnel and obstructions as the vehicle may move during these test.

6. Start the engine and operate with drive train control lock lever. Check for leaks and functioning. Shut off the engine.
7. Install filter (4, Fig. 7C.35) to the filter bracket (3) and secure with bolts (2). Reconnect the electrical wire (5) to the filter base.
8. Reinstall cover (1, Fig. 7C.34) and secure with bolts (2).
9. Reinstall L.H. enclosure (3) on the left hand side and secure with bolts (4).

SECTION 7E

STEERING DRIVE

STEERING DRIVE

CONTENTS

SERVICE/SPECIAL TOOLS

GENERAL

STEERING DRIVE

TWO SPEED STEERING VALVE

STEERING MANIFOLD

SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS

DESCRIPTION		TOOL NUMBER
Steering Drive Output Shaft Retainer Removing Bolt	1/2”-13UNC-2B	
Steering Drive Output Shaft Removing Bolt	5/8”-11UNC-2B	(376-89-1055)
Fuel Tank Lifting Eyebolts	1”-8x1-1/2”	
High Range Clutch Piston Eyebolts	3/8”	
High Range Clutch Piston Springs Compressing Bolts	3/8”-16UNCx6”	
Low Range Clutch Piston Springs Compressing Stud	3/8”-16UNCx3-1/2”	
Main Frame Cover Lifting Eyebolts	1/2”-13UNC-2B	
Steering Drive Assembly Rotational Stand		21.851.0007
Pinion Shaft Bearing Preload Checking Tool		1.249.0017
Pinion Shaft Bearing Preload Checking Tool Adapter Socket		1.541.0055
Bevel Gear Bearing Preload Checking Tool		1.249.0017
Bevel Gear Bearing Preload Checking Tool Adapter Socket		1.541.0055

GENERAL

2. DESCRIPTION

The steering system on this machine consists of a two speed steering drive located in the main frame and a two speed steering valve mounted on the rear main frame cover.

The oil pressure from drive train control valve operates hydraulically and brake pedal cable operates mechanically the steering valve. Electronic controller operates electrically the steering valve through drive train control valve switches. Oil pressure from the steering valve is directed to the steering drive to operate the range and brake clutch packs. The steering drive consists of an individual circuit for each side of the machine: one drive low range clutch pack, one drive high range clutch pack, one brake clutch pack and one planetary for each side. The drive high and low clutch packs are hydraulically applied and spring released whereas the break clutch packs are spring applied and hydraulically released. The planetary provides the gear reduction in speed for low range. If a hydraulic failure occurs or the engine is stopped, the brake clutches in the steering drive will automatically apply.

3. SPECIFICATIONS

Steering Drive

Backlash, bevel gear with pinion gear . . . . 0.25 - 0.33 [mm]
Bevel gear hub bearing preload (pull at 178 mm diameter of carrier) . . . . 18 - 22 [N]
Pinion bearing preload (pull at 203 mm diameter of pinion support housing) . . . . 13 - 18 [N]
Pinion shaft end clearance (measured between end of pinion shaft and raised edge of carrier)
shown in mm and stamped on rear end of pinion shaft with tolerance of . . . . ± 0.07 [mm]
Shaft end play . . . . 0.1 - 0.2 [mm]

Brake clutch pack:

Number of friction discs (internal splined plates) 5
Number of separator plates (external splined plates) 6
Thickness of friction disc . . . . 4.17 - 4.37 [mm]
Thickness of separator plate . . . . 2.24 - 2.34 [mm]

STEERING DRIVE

GENERAL

High range clutch pack:

- Number of friction discs (internal splined plates) 4
- Number of separator plates (external splined plates) 5
- Thickness of friction disc . . . . 4.17 - 4.37 [mm]
- Thickness of separator plate . . . . 2.24 - 2.34 [mm]

Low range clutch pack:

- Number of friction discs (internal splined plates) 6
- Number of separator plates (external splined plates) 7
- Thickness of friction disc . . . . 4.19 - 4.34 [mm]
- Thickness of separator plate . . . . 2.24 - 2.34 [mm]

Special Nut and Bolt Torques
(Torques given are for bolts and nuts lubricated with SAE-30 engine oil)

- Backlash adjusting nut lock ring bolts . . . . 54 [Nm]
- Bearing retainer mounting bolts . . . . 54 [Nm]
- Bevel gear mounting bolt . . . . 255 [Nm]
- Coupling retaining mounting bolts . . . . 54 [Nm]
- Cover mounting bolts . . . . 81 [Nm]
- High range clutch plate retainer mounting bolts . . . . 54 [Nm]
- Low range clutch plate retainer mounting bolts . . . . 81 [Nm]
- Oil scoop mounting bolts . . . . 54 [Nm]
- Oil slinger mounting bolts (LOCTITE 262 applied) . . . . 11 [Nm]
- Pinion support housing mounting bolts . . . . 110 [Nm]
- Rear main frame cover mounting bolts . . . . 265 [Nm]
- Ring gear mounting bolts . . . . 54 [Nm]
- Steering valve brake spool plug (LOCTITE 262 applied) . . . . 22 - 27 [Nm]

Springs Data

Description	Free Length [mm]	Test Length [mm]	Test Load [N]	Total Number of Coils
Steering Drive:				
Brake piston applying spring	87.2	77.5	1104 - 1189	9
High range clutch return inner spring	34.4	25.4	384 - 416	6.5
High range clutch return outer spring	37.6	25.4	564 - 610	5
Low range clutch piston return spring	57.2	38.1	367 - 398	10
Upper Steering Valve:				
Brake spool outer spring	55.5	36	608	6.5
Brake spool inner spring	57	34.3	200	9.5
Brake spool poppet spring	41.7	27.4	72.4 – 81.3	13
Lower Steering Valve:				
HI-LO spool return spring	88.4	63.7	218 - 227	8.5
Manifold:				
Manifold spool spring	46.2	30.9	333	10

STEERING DRIVE

4. REMOVAL

IMPORTANT: *It is suggested that the checks in Paragraph 13, SECTION 7, STEERING SYSTEM OIL PRESSURE CHECK and Paragraph 14, SECTION 7, STEERING SYSTEM FUNCTIONAL CHECK be made before removing the steering drive. In this manner, hydraulic malfunctions can be pinpointed and corrected at time of teardown.*

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

IMPORTANT: *Disconnected hydraulic lines must be properly capped with the correct size plastic cap. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Remove all dirt accumulation from the main frame cover. Tag disconnected lines to facilitate faster and correct installation.*

1. Drain the main frame as described in the OPERATOR'S MANUAL.
2. Unscrew bolts (5, Fig. 7E.1) securing rear plate (3) and remove the plate from the machine.
3. Open the fuel drain valve (2, Fig. 7E.2) and drain the fuel tank (1). Close the drain valve (2).

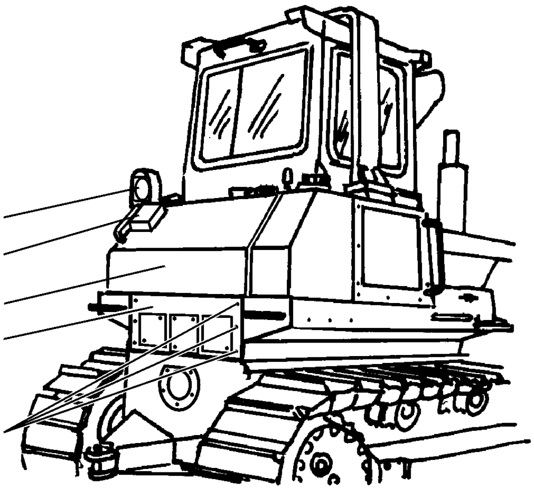


Fig. 7E.1. Rear of the Machine

1. Rear Lamp
2. Back-up Alarm
3. Rear Plate
4. Fuel Tank
5. Bolts

Fig. 7E.2. Fuel Line Disconnecting Points

1. Fuel Tank
2. Fuel Drain Valve
3. Bolt
4. Fuel Return Hose
5. Fuel Supply Hose
6. Fuel Supply Valve
7. Gear Shifting Valve
8. Gear Shifting Valve Bracket

4. Disconnect wires of rear lamp (1, Fig. 7E.1) and back-up alarm (2).
5. Disconnect fuel return and fuel supply hoses (4 and 5, Fig. 7E.2) from the fuel tank (1), unscrew fuel tank bolts (3), using a hoist and eyebolts 1”-8x1-1/2” and remove the tank.
6. Remove the steering valve (4, Fig. 7E.3) as described in Paragraph 9, REMOVAL.
7. Remove the gear shifting valve (7, Fig. 7E.2) as described in Paragraph 29, REMOVAL in SECTION 7C.
8. Remove the breather w/pipe (5, Fig. 7E.3), main frame oil dipstick and filler tube (3), unscrew two cover bolts (2) to remove gear shifting valve bracket and unscrew remaining cover bolts.

STEERING DRIVE

9. Install two lifting eyebolts 1/2”-13UNC-2B (2, Fig. 7E.4) and remove the main frame cover (1).
10. Remove the bolt securing tube (1, Fig. 7E.5) to support bracket (2). Disconnect tube (1) from the steering drive and pull the tube free of main frame. Remove dipstick tube (3) with hardware from the rear surface of the main frame.
11. Remove the pinion access cover with O-ring from the sprocket drive cover. Remove snap ring (1, Fig. 7E.6) that secures shaft retainer (2) in the pinion gear. Thread a bolt 1/2”-13UNC-2B in retainer (2) and pull it out of the pinion gear.

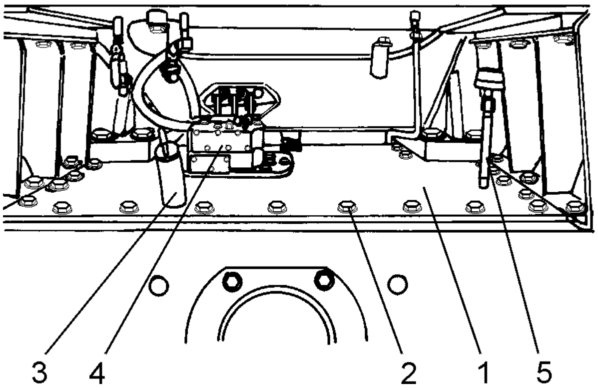


Fig. 7E.3. View on Main Frame Cover

1. Main Frame Cover
2. Cover Bolts
3. Filler Tube and Dipstick
4. Steering Valve
5. Breather w/Pipe

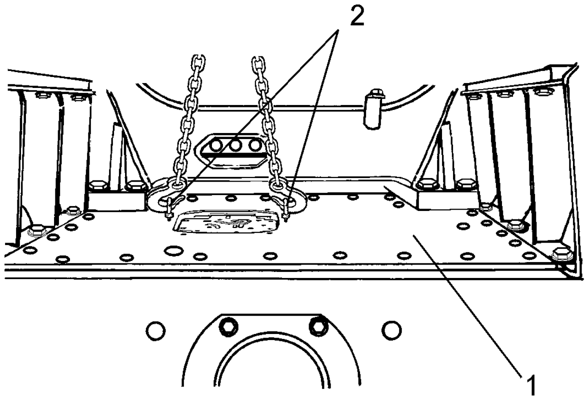


Fig. 7E.4. Main Frame Cover Removing

1. Cover
2. Lifting Eyebolts

12. Thread a bolt 5/8”-11UNC-2B in the steering drive output shaft and pull it free of the steering drive as shown in Fig. 7E.7.

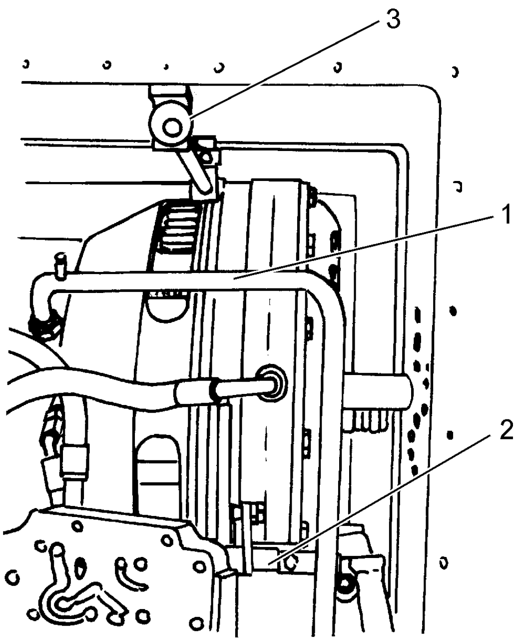


Fig. 7E.5. Removing the Steering Drive Lube Tube

1. Steering Drive Lube Tube
2. Tube Support Bracket
3. Dipstick Tube

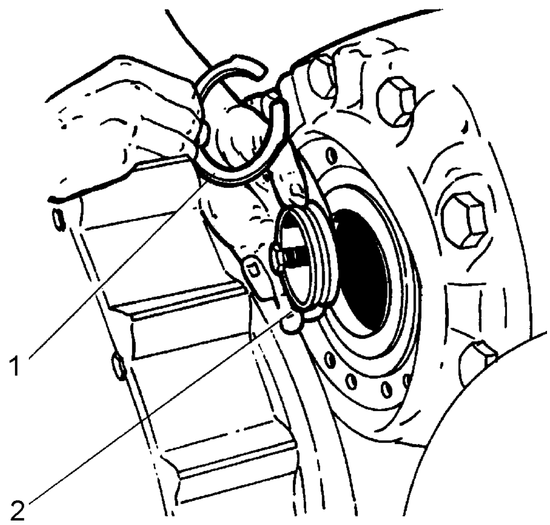


Fig. 7E.6. Removing the Output Shaft Retainer

1. Snap Ring
2. Shaft Retainer

STEERING DRIVE

13. Repeat steps 11 and 12 on the opposite side of the machine.

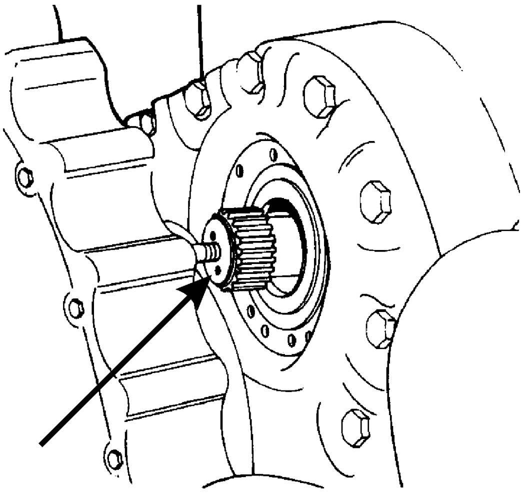


Fig. 7E.7. Removing the Output Shaft from the Steering Drive

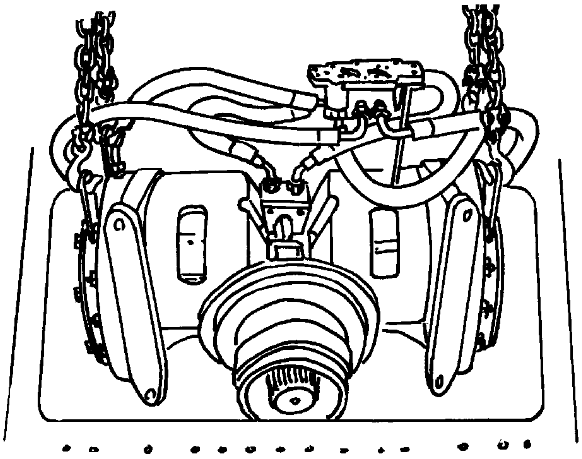


Fig. 7E.8. Removing the Steering Drive

14. Attach a hoist with an adjusting sling to the steering drive as shown in Fig. 7E.8 and take up the slack.

NOTE: *An adjusting sling must be used so that the steering drive can be tilted and leveled.*

15. Remove the bolts securing the steering drive to the front surface of the main frame. Move the steering drive back as far as possible, being sure the spline sleeve stays with the steering drive.

NOTE: *On machines equipped with a cab, it is necessary to lower the steering drive and rotate it, to clear the back of the cab, before raising and removing the steering drive. Therefore, before removing the steering drive, the rear frame suction tube mounting bolts should be removed, allowing the tube to be shifted to prevent damage.*

16. Lift the steering drive up a 0.1 [m] and then tilt it back so that the mounting flanges will clear the main frame opening as shown in Fig. 7E.8.
17. Set the assembly down, disconnect the manifold hoses, elbows and connectors from the steering drive and remove the manifold with hoses (refer to Fig. 7E.9).

STEERING DRIVE

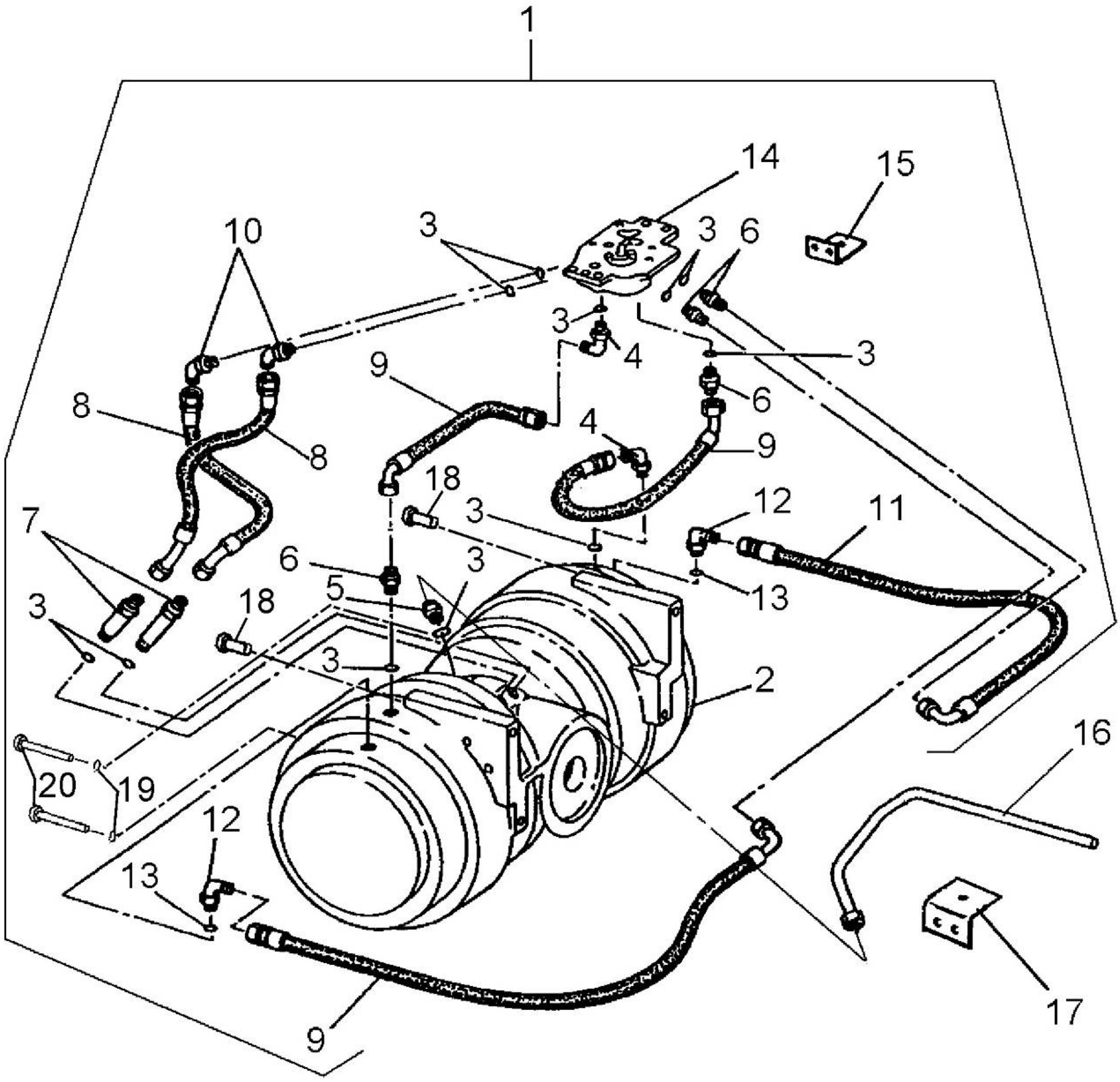


Fig. 7E.9. Two Speed Steering Drive w/Hoses

1. Two Speed Steering Drive w/Hoses
2. Steering Two Speed
3. O-ring
4. Elbow
5. Connector
6. Connector
7. Connector
8. Hose
9. Hose
10. Elbow
11. Hose
12. Elbow
13. O-ring
14. Steering Manifold
15. Bracket
16. Lubrication Tube
17. Bracket
18. Upper Bolt
19. Retaining Ring
20. Lower Bolt

STEERING DRIVE

5. DISASSEMBLY

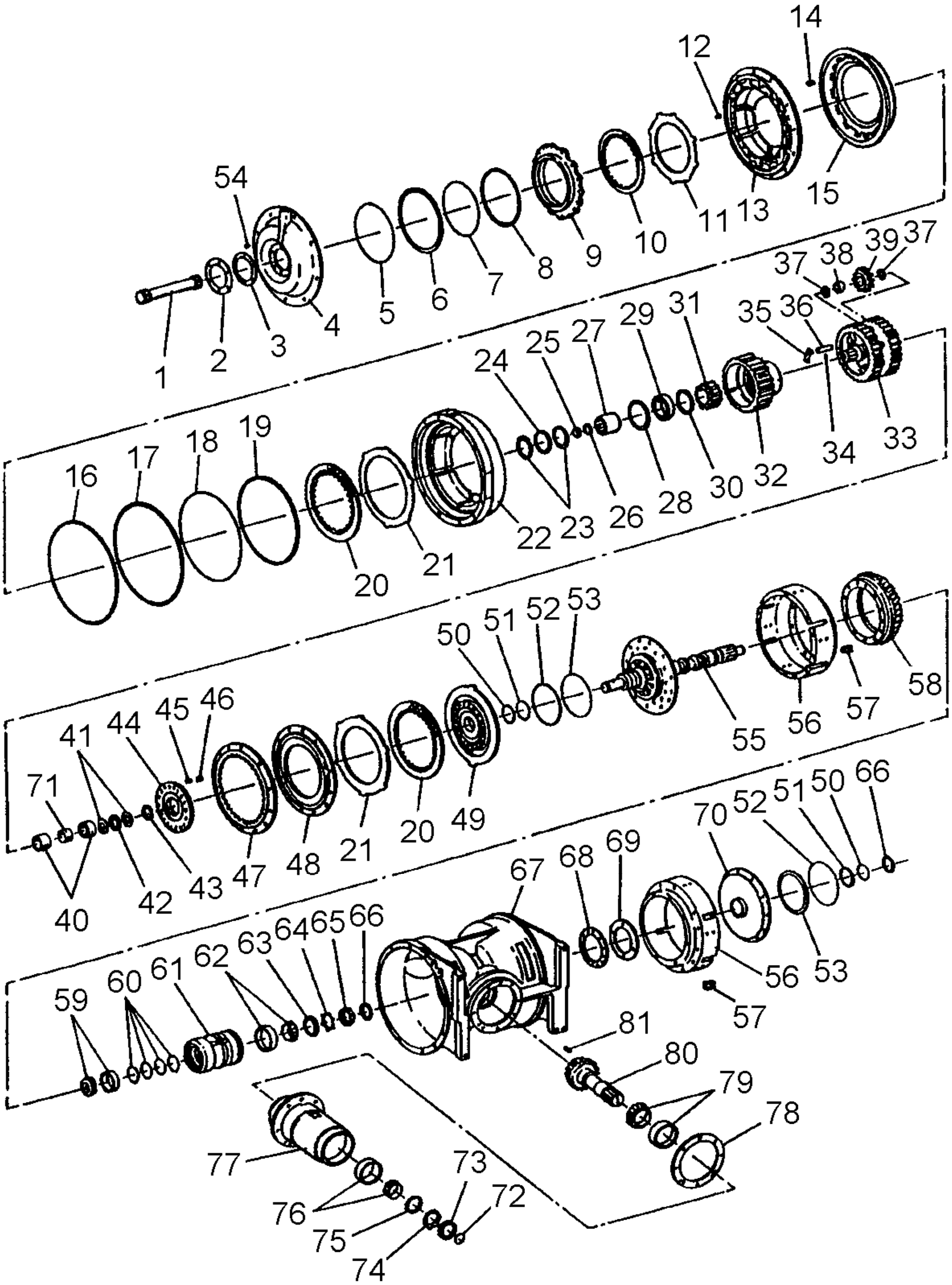


Fig. 7E.10. Exploded View of Two Speed Steering Drive

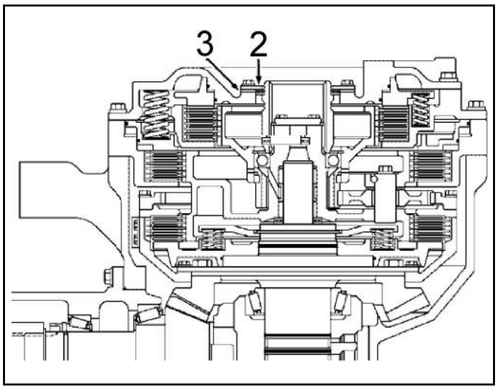
STEERING DRIVE

Legend for Fig.'s 7E.10

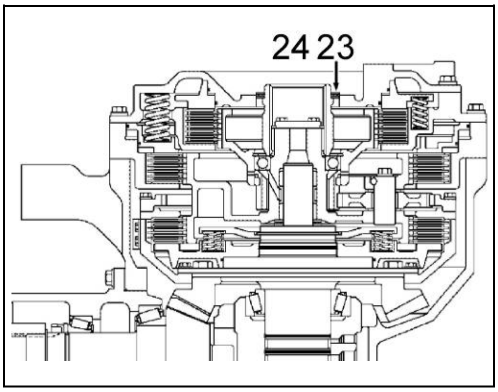
1. Output Shaft
2. Retaining Ring
3. Shim
4. Retainer Cover
5. O-Ring
6. Seal Ring
7. O-Ring
8. Seal Ring
9. Low Range Clutch Piston
10. Friction Disc
11. Clutch Plate
12. Piston Return Spring
13. Thrust Disc
14. Brake Spring
15. Brake Piston
16. O-Ring
17. Seal Ring
18. O-Ring
19. Seal Ring
20. Friction Disc
21. Clutch Plate
22. Thrust Disc
23. Thrust Bearing Race
24. Thrust Bearing
25. Thrust Washer
26. Retaining Ring
27. Output Shaft Sleeve
28. Retaining Ring
29. Ball Bearing
30. Backup Ring
31. Sun Gear
32. Sun Gear Hub
33. Planet Carrier
34. Steel Ball
35. Oil Scoop
36. Planet Gear Shaft
37. Thrust Washer
38. Planet Gear Bearing
39. Planet Gear
40. Roller Bearing
41. Thrust Bearing Race
42. Thrust Bearing
43. Retaining Ring with Shims
44. Thrust Disc
45. Clutch Return Inner Spring
46. Clutch Return Outer Spring
47. Ring Gear
48. Thrust Disc
49. High Range Clutch Piston
50. Seal Ring
51. O-Ring
52. Seal Ring
53. O-Ring
54. Plug
55. Bevel Gear Hub
56. Housing
57. Oil Slinger
58. Bevel Gear
59. Tapered Bearing
60. Seal Ring
61. Bearing Carrier
62. Tapered Bearing
63. Tongued Washer
64. Lock Washer
65. Lock Nut
66. Retaining Ring
67. Main Housing
68. Adjusting Nut
69. Nut Lock Ring
70. Piston Retainer Hub
71. Spacer Sleeve
72. Retaining Ring
73. Lock Nut
74. Lock Washer
75. Tongued Washer
76. Tapered Bearing
77. Pinion Gear Shaft Housing
78. Shim
79. Tapered Bearing
80. Pinion Gear Shaft
81. Dowel Pin

NOTE: *Unless otherwise notated, all reference callouts refer back to Fig.'s 7E.10.*

1. Set the assembly on end so that the right hand side is up. Remove the retaining ring (2) and shims (3). Keep the shims with the retaining for proper assembly.

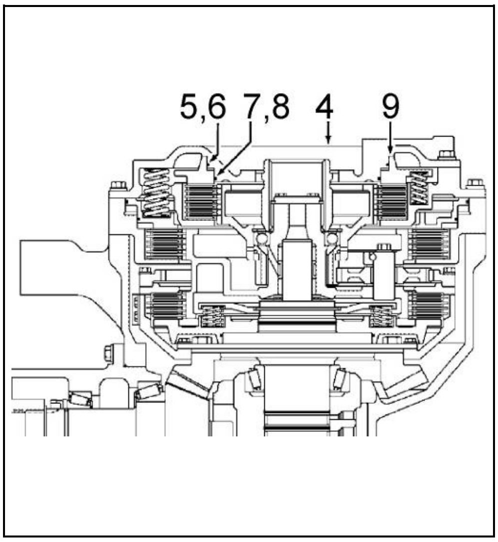


2. Remove the thrust bearing (24) and thrust bearing race (23).



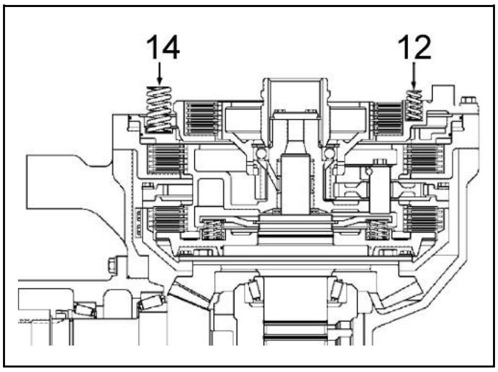
STEERING DRIVE

3. Remove four bolts equispaced around the retainer cover (4). Install threaded rod with washers and nuts and tighten. Remove the remaining hardware securing the cover. Slowly loosen the nuts until all spring tension is released. Lift the cover with low range clutch piston (9) and seals (6 through 7). To remove the piston from the cover, apply compressed air to the port in the cover. Remove and discard the seal rings (6 and 8) and O-rings (5 and 7) from the cover.

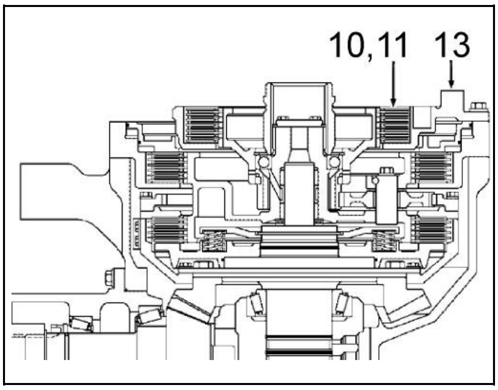


WARNING! SPRING LOADED ASSEMBLY. Assembly must be held to relieve the spring pressure. Use extreme care when disassembling.

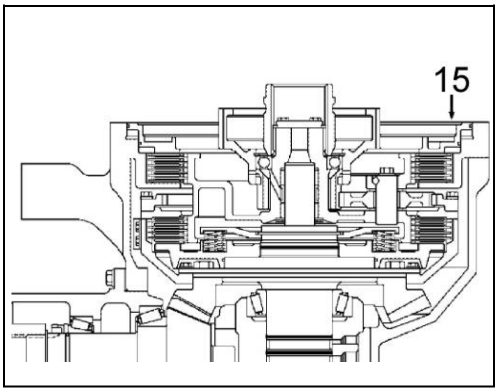
4. Remove the springs (12), shims (if equipped) and springs (14).

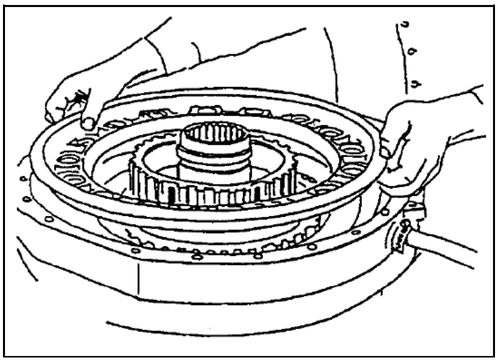


5. Remove the bolts securing the thrust disc (13) and lift the disc with piston (15), friction discs (10) and the clutch plates (11) from the assembly. Remove the discs and plates from the thrust disc.

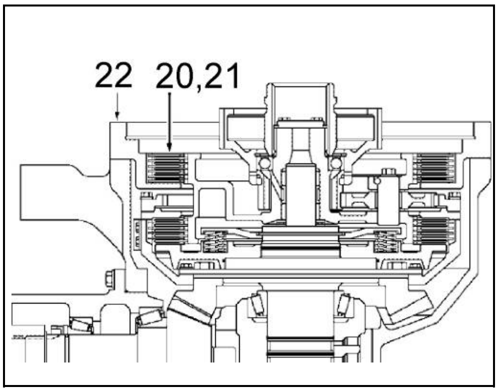


6. Remove the brake piston (15) from the thrust disc, using compressed air. Remove and discard the seal rings (17 and 19) and O-rings (16 and 18) from the brake piston.

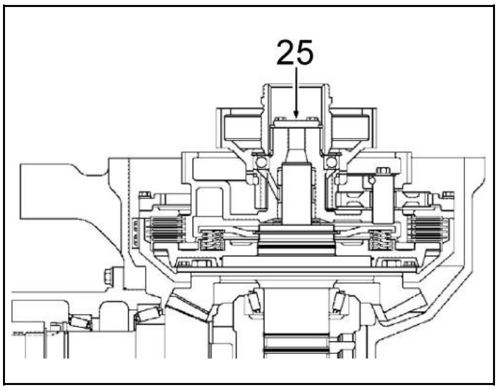




7. Lift the thrust disc (22) with the friction discs (20) and clutch plates (21) from the assembly. Remove the discs and plates from the thrust disc.

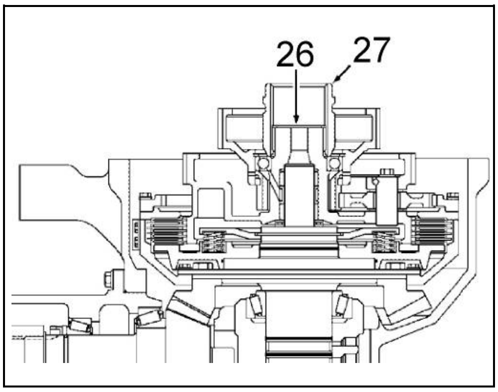


8. Remove the hardware securing the sleeve retaining washer (25) to the shaft.

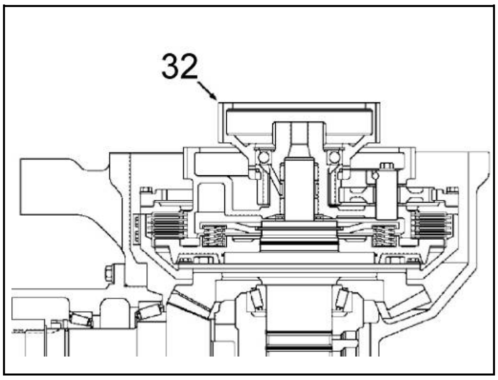


STEERING DRIVE

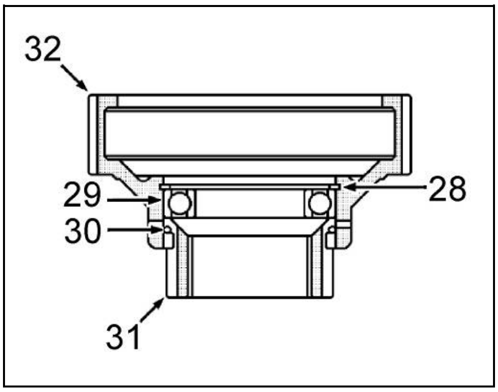
9. Remove the retaining ring (26) and the output shaft sleeve (27).



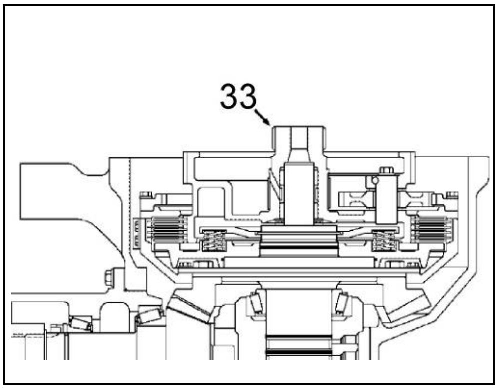
10. Pull the sun gear hub (32) together with attaching parts (28 through 30) off the shaft of the planet carrier.



11. Remove the retaining ring (28) from the gear hub (32). Place the hub in a press with the sun gear (31) up and press the gear, together with the bearing (29) and the backup ring (30), out of the hub. Remove the backup ring (30) from the sun gear (31).

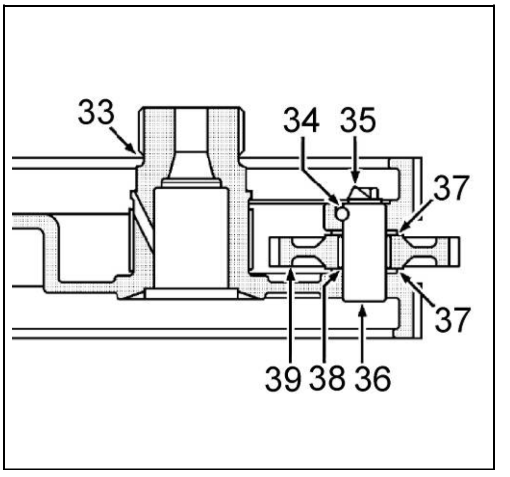


12. Remove the planet carrier (33) with attached parts (35 through 38).



STEERING DRIVE

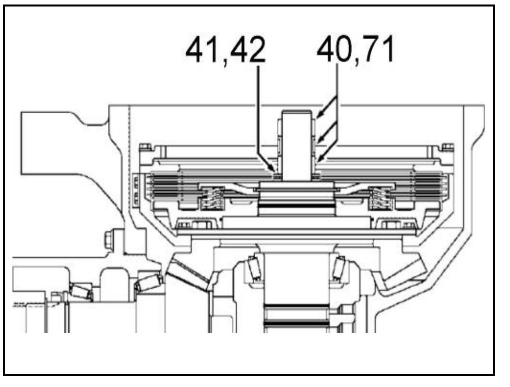
13. Disassemble the planet carrier as follows;
    A. Remove the two bolts, securing the oil scoop (35) and remove the scoop. Turn the planet carrier (33) over and drive the planet gear shaft (36) from the gear (39) and the carrier. When removing the shaft, be careful not to lose the steel ball (34).
    B. Slide the planet gear (39) to the outside, placing one hand under the gear as the washers (37) and bearing (38) are free to drop out.
    Remove the bearing from the planet gear.



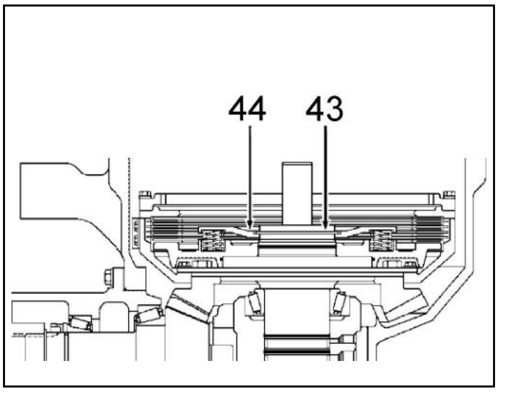
14. Remove the two remaining planet gears from the planet carrier in the same manner described in Step 13.

15. Remove the bearings (40) and spacer sleeve (71) from the planet carrier.

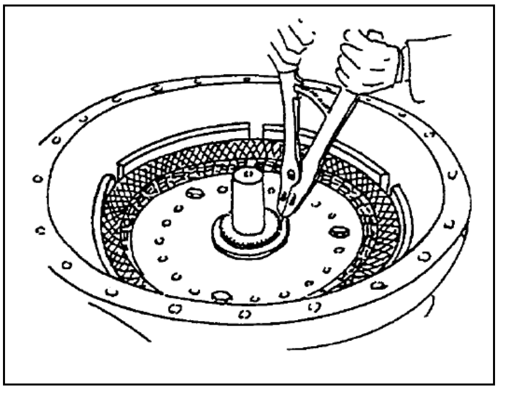
16. Remove the thrust race (41) and the thrust bearing (42) from the bevel gear hub.



17. Install three bolts with nuts and washers through the thrust disc (44) and thread them into the tapped holes in the clutch piston.
    Turn the nuts down to compress the springs and remove the retaining ring with shims (43)(if equipped).
    Slowly back off the nuts to completely relieve the spring tension and remove the remaining bolts.

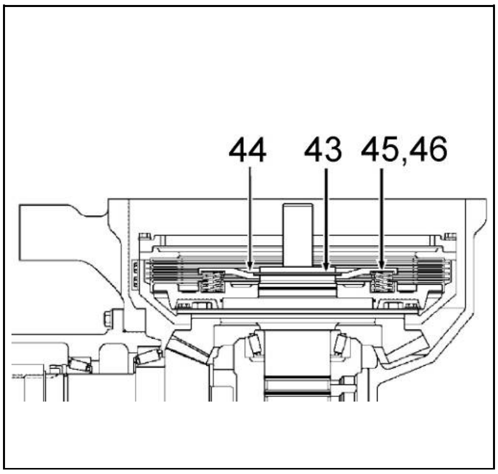


WARNING! SPRINGS LOADED ASSEMBLY. Assembly must be held to relieve the springs pressure. Use extreme care when disassembling.

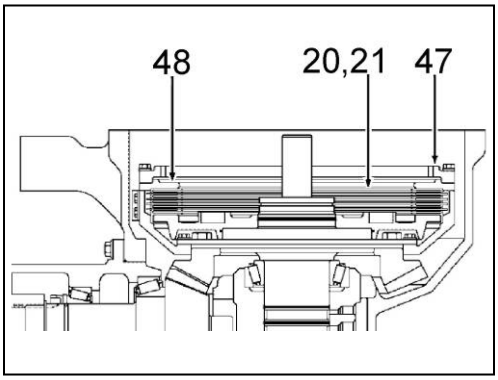


STEERING DRIVE

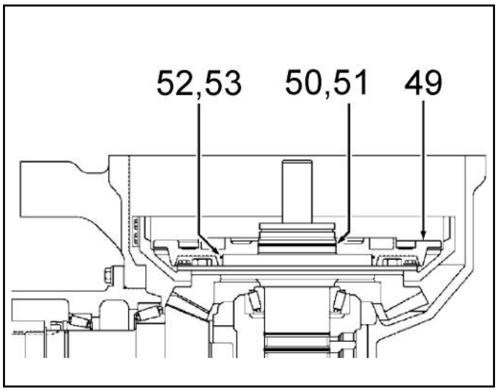
18. Remove the thrust disc (44), shims (43) (if equipped) and return springs (45 and 46).

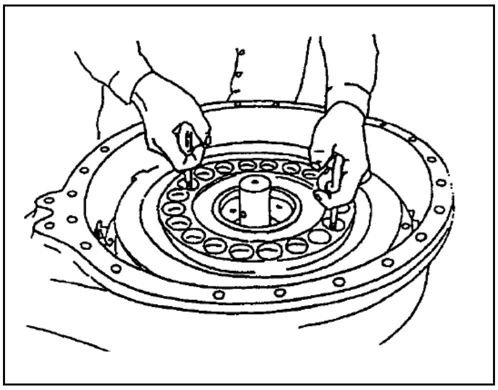


19. Remove the hardware securing the ring gear (47) and thrust disc (48) to the housing. Remove the thrust disc, clutch plates (21) and friction discs (20).



20. Thread two eyebolts (refer to SERVICE /SPECIAL TOOLS in this Section) into the tapped holes in the high range clutch piston (49) and remove. Remove and discard the O-rings (51 and 53) and seal rings (50 and 52).



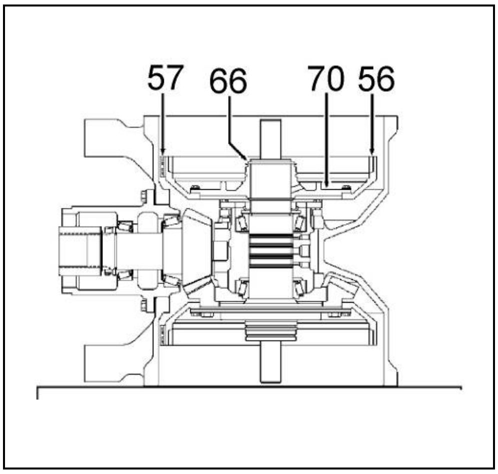


STEERING DRIVE

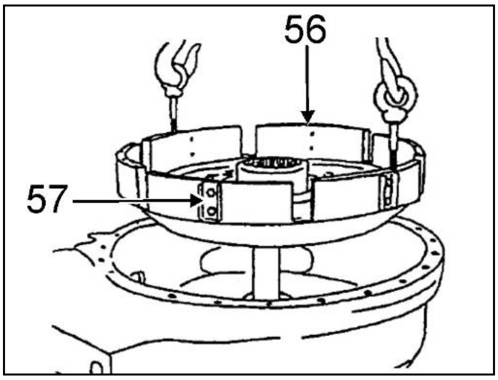
STEERING DRIVE

Turn the assembly over and repeat Steps 1 through 20 on the left side.

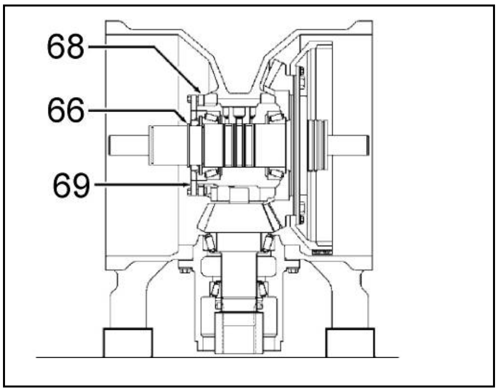
21. Remove the retaining ring (66) from the bevel gear hub.



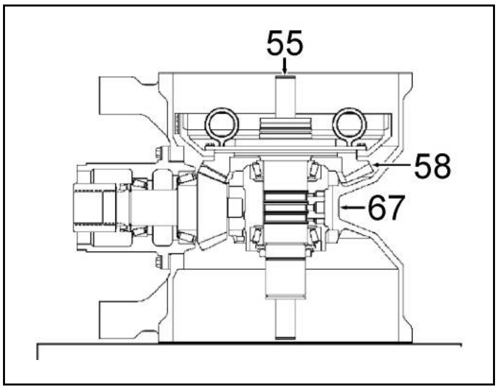
22. Install two bolts into the tapped holes in housing (56) and lift it out along with the piston retainer hub (70). Remove the bolts securing the housing to the piston retainer hub and separate.
    Remove the oil slingers (57) from the housing.



23. Position the main housing on blocking with the pinion gear housing facing down. Remove the retaining ring (66). Remove the hardware securing the nut lock ring (69) to the housing and remove with the adjusting nut (68).

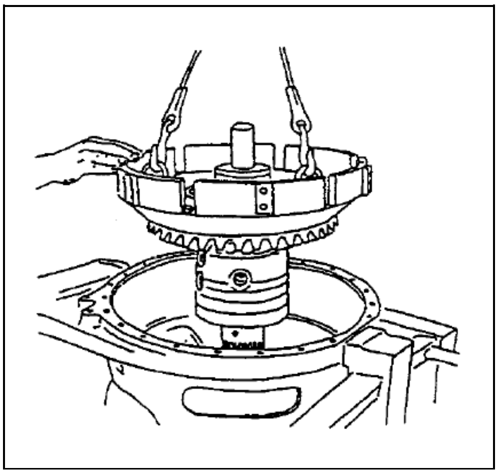


24. Turn the main housing (67) over so that the ring gear side is facing up.
    Remove two of the bolts that secure the bevel gear (58) to the bevel gear hub (55) and install eyebolts.

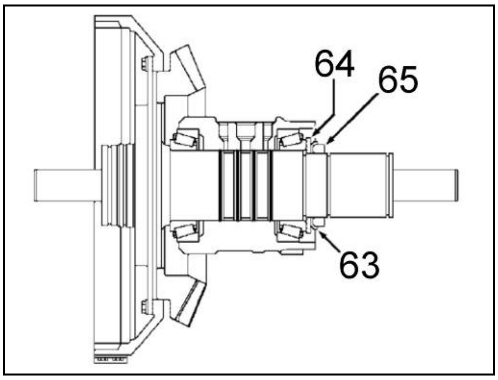


STEERING DRIVE

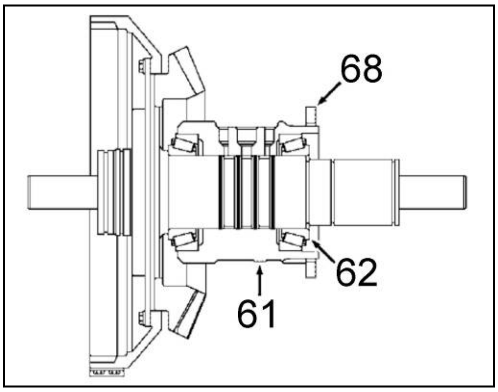
25. Attach a hoist to the eyebolts and lift out as an assembly.



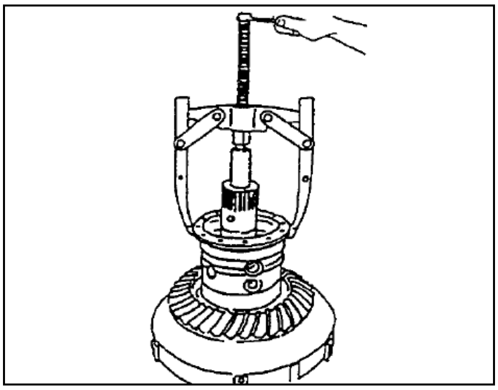
26. Bend up the tabs of the tongued washer (63), remove the lock nut (65) and lock washer (64).



27. Thread the adjusting nut (68) on the bearing carrier (61) and install a bearing puller.

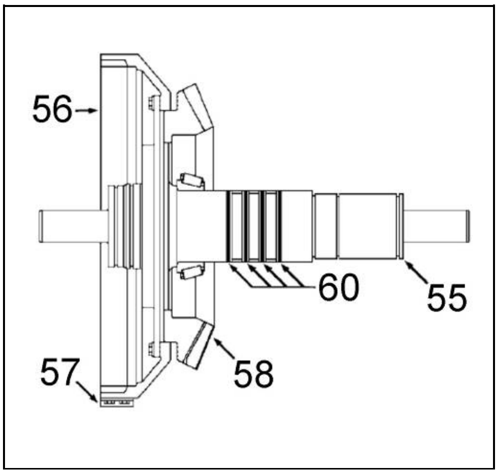


28. Pull up on the carrier to unseat the bearing cone (62). Remove the bearing cone and carrier. Remove the nut from the carrier.

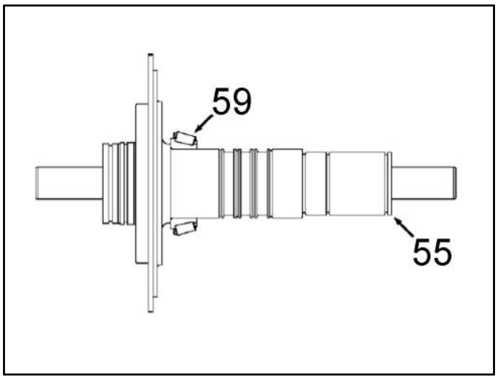


STEERING DRIVE

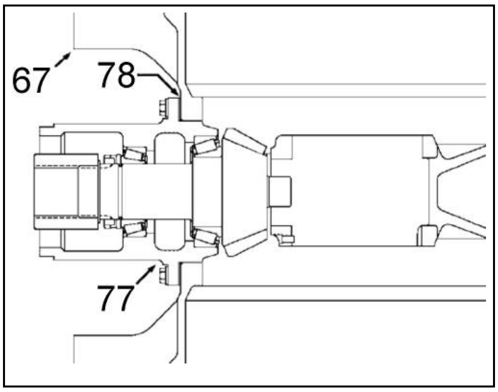
29. Remove the seal rings (60) from the hub (55) and discard. Remove the bevel gear (58) and the housing (56) from the hub. Remove the oil slingers (57) from the housing.



30. If bearing replacement is necessary, remove the bearing cone (59) from the hub (55) and remove the bearing cups from the carrier (61).

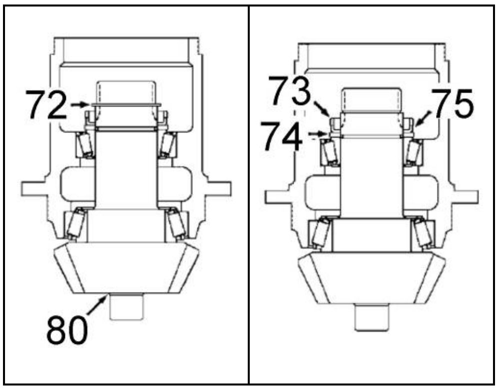


31. Remove the bolts securing the pinion shaft housing (77) and shims (78) to the main housing (67). Remove the pinion shaft assembly.



32. Remove the retaining ring (72) from the pinion gear shaft (80).

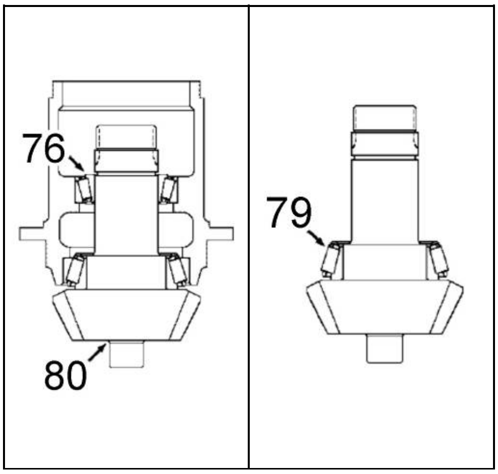
33. Bend up the tabs of the tongued washer (75) and remove the lock nut (73), lock washer (74) and the tongued washer from the pinion gear shaft.



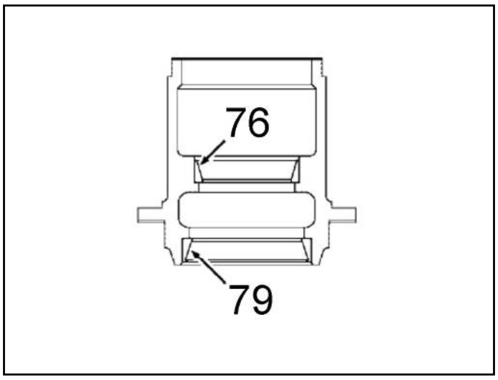
STEERING DRIVE

34. Press the pinion gear shaft (80) out of the housing. When the shaft is pressed out, the bearing cone (76) can be lifted out of housing.

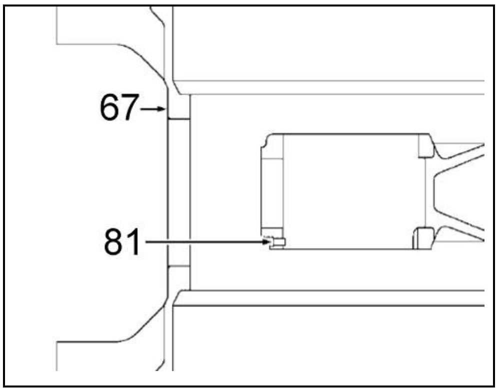
35. Press the bearing cone (79) off the gear shaft.



36. If bearing replacement is necessary, remove the bearing cups (76 and 79) from the housing.



37. If replacement is necessary, remove the dowel pin (81) from the main housing (67).



STEERING DRIVE

6. INSPECTION AND REPAIR

1. It is recommended that new O-rings and seal rings be installed whenever the steering drive is disassembled for service.
2. Clean all parts thoroughly in a suitable solvent. Dry thoroughly with compressed air or a clean cloth.

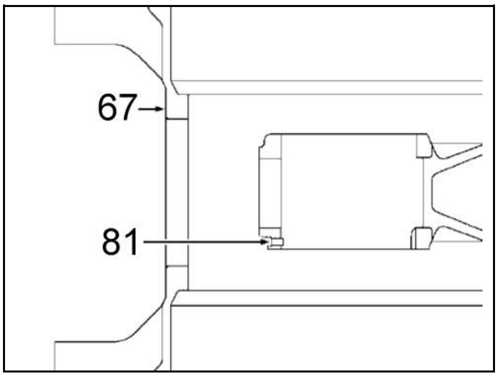
NOTE: *Do not spin bearings with the compressed air.*

3. Inspect bearings for excessive wear or damage and replace if necessary. Reusable bearings should be soaked in clean oil and wrapped with clean paper until ready for reassembly.
4. Inspect the gears for wear or chipped or broken teeth. Replace if wear is excessive or teeth are damaged.
5. Inspect all splines for wear. Replace parts if wear is excessive. Slight burrs can be smoothed down with a stone.
6. Inspect the clutch plates for excessive wear or warpage and replace if necessary. Check flatness and thickness of separator and friction plates. If they do not fall within tolerances given in Paragraph 3, SPECIFICATIONS must be replaced.
7. Using an oil stone, remove any burrs that might damage sealing surfaces or increase wear to close tolerance parts.
8. Check the compression springs for damage and fatigue. If they do not fall within the tolerances given in Paragraph 3, SPECIFICATIONS, they must be replaced.
9. The rear main frame cover mounting surfaces must be cleaned with proper solvent and inspected for scratches, irregularities, and flatness. (Maximum out of flat between any two consecutive mounting holes to be 0.25 [mm]). If the cover does not meet this requirement, the cover should be replaced.

7. REASSEMBLY

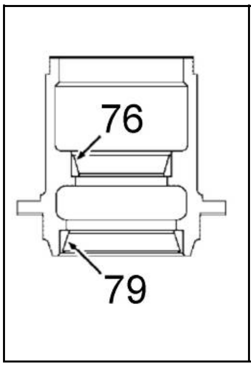
NOTE: *Unless otherwise notated, all reference callouts refer back to Fig. 7E.10.*

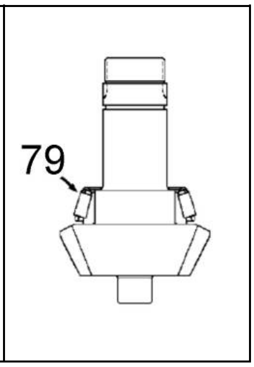
1. If the dowel pin (81) was removed, install a new pin in the main housing (67) flush.



2. If the bearing cups (76 and 79) were replaced, press the new cups in the pinion gear housing until they bottom.

3. Heat the bearing cone (79) to 120 [°C] for 45 minutes and press on the pinion gear shaft (80) until it bottoms.

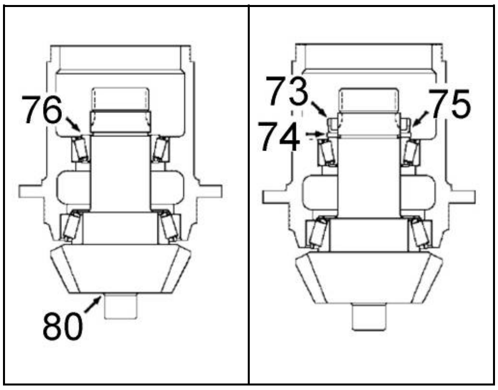




STEERING DRIVE

4. Insert the pinion gear shaft (80) in the flange end of the housing (77). Place the assembly in a press. Heat the bearing cone (76) to 120 [°C] for 45 minutes and press on the cone until it clears the threads on the shaft.

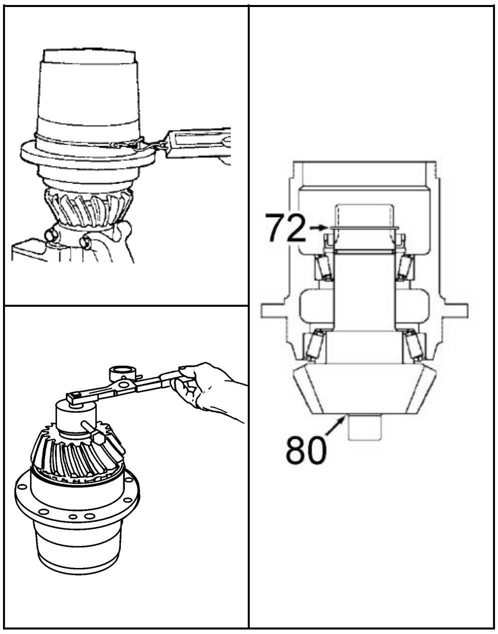
5. Install the tongued washer (75) and lock washer (74). Thread adjusting nut (73) on finger tight.



6. **I Method.** Wrap a cord around the 203 [mm] diameter of the pinion support housing (77) and attach a spring scale. Take a reading of the drag needed to keep the housing rolling at an even pace. Tighten lock nut (73) until a reading of 13 to 18 [N] is obtained.
   II Method. Install preload checking tool (refer to SERVICE /SPECIAL TOOLS in this Section) as shown near and check the pinion gear shaft rolling torque. Tighten lock nut (73) until a reading of 1.4 – 1.8 [Nm] is obtained. Bend back tabs of lock washer (74) when correct rolling pull is reached.

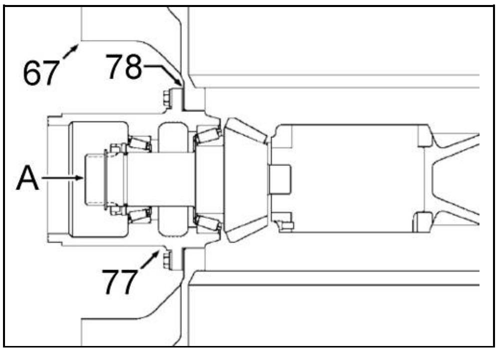
NOTE: *The initial pull needed to start the housing rolling will be greater.*
Do not use this reading for the adjustment.

7. Bend back the tabs of the lock washer (74). Install the retaining ring (72) in the groove of the pinion gear shaft (80).

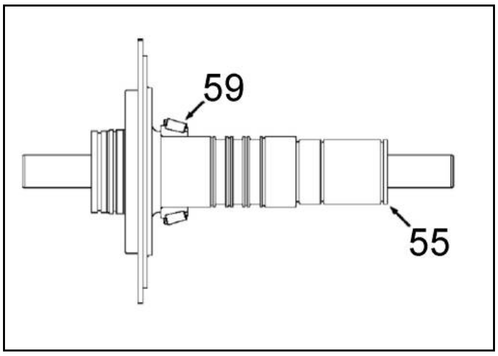


8. Install the pinion housing (77) to the main housing (67) with the same amount of shims (78) previously removed and secure with hardware.
   Tighten pinion housing bolts to 110 [Nm].

NOTE: *Record the etched dimension (**A**) located at the spline end of the pinion gear shaft.*



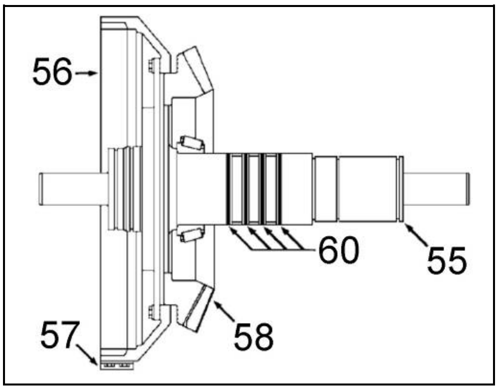
9. If the bearing cone (59) was removed, heat the cone to 120 [°C] for 45 minutes and install on gear hub (55) until it bottoms. To assure the cone is seated, keep pressure against it until it cools a few seconds.



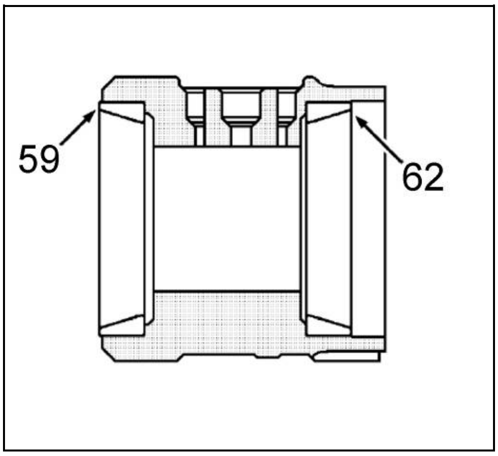
STEERING DRIVE

10. Position the oil slingers (57) on the housing (56) and secure with hardware. Install the housing on the bevel gear hub (55) and secure with hardware. Bevel gear (58) may be heated to 120 [°C] for easier assembly, install on the gear hub and secure with hardware. Install new seal rings (60) to the shaft.

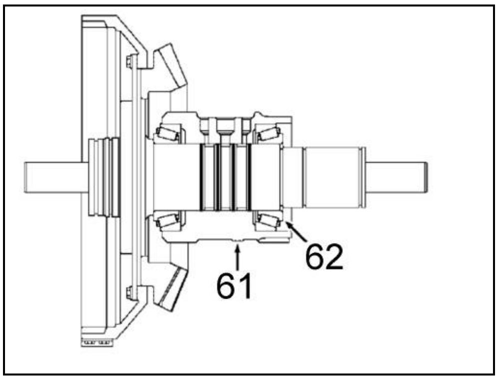
    Coat oil slinger bolts threads with Loctite #262
    Torque oil slinger bolts to 11 [Nm], hub retainer bolts to 54 [Nm] and bevel gear bolts to 255 [Nm].



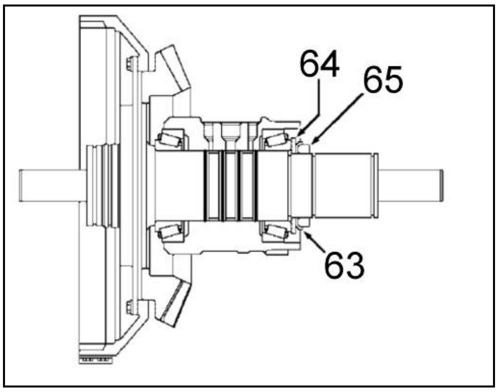
11. If the bearing cups (59 and 62) were removed, press the cups into the carrier (61) until they bottom.



12. Install the bearing carrier (61) on the hub. Heat the bearing cone (62) to 120 [°C] for 45 minutes and install on the gear hub until it contacts the bearing cup.

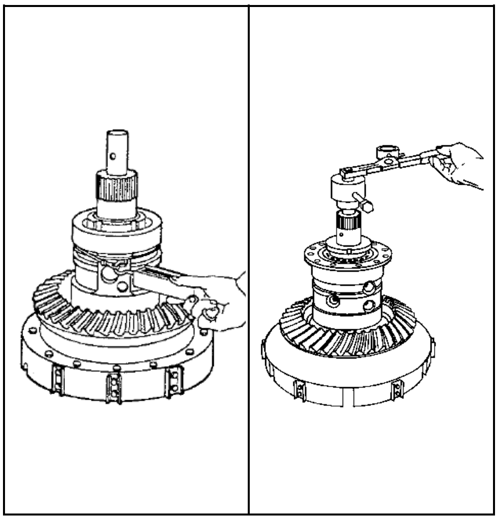


13. Install the lock washer (64) and tongued washer (63). Thread the lock nut (65) on finger tight.



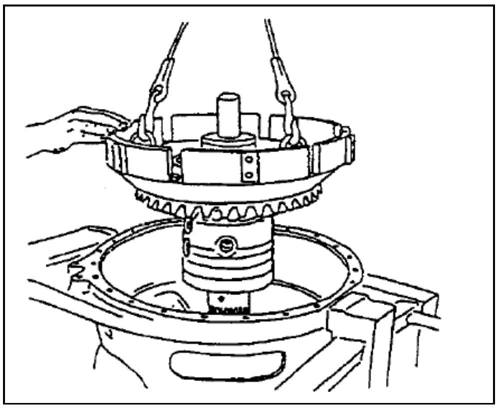
STEERING DRIVE

14. **I Method**. Wrap a cord around the 178 [mm] diameter of the bearing carrier (61) and attach a spring scale. Take a reading of the drag needed to keep the carrier rolling at an even pace. Tighten the nut (65) until a reading of 18 to 22 [N] is obtained. Bend back the tabs of the lock washer (64).
    II Method. Install preload checking tool (refer to SERVICE /SPECIAL TOOLS in this Section) over shaft and check the bearing carrier rolling moment. Take a reading of drag needed to keep bearing carrier (61) rolling at an even pace. Tighten lock nut (65) until a reading of 1.6 - 2.3 [Nm] is obtained.

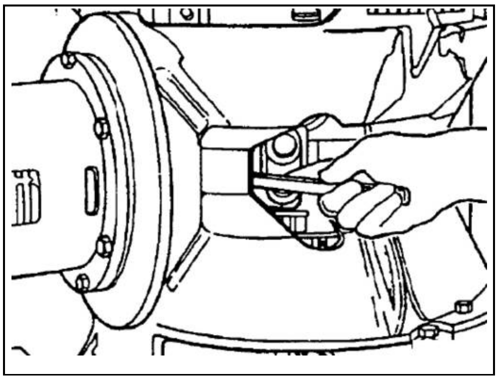


NOTE: *The initial pull needed to start the carrier rolling will be greater. Do not use this reading for adjustment.*

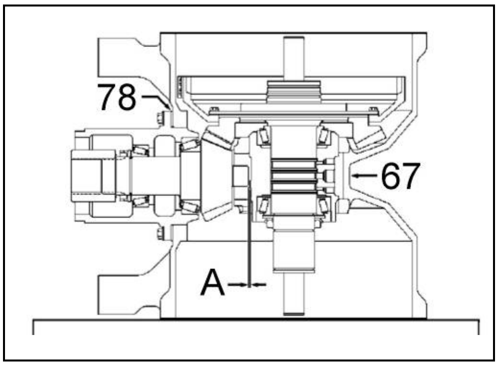
15. Set the main housing (67) down so that the right hand side is up. Attach a hoist to the bevel gear hub and lower it into the main housing being sure that the dowel pin (81) engages the slot in bearing carrier. Lower the bevel gear hub enmeshing the ring and pinion gears, then remove the hoist.



16. Working through the opening in the top of the main housing (67), measure the gap (**A**) between the end of the pinion gear shaft (80) and the raised edge of the bearing carrier (61). This gap is stamped on the end of the pinion gear shaft, see Step 8.

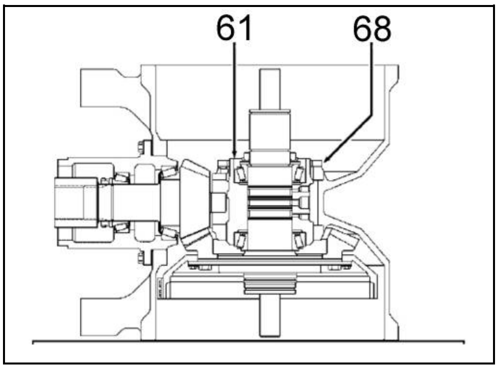


17. If necessary, remove or add shims (78) to obtain the correct gap.



STEERING DRIVE

18. Install the adjusting nut (68) onto the bearing carrier (61) hand tight.

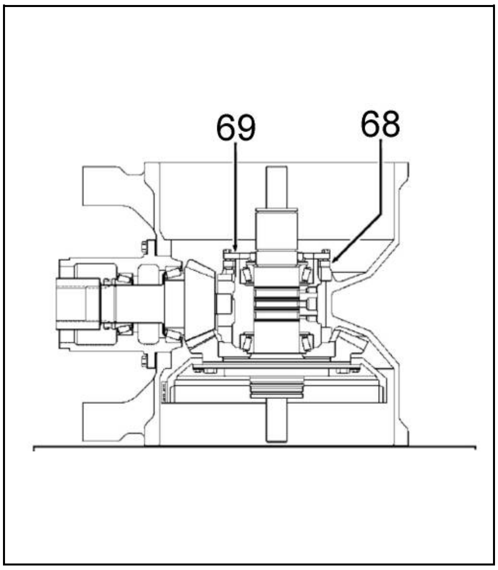


19. Adjust the ring gear and pinion gear shaft backlash as follows:

A. Tighten the adjusting nut (68) until the bolt holes in the nut line up with the bolt holes in the main housing and there is little or no gear backlash. Install the lock ring (69) and secure with hardware.
Torque lock ring bolts to 54 [Nm].

B. Position a dial indicator on the main housing so that the pointer rests against the heel of a pinion gear shaft tooth.

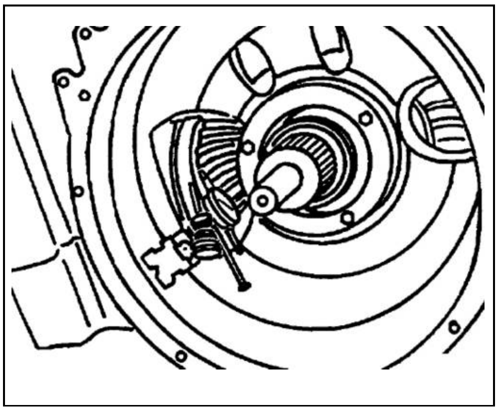
C. Hold the bevel gear stationary and turn the pinion gear to the limit of its movement. Set the indicator to zero. Next move the pinion gear shaft to its limit of free play while holding the ring gear stationary and note the indicator reading.



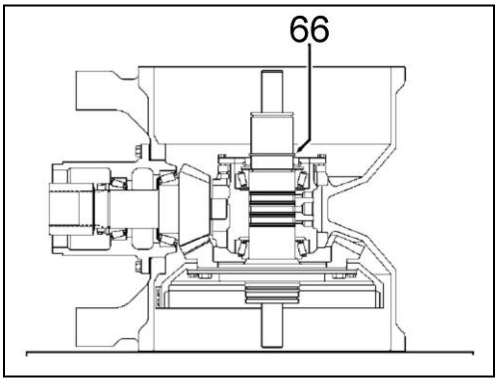
D. Repeat Steps B and C at four equidistant points on the bevel gear and adjust for the minimum backlash at the tightest point.

Required gear backlash 0.25 to 0.33 [mm].

E. To change the gear backlash, remove the nut lock ring (69) and turn the adjusting nut (68). Backlash is changed in increments of 0.08 [mm] by turning the nut until the next bolt pattern lines up between the nut and the housing. Reinstall the nut lock ring and secure with hardware. Recheck gear backlash.
Torque lock ring bolts to 54 [Nm].



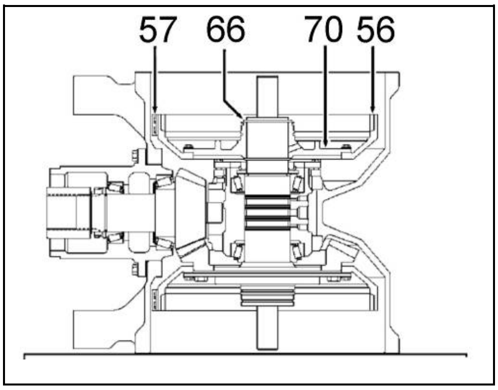
20. Install the retaining ring (66) to the shaft.

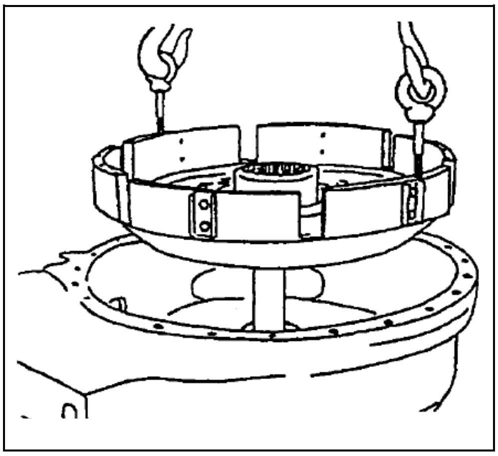


STEERING DRIVE

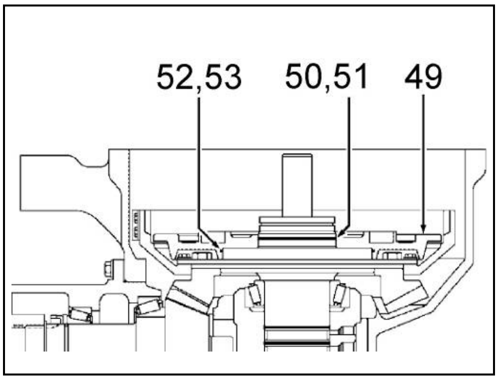
21. Install the piston retainer hub (70) on the gear hub bottoming it against the retainer ring. Position the oil slingers (57) on the housing (56) and secure with hardware. Install the housing on the bevel gear hub (55) and secure with hardware. Install retainer ring (66).

    Coat oil slinger bolts threads with Loctite #262.
    Torque oil slinger bolts to 11 [Nm] and clutch plate retainer bolts to 54 [Nm].

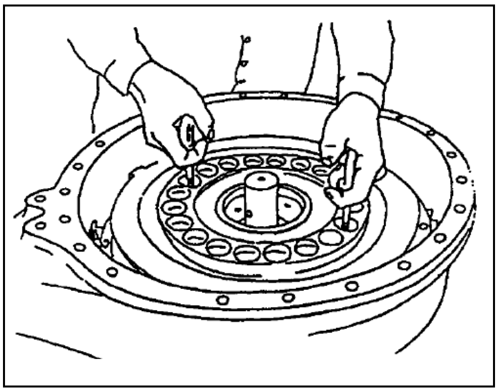




22. Install new seal rings (50 and 52) and O-rings (51 and 53) to the piston (49) and the piston retainer hub (70).



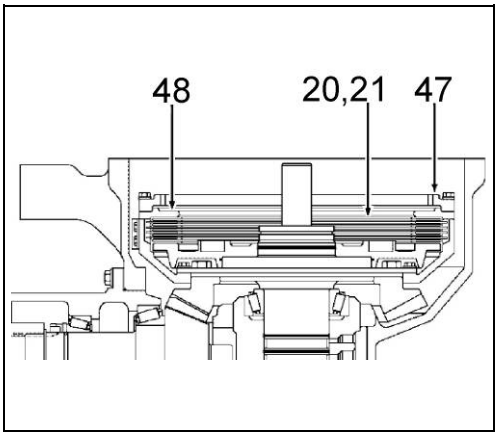
23. Using two eyebolts (refer to SERVICE/ SPECIAL TOOLS in this Section) install the high clutch piston (49) in place being careful not to damage the piston seals.



STEERING DRIVE

24. Alternately install one internally splined friction disc (20) and one externally splined clutch plate (21) in the housing. Install the ring gear (47) and thrust disc (48) to the housing and secure with hardware.
Torque ring gear bolts to 54 [Nm].

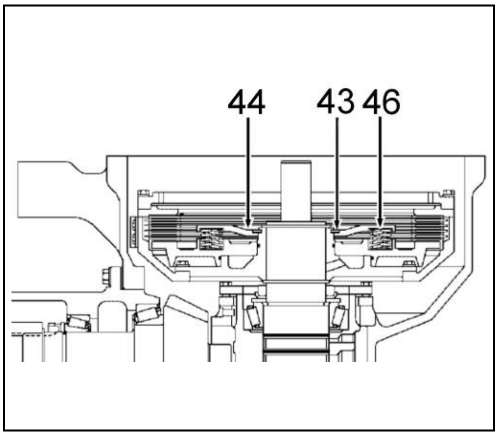
NOTE: *The internally splined friction disc must be thoroughly oiled prior to assembling in the hub. Because the friction disc facing is porous and absorbs oil, a light oiling may not be sufficient. When possible, the plates must be soaked, for at least two minutes, in a container of clean oil. If facilities are not available for soaking, a heavy oiling on both surfaces may be sufficient.*



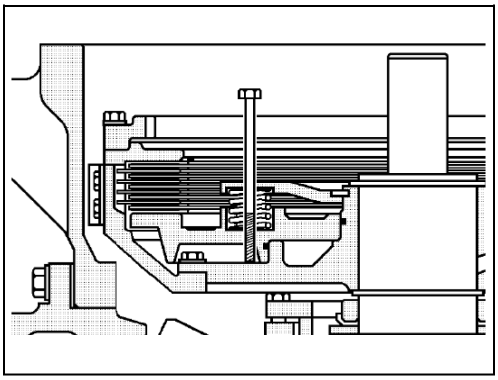
25. Shims may be required between the thrust disc (44) and the spring retaining ring (43). To determine if necessary and how many are required, proceed as follows:

A. Place four outer clutch springs (46) into the four piston pockets with the tapped holes in the center. Place the thrust disc (44) over the piston with its four holes centered above the four springs.

B. Compress the springs and install the retaining ring (43).

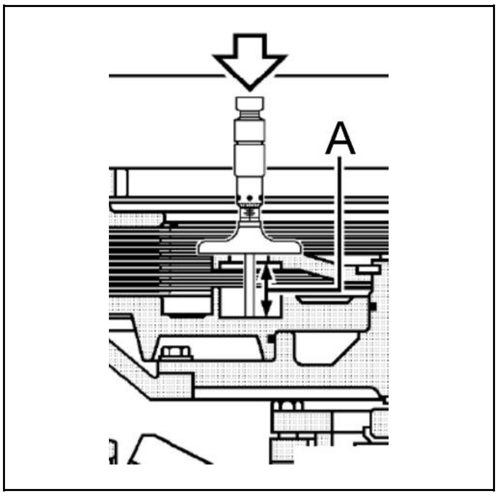


C. Screw in two compressing bolts (3/8”-16UNCx6”), 180 [°] apart until they bottom. Torque the bolts to 14 [Nm]. This will cause the piston to make contact with the clutch pack.



D. Determine the average distance (**A**) between the clutch piston (49) and the thrust disc (44). To obtain this figure, use a depth gauge to measure the distance from the piston to the outer edge of the thrust disc. Measure through two holes. Then remove the thrust disc and measure the thrust disc thickness with a micrometer. Subtract the thrust disc thickness from the total distance. Average the distance (**A**) from the two holes.

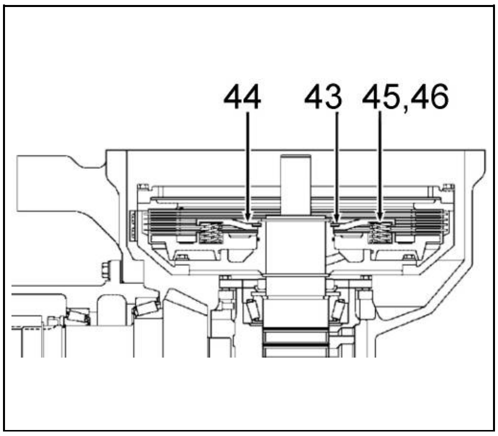
E. If the average distance (**A**) is below 25.4 [mm], shimming is not required. If the distance is more than this figure, add shims as necessary to bring the distance as close to a figure of 25.4 [mm] as possible. Each shim is 0.51 [mm]. No more than three shims should be required.



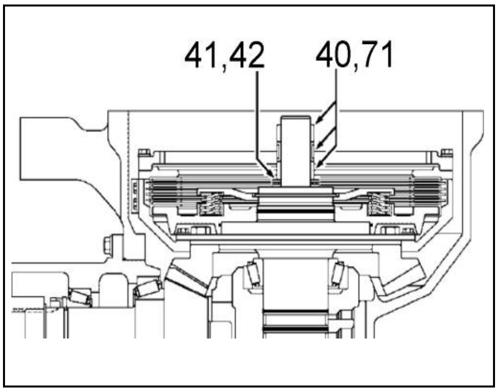
STEERING DRIVE

F. Position the inner and outer clutch return springs (45 and 46) on the clutch piston and place the thrust disc (44) on top of the springs. Compress the springs and install the spring retaining ring with shims (43) (if required). Remove the bolts, nuts and washers. The springs must nest in the counterbores of the thrust disc.

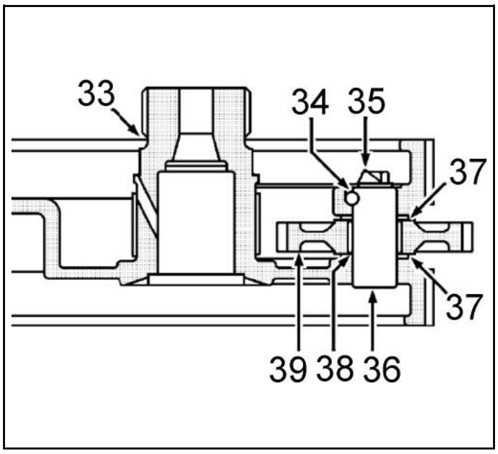
WARNING! SPRING LOADED ASSEMBLY. Use extreme care when assembling.



26. Install the clutch hub thrust race (41), side thrust bearing (42) and roller bearing (40) with spacer sleeve (71) on the bevel gear hub.

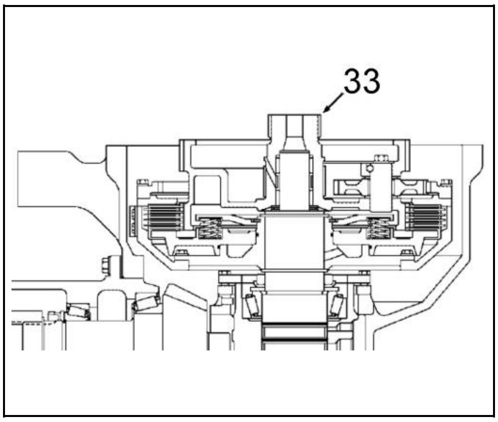


27. Position the planet gear (39) with the planet gear bearing (38) installed on the outer diameter of the planet carrier (33). Use a round tool to center the planet gear and thrust washers (37) with the shaft bore in the planet carrier before installing the planet gear shaft (36).
    Tap the shaft with the steel ball (34) into the carrier, aligning the ball with the slot in the carrier. Install the bearing scoop (35) and secure with hardware.
    Torque oil scoop bolts to 54 [Nm].



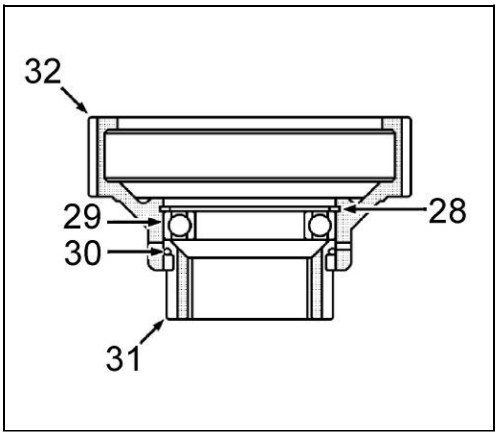
28. Install the remaining two planet gears in the same manner.

29. Install the planet gear carrier (33) with attached parts. Be sure all the internally splined discs are aligned in the carrier and that the planet gears mesh with the ring gear and the assembly sits squarely on the bearings.

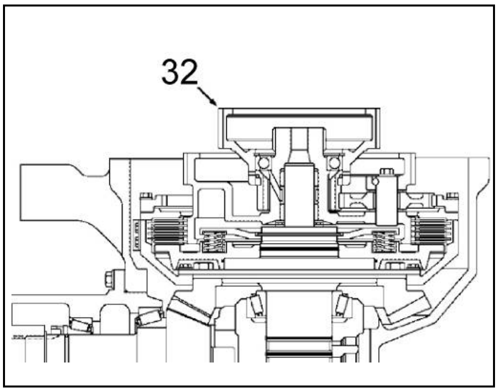


STEERING DRIVE

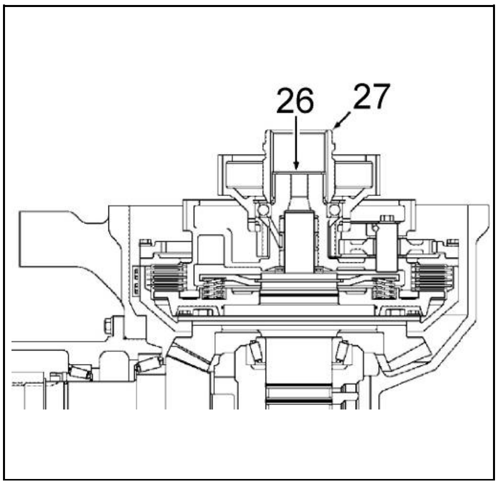
30. Install the sun gear backup ring (30) on the sun gear (31). Install the sun gear into the sun gear hub (32). Press the ball bearing (29) into the sun gear hub until it bottoms on the sun gear. Install the retaining ring (28) in the groove of the hub.



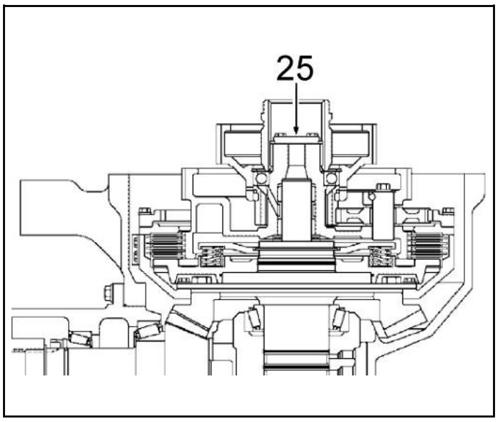
31. Press the sun gear hub assembly (32) on the planet carrier until the bearing bottoms. Be sure the sun gear meshes with the planet gears.



32. Install the retaining ring (26) into the output shaft sleeve (27). Install the sleeve onto the shaft of the planet carrier, taper end first, until the retaining ring is against the shaft.



33. Install the sleeve retaining washer (25) in the shaft sleeve and secure with hardware.
Torque sleeve retaining washer bolt to 54 [Nm].

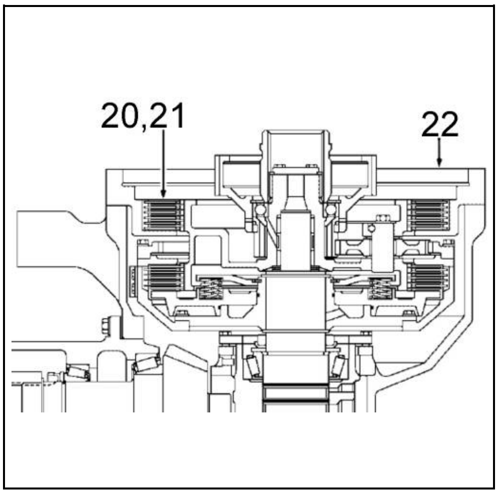


STEERING DRIVE

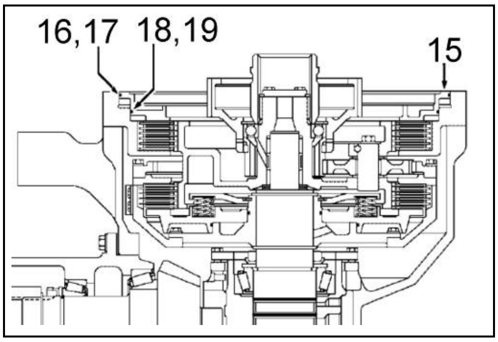
34. Position the thrust disc (22) on the main housing (67) so the port on the thrust disc is in line with the port on the housing.

35. Alternately install one externally splined clutch plate (21) and one internally splined friction disc (20) into the thrust disc.

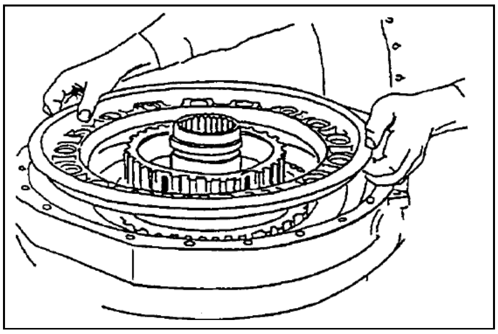
NOTE: *The internally splined friction disc must be thoroughly oiled prior to assembling in the hub. Because the friction disc facing is porous and absorbs oil, a light oiling may not be sufficient. When possible, the plates must be soaked, for at least two minutes, in a container of clean oil. If facilities are not available for soaking, a heavy oiling on both surfaces may be sufficient.*



36. Install the O-rings (16 and 18) and seal rings (17 and 19) on the brake piston (15).



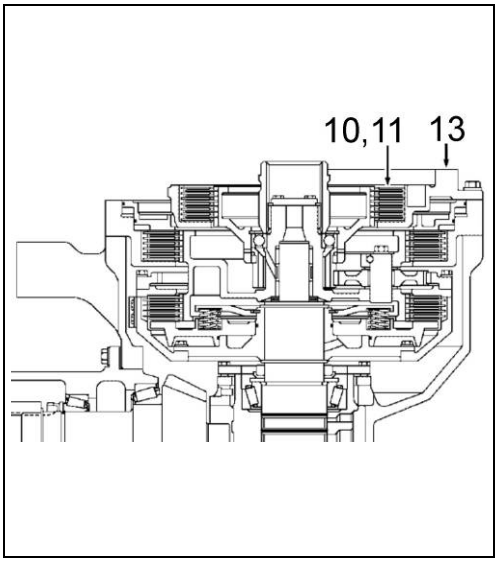
37. Install the piston (15) on the thrust disc.



38. Position the thrust disc (13) on top of the thrust disc. Secure both thrust disc to the housing (67) with hardware.
Torque thrust disc bolts to 81 [Nm].

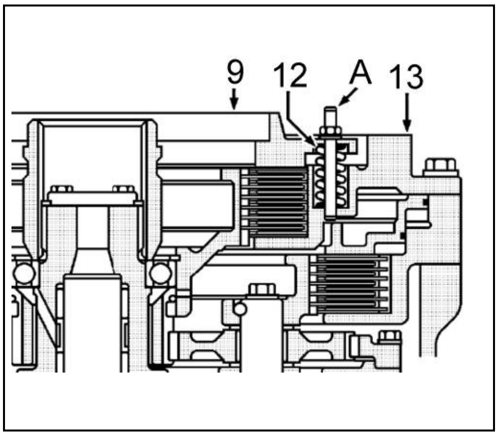
39. Alternately install one externally splined clutch plate (11) and one internally splined friction disc (10) into the thrust disc.

NOTE: *The internally splined friction disc must be thoroughly oiled prior to assembling in the hub. Because the friction disc facing is porous and absorbs oil, a light oiling may not be sufficient. When possible, the plates must be soaked, for at least two minutes, in a container of clean oil. If facilities are not available for soaking, a heavy oiling on both surfaces may be sufficient.*



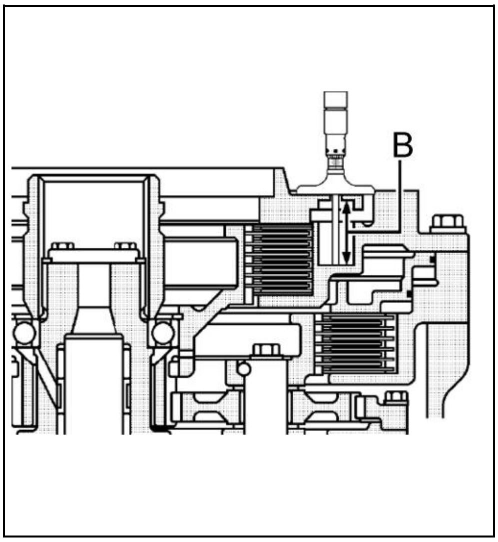
STEERING DRIVE

40. Shims may be required under the springs (12). To determine if necessary, and how many, proceed as follows:



A. Place four of the clutch springs (12) into the four pockets with the tapped holes in the center of the thrust disc (13). Place the piston (9) over the springs.

B. Thread two studs (3/8"-16UNCx3-1/2") (**A**) into two of the pockets 180° apart. Screw the studs approximately 10 [mm] into the thrust disc. Using a washer and a nut, pull the piston against the clutch pack. Torque the nuts to 14 [Nm].

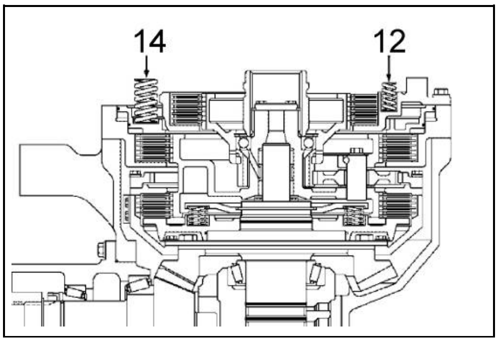


C. Determine the average distance between the piston and the thrust disc. To obtain this figure, use a depth gauge to measure the distance from the outer edge of the piston to the thrust disc. Measure through two holes. Then remove the piston and measure the piston thickness with a micrometer. Subtract the thickness from the total depth. Then average the distance (**B**) from the two holes.

D. If the average distance is below 38.1 [mm], shimming is not required. If the distance is more than this figure, add shims as necessary to bring the distance as close to a figure of 38.1 [mm] as possible. Each shim is 0.510 [mm] thick. The shims are to be placed on the thrust disc side of each spring.

E. Remove the piston and the studs from the thrust disc.

41. Position the brake springs (14) on the brake piston and the piston return springs (12) with shims (if equipped, see Step 40) on the thrust disc.

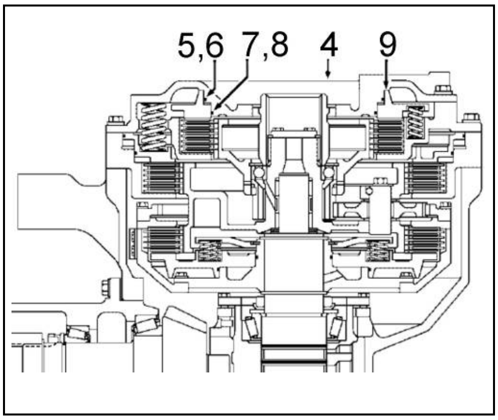


42. Install the low range clutch piston (9) on top of the springs. The springs must nest in the counterbores of the piston.

43. Install new O-rings (5 and 7) and seal rings (6 and 8) on the retainer cover (4) and install on the thrust disc and secure with hardware.

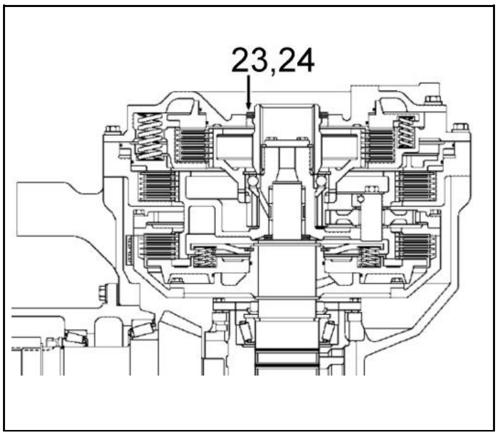
Torque retainer cover bolts to 81 [Nm].

WARNING! SPRING LOADED ASSEMBLY. Use extreme care when assembling.

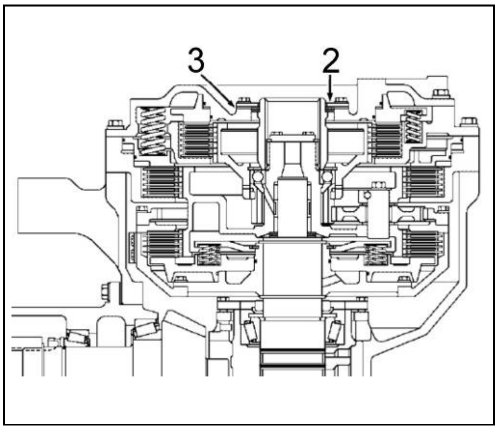


STEERING DRIVE

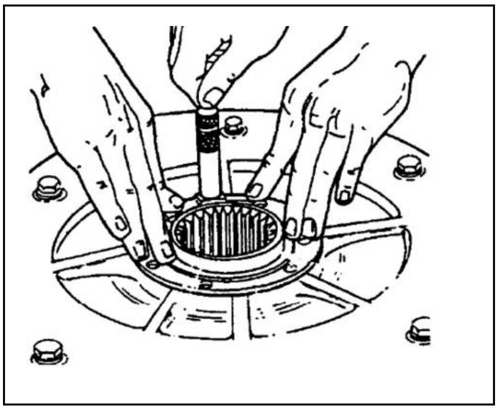
44. Position the thrust bearing race (23) and the side thrust bearing (24) on the output shaft sleeve.



45. Position the same amount of shims (3) that were previously removed on the retainer cover. Using a depth gauge, measure the difference between the surface of the thrust bearing race and the surface of the shims. The thrust bearing race should be 0.1 to 0.2 [mm] below the shims. Add or subtract shims to obtain a 0.1 to 0.2 [mm] gap.



46. Add the correct amount of shims determined. Install the retaining ring (2) and secure with hardware. Torque shim retaining bolts to 54 [Nm].



Turn the assembly over and repeat Steps 21 through 46 on the left side.

STEERING DRIVE

8. INSTALLATION

1. Set the steering drive down flat and temporarily secure the junction manifold to the manifold bracket located on the top left of the steering drive. Connect the manifold hoses to the steering drive (refer to Fig. 7E.9) and then free the manifold from the bracket.

NOTE: *The manifold bracket is only used to correctly position and hold the manifold in place during hose installation.*

2. Be sure the steering drive output shafts are in position in the main frame.

NOTE: *The output shafts can not be installed once the steering drive is in place.*

3. Thoroughly clean the mating surfaces of the main frame and the steering drive. Apply LOCTITE 120 to the main frame mounting pads that mate with the steering drive assembly.

NOTE: *When applying LOCTITE 120 to the steering drive housing, apply only around the tapped holes and not to the entire machined surface.*

4. Attach a hoist with an adjusting sling to the steering drive as shown in Fig. 7E.8. Raise the steering drive up over the main frame and lower the drive into the main frame until the mounting flanges clear the frame opening.
5. Move the steering drive forward and rock it until the spline sleeve engages the transmission output shaft. Secure the drive to the main frame with the hardware previously removed. Remove the hoist.

NOTE: *If the rear frame suction tube has been loosened during removal, reinstall at this point.*

6. With a bolt 5/8”-11UNC-2B installed in the end of the steering drive output shaft (Fig. 7E.7), slide the shaft in so it splines first with the sprocket drive pinion gear and then with the steering drive. Remove the bolt.

NOTE: *If the shaft will not spline with the steering drive, slightly rotate the sprocket with a floor jack positioned under a rear track grouser.*

7. With a bolt 1/2”-13UNC-2B threaded in output shaft retainer (2, Fig. 7E.6), install the retainer with new seal ring in the pinion gear of sprocket drive. Remove the bolt and install snap ring (1). Reinstall the pinion access cover with new O-ring on the sprocket drive cover.
8. Repeat Steps 6 and 7 on the opposite side of the machine.
9. Reinstall tube (1, Fig. 7E.5) between the steering drive and the front surface of the main frame. Secure the tube to support bracket (2) with the hardware previously removed.
10. Secure the dipstick tube (3, Fig. 7E.5) to the rear surface of the main frame with the hardware previously removed.
11. Install two lifting eyebolts 1/2”-13UNC-2B (3, Fig. 7E.11) to the main frame cover (1).
12. Thoroughly clean the mating surfaces of the main frame and cover. Apply LOCTITE 504, to the cover surfaces only. Using a hoist (2, Fig. 7E.11), position the cover on the main frame, being careful not to get excessive amounts of LOCTITE inside the rear main frame. Install the hardware previously removed and torque to 265 [Nm].

STEERING DRIVE

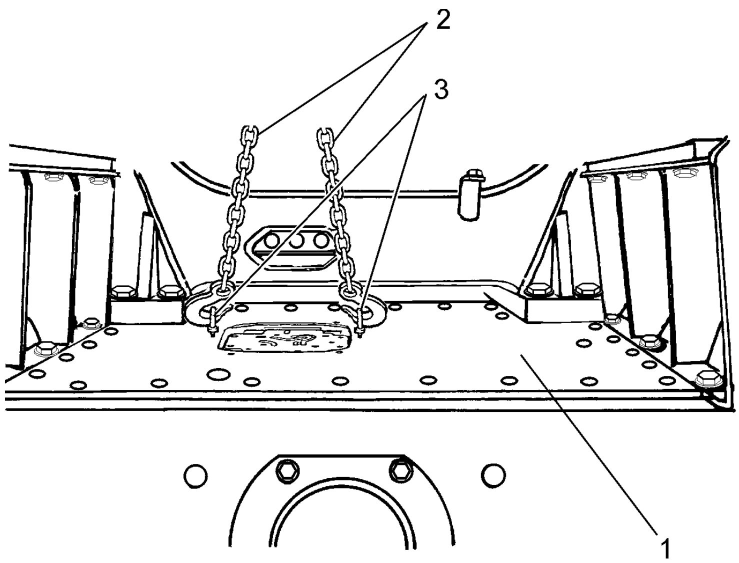


Fig. 7E.11. Positioning the Main Frame Cover

1. Main Frame Cover
2. Lifting Hoist
3. Eyebolts

13. Install the main frame filler tube and dipstick (3, Fig. 7E.3) and the breather with pipe (5).
14. Install the gear shifting valve (7, Fig. 7E.2) as described in Paragraph 33, INSTALLATION in SECTION 7C.
15. Install the steering valve (4, Fig. 7E.3) as described in Paragraph 13, INSTALLATION.
16. Check and adjust the steering valve linkage as described in the SECTION 7.

IMPORTANT: *Before installing the fuel tank, pressure test the rear main frame-to-cover seal (after specified set-up time of liquid gasket) by introducing air through the breather opening. Maximum pressure should not exceed 35 [kPa]. Use soap solution around the edge of the rear main frame cover. If air bubbles occur, mark the area of leakage, remove the cover and repeat steps 12 to 15.*

17. Attach a hoist to eyebolts 1”-8x1-1/2” and position the fuel tank on rear of machine. Secure the tank with the bolts (3, Fig. 7E.2) previously removed. Reconnect wires of rear lamp (1, Fig. 7E.1) and back-up alarm (2).
18. Reconnect fuel return and fuel supply hoses (4 and 5, Fig. 7E.2) to the fuel tank (1).
19. Fill the fuel tank as described in the OPERATOR'S MANUAL. Open fuel supply valve (6) and check for leaks.
20. Fill the main frame as described in the OPERATOR'S MANUAL.
21. Start the engine and operate the drive control valve lever and foot brake. Check for leaks.
22. Reinstall the rear plate (3, Fig. 7E.1).

STEERING DRIVE

TWO SPEED STEERING VALVE

9. REMOVAL (Refer to Fig. 7E.12)

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

***IMPORTANT**: Disconnected hydraulic lines must be properly capped with the correct size plastic cap. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Remove all dirt accumulation from the main frame cover. Tag disconnected lines to facilitate faster and correct installation.*

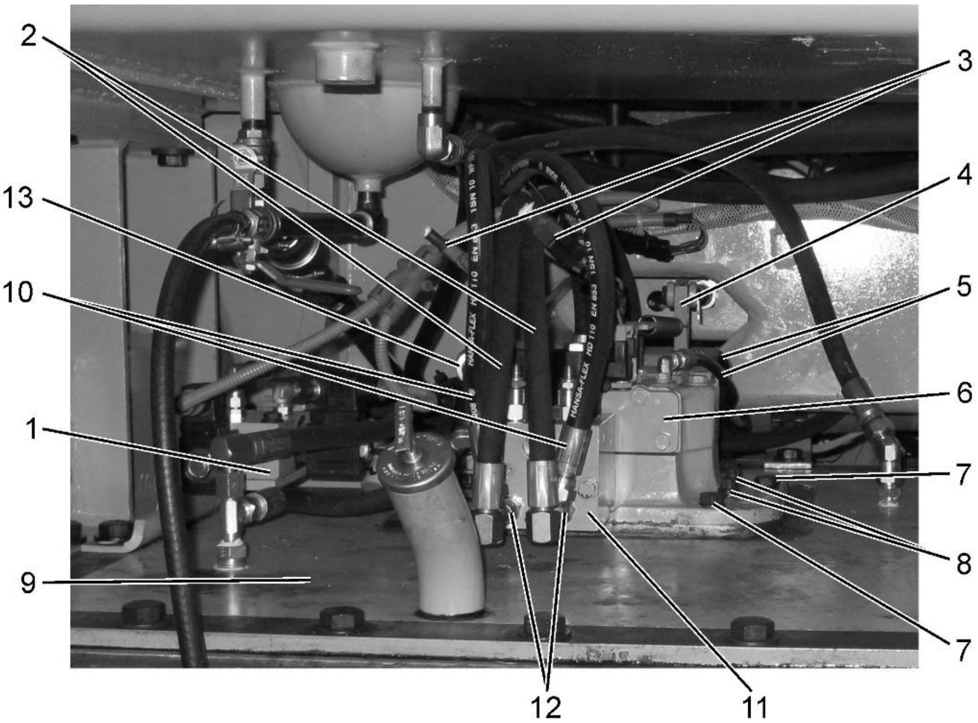


Fig. 7E.12. Two Speed Steering Valve Disconnect Points

1. Gear Shifting Valve
2. Pilot Hoses (Short)
3. Solenoids Wiring Harnesses
4. Brake Lever
5. Pressure Check Hoses
6. Two Speed Steering Valve
7. Bolts
8. Bolts
9. Main Frame Cover
10. Drain Hoses
11. Hi-Lo Valve
12. Pilot Hoses (Disconnected)
13. Supply Hose

1. Perform Steps 2 to 5 as described in Paragraph 4, REMOVAL in this SECTION.
2. Disconnect wiring harnesses (3) at two solenoids of Hi-Lo valve (11).
3. Disconnect clevis from the brake lever (4).
4. Disconnect two pilot hoses (12) at the steering valve (6), drain hoses (10) at the Hi-Lo valve (11) and two short pilot hoses (2).
5. Disconnect pressure supply hose (13) and two pressure check hoses (5).
6. Unscrew the three stud nuts. Remove ten bolts (7 and 8) from both sides securing the steering valve (6) to the main frame cover (9) and remove the valve. Discard the gasket.

NOTE: *Cover the steering valve opening to prevent dirt from entering the system.*

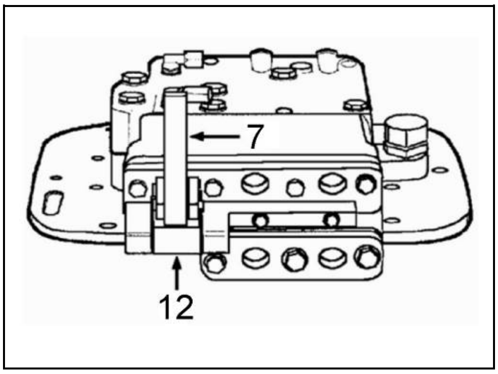
10. DISASSEMBLY

Linkage and Valves (Refer to Fig. 7E.13)

1. Remove the Hi-Lo valve (2, Fig. 7E.15) from the rear of the lower steering valve with valve gasket (10).

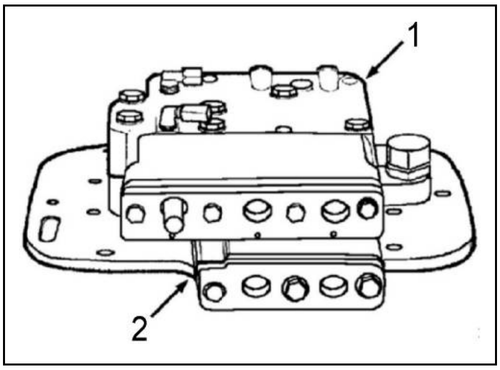
   Disconnect and remove the brake lever (7) with shaft (6), links (8) and pins (9) from the lever bracket (12) and from the spool. Remove roller bearings and lube fitting, if necessary.

   Remove the lever bracket (12) from the valve (1).

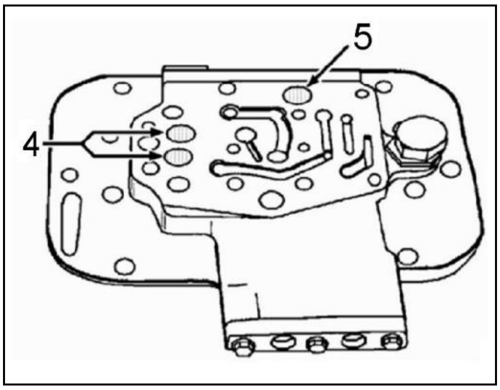


2. Remove the hardware and separate the upper steering valve (1) from the lower steering valve (2).

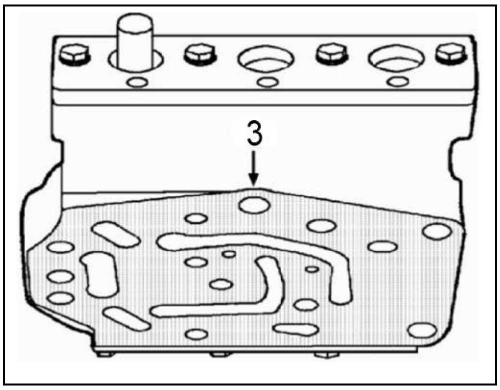
   Refer to individual valve breakdowns in this Section.



3. Take out the large (5) and small balls (4) from the lower steering valve (2).



4. Remove and discard the gasket (3) from the upper steering valve (1).



STEERING DRIVE

TWO SPEED STEERING VALVE

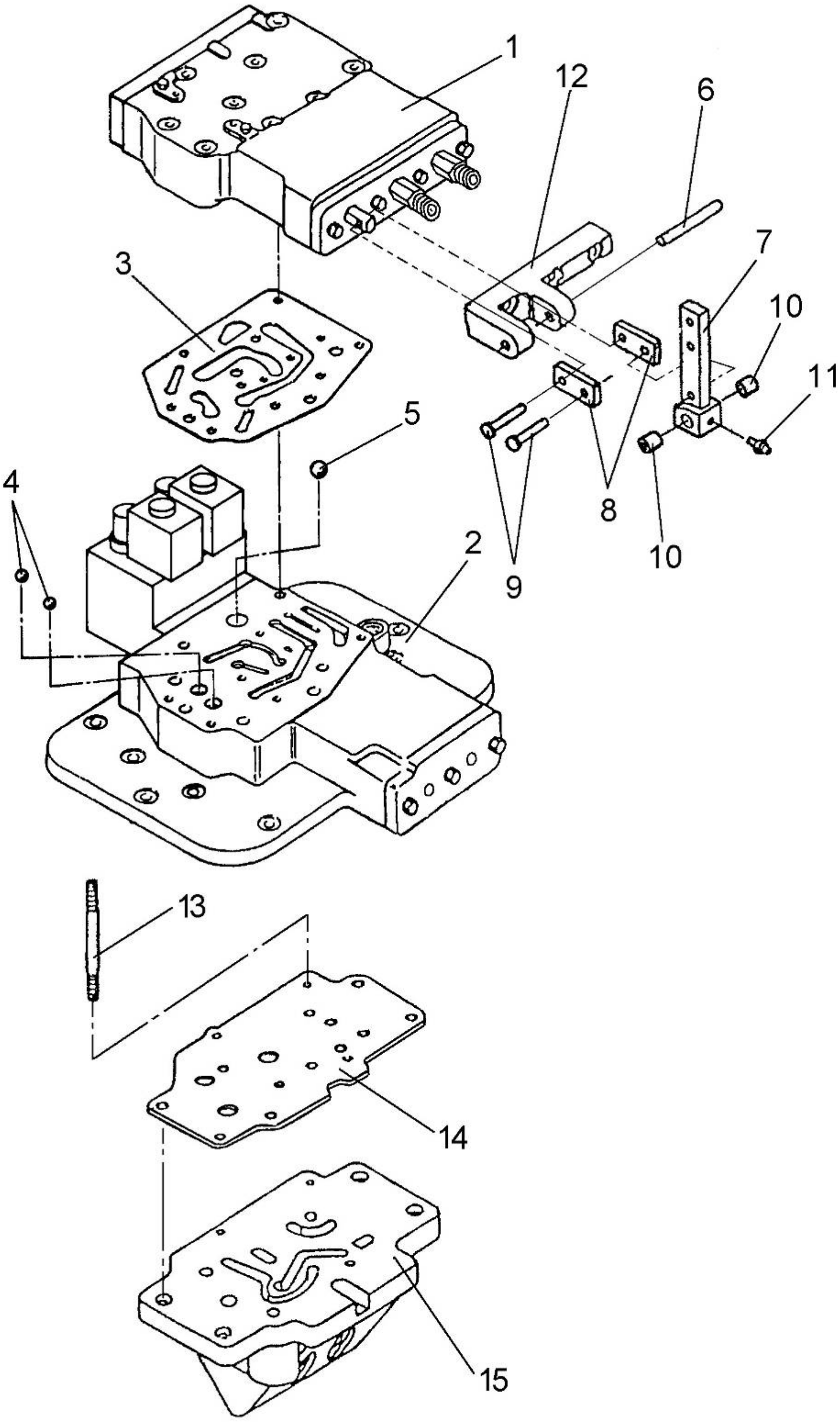


Fig. 7E.13. Exploded View of Two Speed Steering Valve

1. Upper Steering Valve
2. Lower Steering Valve
3. Valve Gasket
4. Small Ball
5. Large Ball
6. Lever Shaft
7. Brake Lever
8. Lever to Valve Link
9. Lever Pin
10. Roller Bearing
11. Lube Fitting
12. Lever Bracket
13. Stud with Washer and Nut
14. Manifold Gasket
15. Steering Manifold

Upper Steering Valve (Refer to Fig. 7E.14)

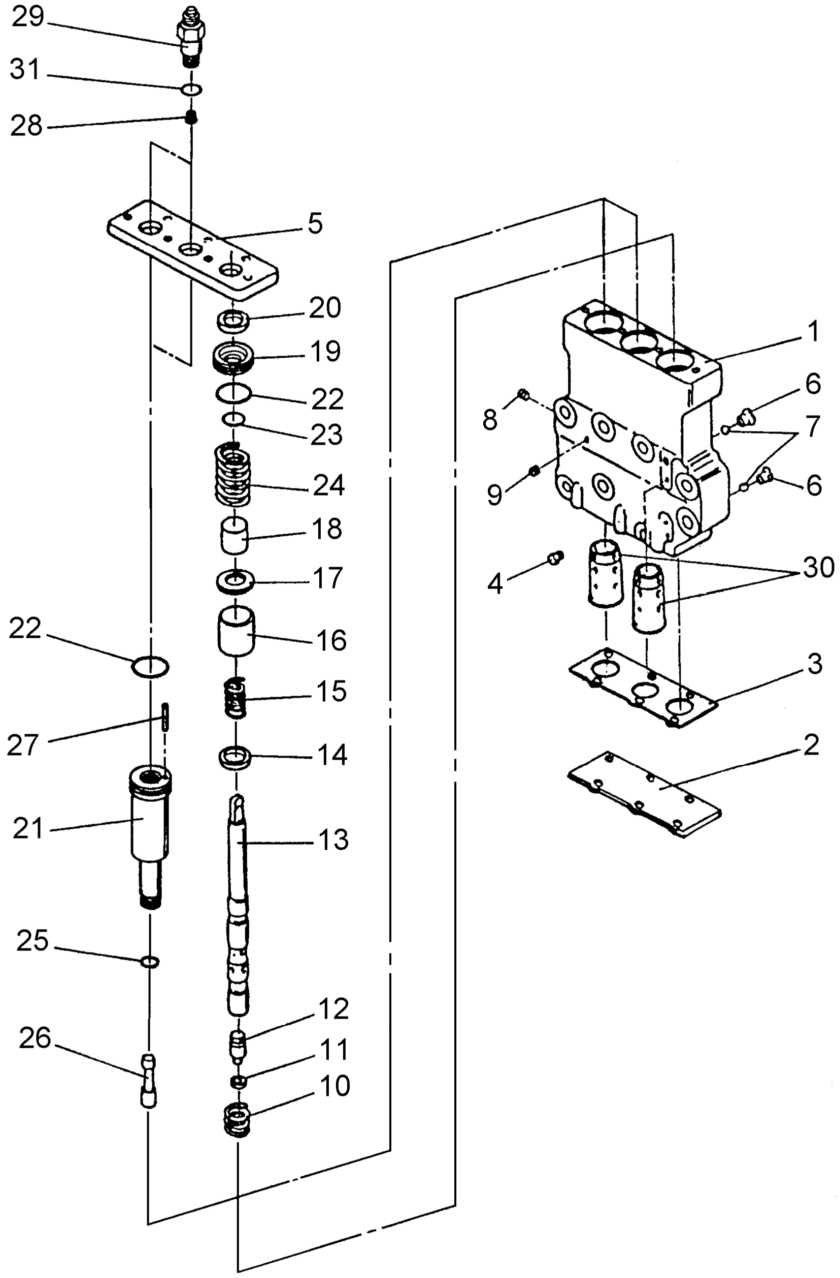


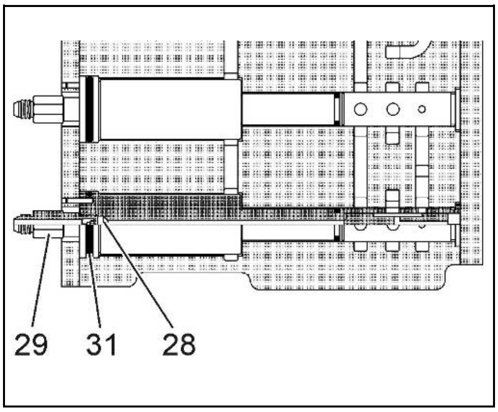
Fig. 7E.14. Exploded View of Upper Steering Valve

1. Housing
2. Rear Cover
3. Rear Cover Gasket
4. Plug
5. Front Cover
6. Check Ball Body
7. Check Ball
8. Port Plug
9. Port Plug
10. Spring
11. Shim
12. Spool Poppet
13. Brake Spool
14. Washer
15. Inner Spool Spring
16. Spring Stop
17. Spring Spacer
18. Outer Spring Stop
19. End Cap
20. Wiper Seal
21. Pilot Tube
22. Outer O-Ring
23. Inner O-Ring
24. Outer Spool Spring
25. O-Ring
26. Metering Spool
27. Dowel Pin
28. Nozzle
29. Connector
30. Spool Sleeve
31. O-Ring

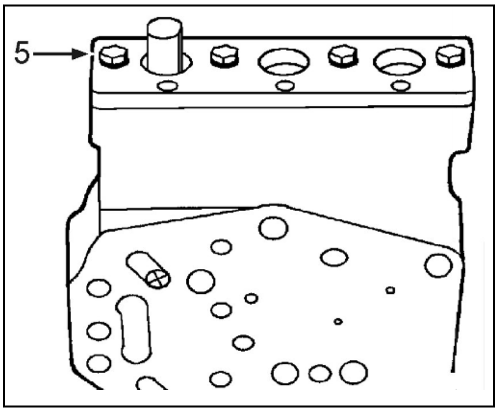
STEERING DRIVE

TWO SPEED STEERING VALVE

5. Unscrew hydraulic connectors (29) with O-rings (31). Remove nozzles (28), if necessary.

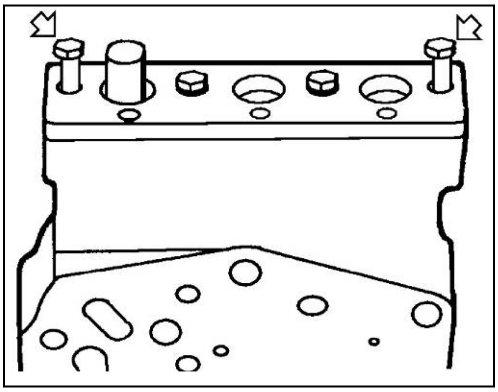


6. Stand the valve on end. Remove the front cover (5) outer bolts.

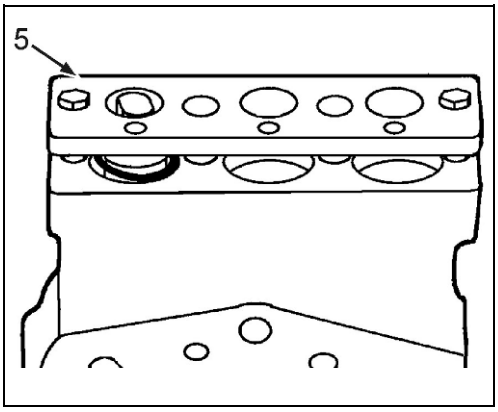


7. Install bolts that are about 25.0 [mm] longer.

WARNING! Spring loaded assembly. Use extreme care when disassembling.

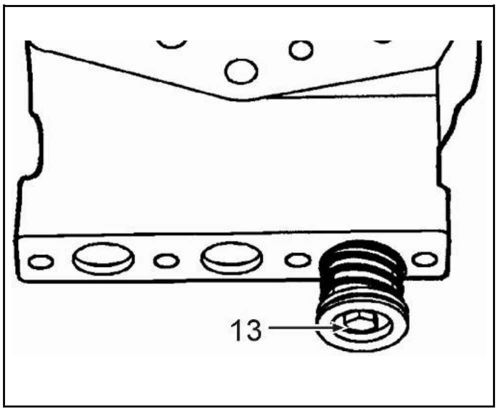


8. Slowly remove inner bolts allowing cover to rest on outer bolts. Install bolts that are about 25.0 [mm] longer in the inner bolt holes. Slowly remove the outer bolts allowing the cover up against the inner bolts. Install bolts that are about 25.0 [mm] longer in the outer bolt holes. Slowly back off the bolts until all tension is off the springs. Remove the front cover (5).



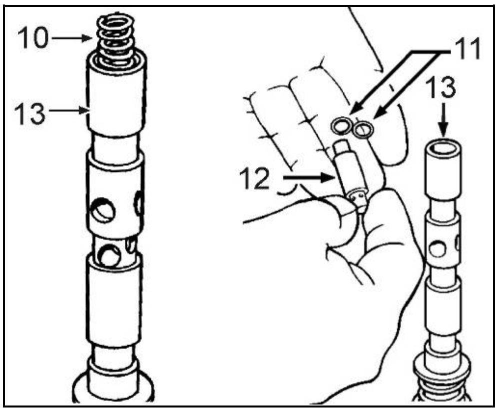
TWO SPEED STEERING VALVE

9. Remove the brake spool as an assembly by pulling spool (13) out front of housing.



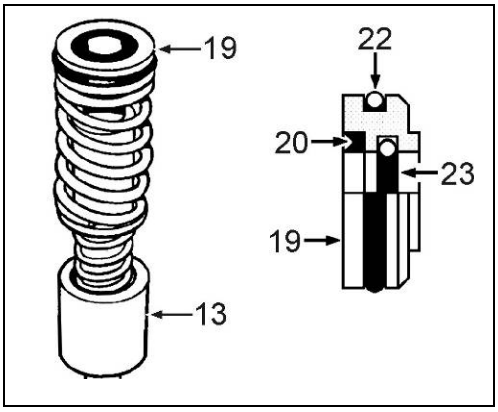
10. At the end of the brake spool (13), remove the spool poppet spring (10).

11. Remove the spool poppet (12) and shims (11) from the brake spool (13).



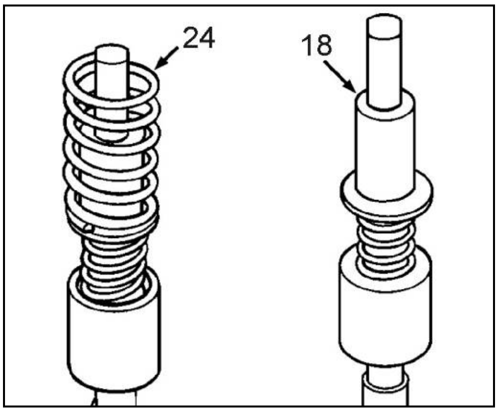
12. Turn the spool over and remove the end cap (19) with the seals.

13. Remove and discard the wiper seal (20) and the inner (23) and outer (22) O-rings.



14. Remove the outer spool spring (24).

15. Remove the outer spring stop (18).

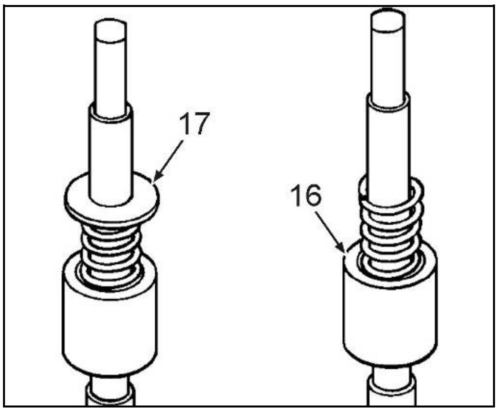


STEERING DRIVE

TWO SPEED STEERING VALVE

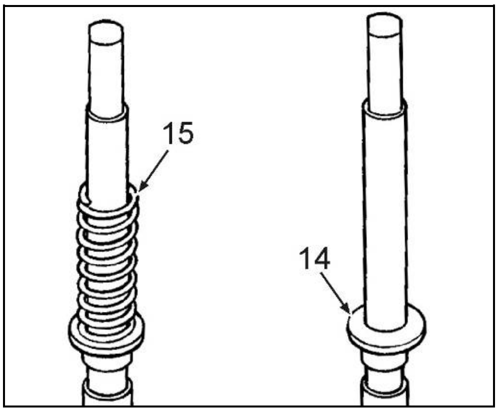
16. Remove the spring spacer (17).

17. Remove the spring stop (16).

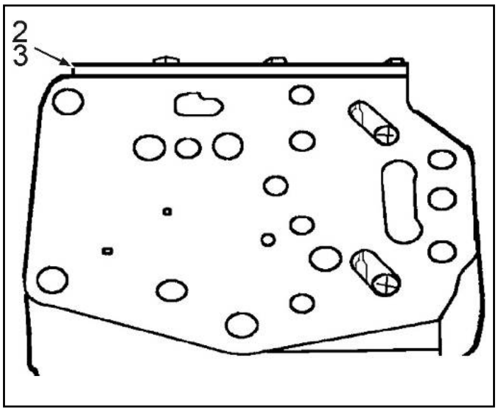


18. Remove inner spool spring (15).

19. Remove the spring washer (14).

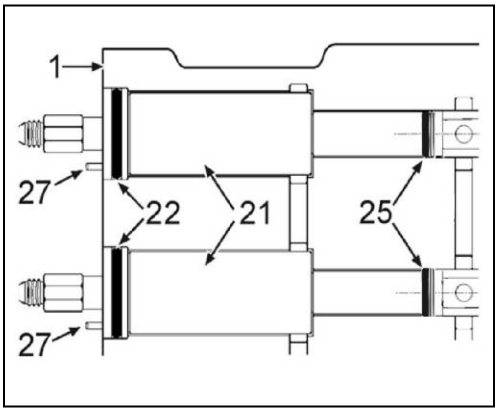


20. Remove the rear cover (2) and discard the gasket (3).



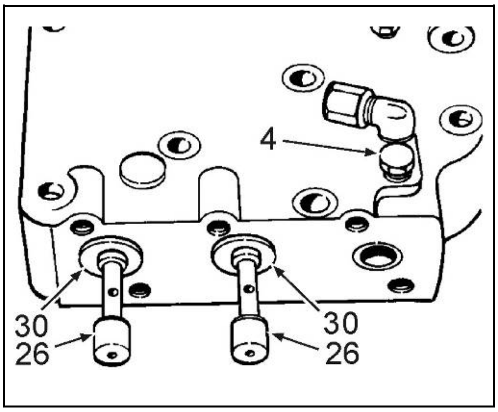
21. Pull the left and right pilot tubes (21) out of the valve housing (1). Remove and discard the O-rings (22 and 25) from pilot tubes. Remove dowel pins (27), if necessary.

NOTE: *Use connector (29) as a tool for pilot tubes removal.*



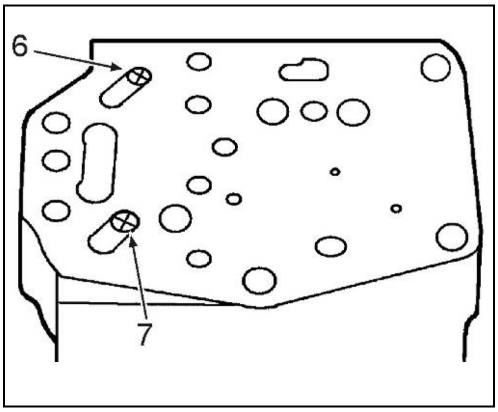
TWO SPEED STEERING VALVE

22. Remove the metering spools (26) and spool sleeves (30) using care so not to scratch or score inside diameter of sleeves (30).



23. If necessary, remove plugs (4) or fittings from top of housing.

24. Remove the check ball body (6) and check ball (7) from the valve housing, if needed.



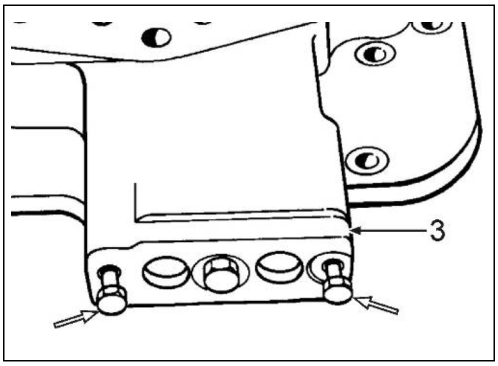
Lower Steering Valve (Refer to Fig. 7E.15)

NOTE: *It is possible to remove the Hi-Lo valve from the rear of the lower steering valve before or after separating the upper steering valve from the lower steering valve.*

25. If previously not done, remove the Hi-Lo valve (2) from the rear of the lower steering valve. Remove and discard the between valve gasket (10).

26. Remove front cover (3) bolts and replace with ones 25.0 [mm] longer. Slowly back out the center bolt until the cover rests against the outer bolts.

WARNING! Spring loaded assembly. Use extreme care when disassembling.



STEERING DRIVE

TWO SPEED STEERING VALVE

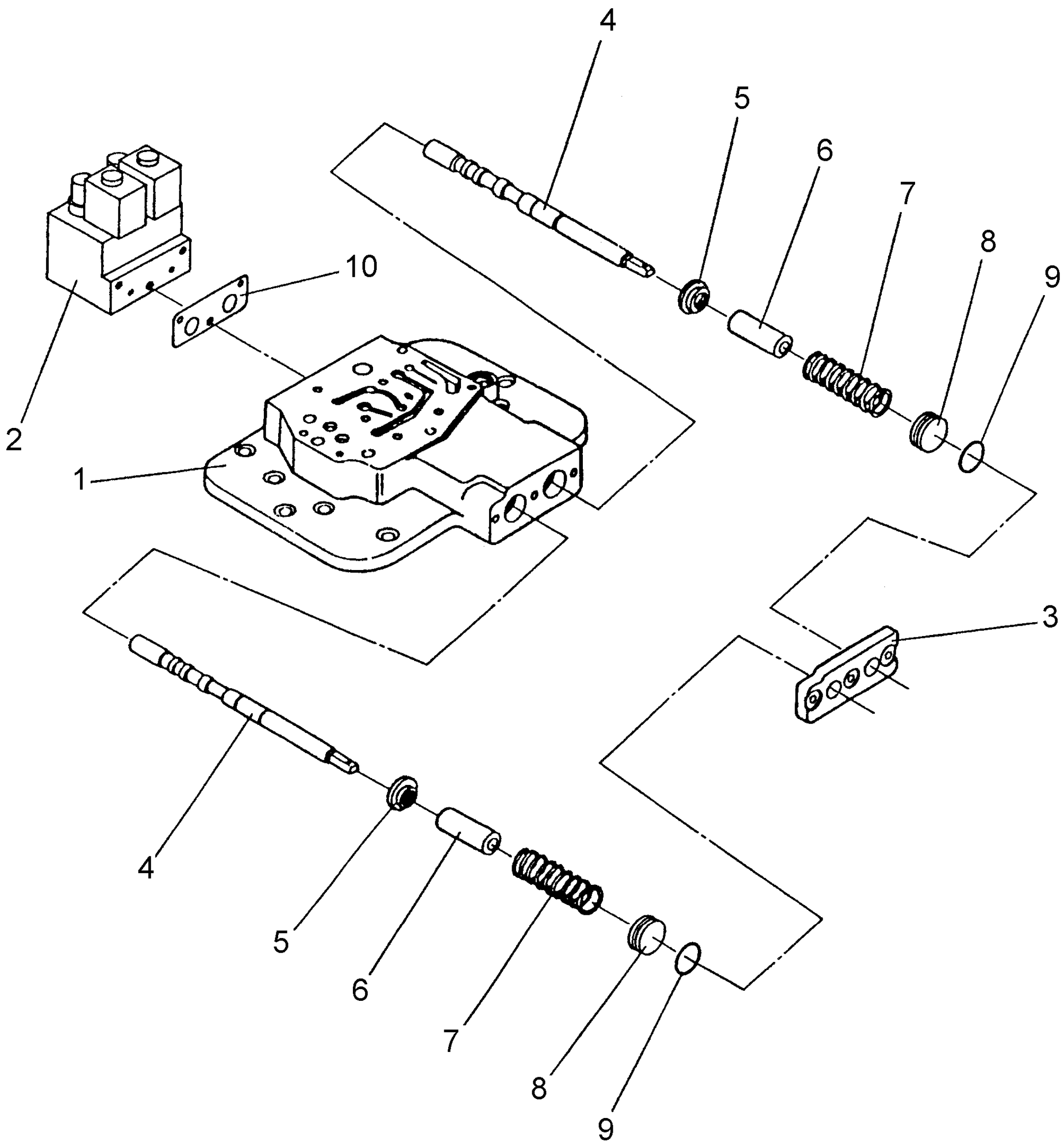
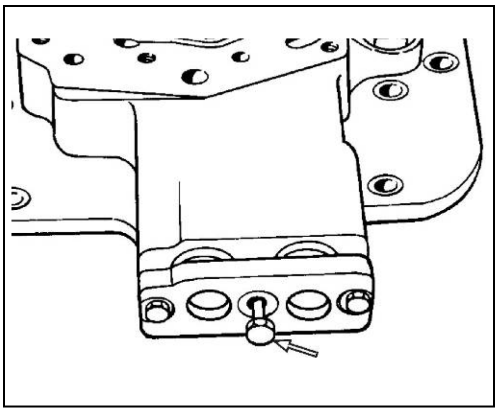


Fig. 7E.15. Exploded View of Lower Steering Valve

1. Valve Housing
2. Valve (Hi-Lo)
3. Front Cover
4. Valve Spool
5. Spring Seat
6. Spring Spacer
7. Spool Spring
8. Plug
9. Outer O-Ring
10. Rear Cover Gasket

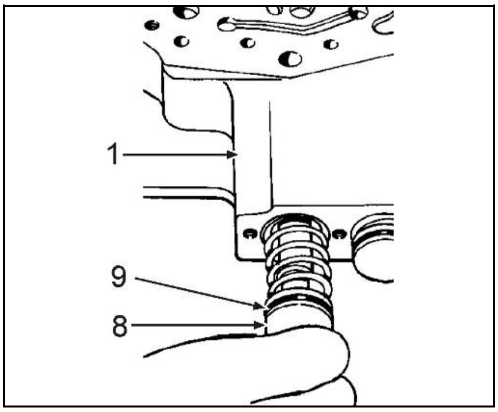
27. Remove the inner cover bolt and replace with one 25.0 [mm] longer. Slowly back out outer bolts until all spring tension is released.



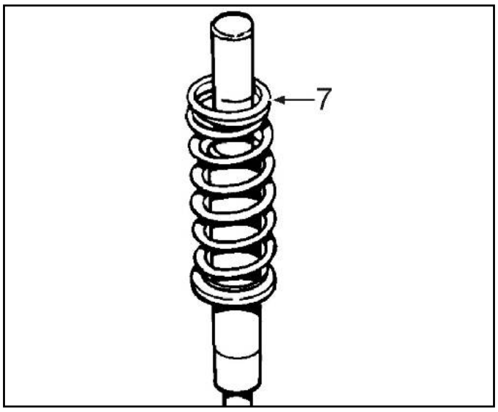
TWO SPEED STEERING VALVE

28. Pull out the plugs (8) with outer O-rings (9) by pulling spools out of the valve housing (1). Discard the O-rings.

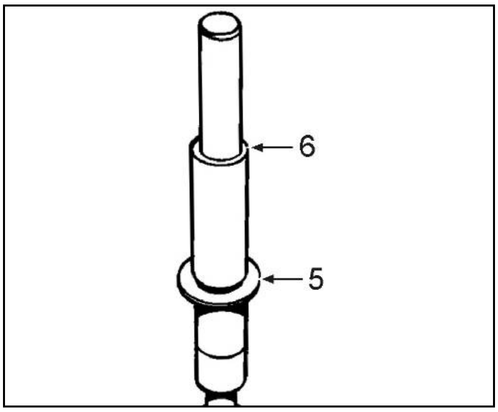
    Remove items (4 thru 7) as an assembly by pulling spools (4) out front of valve housing.



29. Remove the spool springs (7).



30. Remove the spring spacers (6) and spring seats (5).



STEERING DRIVE

TWO SPEED STEERING VALVE

Hi-Lo Valve (Fig. 7E.16)

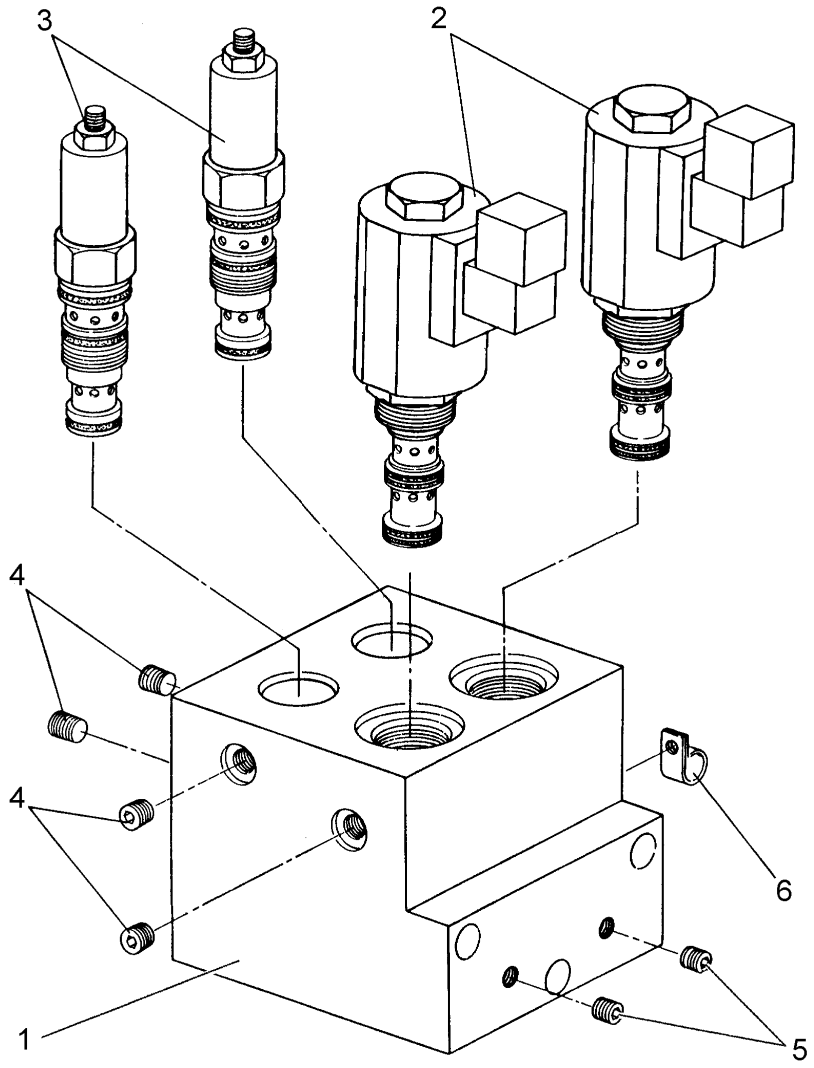


Fig. 7E.16. Exploded View of Hi-Lo Valve

1. Valve Housing
2. Solenoid Valve
3. Sequence Valve
4. Plug
5. Nozzle
6. Clip

31. Remove the sequence valves (3) from the valve housing (1). Remove and discard the valve seal kit.

32. Unscrew the solenoid coil from the solenoid valve (2). Remove the solenoid valve (2) bodies from the valve housing (1). Remove and discard the valve seal kit.

33. Remove nozzles (5) from the valve housing (1). Remove plugs (4) and clip (6), if necessary.

11. INSPECTION AND REPAIR

1. It is recommended that all new O-rings and seal rings be installed upon reassembly of the valve.
2. Clean all parts in a suitable solvent and blow dry with compressed air. Be sure all oil passages in the valve bodies and spools are free of obstructions.
3. Inspect the parts for excessive wear and replace if necessary (refer to **NOTE**). Upper steering valve metering spools (26, Fig. 7E.14) should slide freely inside spool sleeves (30). Closely inspect the inside diameter of spool sleeves (30) for nicks, scratches, etc. and replace if necessary.

NOTE: *The oil inlet port of the lower valve housing may show signs of wear caused from the ball PEENING the valve section each time pressure re-enters the valve. Do not replace the valve section when this appearance is observed*.

4. Inspect the condition of the springs. If they are damaged or do not fall within the specifications shown in Paragraph 3, SPECIFICATIONS, they must be replaced.
5. Clean threads with a stiff brush and solvent. Check for damage.

12. REASSEMBLY

Hi-Lo Valve (Refer to Fig. 7E.16)

1. Install nozzles (5) in the valve housing (1). If removed, apply LOCTITE #242 to plugs (4) and install them in the housing (1). Install clip (6), if removed.

2. Install a new seal kits to the solenoid valves (2). Install the solenoid valves (2) bodies to the valve housing (1). Torque the solenoid valve bodies to 40 [Nm]. Install the solenoid coils on valve (2) bodies and torque the coil nut to 5.4 ÷ 8.1 [Nm].

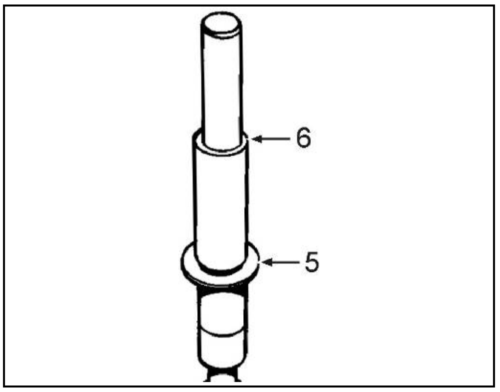
3. Install a new seal kits to the sequence valves (3). Install the sequence valves (3) to the valve housing (1). Torque the sequence valve bodies (3) to 45 • 50 [Nm].

STEERING DRIVE

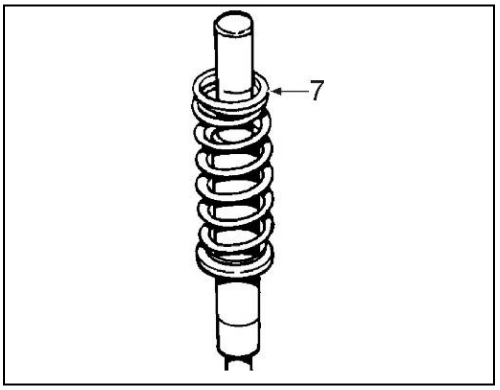
TWO SPEED STEERING VALVE

Lower Steering Valve (Refer to Fig. 7E.15)

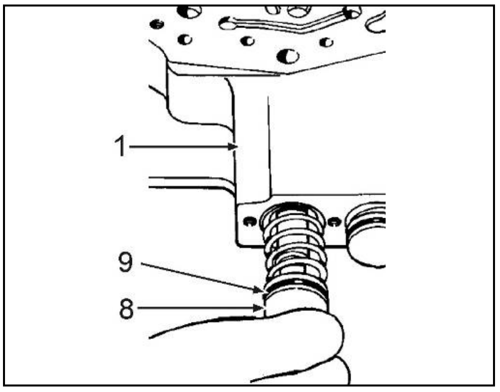
4. Install the spring seats (5) and spring spacers (6) on both valve spools.



5. Install the spool springs (7) on front end of spools (4).

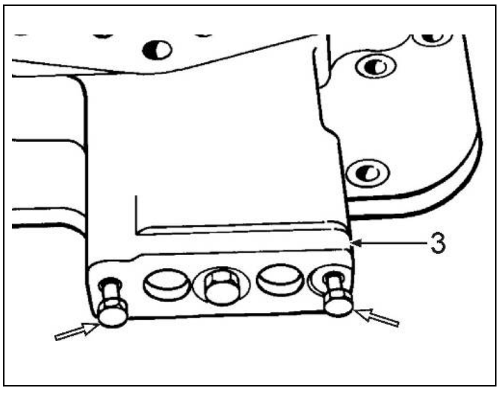


6. Slide both of the spools into front of valve housing (1). Install new O-rings (9) on plugs (8) and install them into front of valve housing (1).



7. Install the front cover (3) using cover bolts until the cover (3) rests against the valve housing (1).

WARNING! Spring loaded assembly. Use extreme care when assembling.

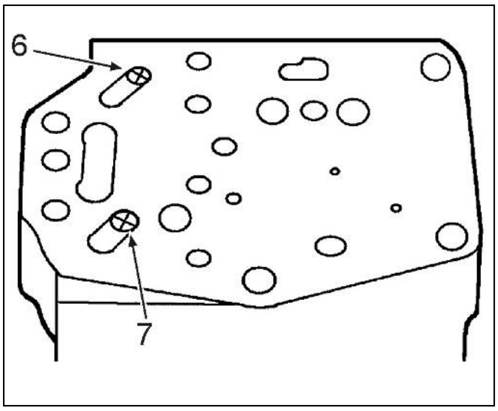


8. If removed, reinstall the Hi-Lo valve (2) with gasket (10) at the rear of lower steering valve housing (1).

Upper Steering Valve (Refer to Fig. 7E.14)

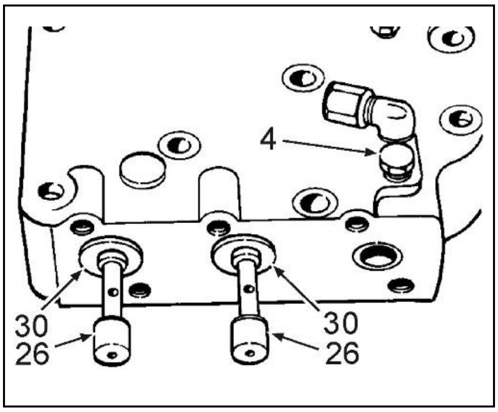
NOTE: *If replacement of housing ports (balls) (8 and/or 9) are required, press the new ball 0,25-0,75 [mm] below the surface of housing (1).*

9. If removed, install the check balls (7) into the housing (1) bores. Coat the check ball body (6) threads with LOCTITE #262 and install into the housing (1). Torque check ball bodies (6) to 32 [Nm].



10. Apply LOCTITE PIPE SEALANT #592 to the threads of port plugs (4) and the hose fittings (if removed) and install the plugs and fittings in the top of housing (1).

11. Reinstall metering spool sleeves (30) into valve housing (1). Lightly lubricate metering spools (26) and install them into sleeves (30) with the rifle, drilled hole positioned towards the rear of the housing (1).

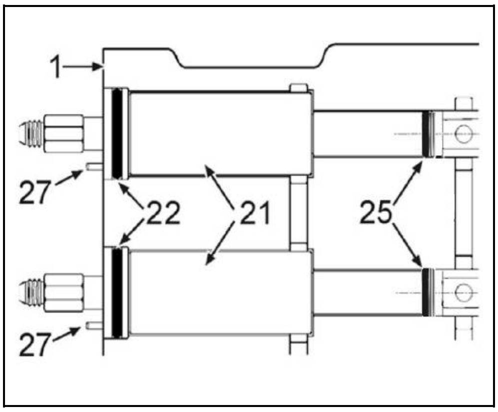


12. Prior to installation of rear cover (2), verify metering spools (26) move freely in spool sleeves (30). Use a new gasket (3) and secure rear cover (2) to the upper steering valve housing (1).

13. Install new O-rings (22 and 25) to left and right pilot tubes (21). If removed, install dowel pins (27) in pilot tubes (21).

14. Install the pilot tubes into the valve housing (1).

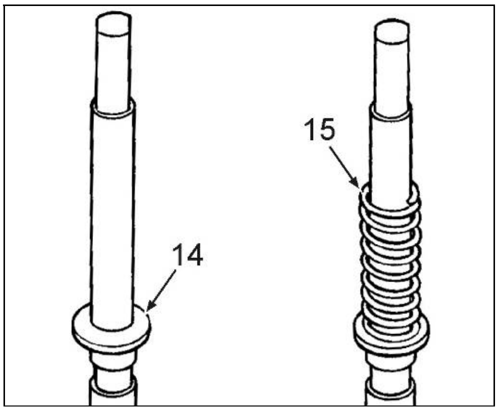
NOTE: *Use connector (29) as a tool for pilot tubes mounting.*



TWO SPEED STEERING VALVE

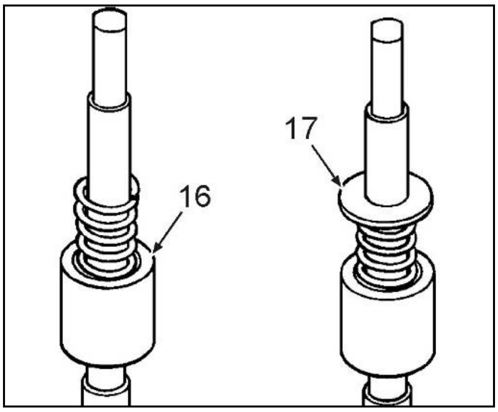
15. Install the spring washer (14) over the brake spool.

16. Install inner spool spring (15).



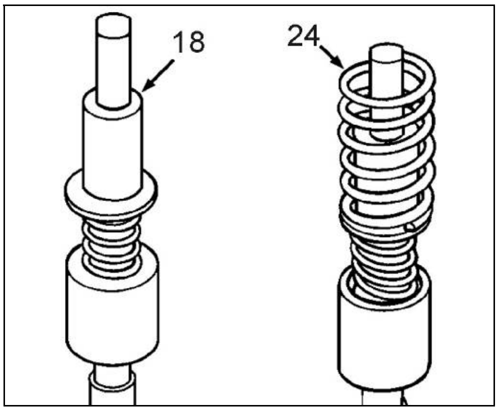
17. Install the inner spring stop (16).

18. Install the spring spacer (17).



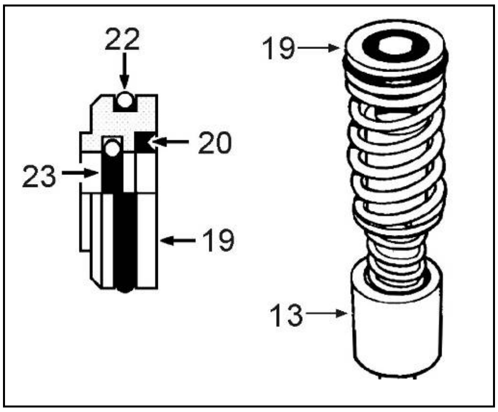
19. Install the outer spring stop (18)

20. Install the outer spool spring (24).



21. Install the wiper seal (20) and the inner (23) and outer (22) O-rings to the end cap (19).

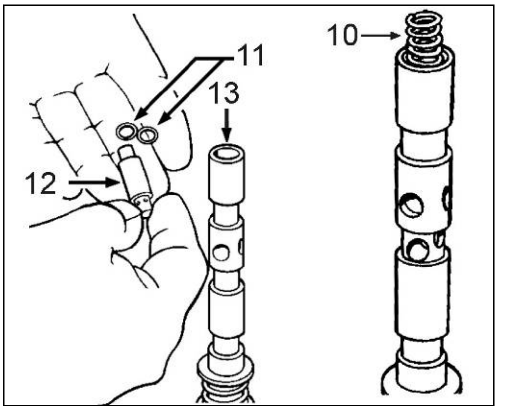
22. Reinstall the end cap (19) with seals to the brake spool.



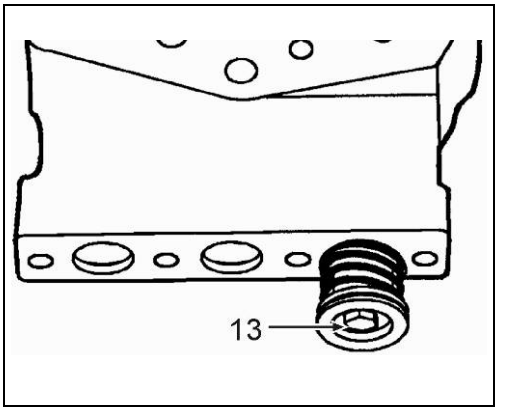
TWO SPEED STEERING VALVE

23. At the end of brake spool (13) install the spool poppet (12) with originally removed shims (11).

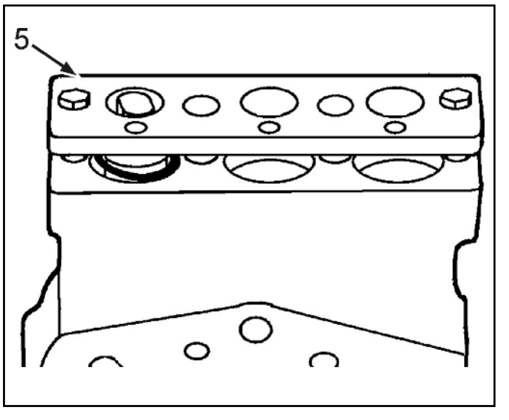
24. Install the spool spring (10) towards the rear of the housing (1).



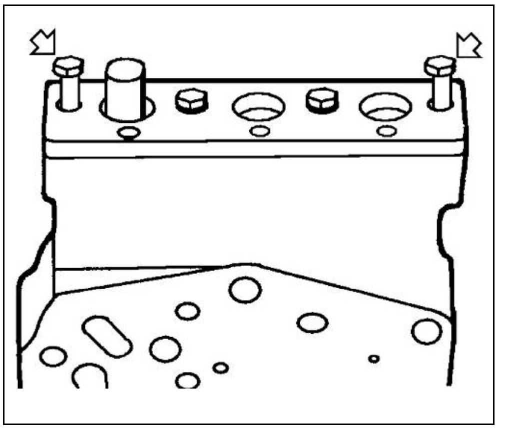
25. Reinstall the brake spool (13) with mounted parts into the valve housing.



26. Install the front cover (5) to the housing and secure with long bolts at outer holes

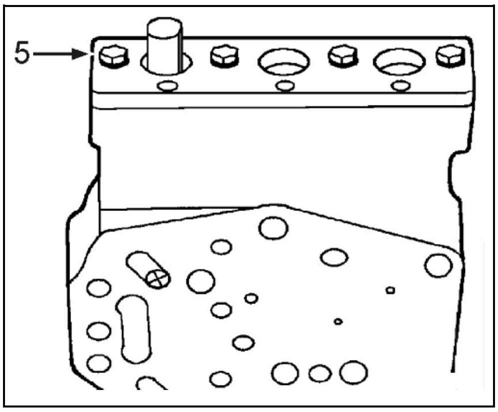


27. Compress the spring tension and secure the front cover with bolts in the inner holes.

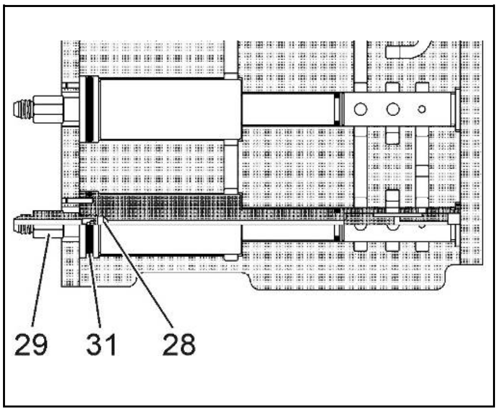


WARNING! Spring loaded assembly. Use extreme care when assembling

28. When the spring tension is fully compressed, secure the front cover (5) with the remaining hardware.

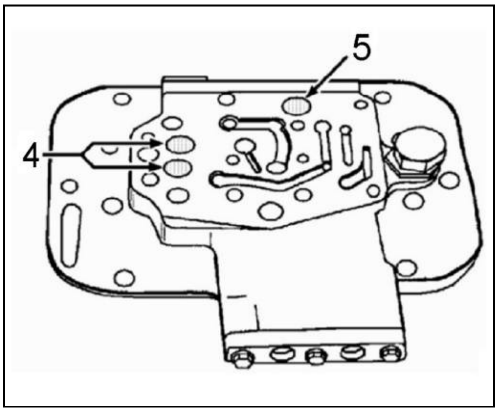


29. Reinstall nozzles (28) into connectors (29), if removed. Screw connectors (29) with new O-rings (31) into pilot tubes (21).

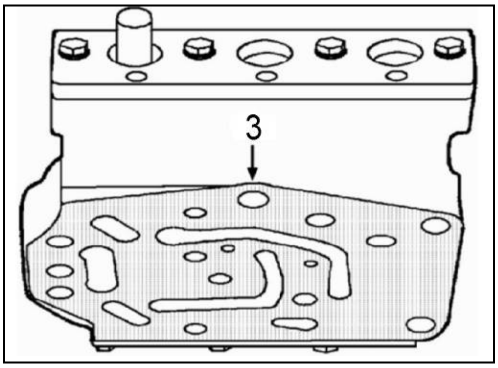


Linkage and Valves (Refer to Fig. 7E.13)

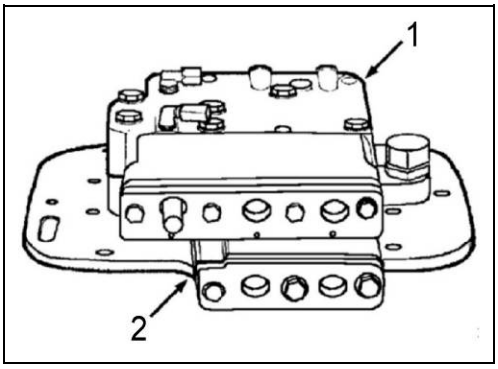
30. Put the balls (4 and 5) into their seats in the lower steering valve.



31. Install between upper (1) and lower (2) steering valve new gasket (3). Install six bolts and torque them to 52 [Nm].

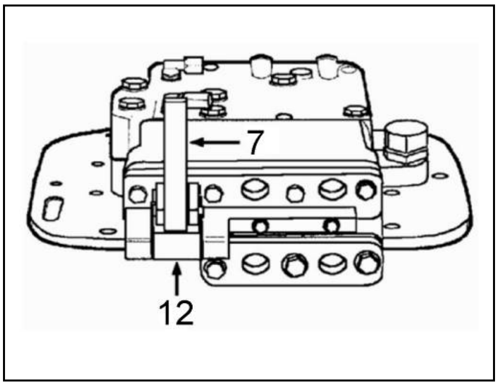


32. Install six bolts securing upper steering valve (1) to lower steering valve (2) and torque the bolts to 52 [Nm].



33. Install lever bracket (12) to the lower steering valve (2).

34. Reinstall brake lever (7) with shaft (6) and links (8) with pins (9) to the lever bracket (12) and upper steering valve brake spool respectively.



13. INSTALLATION (Refer to Fig. 7E.12)

1. Remove covering from the steering valve opening in the main frame and install steering valve as follows:
   A. Install a new gasket (14, Fig. 7E.13) over studs (13, Fig. 7E.13).
   B. Thoroughly clean the mating surfaces of the main frame cover and steering valve. Apply LOCTITE #504 to rear main frame cover in a continuous bead on centerline of valve mounting holes (refer to Fig. 7E.17).
   C. Lower steering valve (6) onto studs. Secure valve (6) with three nuts and washers on studs and ten bolts (7 and 8).
2. Reconnect pressure supply hose (13) and two pressure check hoses (5).
3. Reconnect two pilot hoses (12) and two short pilot hoses (2) to the steering valve (6) and drain hose (10) to the Hi-Lo valve (11).
4. Reconnect clevis with brake control cable to the brake lever (4).
5. Reconnect wiring harnesses (3) to the two solenoids.
6. Pressure test rear main frame (after specified set-up time of liquid gasket) as follows:
   A. Remove rear main frame breather and introduce air through breather opening. Maximum pressure should not exceed 35 [kPa].
   B. Use a soap solution around edge of rear main frame cover, power take off cover, steering valve and mounting bolts. If bubbles occur, mark area of leakage, remove part and check for proper surface finish and flatness, reseal and recheck. Reinstall rear main frame breather.

STEERING DRIVE

TWO SPEED STEERING VALVE

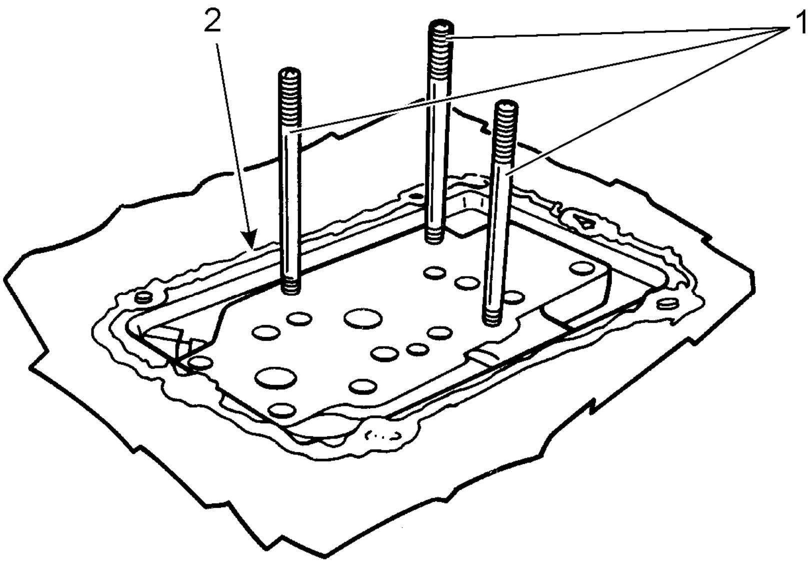


Fig. 7E.17. LOCTITE to Rear Cover

1. Stud 2. LOCTITE #504 Gasket Eliminator

7. Perform Steps 15 to 19 as described in Paragraph 8, INSTALLATION in this SECTION.
8. Remove the rear main frame inspection cover. Check if it is free of leaks at hydraulic hoses that connect the steering manifold to the steering drive.

IMPORTANT: *The steering drive bottom manifold can leak in normal operation. The leaks can have the following figures:*

- *steering valve inactive: maximum total leak – 2.5 [l/min],*
- *with one gear shifting/ range change operation or master brake application the leaks can total – 17 [l/min].*

14. STEERING VALVE BRAKE SECTION TEST AND ADJUSTMENT

1. Install a 3000 [kPa] pressure gauge in right or left brake port of diagnostic center. Gauge should have a hose of sufficient length to reach operators compartment. Start machine and run engine at idle speed.
2. Release parking brake lock and place drive train control lever in neutral position. Press foot brake pedal down lightly until a resistance is felt in downward travel of pedal. At this point read pressure gauge, pressure showing on gauge is FEEL POINT pressure. Refer to Paragraph 13, STEERING SYSTEM OIL PRESSURE CHECK in SECTION 7.
3. Add or deduct shims (11, Fig. 7E.14), to increase or reduce feel point pressure. To do this remove valve rear cover (2) and gasket (3). Remove poppet (12), and add or deduct shims (11). Each shim will raise FEEL POINT pressure 35 [kPa]. Reinstall valve rear cover (2), with a new gasket (3). Recheck feel point pressure.

STEERING MANIFOLD

15. REMOVAL

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

IMPORTANT: *Disconnected hydraulic lines must be properly capped with the correct size plastic cap. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Remove all dirt accumulation from the main frame cover. Tag disconnected lines to facilitate faster and correct installation.*

1. Remove the steering valve as described in Paragraph 9, REMOVAL in this Section.
2. Double nut and remove the three studs from manifold.
3. Remove the main frame cover as described in Step 5 to 9 Paragraph 4, REMOVAL, in this Section.
4. Secure the steering manifold to the manifold bracket located on the top left of the steering drive. Disconnect hoses from steering manifold and remove the manifold out of machine.

16. DISASSEMBLY (Refer to Fig. 7E.18)

1. Remove plug (5) with O-ring (4) from housing (1). Remove O-ring from plug.
2. Pull spool (3) and spring (2) from housing (1).

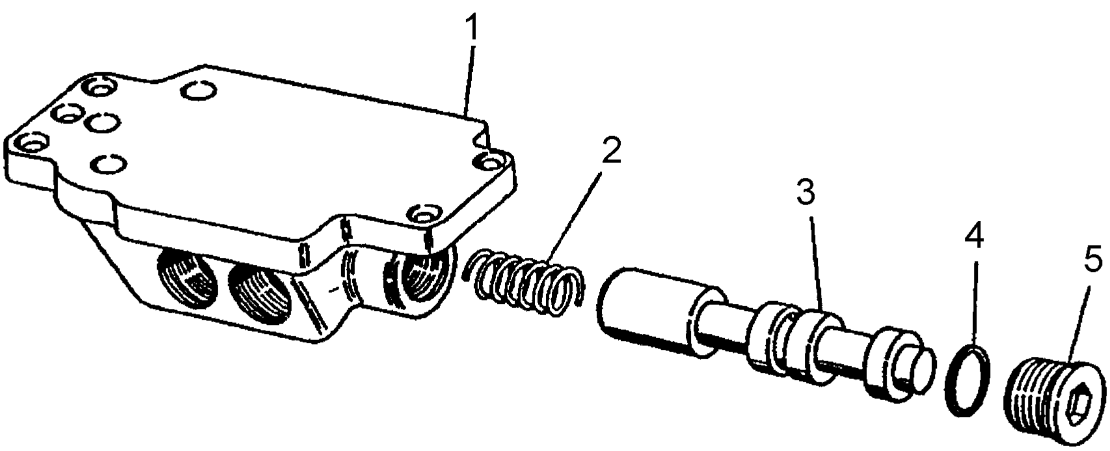


Fig. 7E.18. Exploded View of Steering Manifold

1. Manifold Housing
2. Spool Spring
3. Manifold Spool
4. O-Ring
5. Spool Plug

STEERING DRIVE

STEERING MANIFOLD

17. INSPECTION AND REPAIR

1. It is recommended that new O-ring be installed whenever the steering manifold is disassembled for service.
2. Wash all parts thoroughly in a suitable solvent. Dry thoroughly with compressed air.
3. Inspect machined surfaces of the manifold and spool for scoring, damage or excessive wear.
4. Inspect the condition of the return spring. If damaged or if it does not fall within the specifications shown in Paragraph 3, SPECIFICATIONS, it must be replaced.
5. The rear main frame cover mounting surfaces must be cleaned with proper solvent and inspected for scratches, irregularities and flatness. Maximum out of flat between any two consecutive mounting holes to be 0.25 [mm]. If the cover does not meet this requirement, the cover should be replaced.

18. REASSEMBLY (Refer to Fig. 7E.18)

1. Insert spring (2) into the end of spool (3).
2. Slide spool (3) into the housing (1), spring end first.
3. Assemble new O-ring (4) onto plug (5). Secure into housing (1).

19. INSTALLATION

1. Temporarily secure the steering manifold to the manifold bracket located on the top left of the steering drive. Reconnect the hoses to the junction manifold and then free the manifold from the bracket.
2. Install three studs (1, Fig. 7E.17) to the manifold.

NOTE: *The manifold bracket is only used to correctly position and hold the manifold in place during hose installation.*

3. Perform Steps 11 to 14 as described in Paragraph 8, INSTALLATION in this SECTION.
4. Install the steering valve as described in Paragraph 13, INSTALLATION in this SECTION.

SECTION 7F

FINAL DRIVE

FINAL DRIVE

CONTENTS

SERVICE/SPECIAL TOOLS

GENERAL

SPROCKET

FINAL DRIVE ASSEMBLY

PLANETARY CARRIER HOUSING

PINION GEAR HOUSING

SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS

DESCRIPTION	TOOL NUMBER	
Output Shaft Retainer Removing Bolt	1/2”-13UNC-2B	
Steering Drive Output Shaft Removing Bolt	5/8”-11UNC-2B	(376-89-1055)
Planetary Carrier Housing Lifting Eye Bolt	3/4”- 10UNC-2B	

GENERAL

2. DESCRIPTION (Refer to Fig. 7F.4)

The final drive assembly consists of a set of spur gears and a planetary assembly on each side at the rear of the machine. Power is transmitted from the steering drive, through the output shaft to the final drive pinion gear (12). The output shaft is splined to the steering drive output shaft sleeve at one end and to the final drive pinion gear at the other end. The final drive pinion gear (12) is meshed with the final bull gear (13), which provides the first gear reduction.

The final bull gear (13) is attached to the sun gear shaft (37), which is supported on the final drive cover (19) by a double-row bull gear bearing (17). Three planet gears (34) are meshed with the sun gear shaft, which is splined to the bull gear (13), and are also meshed with the final planetary ring gear (38).

The final drive ring gear hub (41) is splined to the final drive cover (19) and is in mesh with the planetary ring gear (38), keeping the ring gear stationary during operation. The planet gears provide the second gear reduction. Two tapered roller bearings (32) support each planet gear (34) on its shaft (35). The shafts are housed in the planetary carrier housing (30). The planetary carrier housing (30) and the drive sprocket (22) are both attached to the sprocket hub (23) which is supported on the carrier drive cover (19) by two tapered roller bearings (27).

As the final bull gear and sun gear (5, Fig. 7F.1) revolves, it causes the planet gears (1) to rotate on their shafts. The planet gears (1), being meshed with the stationary ring gear (2), cause the planetary carrier housing (3), sprocket hub and sprocket (4) to rotate in direction “A” driving the machine in direction “B” as shown on Fig. 7F.1.

The final drive assy has its own lubrication and is sealed against leakage and dirt.

FINAL DRIVE

GENERAL

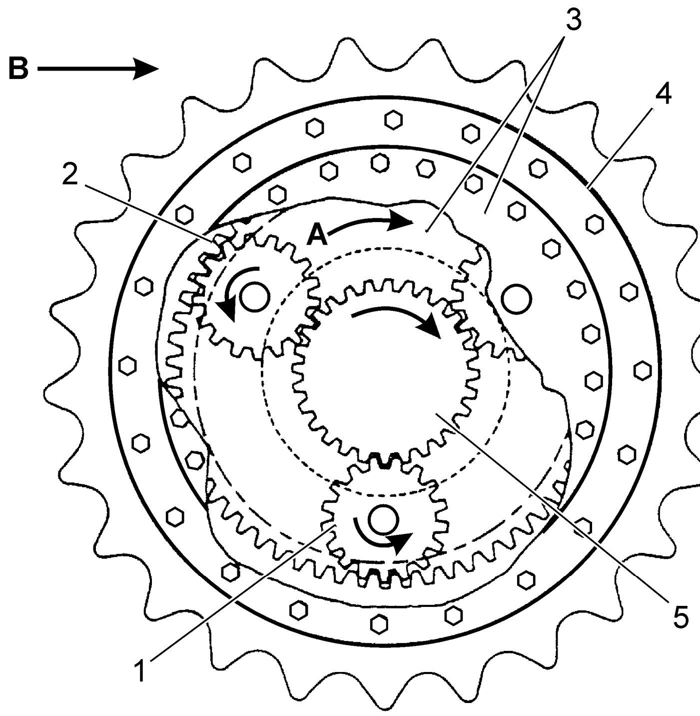


Fig. 7F.1. Planetary Drive

1. Planet Gear
2. Ring Gear
3. Planetary Carrier Housing
4. Sprocket
5. Sun Gear

3. SPECIFICATIONS

Special Bolt and Nut Torque Data

Planet carrier housing mounting bolts	610 [Nm]
Sprocket gear hub retainer plate bolts	245 [Nm]
Sprocket drive mounting bolts	735 [Nm]
Sprocket mounting nuts	435 [Nm]
Sprocket rock deflector mounting bolts	455 [Nm]
Pinion gear housing bolts	220 [Nm]
Pinion access cover bolts	100 [Nm]
Sprocket gear hub bearing retainer plate	125 [Nm]
Ring gear retainer	125 [Nm]
Planet gear shaft	220 [Nm]
Final drive oil seal shield bolts	80 [Nm]

NOTE: *Except for special torques shown, all bolts and nuts are to be given a standard torque. Refer to the STANDARD TORQUES in SECTION 1, INTRODUCTION.*

GENERAL

4. SERVICE DIAGNOSIS

COMPLAINT	
PROBABLE CAUSE	REMEDY
Final Drive Overheating	
1. Improper or insufficient lubrication	Use proper grade and amount of lubricant. Check for leaks.
2. Bearing seizure	Remove final drive and inspect for damaged bearings.
Noise	
1. Improper, dirty or insufficient lubricant	Use proper grade and amount of clean lubricant.
2. Bearings scored or damaged	Replace bearings.
3. Worn or damaged gears	Inspect all the gears and replace as necessary.
Lubricant Leakage	
1. Lubricant leaks at drain plugs or level plug	Tighten plug or replace sealing ring as necessary.
2. Lubricant leaks between final drive cover and rear main frame or between planetary carrier housing and sprocket hub	Clean sealing surfaces and apply liquid gasket.
3. Lubricant leaks between the sprocket hub and sprocket drive cover	Replace carrier oil seal.
Final Drive Lubricant Level to High	
1. Oil seal damaged between rear frame and final drive	Change oil seal.
2. Oil seal output shaft surface damaged	Change the shaft and oil seal.
Excessive Wear on Sprockets	
1. Tracks run too loosely	Adjust the tracks.
2. Tracks worn excessively	Install new tracks.
3. Track frame out of alignment or damaged	Adjust, repair or install new track frame.

SPROCKET

5. REMOVAL AND INSTALLATION

1. Remove sprocket outer rock shield (if equipped). Remove track chain, refer to SECTION 15. It is not necessary to remove chain from under machine. Jack up rear of machine enough to allow sprocket to clear track chain and block main frame.
2. Attach a hoist to the sprocket and take up the slack. Remove bolts and washers securing the sprocket to the sprocket carrier. Remove the sprocket. Check for excessive wear on the sprocket. Refer to SERVICE DIAGNOSIS in this section, for causes of excessive wear and how they can be corrected. To install the sprocket, reverse removal procedure.

NOTE: *Torque the sprocket mounting nuts and the sprocket rock deflector bolts to values shown in SPECIFICATIONS, in this Section.*

FINAL DRIVE

FINAL DRIVE ASSEMBLY

6. REMOVAL (Refer to Fig. 7F.4)

1. Remove the track chain, refer to SECTION 15. It is not necessary to remove the track chain from under the machine. Move the machine until the drain plug (2) in hub (23) is at the bottom. Drain the final drive system through this plug and the final drive compartment drain plug in the bottom of the side rear main frame.
2. Remove the sprocket rock shield (if equipped).
3. Jack up the rear of the unit enough for sprocket to clear the track chain. Block under the main frame. Remove cover (7) with O-ring (8) from cover (19) and remove retaining ring (9). Thread a bolt 1/2”-13UNC-2B in shaft retainer (10) and pull it out of pinion gear (12). Remove from retainer (10) O-ring (11). Thread a bolt 5/8”-11UNC-2B in the steering drive output shaft and pull it free of the steering drive as shown in Fig. 7F.2.
4. Remove the top sprocket mounting bolt and the top planetary carrier mounting bolt. Attach a hoist at these points as shown in Fig. 7F.3. Remove one of the sprocket drive cover mounting bolts and insert a brass drift in the hole as shown in Fig. 7F.3. The drift will support the cover when it is first freed from the main frame.
5. Remove the remaining final drive cover mounting bolts and free the cover from the main frame. Insert a pry bar as shown in Fig. 7F.3 to hold the cover up as it clears the drift. Pull the sprocket drive assembly away from the main frame. Remove the pry bar and let cover (19) swing down slowly. Remove the steering drive output shaft from gear (12).

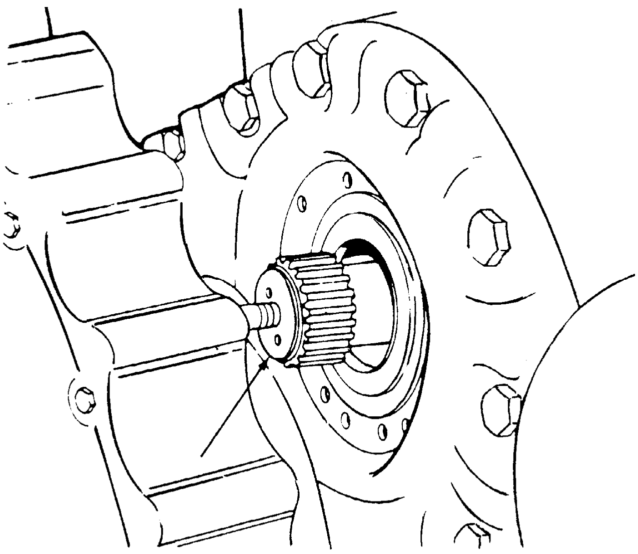


Fig. 7F.2. Pulling Output Shaft

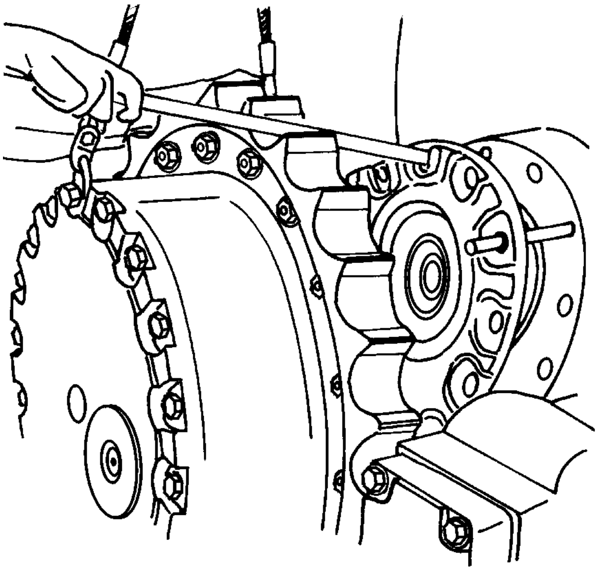


Fig. 7F.3. Removing the Final Drive

FINAL DRIVE ASSEMBLY

7. DISASSEMBLY (Refer to Fig.'s 7F.4 and 7F.4A)

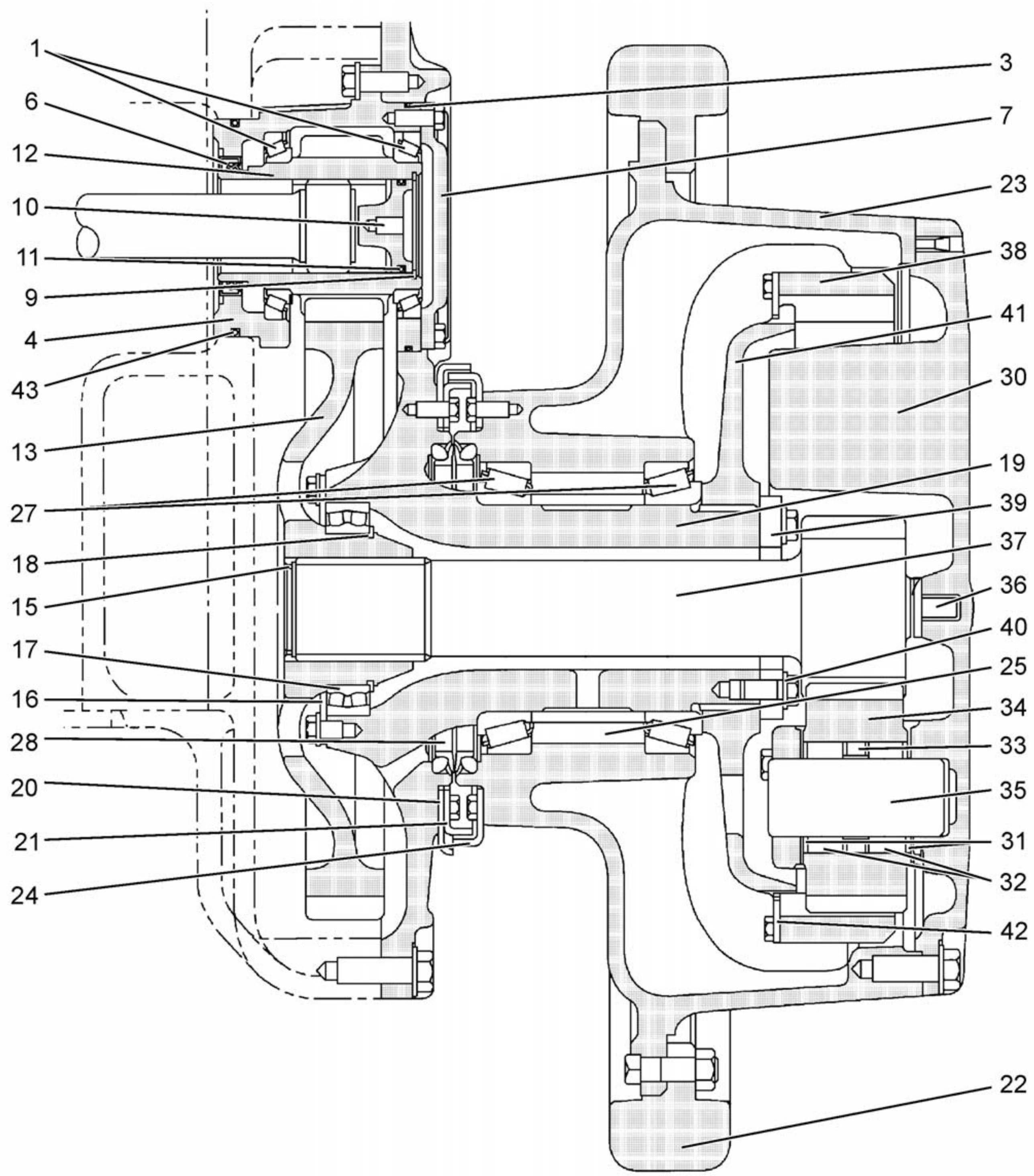


Fig. 7F.4. Cross Section View of Final Drive

FINAL DRIVE

FINAL DRIVE ASSEMBLY

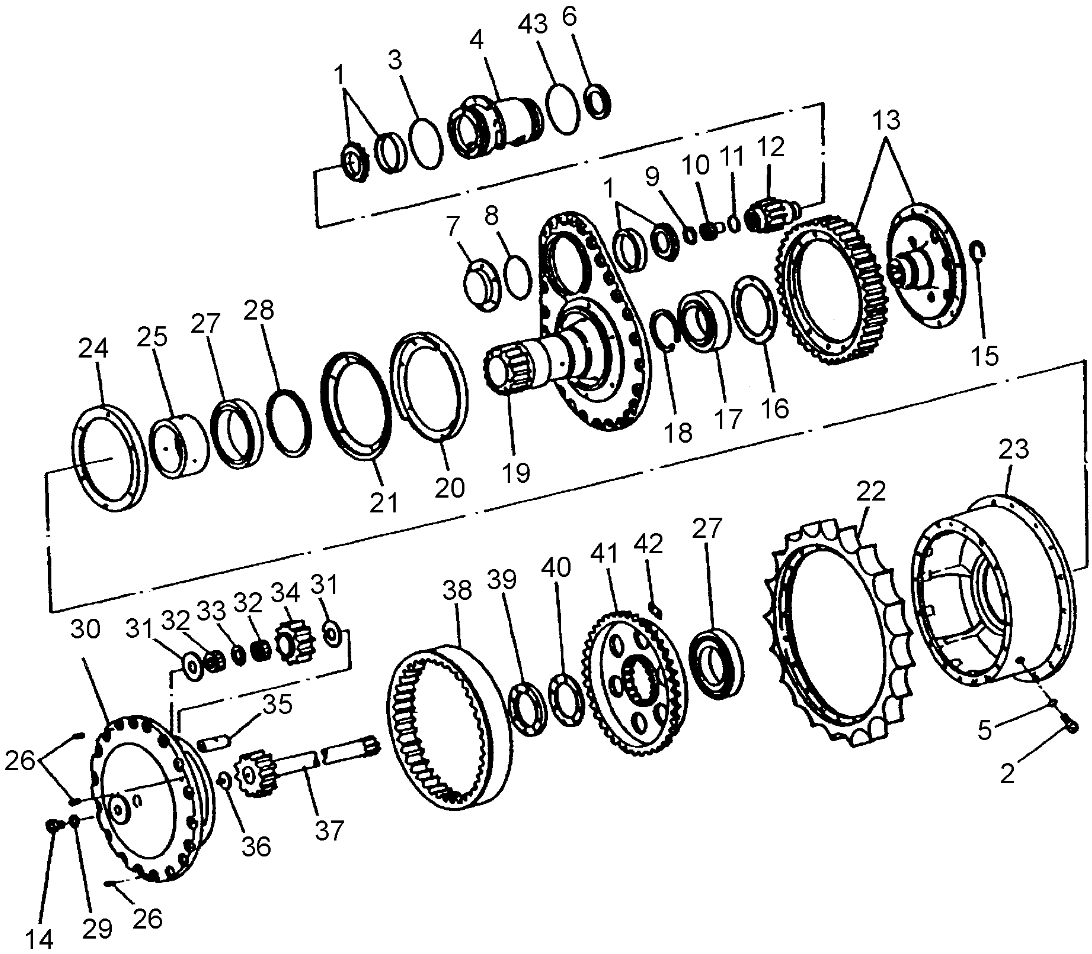


Fig. 7F.4A. Exploded View of Final Drive

1. Pinion Gear Bearing
2. Drain or Filler Plug
3. O-Ring
4. Pinion Gear Housing
5. Gasket
6. Pinion Gear Oil Seal
7. Pinion Gear Access Cover
8. O-Ring
9. Retaining Ring
10. Shaft Retainer
11. O-Ring
12. Pinion Gear
13. Bull Gear
14. Level and Filler Plug
15. Retainer Ring
16. Bearing Retainer
17. Bull Gear Bearing
18. Retaining Ring
19. Final Drive Cover
20. Oil Seal Shield
21. Oil Seal Shield
22. Drive Sprocket
23. Sprocket Hub
24. Oil Seal Shield
25. Bearing Spacer
26. Cork Plug
27. Tapered Bearing
28. Oil Seal
29. Gasket
30. Planetary Carrier Housing
31. Planetary Gear Thrust Washer
32. Roller Bearing
33. Planetary Gear Bearing Spacer
34. Planetary Gear
35. Planetary Gear Shaft
36. Thrust Button
37. Sun Gear Shaft
38. Planetary Ring Gear
39. Bearing Retainer Plate
40. Shim
41. Planet Ring Gear Hub
42. Ring Gear Retainer
43. O-Ring

1. Set the final drive assembly down on the housing (30) so that gear (13) is up.
2. Remove the bolts and washers securing retainer (16) to cover (19). Turn bull gear (13) as necessary, to reach all retainer mounting bolts through openings in hub (23).
3. Remove the bolts and washer securing housing (4) to cover (19). Attach a hoist to bull gear hub (Fig. 7F.5) and lift slowly until bull gear (13) contacts housing (4). Install jack screw in the holes provided in housing (4) and free the housing from cover (19). Remove the housing.

NOTE: *If disassembly of the pinion gear assembly is necessary, refer to PINION GEAR in this section.*

FINAL DRIVE ASSEMBLY

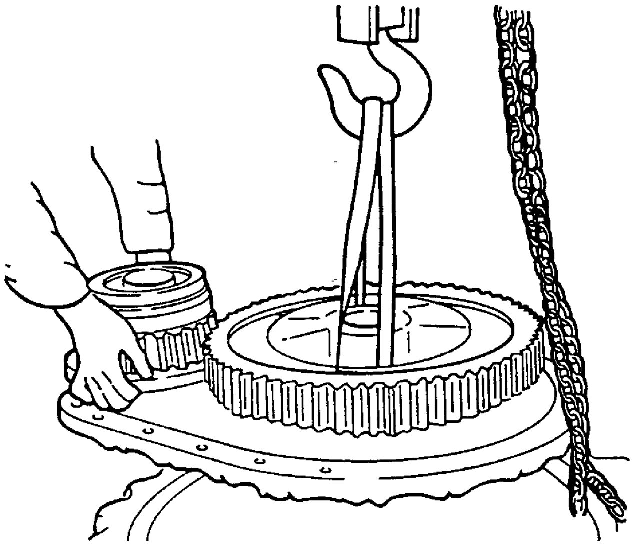


Fig. 7F.5. Pinion Gear Assembly

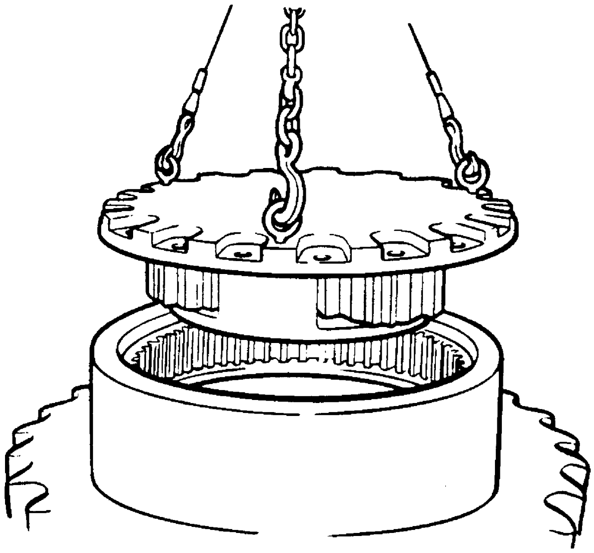


Fig. 7F.6. Planetary Carrier Housing

4. Lift the drive gear assembly (13, 15, 16, 17 and 18) from sun gear shaft (37). Remove retaining rings (15 and 18), bearing (17) and retainer (16) from bull gear (13).

NOTE: *It is impossible to remove bearing (17) without damaging it, if replacement is necessary.*

5. Turn assembly over as shown Fig. 7F.6 and support it on cover (19). Remove bolts securing housing (30) to hub (23). Remove protective corks from three puller holes and install puller bolts. Break the housing loose from the hub and remove the puller bolts. Install lifting eyes in puller holes, attach a hoist as shown in Fig. 7F.6 and remove housing.

NOTE: *If disassembly of the planetary is necessary, refer to PLANETARY CARRIER HOUSING in this Section.*

6. Install an eyebolt 3/4” 10 UNC - 2B in the end of shaft (37) and lift shaft straight up. Remove bearing retainer plate (39) and shims (40). Keep shims together for proper installation.
7. Using a puller and driver as shown in Fig. 7F.7, remove the ring gear assembly (38, 41, and 42) from cover (19). Heat ring gear hub assembly (41) to max. 260 [°C] with a torch if necessary. Separate ring gear (38) from hub (41) by removing retainer plates (42).
8. Install four eyebolts 90° apart in the hub (23) as shown in Fig. 7F.8 and attach a hoist to two opposite eyebolts. Install a bar in two remaining eyebolts and position a hydraulic ram under the bar. Use the ram to free bearing cone (27) from shaft of cover (19) and lift hub (23) off with hoist. If replacement is necessary, remove bearing cups (27), sprocket (22) and shield (24) from hub (23).
9. Remove the oil seal assembly (28). Half of the seal may be on hub (23) and the other half on carrier (19). Lift spacer (25) from the shaft of cover (19). Bearing cone (27) should not be removed from cover (19) unless replacement is necessary. Shields (20 and 21) need not be removed unless replacement or cleaning is necessary.

FINAL DRIVE ASSEMBLY

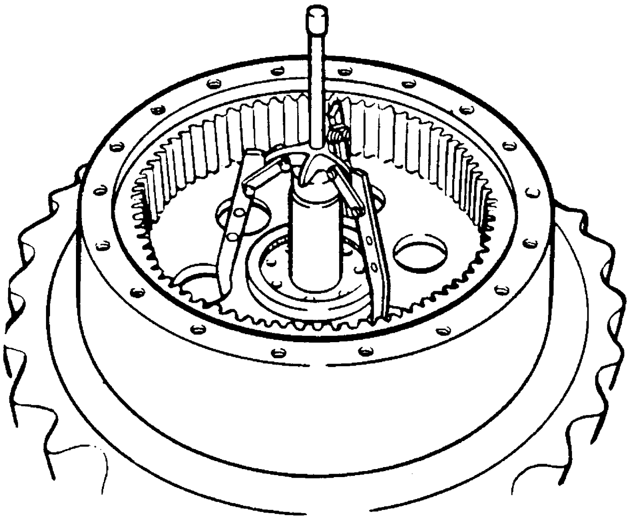


Fig. 7F.7. Ring Gear Removing

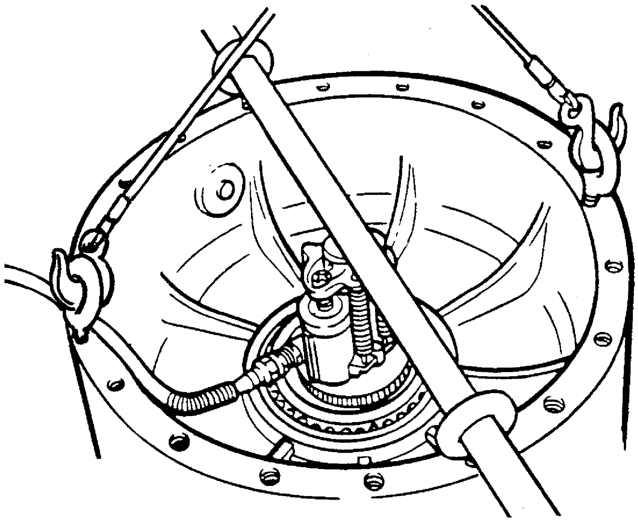


Fig. 7F.8. Sprocket Hub

8. INSPECTION AND REPAIR (Refer to Fig.'s 7F.4 and 7F.4A)

1. It is recommended that new O-rings and oil seals be installed whenever the final drive is disassembled for service.
2. Make a preliminary inspection of all parts before cleaning to detect discrepancies which may not show up once the parts are cleaned. Examine the oil for metal particles, dirt and other foreign material. Check for foreign material in the bearings which will cause excessive wear.
3. Wash all parts thoroughly in a suitable solvent and dry thoroughly with compressed air or a clean cloth.

NOTE: *Do not spin bearings with compressed air.*

4. Inspect bearings for scores, cracks and wear. Replace if necessary. Reusable bearings should be soaked in clean oil and wrapped with clean paper until ready for reassembly.
5. Using coarse paper, a file or a hand grinder, remove any corrosion or hardened foreign material that may exist on the seal bore surfaces of hub (23) and cover (19). Do this carefully to avoid changing the dimensions of the bore.
6. Thoroughly scrape the final drive mating surfaces clean. Be careful not to scratch these finished surfaces or sealing may become ineffective.
7. Inspect the ring gear, ring gear hub, sun gear and planetary gear teeth for damage or wear. Inspect the ring gear hub and sun gear splines for excessive wear or damage. Slight burrs can be smoothed down with a stone.
8. It is recommended that new oil seal (28) be installed whenever the final drive is disassembled. Refer to SEAL INSPECTION under METAL TYPE FACE SEALS in SECTION 14, SUSPENSION.

FINAL DRIVE ASSEMBLY

9. REASSEMBLY (Refer to Fig.'s 7F.4 and 7F.4A)

1. Support cover (19), shaft up. If the sprocket hub bearings were replaced, heat inner bearing cone (27) to 150 [°C] and install on cover until it is solid against shoulder with small diameter of taper up. To assure the cone is against shoulder, make a final press after the cone has reasonably cooled down. The outer bearing cone (27) will be installed later. Install spacer (25) on the shaft of cover (19).
2. Install the oil seal shields (20 and 21) on cover (19). Press the bearing cups (27) into hub (23), if removed. Install the oil seal shield (24) to the hub (23). Coat metal rings of oil seal (28) with a light film of oil and reinstall them on drive cover (19) and sprocket hub (23). Refer to SEAL INSTALLATION under METAL TYPE FACE SEALS in SECTION 14, SUSPENSION.
   If removed, install sprocket (22) on hub (23) and torque the nuts to 435 [Nm]. Install the plug (2) with gasket (5).
3. With the aid of a hoist, position sprocket hub assembly on cover (19) being sure bearing cup (27) seats properly on cone. Install ring gear (38) on hub (41) and secure with retainers (42) and bolts, if removed. Torque the bolts to 125 [Nm]. Heat ring gear hub assembly to max. 260 [°C]. Install bearing cone (27) on the shaft of cover (19) until it bottoms against the spacer. Install the heated ring gear hub assembly on shaft splines of cover (19) until it bottoms on bearing cone (27). Install retainer plate (39) and the same thickness of shims (40) which were removed and torque to 135 [Nm]. After parts cooled release torque and retorque to 245 [Nm].

NOTE: *If hub (41), bearings (27), hub (23) or spacer (25) were replaced, install retainer plate (39) without shims (40) only with plate 25 [mm] thickness.*

Torque four retainer bolts to 135 [Nm] torque while rotating hub (23) to assure proper seating of its bearings. Release torque, after parts have cooled then retorque four bolts equally spaced to 70 [Nm]. Then measure shim gap between plate (39) and end cover (19).

4. If hub (41), bearings (27), hub (23) or spacer (25) were replaced, check the end clearance of the bearing retainer plate as follows:

   Measure gap between retainer plate (39) and the end of shaft of cover (19). Subtract 0.075 to 0,1 [mm] from this gap and assemble a shim pack (40) of this size. The shim pack should never be the same or greater than gap measurement. Remove retainer plate (39) and plate 25 [mm], install the shims (40), and reinstall retainer (39). Torque the eight new bolts to 245 [Nm].
5. Install shaft (37) through the shaft of cover (19). Apply a coat of grease to button (36) and install in housing (30).

NOTE: *The plug (14) in planet carrier housing (30) must be placed at angle 90 [°] to the plug (2) in hub (23).*

6. Apply LOCTITE #120 to mating surface of hub (23). Attach a hoist to housing (30) as shown in Fig. 7F.6 and lower the housing on hub (23) being sure gears (34) mesh with sun gear and the ring gear. Secure housing (30) to hub (23) and torque the bolts to 610 [Nm]. Install protective corks (26) in puller holes.
7. Turn the sprocket drive over and set it on housing (30). Install retaining ring (15) into bull gear (13). Place bearing retainer (16) over the spindle on hub. Heat bearing (17) to 90 [°C] and install on the spindle of bull gear (13). Install retaining ring (18).
8. Attach a hoist to gear (13) as shown in Fig. 7F.5 and partly lower it onto shaft (37). Position pinion gear housing assembly (4) with new O-ring (3) on cover (19) and tap it down with a soft faced hammer. Lower gear and using a drift on the outer race of bearing (17), tap the bearing evenly in the bore of cover (19). Secure housing (4) to cover (19). Torque the bolts to 220 [Nm]. Through the holes in bull gear (13), insert the six bolts with washers securing retainer (16) to cover (19). Torque the bolts to 125 [Nm].

FINAL DRIVE ASSEMBLY

10. INSTALLATION (Refer to Fig.'s 7F.4 and 7F.4A)

1. Be sure the sealing surfaces of the final drive cover and the machine frame are clean of the old gasket and apply LOCTITE #120 to both mating surfaces.
2. Attach a hoist to the final drive as shown in Fig. 7F.3. Rotate cover (19) up into position and hold with a pry bar. Position the steering drive output shaft in gear (12). Move the final drive into position using the drift as a guide as shown in Fig. 7F.3. Remove the pry bar and push the sprocket drive in all the way. Install the sprocket mounting bolts and remove the drift. Torque the bolts to 735 [Nm].
3. Remove the hoist and install the bolts removed for attaching the hoist.
4. With a bolt installed in the end of the steering drive output shaft, slide the shaft in so it splines first with the sprocket drive pinion gear and then with the steering drive. Remove the bolt.

NOTE: *If the shaft will not spline with the steering drive, slightly rotate the sprocket.*

5. With a bolt threaded in shaft retainer (10), install the shaft retainer with new O-ring (11) in pinion gear (12). Remove the bolt and install retaining ring (9). Reinstall cover (7) with new O-ring (8).
6. Remove the blocking from under the rear frame and slowly lower the unit until the sprocket rests on the track chain. Remove the jack. Install the track chain, refer to SECTION 15.
7. Install the sprocket rock shields. Torque the bolts to 455 [Nm].
8. Be sure the drain plug in the sprocket hub and the frame are installed and tight. Fill the sprocket drive as described in the OPERATOR'S MANUAL.

PLANETARY CARRIER HOUSING

11. REMOVAL (Refer to Fig.'s 7F.4 and 7F.4A)

1. Remove final drive as described in REMOVAL, under FINAL DRIVE ASSEMBLY. Set the sprocket drive down with housing (30) up.
2. Remove the bolts securing housing (30) to hub (23). Remove protective corks (26) from the three puller holes and install puller bolts. Break the housing loose from the hub and remove the puller bolts. Install lifting eyes in puller holes, attach a hoist as shown in Fig. 7F.6 and remove housing. Remove thrust button (36) from housing (30).

12. DISASSEMBLY (Refer to Fig.'s 7F.4 and 7F.4A)

1. Place the assembly on a bench planet gear side up. Remove the bolt with washer securing gear shaft (35) in housing (30). Install an eye bolt in the end of the shaft and pull it out of the housing.
2. Slide the planetary gear (34), roller bearings (32), thrust washers (31) and spacer (33) from carrier housing (30). Disassemble the remaining two planet gear assemblies in the same manner.
3. Remove plug (14) and discard gasket (29).

PLANETARY CARRIER HOUSING

13. INSPECTION AND REPAIR

1. Make a preliminary inspection of all parts before cleaning to detect discrepancies which may not show up once the parts are cleaned. Examine the oil for metal particles, dirt and other foreign material. Check for foreign material in the bearings which will cause excessive wear.
2. Wash all parts thoroughly in a suitable solvent. Dry thoroughly with compressed air or a clean cloth.

NOTE: *Do not spin dry with compressed air.*

3. Inspect bearings for excessive wear or damage and replace if necessary. Reusable bearings should be soaked in clean oil and wrapped with clean paper until ready for reassembly.
4. Thoroughly scrape the final drive mating surfaces clean. Be careful not to scratch these finished surfaces or sealing may become ineffective.
5. Inspect the planet gear shaft and planet gear bore for wear and replace if necessary.

14. REASSEMBLY (Refer to Fig.'s 7F.4 and 7F.4A)

1. Slide the bearing spacer (33) and the roller bearings (32) one from each side, into the planet gear.
2. Assemble the thrust washers (31), tab side facing away from gear, on each side of the planet gear and slide assembly into carrier housing (30). Align the gear assembly with the shaft hole in carrier housing and install gear shaft (35). Remove the eye bolt.
3. Secure the shaft with the bolt and washer previously removed and torque to 220 [Nm]. Assemble the remaining two planet gear assemblies in the same manner.

15. INSTALLATION (Refer to Fig.'s 7F.4 and 7F.4A)

1. Apply a coat of grease to thrust button (36) and install in carrier housing (30). Attach a hoist to carrier housing (30) as shown in Fig. 7F.6 and lower the housing on hub (23) being sure planetary gears (34) mesh with the sun gear and the ring gear.
2. Secure housing (30) to hub (23) with hardware previously removed. Torque the bolts to 610 [Nm]. Install the protective corks (26) in puller holes. Install plug (14) with new gasket (29).
3. Install sprocket drive as described in INSTALLATION, under FINAL DRIVE ASSEMBLY in this Section.

PINION GEAR HOUSING

16. REMOVAL (Refer to Fig.'s 7F.4 and 7F.4A)

1. Remove the sprocket drive as described in REMOVAL under FINAL DRIVE ASSEMBLY in this Section. Set the sprocket drive down on carrier housing (30) so that bull gear (13) is up.
2. Remove the bolts and washers securing retainer (16) to cover (19). Turn bull gear (13) as necessary to reach all retainer mounting bolts through openings in bull gear (13). Remove the bolts and washers securing housing (4) to cover (19).

FINAL DRIVE

PINION GEAR HOUSING

3. Attach a hoist to bull gear (13) as shown in Fig. 7F.5 and lift slowly until gear contacts gear housing (4). Install jack screws in the holes provided in gear housing (4) and free the housing from cover (19). Remove the housing as shown in Fig. 7F.5.

17. DISASSEMBLY (Refer to Fig.'s 7F.4 and 7F.4A)

1. Place gear housing (4) in a press so that the mounting flange is down. Place a suitable driver on the end of pinion gear (12) and press the gear with bearings (1) out of gear housing (4).
2. The bearings (1) and cup need not be removed unless replacement is necessary. Remove oil seal (6) and O-ring (3 and 43) from gear housing (4).

18. INSPECTION AND REPAIR

1. It is recommended that new O-rings and oil seal be installed whenever the final drive is disassembled for service.
2. Make a preliminary inspection of all parts before cleaning to detect discrepancies which may not show up once the parts are cleaned. Examine the oil for metal particles, dirt and other foreign material. Check for foreign material in the bearings which will cause excessive wear.
3. Wash all parts thoroughly in a suitable solvent. Dry thoroughly with compressed air or a clean cloth.

NOTE: *Do not spin dry with compressed air.*

4. Inspect bearings for excessive wear or damage and replace if necessary. Reusable bearings should be soaked in clean oil and wrapped with clean paper until ready for reassembly.
5. Inspect the pinion splines and gear teeth for damage. Slight burrs can be smoothed down with a stone. If the pinion gear teeth are worn, the pinion and possibly the drive gear will have to be replaced.
6. Thoroughly scrape the sprocket drive mating surfaces clean. Be careful not to scratch these finished surfaces or sealing may become ineffective.

19. REASSEMBLY (Refer to Fig.'s 7F.4 and 7F.4A)

1. If bearings were replaced, heat bearing cones (1) to 150 [°C] and install on pinion gear (12) until they are solid against shoulder. To assure cones are against the shoulder, keep pressure against cones until they reasonably cool down.
2. Install the oil seal (6) and O-rings (3 and 43) on gear housing (4). Insert the pinion gear (12) into gear housing (4), being careful not to damage the oil seal, until cone (1) seats in cup.
3. Press remaining bearing cup (1) into gear housing (4) against the shoulder. The bearing cone must be flush with cover (7) mounting face. Use cover (7) and three bolts as a driver.
4. The preload of bearings can be checked by wrapping a string around the pinion gear teeth and using a spring scale. The rolling gear pull should not exceed 45 [N] rolling pull. The end play should not exceed 0.03 [mm].
5. If it is found that the rolling gear pull with spring scale exceeds maximum, an assembly error (cocking) of bearing cones and/or cups may have been made. The complete assembly should then be inspected for any misassembly of parts.

PINION GEAR HOUSING

20. INSTALLATION

1. Position housing (4) on cover (19) and tap it down with a soft faced hammer. Lower bull gear and using a drift on the outer race of bearing (17) tap the bearing evenly in the bore of cover (19). Secure gear housing (4) to cover (19) with the hardware previously removed. Torque the bolts to 220 [Nm].
2. Through the holes in bull gear (13), insert the six bolts and washer securing retainer (16) to cover (19). Torque the bolts to 125 [Nm].
3. Install the final drive as described in INSTALLATION, under FINAL DRIVE ASSEMBLY in this Section.

SECTION 8

ELECTRICAL

ELECTRICAL

CONTENTS

Page

GENERAL

1. SERVICE/SPECIAL TOOLS

DESCRIPTION	TOOL NUMBER
Volt/Ammeter	Locally purchased
Electronic Battery Tester	Locally purchased

2. DESCRIPTION

A 24 [V] negatively grounded electrical system is used, consisting of a tractor circuit and cab circuit.
Two 12 [V] batteries connected in series supply the 24 [V].
A master switch located on the positive side of the electrical circuit, is used to cut out the electrical power.
The lights are sealed boom type and are controlled by the light switches on the cab panel.
The circuits are protected by an automatic reset circuit breakers. In the event of a short circuit or ground, the circuit breaker will open before damage occurs and will continue to open and close until the trouble clears or is corrected. The circuit breaker will then return and stay in its normal closed position. As a guide for identifying the various electrical units and for tracing the electrical cables and connections, refer to the Wiring Diagram in this Section.

IMPORTANT: *Never disconnect the alternator, master switch or batteries while the alternator is in operation.*

Surfaces under all terminals must be clean, and good electrical connections must be established after assembly. All clips must grip cables tightly to prevent vibration and rapid cable wear.

CAUTION! When installing batteries, be sure to connect the ground cable to the negative (-) terminal.
Before working on any part of the electrical system turn the master switch in the "OFF" position and take key out to prevent accidental starting.

WIRING DIAGRAM

3. MACHINE ELECTRICAL SYSTEM (Fig. 8.1)

Electrical tractor system consists of starting circuit, charging circuit, fan circuit, drive train control circuit, equipment circuit, warning light circuit and accessories circuit.

a. Starting Circuit

The electric system master switch (49) located in the positive lead of batteries (32) must be in the “ON” position to complete the battery circuit for starting power. When the starting key is turned in the starting switch (58) to “START”, current flows from battery to starting switch by circuit breaker 10 [A] (66F, Fig. 8.A0) and the next to start-up lock switch (29, Fig.8.A1). If the drive train start-up lock lever is in its lower “LOCKED” position current flows by start-up lock switch (29) closed contacts to solenoid of engine starting magnetic switch (63, Fig. 8.A0). The cranking motor (10) solenoid is actuated by closed contacts of magnetic switch (63) and it draws the cranking motor spool in, engaging the drive gear for the starter and connecting the battery cable to motor for cranking. Both the magnetic switch and starter solenoid are spring tensioned to remain in the “disengaged” position. When the starting switch (58) is released, both units release their spools, breaking the circuit.

ELECTRICAL

WIRING DIAGRAM

IMPORTANT: *When the booster battery is used for engine startup, electric system master switch must be in the ON position. Alternator can be damaged when the engine startup takes place with the master switch in the OFF position.*

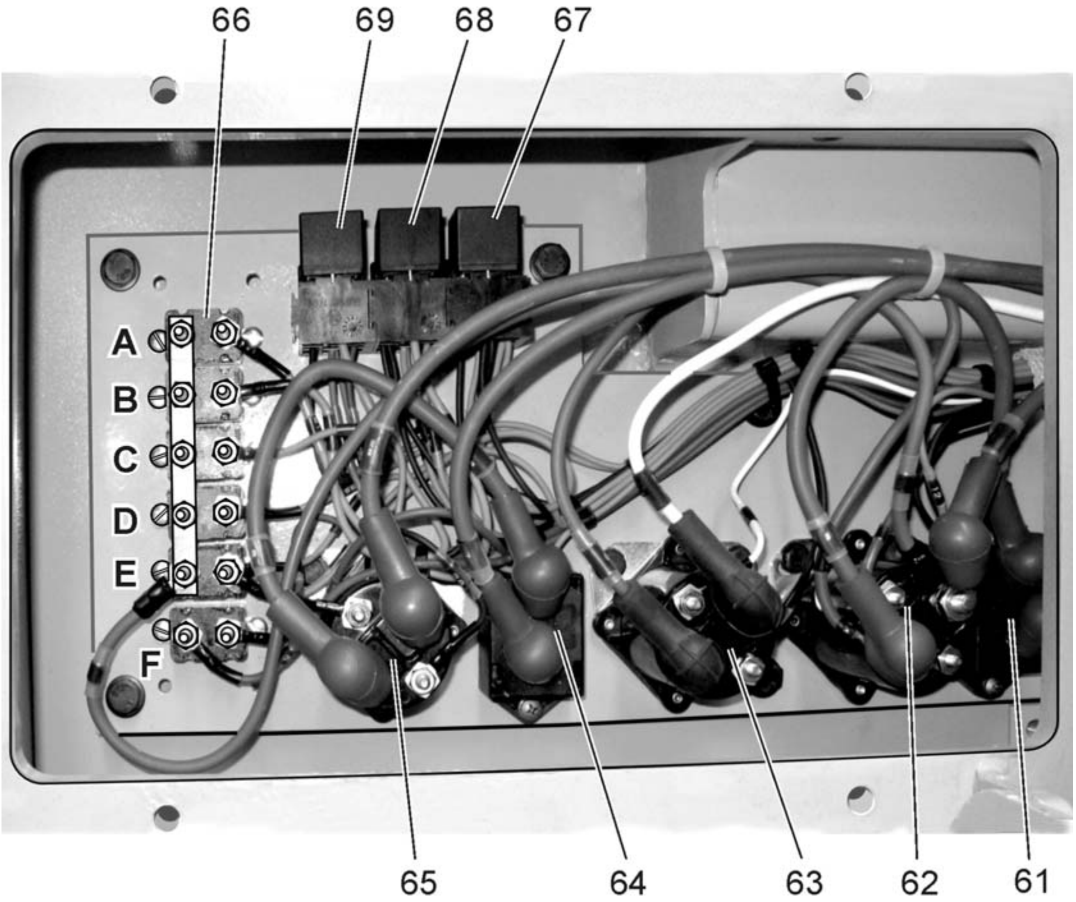


Fig. 8.A0. R.H. Fender Circuit Breakers Box

61. Main Circuit Breaker
62. Electric System Magnetic Switch
63. Engine Starting Magnetic Switch
64. Engine Intake Air Heater Circuit Breaker
65. Engine Intake Air Heater Magnetic Switch
66. Circuit Breakers
67. Drive Train Lock Lever Neutral Position Signal Relay
68. Cab Lamps Relay
69. Dozer Headlamps Relay

66A. Dozer Lamps Circuit Breaker
66B. Cab Lamps Circuit Breaker
66C. Drive Train Electronic Controller Circuit Breaker
66D. Drive Train Lock Solenoid Valve, Horn, Backup Alarm Circuits Breaker
66E. Blade Double Tilt/Pitch Solenoids, Portable Lamp Circuits Breaker
66F. Starting Switch Circuit Breaker

b. Charging Circuit

The charging circuit contains the alternator (6) and the batteries (32). Once the engine is running, the alternator output is used to supply the power demands as well as recharge the batteries. An integral regulator is located in alternator itself. The integral regulator senses the entire system draw and compensates by increasing or decreasing the voltage output.

WIRING DIAGRAM

c. Fan Circuit

Three temperature sensors supply engine electronic control module (ECM) with control signals, which, in turn, control fan pump solenoid (15).The fan speed will ramp up or down depending on the systems' temperature.

In a situation when the drive train oil temperature is below 92 [°C], the engine coolant temperature is below 85 [°C] and engine inlet air temperature is below 45 [°C] the fan is working at minimum speed below 680 [RPM] (at min engine [RPM]). At the same time the fan pump solenoid (15) is supplied from electronic control module ECM (20) by the max signal. When the temperature in drive train oil is raising the resistance of sensor (14) is decreasing and signal from ECM is dropping. The fan starts to work at higher speed. Engine air inlet temperature sensor and engine coolant temperature sensor (refer to Electrical Diagram at Troubleshooting and Repair Manual ISB, ISBe4, QSB4.5, QSB5.9, QSB6.7, ISC, QSC8.3, ISL, ISLe3 and QSL9 Engines, CM850 Electronic Control System, Bulletin 4021416) are connected to ECM (20) too. When air inlet temperature or cooling temperature rises the fan starts to work at higher speed too. The fan will work at max speed 1960 [RPM] (at max engine [RPM]) when drive train oil temperature reach 115 [°C] or engine inlet air temperature reach 61 [°C] or engine cooling temperature reach 95 [°C]. Authorized Cummins Engine Service is provided with a program for checking the signals sourced by the following sensors: both the engine intake air and coolant temperatures as well as the fan pump coil power supply signal.

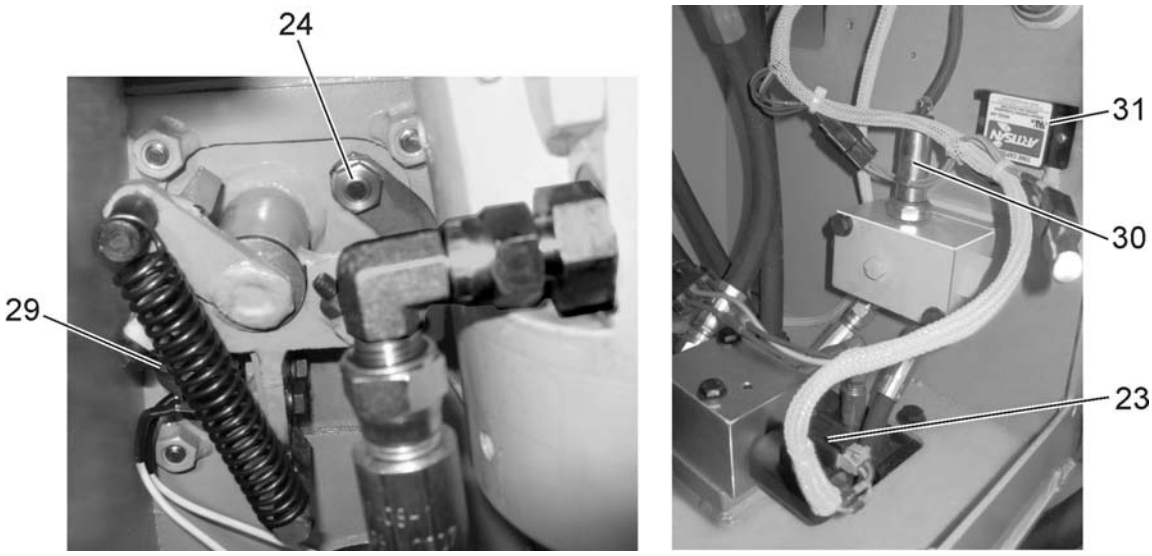


Fig. 8.A1 Drive Train Lock Circuit and Time Delay Module (Platform Inside, L.H. Side)

23. Drive Train Lock Solenoid Valve
24. Drive Train Lock Relay Proximity Switch
29. Start-Up Lock Switch
30. Low Transmission Main Pressure and Range Clutches Pressure Warning Light Switch
31. Time Delay Module

d. Drive Train Control Circuit

With the engine started, the machine remains stationary as drive train lock is actuated. The drive train lock lever shifted upwards (UNLOCKED) will cause drive train lock relay proximity switch (24, Fig. 8.A1) to activate, and, as a result, the drive train lock solenoid valve (23, Fig. 8.A1). Consequently, pressurized oil will enter the drive train control valve. The following features are available with the drive train control lever (25) which incorporates both the (UP, DN) buttons and HI/LO (LT, RT) switches.

ELECTRICAL

WIRING DIAGRAM

The drive train control lever (25) that is located at the operator's LH side is responsible for the following, among others:

1. Gears upshift and downshift. It makes shifting gear ranges possible for machine forward or rearward operations. To do it, press the UP or DN button. Once the UP button has been pressed, the gear will be upshifted that is 2nd or 3rd will be engaged. The DN button pressed will downshift the gears to a lower gear in a sequence. The first gear is a default gear after the engine start-up. The solenoid valves (106 and 107) will be deenergized at that point. The second gear will be engaged when the solenoid valve (107) is reenergized; while the third gear requires the solenoid valve (106) to get reenergized. The drive train electronic controller (26) is in charge of solenoid valves being reenergized or deenergized. The time duration the control button is depressed has no bearing on gear shifting.
2. The HI/LO (LT and RT) speed range switches make possible for machine speed range to be chosen (low or high). HI-LO range solenoid valves (104 and 105) will get reenergized thru the controller (26) when both speed range switches are shifted in HI position. Shifting both speed range switches in LO position will cause the both solenoid valves to revert to their neutral position (deenergized) with the resultant LO range to be activated.
3. The HI/LO(RT) speed range switch shifted to its upper (HI) position and the HI/LO(LT) switch in its lower (LO) position will make possible to do a gradual turn to the left. In that case the RT solenoid valve (104) thru controller (26) will get reenergized while the LT solenoid valve (105) will get deenergized. With the HI/LO(LT) speed range switch shifted to its upper (HI) position and the HI/LO(RT) switch in its lower (LO) position the right gradual turn will be made with the LT solenoid valve (105) reenergized and RT solenoid valve (104) deenergized. The machine will make a gradual turn so long as one of the speed range switches gets reactivated. Then the machine will revert to straight travel in a range it was engaged in prior to the gradual turn activation.
4. The travel direction will be hydraulically engaged with the lever shifted forward or rearward. At the same time one of pressure switches (34 or 35) will get energized with a signal being passed to the controller (26). If rearward will be engaged at the same time pressure switch (35) will powering the backup alarm (102).

The display (52) powered from the controller (26) will indicate both the gear and range engaged.

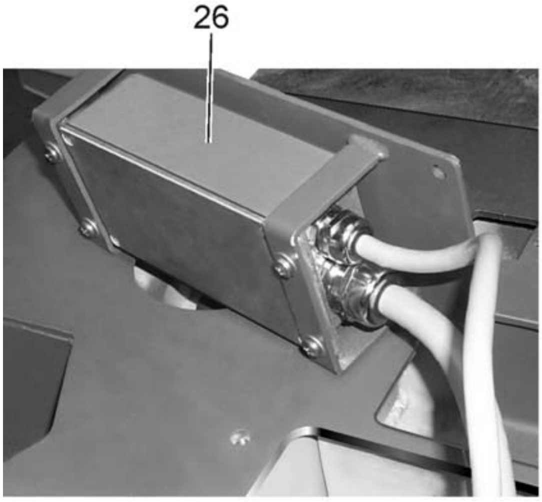


Fig. 8.A2 Drive Train Electronic Controller (under Left Armrest)

26. Drive Train Electronic Controller

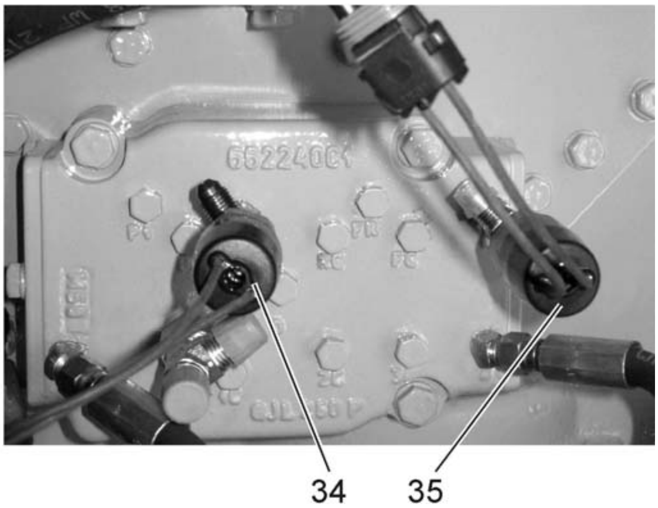


Fig. 8.A3. FWD & RWD Travel Pressure Switches on Transmission Selector Valve

34. Forward Travel Pressure Switch
35. Reverse Travel Pressure Switch

WIRING DIAGRAM

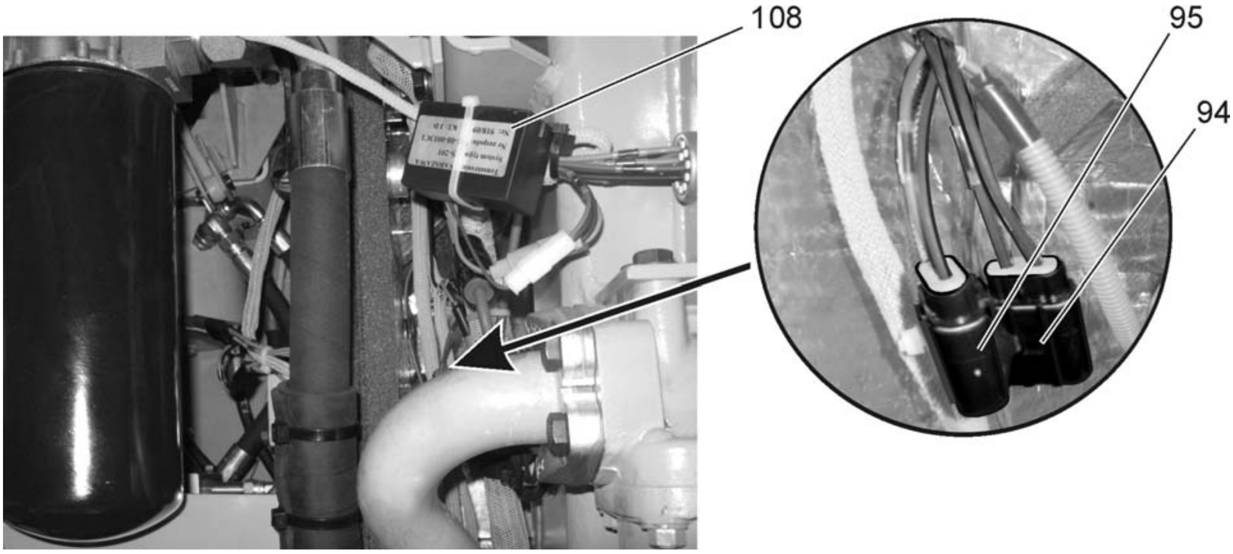


Fig. 8.A4. EPD and Fuses (Voltage Converter and Seat Suspension Circuits)

94. Fuse – 15 [A] – Voltage Converter Circuit
95. Fuse – 10 [A] – Operator's Seat Suspension System Power Supply
108. Over Current and Voltage Protection Device (EPD) for Drive Train Electronic Controller

e. Equipment Circuit

The machine is always equipped with blade floating position electromagnetic latch (70) located at the blade control valve. The electromagnetic latch is energized through magnetic switch (62, Fig. 8.A0) once the starting switch (58) is turned ON.
The machine can also be equipped with dozer equipment provided with a blade double tilt and pitch. In case a double tilt and pitch the blade control lever is provided with a buttons (71 and 72). If the button (72) is depressed this will cause the blade double tilt solenoid valve coil (7) to energize. If the button (71) is depressed this will cause the blade pitch solenoid valve coil (8) to energize. It is not possible to activate both blade tilt and pitch at the same time.

f. Warning Lamps Circuit

The warning lamps are activated through suitable switches, which are as follows: lamp (A) is activated through a switch (60 and/or 73 and/or 74), lamp (B) through a ECM (20) and relay (42, Fig. 8.A5), lamp (C) through a switch (30, Fig. 8.A1), lamp (D) through a switch (100), lamp (E) through a switch (12), lamp (F) through sensors (3) and a relay (39) (gives signal to ECM (20) and next through relay (38, Fig. 8.A5). At the same time as lamps (B and/ or F) come on, the alarm (46) will sound. The lamps are checked through the starting switch (58) and diodes assembly (44).

g. ECM Circuit

Engine and fan electronic control module (20) (ECM) is outlined in Troubleshooting and Repair Manual ISB, ISBe4, QSB4.5, QSB5.9, QSB6.7, ISC, QSC8.3, ISL, ISLe3 and QSL9 Engines, CM850 Electronic Control System, Bulletin 4021416).

h. Accessories Circuit

This circuit supplies power to the lights, fuel solenoid valve, ether start, instruments and any accessory items on the machine. Automatic reset circuit breakers (66, Fig.8.A0) are used to protect them.

ELECTRICAL

WIRING DIAGRAM

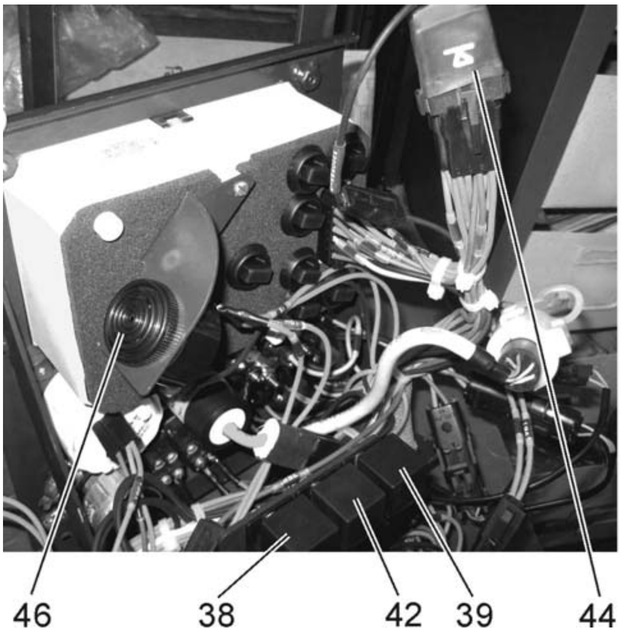


Fig. 8.A5. Instrument Panel
Rear Side

38. Low Coolant Level Warning Light Relay
39. Low Coolant Level Sensors Relay
42. Hourmeter and Low Engine Oil Pressure Warning Light Relay
44. Diode Assy
46. Low Engine Coolant Level or Low Engine Oil Pressure Alarm

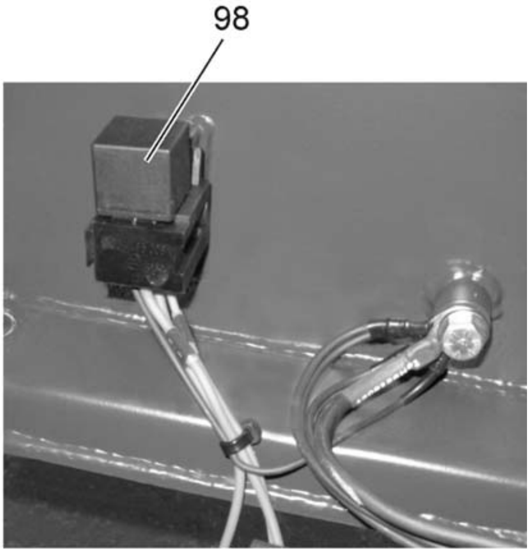


Fig. 8.A6. Condenser Fans Power Relay
(Cab Inside, L.H. Side)

98. Condenser Fans’ Power Relay

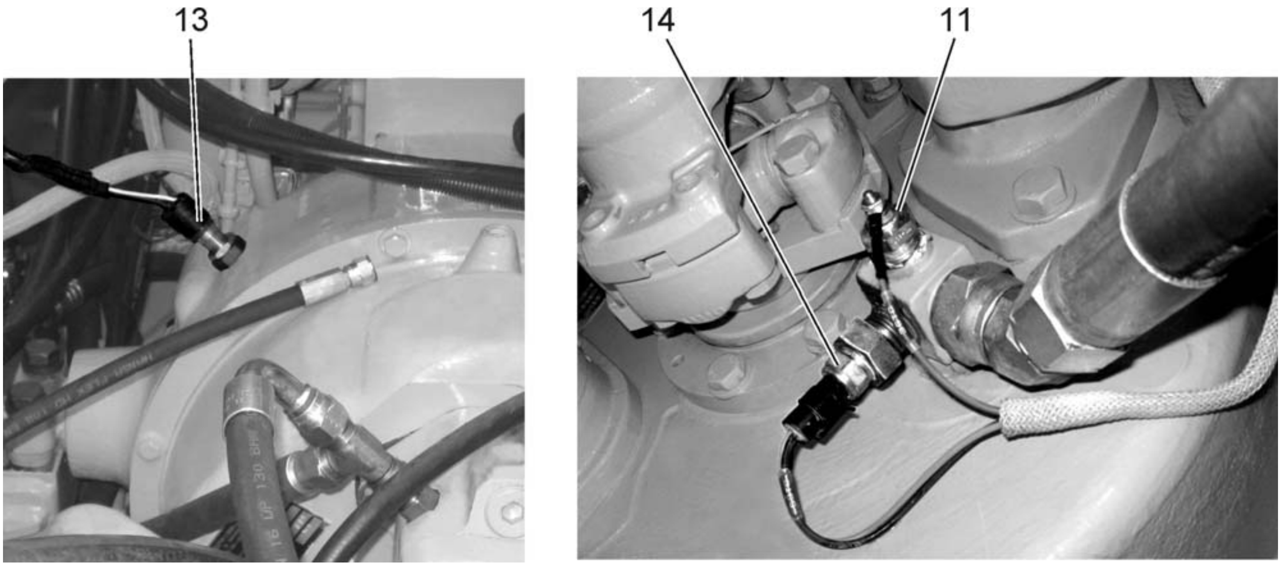


Fig. 8.A7. Torque Converter Oil Temperature Sensors

11. Drive Train System Oil Temperature Gauge Sensor
13. Engine RPM Sensor
14. Drive Train System Oil Temperature Sensor that Controls Fan RPM (ECM System)

WIRING DIAGRAM

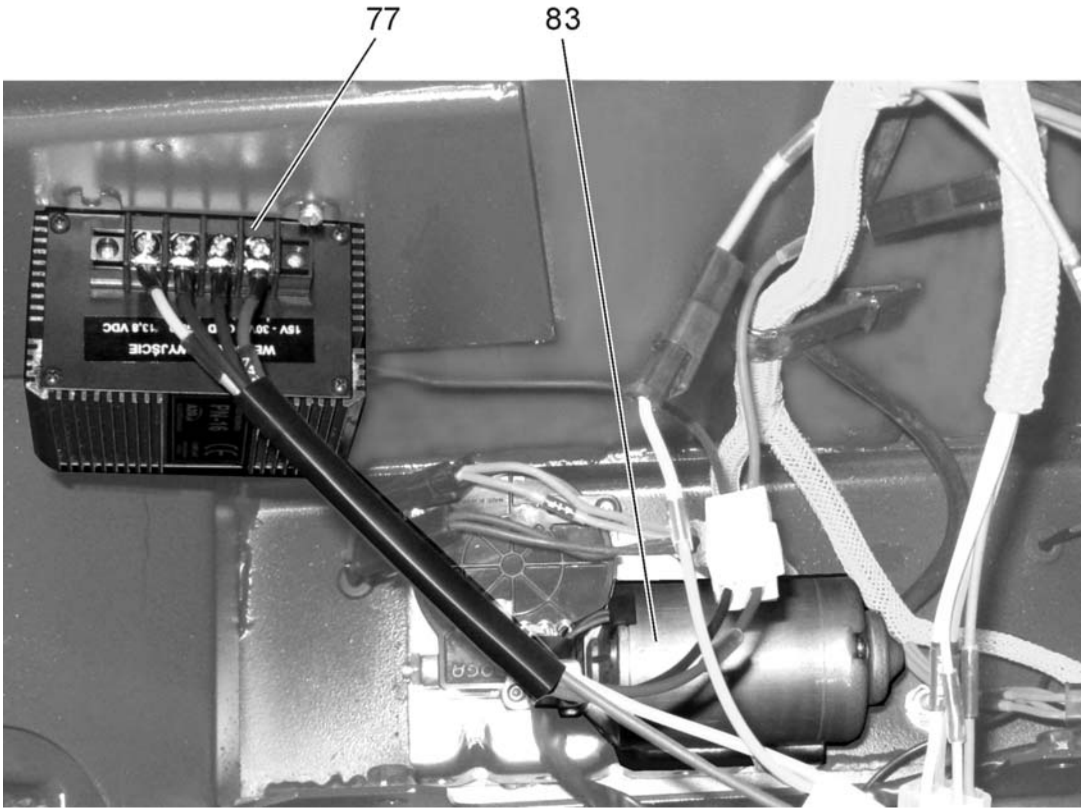


Fig. 8.A8. 24 [V] /12 [V] Voltage Converter and Front Wiper Motor
(Cab Inside Front up View)

77. 24 [V] /12 [V] Voltage Converter (Mounted on Cab Roof)
83. Front Wiper Motor

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WIRING DIAGRAM

Legend for machine wiring diagram (Fig. 8.1)

1. Front Dozer Headlamps at Blade Cylinders
2. Horn
3. Coolant Level Sensors
4. N/A
5. Coolant Temperature Sensor
6. Alternator
7. Blade Double Tilt Solenoid Valve
8. Blade Pitch Solenoid Valve
9. Receptacle 24 [V]
10. Cranking Motor
11. Drive Train Oil Temperature Gauge Sensor
12. Clogged Air Cleaner Warning Light Switch
13. Engine RPM Sensor
14. Drive System Oil Temperature Sensor that Controls Fan RPM
15. Fan Drive Pump Solenoid Valve
16. Engine Intake Air Heater
17. Fuse – 1 [A]
18. Fuses 30 [A] – ECM Power Supply
19. Air Conditioner Compressor Electromagnetic Clutch
20. Engine and Fan Electronic Control Module (ECM)
21. Fuse – 5 [A]
22. Engine Oil Pressure Sensor
23. Drive Train Lock Solenoid Valve
24. Drive Train Lock Relay Proximity Switch
25. Drive Train Control Lever
26. Drive Train Electronic Controller
27. Gear Presetting Mode Switch
28. Auto-downshift Mode Switch
29. Start-Up Lock Switch
30. Low Transmission Main Pressure and Range Clutches' Pressure Warning Light Switch
31. Time Delay Module
32. Batteries
33. Window Washers' Pumps
34. Forward Travel Pressure Switch
35. Reverse Travel Pressure Switch
36. Transmission Input Shaft RPM Sensor
37. Engine (ECM) Electronic Module Diagnostic Connector
38. Low Coolant Level Warning Light Relay
39. Low Coolant Level Sensors Relay
40. Resistor 20 [kΩ]
41. Resistor 560 [kΩ]
42. Hourmeter and Low Engine Oil Pressure Warning Light Relay
43. Gauge Cluster
44. Diode Assy
45. Engine RPM Control Potentiometer
46. Alarm (Low Engine Oil Pressure or Low Coolant Level)
47. Hourmeter
48. Fuel Level Gauge

WIRING DIAGRAM

49. Electric System Master Switch
50. Engine ECM Memory Activation Momentary Switch
51. Engine ECM Failure Code Display Momentary Switch
52. Gear and Range Display
    1 – First Gear
    2 – Second Gear
    3 – Third Gear
    H – High Range
    L – Low Range
53. WARNING LIGHT “STOP” (RED)
54. WARNING LIGHT “!” (YELLOW)
55. Engine Intake Air Preheating Signal Light
56. Cab Headlamps Switch
57. Machine Headlamps Switch
58. Starting Switch
59. Portable Lamp Receptacle
60. Fan Drive System Return Filter’s Clogging Warning Light Switch
61. Main Circuit Breaker
62. Electric System Magnetic Switch
63. Engine Starting Magnetic Switch
64. Engine Intake Air Heater Circuit Breaker
65. Engine Intake Air Heater Magnetic Switch
66. Circuit Breakers
67. Drive Train Lock Lever Neutral Position Signal Relay
68. Cab Lamps Relay
69. Dozer Headlamps Relay
70. Float Position Latch Electromagnet
71. Blade Pitch Solenoid Valve Button
72. Blade Double Tilt Solenoid Valve Button
73. Hydraulic Pilot System Filter Warning Light Switch
74. Hydraulic System Return Filter Warning Light Switch
75. Horn Pushbutton
76. RH Rear Lamp
77. 24 [V]/12 [V] Converter
78. Radio Antenna (option)
79. Radio (option)
80. RH Door Wiper
81. Defroster Fans (option)
82. Cab Front Lamps
83. Front Wiper
84. Dome Light
85. LH Door Wiper
86. Radio Speakers (option)
87. Cab Rear Lamps
88. Rear Wiper
89. Condenser Fans
90. Air Conditioner /Heater Blower Switch
91. Door Window Wiper Switch and Washer Button
92. Cab Window Wiper Switch and Washer Button
93. Cab Automatic Circuit Breakers
94. Fuse – 15 [A] – Voltage Converter Circuit
95. Fuse – 10 [A] - Operator’s Seat Suspension System Power Supply

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WIRING DIAGRAM

96. Heater Valve Control Potentiometer
97. Air Conditioner /Heater
98. Condenser Fans' Power Relay
99. Operator's Seat Suspension System Pump (option)
100. Drive Train Pressure Filters' Clogging Warning Light Switch
101. Fuel Level Sensor
102. Backup Alarm
103. LH Rear Lamp
104. HI/LO(RT) Solenoid Valve
105. HI/LO(LT) Solenoid Valve
106. Third Gear Solenoid Valve
107. Second Gear Solenoid Valve
108. Over Current and Voltage Protection Device (EPD)

Gauge cluster components:

A – Hydraulic and Fan Drive System Return Filter and Pilot Control System Filter Warning Light
B – Low Engine Oil Pressure Warning Light
C – Main and Speed Clutches Oil Pressure Warning Light
D – Drive Train Oil Filter Warning Light
E – Air Cleaner Vacuum Warning Light
F – Low Coolant Level Warning Light
H – Coolant Temperature Gauge
J – Drive Train System Oil Temperature Gauge
K – Engine Oil Pressure Gauge
L – Gauges' Illumination Lights
M – Voltmeter

Wire color code

Code	Color
R	Red
T	Amber
W	White
Y	Yellow
B	Black
BR	Brown
G	Gray
O	Orange
P	Pink
V	Violet
DB	Dark Blue
LB	Light Blue
DG	Dark Green
LG	Light Green
GR	Green

Wire cable marking:

W/LG – 38D wire color code /cable designation

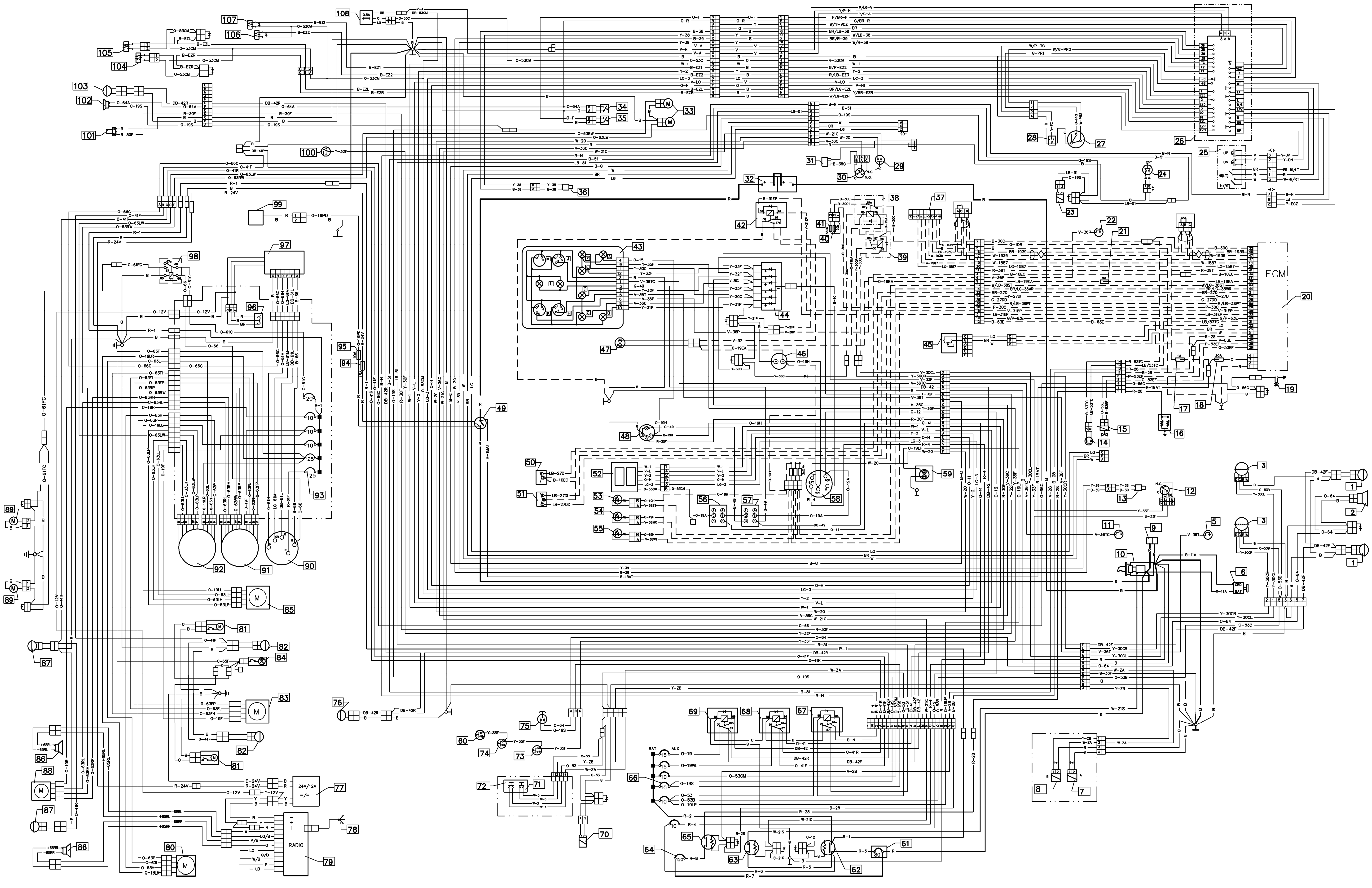

Fig. 8.1. Machine Wiring Diagram

3A. DRIVE TRAIN CONTROL SYSTEM

3A.1. DRIVE TRAIN CONTROL SYSTEM STRUCTURE

The system will incorporate the following components:

- drive train hydraulic control valve ;
- drive train system control lever that incorporates switches and buttons;
- solenoid valves: for gear shifting and steering drive range change (EZ2 and EZ3), (EZL and EZR), respectively;
- active gear and for range display (D) (two speed steering drive) ;
- (CMCV) drive train microprocessor controller (ST);
- the (WB) gear presetting mode switch;
- the (WO) auto downshift mode switch;
- magnetic sensors for engine RPM, torque converter output RPM and machine motion speed, if necessary, being (CS) and (CIW), respectively;
- motion direction pressure switches (WF and WR);
- over voltage & current protection module (EPD).

3A.2. DRIVE TRAIN CONTROL SYSTEM OPERATION PRINCIPLE

a. General

The drive control is done in two different ways. First, hydraulically, with a valve control lever of the drive control system that actuates suitable valves; the other being a combination of electrical and electronics with control lever imbedded buttons /rocker switches assisted with a microprocessor controller, sensors and switches and solenoid valves.
The motion direction is changed with a control lever shifted forward or rearward while this lever tilted sideways will steer the machine what is accomplished with selection and steering valves operation, respectively.
The microprocessor controller is responsible for the following: gear change, speed range change, gradual turns (different ranges being used for both tracks), auto downshift and gear presetting.

b. Description to signal diodes incorporated in the drive train electronic controller

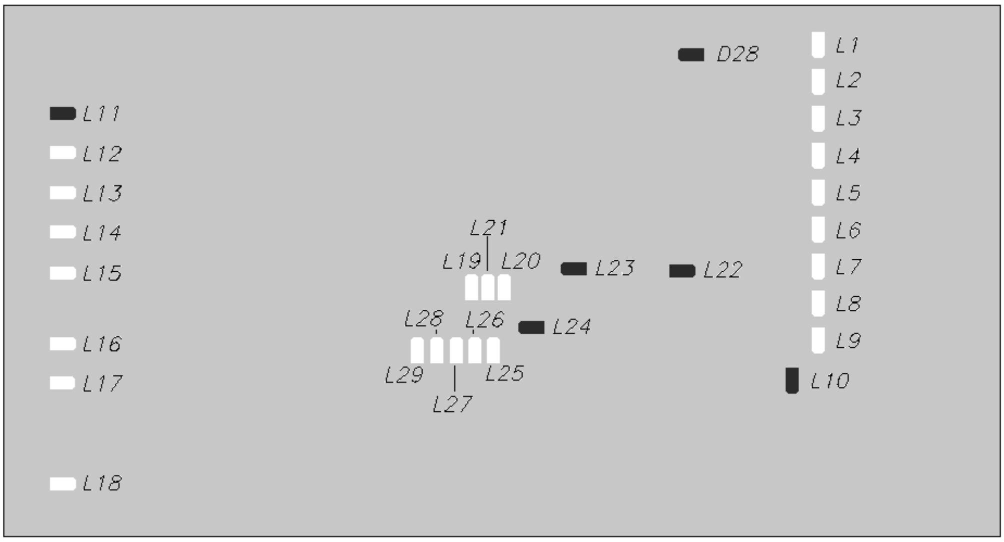

Fig. 8.1B. LEDs arrangement on the electronic controller

ELECTRICAL

WIRING DIAGRAM

Drive control system is provided with a LED array that presents the controller current operation status which facilitates the controller diagnosis. Below find LED function description whose labeling will be referred to later in this instruction.

- **D28** – service signal light that is used during the controller programming only;
- **L1** – ON, when the up shift button (*Up*) at the control lever is depressed;
- **L2** – ON, when the downshift button (*Dn*) at the control lever is depressed;
- **L3** – ON, when the drive train neutral lock lever is in locked position.
- **L4** – OFF, not used in SUREGRIP control lever;
- **L5** – OFF, not used in SUREGRIP control lever;
- **L6** – ON, when the LH switch is at the high range;
- **L7** – ON, when the RH switch is at the high range;
- **L8** – ON, when the machine moves forward – the WF forward motion sensor activated;
- **L9** – ON, when the machine moves reverse – the WR reverse motion pressure switch will get activated;
- **L10** – not used
- **L11** – not used
- **L12** – ON, when the solenoid valve *EZR* is activated which means;

the machine operates at the high range (*L 6, L7 L13* and *L14* are ON also)

or

the machine has been operated at the high range straight on (*L6*, *L7*, *L12*, *L13* and *L14* were ON*)* and with the LT left switch changed from the high to low range that is a gradual turn to the left (*L13*, *L14* and *L6* came OFF while both *L15* and *L7* are still ON) and if the drive train neutral lock lever is in unlocked position, (*L3* LED is OFF);

or

the machine has been operated at the low range straight on (*L15* was ON) and with the RT right switch changed from the low to high range that is a gradual turn to the left (*L7* ON) and if the if the drive train neutral lock lever is in unlocked position, (*L3* LED is OFF);

- **L13** – ON, when the solenoid valve *EZL* is activated which means;

the machine operates at the high range (*L 6, L7 L12* and *L14* are ON also)

or

the machine has been operated at the high range straight on (*L6*, *L7*, *L12*, *L13* and *L14* were ON*)* and with the RT right switch changed from the high to low range that is a gradual turn to the right (*L12*, *L14* and *L7* came OFF while both *L15 and L6* are still ON) and if the drive train neutral lock lever is in unlocked position, (*L3* LED is OFF);

or

the machine has been operated at the low range straight on (*L15* was ON) and with the left switch changed from the low to high range that is a gradual turn to the right (*L6* ON) and if the drive train neutral lock lever is in unlocked position, (*L3* LED is OFF);

- **L14** – ON, when the machine operates at the high range, *L15* must not be ON;
- **L15** – ON, when the machine operates at the low range, *L14* must not be ON;
- **L16** – ON, when the 3rd gear was engaged, *L17* and *L18* must not be ON;
- **L17** – ON, when the 2nd gear was engaged, *L16* and *L18* must not be ON;
- **L18** – ON, when the 1st gear was engaged, *L16* and *L17* must not be ON;
- **L19, L20, L21** – are used to learn the machine type code (different wiring). Refer to Table 8.1.

WIRING DIAGRAM

Table 8.1. Machine type code:

Machine Type	Deutsch connector pin voltage providing power to controller [V]			LED ON		
	A	H	V	**L20**	**L21**	**L19**
TD-15M EXTRA	0	0	0	NO	NO	NO
TD-20M EXTRA	24	0	0	YES	NO	NO
TD-25M EXTRA	24	24	0	YES	YES	NO
TD-40E EXTRA	24	24	24	YES	YES	YES

- **L22** – ON, when the controller is fed with a pulse train coming from the torque converter output CIW magnetic sensor; this pulse train is a must for correct operation of auto downshift;
- **L23** – ON, when the controller is fed with a pulse train coming from the engine CS magnetic sensor; this pulse train is a must for correct operation of auto downshift;
- **L24** – ON, when the machine type code wiring is faulty, being corrupted connection integrity, at least at one lead to Deutsch connector pins A, H, V providing power to the controller. Diodes *L19, L20* and *L21* dim will give a hint to which lead is at fault:
  - *L20* – dim diode means that lead connection to pin A of controller Deutsch connector is corrupted;
  - *L21* – dim diode means that lead connection to pin H of controller Deutsch connector is corrupted;
  - *L19* – dim diode means that lead connection to pin V of controller Deutsch connector is corrupted;
- **L25** – ON, when the auto downshift mode was activated – *WO* switch contacts shorted;
- **L26, L27** – not used;
- **L28** – ON, when „2/2” presetting mode II was activated;
- **L29** – ON, when „1/2” presetting mode I was activated;

3A.3. ELECTRONIC CONTROLLER OPERATION AFTER POWER UP

a. Power up with the control system operative

In order for the control system to operate correctly the following must be met:
- power ranging 18 [V] ≤ U ≤ 36 ± 0.5 [V]
- EPD protection “ON”
- the system is fed with a pulse train coming from RPM magnetic sensors
- correct machine type coding.

b. Electronic controller operation after power up and prior to starting the engine

After power up to the controller, letter “L” is to display immediately on the display RH position at the instrument panel with the machine equipped with a two speed steering drive, while the electronic controller based green diode **L15** for a low range will come ON. After ca. one second the controller processor is to end self test and to start the program execution. The LH position of two digit display or single digit display is to show “1” (for machines equipped with a single speed steering drive, while the electronic controller based green diode **L18** will come ON

The same will be true if the presetting mode switch is set in its “1/2” position (yellow diode **L29** ON). The same status will be if one of the range switches of the control lever is in the LO range and the other in HI. If two switches are set to HI range then “L” displayed will change to “H” after a second elapsed. Have in mind that the display will dim at a startup only.

WIRING DIAGRAM

After power up when the presetting mode switch is in “2/2” position (a yellow diode **L28** will come on) “2” gear will display and the solenoid valve *EZ2* will get activated. Then diode **L18** will blink (for a fraction of a second), then it will come off and a green diode **L17** will come on.

After power up with the drive train neutral lock lever in its lower locked (ON) position and the proximity switch is operative and adjusted correctly, the yellow diode **L3** will come on. After power up, depending on a machine type, the yellow diodes **L19**, **L20**, **L21** will come on brightly, (refer to Table 8.1), what witnesses to machine type correct code.

c. Controller operation after engine startup

After engine startup the red diodes **L22** and **L23** have to be ON what will signal that the controller has been fed with a pulse train from the magnetic sensors.

d. Power up with the control system inoperative

NOTE: *Bear in mind that if magnetic sensors for torque converter output RPM (CIW) or engine RPM (CS) are replaced then the drive control system may malfunction in case the sensors relative position has been disturbed.*

1. If at power up only “L” displays, check the following:
   a) Check the voltage coming from 10 [A] automatic circuit breaker (66C, Fig.8.1A) at EPD input terminals
   - If there is no voltage on EPD input terminals or the voltage is incorrect, the automatic breaker - or its wiring - is at fault.

   b) If the voltage coming from 10 [A] automatic circuit breaker on EPD input terminals is OK, it’s necessary to check the voltage on EPD output connectors without their disconnecting. If the voltage is OK the electronic controller (CMCV) - or its wiring - is damaged. If there is no voltage on EPD output connectors, it’s necessary to disconnect these connectors and measure the voltage on EPD output connectors once again. If the voltage is OK, the CMCV controller is damaged, but if there is no voltage at EPD output connectors - the EPD is damaged.

   Regardless of fault type mentioned above, machine “limp home” mode is always possible (1^{st} gear, low range).

NOTE: *For EPD to restore the controller power, cut the power to the drive control system, clear the short (overloading) cause or source of disturbance and then restore power to the drive control system; if with the power restored after a 7 second power down the “L” would display only that means the cause for EPD tripping has not been cleared.*

2. If at power up and gear up shift with high range the controller will downshift automatically with subsequent range reduction to “1L”, and symbols for gear and range will display, then voltage calls for recheck.
   a) At momentary power down to below 18 [V], the controller processor will reset and then restart. A 10 [A] automatic circuit breaker - and/or its wiring - which protects the entire drive control system, solenoid valves included, can be at fault.
   b) With the over voltage U > 36 [V], the alternator (alternator voltage regulator) which sets the outputted voltage level can be at fault.
3. If at power up all or a single yellow diode **L19**, **L20**, **L21** fails to come on at full brightness and the red diode **L24** will come on, this means that the machine type coding is at fault - at least one of the pins A, H, V (refer to Table 8.1) got corrupted.
4. If a single solenoid valve is at fault, take a voltage check at the solenoid valve coil’s terminals. DO NOT take a voltage to the machine ground.

WIRING DIAGRAM

3A.4. DRIVE TRAIN CONTROL SYSTEM OPERATION AT GEAR SHIFTING

The gear shifting system features several operation modes having different priorities.

a. Manual gear shifting mode

Manual gear shifting mode is provided with a least priority. It is sketched in Fig. 8.1C.

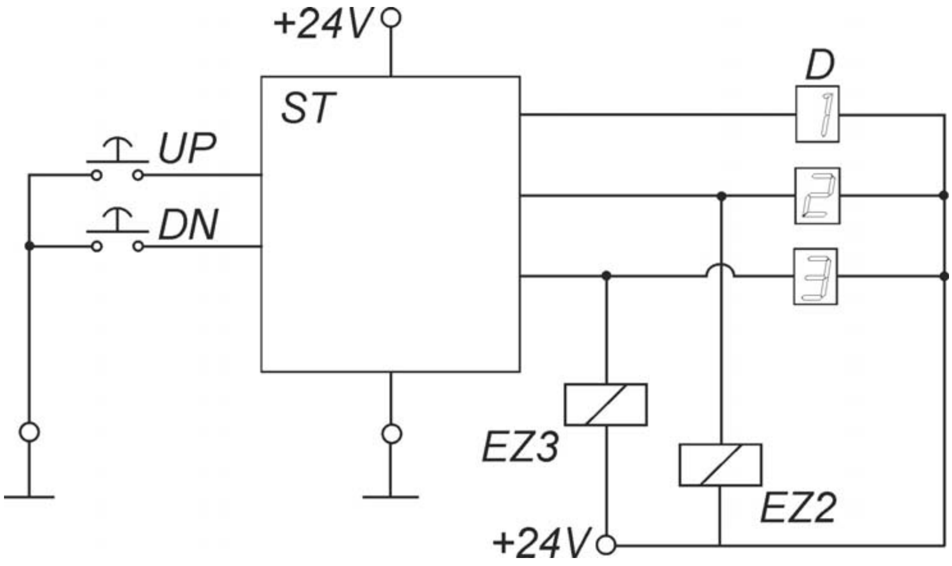

Fig. 8.1C. Manual gear shifting system schematic

UP – Up shift Button
DN – Down-shift Button
ST – Electronic Controller
D – Display
EZ2 – 2nd Gear Solenoid Valve
EZ3 – 3rd Gear Solenoid Valve

Set the gear change mode switch *WB* to the "deactivated" position and deactivate the auto downshift mode at the instrument panel to choose this mode of operation. Diodes **L29**, **L28** and **L25** are not to come on. The gear change can take place (as per controller algorithm) if at the power up the drive train neutral lock lever is in its locked position. There are two lever incorporated buttons for a gear change. Depress the *Up* button to up shift and a *Dn* button to downshift. Depress this button once for a gear to be changed; however if you keep depressing the button this will not change the controller status – if the operator wants a gear change that involves two gears, he is to depress the suitable button twice. Only one button can be depressed at a time; the controller will ignore any attempt to depress more buttons than one.

When the *Up* button is depressed it is accompanied with a yellow diode **L1** coming on; the same is true when the *Dn* button is depressed, then diode **L2** will come on. Depending on a current state, when the up shift takes place, the microprocessor controller is to behave as described below:

- when the actual gear was the first gear – the display will change from "1" to "2", diode **L18** will come off and **L17** will come on, the second gear solenoid valve *EZ2* will energize, while that for third gear *EZ3* will de-energize;
- when the actual gear was the second gear – the display will change from "2" to "3", diode **L17** will come off and **L16** will come on, the third gear solenoid valve *EZ3* will energize, while that for third gear *EZ2* will de-energize;

WIRING DIAGRAM

- when the actual gear was the third gear – the controller will do nothing, the display will continue to show "3", the third gear solenoid valve *EZ3* will energize while that for the second gear will not, the **L16** diode will come on, and **L17** and **L18** will come off.

Similarly for downshift, the controller is to behave as described below:

- when the actual gear was the third gear – the display will change from "3" to "2", diode **L16** will come off and **L17** will come on, the second gear solenoid valve *EZ2* will energize, while that for third gear *EZ3* will de-energize;
- when the actual gear was the second gear – the display will change from "2" to "1", diode **L17** will come off and **L18** will come on, the second and third gear solenoid valves *EZ2* and *EZ3,* respectively will de-energize;
- when the actual gear was the first gear – the controller will do nothing, the display will continue to show "1", the second and third gear solenoid valves *EZ2* and *EZ3*, respectively will de-energize, the **L18** diode will come on, and **L17** and **L16** will come off.

b. Auto downshift mode

Auto downshift mode is provided with a higher priority in the gear change system. *WO* switch (position „I" at the instrument panel) is used to activate this function; this is accompanied with a yellow diode **L25** coming on. Figure 8.1D sketches all components and their setup for this function to be operative.

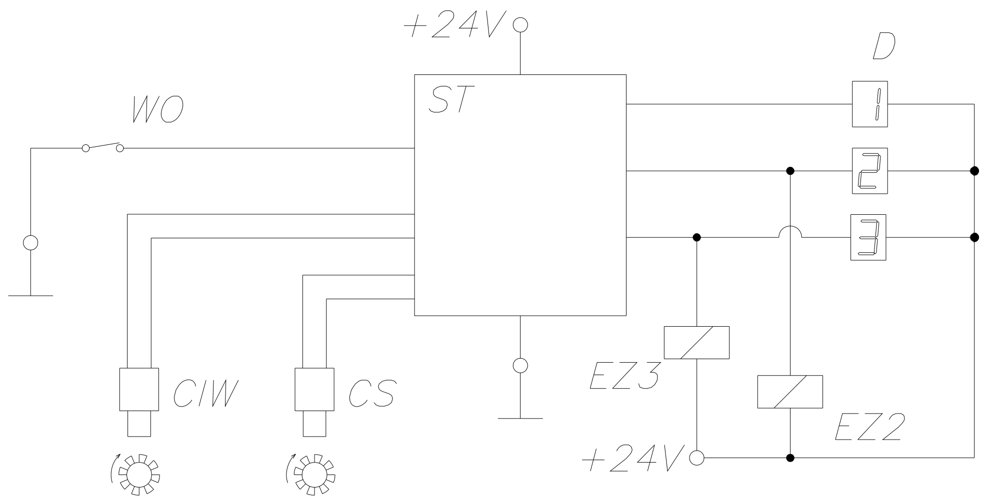

Fig. 8.1D. Auto Downshift Mode and Components Setup Schematic

WO – Auto Downshift Mode Switch
CIW – Torque Converter Output RPM Magnetic Switch
CS – Engine RPM Magnetic Switch
ST – Electronic Controller
D – Display
EZ2 – 2nd Gear Solenoid Valve
EZ3 – 3rd Gear Solenoid Valve

WIRING DIAGRAM

There are two extra magnetic switches beside the *WO* switch mentioned above in the auto downshift system.

- engine RPM (CS);
- torque converter output RPM (CIW)

Based on the pulse train coming from these sensors the microprocessor controller will compute the torque converter kinematics ratio. If the controller is fed with a pulse train from the *CS* sensor, the red diode **L23** is to come on. Similarly, if the pulse train from *CIW* sensor is fed, then **L22** will come on.

The controller will operate as described below depending on the torque converter kinematics ratio.

- if the ratio ranges from 0.75 to 1 – a manual gear change is possible with *Up* and *Dn* buttons as described above;
- if the ratio ranges from 0.40 to 0.75 - a manual downshift is possible with *Dn* button as described above; however the controller will not allow for up shift with *Up* button;
- if the ratio is less than 0.40, and the machine rides in say, the third gear, the controller will automatically downshift and after about 5 seconds will recheck the ratio. If the ratio is still below 0.40 (the machine is riding in the second gear), another downshift will take place, diodes will come on as per algorithm described for a manual downshift. Manual up shift will be deactivated unless the ratio is over 0.75, regardless of the gear engaged (excluding third gear).

It goes without saying that with the auto downshift mode disabled, the manual up shift is immediately activated, regardless of the ratio.

c. Presetting mode

Presetting mode is provided with the highest priority in a gear change system. Generally, presetting allows the machine motion at well predefined gears; gear can be defined regardless the machine motion forward or reverse. The controller ignores *Up* and *Dn* buttons in this gear change mode. The auto downshift mode is not operational either, regardless the *WO* switch position. Machines are provided with two presetting modes which can be chosen with a gear mode change switch (presetting) *WB* that can be found at the instrument panel.

1/2 Presetting mode

In this mode the *WB* switch is set to *1/2* position which in turn, will cause a yellow diode **L29** to come on. The machine will move forward in the first gear (green diode **L18** will come on, **L17** and **L16** will come off, while solenoid valves *EZ2* and *EZ3* will get deactivated), and in the second gear reverse (diode **L17** will come on, **L18** and **L16** will come off, *EZ2* activated, *EZ3* deactivated). The display will show the active gear, while the motion direction will be signaled with a suitable diode. There are two pressure switches in the drive control system that will provide information to the microprocessor controller on the machine motion direction. *WF* – which will shot the controller to the machine ground in case the machine would move forward; its operation will cause the yellow diode **L8** to come on, as well as *WR* - which will shot the controller to the machine ground in case the machine would move reverse; its operation will cause the yellow diode **L9** to come on. When the machine is stopped both sensors will not provide any signal to the controller and diodes **L8** and **L9** will be off. Fig. 8.1E. provides a control system schematic in this operation mode.

ELECTRICAL

WIRING DIAGRAM

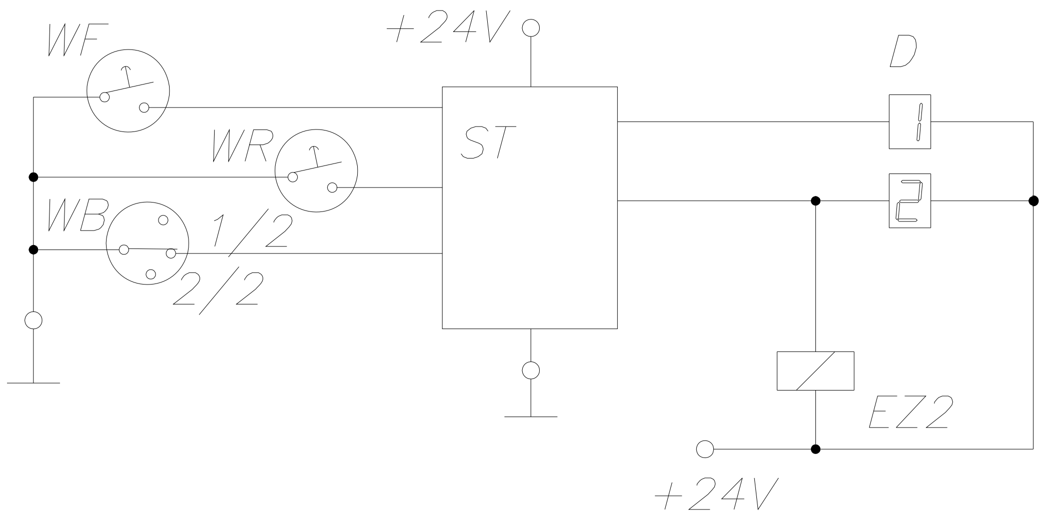

Fig. 8.1E. Control System Schematic for 1/2 Presetting Mode

WF – Machine Forward Pressure Switch
WR – Machine Reverse Pressure Switch
WB – Gear Presetting Mode Switch
ST – Electronic Controller
D – Display
EZ2 – 2nd Gear Solenoid Valve

2/2 Presetting mode

In this mode the *WB* switch is set to *2/2* position which in turn, will cause a yellow diode **L28** to come on. Machine will move forward and reverse in the second gear. The actual gear is displayed. The second gear solenoid valve *EZ2* is activated, while *EZ3* is deactivated, diode **L17** will come on, while **L16** and **L18** will come off. Fig. 8.1F. provides a drive control system schematic in this operation mode.

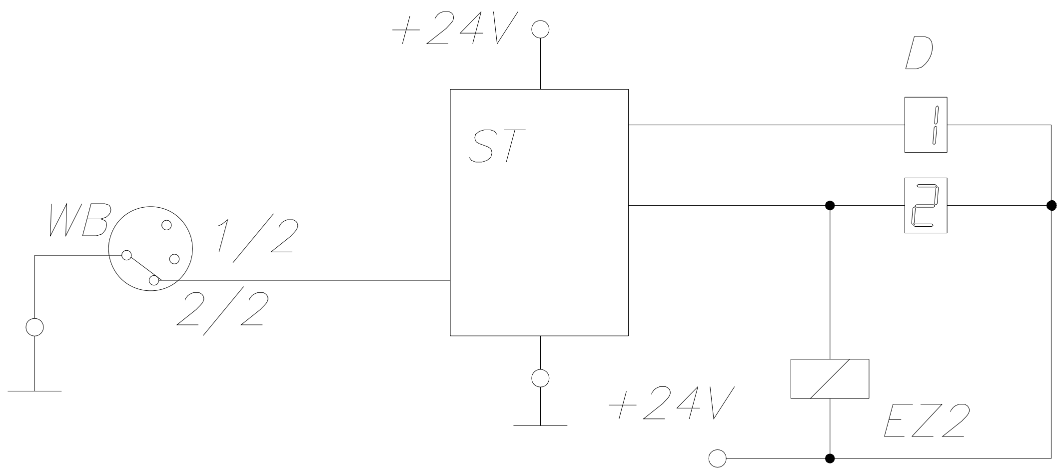

Fig. 8.1F. Control System Schematic for 2/2 Presetting Mode

WB – Gear Presetting Mode Switch
ST – Electronic Controller
D – Display
EZ2 – 2nd Gear Solenoid Valve

WIRING DIAGRAM

3A.5. DRIVE TRAIN CONTROL SYSTEM OPERATION AT SPEED RANGE CHANGE

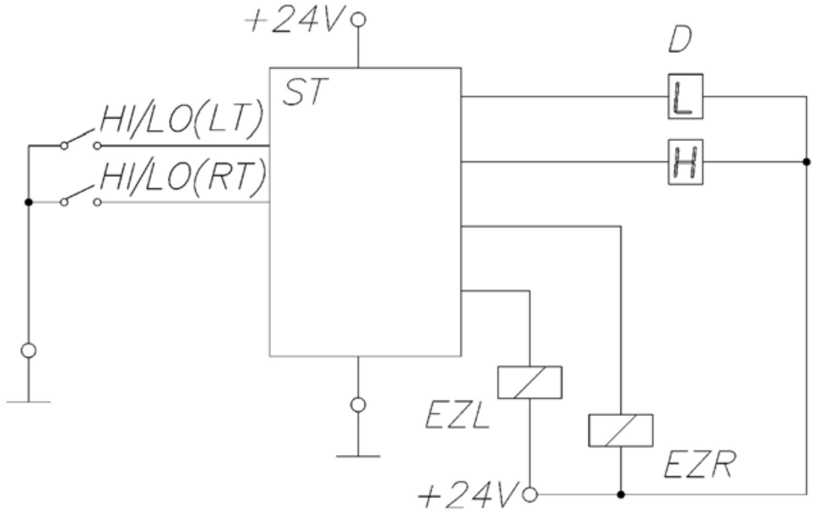

Fig. 8.2. Speed Range and Gradual Turn Control Schematic

HI/LO(LT) – Left Track Speed Range Rocker Switch
HI/LO(RT) – Right Track Speed Range Rocker Switch
ST – Electronic Controller
D – Display
EZR – Solenoid Valve for Right Track Steering Drive Range Change
EZR – Solenoid Valve for Left Track Steering Drive Range Change

This lever features two rocker type switches.
The high range is active when the both switches are in positions of high speed range. The microprocessor controller will activate the *EZL* and *EZR* solenoid valves what will be signaled with green diodes **L13** and **L12** which will come on, respectively. The display RH position is to show "H", diode **L14** is to come on, while **L15** is to remain off. The low range is active when both switches are in positions of low speed range. The microprocessor controller will deactivate the *EZL* and *EZR* solenoid valves what will be acknowledge with green diodes **L13** and **L12** which will come off. The display RH position is to show "L", diode **L15** will come on, while **L14** will come off. When the rocker switches are in different positions, machine will make a gradual turn, the description of which will follow later in the text.

3A.6. DRIVE TRAIN CONTROL SYSTEM OPERATION WHILE MAKING GRADUAL TURNS

The following description refers to Fig. 8.2.
The machine will turn if one of the rocker switches is set to high speed range and the other – in low speed range. During gradual turn the display RH position will show "L" and diode **L15** will come on, while **L14** will come off.

If *HI/LO(LT)* switch is set to high speed range which, in turn, will cause a yellow diode **L6**, to come on, and *HI/LO(RT)* switch is set to low speed range (diode **L7** will come off), then the microprocessor controller will activate the *EZL* solenoid valve – a diode **L13** will come on. The *EZR* solenoid valve will remain deactivated – the **L12** diode will come off. The result will be machine right gradual turn.

Similarly, if *HI/LO(RT)* switch is set to high speed range which, in turn, will cause a yellow diode **L7**, to come on, and *HI/LO(LT)* switch is set to low speed range (diode **L6** will come off), then the microprocessor controller will activate the *EZR* solenoid valve – a diode **L12** will come on. The *EZL* solenoid valve will remain deactivated – the **L13** diode will come off. The result will be machine left gradual turn.

ELECTRICAL

WIRING DIAGRAM

4. SERVICE DIAGNOSIS

When performing any service diagnosis on the electrical system, refer to the wiring diagram to identify the various electrical components and for tracing the wiring of the problem circuit.
Before performing tests, check the following;

a. Battery terminals are clean and tight.

b. All component connections and grounding connections are clean and tight.

c. The master switch is “ON” unless using a tester with its own power supply such as ohmmeter which must never be connected to battery voltage.

d. That the key start switch is in the proper position when checking a circuit that receives its power through this switch. Refer to the wiring diagram.

WARNING! Avoid accidental engine starting. Tag the cab panel to alert other personnel that work is being performed on the machine with the master switch in position “ON”.

COMPLAINT	
PROBABLE CAUSE	REMEDY
Engine will not Crank or Crank Slowly	
1. Weak batteries	Check the condition of each battery. Refer to ”Testing and Maintenance the Battery” in this Section
2. Dirty or loose power cable connections	Clean all connections and tighten
3. Defective starting switch, 10[A] circuit breaker, neutral safety switch, magnetic starting switch, cranking motor solenoid switch, cranking motor, master switch	By process of elimination, check for voltage using a voltmeter or check lamp, beginning at the power source and step by step until problem is found. Refer to Starting Circuit in Paragraph 2 in this Section
Transmission Control Malfunction	
1. Electrical problem in direction, range or drive disconnect circuit	Refer to Drive Train Control Circuit in Paragraph 3 in this Section
2. Hydraulic or mechanical problem in transmission or valves	Refer to “SERVICE DIAGNOSIS” in SECTION 7 “DRIVE TRAIN” and to SECTION 7C “TRANSMISSION”
Cooling Systems Fan Control Malfunction	
1. Electrical problem in automatic fan control circuit	Refer to Fan Circuit in Paragraph 3 in this Section
2. Problem in fan drive system	Refer to “SERVICE DIAGNOSIS” in SECTION 10 “HYDRAULIC”
Machine Doesn’t Move	
1. Problem in drive train lock solenoid valve electrical circuit	Check drive train lock relay proximity switch (24), neutral position relay (67) and solenoid valve (23) for malfunction. Refer to Wiring Diagram in this Section.
Machine Moves in “Limp Home” Mode Only	
1. Problem in drive train electronic controller electrical circuit	Refer to CONTROLLER OPERATION AFTER POWER UP, Paragraph 3A in this Section.

NOTE: *For location of electrical switches on the machine refer to MACHINE ELECTRICAL SYSTEM in this Section.*

ALTERNATOR

5. SPECIFICATIONS

Manufacturer type . . . . Delco Remy 20SI 24 [V] / 50 [A]
Adjusted voltage at external temp. 26 [°C] . . . . 27.4 ± 0.4 [V]
Adjusted load parallel to the battery . . . . 2 [kW]
Permissible voltage spread at 10 [A] and 2000 [RPM] . . . . 27.4 ± 0.4 [V]
Permissible voltage change at 5000 [RPM] and load (5 - 95 [%]) max of current . . . . -0.8 [V]
Current [A] at [RPM] . . . . 12/2000 [A] / [RPM]
26/3000 [A] / [RPM]
35/4000 [A] / [RPM]
41/5000 [A] / [RPM]
50/6000 [A] / [RPM]

Voltage setting at 10 [A] and 5000 [RPM] . . . . 27.4 ± 0.6 [V]

Bolts torques values:

M8x1.25 SAE Grade 5 . . . . 29 [Nm]
M8x1.25 SAE Grade 8 . . . . 37 [Nm]
M10x1.5 SAE Grade 5 . . . . 57 [Nm]
M10x1.5 SAE Grade 8 . . . . 72 [Nm]

6. INTRODUCTION

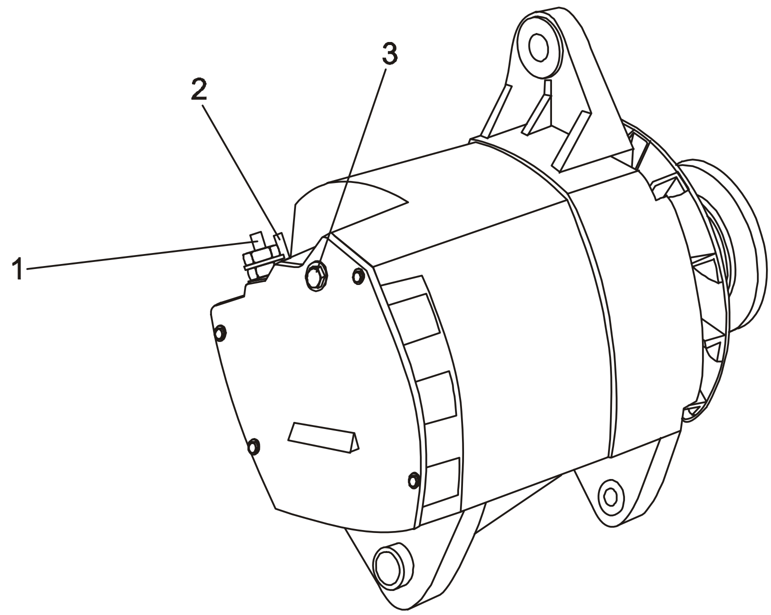

Fig. 8.3. View of Alternator
1. Pos. or Output Terminal
2. Relay Terminal
3. Ground Screw

ELECTRICAL

ALTERNATOR

The Integral Charging System shown in Fig. 8.4 is a brushless unit featuring a built-in voltage regulator. The only movable part in the assembly is the rotor, which is mounted on a ball bearing at the drive and a roller bearing at the rectifier end. All current-carrying conductors are stationary. These conductors are the field winding, the stator windings, the six rectifying diodes, and the regulator circuit components. A fan located on the drive end provides airflow for cooling. The bearings are sealed so no periodic lubrication is required.
Only one wire is needed to connect the Integral Charging System to the battery, along with an adequate ground return. An "R" terminal is provided for use in some circuits to operate auxiliary equipment.

7. OPERATING PRINCIPLES

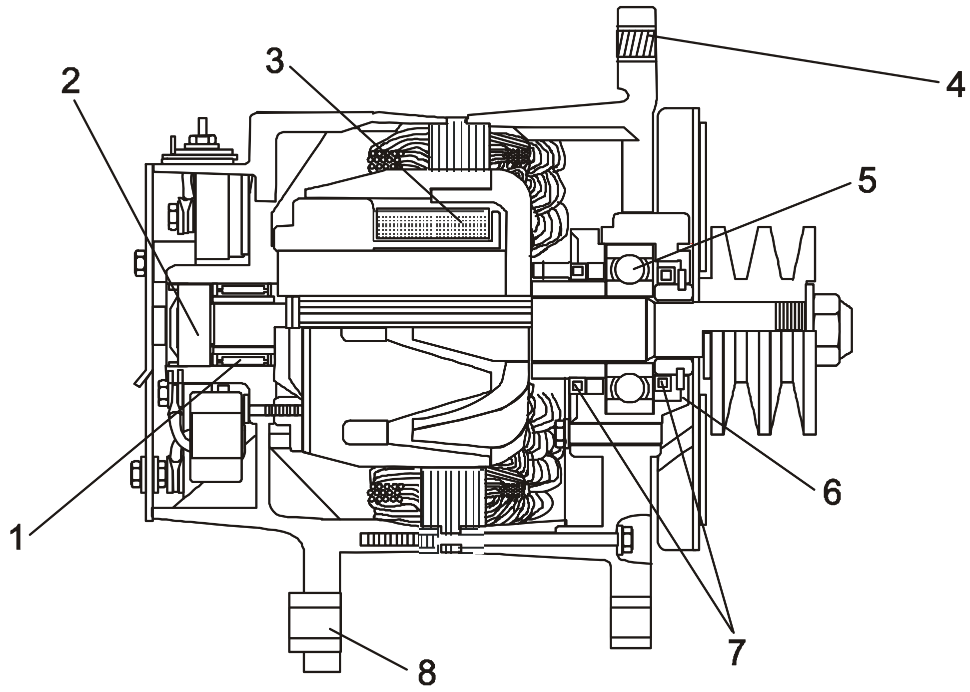

Fig. 8.4. Cross Sectional View Integral Charging System

1. Heavy - Duty Roller Bearing with Lip Seal
2. Grease Reservoir
3. Stationary Field Coil (Brushless Construction)
4. Steel Thread Insert
5. Double Sealed Heavy - Duty Ball Bearing
6. Labyrinth Seal
7. Felt Seals
8. Adjustable Steel Bushing

ALTERNATOR

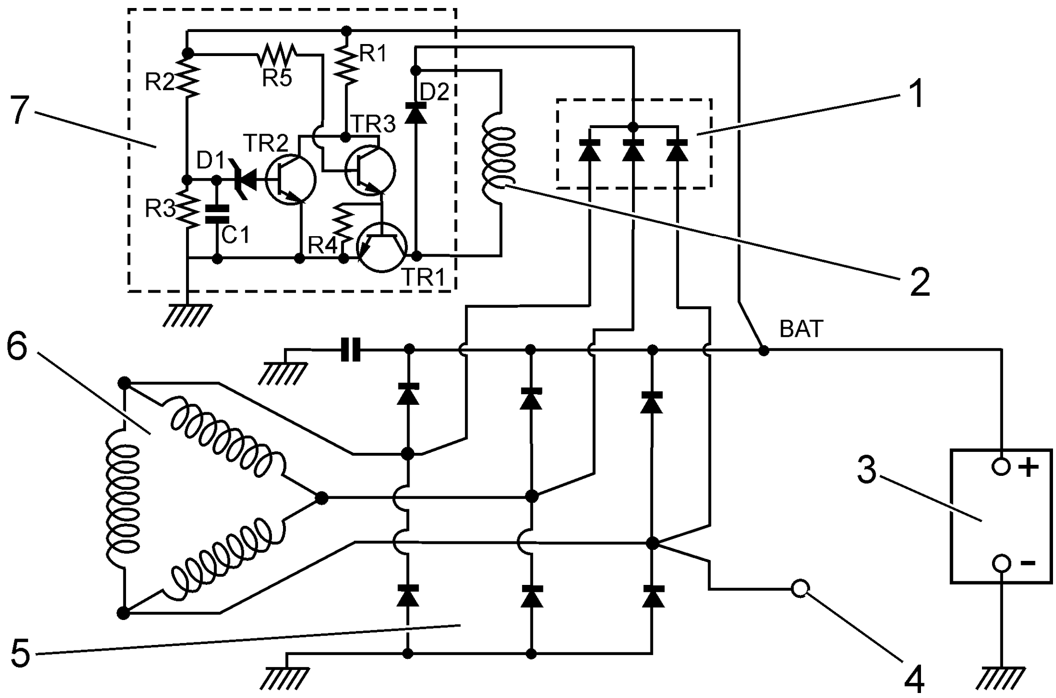

Fig. 8.5. Alternator Wiring Diagram (Integral Charging System)

1. Diode Trio
2. Field
3. Battery
4. “R” Terminal (not used)
5. Rectifier Bridge
6. Stator
7. Regulator

A wiring diagram is shown in Fig. 8.5. The basic operating principles are explained as follows:

The base-emiter of transistors (TR3 and TR1) is connected to the battery through resistor (R5), thus turning these transistors on. Also, resistors (R2 and R3) are connected to the battery, but the discharge current of the battery is very low because of the resistance values of (R2, R3, R5, TR1 and TR3).

With the generator operating, A.C. voltages initially are generated in the stator windings by residual magnetism in the rotor. The diodes in the rectifier bridge change the stator A.C. voltages to a D.C. voltage which appears between ground and the POS. terminal. As speed increases, current is provided for charging the battery and operating electrical accessories.
The stator also supplies D.C. field current through the diode trio, the field, (TR1), and then through the diodes in the rectifier bridge back to the stator.

As the speed and voltage increase the voltage between (R2) and (R3) increases to the value where zener diode (D1) conducts. Transistor (TR2) then turns on and (TR1) and (TR3) turn off. With (TR1) off, the field current and system voltage decrease and (D1) then blocks current flow causing (TR1) and (TR3) to turn back on. The field current and system voltage increase and this cycle then repeats many times per second to limit the voltage to the adjusted value.

If the connection between POS. and (R2) should become open-circuit (TR3) and (TR1) will turn off, thus preventing high system voltage.

Capacitor (C1) smoothes out the voltage across (R3), resistor (R4) prevents excessive current through (TR1) at high temperatures, and diode (D2) prevents high-induced-voltages in the field windings when (TR1) turns off.

ELECTRICAL

ALTERNATOR

8. TROUBLESHOOTING PROCEDURES

a. Energizing Speed

The energizing speed is the rpm at which the regulator turns on to energize the field coil. This speed is higher than some speeds at which output can be obtained. Therefore, when checking output at low speeds, increase the speed until the regulator turns on, then reduce the speed to check the output. No output can be obtained until the regulator turns on. Once the regulator turns on, it will remain turned on until the engine is stopped.

b. Rated Voltage

The Integral Charging System output preferably should be checked at the RATED VOLTAGE given below. However, it is permissible to check the output in amperes at any voltage within the OPERATING RANGE listed below, since the current output will be quite close to the value that would be obtained at RATED VOLTAGE. The voltage should never be allowed to rise above the OPERATING RANGE for any length of time.

SYSTEM VOLTAGE	RATED VOLTAGE	OPERATING RANGE
24	28.0	26.0 - 30.0

It should be noted that the voltage may be below the OPERATING RANGE if the battery is in a low state of charge. However, as the battery receives a charge, the voltage will rise to some value within the OPERATING RANGE.

c. Magnetizing the Rotor

The rotor normally retains magnetism to provide voltage buildup when the engine is started. After disassembly or servicing, however, it may be necessary to reestablish the magnetism. To magnetize the rotor, connect the Integral Charging System to the battery in a normal manner, then momentarily connect a jumper lead from the **battery positive post to the Integral Charging System relay terminal,** identified in Fig. 8.3. This procedure will restore the normal residual magnetism in the rotor.

A basic wiring diagram is shown in Fig. 8.6. On 24-Volt systems, two 12-Volt batteries will be connected in series.

1. Insure that an undercharged condition has not been caused by accessories having been left on for extended periods.
2. Check the drive belt for proper tension.
3. If a battery defect is suspected, check per the applicable Battery Test.
4. Inspect the wiring for defects. Check all connections for tightness and cleanliness, including the cable clamps and battery posts.
5. Connect a voltmeter from POS. terminal on Integral Charging System to ground. A zero reading indicates an open between voltmeter connection and battery.
6. With all accessories turned off, increase engine speed as required to obtain maximum voltage reading.
7. If voltage exceeds 30 Volts on a 24-Volt system remove Integral Charging System for repair as covered below under heading of INTEGRAL CHARGING SYSTEM REPAIR.

ALTERNATOR

8. If previous Steps 1 through 7 check satisfactorily, check Integral Charging System as follows:
   a. Disconnect battery ground cable.
   b. Connect an ammeter in the circuit at the POS. terminal of the Integral Charging System.
   c. Reconnect battery ground cable.
   d. Turn on accessories. Connect carbon pile across one battery.
   e. Operate engine at moderate speed as required, usually 4000 alternator [RPM] or more, and adjust carbon pile as required, to obtain maximum current output.

IMPORTANT: *Initial voltage buildup is by residual magnetism in the rotor. Increase the speed as required to obtain maximum current output.*

   f. If ampere output is within 10 Amperes of rated output as stamped on alternator frame, Integral Charging System is not defective.
   g. If ampere output is not within 10 Amperes of rated output as stamped on Integral Charging System frame, remove the Integral Charging System for repair as covered in section entitled INTEGRAL CHARGING SYSTEM REPAIR.

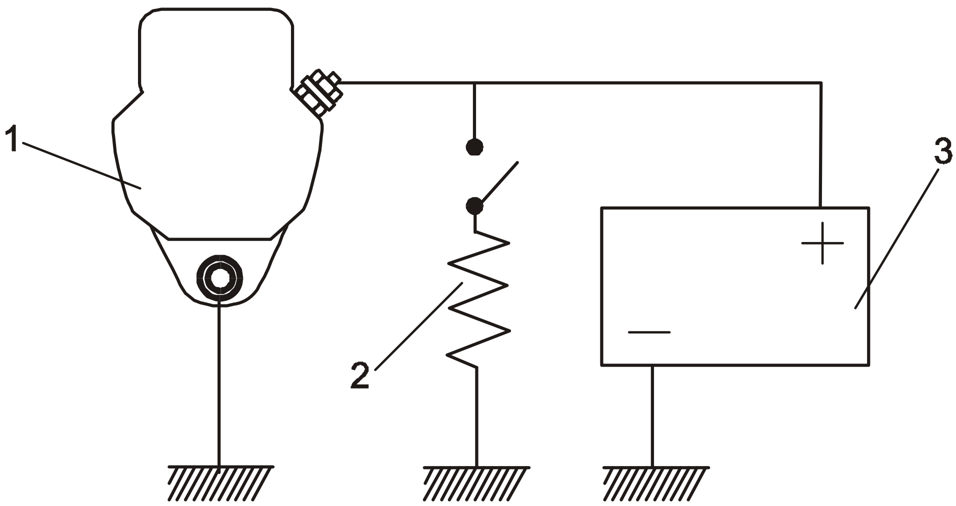

Fig. 8.6. Basic Wiring Diagram
1. Integral Charging System
2. Vehicle Loads
3. Battery

ALTERNATOR

9. INTEGRAL CHARGING SYSTEM REPAIR

Component parts and connections are shown in Fig. 8.7.

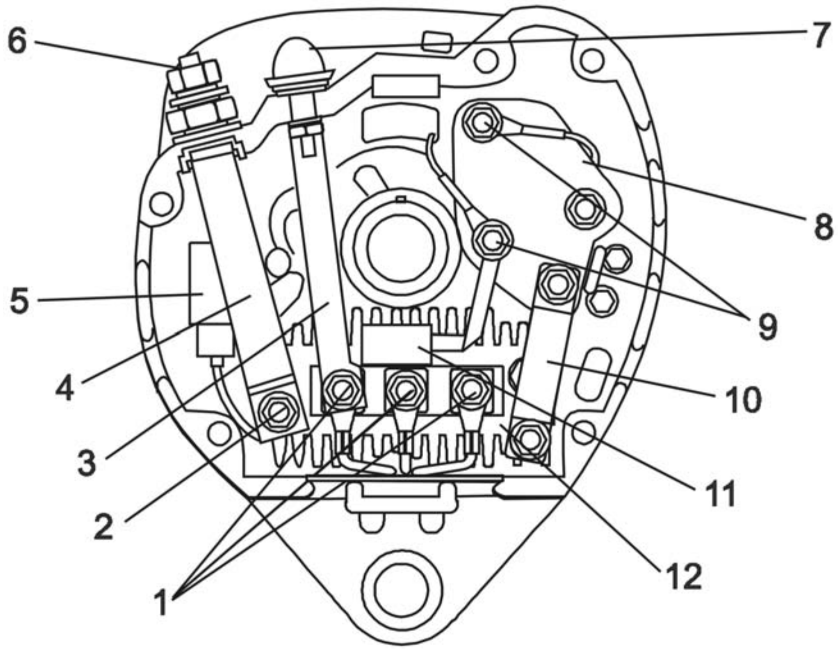

Fig. 8.7. Rectifier End Frame, 20-SI (Cover Plate Removed)

1. Stator Leads
2. Capacitor Lead
3. Relay Terminal Connector
4. Output Terminal Connector
5. Capacitor
6. Output Terminal
   Nut
   Lock Washer
   Washer
   Nut
   Lock Washer
   Washer
   Insulated
   Washer
7. Relay Terminal
   Bushing
   Washer
   Bushing
   Washer
   Connector
   Washer
   Nut
8. Regulator
9. Two Field Leads Two Insulated Screw
10. Connector
11. Diode Trio
12. Rectifier Bridge

a. Regulator Check

The regulator cannot be checked with an ohmmeter. Use an approved regulator tester available from various test equipment manufacturers.

ALTERNATOR

b. Diode Trio Check

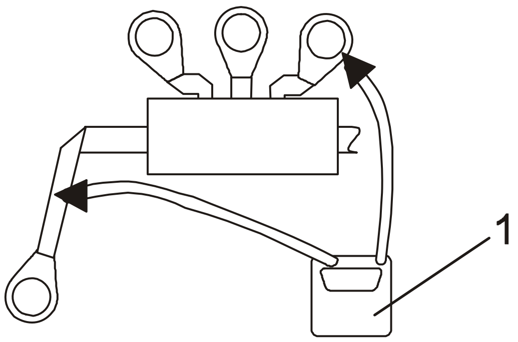

Fig. 8.8. Checking Trio
1. Ohmmeter

To check the diode trio, remove it from the end frame assembly by detaching the nuts and attaching screw.

NOTE: *The insulating washer on the screw is assembled over the top of the diode trio connector.*

Connect an ohmmeter having a $1^1/_2$-Volt cell to the single connector and to one of the three connectors, (Fig. 8.8). Using the lowest range scale, observe the reading. Then reverse the ohmmeter leads to the same two connectors. If both readings are the same, replace the diode trio. A good diode trio will give one high and one low reading. Repeat this same test between the single connector and each of the other two connectors.

c. Rectifier Bridge Check

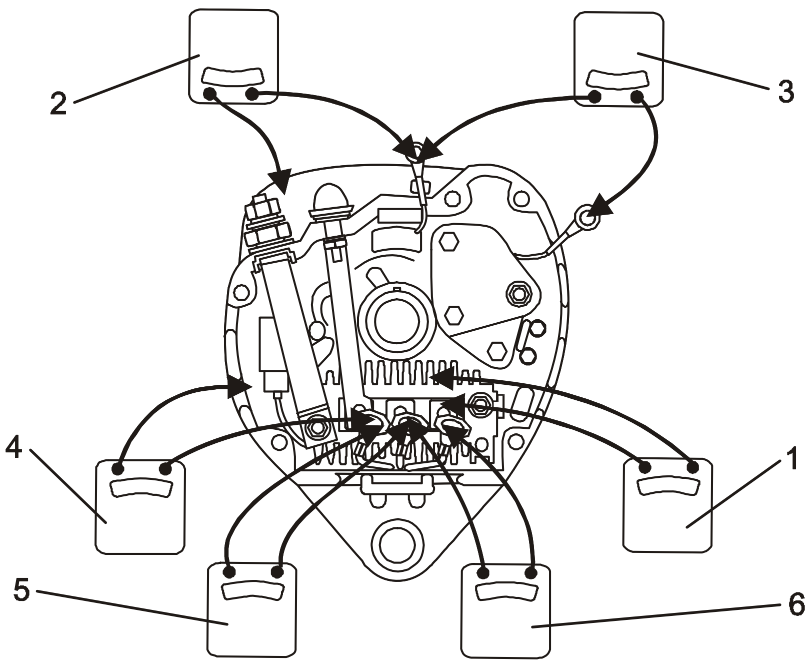

Fig. 8.9. Checking Components

1. Ohmmeter
2. Ohmmeter
3. Ohmmeter
4. Ohmmeter
5. Ohmmeter
6. Ohmmeter

ALTERNATOR

Omit for overcharged battery. To check the rectifier bridge, connect the ohmmeter to a heat sink and one of the three terminals (Step 1, Fig. 8.9). Then reverse the lead connections to the same heat sink and same terminal. If both readings are the same, replace the rectifier bridge by detaching the necessary screws and nuts. A good rectifier bridge will give one high and one low reading. Repeat this same test between the same heat sink and the other two terminals, and between the other heat sink and each of the three terminals. This makes a total of six checks, with two readings taken for each check.

d. Field Coil Checks

To check for grounds, connect an ohmmeter to one field coil lead and to the end frame as illustrated in (Step 2, Fig. 8.9). If ohmmeter reading is low, the field coil is grounded.
To check for opens, connect an ohmmeter to the two field coil leads as shown in (Step 3, Fig. 8.9). If ohmmeter reading is high (infinite), the field coil is open.

The winding is checked for short circuits by connecting a battery and ammeter in series with the field coil. Note the ammeter reading. If reading is in range (3.3 - 4.0 [A]) the field coil is good. An ammeter reading above the specified value indicates shorted windings. An alternate method is to check the resistance of the field by connecting an ohmmeter to the field coil (Step 3, Fig. 8.9). If the resistance reading is below the specified value, the winding is shorted. The specified resistance value can be determined by dividing the voltage by the current given above. To replace the field coil, see the Par. below entitled Disassembly and Repairing.

e. Stator Checks

Omit for overcharged battery. The stator windings may be checked with a 110-Volt test lamp or an ohmmeter. If the lamp light, or if the meter reading is low when connected from any stator lead to the frame, the windings are grounded (Step 4, Fig. 8.9).
If the lamp fails to light, or if the meter reading is high when successively connected between each pair of stator leads, the windings are open (Steps 5 and 6, Fig. 8.9).
A short circuit in the stator windings is difficult to locate without laboratory test equipment due to the low resistance of the windings. However, if all other electrical checks are normal and the generator fails to supply rated output, shorted stator windings are indicated.

f. Disassembly and Repairing (Fig. 8.10)

Legend for Fig. 8.10

1. Housing Rectifier
2. Rotor
3. Stator
4. Frame
5. Rectifier Bridge
6. Diode Trio
7. Field Coil and Support
8. End Cover
9. Regulator and Resistor
10. Output Terminal Connector
11. Relay Terminal Connector
12. Regulator Connector
13. Output Terminal Package
14. Relay Terminal Package
15. Capacitor
16. Capacitor Mounting Bracket
17. Retainer Plate (Inside)
18. Retainer Plate (Outside)
19. Ball Bearing
20. Inside Collar
21. Outside Collar
22. Fan and Baffle
23. Nut
24. Nut
25. Nut
26. Bolt
27. Bolt
28. Bolt
29. Bolt
30. Bolt
31. Bolt
32. Bolt
33. Bolt
34. Washer
35. Washer
36. Washer
37. Washer
38. Rectifier Housing Bearing
39. Bolt
40. Pivot Bushing
41. Mounting Screw Bushing
42. Relay Terminal Cup
43. Felt Washer Cup
44. Grommet
45. Insulator
46. Shield (Bearing Retainer Plate)

ALTERNATOR

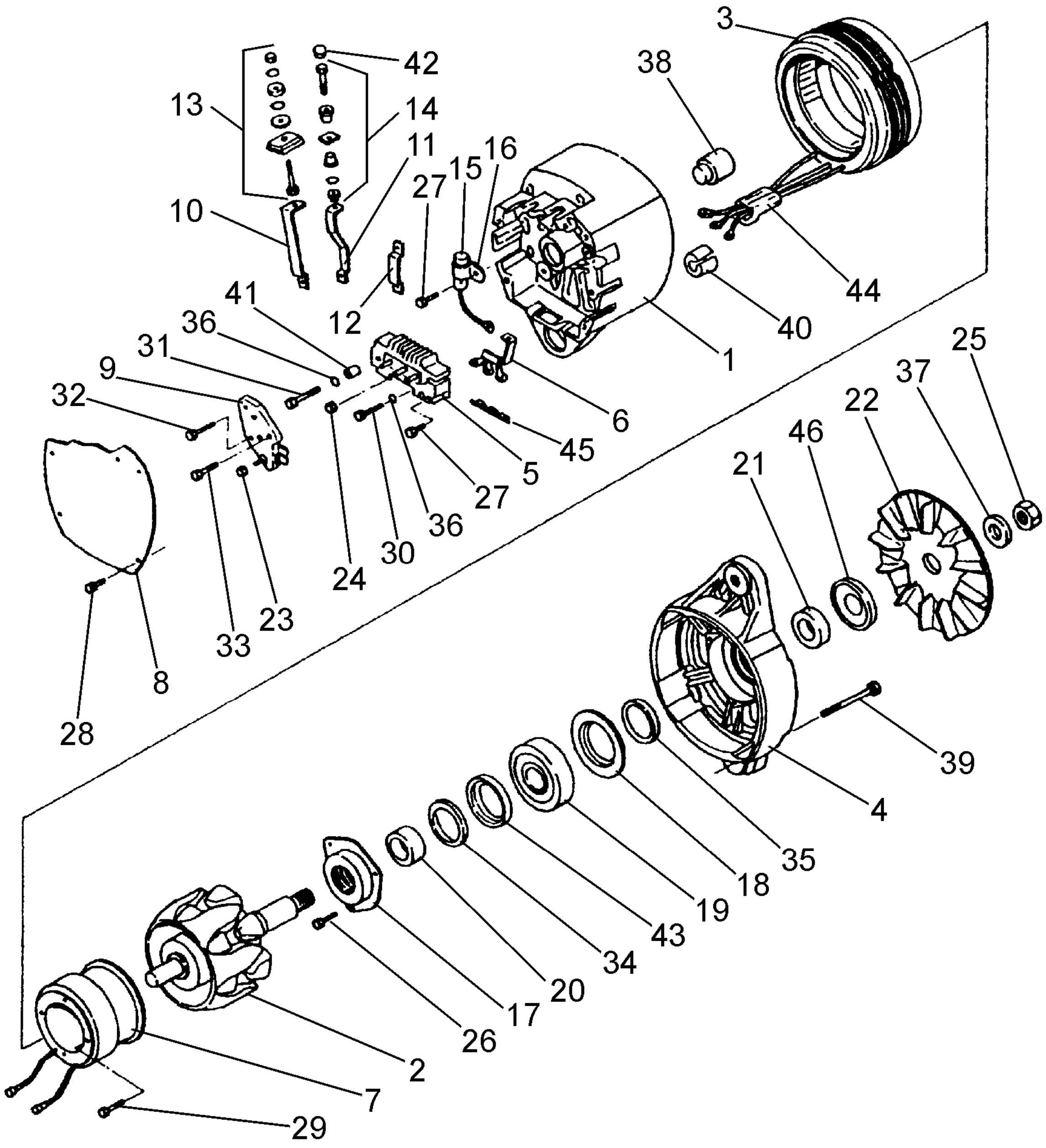

Fig. 8.10. Exploded View of Alternator

1. Remove bolts (28) and end cover (8).
2. Remove fan (22) and pulley.
3. Remove 4 thru-bolts (39).
4. Separate drive end frame (4) and rotor (2) from rectifier end frame (1) and stator (3).
5. Press rotor (2) from end frame (4).
6. Remove inside collar (20) from rotor (2).

ALTERNATOR

7. To replace drive end frame bearing (19):

   a. Remove four retaining plate (17) attaching bolts (26).
   b. Remove retainer plate (17) and felt washer (34).
   c. Push on race to remove bearing (19).
   d. Replace or re-use retainer plate (18), felt washer cup (43) and felt washer (34 and 35).
   e. Press in new bearing (19) against outer race.
   f. Soak felt washer (34 and 35) with light oil.
   g. Assemble retainer (18) with bolts.
   h. Assemble inside collar (20) over shaft.
   i. Assemble outside collar (21) under felt washer (35) next to bearing (19) while supporting outside collar (21).
   j. Press rotor (2) into drive end frame (4).

8. To replace rectifier housing bearing (38):

   a. Push out bearing (38) from either end.
   b. Use a thin wall tube in space between grease cup and housing to push bearing (38) in to dimension as shown in Fig. 8.11.

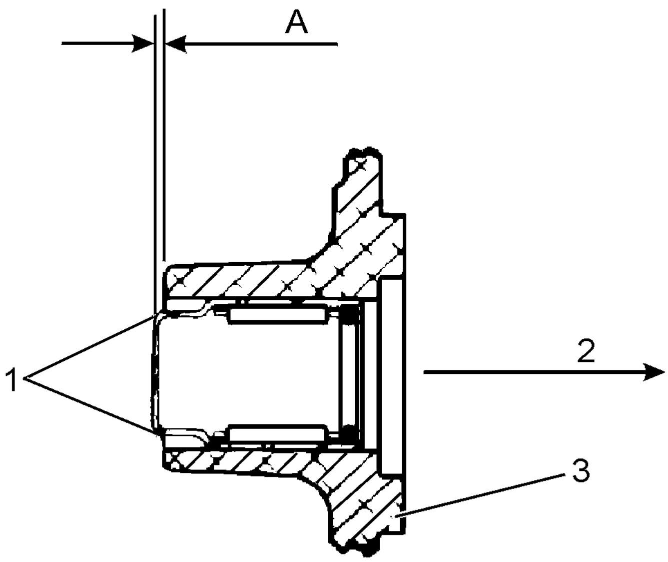

Fig. 8.11. Installing Bearing

1. Use Thin Wall Tube in Space Between Grease Cup and Housing to Push Bearing into Dimension Shown
2. Drive End
3. Partial View Rectifier End Frame

A . . . . 2.5 [mm]

g. Reassembly

After reassembly, before attaching rear cover, dip housing rectifier about 25 [mm] deep into clear electric grade varnish, or use spray can, to restore assembly to new condition.

BATTERY

10. SAFETY PRECAUTIONS

a. Handling Battery Acid

1. When working with acid, wear a face shield, protective clothing, galosh, gloves.
2. Avoid spilling or splashing electrolyte as it can destroy clothing and burn the skin.
3. If electrolyte is spilled or splashed on clothing or the body, it should be neutralized immediately and then rinsed with clean water. A solution of baking soda or household ammonia and water may be used as a neutralizer.
4. When handling a battery avoid spew electrolyte through the vent.
5. If electrolyte splashed into the eyes, force the eye open and flood it with cool, clean water for approximately fifteen minutes, and doctor should be called immediately.
6. Do not place a battery or acid within the reach of children. If acid is taken internally drink large quantities of water or milk. Follow with milk of magnesia, beaten egg or vegetable oil.
7. To prepare electrolyte always pour the concentrated acid slowly into the water, not the water into the acid. Except for lead or lead lined containers, use nonmetallic receptacles and/or funnels. Do not store acid in excessively warm locations or in direct sunlight.

b. Danger of Exploding Battery

1. Keep sparks, flames, burning cigarettes or other ignition sources away at all times, because batteries expel explosive gases.
2. Never lean over battery during charging, testing or "Jump Starting" operations.
3. Do not break "live" circuits at the terminals of batteries.
4. Make certain the battery cable clamps are making good connections.
5. Be careful that tools or metallic objects do not fall across the battery terminal.

c. Charging a Battery

1. The compartment in which the battery is being charged should be well ventilated.
2. Do not charge a battery unless you are thoroughly familiar with manufacturer's instructions.
3. Do not put a battery on charge unless you are wearing safety goggles and a face shield.
4. Turn the charge rate switch and timer to the "OFF" position before connecting the leads to the battery. Next, connect the charger leads to the battery terminals, red positive (+) lead to positive terminal and black negative (–) lead to negative terminal. Now, turn on the charger and slowly increase the charging rate until the desired ampere value is reached. If smoke or dense vapor comes from the battery shut off the charger and reject the battery. If violent gassing or spewing of electrolyte occurs, reduce or temporarily halt the charging.
5. Never touch the charger leads when the charger is "ON". Always turn the charger "OFF" before removing a charger lead from the battery.

ELECTRICAL

BATTERY

11. ELECTROLYTE STATE OF CHARGE

A battery with a fully charged specific gravity of 1.265 corrected to 26.7 [°C] contains an electrolyte with approximately 36% sulfuric acid by weight or 25% by volume. Pure sulfuric acid has a specific gravity of 1.835. The specific gravity can be measured directly with a hydrometer or determined by the stabilized voltage.

The state-of-charge battery shows the chart below.

Charge Level	Specific Gravity	Voltage
100 [%]	1.265	12.68
75 [%]	1.225	12.45
50 [%]	1.190	12.24
25 [%]	1.155	12.06
Discharged	1.120	11.89

Never take a hydrometer reading immediately after water is added to the cell. The water must be thoroughly mixed with electrolyte, by charging. If a reading is being taken immediately after prolonged cranking, it will be higher than the true value.
A correction factor must be applied for any specific gravity reading made when the electrolyte temperature is not 26.7 [°C].
A correction factor of 0.004 specific gravity is used for each 5.5 [°C] change in temperature, (0.004 are added to the each 5.5 [°C] increment above 26.7 [°C] and 0.004 are subtracted for each 5.5 [°C] increment below 26.7 [°C]).

12. ELECTROLYTE IN TROPICAL AND ARCTIC CLIMATES

a. Tropical Climate

Batteries used in temperature climates have a fully charged specific gravity in the 1.250 to 1.280 range. A fully charged electrolyte specific gravity of 1.210 to 1.230 is used in tropical climates. This increases the service life of the battery.
The state "OFF" charge batteries at various climate shows chart below.

State of charge	Specific gravity in arctic climate	Specific gravity in tropical climate
100 [%]	1.265	1.225
75 [%]	1.225	1.185
50 [%]	1.190	1.150
25 [%]	1.155	1.115
Discharged	1.120	1.080

b. Arctic Climate

Batteries used in arctic climate use stronger electrolyte of 1.290 to 1.300. Higher specific gravity decrease the service life of the battery.
As the battery approaches the discharged condition, the easier it is for its electrolyte to freeze.

Electrolyte freezing point shows chart below.

Freezing point	Specific gravity
-10 [°C]	1.120
-27 [°C]	1.200
-54 [°C]	1.255
-65 [°C]	1.270

13. TESTING AND MAINTENANCE THE BATTERY

a. Visual Inspection

Visually inspect the outside of the battery for obvious damage such as a cracked or broken case or cover which would allow electrolyte loss. If top of battery is a dirty, secure vent plug, clean it with a brush dipped in ammonia or soda solution. After foaming stops, flush of battery with clean water. Check for terminal damage. Check the condition of the battery cables.

b. Electrolyte Levels and State of Charge

In abnormal conditions (above 32 [°C] and below 0 [°C] it is recommended to check electrolyte level frequently, to prevent electrolyte within cells from evaporating below top of plates. Although these batteries are designed to preclude the need to add water, the volume of reserve electrolyte above the plates may eventually be depleted. In most cases, this will signal the end of the battery´s useful life. If electrolyte levels are found to be low or a battery is in a deep state of discharge, check for charging system malfunction and/or loose battery trays and hold-down clamps. Add water before proceeding further. The state-of-charge of low water loss batteries can be determined with an accurate voltmeter.

1. If the stabilized open circuit voltage is below 12.4 [V], charge the battery as described under BATTERY CHARGING until an open circuit voltage at least 12.4 [V] is obtained (after surface charge has been taken off). When a hydrometer reading can be taken, a value of 1.225 at 26.7 [°C] can be used instead of the 12.4 voltage reading. After the battery is charged, proceed to Step 3.
2. If the state-of-charge of a battery cannot be determined, it must be charged. After the battery is charged, proceed to Step 3.
3. Remove surface charge by attaching load test leads to the terminals and applying a load 475 [A] (1/2 of the Cold Cranking Amperes at –18 [°C]) rating of the battery for 15 seconds. The battery can be tested with the Electronic Battery Tester, number 15-550, or carbon pile load tester. Proceed to Load Procedure.
4. If the stabilized voltage of the battery was 12.4 [V] or above when it was first examined, proceed to Load Procedure.

BATTERY

c. Load Procedure

NOTE*: This procedure is valid only if the battery is at or above the state of charge specified in Electrolite Levels and State of Charge .*

The load test procedure is conducted to determine if the battery has adequate electrical performance or must be replaced.

Voltage Chart	
Estimated Electrolyte Temperature	Minimum Required voltage is under 15 second load
21 [°C] and above	9.6
16 [°C]	9.5
10 [°C]	9.4
4 [°C]	9.3
-1 [°C]	9.1
-7 [°C]	8.9
-12 [°C]	8.7
-18 [°C]	8.5

1. Connect the voltmeter and load test leads to the battery terminals, making sure the load switch is in the "OFF" position
2. Apply a load test equal 475 [A] (1/2 of the Cold Cranking Amperes at –18 [°C]) rating of the battery. Read voltage after 15 seconds with load connected, remove load. Estimate or measure battery temperature and compare voltage reading with the "Voltage Chart".

If the voltage is less than the minimum specified, replace the battery. If the voltage meets or exceeds the specified minimum, return it to service.

d. Charging Low Water Loss Batteries

Refer to "SAFETY PRECAUTIONS". If, when charging the battery, violent gassing or spewing of electrolyte occurs, or the battery case feels hot 52 [°C], reduce or temporarily halt charging to avoid damaging the battery. For best results, batteries should be charged while the electrolyte is at room temperature (13-30) [°C]. Since age, state of charge of batteries vary. Time and attention must be given to batteries during any charging process.

The charge a battery receiver is equal to the charge rate in amperes multiplied by the time in hours. Thus a five ampere rate applied to a battery for ten hours would be a 50 ampere-hour charge to the battery. To fully recharge a battery, you must replace the ampere-hours or ampere-minutes removed from it: plus an extra 20 [%] charge.

BATTERY

14. BATTERY CHARGING GUIDE

Recommended Rate and Time for Fully Discharged Condition

Rated Battery Capacity	Charge	
Above 126 to 170 Minutes	2.75 hours at 30 Amperes	3 hours at 25 Amperes
	4 hours at 20 Amperes	5.5 hours at 15 Amperes

Determine the state-of-charge of the battery with a hydrometer or open circuit voltmeter. The best method of making certain a battery is fully charged, is to measure the specific gravity of a cell once per hour. The battery is fully charged when the cells are gassing freely at low charging rate and less than 0.003 change in specific gravity occurs over a three- hour period.

When any battery is being charged, periodically measure the temperature of the electrolyte, if the temperature exceeds 52 [°C], or if violent gassing or spewing of electrolyte occurs, the charging rate must be reduced or temporarily halted.

The battery generally cannot be fully charged the fast charge method. But it will receive sufficient charge (70 to 90) [%] for practical service. To completely recharge a battery, follow the fast charge with a slow charge until to change in specific gravity occurs over a three- hour period.

A battery with electrolyte specific gravity of 1.225 or above, should never be charged at a high rate. If the battery is badly sulfated, the temperature may rise rapidly soon after it is placed on charge. As the sulfate starts to break up, the charge rate in amperes will increase noticeably. These batteries should be placed on a slow charge.

If a battery is to be recharged overnight (16 hours), a timer or voltage controlled charger is recommended. If a battery cannot be restored to a fully charged condition by slow charging, it should be rejected. The slow charge conditions are above in Battery Charging Guide. The temperature of a normal battery may rise above the desired maximum of 52 [°C] if it reaches the fully charged state and is left on charge.

15. BATTERY STORAGE

Low water loss batteries have excellent shelf life due to their low self-discharge rates. Batteries should be stored in a cool, dry place. Storage above 27 [°C] increases self-discharge. If batteries are discharged, the electrolyte may freeze when stored below -7 [°C].

Battery stock must be rotated on a strict "first-in, first-out" basis.
Batteries in stock should be recharged when the stabilized voltage falls to 12.2 volts or specific gravity drops below 1.240. If good stock rotation and inventory control have been maintained, the battery may be installed without charging. However, if the battery stabilized voltage is less than 12.2 [V] it should be recharged before installation.

BATTERY

16. BATTERY PRIMARY RATINGS

Batteries are rated to perform in accordance with the COLD CRANKING PERFORMANCE and RESERVE CAPACITY ratings.

1. Cold cranking performance
   The Cold Cranking Performance is designated as the discharge load in amperes which a battery at -18 [°C] can deliver for 30 seconds and maintain a voltage of 1.2 volts per cell or higher.
2. Reserve capacity
   The Reserve Capacity Rating is the number of minutes a new fully charged battery at 26.7 [°C] can be discharged at 25 amperes to an out point of 10.5 volts.

17. COLD ENGINE CRANKING PERFORMANCE

Effect of temperature and oil viscosity on ENGINE CRANKING PERFORMANCE

1. Battery capacity is greatly reduced by cold. The reduction in cranking power when the temperature drops from 26.7 [°C] to 0 [°C] is 65 [%] or –18 [°C] is 40 [%].
2. Stiff engine oil adds to the load of starting. With the use of single-viscosity winter-grade SAE 20W oil the cranking power requirement rises about 2 1/2 times on the drop in temperature from 27 [°C] to –18 [°C]. Note that a nearly-discharged battery at –18 [°C] has less than 1/10 the available cranking power of a fully charged battery at 27 [°C].

18. DRY CHARGE ACTIVATION

1. Before attempting to activate a battery read and understand the Safety Precautions in this chapter.
2. Battery and acid must be at a temperature of 15 [°C] to 38 [°C] at time of filling.
3. Remove the plugs and fill each cell to level 21 ÷ 27 [mm] above the top edge plates. Electrolyte gravity should be 1.265 ±0.005 at temperature 27 [°C].
4. Wait for minimum 20 minutes to soak plates. Add additional electrolyte to proper level. It is recommended wait for 3 hours after filling of battery.
5. Charge battery no more than 7 [A] for 30 minutes. Battery is ready if specific gravity is 1.250 or more at temperature 15.5 [°C].
6. Check electrolyte level and add distillated water if need.
7. Dry charged batteries may be placed in service immediately after activation. However, to insure good performance these additional steps are recommended.
8. Check the specific gravity of all cells. Under good storage conditions, the electrolyte specific gravity on activating a dry-charged battery will drop approximately 0.010 and temperature will rise 4 [°C] to 5.6 [°C] within twenty minutes of filling the battery. A battery under these conditions requires little boost charging. However, should the specific gravity drop 0.030 or more with a corresponding increase in temperature, the negative plates have been oxidized and the battery should be fully recharged before use. Also, the battery should be recharged if one or more cells gas violently after the addition of electrolyte. After electrolyte is added, check the open circuit terminal voltage of the battery. If battery reads less than 10 volts this indicates a reverse cell, an "open" circuit or a shorted cell, and the battery should be replaced.

BATTERY

19. TYPICAL OF CAUSE OF BATTERY FAILURE

1. Is the battery being used in the application for which it was designed.
2. Does the hold-down hardware fit the battery properly.
3. Has the battery required frequent water addition in one or more cells? Excessive water loss in one cell may indicate a short. Excessive water loss in all cells may indicate overcharging, a worn out battery, or both.
4. Is the electrolyte cloudy, discolored, or contaminated with foreign material? Cloudy electrolyte can indicate active material shedding due to overcharge or vibration. Electrolyte contamination can cause high self-discharge rates and poor performance.
5. Are alternate plates dark and light colored? In a charged cell, the positive plates should be dark in color and the negative plates light. If all plates are very light, severe undercharging could be indicated.
6. Is voltage regulator setting correct? A high voltage regulator setting can cause excessive gassing and water loss, thermal runaway, and eventual damage to plates and separators. If the voltage regulator setting is too low, the battery will be in constant state of discharge.

20. VISUAL INSPECTION OF BATTERY

a. Inspection Before Disassembly

The following will describe a procedure which could be used to make an internal examination of a battery which has failed. First, the battery is fully charged: at least an attempt is made to fully charge it. The specific gravity of the electrolyte in each cell is recorded. The battery open circuit voltage is recorded. All cell voltages should be recorded. The battery is allowed to stand for three days and the specific gravity readings are recorded a second time. An excessive specific gravity drop (35 points) in one or more cells is an indication that shorts exist in those cells. If two adjacent cells have gravity readings considerably lower than the others, it is a good indication that electrical leakage exists between the two cells and is discharging them. If the container and/or cover is cracked it could be due to abuse (an impact blow), freezing or the battery exploded. High temperatures may permit the container to bulge.

b. Inspection After Disassembly

The next step is to pour the electrolyte from the battery and remove the cover by sawed off the battery with a hacksaw or band saw. The next step is to cut the intercell connections. This can be done with a bolt cutter. The elements can now be lifted from the container. Remove the element from the cell with the lowest specific gravity electrolyte. Squeeze the element gently and let excess acid drain from it. Examine the sides of the element for treeing shorts between positive and negative plates. These are generally caused by misalignment of the plates and separators. Check for broken or bent grid frames shorting against an adjacent plate. Look under the plate straps to see if there is a lead rundown from the strap to a plate beneath it. Determine if the top of a grid frame has broken and moved upward until it is shorting against a plate strap. Remove the plates from the plate strap with a hacksaw.

BATTERY

1. POSITIVE PLATE; If the plate has a distinct zone of white sulfate near the top this was caused by a low electrolyte level. Restoring the electrolyte level will not help the sulfated area. Uniform shedding over the entire surface of the positive plates is normal for a battery after long service. When material has shed from the plate in small chunks, it could be due to vibration, too high a charging rate on a sulfated plate, or the battery freezing while it was discharged. Continued overcharging oxidizes the positive grids and reduces the cross-section of the wires. If the plate is hard when scratched, or has areas of white sulfate on it, the battery has stood in a discharged condition.

2. NEGATIVE PLATES; The sponge lead of the negative plate is normally a slate gray color. If you rub the back of your thumbnail or a spatula across a good negative plate, this will create a path of metallic sheen. If a metallic sheen is not created, the negative material is inactive.

   A partially charged negative plate has sandy appearance. If the negative plate material of a fully charged battery appears sandy, the plates are worthless. This condition may result from operation of the battery while the element was shorted. It can be caused by high gravity acid and high temperature conditions prevail for some time, the negative plate material may become soft. If negative plates have a white discoloration, it is probably due to an accumulation of lead sulfate.

   The sulfate could result from a low electrolyte level or being in a low state of charge for a considerable length of time. Negative plates that are severely cracked can be the cause of failure. This is typically caused by many repeated, shallow discharge-recharge cycles. The positive plates may eventually be destroyed by the overcharging, although the prime reason for the battery failure could have been the negative plates.

3. SEPARATORS; Hold the separators in front of a bright light and visually inspect for holes, dendrites, or active material through the pores of the separator web, or other visible damage.

CRANKING MOTOR 42MT

21. SPECIFICATIONS

Manufacturer type . . . . Delco Remy 42 MT
Maximum power . . . . 10.4 [HP]
Supply voltage . . . . .24 [V]
Noise housing bolts torque . . . . 190 - 250 [Nm]

No-Load Test

Volts 20
Min. Amperes 50
Max. Amperes 90
Min. [RPM] 6300
Max. [RPM] 8400

Solenoid Checks

Pull-in Winding:
Amperes . . . . 8.5 - 10.0
Volts 5
Ohms . . . . 0.5 - 0.59

Hold-in Winding
Amperes . . . . 11 - 15
Volts 20
Ohms . . . . 1.3 - 1.8

22. INTRODUCTION

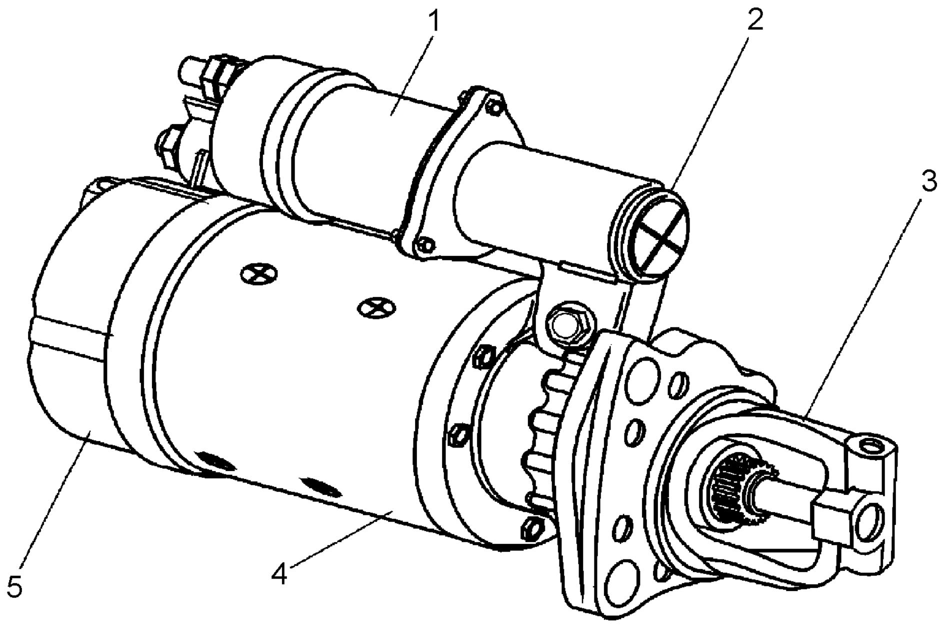

Fig. 8.12. View of Cranking Motor

1. Solenoid
2. Lever Housing
3. Nose Housing
4. Field Frame
5. End Cap

CRANKING MOTOR 42MT

Heavy duty cranking motors have a shift lever in lever housing (2, Fig. 8.12) and plunger in solenoid (1) that are totally enclosed to protect them from exposure to dirt, icing conditions and splash. The nose housing (3) can be rotated to obtain a number of different solenoid (1) positions with respect to the mounting flange.

Lubrication is provided to the sintered bronze bushings by an oil saturated wick (3, 9 and 14, Fig. 8.13). Oil can be added to each wick by removing an oil reservoir cup which is accessible on the outside of the motor.

The pinion is moved into mesh with the ring gear by the action of the solenoid. The pinion remains engaged until the solenoid circuit is interrupted. In case of a butt engagement the motor will not be energized to prevent damage to the pinion and gear teeth.

Under normal operating conditions, no maintenance will be required between engine overhaul periods. At time of engine overhaul, motors should be disassembled, inspected, cleaned, and tested as described in succeeding paragraphs.

As shown in the cross-sectional view of Fig. 8.13, the nose housing is attached to the lever housing by means of bolts located around the outside of the housing. To relocate the housing, it is only necessary to remove the bolts, rotate the housing to the desired position, and reinstall the bolts. In this type of assembly, the lever housing and the commutator end cap are attached to the field frame independently by bolts entering threaded holes in the field frame.

23. OPERATIONS (Fig.'s 8.10 and 8.11)

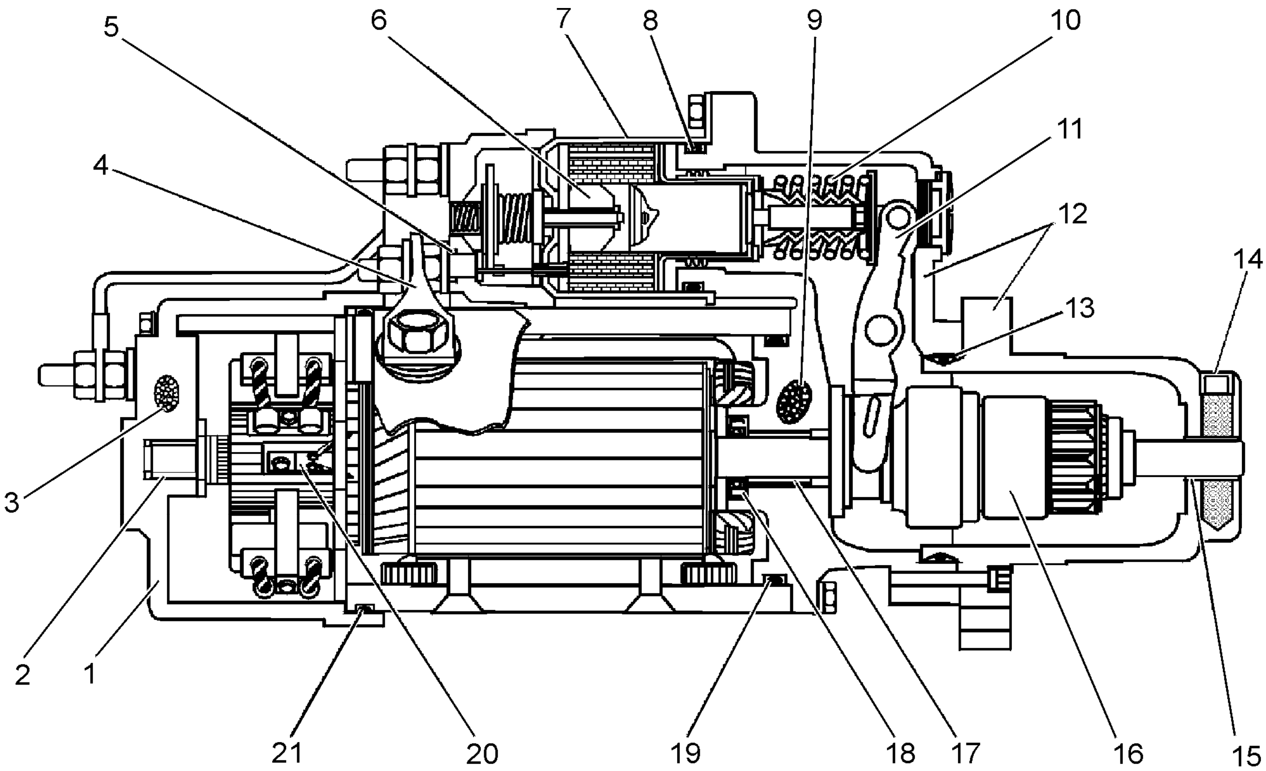

Fig. 8.13. Cross - Sectional View of Cranking Motor

CRANKING MOTOR 42MT

Legend for Fig. 8.13

1. Removable End Cap for Inspection
2. Bronze Bearing
3. Oil Wick
4. Connector Strap
5. Gasket
6. Low - Friction Bushing
7. Seamless, One - Piece Solenoid Case
8. O-Ring
9. Oil Wick
10. Sealing Boot
11. Totally Enclosed Shift Mechanism
12. Two - Piece Housing
13. O-Ring
14. Oil Wick
15. Bronze Bearing
16. Heavy - Duty 7-Roll Drive
17. Bronze Bearing
18. Shaft Seal
19. O-Ring
20. One - Piece Brush
21. O-Ring

NOTE: *The starting circuit was explained in MACHINE ELECTRICAL SYSTEM, under WIRING DIAGRAM in this Section.*

The solenoid windings are energized and the resulting plunger and shift lever movement causes the pinion to engage the engine flywheel ring gear and the solenoid main contacts to close, and cranking takes place. When the engine starts, pinion overrun protects the armature from excessive speed until the switch is opened, at which time the return spring causes the pinion to disengage. To prevent excessive overrun and damage to the drive and armature windings, the switch must be opened immediately when the engine starts.

A cranking period for all types of motors should never exceed 30 seconds without stopping to allow the motor to cool.

24. TROUBLESHOOTING THE CRANKING CIRCUIT

If the cranking system is not performing properly, make the following check to help determine which part of the circuit is at fault.

a. Battery

To determine the condition of the battery, follow the testing procedure outlined in this Section, BATTERY. Insure that the battery is fully charged. **The wiring, switches, and cranking motor cannot be checked if the battery is defective or discharged.**

b. Wiring

Inspect the wiring for damage. Inspect all connections to the cranking motor, solenoid, magnetic switch, any other control switch, and battery, including all ground connections. Clean and tighten all connections as required.

The cranking system cannot operate properly with excessive resistance in the circuit.

c. Magnetic Switch, Solenoid and Control Switches

Inspect all switches to determine their condition. From the Electrical Dozer System determine which circuits should be energized with the starting switches closed. Use a voltmeter to detect any open circuits.

d. Motor

If the battery, wiring and switches are in satisfactory condition, and the engine is known to be functioning properly, remove the motor and follow the test procedures outlined below.

A cranking motor is designed for intermittent duty only, and should never be operated for more than 30 seconds at a time. After 30 seconds, the cranking must be stopped for at least two minutes to allow the motor to cool.

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With the cranking motor removed from the engine, the armature should be checked for freedom of rotation by prying the pinion with a screwdriver. Tight bearings, a bent armature shaft, or a loose pole shoe screw will cause the armature does not turn freely. If the armature does not turn freely the motor should be disassembled immediately. However, if the armature does rotate freely, the motor should be given a no-load test before disassembly.

e. No-Load Test (Fig. 8.14)

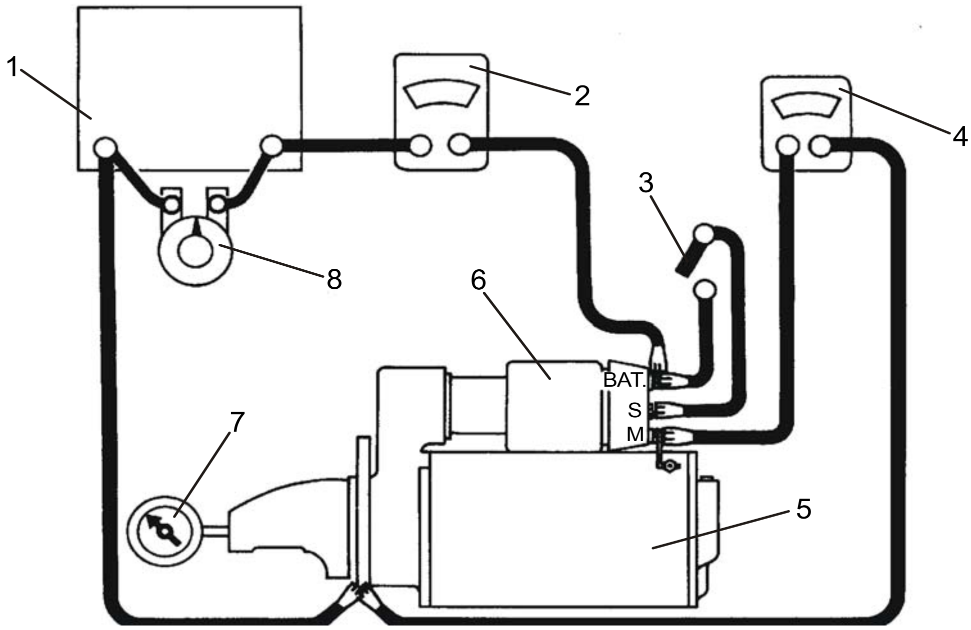

Fig. 8.14. No-Load Test Circuit

1. Battery
2. Ammeter
3. Switch
4. Voltmeter
5. Cranking Motor
6. Solenoid
7. RPM Indicator
8. Carbon Pile

Connect a voltmeter from the motor terminal to the motor frame, and use an [RPM] indicator to measure armature speed. Connect the motor and an ammeter in series with a fully charged battery of the specified voltage, and a switch in the open position from the solenoid battery terminal to the solenoid switch terminal. Close the switch and compare the [RPM], current, and voltage reading with the specifications in this Section. It is not necessary to obtain the exact voltage specified in these specifications, as an accurate interpretation can be made by recognizing that if the voltage is slightly higher the [RPM] will be proportionately higher, with the current remaining essentially unchanged. However, if the exact voltage is desired, a carbon pile connected across the battery can be used to reduce the voltage to the specified value. Connect the carbon pile to only one of the 12-Volt batteries. If the specified current draw does not include the solenoid, deduct from the ammeter reading the specified current draw of the solenoid hold-in winding. Make disconnections only with the switch open. Interpret the test results as follows:

f. Interpreting Results of Tests

1. Rated current draw and no-load speed indicates normal condition of the cranking motor.
2. Low free speed and high current draw indicate:
   a. Too much friction-tight, dirty, or worn bearings, bent armature shaft or loose pole shoes allowing armature to drag.

CRANKING MOTOR 42MT

b. Shorted armature. This can be further checked on a growler after disassembly.

c. Grounded armature or fields. Check further after disassembly.

3. Failure to operate with high current draw indicates:

a. A direct ground in the terminal or fields.

b. "Frozen" bearings (this should have been determined by turning the armature by hand).

4. Failure to operate with no current draw indicates:

a. Open field circuit. This can be checked after disassembly by inspecting internal connections and tracing circuit with a test lamp.

b. Open armature coils. Inspect the commutator for badly burned bars after disassembly.

c. Broken brush springs, worn brushes, high insulation between the commutator bars or other causes which would prevent good contact between the brushes and commutator.

5. Low no-load speed and low current draw indicate:

a. High internal resistance due to poor connections, defective leads, dirty commutator and causes listed above under Number 4.

6. High free speed and high current draw indicate shorted fields.

a. If shorted fields are suspected, replace the field coil assembly and check for improved performance.

g. Disassembly

Normally the cranking motor should be disassembled only so far as is necessary to make repair or replacement of the defective parts. As a precaution, it is suggested that safety glasses be worn when disassembling or assembling the cranking motor.

1. Note the relative position of the solenoid, lever housing, and nose housing so the motor can be reassembled in the same manner.
2. Disconnect field coil connector from solenoid motor terminal, and ground return lead from solenoid if present.
3. On motors which have brush inspection plates, remove the plates and then remove the brush lead screws. This will disconnect the field leads from the brush holders.
4. Remove the attaching bolts and separate the commutator end frame from the field frame.
5. Separate the nose housing and field frame from lever housing by removing attaching bolts.
6. Remove armature and clutch assembly from lever housing.
7. Separate solenoid from lever housing by pulling apart.

h. Cleaning

The drive, armature and fields should not be cleaned in any degreasing tank, or with grease dissolving solvents, since these would dissolve the lubricant in the drive and damage the insulation in the armature and field coils. All parts except the drive should be cleaned with mineral spirits and a brush. The drive can be wiped with a clean cloth.

If the commutator is dirty may be cleaned with No. 00 sandpaper. NEVER USE EMERY CLOTH TO CLEAN COMMUTATOR.

i. Brushes and Holders Servicing

Inspect the brushes for wear. If they are worn excessively when compared with a new brush, they should be replaced. Make sure the brush holders are clean and the brushes are not binding in the holders. The full brush surface should ride on the commutator to give proper performance. Check by hand to insure that the brush springs are giving firm contact between the brushes and commutator. If the springs are distorted or discolored, they should be replaced.

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j. Armature Servicing

If the armature commutator is worn, dirty, out of round, or has high insulation, the armature should be put in a lathe so the commutator can be turned down. As a final step in this procedure, the commutator should be sanded lightly with No. 00 sandpaper.

The armature should be checked for opens, short circuits and grounds as follows:

k. Checking

1. Opens - Opens are usually caused by excessively long cranking periods. The most likely place for an open to occur is at the commutator riser bars. Inspect the points where the conductors are joined to the commutator bars for loose connections. Poor connections cause arcing and burning of the commutator bars as the cranking motor is used. If the bars are not too badly burned, repair can often be effected by resoldering or welding the leads in the riser bars (using rosin flux), and turning down the commutator in a lathe to remove the burned material.

2. Short Circuits - Short circuits in the armature are located by use of a growler. When the armature is revolved in the growler with a steel strip such as hacksaw blade held above it, the blade will vibrate above the of the armature core in which the short circuit is located. Shorts between bars are sometimes produced by brush dust or copper between the bars. These shorts can be eliminated by cleaning out the slots.

3. Grounds - Grounds in the armature can be detected by the use of a 110-Volt test lamp and test points. If the lamp lights when one test point is placed on the commutator with the other point on the core or shaft, the armature is grounded. Grounds occur as a result of insulation failure which is often brought about by overheating of the cranking motor produced by excessively long cranking periods or by accumulation of brush dust between the commutator bars and the steel commutator ring.

l. Field Coil Checks

The various types of circuits used are shown in the wiring diagrams of Fig. 8.15. The field coils can be checked for grounds and opens by using a test lamp.

Grounds-if the motor has one or more coils normally connected to ground, the ground connections must be disconnected during this check. Connect one lead of the 110-Volt test lamp to the field frame and the other lead to the field connector. If the lamp lights, at least one field coil is grounded which must be repaired or replaced. This check cannot be made if the ground connection cannot be disconnected.

Opens - Connect test lamp leads to ends of field coils. If lamp does not light, the field coils are open.

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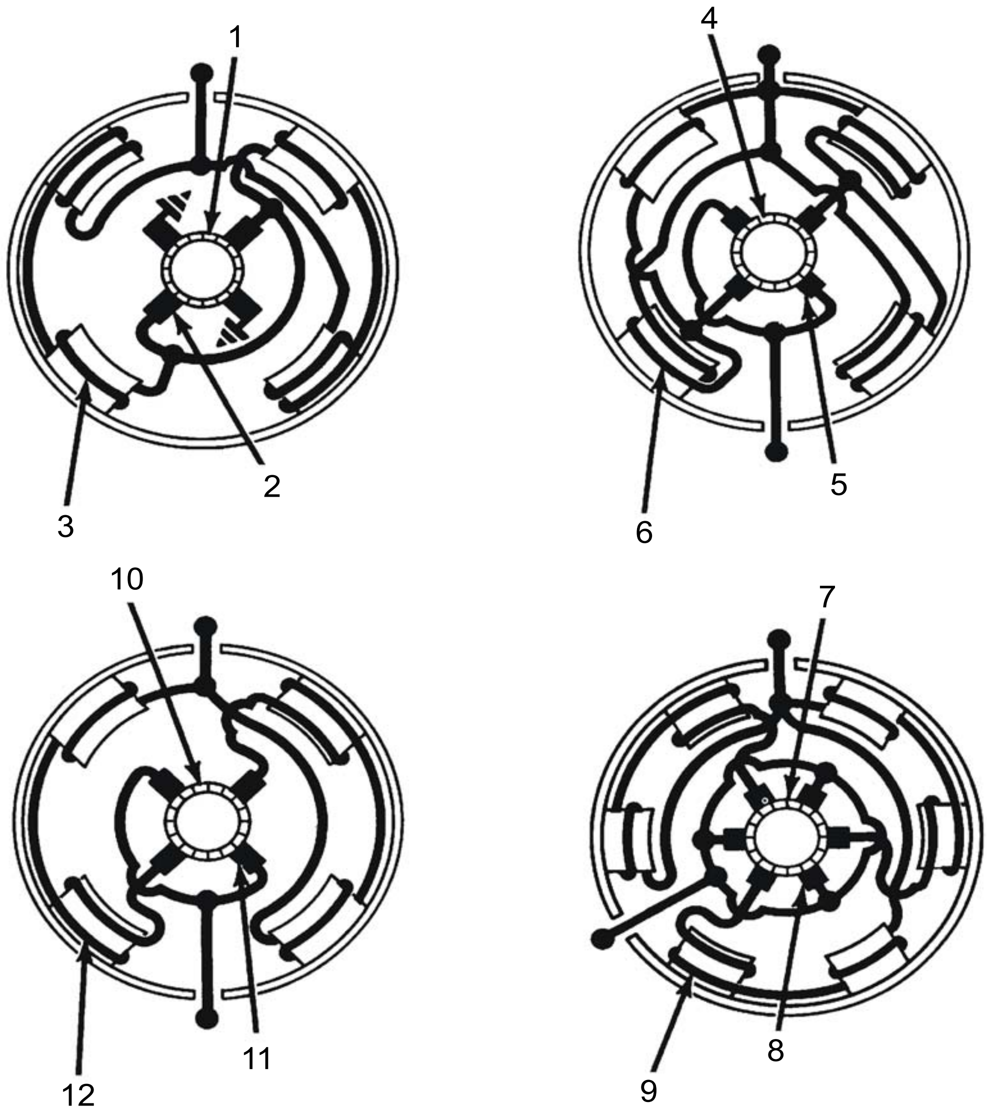

Fig. 8.15. Internal Motor Circuits

1. Commutator
2. Brush
3. Series Coil (4)
4. Commutator
5. Brush
6. Series Coil (4)
7. Commutator
8. Brush
9. Series Coil (6)
10. Commutator
11. Brush
12. Series Coil (4)

m. Field Coil Removal

Field coils can be removed from the field frame assembly by using a pole shoe screwdriver. A pole shoe spreader should also be used to prevent distortion of the field frame. Careful installation of the field coils is necessary to prevent shorting or grounding of the field coils as the pole shoes are tightened into place. Where the pole shoe has a long lip on one side and a short lip on the other, the long lip should be assembled in the direction of armature rotation so becomes the trailing (not leading) edge of the pole shoe.

CRANKING MOTOR 42MT

n. Solenoid Checks

A basic solenoid circuit is shown in Fig. 8.16. With all other leads disconnected, the solenoid windings can be checked by making test connections as covered below. As shown in Fig. 8.17, make connections to the S and ground return terminals. If needed, use the carbon pile to decrease the battery voltage to the value specified in this Section and compare the ammeter reading with the **holding winding specifications**. A high reading indicates a shorted winding and a low reading indicates excessive resistance. To check the pull-in winding connect from the solenoid switch terminal to the solenoid motor terminal (Fig. 8.18). Compare with the **pull-in winding specification.** A high reading indicates a shorted pull-in winding, and a low reading indicates excessive resistance. To avoid excessive heating, leave the pull-in winding connected no more than 10 seconds at a time. The current will decrease as the heating increases.

To check for grounds, move battery lead from M. terminal (Fig. 8.18) to a clean metal ground on the solenoid case, (not shown). Ammeter should read zero. If not, hold-in or pull-in winding is grounded.

NOTE: *If needed to reduce the voltage to the specified value, connect the carbon pile between the battery and the **M** terminal as shown. If the carbon pile is not needed, connect a jumper directly from the battery to the **M** terminal.*

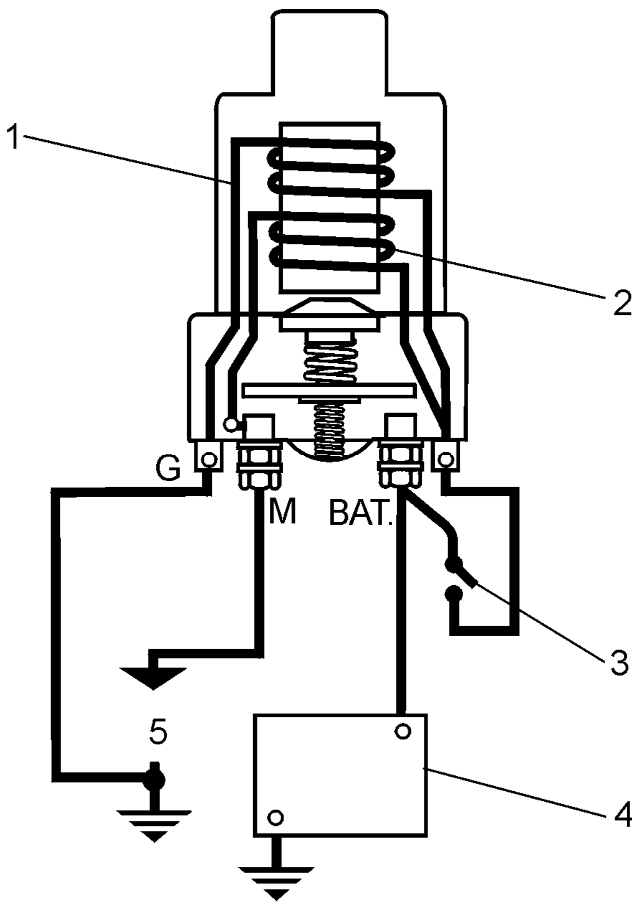

Fig. 8.16. Solenoid Circuit with Ground Return Terminals

1. Hold - In Winding
2. Pull - In Winding
3. Start Switch
4. Battery
5. To Motor Windings

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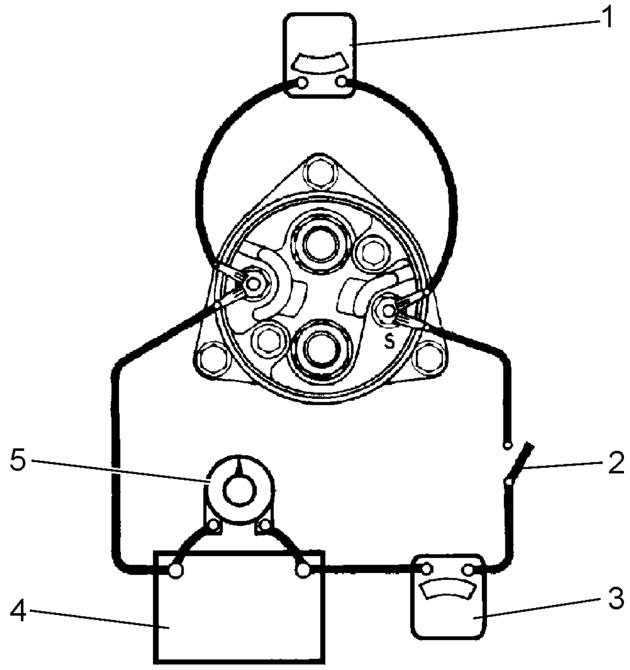

Fig. 8.17. Testing Hold-in Windings Solenoid
1. Voltmeter
2. Switch
3. Ammeter
4. Battery
5. Carbon Pile

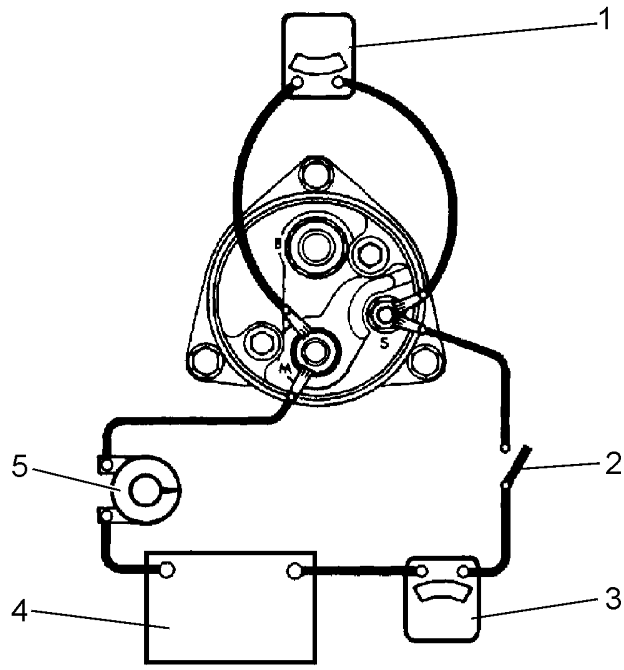

Fig. 8.18. Testing Pull-in Windings Solenoids
1. Voltmeter
2. Switch
3. Ammeter
4. Battery
5. Carbon Pile

WARNING! To prevent overheating, do not leave the pull-in winding energized more than 10 seconds. The current draw will decrease as the winding temperature increases.

A magnetic switch can be checked in the same manner by connecting across its winding.

o. Brushes Reassembly

To reassemble the brush plate assembly with brushes onto the field frame with armature in place, lift the brushes up so the spring contacts the **side** of the brush. Assemble to the field frame with the attaching screw. Lift up springs, and position brushes onto cummutator.

p. Lubrication

All bearings, wicks and oil reservoirs should be saturated with SAE 20 oil. Place a light coat of lubricant Delco Remy No. 1960954 on the washer located on the shaft between the armature and shift lever housing.

Sintered bronze bearings used in these motors have a dull finish, as compared to the early type machined, cast bronze bearings which had a shiny finish.

CRANKING MOTOR 42MT

Before pressing the bearing into place, dip it in SAE 20 oil. Also, tangent wicks should be soaked with SAE No. 20 oil. Insert the wick into place first, and then press in the bearing.

DO NOT DRILL, REAM OR MACHINE sintered bearings in any way!

These bearings are **supplied to size.** If drilled or reamed, the I.D., (Inside Diameter) will be too large, also the bearing pores will be sealed over.

It is not necessary to cross-drill a sintered bearing when used with a tangent wick. Because the bearing is so highly porous, oil from the wick touching the outside bearing surface will bleed through and lubricate the shaft.

Middle bearings are **support** bearings and prevent armature deflection during cranking. As compared to end frame bearings, the clearance between middle bearing and shaft is large and the clearance provides a loose fit when assembled.

r. Pinion Clearance

To check pinion or drive clearance follow the steps listed below.

1. Make connections as shown in Fig. 8.19.
2. **Momentarily** flash a jumper lead from ground return terminal to terminal MTR (Fig. 8.19). The drive will now shift into cranking position and remain so until the battery is disconnected.
3. Push the pinion or drive back towards the commutator end to eliminate slack movement.
4. Measure the distance between drive and housing (Fig. 8.20).
5. Adjust clearance by removing plug and turning shaft nut (Fig. 8.20).

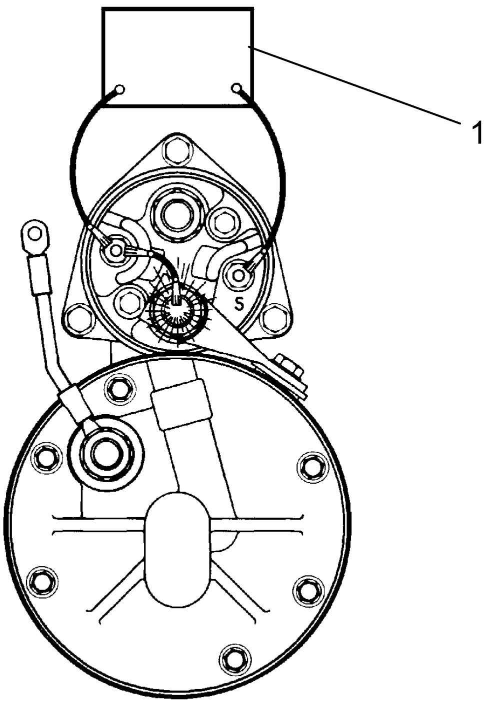

Fig. 8.19. Checking Pinion Clearance Circuit

1. Battery

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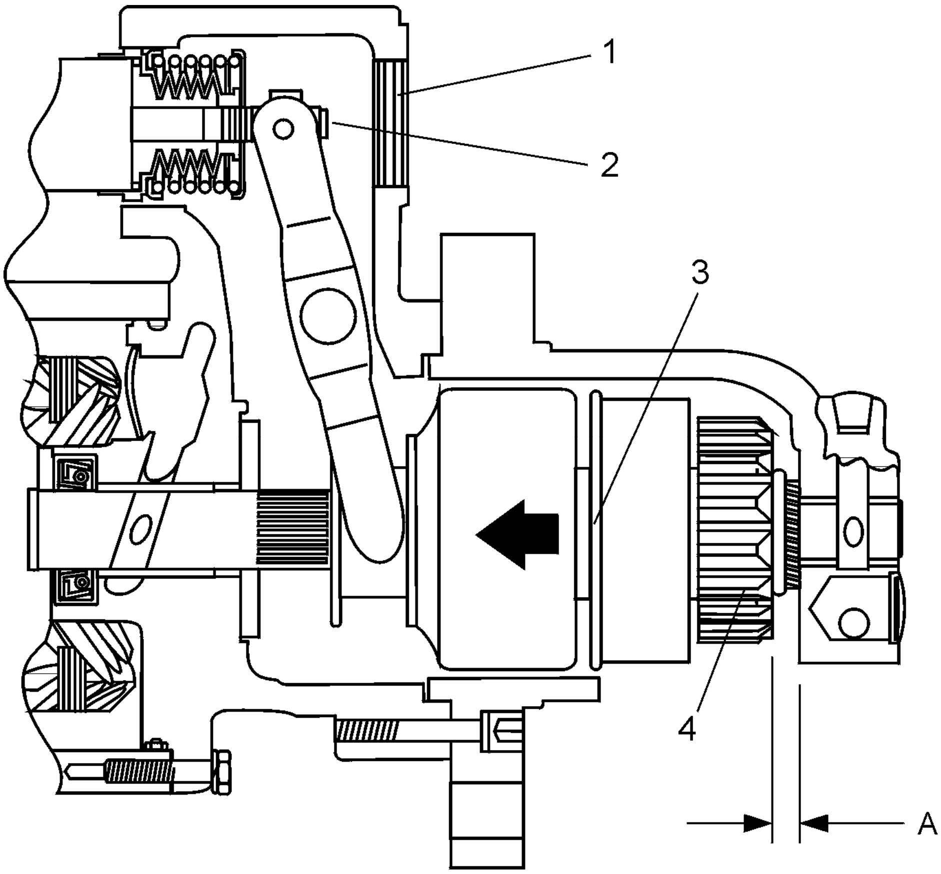


Fig. 8.20. Measuring Pinion Clearance

1. Plug Remove
2. Shaft Nut (Turn to Adjust Pinion Clearance)
3. Press on Drive to Take Up Movement
4. Pinion

A . . . . 8.3 – 9.9 [mm]

CRANKING MOTOR 39MT

NOTE: *New Delco Remy 39MT HD cranking motor for applications up to 16 liters replaces the old 42MT cranking motor.*

25. SPECIFICATIONS

Manufacturer type .... Delco Remy 39 MT HD
Maximum power .... 9.7 [HP]
Supply voltage .... 24 [V]
Pinion tooth 12
Noise housing bolts torque (SAE3 – 3 Bolt 120 degree) .... 43÷53 [Nm]

The technical and design features of the 39MT HD cranking motor as compared to the 42MT cranking motor are:

- Soft start engagement,
- Solid link solenoid,
- High solenoid barrier,
- Wet seal for both dry and wet flywheel housings,
- Enhanced reliability and durability.

NOTE: *The soft start engagement feature of the 39MT-HD increases the in-rush and steady-state current draw requirements compared to the 42MT. Due to the location of switches and safety equipment of some applications, the control side wiring is critical for the 39MT-HD. The Integral Magnetic Switch (IMS, see Fig. 8.23) option, when used with the current magnetic switch reduces the control side current draw for these type of applications. The IMS option provides the opportunity to use a shorter wiring run and reduces the number of attachment points. This should result in a higher quality installation.*

The 39MT HD cranking motor has the similar power as the 42MT, with the same battery configuration, but is a smaller, lighter package size as summarized in Table 1 below:

Table 1

Cranking motor	Weight [kg]	Frame OD [mm]	Mounting Length- flange to motor body[mm]	Mounting Length- flange to ground stud[mm]
39MT HD	~14	114	303	361
42 MT	~26	130	358	393

In general, the electrical requirements for the 39MT HD cranking motor are the same as to the 42MT except for the cranking motor solenoid relay current.

The design features and electrical requirements are summarized in Table 2 below.

Table 2

Profile	42 MT	39MT HD
Cranking motor Solenoid Relay Current	N.A. / 75 [A]	200 / 50* [A]
Cranking Circuit Resistance	Max. 0.002 [Ohm]	Max. 0.002 [Ohm]
Control Circuit Voltage Drop at 20 [°C]	Max. 2 [V]	Max. 2 [V]
Engagement	Positive	Soft Start
Ventilation Orientation	Not Applicable	+/- 30 [°]
Solenoid barrier	Normal or High	High
Seal	Wet or Dry	Wet

* - in-rush / steady-state current

CRANKING MOTOR 39MT

The 39MT HD cranking motor has metric threads and nuts for all connections Fig. 8.21. The tightening torques for the electrical connections on the cranking motor terminal are typically as follows (See Table 3).

Table 3

Terminal	Size	Torque [Nm]
Ground Terminal	M12 x 1.75	24.0 ÷ 28.0
Solenoid Battery Terminal - B+	M12 x 1.75	24.0 ÷ 28.0
Solenoid Switch Terminal – "S"	M5 x 0.8	2.0 ÷ 2.5
Switch Terminal - "M"	M6 x 1.0	2.4 ÷ 3.0

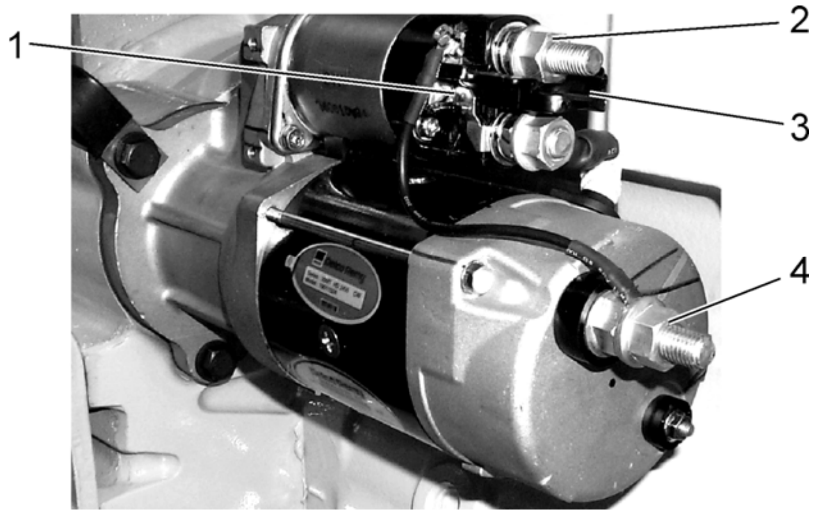


Fig. 8.21. Connection of 39MT HD Cranking Motor

1. Switch Terminal - "M"
2. Solenoid Battery Terminal - B+
3. Solenoid Switch Terminal - "S"
4. Ground Terminal

The 39MT HD cranking motor is more efficient than the earlier 42MT model, providing more output torque for stronger starts with a new planetary gear reduction design. This reduction also reduces heat build-up in the cranking motor. The open construction of the new 39MT HD allows for the release of any condensation that has formed or contamination that has penetrated the device, increasing the reliability of the motor. The smaller size of the 39MT HD provides better clearance, visibility, and access.

The Delco Remy electrical "Soft Start" system slowly rotates the pinion until it is properly engaged to the ring gear before cranking. This feature provides an additional measure of protection from the inputs that can cause pinion chipping and milling which can result in cranking motor failure.

ELECTRICAL

CRANKING MOTOR 39MT

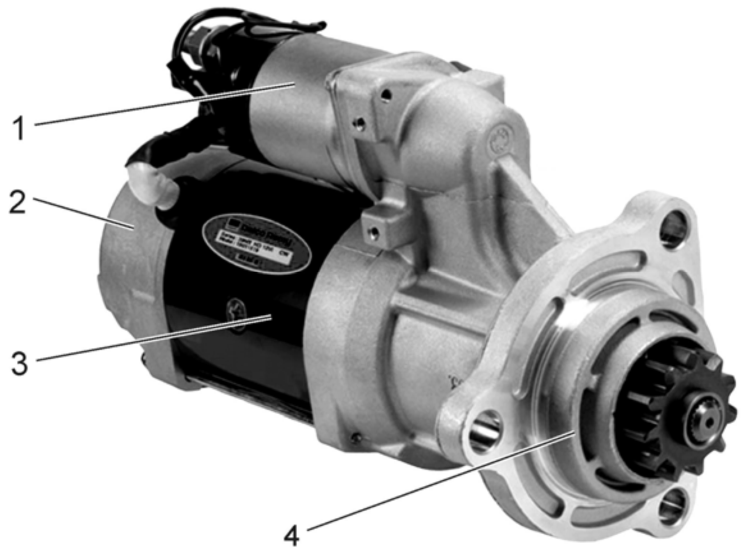


Fig. 8.22. View of 39MT HD Cranking Motor

1. Solenoid
2. End Cap
3. Field Frame
4. Nose Housing

The 39MT HD utilizes a diecast aluminum nose housing (4, Fig. 8.22) to interface with the engine flywheel housing while the 42MT utilizes a cast iron nose housing. The lower compressive yield of the aluminum nose housing requires the use of a mounting washer to prevent brinnelling. In addition to the new mounting hardware, a lower torque value is required as compared to the 42MT cranking motor.

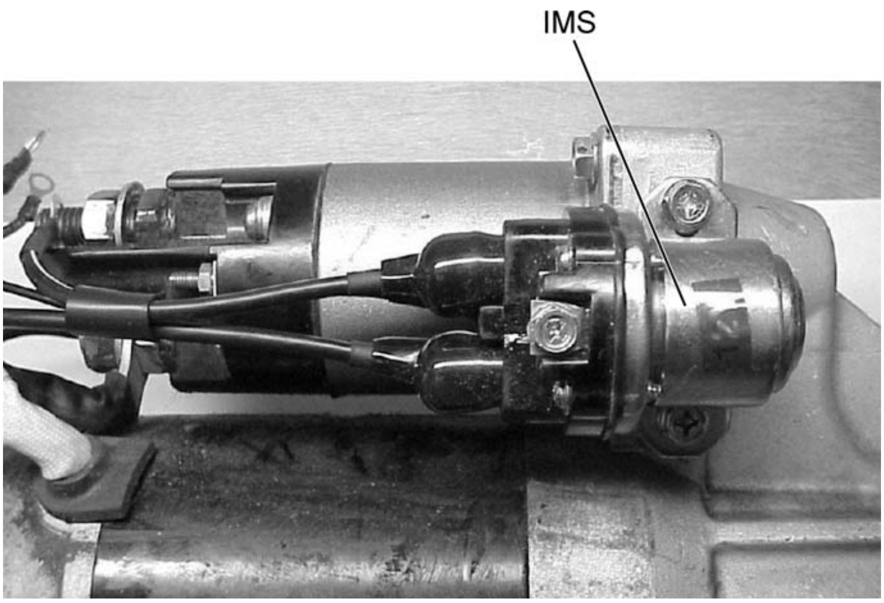


Fig. 8.23. View of 39MT Cranking Motor with Integral Magnetic Switch

IMS- Integral Magnetic Switch

SECTION 9

FRAME

FRAME

CONTENTS

GENERAL

FRAME

CROSSTUBE

FRAME

GENERAL

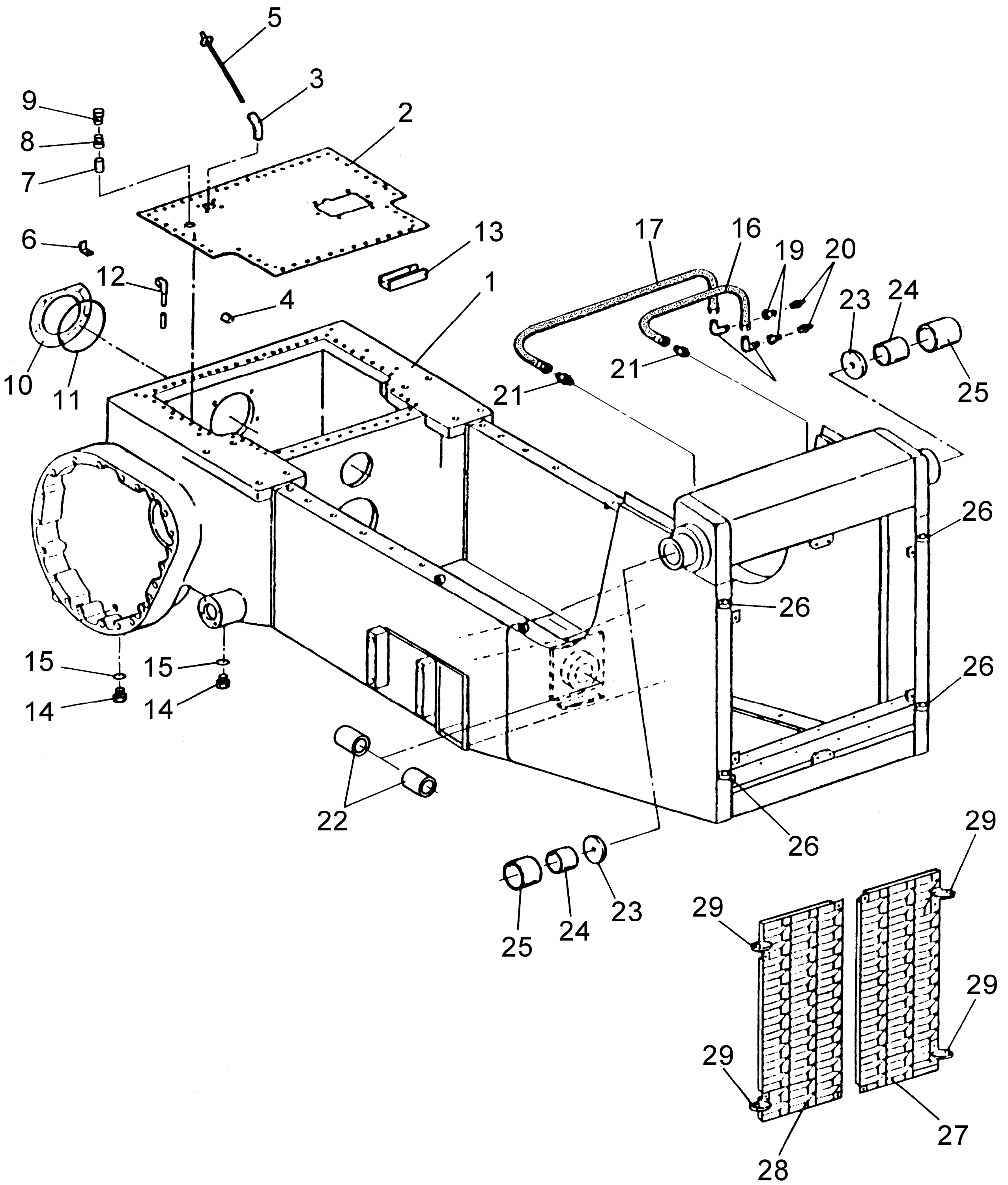


Fig. 9.1. View of Frame

FRAME

GENERAL

Legend for Fig. 9.1

1. Main Frame Assy
2. Cover
3. Oil Level Filler Tube
4. Plug
5. Oil Level Dipstick
6. Bracket
7. Pipe Nipple
8. Pipe Connector
9. Breather
10. Cover
11. O-Ring
12. Oil Level Gauge Sleeve
13. Magnet
14. Drain Plug
15. Plug Gasket
16. Hose
17. Hose
18. Elbow
19. Connector
20. Lube Fitting
21. Connector
22. Equalizer Bar Bushing
23. Plug
24. Bushing
25. Tube Bushing
26. Door Hinge
27. Louver L.H. Door
28. Louver R.H. Door
29. Door Hinge

1. DESCRIPTION

The main frame provides solid support and protection for individual drive train components. It is a one piece weldment consisting of the front frame, rear frame, equalizer bar tunnel and radiator guard.

The front section supports the engine and torque converter and includes an equalizer bar cross tunnel for attaching and housing the equalizer bar and an integral radiator guard for mounting the radiator.

The rear section consists the double wall side steel castings and supports the transmission, the steering drive and final drives. Cross members including equalizer bar tunnel, join the box section side members into rigid and durable structure. Hence, working loads applied to the rear frame by rear mounted attachments or to the crosstube by the blade, are distributed through the frame side members to the undercarriage not affecting the drive train components.

2. WELDING

WARNING! When welding, wear proper protective equipment, such as a helmet, dark safety glasses, protective clothing, gloves and safety shoes. do not look at the arc without proper eye protection.

Successful welding repairs require some knowledge of the materials being worked, use of the correct type and size of welding electrode and preparation of material to be welded. The alloy steels used in the construction of this machine have a low carbon content but have been heat treated to obtain maximum strength, hardness and wear resistance. To retain their strength, the steel members must not be subjected to high residual temperatures.

Any repair welding performed on the frame must be classified as a critical weld. Special attention must be given to the size, strength and surface quality of the repair.

FRAME

3. SPECIFICATIONS

Bushing I.D. (assembled in tunnel) . . . . 76.67 ± 0.09 [mm]

4. MAINTENANCE

A periodic inspection of the frame sections should be made to detect weld cracks, broken welds or damaged brackets. Special attention should be given to the seals bushings, guard and covers are in good condition.

To keep rust and corrosion to a minimum, periodic painting of abrasions and bare metal is recommended.

Change of Frame Bushing

1. Remove the equalizer bar (refer to SECTION 14).
2. Remove the bushings (22, Fig. 9.1) from tunnel.
3. Thoroughly clean bushing bores in tunnel before installing new bushing.
4. Properly align bushing with tunnel bore and press to seat bushing. Press bushing into tunnel until flush. Bushing bore after pressing into tunnel bore should be 76.67 ± 0.09 [mm]. Repeat this step for opposite side of tunnel.
5. Install the equalizer bar (refer to SECTION 14).

CROSSTUBE

5. SPECIFICATIONS

Inner bushing bore after pressing . . . . ø 108.08 + 0.15 [mm]
Outer bushing bore after pressing . . . . ø 114.43 + 0.15 [mm]
Inner bushing installation depth . . . . 189 ± 1.5 [mm]
Outer bushing installation depth . . . . 14 ± 1.5 [mm]

6. REMOVAL

1. Remove blade lift cylinder, (refer to SECTION 10C).
2. Remove the lift cylinder yokes (refer to SECTION 17).
3. Remove outer tube bushing (25, Fig. 9.1) and inner tube bushing (24) from crosstube by unseating them from their bores. Use extreme care as not to nick, scratch or deface bushing bores in crosstube.

CROSSTUBE

7. INSTALLATION

1. Thoroughly clean inner and outer bushing bores in crosstube before installing new bushing.
2. Slide new inner tube bushing (24, Fig. 9.1) into crosstube inner bushing bore and install a 10 ton ram. Properly align bushing with bore and apply hydraulic pressure to seat bushing. Remove the ram.
3. Slide new outer bushing (25) into crosstube outer bushing bore and install a 10 ton ram. Properly align bushing with bore and apply hydraulic pressure to seat bushing. Remove the ram.
4. Measure inner and outer bushing bores after they have been pressed into position. Inner bushing bore after pressing into crosstube bore should be 108.08 + 0.15 [mm]. Outer bushing bore after pressing into crosstube bore should be 114.43 + 0.15 [mm]. Hone bushing to size if they are below specification.
5. Liberally coat bushing bores and lift yoke bushing surfaces with fresh grease.
6. Install the lift cylinder yoke seal (refer to SECTION 17).
7. Install blade lift cylinder, (refer to SECTION 10C).
8. Lubricate crosstube bushings.

SECTION 10

HYDRAULICS

HYDRAULICS

CONTENTS

SERVICE /SPECIAL TOOLS

GENERAL

TEST AND ADJUSTMENT

SERVICE /SPECIAL TOOLS

1. SERVICE /SPECIAL TOOLS

DESCRIPTION	TOOL NUMBER
Digital Optical Tachometer	337 7462
Test Pressure Gauges Kit	910-50-0005
Tool to Check Fan Drive System Operation	910-50-0037

GENERAL

2. DESCRIPTION

The hydraulic system generally consists of the equipment hydraulic system and fan drive hydraulic system, which are interconnected to share a common hydraulic reservoir for efficient operation.

Equipment Hydraulic System (Fig.'s 10.1 and 10.2)

The equipment hydraulic system of the machine includes control, blade and ripper equipment circuits and it will depend upon the application and the attachments ordered. Fig.10.1 and Fig. 10.2 illustrate what is available and are to be used to trace the hydraulic oil flow. Following is a brief description of the hydraulic components.

Hydraulic Reservoir

The reservoir is bolted to the right fender next to the fuel tank. It is a one piece welded assembly with a 100 mesh magnetic suction strainer, and an external 170 [kPa] pressure 2 [kPa] vacuum relief breather. This vacuum relief valve will protect the pumps from cavitation as well as maintaining pressure in the reservoir. Refer to the OPERATOR'S MANUAL for service of this valve.
The reservoir acts as a storage tank for the dozer equipped hydraulic system oil. The remainder of oil fills the lines and system components.

Hydraulic Equipment Pump

The three section hydraulic pump is of the gear type. The pump is flange mounted to the torque converter and is driven by the torque converter accessory drive gear. The flow rate depends on the pump speed at which it is driven, refer to SPECIFICATIONS in this SECTION. For a further description of pump operation, refer to PUMPS in SECTION 10A.

Pilot Control System

The control valves used in this system are mounted on the right fender. This system utilizes either a one or three spool valve depending on whether or not a ripper is used and tilt control valve which will or tilt/pitch control valve which depend on optional equipment. The valves are controlled by pilot pressure and actuated by the pilot control valves mounted in the operator's compartment on the right side.

Hydraulic Cylinders

The blade and ripper cylinders are the single stage double acting type. Hydraulic pressure is introduced through ports at either end to actuate the piston.

GENERAL

One Spool Control Valve

A one spool control valve is used on machines not equipped with a ripper and it is controlled by pilot lines from the blade pilot control valve. The valve inlet cover contains an adjustable pilot operated main pressure relief valve which is used to by pass fluid from the pump back to the reservoir when the fluid pressure exceeds the relief valve setting. The spool is a spring centered, four position type with the FLOAT position being electromagnetically detented at the blade pilot control valve. Incorporated in the valve section is a spring loaded check valve which assures smooth operation when the spool is moved from hold to an operating position. An anticavitation valve is located in the blade lower circuit.

Three Spool Control Valve

A three spool control valve is used on machines equipped with a ripper and it is controlled by pilot lines from the equipment pilot control valves. The valve inlet cover contains an adjustable pilot operated main pressure relief valve which is used to by pass fluid from the pump back to the reservoir when the fluid pressure exceeds the relief valve setting. The blade lift section is a spring centered, four position type with the FLOAT position being electromagnetically detented at the blade pilot control valve. The ripper lift section is used for raising or lower the ripper. The ripper pitch section is used for pitching the ripper forward or rearward. The two ripper section spools are spring centered, three position type. Incorporated in all the sections are spring loaded check valves assure smooth operation when the spool is moved from hold to an operating position. An anticavitation valves are located in the blade lift section and ripper lift section lower circuits.

Blade Tilt Control Valve or Blade Tilt/Pitch Control Valve

This single spool valve consists of an working section, inlet and outlet portion. The working section spool is a three position type spring centered spool. A load check valve is located within the valve. A main relief valve is located in the port adjacent to the inlet section. An adjustable pilot operated tilt (tilt/pitch) pressure relief valve is used to by pass oil from the pump back to reservoir when oil pressure exceeds the relief valve settings. The tilt (tilt/pitch) valve contains a high pressure carry over tube which directs tilt (tilt/pitch) pump flow to the main control valve when no demand on the tilt (tilt/pitch) circuit occurs. The valve is controlled by pilot pressure which is actuated by pilot blade control valve.

Quick Drop Valve

The quick drop valve is used for accelerated movement and improved power efficiency when lowering of the blade is required. The valve is front main frame mounted and is located in the engine compartment inside of right side of frame wall. This hydraulically operated valve allows the blade to drop at a faster rate by diverting return oil through a spool to supplement the blade cylinder input oil from the piston side being used to lower the blade. The valve only diverts the return oil when the vacuum pressure is created in the piston side chamber. It occurs during lowering the blade with inadequate oil supply.

Pilot Pressure Valve

This valve serves two basic functions. First, it controls maximum oil pressure available for the blade and ripper (if equipped) control valve pilot circuits. Second, it provides the means for lowering the blade or ripper with a dead engine or no pilot pump flow.

Shuttle Valve Circuit

In a pilot controlled hydraulic system, pilot pressure is required to move the main control valve spools to actuate the cylinders. If the pilot pump would stop working for any reason while the blade or ripper was raised or the machine is raised on blade lift cylinders or if there would be no pilot flow available to lower the blade, ripper or machine, an alternate hydraulic power source is needed. It will be available from within the both side of blade or one side of ripper cylinder circuits.

GENERAL

Blade Double Tilt/Pitch Solenoid Valve (Blade Double Tilt/ itch Attachment)

The two-coil solenoid valve is used for switching the oil from blade tilt/pitch valve to blade tilt/pitch cylinders. In neutral position the solenoid valve sends oil to cylinder to get tilt the blade. When the blade double tilt solenoid is energized by switch, the coil shifts the solenoid spool to left position to get double tilt. The blade pitch solenoid is energized when the pitch button is pushed and the coil shifts the spool to the right position.

Blade Pilot Control Valve

This valve is a manually controlled for the blade lift, lower and tilt, mounted under vertical plate cover at right side of operator's seat in the operator's compartment. The valve is used to direct pilot oil pressure to the blade lift and tilt (tilt/pitch) valve sections for blade control. When the lever is released, it will return to neutral. A electromagnetic detent mechanism holds the control lever in the FLOAT position. Pilot pressure enters the control valve at the P port and is distributed through the passages to the metering spools. When the lever is in the centered (NEUTRAL) position, oil is active in the passages, but is blocked at the metering spools.
When the lever is moved to any direction, the pivot plate acts against the plunger pivot actuator. In turn, the actuator forces the plunger capsule open the metering spool directing pilot pressure oil to the blade lift section or tilt valve section. When the lever is released it will return to neutral. However, it will remain in the FLOAT position held by the electromagnet located in the valve retaining plate. The lever has to be manually released from the FLOAT position.

Ripper Pilot Control Valve

This valve is a manually controlled for ripper lift, lower and pitch, mounted under vertical plate cover at right side of operator's seat in the operator's compartment. The valve is used to direct pilot oil pressure to the ripper lift and pitch valve sections for ripper control. When the lever is released, it will return to neutral. Pilot pressure enters the control valve at the P port and is distributed through the passages to the metering spools. When the lever is in the centered (NEUTRAL) position, oil is active in the passages, but is blocked at the metering spools.
When the lever is moved to any direction, the pivot plate acts against the plunger capsule which in turn opens the metering spool directing pressure oil to the ripper lift or pitch valve section. When the lever is released it will return to neutral.

HYDRAULICS

GENERAL

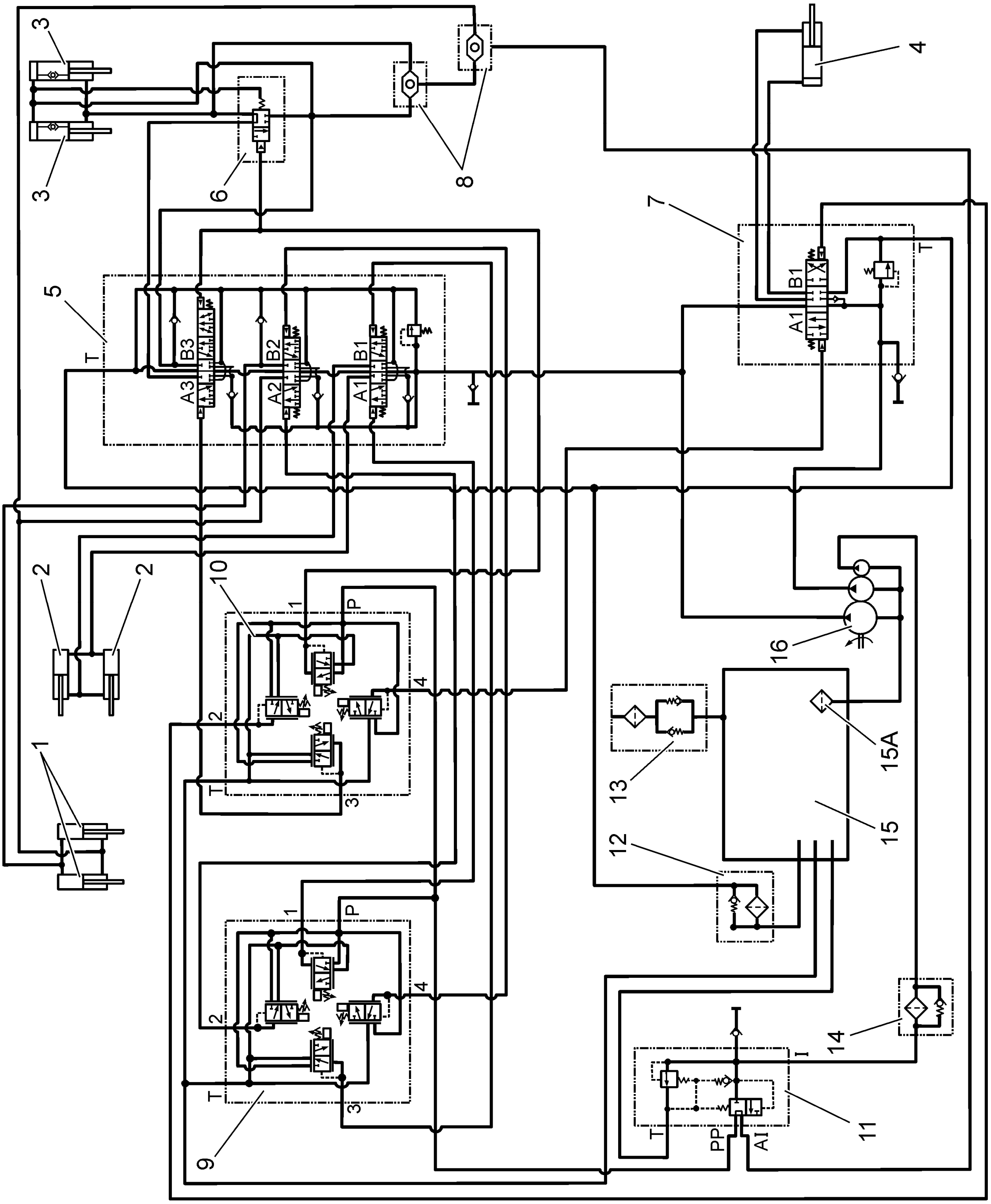


Fig. 10.1. Hydraulic Schematic, Blade Tilt Attachment

1. Ripper Lift Cylinder
2. Ripper Pitch Cylinder
3. Blade Lift Cylinder
4. Blade Tilt Cylinder
5. Three Spool Control Valve
6. Quick Drop Valve
7. Blade Tilt Control Valve
8. Shuttle Valves
9. Ripper Pilot Control Valve
10. Blade Pilot Control Valve
11. Pilot Pressure Valve
12. Return Filter
13. Breather Valve
14. Pilot Pressure Filter
15. Hydraulic Reservoir
15A. Suction Strainer
16. Hydraulic Three Section Pump

GENERAL

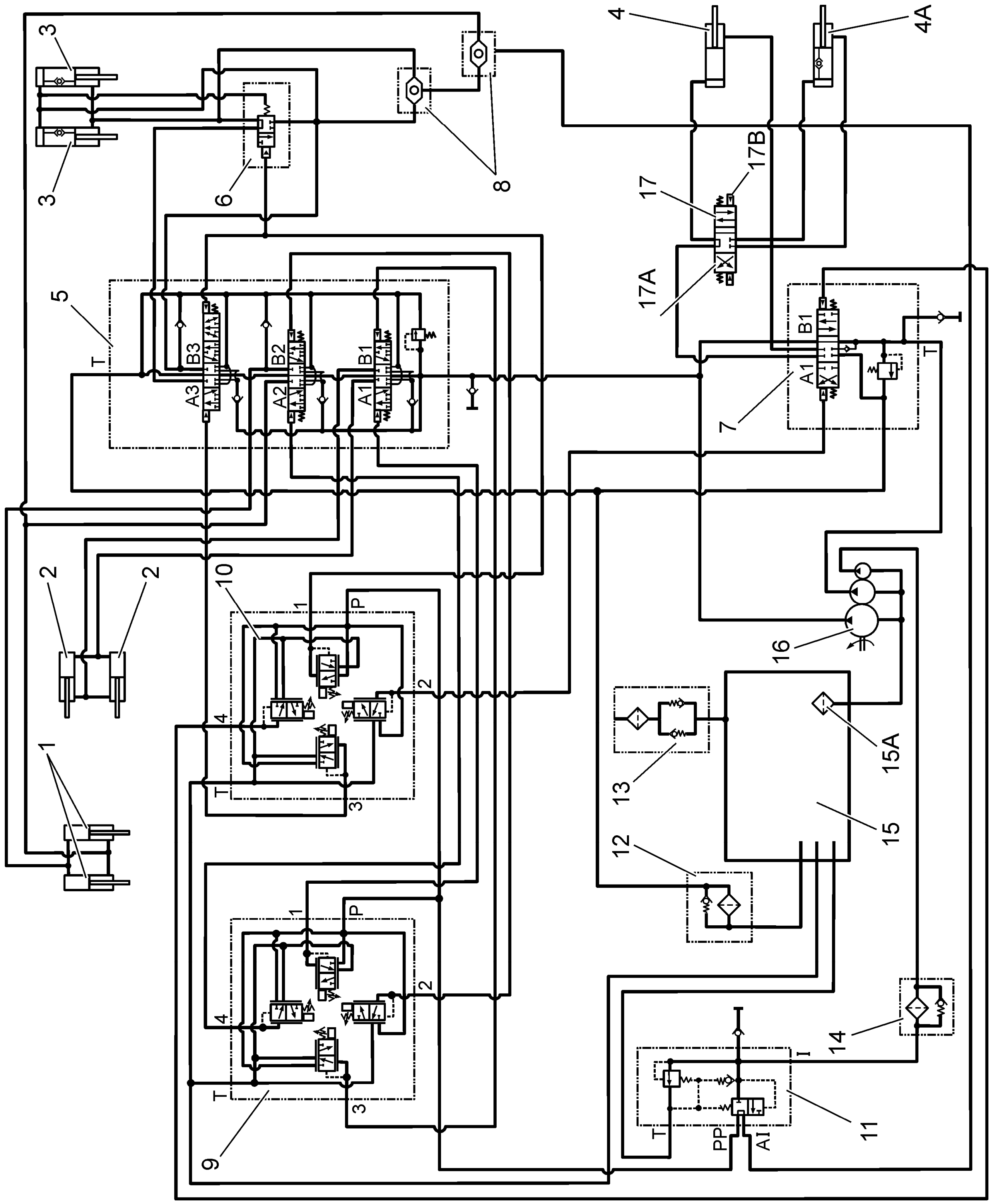


Fig. 10.2. Hydraulic Schematic, Blade Tilt/Pitch Attachment

1. Ripper Lift Cylinder
2. Ripper Pitch Cylinder
3. Blade Lift Cylinder
4. Blade Tilt Cylinder
4A. Blade Tilt/Pitch Cylinder
4B. Blade Double Tilt/Pitch Cylinder
5. Three Spool Control Valve
6. Quick Drop Valve
7. Blade Tilt Control Valve
8. Shuttle Valves
9. Ripper Pilot Control Valve
10. Blade Pilot Control Valve
11. Pilot Pressure Valve
12. Return Filter
13. Breather Valve
14. Pilot Pressure Filter
15. Hydraulic Reservoir
15A. Suction Strainer
16. Hydraulic Three Section Pump
17. Double Tilt/Pitch Solenoid Valve
17A. Pitch Solenoid Valve Coil
17B. Double Tilt Solenoid Valve Coil

HYDRAULICS

GENERAL

Fan Drive Hydraulic System (Figs. 10.3 to 10.6)

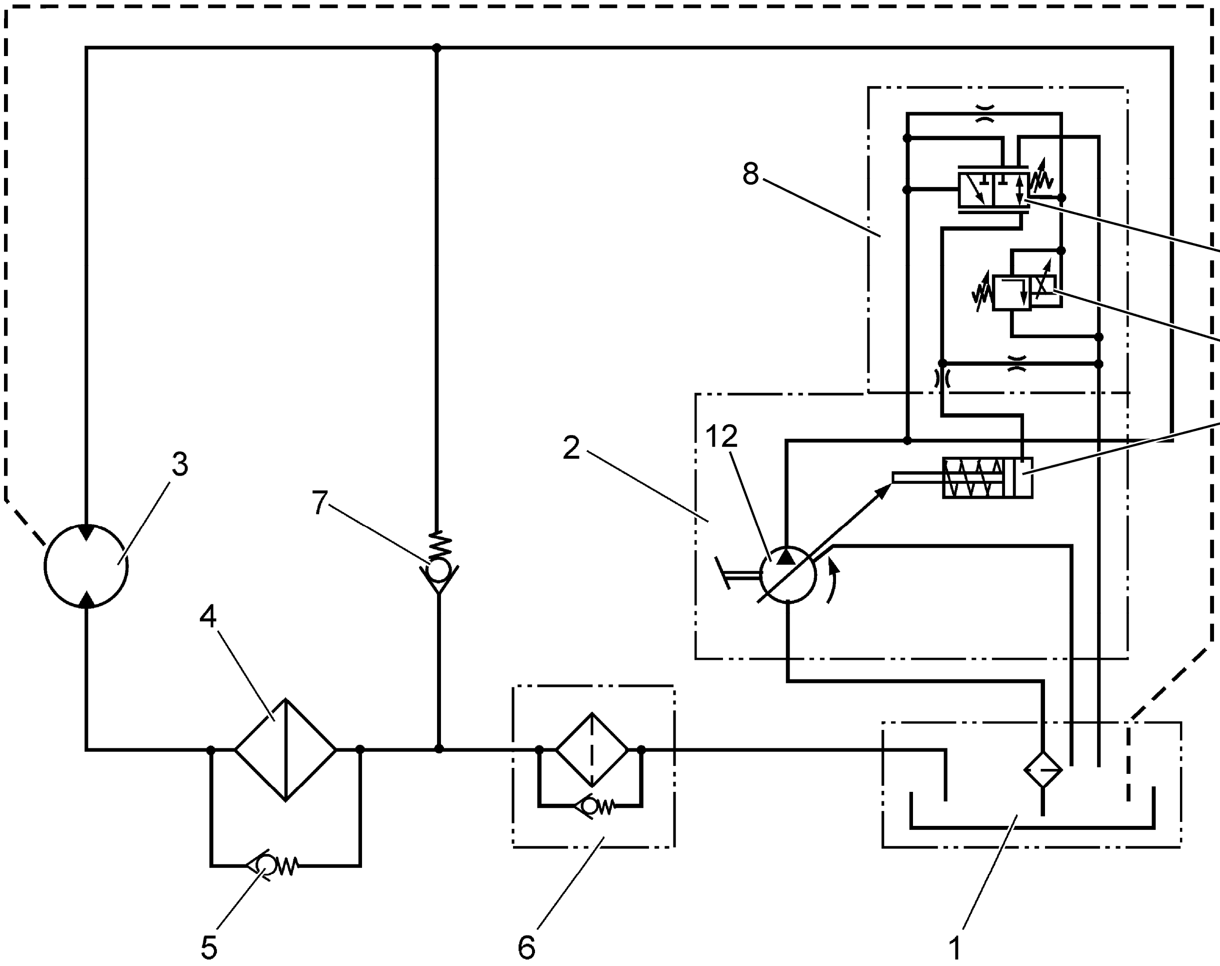


Fig. 10.3. Fan Drive Hydraulic Diagram

1. Hydraulic Reservoir with Suction Strainer
2. Fan Drive Pump with Control Cylinder
3. Fan Hydraulic Motor
4. Oil Cooler
5. By-pass Valve
6. Return Filter
7. Check Valve
8. Electro-hydraulic Pressure Control Module
9. Proportional Valve Solenoid
10. Pressure Valve
11. Pump Control Cylinder
12. Axial Piston Variable Pump

Generally, the fan drive system consists of mechanical and hydraulic portions. Mechanical portion of the fan drive system is detailed in SECTION 6, COOLING SYSTEM.

The hydraulic portion of the fan drive system consists of the common hydraulic reservoir (1), the fan drive pump with control cylinder (2) mounted on the torque converter (13) accessory drive, the fan drive hydraulic motor (3), check valve (7) and hydraulic oil cooler (4) with bypass valve (5). The fan drive axial piston variable pump (12) is controlled by cylinder (11), controlled in turn by electro - hydraulic pressure control module (8) mounted on the pump (12).

GENERAL

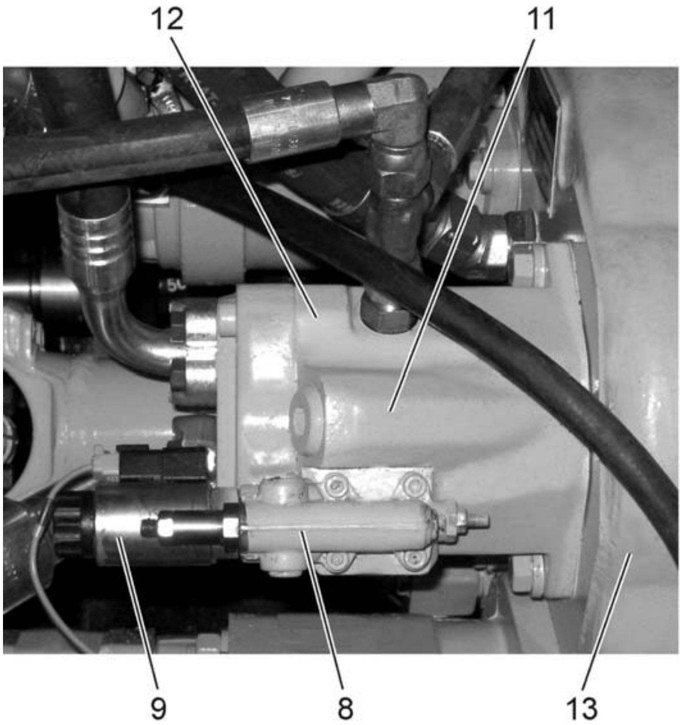


Fig. 10.4. Fan Drive Pump with Control Module (2) Location

8. Electro-hydraulic Pressure Control Module
9. Proportional Valve Solenoid
11. Pump Control Cylinder
12. Axial Piston Variable Pump
13. Torque Converter

Fig. 10.5. Fan Hydraulic Motor

3. Fan Hydraulic Motor
14. Fan (see SECTION 6)

At engine start-up, solenoid (9) of pump control module (8) is energized through the engine electronic control module (ECM). At this moment fan hydraulic motor (3) drives the fan with minimum rotating speed. In case any temperature raises in one of the following systems: drive train system, engine cooling system or engine charge air system, the temperature sensors placed in respective system lines send the signals to the engine ECM. Next, the engine ECM generates and send the control signal to the solenoid (9).

The proportional valve solenoid (9) controls the variable pressure valve (10). The pressure valve (10) controls pump cylinder (11). Pump (12) varies oil flow rate passing to the hydraulic motor (3), which drives the fan (14) from minimum to maximum speed range (refer to SPECIFICATION in this Section).

The fan drive pump output pressure depends on the current intensity to the proportional valve solenoid (9). If pump pressure drops below actual pressure, the pump will try to increase its displacement, hence the flow, to satisfy fan drive system demand. If the pressure reaches this pressure, the pump will adjust its displacement to the required system flow (no excess).

With the inverse proportional control maximum pump pressure level will go to standby pressure at maximum solenoid current, and to maximum pressure at zero current (failsafe in case ECM failure).

Overriding the current signal is an adjustable hydromechanical setting of maximum pressure.

For detailed description of the fan electrical control refer to Paragraph 3, MACHINE ELECTRICAL SYSTEM in SECTION 8, ELECTRICAL.

GENERAL

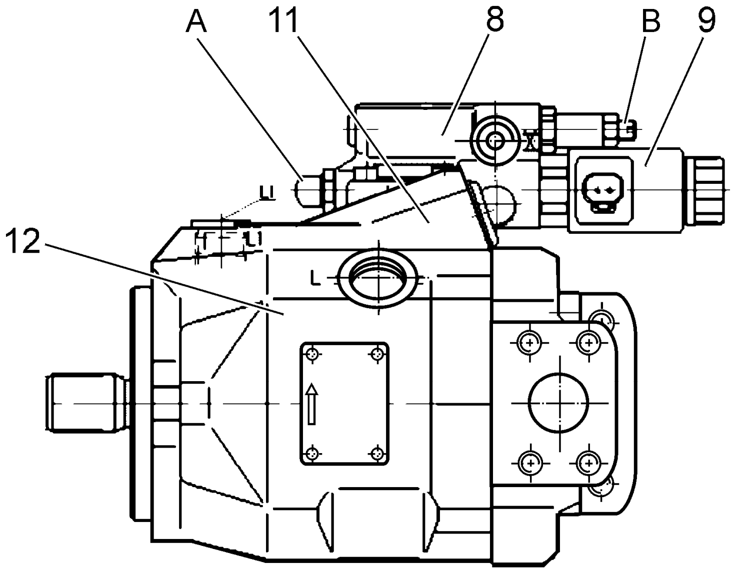


Fig. 10.6. Fan Drive Pump with Control Module

8. Electro-hydraulic Pressure Control Module
9. Proportional Valve Solenoid
11. Pump Control Cylinder
12. Axial Piston Variable Pump

A – Maximum Operating Pressure Adjuster
B – Standby Pressure Adjuster

3. SPECIFICATIONS

Hydraulic Pump

Front Section @ 6900 [kPa] and 2330 [RPM] . . . . 145 [l/min]
Middle Section @ 6900 [kPa] and 2330 [RPM] . . . . 62.4 [l/min]
Pilot Rear Section @ 6900 [kPa] and 2100 [RPM] . . . . 35.1 [l/min]

Pressure Settings

Main Pressure Relief Valve . . . . 16900 – 17600 [kPa]
Tilt Pressure Relief Valve . . . . 18100 – 18800 [kPa]
Pilot Control Pressure Relief Valve . . . . 2400 – 2560 [kPa]
Fan Drive System Maximum Operating Pressure . . . . 13600 – 14000 [kPa]
Fan Drive System Standby Pressure . . . . 2000 [kPa]

Fan Drive Performance

Minimum speed (at min/max engine RPM) . . . . below 680/950 [RPM]
At temperatures:
Engine coolant . . . . up to 85 [°C]
Engine charge air . . . . up to 45 [°C]
Drive train system oil . . . . up to 92 [°C]
Maximum speed (at min/max engine RPM) . . . . .1850/1960 [RPM]
At temperatures:
Engine coolant . . . . from 95 [°C] and above
Engine charge air . . . . from 61 [°C] and above
Drive train system oil . . . . from 115 [°C] and above

GENERAL

4. SERVICE DIAGNOSIS

This portion has been prepared to serve as a guide in locating the source of problems that may be encountered with hydraulic assy. In diagnosing problems it should be remembered that it is possible for a given symptom to be caused by any one of a number of deficiencies. It is also possible for a given deficiency to cause any one or more of various symptoms.

The following chart gives predominant symptoms and their primary causes, based on our experiences. When a number of possible causes of a complaint are given, they are listed in a logical sequence for checking and corrective action.

Tests given in TESTS AND ADJUSTMENTS are used to further pinpoint the problem.

Equipment Hydraulic System

COMPLAINT	
PROBABLE CAUSE	**REMARKS**
Noisy Operation, Oil Foaming	
1. Low oil level	Check level at sight gauge and fill as necessary. Check for external leaks and tighten or replace parts as necessary.
2. Oil viscosity too dense	Use recommended oil. Refer to OPERATOR'S MANUAL.
3. Dirty oil strainer in reservoir	Clean.
4. Dirty or faulty reservoir pressure/vacuum relief valve	Clean or repair.
5. Air leakage into hydraulic suction lines	Apply shave cream to all suction connections, and tighten where cream disappears.
Blade Lift Cylinder Drops	
1. Faulty one of blade lift circuit assembly	Refer to Paragraph 6, BLADE LIFT CYLINDER DRIFT TEST.
Ripper Lift Cylinders Drops	
1. Faulty one of ripper lift circuit assembly	Refer to Paragraph 7A and 7B, BLADE LIFT CYLINDER and RIPPER LIFT CYLINDER DRIFT TEST
Blade Tilt Circuit or Blade Tilt/Pitch Circuit Weak or Slow	
1. Internal leak in tilt or tilt/ pitch cylinder	Refer to Par. 9, PISTON PACKING TEST.
2. Internal leak in tilt control relief valve	Refer to Par. 5, RELIEF VALVE PRESSURE TEST.
3. Middle (blade tilt) section pump worn out	Refer to SECTION 10A, PUMPS.
Blade Lift and Ripper Cylinders Weak and/or Slow Movement	
1. Internal leak in main control relief valve	Refer to Par. 5, RELIEF VALVE PRESSURE TEST.
2. Front section pump worn out	Refer to SECTION 10A, PUMPS.
All Cylinders No or Slow Movement	
1. Insufficient oil supply	Refer to Noisy Operation Oil Foaming.
2. Pilot supply valve out of order	Refer to SECTION 10B, PILOT PRESSURE VALVE.
3. Rear pilot pump worn out	Refer to SECTION 10A, PUMPS.

GENERAL

COMPLAINT	
PROBABLE CAUSE	**REMARKS**
One Blade Lift or Tilt or Ripper Circuit Slow and/or No Movement	
1. Pilot control valve metering assy out of order	Repair or replace.
2. Control valve spool section out of order	Repair or replace suitable valve section. Refer to SECTION 10B, ONE or THREE SPOOL CONTROL VALVE or TILT CONTROL VALVE.
Blade Pitch Cylinders No Movement	
1. The pitch valve solenoid problem	Check 24 [V] on solenoid and spool movement.
Blade Double Tilt Cylinders No Movement	
1. The double tilt valve solenoid problem	Check 24 [V] on this solenoid and spools movement.
Ripper Pitch or Lift, Blade Tilt or Tilt/Pitch or Double Tilt/Pitch Cylinders Drop	
1. Problem in one of system	Refer to Paragraph 9, PISTON PACKING TEST.
Momentary Drop when Actuated from Hold	
1. Load check held of its seat	Clean system. Check for foreign matter.
2. Scored or worn load check valve or seat	Replace.
Oil Overheating	
1. Oil level too low	Fill to proper level.
2. Very light oil in a hot climate	Used recommended oil per the OPERATOR'S MANUAL.
3. Excessive feathering of controls	Review operating instructions in OPERATOR'S MANUAL.
4. Restricted return line of oil	Clean oil return line
Short Life of Pump	
1. Aeration or cavitation	Refer to Noisy Operation, Oil Foaming.
2. Reservoir pressure vacuum valve filter clogged	Clean or wash filter.
Blade and Ripper Cannot Be Lowered after Engine Shutdown	
1. Stuck spool or fatigued spring in pilot pressure valve	Repair or replace parts as necessary. Refer to SECTION 10B, PILOT PRESSURE VALVE

Fan Drive System

COMPLAINT	
PROBABLE CAUSE	**REMARKS**
Inadequate Cooling in the Following Systems: Drive Train System, Engine Cooling System or Engine Charge Air System	
1. Fan rotating speed out of specification	1. Refer to Fan Circuit in SECTION 8, ELECTRICAL. 2. Solenoid valve coil faulty or one of control module valves faulty. Replace control module. 3. Axial piston pump faulty. Replace pump.

TEST AND ADJUSTMENT

5. EQUIPMENT SYSTEM RELIEF VALVES PRESSURE TESTS

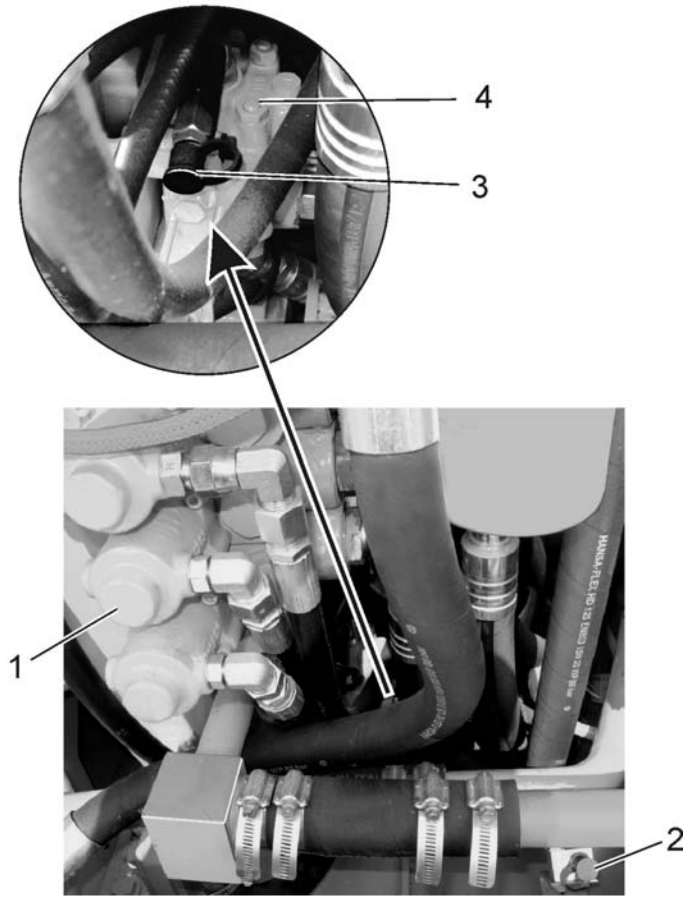


Fig. 10.7. Pressure Check Connect Port

1. One or Three Spool Control Valve
2. Main Pressure Quick Disconnect Fitting
3. Blade Tilt (Tilt/Pitch) Pressure Quick Disconnect Fitting
4. Blade Tilt (Tilt/Pitch) Control Valve
5. Pilot Pressure Quick Disconnect Fitting
6. Pilot Pressure Valve

This machine is provided with three control valve pressure relief valves, one in tilt (tilt/pitch) control valve, one in one or three spool control valve and one in pilot pressure valve. Tilt relief testing and adjustment must proceed lift and ripper relief valve adjustment in order to obtain correct pressures. Pressure checks should be performed with oil at operating temperature. To bring temperature up, move equipment control lever through all positions and bottom cylinders for a few seconds in each position.

NOTE: *Bottoming a cylinder for a short period of time will not damage hydraulic system; but an extended period will produce excessive heat and result in quick oil deterioration.*

TEST AND ADJUSTMENT

Blade Tilt (Tilt/Pitch) Relief Valve Pressure Test

1. Open the door from right side and connect an 40 [MPa] gauge with quick coupler (see SERVICE /SPECIAL TOOLS in this Section) to the quick disconnect fitting (3, Fig. 10.7).

NOTE: *Tilt/pitch attachment only; because of relief poppets in blade tilt/pitch cylinders, one of blade tilt control valve supply line to cylinder must be capped or piston rod must be stopped in the middle position. Lower blade to ground. Open the door from right side and disconnect end RH (or LH) tilt hose from tilt control valve (4, Fig. 10.7). Install a plug with O-ring and secure with hose split flanges at control valve. Cap disconnected hose.*

2. TILT/PITCH ATTACHMENT; Once operating temperature is reached, run engine at high speed and slowly move blade lift control lever to RH (or LH) blade tilt position. Read and record pressure on gauge at which relief valve unloads.
3. TILT ATTACHMENT; Once operating temperature is reached, run engine at high idle and slowly move tilt lever into a power position until cylinder is in an extreme position. Read and record pressure on test gauge at which relief valve unloads.
4. Repeat Step 1 or 2 with engine at low idle. Read and record pressure on gauge at which relief valve unloads.
5. Pressures obtained in Steps 1 or 2 should range from 18100 to 18800 [kPa]; if not proceed as follows:

   If both low and high idle pressure readings are similar but not as specified, system is operating correctly but relief valve must be adjusted. Refer to Step 6.

   If relief pressure is within 18100 - 18800 [kPa] at high idle but cannot be reached at low idle, refer to Paragraph 10, PRESSURE DIAGNOSTIC CHART in this SECTON.
6. Remove cap (1, Fig. 10.8) and outer seal washer (14) of relief valve. Loosen jam nut (3) and turn adjusting screw (2) clockwise to increase pressure or counterclockwise to decrease pressure. After correct pressure is obtained, retighten jam nut (3) while holding adjusting screw (2) from turning. Install cap (1) with outer seal washer (14). Recheck oil pressure.
7. TILT/PITCH ATTACHMENT; Remove plug from RH (or LH) tilt port and reconnect supply hose to valve port.
8. Remove test gauge from the quick disconnect fitting and close the door from right side.

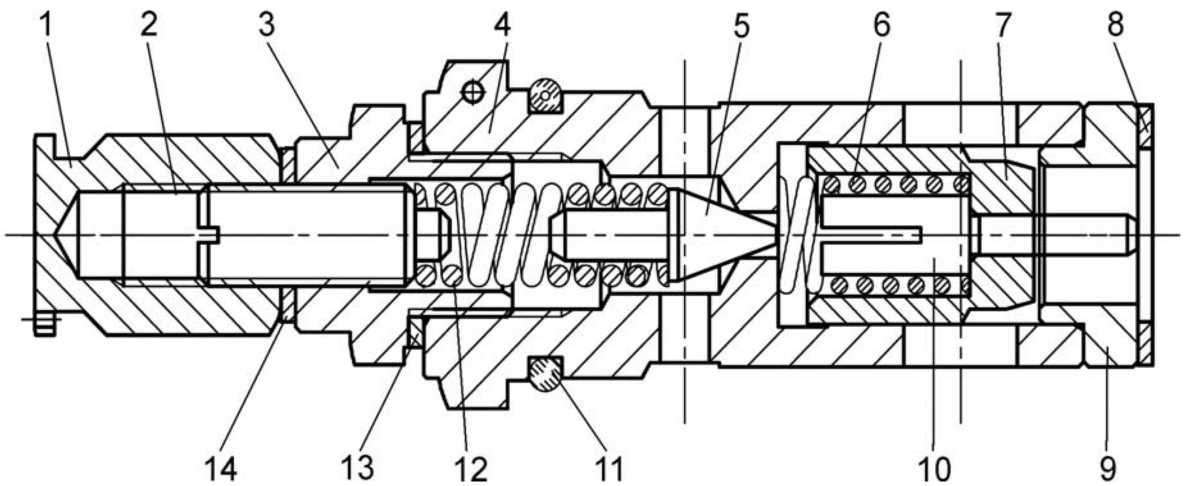


Fig. 10.8. Tilt Relief Valve

1. Valve Cap
2. Adjusting Screw
3. Jam Nut
4. Valve Body
5. Pilot Poppet
6. Spring
7. Piston
8. Seal Washer
9. Valve Seat
10. Spring Guide
11. O-Ring
12. Pilot Poppet Spring
13. Seal Washer
14. Seal Washer

TEST AND ADJUSTMENT

Blade Lift and/or Ripper Relief Valve Pressure Test

Open the door from right side and connect an 40 [MPa] gauge with quick coupler (see SERVICE /SPECIAL TOOLS in this Section) to the quick disconnect fitting (2, Fig. 10.7) and proceed as follows.

NOTE: *One spool control valve only; because of relief poppets in blade lift cylinders, raise supply line must be capped or piston rod must be stopped in the middle position. Lower blade to ground. Open the door from right side and disconnect end raise hose from control valve (1, Fig. 10.7). Install a plug with O-ring and secure with hose split flanges at control valve. Cap disconnected hose.*

1. ONE SPOOL VALVE; Once operating temperature is reached, run engine at high speed and slowly move blade lift control lever to raise position. Read and record pressure on gauge at which relief valve unloads.
2. THREE SPOOL VALVE; Once operating temperature is reached, run engine at high idle and slowly move ripper lift control level into a power position until cylinders are in extreme position. Read and record pressure on gauge at which relief valve unloads. Repeat this procedure with ripper pitch control lever.
3. Repeat Step 1 or 2 with engine at low idle. Read and record pressure on gauge at which relief valve unloads.

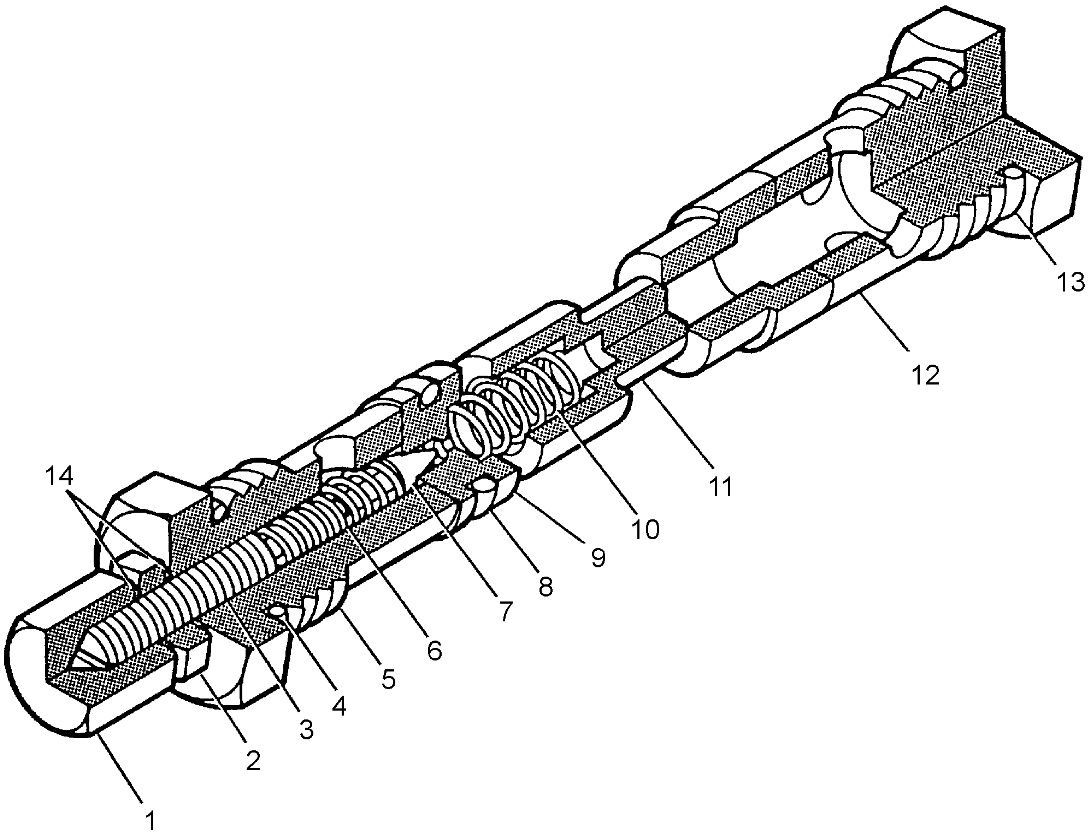


Fig. 10.9. One or Three Spool Control Valve Relief Valve

1. Acorn Nut
2. Jam Nut
3. Adjusting Screw
4. O-Ring
5. End Cap
6. Poppet Spring
7. Relief Poppet
8. O-Ring
9. Pilot Relief Seat
10. Check Valve Spring
11. Check Valve
12. End Cap
13. O-Ring
14. Washer

TEST AND ADJUSTMENT

4. Pressure obtained in Steps 1 or 2 and 3 should range over 16900 to 17600 [kPa], if not refer to Paragraph 10, PRESSURE DIAGNOSTIC CHART in this SECTION.
5. ONE SPOOL CONTROL VALVE; Remove plug from raise supply port and reconnect supply hose to valve port.
6. Remove test gauge from the quick disconnect fitting and close the door from right side.

Pilot Pressure Relief Valve Pressure Test

1. Open the door from right side and connect an 4 [MPa] gauge with quick coupler (see SERVICE /SPECIAL TOOLS in this Section) to the quick disconnect fitting (5, Fig. 10.7) and proceed as follows.
2. Once operating temperature is reached, run engine at high idle speed and read and record pressure on gauge at which relief valve unloads.
3. Repeat Step 2 with engine at low idle.
4. Pressure obtained in Steps 2 and 3 should be 2400 – 2560 [kPa], if not refer to Paragraph 10, PRESSURE DIAGNOSTIC CHART in this SECTION.
5. Remove test gauge from the quick disconnect fitting and close the door from right side.

6. BLADE LIFT CYLINDERS DRIFT TEST (MACHINE WITHOUT RIPPER)

The problem of cylinders drift can be traced to two main causes, which are internal and external leakage. External leakage is not detailed here, since it can be visually. Internal leakage is not always readily pinpointed to its source and may require a series of tests to isolate the problem.

There are six places that might be a source of leakage; one of hydraulic cylinders might be leaking past piston packing or piston poppet(s), control valve could leak at spool and/or quick drop valve spool could be stuck, shuttle valve(s) could leak, pilot pressure valve could leak or blade pilot control valve could leak.

Following is a series of tests to trace the source of internal leakage.

1. Raise and lower blade through its full travel to wash out any foreign material which might prevent piston by pass poppets from seating. Oil temperature should be 82 - 88 [°C].
2. Fully raise blade and move lever to LOWER position releasing it to HOLD before blade drops to ground.
3. Perform blade lift cylinders drift test. Check cylinders for drift, rods should travel out of cylinders no more than 18 [mm] per minute.

NOTE: *The 18 [mm] per minute figure represents the accumulative allowable loss of cylinders, control valve and valves.*

4. If cylinders drift is more than 18 [mm] per minute lower blade and follow below mentioned procedure. Refer to HYDRAULIC CHART Fig. 10.10.
5. Fully lower the blade to raise the front side of machine up. Slightly move the lever to LOWER position and release it to HOLD. Perform blade lift cylinders drift test. Check cylinders for drift. If cylinders drift is much less than checked in point 4 the problem is inside of one blade cylinder. Refer to PISTON PACKING TEST.

TEST AND ADJUSTMENT

6. If cylinders drift is still the same, raise the blade and support it on some block. Plug the pilot pressure valve (11) at point **PP**. Go back with machine to free the blade. If cylinders drift is much less than checked in point 4, blade pilot control valve is faulty. Repair or replace the valve. Refer to BLADE PILOT CONTROL VALVE in SECTION 10B. If cylinders drift is still the same proceed to next point.
7. Raise the blade and support it on some block. Plug the pilot pressure valve (11) at point **AI**. Go back with machine to free the blade. If cylinders drift is much less than checked in point 4, pilot pressure valve is faulty. Repair or replace the valve. Refer to PILOT PRESSURE VALVE in SECTION 10B. If cylinders drift is still the same proceed to next point.
8. Raise the blade and support it on some block. Plug the one spool control valve (5) in point "**A3**". Go back with machine to free the blade. Stop the machine and check for drift. If cylinders drift is much less than checked in point 4, control valve is faulty. Repair or replace the valve. Refer to ONE SPOOL CONTROL VALVE in SECTION 10B. If cylinders drift is still the same, the quick drop valve is faulty. Repair or replace the valve. Refer to QUICK DROP VALVE in SECTION 10B.
9. When proceeding tests are completed, vent hydraulic system and add oil as necessary. Refer to the OPERATOR'S MANUAL. Visually check for oil leakage.

7A. BLADE LIFT CYLINDERS AND RIPPER LIFT CYLINDERS DRIFT TEST (MACHINE WITH RIPPER) /BLADE AND RIPPER LIFT CYLINDERS ARE DROPPING/

There are three places that might be a source of leakage for both ripper and blade cylinders; pilot pressure valve could leak, ripper pilot control valve could leak or blade pilot control valve could leak.

Following is a series of tests to trace the source of internal leakage.

1. Raise and lower ripper and blade through its full travel. Oil temperature should be 82 - 88 [°C].
2. Lower the blade to the ground.
3. Fully raise ripper and move lever to LOWER position releasing it to HOLD before ripper drops to ground.
4. Perform ripper lift cylinders drift test. Check cylinders for drift, rods should travel out of cylinders no more than 16 [mm] per minute.
5. Lower the ripper to the ground.
6. Fully raise the blade and move the blade lift lever to LOWER position releasing it to HOLD before the blade drops to the ground
7. Perform blade lift cylinders drift test. Check cylinders for drift, rods should travel out of cylinders no more than 18 [mm] per minute.

TEST AND ADJUSTMENT

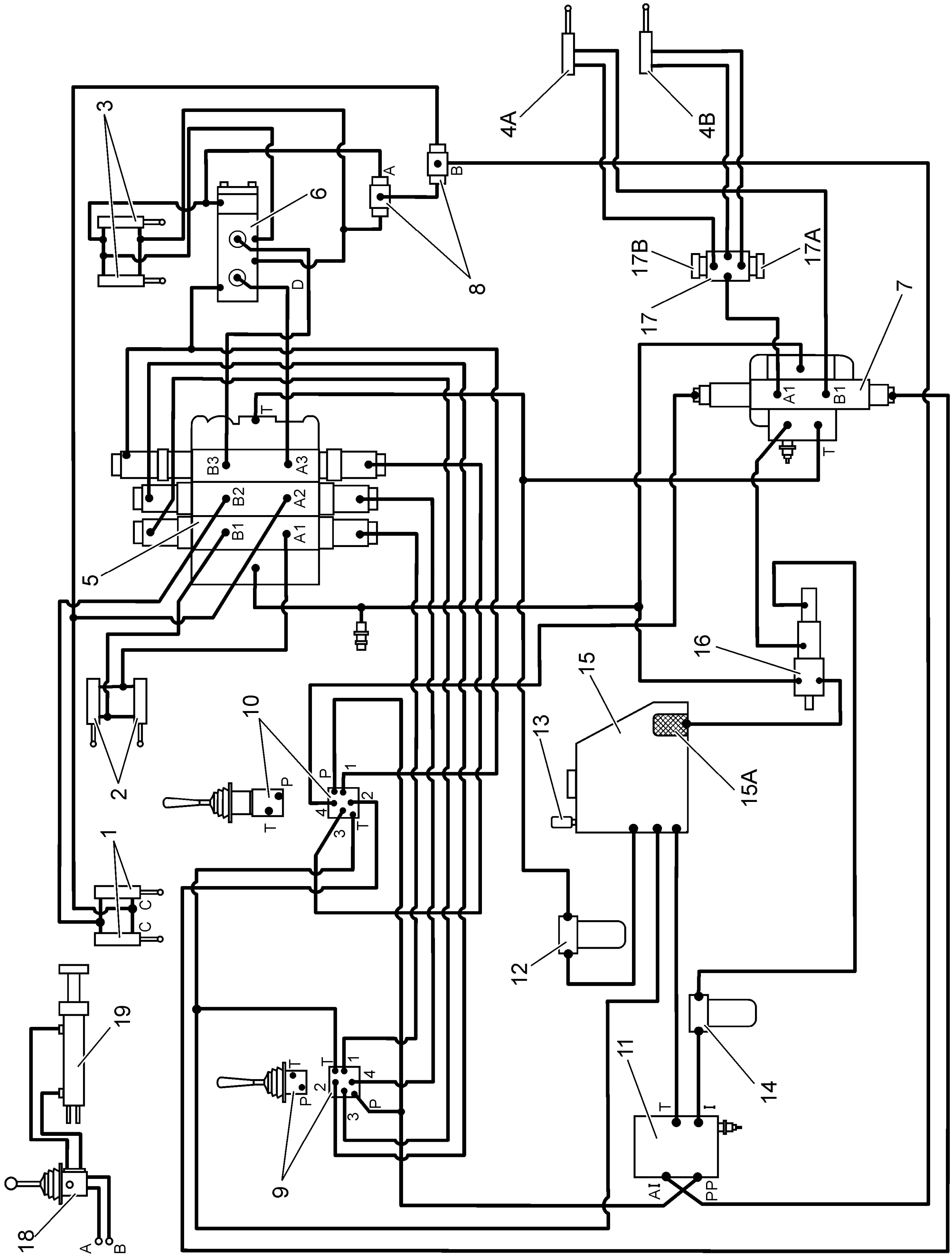


Fig. 10.10. Hydraulic Chart, Blade Tilt/Pitch Attachment

TEST AND ADJUSTMENT

Legend for Fig. 10.10

1. Ripper Lift Cylinders
2. Ripper Pitch Cylinders
3. Blade Lift Cylinders
4A. Blade Tilt/Pitch Cylinder
4B. Blade Double Tilt/Pitch Cylinder
5. Three Spool Control Valve
6. Quick Drop Valve
7. Blade Tilt Control Valve
8. Shuttle Valves
9. Ripper Pilot Control Valve
10. Blade Pilot Control Valve
11. Pilot Pressure Valve
12. Return Filter
13. Breather Valve
14. Pilot Pressure Filter
15. Hydraulic Reservoir
15A. Suction Strainer
16. Hydraulic Three Section Pump
17. Double Tilt/Pitch Solenoid Valve
17A. Pitch Solenoid Valve Coil
17B. Double Tilt Solenoid Valve Coil
18. Pin Puller Valve
19. Pin Puller Cylinder

A. Oil Supply from Pressure Regulator Valve **M** Port Located at Steering Valve
B. Drain to Rear Frame

8. If ripper cylinders drift is more than 16 [mm] per minute and blade cylinders drift is more than 18 [mm] per minute lower the blade and ripper and follow below mentioned procedure. Refer to HYDRAULIC CHART Fig. 10.10.
9. Plug blade pilot control valve (6) at point **P**. If cylinders drift is much less than checked in point 4 or 7, blade pilot control valve is faulty. Repair or replace the valve. Refer to BLADE PILOT CONTROL VALVE in SECTION 10B. If cylinders drift is still the same proceed to next point.
10. Plug ripper pilot control valve (7) at point **P**. If cylinders drift is much less than checked in point 4 or 7, ripper pilot control valve is faulty. Repair or replace the valve. Refer to RIPPER PILOT CONTROL VALVE in SECTION 10B. If cylinders drift is still the same, pilot pressure valve is faulty. Repair or replace the valve. Refer to PILOT PRESSURE VALVE in SECTION 10B.
11. When proceeding tests are completed, vent hydraulic system and add oil as necessary. Refer to the OPERATOR'S MANUAL. Visually check for oil leakage.

7B. RIPPER LIFT CYLINDERS DRIFT TEST /BLADE LIFT CYLINDERS ARE NOT DROPPING/

There are two places that might be a source of leakage; one of hydraulic cylinder could leak post piston packing and second of control valve could leak at its spool.

Following is a test to trace the source of internal leakage.

1. Raise and lower ripper and blade through its full travel. Oil temperature should be 82 - 88 [°C].
2. Lower the blade to the ground.
3. Fully raise the ripper and move the ripper lift lever to LOWER position releasing it to HOLD before the ripper drops to the ground.
4. Perform ripper lift cylinders drift test. Check cylinders for drift, rods should travel out of cylinders no more than 16 [mm] per minute.
5. If ripper lift cylinders drift is more than 16 [mm] per minute lower the ripper and proceed to the next point.
6. Fully lower the ripper to raise the rear of machine up. Slightly move the lever to LOWER position releasing it to HOLD. Perform ripper lift cylinders drift test. If ripper cylinders drift is much less than checked in Point 5 one of ripper cylinders is leaking. Proceed to PISTON PACKING TEST in this SECTION to find which one is faulty.
7. If ripper cylinders drift is still the same control valve spool is leaking. Proceed to THREE SPOOL CONTROL VALVE in SECTION 10B.
8. When proceeding tests are completed, vent hydraulic system and add oil as necessary. Refer to the OPERATOR'S MANUAL. Visually check for oil leakage.

TEST AND ADJUSTMENT

8. CYLINDER TIME CYCLE

Blade Tilt

NOTE: *Before performing cylinder time cycle, perform PISTON PACKING TEST to insure that cylinder is satisfactory. If cylinder is satisfactory, but tilt circuit is weak or slow, problem could be either hydraulic pump or tilt relief valve. Loss of flow can be caused by worn pump or by tilt relief valve not sealing, allowing oil to flow into reservoir passage.*

To check tilt relief valve refer to EQUIPMENT SYSTEM RELIEF VALVES PRESSURE TESTS in this Section.

To check pump, following time cycles should be observed when tilting blade to left and to right.

1. Lift blade off ground. Position the blade 300 [mm] over the ground with tilt/pitch cylinders piston rods pulled out in their pitch midposition (for tilt/pitch attachment only); and next place the blade in its extreme double tilt left position. Oil temperature should be 50 - 60 [°C].
2. Run engine at high idle speed. Starting with blade in its extreme (double) tilt left position, put control lever in RIGHT TILT/DOUBLE TILT and read and record time it takes for blade to reach its extreme right position. SINGLE TILT cycle should take no more than 5,0 seconds (2.5 seconds for DOUBLE TILT). Starting with blade in its extreme (double) tilt right position, put control lever in LEFT TILT/DOUBLE TILT and read and record time it takes for blade to reach its extreme left position. SINGLE AND DOUBLE TILT cycles should take no more than 5,0 and 2.5 seconds respectively, too. Repeat left to right and right to left several times and take an average of readings.
3. If average cycle times are more than 8.0 seconds or 4 seconds (SINGLE TILT cycle or DOUBLE TILT cycle respectively), middle section pump should be repaired or replaced as necessary.

NOTE: *In case of fully retracted (or pulled out) blade tilt/pitch cylinders, maximum cylinder time DOUBLE TILT cycle can reach 6.0 seconds.*

Blade Lift

NOTE: *Before performing cylinder time cycle test, perform cylinder blade tilt test to insure that middle pump is correct.*

NOTE: *Before performing cylinder time cycle test, perform blade lift cylinder drift test to insure that control valve, cylinders and valves are performing satisfactorily.*

If there is no excessive drift when blade lift control is in HOLD position, but slow load speed, slow response or low power is present in RAISE position, problem could be either hydraulic pump or pressure relief valve. Loss of flow can be caused by pressure relief valve not sealing, allowing oil to flow into return to reservoir passage. Refer to EQUIPMENT SYSTEM RELIEF VALVE PRESSURE TESTS in this Section.

To check pump, following time cycles should be observed when raising blade.

1. Position machine so that blade will not touch ground in its fully lowered position. Run engine at high idle speed. Oil temperature should be 50 - 60 [°C].
2. Starting with blade in its fully lowered position, put control lever in RAISE and record time it takes blade to reach full raised position. Repeat this procedure several times and average time readings.
3. Lift cycle should take not more than 3.5 seconds. If average cycle time is more than 5.5 seconds, front pump should be repaired or replaced as necessary.

NOTE: *This check should be made only in blade raising cycle.*

TEST AND ADJUSTMENT

Ripper Lift

NOTE: *Before performing ripper cylinders time cycle test, perform cylinder blade tilt test to insure that middle pump is correct.*

NOTE: *Before performing cylinder time cycle test, perform ripper lift cylinder drift test to insure that control valve, cylinders and valves are performing satisfactorily.*

If there is no excessive drift when ripper lift control is in HOLD position, but slow load speed, slow response or low power is present in RAISE position, problem could be either hydraulic pump or pressure relief valve. Loss of flow can be caused by pressure relief valve not sealing, allowing oil to flow into return to reservoir passage. Refer to EQUIPMENT SYSTEM RELIEF VALVE PRESSURE TESTS in this Section.

To check pump, following time cycles should be observed when raising ripper.

1. Position machine so that ripper will not touch ground in its fully lowered position. Run engine at high idle speed. Oil temperature should be 50 - 60 [°C].
2. Starting with ripper in its fully lowered position, put control lever in RAISE and record time it takes ripper to reach full raised position. Repeat this procedure several times and average time readings.
3. Lift cycle should take not more than 2.5 seconds. If average cycle time is more than 4.0 seconds, front pump should be repaired or replaced as necessary.

NOTE: *This check should be made only in ripper raising cycle.*

9. PISTON PACKING TEST

Blade Tilt and Ripper Cylinders Test

1. Position machine so that cylinder(s) to be tested can be completely extended. Start engine, completely extend cylinder(s) and place control lever in HOLD. Stop engine. Remove rod end hose.

WARNING! During next step, pressurized oil may be expelled from cylinder.

2. Hydraulically extend cylinder(s) again and check rod end port of cylinder(s) for oil flow. If oil flows, remove and repair the cylinder. Refer to SECTION 10C, CYLINDERS.

Blade Lift and Blade Tilt/Pitch Cylinders Test

1. Disconnect the one of blade lift or blade tilt/pitch cylinders piston rod from the blade. Start the engine and retract cylinder to position slightly extended. Stop the engine. Tie the end of rod to the head of cylinder. Repeat the same for the second cylinder. Remove rod end hose and plug the second cylinder hose hole.

WARNING! During next step, pressurized oil may be expelled from cylinder.

2. Hydraulically extend cylinder again and check rod end port of cylinder for oil flow. If oil flows, remove and repair the cylinder.
3. Repeat this procedure for the second cylinder. Refer to SECTION 10C, CYLINDERS.

TEST AND ADJUSTMENT

10. PRESSURE DIAGNOSTIC CHART

PROBLEM	PROBABLE CAUSE
1. Low pilot oil pressure at low and high idle	Pilot pressure valve problem. Dismantle valve for inspection and repair. Refer to SECTION 10B, VALVES.
2. Low pilot oil pressure at low idle only	Worn rear pilot pump. Refer to SECTION 10A, PUMPS.
3. Low tilt oil pressure at low and high idle for tilt cylinder(s) (tilt/pitch if equipped)	Tilt relief valve not sealing. Dismantle relief valve for inspection and repair. Refer to SECTION 10B, VALVES
4. Low tilt oil pressure at low idle only for tilt (tilt/pitch if equipped). Low main oil pressure at low idle only also	Worn middle pump. Refer to SECTION 10A, PUMPS.
5. Low tilt oil pressure at low idle only for tilt (tilt/pitch if equipped). Main oil pressure is correct.	One of cylinders leaking. Refer to PISTON PACKING TEST in this Section.
6. Low main oil pressure at low and high idle for both blade lift and ripper cylinders	Main relief valve not sealing. Dismantle relief valve for inspection and repair. Refer to SECTION 10B, VALVES
7. Low main oil pressure at low idle only for both blade lift and ripper cylinders	Worn front pump. Refer to SECTION 10A, PUMPS
8. Low main oil pressure at low idle only for one cylinder pair (either blade or ripper)	One of cylinders leaking. Refer to Paragraph 6, 7A or 7B, CYLINDERS DRIFT TEST in this Section.

11. FAN DRIVE SYSTEM PERFORMANCE TEST

WARNING! Be sure the area in front and behind the machine is clear of personnel and obstructions. DO NOT allow anyone near the trucks or on the access steps during this test.

NOTE: *Performing test will require two people, one person to operate the machine, the second person to time the machine's performance.*

1. Make sure that no engine fault warning light at the instrument panel is alight before you attempt to check the fan drive system for correct operation. If a fault is spotted, check the fault type based on fault code as described in the OPERATOR'S MANUAL.
   Below please find a description of fault codes for fan drive system.
   - fault code 293 and 294 will tell fan drive system temperature sensor and/or its circuit is at fault. Proceed to repair as described in SECTION 8, ELECTRICAL.
   - fault code 144 and 145 will tell engine coolant temperature sensor and/or its circuit is at fault.
   - fault code 153 and 154 will tell engine air intake temperature sensor and/or its circuit is at fault.
   - fault code 245 and 2377 will tell the ECM and/or wire harness providing power to pump pressure control module solenoid and/or the solenoid is at fault.

TEST AND ADJUSTMENT

All faults mentioned above can be cleared as described in „Troubleshooting and Repair Manual ISB, ISBe4, QSB4.5, QSB5.9, QSB6.7, ISC, QSC8.3, ISL, ISLe3 and QSL9 Engines, CM850 Electronic Control System, Bulletin 4021416” using INSITE™ software of Cummins or by Authorized Cummins Service.

Procedure for checking fan drive system for correct operation.

1. Open the L.H. side door of engine compartment from left side and connect an 40 [MPa] gauge with quick coupler (see SERVICE /SPECIAL TOLS in this Section) to the quick disconnect fitting (3, Fig. 10.11).
2. Start the engine. Use a Digital Optical Tachometer (see SERVICE /SPECIAL TOOLS in this Section) to record fan minimum speed (at max engine RPM). Do it with the engine coolant, engine charge air and drive train system oil temperatures below minimum values given in SPECIFICATIONS in this Section.
3. Stop the engine. Turn the master switch off and wait 30 seconds. Disconnect the electrical harness from the proportional valve solenoid (9, Fig. 10.6) of the pump. Start the engine again. With disconnected valve solenoid the fan speed should increase to its maximum RPM level immediately. With engine at maximum RPM, record the fan drive system oil pressure. Refer to **Pressure Settings**, SPECIFICATIONS in this Section. Stop the engine. Turn the master switch off, wait 30 seconds and reconnect the electrical harness to proportional valve solenoid (9).

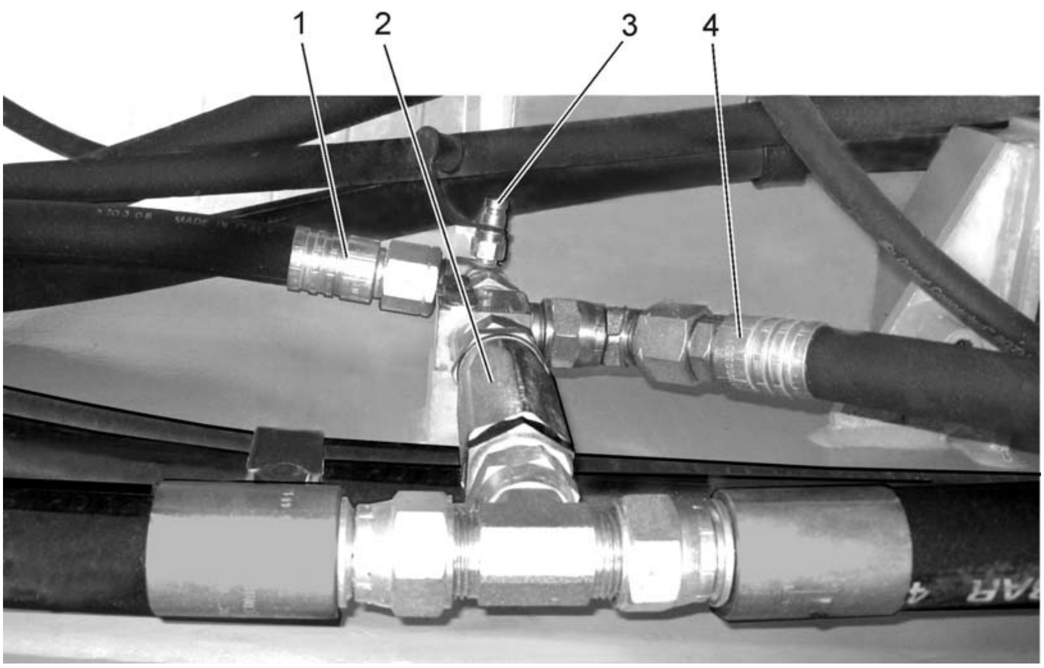


Fig. 10.11. Fan Drive System Pressure Check Connect Port (L.H. Side View)

1. Supply Hose (to Fan Drive Motor)
2. Check Valve
3. Fan Drive System Pressure Quick Disconnect Fitting
4. Supply Hose (from Fan Drive Pump)

TEST AND ADJUSTMENT

4. Use a Tool to check fan drive system operation for a reading of operation and „standby” pressure; refer to SERVICE /SPECIAL TOOLS in this Section. The check tool is accompanied by a measurement and adjustment procedure of pressures for fan drive system as a function of control signal of solenoid of pump pressure control module.
5. If both fan minimum and maximum speeds and operating and „standby” pressures taken in fan drive system:
   - are as given in the SPECIFICATIONS in this Section, this will tell that the fan hydraulic system operates correctly.
   - differ from what is given in SPECIFICATIONS in this Section, this will tell that the fan pump or/and fan hydraulic motor is at fault or worn. Refer to SERVICE DIAGNOSIS in this Section.

6. There is a way how to check fan drive variable pump performance without a check tool. Follow this procedure to do it.

WARNING! During performing below tests, turn the Auto-downshift mode switch to its OFF position to avoid serious injury or death.

a. Start the engine and follow the procedure for “Torque Converter Stall” (refer to TORQUE CONVERTER STALL SPEED CHECK in Section 7, DRIVE TRAIN). While performing this procedure, take note of drive system oil temperature readings (temperature check at the outlet of torque converter). The fan is to rotate at its minimum speed at the test beginning until it reaches a temperature of 92 [ºC]; refer to SPECIFICATIONS in this Section.

NOTE: *Check engine coolant temperature while performing the procedure for “Torque Converter Stall”. This temperature is not to be more than 85 [ºC]. If the engine coolant temperature is more than said above (that means the thermostat will open), then the fan will accelerate regardless of the drive train oil temperature. The same is true for engine air intake manifold temperature.*

b. The fan speed will increase smoothly with a coolant temperature ranging from 92 [ºC] to 115 [ºC], that is from fan minimum to fan maximum speed; refer to SPECIFICATIONS in this Section.
c. If the coolant temperature peaks to over 115 [ºC], then the fan speed is to remain unchanged and steady and equal to fan maximum speed regardless of the coolant temperature further raise.
d. Shut the engine down.
e. The ECM, controlling the fan drive will perform satisfactory, if the above procedure proves successful.
f. If the fan does not perform as said in Steps 6a, 6b or 6c then, engine ECM sourced fan pump control signal characteristics is to be checked with a proprietary INSITE™ software of Cummins or refer this job to Cummins Authorized Service.

SECTION 10A

PUMPS

PUMPS

CONTENTS

SERVICE /SPECIAL TOOLS

EQUIPMENT PUMP

SERVICE /SPECIAL TOOLS

1. SERVICE / SPECIAL TOOLS

DESCRIPTION — **TOOL NUMBER**

Bushing Remover Tool . . . . Fabricate Fig. 10A.1
Seal Remover Tool . . . . Fabricate Fig. 10A.1A
Bushing Installation Tool . . . . Fabricate Fig. 10A.1B
Special Steel Sleeve . . . . Fabricate Fig. 10A.1C
Bar for Lip Seal Installation:
For Rear & Middle Pump . . . . Ø 40 [mm] x 50 [mm] bar
For Front Pump . . . . Ø 60 [mm] x 50 [mm] bar

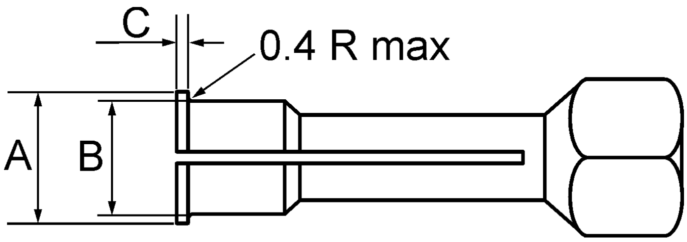
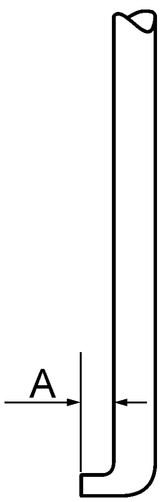


Fig. 10A.1. Bushing Remover Tool

Pump	A [mm]	B [mm]	C [mm]	Make from OTC Collet No. or Equivalent
Rear & Middle Pumps	22.6 – 22.8	20.1 – 20.3	2.3 – 2.5	33863
Front Pump	28.5 – 28.5	22.9 – 25.4	1.3 – 1.8	33864

The bushings may be removed from their bores, using blind hole collect–type bushing pullers similar to those manufactured by Owatonna Tool Co. The table above illustrates the modifications necessary to adapt the OTC collets to this task. Equivalent pullers from other suppliers may be modified in similar fashion.



Easily made from an old screw driver. Heat the tip and bend as shown. Grind the tip to fit the notch behind the shaft seal.

Fig. 10A.1A. Seal Remover Tool

A . . . . 6.5 [mm]

PUMPS

SERVICE /SPECIAL TOOLS

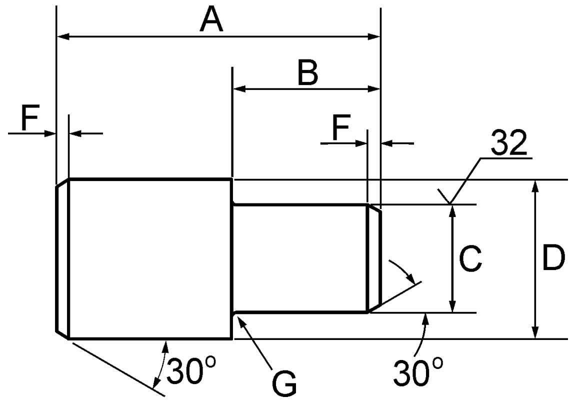


Fig. 10A.1B. Bushing Remover Tool

G. . . . . Grind Relief Allowable
MATERIAL . . . . A.I.S.I. 8620 Bearing Quality Steel Heat Treated

Pump	**A [mm]**	**B [mm]**	**C Dia. [mm]**	**D Dia. [mm]**	**F [mm]**
Rear & Middle Pumps	58.7	29.2	23.80 +0.00 -0.05	31.75	1.5
Front Pump	76.2	37.3	32.56 +0.00 -0.05	41.27	1.5

All external surfaces must be free of scratches and burrs.

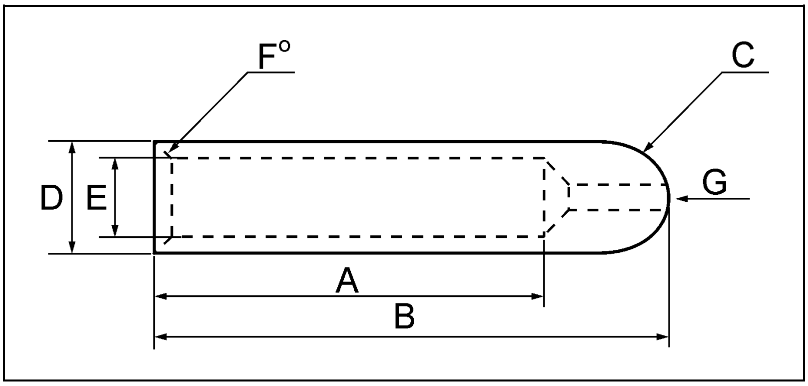


Fig. 10A.1C. Special Steel Sleeve

	A Dim. [mm]	**B** Dim. [mm]	**C** Radius [mm]	**D** Dia. [mm]	**E** Dia. [mm]	**F°** Chamfer [mm]	**G** Dia. Drill Through Hole [mm]
Rear & Middle Pumps	47.6	76.2	14.3	23.98 +0.00 -0.05	22.48 +0.05 -0.00	1.3 x 30[°]	6.35
Front Pump	85.7	114.3	14.3	32.77 +0.00 -0.05	31.75 +0.05 -0.00	0.4 x 30[°]	6.35

3. SPECIFICATIONS

Special Bolt Torque Data

Front Pump
Bearing carrier to front cover mounting nuts . . . . 270 [Nm]

Middle and Rear Pumps
Rear cover to bearing carrier mounting nuts . . . . 190 [Nm]

NOTE: *Except for the special torques shown, all bolts and nuts are to be given a standard torque. Refer to SECTION 1.*

4. SERVICE DIAGNOSIS

COMPLAINT	
PROBABLE CAUSE	REMARKS
Pump Unusually Noisy	
1. Low supply of oil	Fill to proper level.
2. Heavy oil	Change to proper oil.
3. Dirty oil suction filter	Clean filter.
4. Air leak in suction line	Check for loose connections.
5. Oil temperature high causing vapor to form in oil	Check entire circuit.
Pump Takes too Long to Responds or Fails to Respond	
1. Low oil supply	Fill to proper level.
2. Insufficient oil pressure	Refer to SERVICE DIAGNOSIS in SECTION 10.
3. Pump worn or damaged	Inspect, repair or replace
Oil Heating Up	
1. Oil level too low	Fill to proper level.
2. Using very light oil in hot climate	Drain and refill with proper oil.
3. Dirty oil	Drain, flush and refill with proper oil.
4. Foreign material lodged in main pressure relief valve	Inspect and remove any foreign material.
5. Insufficient oil pressure	Refer to SERVICE DIAGNOSIS in SECTION 10.
6. Pump worn (slippage)	Repair or replace.

PUMPS

EQUIPMENT PUMP

COMPLAINT	
PROBABLE CAUSE	REMARKS
Oil Foaming	
1. Oil level too low	Fill to proper level.
2. Air leaking into suction line from reservoir to pump	Tighten all connections.
3. Wrong kind of oil	Drain and refill with proper oil.

The troubleshooting guide lists common difficulties experienced with gear pumps and hydraulic systems. It also indicates probable causes and remedies for each of the troubles listed. It should always be remembered that many apparent pump failures are actually failures of other parts of system. Causes of improper operation is best diagnosed with adequate equipment and a through understanding of the complete hydraulic system.

5. REMOVAL

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

IMPORTANT: *When disconnecting hydraulic lines for any reason, they should be properly capped with the correct size plastic cap. If these caps are not available, tape or clean rubber corks may be used. Hydraulic openings must never be plugged with rags. This practice could easily introduce dirt or lint into critical hydraulic components of the machine. Tag all disconnected oil lines to facilitate easier installation.*

1. Remove floor mat (cab equipped machines) and center floor plate from between operator's seat and instrument panel.
2. Remove the transmission case guard from the bottom of the machine.

WARNING! This procedure requires extreme caution. Use suitable blocking equipment while under confines the machine.

3. Drain the hydraulic system of oil as described in the OPERATOR'S MANUAL.
4. Disconnect brake control cable; refer to SECTION 13, SUPERSTRUCTURE. Disconnect decelerator pedal control cable and remove decelerator pedal assy from the platform; refer to SECTION 12, POWER.

EQUIPMENT PUMP

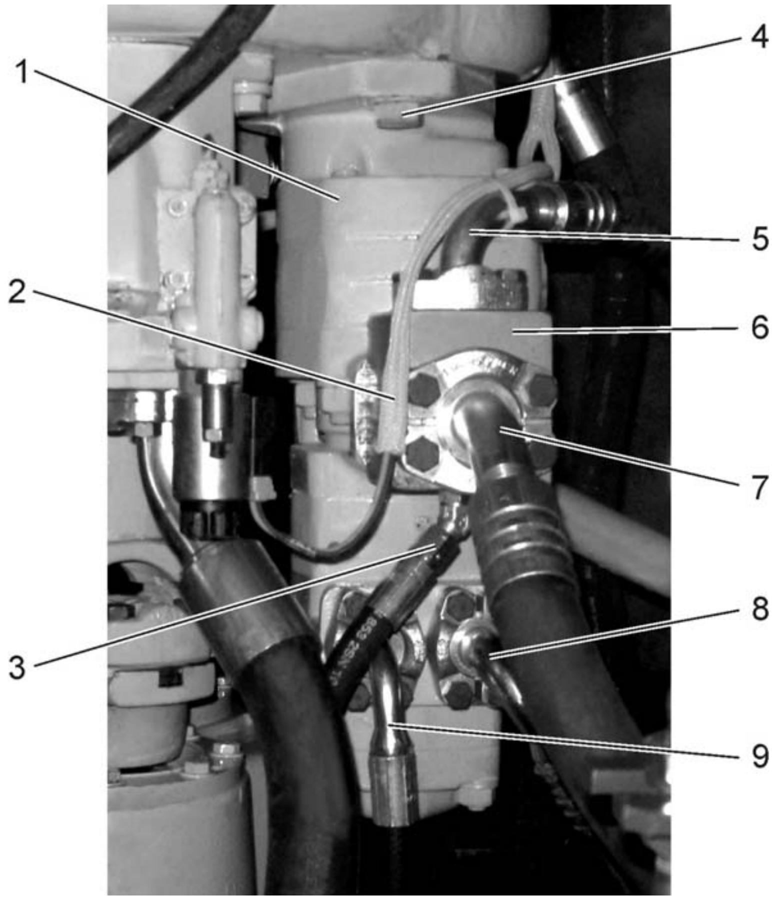


Fig. 10A.2. Equipment Pump Disconnect Points (Top View)

1. Equipment Pump	4. Pump Mounting Bolt	7. Hose
2. Electrical Harness	5. Hose	8. Hose
3. Hose	6. Junction Block	9. Hose

5. Disconnect the electrical harness (2, Fig. 10A.2) from the fan pump and position it out of way.
6. Disconnect hoses (7, 5 and 3) from the junction block (6) located on the top of pump (1).
7. Disconnect hoses (8 and 9) from the top of pump (1)
8. Disconnect the hose (1, Fig. 10A.3) and hydraulic connector (4) from the bottom of pump (5).
9. Disconnect two suction tubes (2 and 3) from the bottom of pump (5).
10. Attach a suitable sling to the pump and remove the two mounting flange bolts (4, Fig. 10A.2). Pull the pump free of the torque converter and lower it out the bottom of the machine.
11. Remove and discard the pump mounting O-ring. Unscrew the four bolts and remove the junction block (6) from the pump.

EQUIPMENT PUMP

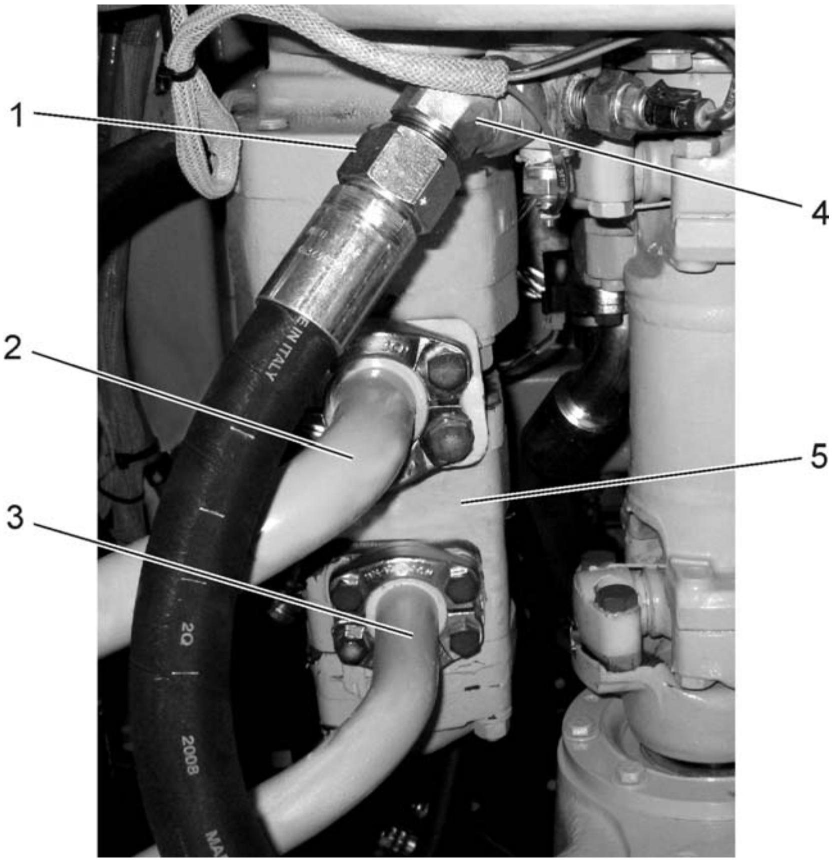


Fig. 10A.3. Equipment Pump Disconnect Points (Bottom View)

1. Oil Cooler Hose
2. Suction Tube
3. Suction Tube
4. Hydraulic Connector
5. Equipment Pump

6. DISASSEMBLY (Refer to Fig. 10A.4)

IMPORTANT: *If prying off sections becomes necessary take extreme care not to mar or damage machined surfaces. Excessive force while prying can result in misalignment and seriously damage parts.*

NOTE: *Gears are closely matched, therefore they must be kept together as sets when removed from a unit. Handle with care avoid damage to the journals or teeth.*

EQUIPMENT PUMP

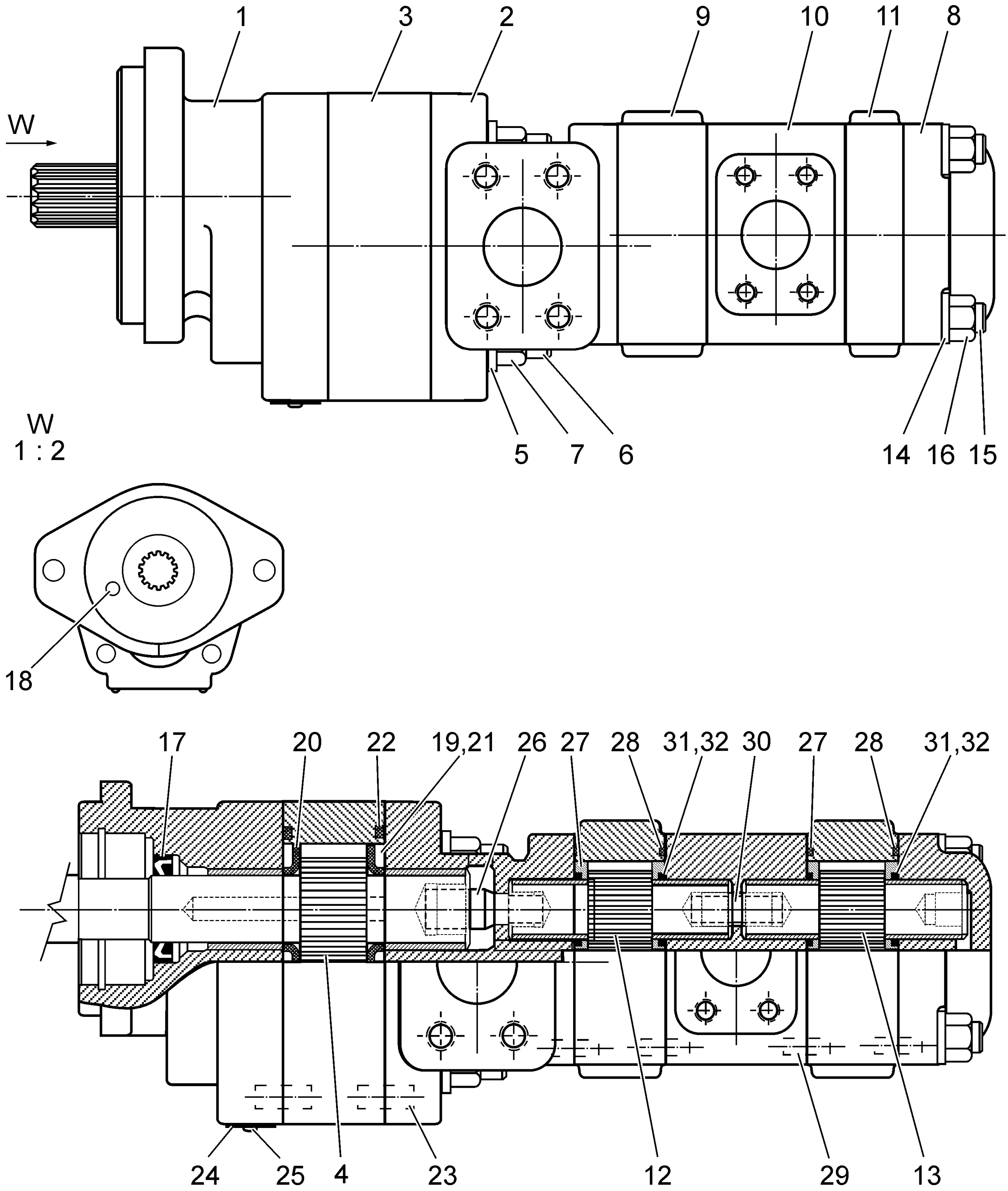
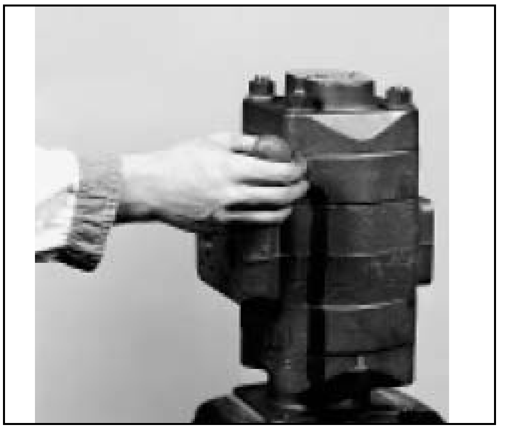


Fig. 10A.4. Exploded View of Charge and Scavenge Pump

1. Front Cover
2. Bearing Carrier
3. Pump Body (Front)
4. Gear Set
5. Washer
6. Stud
7. Nut
8. Rear Cover
9. Pump Body (Middle)
10. Bearing Carrier
11. Pump Body (Rear)
12. Gear Set
13. Gear Set
14. Washer
15. Stud
16. Nut
17. Seal
18. Plug
19. Backup Ring
20. Wear Plate
21. Channel Seal
22. Gasket Seal
23. Dowel Pin
24. Name Plate
25. Screw
26. Connecting Shaft
27. Wear Plate
28. Gasket Seal
29. Dowel Pin
30. Connecting Shaft
31. Channel Seal
32. Backup Ring

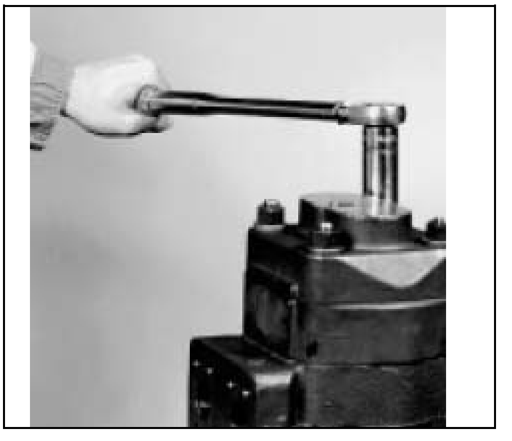
PUMPS

EQUIPMENT PUMP



1. Place the pump in a wise with the drive shaft: pointing down. Index mark all pump sections with a punch. Be sure to align these marks when reassembling.

NOTE: *Do not grip on or near any machined surfaces during assembly or disassembly.*



2. Remove the 4 hex nuts (16) and washers (14) with a socket wrench.

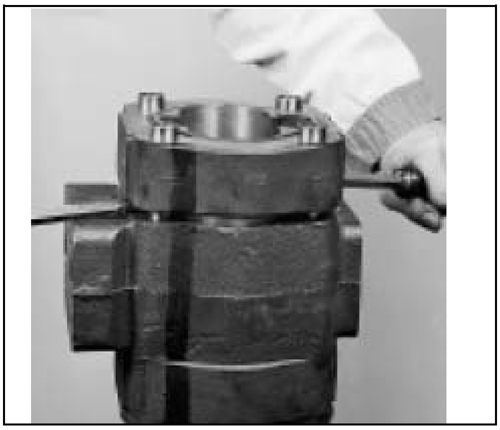
3. Lift off the rear cover (8). If necessary to pry loose, be careful not to damage the machined surfaces. Dowel pins (29) will remain in either the rear cover (8) or the rear pump body (11).

4. Remove the wear plate (27). Examine and replace if necessary.

EQUIPMENT PUMP

5. Carefully remove the gear set (13) of drive and driven gears. Avoid tapping the gear teeth together or against other hardened surfaces. Keep this gears set (13) together because it is a matched set. Examine and replace if necessary.
   Remove the wear plate (27) from the bearing carrier (10). Examine and replace if necessary.

6. Lift the rear pump body (11) from the bearing carrier (10). If prying is necessary, take care not to damage the machined surfaces.



7. Carefully lift or pry off the bearing carrier (10) to prevent damage to contact face and edges. Dowel pins (29) will remain in either the bearing carrier (10) or the middle pump body (9). DO NOT REMOVE THEM.

8. Remove the connecting shaft (30). Remove the wear plate (27).

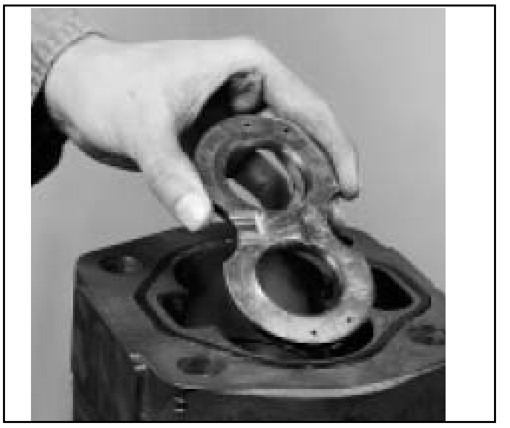
   Carefully remove the gear set (12) of integral drive and driven gears. Keep this gears set (12) together because it is a matched set.

   Be careful not to damage machined surfaces.

PUMPS

EQUIPMENT PUMP

9. Remove the wear plate (27) from the bearing carrier (2).



10. Lift or pry off the middle pump body (9). Be careful not to damage machined surfaces.

11. Carefully lift or pry off the bearing carrier (2) to prevent damage to contact face and edges. Dowel pins (23) will remain in either the bearing carrier (2) or the front pump body (3). DO NOT REMOVE THEM.

12. Remove the connecting shaft (26). Remove the wear plate (20). Examine and replace if necessary.
    Carefully remove the gear set (4) of integral drive and driven gears. Keep this gears set (4) together because it is a matched set.
    Be careful not to damage machined surfaces.
    Remove the wear plate (20) from the front cover (1).

13. Lift or pry off the front pump body (3). Be careful not to damage machined surfaces. Dowel pins (23) will remain in either the front pump body (3) or the front cover (1). DO NOT REMOVE THEM.

14. Grip the front cover (1) in a vise with the mounting face down. Remove lip seal (17) by inserting the special seal removal tool (refer to SERVICE/SPECIAL TOOLS in this Section) into the notch between the lip seal (17) and the front cover (1). Tap the seal (17) out and discard.

15. Inspect all bushings for scoring or discoloration and replace if necessary. Use a bushing remover tool, as shown in SERVICE/ SPECIAL TOOLS in this Section, to remove the bushings.

NOTE: *Apply this Step to front cover (1), bearing carrier (2), bearing carrier (10) and rear cover (8).*

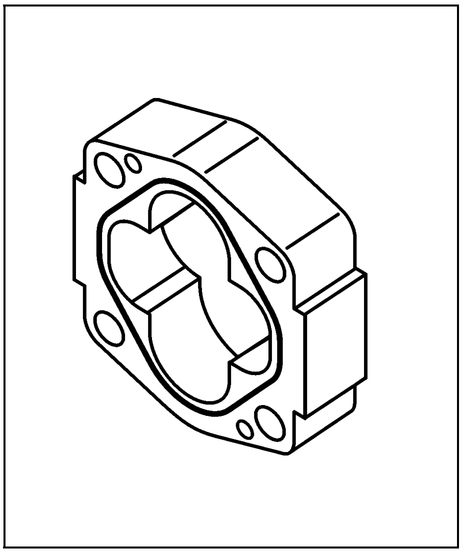
PUMPS

EQUIPMENT PUMP

7. INSPECTION AND REPAIR

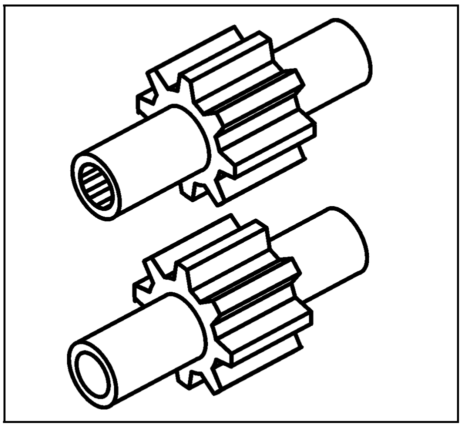
1. Discard all seals, O-rings and wear plates and replace with new ones during reassembly.
2. Wash all parts thoroughly in a suitable solvent. Dry thoroughly with compressed air.
3. Check all parts of pump separately with the following suggestions.

A. Pump bodies
Wear in excess of 0.18 [mm] cut-out necessitates replacement of the pump body.
Place a straight-edge across bore. If you can slip a 0.18 [mm] feeler gage under the straight-edge in the cut-out area, replace the gear body.
Pressure pushes the gears against the body on the low pressure side. As the hubs and bushings wear, the cut-out becomes more pronounced. Excessive cut-out in a short period of time indicates excessive pressure or oil contamination. If the relief valve settings are within prescribed limits, check for shock pressures or tampering. Withdraw oil sample and check it and main frame for dirt.
Where cut-out is moderate, 0.18 [mm] or less, pump body is in good condition, and both ports are of the same size, housing may be flopped over and reused.

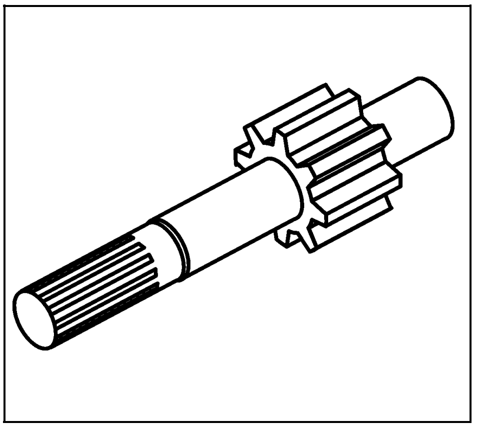


B. Gears
Any wear on gear hubs detectable by touch, or in excess of 0.05 [mm] necessitates replacement. Nicking, grooving, fretting of teeth surfaces or head discoloration also necessitates replacement. Scoring, grooving or burring of outside diameter of teeth generally means replacement is necessary unless damage is light and can be stoned off.

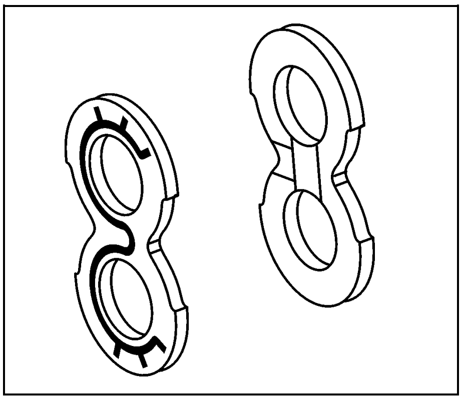
NOTE: *Gears assemblies must be replaced in pairs*.



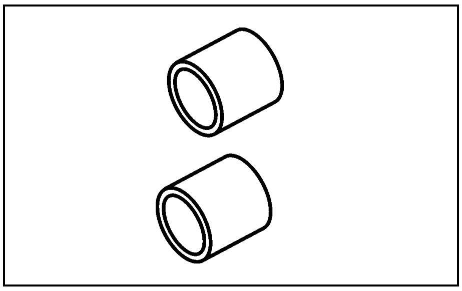
C. Drive shafts
Replace if there is any wear detectable by touch in the seal areas or at the drive coupling. 0.05 [mm] wear is the maximum allowable.
Wear in the shaft seal areas indicate oil contamination and shaft replacement is required. Wear or damage to splines, keys or keyways necessitates replacement.



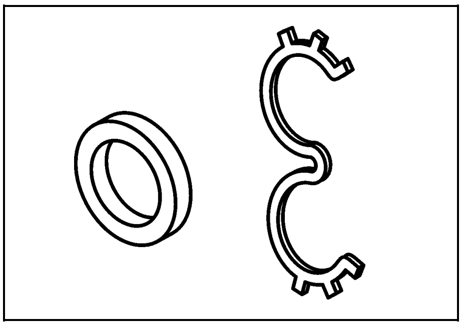
D. Wear plates
The wear plates seal the gear section at the sides of the gears. Wear here will allow internal slippage, that is, oil will bypass within the pump.
A maximum of 0.05 [mm] wear is allowable. Replace wear plates if they are scored, eroded, pitted or discolored. Check center of wear plates where the gears mesh. Erosion here indicates oil contamination. Pitted wear plates indicate cavitation or oil aeration. Discolored wear plates indicate overheating, probably insufficient oil.



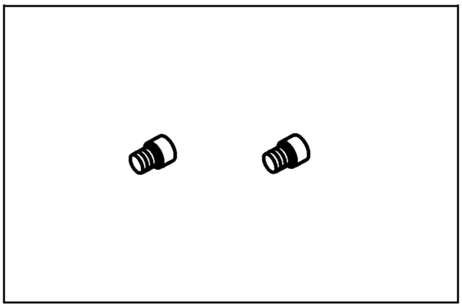
E. Bushings
If gears are replaced, bushings must be replaced. Bushings should fit into the bore with a heavy press fit.



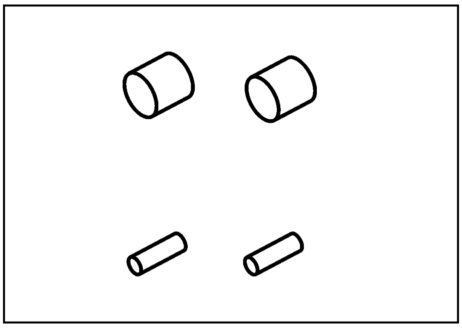
F. Seals and gaskets
Replace all rubber and polymer seals whenever disassembling pump. Include all backup rings, channel seals behind wear plates, shaft seal and gasket seals.



G. Plugs
Examine the plugs in the front cover and rear cover to make sure that they are in the proper position and tight. The rear and middle pumps should have two plugs in both front cover and end cover in tandem units only. The front pump has one plug in its front and rear cover high pressure side only.



H. Dowel Pins
If either the dowel or dowel hole is damaged, the dowel or machined casting, or both, must be replaced.
If more than reasonable force is required to seat dowels, the cause may be poorly deburred or dirty parts; cocking of the dowel in the hole or improper pin-to-hole fit.



PUMPS

EQUIPMENT PUMP

8. REASSEMBLY (Refer to Fig. 10A.4)

NOTE: *If bushings, gears or pump bodies are to be replace, change entire pump section (if included in Parts Catalogue), otherwise replace pump assy.*

1. Stone off all cast machined surfaces with a medium grit carborundum stone (to remove any burrs as a result of disassembly).

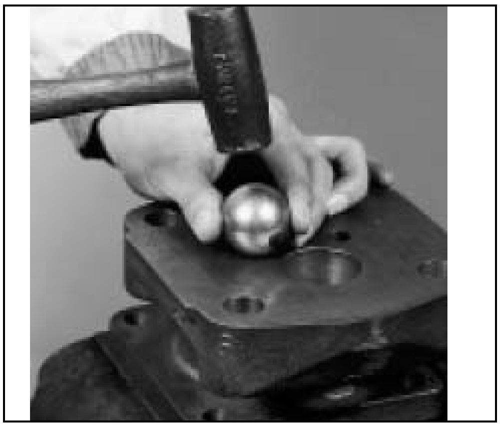
2. If the bushings have been removed, deburr bushings bores with an emery cloth. Rinse parts in a solvent. Air blast all parts and wipe with a clean, lintless cloth before starting reassembly.

3. Grip the front cover (1) in the vise with the mounting face down. Examine the plug (18), to be sure it is tightly in place. Refer to Fig. 10A.2 the "W" view.

NOTE: *The front pump has one plug on the outlet side of its front cover and bearing carrier.*

4. New plugs should be screwed in tightly. Stake the plug with a prick punch at both ends of the screwdriver slots and around the edges. Peen the edge of the hole 0.8 [mm] to 1.6 [mm] with a 38.1 [mm] diameter steel ball.

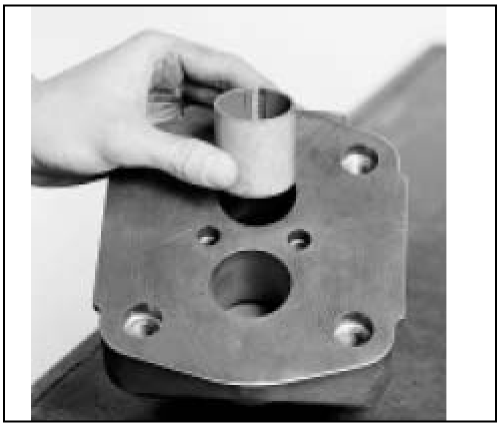
NOTE: *If new plug or plugs are being installed, coat threads with LOCTITE thread sealant.*



NOTE: *ASSEMBLY STEPS 5, 6, 7 AND 8 APPLY TO FRONT COVER (1), BEARING CARRIER (2), BEARING CARRIER (10) AND REAR COVER (8).*

5. If any bushings have been removed from the front cover (1), bearing carrier (2), bearing carrier (10) or rear cover (8), replace the bushings by pressing them into the bushing bore with an arbor press. Assemble the bushings in the drive bores with the groove to the top of unit (12 o'clock). Assemble the bushings in the driven bores with the groove to the bottom of the unit (6 o'clock).

NOTE: Both *middle and rear sections of the pump do not have grooved bushings, therefore the bushing seams should be placed at the 12 and 6 o'clock positions respectively.*



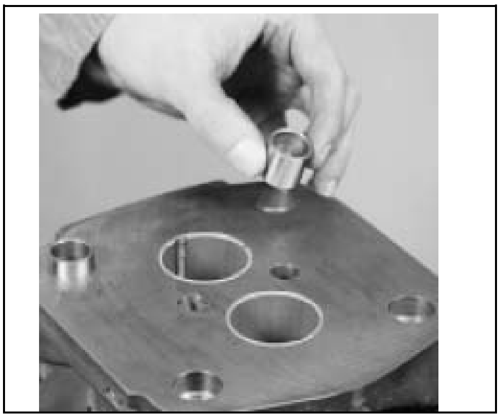
6. Bushings should be pressed into the bores, one at time, using the bushing installation tool (refer to SERVICE/SPECIAL TOOLS in this Section) and on arbor press. Be sure that the grooves (or seams) are positioned as stated in Step 5. The bushings must be pressed into the bores flush with the casting face. Be sure to support the castings so that they are square and level.

7. Repeat Step 1 and Step 2, stone and rinse parts.

PUMPS

EQUIPMENT PUMP

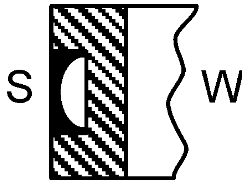
8. See that dowel pins (23 or 29) are in place in any new castings. Examine all of the dowels. Before inserting, make certain that the hole is clean and free from burrs. Gently start the pin straight into the hole and tap lightly with a soft hammer.



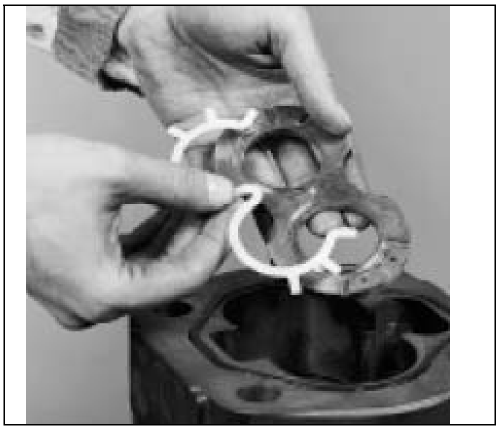
9. Before inserting a new lip seal (17) in the front cover (1), coat the outer edge of the lip seal (17) and its recess with Permatex Aviation Form-A-Gasket No. 3 non-hardening sealant or equivalent. With the metal side of the seal (17) up, press it into the mounting flange side of the front cover (1) with an arbor press and steel sleeve tool (refer to SERVICE/SPECIAL TOOLS in this Section). Be careful not to damage the lip of the seal (17). Press in until flush with the recess. Wipe off excess sealant.

10. Grease the new gasket seals (22 and 28) and insert them into the grooves in both sides of all pump bodies (3, 9 and 11) respectively. Position the first pump body (3) over the front cover (1) and dowels (23). Tap it with a soft hammer until it rests tightly against the front cover (1). Be careful not to pinch the gasket seal (22). Also be sure that the large rounded core is on the inlet side.

11. Assemble the channel seals (21 or 31) and backup rings (19 or 32) into the grooves in the wear plates (20 or 27) respectively, with the flat side of the seal facing away from the wear plate as shown below.



S – Flat Side of Seal Assy
W – Wear Plate



12. Gently slip the wear plate (20) through the pump body (3) and into place on the front cover (1). The seal assy (21 and 19) should face the front cover (1). The relief groove in the plate (20) should face the outlet side of the pump.

13. Slide the driven gear of gear set (4) through the pump body and into the bushing in the front cover (1). Coat the steel sleeve tool (refer to SERVICE/SPECIAL TOOLS in this Section) with grease. Place the lightly-greased drive shaft of gear set (4) inside the special sleeve and slide both through the front cover (1) with a twisting motion, until the integral gear rests against the wear plate (20). Avoid damaging the double lip seal (17). Remove the steel sleeve. Squirt clean oil over the gears (4).

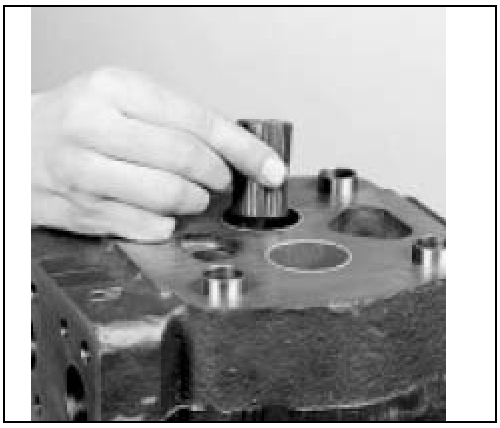
14. Slip the wear plate (20) with the seal assy (21 and 19) over the gear journals and into the pump body (3) bore. The flat side of the seal should face up with the relief groove facing the outlet side.

15. Place the bearing carrier (2) onto the journals of gear set (4). Be sure to line up the dowel holes over the dowel pins (23). When the parts are parallel, squeeze them together or alternately tap over each dowel until the parts are together.
Thread the studs (6) into the front cover (1) and secure with nuts (7) and washers (5). Tighten nuts alternately or cross corner. Rotate the drive shaft with a 6” wrench to check for binding. If there is no internal binding, torque diagonally opposed nuts to 270 [Nm].

PUMPS

EQUIPMENT PUMP

16. Insert the connecting shaft (26) into the spline of the drive gear (4). Position and place the middle pump body (9) on the bearing carrier (2) as outlined in Step 10.



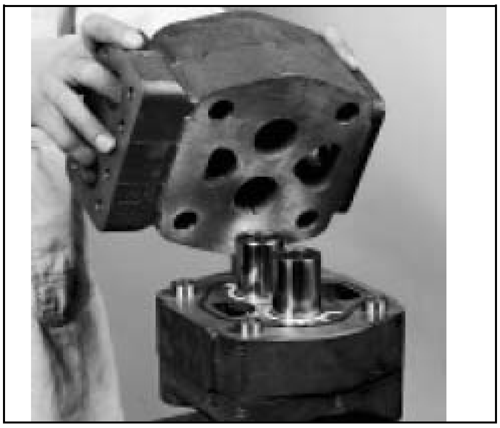
17. Gently slip the wear plate (27) through the pump body (9) and into place on the bearing carrier (2). The seal assy (31 and 32) should face the bearing carrier (2). The relief groove in the plate (27) should face the outlet side of the pump.

18. Insert the gear set (12) of the middle pump in their respective bushings. Make certain the gears (12) are in contact with the wear plate (27) face.

19. Slip the wear plate (27) with the seal assy (31 and 32) over the gear journals and into the middle pump body (9) bore. The flat side of the seal should face up with the relief groove facing the outlet side.

20. Check the plugs in the bearing carrier (10) to be sure that they are tight. Follow the procedure outlined in Step 4 for new plugs.

21. Place the bearing carrier (10) onto the journals of gear set (12). Be sure to line up the dowel holes over the dowel pins (29). When the parts are parallel, squeeze them together or alternately tap over each dowel until the parts are together.



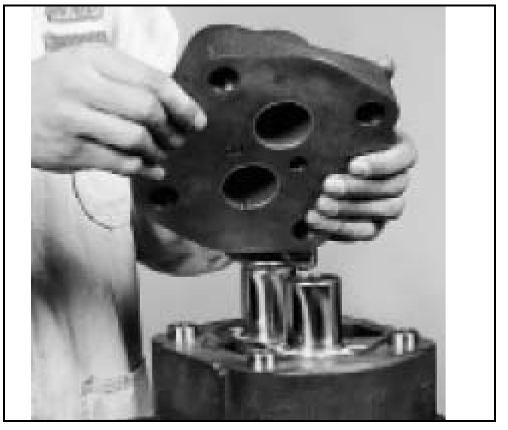
22. Insert the connecting shaft (30) into the spline of the drive gear (12). Position and place the third pump body (11) on the bearing carrier (10) as outlined in Step 10.

23. Place the wear plate (27) in the pump body (11) per Step 17. Insert the gear set (13) of the rear pump section in their respective bushings. Make certain the gears (13) are in contact with the wear plate (27) face. Place the wear plate (27) with seal assy (31 and 32) in the pump body (11) bore per Step 19.

EQUIPMENT PUMP

24. Check the plugs in the rear cover (8) to be sure that they are tight. If necessary follow the procedure outlined in Step 4 for new plugs.

25. Place the rear cover (8) over the journals of gear set (13). Align the dowels (29) with the holes in the mating casting. Being careful not to pinch the gasket seal (28), tap the rear cover (8) lightly in the center between bushings bores to engage the dowels (29) and to move parts together in the final seating.



26. Thread the studs (15) into the bearing carrier (2) and secure with nuts (16) and washers (14). Tighten nuts alternately or cross corner. Rotate the drive shaft with a 6” wrench to check for binding. If there is no internal binding, torque diagonally opposed nuts to 190 [Nm].

27. After assembly it is recommended to check the pump according to PUMP TEST PROCEDURE in this Section.

    If pump meets requirements given in SPECIFICATIONS in this Section, the pump is ready for installation and immediate duty operation on equipment. Refer to INSTALLATION in this Section.

    If pump does not meet requirements given in SPECIFICATIONS, the equipment pump should be reworked or replaced.

9. PUMP TEST PROCEDURE ON THE STAND

1. Make certain that there is an adequate supply of oil for the pump; at least one liter [l] of oil for each [liter/min] of pump capacity.
2. If one section of a pump is being tested, make sure that other sections not being tested are adequately supplied with oil. If any of the other sections run dry, or if plugs are left in ports, serious and permanent damage will result.
3. The oil should be a good quality hydraulic oil; see OPERATOR'S MANUAL.
4. The feed line must be of adequate size.

IMPORTANT: *Feeding hot oil into a cold pump may cause the pump to seize. Jog the pump by momentarily starting and stopping repeatedly the driving engine or motor to gradually equalize pump and oil temperature.*

5. Run the pump at least two minutes at no load and moderate speed (not over 1500 [RPM]). If the pump becomes excessively hot, shut down immediately and locate the problem source.
6. Gradually increase pressure on pump, in 3.5 [MPa] increments until the desired test pressure has been reached. This should take about five minutes.
7. Delivery should run close to rated dates specified in SPECIFICATIONS in SECTION 10, HYDRAULICS. A 5 % lower reading may be used as a rated minimum if new or relatively new parts have been used. When rebuilding the pump with parts from the original pump, which, while worn, appear satisfactory for reuse, a 10% lower reading may be permitted.
8. At test speeds other than 1800 [RPM], lpm delivery will vary almost proportionately, but the same (drop-off) figures should be used.

Delivery [l/min] at 1800 [rpm]	[l/min] drop off at …		
0.7 [Mpa]	7 [MPa]	14 [MPa]	21 [MPa]
38 – 115	5.7 – 11.4	7.6 – 13.3	9.5 – 15.2
115 – 190	7.6 – 11.4	9.5 – 15.2	11.4 – 17.1
190 – 265	9.5 – 13.3	11.4 - 19	13.3 – 20.9

IMPORTANT: *Be sure to run the pump in the direction for which it were designed and built. Driving the pump in the wrong direction will build up pressure behind the shaft seal, damaging it and necessitating replacement.*

PUMPS

EQUIPMENT PUMP

10. INSTALLATION

NOTE: *All gaskets and any collapsed hoses or damaged connections must be replaced with new. Whenever a sealing ring is required at a disconnected line, it is recommended that a new sealing ring be installed.*

1. Thoroughly clean the mating surfaces of the torque converter housing and the equipment pump front cover.
2. Install the junction block (6, Fig. 10A.2) to the pump and secure with four bolts.
3. Install a new O-ring on the pump front cover flange.

NOTE: *As the equipment pump front cover enters the torque converter housing, be sure the O-ring is properly seated in the groove of the equipment pump front cover.*

CAUTION!*: The equipment pump installing procedure requires two people for appropriate handling of sling with pump during pump lift off to the machine.*

4. Attach a suitable sling to equipment pump (1). The sling must be installed to give the best possible balance. Handle the pump with care to install the pump to the torque converter and secure with bolts and washers (4).

IMPORTANT: *Before connecting any lines to the pump, fill all ports with clean oil before start to provide initial lubrication and avoid the unit damage.*

5. Reconnect two suction tubes (2 and 3, Fig. 10A.3) to the bottom of pump (5).
6. Reconnect the hydraulic connector (4) and hose (1) to the bottom of pump (5).
7. Reconnect hoses (8 and 9, Fig. 10A.2) to the top of pump (1).
8. Reconnect hoses (3, 5 and 7) to the junction block (6) located on the top of pump (1),
9. Reconnect the electrical harness (2) to the fan pump.
10. Install decelerator pedal assy to the platform. Reconnect decelerator pedal control cable. Refer to SECTION 12, POWER
11. Reconnect brake control cable; refer to SECTION 13, SUPERSTRUCTURE.
12. Refill hydraulic reservoir as described in the OPERATOR'S MANUAL.
13. Start the engine and check for external leaks in the hydraulic system.
14. Check the oil level in hydraulic reservoir and add oil if necessary.
15. Stop the engine. Install the center floor plate and floor mat (if equipped). Install the transmission case guard to the bottom of machine.

SECTION 10B

VALVES

VALVES

CONTENTS

SERVICE /SPECIAL TOOLS

CONTROL VALVE

PILOT PRESSURE VALVE

QUICK DROP VALVE

BLADE TILT CONTROL VALVE

VALVES

SERVICE /SPECIAL TOOLS

1. SERVICE /SPECIAL TOOLS

DESCRIPTION	TOOL NUMBER
Special Purpose Stud (A) ……...	M10 x 100

CONTROL VALVE

2. DESCRIPTION

The control valves used in this system are mounted to a bracket at the right side in front of the reservoir. Either one or three spool control valve is used in the system depending on the equipment. The valves are controlled by pilot lines from the pilot valves.

The control valve is a directional hydraulic valve. Each section directs oil to the appropriate hydraulic cylinder controlling the action of a certain equipment. Each section controls one hydraulic circuit.

Three spool control valve is controlled by two pilot valves. The blade pilot valve controls the blade lift and tilt cylinders. The ripper pilot valve controls the ripper lift and pitch cylinders.

In the neutral position of the pilot valves the oil flows freely through the spool without any response of the appropriate equipment. If a pilot valve is shifted the oil flow is directed to the cylinder causing the desired response of the equipment. All the operating positions except the blade FLOAT position are not detented and all the spools of the valve are spring centered for return to the HOLD position.

All sections are assembled between the inlet and outlet cover. All section housings are of the same design although the spools differ in their functioning.

Regardless of the number of sections each control valve has both the inlet and outlet cover.

Incorporated in the inlet cover is a relief valve, which is used to by-pass oil from the pump back to the reservoir when the oil pressure exceeds the relief valve setting. Blade lift section and ripper lift section are equipped with anticavitation valves. Each valve spool has a corresponding check valve which provides smooth movement of the load when the spool position is changed from the HOLD position to an operating one.

3. REMOVAL

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

IMPORTANT: *Disconnected hydraulic lines must be capped with the correct size plastic cap. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Tag all disconnected lines to facilitate their proper installation.*

VALVES

CONTROL VALVE

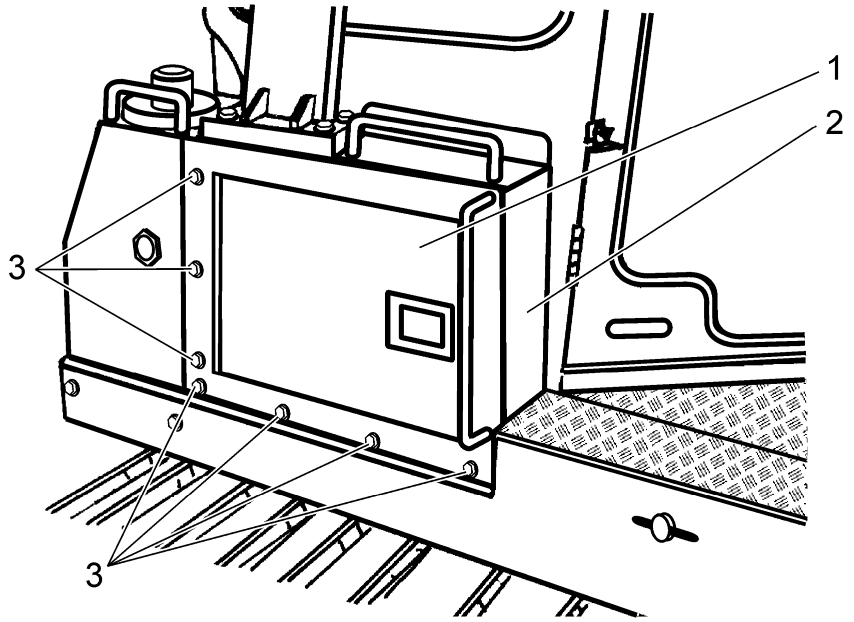


Fig. 10B.1. Disassembly R.H. Enclosure

1. R.H. Door 2. R.H. Enclosure 3. Bolts

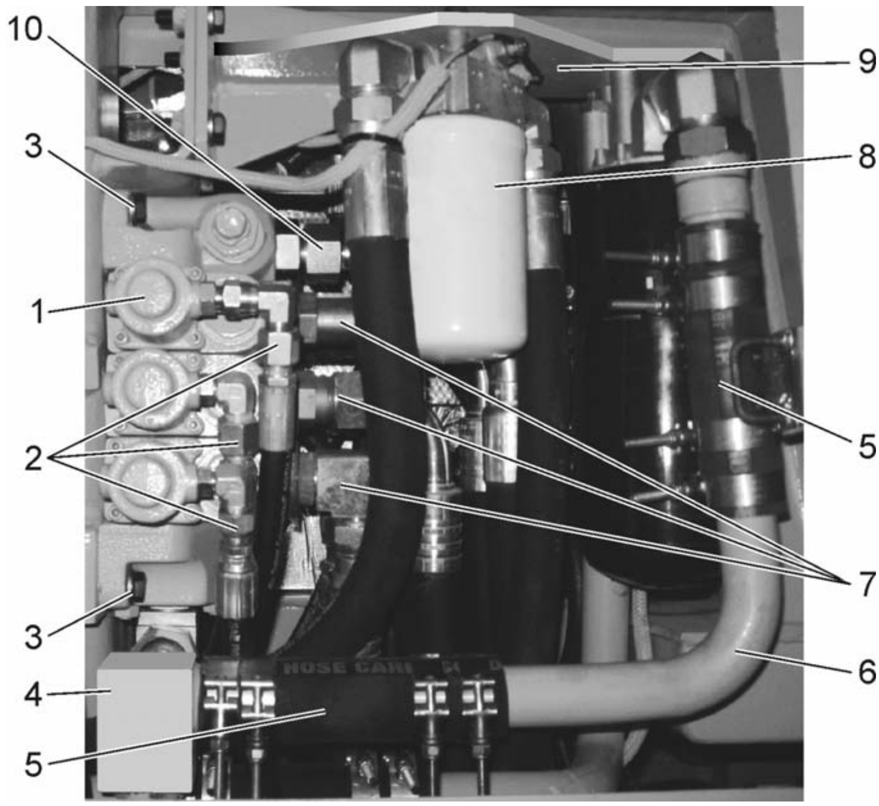


Fig. 10B.2. Hydraulic Return Filters Removal (R.H. Side)

1. One Spool or Three Spool Control Valve
2. Pilot Hoses (R.H.)
3. Mounting Bolt with Washer
4. Return Tee
5. Connecting Hose
6. Return Tube
7. Outlet Hoses
8. Fan Filter Assy
9. Filter Bracket
10. Inlet Hose

CONTROL VALVE

1. Drain the hydraulic system of oil as described in OPERATOR'S MANUAL.
2. Unscrew bolts (3, Fig. 10B.1) and remove R.H. enclosure (2) with R.H. door (1).
3. Loosen clamps of connecting hoses (5, Fig. 10B.2) and remove return tube (6).
4. Loosen clamp at the bottom of return tee (4) and disconnect the hose from tee (4). Disconnect the return tee (4) from control valve (1) and remove it.
5. Unscrew four bolts securing head of filter (8) to filter bracket (9). Position filter assy (8) with hoses out of way to gain access to control valve (1).

NOTE: *To make easier control valve removal unscrew bolts securing R.H. console cover to the platform R.H. console (4, Fig. 10B.4) and remove the access cover to gain access to control valve (1).*

6. Disconnect valve inlet hose (10. Fig. 10B.2) or (6, Fig. 10B.4) from control valve (1).
7. Disconnect R.H. pilot hoses (2, Fig. 10B.2) or pilot hose (3, Fig. 10B.4) R.H. side from control valve (1).
8. THREE SPOOL CONTROL VALVE: Disconnect outlet hoses (7, Fig. 10B.2 and 4, Fig. 10B.3) from sections of control valve (1).
9. ONE SPOOL CONTROL VALVE: Disconnect outlet hoses (5, Fig. 10B.4)
10. Disconnect L.H. pilot hoses from connectors (2, Fig. 10B.3) or pilot hose (3, Fig. 10B.4) L.H. side from control valve (1).
11. Protect the control valve (1) with a wooden plank against gravitating. Remove three bolts and washers (3, Fig. 10B.2 and 3, Fig. 10B.3) securing valve to the ROPS bracket and remove it from machine using suitable hoist.

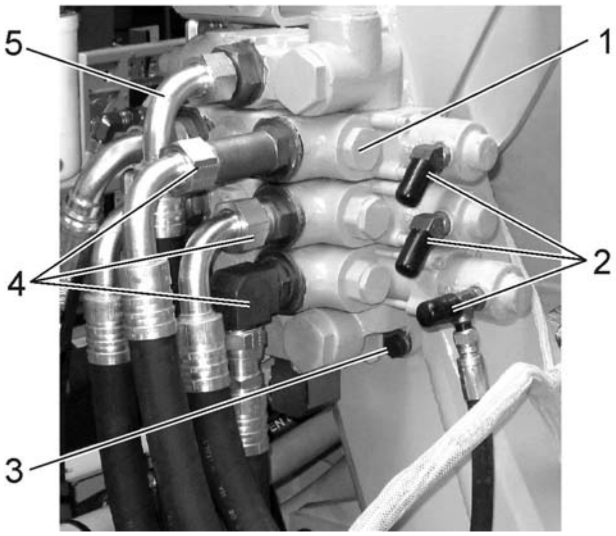


Fig. 10B.3. Control Valve Disconnect Points (L.H. Side)

1. Three Spool Control Valve
2. Pilot Hoses Connectors (L.H.)
3. Mounting Bolt with Washer
4. Outlet Hoses
5. Inlet Hose

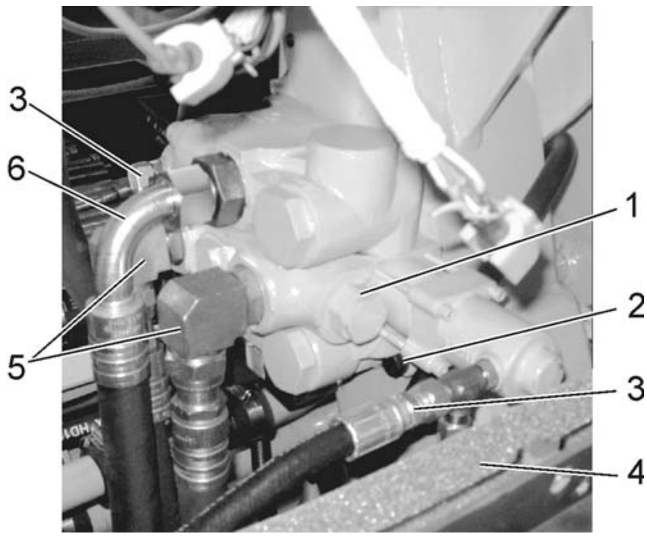


Fig.10B.4. Control Valve Disconnect Points (Cab Inside View)

1. One Spool Control Valve
2. Mounting Bolt with Washer
3. Pilot Hoses
4. Platform R.H. Console
5. Outlet Hoses
6. Inlet Hose

CONTROL VALVE

4. DISASSEMBLY

NOTE: *It is recommended to mark all control valve sections before removal for proper assembly.*

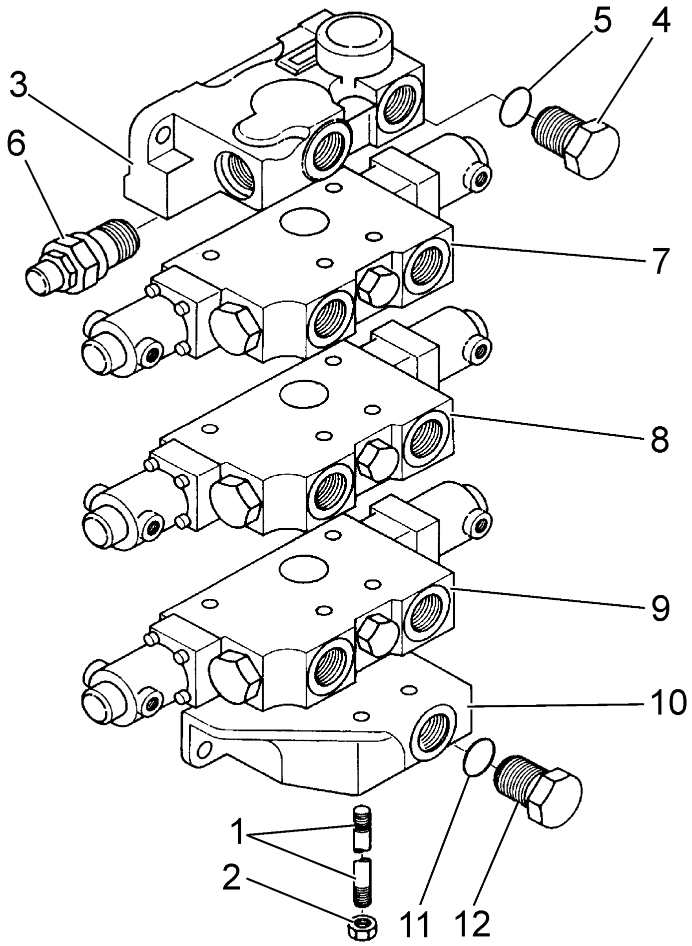


Fig. 10B.5. Exploded View of Control Valve

1. Mounting Stud	4. Plug	7. Ripper Pitch section	10. Outlet Cover Plate Assy
2. Nut	5. O-Ring	8. Ripper Lift Section	11. O-Ring
3. Inlet Cover Plate Assy	6. Relief Valve	9. Blade Lift Section	12. Plug

1. Remove all hydraulic connectors threaded into the control valve.
2. Position the control valve on a work bench with the mounting studs (1, Fig. 10B.5) facing up.
3. Remove four nuts (2) from the mounting studs (1).
4. Remove the outlet cover plate (10) from the valve bank. Remove and discard intersection seal rings.
5. Remove the blade lift section (9) from the valve bank. Remove and discard the between section seal rings. Refer to BLADE LIFT SECTION, Paragraph 8 in this Section.
6. THREE SPOOL CONTROL VALVE: Remove the ripper lift section (8) from the valve bank. Remove and discard the between section seal rings. Refer to RIPPER LIFT SECTION, Paragraph 9 in this Section.
7. THREE SPOOL CONTROL VALVE: Remove the ripper pitch section (7) from the valve bank. Remove and discard the between section seal rings. Refer to RIPPER PITCH SECTION, Paragraph 10 in this Section.

CONTROL VALVE

8. Remove the relief valve (6) from the inlet cover (3). Refer to MAIN PRESSURE RELIEF VALVE, Paragraph 11 in this Section.
9. Remove the port plugs (4 and 12) from the inlet (3) and outlet (10) covers. Remove and discard O-rings (5 and 11).

5. INSPECTION AND REPAIR

1. It is recommended that new seal rings be installed whenever the control valve is disassembled for service.
2. Make a preliminary inspection of all parts before cleaning to detect discrepancies which may not show up once the parts are cleaned. Examine the oil for metal particles, dirt and other foreign material.
3. Wash all the parts thoroughly in suitable solvent and dry with compressed air or a clean cloth.

6. REASSEMBLY

1. Install the port plug (12, Fig. 10B.5) with new O-ring (11) to the outlet cover (10) port. Position O-ring (11) properly in its groove to prevent its damage. Torque the plug to 45 – 53 [Nm].
2. Install the relief valve (6) and port plug (4) with new O-ring to the inlet cover plate (3). Position O-rings properly in theirs grooves to prevent their damage. Torque the relief valve to 45 – 53 [Nm]. Torque the plug to 129 – 156 [Nm].
3. Oil the threads of the mounting studs (1) and install into the inlet cover (3).
4. ONE SPOOL CONTROL VALVE: Install the between section seals. Slide the blade lift section (9) on the studs (1) up against the inlet cover (3).
5. THREE SPOOL CONTROL VALVE: Install the between section seals. Slide the blade lift section (9), ripper lift section (8) and ripper pitch section (7) on the studs (1) up against the inlet cover (3).
6. Install the outlet cover (3) on the studs (1) against the ripper pitch section (7). Oil the nut (2) threads and install to the mounting studs (1). Tighten the stud nuts to 68 – 82 [Nm].
7. Install all hydraulic connectors previously removed.

NOTE: *If the stud nuts are not tightened to the above specified torque value, valve spools seizure or O-ring displacement can occur.*

7. INSTALLATION

NOTE: *To make easier control valve removal unscrew bolts securing R.H. console cover to the platform R.H. console (4, Fig. 10B.4) and remove the access cover to gain access to control valve (1).*

1. Attach a hoist with a suitable sling to control valve (1, Fig. 10B.3) and position control valve on machine. Install three bolts with washers (3, Fig. 10B.2 and 3, Fig. 10B.3) and secure control valve (1) to ROPS mounting bracket.
2. Reconnect L.H. pilot hoses to connectors (2) of control valve (1) or reconnect pilot hose (3, Fig. 10B.4) L.H. side to control Valve (1).
3. ONE SPOOL CONTROL VALVE: Reconnect outlet hoses (5, Fig. 10B.4) to control valve (1).
4. THREE SPOOL CONTROL VALVE: Reconnect outlet hoses (7, Fig. 10B.2 and 4, Fig.10B.3) to control valve (1).

VALVES

CONTROL VALVE

5. Reconnect valve inlet hose (10, Fig. 10B.2) or (6, Fig. 10B.4) to control valve (1).
6. Reconnect R.H. pilot hoses (2, Fig. 10B.2) or pilot hose (3, Fig. 10.B4) R.H. side to control valve (1).
7. Reinstall head of filter (8) to the filter bracket (9) and secure it with four bolts.
8. Reconnect reservoir return tee (4) to control valve (1) hydraulic connector. Install return hose to the bottom of tee (4) and secure with clamp.
9. Install return tube (6) with connecting hoses (5) and secure with clamps (see Fig. 10B.2).
10. Reinstall R.H. enclosure (2, Fig. 10B.1) with R.H. door (1) and secure it with bolts (3).
11. Refill the hydraulic system and vent it as described in the OPERATOR'S MANUAL.
12. Check the operation of the control valve by shifting the control levers into all operating positions. Check and correct possible leakage.
13. Adjust the main pressure relief valve as described in SECTION 10, RELIEF VALVES PRESSURE TESTS. Close the door (1).

8. BLADE LIFT SECTION

Description

Blade lift section is a spring centered, four position type with the FLOAT position being electro-magnetically detented at the blade pilot valve. Incorporated in valve section is a spring loaded check valve which assures smooth operation when the spool is moved from hold to an operating position. An anticavitation valve is located in the lower part of section.

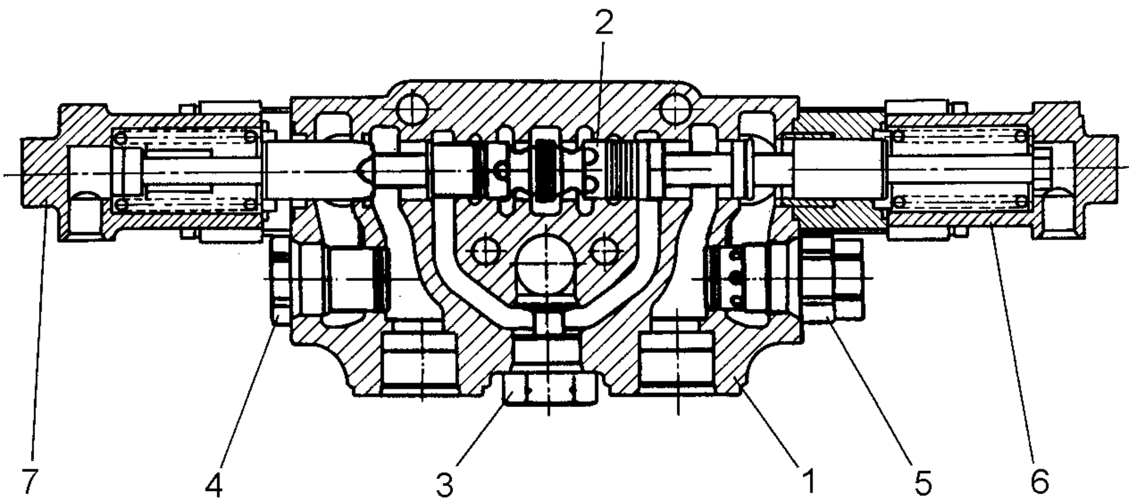


Fig. 10B.6. Cross Section View of Blade Lift Section

1. Section Housing
2. Float Spool
3. Check Load Valve
4. Port Plug
5. Anticavitation Valve
6. Hydraulic Remote Positioner
7. Hydraulic Remote Positioner

Disassembly

1. Remove the check load valve (3, Fig. 10B.6), the port plug (4) and the anticavitation valve (5). The anticavitation valve (5), the plug (4) and the check valve (3) are the only replacable parts.
2. If needed, remove the float spool positioners (6 and 7) bolts and then remove float spool (2).

CONTROL VALVE

Inspection and Repair

1. Wash all parts thoroughly in a suitable solvent. Dry thoroughly with compressed air.
2. Discard all O-rings and seals and replace them with new ones.
3. Inspect all parts for scoring, damage or excessive wear. If float spool (2) or section housing bore (1) are worn out too much, the whole section must be replaced as these parts are not available separately.
4. Lubricate with engine oil SAE10W all clean parts that can be reinstalled.

Reassembly

1. Reassemble the parts in the reverse order to that of their disassembly.
2. Tighten the spool positioners (6 and 7) mounting bolts to 12 - 15 [Nm].
3. Tighten the anticavitation valve (5), check load valve (3) and port plug (4) to 45 - 53 [Nm].

9. RIPPER LIFT SECTION

Description

The ripper lift section valve is used for raising or lower the ripper. The section valve is a spring centered spool, three position type. Incorporated in the valve section is a spring loaded check valve which assures smooth operation when the spool is moved from hold to an operating position. An anticavitation valve is located in the lower part of section.

Disassembly

1. Remove the check load valve (3, Fig. 10B.7), the port plug (4) and the anticavitation valve (5). The anticavitation valve (5), the plug (4) and the check valve (3) are the only replacable parts.
2. If needed, remove the float spool positioners (6 and 7) bolts and then remove float spool (2).

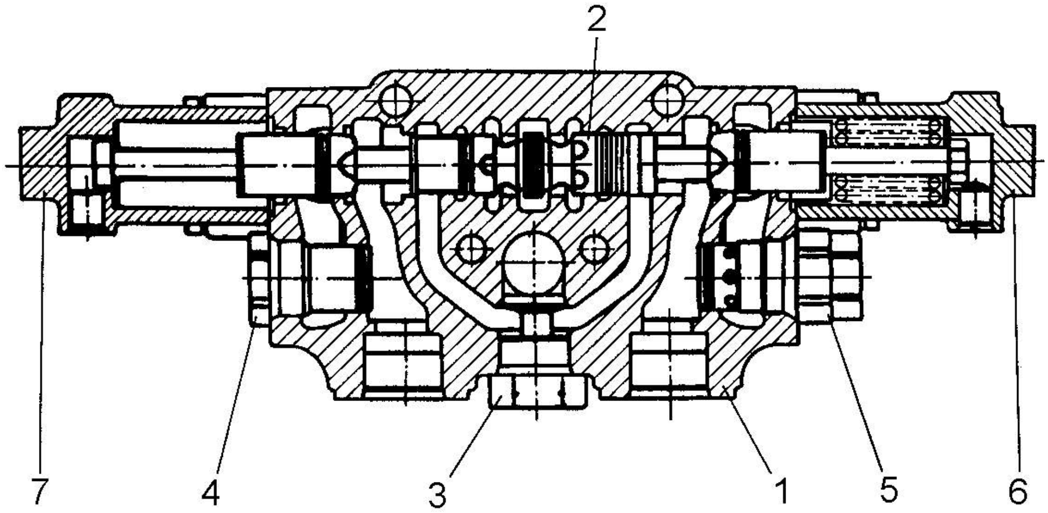


Fig. 10B.7. Cross Section View of Ripper Lift Section

1. Section Housing
2. Float Spool
3. Check Load Valve
4. Port Plug
5. Anticavitation Valve
6. Hydraulic Remote Positioner
7. Hydraulic Remote Positioner

CONTROL VALVE

Inspection and Repair

Refer to BLADE LIFT SECTION above, in this Section.

Reassembly

1. Reassemble the parts in the reverse order to that of their disassembly.
2. Tighten the spool positioners (6 and 7) mounting bolts to 12 - 15 [Nm].
3. Tighten the anticavitation valve (5), check load valve (3) and port plug (4) to 45 - 53 [Nm].

10. RIPPER PITCH SECTION

Description

The ripper pitch section valve is used for pitching the ripper forward or rearword. The section valve is a spring centered spool, three position type. Incorporated in the valve section is a spring loaded check valve which assures smooth operation when the spool is moved from hold to an operating position.

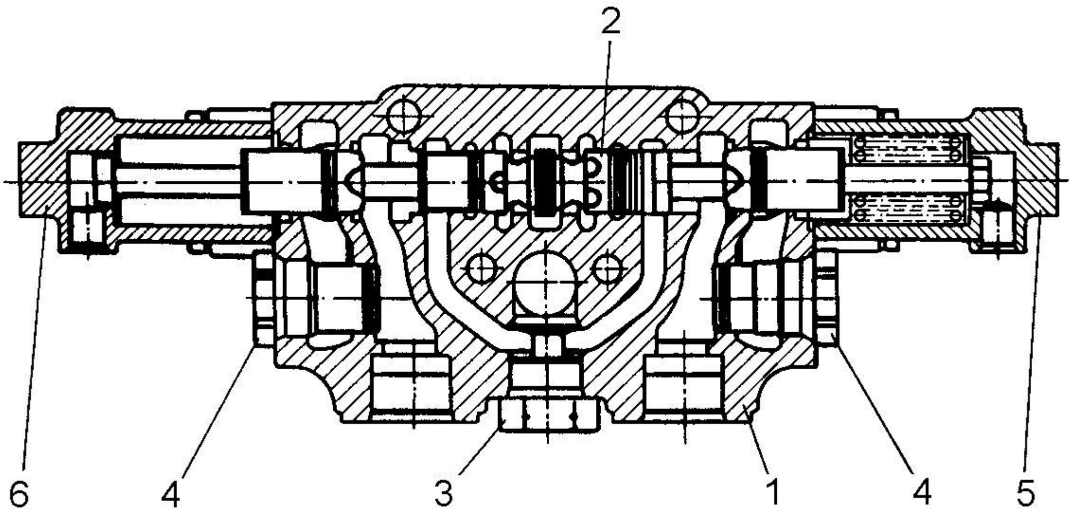


Fig. 10B.8. Cross Section View of Ripper Pitch Section

1. Section Housing
2. Float Spool
3. Check Load Valve
4. Port Plug
5. Hydraulic Remote Positioner
6. Hydraulic Remote Positioner

CONTROL VALVE

Disassembly

1. Remove the check load valve (3, Fig. 10B.8) and the port plugs (4). The plugs (4) and the check valve (3) are the only replacable parts.
2. If needed, remove the float spool positioners (5 and 6) bolts and then remove float spool (2).

Inspection and Repair

Refer to BLADE LIFT SECTION above, in this Section.

Reassembly

1. Reassemble the parts in the reverse order to that of their disassembly.
2. Tighten the spool positioners (5 and 6) mounting bolts to 12 - 15 [Nm].
3. Tighten the check load valve (3) and port plugs (4) to 45 - 53 [Nm].

11. MAIN PRESSURE RELIEF VALVE

Removal and Disassembly

1. Remove main pressure relief valve (6, Fig. 10B.5) from inlet cover plate (3), if not removed earlier.
2. Position the relief valve in a vise, adjusting end up. Remove the tamper proof cover. While holding the adjusting screw (1, Fig. 10B.9), remove the jam nut (2) and flat washer (3).

WARNING! Spring loaded assembly. Assembly must be held with bracket to relieve spring pressure. Use extreme care when disassembling.

3. Remove the adjusting screw (1).
4. Remove the pilot poppet (4) and the spring (5).
5. Remove the pilot poppet housing (6).
6. Remove the main poppet spring (7).
7. Remove the main poppet (8) with the filter screen (9).
8. Remove the seal ring (10) and the backup ring (11) from the main poppet (8) and discard.
9. Remove the seal ring (12) from the pilot poppet housing (6) and discard.
10. Remove the seal ring (13) from the adjusting screw (1) and discard.
11. Remove the seal ring (14) and backup ring (15) from inside the valve housing (19) and discard.
12. Remove the seal rings (16 and 17) and backup ring (18) on the outside of the valve housing (19) and discard.

CONTROL VALVE

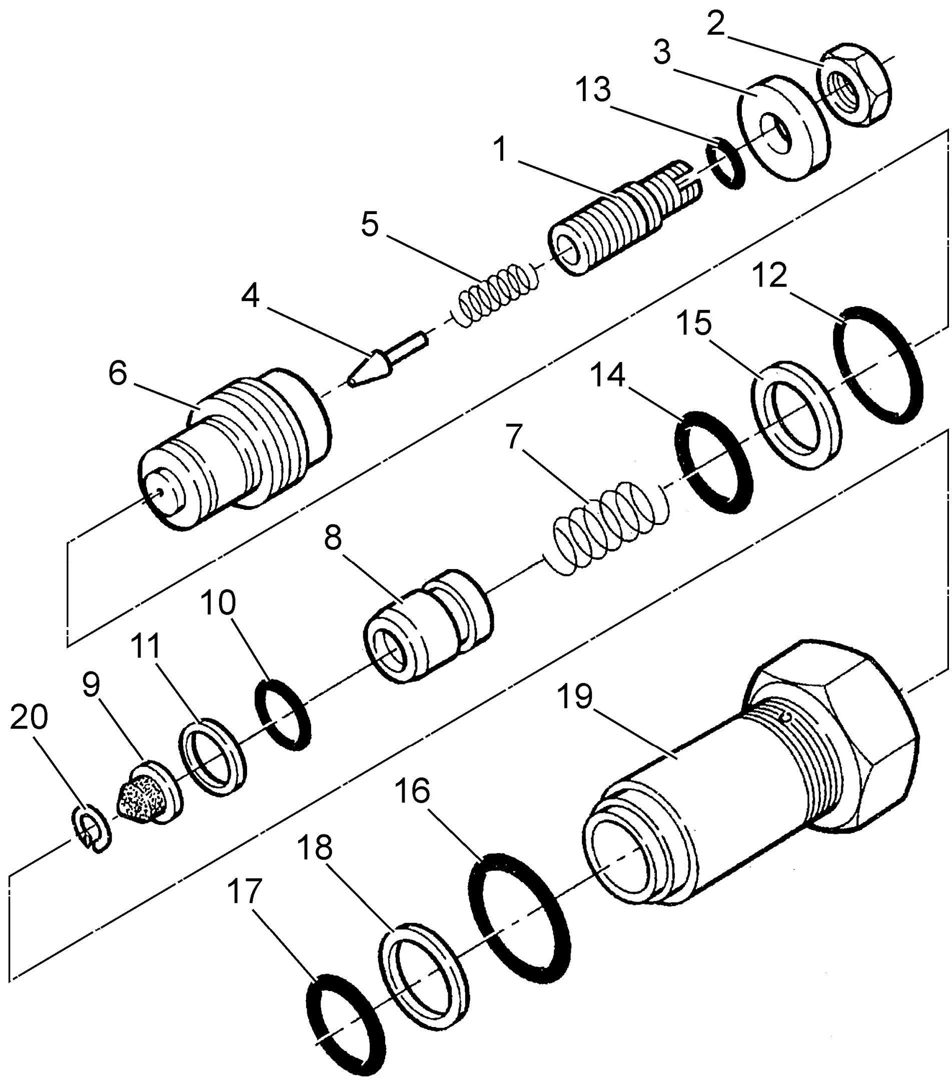


Fig. 10B.9. Exploded View of Main Pressure Relief Valve

1. Pressure Adjusting Screw
2. Adjusting Screw Jam Nut
3. Flat Washer
4. Pilot Poppet
5. Pilot Poppet Return Spring
6. Pilot Poppet Housing
7. Main Poppet Spring
8. Main Poppet
9. Orifice Screen
10. Seal Ring
11. Backup Ring
12. Seal Ring
13. Seal Ring
14. Seal Ring
15. Backup Ring
16. Seal Ring
17. Seal Ring
18. Backup Ring
19. Valve Housing
20. Retaining Ring

Inspection and Repair

1. Wash all parts thoroughly in a suitable solvent. Dry thoroughly with compressed air.
2. Discard all seals and replace them with new ones.
3. Due to the close tolerances of the working parts, the main relief valve internal parts are not serviced. If service other than the seals is required, replace the complete relief valve.
4. Lubricate with engine oil SAE 10W all clean parts that can be reinstalled.

CONTROL VALVE

Reassembly and Installation

1. Install seal rings (16 and 17) and backup ring (18) on the outside of the valve housing (19).
2. Install seal ring (14) and backup ring (15) down inside the valve hosing (19).
3. Install seal ring (13) to the adjusting screw (1).
4. Install seal ring (12) to the pilot poppet housing (6).
5. Install seal ring (10) and backup ring (11) to the main poppet (8).
6. Install the main poppet (8) with the orifice screen (9) into the valve housing (19).
7. Install the main poppet spring (7)
8. Install the pilot poppet housing (6). Tighten housing (6) to 11 – 16 [Nm].
9. Install the pilot poppet (4) and the return spring (5).
10. Install the adjusting screw (1) half way into the pilot poppet housing (6).
11. While holding the adjusting screw (1), install jam nut (2).
12. Tighten valve housing (19) to 45 – 53 [Nm].
13. Final adjustment of the main pressure valve will have to be made with the three/one spool control valve reinstalled into machine. Refer to EQUIPMENT SYSTEM RELIEF VALVES PRESSURE TESTS, Paragraph 5 in SECTION 10.
14. Tighten the jam nut (1) to 11 - 16 [Nm].
15. Reinstall tamper proof cover after adjusting procedure.

PILOT PRESSURE VALVE

12. SPECIFICATIONS (Refer to Fig.'s. 10B.10 and 10B.11)

Spring Data

Regulator Spool Spring (5):

Free Length .... 57 [mm]
Test Length .... 33.9 [mm]
Test Load .... 356 ± 18 [N]
Number of Coils 9

Pilot Supply Spool Spring (6):

Free Length .... 54 [mm]
Test Length .... 28.6 [mm]
Test Load .... 66 ± 6 [N]
Number of Coils 14

Relief Valve Spring (1):

Free Length .... 21.7 [mm]
Test Length .... 15 [mm]
Test Load .... 67 ± 3 [N]
Number of Coils 10

13. DESCRIPTION (Refer to Fig.'s. 10B.10 and 10B.11)

The pilot pressure valve serves two basic function. The first is to supply a controlled pressurized oil for blade and ripper pilot control valves. The second is to supply pilot pressure, to allow the blade and/or ripper to be lowered in a dead engine situation.

When the engine is running, pilot pump flow enters port **P**. Spool (2) is a pressure regulator spool set to regulate **P** pressure. **P** pressure enters the right end of the spool (2) through the pilot orifice. This pressure moves spool to the left against the regulating spring (5). When sufficient pressure is reached the spool opens the oil flow to tank through the **T** port. In the event of cold oil, a cold oil relief ball (14) is provided located in the center left end of the spool (2). The cold oil relief limits pressure spikes at start up.

As **P** pressure builds it also pushes against the right end of the pilot supply spool (7) through the pilot orifice. The pilot supply spool (7) shifts to the left against its spring (6). **P** pressure is now open to **PP**. **PP** supplies oil to the pilot valves for blade and ripper controls.

When the engine is off, both spools (2 and 7) shift to the right. In this condition the pilot supply spool (7) directs oil from port **AI** to **PP**. **AI** is connected to the shuttle network from the blade and ripper cylinders. If a blade or ripper cylinder is off of the ground or the equipment is powered into the ground then the trapped cylinder pressure is used through the shuttle network as pilot supply pressure. The stored pressure from the cylinders enters port **AI** and passes out **PP** to the pilot valves.

PILOT PRESSURE VALVE

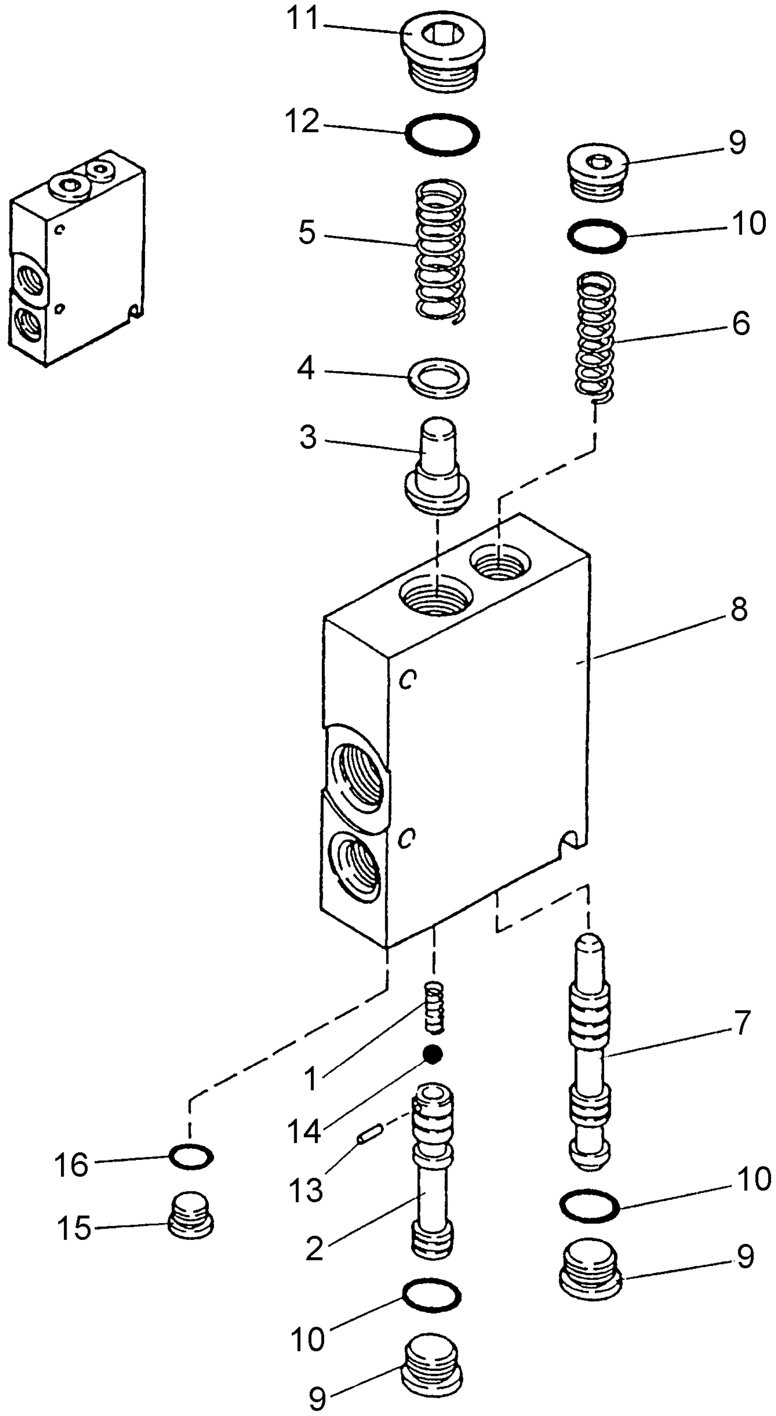


Fig. 10B.10. Exploded View of Pilot Pressure Valve

Legend for Fig.'s. 10B.10 and 10B.11

1. Relief Valve Spring
2. Pressure Regulator Spool
3. Retainer
4. Shim(s)
5. Regulator Spool Spring
6. Pilot Supply Spool Spring
7. Pilot Supply Spool
8. Housing
9. Plug
10. O-Ring
11. Plug
12. O-Ring
13. Pin
14. Ball
15. Plug
16. O-Ring
17. O-Ring
18. Plug
19. O-Ring
20. Plug

PILOT PRESSURE VALVE

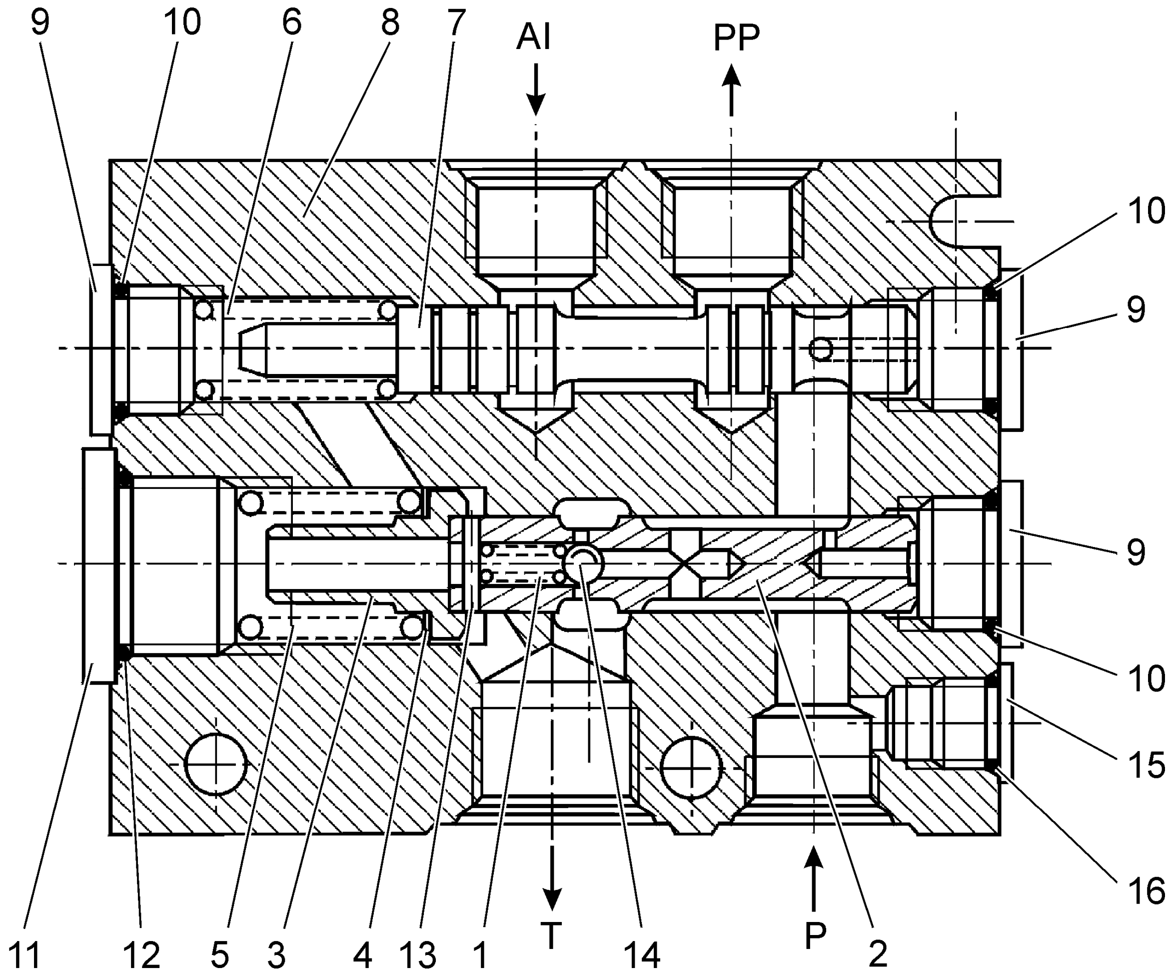


Fig. 10B.11. Cross Section View of Pilot Pressure Valve

14. REMOVAL AND INSTALLATION (Refer to Fig. 10B.12)

NOTE: *When disconnecting hydraulic lines for any reason, they should be properly capped with correct size plastic caps. If these cap are not available, tape or clean rubber corks may be used. Hydraulic openings must never be plugged with rags. This practice could easily induce dirt, lint or contaminants into critical hydraulic components. Tag disconnected lines to facilitate correct and faster installation.*

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

PILOT PRESSURE VALVE

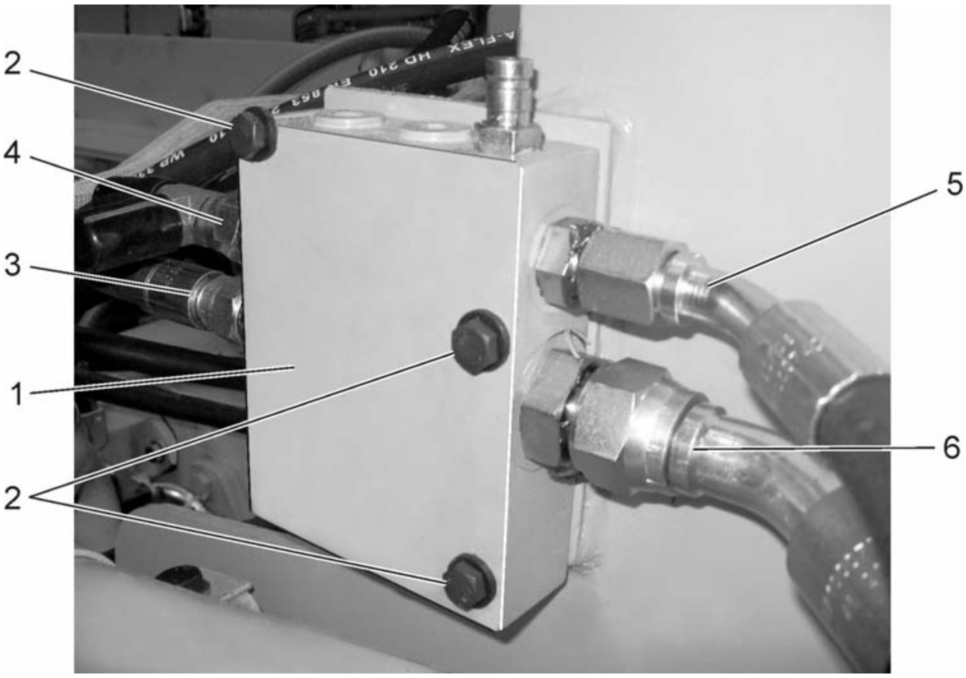


Fig. 10B.12. Pilot Pressure Valve Disconnecting Points

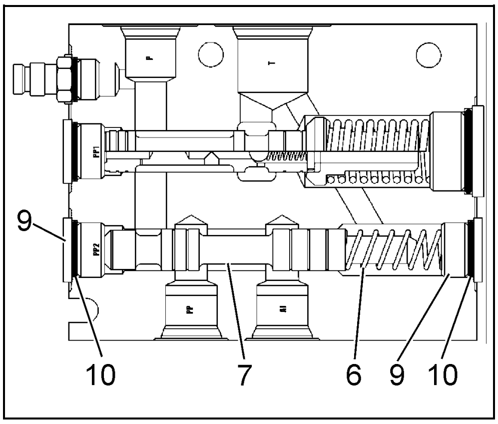
1. Pilot Pressure Valve
2. Bolts with Washers
3. Hose
4. Tee with Hoses
5. Hose
6. Hose

1. Open the right rear door. Disconnect tee (4) with two hoses and hoses (3, 5 and 6) at sides of pilot pressure valve (1) and move out of the way. Remove mounting bolts with washers (2) securing pilot pressure valve (1) to mounting bracket. Remove the pilot pressure valve out of the machine.
2. Installation is reverse of removal.

15. DISASSEMBLY (Refer to Fig.'s. 10B.10 and 10B.11)

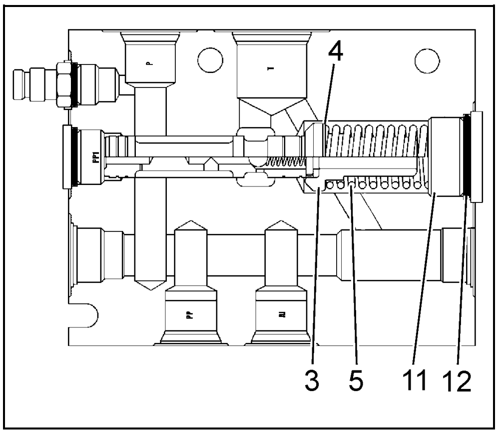
WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme caution when disassembling.

1. Slowly remove each end plugs (9) until spool spring (6) pressure is alleviated, then remove the supply spool (7) and spring (6). Remove and discard the O-rings (10) from the end plugs (9).

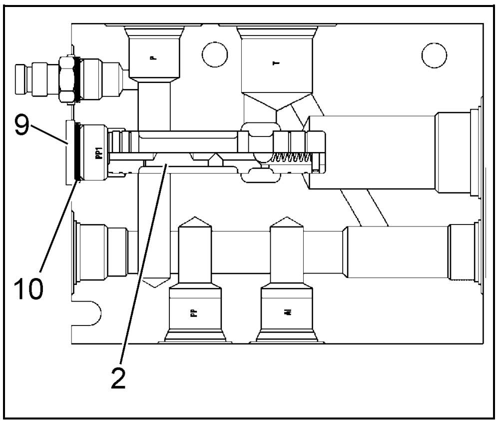


PILOT PRESSURE VALVE

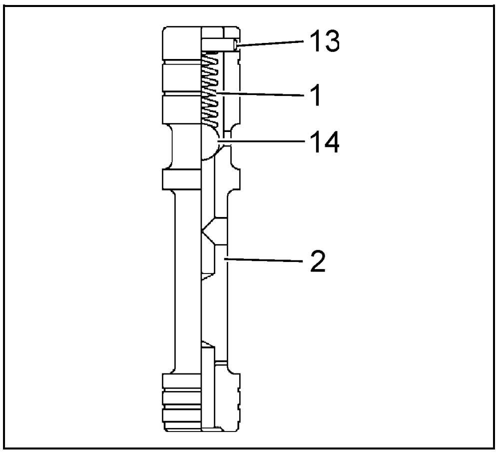
2. Slowly remove the end plug (11) until the regulator spool spring (5) pressure is alleviated, then remove the spring retainer (3), shim(s) (4) and spring (5). Remove and discard the O-ring (12) from the end plug (11).



3. Remove the end plug (9) and discard the O-ring (10). Remove the pressure regulating spool (2) from the valve housing (8).



4. Using a drift, remove the roll pin (13) from the pressure regulator spool (2). Slowly retract the drift pin and remove the relief valve spring (1) and the check ball (14) from the spool.



PILOT PRESSURE VALVE

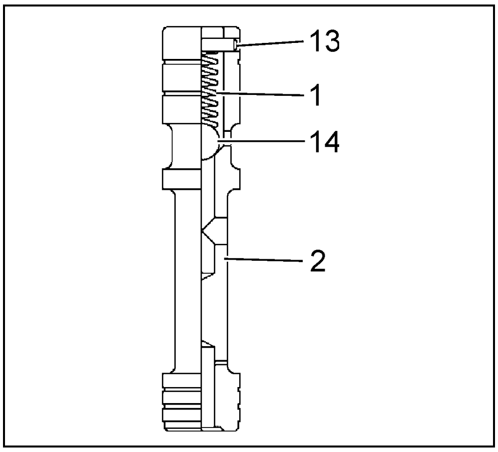
16. INSPECTION AND REPAIR

1. It is recommended that all new O-rings be installed upon reassembly of the valve.
2. Clean all parts in a suitable solvent and blow dry with compressed air. Be sure all oil passages in the valve housing and spools are clean and free of obstructions.
3. Check free movement of spools and their surfaces for wear, scores or scratches and replace if necessary.
4. Inspect the condition of the springs. If they are damaged or do not fall within the specifications shown in Paragraph 12, SPECIFICATIONS, they must be replaced.

17. REASSEMBLY (Refer to Fig.'s. 10B.10 and 10B.11)

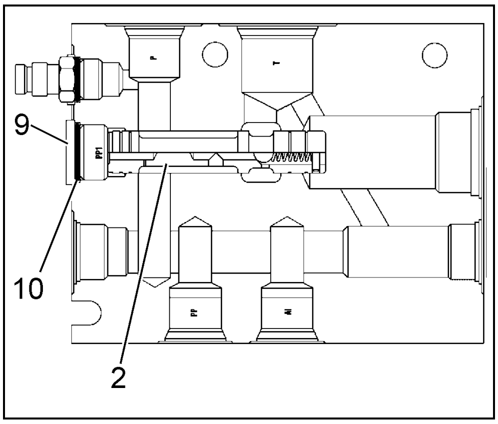
WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme caution when assembling.

1. Install the check ball (14) and the relief valve spring (1) into the pressure regulating spool (2). Compress the spring (1) and hold with a drift pin. Install roll pin (13), driving drift pin out below the edge of the spool.



WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme caution when assembling.

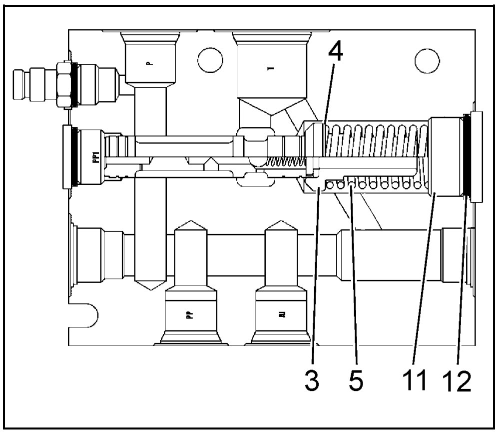
2. Coat the pressure regulator spool (2) with clean oil and install into the valve housing (8). Install the end plug (9) with a new O-ring (10).



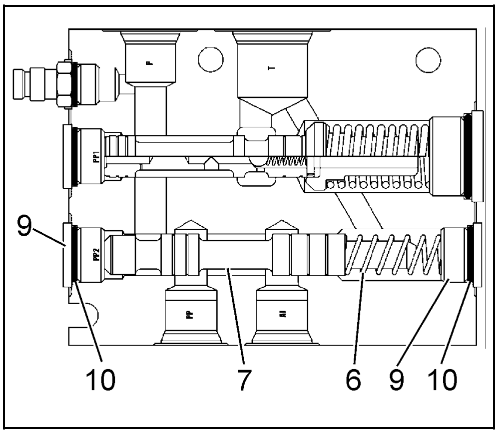
PILOT PRESSURE VALVE

3. Install the spring retainer (3), shim(s) (4) – that were removed – and regulator spool spring (5) and secure with the plug end (11) with a new O-ring (12).

NOTE: *Each shim (4) that is added or removed will raise or lower the regulator pressure by 35 [kPa].*



4. Coat the pilot supply spool (7) with clean oil and insert into the valve housing with the pilot supply spool spring (6). Install a end plug (9) with a new O-ring (10) at one end of the housing. Compress the spring (6) and install the remaining end plug (9) with a new O-ring (10).



QUICK DROP VALVE

18. SPECIFICATION (Refer to Fig.'s 10B.13 and 10B.14)

Spring Data

Spool Inner Spring (6):

Free Length .... 92.6 [mm]
Test Length .... 36.5 [mm]
Test Load .... 303 [N]
Number of Coils 11

Spool Outer Spring (7):

Free Length .... 91 [mm]
Test Length .... 40.5 [mm]
Test Load .... 872 [N]
Number of Coils 9

19. DESCRIPTION

The quick drop valve is used for accelerated movement and improved power efficiency when lowering of the blade is required. The valve is front main frame mounted and is located in the engine compartment inside of right side of frame wall. This hydraulically operated valve allow the blade to drop at a faster rate by diverting return oil through a spool to supplement the blade cylinder input oil from the piston side being used to lower the blade. The valve only diverts the return oil when the vacuum pressure is created in the piston side chamber. It occurs during lowering the blade with inadequate oil supply.

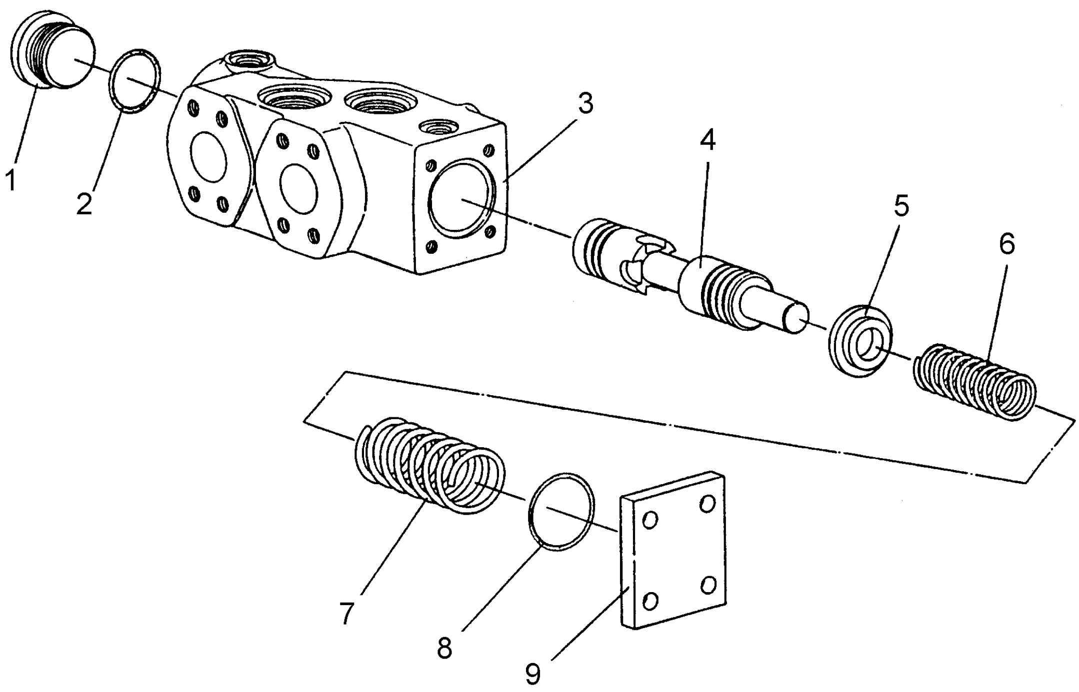


Fig. 10B.13. Exploded View of Quick Drop Valve

Legend for Fig. 10B.13 and 10B.14

1. Plug
2. O-Ring
3. Valve Housing
4. Spool
5. Spring Retainer
6. Inner Spring
7. Outer Spring
8. O-Ring
9. Cover, Bolts, Washers

QUICK DROP VALVE

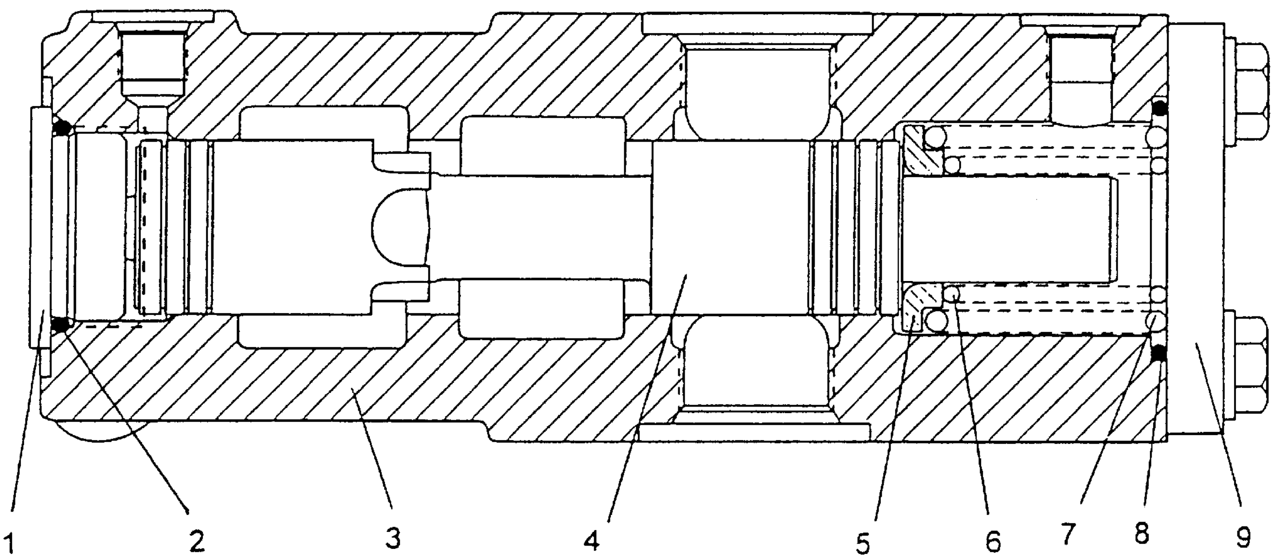


Fig. 10B.14. Cross Section View of Quick Drop Valve

20. REMOVAL AND INSTALLATION (Refer to Figs. 10B.15 and 10B.16)

NOTE: *When disconnecting hydraulic lines for any reason, they should be properly capped with correct size plastic caps. If these caps are not available, tape or clean rubber corks may be used. Hydraulic openings must never be plugged with rags. This practice could easily introduce dirt, lint or contaminants into critical hydraulic components. Tag disconnected lines to facilitate correct and faster installation.*

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

1. Open the right front door of engine compartment and remove engine shield from bottom of the machine.
2. Disconnect three hoses (7, 4 and 2, Fig. 10B.15) from the top of quick drop valve (3).
3. Disconnect two hoses (5 and 6, Fig. 10B.16) form the bottom of quick drop valve (1).
4. Unscrew bolts and disconnect hoses (3 and 4) from quick drop valve (1). Unscrew elbows, tee and connectors from quick drop valve (1). Remove and discard old O-rings.
5. Unscrew three bolts (2) with washers securing plate (7) to main frame. Remove valve (1) together with plate (7).
6. Unscrew three bolts with washers securing quick drop valve (1) to plate (7) and remove valve from plate.
7. Installation is reverse of removal.

QUICK DROP VALVE

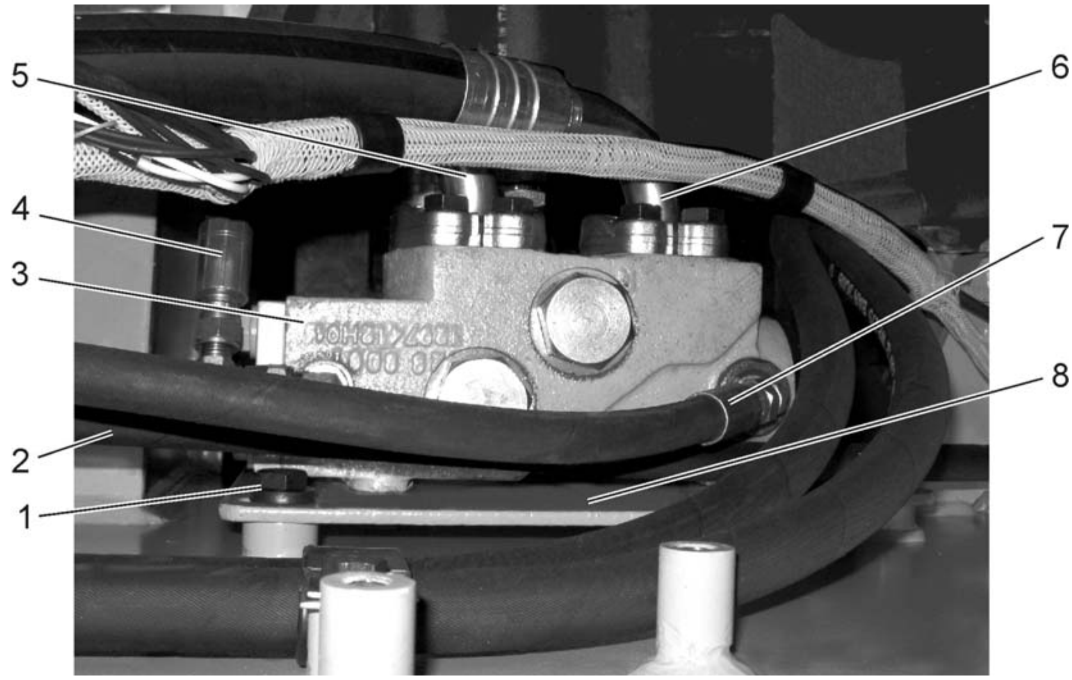


Fig. 10B.15. Quick Drop Valve Disconnecting Points
View from top Machine on the Right Frame

1. Bolt	3. Quick Drop Valve	5. Hose	7. Hose
2. Hose	4. Hose	6. Hose	8. Mounting Plate

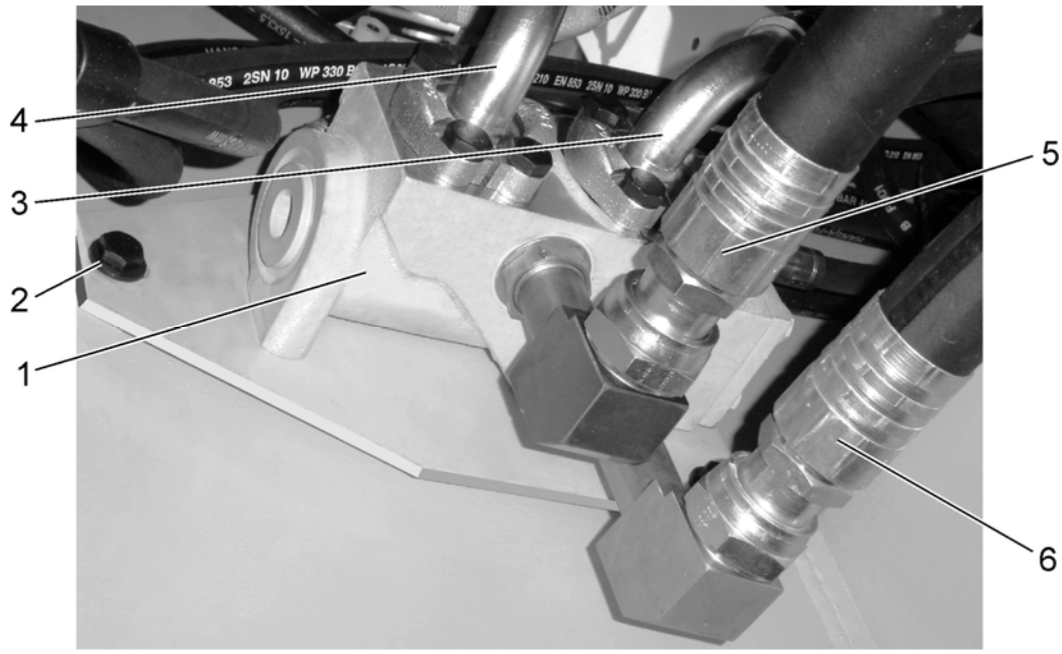


Fig. 10B.16. Quick Drop Valve Disconnecting Points
View from under Machine on the Right Frame

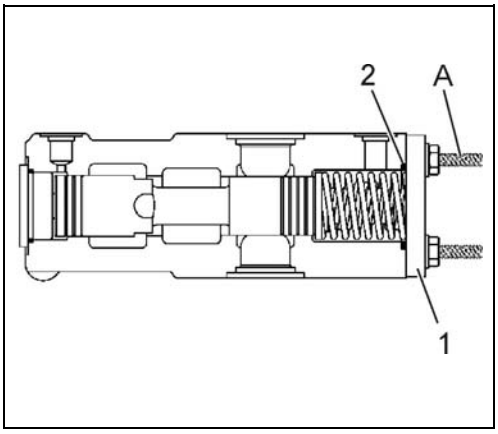
1. Quick Drop Valve	3. Hose	5. Hose
2. Bolt	4. Hose	6. Hose

QUICK DROP VALVE

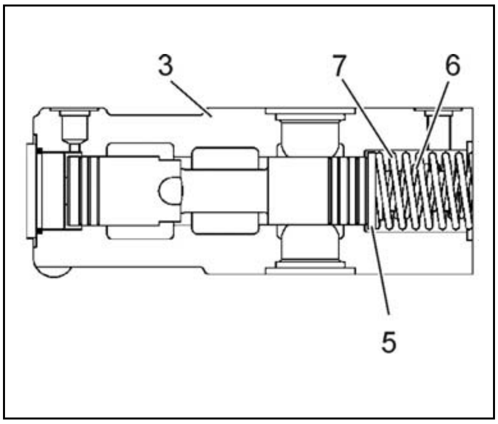
21. DISASSEMBLY (Refer to Fig.'s. 10B.13 and 10B.14)

1. Remove two of the bolts from the cover (9). Install M10 x 100 studs (A) and secure with M10 nuts and washers. Remove the remaining two bolts from the cover (9). Slowly loosen the nuts until all of the tension from the return springs is dissipated. Remove and discard the cover O-ring (8).

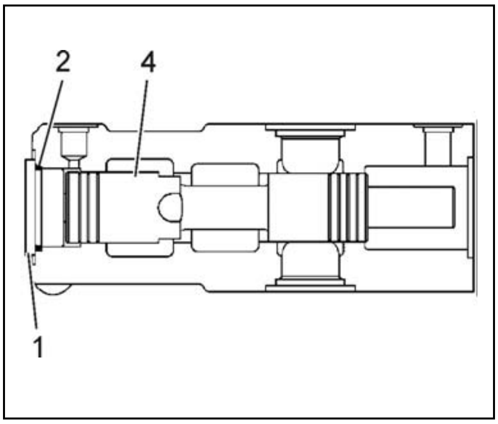
WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme caution when disassembling.



2. Remove the outer (7) and inner (6) return springs and the spring retainer (5) from the valve housing (3).



3. Remove the end plug (1) and discard the O-ring (2). Remove the valve spool (4) from the housing.



22. INSPECTION AND REPAIR

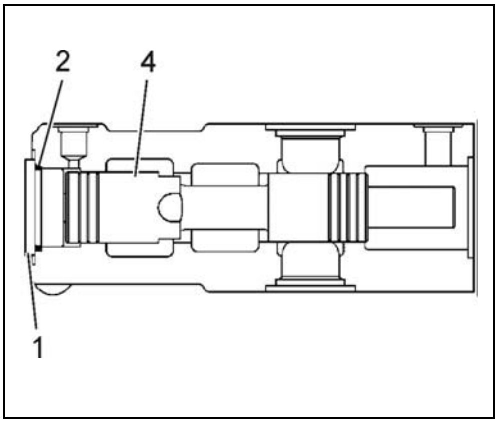
1. It is recommended that all new O-rings be installed upon reassembly of the valve.
2. Clean all parts in a suitable solvent and blow dry with compressed air. Be sure all oil passages in the valve housing and spools are clean and free of obstructions.

QUICK DROP VALVE

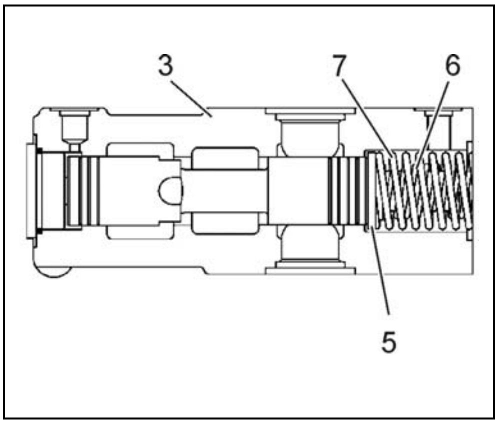
3. Check free movement of spools and their surfaces for wear, scores or scratches and replace if necessary. If either a spool or housing bore is worn or scored allowing excessive internal leakage, install a new control valve.
4. Inspect the condition of the springs. If they are damaged or do not fall within the specifications shown in Paragraph 18, SPECIFICATIONS, they must be replaced.
5. Clean threads with a stiff brush and solvent. Check for damage.

21. ASSEMBLY (Refer to Fig.'s. 10B.13 and 10B.14)

1. Install the valve spool (4) into the valve housing (3). Install end plug (1) with new O-ring (2) to the valve housing (3).



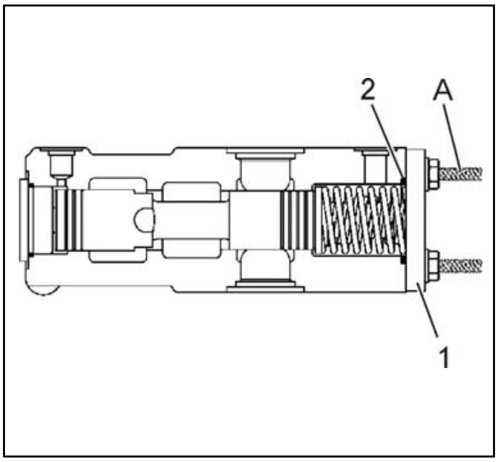
2. Install the spring retainer (5) and inner (6) and outer (7) return springs into the valve housing (3).



3. Install a new O-ring (8) into the valve housing. Install M10 x 100 studs studs (A) into the valve housing. Position the cover (9) over the studs onto the return springs. Using the nuts and washers, draw the cover (9) down and secure with bolts. Torque the bolts to 41 – 51 [Nm].

   Attach the valve with all external hydraulic connectors, if previously disconnected, using new O-rings.

WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme caution when assembling.



BLADE TILT CONTROL VALVE

24. SPECIFICATIONS

Weights

Blade Tilt Control Valve .... 11.6 [kg]

Torque Data

Stud Clamping Torque (13) .... 50 [Nm]

Inlet Section (1):
- Plug (2) .... 80 [Nm]
- Relief valve (3) .... 80 [Nm]
- Relief valve Cap (3) .... 20 [Nm]

Working Section (5):
- Check valve (9) .... 80 [Nm]
- Control section (7) mounting bolts .... 4 - 6 [Nm]

25. DESCRIPTION

The purpose of a control valve is to direct pump flow to the work function. When no work function is being performed the spool is spring centered for return to the neutral position. With the spool in this position oil flows freely through the spool to supplement pump feed for the main control valve. Actuating the spool closes off the center by-pass and directs the pump flow to a cylinder port. A load check valve allow pump operating pressure to build up to the work load pressure before opening which prevents oil reversal or the load being dropped. This is a double acting valve spool. This valve incorporates an adjustable pilot operated relief valve which limits the maximum operating pressure of the system. The pilot operated type functions by a pilot poppet which signals the piston to open allowing the pump flow to go to the low pressure core and valve outlet.

BLADE TILT CONTROL VALVE

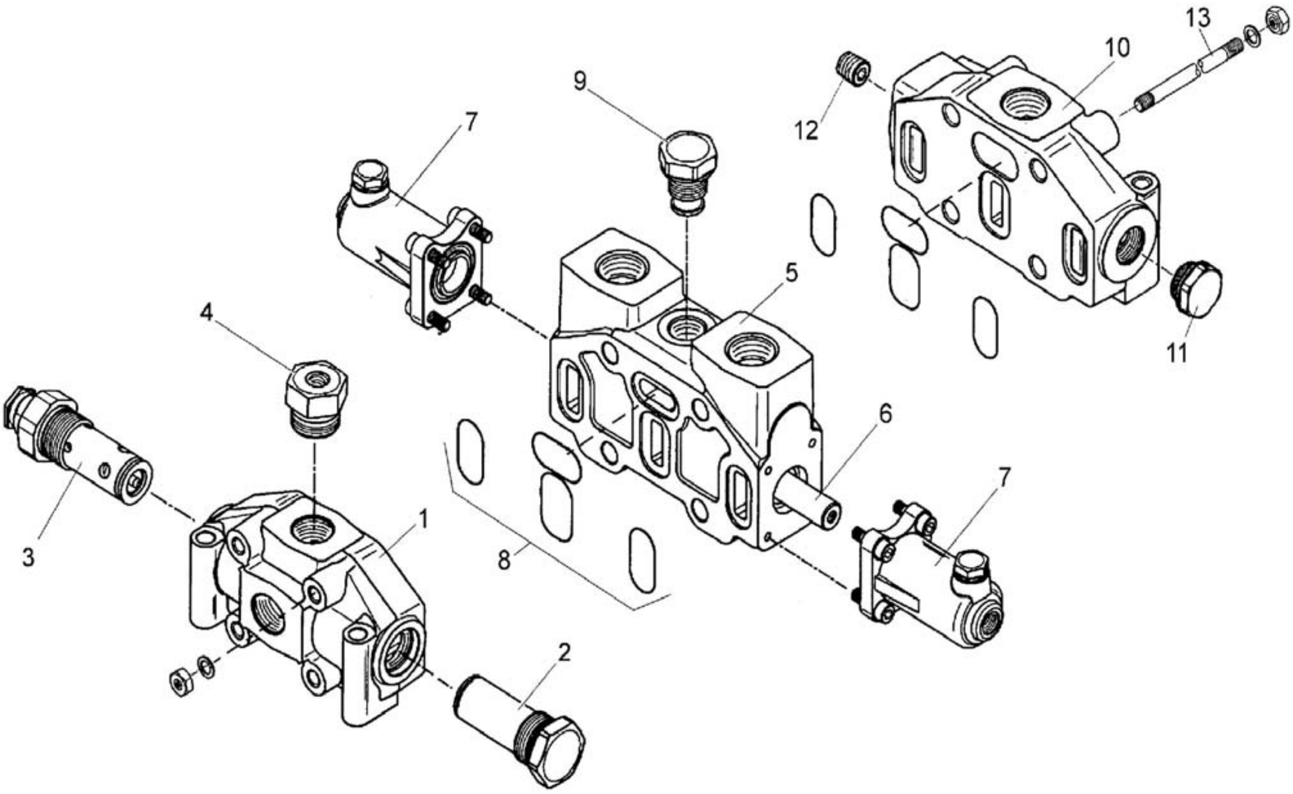


Fig. 10B.17. Exploded View of Blade Tilt Control Valve

1. Inlet Section Housing
2. Plug
3. Relief Valve
4. Plug
5. Working (Tilt) Section Housing
6. Spool
7. Control Section
8. Seal Kit
9. Check Valve
10. Outlet Section Housing
11. Plug
12. Plug
13. Stud Kit

The normal operating sequence for the relief valve is as follows (Fig. 10B.18):

Step 1. The relief valve closes the communication between the inlet port **HP** and reservoir return port **LP**.
Oil is admitted through the piston (7) around spring guide (10) pin and enters cavity **A**. The spring (6) holds the piston (7) in the valve seat (9), cutting off flow of oil.

Step 2.
The oil pressure in the inlet port **HP** and in the cavity **A** has reached the setting of the pilot poppet spring (12) force and unseats the pilot poppet (5). Therefore oil flows from cavity **A** around the poppet through the cross drilled holes and to the reservoir return port **LP**.

Step 3.
The imbalance of pressure inside cavity **A** as compared to that of cylinder port **HP**, forces the piston (7) to open and relieve the oil directly to the reservoir return port in the valve. Consequently pilot poppet (5) moves back and cut off the flow from cavity **A**.

Step 4
The loss of oil pressure in cavity **A** effected by the opening of pilot poppet (5), causes piston to move back and seat against valve seat (9). This shuts off the oil flow to the area **LP** behind piston (7), and causes a low pressure in cavity **A**.

BLADE TILT CONTROL VALVE

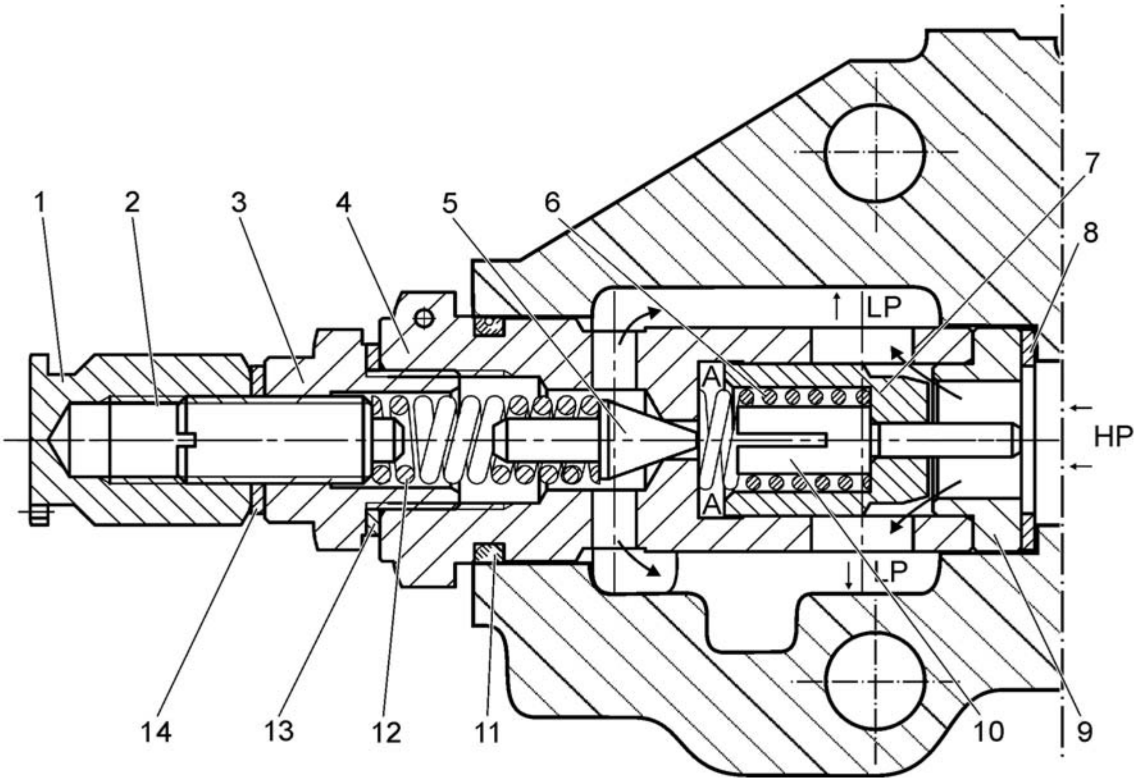


Fig. 10B.18. Relief Valve Operation

1. Valve Cap
2. Adjusting Screw
3. Jam Nut
4. Valve Body
5. Pilot Poppet
6. Spring
7. Piston
8. Seal Washer
9. Valve Seat
10. Spring Guide
11. O-Ring
12. Pilot Poppet Spring
13. Seal Washer
14. Seal Washer

HP. Inlet Port
LP. Return Port

26. REMOVAL AND INSTALLATION

NOTE: *When disconnecting hydraulic lines for any reason, they should be properly capped with correct size plastic caps. If these cap are not available, tape or clean rubber corks may be used. Hydraulic openings must never be plugged with rags. This practice could easily induce dirt, lint or contaminants into critical hydraulic components. Tag disconnected lines to facilitate correct and faster installation.*

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

1. Drain the hydraulic system of oil as described in OPERATOR'S MANUAL.
2. Unscrew bolts (3, Fig. 10B.19) and remove R.H. enclosure (2) with R.H. door (1).

BLADE TILT CONTROL VALVE

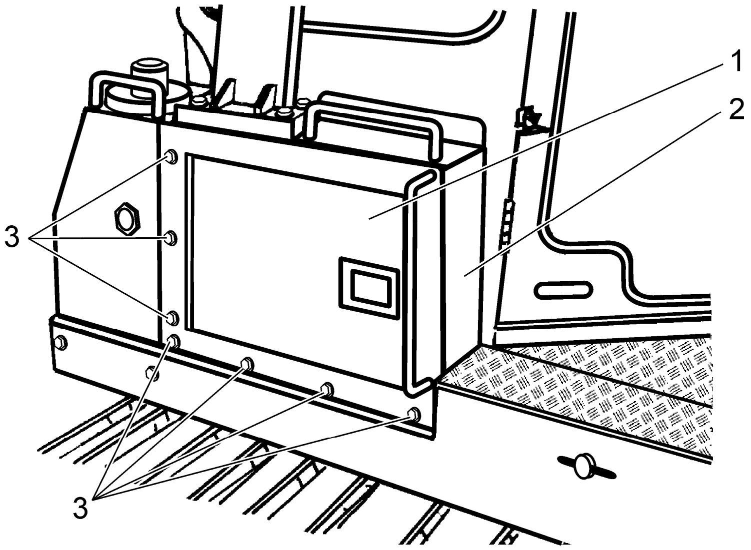


Fig. 10B.19. Disassembly R.H. Enclosure

1. R.H. Door 2. R.H. Enclosure 3. Bolts

3. Loosen clamps of connecting hoses (1 and 3, Fig. 10B.20) and remove return tubes (2).
4. Unscrew four bolts securing head of filter (5) to filter bracket. Position filter assy (5) with hoses out of way to gain access to control valve (4).

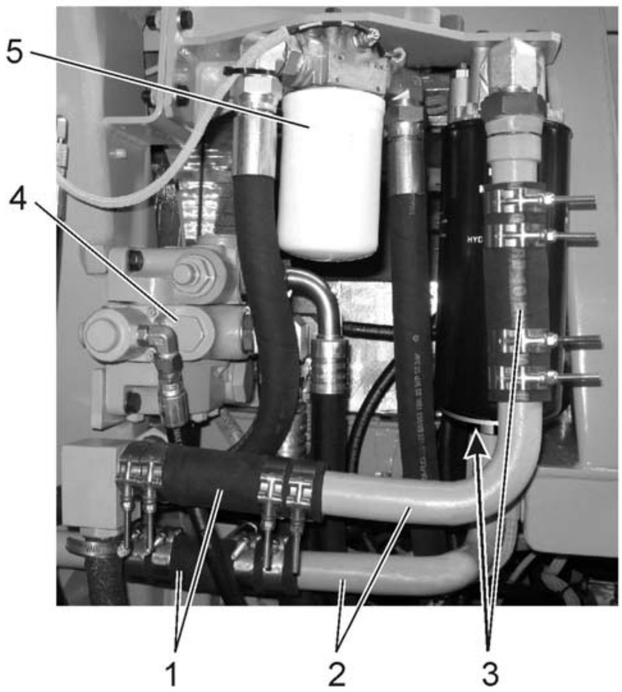


Fig. 10B.20. Utility Box

1. Connecting Hoses with Clamps
2. Return Tubes
3. Connecting Hoses with Clamps
4. Control Valve
5. Fan Filter Assy

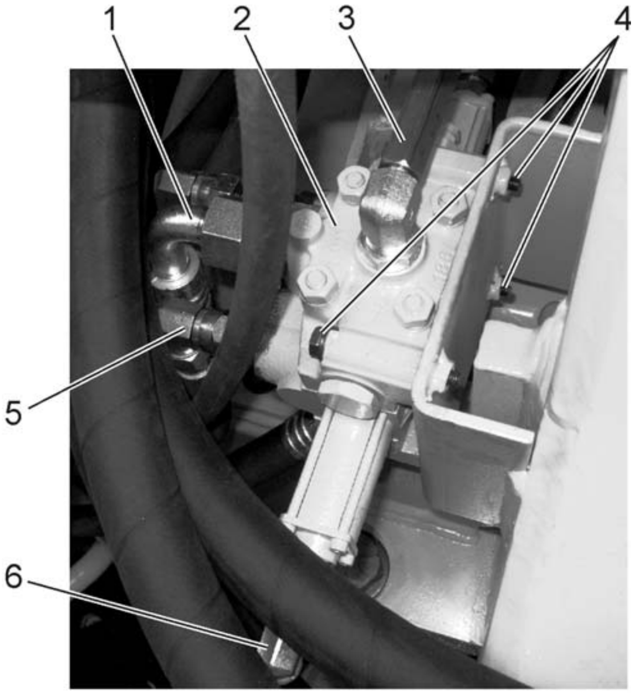


Fig. 10B.21. Hydraulic Return Filters Removing

1. Equipment Pump Inlet Hose
2. Blade Tilt Control Valve
3. Quick Disconnect Fitting
4. Bolts with Washers
5. Outlet Hose
6. Pilot Hose

BLADE TILT CONTROL VALVE

5. If necessary, disconnect suitable hoses from the control valve (4) to gain access to blade tilt control valve. Refer to REMOVAL under CONTROL VALVE in this Section.
6. Disconnect two pilot hoses (6, Fig.10B.21) from both sides of blade tilt control valve (2).
7. Disconnect inlet hose (1), two outlet hoses (5) and reservoir return tube (not visible) from the blade tilt control valve (2).
8. Attach a hoist to blade tilt control valve (2) and remove four mounting bolts with washers (4) securing valve (2) to mounting bracket. Remove the valve (4) out of the machine. Disconnect quick disconnect fitting (3) and all hydraulic connectors from the valve if needed.
9. Installation is reverse of removal.

27. SERVICE

Valve (Refer to Fig. 10B.17)

A. Position valve on work bench. Remove relief valve (3) from inlet section housing (1). Remove nuts from the studs (13) and separate components: inlet section (Fig. 10B.21), tilt section (Fig. 10B.22) and outlet section (Fig.10B.23). Discard seal kit (8) and replace with new. Refer to the following for relief valve and blade tilt section service.

B. Thread nuts on the studs (13) and position through outlet section housing (10). Place outlet housing (10) with sealing surface up on bench. Insert new seal kit (8) to outlet section housing (10) and tilt section (5). Slide tilt section (5) and inlet section (1) on the studs (13). Secure remaining nuts to the studs and torque. Install relief valve (3) to inlet housing (1) and torque. Refer to SPECIFICATIONS under BLADE TILT CONTROL VALVE in this Section.

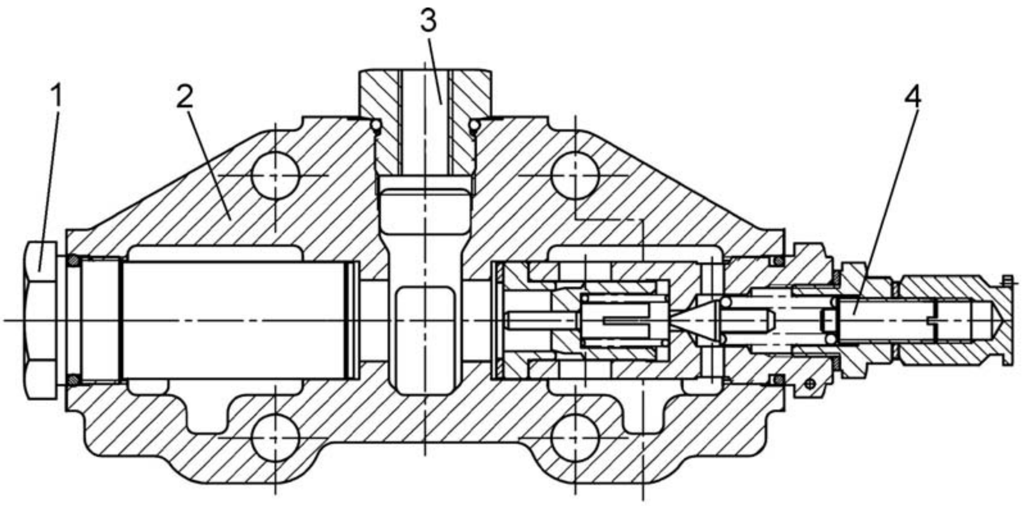


Fig. 10B.22. Cross Section View of Inlet Section

1. Plug
2. Inlet Housing
3. Plug
4. Relief Valve

BLADE TILT CONTROL VALVE

Relief Valve (Refer to Fig. 10B. 18)

NOTE: *Part (4, Fig. 10B.18) together with parts (6, 7, 9 and 10) are not serviced separately.*

A. Remove valve cap (1) and discard seal washer (14). Back out adjusting screw (2) to relieve tension off of pilot poppet spring (12). Remove valve body (4) with adjusting screw. Remove jam nut (3) with adjusting screw (2) and discard seal washer (13). Remove pilot poppet spring (12), pilot poppet (5) and O-ring (11) from valve body (4). Remove seal washer (8) from the inlet section housing. Replace all discarded parts with new seal kit. Clean all parts and check for wear scores or scratches and replace if necessary.

B. Install new O-ring (11) to valve body (4). Insert pilot poppet (5) with new spring (12) into valve body (4). Thread jam nut (3) with adjusting screw (2) and seal washer (13) into valve body (4). Thread valve body (4) into inlet housing (2, Fig. 10B.14) and torque it. Screw in adjusting screw (2) into jam nut (3) finger tight to attain tension on poppet (5). Install seal washers (14) and valve cap (1) onto nut (3). DO NOT apply torque to nuts at this time as relief valve has to be adjusted when blade tilt valve is reinstalled on machine. Refer to SECTION 10, HYDRAULICS.

Tilt Section (Refer to Fig. 10B.22)

A. Unscrew bolts (9) and remove control section (11) from section housing (10). Remove centre ring (5), spacer sleeve (2), spring (6) and washer (1) from control section housing (11). Discard O-rings (3 and 4) from centre ring (5). Replace all O-rings with new. Check all parts for excessive wear, scores or scratches and repair or replace as necessary.

B. Install new O-rings (3 and 4) on centre ring (5). Install washer (1), spring (6), spacer sleeve (2) and centre ring (5) to control section housing (11). Install control section (11) with hardware to section housing (10) and torque bolt.

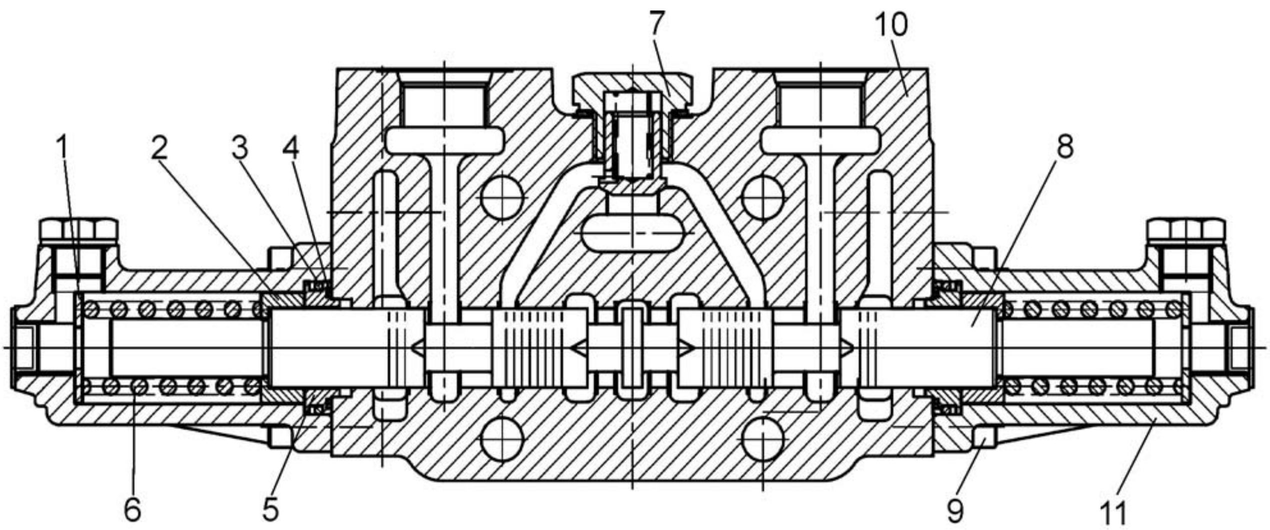


Fig. 10B.23. Cross Section View of Blade Tilt Section

1. Flat Washer
2. Spacer Sleeve
3. O-Ring
4. O-Ring
5. Centre Ring
6. Spool Return Spring
7. Check Valve
8. Valve Spool
9. Bolt
10. Section Housing
11. Control Section Housing

BLADE TILT CONTROL VALVE

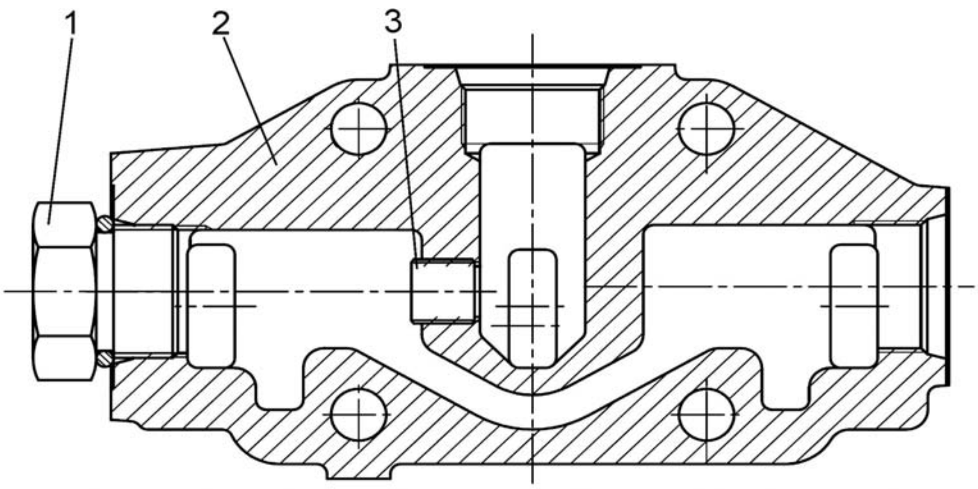


Fig. 10B.24. Cross Section View of Outlet Section

1. Plug 2. Outlet Housing 3. Plug

SECTION 10C

CYLINDERS

CYLINDERS

CONTENTS

SERVICE /SPECIAL TOOLS

BLADE LIFT CYLINDER

BLADE TILT CYLINDER (D-2)

BLADE TILT /PITCH CYLINDERS (D-2)

RIPPER LIFT AND PITCH CYLINDERS /BLADE TILT CYLINDERS (G-2)

SERVICE /SPECIAL TOOLS

1. SERVICE /SPECIAL TOOLS

TOOLS' DESCRIPTION	TOOL NUMBER
Piston Seal Compressing Tool	1.549.0176

BLADE LIFT CYLINDER

2. REMOVAL

WARNING! Before working on a machine, be sure that the blade and ripper have been lowered to the ground, the engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and controls are tagged to prevent inadvertent engine starting.

WARNING! Before disconnecting hydraulic hoses, cycle all hydraulic controls in all directions to relieve trapped pressure as described in OPERATOR'S MANUAL.

IMPORTANT: *Disconnected hydraulic lines must be capped with the correct size plastic cap. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Tag all disconnected lines to facilitate proper installation.*

1. Disconnect the lift cylinders (7, Fig. 10C.1) at the blade (2) by drive out the mounting pins (1) on both side of the dozer.

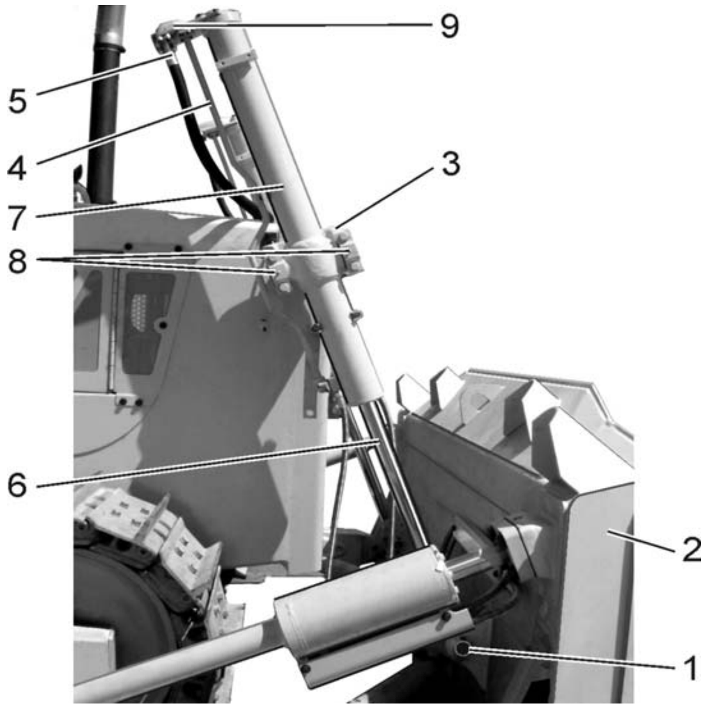


Fig. 10C.1. Blade Lift Cylinder Removal

1. Cylinder Rod Pin	4. Tube	7. Blade Lift Cylinder
2. Blade	5. Hoses	8. Yoke Cap
3. Lift Yoke	6. Cylinder Rod	9. Cylinder Manifold

BLADE LIFT CYLINDER

2. Start the engine and hydraulically retract both the cylinder rods (6). Shut off the engine. Using wire, secure the cylinder rod ends (6) of both cylinders to the cylinders (7).
3. Disconnect hoses (5) at the cylinder manifold (9).
4. Attach a hoist sling to the cylinder. The hoist must be installed to give the best possible balance. Place tension on the hoist and check for contact between the hoist and the manifold tube on the cylinder which could result in damage to the tubing.

NOTE: *The bearing caps are matched with the ears of the yoke. If not marked, stamp letters A and B on the caps (1) and corresponding yoke (2)ears in the areas shown in Fig. 10C.2. Identification marks to be in the same area, either side or end as shown bellow.*

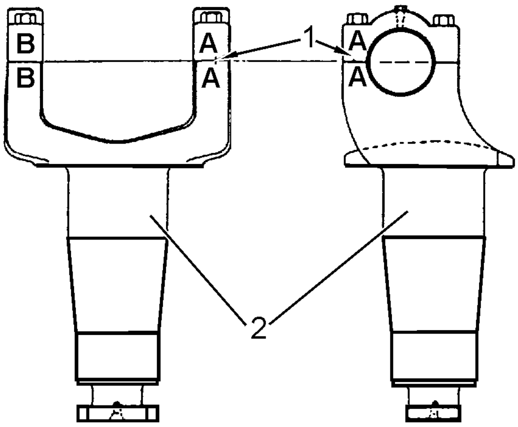


Fig. 10C.2. Yoke and Cap Stamp Marks

1. Yoke Caps 2. Lift Yoke

5. Remove the bolts securing the yoke caps (8, Fig. 10C.1) to the mounting lift yoke (3) and remove the yoke caps with pins. Keep pins with yoke caps for proper installation. Remove the cylinder hangers and remove the blade lift cylinders (7) from machine.

3. DISASSEMBLY (Refer to Fig.'s 10C.3 and 10C.4)

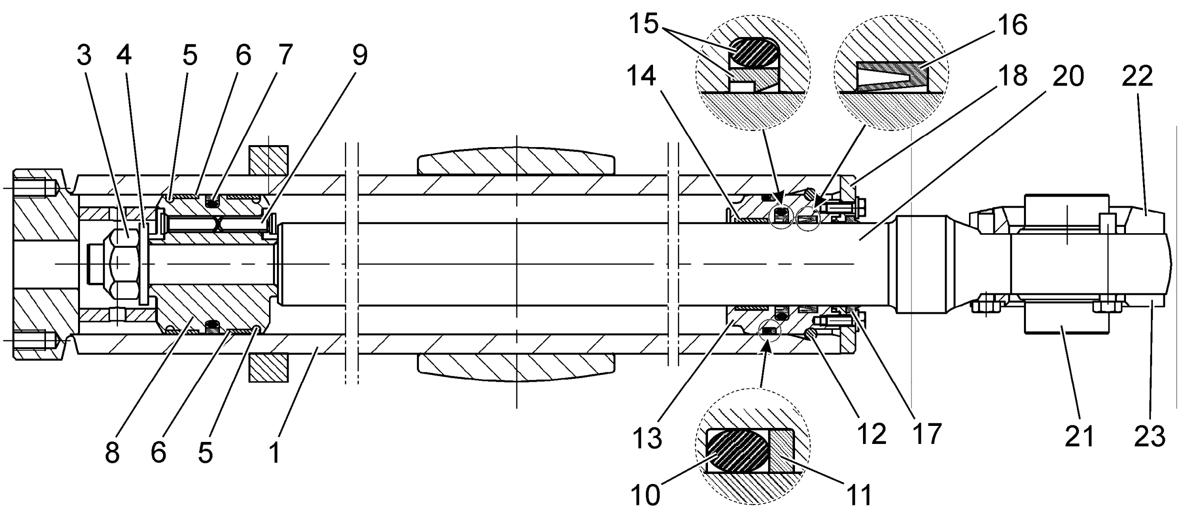


Fig. 10C.3. Cross Section View of Blade Lift Cylinder

CYLINDERS

BLADE LIFT CYLINDER

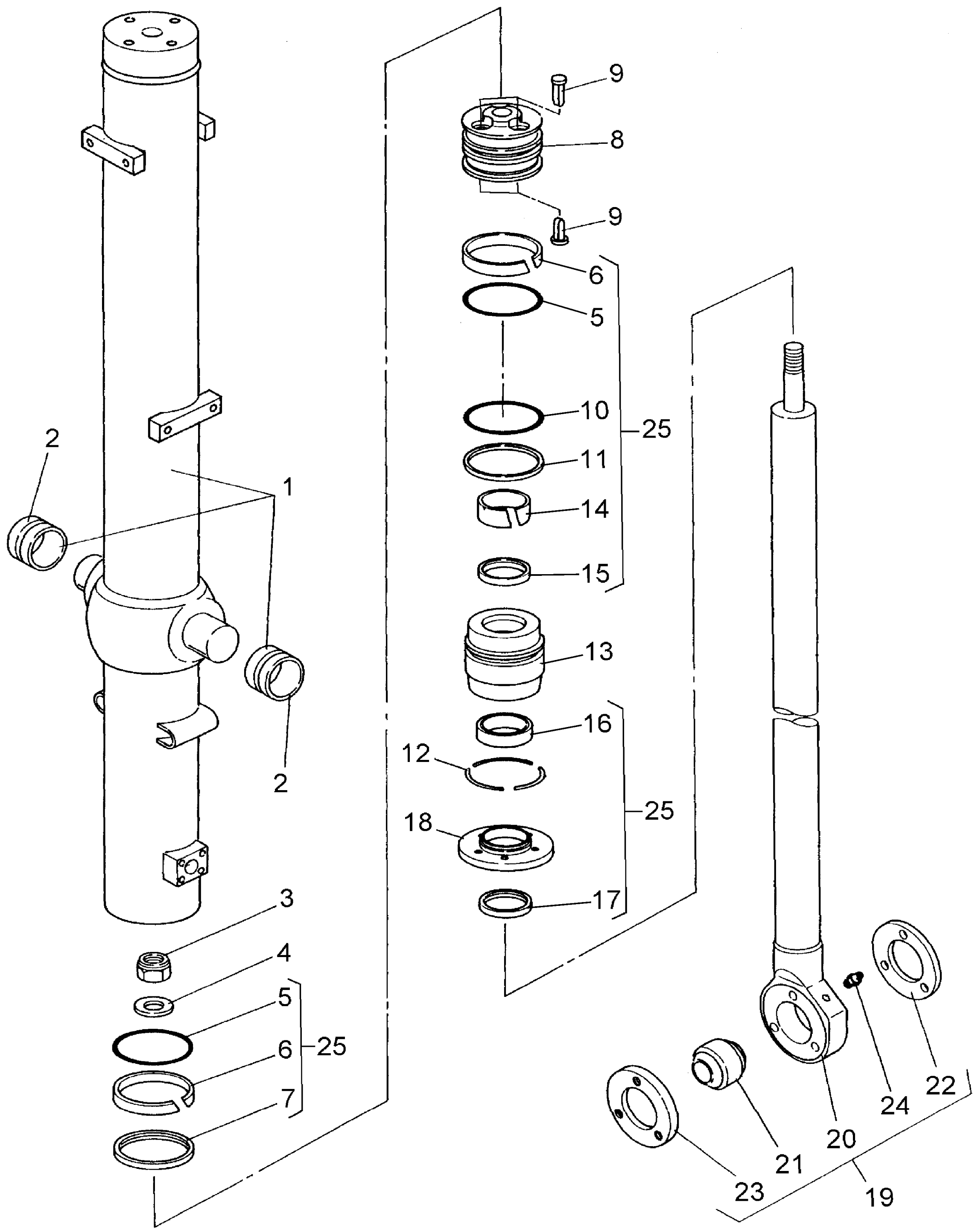


Fig. 10C.4. Exploded View of Blade Lift Cylinder

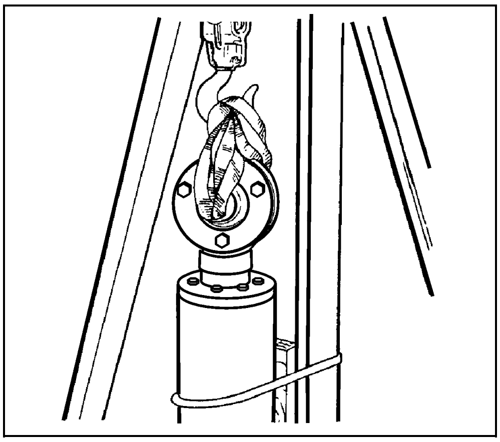
Legend for Fig.'s 10C.3 and 10C.4

1. Cylinder Housing
2. Cylinder Bushing
3. Lock Nut
4. Washer
5. O-Ring
6. Wear Ring
7. Seal Ring
8. Piston
9. Relief Poppet
10. O-Ring
11. Backup Ring
12. Lock Segments
13. Cylinder Gland
14. Wear Ring
15. Buffer Ring with O-Ring
16. Seal Ring
17. Wiper Ring
18. End Cover
19. Cylinder Rod Assy
20. Cylinder Rod
21. Rod Bearing
22. Retainer Plate
23. Retainer Plate
24. Lubrication Fitting
25. Service Kit

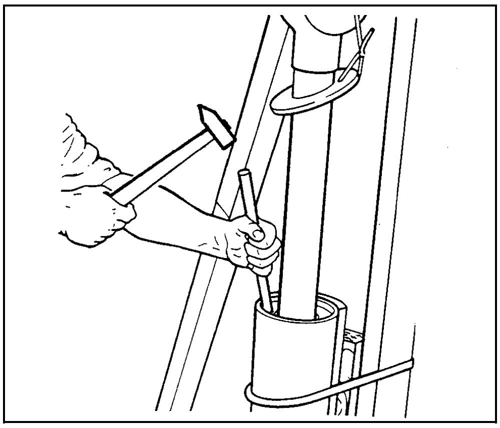
CYLINDERS

BLADE LIFT CYLINDER

1. Steam clean or wash the cylinder with solvent before disassembly. Remove the wire securing the cylinder rod to the cylinder housing.
2. Remove the tube (4, Fig. 10C.1) and cylinder manifold (9) from cylinder (7).
3. Attach a hoist to the cylinder rod eye as shown, using a strap to protect the bearing in the rod eye. Raise the cylinder up and secure it to the hoist frame. Using the hoist, pull the cylinder rod out to approximately 1/2 stroke.

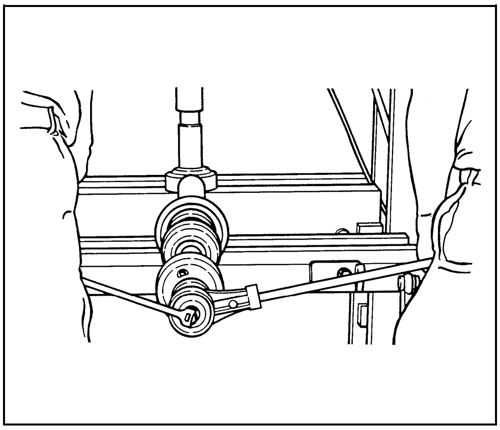


4. Remove bolts with washers securing cover (18) to gland (13) and tie the cover up to the rod eye.
5. Using a brass drift, drive gland (13) into housing (1) until the tension of the lock segments (12) is off.
6. Remove three piece lock segments (12) from housing (1) and pull the cylinder rod assembly (19) out of the housing with the hoist.

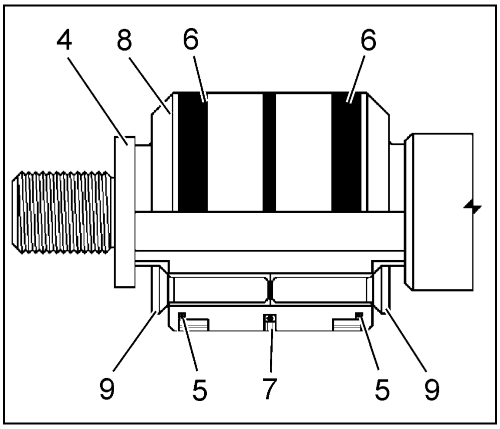


7. Remove the piston rod nut (3).

NOTE: *It will be necessary to hold the eye end of the rod stationary when removing the nut. A suggested method is to clamp the eye end of the piston rod in a hydraulic press and use a torque multiplier, or an impact tool.*

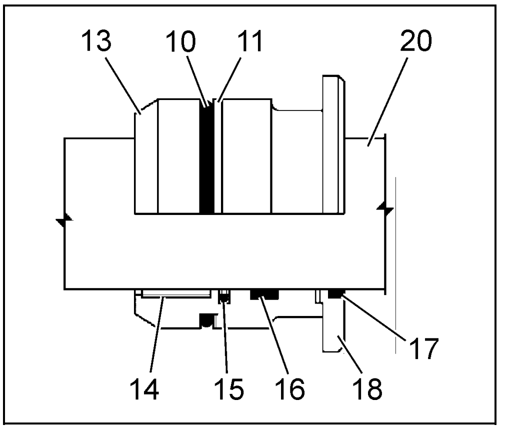


8. Remove washer (4) and piston (8) from the cylinder rod (20). Remove the relief poppets (9), wear rings (6), O-rings (5) and piston seal ring (7) from piston (8).



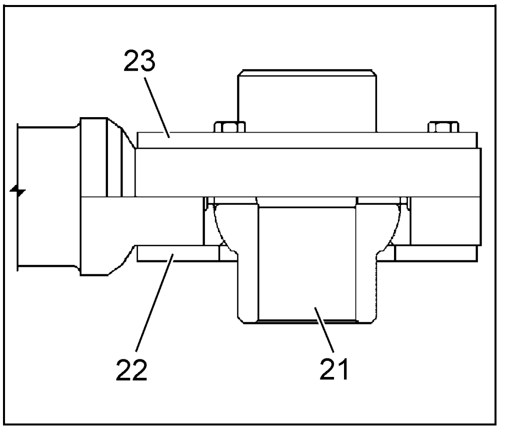
BLADE LIFT CYLINDER

9. Slide gland (13) from the cylinder rod (20). Remove O-ring (10), backup ring (11), wear ring (14), seal ring (16) and buffer ring with O-ring (15) from gland (13). Slide cover (18) off of rod (20) and remove wiper ring (17) from cover.



10. If bearing (21) needs replacement, remove the retainer plates (22 and 23) and press out the old bearing from cylinder rod eye.

11. If necessary, remove the steel cylinder bushings (2) from cylinder trunnions.



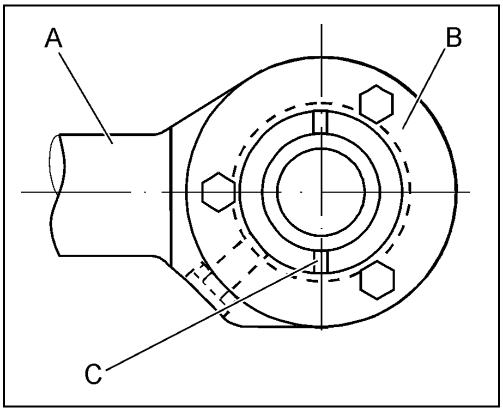
4. INSPECTION AND REPAIR

1. It is recommended that new seal kit be installed when the lift cylinder is disassembled.
2. Wash all parts in a suitable solvent and air dry. Lubricate machined surfaces of usable parts to protect them.
3. Inspect the cylinder housing for roundness through its length. If a tight spot is noticed when removing the piston, the area of binding should be given particular attention. A cylinder housing that is out-of-round should be replaced.
4. Check the cylinder housing and cylinder rod for scratches or grooves. Shallow scratches can be polished out with fine emery cloth and oil so a smooth surface is presented to the packing.
5. Inspect all sealing ring grooves for scratches, burrs or other damage. ”Dress-up” grooves or replace part as necessary.
6. Inspect tapped holes for damaged threads.
7. If the piston rod eye bearing was removed, remove all rust, scale or paint from the bore in the piston rod eye.
8. Inspect the cylinder mounting bushings for excessive wear or damage and replace if necessary.
9. Inspect the poppets and their seats in the piston.

BLADE LIFT CYLINDER

5. REASSEMBLY (Refer to Fig.'s 10C.3 and 10C.4)

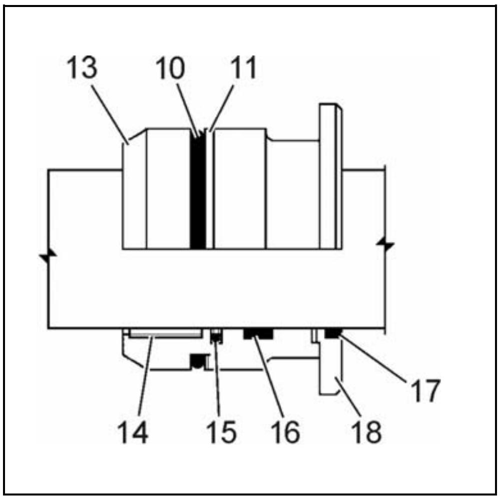
1. If bearing (21) was removed, press the new bearing in the rod eye. Install retainer plates (22 and 23). Torque the bolts to 130 [Nm].



NOTE: *The bearing (21) must be installed in the bore of the piston rod (A) with the slots (C) positioned as shown.*

A. Cylinder Rod
B. Retainer Plate
C. Install Bearing with Slots Positions as Shown

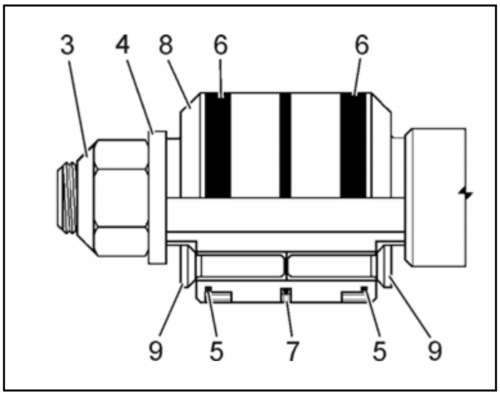
2. Install wiper ring (17), lip facing out, into cover (18) and position cover onto cylinder rod (20).



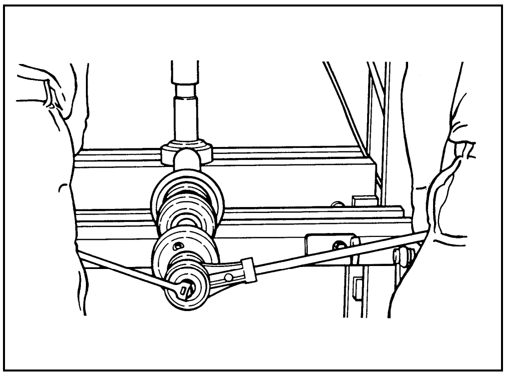
NOTE: *Outer end of gland is determined as bolts end and inside end as facing piston.*

3. Coat the bores and grooves of gland (13) with grease. Install seal ring (16) by squeezing the side of the seal together and starting the seal into the groove. Then work the remainder in with the thumbs. DO NOT use a screwdriver as it will damage the seal.
4. Install buffer ring with O-ring (15) (notched edge facing in) into gland (13) and follow with wear ring (14). Install O-ring (10) and backup ring (11) into gland (13). Slide gland (13) onto rod (20), tapped holes toward rod eye.

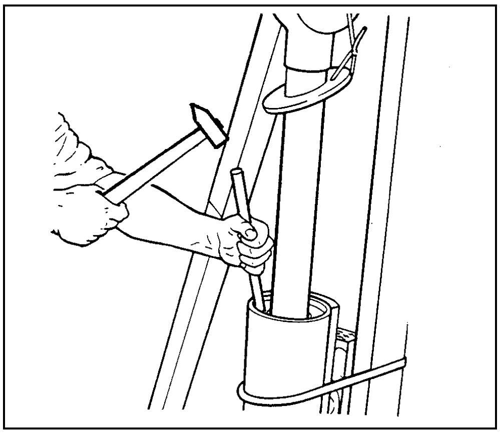
5. Install seal ring (7) onto piston (8). Compress seal (7) using compressing sleeve or compressing tool (refer to SERVICE/SPECIAL TOOLS in this Section). Install O-rings (5) and wear rings (6) on each end of piston (8). Install relief poppets (9), three each end, into piston (8) and slide piston onto cylinder rod (20). Secure with washer (4) and nut (3).



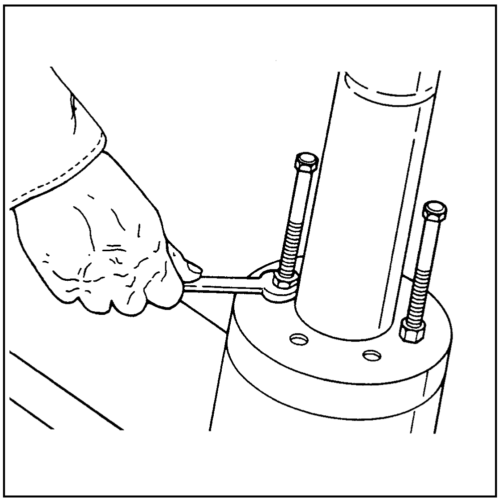
6. Clamp rod assembly into press and using a multiplier torque piston nut (3) to 1020 - 1090 [Nm].



BLADE LIFT CYLINDER



7. Apply a generous amount of fresh grease to the inside of the cylinder housing (1) and secure it to hoist frame. Install a ring compressor on the piston and compress the wear rings. Compressing the wear rings will memory the rings back to size and greatly reduce the possibility of damage during installation. Attach hoist to rod eye and lower rod assembly into housing (1) using extreme care not to damage wear rings (6) and piston seal (7). Once piston (8) has entered housing, remove the compressor. Drive rod down to about 1/2 stroke.



8. Tie cover (18) to rod eye to provide working clearance. Start gland assembly (13) into housing (1) and drive in just below lock segments groove in housing. Install lock segments (12) into housing groove. Install two puller bolts M8x100 [mm] and nuts and thread into gland. Tighten nuts to draw gland up against lock segments. Remove puller arrangement. Coat inner cylinder housing surface over the gland with high temperature type 230 HHT grease 1 [mm] in thickness. Secure cover (18) to gland (13) and torque bolts with washers to 28 ÷ 34 [Nm].
9. If removed, install new steel cylinder bushings (2) onto cylinder housing yokes.
10. Install the cylinder manifold (9, Fig. 10C.1) and tube (4) to the cylinder (7). Using wire, secure the rod end (6) to the cylinder (7).

6. INSTALLATION

1. Attach a hoist sling to the blade lift cylinder (7, Fig. 10C.1) as was done in removal procedure and position it in the lift yoke (3).
2. Check to be sure pins protrudes 3 [mm] from the machined surfaced of yoke caps (8).
3. Slip yoke caps (1, Fig. 10C.2), marked sides appropriately matched to lift yoke (2) A to A and B to B.
4. Secure the yoke caps (8, Fig. 10C.1) to the lift yoke (3). Check to be sure that pins are still engaged in the hole in the yoke bushings. Torque the mounting bolts with washers to 450 [Nm].
5. Connect the cylinder hoses (5) to the cylinder manifold (9). Remove the hoist sling.
6. Remove the wire securing the cylinder rod end (6) to the cylinder (7). Start the engine and extend the cylinder rod the eyes line up with brackets on the rear of the blade. Insert the lift cylinder mounting pin (1) through the bracket. Secure the pins(1) with the locking hardware.
7. Repeat the same for the second cylinder, if necessary.
8. Vent the hydraulic system and add oil as necessary, refer to the OPERATOR'S MANUAL. Visually check for oil leakage.
9. Cycle cylinder a few times. Recheck cylinder and cover bolt torque.

BLADE TILT CYLINDER (D-2)

7. REMOVAL

IMPORTANT: *Disconnected hydraulic lines must be capped with the correct size plastic cap. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Tag all disconnected lines to facilitate proper installation.*

WARNING! Before working on a machine, be sure that the blade and ripper have been lowered to the ground, the engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and controls are tagged to prevent inadvertent engine starting.

WARNING! Before disconnecting hydraulic hoses, cycle all hydraulic controls in all directions to relieve trapped pressure as described in OPERATOR'S MANUAL.

1. Remove the hoses guard (1, Fig. 10C.5) and disconnect hoses (2) at the tilt cylinder (3) and position out of way.
2. Attach a hoist sling (A) to the tilt cylinder (3). The hoist must be installed to give the best possible balance. Place tension on the hoist.
3. Remove the bolts securing the socket cap (4) to the blade and move the cap off of the blade. Keep the socket cap shims (5) with the blade.
4. Remove the pin (6), then remove the cylinder (2) from machine.

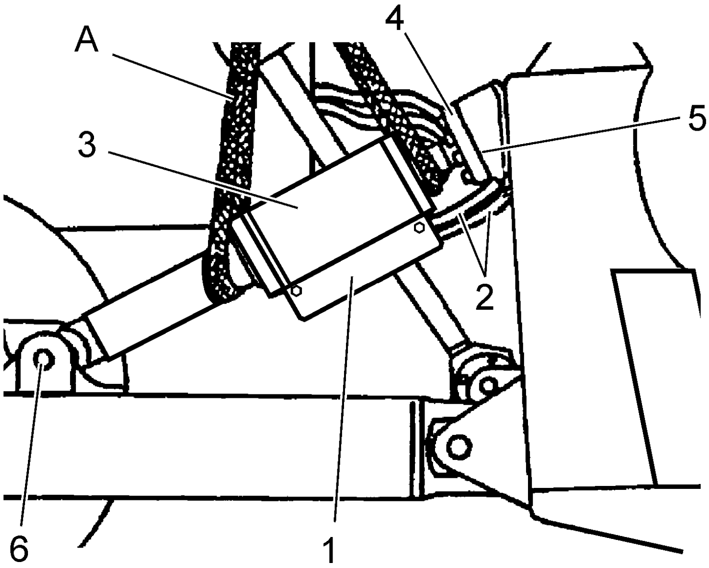


Fig. 10C.5. Bulldozer Blade Tilt Cylinder Removal

1. Hoses Guard
2. Hoses
3. Bulldozer Blade Tilt Cylinder
4. Socket Cap
5. Socket Cap Shims
6. Pin

A. Hoist Sling

BLADE TILT CYLINDER (D-2)

8. DISASSEMBLY (Refer to Fig.'s 10C.6 and 10C.7)

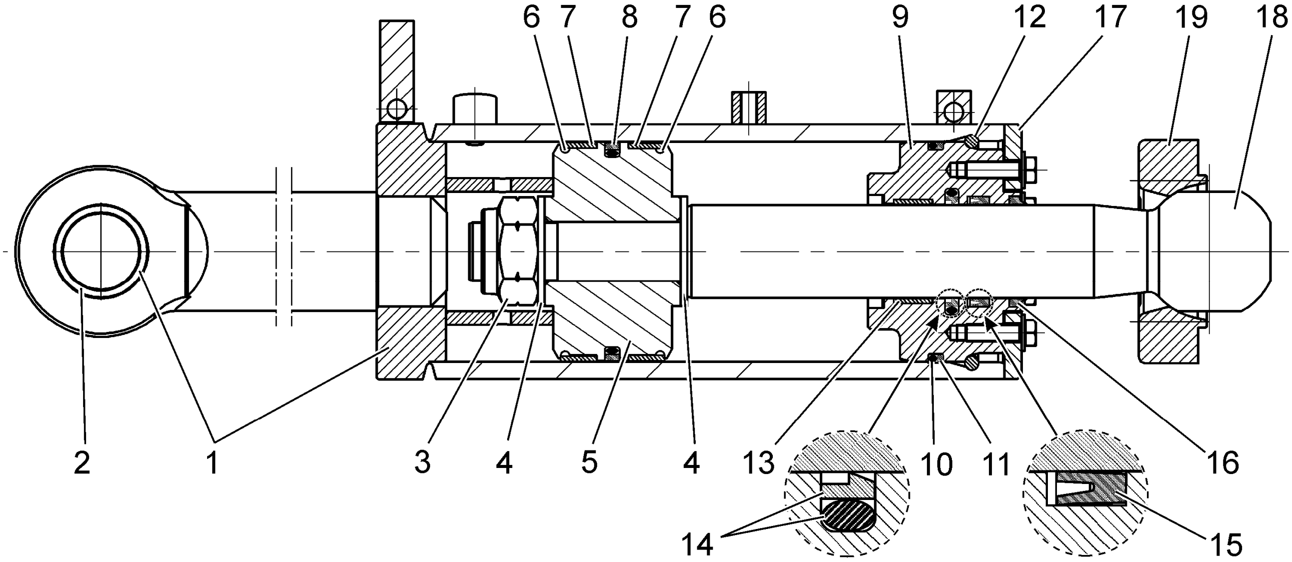


Fig. 10C.6. Cross Section View of Blade Tilt Cylinder

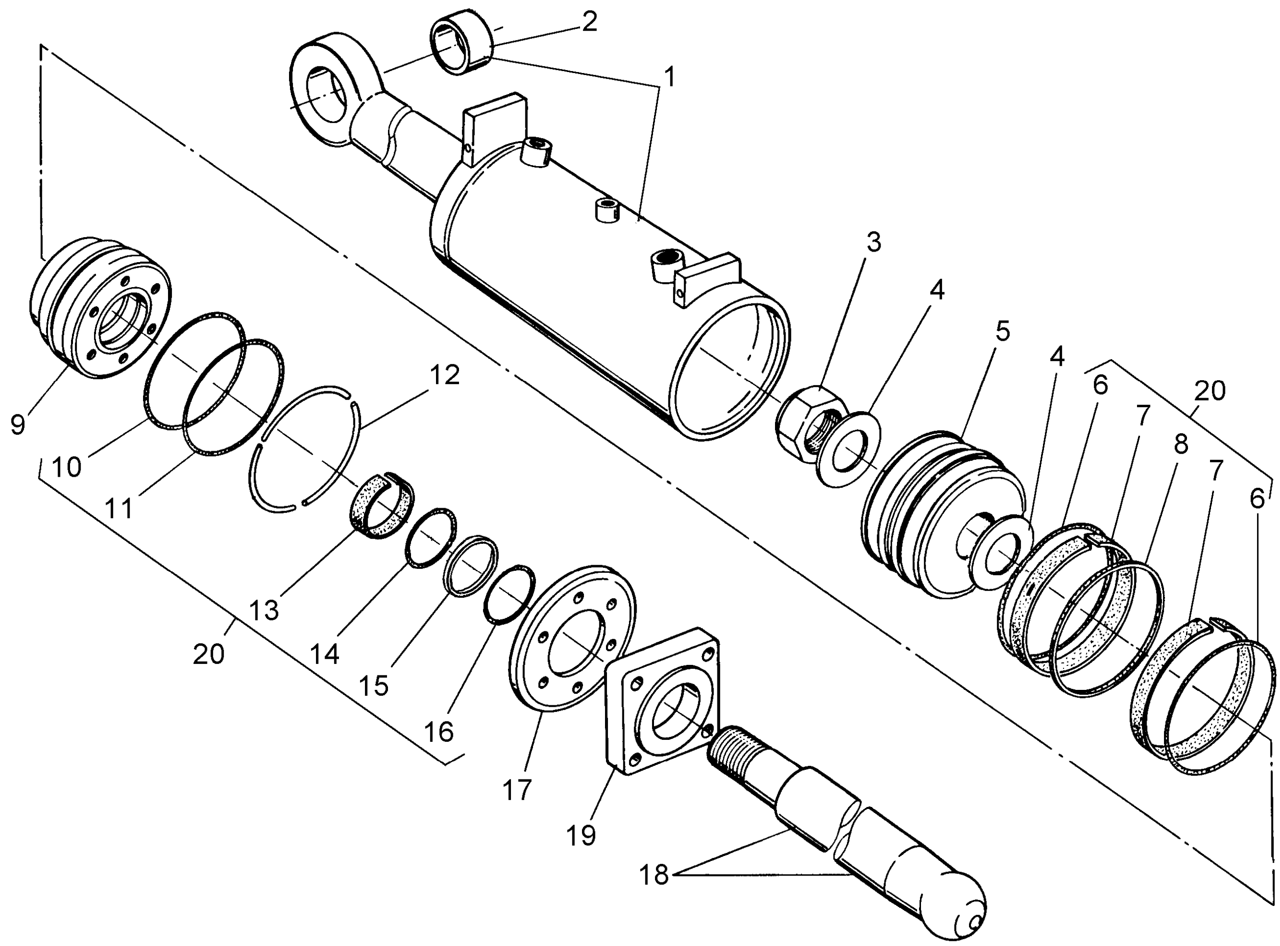


Fig. 10C.7. Exploded View of Blade Tilt Cylinder

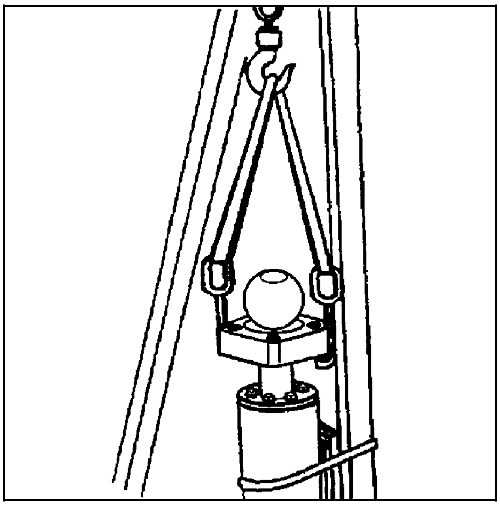
CYLINDERS

BLADE TILT CYLINDER (D-2)

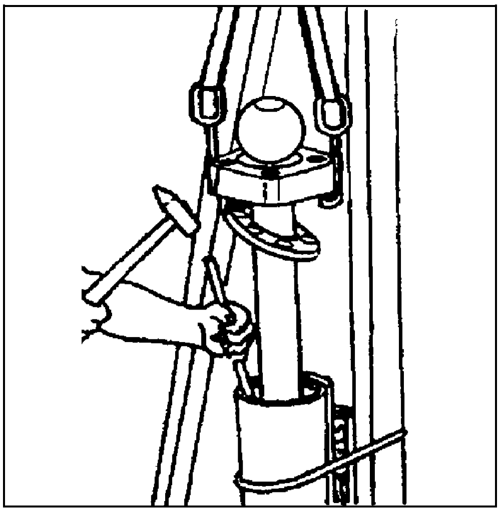
Legend for Fig.'s 10C.6 and 10C.7

1. Cylinder Housing	6. O-Ring	11. Backup Ring	16. Wiper Ring
2. Cylinder Bushing	7. Wear Ring	12. Lock Segments	17. End Cover
3. Nut	8. Seal Ring	13. Wear Ring	18. Cylinder Rod
4. Washer	9. Cylinder Gland	14. Buffer Ring with O-Ring	19. Socket Cap
5. Piston	10. O-Ring	15. Seal Ring	20. Service Kit

1. Steam clean or wash the cylinder with solvent before disassembly. Remove the elbows of hoses with O-rings from the cylinder.
2. Attach a hoist and sling to the socket cap (19). Raise the cylinder up and secure it to the hoist frame. Using the hoist, pull the cylinder rod out to approximately 1/2 stroke.

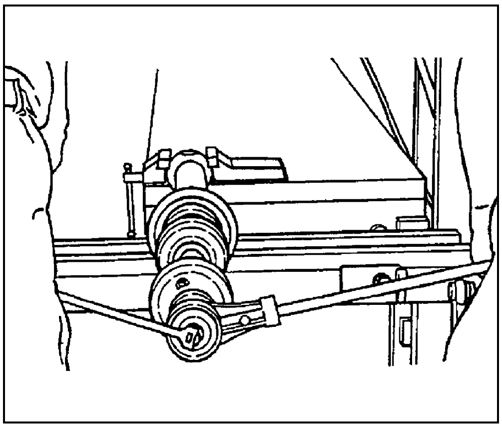


3. Remove bolts with washers securing end cover (17) to gland (9) and tie the cover to the socket cap to provide working clearance.
4. Using a brass drift, drive gland (9) into housing (1) until the tension of the lock segments (12) is off.
5. Remove three piece lock segments (12) from housing (1) and pull the cylinder rod assembly out of the housing with the hoist.



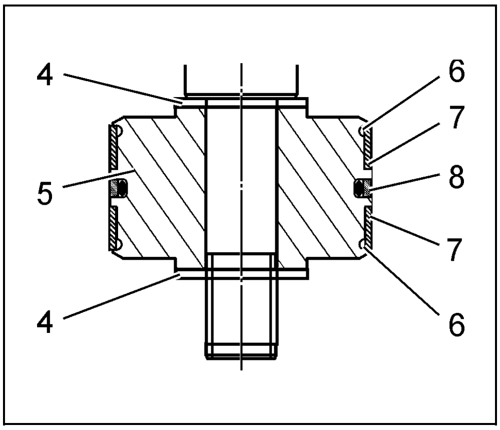
6. Remove the piston rod nut (3)

NOTE: *It will be necessary to hold the eye end of the rod stationary when removing the nut. A suggested method is to clamp the eye end of the piston rod in a hydraulic press and use a torque multiplier, or an impact tool.*

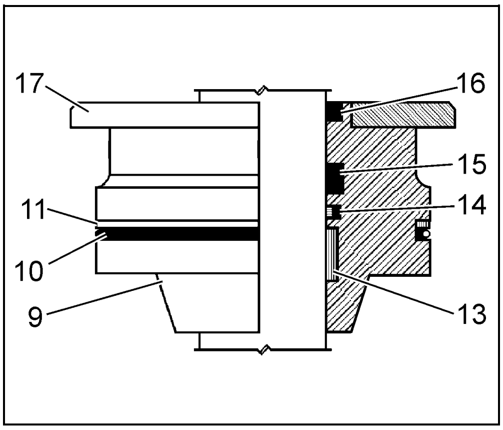


BLADE TILT CYLINDER (D-2)

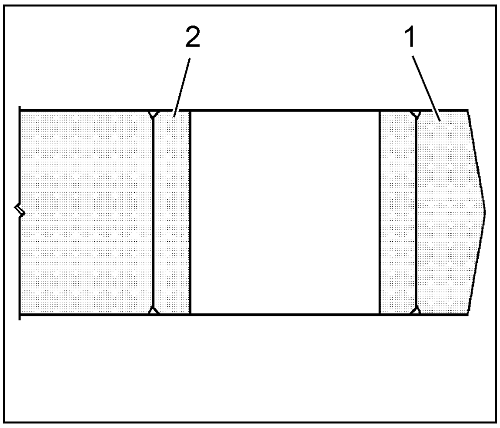
7. Remove washer (4), piston (5) and washer (4) from the cylinder rod (18). Remove wear rings (7), O-rings (6) and piston seal ring (8) from piston (5).



8. Slide gland (9) from the cylinder rod (18). Remove O-ring (10), backup ring (11), wear ring (13), seal ring (15), buffer ring with O-ring (14) and wiper ring (16) from gland (9). Slide cover (17) off of rod (18). Remove the socket cup (19) off of the rod (18).



9. If necessary, press the bushing (2) from the housing (1).



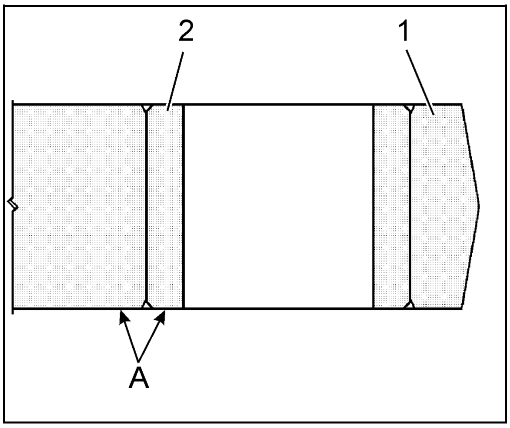
BLADE TILT CYLINDER (D-2)

9. INSPECTION AND REPAIR

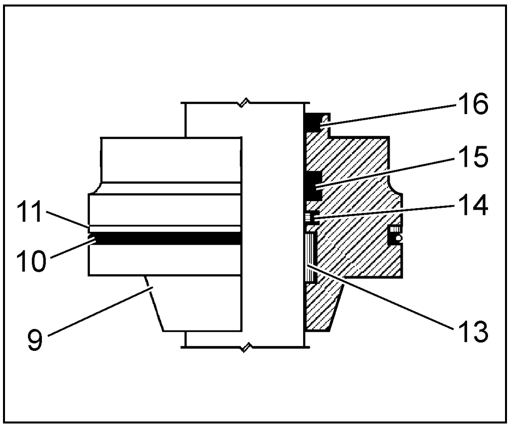
1. It is recommended that new service kit be installed when the cylinder is disassembled.
2. Wash all parts in a solvent and air dry. Lubricate machined surfaces of usable parts to protect them.
3. Inspect the cylinder housing for roundness throughout its length. If a tight spot is noticed when removing the piston, the area of binding should be given particular attention. A cylinder housing that is out-of-round should be replaced.
4. Check the cylinder housing and piston rod for scratches or grooves. Shallow scratches can be polished out with fine emery cloth and oil so a smooth surface is presented to the packing.
5. Inspect all sealing ring grooves for scratches, burrs or other damage. "Dress-up" grooves or replace as necessary.
6. Inspect tapped holes for damaged threads.
7. Inspect the cylinder mounting bushing for excessive wear or damage and replace, if necessary.
8. If the eye bushing was removed, remove all rust, scale or paint from the bushing bore.

10. REASSEMBLY (Refer to Fig.'s 10C.6 and 10C.7)

1. If removed, press new bushing (2) into the housing (1) until flush (A).



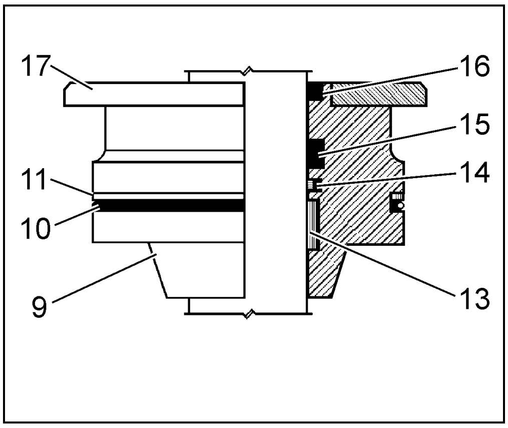
2. Coat the bore and grooves of gland (9) with fresh grease. Install seal ring (15) by squeezing the side of the seal together and starting the seal into the groove. Then work the remainder in with the thumbs. DO NOT use a screwdriver as it will damage the seal.
3. Install buffer ring with O-ring (14), notched edge facing in, into gland (10) and follow with wear ring (13). Install O-ring (10) and backup ring (11) onto gland (9). The tapped holes in gland (9) must face toward the rod ball. Install wiper ring (16) into gland (10).



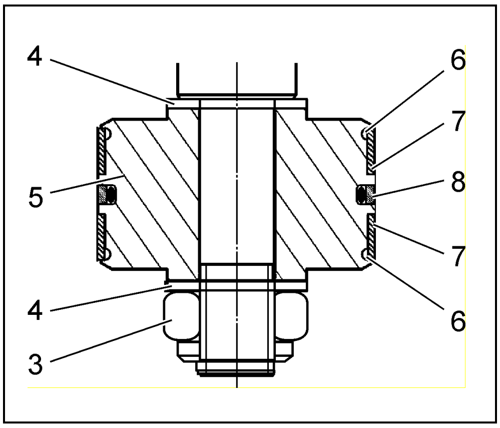
BLADE TILT CYLINDER (D-2)

4. Position socket cap (19) and cover (17) and gland assy (9) onto cylinder rod (18).

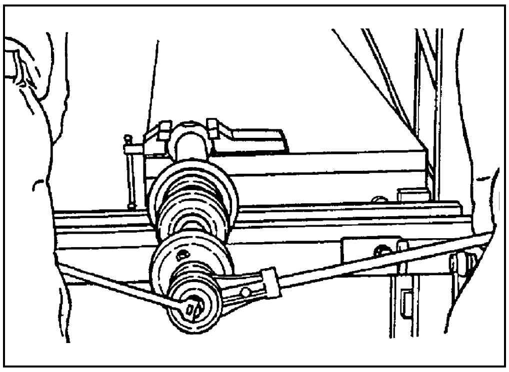
NOTE: *Outer end of gland is determined as bolt end and inside end as facing piston.*



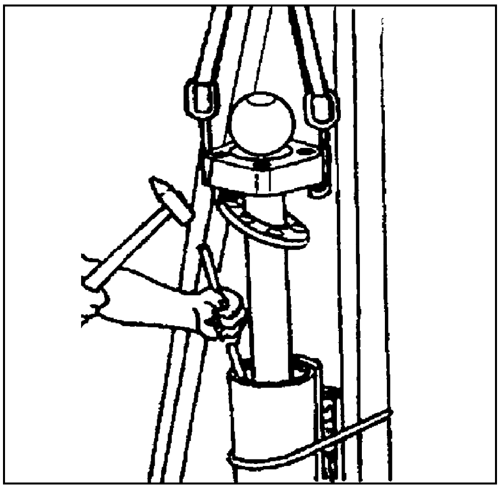
5. Install seal ring (8) onto piston (5). Install O-rings (6) and wear rings (7) on each end of piston (5). Install and slide washer (4) and piston onto rod (18). Secure with washer (4) and nut (3).



6. Clamp rod assembly into press and using a multiplier torque piston nut (3) to 2040 - 2100 [Nm].



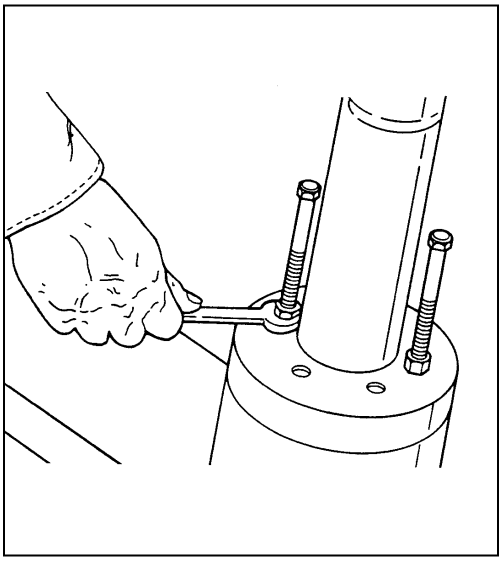
7. Apply a generous amount of fresh grease to the inside of the cylinder housing (1) and secure it to hoist frame. Install a ring compressor on the piston and compress the wear rings. Compressing the wear rings will memory the rings back to size and greatly reduce the possibility of damage during installation. Tie the end cover (17) to the socket cup (19) to provide working clearance. Attach hoist to the socket cup (19) and lower rod assembly into housing (1) using extreme care not to damage wear rings (7) and piston seal (8). Once piston (5) has entered housing, remove the compressor. Drive cylinder rod down to about 1/2 stroke.



BLADE TILT CYLINDER (D-2)

8. Start gland assembly (9) into housing (1) and drive in just below lock segments groove in housing. Install lock segments (12) into housing groove. Release the end cover (17) and position in place. Install two puller bolts 1/2" – 13 UNC x 4" and nuts and thread into gland. Tighten nuts to draw gland up against lock segments. Remove puller arrangement. Coat inner cylinder housing surface over the gland with high temperature type 230 HHT grease 1 [mm] in thickness. Secure cover (17) to gland (9) and torque bolts with washer to 108 ÷ 119 [Nm].

9. Install the elbows of hoses with new O-rings to cylinder housing.



11. INSTALLATION

1. Attach a hoist sling (A, Fig. 10C.5) to the blade tilt cylinder (3) and position the housing eye of the tilt cylinder into the bracket on the push arm at R.H. side of the machine. Install pin (6) into push arm bracket and secure with retainer plate.
2. Install cylinder rod ball in socket of blade. Install socket cap (4) and evenly tighten bolts to 270 [Nm]. Measure gap between socket cap (4) and socket and remove bolts. Install a shims pack (5) of measured gap plus an additional shim for clearance. Each shim is 0.75 [mm] thick. Install bolts with washers and torque to 845 [Nm]. Remove the hoist sling.
3. Connect the cylinder hoses (2) to cylinder (3).
4. Vent the hydraulic system and add oil as necessary, refer to the OPERATOR'S MANUAL. Visually check for oil leakage.
5. Cycle cylinder a few times and recheck cylinder pin and cover bolts torque.
6. Install the hose guard (1).

BLADE TILT /PITCH CYLINDERS (D-2)

NOTE: *REMOVAL, SERVICE AND INSTALLATION OF THE BLADE TILT /PITCH CYLINDER (O.D. 195 [mm] – L.H. side mounted) IS SIMILAR TO THIS SHOWN FOR THE BLADE DOUBLE TILT /PITCH CYLINDER (O.D. 216 [mm] – R.H. side mounted).*

12. REMOVAL

IMPORTANT: *Disconnected hydraulic lines must be capped with the correct size plastic cap. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Tag all disconnected lines to facilitate proper installation.*

WARNING! Before working on a machine, be sure that the blade and ripper have been lowered to the ground, the engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and controls are tagged to prevent inadvertent engine starting.

WARNING! Before disconnecting hydraulic hoses, cycle all hydraulic controls in all directions to relieve trapped pressure as described in OPERATOR'S MANUAL.

1. Remove the hoses guard (1, Fig. 10C.8) and disconnect hoses (2) at the double tilt/pitch cylinder (3) and position out of way.
2. Attach a hoist sling (A) to the cylinder (3). The hoist must be installed to give the best possible balance. Place tension on the hoist.
3. Remove the bolts securing the socket cap (4) to the blade and move the cap off of the blade. Keep the socket cap shims (5) with the blade.
4. Remove the pin (6), then remove the cylinder (2) from machine.

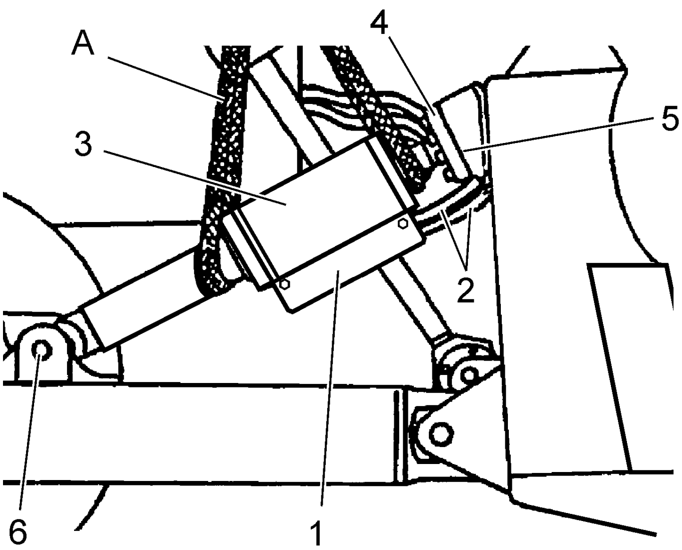


Fig. 10C.8. Bulldozer Blade Double Tilt/Pitch Cylinder Removal (R.H. Side)

1. Hoses Guard
2. Hoses
3. Bulldozer Blade Double Tilt/ Pitch Cylinder
4. Socket Cap
5. Socket Cap Shims
6. Pin

A. Hoist Sling

CYLINDERS

BLADE TILT /PITCH CYLINDERS (D-2)

13. DISASSEMBLY (Refer to Fig.'s 10C.9 and 10C.10)

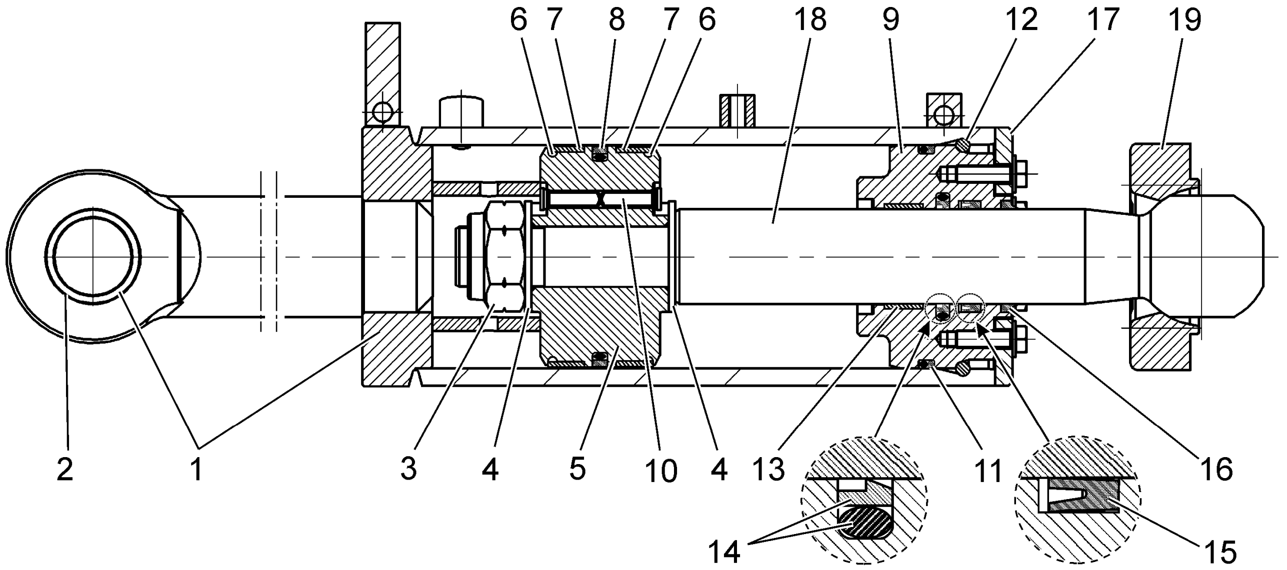


Fig. 10C.9. Cross Section View of Blade Double Tilt/Pitch Cylinder

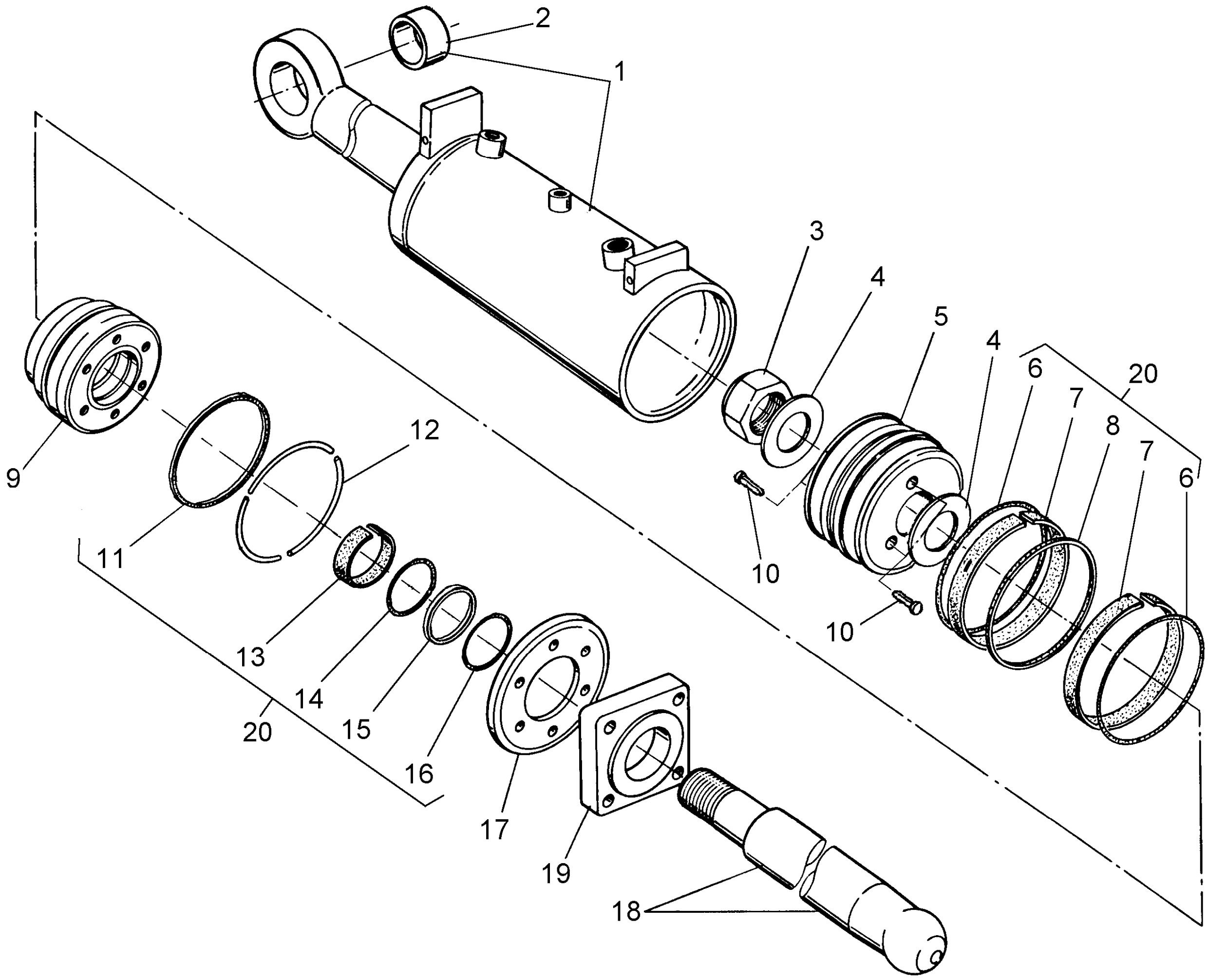


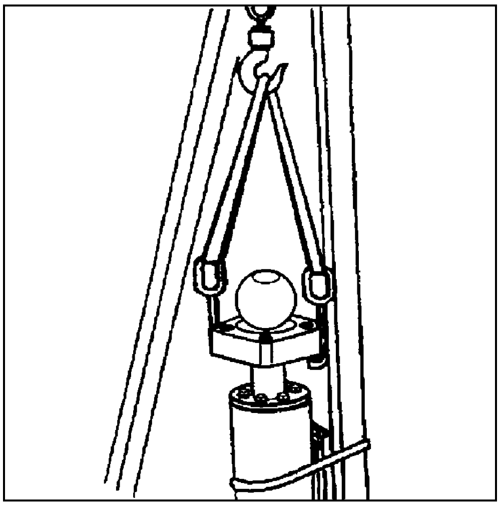
Fig. 10C.10. Exploded View of Blade Double Tilt /Pitch Cylinder

BLADE TILT /PITCH CYLINDERS (D-2)

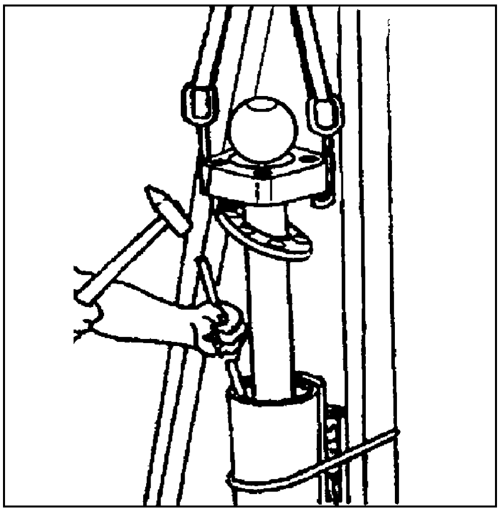
Legend for Fig.‘s 10C.9 and 10C.10

1. Cylinder Housing
2. Cylinder Bushing
3. Nut
4. Washer
5. Piston
6. O-Ring
7. Wear Ring
8. Seal Ring
9. Cylinder Gland
10. Relief Poppet
11. Seal Ring
12. Lock Segments
13. Wear Ring
14. Buffer Ring with O-Ring
15. Seal Ring
16. Wiper Ring
17. End Cover
18. Cylinder Rod
19. Socket Cap

1. Steam clean or wash the cylinder with solvent before disassembly. Remove the elbows of hoses with O-rings from the cylinder.
2. Attach a hoist and sling to the socket cap. Raise the cylinder up and secure it to the hoist frame. Using the hoist, pull the cylinder rod out to approximately 1/2 stroke.

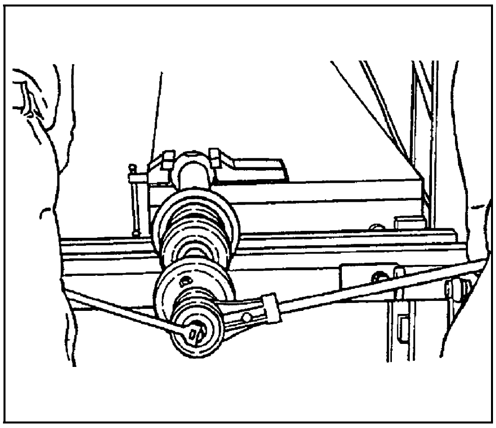


3. Remove bolts with washers securing end cover (17) to gland (9) and tie the cover to the socket cap to provide working clearance.
4. Using a brass drift, drive gland (9) into housing (1) until the tension of the lock segments (12) is off.
5. Remove three piece lock segments (12) from housing (1) and pull the cylinder rod assembly out of the housing with the hoist.



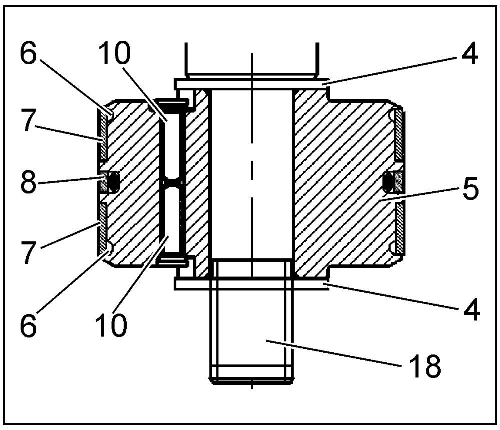
6. Remove the piston rod nut (3).

NOTE: *It will be necessary to hold the eye end of the rod stationary when removing the nut. A suggested method is to clamp the eye end of the piston rod in a hydraulic press and use a torque multiplier, or an impact tool.*

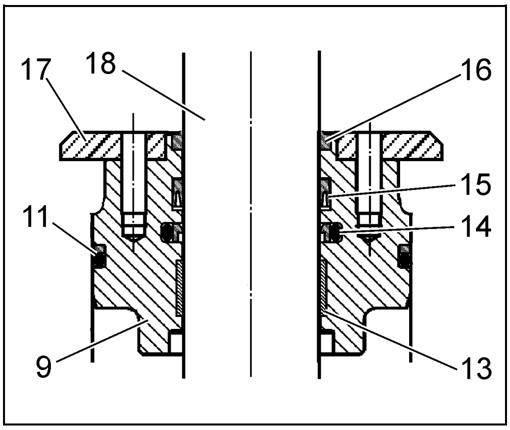


BLADE TILT /PITCH CYLINDERS (D-2)

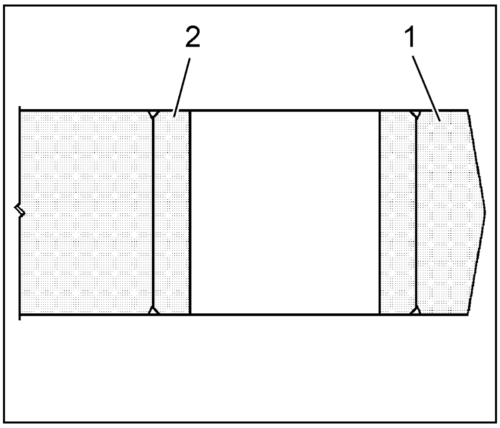
7. Remove washer (4), piston (5) and washer (4) from the cylinder rod (18). Remove poppets (10), wear rings (7), O-rings (6) and seal ring (8) from piston (5).



8. Slide gland (9) from the cylinder rod (18). Remove seal ring (11), wear ring (13), buffer ring with O-ring (14), seal ring (15) and wiper ring (16) from gland (9). Slide cover (17) off of rod (18). Remove the socket cup (19) off of the rod (18).



9. If necessary, press the bushing (2) from the housing (1).



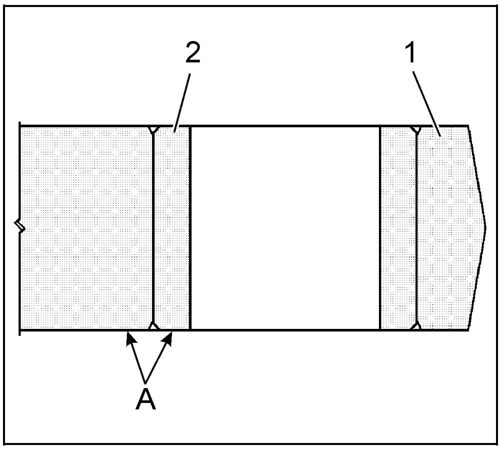
BLADE TILT /PITCH CYLINDERS (D-2)

14. INSPECTION AND REPAIR

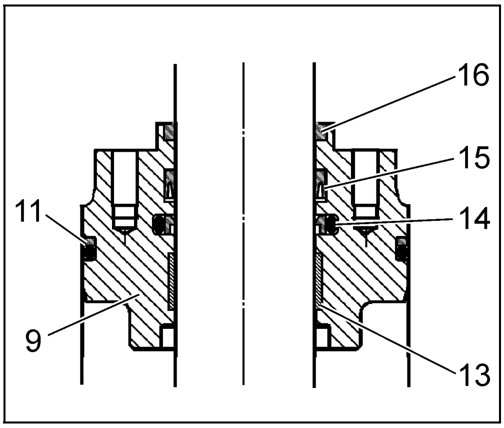
1. It is recommended that new service kit be installed when the cylinder is disassembled.
2. Wash all parts in a solvent and air dry. Lubricate machined surfaces of usable parts to protect them.
3. Inspect the cylinder housing for roundness throughout its length. If a tight spot is noticed when removing the piston, the area of binding should be given particular attention. A cylinder housing that is out-of-round should be replaced.
4. Check the cylinder housing and piston rod for scratches or grooves. Shallow scratches can be polished out with fine emery cloth and oil so a smooth surface is presented to the packing.
5. Inspect all sealing ring grooves for scratches, burrs or other damage. "Dress-up" grooves or replace as necessary.
6. Inspect tapped holes for damaged threads.
7. Inspect the cylinder mounting bushing for excessive wear or damage and replace, if necessary. Inspect the poppets and their seats in the piston.
8. If the eye bushing was removed, remove all rust, scale or paint from the bushing bore.

15. REASSEMBLY (Refer to Fig.'s 10C.9 and 10C.10)

1. If removed, press new bushing (2) into the housing (1) until flush (A).



2. Coat the bore and grooves of gland (9) with fresh grease. Install seal ring (15) by squeezing the side of the seal together and starting the seal into the groove. Then work the remainder in with the thumbs. DO NOT use a screwdriver as it will damage the seal.
3. Install buffer ring with O-ring (14), notched edge facing in, into gland (9) and follow with wear ring (13). Install seal ring (11) onto gland (9). The tapped holes in gland (9) must face toward the rod ball. Install wiper ring (16) into gland (10).

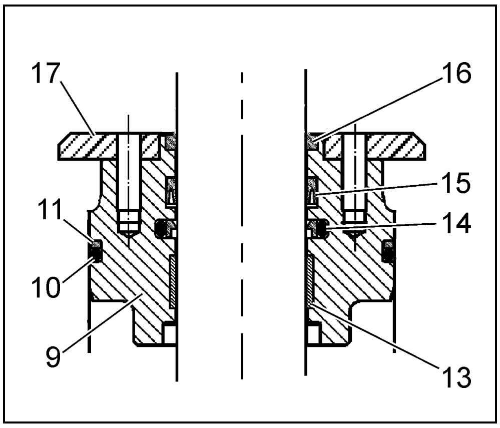


CYLINDERS

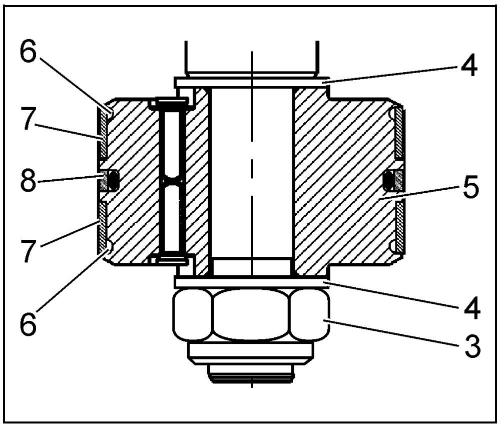
BLADE TILT /PITCH CYLINDERS (D-2)

4. Position socket cap (19), cover (17) and gland assy (9) onto cylinder rod (18).

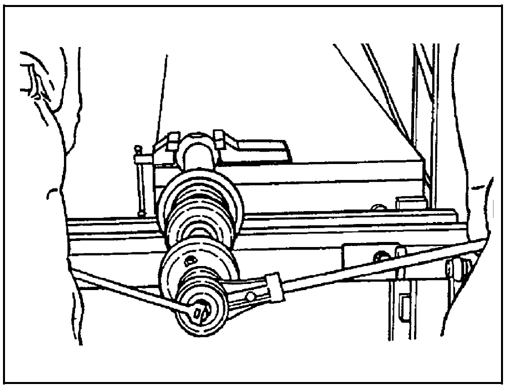
NOTE: *Outer end of gland is determined as bolt end and inside end as facing piston.*



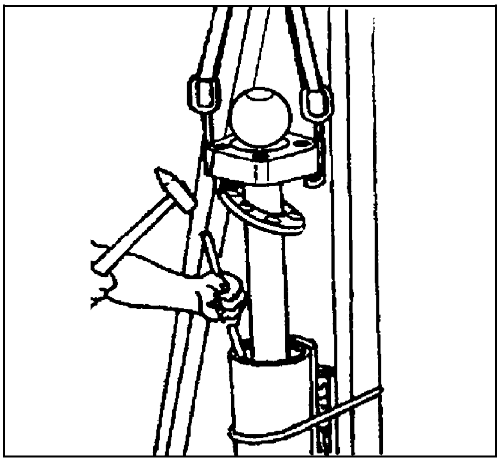
5. Install seal ring (8) onto piston (5). Install O-rings (6) and wear rings (7) on each end of piston (5). Install three poppets (10) into piston and slide washer (4) and piston onto rod (18). Install next three poppets (10) and secure with washer (4) and nut (3).



6. Clamp rod assembly into press and using a multiplier torque piston nut (3) to 2040 - 2100 [Nm].



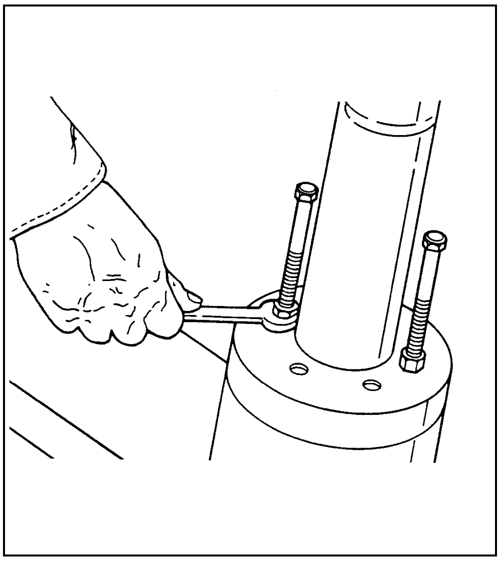
7. Apply a generous amount of fresh grease to the inside of the cylinder housing (1) and secure it to hoist frame. Install a ring compressor on the piston and compress the wear rings. Compressing the wear rings will memory the rings back to size and greatly reduce the possibility of damage during installation. Tie the end cover (17) to the cup (19) to provide working clearance. Attach hoist to the socket cup (19) and lower rod assembly into housing (1) using extreme care not to damage wear rings (7) and piston seal (8). Once piston (5) has entered housing, remove the compressor. Drive cylinder rod down to about 1/2 stroke.



BLADE TILT /PITCH CYLINDERS (D-2)

8. Start gland assembly (9) into housing (1) and drive in just below lock segments groove in housing. Install lock segments (12) into housing groove. Release the end cover (17) and position in place. Install two puller bolts 1/2” – 13 UNC x 4” and nuts and thread into gland. Tighten nuts to draw gland up against lock segments. Remove puller arrangement. Coat inner cylinder housing surface over the gland with high temperature type 230 HHT grease 1 [mm] in thickness. Secure cover (17) to gland (9) and torque bolts with washer to 108 ÷ 119 [Nm].

9. Install the elbows of hoses with new O-rings to cylinder housing.



16. INSTALLATION

1. Attach a hoist sling (A, Fig. 10C.8) to the blade double tilt/pitch cylinder (3) and position the housing eye of the double tilt /pitch cylinder into the bracket on the push arm at R.H. side of the machine. Install pin (6) into push arm bracket and secure with retainer plate.
2. Install cylinder rod ball in socket of blade. Install socket cap (4) and evenly tighten bolts to 270 [Nm]. Measure gap between socket cap (4) and socket and remove bolts. Install a shims pack (5) of measured gap plus an additional shim for clearance. Each shim is 0.75 [mm] thick. Install bolts with washers and torque to 845 [Nm]. Remove the hoist sling.
3. Connect the cylinder hoses (2) to cylinder (3).
4. Vent the hydraulic system and add oil as necessary, refer to the OPERATOR'S MANUAL. Visually check for oil leakage.
5. Cycle cylinder a few times and recheck cylinder pin and cover bolts torque.
6. Install the hose guard (1).

CYLINDERS

RIPPER LIFT AND PITCH CYLINDERS /BLADE TILT CYLINDERS (G-2)

NOTE: DISASSEMBLY*, INSPECTION AND ASSEMBLY OF THE RIPPER LIFT CYLINDER AND BLADE TILT CYLINDER (G-2) ARE SIMILAR TO THIS SHOWN FOR THE RIPPER PITCH CYLINDER.*

17. REMOVAL

WARNING! Before working on a machine, be sure that the blade and ripper have been lowered to the ground, the engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and controls are tagged to prevent inadvertent engine starting.

WARNING! Before disconnecting hydraulic hoses, cycle all hydraulic controls in all directions to relieve trapped pressure as described in OPERATOR'S MANUAL.

IMPORTANT: *Disconnected hydraulic lines must be capped with the correct size plastic cap. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Tag all disconnected lines to facilitate proper installation.*

Ripper Pitch Cylinder Removal (Refer to Fig. 10C.11)

1. Disconnect hydraulic hoses (1) from the pitch cylinder (2).
2. Attach a hoist and sling to the cylinder (2). The hoist and sling must be installed to give the best possible balance. Place tension on the sling.
3. Remove the pin retainer plates (3) and take out the pins (4) from both sides of the cylinder (2).

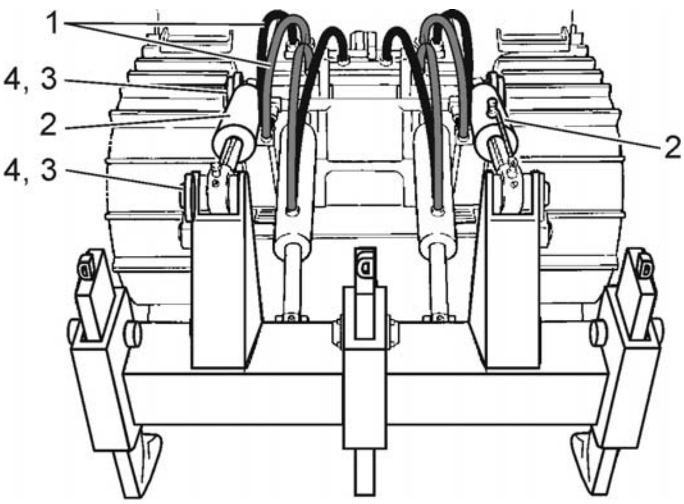


Fig. 10C.11. Ripper Pitch Cylinder Removal

1. Pitch Cylinder Hoses
2. Ripper Pitch Cylinder
3. Pin Retainer Plate
4. Pin

Ripper Lift Cylinder Removal (Refer to Fig. 10C.12)

1. Disconnect hydraulic hoses (1, Fig. 10C.12) from the lift cylinder (2).
2. Attach a hoist and sling to the cylinder (2). The hoist and sling must be installed to give the best possible balance. Place tension on the sling.

RIPPER LIFT AND PITCH CYLINDERS /BLADE TILT CYLINDER (G-2)

3. Remove the pin retainer plates (3) and take out the pins (4) from both sides of the cylinder (2).

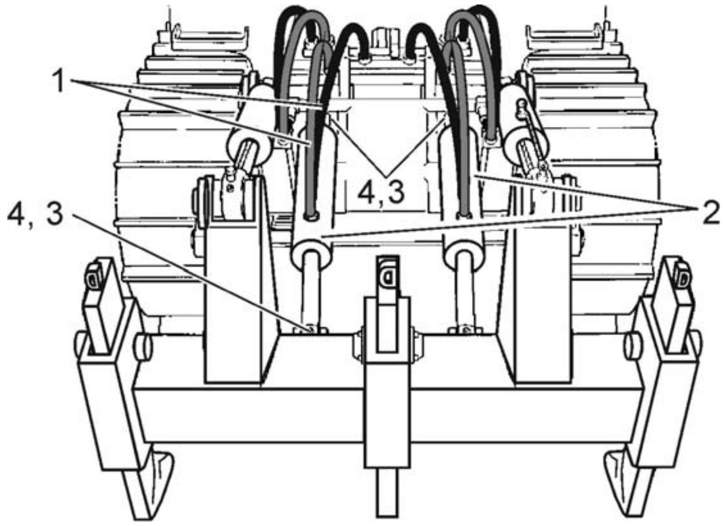


Fig. 10C.12. Ripper Lift Cylinder Removal

1. Lift Cylinder Hoses
2. Ripper Lift Cylinder
3. Pin Retainer Plate
4. Pin

Bullgrader Blade Tilt Cylinder (G-2) Removal

1. Remove the house guard from the cylinder and disconnect the two hoses at the cylinder.
2. Attach a hoist sling to the cylinder. The hoist must be installed to give the best possible balance. Place tension on the hoist.
3. Remove the cylinder mounting pin locking hardware and drive the mounting pins out of the swivel bar and bracket on the blade and strut. Remove cylinder from the machine.

18. DISASSEMBLY (Refer to Fig.'s 10C.13, 10C.14 and 10C.15)

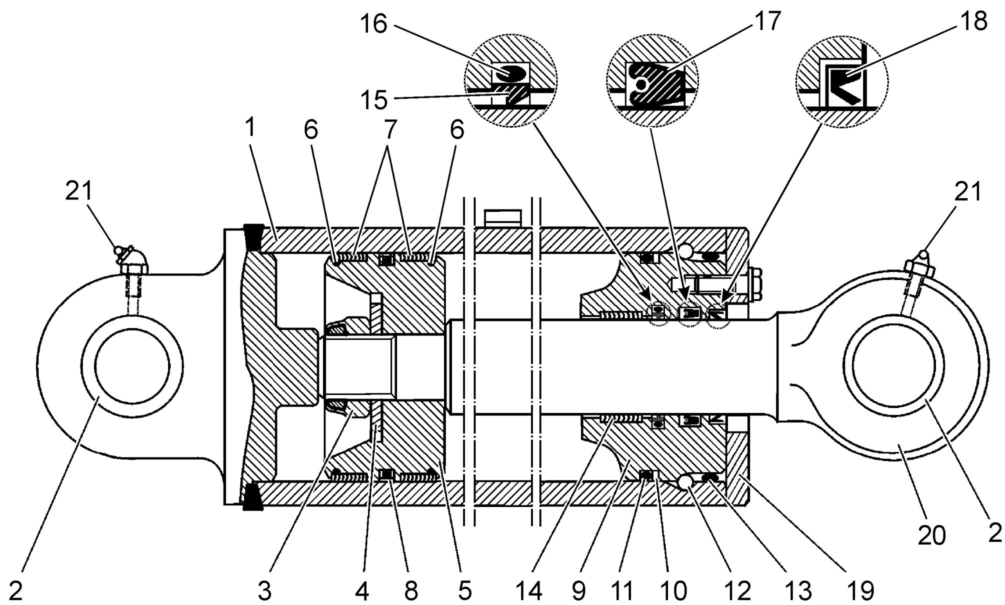


Fig. 10C.13. Cross Section View of Ripper Lift and Pitch Cylinder

CYLINDERS

RIPPER LIFT AND PITCH CYLINDERS /BLADE TILT CYLINDER (G-2)

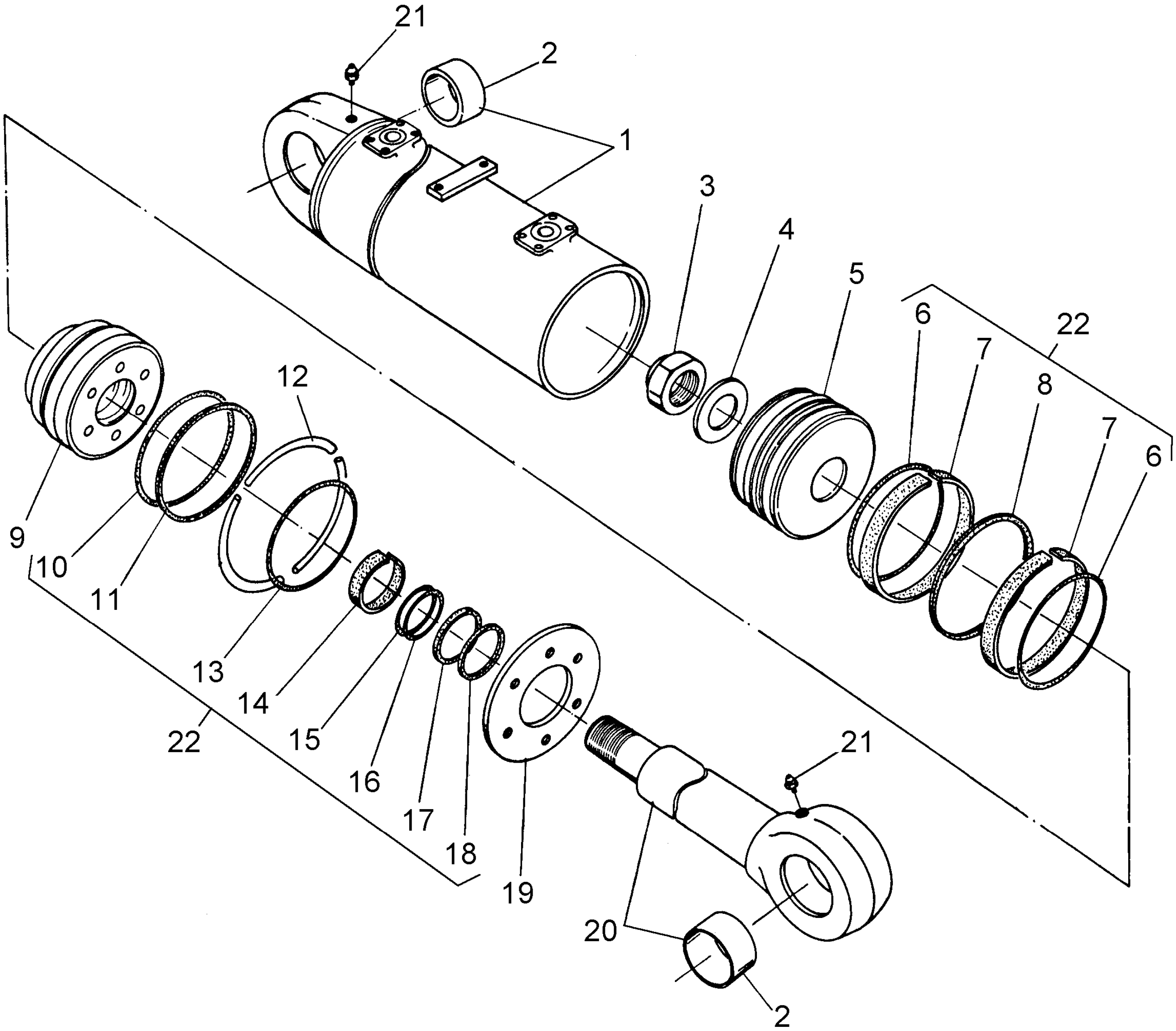


Fig. 10C.14. Exploded View of Ripper Lift Cylinder

Legend for Fig.'s 10C.13, 10C.14 and 10C.15

1. Cylinder Housing
2. Cylinder Bushing
3. Nut
4. Washer
5. Piston
6. O-Ring
7. Wear Ring
8. Piston Seal Ring
9. Cylinder Gland
10. O-Ring
11. Backup Ring
12. Lock Segments
13. O-Ring
14. Wear Ring
15. Buffer Ring
16. O-Ring
17. Seal Ring
18. Wiper Ring
19. End Cover
20. Cylinder Rod Assy
21. Fitting Lube
22. Service Kit

RIPPER LIFT AND PITCH CYLINDERS /BLADE TILT CYLINDER (G-2)

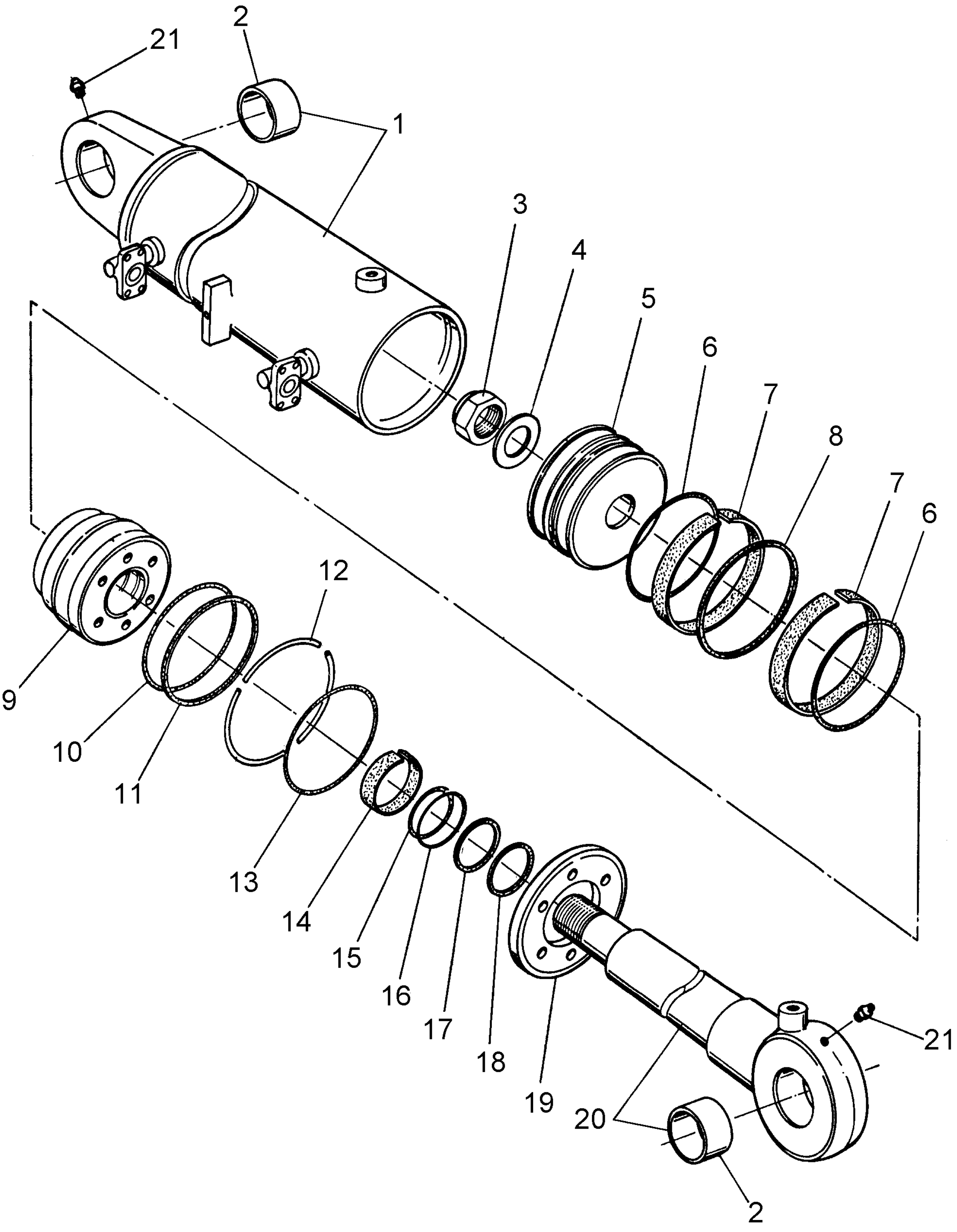
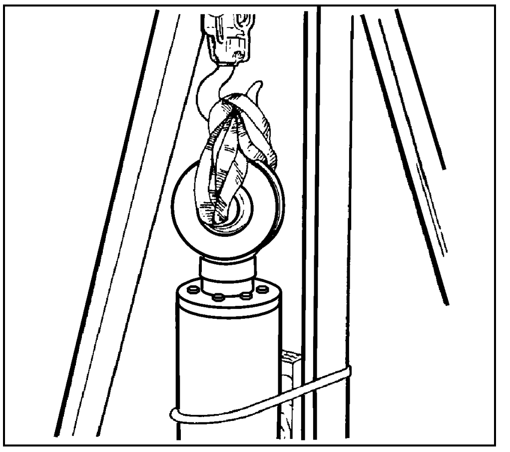


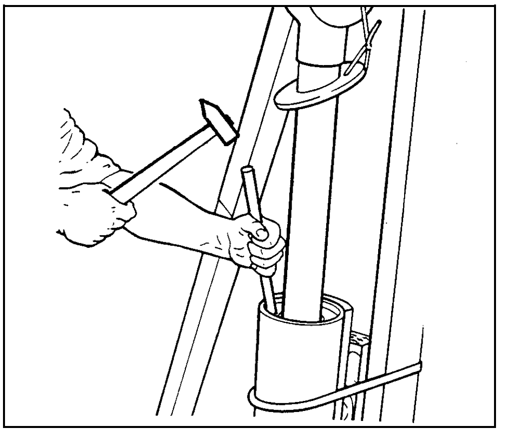
Fig. 10C.14. Exploded View of Ripper Pitch Cylinder

RIPPER LIFT AND PITCH CYLINDERS /BLADE TILT CYLINDER (G-2)

1. Steam clean or wash the cylinder with solvent before disassembly. Remove the elbows of hoses with O-rings from the cylinder.
2. Attach a hoist and sling to the rod eye. Raise the cylinder up and secure it to the hoist frame. Using the hoist, pull the cylinder rod out to approximately 1/2 stroke.

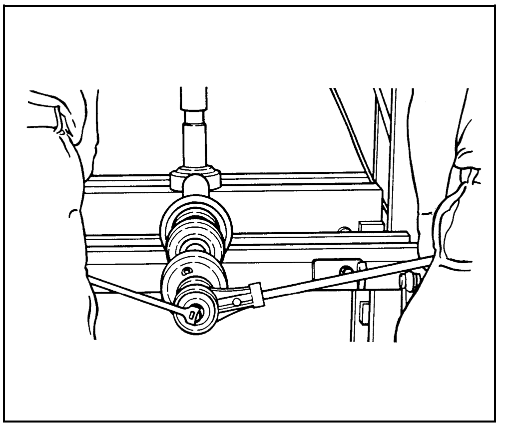


3. Remove bolts with washers securing end cover (19) to gland (9) and tie the cover to the rod eye to provide working clearance.
4. Using a brass drift, drive gland (9) into housing (1) until the tension of the lock segments (12) is off.
5. Remove three piece lock segments (12) from housing (1) and pull the cylinder rod assembly out of the housing with the hoist.

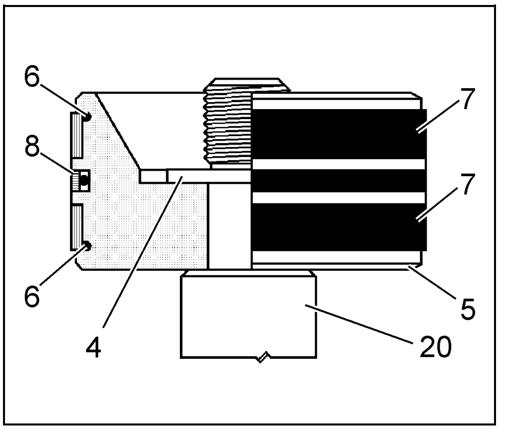


6. Remove the piston rod nut (3)

NOTE: *It will be necessary to hold the eye end of the rod stationary when removing the nut. A suggested method is to clamp the eye end of the piston rod in a hydraulic press and use a torque multiplier, or an impact tool.*

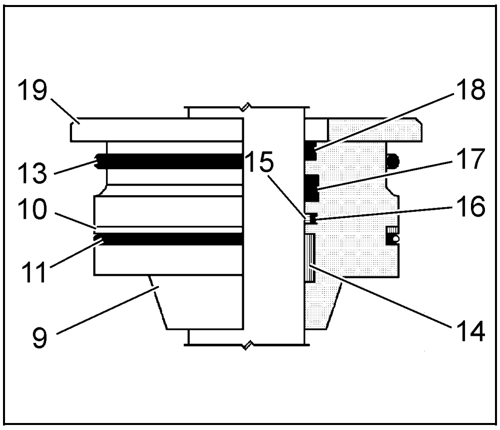


7. Remove washer (4) and piston (5) from the cylinder rod (20). Remove wear rings (7), O-rings (6) and piston seal ring (8) from piston (5).

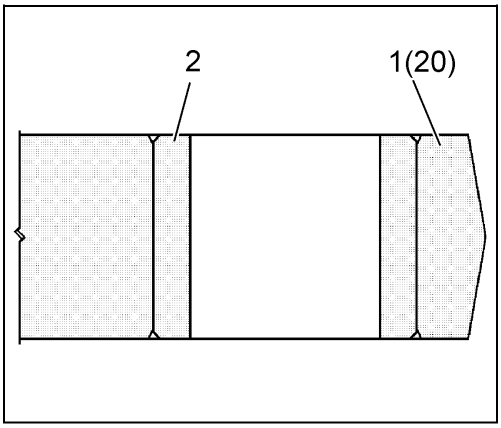


RIPPER LIFT AND PITCH CYLINDERS /BLADE TILT CYLINDER (G-2)

8. Slide gland (9) from the cylinder rod (20). Remove O-ring (11), backup ring (10), wear ring (14), buffer ring (15), O-ring (16) seal ring (17) and wiper ring (18) from gland (9). Remove O-ring (13), slide end cover (19) off of rod (20).



9. If necessary, press the bushing (2) from the housing (1) and from rod (20).



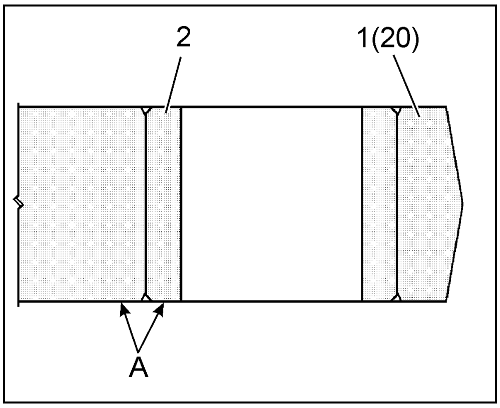
19. INSPECTION AND REPAIR

1. It is recommended that new service kit be installed when the cylinder is disassembled.
2. Wash all parts in a solvent and air dry. Lubricate machined surfaces of usable parts to protect them.
3. Inspect the cylinder housing for roundness throughout its length. If a tight spot is noticed when removing the piston, the area of binding should be given particular attention. A cylinder housing that is out-of-round should be replaced.
4. Check the cylinder housing and piston rod for scratches or grooves. Shallow scratches can be polished out with fine emery cloth and oil so a smooth surface is presented to the packing.
5. Inspect all sealing ring grooves for scratches, burrs or other damage. "Dress-up" grooves or replace as necessary.
6. Inspect tapped holes for damaged threads.
7. Inspect the cylinder mounting bushings for excessive wear or damage and replace, if necessary.
8. If the housing or rod eye bushings were removed, remove all rust, scale or paint from the bushing bore.

RIPPER LIFT AND PITCH CYLINDERS /BLADE TILT CYLINDER (G-2)

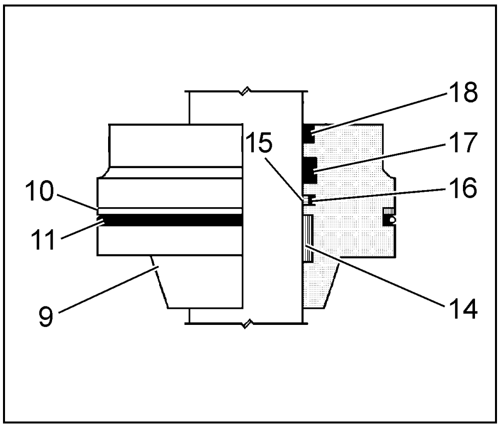
20. REASSEMBLY (Refer to Fig.'s 10C.13, 10C.14 and 10C.15)

1. If removed, press new bushing (2) into the housing (1) and rod (20) until flush (A).



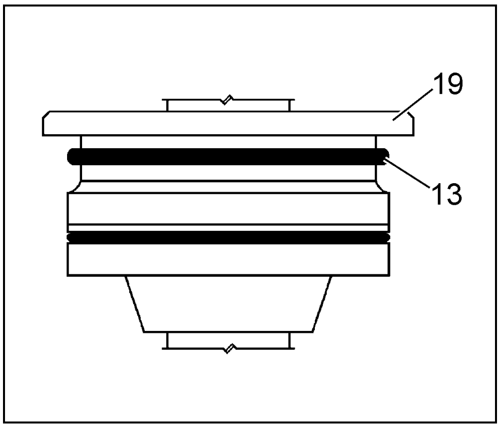
2. Coat the bore and grooves of gland (9) with fresh grease. Install seal ring (17) by squeezing the side of the seal together and starting the seal into the groove. Then work the remainder in with the thumbs. DO NOT use a screwdriver as it will damage the seal.

3. Install O-ring (16) and buffer ring (15), notched edge facing in, into gland (9) and follow with wear ring (14). Install the wiper ring (18) into gland. Install O-ring (11) and backup ring (10) onto gland (9).

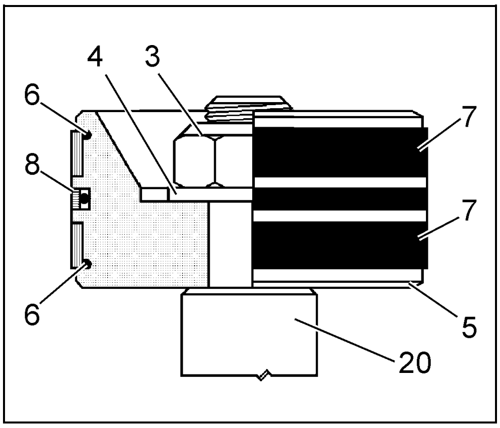


4. Install the O-ring (13) onto gland. The tapped holes in gland (9) must face toward the rod eye. Position end cover (19) and gland (9) onto cylinder rod (20).

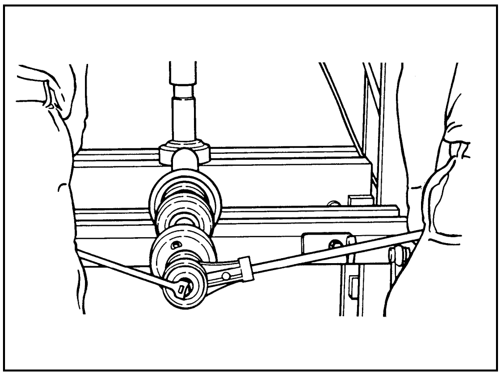
NOTE: *Outer end of gland is determined as bolt end and inside end as facing piston.*



5. Install seal ring (8) onto piston (5). Install O-rings (6) and wear rings (7) on each end of piston (5). Install and slide piston onto rod (20). Secure with washer (4) and nut (3).



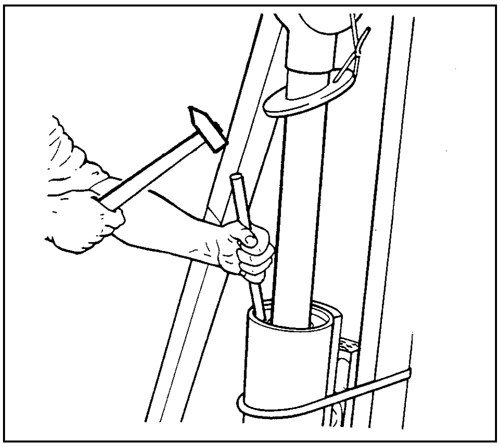
RIPPER LIFT AND PITCH CYLINDERS /BLADE TILT CYLINDER (G-2)



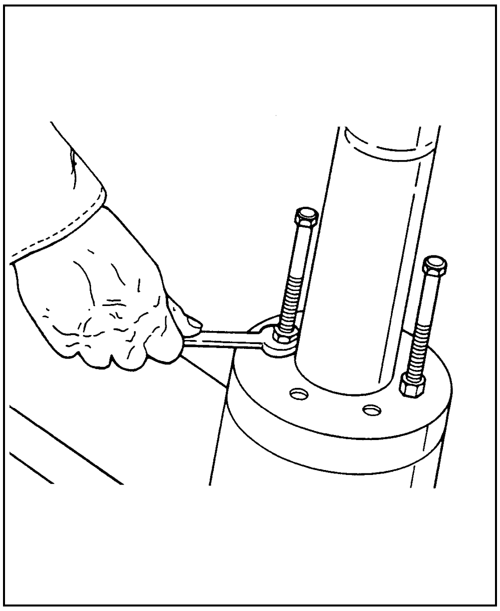
6. Clamp rod assembly into press and using a multiplier torque piston nut (3).

RIPPER LIFT CYLINDER: Torque nut to 2780÷2910 [Nm]
RIPPER PITCH CYLINDER: Torque nut to 1700÷1760 [Nm]

BLADE TILT CYLINDER G-2:Torque nut to 1730÷1800 [Nm]



7. Apply a generous amount of fresh grease to the inside of the cylinder housing (1) and secure it to hoist frame. Install a ring compressor on the piston and compress the wear rings. Compressing the wear rings will memory the rings back to size and greatly reduce the possibility of damage during installation. Tie the end cover (19) to rod end to provide working clearance. Attach hoist to the rod eye and lower rod assembly into housing (1) using extreme care not to damage wear rings (7) and piston seal (8). Once piston (5) has entered housing, remove the compressor. Drive cylinder rod down to about 1/2 stroke.



8. Start gland assembly (9) into housing (1) and drive in just below lock segments groove in housing. Install lock segments (12) into housing groove. Release the end cover (19) and position in place. Install two puller bolts 3/8" – 16 UNC x 4" (ripper cylinders) or 1/2" – 13 UNC x 4" (blade tilt cylinder (G-2)) and nuts and thread into gland. Tighten nuts to draw gland up against lock segments. Remove puller arrangement. Coat inner cylinder housing surface over the gland with high temperature type 230 HHT grease 1 [mm] in thickness. Secure cover (19) to gland (9) and torque bolts with washers to 36 ÷ 38 [Nm] (ripper cylinders) or 73 ÷89 [Nm] (blade tilt cylinder (G-2)).

9. Install the elbows of hoses with new O-rings to cylinder housing.

RIPPER LIFT AND PITCH CYLINDERS /BLADE TILT CYLINDER (G-2)

21. INSTALLATION

Installation Ripper Pitch Cylinder (Refer to Fig. 10C.11)

1. Attach a hoist to the pitch cylinder (2), position housing eye to frame. Install pin (4) and secure with retainer plate (3) and hardware.
2. Position cylinder rod eye in toolbeam. Install pin (4) and secure with retainer plate (3) and hardware.
3. Reconnect hydraulic hoses (1) to pitch cylinder (9).
4. Vent the hydraulic system and add oil as necessary, refer to OPERATOR'S MANUAL. Visually check for oil leakage.
5. Cycle cylinder a few times and recheck cylinder cover bolts torque.

Ripper Lift Cylinder Installation (Refer to Fig. 10C.12)

1. Attach a hoist to the lift cylinder (2), position housing eye to frame. Install pin (4) and secure with retainer plate (3) and hardware.
2. Position cylinder rod eye in toolbeam. Install pin (4) and secure with retainer plate (3) and hardware.
3. Reconnect hydraulic hoses (1) to lift cylinder (9).
4. Vent the hydraulic system and add oil as necessary, refer to OPERATOR'S MANUAL. Visually check for oil leakage.
5. Cycle cylinder a few times and recheck cylinder cover bolts torque.

Bullgrader Tilt Cylinder (G-2) Installation

1. Attach a hoist sling to the cylinder and position the housing eye of the tilt cylinder into the bracket on the strut. Install pin into strut bracket and secure with lock pin.
2. Position the cylinder rod eye in the swivel bar on the blade. Install the pin into the blade and secure with hardware.
3. Reconnect the two hoses to the cylinder.
4. Vent the cylinders and add oil to cylinders and to the reservoir as necessary, refer to the OPERATOR'S MANUAL. Visually check for oil leakage.
5. Cycle cylinder a few times and recheck cylinder pin hardware and cover bolts torque.
6. Install the hoses guard.

SECTION 10E

RESERVOIRS AND FILTERS

RESERVOIRS AND FILTERS

CONTENTS

RESERVOIRS AND FILTERS

HYDRAULIC RESERVOIR

1. DESCRIPTION (Refer to Fig. 10E.1)

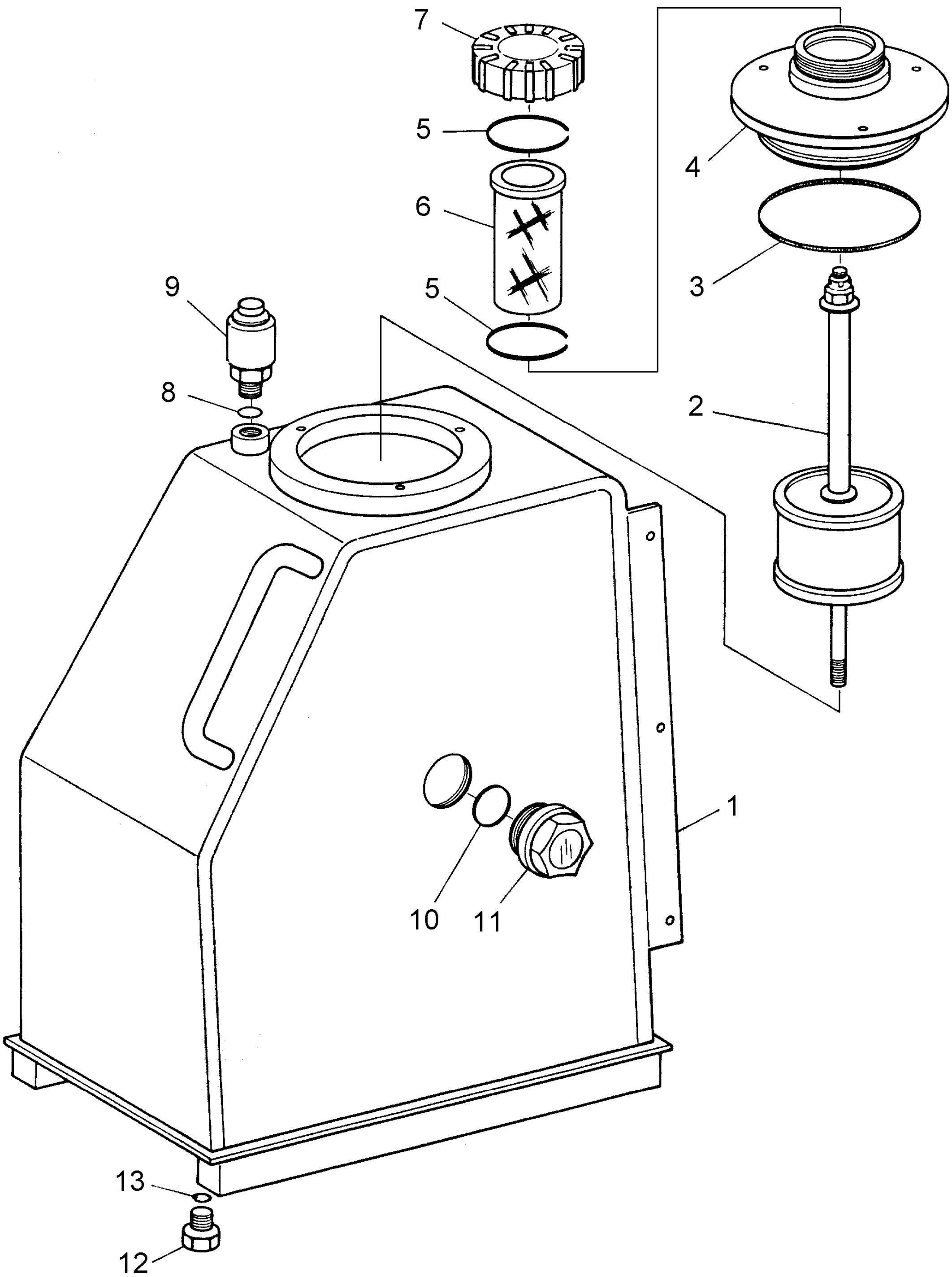


Fig. 10E.1. Exploded View of Hydraulic Reservoir

1. Hydraulic Reservoir
2. Strainer Assembly
3. O-Ring
4. Reservoir Cover
5. Retaining Ring
6. Filler Strainer
7. Filler Cap
8. O-Ring
9. Breather Valve Assy
10. O-Ring
11. Sight Gauge
12. Drain Valve
13. Washer

HYDRAULIC RESERVOIR

The reservoir is bolted to the right fender next to the fuel tank. It is a one piece welded assembly (1) with strainer (2), filler strainer (6), breather valve (9), drain valve (12), sight gauge (11) and various parts for suction lines.

The reservoir acts as a storage tank for the majority of the dozer equipped hydraulic system oil. The remainder of oil fills the lines and system components. The breather valve (9) protects the pumps from the cavitating as well as maintaining pressure in the reservoir. Refer to the OPERATOR'S MANUAL for service of this valve.

2. REMOVAL

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

IMPORTANT: *Disconnected hydraulic lines must be capped with the correct size plastic caps. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Tag all disconnected lines to facilitate proper installation.*

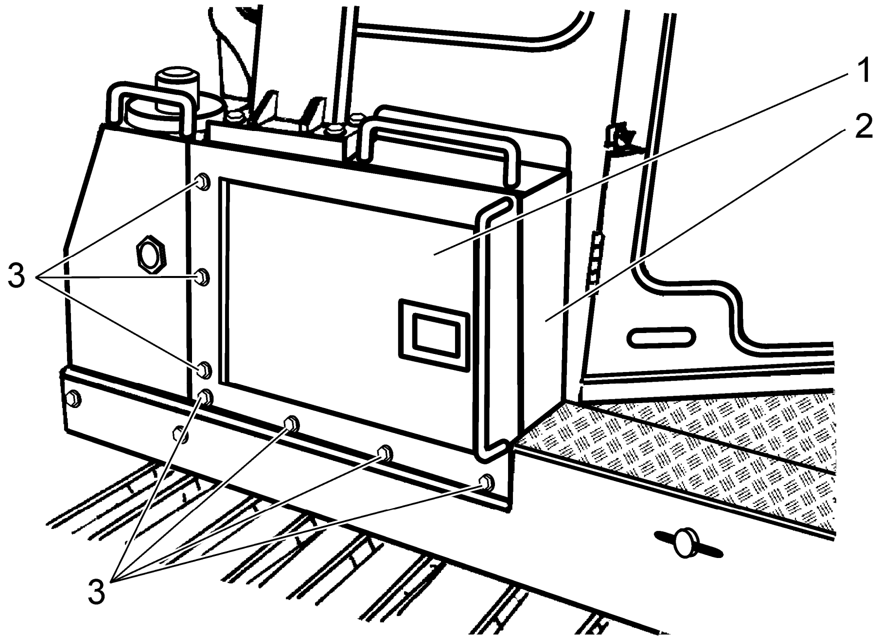


Fig. 10E.2. Disassembly R.H. Enclosure

1. R.H. Door
2. R.H. Enclosure
3. Bolts

1. Drain the hydraulic reservoir. Refer to the OPERATOR'S MANUAL for this procedure.
2. Disconnect wire harness of rear lamp.
3. Unscrew bolts (3, Fig.10E.2) and remove R.H. enclosure (2) with R.H. door (1).

HYDRAULIC RESERVOIR

Fig. 10E.3. Hydraulic Reservoir Disconnecting Points

1. Suction Tube (to Equipment Pump)
2. Return Hose (from Pilot Pressure Valve)
3. Return Tube (from Equipment Return Filter)
4. Hydraulic Reservoir
5. Return Hose (from Fan Return Filter)
6. Return Hose (from Fan Drive Pump)
7. Suction Hose (to Fan Drive Pump)
8. Return Hose (from Blade Pilot Valve)

4. Disconnect return hoses (5, 2, 8 and 6, Fig.10E.3) and return tube (3) from the reservoir (4). Remove and discard old O-rings.
5. Disconnect suction tube (1) and suction hose (7) from the reservoir (4). Remove and discard old O-rings. Cap the reservoir ports to prevent entry of dirt.
6. Attach a suitable hoist sling to holder mounted on the reservoir (4). Remove reservoir (4) mounting bolts from the bottom of reservoir and lift the reservoir up using the hoist. Remove the reservoir from the machine.

HYDRAULIC RESERVOIR

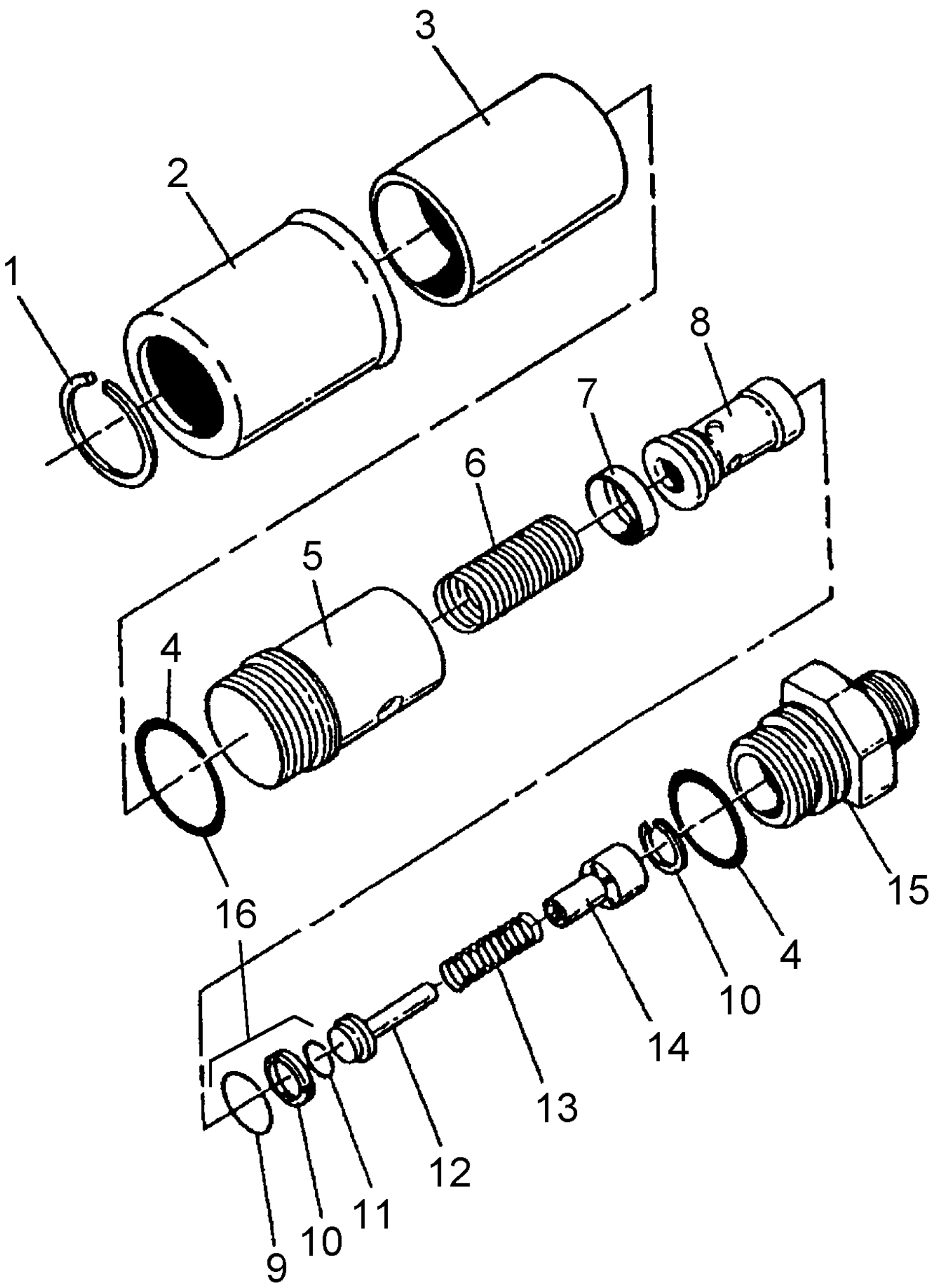


Fig. 10E.4. Exploded View of Vacuum Pressure Relief Valve

1. Retainer Ring	5. Cover	9. O-Ring	13. Poppet Spring
2. Cover	6. Spring	10. Ring	14. Poppet Guide
3. Ceramic Filter	7. Retainer	11. O-Ring	15. Valve Housing
4. Gasket	8. Sleeve	12. Poppet	16. Service Kit

HYDRAULIC RESERVOIR

3. DISASSEMBLY (Refer to Fig. 10E.1)

1. Remove the breather valve (9).

   If necessary, disassemble the component parts of the breather valve (9) in the sequence indicated by the reference numbers in Fig. 10E.4.
2. Remove the upper retaining ring (5) and filler strainer (6).
3. Unscrew three bolts securing cover (4) and remove the cover (4) with O-ring (3). If necessary, remove the lower retaining ring (5) and O-ring (3) from cover (4).
4. Unscrew nut with washer and remove the strainer assembly (2).
5. Unscrew the sight gauge (11) with O-ring (10), if necessary.

4. INSPECTION AND REPAIR

1. It is recommended that all new O-rings be installed when the reservoir is disassembled.
2. Before cleaning the reservoir, inspect the residue in the tank. Check for deposition of foreign particles that could indicate a component failure of system.
3. Clean and dry all parts thoroughly. Clean the strainers (2 and 6, Fig. 10E.1) in a suitable solvent and air dry. Refer to the OPERATOR'S MANUAL for this procedure.
4. Inspect the reservoir and all fittings for signs of wear or damage.
5. Be sure all parts move freely in the breather valve. Clean or replace the breather valve ceramic filter (3, Fig. 10E.4).
6. Check the springs (6 and 13, Fig. 10E.4) for damage, distortion or weakens.

5. REASSEMBLY (Refer to Fig. 10E.1)

1. Install the sight gauge (11) with O-ring (10), if removed.
2. Install the strainer assembly (2) inside the reservoir (1) and secure with washer and nut.
3. Install the O-ring (3) and lower retaining ring (5) to cover (4), if removed.
4. Install the cover (4) with O-ring (3) and lower retaining ring (5) to the reservoir (1). Secure the cover (4) with three bolts.
5. Install the filler strainer (6) and upper retaining ring (5) to the cover (4).
6. Install the breather valve (9).

HYDRAULIC RESERVOIR

6. INSTALLATION

1. Attach a hoist sling to holder mounted on the reservoir (4, Fig. 10E.3) and position the hydraulic reservoir on rear of the machine. Secure the reservoir (4) with the bolts previously removed.
2. Reconnect suction hose (7) and suction tube (1) to the reservoir (4).
3. Reconnect return tube (3) and return hose (6, 8, 2 and 5) to the reservoir (4).
4. Reinstall R.H. enclosure (2, Fig. 10E.2) with R.H. door (1) and secure it with bolts (3).
5. Reconnect wire harness of rear lamp.
6. Fill the hydraulic reservoir. Refer to the OPERATOR'S MANUAL for this procedure.
7. Start the engine, move the hydraulic controls in all directions and visually check hoses and connections for leakage, check oil level and add oil if needed.

SECTION 12

POWER

POWER

CONTENTS

1. DESCRIPTION

The machine is powered by Cummins QSC8.3, 6-cylinder, turbocharged with charge air cooler (CAC) diesel engine. This engine is a four cycle, four valve per cylinder type, using a 24 [V] direct starting system. The engine has high pressure common rail fuel system.

2. SPECIFICATIONS

Special Bolt and Nut Torque Data

Cranking motor:

No.10-32 switch terminal . . . . 1.8 – 3.4 [Nm]

½” -13 ground terminal . . . . 27 – 35 [Nm]

(Torques given are for bolts and nuts lubricated with SAE-30 engine oil.)

NOTE: *Except for the special torques shown, all bolts and nuts are to be given a standard torque. Refer to the „STANDARD TORQUE DATA CHART” in Section 1, „GENERAL.”*

3. AIR INDUCTION SYSTEM TEST

1. Remove the end cover from the air cleaner. Remove both filter elements from the air cleaner. See Operator’s Manual.
2. Using duct tape, mask outside diameter of the safety (small) element. Sealing must be air tight. Reinstall the tapped element only and end cover.
3. Remove the air cleaner warning light switch (1, Fig. 12.1). Tee in a 0 to 100 [kPa] pressure gauge.
4. Remove the plug (2) from the air intake manifold. Connect a manually regulated compressed air supply.
5. Adjust the air regulator until the pressure gauge registers 20 [kPa]. If pressure cannot be reached, it may be necessary to rotate the engine crankshaft over slightly until a minimal leakage occurs past the engine valves.

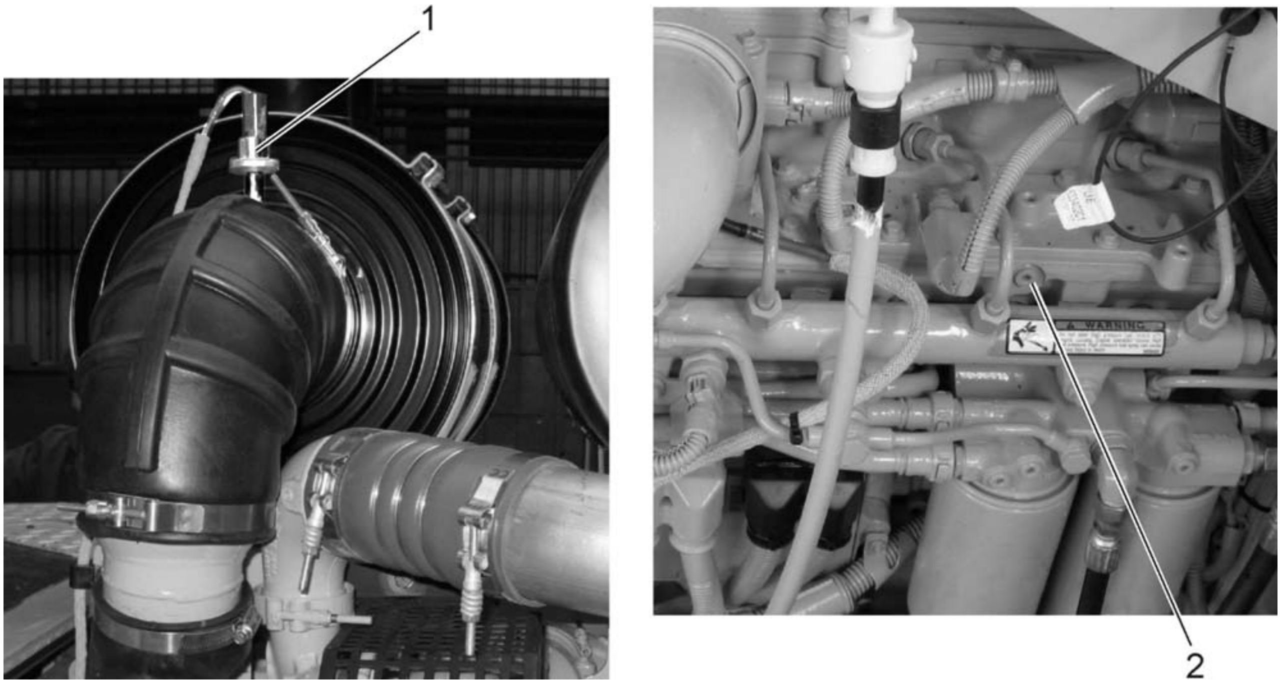
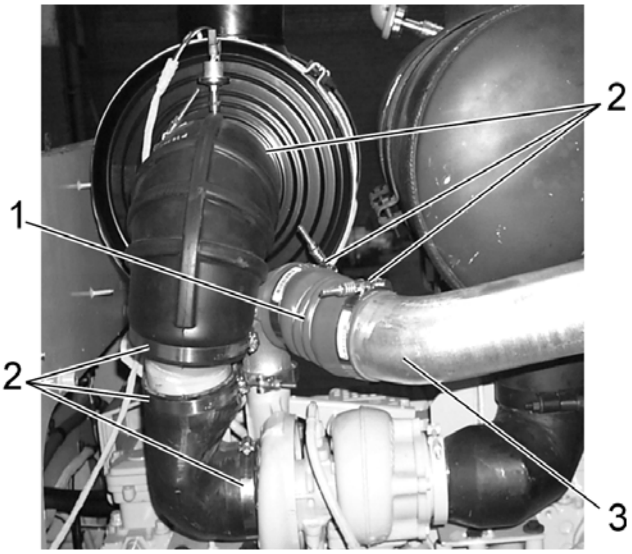
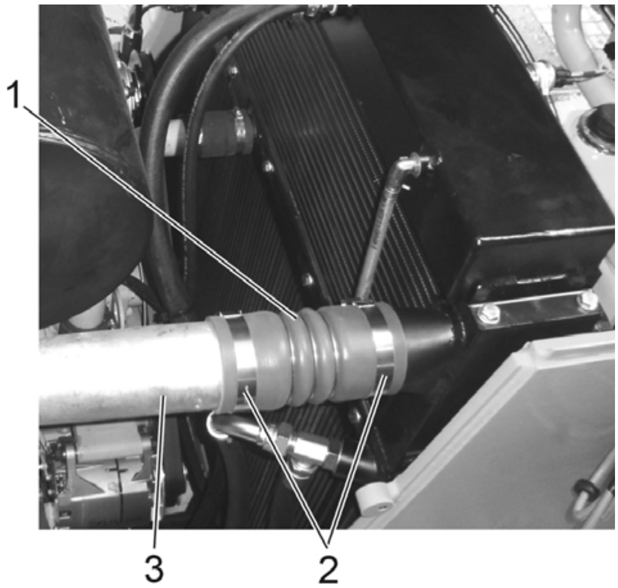


Fig. 12.1. Air Induction System Service Points

1. Air Cleaner Warning Light Switch
2. Plug threaded (M10x1)

6. Using a soap solution and a paint brush, coat the following places and check for leaks (Fig. 12.2):
   a. Air cleaner body surfaces around the outlet tube connections.
   b. Air cleaner restriction indicator warning light switch to air cleaner outlet.
   c. All clamped hose connections between air cleaner outlet, including connections at turbocharger and charge air cooler (CAC) to intake manifold elbow.
7. No leakage is permitted between the air cleaner and suction side of the turbocharger and between turbocharger outlet elbow, charge air cooler and intake manifold flange. If leakage at the joints is detected, tighten hose clamps. If leakage still persists, remove the parts to determine cause. Inspect and replace worn parts as necessary and retest.
8. Remove the filter element and remove the duct tape. Inspect the seals for damage. Reinstall both elements and the end cover.





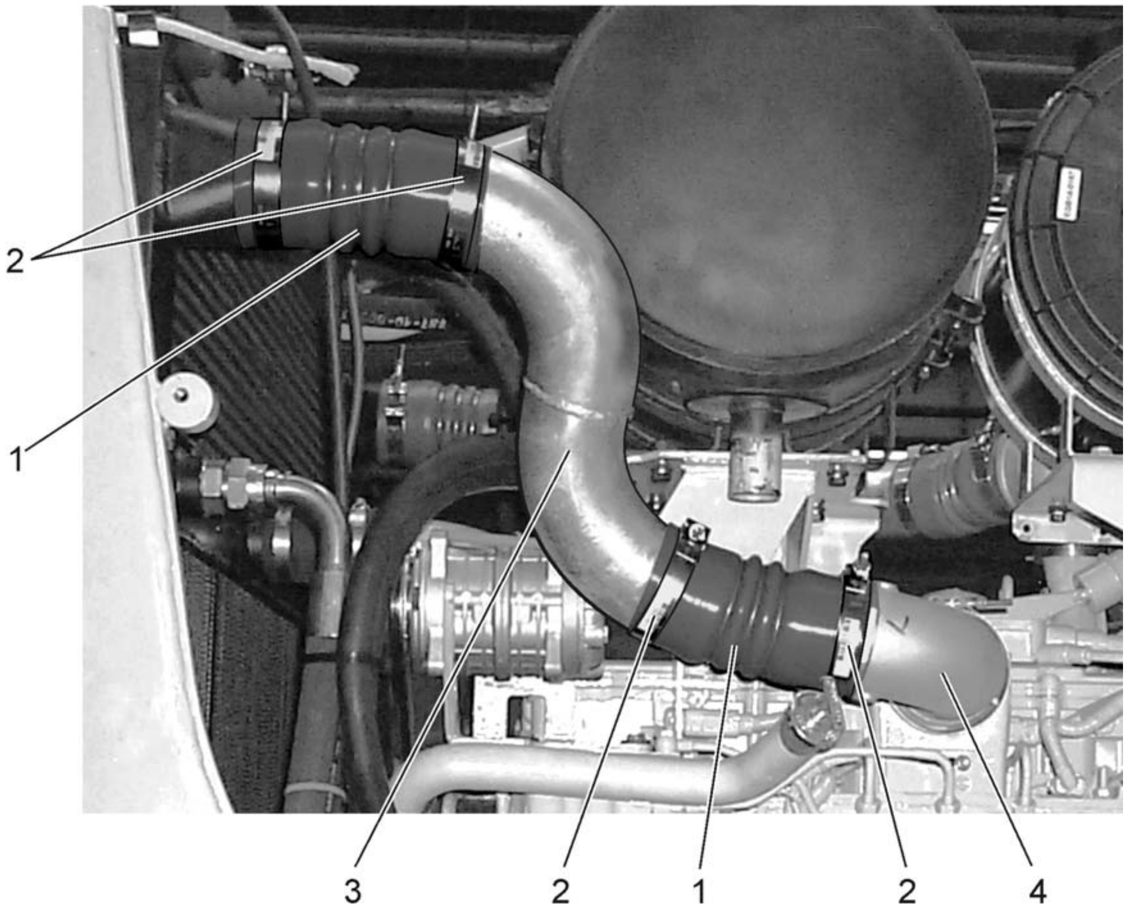


Fig. 12.2. Engine Charge Air Cooler (CAC) Connection Check Places

1. Bumper Hose
2. Clamps
3. Air Transfer Tube
4. Intake Air Connection (elbow)

Charging system restriction flow test

1. Perform the charge air cooler system performance tests with engine running:
   - check pressure drop test (internal air flow restriction)
   - ambient and intake air temperature differential (efficiency of cooling system)

   due to significant influence for the engine performance, durability and emission compliance.
   For detailed procedure, refer to Engine Manuals.

4. CONTROLS ADJUSTMENTS

WARNING! The following checking and adjusting procedures are to be performed with the engine stopped unless otherwise stated. Whenever it is necessary to have the engine running, be sure the drive train lock lever is locked and brake pedal is locked in applied position.

ENGINE NOT RUNNING ADJUSTMENTS (Refer to Fig. 12.3)

Engine Control Adjustments – (mechanical parts)

General

NOTE: *Engine speed control lever must be adjusted correctly before checking operation of decelerator.*

Before performing the adjustments, remove all dirt accumulation from the control linkage. Check and replace worn parts (i.e. pins, flexible connections, ball joints, springs) if required.

After adjustment has been performed, machine must be checked out in actual operation for proper functioning.

WARNING! For your personal protection never perform unassisted any adjustments with engine running. Always have another experienced person helping in the operator's compartment when adjustments must be done with the engine running.

WARNING! When removing or installing the measuring equipment, or during measuring engine speed, be careful not to touch any high temperature parts or rotating parts.

1. Remove the center floor plate in operator's compartment.
2. Disconnect wire harness connector (18) of the potentiometer (17).
3. Remove bolts (11) and remove bracket (25) with control elements from under the pod.
4. Check that the nuts (10) are not loosen. Remove pin (12) and (21).
5. Check that the plate (16) and potentiometer (17) are not loosen.
6. Check that the control lever (1) is moving without restriction from forward (LO) to backward (HI) position.
7. Check that the potentiometer control lever (19) is mounted properly and rocking angle is equal in both sides in relation to the vertical axle (app. 25 degree either side). Adjust as required.

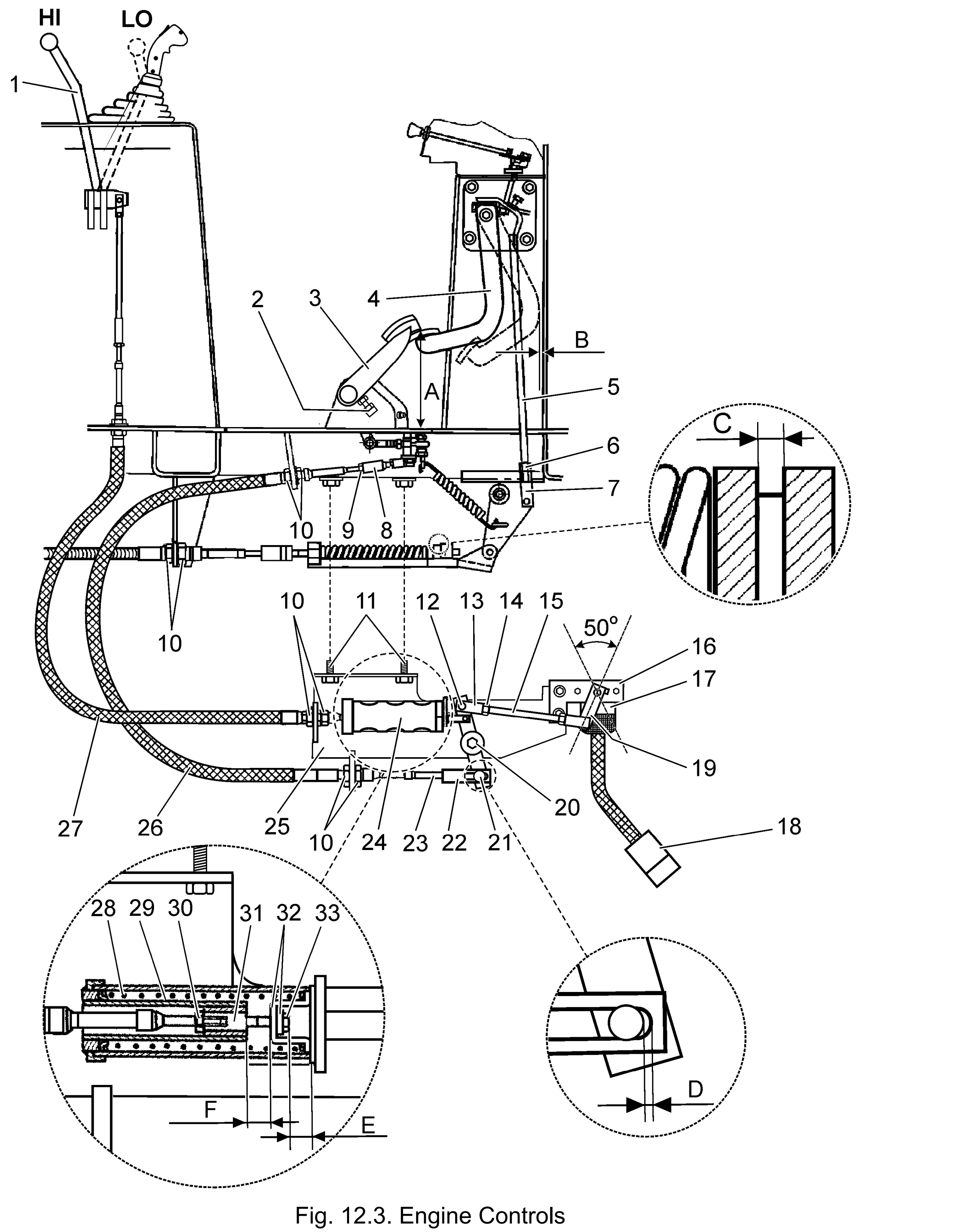


Fig. 12.3. Engine Controls

1. Control Lever
2. Adjusting Bolt
3. Decelerator Pedal
4. Brake Pedal
5. Control Rod
6. Lock Nut
7. Clevis
8. Link
9. Lock Nut
10. Nuts
11. Bolts
12. Pin
13. Clevis
14. Lock Nut
15. Control Rod
16. Plate
17. Potentiometer
18. Wire Harness Connector
19. Control Lever
20. Intermediate Lever
21. Pin
22. Clevis
23. Lock Nut
24. Spring Enclosure
25. Bracket
26. Control Cable
27. Control Cable
28. Spring
29. Bushing
30. Lock Nut
31. Link
32. Washer and Cup
33. Nut

A. Dimension 185 to 188 [mm]
B. Gap 6 [mm]
C. Gap 2 - 3 [mm]
D. Gap 0.0 [mm]
E. Dimension 19.5 [mm]
F. Dimension 10.5 [mm]

8. Move control lever (1) in forward position (LO). Loosen lock nut (14). Adjust length of control rod (15) with clevis (13) to align the holes. Install clevis (13) to the intermediate lever (20), with the pin (12). Tighten the lock nut (14).
9. Install pin (21), position control lever (1) in rear position (HI).
10. Loosen lock nuts (9). Check and adjust the cable (26) with link (8) to 0.0 [mm] gap at point “D”. Tighten the lock nut (9).

NOTE: *Force to depress decelerator pedal (3) should be 63 to 77.5 [N]. If the force is out of specification replace decelerator pedal control cable (26) and check operation. If the system is still operating improperly, loosen nut (10) and disconnect a spring enclosure (24) from the intermediate lever (20). Remove control cable (27) from the bracket (25). Remove end plate of spring enclosure (24). Remove nut (33), washer and cup (32). Remove end of the control cable (27) from the bushing (29). Remove spring (28) and check the spring free length for 336 [mm], replace if damaged or worn. Install the spring (28) in to the spring enclosure (24). Install cup and washer (32) with nut (33). Check “F” dimensions for 10.5 [mm] and “E” for 19.5 [mm], relocate link (31) and tighten lock nut (30) to obtain these dimensions if necessary. Reassemble end plate of spring enclosure (24). Reassemble control cable (27) to the bracket (25), torque the nut (10) to 60 to 80 [Nm]. Reassemble the spring enclosure (24) to the intermediate control lever (20). Perform adjustment as described above step 2 to 9.*

11. Reinstall bracket (25) to pod with bolts (11). Reconnect wire harness connector (18) of the potentiometer (17).

Brake pedal adjustment

1. Depress brake pedal (4) to obtain gap “B” 6.0 [mm] between the pedal arm and instrument panel console wall. In this position brake spool of the steering valve (Refer to SECTION 7E) should be fully moved out. If the brake spool is not fully moved out, loosen lock nut (6) and make adjustment of rod (5) with clevis (7). Tighten lock nut (6).
2. Press brake pedal (4) as far as it will go. Check if “C” gap 2 to 3 [mm] is obtained.
3. Release brake pedal (4) and check “A” dimension (between floor and pedal center top) which should be 185 to 188 [mm].

Engine Running

1. With control lever (1) in the forward position (LO), check to make sure engine is running at designated low idle speed 600 - 800 [RPM].
2. With control lever (1) in the rearmost position (HI), check to make sure engine is running at designated high idle speed 2300 - 2500 [RPM].
3. If designated speed is not reached, check the wire harness and potentiometer resistances as described below in Engine Control Potentiometer and Circuit Check in and Repair.
4. Place control lever (1) in the rearmost position (HI). Adjust decelerator pedal adjusting bolt (2) so that when decelerator pedal (3) is pressed 40 [mm], specified decelerated engine speed is obtained 1100 - 1300 [RPM]. Stop the engine.

NOTE: *If designated speeds can not be reached, contact with nearest Cummins Authorized Service.*

Engine not Running

Engine Control Potentiometer and Circuit Check in and Repair (Refer Fig. 12.4)

NOTE: *When making engine connection test, the starting switch MUST be in „OFF" position and all test points MUST be feed into, leaving all engine sensors properly installed in their respective ports and electronically connected to the ECM. If any sensors are disconnected during engine operation, a fault code(s) will result. This fault code(s) (if active) will derate the engine and will require clearing in the ECM by a Cummins Authorized Service.*

Inspect OEM harness if fault code 131, 132 or 387 is active.

1. Unplug connector (2), measure the ECM 24 [V] supply voltage, between pins 1 and 3. Reconnect plug.
2. Disconnect potentiometer harness (3), check the potentiometer supply voltage 4.75 to 5.25 [V] DC (pins 22 and 23).
3. Disconnect harness of 50 pin connector (1) from the ECM and potentiometer harness plug (3). Flush the dirt, debris or moisture from the disconnected connector pins. Dry connector by using electrical contact cleaner P/N 3824510.
4. Inspect the harnesses and the potentiometer connector pins are not corroded, bent or broken, pushed back or expanded.
5. Use a typical multimeter to measure the resistance of the potentiometer circuit (3), harness of 50 pins connector (1). Check if resistances are as follows (refer to machine wiring diagram in Section 8 for connector pins identification):

1	Potentiometer resistance, supply and return (C, B)	2500 – 3000 [Ω]
2	Between potentiometer sensor pins (A, B)	1500 – 3000 [Ω] (lever position – LO) 250 – 1500 [Ω] (lever position – HI)
3	OEM harness, potentiometer resistance between supply and return (22, 23)	2000 – 3000 [Ω]
4	OEM harness, supply and signal wire for open circuit	Less than 10 [Ω]
5	OEM harness, signal pin and all other pins in OEM connector for short circuit	More than 100 [kΩ]
6	OEM harness, signal pin for short circuit to ground	More than 100 [kΩ]

6. If the resistance values are not within the specification the potentiometer or wire harness has failed. Replace the accelerator pedal, repair (run the new wires) or replace OEM harness.
7. Before reconnecting connectors (1), (2), (3), use quick-dry electrical connectors cleaner to remove all dirt and moisture from the connectors ports and the harness connectors. Apply a small amount of lubricant DS-ES (P/N 38229034*)* to the connector terminals. Do not fill the entire connector cavity with lubricant.

IMPORTANT: *Use only Cummins recommended lubricant DS-ES. Other lubricants, such as lubricating oil or grease, in the connectors can cause Electronic Control Module (ECM) damage, poor engine performance, or premature connector pin wear.*

NOTE: *If potentiometer is changed or calibration downloaded, move the control lever (1, Fig. 12.3) (key switch ON) though its complete travel 3 times. This procedure calibrates the new potentiometer with the ECM.*

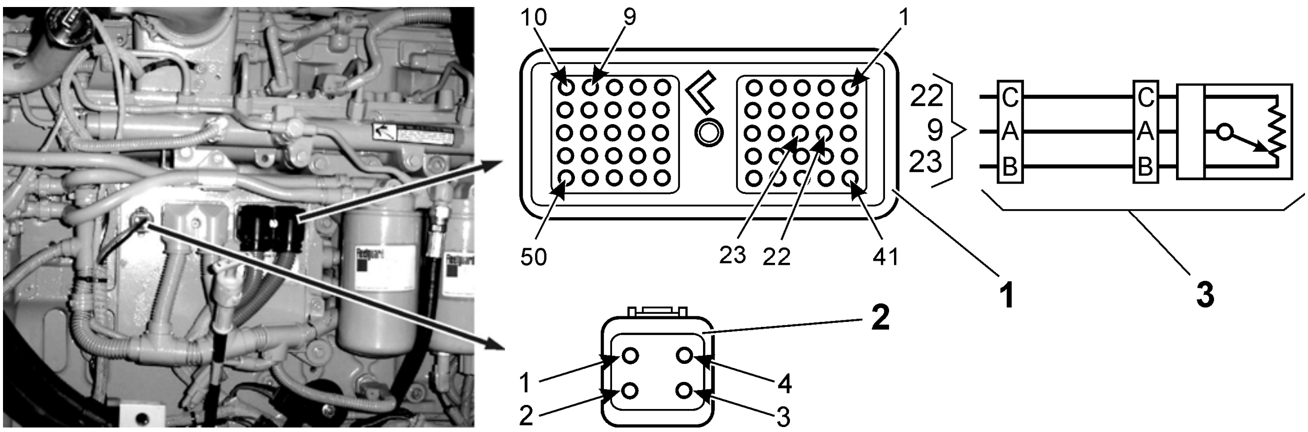


Fig. 12.4. Engine Control Interface Connectors

1. OEM Harness (50 Pins Connector)
2. ECM Supply connector
3. Potentiometer Harness

C – +5 [V] Supply
A – Signal
B – Return

After checking has been performed, machine must be checked out in actual operation for proper functioning.

NOTE: *If designated engine speeds are not achieved contact with Authorized Cummins Service.*

5. REMOVAL

1. Position the machine in a place which makes it possible to use a lifting device for lifting of disassembled assemblies.

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF and brake is set. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

2. Turn the electrical master switch to the „OFF" position.
3. Remove engine radiator as described in section 6 COOLING SYSTEM.
4. Disconnect the engine wire harness connectors (1 and 7, Fig. 12. 5). Remove harness from the clips (5), attach harness to the engine.

IMPORTANT: *Disconnected electrical connectors must be capped with the correct size plastic cap. Protect connectors from dirt and humidity as this can cause problems in engine control system.*

5. Remove the cranking motor cables positive (+) and ground (-) (3 and 4).
6. Remove cab heater supply hose (2) and return hose (6) from their valves.
7. MACHINES EQUIPPED WITH A/C SYSTEM: Disconnect the A/C system compressor magnetic clutch wire connector (3, Fig. 12.6). Remove bolts (1) securing A/C compressor (2) to the bracket. Remove A/C compressor drive belt. Remove compressor with attached hoses. Do not disconnect the hoses of the compressor. Disconnecting the hoses causes gas escape out of air conditioner system. Secure disassembled assembly out of the way.
8. Disconnect the engine speed sensor connector (6).

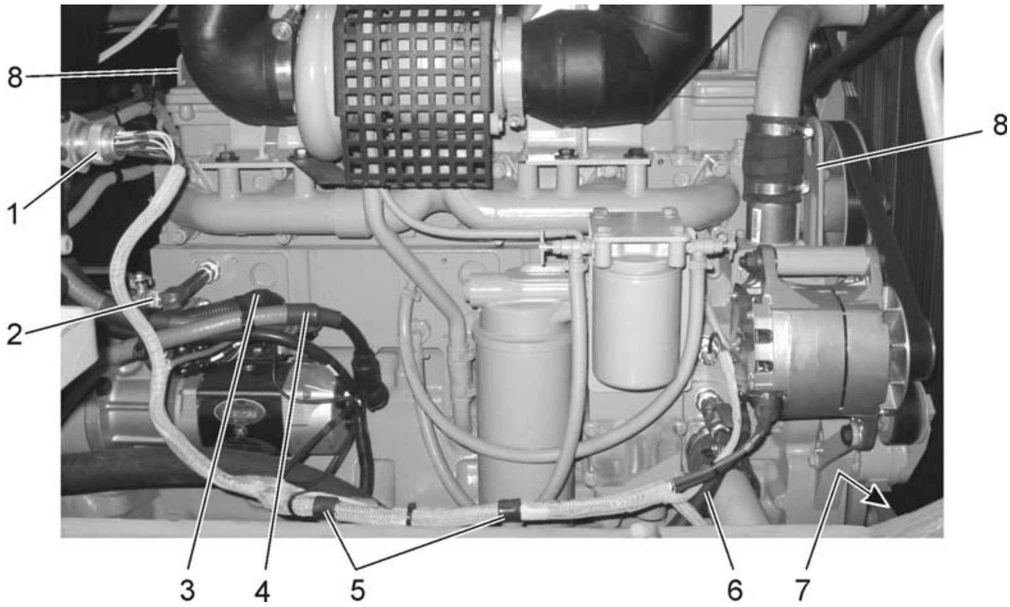


Fig. 12.5. Cranking Motor Disconnecting Points (RH side)

1. Harness Connector
2. Cab Heater Supply Hose
3. Positive Cable (+)
4. Ground Cable (-)
5. Clip
6. Cab Heater Return Hose
7. Harness Connector
8. Lifting Brackets

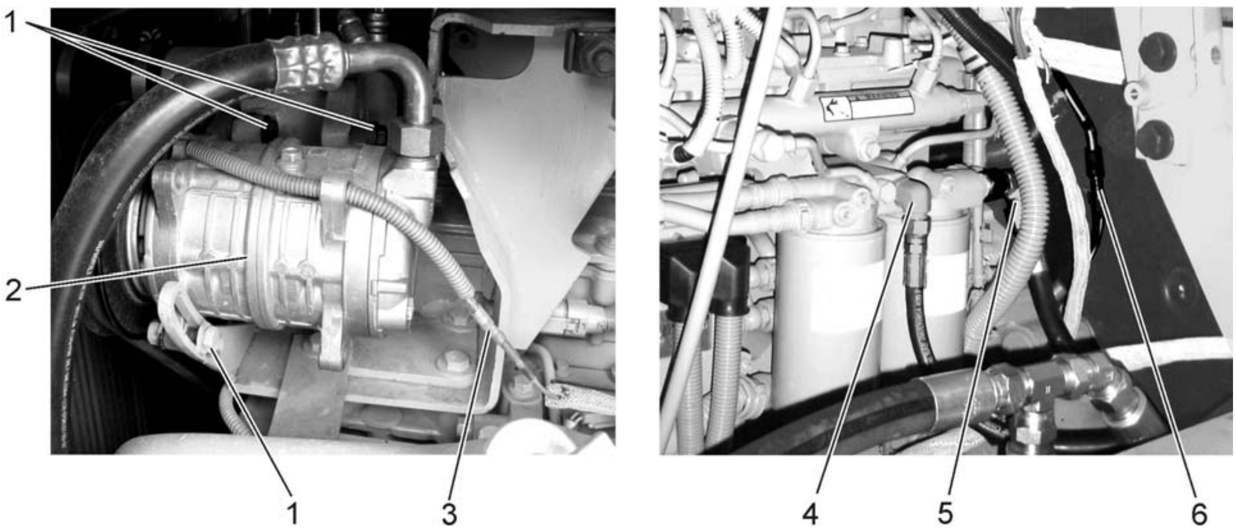


Fig. 12.6. A/C system and Fuel System Disconnecting Points (LH side)

1. Bolts
2. A/C system Compressor
3. Magnetic Clutch Wire Connector
4. Fuel Return Hose
5. Fuel Supply Hose
6. Engine Speed Sensor Harness Connector

9. Close the valve under the fuel tank, remove fuel supply hose (5) and return hose (4) from the fuel filter head.

IMPORTANT: *Disconnected hydraulic or fuel lines must be capped with the correct size plastic cap. If these caps are not available, tape or clean rubber corks may be used. Hydraulic or fuel openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic or fuel system components. Also tag all disconnected lines and wires for easier installation.*

10. Disconnect the wire connector from air cleaner warning light switch (1, Fig. 12.1). Secure the wire to the hood support.
11. Remove plate on the fender. Disconnect the engine control potentiometer wire harness connector (2, Fig. 12.7).
12. Remove floor plate in the cab to gain the access to the torque converter fasteners.
13. Disconnect the harness connectors (1 and 3). Remove harness from the clip and secure to the engine.

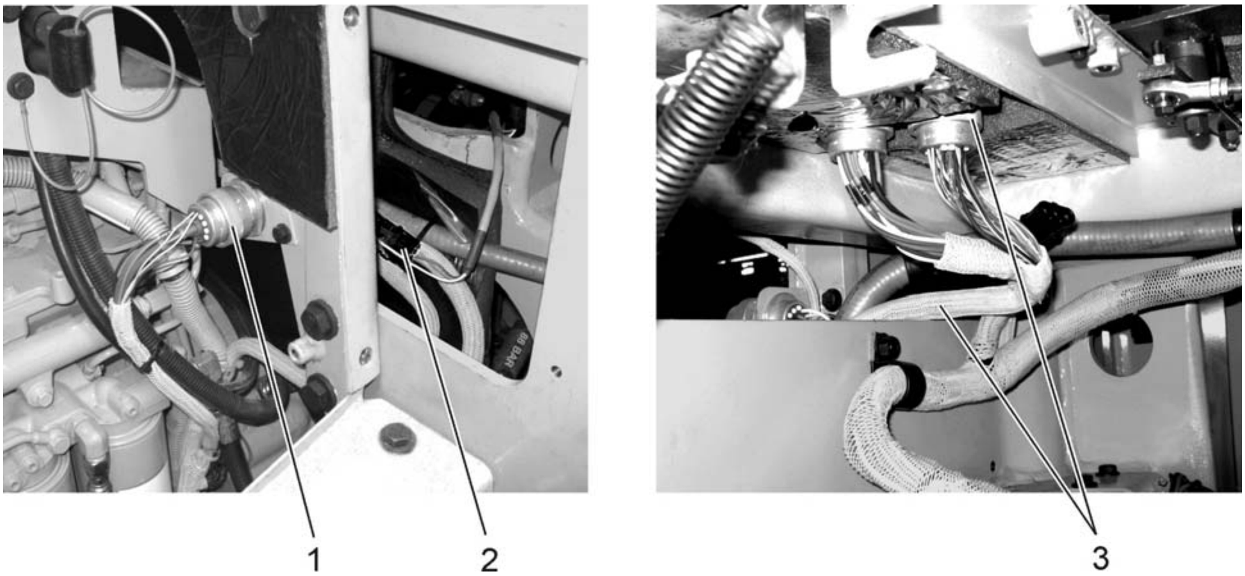


Fig. 12.7. OEM Wire Harness Disconnecting Points (LH side)

1. Harness Connector
2. Engine Control Potentiometer Wire Harness Connector
3. Harness and Connector (under the pod View from the cab)

14. Working under machine, remove transmission guard to get the access to the torque converter compartment on the bottom.

WARNING! This procedure requires extreme caution. Use suitable blocking equipment while working under the machine.

15. Disconnect wires from the temperature sensors (2 and 3, Fig. 12.8).
16. Remove torque converter outlet hose (4).
17. Remove torque converter drain hose (5) from the flywheel housing.
18. Remove bolts securing drive shaft (1) to the torque converter output flange. Secure the disconnected shaft with wire.

19 Drain the oil from the hydraulic oil reservoir. Refer to Operator's Manual. Remove flange splits securing tubes (6) to the hydraulic system pump.

20. Remove torque converter vent hose (6, Fig. 12.9).
21. Disconnect the fan drive system pump solenoid wire harness plug (4).
22. Remove bolts and separate fan drive system pump (3) from the torque converter, wire the pump.
23. Remove bolts and separate hydraulic system pump (5) from the torque converter, wire the pump.

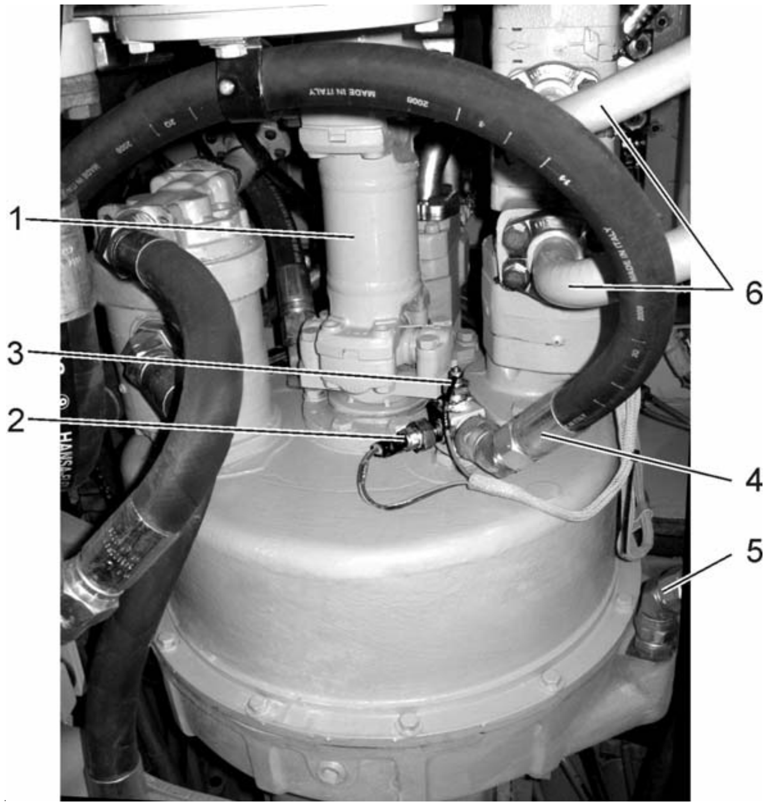


Fig. 12.8. Torque Converter Disconnecting Points (bottom view)

1. Drive Shaft
2. Oil Temperature Sensor (for ECM)
3. Oil Temperature Sensor (for cab indicator)
4. Torque Converter Hose (outlet)
5. Drain Hose
6. Tubes (inlet)

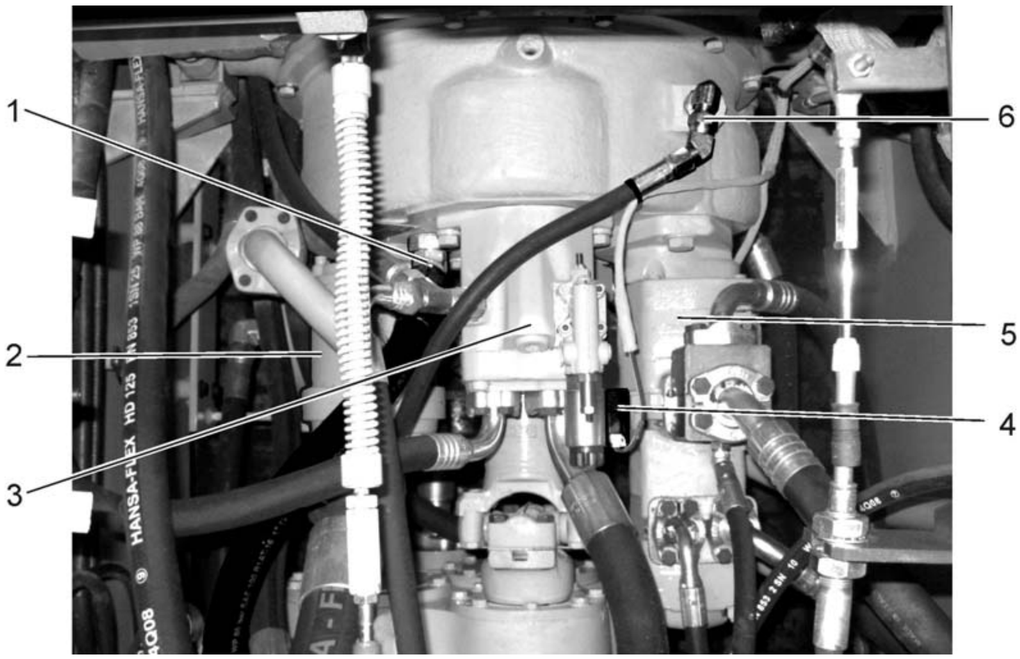


Fig. 12.9. Torque Converter Disconnecting Points (top view)

1. Torque Converter Hose (inlet)
2. Drive Train System Pump
3. Fan Drive System Pump
4. Fan Drive System Pump Solenoid Wire Harness Plug
5. Hydraulic System Pump
6. Torque Converter Vent Hose

24. Remove torque converter inlet hose (1).
25. Remove bolts and separate drive train system pump (2) from the torque converter. Wire the pump.
26. Unscrew bolts (1, Fig. 12. 10) securing engine brackets to frame on both sides of the engine.
27. Install an engine lifting attachment to engine lifting brackets (8, Fig. 12.5).

NOTE: *Engine flywheel housing is critically close to the equalizer bar tunnel. For this reason it is hard to dismount torque converter off engine. We recommend dismounting the engine complete with the torque converter.*

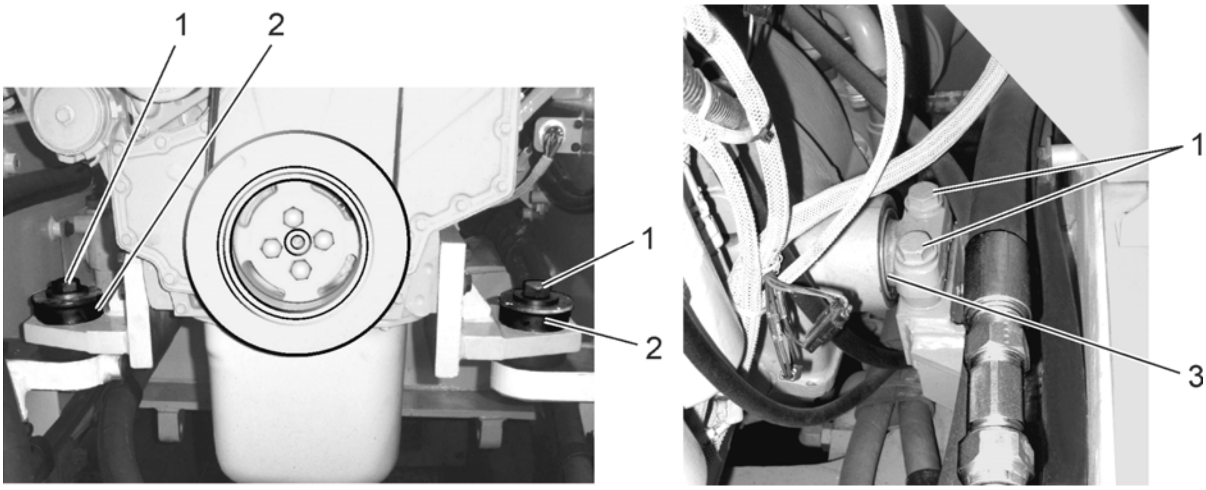


Fig. 12.10. Front and Rear Engine Brackets

1. Bolts
2. Shock Absorber
3. Silentblock

NOTE: *Whenever possible, a load adjusting sling should be used to remove the engine. With an adjusting sling, engine can be tilted or leveled as required, reducing job time, effort and hazard.*

WARNING! The wet weight of QSC engine with torque converter is 800 [kg]. The engine lifting equipment must be designed to safely lift the engine.

28. Raise engine with torque converter up (approximately 10 [cm]. Make a visual inspection around engine to be sure that all disconnects required for engine removal have been made. Guide the engine with torque converter forward. Then lift and turn assy round vertical axis until torque converter is outside of machine frame.
29. Position engine into the suitable engine support stand.

NOTE: *After engine is removed from machine, it should be placed on a prepared block frame support.*

30. Install the hoist to the torque converter. Remove bolts securing torque converter to the flywheel housing and separate it.

6. ENGINE REPAIR

For detailed information pertaining to maintenance or engine repair, refer to the Engine Operation and Maintenance Manual QSC8.3 and QSL9 Engine, Bulletin No 4021518; Troubleshooting and Repair Manual ISC, ISC^e, QSC8.3, ISL, and QSL9 Engines, Bulletin 4021418 and Troubleshooting and Repair Manual ISB, ISBe4, QSB4.5, QSB5.9, QSB6.7, ISC, QSC8.3, ISL, SLe3 and QSL9 Engines, CM 850 Electronic Control System, Bulletin No.4021416.

7. INSTALLATION

1. Install new seal ring in the torque converter housing groove.

IMPORTANT: *Whenever a seal ring is required at a disconnected line, it is recommended that a new seal ring be installed.*

2. Install the hoist to the torque converter. Lift and guide the torque converter into position until torque converter housing properly seated in flywheel housing. Install bolts securing torque converter to the flywheel housing.

IMPORTANT: *As converter housing enters flywheel housing, be sure seal ring is properly seated in groove of converter housing.*

NOTE: If gear of the converter does not seat in to engine flywheel, use tool P/N 3824591 to turn the crankshaft of engine until the torque converter gear properly meshes in the flywheel.

NOTE: *Check engine suspension parts, shock absorber (2, Fig. 12.10) and silentblock (3), replace for a new one if cracked or worn before engine mounting.*

3. Install an engine lifting attachment to the engine lifting brackets (8, Fig. 12.5). Hoist the engine assy above frame, lower and guide the assy into position. Before lowering the engine on the brackets, introduce the bolts (1, Fig. 12.10) securing assembly into the threaded holes of the brackets. Torque front and rear engine mounting bolts. Disassemble the engine lifting attachment.

WARNING! The wet weight of QSC engine with torque converter is 800 [kg]. The engine lifting equipment must be designed to safely lift the engine.

4. Use a new gasket and reinstall drive train system pump (2, Fig. 12.9) to the torque converter with the bolts.
5. Reinstall torque converter inlet hose (1).
6. Use a new gasket and reinstall hydraulic system pump (5) to the torque converter with the bolts.
7. Use a new gasket and reinstall fan drive system pump (3) to the torque converter with the bolts.
8. Reconnect the wire harness plug (4) to the fan drive system pump solenoid.
9. Reinstall torque converter vent hose (6).

10 Reinstall tubes (6, Fig. 12.8) to the hydraulic system pump with flange splits.

11. Reinstall drive shaft (1) to the torque converter output flange with the bolts.

12. Reinstall torque converter drain hose (5) to the flywheel housing.
13. Reinstall torque converter outlet hose (4).
14. Reconnect wires to the temperature sensor (2 and 3).
15. Reconnect the harness connectors (1 and 3, Fig. 12.7). Secure harness with the clip.
16. Reconnect the engine control potentiometer wire harness connector (2). Install the plate on the fender.
17. Reconnect the wire connector to the air cleaner warning light switch (1, Fig. 12.1).
18. Reinstall fuel supply hose (5, Fig. 12.6) and return hose (4) to the fuel filter head.
19. Reconnect the engine speed sensor connector (6).
20. MACHINES EQUIPPED WITH AIR CONDITIONER: Reassemble A/C system compressor (2) to the bracket with the bolts (1). Connect the magnetic clutch wire connector (3). Reinstall the belt and adjust correct belt tension. Refer to Operators Manual.
21. Reinstall cab heater supply hose (2, Fig. 12. 5) and return hose (6) to their valves.
22. Reinstall positive (+) and ground (-) cables (3 and 4) to the cranking motor terminals.
23. Reconnect the engine wire harness connectors (1 and 7). Install harness with the clips (5) to the frame.
24. Reassemble engine radiator as described in section 6 COOLING SYSTEM.
25. Open the valve under the fuel tank and refill the hydraulic oil reservoir with the oil. Check the drive train oil level. Refer to Operators Manual.
26. Turn the electrical master switch to the „ON" position.
27. Start the engine. Visually check all connections for leakage. Stop the engine, turn the master switch to "OFF" position. Check coolant level, drive train oil level and hydraulic reservoir oil level. Refer to Operator's Manual.
28. Install floor plate in the cab.
29. Working under machine, install transmission case guard. Use lifting device for lifting heavy guards

WARNING! This procedure requires extreme caution. Use suitable blocking equipment while working under confines of machine.

30. If necessary perform engine control system adjustments as described in Par. 4, CONTROL ADJUSTMENTS.

SECTION 13

SUPERSTRUCTURE

SUPERSTRUCTURE

CONTENTS

GENERAL

1. DESCRIPTION

The TD-20M Extra dozer is equipped with 6-sided, 2-door cab symmetrically located on the machine. The cab is installed to the shock absorber mounted platform, separated from the engine compartment to reduce noise. The platform is supported in four points to the crossbeam assembly and front bar mounted to the main frame.
The operator's compartment is fully protected by structure ROPS and cab FOPS (the structure protecting against rolling over of machine and falling rocks).
The cab and ROPS are easy removable for transport if required.

2. SPECIFICATION

Special Torque Data:
Main Harness Connector Nut to Platform . . . . 0.7 [Nm]
Battery Terminals . . . . 31 [Nm]
Master Switch Mounting Nut . . . . 51 [Nm]
Cab to Platform Mounting Bolts. . . . . 80 [Nm]
ROPS Mounting Bolts . . . . 920 [Nm]

(Torques given are for bolts and nuts lubricated with SAE-30 engine oil.)

NOTE: *Except for the special torques shown, all bolts and nuts are to be given a standard torque. Refer to the „STANDARD TORQUE DATA CHART" in Section 1, „GENERAL".*

3. CAB REMOVAL

1. Position machine in place which makes it possible to use a lifting device for lifting of disassembled assembles.
2. Turn electrical master switch to "OFF" position.

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train control lever is locked in neutral position and parking brake is set. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

3. Use lifting device to remove the ROPS structure. Unscrew the bolts them (1, Fig. 13.1) securing ROPS to the crossbeam assembly (five bolts on each side) and remove.
4. Remove Quick couplings cover and disconnect quick couplings (2, Fig. 13.1) of A/C system, protect them against dirt.
5. Remove the armrest, rear, left and right plastic shields in the cab.
6. Disconnect electrical connectors for two cables (1 and 2, Fig. 13.2), supply (+) and ground (-) of the cab electrical system.
7. Disconnect heater control potentiometer wire harness plug (3) and A/C heater switch wire harness plug (5).
8. Disconnect cab head lamps wire harness plug (4) and ROPS lamps plug (6).

NOTE: *Disconnected electrical harnesses plugs must be protected against dirt, oil, grease and water.*

9. Secure instrument panel (7) with wire harness to the cab.

SUPERSTRUCTURE

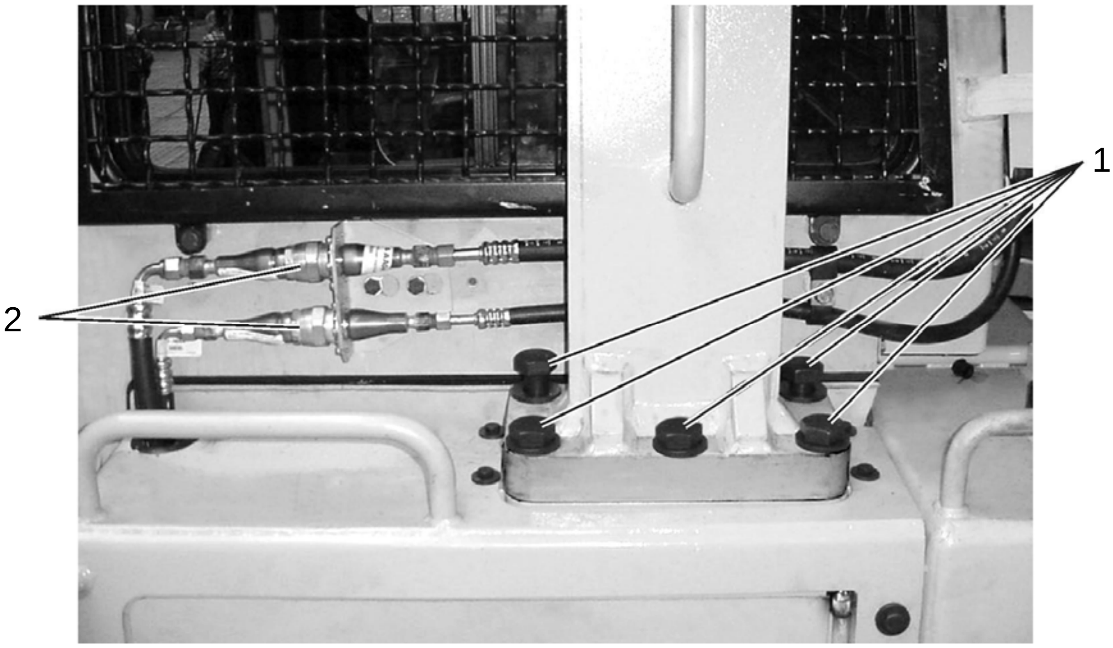


Fig. 13.1. A/C System Condenser and ROPS Disconnecting Points (LH side)

1. Bolts
2. A/C System Quick Couplings

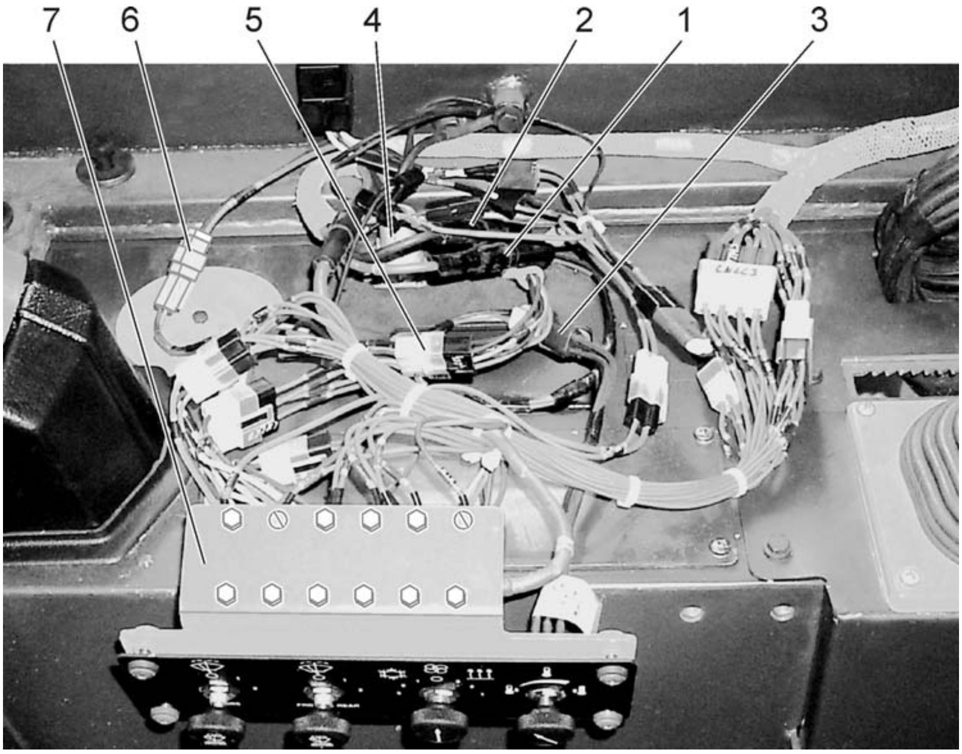


Fig. 13.2. Control Panel Disconnecting Points

1. Supply Cable (+)
2. Ground Cable (-)
3. Heater Control Potentiometer Plug
4. Front and Rear Lamps Plug
5. A/C Heater Control Switch Plug
6. ROPS Lamps Plug
7. Control Panel

10. Remove floor plate (2, Fig. 13.6) and disconnect hoses from the wipers washer tanks (1, Fig. 13.4). Remove hoses up thru platform hole and attach them to the cab.
11. Attach the hoist to the cab lifting points (2, Fig. 13.3).
12. Unscrew front bolts (1, Fig. 13.3) at both sides of the cab and rear bolts (3) securing cab to the platform. Lift and remove the cab. Position cab assy in prepared stand, protect cab seal gasket (5) against damage.

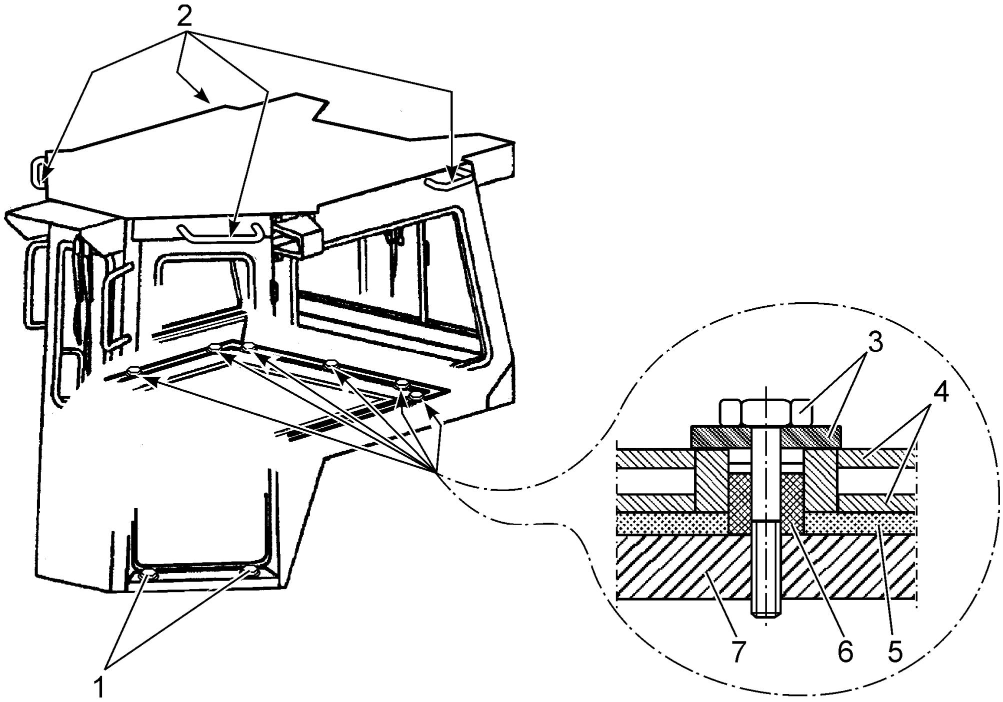


Fig. 13.3. Cab Mounting Points to Pod Assy

1. Front Bolts
2. Cab Lifting Points
3. Bolts with Washers
4. Cab Element
5. Seal Gasket
6. Threaded Sleeve
7. Pod

4. POD REMOVAL

1. Remove the operator's seat.
2. Remove R.H. console cover (4, Fig. 13.6), unscrew the bolts securing the blade control pilot valve (5) and ripper control pilot valve (7) to the mounting plate. Pull the valves down.
3. Pull the horn push button (6) down.
4. Disconnect brake control cable (2, Fig. 13.4). Remove brake control cable from the bracket under pod.
5. Remove plate on the LH fender. Disconnect wire harness plug (3, Fig. 13.4) of the engine control potentiometer.
6. Remove the plate from instrument panel column and disconnect electrical connectors for two cables (4, Fig. 13.7) of the instrument panel supply. Disconnect wire harness plugs (2). Unscrew the nut and remove one socket down from the platform hole.
7. Remove the transmission pressure filters cover and L.H. console cover plate in order to gain access to the hydraulic connections of drive train control valve (1, Fig. 13.5), pilot lock valve (5) and switching valve (7).

NOTE: *Remove the transmission filters bracket bolts and swing filters assy out to the to gain easier access to the hydraulic and electrical connections in L.H. console.*

8. Tag and remove the hoses (6, Fig. 13.5) from the pilot lock valve (5) and switching valve (7).

NOTE: *When disconnecting hydraulic lines for any reason, they should be properly capped with correct size plastic cap. If these caps are not available, tape or clean rubber corks may be used. Hydraulic openings must never be plugged with rags. This practice could easily introduce dirt or lint into critical hydraulic components of machine. Tag all disconnect oil lines to facilitate installation.*

9. Tag and remove the hoses (2, 3 and 4) from the drive train control valve. Remove the frame on the bottom of console. Pool the hoses down from console.

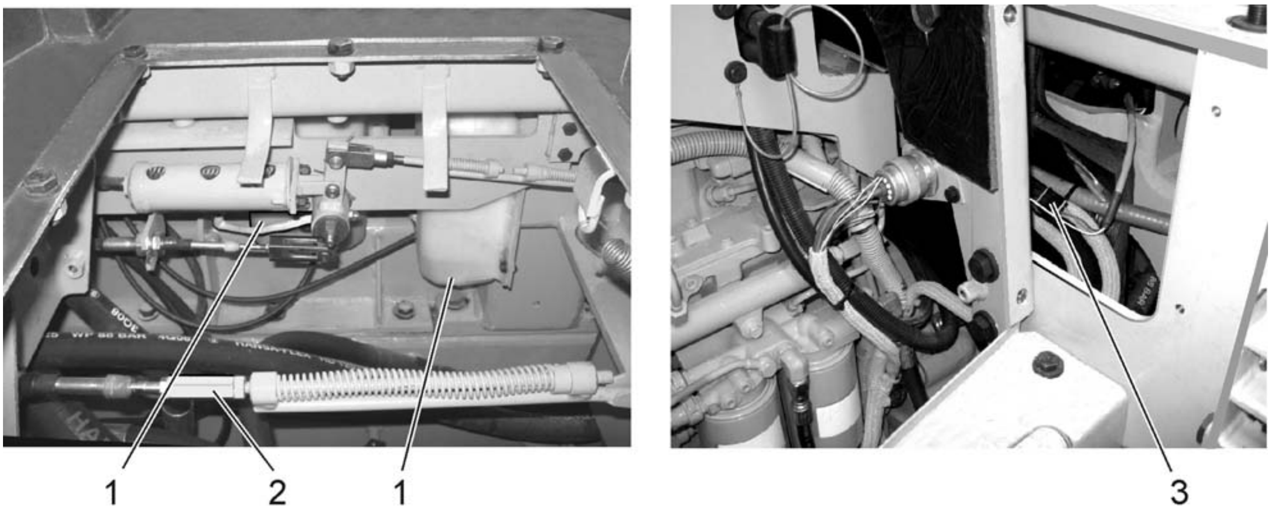


Fig. 13.4. Disassemble Points Under the Pod

1. Wiper Washer Tanks
2. Brake Control Cable
3. Engine Control Potentiometer Wire Harness Plug

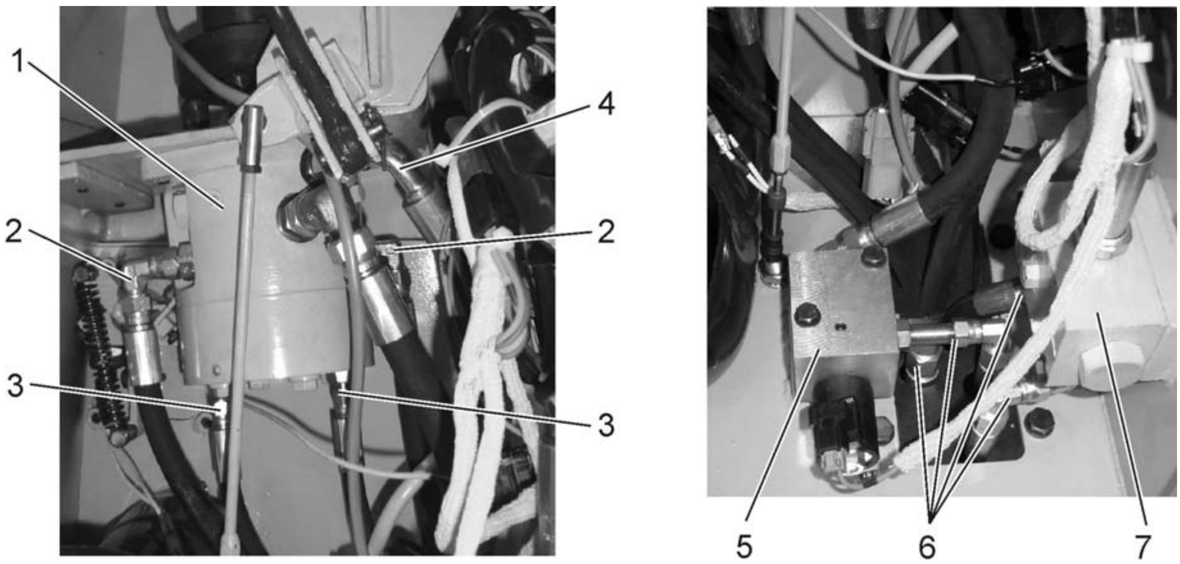


Fig. 13.5. Lock Valve and Control Valve Disconnecting Points (LH console)

1. Drive Train Control Valve
2. Hoses (steering control)
3. Hoses (forward – rear)
4. Hose (Drain)
5. Pilot Lock Valve
6. Hydraulic Hoses
7. Switching Valve

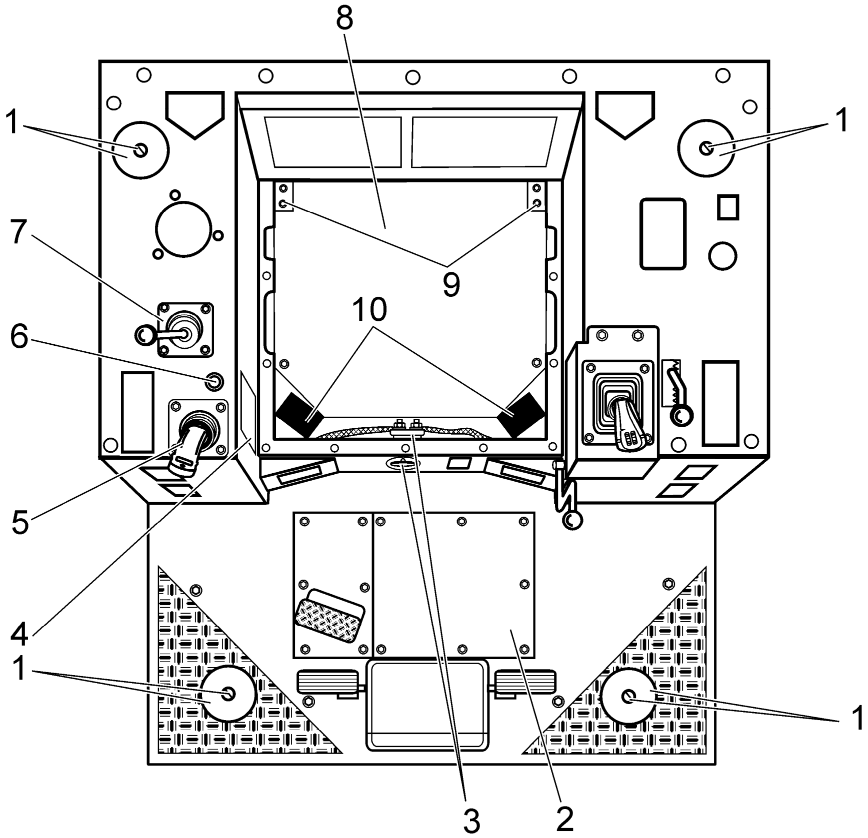
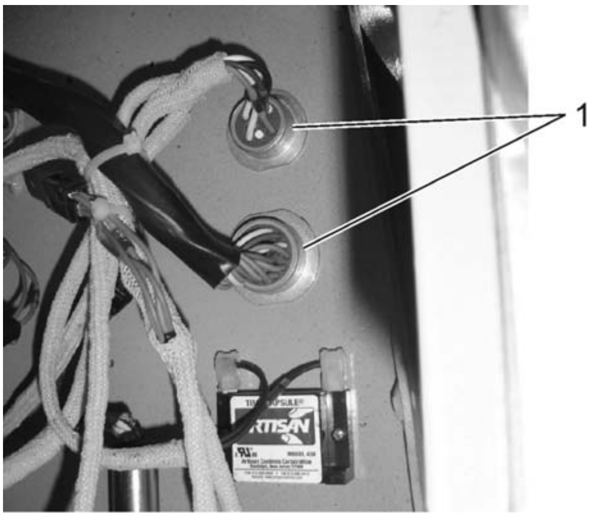


Fig. 13.6. Pod Assy Disassembly Points

1. Bolt and Plate
2. Floor Plate
3. Master Switch
4. R.H. Console Cover
5. Blade Control Pilot Valve
6. Horn Push Button
7. Ripper Control Pilot Valve
8. A/C Heater Assy
9. Conditioner Mounting Hardware
10. Air Hoses



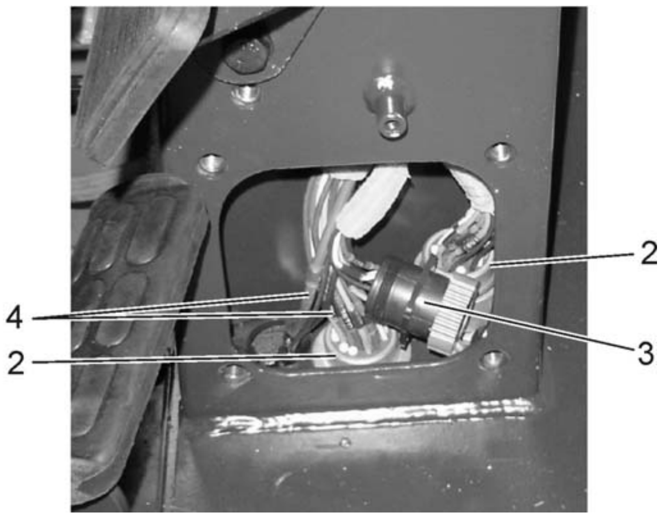


Fig. 13.7. LH Console and Instrument Panel Column Electrical Connections

1. Wire Harness Sockets
2. Wire Harness Plugs
3. Engine Data Link Connector
4. Instrument Panel Supply and Ground Cables

10. Remove wire harness plugs from the sockets (1, Fig. 13.7).

11. Remove the A/C heater compartment cover. Disconnect air conditioner hoses (10, Fig. 13.6), Disassembly mounting hardware (9), turn and carefully lower conditioner (8) down. Do not remove the hoses of the air conditioner (evaporator). Removing the hoses causes gas escape out the A/C system.
12. Disconnect ground (-) cable from the battery. Remove master switch (3) with cables.
13. Disassemble bolt and plate (1) covering the platform mounting bolts. Remove platform mounting bolts (4, Fig. 13.8) and plate (3). Attach the hoist and lift pod. Make a visual inspection around the pod to be sure that all disconnects required for pod removal have been made.
14. Raise the pod enough to separate the frame. Place the platform on suitable support stand.
15. Protect the air conditioner assy (8) against damage.
16. Disassemble bolt and nut (7, Fig. 13.8), rubber shock absorber (1) and plate (2) if necessary.

5. INSPECTION

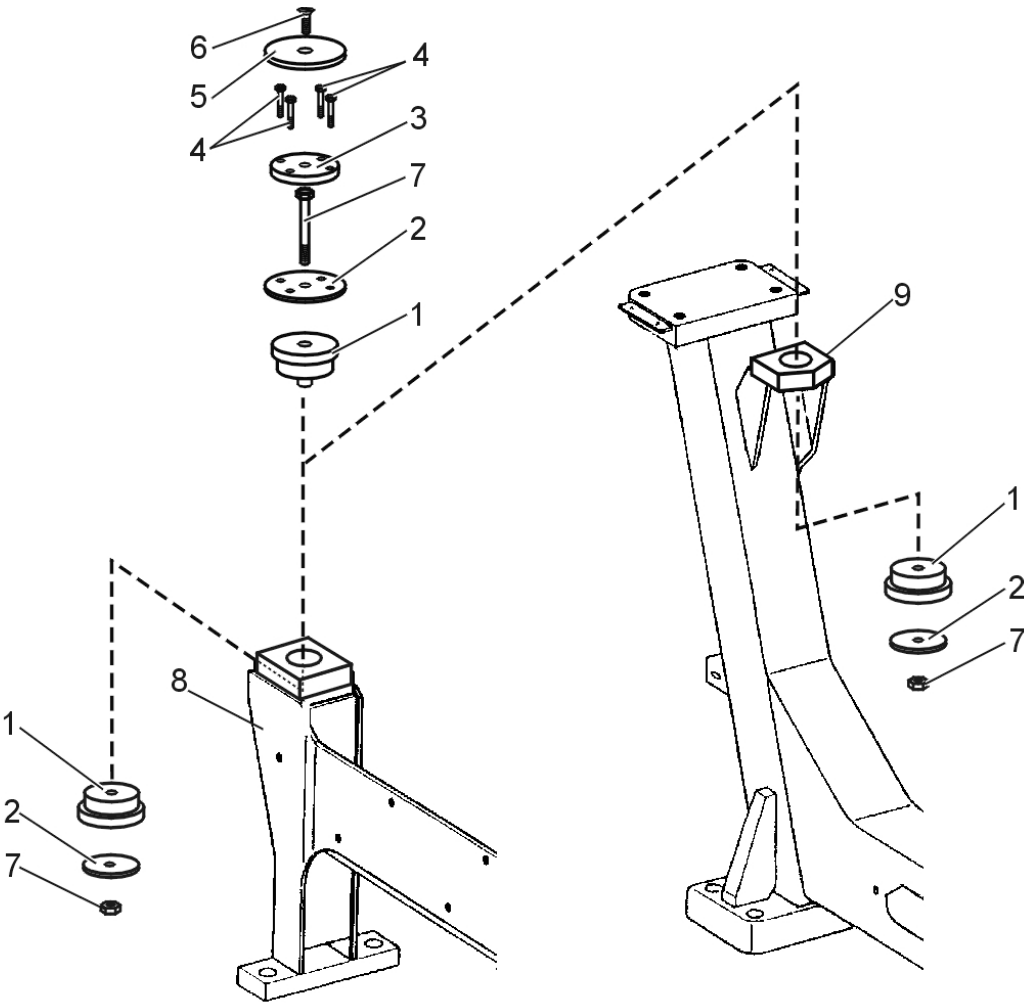


Fig. 13.8. Front and Rear Support of Platform

1. Rubber Shock Absorber
2. Plate
3. Plate
4. Bolts
5. Cover Plate
6. Bolt
7. Bolt and Nut
8. Front Bracket
9. Rear Bracket

1. Check the ROPS structure and cab for cracks.
2. Check and complete the lacking insulation's elements of cab and pod.
3. Check and replace if necessary rubber shock absorber of the pod.
4. Inspect the electrical harness for damage and repair if necessary.
5. Inspect, repair or replace all control system elements (links, cables, springs, levers and connections) if damaged.

6. POD REASSEMBLY

1. Reassembly rubber shock absorber (1, Fig. 13.8) and plates (2) with bolt and nut (7) to the front (8) and rear (9) brackets of pod.
2. Raise the pod and carefully put on the brackets.
3. Install plate (3, Fig. 13.8) and bolts (4). Assemble cover plate (5) with bolt (6).
4. Install master switch (3, Fig. 13.6) with cables, torque nut to 51 [Nm]. Reconnect negative (-) cable to the battery. Torque nut to 31 [Nm].
5. Lift up air conditioner heater assy (8), reassemble mounting hardware (9) and air conditioner hoses (10). Reassemble A/C heater compartment cover.
6. Reinstall the frame with the hoses on the bottom of console. Reinstall the hoses (2, 3 and 4, Fig. 13.5) to the drive train control valve.
7. Reinstall the hoses (6) to pilot lock valve (5) and switching valve (7).
8. Reinstall wire harness plugs to the sockets (1, Fig. 13.7).
9. Reinstall one wire harness socket in the platform hole, torque the nuts to 0.7 [Nm]. Reconnect wire harness plugs (2). Reconnect electrical connectors for two cables (4) of the instrument panel supply. Install the plate.
10. Reconnect wire harness plug (4, Fig. 13.4) of the engine control potentiometer. Install the plate on fender.
11. Reinstall brake control cable to the bracket under pod. Reconnect brake control cable (3).
12. Pull the horn push button (6, Fig. 13.6) up.
13. Pull the valves up. Install the bolts securing the blade control pilot valve (5) and ripper control pilot valve (7) to the mounting plate. Install R.H. console cover (4, Fig. 13.6).
14. Install the operator's seat.

7. CAB REASSEMBLY

1. Attach the hoist to the cab lifting points (2, Fig. 13.3), position the cab on the platform. Install bolts (1) (on both sides of the cab) and hand tighten. Turn back the threaded sleeve (6) at mounting points (3), so there is no contact with the platform surface. Torque bolts (1) to 80 [Nm] at both sides of the cab.
2. Screw in threaded sleeve (6) until it comes to contact with the pod surface. Install the bolts with washers (3) and torque to 80 [Nm]. Check the seal gasket (5) between the cab (4) and pod (7) for defects in spots where dust could penetrate inside the cab.

NOTE: *Sequence of cab to platform securing bolts torquing described in points 1and 2 is to be followed strictly. Any change in torquing procedure may lead to cab stress and deformation.*

3. Reconnect A/C system quick couplings (2, Fig. 13.1), install the couplings cover.
4. Thread wipers hoses down thru hole in the platform and reconnect hoses to the wipers washer tanks (1, Fig. 13.4).
5. Reconnect cab head lamps wire harness plug (4, Fig. 13.2) and ROPS lamps plug (6).
6. Reconnect heater control potentiometer wire harness plug (3) and A/C heater switch wire harness plug (5).
7. Reconnect electrical connectors for two cables (1 and 2), supply (+) and ground (-) of the cab electrical system.
8. Install left, right and rear plastic shields in the cab. Install the armrest.
9. Position ROPS structure. Install the bolts (1, Fig. 13.1) securing ROPS to the crossbeam assembly (five bolts on each side) and torque them to 920 [Nm].
10. Turn electrical master switch to „ON" position. Start the engine. Refer to Operator's Manual. Check for leaks disconnected previously hydraulic lines of drive train control valve (1, Fig. 13.5) pilot lock valve (4) and switching valve (7). Stop the engine.
11. Install console cover plate and transmission pressure filters cover.
12. Install floor plate (2, Fig. 13.6) in the cab.

SECTION 14

SUSPENSION

SUSPENSION

CONTENTS

SERVICE/SPECIAL TOOLS

GENERAL

FRONT IDLER

HYDRAULIC TRACK ADJUSTER

TRACK TOP IDLER

TRACK ROLLER

SUSPENSION

TRACK FRAME GUIDE

EQUALIZER BAR

TRACK FRAME

PIVOT SHAFT

TRACK SPRING

TRACK FRAME ALIGNMENT

METAL TYPE FACE SEALS

SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS

All service (purchased) and special (fabricated) tools shown in this manual are included in the following list. Special tools are to be locally fabricated using the illustrations shown in this manual.

DESCRIPTION	TOOL NUMBER
Undercarriage Components Measurement Kit.	910-50-0200
Pivot Shaft Seal Tool (Ring)	1.547.0177
Pivot Shaft Seal Tool (Sleeve)	1.559.0231
Pivot Shaft Aligning Tool	Fig. 14.A
Pivot Shaft Removing Tool.	Fig.'s 14.B to 14.F

SERVICE/SPECIAL TOOLS

PIVOT SHAFT ALIGNING TOOL

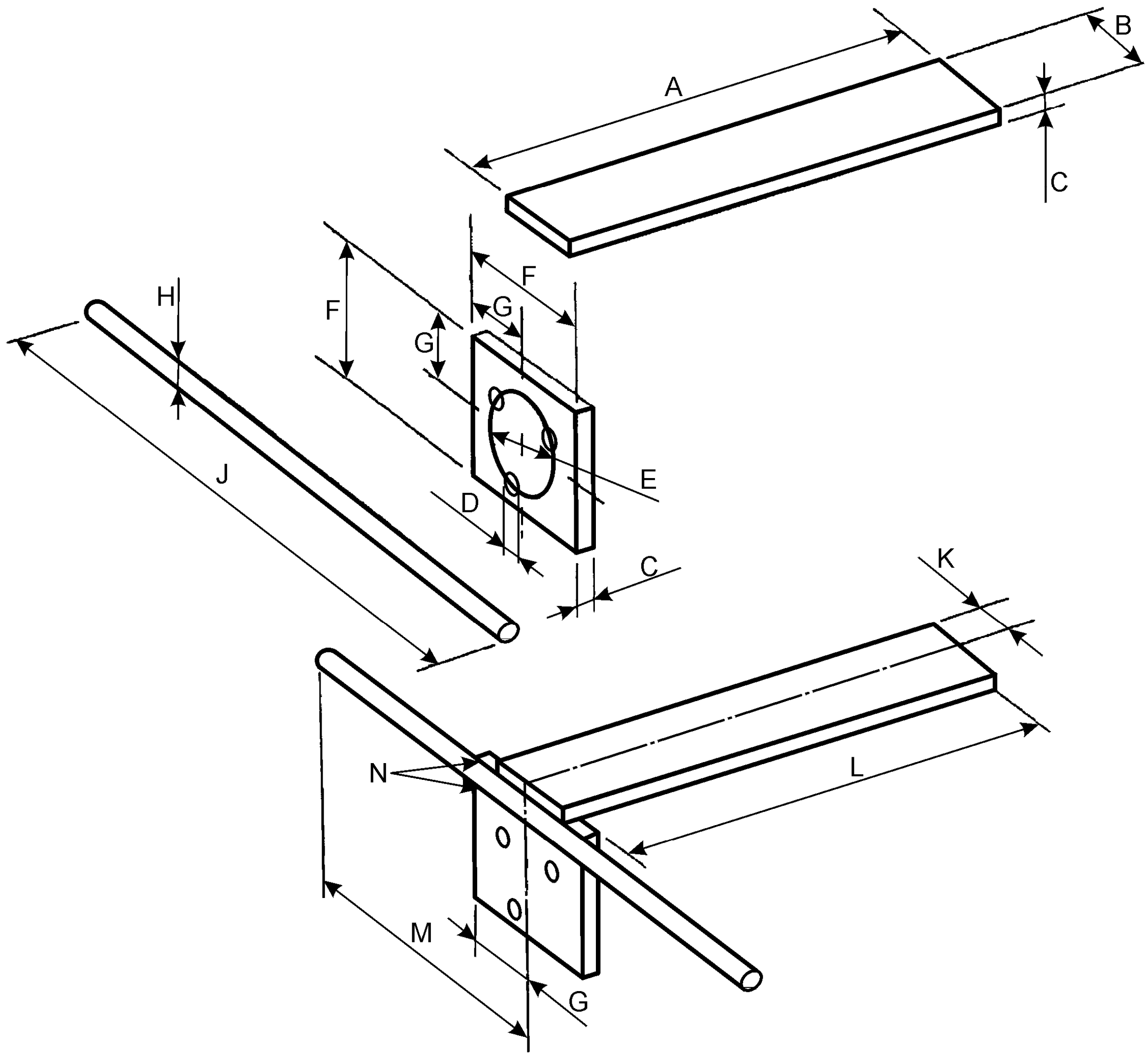


Fig. 14.A. Pivot Shaft Aligning Tool

A . . . . 432 [mm]
B . . . . 76 [mm]
C . . . . 13 [mm]
D . . . . ∅ 19 [mm] (drill 3 holes equally spaced)
E . . . . ∅ 70 [mm] (bolt center)
F . . . . 127 [mm]
G . . . . 63.5 [mm]
H . . . . ∅ 16 [mm]
J . . . . 508 [mm]
K . . . . 38 [mm]
L . . . . 418 [mm]
M . . . . 254 [mm]
N . . . . weld
Material . . . . 4140 H.T.

SERVICE/SPECIAL TOOLS

PIVOT SHAFT REMOVING TOOL

Pivot Shaft Removing Tool Assembled

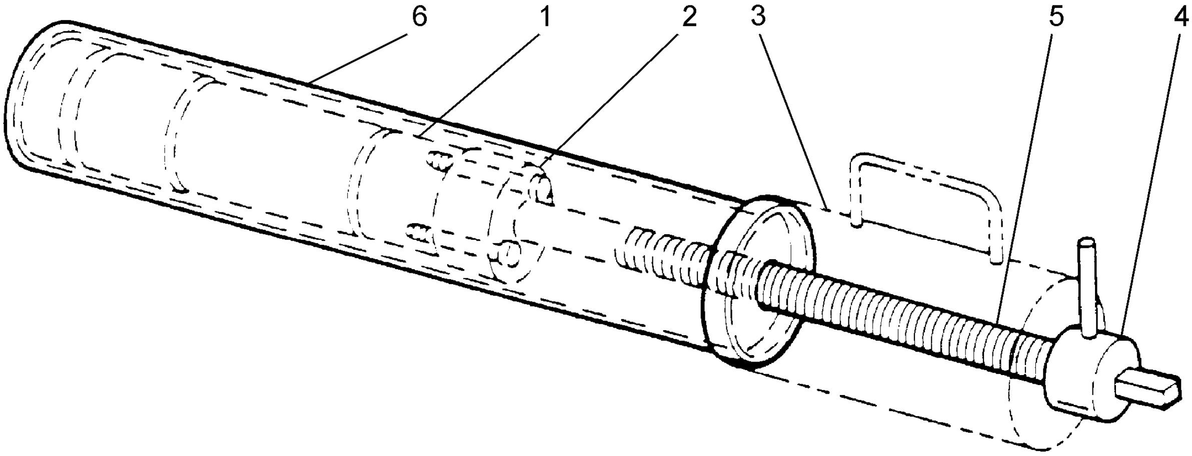


Fig. 14.B. Pivot Shaft Removing Tool Assembled

1. Pivot Shaft
2. Adapter
3. Hydraulic Ram - 100 ton
4. Speed Nut
5. Ram Screw
6. Tube Assembly

Tube Assembly

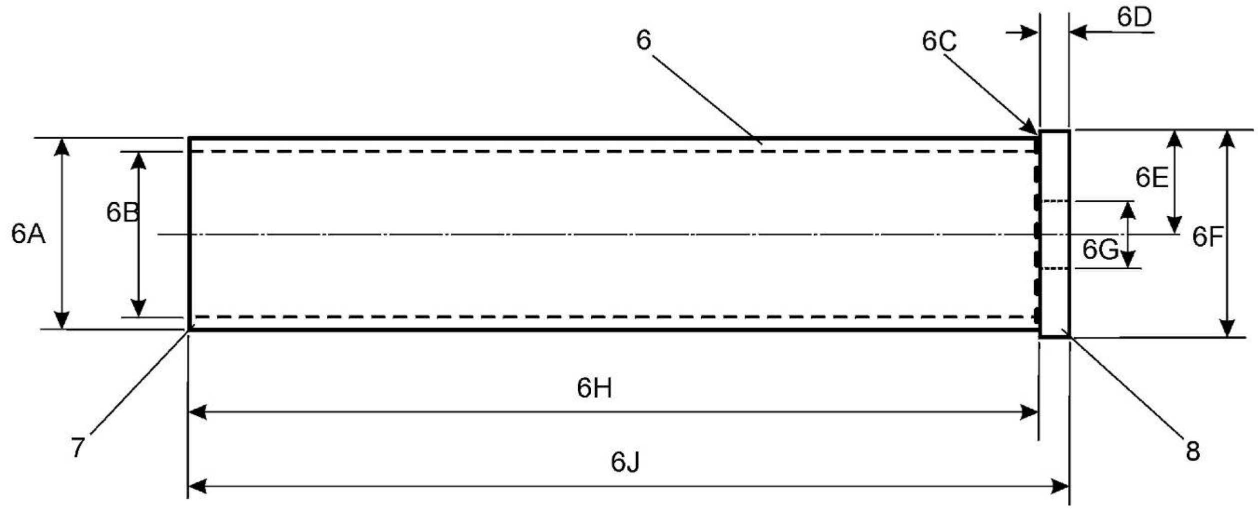


Fig. 14.C. Tube Assembly

6. Tube Assembly
7. Seamless Steel Tubing
8. Material - Cold Rolled Steel

6A . . . . ∅ 158.8 [mm]
6B . . . . ∅ 139.7 [mm]
6C . . . . weld
6D . . . . 19 [mm]
6E . . . . 82.5 [mm]
6F . . . . ∅ 165 [mm]
6G . . . . hole thru ∅ 50.8 [mm]
6H . . . . 673 [mm]
6J . . . . 692 [mm]

SERVICE/SPECIAL TOOLS

Ram Screw

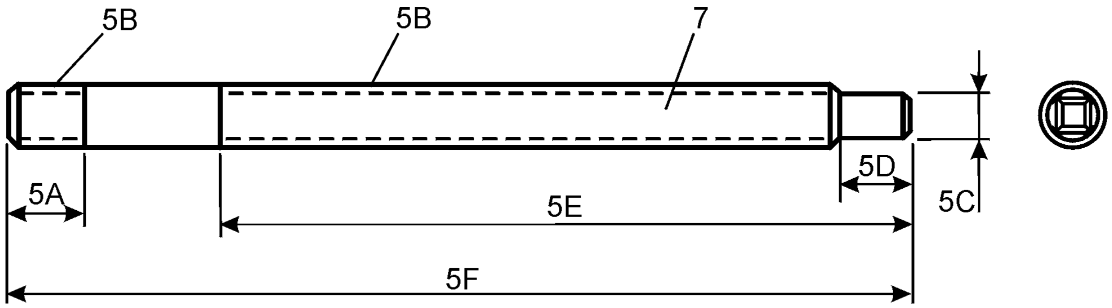


Fig. 14.D. Ram Screw

7. Ram Screw

5A	50.8 [mm]
5B	1 5/8" - 5 1/2 thd.
5C	25.8 [mm]
5D	50.8 [mm]
5E	518 [mm]
5F	695 [mm]
Material	Cold Rolled Steel

Speed Nut

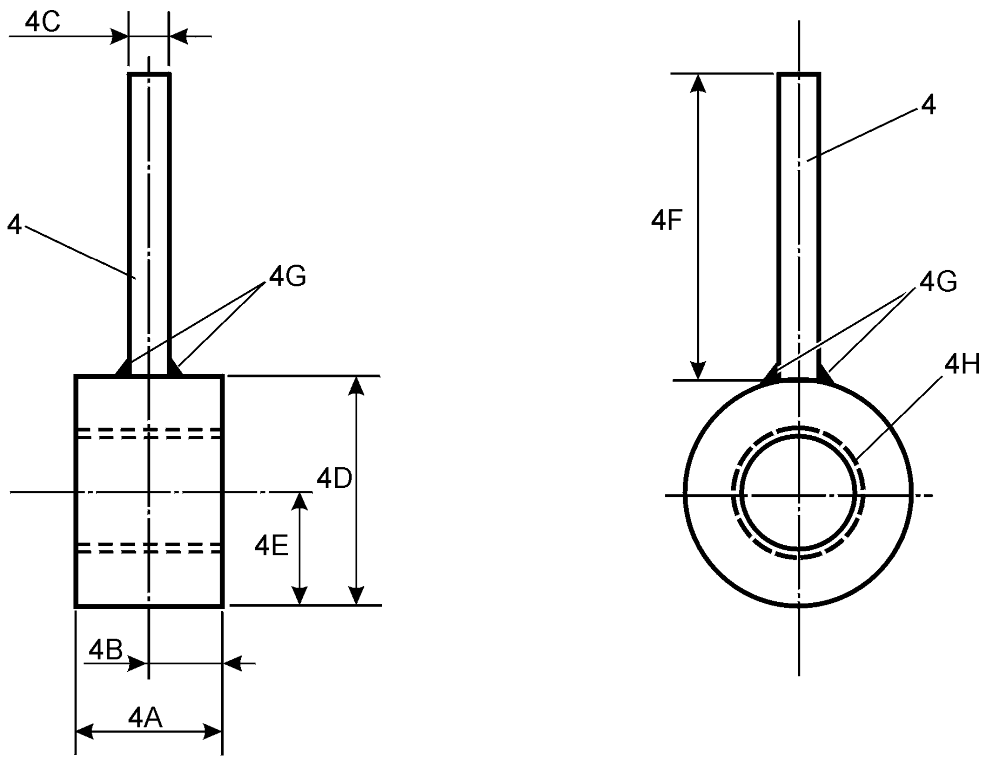


Fig. 14.E. Speed Nut

SERVICE/SPECIAL TOOLS

Legend for Fig. 14.E.

4. Speed Nut

4A . . . . 50.8 [mm]
4B . . . . 25.4 [mm]
4C . . . . ∅ 13 [mm]
4D . . . . ∅ 76.2 [mm]
4E . . . . 38.1 [mm]
4F . . . . 101.6 [mm]
4G . . . . weld
4H . . . . 1 5/8” - 5 1/2 thd.
Material . . . . Cold Rolled Steel

Adapter

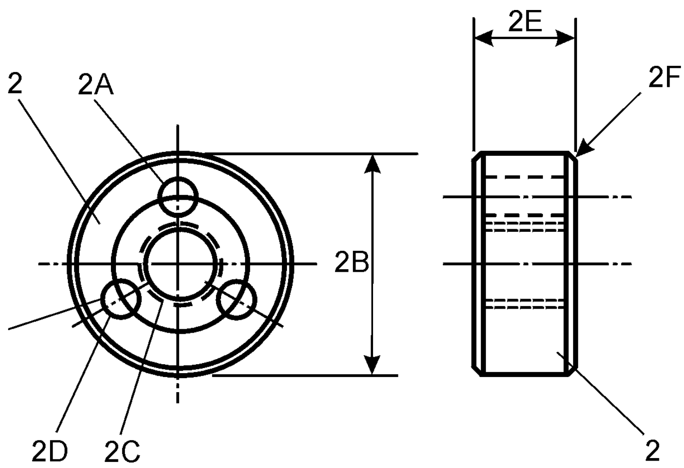


Fig. 14.F. Adapter

2. Adapter

2A . . . . ∅ 70 [mm] (bolt center)
2B . . . . ∅ 114.3 [mm]
2C . . . . 1 5/8” - 5 1/2 tap (thread must be sq. w/faces)
2D . . . . 3/4” - 16 x 3 1/2” (for socked hd cap screw)
2E . . . . 50.8 [mm]
2F . . . . 1.5 x 45° (both sides)
Material . . . . Steel SAE No. 4140

SUSPENSION

GENERAL

2. DESCRIPTION

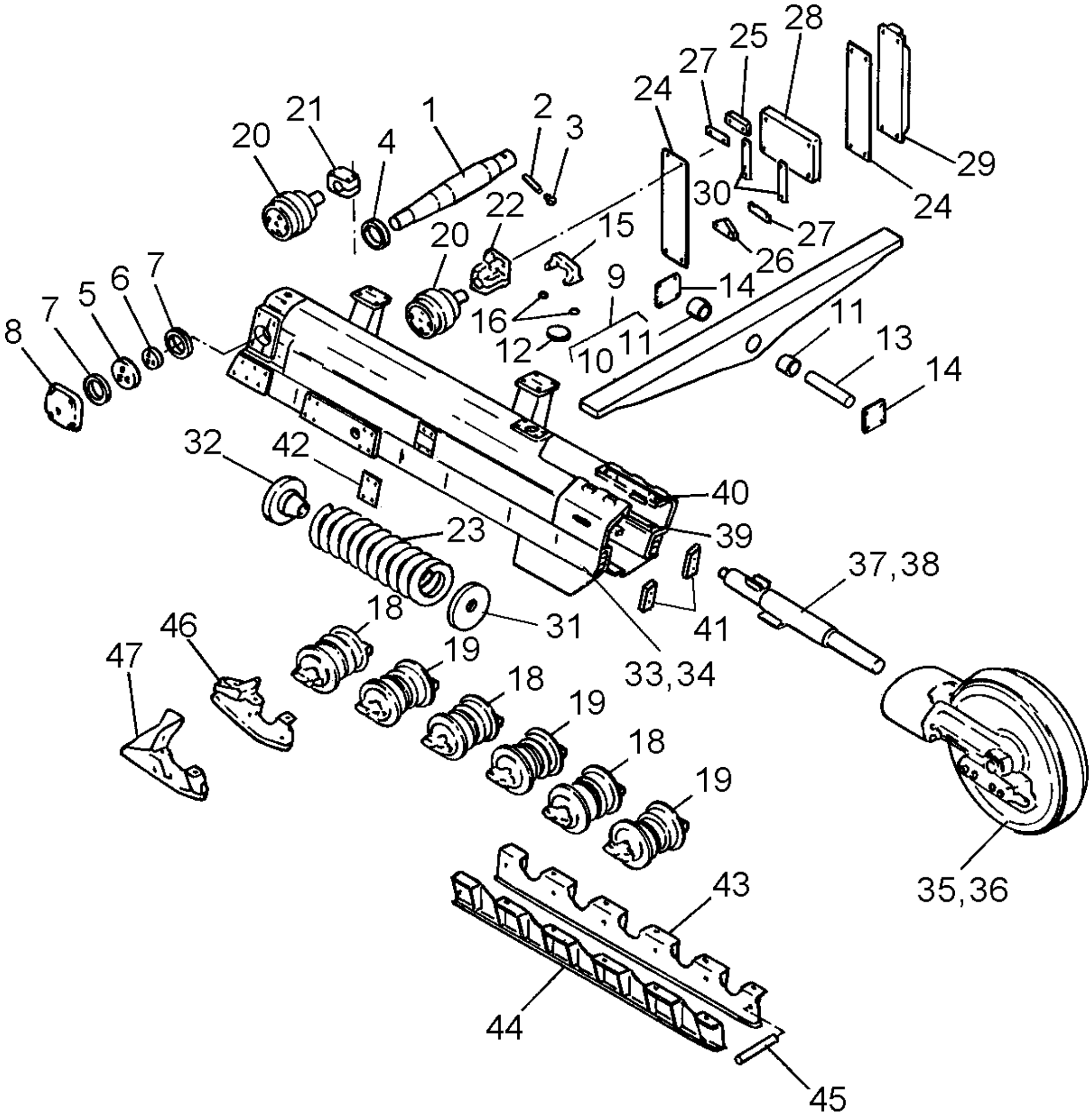


Fig. 14.1. Exploded View of Track Assembly (STD)

1. Pivot Shaft
2. Pivot Shaft Lock Pin
3. Pin Lock Plug
4. Pivot Shaft Seal
5. Thrust Plate
6. Shim
7. Wear Washer
8. Pivot Shaft Cover
9. Equalizer Bar Assembly
10. Equalizer Bar
11. Equalizer Bar Bushing
12. Wear Pad
13. Pivot Pin
14. Retainer Plate
15. Rebound Bracket
16. Shim
18. Double Flange Track Roller
19. Single Flange Track Roller
20. Track Top Idler
21. Rear Idler Mounting Block
22. Front Idler Mounting Block
23. Track Spring
24. Wear Plate
25. Upper Guide Wear Spacer
26. Lower Guide Wear Spacer
27. Track Frame Guide Shim
28. Guide Wear Plate
29. Outer Guide Plate
30. Guide Plate Shim
31. Track Spring Front Seat
32. Track Spring Rear Seat
33. Left Track Frame
34. Right Track Frame
35. Right Front Idler
36. Left Front Idler
37. Left Track Adjuster
38. Right Track Adjuster
39. Lower Guide Bar Assy
40. Upper Guide Bar Assy
41. Front Idler Dirt Shield
42. Cover
43. Left Track Roller Shield
44. Right Track Roller Shield
45. Spacer Sleeve
46. Left Deflector
47. Right Deflector

GENERAL

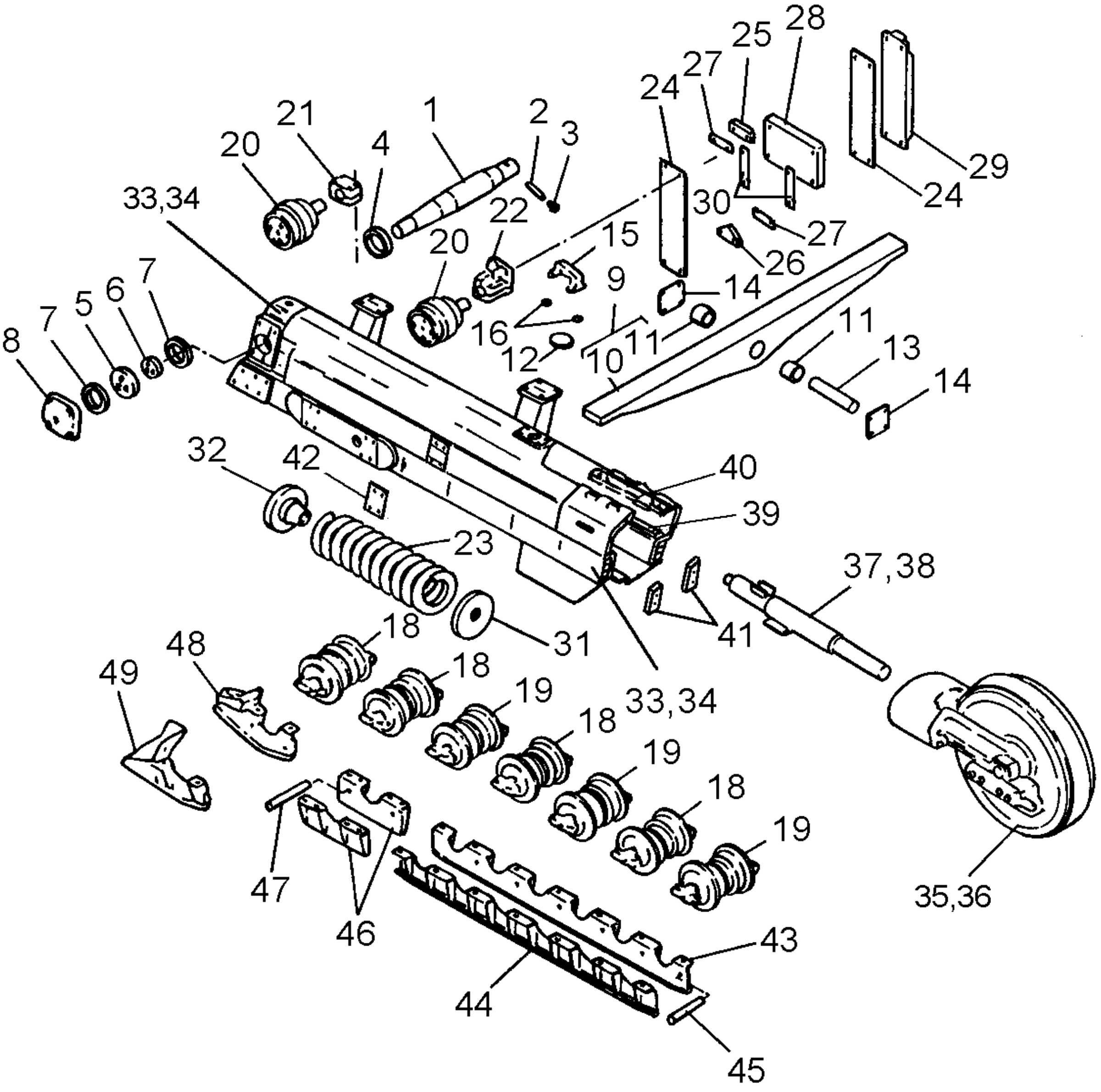


Fig. 14.2. Exploded View of Track Assembly (LGP, LT)

1. Pivot Shaft
2. Pivot Shaft Lock Pin
3. Pin Lock Plug
4. Pivot Shaft Seal
5. Thrust Plate
6. Shim
7. Wear Washer
8. Pivot Shaft Cover
9. Equalizer Bar Assembly
10. Equalizer Bar
11. Equalizer Bar Bushing
12. Wear Pad
13. Pivot Pin
14. Retainer Plate
15. Rebound Bracket
16. Shim
18. Double Flange Track Roller
19. Single Flange Track Roller
20. Track Top Idler
21. Rear Idler Mounting Block
22. Front Idler Mounting Block
23. Track Spring
24. Wear Plate
25. Upper Guide Wear Spacer
26. Lower Guide Wear Spacer
27. Track Frame Guide Shim
28. Guide Wear Plate
29. Outer Guide Plate
30. Guide Plate Shim
31. Track Spring Front Seat
32. Track Spring Rear Seat
33. Left Track Frame
34. Right Track Frame
35. Right Front Idler
36. Left Front Idler
37. Left Track Adjuster
38. Right Track Adjuster
39. Lower Guide Bar Assy
40. Upper Guide Bar Assy
41. Front Idler Dirt Shield
42. Cover
43. Left Track Roller Shield
44. Right Track Roller Shield
45. Spacer Sleeve
46. Track Chain Guide Assy
47. Spacer Sleeve
48. Left Deflector
49. Right Deflector

SUSPENSION

GENERAL

The track frame assembly consists of a sturdy one-piece track frame of heavy steel construction. Each standard track frame has six track roller attached to it. Each long track or low ground pressure frame has seven track rollers attached to it. The track top idlers on both sides are mounted in brackets and bolted to the track frame. The track frame coil springs is provided in each track for tensioning the track. This type of track spring permits the front idlers to recoil under shock loads, exert no tension on the track in normal operation position. Track frames are mounted on each side of the dozer, and they support the weight of the dozer on the track rollers.

The track frames are mounted at the main frame both side of machine. A guide bracket is welded to the frame to provide proper spacing between the two tracks. The track frames are attached at the rear of the dozer to the pivot shafts. Each track is free to oscillate vertically independently of the other track. The equalizer bar contacts both sides of the track frame.

The sprockets pull the track chain around the track rollers, up and over the top idlers and the front idlers. The front idlers are attached to the front idler forks located between the two channels of the track frames. The front idlers slide back and forth on the track frame to take up shock loads.
The front idlers are also adjustable backward and forward for the purpose of adjusting the track chain tension.

3. SPECIFICATIONS

Front Idler

Front idler housing flange height . . . . 23.3 [mm]
Front idler maximum permissible housing flange height . . . . 33 [mm]
Front idler wear bar thickness . . . . 22.2 [mm]
Front idler bore . . . . 111.2 [mm]
Distance bushing pressed into front idler . . . . 7.4 ± 0.3 [mm]
Bushing ID (assembled in idler) . . . . 105.3 ± 0.1 [mm]

Top Idler

Idler rolling diameter
(rolling diameter is diameter at point of contact with track chain) . . . . 190.5 [mm]
Maximum permissible wear of rolling diameter . . . . 12.7 [mm]

Track Roller

Track roller rolling diameter
(rolling diameter is diameter at point of contact with track chain) . . . . 228.6 [mm]
Maximum permissible wear of track roller rolling diameter . . . . 25.2 [mm]

Track Frame Guide

Wear plate thickness . . . . 6.3 [mm]
Guide plate thickness . . . . 50.7 ± 0.1 [mm]

Equalizer bar

Wear pad thickness . . . . 20.4 [mm]
Bushing ID (assembled in bar) . . . . 76.7 ± 0.1 [mm]
Equalizer bar and rebound bracket clearance . . . . 8.5 ± 1 [mm]

GENERAL

Track Frame

Outer pivot shaft bushing ID
Assembled in frame . . . . 101.75 ± 0.1 [mm]
Inner pivot shaft bushing ID
Assembled in frame . . . . 120.8 ± 0.1 [mm]
Pivot shaft wear plate thickness . . . . 22.1 ± 0.1 [mm]
Pivot shaft thrust washer thickness . . . . 3.16 ± 0.14 [mm]
Inner bushing surface diameter . . . . 120.5 ± 0.05 [mm]
Outer bushing surface diameter . . . . 101.45 ± 0.05 [mm]

Track Spring

Free length . . . . 823 [mm]
Test length . . . . 717.55 ± 1.27 [mm]
Test load . . . . 22700 [kg] ± 10 %
Number of coils 10.5

Special Nut and Bolt Torque Data
(Torques given are for bolts and nuts lubricated with SAE-30 engine oil)

NOTE: *Except for the special torques shown all bolts and nuts are to be given a standard torque. Refer to SECTION 1.*

Front Idler

Seal retainer bolts . . . . 134 [Nm]
Fork bolts . . . . 455 [Nm]
Lubrication plug . . . . 21 - 55 [Nm]

Top Idler

Idler shaft bolts in slide block . . . . 730 [Nm]
Lubrication plug . . . . 21 - 55 [Nm]

Track Roller

Seal thrust cover bolts . . . . 134 [Nm]
Roller shaft bracket bolts . . . . 455 [Nm]
Sprocket rock deflector's bolts . . . . 455 [Nm]
Shield bolts . . . . 455 [Nm]
Lubrication plug . . . . 21 - 55 [Nm]

Track Frame Guide

All mounting bolts . . . . 1110 [Nm]

Equalizer bar

Bracket bolts . . . . 455 [Nm]
Pivot retainer plate bolts . . . . 265 [Nm]

GENERAL

4. SERVICE DIAGNOSIS

COMPLAINT	
PROBABLE CAUSE	REMARKS
Track Chain Comes Off During Operation	
1. Track chain loose	Adjust track tension.
2. Rock in track assembly	Clean out the tracks.
3. Front idler worn	Inspect front idler for wear. Replace if necessary.
4. Front idler misaligned	Correct alignment of the front idler.
Tractor Creeps to One Side	
1. Track loose on one side	Adjust the track chain tension.
2. Track shoes loose	Tighten bolts to proper torque.
Track Chain Loose	
1. Track not properly adjusted	Adjust the track tension.
2. Sprocket worn	Inspect sprocket for worn teeth or damage. If wear is excessive, replace the sprocket rim.
3. Track links or bushings worn	Inspect track links and bushings for wear or damage. Replace any damaged parts if necessary.
Excessive or Uneven Wear of Track, Track Rollers, Track Idlers, Front Idler and Sprocket	
1. Improper track tension	Adjust the track tension.
2. Damaged sprocket	Replace the sprocket carrier or rim halves as necessary.
3. Front idler misaligned	Correct alignment of front idler.
4. Track rollers do not turn	Internal seizure. Remove and replace defective parts.
5. Track idler does not turn	Internal seizure. Remove and replace defective parts.
Lubricant Leakage	
1. Leakage at track roller	Remove track roller and repair.
2. Leakage at track idler	Remove, inspect and replace defective parts.
3. Leakage at front idler	Remove the front idler, and make necessary repairs.
Front Idler Does Not Turn	
1. Insufficient lubrication	Use correct amount of lubricant.
2. Mud packed around idler	Remove the mud.
Top Idlers Do Not Turn	
1. Insufficient lubrication	Use correct amount of lubricant.
2. Mud packed against idler	Remove the mud.
3. Internal seizure	Remove, inspect, clean and replace if necessary.

GENERAL

COMPLAINT	
PROBABLE CAUSE	REMARKS
Track Rollers Do Not Turn	
1. Work in mud conditions with roller shield	Remove shield.
2. Insufficient lubrication	Use correct amount of lubricant.
3. Bushings seized	Remove faulty roller and replace bushing.
4. Packed dirt between roller and track frame	Remove packed dirt and check lubrication of roller.
Machine Loses Power	
1. Track chains too tight	Adjust track chains. Tight track chains will cause machine to lose up to 75 percent of horsepower.
Track Shoe Bolts Break	
1. Bolts not properly tightened	Tighten bolts to proper torque.
2. Bolt head snap off	Track shoes out-of-flat. Replace track shoes.

5. CHECKING UNDERCARRIAGE WEAR

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

Undercarriage components have a certain dimension when new. As wear occurs the dimension will decrease (or increase in the case of track pitch and front idler flange height) until a decision must be made whether to rebuild or recondition components, replace them or run them to destruction. The 100% dimension is the dimension of the component when an new. The 0% dimension is the point at which either maintenance must take place or the components run to destruction. Before inspecting an undercarriage, the track tension on both sides must be tightened. To do this, blocks of wood or metal should be placed in the sprocket tooth under the track chain as shown in Fig. 14.3. The machine should then be moved backward so the sprocket can grab the block and tighten the chain. This pulls the chain tight and up off the top idler.

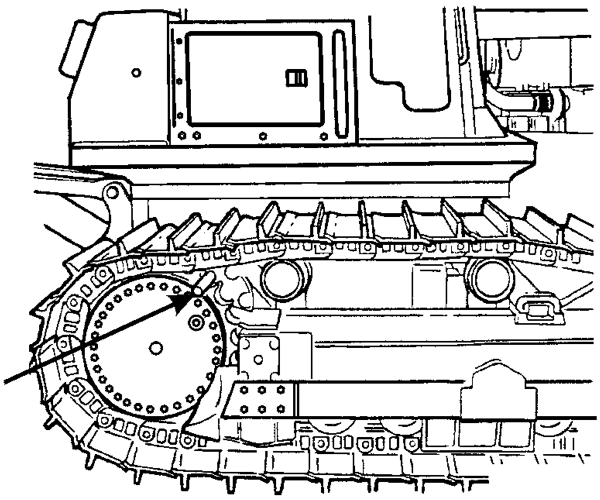


Fig. 14.3. Tightening Track Chain

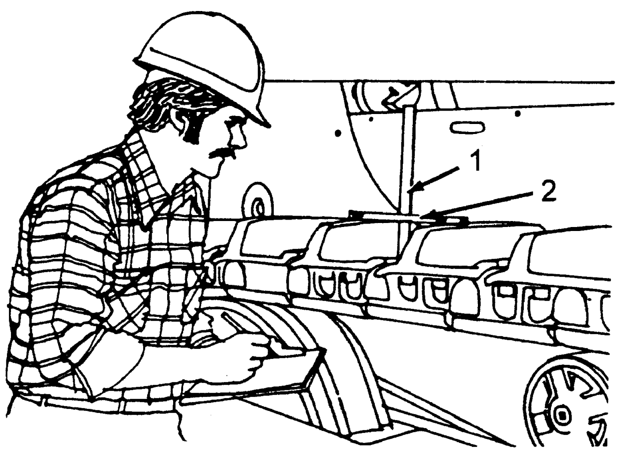


Fig. 14.4. Measuring Grouser Height

GENERAL

Track shoe grouser height (Fig. 14.4)

Clean off all materials on shoe plate and grouser tops. Lay squeeze bar (2) across grousers approximately 1/4 of way in from end of shoe. Insert about 300 [mm] scale (1) in squeeze bar so that scale is against top of track plate and take a reading. Measure two or more shoes to get an average and compare with dimensions given, refer to SPECIFICATIONS in SECTION 15.

Link height (Fig. 14.5)

Clean out all materials between links. Place squeeze bar (1) across center of links. Insert about 300 [mm] scale (2) in squeeze bar so that scale is against bottom of track shoe plate and take a reading. Measure two or more place along chain to get an average and compare with dimensions given, refer to SPECIFICATIONS in SECTION 15.

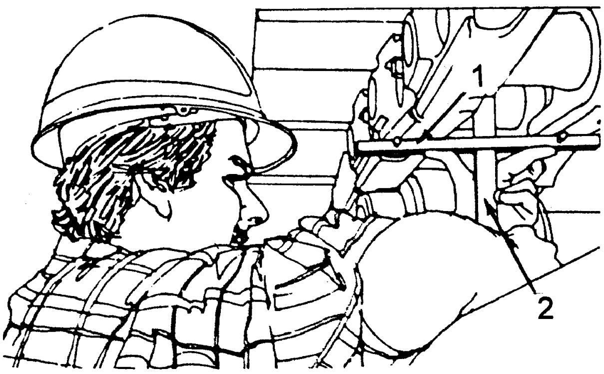


Fig. 14.5. Measuring Link Height

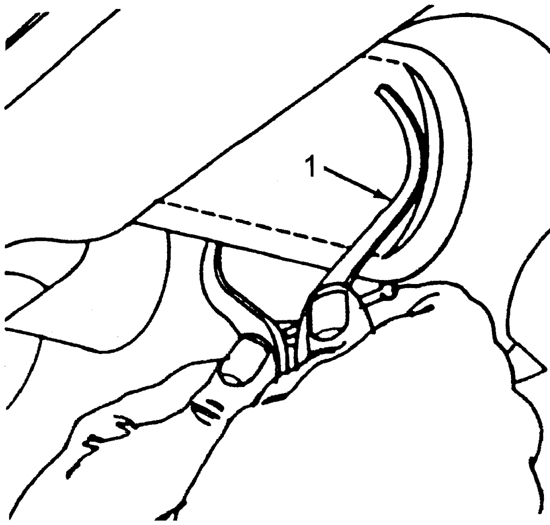


Fig. 14.6. Measuring Bushing OD

Bushing outside diameter (Fig. 14.6)

Close 100 [mm] outside caliper (1) around bushing with a minimum amount of drag, making certain that one of caliper tips is positioned in forward drive side wear area. Slide caliper off bushing and measure distance between caliper tips using about 300 [mm] scale. Repeat on the reverse drive side wear area. Measure two or more bushings to get an average and compare with dimensions given, refer to SPECIFICATIONS in SECTION 15. Whichever wear is greater, determines percentage of wear remaining.

Internal pin and bushing wear (pitch) (Fig. 14.7)

With track chain tight, place end of 3000 [mm] tape on front one track pin and measure length of four links to front of fifth track pin. Compare with dimensions given, refer to SPECIFICATIONS in SECTION 15.

Front idler flange height (Fig. 14.8)

Insert about 300 [mm] scale (1) in squeeze bar. Rest squeeze bar on top of flange and push scale down until it makes contact in middle of treat area as shown and take a reading. Compare with dimensions given, refer to SPECIFICATIONS in this Section.

GENERAL

Track roller rolling diameter (Fig. 14.9)

Place tips of 300 [mm] caliper (1) against tread area of roller. Adjust caliper so a slight drag is present when caliper is removed. Using about 300 [mm] scale (2) measure distance between caliper tips. Compare with dimensions given, refer to SPECIFICATIONS in this Section. Repeat steps on remaining rollers.

Fig. 14.7. Measuring Track Pitch

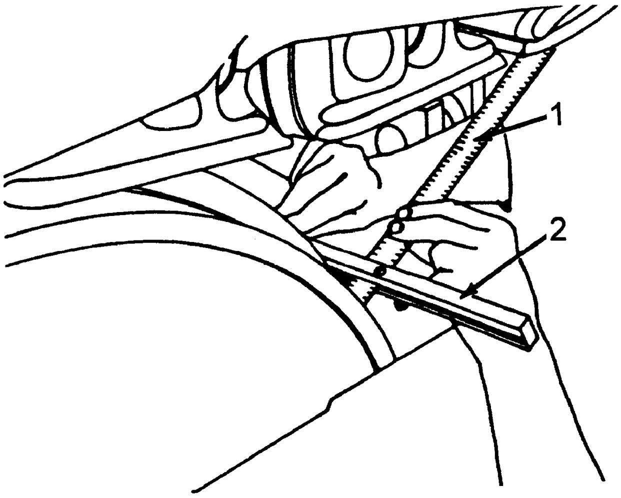


Fig. 14.8. Measuring Flange Height

Top idler rolling diameter (Fig. 14.10)

Place tips of 300 [mm] caliper (1) snugly around tread area of top idler and remove. Using about 300 [mm] scale, measure distance between caliper tips. Compare with dimensions given, refer to SPECIFICATIONS in this Section.

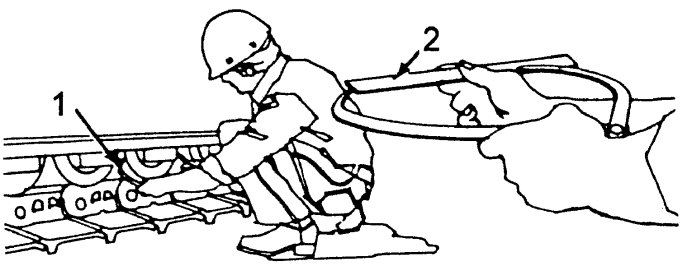


Fig. 14.9. Measuring Track Roller Rolling Diameter

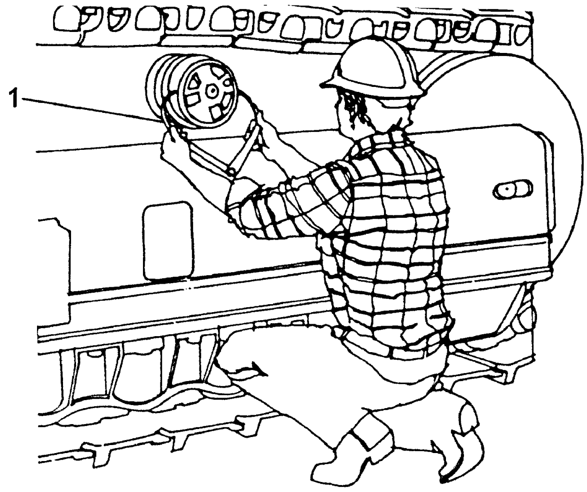


Fig. 14.10. Measuring Top Idler Rolling Diameter

FRONT IDLER

6. DESCRIPTION

The front idler provides a freely rotating, guiding support of the track chain. The idler is supported on replaceable wear bars which slide on the track frame channels. This sliding feature helps protect the track frame components by allowing the track spring to absorb shock loads. The idlers are heat-treated steel castings and rotate around bushing. The idlers are equipped with metal face-type seals which maintain a leak and dirt-proof seal.

7. REMOVAL

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

WARNING! Lift and handle all heavy parts with a lifting of proper capacity. Be sure parts are secured by proper slings and hook. Use lifting eyes if provided. Warn people in the area to stand clear.

1. Remove the track chain as described in SECTION 15. It is only necessary to lift chain free from front idler. Remove front idler covers (1, Fig. 14.11) from the track frame (2).
2. Be sure the relief valve (1, Fig. 14.12) is unscrewed one full turn to avoid entering a vacuum in the cylinder.
3. Attach a hoist to front idler and fork (5 and 1, Fig. 14.17A) and remove from track frame.

WARNING! After front idler and fork clears track frame, it will swing down. Stay clear or area.

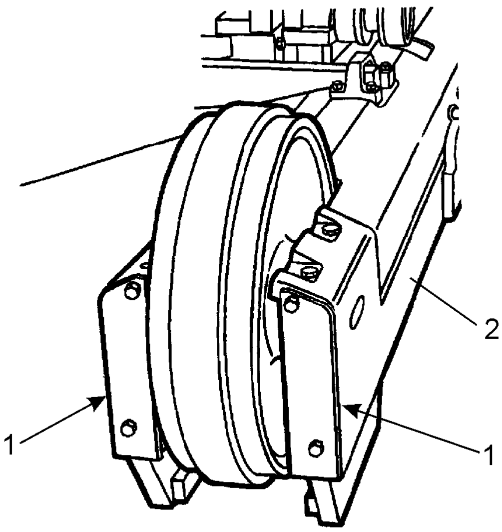


Fig. 14.11. Front Idler

1. Front Idler Covers
2. Track Frame

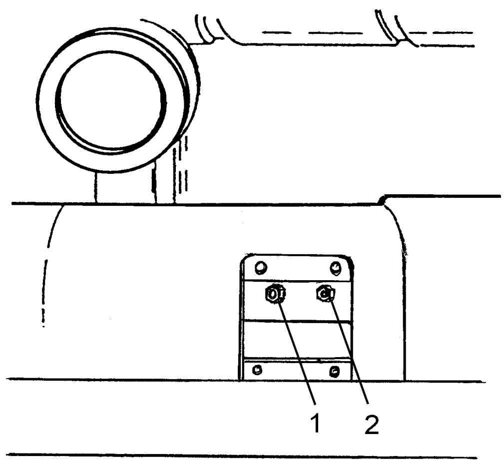


Fig. 14.12. Track Adjuster

1. Relief Valve
2. Lubrication Fitting (Check Valve)

FRONT IDLER

8. DISASSEMBLY (Refer to Fig. 14.13)

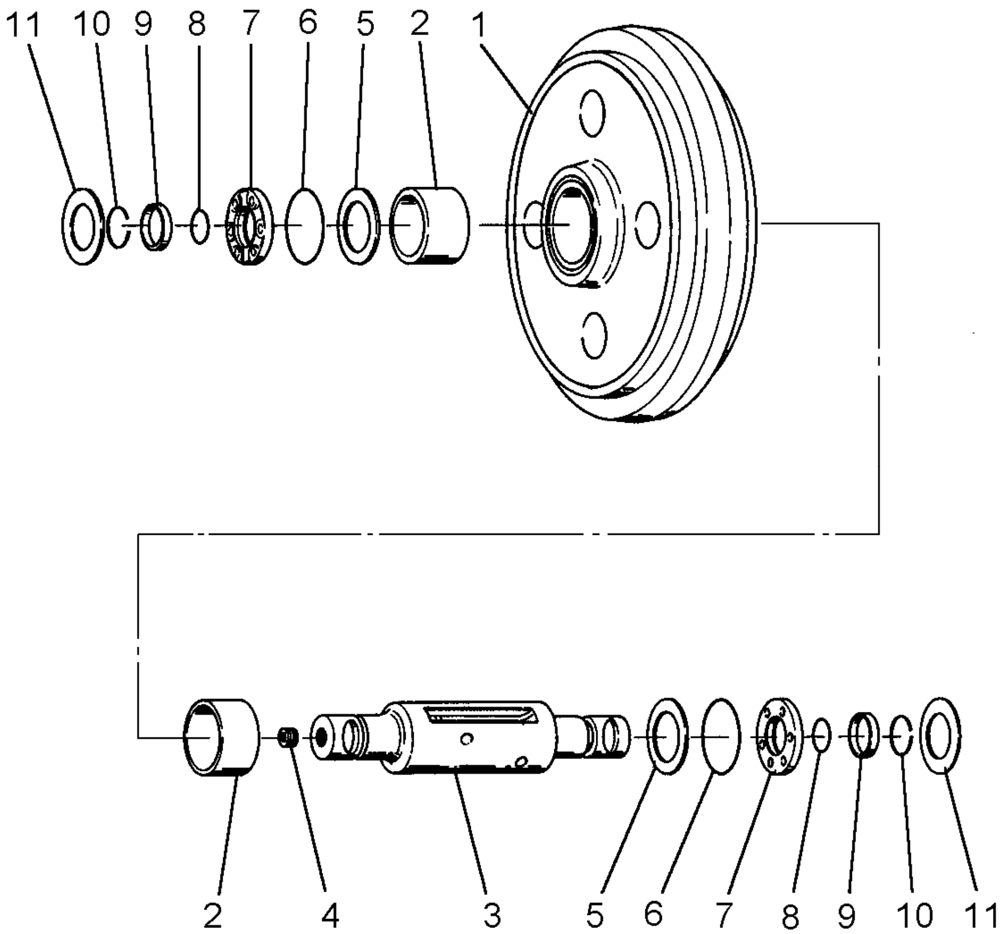


Fig. 14.13. Exploded View of Front Idler

1. Front Idler Housing
2. Bushing
3. Front Idler Shaft
4. Drain Plug
5. Thrust Washer
6. O-Ring
7. Seal Retainer
8. O-Ring
9. Seal Kit
10. Retaining Ring
11. Spacer Ring

1. Remove hardware and fork (1, Fig. 14.17A) from front idler (5, Fig. 14.17A). Remove clamp bolts from blocks (3 and 4, Fig. 14.17A). Using large pry bar, relief clamping tension on idler shaft. Remove the blocks. Remove the spring pin (2, Fig. 14.17A) from idler shaft.
2. Remove the plug (4) and drain oil from front idler. Remove the retaining ring (10) and slide spacer ring (11) with O-ring (8) off shaft. Remove seal kit half (9) from shaft (3). One half of the seal kit (9) will remain in seal retainer (7). Repeat this step for other side of idler. Remove remaining kit seal half from retainer and keep both halves (from each side) together.

NOTE: *Keep original mated metal rings as a set. Do not mix a metal ring from oil seal in one side of idler with one from oil seal on other side.*

3. Remove mounting hardware and seal retainer (7) with O-ring (6) from each side of idler. Remove washer (5). Position idler in press and remove shaft (3). Bushing (2) are a press fit in idler housing (1) and must not be removed unless replacement is necessary.

FRONT IDLER

9. INSPECTION AND REPAIR

1. It is recommended that new O-rings be installed whenever the front idler is disassembled for service.
2. Wash all parts thoroughly in a suitable solvent. Dry thoroughly with compressed air.
3. Inspect the idler shaft, bushing, washer and idler for cracks, scores or excessive wear.
4. Check the clearance limits given in Fig. 14.14.
5. Inspect the blocks and guide for distortion or excessive wear. Replace if necessary.
6. Whenever the front idlers is disassembled, the oil seal must be rebuilt or replaced. Refer to SEAL INSPECTION under METAL TYPE FACE SEALS in this Section.

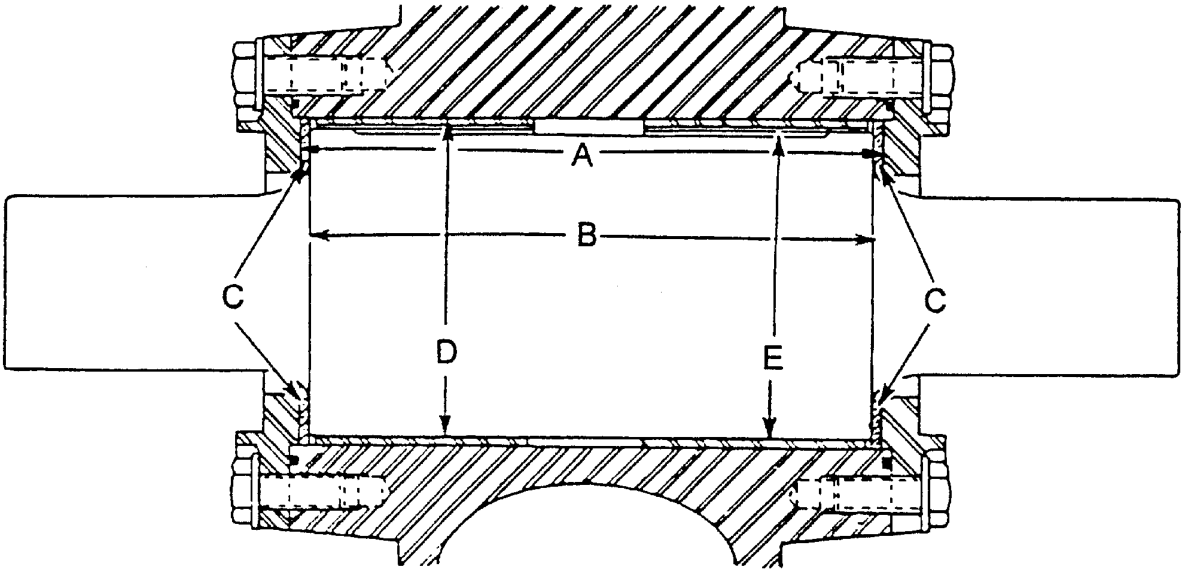


Fig. 14.14. Front Idler Bushing Clearances

A. Distance Between Seal Retainer Surfaces . . . . 201.65 ± 0.15 [mm]
B. Width of Idler Shaft Bushing Surface . . . . 194.8 ± 0.1 [mm]
C. Washer Thickness . . . . 3.15 ± 0.05 [mm]
D. Bushing Inside Diameter (assembled) . . . . 105.3 ± 0.1 [mm]
E. Idler Shaft Diameter . . . . 104.95 ± 0.05 [mm]
Diametral Clearance (D-E) . . . . 0.35 ± 0.15 [mm]
End Clearance A-(B+2C) . . . . 0.55 ± 0.35 [mm]

10. REASSEMBLY (Refer to Fig. 14.13)

1. If replacing bushings, coat 25 [mm] of outer end of idler bore and leading edges of bushing OD with LOCTITE #609. Press bushing in to depth as indicated in Fig. 14.15.
2. Place washer (5) in idler housing bore so it is flat against bushing. Apply a small amount of grease to O-ring (6) and install in groove in retainer (7). Secure retainer (7) to front idler housing (1) and torque bolts 134 [Nm].

FRONT IDLER

3. Turn assembly around and apply a thin coat of engine oil to inside of bushings. Insert shaft (3) in font idler housing. Repeat Step 2 on opposite side of front idler housing.

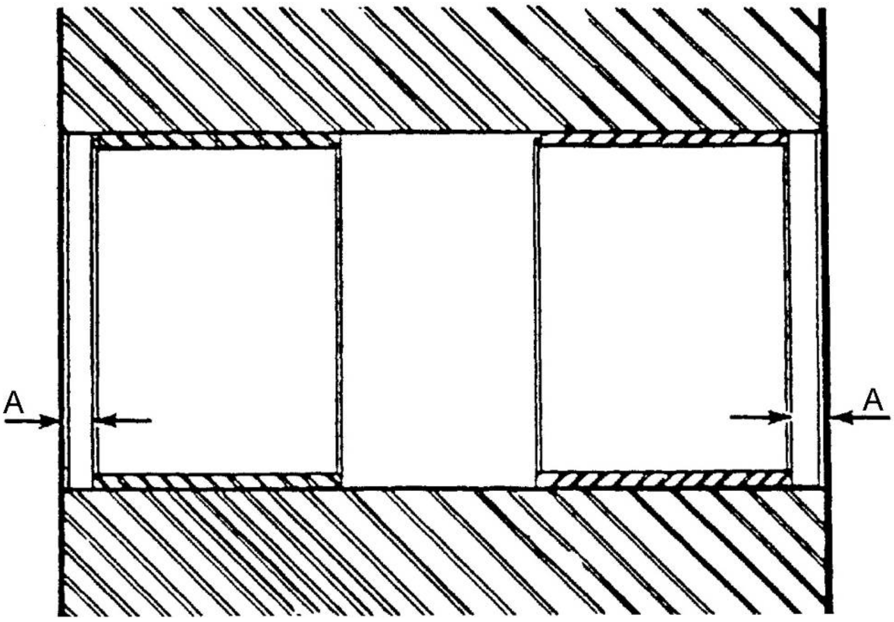


Fig. 14.15. Bushing Installation

A . . . . 7.4 ± 0.3 [mm]

4. Check that front idler end clearance is within tolerance given in Fig. 14.14. From side of roller dial indicator is to be mounted, push roller shaft into housing to be sure it is bottomed against washer. Place indicator base on idler housing with indicator pointer resting against end of the shaft (Fig. 14.16). Set the indicator at zero. Push shaft toward indicator until it bottoms and take a reading. If reading obtained is below specification, check measured surfaces (A, B, C, Fig. 14.14) for squareness. If above specifications, check parts for excessive wear.

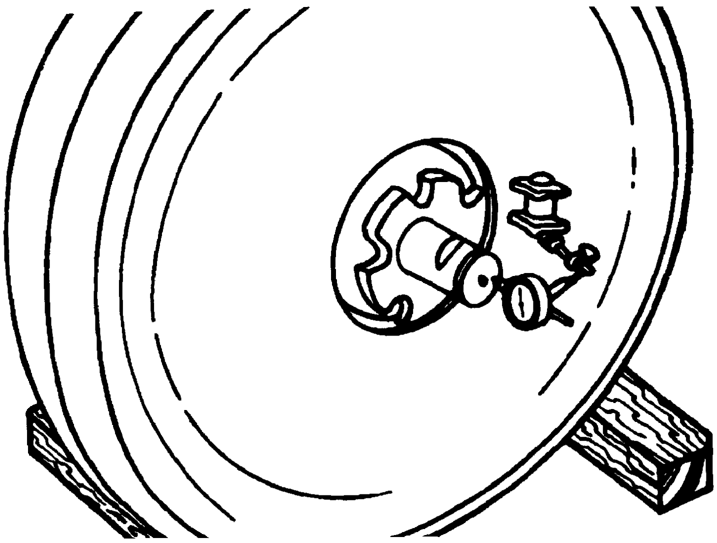


Fig. 14.16. Idler Shaft End Clearance

SUSPENSION

FRONT IDLER

NOTE: *Do not at any time handle metal face type oil seal with greasy oily or dirty hands. Idler must not be filled with lubricant until idler track frame are in position.*

5. Apply a small amount of grease on O-ring (8) and install in groove shaft (3). Before installing seal (9), be sure seal contacting surfaces of block and retainer (7) are clean and dry. Also that rubber rings of seal assembly are correctly positioned on metal rings. Refer to SEAL INSTALLATION under METAL TYPE FACE SEALS in this Section. Repeat Step 5 on opposite side of idler.
6. Before installing the plug (4), apply LOCTITE Pipe Sealant with Teflon #592 to the plug threads. When reusing a pipe plug, clean the plug before applying new LOCTITE to assure a tight seal. Use only Grade 30, series 3 engine oil to lubricate front idlers. Insert lubricator nozzle all way into shaft until it enters small fill hole in center of shaft. Pump lubricant in until air is forced out and lubricant back flows freely out plug hole in shaft. Then quickly remove lubricator nozzle and torque lubrication plug to 21 - 55 [Nm].

NOTE: *When reassembling front idler to blocks and fork, drain plug must be facing to outside and roll pin to the inside.*

7. Coat bores of mounting blocks (3 and 4, Fig. 14.17A) with grease. Install the spring pin (2, Fig. 14.17A) into idler shaft (3). Install blocks onto idler shaft (3) and secure with fork (1, Fig. 14.17A) and hardware. Torque fork bolts to 455 [Nm]. Install mounting block clamping bolts. Install mounting block with spring pin to inside (opposite lube plug) shaft of front idler and mounting block without spring pin to outside shaft and secure with hardware. Torque the idler shaft bolts to 730 [Nm].

11. INSTALLATION

1. Using a hoist and sling position front idler and fork onto guide bars up against adjuster cylinder.
2. Tighten the relief valve (1, Fig. 14.12) to 68 [Nm].
3. Install the inner and outer track frame cover.
4. Install the track chain, refer to SECTION 15.
5. Adjust the track tension, refer to the ADJUSTING TRACK TENSION in SECTION 15.

HYDRAULIC TRACK ADJUSTER

12. DESCRIPTION

The hydraulic track adjuster is supported between the track spring front seat and rear of the front idler fork. Lubricant is introduced into the cylinder by the use of a lubrication fitting on top of the cylinder. This lubricant acting upon the piston and adjusting rod forces the idler fork and idler forward for track chain adjustment.

HYDRAULIC TRACK ADJUSTER

13. REMOVAL

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

1. Remove the front idler, refer to REMOVAL under FRONT IDLER in this Section.
2. Remove the hydraulic track adjuster from front of track frame by sliding it out front of track frame.

14. DISASSEMBLY (Refer to Fig. 14.17)

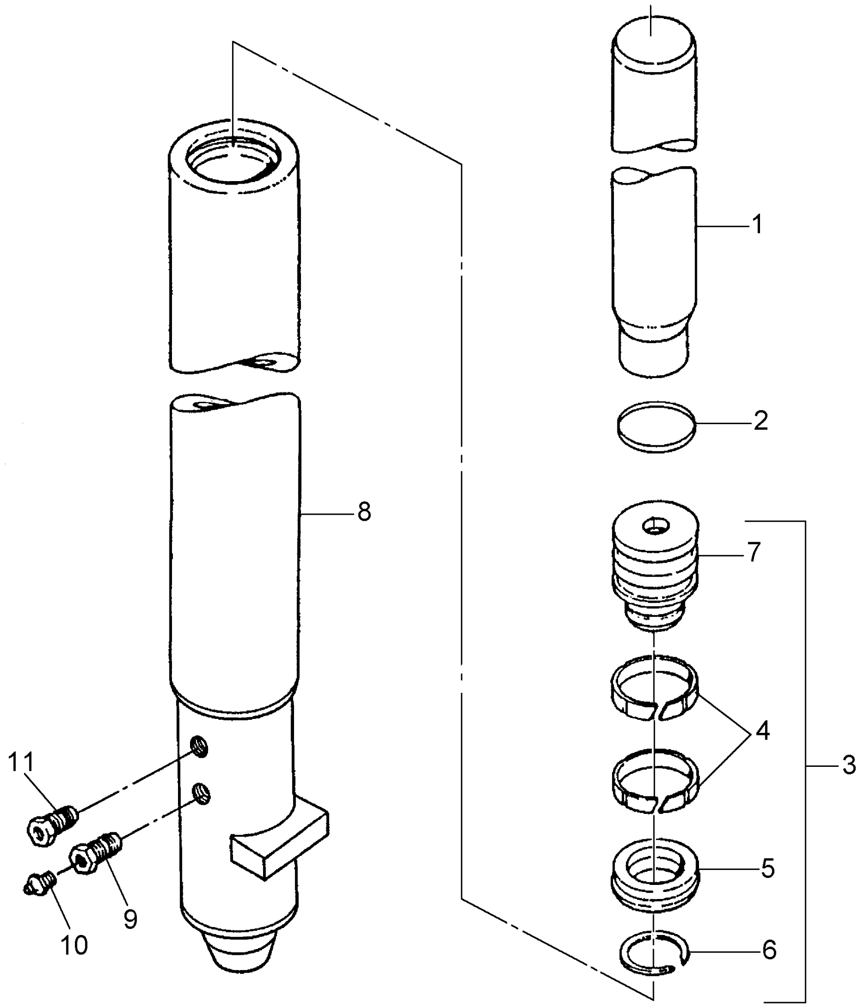


Fig. 14.17. Exploded View of Track Adjuster

1. Adjuster Rod
2. Rod Wiper
3. Piston
4. Guide Ring
5. Piston Seal
6. Retaining Ring
7. Adjuster Cylinder Piston
8. Adjuster Cylinder Housing
9. Ball Check Valve
10. Lube Fitting
11. Relief Valve

HYDRAULIC TRACK ADJUSTER

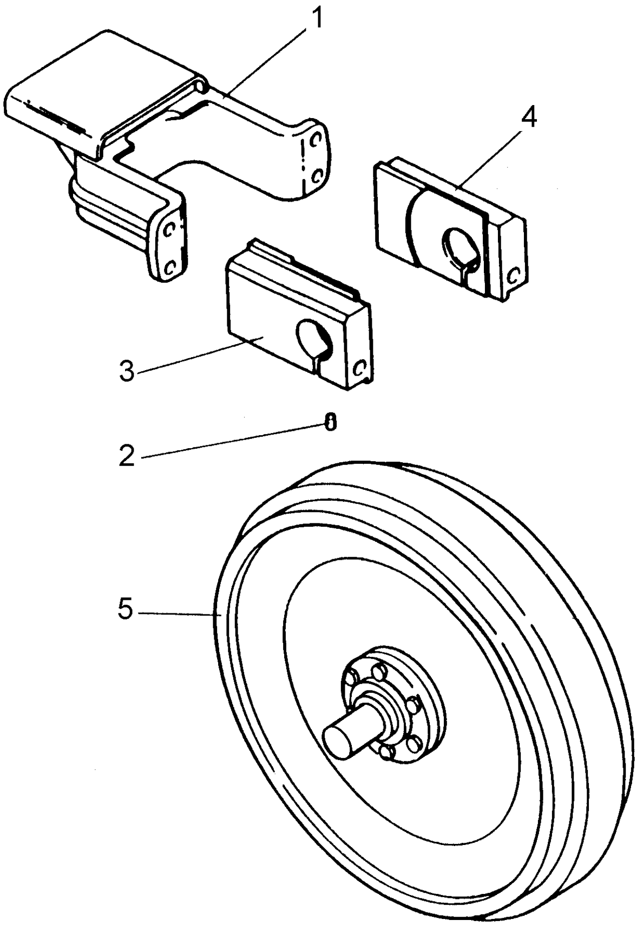


Fig. 14.17A. Front Idler and Fork

1. Fork Assy
2. Spring Pin
3. Right Block
4. Left Block
5. Front Idler

1. Pull rod (1) out of housing (8). Remove the rod wiper (2) from the housing bore.
2. Remove the piston (3) from housing (8). A 1/2 in. NC tapped hole is provided in the piston to facilitate removal.
3. Remove the retaining ring (6), piston seal (5) and guide rings (4) from piston (3).
4. Remove the lube fitting (10), ball check valve (9) and relief valve (11) from the housing (8).

15. INSPECTION AND REPAIR (Refer to Fig. 14.17)

1. It is recommended that a new retaining ring (6) and piston seal (5) be installed whenever the track adjuster is disassembled.
2. Wash all parts thoroughly in a suitable solvent. Dry completely with compressed air.
3. Inspect parts (1, 4, 7 and 8) for excessive wear or damage and replace if necessary.
4. Inspect the blocks (3 and 4, Fig. 14.17A) for damage or excessive wear and replaced if necessary.

HYDRAULIC TRACK ADJUSTER

16. REASSEMBLY (Refer to Fig. 14.17)

1. If removed, install two new guide rings (4) onto piston (7). Position guide rings (4) on piston with cuts 180 [^{o}] apart. Install seal (5) on piston (7) so that U cup of seal will be facing towards taper (retaining ring groove) end of piston (7).
2. Install retaining ring (6) in groove on piston (7).
3. Place a small amount of grease in bore of housing (8). Insert piston assembly, seal end first, into housing bore until it bottoms, so that all air be expelled. Grease appears through valve openings in housing (8).
4. Thread lube fitting (10) into ball check valve (9).
5. Install ball check valve (9) and relief valve (11) on housing (8) and torque to 68 [Nm].
6. Coat housing bore with grease. Install a new rod wiper (2) into groove on housing bore. Lip on wiper seal should face outward.
7. Install rod (1), large undercut end first, slowly and evenly into cylinder bore until it bottoms. If too much grease was installed in cylinder behind piston, rod wiper (2) may be forced out as rod is inserted. If this happens, remove rod and reinstall wiper ring and rod.

17. INSTALLATION

1. Slide track adjuster (rod end toward front idler) into front of track frame.
2. Install front idler, refer to INSTALLATION under FRONT IDLER in this Section.

TRACK TOP IDLER

18. DESCRIPTION

The upper section of the track between the sprocket and the front idler is supported by two idlers. The idlers are mounted on brackets which are part of the track frame. The track idlers revolve on heat-treated replaceable steel shafts, which are secured to the track frame brackets with a bolts (1, Fig. 14.19). The idlers are sealed against the entrance of dirt, water and the loss of lubricant by a seal and O-rings.

The idlers are equipped with tapered roller bearings and a metal face type seal.

19. REMOVAL

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

TRACK TOP IDLER

1. Release the track tension, refer to RELIEVING TRACK TENSION in SECTION 15.

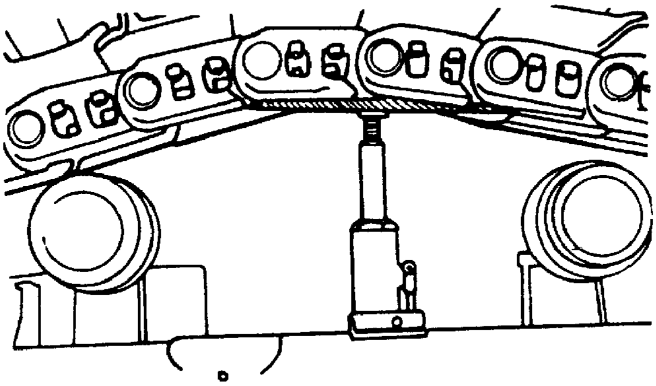


Fig. 14.18. Raising Track Chain

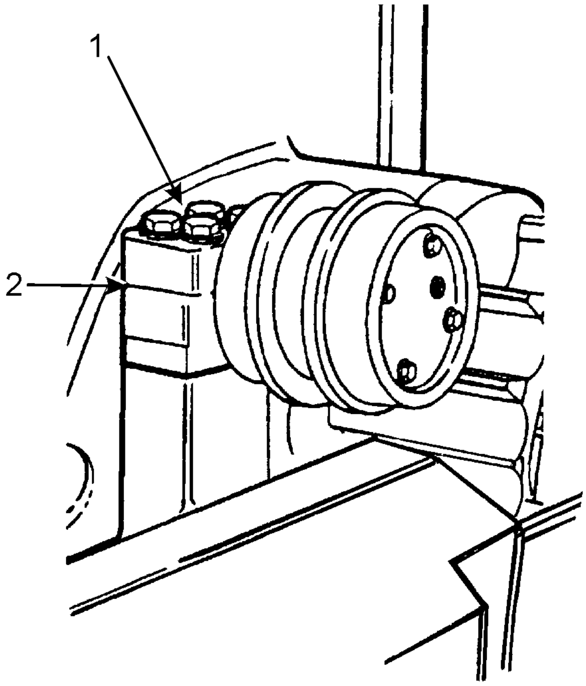


Fig. 14.19. Top Idler

1. Bolts 2. Mounting Block

2. Position a jack on top of the track frame. With a wooden block placed on the jack seat, raise the track until it is clear of the top idler (Fig. 14.18).
3. Loosen all bolts (1, Fig. 14.19) securing block (2) and spread blocks with a chisel. Pull the idler from the block.

20. DISASSEMBLY (Refer to Fig. 14.20)

1. Remove drain plug (1) and drain top idler. Remove pin (12) from retainer cover (11). Remove retainer (11) and seal kit (10) from idler assembly. If seal kit inner rubber ring does not come off with seal, it can easily be pulled from idler bore. Remove seal and O-ring (9) from retainer.
2. Turn idler assembly on its side and remove cover (2) and O-ring (3). Remove retaining ring (4) from idler shaft (7).
3. Place idler in a press so that it is supported by housing (8) and long shaft end is down. Press shaft (7) out of body and remove bearing cone (5). If bearing cone (6) needs to be replaced, press cone off shaft (7). Bearing cups (5 and 6) need not be removed from housing (8) unless replacement is necessary.
4. Using coarse paper, a file, or a hand grinder, remove any corrosion or hardened foreign material that may exist on seal bore surfaces of housing (8) and retainer cover (11). Do this carefully to avoid changing dimensions of bore.

TRACK TOP IDLER

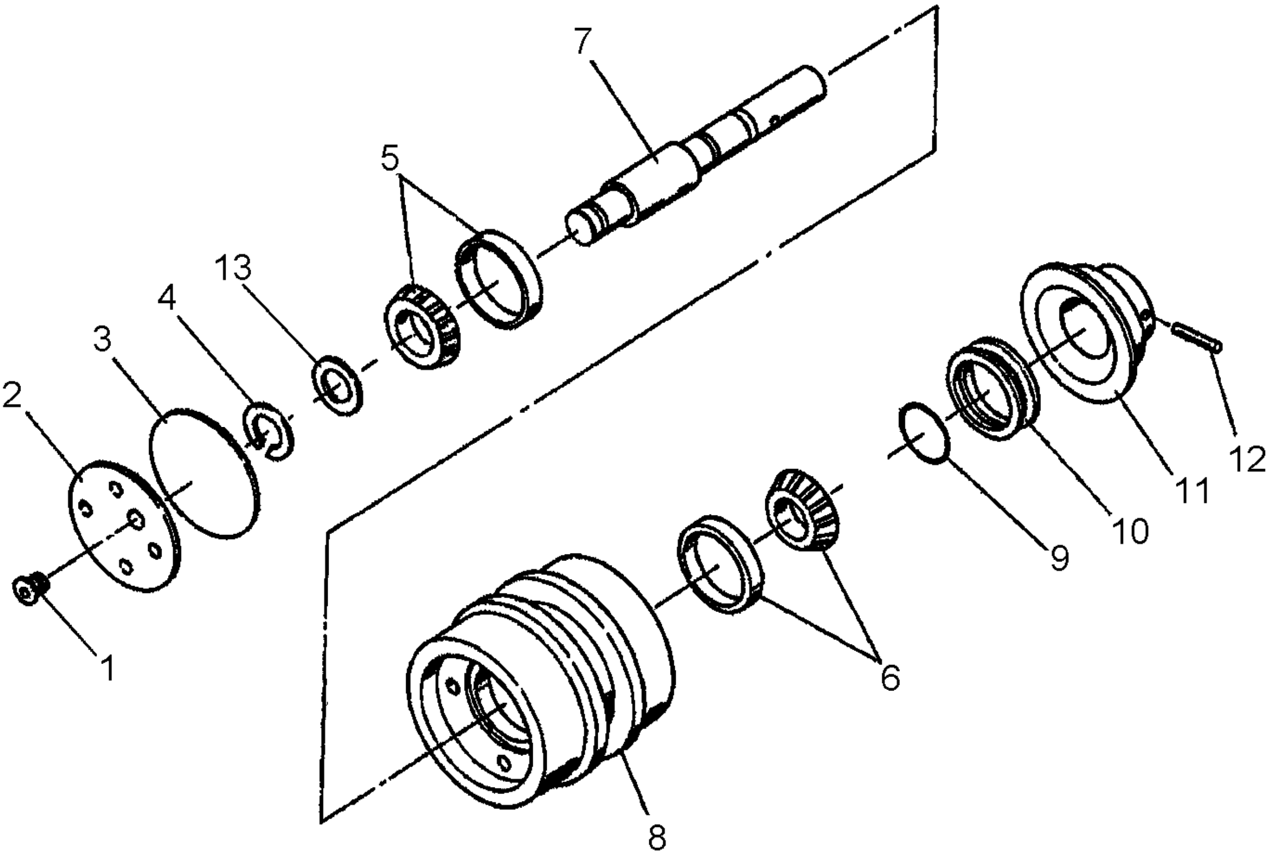


Fig. 14.20. Exploded View of Top Idler

1. Drain Plug
2. End Cover
3. O-Ring
4. Retaining Ring
5. Tapered Roller Bearing
6. Tapered Roller Bearing
7. Top Idler Shaft
8. Top Idler Housing
9. O-Ring
10. Seal Kit
11. Retainer Cover
12. Spring Pin
13. Bearing Spacer

21. INSPECTION AND REPAIR

NOTE: *Clean all parts thoroughly in a dry cleaning solvent, especially the inside of the idler. Blow all parts dry with compressed air.*

1. Inspect the bearings for cracks, scores and wear. Replace if necessary. Soak in oil, wrap and cover all re-usable bearings until ready for assembly.
2. Check the bearing bores in the idler body for scoring or other evidence of bearings turning in their bores. Inspect for cracks or other damage. Inspect the idler shaft for excessive wear or damage. Replace shaft if necessary. Slight burrs can be smoothed down with a stone.
3. Discard the sealing rings.
4. Whenever the track idler is disassembled, the oil seal must be rebuilt or replaced with a new oil seal. Refer to SEAL INSPECTION under METAL TYPE FACE SEALS in this Section.

TRACK TOP IDLER

22. REASSEMBLY (Refer to Fig. 14.20)

NOTE: *To ease assembly, apply a small amount of oil, same as used to fill idler, to bearing cup bores of housing (8) and bearing cone diameters of shaft (7) prior to bearing installation.*

1. If bearing replacement was necessary press new bearing cups (5 and 6) into idler housing until they bottom in bore. If bearing cone (6) was removed, press cone into shaft (7) until it is against shaft shoulder.
2. Insert shaft in idler housing (8) and position assembly in a hydraulic press so that it is supported by shaft. Press bearing cone (5) onto shaft (7). Install retaining ring (4). With assembly still supported by shaft (7), rotate idler housing. If it does not turn freely, tap end of shaft with a brass mallet to set bearings.
3. Install bearing spacer (13) on shaft (7) and into housing (8). Place assembly on a bench, cover plate end down. Apply a thin coating of grease to O-ring (9) and install it in retainer cover (11).

NOTE: *Do not at any time handle seal (10) with greasy, oily or dirty hands. Track idler must not be filled with lubricant until idler and track frame are in position on machine.*

4. Before installing seal assembly, be sure seal contacting surfaces of idler body bore and seal retainer are clean. Also that rubber rings of seal assembly are correctly positioned on metal rings. Install seal. Refer to SEAL INSTALLATION under METAL TYPE FACE SEALS in this Section.
5. Install retainer cover (11) on shaft so that seal bore of retainer uniformly envelops oil seal rubber ring. Position seal retainer so spring pin holes in shaft and retainer are aligned. Install pin (12) into retainer and peen over metal area around pin hole. Install cover (2) with O-ring (3) on idler assembly. Torque cover bolts to 21 - 55 [Nm].

23. INSTALLATION

1. Slide track idler shaft into mounting block or bracket so that seal retainer pin (12, Fig. 14.20) is in a horizontal position. Align track idler with front idler and other track idler. Remove chisel from mounting block and secure block to track frame. Torque bolts to 730 [Nm].
2. Fill idler with recommended lubricant. Refer to OPERATOR'S MANUAL for recommended lubricant. Clean threads of plug (1) and apply LOCTITE Pipe Sealant with Teflon #592. Install plug in cover (2) and torque to 21 - 55 [Nm]. Lower track chain onto idlers and remove jack.
3. Adjust the track tension, refer to the ADJUSTING TRACK TENSION in SECTION 15.

TRACK ROLLER

24. DESCRIPTION

The track rollers are attached to the underside of the track frames and carry the weight of the dozer. The rollers are heat-treated steel forging, and rotate around bushings. The rollers are equipped with metal face type seals which maintain a leak and dirt-proof seal.

Rollers have single or double flanges, and they are positioned in the track frame as shown in Fig. 14.30.

TRACK ROLLER

25. REMOVAL

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

1. Release the tension in the track chain, refer to ADJUSTING TRACK TENSION in SECTION 15.
2. Wedge a steel plate between the frame and equalizer bar.
3. Remove the track roller rock shields.
4. Place a jack under the front frame and also place one under the rear main frame. Place a heavy steel plate between the jacks and the frames. This will prevent any damage being done to the rear main frame. Run up the jacks until the rollers are free of the track approximately 150 [mm].
5. Remove the bolts securing the track roller brackets to the track frame (Fig. 14.21).
6. If there is not enough track chain slack to remove the roller, position two small jacks between the track and track frame. Jack up until sufficient clearance exists to remove the track roller.

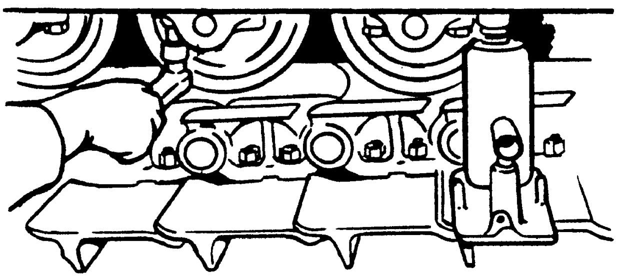


Fig. 14.21. Removing Roller

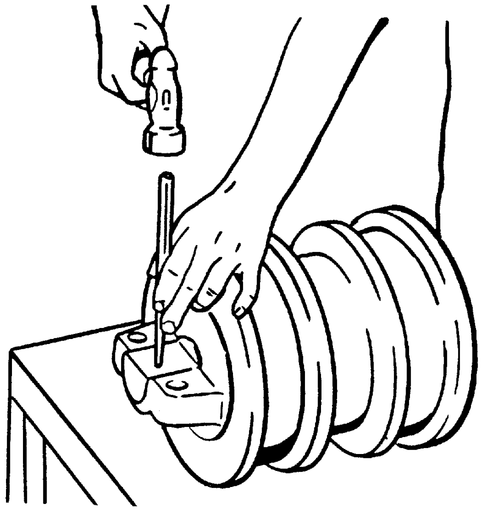


Fig. 14.22. Removing Spring Pin

26. DISASSEMBLY (Refer to Fig. 14.23)

1. Remove drain plug (12) and drain roller. Drive out spring pin (11) securing the bracket (1) on each side of the shaft (10) as shown in Fig. 14.22.
2. Remove the track roller shaft brackets (1) with the O-rings (2) and the stators of the seal kits (3). Discard the O-rings. Remove the seal kits stators from the brackets and discard the rubber rings.
3. Remove the bolts securing the bushing retainers (4) to each side of the roller housing and remove the retainers with O-rings (5) and the rotors of the seal kits (3). Discard the O-ring (5). Remove the seal kits from the retainers and discard rubber rings.

SUSPENSION

TRACK ROLLER

IMPORTANT: *Keep original mated metal rings as a set, do not mix a metal ring from the oil seal on one side of the roller with a metal ring from the oil seal on the opposite side of the roller.*

4. Remove the washers (6). With parts removed from both sides of the roller housing, remove the shaft (10) from the roller housing and bushings (7).
5. The bushings (7) are a pressed into the roller housing. When replacement is necessary, they can be pressed from position.

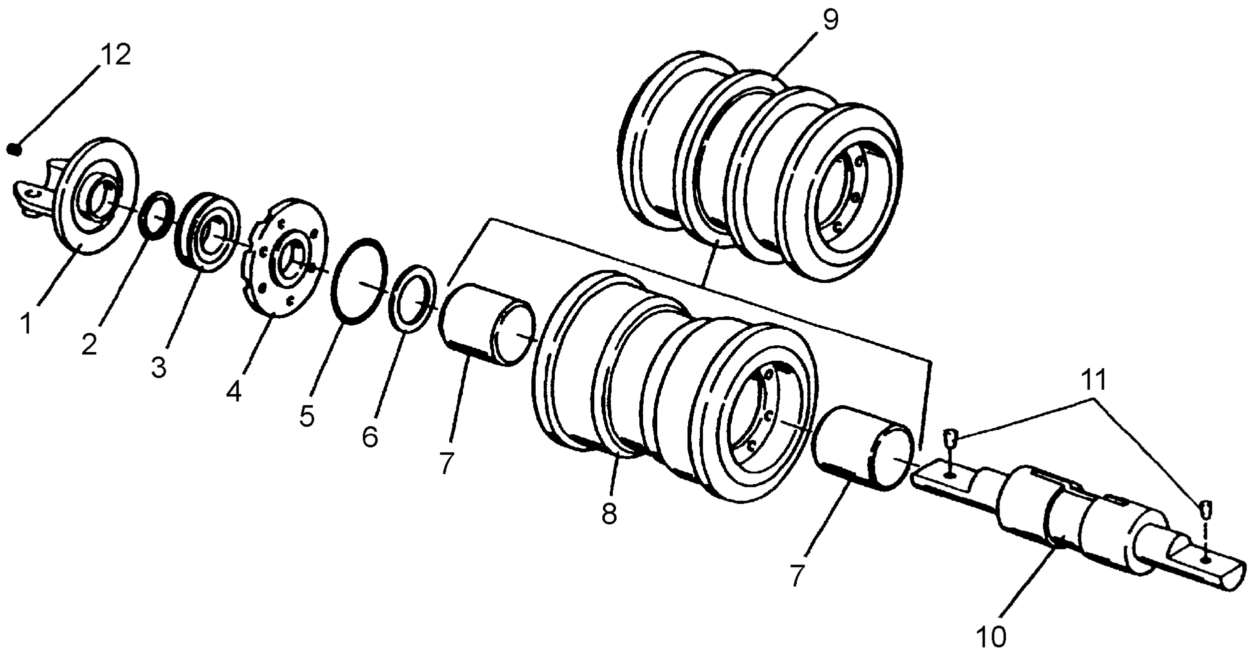


Fig. 14.23. Exploded View of Track Roller

1. Roller Bracket
2. O-Ring
3. Seal Kit
4. Bushing Retainer
5. O-Ring
6. Thrust Washer
7. Track Roller Bushings
8. Track Roller (Single Flange)
9. Track Roller (Double Flange)
10. Track Roller Shaft
11. Spring Pin
12. Drain Plug

27. INSPECTION AND REPAIR

1. Wash all the parts thoroughly in a solvent and dry with compressed air. Wash all the bushings. Clean and flush out the bore of the track roller, as well as the oil passage in the roller shaft.
2. Replace all O-rings and sealing rings with new.
3. Inspect the roller shafts, bushings and rollers for cracks, scores or excessive wear, refer to REASSEMBLY under TRACK ROLLER in this Section for installing new bushings.
4. Determine if the thrust washers are worn beyond the limits given in Fig. 14.24. If worn, replace with new.
5. Check the end clearance and diametral clearance given in Fig. 14.24.
6. Whenever the track roller is disassembled, the oil seal must be rebuilt or replaced with a new seal. Refer to SEAL INSPECTION under METAL TYPE FACE SEALS in this Section.

TRACK ROLLER

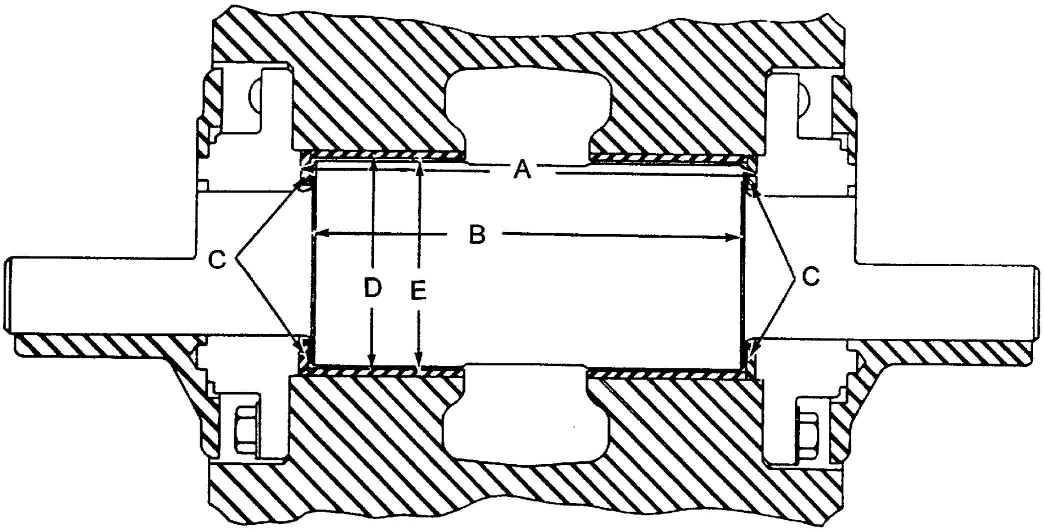


Fig. 14.24. Track Roller Bushing Clearance

A. Distance Between Seal Retainer Surfaces . . . . 201.67 ± 0.15 [mm]
B. Width of Idler Shaft Bearing Surfaces . . . . 194.8 ± 0.1 [mm]
C. Thrust Washer Thickness (each) . . . . 3.15 ± 0.05 [mm]
D. Bushing Inside Diameter (assembled) . . . . 105.3 ± 0.05 [mm]
E. Roller Shaft Diameter . . . . 104.93 ± 0.03 [mm]
Diametral Clearance (D-E) . . . . 0.35 ± 0.1 [mm]
End Clearance A-(B+2C) . . . . .0.6 ± 0.3 [mm]

28. REASSEMBLY (Refer to Fig. 14.23)

1. If replacing bushings, coat 25 [mm] of outer end of roller bore and leading edges of bushing OD with LOCTITE #601. Press bushing in as indicated in Fig. 14.25.

IMPORTANT: *Do not at any time handle the oil seal with greasy, oily dirty hands. The track rollers must not be filled with lubricant until the rollers and track frame are in position on the dozer.*

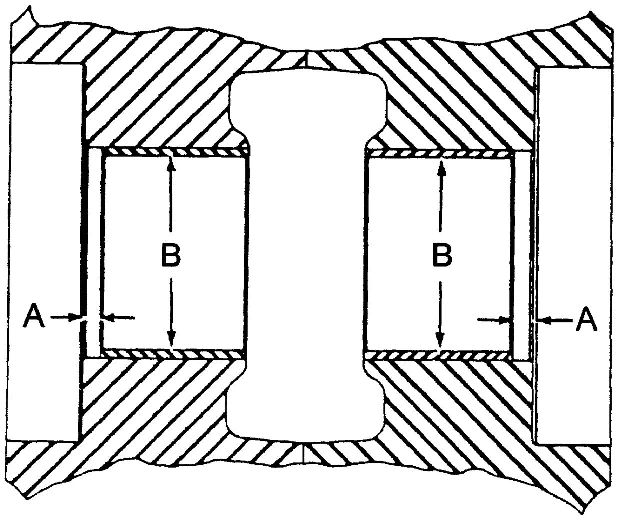


Fig. 14.25. Bushing Installation

A. Bushing Pressed Below Edge of Roller Bore . . . . 7.4 ± 0.3 [mm]
B. Bushing Inside Diameter (assembled) . . . . 104.88 ± 0.07 [mm]

TRACK ROLLER

2. Before installing seal assembly, be sure seal contacting surfaces of seal retainer and track roller shaft bracket are clean. Also that rubber rings of seal assembly are correctly positioned on metal rings. Refer to SEAL INSTALLATION under METAL TYPE FACE SEALS in this Section.
3. Install the washer (6) in the roller bore. Apply a small amount of grease to O-ring (5) and install in groove in bushing retainer (4). Apply LOCTITE #262 to threads and secure the bushing retainer to the roller housing. Torque the bolts to 134 [Nm]. To prevent roller assembly from moving as bolts are torqued, a strap can be used to secure roller body to bench as shown in Fig. 14.26.

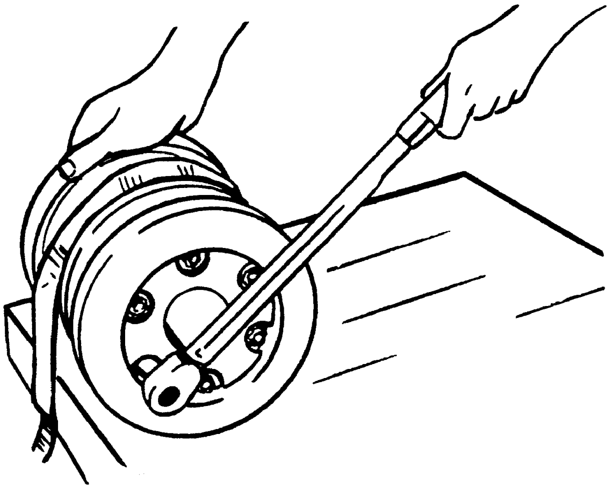


Fig. 14.26. Torquing Bolts

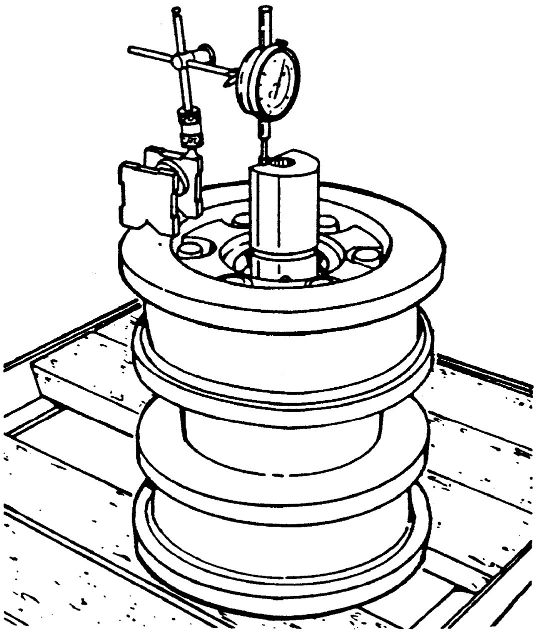


Fig. 14.27. Roller end Clearance

4. Insert the shaft (10) into the roller body so the end of the shaft with drain plug (12) is on the same side as the two drilled holes in the roller body. Install the washer, sealing ring and bushing retainer on the opposite side of the roller housing as was done previously.
5. Check that track roller end clearance is within tolerance given in Fig. 14.24. From side of roller dial indicator is to be mounted to, push roller shaft into housing to be sure it is bottomed against washer. Place dial indicator magnetic base on roller housing with indicator pointer resting against end of shaft. Set indicator at zero (Fig. 14.27). Pull up on shaft until it bottoms and take a reading. If reading obtained is below specification, check surfaces (A, B and C, Fig. 14.24) for squareness. If above specifications, check parts for excessive wear.
6. Install the seal kit (3) as described in the instructions furnished with the seal kit.
7. Install the O-ring (2) into the groove on the inside of the roller shaft bracket (1) and lubricate the O-ring with chassis lubricant.
8. Install roller bracket (1) on shaft (10). Apply hand pressure to roller shaft bracket (1) as shown in Fig. 14.28 until spring pin holes are aligned. Install pin (11) until it is slightly below bracket surface and peen over bracket casting to maintain its position. Repeat on opposite side of roller.

TRACK ROLLER

29. INSTALLATION

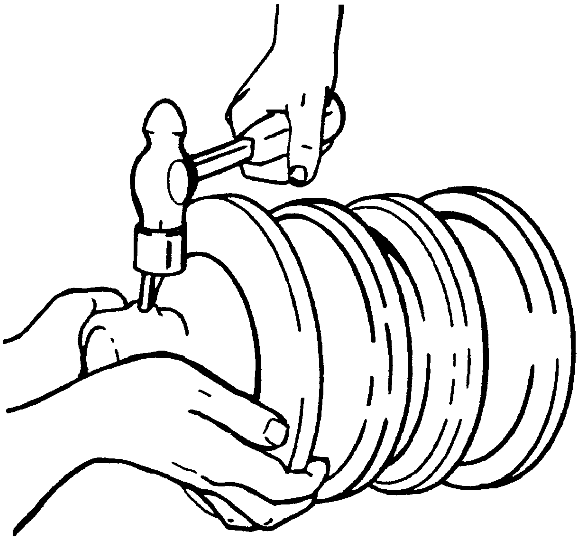


Fig. 14.28. Installing Spring Pin

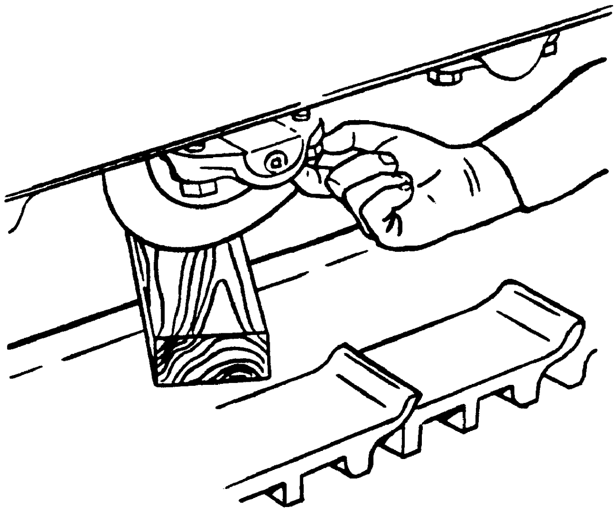


Fig. 14.29. Installing Roller

1. Clean the inside and lower faces of the track frame inner and outer rails in the areas that contact the brackets when the roller are installed.
2. Install the roller assembly in the track frame so that the end of the shaft for the lubricating plug is to the outside of the dozer (Fig. 14.29).
3. Remove the jacks from between the track frame.
4. Release the jacks under the front frame and rear main frame slowly until the slot in the track frame and track roller are in position.
5. Secure the roller in position by installing bolts through the track roller shaft brackets and into the track frame. Tighten the bolts evenly. Release the jacks the rest of the way.

NOTE: *When securing the track roller shaft bracket to the track frame, install the forward bolt with just enough force to bring the bracket in contact with the frame rail. Install the rear bolt completely and torque. Apply full torque to the front bolt. Torque bolts to 455 [Nm].*

6. Remove the steel wedge from between the equalizer bar and the track frame.
7. Install the roller shield using 455 [Nm] torque. Adjust the track tension, refer to the ADJUSTING TRACK TENSION in SECTION 15.
8. Fill roller with recommended lubricant, refer to OPERATOR'S MANUAL for recommended lubricant. Clean threads of plug (12, Fig. 14.23) and apply LOCTITE Pipe Sealant with Teflon #592. Install plug in bracket (1) and torque to 21 - 55 [Nm].

30. ARRANGEMENT OF TRACK ROLLERS (Refer to Fig. 14.30)

Standard Track

The six-roller track frame uses a total of three double-flange and three single-flange track rollers on each side. Rollers 1,3 and 5 on each side of dozer have single flanges and 2, 4 and 6 have double flanges.

SUSPENSION

TRACK ROLLER

Long Track or Low Ground Pressure

The seven-roller track frame uses a total of three double-flange and four single-flange track rollers on each side. Rollers 1, 3 and 5 on each side of dozer have single flanges and 2, 4, 6 and 7 have double flanges.

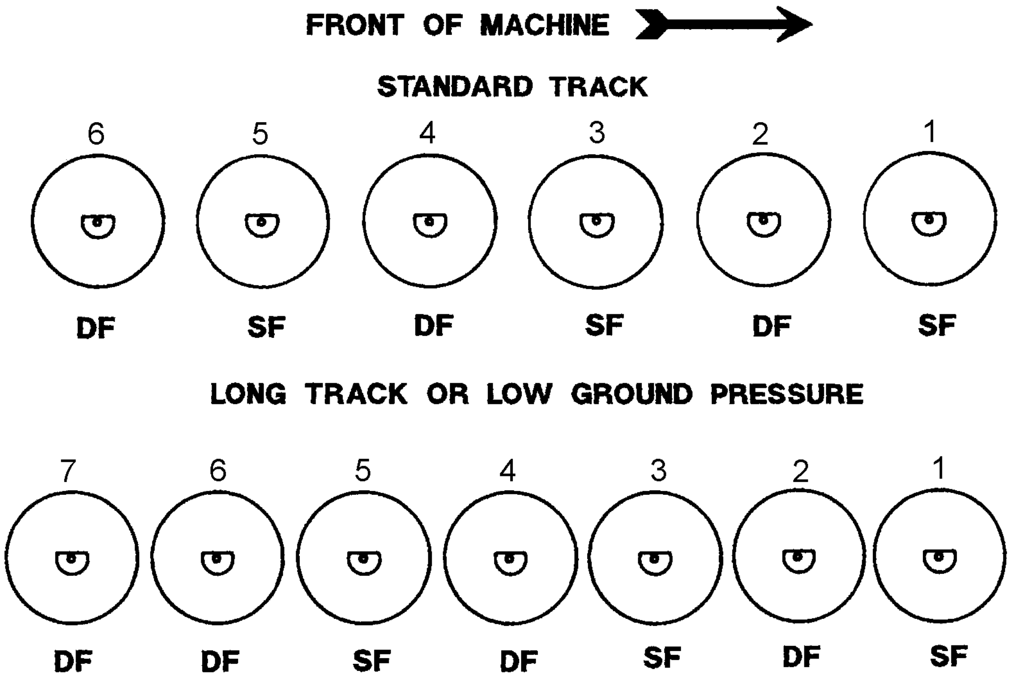


Fig. 14.30. Track Roller Arrangement

DF - Double Flanged SF - Single Flanged

TRACK FRAME GUIDE

31. DESCRIPTION

The track frame guides allow the track frames to oscillate vertically on guide plates.
The guide plates are secured to the guide bracket, which is a welded part of the front frame, by four bolts. The wear plates and guide spacers are secured between the track frame and guide retainer by bolts.

Legend to Fig. 14.31. Track Frame Guide

22. Front Idler Mounting Block
24. Wear Plates
25. Upper Guide Wear Spacer
26. Lower Guide Wear Spacer
27. Track Frame Guide Shim
28. Guide Wear Plate
29. Outer Guide Plate
30. Guide Plate Shim

TRACK FRAME GUIDE

Fig. 14.31. Track Frame Guide

32. REMOVAL (Refer to Fig. 14.31)

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

WARNING! Lift and handle all heavy parts with a lifting of proper capacity. Be sure parts are secured by proper slings and hook. Use lifting eyes if provided. Warn people in the area to stand clear.

NOTE: *When the track frame guides are disassembled in order their repair or replace, new shims must be applied and clearance adjustment (A and B, Fig. 14.31) to 0.8 [mm] must be followed.*

NOTE: *When the track frame guides are disassembled in order repair or replace of other parts of the machine, the guides must be checked for excessive wear and replace, if necessary. At assembly new or old guides adjust clearance (A and B, Fig. 14.31) to 0.8 [mm].*

1. Remove bolts securing plate (29) to track frame and front top idler block and remove plates (24 and 29), spacer (25 and 26) and shims (27).
2. Remove hardware securing plate (28) to machine frame and remove plate with shims (30). Keep shims with plate for proper installation.

SUSPENSION

TRACK FRAME GUIDE

33. INSPECTION AND REPAIR

1. Wash all parts thoroughly in a suitable solvent. Dry thoroughly with compressed air.
2. Inspect wear plates and guide plate for excessive wear or damage.
3. Check the guide bracket for broken welds. Any track frame guide parts that are damaged must be replaced with new parts.

34. INSTALLATION (Refer Fig. 14.31)

1. Secure plate (28) to machine frame with same thickness of shims (30) as were removed. Torque bolts to 1110 [Nm].
2. Position wear plate (24) between track frame and plate (28). Insert top bolts through holes in block (22) and plate (24) and install spacer (25). Position plates (24 and 29) between plate (28) and machine frame and loosely secure with bolts. Install shims (27) between spacer (25) and plate (24).
3. Working from underneath machine, position spacer (26) between plates (24) and insert hardware. Install shims (27) between spacer (26) and plate (24). Torque all bolts 1110 [Nm].
4. Measure clearances A and B (Fig. 14.31). If total of clearances is 0.8 [mm] or less, adjust by removing shims (27) from between spacers (25 and 26) and plate (24). Remove enough shims to allow for equal spacing. If removal of all shims (27) will not provide a total clearance of less than 0.8 mm, replace worn guide plate (28) and / or wear plates (24) as required. Reinstall shims and repeat check. Lubricate track frame guides.

EQUALIZER BAR

35. DESCRIPTION

The equalizer bar supports the front of the dozer and permits track oscillation. The equalizer bar is fitted with bushings to take the wear as the track frame oscillates. The ends of the equalizer bar ride on hardened pads inserted into the track frames.

36. REMOVAL AND DISASSEMBLY (Refer to Fig. 14.32)

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

WARNING! Lift and handle all heavy parts with a lifting of proper capacity. Be sure parts are secured by proper slings and hook. Use lifting eyes if provided. Warn people in the area to stand clear.

EQUALIZER BAR

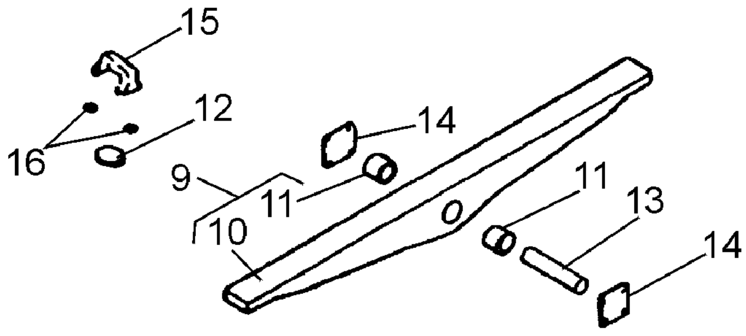


Fig. 14.32. Exploded View of Equalizer Bar

9. Equalizer Bar Assembly
10. Equalizer Bar
11. Equalizer Bar Bushing
12. Wear Pad
13. Pivot Pin
14. Retainer Plate
15. Rebound Bracket
16. Shim

1. Remove the crankcase guard and the transmission case guard.
2. Remove bracket (15) and shims (16) from both track frames. Keep the shim with the brackets for proper installation.
3. Jack up the front of the dozer until the weight is off the equalizer bar and install blocking under the main frame.
4. Remove the plates (14) and push pivot pin (13) out of the equalizer bar tunnel.
5. Remove the equalizer bar out either side of the dozer.
6. If replacement is necessary, press bushing (11) out of bar (10).
7. If replacement is necessary, remove the two pivot pin bushing located inside the equalizer bar tunnel.

37. INSPECTION AND REPAIR

1. Wash all parts thoroughly in a suitable solvent. Dry thoroughly with compressed air.
2. Inspect equalizer bar, bushings, brackets, pads, pin and retainer plates for excessive wear or damage and replace if necessary.

38. REASSEMBLY AND INSTALLATION (Refer to Fig. 14.32)

1. Be sure pads (12) are in place on the track frames.
2. If bushings (11) was removed, pack the new bushing with grease and press into bar (10) until flush.
3. If the pivot pin bushings were removed, install the new bushings in the equalizer bar tunnel.
4. Insert the equalizer bar in the tunnel and align the pivot pin holes. Lightly grease pin (13) and install it through the rear of the tunnel. Install plates (14). Torque the bolts to 265 [Nm].
5. Lower the front of the dozer so that bar (10) rests on pads (12) and remove the jack.
6. Install shims (16) and bracket (15). Check the clearance between the top of the equalizer bar and the bottom of bracket (15). Add or subtract shims (16) to obtain a clearance of 5.6 ± 0.8 [mm]. Torque the bracket bolts to 455 [Nm].

TRACK FRAME

39. DESCRIPTION

Each standard track frame has six track roller attached to it. Each long track or low ground pressure frame has seven track rollers attached to it. The track top idlers on both sides are mounted in brackets and bolted to the track frame. The track spring housing is a permanent welded part of the track frame, with the heavy coil spring being trapped within it. The track frames are attached at the rear to the pivot shaft and at the front to the track frame guides. A guide bracket is welded to each side of the front frame to provide the proper spacing between the two tracks. A hydraulic track adjuster and coil spring are located between the two channels of the track frame and slide back and forth to take up shock loads and for adjusting the track chain tension.

40. REMOVAL AND DISASSEMBLY (Refer to Fig. 14.1 and 14.2)

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

WARNING! Lift and handle all heavy parts with a lifting of proper capacity. Be sure parts are secured by proper slings and hook. Use lifting eyes if provided. Warn people in the area to stand clear.

1. Remove the blade and pusharm, refer to SECTION 17. Remove track chain, refer to SECTION 15. It is necessary to remove tracks from under machine.
2. Remove front idler assembly, refer to FRONT IDLER in this Section.
3. Remove sprocket rock deflector from rear of track frame.
4. Install blocks in equalizer bar tunnel on each side of machine to prevent movement of equalizer bar. Remove equalizer bar, refer to EQUALIZER BAR in this Section.
5. Remove guide plate and shims from main frame, refer to TRACK FRAME GUIDE in this Section. Keep shims with guide plate for proper installation.
6. Jack front and rear of machine up and block it securely. Machine should be raised high enough for track rollers and shields to clear chain. Attach a hoist to two track idlers as shown in Fig. 14.33. Lift track frame load off pivot shaft and track chain.

NOTE: *Whenever possible, an adjusting sling should be used to remove track frame. With an adjusting sling, track frame can be tilted or leveled as required, reducing job time, effort and hazard.*

7. Remove cover (8), outer wear washer (7), thrust plate (5), inner wear washer (7) and shims (6) from end of pivot shaft (1). Keep shims with plate (5) to facilitate installation.
8. Using a pry bar between track frame and main frame, move track frame out horizontally. Swing track frame from pivot shaft and away from machine. Using a bearing puller, remove seal (4) from bore of track frame. If bushings need replacement, they can be removed with aid of a portable hydraulic press.

TRACK FRAME

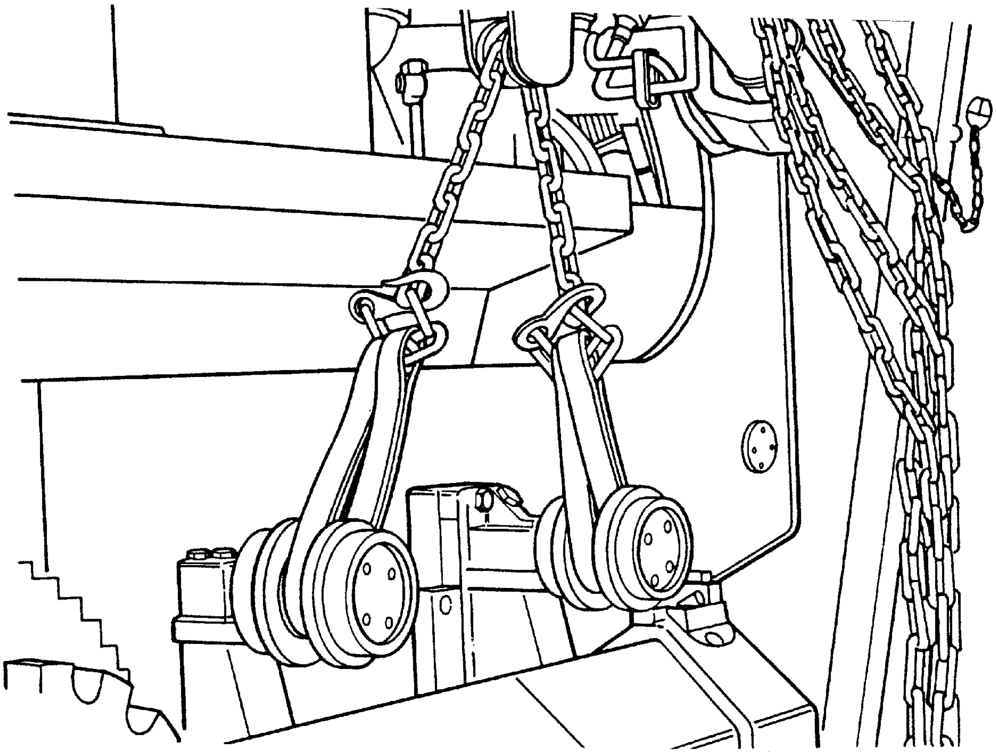


Fig. 14.33. Track Frame Removal

41. INSPECTION AND REPAIR

1. It is recommended that new seals be installed whenever the track frame is removed.
2. Wash all parts thoroughly in a suitable solvent. Dry thoroughly with compressed air.
3. Check surface for sharp corner. If necessary, grind and polish.
4. Inspect thrust plate, wear plates, pivot shaft and bushings for damage or excessive wear and replace if necessary.
5. Inspect guide bars for distortion or broken welds. If replacement is necessary, cut bars off track frame and replace.
6. Inspect the track frame for damage and excessive warpage.
7. Inspect the equalizer wear pad for excessive wear or damage and replace if necessary. If the equalizer wear pad need to be replaced, also check the contacting surfaces on the equalizer bar ends.

42. REASSEMBLY AND INSTALLATION (Fig.'s 14.1 and 14.2)

1. Install seal (4) on the pivot shaft (1). Check seal, it must be flush against frame.
2. If bushings were removed, apply LOCTITE Primer T or N on outside surface of bushings and allow to dry completely. Be sure bore of track frame is clean and dry. Coat 6 [mm] of outer edge of track frame bore and leading edge of bushing with LOCTITE #601. Press bushings into track frame until each are flush with outside edges of track frame.

NOTE: *Bushings must be pressed in within five minutes after applying LOCTITE.*

TRACK FRAME

3. Apply a light coating of chassis lubricant to bushings. Attach a hoist to track frame and keeping it horizontal, position it over pivot shaft. Install inner wear washer (7) into track frame. To seat seal (4) in bore of track frame, position a 12 [mm] shim pack (6) on end of pivot shaft and secure plate (5). Then remove enough shims to align the center line of the last track roller with the center line of the sprocket and reinstall plate (5). Torque the bolts to 455 [Nm].
4. Install outer wear washer (7) in cover (8). Apply LOCTITE #504 to mating surface of cover (8). Torque cover bolts to 455 [Nm].
5. Remove the hoist from the track frame. Remove the blocking from the machine and lower the machine onto the track chain.
6. Install guide plate with same thickness shims as were removed. Torque bolts to 1110 [Nm]. Install equalizer bar, refer to EQUALIZER BAR in this Section. Remove blocks from equalizer bar tunnel on each side of machine.
7. Install front idler assembly, refer to FRONT IDLER in this Section.
8. Refill pivot shaft housing as described in the OPERATOR'S MANUAL.
9. Install track chain and sprocket shields, refer to TRACK CHAIN in SECTION 15. Whenever a new track frame or wear plates are installed, track frame alignment must be checked, refer to TRACK FRAME ALIGNMENT in this Section.

PIVOT SHAFT

43. DESCRIPTION

The pivot shaft supports the rear track frame and permits free track oscillation in conjunction with the equalizer bar. It is fitted with bushings to take the wear as the frames oscillation. One end of the shaft is mounted in the rear frame and held in place with a lock pin. The shaft mounts to the track frames and is lubricated in a oil reservoir within the track frame itself.

44. REMOVAL AND DISASSEMBLY (Refer to Fig.'s 14.1 or 14.2 and 14.34)

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

WARNING! Lift and handle all heavy parts with a lifting of proper capacity. Be sure parts are secured by proper slings and hook. Use lifting eyes if provided. Warn people in the area to stand clear.

PIVOT SHAFT

NOTE: *The pivot shaft has a 0,05 to 0,10 [mm] press fit into rear frame outer pivot shaft bore. Because of press fit, special tooling is required to pull pivot shaft from rear frame. In addition to special tooling, heating of rear frame area (outer pivot shaft bore), which houses pivot shaft, is required. Special tooling should be fabricated locally per SPECIAL/SERVICE TOOLS in SECTION 1.*

1. Drain oil from rear frame as described in the OPERATOR'S MANUAL.
2. Remove track frame assembly, refer to REMOVAL under TRACK FRAME in this Section.
3. Remove the transmission guard for access to pivot shaft lock pin from underneath the machine. The lock pins are located at lower corners on front wall of the rear frame. Remove the pin plug (3) and remove lock pin (2) with a slide hammer end 3/4 in. NC adapter or a hydraulic ram end 3/4 in. NC threaded rod.
4. Install adapter plate (2, Fig. 14.35) to pivot shaft with three 3/4-16 x 3-1/2 in. socket head bolts and thread ram screw (5) into the adapter. Position tube assembly (6) over ram screw and pivot shaft and against rear frame. Install 100 ton ram (3) over ram screw and against tube assembly. Lock ram screw with speed nut (4).
5. Use a steady pull on ram while heating to max. 260 [°C] outer pivot shaft bore until shaft is free. It is recommended that two torches with multiple orifice tips (rosebuds) be used to heat area around hub and at bottom and forward wall of rear frame in bore area of outer pivot shaft. Keep flame away from pivot shaft and stand to side never in front of shaft while applying hydraulic pressure.

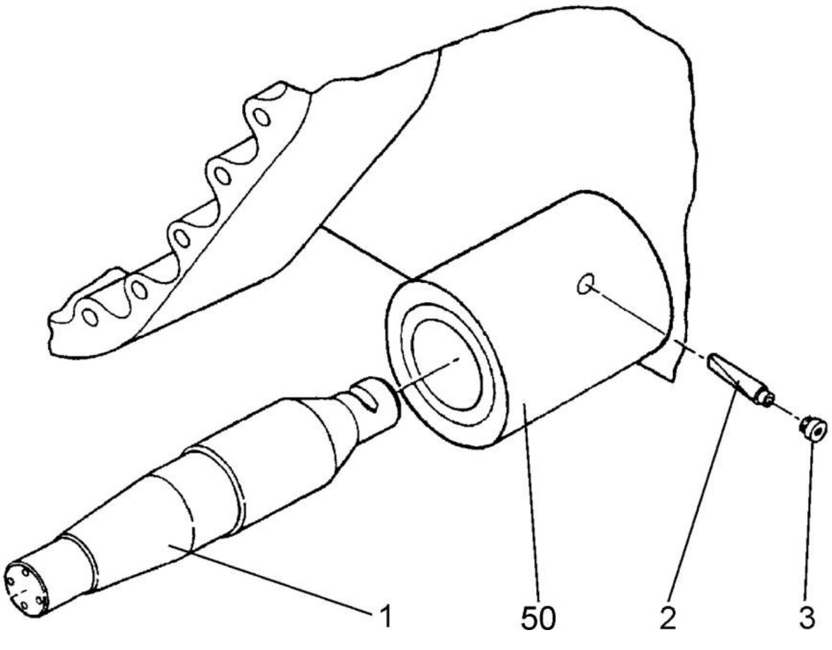


Fig. 14.34. Pivot Shaft

1. Pivot Shaft 2. Lock Pin 3. Pin Plug 50. Rear Main Frame

PIVOT SHAFT

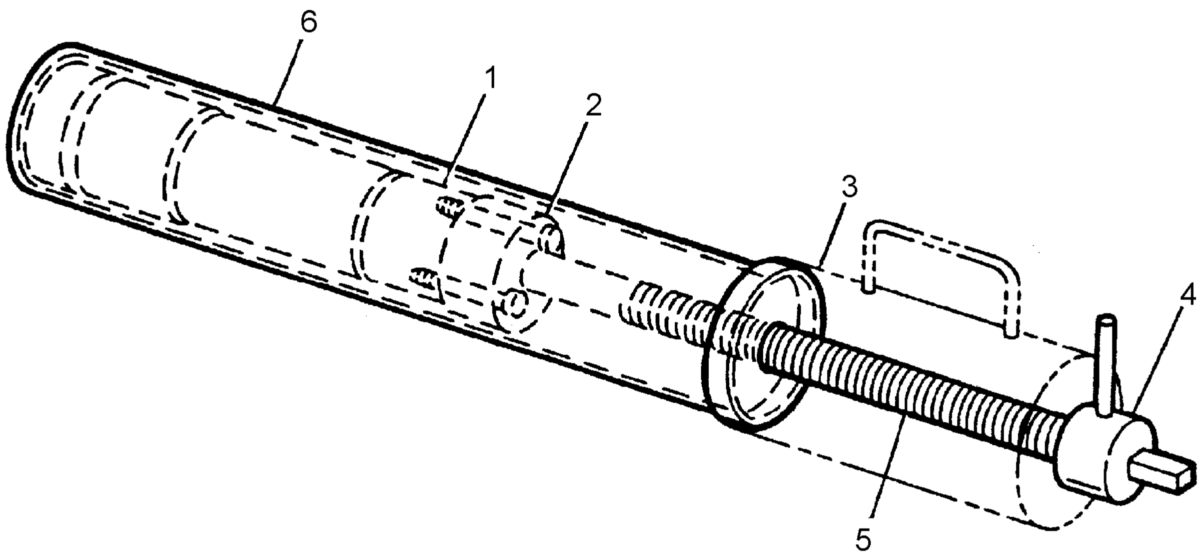


Fig. 14.35. Pivot Shaft Removal Tool

1. Pivot Shaft
2. Adapter Plates
3. 100 ton Ram
4. Speed Nut
5. Ram Screw
6. Tube Assembly

45. INSTALLATION

1. Pivot shaft can be installed easier by packing shaft in ice or dry ice for 2 to 3 hours before installing. Prepare pivot shaft lock pin for installation by threading it onto a 3/4 in. NC threaded rod of bolt at least 150 [mm] long. Expand pivot shaft bore in rear frame by heating to max. 260 [^{o}C]. This will be enough heat to install shaft by hand, especially if it was packed in ice or dry ice. Two torches with multiple orifice tips (rosebuds) are recommended. Use a soft flame, playing it back and forth on area being heated. Specified degree of heat is critical and must be determined with a Tempilstik applied to an area adjacent to bore. Do not put flame directly on Tempilstik but allow heat to spread gradually to it. Heating time will vary according to ambient temperature of rear frame.
2. Install alignment tool, refer SERVICE/SPECIAL TOOL in this Section, to pivot shaft with 3/4 in. NF bolts. Position of pivot notch in relation to tool handle must be as shown in Fig. 14.36 so tool handle will clear sprocket drive.

NOTE: *Once started, installation of pivot shaft must be completed quickly or heat will transfer from bore to shaft causing to bind.*

3. Guide pivot shaft into rear frame with notch facing up. When end of alignment tool bottoms against hub on rear frame, shaft will be installed to correct depth. Rotate pivot shaft with tool handle to align groove in shaft with lock pin. Unscrew threaded rod from lock pin and install lock pin (2, Fig. 14.34). Torque pin plug (3) to 275 [Nm].
4. Install transmission guard.
5. Install track frame assembly, refer to REASSEMBLY and INSTALLATION under TRACK FRAME in this Section.
6. Refill rear frame as described in the OPERATOR'S MANUAL.

PIVOT SHAFT

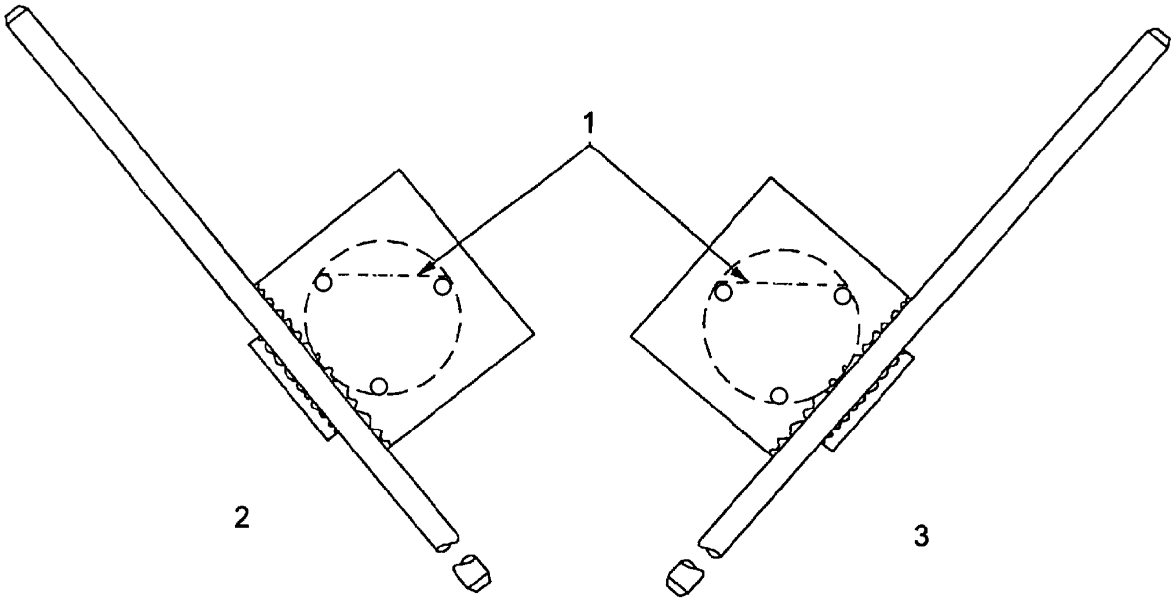


Fig. 14.36. Alignment Tool Bolted to Pivot Shaft

1. Lock Pin Notch in Pivot Shaft   2. Left Side   3. Right Side

TRACK SPRING

46. DESCRIPTION

A heavy coil spring is provided in each track. They permit the front idlers to recoil under shock loads, but exert no tension on the track in normal operation position. Each track spring is contained in a welded housing, which is a permanent part of the track frame. The track spring is compressed and trapped in the ends of the housing between a front and rear seat. The rear of the adjusting rod bears against the track spring front seat.

47. REMOVAL

Legend to Fig. 14.37. Spring in Track Frame

A. Assembly Length in Track Frame . . . . 761 [mm]
B. Spring Solid Length . . . . 641.35 [mm]
Installed Length Load . . . . 22700 [kg]
Solid Length Load . . . . 38950 [kg]
C. Tool Head to Bulkhead Clearance . . . . 12.7 [mm]
D. Spring Free Length with Seats . . . . 880.4 [mm]
E. Assembled Length in Machine . . . . 773.45 [mm]
F. Spring Bolt Washer 338 158 R1
G. Spring Bolt . . . . CZG 1365

SUSPENSION

TRACK SPRING

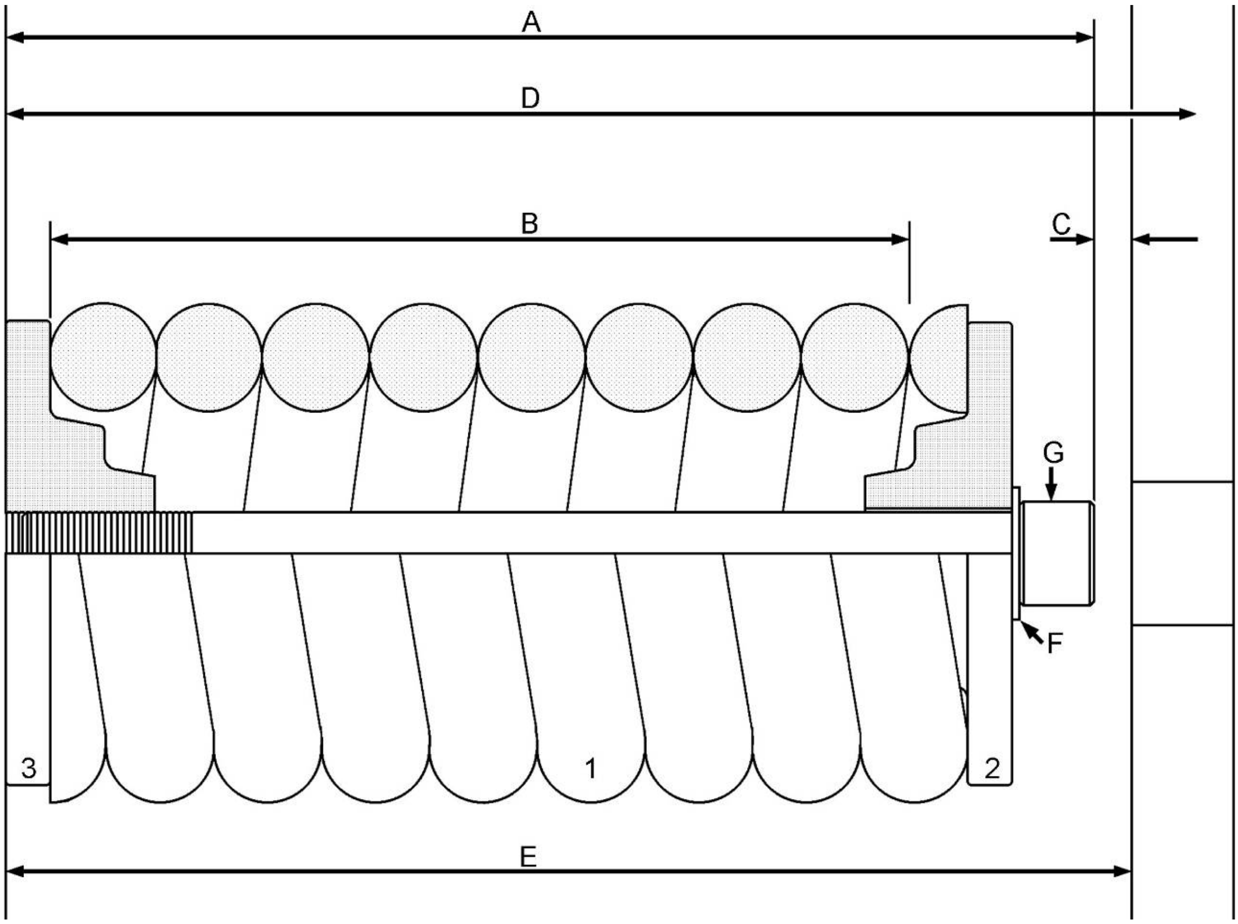


Fig. 14.37. Spring in Track Frame

1. Track Spring 2. Front Spring Seat 3. Rear Spring Seat

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

CAUTION! Lift and handle all heavy parts with a hoist of proper capacity. Be sure parts are secured by proper slings and hook. Use lifting eyes if provided. Warn people in the area to stand clear.

NOTE: *The track spring has a solid height load. Tools necessary for removal and installation can be fabricated locally per SPECIAL/SERVICE TOOLS in this Section.*

1. Remove the track chain, refer to SECTION 15 for this procedure.
2. Remove the front idler, refer to REMOVAL under FRONT IDLER in this Section.
3. Remove the track frame, refer to REMOVAL under TRACK FRAME in this Section.
4. Position track frame on 300x300 [mm] blocks as shown in Fig. 14.38 and remove all track rollers.
5. If spring is broken, us a torch and cut in pieces for removal.

TRACK SPRING

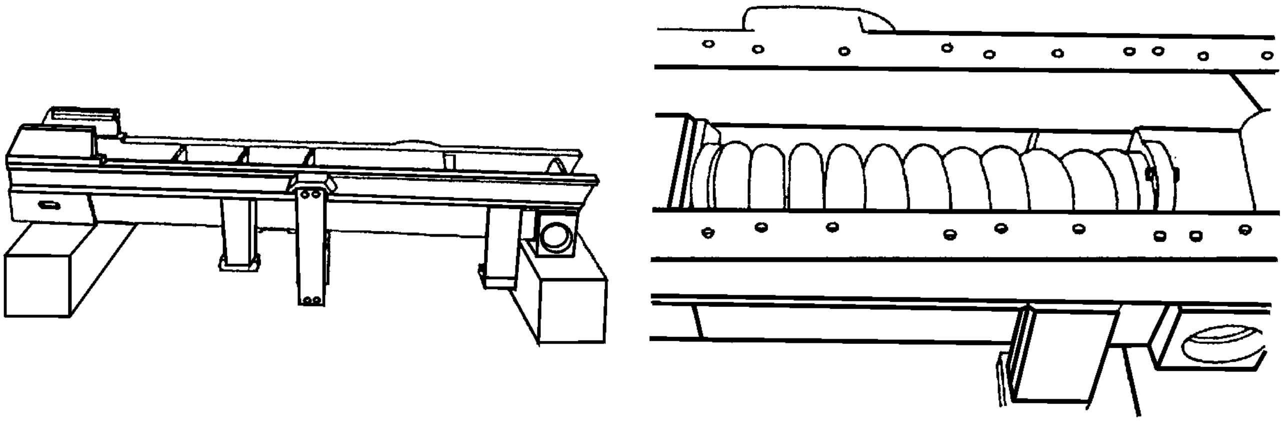


Fig. 14.38. Track Frame Position

6. The following ram tools are required to remove spring (Fig.'s 14.39 or 14.40):

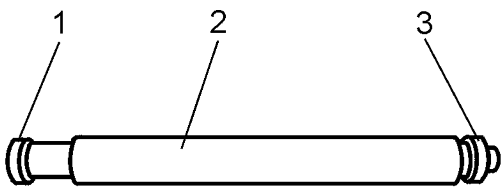
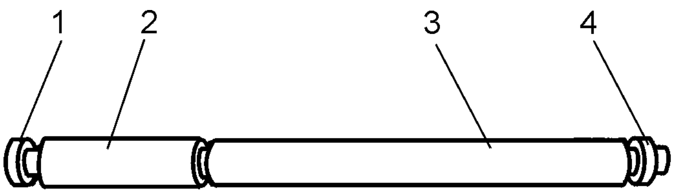


Fig. 14.39. Track Spring Tool (STD)

1. Ram Rod
2. Ram Tube
3. Retainer Plug



14.40. Track Spring Tool (LT or LGP)

1. Ram Rod
2. Tube Extension
3. Ram Tube
4. Retainer Plug

7. Standard Track Frame:

   Insert as an assembly, ram rod (1, Fig. 14.39), ram tube (2) and retainer plug (3) in through front of track frame inserting retainer plug into bore of front spring retainer.

8. Long or Low Ground Pressure Track Frame:

   Insert as an assembly, ram tube (3, Fig. 14.40) and retainer plug (4) in through front of track frame inserting retainer plug into bore of front spring retainer. Install ram rod (1) and tube extension (2) to ram tube (3).

9. Install straight support brace (1, Fig. 14.41) with wooden block (2) under head of ram rod. Install ram base plate (1, Fig. 14.42) in track frame against upper (2) and lower (3) guides.
10. Slide idler hole brace (3, Fig. 14.43) through track frame. Install interim brace (1) between ram base plate (2) and idler hole brace (3) as shown in Fig. 14.43.
11. Install ram (1, Fig. 14.44), with piston rod completely retracted, onto support brace. Using a pry bar (2) take up slack between ram and ram rod (3) as shown in Fig. 14.44.

TRACK SPRING

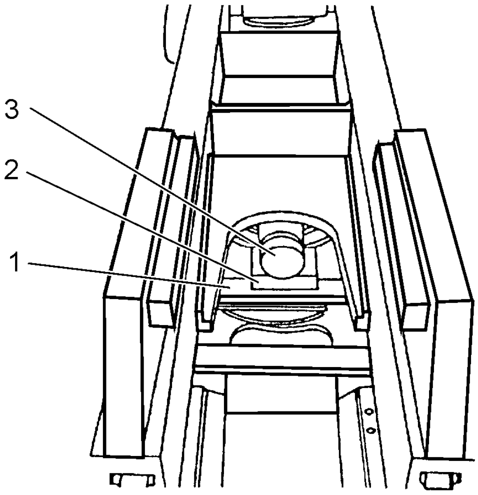


Fig. 14.41. Support Brace Installation

1. Support Brace
2. Wooden Block
3. Rod

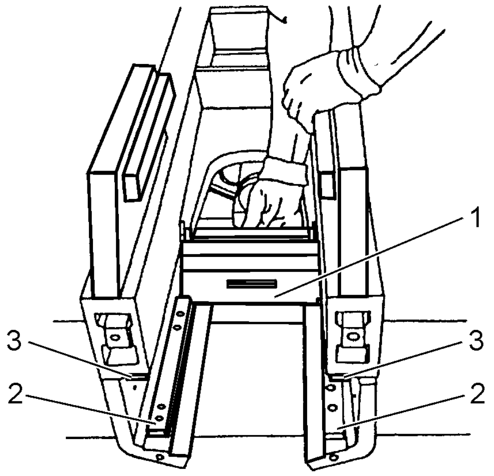


Fig. 14.42. Ram Base Plate Installation

1. Ram Base Plate
2. Upper Guide
3. Lower Guide

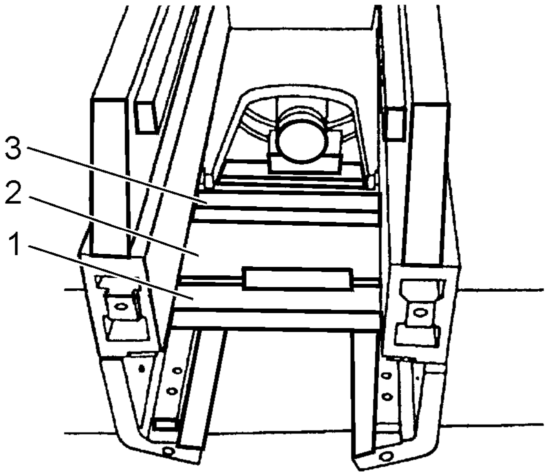


Fig. 14.43. Interim Brace Installation

1. Interim Brace
2. Ram Base Plate
3. Idler Hole Brace

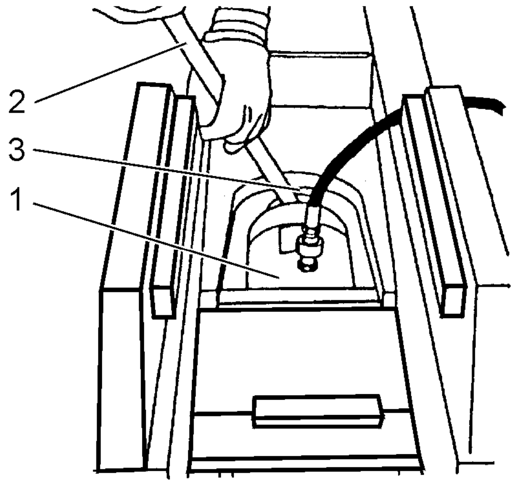


Fig. 14.44. Ram Installation

1. Ram
2. Pry Bar
3. Ram Rod

12. Measure distance between end of ram and ram rod and install spacing (2, Fig. 14.45) between ream of ram (3) and base plate (1).
13. Position retainer bridge on track frame. Using ram pump, compress track spring far enough to install bridge. Install retainer bridge (1, Fig. 14.46) between front spring retainer (2) and track frame support rib. Removal all spring compression tools from track frame.

TRACK SPRING

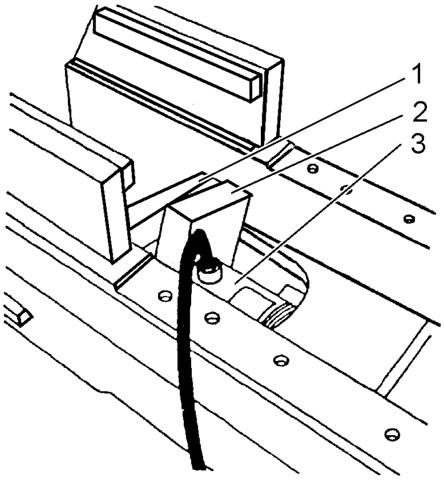


Fig. 14.45. Spacing Installation

1. Base Plate 2. Spacing 3. Ram

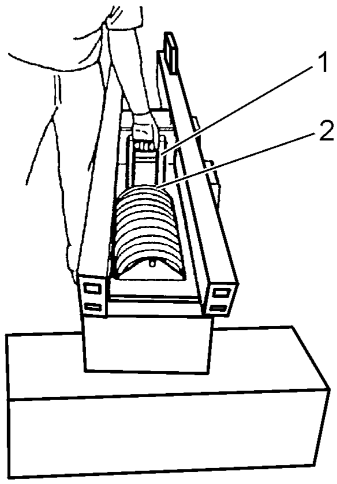


Fig. 14.46. Retainer Bridge Installation

1. Retainer Bridge 2. Front Spring Retainer

14. Liberally coat thread end of spring bolt with grease. Install bolt through front of track frame. Through hole in bottom plate, thread bolt into rear spring retainer. Tighten bolt, but DO NOT put an over of tension on spring bolt.
15. Position lifting sling (1, Fig. 14.47), centering around track spring (2) and attach to hoist. Remove locating bolt and nut (3).

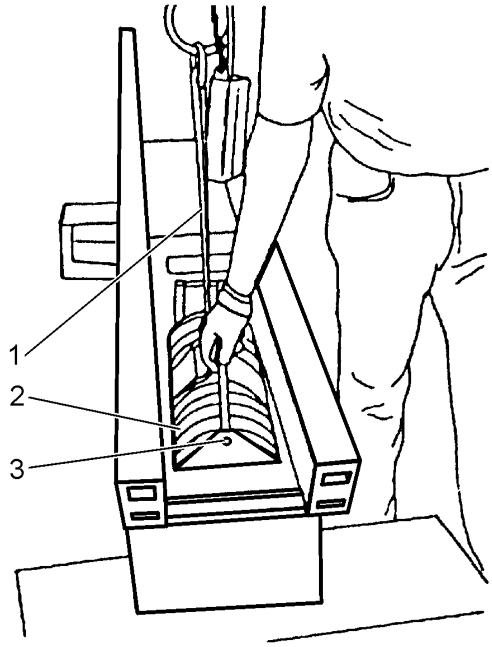


Fig. 14.47. Lifting Sling Installation

1. Lifting Sling 2. Track Spring 3. Nut

SUSPENSION

TRACK SPRING

16. The following ram tools are required to remove retainer bridge (Fig.'s 14.48 or 14.49):

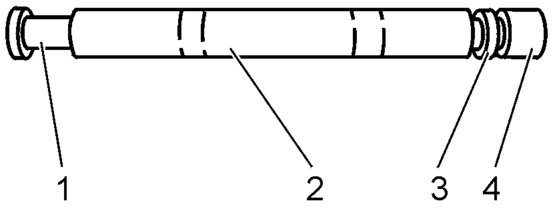


Fig. 14.48. Track Frame Tool (STD)

1. Ram Rod
2. Ram Tube
3. Retainer Plug
4. Bolt Adapter

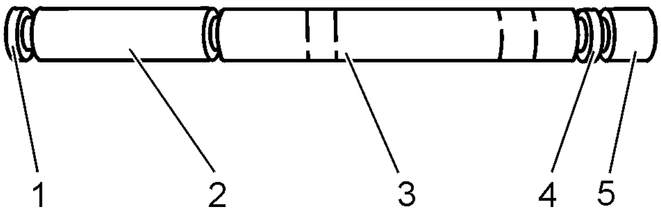


Fig. 14.49. Track Frame Tool (LT or LGP)

1. Ram Rod
2. Tube Extension
3. Ram Tube
4. Retainer Plug
5. Bolt Adapter

17. Install bolt adapter on retainer plug and repeat Steps 7 through 10. Be sure adapter sits squarely over spring bolt head. Repeat Steps 11 through 12. Compress track spring to allow of retainer bridge. Back off ram and remove compression tools. Remove spring from track frame.

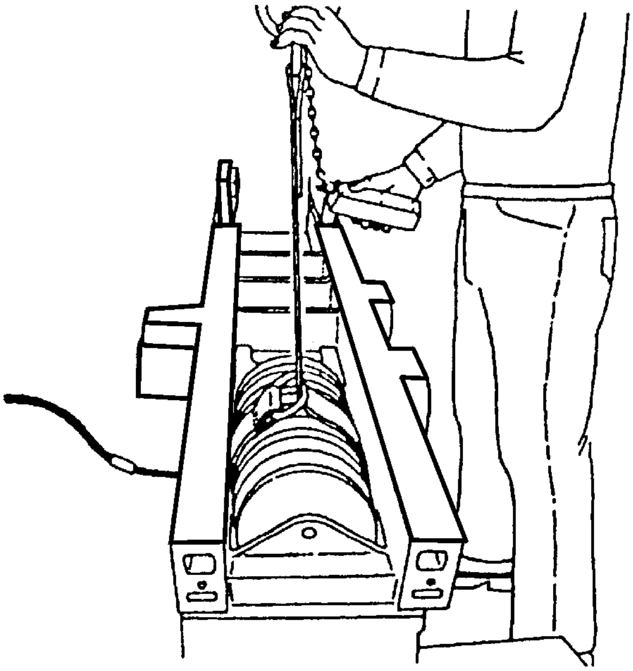


Fig. 14.50. Track Spring Removal

48. DISASSEMBLY

1. Position spring (3, Fig. 14.51), bolt end towards access hole (5), into coffin (4). Center spring (3) in coffin (4) and place well oiled sliding plate (1) up against spring rear retainer (2).
2. Position ram (3, Fig. 14.52) with suitable blocking (1) and raise ram to approximate center of spring, in to coffin (5). Place suitable blocking (1) behind ram (3). Compress spring (7) to relieve tension on bolt (6). Remove bolt. Position long spacers (2) at each corner of coffin (5). Slowly let off ram (3) until sliding plate (4) contacts spacers. Remove a piece of blocking (1).

TRACK SPRING

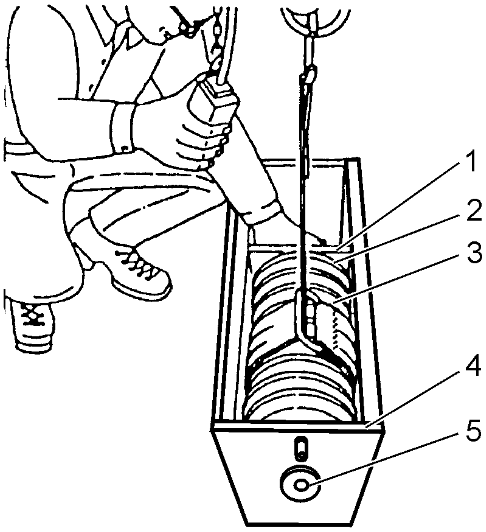


Fig. 14.51. Position Spring into Coffin

1. Sliding Plate
2. Spring Rear Retainer
3. Spring
4. Spring coffin
5. Access Hole

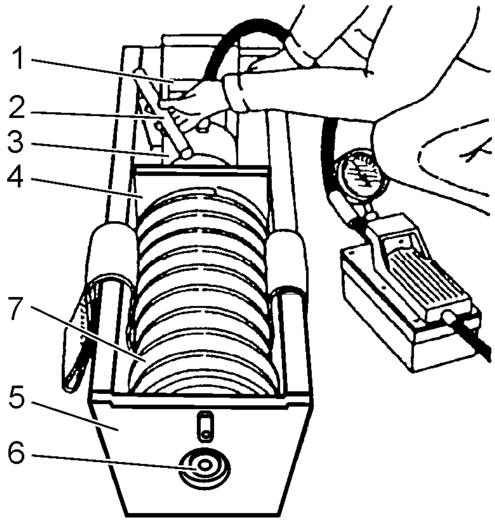


Fig. 14.52. Spring Disassembling

1. Blocking
2. Spacers
3. Ram
4. Sliding plate
5. Spring coffin
6. Bolt
7. Spring

3. Compress spring to allow long spacers to be removed. Position short spacer (2, Fig. 14.53) at each corner of coffin (4) and let off of ram (3). Remove remaining blocking (1). Compress spring (5) to allow short spacers (2) to be removed. Let off ram (3) and allow spring (5) to fully decompress. Remove ram from coffin.
4. Using pry bar position spring in center of coffin. Remove front and rear retainers from track spring and coffin. Attach sling to hoist and remove track spring from coffin as shown in Fig. 14.54.

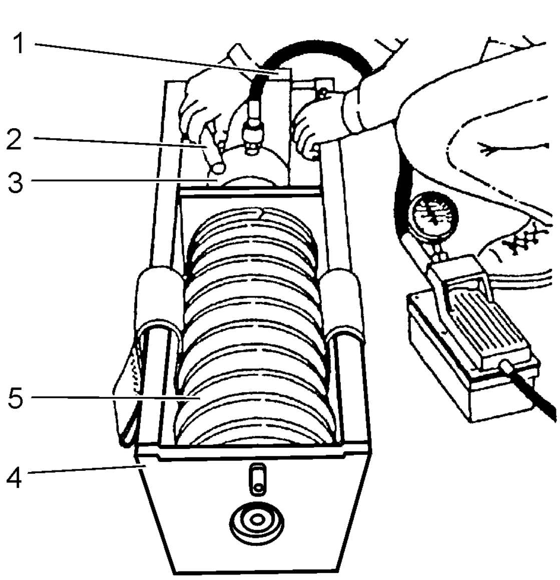


Fig. 14.53. Spring Disassembling

1. Blocking
2. Short Spacer
3. Ram
4. Spring coffin
5. Spring

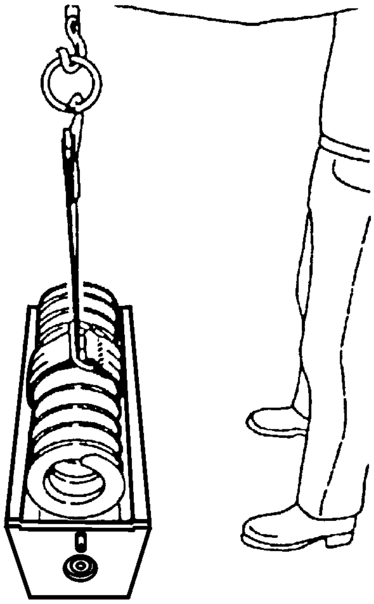


Fig. 14.54. Removing Spring from Coffin

SUSPENSION

TRACK SPRING

49. REASSEMBLY

1. Attach sling to hoist and install track spring into coffin. Install front and rear retainers to track spring and position in coffin as shown in Fig. 14.54.
2. Position slide plate (3, Fig. 14.55) up against rear spring seat (4). Install ram (2) with adequate blocking to center with spring. Compress spring (5) and install four short spacers (1) at each corner of coffin (6). Let off on ram so sliding plate bottoms on spacers. Place suitable blocking (7) behind ram (2). Compress spring (5) to allow removal of short spacers (1). Continue to compress spring and install four long spacers at each corner of coffin (6). Let off ram so sliding plate (3) bottoms on spacers.
3. Start spring bolt (1, Fig. 14.56) and bottom against front spring seat (5). With bolt (1) holding spring (2), place additional blocking (3) behind ram (4). Compress spring and tighten bolt, but DO NOT put an over amount of tension on spring bolt.
4. Measure spring housing in track frame. Subtract spring seat thickness from this measurement. Add 3 [mm] to outcome. This dimension is what track spring with spring seat has to be compressed to.
5. Compress spring and spring seat to previous measured dimension. Remove all compression tools from coffin. Slide captured spring back in coffin and attach sling to hoist.

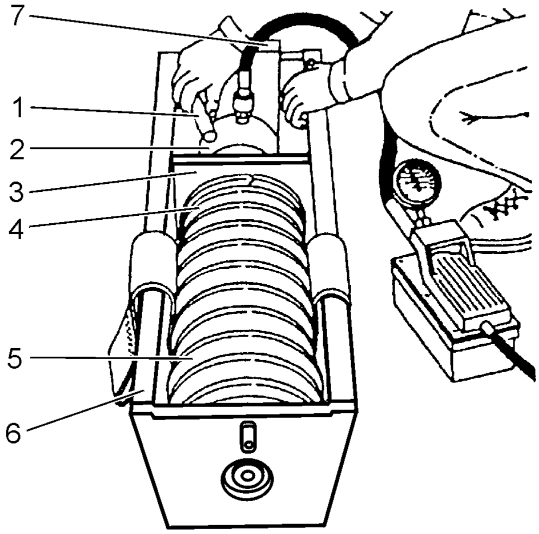


Fig. 14.55. Spring Reassembling

1. Short Spacer
2. Ram
3. Slide Plate
4. Spring Seat
5. Spring
6. Spring coffin
7. Blocking

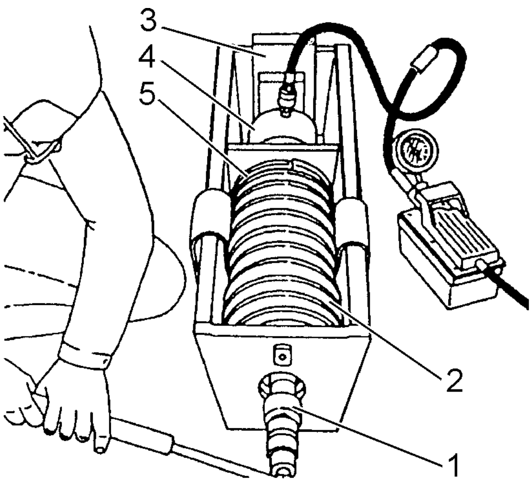


Fig. 14.56. Spring Reassembling

1. Bolt
2. Spring
3. Blocking
4. Ram
5. Spring Seat

50. INSTALLATION

1. Install captured spring (1, Fig. 14.57) with bolted end (2) towards front of track frame (3). The following ram tools are required to remove retainer bridge (Fig.'s 14.48 or 14.49).
2. Standard track frame:

   Install bolt adapter (4, Fig. 14.48) on retainer plug (3). Insert as an assembly, ram rod (1), ram tube (2) and retainer plug (3) with bolt adapter (4) in through front of track frame inserting retainer plug into bore of front spring retainer.

TRACK SPRING

NOTE: *Addition personal may be required to assist in aligning assembly into front spring retainer bore.*

3. Long or Low Ground Pressure track frame:

Install bolt adapter (5, Fig. 14.49) on retainer plug (4). Insert as an assembly, ram tube (3) and retainer plug (4) with bolt adapter (5) in through front of track frame inserting retainer plug into bore of front spring retainer.

NOTE: *Addition personal may be required to assist in aligning assembly into front spring retainer bore.*

Install ram rod (1) and tube extension (2) to ram tube (3).

4. Install straight support brace (1, Fig. 14.41) with wooden block (2) under head of ram rod (3). Position slightly bent support brace (1) in track frame.

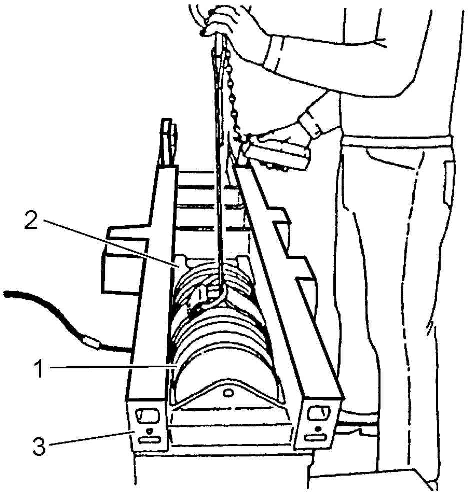


Fig. 14.57. Track Spring Installation

1. Captured Spring 3. Track Frame
2. Bolted End

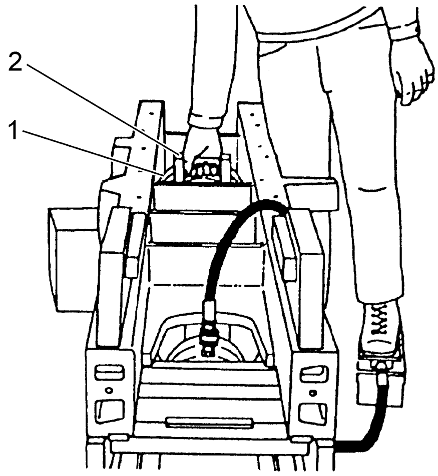


Fig. 14.58. Compression Tools Removing

1. Track Spring
2. Retainer Bridge

5. Install ram base plate (1, Fig. 14.42) in track frame against upper (2) and lower (3) guide.
6. Slide idler hole brace (3, Fig. 14.43) through track frame. Install interim brace (1) between ram base plate (2) and idler hole brace (3).
7. Install ram (1, Fig. 14.44), with piston rod completely retracted, onto support brace. Using a pry bar (2) take up slack between ram and ram rod (3).
8. Measure distance between end of ram (3, Fig. 14.45) and ram rod and install spacing (2) between rear of ram (3) and base plate (1).
9. Compress track spring (1, Fig. 14.58) and seat retainer bridge (2) squarely against spring retainer and frame support rib. Install locating bolt and nut. Back off ram and remove compression tools. Through access hole in frame, loosen spring bolt and remove.
10. The following ram tools are required to remove spring (Fig.'s 14.39 or 14.40).
11. Repeat Steps 3 through 11. Compress spring and remove bridge. Slowly release ram sitting spring and retainers squarely in track frame. Remove all compression tools.
12. Install track rollers to track frame and track frame to machine, refer to INSTALLATION under TRACK FRAME in this Section.
13. Install the front idler, refer to INSTALLATION under FRONT IDLER in this Section.
14. Install the track chain, refer to SECTION 15 for this procedure.

TRACK FRAME ALIGNMENT

51. TRACK FRAME ALIGNMENT (Refer to Fig. 14.59)

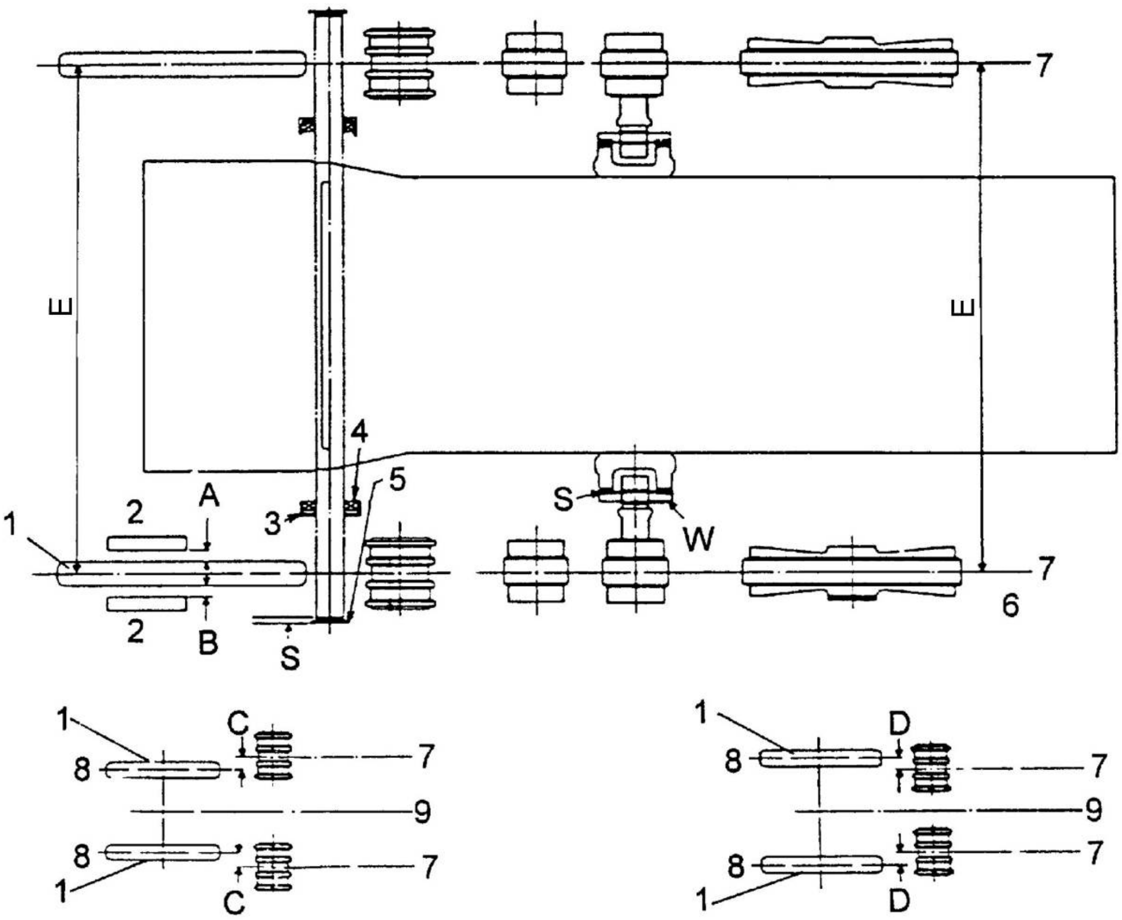


Fig. 14.59. Track Frame Alignment

1. Sprocket
2. Link
3. Housing Seal
4. Seal Shaft
5. Pivot Shaft Wear Plate
6. Front Idler
7. Track Frame Center Line
8. Sprocket Center Line
9. Dozer Center Line

W. Track Frame Guide Plate
C. Outside
D. Inside
S. Shims

E . . . . 1980 [mm]

Checking Alignment

1. Operate the machine on level terrain, stopping the machine in forward direction.
2. Measure the distance between the sprocket and track links A and B on both sides of machine. Measure distance between center line of sprockets and center line distance between front idlers. These should both check out to 1980 [mm]. Check to see if sprocket is in line and parallel to inside of center flange of rear roller.
3. Study these measurements and determine which direction track frame or frames must be moved to obtain proper alignment in relationship to sprocket. Track frame alignment is correct when center line dimensions C between sprockets are equal to center line dimensions C of front idler and sprocket indexes correctly with inside of center flanges of rear roller and distances A and B are equal. If alignment is not correct, proceed as follows:

TRACK FRAME ALIGNMENT

Correcting Alignment

4. If dimension B is greater than dimension A, it will appear as shown in view A, which is greatly exaggerated. If this condition exists, remove some or all of shims S at pivot shaft until dimensions A and B are equal. Then remove same amount of shims at track frame guide plate. Never use more shims than required, since this will unseat seal from rear frame when cover plate is installed. If dimension A is greater than dimension B, it will appear as shown in view B, which is greatly exaggerated. If this condition exists, add shims S at pivot shaft until dimensions A and B are equal. Then add same amount of shims at track frame guide plate. When all alignment is completed, torque all bolts.

METAL TYPE FACE SEALS

52. SEAL INSPECTION

IMPORTANT: *Do not intermix metal sealing rings; keep original mated rings as a set. Do not drop, bump or roughly handle these rings. Cleanliness is critical. Do not handle with dirty or greasy hands.*

1. Inspect the condition of the seal metal rings as described in the following steps to determine if existing kit seal could be reused or if a completely new seal is needed.

1A. Check condition of rubber seal rings. If any sign of wear, scratches, nicks, cuts, etc. replace complete seal. Inspect condition of metal ring seal surfaces as follows. Highly polished surfaces of rings must be free of chips, pocks and deep scratches.

1B. The narrow, highly polished sealing band must be within outer half of the sealing face (see Figs. 14.60 and 14.61).

1C. The narrow band must be uniform and be concentric with the I.D. and O.D. (see Figs. 14.61 and 14.62).

2. If the metal rings do not conform to the specifications described, discard seal and replace with new. If the metal rings do conform, they must be cleaned and checked as follows:

2A. Remove any corrosion or hardened material that may exist on surface **A** (see Fig. 14.63). Use a scraper and/or any stiff bristled fiber brush to remove this material from entire surface.

2B. Wash the metal rings with non flammable solvent to remove all oil and wipe dry. Use a lint free wiper to remove all traces of oil or grease from all surfaces.

2C. Apply a thin coat of clean SAE 30 oil on sealing face only (see Fig. 14.63) of metal rings. Do not allow oil to wet other surfaces. Slide sealing faces of two metal rings together.

2D. If the rings have been properly cleaned and oiled, the bottom ring should cling to the top ring for a minimum of two seconds when the top ring is picked up and held an 30 [mm] above a table surface. Failure to meet this requirements indicates that the metal rings are unusable or dirty. Repeat Steps 2A. through 2D. to verify this condition. If separation condition persists, discard seal kit and replace with new.

2E. Cover usable metal rings in a lint free wrapping until ready for installation. Refer to SEAL INSTALLATION under METAL TYPE FACE SEALS in this Section for the proper handling and installation of a new seal kit.

METAL TYPE FACE SEALS

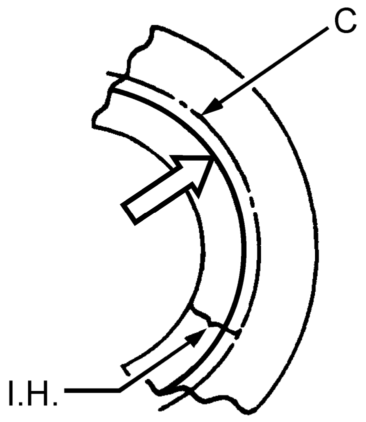


Fig. 14.60. Metal Ring Acceptable for Rebuild

Arrow (⇨) shows narrow highly polished sealing band concentric with I.D. and O.D. and within outer half of sealing face.

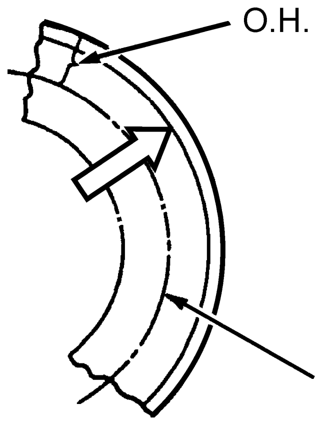


Fig. 14.61. Metal Ring Acceptable for Rebuild

Arrow (⇨) shows narrow sealing band within inner half of sealing face.

C – Center of Sealing Face
O.H. – Outer Half of Sealing Face
I.H. – Inner Half of Sealing Face

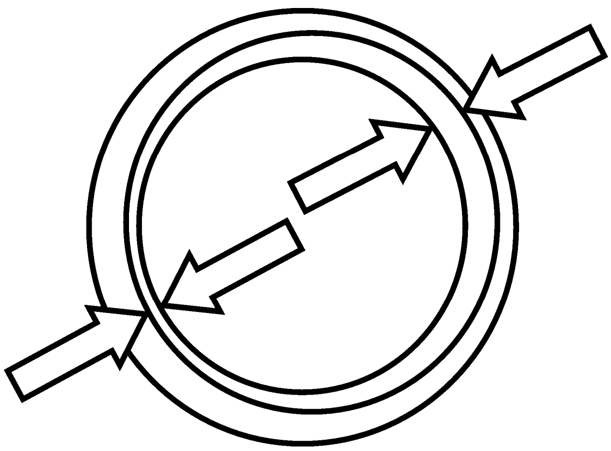


Fig. 14.62. Metal Ring Not Acceptable for Rebuild

Arrows (⇨) show sealing band not concentric with I.D. and O.D.

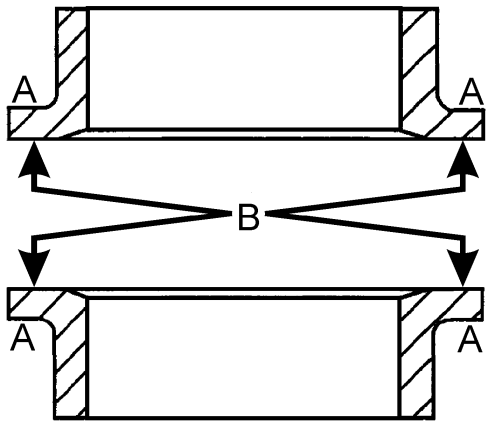


Fig. 14.63. Rubber Ring and Sealing Surfaces of Metal Face Type Oil Seal

A – Rubber Ring Surfaces
B – Sealing Faces

53. SEAL INSTALLATION

NOTE: *Cleanliness is critical when handling seals. never handle seal with greasy, oily or dirty hands. Keep the seals in their original packages until ready for assembly. Do not do not drop, bump or roughly handle the metal sealing rings as the mating surfaces of these ring shave a highly polished finish that could be damaged by careless handling.*

1. Brake shrinkable protector plastic, if exist. Remove any corrosion or hardened material that may exist on surface (1, Fig. 14.64) that contact rubber rings. Use a non petroleum base solvent and wipe dry with a lint free wrapper. Make sure outer edge (2) is free of burrs.

METAL TYPE FACE SEALS

2. Carefully remove shrinkable plastic and gently "slide" (1, Fig. 14.65) two seal halves apart. Be careful not to scratch or damage seal faces. Do not cut or damage rubber rings. Metal ring faces must not be damaged or contaminated. Check to be sure rubber rings are seated flush against inside shoulder (2) of metal ring.

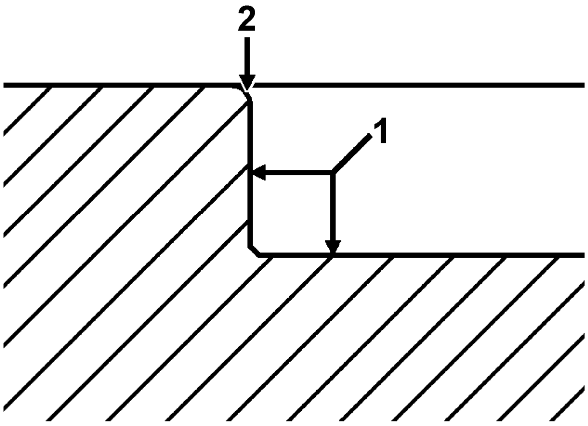


Fig. 14.64. Metal Ring Surfaces Checking

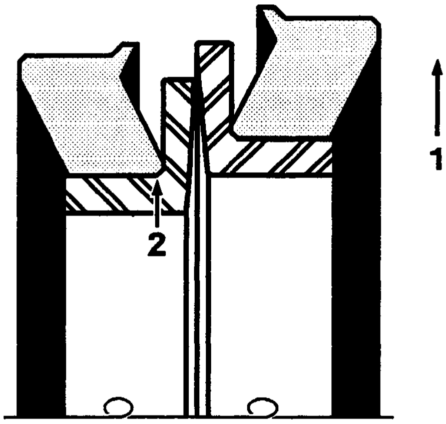


Fig. 14.65. Metal Ring Faces Checking

3. Install one seal half (1, Fig. 14.66) into receptacle (2) so protruding lip just contacts seal bore. Press with both clean hands (180 [°] apart) against metal ring until rubber ring is evenly seated against bore shoulder. Make sure seal is not cocked in bore. Repeat procedure for other seal half (3) and receptacle (4). Wipe both metal ring sealing faces clean (5) with a lint free wiper. Apply a light coat, just enough to wet faces, of clean lubricant (6) to seal faces of metal rings.
4. Final installation assembly will energize seal as shown in Fig. 14.67, so that rubber rings load seal and drive mating metal rings together.

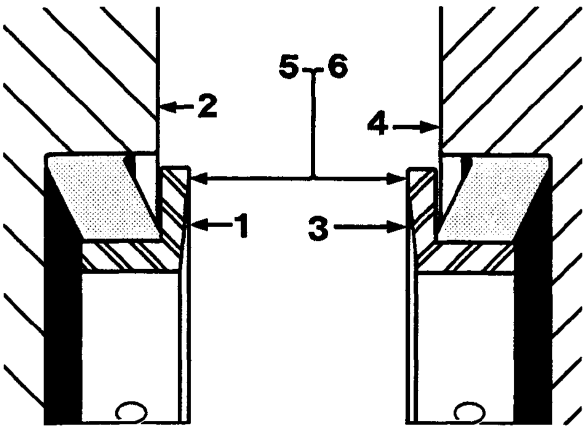


Fig. 14.66. Seal Kit Preparing for Installation

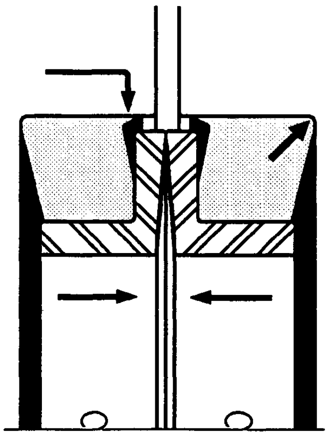


Fig. 14.67. Seal Kit Final Installation

SECTION 15

TRACKS OR WHEELS

TRACKS OR WHEELS

SECTION 15

CONTENTS

SERVICE/SPECIAL TOOLS

TRACK CHAIN

SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS

DESCRIPTION	TOOL NUMBER
Seal Tester and Lubricator	1262363H91
Vacuum Pump	5P2420
100 [Ton] Portable Track Press	DR11-802
Or 100 [Ton] Hydraulic Portable Track Press (Hand Pump)	910-50-0300
Or 100 [Ton] Hydraulic Portable Track Press (Power-Driven Pump)	910-50-0400
Auxiliary tooling for 100 [Ton] Hydraulic Track Press	910-50-0500
Twin Head Hydraulic Track Table Press and Small Hydraulic Ram	Purchase Locally
Plug mounting tool	15.547.0003
Pin hole punching header	15.547.0004

TRACK CHAIN

2. DESCRIPTION

The track assembly is composed of a track chain and track shoes. The track chain consists of drop-forged, heat-treated steel links which are held together by bushings and pins to form a continuous chain. The bushings and pins are a press-fit in the links, with the pins pivoting inside of the bushings. The left and right track chains are interchangeable. Each track has a split master link. Belleville washers (dry sealed tracks) are used in the counterbored portion of the link to seal against the entrance of abrasives. Seals and O-rings (lubricated tracks) are used to seal counterbored portion of the link. The track shoes are attached to the track links, and they are held in place with special heat-treated bolts and nuts.

3. SPECIFICATIONS

Pin and Bushing

Pin and bushing (pitch) (4 link) . . . . 863.6 $\pm$ 0.4 [mm]
Maximum permissible track chain pitch wear (4 link) . . . . 12.7 [mm]

Track Shoe

Track shoe grouser height . . . . 66 [mm]
Maximum permissible grouser wear . . . . 34 [mm]
Number of track shoes (STD) (one track) 40
Number of track shoes (LGP, LT) (one track) 42

Track Link

Track link height . . . . 127 [mm]
Maximum permissible track link wear . . . . 13 [mm]

Track Pin Bushing

Track pin bushing OD . . . . 72.7 [mm]

TRACK CHAIN

Maximum permissible track pin bushing wear:
OD dry sealed tracks . . . . 3.1 [mm]
OD lubricated tracks . . . . 6.2 [mm]

Track chain adjustment:

Dry sealed tracks:
in normal . . . . 25 - 38 [mm]
in mud or snow . . . . 38 - 50 [mm]

Lubricated tracks:
in normal . . . . 38 - 64 [mm]
in mud or snow . . . . 64 - 76 [mm]

Special Bolt Torque Data
(Torques given are for bolts and nuts lubricated with SAE-30 engine oil)

NOTE: *Except for the special torques shown all bolts and nuts are to be given a standard torque. Refer to SECTION 1.*

Track Shoe

Track shoe and split link bolts
Mounting torque . . . . 400 ± 70 [Nm] + 120 [°] of turn
Checking torque . . . . 700 [Nm]

4. SERVICE DIAGNOSIS

For service diagnosis of the tracks refer to ”SERVICE DIAGNOSIS” in SECTION 14, SUSPENSION.

5. MAINTENANCE

The track links have only one wearing surface which contacts the track rollers, front idler and track idlers. However, it usually becomes necessary to replace pins and bushings before the links wear out, and it is a matter of judgement then whether the links are good enough to justify a new set of pins and bushings. Only the wear on the outside of the bushings is visible. Wear on the pins and interior of the bushings is indicated by track „stretch” (forward adjustment of the front idler).

The amount of wear can be determined by measuring the pitch length of the track (distance between centers of pins) under tension and comparing it with the new and maximum allowable pitch lengths listed in SPECIFICATIONS in this Section.

Sprocket wear must also be considered in conjunction with track chain wear. Wear of the sprocket teeth decreases the pitch length of the sprocket, while wear of pins and bushings increases the pitch length of the track. The results are that the pitch lengths of the sprocket and track become more and more out-of-phase, and the bushings ride higher on the sprocket teeth. Combined wear of sprocket and track should never be allowed to reach this point as spinning of the sprocket may result and cause serious breakage. Whenever new or rebuilt chains are installed, the sprocket rims should also be replaced or interchanged to present the better side of the teeth to the bushings.

TRACK CHAIN

Never remove one link to bring a ”stretched” track to within the range of proper track adjustment. A track that is worn badly enough to take up the length of one link, will be so far out of pitch that the increased wear on the sprocket will far more than offset the saving obtained by the removal of one link in the track chain. Refer to "Rotating the Track Pins and Bushings" in Par. 7 ”TRACK CHAIN REPAIR”.

Improper track tension and loose track shoes will cause damage and premature wear to the track. Periodically inspect the track shoe bolts. If necessary, install new bolts and tighten to the proper torque (Fig. 15.2). Inspect the tension of the track chain, and tighten if necessary (Fig. 15.1A).

When new tracks or track shoes are installed, the track tension and track shoe bolts must be checked after first 10 hours and adjusted if necessary.

Checking Track Tension (Refer to Fig. 15.1)

Place a wooden block approximately one foot in height, under the foremost track shoe lug. Drive the machine forward until the track chain is tight along the ground and around the sprocket. Apply and lock the brake pedal, lock the transmission shift lever in NEUTRAL position and stop the engine, turn the master switch off and remove the key. Track tension measurement after drive in reverse and stopping shall give incorrect results. Stand on the track between the front idler and the first track idler in order to accumulate all the chain slack at this point. Place a straightedge on the track so the ends rest over the front idler and track idler. Measure the clearance between the bottom of the straightedge and the top of the shoe grouser with a ruler at the midway point between the idlers. If this clearance is not to specifications adjust track tension according to specifications in Par. 3.

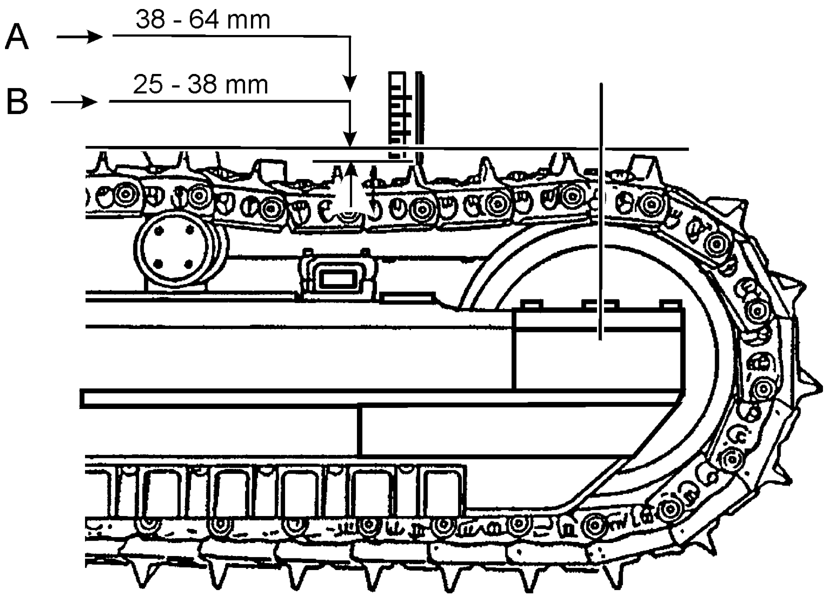


Fig. 15.1. Checking Track Tension

A. Track Sag of Lubricated Chain B. Track Sag of Non-lubricated Chain

Adjusting Track Tension (Refer to Fig. 15.1A)

Track chains are adjusted by hydraulic pressure. Lubricant is introduced into the hydraulic cylinder (which is attached to the front end of the track spring housing) by the use of a lubrication fitting (2). This lubricant, acting upon the piston within the hydraulic cylinder, forces the front idler fork and front idler forward for track adjustment. The relief valve port (1) is used to relieve the hydraulic pressure.

TRACK CHAIN

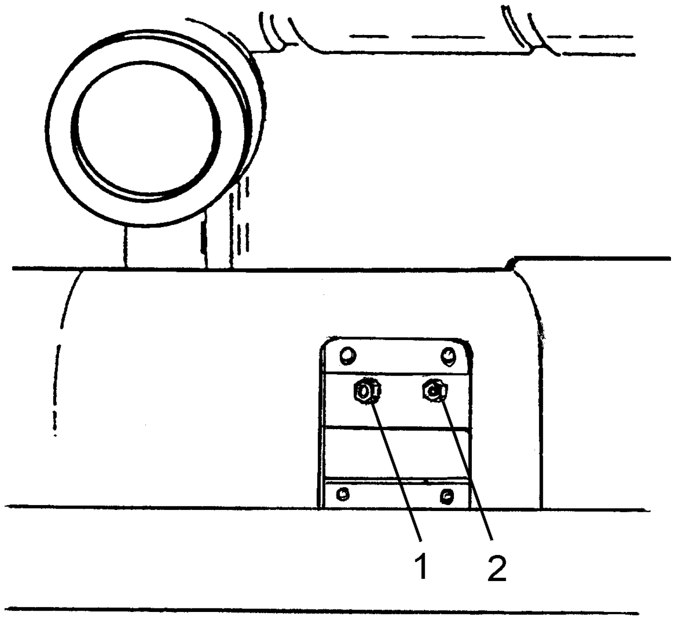


Fig. 15.1A. Track Adjuster

1. Relief Valve
2. Lubrication Fitting (Check Valve)

DANGER! To avoid possible injury, always stand to the side of the bleeder plug when making track adjustment. The pressure in the front idler fork is held by the check (2) and the relief (1) valve. A loose or improper fit of either of these parts can allow them to be ejected by the pressure of the lubricant, causing possible injury. When increasing track tension, be sure these parts are properly torqued. When relieving track tension, never loosen these valves more than 2 – 2 ½ turns.

If adjustment becomes necessary, remove the capscrews securing the track adjuster cover to the track frame and proceed as follows:

Increasing Track Tension (Refer to Fig. 15.1A)

WARNING! Before adding lubricant for track adjustment, be sure the check (2) and relief (1) valves are properly torqued to 61 – 75 [Nm].

1. Connect the lubricator nozzle to the fitting.
2. Determine the amount of adjustment necessary and add lubricant to obtain proper track chain tension. It is advisable to move the machine forward and backward slightly to be sure the correct tension has been obtained.

Relieving Track Tension (Refer to Fig. 15.1A)

1. Before relieving track tension, insert a wire through the relief passages in the manifold to clear them of any possible obstruction.
2. Loosen the relief valve (1) one-half to one full turn. This opens a relief passage for the pressurized lubricant. If lubricant does not escape through the relief passage, loosen the check valve (2) one-half to one full turn to allow the pressurized lubricant to escape from the opposite relief passage.

TRACK CHAIN

WARNING! Use extreme care when relieving pressure with the following emergency method. If loosened excessively, the relief valve or check valve can be ejected by cylinder pressure. Never loosen the check and relief valves more than a total of 2-1/2 turns.

3. Should the relief passages become blocked, unscrew the relief valve (1) an additional 1-1/2 to 2 turns (2-1/2 total turns). If lubricant still does not appear, tighten the relief valve and unscrew check valve (2) an additional 1-1/2 to 2 turns (2-1/2 total turns).
4. When the proper tension has been obtained, secure the relief valve and check valve using 61 - 75 [Nm] torque.

After all adjustments are completed, secure the track adjuster cover to the track frame.

Track Shoe Bolts

On a new track chain, the track shoe bolts must be tightened after the first 10 hours of operation or until it becomes evident that the shoes have become permanently set (Fig. 15.2). Torque the bolts to 700 [Nm]. Strike the heads of the bolts several heavy blows with a hammer when retightening them.

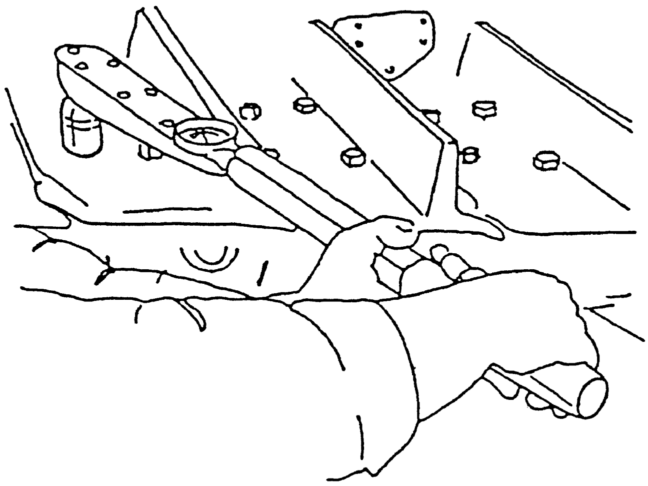


Fig. 15.2. Checking Track Shoe Bolts Torque

NOTE: *If tight a new removed shoe bolt torque the one to 400 ± 70 [Nm] + 120 [°] of turn.*

WARNING! As a safety measure, use goggles to protect your eyes while striking bolts.

IMPORTANT: *Do not use common bolts in the track shoes.*

6. REMOVAL

1. Move the machine forward until split link is located on front lower half of front idler as shown in Fig. 15.3 and block up under track.

TRACKS OR WHEELS

TRACK CHAIN

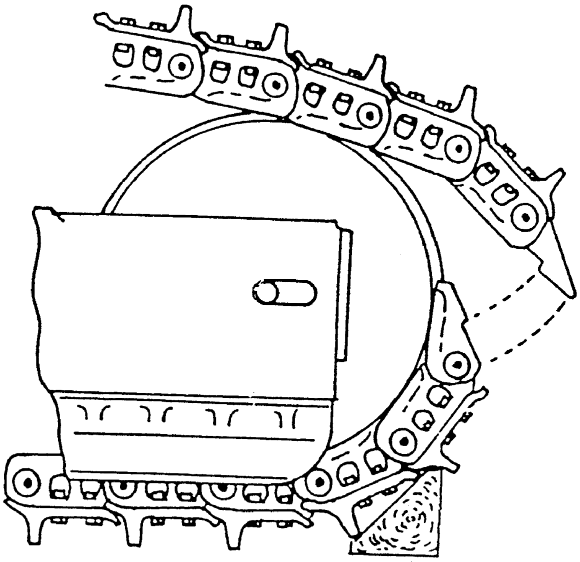


Fig. 15.3. Removing Split Link

WARNING! Before disconnecting track chain, be sure to first relieve pressure on hydraulic track adjuster. This must be done for safety reasons even if there is the slack in chain. To insure that there is no pressure against the idler, pry the front idler and fork back away from the front idler stops.

2. Remove the master link track shoe bolts.

DANGER! Everyone must be clear and well away from the track chains and dozer before performing step 3 and 4. When the sprocket rotates, the track chain will roll rearward, falling to the ground, which can cause serious bodily injury or death.

3. Start the machine and slowly turn the sprocket counterclockwise. Continue to rotate the sprocket slowly until upper section of the track chain is on the ground and free of sprocket.
4. Place a plank flush against the rear of the track when the track is flat on the ground as shown in Fig. 15.4. The plank should be approximately the same thickness as the track and long enough so that the entire dozer can rest on the plank. If a new track is to be installed, remove the old chain as described above, and place the new chain on the ground ahead of the dozer, with the open link end flush against the front of the old chain.

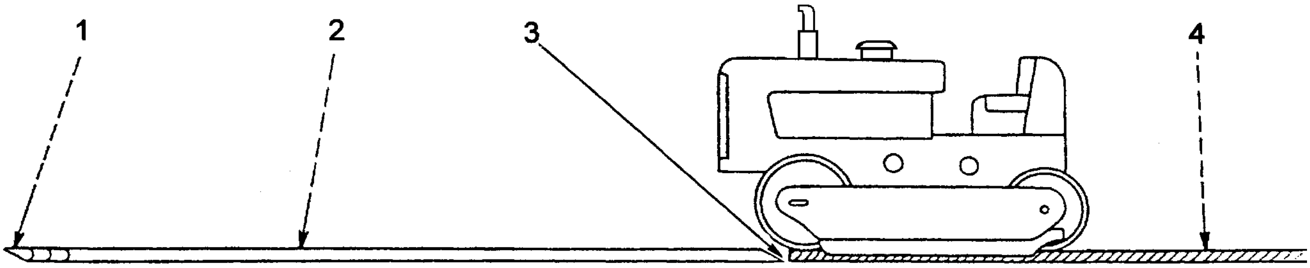


Fig. 15.4. Removing the Track Chain

1. End with Wearing Surface
2. New Track
3. End with No Wearing Surface
4. Plank or Old Track

TRACK CHAIN

7. TRACK CHAIN REPAIR

To repair or replace worn track pins, bushings or links, a hydraulic track press will be necessary. The operation and procedure instructions for each track press will vary, so specific disassembly instructions will be found with the manufacturer's operational instructions.

LUBRICATED TRACK SYSTEM

Sprocket wear must also be considered in conjunction with track chain wear. Wear of sprocket teeth decreases pitch length of track. Results are that pitch lengths of sprocket and track become more and more out-of-phase; and bushings ride higher on sprocket teeth. Combined wear of sprocket and track should never be allowed to reach this point as spinning of sprocket may result and cause serious breakage whenever new or rebuilt track chains are installed. Sprockets should also be replaced.

Never remove one link to bring a stretched track to within range of proper track adjustment. A track that is worn badly enough to take up length of one link will be so far out of pitch that increased wear on sprocket will far more than offset saving obtained by removal of one link in track chain. Refer to CHECKING UNDERCARRIAGE WEAR in SECTION 14.

Sealed and lubricated track pins have a hollow center which is used as an oil reservoir. A cross-drilled passage permits oil to enter bushings for lubrication of pins, bushings and oil seals. If seals become dry, dirt can enter and cause sealing surface of bushing to wear. Track chains are factory lubricated; no oil level checks are necessary.

Leaking joints can be detected by any of following methods:

Oil leakage noted at joint area, very difficult on units operating in field. Hand feel for warm or hot bushings after machine has been running. Check for extending chain pitch. Squeaking while going around front idler or sprocket. When it has been determined which joint is leaking, joint should be identified for repair. One method of identification is to spray paint squeaking joint.

NOTE: *Two methods of repairing a track are available. One method is to repair complete chain using a twin-head hydraulic track table press. Another method is to rebuild only leaking chain joints using a portable 100 ton track press (refer to SERVICE/SPECIAL TOOLS in this Section).*

COMPLETE CHAIN REBUILD

Disassembly

1. Remove track shoes. Using a slow-speed drill and a 12 mm drill bit, remove rubber plugs (11, Fig. 15.5) from pins (5). Position track chain on track press so that bushing end (non-threaded end) (3 and 4) of split link is toward rams.

2. Install disassembly adapters on ram heads. Advance track and lower table so split link drops into saddle. Press pin out of right link (9), then press pin out of left link (8). Remove loose split links from press. Advance track so next link drops into saddle. Press pin (5) and bushing (6) out of right link (9), then press pin and bushing out of left link (8). Remove loose links, bushing and pin from press. Repeat this step with remaining sections of chain. Remove seals (10) from track links. Inspect parts for wear/damage or improper assembly. Discard any parts which would adversely affect rebuild.

3. Tag all mating parts if installed later.

TRACK CHAIN

Reassembly

1. Dress up parts with emery cloth as required. Clean parts. On new or reused pins, mark an index mark (1, Fig. 15.6) on lube hole (2) end of pins on opposite side of cross-drilled hole (3).

2. Install assembly adapters on ram heads. Bolt halves of split links together and position them on press assembly adapters. Position a bushing (6, Fig. 15.5) in press saddle. Press links (3 and 4) onto bushing until bushing is seated against assembly adapter. Remove bolts securing two halves together. Advance track on press and position a pin (5) in assembled bushing (6). Apply a coat of oil on ends of bushing with tissue (not your fingers) as shown in Fig. 15.8, being careful not to get it on pin surface. Position next bushing (6) in press saddle. Check that seal halves are properly assembled as shown in Fig. 15.7.

3. Install O-rings (2) and seals (1) and thrust rings (7) in counterbore of next track links (8 and 9, Fig. 15.5) and apply LOCTITE #680 sparingly in outer half of pin bore of links (8 and 9) as shown in Fig. 15.9. Position links on press assembly adapter. Check that index mark (1, Fig. 15.6) is at bottom. Lube holes (2) must all face in same direction.

4. Press links (8 and 9, Fig. 15.5) onto pins (5) and bushings (6) being sure that link counterbore and bushing face are seated thrust ring (7). Do not exceed force indicated as this can damage ring (7). Do not adjust links for bolt hole location. Before chain is moved to next position, pressurize joint with 350 [kPa] of air pressure. After pressure holds for 10 [sec], place a special purpose rubber plug in end of pin of assembled joint using mounting tool (refer to SERVICE /SPECIAL TOOLS in this Section). Tap it in until it is flush or slightly below chamber of pin hole.

5. For final check of the seal use seal tester or vacuum pump (refer to SERVICE/SPECIAL TOOLS in this Section). Insert lubricator nozzle of tool through plug. Pull a vacuum of 70 ± 5 [kPa] and hold for 10 [sec]. In event that vacuum cannot be held, either seal to bushing face or chain pin to link bore mating surfaces are leaking. To determine which side is leaking, pressurize joint with 350 [kPa] of air pressure, apply soap solution to both seal areas and check for soap bubbles. After finding which side is leaking, joint must be rebuilt. If vacuum holds for 10 [sec], fill evacuated pin with oil under 100 to 170 [kPa] to obtain required oil level 54 to 74 [mm] below the end face of the pin.

   Use oil recommended in OPERATOR'S MANUAL with 0.02% red dye. Remove lubricator. Remove special purpose plug and install proper plug (11, Fig. 15.5) using mounting tool (refer to SERVICE/SPECIAL TOOLS in this Section). Tap it in until it is 3 [mm] below chamfer edge of pin hole. After installing plug punch the pin hole around its chamfer edge using header (refer to SERVICE/SPECIAL TOOLS in this Section) to prevent plug from escaping.

NOTE: *Once joint is lubricated, there is no way of checking for leaks.*

6. Install track shoes on chain (refer to SERVICE /SPECIAL TOOLS in this Section). Prepare chains for transport back to machine.

TRACK CHAIN

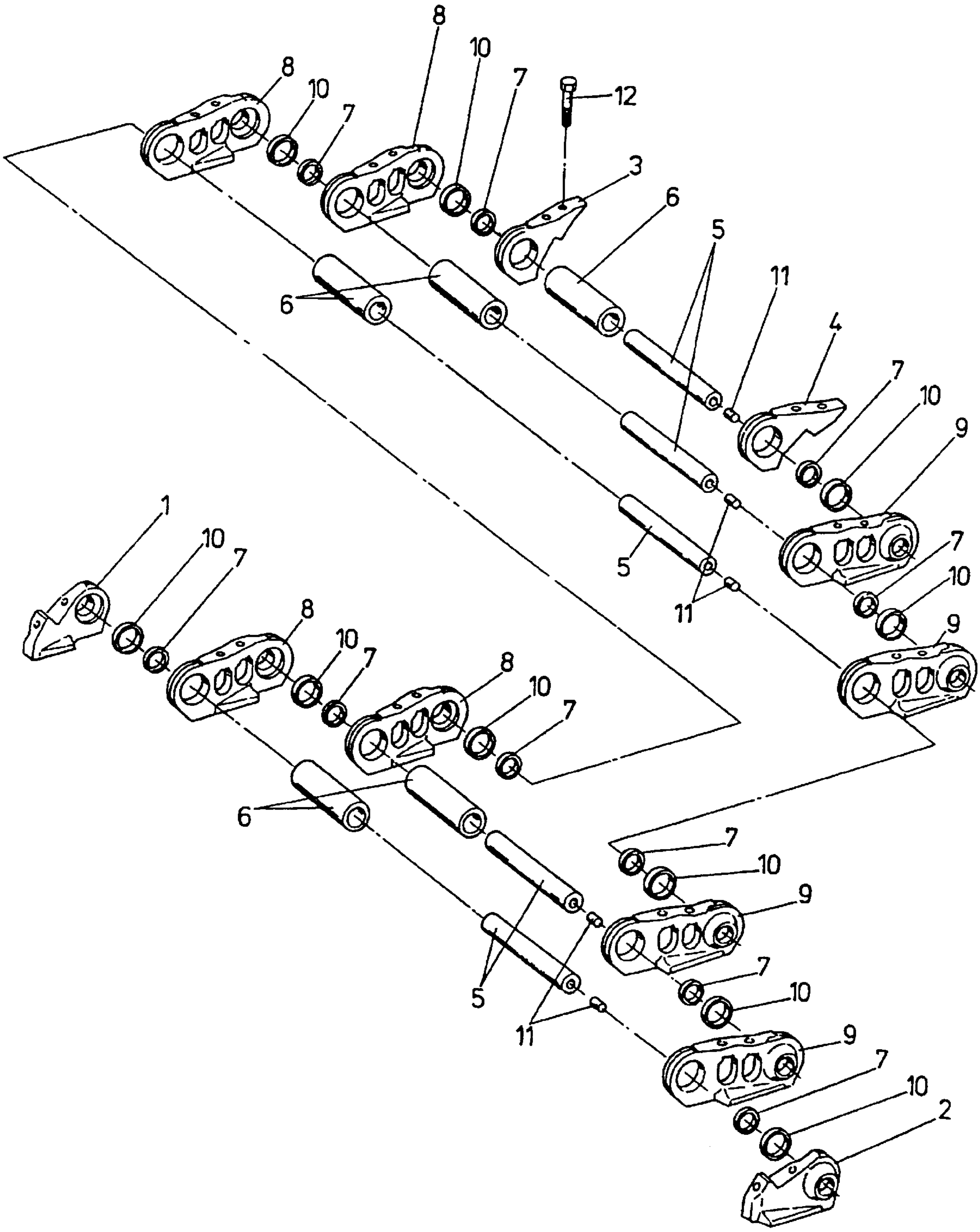


Fig. 15.5. Exploded View of Lubricated Track System

1. Left Link, on Pin	5. Pin	9. Right Track Link
2. Right Link, on Pin	6. Bushing	10. Track Seal
3. Left Link, on Bushing	7. Thrust Ring	11. Pin Plug
4. Right Link, on Bushing	8. Left Track Link	12. Bolt

TRACK CHAIN

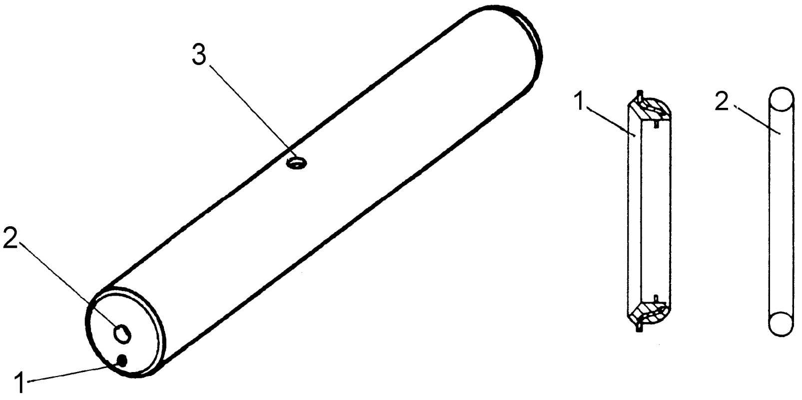


Fig. 15.6. Pin

1. Index Mark
2. Lube Hole
3. Cross Drilled Hole

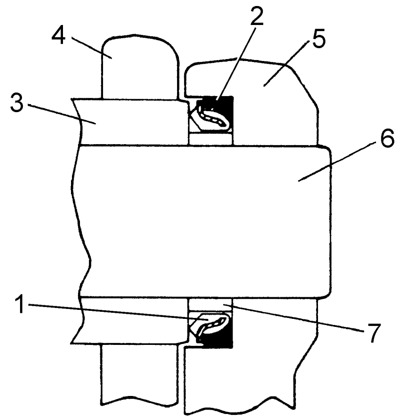


Fig. 15.7. Seal Assembly

1. Track Seal
2. O-Ring
3. Bushing
4. Track Link
5. Track Link
6. Pin
7. Thrust Ring

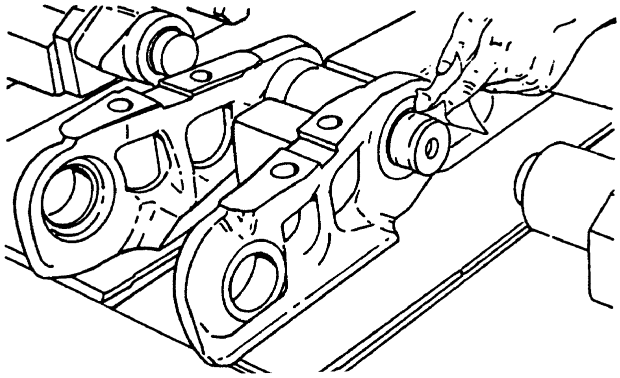


Fig. 15.8. Coat of Oil to Bushing

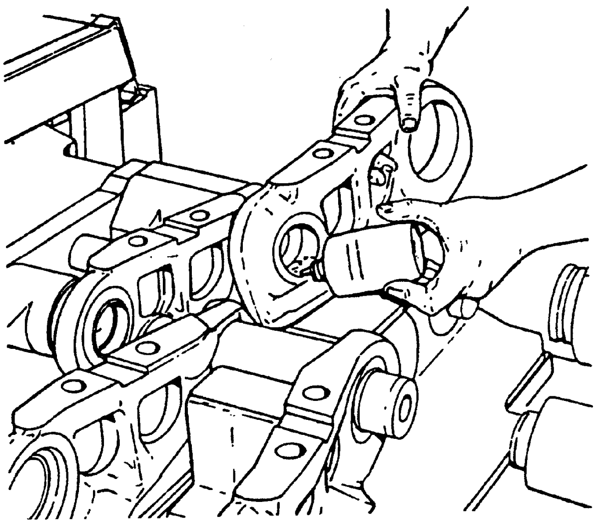


Fig. 15.9. LOCTITE #680 to Pin Bore

SINGLE CHAIN JOINT REBUILD

Disassembly

NOTE: *Track must be on floor and be blocked up on each side of pin to be removed.*

Assemble Ram (Fig. 15.10) as follows:

Install hoses from pump to ram. Thread connecting rods (3) into cylinder (1). Install bolster (2) on connecting rods (3). Thread nuts (6) on connecting rods (3).

NOTE: *Be sure connecting rods are fully threaded into cylinder. Position rods between tracks. Be sure nuts are fully threaded on connecting rods.*

TRACK CHAIN

Pin Removal (Fig. 15.11)

1. Using a slow speed drill and a 12 [mm] drill bit, remove rubber plug from leaking joint pin. Thread forcing pin (8) on cylinder rod (5).

NOTE: *Be sure forcing pin is fully threaded on rod.*

2. Install pin receiver (9) to bolster (2). Align forcing pin on track pin and press track pin out. Remove oil seals and spacers from track links. Inspect parts for wear or damage.

NOTE: *If bushing removal is not required, proceed with Step 1 under pin installation. If bushing removal is required, refer to bushing removal.*

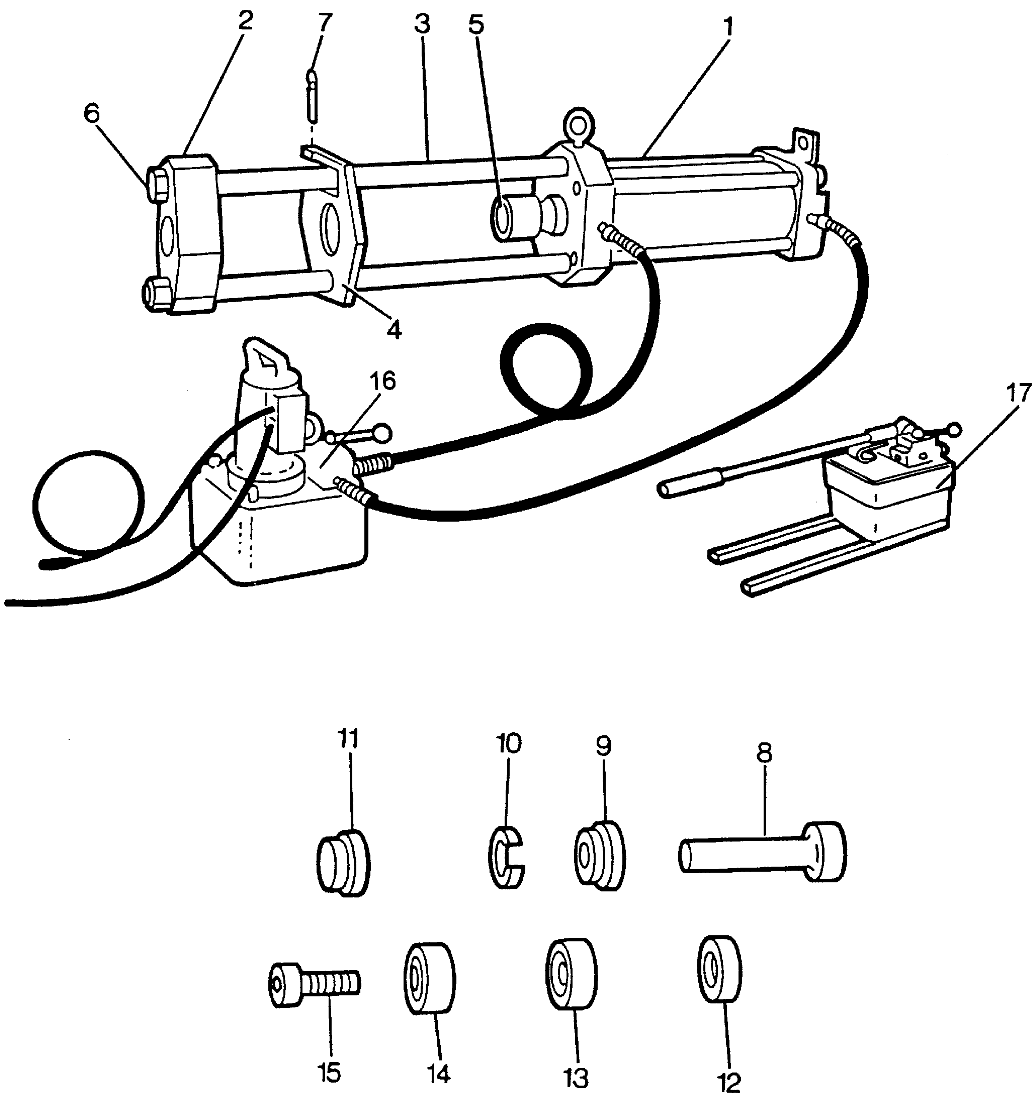


Fig. 15.10. 100 Ton Ram - DR11-802

1. Cylinder Assembly
2. Bolster
3. Connecting Rods
4. Guide Plate
5. Cylinder Rod
6. Connecting Rod Nut
7. Hitch Pin
8. Forcing Pin
9. Pin Receiver
10. Bushing Adapter
11. Pin Adapter
12. Bushing Receiver
13. Ram Cap
14. Adapter Plug
15. Cap Screw
16. Electric Pump
17. Hand Pump

TRACKS OR WHEELS

TRACK CHAIN

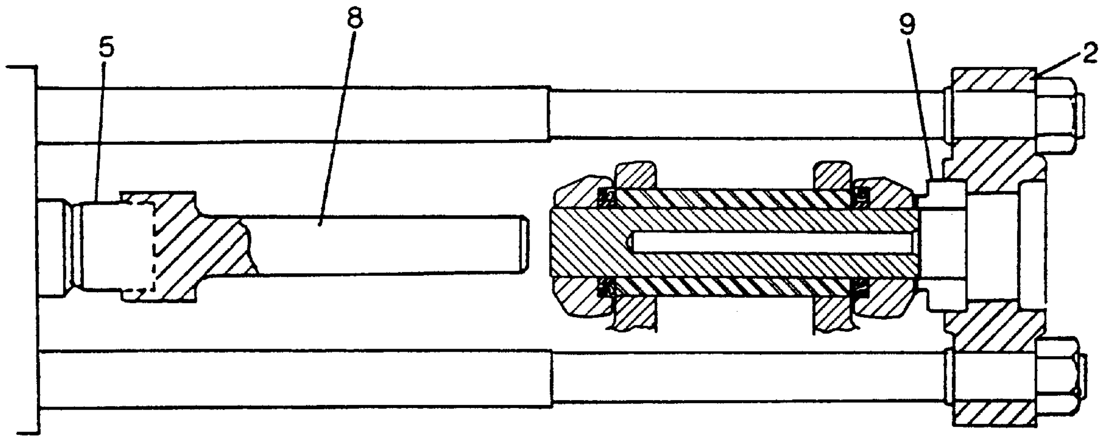


Fig. 15.11. Pin Removal

2. Bolster
5. Cylinder Rod
8. Forcing pin
9. Pin Receiver

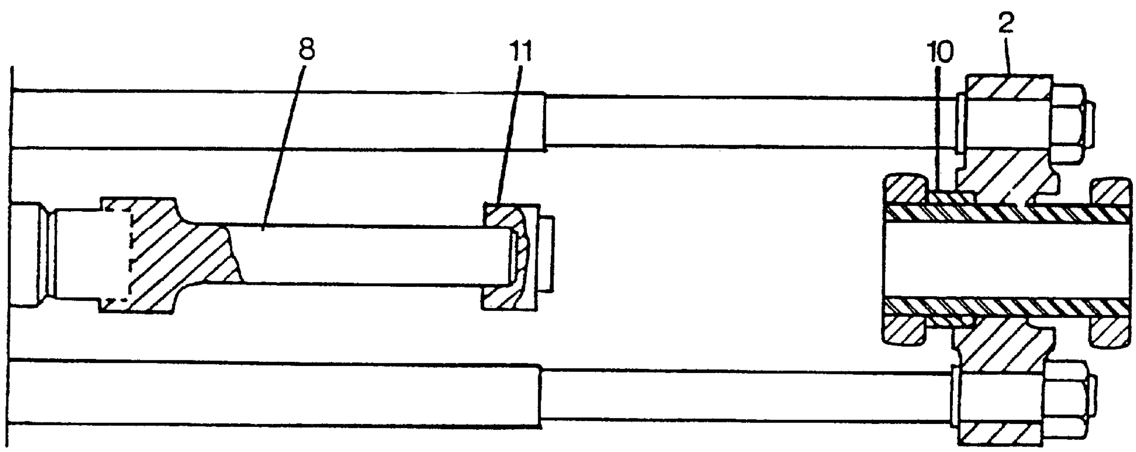


Fig. 15.12. Bushing Removal

2. Bolster
8. Forcing Pin
10. Bushing Adapter
11. Pin Adapter

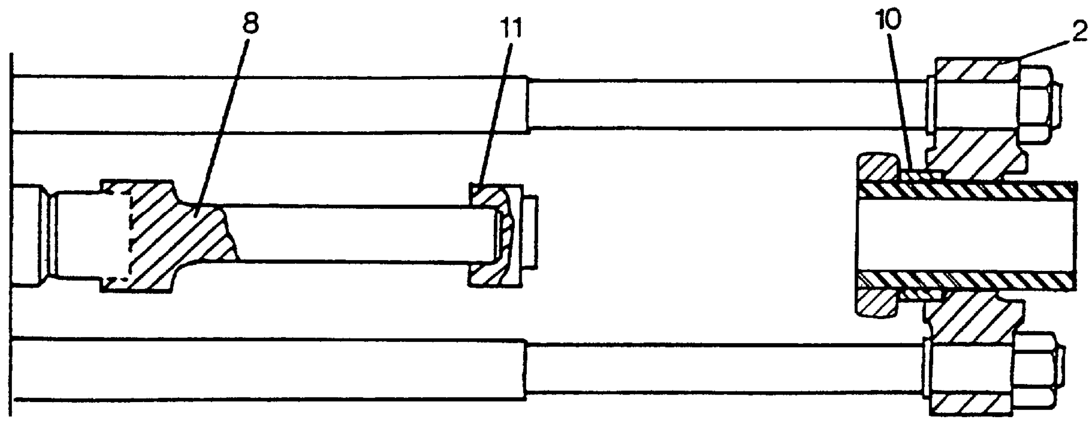


Fig. 15.13. Bushing Removal

2. Bolster
8. Forcing Pin
10. Bushing Adapter
11. Pin Adapter

TRACK CHAIN

Bushing Removal (Fig.'s. 15.12 and 15.13)

1. Using a slow speed drill and a 12 mm drill bit, remove rubber stopper from pin next to previously removed pin. Align forcing pin on track pin and press track pin out. Remove pin receiver from bolster (2). Install bushing adapter (10) in bolster (2). Install pin adapter (11) on forcing pin (8). Press bushing off link. Reposition ram and press bushing off other link.

Reassembly

Bushing Installation (Fig.'s. 15.14 and 15.15)

1. Clean up parts with emery cloth as required. Remove bushing adapter from bolster (2). Install bushing receiver (12) in bolster (2). Align ram and press bushing into link until it bottoms against bushing receiver (12). Reposition ram and press bushing into other link. Install new seals (Fig. 15.15) and spacers in links.

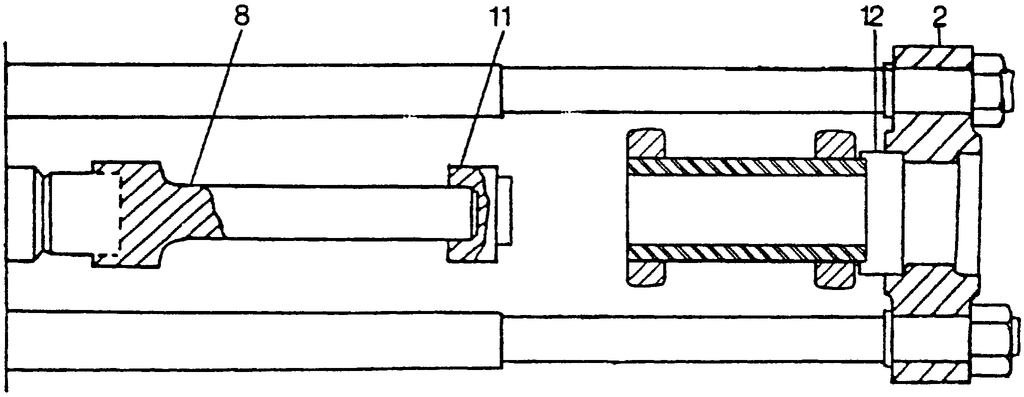


Fig. 15.14. Bushing Installation

2. Bolster 8. Forcing Pin 11. Pin Adapter 12. Bushing Receiver

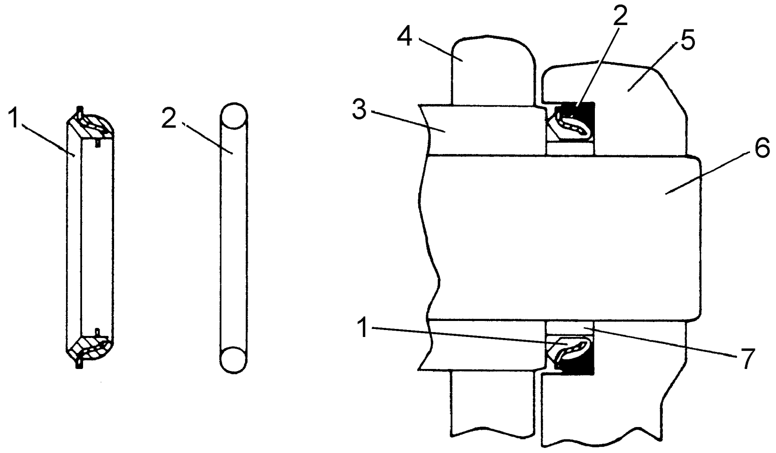


Fig. 15.15. Seal Installation

1. Track Seal
2. O-Ring
3. Bushing
4. Track Link
5. Track Link
6. Pin
7. Thrust Ring

Pin Installation (Fig. 15.16)

1. On new or reused pin, make an index mark on lube hole end of pin opposite cross-drilled hole. Remove nuts and bolster from connecting rods. Install guide plate (4) with hitch pin (7). Reinstall bolster and connecting rod nuts.

TRACK CHAIN

NOTE: *Be sure nuts are fully threaded on connecting rods.*

2. Remove forcing pin and pin adapter from ram. Install ram cap (13) on ram. Install adapter plug (14).

NOTE: *Be sure ram cap is fully threaded on ram. Be sure ram cap bolt is fully threaded into ram cap.*

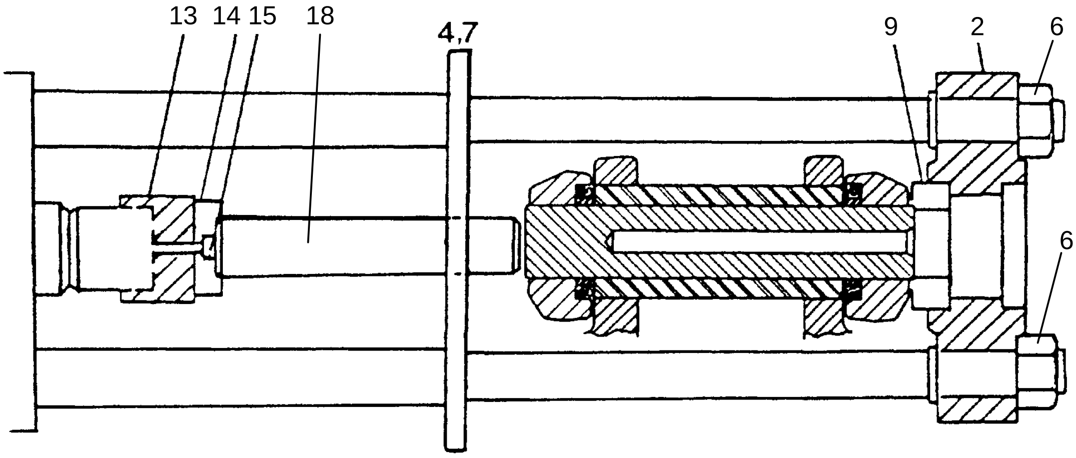


Fig. 15.16. Pin Installation

2. Bolster	7. Hitch Pin	14. Adapter Plug
4. Guide Plate	9. Pin Receiver	15. Ram Cap Bolt
6. Connecting Rod Nut	13. Ram Cap	18. Pilot Pin

3. Remove bushing receiver (12, Fig. 15.14) from bolster (2). Install pin receiver (9) to bolster (2).
4. Position pilot pin (18) in track assembly so that pilot pin fits freely. Position new track pin in guide plate (4) with index mark (1, Fig. 15.6) facing toward track shoe mounting surface cross-drilled hole (3, Fig. 15.6) will be facing away from track shoe mounting. Apply LOCTITE #680 in bore of link and on OD of track pin. Align track pin on adapter plug (14), guide plate (4) and pilot pin (18) and press track pin in until it bottoms.
5. Repeat Steps 1 through 4 for other track pin.
6. For initial check of the seal pressurize joint with 350 [kPa] of air pressure. After pressure holds for 10 [sec], place a special purpose rubber plug in end of pin of assembled joint using mounting tool (refer to SERVICE/SPECIAL TOOLS in this Section).Tap it in until it is flush or slightly below chamber of pin hole.
7. For final check of the seal use seal tester or vacuum pump (refer to SERVICE/SPECIAL TOOLS in this Section). Insert lubricator nozzle of tool through plug. Pull a vacuum of 70 ± 5 [kPa] and hold for 10 [sec]. In event that vacuum cannot by held, either seal to bushing face or chain pin to link bore mating surfaces are leaking. To determine which side is leaking, pressurize joint with 350 [kPa] of air pressure, apply soap solution to both seal areas and check for soap bubbles. After finding which side is leaking, joint must be rebuilt. If vacuum holds for 10 [sec], fill evacuated pin with oil under 100 to 170 [kPa] to obtain required oil level 54 to 74 [mm] below the end face of the pin.

   Use oil recommended in OPERATOR’S MANUAL with 0.02% red dye. Remove lubricator. Remove special purpose plug and install proper plug (10, Fig. 15.5) using mounting tool (refer to SERVICE/SPECIAL TOOLS in this Section). Tap it in until it is 3 [mm] below chamfer edge of pin hole. After installing plug punch the pin hole around its chamfer edge using header (refer to SERVICE/SPECIAL TOOLS in this Section) to prevent plug from escaping.

NOTE: *Once joint is lubricated, there is no way of checking for leaks.*

TRACK CHAIN

DRY SEALED TRACK SYSTEM

COMPLETE CHAIN REBUILD

Disassembly (Refer to Fig. 15.17)

1. Position chain on press so that bushing end (non-threaded end) of split link (8 and 9) is toward rams. Remove track shoes. Install disassembly adapters on ram heads. Advance chain and lower table so split link drops into saddle. Press pin out of right link (7). then press pin out of left link (6). Remove loose split links from press. Advance track chain so next link drops into saddle. Press pin (4) and bushing (3) out of right link (7), then press pin and bushing out of left link (6). Remove loose links, bushing and pin from press. Repeat this step with remaining sections of chain. Remove belleville washers (1) from chain links.

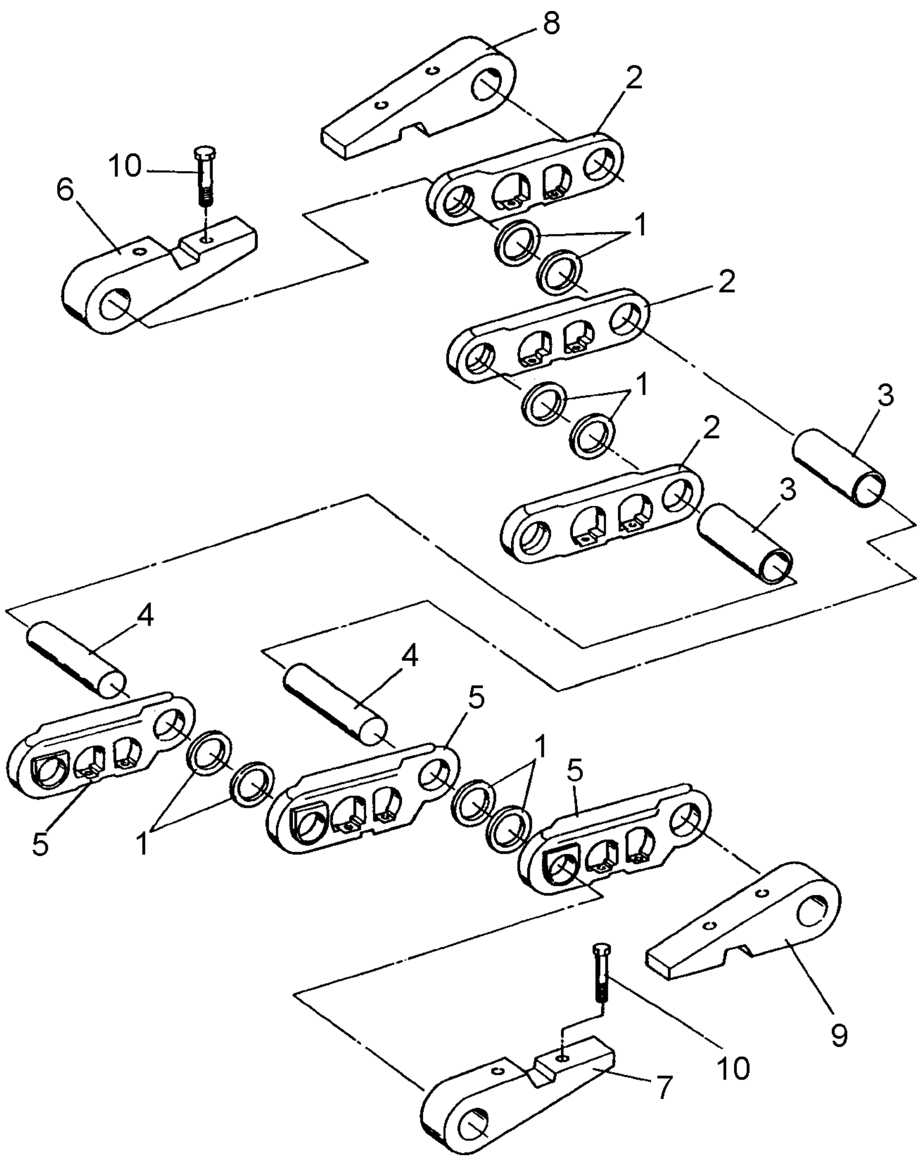


Fig. 15.17. Exploded View of Dry Sealed Track System

1. Belleville Washer
2. Left Track Link
3. Bushing
4. Pin
5. Right Track Link
6. Left Link, on Pin
7. Right Link, on Pin
8. Left Link, on Bushing
9. Right Link, on Bushing
10. Bolt

TRACK CHAIN

Reassembly

1. Install assembly adapters on ram heads. Bolt halves of split links together and position them on press assembly adapters. Position a bushing (3) in press saddle. Press links (8 and 9) onto bushing (3) until bushing is seated against assembly adapter. Remove bolts securing two halves together.
2. Advance track on press and position a pin (4) in assembled bushing (3). Apply a coat of oil on ends of bushing with tissue (not your fingers) as shown in Fig. 15.8, being careful not to get it on pin surface. Position next bushing (3) in press saddle. Install belleville washers (1) in counterbore of next track links (2 and 5). Position links on press assembly adapters. Coat inside bore of track chain link with oil. Press links (2 and 5) onto pins (4) and bushings (3) being sure that link counterbore and bushing face are seated against spring seal washers. Do not exceed force indicated as this can damage washers.
3. Install track shoes on chain and torque the bolts. Refer to SPECIFICATIONS in this Section. Prepare chains for transport back to machine.

SINGLE CHAIN JOINT REBUILD

1. To replace a damaged section of track, remove the track shoes, and cut out the damaged section with a cutting torch. Remove the end links as outlined in the following Step 3. Rebuild the section onto the track by pressing individual links, link pins and bushings together with a hydraulic track press using the installing tool with necessary adapters listed in Fig. 15.10.
2. To replace an individual link that is damaged, remove the track from the machine. After the track is free and extended flat, remove three or four of the track shoes adjacent to the damaged part. Cut the pins and bushings of the damaged link with a torch. The cuts should be made as close to the inside faces of the inner links as possible (Fig. 15.18) to provide sufficient clearance between the links for the removal of the remaining pin and bushing sections.

IMPORTANT: *Be careful not to damage the inner faces of the links when cutting the bushings and pins.*

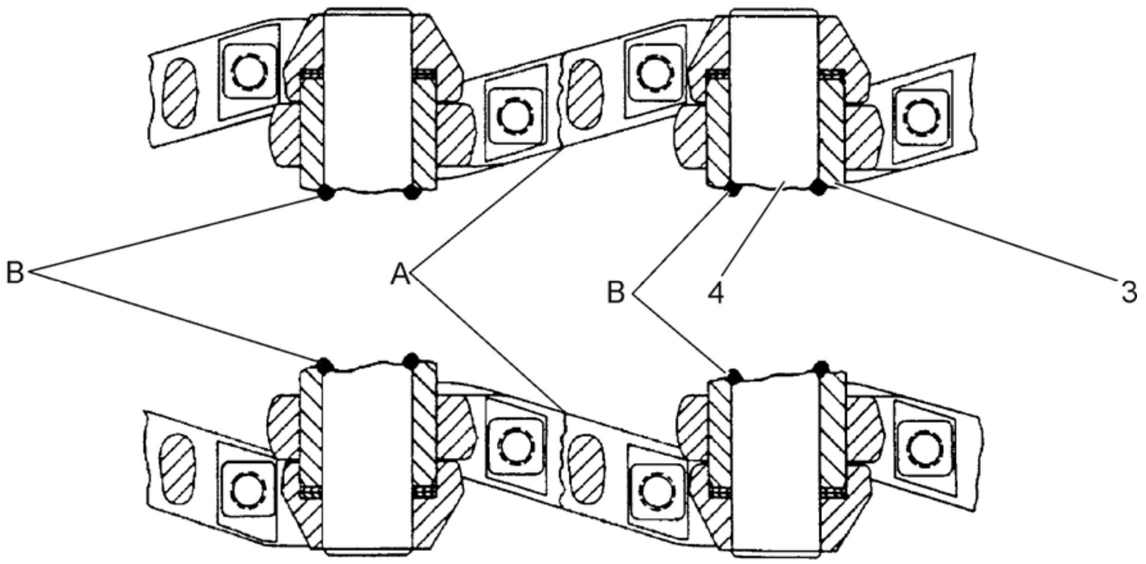


Fig. 15.18. Removal of Damaged Links

3. Bushing   A. Broken Link or Links to be Replaced
4. Pin   B. Torch Cut and Weld Pins and Bushings at Each End of Broken Links

TRACK CHAIN

3. The pieces of the pins and bushings remaining in the links must now be securely welded together at the cuts (Fig. 15.18). It is important that the welds be strong enough to carry the bushing out with the pin. Press each of the pin and bushing assemblies (welded) out of the links. Remove the sealing washers from the link counterbore.

4. Remove and replace the damaged link or links. Assemble the two loose, right and left, track links using a bushing (Fig. 15.19). Assemble a bushing also into the links attached to the track (Fig. 15.20). Place the spring seal washers into the link counterbore (Fig. 15.19). Place the bushing and links assembly onto the track and insert the aligning pin to hold the track link alignment while the new pin is pressed in position (Fig. 15.19). Use the aligning pin again when joining the two sections of track.

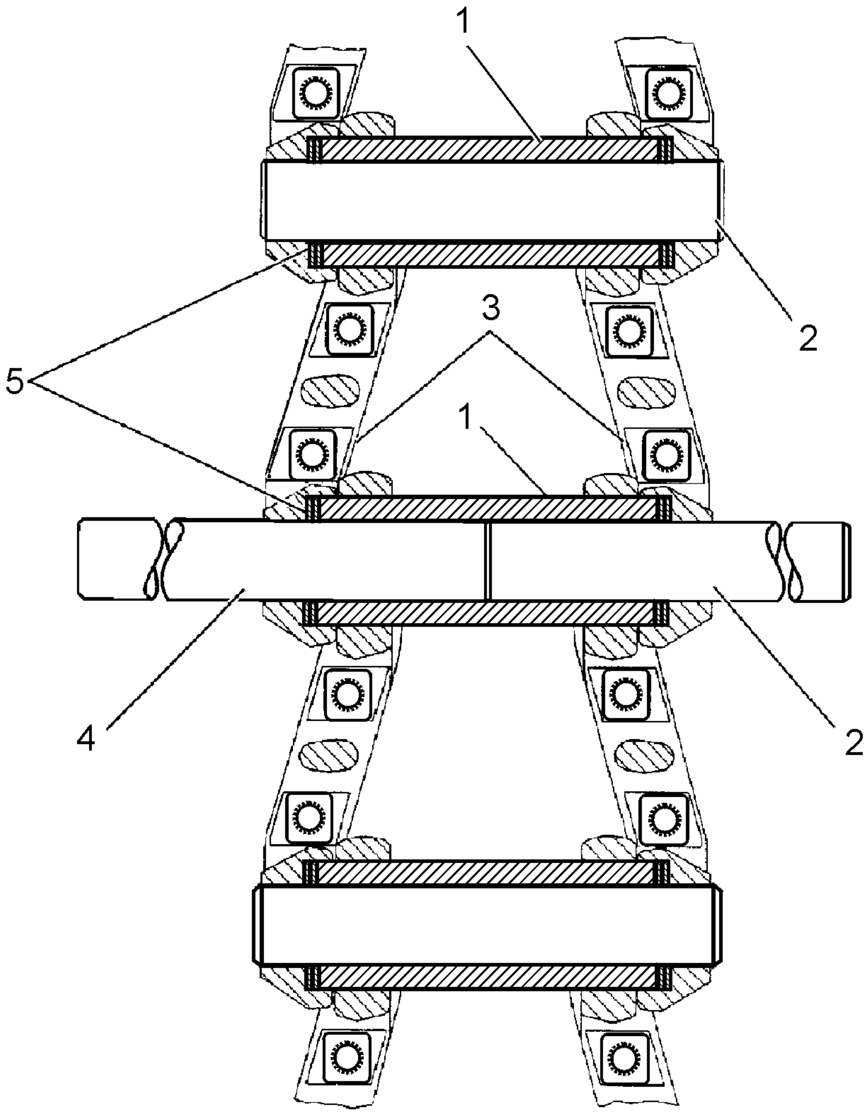


Fig. 15.19. Assembly of New Links

1. Master Bushing
2. Standard Pin
3. New Link or Links
4. Aligning Pin
5. Spring Seal Washers

TRACKS OR WHEELS

TRACK CHAIN

Rotating the Track Pins and Bushings

As internal and external wear on track pins and bushings develop, the tracks actually get longer and the separations between the parting edges of the links become greater. This gradual wear, in time, produces excessive stretch in the track assembly and requires that the idler be adjusted forward to maintain the proper track tension. Improperly adjusted tracks, either too tight or too loose, affect the rates of wear on all track parts such as pins, bushings, links, etc.
Since wear occurs on one side of the link pins and bushing (Fig. 15.20), the track pins and bushings can be reversed to obtain additional service from the track. To do this, press out all the track pins and bushings. Rebuild the track chain, pressing the pins and bushings in so that they are turned 180 degrees (1/2 turn). Follow the instructions furnished with the track pin press and installing tool. Be sure the sealing washers are installed as described below in Par. 8 ”INSTALLATION”. By doing this, the unworn surface of each pin is operating against the unworn surface in its bushing and the unworn outside surface of the bushing which contacts the sprocket.

Reconditioning Track Shoe Grousers by Manual Arc Welding

When the wear of the track shoe grousers reaches a point called the "permissible wear limit" it should then be decided whether a set of new shoes is to be installed, or whether the old ones are in good enough condition to be rebuilt by welding a millrolled, specially shaped grouser bar to the worn grousers.

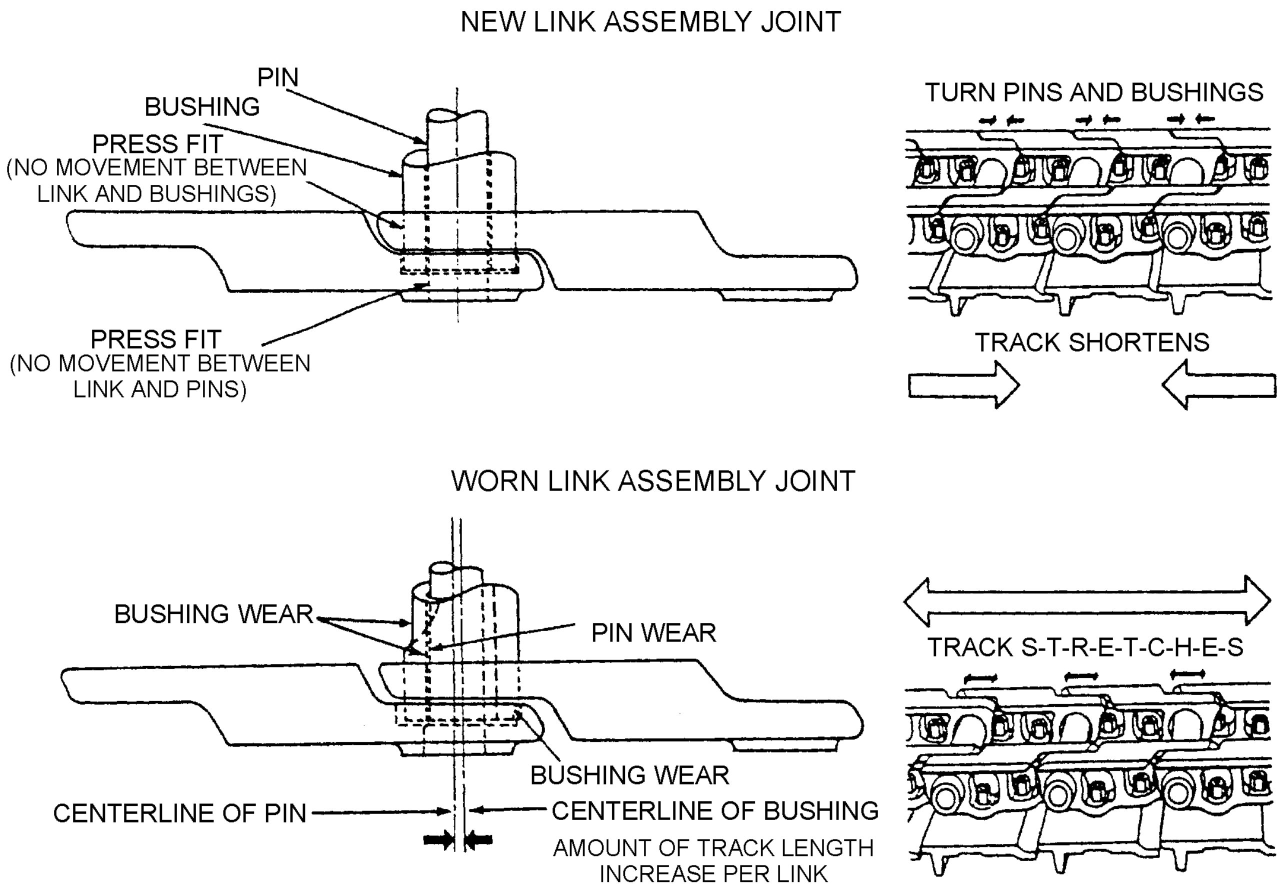


Fig. 15.20. Showing Effects of Track Pin and Bushing Wear

TRACK CHAIN

8. INSTALLATION

Installing Chain When Removed from Under Machine

1. Raise machine with suitable lifting equipment. Properly place suitable capacity stands under machine frame and remove lifting equipment. With suitable lifting equipment, arrange track chain under sprocket, rollers and front idler. Split link half with wearing surface toward next regular link should be positioned before front idler. Align track chain on ground with sprocket.
2. With suitable lifting equipment, start to engage sprocket teeth with split link half which has track shoe surface. Start machine and move sprocket clockwise. Make sure track chain is pulled up and onto sprocket. Continue to guide track chain over top idlers and over front idler.
3. Block track chain on front idler as shown in Fig. 15.3. Be sure mating surfaces of split link are clean. Interlock split link halves in front of front idler. Install split link bolts checking visually and by hand tightening to insure alignment. Care should be exercised not to strip tapped holes. Remove master link bolts and install track shoe. Coat split link bolt threads with engine oil and torque to 400 ± 70 [Nm] + 120 [°] of turn.
4. Adjust track tension, refer to ”SPECIFICATIONS” in this Section.

Installing Chain When not Removed from Under Machine

1. Position split link half with wearing surface and next link just past front idler. Block track chain on front idler as shown in Fig. 15.3. Align track on ground with sprocket. With suitable lifting equipment, start to engage sprocket teeth with split link half which has track shoe surface.
2. Make sure track chain is pulled up and onto sprocket. Continue to guide track chain over top idlers and over front idler Be sure mating surfaces of split link are clear. Interlock split link halves in front of front idler. Install split link bolts checking visually and by hand, tightening to insure alignment. Care should be exercised not to strip tapped holes. Remove split link bolt and install track shoe. Coat split link bolt threads with engine oil and torque to 400 ± 70 [Nm] + 120 [°] of turn. If only leaking joints were rebuilt, install track shoes on both sides of repaired joints.
3. Adjust track tension, refer to ”SPECIFICATIONS” in this Section.

SECTION 17

MOUNTED EQUIPMENT

MOUNTED EQUIPMENT

CONTENTS

GENERAL

1. SPECIFICATIONS

Special Bolts Torque Data

Bulldozer Cutting Edge	725 [Nm]
Bulldozer End Bit	725 [Nm]
Bullgrader Cutting Edge	725 [Nm]
Bullgrader End Bit	725 [Nm]
Bulldozer Cylinder Yoke Bolts	450 [Nm]
Bullgrader Cylinder Yoke Bolts	450 [Nm]
Push Arm Trunnion Cap Bolts	1050 [Nm]
C Frame Trunnion Cap Bolts	1050 [Nm]
Pivot Trunnion Bolts	1050 [Nm]
Upper Strut / Tilt Cylinder / Tilt & Pitch Cylinders Cap Bolts	1050 [Nm]
Diagonal Strut Cap Bolts	1050 [Nm]
Ripper Mounting Frame Bolts	1800 [Nm]

Weights

Blade D-2	1750 [kg]
Blade S-2	1600 [kg]
Blade G-2	1320 [kg]
Bulldozer Blade Tilt Cylinder	150 [kg]
Bullgrader Blade Tilt Cylinder	150 [kg]
Bulldozer Diagonal Strut	70 [kg]
Bulldozer Upper Strut	85 [kg]
Bullgrader Lower Strut	125 [kg]
Push Arm Assy	440 [kg]
C Frame	1400 [kg]
Ripper Connecting Link	60 [kg]
Ripper Mounting Frame	510 [kg]
Ripper Draft Frame	660 [kg]
Ripper Tool Beam	1050 [kg]
Ripper Shank	190 [kg]

MOUNTED EQUIPMENT

BULLDOZER BLADE

2. REMOVAL

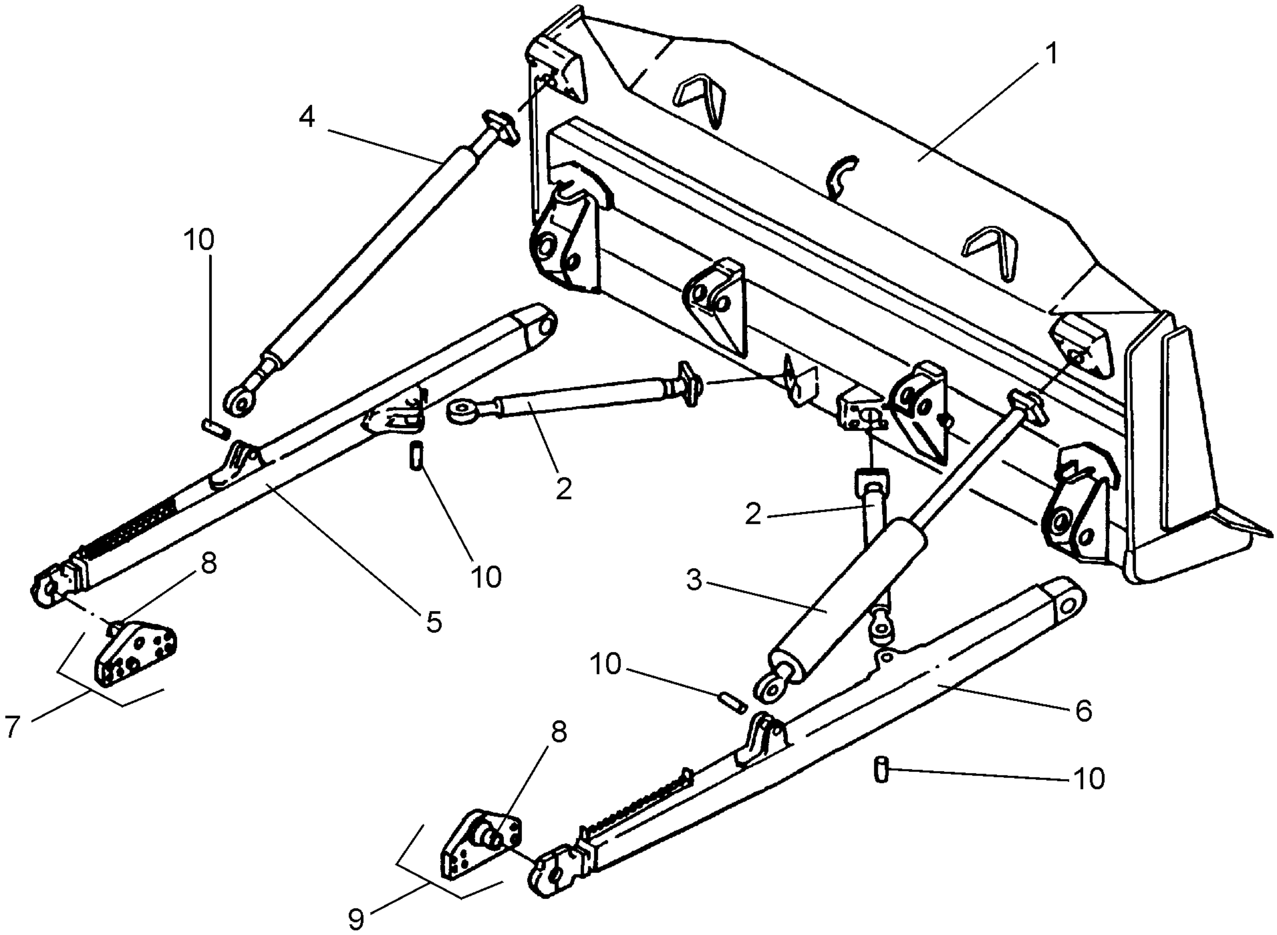


Fig. 17.1. Exploded View of Blade, Push Arms and Struts

1. Blade Assy
2. Diagonal Strut
3. Blade Tilt Cylinder
4. Upper Strut
5. L.H. Push Arm Assy
6. R.H. Push Arm Assy
7. L.H. Trunnion Assy
8. Trunnion Ball
9. R.H. Trunnion Assy
10. Pin

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

WARNING! Due to the considerable weight and bulk of each bulldozer component, a suitable hoist or lifting device MUST be used. Remove each component separately using suitable blocking on the remaining components.

IMPORTANT: *Disconnected hydraulic lines must be capped with the correct size plastic cap. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Tag all disconnected lines to facilitate proper installation.*

BULLDOZER BLADE

Blade Only

1. Lower the blade (1, Fig. 17.1) to the ground and install a block under the front portion of push arms (5 and 6). Attach a hoist to the blade lifting eye and take up the slack.
2. Disconnect the lift cylinders (4, Fig. 17.2) at the blade (1) by removing the pin locking hardware and drive out the mounting pin. Hydraulically retract the rods and secure the cylinders to the radiator guard with the cylinder hangers.
3. Install blocks under diagonal struts (2, Fig. 17.1) and remove the bolts securing the strut cap to blade socket.

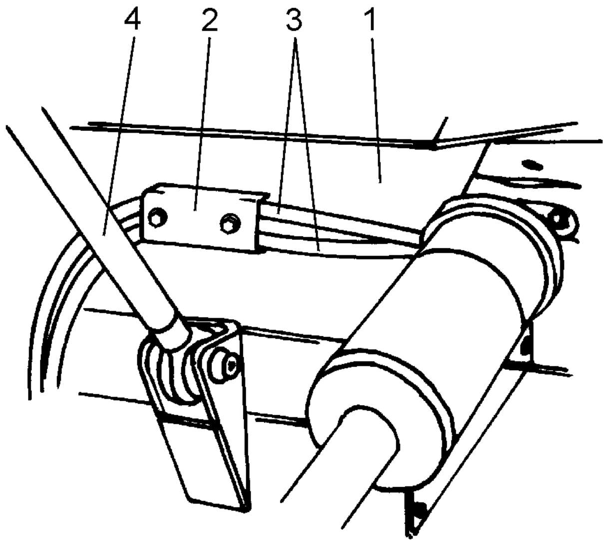


Fig. 17.2. Removing the Hose Guard

1. Blade
2. Hose Guard
3. Tilt Hoses
4. Lift Cylinder

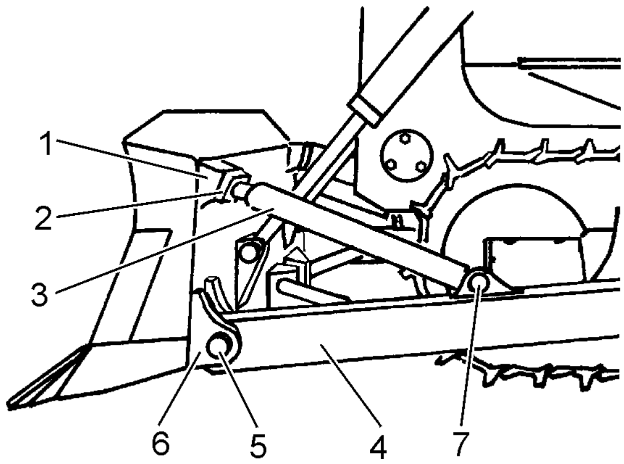


Fig. 17.3. Blade Disconnect Points

1. Blade Socket
2. Upper Strut Cap
3. Upper Strut
4. Push Arm
5. Pin
6. Blade Bracket
7. Mounting Pin

4. Remove the hose guard (2, Fig. 17.2) on the rear of the blade (1) to free the tilt hoses (3).
5. Remove the bolts securing upper strut cap (2, Fig. 17.3) to blade socket (1). Flip the upper strut (3) back away from the blade and remove the shims. Repeat this procedure on the tilt cylinder.
6. Disconnect the push arm (4, Fig. 17.3) from the blade bracket (6) by removing the pin mounting hardware and drive out pin (5).
7. Remove the blade.

Blade w/Push Arms

1. Lower the blade (1, Fig. 17.1) to the ground and install blocks under the rear end of the push arms (5 and 6)
2. Disconnect the lift cylinders (4, Fig. 17.2) at the blade (1) by removing the pin locking hardware and drive out the mounting pin. Hydraulically retract the rods and secure the cylinders to the radiator guard with the strength wires.
3. Remove the hose clamp. Disconnect hoses at the manifold.

BULLDOZER BLADE

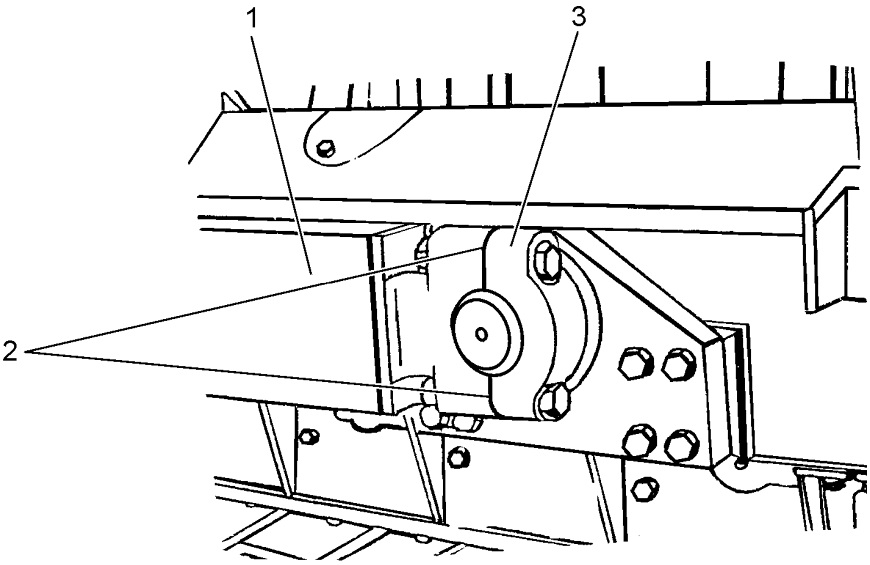


Fig. 17.4. Removing the Trunnion Caps

1. Push Arm 2. Shims 3. Trunnion Cap

4. Remove trunnion cap (3, Fig. 17.4) and shims (2) from each push arm (1).
5. Back the machine out from between the push arms.

3. INSTALLATION

Blade Only

1. Attach a hoist to the blade lifting eye and lower it into position.
2. Align the pin hole in the pivot of push arm (4, Fig. 17.3) with the hole in blade bracket (6). Insert pin (5) through the bracket, aligning the lock holes. Secure the pin with the locking hardware. Repeat this step on the opposite side of the machine.
3. Insert the ball of upper strut (3, Fig. 17.3) in blade socket (1) and connect upper strut cap (2) to the socket with the bolts. Be sure to tighten the bolts evenly. Determine the number of shims needed to fill the gap between upper strut cap (2) and blade socket (1), then add one additional shim to provide clearance. Remove the bolts, add the amount of shims required and install and torque the bolts to 1050 [Nm]. Repeat this procedure on the tilt cylinder.
4. Secure the tilt hoses(3, Fig. 17.2) to the rear of the blade with the hose guard (2).
5. Insert the ball of diagonal strut (1, Fig. 17.5) to blade socket (4) and connect the diagonal strut cap (2) to the socket with the bolts (6). Be sure to tighten the bolts (6) evenly. Determine the number of shims (5) needed to fill the gap between cap (2) and socket (4), then add one additional shim to provide clearance. Remove the bolts (6) and add the amount of shims required. Install the bolts (6) and torque to 1050 [Nm]. Repeat this procedure on the opposite diagonal strut.

BULLDOZER BLADE

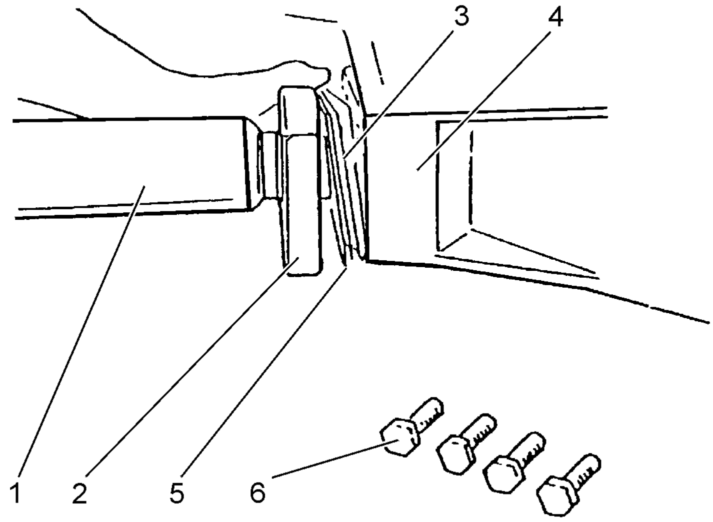


Fig. 17.5. Installing Diagonal Strut to Blade Socket

1. Diagonal Strut
2. Strut Cap
3. Strut Ball
4. Blade Socket
5. Shims
6. Bolts

6. Disconnect the lift cylinder hangers from the radiator guard and hydraulically extend the cylinder rods until the eyes line up with brackets on the rear of the blade. Insert the lift cylinder mounting pins through the bracket, aligning the lock hole in the pins with the lock holes brackets. Secure the pins with the locking hardware (Fig. 17.2).

Blade w/Push Arms

1. Drive the machine between the push arms (1, Fig. 17.4). Position trunnion cap (3) over the trunnion and connect it to push arm (1) with the two bolts and nuts. Be sure to tighten the bolts evenly. Determine the number of shims (2) needed to fill the gap between cap (3) and push arm (1), than add one additional shim to provide clearance. Remove the bolts, add the number of shims (2) required and install and torque the bolts to 1050 [Nm]. Repeat this procedure on the opposite side of machine. It may be necessary to adjust the diagonal struts to move the push arms either in or out before attaching them to the trunnions.
2. Disconnect the lift cylinder hangers from the radiator guard and hydraulically extend the cylinder rods until the eyes line up with the brackets on the rear of the blade. Insert the mounting pins through the brackets, aligning the lock hole in the pins with the lock holes in the bracket. Secure the pins with the locking hardware (Fig. 17.2).
3. Remove the caps from the tilt hoses and connect them to the manifold. Reinstall the clamp. Operate the tilt cylinder and check for leaks.

NOTE: *After first 10 hours of operation, check and retorque the trunnion cap bolts.*

MOUNTED EQUIPMENT

BULLDOZER PUSH ARMS

4. REMOVAL

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

WARNING! Due to the considerable weight and bulk of each bulldozer component, a suitable hoist or lifting device MUST be used. Remove each component separately using suitable blocking on the remaining components.

IMPORTANT: *Disconnected hydraulic lines must be capped with the correct size plastic cap. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Tag all disconnected lines to facilitate proper installation.*

1. Lower the blade to the ground and install blocks under the front and rear push arm being removed.
2. Disconnect the upper strut (3, Fig. 17.3) or tilt cylinder from the push arm (4) by removing the pin locking hardware and drive out mounting pin (7). Tie the strut or cylinder up out of the way.
3. Install blocks under the diagonal strut. Disconnect strut (2, Fig. 17.1) from the push arm by removing the pin locking hardware and drive out the mounting pin.
4. Disconnect the push arm from the blade by removing the pin mounting hardware and drive out pin (5, Fig. 17.3).
5. Remove the trunnion cap (3, Fig. 17.4) and shims (2) from the push arm (1) and remove the push arm.

5. INSTALLATION

1. Position the push arm so that the bracket (6, Fig. 17.3) and the rear of the arm is up against the trunnion.
2. Position trunnion cap (3, Fig. 17.4) over the trunnion and connect it to push arm (1) with the two bolts and nuts. Be sure to tighten the bolts evenly. Determine the number of shims (2) needed to fill the gap between cap (3) and push arm (1), then add one additional shim to provide clearance. Remove the bolts, add the number of shims (2) required, install the bolts and torque to 1050 [Nm].
3. Align the pin hole in push arm (4, Fig. 17.3) with the holes in blade bracket (6). Insert the push arm mounting pin (5) so that the groove in the pin is on the side of blade bracket (6) with the tapped holes. Secure the pin with the locking hardware.
4. Position the eye of the diagonal strut (2, Fig. 17.1) in the bracket on the side of the push arm so that the pin holes are aligned. Insert the mounting pin through the bracket, aligning the lock holes. Secure the pin with the locking hardware.
5. Position the eye of the upper strut (3, Fig. 17.3) or tilt cylinder in the bracket on top of the push arm (4) so that the pin holes are aligned. Insert pin (7) through the bracket, aligning the lock holes. Secure the pin with the locking hardware.

BULLDOZER STRUTS

6. REMOVAL AND DISASSEMBLY

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

WARNING! Due to the considerable weight and bulk of each bulldozer component, a suitable hoist or lifting device MUST be used. Remove each component separately using suitable blocking on the remaining components.

Upper Strut

1. Disconnect upper strut (3, Fig. 17.3) from the push arm (4) by removing the pin locking hardware and drive out pin (7),
2. Remove the bolts securing cap (2, Fig. 17.3) to socket (1) and remove the strut and shims.
3. Remove the eye bolt (1, Fig. 17.6) from strut (2).

Diagonal Struts

1. Disconnect the diagonal strut (2, Fig. 17.1) from the push arm (5 or 6) by removing the pin locking hardware and drive out the mounting pin.
2. Remove the bolts (6, Fig. 17.5) securing cap (2) to socket (4) and remove the strut (1) and shims (5).
3. Remove the eye bolt (2, Fig. 17.7) from diagonal strut (1).

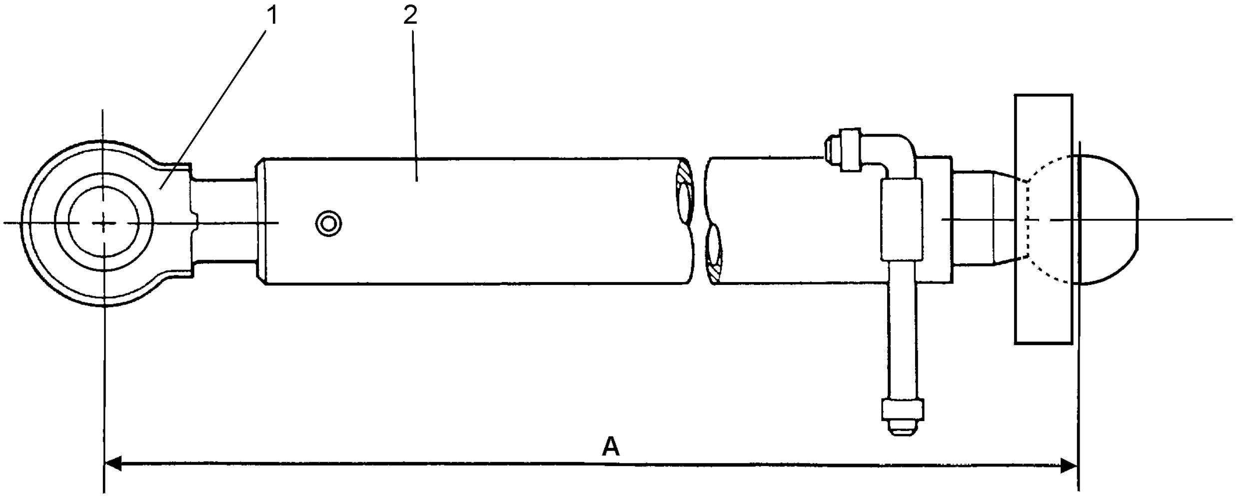


Fig. 17.6. Upper Strut Adjustment

1. Eye Bolt 2. Upper Strut

A. Nominal Strut Mounting Length . . . . 1383 [mm]

MOUNTED EQUIPMENT

BULLDOZER STRUTS

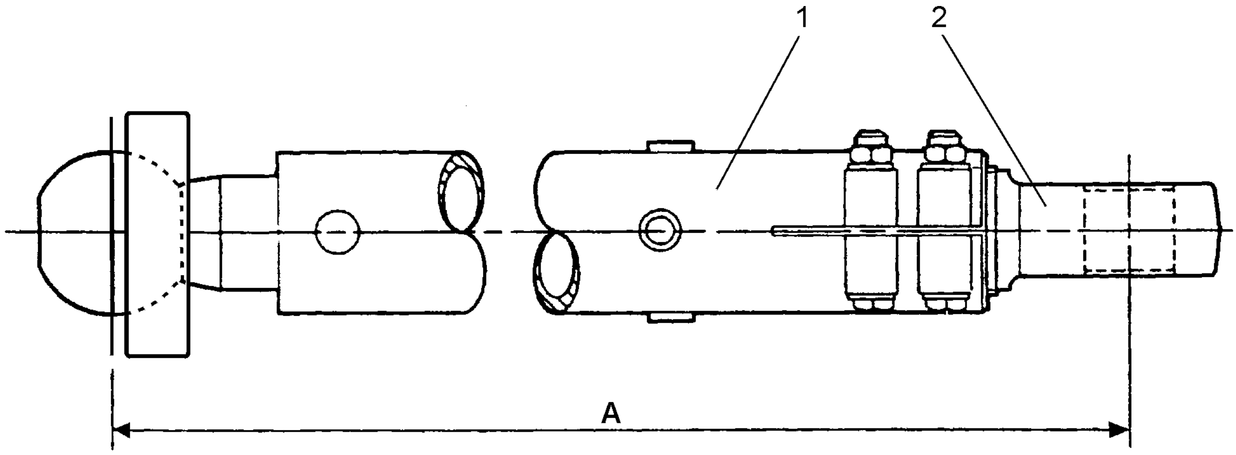


Fig. 17.7. Diagonal Strut Adjustment

1. Diagonal Strut 2. Eye Bolt

A. Nominal Strut Mounting Length . . . . 1034 ± 1 [mm]

7. REASSEMBLY AND INSTALLATION

Upper Strut

1. Install the eye bolt (1, Fig. 17.6) on strut (2).
2. Adjust the upper strut to nominal mounting length 1383 [mm] (Fig. 17.6).
3. Position the upper strut (3, Fig. 17.3) so that the eye is inside the bracket on top of the push arm (4) and the strut ball is in socket (1). Connect strut cap (2) to socket (1) with the four bolts. Be sure to tighten the bolts evenly. Determine the number of shims needed to fill the gap between cap (2) and socket (1), then add one additional shim to provide clearance. Remove the bolts, add the amount of shims required and install and torque the bolts to 1050 [Nm].
4. Position the eye of the upper strut in the bracket on top of the push arm so that the pin holes are aligned. Insert pin (7) through the bracket, aligning the lock holes. Secure the pin with the locking hardware.

Diagonal Strut

1. Install the eye bolt (2, Fig. 17.7) on strut (1).
2. Adjust the diagonal strut to nominal mounting length 1034 ± 1 [mm] (Fig. 17.7).
3. Position the diagonal strut (2, Fig. 17.1) so that the eye is inside the bracket on the side of the push arm and the strut ball in the socket. Connect the strut socket cap (2, Fig. 17.5) to the socket (4) with the four bolts (6). Be sure to tighten the bolts evenly. Determine the number of shims (5) needed to fill the gap between strut socket cap and socket then add one additional shim to provide clearance. Remove the bolts, add the amount of shims required and install and torque the bolts to 1050 [Nm].
4. Position the eye of the diagonal strut in the bracket on the side of the push arm so that the pin holes are aligned. Insert the mounting pin through the bracket, aligning the lock holes. Secure the pin with the locking hardware.

BULLGRADER BLADE

8. REMOVAL (Refer to Fig. 17.8)

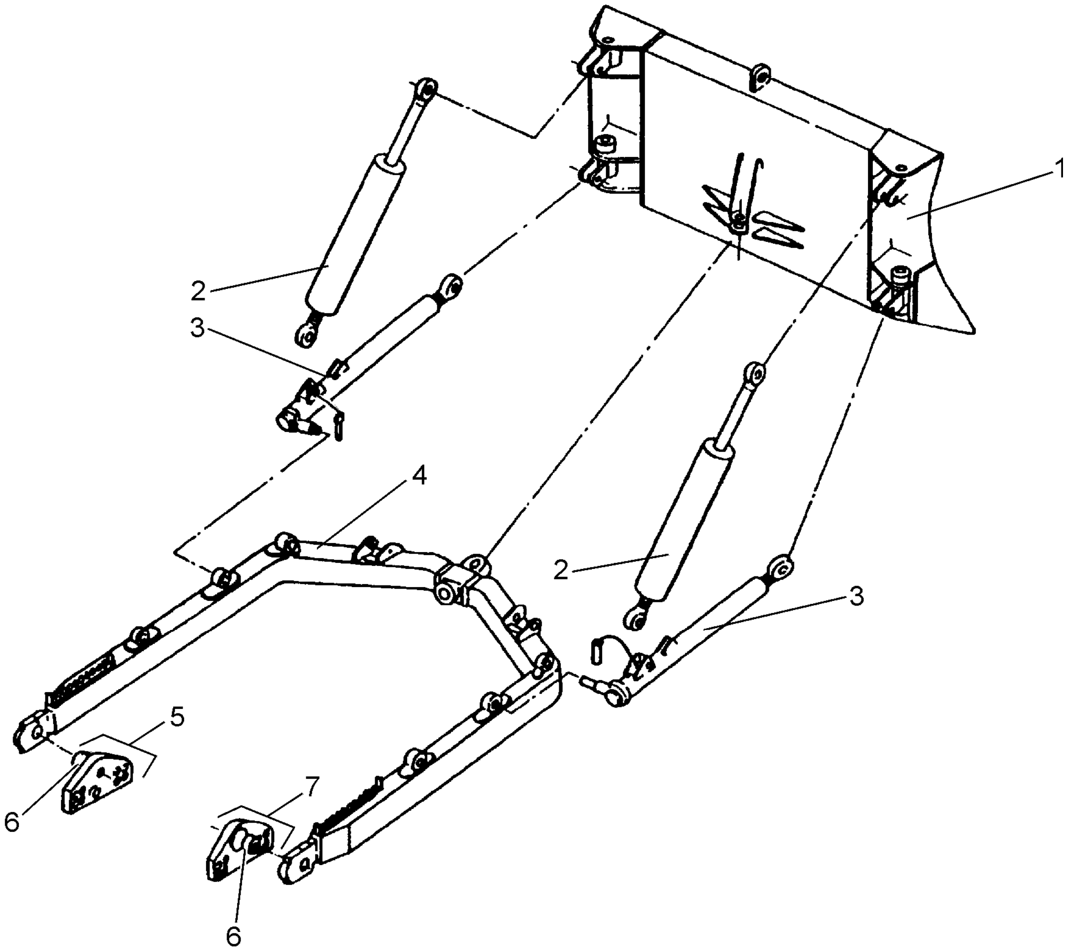


Fig. 17.8. Exploded View of Bullgrader Blade C Frame and Struts

1. Blade Assy
2. Tilt Cylinder
3. L.H. Lower Strut
   R.H. Lower Strut
4. C Frame
5. L.H. Trunnion
6. Trunnion Ball
7. R.H. Trunnion

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

WARNING! Due to the considerable weight and bulk of each bullgrader component, a suitable hoist or lifting device MUST be used. Remove each component separately using suitable blocking on the remaining components.

IMPORTANT: *Disconnected hydraulic lines must be capped with the correct size plastic cap. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Tag all disconnected lines to facilitate proper installation.*

MOUNTED EQUIPMENT

BULLGRADER BLADE

Blade Only

1. Lower the blade (1) to the ground and install blocks under the front portion of the C frame (4). Attach a hoist to the blade lifting eye and take up the slack.
2. Remove the plate and hose guards to free the tilt hoses from the rear of the blade (1).
3. Disconnect the tilt cylinders (2) from the swivel bar by removing the pin locking hardware and drive out pins. Flip the tilt cylinders (2) back away from the blade (1).
4. Install blocks under struts (3). Remove the pin mounting hardware and drive out pins.
5. Disconnect the C frame (4) from blade (1) by removing the cotter pin, mounting pin and drive out blade pin.
6. Lift off the blade.

Blade w/C Frame

IMPORTANT: *Disconnected hydraulic lines must be capped with the correct size plastic cap. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Tag all disconnected lines to facilitate proper installation.*

1. Lower the blade (1) to the ground and install blocks under the rear portion of the C frame (4).
2. Disconnect the lift cylinder from the C frame (4) by removing the pin locking hardware and drive out the mounting pins. Hydraulically retract the rods and secure the cylinders to the radiator guard with the cylinder hangers.
3. Remove the hose clamp. Disconnect hoses at the manifold.
4. Remove the trunnion cap and shims from each side of C frame (4). Back the machine out from between the C frame.

9. INSTALLATION (Refer to Fig. 17.8)

Blade Only

1. Position blade (1) on the front of C frame (4) so that pin is aligned in bracket. Insert the blade pin through the bracket, aligning the lock holes. Secure the blade pin with the mounting pin and cotter pin.
2. Attach struts (3) to the blade by positioning the swivel bars in blade brackets and insert pins, aligning the lock holes. Secure the pin with the locking hardware.
3. Attach tilt cylinders (2) to the blade by positioning swivel bars in blade bracket and insert pins, aligning the lock holes. Secure the pins with the locking hardware.
4. Secure the tilt hoses to the rear of the blade with the hose guards and install the plate.

BULLGRADER BLADE

Blade w/C Frame

1. Drive the machine between the C frame. Position trunnion caps over the trunnions and connect them to the C frame with the bolts and nuts. Be sure to tighten the bolts evenly. Determine the number of shims needed to fill the gap between trunnion caps and the C frame, then add one additional shim to provide clearance. Remove the bolts, add the number of shims required and install and torque the bolts to 1050 [Nm].
2. Disconnect the lift cylinder hangers from the radiator guard and hydraulically extend the cylinder rods until the eyes line up with the bracket on the C frame. Insert the mounting pins through the brackets, aligning the lock holes. Secure the pins with the lock hardware.
3. Remove the caps from the tilt hoses and connect them to the manifold. Reinstall the clamp. Operate the tilt cylinder and check for leaks.

NOTE: *After first 10 hours of operation, check and retorque the trunnion cap bolts.*

BULLGRADER C FRAME

10. REMOVAL (Refer to Fig. 17.8)

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

WARNING! Due to the considerable weight and bulk of each bullgrader component, a suitable hoist or lifting device MUST be used. Remove each component separately using suitable blocking on the remaining components.

IMPORTANT: *Disconnected hydraulic lines must be capped with the correct size plastic cap. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Tag all disconnected lines to facilitate proper installation.*

1. Lower the blade (1) to the ground and install blocks under the front of the C frame (4).
2. Disconnect the lift cylinders from the C frame (4) by removing the pin locking hardware and drive out the mounting pins. Hydraulically retract the rods and secure the cylinders to the radiator guard with the cylinder hangers.
3. Remove the hose clamp. Disconnect hoses at the manifold.
4. Remove the pin locking hardware and drive pin out of blade bracket.
5. Remove the pins securing C frame trunnions and free the trunnions from the C frame brackets. Using the hoist, remove the blade (1) with struts (3) and tilt cylinders (2).
6. Install blocks under the rear of the C frame (4) on each side of the machine. Remove cap and shims from each side of C frame (4). Back the machine out from between the C frame (4).

11. INSTALLATION (Refer to Fig. 17.8)

1. Drive the machine between the C frame (4). Position trunnion caps over the trunnions and connect them to the C frame (4) with the bolts and nuts. Be sure to tighten the bolts evenly. Determine the number of shims needed to fill the gap between caps and the C frame, then add one additional shim to provide clearance. Remove the bolts, add the number of shims required and install and torque the bolts to 1050 [Nm].
2. Position the blade in front of the C frame (4). Insert the C frame trunnions in the brackets on top of the C frame (4) and secure with the trunnion pins.
3. Position blade swivel pin in blade bracket and pin through blade bracket, aligning the lock hole. Secure the pin with the locking hardware.
4. Disconnect the lift cylinder hangers from the radiator guard and hydraulically extend the cylinder rods until the eyes line up with the bracket on the C frame (4). Insert the mounting pins through the brackets, aligning the lock holes. Secure the pins with the lock hardware.
5. Remove the caps from the tilt hoses and connect them to the manifold. Reinstall the clamp. Operate the tilt cylinder and check for leaks.

NOTE: *After first 10 hours of operation, check and retorque the trunnion cap bolts.*

BULLGRADER STRUTS

12. REMOVAL (Refer to Fig. 17.8)

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

WARNING! Due to the considerable weight and bulk of each bullgrader component, a suitable hoist or lifting device MUST be used. Remove each component separately using suitable blocking on the remaining components.

1. Disconnect tilt cylinder (2) from strut (3) by removing the lock pin and drive out pin. Tie tilt cylinder (2) up out of the way.
2. Disconnect the strut (3) from swivel bar by removing the pin locking hardware and drive out pin.
3. Remove the pin securing the C frame trunnion and free the trunnion from the C frame bracket.
4. Remove the eye bolt (2, Fig. 17.9) from strut (1)

13. INSTALLATION (Refer to Fig. 17.8)

1. Install the eye bolt (2, Fig. 17.9) and strut (1).
2. Adjust the lower strut to nominal mounting length 1552 [mm] (Fig. 17.9).
3. Position strut (3) so that eye bolt is in swivel bar. Install pin, aligning the lock holes and secure with the locking hardware. Position C frame trunnion in the bracket on top of the C frame. Secure the trunnion with the pin.
4. Position tilt cylinder (2) so that eye bolt is in the bracket on the lower strut. Install pin, aligning the lock holes and secure with the pin lock pin.

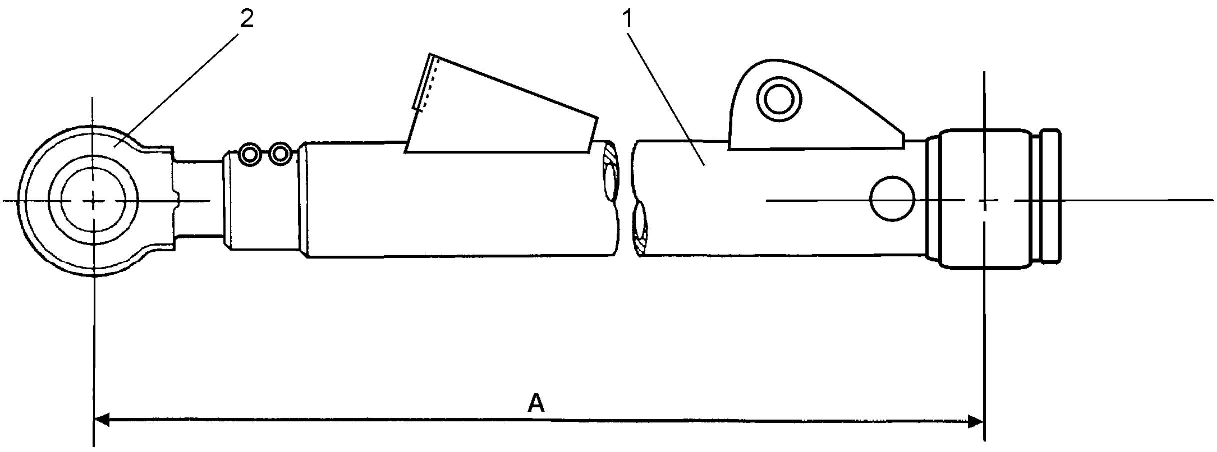


Fig. 17.9. Lower Strut Adjustment

1. Lower Strut 2. Eye Bolt

A. Nominal Strut Mounting Length . . . . 1552 [mm]

MOUNTED EQUIPMENT

TRUNNIONS

14. TRUNNION REPLACED

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

WARNING! Due to the considerable weight and bulk of each bulldozer or bullgrader component, a suitable hoist or lifting device MUST be used. Remove each component separately using suitable blocking on the remaining components.

1. Remove the blade with push arm or C frame as described in this Section.
2. Remove the bolts securing the trunnion to the track frame and remove the trunnion.
3. Remove any paint or dirt from the trunnion pad on the track frame.
4. Mount the trunnion to the track frame. Secure the trunnion with eight bolts. Tighten the bolts to 1050 [Nm].
5. Install the blade with push arm or C frame as described in this Section.

NOTE: *After every 10 hours of operation, check and retorque the trunnion and trunnion cap bolts.*

LIFT CYLINDER YOKE

15. LIFT CYLINDER YOKE REPLACEMENT (Refer to Fig. 17.10)

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

WARNING! Due to the considerable weight and bulk of each bulldozer or bullgrader component, a suitable hoist or lifting device MUST be used. Remove each component separately using suitable blocking on the remaining components.

IMPORTANT: *Disconnected hydraulic lines must be capped with the correct size plastic cap. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Tag all disconnected lines to facilitate proper installation.*

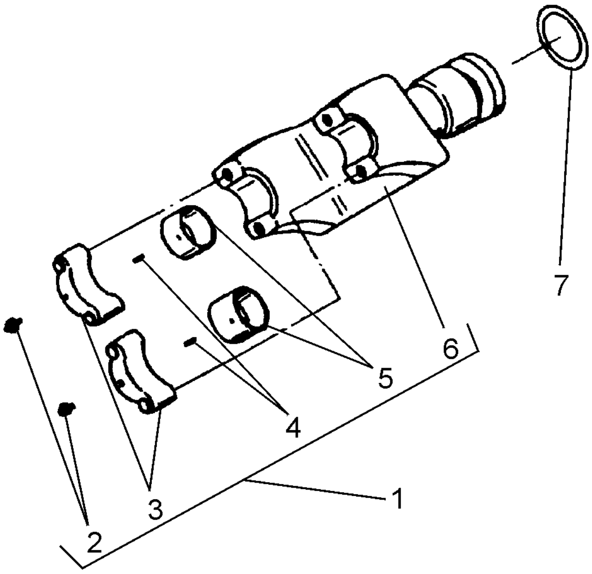


Fig. 17.10. Lift Cylinder Yoke

1. Lift Yoke Assembly
2. Lube Fitting
3. Yoke Cap
4. Pin
5. Yoke Bushing
6. Lift Yoke
7. Wiper Ring

1. Remove the hydraulic lift cylinder. Refer to SECTION 10C, CYLINDERS for removal procedure.
2. Rotate the yoke (6) 90 degrees toward the front of the machine and remove the yoke from the crosstube. The wiper ring (7) will come out with the yoke.
3. Install the new yoke as follows:
   a). Install the new wiper ring (7) over the shaft of the yoke (6).
   b). If necessary, install new bushing in the ends of the cylinder crosstube.
   c). Align the tang of the eccentric yoke (6) with the slot in the crosstube. Insert and turn the yoke 90 degrees to the rear of the machine. The turning action will lock the yoke into position.
4. Install the hydraulic lift cylinder. Refer to SECTION 10C, CYLINDERS for installation procedure.

RIPPER

16. REMOVAL (Refer to Fig. 17.11)

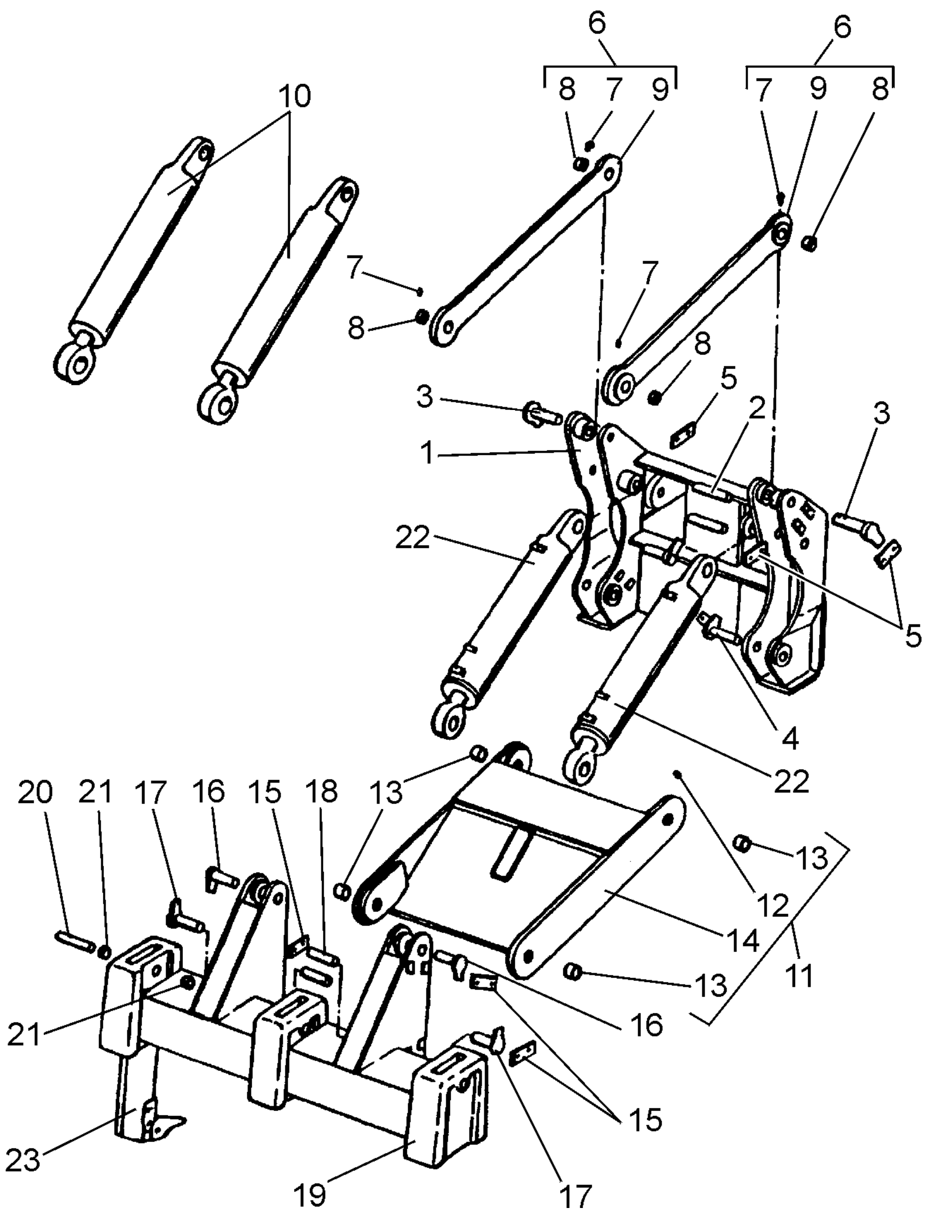


Fig. 17.11. Multi Shank Ripper

1. Mounting Frame
2. Lift Cylinder Pin
3. Pin
4. Draft Frame Pin
5. Pin Retainer Plate
6. Connecting Link Assembly
7. Lube Fitting
8. Link Bushing
9. Connecting Link
10. Ripper Pitch Cylinder
11. Draft Frame Assembly
12. Lube Fitting
13. Draft Frame Bushing
14. Draft Frame
15. Pin Retainer Plate
16. Pin Assy
17. Draft Frame Pin
18. Pin
19. Tool Beam
20. Shank Mounting Pin
21. Locking Sleeve
22. Ripper Lift Cylinder
23. Ripper Shank Assembly

RIPPER

WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train lock lever is in its lower locked (ON) position and parking brake is applied. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls are tagged to prevent inadvertent engine starting.

WARNING! Due to the considerable weight and bulk of each ripper component, a suitable hoist or lifting device MUST be used. Remove each component separately using suitable blocking on the remaining components.

IMPORTANT: *Disconnected hydraulic lines must be capped with the correct size plastic cap. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Tag all disconnected lines to facilitate proper installation.*

1. With Connecting Link (6); Position suitable blocking under draft frame (11) and tool beam (19). Attach hoist to link and take out slack. Remove hardware securing pins (3 and 16) at mounting frame (1) and tool beam (19) and lift link (6) off of ripper. Reinstall mounting pins (3 and 16) in mounting frame (1) and tool beam (19).
2. With Ripper Pitch Cylinder (10); Position suitable blocking under draft frame (11) and tool beam (19). Remove pitch cylinder, refer to SECTION 10C, CYLINDERS. Reinstall mounting pins (3 and 16) in mounting frame (1) and tool beam (19).
3. Remove ripper lift cylinders (2), refer to SECTION 10C, CYLINDERS.
4. Attach hoist to cylinder mounting pins (16) at tool beam (19) and take out slack in hoist. Remove draft frame pins (17) and lift tool beam (19) from ripper. Remove shanks if necessary.
5. Attach hoist to draft frame (11) and take out slack in hoist. Remove draft frame pins (4) and lift draft frame from ripper.
6. Attach hoist to cylinder mounting pins (3) at mounting frame (1) and take out slack in hoist. Remove mounting hardware and lift frame from machine.

17. CONNECTING LINK (Refer to Fig. 17.11)

1. Remove the old connecting link bushing (8) from connecting link (6).
2. Position connecting link (6) in press. Place new bushing (8) in connecting link (6) and press in. Repeat for other bushings. Remove connecting link from press. Coat inner surfaces of bushings with fresh grease.

18. DRAFT FRAME (Refer to Fig. 17.11)

1. Remove the old draft frame bushing (13) from draft frame (14).
2. Position draft frame (14) in press. Place new bushing (13) in draft frame (14) and press in. Repeat for other bushings. Remove draft frame from press. Coat inner surfaces of bushings with fresh grease.

MOUNTED EQUIPMENT

RIPPER

19. INSTALLATION (Refer to Fig. 17.11)

1. Clean mating surfaces of mounting frame (1) to rear main frame. Using hoist on cylinder pins (3) place mounting frame (1) into position. Install hardware and torque bolts to 1800 [Nm]. Remove pins (3) from mounting frame (1).
2. Attach hoist to draft frame (11) and place in position in mounting frame (1). Install mounting pins (4), being careful not to damage bushings (13), and secure with plate and hardware. Hoist draft frame (11) and support with blocking.
3. Attach hoist to cylinder pins (16) on tool beam (19) and place in position. Secure tool beam (19) to draft frame (11) with pins (17), plates and hardware. Position suitable blocking under tool beam (19).
4. Install ripper lift cylinders (22), refer to SECTION 10C, CYLINDERS.
5. With Connecting Link (6); Attach hoist to link (6) and place in position between mounting frame (1) and tool beam (19). Secure with pins, being careful not to damage bushings, and secure with plates and hardware.
6. With Ripper Pitch Cylinder (10); Install ripper pitch cylinders, refer to SECTION 10C, CYLINDERS.