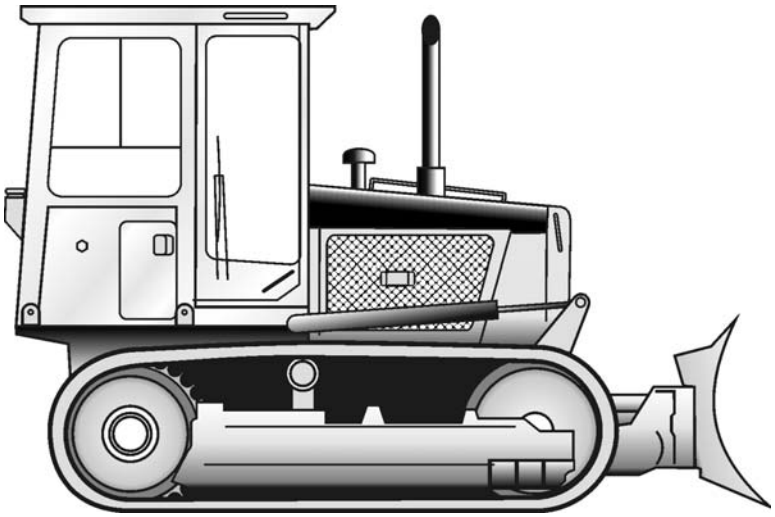
SMTD78910M06/1E

SERVICE MANUAL

TD-7M, TD-8M
TD-9M, TD-10M

SERIAL NUMBER
TD-7M – 27501 AND UP
TD-8M – 37501 AND UP
TD-9M – 47501 AND UP
TD-10M – 57501 AND UP



DRESSTA

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CONTENTS

1. INTRODUCTION

4. BRAKES

6. COOLING SYSTEM

7. DRIVE TRAIN

    7A. DIRECT DRIVE

    7B. TORQUE CONVERTER

    7C. TRANSMISSION

    7E. STEERING DRIVE

    7F. FINAL DRIVE

8. ELECTRICAL

9. FRAME

10. HYDRAULICS

    10A. PUMPS AND MOTORS

    10B. VALVES

    10C. CYLINDERS

    10E. RESERVOIRS AND FILTERS

12. POWER

13. SUPERSTRUCTURE

14. SUSPENSION

15. TRACKS

17. MOUNTED EQUIPMENT

SECTION 1

INTRODUCTION

INTRODUCTION

SECTION 1

CONTENTS

SAFETY PRECAUTIONS

1. GENERAL 3
2. BEFORE STARTING THE ENGINE 6
3. OPERATION. 7
4. MAINTENANCE 9
5. WHEN PARKING 12

SERVICE INFORMATION

6. SERIAL NUMBERS 13
7. INSPECTION AND REPAIR 13

LOCTITE USAGE

8. SURFACE PREPARATION 14
9. APPLICATION 15
10. SETTING TIME (BEFORE PLACING IN OPERATION) 15
11. REMOVAL 16
12. APPLICATIONS AT LOW TEMPERATURES 16

STANDARD TORQUES

13. BOLT IDENTIFICATION CHART 16
14. TORQUE VALVES FOR STANDARD FASTENERS 17
15. SPLIT FLANGE CONNECTIONS 19
16. HYDRAULIC TUBES AND FITTINGS 19
17. HOSE CLAMPS 20
18. TORQUE VALUES FOR AIR CONDITIONING TUBES AND FITTINGS 20
19. TORQUE VALUES FOR AIR CONDITIONING O-RING CONNECTIONS 20

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-7 (TD-8, TD-9, TD-10) Series M 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 or it is to be mounted on ROPS at the machine LH side. Refer to OPERATOR’S MANUAL for the fire extinguisher location.

It is placed in a holder preventing uncontrolled movement during machine operation. In case of a fire the extinguisher can be easily removed from the holder. The extinguisher is provided with a label containing the instructions of its use and application. The operator should be familiar with these instructions.

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 frame 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.

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.

If 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.

INTRODUCTION

SAFETY PRECAUTIONS

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

Never place gasoline or diesel fuel in open pan.

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 control lever is in neutral 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.

SAFETY PRECAUTIONS

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.

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.

INTRODUCTION

SAFETY PRECAUTIONS

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.

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.

WELDING ON A VEHICLE WITH AN ELECTRONIC CONTROLLED FUEL SYSTEM (APPLICABLE TO TD-10M) 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.

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.

SAFETY PRECAUTIONS

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.

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.

INTRODUCTION

SAFETY PRECAUTIONS

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.

Ether starting fluid is flammable. Follow the precautions printed on the container. An explosion can result if sparks or flame contact the ether in the container or if the container is stored in an area in which the temperature exceeds 70 [°C]. Observe the following precautions:

1. Follow the correct method for starting the engine. Refer to Section 4, "STARTING THE ENGINE" in OPERATOR'S MANUAL.
2. Do not use the ether injector when the ambient temperature is above freezing.
3. For your own personal safety, always remove the ether container when welding, grinding or fusing a torch on the machine.
4. Do not let ether come in contact with your skin, as it can cause localized freezing.
5. Do not breathe the hazardous ether vapor.
6. Keep the fluid container out of the reach of children.
7. Never puncture the fluid container or put it into a fire. Dispose of empty container as per attached instruction to the container.
8. Do not store fluid containers in the operator's compartment.

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.

When leaving the machine unattended, slowly lower the hydraulic equipment to the ground, shift the drive train control lever into neutral and lock the lever in this position, shut off the engine, apply and lock the parking brake. Relieve any pressure in the hydraulic system by moving the controls in both 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.

SAFETY PRECAUTIONS

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.

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 the 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.

LOCTITE USAGE

8. SURFACE PREPARATION

Plain and Phosphate Coated Parts

Clean the surfaces where compounds are to be applied to remove heavy coating of oil, grease and dirt (rust or light oil film are not detrimental).
Normal shop practice of cleaning or degreasing is adequate. Phosphate and oiled hardware is used in as received condition provided it is dry to touch.

Zinc or Cadmium Plated Parts or For Rapid Curing of Compound

At least one mating surface should be degreased with a cleaning solution to which concentrated primer has been added, (1 part primer concentrate to 30 parts trichlorethylene or 1-1-1 trichlorethene). Allow surfaces to dry for 3 to 5 minutes before applying compound.

Drawbar Studs or Special Stud Applications

Degrease parts with a cleaning solution to which concentrated primer has been added, (1 part primer concentrate to 30 parts trichlorethylene or 1-1-1 trichlorethene). Allow surfaces to dry for 3 to 5 minutes before applying compound. In blind holes, be sure to remove all chips and oil.

Face Sealant

Mating parts must be cleaned as for plain and phosphate coated parts.

LOCTITE USAGE

9. APPLICATION

Bolt and Pipe Threads

Fill first 2 to 3 leading threads in area of engagement with compound. For larger quantities of bolts, compound may be applied by tumbling method.

Studs

Fill full length of thread with one strip on diameters up to 25 [mm], two strips 180 [°] apart on diameters up to 51 [mm], and three strips 120 [°] apart on diameters over 51 [mm].
In all cases, only apply one strip into tapped hole. On blind hole applications, apply enough compound to fill bottom 2 to 3 threads of engagement, then insert stud. If engagement length exceeds one diameter, use proportionally more compound. For nonseated studs turn stud one turn deeper than required. After bubbling stops, apply compound around stud at top of hole, then turn back to required height.

Primers

Apply primer to surface where sealant is to be applied. Allow primer solvent to evaporate 3 to 5 minutes before applying sealant. When sealant is applied to a primed surface, parts should be assembled within 3 minutes.

Face Sealant

For liquid sealants, spread an even coat on one of the mating surfaces. Assemble and tighten bolts.

For gel sealants, apply as continuous bead to surface of one mating face.

NOTE: *When the compound is used as a gasket, bolts which attach the parts should be coated with MPL (gear lube) to prevent the compound from sticking to bolts.*

10. SETTING TIME (BEFORE PLACING IN OPERATION)

Normal time for compound grades without use of any primer 6 to 24 hours at room temperature with machined carbon steel parts.

Higher temperatures will accelerate cure and lower temperatures will retard cure. Other base metals will provide more or less catalytic effect on cure.

Primed surfaces 2 to 6 hours. This may be speeded by pretreating mating surfaces with special primers. Some metals (such as zinc and cadmium plate, anodized aluminum and passivated stainless steel) are inactive and require heat or primer to cure the component.

A fast curing type primer will fix parts for normal handling in 10 to 15 minutes and will achieve 75 [%] of ultimate strength in 1 hour and full cure in 2 to 4 hours.

INTRODUCTION

LOCTITE USAGE

11. REMOVAL

Parts difficult to remove can be preheated to 200 to 260 [^{o}C] prior to removal.

12. APPLICATIONS AT LOW TEMPERATURES

Without special precautions, these compounds can be applied and will cure at temperatures down to 10 [°C] and at that temperature full strength will be obtained within 72 hours.

At temperatures from 10 to -18 [°C] the use of a primer is recommended. If necessary, compounds can be applied at temperatures below -18 [°C], only if heat is used to accelerate the cure as follows:

65 [°C] for 60 minutes
95 [°C] for 45 minutes
120 [°C] for 30 minutes

STANDARD TORQUES

13. 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.	

STANDARD TORQUES

14. 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.

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

INTRODUCTION

STANDARD TORQUES

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

STANDARD TORQUES

15. 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

16. 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 0.89 [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 [°] 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

17. 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

18. 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	¾ – 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

19. 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	¾ – 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 4

BRAKES

BRAKES

SECTION 4

CONTENTS

SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS 3

GENERAL

2. DESCRIPTION 3

BRAKE PEDAL

3. BRAKE PEDAL 6

BRAKE AND CLUTCH CYLINDERS ASSEMBLY

4. BRAKE AND CLUTCH CYLINDERS ASSEMBLY 12

MOUNTING PLATE

5. MOUNTING PLATE 28

BRAKE/STEERING SHOES

6. APPLY/BACK UP SHOES 31

BRAKE VALVE

7. BRAKE VALVE 37

SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS

DESCRIPTION	TOOL NUMBER
Brake Cylinder Spring Compression Tool	1549.0189-1/2
Brake Cylinder Assy Securing Pin	1549.0189-2/2
Pressure Test Gauges Set	910.50.0005

GENERAL

2. DESCRIPTION

These machines are equipped with a disc and pad type brake system which can be applied manually or hydraulically. The foot brake manually actuates the brakes and the drive train control lever controls the hydraulic system. This section covers the external portion of the brake control system with brake valve and internal portions with the hydraulics.

Brake Pedal Linkage (Refer to Fig. 4.1)

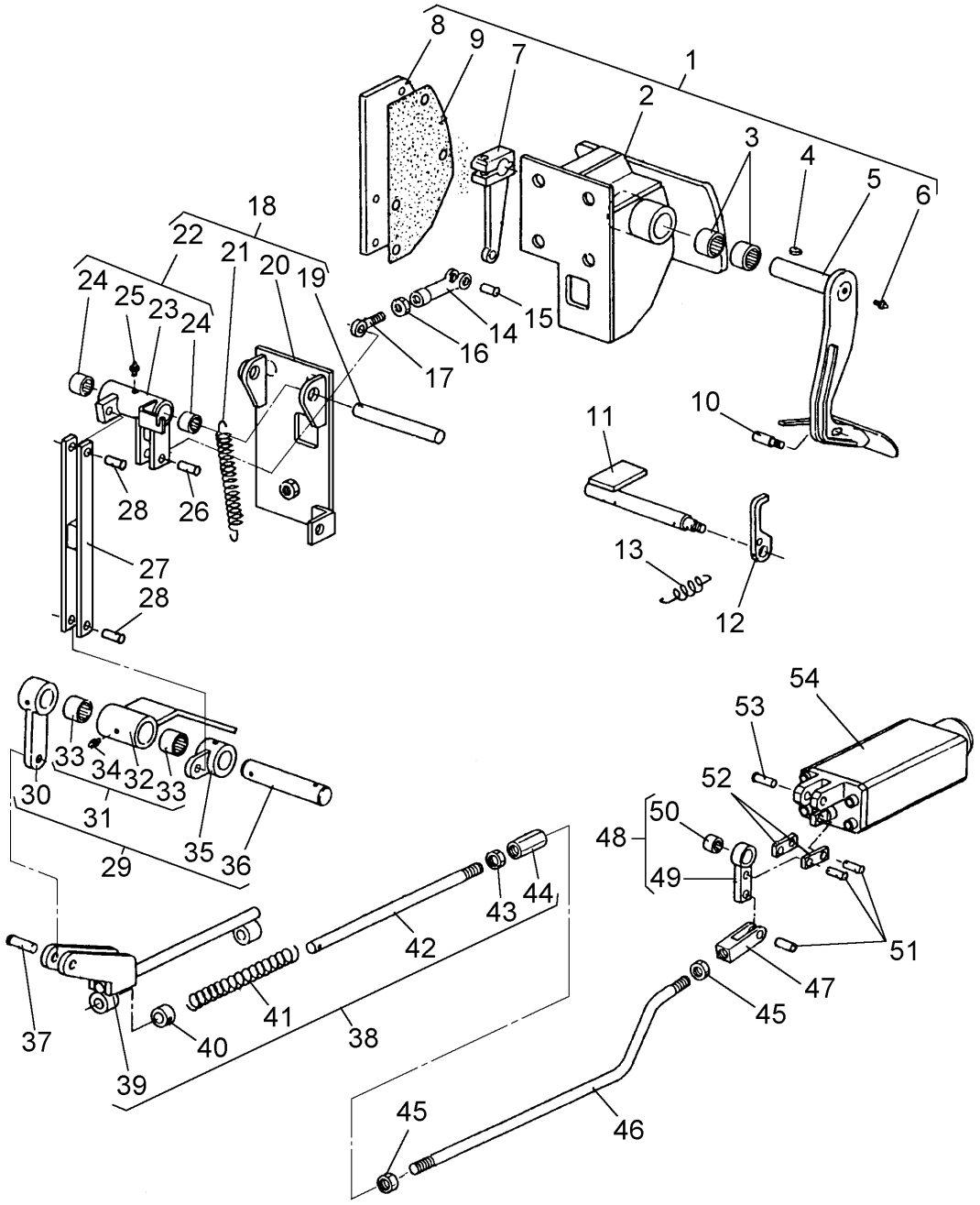
The drive train control valve and a brake pedal rod operate the brake valve (bolted to the rear cover). The brake pedal rods (38 and 46) connect to the brake valve lever assy (48) control the spool of the brake valve (54). This spool is held in the drive position by return springs. In this position oil pressure from the drive train control valve enter the brake valve through two separate circuits and is directed to the left brake hydraulic cylinder and to the right brake hydraulic cylinder (refer to Fig. 7.2, in SECTION 7, DRIVE TRAIN). When the brake is applied, the spool moves forward and begins to dissipate the oil pressure to both brake cylinders simultaneously.

Brake and Clutch Cylinders Assembly (Refer to Fig. 4.3)

A steering cylinder bracket assy (1) is bolted to the steering cylinder base plate on right and left side of the rear frame. Each base plate supports the cylinder mounting bracket (1) for the clutch and brake cylinders. The pistons (27) of the clutch cylinders are connected to the clutch steering arms (30) at the rear inside of the rear frame. The pistons (7) of the brake cylinders are connected to the brake apply arms (29) through the connecting rod (28) at the front inside of the rear frame.

BRAKES

GENERAL



4.1. External Brake Valve Controls (Standard Version)

1. Pedal Bracket Assy
2. Pedal Bracket
3. Needle Bearing
4. Key
5. Brake Pedal
6. Lube Fitting
7. Lever Assy
8. Cover
9. Gasket
10. Pin
11. Shaft Assy
12. Pawl
13. Spring
14. Fork
15. Pin
16. Nut
17. Eye End
18. Brake Bracket Assy
19. Control Shaft
20. Brake Bracket
21. Spring
22. Bell-crank Assy
23. Bell-crank
24. Needle Bearing
25. Lube Fitting
26. Pin
27. Link
28. Pin
29. Lever Assy
30. Lever
31. Bracket Assy
32. Bracket
33. Bearing Needle
34. Lube Fitting
35. Lever Assy
36. Shaft
37. Pin
38. Rod Assy
39. Rod Assy
40. Sleeve
41. Spring
42. Rod
43. Nut
44. Nut
45. Nut
46. Rod
47. Clevis
48. Lever Assy
49. Lever
50. Needle Bearing
51. Pin
52. Link
53. Shaft
54. Brake Valve

GENERAL

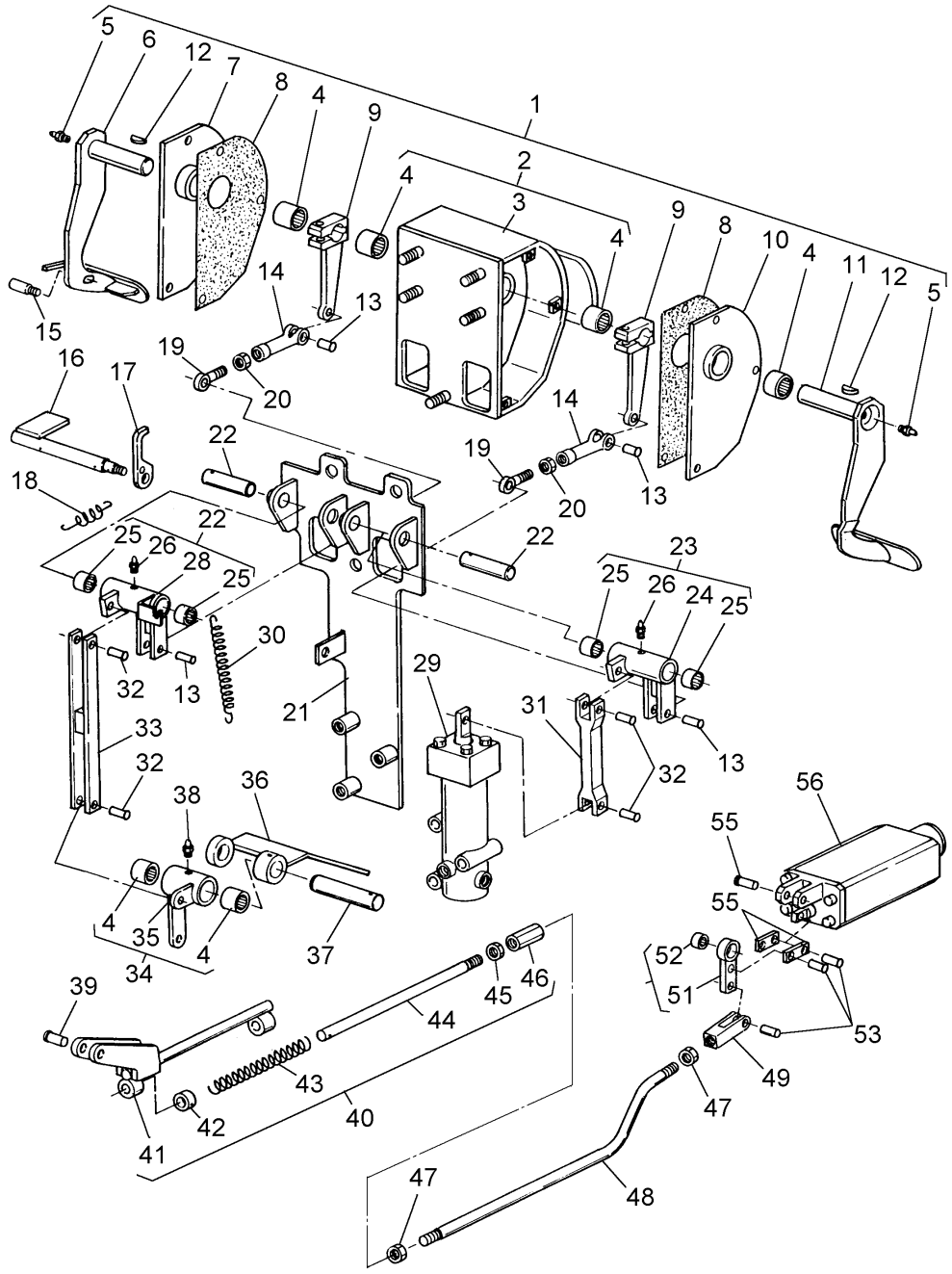


Fig. 4.2. External Brake Valve Controls (Direct Drive Version)

1. Brake/Clutch Pedal Bracket Assy
2. Housing with Bearings
3. Housing
4. Needle Bearing
5. Lube Fitting
6. Brake Pedal
7. Cover
8. Gasket
9. Lever Assy
10. Cover
11. Clutch Pedal
12. Key
13. Pin
14. Fork
15. Pin
16. Shaft Assy
17. Pawl
18. Spring
19. Eye End
20. Nut
21. Valve Bracket
22. Pin
23. Clutch Lever Assy
24. Clutch Lever
25. Needle Bearing
26. Lube Fitting
27. Brake Lever Assy
28. Brake Lever
29. Inching Valve
30. Spring
31. Clutch link
32. Pin
33. Link
34. Lever Assy
35. Lever
36. Bracket
37. Shaft
38. Lube Fitting
39. Pin
40. Rod Assy
41. Rod Assy
42. Sleeve
43. Spring
44. Rod
45. Nut
46. Nut
48. Rod
49. Clevis
50. Lever Assy
51. Lever
52. Needle Bearing
53. Pin
54. Link
55. Shaft
56. Brake Valve

BRAKE PEDAL

3. BRAKE PEDAL

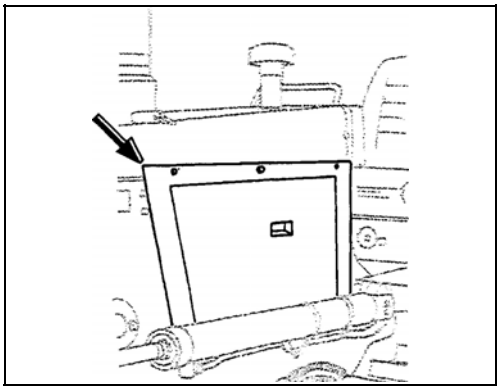
WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train control lever is in NEUTRAL position, drive train lock lever is in ON position and parking brake is set. The starting switch and the electrical system master switch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

REMOVAL

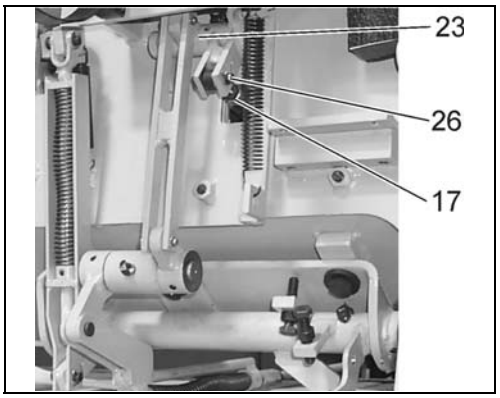
NOTE: *Removal of brake pedal in machines with Direct Drive is similar to brake pedal removal in machines with Torque Converter shown below.*

NOTE: *Callouts from exploded view (Fig. 4.1) correspond with most callouts in following steps.*

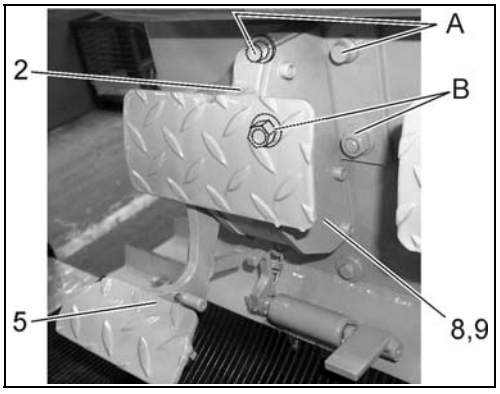
1. Remove engine left and right side doors.



2. Remove cotter and fork pins (26) from brake bell-crank (23) and release fork eye end (17).



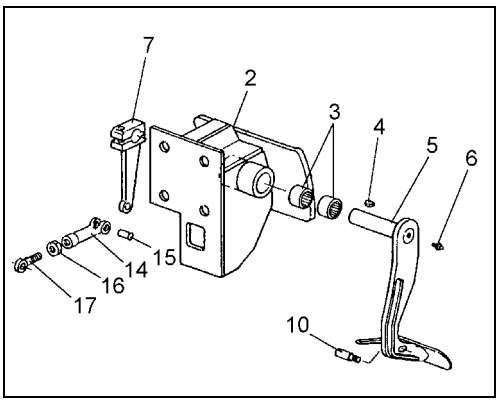
3. Remove hardware securing cover (8) to bracket (2). Remove cover (8) with gasket (9). Remove two bolts (A) and two nuts (B) securing bracket with pedal (5) to dashboard. Remove the bracket with pedal.



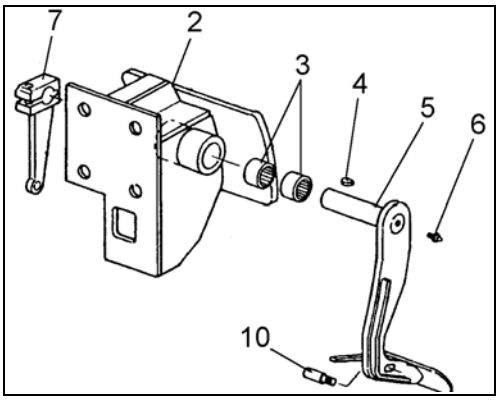
BRAKE PEDAL

DISASSEMBLY

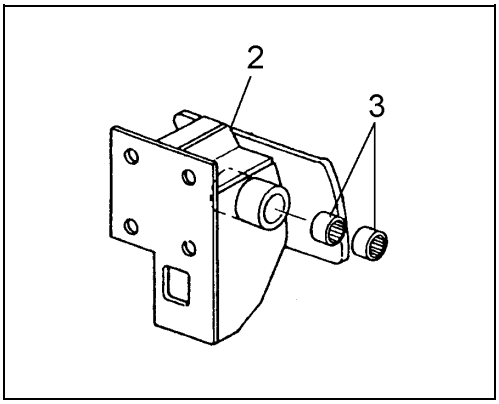
4. Remove cotter pin from pin (15). Remove pin (15) and release fork (14) with eye end (17) from lever (7).



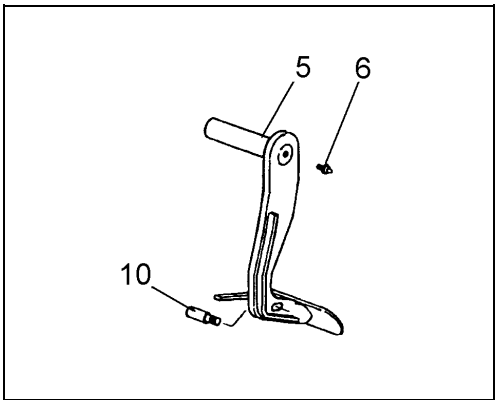
5. Remove bolt with washer securing clamped lever (7) to brake pedal (5) and remove from pedal shaft. Pull pedal from bracket (2) with catching key (4).



6. Press pedal pivot needle bearings (3) from pedal bracket (2), if necessary.



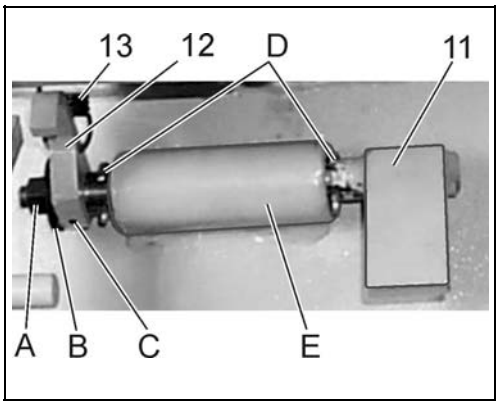
7. If desired, remove lubrication fittings (6) and pin (10) with washer and nut from brake pedal (5).



BRAKES

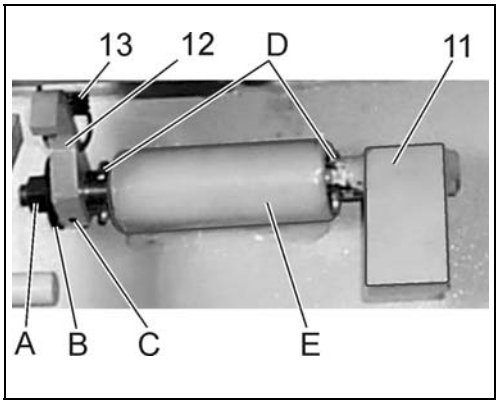
BRAKE PEDAL

8. If necessary, remove brake pedal lock lever. To do it remove the return spring (13) and unscrew nut (A). Remove nut (A) with washer (B) and remove the pin (C) to take off the pawl (12). Remove two cotter pins (D) and pull out the lever shaft (11) from the bracket sleeve (E).

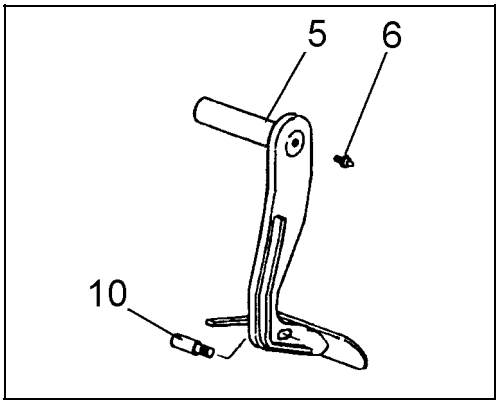


REASSEMBLY

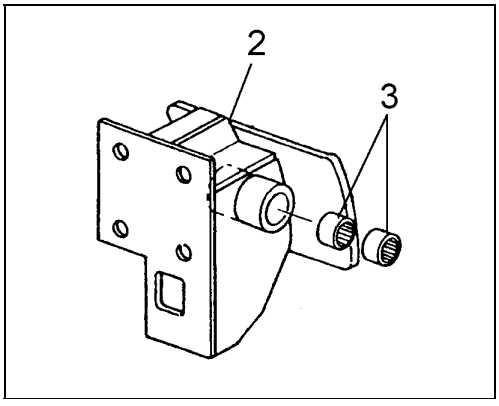
1. If removed, install brake pedal lock lever. To do it insert the lever shaft (11) into the bracket sleeve (E) and secure with two cotter pins (D). Install the pawl (12) and secure with pin (C) and nut (A) with washer (B). Install the return spring (13).



2. If removed, reinstall lubrication fitting (6) and pin (10) with washer and nut into brake pedal (5).

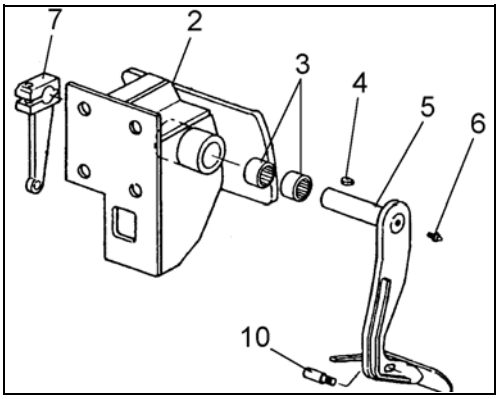


3. If removed, press pedal pivot needle bearings (3) flush with the edge of pedal bracket (2).

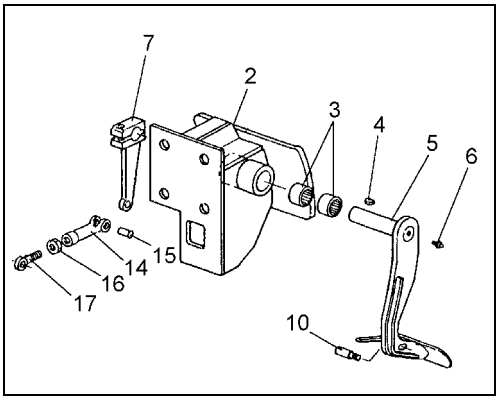


BRAKE PEDAL

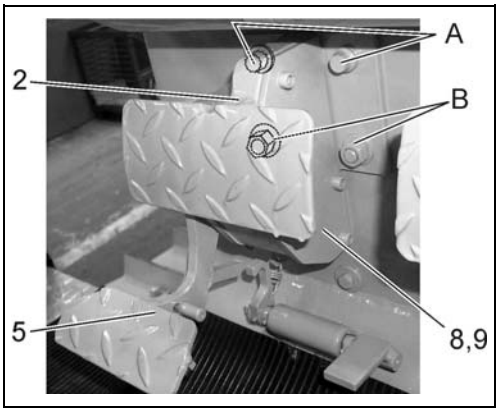
4. Slide brake pedal (5) into bracket (2) through center of bearings. Pack key way in brake pedal with fresh grease and insert catching key (4). Install clamped lever (7) on pedal shaft aligning key with way in lever. Install clamped lever bolt with washer and torque to 46 ± 10% [Nm].



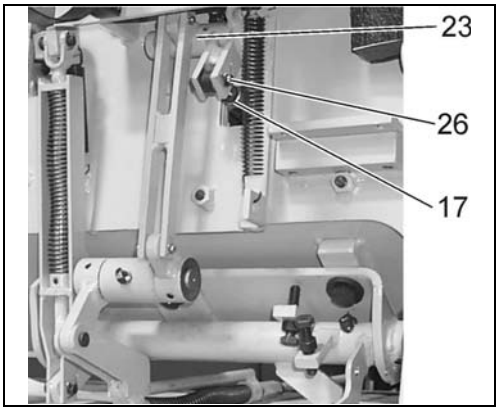
5. Install fork (14) with eye end (17) on lever (7) using pin (15). Secure with cotter pin.



6. Install bracket (2) with pedal (5) to the dashboard. Mount pedal and bracket to dashboard with two bolts (A) and two nuts (B). Torque bolts and nuts to 92 ± 10% [Nm]. Install cover (8) with gasket (9). Torque bolts to 21 ± 10% [Nm].



7. Connect fork eye end (17) to brake bell-crank (23) with new cotter and fork pins (26).

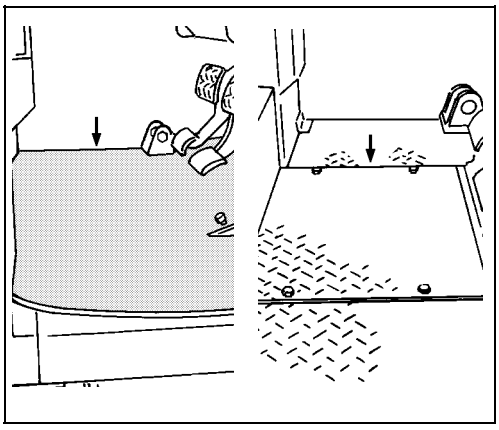


BRAKES

BRAKE PEDAL

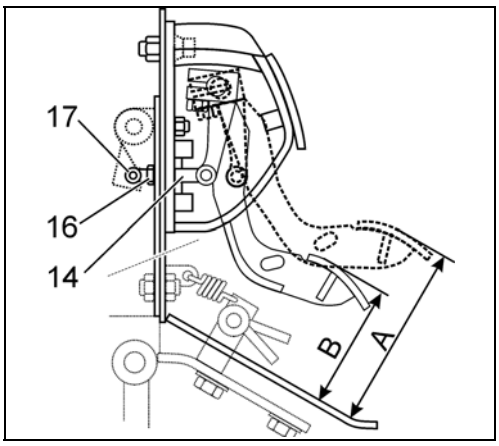
8. Verify brake adjustment as follows:

Remove operators compartment floor mat and floor plate.



8A. Fully released brake pedal (A), it must be 149 ± 1.5 [mm] from floor plate. If dimension is not obtained do or undo eye end (17) to get required (A) brake pedal position. Secure with nut (16).

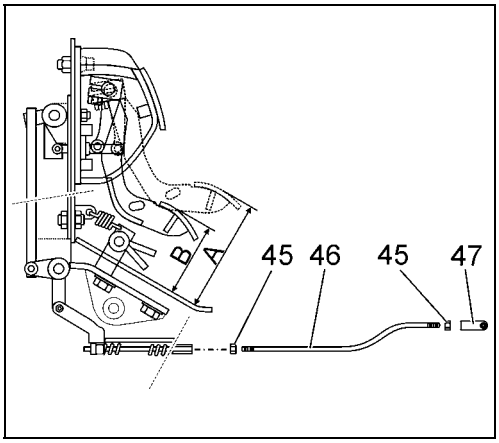
NOTE: *Make sure with the pedal released brake valve spool is to be fully retracted.*



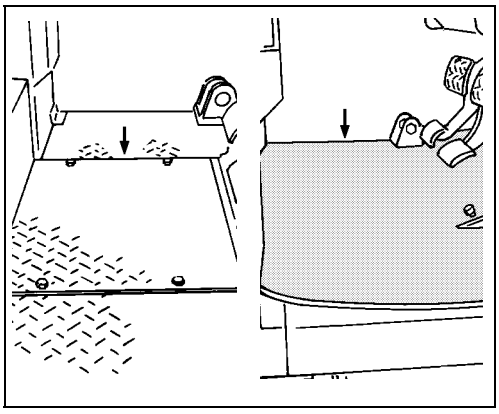
8B. Fully depress brake pedal (B), it must be 96 [mm] from floor plate. In this position brake pedal should be blocked with brake pawl easily.

NOTE: *Make sure brake valve spool is in its fully extended position (the brake valve spool stroke is 10.2 ± 0.1 [mm]).*

If full spool stroke is not obtained do or undo clevis (47) to get required brake valve spool stroke. Secure with nut (45).

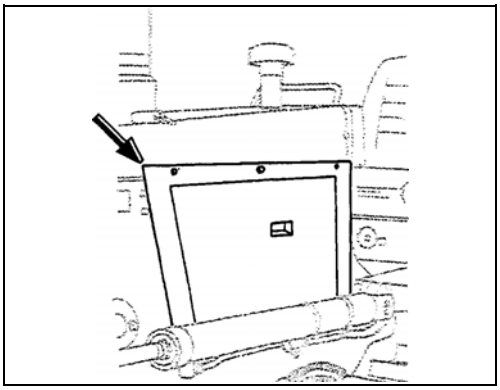


8C. Install operators compartment floor plate. Torque bolts to 38 ±10% [Nm]. Install floor mat.



BRAKE PEDAL

9. Install engine left and right side doors and secure with hardware. Torque bolts to 38 ± 10% [Nm].



BRAKE AND CLUTCH CYLINDERS ASSEMBLY

4. BRAKE AND CLUTCH CYLINDERS ASSEMBLY

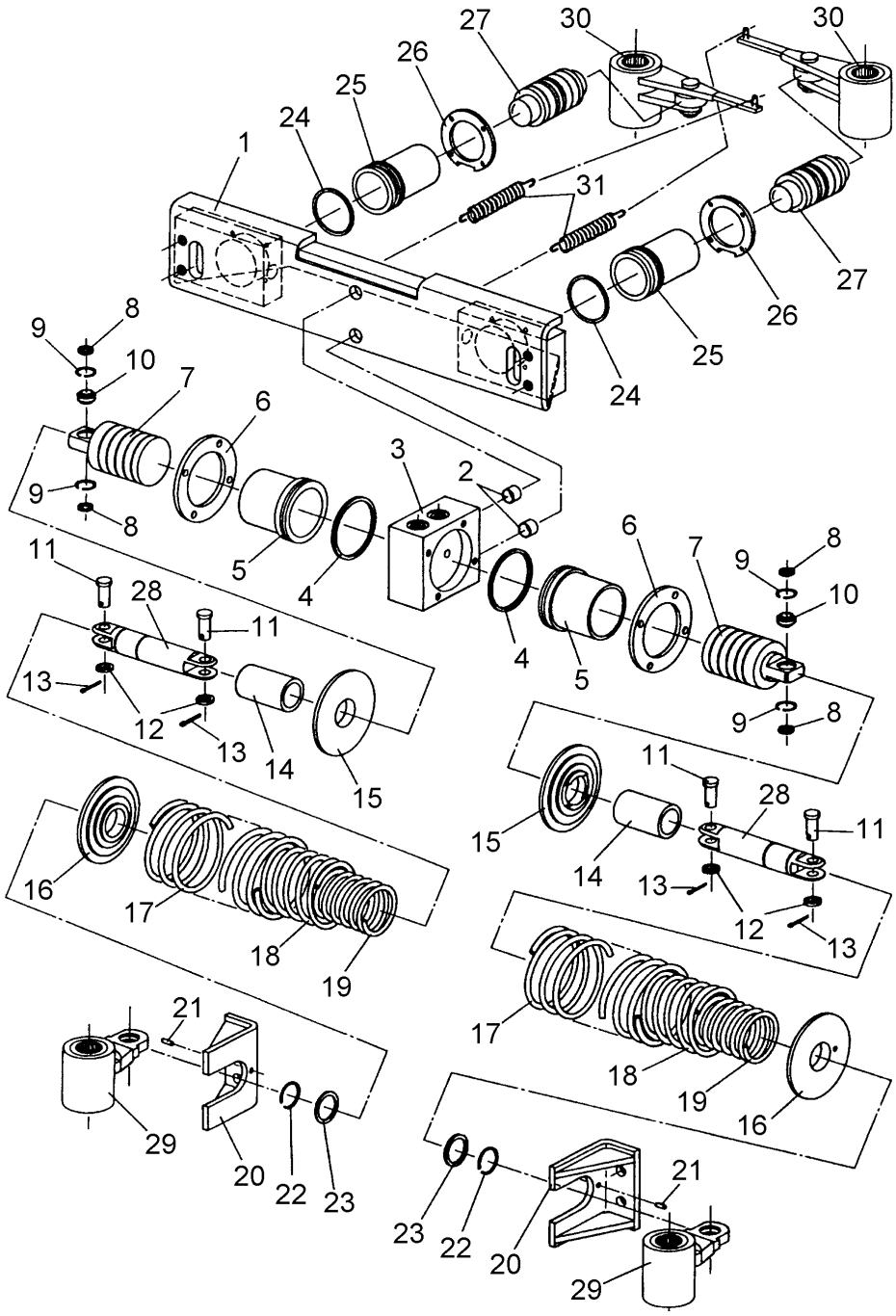


Fig. 4.3. Exploded View of Clutch/Brake Steering Cylinders Assy

1. Bracket Assy
2. Spacer Sleeve
3. Brake Cylinder Housing
4. O-Ring
5. Brake Cylinder Sleeve
6. Brake Cylinder Disc
7. Brake Control Piston
8. Spacer Ring
9. Retaining Ring
10. Spherical Bearing
11. Pin
12. Washer
13. Cotter Pin
14. Thrust Sleeve
15. Thrust Inner Disc
16. Thrust Outer Disc
17. Outer Spring
18. Middle Spring
19. Inner Spring
20. Thrust Support
21. Dowel Pin
22. Retaining Ring
23. Spacer Washer
24. O-Ring
25. Clutch Cylinder Sleeve
26. Clutch Cylinder Disc
27. Clutch Cylinder Piston
28. Connecting Rod
29. Brake Arm
30. Steering Arm
31. Spring

BRAKE AND CLUTCH CYLINDERS ASSEMBLY

DESCRIPTION AND OPERATION

Steering cylinders are a single acting, single rod type that control engaging and disengaging of the clutch plates. The cylinders are operated by the brake valve through hoses.
Fluid from the brake valve enters the designated port extending the cylinder rod on the opposite side. Return direction of the steering cylinder is caused by the return spring.

The brake cylinder is a single acting, single rod cylinder type that controls engaging and disengaging of the brake. The cylinders are operated by the brake valve through the hose. Fluid from the brake valve enters the base plate port extending the cylinder rods thus releasing the brakes. If the machine becomes disabled, fluid can be pumped into cylinder through the test port to manually disengage the brakes and move it.

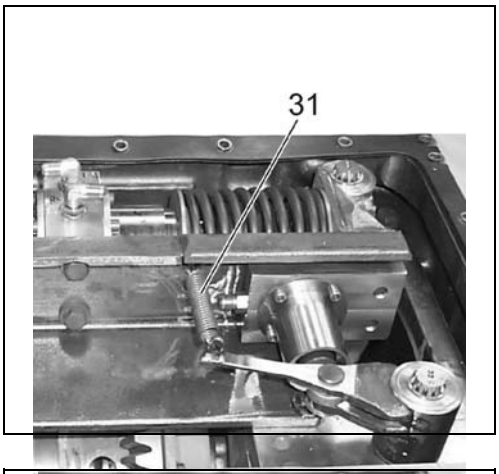
REMOVAL

For removal of the brake and clutch cylinders assembly, refer to STEERING DRIVE, Section 7E and follow the steps until brake and clutch cylinders assy is ready to be removed. The final drives on each side of the machine do not have to be removed to remove the brake/clutch cylinders assy.

DISASSEMBLY

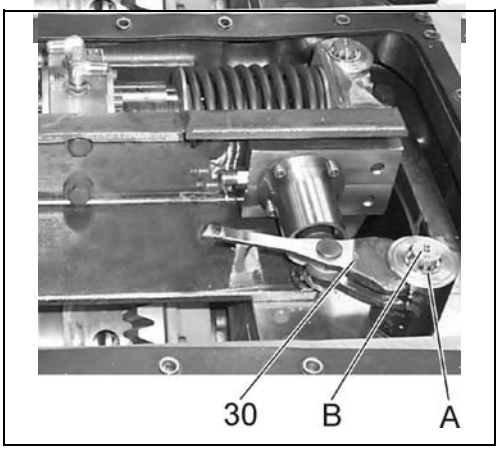
NOTE: *Callouts from exploded view (Fig. 4.3) correspond with most callouts in following steps.*

1. Using needle nose pliers, get a good grip on arm return spring (31) hook and remove. Repeat for remaining spring.



WARNING! Loaded assembly. Use extreme care when removing.

2. Remove retaining ring (A) from eccentric shaft (B). Remove steering arm assy (30). Repeat for remaining side.

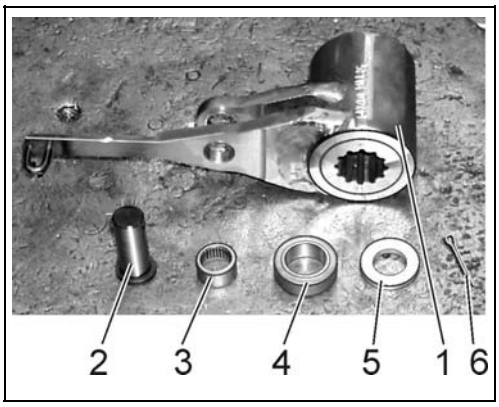


BRAKES

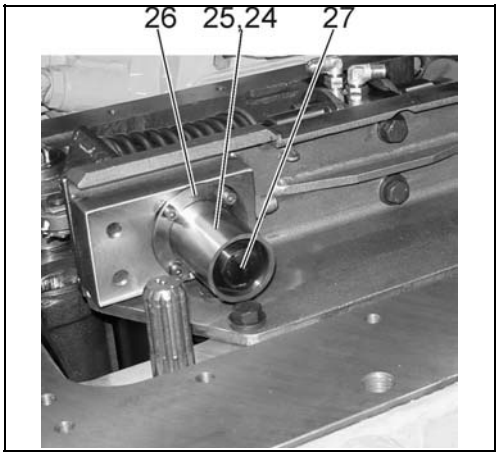
BRAKE AND CLUTCH CYLINDERS ASSEMBLY

3. Disassembly steering arm, if necessary.

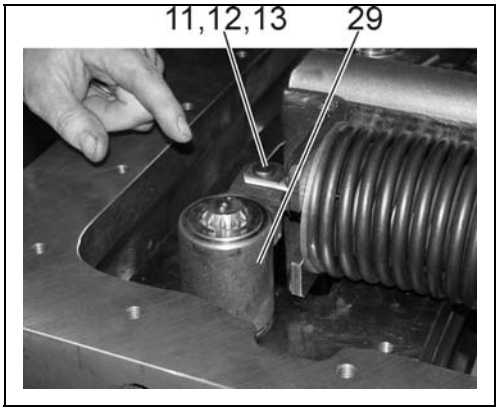
    1. Steering Arm Body
    2. Pin
    3. Needle Bearing
    4. Bearing Roller
    5. Washer
    6. Cotter Pin



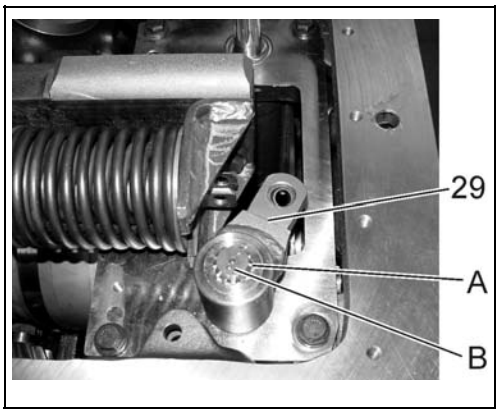
4. Unscrew clutch cylinder disc (26) mounting hardware. Remove disc (26), clutch cylinder sleeve (25) with O-ring (24) and piston (27). Repeat for remaining side.



5. Remove cotter pin (13) with washer (12) from brake arm pivot pin (11). Remove pivot pin (11). Repeat for remaining side.

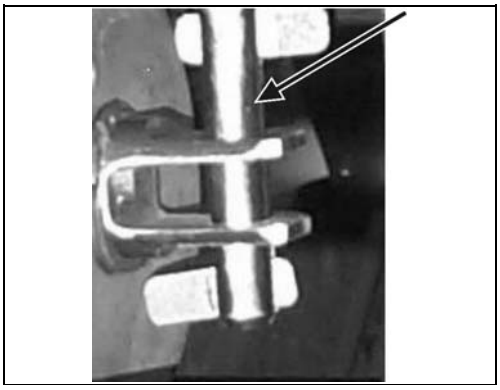


6. Using lock ring pliers, remove retaining ring (A) from eccentric shaft (B). Remove brake arm (29). Repeat for remaining side.

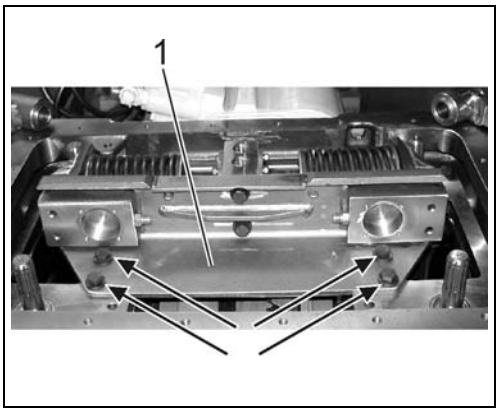


BRAKE AND CLUTCH CYLINDERS ASSEMBLY

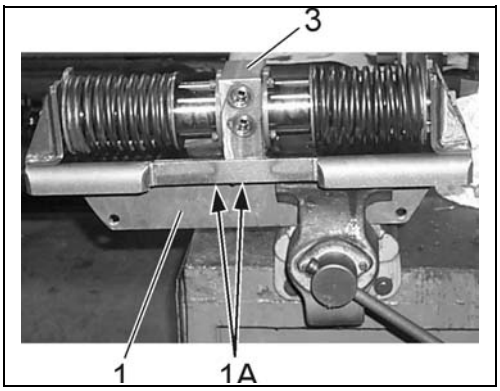
7. Secure brake cylinder assy using brake cylinder assy securing pin (refer to SERVICE/SPECIAL TOOLS in this Section). Repeat for remaining side.



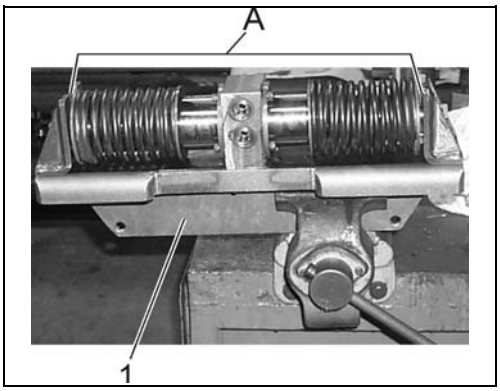
8. Unscrew four bolts with washers and remove clutch and brake cylinders mounting bracket assy (1) from the rear frame.



9. Position the clutch and brake cylinders mounting bracket (1) in a vise. Remove two bolts with washers (1A) securing brake cylinder housing (3) to bracket (1).



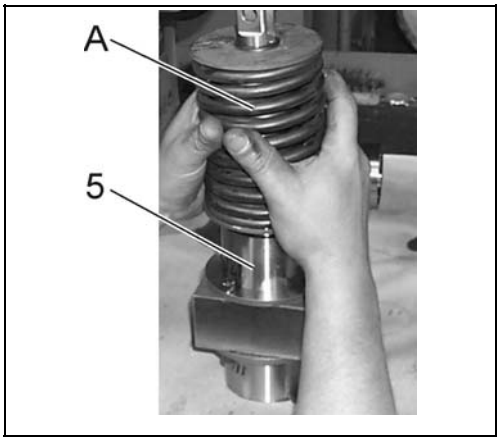
10. Remove brake cylinders assembly (A) from the bracket (1).



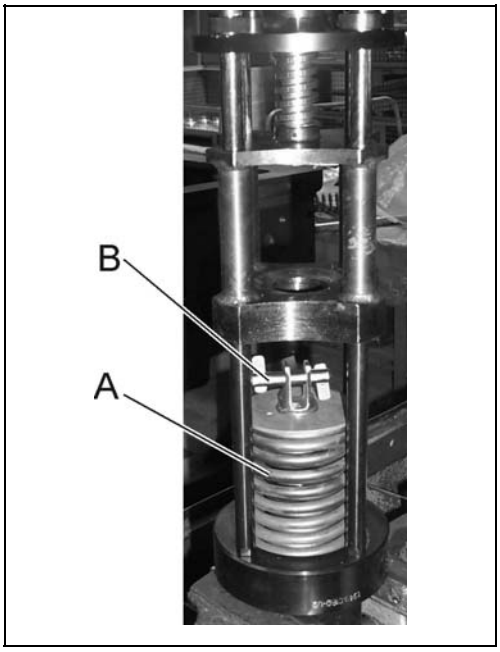
BRAKE AND CLUTCH CYLINDERS ASSEMBLY

11. Pull brake piston assy (A) off from the brake cylinder sleeve (5).

    Repeat this operation for the other side of brake cylinder housing.

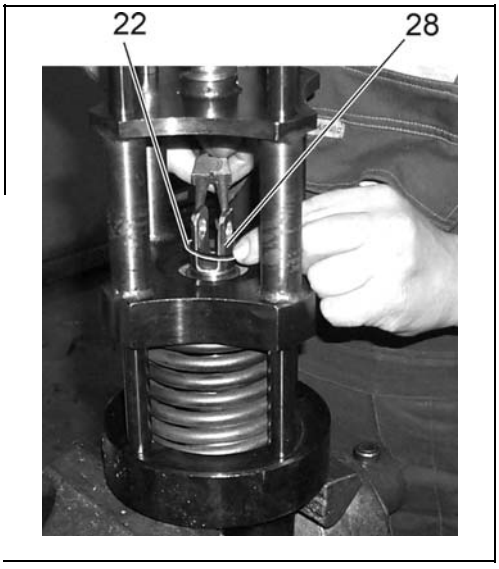


12. Position brake piston assy (A) in compression tool (refer to SERVICE/ SPECIAL TOOLS in this Section) and remove brake cylinder assy securing pin (B) (refer to SERVICE/ SPECIAL TOOLS in this Section) from brake piston connecting rod.



13. Compress the springs by compression tool retainer bolt. Using pliers remove retaining ring (22) from brake piston connecting rod (28) .

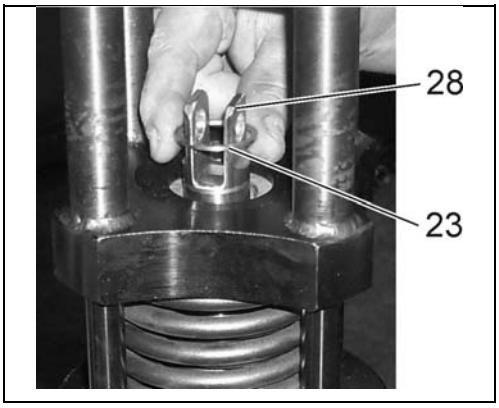
WARNING! Spring loaded assembly. Use extreme caution when disassembling.



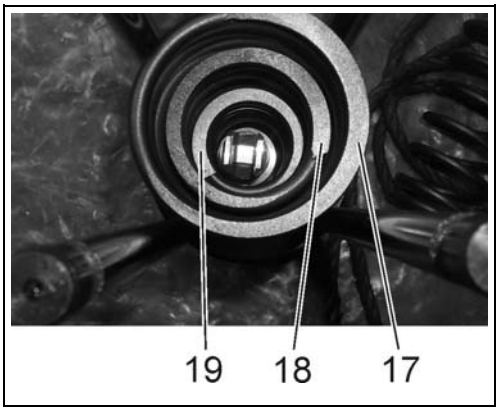
BRAKE AND CLUTCH CYLINDERS ASSEMBLY

14. Remove spacer washer (23) from brake piston connecting rod (28). Start to loosen the retainer bolt of compressing tool until all tension is relieved off of the inner, middle and outer springs.

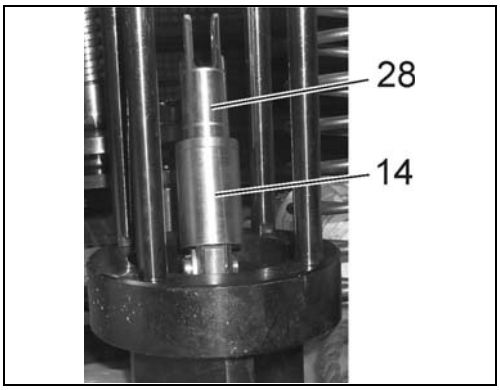
WARNING! Spring loaded assembly. Use extreme caution when disassembling.



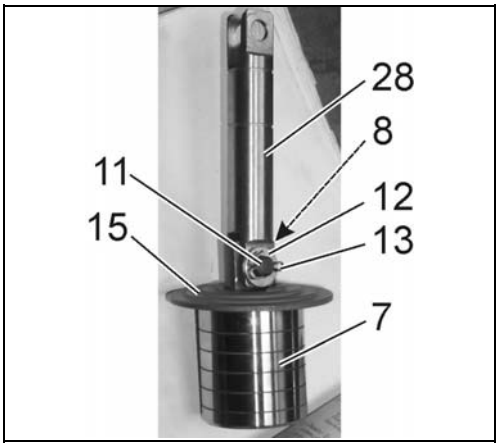
15. After all tension is relieved, remove the upper part of compressing tool and thrust outer disc (16). Remove the outer spring (17), middle spring (18) and inner spring (19).



16. Remove brake piston subassy with connecting rod (28) from compressing tool. Remove thrust sleeve (14) from connecting rod (28).



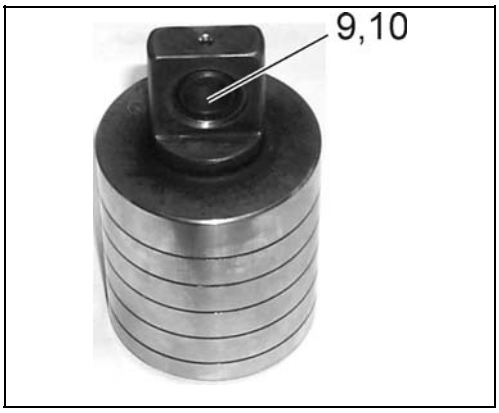
17. Remove cotter pin (13) with washer (12). Pull out pin (11) to separate connecting rod (28) from brake piston (7). Remove two spacer rings (8) during separating. Remove thrust inner disc (15) from piston (7).



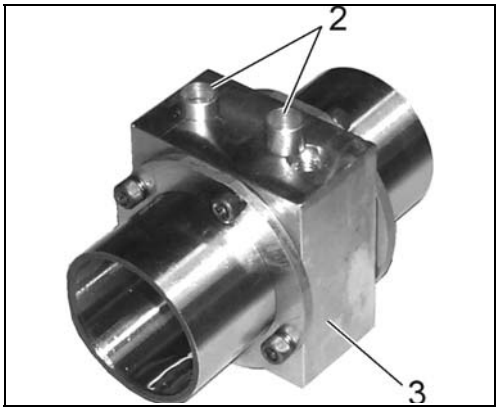
BRAKE AND CLUTCH CYLINDERS ASSEMBLY

18. Remove two retaining rings (9) securing brake piston bearing (10). Remove bearing (10), if necessary.

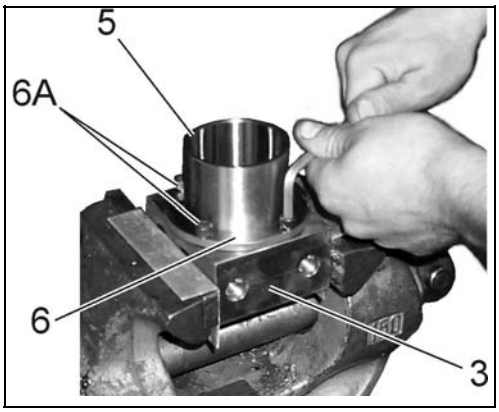
Repeat Steps 12 through 18 for remaining side.



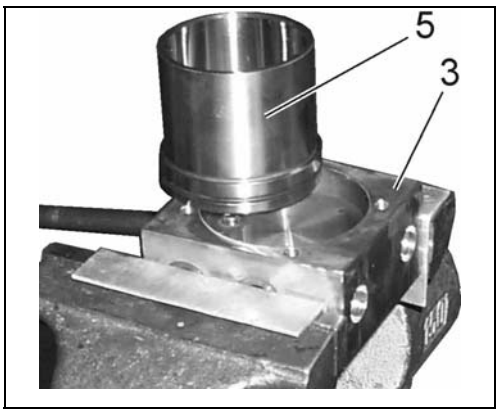
19. Remove two spacer sleeves (2) from brake cylinder housing (3), if necessary.



20. Position housing (3) in a vise. Unscrew four bolts (6A) and remove brake cylinder disc (6) from brake sleeve (5).



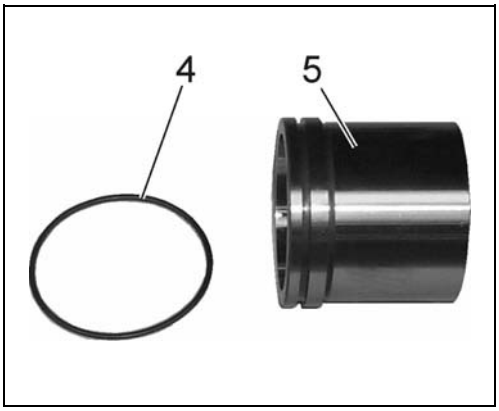
21. Remove brake cylinder sleeve (5) from brake cylinder housing (3).



BRAKE AND CLUTCH CYLINDERS ASSEMBLY

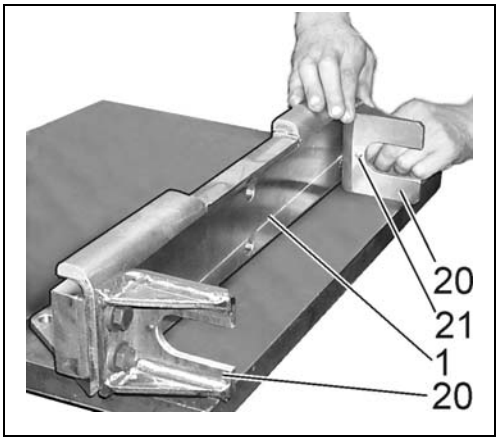
22. Remove O-ring (4) from brake cylinder sleeve (5).

Repeat Steps 20 through 22 for remaining side.



23. Separate thrust support (20) from bracket assy (1). Remove dowel pin (21), if necessary.

Repeat for remaining side.



INSPECTION AND REPAIR

1. If not already done, discard all O-rings and replace with a new.
2. Clean all remaining parts in solvent and dry thoroughly with compressed air.
3. Inspect the cylinder sleeves and pistons for wear, scoring, scratches and grooves that may cause the leakage. Very slight scratches can be polished out with a fine emery cloth and oil.
4. Inspect all parts for cracks and breakage and replace as necessary.
5. Inspect the condition of the springs. If they are fatigue or damaged, they must be replaced.
6. Inspect the condition of retaining rings and their groves in mating parts. Replace the parts, if necessary.

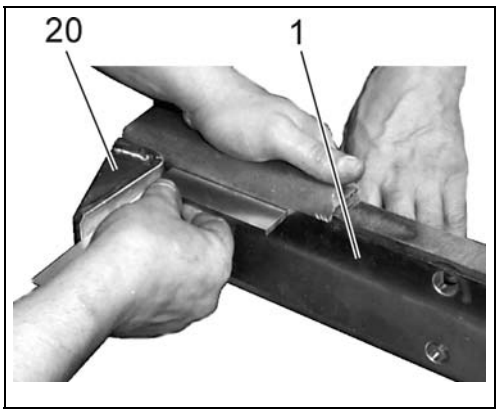
BRAKE AND CLUTCH CYLINDERS ASSEMBLY

REASSEMBLY

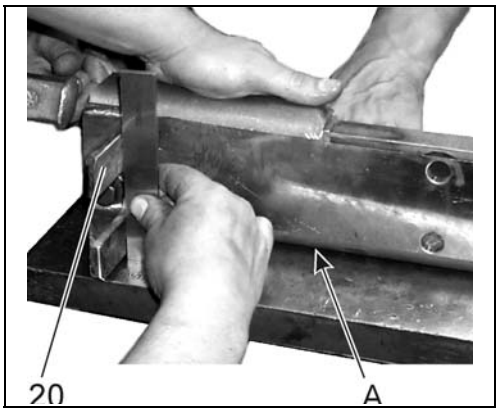
NOTE: *Coat all the cylinder pistons and sleeves with a liberal layer of clean oil.*

NOTE: *Callouts from exploded view (Fig. 4.3) correspond with most callouts in following steps.*

1. Position bracket assy (1) on the work-bench flat surface. Using right angle combination square position right thrust support (20) perpendicular to bracket (1) surface.



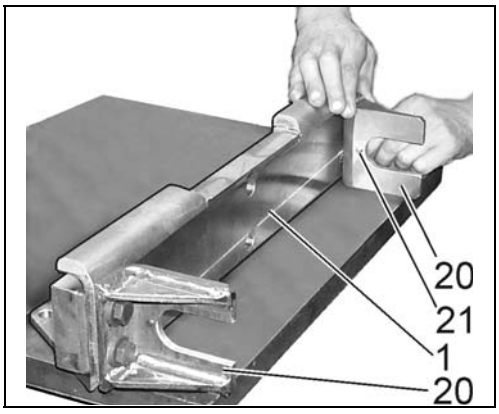
2. Using right angle combination square position right thrust support (20) perpendicular to lower bracket (1) surface (A).



3. Secure right trust support (20) with hardware. Apply LOCTITE #262 to bolts and torque them to 100 ± 8 [Nm]. Install dowel pin (21), if removed.

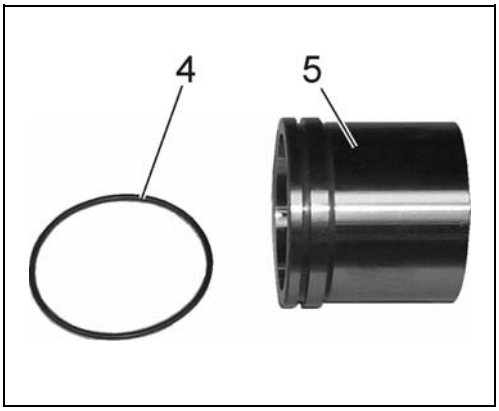
NOTE: *If needed, check mutual position of bracket (1) and thrust supports (20) according to Steps 1 and 2 after bolts tightening.*

Repeat Steps 1 through 3 for remaining side.

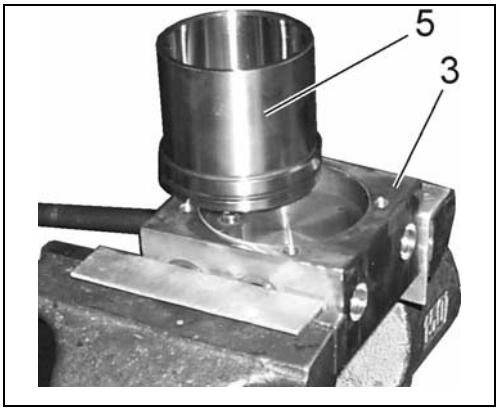


BRAKE AND CLUTCH CYLINDERS ASSEMBLY

4. Install a new O-ring (4) to the groove on the brake cylinder sleeve (5).

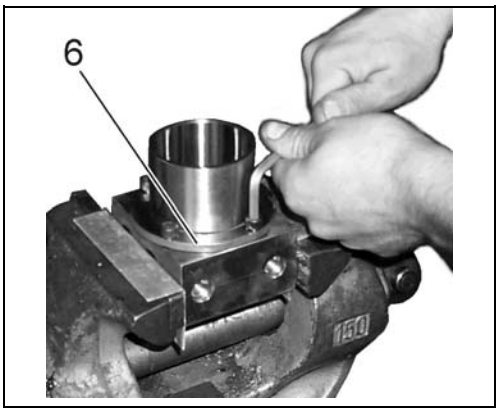


5. Position the brake cylinder housing (3) in a vise. Install brake cylinder sleeve (5) into housing (3).

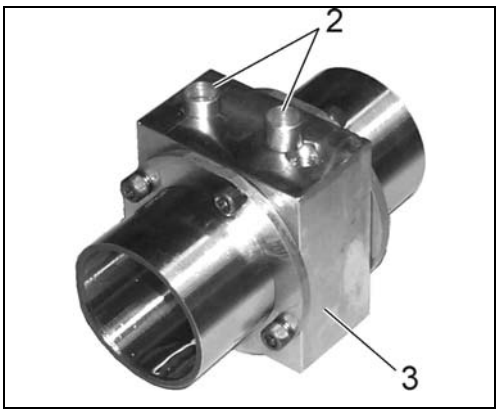


6. Install brake cylinder disc (6) and secure with hardware. Apply LOCITE #262 to bolts and torque them to 14 ÷ 16 [Nm].

Repeat Steps 4 through 6 for remaining side

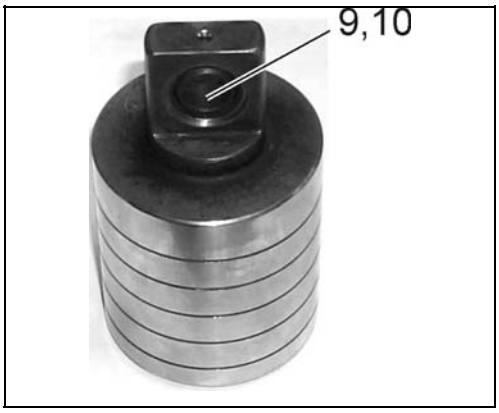


7. Install two spacer sleeves (2) into brake cylinder housing (3), if removed.

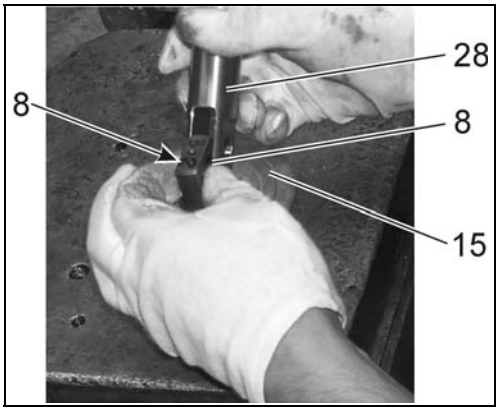


BRAKE AND CLUTCH CYLINDERS ASSEMBLY

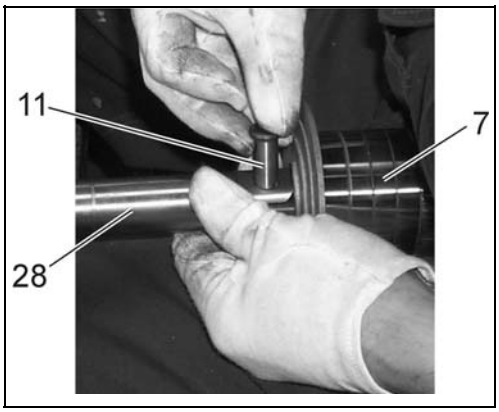
8. Install first retaining ring (9) and press bearing (10) into brake piston eye end. Secure with second retaining ring (9).



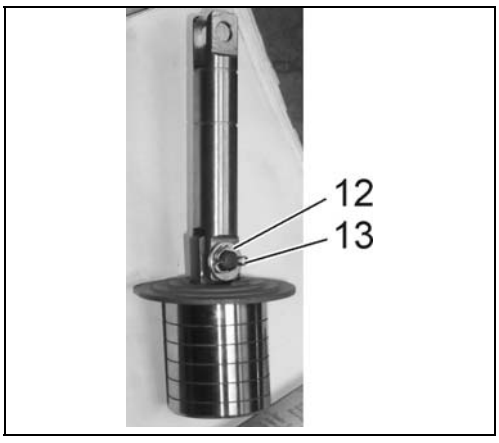
9. Install thrust inner disc (15) on brake piston (7) eye end. Install two spacer rings (8) into brake piston eye end both sides and reconnect it with the connecting rod (28).



10. Connect rod (28) with brake piston (7) using pin (11).

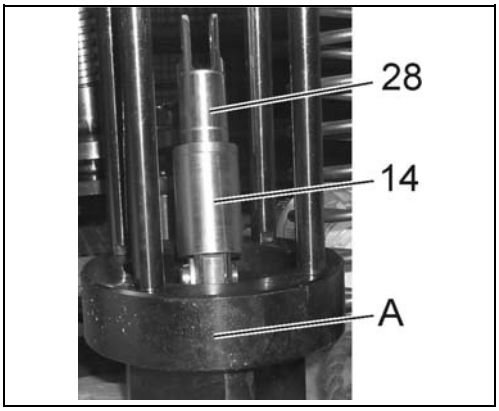


11. Secure with washer (12) and cotter pin (13).



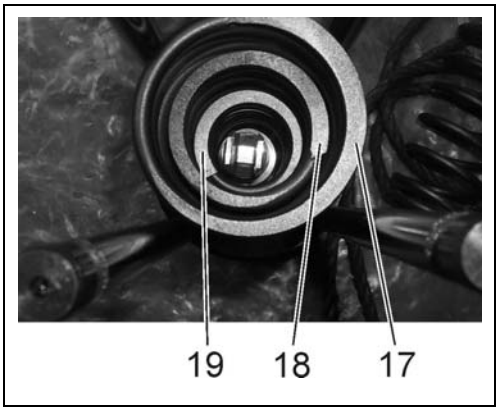
BRAKE AND CLUTCH CYLINDERS ASSEMBLY

12. Slide thrust sleeve (14) on connection rod (28). Position brake control piston assembly in the compression tool (A) (refer to SERVICE / SPECIAL TOOLS in this Section).



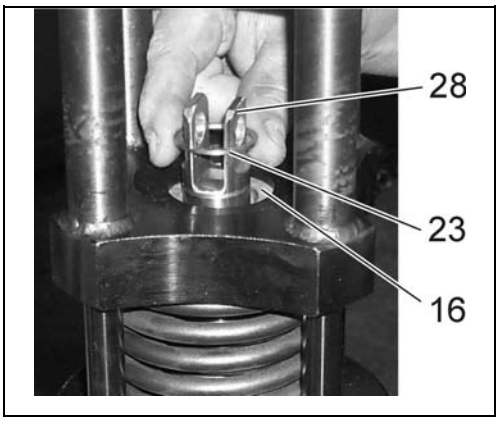
13. Install the outer spring (17), middle spring (18) and inner spring (19).

NOTE: *Position springs so their coil ends be equal distanced 120 [°] each other.*

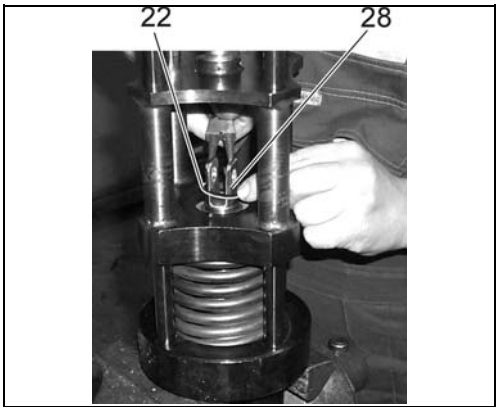


14. Position thrust outer disc (16) on the spring. Install the upper part of compressing tool. Compress the springs with the compressing tool until the rod groove will be visible. Install spacer washer (23) on brake piston connecting rod (28).

WARNING! Spring loaded assembly. Use extreme caution when loading the springs.

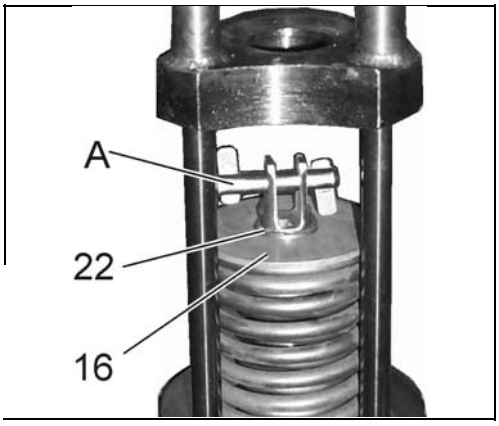


15. Using pliers install retaining ring (22) on the brake piston connecting rod (28). Install retaining ring into rod groove over spacer washer (23).



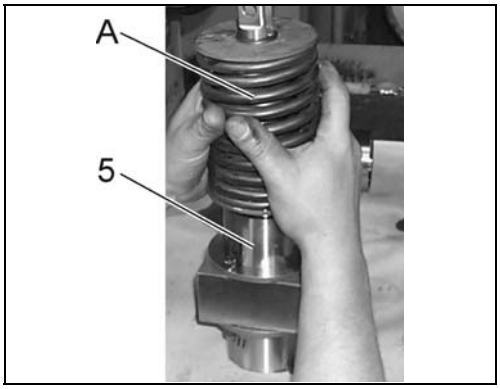
BRAKE AND CLUTCH CYLINDERS ASSEMBLY

16. Start to loosen compression tool until the springs tension is held up with thrust outer disc (16) secured with retaining ring (22). Secure brake piston assy using special securing pin (A), (refer to SERVICE/ SPECIAL TOOLS in this Section). Remove brake cylinder assembly from compression tool.



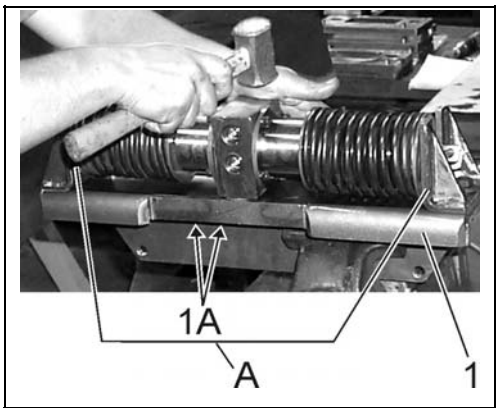
WARNING! Spring loaded assembly. Use extreme caution when unloading the springs.

17. Slide brake piston with assemblies into brake cylinder sleeve (5).

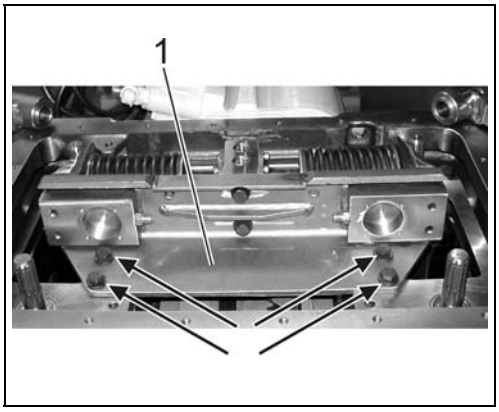


Repeat Steps 8 through 17 for remaining side.

18. Position the brake and clutch cylinders mounting bracket (1) in a vise. Install brake cylinders assembly (A) into the bracket (1). Secure with hardware. Apply LOCTITE #262 to bolts and torque the bolts with washers (1A) to 100 ± 8 [Nm].



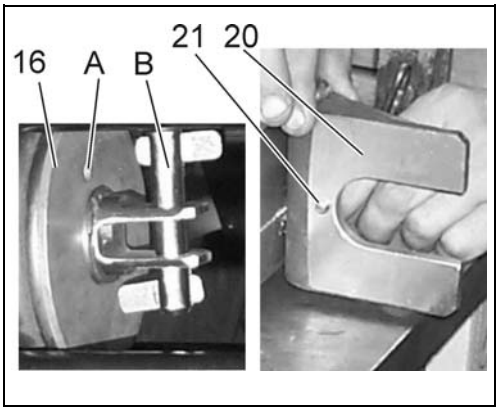
19. Install brake and clutch cylinders mounting bracket assy (1) into rear main frame. Secure bracket to mounting plate with hardware. Apply LOCTITE #262 to bolts and torque them to 100 ± 8 [Nm].



BRAKE AND CLUTCH CYLINDERS ASSEMBLY

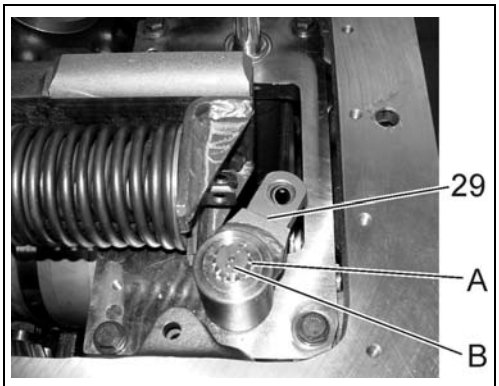
20. Reposition thrust outer disc (16) until dowel pin (21), placed in thrust support (20) comes into alignment with opening (A). Have the pin slide into outer disc (16) opening (A). Remove special securing pin (B).

    Repeat for remaining side.



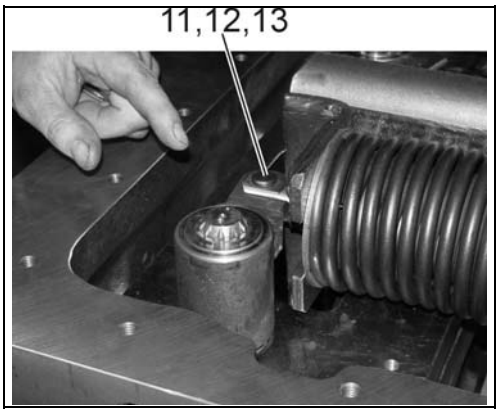
21. Install left and right brake arms (29) indexing factory marks on arms with marks on eccentric shafts. Using lock ring pliers, install retaining rings (A) onto eccentric shafts (B).

    Repeat for remaining side.

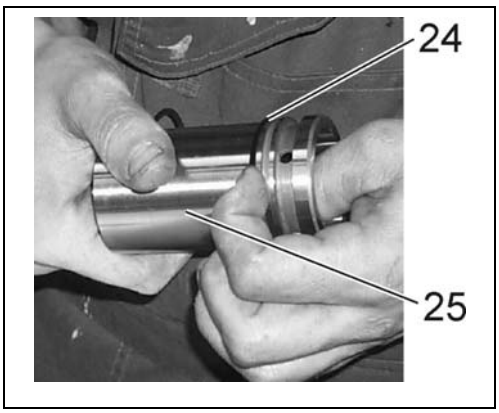


22. Position brake arm (29) in brake connecting rod eye end (28) and secure with pivot pin (11) with washer (12) and new cotter pin (13).

    Repeat for remaining side.



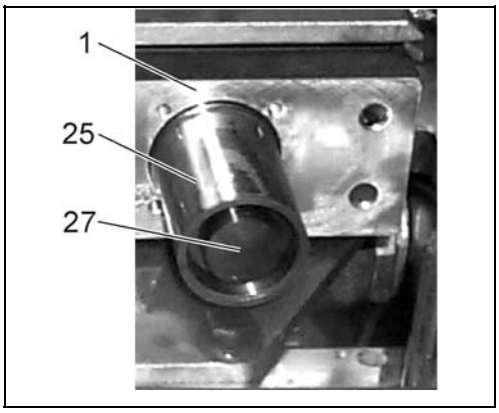
23. Install a new O-ring (24) to the groove on the clutch cylinder sleeve (25).



BRAKE AND CLUTCH CYLINDERS ASSEMBLY

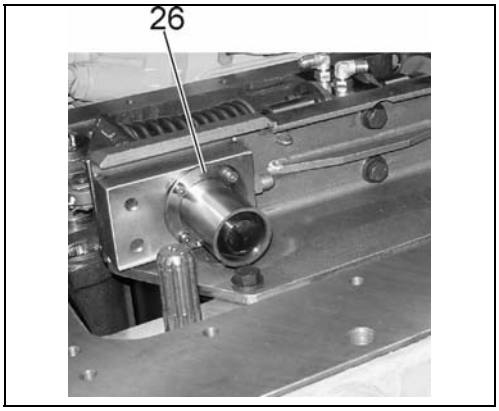
24. Coat the clutch cylinder piston (27) with a liberal layer of clean oil. Slide the piston into sleeve (25). Install sleeve with piston inside into brake and clutch bracket assy (1).

    Repeat for remaining side.



23. Install clutch cylinder disc (26) and secure with hardware. Apply LOCTITE #262 to bolts and torque them to 9.5 ÷ 12 [Nm].

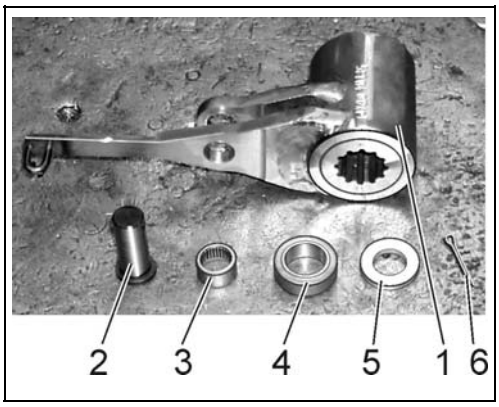
    Repeat for remaining side.



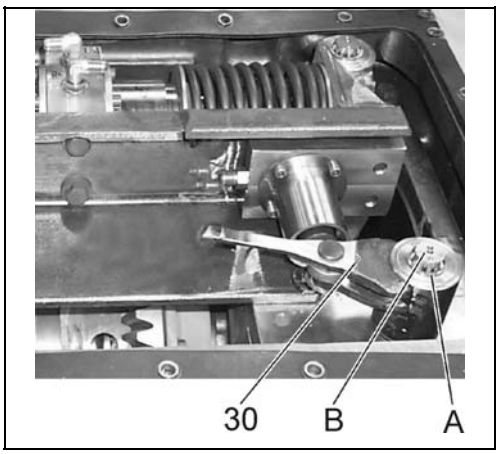
24. Reassembly steering arm, if needed.

    1. Steering Arm Body
    2. Pin
    3. Needle Bearing
    4. Bearing Roller
    5. Washer
    6. Cotter Pin

    Repeat for remaining side.

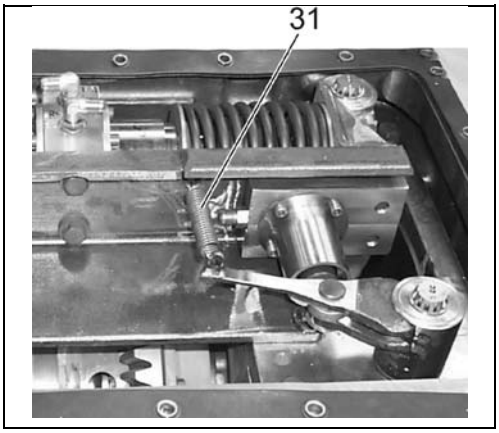


25. Install left and right steering arms (30) indexing factory marks on arms with marks on eccentric shafts. Using lock ring pliers install retaining rings (A) on eccentric shafts (B) to secure two steering arms.



BRAKE AND CLUTCH CYLINDERS ASSEMBLY

26. Install both steering arm return springs (31).



WARNING! Loaded assembly. Use extreme care when installing.

26. To adjust steering arm/clutch apply shoe position, refer to REASSEMBLY in STEERING DRIVE, Section 7E.

    Perform brake and clutch cylinders oil leakage test, refer to REASSEMBLY in STEERING DRIVE, Section 7E.

INSTALLATION

For installation of brake and clutch cylinders assembly, refer to REASSEMBLY, STEERING DRIVE, in Section 7E and follow steps from brake and clutch cylinders assembly installation to end.

MOUNTING PLATE

5. MOUNTING PLATE

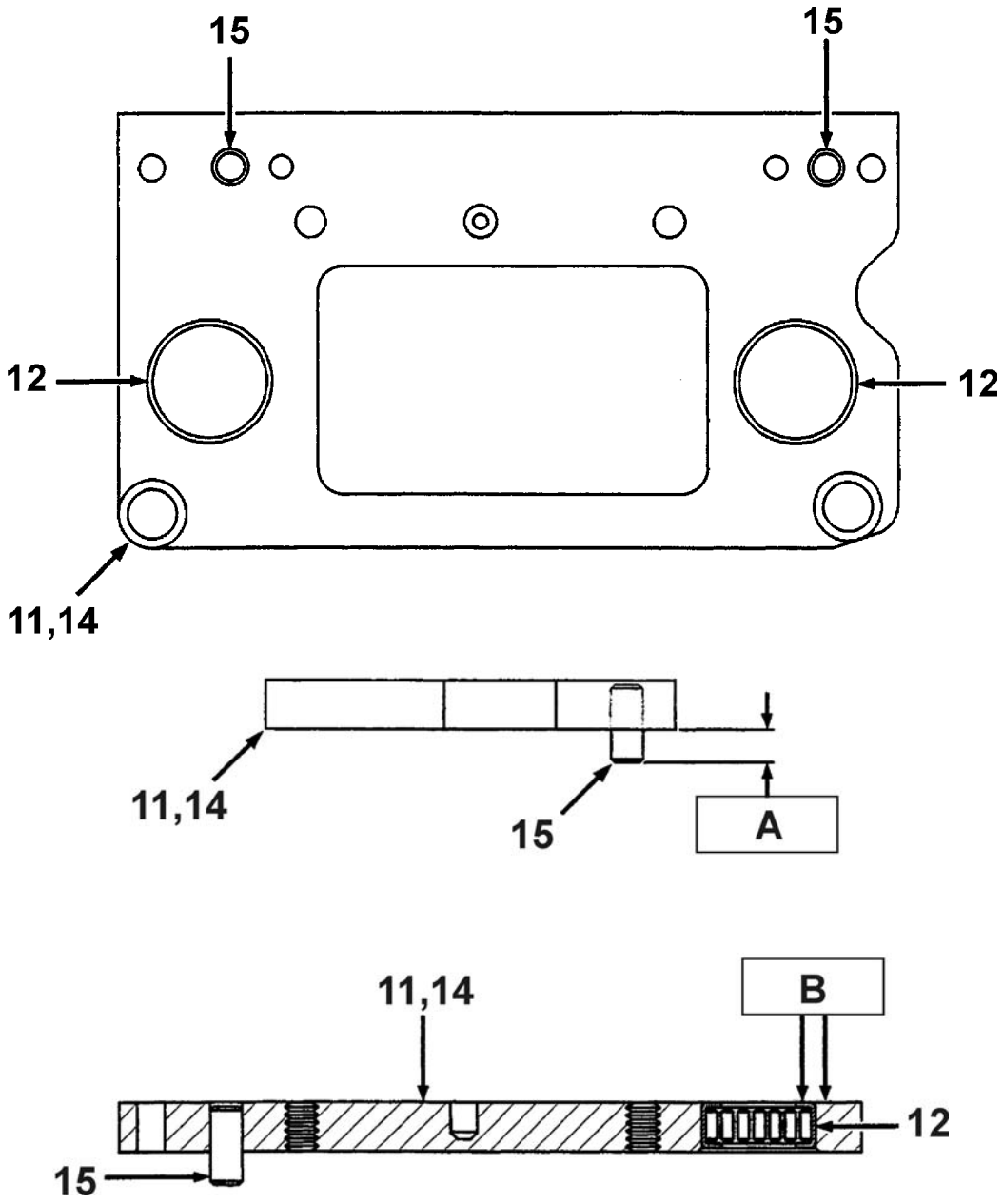


Fig. 4.4. Section View of Cylinder Plate

11. Left Mounting Plate
12. Needle Bearing
14. Right Mounting Plate
15. Dowel Pin

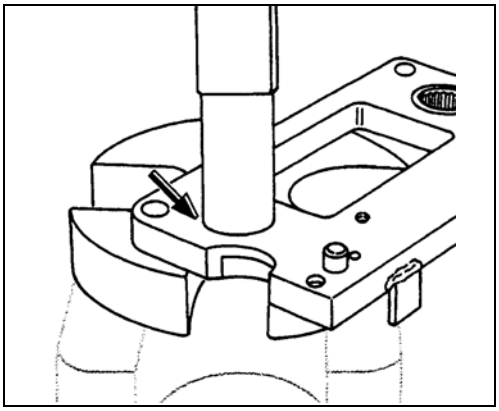
A. Press Pin in to 15.7 [mm] Protrusion
B. Press Bearing Flush with Edge

MOUNTING PLATE

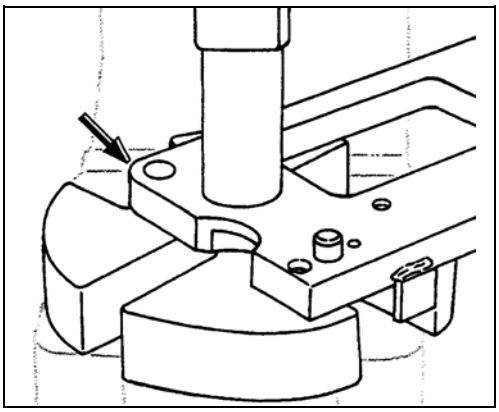
SERVICE

NOTE: *For removal of mounting plate, refer to DISASSEMBLY, STEERING DRIVE, Section 7E and follow steps to mounting plate removal.*

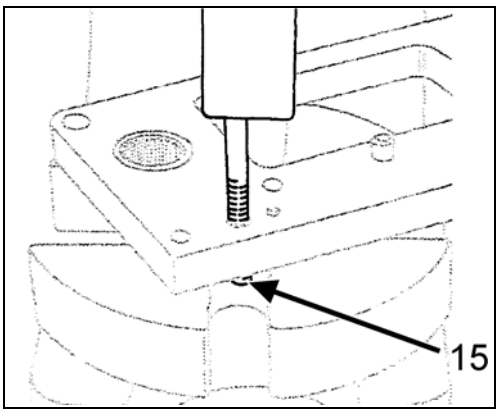
1. Position mounting plate in press with bearing over open area. Apply press and remove bearing.



2. Position mounting plate in press with bearing over closed area. Apply press and install bearing flush with both edges of plate.

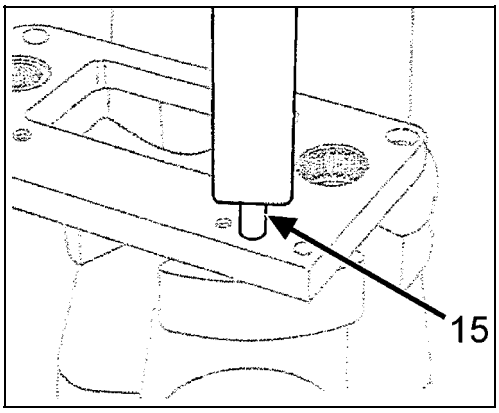


3. Using press and pusher rod, remove dowel pins (15) from mounting plate.

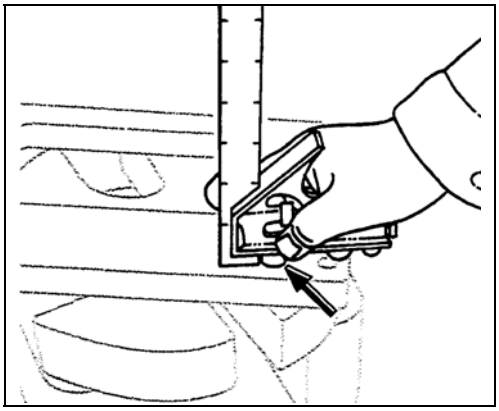


MOUNTING PLATE

4. Press new dowel pin (15) in place into plate at a 15.7 [mm] protrusion.



5. Measure pin height and correct as necessary.



NOTE: *For installation of mounting plate, refer to REASSEMBLY, STEERING DRIVE in Section 7E and follow steps from mounting plate installation to end.*

BRAKE/STEERING SHOES

6. APPLY/BACK UP SHOES

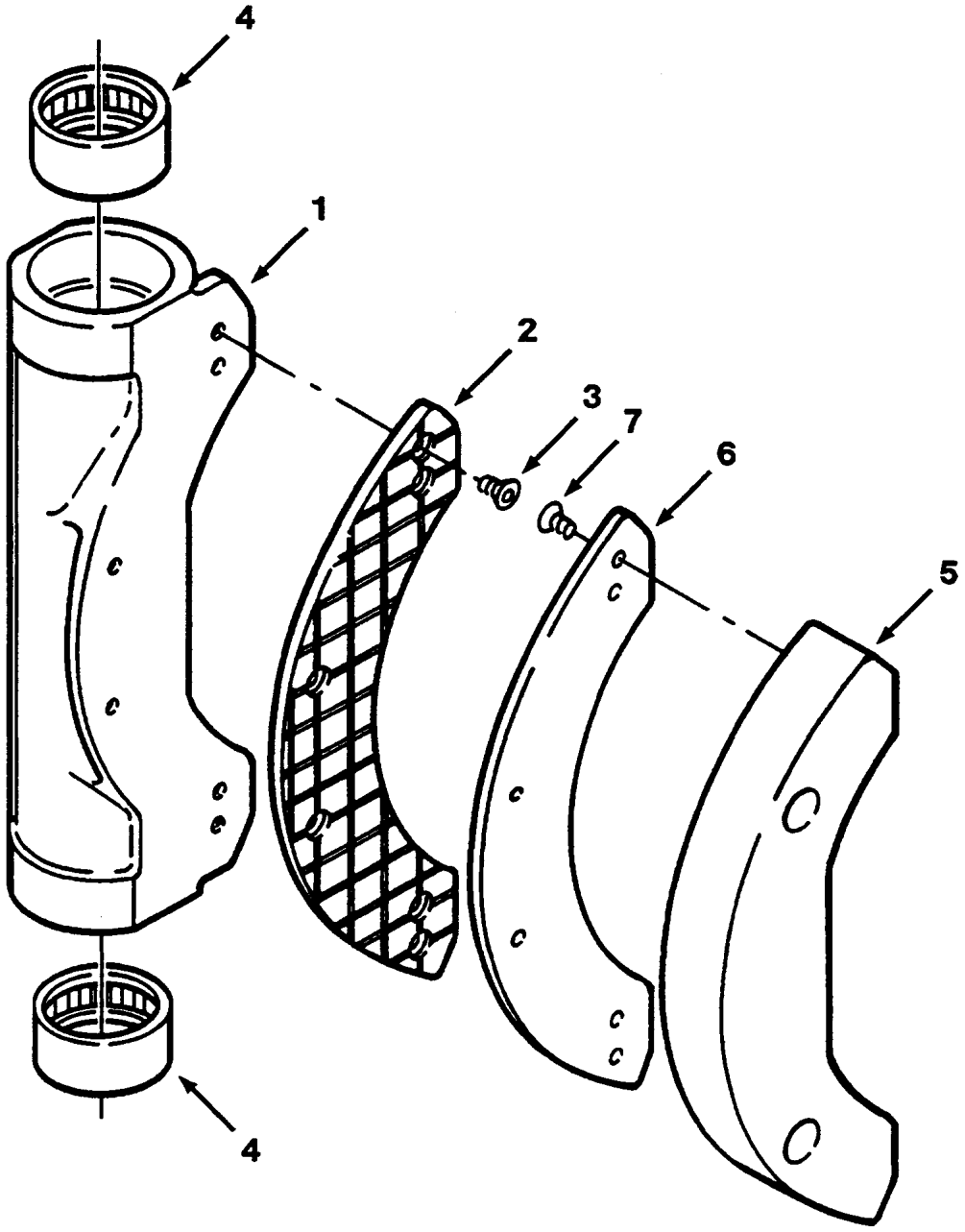


Fig. 4.5. Exploded View of Brake or Steering Shoes

Legend for Figs. 4.5 and 4.6

Apply Shoe Assembly

1. Apply Shoe
2. Shoe Lining
3. Mounting Screw
4. Needle Bearing

Back Up Shoe Assembly

5. Back Up Shoe
6. Shoe Lining
7. Mounting Screw

BRAKE/STEERING SHOES

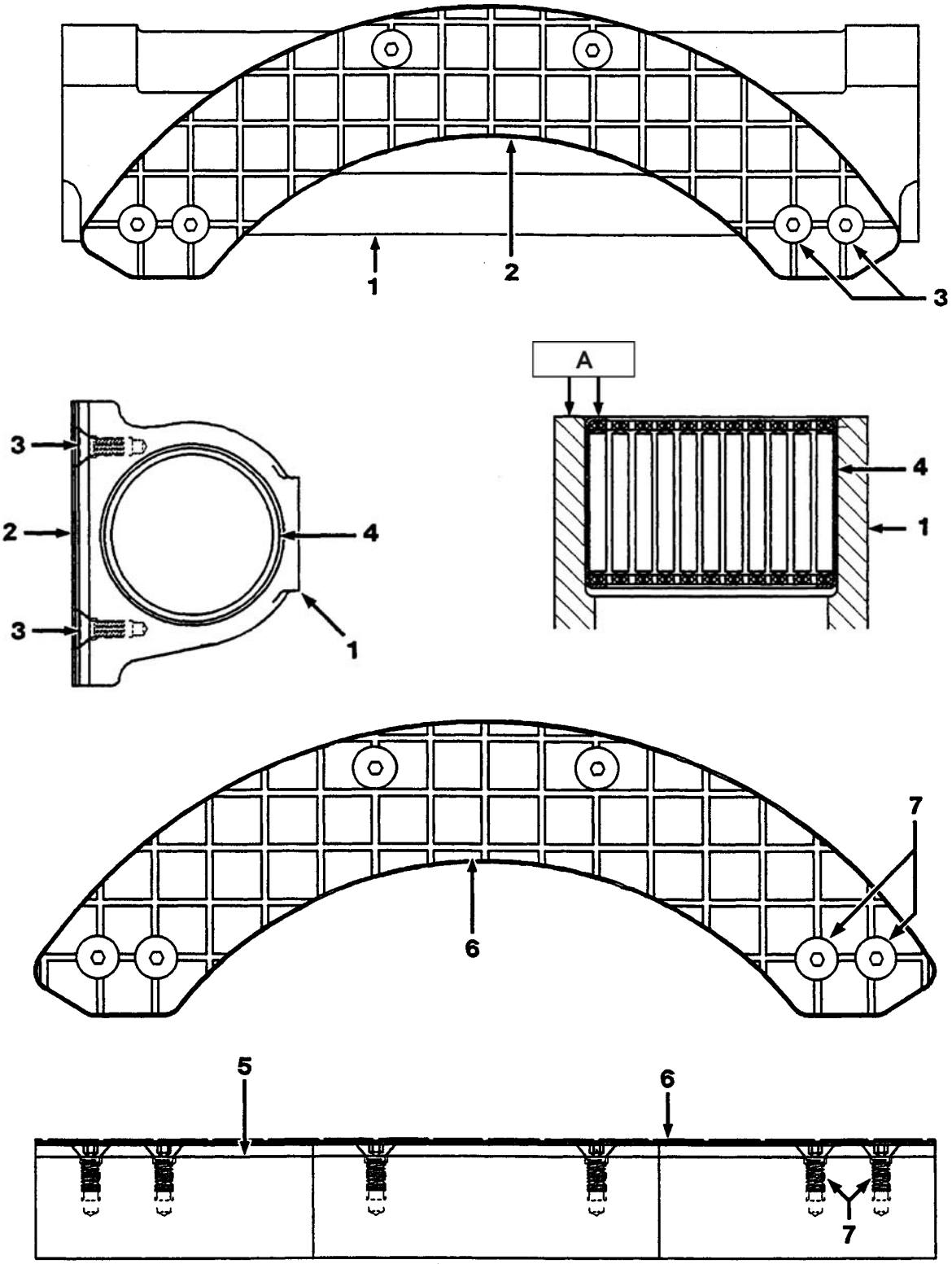


Fig. 4.6. Section View of Brake or Steering Shoes

A – Flush to 0.25 [mm] below Surface Both Ends

BRAKE/STEERING SHOES

SPECIFICATIONS

Mating Surfaces Degreaser..... Cleaning Solvent
Mating Surfaces Set Up ..... LOCTITE Activator “T”
Mating Surfaces Adherent..... LOCTITE #12017
Mounting Screw Adherent .....LOCTITE #262
Mounting Screw Torque ..... 9.5 ÷ 12 [Nm]
Bearing Press.....Flush or 0.25 [mm] Below Finished Surface

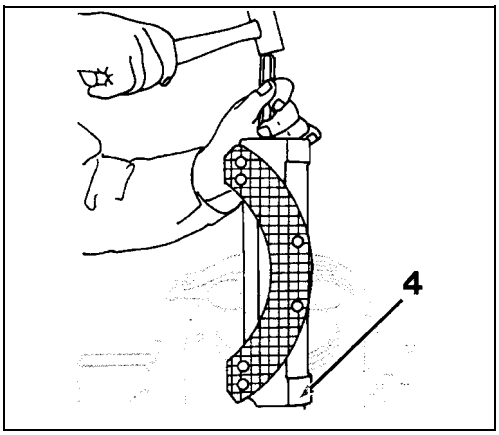
SERVICE

NOTE: *For removal of brake or steering shoes, refer to DISASSEMBLY, STEERING DRIVE in Section 7E and follow steps to shoe removal.*

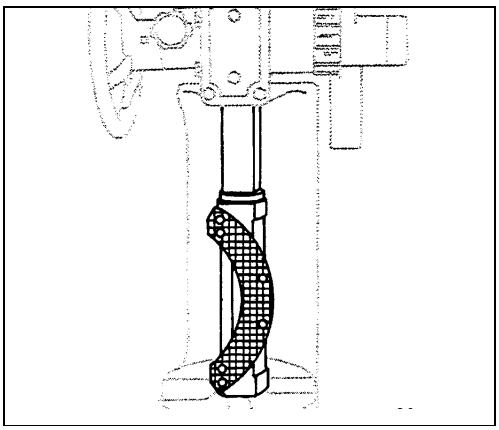
NOTE: *Callouts from exploded and section views correspond with callouts in following steps.*

APPLY SHOES

1. Using a long drift, drive bearings (4) out of each end of shoe housing.

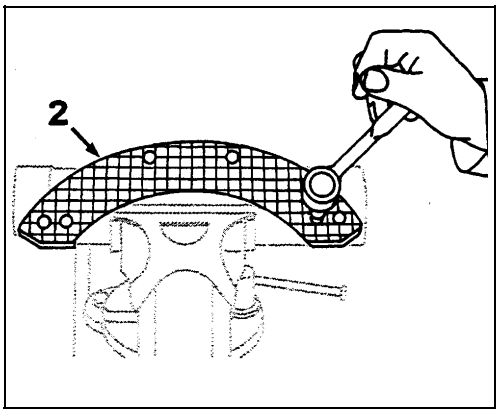


2. Press new bearing in flush or 0.25 [mm] below finished surface at both ends.

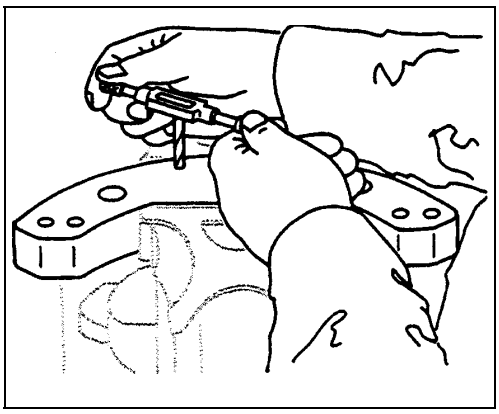


BRAKE/STEERING SHOES

3. Remove lining (2) from shoe and discard.

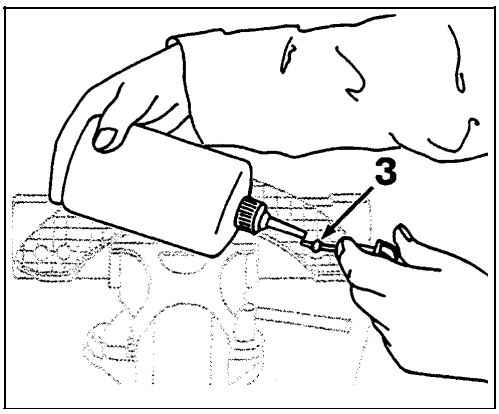


4. Using a 1/4NC tap, remove all LOCTITE from threaded holes in shoe.

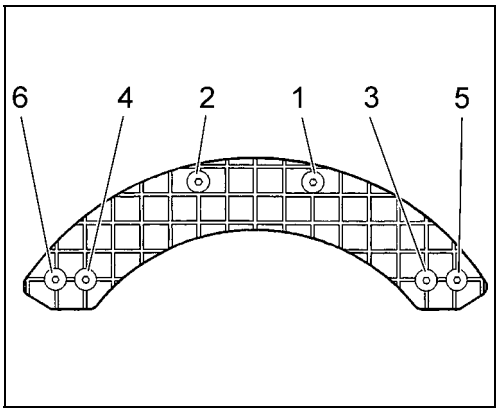


5. Degrease mating surfaces of lining and shoe with cleaning solvent. Apply LOCTITE Activator "T" and LOCTITE 12017 per instructions that come with material. Allow an adequate period for fixture time.

   Apply LOCTITE #262 to threads of screws (3) and install.

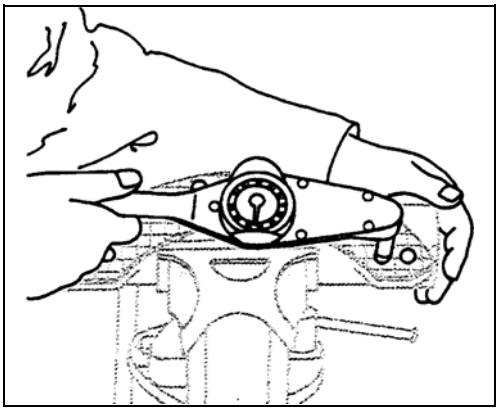


NOTE: *Install and torque screws (3) in order 1 through 6 showed in the picture.*



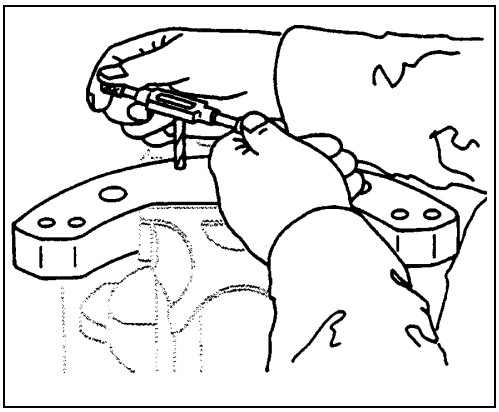
BRAKE/STEERING SHOES

6. Torque screws to 9.5 to 12 [Nm].



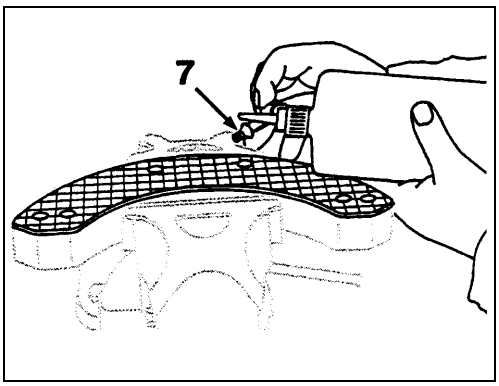
BACK UP SHOES

7. Remove lining from shoe and discard. Using a 1/4NC tap, remove all LOCTITE from threaded holes in shoe.

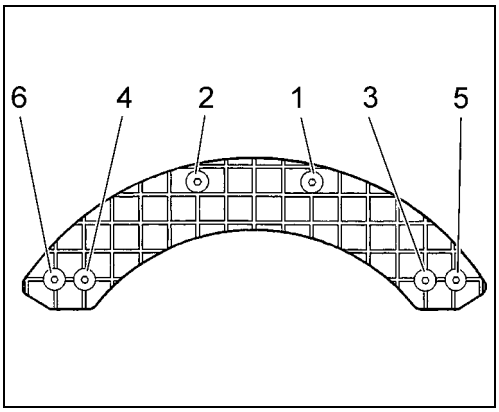


8. Degrease mating surfaces of lining and shoe with cleaning solvent. Apply LOCTITE Activator “T” and LOCTITE #12017 per instructions that come with material. Allow an adequate period for fixture time.

   Apply LOCTITE #262 to threads of screws (7) and install.

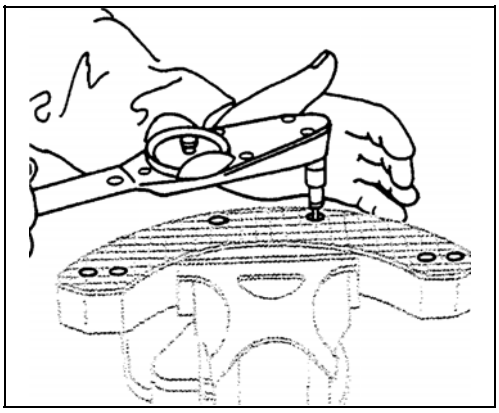


NOTE: *Install and torque screws (7) in order 1 through 6 showed in the picture.*



BRAKE/STEERING SHOES

9. Torque screws to 9.5 to 12 [Nm].



NOTE: *For installation of brake or steering shoes, refer to REASSEMBLY, STEERING DRIVE, in Section 7E and follow steps from brake or steering shoes installation to end.*

BRAKE VALVE

7. BRAKE VALVE

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 in NEUTRAL position, drive train neutral lock lever is in ON 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.

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.*

REMOVAL (Refer to Fig. 4.7)

1. For removal of brake valve, refer to DISASSEMBLY, STEERING DRIVE in Section 7E and follow steps to brake valve removal.
2. Remove shaft (53, Fig. 4.1) and lever assy (48) with links (52) and pins (51).
3. Remove three blank flanges in points A-B and unscrew three bolts A-B.

NOTE: *FOR EARLIER VERSION MACHINES ONLY. To access and then unscrew bolt B it is necessary to remove bolt "X" first.*

4. Remove remaining bolts (A and B) securing brake valve to the rear frame cover and manifold. Remove the valve. Discard the gasket.

BRAKES

BRAKE VALVE

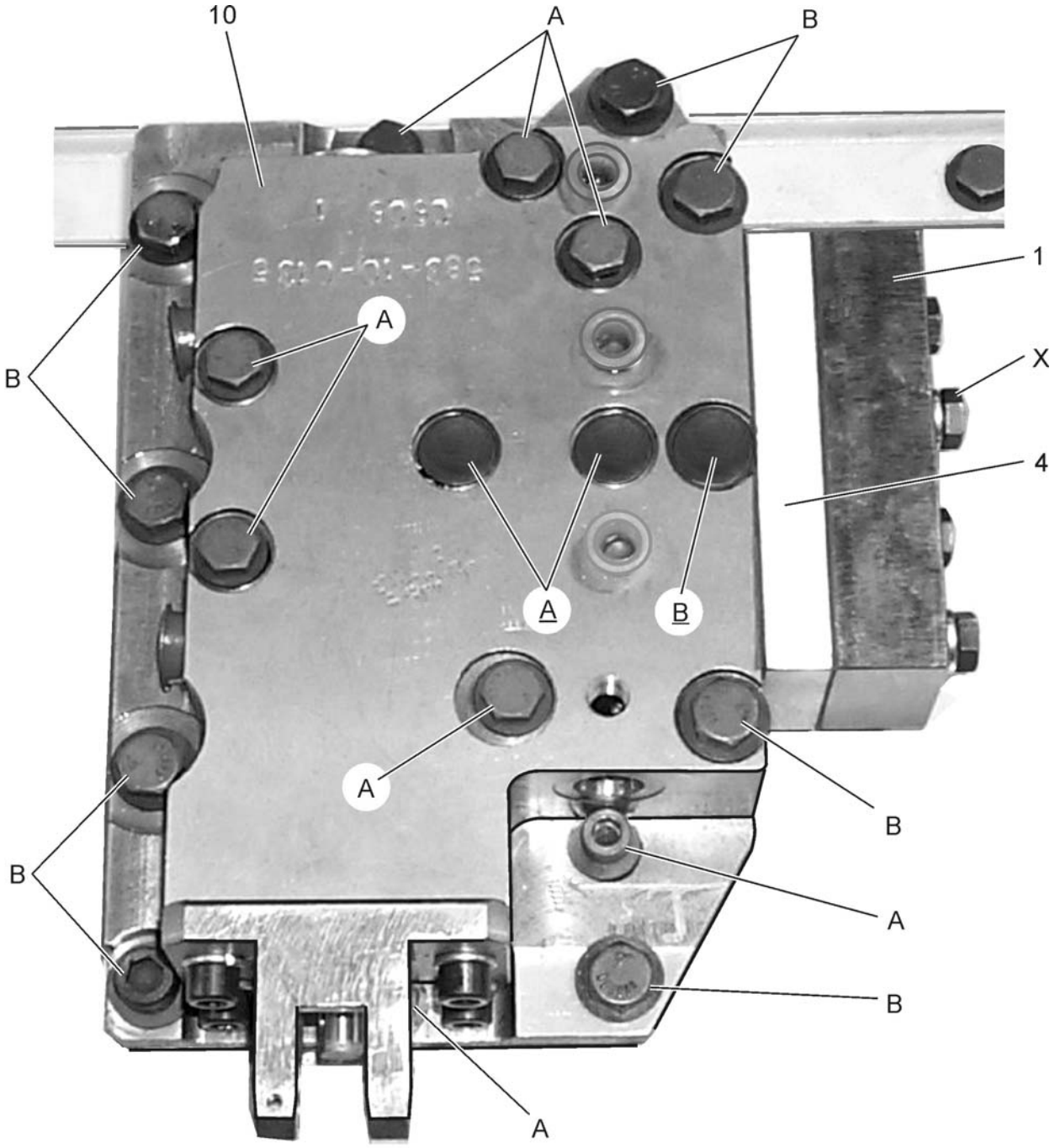


Fig. 4.7. Exploded View of Brake Valve

1. Guard
4. Cover
10. Valve Body
A, A - Brake Valve to Bottom Manifold Mounting Bolts
B, B - Brake Valve to Rear Main Frame Cover Mounting Bolts

BRAKE VALVE

DISASSEMBLY (Refer to Fig.'s 4.8 and 4.9)

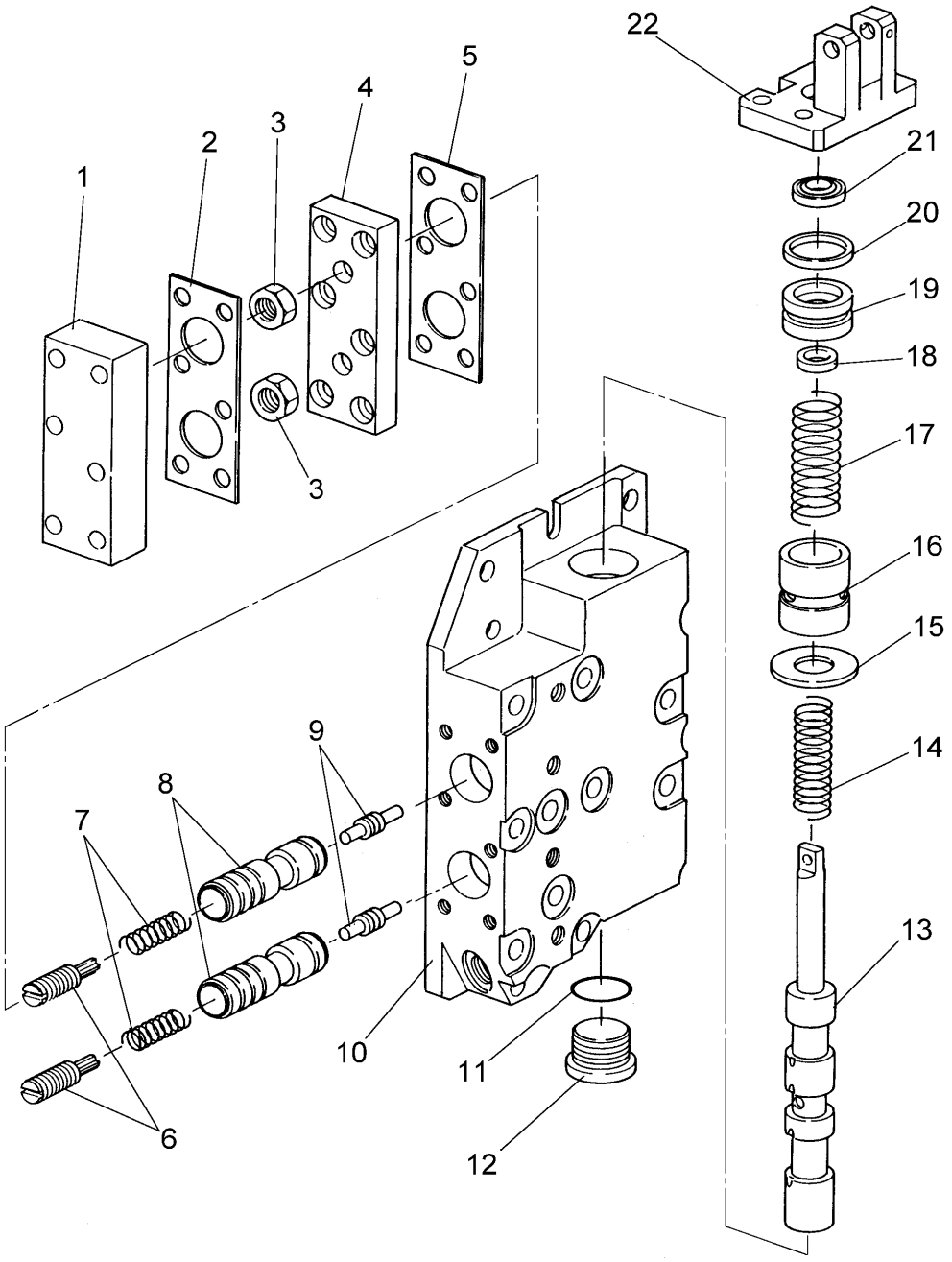


Fig. 4.8. Exploded View of Brake Valve

Legend for Fig.'s 4.8 and 4.9

1. Guard
2. Gasket
3. Nut
4. Cover
5. Gasket
6. Adjusting Screw
7. Spring
8. Bleeder Piston
9. Support Piston
10. Valve Body
11. O-Ring
12. Plug
13. Spool
14. Inner Spring
15. Thrust Ring
16. Spool Sleeve
17. Outer Spring
18. O-Ring
19. Gland
20. O-Ring
21. Wiper Ring
22. End Cover

BRAKES

BRAKE VALVE

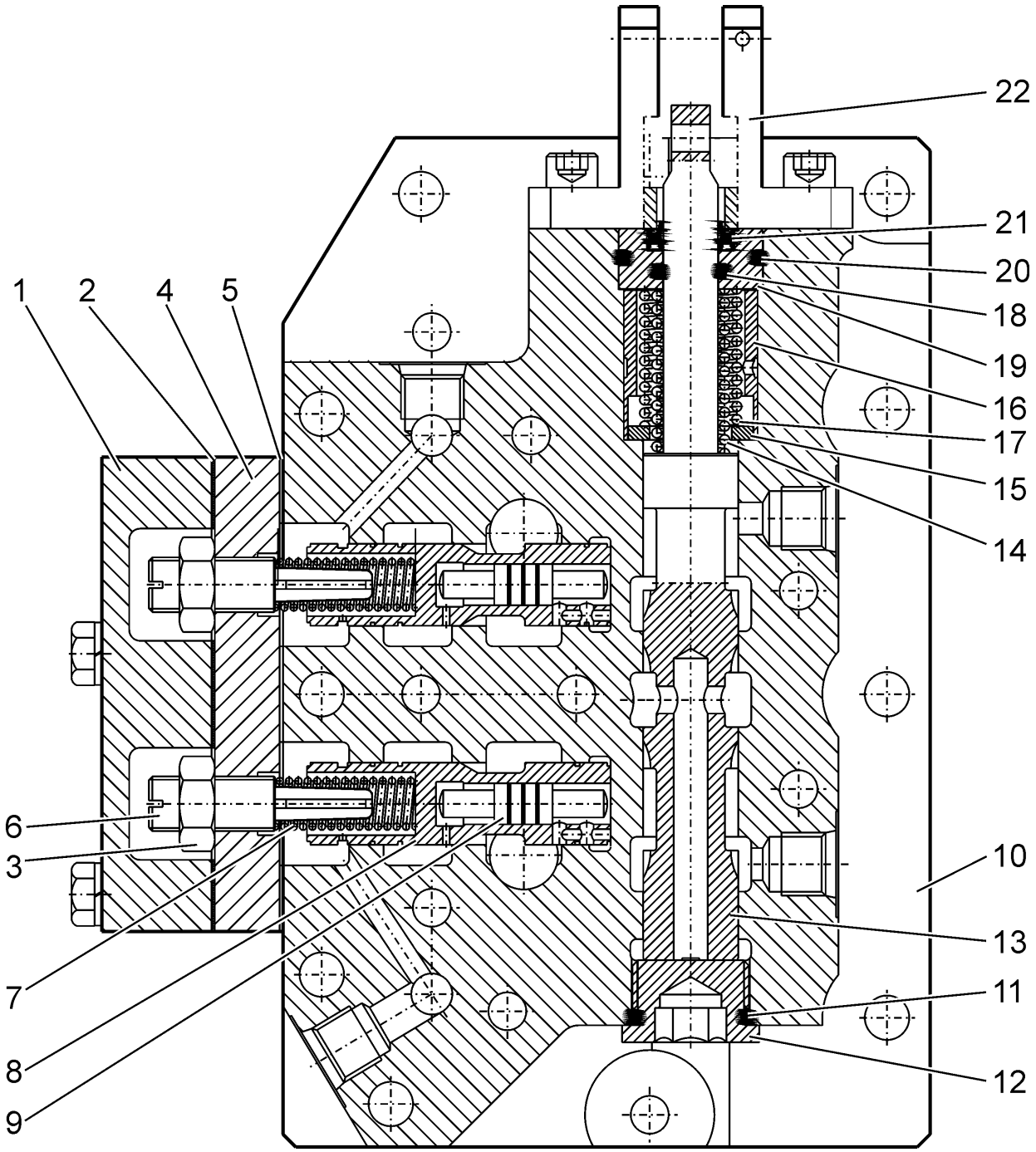


Fig. 4.9. Cross Section View of Brake Valve

BRAKE VALVE

1. Position the valve in a vise with guard (1) up. Remove the guard (1) with gasket (2) from the valve body (10).
2. If needed, remove cover (4) with adjusting screws (6) and nuts (3) from valve body (10). Remove gasket (5).

NOTE: *Exert an inward pressure while unscrewing cover (4) from valve body (10) to counteract the spring tension*.

3. If needed, separate adjusting screw (6) with nuts (3) from the cover (4).
4. Remove spring (7) from bleeder pistons openings. Remove bleeder pistons (8) with support pistons (9).
5. Reposition the valve in a vise with end cover (22) up. Remove end cover (22) from valve body (10).
6. Remove spool assy (13) from the valve body (10). Remove gland (19), spool sleeve (16) with inner and outer springs (14 and 17) and thrust ring (15) from the spool (13).
7. Remove O-ring (20), wiper ring (21) and O-ring (18) from the gland (19).
8. Remove plug (12) with O-ring (11), if necessary.

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 pistons and spool, valve body and valve cover 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.

BRAKE VALVE

REASSEMBLY (Refer to Figs. 4.8 and 4.9)

IMPORTANT: *Sealing rings should be lubricated with petroleum jelly for ease of assembly. The valve pistons, and theirs bores should also be lightly lubricated.*

1. Position the valve components on a shop bench.
2. Thread a plug (12) with an O-ring (11) into a taped hole of valve body (10).
3. Install O-ring (18) and wiper ring (21) into the gland (19). Install O-ring (20) on the gland (19).
4. Install spool (13), thrust ring (15), spool sleeve (16) with inner and outer springs (14 and 17) and gland assy (19) into the valve body (10).
5. Bolt end cover (22) to valve body (1) with four bolts. Apply LOCTITE #262 to bolts and torque them to 21 [Nm].
6. Install support pistons (9) into bleeder pistons (8).

NOTE: *Support pistons (9) should move smoothly (without jamming) inside pistons (8).*

7. Install bleeder pistons (8) with pistons (9) and springs (7) into the valve body (10).
8. Thread adjusting screws (6) into a tapped hole of cover (4), if removed. Thread nuts (3) onto adjusting screws (6).
9. Position gasket (5) on valve body (10). Position cover (4) with elements protruding from cover on valve body (1). Press the cover against body (10) compressing the springs.



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

10. Bolt cover (4) to valve body. Apply LOCTITE #262 to bolts and torque them to 21 [Nm].
11. Position gasket (2) on the cover (4). Bolt guard (1) to cover (4) using bolts with spring washers.

NOTE: *FOR EARLIER VERSION MACHINES ONLY. Install bolt "X" securing guard (1) to brake valve body(10) after installing the bolt "B" (Fig. 4.7).*

INSTALLATION (Refer to Fig. 4.7)

1. Install new gasket over brake valve manifold.
2. Thoroughly clean the mating surfaces of the rear main frame cover and brake valve. Apply LOCTITE #515 to the rear main frame cover in a continuous bead on centerline of valve mounting holes.
3. Lower the brake valve onto rear main frame and manifold surface.
4. Secure the brake valve with bolts (A and B). Apply LOCTITE #262 to the "A" bolts and torque them to 14 ÷16 [Nm]. Apply LOCTITE #262 to the "B" bolts and torque them to 26 ÷ 29 [Nm].
5. Install three blank flanges in points A-B.
6. Install shaft (53, Fig. 4.1) and lever assy (48) with links (52) and pins (51).

NOTE: *Apply ample amount of grease to bearing (50, Fig. 4.1) before lever assy (48) installation.*

7. Continue installation of brake valve, refer to REASSEMBLY, STEERING DRIVE, in Section 7E and follow steps to end of brake valve hydraulic installation.
8. Adjust the valve as per procedure described under VALVE ADJUSTMENT BEFORE TESTING, in this Section. Perform brake valve pressure test (refer to BRAKE VALVE PRESSURE TEST below).
9. In case of successful test pressure results, continue installation as described under INSTALLATION in SECTION 7E, STEERING DRIVE.

BRAKE VALVE

VALVE ADJUSTMENT BEFORE TESTING

1. Install brake valve on the rear main frame as described under INSTALLATION in this Paragraph in this Section.
2. The brake pedal should be in its upper released position. Refer to BRAKE PEDAL in this Section. If needed, adjust the brake pedal position.
3. Brake spool adjustment with brake pedal fully applied:
   a. Press brake pedal gradually from fully released to fully applied position. Brake spool (13) should be shifted outside the valve body of 10.2 ± 0.1 [mm]. Use clevis with nut to adjust spool stroke (refer to BRAKE PEDAL in this Section).
   b. With brake pedal released spool must move back to its initial position.

BRAKE VALVE PRESSURE TEST (Refer to Fig.'s 7.2 or 7.6 in SECTION 7)

NOTE: *Before performing the brake valve pressure test, the drive train oil pressures should be checked. Refer to TRANSMISSION AND TORQUE CONVERTER OIL PRESSURE TEST (TC) or to TRANSMISSION OIL PRESSURE TEST (DD) in SECTION 7, DRIVE TRAIN.*

1. Connect Pressure Test Gauges (refer to SERVICE/SPECIAL TOOLS in this Section) to main pressure (M), right (RB) and left (LB) brake quick coupling fittings (refer to SECTION 7, DRIVE TRAIN). Next connect pressure gauges to left (CL) and right (CR) clutch coupling fittings (refer to SECTION 7, DRIVE TRAIN).

2. Apply parking brake. Start the engine.



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 brake pedal and shift the drive train control lever to NEUTRAL.

3. Brake valve oil pressure check.

   With the drive train control lever in neutral (N), brake pedal released and the engine running at high idle proceed as follows:

   Press brake pedal gradually from fully released to fully applied brake pedal position. Check brake spool (13) stroke (refer to VALVE ADJUSTMENT BEFORE TESTING in this Paragraph).

   In the brake pedal fully released position all the pressures in points RB, LB, CR and CL should be $M\ ^{+0.05}/_{-0.07}$ [MPa].

   Apply brake pedal gradually to fully applied position. The pressures in points RB and LB should be 0.0 [MPa]. The pressures in points CL and CR should be $M\ ^{+0.05}/_{-0.07}$ [MPa]. With brake pedal released, the brake valve spool returns automatically to its initial position restoring all the pressures. Pressure raise and drop must take place all the same time for both sides.

   Maximum allowable brake valve leakage rate with brake spool fully extracted is 0.2 [l/min].
   Maximum allowable brake valve leakage rate with brake spool fully retracted is 20.0 [l/min].
   If internal leakage of brake valve exceeds the limits the valve should be removed and repaired.

BRAKE VALVE

4. Brake valve left and right steering pressure test.

   With the drive train control lever in neutral (N), brake pedal released and the engine running at high idle proceed as follows:

   a. Shift the drive train control lever from neutral (N) to the right “feel point” position. With the lever shifted from neutral (N) to the right “feel point” position the pressure in point CR should be dropping gradually from $M\ ^{+0.05}/_{-0.07}$ to 0.0 [MPa]. After CR pressure dropped to 0.0 [MPa], the pressure in RB point should rapidly drop to 1.6 ± 0.02 [MPa] and should stay at this level with lever shifted within 1°30”. With the lever further shifted at the same direction the pressure in point RB should be dropping gradually from 1.6 ± 0.02 to 0.0 [MPa]. The pressure in test point CR must be 0.0 [MPa].

   b. Repeat this procedure for left (LH) drive train control lever direction. The pressures must be the same.

5. Brake valve left and right section adjustment.

   If pressures are different from specified above readings per point 4, brake valve should be adjusted as follows:

   a. If necessary to adjust brake valve on operational machine proceed as follows. To access brake valve, remove rear plate, operator’s seat with mounting plate and fuel tank (refer to REMOVAL in SECTION 7E, STEERING DRIVE). Next, remove the valve guard with gasket (1 and 2, Figs. 4.8 and 4.9) and loose the lock nut (3). With drive control lever in right “feel point” position, rotate the adjusting screw (6) for the right section of brake valve to get the specified RB pressure described in Step 4 above. Doing that, the pressure in test point CR must be 0.0 [MPa].

   b. Repeat this procedure for left (LH) direction. The pressures in points LB and CL should be identical as for RH direction. Shut the engine off.

   c. When finished, reinstall fuel tank, operator’s seat with mounting plate and rear plate (refer to INSTALLATION in SECTION 7E, STEERING DRIVE).

SECTION 6

COOLING SYSTEM

COOLING SYSTEM

SECTION 6

CONTENTS

1. DESCRIPTION 3
2. OPERATION 3
3. SPECIFICATIONS 6
4. SERVICE DIAGNOSIS 6
5. REMOVAL 8
6. DISASSEMBLY 11
7. INSPECTION AND REPAIR 11
8. REASSEMBLY 11
9. INSTALLATION 12

1. DESCRIPTION

Two cooling systems are used on this series machines. First system cools engine coolant, second cools drive train oil. Both systems use the modular radiator assy, which is mounted on front part of the machine. The radiators assy have replaceable separated cores worked in the particular systems.
Air flow through the radiator is provided by the belt driven blower fan.

Engine Cooling Systems

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

For detailed information on a subject of the engine cooling system subassemblies refer to: Machine Operator's Manual and for the machines TD7M, TD8M and TD9M – Operation and Maintenance Manual Industrial B3.9, B4.5 and B5.9 Series Engines Bulletin No. 4021389, B Series Shop Manual Bulletin No. 3666017 and Troubleshooting and Repair Manual B Series Bulletin No. 3666087, for the machine TD10M - Operation and Maintenance Manual Industrial QSB-3.9-30, QSB4.5-30 and QSB-5.9-30 Series Engines Bulletin No 4021388, and Troubleshooting and Repair Manual Industrial QSB-3.9-30,QSB4.5-30 and QSB-5.9-30 Series Engines Bulletin No 4021398.

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 rear frame.

2. OPERATION

Cooling Systems

Engine System Cooling (Refer to Fig. 6.1 and Fig. 6.1A)

Mounted to engine block belt driven centrifugal coolant pump (13), draws coolant from bottom of the radiator core (7) and pumps it through engine oil cooler (14) to coolant manifold (15) in engine block. From manifold coolant is forced to engine cylinder block, where passes around cylinders and to cylinder head (16) and her passages. Then coolant flows to the thermostat chamber. Thermostat (17) controls coolant flow thereby controlling engine cooling intensity.

If the engine is cold, thermostat prevents coolant flow through the radiator. Coolant flows in internal drilled channel 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 core (7), to bottom. Air flowing through the radiator core carries heat away to the atmosphere. Air flow is forced by the belt driven blower fan from the engine.

Engine radiator core and cylinders head are vented to auxiliary tank (1) with the vent hoses (4) and (5). Auxiliary tank has fill hose (6) connected to the coolant outlet tube (3).
The auxiliary tank has an automotive type radiator cap with a built in pressure-vacuum relief valve. The relief valve of the cap is incorporated to maintain a minimum and maximum pressure in the cooling system. The valve allows excess air and vapor to escape trough an overflow hose (9) at a pressure of 45 - 55 [kPa].

COOLING SYSTEM

The cab heater (18) is parallel connected to the cylinder head (15) and coolant tube (3).

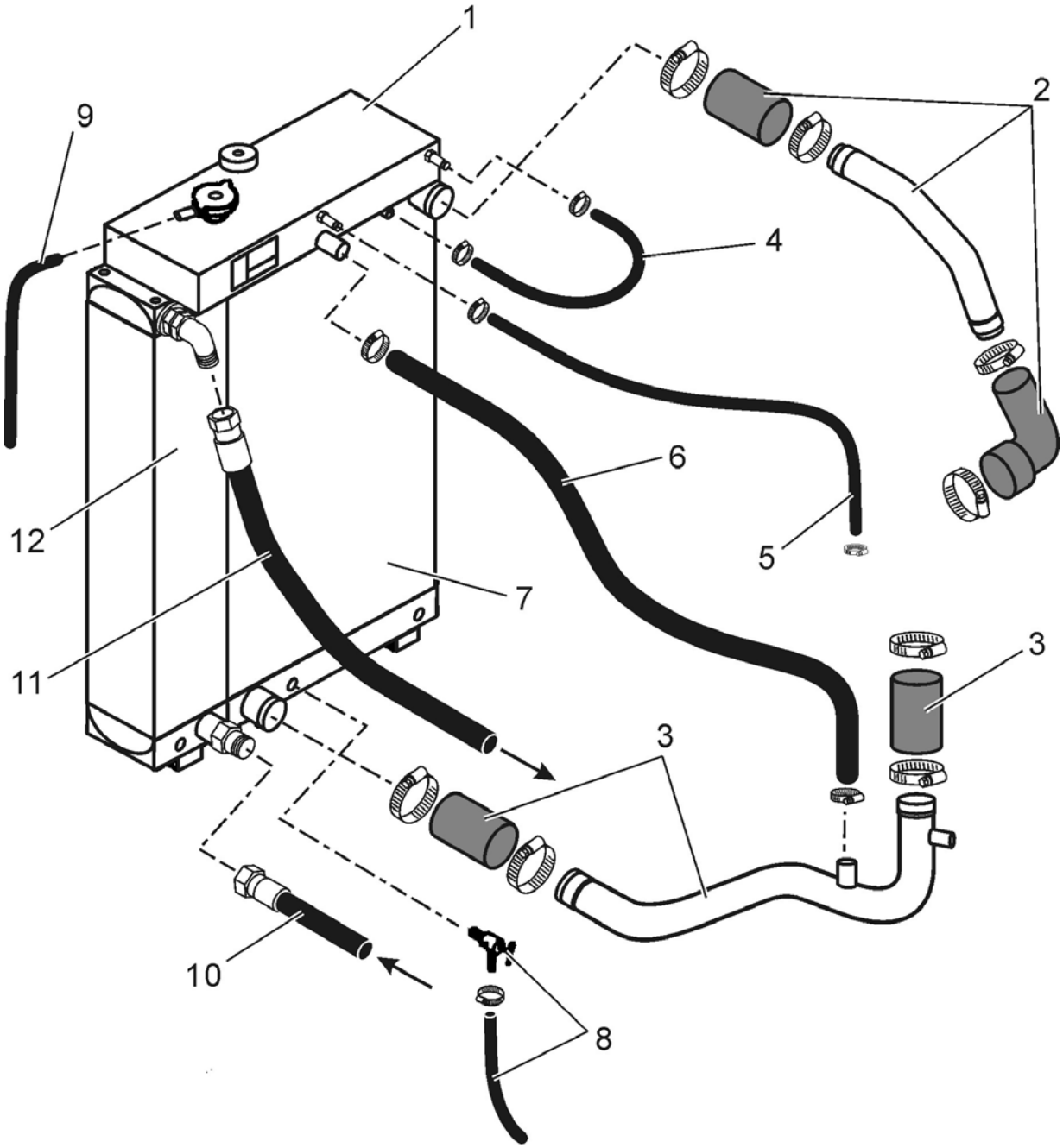


Fig. 6.1. Cooling Systems Radiator Connections

1. Auxiliary Tank
2. Coolant Inlet Tube (to radiator)
3. Coolant Outlet Tube (from radiator)
4. Radiator Core Vent Hose
5. Engine Vent Hose
6. Cooling System Fill Hose
7. Radiator
8. Cooling System Drain Valve
9. Overflow Hose
10. Drive Train Oil Inlet Hose
11. Drive Train Oil Outlet Hose
12. Drive Train Oil Cooler

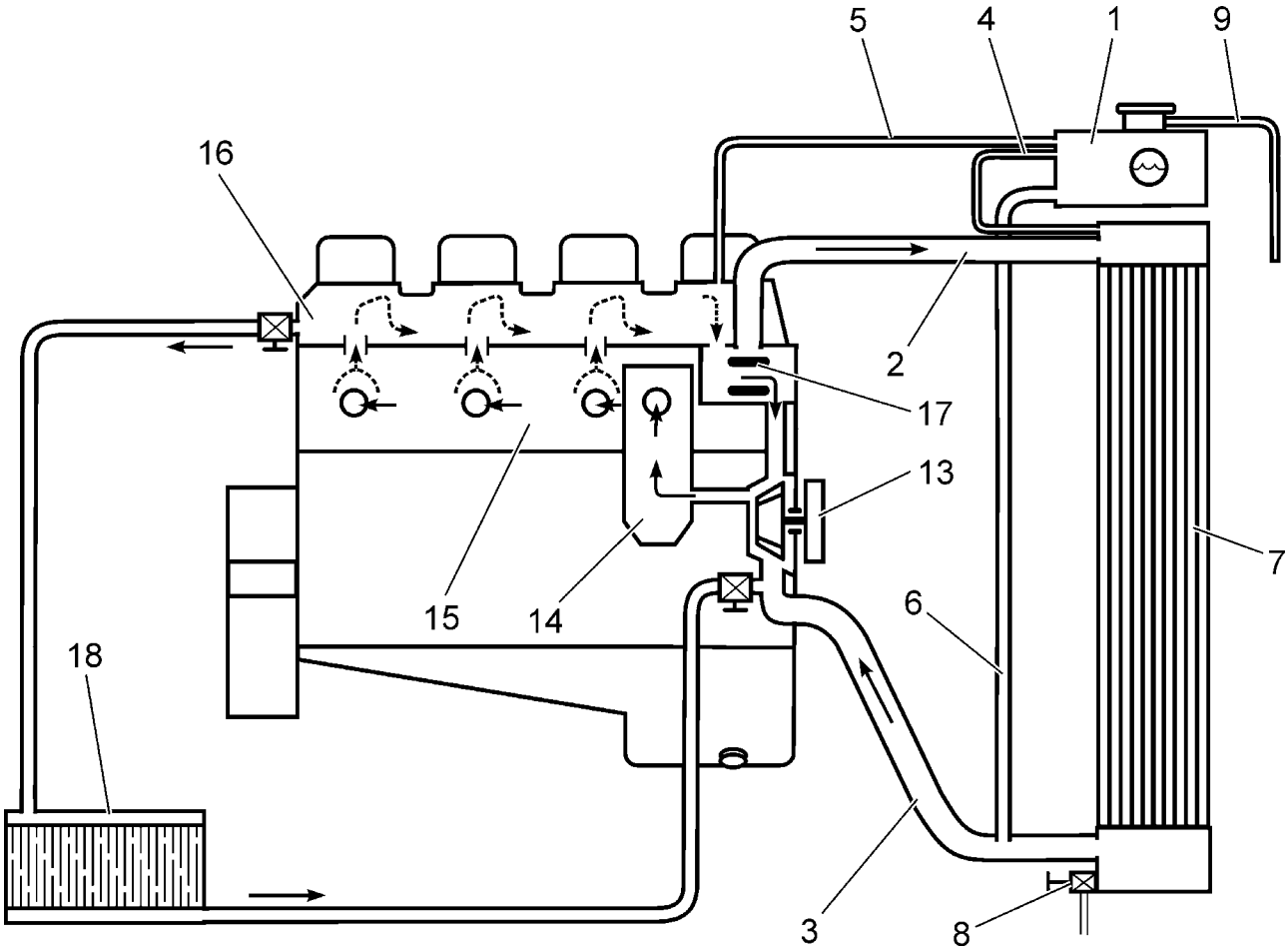


Fig. 6.1A. Coolant Flow in Engine Cooling Systems

1. Auxiliary Tank
2. Coolant Inlet Tube (to radiator)
3. Coolant Outlet Tube (from radiator)
4. Radiator Core Vent Hose
5. Engine Vent Hose
6. Cooling System Fill Hose
7. Radiator
8. Cooling System Drain Valve
9. Overflow Hose
13. Coolant Pump
14. Engine Oil Cooler
15. Coolant Manifold
16. Cylinder Head
17. Thermostat
18. Cab Heater

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

The oil used in drive train system is directed to the inlet hose (10) of the oil cooler (12) as it leaves the torque converter. The heat from the oil is dissipated to the air being forced past the outside of the core tubes by the belt driven blower fan from the engine. The oil is then directed to the lubrication purpose of transmission with the hose (11).

COOLING SYSTEM

3. SPECIFICATIONS

Engine Cooling System

Capacity . . . . . 45 [l]
Coolant pump type . . . . . Centrifugal
Standard thermostat range . . . . . 82 to 93 [°C]
Minimum recommended operating temperature . . . . . 71 [°C]
Maximum allowed operating temperature . . . . . 102 [°C]
Minimum recommended pressure cap . . . . . 50 [kPa]

Engine cooler:

Type . . . . . coolant-to-air
Core . . . . . replaceable, with air fins, bar and plate type vertical tubes
Test pressure . . . . . 0.2 [Mpa]

Drive Train Oil Cooler

Type . . . . . oil-to-air
Core . . . . . replaceable, with air fins, bar and plate type vertical tubes
Test pressure . . . . . 2.0 [Mpa]

Special Nut and Bolt Torque Data:

Fan mounting bolt . . . . . 40-45 [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

Cooling System

COMPLAINT	
PROBABLE CAUSE	SUGGESTED REMEDY
Overheating Due to Restricted Air Flow	
1. Radiator core obstructed with debris.	Clean radiator core from outside by applying air or water pressure.
2. Bent radiator fins.	Straighten bent fins, improve air flow.
3. Fan drive belt slippage.	Replace fan belt tensioner. Refer to Engine Manual.
4. Fan blades damaged.	Replace fan.
5. Fan shroud damaged.	Repair or replace fan shroud.

Engine cooling system

COMPLAINT	
PROBABLE CAUSE	SUGGESTED REMEDY
Overheating	
1. Low coolant level.	Add coolant to proper level. Refer to Operator's Manual.
2. Radiator cap damaged.	Check, replace radiator cap.
3. Faulty thermostat.	Check thermostat for operation. Replace if faulty.
4. Faulty coolant temperature sensor or gauge.	Replace coolant temperature sensor or gauge.
5. Restriction in radiator core.	Drain the system. Flush or replace core.
6. Damaged water pump.	Replace pump. Refer to Engine Manual.
Internal leakage of oil to coolant	
1. Incorrectly tightened cylinder head.	Tighten cylinder head. Refer to Engine Manual.
2. Damaged engine oil cooler.	Remove oil cooler, test for leaks. Refer to Engine Manual.
External leakage of coolant	
1. Damaged hoses or clamps.	Replace damaged hoses and clamps.
2. Radiator leaks.	Remove radiator, test for leaks, remove leakage.
Low coolant temperature	
1. Coolant temperature gauge or sensor faulty.	Replace sensor or temperature gauge.
2. Extremely cold weather.	Cover radiator. Restrict air flow through the radiator.
3. Thermostat inoperative.	Check, replace thermostat.

Drive Train Cooling System

COMPLAINT	
PROBABLE CAUSE	SUGGESTED REMEDY
Drive Train Oil Overheating	
1. Operating too long in low efficiency ranges.	Review operating instructions in the Operator's Manual.
1. Clogged oil coler.	Flush with steam for external clogging.
3. Temperature gauge or sensor faulty.	Replace sensor or temperature gauge.
4. Drive train system problem.	Refer to Section 7.

COOLING SYSTEM

5. REMOVAL

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

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 control lever is locked 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.

2. Turn electrical master switch to "OFF" position.
3. Remove bolts and disassemble side enclosure (2, Fig. 6.2).
4. Loosen the clamp and remove the air precleaner (3).
5. Remove bolts securing the hood (1). Attach a suitable lifting device to the hood. Remove the hood assembly from the machine.
6. Attach a suitable lifting device to the crankcase guard, remove the hardware and lower the guard on the ground to give the access to the bottom radiator connections.

WARNING! This procedure requires extreme caution. Use suitable blocking equipment while working under the machine.

7. Drain coolant from engine cooling system. Refer to Operator's Manual.

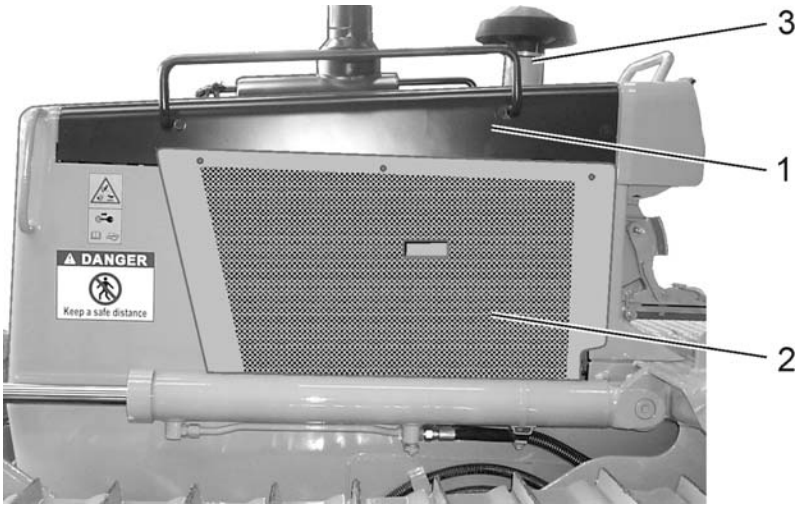


Fig. 6.2. Hood and Engine Enclosure

1. Hood 2. Side Enclosure 3. Air Precleaner

8. Remove hydraulic hose (1, Fig. 6.3) from drive train oil cooler. Secure hose in an upright position to frame.

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.*

9. Loosen the clamp and remove vent hose (2) from the auxiliary tank and attach it to engine
10. Loosen the clamp and remove system fill hose (6) from the auxiliary tank.

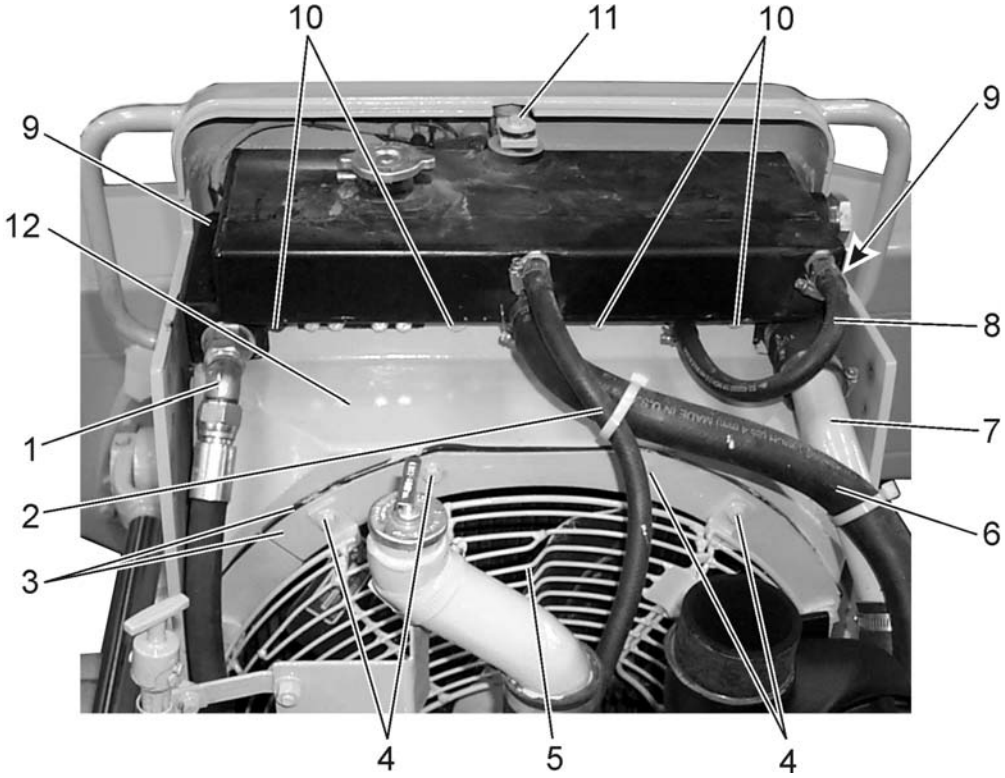


Fig. 6.3. Radiators Assy Connections (upper)

1. Hydraulic Hose (outlet)
2. Engine Vent Hose
3. Stiffening Ring and Rubber Seal Ring
4. Bolts with Washers
5. Fan Guard
6. Cooling System Fill Hose
7. Coolant Inlet Tube
8. Radiator Core Vent Hose
9. Bolts with Washers
10. Bolts with Washers
11. Radiator Bracket Bolt
12. Fan Shroud (upper part)

11. Loosen the clamps and remove coolant tube (7) from the radiator and engine outlet connection.
12. Remove bolts with washers (4) securing fan guard, stiffening ring and seal ring to fan shroud (112). Remove both parts of fan guard (5).
13. Remove upper part of stiffening ring and seal ring (3).
14. Remove bolts with washers (10) securing upper part of fan shroud to radiator. Remove upper fan shroud (12).
15. Remove bolts securing fan to the fan hub. Remove fan.
16. Loosen the clamps and remove coolant outlet tube (3, Fig. 6.5) from the radiator and engine inlet connection.
17. Remove hydraulic hose (1) from drive train oil cooler. Secure hose in an upright position to frame.

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

18. Remove two bolts (9, Fig. 6.3) securing auxiliary tank to radiator. Install the eye bolts in the holes.

COOLING SYSTEM

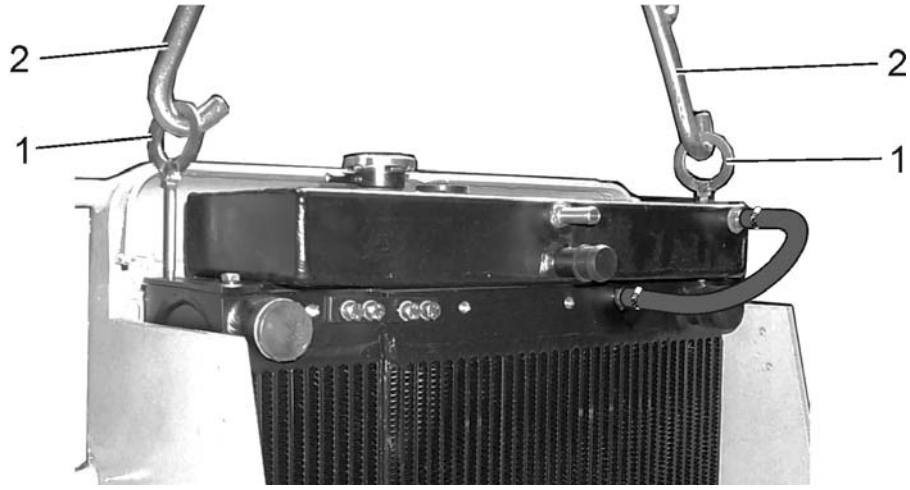


Fig. 6.4. Radiator Assy Hoisting

1. Eye Bolts 2. Slings

19. Install the slings (2, Fig. 6.4) to the eye bolts (1) and tighten.
20. Remove bolt (11, Fig. 6.3) securing radiator assy to the frame.
21. Remove bolts with washers (2, Fig. 6.5) securing radiator assy to brackets at the bottom.

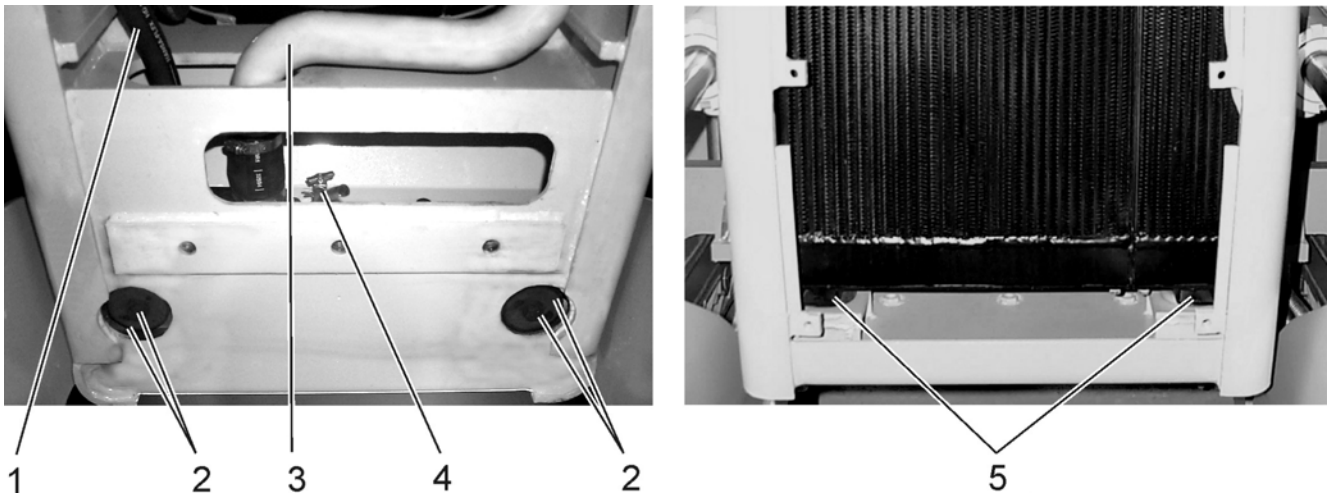


Fig. 6.5. Radiator Assy Disassembly Points (bottom and top view)

1. Hydraulic Hose (inlet)
2. Bolt with Washer and Shock Absorber
3. Coolant Outlet Tube
4. Coolant Drain Valve
5. Shock Absorber (upper element)

22. Carefully hoist the radiator assy up and over frame. Position assy, in horizontal position using suitable height wooden pads.

NOTE: *Radiator assy is the rubber shock absorber supported (mounted) on the frame bracket form the bottom. Wire both parts of shock absorber (5) to the bracket after removing the radiator.*

NOTE: *If the radiator is to be disassembled, first remove four bolts securing lower part of the fan shroud to radiator.*

6. DISASSEMBLY (Refer to Fig. 6.6)

1. Remove radiator core vent hose (15).
2. Remove bolts (2) securing auxiliary tank (1) to cooler and radiator, remove tank.
3. Remove bolts (8) and link plates (7) securing cooler (3) and radiator (6).
4. Remove bolts (5) securing cooler (3) and radiator (6) to bottom plate (4).
5. Remove seal from the slots between the coolers (use a knife).

7. INSPECTION AND REPAIR (Refer to Fig. 6.6)

1. Examine of cooler for damage. Straighten bent fins if possible to avoid air flow restrictions. Clean cooler outside with compressed air or water with additives not aggressive for aluminum. The direction of cleaning stream should be parallel to the fins in order to avoid damage.
2. Inspect particular core for cracks. Perform pressure test of a particular (core) if necessary. Repair or replace for new one if damaged or corroded.
3. Check condition, repair or replace fan guard (14), fan shroud (10) stiffening (13) and seal ring (12) for cracks and deformation. Replace shrouds seals (11) if damaged for a new.
4. Inspect radiator cap (9), rubber seal and spring.
5. Inspect all hoses for cracks or rupture and install new when in doubt.
6. Inspect rubber shock absorber for wear.
7. Check fan (blades) for cracks and other damage. Do not repair. Replace for new one.

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

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

8. REASSEMBLY (Refer to Fig. 6.6)

1. Install bottom plate (4) to core (3) with the bolts (5).
2. Position the cooler (6), install bolts (5) and plates (7) with the bolts (8).

NOTE: *Do not tightening bolts at this stage.*

3. Position auxiliary tank (1), install bolts (2).

NOTE: *Do not install two bolts securing tank on both sides, install eye bolts if removed.*

5. Tighten all bolts with care. Apply standard torques values for aluminum.
6. Seal the slot between the cooler (6) and radiator (3) with the temperature resistant sealant (Sicaflex 221).
7. Install radiator core vent hose (15).

COOLING SYSTEM

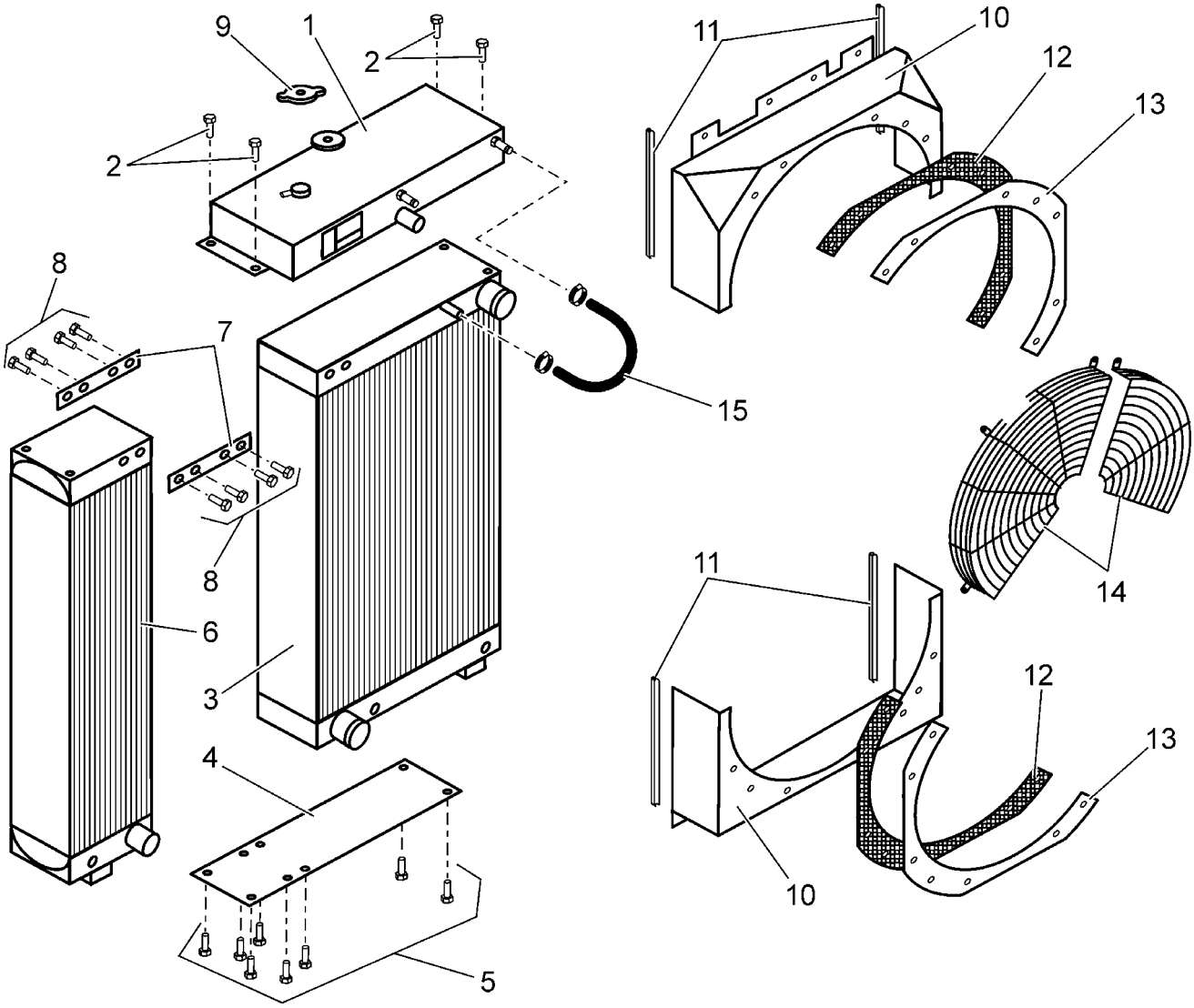


Fig. 6.6. Radiator Assy and Fan Shroud Exploded View

1. Auxiliary Tank
2. Bolts
3. Radiator Core
4. Bottom Plate.
5. Bolts
6. Drive Train Oil Cooler
7. Link Plate
8. Bolts
9. Radiator Cup
10. Fan Shroud
11. Rubber Seals
12. Rubber Seal Ring
13. Stiffening Ring
14. Fan Guard
15. Radiator Core Vent Hose

9. INSTALLATION

NOTE: *Install lower part of the fan shroud to the radiator if disassembled.*

1. Position shock absorber (5, Fig. 6.5) onto the frame brackets.
2. Install the slings (2, Fig. 6.4) to the eye bolts (1). Carefully hoist the radiator assy and lower in to the frame. Position radiator assy on the shock absorber (5, Fig. 6.5). From the bottom install shock absorber with the bolts (2) an tighten by hand.

3. Install bracket bolt (11, Fig. 6.3). Remove lifting slings. Tighten bolts securing the radiator assy to the brackets starting from bottom.

NOTE: *After tightening bolts* (2, Fig. 6.5) *on the bottom brackets, check there is the equal gap between radiator and frame face.*

.4. Remove eye bolts (1, Fig. 6.4), install bolts (9, Fig. 6.3).
5. Install hydraulic hose (1, Fig. 6.5) to the drive train oil cooler.
6. Install coolant outlet tube (3) to the radiator and engine inlet connection. Tighten the clamps.
7. Install fan to the fan hub wit the bolts. Tighten bolts to 40-45 [Nm].
8. Install upper part of fan shroud (12) to radiator with the bolts (10, Fig. 6.3).
9. Install upper part of stiffening ring and seal ring (3) with the bolts (4).

NOTE: *Install the bolts securing the stiffening ring and seal ring to shroud only. Check equal gap between fan blades and rubber ring to be 5 to 8 [mm]. Adjust equal gap if required.*

10. Install both parts of fan guard (5) with the bolts (4).
11. Install coolant tube (7) to the radiator and engine outlet connection. Tighten the clamps.
12. Install system fill hose (6) to the auxiliary tank. Tighten the clamp.
13. Install engine vent hose (2) to the auxiliary tank. Tighten the clamp.
14. Install hydraulic hose (1) to the drive train oil cooler
15. Refill cooling system with the coolant. Refer to Operator's Manual.
16. Start the engine. After reaching operating temperatures, check all disconnected previously lines of cooling and hydraulic systems for leaks. Stop the engine. Check the coolant level and drive train oil level, refer to Operator's Manual.
17. Attach a suitable lifting device to the crankcase guard. Install bolts securing guard to the frame.

WARNING! This procedure requires extreme caution. Use suitable blocking equipment while working under the machine.

19. Position the hood assembly on the machine. Install bolts securing the hood (1, Fig. 6.2).
20. Install air precleaner (3).
21. Reinstall side enclosure (2).

SECTION 7

DRIVE TRAIN

DRIVE TRAIN

CONTENTS

SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS 3

TORQUE CONVERTER

2. DESCRIPTION 3
3. OPERATION 5
4. SPECIFICATIONS 7
5. SERVICE DIAGNOSIS 8
6. TRANSMISSION AND TORQUE CONVERTER OIL PRESSURE TEST 10
7. TORQUE CONVERTER STALL SPEED CHECK 14
8. DRIVE TRAIN CLUTCH TEST 15
9. STEERING SYSTEM OIL PRESSURE CHECK 16

DIRECT DRIVE

10. DESCRIPTION 18
11. OPERATION 19
12. SPECIFICATIONS 21
13. SERVICE DIAGNOSIS 21
14. TRANSMISSION OIL PRESSURE TEST 23
15. DRIVE TRAIN CLUTCH TEST 27
16. STEERING SYSTEM OIL PRESSURE CHECK 28

SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS

DESCRIPTION	TOOL NUMBER
Digital Optical Tachometer	3377462
Test Pressure Gauges Kit	910.50.0005

TORQUE CONVERTER

2. DESCRIPTION

Power from the engine (1, Fig. 7.1) is transmitted through a flywheel drive ring to the torque converter (2). A drive shaft (3) couples the output flange of the torque converter with the input shaft of the transmission (4). The torque converter converts the delivered torque according to the variation in load on the oil used as the medium, and transmits the power to the input shaft of transmission (4). The engine power is transmitted to the charge pump (front section (3, Fig. 7.2)) too, through the accessory drive gear in the torque converter (2), thereby driving the pump.

The transmission (4, Fig. 7.1) 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 output shaft of the transmission (4) and pinion gear transmits power to bevel gear (7) carrier in the rear main frame (6).

In a turn, the clutch disc (9) on the side to which the turn is made is released from the clutch shoe. When the clutch disc (9) is released, the planet gear (8) rather than turning the planet gear carrier, rotate freely on their respective shafts and transfer motion to the free clutch disc. At this time, the track on this side of the machine is just being carried along the ground. When the track is held stationary, the clutch disc (9) is still free and the transfer of motion is to the free clutch disc as before only now the brake disc (10) is held by the brake shoe preventing the sprocket drive (12) pinion shaft from turning.

DRIVE TRAIN

TORQUE CONVERTER

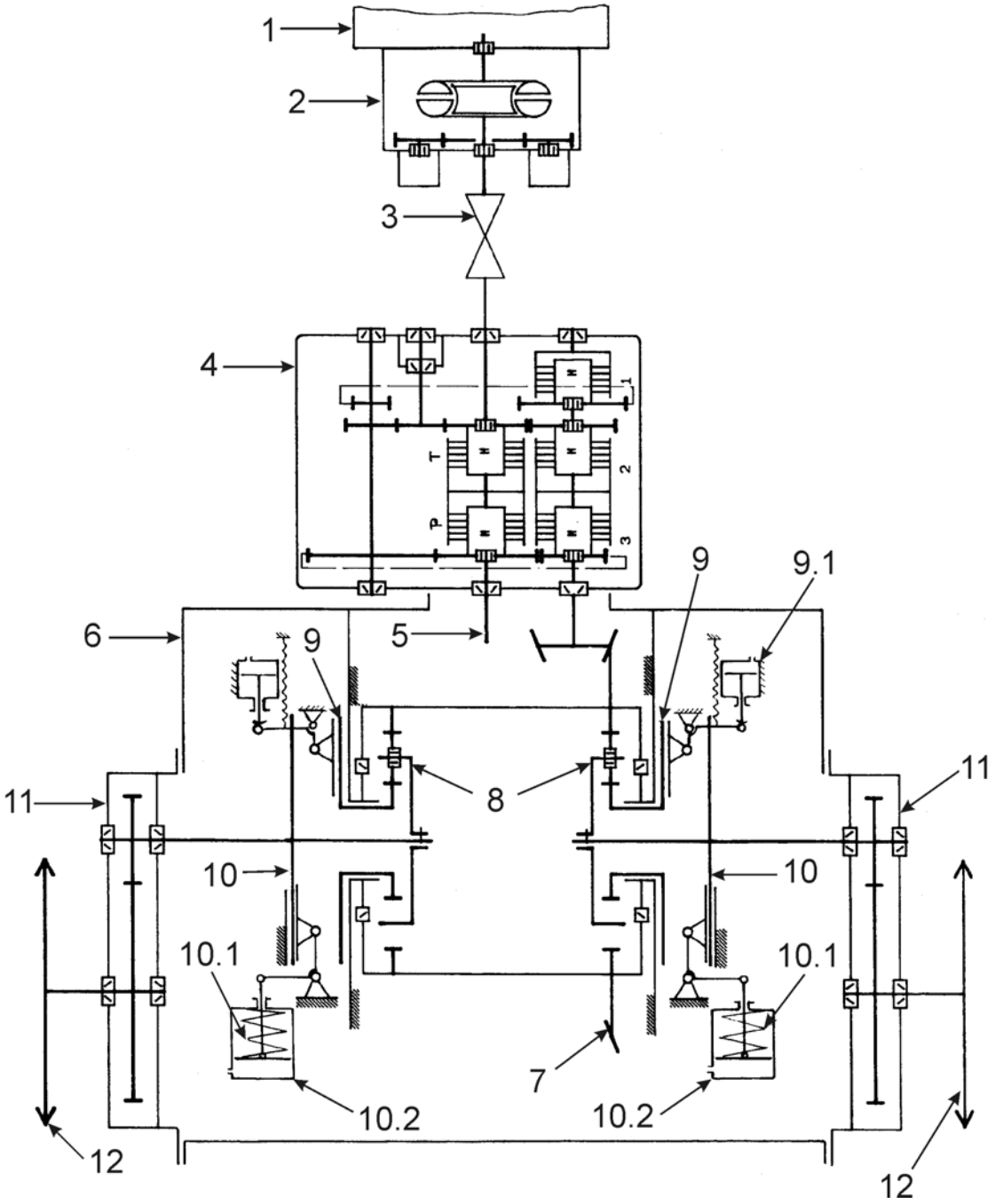


Fig. 7.1. Drive Train Kinematics Schematic

1. Engine
2. Torque Converter
3. Drive Shaft
4. Transmission
   - P – Forward Clutch
   - T – Reverse Clutch
   - 1 – First Gear Clutch
   - 2 – Second Gear Clutch
   - 3 – Third Gear Clutch
5. PTO
6. Rear Frame
7. Pinion/Bevel Gear Set
8. Planet Gear
9. Clutch Disc
   - 9.1 Clutch Engagement Hydraulic Cylinder
10. Brake Disk
    - 10.1 Brake Apply Springs
    - 10.2. Brake Release Hydraulic Cylinder
11. Final Drive
12. Sprocket

TORQUE CONVERTER

3. OPERATION

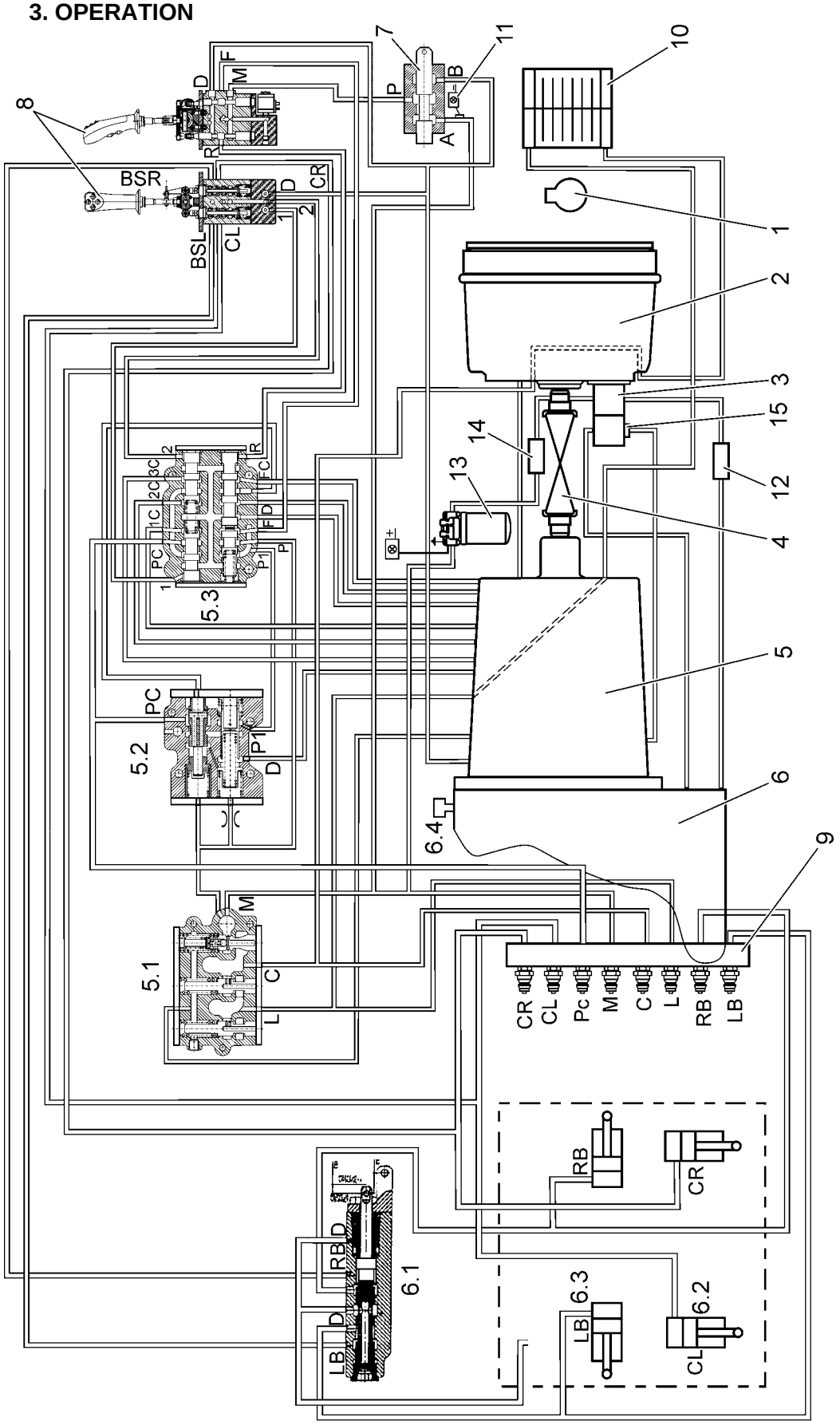


Fig. 7.2. Drive Train Hydraulic System

DRIVE TRAIN

TORQUE CONVERTER

Legend for Fig. 7.2

1. Engine
2. Torque Converter
3. Charge and Scavenge Pump
4. Drive Shaft
5. Transmission
   - 5.1. Pressure Regulator Valve
   - 5.2. Rate of Raise Valve
   - 5.3. Range Selector Valve
6. Rear Frame (Drive Train Oil Reservoir)
   - 6.1. Brake Valve
   - 6.2. (CL) Left and (CR) Right/ Clutch Hydraulic Cylinders
   - 6.3. (LB) Left and (RB) Right/ Brake Hydraulic Cylinders
   - 6.4. Breather
7. Drive Train Lock Valve
8. Drive Train Control Valve
9. Pressure Diagnostic Center
10. Radiator, Drive Train Oil Cooler
11. Main Oil Pressure Switch
12. Suction Strainer
13. Pressure Filter
14. Hydraulic Damper
15. Oil Strainer

The rear main frame (6, Fig. 7.2) is the common oil reservoir for the torque converter, transmission and steering drive. When the engine (1) is running, oil is drawn from bottom of the rear main frame (6), through suction strainer (12) and on to the charge and scavenge pump (3) (front section). The charge pump (3) delivers oil flow through the pressure filter (13) to the M port of the pressure regulator valve (5.1). For a more complete description and operation of the pressure regulator valve, refer to Section 7C, TRANSMISSION.

The charge pump (3) flow is also tees off the line to the pressure regulator valve (5.1) to feed the brake valve (6.1) and cylinders (6.2 and 6.3). For a complete description of both components, refer to Section 7E, STEERING DRIVE.
Again, the charge pump (3) flow is tees off the outlet elbow of the pressure filter (13) and directed to the drive train control valve (8) at the M port through drive train lock valve (7). Main pressure oil is directed out the F or R port to range selector valve to and can also be directed out the 1 or 2 port to the range selector valve to shift the spools. Pressurized oil enters the M port of drive train control valve (8) is also available for steering and breaking. When oil is directed out CL/CR ports, main pressure oil is routed by hoses to the CL and CR clutch hydraulic cylinders (6.2) to engage drive clutch packs. When oil is directed out BSL/BSR ports, main pressure oil is routed by hoses to the brake valve (6.1). This oil through the brake valve (in neutral position) is directed to brake hydraulic cylinders (6.3) to release brake clutch packs. When the foot brake is applied, oil pressure to both brake clutch packs is dissipated. As the pressure drops, springs engage both brakes simultaneously. For a complete description of the drive train control valve and range selector valve, refer to Section 7C, TRANSMISSION.

Main pressurized oil from the pressure regulator valve (5.1) is directed to the rate of rise valve (5.2) and the range selector valve (5.3). For a complete description of the rate of rise valve, refer to Section 7C, TRANSMISSION.

Converter pressurized oil from the C port of the pressure regulator valve (5.1) is directed by hose to the inlet port of the torque converter (2). After pressurized oil is used for torque multiplication, it exits the torque converter (2) at the outlet port and is directed by hose to the inlet port of the oil cooler (10), which is located in one block of radiators. For a more complete description and operation of the torque converter, refer to Section 7B, TORQUE CONVERTER.

Cooled oil from the outlet port of the oil cooler (10) is regulated by the lubrication spool in the pressure regulator valve (5.1) and directed to the transmission (5) for lubrication purposes.

Oil from the transmission (5) housing is scavenged by hose through an inline oil strainer (15) and through the rear element of charge and scavenge pump (3). From the pump outlet, oil is delivered back to the rear main frame (6).

TORQUE CONVERTER

4. SPECIFICATIONS

Transmission Test Oil Pressures

Main oil pressure (M).....1790 to 1960 [kPa]
Torque converter inlet oil pressure (C) .....480 to 660 [kPa]
Lubricating oil pressure (L):

In neutral.....170 to 240 [kPa]
In gear..... 140 to 210 [kPa]

Transmission forward and reverse clutch oil pressure (FR):

In neutral ..... ……0 [kPa]
In gear ..... ….Main (M) minus 0 to 70 [kPa]

Transmission first, second and third speed clutch oil pressures (PC):

In neutral ..... ……0 [kPa]
In gear..... Main (M) minus 35 to 105 [kPa]

Torque Converter

Stall Speeds:

Converter Stall:

TD7-M .....2310 ± 100 [RPM]
TD8-M .....2010 ± 100 [RPM]
TD9-M .....2050 ± 100 [RPM]
TD10-M .....2060 ± 100 [RPM]

Converter Stall at Full Hydraulic Pressure

TD7-M .....2010 ± 100 [RPM]
TD8-M .....1780 ± 100 [RPM]
TD9-M .....1810 ± 100 [RPM]
TD-10M .....1840 ± 100 [RPM]

TORQUE CONVERTER

5. SERVICE DIAGNOSIS

COMPLAINT	
PROBABLE CAUSE	**REMARKS**
Main Low Pressure Warning Light Glows Red (Engine Run, Oil Warm)	
1. Low main pressure.	Refer to TRANSMISSION AND TORQUE CONVERTER DIAGNOSTIC CHART, Par. 6 in this Section.
2. Pressure switch malfunction.	Check and replace switch.
Main Low Pressure Warning Light Glows Red and Low Clutch Pressure (Installed Gauge on (PC) Test Port)	
1. Low pressure at gear.	Refer to TRANSMISSION AND TORQUE CONVERTER DIAGNOSTIC CHART, Par. 6 in this Section.
No Gear/Direction Engagement	
1. Low main and/or gear pressure.	Refer to “Main Low 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. Operating too long in low efficiency ranges.	Review operating instructions per OPERATOR’S MANUAL.
3. Clogged oil cooler.	Clean according to OPERATOR’S MANUAL.
4. Temperature gauge or sensor malfunction.	Replace gauge or sensor.
5. Clogged transmission 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 TRANSMISSION AND TORQUE CONVERTER DIAGNOSTIC CHART, Par.6 in this Section.
8. Torque converter oil leakage excessive.	Refer to Section 7B, TORQUE CONVERTER.
9. Clogged or restricted torque converter drain line (T.C. oil pressure is O.K.).	Clean and check for correct routing.
10. Brake disc dragging.	Readjust. Refer to SECTION 7E.

TORQUE CONVERTER

PROBABLE CAUSE	REMARKS
Loss of Power Under Load	
1. Low oil level.	Check level in rear main frame and fill as necessary. Refer to OPERATOR'S MANUAL.
2. Engine not up to rated performance.	Refer to TORQUE CONVERTER STALL SPEED CHECK, Par.7 in this SECTION.
3. Low transmission clutches oil pressure.	Check oil pressures. Refer to TRANSMISSION AND TORQUE CONVERTER OIL PRESSURE TEST, Par.6 in this Section.
4. Transmission oil level too high	Check operation and condition of scavenge circuit.
5. Slipping clutch packs.	Refer to DRIVE TRAIN CLUTCH TEST, Par.8 in this Section.
8. Torque converter oil leakage excessive.	Refer to Section 7B, TORQUE CONVERTER.
Slow or Erratic Clutch Engagement	
1. Low transmission oil pressure.	Check oil pressures. Refer to TRANSMISSION AND TORQUE CONVERTER OIL PRESSURE TEST, Par.6 in this Section.
2. Rate of rise valve malfunction.	Check valve and screen under valve. Install new valve housing gasket.
3. Range selector valve malfunction.	Check valve. Repair or replace.
Machine Fades to One Side	
1. Brake disc dragging.	Adjust. Refer to SECTION 7E.
2. Brake valve malfunction.	Refer to SECTION 7E.
3. Brake/clutch controls malfunction.	Repair or replace. Refer to SECTION 7E.
4. Clutch out of adjustment.	Adjust. Refer to SECTION 7E.
5. Clutch disc pad worn out.	Replace. Refer to SECTION 7E.
6. Drive train control valve malfunction.	Repair or replace. Refer to SECTION 7C.
Machine Will Not Pivot Turn.	
1. Brakes/clutch out of adjustment.	Adjust. Refer to SECTION 7E.
2. Brake clutch disc pads worn out.	Replace. Refer to SECTION 7E.
3. Brake valve malfunctions.	Refer to SECTION 7E.
4. Brake/clutch controls malfunction.	Repair or replace. Refer to SECTION 7E.
5. Drive train control valve malfunction.	Repair or replace. Refer to SECTION 7C.
No 2nd and/or 3rd Gear Engagement	
1. Electrical or electronic system malfunction.	Refer to SECTION 8, ELECTRICAL
2. Low clutch pressure at PC test port.	Refer to TRANSMISSION AND TORQUE CONVERTER DIAGNOSTIC CHART, Par.6 in this Section.

6. TRANSMISSION AND TORQUE CONVERTER OIL PRESSURE TEST

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.

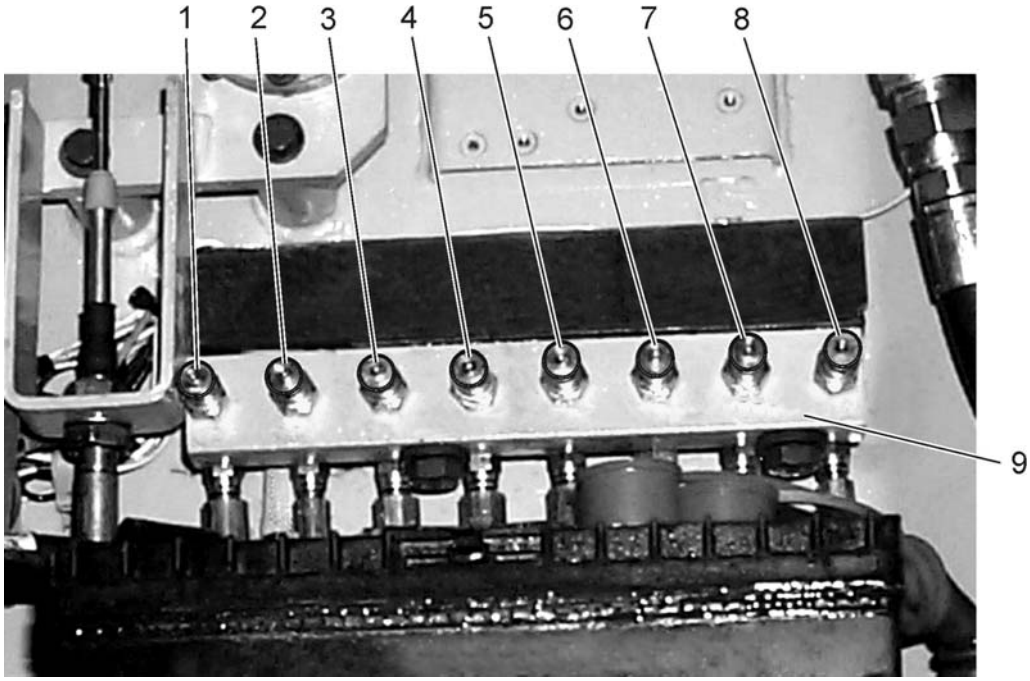


Fig. 7.3. Diagnostic Center Pressure Gauge Connect Points

1. Right Clutch (CR)
2. Left Clutch (CL)
3. Range Clutch (PC)
4. Main (M)
5. Converter (C)
6. Lubrication (L)
7. Right Brake (RB)
8. Left Brake (LB)
9. Diagnostic Center Block

1. Open the door at the left hand side of the platform. Remove the protective covers from quick disconnect fittings and connect Test Pressure Gauges Kit (refer to SERVICE/ SPECIAL TOOLS in this Section) to the diagnostic center ports (quick disconnect fittings 3,4,5 and 6) shown in Fig. 7.3.
2. If necessary, remove operator's foot platform and connect Test Pressure Gauges Kit (refer to SERVICE / SPECIAL TOOLS in this Section) to the range selector valve ports as shown in Fig. 7.4.

NOTE: *Identify each test gauge with the corresponding description 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.*

TORQUE CONVERTER

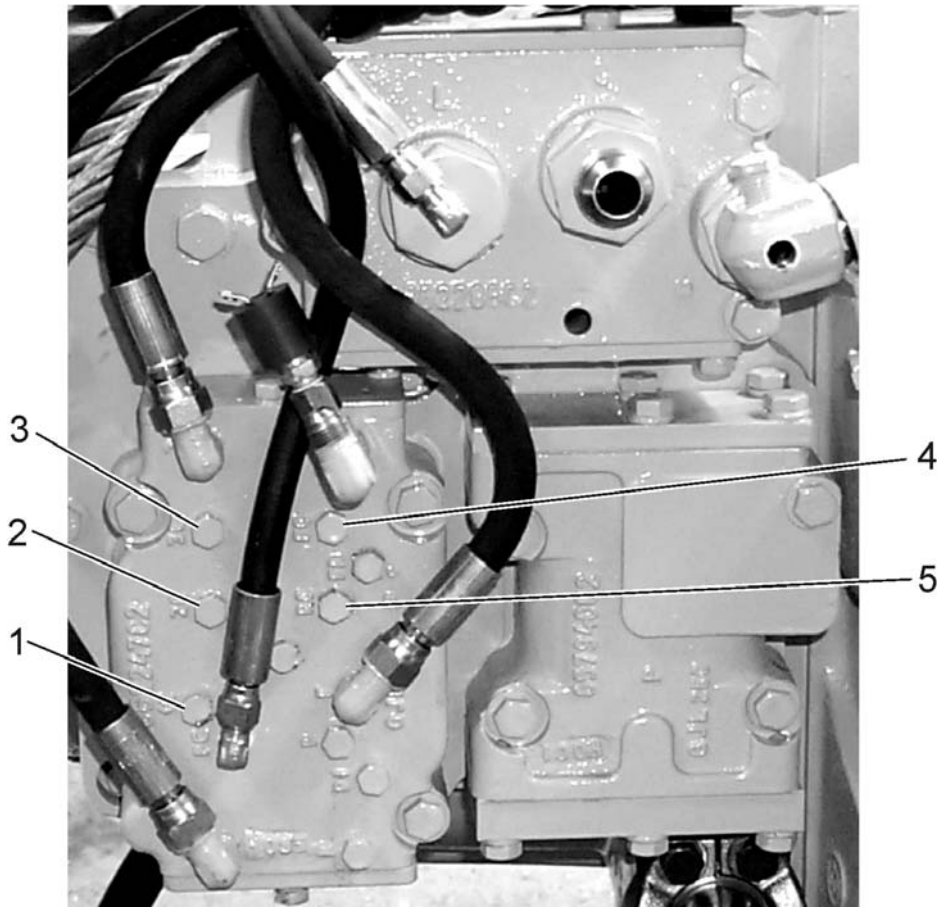


Fig. 7.4. Pressure Gauge Connect Points

1. First (1C)
2. Second (2C)
3. Third (3C)
4. Forward (FC)
5. Reverse (RC)

3. 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 below chart. Fully depress the decelerator pedal.

   With the engine running at low idle, shift 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 range, machine stands still. Observe the readings of the pressure test gauges. The readings should be the pressures as shown in the below 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.

TORQUE CONVERTER

Transmission and Torque Converter Test Oil Pressure Chart

GEAR RANGE	TEST PORT DESCRIPTION (All readings are given in [kPa])								
	MAIN (M)	DIRECT CLUTCH (FR) FWD	DIRECT CLUTCH (FR) REV	RANGE CLUTCH (PC) 1C	RANGE CLUTCH (PC) 2C	RANGE CLUTCH (PC) 3C	TORQUE CONV. (C)	LUBE (L)NOTE 1	LUBE (L)NOTE 2
NEUTRAL	1790-1960	0	0	0	0	0	480-655	170-240	170-240
1ST FWD	1790-1960	M minus 0 - 70	0	M minus 100 - 170	0	0	480-655	140-210	140-210
2ND FWD	1790-1960	M minus 0 – 70	0	0	M minus 100 - 170	0	480-655	140-210	140-210
3RD FWD	1790-1960	M minus 0 - 70	0	0	0	M minus 100 - 170	480-655	140-210	100-210
1ST REV	1790-1960	0	M minus 0 - 70	M minus 100 - 170	0	0	480-655	140-210	140-210
2ND REV	1790-1960	0	M minus 0 - 70	0	M minus 100 - 170	0	480-655	140-210	140-210
3RD REV	1790-1960	0	M minus 0 - 70	0	0	M minus 100 - 170	480-655	140-210	100-210

NOTE 1: *The values in this column are lube pressures at the (L) port of pressure regulator valve during dynamic testing with tractor on test stand with track elevated off the ground or with no track chains on machine.*

NOTE 2: *The values in this column are lube pressures at the (L) port of pressure regulator valve during dynamic testing with tracks in continuous contact with the ground.*

4. Shift the drive train control lever into neutral and move the drive train neutral lock lever to ON position. Place the engine speed control lever in the low idle position and stop the engine.
5. If the readings are within these ranges with the oil at operating temperature, proceed with TORQUE CONVERTER STALL SPEED TEST, Par.7 and DRIVE TRAIN CLUTCH TEST, Par.8 in this Section.
6. If the readings are not within these ranges with the oil at operating temperature, refer to the following diagnostic chart.

TORQUE CONVERTER

Transmission and Torque Converter Diagnostic Chart

PROBLEM	PROBABLE CAUSE
1. Low main pressure.	Low oil level in rear frame. Refer to OPERATOR'S MANUAL.
	Leaking pump inlet lines.
	Fatigued or broken main spool springs in pressure regulator valve.
	Safety check ball or spring in pressure regulator valve malfunction.
	Steering system leaking. Refer to SECTION 7E.
	Defective front section of pump.
2. High main oil pressure	Stuck main spool in pressure regulator valve.
3. Low torque converter oil pressure.	Low main oil pressure. Refer to problem 1 above.
	Clogged suction oil filter. Refer to OPERATOR'S MANUAL.
	Leaking pump inlet lines.
	Stuck converter spool in pressure regulator valve.
	Fatigued or broken converter spool spring in pressure regulator valve.
	Internal leak in converter. Check ground sleeve hub and output shaft seal rings.
	Defective front section of pump.
4. High torque converter oil pressure	Restricted or blocked oil passage or line.
	Restricted oil cooler.
5. Low transmission lubrication oil pressure.	Low torque converter oil pressure. Refer to problem 3 above.
	Fatigued or broken lubrication spool spring in pressure regulator valve.
	Stuck lubrication spool in pressure regulator valve.
6. Low or zero, each forward FC / reverse RC and (PC) range clutch oil pressure.	Low main oil pressure. Refer to problem 1 above.
	No or tow signal pressure from drive train control valve. Tee in 3000 [kPa] test pressure gauge at F or R port on the range selector valve and check and test for oil pressure.
	Stuck switch spool in range selector valve.
	Rate of rise valve damaged.
	Screen under rate of rise valve clogged.
7. Low or zero pressure at both forward and reverse clutch.	Leaking manifold seal ring between F and R gear on input shaft.

TORQUE CONVERTER

PROBLEM	PROBABLE CAUSE
8. Low or zero pressure at both 2nd and 1st or 1st and 3rd.	Leaking manifold seal ring gear on output shaft (between 2 and 1 or 1 and 3).
9. Low or zero one of F or R clutch pressure.	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.
	Range selector valve directional spool damaged.
	Leaking one of manifold outside seal gear (F,R) on input shaft.
	Leaking one of directional clutch pack seals.
10. Low or zero one of 1st, 2nd or 3rd clutch pressure.	Faulty solenoid valve on drive train control valve (2nd or 3rd).
	Range selector valve range spool damaged.
	Leaking one of outside manifold seal on output shaft (for 2nd or 3rd gear only).

7. 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 check.

NOTE: *Following check should be performed with engine running at full throttle and oil at operating temperature.*

1. Remove the front center floor plate in the operator's platform.
2. Use the Digital Optical Tachometer 3377462.
3. With the engine speed at full throttle and the foot brakes applied, shift the transmission into third forward and record the stall speed RPM.
4. If the stall speed does not meet specifications (drive shaft stationary), refer to the following chart.
5. If the stall speed meets specifications, proceed with DRIVE TRAIN CLUTCH TEST, Par.8 in this Section.

Torque Converter Stall Speed Chart

PROBLEM	PROBABLE CAUSE
1. Stall speed too low	a. Too low engine power. Refer to ENGINE REPAIR MANUAL.
2. Stall speed too high	a. Engine fuel system problem.

TORQUE CONVERTER

8. DRIVE TRAIN CLUTCH TEST

NOTE: *Before performing the drive train clutch test, the drive train oil pressures should be checked. Refer to TRANSMISSION AND TORQUE CONVERTER OIL PRESSURE TEST*, Par.6 *and to STEERING SYSTEM OIL PRESSURE CHECK*, Par.9 *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. Do not hold the machine in a stall condition for more than ten seconds after the pointer of the converter oil temperature gauge is within the RUN range.

1. Apply the brake pedal and lock it. Remove the front center floor plate in the operator's platform.

NOTE: *Pressures should be checked with engine running at full throttle and oil at operating temperature.*

2. Start the engine. Place the engine speed control lever in the high idle position and depress the decelerator pedal to decrease the engine speed. Move the drive train neutral lock lever to the OFF position.
3. Shift the drive train control lever into forward second gear range; gradually release the decelerator pedal and check for drive shaft rotation and final drive sprocket rotation. 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 neutral 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.

TORQUE CONVERTER

Drive Train Clutch Diagnostic Chart

PROBLEM	PROBABLE CAUSE
1. Sprocket stationary, but drive shaft rotates in 2nd and 3rd transmission ranges.	Drive clutch discs slipping in steering drive.
2. Sprocket stationary, but drive shaft rotates in 2nd forward and reverse.	2nd range clutch pack slipping in transmission.
3. Sprocket stationary but drive shaft rotates in 3rd forward and reverse.	3rd range clutch pack slipping in transmission.
4. Sprocket stationary but drive shaft rotates in 3rd forward but not 3rd reverse.	Forward directional clutch pack slipping in transmission.
5. Sprocket stationary but drive shaft rotates in 3rd reverse but not 3rd forward.	Reverse directional clutch pack slipping in transmission.
6. Sprocket rotates in 3rd or in 2nd and 3rd with brakes applied.	Brake clutch discs in steering drive slipping.

9. STEERING SYSTEM OIL PRESSURE CHECK

1. Stop the engine and open the door at the left hand side of the platform.
2. Connect Test Pressure Gauges Kit (refer to SERVICE/ SPECIAL TOOLS in this Section) to right (CR) and left (CL) clutch quick disconnect fittings (1 and 2, Fig. 7.3) and to the right (RB) and left (LB) brake quick disconnect fittings (7 and 8, Fig. 7.3) on the diagnostic center (9). Identify each test gauge with the corresponding description 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.*

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

TORQUE CONVERTER

Steering System Test Oil Pressure Chart

DRIVE TRAIN CONTROL LEVER POSITIONS AND BRAKE PEDAL POSITIONS	TEST PORT DESCRIPTION				
	MAIN [kPa]	CL CLUTCH [kPa]	LB BRAKE [kPa]	CR CLUTCH [kPa]	RB BRAKE [kPa]
Control lever in neutral position.	1790 - 1960	Main $^{+50}_{-70}$	Main $^{+50}_{-70}$	Main $^{+50}_{-70}$	Main $^{+50}_{-70}$
Left track in clutch engagement and right track in pivot or brake. Control lever fully shifted to the right. (Check for FWD and REV directions).	1790 - 1960	Main $^{+50}_{-70}$	Main $^{+50}_{-70}$	0	0
Left track in clutch engagement and right track at feel point. Initial movement of the control lever to the right.	1790 - 1960	Main $^{+50}_{-70}$	Main $^{+50}_{-70}$	0	1600 ± 20
Left track in pivot or brake and right track in clutch engagement. Control lever fully shifted to the left. (Check for FWD and REV directions).	1790 - 1960	0	0	Main $^{+50}_{-70}$	Main $^{+50}_{-70}$
Left track at feel point and right track in clutch engagement. Initial movement of the control lever to the left.	1790 - 1960	0	1600 ± 20	Main $^{+50}_{-70}$	Main $^{+50}_{-70}$
Both tracks in clutch engagement. Control lever in neutral and foot brake pedal fully applied.	1790 - 1960	Main $^{+50}_{-70}$	0	Main $^{+50}_{-70}$	0

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.	a. RH or LH supply hose leaking. b. RH or LH clutch cylinder piston leaking. c. Brake valve gasket leaking.
3. Low or zero right or left brake pressure.	a. Brake valve spool seized. b. Brake valve gasket leaking. c. Hose in rear main frame leaking. d. Brake piston leaking.

DRIVE TRAIN

DIRECT DRIVE

10. DESCRIPTION

Power from the engine (1, Fig. 7.5) is transmitted through a dampener plate (2) to the DD main clutch (3). A drive shaft (4) couples the output flange (5) of the main clutch (3) with the input flange (6) of the transmission (7).

When the transmission (7) is engaged, power is transmitted from the output shaft and pinion gear (8) to the bevel gear carrier (9) in the rear frame (10).

The transmission (7) 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 output shaft and pinion gear (8) of the transmission (7) transmits power to bevel gear carrier (9) in the rear main frame (10).

In a turn, the clutch disc on the side to which the turn is made is released from the clutch shoe. When the clutch disc is released, the planet gear rather than turning the planet gear carrier, rotate freely on their respective shafts and transfer motion to the free clutch disc. At this time, the track on this side of the machine is just being carried along the ground. When the track is held stationary, the clutch disc is still free and the transfer of motion is to the free clutch disc as before only now the brake disc is held by the brake shoe preventing the sprocket drive pinion shaft from turning.

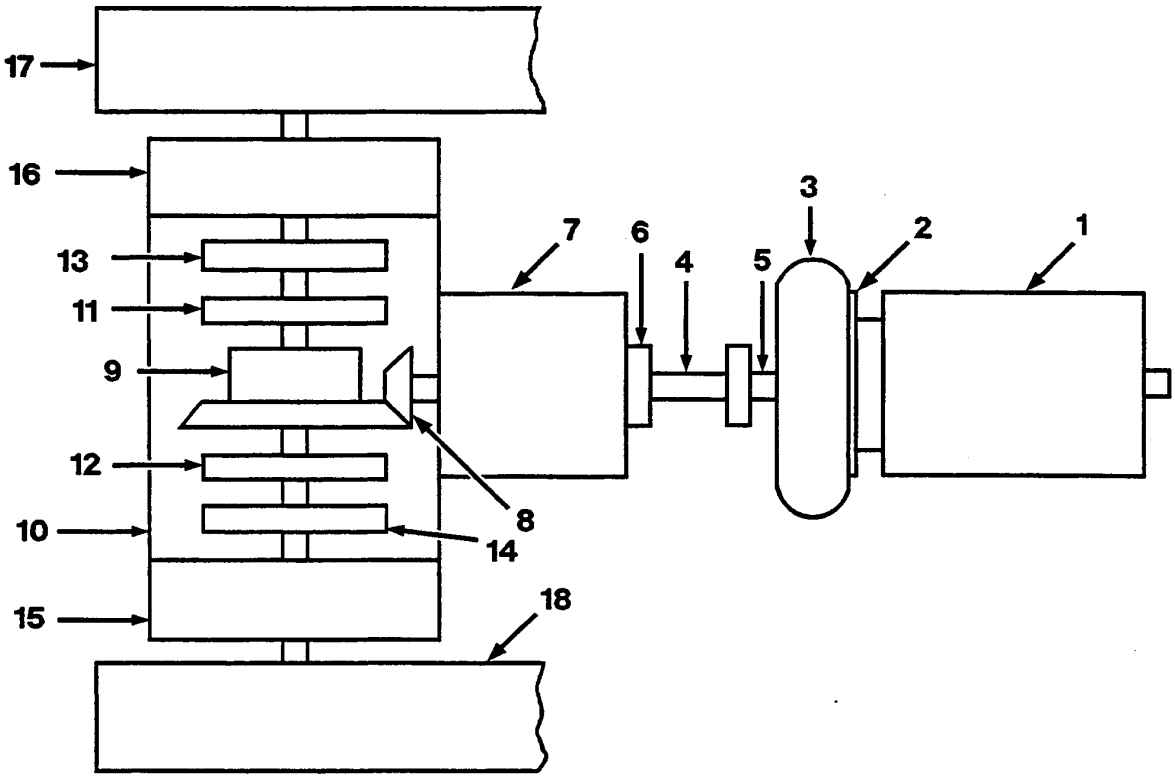


Fig. 7.5. Drive Train Components – Direct Drive

1. Engine
2. Dampener Plate
3. Main Clutch (DD)
4. Drive Shaft
5. Output Flange
6. Transmission Input Flange
7. Transmission
8. Output Shaft and Pinion
9. Bevel Gear Carrier
10. Rear Frame
11. Left Clutch Disc
12. Right Clutch Disc
13. Left Brake Disc
14. Right Brake Disc
15. Right Sprocket Drive
16. Left Sprocket Drive
17. Left Track
18. Right Track

DIRECT DRIVE

11. OPERATION

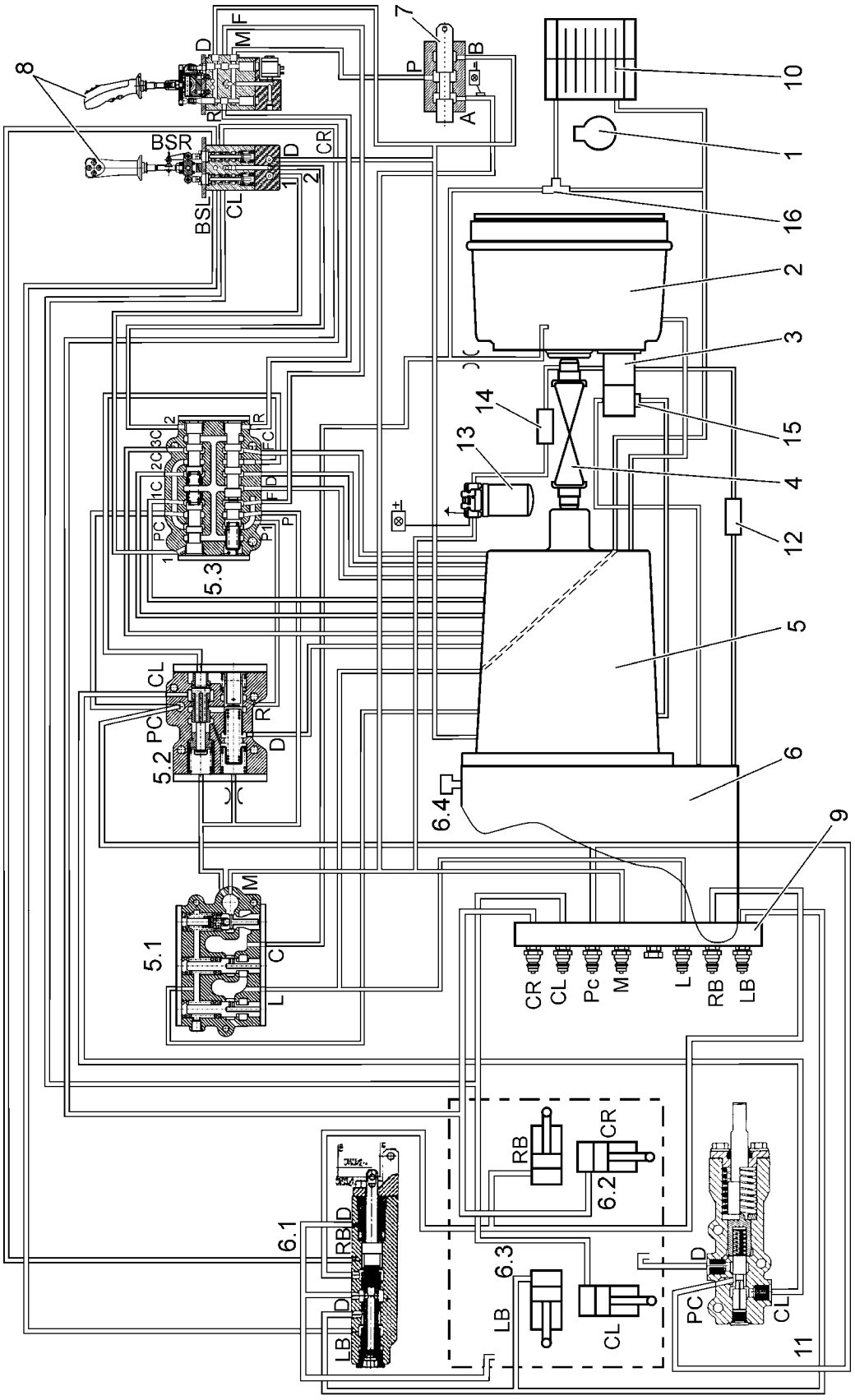


Fig. 7.6. Drive Train Hydraulic System - Direct Drive

DRIVE TRAIN

DIRECT DRIVE

Legend for Fig. 7.6

1. Engine
2. Main Clutch (DD)
3. Charge and Scavenge Pump
4. Drive Shaft
5. Transmission
   - 5.1. Pressure Regulator Valve
   - 5.2. Rate of Raise Valve
   - 5.3. Range Selector Valve
6. Rear Frame (Drive Train Oil Reservoir)
   - 6.1. Brake Valve
   - 6.2. (CL) Left and (CR) Right/Clutch Hydraulic Cylinders
   - 6.3. (LB) Left and (RB) Right/Brake Hydraulic Cylinders
   - 6.4. Breather
7. Drive Train Lock Valve
8. Drive Train Control Valve
9. Pressure Diagnostic Center
10. Radiator, Drive Train Oil Cooler
11. Inching Valve
12. Suction Strainer
13. Pressure Filter
14. Hydraulic Damper
15. Oil Strainer
16. Thermostatic Valve

The rear main frame (6, Fig. 7.6)) is the common oil reservoir for the main clutch (DD), transmission and steering drive. When the engine (1) is running, oil is drawn from bottom of the rear main frame (6), through suction strainer (12) and on to the charge and scavenge pump (3) (front section). The charge pump (3) delivers oil flow through the pressure filter (13) to the M port of the pressure regulator valve (5.1). For a more complete description and operation of the pressure regulator valve, refer to Section 7C, TRANSMISSION.

The charge pump (3) flow is also tees off the line to the pressure regulator valve (5.1) to feed the brake valve (6.1) and cylinders (6.2 and 6.3). For a complete description of both components, refer to Section 7E, STEERING DRIVE.

Again, the charge pump (3) flow is tees off the outlet elbow of the pressure filter (13) and directed to the drive train control valve (8) at the M port through drive train lock valve (7). Main pressure oil is directed out the F or R port to range selector valve to and can also be directed out the 1 or 2 port to the range selector valve to shift the spools. Pressurized oil enters the M port of drive train control valve (8) is also available for steering and breaking. When oil is directed out CL/CR ports, main pressure oil is routed by hoses to the CL and CR clutch hydraulic cylinders (6.2) to engage drive clutch packs. When oil is directed out BSL/BSR ports, main pressure oil is routed by hoses to the brake valve (6.1). This oil through the brake valve (in neutral position) is directed to brake hydraulic cylinders (6.3) to release brake clutch packs. When the foot brake is applied, oil pressure to both brake clutch packs is released. As the pressure drops, springs engage both brakes simultaneously. For a complete description of the drive train control valve and range selector valve, refer to Section 7C, TRANSMISSION.

Main pressurized oil from the pressure regulator valve (5.1) is directed to the rate of rise valve (5.2) and the range selector valve (5.3). For a complete description of the rate of rise valve, refer to Section 7C, TRANSMISSION.

Oil is ported from the rate of rise valve (5.2) to feed the inching valve (11). For a complete description of the inching valve, refer to Section 7A, DIRECT DRIVE.

Pressurized oil from the C port of the pressure regulator valve (5.1) is split into two separate circuits. One orificed for inlet port of main clutch DD (2.0) and the other, as the main supply, for the oil cooler (10) with a thermostatic by-pass. When the oil temperature is below 85 [°C] the thermostatic valve (16) is closed and oil goes to the transmission directly. When the oil temperature increases to 85 [°C] thermostatic valve (16) begins to open and oil is directed to the oil cooler (10). The valve (16) complete opening occurs with oil at 93 [°C]. For a more complete description and operation of the main clutch DD, refer to Section 7A, DIRECT DRIVE.

After pressurized oil is used for main clutch lubrication, it exits the main clutch (2) at the outlet port and is directed by hose to the sump of transmission (5). As well, cooled oil from the outlet port of the oil cooler (10) is directed to the transmission (5) for lubrication purposes. The cooled oil pressure is regulated by the lubrication spool in the pressure regulator valve (5.1).

Oil from the transmission (5) housing is scavenged by hose through an inline oil strainer (15) and through the rear element of charge and scavenge pump (3). From the pump outlet, oil is delivered back to the rear main frame (6).

DIRECT DRIVE

12. SPECIFICATIONS

Transmission Test Oil Pressures

Main oil pressure (M)..... …… 1790 to 1960 [kPa]
Main clutch (DD) lube (across orifice) …… 19 [l] @ 345 [kPa]
Lubricating oil pressure (L):
In Neutral ..... ……..... 170 to 240 [kPa]
In Gear ..... …… 140 to 210 [kPa]
Transmission forward and reverse clutch oil pressure (FR):
In neutral ..... …….. 0 [kPa]
In gear ..... ……... Main (M) minus 0 to 70 [kPa]
Transmission first, second and third speed clutch oil pressures (PC):
In neutral ..... …….. 0 [kPa]
In gear..... …….. Main (M) minus 35 to 105 [kPa]

13. SERVICE DIAGNOSIS

COMPLAINT	
PROBABLE CAUSE	**REMARKS**
Main Low Pressure Warning Light Glows Red (Engine Run, Oil Warm)	
1. Low main pressure.	Refer to TRANSMISSION DIAGNOSTIC CHART, Par.14 in this Section.
2. Pressure switch malfunction.	Check and replace switch.
Main Low Pressure Warning Light Glows Red and Low Clutch Pressure (Installed Gauge on (PC) Test Port)	
1. Low pressure at gear.	Refer to TRANSMISSION DIAGNOSTIC CHART, Par.14 in this Section.
No Gear / Direction Engagement	
1. Low main and/or gear pressure.	Refer to “Main Low Pressure Warning Light Glows Red” above.
High Transmission Oil Temperature (Gauge on Instrument Panel)	
1. Low main frame oil level.	Check according to OPERATOR”S MANUAL.
2. Operating too long in low efficiency ranges.	Review operating instructions per OPERATOR’S MANUAL.
3. Clogged oil cooler.	Clean according to OPERATOR’S MANUAL.
4. Temperature gauge or sensor malfunction.	Replace gauge or sensor.
5. Clogged transmission suction strainer.	Remove and clean.
6. Leakage on suction line.	Check suction line for tightness.

DIRECT DRIVE

PROBABLE CAUSE	REMARKS
7. Transmission problem.	Check transmission temperature and clutches oil pressure. Refer to TRANSMISSION DIAGNOSTIC CHART, Par. 14 in this Section.
8. Clogged or restricted DD clutch drain line.	Clean and check for correct routing.
9. Brake disc dragging.	Readjust. Refer to SECTION 7E.
Loss of Power Under Load	
1. Low oil level.	Check level in rear main frame and fill as necessary. Refer to OPERATOR'S MANUAL.
2. Engine not up to rated performance.	Refer to ENGINE SHOP MANUAL.
3. Low transmission clutches oil pressure.	Check oil pressures. Refer to TRANSMISSION OIL PRESSURE TEST, Par. 14 in this Section.
4. Transmission oil level too high.	Check operation and condition of scavenge circuit.
5. Slipping clutch packs.	Refer to DRIVE TRAIN CLUTCH TEST, Par. 15 in this Section.
Slow or Erratic Clutch Engagement	
1. Low transmission oil pressure.	Check oil pressures. Refer to TRANSMISSION OIL PRESSURE TEST, Par. 14 in this Section.
2. Rate of rise valve malfunction.	Check valve and screen under valve. Install new valve housing gasket.
3. Range selector valve malfunction.	Check valve. Repair or replace.
4. Inching valve malfunction.	Check valve. Repair or replace.
Machine Fades to One Side	
1. Brake disc dragging.	Adjust. Refer to SECTION 7E.
2. Brake valve malfunction.	Refer to SECTION 7E.
3. Brake/clutch controls malfunction.	Repair or replace. Refer to SECTION 7E.
4. Clutch out of adjustment.	Adjust. Refer to SECTION 7E.
5. Clutch disc pad worn out.	Replace. Refer to SECTION 7E.
6. Drive train control valve malfunction.	Repair or replace. Refer to SECTION 7C.
Machine Will Not Pivot Turn.	
1. Brakes/clutch out of adjustment.	Adjust. Refer to SECTION 7E.
2. Brake clutch disc pads worn out.	Replace. Refer to SECTION 7E.
3. Brake valve malfunctions.	Refer to SECTION 7E.
4. Brake/clutch controls malfunction.	Repair or replace. Refer to SECTION 7E.
5. Drive train control valve malfunction.	Repair or replace. Refer to SECTION 7C.
No 2nd and/or 3rd Gear Engagement	
1. Electrical or electronic system malfunction.	Refer to SECTION 8, ELECTRICAL.
2. Low clutch pressure at PC test port.	Refer to TRANSMISSION DIAGNOSTIC CHART, Par. 14 in this Section.

DIRECT DRIVE

14. TRANSMISSION OIL PRESSURE TEST

WARNING! Be sure the area around the machine is clear of personnel and obstructions as the machine moves during these tests.

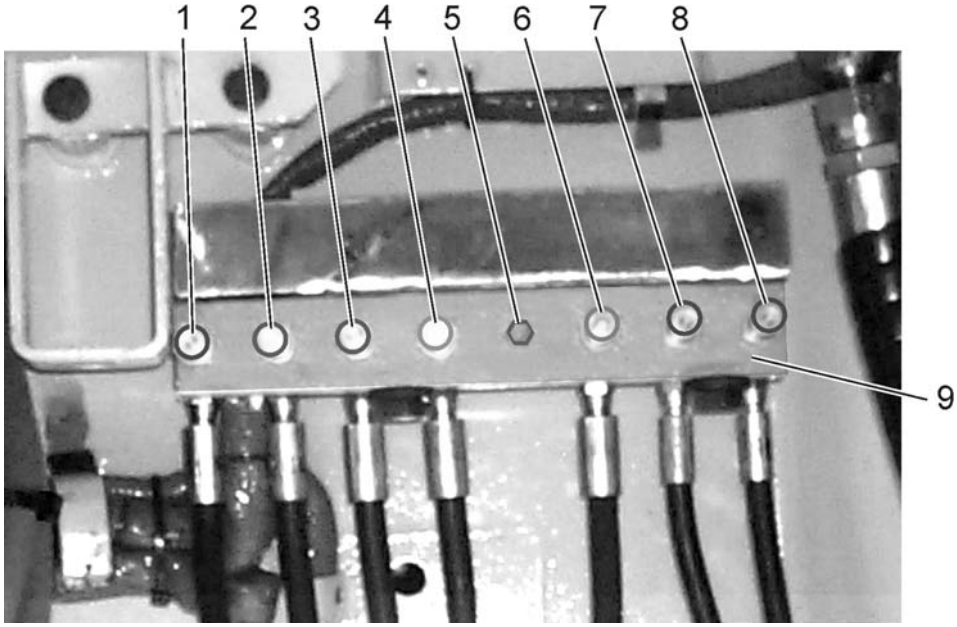


Fig. 7.7. Diagnostic Center Pressure Gauge Connect Points

1. Right Clutch (CR)
2. Left Clutch (CL)
3. Range Clutch (PC)
4. Main (M)
5. Not Connected
6. Lubrication (L)
7. Right Brake (RB)
8. Left Brake (LB)
9. Diagnostic Center Block

1. Open the door at the left hand side of the platform. Remove the protective covers from quick disconnect fittings and connect Test Pressure Gauges Kit (refer to SERVICE / SPECIAL TOOLS in this Section) to the diagnostic center ports (quick disconnect fittings 3, 4 and 6) shown in Fig. 7.7.
2. If necessary, remove operator's foot platform and connect Test Pressure Gauges Kit (refer to SERVICE / SPECIAL TOOLS in this Section) to the range selector valve ports as shown in Fig. 7.8.

NOTE: *Identify each test gauge with the corresponding description 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.*

DIRECT DRIVE

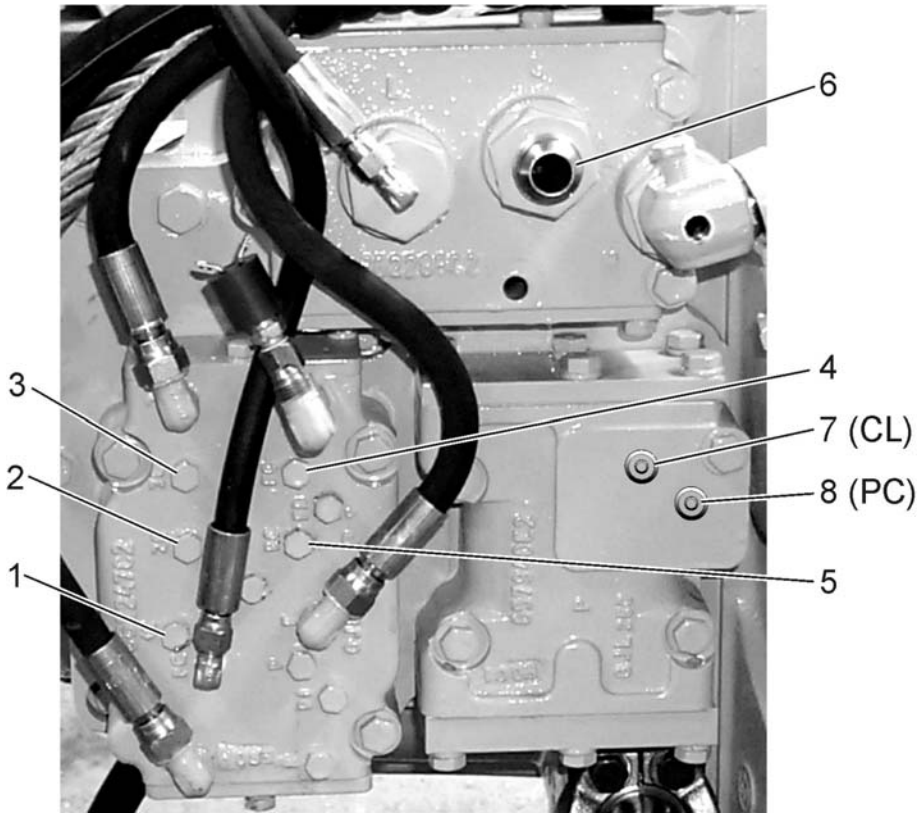


Fig. 7.8. Pressure Gauge Connect Points

1. First (1C)
2. Second (2C)
3. Third (3C)
4. Forward (FC)
5. Reverse (RC)
6. Cooler Inlet (C)
7. Inching Valve Inlet (CL)
8. Inching Valve Outlet (PC)

3. With the drive train control lever in neutral, drive train neutral lock lever in OFF position, brake pedal applied and the engine running at high idle, observe the readings of the test pressure gauges. The readings should be the pressures as shown in the chart below.

   Fully depress the decelerator pedal. Release brake pedal and fully apply clutch pedal. With the engine running at deceleration speed, shift the drive train control lever into transmission forward first and slowly release the clutch pedal, machine is moving. With the engine running at high idle, shift the transmission through second and third forward gear range. Observe the readings of the test pressure gauges. The readings should be the pressures as shown in the chart below. Oil pressures should increase and decrease rapidly when engaging and disengaging clutch packs. Fully depress the clutch pedal and shift the transmission in neutral.

   Repeat this step for each transmission reverse gear range.

DIRECT DRIVE

Transmission Test Oil Pressure Chart

GEAR RANGE	TEST PORT DESCRIPTION (All readings are given in [kPa])							
	MAIN (M)	DIRECT CLUTCH (FR) FWD	DIRECT CLUTCH (FR) REV	RANGE CLUTCH (PC) 1C	RANGE CLUTCH (PC) 2C	RANGE CLUTCH (PC) 3C	LUBE (L) NOTE 1	LUBE (L) NOTE 2
NEUTRAL	1790 -1960	0	0	0	0	0	170-240	170-240
1ST FWD	1790 -1960	M minus 0 - 70	0	M minus 100 - 170	0	0	140-210	140-210
2ND FWD	1790 -1960	M minus 0 – 70	0	0	M minus 100 - 170	0	140-210	140-210
3RD FWD	1790 -1960	M minus 0 - 70	0	0	0	M minus 100 - 170	140-210	100-210
1ST REV	1790 -1960	0	M minus 0 - 70	M minus 100 - 170	0	0	140-210	140-210
2ND REV	1790 -1960	0	M minus 0 - 70	0	M minus 100 - 170	0	140-210	140-210
3RD REV	1790 -1960	0	M minus 0 - 70	0	0	M minus 100 - 170	140-210	100-210

NOTE 1: *The values in this column are lube pressures at the (L) port of pressure regulator valve during dynamic testing with tractor on test stand with track elevated off the ground or with no track chains on machine.*

NOTE 2: *The values in this column are lube pressures at the (L) port of pressure regulator valve during dynamic testing with tracks in continuous contact with the ground.*

4. Shift the drive train control lever into neutral and move the drive train neutral lock lever to ON position. Place the engine speed control lever in the low idle position and stop the engine.
5. If the readings are within these ranges with the oil at operating temperature transmission is acceptable. Proceed with DRIVE TRAIN CLUTCH TEST, Par. 15 in this Section.
6. If the readings are not within these ranges with the oil at operating temperature, refer to the following diagnostic chart.

DIRECT DRIVE

Transmission Diagnostic Chart

PROBLEM	PROBABLE CAUSE
1. Low main pressure.	Low oil level in rear frame. Refer to OPERATOR'S MANUAL.
	Leaking pump inlet lines.
	Fatigued or broken main spool springs in pressure regulator valve.
	Safety check ball or spring in pressure regulator valve malfunction.
	Steering system leaking. Refer to SECTION 7E.
	Defective front section of pump.
2. High main oil pressure	Stuck main spool in pressure regulator valve.
3. Low transmission lubrication oil pressure.	Low cooler inlet oil pressure. Refer to problem 3 above.
	Fatigued or broken lubrication spool spring in pressure regulator valve.
	Stuck lubrication spool in pressure regulator valve.
4. Low or zero, each forward FC / reverse RC and (PC) range clutch oil pressure.	Low main oil pressure. Refer to problem 1 above. (See Problem 5).
	No or low signal pressure from drive train control valve. Tee in 3000 [kPa] test pressure gauge at F or R port on the range selector valve and check and test for oil pressure.
	Stuck switch spool in range selector valve.
	Rate of rise valve damaged.
	Screen under rate of rise valve clogged..
5. Low or zero pressure at both forward and reverse clutch.	Leaking manifold seal ring between F and R gear on input shaft.
6. Low or zero pressure at both 2nd and 1st or 1st and 3rd.	Leaking manifold seal ring gear on output shaft (between 2 and 1 or 1 and 3).6
7. Low or zero one of F or R clutch pressure.	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.
	Range selector valve directional spool damaged.
	Leaking one of manifold outside seal gear (F,R) on input shaft.
	Leaking one of directional clutch pack seals.
8. Low or zero one of 1st, 2nd or 3rd clutch pressure.	Faulty solenoid valve on drive train control valve (2nd or 3rd).
	Range selector valve range spool damaged.
	Leaking one of outside manifold seal on output shaft (for 2nd or 3rd gear only).

DIRECT DRIVE

15. DRIVE TRAIN CLUTCH TEST

NOTE: *Before performing the drive train clutch test, the drive train oil pressures should be checked. Refer to TRANSMISSION OIL PRESSURE TEST*, Par. 14 *and to STEERING SYSTEM OIL PRESSURE CHECK*, Par. 16 *in this Section.*

If the pressures readings are within the specifications (see TRANSMISSION OIL PRESSURE TEST, Par. 14 and to STEERING SYSTEM OIL PRESSURE CHECK, Par. 16 in this Section) and machine is week in a given gear or both direction, or with all gears; proceed as follows:

NOTE: *With a machine braked and having the above condition the engine will still operate without shut off.*



WARNING! Be sure the area around the machine is clear of personnel and obstructions as the machine moves during this test.

1. Apply the brake pedal and lock it. Remove the front center floor plate in the operator's platform.
2. Start the engine. Place the engine speed control lever in the high idle position and depress the clutch pedal. Move the drive train neutral lock lever to the OFF position.
3. Machine week with all ranges at forward and reverse. Shift through all gears and direction gradually release the clutch pedal and check drive shaft rotation. If the drive shaft between main clutch and transmission rotates, refer to Point 1 in Drive Train Clutch Diagnostic Chart below.
4. Machine week in a gear of forward and reverse or in one direction. Engage given gear or direction, gradually release the clutch pedal and check drive shaft rotation. If the drive shaft between main clutch and transmission rotates, refer to Point 2 through 6 in Drive Train Clutch Diagnostic Chart below.
5. 1st, 2nd or 3rd gear engaged and direction shifted and machine week in braking. Gradually release the clutch pedal and check final drive sprocket rotation. If the final drive sprocket rotates, refer to Point 7 in Drive Train Clutch Diagnostic Chart below.
6. Fully depress the clutch pedal and shift transmission into neutral. Move the drive train neutral lock lever to the ON position. Place the engine speed control lever in the low idle position and release the clutch pedal. Stop the engine.
7. Reinstall the front center floor plate in the operator's platform.

Drive Train Clutch Diagnostic Chart

PROBLEM	PROBABLE CAUSE
1. Sprocket stationary, but drive shaft rotates in all transmission ranges both directions.	Drive clutch discs slipping in steering drive.
2. Sprocket stationary, but drive shaft rotates in 1st on both directions.	1st range clutch pack slipping in transmission.
3. Sprocket stationary, but drive shaft rotates in 2nd on both directions.	2nd range clutch pack slipping in transmission.
4. Sprocket stationary but drive shaft rotates in 3rd forward and reverse.	3rd range clutch pack slipping in transmission.
5. Sprocket stationary but drive shaft rotates in 3rd forward but not 3rd reverse.	Forward directional clutch pack slipping in transmission.
6. Sprocket stationary but drive shaft rotates in 3rd reverse but not 3rd forward.	Reverse directional clutch pack slipping in transmission.
7. Sprocket rotates with brakes applied.	Brake clutch discs in steering drive slipping.

DIRECT DRIVE

16. STEERING SYSTEM OIL PRESSURE CHECK

1. Stop the engine and open the door at the left hand side of the platform.
2. Connect one or more Test Pressure Gauges Kit (refer to SERVICE /SPECIAL TOOLS in this Section) to the right (CR) and left (CL) clutch quick disconnect fittings (1 and 2, Fig. 7.3) and to the right (RB) and left (LB) brake quick disconnect fittings (7 and 8, Fig. 7.3) on the diagnostic center (9). Identify each test gauge with the corresponding description 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.*

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

Steering System Test Oil Pressure Chart

DRIVE TRAIN CONTROL LEVER POSITIONS AND BRAKE PEDAL POSITIONS	TEST PORT DESCRIPTION				
	MAIN [kPa]	**CL CLUTCH [kPa]**	**LB BRAKE [kPa]**	**CR CLUTCH [kPa]**	**RB BRAKE [kPa]**
Control lever in neutral position.	1790 - 1960	Main $^{+50}_{-70}$	Main $^{+50}_{-70}$	Main $^{+50}_{-70}$	Main $^{+50}_{-70}$
Left track in clutch engagement and right track in pivot or brake. Control lever fully shifted to the right. (Check for FWD and REV directions).	1790 - 1960	Main $^{+50}_{-70}$	Main $^{+50}_{-70}$	0	0
Left track in clutch engagement and right track at feel point. Initial movement of the control lever to the right.	1790 - 1960	Main $^{+50}_{-70}$	Main $^{+50}_{-70}$	0	1600 ± 20
Left track in pivot or brake and right track in clutch engagement. Control lever fully shifted to the left. (Check for FWD and REV directions).	1790 - 1960	0	0	Main $^{+50}_{-70}$	Main $^{+50}_{-70}$
Left track at feel point and right track in clutch engagement. Initial movement of the control lever to the left.	1790 - 1960	0	1600 ± 20	Main $^{+50}_{-70}$	Main $^{+50}_{-70}$
Both tracks in clutch engagement. Control lever in neutral and foot brake pedal fully applied.	1790 - 1960	Main $^{+50}_{-70}$	0	Main $^{+50}_{-70}$	0

DIRECT DRIVE

Steering Drive Diagnostic Chart

PROBLEM	PROBABLE CAUSE
1. No clutch and brake pressures.	a. Low main pressure. Refer to “Transmission Diagnostic Chart” above.
2. Low or zero right or left clutch pressure.	a. RH or LH supply hose leaking. b. RH or LH clutch cylinder piston leaking. c. Brake valve gasket leaking.
3. Low or zero right or left brake pressure.	a. Brake valve spool seized. b. Brake valve gasket leaking. c. Hose in rear main frame leaking. d. Brake piston leaking.

SECTION 7A

DIRECT DRIVE

DIRECT DRIVE

CONTENTS

SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS 3
2. DESCRIPTION 3
3. SPECIFICATIONS 3

MAIN CLUTCH

4. REMOVAL 4
5. DISASSEMBLY 11
6. INSPECTION AND REPAIR 16
7. REASSEMBLY 17
8. INSTALLATION 23

INCHING VALVE

9. DESCRIPTION 28
10. OPERATION 29
11. SPECIFICATIONS 30
12. REMOVAL 31
13. DISASSEMBLY 33
14. REASSEMBLY 35

SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS

DESCRIPTION	TOOL NUMBER
Main Clutch Lifting Eyebolt	M10
Rear Housing Aligning Studs	M10 x 60
Rear Housing Lifting Eyebolts	1/2 NC
Driven Gear Installing Bolt with Nut and Two Suitable Washers	3/4 NC x 5
Retainer Plate Aligning Dowel	M10 x 80
Damper Plate Aligning Stud	3/8 UNC x 1.5

2. DESCRIPTION (Refer to Fig. 7A.1)

The main clutch acts as a cushion to prevent engine vibration from being transmitted directly to the transmission. Power from the engine is transmitted to the damper (1) through the flywheel (2). Power without vibration (absorbed) is transmitted to the output shaft (3) and yoke (4) through the drive shaft to the transmission. The pump drive gear (5) is directly splined to the output shaft driving the drive train and equipment pumps whenever the engine is running.

When the inching pedal is depressed, the inching valve spool is actuated. Depending on pedal depression and valve spool actuation, the range clutch in the transmission is partially or fully disengaged. This allows a fine adjustment to the machine travel speed or a complete stop.

3. SPECIFICATIONS

Special Bolt Torque Data

Retainer plate to rear housing mounting bolts	40 – 45 [Nm]
Rear cover to retainer plate mounting bolts	22 – 27 [Nm]
Rear housing to clutch housing mounting bolts	40 – 45 [Nm]
Main clutch mounting bolts	43 [Nm]
Drive shaft mounting bolts:	
TD-8M,	33 [Nm]
TD-9M, TD-10M	57 [Nm]

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

Sealants

Electrical Terminals ..... Grafo 112-X (1270464H1)

DIRECT DRIVE

MAIN CLUTCH

4. REMOVAL

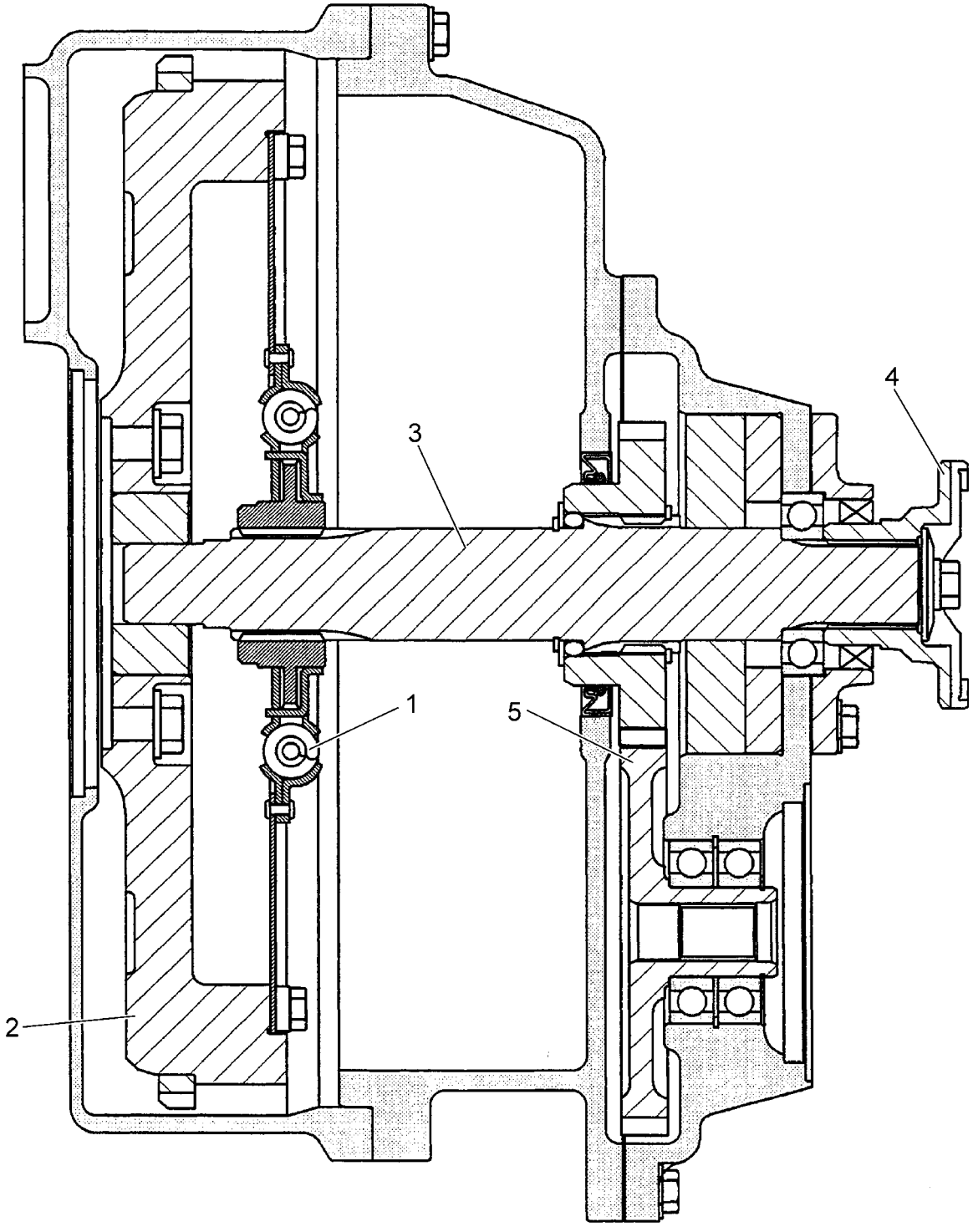


Fig. 7A.1. Direct Drive Main Clutch

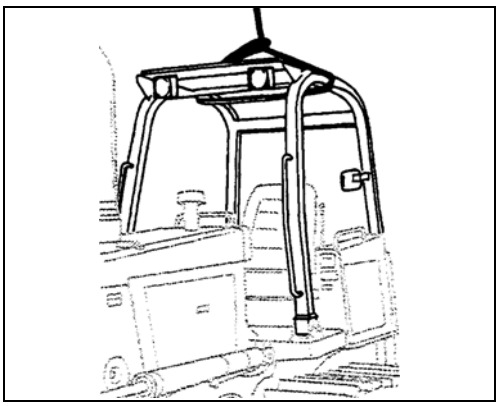
1. Damper Plate
2. Flywheel
3. Output Shaft
4. Output Yoke
5. Pump Drive Gear

MAIN CLUTCH

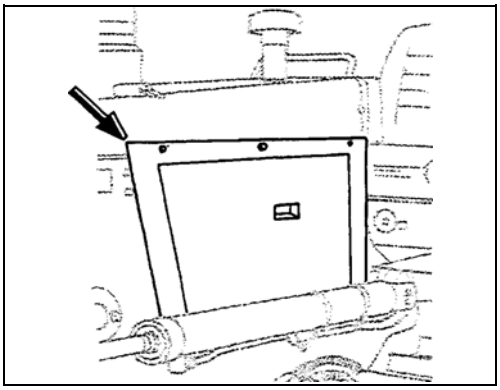
WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train control lever is in NEUTRAL position, drive train neutral lock lever is in ON position and parking brake is set. The starting switch and the electrical system master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

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. Turn the master switch to the OFF position and take out the key.
2. Drain the equipment hydraulic reservoir and drive train system as described in the OPERATOR'S MANUAL.
3. Remove the ROPS structure (or cab, if equipped). Refer to SUPERSTRUCTURE, SECTION 13 for this procedure.

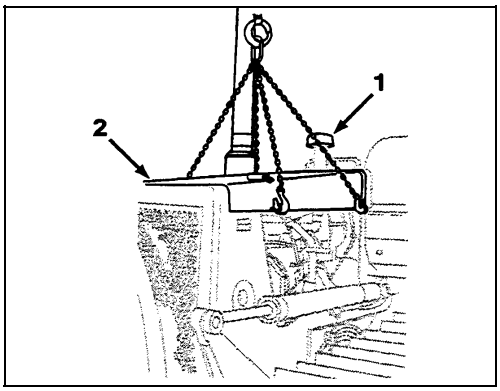


4. Remove engine left and right side doors.

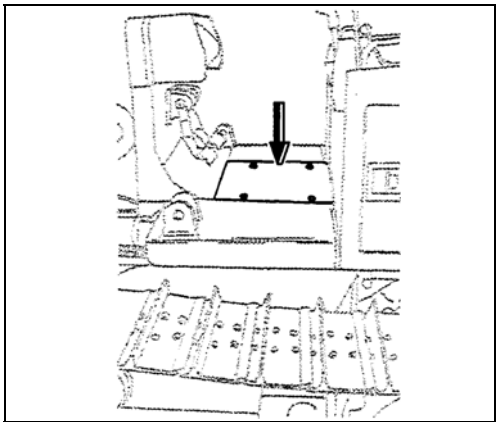


MAIN CLUTCH

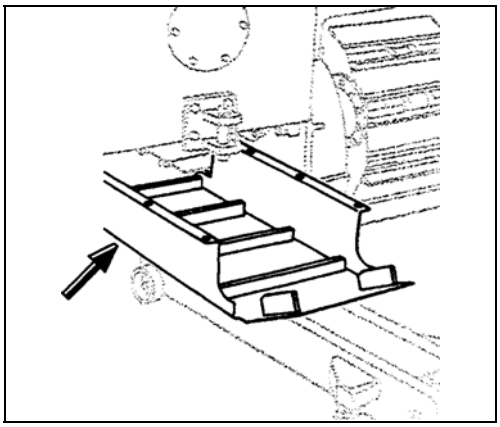
5. Remove air pre-cleaner cap (1) from inlet tube. Remove hood (2) from machine. Refer to POWER, SECTION 12 for this procedure.



6. Remove operators compartment floor plate.

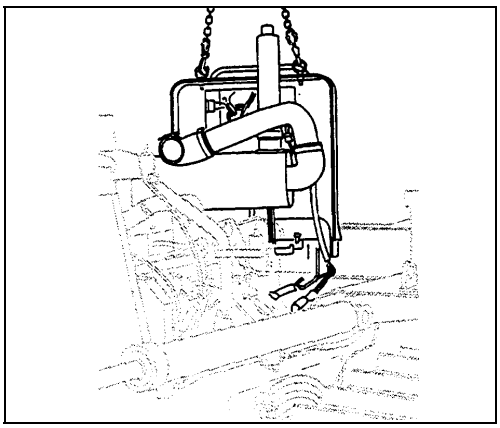


7. Using a rolling floor jack, remove transmission guard from under machine.



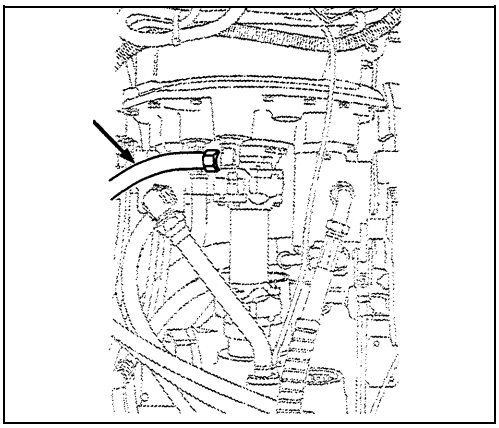
8. Remove dashboard from the machine. Refer to POWER, SECTION 12 for this procedure.

NOTE: *On some machines there will be shims between dashboard and main frame. Keep shims with sides they were removed from.*

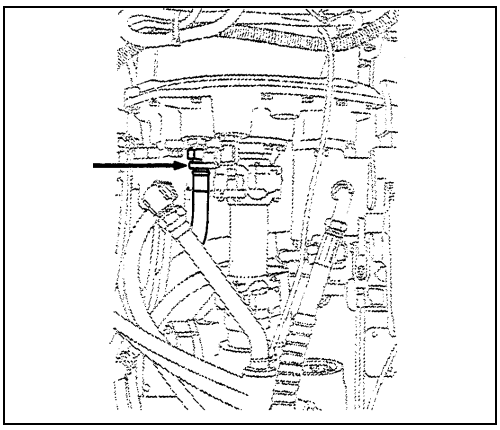


MAIN CLUTCH

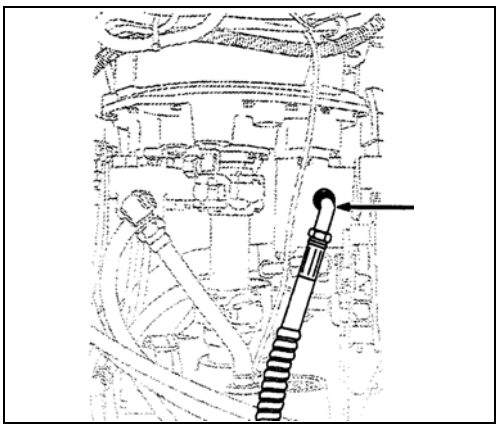
9. Disconnect lube hose at main clutch housing.



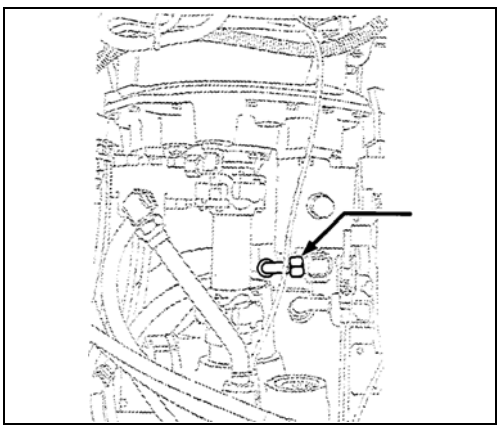
10. Disconnect drain hose at main clutch housing.



11. Disconnect pump to filter hose at front port of charge and scavenge pump.



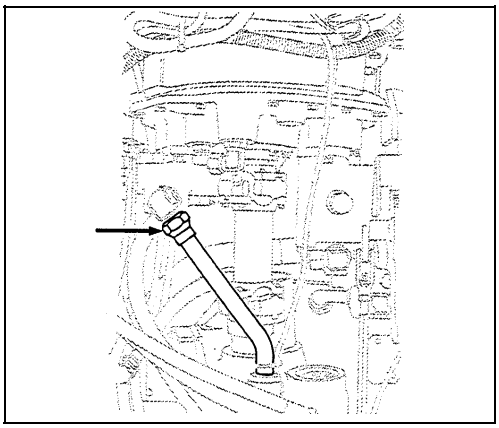
12. Disconnect pump to rear main frame hose at rear port of charge and scavenge pump.



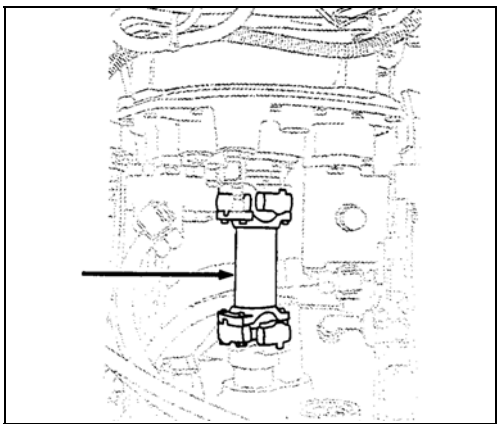
DIRECT DRIVE

MAIN CLUTCH

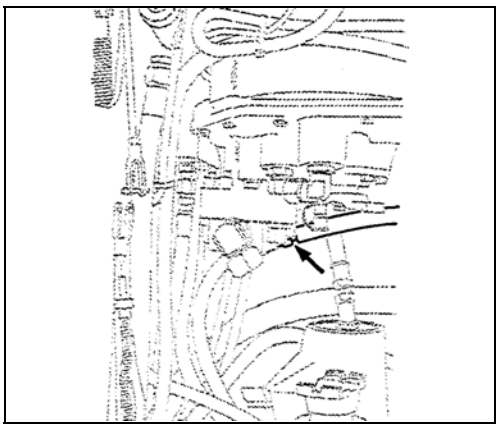
13. Disconnect front half of reservoir to pump tube at top port of equipment pump. Remove front tube.



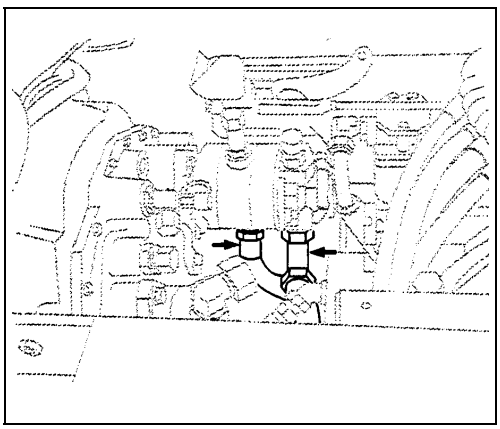
14. Remove mounting hardware and drive shaft.



15. Disconnect pump to equipment valve hose at bottom port of equipment pump.

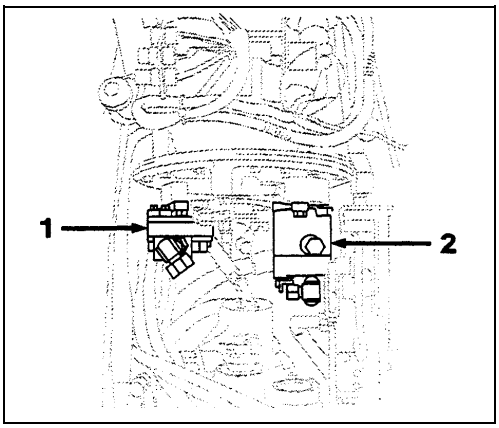


16. Disconnect both hoses at bottom ports of charge and scavenge pump. Remove strainer with fitting and tee connector with drive train temperature sensor from rear section of pump.

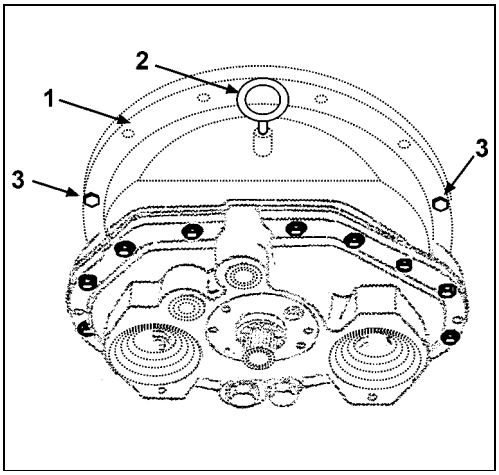


MAIN CLUTCH

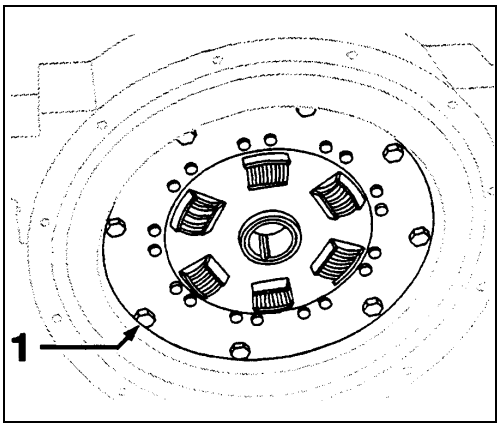
17. Remove mounting hardware from equipment pump (1), slide out of main clutch and remove. Remove mounting hardware from charge and scavenge pump (2), slide out of main clutch and remove.



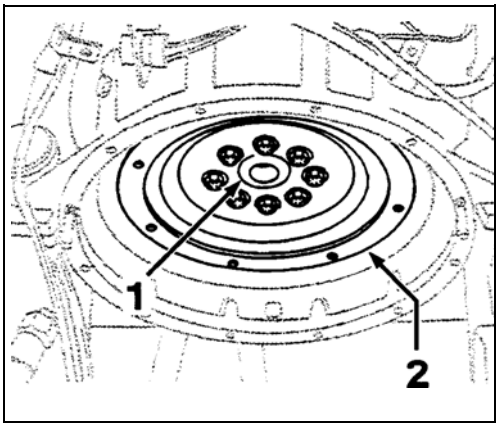
18. Unscrew three clutch mounting bolts with clips. Release harness and cable from main clutch housing. Position wiring out of the way. Refer to POWER, SECTION 12 for this procedure.
19. Install eyebolt M10 (2) in the threaded hole located in the top of main clutch housing (1). Attach a hoist. Place a sling tension on the hoist and remove remaining clutch mounting bolts. Install two M10 mounting studs (3) and slide main clutch out. Slide clutch assembly out, far enough so output shaft clears damper plate, off of studs and lift out of machine. Damper plate will stay with flywheel.



20. Remove mounting hardware (1) and withdraw damper plate from flywheel.

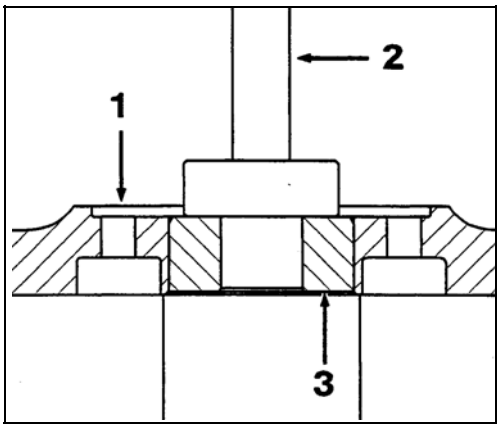


21. Check condition of output bushing (1) in flywheel (2). If replacement is necessary remove flywheel from machine.



MAIN CLUTCH

22. Position flywheel (1) in press (2). Engage ram and remove bushing (3).



NOTE: *Bushing is an interference fit with flywheel.*

MAIN CLUTCH

5. DISASSEMBLY

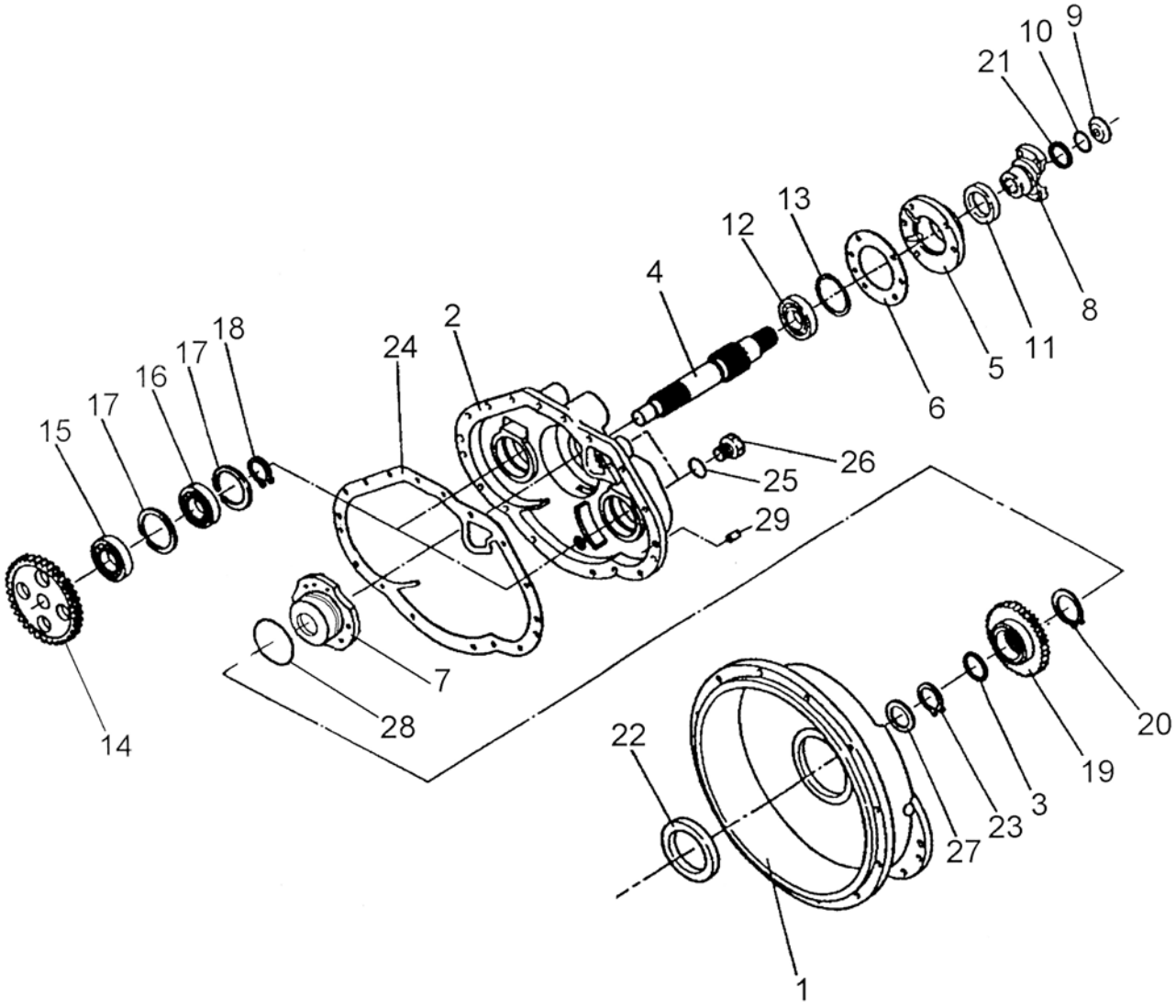


Fig. 7A.2. Exploded View of Direct Drive Main Clutch

Legend for Fig.'s 7A.2 and 7A.3.

1. Clutch Housing
2. Rear Housing
3. Seal Ring
4. Output Shaft
5. Rear Cover
6. Rear Cover Gasket
7. Retainer Plate
8. Output Yoke
9. Washer
10. Seal Ring
11. Seal Ring
12. Ball Bearing
13. Bearing Shim
14. Driven Gear
15. Roller Bearing
16. Ball Bearing
17. Retaining Ring
18. Retaining Ring
19. Drive Gear
20. Retaining Ring
21. Thrust Ring
22. Seal Ring
23. Retaining Ring
24. Cover Gasket
25. O-Ring
26. Drain Plug
27. Thrust Washer
28. Seal Ring
29. Dowel Pin
30. Damper Plate
31. Flywheel Bushing

DIRECT DRIVE

MAIN CLUTCH

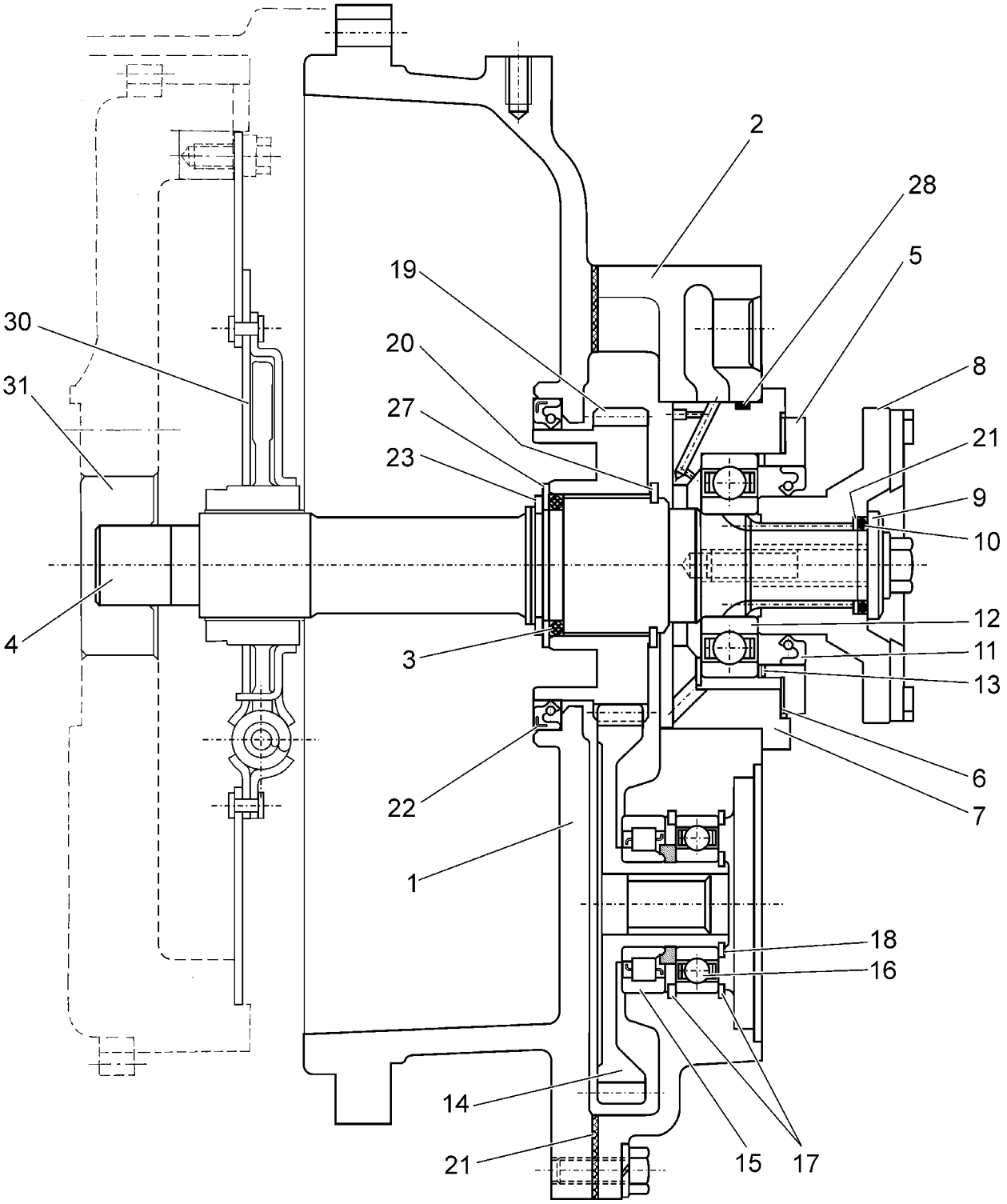
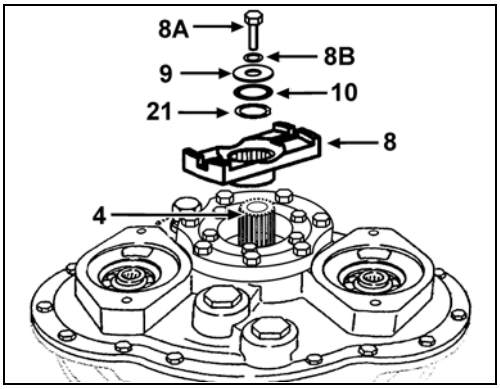


Fig. 7A.3. Cross Section View of Direct Drive Main Clutch

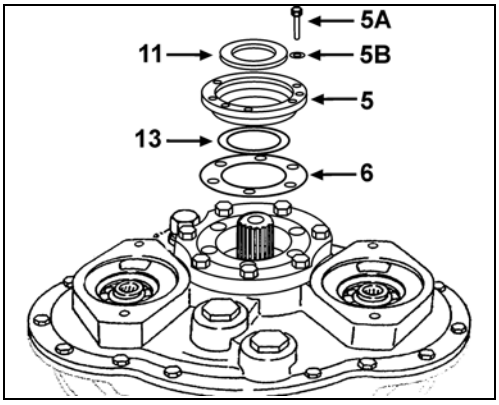
MAIN CLUTCH

NOTE: *Callouts from exploded and cross section views (Fig.'s 7A.2 and 7A.3) correspond with callouts in following steps.*

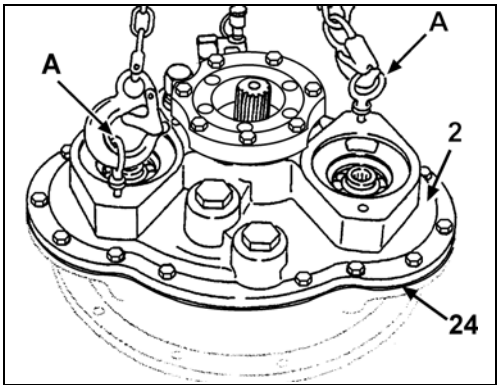
1. Remove one rear cover (5) bolt and install longer one that will allow output yoke (8) to be retained while removing yoke bolt (8A). Remove yoke bolt (8A) with washer (8B). Remove washer (9), seal ring (10) and thrust ring (21). Remove the output yoke (8) from the splined shaft.



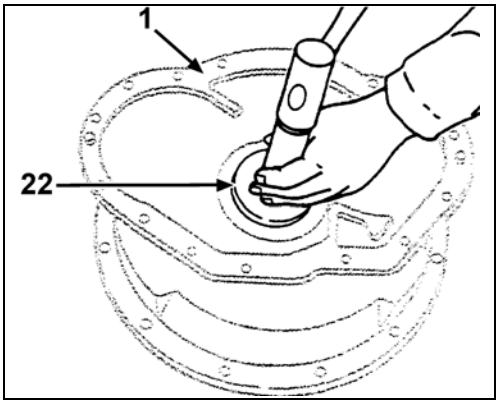
2. Remove the bolts (5A) and washers (5B) from the rear cover (5). Using three bolts as jack screws, remove the rear cover (5). Remove the gasket (6) and seal ring (11) from the cover (5) and discard. Remove the bearing shims (13) from the shaft.



3. Insert two 1/2NC eye bolts (A) to pump mounting holes and connect hoist. Remove rear housing (2) mounting hardware. Lift rear housing off from clutch housing. Discard gasket (24).



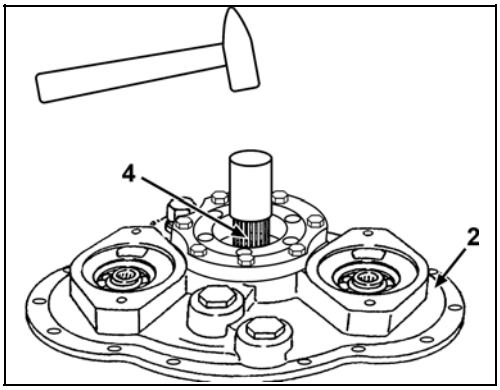
4. Drive seal ring (22) from clutch housing (1) and discard.



DIRECT DRIVE

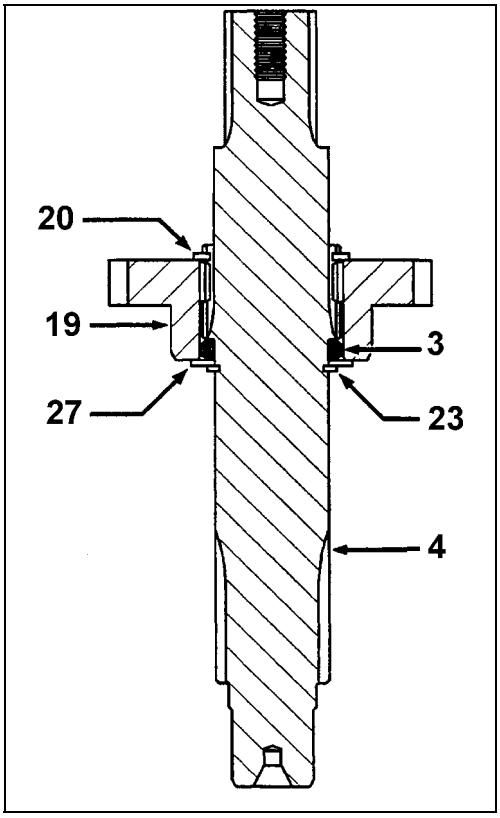
MAIN CLUTCH

5. Using a drift remove the output shaft (4) with drive gear (19) from the rear housing (2).

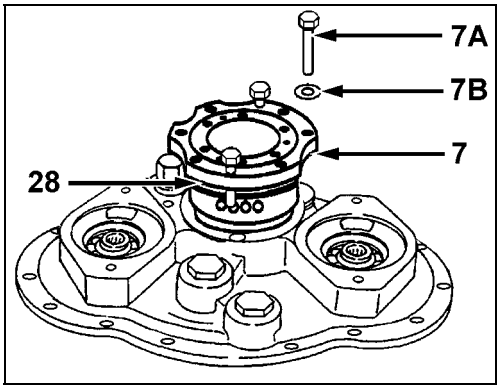


6. Position the output shaft (4) in a vise and disassemble components as follows:

   A. Remove retaining ring (23), thrust washer (27) and seal ring (3) from output shaft (4) and slide drive gear (19) off.
   B. Remove retaining ring (20) from output shaft (4).

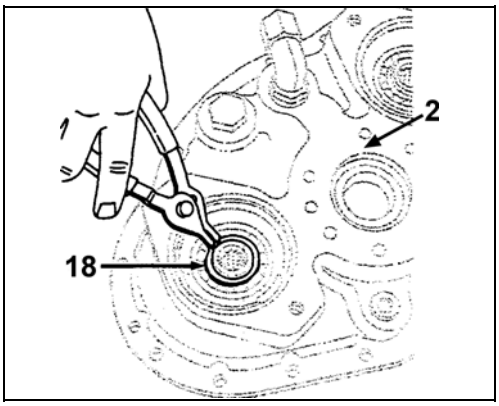


7. Remove the retainer plate (7) mounting bolts (7A) and washers (7B). Using two bolts as jack screws in the holes provided, remove the retainer plate (7). Remove and discard the seal ring (28).
   Place the retainer plate (7) in a vise. Using a puller, remove the bearing (12) from the retainer plate (7).

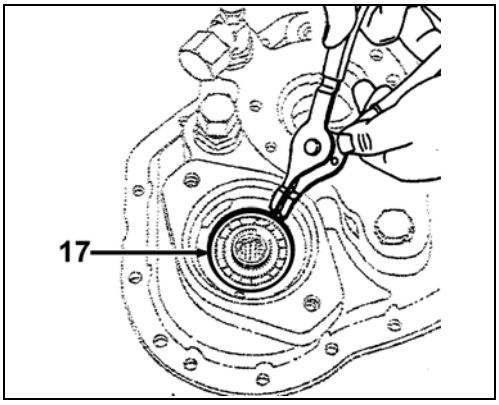


MAIN CLUTCH

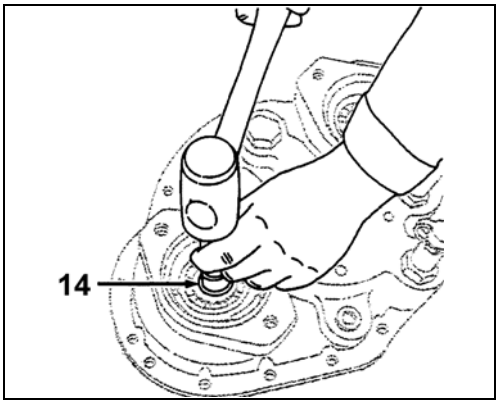
8. Position rear housing (2) on solid blocking. Remove bearing retaining ring (18) at each pump driven gear (14).



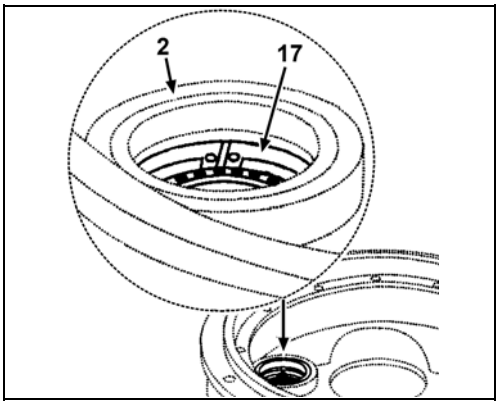
9. Remove the outer retaining ring (17) at each bearing (16).



10. Using a drift, remove the gears (14) with bearings (15) from the rear housing (2). The outer bearings (16) will stay in the housing.

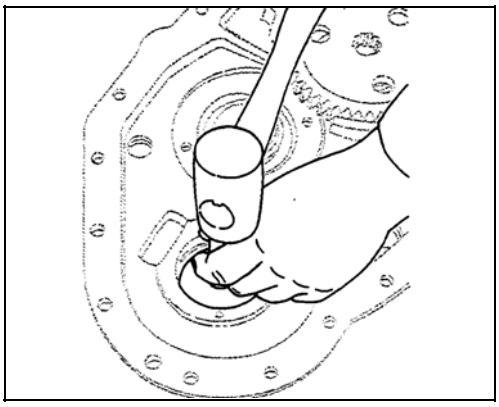


11. Turn the rear housing (2) over and remove the inner retaining ring (17) from the housing.

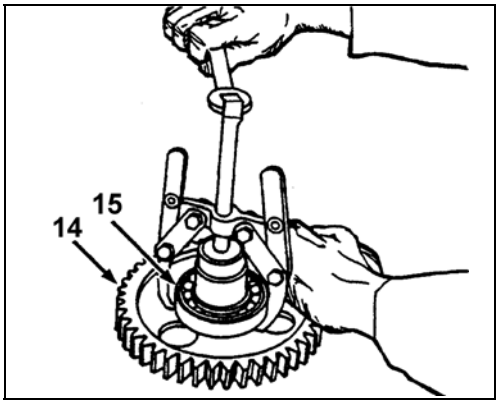


MAIN CLUTCH

12. Using a driver, remove the ball bearing (16) from the rear housing (2).



13. Remove the outer race, rollers and cage of the roller bearing (15). Using the two holes on the backside of the pump drive gear (14) start the bearing inner race away from the gear shoulder. Move the inner race far enough out to install a puller, remove the inner race of roller bearing (15) from gear (14).



6. INSPECTION AND REPAIR

1. Wash all components thoroughly in a suitable solvent after the main clutch has been disassembled. Dry thoroughly with compressed air or a clean cloth. Clean thoroughly all sealing surfaces that were coated with LOCTITE or sealed by gaskets 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 main clutch is disassembled for service. Replace definitely seal ring (22) placed between the clutch housing and the drive gear when excessive outer 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.

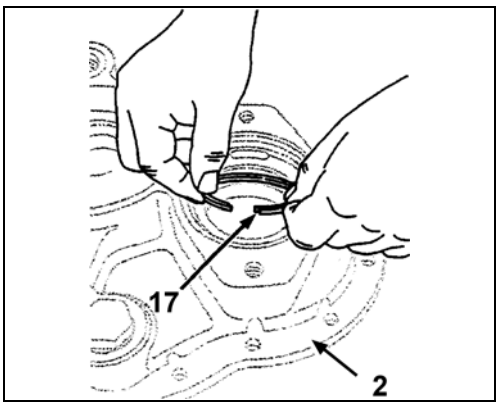
MAIN CLUTCH

7. Inspect thoroughly drive gear (19) outer surface that mates with seal ring (22). Drive gear (19) outer surface and seal ring (22) contact surface shall not be grooved.
8. Output yoke (8) shall not be grooved by seal ring (11) while contact surface smoothing and darkening are admissible.
9. Replace the converter housing (1) and rear housing (2) if cracks, thread stripping or bearing bores damages occurs.

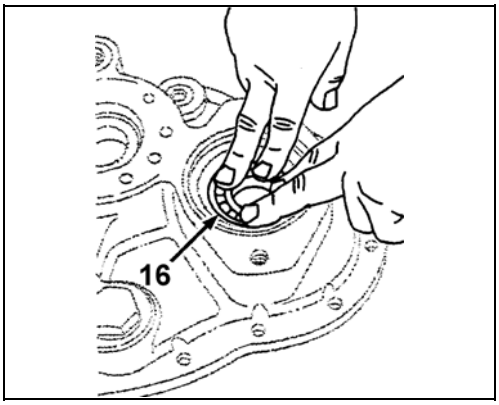
7. REASSEMBLY

NOTE: *Callouts from exploded and cross section views (Fig.'s 7A.2 and 7A.3) correspond with callouts in following steps.*

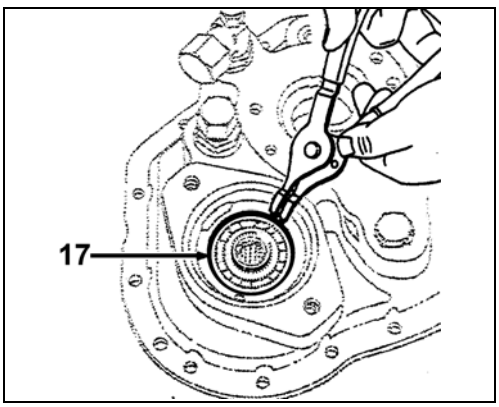
1. Position the housing (2) with the output yoke side up. Install retaining rings (17) into the housing in the bottom grooves at each bearing bore.



2. Finger press the ball bearings (16) into the housing. Using a driver against the outer race of bearing (16), tap each bearing until it bottoms the retaining ring (17).

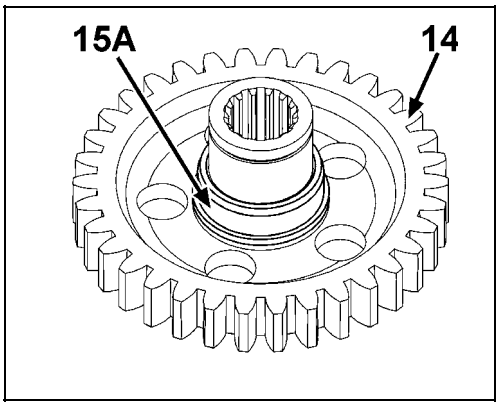


3. Install the outer retaining ring (17) into the top groove against each bearing (16).



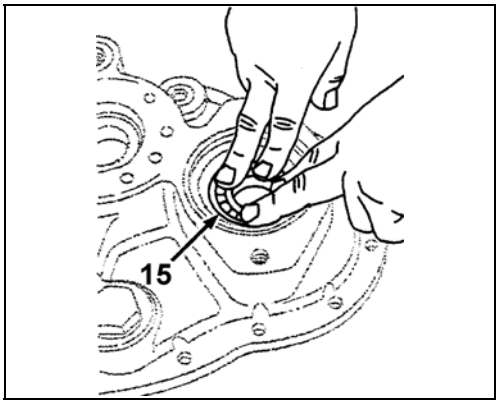
MAIN CLUTCH

4. Position pump driven gear (14) in press. Press roller bearing inner race (15A) onto driven gear (14) hub with the larger outer diameter pointed towards the gear, until it bottoms. Repeat for the second gear (14).

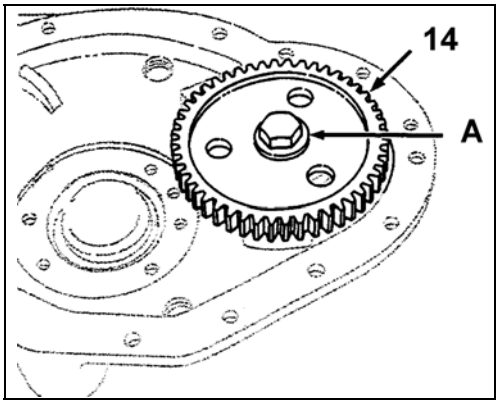


5. Turn the rear housing (2) over. Install angle rings and outer bearing races rollers of roller bearings (15) in the pump seats.

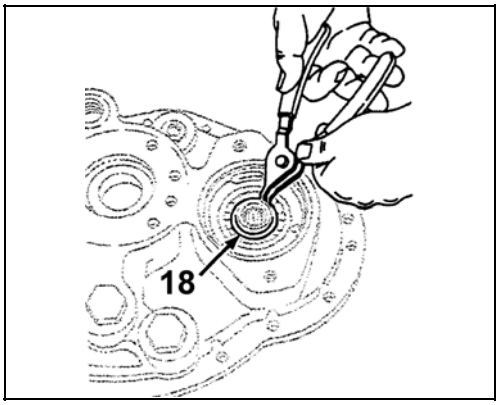
   NOTE: The c*omplete bearing always must be press with its angle ring inward, until it bottoms on the retaining ring. This installation procedure ensures bearing's races (inner and outer) will not be out of alignment with each other.*



6. Install driven gears (14) into the housing (2). Press the gears in until the retaining ring groove in the gear appears.
   Use a 3/4 NCx5 bolt (A) with nut and two suitable washers to pull the gears into the ball bearing (16) seats.



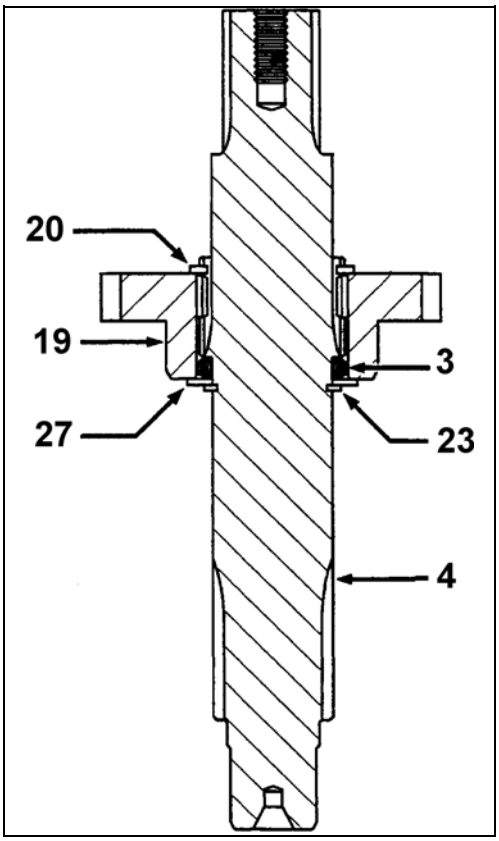
7. From the other side of the housing install retaining rings (18) on driven gears (14).



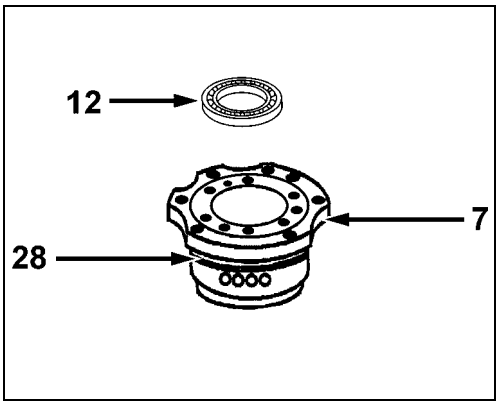
MAIN CLUTCH

8. Reassemble output shaft (4) assembly as follows;

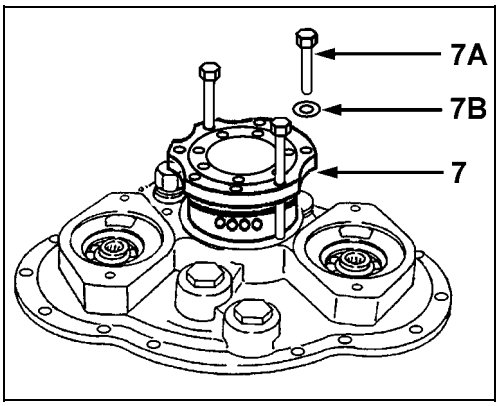
   A. Install retaining ring (20) on output shaft (4).
   B. Slide drive gear (19) down output shaft (4). Install seal ring (3) into cavity under drive gear (19). Install thrust washer (27) against drive gear and secure with retaining ring (23).



9. Position retainer plate (7) in press and install ball bearing (12) until it bottoms. Install seal ring (28) to the groove on the retainer plate (7).



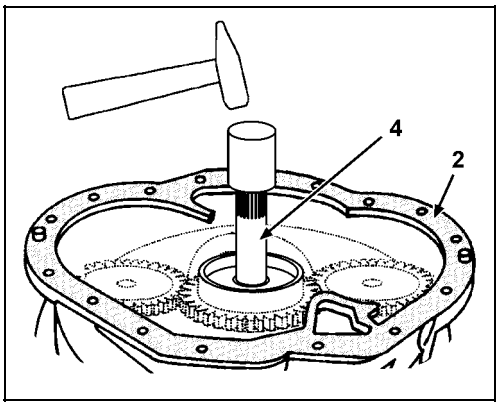
10. Install two M10x80 aligning dowels 180 [°] apart. Install plate retainer (7) in the rear housing and secure with bolts (7A) and washers (7B). Torque the bolts to 40 – 45 [Nm].



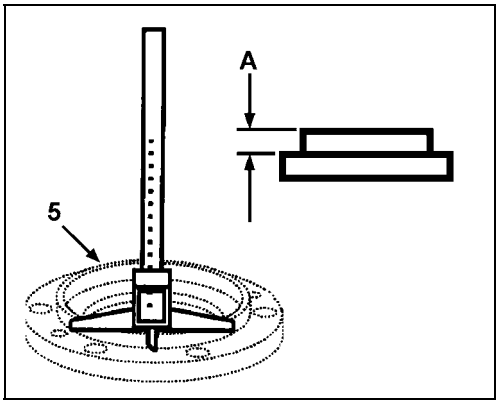
DIRECT DRIVE

MAIN CLUTCH

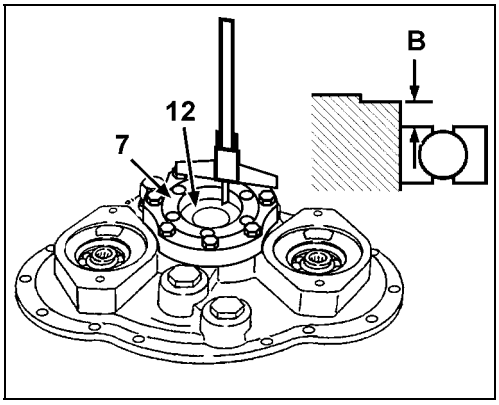
11. Turn the rear housing (2) over. Position suitable sleeve under the bearing (12) against the inner bearing ring. Insert assembled shaft (4) into retainer plate and bottom with a driver.



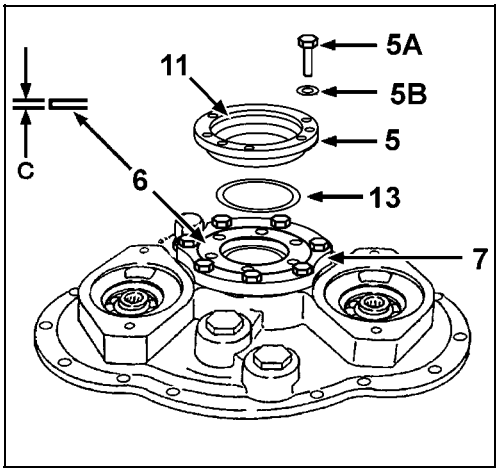
12. Measure dimension A, the protrusion height on the rear cover (5).



13. Measure dimension B, the distance from the top of the bearing face (12) to the rear cover mounting surface of the retainer plate (7).

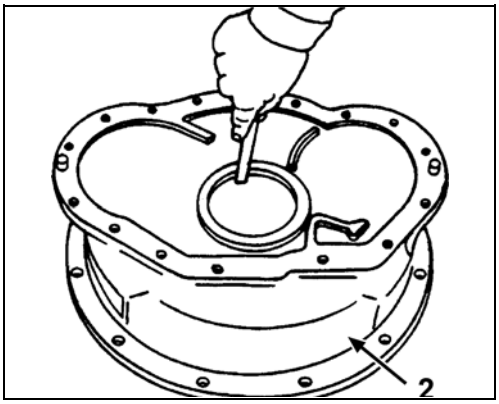


14. Measure dimension C, the thickness of the gasket (6).
15. Prepare a shim pack using as many shims (13) as possible so that the shim pack thickness is less than dimensions **B + C - A**. The resulting bearing - shaft end play will be 0.05 to 0.10 [mm] maximum.
16. Install the seal ring (11), garter spring end down, into the rear cover (5) 1 to 2 [mm] below the cover face surface.
17. Position the shims (13) and gasket (6) to the housing. Align the notch in the cover (5) to the groove in the retainer plate (7) and thread down with the bolts (5A) and washers (5B). Torque the bolts to 22 – 27 [Nm].

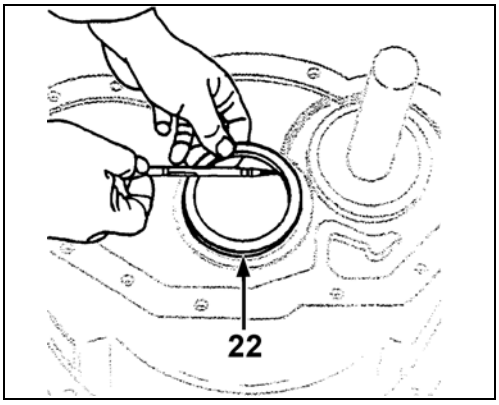


MAIN CLUTCH

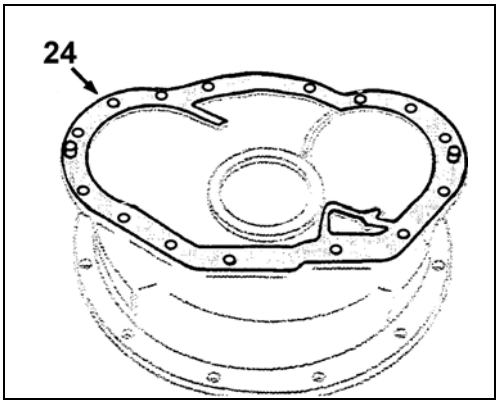
18. Clean out oil seal mounting area in clutch housing (2).



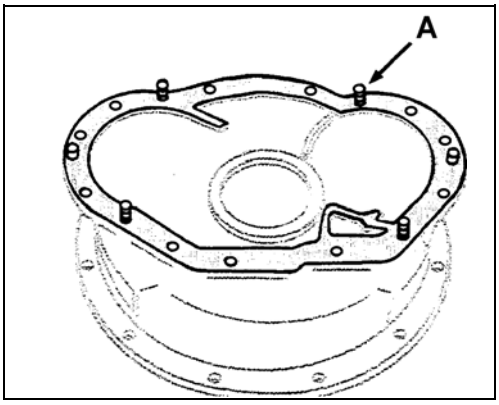
19. Position seal ring (22) with spring garter lip facing clutch housing.



20. Install new gasket (24) on clutch housing (2).



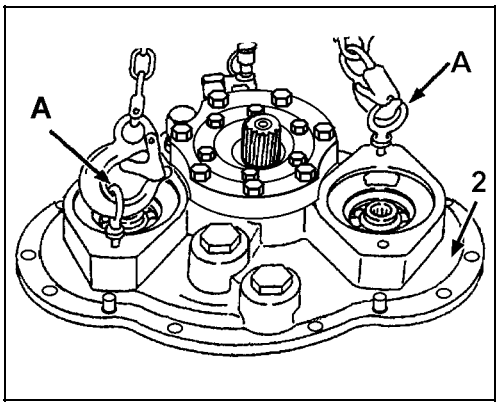
21. Install four aligning studs M10 x 50 (A), to clutch housing (1).



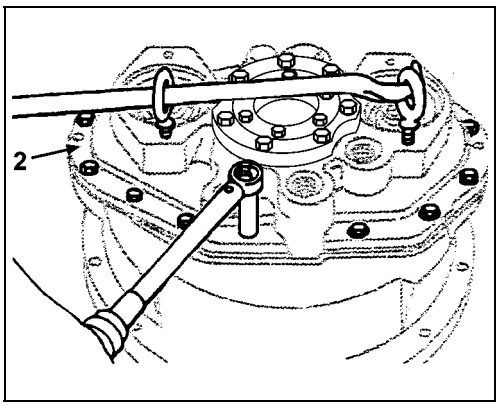
DIRECT DRIVE

MAIN CLUTCH

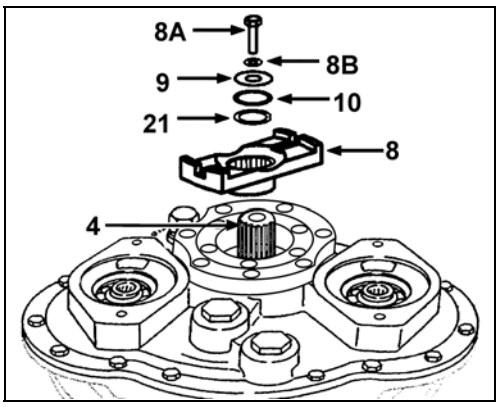
22. Reinstall one rear cover bolt to retainer plate to secure output shaft assembly to rear housing. Insert two 1/2NC eye bolts (A) to pump mounting holes and connect hoist. Coat spur gear oil seal surface liberally with fresh oil. Lower rear housing (2) on clutch housing aligning studs and dowel pins being careful not to damage or dislodge seal ring from clutch housing.



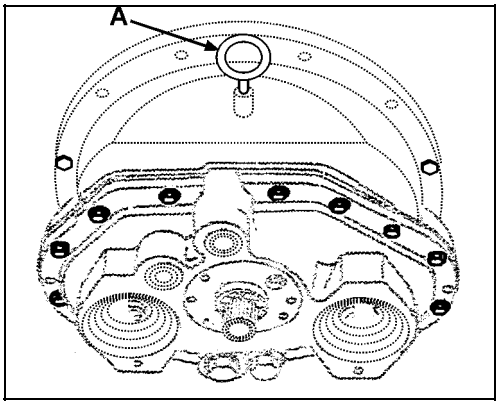
23. Reposition eye bolts as shown. Install rear housing (2) mounting hardware. Using a breaker bar, torque bolts to 40 to 45 [Nm].



24. Install output yoke (8) to the output shaft (4) being careful, not to cut or damage the seal ring (11). Install thrust ring (21) on the shaft, then seal ring (10), and washer (9) and secure with bolt (8A) and washer (8B). Torque bolt to 72 to 88 [Nm].



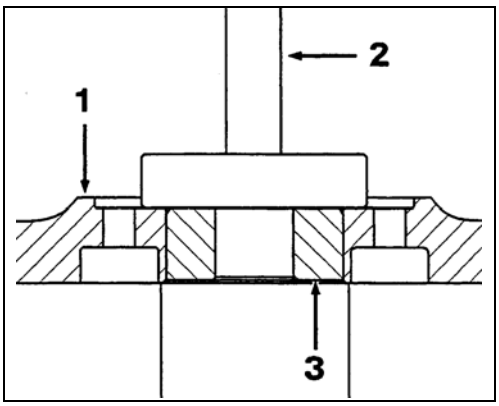
25. Install fittings with new O-rings to rear housing at marked positions. Install eyebolt M10 (A) to clutch.



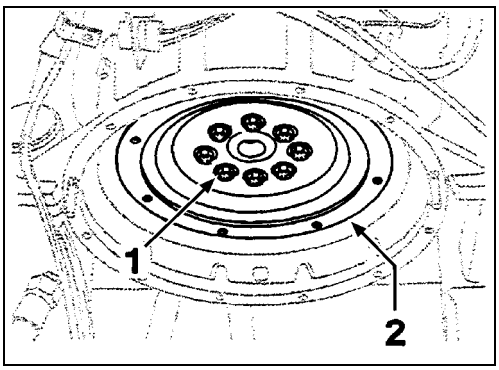
MAIN CLUTCH

8. INSTALLATION

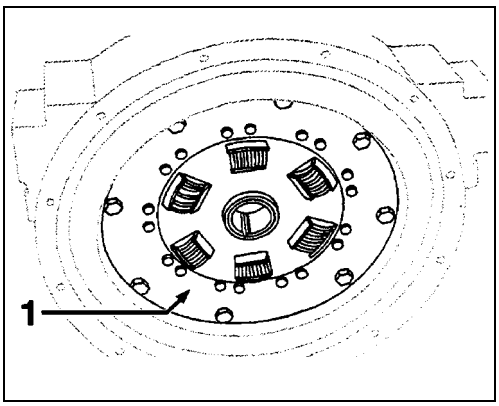
1. If flywheel bushing replacement is required proceed as follows;
   A. Position flywheel (1) in press (2) crankcase side facing up.
   B. Heat bushing bore in flywheel to 95 [°C].
   C. Position bushing (3) in bore, external chamfer facing up - internal chamfer facing down. Using an oversize driver press bushing into flywheel until flush with edge.



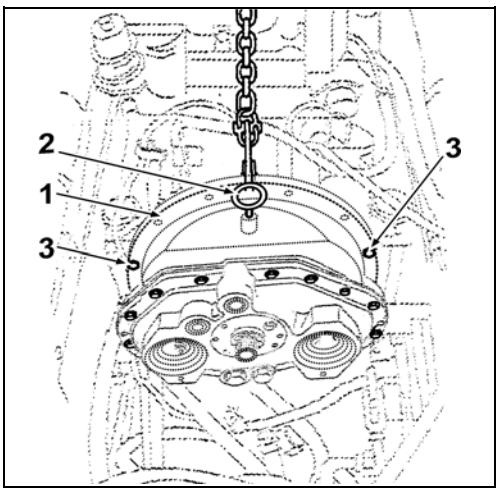
2. Install flywheel (2) to crankcase and secure with hardware (1), refer to ENGINE SHOP MANUAL.



3. Install two aligning studs 3/8 UNC x 1.5, 180° apart to flywheel. Position damper plate (1) to flywheel on studs. Apply Loctite #562 to bolts and install with spacers. Remove studs and repeat for remaining bolts. Torque the bolts to 38 ±10% [Nm].

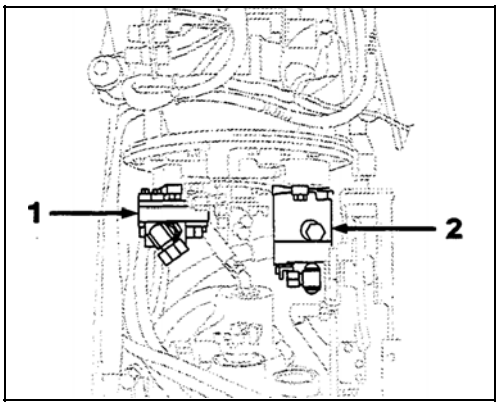


4. Position main clutch (1) in frame. Slide up on M10 studs (3) aligning output shaft splines with splines in damper plate. Rotate output yoke for spline alignment. Continue to slide in until output shaft engages and seats in flywheel bushing. Secure with half of the metric bolts. Remove eyebolt (2) and studs.
5. Reinstall harness and cable to main clutch housing by reinstalling three clutch mounting bolts with clips previously removed (refer to POWER, SECTION 12 for this procedure). Install remaining mounting bolts and torque all to 43 [Nm]. Apply electrical sealing grease, Grafo 112-X (1270464H1) to terminal connectors.

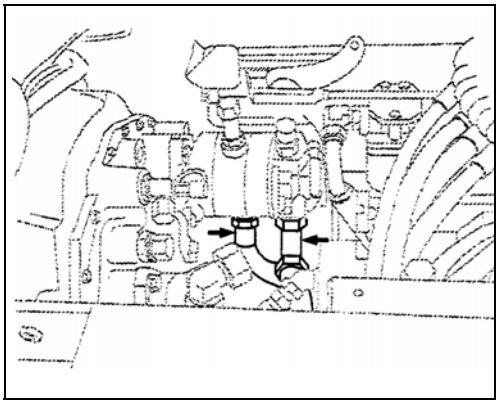


MAIN CLUTCH

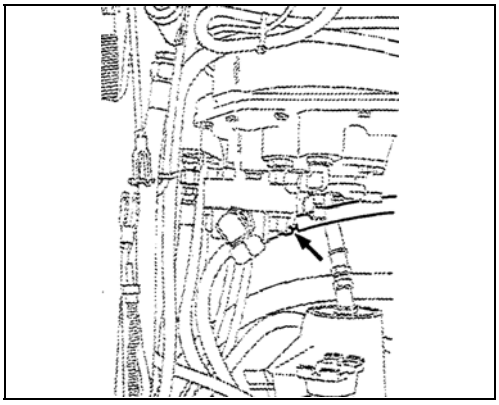
6. Install new o-ring to equipment pump (1) and slide in main clutch and secure with hardware. Install new o-ring to charge and scavenge pump (2) and slide in main clutch and secure with hardware.
   Torque the bolts to 92 ± 10%. [Nm]



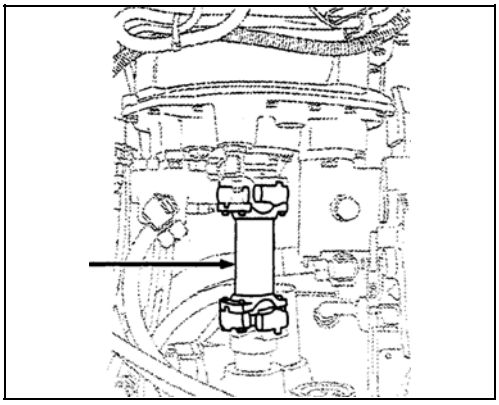
7. Install tee connector with drive train temperature sensor and strainer with fitting at rear section of charge and scavenge pump. Install both hoses at bottom ports of pump.



8. Connect pump to equipment valve hose to bottom port of equipment pump.

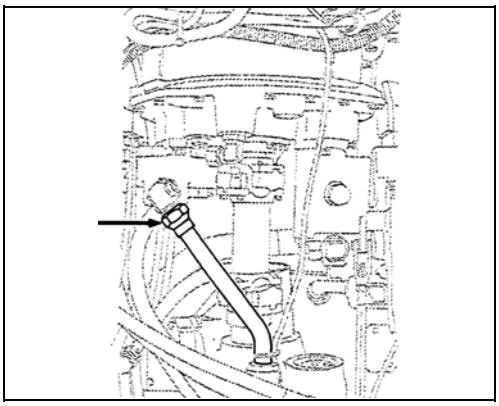


9. Install drive shaft with mounting hardware. Torque bolts to 33 [Nm] (for TD-8M) or 57 [Nm] (for TD-9M, TD-10M).

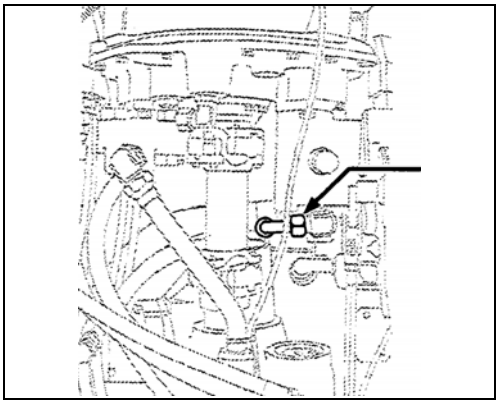


MAIN CLUTCH

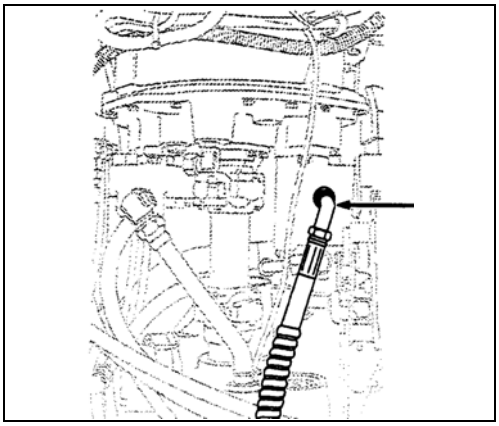
10. Connect front half of reservoir to pump tube to top port of equipment pump.



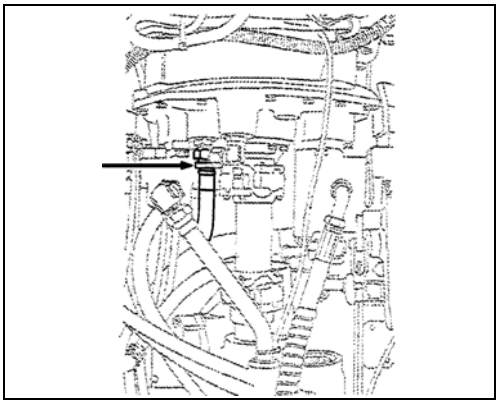
11. Connect pump to rear main frame hose to rear port of charge and scavenge pump.



12. Connect pump to filter hose at front port of charge and scavenge pump.

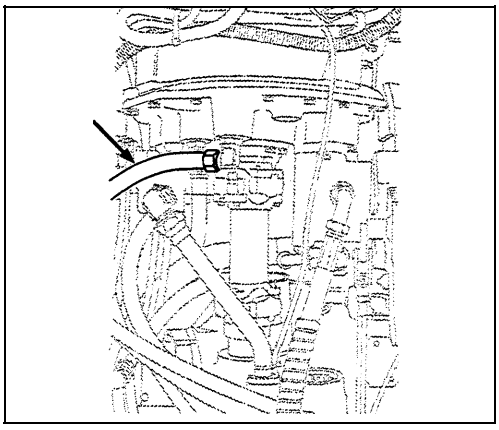


13. Connect drain hose at main clutch housing.



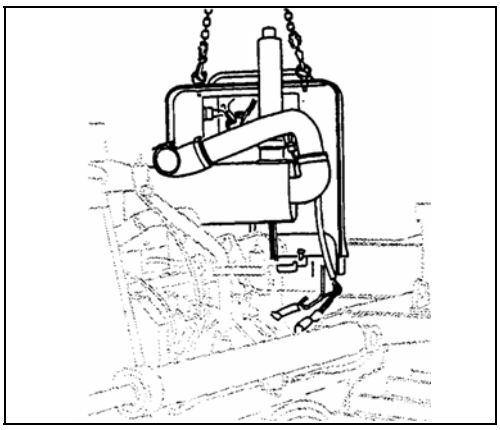
MAIN CLUTCH

14. Connect inlet hose at main clutch housing.

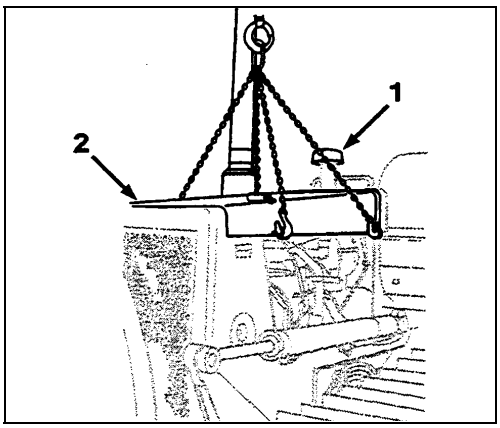


15. Position dashboard in the machine and secure with hardware. Torque bolts to 92 ± 10%. [Nm]. Refer to POWER, SECTION 12 for this procedure.

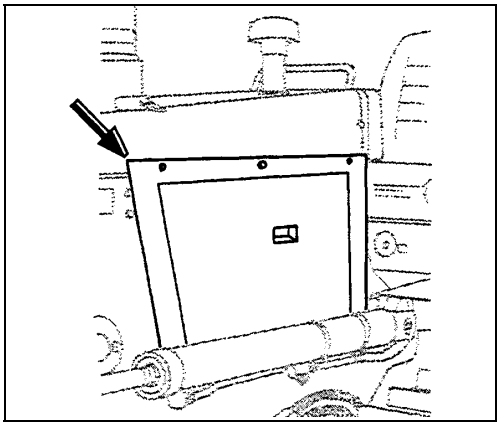
NOTE: *On some machines there will be shims between dashboard and main frame. Keep shims with sides they were removed from.*



16. Install hood (2) to machine. Install air pre-cleaner cap (1). Refer to POWER, SECTION 12 for this procedure.

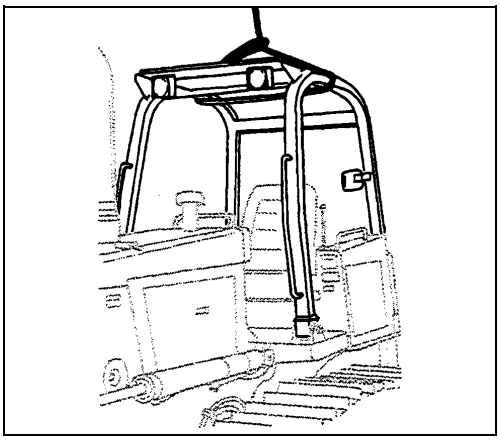


17. Install engine left and right side doors and secure with hardware. Torque bolts to 38 ±10% [Nm].



MAIN CLUTCH

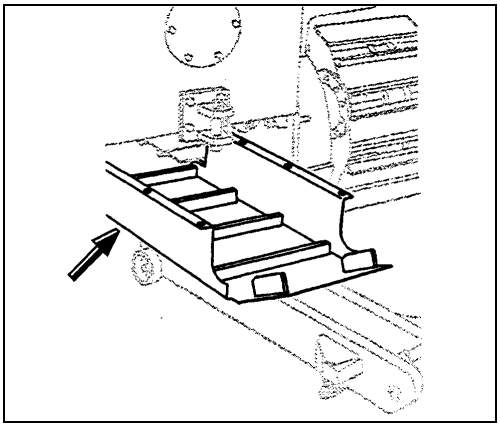
18. Using hoist install ROPS on machine (or cab, if equipped). Refer to SUPERSTRUCTURE, SECTION 13 for this procedure.



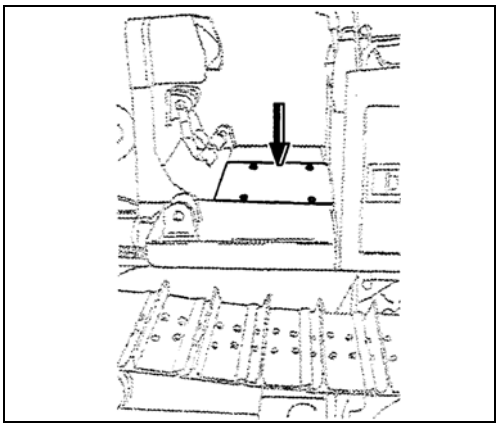
19. Refill hydraulic and drive train systems as described in OPERATOR'S MANUAL.

20. Place the drive train control lever in NEUTRAL and the neutral lock lever in the ON position. Start the engine and visually check hoses and connections for leakages.

21. Using a rolling floor jack, install transmission guard to machine and secure with hardware. Torque bolts to 92 ± 10% [Nm].



22. Install operators compartment floor plate and secure with hardware. Torque bolts to 38 ±10% [Nm].



INCHING VALVE

9. DESCRIPTION

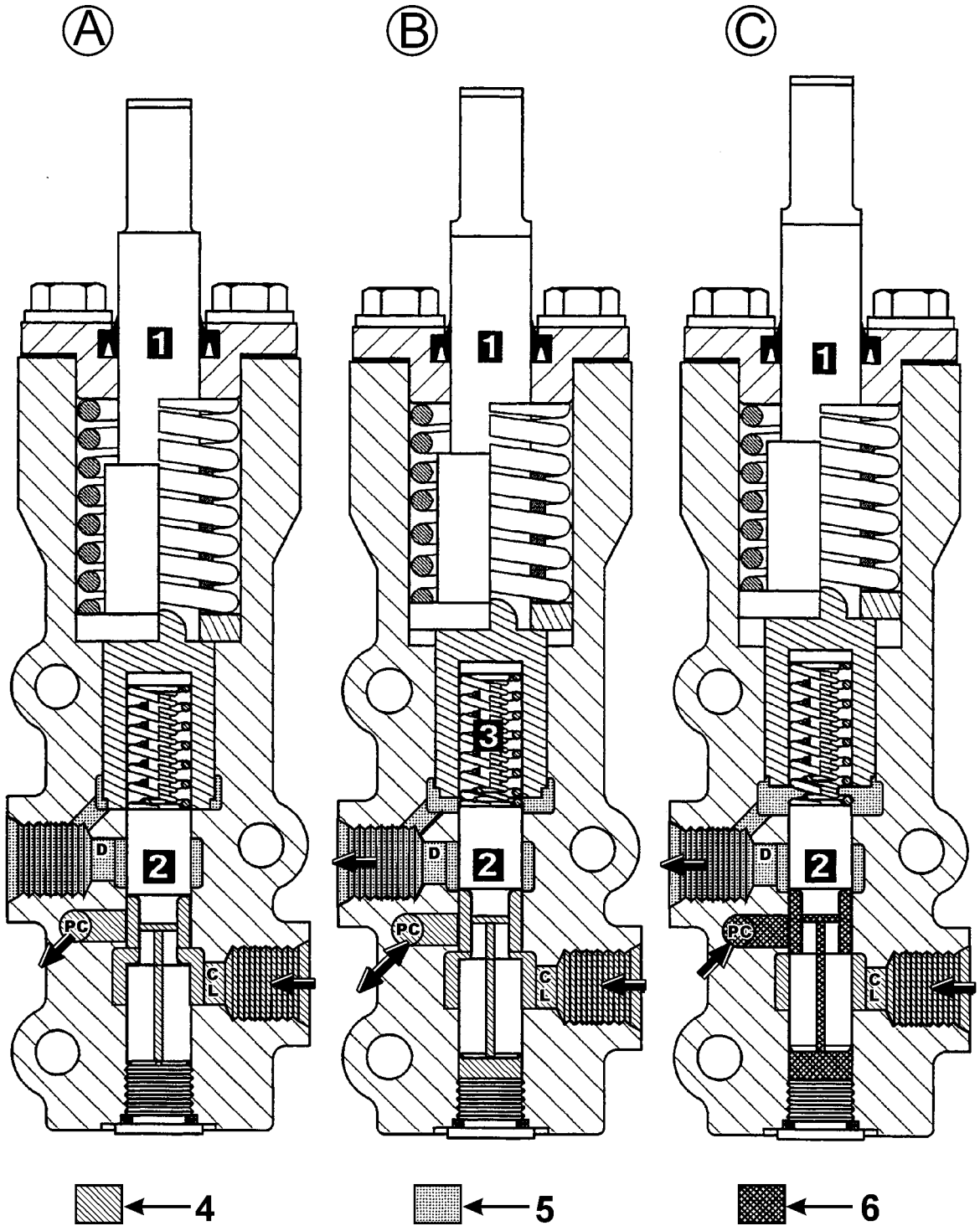


Fig. 7A.4. Inching Valve Operation (Cross Section View)

A. Inching Pedal Upright Position
B. Inching Pedal Partially Depressed
C. Inching Pedal Fully Depressed

1. Input Spool
2. Metering Piston
3. Double Return Spring Arrangement
4. Fluid from Rate of Rise Valve (CL)
5. Fluid to Drain (D)
6. Fluid from Speed Clutch (1^{st}, 2^{nd} or 3^{rd}) (PC)

INCHING VALVE

The inching valve performs three functions in the drive train hydraulic system.

The first function, pedal upright, is to allow full engagement of one of the speed clutch (1st, 2nd or 3rd).The second function, pedal partially depressed, is to allow slippage of one of the speed clutch (1st, 2nd or 3rd). The third function, pedal fully depressed, is to allow no engagement of one of the speed clutch (1st, 2nd or 3rd).

10. OPERATION

NOTE*: Callouts from cross section view (Fig. 7A.4) correspond with callouts in following text.*

Inching Pedal Upright (A)

When the inching pedal is fully upright position (no depression), the input spool (1) is positioned down against its stop. Pressurized oil from the rate of rise valve enters the CL port past the metering piston (2) and out the PC port. The metering spool is unable to move because of mechanical stack up of its internal components. From the PC port fluid enters back to rate of rise valve and is directed onward to the range selector valve speed packs (1st, 2nd or 3rd).

Inching Pedal Partially Depressed (B)

When the inching pedal is in the partially depressed position, the input spool (1) is pulled up off its mechanical stop. Pressurized oil from the rate of rise valve enters the CL port around the metering piston (2). Oil enters the drilled passage moving the metering spool upwards. As the metering spool shifts, the D (drain) port is slightly open, dropping the pressure in the speed clutch, allowing partial engagement of the clutch. As the partial drain off of oil occurs, pressure will drop at the PC port of the metering spool allowing the double return spring arrangement (3) to shift the metering spool back down and shut off D port. The metering spool fluctuates rapidly between both positions allowing precise control of machine speed.

Inching Pedal Fully Depressed (C)

When the inching pedal is in the fully depressed position, the input spool (1) is pulled up off its mechanical stop. Pressurized oil from the rate of rise valve enters the CL port around the metering piston (2). Oil enters the drilled passage moving the metering spool upwards. As the metering spool shifts, the D (drain) port is fully open, dropping the pressure in the PC (port), range clutch, allowing full disengagement of the speed clutch. The D port has a drilled passage to the spring side of the metering spool for lubrication of the valve components.

INCHING VALVE

11. SPECIFICATIONS

NOTE: *Callouts in following springs data correspond with callouts from exploded and cross section views (Fig.'s 7A.6 and 7A.7)*

Metering Piston Outer Spring (11):

Free Length..... 35.6 [mm]
Test Length ..... 23.0 [mm]
Work Length ..... 23.0 to 35.3 [mm]
Test Load..... 17.5 [N]
Number of Working Coils 12

Input Spool Return Spring (5):

Free Length ..... 63.8 [mm]
Test Length ..... 46.5 [mm]
Work Length ..... 33.2 to 46.5 [mm]
Test Load..... 311 [N]
Number of Working Coils 6

Metering Piston Inner Spring (10):

Free Length ..... 26.0 [mm]
Test Length ..... 22.5 [mm]
Work Length ..... 22.5 to 26.0 [mm]
Test Load..... 38 ± 22 [N]
Number of Working Coils 7.5

INCHING VALVE

12. REMOVAL

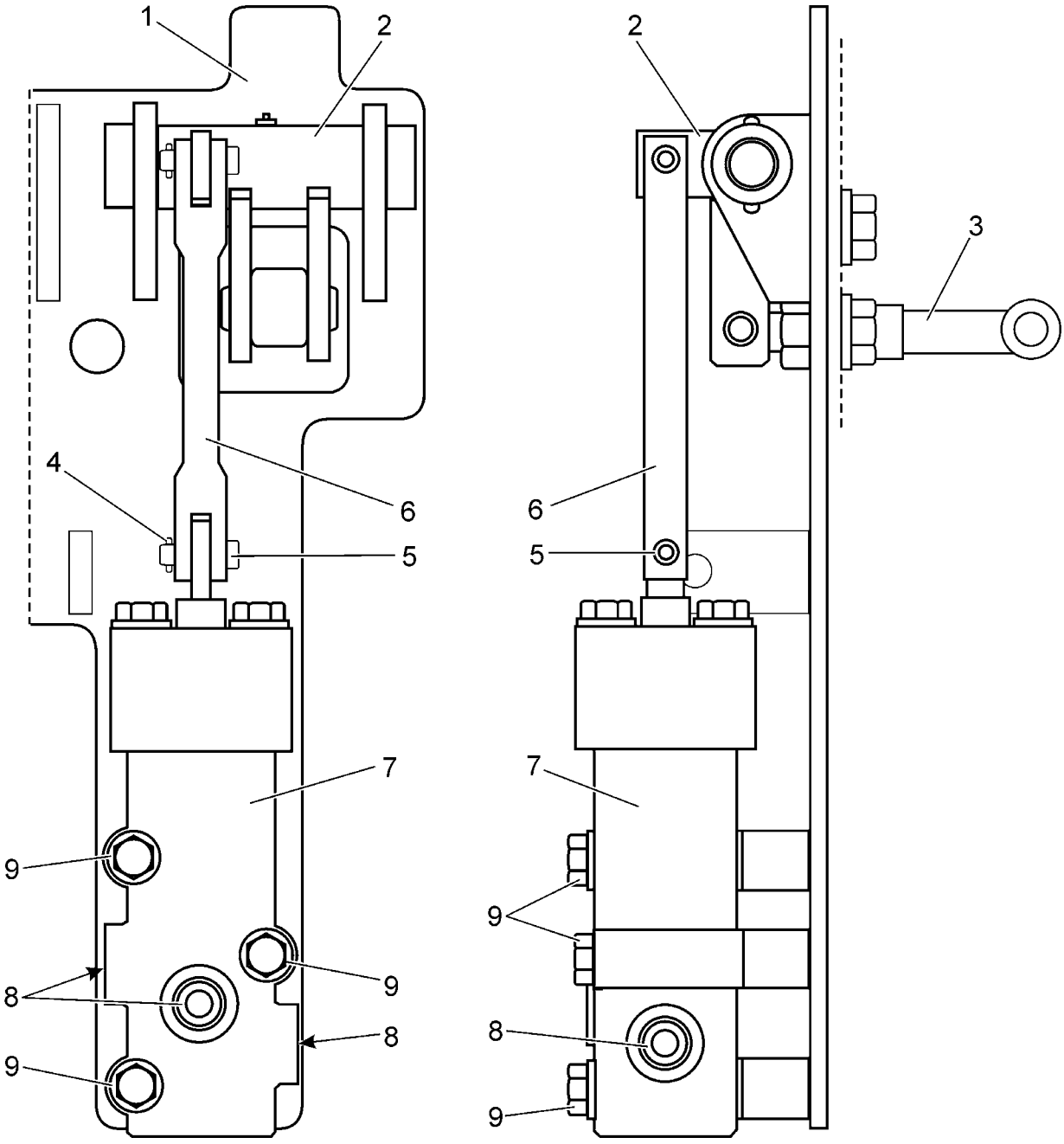


Fig. 7A.5. Inching Valve Removal

1. Valve Bracket
2. Clutch Lever
3. Clevis
4. Cotter Pin
5. Link Pin
6. Clutch Link
7. Inching Valve
8. Hoses and Fittings
9. Mounting Hardware

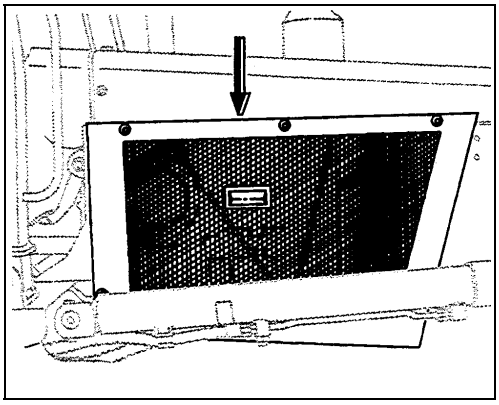
DIRECT DRIVE

INCHING VALVE

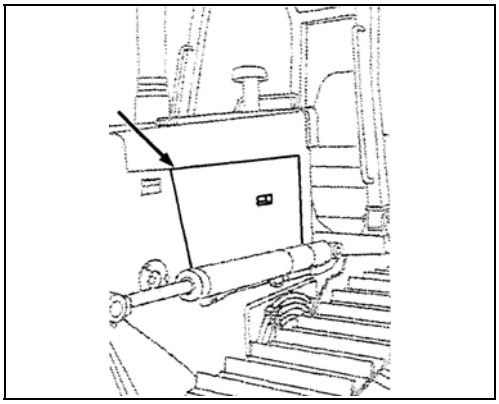
WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train control lever is in NEUTRAL position, drive train neutral lock lever is in ON position and parking brake is set. The starting switch and the electrical system master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

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 right engine side door.



2. Remove left engine side door to get access to the inching valve located on the dashboard inside the engine compartment.



3. Remove lower cotter (4) and clutch link (5) pins. Detach link (6) from inching valve (7).
4. Disconnect and tag three hoses (8) at valve. Remove mounting hardware (9) and remove valve (7) from bracket (1).

INCHING VALVE

13. DISASSEMBLY

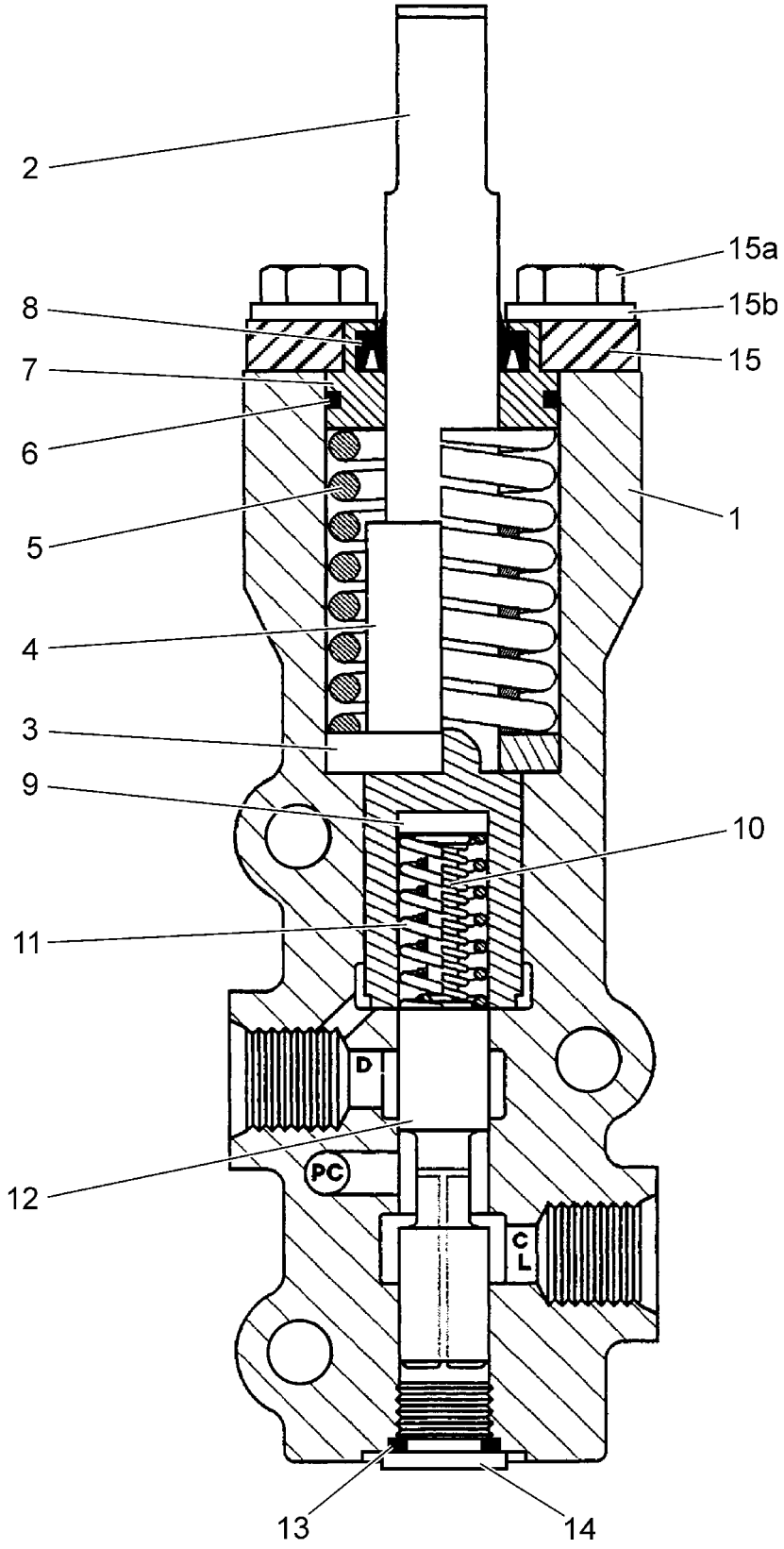


Fig. 7A.6. Cross Section View of Inching Valve

INCHING VALVE

Legend for Fig.'s 7A.6 and 7A.7

1. Valve Housing
2. Input Spool
3. Washer
4. Sleeve Stop
5. Return Spring
6. O-Ring
7. Seal Retainer
8. Seal Ring
9. Spring Guide
10. Metering Piston Inner Spring
11. Metering Piston Outer Spring
12. Metering Piston
13. O-Ring
14. Plug
15. Cover

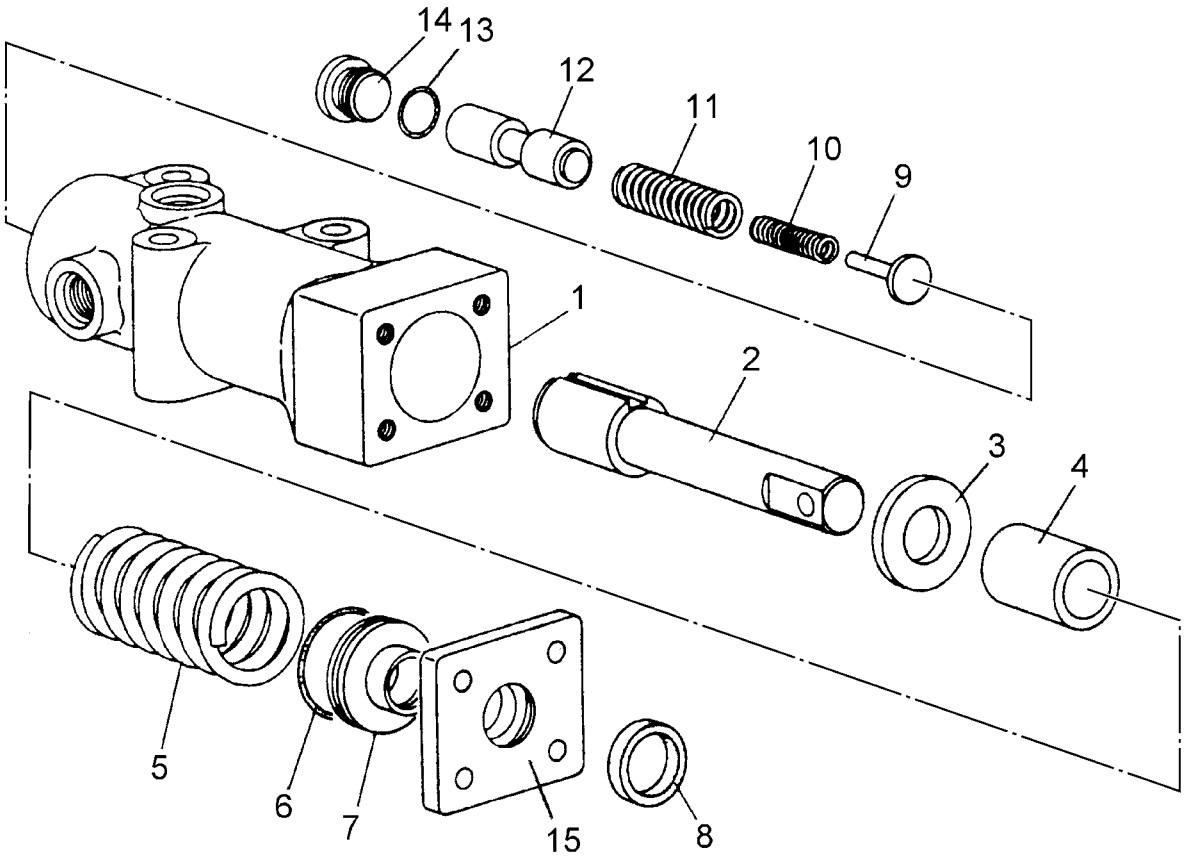


Fig. 7A.7. Exploded View of Inching Valve

NOTE: *Callouts from exploded and cross section views (Fig.'s 7A.6 and 7A.7) correspond with callouts in following steps.*

1. Position inching valve in vise. Carefully remove port plug (14) from bottom of housing (1). Remove and discard O-ring (13) from plug and replace with new.

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

2. Slide metering piston (12) out of housing. Remove inner (10) and outer (11) piston springs with spring guide (9) from valve housing.

NOTE: *Check spring for damage and fatigue against those values shown in specifications.*

INCHING VALVE

3. Remove two mounting bolts (15A) cross cornered from each other. Install 2 [inch] long bolts with washers (15B) in their place. Slowly remove remaining bolts until end cover (15) rests against longer bolts. Install 3 [inch] long bolts with washers (12) in their place. Slowly remove shorter bolts until cover comes to rest. Repeat until all spring tension is released. Remove remaining hardware.

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

4. Remove end cover (15) with seal retainer (7). Pry seal retainer (7) from cover. Pry seal ring (8) from retainer. Discard seal ring and replace with new. Remove O-ring (6) from retainer and discard. Replace with new O-ring.
5. Lift input spool (2) with washer (3), sleeve stop (4) and return spring (5) from housing (1).

NOTE: *Check spring for damage and fatigue against those values shown in specifications.*

14. REASSEMBLY

NOTE: *Callouts from exploded and cross section views (Fig.'s 7A.6 and 7A.7) correspond with callouts in following steps.*

1. Preassemble input spool (2) with washer (3), sleeve stop (4) and return spring (5) and insert into valve housing (1).
2. Install seal ring (8) into groove in seal retainer (7). Refer to Fig. 7A.8. Install O-ring (6) onto retainer (7).

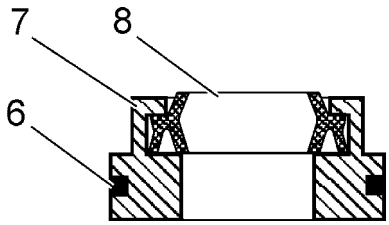


Fig. 7A.8. Seal Ring Installation

6. O-Ring
7. Seal Retainer
8. Seal Ring

3. Position end cover (15) on seal retainer (7). Carefully start end cover (15) with retainer (7) over input spool (2) making sure not to cut or slice seal ring (8).
4. Reverse Step 3 under DISASSEMBLY and secure end cover with hardware (15A and 15B). Torque bolts to 21 ± 10% [Nm].

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

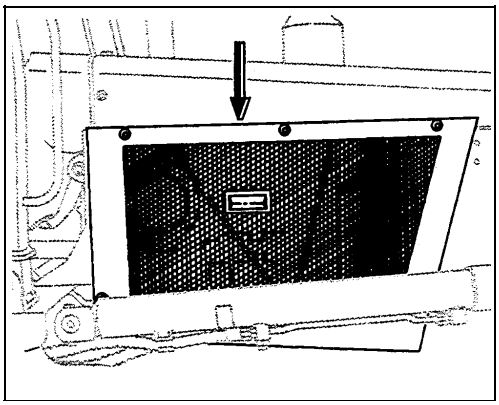
INCHING VALVE

5. Install spring guide (9) into other end of valve housing (1). Install inner (10) and outer (11) piston springs over guide.
6. Slide metering piston (12), with drilled passage facing outward, into valve housing.
7. Install new O-ring (13) to port plug (14). Pushing in on metering piston, install port plug and tighten.

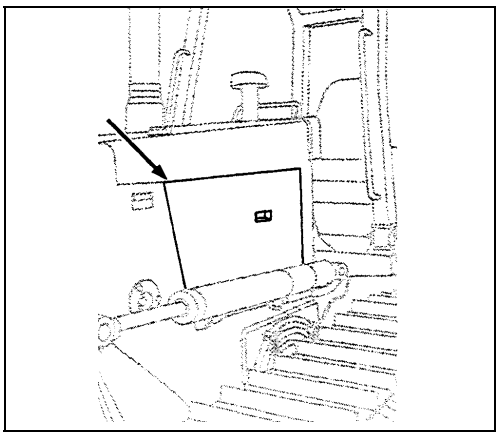
WARNING! Spring loaded assembly. Assembly must be held to install spring. Use extreme care when assembling.

15. INSTALLATION

1. Position inching valve (7, Fig. 7A.5) to bracket (1) and secure with hardware (9). Torque bolts to 21 ± 10% [Nm]. Reconnect hoses (8) to valve.
2. Attach link (6) to valve and secure with link (5) and new cotter (4) pins.
3. Install right engine side door and secure with hardware. Torque bolts to 38 ±10% [Nm].



4. Install left engine side door and secure with hard ware. Torque bolts to 38 ± 10%.[Nm].



SECTION 7B

TORQUE CONVERTER

TORQUE CONVERTER

SECTION 7B

CONTENTS

Page

SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS 3

GENERAL

2. DESCRIPTION AND OPERATION 3
3. SPECIFICATIONS 6
4. SERVICE DIAGNOSIS 7
5. TORQUE CONVERTER INTERNAL LEAKAGE TEST 7

TORQUE CONVERTER

6. REMOVAL 9
7. DISASSEMBLY 16
8. INSPECTION AND REPAIR 23
9. REASSEMBLY 24
10. INSTALLATION 33

SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS

DESCRIPTION	TOOL NUMBER
Torque Converter Lifting Eyebolt	M10
Rear Housing Aligning Studs	M10x60
Rear Housing Lifting Eyebolts	$^{1}/_{2}$ NC
Driver Gear Installing Bolt witch Nut and Two Suitable Washers	$^{3}/_{4}$ NCx5
Retainer Plate Aligning Dowel	M10x80
Engine Barring Tool	3824591

GENERAL

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

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 machine. 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 (3) is flange-mounted to the machine engine. Engine power is transferred through impeller shield (18) driven by a flexible coupling disc (2) bolted to the engine flywheel. Impeller (4) bolted to impeller shield (18) drives drive gear (8), which, in turn, drives gear pumps through driven gears (14) that supply oil both to machine drive train and its hydraulic equipment. Turbine assy (1) is splined to the output shaft (7) on one hand and there is the output yoke (13) splined to the output shaft (7) on the other hand. The stator (5) is mounted between the impeller and turbine assy splined to the stationary ground sleeve hub (6). There is no direct mechanical connection between the impeller and turbine or stator.

Operating engine turns bladed impeller (4) bolted to impeller shield (18). 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 (1) 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 (5) blades, giving a surplus torque charging the turbine (1). The curved blades of the stator (5) 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 (7) of the torque converter.

Torque multiplication is determined by the speed of the turbine in relation to the impeller. A ball 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 ball. Similarly, when the turbine (1) is rotating as fast as the impeller (4), the oil passes easily through the turbine applying little or no force to the blades.

TORQUE CONVERTER

GENERAL

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 rings (12) and (23) at oil inlet and 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.

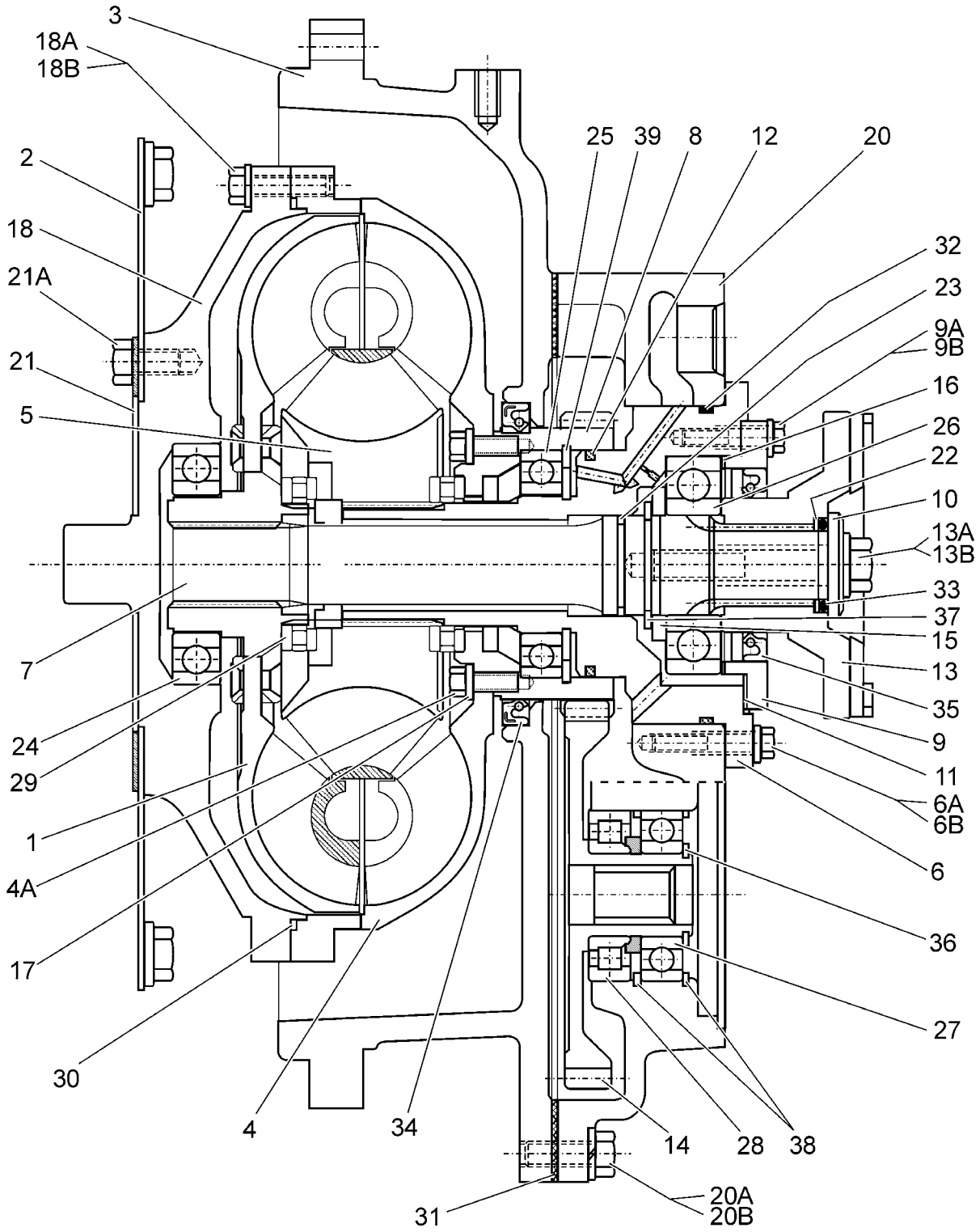


Fig. 7B.1. Cross Section View of Torque Converter

GENERAL

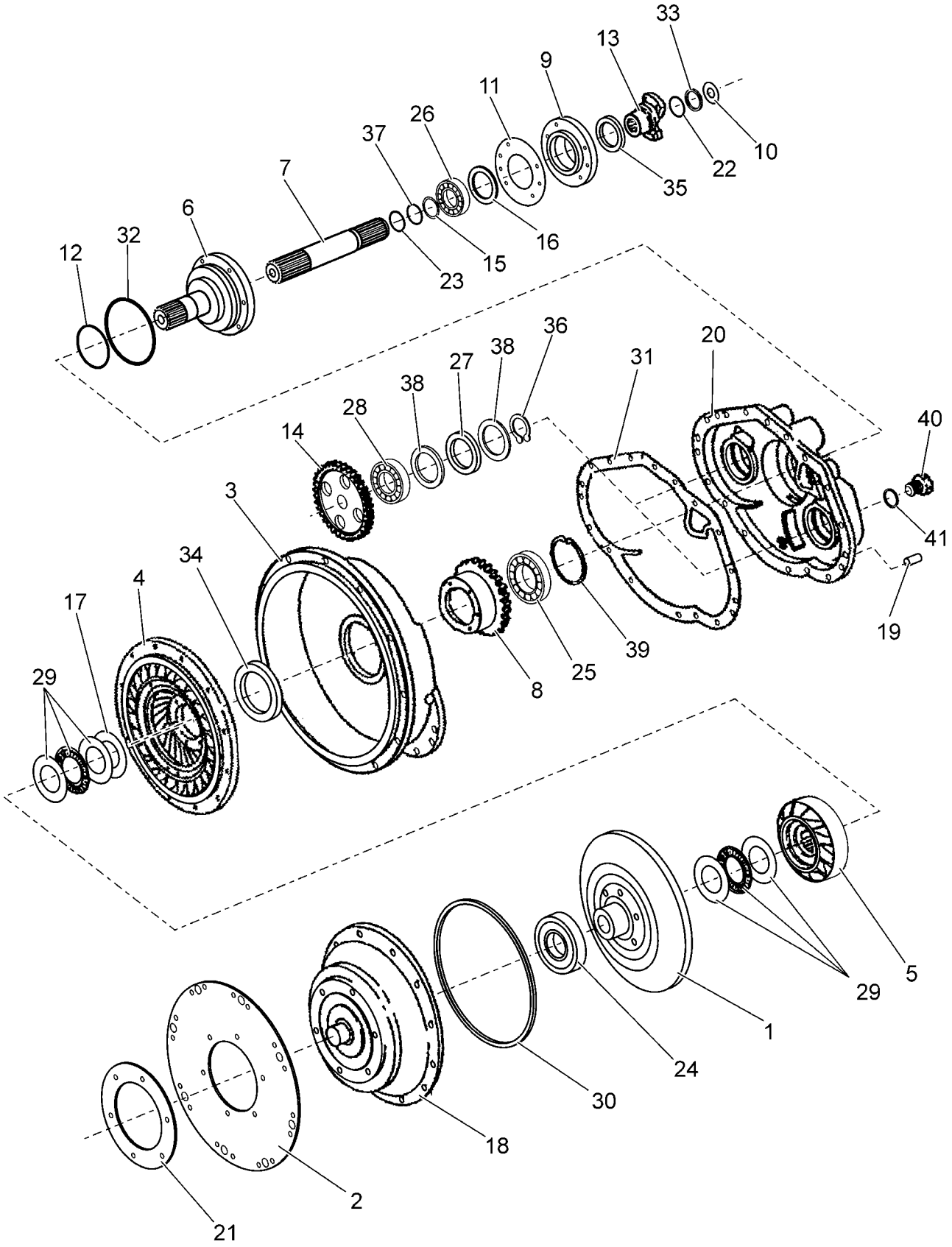


Fig. 7B.2. Exploded View of Torque Converter

TORQUE CONVERTER

GENERAL

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

1. Turbine Assy
2. Coupling Disc
3. Converter Housing
4. Impeller
4A. Bolt
5. Stator
6. Ground Sleeve Hub
6A. Bolt
6B. Washer
7. Output Shaft
8. Drive Gear
9. Rear Cover
9A. Bolt
9B. Washer
10. Washer
11. Rear Cover Gasket
12. Seal Ring
13. Output Yoke
13A. Bolt
13B. Washer
14. Driven Gear
15. Spacer
16. Shims
17. Thrust Washer
18. Impeller Shield
18A. Bolt
18B. Washer
19. Dowel Pin
20. Rear Housing
20A. Bolt
20B. Washer
21. Thrust Washer
21A. Bolt
22. Thrust Ring
23. Seal Ring
24. Ball Bearing
25. Ball Bearing
26. Ball Bearing
27. Ball Bearing
28. Roller Bearing
29. Roller Bearing
30. Seal Ring
31. Cover Gasket
32. O-Ring
33. Seal Ring
34. Seal Ring
35. Seal Ring
36. Retaining Ring
37. Retaining Ring
38. Retaining Ring
39. Retaining Ring
40. Plug
41. O-Ring

3. SPECIFICATIONS

Torque Converter Weight:

TD7-M ..... 81 [kg]
TD8-M ..... 82 [kg]
TD9-M ..... 82 [kg]
TD10-M ..... 91 [kg]

Torque converter admissible leakage rate . . . . . 1 ÷ 6 [lpm]

Torque converter stall speed . . . . . Refer to SECTION 7, DRIVE TRAIN

Special Bolt Torque Data

Rear cover to ground sleeve hub mounting bolts . . . . . 22 – 27 [Nm]
Ground sleeve hub to rear housing mounting bolts . . . . . 40 – 45 [Nm]
Rear housing to converter housing mounting bolts . . . . . 40 – 45 [Nm]
Turbine to drive gear mounting bolts . . . . . 18 – 22 [Nm]
Impeller shield to impeller mounting bolts . . . . . 18 – 22 [Nm]
Coupling disc to impeller shield mounting bolts . . . . . 55 –60 [Nm]
Coupling disc to flywheel mounting bolts . . . . . 110 ± 10% [Nm]
Torque converter mounting bolts . . . . . 43 [Nm]
Universal joint mounting bolts
TD-7M, ... 33 [Nm]
TD-8M, TD-9M, TD-10M . . . . . 57 [Nm]

GENERAL

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 converter	Check the converter under pressure. Torque mounting hardware, check again and replace parts if necessary.
Grinding or Scraping Noise Inside Converter Housing	
Bearing failure allowing the turbine or impeller blades to strike the fixed stator	Remove converter and replace damaged parts.
High Torque Converter Oil Temperature (Gauge on Dash)	
See SERVICE DIAGNOSIS in SECTION 7	
Loss of Power	
See SERVICE DIAGNOSIS in SECTION 7	

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 control lever to the NEUTRAL and move the drive train neutral lock lever to ON position. Turn the electrical master switch to the OFF position and take out of the key from the master switch to prevent accidental starting.



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 in NEUTRAL position, drive train neutral lock lever is in ON 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.



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

TORQUE CONVERTER

GENERAL

2. Remove transmission guard from under machine.

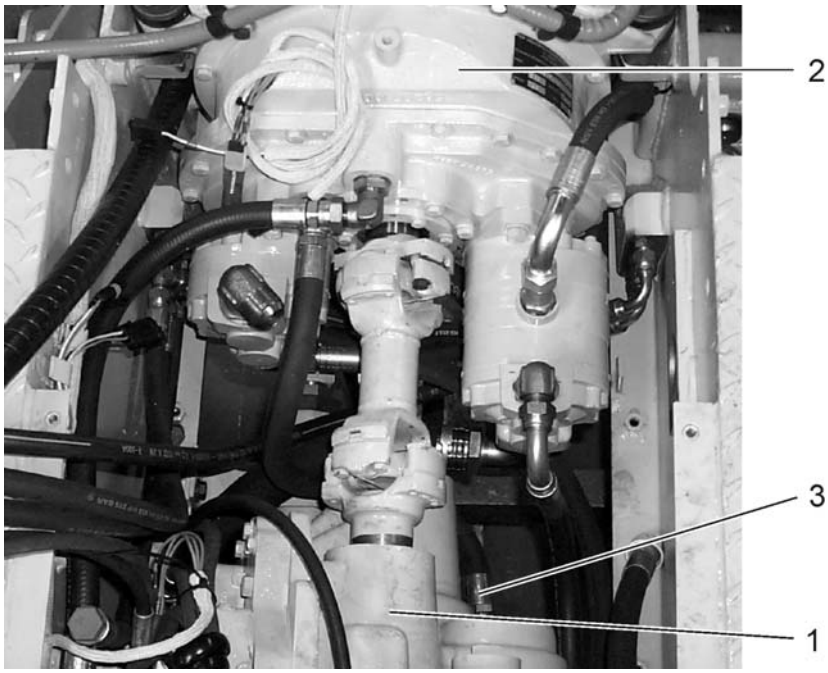


Fig. 7B.3. Drain Hose End Disconnecting

1. Transmission
2. Torque Converter
3. Torque Converter Drain Hose

3. Disconnect the torque converter drain hose (3) from the transmission. Cap the hole in the transmission.
4. Place the hose end into a suitable container, turn the electric master switch ON and start the engine with the drive train control lever in NEUTRAL position and drive train lock lever in ON position.
5. Operate the engine at full throttle and be filling the container for 30 seconds, omitting the initial, stronger oil flow-out.
6. Stop the engine and turn the electric master switch OFF.
7. Reconnect the torque converter drain hose (3) to the transmission. Reinstall transmission guard.
8. Carry out a measurement of the drained oil.

A. If volume of oil is less than 3 [l] (6 [l], per minute), the internal leakage of torque converter is allowable.

B. If volume of oil is more than 3 [l] (6 [l], per minute), the internal leakage of torque converter exceed the limit. The torque converter should be removed from the machine and repaired.

TORQUE CONVERTER

6. REMOVAL

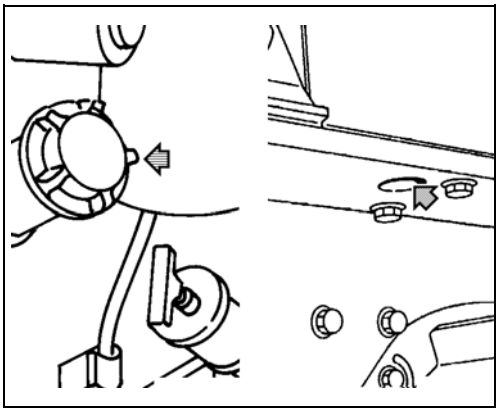
WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train control lever is in NEUTRAL position, drive train neutral lock lever is in ON position and parking brake is set. The starting switch and the electrical system master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

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

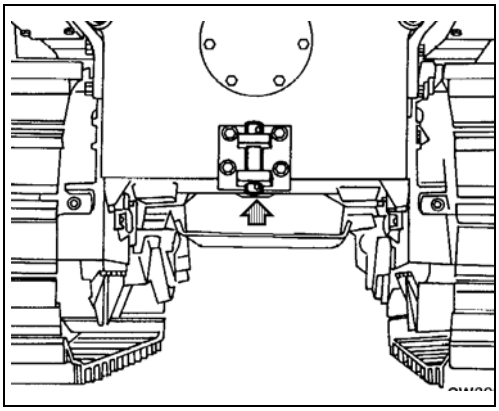
IMPORTANT: *Disconnected hydraulic lines must be capped with the correct size plastic caps. If these caps are not available, tape or clean rubber corks may be used. Hydraulic openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components of the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

1. Turn the master switch to the OFF position and take out the key. Close the fuel shut off valve. Refer to OPERATOR'S MANUAL.

2. Drain the equipment hydraulic reservoir as described in the OPERATOR'S MANUAL.



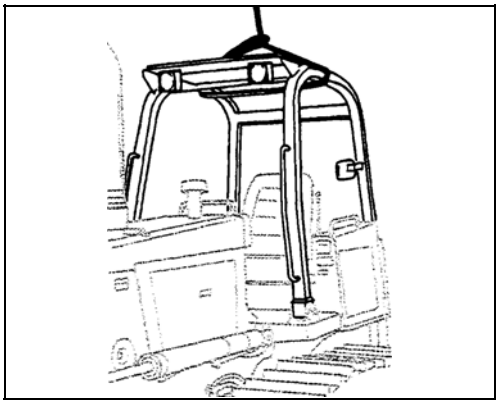
3. Drain the drive train system as described in the OPERATOR'S MANUAL.



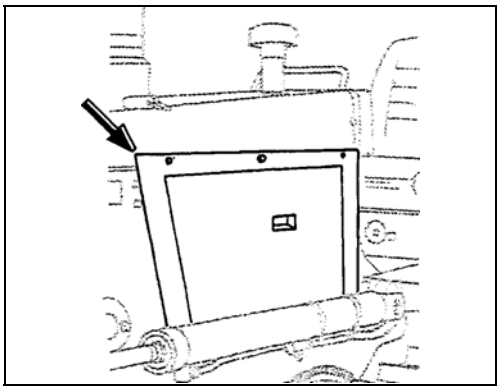
TORQUE CONVERTER

TORQUE CONVERTER

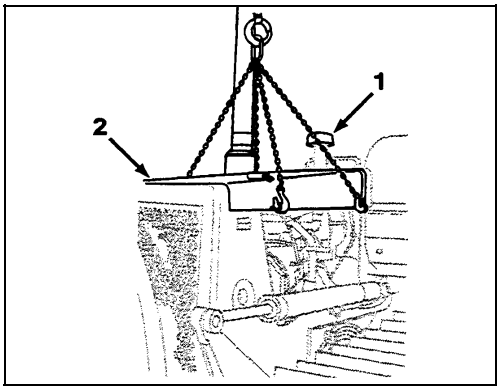
4. Remove the ROPS structure (or cab, if equipped). Refer to SUPERSTRUCTURE, SECTION 13 for this procedure.



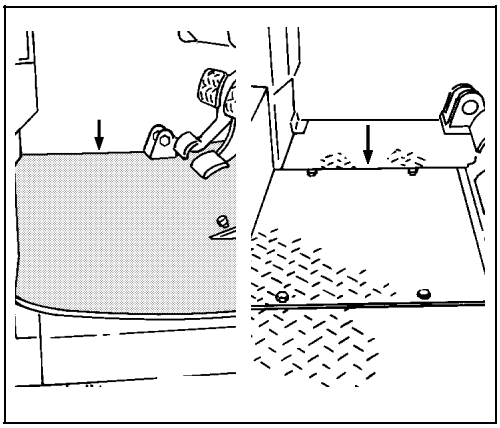
5. Remove engine left and right side doors.



6. Remove air pre-cleaner cap (1) from inlet tube. Remove hood (2) from machine. Refer to POWER, SECTION 12 for this procedure.

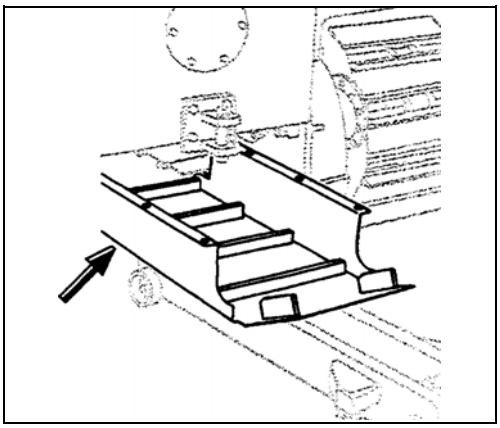


7. Remove operators compartment floor mat and floor plate.



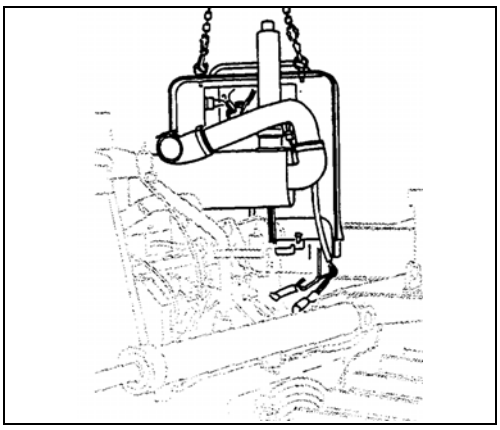
TORQUE CONVERTER

8. Using a rolling floor jack, remove transmission guard from under machine.

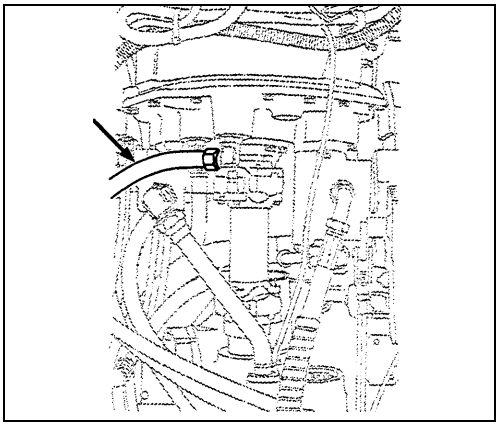


9. Remove dashboard from the machine. Refer to POWER, SECTION 12 for this procedure.

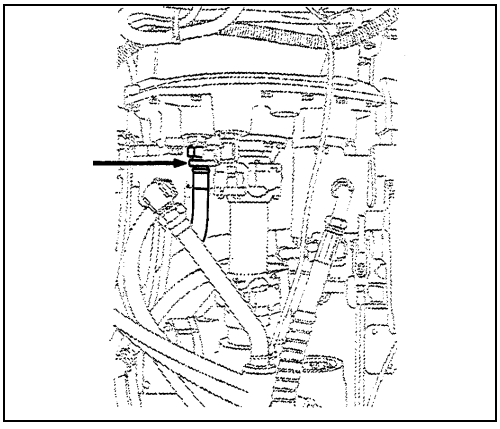
NOTE: *On some machines there will be shims between dashboard and main frame. Keep shims with sides they were removed from.*



10. Disconnect converter inlet hose at torque converter.

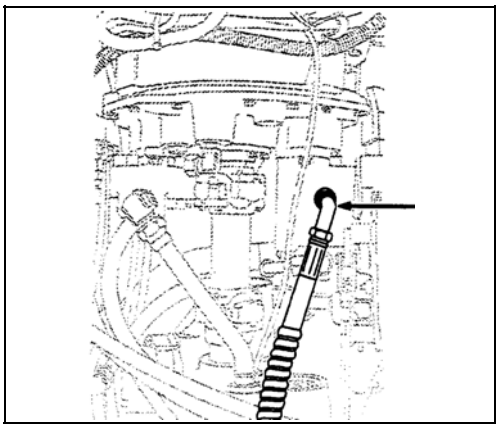


11. Disconnect converter drain hose at torque converter.

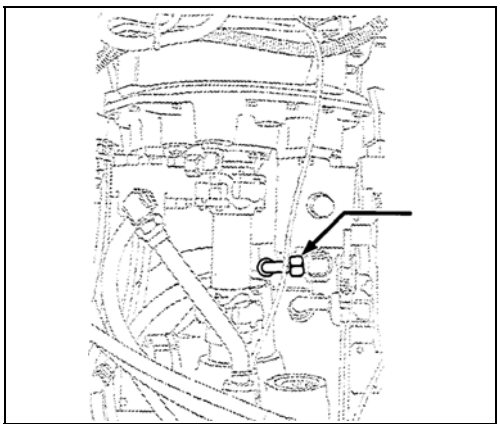


TORQUE CONVERTER

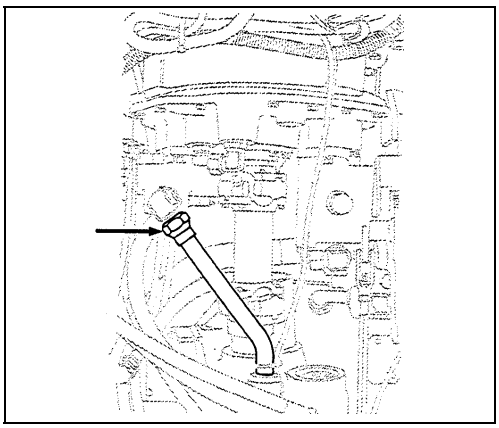
12. Disconnect pump to filter hose at front port of charge and scavenge pump.



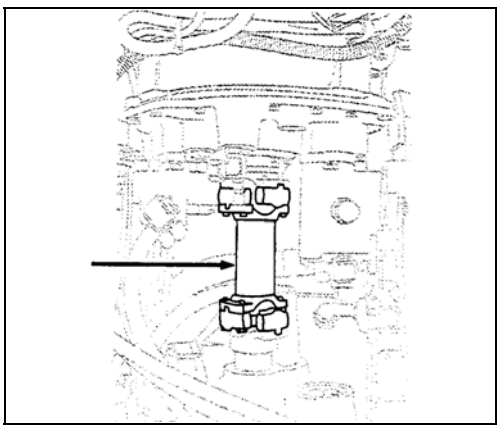
13. Disconnect pump to rear main frame hose at rear port of charge and scavenge pump.



14. Disconnect front half of reservoir to pump tube at top port of equipment pump. Remove front tube.

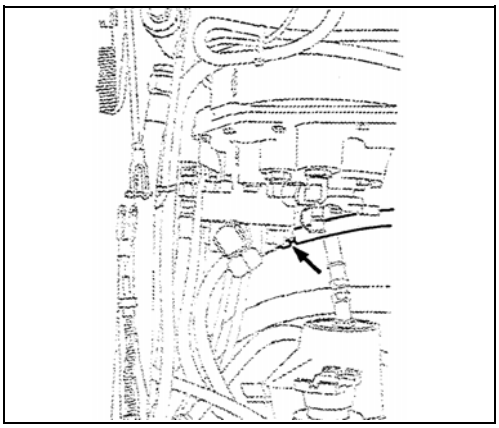


15. Remove mounting hardware and drive shaft.

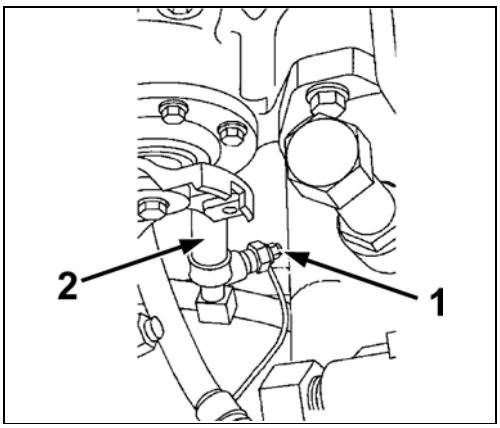


TORQUE CONVERTER

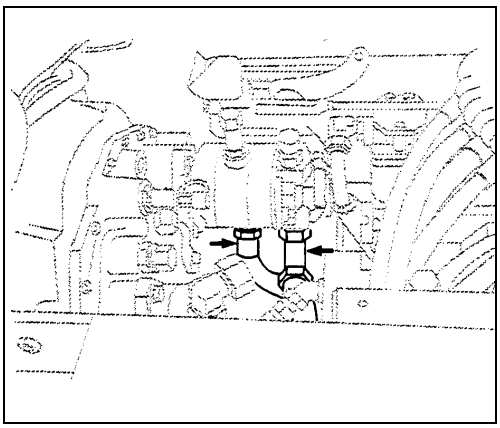
16. Disconnect pump to equipment valve hose at bottom port of equipment pump.



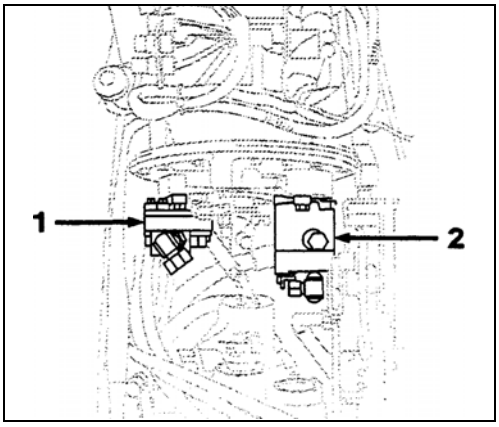
17. Disconnect the drive train temperature lead at the sensor (1). Disconnect converter outlet sensor tube adapter (2) at bottom of torque converter.



18. Disconnect both hoses at bottom ports of charge and scavenge pump. Remove strainer with fitting from rear section of pump.

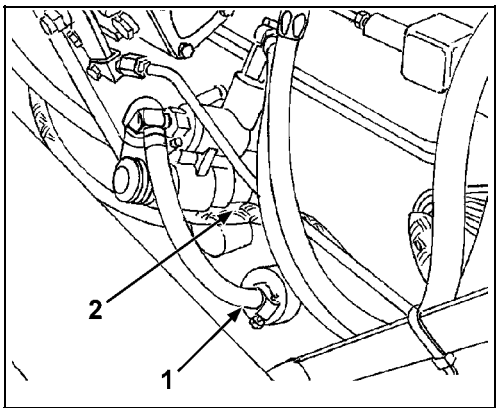


19. Remove mounting hardware from equipment pump (1), slide out of torque converter and remove. Remove mounting hardware from charge and scavenge pump (2), slide out of converter and remove.



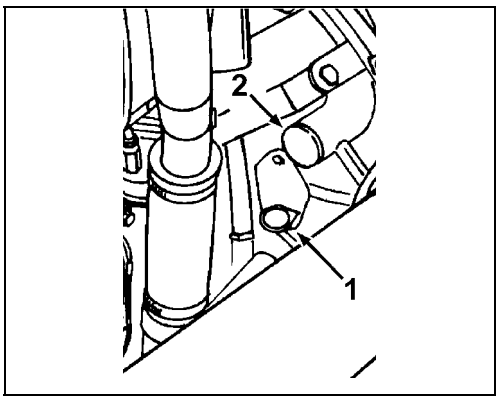
TORQUE CONVERTER

20. Reposition the fuel strainer (1) and the wire harness (2) out of the way.

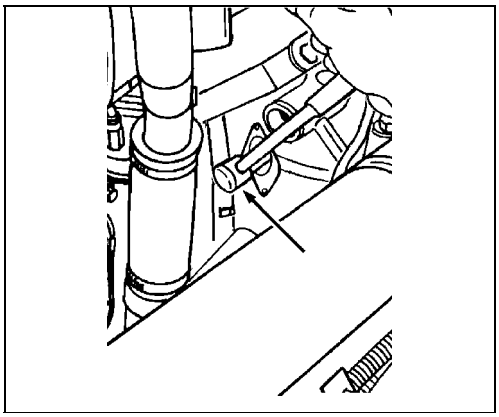


21. Remove the access cover (1) and barring tool cover (2).

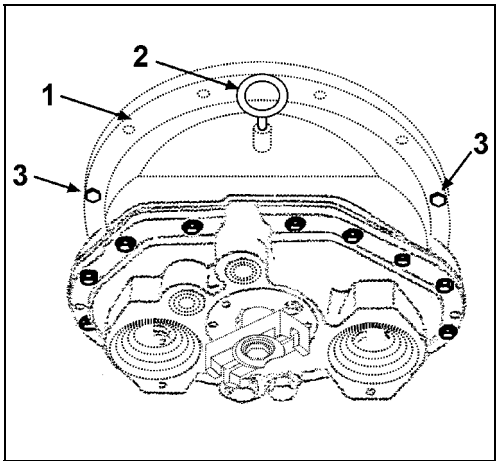
NOTE: *For TD-10M: Unscrew engine ECM controller and reposition it away to get access to cover (1) and (2).*



22. Using barring tool (refer to SPECIAL/SERVICE TOOLS in this Section), rotate the engine so that all the eight flywheel to flex plate bolts can be removed.

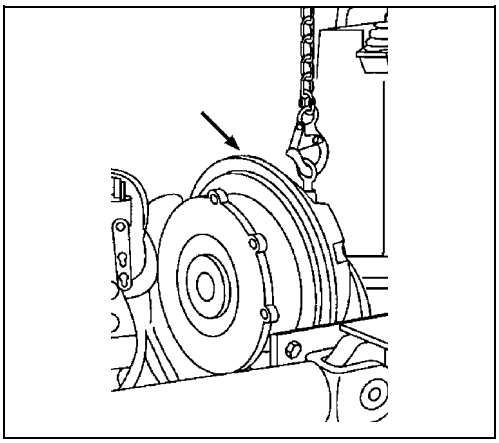


23. Unscrew three clutch mounting bolts with clips. Release harness and cable from main clutch housing. Position wiring out of the way. Refer to POWER, SECTION 12 for this procedure.
24. Install eyebolt M10 (2) in the threaded hole located in the top of torque converter housing (1). Attach a hoist. Place a sling tension on the hoist and remove remaining converter mounting bolts. Install two M10 mounting studs (3) and slide converter out. Adjust the balancing slide of the bracket so the converter hangs evenly.

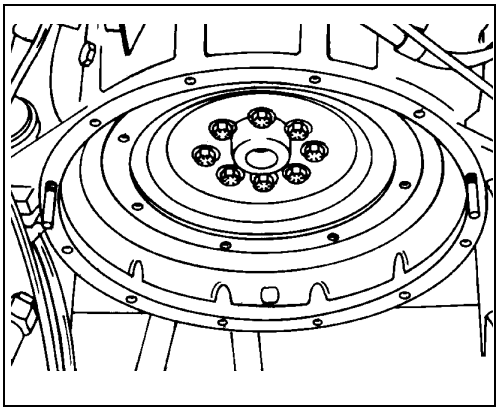


TORQUE CONVERTER

25. Lift torque converter out of machine.



26. Check condition of flywheel and housing, refer to ENGINE SHOP MANUAL. Flywheel housing is a dry type and should not contain any oil.



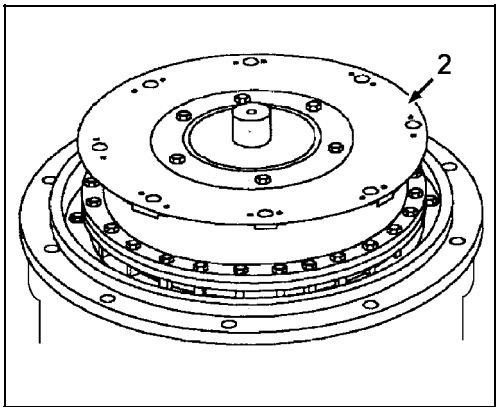
TORQUE CONVERTER

7. DISASSEMBLY (Refer to Fig.'s 7B.1 and 7B.2)

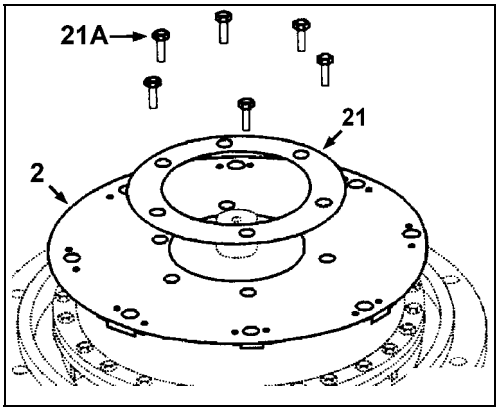
Complete Assembly

NOTE: *Callouts from exploded and cross section views (Fig.'s 7B.1 and 7B.2) correspond with callouts in following steps.*

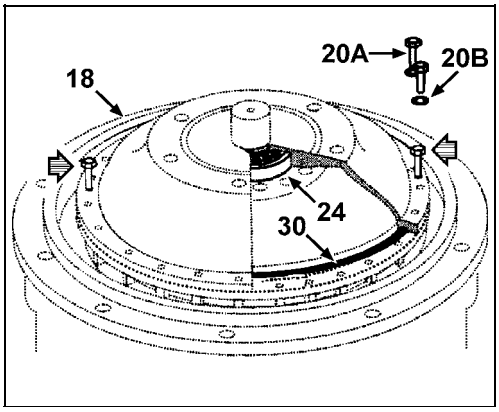
1. Position torque converter over with coupling disc (2) facing up.



2. Remove bolts (21A), thrust washer (21) and coupling disc (2) from torque converter.

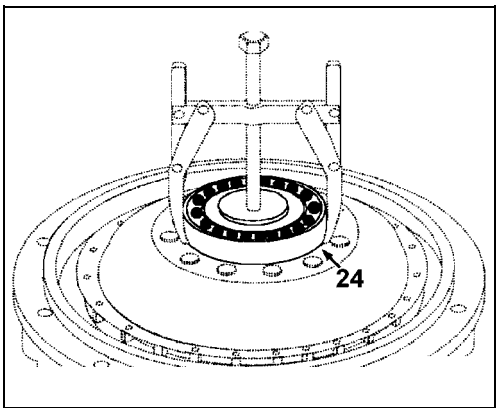


3. Index mark impeller shield (18) and impeller (4) with a punch. Be sure to align these marks when reassembly. Remove bolts (20A) and washers (20B) securing impeller shield (18) to the impeller. Using two of bolts at opposite ends of the impeller shield as jack screws to free bearing (24), remove impeller shield (18). Remove seal ring (30) and discard.

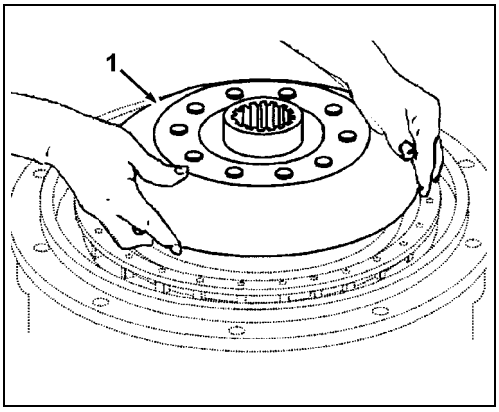


TORQUE CONVERTER

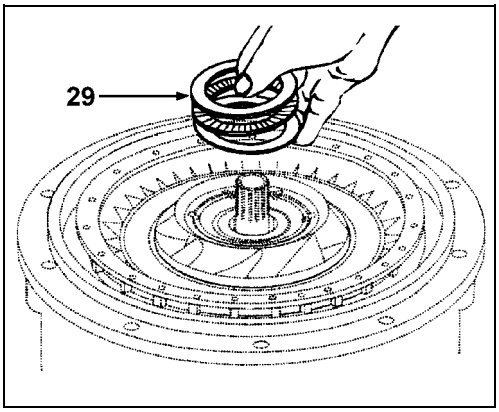
4. Remove ball bearing (24) from the turbine, using a bearing puller if needed.



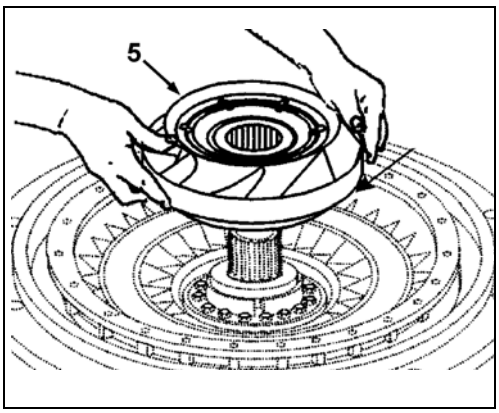
5. Remove the turbine (1) from the assembly.



6. Remove roller bearing (29) from the stator.

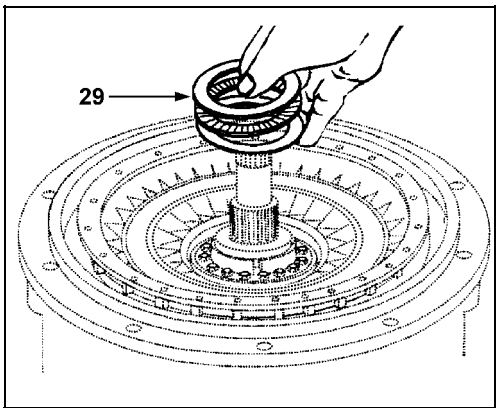


7. Remove the stator (5).

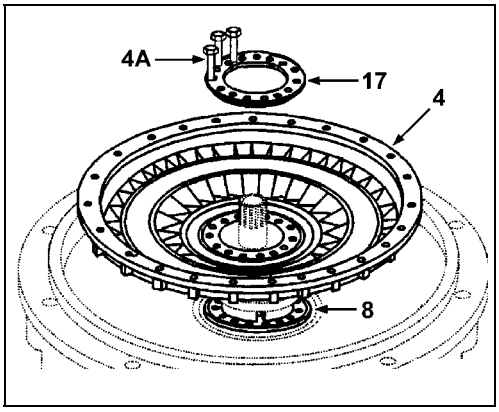


TORQUE CONVERTER

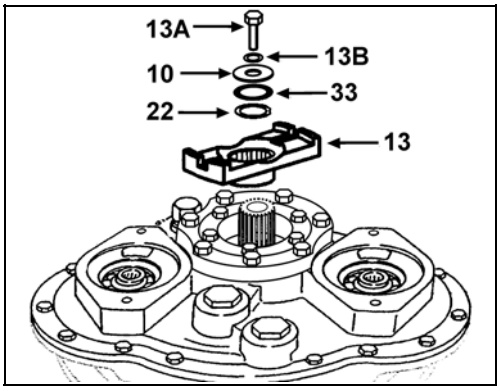
8. Remove roller bearing (29) from impeller.



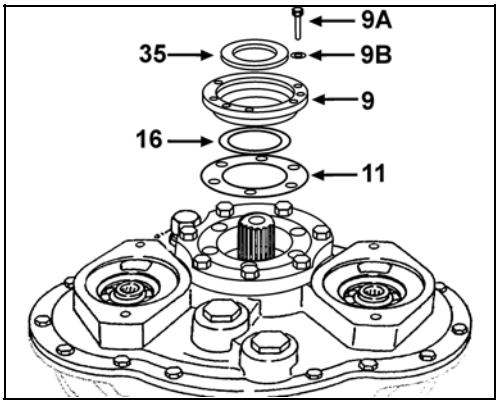
9. Remove bolts (4A) and thrust washer (17) from the impeller (4). Remove impeller from drive gear (8).



10. Turn converter over with yoke (13) facing up. Remove one rear cover bolt (9A) and install longer one that will allow output yoke (13) to be retained while removing yoke bolt (13A). Remove yoke bolt (13A) with washer (13B). Remove washer (10), seal ring (33) and thrust ring (22). Remove the output yoke (13) from the splined shaft.

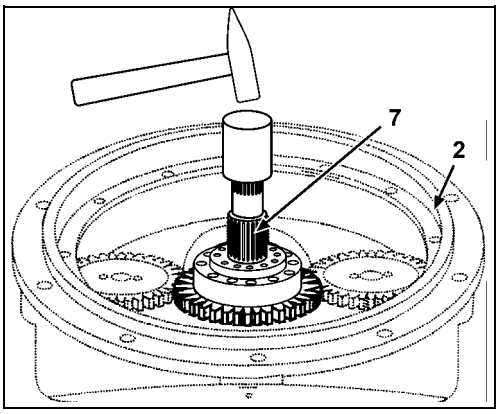


11. Remove the bolts (9A) and washers (9B) from the rear cover (9). Using three bolts as jack screws, remove the rear cover (9). Remove the gasket (11) and seal ring (35) from the cover (9) and discard. Remove the bearing shims (16) from the shaft.

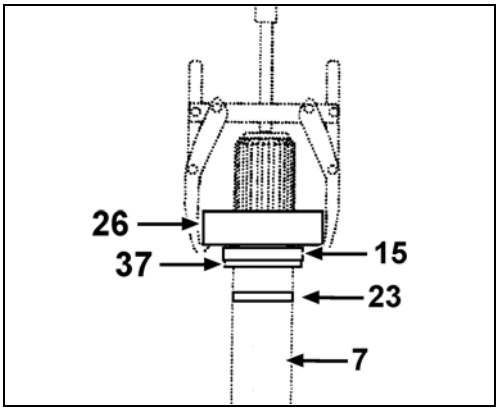


TORQUE CONVERTER

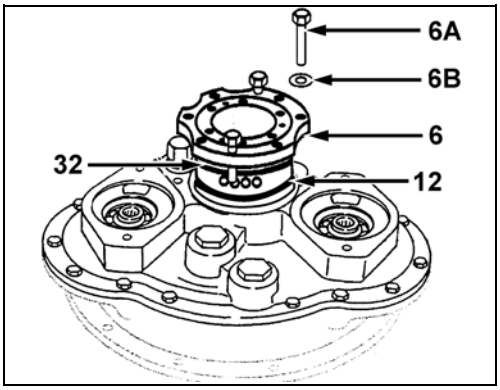
12. Turn the converter over. Remove the output shaft (7) with bearing.



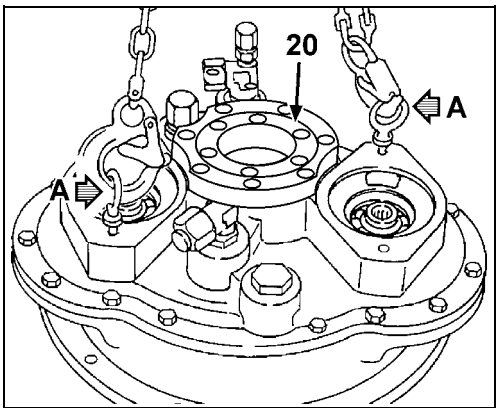
13. Check condition of the bearing (26) and if replacement is necessary, remove bearing from output shaft (7) using a puller. Remove spacer (15) and retaining ring (37). Remove seal ring (23) and discard.



14. Remove ground sleeve hub (6) mounting bolts (6A) and washers (6B). Using two bolts as jack screws in the holes provided, remove ground sleeve hub (6). Remove and discard O-ring (32) and seal ring (12).

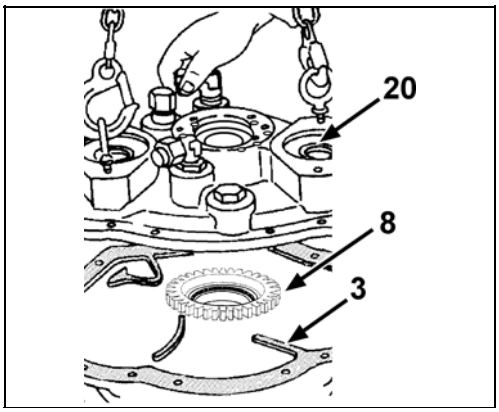


15. Insert two 1/2NC eye bolts (A) to pump mounting holes and connect hoist. Remove rear housing (20) mounting hardware.

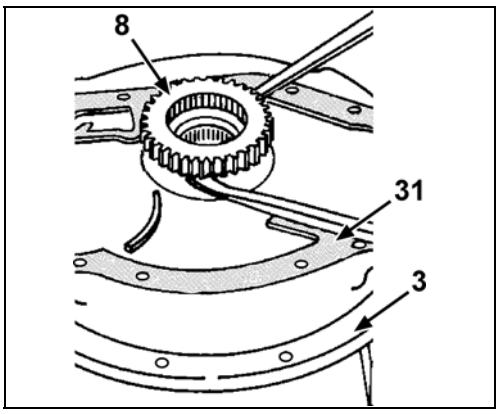


TORQUE CONVERTER

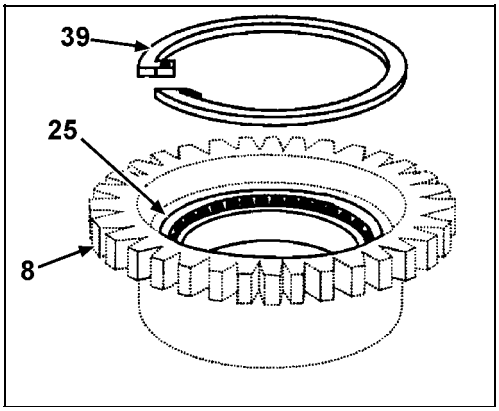
16 Lift rear housing (20) off from converter housing (3).



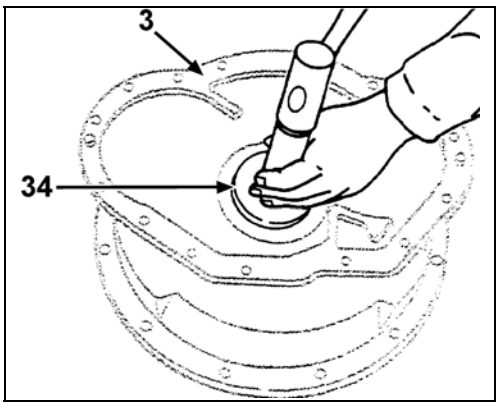
17. Remove gasket (31) and discard. Carefully pry drive gear (8) from the converter housing.



18. Remove retaining ring (39) and bearing (25) from the drive gear (8).

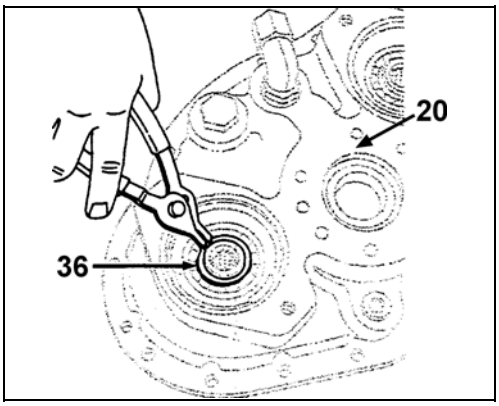


19. Drive seal ring (34) from clutch housing (3) and discard.

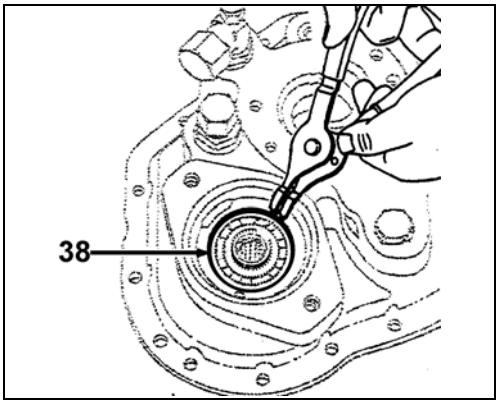


TORQUE CONVERTER

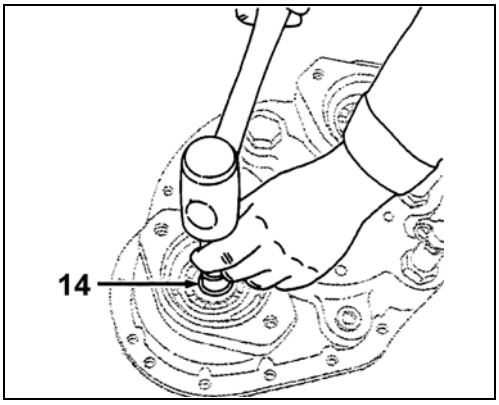
20. Position rear housing (20) on solid blocking. Remove bearing retaining ring (36) at each pump driven gear (14).



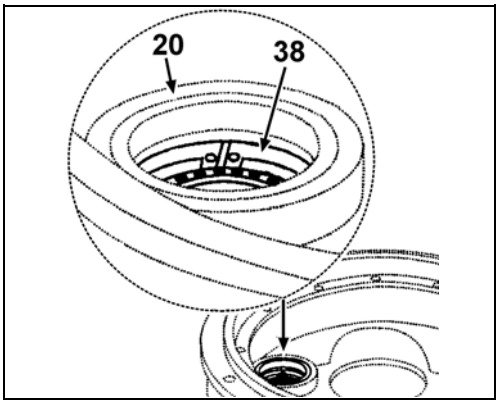
21. Remove the outer retaining ring (38) at each bearing (27).



22. Using a drift, remove the gears (14) with bearings (28) from the rear housing (20). Remove the angle rings. The outer bearings (27) will stay in the housing.

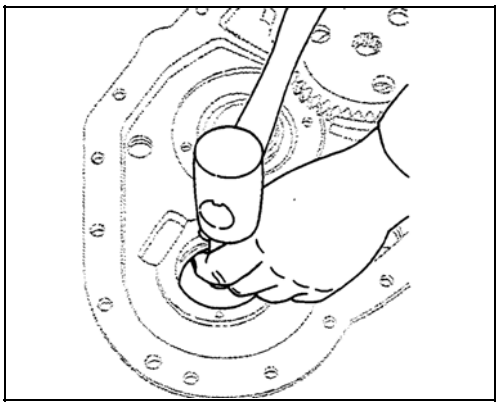


23. Turn the rear housing (20) over and remove the inner retaining ring (38) from the housing.

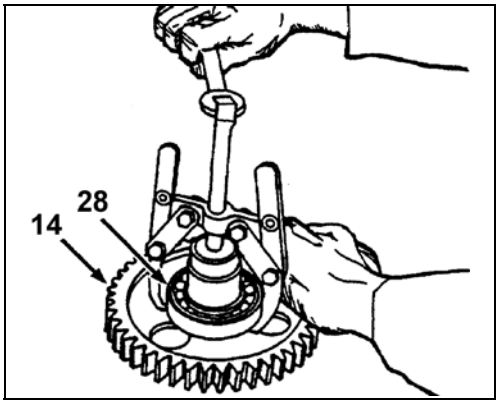


TORQUE CONVERTER

24. Using a driver, remove the ball bearing (27) from the rear housing (20).



25. Remove the outer race, rollers and cage of the roller bearing (28). Using the two holes on the backside of the pump drive gear (14) start the bearing inner race away from the gear shoulder. Move the inner race far enough out to install a puller, remove the inner race of roller bearing (28) from gear (14).



TORQUE CONVERTER

8. INSPECTION AND REPAIR

1. Wash all components thoroughly in a suitable solvent after the main clutch 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.*

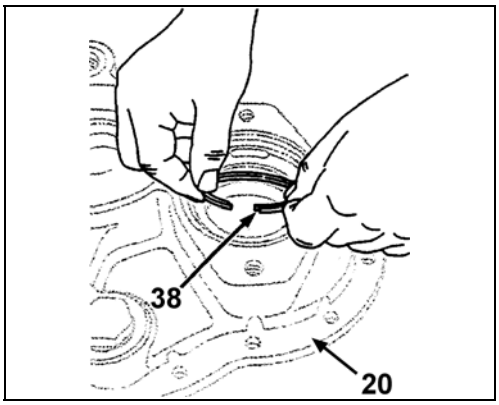
2. Inspect all bearings condition. Replace all bearings that do not rotate freely or show excessive clearance.
3. It is recommended that new O-rings, gaskets and oil seals be installed whenever the converter is disassembled for service. Replace definitely seal ring (12) at the converter input and seal ring (23) at the converter output when excessive oil leakage occurs during the test. Replace seal ring (34) placed between the converter housing and the drive gear when oil leakage appears between converter housing and flywheel housing.
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 (1) riveted joints. If any rivet loose exists the entire turbine assy must be replaced.
8. Inspect the blades of impeller (4), stator (5) and turbine assy (1) for mechanical damage. If the blades are excessively worn or damage, the entire assembly must be replaced.
9. Inspect thoroughly drive gear (8) inner bore that mates with seal ring (12). Drive gear (8) inner bore and seal ring (12) contact surface shall not be grooved. Inspect drive gear (8) outer surface that mates with seal ring (34). Drive gear (8) outer surface and seal ring (34) contact surface shall not be grooved.
10. Inspect ground sleeve hub (6) bore interacting with seal ring (23). 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 (8) bore surface and shaft (7), the hub must be replaced.
11. Output yoke (13) shall not be grooved by seal ring (35) while contact surface smoothing and darkening are admissible.
12. Replace the converter housing (3) and rear housing (20) if cracks, thread stripping or bearing bores damages occurs.

TORQUE CONVERTER

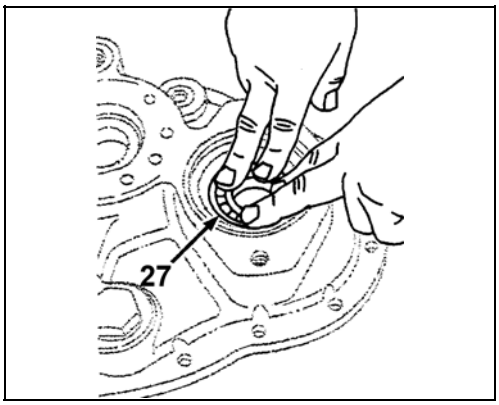
9. REASSEMBLY

NOTE: *Callouts from exploded and cross section views (Fig.'s 7A.2 and 7A.3) correspond with callouts in following steps.*

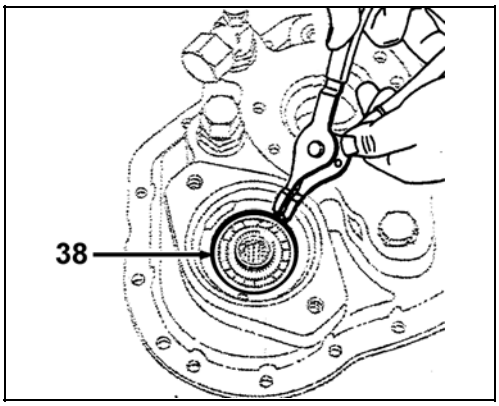
1. Position the rear housing (20) with the output yoke side up. Install retaining rings (38) into the housing in the bottom grooves at each bearing bore.



2. Finger press the ball bearings (27) into the housing. Using a driver against the outer race of bearing (27), tap each bearing until it bottoms the retaining ring (38).

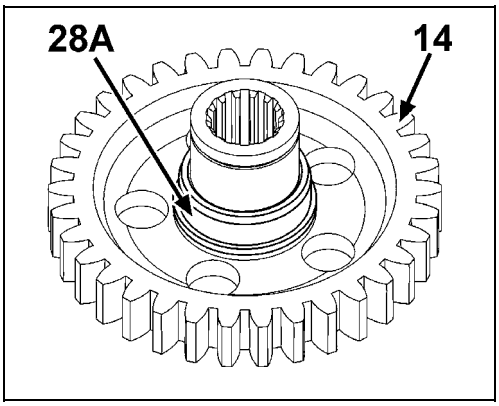


3. Install the outer retaining ring (38) into the top groove against each bearing (27).



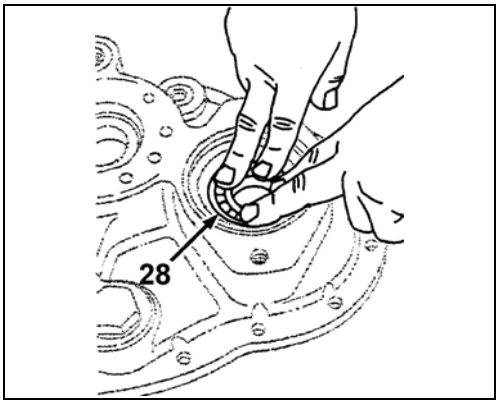
TORQUE CONVERTER

4. Position pump driven gear (14) in press. Press roller bearing inner race (28A) onto driven gear (14) hub with the larger outer diameter pointed towards the gear, until it bottoms. Repeat for the second gear (14).



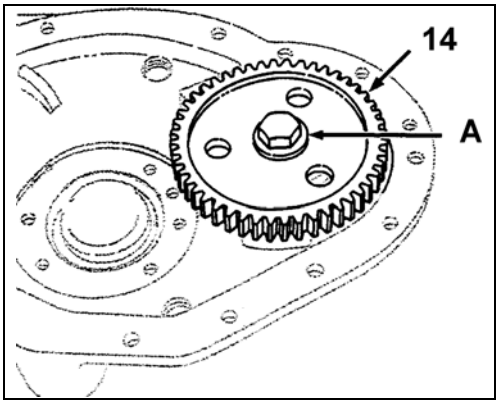
5. Turn the rear housing (20) over. Install angle rings and outer bearing races rollers of roller bearings (28) in the pump seats.

NOTE: The c*omplete 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.*

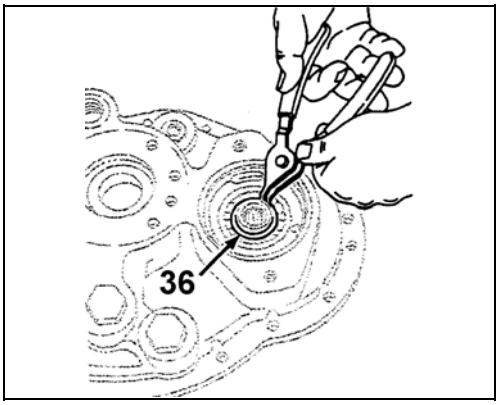


6. Install driven gears (14) into the housing (20). Press the gears in until the retaining ring groove in the gear appears.

   Use a ¾ NCx5 bolt (A) with nut and two washers to pull the gears into the ball bearing (27) seats.

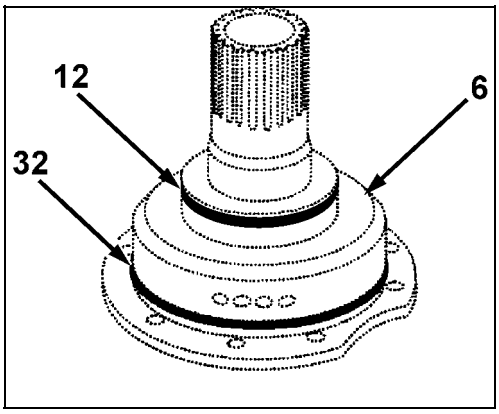


7. From the other side of the housing install retaining rings (36) on driven gears (14).

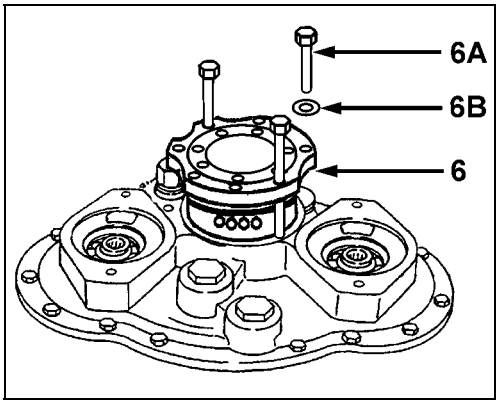


TORQUE CONVERTER

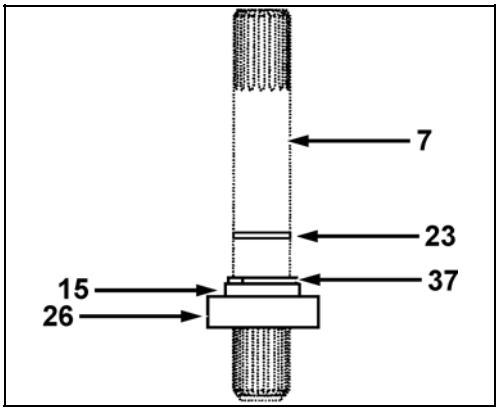
8. Install the O-ring (32) and seal ring (12) to the groove on the ground sleeve hub (6).



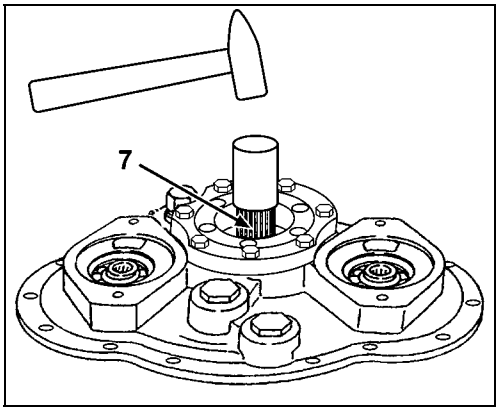
9. Install two M10x80 aligning dowels 180 [°] apart. Install ground sleeve hub (6) in the rear housing and secure with bolts (6A) and washers (6B) using LOCTITE #262. Torque the bolts to 40 – 45 [Nm].



10. Install the retaining ring (37) and spacer (15) to output shaft (7). Install and bottom the bearing (26) against the spacer. Install the seal ring (23) to the shaft (7).

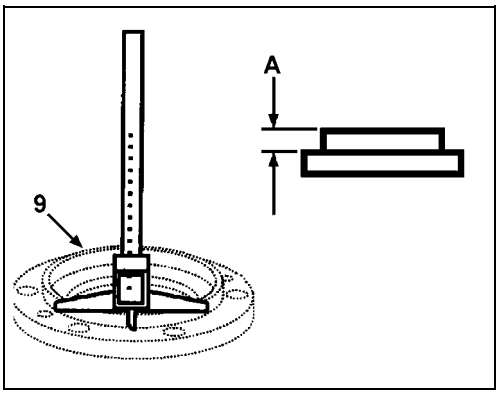


11. Insert the assembled shaft (7) in the ground sleeve hub and bottom with a driver.

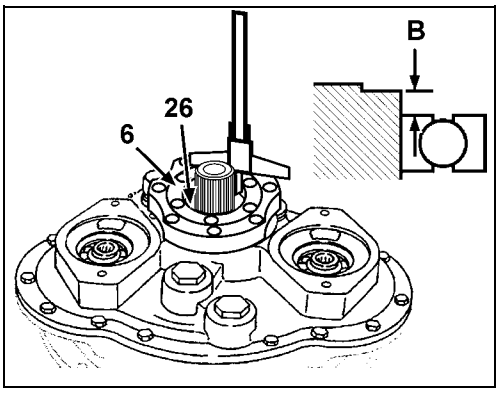


TORQUE CONVERTER

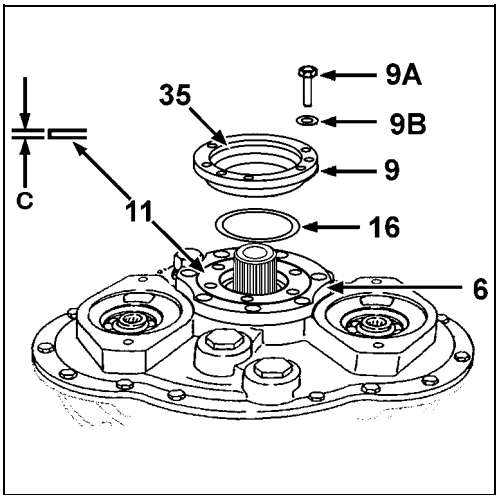
12. Measure dimension A, the protrusion height on the rear cover (9).



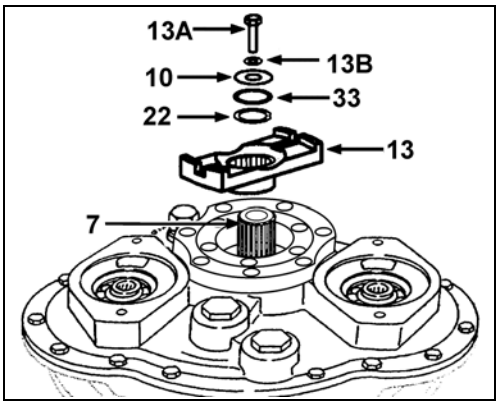
13. Measure dimension B, the distance from the top of the bearing face (26) to the rear cover mounting surface of ground sleeve hub (6).



14. Measure dimension C, the thickness of the gasket (11).
15. Prepare a shim pack using as many shims (16) as possible so that the shim pack thickness is less than dimensions **B + C - A**. The resulting bearing - shaft end play will be 0.05 to 0.10 [mm] maximum.
16. Install the seal ring (35), garter spring end down, into the rear cover (9) 1 to 2 [mm] below the cover face surface.
17. Position the shims (16) and gasket (11) to the housing. Align the notch in the cover (9) to the groove in the ground sleeve hub (6) and thread down with the bolts (9A) and washers (9B) using LOCTITE #262. Torque the bolts to 22 – 27 [Nm].

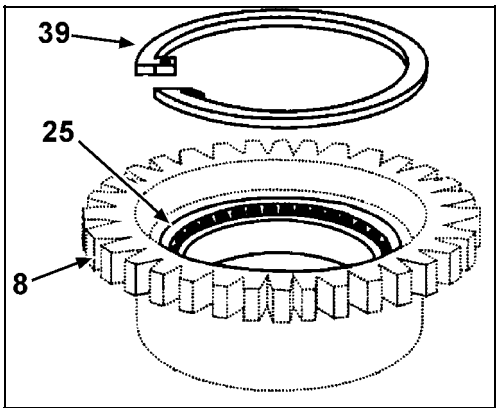


18. Install output yoke (13) to the output shaft (7) being careful, not to cut or damage the seal ring (35). Install thrust ring (22) on the shaft, then seal ring (33), and washer (10) and secure with bolt (13A) and washer (13B) using LOCTITE #262. Torque bolt to 72 to 88 [Nm].

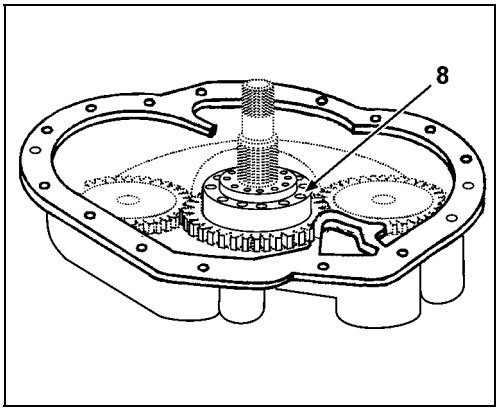


TORQUE CONVERTER

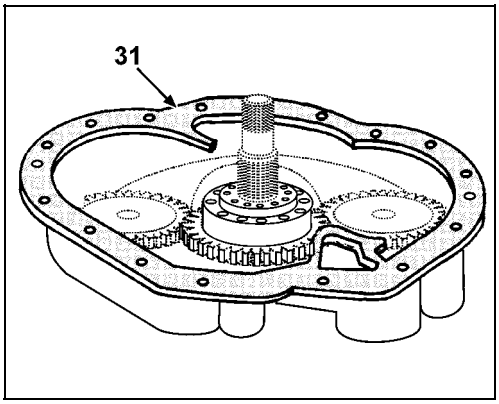
19. Press the bearing (25) into the drive gear (8) and bottom. Install the retaining ring (39) into the gear.



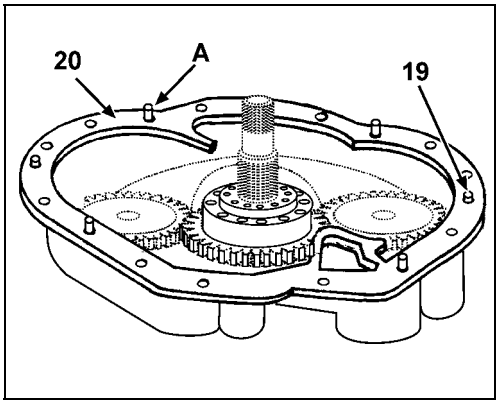
20. Turn the rear housing over. Install the drive gear (8) on the ground sleeve hub. Take caution not to cut the seal ring (12) during gear installation.



21. Install new gasket (31) on rear housing (20).

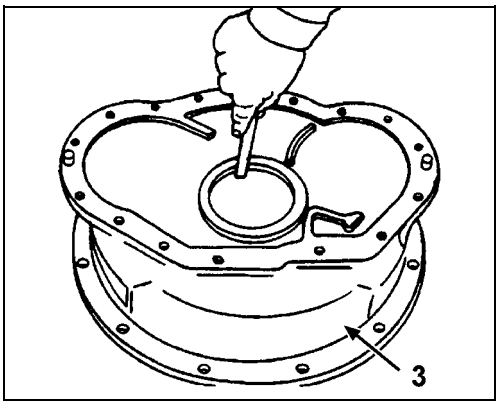


22. Install two dowel pins (19), if removed. Install four aligning studs M10x50 (A), to rear housing (20).

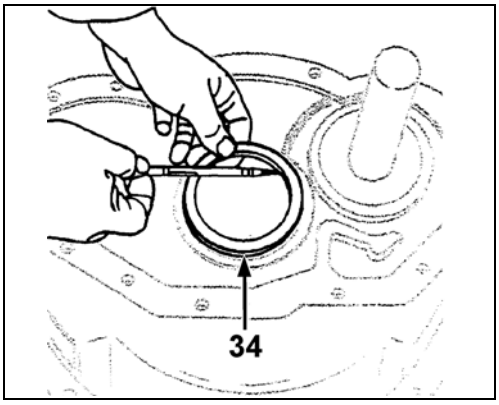


TORQUE CONVERTER

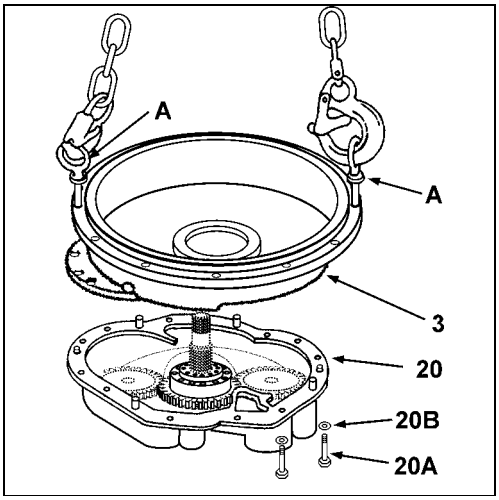
23. Clean out oil seal mounting area in the torque converter housing (3).



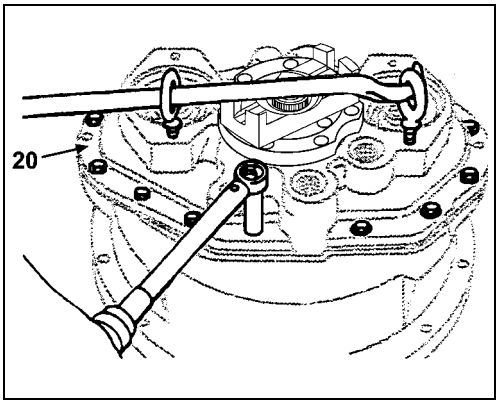
24. Position seal ring (34) with spring garter lip facing converter housing.



25. Insert two M10 eye bolts (A) to converter assy mounting holes and connect a hoist. Lower the converter housing (3) on rear housing aligning studs and dowel pins being careful not to damage or dislodge seal ring (34) from converter housing. Remove four aligning studs. Install mounting bolts (20A) and washers (20B) using finger pressure. Use LOCTITE #262.

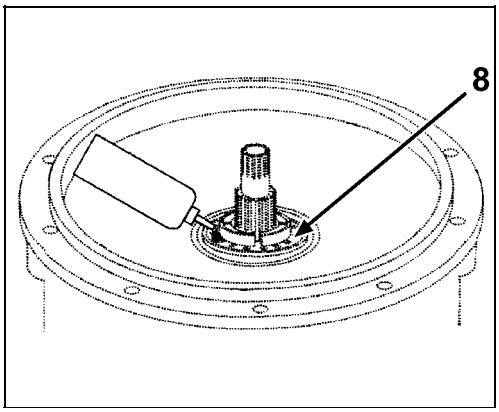


26. Turn the converter over. Using a breaker bar and rear housing (20) eye bolts ½ NC as shown, torque bolts to 40 to 45 [Nm].



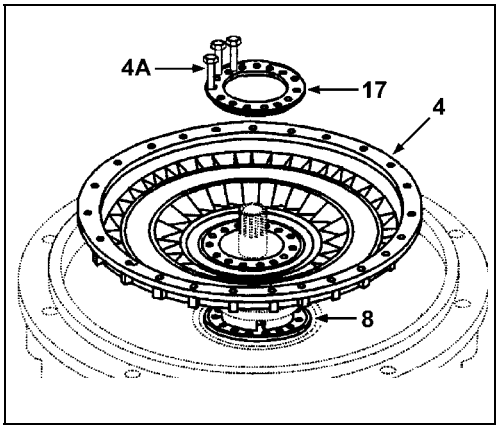
TORQUE CONVERTER

27. Apply LOCTITE #515 to the mounting face of the drive gear (8), ensuring that a leak proof joint will be obtained. Apply LOCTITE Primer N to the mating flange of the impeller (4).

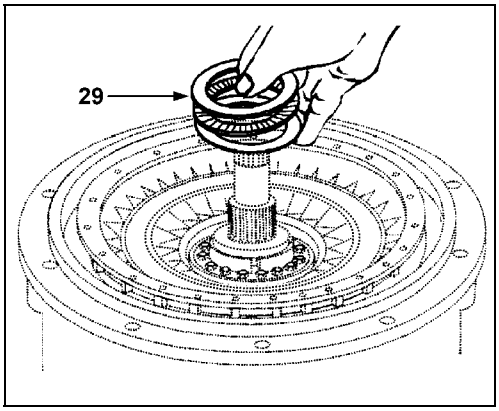


28. Apply LOCTITE #262 to the threads of the mounting bolts (4A). Position the impeller (4) on the drive gear (8) and secure with the bolts (4A) and thrust washer (17). Torque the mounting bolts in an alternate pattern to 18 to 22 [Nm] to obtain uniform contact pressure.

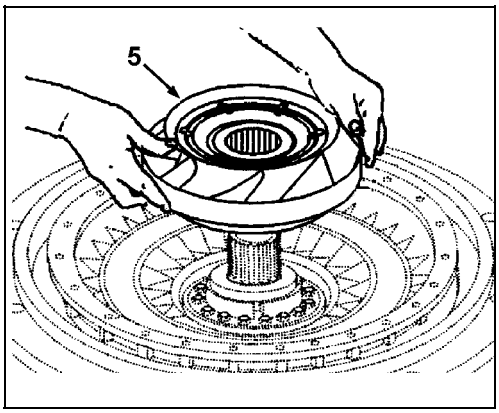
NOTE: *Primer N accelerates the curing of LOCTITE #515. The mounting bolts (4A) must be torqued immediately after the mating parts are coupled.*



29. Install the roller bearing assembly (29) on the drive gear with the larger ID washer against the drive gear face.

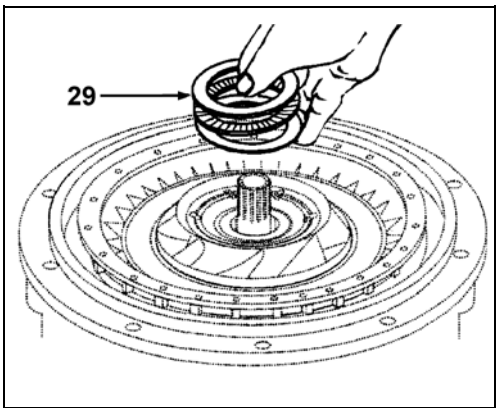


30. Install the stator (5) down over the ground sleeve hub.

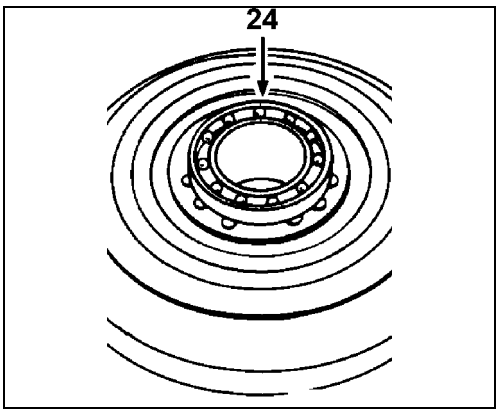


TORQUE CONVERTER

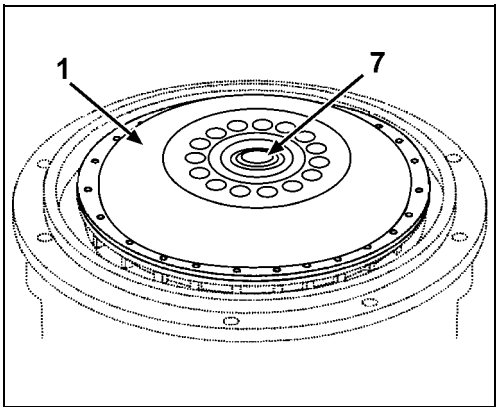
31. Install the roller bearing assy (29) on the stator with the larger ID washer against the stator face.



32. Using a press, bottom the ball bearing (24) on the turbine hub.

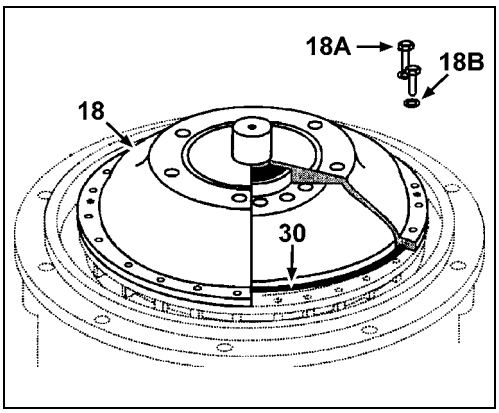


33. Position the turbine (1) over the splined end of the output shaft (7).



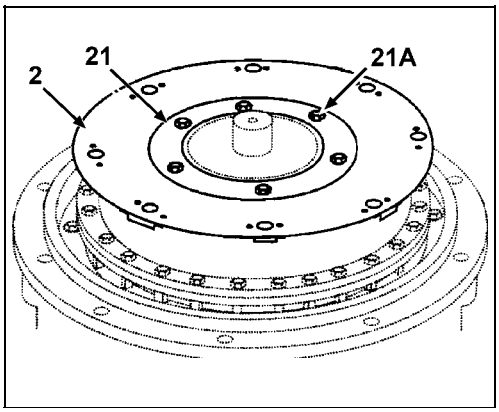
34 Install the seal ring (30) in the impeller shield (18) rim lip. Position the impeller shield on the bearing. Using four bolts (18A) (with LOCTITE #243) and washers (18B) equally spaced around the housing, slowly and evenly draw the housing down over the bearing. Secure with the remaining bolts and washers. Torque the bolts to 18 to 22 [Nm].

NOTE: *Make sure that the index marks of the impeller assy (see Step 3. Disassembly) are properly aligned.*



TORQUE CONVERTER

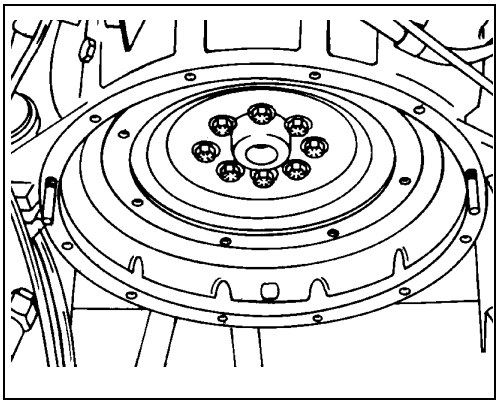
35. Install the coupling disc (2) and the thrust washer (21) and secure with bolts (21A) using LOCTITE #262. Torque the bolts to 55 to 60 [Nm].



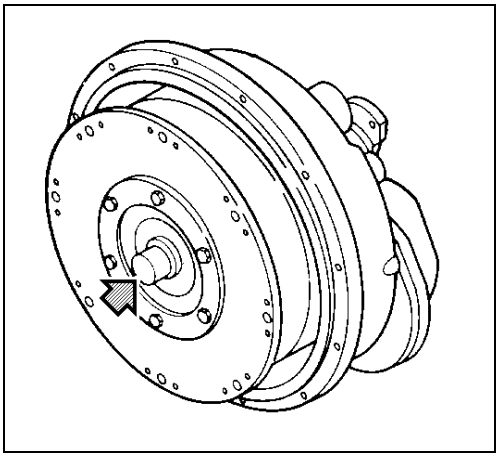
TORQUE CONVERTER

10. INSTALLATION

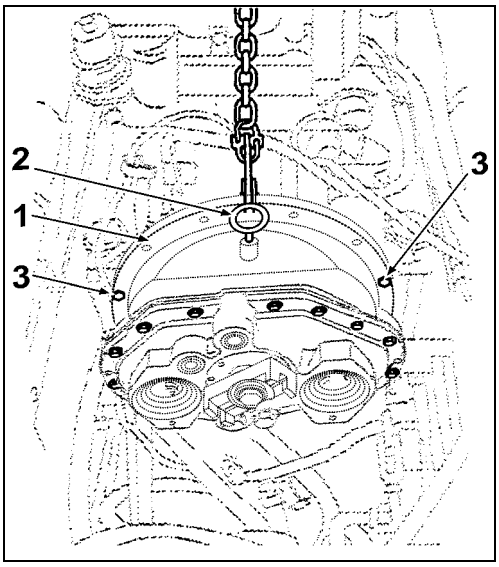
1. Install two M10 aligning studs, 180° apart to flywheel housing to mount the torque converter.



2. Use Anti seize LOCTITE #767 for pilot stub shaft OD before converter mounting.

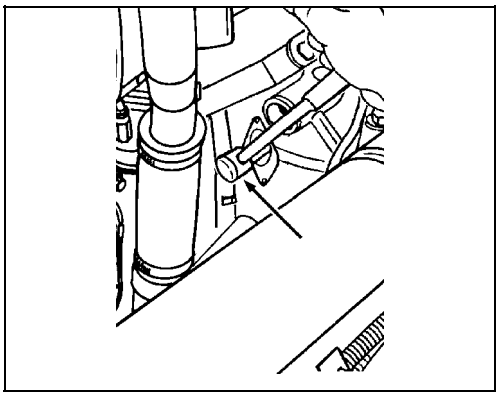


3. Install eyebolt M10 (2) in the threaded hole located in the top of torque converter housing (1). Attach a hoist. Place a sling tension on the hoist and position the converter (1) in the frame. Slide up on studs (3) aligning pilot stub shaft OD with flywheel bore. Secure with half of the metric bolts. Remove eyebolt (2) and studs (3).
4. Reinstall harness and cable to converter housing by reinstalling three converter mounting bolts with clips previously removed (refer to POWER, SECTION 12 for this procedure). Install remaining mounting bolts and torque all to 43 [Nm]. Apply electrical sealing grease, Grafo 112-X (1270464H1) to terminal connectors.



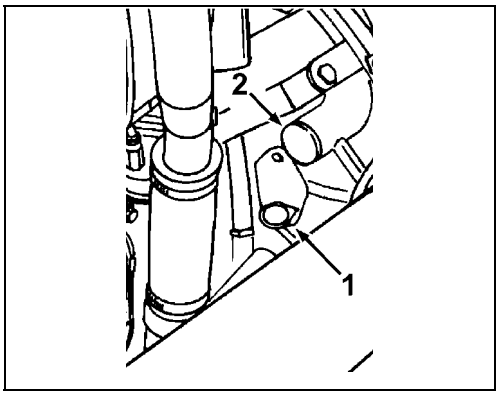
TORQUE CONVERTER

5. Using barring tool (refer to SPECIAL/SERVICE TOOLS in this Section), rotate the engine so that all the eight flywheel to flex plate bolts can be installed. Torque the bolts to 110 ± 10% [Nm].

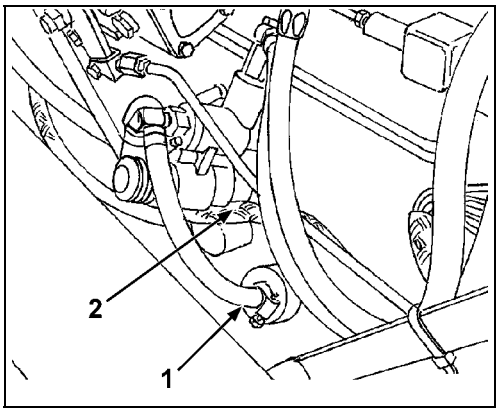


6. Install the access cover (1) and barring tool cover (2).

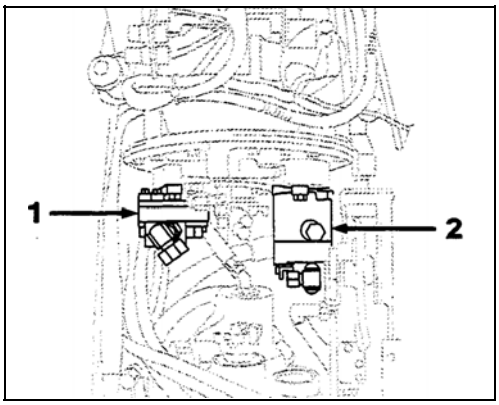
NOTE: *For TD-10M: Install engine ECM controller previously removed.*



7. Install the wire harness (2) and the fuel strainer (1).

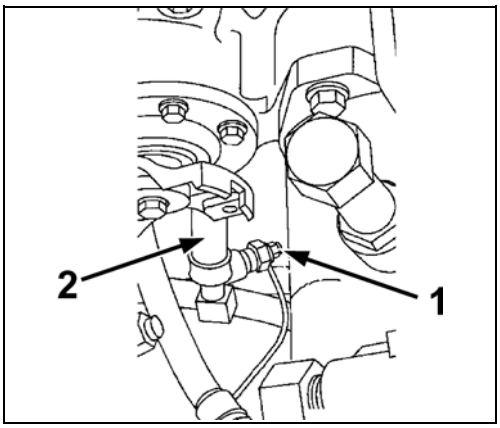


8. Install new O-ring to equipment pump (1) and slide in torque converter and secure with hardware. Install new O-ring to charge and scavenge pump (2) and slide in torque converter and secure with hardware. Torque bolts to 92 ± 10% [Nm].

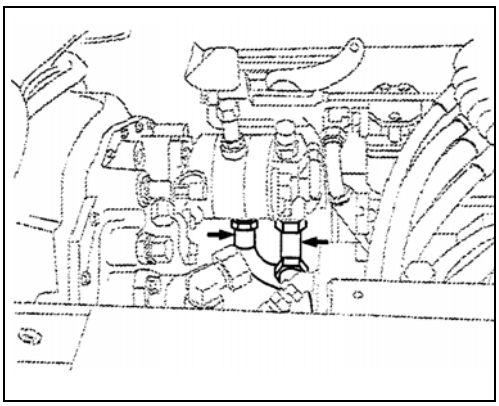


TORQUE CONVERTER

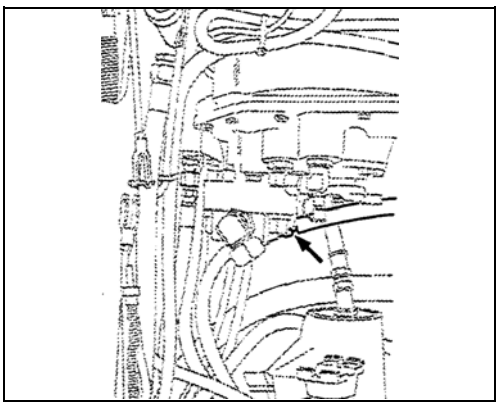
9. Install converter outlet sensor tube adapter (2) at bottom of torque converter. Reconnect the drive train temperature lead at the sensor (1).



10. Install fitting with strainer to rear section of charge and scavenge pump. Reconnect both hoses at bottom ports of pump.



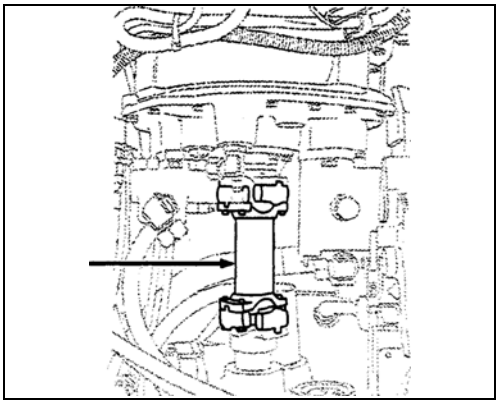
11. Connect pump to equipment valve hose to bottom port of equipment pump.



12. Install drive shaft with mounting hardware. Torque the bolts to:

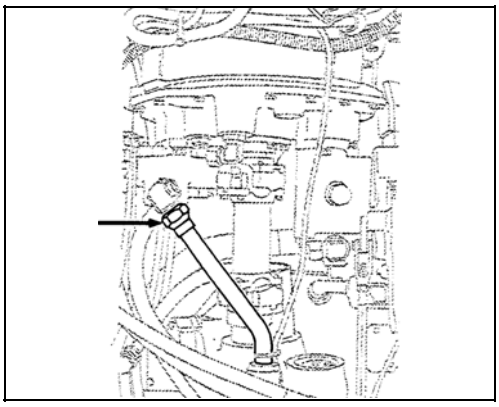
    For TD-7M . . . . . 33 [Nm]

    For TD-8M, TD-9M, TD-10M . . . . . 57 [Nm]

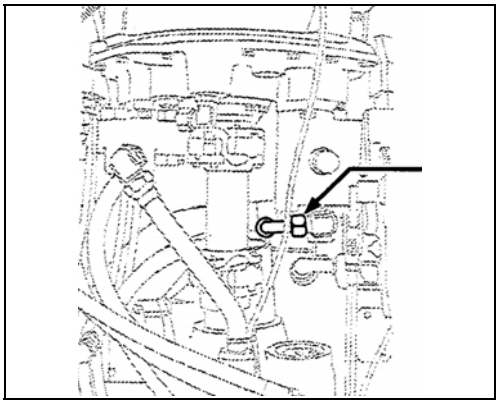


TORQUE CONVERTER

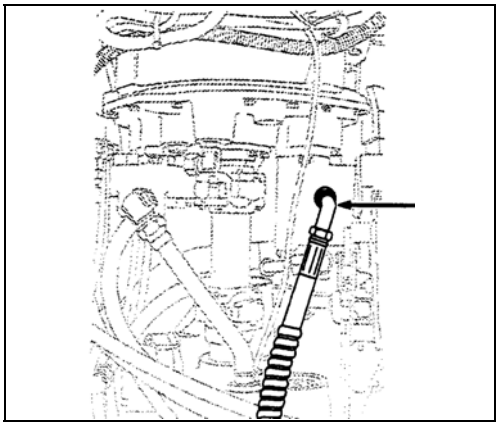
13. Connect front half of reservoir to pump tube to top port of equipment pump.



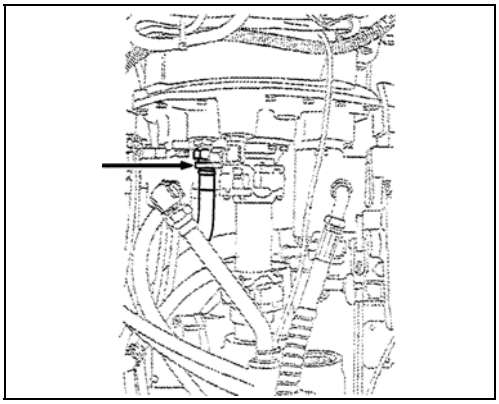
14. Connect pump to rear main frame hose to rear port of charge and scavenge pump.



15. Connect pump to filter hose at front port of charge and scavenge pump.

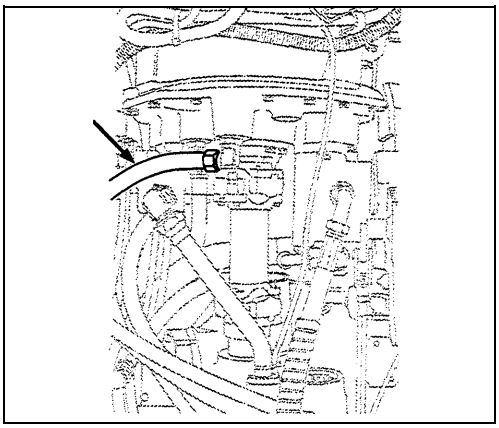


16. Connect drain hose at torque converter housing.



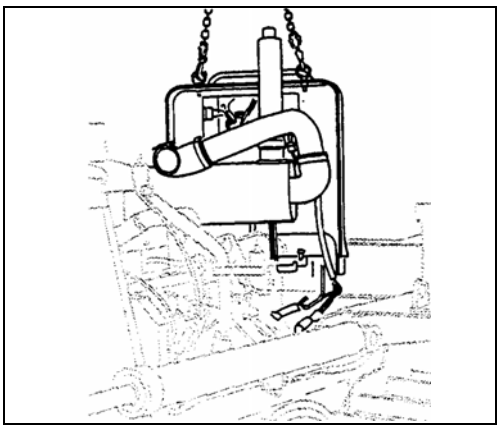
TORQUE CONVERTER

17. Connect inlet hose at torque converter housing.

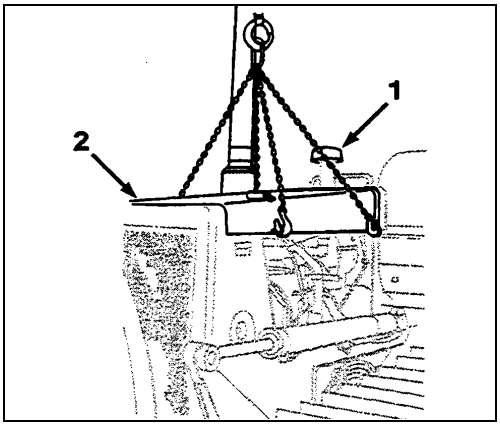


18. Position dashboard in the machine and secure with hardware. Torque bolts to 92 ± 10%. [Nm]. Refer to POWER, SECTION 12 for this procedure.

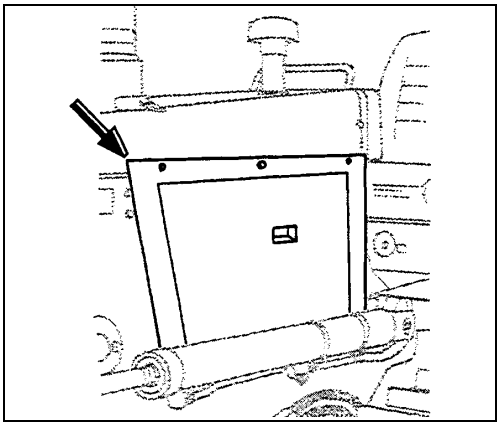
NOTE: *On some machines there will be shims between dashboard and main frame. Install removed shims with sides in which they were removed.*



19. Install hood (2) to machine. Install air pre-cleaner cap (1). Refer to POWER, SECTION 12 for this procedure.



20. Install engine left and right side doors and secure with hardware. Torque bolts to 38 ±10% [Nm].

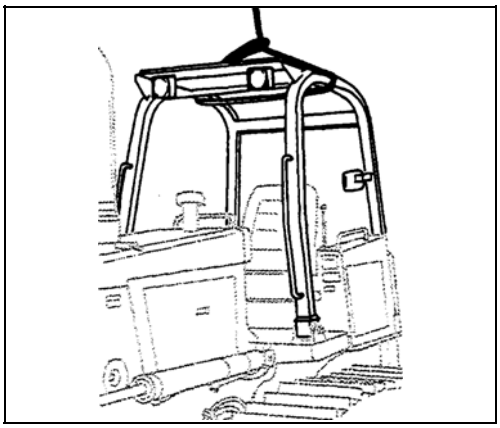


TORQUE CONVERTER

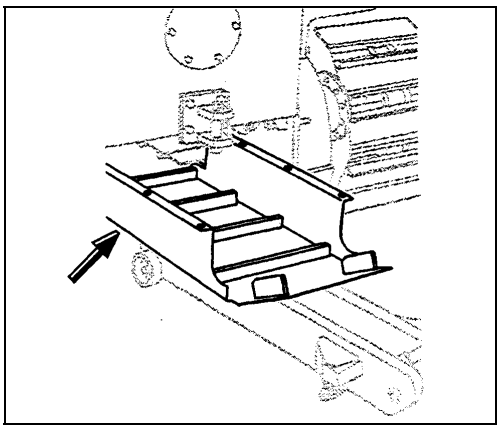
21. Using hoist install ROPS (or cab, if equipped) on machine Refer to SUPERSTRUCTURE, SECTION 13 for this procedure.

19. Refill hydraulic and drive train systems and open the fuel shut off valve as described in OPERATOR'S MANUAL.

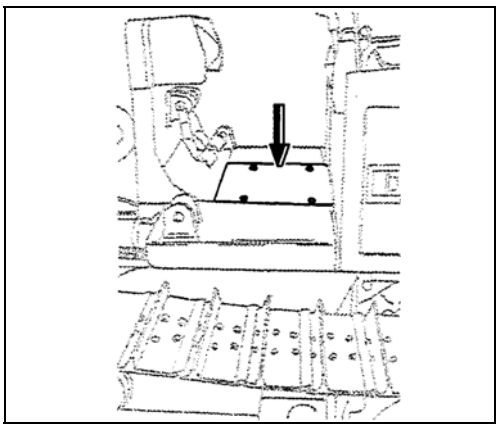
20. Place the drive train control lever in NEUTRAL and the neutral lock lever in the ON position. Start the engine and visually check hoses and connections for leakages.



21. Using a rolling floor jack, install transmission guard to machine and secure with hardware. Torque bolts to 92 ± 10% [Nm].



22. Install operators compartment floor plate and secure with hardware. Torque bolts to 38 ±10% [Nm]. Install the floor mat.



SECTION 7C

TRANSMISSION

TRANSMISSION

SECTION 7C

CONTENTS

SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS 3

GENERAL

2. DESCRIPTION 3
3. OPERATION 5
4. SPECIFICATIONS 8

TRANSMISSION

5. REMOVAL 9

COMPLETE ASSEMBLY

6. DISASSEMBLY 19
7. REASSEMBLY 29

DIRECTIONAL (INPUT) SHAFT

8. GENERAL 45
9. DISASSEMBLY 47
10. REASSEMBLY 58

COUNTER SHAFT

11. GENERAL 72
12. DISASSEMBLY 73
13. REASSEMBLY 74

RANGE (OUTPUT) SHAFT

14. GENERAL 77
15. DISASSEMBLY 79
16. REASSEMBLY 93

REVERSE IDLER SHAFT

17. GENERAL 116
18. DISASSEMBLY 117
19. REASSEMBLY 118

PRESSURE REGULATOR VALVE

20. DESCRIPTION 120
21. THEORY OF OPERATION 121
22. SPECIFICATIONS 122
23. DISASSEMBLY 123
24. REASSEMBLY 126

RANGE SELECTOR VALVE

25. DESCRIPTION 130
26. THEORY OF OPERATION 131
27. SPECIFICATIONS 132
28. DISASSEMBLY 132
29. REASSEMBLY 135

TRANSMISSION

RATE OF RISE VALVE

30. RATE OF RISE VALVE (TORQUE CONVERTER MACHINES) 138
31. RATE OF RISE VALVE (DIRECT DRIVE MACHINES) 140
32. SPECIFICATIONS 141
33. DISASSEMBLY 143
34. REASSEMBLY 148

TRANSMISSION

35. INSTALLATION 152

DRIVE TRAIN CONTROL VALVE

37. REMOVAL 165
38. DISASSEMBLY (Refer to Fig.'s 7C.23 and 7C.24) 167
39. INSPECTION AND REPAIR 170
40. REASSEMBLY (Refer to Fig.'s 7C.23 and 7C.24) 170
41. VALVE ADJUSTMENT BEFORE TESTING 171
42. PRESSURE TEST 172
43. INSTALLATION 173

SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS

DESCRIPTION	TOOL NUMBER
Dowel Pin Installing Tool	21.547.0122
Directional (Input) Shaft Manifold Tool	21.549.0079
Range (Output) Shaft Manifold Tool	21.549.0078
Directional (Input) Shaft Puller Bridge Tool	21.282.0101
Directional (Input) Shaft End Play Adjuster Bridge Tool	21.282.0102
Range (Output) Shaft Puller Bridge Tool	21.282.0099
Range (Output) Shaft End Play Adjuster Bridge Tool	21.282.0100
Countershaft Puller Bridge Tool	21.282.0103
Countershaft End Play Adjuster Bridge Tool	21.282.0125
Transmission Clutch Pack Spring Compressing Tool	21.552.0029
Range (Output) Shaft 1st Pack Compacting Tool	21.552.0034
Directional (Input) Shaft Seal Ring Compressing Sleeve	21.549.0077
Pinion Gear Locking Arm (2 different pinion gear dia. for TD-7/8M and TD-9/10M)	049R134

GENERAL

2. DESCRIPTION

The transmission 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 (3), range (output) shaft (15), countershaft (11) and reverse idler shaft (14).

Directional (Input) Shaft

The directional (input) shaft (3) rotates on two tapered roller bearings. It consists of a forward drive gear (3B), reverse drive gear (3A) and dual hydraulic clutch packs.

Range (Output) Shaft

The range (output) shaft (15) rotates on two tapered roller bearings. It consists of the 3rd speed driven gear (15C), the 2nd speed driven gear (15B) and the 1st speed driven gear (15A). It also contains dual hydraulic clutch pack for 2nd and 3rd speeds and a single clutch pack assembly for 1st speed.

Reverse Idler Shaft

The reverse idler shaft (14) is bolted to the housing (1). It consists of a reverse idler gear (14A) which rides on two tapered roller bearings and is in constant mesh with reverse drive gear (3A) and 2nd speed drive gear (11B).

Countershaft

The countershaft (11) rotates on two tapered roller bearings. It consists of 3rd speed drive gear (11C), 2nd speed drive gear (11B) and 1st speed drive gear (11A).

TRANSMISSION

GENERAL

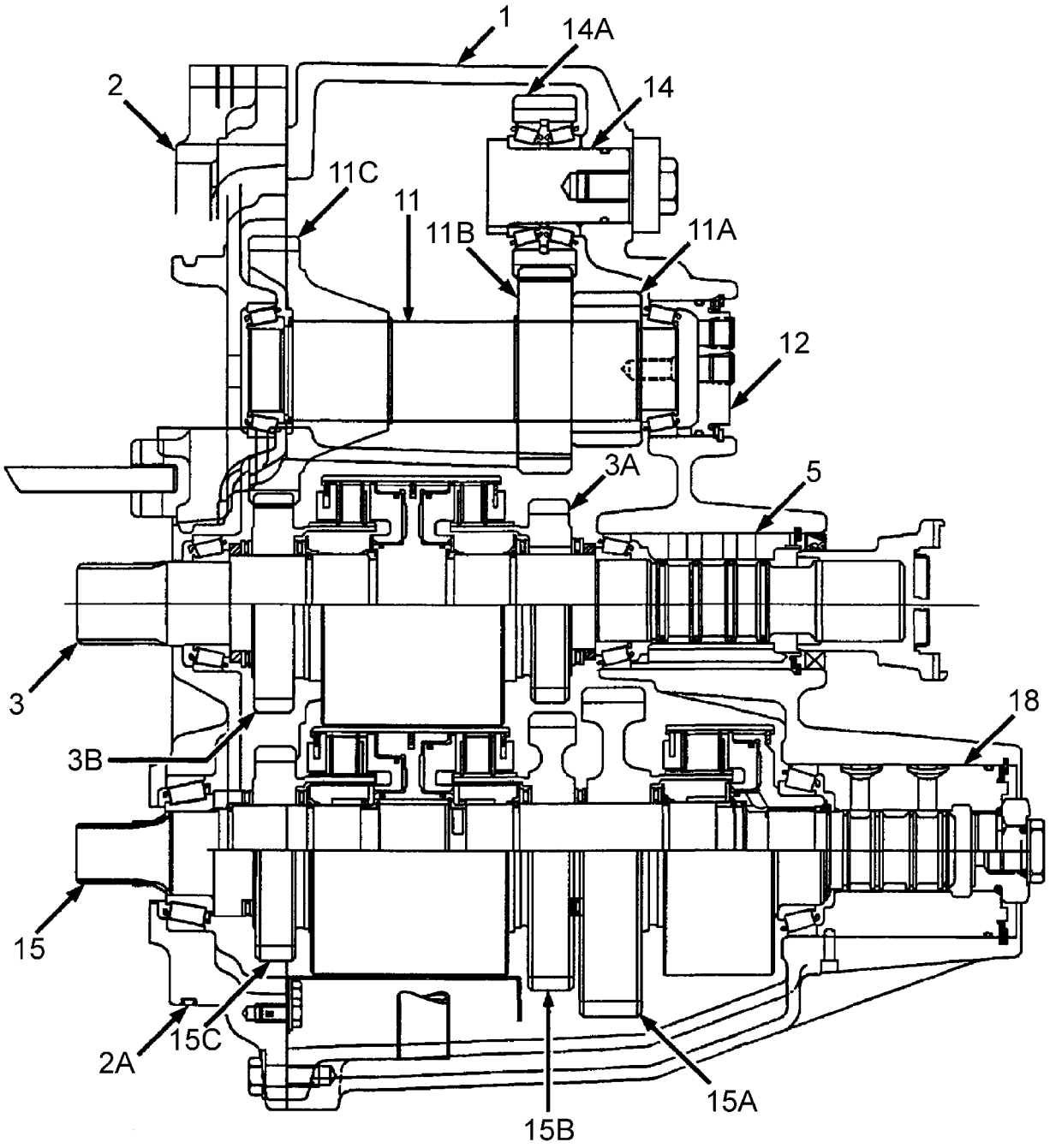


Fig. 7C.1. Cross Section View of Transmission

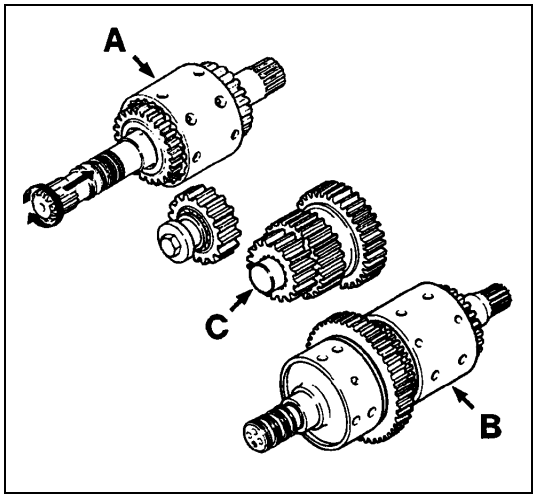
1. Transmission Housing
2. Rear Cover
2A. Mounting O-Ring
3. Directional (Input) Shaft
3A. Reverse Gear
3B. Forward Gear
5. Directional Shaft Manifold
11. Countershaft
11A. 1st Speed Gear
11B. 2nd Speed Gear
11C. 3rd Speed Gear
12. Countershaft Cover
14. Reverse Idler Shaft
14A. Reverse Idler Gear
15. Range (Output) Shaft
15A. 1st Speed Driven Gear
15B. 2nd Speed Driven Gear
15C. 3rd Speed Driven Gear
18. Range Shaft Manifold

NOTE: *Unless otherwise notated, all reference callouts refer to cross section and exploded views of the transmission (refer to Fig.'s 7C.1 and 7C.2).*

GENERAL

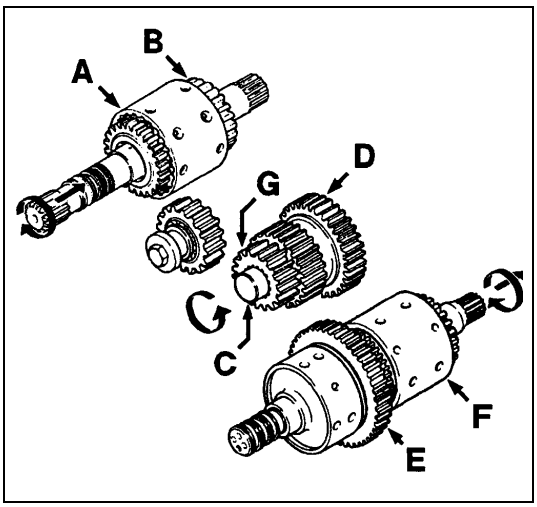
3. OPERATION

Main pressure oil is detected from the range selector valve through passages in the transmission housing to the manifolds and on through the shafts to engage the desired clutch pack. Lubrication oil is always directed through passages to lubricate the bearings, clutches and shafts.

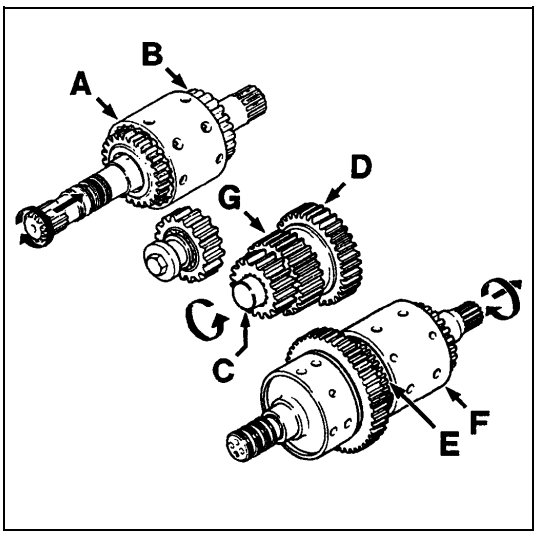


Neutral
Engine power and torque are delivered through the converter and drive shaft to the transmission directional (input) shaft (A). As the forward and reverse clutch packs are not engaged, the shaft turns freely inside the gears. No power is transmitted to the countershaft (C) or to the range (output) shaft (B).

1st Speed Forward
Engine power and torque are delivered through the converter and drive shaft to the directional (input) shaft (A). As the forward clutch pack is activated, it engages the forward gear (B) and rotates it in the same direction as the shaft. The countershaft (C), through the 3rd speed drive gear (D), is rotated in the opposite direction. As the 1st speed clutch pack is activated, it engages the 1st speed driven gear (E) to the range (output) shaft (F). Power from the countershaft is transferred, through the 1st speed drive gear (G), to the range (output) shaft in the opposite direction of rotation. Power is delivered from the range (output) shaft to the steering and sprocket drives and on to the tracks.



2nd Speed Forward
Engine power and torque are delivered through the converter and drive shaft to the directional (input) shaft (A). As the forward clutch pack is activated, it engages the forward gear (B) and rotates it in the same direction as the shaft. The countershaft (C), through the 3rd speed drive gear (D), is rotated in the opposite direction. As the 2nd speed clutch pack is activated, it engages the 2nd speed driven gear (E) to the range (output) shaft (F). Power from the countershaft is transferred, through the 2nd speed drive gear (G), to the range (output) shaft in the opposite direction of rotation. Power is delivered from the range (output) shaft to the steering and sprocket drives and on out to the tracks.

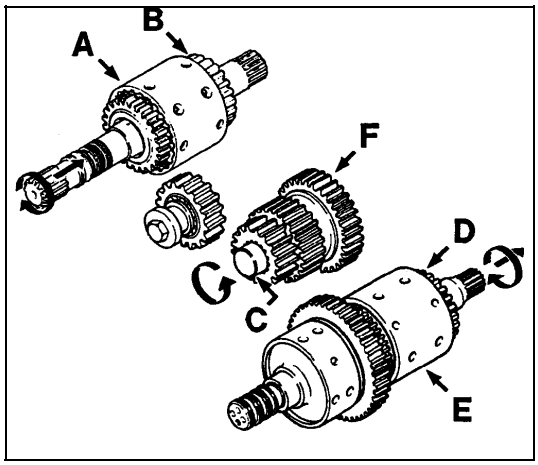


TRANSMISSION

GENERAL

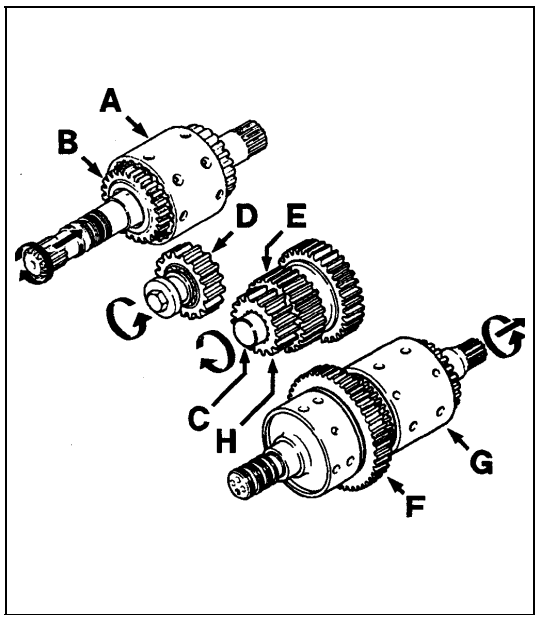
3rd Speed Forward

Engine power and torque are delivered through the converter and drive shaft to the directional (input) shaft (A). As the forward clutch pack is activated, it engages the forward gear (B) and rotates it in the same direction as the shaft. The countershaft (C), through the 3rd speed clutch pack, is activated and engages the 3rd speed driven gear (D) to the range (output) shaft (E). Power from the 3rd speed drive gear (F) is transferred to the range (output) shaft in the opposite direction of rotation. Power is delivered from the range (output) shaft to the steering and sprocket drive and on out to the tracks.



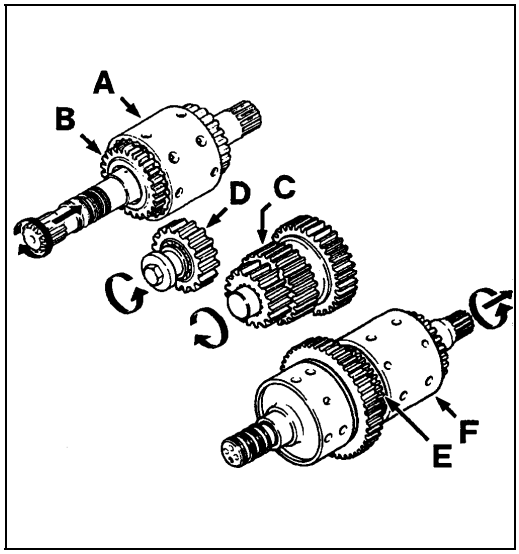
1st Speed Reverse

Engine power and torque are delivered through the torque converter and drive shaft to the directional (input) shaft (A). As the reverse clutch pack is activated, it engages the reverse gear (B) and rotates it in the same direction as the shaft. The countershaft (C), through the reverse idler gear (D) and the 2nd speed drive gear (E), is rotated in the same direction as the directional (input) shaft. As the 1st speed clutch pack is activated it engages the 1st speed driven gear (F) to the range (output) shaft (G). Power from the countershaft is transferred, through the 2nd and 1st speed drive gear (H) and 1st speed driven gear, to the range (output) shaft in the opposite direction of rotation. Power is delivered from the range (output) shaft to the steering and sprocket drives and on out to the tracks.



2nd Speed Reverse

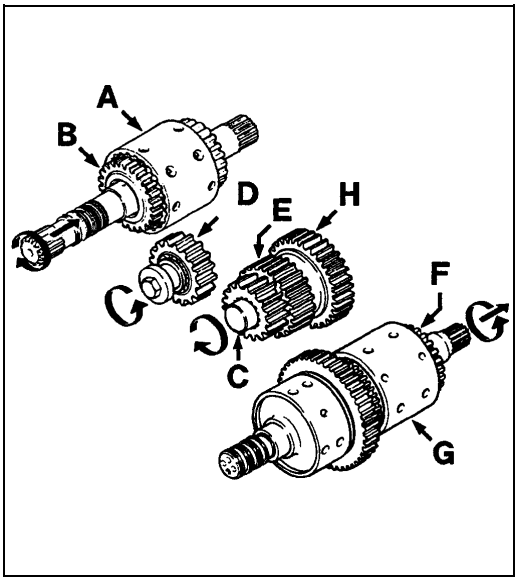
Engine power and torque are delivered through the torque converter and drive shaft to the directional (input) shaft (A). As the reverse clutch pack is activated, it engages the reverse gear (B) and rotates it in the same direction as the shaft. The 2nd speed drive gear (C), through the reverse idler gear (D), is rotated in the same direction as the directional (input) shaft. As the 2nd speed clutch pack is activated, it engages the 2nd speed driven gear (E) to the range (output) shaft (F). Power is transferred from the 2nd speed drive gear to the range (output) shaft through the driven gear and clutch pack in the opposite direction of rotation from the directional (input) shaft. Power is delivered from the range (output) shaft to the steering and sprocket drives and on out to the tracks.



GENERAL

3rd Speed Reverse

Engine power and torque are delivered through the torque converter and drive shaft to the directional (Input) shaft (A). As the reverse clutch pack is activated, it engages the reverse gear (B) and rotates it in the same direction as the shaft. The countershaft (C), through the reverse idler gear (D) and the 2nd speed drive gear (E), is rotated in the same direction as the directional (Input) shaft. As the 3rd speed clutch pack is activated, it engages the 3rd speed driven gear (F) to the range (output) shaft (G). Power from the countershaft is transferred to the range (output) shaft through the 3rd speed drive gear (H) and driven gear and the clutch pack in the opposite direction of rotation. Power is delivered from the range (output) shaft to the steering and sprocket drives and on out to the tracks.



TRANSMISSION

GENERAL

4. SPECIFICATIONS

Type ..... Power shift
Number of Speeds ..... 3 Forward - 3 Reverse
Shaft End Play - All Shafts ..... 0.18 to 0.31 [mm]

Forward or Reverse Clutch Pack:
Friction Discs 7
Separator Plates 6

1st Speed Clutch Pack:
Friction Discs 8
Separator Plates 7

2nd or 3rd Speed Clutch Pack:
Friction Discs 7
Separator Plates 6

Sealant:
Transmission Rear Cover ..... LOCTITE #515
Countershaft Cover Pipe Plugs ..... LOCTITE #592
Transmission Valve Manifold Bolts ..... LOCTITE #262
Transmission Valve Manifold Orifice Fitting ..... LOCTITE #592
Transmission Valve Bolts ..... LOCTITE #262
Range (Output) Shaft Splines ..... "Never Seez"
Electrical Sealing Grease ..... Grafo 112-X

Weights:
Transmission with Valves ..... 203 [kg]
Transmission w/o Valves ..... 168 [kg]

Special Bolt Torque Data:
Battery Hold Down Nuts ..... 0.9 [Nm]
Battery Terminal Nuts ..... 31 [Nm]
Transmission Mounting Bolts ..... 325 [Nm]
Pinion Gear Bolt ..... 380 to 410 [Nm]

TRANSMISSION

5. REMOVAL

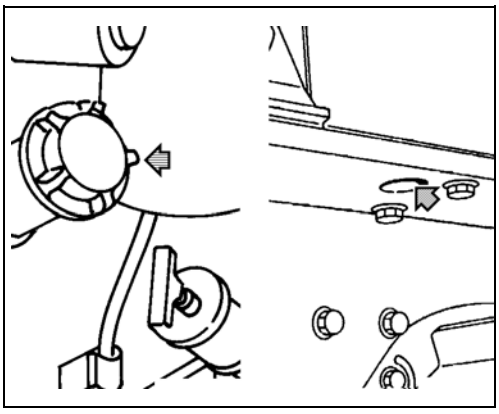
WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train control lever is in NEUTRAL position, drive train neutral lock lever is in ON position and parking brake is set. The starting switch and the electrical system master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

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

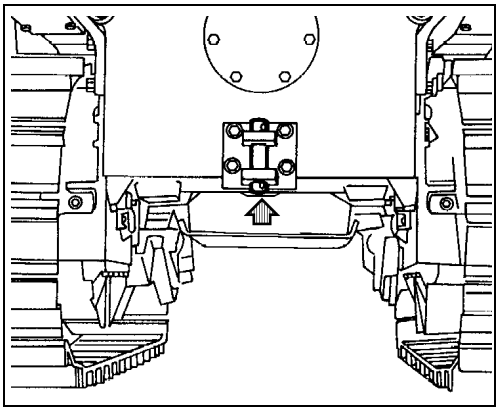
IMPORTANT: *Disconnected hydraulic lines must be capped with the correct size plastic caps. If these caps are not available, tape or clean rubber corks may be used. Hydraulic openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components of the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

1. Turn the master switch to the OFF position and take out the key.

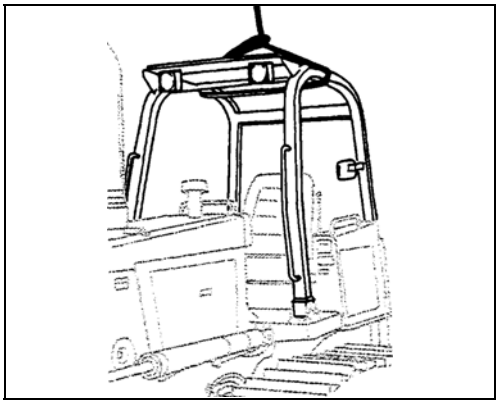
2. Drain the equipment hydraulic reservoir as described in the OPERATOR'S MANUAL.



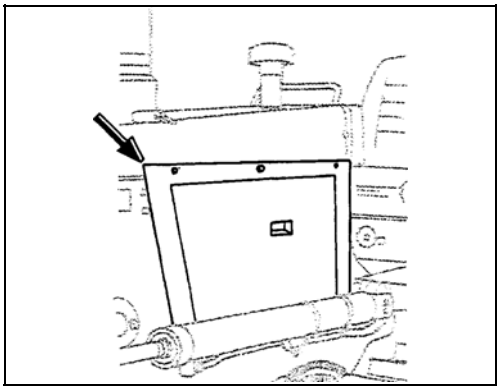
3. Drain the drive train system as described in the OPERATOR'S MANUAL.



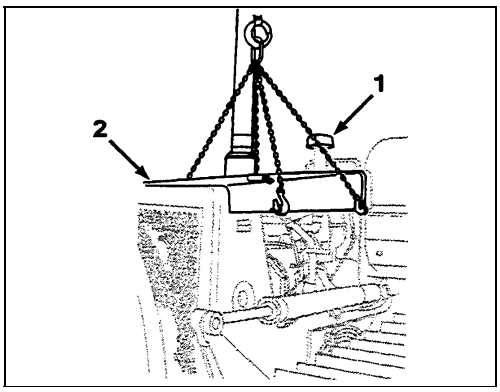
4. Remove the ROPS structure (or cab, if equipped). Refer to SUPERSTRUCTURE, SECTION 13 for this procedure.



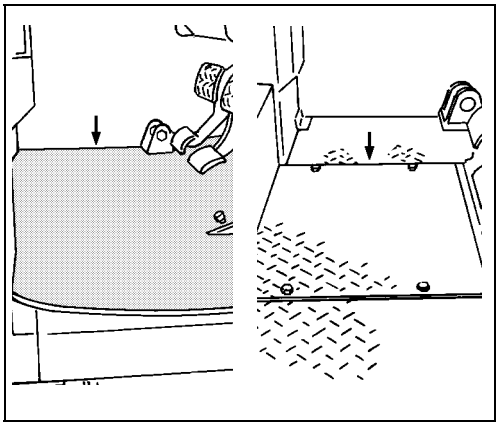
5. Remove engine left and right side doors.



6. Remove air pre-cleaner cap (1) from inlet tube. Remove hood (2) from machine. Refer to POWER, SECTION 12 for this procedure.

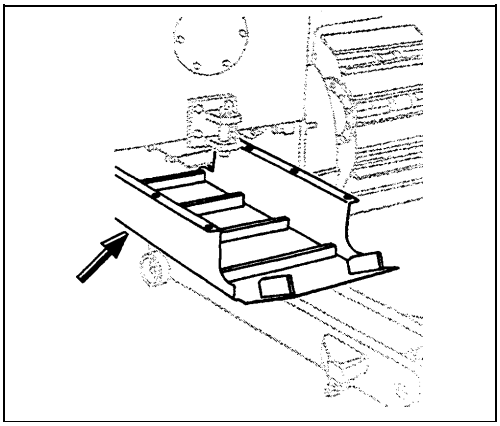


7. Remove operators compartment floor mat and floor plate.



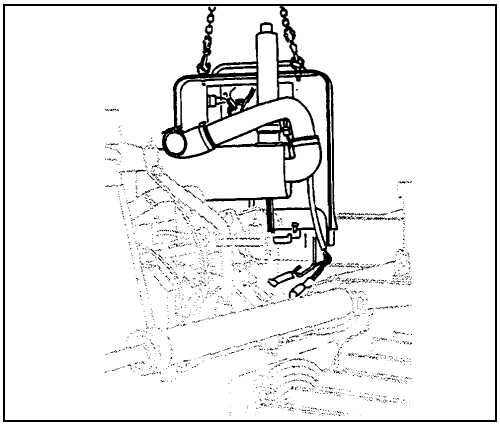
TRANSMISSION

8. Using a rolling floor jack, remove transmission guard from under machine.

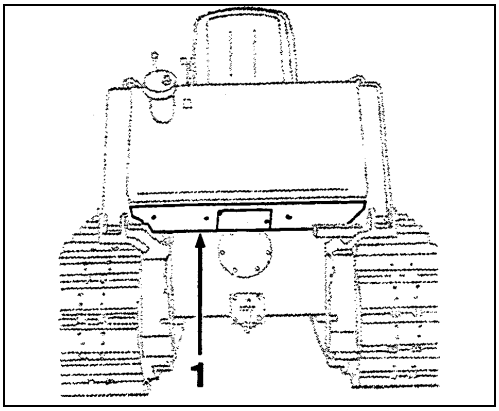


9. Remove dashboard from the machine. Refer to POWER, SECTION 12 for this procedure.

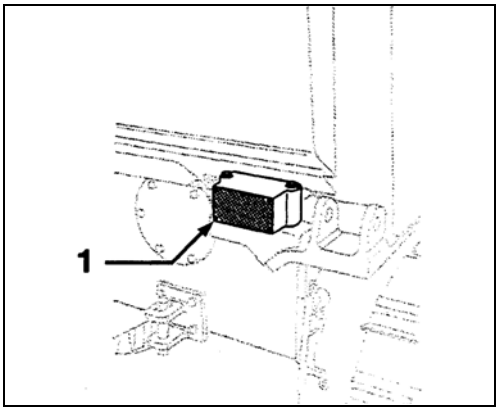
NOTE: *On some machines there will be shims between dashboard and main frame. Keep shims with sides they were removed from.*



10. Remove rear cover (1).

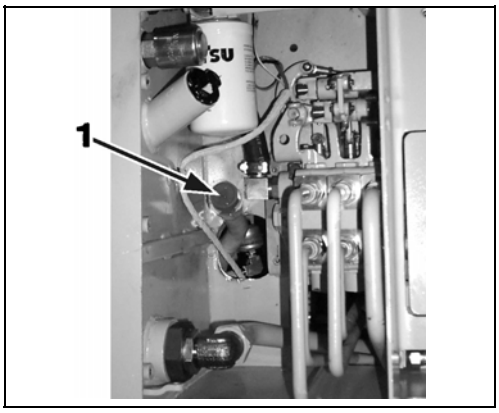


11. Disconnect wiring at back up alarm (1) and remove from machine.

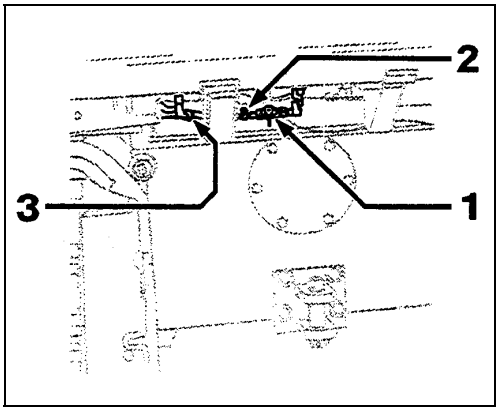


TRANSMISSION

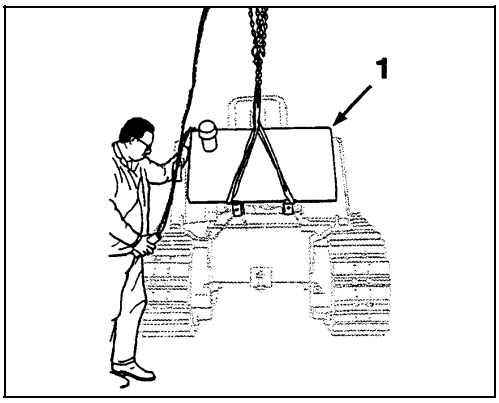
12. Remove drive train oil level gauge (1). Cap tube.



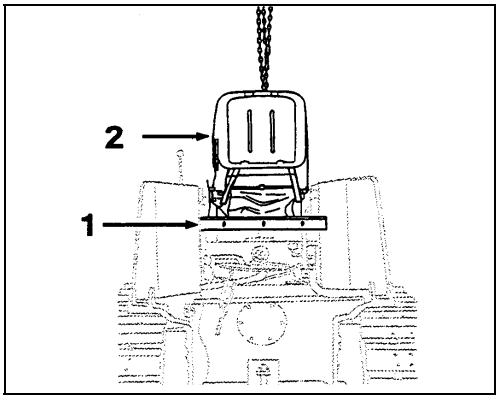
13. Close fuel shut off valve (1). Disconnect hose (2). Disconnect fuel return hose (3).



14. Remove hardware securing rear of seat platform to fuel tank (1). Disconnect wiring at fuel level sensor. Install lifting straps to fuel tank and connect hoist. Remove tank mounting hardware and spacers and remove from machine.

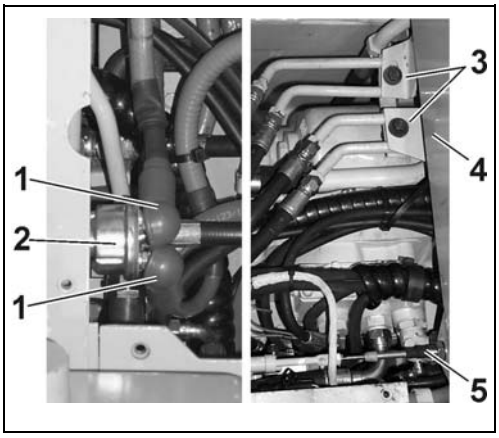


15. Remove remaining seat platform (1) mounting hardware. Attach straps with hoist to seat (2) and remove from machine.

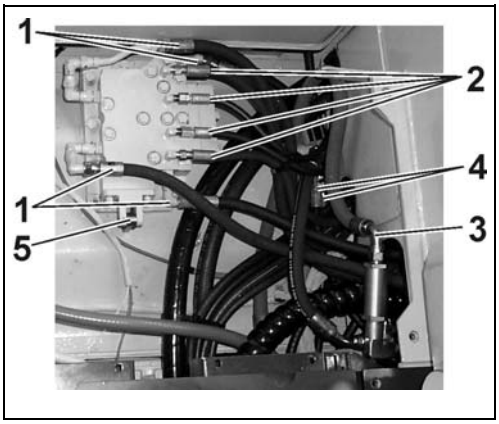


TRANSMISSION

16. Disconnect cables (1) from master disconnect switch (2). Release tube brackets (3) from front support plate (4). At lower left side support plate disconnect throttle cable (5) from plate. Remove hardware and support plate from machine.

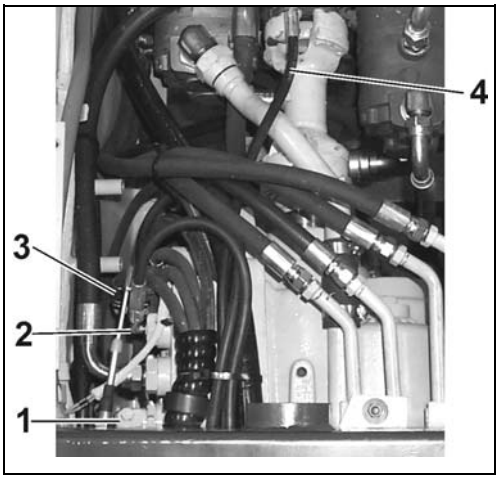


17. Disconnect four steering hoses (1) at brake valve fittings and position in battery box. Disconnect four check hoses (2) at brake valve fittings and position in battery box. Disconnect neutral lock valve supply hose (3). Disconnect drive train drain hoses (4) from elbow on rear main frame cover and position in battery box. Disconnect brake rod with clevis from brake valve (5) and remove it.

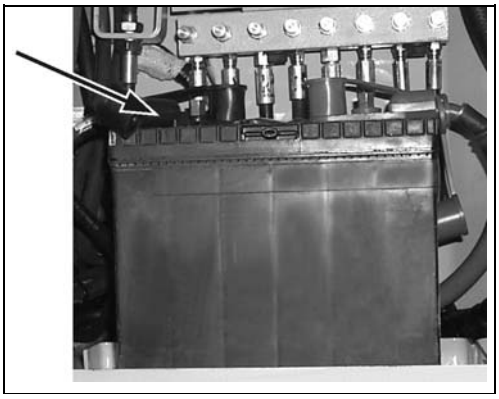


18. Disconnect M pressure check hose (1) and L pressure check hose (2) at pressure regulator valve fittings and position in battery box. Disconnect Pc pressure check hose (3) at range selector valve fitting and position in battery box. Disconnect C pressure check hose (4) at torque converter fitting and position in battery box.

NOTE: *The C pressure check hose does not exist in Direct Drive versions of TD-8M, TD-9M and TD-10M machines.*

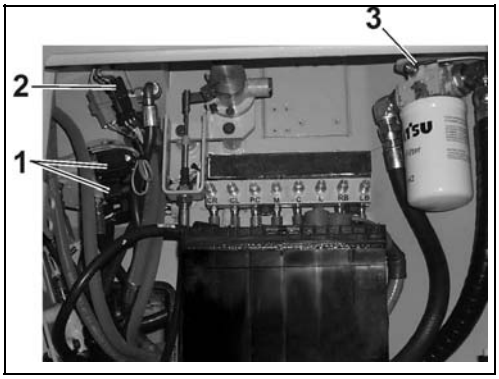


19. From inside battery box, disconnect and remove negative battery cable and position outside of box.

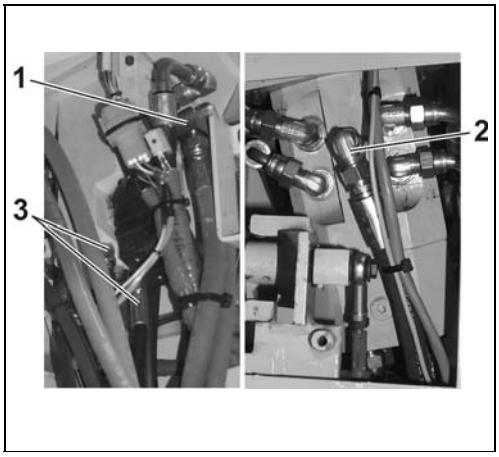


TRANSMISSION

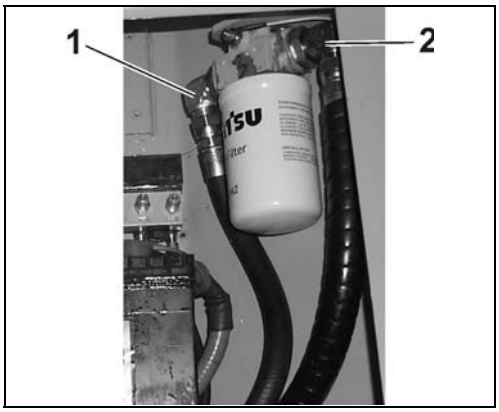
20. From inside battery box, disconnect wiring at solenoid valves (1) of drive train control valve, drive train electronic controller (2), drive train oil pressure filter switch (3), startup lock switch, backup alarm pressure switch and main oil pressure switch.



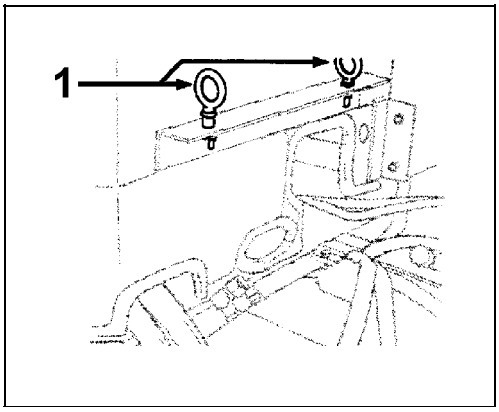
21. Disconnect one steering (F) hose (1) at rear side of drive train control valve, one steering (R) hose (2) at front side and two gear steering (1st, 2nd) hoses (3) at bottom of drive train control valve. Position hoses outside of battery box.



22. Disconnect filter inlet hose (1) and filter outlet hose (2) from filters elbows and position hoses outside battery box.

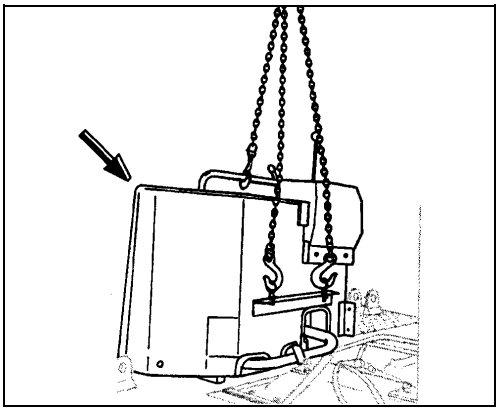


23. Install two 5/8NC eye bolts (1) to seat platform bracket.

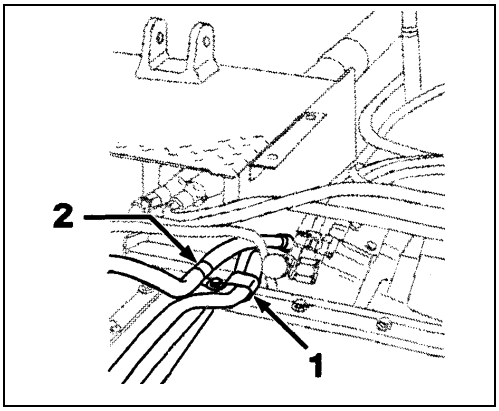


TRANSMISSION

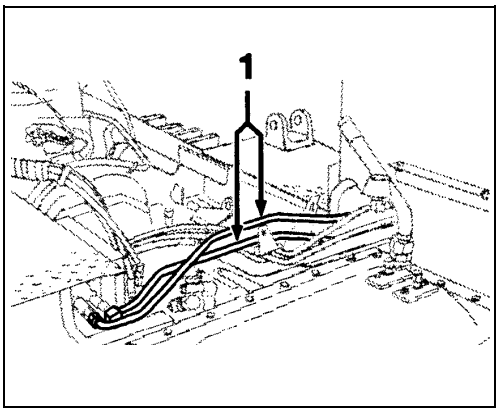
24. Curl all hoses into battery box. Attach chain and hoist to eye bolts and assist rail. Remove mounting hardware and remove from machine. Keep shims in positions they were removed.



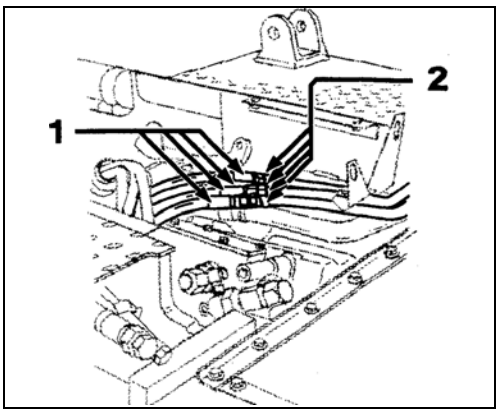
25. Unclip fuel lines (1) and battery cables (2) and position out of the way.



26. Remove two crossover tubes (1).

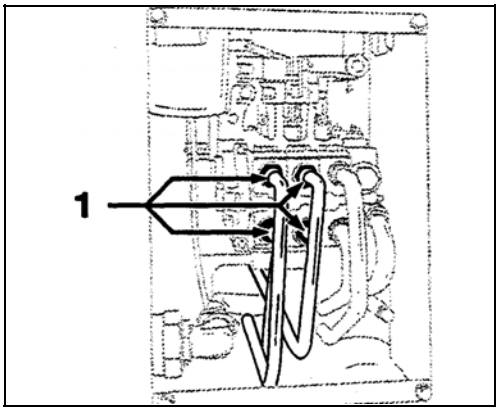


27. Disconnect four hoses (1) from tubes (2).

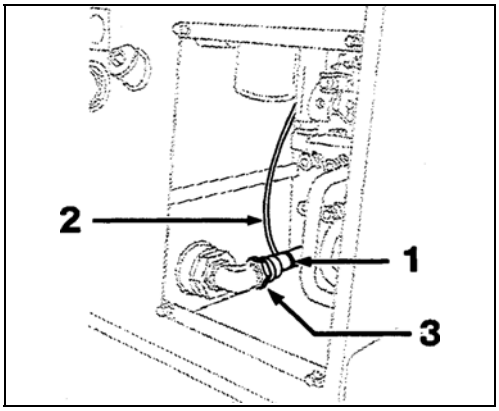


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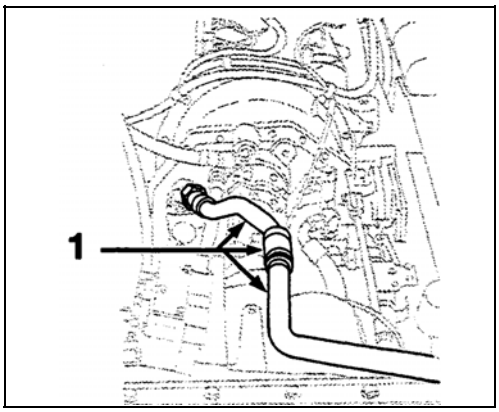
28. Remove hydraulic equipment control valve access panel. Remove upper and lower rear tubes (1) from control valve.



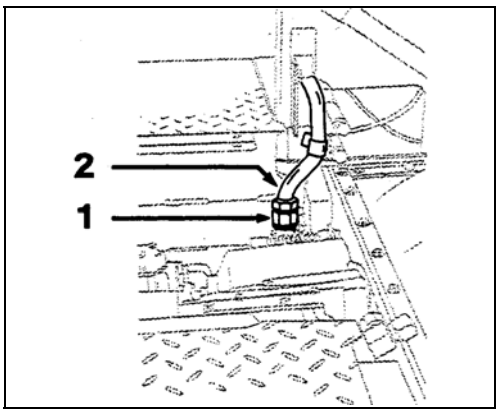
29. Cut tie strap (1) from harness (2). Disconnect rear equipment suction tube (3) from fitting.



30. Disconnect suction tube assembly (1) from pump and remove.

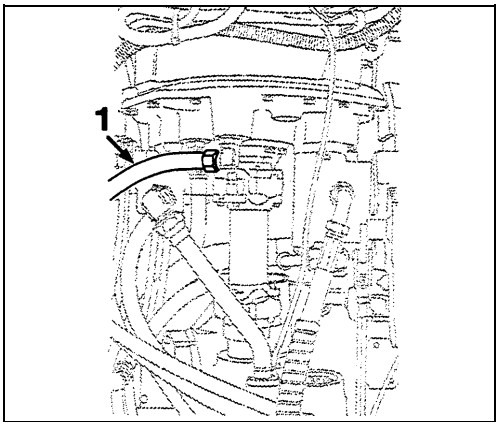


31. Disconnect control valve inlet hose (1) from tube (2).

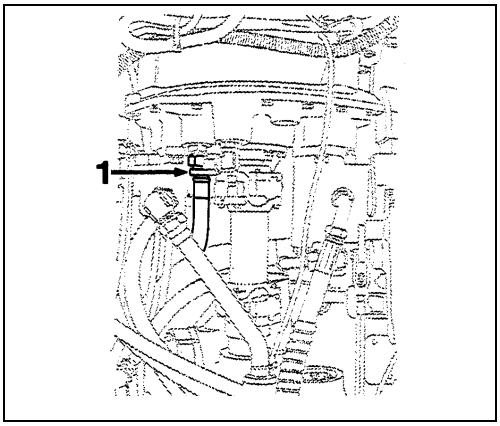


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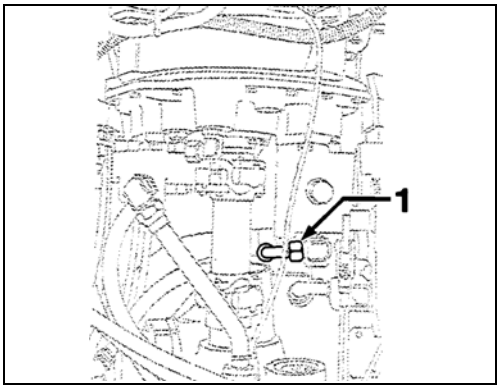
32. Disconnect converter inlet hose (1) at torque converter.



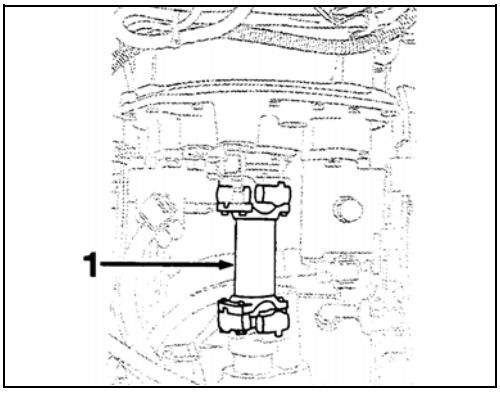
33. Disconnect converter drain hose (1) at torque converter.



34. Disconnect pump to rear main frame hose (1) at rear port of charge and scavenge pump.

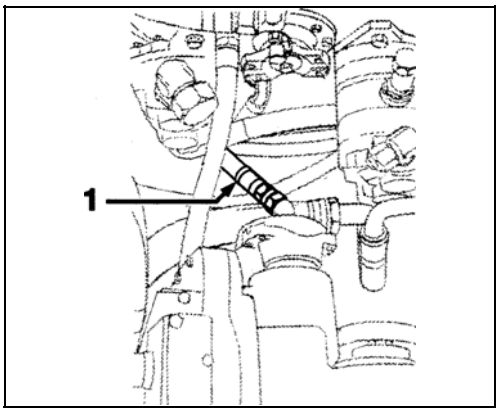


35. Remove mounting hardware and drive shaft (1).

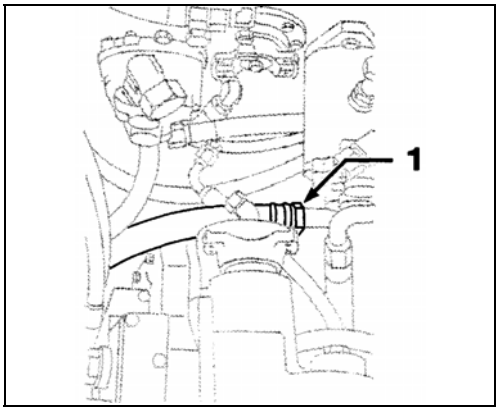


TRANSMISSION

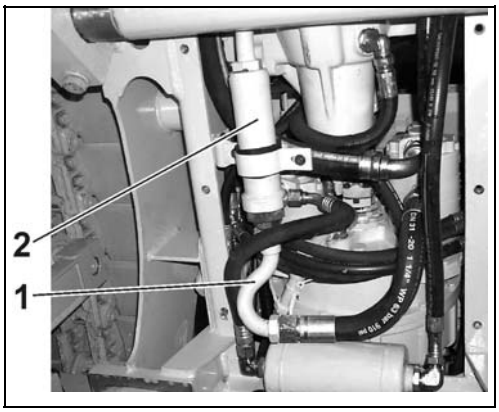
36. Disconnect cooler outlet hose (1) from front of transmission. Position out of the way.



37. Remove large scavenge hose (1) from bottom rear section of pump and transmission.

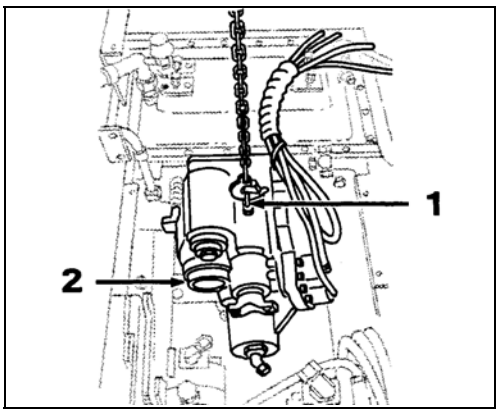


38. Disconnect tube (1) at suction strainer (2) and position out of the way. Cap port on strainer. Remove strainer and mounting bracket from machine.



39. Install a 1/2NC eye bolt (1) at top of transmission (2) and attach hoist. Remove mounting hardware. Work transmission away from rear main frame face and remove from machine.

NOTE: *Transmission sealing O-ring on case will cause a drag when removing.*



TRANSMISSION

6. DISSASEMBLY

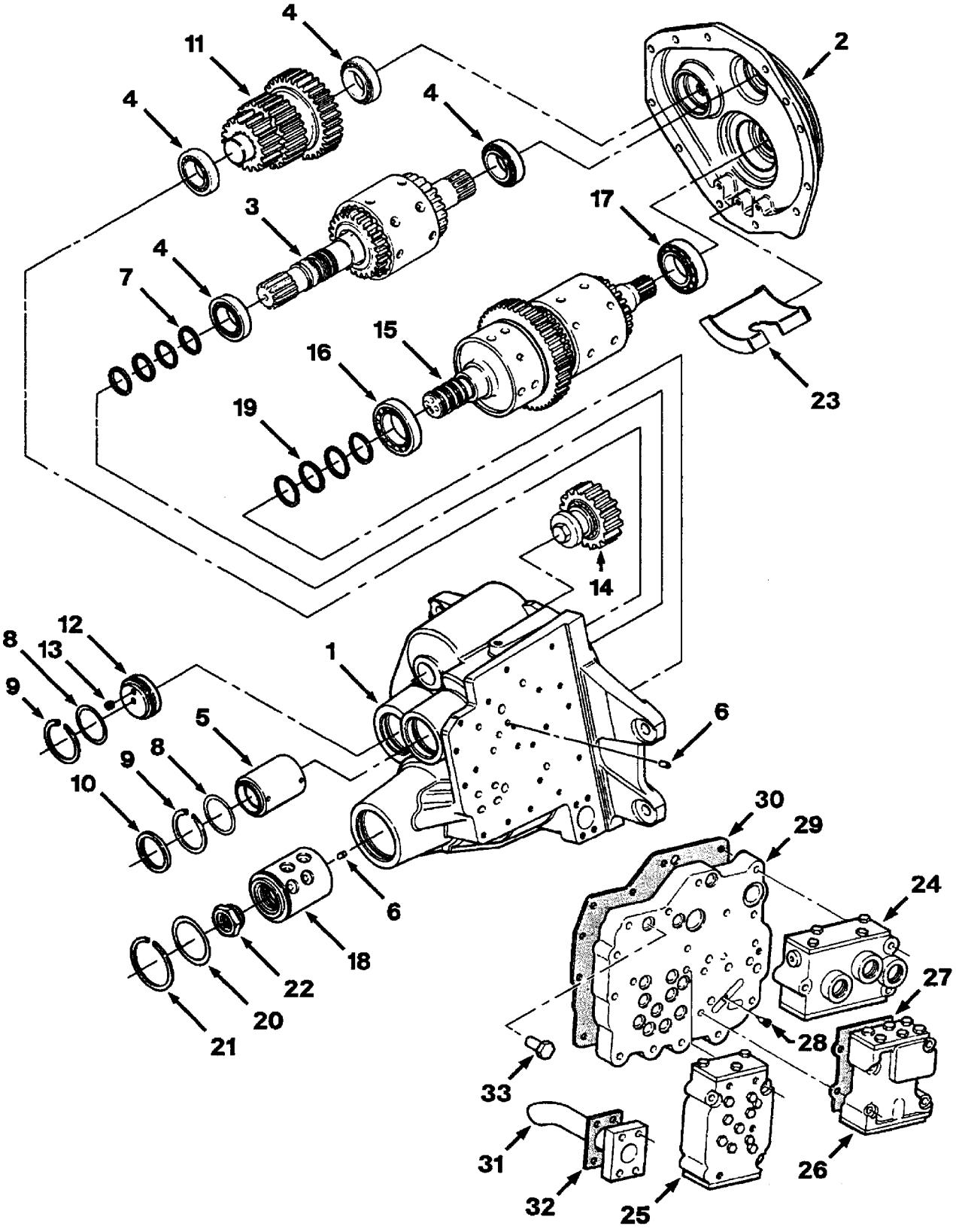


Fig. 7C.2. Exploded View of Complete Assembly

COMPLETE ASSEMBLY

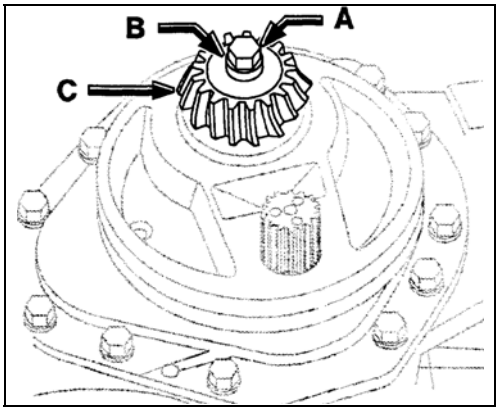
Legend for Fig. 7C.2

1. Transmission Housing
2. Rear Cover
3. Directional (Input) Clutch Shaft
4. Tapered Roller Bearing
5. Directional Shaft Manifold
6. Guide Pin
7. Seal Ring
8. Shim
9. Retaining Ring
10. Seal Ring
11. Countershaft
12. Countershaft Cover
13. Port Plug
14. Reverse Idler Shaft
15. Range (Output) Clutch Shaft
16. Tapered Roller Bearing
17. Tapered Roller Bearing
18. Range Shaft Manifold
19. Seal Ring
20. Shim
21. Retaining Ring
22. Connector
23. Scavenge Tube Oil Baffle
24. Pressure Regulator Valve
25. Range Selector Valve
26. Rate of Rise Valve
27. Valve Gasket
28. Orifice Strainer
29. Valve Manifold
30. Manifold Gasket
31. Scavenge Tube
32. Scavenge Tube Gasket
33. Plug

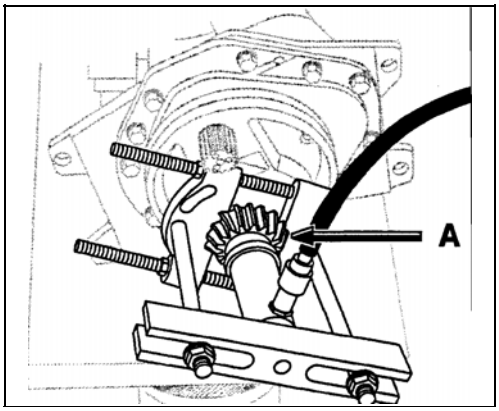
NOTE: *Callouts from exploded view (refer to Fig. 7C.2) correspond with callouts in the following steps.*

Transmission Complete Assembly

1. Remove mounting bolt (A) and spacer (B) securing pinion gear (C) to output shaft.

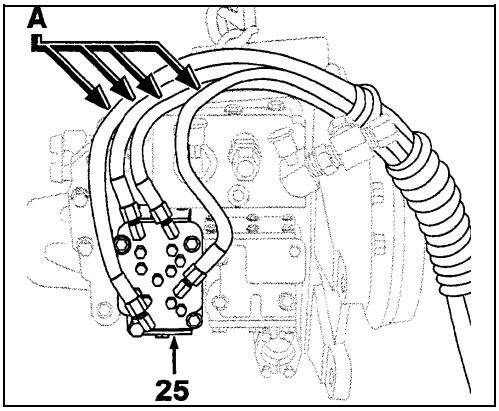


2. Remove pinion gear (A) from output shaft. A puller arrangement may be necessary to remove gear.

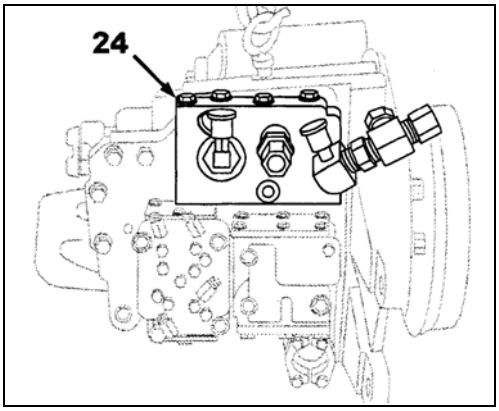


COMPLETE ASSEMBLY

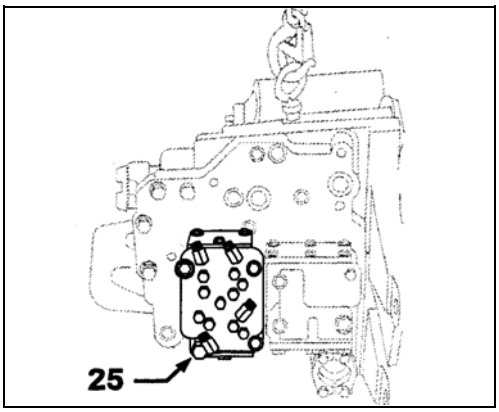
3. Remove four hoses (A) at range selector valve (25).



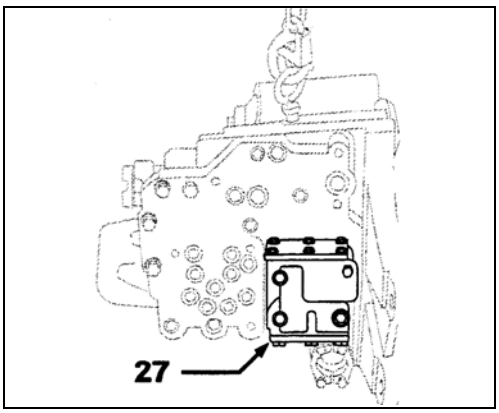
4. Remove main regulator valve (24). Discard two large and two small mounting O-rings. Refer to PRESSURE REGULATOR VALVE in this Section for service.



5. Remove range selector valve (25). Remove and discard ten mounting O-rings. Refer to RANGE SELECTOR VALVE in this Section for service.

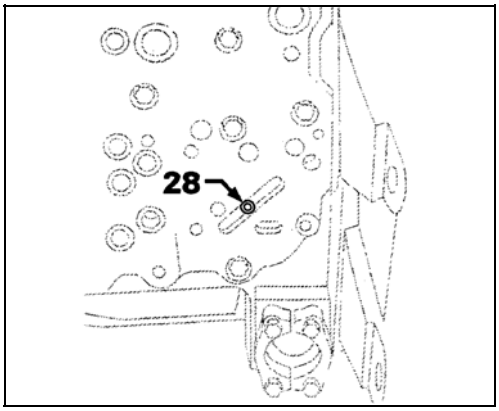


6. Remove rate of rise valve (27). Discard mounting gasket. Refer to RATE OF RISE VALVE in this Section for service.



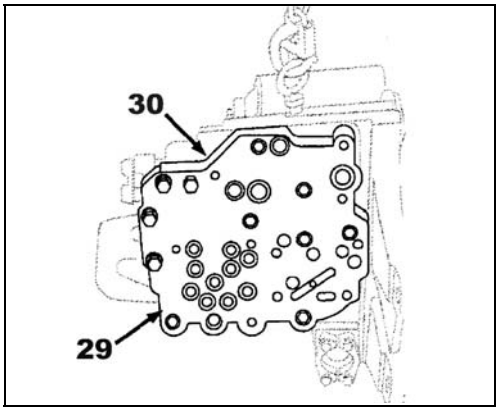
COMPLETE ASSEMBLY

7. If necessary, remove orifice strainer (28) from valve manifold plate.

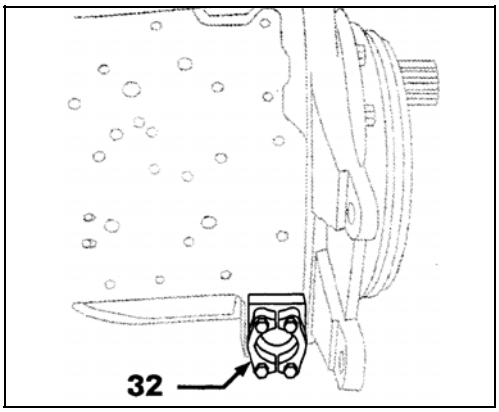


8. Remove valve manifold (29) from transmission housing. Discard manifold gasket (30).

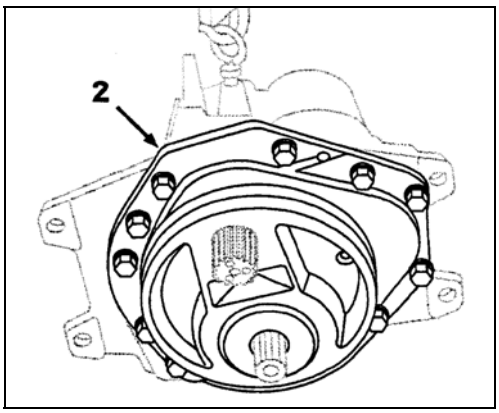
NOTE: *Eleven bolts secure valve manifold to transmission housing. Three are 5.1 [mm] long and eight are 3.6 [mm] in long.*



9. Remove scavenge tube (32). Discard mounting gasket.

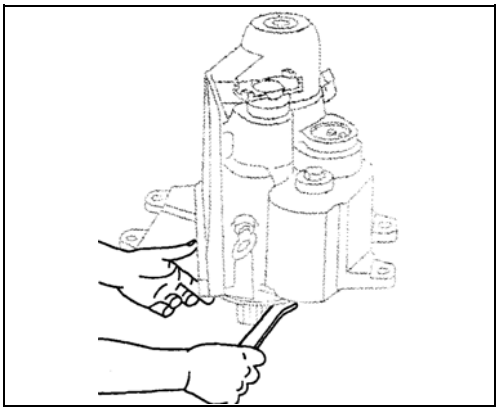


10. Break loose, do not remove, rear cover (2) mounting bolts.

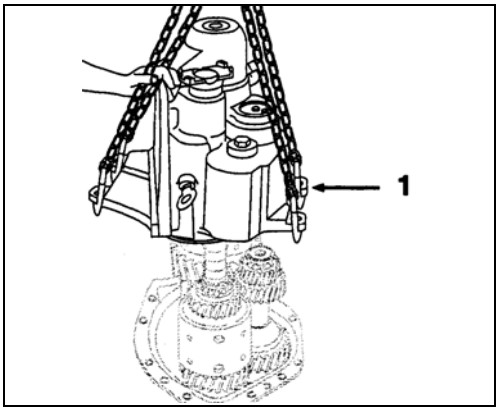


COMPLETE ASSEMBLY

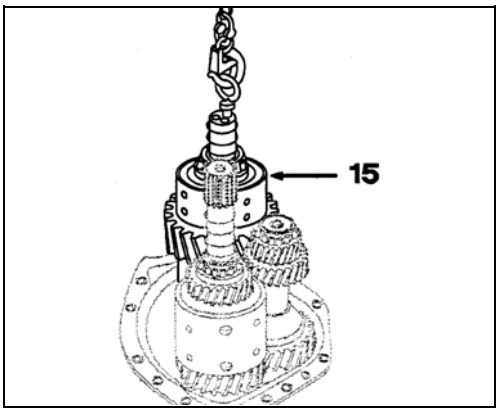
11. Rotate assembly and rest on mounting flanges. Remove rear cover mounting bolts.



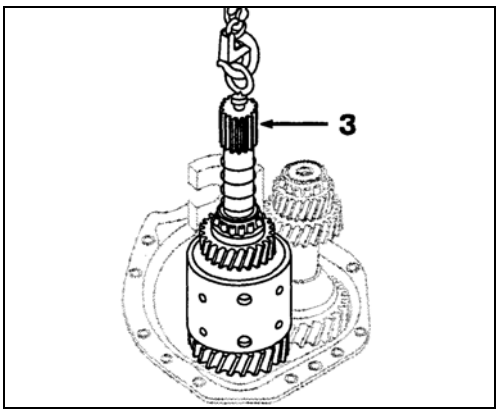
12. Attach a chain to mounting flange holes and remove transmission housing (1).



13. Attach eye bolt to range (output) shaft (15) and remove. Refer to RANGE (OUTPUT) SHAFT in this Section for service.

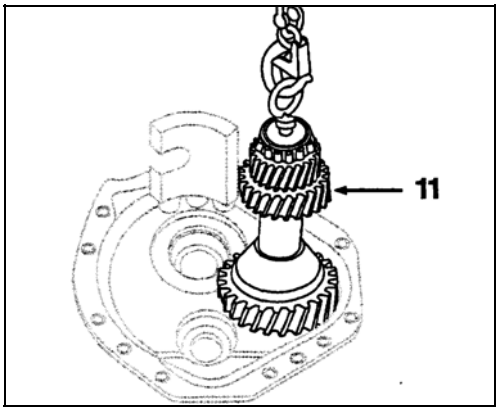


14. Attach eye bolt to directional (input) shaft (3) and remove. Refer to DIRECTIONAL (INPUT) SHAFT in this Section for service.

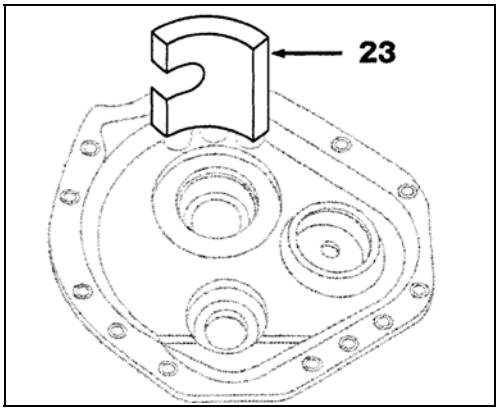


COMPLETE ASSEMBLY

15. Attach eye bolt to countershaft (11) and remove. Refer to COUNTERSHAFT in this Section for service.

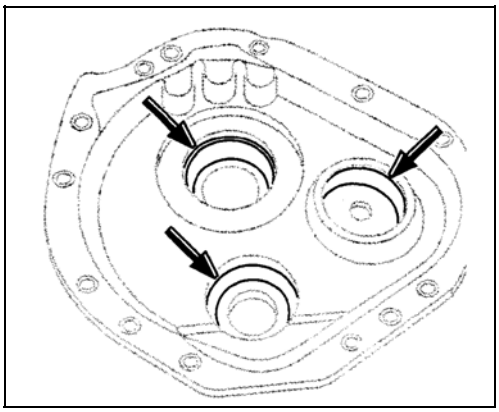


16. Remove scavenge tube baffle (23).

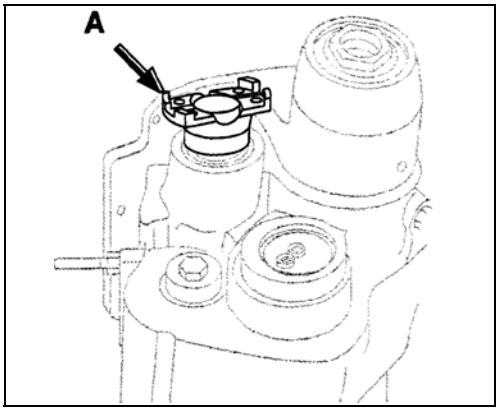


17. If bearing cup(s) require replacement, weld a bead around cup to shrivel, then remove.

NOTE: *When one or two cups are removed, make sure remaining cup(s) are completely covered.*

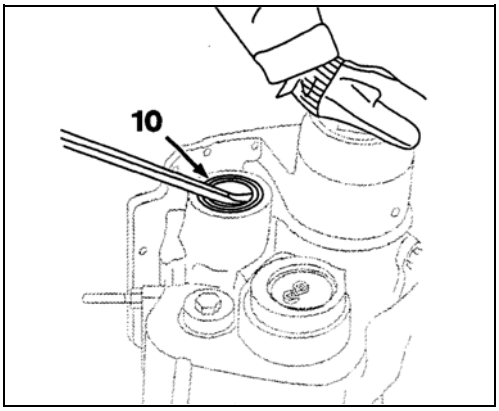


18. Remove drive shaft yoke (A).

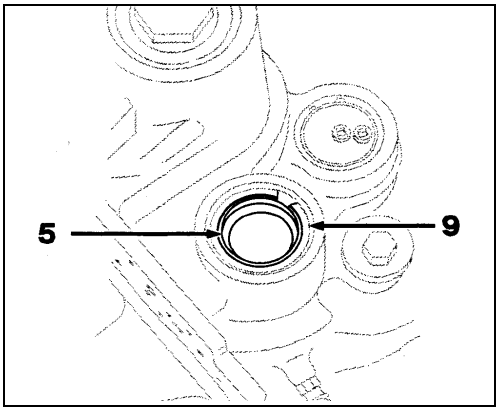


COMPLETE ASSEMBLY

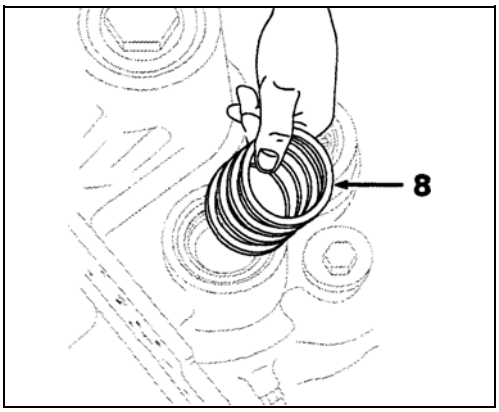
19. Pry oil seal (10) from housing.



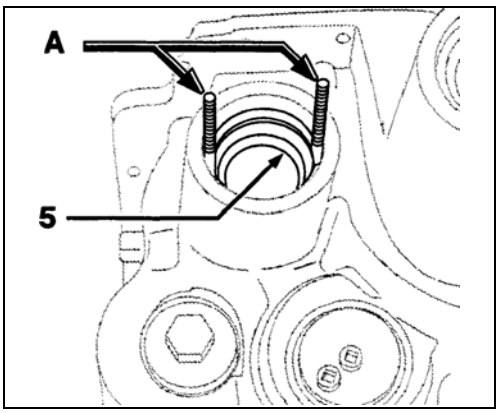
20. Carefully tap down on directional shaft manifold (5) to free up retaining ring (9). Remove ring.



21. Remove shims (8).



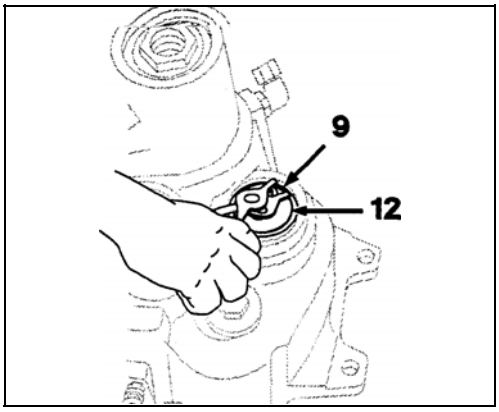
22. Install manifold tool (A), see SERVICE/SPECIAL TOOLS in this Section, to directional shaft manifold (5). Equally pull up on tool and remove manifold.



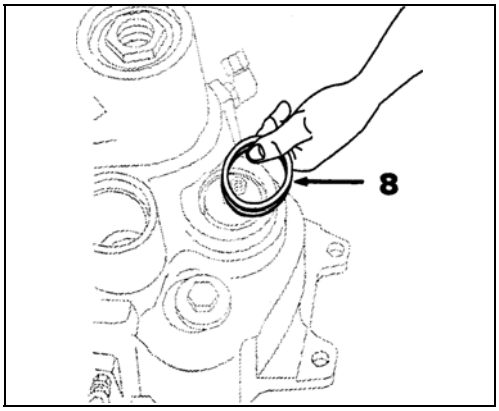
TRANSMISSION

COMPLETE ASSEMBLY

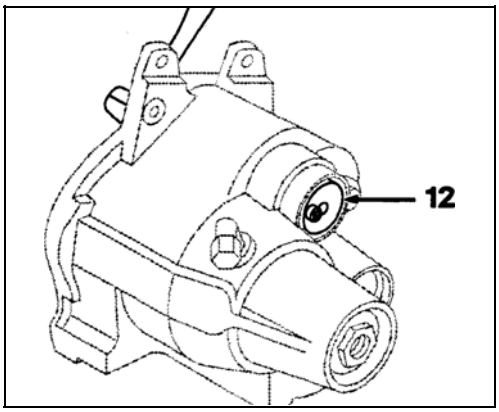
23. Tap down on countershaft cover (12) to free up retaining ring (9), then remove.



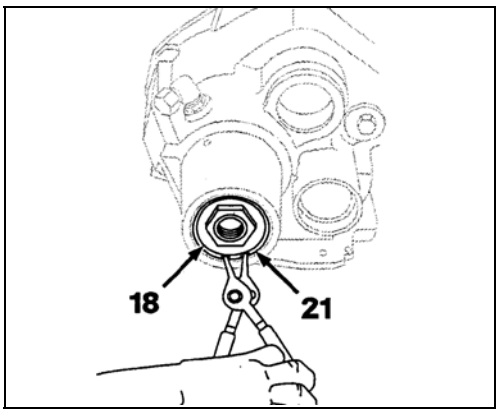
24. Remove shims (8).



25. From inside housing, drive countershaft cover (12) out. This is necessary to overcome drag caused by O-ring. Remove and discard O-ring.

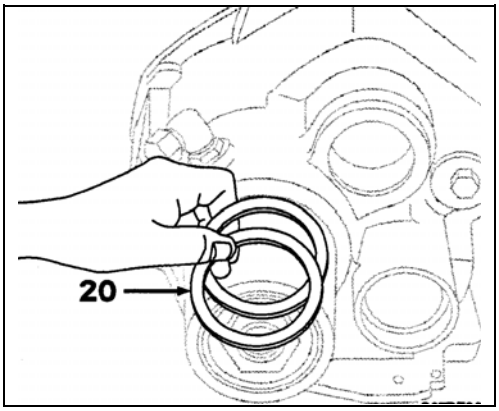


26. Tap on range clutch manifold (18) to free up retaining ring (21), then remove ring.

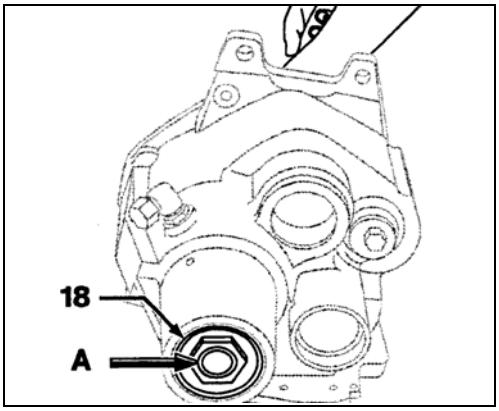


COMPLETE ASSEMBLY

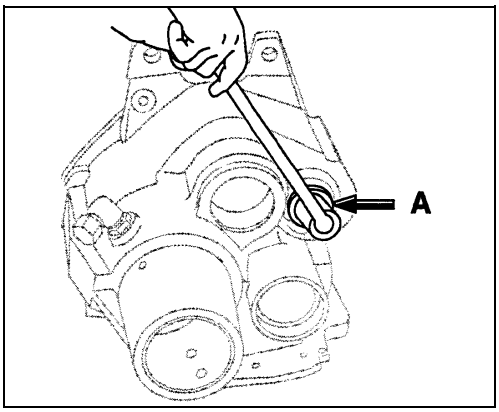
27. Remove shims (20).



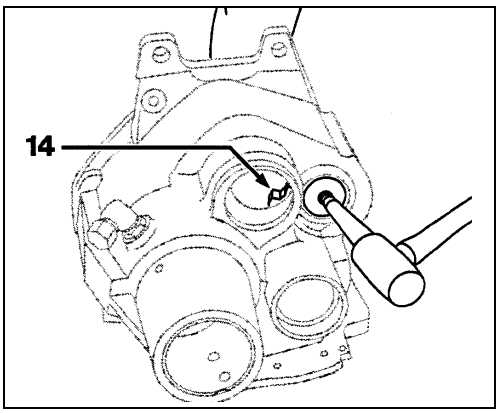
28. Install port plug (A) in connector (22) in range shaft manifold (18). Using a long drift on port plug from inside housing, remove manifold.



29. Remove reverse idler gear mounting bolt and spacer (A).

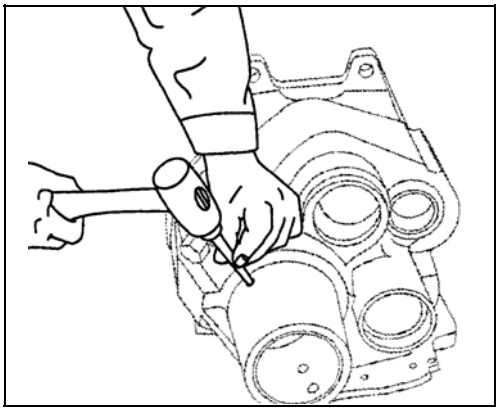


30. Install a long bolt to reverse idler gear (14) shaft and drive from housing. This is necessary to overcome drag of shaft O-ring. Refer to REVERSE IDLER GEAR in this Section for service.

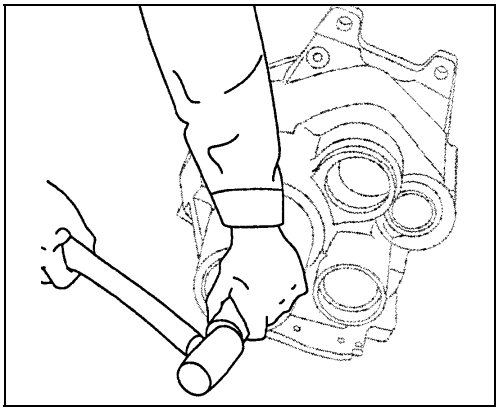


COMPLETE ASSEMBLY

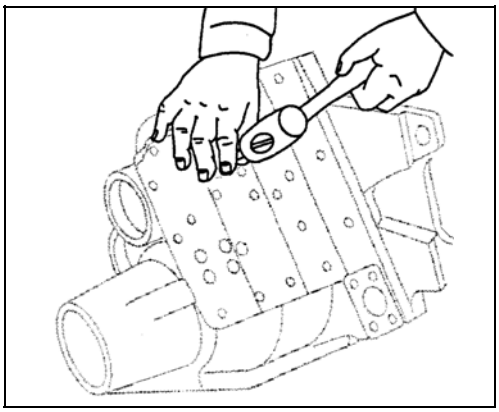
31. Drive dowel pin from housing.



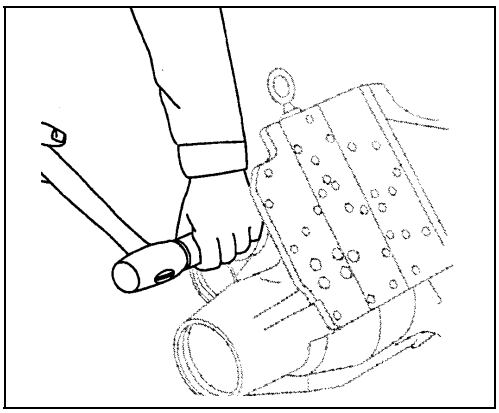
32. Using a suitable drive, remove bearing cup from housing.



33. Drive dowel pin from input shaft bore.



34. Using a suitable driver, remove bearing cup from input shaft bore. Using same driver, remove bearing cup from countershaft bore.

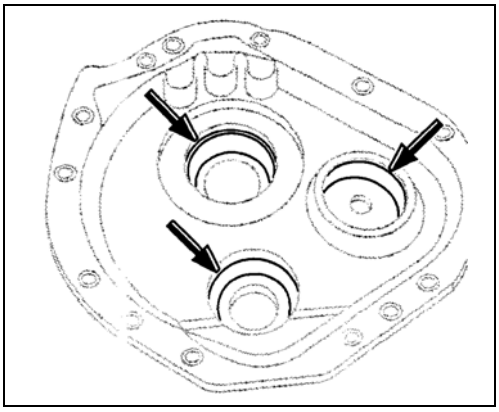


COMPLETE ASSEMBLY

7. REASSEMBLY

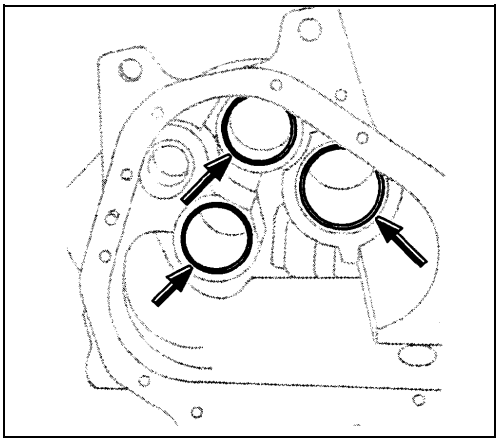
NOTE: *Callouts from exploded view (Refer to Fig. 7C.2) correspond with callouts in following steps.*

1. If removed, install new bearing cups in rear cover. Bottom new cups in their bores.

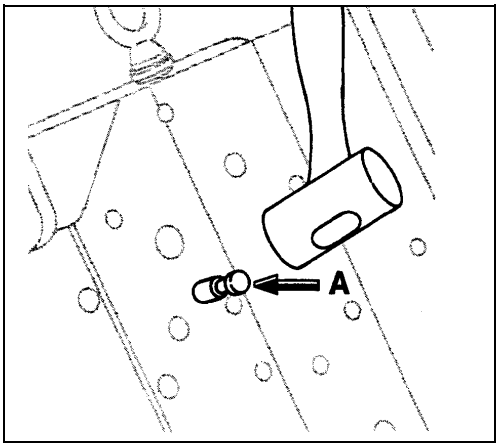


2. Install bearing cups in housing flush with edges.

NOTE: *Bearing cups edges protruding up to 3 [mm] max over housing is allowed.*

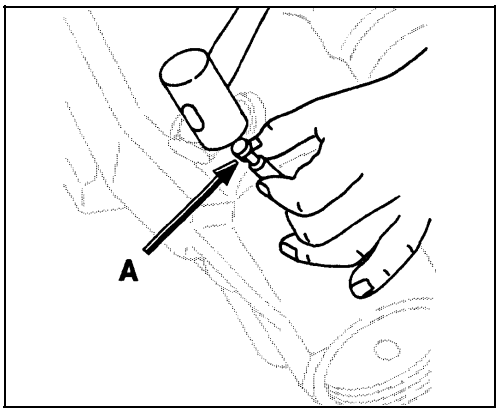


3. If removed, assemble (step 3 and 4) two dowels pins to transmission housing and set to 10 ± 0.8 [mm] dimension. Insert dowel pin into input shaft bore. Using installing tool (A), see SERVICE/SPECIAL TOOLS in this Section, position to predetermined depth.

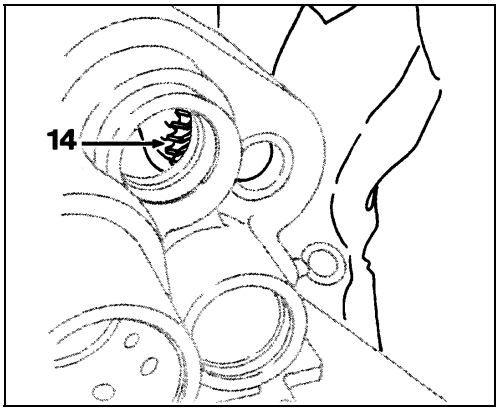


COMPLETE ASSEMBLY

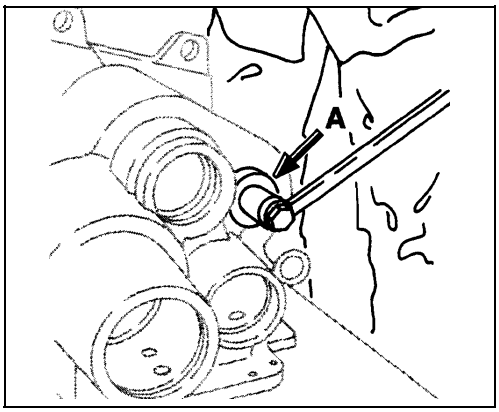
4. Insert dowel pin into output shaft bore. Using installing tool (A), see SERVICE/SPECIAL TOOLS in this Section, position to predetermined depth.



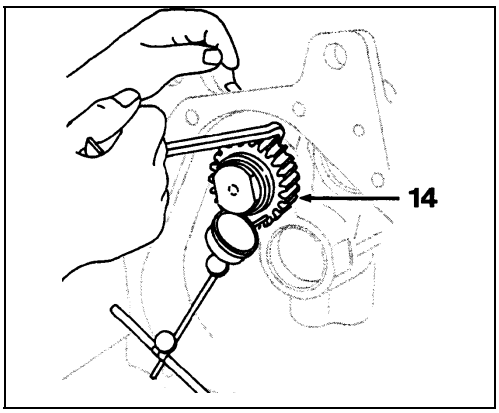
5. Coat leading edge of reverse idler gear (14) shaft with amber grease and install into transmission housing. Be careful not to cut or distort shaft O-ring while installing.



6. Install shaft retainer and bolt (A) and torque to 325 ± 10% [Nm].

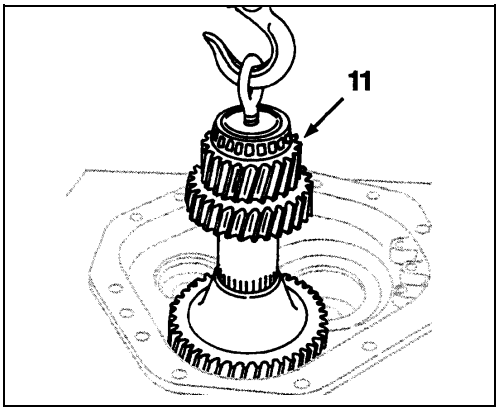


7. Using a dial indicator, check reverse idler gear (14) for end play. These bearings are non adjustable. The idle gear should turn freely with 0 to 0.25 [mm] end play.

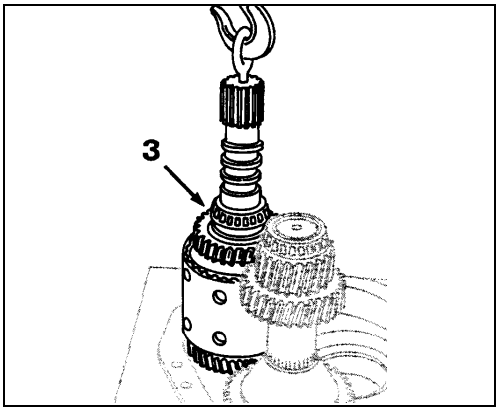


COMPLETE ASSEMBLY

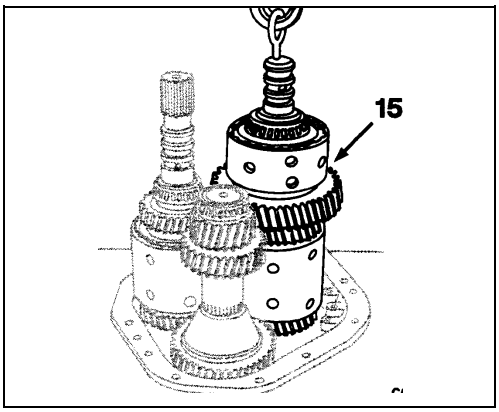
8. Install countershaft (11) into bearing cup in rear cover.



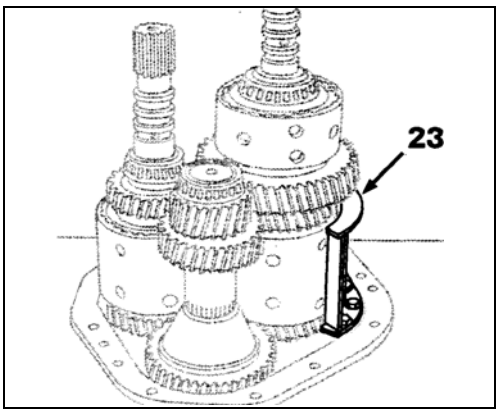
9. Install directional (input) shaft (3) into bearing cup in rear cover.



10. Install range (output) shaft (15) into bearing cup in rear cover.

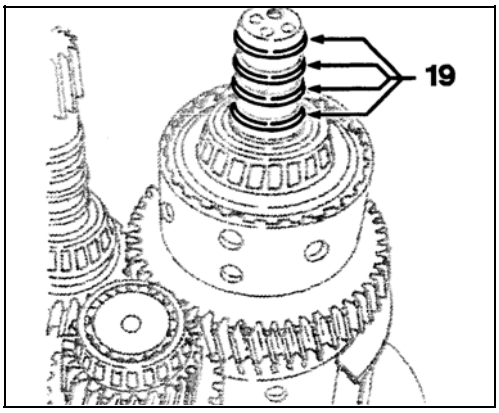


11. Install scavenge tube baffle (23) and secure with hardware. Torque to 38 ± 10% [Nm].

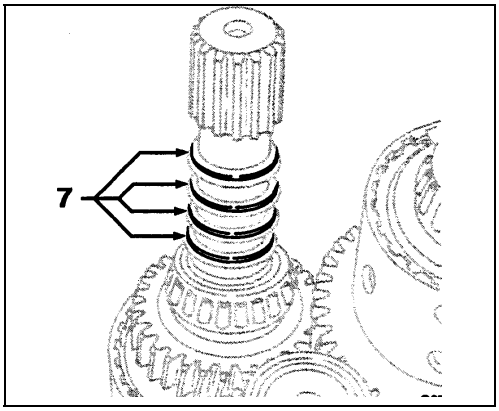


COMPLETE ASSEMBLY

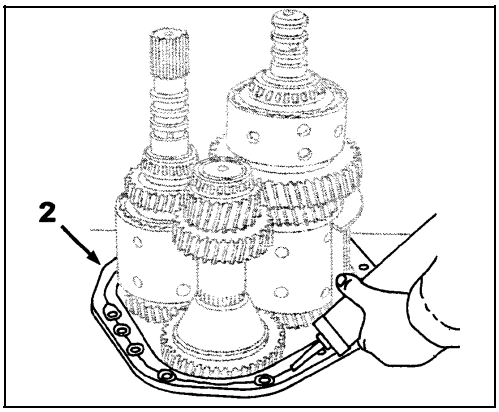
12. Install new seal rings (19) to range (output) shaft.



13. Install new seal rings (7) to directional (input) shaft.

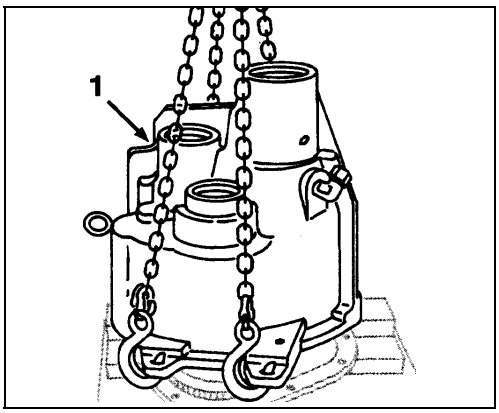


14. Apply LOCTITE #515 to mating surface of rear cover (2). Loop around bolt holes.



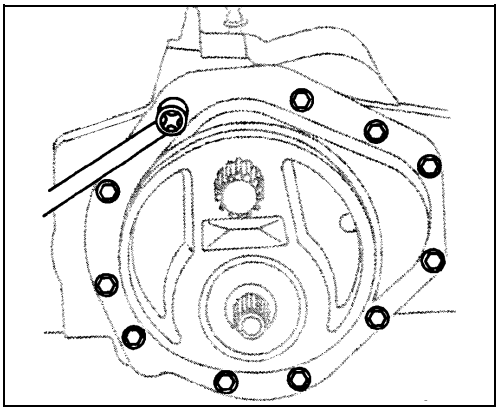
15. Using four legged chain lower transmission housing (1), over shafts, aligning dowel pins with holes. Install hardware finger tight.

NOTE: *Use LOCTITE #262 for two rear cover mounting bolts next to reverse idler shaft (on either side of dowel pin).*

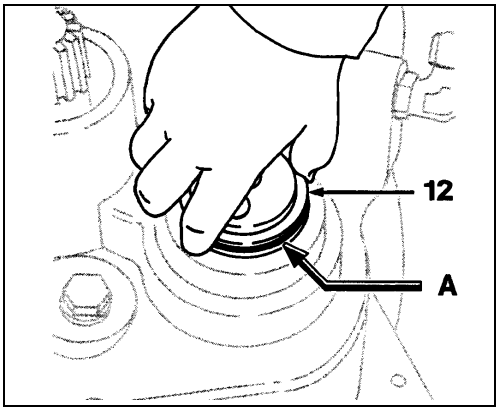


COMPLETE ASSEMBLY

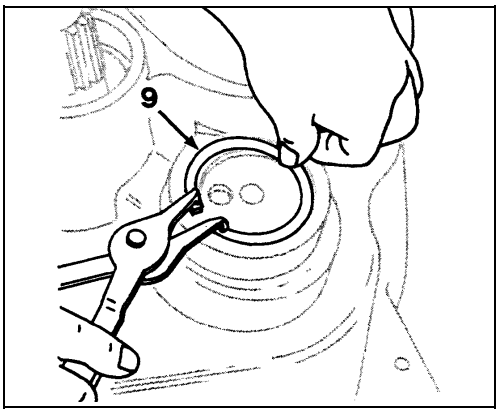
16. Turn assembly over on its side. Torque mounting bolts in crosswise order to 92 ± 10% [Nm].



17. Install countershaft cover (12) with new O-ring (A) into transmission housing. For ease of assembly cover O-ring with a coat of amber grease.

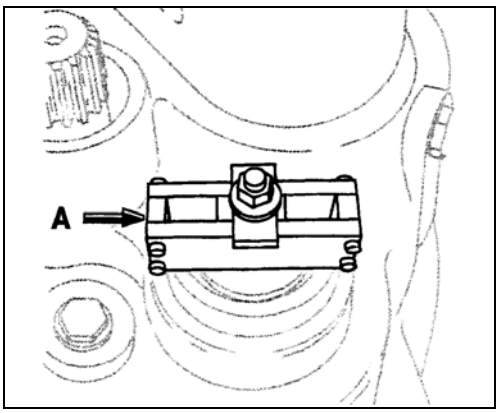


18. Assemble shim pack from shims (8) to achieve preliminary end play 0.18 - 0.31 [mm]. Shim pack must include at least one 0.80 [mm] shim (8) to be placed against retaining ring. Install retaining ring (9).



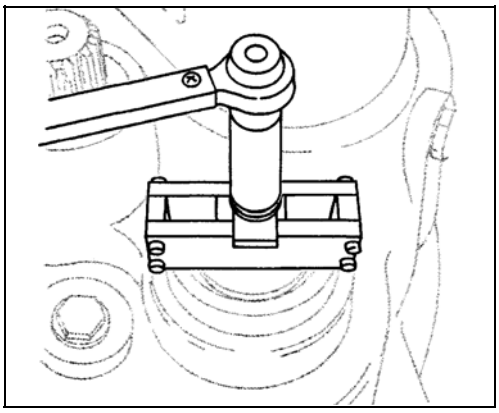
19. Install puller bridge tool (A), see SPECIAL/SERVICE TOOLS in this Section, as follows;

    Thread rod through countershaft cover center hole into countershaft lifting threads. Lock nut against cover. Install bridge and secure with clamp, washer and nut.

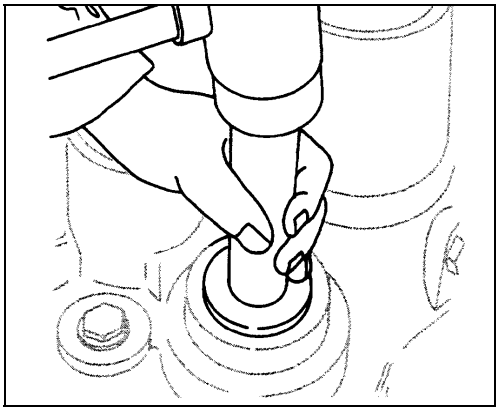


COMPLETE ASSEMBLY

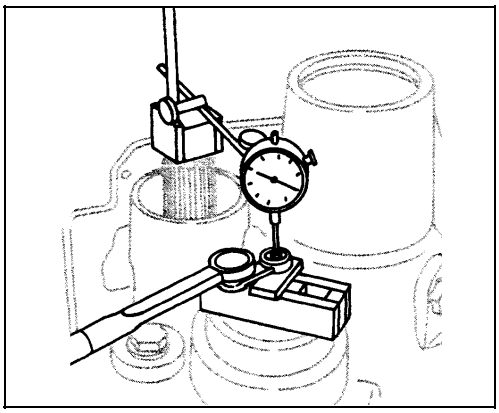
20. Pull up on countershaft with a torque of 110 [Nm] to seat components. Reduce torque to zero.



21. Remove tool. Lightly tap down on countershaft cover to attempt to achieve an excessive initial end play condition.

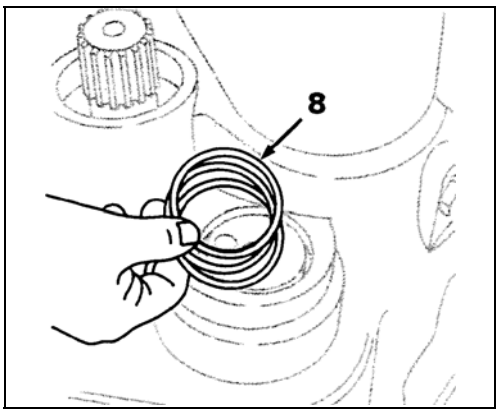


22. Install end play adjuster bridge tool to countershaft, see SPECIAL/SERVICE TOOLS in this Section. Install torque wrench. Set dial indicator to zero. Pull up on countershaft with 60 [Nm] until indicator movement stabilizes. Record indicator movement value.



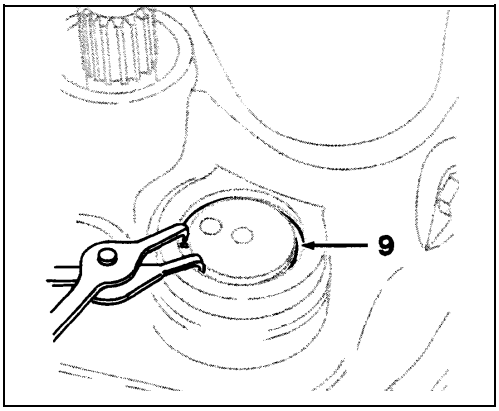
23. Add or remove shims to achieve desired end play 0.18 - 0.28 [mm]. Proper shim pack (8) must include at least one 0.80 [mm] shim (8) to be placed against retaining ring.

NOTE: *If it is determined that end play adjustment falls out specification the shaft must be pulled up again with new shim pack as described above.*

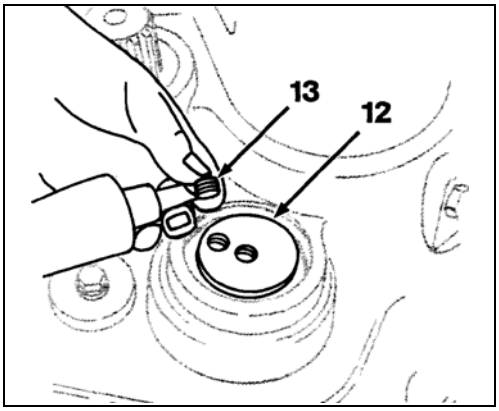


COMPLETE ASSEMBLY

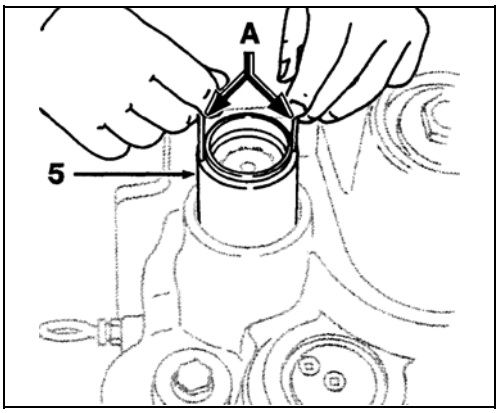
24. Install retaining ring (9) up against 0.80 [mm] shim (8) into groove in housing. Recheck shaft end play after this procedure.



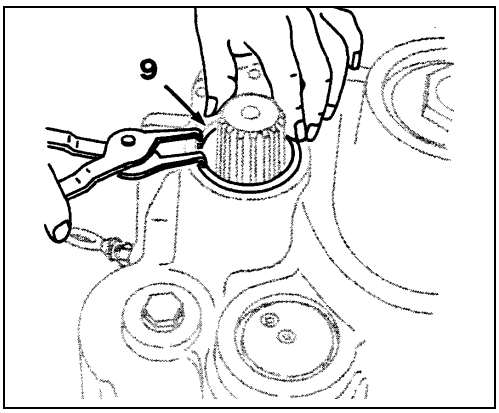
25. Coat pipe plugs (13) threads with LOCTITE #592 and install into countershaft cover (12).



26. Using tool (A), see SPECIAL/SERVICE TOOLS in this Section, install directional (input) shaft manifold (5), indexing manifold slot with dowel pin, into transmission housing. Be careful not to cut, twist or distort seal rings on shaft.



27. Assemble shim pack from shims (8) to achieve preliminary end play 0.18 – 0.31 [mm]. Shim pack must include at least one 0.80 [mm] shim (8) to be placed against retaining ring. Install retaining ring (9) into groove in transmission housing.

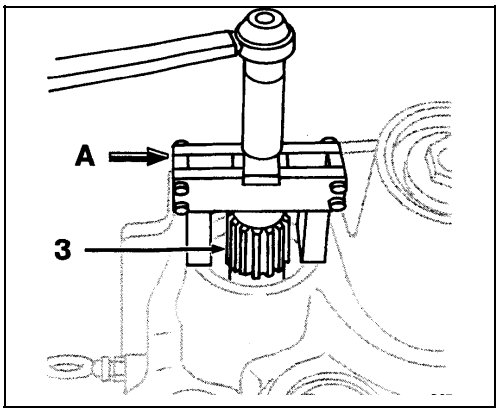


COMPLETE ASSEMBLY

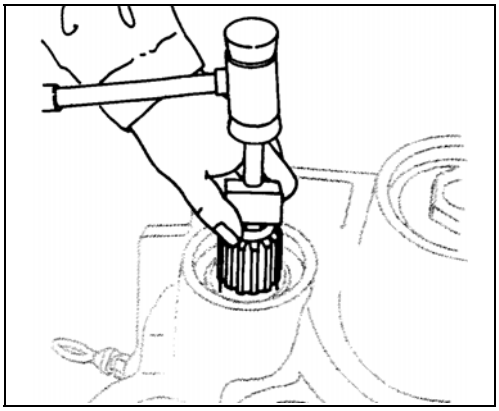
28. Install puller bridge tool (A), see SPECIAL/SERVICE TOOLS in this Section, as follows;

    Thread rod into directional (input) shaft (3) lifting threads. Lock nut against shaft. Install bridge with extension legs and secure with clamp, washer and nut.

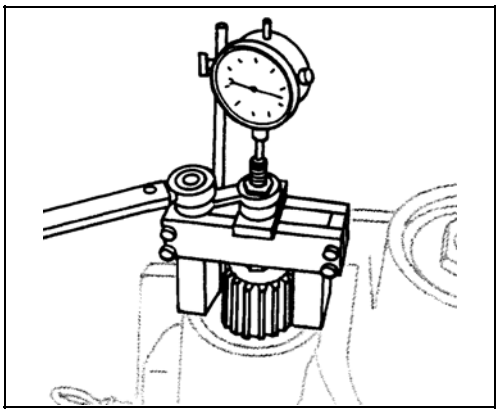
    Pull up on directional (input) shaft with a torque of 110 [Nm] to seat components. Reduce torque to zero.



29. Remove bridge tool. Lightly tap down on directional (input) shaft to attempt to an excessive initial end play condition.

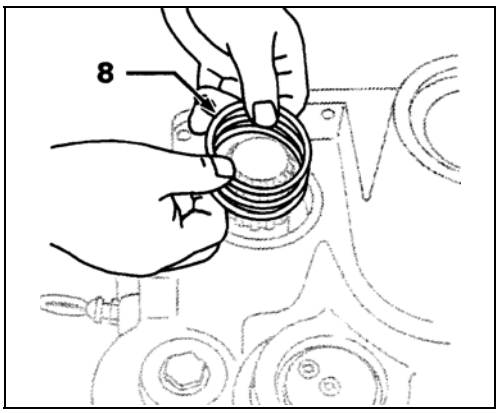


30. Install end play adjuster bridge tool to directional (input) shaft, see SPECIAL/SERVICE TOOLS in this Section. Install torque wrench. Set dial indicator to zero. Pull up on directional (input) shaft with 60 [Nm] until indicator movement stabilizes. Record indicator movement value.



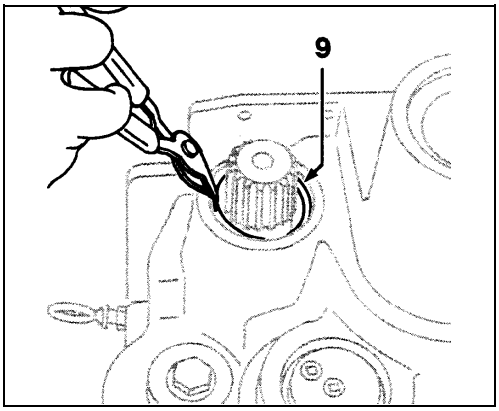
31. Add or remove shims to achieve desired end play 0.18 - .0.28 [mm]. Proper shim pack (8) must include at least one 0.80 [mm] shim (8) to be placed against retaining ring.

NOTE: *If it is determined that end play adjustment falls out specification the shaft must be pulled up again with new shim pack as described above.*

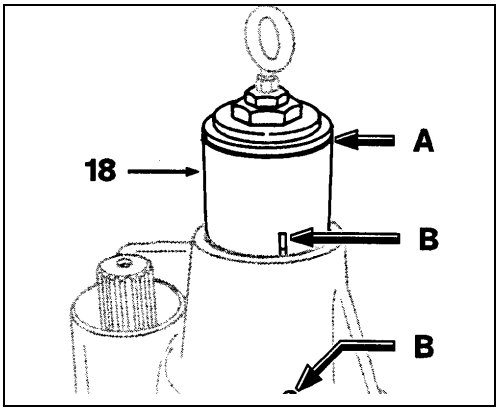


COMPLETE ASSEMBLY

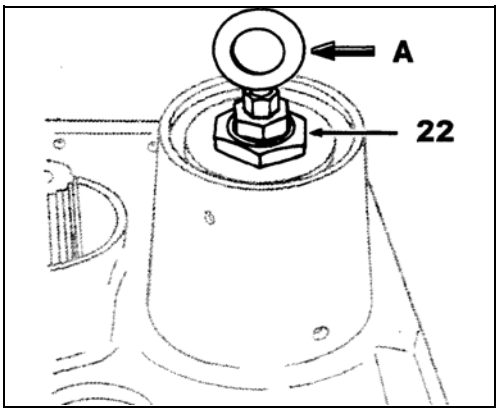
32. Install retaining ring (9) up against 0.80 [mm] shim into groove in housing. Recheck shaft end play after this procedure.



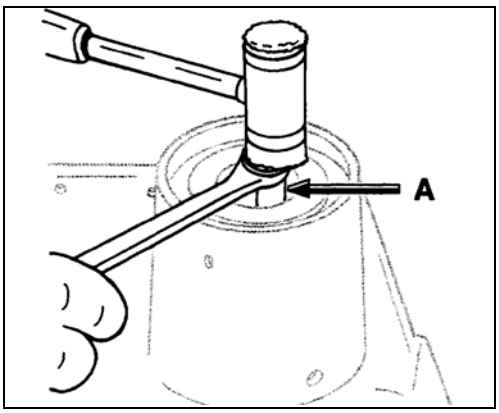
33. Install new O-ring (A) to range (output) shaft manifold (18). Install manifold, indexing slot (B) with dowel pin, into transmission housing (use range shaft manifold tool, see SPECIAL/SERVICE TOOLS in this Section, if necessary). Be careful not to cut, twist or distort seal rings on shaft.



34. Remove lifting eye (A) and connector (22).

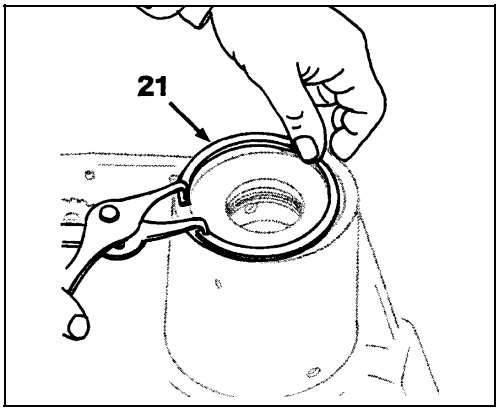


35. Install long bolt (A) to range (output) shaft and tap down on shaft while rotating.



COMPLETE ASSEMBLY

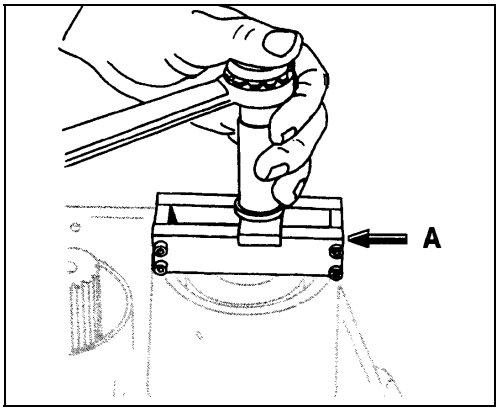
36. Assemble shim pack from shims (20) to achieve preliminary end play 0.18 – 0.31 [mm]. Shim pack must include at least one 0.80 [mm] shim (20) to be placed against retaining ring. Install retaining ring (21) into groove in transmission housing.



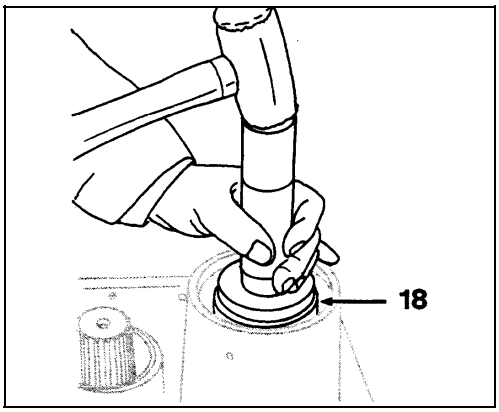
37. Install puller bridge tool (A), see SPECIAL/SERVICE TOOLS in this Section, as follows;

    Thread rod into range (output) shaft lifting threads. Lock nut against shaft. Install bridge and secure with clamp, washer and nut.

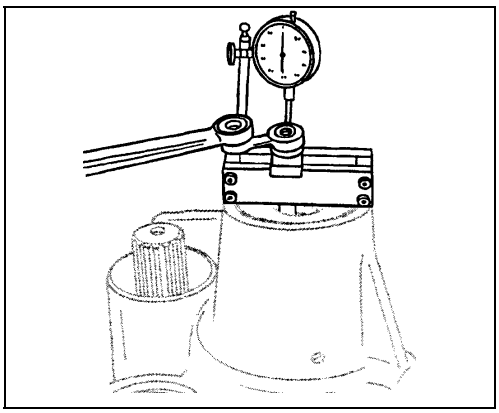
    Pull up on range (output) shaft with a torque of 110 [Nm] to seat components. Reduce torque to zero.



38. Remove bridge tool. Lightly tap down on range (output) shaft manifold (18) to attempt to achieve an excessive initial end play condition.



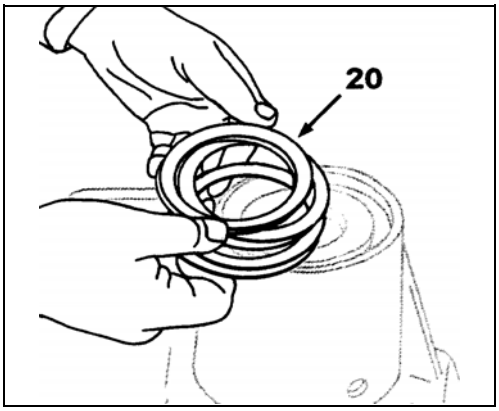
39. Install end play adjuster bridge tool to range (output) shaft, see SPECIAL/SERVICE TOOLS in this Section. Install torque wrench. Set dial indicator to zero. Pull up on directional (input) shaft with 60 [Nm] until indicator movement stabilizes. Record indicator movement value.



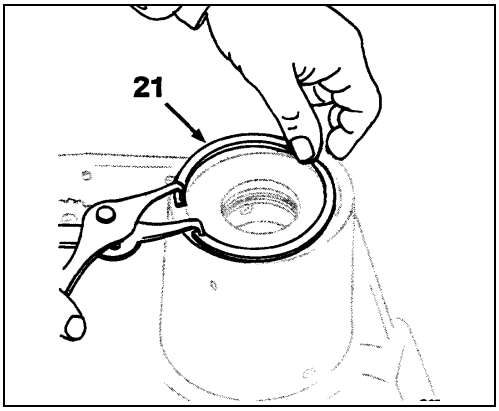
COMPLETE ASSEMBLY

40. Add or remove shims to achieve desired end play 0.18 - .0.28 [mm]. Proper shim pack (20) must include at least one 0.80 [mm] shim (20) to be placed against retaining ring.

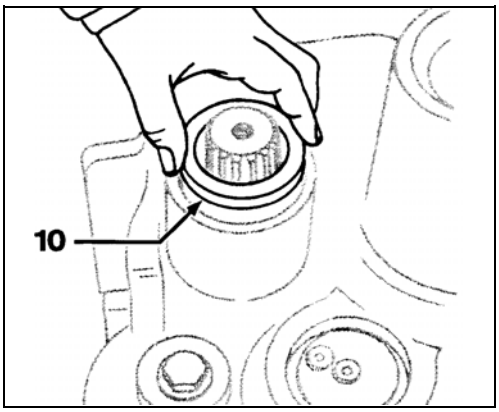
NOTE: *If it is determined that end play adjustment falls out specification the shaft must be pulled up again with new shim pack as described above.*



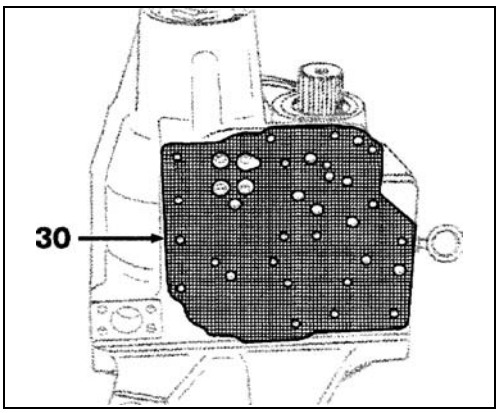
41. Install retaining ring (21) up against 0.80 [mm] shim into groove in housing. Recheck shaft end play after this procedure.



42. Install new seal ring (10) flush with transmission housing.

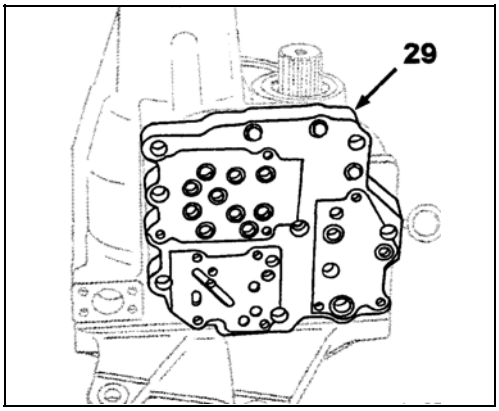


43. Position gasket (30) on transmission mating surface.

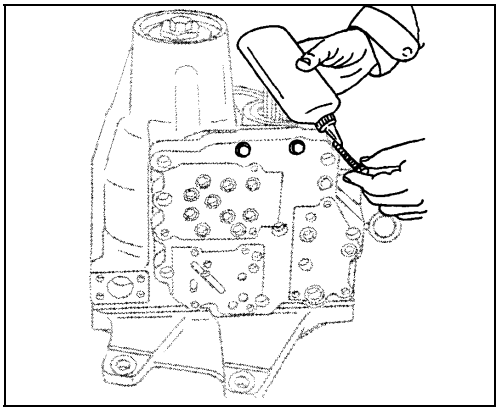


COMPLETE ASSEMBLY

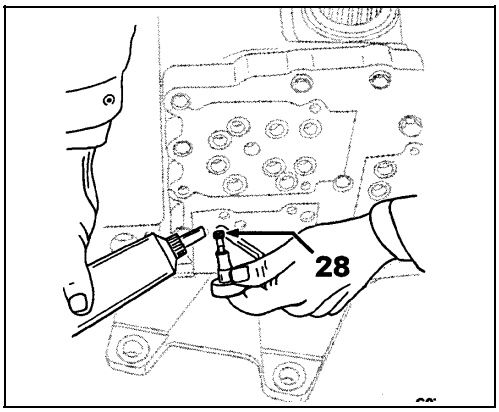
44. Install valve manifold (29). Apply LOCTITE #262 to two mounting bolts and install.



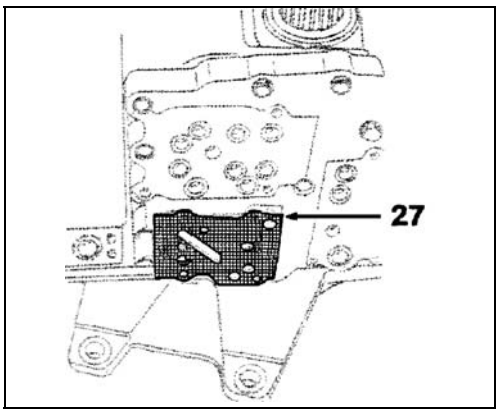
45. Apply LOCTITE #262 to remaining mounting bolts and install. Torque to 38 ± 10% [Nm].



46. Coat orifice strainer (28) threads with LOCTITE #592 and install to port in rate of rise valve land.

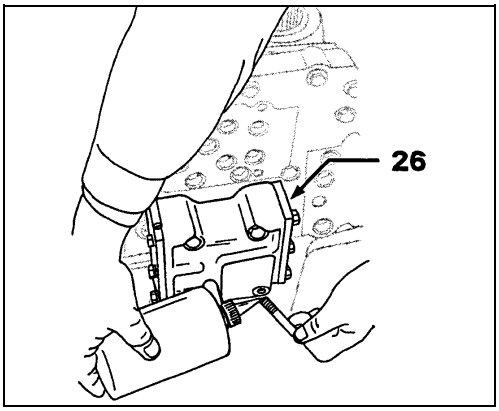


47. Position gasket (27) on manifold mating surface.

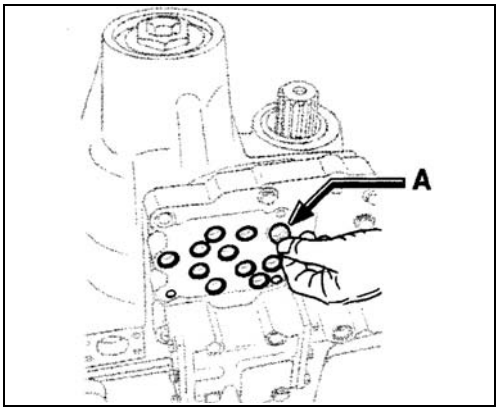


COMPLETE ASSEMBLY

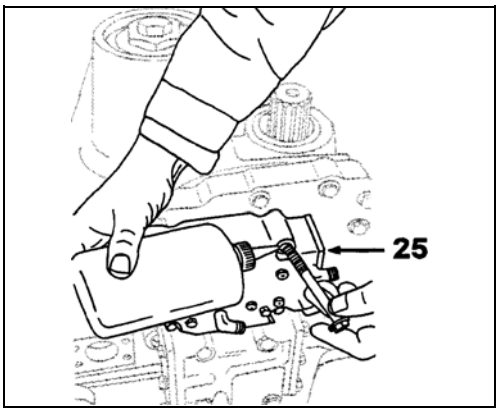
48. Position rate of rise valve (26). Apply LOCTITE #262 to bolts and install. Torque bolts to 38 ± 10% [Nm].



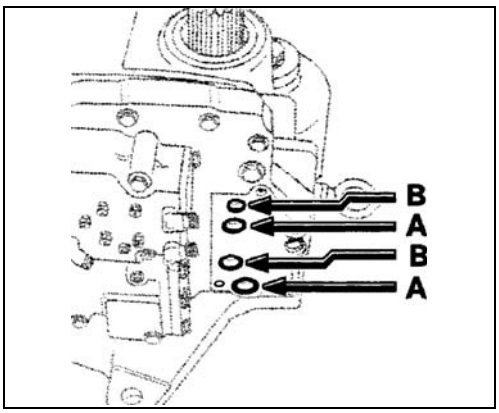
49. Position O-rings (B), (qty. 10), to ports to prepare range selector valve installing.



50. Position range selector valve (25). Apply LOCTITE #262 to top bolts and install. Install two bottom bolts with LOCTITE #262. Torque bolts to 38 ± 10% [Nm].

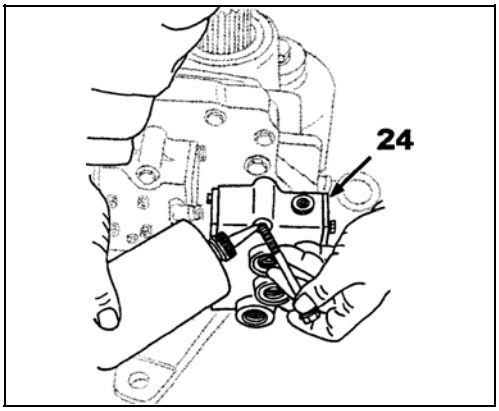


51. Position O-rings, two large (A), two small (B), to ports to prepare pressure regulator valve installing.

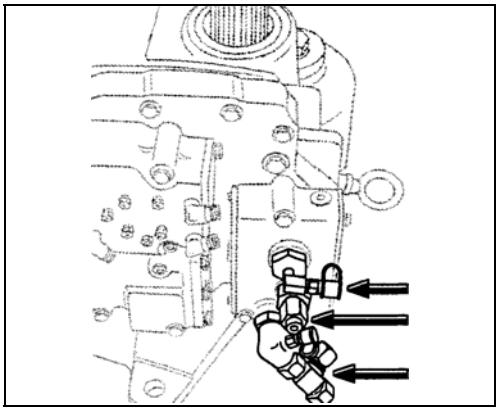


COMPLETE ASSEMBLY

52. Position main regulator valve (24). Apply LOCTITE #262 to top bolt and install. Install two bottom bolts with LOCTITE #262. Torque bolts to 38 [Nm] ±10%.

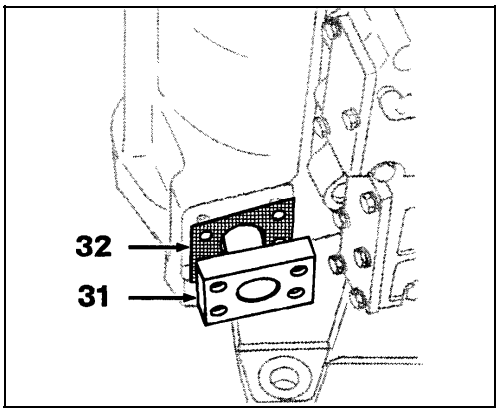


53. Install fittings to main regulator valve.

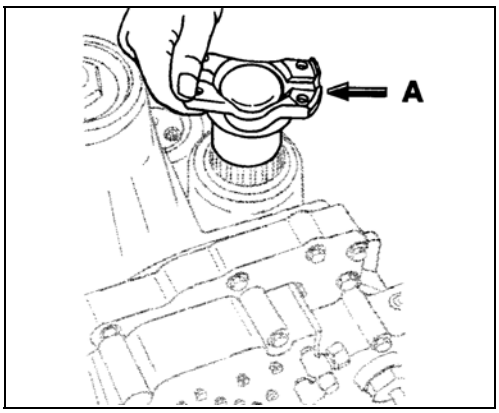


54. Install scavenge tube (31) and gasket (32) and secure with one bolt.

NOTE: *Scavenge tube and gasket are secured with hose, split flanges and bolts mounted at installation.*

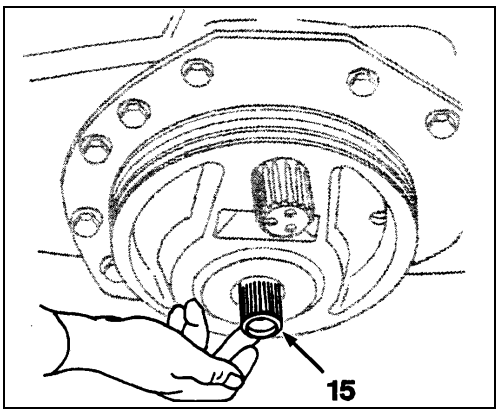


55. Install transmission input flange (A).

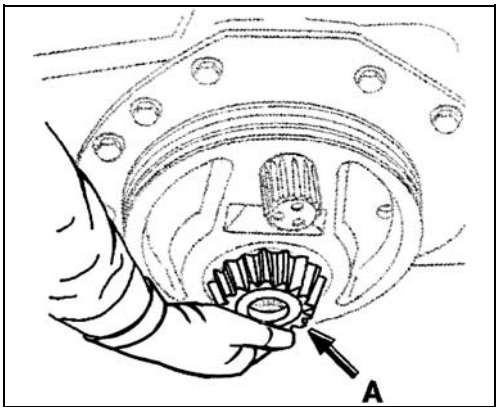


COMPLETE ASSEMBLY

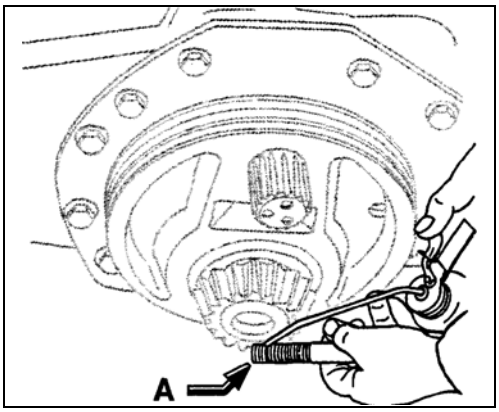
56. Coat range (output) shaft (15) splines with “Never Seez”.



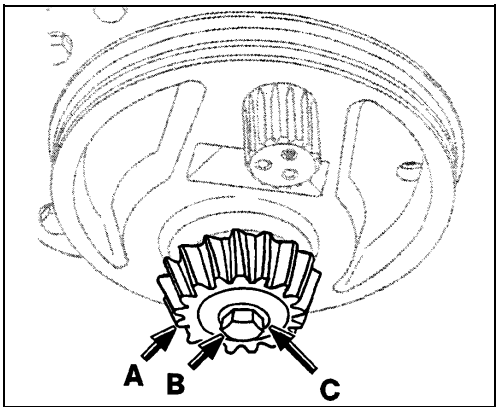
57. Heat pinion gear (A) to 210 [°C] for 45 [minutes]. Install on splines and bottom. To insure gear is seated, lightly tap on gear to bottom it.



58. Coat mounting bolt (A) threads with clean oil.



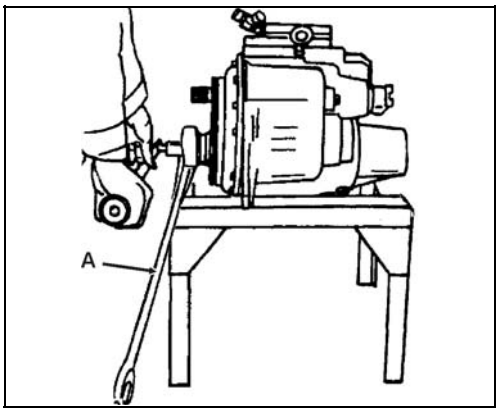
59. Secure pinion gear (A) to range (output) shaft with bolt (B) and spacer (C).



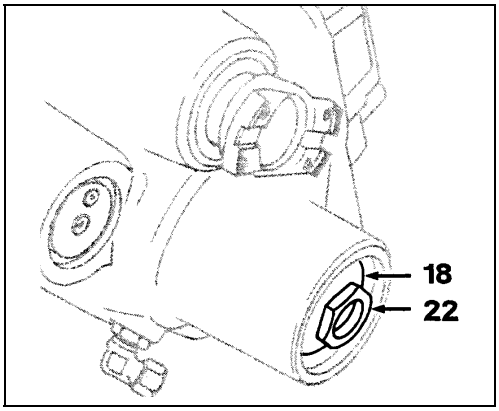
COMPLETE ASSEMBLY

60. Secure range (output) shaft on pinion gear with locking arm (A), see SERVICE/SPECIAL TOOLS in this Section. Torque pinion gear mounting bolt to 380 - 410 [Nm].

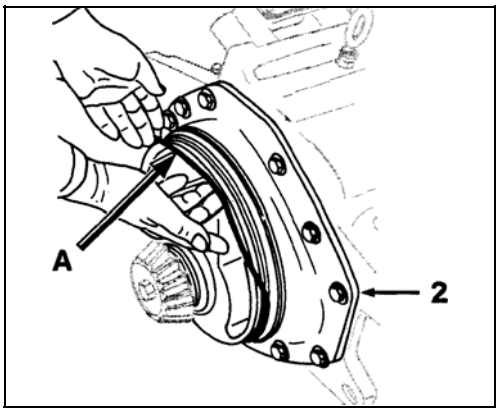
NOTE: *For TD-7M and TD-8M use locking arm with smaller diameter and for TD-9M and TD-10M with larger one.*



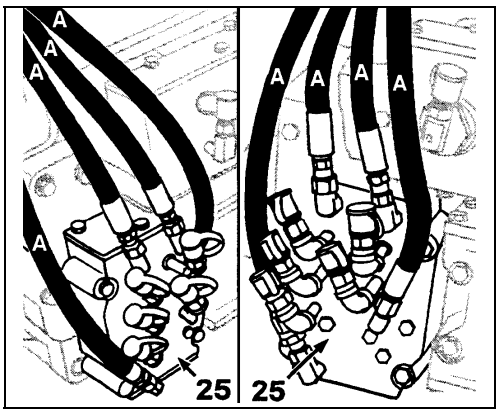
61. Install connector (22) with new O-ring to range (output) shaft manifold (18).



62. Install new O-ring (A) to rear cover (2).



63. Install hoses (A) to fittings at range selector valve (25). Test fittings may be installed at this time to aid later testing of transmission.



DIRECTIONAL (INPUT) SHAFT

8. GENERAL

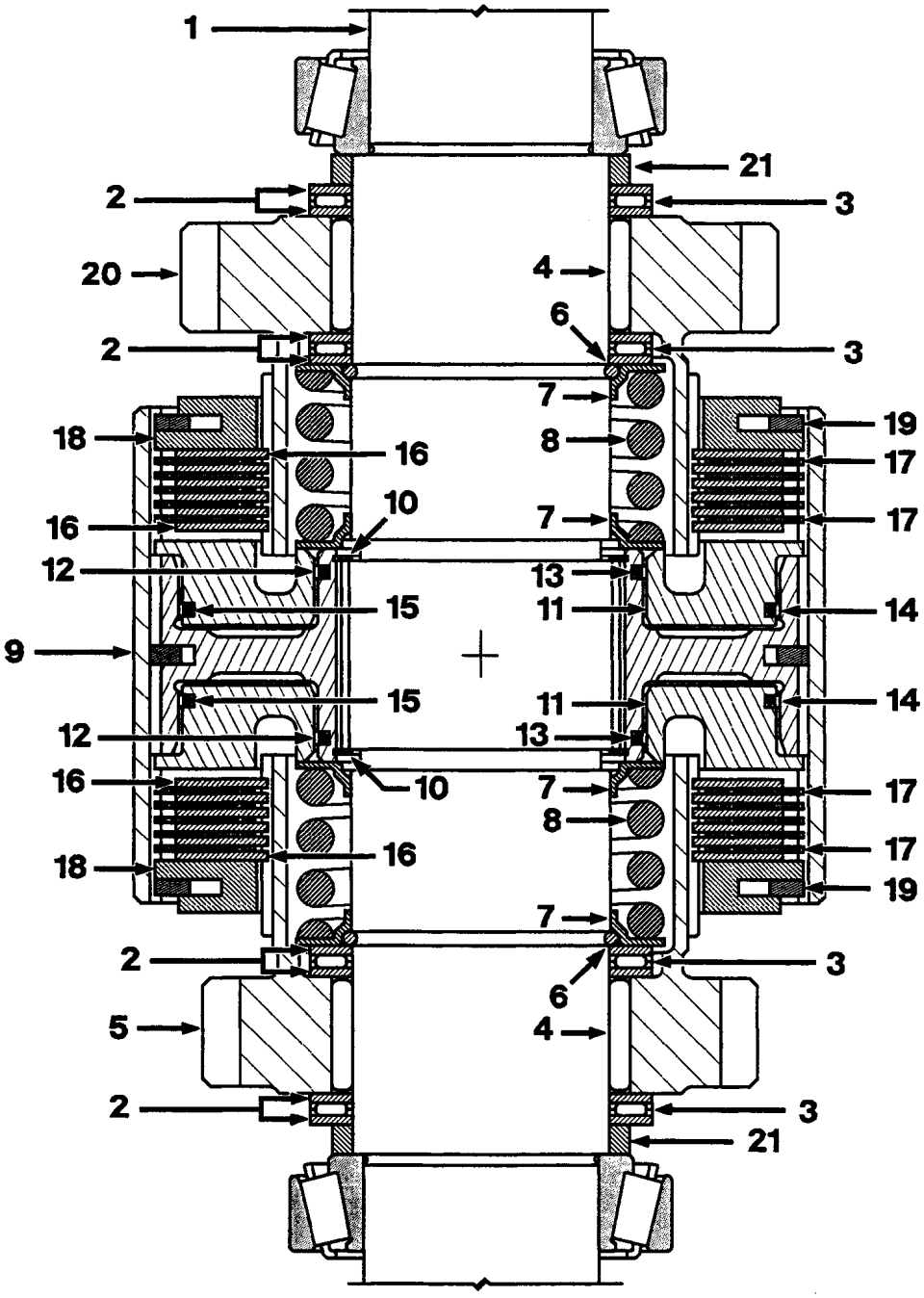


Fig. 7C.3. Cross Section View of Directional (Input) Shaft

Legend for Exploded and Cross Section Views

1. Input Shaft
2. Thrust Race Washer
3. Thrust Bearing
4. Needle Bearing
5. Forward Driver Gear and Hub
6. Retaining Ring
7. Spring Plate
8. Return Spring
9. Hub and Drum Kit
10. Retaining Ring
11. Clutch Piston (1st or 2nd Speed)
12. Seal Ring
13. O-Ring
14. Outer Piston Seal Ring
15. O-Ring
16. Friction Disc
17. Separator Plate
18. Clutch Support Plate
19. Captured Retaining Ring
20. Reverse Gear and Hub
21. Bearing Spacer Ring

DIRECTIONAL (INPUT) SHAFT

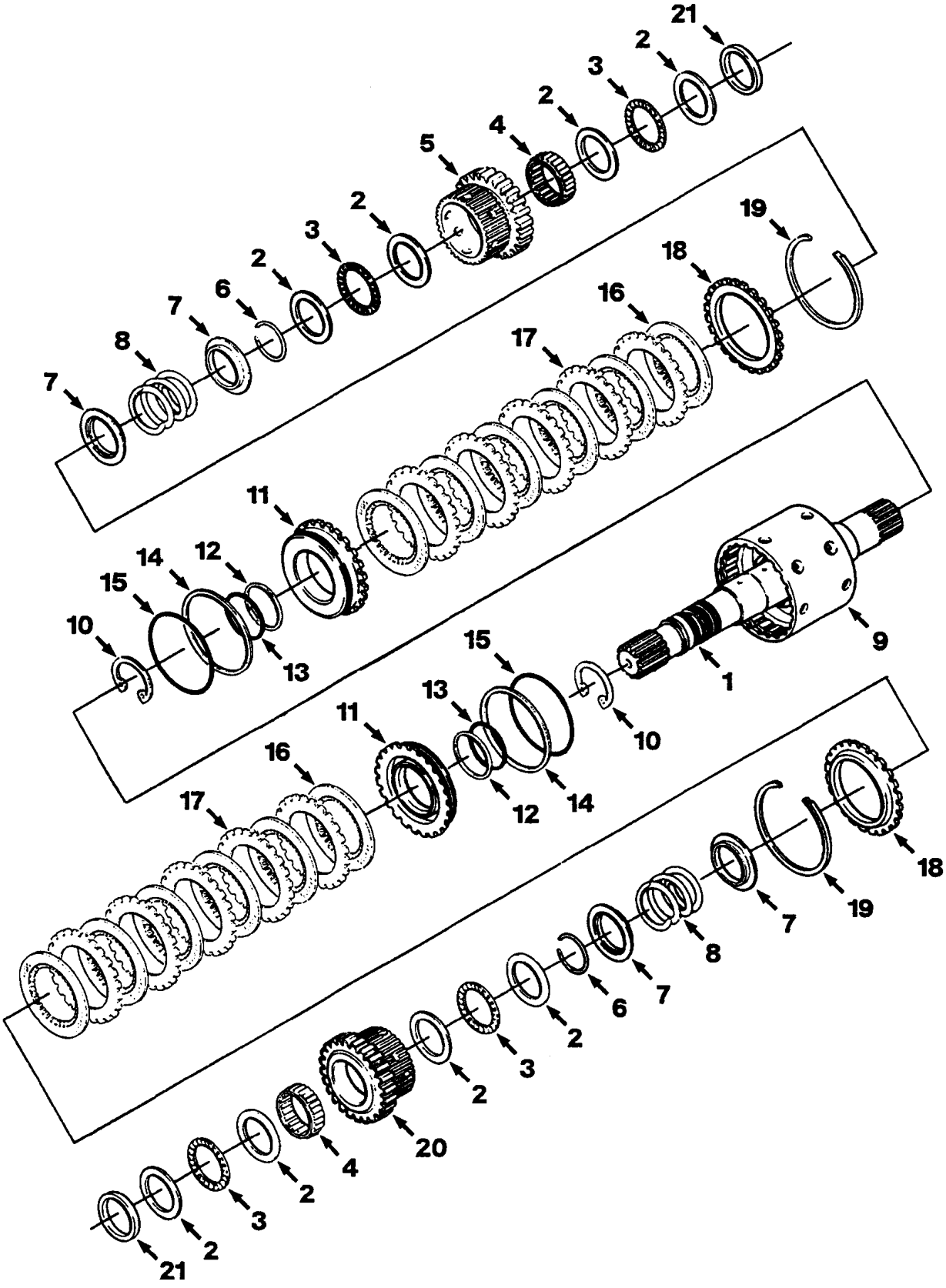


Fig. 7C.4. Exploded View of Directional (Input) Shaft

DIRECTIONAL (INPUT) SHAFT

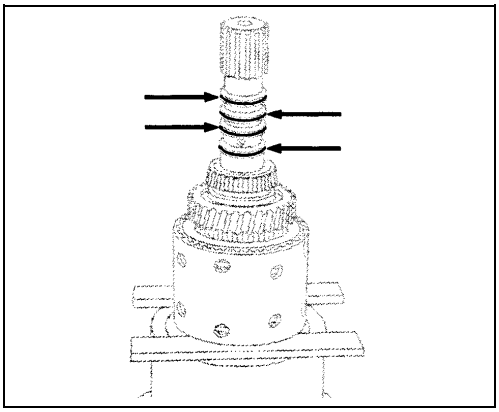
Piston Return Spring Criterion

Free Length.....56.0 [mm]
Test Length .....36.3 [mm]
Work Length.....129.6 to 36.3 [mm]
Test Load .....1490 ±150 [N]
Number of Working Coils 1.7

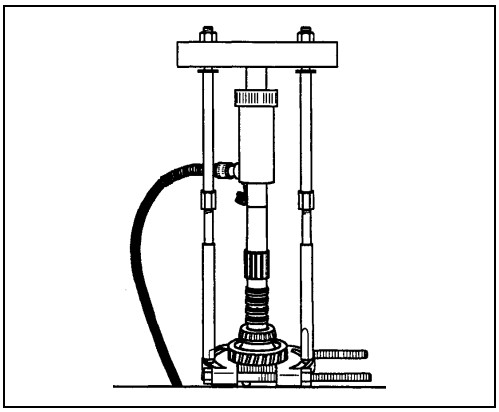
9. DISASSEMBLY

NOTE: *Callouts from exploded and cross section views (refer to Fig.'s 7C.3 and 7C.4) correspond with callouts in following steps.*

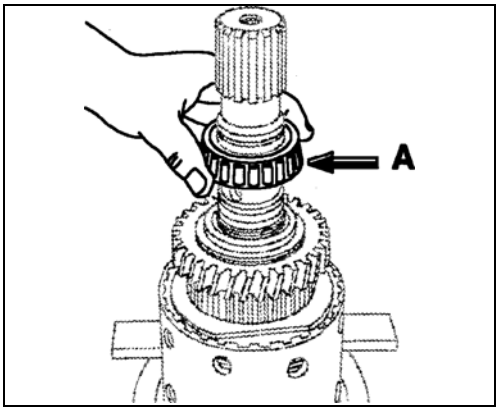
1. Position directional (input) shaft in stand supported by bars. Remove four seal rings from shaft.



2. Install bearing puller arrangement on reverse gear and hub. Activate ram to unseat bearing press fit. Remove arrangement after press fit is unseated.

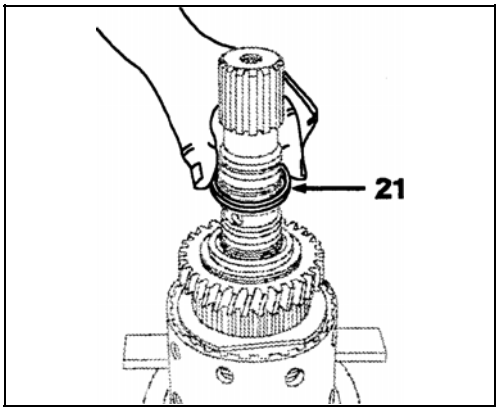


3. Remove bearing cone (A) from directional (input) shaft.

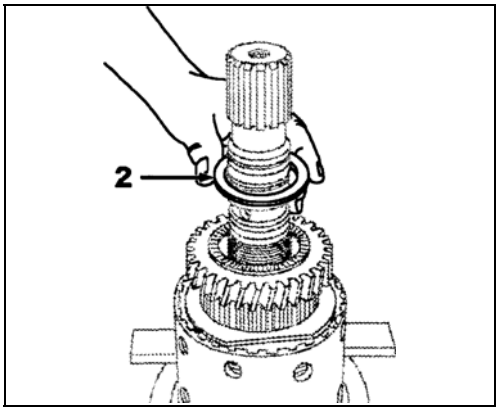


DIRECTIONAL (INPUT) SHAFT

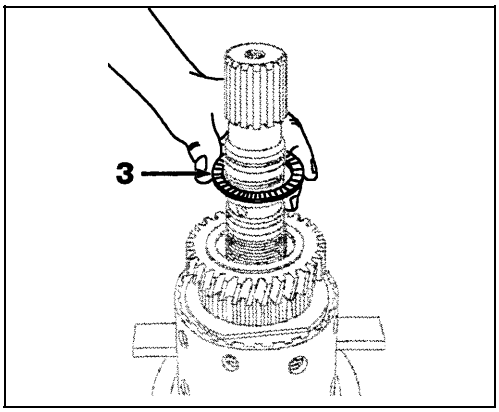
4. Remove bearing spacer ring (21) from directional (input) shaft.



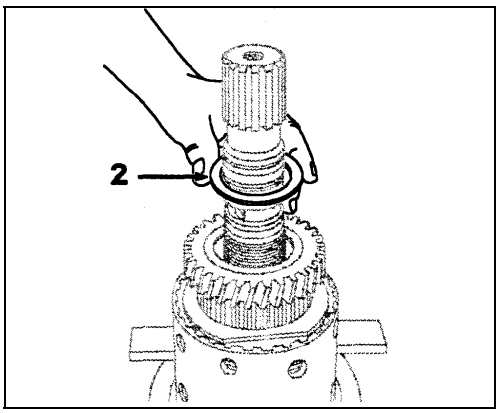
5. Remove outer thrust race washer (2).



6. Remove thrust bearing (3).

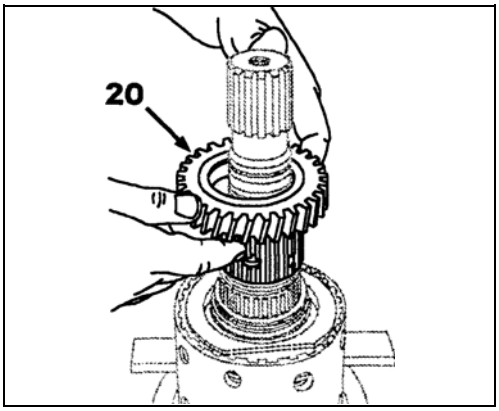


7. Remove inner thrust race washer (2).

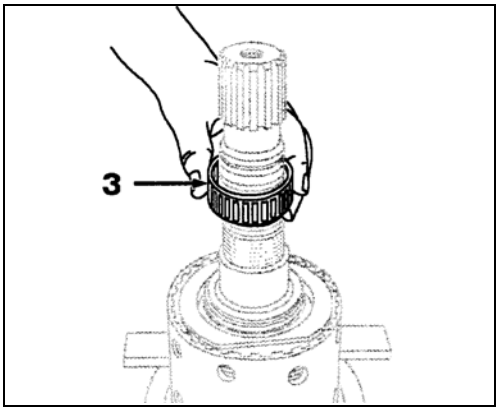


DIRECTIONAL (INPUT) SHAFT

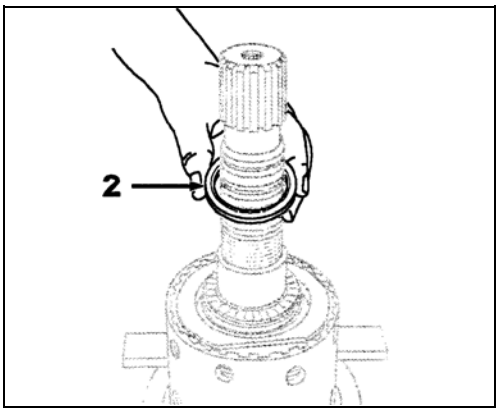
8. Remove reverse gear and hub (20) from directional (input) shaft.



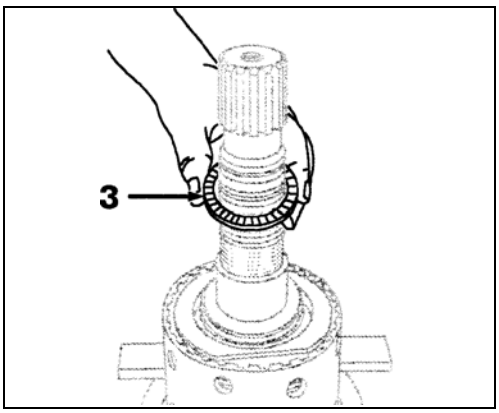
9. Remove needle bearing (4).



10. Remove outer thrust race washer (2).

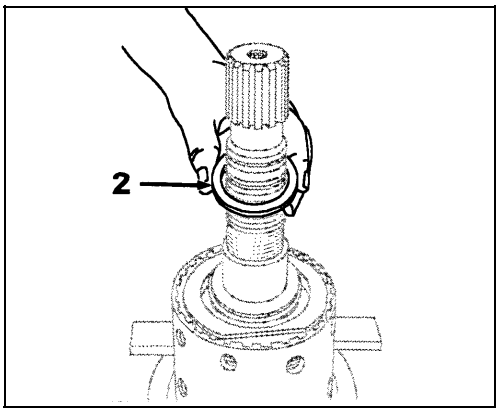


11. Remove thrust bearing (3).

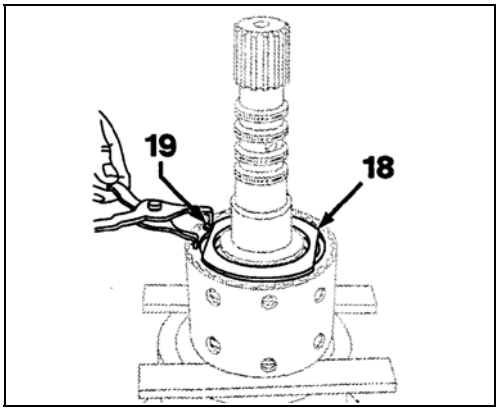


DIRECTIONAL (INPUT) SHAFT

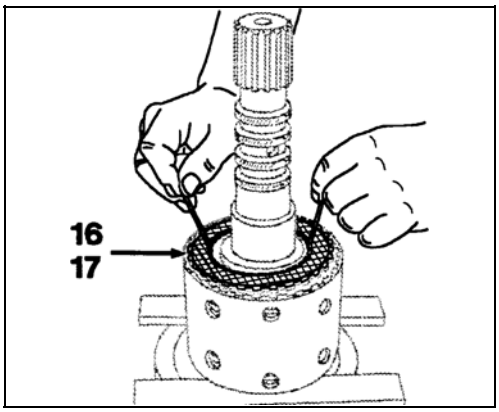
12. Remove inner thrust race washer (2).



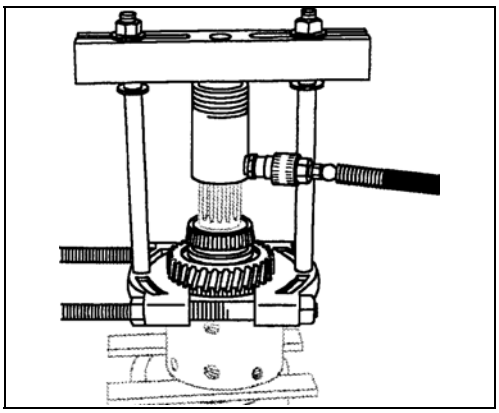
13. Using retaining ring pliers, retract captured retaining ring (19) and remove with support plate (18).



14. Remove friction discs (16) and separator plates (17).

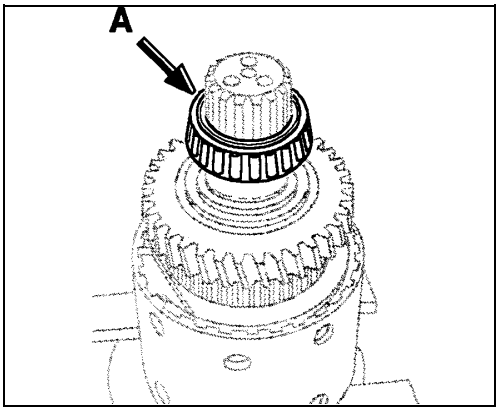


15. Turn assembly over in stand and support with metal bars. Install bearing puller arrangement on forward gear and hub. Activate ram to unseat bearing press fit. Remove puller arrangement after press fit is unseated.

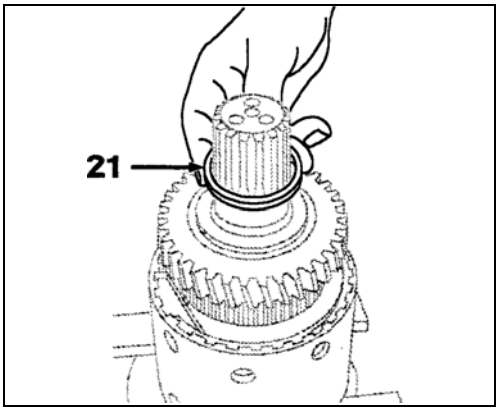


DIRECTIONAL (INPUT) SHAFT

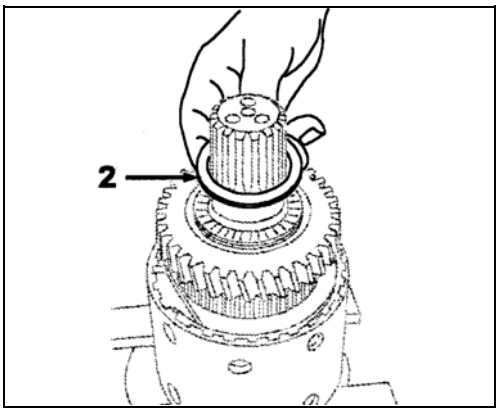
16. Remove bearing cone (A) from directional (input) shaft.



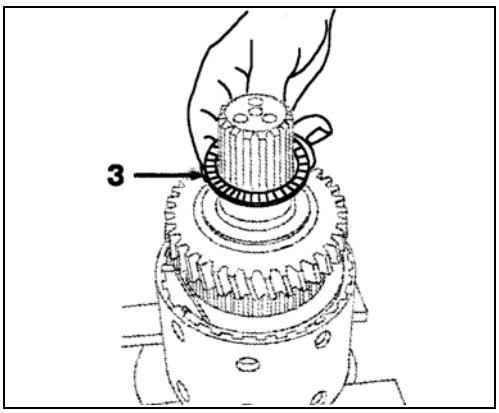
17. Remove bearing spacer (21) from directional (input) shaft.



18. Remove outer thrust race washer (2).

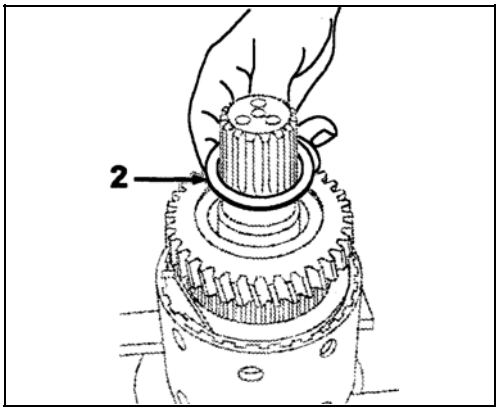


19. Remove thrust bearing (3).

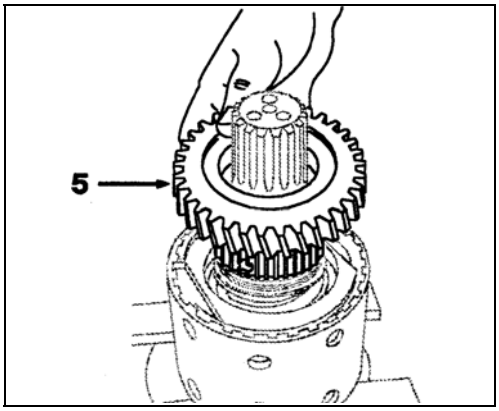


DIRECTIONAL (INPUT) SHAFT

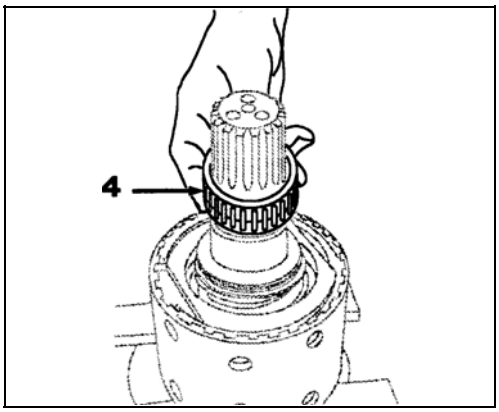
20. Remove inner thrust race washer (2).



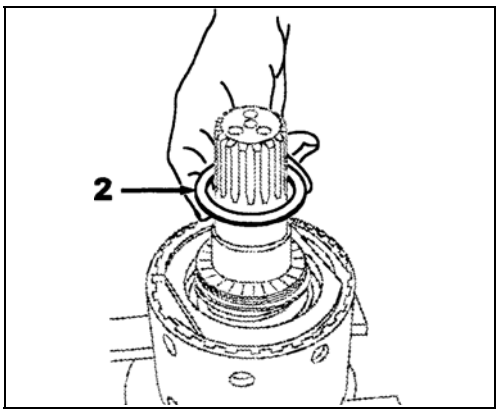
21. Remove forward gear and hub (5) from directional (input) shaft.



22. Remove needle bearing (4).

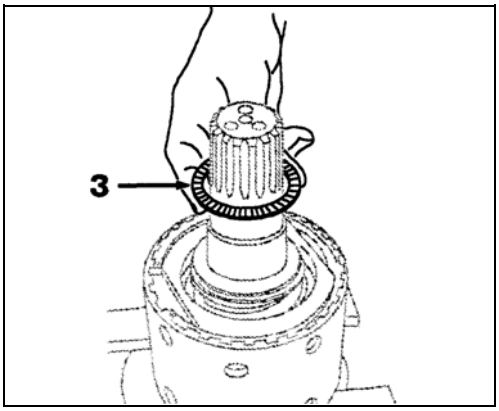


23. Remove outer thrust race washer (2).

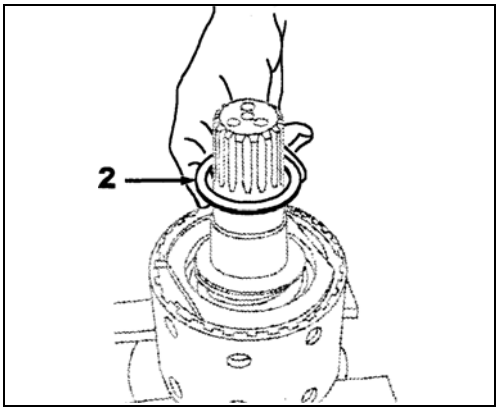


DIRECTIONAL (INPUT) SHAFT

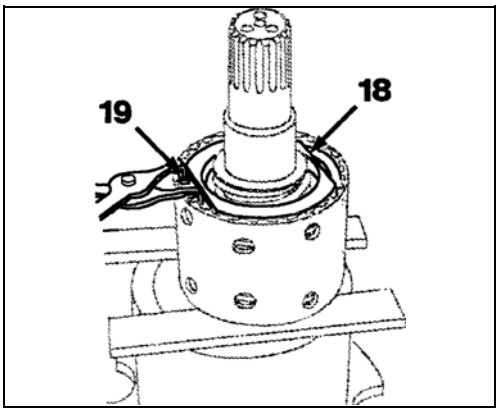
24. Remove thrust bearing (3).



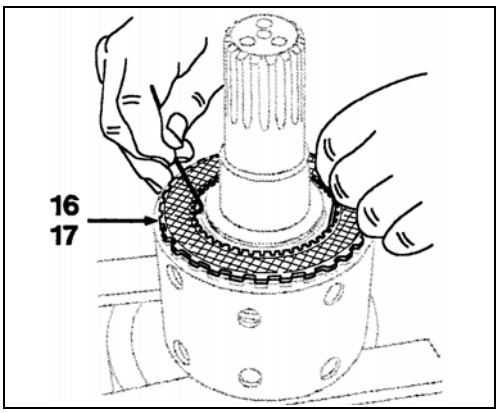
25. Remove inner thrust race washer (2).



26. Using retaining ring pliers, retract captured retaining ring (19) and remove with support plate (18).

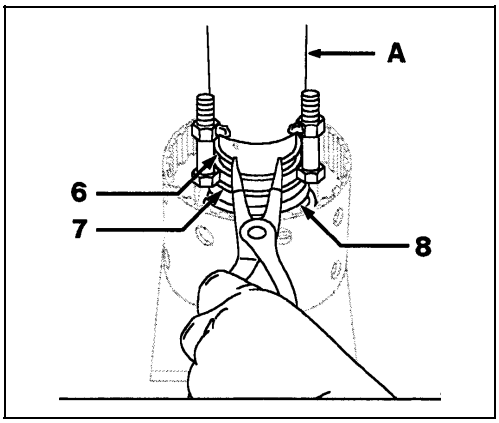


27. Remove friction discs (16) and separator plates (17).



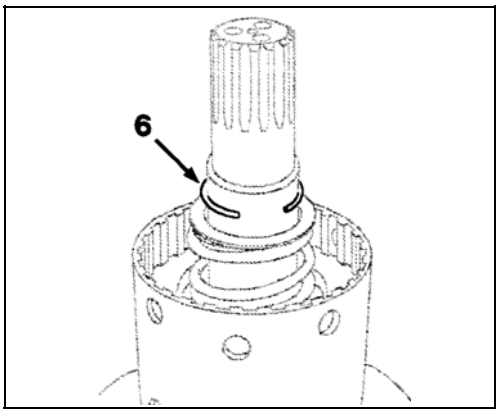
DIRECTIONAL (INPUT) SHAFT

28. Position assembly in press and install spring compressor tool (A), see SERVICE/SPECIAL TOOLS in this Section, on spring plate (7). Activate press to move plate below retaining ring (6). Move ring out of groove and up on shaft. Slowly let off press until spring (8) fully decompresses. Turn assembly over in press and repeat for remaining side.

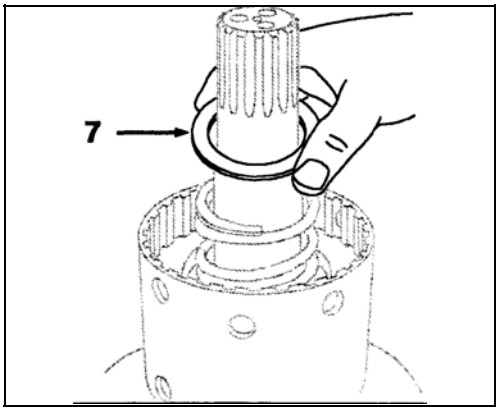


WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme care when disassembling.

29. Position assembly back in stand seal ring groove side down (reverse). Remove retaining ring (6) from shaft.

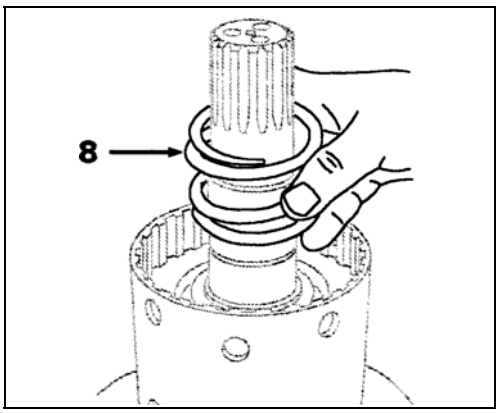


30. Remove outer spring plate (7).



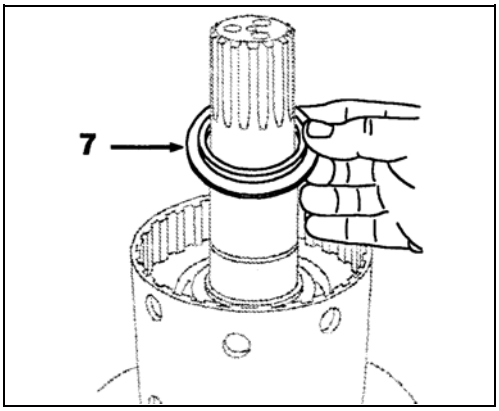
31. Remove spring (8).

NOTE: *Check spring for damage and fatigue against those values shown in spring criterion.*

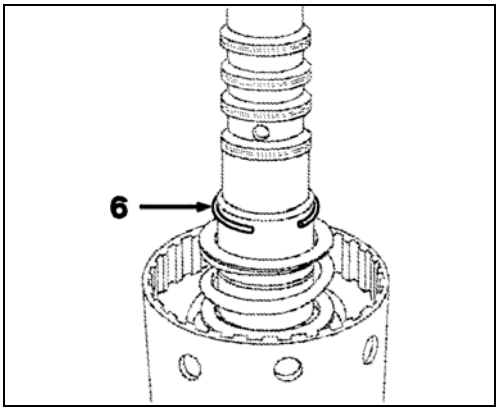


DIRECTIONAL (INPUT) SHAFT

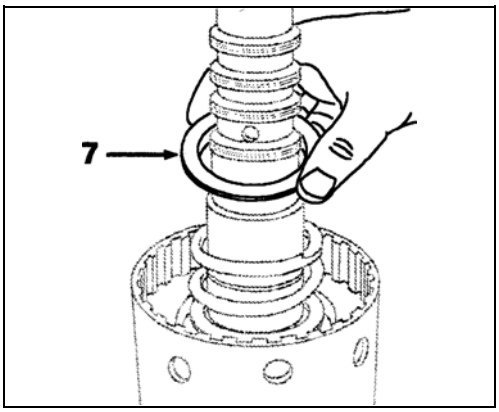
32. Remove inner spring plate (7).



33. Turn assembly over in stand seal ring groove side up (reverse). Remove retaining ring (6) from shaft.

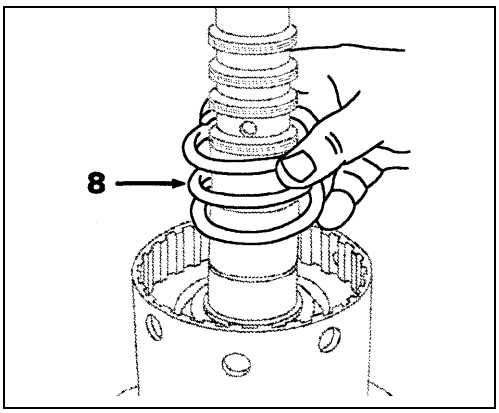


34. Remove outer spring plate (7).



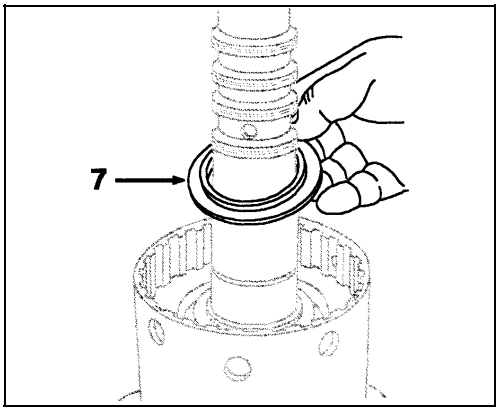
35. Remove spring (8).

NOTE: *Check spring for damage and fatigue against those values shown in spring criterion.*



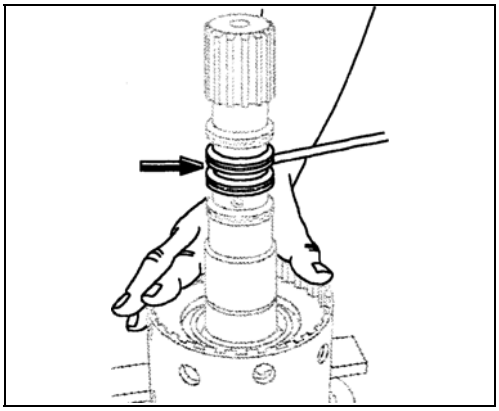
DIRECTIONAL (INPUT) SHAFT

36. Remove inner spring plate (7).

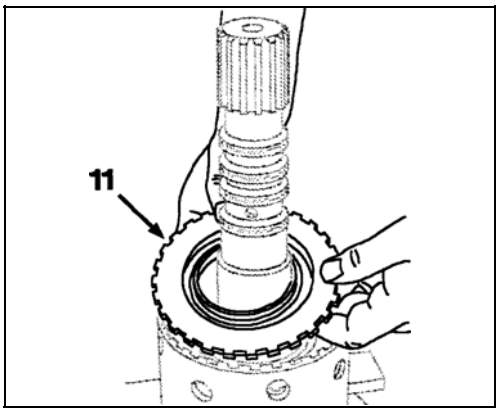


37. Using compressed air in center (reverse) groove port, unseat piston from clutch hub and drum.

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

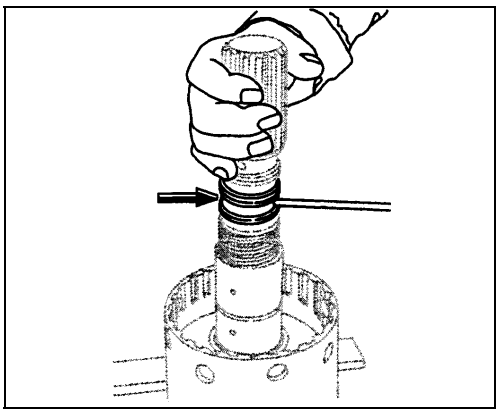


38. Remove piston (11) from hub and drum.



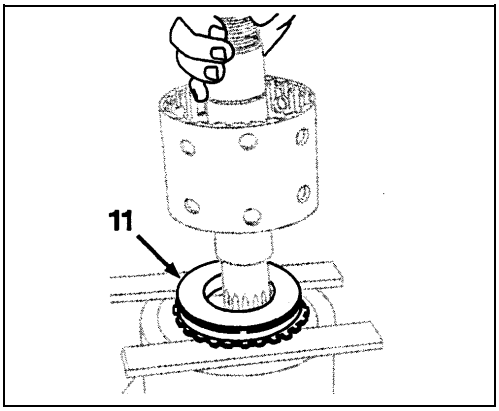
39. Using compressed air in lower (forward) groove port, unseat piston from clutch hub and drum.

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

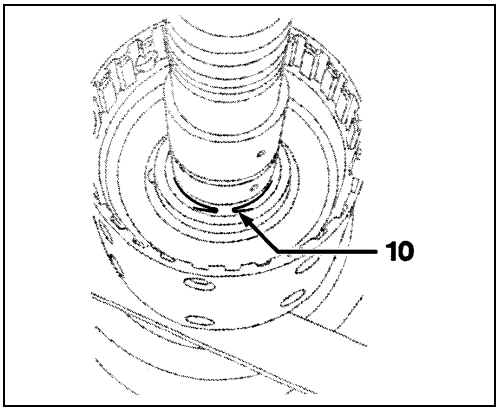


DIRECTIONAL (INPUT) SHAFT

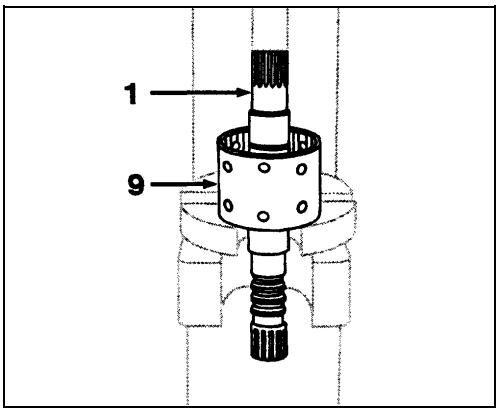
40. Raise assembly and remove piston (11).



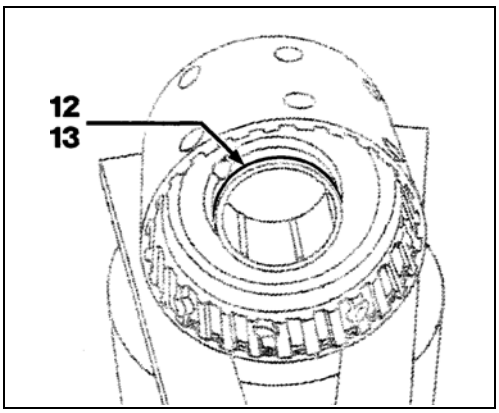
41. Remove retaining ring (10) from each side of hub and drum.



42. Position assembly in press and separate shaft (1) from hub and drum (9).

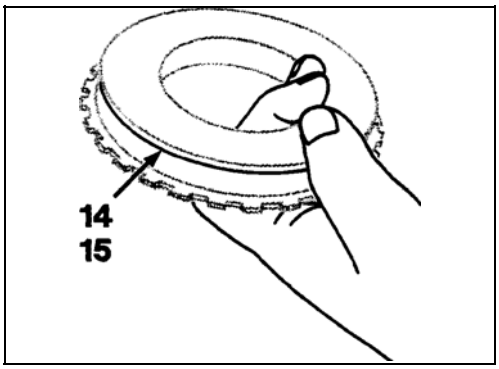


43. Remove piston seal ring (12) and O-ring (13) from each side of hub and drum.



DIRECTIONAL (INPUT) SHAFT

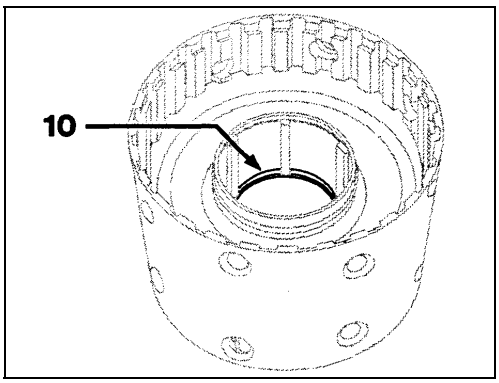
44. Remove piston seal ring (14) and O-ring (15) from each piston.



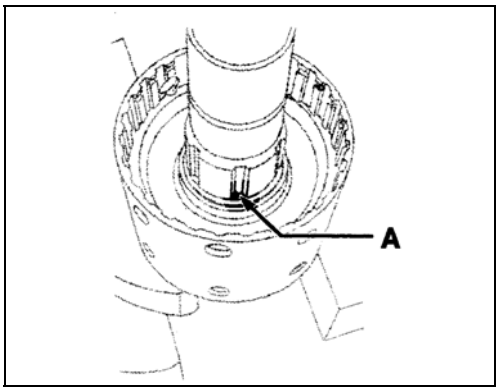
10. REASSEMBLY

NOTE: *Callouts from exploded and cross section views (refer to Fig.'s 7C.3 and 7C.4) correspond with callouts in following steps.*

1. Install one retaining ring (10) in groove in hub and drum.

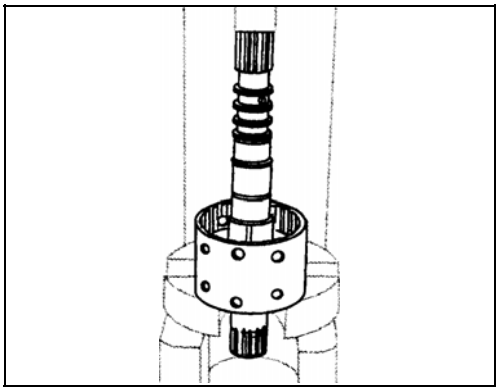


2. Position hub and drum in press. Align dowel pin (A) in shaft with notched spline of hub and drum.



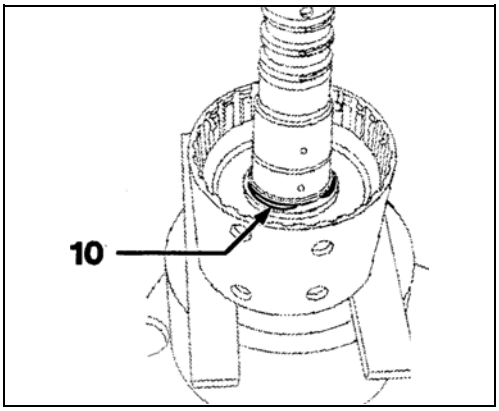
3. Press shaft into hub and drum bottoming against retaining ring.

NOTE: *To make hub and drum installation easier heat hub to max 200 [°C].*

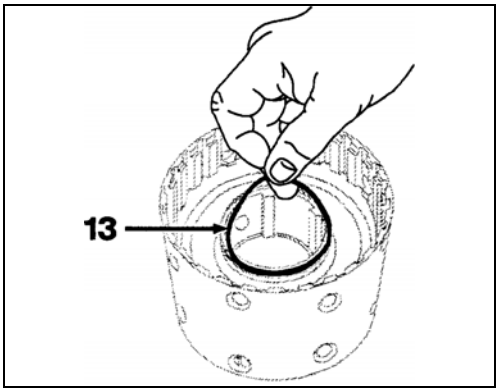


DIRECTIONAL (INPUT) SHAFT

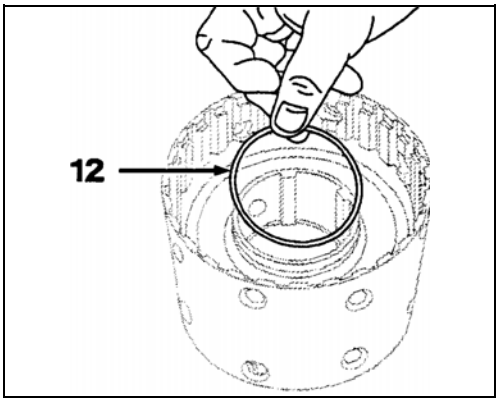
4. Install remaining retaining ring (10).



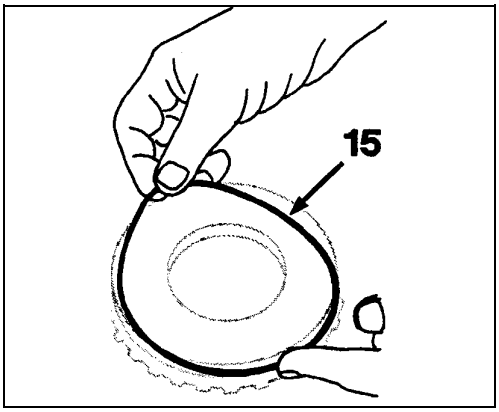
5. Install new O-ring (13) in groove at each side of hub and drum.



6. Install new piston seal ring (12) over O-ring in groove at each side of hub and drum.

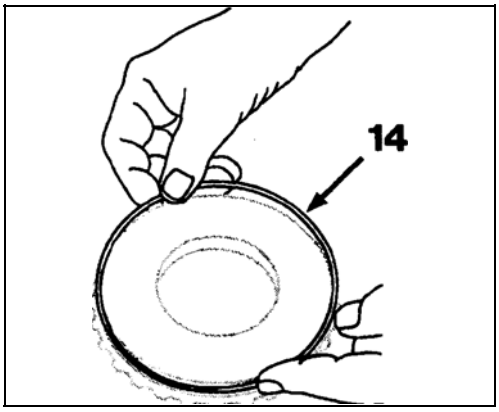


7. Install O-ring (15) in groove on piston.

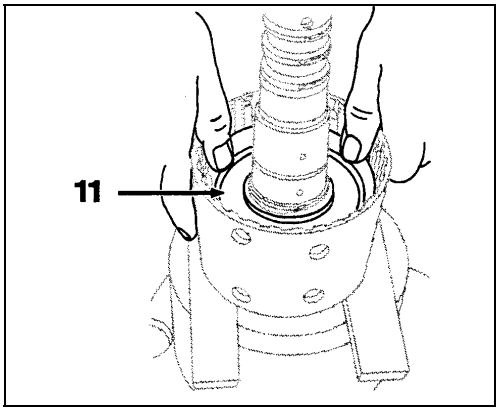


DIRECTIONAL (INPUT) SHAFT

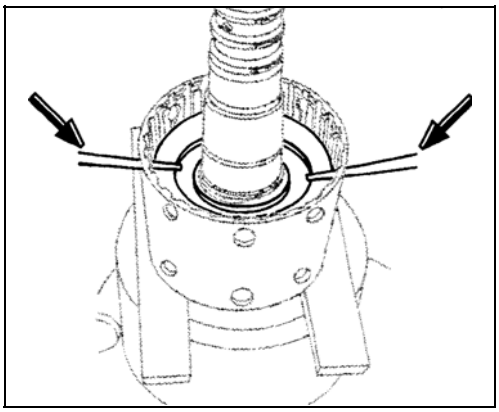
8. Install piston seal ring (14) over O-ring in groove on piston. Repeat previous and this step for other piston.



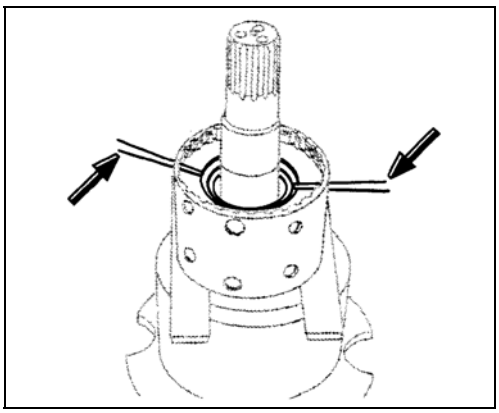
9. Coat lead in chamfers of hub and drum with clean oil. Spline piston (11) in hub and press in place being careful not to damage piston rings.



10. Using wooden dowels, carefully bottom piston into hub and drum.

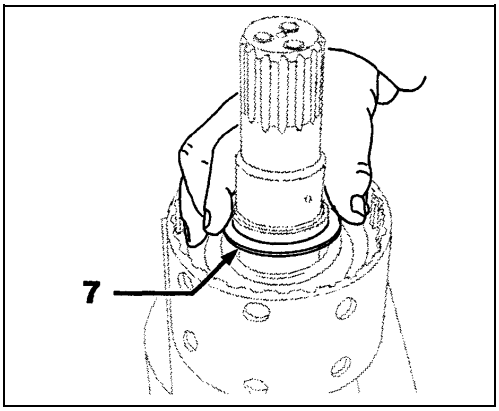


11. Turn assembly over in stand and support with bars. Coat lead in chamfers of hub and drum with clean oil. Spline piston (11) in hub and press in place being careful not to damage piston rings. Using wooden dowels, carefully bottom piston into hub and drum.

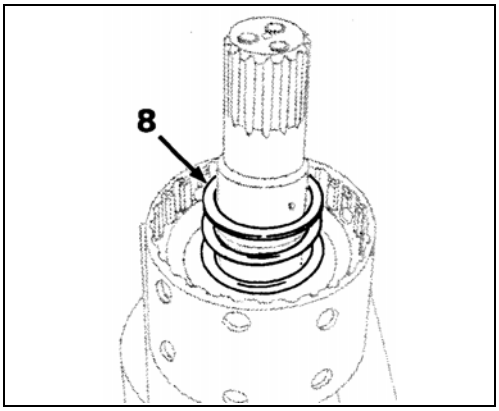


DIRECTIONAL (INPUT) SHAFT

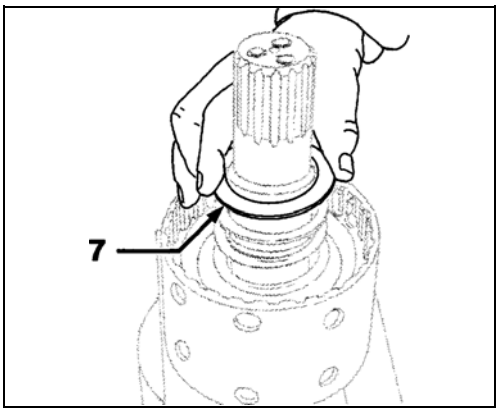
12. Install inner spring plate (7).



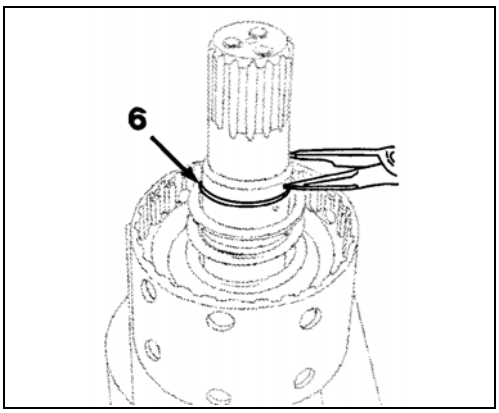
13. Install piston return spring (8).



14. Install outer spring plate (7).

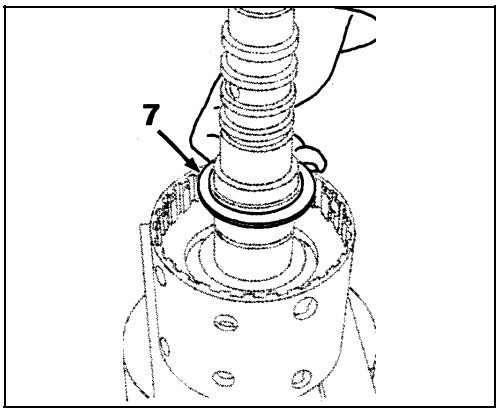


15. Position retaining ring (6) on shaft.

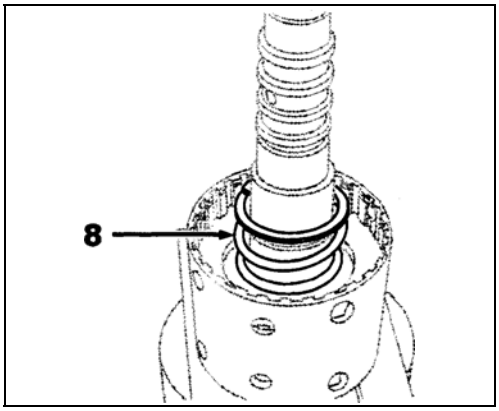


DIRECTIONAL (INPUT) SHAFT

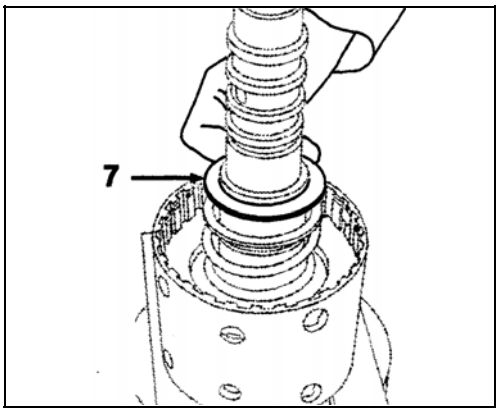
16. Turn assembly over in stand and support with bars. Install inner spring plate (7).



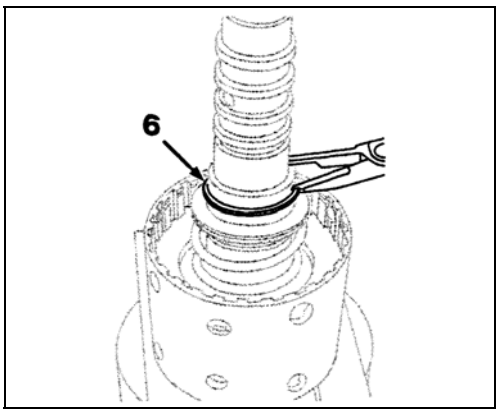
17. Install piston return spring (8).



18. Install outer spring plate (7).

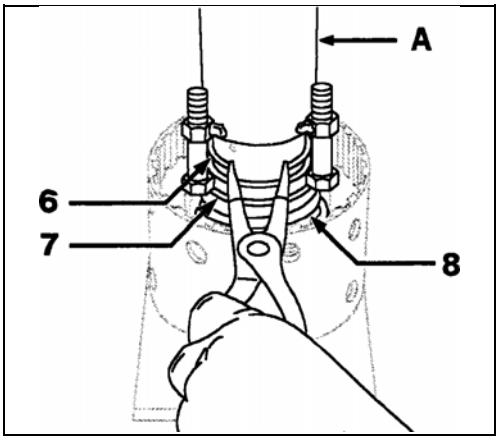


19. Position retaining ring (6) on shaft.



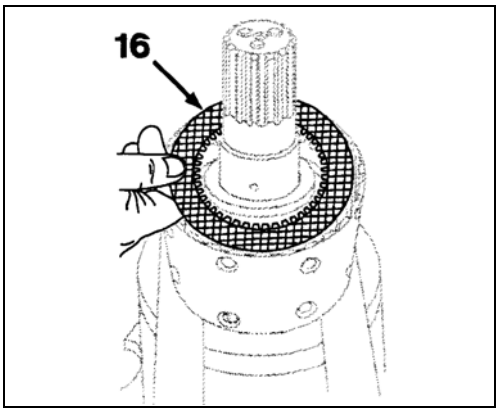
DIRECTIONAL (INPUT) SHAFT

20. Position assembly in press and install spring compressor tool (A), (see SERVICE/SPECIAL TOOLS in this Section), on spring plate (7). Activate press to move retainer below retaining ring (6). Install ring in groove on shaft. Slowly let off press until spring (8) is held by plate. Turn assembly over in press and repeat for remaining side.

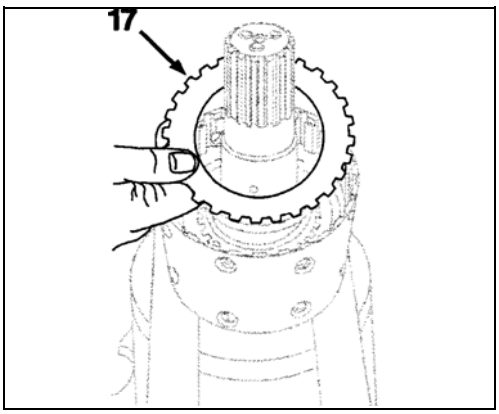


WARNING! Spring loaded assembly. Assembly must be held to install spring. Use extreme care when assembling.

21. Position assembly in stand and support with bars. Coat friction disc (16) lightly with clean oil and install into assembly.

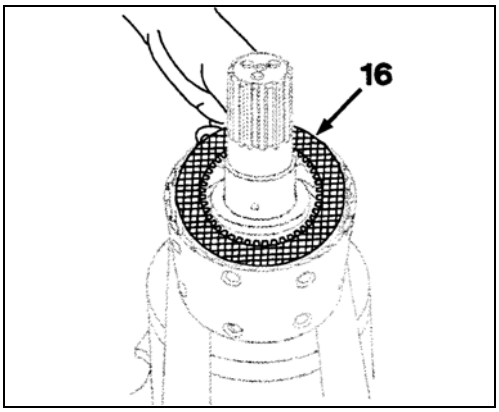


22. Install separator plate (17).



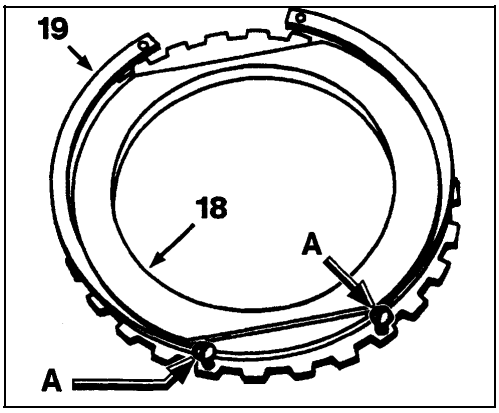
23. Alternately install friction disc and separator plates ending with friction disc (16). A total of seven friction discs and six separator plates are to be used.

NOTE: *To insure proper assembly of forward speed clutch components measure total dimension of friction discs pack and separator plates pack. If dimensions are within 13.3 ÷14.0 [mm] and 7.0 ÷ 7.6 [mm] respectively, friction discs and separator plates packs are correct and can be installed in forward clutch pack.*

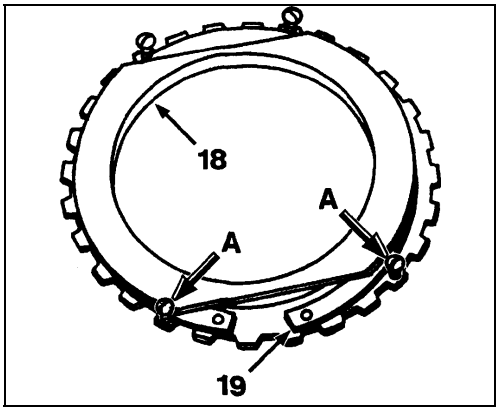


DIRECTIONAL (INPUT) SHAFT

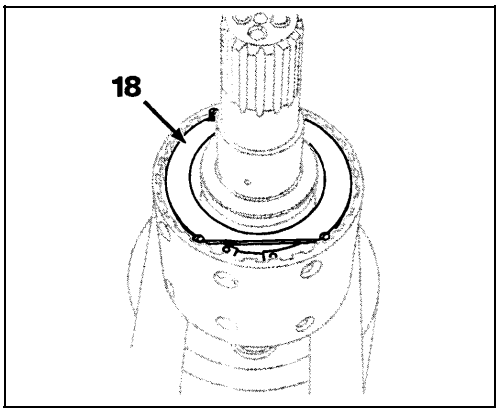
24. Position captured retaining ring (19) into support plate (18). Install two #6-32 screws (A) at opposite side of retaining ring opening.



25. Retract retaining ring (19) and install two #6-32 screws (A) in support plate (18).

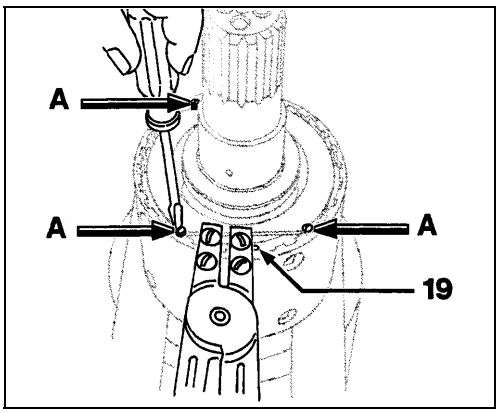


26. Install support plate (18) into assembly.



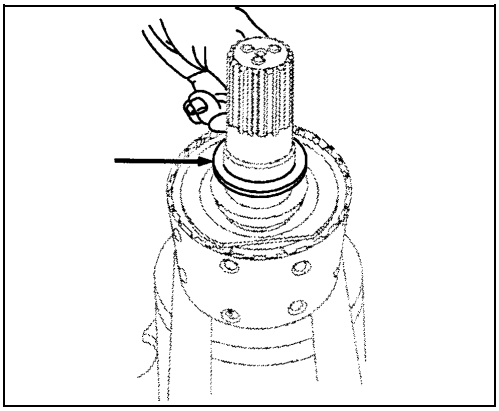
27. Retract retaining ring (19) and remove four screws (A). Carefully let off retaining ring until it seats in groove in drum.

NOTE: *Desired clutch axial clearance should be within 1.1 ÷ 2.4 [mm].*

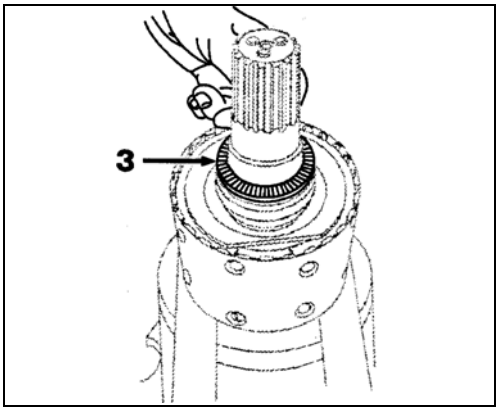


DIRECTIONAL (INPUT) SHAFT

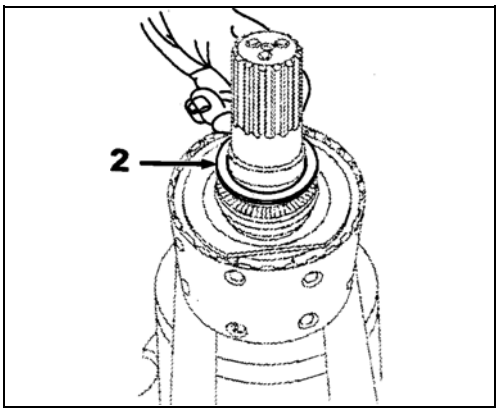
28. Install inner thrust race washer (2).



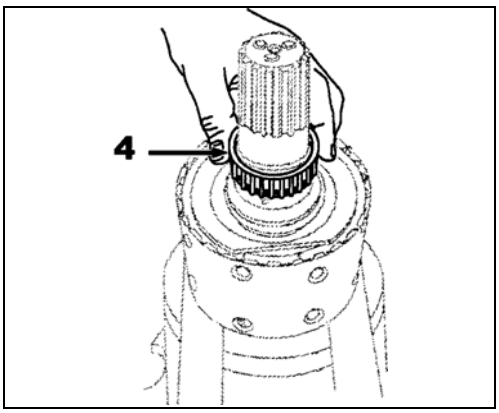
29. Install thrust bearing (3) to race washer. Coat bearing needles with clean oil.



30. Install outer thrust race washer (2).

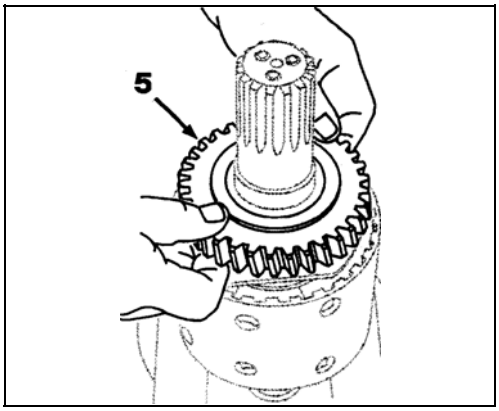


31. Install gear needle bearing (4). Coat bearing needles with clean oil.

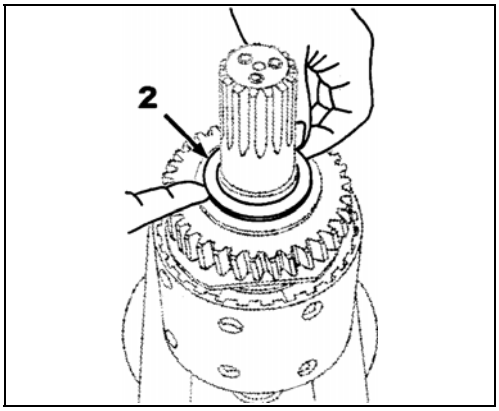


DIRECTIONAL (INPUT) SHAFT

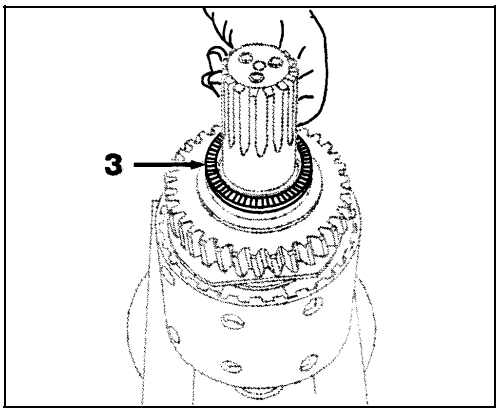
32. Install forward gear and hub (5) aligning all seven friction disc.



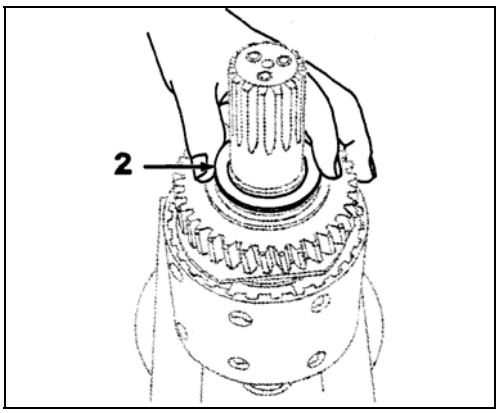
33. Install inner thrust race washer (2).



34. Install thrust bearing (3) to race washer. Coat bearing needles with clean oil.

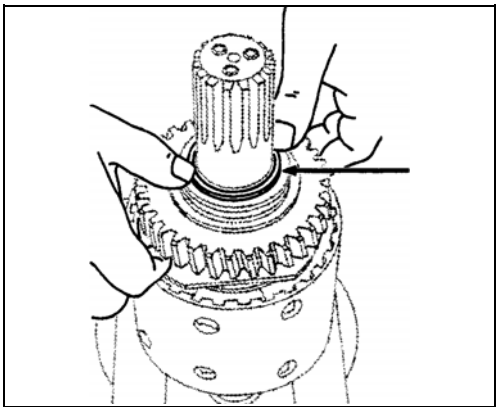


35. Install outer thrust race washer (2).

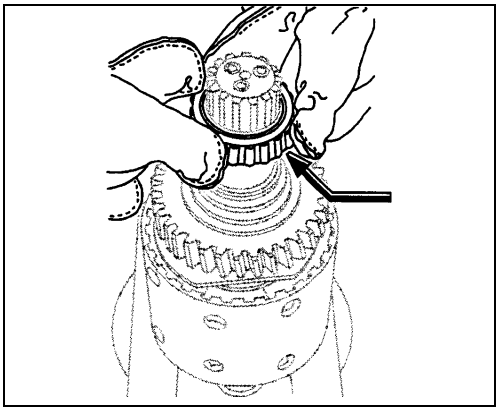


DIRECTIONAL (INPUT) SHAFT

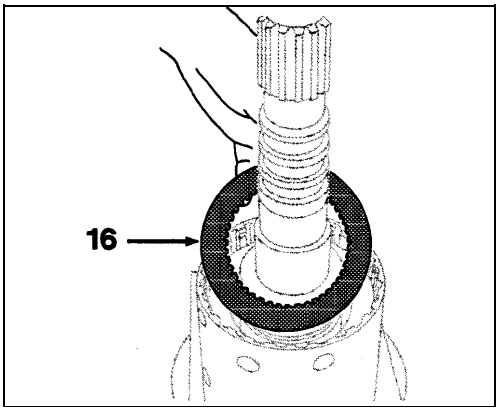
36. Install bearing spacer ring (21).



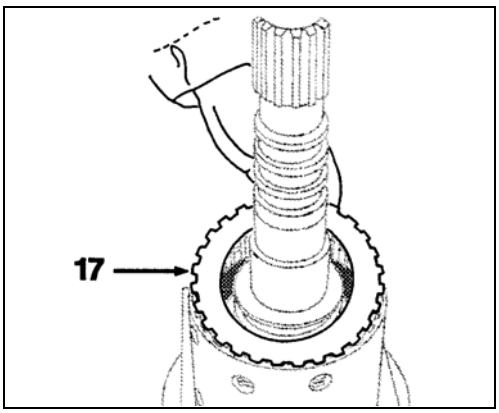
37. Heat bearing cone (A) to 135 [°C] for 45 [minutes]. Install on shaft and bottom. To insure cone is seated, keep pressure against cone until it cools.



38. Turn assembly over in stand and support with bars. Coat friction disc (16) lightly with clean oil and install into assembly.



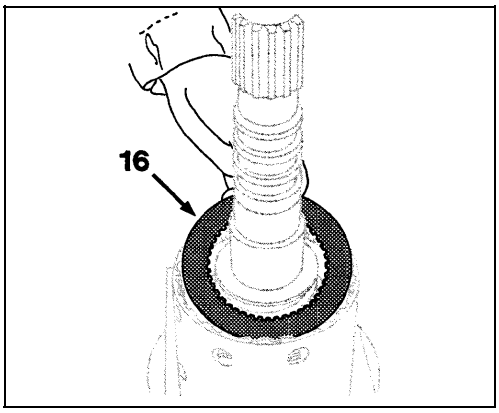
39. Install separator plate (17).



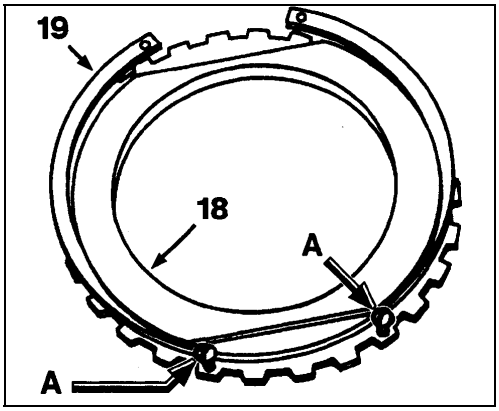
DIRECTIONAL (INPUT) SHAFT

40. Alternately install friction disc and separator plates ending with friction disc (16). A total of seven friction discs and six separator plates are to be used.

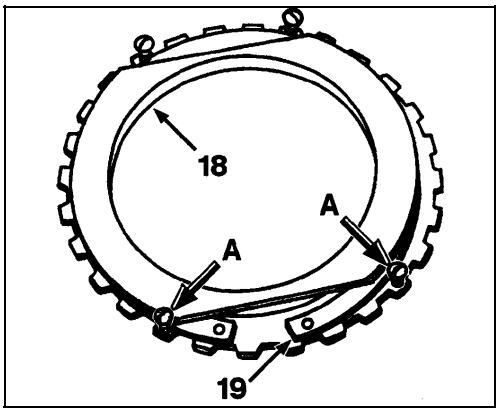
NOTE: *To insure proper assembly of reverse speed clutch components measure total dimension of friction discs pack and separator plates pack. If dimensions are within 13.3 ÷14.0 [mm] and 7.0 ÷ 7.6 [mm] respectively, friction discs and separator plates packs are correct and can be installed in reverse clutch pack.*



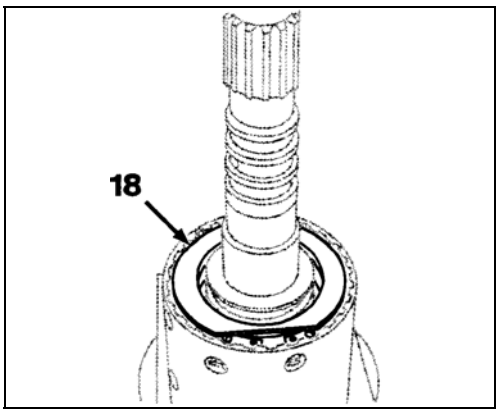
41. Position captured retaining ring (19) into support plate (18). Install two #6-32 screws (A) at opposite side of retaining ring opening.



42. Retract retaining ring (19) and install two #6-32 screws (A) in support plate (18).



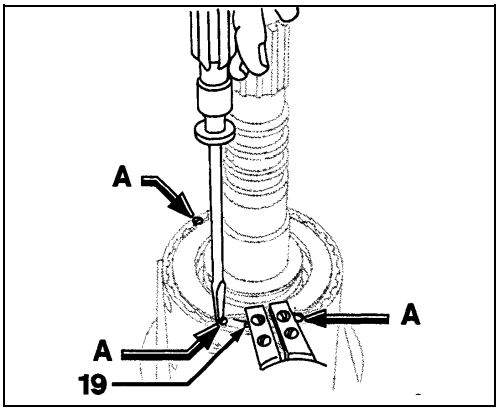
43. Install support plate (18) into assembly.



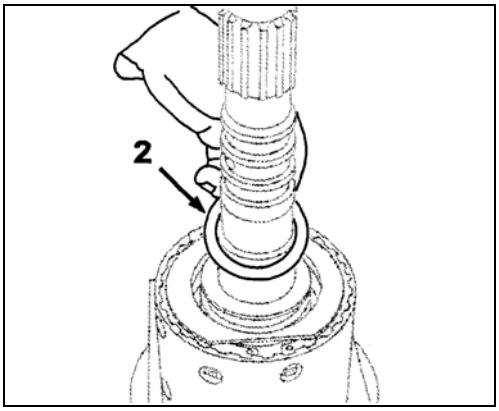
DIRECTIONAL (INPUT) SHAFT

44. Retract retaining ring (19) and remove four screws (A). Carefully let off retaining ring until it seats in groove in drum.

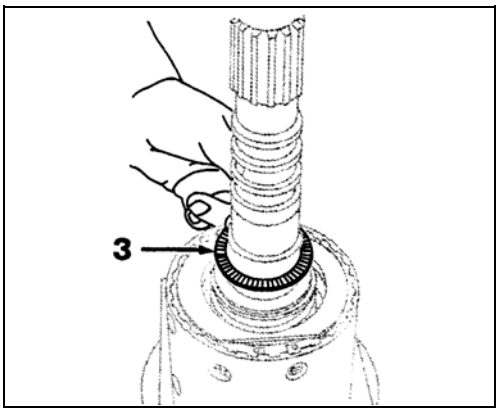
NOTE: *Desired clutch axial clearance should be within 1.1 ÷ 2.4 [mm].*



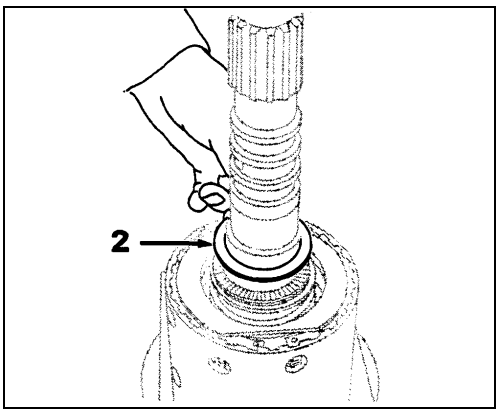
45. Install inner thrust race washer (2).



46. Install thrust bearing (3) to race washer. Coat bearing needles with clean oil.

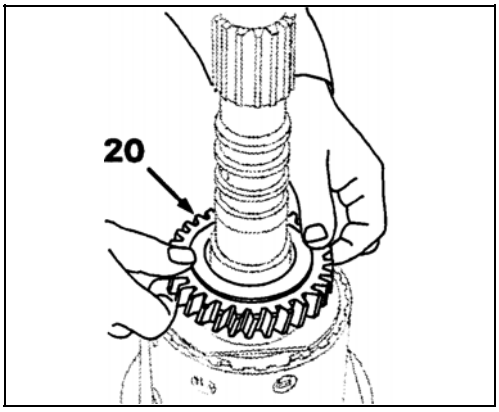


47. Install outer thrust race washer (2).

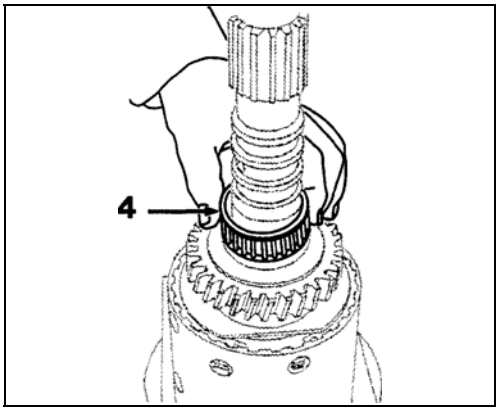


DIRECTIONAL (INPUT) SHAFT

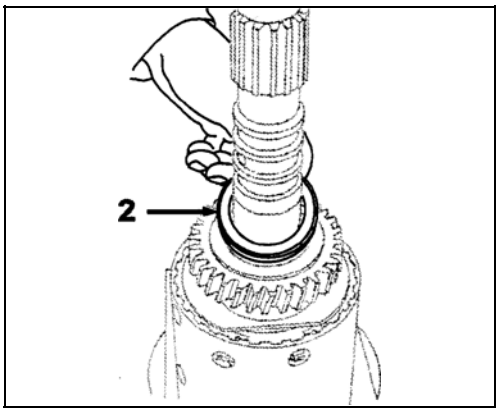
48. Install reverse gear and hub (20) aligning all seven friction discs.



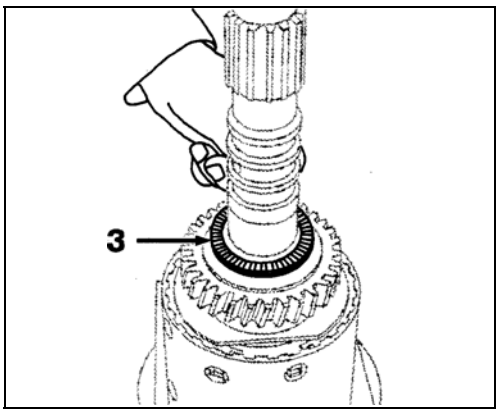
49. Install gear needle bearing (4). Coat bearing needles with clean oil.



50. Install inner thrust race washer (2).

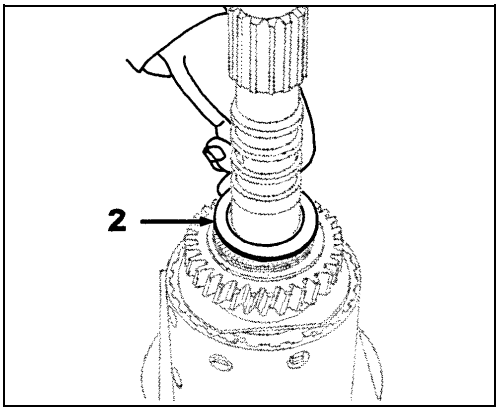


51. Install thrust bearing (3). Coat bearing needles with clean oil.

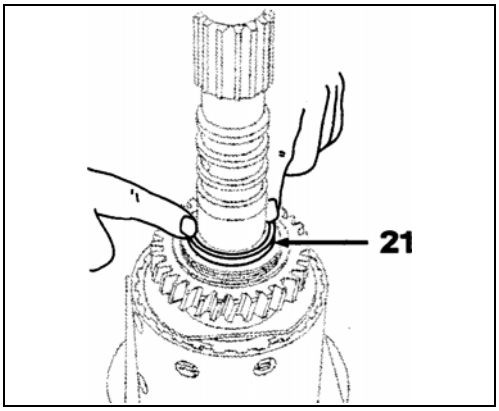


DIRECTIONAL (INPUT) SHAFT

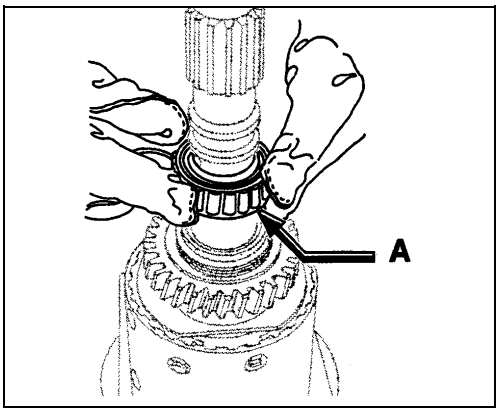
52. Install outer thrust race washer (2).



53. Install bearing spacer ring (21).

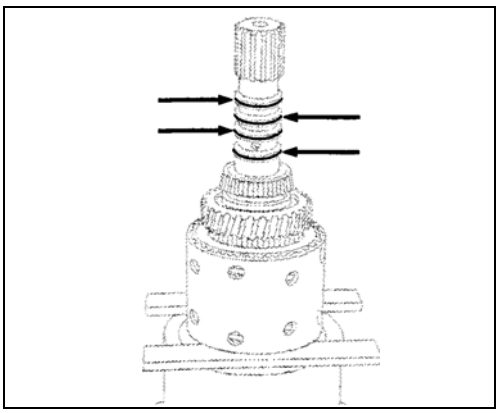


54. Heat bearing cone (A) to 135 [°C] for 45 [minutes]. Install on shaft and bottom. To insure cone is seated, keep pressure against cone until it cools.



55. Install four new manifold seal rings to shaft. Coat seal rings and shaft with clean oil.

NOTE: *Compress seal rings after installation using compressing sleeve (see SERVICE/SPECIAL TOOLS in this Section),*



COUNTERSHAFT

11. GENERAL

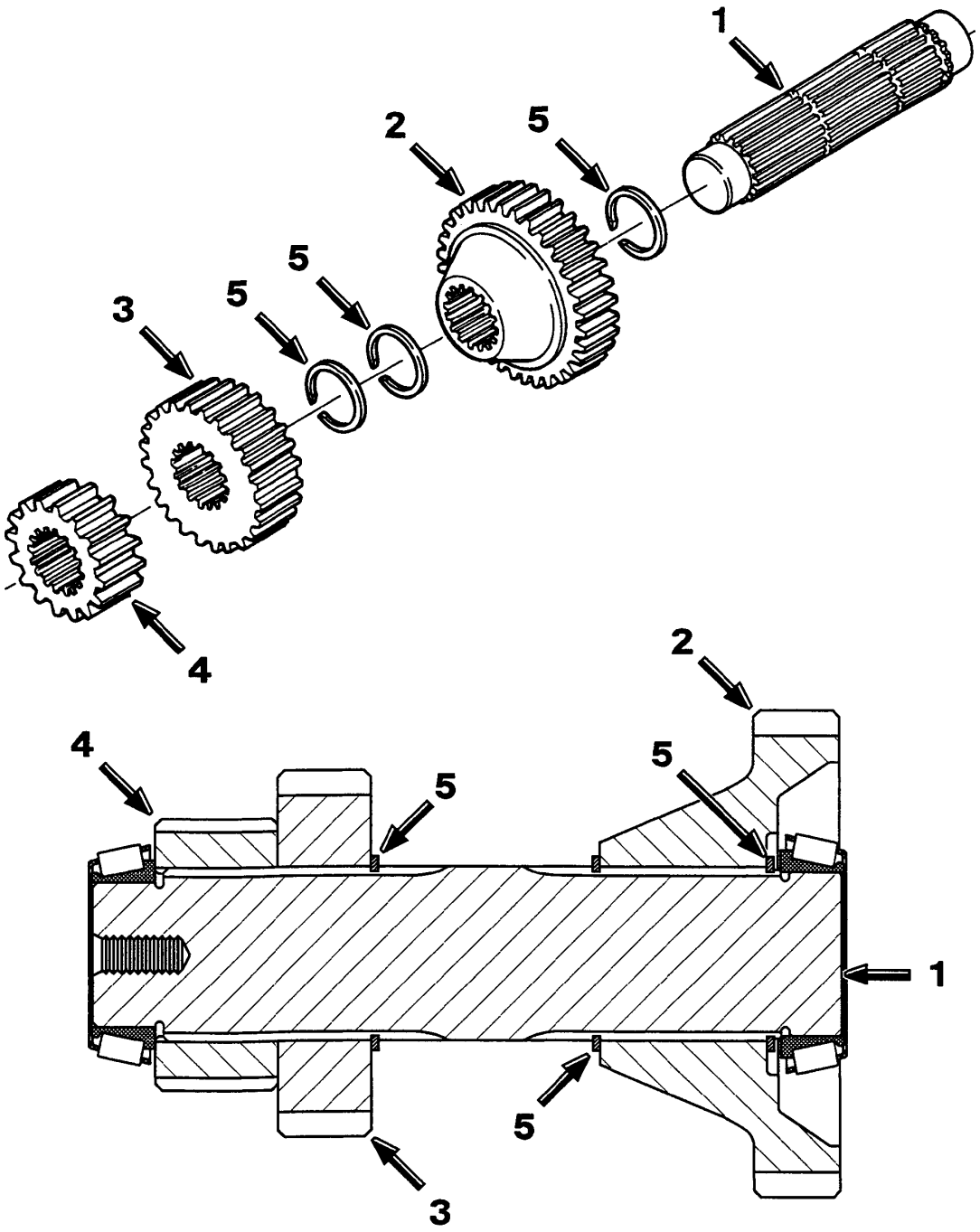


Fig. 7C.5. Exploded and Cross Section Views of Countershaft

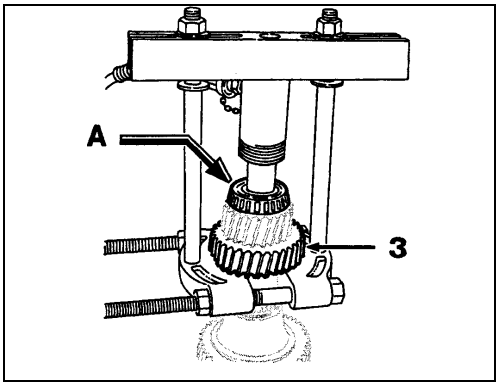
1. Countershaft
2. 3rd Speed Gear
3. 2nd Speed Gear
4. 1st Speed Gear
5. Retaining Ring

COUNTERSHAFT

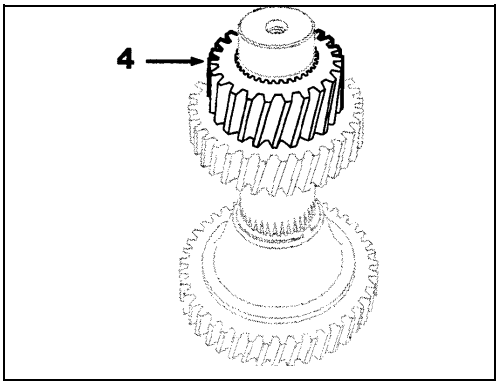
12. DISASSEMBLY

NOTE: *Callouts from exploded and cross section views (refer to Fig. 7C.5) correspond with callouts in following steps.*

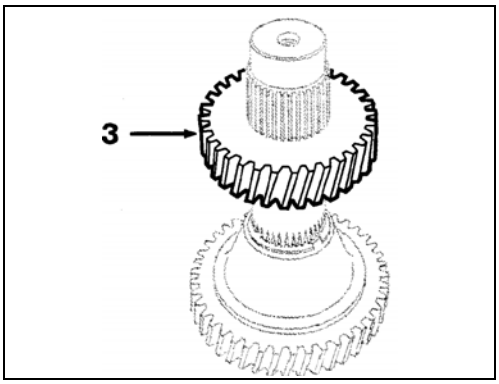
1. Install bearing puller arrangement to 2nd speed gear (3). Activate ram to unseat bearing (A) press fit. Remove puller arrangement and bearing after press fit is unseated.



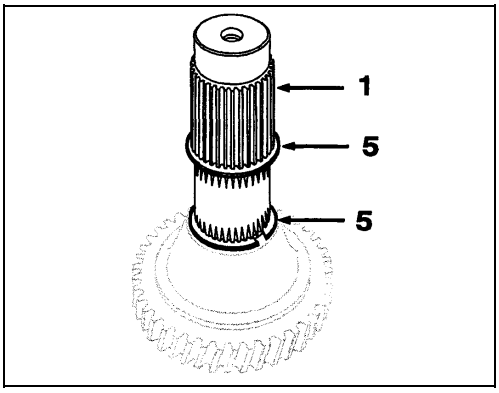
2. Remove 1st speed gear (4).



3. Remove 2nd speed gear (3).

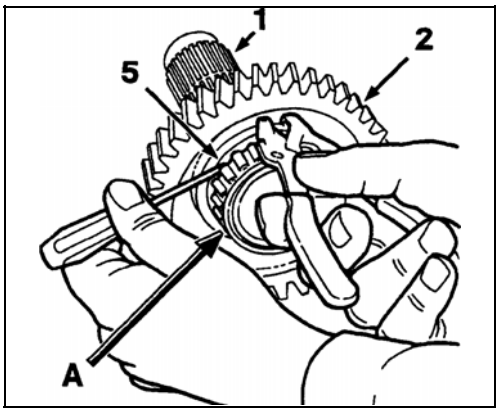


4. Remove retaining rings (5) from shaft (1).

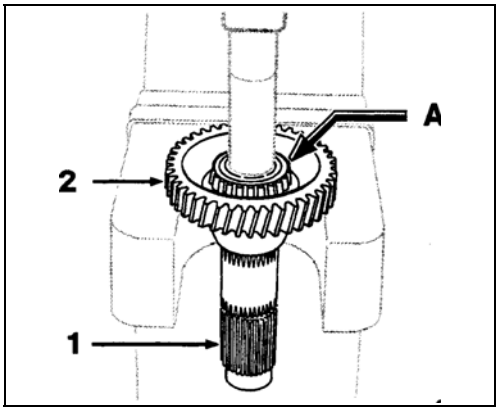


COUNTERSHAFT

5. Slide 3rd speed gear (2) inboard on shaft (1) as far as possible. Working behind bearing (A) with pliers and screwdriver, unseat retaining ring and remove.



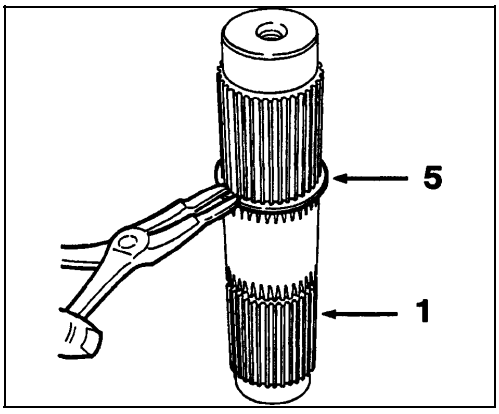
6. Position assembly in press. Supporting countershaft (1), press from 3rd speed gear (2) and bearing (A).



13. REASSEMBLY

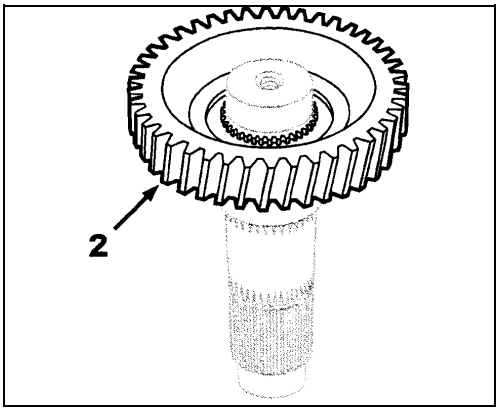
NOTE: *Callouts from exploded and cross section views (refer to Fig. 7C.5) correspond with callouts in following steps.*

1. Position countershaft (1) with 3rd speed gear end up, side with two retaining ring grooves. Install retaining ring (5) to lower groove.

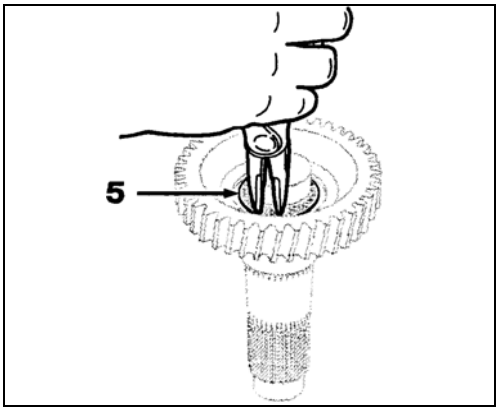


COUNTERSHAFT

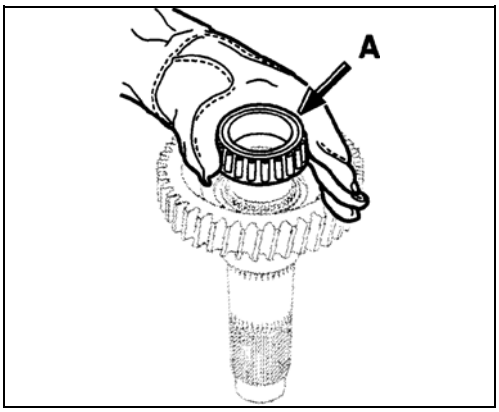
2. Install 3rd speed gear (2).



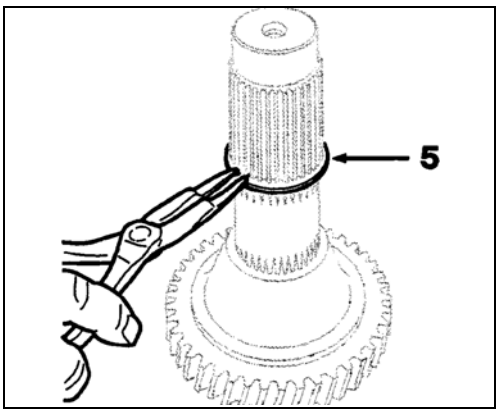
3. Install retaining ring (5) to top groove in countershaft.



4. Heat bearing cone (A) to 135 [°C] for 45 [minutes]. Install on shaft and bottom. To insure cone is seated, keep pressure against cone until it cools.

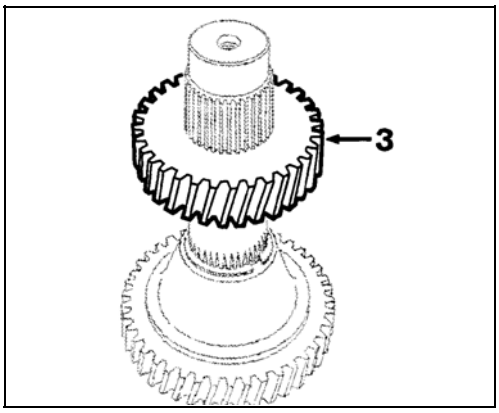


5. Turn countershaft over. Install retaining ring (5).

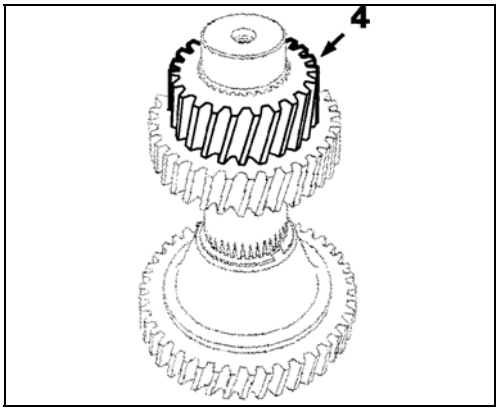


COUNTERSHAFT

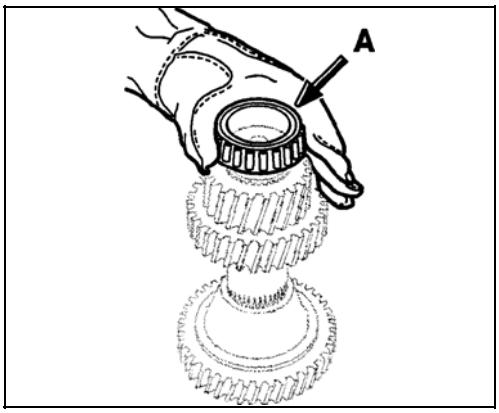
6. Install 2nd speed gear (3) on countershaft against retaining ring.



7. Install 1st speed gear (4) on countershaft against 2nd speed gear.



8. Heat bearing cone (A) to 135 °C for 45 minutes. Install on shaft and bottom. To insure cone is seated, keep pressure against cone until it cools.



RANGE (OUTPUT) SHAFT

14. GENERAL

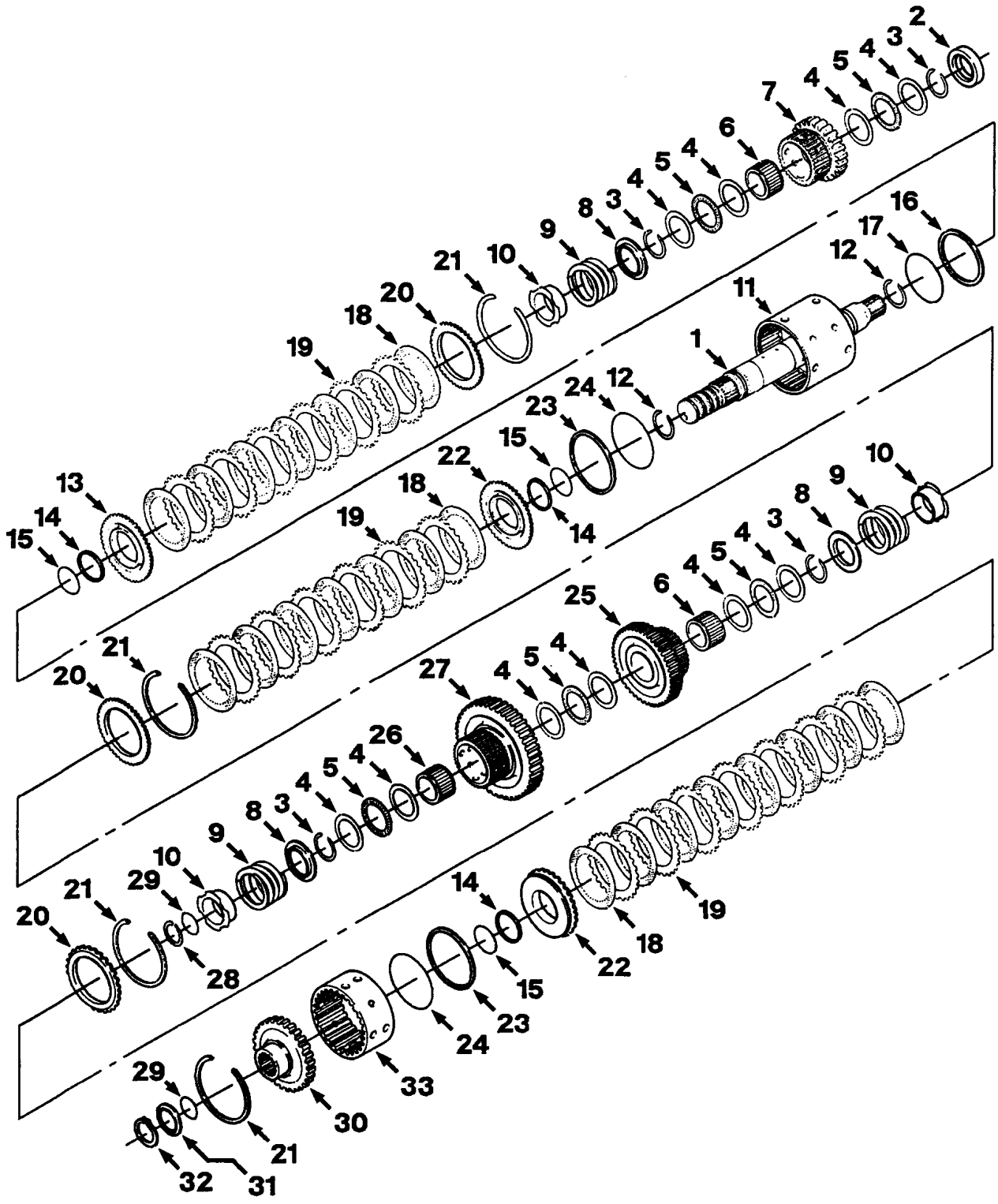


Fig. 7C.6. Exploded View of Range (Output) Shaft

RANGE (OUTPUT) SHAFT

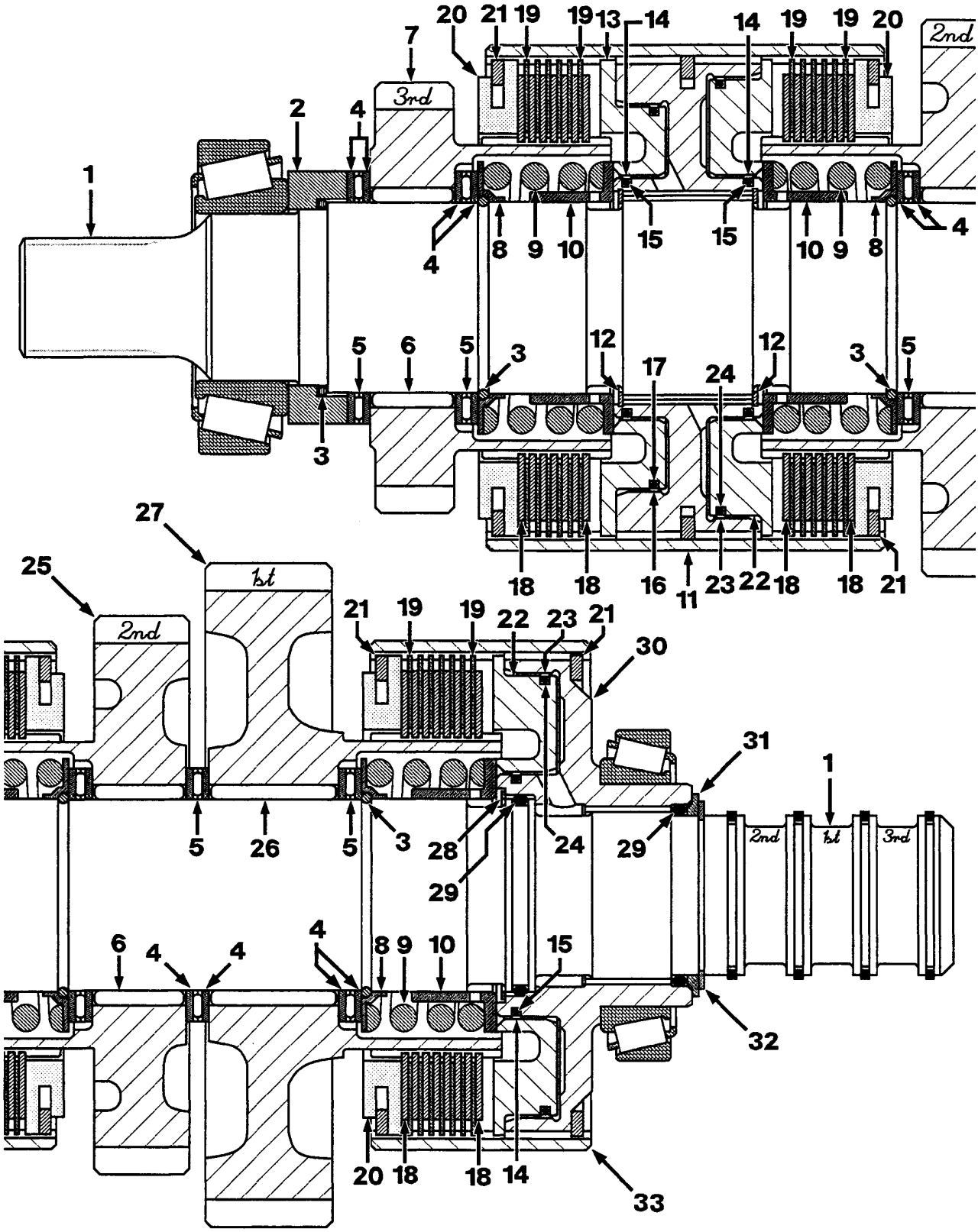


Fig. 7C.7. Cross Section View of Range (Output) Shaft

RANGE (OUTPUT) SHAFT

Legend For Exploded And Cross Section Views (Fig.'s 7C.6 and 7C.7)

1. Output Shaft
2. Bearing Spacer Ring
3. Retaining Ring
4. Thrust Race Washer
5. Thrust Bearing
6. Needle Bearing
7. 3rd Speed Gear and Hub
8. Spring Plate
9. Return Spring
10. Lube Sleeve
11. Hub and Drum Kit
12. Retaining Ring
13. 3rd Speed Piston
14. Seal Ring
15. O-Ring
16. Piston Seal Ring
17. O-Ring
18. Friction Disc
19. Separator Plate
20. Clutch Support Plate
21. Captured Retaining Ring
22. 1st or 2nd Speed Piston
23. Piston Seal Ring
24. O-Ring
25. 2nd Speed Gear and Hub
26. Needle Bearing
27. 1st Speed Gear and Hub
28. Retaining Ring
29. O-Ring
30. 1st Speed Hub
31. Spacer Ring
32. Retaining Ring
33. 1st Speed Drum

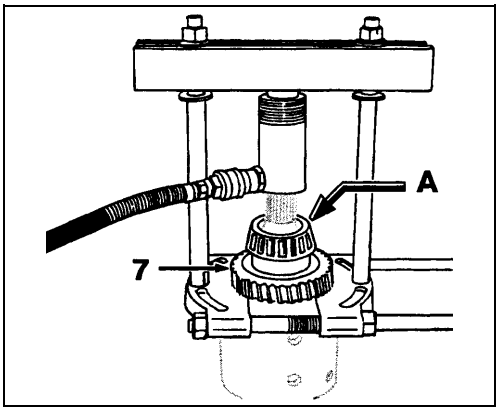
Piston Return Spring Criterion

Free Length ..... 56 [mm]
Test Length ..... 36.3 [mm]
Work Length ..... 29.6 to 36.3 [mm]
Test Load ..... 1490 ±150 [N]
Number of Working Coils 1.7

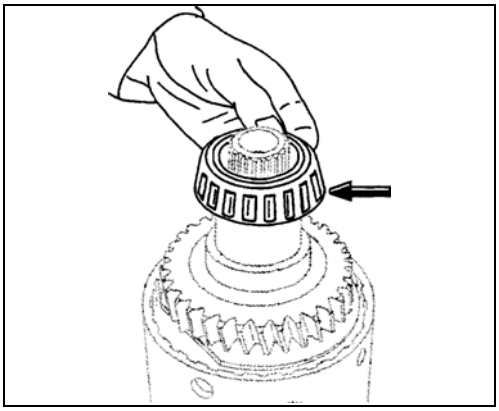
15. DISASSEMBLY

NOTE: *Callouts from exploded and cross section views (refer to Fig.'s 7C.6 and 7C.7) correspond with callouts in following steps.*

1. Position range (output) shaft in stand, 3rd speed clutch up, supported by bars. Install a puller arrangement to 3rd speed gear and hub (7). Apply ram to puller arrangement and unseat bearing (A).

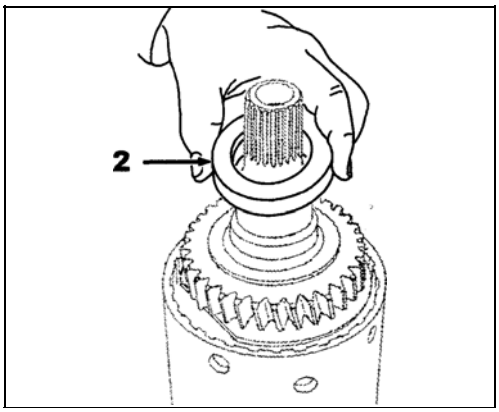


2. Remove bearing (A) from assembly.

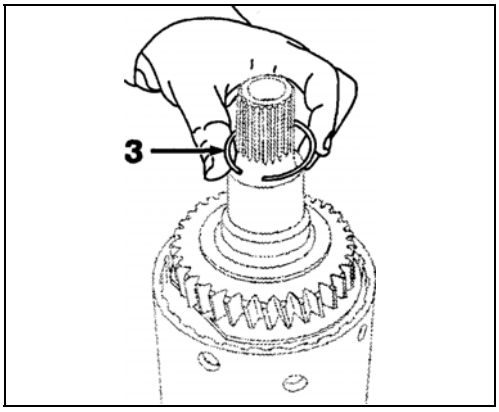


RANGE (OUTPUT) SHAFT

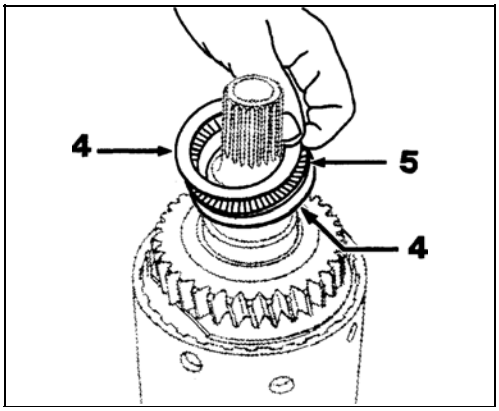
3. Remove bearing spacer ring (2).



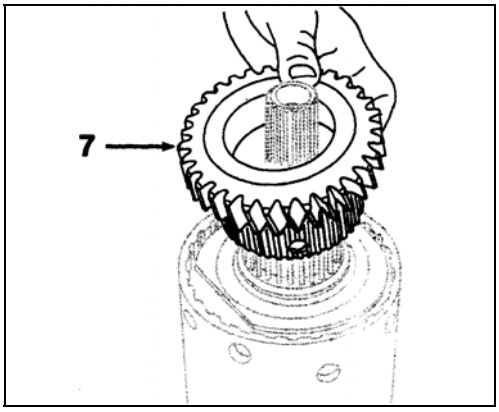
4. Remove retaining ring (3).



5. Remove thrust race washers (4) and thrust bearing (5) together.

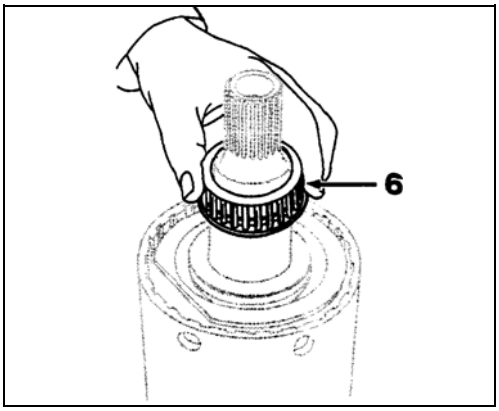


6. Remove 3rd speed gear and hub (7).

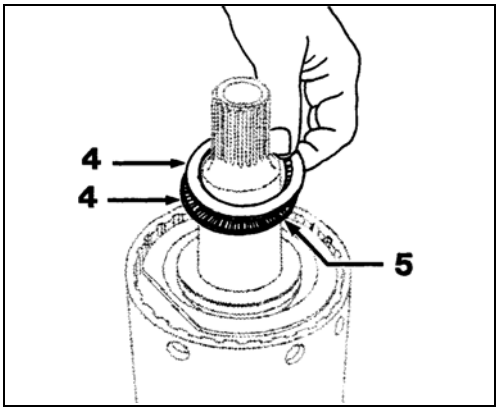


RANGE (OUTPUT) SHAFT

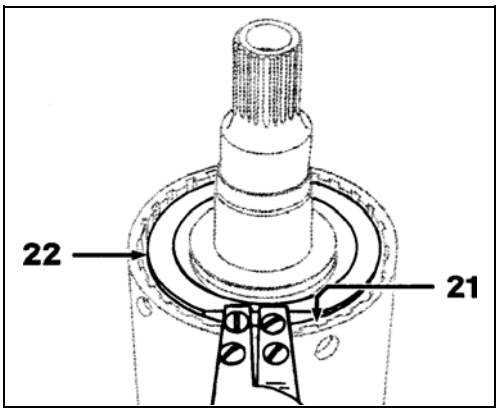
6. Remove needle bearing (6).



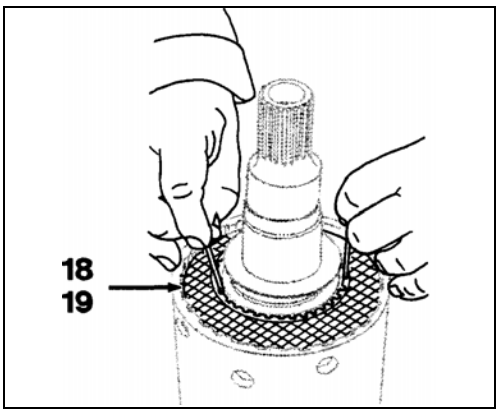
7. Remove thrust race washers (4) and thrust bearing (5).



8. Using retaining ring pliers, retract captured retaining ring (21) and remove with support plate (20).

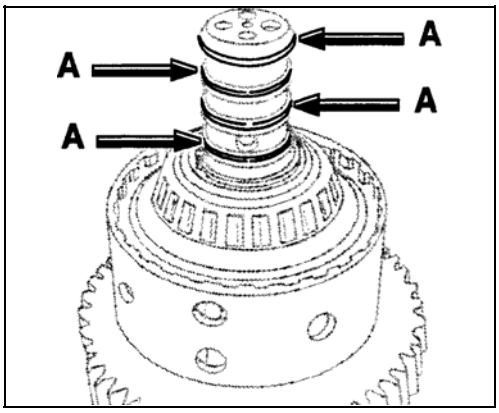


9. Remove friction discs (18) and separator plates (19).

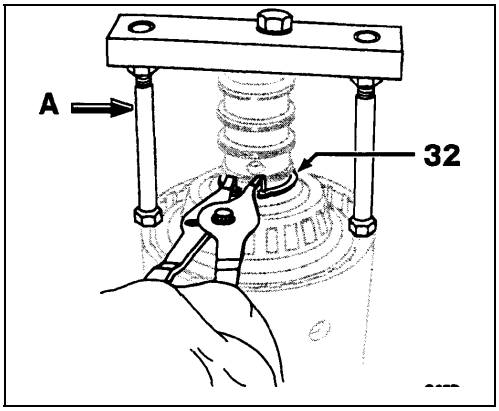


RANGE (OUTPUT) SHAFT

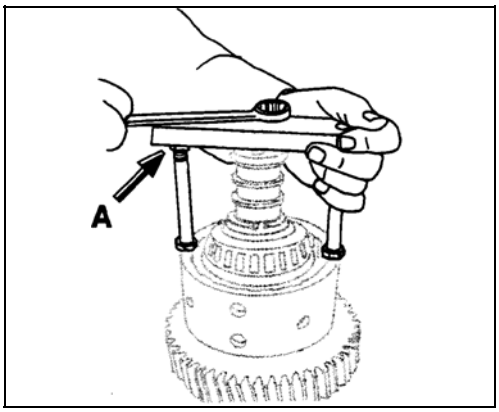
10. Turn assembly over in stand and support with metal bars. Remove four seal rings (A) from shaft.



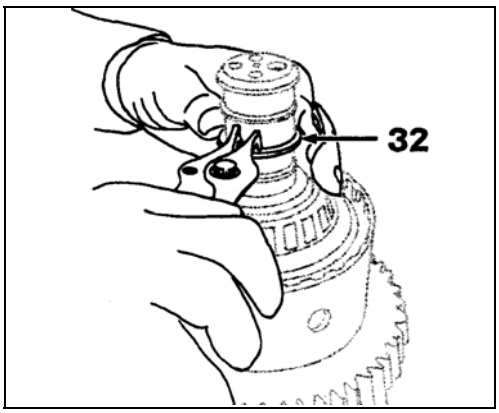
11. Install 1st pack compressing tool (A), see SERVICE/SPECIAL TOOLS in this Section, to shaft. Draw down on center bolt until retaining ring (32) clears housing. Move retaining ring out of groove and up shaft.



12. Remove 1st pack compressing tool (A).

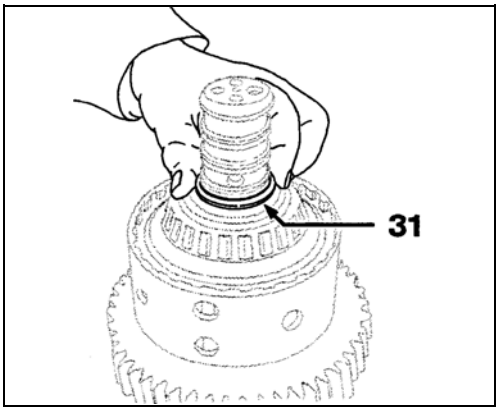


13. Remove retaining ring (32) from shaft.

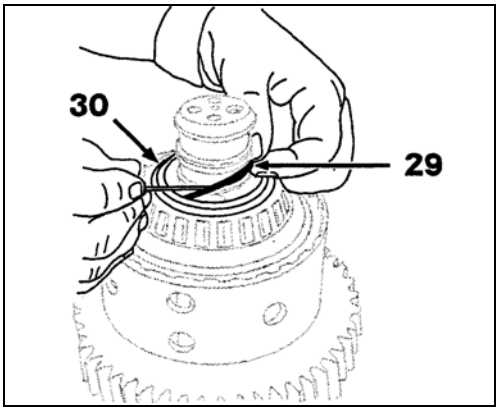


RANGE (OUTPUT) SHAFT

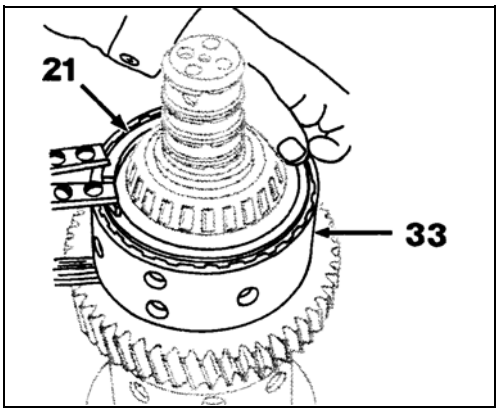
14. Remove spacer ring (31).



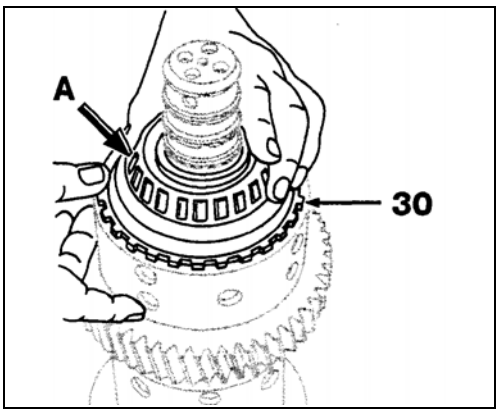
15. Remove O-ring (29) from under 1st speed piston hub (30).



16. Position blocking under 1st speed drum (33). Using retaining ring pliers, retract captured retaining ring (21) and remove.

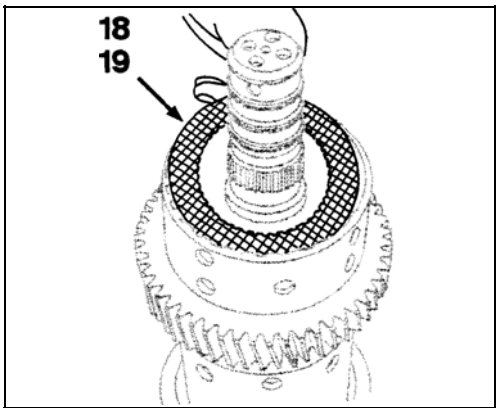


17. Remove 1st piston hub (30) with bearing (A).

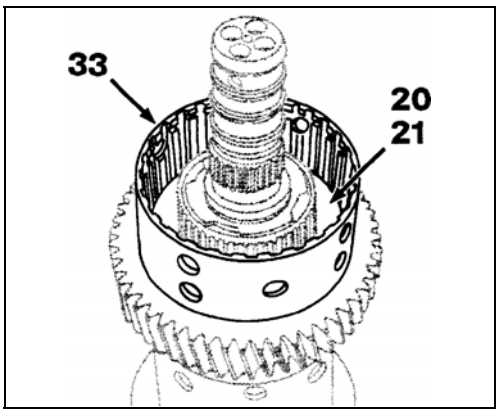


RANGE (OUTPUT) SHAFT

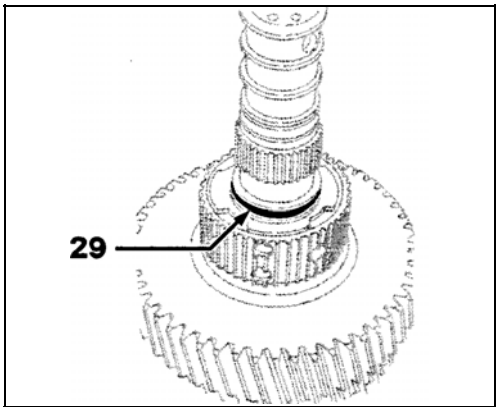
18. Remove eight friction discs (18) and seven separator plates (19).



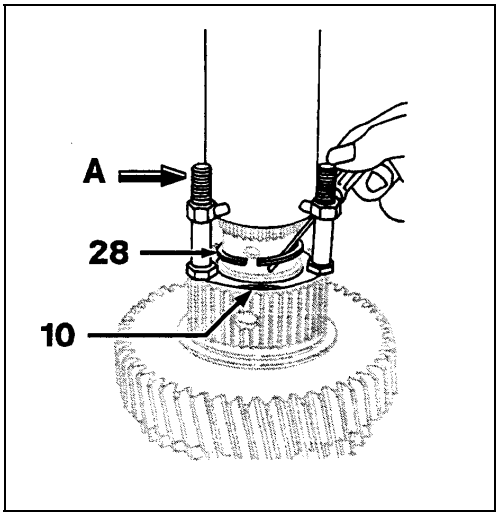
19. Remove 1st speed drum (33) with support plate (20) and captured retaining ring (21).



20. Remove O-ring (29) from groove in shaft.



21. Position assembly in press and install spring compressor tool (A), see SERVICE/SPECIAL TOOLS in this Section, on lube sleeve (10). Activate press to move retainer below retaining ring (28). Move ring out of groove and up on shaft. Slowly let off press until spring fully decompresses. Remove tool and retaining ring from shaft.

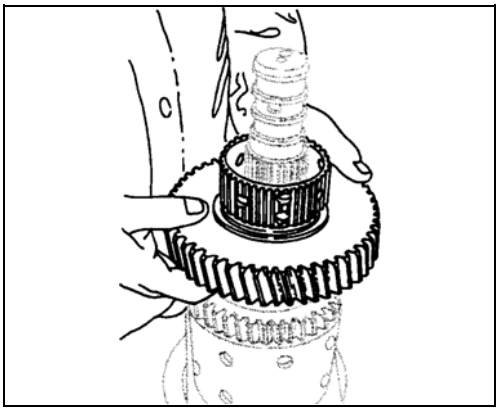


WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme care when disassembling.

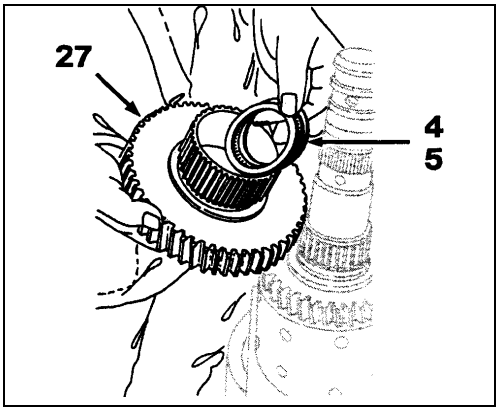
Remove lube sleeve (10), spring (9), spring plate (8) and retaining ring (3) from assembly.

RANGE (OUTPUT) SHAFT

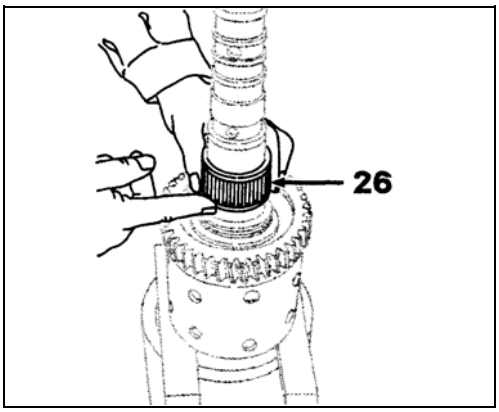
22. Remove 1st speed gear and hub (27).



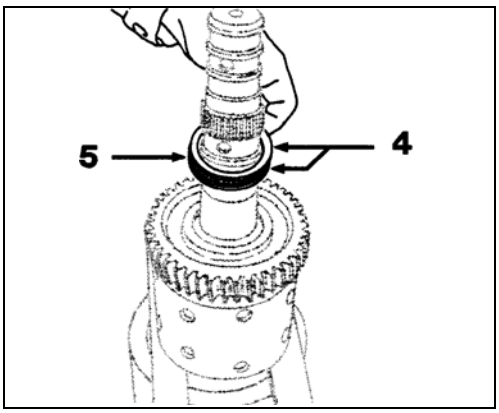
23. Remove thrust race washers (4) and thrust bearing (5) from inside 1st speed gear and hub (27).



24. Remove needle bearing (26).



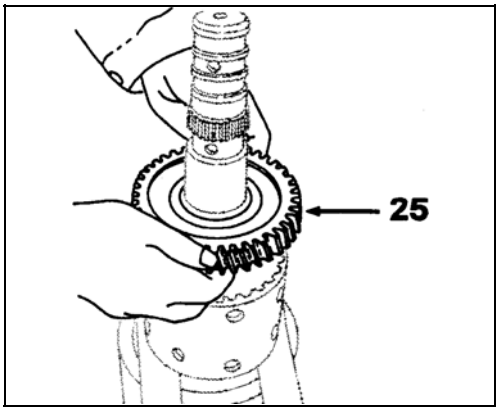
25. Remove thrust race washers (4) and thrust bearing (5).



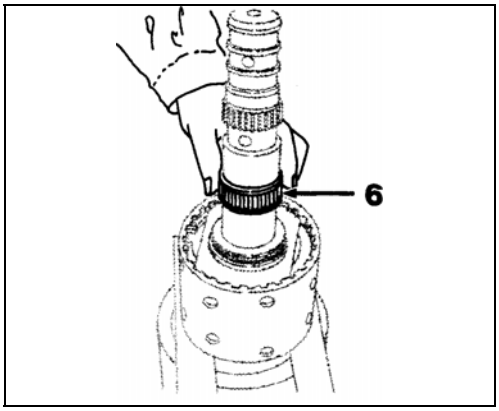
TRANSMISSION

RANGE (OUTPUT) SHAFT

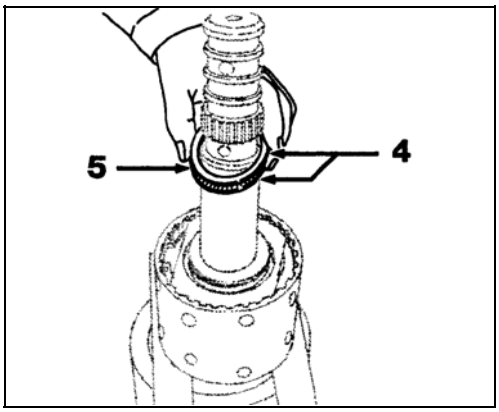
26. Remove 2nd speed gear and hub (25).



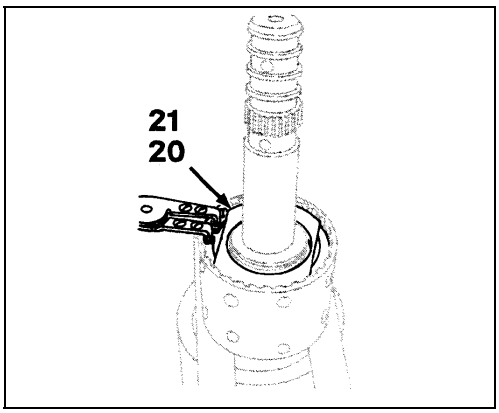
27. Remove needle bearing (6).



28. Remove thrust race washers (4) and thrust bearing (5).

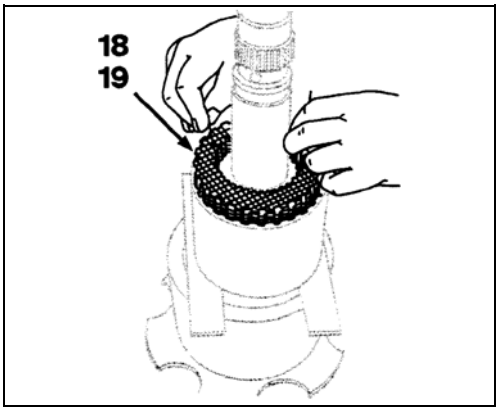


29. Using retaining ring pliers, compact captured retaining ring (21) and remove with support plate (20).



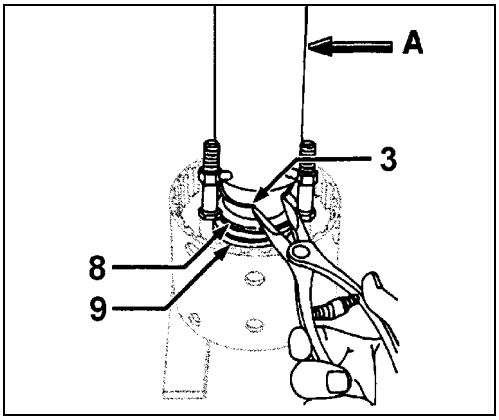
RANGE (OUTPUT) SHAFT

30. Remove seven friction discs (18) and six separator plates (19).

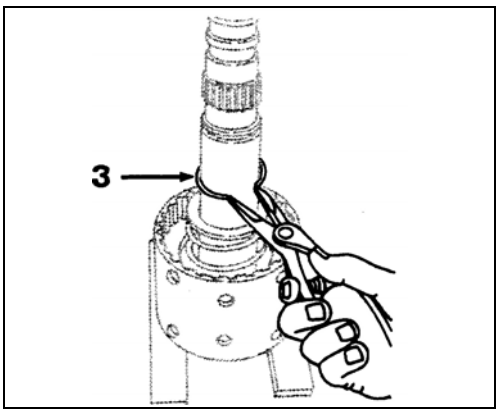


31. Position assembly in press and install spring compressor tool (A), see SERVICE/SPECIAL TOOLS in this Section, on spring plate (8). Activate press to move retainer below retaining ring (3). Move ring out of groove and up on shaft. Slowly let off press until spring (9) fully decompresses.

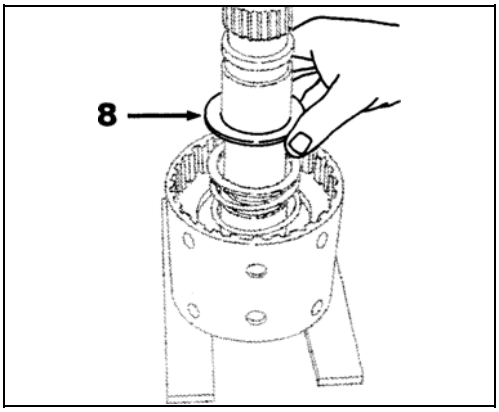
WARNING! Spring loaded assembly. Assembly must be held to relieve spring pressure. Use extreme care when disassembling



32. Let off press and remove compression tool. Remove retaining ring (3) from shaft.



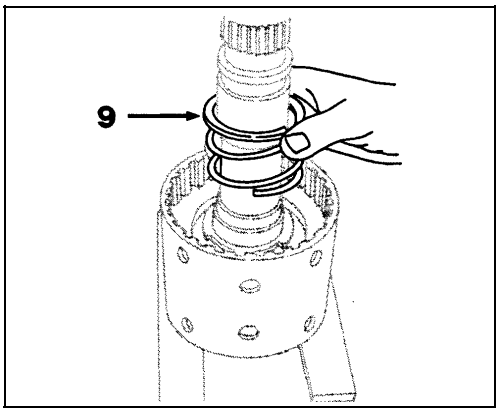
33. Remove spring plate (8).



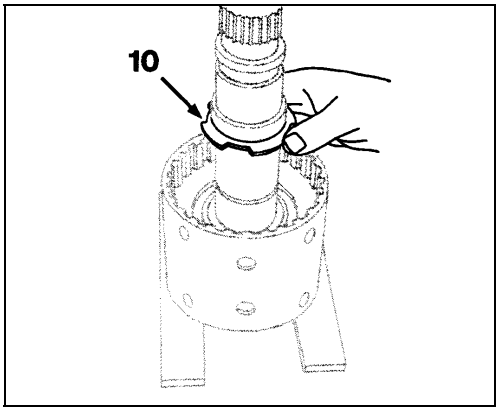
RANGE (OUTPUT) SHAFT

34. Remove piston return spring (9).

NOTE: *Check spring for damage and fatigue against those values shown in spring criterion.*

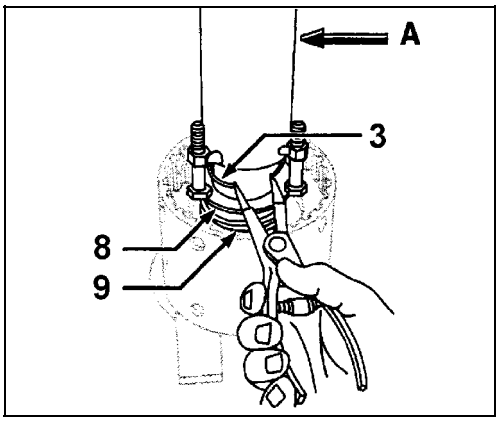


35. Remove lube sleeve (10).

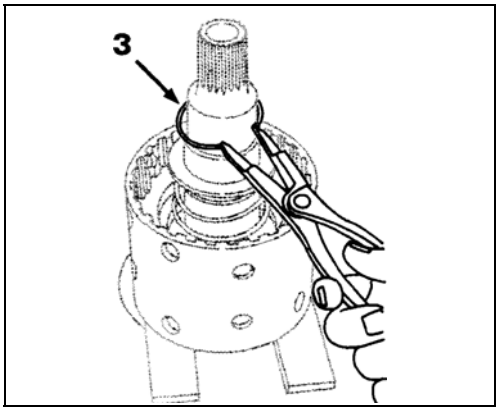


36. Turn assembly over in press and install spring compressor tool (A), see SERVICE/SPECIAL TOOLS in this Section, on spring (8). Activate press to move retainer below retaining ring (3). Move ring out of groove and up on shaft. Slowly let off press until spring (9) fully decompresses.

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

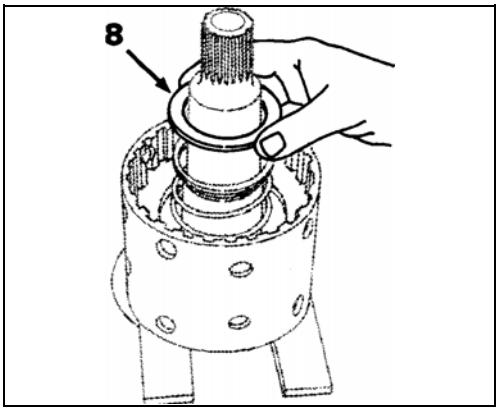


37. Let off press and remove compression tool. Remove retaining ring (3) from shaft.



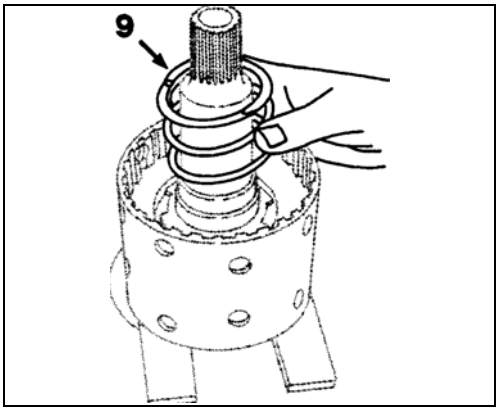
RANGE (OUTPUT) SHAFT

38. Remove spring plate (8).

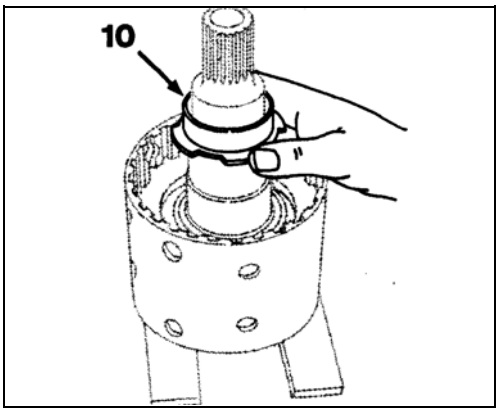


39. Remove piston return spring (9).

NOTE: *Check spring for damage and fatigue against those values shown in spring criterion.*

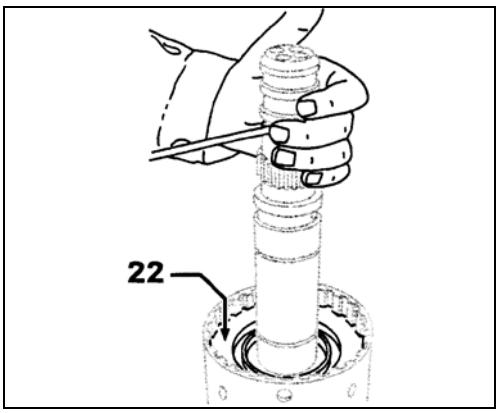


40. Remove lube sleeve (10).



41. Position assembly back in stand seal ring groove side up. Using compressed air in bottom (2nd) groove port, unseat 2nd speed piston (22) from hub and drum.

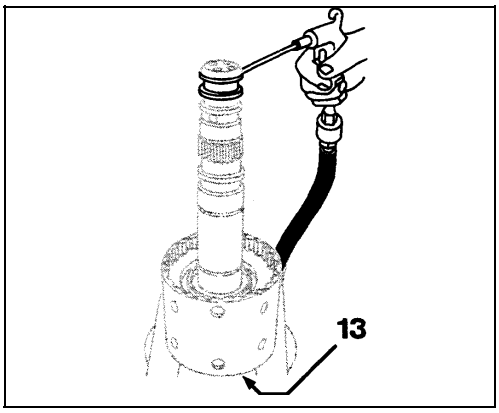
NOTE: *Wear eye protection when using air under pressure. limit air pressure to 200 [kPa].*



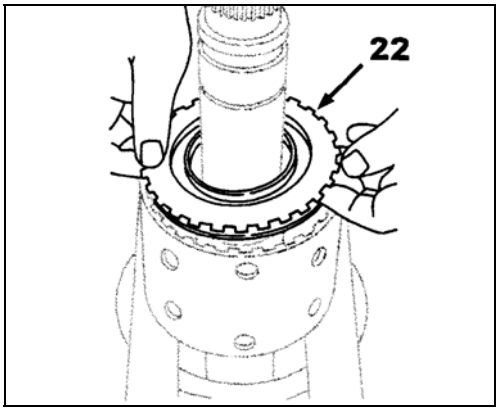
RANGE (OUTPUT) SHAFT

42. Using compressed air in top (3rd) groove port, unseat 3rd speed piston (13) from hub and drum.

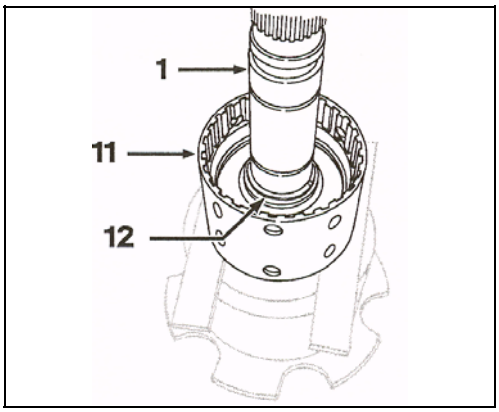
NOTE: *Wear eye protection when using air under pressure. limit air pressure to 200 [kPa].*



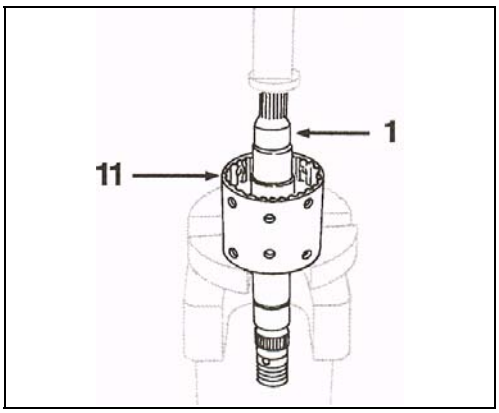
43. Remove 2nd (22) and 3rd (13) speed pistons from hub and drum.



44. If hub and drum (11) is to be remove from output shaft (1), remove retaining rings (12) from each side.

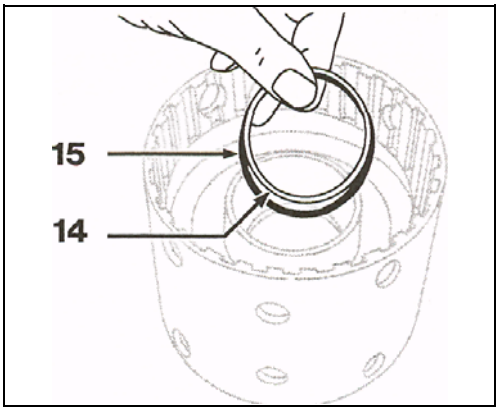


45. Position assembly in press and separate shaft (1) from hub and drum (11).

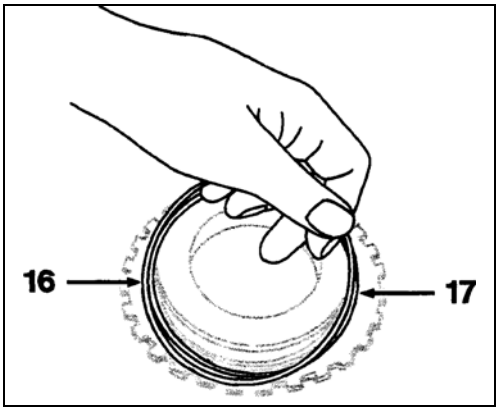


RANGE (OUTPUT) SHAFT

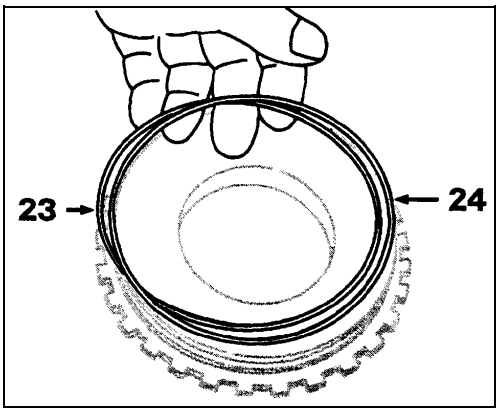
46. Remove piston seal ring (14) and O-ring (15) from each side of hub and drum.



47. Remove piston seal ring (16) and O-ring (17) from 3rd speed piston (13).

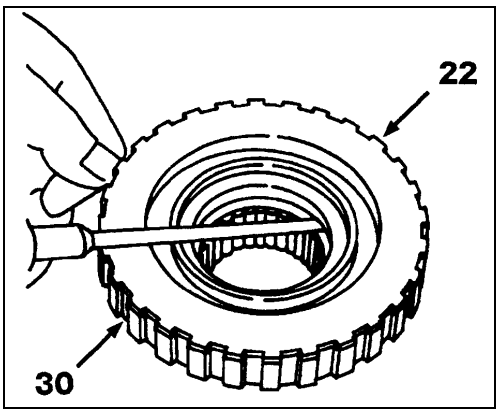


48. Remove piston seal ring (23) and O-ring (24) from 2nd speed piston (22).



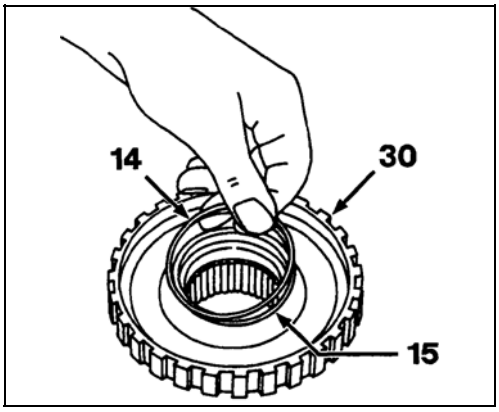
49. Using compressed air through port in 1st piston hub (30), remove 1st speed piston (22).

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

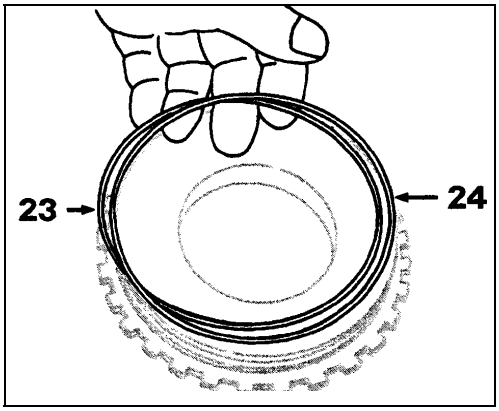


RANGE (OUTPUT) SHAFT

50. Remove piston seal ring (14) and O-ring (15) from 1st piston hub (30).



51. Remove piston seal ring (23) and O-ring (24) from 1st speed piston (22).

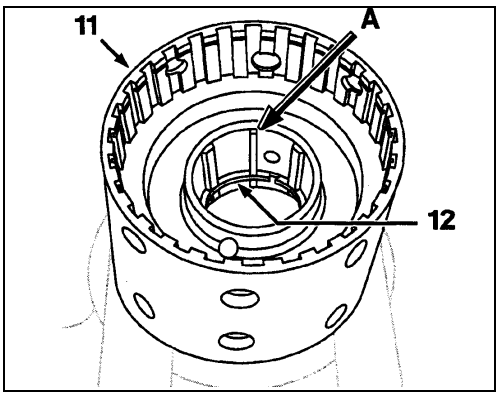


RANGE (OUTPUT) SHAFT

16. REASSEMBLY

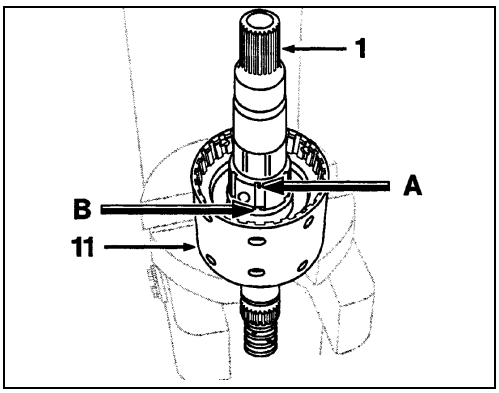
NOTE: *Callouts from exploded and cross section views (refer to Fig.'s 7C.6 and 7C.7) correspond with call-outs in following steps.*

1. Install one retaining ring (12) in groove in hub and drum (11). Take note of half notched spline (A) in hub and drum.



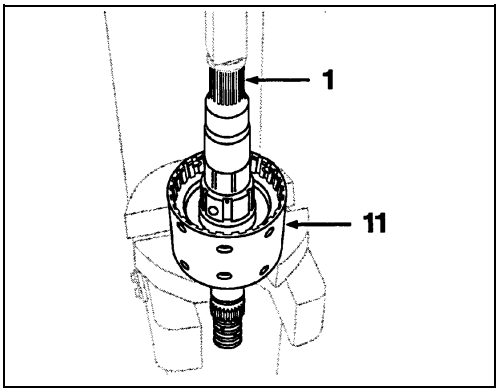
2. Position hub and drum (11) in press. Align dowel pin (A) in shaft (1) with notched spline (B) of hub and drum.

NOTE: *3rd clutch side of hub and drum assembly is identified by a smaller inner diameter of hub from splined end of shaft side.*



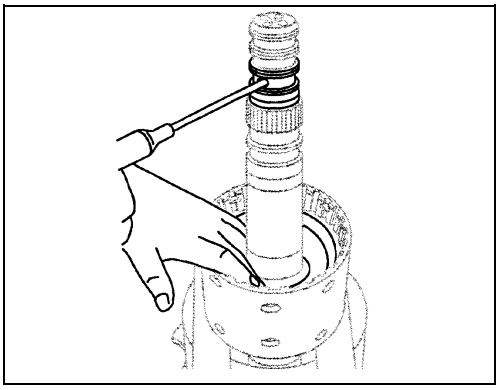
3. Press shaft (1) into hub and drum (11) bottoming against retaining ring.

NOTE: *To make hub and drum installation easier heat hub to max 200 [°C].*



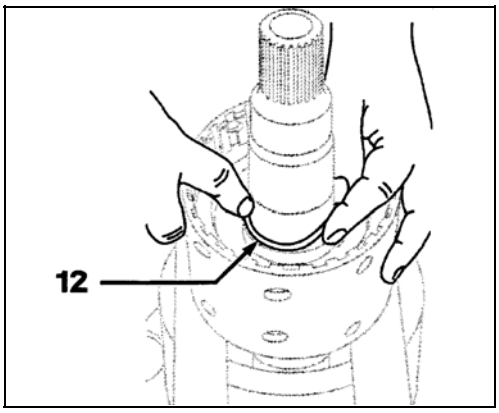
4. Using compressed air through port of bottom groove, ascertain that piston apply ports align.

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

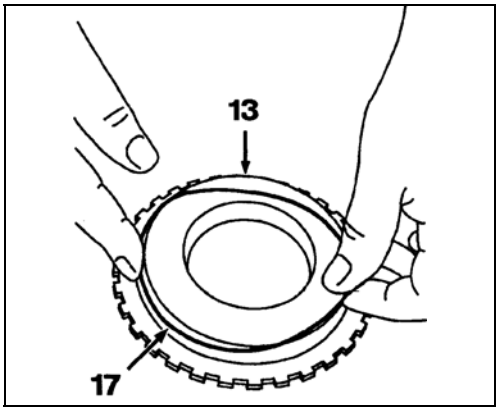


RANGE (OUTPUT) SHAFT

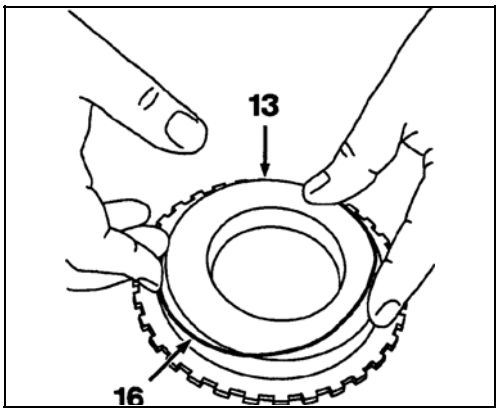
5. Work remaining retaining ring (12) into groove in hub and drum.



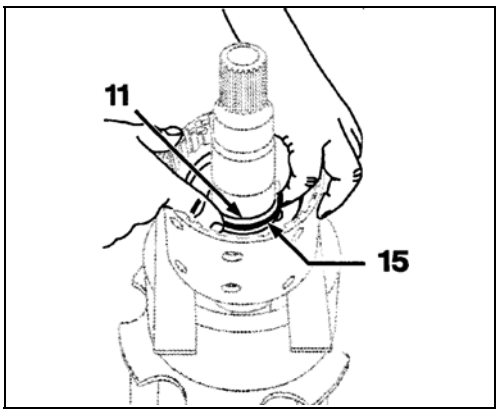
6. Install new O-ring (17) in groove on 3rd speed piston (13).



7. Install new piston seal ring (16) over O-ring into groove on 3rd speed piston (13).

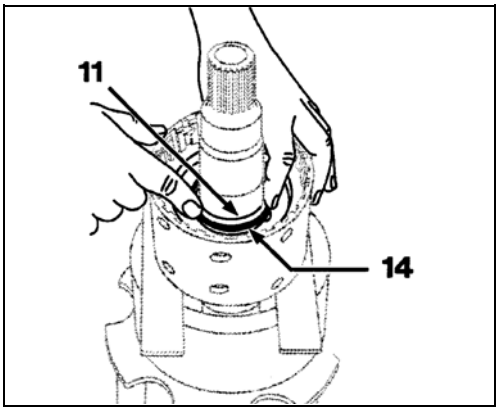


8. Install new O-ring (15) into groove at hub and drum (11).

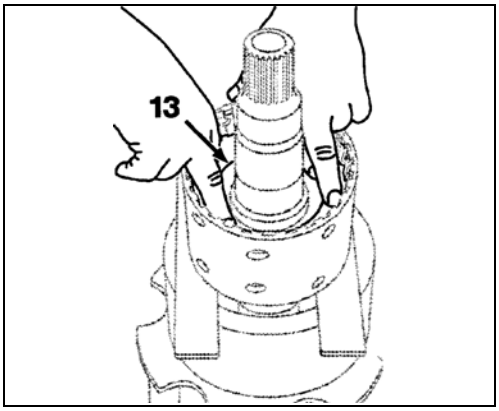


RANGE (OUTPUT) SHAFT

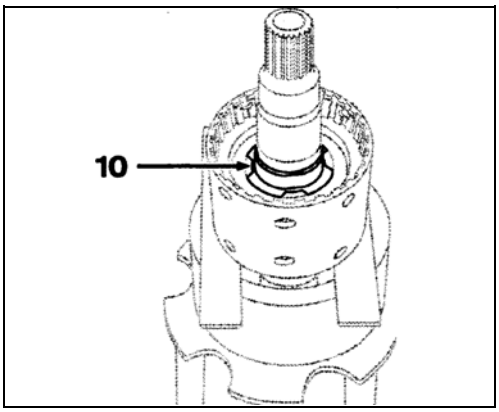
9. Install new piston seal ring (14) over O-ring into groove at hub and drum (11).



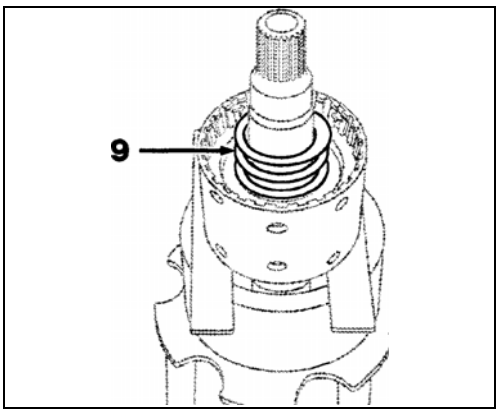
10. Coat lead in chamfers of hub and drum with clean oil. Spline piston (13) in hub and press in place being careful not to damage piston rings.



11. Install lube sleeve (10).

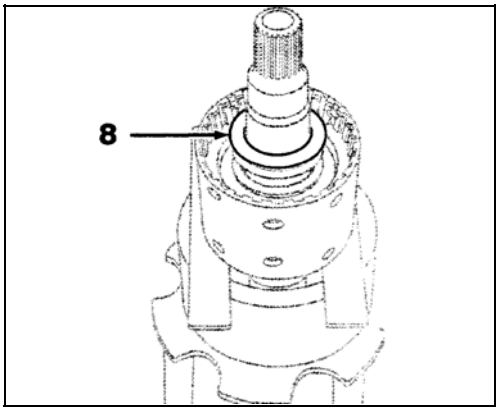


12. Install piston return spring (9).

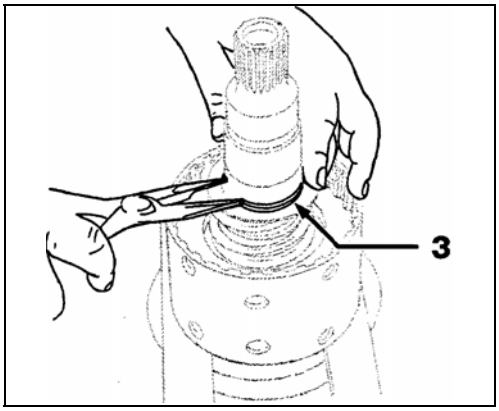


RANGE (OUTPUT) SHAFT

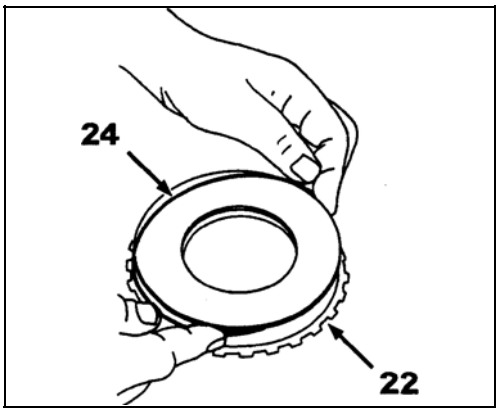
13. Install spring plate (8) over spring.



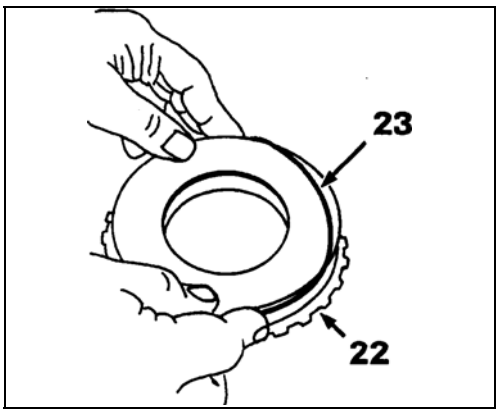
14. Install retaining ring (3) as far down shaft as possible.



15. Install new O-ring (24) in groove on 2nd speed piston (22).

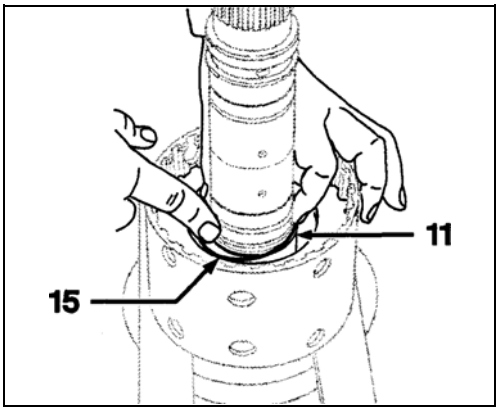


16. Install new piston seal ring (23) over O-ring into groove on 2nd speed piston (22).

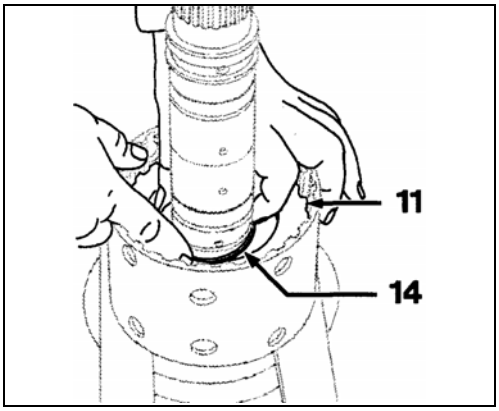


RANGE (OUTPUT) SHAFT

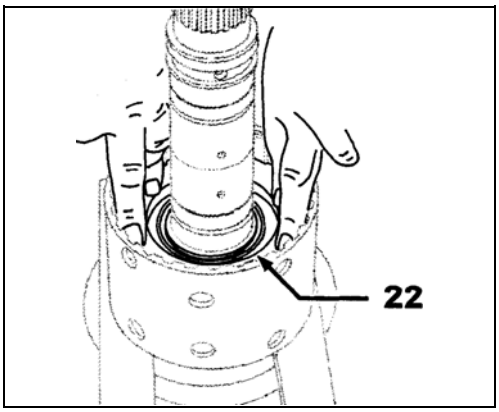
17. Install new O-ring (15) into groove at hub and drum (11).



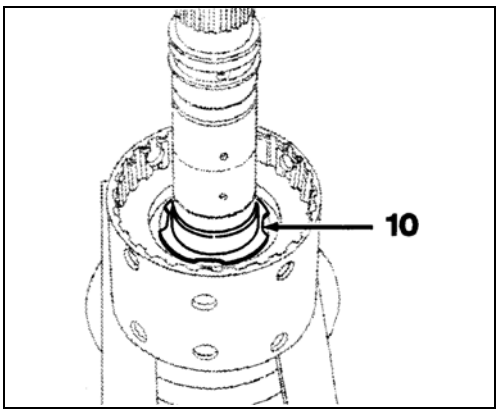
18. Install new piston seal ring (14) over O-ring into groove at hub and drum (11).



19. Coat lead in chamfers of hub and drum with clean oil. Spline piston (22) in hub and press in place being careful not to damage piston rings.

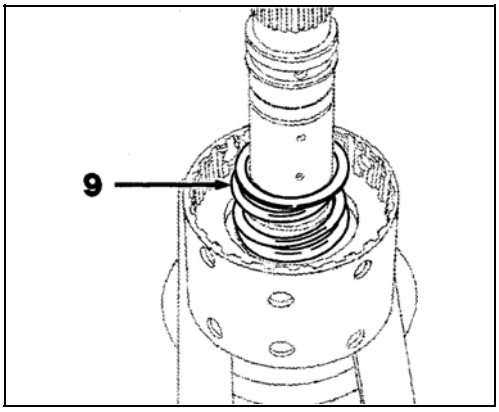


20. Install lube sleeve (10).

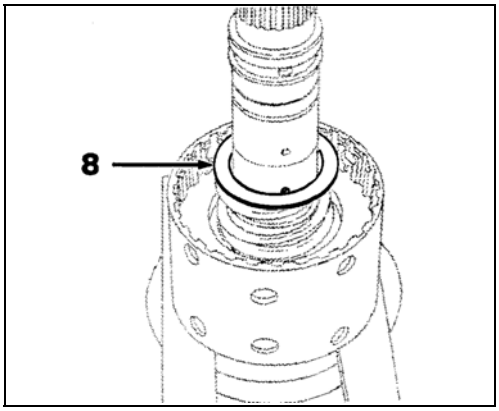


RANGE (OUTPUT) SHAFT

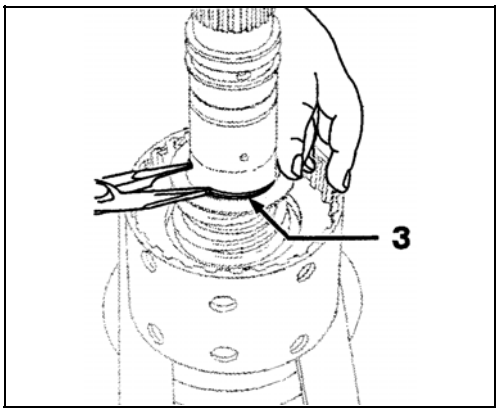
21. Install piston return spring (9).



22. Install spring plate (8) over spring.

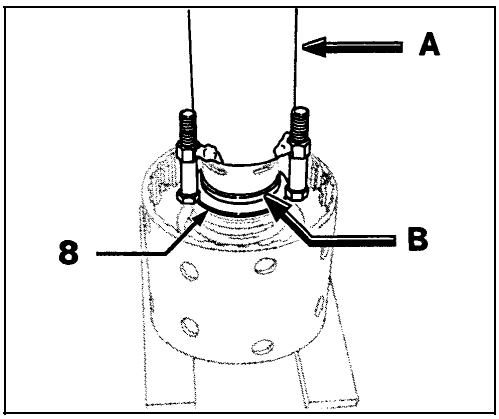


23. Install retaining ring (3) as far down shaft as possible.



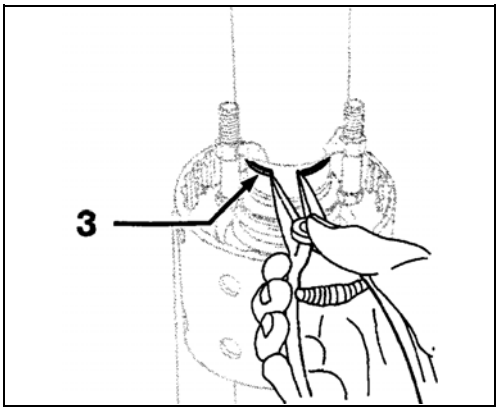
24. Position assembly in press and install spring compressing tool (A), (see SERVICE/SPECIAL TOOLS in this Section), on spring plate (8). Activate press to move plate below ring groove (B).

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



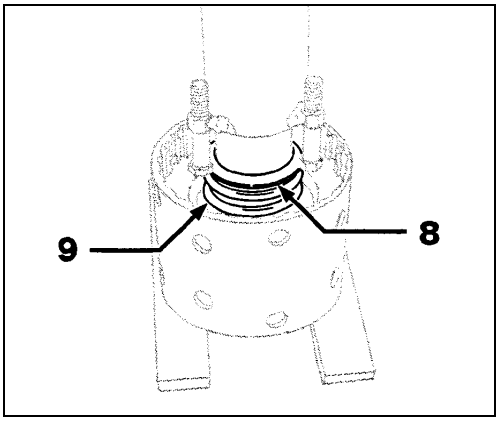
RANGE (OUTPUT) SHAFT

25. Install retaining ring (3) into groove on shaft.

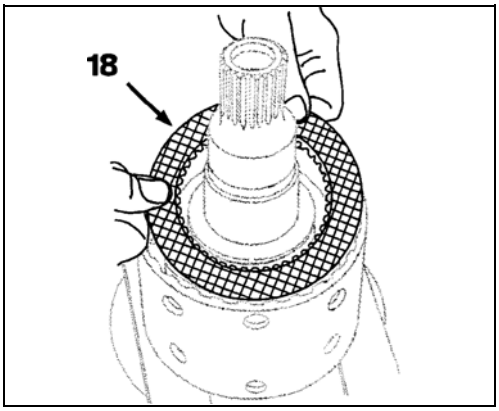


26. Slowly let off press until spring (9) is held by plate (8). Turn assembly over in press and repeat steps 24 through 26 for remaining side.

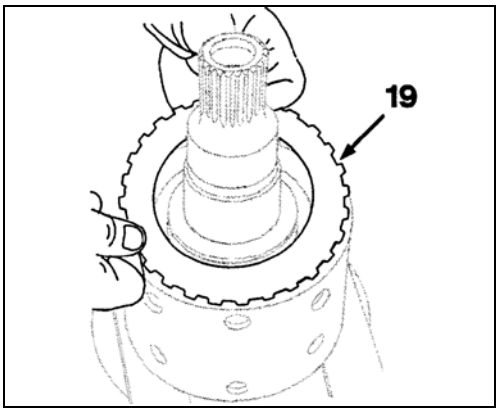
WARNING! Spring loaded assembly. Assembly must be held to install spring. Use extreme care when assembling.



27. Position assembly in stand and support with bars. Coat friction disc (18) lightly with clean oil and install into assembly.



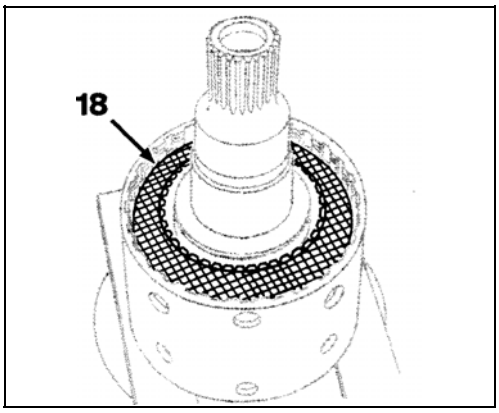
28. Install separator plate (19).



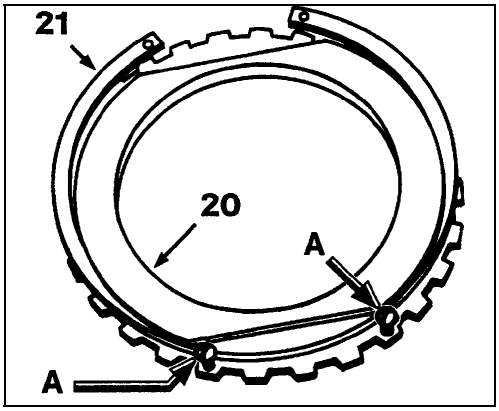
RANGE (OUTPUT) SHAFT

29. Alternately install friction disc and separator plates ending with friction disc (18). A total of seven friction discs and six separator plates are to be used.

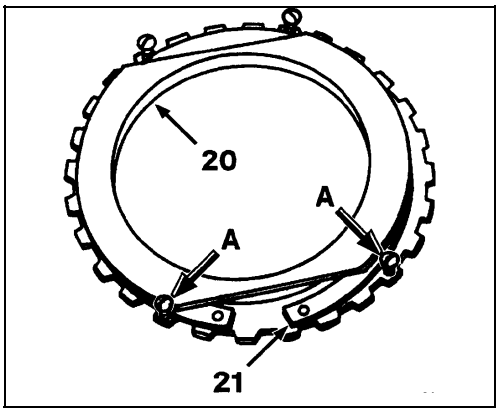
NOTE: *To insure proper assembly of third speed clutch components measure total dimension of friction discs pack and separator plates pack. If dimensions are within 13.3 ÷ 14.0 [mm] and 7.0 ÷ 7.6 [mm] respectively, friction discs and separator plates packs are correct and can be installed in third speed clutch pack.*



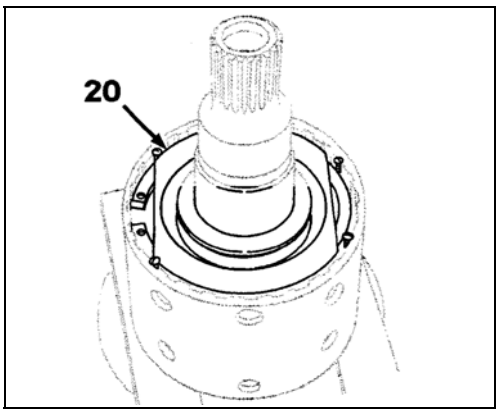
30. Position captured retaining ring (21) into support plate (20). Install two #6-32 screws (A) at opposite side of retaining ring opening.



31. Retract retaining ring (21) and install two #6-32 screws (A) in support plate (20).



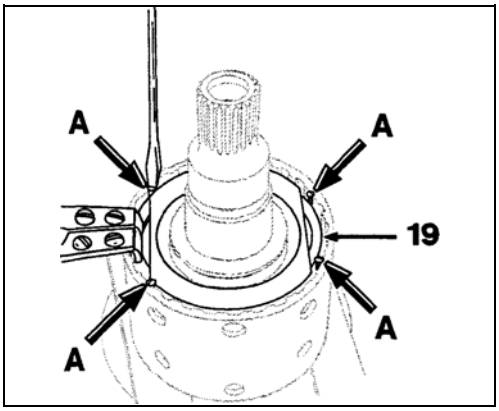
32. Install support plate (20) into assembly.



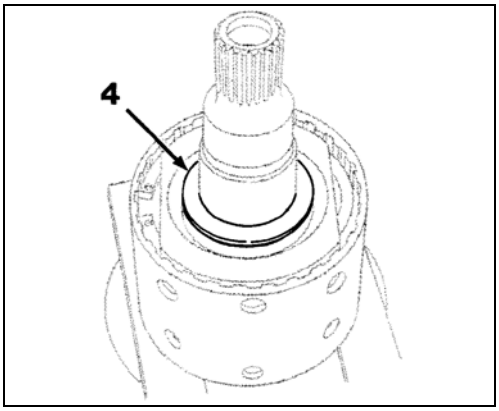
RANGE (OUTPUT) SHAFT

33. Retract retaining ring (21) and remove four screws (A). Carefully let off retaining ring until it seats in groove in drum.

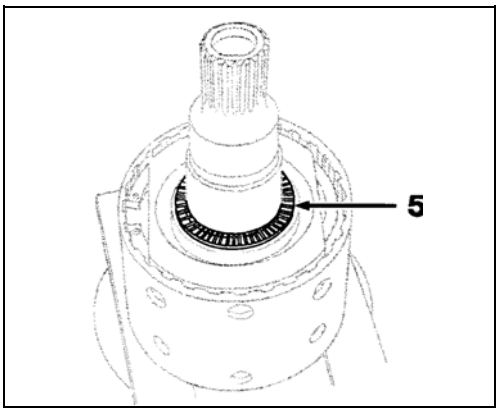
NOTE: *Desired clutch axial clearance should be within 1.5 ÷ 4 [mm].*



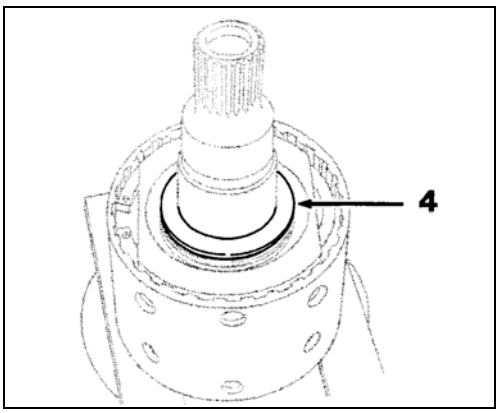
34. Install inner thrust race washer (4).



35. Install thrust bearing (5) to race washer. Coat bearing needles with clean oil.

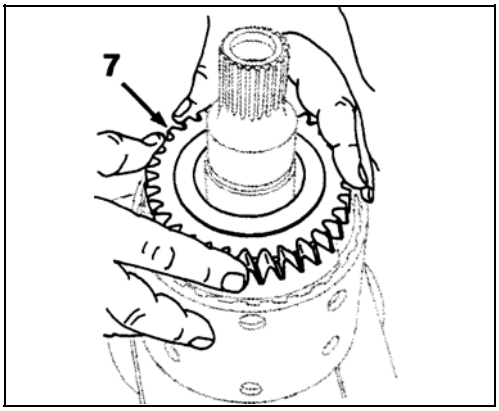


36. Install outer thrust race washer (4).

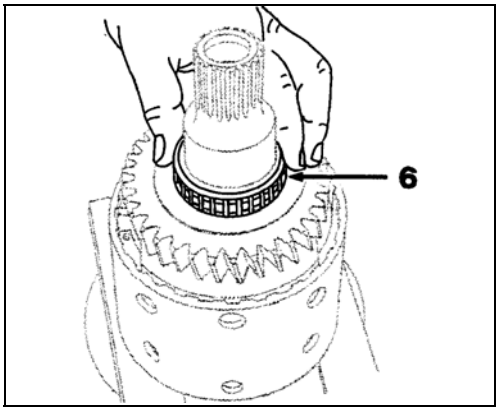


RANGE (OUTPUT) SHAFT

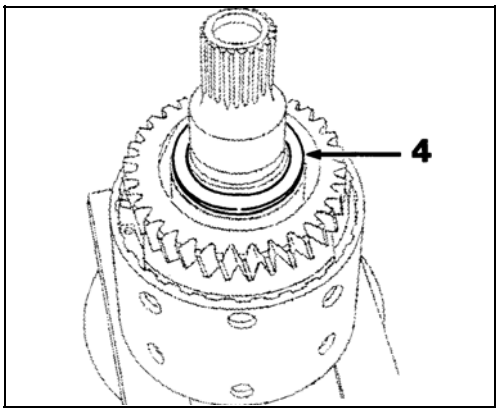
37. Install 3rd speed gear and hub (7) aligning all seven friction discs.



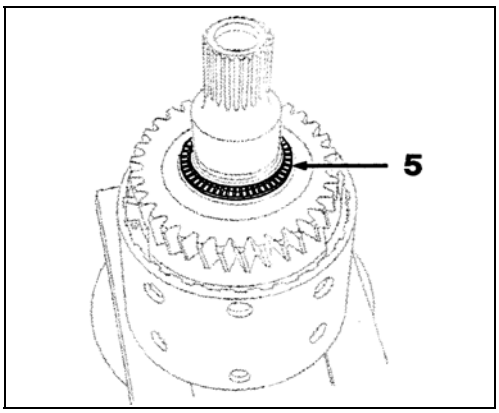
38. Install needle bearing (6) inside 3rd speed gear and hub. Coat bearing needles with clean oil.



39. Install inner thrust race washer (4).

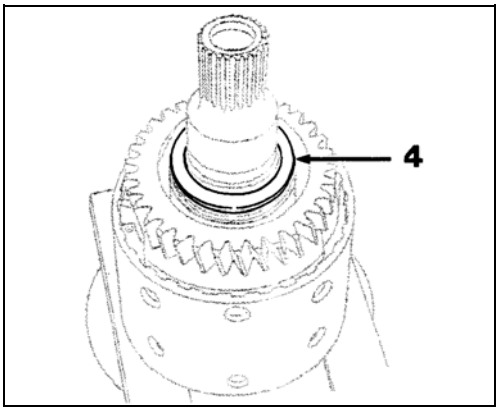


40. Install thrust bearing (5) to race washer. Coat bearing needles with clean oil.

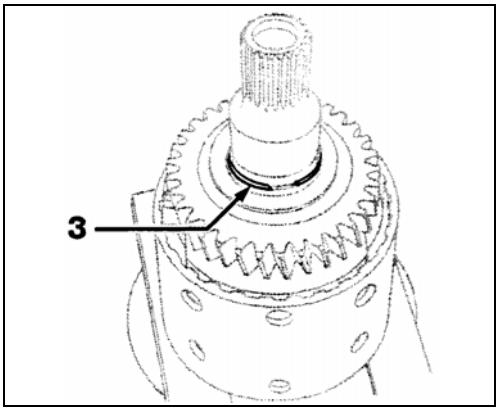


RANGE (OUTPUT) SHAFT

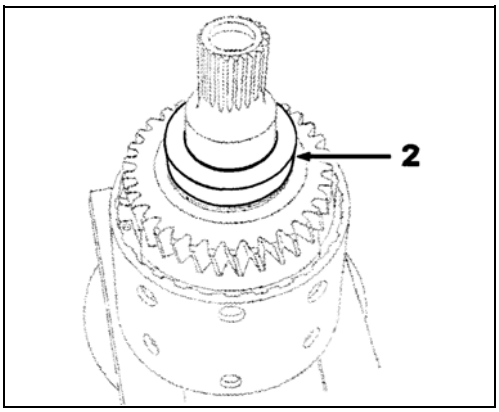
41. Install outer thrust race washer (4).



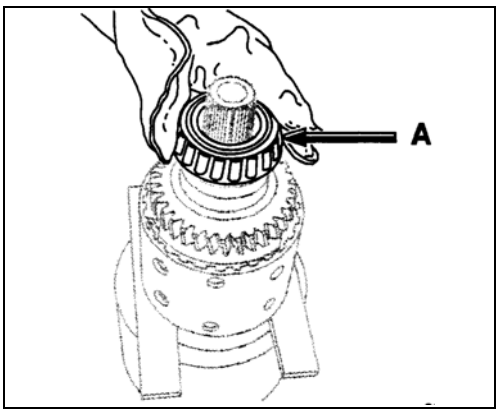
42. Install retaining ring (3) up against step on output shaft.



43. Seat bearing spacer ring (2) on outer thrust race washer against retaining ring.

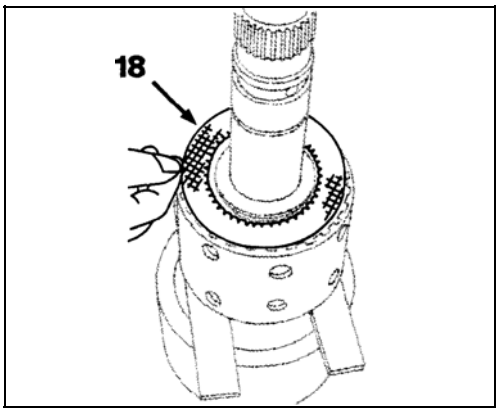


44. Heat bearing cone (A) to 135 [°C] for 45 [minutes]. Install on shaft and bottom. To insure cone is seated, keep pressure against cone until it cools. After bearing has cooled turn assembly over in clutch stand.

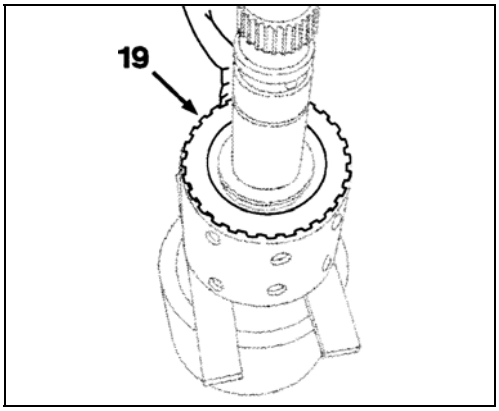


RANGE (OUTPUT) SHAFT

45. Coat friction disc (18) lightly with clean oil and install into assembly.

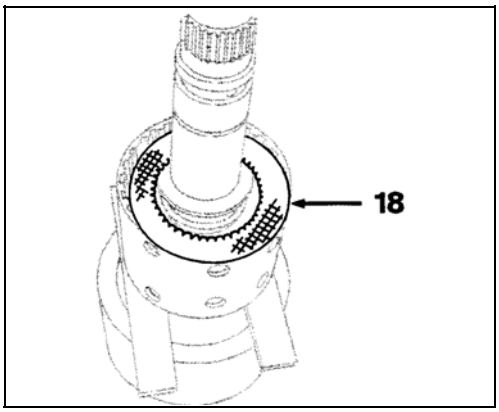


46. Install separator plate (19).

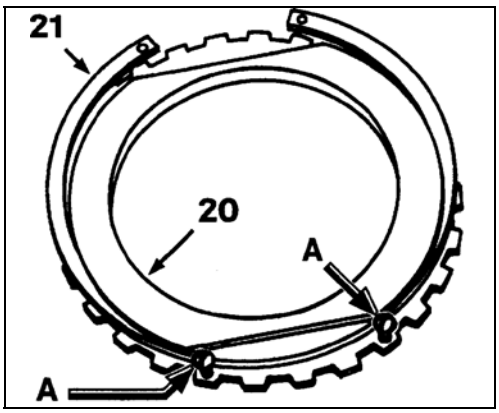


47. Alternately install friction disc and separator plates ending with friction disc (18). A total of seven friction discs and six separator plates are to be used.

NOTE: *To insure proper assembly of second speed clutch components measure total dimension of friction discs pack and separator plates pack. If dimensions are within 13.3 ÷ 14.0 [mm] and 7.0 ÷ 7.6 [mm] respectively, friction discs and separator plates packs are correct and can be installed in second speed clutch pack.*

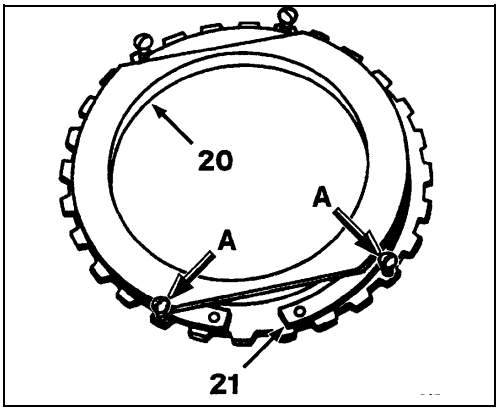


48. Position captured retaining ring (21) into support plate (20). Install two #6-32 screws (A) at opposite side of retaining ring opening.

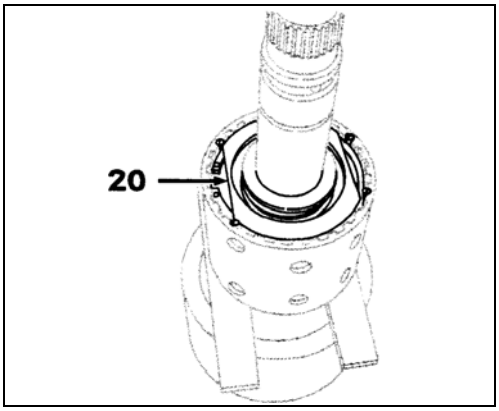


RANGE (OUTPUT) SHAFT

49. Retract retaining ring (21) and install two #6-32 screws (A) in support plate (20).

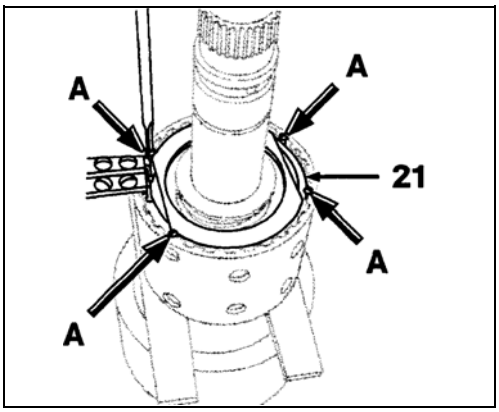


50. Install support plate (20) into assembly.

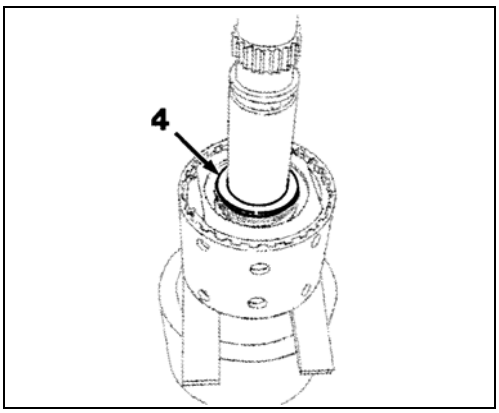


51. Retract retaining ring (21) and remove four screws (A). Carefully let off retaining ring until it seats in groove in drum.

NOTE: *Desired clutch axial clearance should be within 1.5 ÷ 4 [mm].*

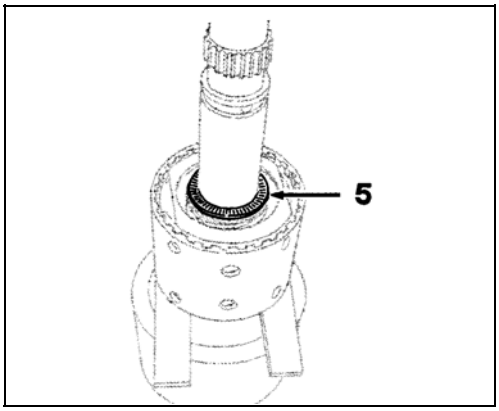


52. Install inner thrust race washer (4).

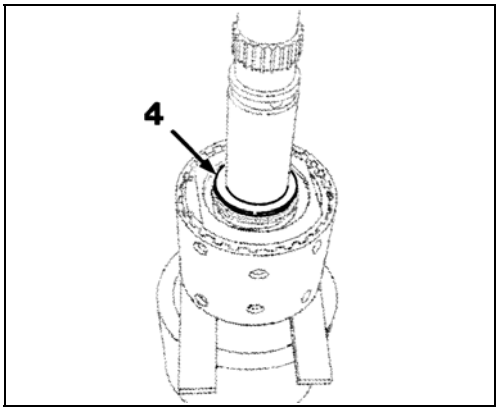


RANGE (OUTPUT) SHAFT

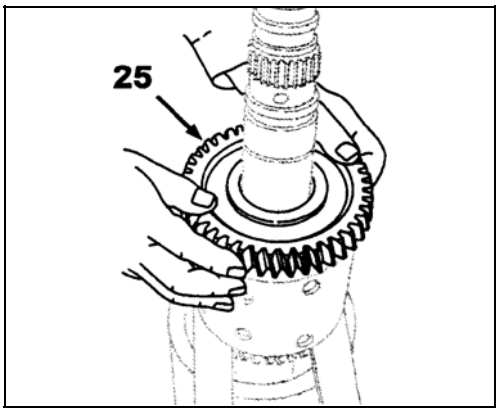
53. Install thrust bearing (5) to race washer. Coat bearing needles with clean oil.



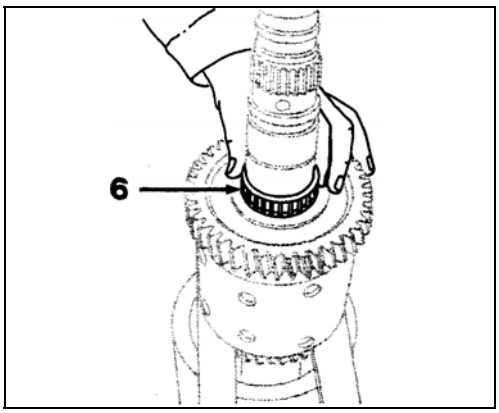
54. Install outer thrust race washer (4).



55. Install 2nd speed gear and hub (25) aligning all seven friction discs.

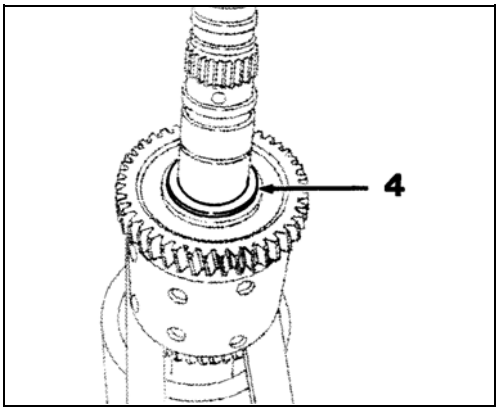


56. Install needle bearing (6) inside 2nd speed gear and hub. Coat bearing needles with clean oil.

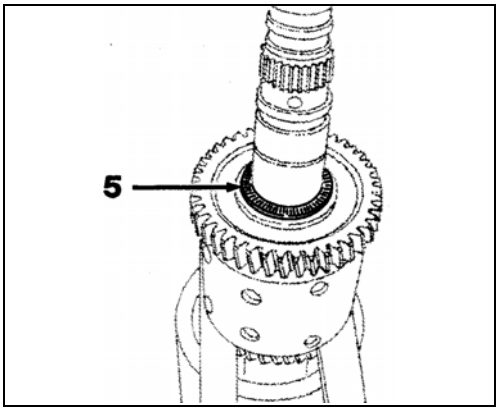


RANGE (OUTPUT) SHAFT

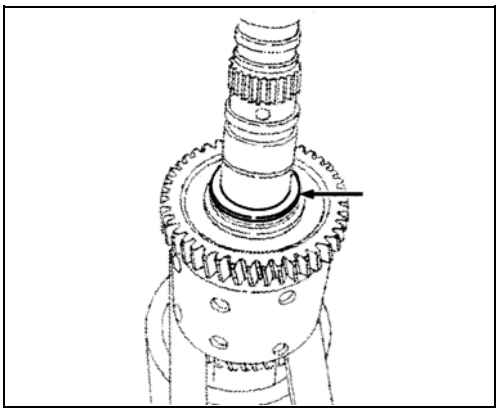
57. Install inner thrust race washer (4).



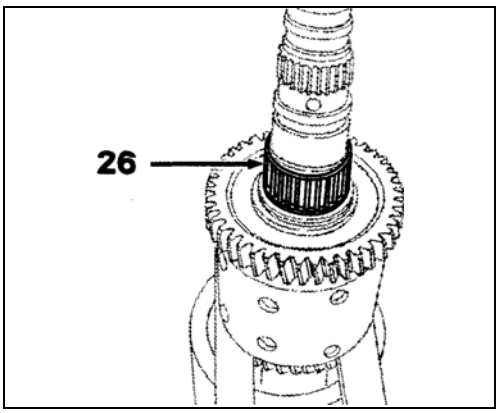
58. Install thrust bearing (5) to race washer. Coat bearing needles with clean oil.



59. Install outer thrust race washer (4).

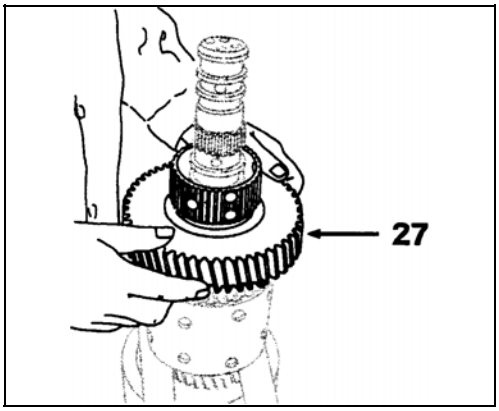


60. Install gear needle bearing (26). Coat bearing needles with clean oil.

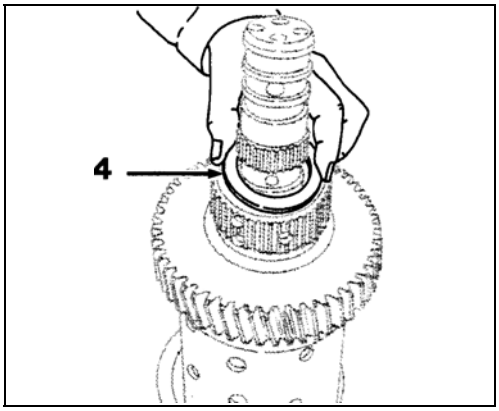


RANGE (OUTPUT) SHAFT

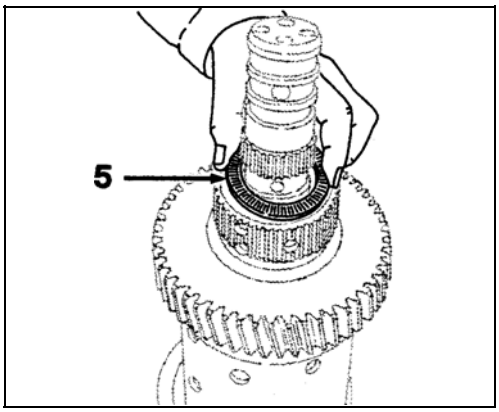
61. Install 1st speed gear and hub (27) over needle bearing onto outer thrust race washer.



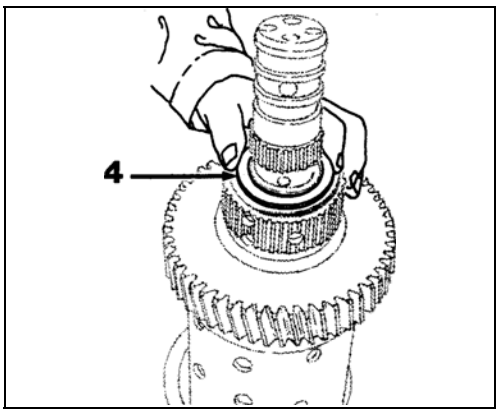
62. Install inner thrust race washer (4).



63. Install thrust bearing (5) to race washer. Coat bearing needles with clean oil.

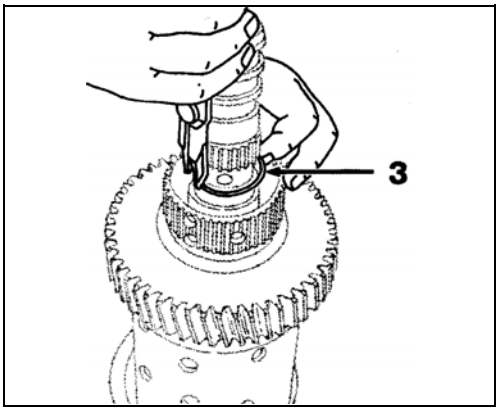


64. Install outer thrust race washer (4).

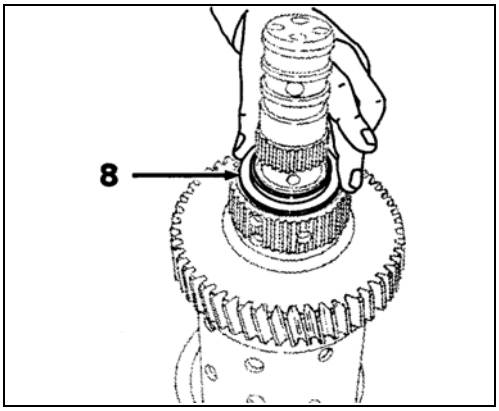


RANGE (OUTPUT) SHAFT

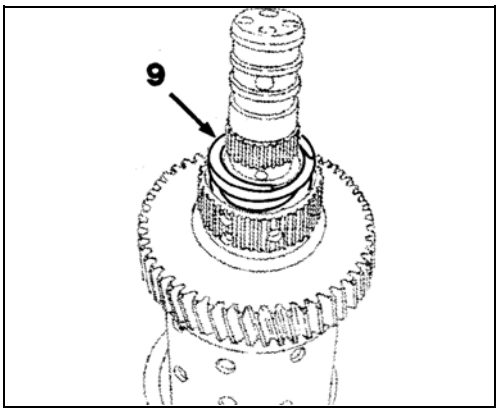
65. Install retaining ring (3) into groove against outer thrust race washer.



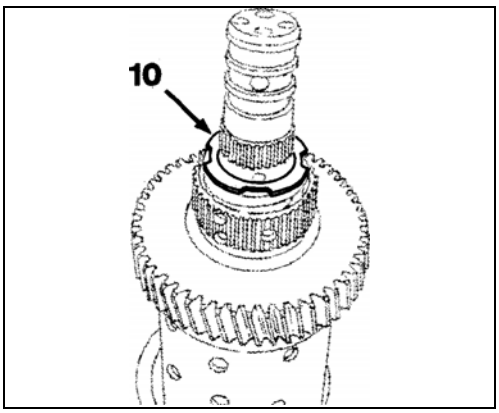
66. Install spring plate (8) against retaining ring.



67. Install piston return spring (9) to plate.

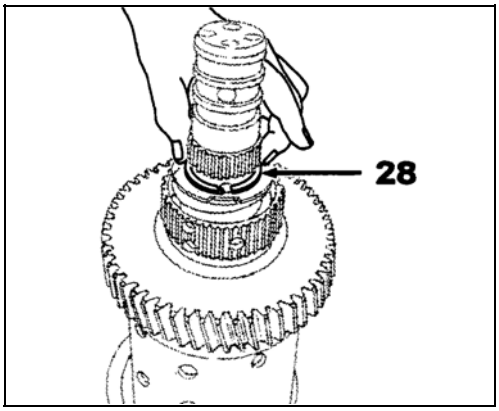


68. Install lube sleeve (10) to spring.



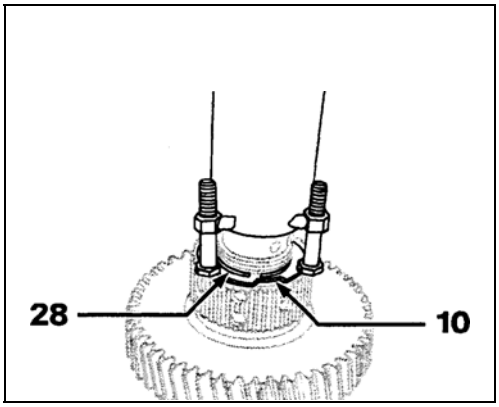
RANGE (OUTPUT) SHAFT

69. Position retaining ring (28) as far down on shaft as possible.

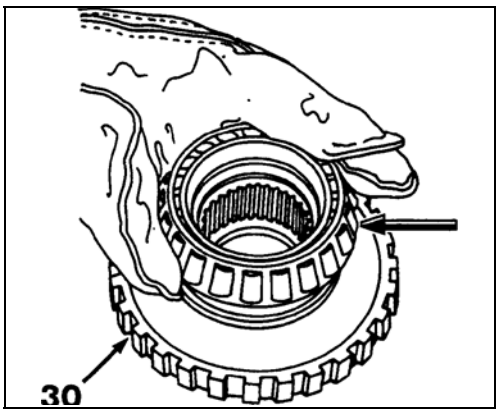


70. Position assembly in press and install spring compressor tool (A), (see SERVICE/SPECIAL TOOLS in this Section), on lube sleeve (10). Activate press to move retainer below retaining ring groove. Install retaining ring (28) in groove on shaft. Slowly let off press until spring is held by lube sleeve.

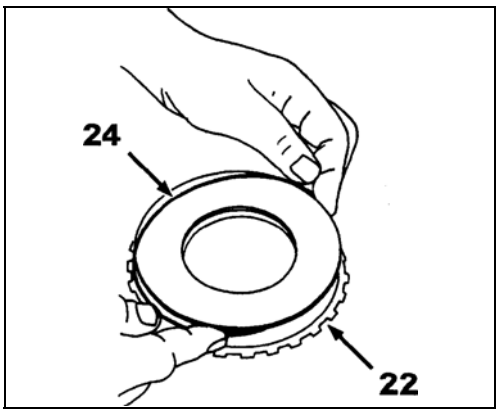
WARNING! Spring loaded assembly. Assembly must be held to install spring. Use extreme care when assembling.



71. Heat bearing cone (A) to 135 [°C] for 45 [minutes]. Install on 1st piston hub (30) and bottom. To insure cone is seated, keep pressure against cone until it cools.

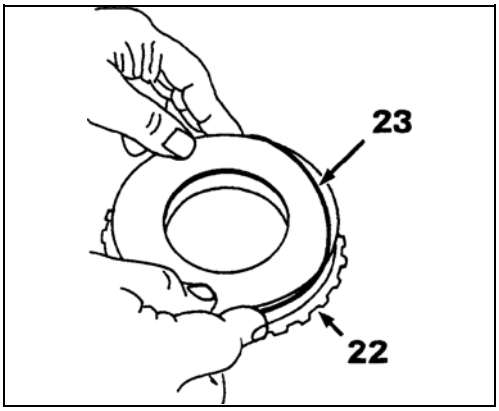


72. Install new O-ring (24) in groove on 1st speed piston (22).

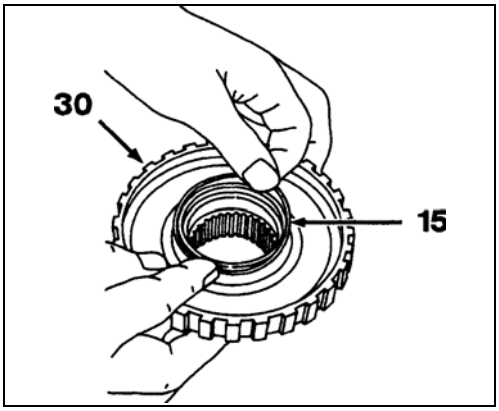


RANGE (OUTPUT) SHAFT

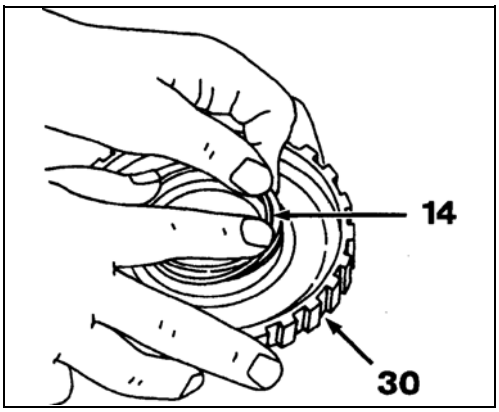
73. Install new piston seal ring (23) over O-ring into groove on 1st speed piston (22).



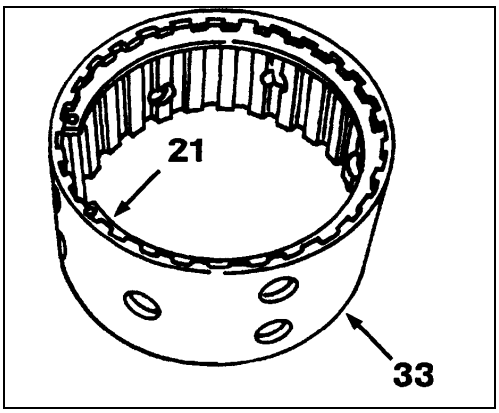
74. Install new O-ring (15) to groove in 1st speed piston hub (30).



75. Install new piston seal ring (14) over O-ring into groove on 1st speed piston hub (30).

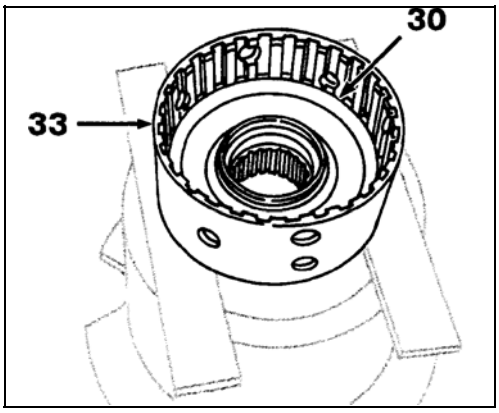


76. Install retaining ring (21) into groove at one side of 1st speed drum (33).

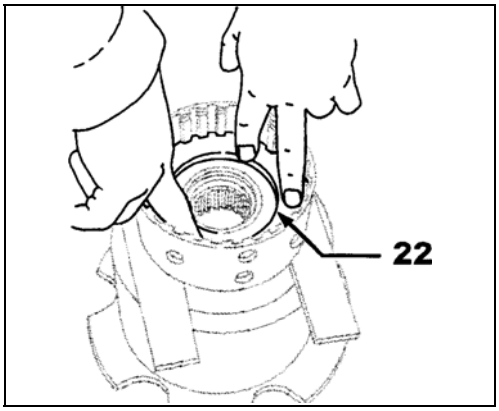


RANGE (OUTPUT) SHAFT

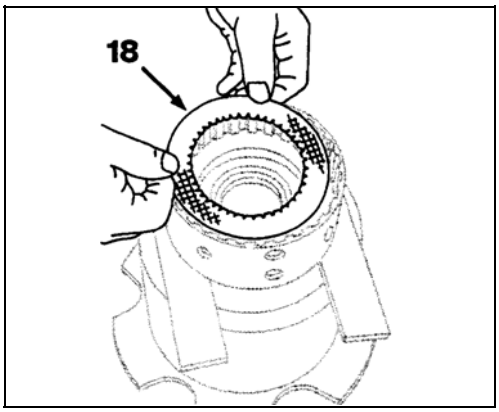
77. Position 1st speed drum (33), installed retaining ring side down, on clutch stand. Insert 1st speed hub (30), bearing end down, up against retaining ring.



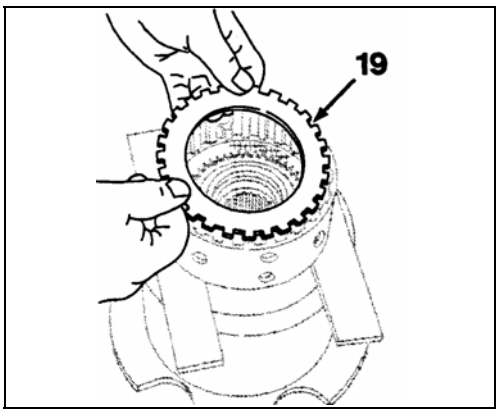
78. Coat lead in chamfers of hub and drum with clean oil. Spline piston (22) in housing and press in place being careful not to damage piston rings.



79. Coat friction disc (18) lightly with clean oil and install into assembly.



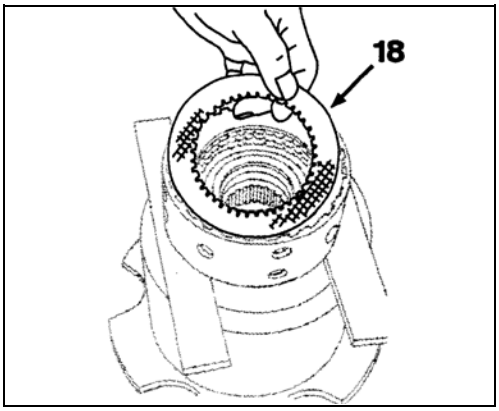
80. Install separator plate (19).



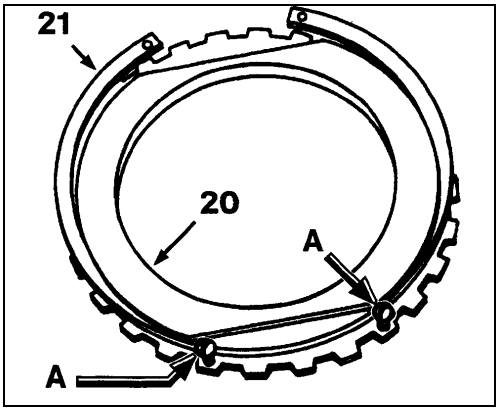
RANGE (OUTPUT) SHAFT

81. Alternately install friction disc and separator plates ending with friction disc (18). A total of eight friction discs and seven separator plates are to be used.

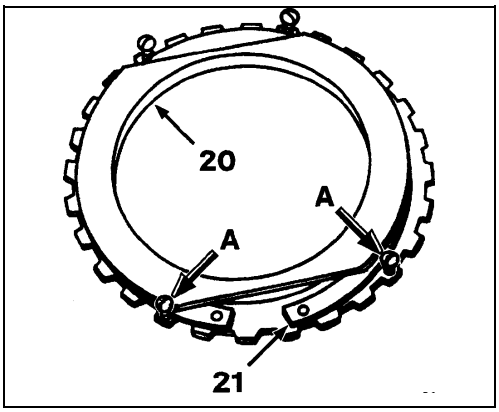
NOTE: *To insure proper assembly of first speed clutch components measure total dimension of friction discs pack and separator plates pack. If dimensions are within 15.2 ÷ 16.0 [mm] and 8.2 ÷ 8.9 [mm] respectively, friction discs and separator plates packs are correct and can be installed in first speed clutch pack.*



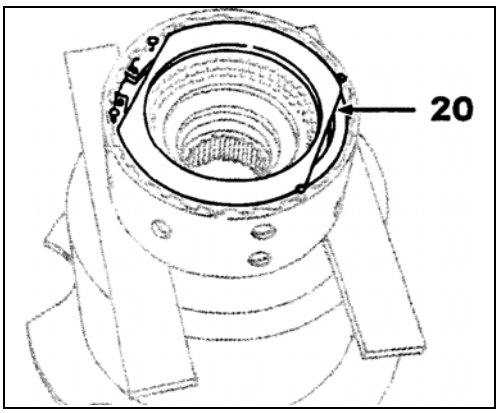
82. Position captured retaining ring (21) into support plate (20). Install two #6-32 screws (A) at opposite side of retaining ring opening.



83. Retract retaining ring (21) and install two #6-32 screws (A) in support plate (20).



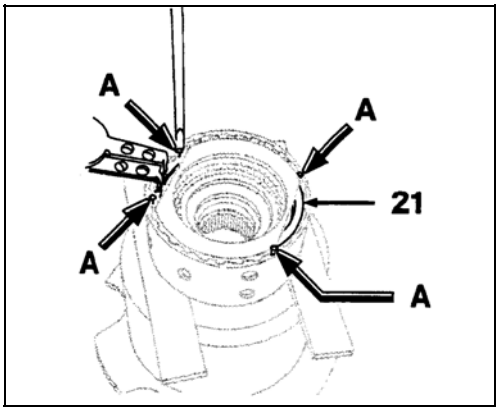
84. Install support plate (20) into assembly.



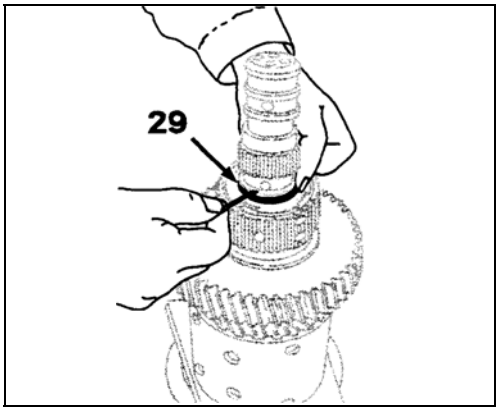
RANGE (OUTPUT) SHAFT

85. Retract retaining ring (21) and remove four screws (A). Carefully let off retaining ring until it seats in groove in drum.

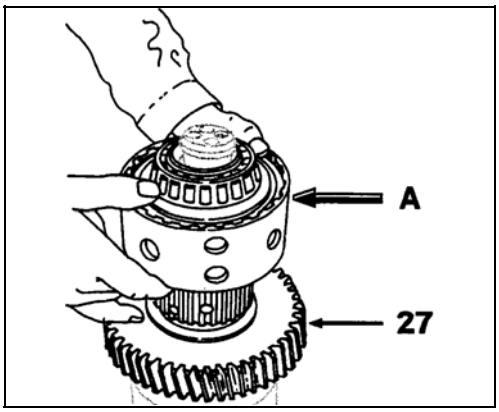
NOTE: *Desired clutch axial clearance should be within 1.0 ÷ 3.5 [mm].*



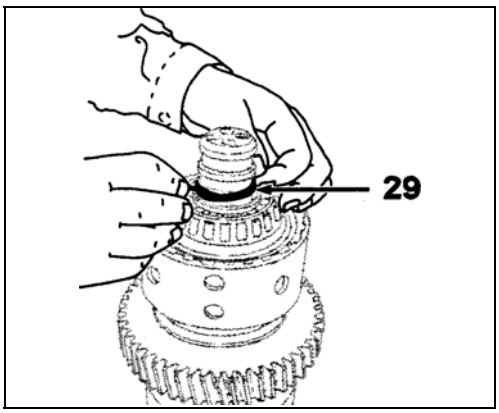
86. Install O-ring (29) to groove in shaft.



87. Install 1st clutch assembly (A) on shaft aligning eight friction discs with 1st speed gear and hub (27) and 1st piston hub with shaft. Be careful not to cut inner seal ring.

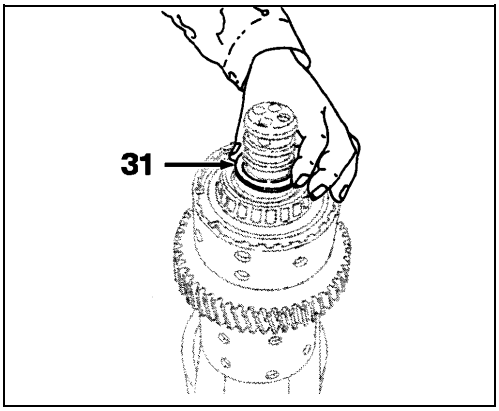


88. Install O-ring (29) under 1st piston hub up against step on shaft.

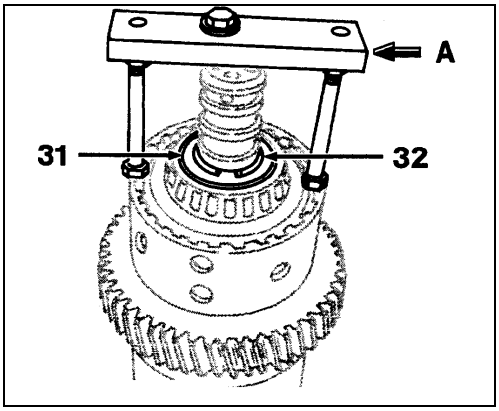


RANGE (OUTPUT) SHAFT

89. Install spacer ring (31) against O-ring.



90. Start retaining ring (32) on shaft and position next to spacer ring (31). Install compression tool (A), (see SERVICE/SPECIAL TOOLS in this Section) and move clutch assembly down until retaining ring can be inserted into groove on shaft. Insert. Remove tool.



REVERSE IDLER SHAFT

17. GENERAL

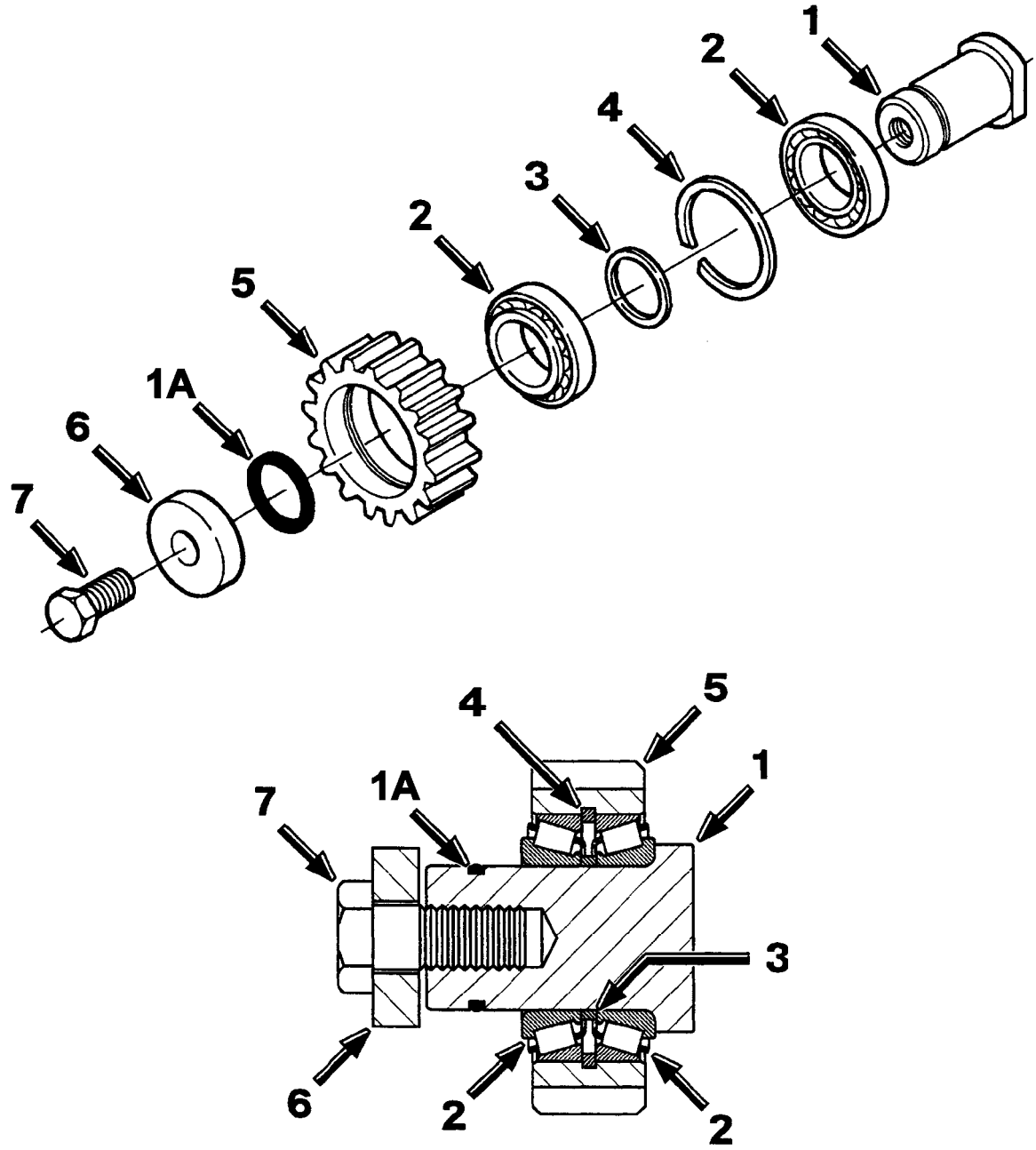


Fig. 7C.8. Exploded and Cross Section Views of Reverse Idler Shaft

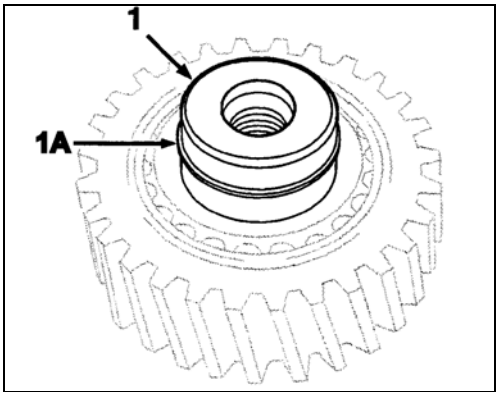
1. Reverse Idler Shaft
1A. O-Ring
2. Tapered Bearing
3. Bearing Cone Spacer
4. Retaining Ring
5. Reverse Idler Gear
6. Retaining Plate
7. Mounting Bolt

REVERSE IDLER SHAFT

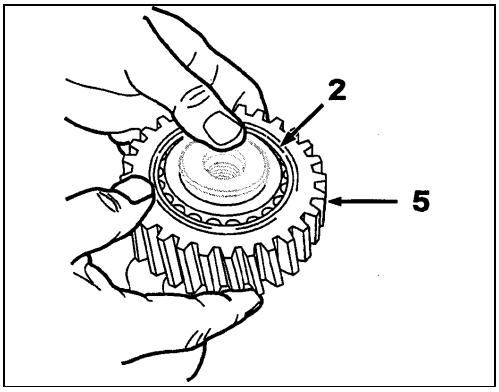
18. DISASSEMBLY

NOTE: *Callouts from exploded and cross section views (refer to Fig. 7C.8) correspond with callouts in following steps.*

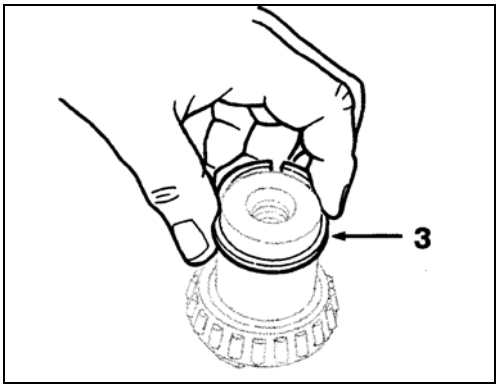
1. Remove O-ring (1A) from reverse idler shaft (1).



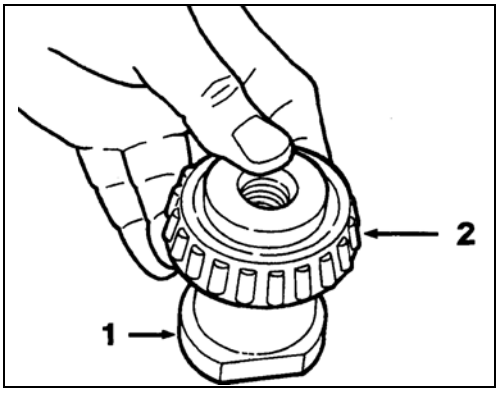
2. Remove reverse idler gear (5) with outer tapered roller bearing (2) cone. Remove cone from gear.



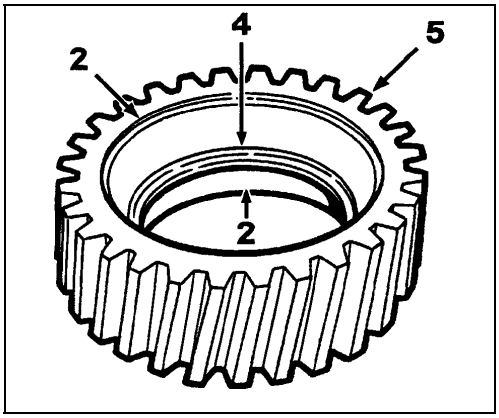
3. Remove bearing cone spacer (3).



4. Remove inner tapered roller bearing (2) cone from reverse idler shaft (1).



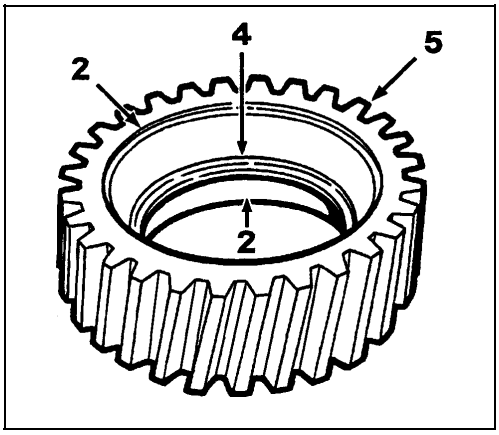
5. Drive tapered roller bearing (2) cups from reverse idler gear (5). Remove bearing retaining ring (4).



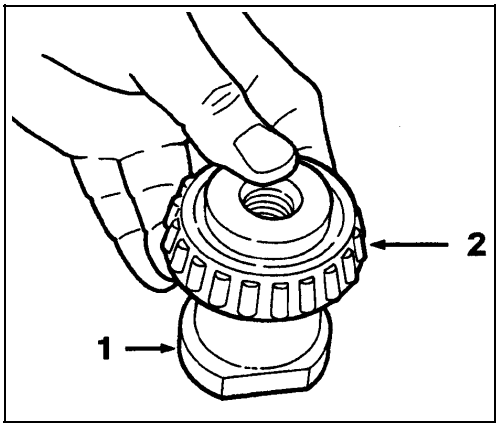
19. REASSEMBLY

NOTE: *Callouts from exploded and cross section views (refer to Fig. 7C.8) correspond with callouts in following steps.*

1. Install bearing retaining ring (4) into groove in reverse idler gear (5). Press each tapered roller bearing (2) cup into gear and bottom against ring.

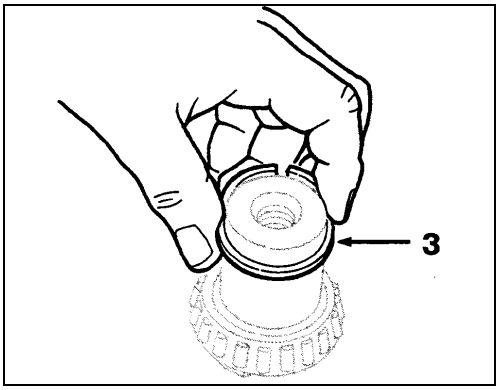


2. Install inner tapered roller bearing (2) on reverse idler shaft (1) and bottom against step.

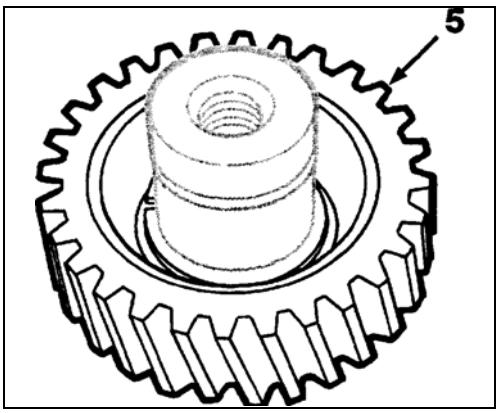


REVERSE IDLER SHAFT

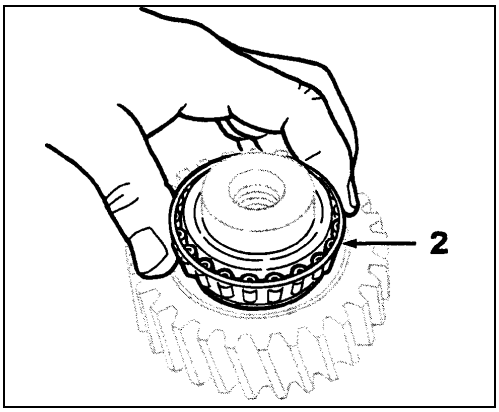
3. Install bearing cone spacer (3).



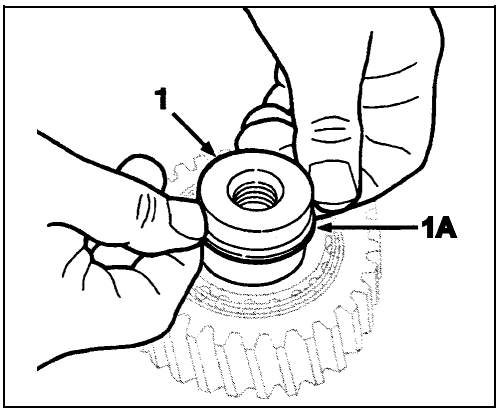
4. Install reverse idler gear (5) on inner tapered roller bearing cone.



5. Install outer tapered roller bearing (2) cone.



6. Install new O-ring (1A) to groove on reverse idler shaft (1).



PRESSURE REGULATOR VALVE

20. DESCRIPTION

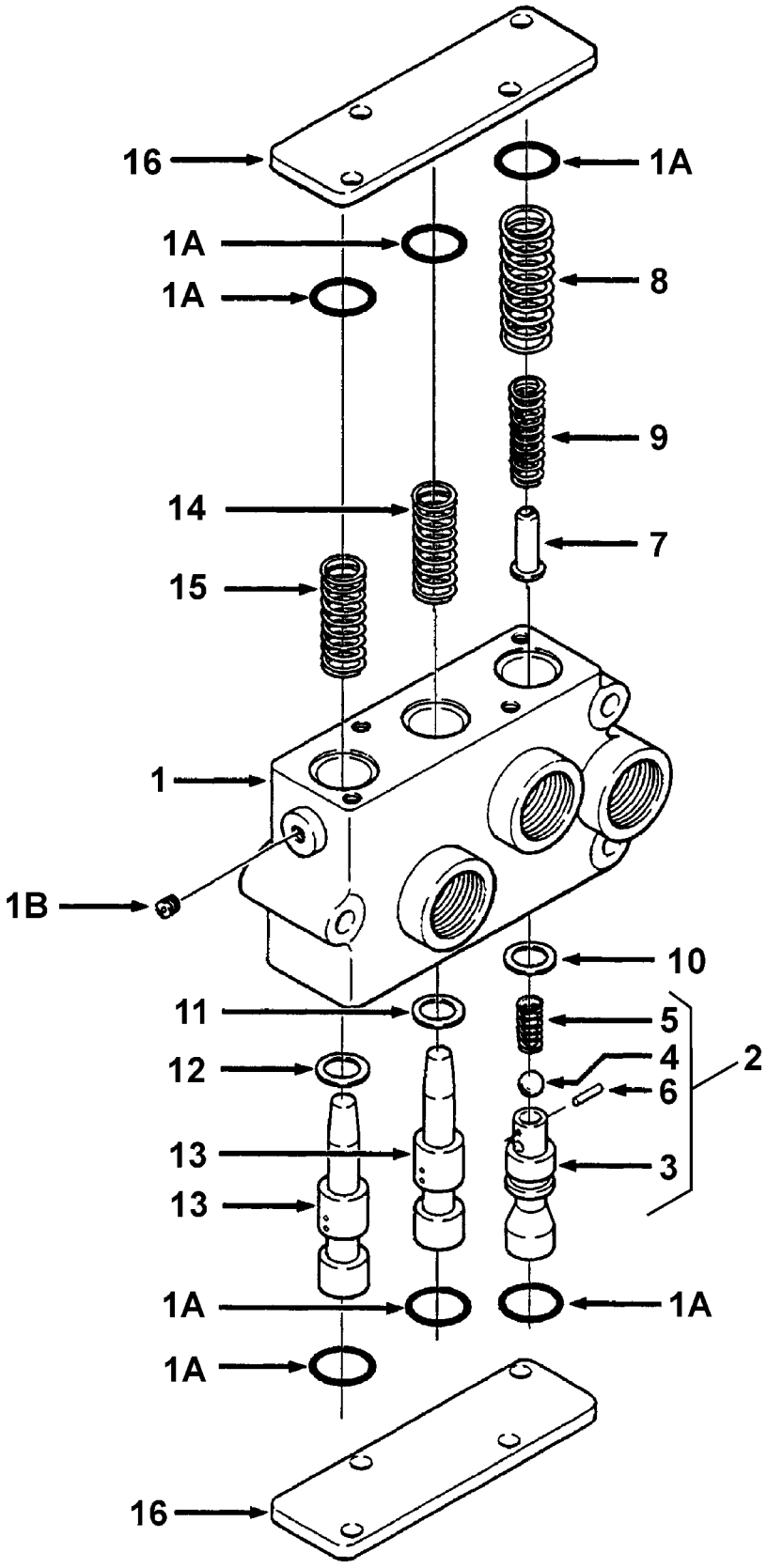


Fig. 7C.9. Exploded View of Main Regulator Valve

PRESSURE REGULATOR VALVE

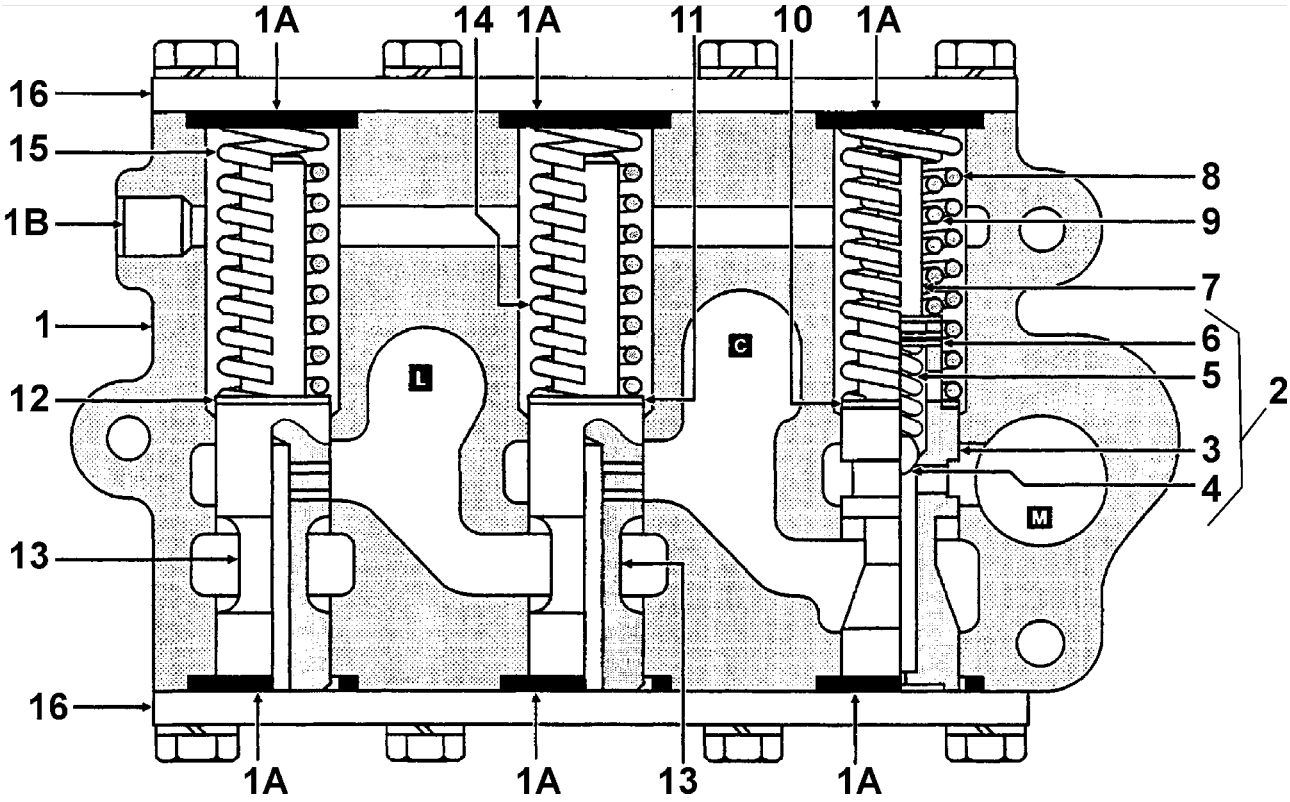


Fig. 7C.10. Cross Section View of Pressure Regulator Valve

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

This valve is a cascade type, pressure control valve consisting of three individual valves encased in one housing. The first valve is used to control pressure for engagement of the clutches in the transmission and the steering drive. The second valve is used to control pressure in the converter for torque converter machines or cooler/rear damper housing lube on machines with direct drive machines. The third valve is used to control lube pressure in the transmission. A cold oil relief valve is included in the first valve.

21. THEORY OF OPERATION

Oil from the pump enters the valve at cavity M. This oil is then directed through the other control valves and on to the transmission and steering drive to operate the clutch packs. As pump flow continues, pressure builds and oil is forced through the center of spool (3), causing the spool to move against the outer and inner springs (8 and 9). When the pressure reaches 1790 to 1960 [kPa] the first valve opens and allows oil to enter cavity C. The main spool also contains a cold oil relief valve. When the oil is cold pressure can exceed 1960 kPa. When this happens, the check ball (4) is forced against the spring (5) and excessive pressure is relieved and valve chatter is prevented.

PRESSURE REGULATOR VALVE

Oil from cavity C is directed on to the converter or cooler/rear damper housing lube (version DD). When flow requirements for the converter or cooler/rear damper housing lube are met, pressure builds and oil is forced through the center of the spool (13) causing the spool to move against the spring (14). When pressure reaches 480 to 655 [kPa] in neutral or in gear, the second valve opens and allows oil to enter cavity L. Return oil from the oil cooler and excessive oil from cavity C enters cavity L and is then directed to the transmission for lube. Whenever this lube oil reaches 170 to 240 [kPa] in neutral or 140 to 210 [kPa] in gear, the third valve opens and dumps the oil to drain.

22. SPECIFICATIONS

Spring Criteria:

Main Spool Valve Check Ball Spring (5):
Free Length .. .. 21.1 [mm]
Test Length ..... 15.4 [mm]
Work Length ..... 9.5 to 15.4 [mm]
Test Load ..... 74.7 to 83.6 [N]
Number of Working Coils 7

Main Spool Outer Spring (8):
Free Length ..... 76.4 [mm]
Test Length ..... 52.4 [mm]
Work Length ..... 47.2 to 53.8 [mm]
Test Load ..... 380 to 398 [N]
Number of Working Coils 11-1/2

Main Spool Inner Spring (9):
Free Length ..... 49.8 [mm]
Test Length ..... 35.1 [mm]
Work Length ..... 30.0 to 36.6 [mm]
Test Load ..... 193 to 207 [N]
Number of Working Coils 10-1/2

Converter or Cooler/Rear Damper Housing Lube Valve Spring (14):
Free Length ..... 64.8 [mm]
Test Length ..... 50.8 [mm]
Work Length ..... 45.7 to 54.0 [mm]
Test Load ..... 169 to 195 [N]
Number of Working Coils 10

Lube Valve Spring (15):
Free Length ..... 67.1 [mm]
Test Length ..... 50.8 [mm]
Work Length ..... 45.7 to 54.0 [mm]
Test Load ..... 65 to 78.4 [N]
Number of Working Coils 11

Torque:

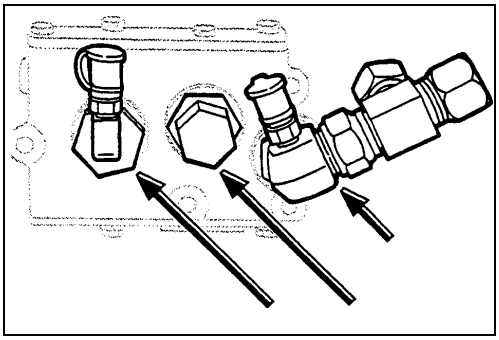
End Cover Bolts ..... 21 ± 10% [Nm]

PRESSURE REGULATOR VALVE

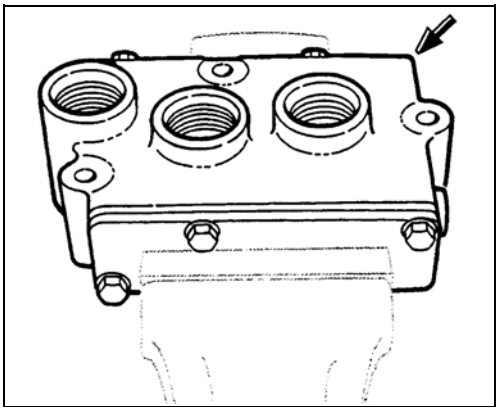
23. DISASSEMBLY

NOTE: *Callouts from exploded and cross section views (refer to Figs'. 7C.9 and 7C.10) correspond with callouts in following steps.*

1. Remove fittings from valve housing.

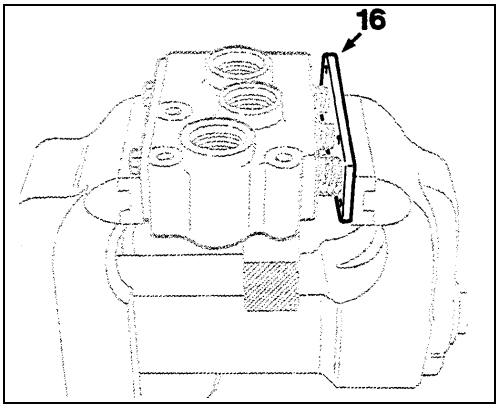


2. Position valve assembly into vise, supporting valve as necessary.

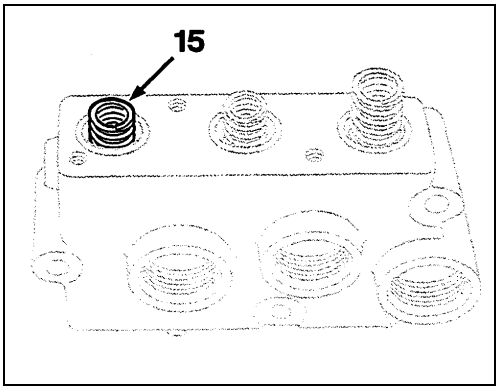


3. Remove bolts and lock washers from end cover (16). Slowly back off vise allowing springs to decompress.

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



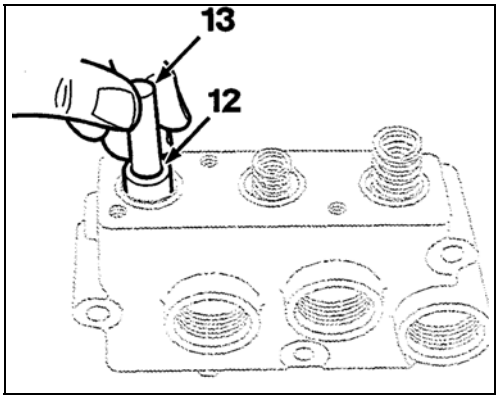
4. Remove lube spool spring (15). Identify spring for ease of testing and reassembly.



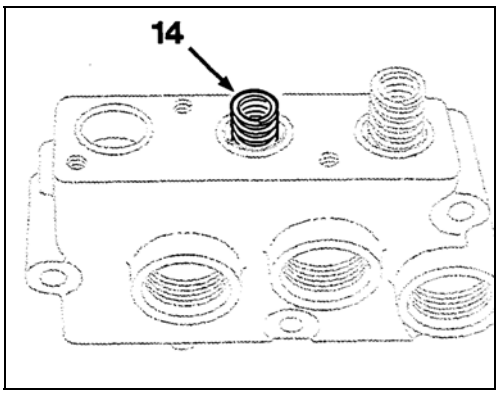
PRESSURE REGULATOR VALVE

5. Remove lube spool (13) with spring shims (12). Keep removed amount of shims with spool.

NOTE: *Do not switch spools (13) in each others housing bore*.

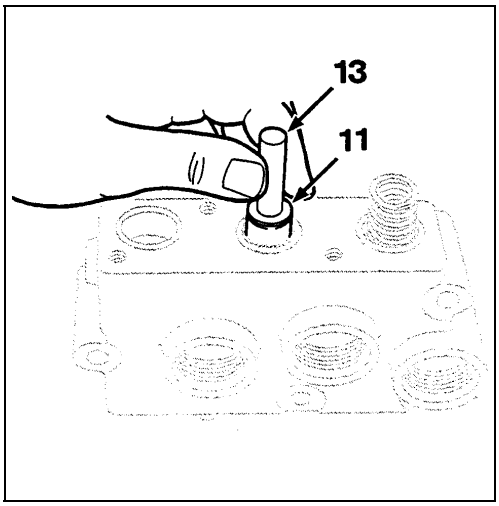


6. Remove converter or cooler/rear damper housing lube spool spring (14). Identify spring for ease of testing and reassembly.

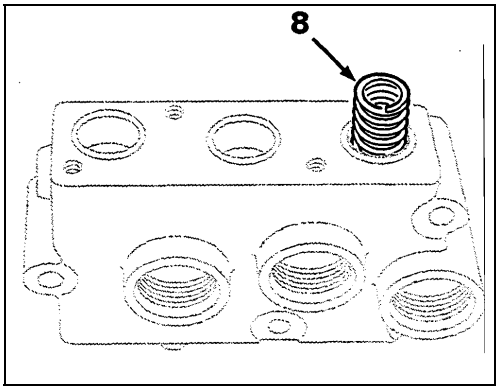


7. Remove converter or cooler/rear damper housing lube spool (13) with spring shims (11). Keep removed amount of shims with spool.

NOTE: *Do not switch spools (13) in each others housing bore*.

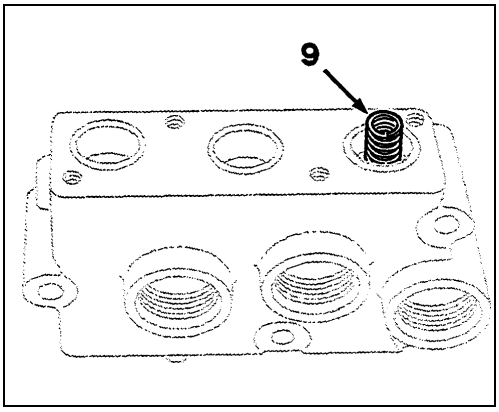


8. Remove main spool outer spring (8). Identify spring for ease of testing and reassembly.

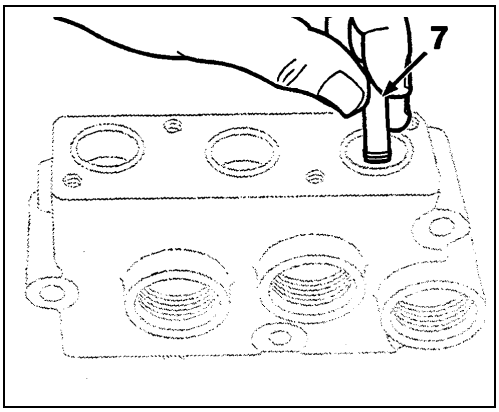


PRESSURE REGULATOR VALVE

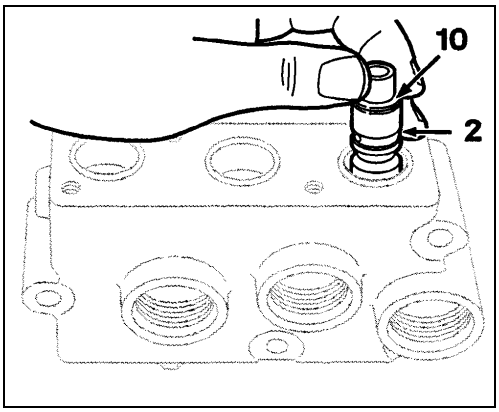
9. Remove main spool inner spring (9). Identify spring for ease of testing and reassembly.



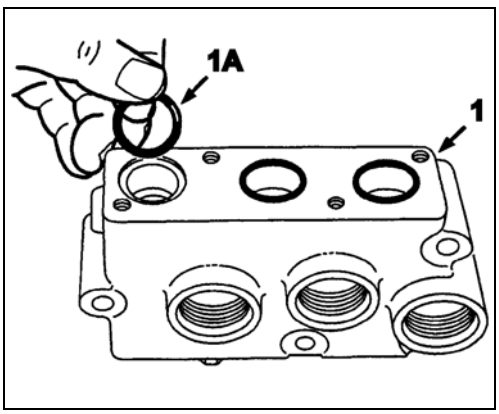
10. Remove spring guide pin (7).



11. Remove main spool assembly (2) with spring shims (10). Keep removed amount of shims with spool.

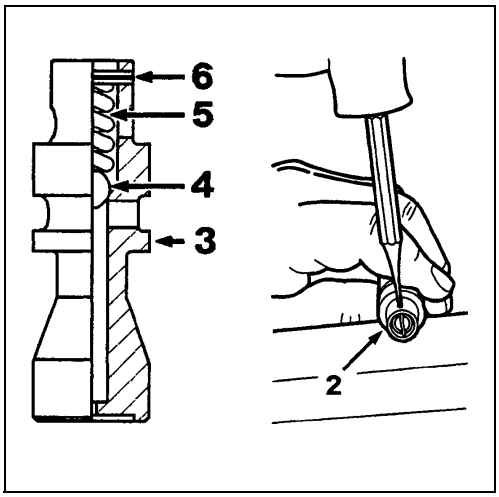


12. Remove and discard O-rings (1A) from housing (1). Remove remaining end cover and discard O-rings.



PRESSURE REGULATOR VALVE

13. If necessary, disassemble main spool (2) as follows; Rest assembly (2) on block of wood. Using pin drift drive spring pin (6) from spool (3) allowing pin drift to check ball spring (5). Carefully remove pin drift allowing check ball spring to decompress. Remove spring and check ball (4).



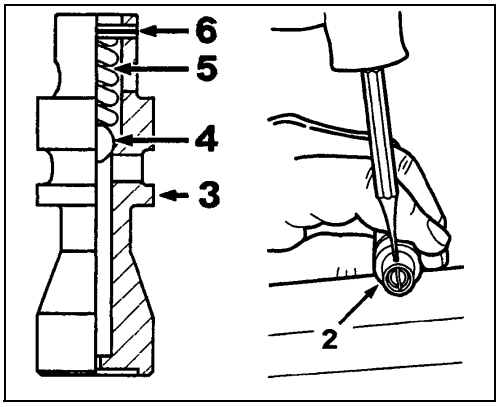
WARNING! Spring loaded assembly. Assembly must be contained to relieve spring pressure. Use extreme caution when disassembling.

NOTE: *Check all springs for damage and fatigue against those values shown in specifications.*

24. REASSEMBLY

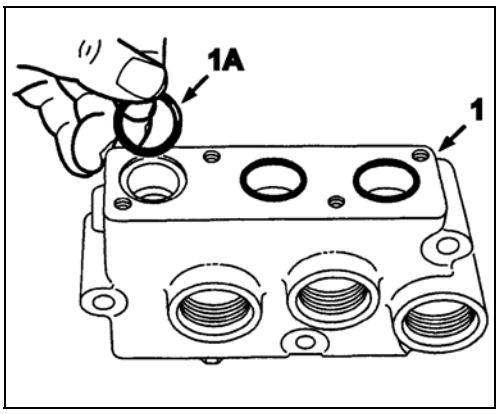
NOTE: *Callouts from exploded and cross section views (refer to Figs'. 7C.9 and 7C.10) correspond with callouts in following steps.*

1. Reassemble main spool assembly (2) as follows; Install check ball (4) and check ball spring (5) into spool (3). Compress spring and secure with spring pin (6).



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

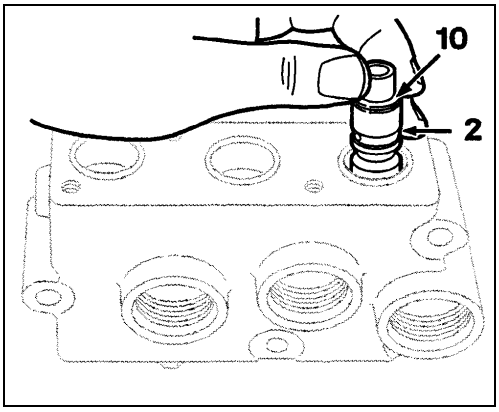
2. Install new O-rings (1A) into bottom of housing and bolt bottom end cover (16) in place. Torque bolts to 21 ± 10% [Nm]. Install new O-rings (1A) into top of housing (1).



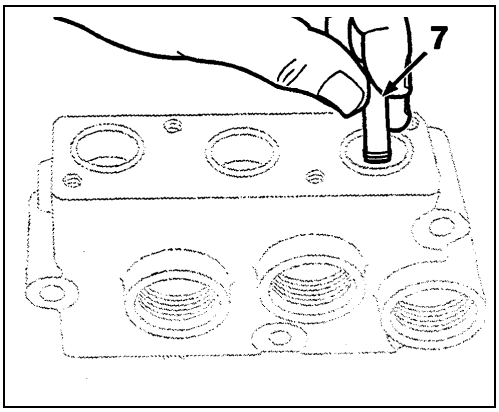
PRESSURE REGULATOR VALVE

3. Install main spool assembly (2) with same amount of shims (10) that were removed.

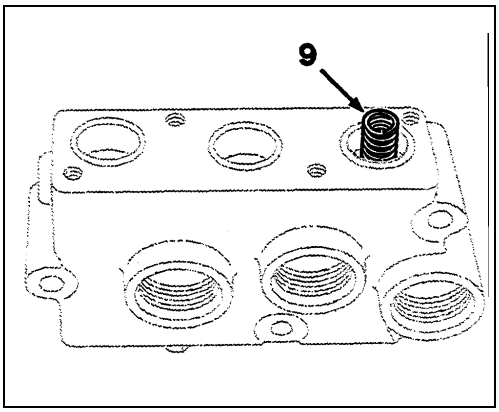
NOTE: *A total quantity of 3 shims can be used under spool spring. Each shim added or deleted will raise or lower main pressure by 34 [kPa].*



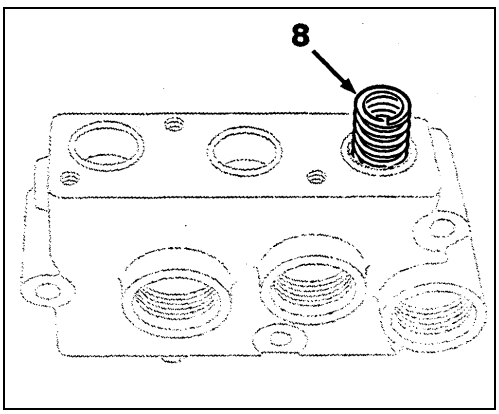
4. Install spring guide pin (7) in housing bore.



5. Install main inner spring (9).

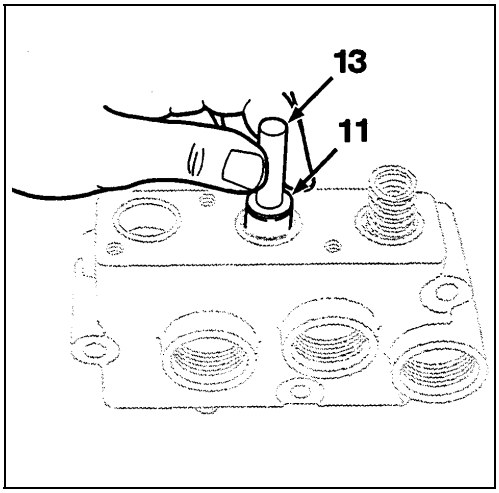


6. Install main outer spring (8).



PRESSURE REGULATOR VALVE

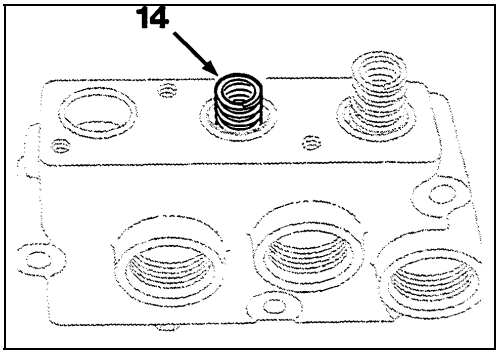
7. Install converter or cooler/rear damper housing lube spool (13) with spring shims (11) that were removed with spool.



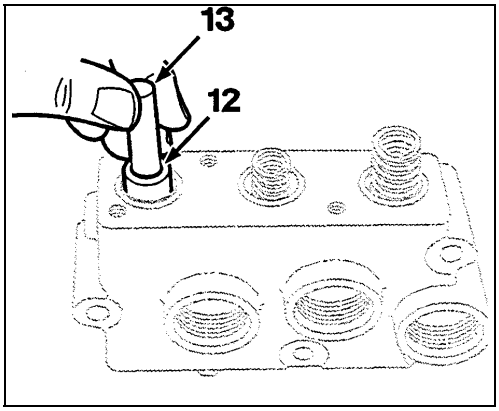
NOTE: *A total quantity of 5 shims can be used under spool spring. Each shim added or deleted will raise or lower converter or cooler/rear damper housing lube pressure by 24 [kPa].*

NOTE: *Lube spool (13) and converter or cooler/rear damper housing lube spool (13) are interchangeable. Do not switch spools in each others housing bore*.

8. Install converter or cooler/rear damper housing lube spool spring (14).



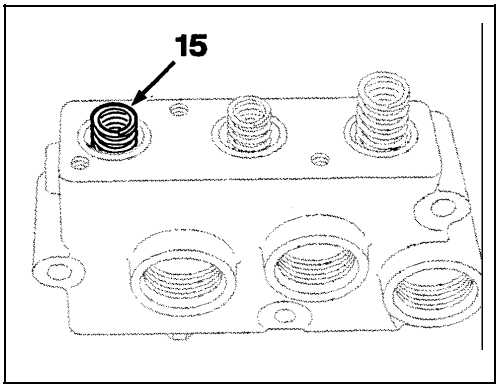
9. Install lube spool (13) with spring shims (12) that were removed with spool.



NOTE: *A total quantity of 3 shims can used under spool spring. Each shim added or deleted will raise or lower lube pressure by 6.9 [kPa].*

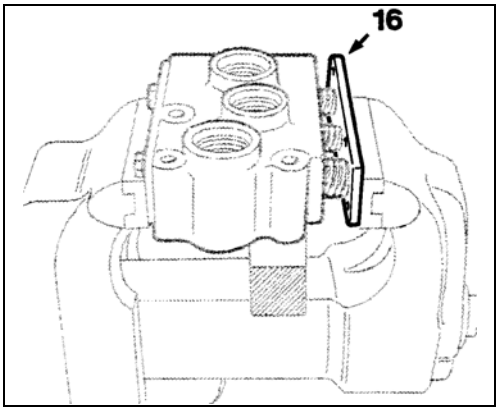
NOTE: *Lube spool (13) and converter or cooler/rear damper housing lube spool (13) are interchangeable. Do not switch spools in each others housing bore*.

10. Install lube spool spring (15).

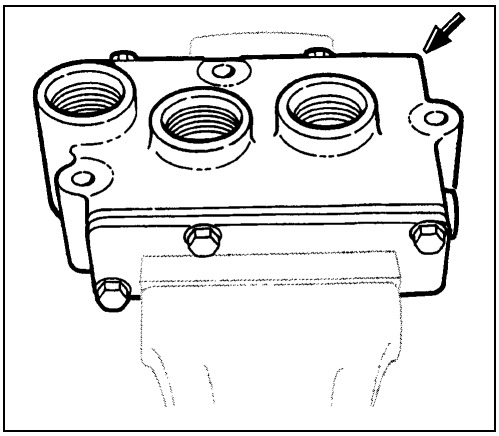


PRESSURE REGULATOR VALVE

11. Position valve and end cover (16) in vise.



12. Slowly compress vise and install mounting hardware. Torque bolts to 21 ± 10%.[Nm].



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

TRANSMISSION

RANGE SELECTOR VALVE

25. DESCRIPTION

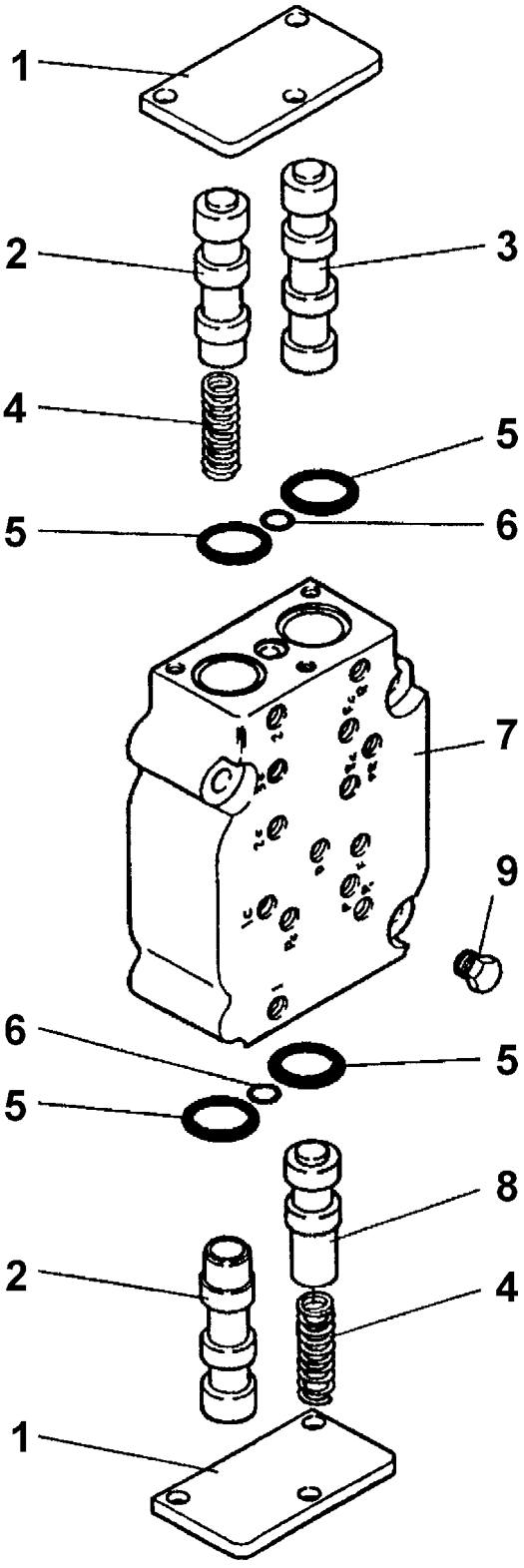


Fig. 7C.11. Exploded View of Range Selector Valve

RANGE SELECTOR VALVE

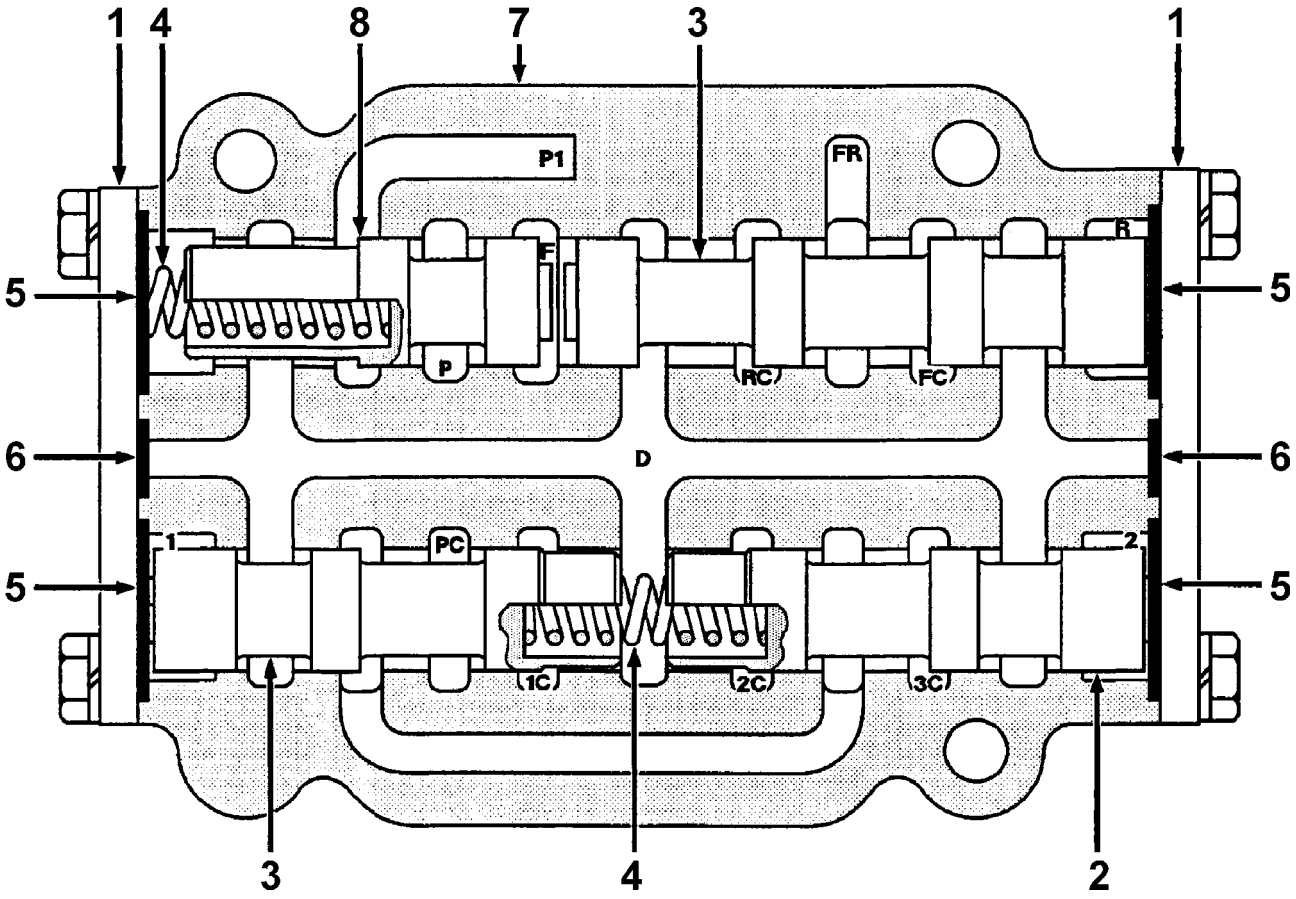


Fig. 7C.12. Cross Section View of Range Selector Valve

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

Range selector valve is a hydraulically controlled, directional control valve consisting of two speed spools one switch spool and one directional spools. Speed spools are separated in valve housing by a centering spring. Directional and switch spools are held together at one side by their return spring.

26. THEORY OF OPERATION

Function of range selector valve is to provide main pressure oil to rate of rise valve and return oil from rate of rise valve to desired clutch packs. Valve is hydraulically controlled by drive train control valve. Short directional switch spool (8) controls flow of oil to rate of rise valve. When in neutral, return spring (4) holds this spool (8) against long directional selector spool (3), thereby cutting off flow of oil. When drive train control lever is placed in forward, main pressure oil from drive train control valve enters port F and shifts spool (8) against return spring (4). When control lever is placed in reverse, main pressure oil from drive train control valve enters port R and shifts both spools (8 and 3) against return spring (4).

RANGE SELECTOR VALVE

Once short switch spool (8) is shifted over, port P1 is open to port P, directing oil to rate of rise valve. Long directional selector spool (3) controls flow of oil to forward and reverse clutch packs. When control lever is in forward, oil from rate of rise valve enters port FR, and is directed out port FC to engage forward clutch shaft. When control lever is placed in reverse, main pressure oil enters port R, shifts spool (3) and port FR is opened to port RC to engage reverse clutch pack. Two range selector (speed) spools (2) control flow of oil to speed clutch packs. When first speed is selected, main pressure oil from drive train control valve enters port 1, shifting spool (2) against return spring (4). When in this position, oil from rate of rise valve enters port PC and is directed out port 1C to engage first speed clutch pack. When second speed is selected, oil enters port 2 to shift spool (2) and port PC is opened to port 2C to engage second speed clutch pack. When third speed is selected, return spring (4) holds spools (2) in place and port PC is opened to port 3C to engage third speed clutch pack.

27. SPECIFICATIONS

Spring Criteria:

Speed Selector Spool Spring and Directional Selector Spool Spring

Free Length	49.0 [mm]
Test Length	35.6 [mm]
Work Length	35.6 to 43.5 [mm]
Test Load	232.0 [N]
Number of Working Coils	11-1/2

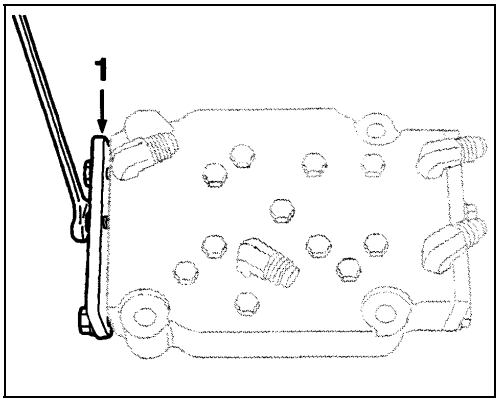
Bolt Torque:

End Cover Bolts	21 ± 10% [Nm]

28. DISASSEMBLY

NOTE: *Callouts from exploded and cross section views (refer to Figs'. 7C.11 and 7C.12) correspond with callouts in following steps.*

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

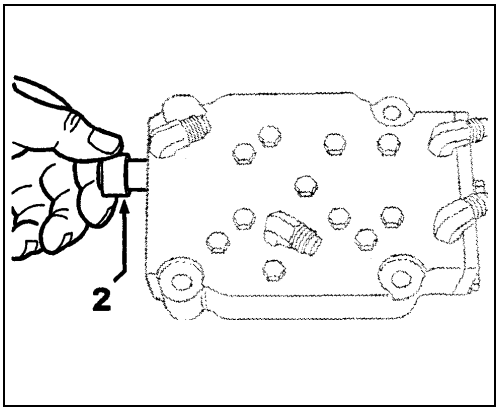


WARNING! Spring loaded assembly. Assembly must be contained to relieve spring pressure. Use extreme caution when disassembling.

RANGE SELECTOR VALVE

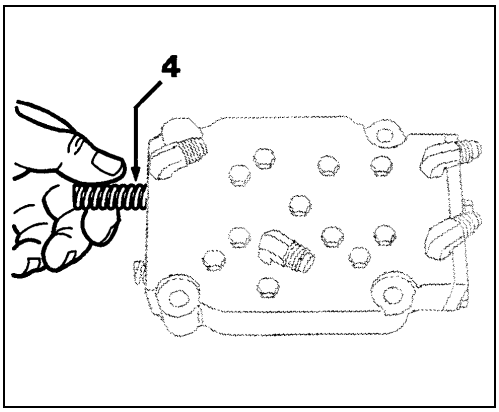
2. Remove range selector spool (2) from housing.

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



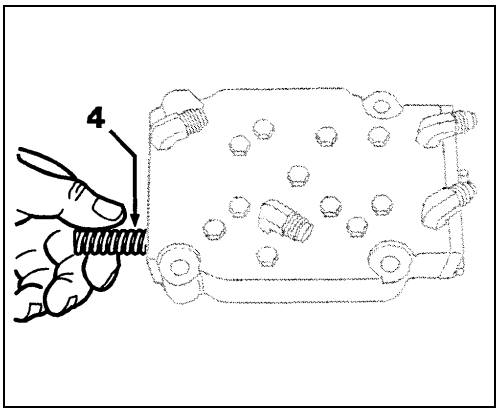
3. Remove range selector spool return spring (4) from housing bore.

NOTE: *Check spring for damage and fatigue against those values shown in specifications*.

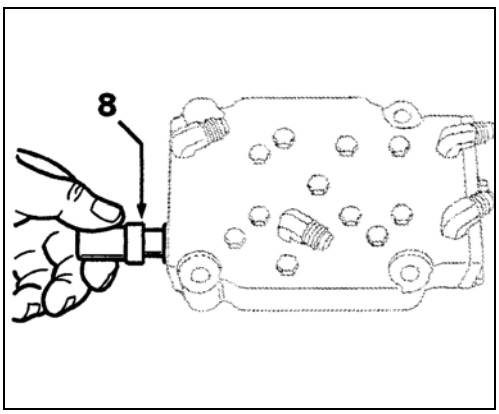


4. Remove directional spool return spring (4) from housing bore.

NOTE: *Check spring for damage and fatigue against those values shown in specifications.*

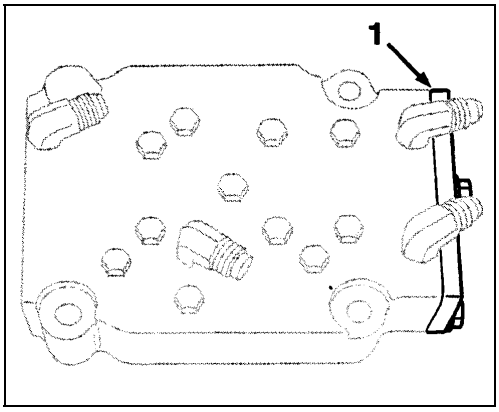


5. Remove short switch directional spool (8) from housing bore.



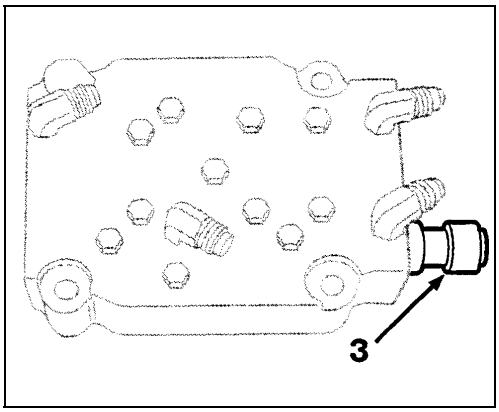
RANGE SELECTOR VALVE

6. Remove remaining end cover (1).



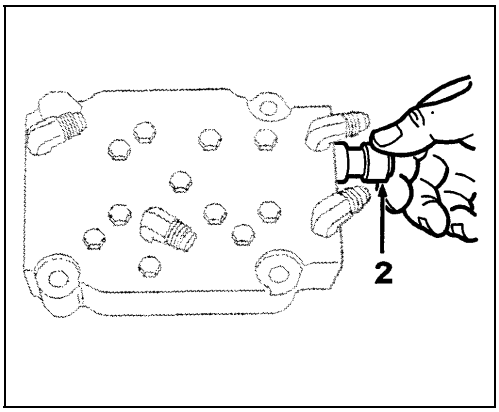
7. Remove long directional spool (3) from housing bore.

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

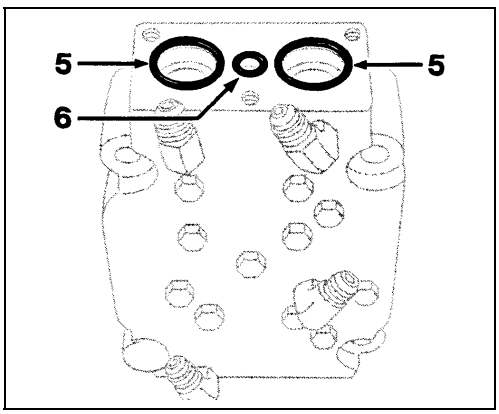


8. Remove remaining range selector spool (2) from housing bore.

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



9. Remove large (5) and small (6) O-rings from each end of housing. Discard O-rings and replace with new.

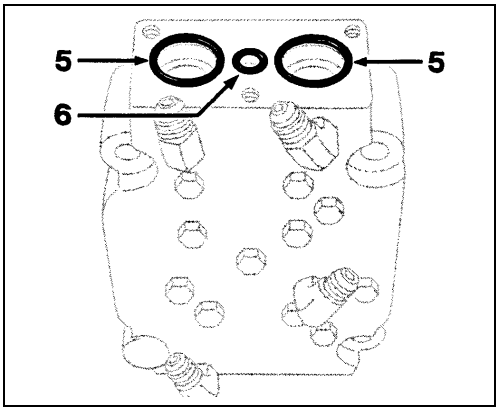


RANGE SELECTOR VALVE

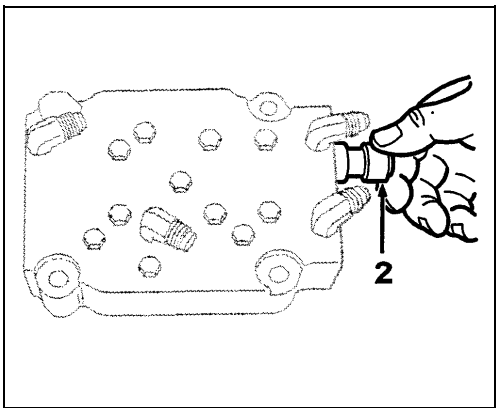
29. REASSEMBLY

NOTE: *Callouts from exploded and cross section views (refer to Figs'. 7C.11 and 7C.12) correspond with callouts in following steps.*

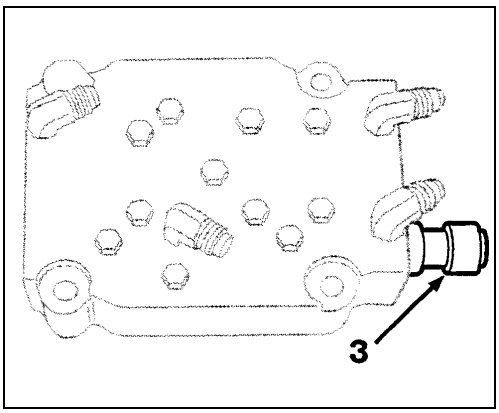
1. Coat new large (5) and small (6) O-rings with amber grease and install in counterbores in each end of housing.



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

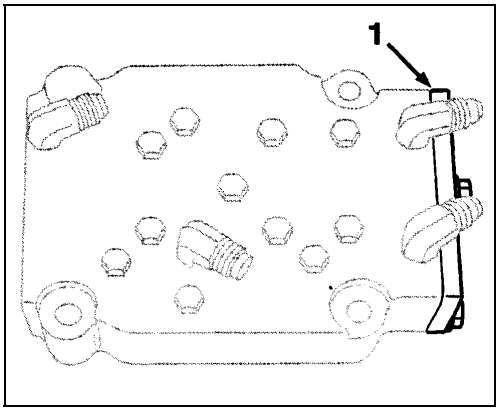


3. Install long directional selector spool (3) into its housing bore.

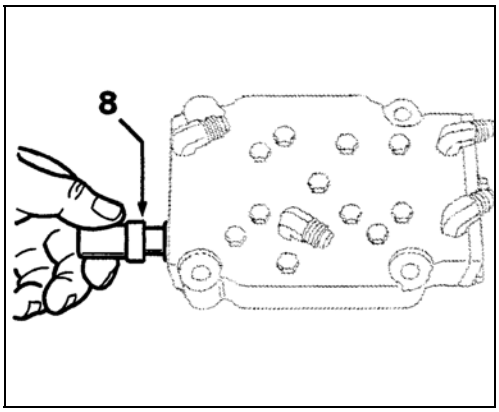


RANGE SELECTOR VALVE

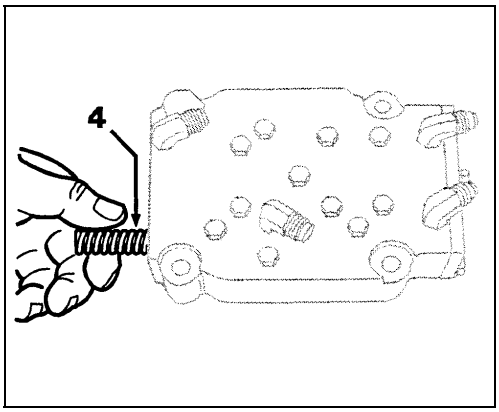
4. Install end cover (1) and secure with hardware. Torque bolts to 21 ± 10% [Nm].



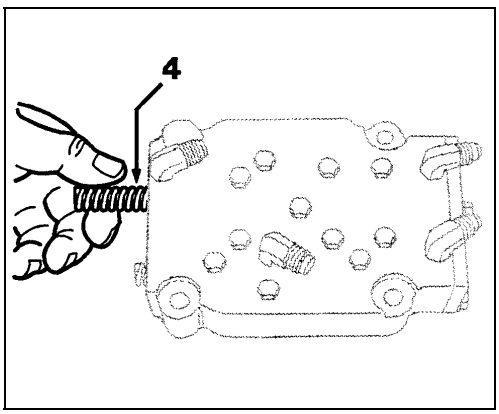
5. Install short directional switch spool (8) into its housing bore.



6. Install directional spool return spring (4) into spool.

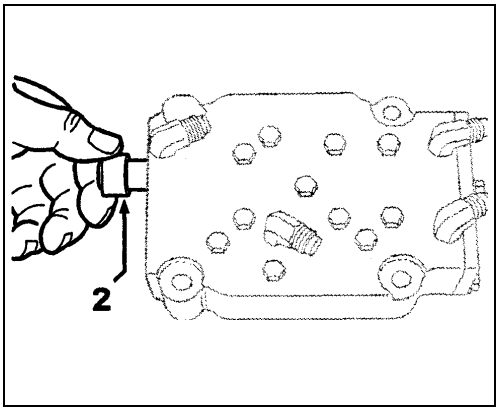


7. Install range spool return spring (4) into spool.

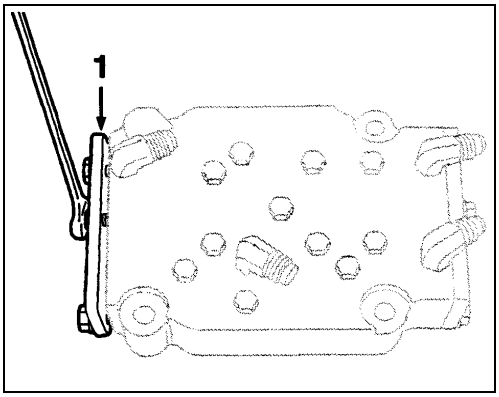


RANGE SELECTOR VALVE

8. Install remaining range selector spool (2) into its housing bore.



9. Install end cover (1) and secure with hardware. Torque bolts to 21 ± 10% [Nm].



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

RATE OF RISE VALVE

30. RATE OF RISE VALVE (TORQUE CONVERTER MACHINES)

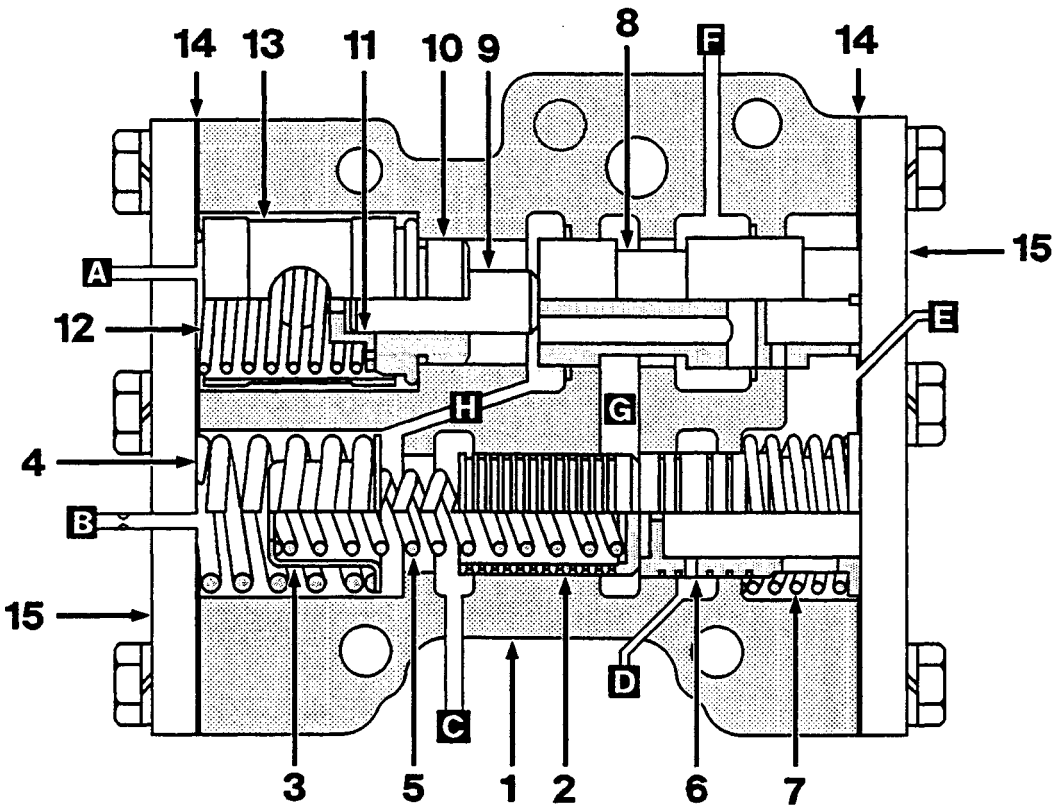


Fig. 7C.13. Cross Section View of Rate Of Rise Valve

A. Main Pressure Oil
B. Orificed Main Pressure Oil
C. Drain Port
D. Main Pressure Oil from Short Directional Spool
E. Main Oil Pressure to Directional Spool
F. Main Oil Pressure to Range Spools
G. Internal Passage
H. Internal Passage

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

DESCRIPTION (Refer to Fig. 7C.13)

The rate of rise valve is a sequencing, pressure regulating valve use to provide a smooth shift without shock. This valve controls the length of time that it takes to fully pressurize a clutch pack and also allows the directional clutch pack to engage before range pack clutch.

The rate of rise valve has six ports (A to F) and two passages (G and H) which are located on the bottom of the valve but which are shown in cross section on the sides of the valve, for clarity. Main pressure oil from the main regulator valve enters the left hand upper cavity through port A and keeps this cavity at main pressure whenever the engine is running. Main pressure oil from the main regulator valve enters the left hand lower cavity through port B. This port contains an orifice that limits the flow of oil into this cavity. This lower cavity is open to drain port C. The modulating piston (2) acts as a variable orifice for this drain to control pressure in this cavity.

RATE OF RISE VALVE

When a shift occurs, the range selector valve directs oil to port D. This oil flows through the holes in the reducing spool (6) and exits through port E to fill the directional clutch pack. Some oil can also pass through the orifice in the end of the reducing spool (6), but because the passage G is still open to drain, the modulation piston (2) will not shift. When the directional clutch pack is full, pressure begins to build in the clutch pack and in the cavity on the right side of the rate of rise valve. As pressure builds, the sequence spool (8) begins to move against the tension of the spring (12) and main pressure from port A. As this spool moves to the left, the metering holes in the sequence spool (8) index with port F and the drain holes in the left side of the spool are cut off from passage H. Oil from port D can now pass through the metering holes in the sequence spool (8) to port F to fill the range clutch pack. Because oil must pass through the metering holes, pressure in the right hand cavity of the valve and pressure to the directional clutch pack will remain higher than the pressure at port F going to the range clutch pack. During the range clutch pack fill sequence, the sequence spool (8) also blocked off passage G. Oil passing through the orifice in the end of the reducing spool (6) begins to build pressure against the modulating piston (2), pushing it slowly to the left against the springs (4 and 5). The modulating piston (2) has a series of orifices which decrease in size from left to right. As the piston (2) moves to the left, decreasing size holes index with drain port C causing a restriction to flow of oil from port B. This causes pressure to build against the back side of the piston (2) which slows its left hand movement, which in turn allows the build up of pressure in the clutch packs.

RATE OF RISE VALVE

31. RATE OF RISE VALVE (DIRECT DRIVE MACHINES)

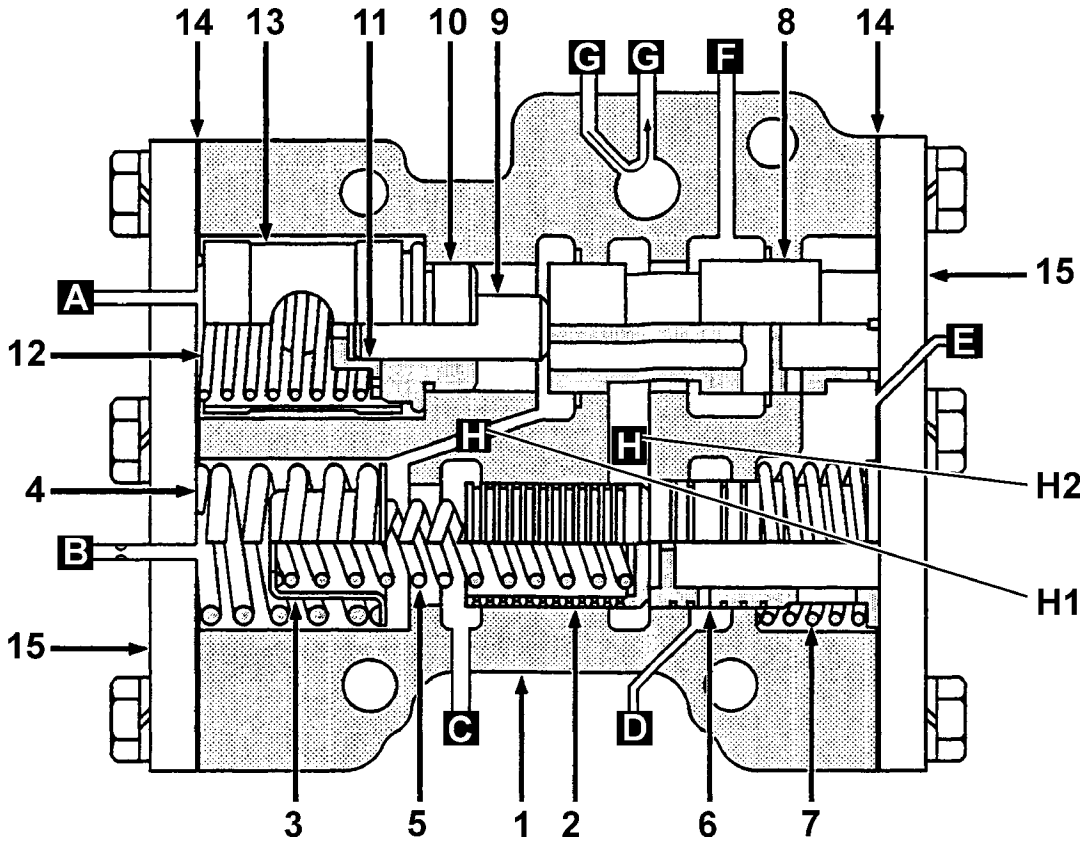


Fig. 7C.14. Cross Section View Of Rate of Rise Valve

A. Main Pressure Oil
B. Orificed Main Pressure Oil
C. Drain Port
D. Main Pressure Oil from Short Directional Spool
E. Main Oil Pressure to Directional Spool
F. Main Oil Pressure to Inching Valve
G. Main Oil Pressure from Inching Valve to Range Spool
H1, H2. Internal Passages

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

DESCRIPTION (Refer to Fig. 7C.14)

The rate of rise valve is a sequencing, pressure regulating valve used to provide a smooth shift without shock. This valve controls the length of time that it takes to fully pressurize a clutch pack and also allows the directional clutch pack to engage before the range pack clutch. The rate of rise valve has seven ports (A to G) and two passages (H) which are located on the bottom and top of the valve but which are shown in cross section on the sides of the valve, for clarity. Main pressure oil from the main regulator valve enters the left hand upper cavity through port A and keeps this cavity at main pressure whenever the engine is running. Main pressure oil from the main regulator valve enters the left hand lower cavity through port B. This port contains an orifice that limits the flow of oil into this cavity. This lower cavity is open to drain port C. When a shift occurs, the range selector valve directs main pressure oil to port D. This oil flows through the holes in the reducing spool (6) and exits through port E to fill the directional clutch pack.

RATE OF RISE VALVE

Some oil can also pass through the orifice in the end of the reducing spool (6), but because the passage H1 and H2 are still open to drain, the modulation piston (2) will not shift. When the directional clutch pack is full, pressure begins to build in the clutch pack and in the cavity on the right side of the rate of rise valve. As pressure builds, the sequence spool (8) begins to move against the tension of the spring (12) and main pressure from port A. As this spool moves to the left, the metering holes in the sequence spool (8) index with port F and the drain holes in the left side of the spool are cut off from passage H2. Oil from port D can now pass through the metering holes in the sequence spool (8) to port F to the inching valve and back through port G to fill the range clutch pack. Because oil must pass through the metering holes, pressure in the right hand cavity of the valve and pressure to the directional clutch pack will remain higher than the pressure at port F to the inching valve and back through port G going to the range clutch pack. During the range clutch pack fill sequence, the sequence spool (8) also blocked off passage H1. Oil passing through the orifice in the end of the reducing spool (6) begins to build pressure against the modulating piston (2), pushing it slowly to the left against the springs (4 and 5). The modulating piston (2) has a series of orifices which decrease in size from left to right. As the piston (2) moves to the left, decreasing size holes index with drain port C causing a restriction to flow of oil from port B. This causes pressure to build against the back side of the piston (2) which slows its left hand movement, which in turn allows the build up of pressure in the clutch packs.

32. SPECIFICATIONS

Spring Criteria:

Modulating Piston Outer Spring (4);
Free Length .....46.2 [mm]
Test Length.....31.7 [mm]
Work Length ..... 21.6 to 36.0 [mm]
Test Load .....160 to 178 [N]
Number of Working Coils.....4

Modulating Piston Inner Spring (5);
Free Length .....87.6 [mm]
Test Length.....71.1 [mm]
Work Length .....55.9 to 73.1 [mm]
Test Load ..... 160 to 178 [N]
Number of Working Coils.....15.4

Reducing Spool Spring (7);
Free Length .....37.5 [mm]
Test Length.....19.0 [mm]
Work Length ..... 19.0 to 23.5 [mm]
Test Load ..... 160 to 178 [N]
Number of Working Coils..... 3.2

Sequence Spool Spring (12);
Free Length .....45.4 [mm]
Test Length.....25.4 [mm]
Work Length ..... 15.1 to 29.4 [mm]
Test Load .....17.8 [N]
Number of Working Coils..... 5

Bolt Torque:

End Cover Bolts .....38 ± 10% [Nm]

TRANSMISSION

RATE OF RISE VALVE

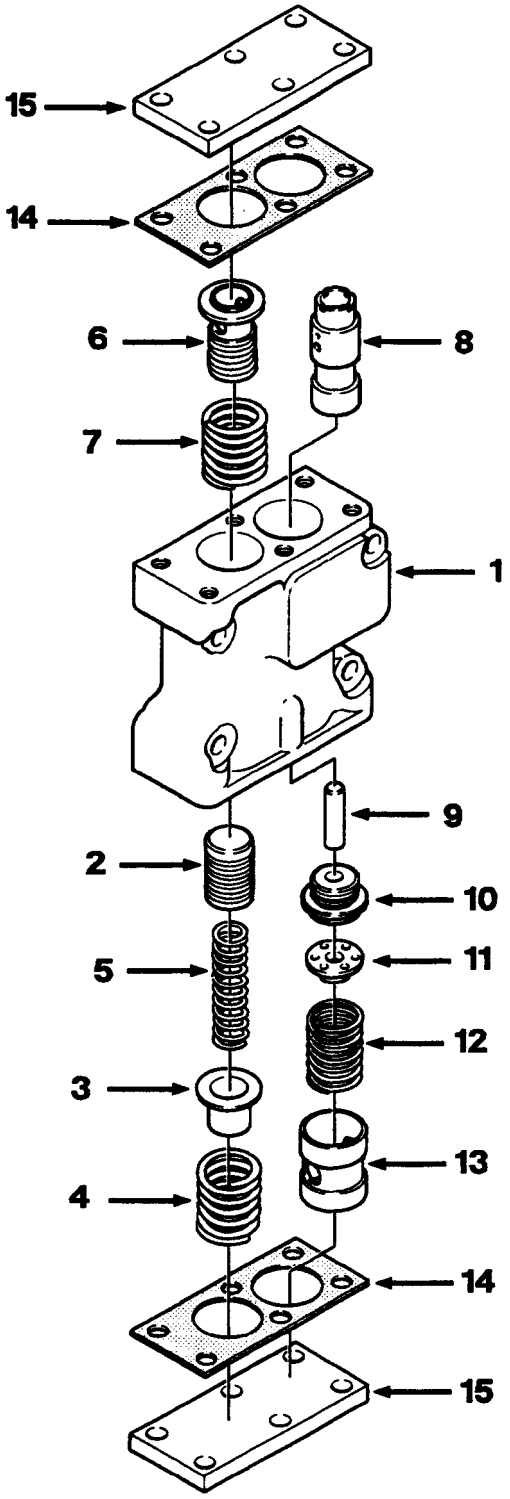


Fig. 7C.15. Exploded View Of Rate Of Rise Valve

RATE OF RISE VALVE

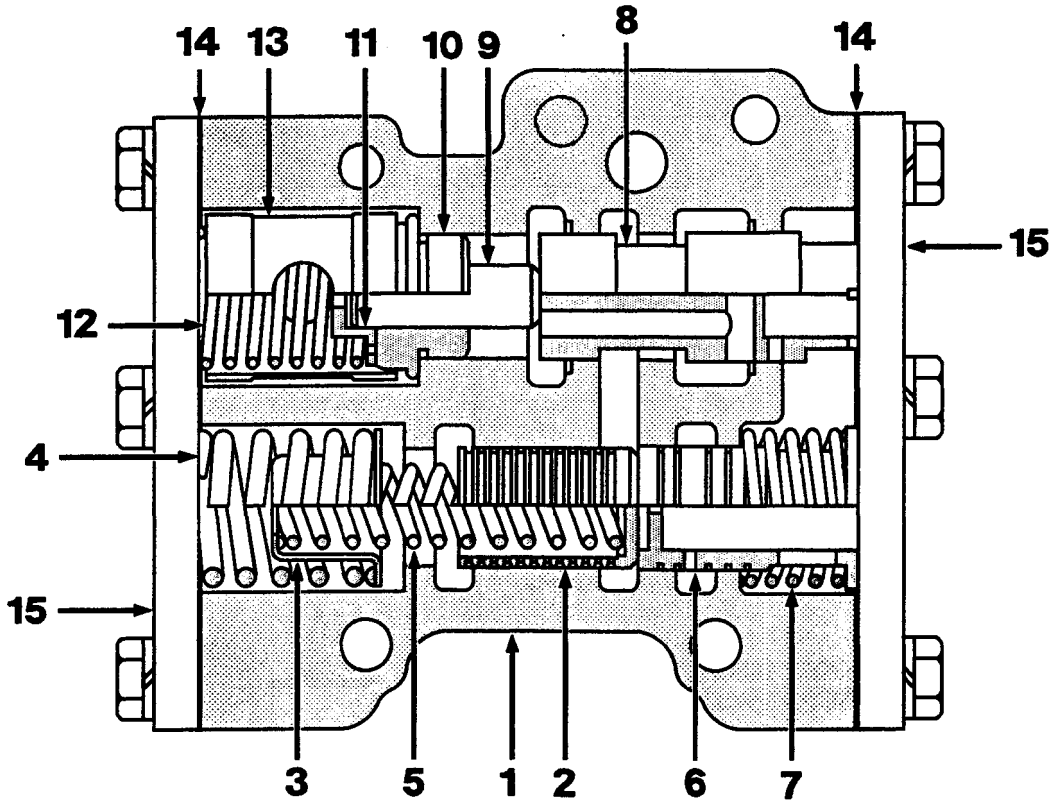


Fig. 7C.16. Cross Section View of Rate of Rise Valve

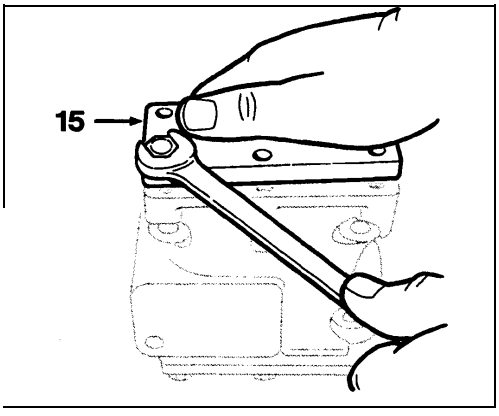
Legend for Figs. 7C.15 and 7C.16

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

33. DISASSEMBLY

NOTE: *Callouts from exploded and cross section views (refer to Figs. 7C.21 and 7C.22) correspond with callouts in following steps.*

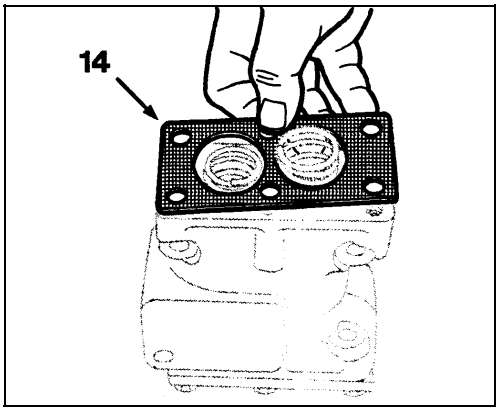
1. While holding down on end cover (15), slowly let off mounting bolts until all spring tension is released. Then remove cover.



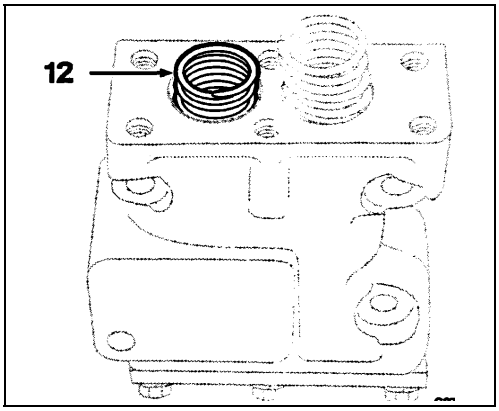
WARNING! Spring loaded assembly. Assembly must be contained to relieve spring pressure. Use extreme caution when disassembling.

RATE OF RISE VALVE

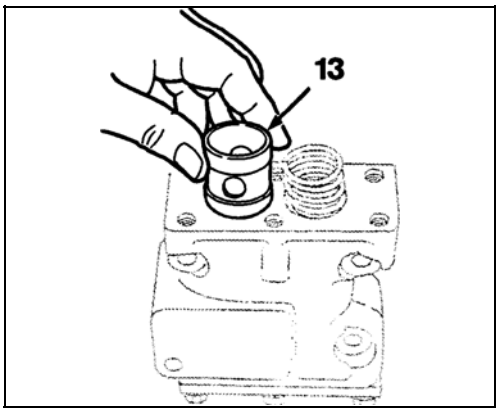
2. Remove and discard end cover gasket (14).



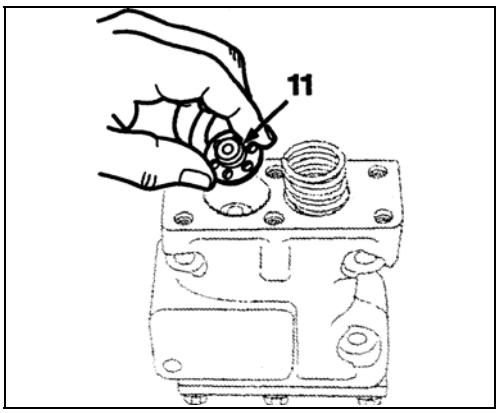
3. Remove sequence spool spring (12) from housing bore.



4. Remove tube spacer (13) from housing bore.

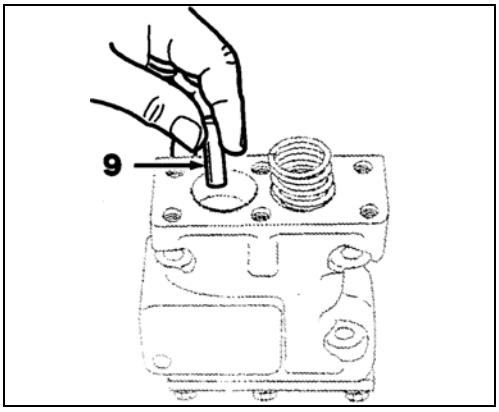


5. Remove sequence spool disc (11) from housing bore.

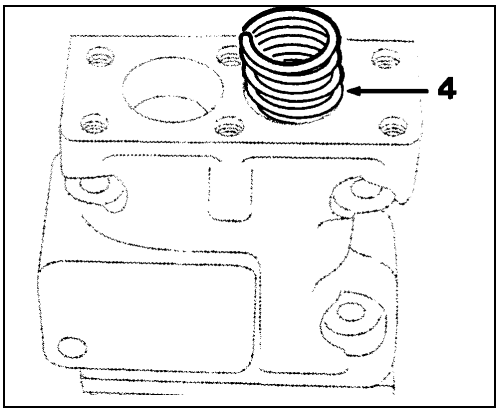


RATE OF RISE VALVE

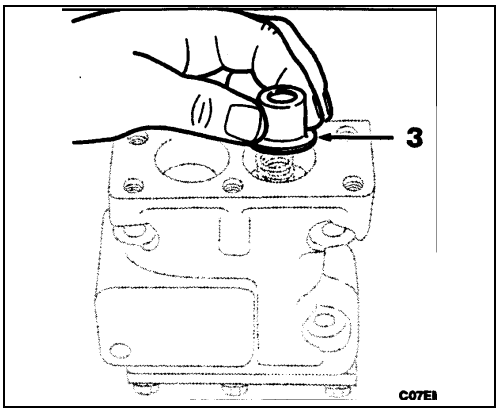
6. Remove dowel pin (9) from housing bore.



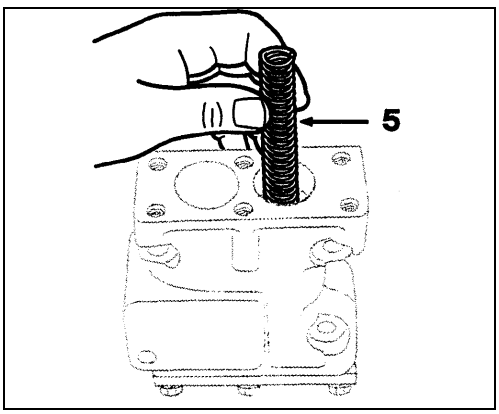
7. Remove outer piston spring (4) from housing bore.



8. Remove piston spring retainer (3) from housing bore.

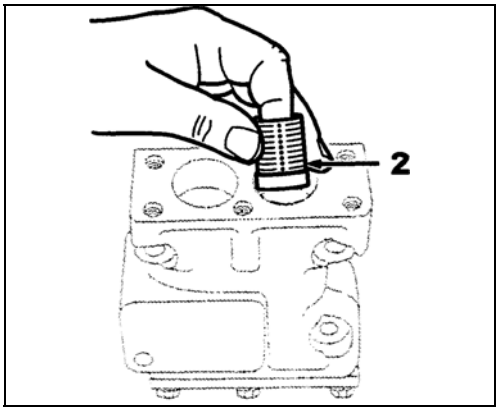


9. Remove inner piston spring (5) from housing bore.

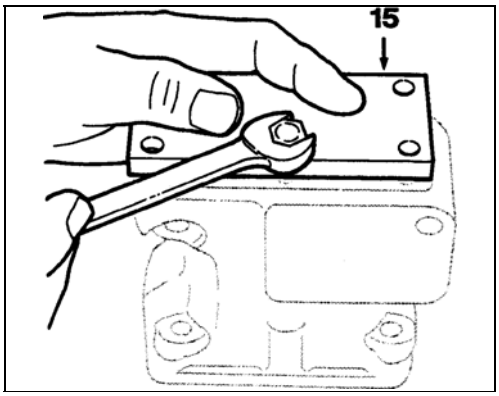


RATE OF RISE VALVE

10. Remove modulating piston (2) from housing bore.

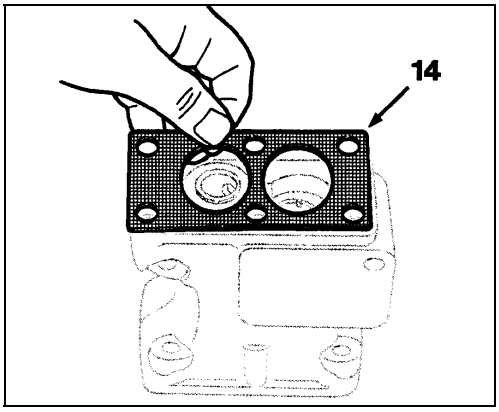


11. Slowly remove end cover (15) hardware until all spring tension is released. Remove cover.

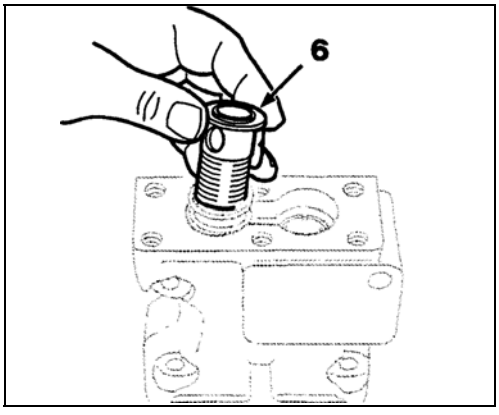


WARNING! Spring loaded assembly. Assembly must be contained to relieve spring pressure. Use extreme caution when disassembling.

12. Remove and discard end cover gasket (14).

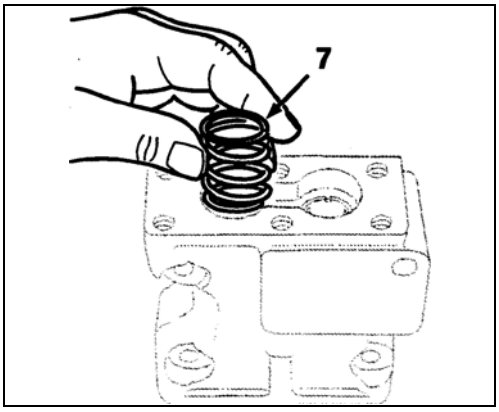


13. Remove reducing spool (6) from housing bore.

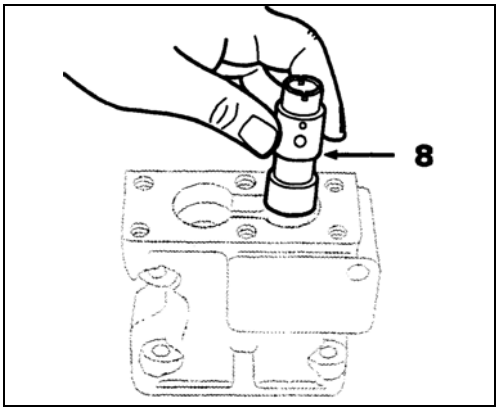


RATE OF RISE VALVE

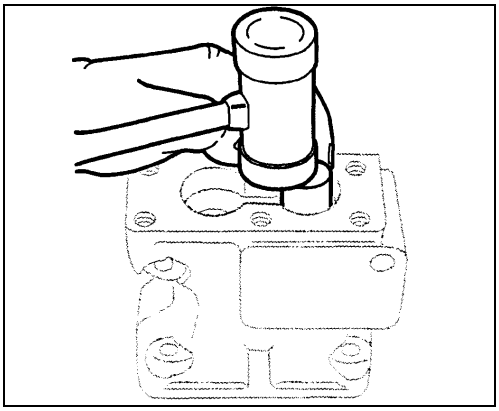
14. Remove reducing spool spring (7) from housing bore.



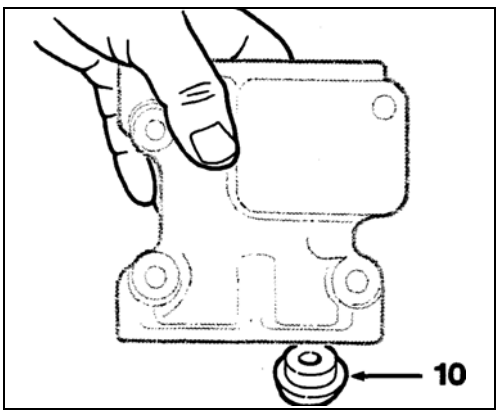
15. Remove sequence spool (8) from housing bore.



16. Using a wooden dowel pin, insert into housing bore up against sequence spool spacer. Gently tap on dowel to dislodge spacer from housing.



17. Remove sequence spool spacer (10) from housing.



NOTE: *Check all springs for damage and fatigue against those values shown in specifications*

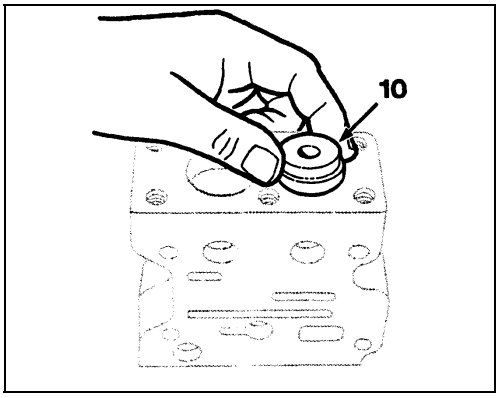
TRANSMISSION

RATE OF RISE VALVE

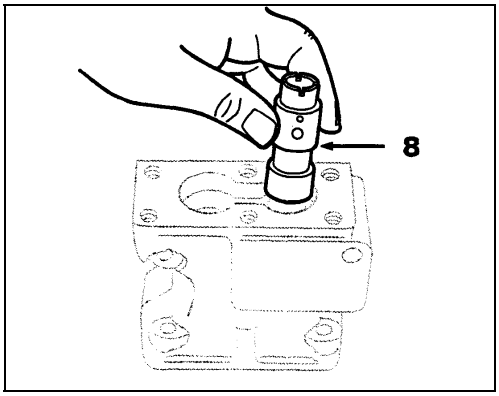
34. REASSEMBLY

NOTE: *Callouts from exploded and cross section views (refer to Figs. 7C.15 and 7C.16) correspond with callouts in following steps.*

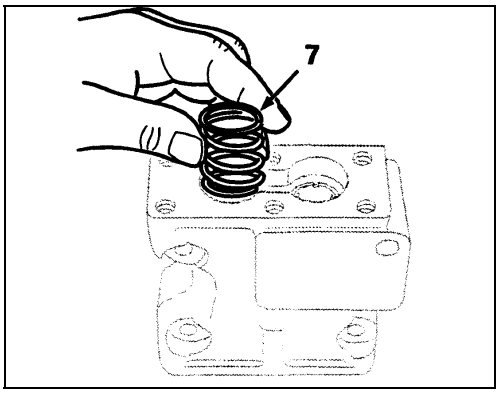
1. Squarely seat sequence spool spacer (10) into housing bore.



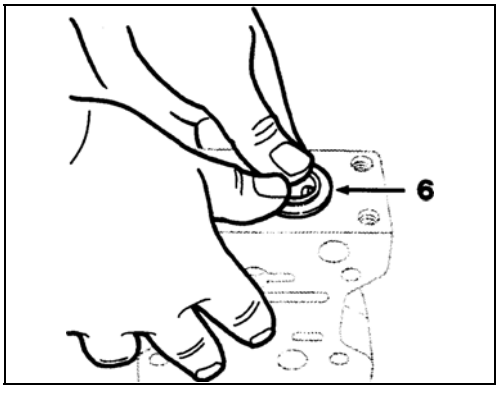
2. Install sequence spool (8) into housing bore.



3. Install reducing spool spring (7) into housing bore.

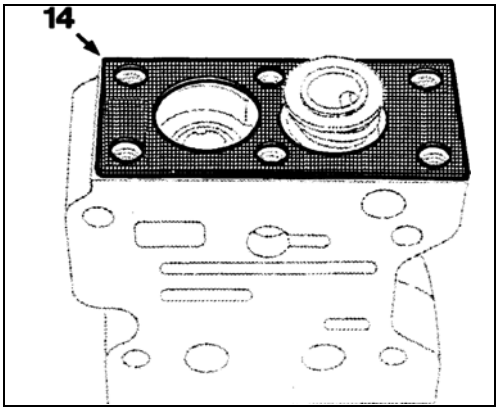


4. Seat reducing spool (6) in housing bore.

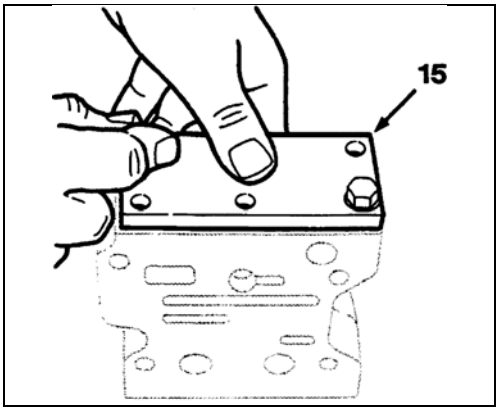


RATE OF RISE VALVE

5. Install new end cover gasket (14) to housing.

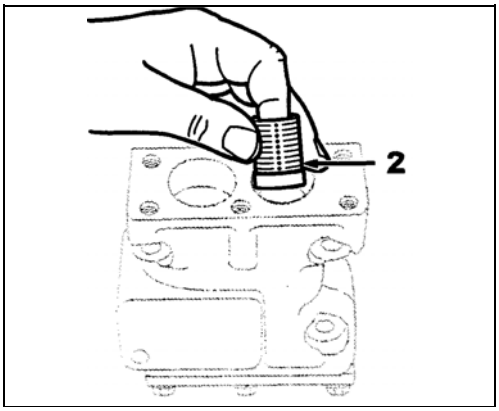


6. Install end cover (15) and secure with four bolts. Install remaining bolts. Torque bolts to 38 ± 10% [Nm].

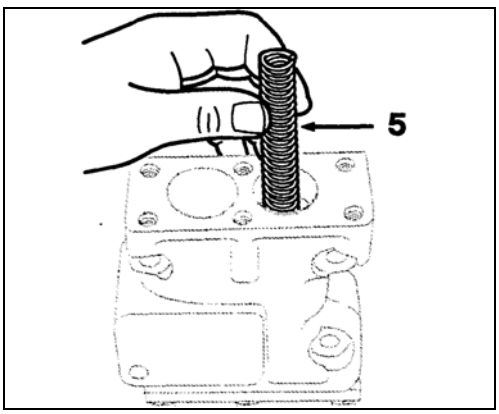


WARNING! Spring loaded assembly. Assembly must be held to install spring. Use extreme care when assembling.

7. Install modulating piston (2) into housing bore.

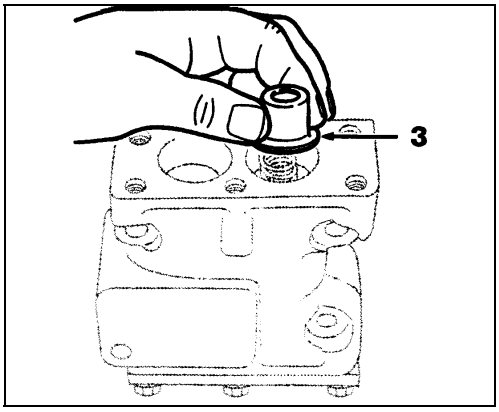


8. Install inner piston spring (5) into modulating piston in housing bore.

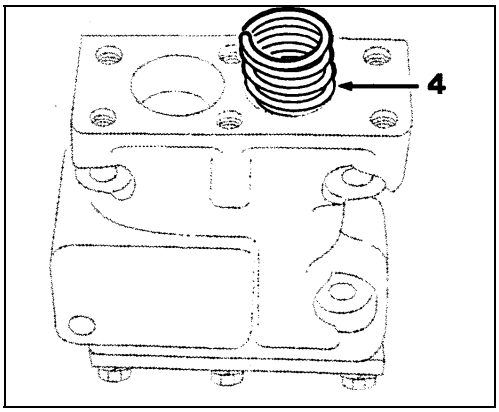


RATE OF RISE VALVE

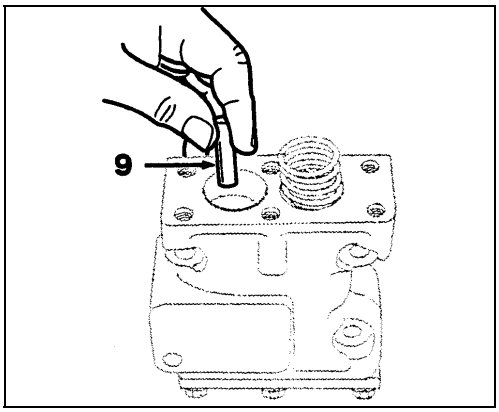
9. Install piston spring retainer (3) over spring.



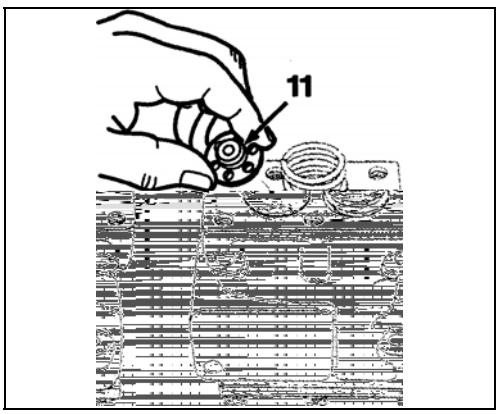
10. Install outer piston spring (4) over retainer.



11. Install dowel pin (9) in housing bore into sequence spool spacer.

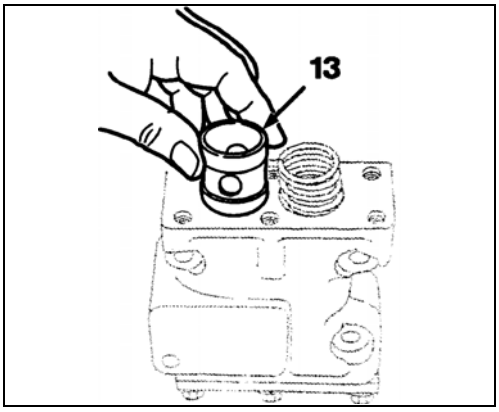


12. Install sequence spool disc (11) on dowel pin.

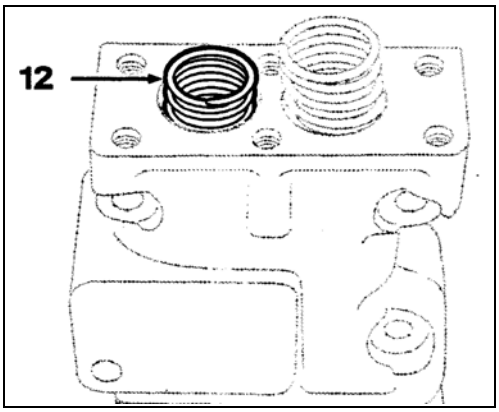


RATE OF RISE VALVE

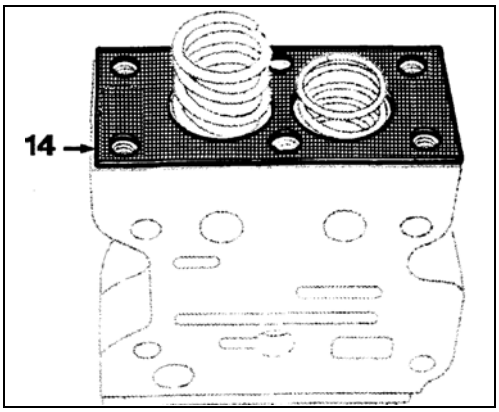
13. Install tube spacer (13).



14. Install sequence spool spring (12) inside tube spacer.

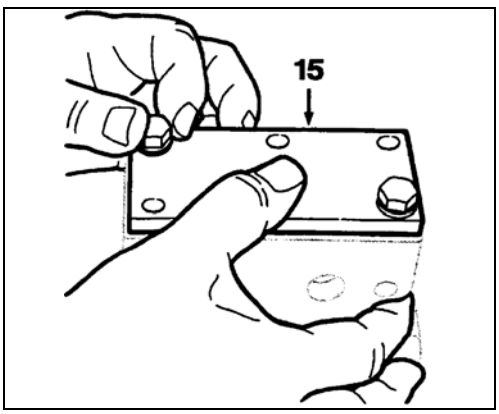


15. Install new end cover gasket (14) to housing.



16. Install end cover (15) and secure with four bolts. Install remaining bolts. Torque bolts to 38 Nm ±10%.

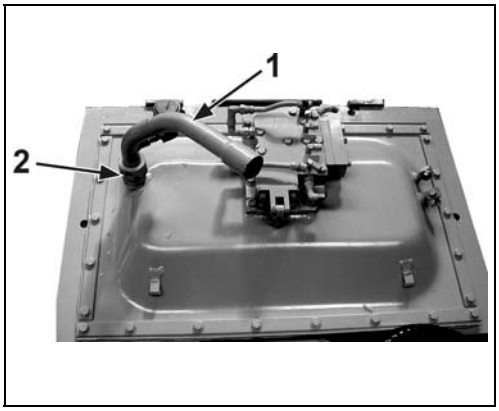
WARNING! Spring loaded assembly. Assembly must be held to install spring. Use extreme care when assembling.



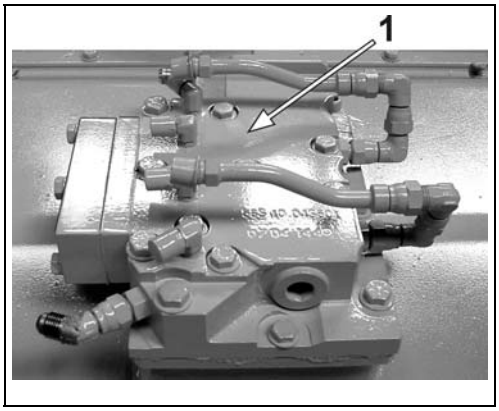
TRANSMISSION

35. INSTALLATION

1. Remove upper filler tube (1) and lower filler tube (2). Plug port.

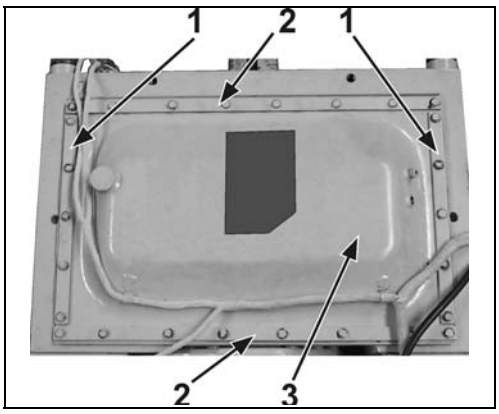


2. Remove brake valve (1); refer to REMOVAL in Section 4 BRAKES.

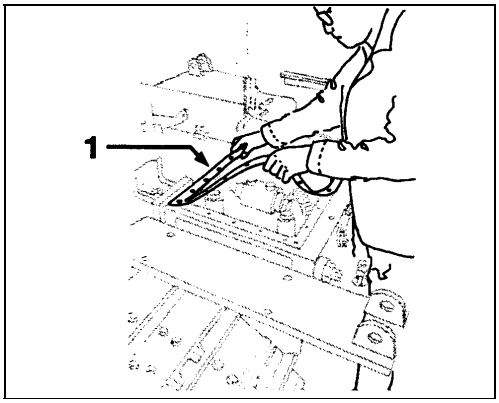


j

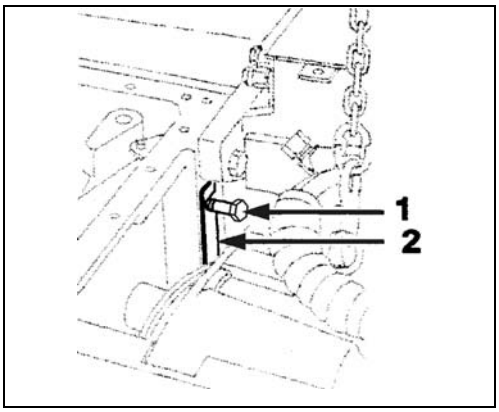
3. Remove hardware and side (1) and front and back (2) stiffeners. Remove rear frame cover (3).



4. Remove and discard rear frame cover gasket (1). Replace gasket with new.

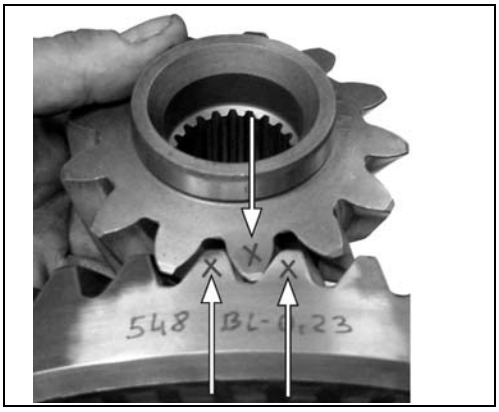


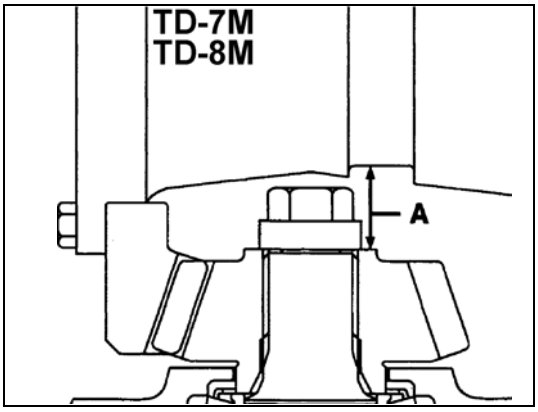
5. Install two mounting bolts (1), to top transmission mounting bolt holes. Position five 0.50 [mm] mounting shims (2) on each bolt. On pinion gear notate and record dimension etched on face of gear. Coat new mounting O-ring with liberal amount of amber grease. Using hoist position transmission in place and work into rear main frame engaging pinion gear with ring gear. Install mounting bolts and torque to130 [Nm].

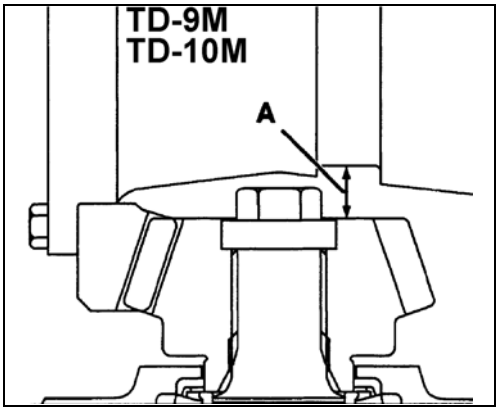


6. The „X" marked tooth of the pinion gear is to be intermeshed with „X" marked two teeth of the steering drive ring gear while assembling the transmission.

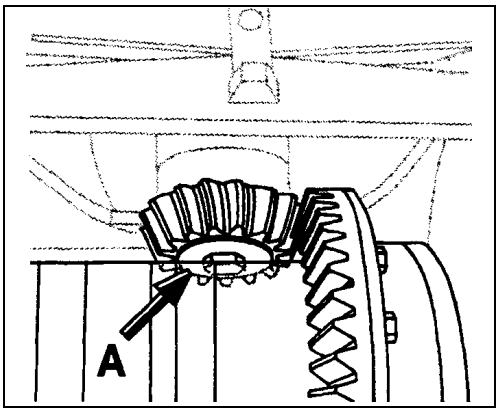
NOTE: *Follow the procedure outlined in items 7 through 8 when the following have been replaced: transmission housing, output shaft end play shimming, transmission to rear frame shimming, transmission pinion shaft and steering drive ring gear assy.*





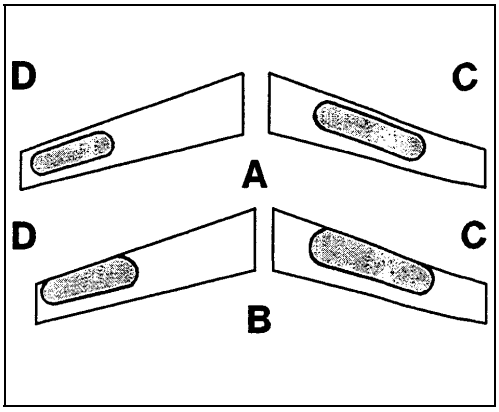


7. Measure and record distance (A) between face of pinion gear to ring gear carrier machined groove. Add or subtract mounting shims to bring pinion gear within dimension etched on face, recorded in Step 5, within 0.025 [mm]. Torque transmission mounting bolts to 325 [Nm].

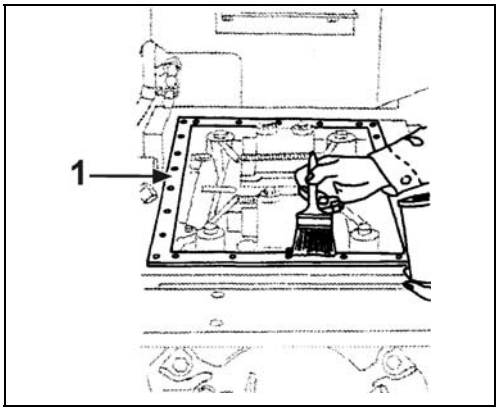


8. Check, if the transmission assembly operation has been done correctly. To this aim check the tooth pattern of the pinion gear and ring gear teeth of the steering drive. The tooth pattern while rotating the ring gear to the left/right is to be similar to that of the left/ right hand sketch, respectively. The top/bottom of the sketch shows the ring gear/pinion gear tooth pattern, respectively.

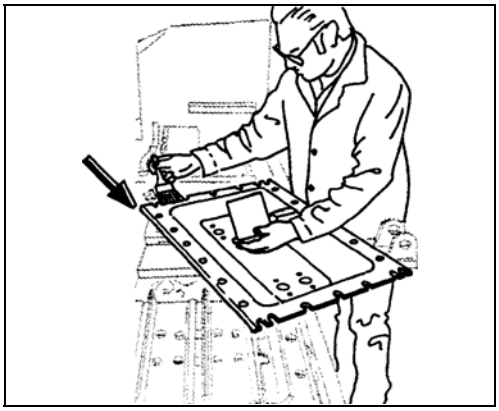
   A. Ring Gear
   B. Pinion Gear
   C. Coast Side
   D. Drive Side



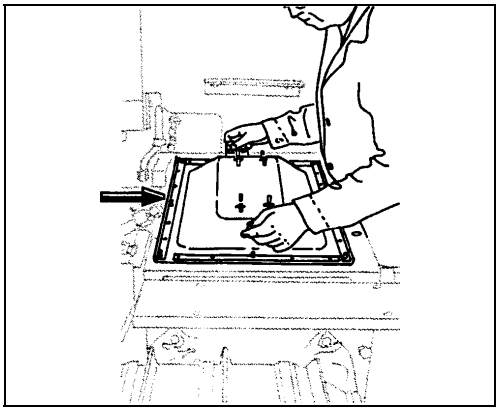
9. Thoroughly clean all mounting surfaces of cover, rear frame and new gasket with methyl ethyl ketone (MEK). Position gasket (1) over rear frame surface with one odd square corner located at right rear corner. Install all mounting bolts to rear frame. Apply gasket cement, to top surface of gasket.



10. Apply gasket cement, to mounting surface of rear frame cover.

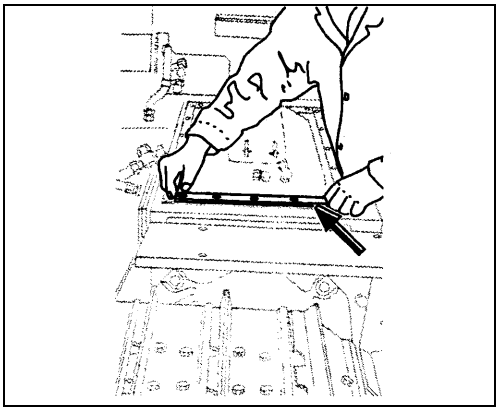


11. Position rear frame cover on gasket centering gasket metal spacers within cover mounting bolts.

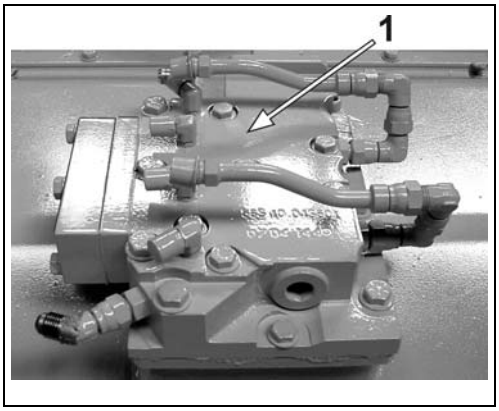


TRANSMISSION

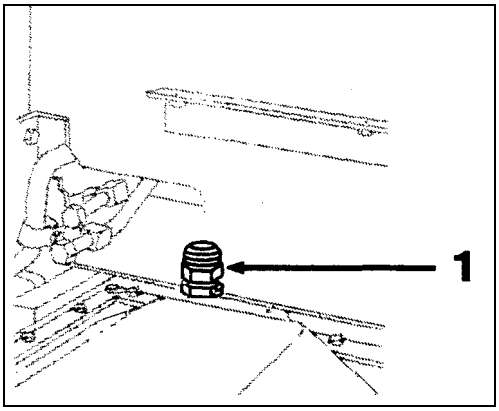
12. Install front, back and side stiffeners and secure with hardware. Torque bolts to 55 [Nm].



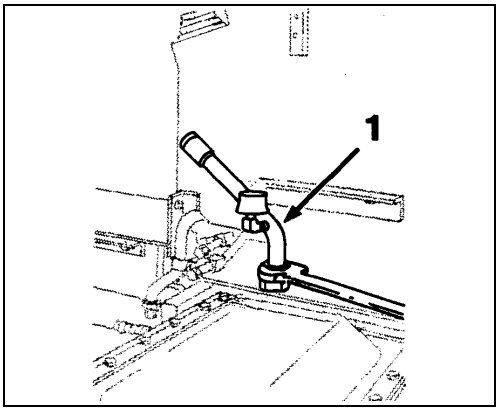
13. Install brake valve (1); refer to Installation in Section 4 BRAKES.



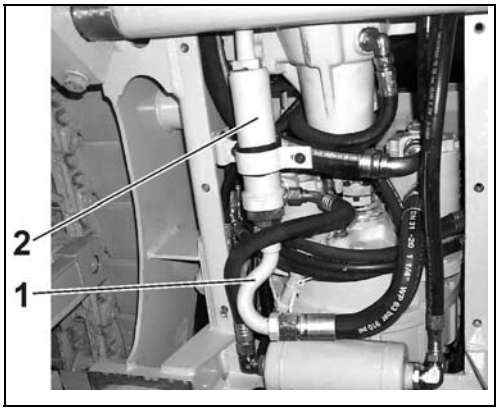
14. Install lower filler tube (1).



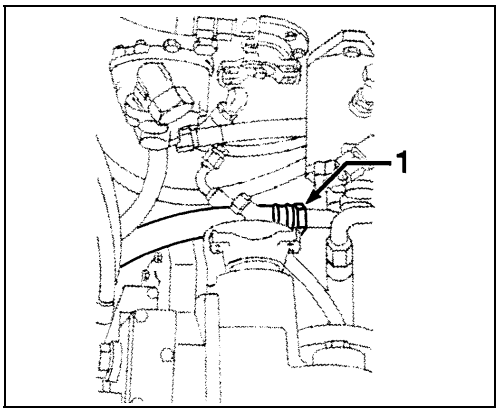
15. Install upper filler tube (1).



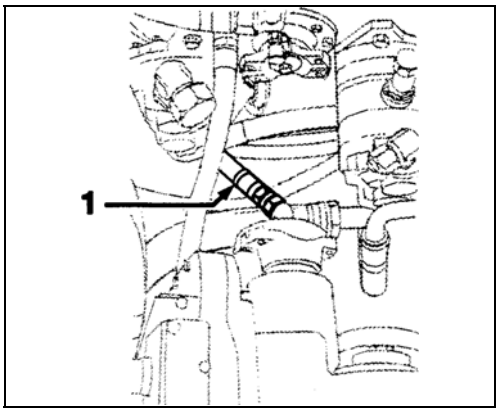
16. Install suction strainer (2) and bracket and secure with hardware. Torque bolts to 38 ± 10% [Nm]. Reconnect tube (1) at suction strainer (2).



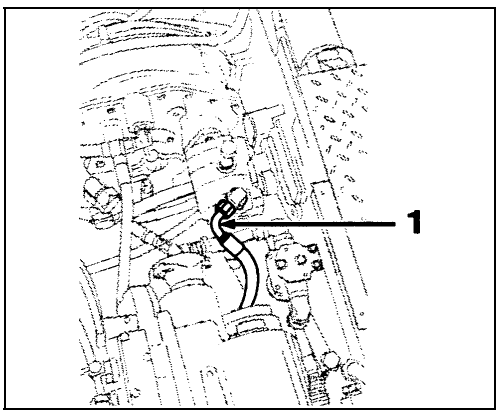
17. Install large suction hose (1) between bottom rear section of pump and transmission.



18. Install cooler outlet hose (1) to front of transmission.



19. Install pump to rear mainframe hose (1).

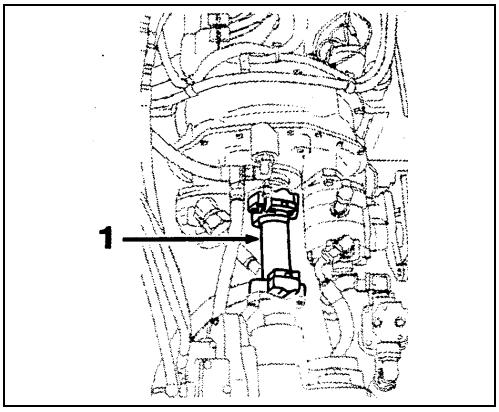


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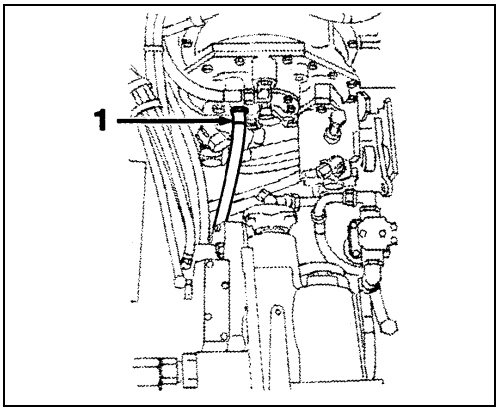
20. Install drive shaft (1) and secure with bolts.

TD-7M or TD-8M; Torque bolts to 33 [Nm].

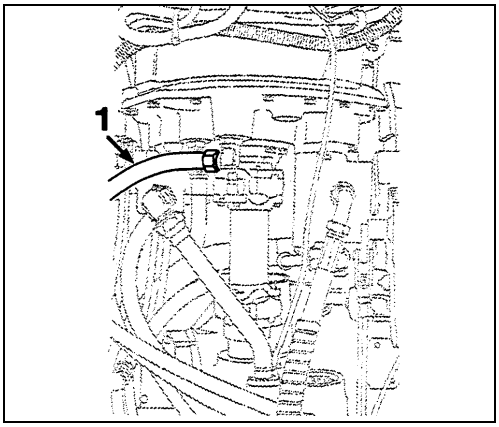
TD-9M or TD-10M; Torque bolts to 57 [Nm].



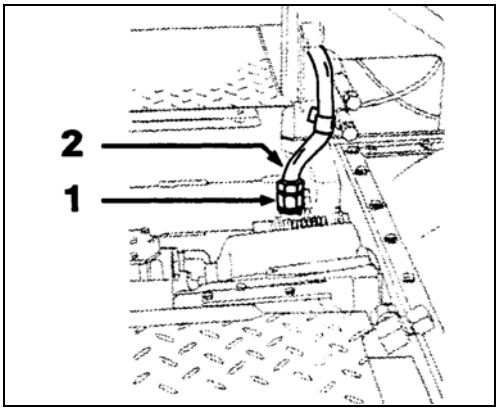
21. Install drain hose (1) between torque converter and transmission.



22. Install converter inlet hose (1) at torque converter.

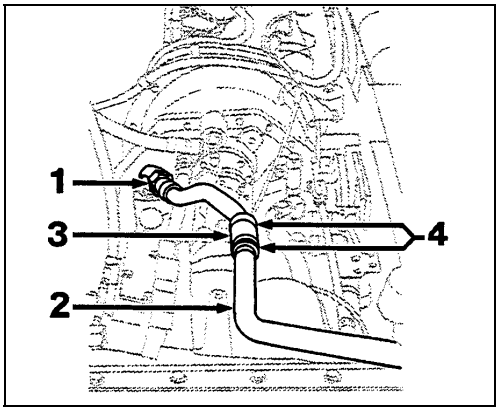


23. Connect control valve inlet hose (1) to tube (2).

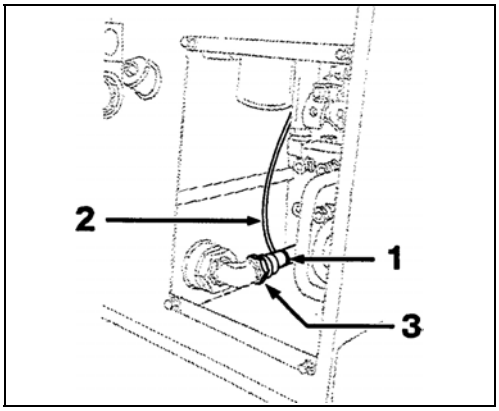


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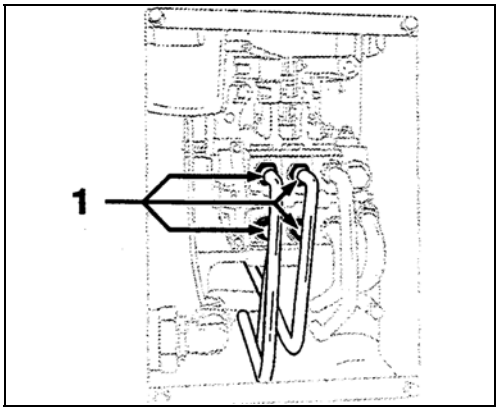
24. Connect front suction tube (1) to equipment pump. Connect front suction tube to rear suction tube (2) with rubber hose (3) and clamps (4).



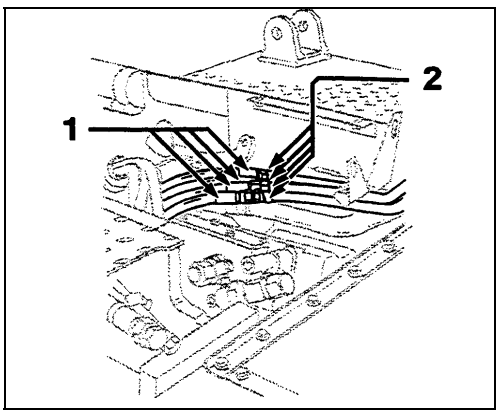
25. Install rear suction tube (3) to fitting at reservoir. Tie strap (1) harness (2) to tube.



26. Install upper and lower rear tubes (1) at control valve.

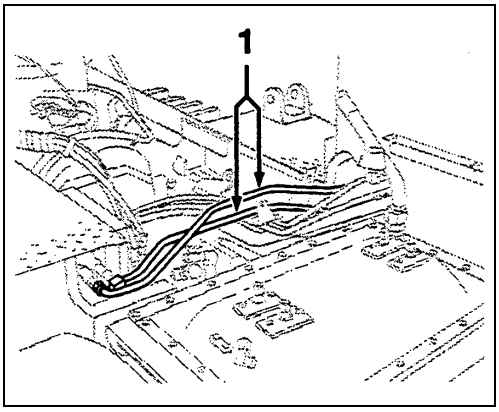


27. Connect four hoses (1) to tubes (2).

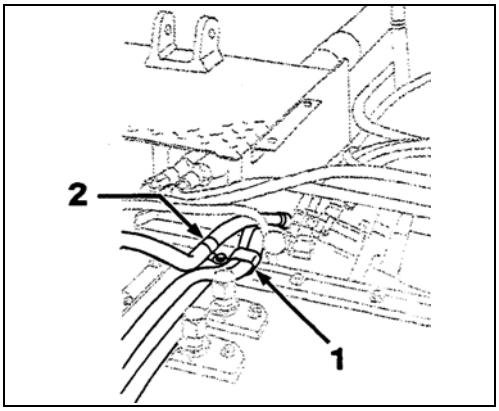


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28. Install two crossover tubes (1).

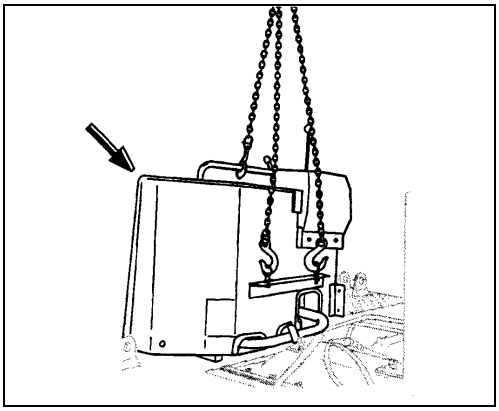


29. Reclip fuel lines (1) and battery cables (2). Torque clip bolt at rear cover to 55 [Nm].

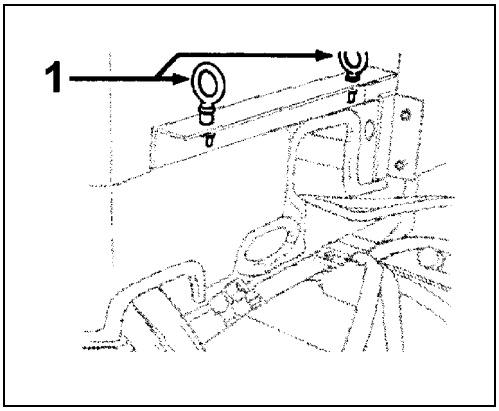


30. Position battery box in place on fender with shims that were removed with it and secure with hardware. Torque bolts to 180 ± 10% [Nm].

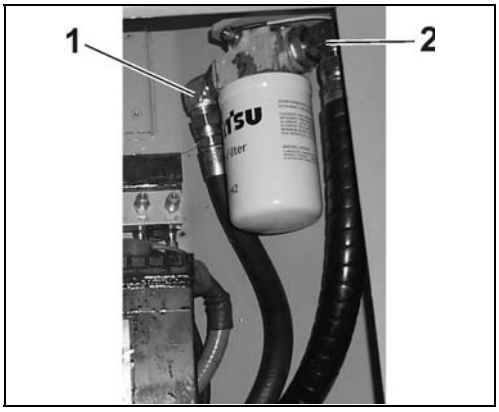
NOTE: *When installing battery box, make sure crossover hoses at left front of rear frame clear bottom floor plate of box. Tubes go inside box.*



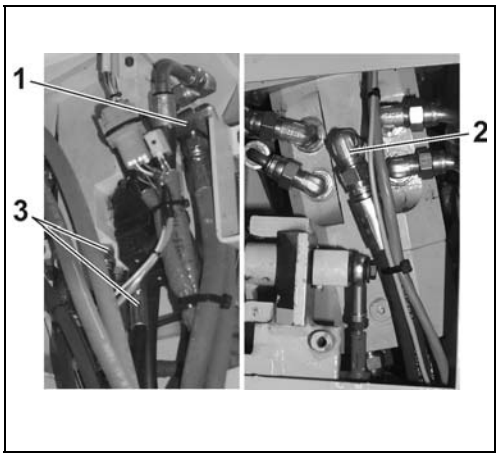
31. Remove eye bolts *(2).*



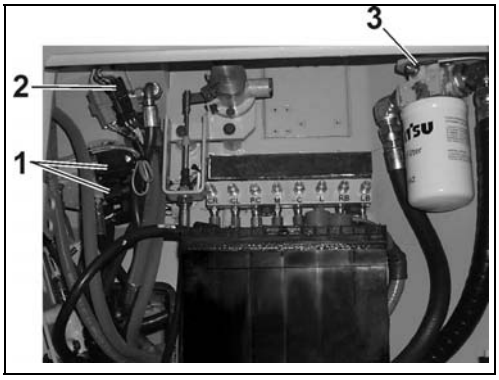
32. Install filter inlet hose (1) and filter outlet hose (2) to filters elbows.



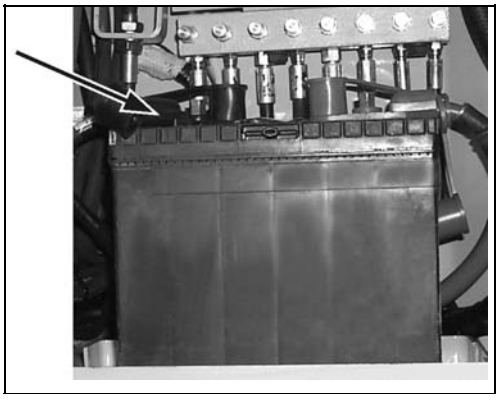
33. Reconnect one steering (F) hose (1) to rear side of drive train control valve, one steering (R) hose (2) to front side and two gear steering (1st, 2nd) hoses (3) to bottom of drive train control valve.



34. From inside battery box, reconnect wiring at solenoid valves (1) of drive train control valve, drive train electronic controller (2), drive train oil pressure filter switch (3), startup lock switch, backup alarm pressure switch and main oil pressure switch.



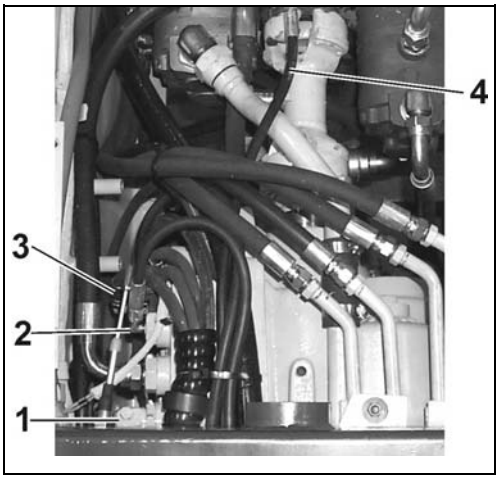
35. From inside battery box, apply electrical sealing grease, Grafo 112-X to negative battery cable (1) and connect to battery. Torque nut to 31 [Nm].



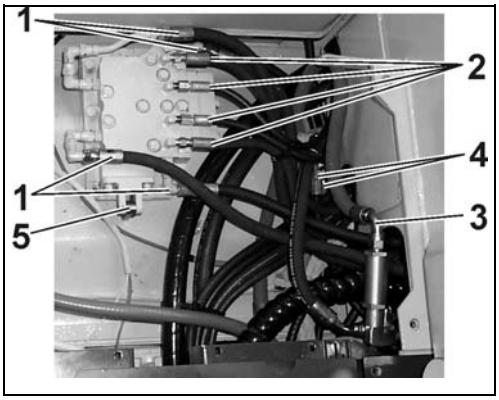
TRANSMISSION

36. Install M pressure check hose (1) and L pressure check hose (2) to pressure regulator valve fittings. Install Pc pressure check hose (3) to range selector valve fitting. Install C pressure check hose (4) to torque converter fitting and position in battery box.

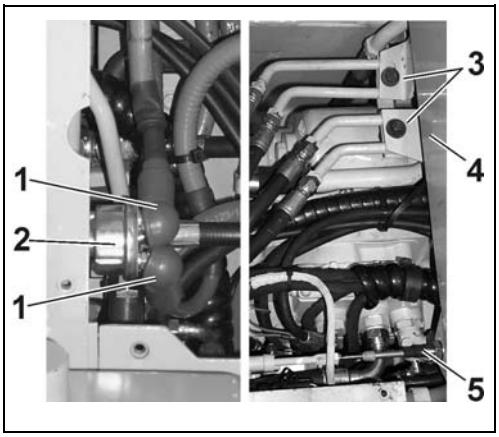
NOTE: *The C pressure check hose does not exist in Direct Drive versions of TD-8M, TD-9M and TD-10M machines.*



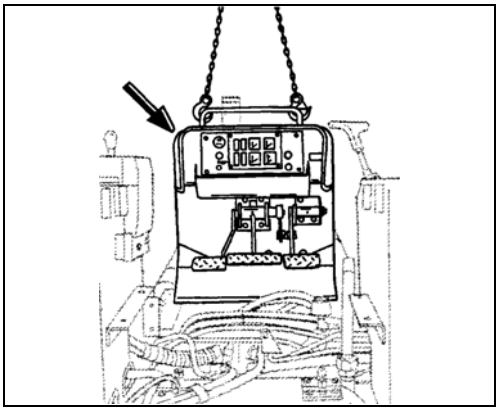
37. Install four steering hoses (1) to brake valve fittings. Install four check hoses (2) to brake valve fittings. Install neutral lock valve supply hose (3). Install drive train drain hoses (4) to elbow on rear main frame cover. Install brake rod with clevis to brake valve (5).



38. Apply electrical sealing grease, Grafo 112-X to cables (1) and connect to master disconnect switch (2). Torque nuts to 12 [Nm]. Install tube brackets (3) to front support plate (4). Torque center $^{3}/_{8}$NC bolt to 38 ± 10% [Nm] and right $^{1}/_{2}$NC bolts to 92 ±10 % [Nm]. At lower left of seat support plate (4) connect throttle cable (5) to support plate. Install seat support plate to machine and secure with hardware. Torque bolts to 38 ±10 % [Nm].

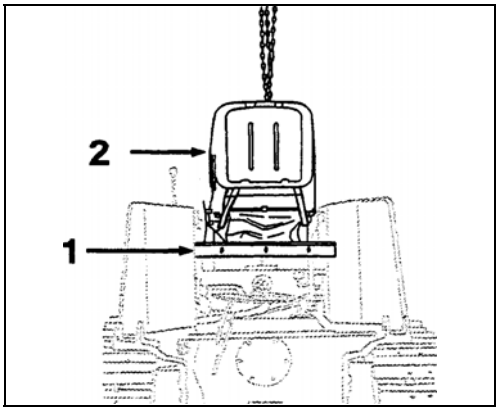


39. Position dashboard in place and secure with hard ware and shims (if required). Torque bolts to 92 Nm±10%. Refer to POWER, SECTION 12 for this procedure.

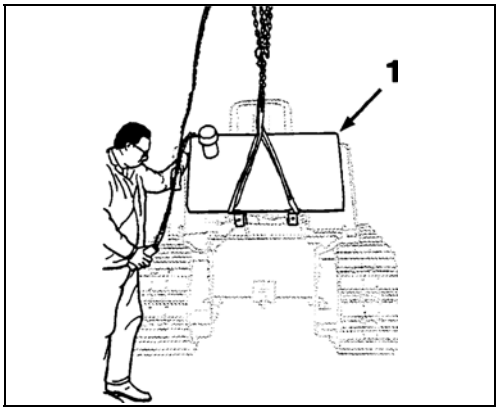


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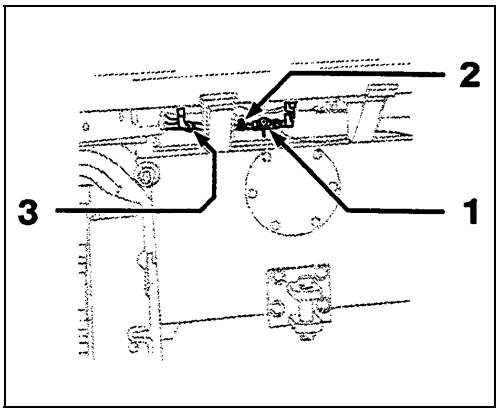
40. Position seat (2) and platform (1) in place and secure with side and front hardware. Torque bolts to 38 ± 10% [Nm].



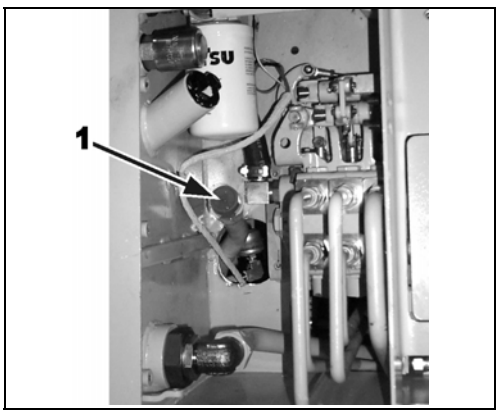
41. Position fuel tank in place and secure with mounting hardware and spacers. Torque $^{3}/_{4}$NC bolts to 325 ± 10% [Nm]. Install rear seat platform to fuel tank hardware and torque 1/2NC bolts to 92 Nm ±10%.



42. Connect fuel return hose (3) to fitting at tank. Connect fuel supply hose (2) to shut off valve (1). Open valve.

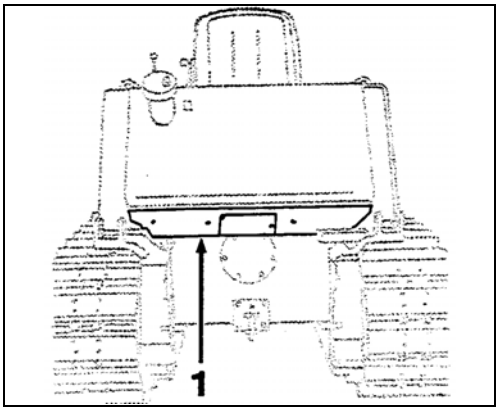


43. Remove plug and install drive train oil level gauge (1).

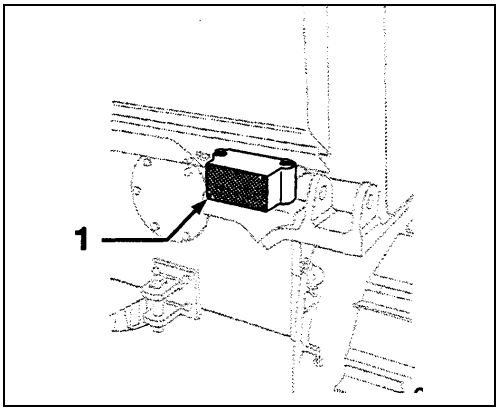


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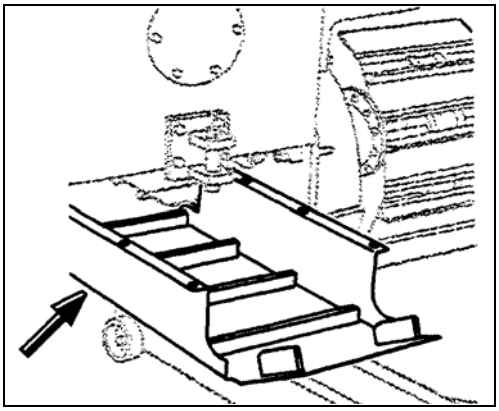
44. Position rear cover (1) in place and secure with hardware. Torque bolts to 92 ±10% [Nm].



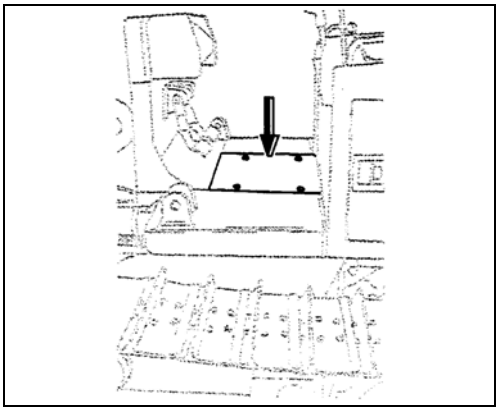
45. Position back up alarm (1) in place and secure with hardware. Torque bolts to 38 ± 10% [Nm]. Apply electrical sealing grease, Grafo 112-X to wires and connect at back of alarm. Torque nuts to 1.8 ± 10 % [Nm].



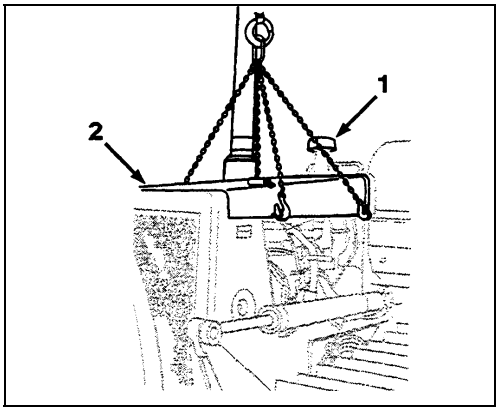
46. Using a rolling floor jack, install transmission guard to machine and secure with hardware. Torque bolts to 92 ± 10% [Nm].



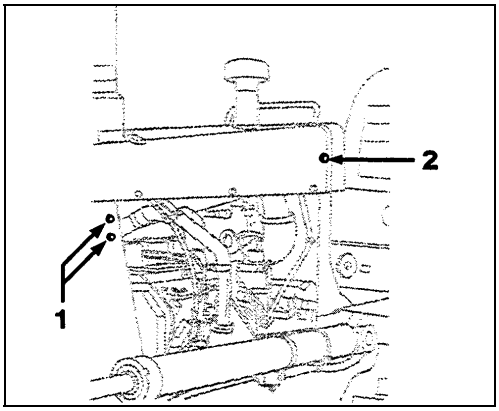
47. Install operators compartment floor plate. Torque bolts to 38 ±10% [Nm].



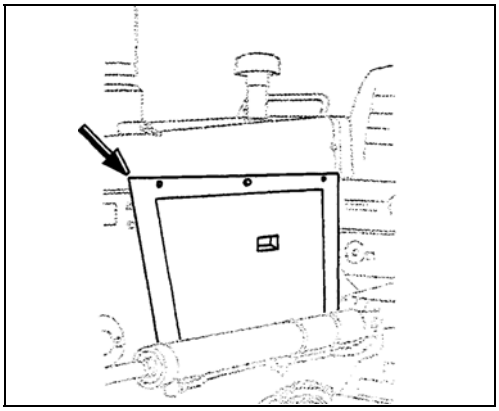
48. Install hood (2) to machine. Install air inlet cap (1) to inlet pipe. Refer to POWER, SECTION 12 for this procedure.



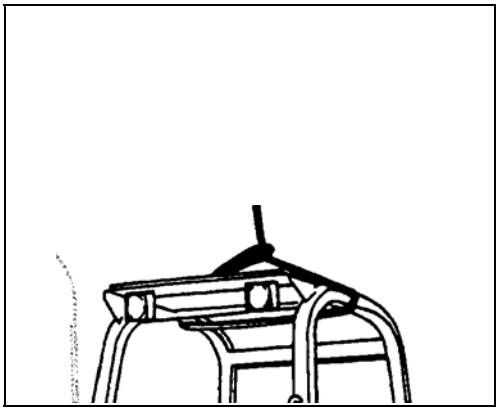
49. From inside of engine compartment, install hood tie down brackets (1). Torque bolts to 10 ± 10% [Nm]. Install hood rod, ball and bracket and tighten until ball compresses. Repeat for other side. Install hood rear mounting hardware (2). Torque bolts to 92 ± 10% [Nm].



50. Install engine left and right side doors. Torque bolts to 38 ± 10% [Nm].



51. Using hoist install ROPS on machine securing with hardware (nuts inward) and torque to 822 ± 47 [Nm]. Connect ROPS light connections at rear left leg. Refill hydraulic and drive train systems with proper fluid, refer to the OPERATIOR'S MANUAL. Test transmission as described in Section 7, DRIVE TRAIN.



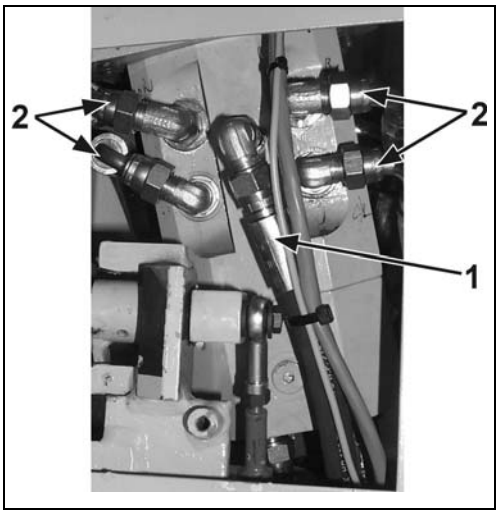
DRIVE TRAIN CONTROL VALVE

37. REMOVAL

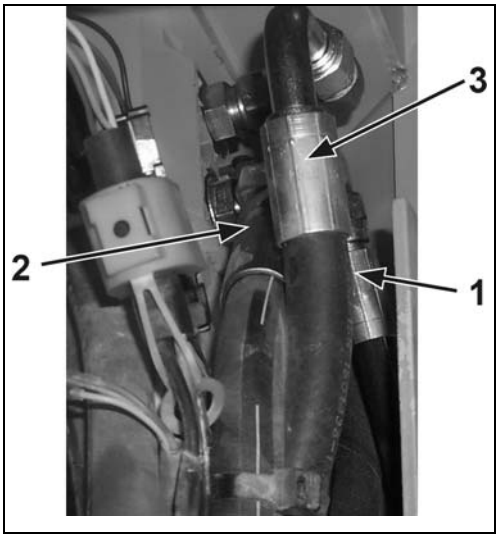
WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train control lever is in NEUTRAL position, drive train neutral lock lever is in ON position and parking brake is set. The starting switch and the electrical system master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

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. Through access cover in front of battery box disconnect one steering (R) hose (1) and four steering (CR, CL, BSR and BSL) hoses (2) at front side of drive train control valve.

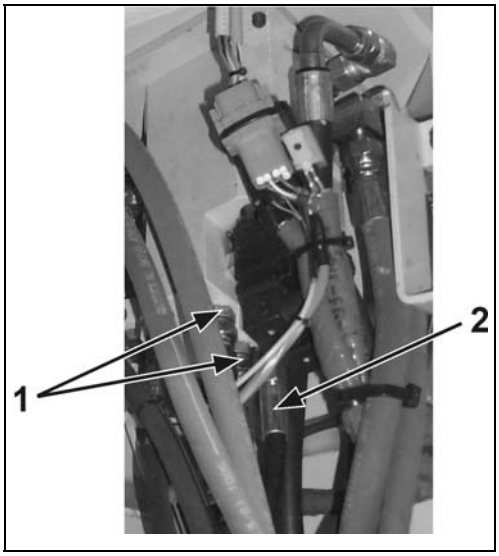


2. Disconnect steering (F) hose (1), supply (M) hose (2) and drain (D) hose (3) at rear side of drive train control valve.

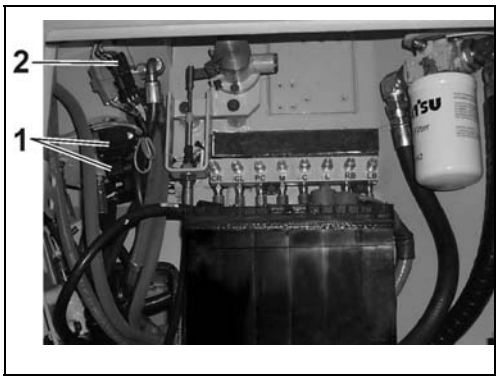


DRIVE TRAIN CONTROL VALVE

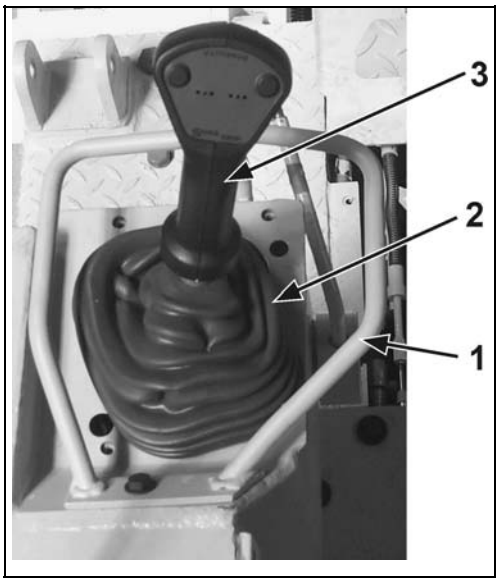
3. From inside battery box disconnect two gear steering (1st, 2nd) hoses (1) and two drain (D) hoses (2)at bottom of drive train control valve. Position hoses outside of battery box.



4. From inside battery box, disconnect wiring at solenoid valves (1) of drive train control valve and drive train electronic controller (2).



5. Remove feathering handle (1). Unscrew four mounting bolts securing drive train control valve boot (2) to battery box. Unscrew next four mounting bolts securing drive train control valve (3) to the battery box and remove the valve from the console. Remove handle with electrical connectors.



DRIVE TRAIN CONTROL VALVE

38. DISASSEMBLY (Refer to Fig.'s 7C.23 and 7C.24)

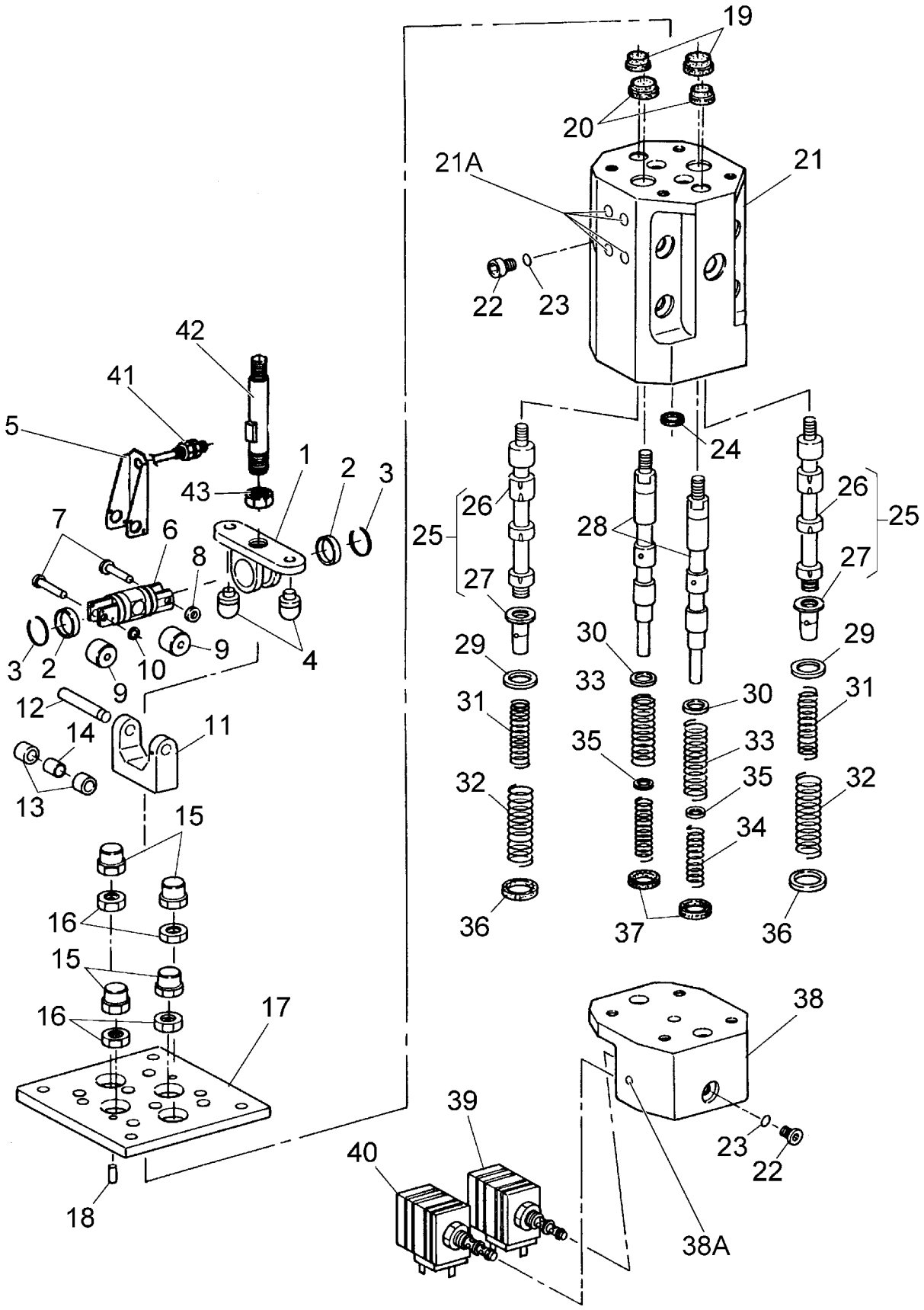


Fig. 7C.23. Exploded View of Drive Train Control Valve

DRIVE TRAIN CONTROL VALVE

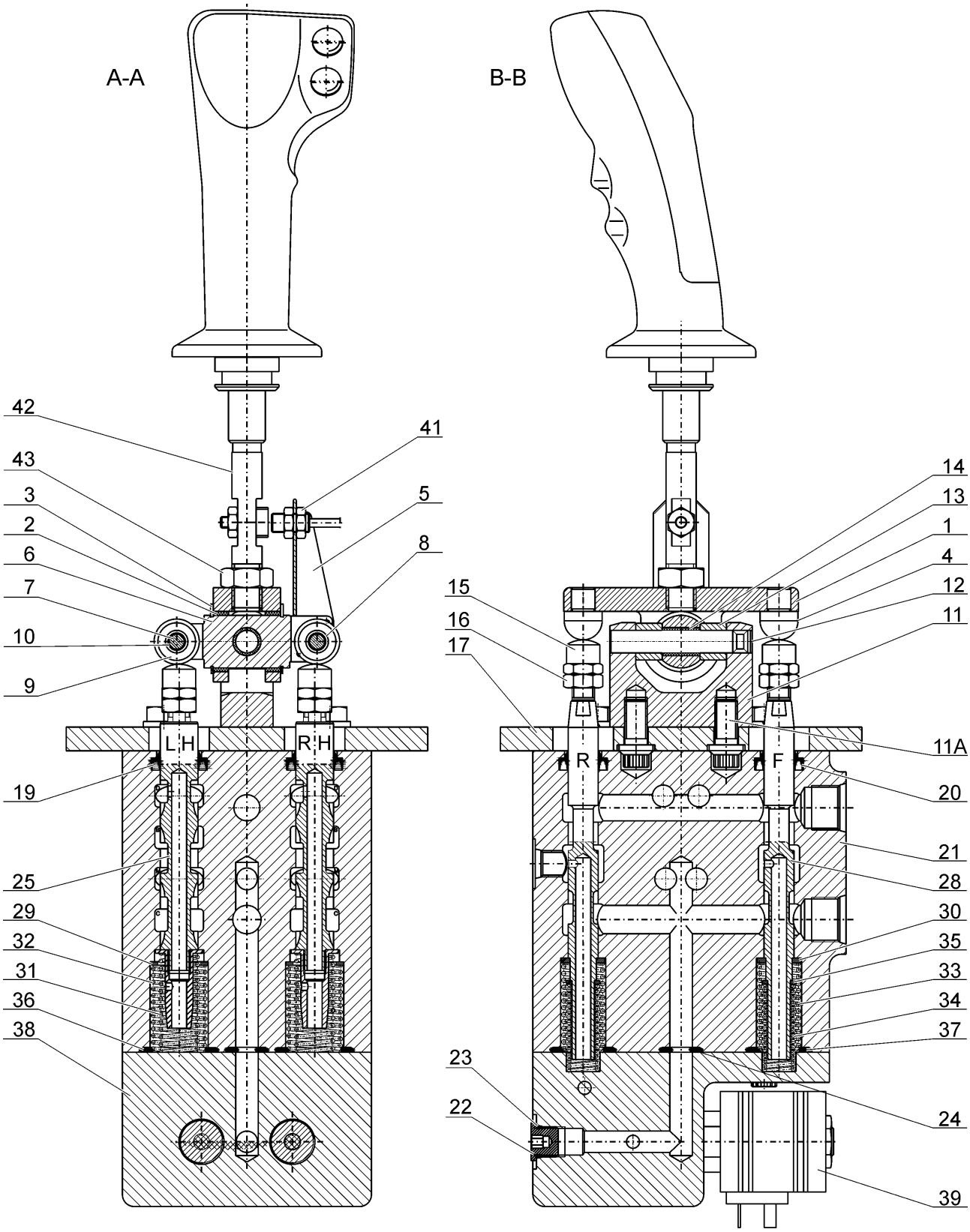


Fig. 7C.24. Cross Section View of Drive Train Control Valve

DRIVE TRAIN CONTROL VALVE

Legend for Fig.'s 7C.23 and 7C.24

1. Rocker
2. Bearing
3. Retaining Ring
4. Spherical Rocker End
5. Switch Bracket
6. Rocker Shaft
7. Pin
8. Washer
9. Roller Bearing
10. Washer
11. Bracket

11A. Bolt

12. Shaft
13. Spacer
14. Bearing
15. Cup Nut
16. Nut
17. Upper Plate
18. Pin
19. Seal Ring
20. Seal Ring
21. Housing

21A. Spring Pin

22. Plug
23. O-Ring
24. O-Ring
25. Piston Assy
26. Piston
27. Spool Sleeve
28. Piston
29. Ring
30. Ring
31. Spring
32. Spring
33. Spring
34. Spring
35. Ring
36. O-Ring
37. O-Ring
38. Cover

38A. Spring Pin

39. Solenoid Valve
40. Solenoid Valve
41. Proximity Switch
42. Lever
43. Nut

1. Position the valve in a vise with rocker assembly (1) up. Remove the proximity switch (41) from the bracket (5). Remove lever (42) with nut (43) from the rocker (1).
2. Remove the upper plate (17) with rocker assembly from valve housing (21).
3. Remove the hardware and separate the bracket (11) with rocker assembly (1) from the upper plate (17). Remove pins (38A) if necessary.
4. Remove the hardware and separate washers (8 and 10), pins (7) and roller bearings (9) from the rocker shaft (6). Remove switch bracket (5) from the shaft (6).
5. Remove shaft (12) with spacers (13) to separate rocker and shaft assembly (1 and 6) from bracket (11).
6. Remove retaining rings (3) from shaft (6) and separate the shaft (6) from rocker (1).
7. Remove the bearing (14) from rocker shaft (6), if needed.
8. Remove the bearings (2) from the rocker (1). Remove rocker ends (4) from the rocker (1).
9. Remove cup nuts (15) and nuts (16) from each spool.
10. Position the valve housing (21) bottom side facing up in a vise.
11. Remove the solenoid valve (39) and solenoid valve (40) from cover (38) seats.

NOTE: *Exert an inward pressure while unscrewing cover (38) from housing (21) to counteract the spring tension*.

12. Remove the cover (38) from the valve housing (21).
13. Remove and discard O-rings (36), O-rings (37) and O-ring (24) from the bottom of housing (21). Remove return springs (31and 32) and rings (29) from valve housing.
14. From under the valve housing, push the piston assembly (25) up and out of the valve housing (21). Repeat for the second piston.
15. Remove springs (34 and 33), rings (35 and 30) and pistons (28).
16. Remove seal rings (19) and (20) from the housing.
17. Remove plug (22) with O-ring (23), if necessary.
18. Remove four spring pins (21A) from the valve housing and five spring pins (38A) from the cover (38) if necessary.
19. Unscrew sleeves (27) from pistons (26) if necessary.

DRIVE TRAIN CONTROL VALVE

39. 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 pistons, valve housing and valve cover 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 spherical rocker ends, roller bearings and pistons cup nuts for excessive wear or scratches and replace if necessary.

40. REASSEMBLY (Refer to Figs.' 7C.23 and 7C.24)

IMPORTANT: *Sealing rings should be lubricated with petroleum jelly for ease of assembly. The valve pistons, and theirs bores should also be lightly lubricated.*

1. Position the valve components on a shop bench.
2. If removed, press four spring pins (21A) into the valve housing (21), (balls should be 0. 25 to 0.75 [mm] below the valve face).
3. Thread a plug (22) with an O-ring (23) into a taped hole of housing (21).
4. Install seal rings (19) and seal rings (20) into the housing. Install pistons (28) into sleeve holes in the housing.
5. Install rings (30), springs (33), rings (35) and springs (34) on pistons (28).
6. If removed apply LOCTITE #242 into pistons (26) threads, and thread them into spool sleeves (27). Install the piston's assy (25) into sleeve holes.
7. Install rings (29) with Ø 20.9 [mm] recessed countersink towards piston. Install springs (31) and springs (32).
8. Press spring pins (38A) (5 pcs) into cover (38) if removed, (balls should be 0. 25 to 0.75 [mm] below the valve face).
9. Thread plug (22) with O-ring (23) into taped hole in cover.
10. Install O-rings (36), two O-rings (37), O-ring (24) into housing (21).
11. Position cover (38) on elements protruding from housing, press the cover against housing (21) compressing the springs.
12. Bolt cover (38) to housing using bolts (2 x 2 pcs) and torque them to 38 $\pm$ 3 [Nm].
13. Install solenoid valve (39) and solenoid valve (40) into cover (38) seats.
14. Thread nuts (16) and cap nuts (15) into pistons ends (28) and (26), respectively.
15. Press spherical rocker ends (4) into rocker (1) dia. 10H7 bore. Install bearings (2) into rocker bore having dia. 25.39 [mm].
16. Press bearing (14) into rocker shaft (6) bore having dia. 11.90 [mm].
17. Install rocker shaft (6) into rocker (1) and secure with retaining rings (3).
18. Install rocker (1) and shaft (6) assy in bracket (11) using spacers (13) and shaft (12); secure with a screw.

19. Install roller bearing (9) into shaft (6) end. Install switch bracket (5) and pin (7). Use screws and washers to tighten switch bracket (5).
20. Install washer (8) on the pin (7) and secure with the spring pin. Install the bearing (9) and pin (7) on the other side of rocker shaft (6). Install washer (10) on the pin and secure with the spring pin.
21. Bolt the rocker assy into upper plate (17) using bolts (11A) and tighten bolts to 38 $\pm$ 3 [Nm]. Spherical rocker ends (4) are to align with pistons (28) axles within 0.1 [mm]. Lower the upper plate (17) with rocker assy to valve housing (21) until dowel pins (18) in housing (21) enter plate. Torque four bolts with washers to 43 $\pm$ 4 [Nm].
22. Install lever (42) with nut (43) and handle.
23. Install proximity switch (41) and adjust it to 0.5-1.5 [mm] from the bolt surface.
24. Adjust the valve as per procedure described under VALVE ADJUSTMENT BEFORE TESTING, Par. 41 in this Section.

41. VALVE ADJUSTMENT BEFORE TESTING

1. The control lever should be vertical to upper plate (17). If needed, adjust the cup nuts (15).
2. Forward – Rearward (FWD – RWD) adjustment.
   a. Shift the drive train control lever from neutral (N) to forward (FWD) position. Directional spool “R” (28) should be shifted down of 5.08 ± 0.1 [mm] until it rests on the cover (38).
   b. In the same time directional spool “F” (28) should be shifted of 5.08 ± 0.1 [mm] in the opposite direction. Use cup nuts (15) to adjust spool stroke.
   c. Repeat this procedure for the rearward (RWD) drive train control lever position.
   d. The control lever should be vertical with no free play between the spherical rocker ends (4) and cup nuts (15). Permissible difference between “heights” of two spools should not exceed 0.25 [mm].
3. Left and right steering adjustment.
   a. Shift the drive train control lever from neutral (N) to right maximum position. The piston “RH” (25) should be shifted of 10.16 ± 0.1 [mm] until the piston rest on the cover (38). Use cup nuts (15) to adjust piston stroke.
   b. In the same time the left piston “LH” (25) should not move.
   c. Repeat this procedure for the left drive train control lever position.
   d. Permissible difference between “heights” of two pistons should not exceed 0.25 [mm].
   e. The control lever should be vertical to upper plate (17). Max deviation 0$\pm$15’ in all directions.
4. Apply a generous amount of grease to surfaces of the cup nuts (15) and roller bearings (9).

DRIVE TRAIN CONTROL VALVE

42. PRESSURE TEST

Drive train control valve pressure test. (Refer to Fig.'s 7.2 or 7.6 in SECTION 7)

1. Install drive train control valve in the platform console as described in steps 1 to 5, Paragraph 43, INSTALLATION in this Section.
2. Install OEM-1212 pressure test kit gauges in respective pressure lines.
3. Apply parking brake. Start the engine.
4. "FWD - RWD" steering pressure test.
   a. Shift the drive train control lever from neutral (N) to forward (FWD) position. It causes the lever will be in latched position at 7°±15' until shifted back to the neutral. The pressure in test point "F" must be M-0.07 [MPa] and in point "R" must be 0.0 [Mpa].
   b. Repeat this procedure for the rearward (RWD) drive train control lever position. The pressure must be the same.
   c. The pressure 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
   a. In the drive train control lever neutral position the pressures should be M-0.07[MPa] in all points.
   b. Gradually shift the lever from neutral (N) position to the right (RH) direction
      - with the lever shifted from 2°15' to 7°15' the pressure in point CR should be dropping gradually from M-0.07 to 0.07 [Mpa]; with the lever shifted from 7°15' to 15° the pressure in point CR should be dropping gradually from 0.07 [Mpa] to 0.0 [Mpa].
      - after shiftment of the lever the pressure in point BSR is dropping rapidly at 7°15' from M-0.07 to (1.59 ÷ 1.4) [Mpa]; and next with the lever shifted from 7°15' to 19° the pressure in point BSR should be dropping gradually from M-0.07 to 0.0 [Mpa].

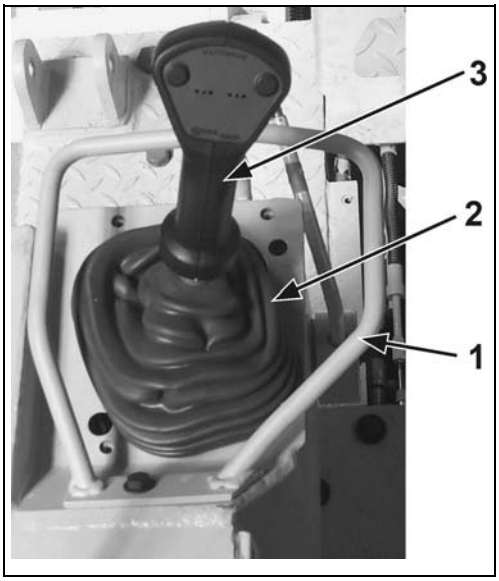
   NOTE: *Rapidly pressure dropping is caused by brake valve functioning. Refer to SECTION 4, BRAKES.*

   c. Repeat this procedure for left (LH) direction. The pressures in points CL and BCL should be identical as for RH direction.
6. Solenoid valves test
   a. Supply 12[V] to solenoid valve (39). The oil pressures at point "1" and "2" should be 0.0 [Mpa].
   b. Supply 12[V] to solenoid valve (40). The oil pressure at point "1" should be 0.0 [Mpa]. and at point "2" M - 0.07 [Mpa].
   c. 0 [V] on both solenoid valves. The oil pressure at point "2" should be 0.0 [Mpa]. and at point "1" M - 0.07 [Mpa].
7. If values of pressures are different from above mentioned readings, control valve should be repaired or replaced, as necessary.
8. Shut off the engine and, in case of successful test pressure results, continue installation as described in Paragraph 43, INSTALLATION in this Section.

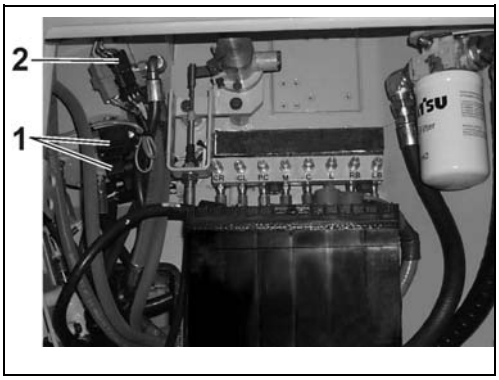
DRIVE TRAIN CONTROL VALVE

43. INSTALLATION

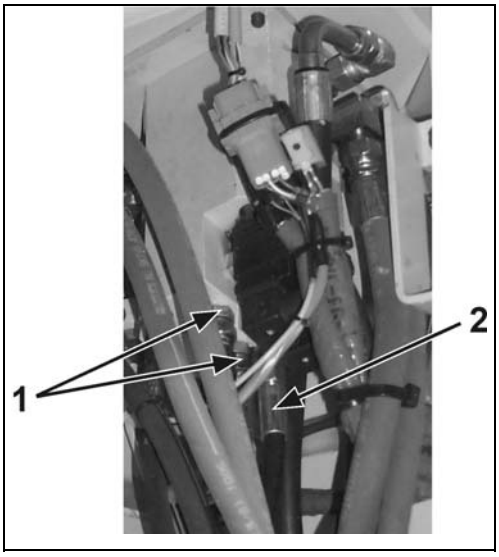
1. Install handle with electrical connectors. Put the drive train control valve (3) to the console. Screw four mounting bolts securing valve to the battery box. Screw next four mounting bolts securing drive train control valve boot (3) to the battery box. Install the feathering handle (1).



2. From inside battery box, connect wiring at solenoid valves (1) of drive train control valve and drive train electronic controller (2).

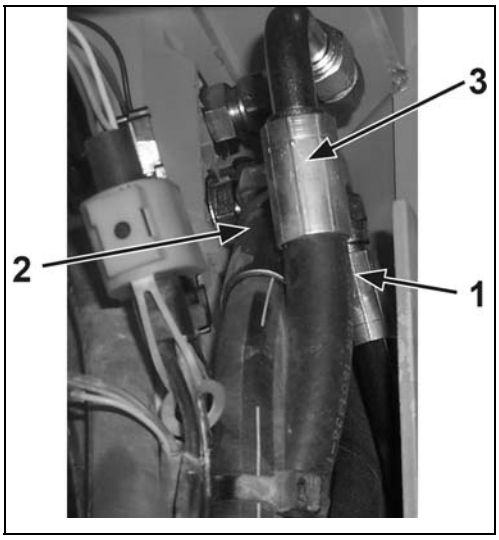


3. From inside battery box connect two gear steering (1st, 2nd) hoses (1) and two drain (D) hoses (2) at bottom of drive train control valve.

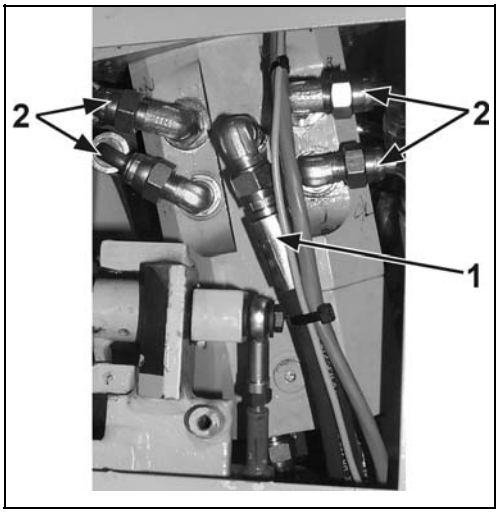


DRIVE TRAIN CONTROL VALVE

4. Connect steering (F) hose (1), supply (M) hose (2) and drain (D) hose (3) at rear side of drive train control valve.



5. Through access cover in front of battery box connect one steering (R) hose (1) and four steering (CR, CL, BSR and BSL) hoses (2) at front side of drive train control valve.



6. Check the oil level in the rear main frame as described in the Operator's Manual, add oil if required.
7. Start the engine and check the drive train system functioning and the valve connection for leakage. Stop the engine per Operator's Manual.

SECTION 7E

STEERING DRIVE

STEERING DRIVE

SECTION 7E

CONTENTS

SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS 3

GENERAL

2. DESCRIPTION.....3
3. OPERATION.....3
4. SPECIFICATIONS 6

STEERING DRIVE

5. REMOVAL 7
6. DISASSEMBLY..... 16
7. REASSEMBLY..... 30
8. INSTALLATION 50
9. STEERING DRIVE OPERATING TEST 58

SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS

DESCRIPTION	TOOL NUMBER
Bearing Carrier Loading Fixture	049R140
Brake Adjusting Screw Tool	85.549.0011
Clutch Steering Arm Combination Square	85.861.0026

GENERAL

2. DESCRIPTION

This steering system combines a planetary gear type drive, hydraulically applied clutch and brake discs and a spring applied hydraulic released brake cylinders – that doubles as a parking brake - all located in the rear main frame. Steering is operated by the drive train control valve. The brake pedal is used to apply both brake discs simultaneously for stopping or holding the machine. The planetary gear type drive consists of a bevel gear, bevel gear carrier, to which the bevel gear mounts, and two planet gear carriers (located within the bevel gear carrier) which supports the planet gear assemblies. A clutch disc and sun gear assembly is located on each side of the bevel gear carrier. The clutch disc is splined to the sun gear and held with retainer rings. The sun gear is supported on bushings in the bevel gear carrier bearing cage and meshes with the planet gears. The brake discs (disc next to each clutch disc) are splined to the sprocket drive pinion shaft.

3. OPERATION (Refer to Fig.'s 7E.1 and 7E.2)

During normal operation (machine moving in a straight line) power transfer is from the bevel gear and gear carrier assembly through the planet gears to the planet gear carriers out the sprocket drive pinion shaft to the sprocket drive and tracks. During this time, the clutch discs are held stationary by the clutch shoes allowing the planet gear to walk around the clutch disc sun gear carrying the planet gear carriers with them as they rotate on their respective shafts. In turn, the clutch disc on the side to which the turn is made is released from the clutch shoe. When the clutch disc is released, the planet gears rather than turning the planet gear carrier, rotate freely on their respective shafts and transfer motion to the free clutch disc. At this time, the track on this side of the machine is just being carried along the ground. When the track is held stationary (as in a pivot turn), the clutch disc is still free and the transfer of motion is to the free clutch disc as before only now the brake disc is held by the brake shoe preventing the sprocket drive pinion shaft from turning.

STEERING DRIVE

GENERAL

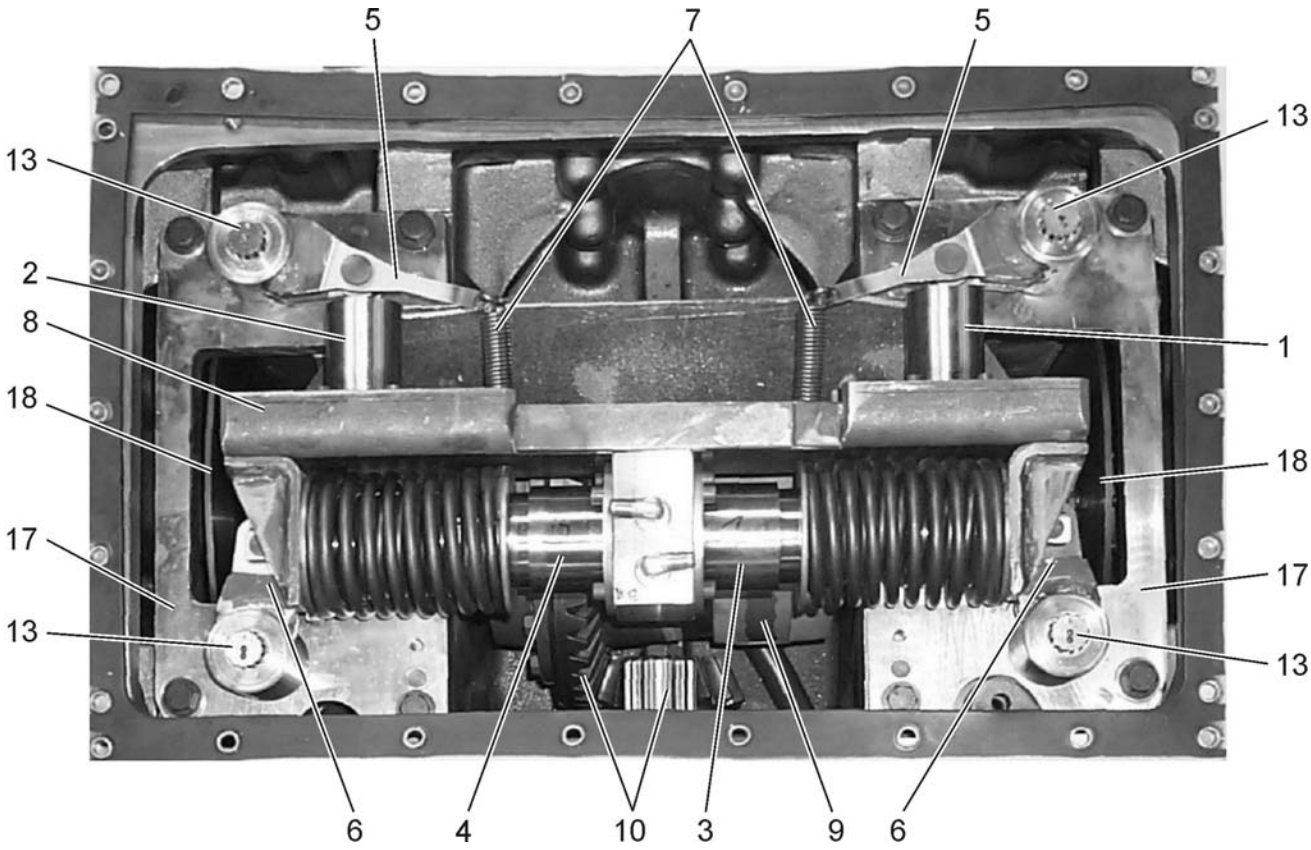


Fig. 7E.1 Steering Drive (Upper View)

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

1. Right Clutch Hydraulic Cylinder
2. Left Clutch Hydraulic Cylinder
3. Right Brake Hydraulic Cylinder
4. Left Brake Hydraulic Cylinder
5. Clutch Disc Steering Arm
6. Brake Disc Apply Arm
7. Steering Arm Return Spring
8. Cylinder Mounting Bracket Assy
9. Ring Gear Carrier
10. Ring and Pinion Gear Set
11. Sprocket Pinion Shaft
12. Clutch Disc Apply Shoe
13. Eccentric Shaft
14. Clutch Back Up Shoe
15. Brake Disc Apply Shoe
16. Brake Back Up Shoe
17. Base Plate Assy
18. Brake Disc
19. Clutch Disc
20. Sun Gear

GENERAL

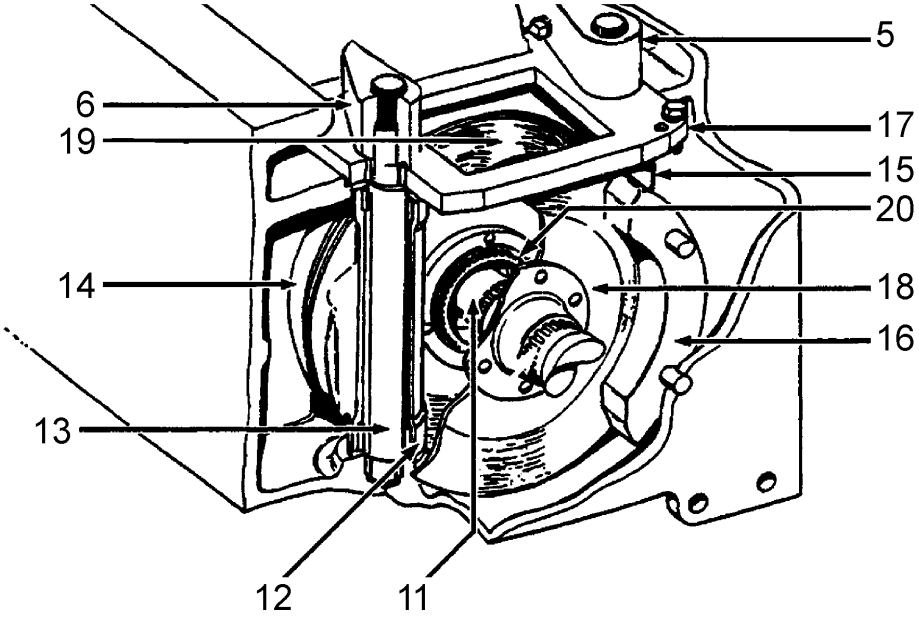


Fig. 7E.2. Steering Drive (Side View)

Steering Operation

Oil for the steering system is supplied by the transmission hydraulic system. With the drive train control valve in the centered position, oil enters the valve and is directed to the clutch hydraulic cylinders (1 and 2), through the brake valve, to apply pressure against the pistons. The pistons push against the clutch steering arms (5) which cause the eccentric shafts (13) to rotate, clamping the clutch discs (19) between the clutch shoes (12 and 14). When either the drive train control valve is moved left or right slightly, the valve spool begins metering pressurized oil to the clutch cylinder (1 or 2). This action releases the clutch disc (19), so neither the clutch or the brake disc is held. Further movement of the drive train steering valve causes the spool begins metering pressurized oil, through the brake valve, to the brake cylinder (3 or 4), rotating the eccentric shaft (13) and clamping the brake disc (18).

Brake Pedal Linkage

The drive train control valve and a brake pedal rod operate the brake valve (bolted to the rear cover). The brake pedal rod connects to the brake valve lever and controls the spool of the brake valve. This spool is held in the drive position by return springs. In this position oil pressure from the drive train control valve enter the brake valve through two separate circuits and is directed to the left brake hydraulic cylinder and to the right brake hydraulic cylinder. When the brake is applied, the spool moves forward and begins to dissipate the oil pressure to both brake cylinders simultaneously.

Steering Cylinders

A steering cylinder base plate (17) is bolted and doweled to a pad on each side of the rear frame. Each base plate has bearings to support the top of clutch and brake eccentric shafts (13). Each base plate also supports the cylinder mounting bracket (8) for the clutch and brake cylinders. The piston of the clutch cylinder (1 and 2) is connected to the clutch steering arm (5) at the rear of the rear frame. The piston of the brake cylinder (3 and 4) is connected to the brake apply arm (6) at the front of the rear frame.

GENERAL

Clutch And Brake Shoe Actuating Linkage

The clutch and brake eccentric shafts (13) are supported in bearings at the bottom of the frame and at the top in the steering cylinder base plates (17). The clutch and brake shoes (12 and 15) are supported on bearings located on the eccentric shafts. The shaft bearing surfaces supporting shoes are off center from the shaft bearing surfaces in the frame and the cylinder base plate which results in eccentricity between the shafts and shoes. The clutch and brake arms (5 and 6) are splined and indexed to the top of the eccentric shafts. The return spring (7) connected between the clutch steering arm (5) and mounting bracket (8) is used to assure full release of clutch disc. The brake shoes (15) contact their discs (18) at the front of the frame while the clutch shoes (12) contact their discs (19) at the rear of the frame. The clutch and brake back-up shoes (14 and 16) are mounted (loose fit) on dowels in the main frame. The clutch adjusting screw is threaded into the frame and secured with a lock plate. This screw can only be reached when the rear frame cover is removed or, without rear mounted equipment, through the power take off opening in the rear of the frame. The brake adjusting screw passes through the side of the rear frame and sprocket housing and can be reached externally. Each adjusting screw is used to position correctly its respective backup shoe in the frame.

4. SPECIFICATIONS

Bevel Pinion Gear Set Backlash	0.18 to 0.30 [mm]
Bevel Gear Carrier Preload (Rolling Torque)	13.50 [Nm]
Pinion Shaft End Clearance	Stamped on End of Pinion Shaft ± 0.025 [mm]
Bevel Gear to Carrier Mounting Bolts	75 ±10% [Nm]
Transmission Mounting Bolts	360 to 410 [Nm]
Loading Fixture Nut	34 [Nm]
Bearing Carrier Mounting Bolts	75 ±10% [Nm]
Base Plate Mounting Bolts	130 ±10% [Nm]
Steering Cylinder Bracket Mounting Bolts	100 [Nm]
Brake Adjusting Screw Jam Nut	170 [Nm]
Rear Main Frame Cover Bolts	55 ±10% [Nm]

STEERING DRIVE

5. REMOVAL

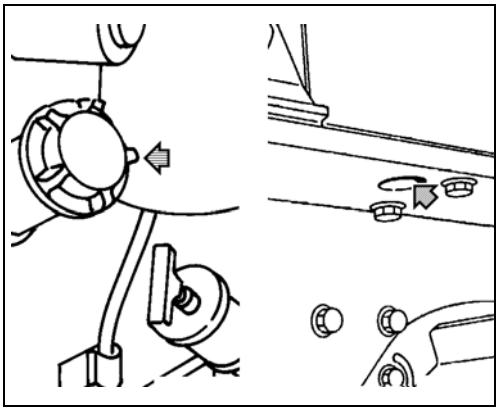
IMPORTANT**:** *It is suggested that the checks in Paragraph 9, SECTION 7, STEERING SYSTEM OIL PRESSURE CHECK (Torque Converter) or Paragraph 16, SECTION 7, STEERING SYSTEM OIL PRESSURE CHECK (Direct Drive) be made before removing the steering drive. In this manner, hydraulic malfunctions can be pinpointed and corrected at time of tear down.*

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 in NEUTRAL position, drive train lock lever is in ON 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.

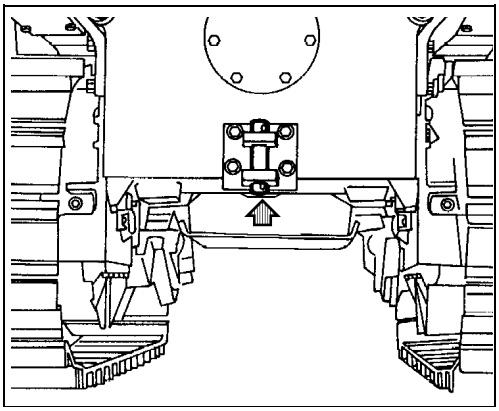
IMPORTANT**:** *Disconnected hydraulic lines must be properly capped with the correct size plastic cap. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Remove all dirt accumulation from the main frame cover. Tag disconnected lines to facilitate faster and correct installation*.

1. Turn the master switch to the OFF position and take out the key.

2. Drain the equipment hydraulic reservoir as described in the OPERATOR'S MANUAL.

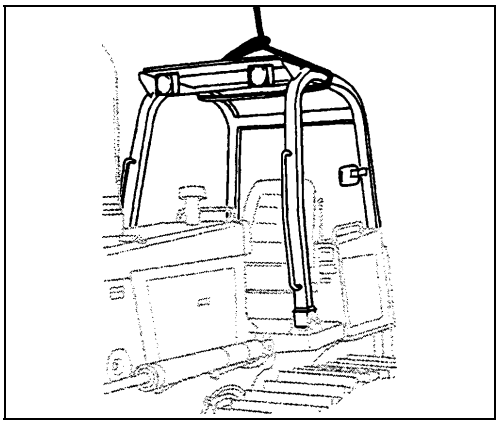


3. Drain the drive train system as described in the OPERATOR'S MANUAL.

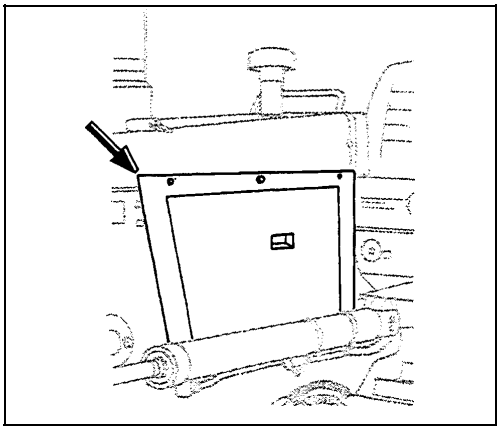


STEERING DRIVE

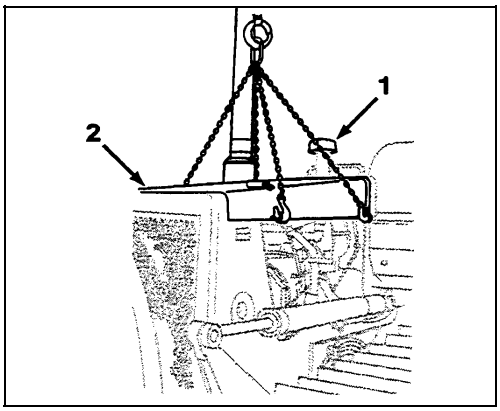
4. Remove the ROPS structure (or cab, if equipped). Refer to SUPERSTRUCTURE, SECTION 13 for this procedure.



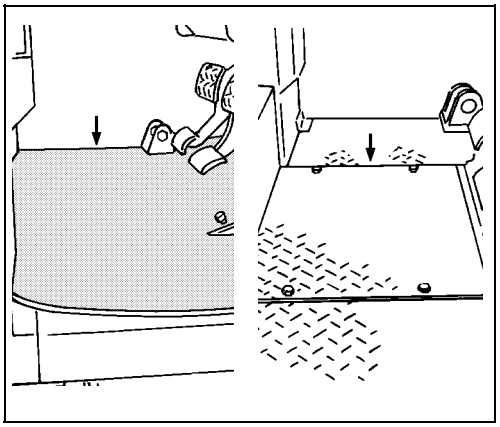
5. Remove engine left and right side doors.



6. Remove air pre-cleaner cap (1) from inlet tube. Remove hood (2) from machine. Refer to POWER, SECTION 12 for this procedure.

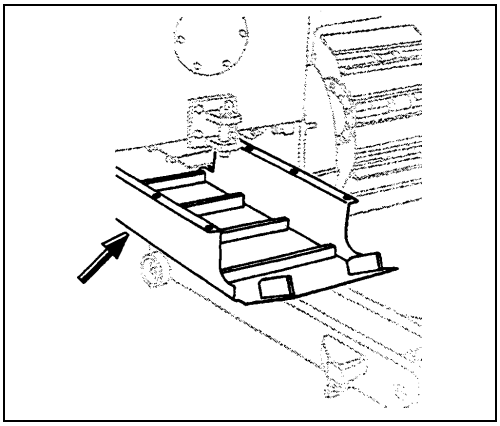


7. Remove operators compartment floor mat and floor plate.



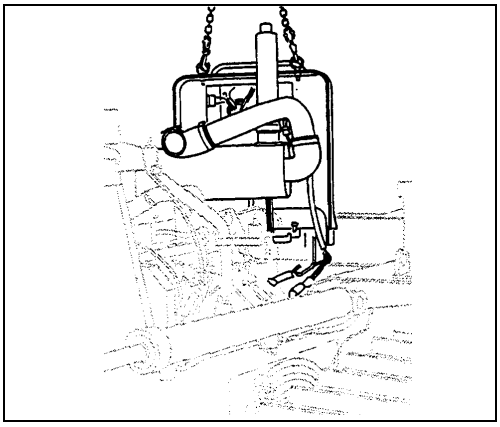
STEERING DRIVE

8. Using a rolling floor jack, remove transmission guard from under machine.

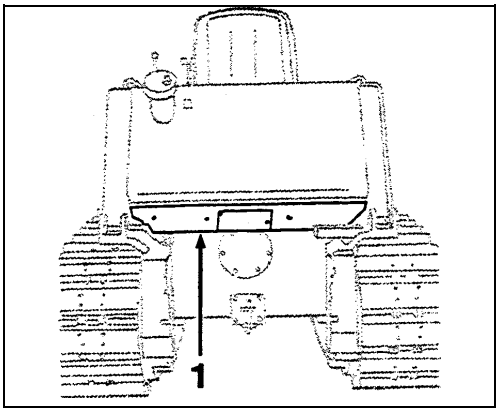


9. Remove dashboard from the machine. Refer to POWER, SECTION 12 for this procedure.

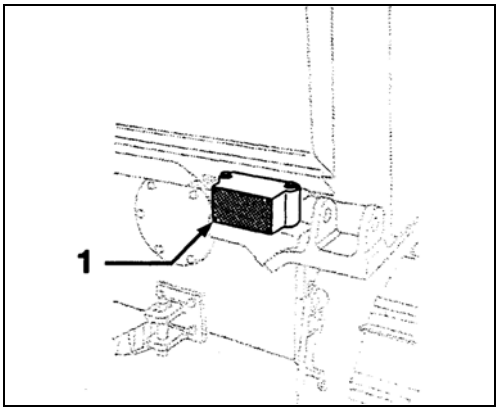
NOTE: *On some machines there will be shims between dashboard and main frame. Keep shims with sides they were removed from.*



10. Remove rear cover (1).

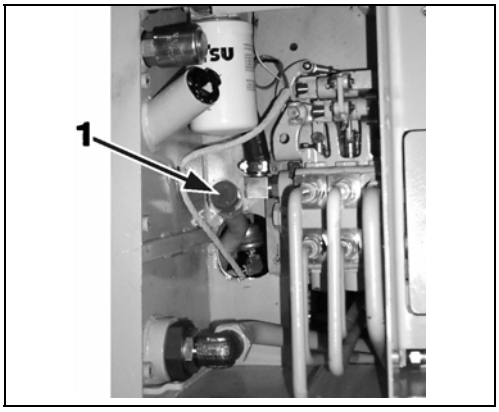


11. Disconnect wiring at back up alarm (1) and remove from machine.

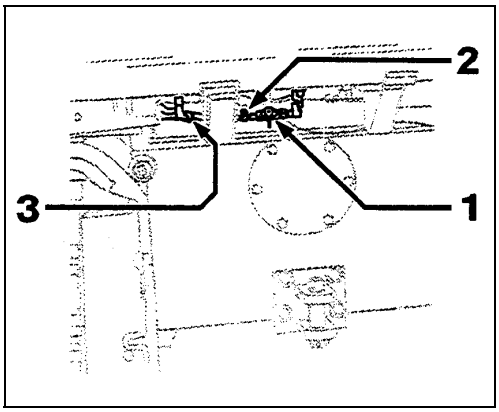


STEERING DRIVE

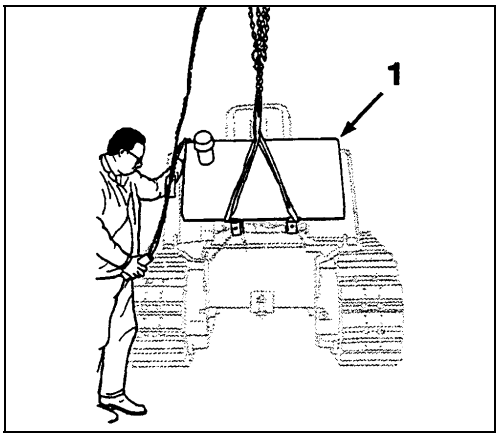
12. Remove drive train oil level gauge (1). Cap tube.



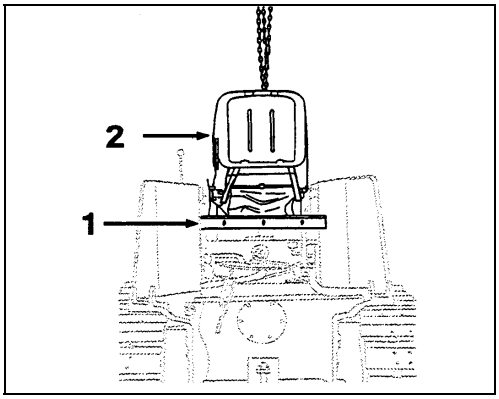
13. Close fuel shut off valve (1). Disconnect hose (2). Disconnect fuel return hose (3).



14. Remove hardware securing rear of seat platform to fuel tank (1). Disconnect wiring at fuel level sensor. Install lifting straps to fuel tank and connect hoist. Remove tank mounting hardware and spacers and remove from machine.

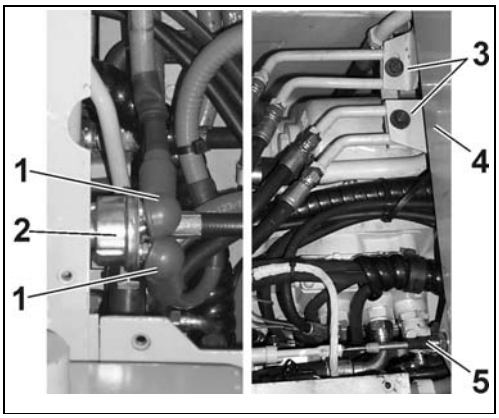


15. Remove remaining seat platform (1) mounting hardware. Attach straps with hoist to seat (2) and remove from machine.

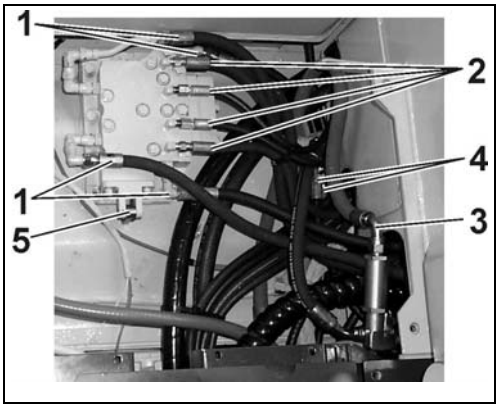


STEERING DRIVE

16. Disconnect cables (1) from master disconnect switch (2). Release tube brackets (3) from front support plate (4). At lower left side support plate disconnect throttle cable (5) from plate. Remove hardware and support plate from machine.

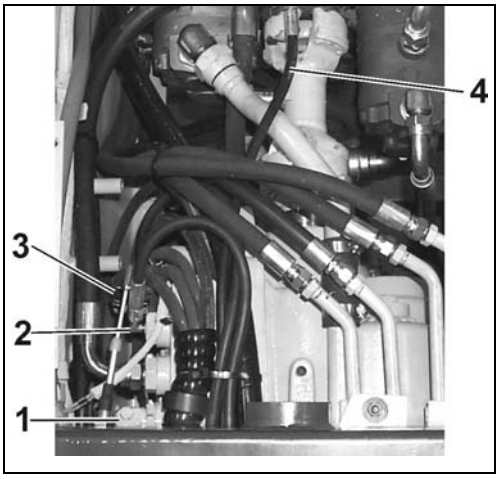


17. Disconnect four steering hoses (1) at brake valve fittings and position in battery box. Disconnect four check hoses (2) at brake valve fittings and position in battery box. Disconnect neutral lock valve supply hose (3). Disconnect drive train drain hoses (4) from elbow on rear main frame cover and position in battery box. Disconnect brake rod with clevis from brake valve (5) and remove it.

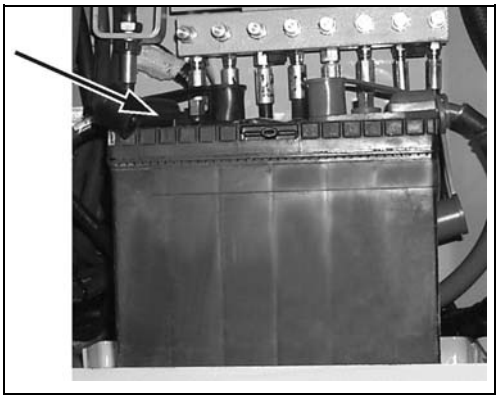


18. Disconnect M pressure check hose (1) and L pressure check hose (2) at pressure regulator valve fittings and position in battery box. Disconnect Pc pressure check hose (3) at range selector valve fitting and position in battery box. Disconnect C pressure check hose (4) at torque converter fitting and position in battery box.

NOTE: *The C pressure check hose does not exist in Direct Drive versions of TD-8M, TD-9M and TD-10M machines.*

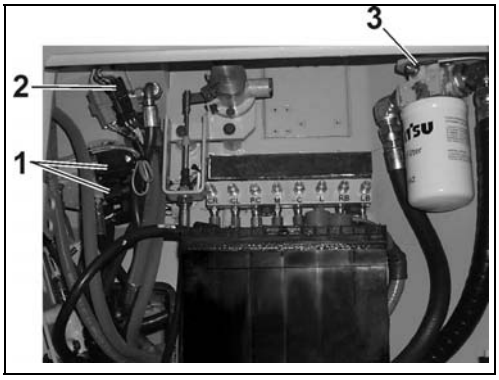


19. From inside battery box, disconnect and remove negative battery cable and position outside of box.

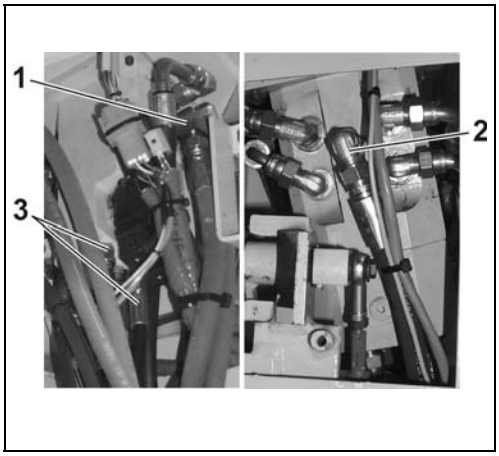


STEERING DRIVE

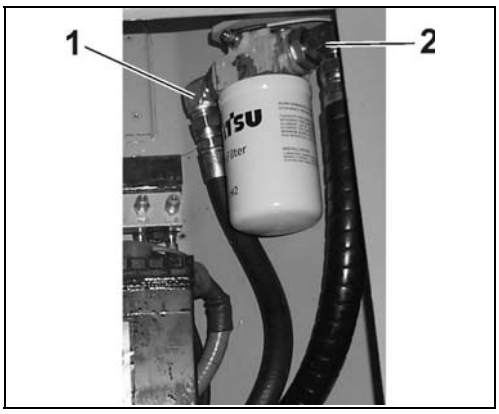
20. From inside battery box, disconnect wiring at solenoid valves (1) of drive train control valve, drive train electronic controller (2), drive train oil pressure filter switch (3), startup lock switch, backup alarm pressure switch and main oil pressure switch.



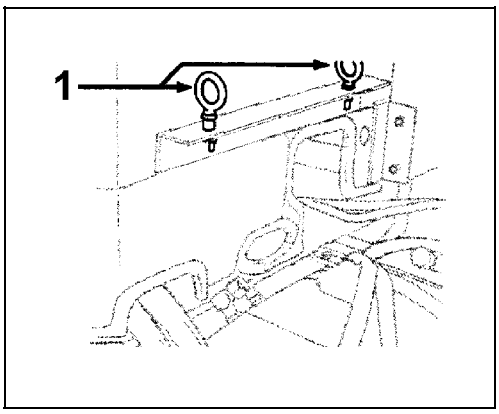
21. Disconnect one steering (F) hose (1) at rear side of drive train control valve, one steering (R) hose (2) at front side and two gear steering (1st, 2nd) hoses (3) at bottom of drive train control valve. Position hoses outside of battery box.



22. Disconnect filter inlet hose (1) and filter outlet hose (2) from filter elbows and position hoses outside battery box.

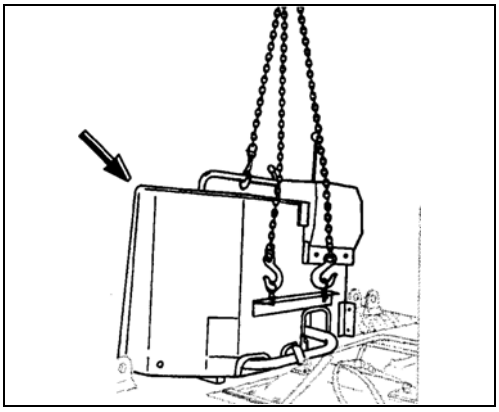


23. Install two 5/8NC eye bolts (1) to seat platform bracket.

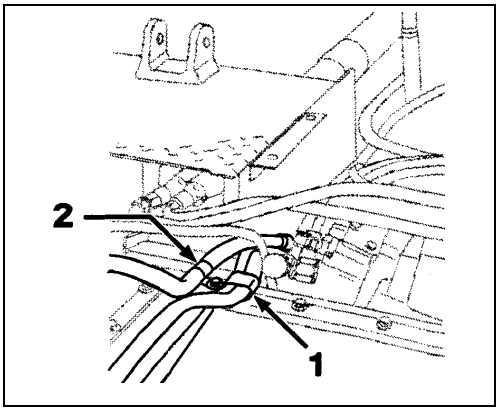


STEERING DRIVE

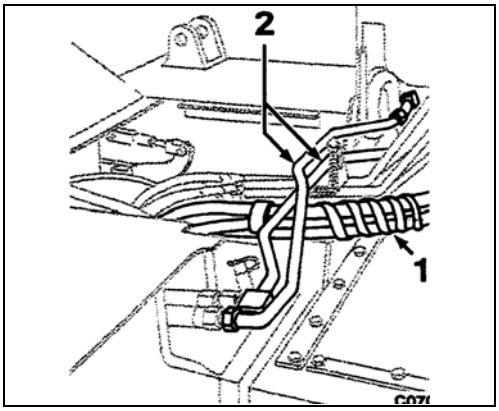
24. Curl all hoses into battery box. Attach chain and hoist to eye bolts and assist rail. Remove mounting hardware and remove from machine. Keep shims in positions they were removed.



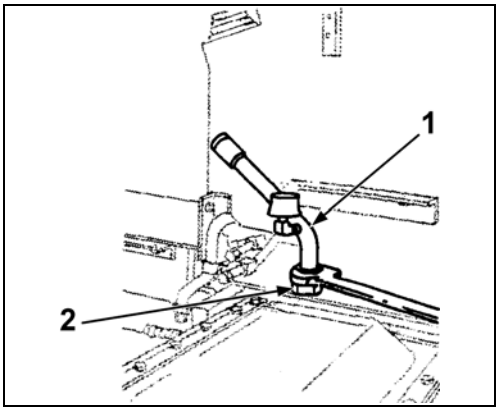
25. Unclip fuel lines (1) and battery cables (2) and position out of the way.



26. Move transmission hoses (1) out from under cross over tubes (2) and position out of way.

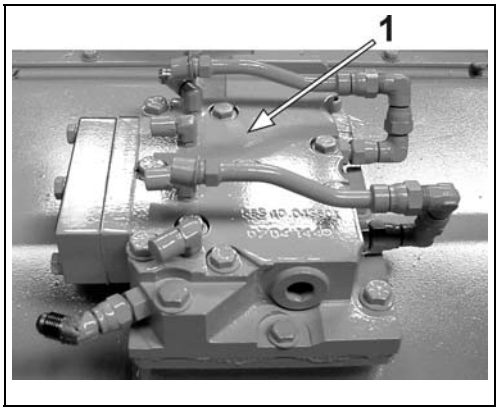


27. Remove upper filler tube (1) and lower filler tube (2). Plug port.

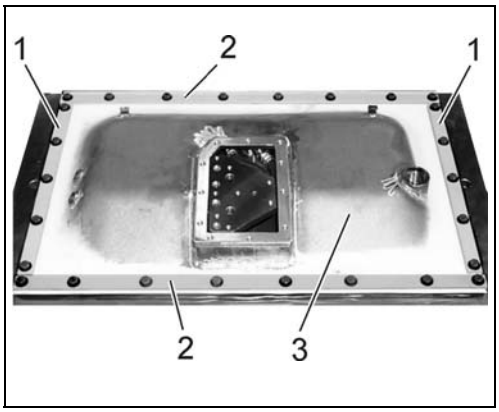


STEERING DRIVE

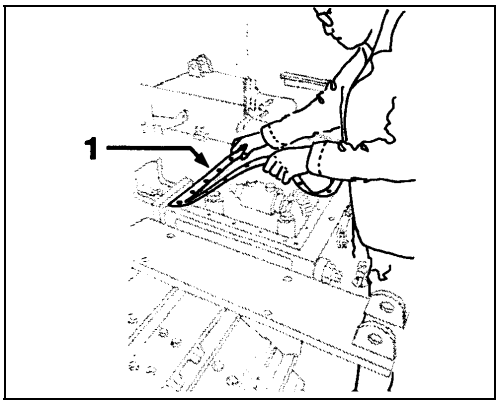
28. Remove brake valve (1) with bottom gasket; refer to REMOVAL in Section 4 BRAKES.



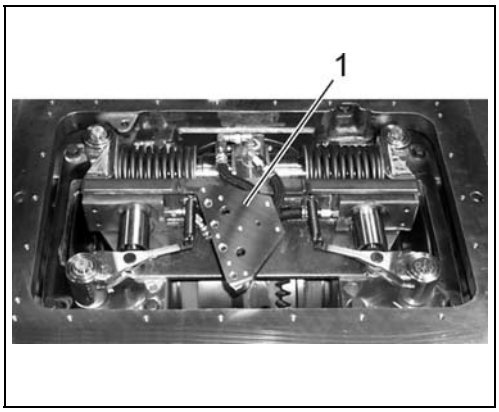
29. Remove hardware and side (1) and front and back (2) stiffeners. Remove rear frame cover (3).



30. Remove and discard rear frame cover gasket (1). Replace gasket with new.



31. Disconnect the manifold hoses, connectors, and elbows from clutch and brake cylinders assy and remove the lower manifold (1) with hoses (refer to Fig. 7E.3).



STEERING DRIVE

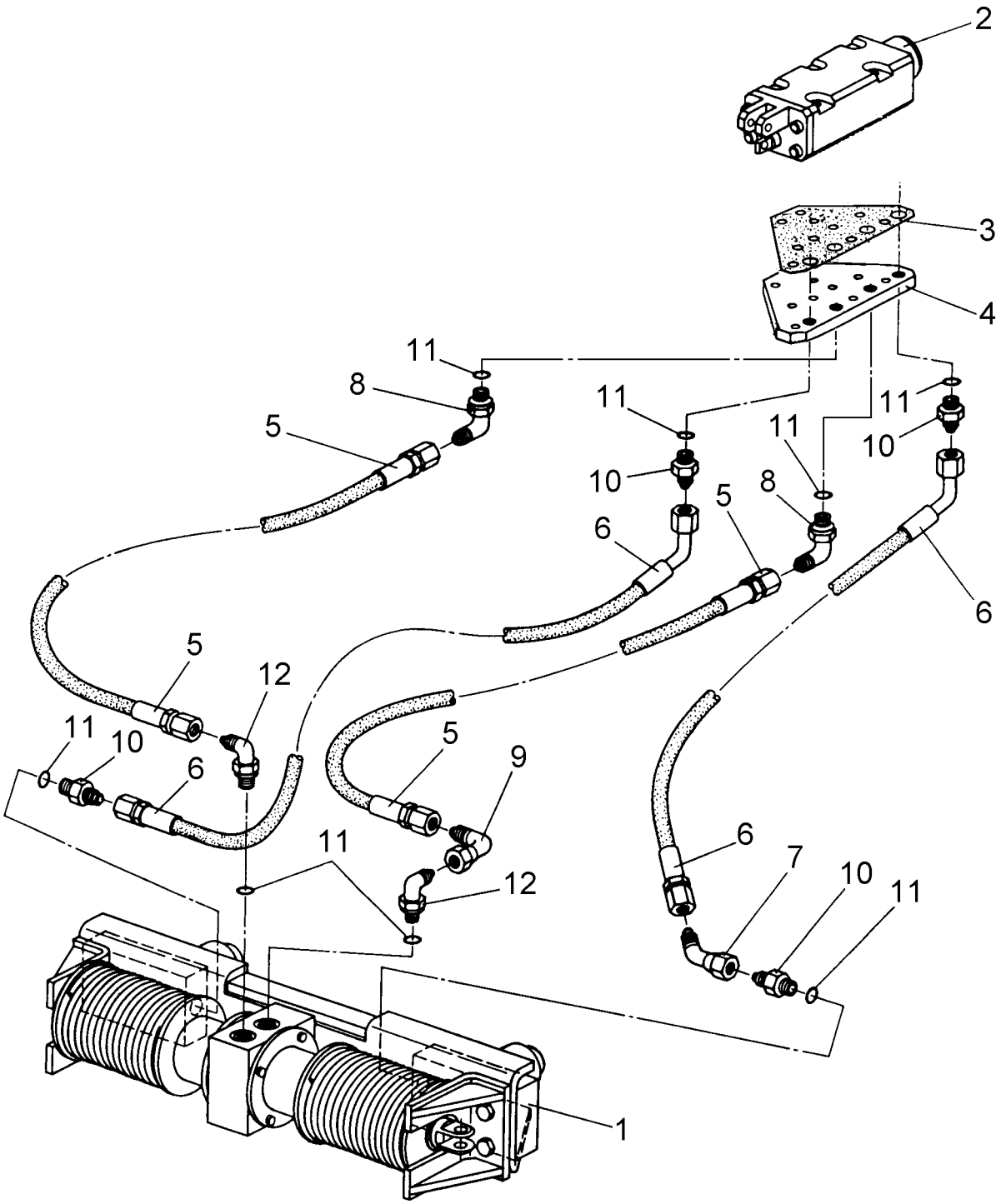


Fig. 7E.3. Clutch and Brake Cylinders with Hoses

1. Clutch and Brake Cylinders Assy
2. Brake Valve
3. Gasket
4. Lower Manifold
5. Brake Cylinder Control Hose
6. Brake Cylinder Control Hose
7. Elbow
8. Elbow
9. Elbow
10. Connector
11. O-Ring
12. Elbow

STEERING DRIVE

6. DISASSEMBLY

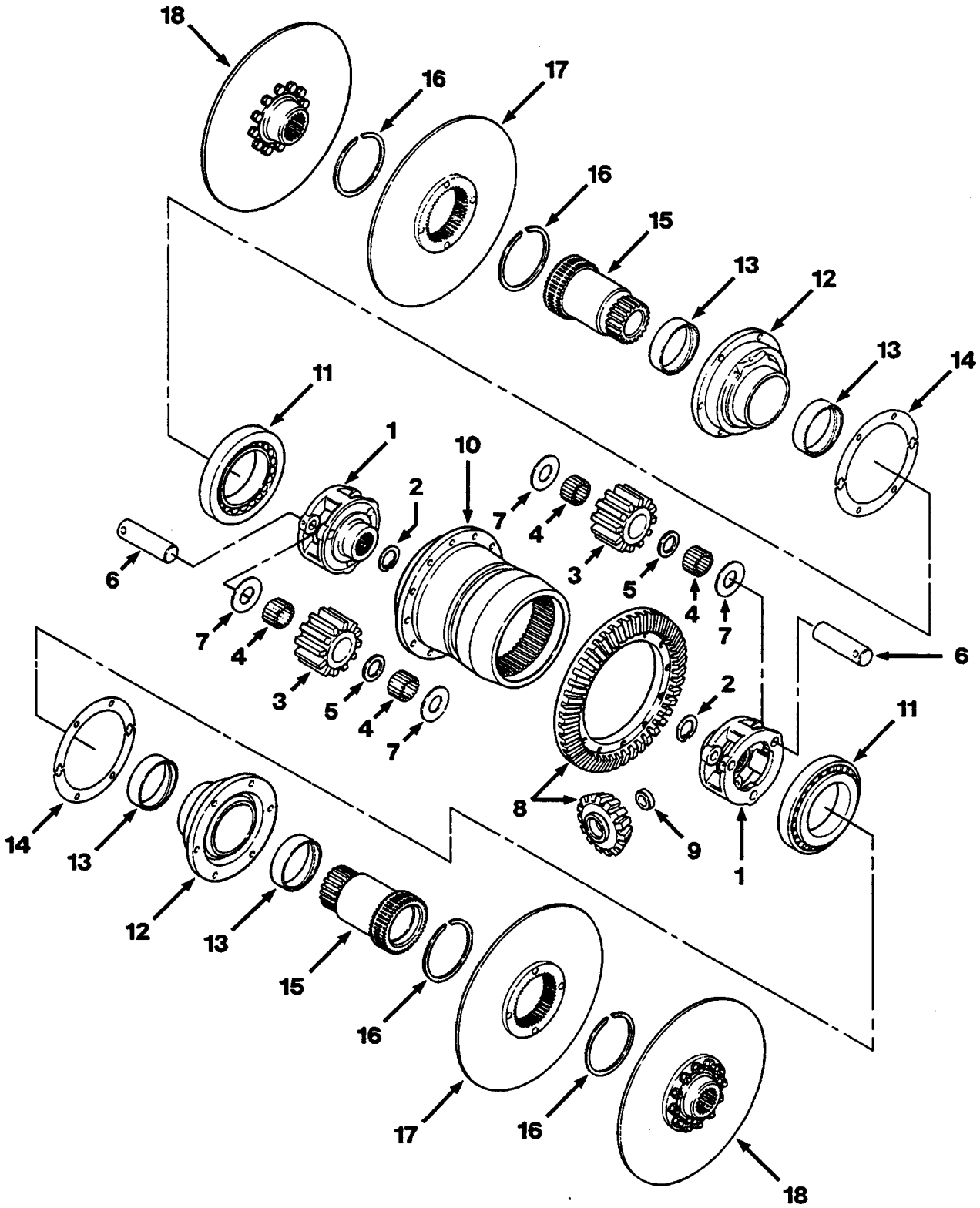


Fig. 7E.4. Exploded View of Steering Drive

STEERING DRIVE

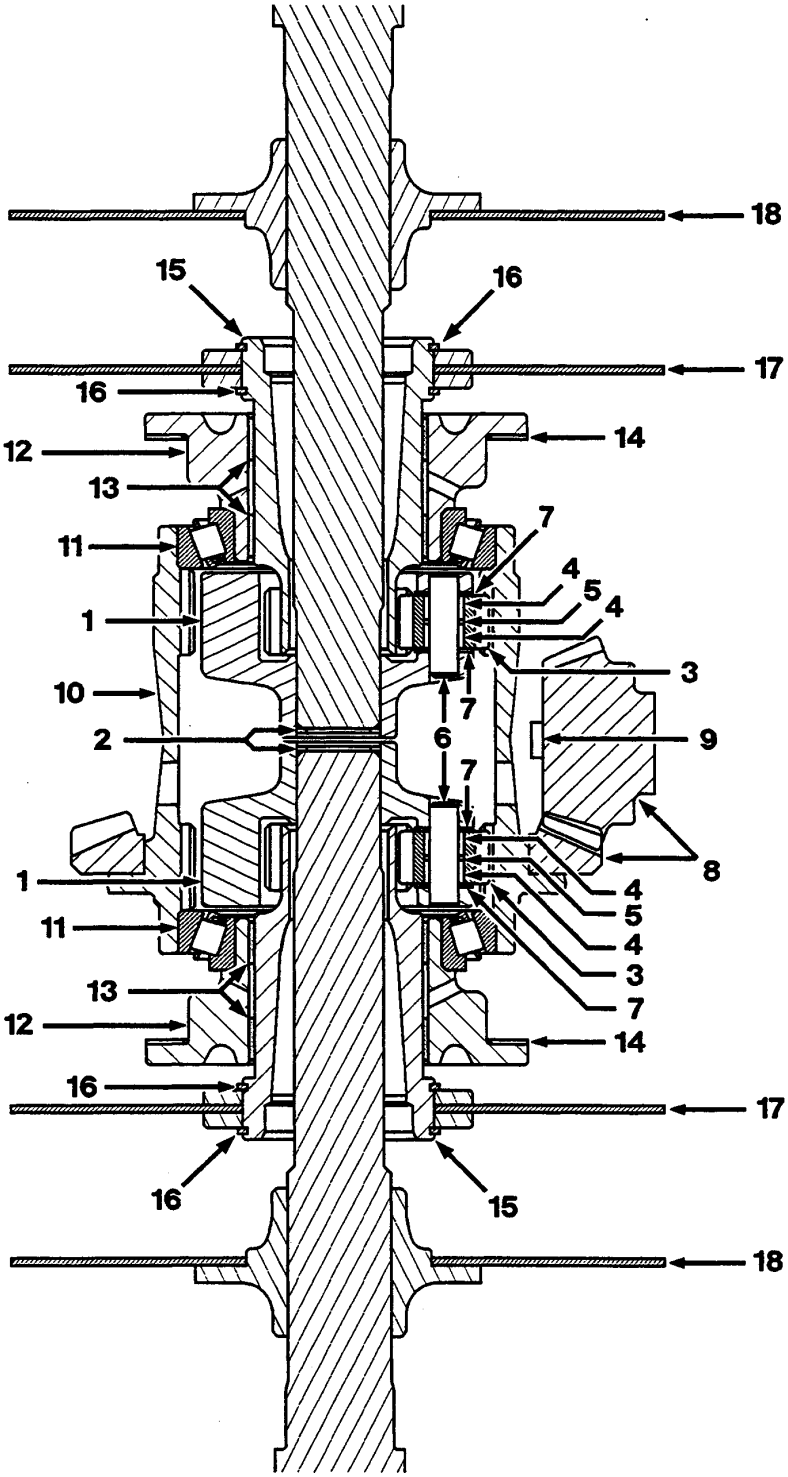


Fig. 7E.5. Cross Section View of Steering Drive

Legend for Fig.'s 7E.4 and 7E.5

1. Planet Gear Carrier
2. Retaining Ring
3. Planet Gear
4. Needle Bearing Kit
5. Needle Bearing Spacer
6. Planet Gear Shaft
7. Thrust Washer
8. Ring and Pinion Gear Set
9. Retainer Plate
10. Ring Gear Carrier
11. Tapered Roller Bearing
12. Bearing Carrier
13. Carrier Bushing
14. Carrier Shim
15. Sun Gear
16. Retaining Ring
17. Clutch Disc Assembly
18. Brake Disc Assembly

STEERING DRIVE

STEERING DRIVE

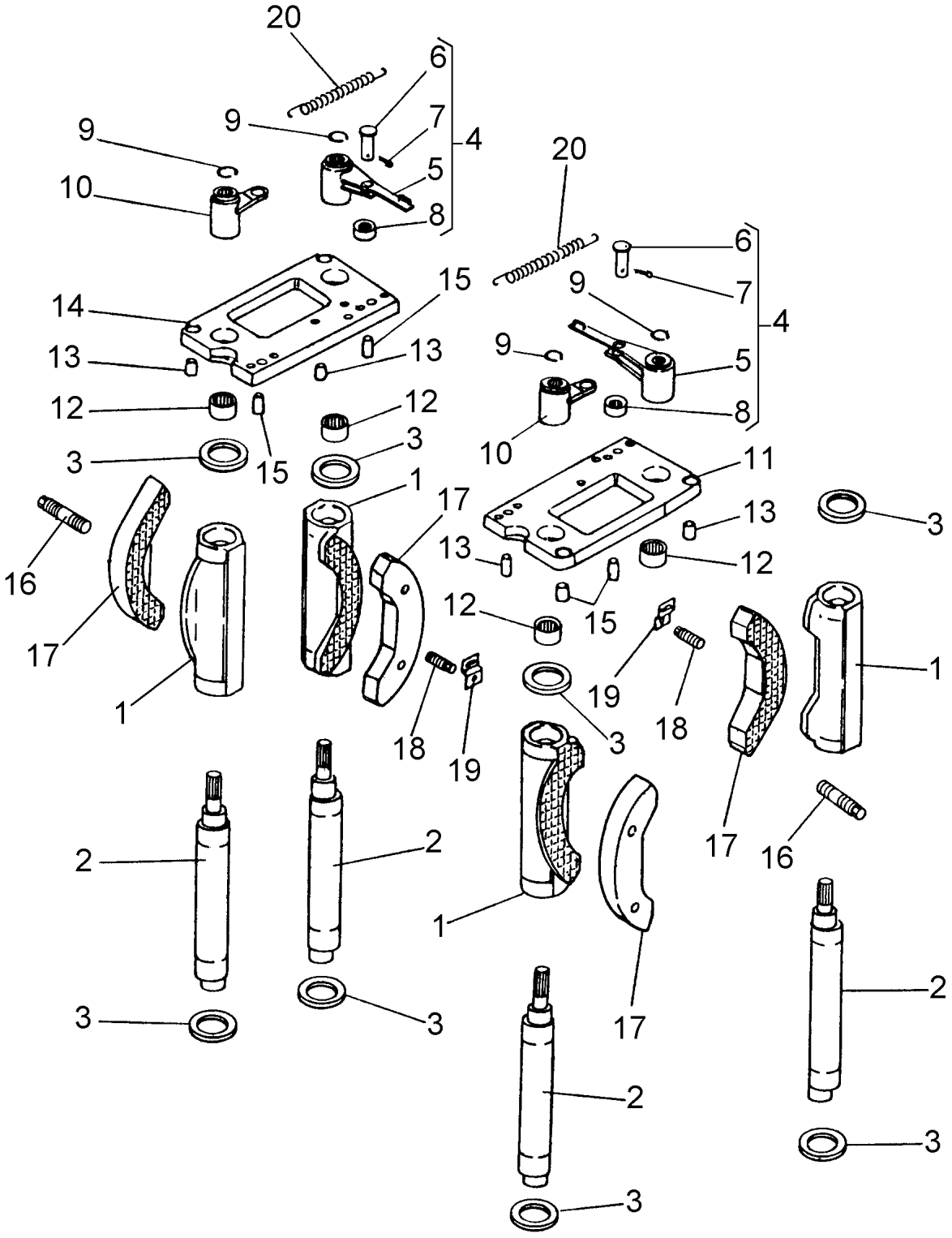


Fig. 7E.6. Exploded View of Steering Drive Shoes and Levers

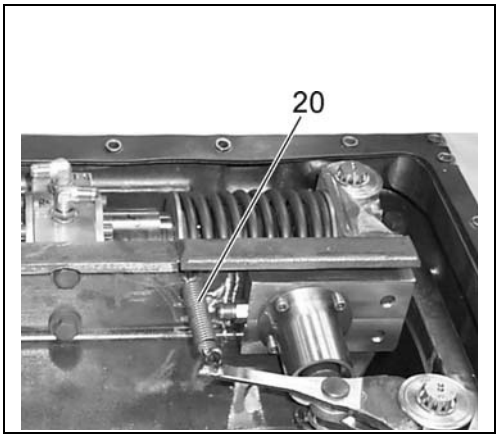
1. Apply Shoe Assy
2. Eccentric Shaft
3. Thrust Washer
4. Steering Arm Assy
5. Steering Arm
6. Pivot Pin
7. Cotter Pin
8. Needle Bearing
9. Retaining Ring
10. Brake Arm
11. L.H. Mounting Plate
12. Needle Bearing
13. Plate Spacer Sleeve
14. R.H. Mounting Plate
15. Dowel Pin
16. Brake Shoe Adjustment Screw
17. Back Up Shoe Assy
18. Drive Shoe Adjustment Screw
19. Locking Plate
20. Arm Return Spring

STEERING DRIVE

Clutch and Brake Cylinders Assembly

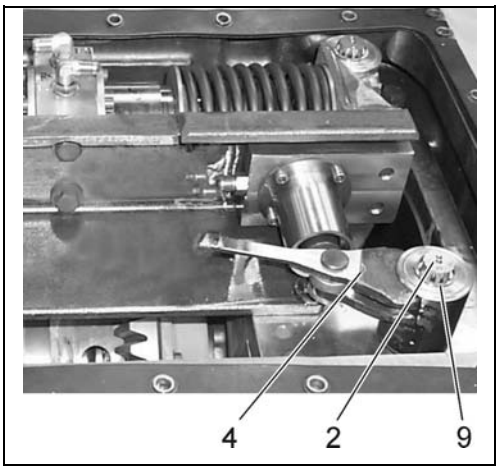
NOTE: *Callouts from exploded view (Fig. 7E.6) correspond with callouts in following steps, unless other callouts were used.*

1. Using needle nose pliers, get a good grip on arm return spring (20) hook and remove. Repeat for remaining spring.



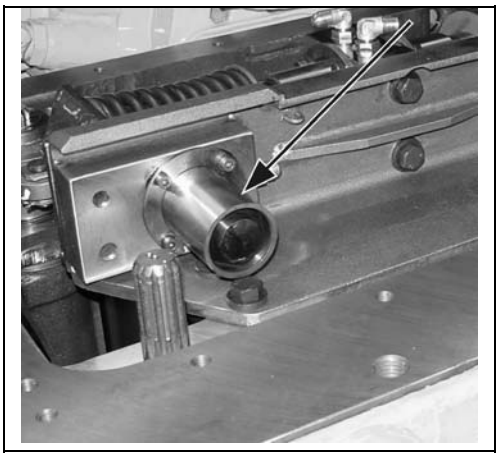
WARNING! Loaded assembly. Use extreme care when removing.

2. Remove retaining ring (9) from eccentric shaft (2). Remove steering arm assy (4). Repeat for remaining side.



3. Remove clutch cylinder disc with mounting hardware. Remove clutch cylinder sleeve with piston and O-ring. Repeat for remaining side.

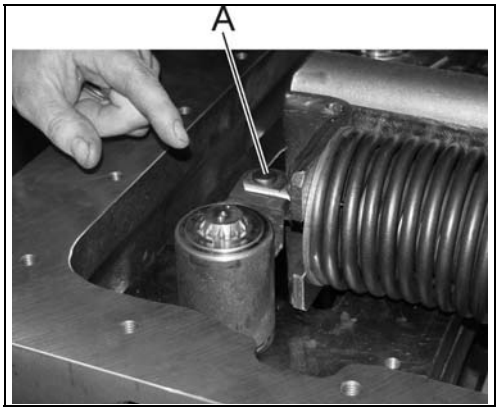
   For details refer to Brake and Clutch Cylinder Assembly in Section 4, BRAKES.



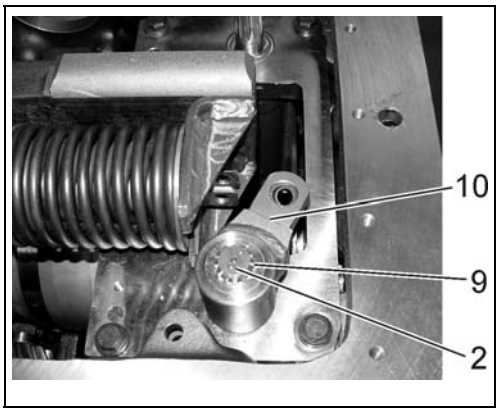
STEERING DRIVE

4. Remove cotter pin with washer from brake arm pivot pin (A). Remove pivot pin. Repeat for remaining side.

   For details refer to Brake and Clutch Cylinder Assembly in Section 4, BRAKES.

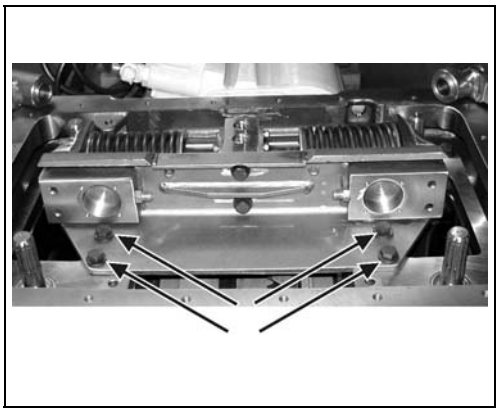


5. Using lock ring pliers, remove retaining ring (9) from eccentric shaft (2). Remove brake arm (10). Repeat for remaining side.

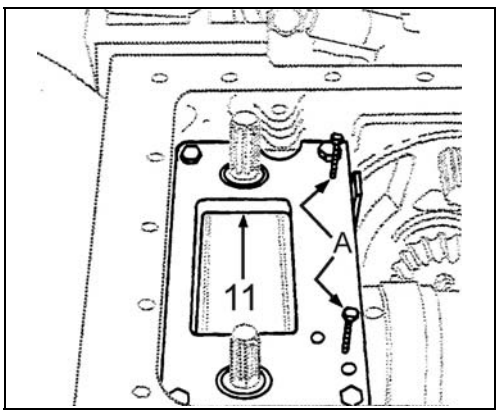


6. Remove clutch and brake cylinders mounting bracket.

   For details refer to Brake and Clutch Cylinder Assembly in Section 4, BRAKES.

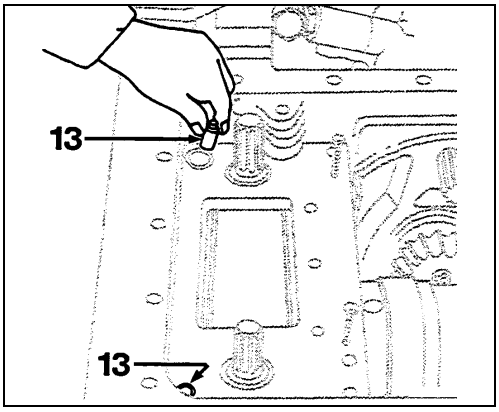


7. Remove L.H. mounting plate (11) hardware. Install two 3/8 NC jacking bolts (A) to plate.

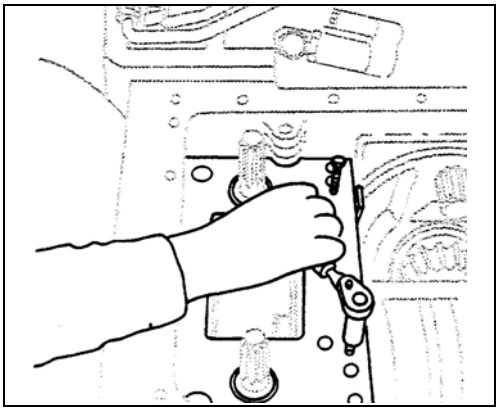


STEERING DRIVE

8. Remove bolt spacer sleeves (13) from outer mounting holes.

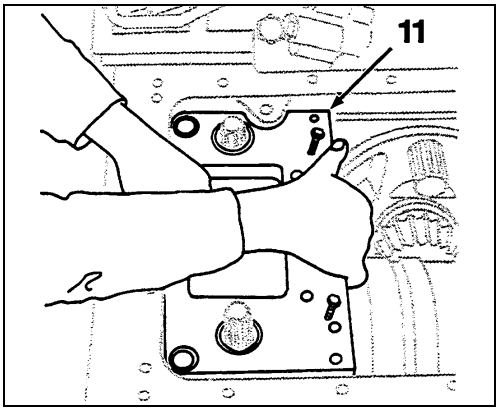


9. Using jacking bolts equally break loose mounting plate.

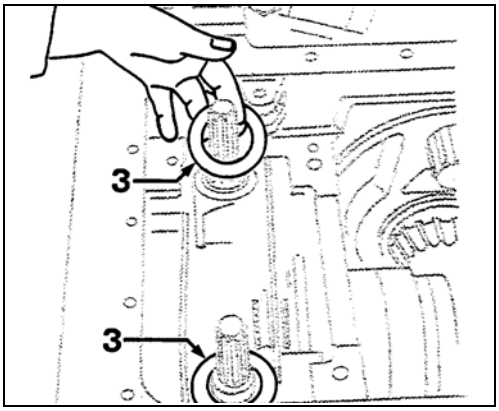


10. Remove L.H. mounting plate (11). Repeat steps for remaining (right) side.

    Refer to MOUNTING PLATE in Section 4, BRAKES for service.

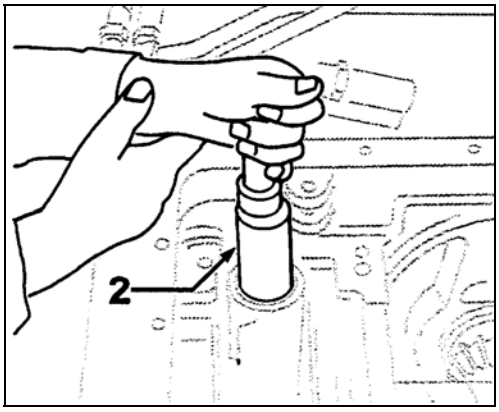


11. Remove thrust washers (3).



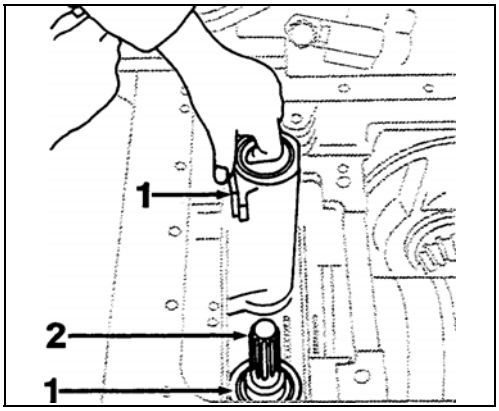
STEERING DRIVE

12. Remove left front eccentric shaft (2).

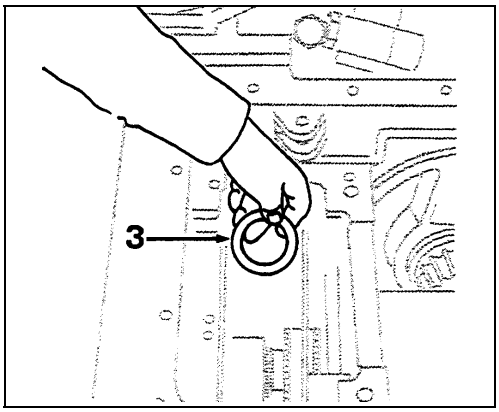


13. Remove left front apply shoe (1). Remove left rear eccentric shaft (2) and apply shoe (1).

    Refer to CLUTCH/BRAKE SHOES in Section 4, BRAKES for service.

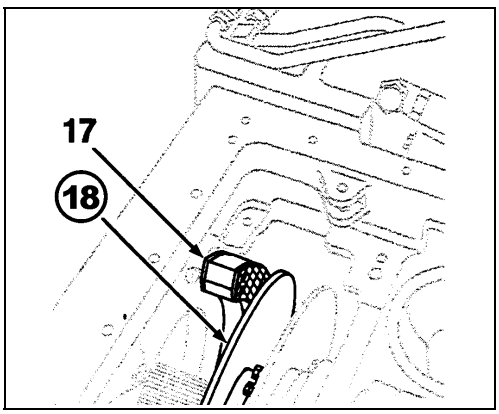


14. Remove thrust washers (3) from bottom front and rear of frame.



15. Slide brake disk (⑱, Fig.'s 7E.4 or 7E.5) inboard and remove left front back up shoe (17). Repeat steps 11 to 15 for remaining (right) side.

    Refer to CLUTCH/BRAKE SHOES in Section 4, BRAKES for service.

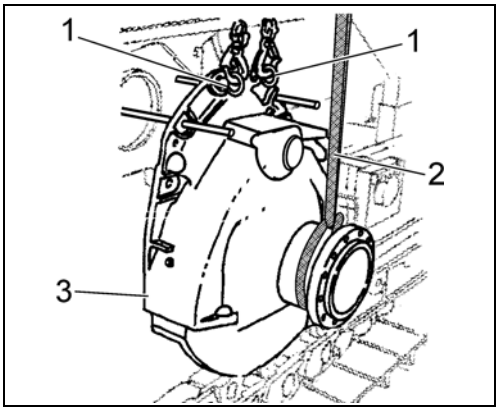


STEERING DRIVE

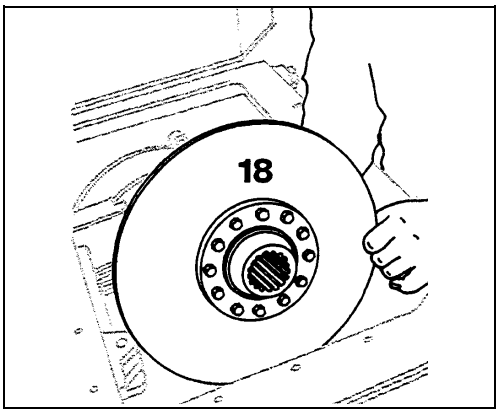
Steering Drive Complete Assembly

NOTE: *Callouts from exploded and cross section views (Fig.'s 7E.4 and 7E.5) correspond with callouts in following steps, unless other callouts were used.*

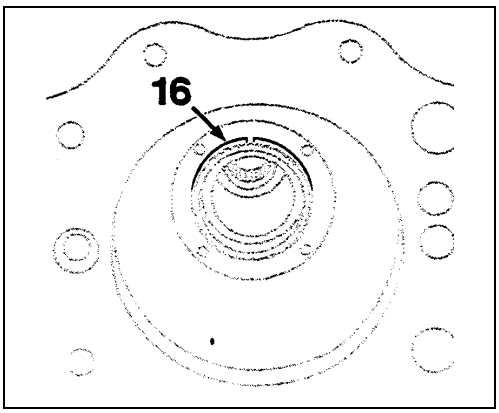
16. Remove final drives from each side, refer to SECTION 7F, FINAL DRIVE.



17. Remove brake disc (18) from both sides.

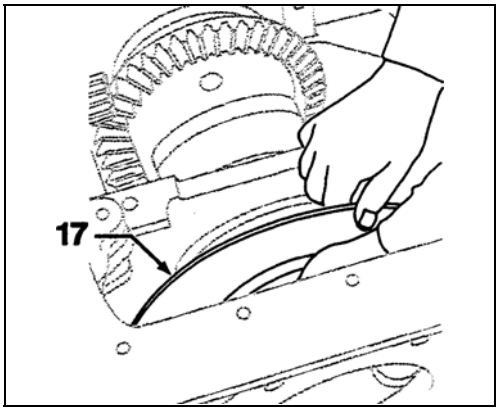


18. Remove outer retaining ring (16) from sun gear at both side.

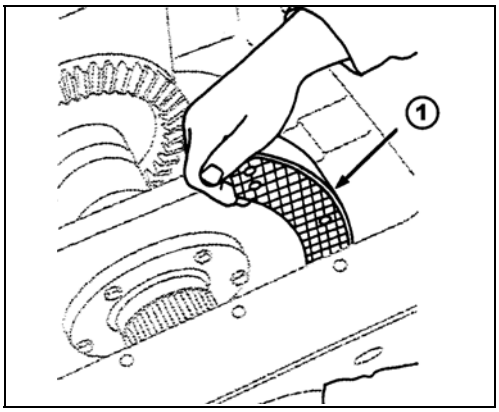


STEERING DRIVE

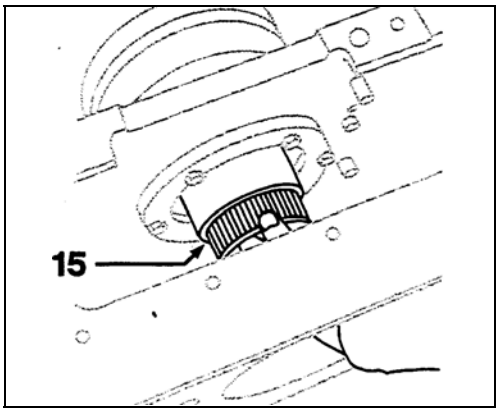
19. Remove clutch disc (17) from each side.



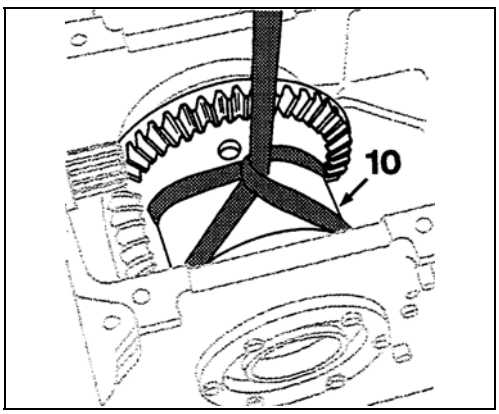
20. Remove rear apply shoe (①, Fig. 7E.6) from each side.



21. Remove sun gear (15) from each side.

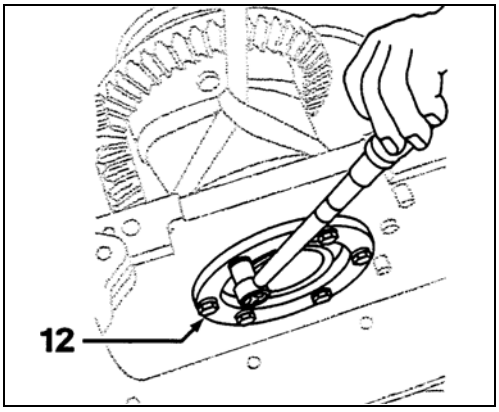


22. Attach hoist and sling to ring gear carrier (10).

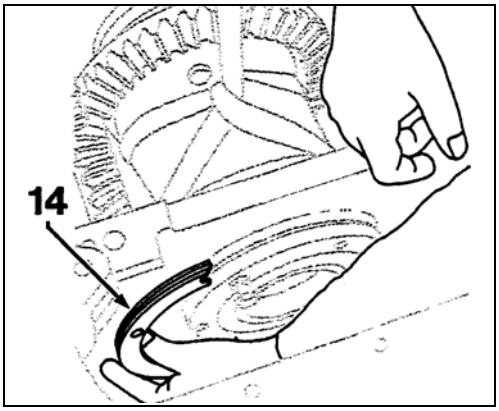


STEERING DRIVE

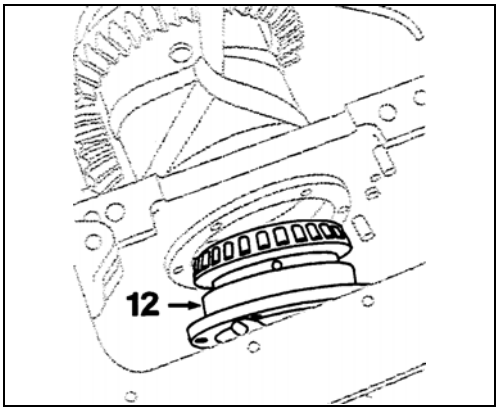
23. Loosen bearing carrier (12) hardware at each side.



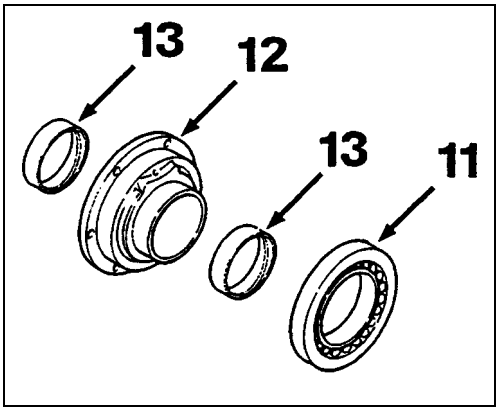
24. Remove shim halves (14) from each side.



25. Remove hardware and bearing carriers (12) from each side allowing sling and hoist to support ring gear carrier.



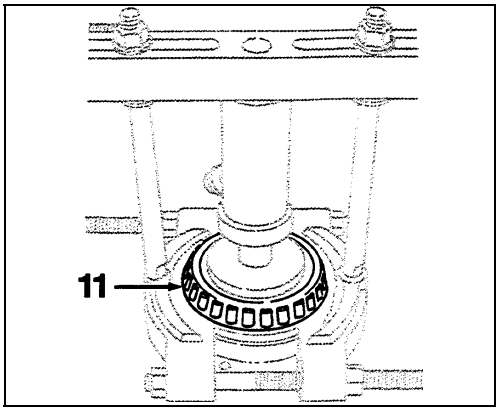
26. Disassemble bearing carriers as follows.



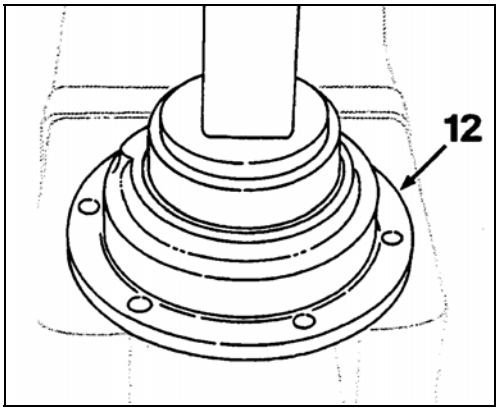
11. Tapered Roller Bearing
12. Bearing Carrier
13. Carrier Bushing

STEERING DRIVE

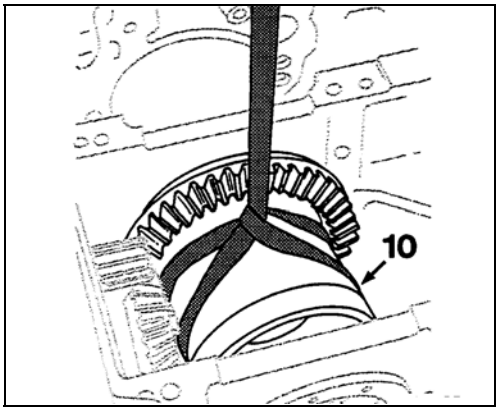
26A. Install puller arrangement to bearing cone (11). Apply ram to puller arrangement and unseat bearing cone.



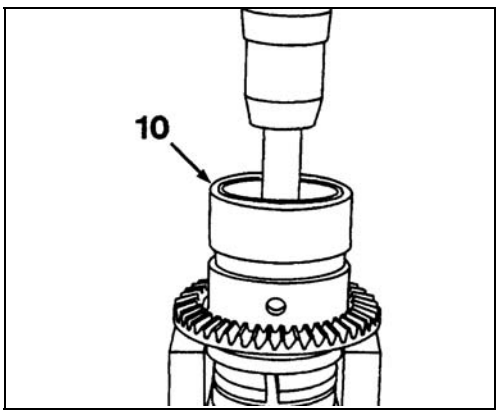
26B. Position bearing carrier (12) in press with opening under carrier large enough so pressed out bushings (13) will clear when removed. Apply press and remove both bushing at same time.



27. Remove ring gear carrier (10) from rear main frame.

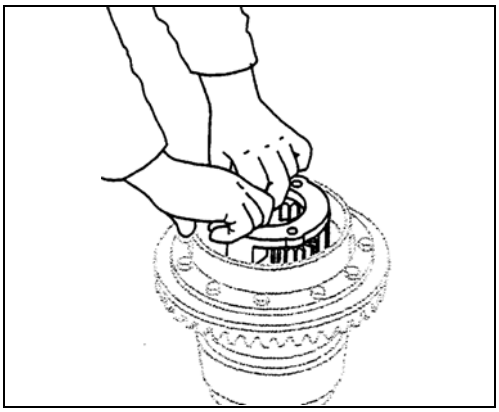


28. Position gear carrier (10) in press. Using properly sized plates, press down on planet gear carrier to unseat bearing cup.

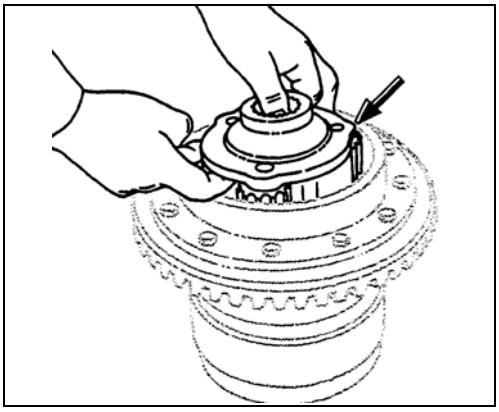


STEERING DRIVE

29. Remove assembly from press. Remove planet gear carrier (1 through 7).

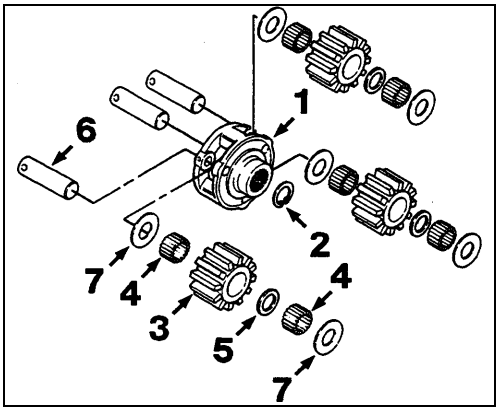


30. Remove remaining planet gear carrier (1 through 7).

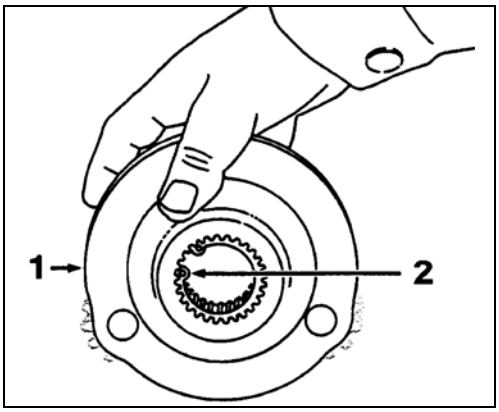


31. Disassembly planet gear carrier as follows:

1. Planet Gear Carrier
2. Retaining Ring
3. Planet Gear
4. Needle Bearing Kit
5. Needle Bearing Spacer
6. Planet Gear Shaft
7. Thrust Washer

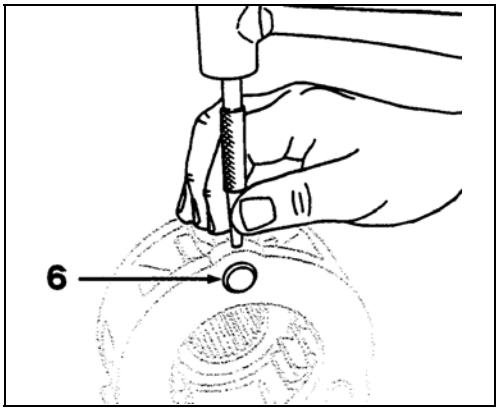


31A. Remove retaining ring (2) from inside planet gear carrier (1).

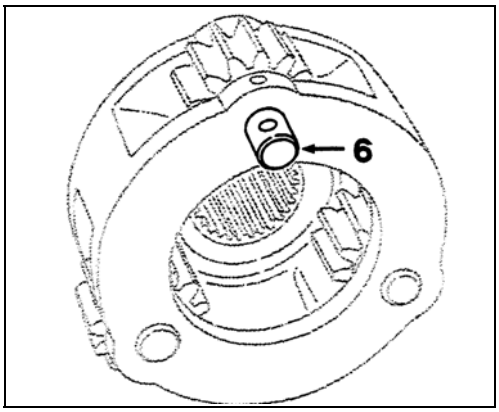


STEERING DRIVE

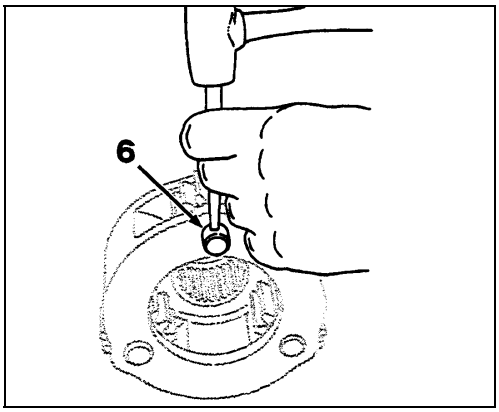
31B. Drive roll pin into shaft (6).



31C. Push planet gear shaft (6) out of carrier.

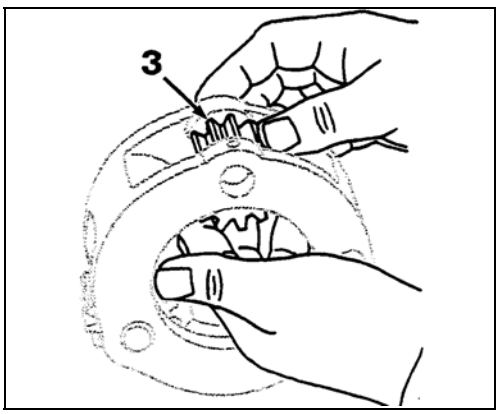


31D. Drive roll pin from planet gear shaft (6).



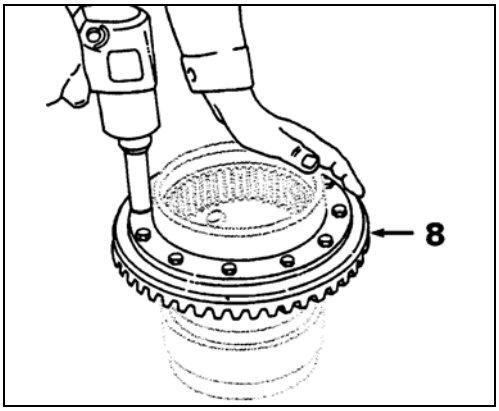
31E. While supporting gear (3) assembly from inside of planet gear carrier, remove shaft and gear. Disassemble gear and keep shaft, gear, bearing needles, bearing spacer and thrust washers together.

Repeat procedure for remaining five planet gears.

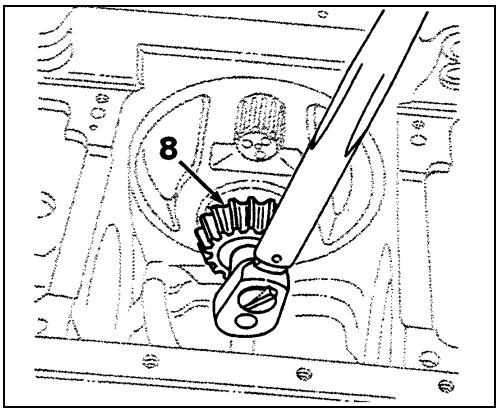


STEERING DRIVE

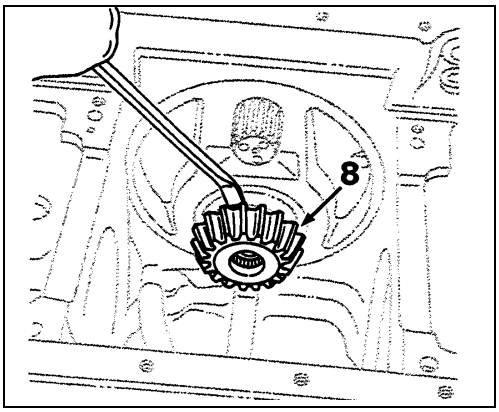
32. Remove ring gear (8) from carrier.



33. Remove pinion gear (8) mounting hardware.



34. Remove pinion gear (8) from transmission output (range) shaft.



STEERING DRIVE

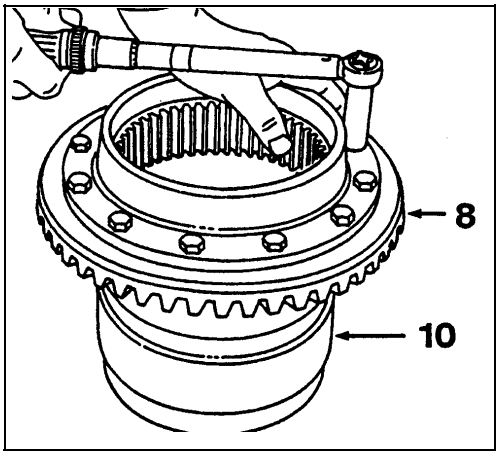
7. REASSEMBLY

Steering Drive Complete Assembly

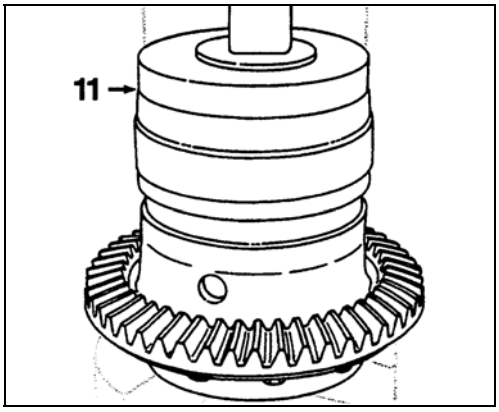
NOTE: *Callouts from exploded and cross section views (Fig.'s 7E.4 and 7E.5) correspond with callouts in following steps.*

NOTE: *Thoroughly coat all moving surfaces with clean oil. Refer to OPERATOR'S MANUAL for proper type and grade.*

1. Clean all of the tapped holes in the gear. Use Gasket Remover (1232275 H1) to remove any residual cured LOCTITE that may be present.
2. Secure bevel gear (8) to gear carrier (10) with two bolts and washers. Apply Activator N to the remaining bolt threads and the ten open hole threads.
3. Lubricate remaining bolts with LOCTITE #242 and install. Remove two securing bolts and washer, and as before, apply Activator N and LOCTITE #242 and reinstall. Torque bolts to 75 ± 10% [Nm].

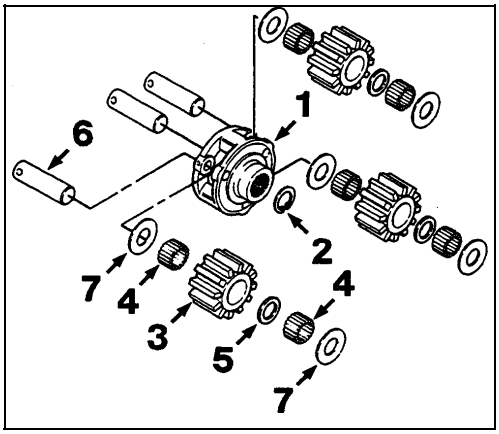


4. Position carrier assembly in press with bevel gear end down. Place bearing cup (11) in carrier. Using suitable pusher plate, apply press and install cup flush with edge of carrier.



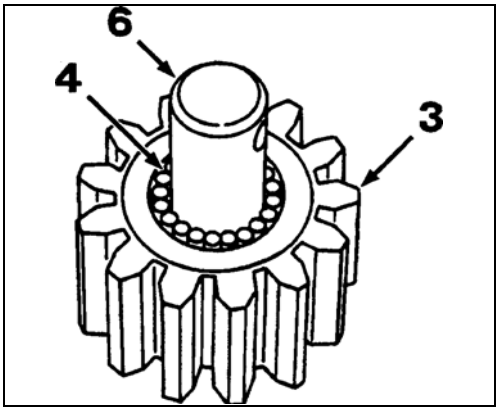
5. Assemble planet gear carrier assemblies as follows.

    1. Planet Gear Carrier
    2. Retaining Ring
    3. Planet Gear
    4. Needle Bearing Kit
    5. Needle Bearing Spacer
    6. Planet Gear Shaft
    7. Thrust Washer

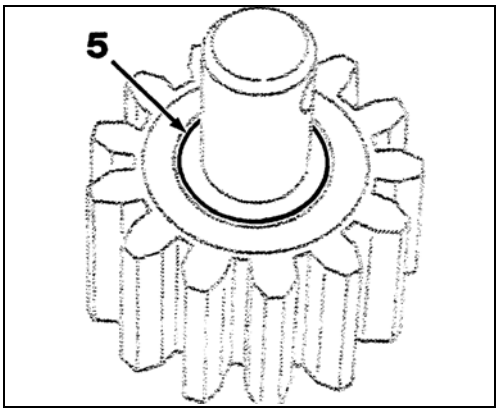


STEERING DRIVE

5A. Liberally coat planet gear (3) bore with amber grease. Position shaft (6) in gear. Install bottom row of bearing needles (4) around shaft (qty. 20).

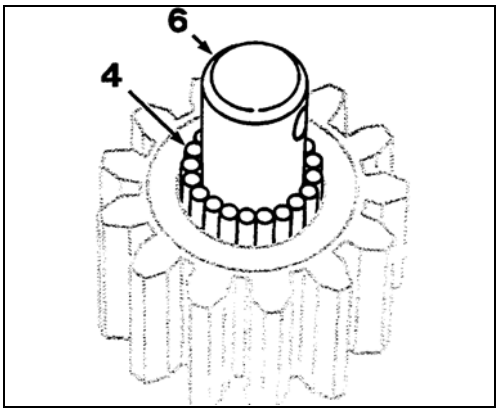


5B. Install bearing needle spacer (5) and press bottom row of needle bearings down into gear.

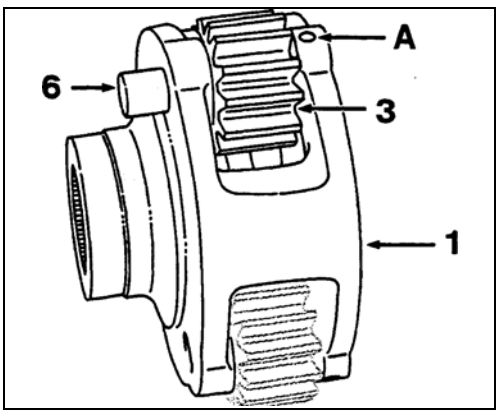


5C. Fill gear bore with a second row of needle bearing (4) (qty. 20) and bottom against bearing spacer. Place a thrust washer on each side of planet gear to retain bearing needles. Slowly pull shaft out (6) being careful not to disturb needle bearings.

Repeat for remaining five gears.

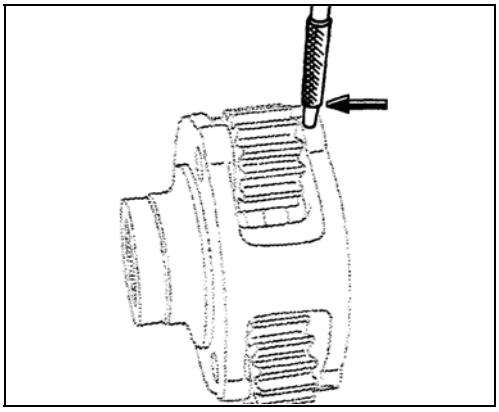


5D. Align pin hole in shaft with hole (A) in carrier (1). While holding gear (3) assembly in place, install shaft (6) into carrier and gear being careful not to disturb needle bearings.

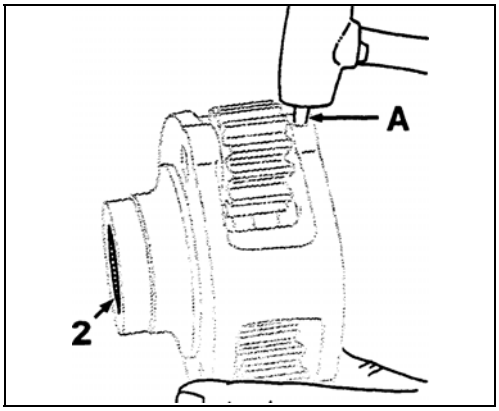


STEERING DRIVE

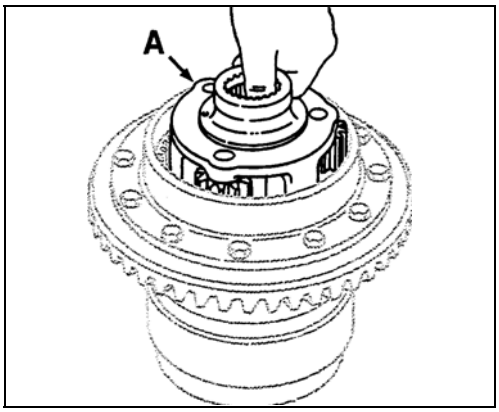
5E. Using pin driver, completely align holes in carrier and shaft.



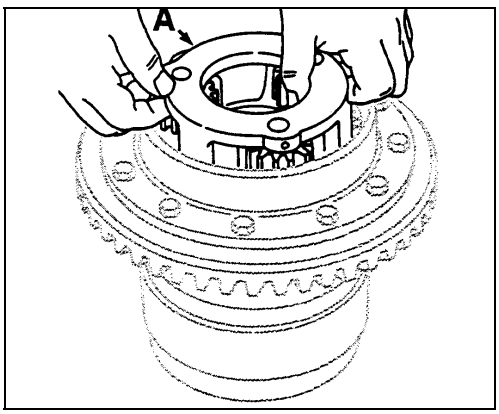
5F. Secure planet gear shaft to carrier with roll pin (A). Install retaining ring (2) into carrier.



6. Remove carrier assembly from press and position with bevel gear end up. Install one planet carrier assembly (A) with retaining ring end up.

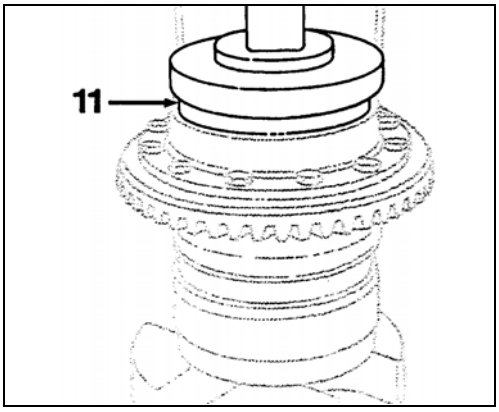


7. Install remaining planet gear carrier assembly (A) with retaining ring end down.

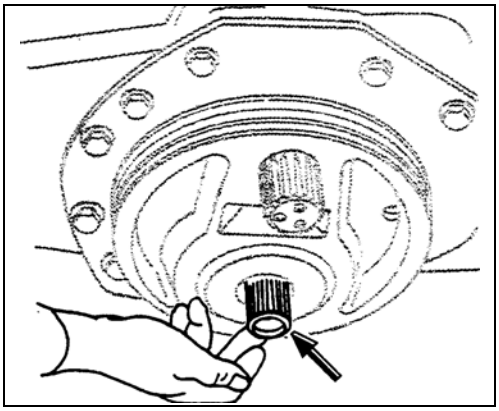


STEERING DRIVE

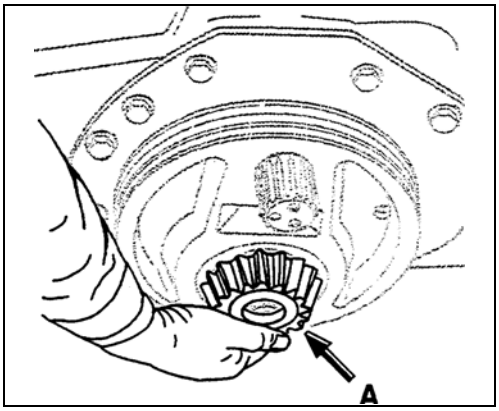
8. Reposition assembly in press, bevel gear end up. Place bearing cup (11) in carrier. Using suitable push plate, apply press and install cup flush with edge of carrier.



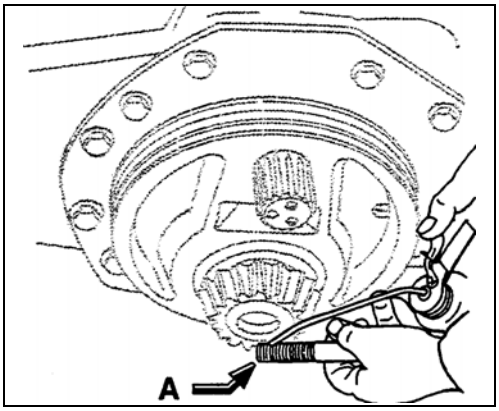
9. Coat transmission range (output) shaft splines with "Never Seez".



10. Install pinion gear (A) on splines. Refer to REESAMBLY in Section 7C, TRANSMISSION.

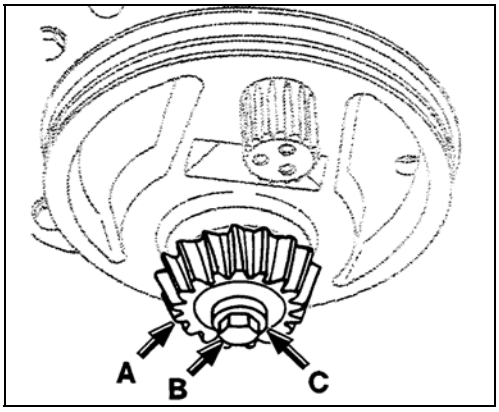


11. Coat mounting bolt (A) threads with clean oil.



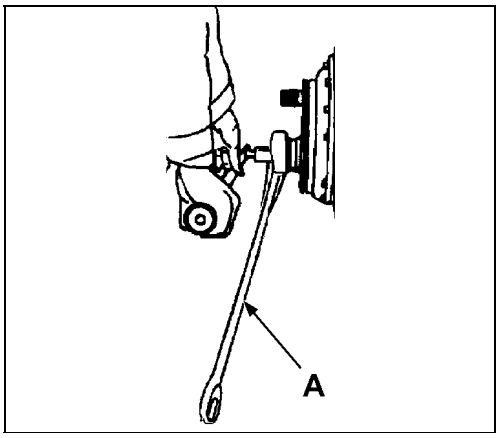
STEERING DRIVE

12. Secure pinion gear (A) to range (output) shaft with bolt (B) and spacer (C).

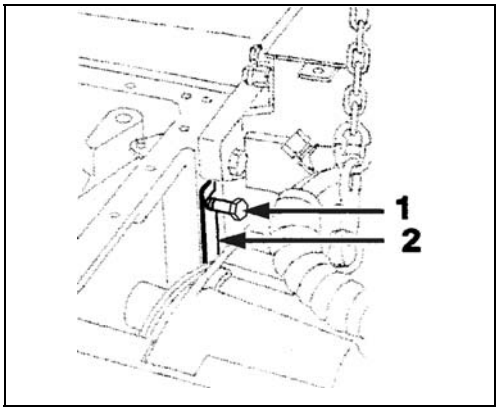


13. Secure range (output) shaft on pinion gear with locking arm (A), see SERVICE/SPECIAL TOOLS in Section 7C, TRANSMISSION. Torque pinion gear mounting bolt to 360 - 410 [Nm].

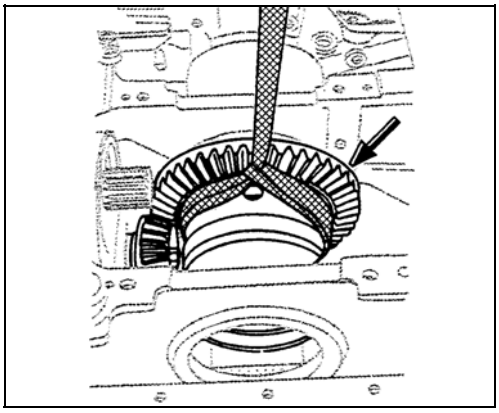
NOTE: *For TD-7M and TD-8M use locking arm with smaller diameter and for TD-9M and TD-10M with larger one.*



14. Loosen transmission mounting bolts (1) and remove shims. Start installation with five 0.50 [mm] mounting shims (2) on each side. Retorque mounting bolts to 135 ± 10% [Nm]. Read and record gauge distance dimension and backlash etched on face of pinion gear.

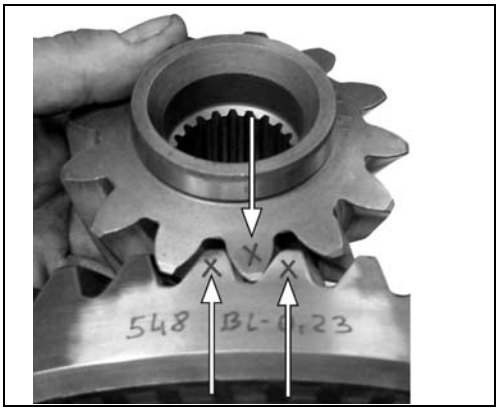


15. Using a hoist position bevel gear, to right side, and carrier assembly in rear main frame.



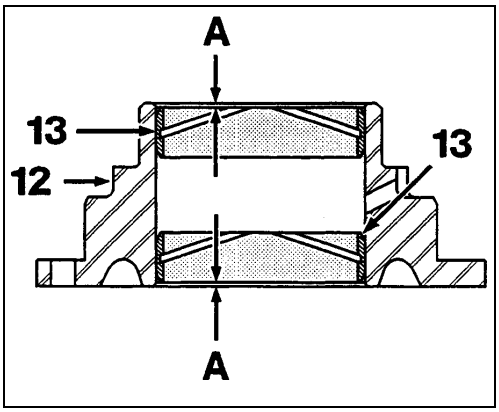
STEERING DRIVE

16. The „X” marked tooth of the pinion gear is to be intermeshed with „X” marked two teeth of the steering drive ring gear while assembling planet gear carrier.

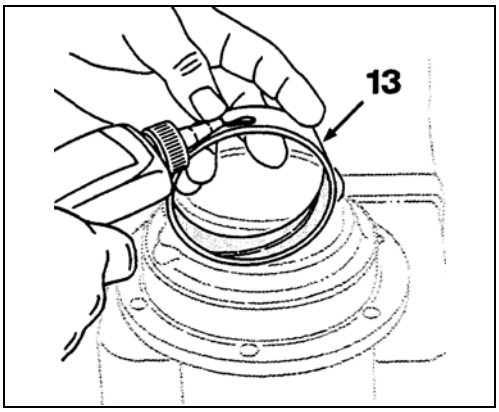


17. Assemble bearing carriers (12) as follows.

A. 0.8 to 1.8 [mm] (below the edge of the carrier)
12. Bearing Carrier
13. Bearing Carrier Bushings

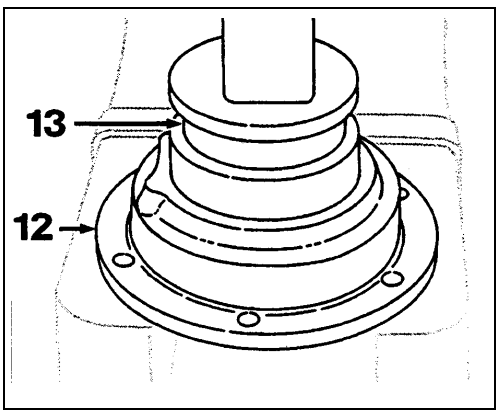


17A. Apply coat of LOCTITE #609 to outside diameter of bushing (13).



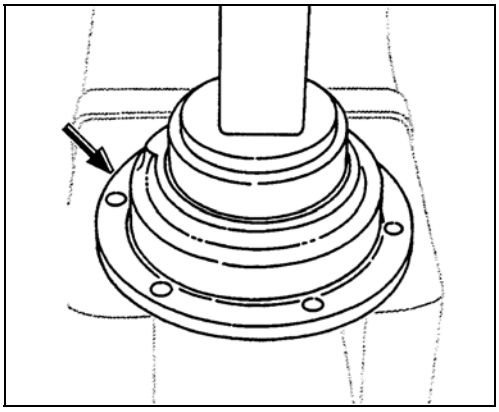
17B. Position bearing carrier (12) in press, bearing surface facing up. Start chamfered edge of bushing (13) into carrier and secure with press.

NOTE: *Position bushings (13) in bearing carrier (12) as shown in the drawing in Step 17. Pay attention to bushing lubrication grooves.*

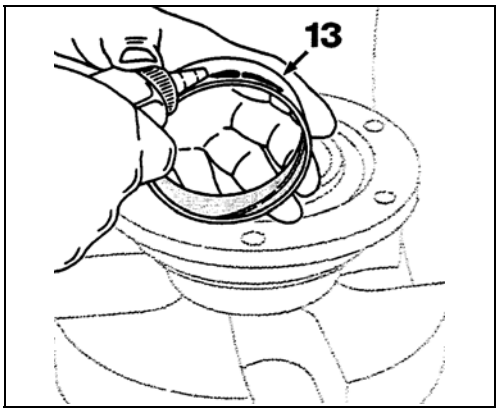


STEERING DRIVE

17C. Apply press and install bushing 0.8 to 1.8 [mm] below edge of carrier.

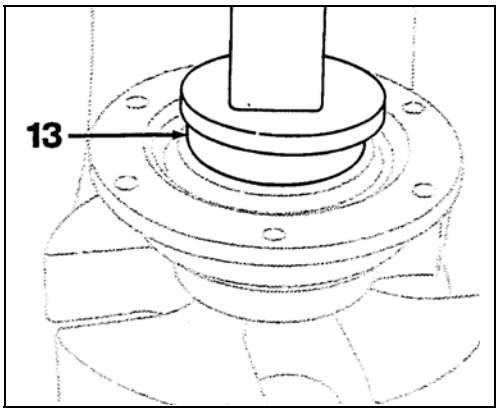


17D. Turn carrier over in press. Apply coat of LOCTITE #609 to outside diameter of bushing (13).

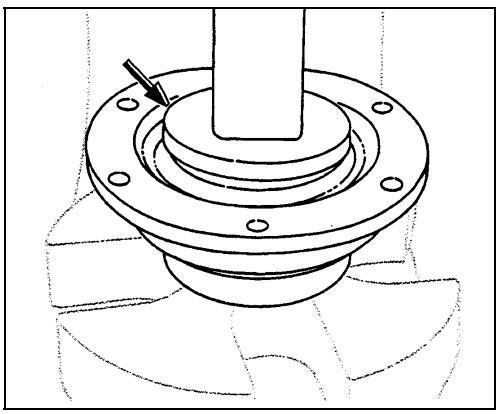


17E. Start chamfered edge of bushing (13) into carrier and secure with press.

NOTE: *Position bushings (13) in bearing carrier (12) per drawing in Step 17.*

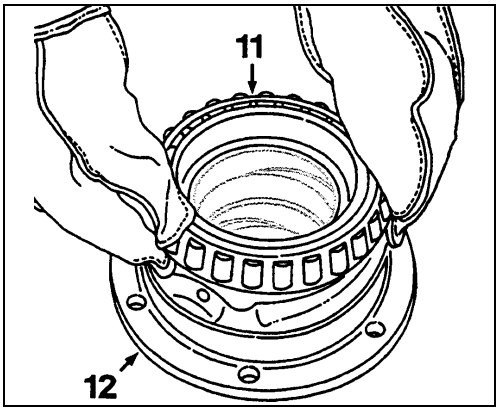


17F. Apply press and install bushing 0.8 to 1.8 [mm] below edge of carrier.

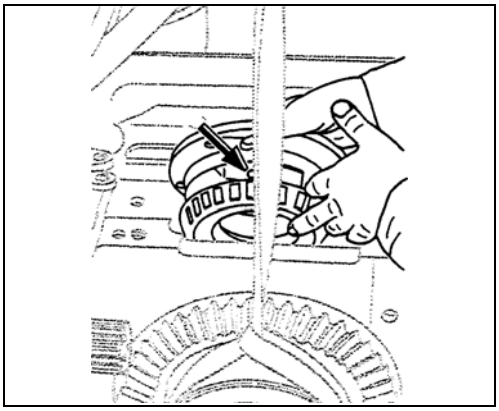


STEERING DRIVE

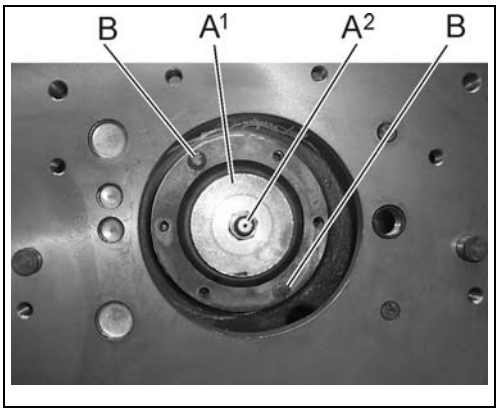
17G. Heat bearing cone (11) to 135 [°C] for 45 [minutes]. Install on bearing carrier (12) and bottom. To insure cone is seated, keep pressure against cone until it cools.



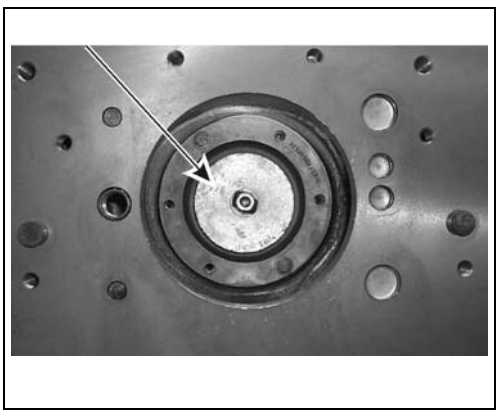
18. Install right bearing carrier assembly with lube hole facing up.



19. Partially assemble bearing carrier loading fixture (A) (refer to SERVICE / SPECIAL TOOLS in this Section). Assemble retainer disc (A^1) with center rod (A^2). Hold in place bearing carrier with loading fixture disc (A^1) and rod (A^2) and secure with two bolts (B) from R.H. side. Snug up bolts.

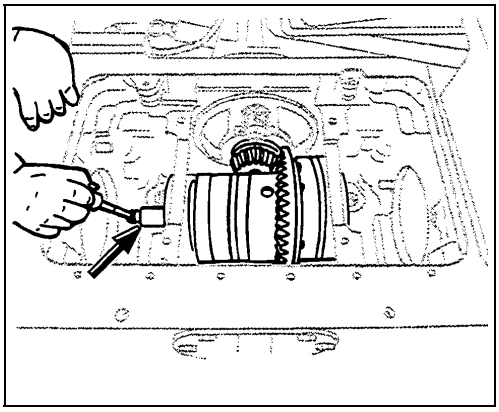


20. Install left bearing carrier assembly with lube hole facing up. Secure with remaining parts of loading fixture from L.H. side. Snug up bolts.

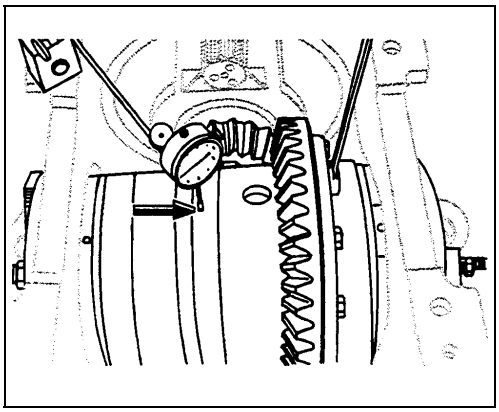


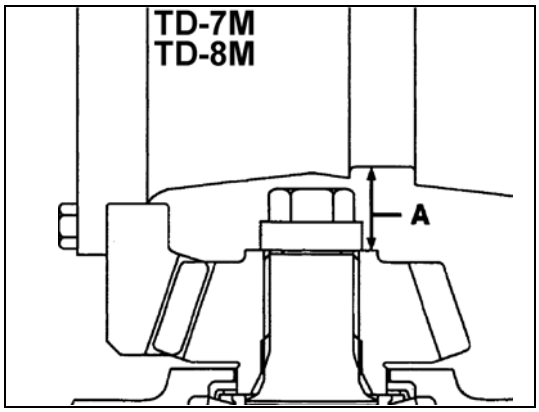
STEERING DRIVE

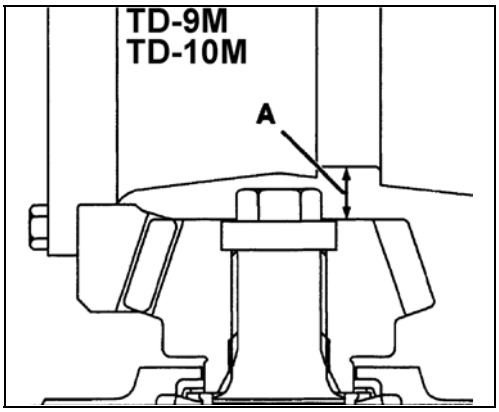
21. From left side, preload carrier bearings by torquing mounting fixture to 34 ± 10% [Nm]. Leave loading fixture mounting bolts (two each side). Remove hoist and sling.



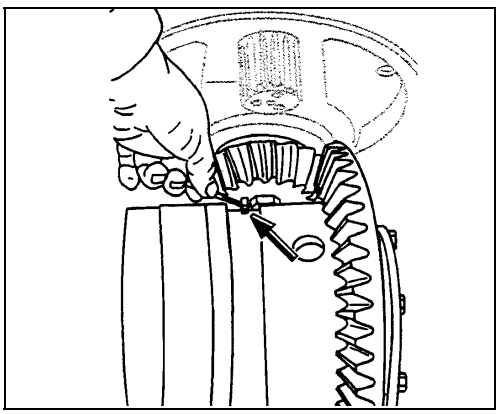
22. Position dial indicator on machined bevel gear carrier surface and determine distance between extremes of eccentricity. Maximum permissible 0.1 [mm] TIR (total indicator run out).





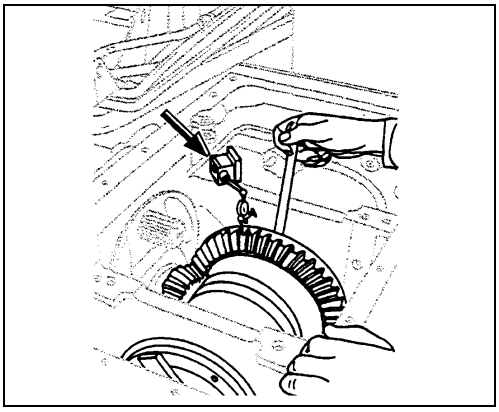


23. Measure and record distance (A) between face of pinion gear to ring gear carrier machined groove. Add or subtract mounting shims to bring pinion gear within dimension etched on face, recorded in Step 14, within 0.025 [mm]. Torque transmission mounting bolts to 325 ± 10% [Nm].



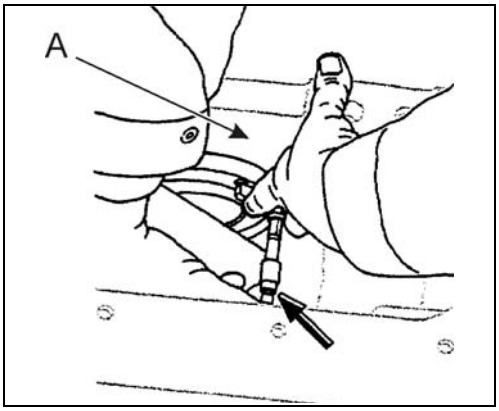
STEERING DRIVE

24. Position dial indicator on heel of ring gear. Check backlash with dimension recorded from Step 14. To decrease backlash, turn loading fixture right bolt in. To increase backlash, turn loading fixture left bolt in.



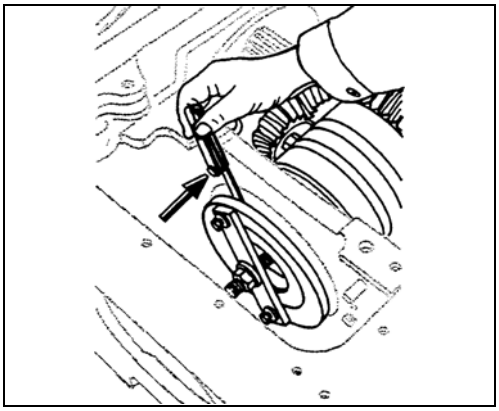
25. On one side, use depth micrometer, to measure depths at open holes in bearing carrier. Record and average readings. Repeat for remaining side.

NOTE: *Gap difference between bearing carrier and main frame wall (A) supporting the bearing carrier at left and right side should not exceed 0.13 [mm].*

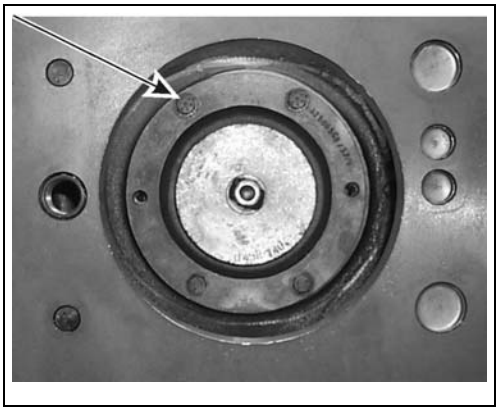


Or:

On one side and using set of feeler gauges, measure gap between bearing carrier and main frame wall at three places. Record and average readings for that side. Repeat for remaining side.

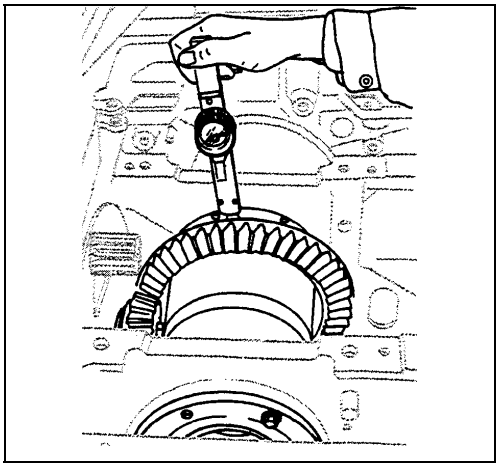


26. Install averaged shim pack at right side and secure with four bolts. Torque bolts to 75 ± 10% [Nm]. Install averaged shim pack at left side and secure with four bolts finger tight. Remove loading fixture.

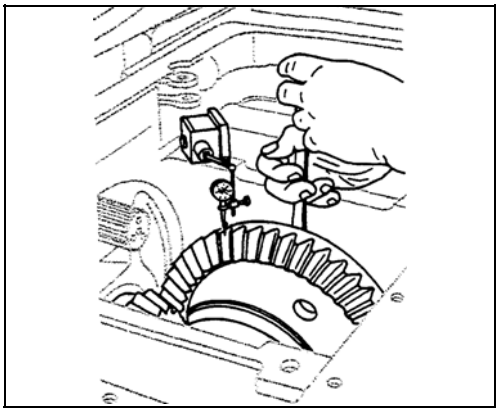


STEERING DRIVE

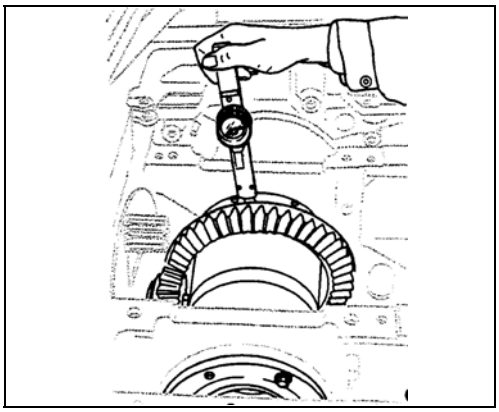
27. Apply a thorough coat of clean oil to carrier bearings. Rotate ring gear carrier five or six revolutions for proper seating. Using a torque wrench read and record ring gear carrier rolling torque. Reading not to exceed 13.6 [Nm].
    - If above value, check transmission for binding.
    - If within value, torque two opposite left side bearing carrier bolts to 75 ±10% [Nm]. Recheck rolling torque, an increase of 2.3 to 7.3 [Nm] from previous pull.
    - If value is exceeded, add shims to left side. If value is too low, remove shims from left side.
    - Recheck until value is correct. Install all remaining bearing carrier hardware and torque to75 ± 10% [Nm].



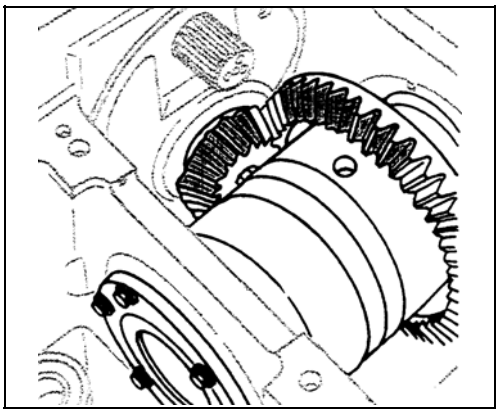
28. Recheck backlash at 3 places around ring gear, must be with 0.18 to 0.30 [mm].
    - If value is too high, move shims from right side to left side.
    - If value is too low, move shims from left side to right side.



29. Recheck rolling torque. Value should not exceed one obtained in second pull of Step 27 by more than 2.3 [Nm].



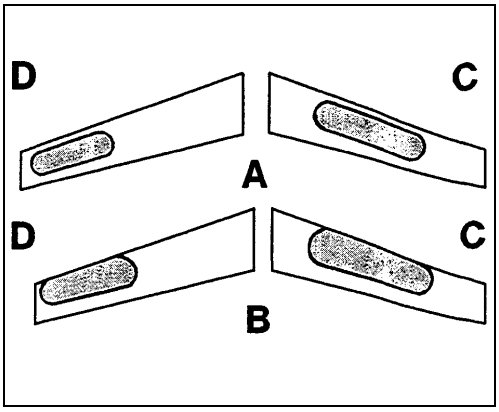
30. Required backlash, gauge distance and bearing setting should now be correctly set. To check, coat ring gear teeth (about 8 to 10) with white pattern paste. Rotate ring gear against pinion gear to obtain tooth patterns.



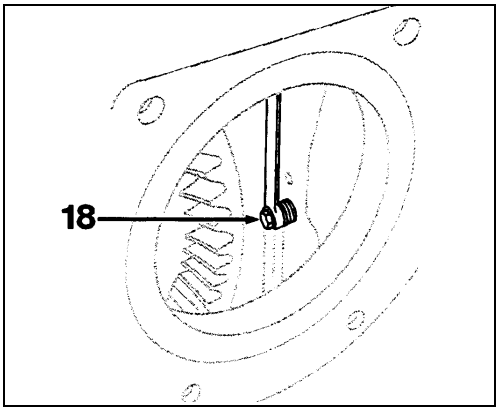
STEERING DRIVE

31. Compare tooth patterns with those shown. If patterns are not closely approximated, recheck all settings. The tooth pattern while rotating the ring gear to the left/ right is to be similar to that of the left/ right hand sketch, respectively. The top/ bottom of the sketch shows the ring gear/ pinion gear tooth pattern, respectively.

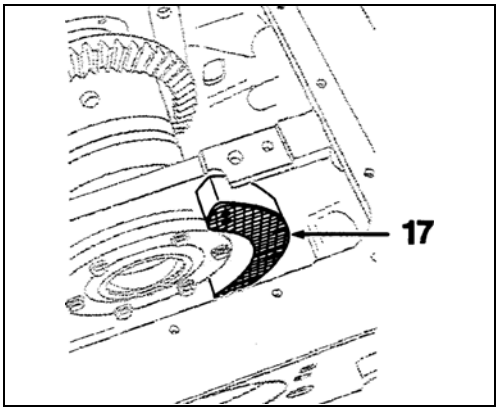
    A. Ring Gear
    B. Pinion Gear
    C. Coast Side
    D. Drive Side



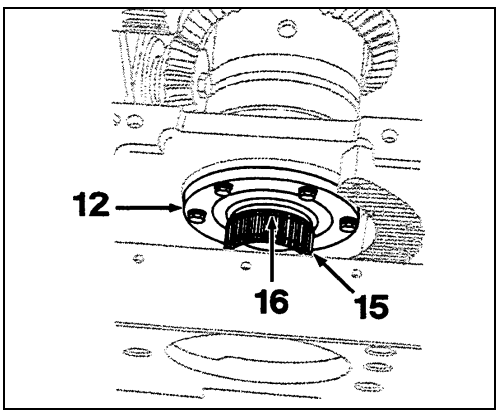
32. Install drive shoe adjustment screw (18, Fig. 7E.6) (both sides) partially into rear main frame.



33. Install clutch back up shoe (17, Fig. 7E.6) onto dowels in rear main frame.

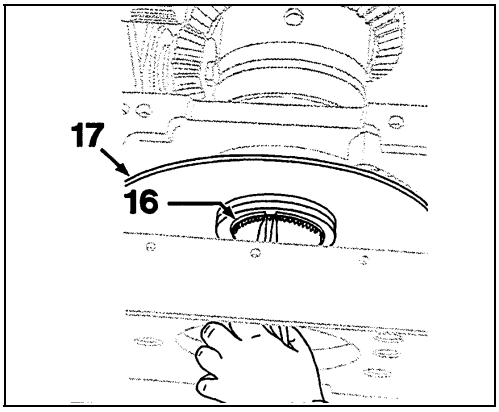


34. Install sun gear (15) with inner retaining ring (16) into bearing carrier (12) meshing with three planet gears.



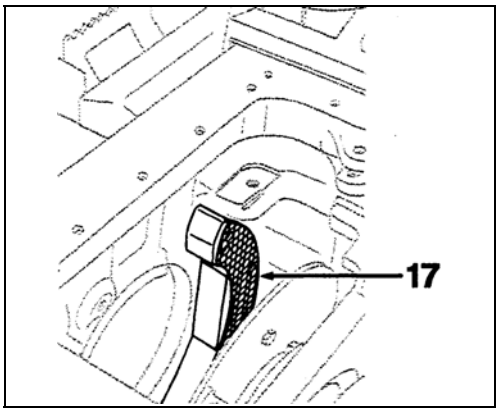
STEERING DRIVE

35. Install clutch (drive) disc (17) on sun gear and secure with outer retaining ring (16).

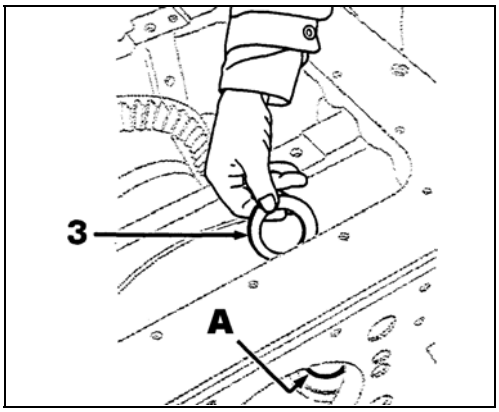


36. Install back up (brake) shoe (17, Fig. 7E.6) on dowel pins in rear main frame.

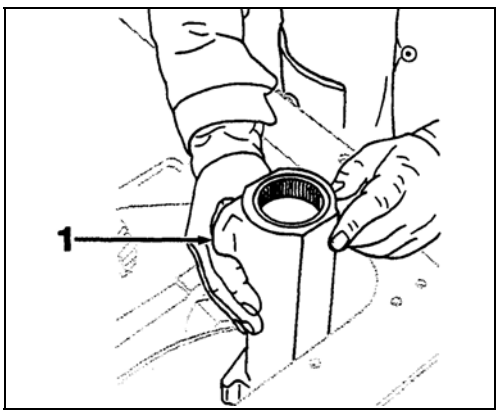
    Repeat Steps 32 through 36 for remaining side.



37. Coat bottom thrust washer (3, Fig. 7E.6) with clean oil and place in position over lower bearing (A).

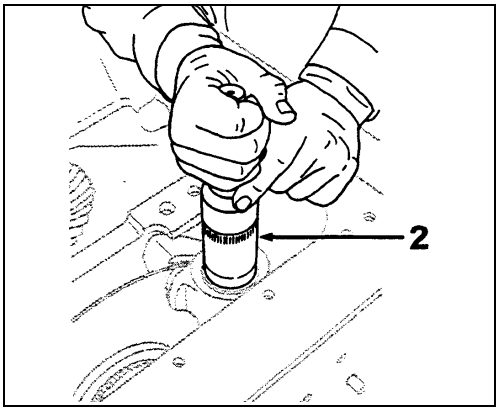


38. Position apply (drive) shoe (1, Fig. 7E.6) in rear main frame.



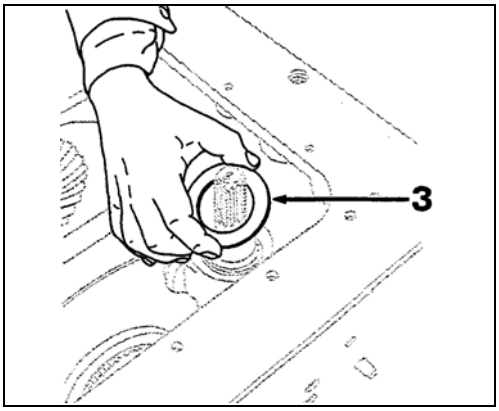
STEERING DRIVE

39. Install eccentric shaft (2, Fig. 7E.6) through apply shoe engaging bearing in rear main frame.

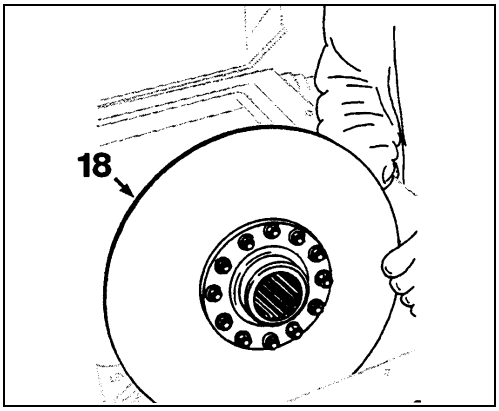


40. Install top thrust washer (3, Fig. 7E.6) to eccentric shaft.

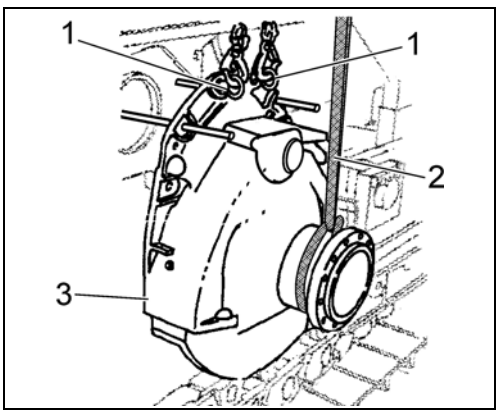
    Repeat Steps 37 through 40 for remaining side.



41. Position brake disc (18) in rear main frame on both sides.



42. Install final drive to both sides. Refer to SECTION 7F, FINAL DRIVE.

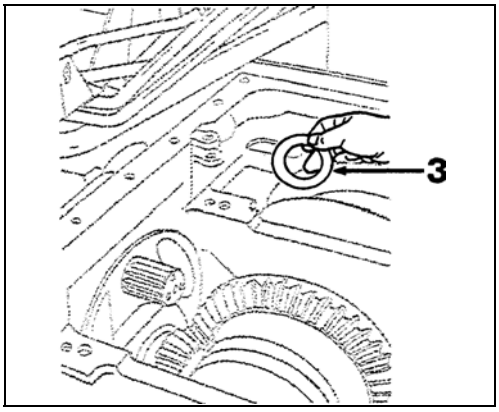


STEERING DRIVE

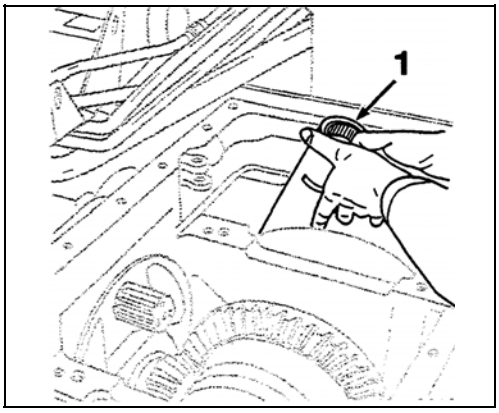
Clutch and Brake Cylinders Assembly

NOTE: *Callouts from exploded view (Fig. 7E.6) correspond with callouts in following steps.*

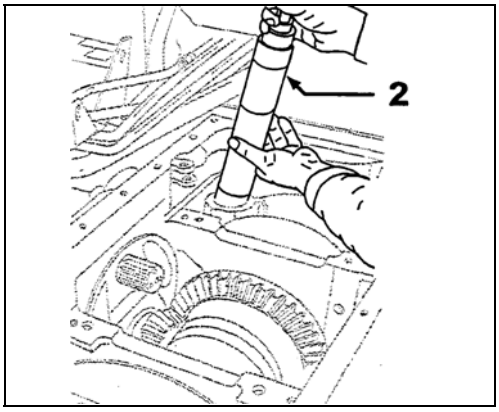
43 Coat bottom thrust washer (3) with clean oil and place in position over lower bearing.



44. Position apply (brake) shoe (1) in rear main frame.

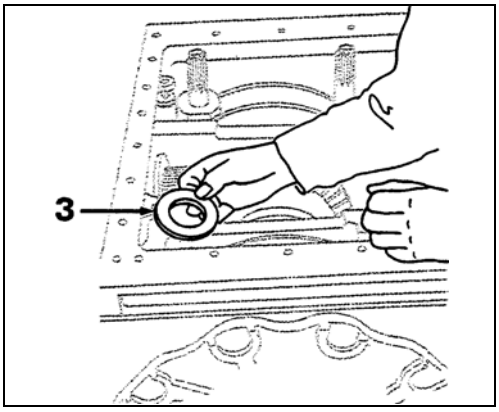


45. Install eccentric shaft (2) through apply shoe engaging bearing in rear main frame. Install top thrust washer to eccentric shaft.

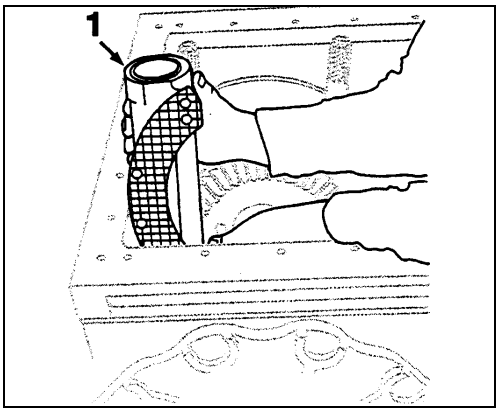


STEERING DRIVE

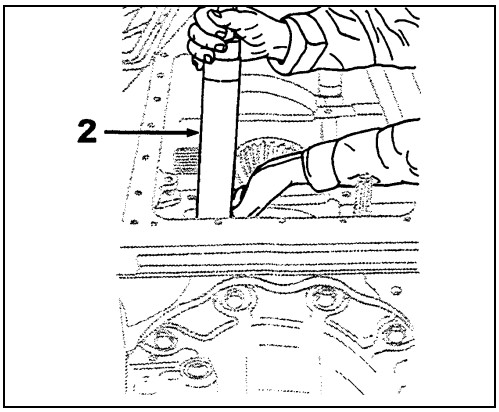
46. Coat bottom thrust washer (3) with clean oil and place in position over lower bearing.



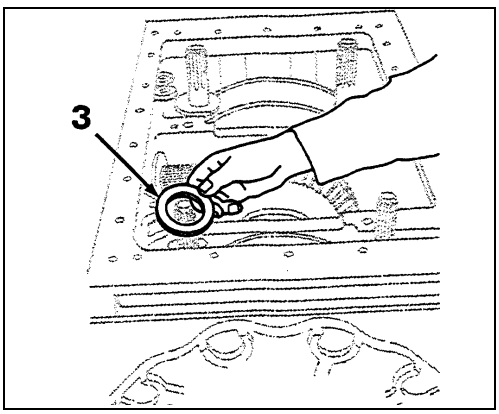
47. Install apply (brake) shoe (1) on thrust washer.



48. Install eccentric shaft (2) through apply shoe engaging bearing in rear main frame.

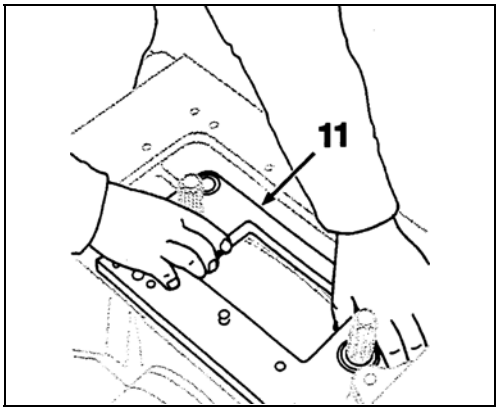


49. Install top thrust washer (3).

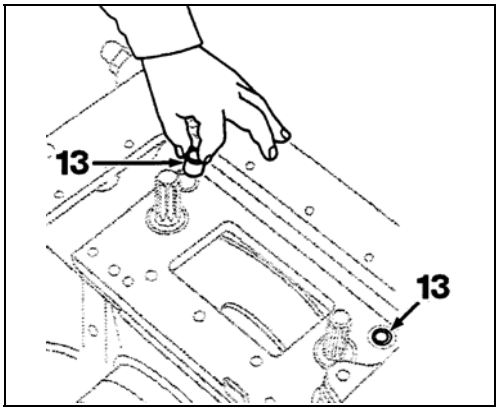


STEERING DRIVE

50. Reassemble mounting plate as described in Section 4, Install L.H. mounting plate (11) over eccentric shafts engaging dowel pins (15) in rear main frame.

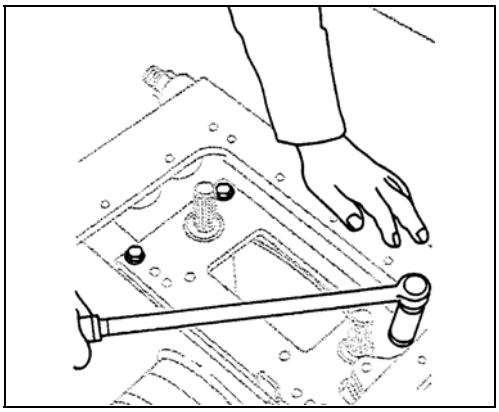


51. Install plate spacer sleeves (13) at each outside corner.

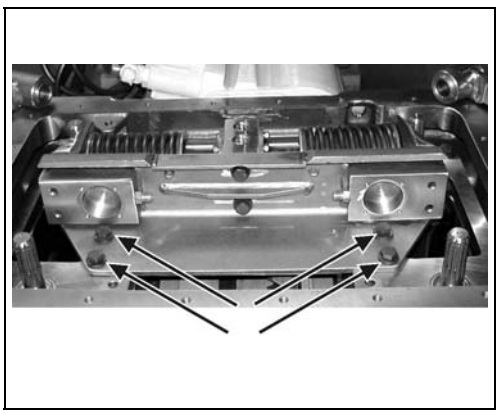


52. Secure mounting plate with hardware. Torque bolts to 129 ± 10% [Nm].

NOTE: *Drawing down on hardware may be* necessary to seat *mounting plate to rear main frame on dowel pins.*

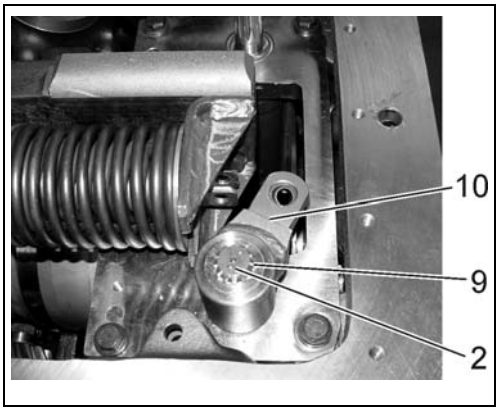


53. Install clutch and brake cylinders mounting bracket with brake cylinders (Refer to Brake and Clutch Cylinders Assembly in Section 4, BRAKES for assembly procedure). Secure bracket to mounting plate with hardware and torque bolts to 100 ± 8 [Nm].

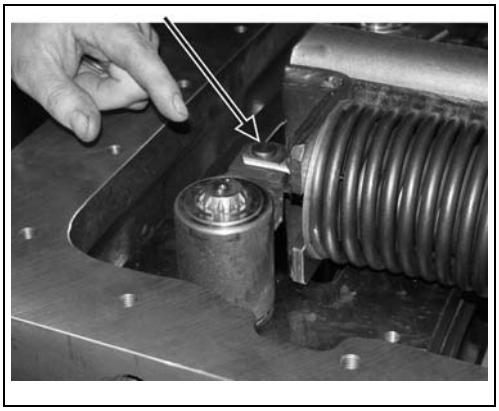


STEERING DRIVE

54. Install left and right brake arms (10) indexing factory marks on arms with marks on eccentric shafts. Using lock ring pliers, install retaining rings (9) onto eccentric shafts (2).

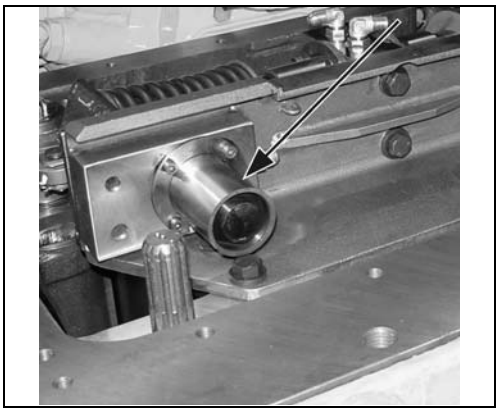


55. Position brake arm in brake connecting rod and secure with pivot pin and new cotter pin. Repeat for remaining side.

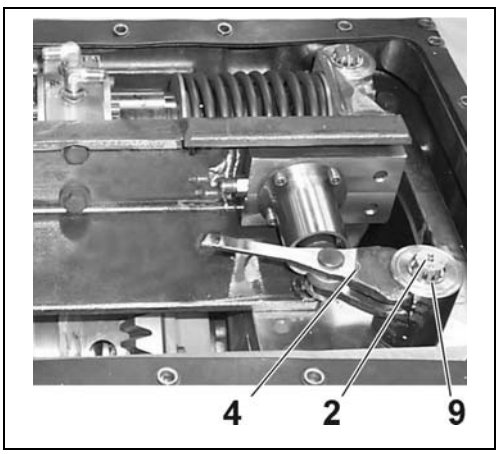


56. Install clutch cylinder sleeve with piston and O-ring and secure with clutch cylinder disc with hardware. Repeat for remaining side.

    For details refer to Brake and Clutch Cylinders Assembly in Section 4, BRAKES.

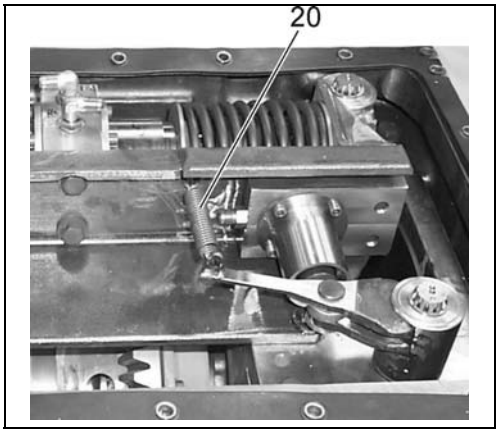


57. Install left and right steering arms (4) indexing factory marks on arms with marks on eccentric shafts. Using lock ring pliers install retaining rings (9) on eccentric shafts (2) to secure two steering arms.



STEERING DRIVE

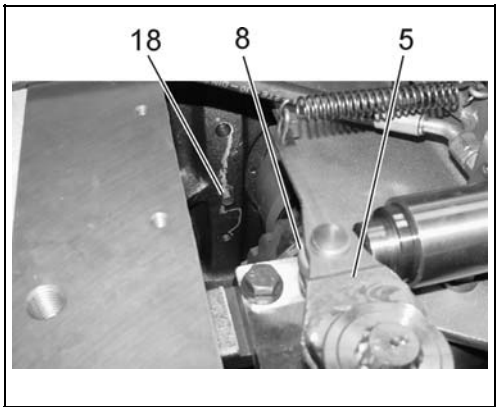
58. Install both steering arm return springs (20).

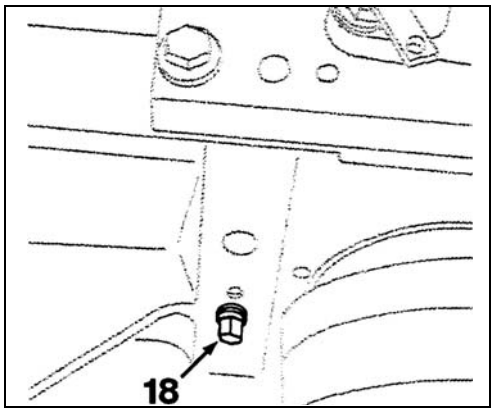


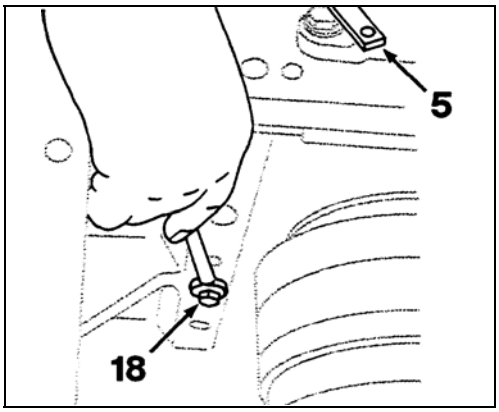
WARNING! Loaded assembly. Use extreme care when installing.

59. From inside rear main frame, turn in adjusting screw (18) until bottoms against apply shoe surface and resistance is felt. Back the screw out 1/8th of a turn.

NOTE: *Gap between clutch apply shoe and clutch disc surface should be within 1.1 ÷ 1.3 [mm].*

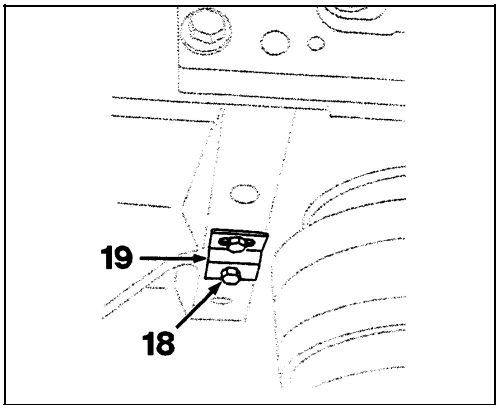






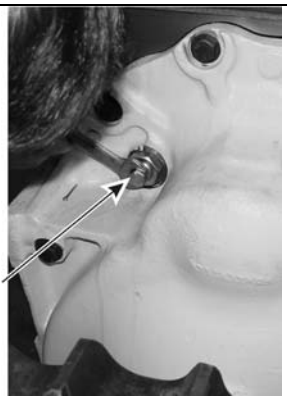
60. Secure adjusting screw (18) in place with lock plate (19) and hardware. Torque bolts to 38 ±10% [Nm].

Repeat Steps 59 through 60 for remaining side.



STEERING DRIVE

61. It is possible to check steering drive for correct reassembly through preliminary brake clutch adjustment. To do it use hand oil pump. Apply 2.1 [MPa] oil pressure to left brake cylinder. Turn adjusting screw (16) in by hand until clearance is removed and screw bottoms against left brake apply shoe (1). Mark screw head and frame on bottom position. Then turn screw out 1/8th of a turn. Hold screw in this position and snug locknut to maintain this position.



NOTE: *Avoid over tightening, which will cause erroneous adjustment.*

62. Release the pressure in brake cylinder and torque lock nut to 170 [Nm].



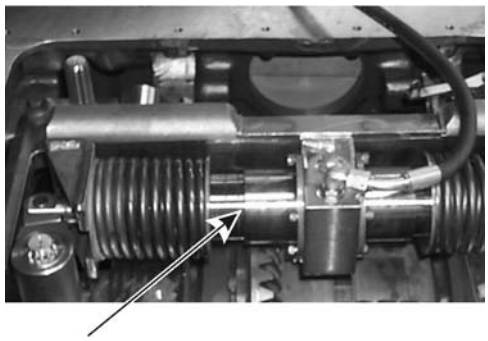
Repeat Steps 61 through 62 for remaining side.

63. If brake cylinder checking for leaks is necessary proceed as detailed below. Use hand oil pump and apply 1.9 [MPa] oil pressure to right brake cylinder. Place the small container under cylinder sleeve where piston leaves the cylinder. Allow the escaping oil to fill small container for 60 [sec] and measure the drained oil.

If volume of oil is less than 10 [ml] per minute, the leakage of brake cylinder is allowable.

If volume of oil is more than 10 [ml] per minute, the leakage of brake cylinder exceed the limit. The brake cylinder should be removed from machine and repaired.

Repeat for remaining side.

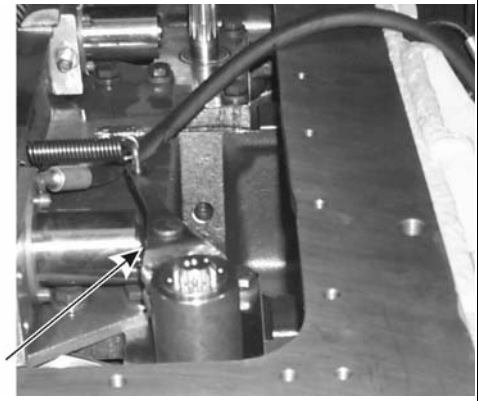


64. If clutch cylinder checking for leaks is necessary proceed as detailed below. Use hand oil pump and apply 1.9 [MPa] oil pressure to right clutch cylinder and check it for leakage. Place the small container under cylinder sleeve where piston leaves the cylinder. Allow the escaping oil to fill small container for 60 [sec] and measure the drained oil.

If volume of oil is less than 10 [ml] per minute, the leakage of steering cylinder is allowable.

If volume of oil is more than 10 [ml] per minute, the leakage of steering cylinder exceed the limit. The steering cylinder should be removed from machine and repaired.

Repeat for remaining side.

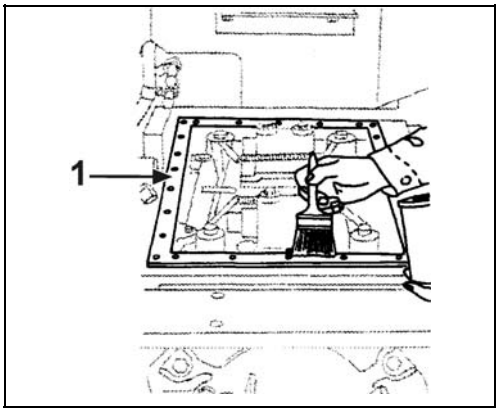


STEERING DRIVE

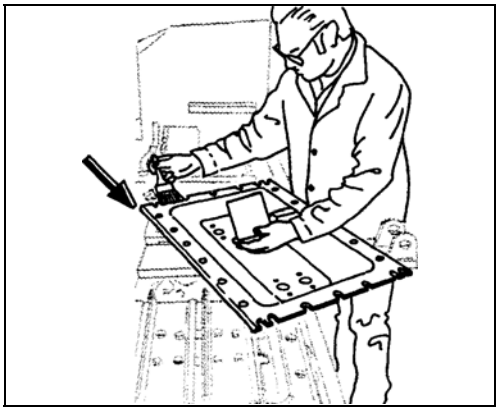
8. INSTALLATION

1. Reconnect the manifold hoses, connectors, and elbows to clutch and brake cylinders and position manifold with hoses in rear main frame (refer to Fig. 7E.3).

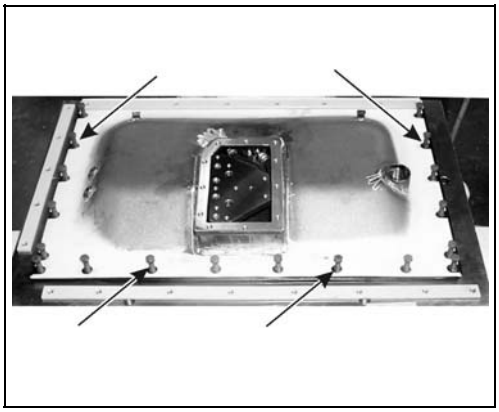
2. Thoroughly clean all mounting surfaces of cover, rear frame and new gasket with methyl ethyl ketone (MEK). Position gasket (1) over rear frame surface with one odd square corner located at right rear corner. Install all mounting bolts to rear frame. Apply gasket cement, to top surface of gasket.



3. Apply gasket cement, to mounting surface of rear frame cover.

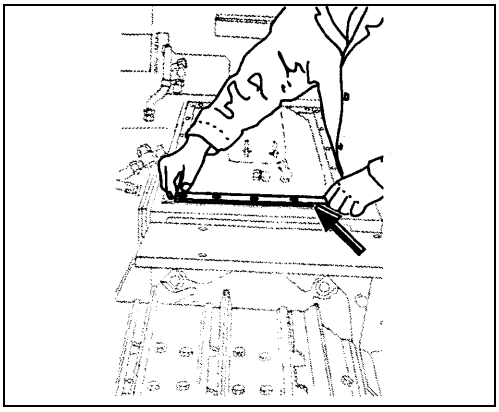


4. Position rear frame cover on gasket centering gasket metal spacers within cover mounting bolts openings.

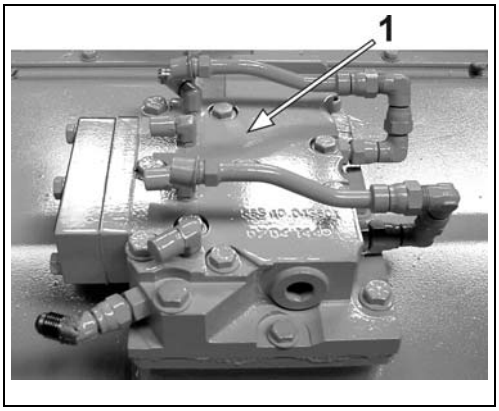


STEERING DRIVE

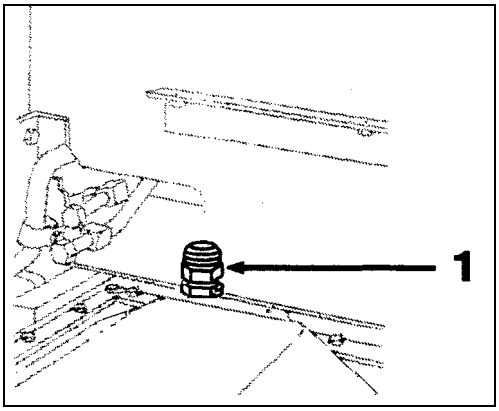
5. Install front, back and side stiffeners and secure with hardware. Torque bolts to 55 ± 10% [Nm].



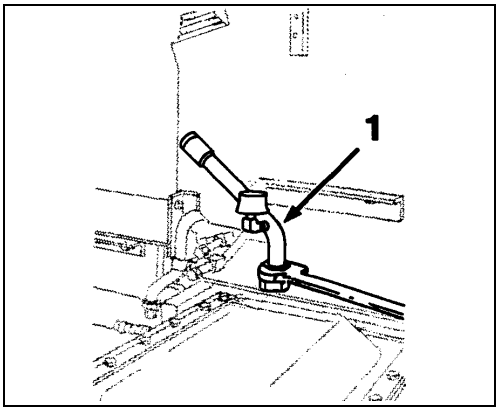
6. Install brake valve (1); refer to Installation in Section 4 BRAKES.



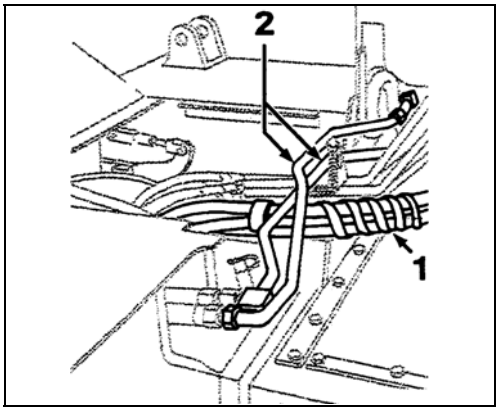
7. Unplug port. Install lower filler tube (1) using LOCTITE #569.



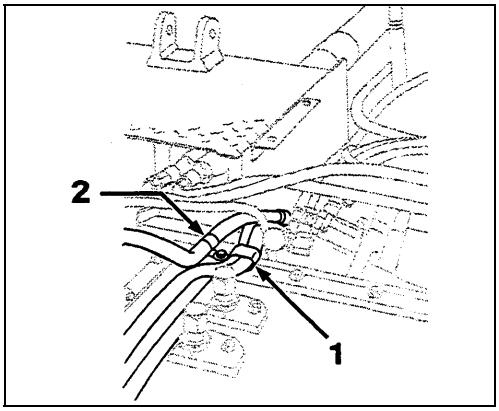
8. Install upper filler tube (1).



9. Reposition transmission hoses (1) under cross over tubes (2).

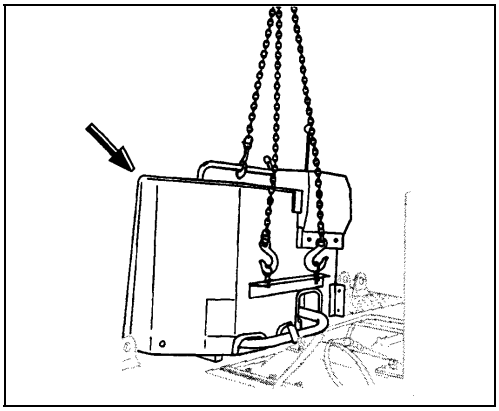


10. Reclip fuel lines (1) and battery cables (2). Torque clip bolt at rear cover to 55 [Nm].

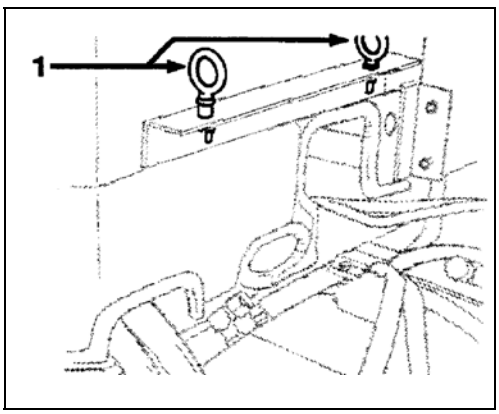


11. Position battery box in place on fender with shims that were removed with it and secure with hardware. Torque bolts to 180 ± 10% [Nm].

NOTE: *When installing battery box, make sure crossover hoses at left front of rear frame clear bottom floor plate of box. Tubes go inside box.*

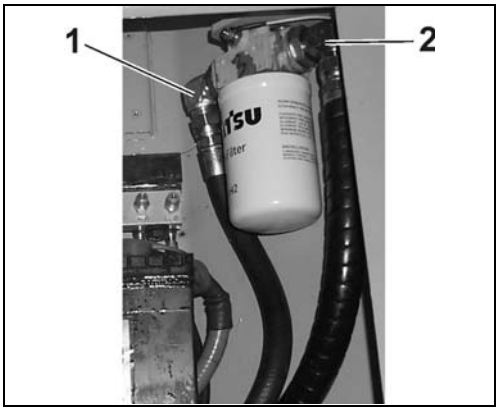


12. Remove eye bolts *(2).*

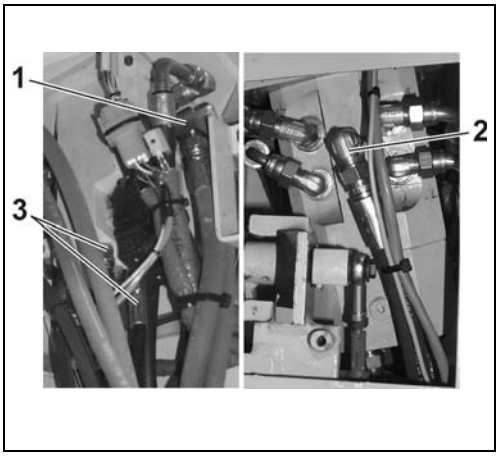


STEERING DRIVE

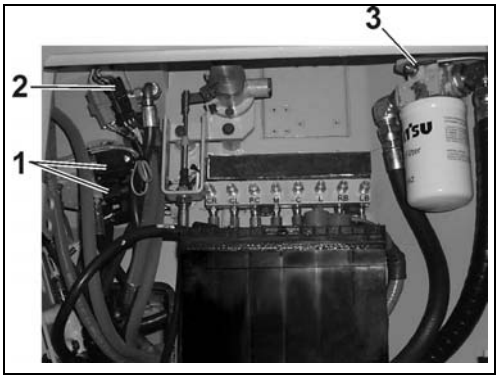
13. Install filter inlet hose (1) and filter outlet hose (2) to filter elbows.



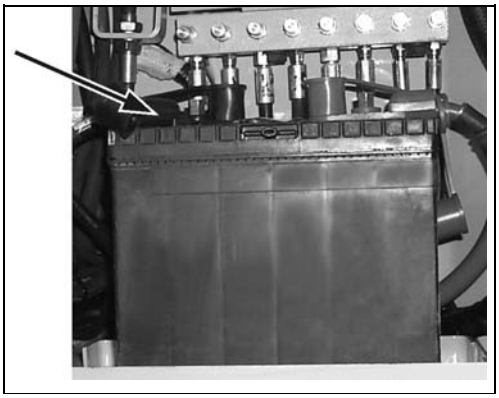
14. Reconnect one steering (F) hose (1) to rear side of drive train control valve, one steering (R) hose (2) to front side and two gear steering (1st, 2nd) hoses (3) to bottom of drive train control valve.



15. From inside battery box, reconnect wiring at solenoid valves (1) of drive train control valve, drive train electronic controller (2), drive train oil pressure filter switch (3), startup lock switch, backup alarm pressure switch and main oil pressure switch.



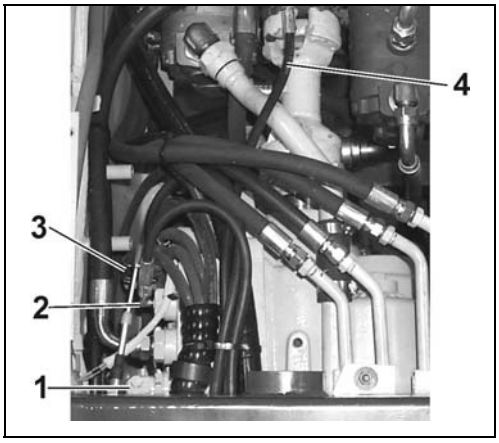
16. From inside battery box, apply electrical sealing grease, Grafo 112-X to negative battery cable (1) and connect to battery. Torque nut to 31 [Nm].



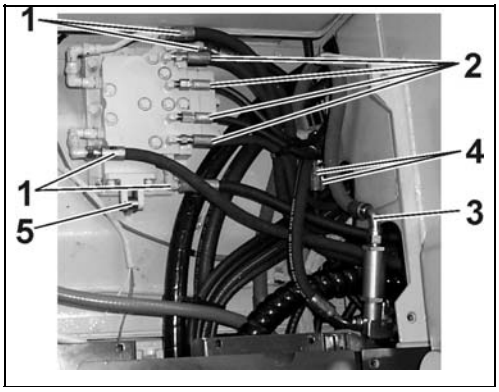
STEERING DRIVE

17. Install M pressure check hose (1) and L pressure check hose (2) to pressure regulator valve fittings. Install Pc pressure check hose (3) to range selector valve fitting. Install C pressure check hose (4) to torque converter fitting and position in battery box.

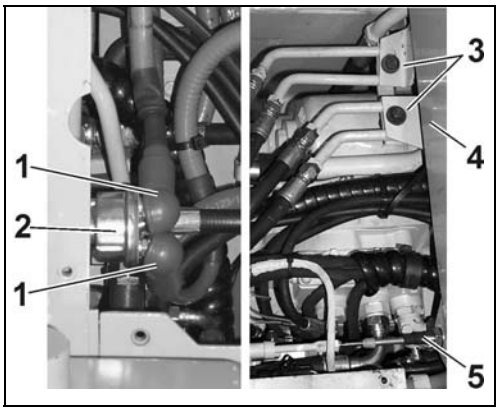
NOTE: *The C pressure check hose does not exist in Direct Drive versions of TD-8M, TD-9M and TD-10M machines.*



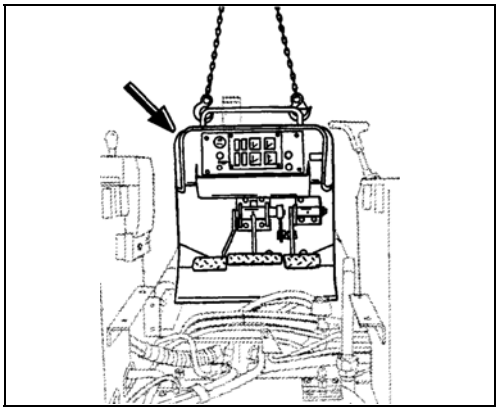
18. Install four steering hoses (1) to brake valve fittings. Install four check hoses (2) to brake valve fittings. Install neutral lock valve supply hose (3). Install drive train drain hoses (4) to elbow on rear main frame cover. Install brake rod with clevis to brake valve (5).



19. Apply electrical sealing grease, Grafo 112-X to cables (1) and connect to master disconnect switch (2). Torque nuts to 12 [Nm]. Install tube brackets (3) to front support plate (4). Torque center $^{3}/_{8}$NC bolt to 38 ± 10% [Nm] and right $^{1}/_{2}$NC bolts to 92 ±10 % [Nm]. At lower left of seat support plate (4) connect throttle cable (5) to support plate. Install seat support plate to machine and secure with hardware. Torque bolts to 38 ±10 % [Nm].

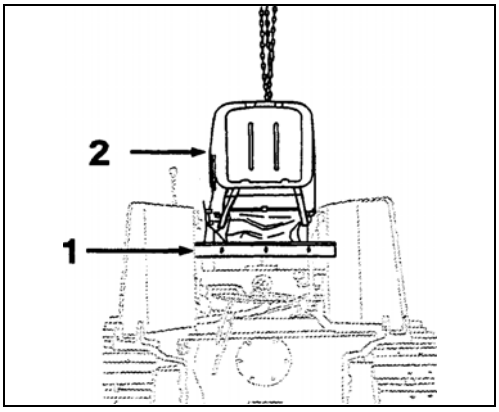


20. Position dashboard in place and secure with hardware and shims (if required). Torque bolts to 92 Nm±10%. Refer to POWER, SECTION 12 for this procedure.

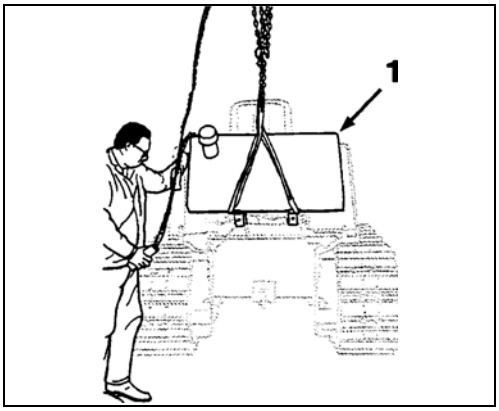


STEERING DRIVE

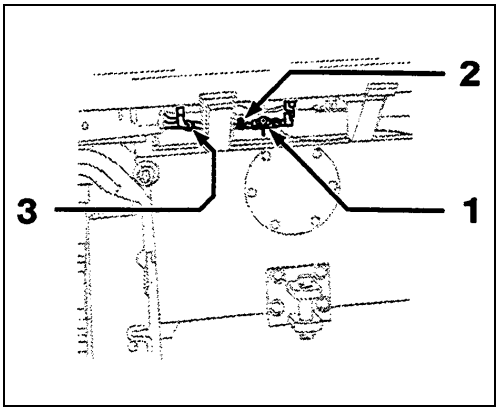
21. Position seat (2) and platform (1) in place and secure with side and front hardware. Torque bolts to 38 ± 10% [Nm].



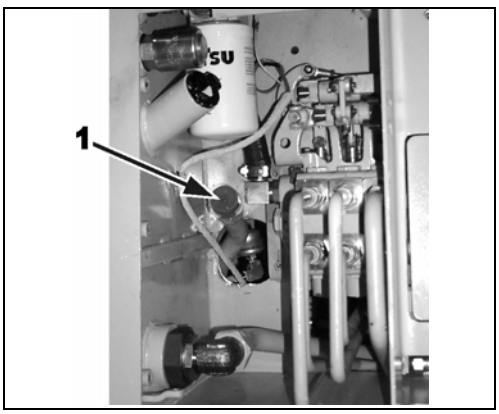
22. Position fuel tank in place and secure with mounting hardware and spacers. Torque $^{3}/_{4}$NC bolts to 325 ± 10% [Nm]. Install rear seat platform to fuel tank hardware and torque 1/2NC bolts to 92 Nm ±10%. Reconnect wiring at fuel level sensor.



23. Connect fuel return hose (3) to fitting at tank. Connect fuel supply hose (2) to shut off valve (1). Open valve.

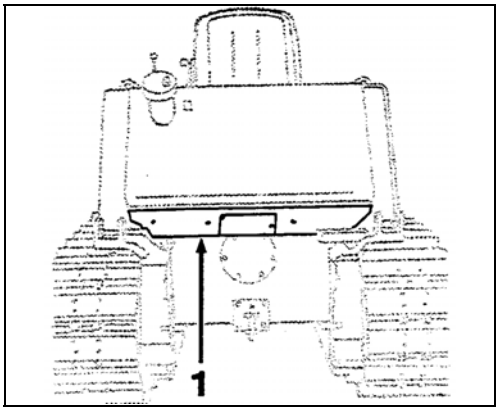


24. Remove plug and install drive train oil level gauge (1).

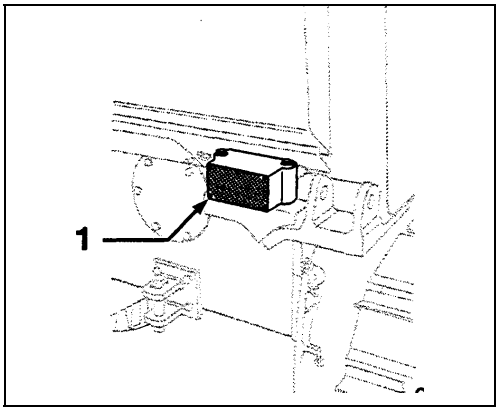


STEERING DRIVE

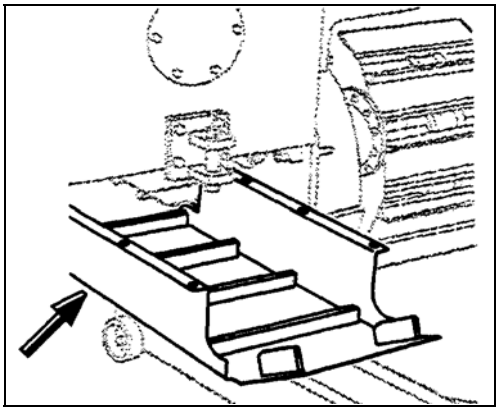
25. Position rear cover (1) in place and secure with hardware. Torque bolts to 92 ± 10% [Nm].



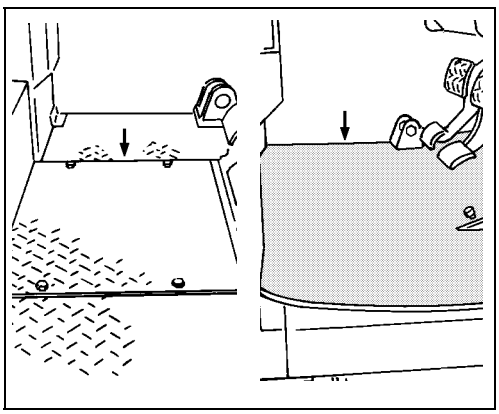
26. Position back up alarm (1) in place and secure with hardware. Torque bolts to 38 ± 10% [Nm]. Apply electrical sealing grease, Grafo 112-X to wires and connect at back of alarm. Torque nuts to 1.8 ± 10 % [Nm].



27. Using a rolling floor jack, install transmission guard to machine and secure with hardware. Torque bolts to 92 ± 10% [Nm].

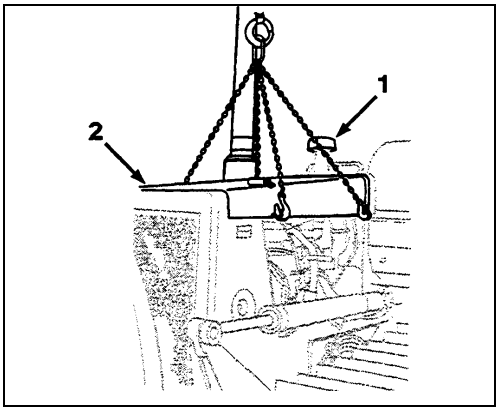


28. Install operators compartment floor plate. Torque bolts to 38 ±10% [Nm]. Install floor mat.

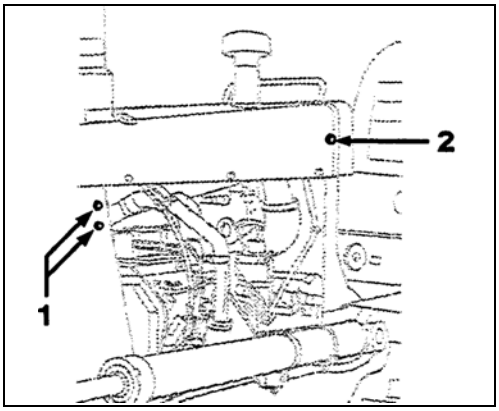


STEERING DRIVE

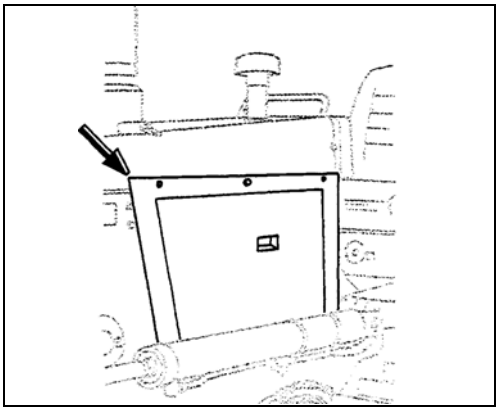
29. Install hood (2) to machine. Install air inlet cap (1) to inlet pipe. Refer to POWER, SECTION 12 for this procedure.



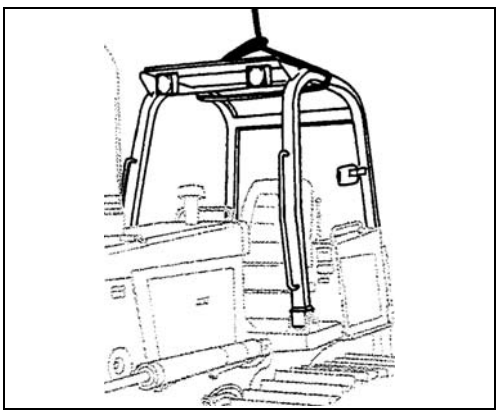
30. From inside of engine compartment, install hood tie down brackets (1). Torque bolts to 10 ± 10% [Nm]. Install hood rod, ball and bracket and tighten until ball compresses. Repeat for other side. Install hood rear mounting hardware (2). Torque bolts to 92 ± 10% [Nm].



31. Install engine left and right side doors. Torque bolts to 38 ± 10% [Nm].



32. Using hoist install ROPS (or cab, if equipped) on machine. Refer to SUPERSTRUCTURE, SECTION 13 for this procedure. Connect ROPS (or cab, if equipped) light connections at rear left leg.
33. Refill hydraulic and drive train systems as described in OPERATOR'S MANUAL.
34. Test steering drive as described in STEERING DRIVE OPERATING TEST, below.



STEERING DRIVE

9. STEERING DRIVE OPERATING TEST

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.

1. Open the door at the left hand side of the platform. Remove the protective covers from male quick disconnect fittings and connect pressure gauges (with 4 [MPa] scale) with pressure gauge female fittings to diagnostic center ports.

NOTE: *Tag each test gauge with the corresponding description 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.*

2. With the engine running at high idle, brake pedal is applied and locked, shift the drive train lock lever to the OFF position then shift the drive train control lever into transmission forward fi rst and slowly release the decelerator pedal. Machine will be moving. Stop the machine. With the engine running at high idle, shift the transmission through second and third forward gear range, machine stands still. Observe the readings of the pressure test gauges. The readings should be the pressures as shown in TRANSMISSION AND TORQUE CONVERTER SYSTEM OIL PRESSURE CHECK, SECTION 7. Fully depress the decelerator pedal and shift the transmission in neutral.

   Repeat this step for each transmission reverse gear range.

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 brake pedal and shift the drive train control lever to NEUTRAL.

3. With the drive train control lever in right “feel point”, brake pedal released and the engine running at high idle, observe the readings of the pressure test gauges. The RB and CR readings should be pressures within 1.6 ± 0.02 [MPa] and 0.0 [MPa] respectively. Fully depress the decelerator pedal.

   Initial movement of the drive train control lever to the right drops right CR clutch steering pressure to 0.0 [MPa] causing the right steering clutch to be in neutral condition. At the same time RB brake steering pressure decreases to 1.6 ± 0.02 [MPa]. The neutral condition is indicated by a “feel point” or effort increase in the control lever movement. Further movement of the control 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.

   If the readings are not within the specifications described in this Step above, refer to Step 4 in this Paragraph.

   If the readings are correct proceed as follows.

STEERING DRIVE

With the engine running at 100 ÷ 200 [rpm] above the deceleration speed, shift drive train control lever into transmission forward second and slowly release the brake pedal, machine is moving. During machine movement shift drive train control lever slowly from neutral to right “feel point”. In this lever position machine should gradually turn right without jerking (left track in clutch engagement and right track dragged).

With the engine running at 100 ÷ 200 [rpm] above the deceleration speed and drive train control lever in right “feel point”, shift the transmission into third forward gear range, machine continues to turn gradually right (without jerking).

Repeat this step for second and third transmission reverse gear range.

If the machine doesn’t move as described above, refer to Step 5 in this Paragraph.

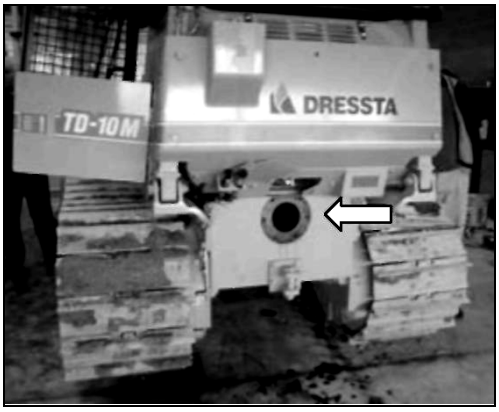
If machine movement is correct shift the drive train control lever into neutral and move the drive train neutral lock lever to the ON position. Place the engine speed control lever in the low idle position and stop the engine.

4. To get specified pressures in RB and LB ports with drive train control lever at right/left “feel point” position, the brake valve calls for adjustment. To do it remove the valve cover, loose the lock nut and turn the adjusting screw to get the specified pressure described in Step 3 above (how to access the brake valve, refer to BRAKE VALVE in SECTION 4, BRAKES).
5. To obtain intended machine movement as described in Step 3 in this Paragraph the Steering Clutch Adjustment Procedure (refer to Step 6) and Brake Clutch Adjustment (refer to Step 7) must be made.

6. **Steering Clutch Adjustment Procedure.**

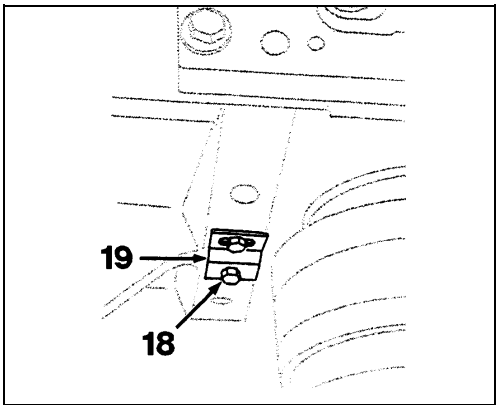
NOTE: *The steering clutches must be adjusted with the engine off (clutches released).*

The adjusting screws are accessible through the PTO opening in the rear main frame. Remove the PTO cover plate.



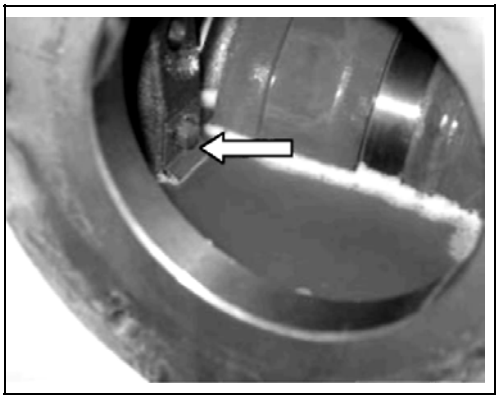
6A. The adjusting screw (18) is held in position with lock plate (19).

NOTE: *Adjusting screw may be under transmission oil level.*

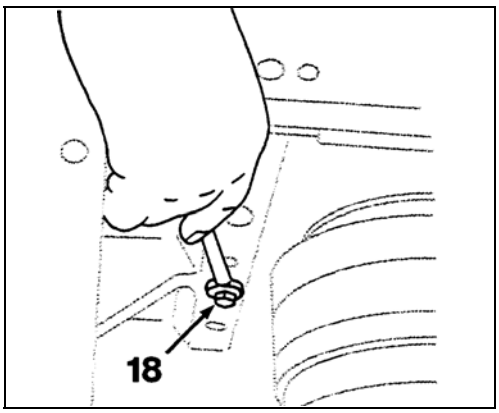


STEERING DRIVE

6B. Remove lock plate (19) with lock bolt at each side.

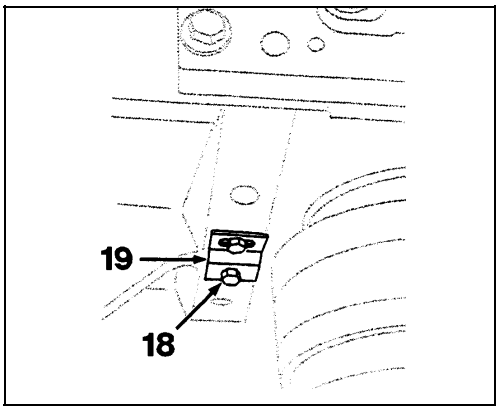


6C. Turn in adjusting screw (18) by hand with care until slight resistance is felt, that is till the screw bottoms against apply shoe surface. Back the screw out 1/8th of a turn.



6D. Install the lock plate (19) in such a position so to lock adjusting screw (18) in its position. Torque lock bolt to 38 ±10% [Nm].

Repeat Steps 6C through 6D for remaining side.



6E. Reinstall the PTO cover.



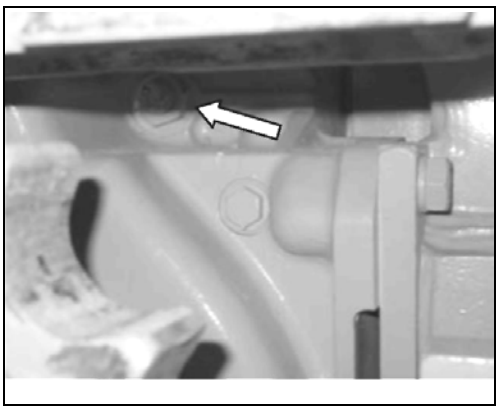
STEERING DRIVE

7. Brake Clutch Adjustment Procedure.

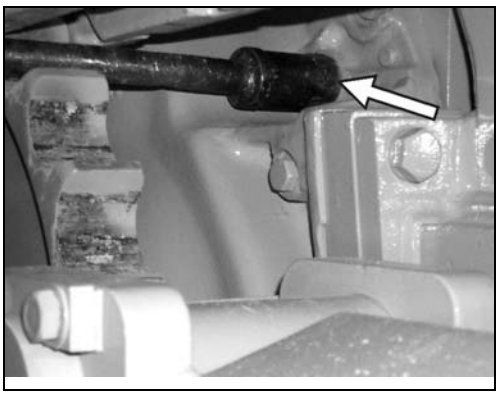
CAUTION: *This procedure requires two personnel – one operator and one technician.*

The brake adjustment must be made with the machine parking on a flat level place with tracks blocked and brakes fully released.
This is done by starting the engine and running at low idle and transmission in neutral.

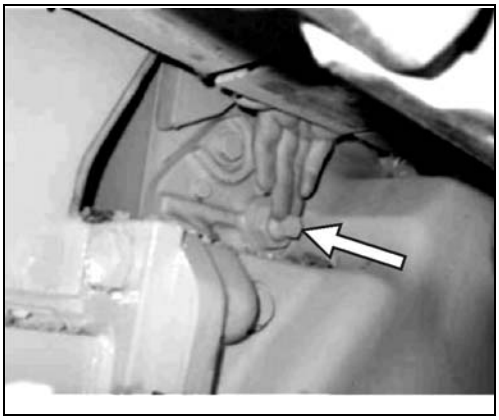
7A. The brake adjustment screw is located on each side of the machine on the main frame, just ahead of the sprocket.



7B. Place the lock lever in lock (DOWN) position and loosen locknut of adjusting screw.



7C. With lock nut loosened, put the lock lever in the unlock (UP) position and screw the adjusting screw all the way out. Clean the threads thoroughly and lubricate.



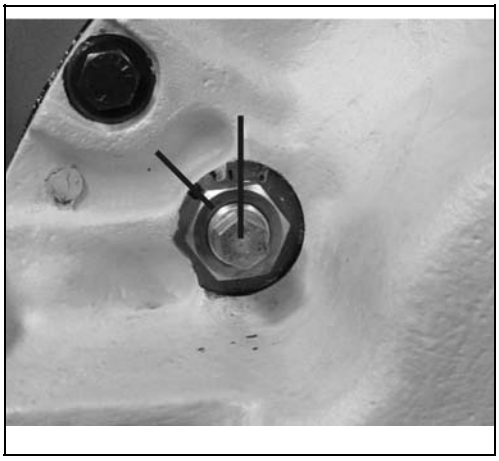
STEERING DRIVE

7D. Reinstall both adjusting screw and lock nut and turn the screw “IN” by hand with care until slight resistance is felt, that is till the screw bottoms against brake shoe.

NOTE: *Avoid over tightening, which will cause erroneous adjustment.*



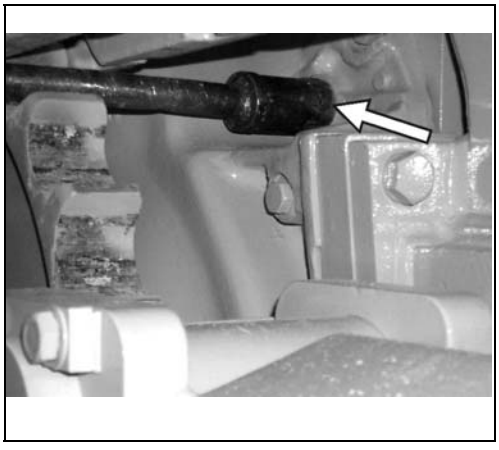
7E. Mark screw head and frame in bottomed position. Then turn screw “OUT” 1/8th of a turn.



7F. Hold screw in this position and snug lock nut to maintain this position. Place lock lever in lock (DOWN) position and tight lock nut with proper torque (refer to REASSEMBLY, Paragraph 7 in this Section).

NOTE: *Avoid over tightening, which will cause erroneous adjustment.*

Repeat Steps 7B through 7F for remaining side. This procedure MUST be performed to both sides individually.



SECTION 7F

FINAL DRIVE

FINAL DRIVE

SECTION 7F

CONTENTS

SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS 3

GENERAL

2. DESCRIPTION 3
3. OPERATION 3
4. SPECIFICATION 5
5. SERVICE DIAGNOSIS 6

FINAL DRIVE

6. REMOVAL 6
7. DISASSEMBLY 11
8. REASSEMBLY 18
9. INSTALLATION 27

SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS

DESCRIPTION	TOOL NUMBER
Final drive assembly rotational stand	21.851.0061
Pinion shaft locking arm	21.549.0142
Pinion shaft solid handle	21.549.0145
Special purpose bearing cone (5A)	21.549.0144
Special purpose washer (8A)	21.282.0182
Special purpose bolt (9A)	21.547.0181
Special retainer bolt (9B)	25964R1
Inner bearing special washer (8B)	21.557.0008 Nr 1

GENERAL

2. DESCRIPTION

The final drive is a single reduction gear type mounted to each side of the machine. The reduction is provided by the sprocket drive gear (13, Fig. 7F.1)) and the drive pinion (15). The final drive housing (12) along with the bottom housing cover (21) serve as a reservoir for the lubricating oil.

3. OPERATION

The pinion shaft (15, Fig. 7F.1) is splined to the planet gear carrier at the inner end and is supported at the outer end by two tapered roller bearings (16 and 17). Power from the planet gear carrier is transmitted through the drive pinion to the sprocket drive gear (13). The drive gear is splined on the carrier shaft (2) and transfers power through the carrier shaft to the sprocket (1), which is mounted to the carrier shaft. The carrier shaft is supported in the final drive housing on tapered roller bearings (4 and 5) and is secured to the drive gear by a mounting bolt (9). The final drive is splash lubricated by its own supply of lubricant and is sealed against leakage and dirt.

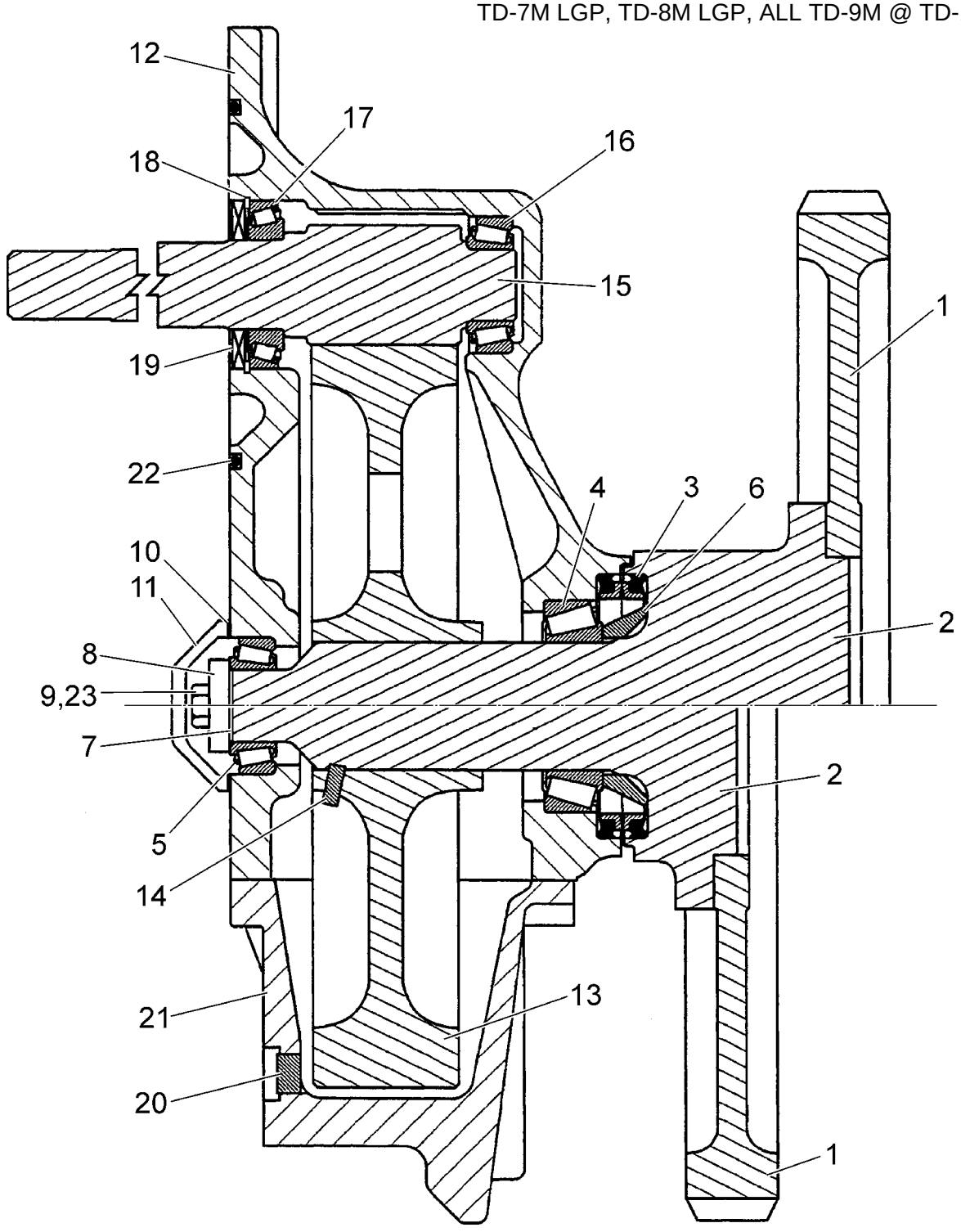
Legend for Fig. 7F.1.

1. Drive Sprocket
2. Sprocket Carrier Shaft
3. Seal Kit
4. Tapered Roller Bearing (Outer)
5. Tapered Roller Bearing (Inner)
6. Spacer Ring
7. Carrier Shim
8. Spacer Washer
9. Mounting Bolt
10. Cover Gasket
11. Carrier Shaft Cover
12. Final Drive Housing
13. Sprocket Drive Gear
14. Retaining Screw and lock Nut
15. Pinion Shaft Gear
16. Tapered Roller Bearing (Outer)
17. Tapered Roller Bearing (Inner)
18. Retaining Ring
19. Seal Ring
20. Drain Plug
21. Housing Bottom Cover
22. Housing O-Ring
23. Washer

FINAL DRIVE

GENERAL

TD-7M LGP, TD-8M LGP, ALL TD-9M @ TD-10M



TD-7M STD, TD-8M STD

Fig. 7F.1. Cross Section View of Final Drive

GENERAL

4. SPECIFICATIONS

Pinion Gear End Play ..... 0.00 to 0.23 [mm]

Special Bolt Torque Data:

Rock Deflector Mounting Bolts ..... 267 [Nm]
Sprocket Mounting Bolts ..... 455 [Nm]
Sprocket Carrier Shaft Retainer Mounting Bolt (TD-7M, TD-8M) ..... 435 ± 5% [Nm]
Sprocket Carrier Shaft Retainer Mounting Bolt (TD-9M, TD-10M) ..... 475 ± 5% [Nm]
Final Drive to Rear Frame Mounting Bolts ..... 190 [Nm]
Final Drive to Front Frame Mounting Bolts ..... 730 [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.*

Weights:

TD-7M or TD-8M Standard Track:

Final Drive with Sprocket..... 249 [kg]
Final Drive w/o Sprocket ..... 213 [kg]
Sprocket ..... 35 [kg]

TD-7M or TD-8M Low Ground Pressure:

Final Drive with Sprocket..... 263 [kg]
Final Drive w/o Sprocket ..... 227 [kg]
Sprocket ..... 35 [kg]

TD-9M or TD-10M:

Final Drive with Sprocket..... 354 [kg]
Final Drive w/o Sprocket ..... 303 [kg]
Sprocket ..... 50 [kg]

Sealants

Final Drive to Rear Main Frame ..... LOCTITE #12017 or LOCTITE #277
Bottom Housing Cover ..... LOCTITE #12017 or LOCTITE #277
Housing Mounting Studs ..... LOCTITE #12017 or LOCTITE #277
Final Drive Fill and Drain Plugs ..... LOCTITE #569
Final Drive Magnetic Plug ..... LOCTITE #592

FINAL DRIVE

GENERAL

5. SERVICE DIAGNOSIS

PROBABLE CAUSE	REMEDY
Final Drive Overheating	
1. Improper or insufficient lubrication.	Use proper grade and amount of lubricant. Check for leaks. Refer to OPERATOR'S MANUAL.
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. Refer to OPERATOR'S MANUAL.
2. Bearings scored or damaged.	Replace bearings.
3. Worn or damaged gears.	Inspect all gears and replace as necessary.
Lubricant Leakage	
1. Lubricant leaks at drain or level plugs.	Tighten plug or replace as necessary.
2. Lubricant leaks between final drive housing and rear main frame.	Remove, clean sealing surfaces and apply new LOCTITE.
3. Leakage between sprocket carrier shaft and final drive housing.	Replace carrier shaft seal.
Excessive Wear on Sprockets	
1. Tracks run too loosely.	Adjust tracks.
2. Tracks worn excessively.	Install new tracks.
3. Track frame out of alignment or damaged.	Repair or install new track frame.

FINAL DRIVE

6. 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 control lever is in NEUTRAL position, drive train neutral lock lever is in ON 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.

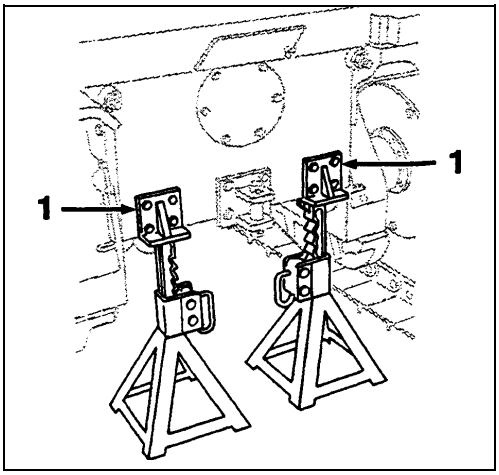


WARNING! This procedure requires extreme caution. Use suitable blocking equipment while under confines of machine.

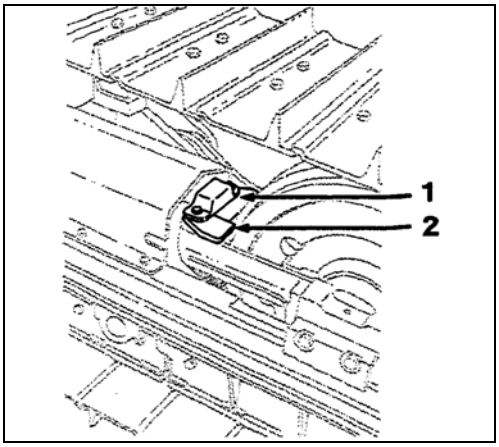
FINAL DRIVE

NOTE: *Following procedure is for removal of final drive on one side of machine. Procedure is identical for opposite side.*

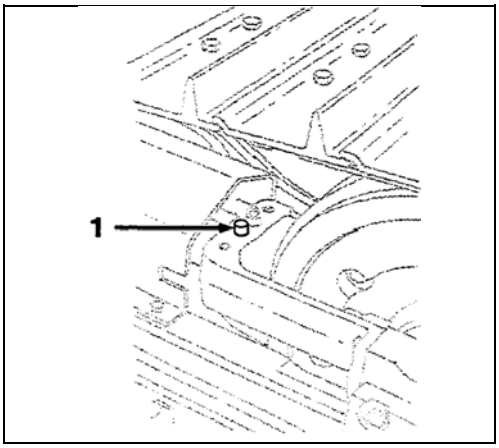
1. Drain rear main frame and final drive to be removed per the OPERATOR'S MANUAL. Install suitable mounting blocks (1) to rear frame and position on jack stands. Position split link at top left position on sprocket.



2. Remove track adjuster shield (1) and scraper plate (2).



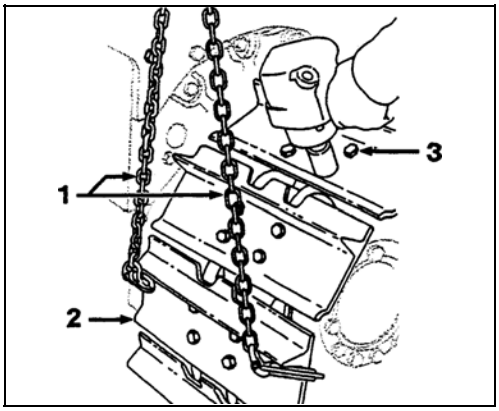
3. Loosen relief valve (1) and allow track chain to fully release. Refer to OPERATOR'S MANUAL for this procedure.



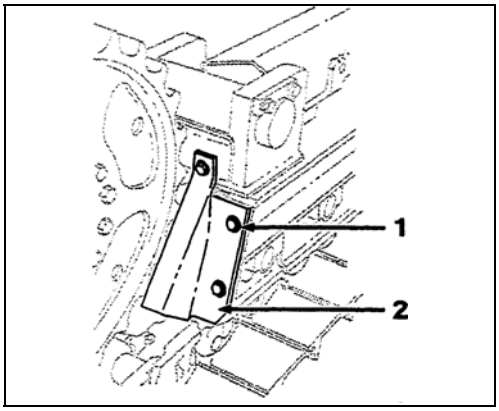
WARNING! Before disconnecting chain for any reason, be sure to relieve all track adjuster pressure. This must be done for safety reason.

FINAL DRIVE

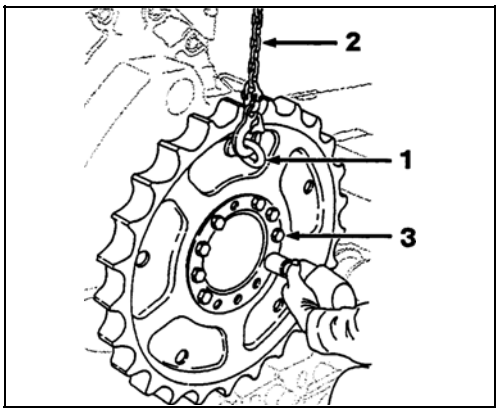
4. Attach hoist (1) to track shoe (2) at rear of chain and tension chain. Remove bolts (3) and track shoe over split link. Separate split link and lower track chain to floor with hoist. Attach hoist to remaining section of track chain and move forward to contact blade.



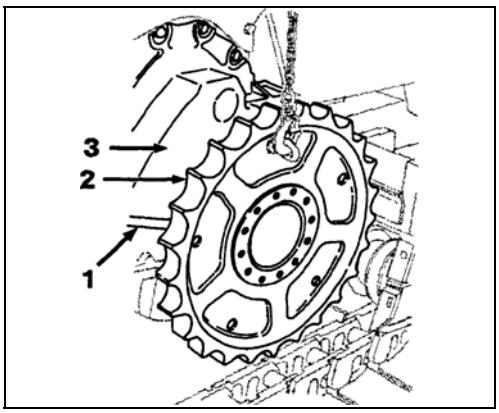
5. Remove bolts (1) and outer rock deflector (2).



6. Attach eye bolt (1) to top hole in sprocket, attach hoist (2) and tension chain. Remove sprocket mounting bolts (3).

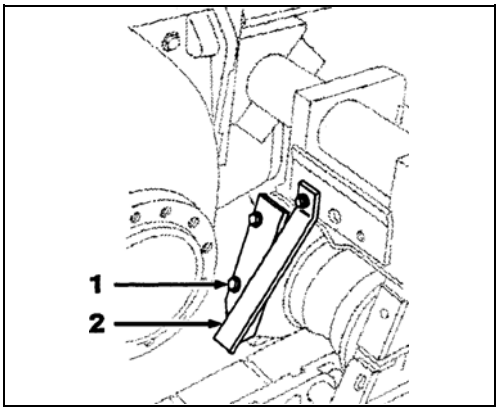


7. Position pry bar (1) between rear of sprocket (2) and final drive housing (3) and remove sprocket.

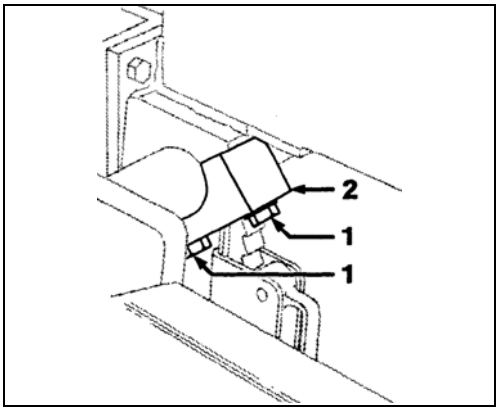


FINAL DRIVE

8. Remove bolts (1) and inner rock deflector (2).

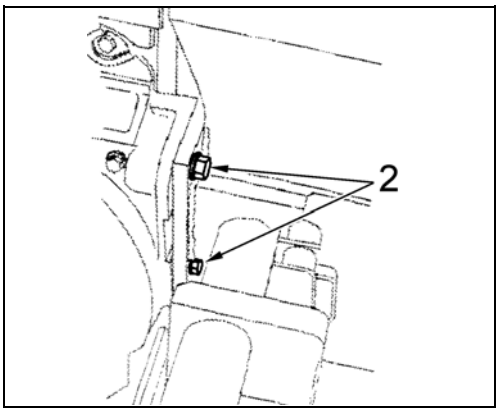


9. Remove bolts (1) and rear rigid crossbar mounting cover (2).

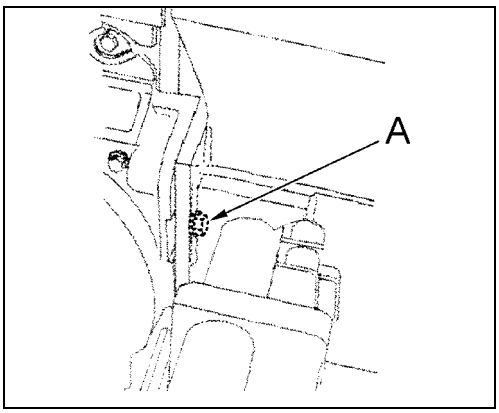


10. Remove four final drive to front frame bolts (2).

NOTE: *For TD-7M and TD-8M: remove spacer plate with final drive to front frame four bolts removing.*

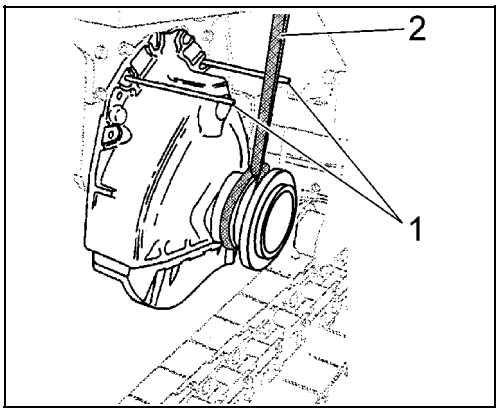


11. From under machine use rear/front frame safety bolts (A) to separate final drive assy from front frame contact surface. Loosen safety bolt (A) lock nut before this procedure.

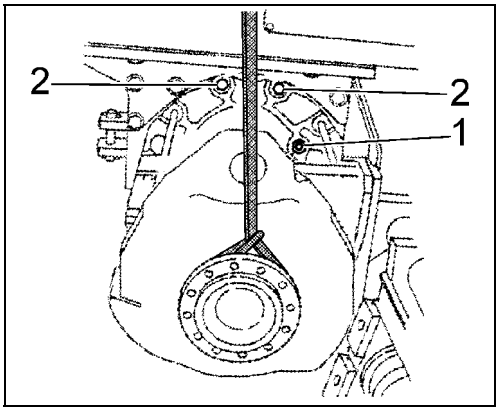


FINAL DRIVE

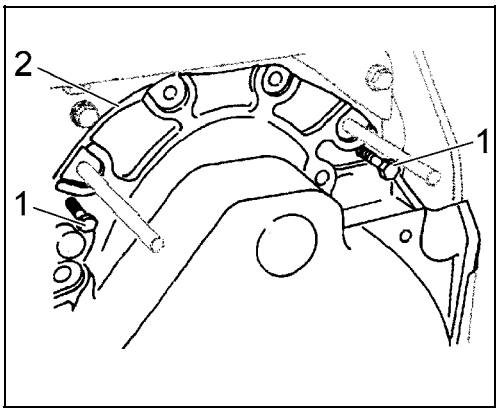
12. Remove two bolts and install 5/8NC removal rods (1) approximately 300 [mm] long. Attach lifting strap (2) to sprocket carrier shaft and take up slack to support weight of final drive when removed from rear main frame.



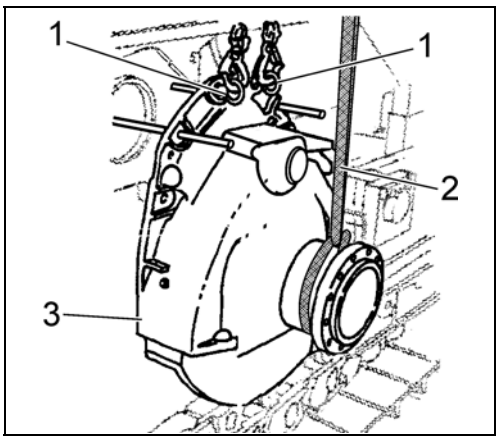
13. Remove lock nut and brake adjuster (1), threaded into rear main frame housing. Remove final drive housing top bolts (2) and inner lower hardware.



14. Remove corks from two puller screw holes. Install two 5/8NCx3 puller bolts (1) and draw final drive (2) away from rear main frame. Slide final drive out to clear side of machine.



15. Install two eye bolts (1) and nuts in top most holes in final drive housing. Attach hoist and tension. Remove lifting strap (2) and remove final drive (3).



FINAL DRIVE

7. DISASSEMBLY

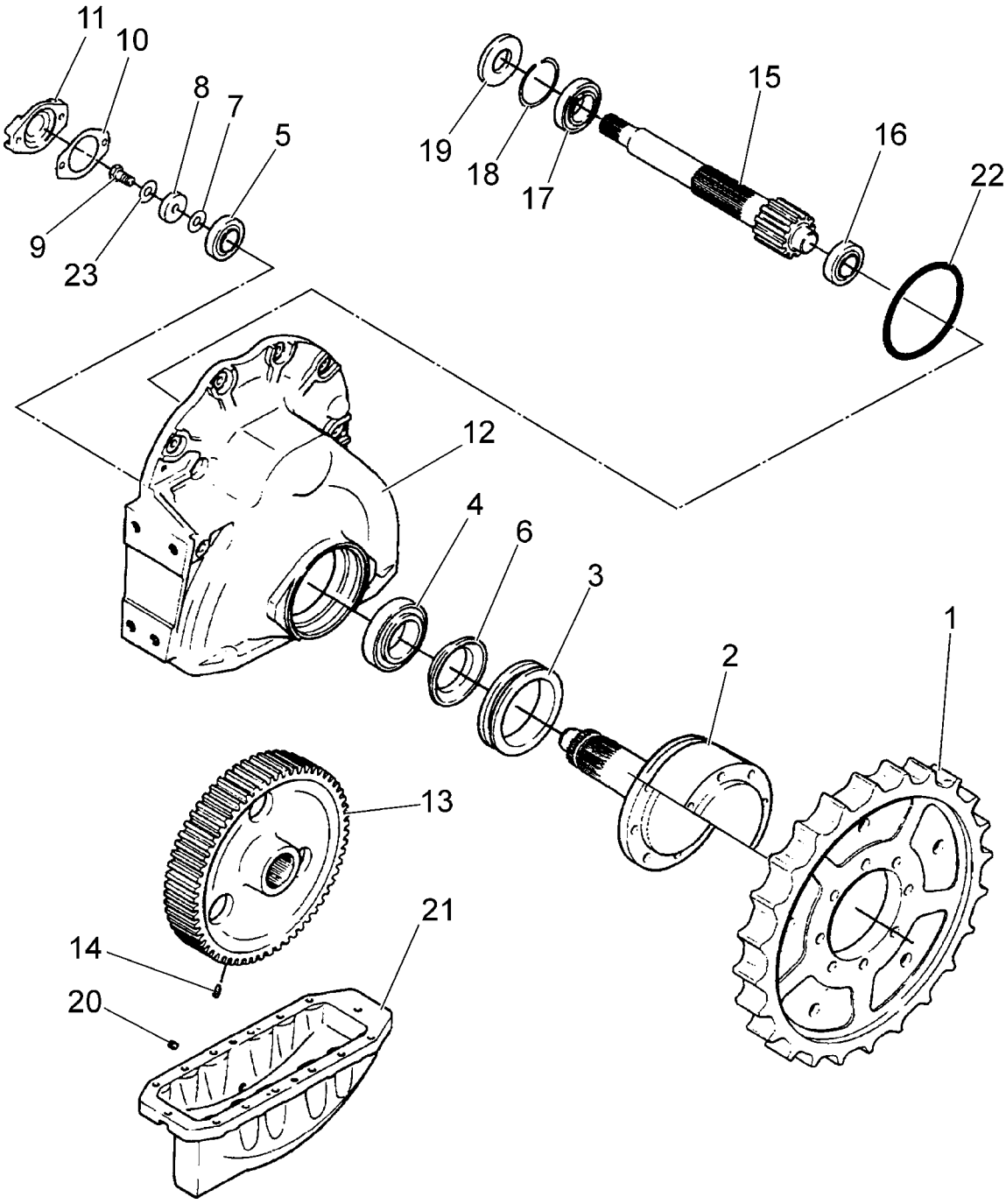


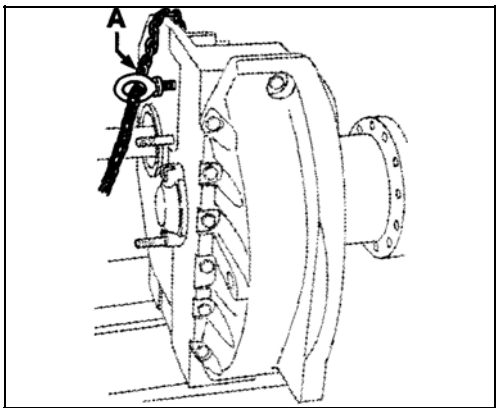
Fig. 7F.2. Exploded View of Final Drive

1. Sprocket
2. Carrier Shaft
3. Seal Kit
4. Outer Bearing
5. Inner Bearing
6. Spacer Ring
7. Shims
8. Spacer Washer
9. Bolt
10. Gasket
11. Cover
12. Housing
13. Drive Gear
14. Screw and Lock Nut
15. Pinion Shaft
16. Outer Bearing
17. Inner Bearing
18. Retaining Ring
19. Seal Ring
20. Drain Plug
21. Bottom Cover
22. O-Ring
23. Washer

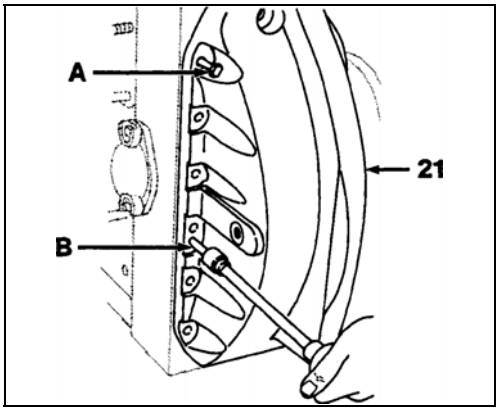
FINAL DRIVE

NOTE: *Callouts from cross section and exploded views (Fig.'s 7F.1 and 7F.2) correspond with callouts in following steps.*

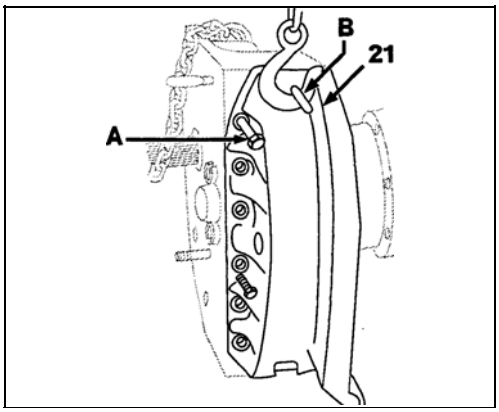
1. Rest final drive on bench with front frame mounting face down. Assemble safety restraint (A). Remove O-ring (22) from mounting face of final drive.



2. Replace two top corner bolts of bottom cover with 1/2NCx7 bolts (A). Remove corks from puller screw holes in bottom cover (21). Remove remaining cover mounting hardware. Install two 1/2NC puller screws (B). Remove bottom cover by running in puller screws.



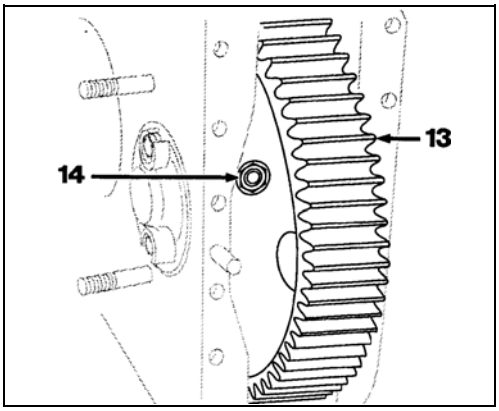
3. Slide bottom cover (21) out on two bolts (A), install eye bolt (B) and nut. Attach hoist to eye bolt and remove bolts then cover. Remove drain plug (20) and filler plug if needed.



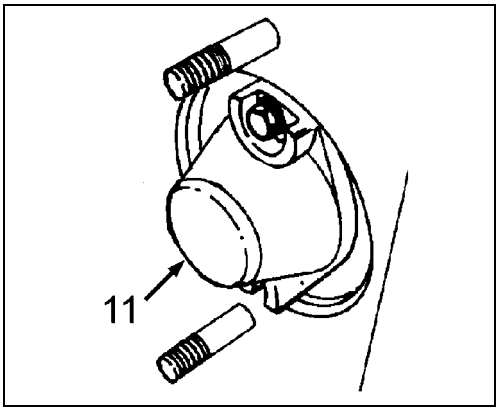
FINAL DRIVE

4. Rotate sprocket drive gear (13) to position retainer nut and screw (14) for removal. Remove sprocket carrier retaining screw and lock nut.

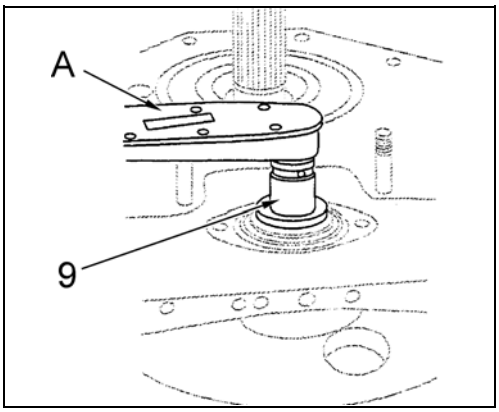
NOTE: *Discard retainer screw and replace with new.*



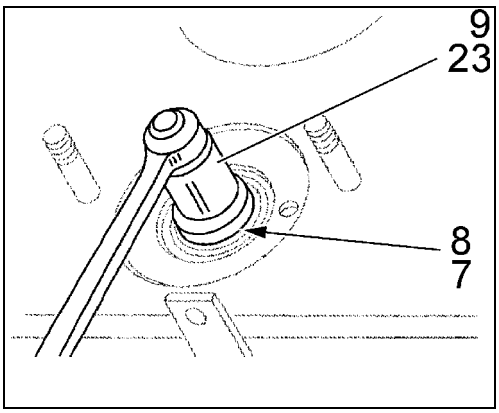
5. Remove carrier shaft cover (11) and discard gasket (10).



6. Using locking arm (A) (see SERVICE/SPECIAL TOOLS in this Section) loosen sprocket carrier bolt (9).

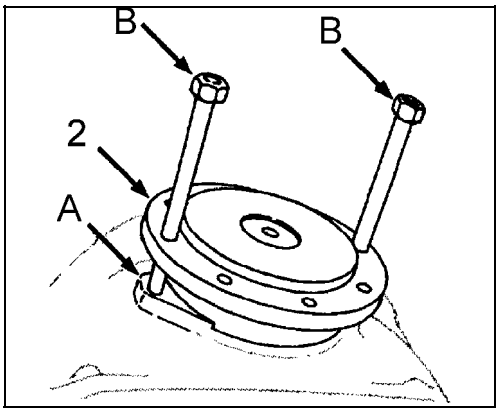


7. Remove sprocket carrier bolt (9) and washer (23), spacer washer (8) and shim pack (7).

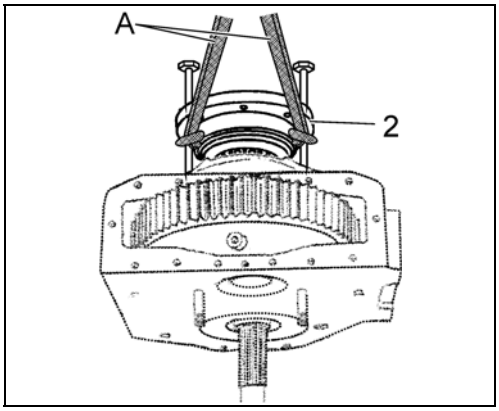


FINAL DRIVE

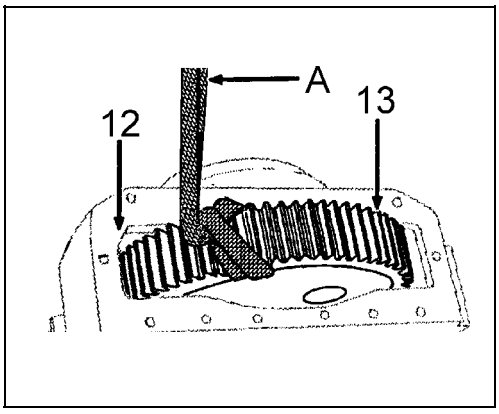
8. Position final drive housing in rotational stand (see SERVICE/SPECIAL TOOLS in this Section). Select the appropriate length puller screws 3/4NC (B) depending on STD or LGP tracks. Apply amber grease to threads and forcing face. Thread puller screws (B) through holes in sprocket carrier shaft (2) and aligned with cast bosses (A) on outside of housing. Thread in puller screws (B) to pull out shaft.



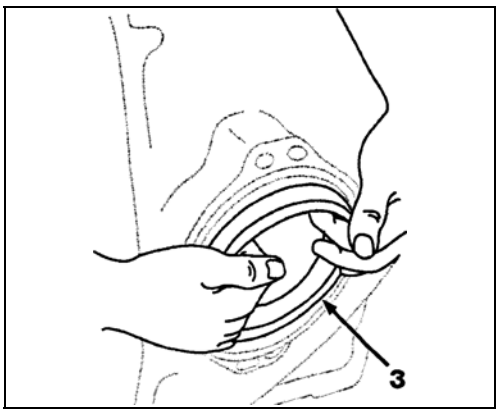
9. Using lifting strap (A) continue to draw out shaft (2) and remove from housing. Remove inner bearing cup (5) and outer bearing cup (4) from housing.



10. Turn housing (12) with drive gear (13) up. Thread lifting strap (A) through top relief hole in sprocket drive gear (13) and support gear with hoist. Remove gear from housing.

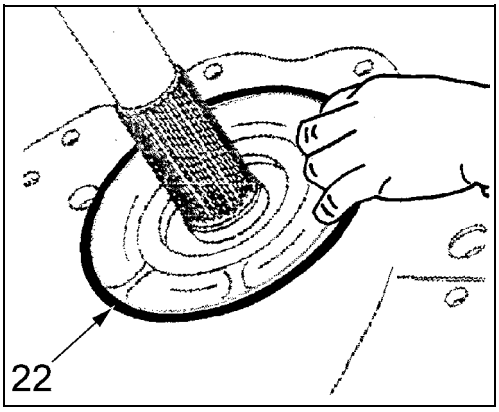


11. Remove sprocket shaft seal half (3) from housing.

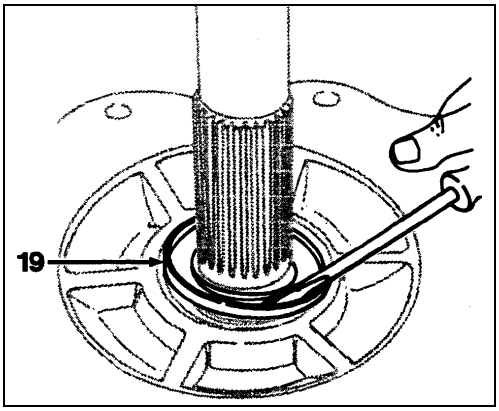


FINAL DRIVE

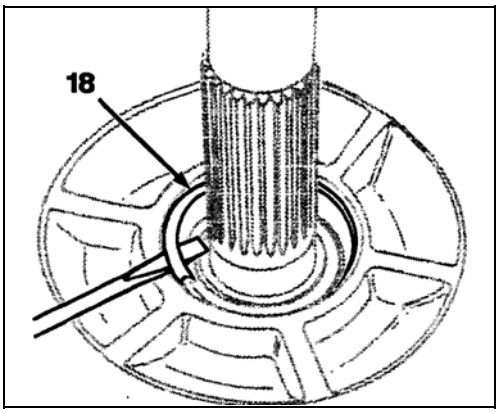
12. Remove O-ring (22) from drive pinion face of housing.



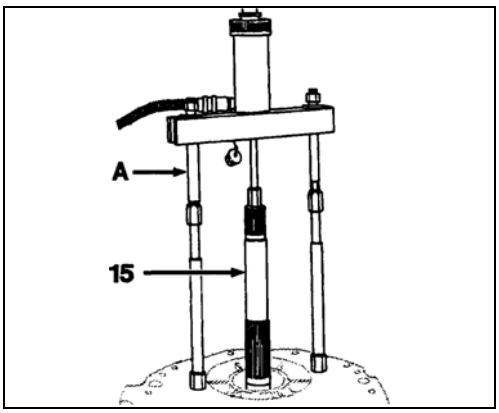
13. Remove seal ring (19) from housing by driving a screwdriver through flange of seal and prying out of housing.



14. Remove retaining ring (18) from housing.

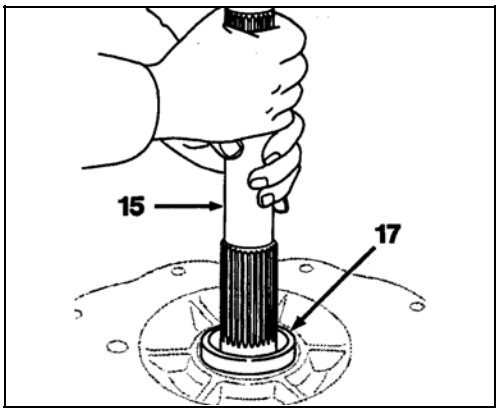


15. Draw out pinion shaft (15) with bearing cones (16 and 17) and inner cup (17) by means of puller arrangement (A) or slide hammer.

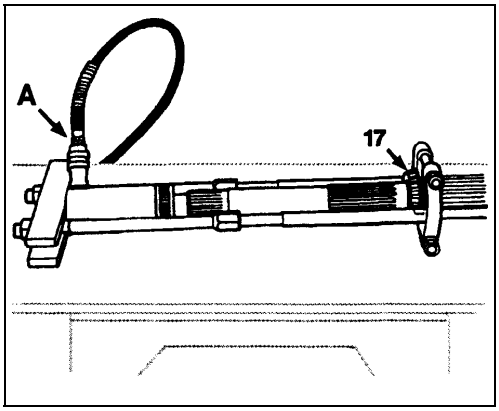


FINAL DRIVE

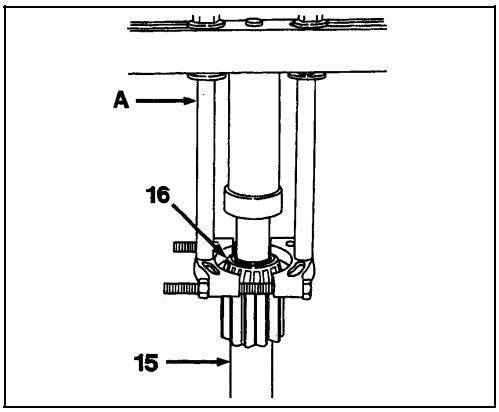
16. Remove puller. Remove pinion shaft (15) and inner cup (17). Inspect and remove outer bearing cup (16) if necessary.



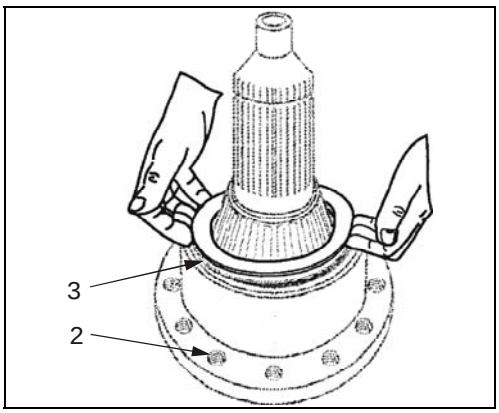
17. Install puller arrangement (A) and remove inner bearing cone (17) from pinion shaft (15).



18. Install puller arrangement (A) and remove outer bearing cone (16) from pinion shaft (15).

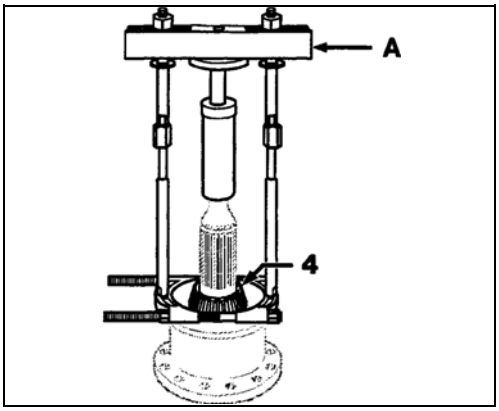


19. Remove seal half (3) from sprocket carrier shaft (2).

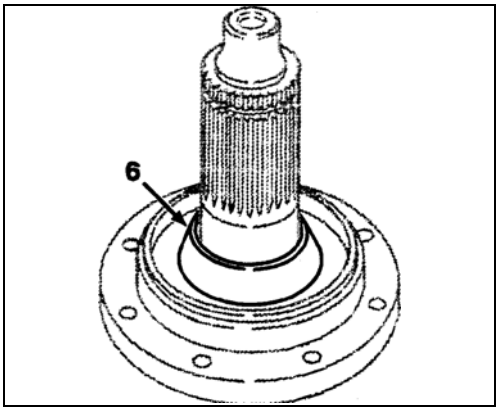


FINAL DRIVE

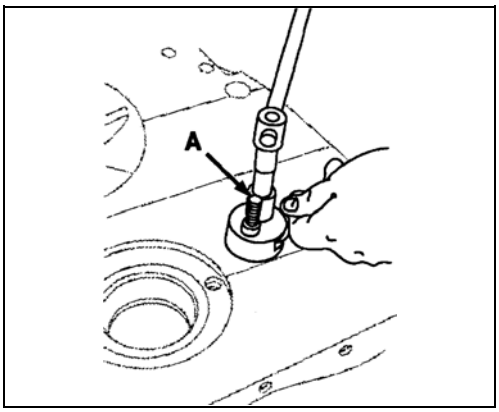
20. Install puller arrangement (A) and remove bearing cone (4) from sprocket carrier shaft.



21. If necessary to replace spacer ring (6), heat and remove. Press fit requires destroying of spacer during removal.



25. If necessary, remove studs (A) from housing.

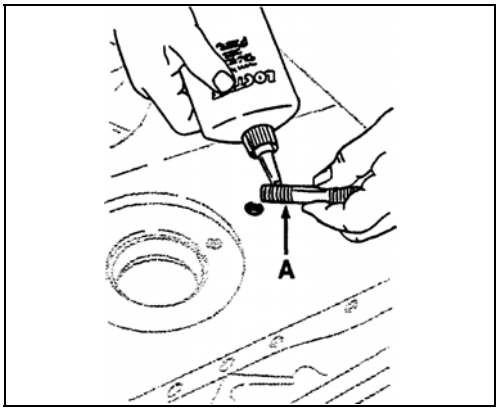


FINAL DRIVE

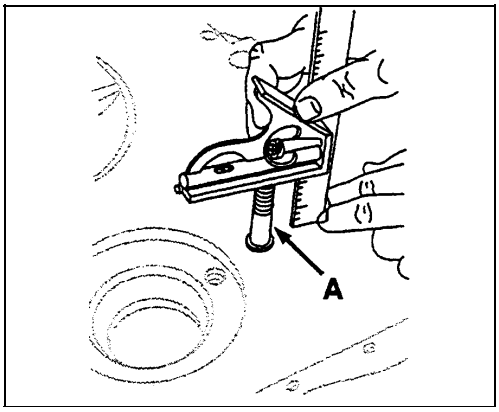
8. REASSEMBLY

NOTE: *Callouts from cross section and exploded views (Fig.'s 7F.1 and 7F.2) correspond with callouts in following steps.*

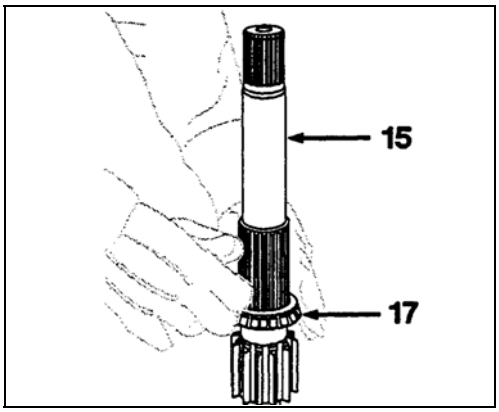
1. Position housing (12) in rotational stand (see SERVICE /SPECIAL TOOLS in this Section). Block final drive housing in a horizontal position with rear main frame mating face up. Check height of two mounting studs for 65 ± 0.8 [mm] dimension. If necessary to install new studs (A), use LOCTITE #12017.



2. Assemble studs (A) to housing and set to 65±0.8 [mm] dimension. If necessary, assemble drive pinion outer bearing cup (16) into housing. Using a driver, tap to seat in housing.

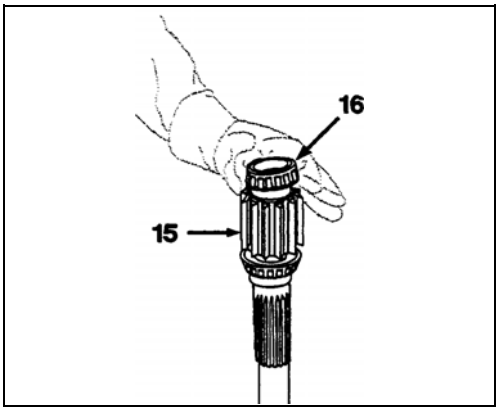


3. Heat drive pinion inner bearing cone (17) to max 150 [°C] for 45 [minutes] and assemble to shaft (15). Tap to seat against shoulder of shaft.

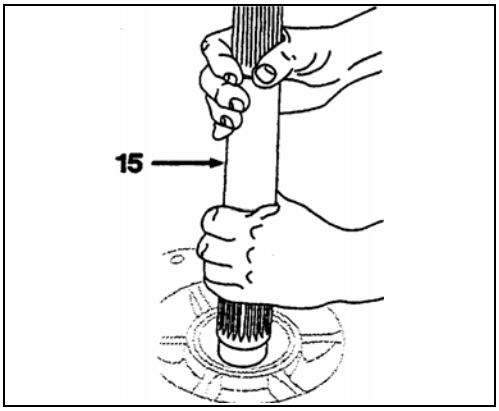


FINAL DRIVE

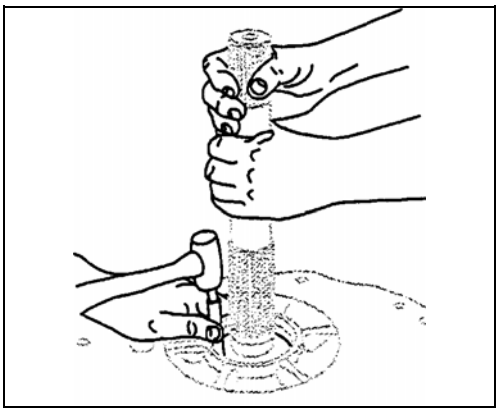
4. Invert shaft. Heat drive pinion outer bearing cone (16) to max 150 [°C] max for 45 [minutes] and assemble to shaft (15). Tap to seat against shoulder of shaft.



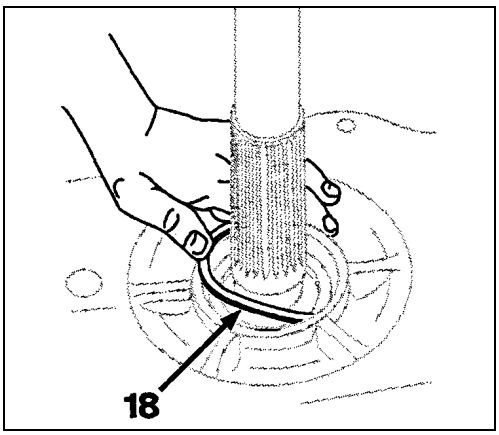
5. Prelube drive pinion bearings and set shaft (15) into outer bearing cup (16).



6. Using driver, install inner bearing cup (17), while rotating shaft, until a slight resistance to rotation is felt.

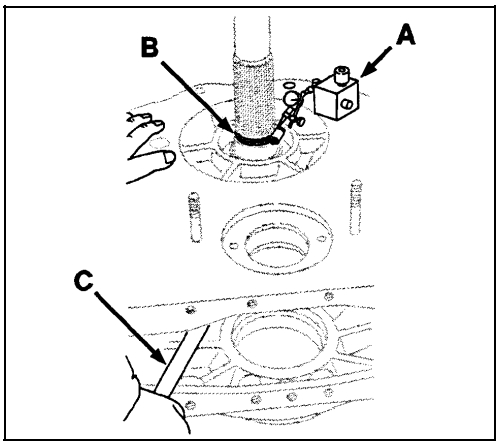


7. Attempt to insert 2.76 [mm] retaining ring (18). If it is possible to insert ring, bump cup back against ring with slide hammer. If shaft rotates freely assembly is complete.

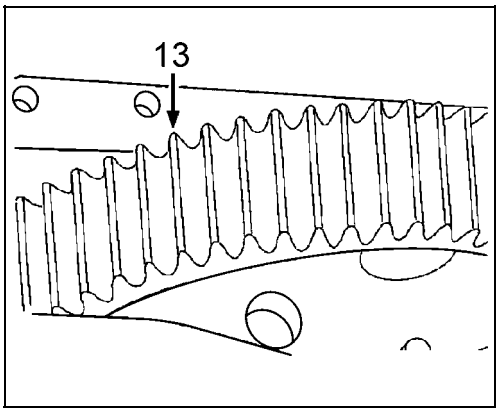


FINAL DRIVE

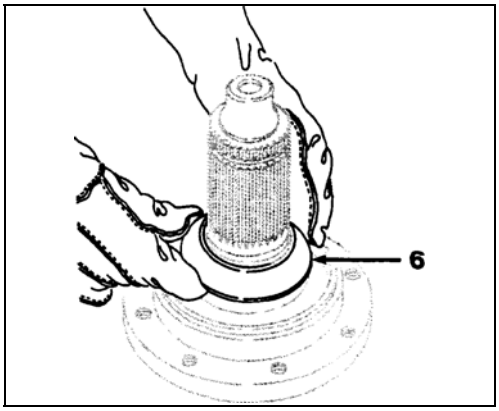
8. Position indicator (A) against hose clamp (B) assembled to shaft. Set to zero. Insert pry bar (C) between housing and shaft. Pry shaft upward from within housing to determine end play. Observe and record reading. Repeat two or three times and average readings. Required end play is 0.00 to 0.23 [mm]. If end play should exceed 0.23 [mm] with 2.76 [mm] retaining ring, install 2.97 [mm] ring and bump cup back against ring. If 2.76 [mm] retaining ring will not fit, or shaft will not rotate freely, install 2.57 [mm] retaining ring and bump cup back against retaining ring.



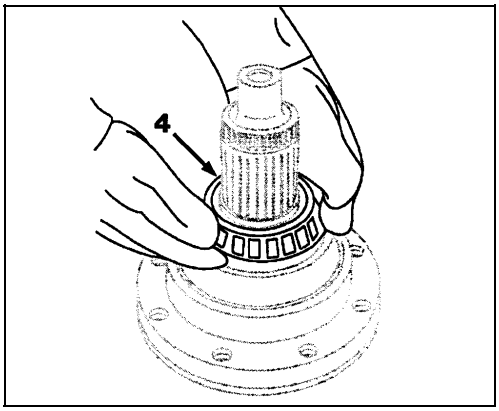
9. Install sprocket carrier shaft inner (5) and outer (4) bearing cups in housing and using a driver, bottom cups. Invert housing (12) with shaft (15) down. With lifting strap, position sprocket drive gear (13) in housing (12) with retainer screw hole facing down. Make sure drive gear (13) is in place inside housing (12).



10. Heat locating spacer (6) to max 150 [°C] and assemble to sprocket carrier shaft (2). With drift and hammer, tap to seat against shaft face.

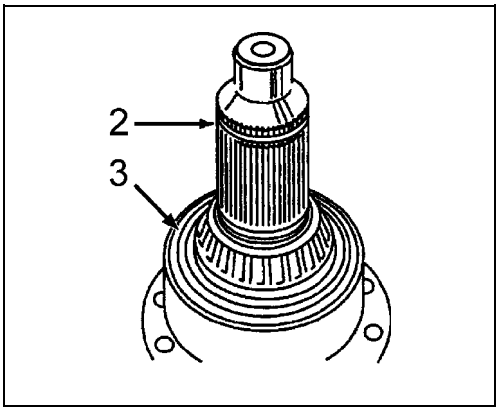


11. Heat sprocket carrier outer bearing (4) to max 150 [°C] max for 45 [minutes]. Install on shaft against locating spacer. With a drift and hammer, tap inner bearing race to seat.

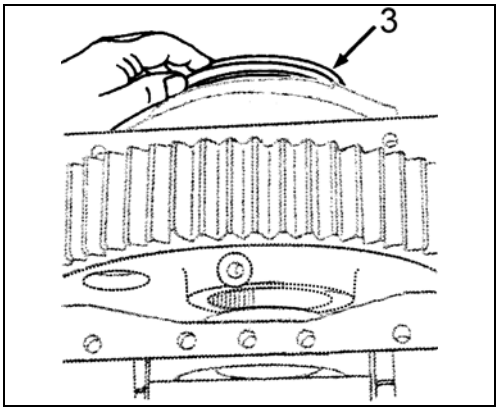


FINAL DRIVE

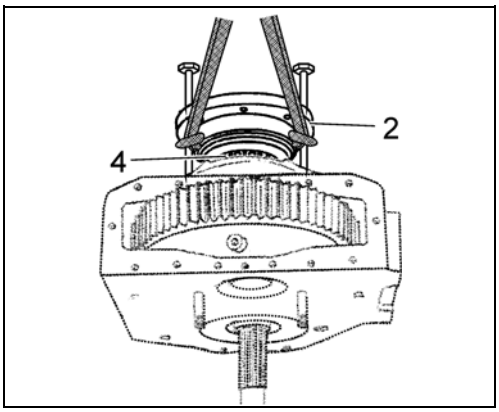
12. Install shaft seal half (3) on carrier shaft (2). Refer to METAL TYPE FACE SEALS in SECTION 14, SUSPENSION.



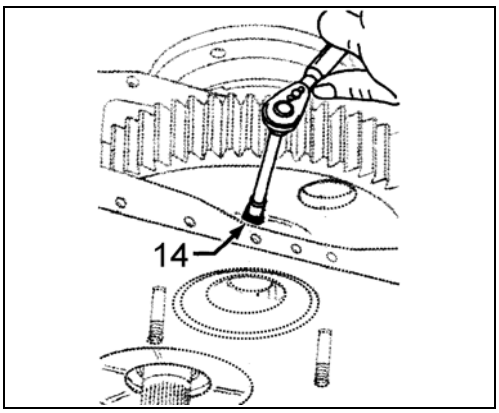
13. Install seal half (3) in housing (12). Refer to METAL TYPE FACE SEALS in SECTION 14, SUSPENSION.



14. Apply oil to outer bearing (4) and leading edge of carrier shaft (2) spline. Using lifting strap and two alignment screws 3/4NC (with appropriate length depending on STD or LGP tracks), lower sprocket carrier shaft (2) into housing (12) allowing leading edge of shaft (2) to extend through splined hole in drive gear (13). Lower carrier shaft to align shaft groove for retainer screw and nut.



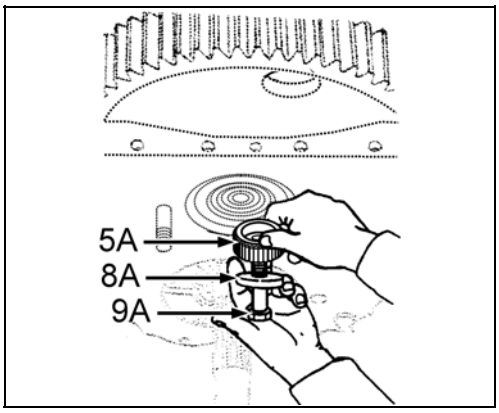
15. Assemble and tighten retainer screw (14) and lock nut. Torque retainer screw to 17 [Nm] and lock nut to 80 [Nm]. Continue to lower shaft to seat.



FINAL DRIVE

16. Install special purpose bearing cone (5A) (see SERVICE/SPECIAL TOOLS in this Section). Assemble special purpose bolt (9A) with special purpose washer (8A) (see SERVICE/SPECIAL TOOLS in this Section) using finger pressure.

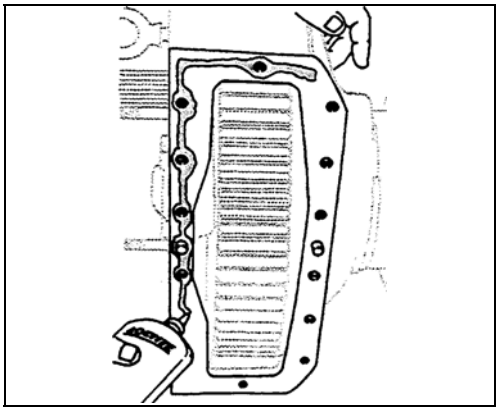
NOTE: *Position housing (12) with pinion shaft (15) down during special purpose bearing cone (5A) installing.*



NOTE: *Housing cover must be installed prior to tightening carrier shaft bolt to prevent housing deflection.*

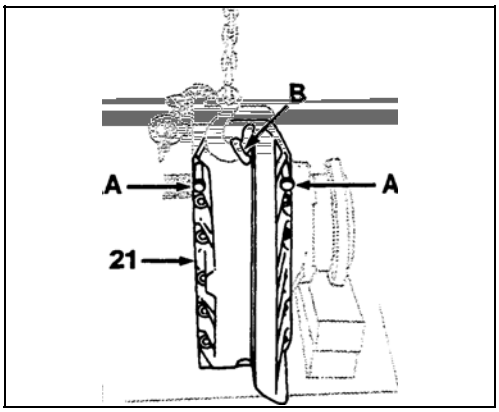
17. Reposition housing onto front frame mounting face. Assemble safety restraint. Apply a 6 [mm] bead of LOCTITE #277 or LOCTITE #12017 to cover mounting face of housing.

NOTE: *Bead must completely encircle each bolt hole.*

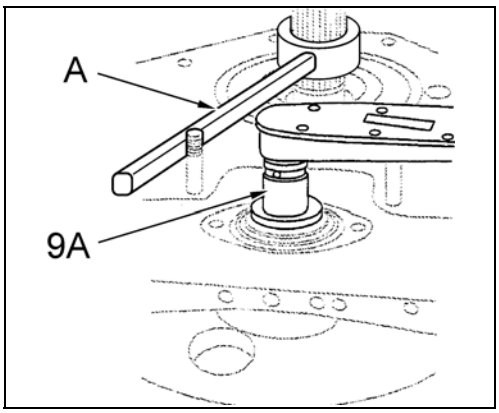


18. If necessary, install dowel pins in bottom cover mounting face of housing. Suspend bottom cover (21) to housing (12). Position two 1/2 NCx7 bolts (A) through cover into housing to slide cover on. Remove eye bolt (B) and seat cover to housing. Secure cover with hardware. Torque bolts to 92 ±10% [Nm].

NOTE: *Bottom cover bolts must be treated witch grease to prevent bolts seizing in case of LOCTITE penetration.*

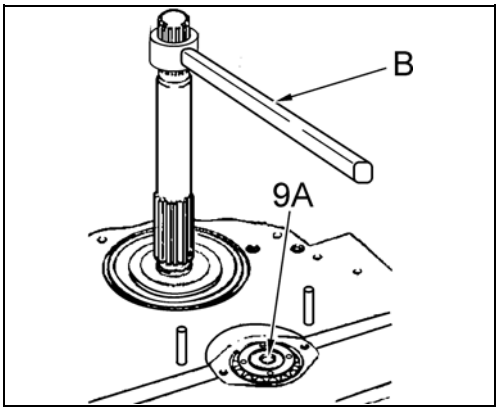


19. Using locking arm (A) (see SERVICE/SPECIAL TOOLS in this Section) torque carrier shaft special purpose bolt (9A) to 34 [Nm].

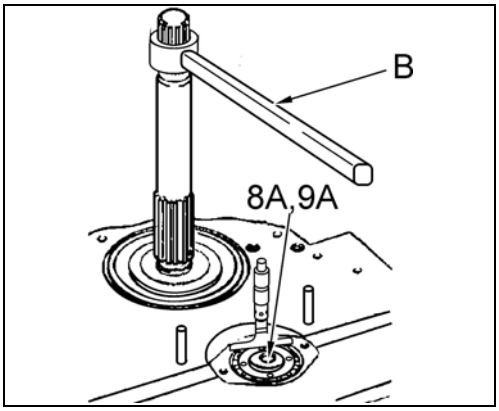


FINAL DRIVE

20. Install pinion shaft solid handle (B) (see SERVICE /SPECIAL TOOLS in this Section) on pinion shaft and rotate carrier shaft five revolutions back and forth. Repeat this procedure until 34 [Nm] torque value on the special purpose bolt (9A) stabilizes.

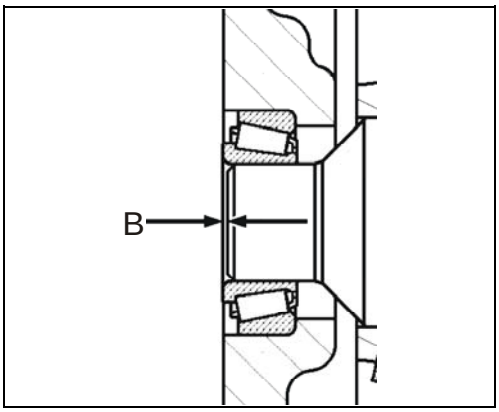


21. Determine the average distance (C) between the top of the sprocket shaft and the top of the special purpose washer (8A). To obtain this figure, use a depth gauge to measure the distance from the sprocket shaft surface to special purpose washer surface in four places through the special washer (8A) holes.



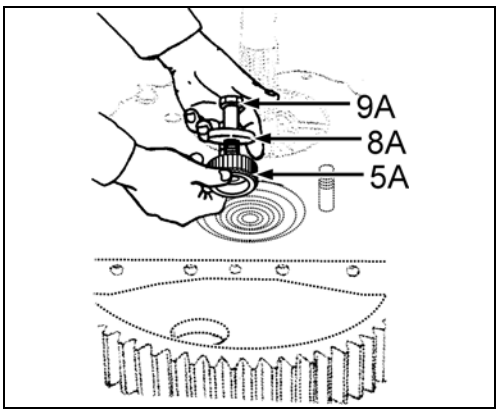
22. Remove the special purpose washer (8A) and measure the washer thickness (D) with a micrometer in two places. The proper shim pack (B) is equal to the measured distance (dimension D) minus the measured washer thickness (dimension C) :

B ± 0.05 [mm] = C - D



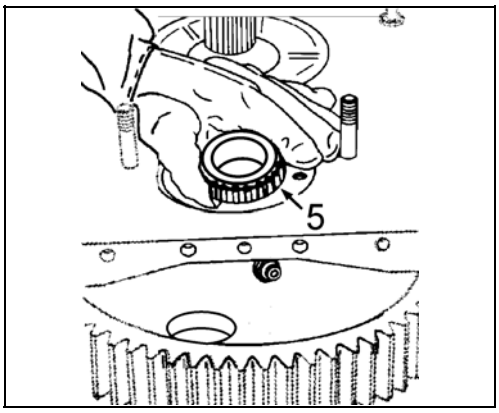
23. Remove the special purpose bolt (9A), and washer (8A). Remove special purpose bearing cone (5A).

NOTE: *Place a hydraulic jack under the center of the sprocket shaft. Using the jack, raise the sprocket shaft until final drive just clears the stand.*

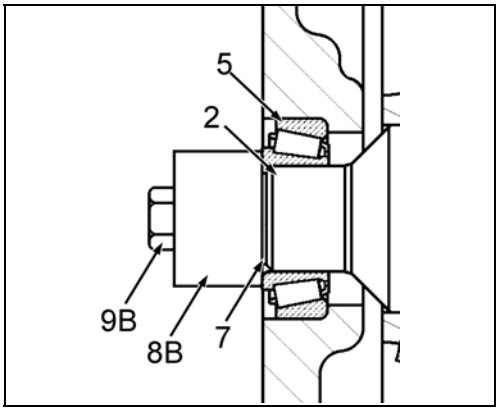


FINAL DRIVE

24. Install proper shim pack (7) on top of the sprocket shaft. Heat bearing cone (5) to max 150 [°C] for 45 minutes. Assemble bearing to sprocket carrier shaft. Tap with driver to seat the top of the bearing cone to the same level of the top of shim pack. Allow bearing to cool to room temperature.

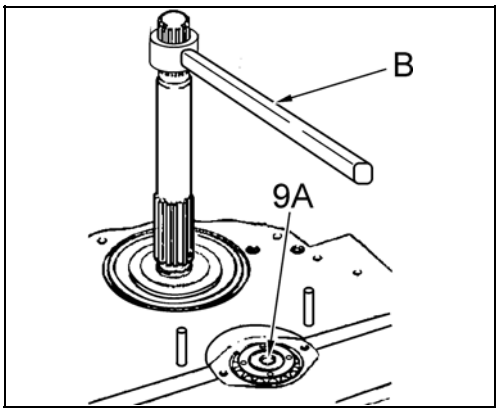


25. Install inner bearing special washer (8B) and special retainer long bolt (9B), 25964R1 (3/4NCx4-3/4). Pull up carrier shaft (2) to shoulder the bearing cup on the shaft (2). Use carrier shaft retainer bolt and pretorque it to 305 ± 5% [Nm].

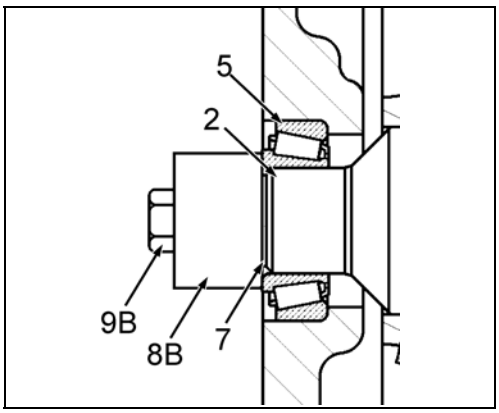


26. Install pinion shaft solid handle (B) (see SERVICE /SPECIAL TOOLS in this Section) on pinion shaft and rotate carrier shaft ten revolutions back and forth. Retorque retainer bolt (9B) to 305 ± 5% [Nm] again. Remove special bolt (9B), washer (8B) with shim pack (7) and check the gap between the top of carrier shaft and top of bearing cone.

NOTE: *The difference between measured distance and shim pack thickness must not exceed 0.05 [mm].*



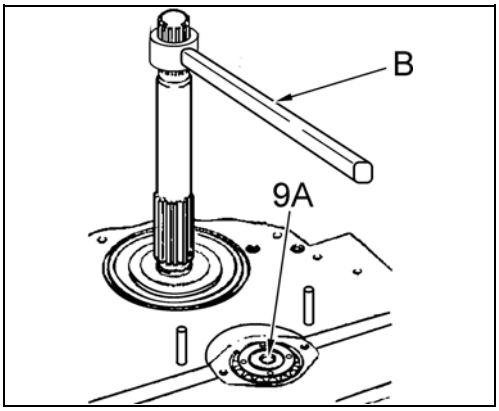
27. Reinstall shim pack (7), inner bearing special washer (8B) and special retainer long bolt (9B), 25964R1 (3/4NCx4-3/4). Pretorque sprocket carrier shaft retainer bolt (9B) to the torque schowed in SPECIFICATIONS.



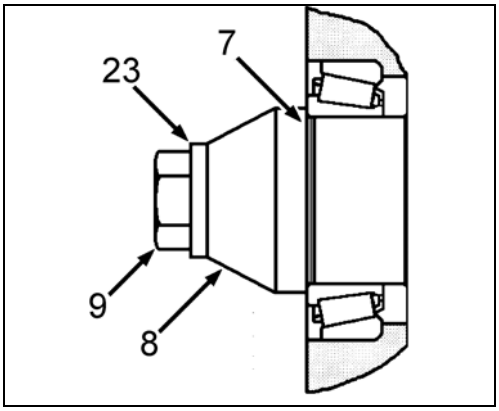
FINAL DRIVE

28. Install pinion shaft solid handle (B) (see SERVICE /SPECIAL TOOLS in this Section) on pinion shaft and rotate carrier shaft ten revolutions back and forth. Retorque retainer bolt (9B) to the torque schowed in SPECIFICATIONS again. Remove special bolt (9B), washer (8B) with shim pack (7) and check the gap between the top of carrier shaft and top of bearing cone.

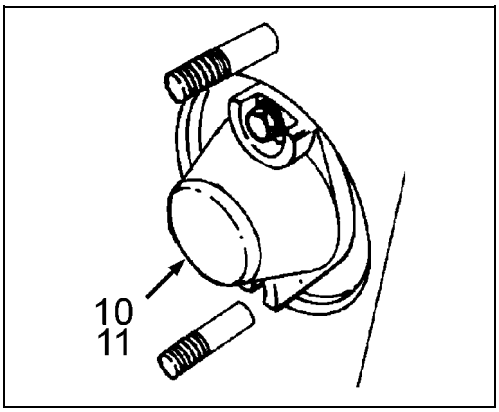
NOTE: *The difference between measured distance and shim pack thickness must not exceed 0.05 [mm].*



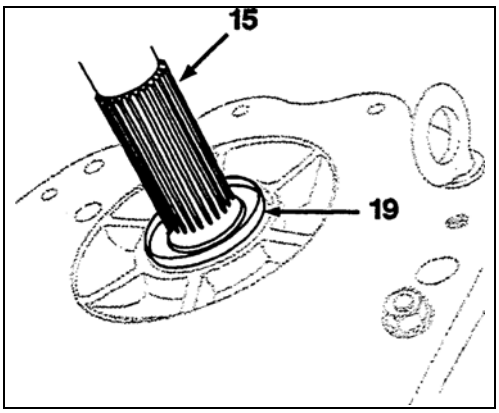
29. Reinstall shim pack (7). Install spacer washer (8), washer (23) and retainer bolt (9). Torque the bolt (9) to the torque schowed in SPECIFICATIONS using locking arm (see SERVICE /SPECIAL TOOLS in this Section).



30. Assemble carrier shaft cover (11) and gasket (10). Secure with hardware. Torque bolts to 60 ±10% [Nm].

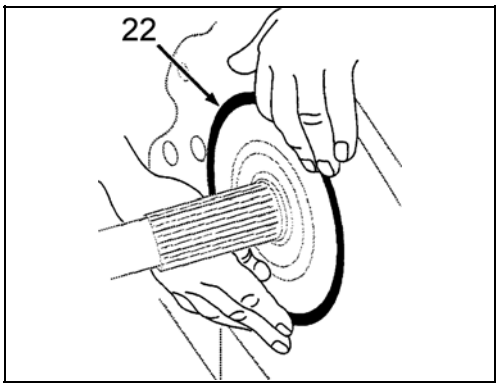


31. Carefully work shaft seal ring (19) (spring garter facing out) down pinion shaft (15), being careful not to cut sealing lip surface. Using a suitable driver, press pinion shaft seal edge flush with shoulder. Install drain plug (20) into bottom cover (21) and filler plug into housing (12) using LOCTITE #592.



FINAL DRIVE

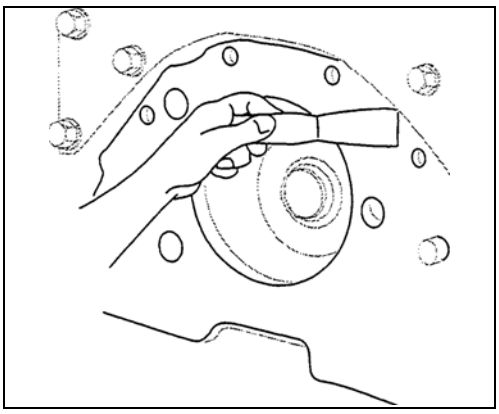
32. Install O-ring (22) to mounting face of final drive.



FINAL DRIVE

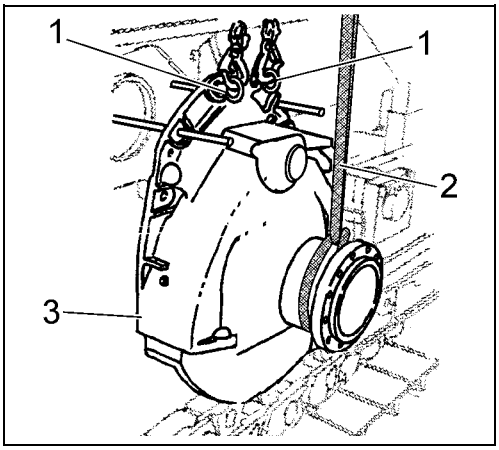
9. INSTALLATION

1. Apply LOCTITE #12017 to final drive mounting face of rear main frame. Spread with evenly putty knife.

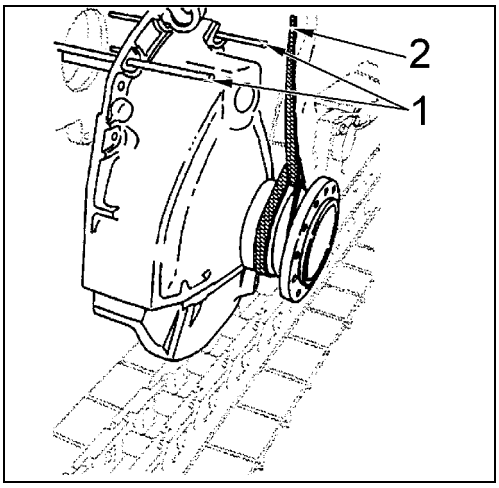


NOTE: *LOCTITE must not be closer than 25 [mm] from outside diameter of large bore and brake adjustment screw hole.*

2. Thread support 5/8NC rods 300 [mm] long into rear main frame. Install two 5/8NC eye bolts (1) into top most holes of final drive (3). Attach two legged chain to eye bolts and lifting strap (2) to sprocket carrier shaft. Adjust strap to maintain pinion shaft perpendicular to rear main frame mounting face.

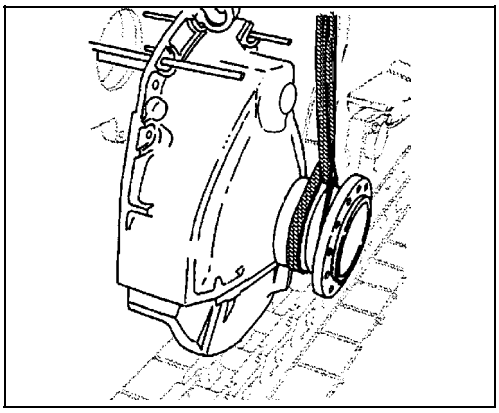


3. Slide final drive to contact rods (1) and support weight of final drive. Lower final drive to rest on rods. Remove two legged chain and eye bolts. Lifting strap (2) remains on sprocket carrier shaft to assist alignment of drive pinion during installation.

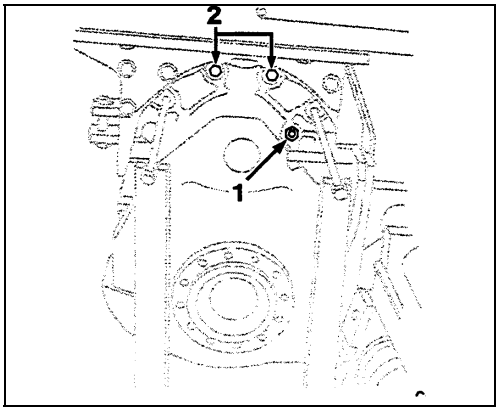


FINAL DRIVE

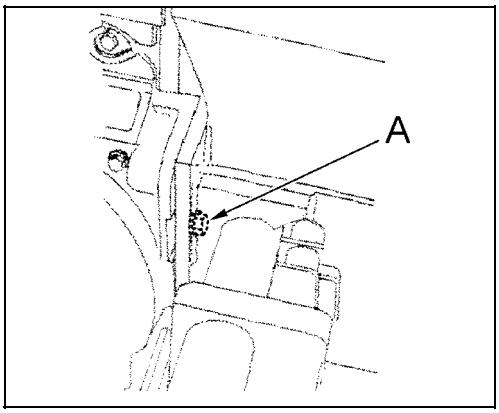
4. Slide final drive against rear main frame while threading drive pinion through brake and clutch discs and into planet gear carrier. Also, studs on inner bottom of final drive slide through bosses of rear main frame.



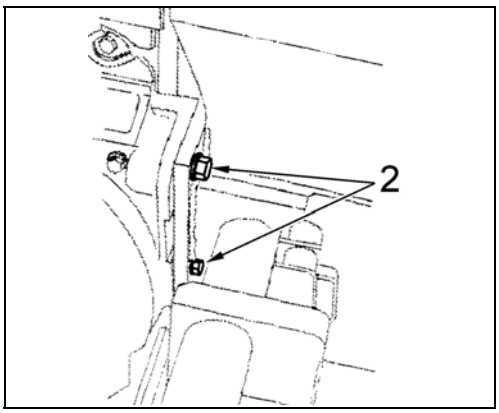
5. Coat mounting bolts (2) with engine oil or grease and install. Install lower inside hardware. Remove two support rods and replace with mounting bolts. Torque mounting bolts to 190 [Nm]. Install brake adjustment screw (1) and locknut. Adjust brakes, refer to Section 7E, STEERING DRIVE. Install and trim corks in two puller screw holes.



6. From under machine screw rear/front frame safety bolts (A) back and secure with counter nut. Refer to SECTION 9, FRAME for this procedure.

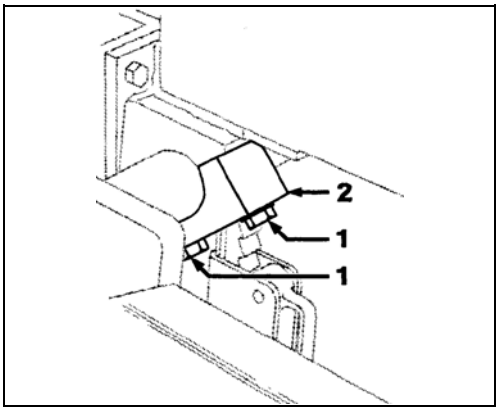


7. Install final drive to front frame bolts (2) and torque to 730 [Nm].

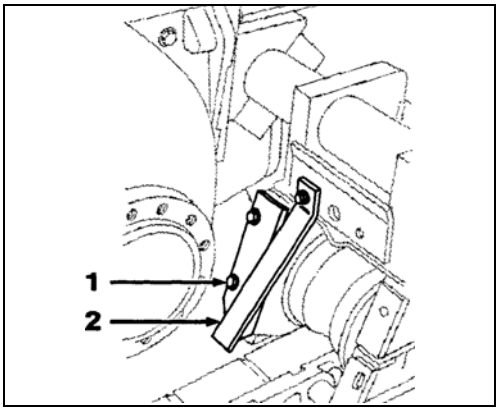


FINAL DRIVE

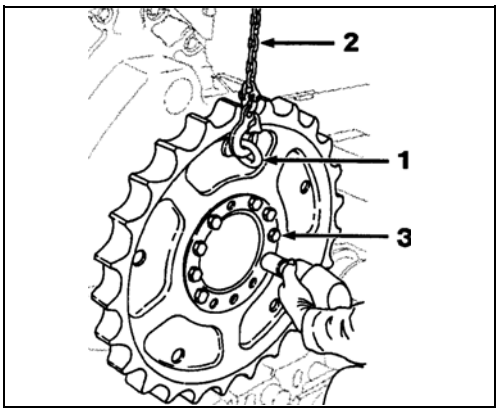
8. Install rear rigid crossbar mounting cover (2) with bolts (1) and torque to 780 [Nm].



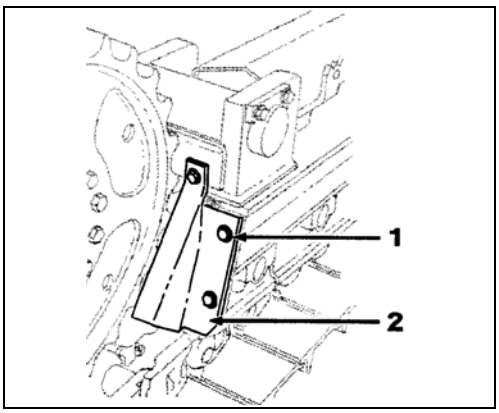
9. Install inner rock deflector (2) and bolts (1) and torque to 267 [Nm].



10. Attach eye bolt (1) to hole in sprocket, attach hoist (2) and install sprocket to carrier. Install bolts (3) and torque to 455 [Nm]. Remove eye bolt.

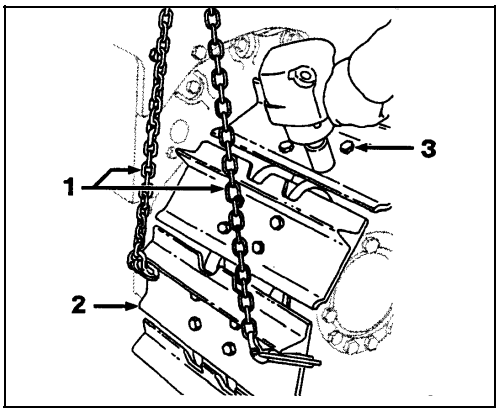


11. Install outer rock deflector (2) and bolts (1) and torque to 267 [Nm].

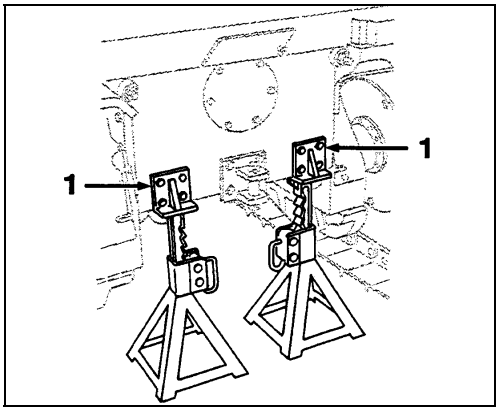


FINAL DRIVE

12. Attach hoist (1) to front section of track chain, pull chain to rear and position split link over sprocket. At least two links should contact sprocket. Reattach hoist to other section of chain, raise chain to engage and align split link. Install track shoe (2) and bolts (3). Liberally lubricate bolts with engine oil or chassis grease. Torque bolts to 90 ± 20 [Nm] plus 120 [°] turn.



13. Raise machine to clear blocking (1), remove, and lower machine to ground.



14. Be sure drain and filler plugs are installed in the final drive and fill final drive with oil as described in OPERATOR'S MANUAL.

15. Refill main frame with oil as described in OPERATOR'S MANUAL.

16. Adjust track chain, refer to OPERATOR'S MANUAL.

SECTION 8

ELECTRICAL

ELECTRICAL

SECTION 8

CONTENTS

GENERAL

1. SERVICE/SPECIAL TOOLS 3
2. DESCRIPTION 3

WIRING DIAGRAM

3. MACHINE AND CAB ELECTRICAL SYSTEM 4
4. SERVICE DIAGNOSIS 16
5. DESCRIPTION OF OPERATION AND DIAGNOSTICS FOR THE MACHINE DRIVE CONTROL SYSTEM 16

CRANKING MOTOR

6. DESCRIPTION 20
7. OPERATION 21
8. SPECIFICATIONS 22
9. SERVICE DIAGNOSIS 23
10. REMOVAL 26
11. TESTS 26
12. DISASSEMBLY 28
13. INSPECTION AND REPAIR 32
14. REASSEMBLY 37
15. INSTALLATION 38

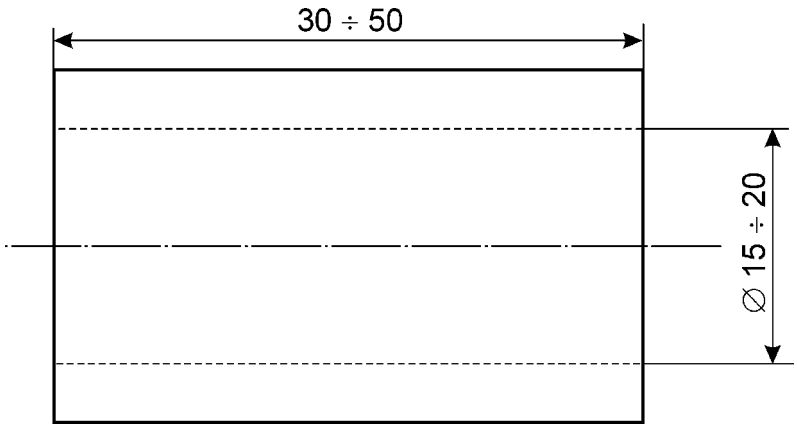
BATTERY

16. SAFETY PRECAUTIONS 39
17. ELECTROLYTE STATE OF CHARGE 40
18. ELECTROLYTE IN TROPICAL AND ARCTIC CLIMATES 40
19. TESTING AND MAINTENANCE THE BATTERY 41
20. BATTERY CHARGING GUIDE 43
21. BATTERY STORAGE 43
22. BATTERY PRIMARY RATINGS 44
23. COLD ENGINE CRANKING PERFORMANCE 44
24. DRY CHARGE ACTIVATION 44
25. TYPICAL OF CAUSE OF BATTERY FAILURE 45
26. VISUAL INSPECTION OF BATTERY 45

GENERAL

1. SERVICE SPECIAL TOOLS

DESCRIPTION	TOOL NUMBER
Multimeter	Any suitable
Electronic Battery Tester	Any suitable



Steel 25 per PN-93/H-84019

Spacer

2. DESCRIPTION

A 12 [V] negatively grounded electrical system is used, consisting of a tractor circuit and cab circuit.
One 12 [V] battery supply the system.
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 switch 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 Diagrams in this section.

IMPORTANT: *Never disconnect the alternator, master switch or battery 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 battery, 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 DIAGRAMS

3. MACHINE AND CAB ELECTRICAL SYSTEM (Fig. 8.1, 8.1A, 8.2, 8.2A and 8.3)

Electrical tractor system consists of starting circuit, charging circuit, drive train control circuit and accessories circuit.

a. Starting Circuit

The electric system master switch (16) located in the positive lead of battery (17) must be in the “ON” position to complete the battery circuit for starting power. When the starting key is turned in the starting switch (26) to “START”, current flows from battery to starting switch (26) and by circuit breaker 20 [A] to start-up lock switch (19). If the drive train neutral lock lever is in “ON” position current flows by start-up lock switch (19) closed contacts to solenoid of start-up magnetic switch (7). The cranking motor (6) solenoid is actuated by closed contacts of magnetic switch (7) 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 (26) is released, both units release their spools, breaking the circuit.

b. Charging Circuit

The charging circuit contains the alternator (4) and the battery (17). Once the engine is running, the alternator output is used to supply the power demands as well as recharge the battery. 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.

c. Drive Train Control Circuit

Once the engine was started, with the shift lever still in neutral, the machine is stationary as neither of the machine travel direction clutch packs has been activated.

The CMCV lever for drive train control (38) that is located at the operator’s LH side is responsible for the following, among others:

1. 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 gear solenoid valves (21 and 22) will be deenergized at that point. The second gear will be engaged when the solenoid valve (22) mounted at the rear LH side of drive train control valve is reenergized; while the third gear requires the solenoid valve (21)mounted at the RH side to get reenergized. The drive train electronic controller (37) 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 travel direction will be hydraulically engaged with the lever shifted forward or rearward. If rearward will be engaged at the same time pressure switch (36) will powering the backup alarm (32).

   The signal light on cluster gauge (31) powered from the controller (37) located at top of LH battery box will indicate the gear engaged.

d. Warning Lamps Circuit

The warning lamps are activated through suitable switches, which are as follows: lamp (C) is activated through a switch (20), lamp (D) through a switch (18), lamp (E) through a switch (10), lamp (F) through a switch (29). The lamps are checked through the starting switch (26) and diodes assembly (24).

e. ECM Circuit

In the TD-10M and TD-10MDD machines engine electronic control modul (ECM) (40) has been used that controls the engine operation. The power to the ECM is through fuses (44 and 45).
Engine electronic control module (40) (ECM) together with components wired to the module and designated with a dashed line are outlined in Troubleshooting and Repair Manual QSB 5.9 Engines.

f. 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 are used to protect them.

ELECTRICAL

WIRING DIAGRAM

Description to TD-7M, TD-8M, TD-8M DD, TD-9M, TD-9M DD WIRING DIAGRAM (Fig. 8.1) (earlier version)

1. Horn
2. Coolant Temperature Sensor
3. Not used
4. Alternator 65 [A]

4A. Alternator 105 [A] (option)

5. RH Headlamp
6. Cranking Motor
7. Engine Startup Electromagnetic Switch
8. Ether Solenoid Valve
9. Not used
10. Air Cleaner Clogging Warning Light Switch
11. Engine Oil Pressure Sensor
12. Low Engine Oil Pressure Warning Light Switch
13. Fuel Pump Solenoid Valve
14. LH Headlamp
15. Drive Train Oil Temperature Sensor
16. Master Switch
17. Battery 12[V]
18. Drive Train Oil Pressure Filter Clogging Warning Light Switch
19. Startup Lock Switch
20. Low Transmission Speed Clutch Oil Pressure Switch
21. 3rd Gear Solenoid Valve
22. 2nd Gear Solenoid Valve
23. Dozer Lights Switch
24. Diodes Assy
25. Dozer Automatic Circuit Breakers
26. Starting Switch
27. Instrument Panel Illumination Light
28. Ether Solenoid Valve Button
29. Equipment Hydraulic System Oil Filter Clogging Warning Light Switch
30. Horn Button
31. Cluster Gauge
32. Backup Alarm
33. Fuel Level Sensor
34. Hourmeter
35. Fuel Level Gauge
36. Backup Alarm Pressure Switch
37. Drive Train Electronic Controller
38. Drive Train Control Lever
39. Rear Lamp
40. Air Conditioner Electromagnetic Clutch

GAUGE CLUSTER COMPONENTS – See description under Fig. 8.1A.

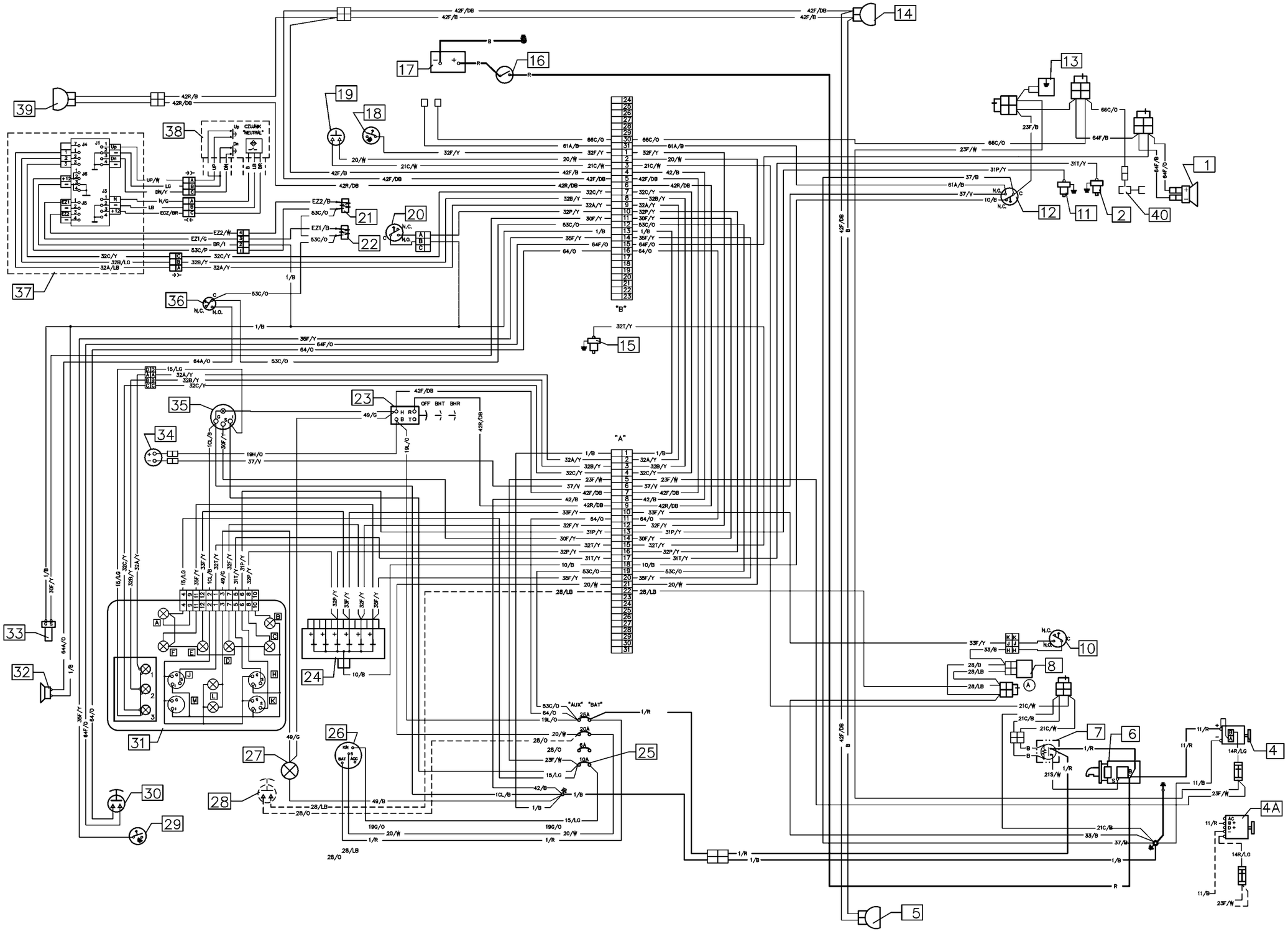


Fig. 8.1. Wiring Diagram: TD-7M, TD-8M, TD-9M, TD-8DD, TD-9DD (earlier version)

ELECTRICAL

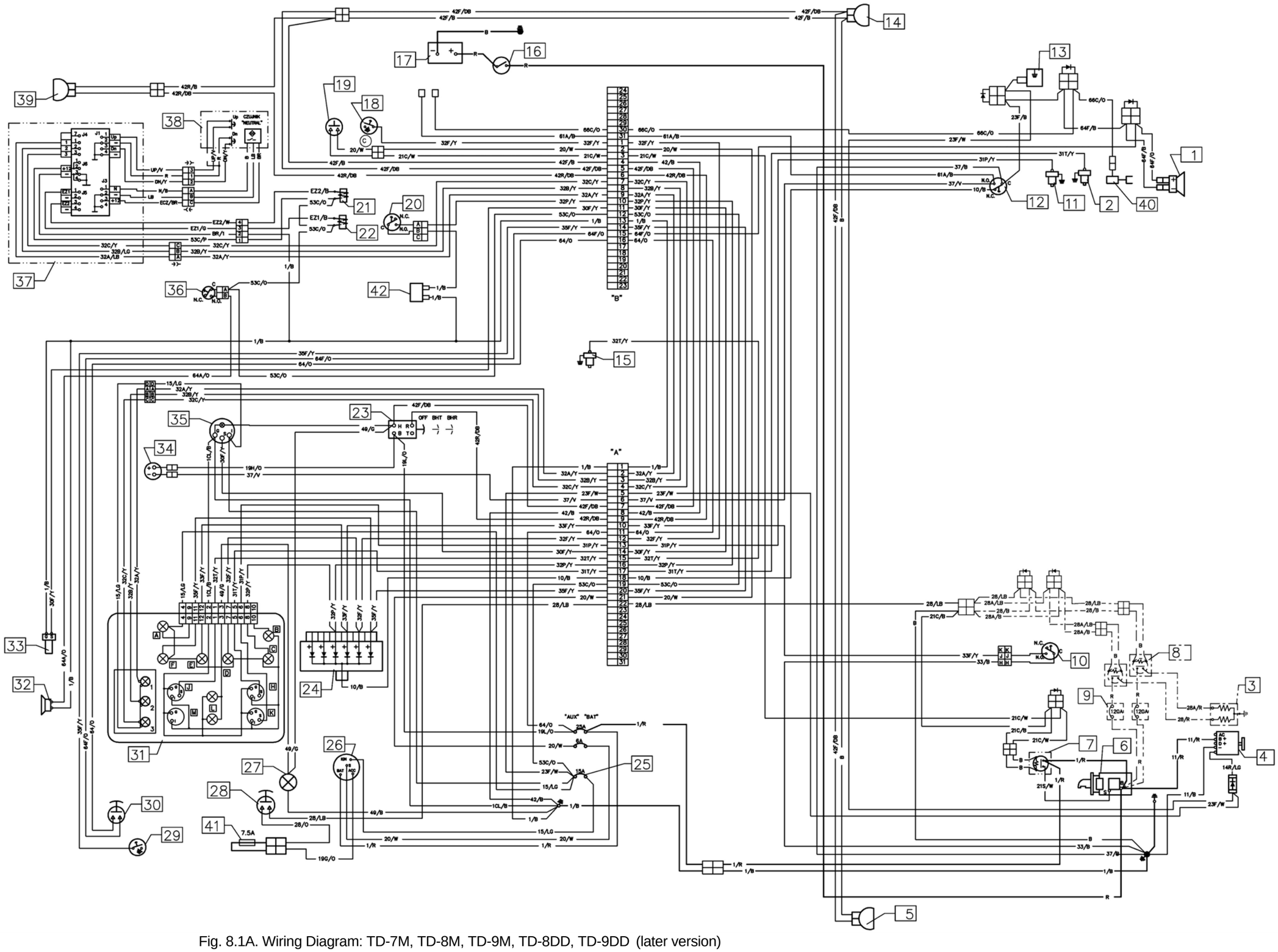


Fig. 8.1A. Wiring Diagram: TD-7M, TD-8M, TD-9M, TD-8DD, TD-9DD (later version)

Description to WIRING DIAGRAM : TD-7M, TD-8M, TD-9M, TD-8M DD, TD-9M DD (Fig. 8.1A) (later version)

1. Horn
2. Coolant Temperature Sensor
3. Engine Air Preheater
4. Alternator 105 [A]
5. RH Headlamp
6. Cranking Motor
7. Engine Startup Electromagnetic Switch
8. Engine Air Preheater Electromagnetic Switches
9. Engine Air Preheater Breakers
10. Air Cleaner Clogging Warning Light Switch
11. Engine Oil Pressure Sensor
12. Low Engine Oil Pressure Switch (Hourmeter, A/C, Fan and Warning Lights Checking Switch)
13. Fuel Pump Solenoid Valve
14. LH Headlamp
15. Drive Train Oil Temperature Sensor
16. Master Switch
17. Battery 12[V]
18. Drive Train Oil Pressure Filter Clogging Warning Light Switch
19. Startup Lock Switch
20. Low Main Oil Pressure Switch
21. 3rd Gear Solenoid Valve
22. 2nd Gear Solenoid Valve
23. Dozer Lights Switch
24. Diodes Assy
25. Dozer Automatic Circuit Breakers
26. Starting Switch
27. Instrument Panel Illumination Light
28. Engine Air Preheater Button
29. Equipment Hydraulic System Oil Filter Clogging Warning Light Switch
30. Horn Button
31. Cluster Gauge
32. Backup Alarm
33. Fuel Level Sensor
34. Hourmeter
35. Fuel Level Gauge
36. Backup Alarm Pressure Switch
37. Drive Train Electronic Controller
38. Drive Train Control Lever
39. Rear Lamp
40. Air Conditioner Electromagnetic Clutch
41. Engine Air Preheater Control Fuse
42. Low Main Oil Pressure Warning Light Time Delay Modul

GAUGE CLUSTER COMPONENTS

A – Light not used
B – Light not used
C – Low Main Oil Pressure Switch Warning Light
D – Drive Train Oil Filter Clogging Warning Light
E – Air Cleaner Clogging Warning Light
F – Equipment Hydraulic System Oil Filter Clogging Warning Light
H – Coolant Temperature Gauge
J – Drive Train Oil Temperature Gauge
K – Engine Oil Pressure Gauge
L – Gauges Illumination Lights
M – Voltmeter
N – „1”, „2”, „3” Engaged Gear Signal Lights

WIRE COLOR CODE

Designation	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

WIRE CABLE MARKING

42 cable designation
DB color code
-42/DB-

Description to TD-10M and TD-10M DD WIRING DIAGRAM (Fig. 8.2) (earlier version).

1. Horn
2. Coolant Temperature Sensor
3. Not used
4. Alternator 65 [A]

4A. Alternator 105 [A] (option)
5. RH Headlamp
6. Cranking Motor
7. Engine Startup Electromagnetic Switch
8. Ether Solenoid Valve
9. Not used
10. Air Cleaner Clogging Warning Light Switch
11. Engine Oil Pressure Sensor
12. Low Engine Oil Pressure Switch (Hourmeter, A/C, Fan and Warning Lights Checking Switch)
13. Air Conditioner Electromagnetic Clutch
14. LH Headlamp
15. Drive Train Oil Temperature Sensor
16. Master Switch
17. Battery 12[V]
18. Drive Train Oil Pressure Filter Clogging Warning Light Switch
19. Startup Lock Switch
20. Low Main Oil Pressure Switch
21. 3rd Gear Solenoid Valve
22. 2nd Gear Solenoid Valve
23. Dozer Lights Switch
24. Diodes Assy
25. Dozer Automatic Circuit Breakers
26. Starting Switch
27. Instrument Panel Illumination Light
28. Ether Solenoid Valve Button
29. Equipment Hydraulic System Oil Filter Clogging Warning Light Switch
30. Horn Button
31. Cluster Gauge
32. Backup Alarm
33. Fuel Level Sensor
34. Hourmeter
35. Fuel Level Gauge
36. Backup Alarm Pressure Switch
37. Drive Train Electronic Controller
38. Drive Train Control Lever
39. Rear Lamp
40. Engine Electronic Control Module (ECM)
41. Water in Fuel Sensor
42. Engine Electronic Control Module (ECM) Control Potentiometer
43. Fuse – Data Readout (10 [A])
44. Fuses – ECM Power Supply (7.5 [A])
45. Fuses – VP-44 Fuel Pump Supply (10 [A])
46. ECM Data Link Connector
47. "STOP" Engine Warning Light (Red)
48. Engine "!"Faults Warning Light (Yellow)
49. Engine Faults „FLUID" Warning Light (Orange)
50. Not used
51. Water in Fuel Filter Warning Light (Yellow)
52. Engine ECM Failure Code Display (in machines S/N up to 57507) and Intermediate Speed Control (ISC) Selector Momentary Switch
53. Engine ECM Failure Code Activation Selector Momentary Switch

GAUGE CLUSTER COMPONENTS – See description under Fig. 8.2A.

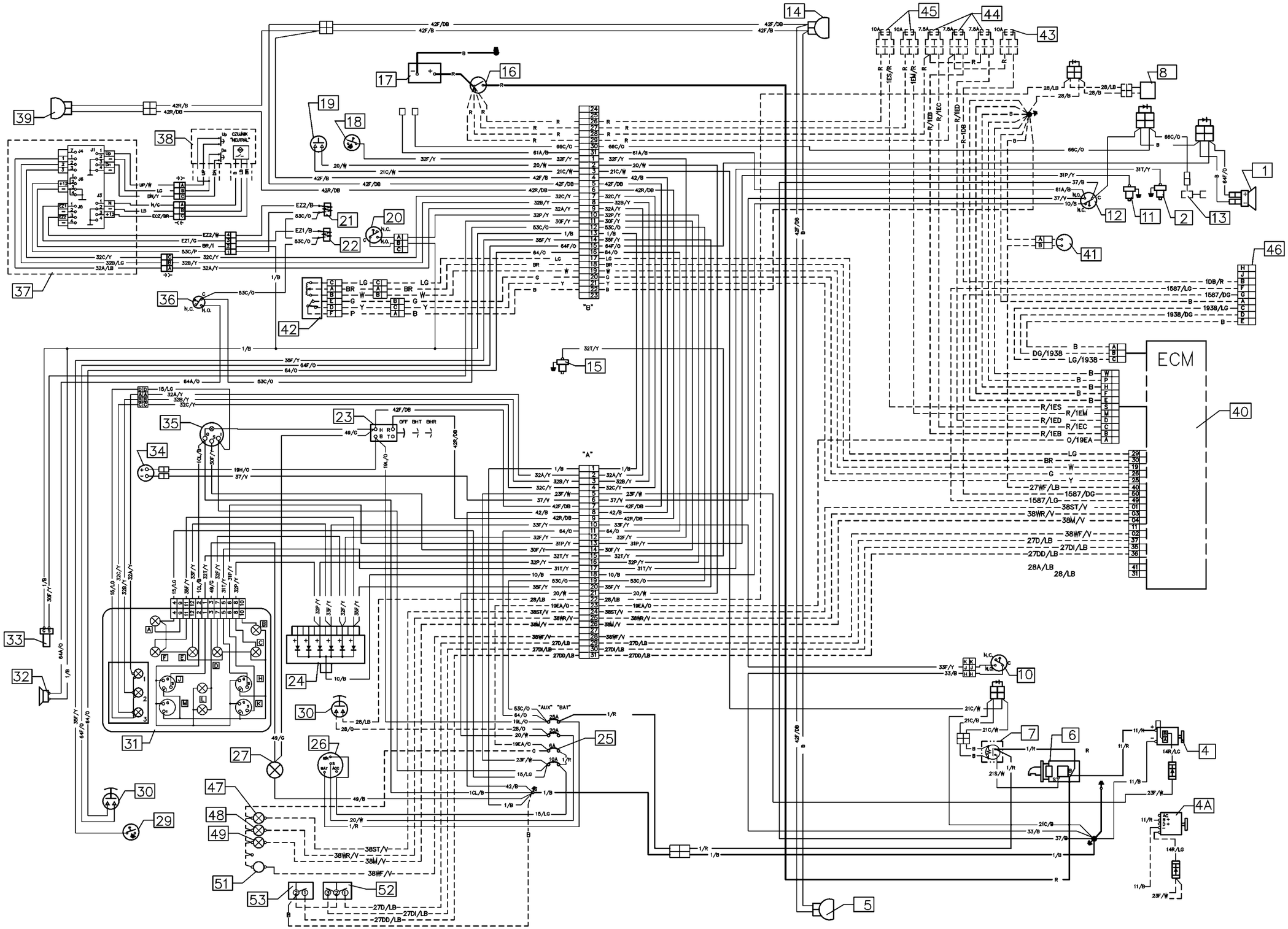


Fig. 8.2. Wiring Diagram to TD-10M, TD-10M DD (earlier version)

ELECTRICAL

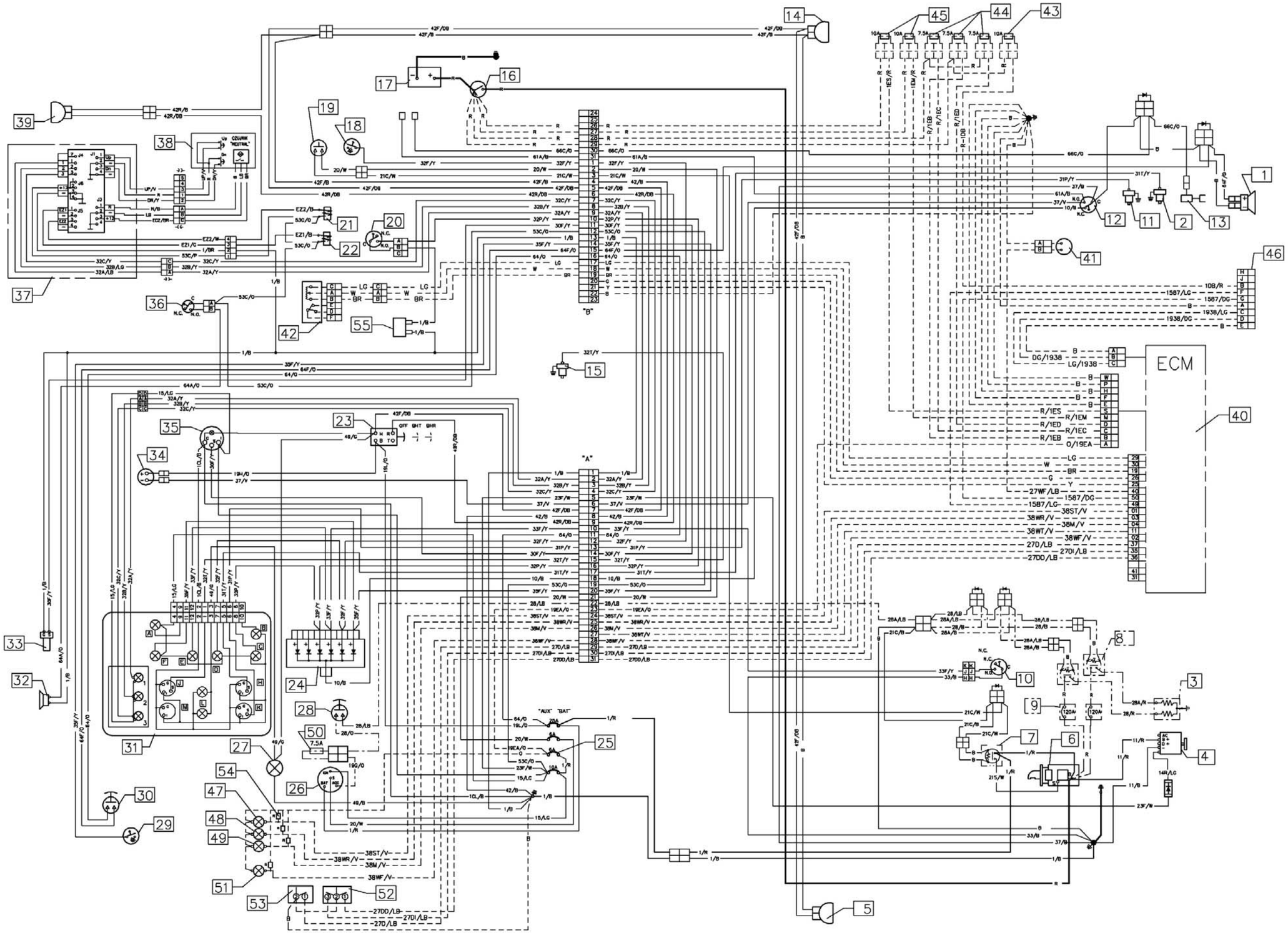


Fig. 8.2A. Wiring Diagram to TD-10M, TD-10M DD (later version)

Description to TD-10M and TD-10M DD WIRING DIAGRAM (Fig. 8.2A) (later version)

1. Horn
2. Coolant Temperature Sensor
3. Engine Air Preheater
4. Alternator 105 [A]
5. RH Headlamp
6. Cranking Motor
7. Engine Startup Electromagnetic Switch
8. Engine Air Preheater Electromagnetic Switch
9. Engine Air Preheater Breakers
10. Air Cleaner Clogging Warning Light Switch
11. Engine Oil Pressure Sensor
12. Low Engine Oil Pressure Switch (Hourmeter, A/C, Fan and Warning Lights Checking Switch)
13. Air Conditioner Electromagnetic Clutch
14. LH Headlamp
15. Drive Train Oil Temperature Sensor
16. Master Switch
17. Battery 12[V]
18. Drive Train Oil Pressure Filter Clogging Warning Light Switch
19. Startup Lock Switch
20. Low Main Oil Pressure Switch
21. 3rd Gear Solenoid Valve
22. 2nd Gear Solenoid Valve
23. Dozer Lights Switch
24. Diodes Assy
25. Dozer Automatic Circuit Breakers
26. Starting Switch
27. Instrument Panel Illumination Light
28. Engine Air Preheater Button
29. Equipment Hydraulic System Oil Filter Clogging Warning Light Switch
30. Horn Button
31. Cluster Gauge
32. Backup Alarm
33. Fuel Level Sensor
34. Hourmeter
35. Fuel Level Gauge
36. Backup Alarm Pressure Switch
37. Drive Train Electronic Controller
38. Drive Train Control Lever
39. Rear Lamp
40. Engine Electronic Control Module (ECM)
41. Water in Fuel Sensor
42. Engine Electronic Control Module (ECM) Control Potentiometer
43. Fuse – Data Readout (10 [A])
44. Fuses – ECM Power Supply (7.5 [A])
45. Fuses – VP-30 Fuel Pump Supply (10 [A])
46. ECM Data Link Connector
47. “STOP” Engine Warning Light (Red)
48. Engine “!”Faults Warning Light (Yellow)
49. Engine Faults „FLUID” Warning Light (Orange)
50. Engine Air Preheater Control Fuse
51. Water in Fuel Filter Warning Light (Yellow)

52. Engine ECM Failure Code Display (in machines S/N up to 5750) and Intermediate Speed Control (ISC) Selector Momentary Switch
53. Engine ECM Failure Code Activation Selector Momentary Switch
54. Resistors
55. Low Main Oil Pressure Warning Light Time Delay Modul

GAUGE CLUSTER COMPONENTS

A – Light not used
B – Light not used

C – Low Main Oil Pressure Switch Warning Light
D – Drive Train Oil Filter Clogging Warning Light
E – Air Cleaner Clogging Warning Light
F – Equipment Hydraulic System Oil Filter Clogging Warning Light
H – Coolant Temperature Gauge
J – Drive Train Oil Temperature Gauge
K – Engine Oil Pressure Gauge
L – Gauges Illumination Lights
M – Voltmeter
N – „1”, „2”, „3” Engaged Gear Signal Lights

WIRE COLOR CODE

Designation	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

WIRE CABLE MARKING
42 cable designation
DB color code
-42/DB-

CAB WIRING DIAGRAM

Description to Cab Wiring Diagram (Fig. 8.3)

1. RH Headlamp
2. Front Wiper
3. Dome Light
4. LH Headlamp
5. LH Bottom Wiper
6. Not used
7. Air Conditioner Electromagnetic Clutch
8. Low Engine Oil Pressure Warning Light Switch
9. Master Switch
10. Battery
11. Lower Washers Wipers Button
12. Upper Washers Wipers Button
13. RH Lower Wiper
14. Dome Light Switch
15. Defroster Fan Switch (option)
16. Defroster Fan (option)
17. Cab Automatic Circuit Breakers
18. Heater/Air Conditioner
19. Heater/Air Conditioner Power Supply Relay
20. Automatic Circuit Breaker
21. Compressor Clutch Power Supply Relay
22. Automatic Circuit Breaker
23. Main Cab Power Supply Automatic Circuit Breaker
24. Fans Relay Automatic Circuit Breaker
25. Fans Power Supply Automatic Circuit Breaker
26. Heater/Air Conditioner Fans Switch
27. Upper (Front and Rear) Wipers Washers Pump
28. Lower (Door) Wipers Washers Pump
29. LH Rear Lamp
30. Rear Wiper
31. RH Rear Lamp
32. Condenser Fans Automatic Circuit Breaker
33. “MCC” Condenser
34. Switch – High/Low Air Conditioner Circuit Pressure
35. Condenser Fans Relay
36. Condenser Fans Electric Motors

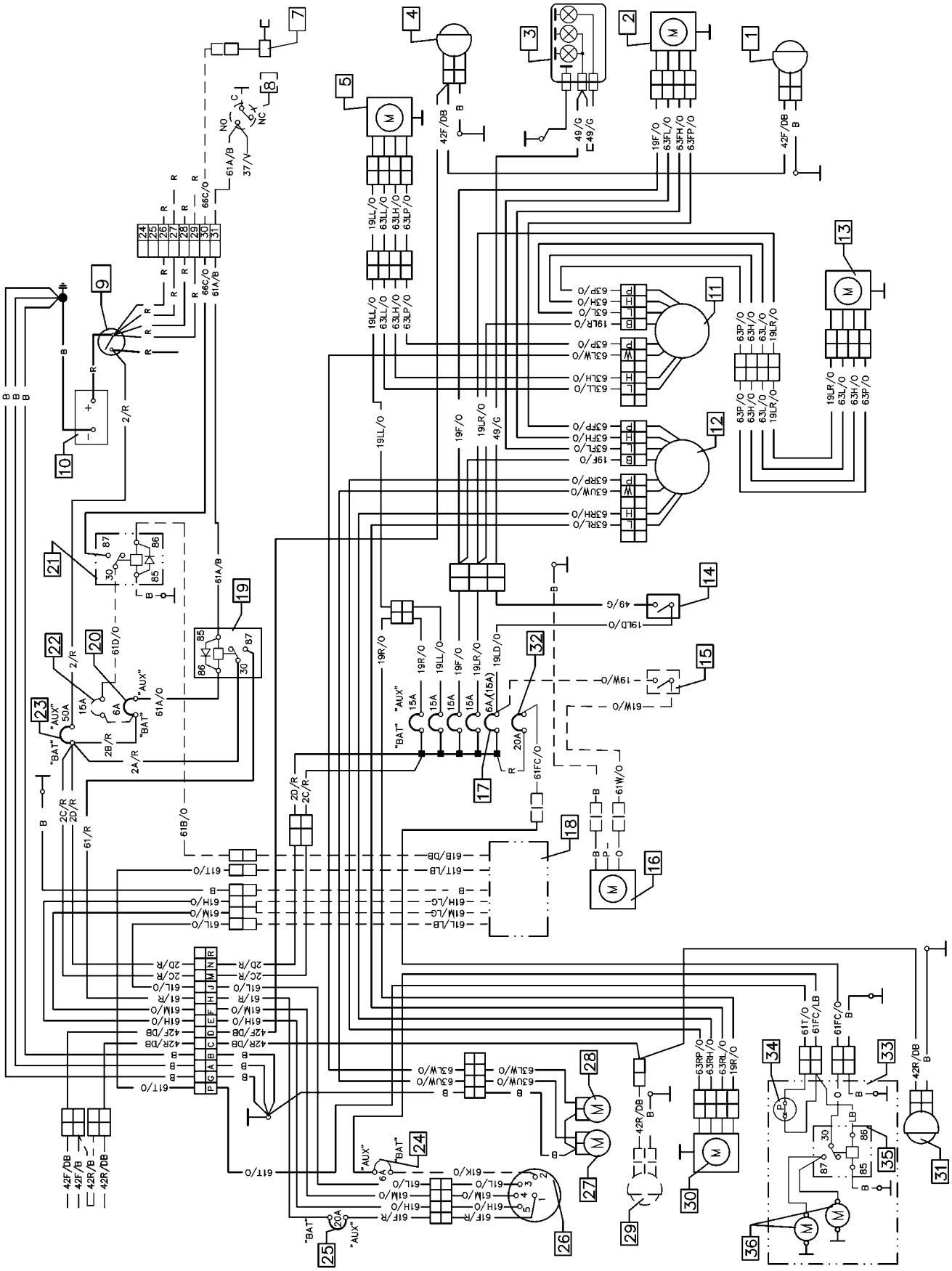


Fig. 8.3. Cab Wiring Diagram

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 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, 20[A] circuit breaker, start-up lock switch, starting electromagnetic 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 3 in this Section
Transmission Control Malfunction	
1. Electrical problem in direction, or drive circuit	Refer to Drive Train Control Circuit in Paragraph 3 in this Section and to Drive Train Control Valve and Controller Signal Diodes Circuit below
2. Problem in transmission or valves	Refer to “SERVICE DIAGNOSIS” in SECTION 7 “DRIVE TRAIN” and to SECTION 7C “TRANSMISSION”

NOTE: *For electrical switches location on the machine refer to their system.*

5. DESCRIPTION OF OPERATION AND DIAGNOSTICS FOR THE MACHINE DRIVE CONTROL SYSTEM

The document describes the drive control system algorithm for machines provided with the CMCV (Crawler Motion Control Valve) Controller

WIRING DIAGRAM

5.1. DRIVE CONTROL SYSTEM STRUCTURE.

The machine control system includes the following:

- drive train hydraulic control valve;
- drive train system control lever that incorporates buttons that can be switched on or off.
- solenoid valves for gear shifting (EZ2, EZ3),
- signal lights for a gear activated (D);
- microprocessor controller (ST);
- inductive sensor for the lever neutral position of the drive train system control valve

5.2. PRINCIPLE OF OPERATION OF DRIVE CONTROL SYSTEM.

5.2.1. 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 electricals and electronics with control lever imbedded buttons assisted with a microprocessor controller 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 though the selection and brake valves, respectively.
The microprocessor controller is in charge of gear selection function.

5.2.2. Description to signal LED diodes incorporated in the controller PCB

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.

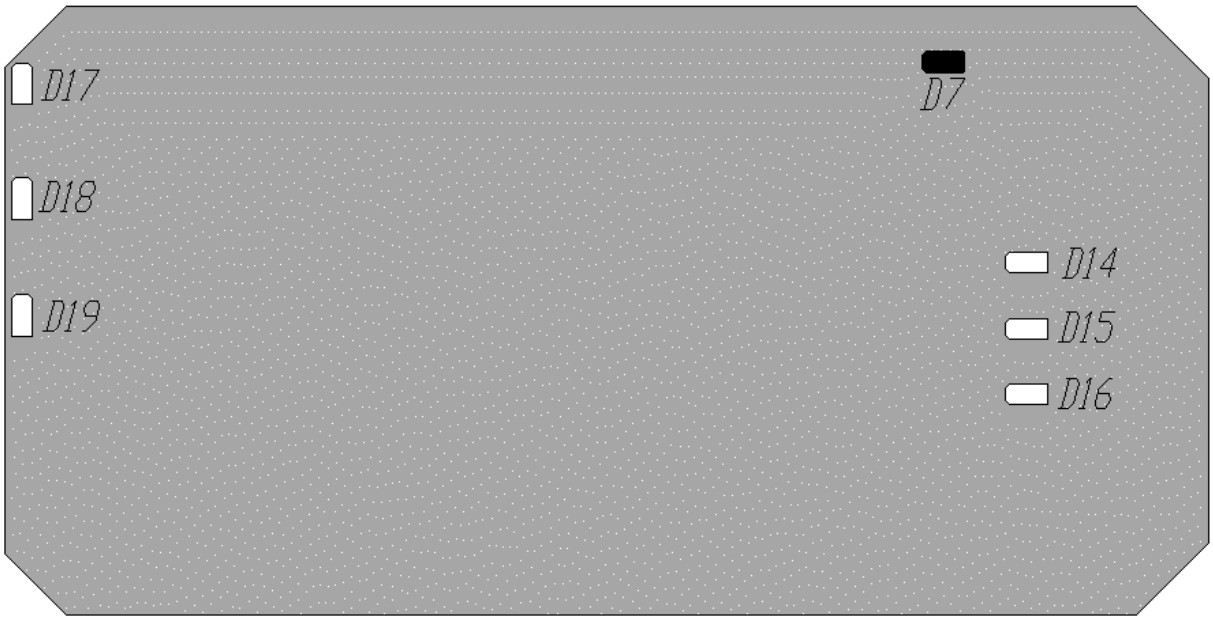


Fig. 8.4. LED Arrangement on the Controller PCB

- **D7** – service signal light that is used during the controller programming only;
- **D14** – ON, when the upshift button (*Up*) at the control lever is depressed;
- **D15** – ON, when the downshift button (*Dn*) at the control lever is depressed;
- **D16** – ON, when the control lever is in neutral position;
- **D19** – ON, when the 3rd gear was engaged, *D18* and *D17* must not be ON;
- **D18** – ON, when the 2nd gear was engaged, D17 and D19 must not be ON;
- **D17** – ON, when the 1st gear was engaged, D18 and D19 must not be ON;

5.3. CONTROLLER OPERATION AFTER POWER UP

5.3.1. Power up with the control system operative.

In order for the control system to operate correctly the following must be met:

- power ranging

Controller operation after power up and prior to starting the engine.

After power up to the controller, within one second, the processor is to end its reset program and start the execution of the program stored in its memory. This operation is evidenced with first gear relay becoming activated which is signaled with an instrument panel located light as well as a D17 green LED at the controller PCB.

At power up, with the control lever in neutral position and an operative neutral position switch correctly adjusted, a yellow diode D16 will come on.

5.3.2. Power up with the control system inoperative.

1. If after power up the instrument panel signal light fails to come on to witness that the first gear has been engaged, the controller connector pins 1 and 2 calls for power presence check.

   a) If power is not present (green LED D17 fails to come on, the machine will move in the first gear only), turn the power off, clear the fault (short or break in power supply, 25[A] fuse blown off) and next restart the power supply.

   b) If U < 9V, the controller processor operation has been held up by power supply watchdog. Turn the control system off, check the cause for voltage down (battery, alternator), clear the fault and restart the power supply.

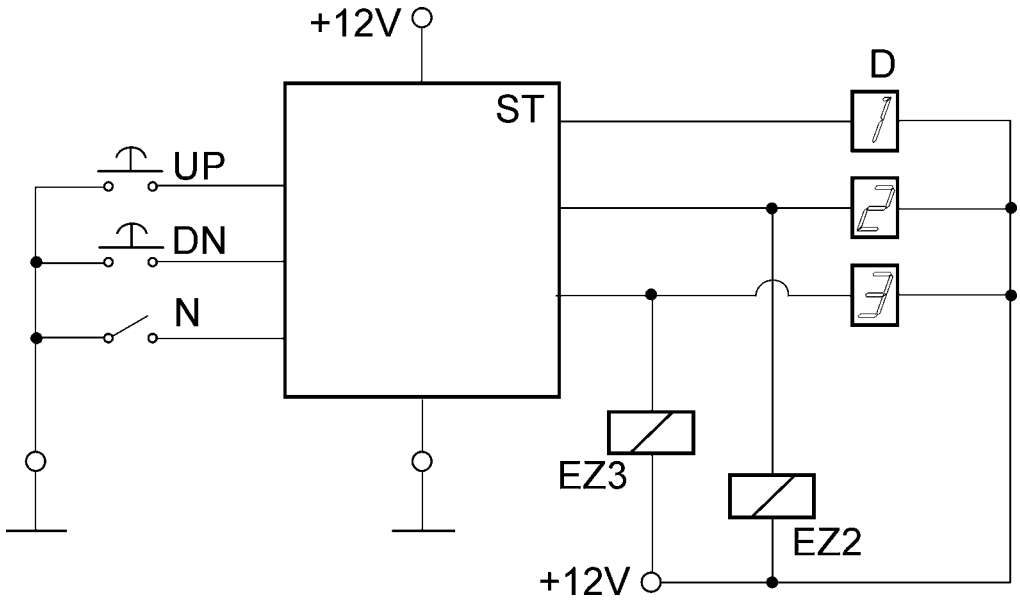
   c) With the over voltage U > 18 [V], the alternator (alternator voltage regulator) which sets the outputted voltage level can be at fault.

2. 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

5.4. THE DRIVE CONTROL SYSTEM OPERATION AT GEAR SHIFTING.

The Controller makes possible for gear change with two valve control lever incorporated buttons. One of three gears is possible to choose. Following block schematic for control system has been provided.



Manual Gear Shifting Schematic.

UP – Up shift Button
DN – Downshift Button
N – Transmission Shifter Neutral Position Inductive Sensor
ST – CMCV Controller
D – 1st, 2nd and 3rd Gear Signal Lights
EZ2 – 2nd Gear Solenoid Valve
EZ3 – 3rd Gear Solenoid Valve

The gear change can take place (as per controller algorithm) if at the power up the control lever is in the neutral position or it took that position even for a moment. 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 both buttons at a time.

When the *Up* button is depressed it is accompanied with a yellow diode **D14** coming on; the same is true when the *Dn* button is depressed, then diode **D15** 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 instrument panel signal diode that witnesses the first gear being engaged will come off. At the same time the second gear diode will come on, while diode **D17** will come off and diode **D18** will come on, the second gear solenoid valve *EZ2* will get activated while that for the third gear *EZ3* will get deactivated;
- when the actual gear was the second gear – the instrument panel signal diode that witnesses the second gear being engaged will come off. At the same time the third gear diode will come on, while diode **D18** will come off and diode **D19** will come on, the third gear solenoid valve *EZ3* will get activated while that for the third gear *EZ2* will get deactivated;

- 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 **D19** diode will come on, and **D17** and **D18** will remain off.

Similarly for downshift, the controller is to behave as described below:

- when the actual gear was the third gear – the instrument panel signal diode that witnesses the third gear being engaged will come off. At the same time the second gear diode will come on, while diode **D19** will come off and diode **D18** will come on, the second gear solenoid valve *EZ2* will get activated while that for the third gear *EZ3* will get deactivated;
- when the actual gear was the second gear – the instrument panel signal diode that witnesses the second gear being engaged will come off. At the same time the first gear diode will come on, while diode **D18** will come off and diode **D17** will come on, both, the second and third gear solenoid valves *EZ2* and *EZ3* will get deactivated;
- 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 get deactivated, **D17** diode will be on, while both **D18** and **D19** diodes will remain off.

CRANKING MOTOR

6. DESCRIPTION

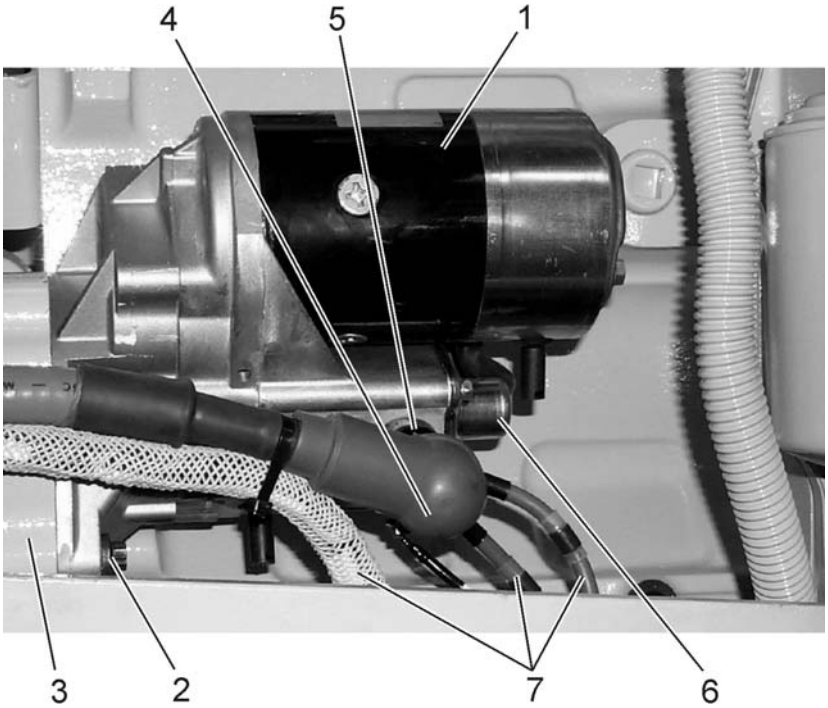


Fig. 8.5. Cranking Motor Location and Disconnect Points (R.H. side View)

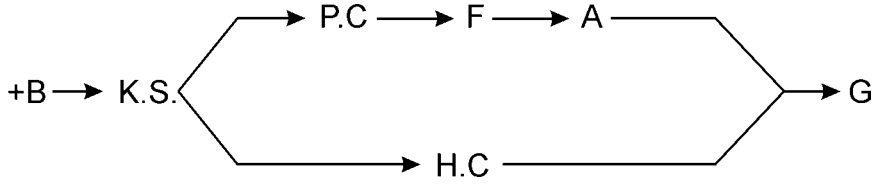
1. Cranking Motor
2. Bolt with Washer
3. Engine Flywheel Housing
4. Battery (+) Cable
5. Ground Cable
6. Solenoid Switch
7. Harness (Cab, Alternator and Cranking Motor Solenoid Switch Leads)

The reduction type R cranking motor consists of the motor, reduction gear set, overrunning clutch and magnetic switch. The cranking motor (1, Fig. 8.5) is located on the R.H. side of the machine and mounted on the engine flywheel housing (3) mounting pad together with spacer and gasket.

CRANKING MOTOR

7. OPERATION (FIG. 8.6)

KEY SWITCH IS ON:
When the starting switch is ON, the current flows through two circuits in the direction indicated by the arrows.



The plunger is pulled by the electromagnetic field produced by the pull-in coil and holding coil. Then the main contact is closed.

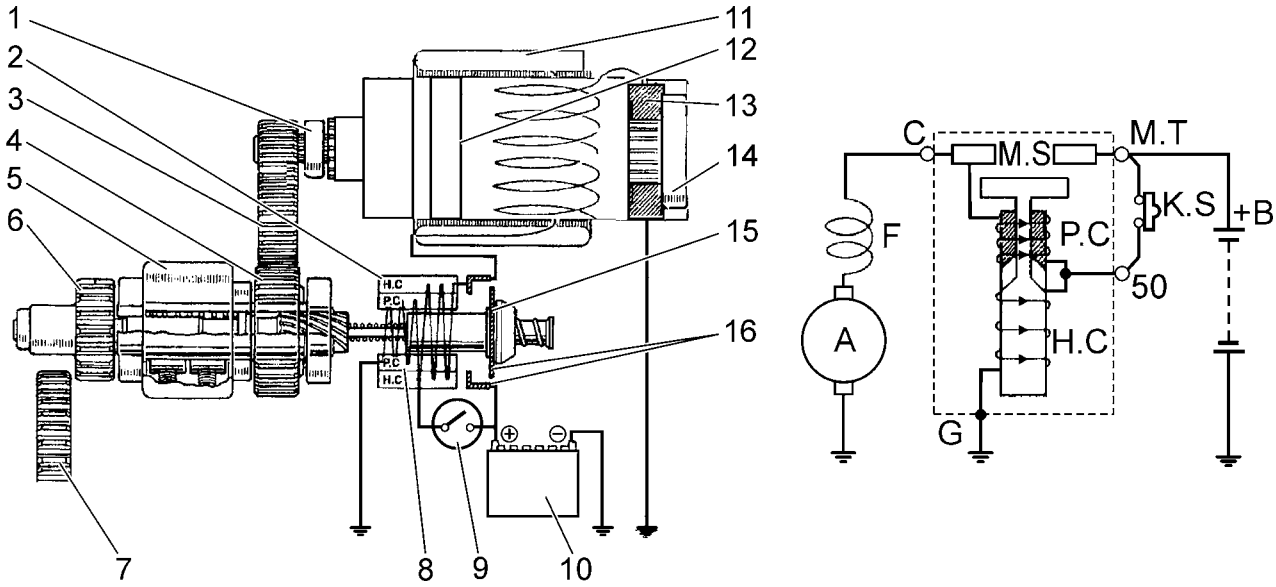


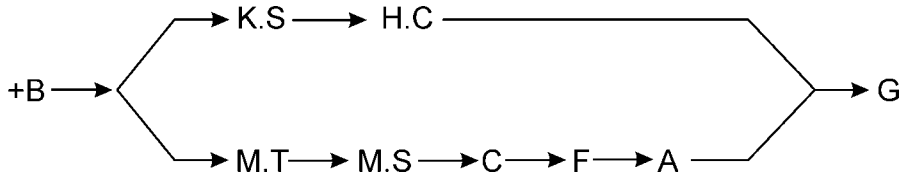
Fig. 8.6. Cranking Motor Cross Section and Circuit Diagram

1. Ball Bearing
2. Holding Coil
3. Idle Gear
4. Clutch Gear
5. Clutch
6. Pinion Gear
7. Ring Gear
8. Pull-in Coil
9. Key Switch
10. Battery
11. Field Coil
12. Armature
13. Brush
14. Ball Bearing
15. Plunger
16. Main Contact

+B. Battery Positive
K.S. Key Switch
P.C. Pull in Coil
H.C. Hold-in Coil
M.S. Main Switch
F. Field

A. Armature
G. Ground
C. Contact Terminal
M.T. Main Terminal
50. Terminal

MAIN CONTACT IS CLOSED:
When the main contact is closed, the current flows in the direction indicated by the arrows below and the cranking motor begins to crank engine



At this time the plunger is held by the electromagnetic field produced by the holding coil only.

CRANKING MOTOR

KEY SWITCH IS OFF:
When the switch is OFF, the current flows in the direction indicated by the arrows below.

+B ⟶ M.T ⟶ M.S ⟶ P.C ⟶ H.C ⟶ G

The current flows in the same direction through both the pull-in and holding coil. This causes the electromagnetic field of the coils to cancel magnetic polarity, causing the plunger to return toward its original position by the return spring opening the main contact.
A cranking period for all types of cranking motors should never exceed 30 [s] without stopping to allow the motor to cool.

8. SPECIFICATIONS

General

Manufacturer type	Denso, R Type
Rated voltage	12 [V]
Rated output	2.7 [kW]
Yoke outer diameter	90 [mm]
Time rating	30 [sec]

Pinion gear

Number of teeth	13
Module pitch	(10)
Rotation (viewed from pinion)	Clockwise

No-load test

Voltage/ max. current min. torque	11.0 [V] /200 [A]
Min. speed	3000 [Rpm]

Load test

Voltage/ min. torque	8.0 [V] /2 [KGm]
Max. current/min. speed	600[A]/1130 [Rpm]

Lock test

Voltage/max. current	3 [V] /1400 [A]
Min. torque	4 [KGm]

Commutator outer diameter

Standard	36 [mm]
Service limit	35 [mm]

Depth of segment mica

Standard	0.7- 0.9 [mm]
Service limit	0.2 [mm]

CRANKING MOTOR

Commutator run-out

Standard ..... 0.02 [mm]
Service limit ..... 0.05 [mm]

Brush length

Standard ..... 20.5 [mm]
Service limit ..... 18.3 [mm]

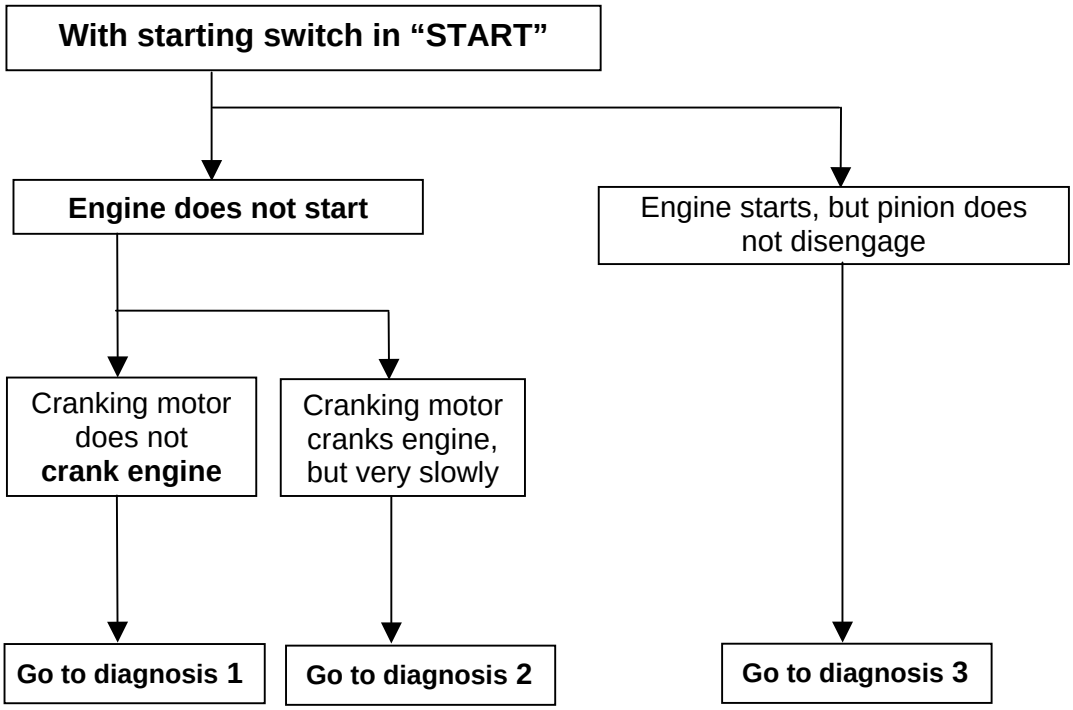
9. SERVICE DIAGNOSIS

Use the diagnosis chart depicted below when you check the starting system. Before diagnosis, be sure the battery is full charged and inspect the cranking motor and battery cables for clean and tight connections.

IMPORTANT: *Do not operate the cranking motor longer than 30 seconds*.

CAUTION! Do not disconnect or short any lead wire while cranking motor is operating.

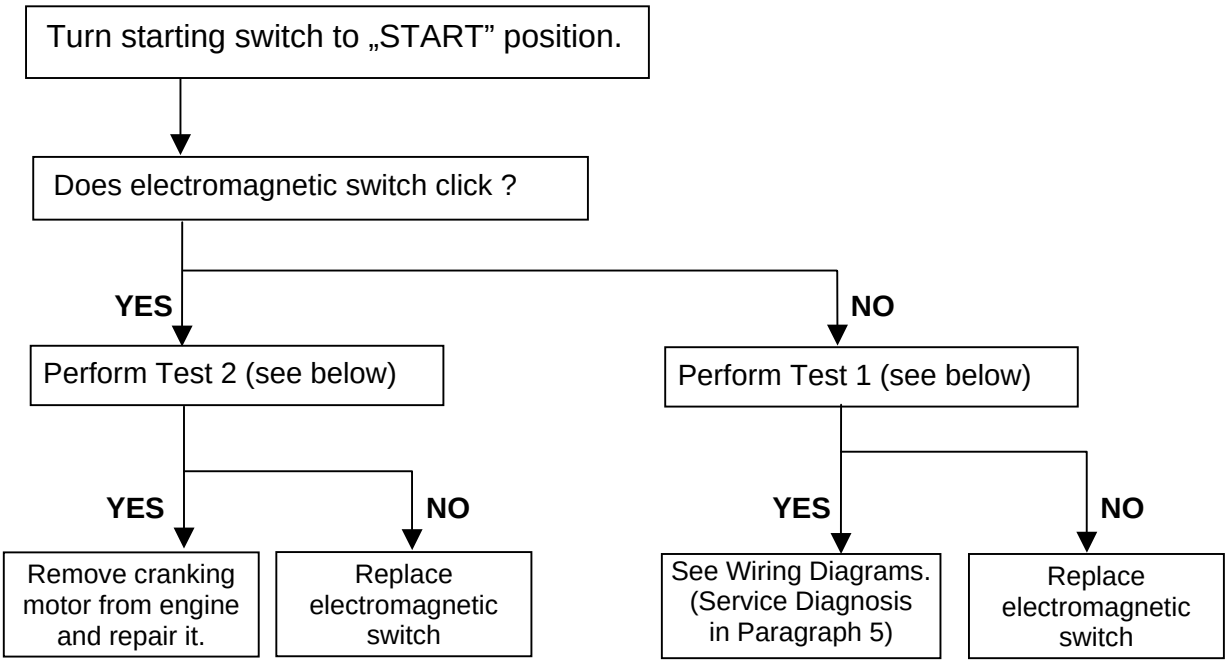
1. DIAGNOSTIC CHART



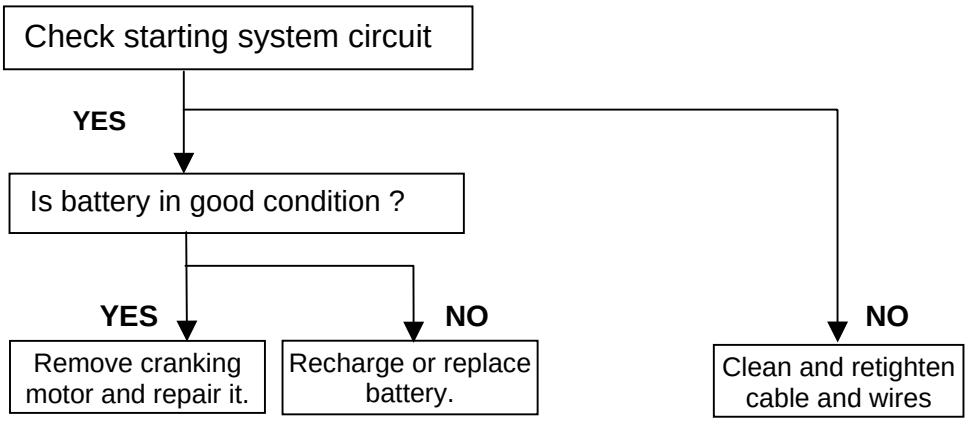
ELECTRICAL

CRANKING MOTOR

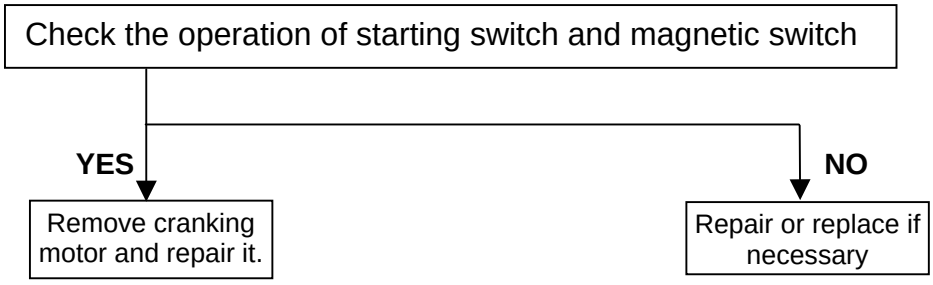
DIAGNOSIS 1



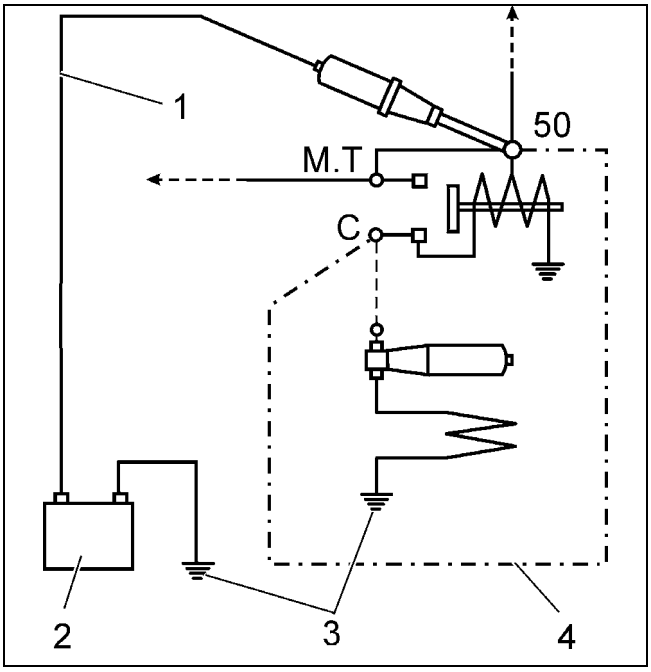
DIAGNOSIS 2



DIAGNOSIS 3



CRANKING MOTOR



1. Jumper Wire
2. Battery
3. To Ground
4. Cranking Motor

TEST 1

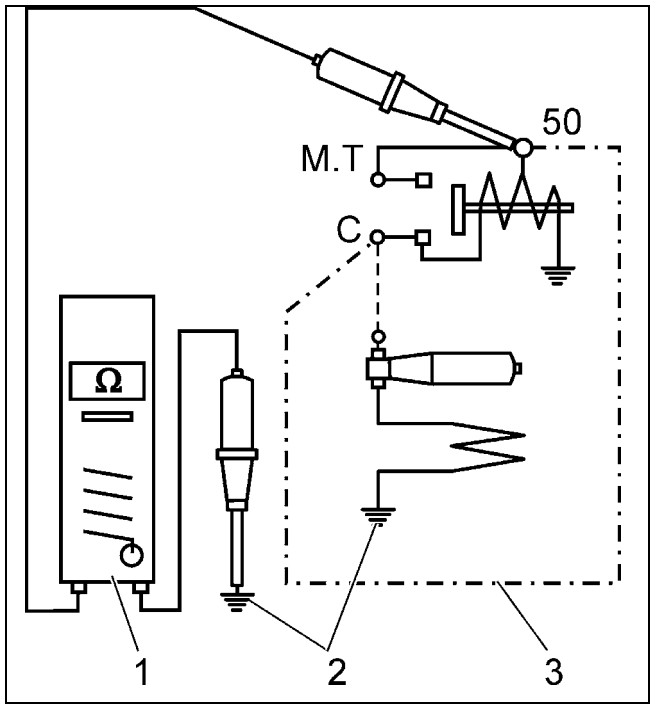
1. Disconnect the cable from C Terminal.
2. Connect a jumper wire to positive terminal of battery.
3. Briefly touch jumper wire to 50 Terminal of electromagnetic switch.

If the electromagnetic switch operates, probable cause of cranking motor failure is in the electrical starting circuit.

TEST 2

1. Disconnect the cables from C, M.T and 50 Terminals.
2. Using an ohmmeter, touch one probe to the 50 Terminal and the other to the cranking motor body. There should be continuity.

If there is no continuity, the hold-in winding is open. Replace the electromagnetic switch if open circuit exists.



1. Ohmmeter
2. To Ground
3. Cranking Motor

CRANKING MOTOR

10. REMOVAL (Fig. 8.5)

WARNING! Before servicing the machine be sure the bucket is lowered, the engine is off, the parking brake is applied, the transmission shifter is in neutral (N), the electric system master switch is OFF and the keys both from the master switch and the starting switch are removed.

1. Lift R.H. side engine guard.

IMPORTANT: *Tag all disconnected cables to avoid wrong reconnections during cranking motor installation on the machine.*

2. Disconnect all electrical leads (4, 5 and 7) from the cranking motor (1) and solenoid switch (6) terminals.
3. Remove two bolts with washers (2) mounting cranking motor (1) to the engine flywheel housing (3) mounting pad.
4. Remove cranking motor (1) out of the machine.
5. Remove gasket, spacer from the cranking motor mounting flange.

11. TESTS

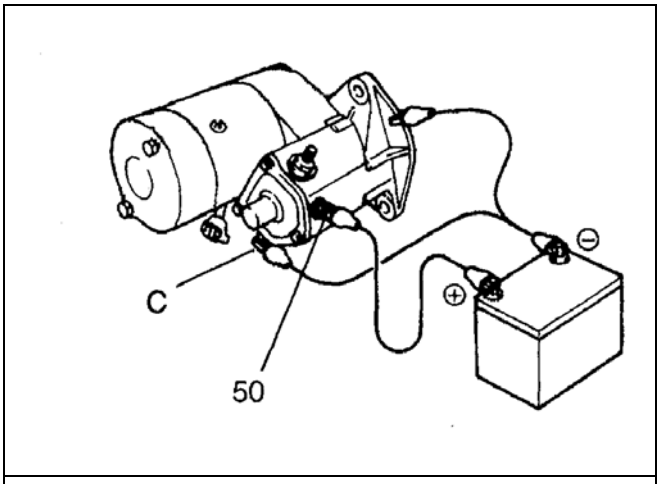
NOTE: *Before disassembling the cranking motor below described inspection and tests should be performed.*

1. VISUAL INSPECTION

With the cranking motor removed from the engine, check armature for freedom of rotation by prying the pinion gear with a screwdriver. If the armature does not turn freely, the cranking motor should be disassembled and repaired. However, if the armature does rotate freely, the motor should be given a tests before disassembly as described below.

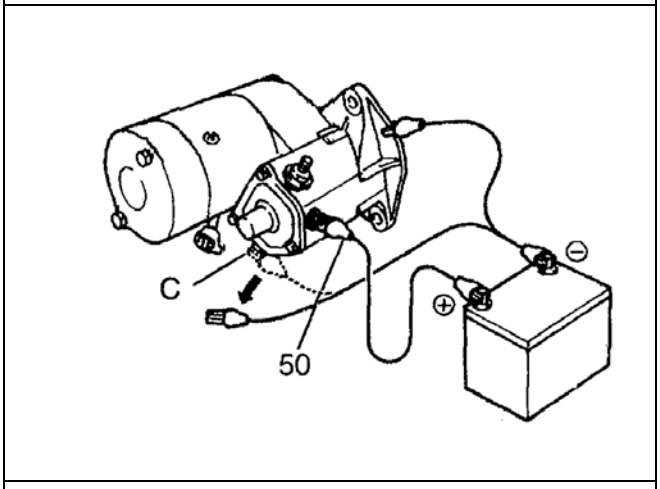
NOTE: *These test should be performed for a short time (3 to 5 seconds) and with the specified voltage applied to prevent the magnetic switch winding from burning.*

CRANKING MOTOR



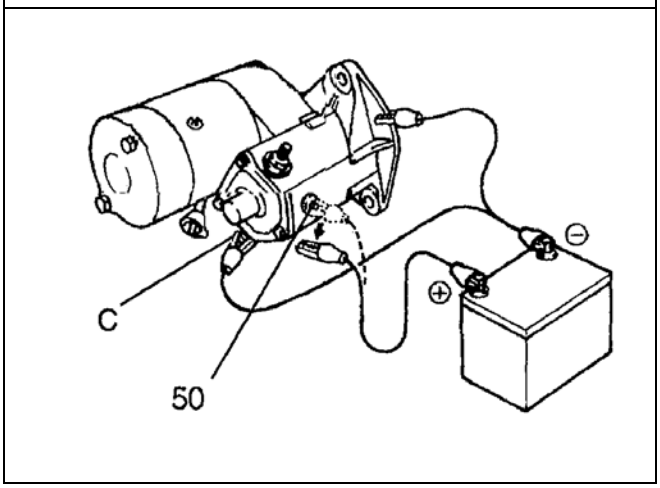
2. PULL-IN TEST

Disconnect the field coil lead wire from C Terminal.
Connect battery to the electromagnetic switch terminals C, 50 and cranking motor housing as shown. Check that the pinion gear moves outward. If the pinion gear does not move, repair or replace the electromagnetic switch.



3. HOLD-IN TEST

While connected as above with the pinion gear out, disconnect the negative (-) lead from C Terminal. Check that the pinion gear remains out. If pinion gear returns inward, repair or replace the electromagnetic switch.



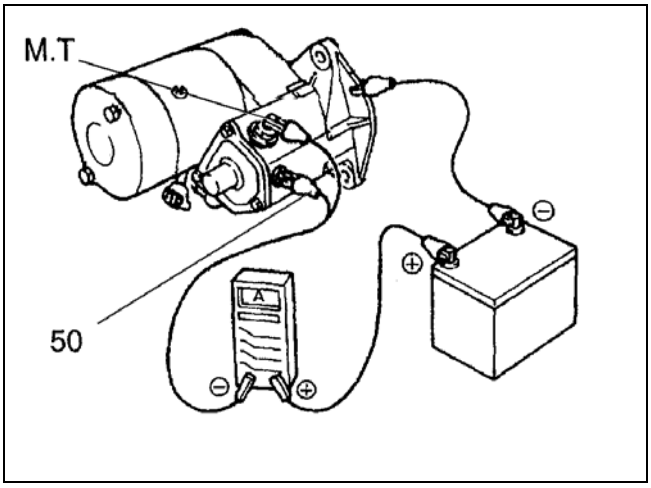
4. INSPECT PLUNGER RETURN
(Solenoid Coil Balance check).

With the same condition as in pull-in test disconnect the positive (+) lead from 50 Terminal. Check that the pinion gear returns inward. If the pinion gear does not return, repair or replace the electromagnetic switch.

CRANKING MOTOR

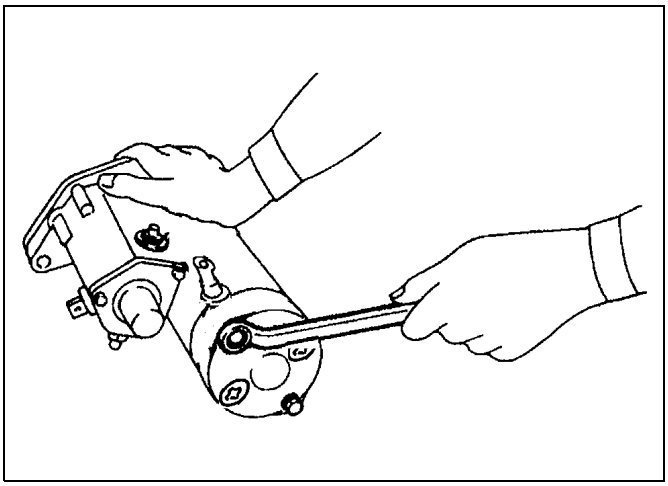
5. NO-LOAD PERFORMANCE TEST

Connect battery and ammeter to the starter as shown. Check that the starter rotates smoothly and steadily with the pinion gear moving out. Check the reading on the ammeter (see SPECIFICATIONS).



12. DISASSEMBLY (Fig. 8.7)

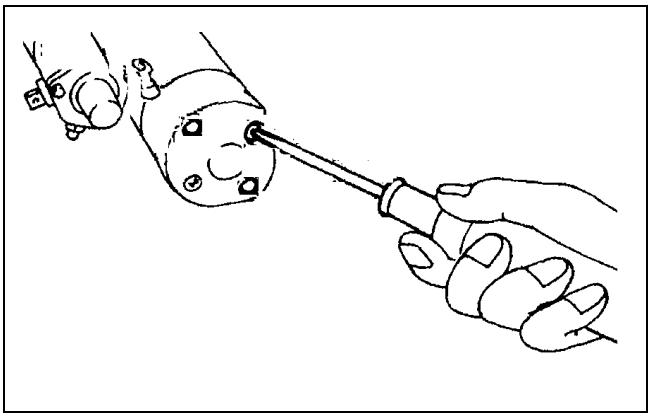
1. Remove the two bolts (46) from the cranking motor guard (39).



NOTE: *Appling locating marks to the field coil (1), electromagnetic switch (17) housing (16) and guard (39) before removing the parts will make it easier to reinstall them.*

2. Remove two screws with washers (47).

3. Remove the guard (39) from the cranking motor.



CRANKING MOTOR

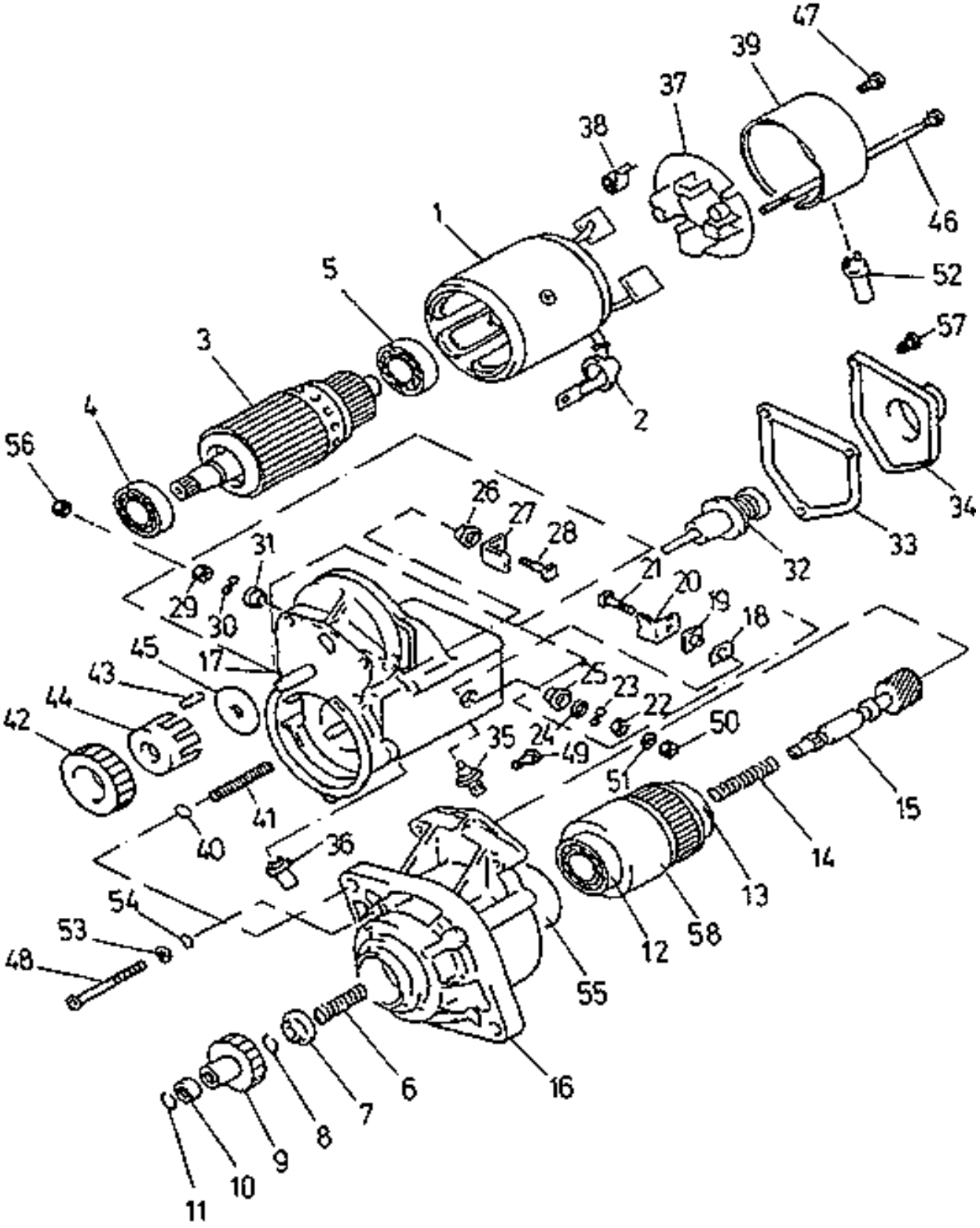


Fig. 8.7. Cranking Motor Exploded View

CRANKING MOTOR

Legend for Fig. 6.7.

1. Field Coil
2. Cover
3. Motor Armature
4. Ball Bearing
5. Ball Bearing
6. Spring
7. Spring Seat
8. Retaining Ring
9. Gear Clutch
10. Bushing
11. Retaining Ring
12. Front Ball Bearing
13. Rear Ball Bearing
14. Spring
15. Shaft
16. Housing
17. Electromagnetic Switch
18. Nut
19. Terminal Insulator
20. Connector
21. Bolt
22. Nut
23. Terminal Insulator
24. Ring
25. Bushing
26. Bushing Gear
27. Connector
28. Bolt
29. Nut
30. Terminal Insulator
31. Bushing
32. Switch Core Assy
33. Gasket
34. Cover
35. Special Bolt
36. Insulator
37. Brush Plate
38. Brush Spring
39. Guard
40. Steel Ball
41. Spring
42. Pinion Gear
43. Clutch Roller
44. Retainer
45. Spacer Ring
46. Bolt
47. Screw with Washer
48. Bolt
49. Screw with Washer
50. Nut
51. Spring Washer
52. Cover
53. Washer
54. O-Ring
55. O-Ring
56. Nut
57. Bolt w/Washer
58. Clutch Assy

4. Using a screwdriver, carefully push from both side the brush springs (38A, Fig. 8.8) back and remove the brushes (-) from the brush plate (37).

NOTE: *Appling locating marks to the field coil (1) and brush plate (37) before removing the parts will make it easier to reinstall them.*

5. In the same means remove the two brush springs (38B), brushes (+) then remove the brush plate (37).

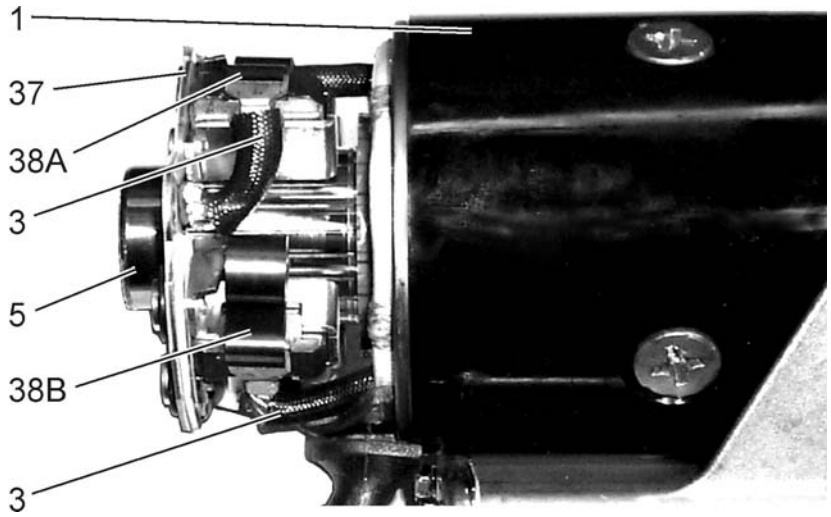
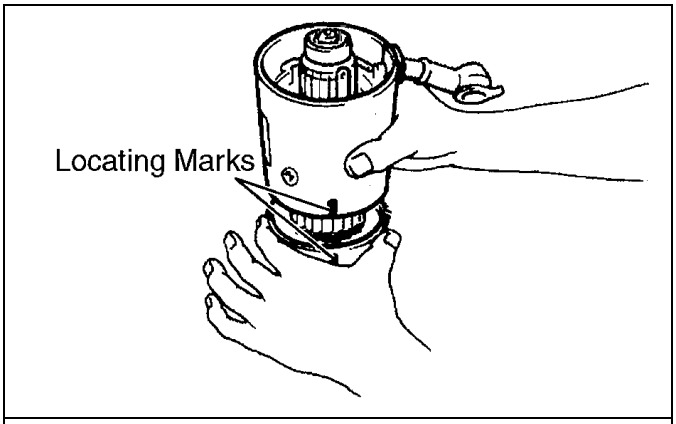


Fig. 8.8. Cranking Motor Exploded View

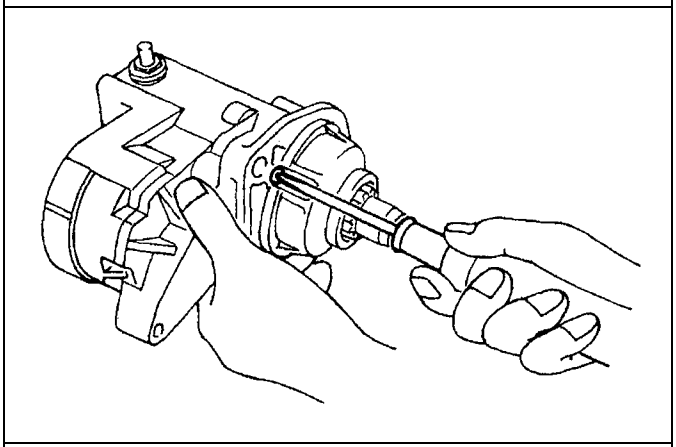
1. Field Coil
3. Brush Set
5. Ball Bearing
37. Brush Plate
38A. Brush spring (Brush -)
38B. Brush spring (Brush+)

CRANKING MOTOR

6. Carefully pull out the field coil (1) and remove motor armature (3) using a plastic hammer.

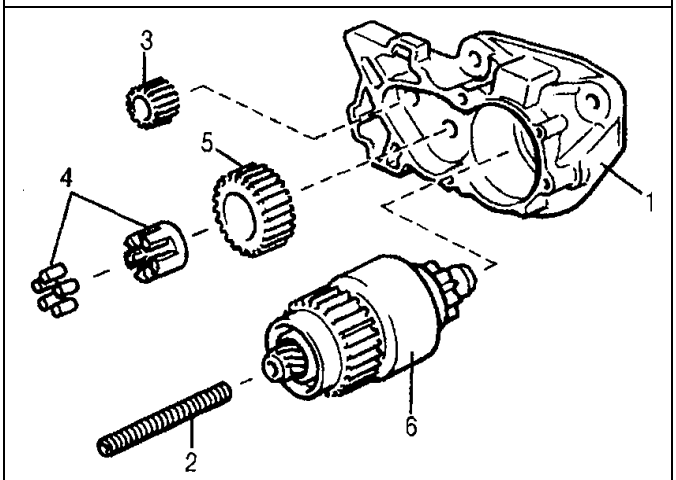


7. Remove the three bolts (48), washers (53) and discard the O-rings (54) from the cranking motor housing (16).

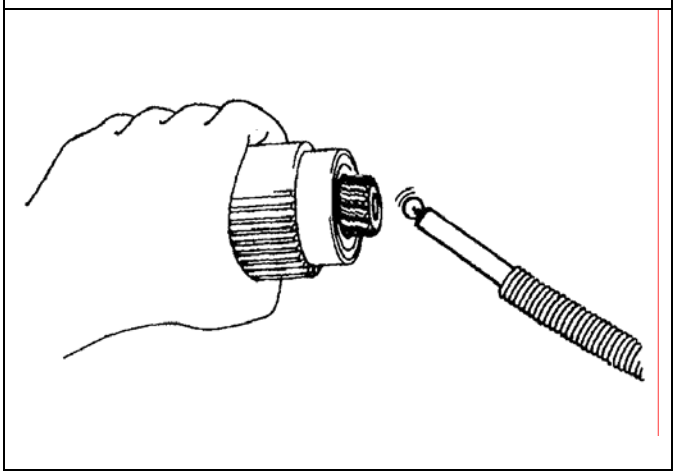


8. Remove the following parts from the cranking motor housing (16):

   1. Housing
   2. Spring
   3. Drive Gear
   4. Retainer and Clutch Rollers
   5. Pinion Gear
   6. Clutch Assy

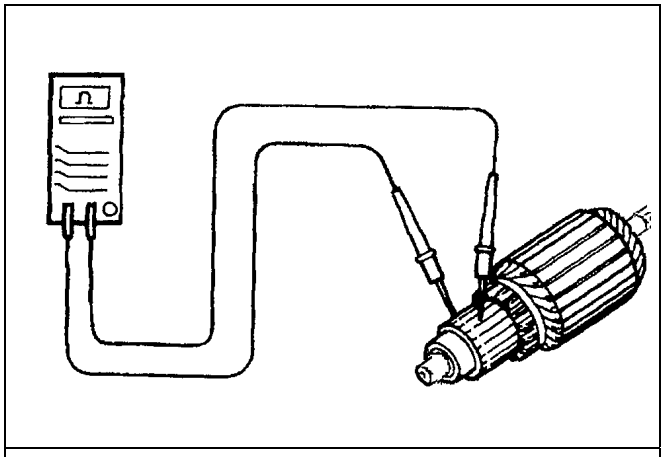


9. Using a small round magnet, remove the steel ball (40) from overrunning clutch shaft hole.



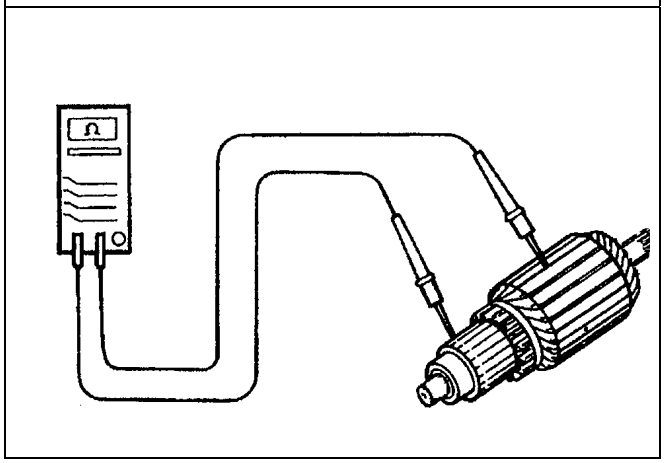
CRANKING MOTOR

13. INSPECTION AND REPAIR



1. INSPECT COMMUTATOR FOR OPEN CIRCUIT.

Using an ohmmeter, check for continuity between the segments of the commutator.
If there is no continuity between any segment, replace the armature.



2. INSPECT COMMUTATOR FOR GROUND

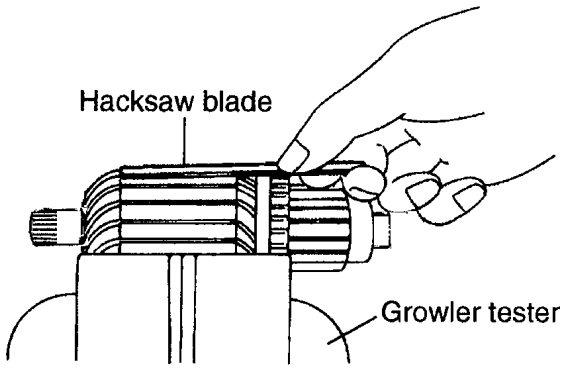
Using an ohmmeter, check for no continuity between the commutator and armature coil core.
If there is continuity, replace the armature.

CRANKING MOTOR

NOTE: *Remove all foreign matter from the armature surface with a soft cloth before doing the test.*

3. ARMATURE SHORT-CIRCUIT TEST

Place the armature on the growler tester, place a hacksaw blade on the armature core, then rotate the armature slowly.
Hacksaw blade is not drawn into the armature and does not vibrate.



4. INSPECT COMMUTATOR FOR DIRT OR BURNT SURFACE AND.

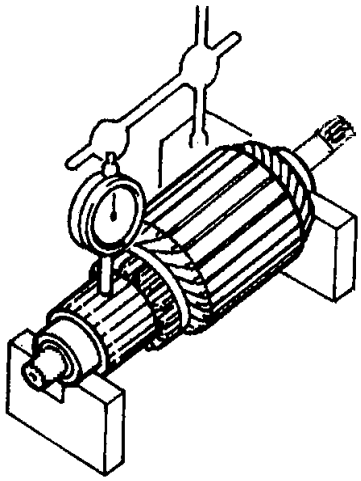
If the surface is dirty or burnt, clean it with sand paper No.400 or on a lathe.

5. INSPECT COMMUTATOR FOR RUN–OUT.

Place V-blocks on a surface plate and mount the commutator on the V-blocks to measure run-out. Using a dial gauge, measure the run-out.

Maximum run-out: 0.05 [mm].

If run-out is greater than maximum, correct it on a lathe.

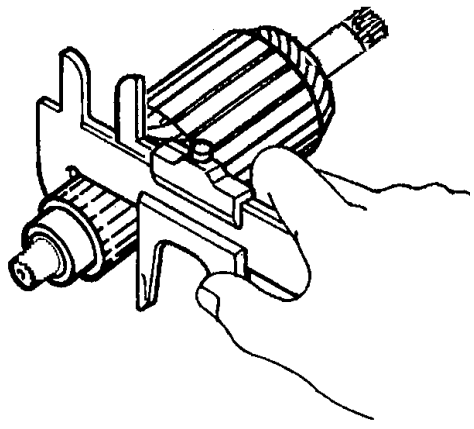


6. INSPECT COMMUTATOR DIAMETER.

Using a vernier or dial caliper, measure the commutator diameter.

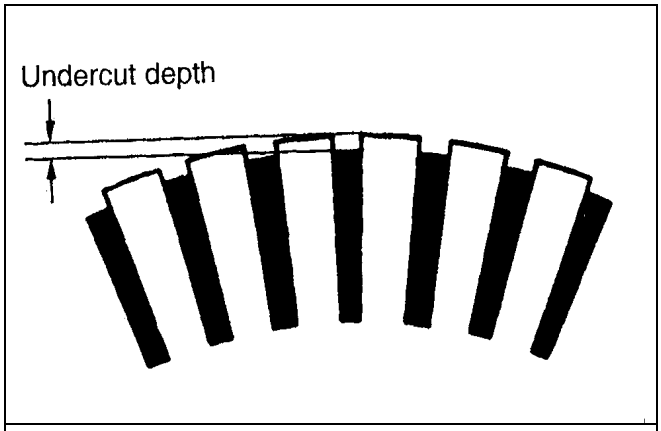
Standard dia. – 36 [mm]
Minimum dia. – 35 [mm]

If the diameter is less than minimum diameter, replace the armature.



CAUTION! If the armatures' commutator was designed or constructed with asbestos replace the armature. Undercutting is not recommended.

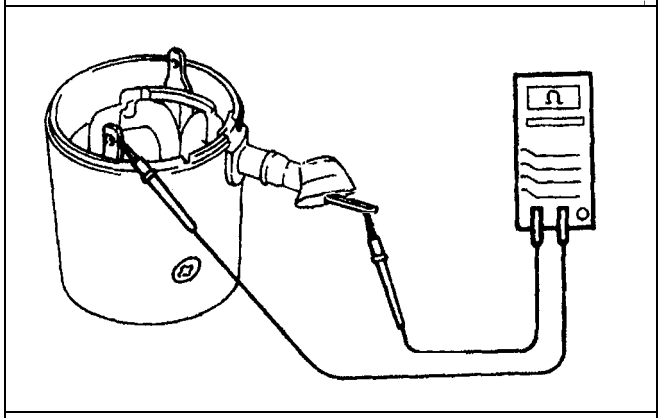
CRANKING MOTOR



7. INSPECT UNDERCUT DEPTH OF THE COMMUTATOR.

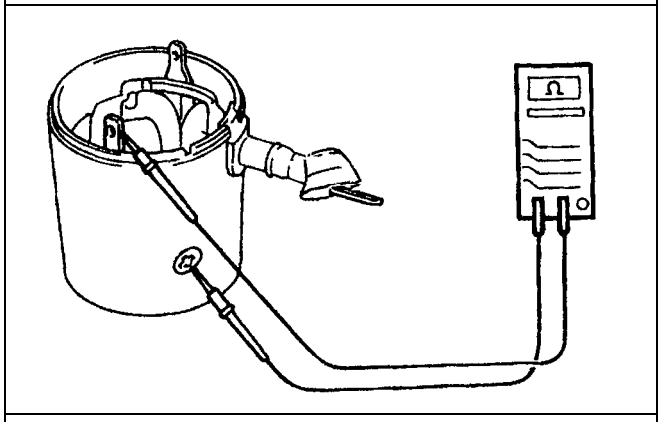
Check that the undercut depth is clean and free of foreign materials.

Standard undercut depth: 0.7÷0.9 [mm]



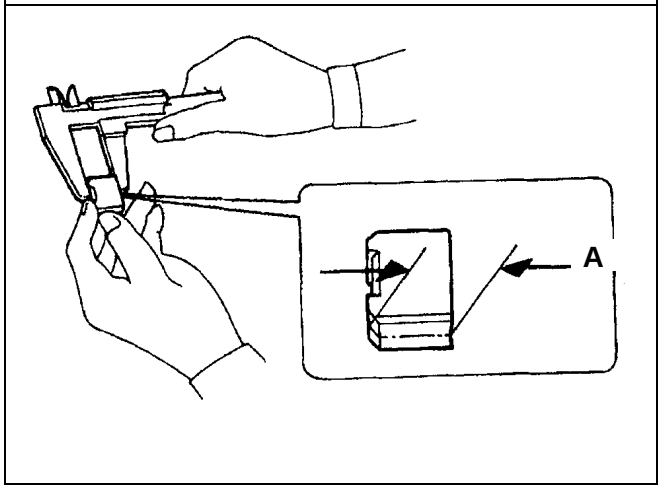
8. INSPECT FIELD COIL FOR OPEN CIRCUIT.

Using an ohmmeter, check for continuity between
The field coil end and the lead wire.
If there is no continuity, replace the field coil.



9. INSPECT FIELD COIL FOR GROUND.

Using an ohmmeter, check for no continuity between the field coil end and field coil outside.
If there is continuity, replace the field coil.



10. INSPECT BRUSH LENGTH.

Using a vernier or dial caliper, measure the brush length (A). If the length is less than minimum length, replace the brush.

Standard length: 20.5 [mm]
Minimum length: 18.3 [mm]

NOTE: *Measure the length of the brush from the center depth.*

11. INSPECT CONTACT SURFACE OF BRUSH.

If the contact surface is rough, correct it with sandpaper No.400.

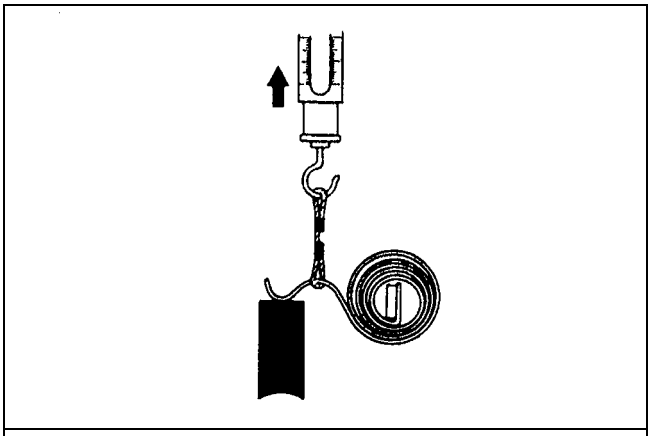
CRANKING MOTOR

12. INSPECT BRUSH SPRING LOAD.

Take the pull scale reading the instant the brush spring separates from the brush.

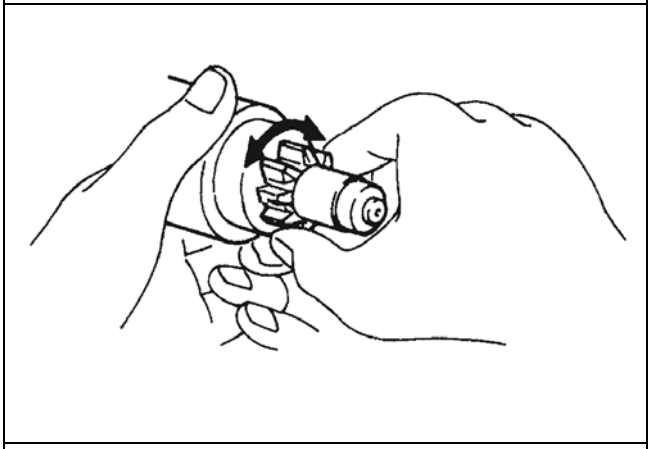
Spring installed load: 30 ÷ 40 [N]

If the installed load is not within specification, replace the brush springs.



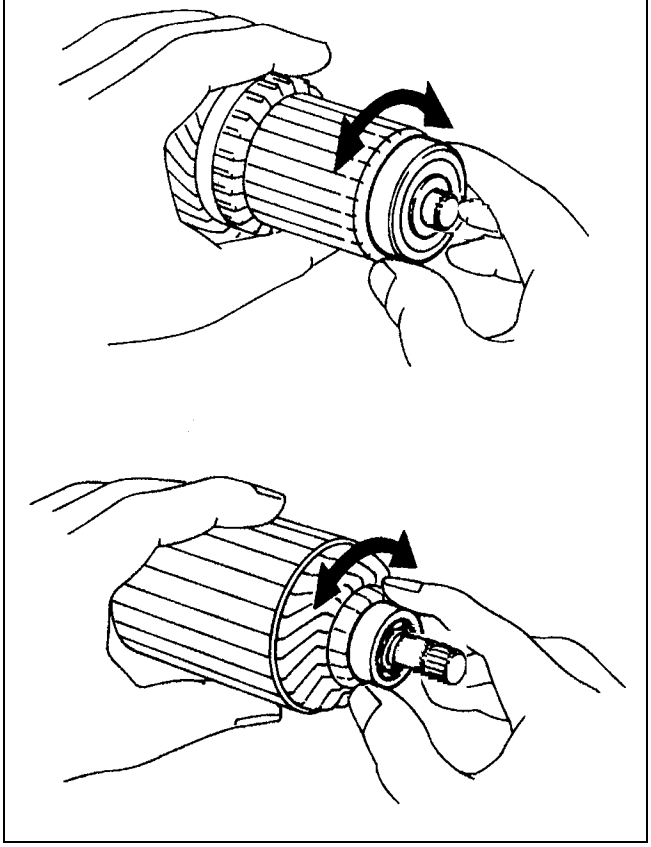
13. INSPECT CLUTCH PINION GEAR.

Rotate the pinion gear counterclockwise and check that it turns freely. Try to rotate the pinion gear clockwise and check that it locks If not, replace the clutch assembly.

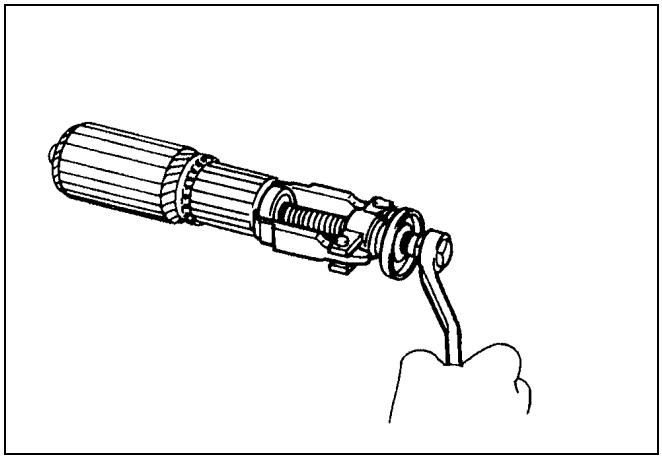


14. INSPECT FRONT AND REAR BEARINGS.

Rotate the bearing by hand while applying inward force. If the bearing sticks or does not rotate smoothly, replace the bearing.



CRANKING MOTOR

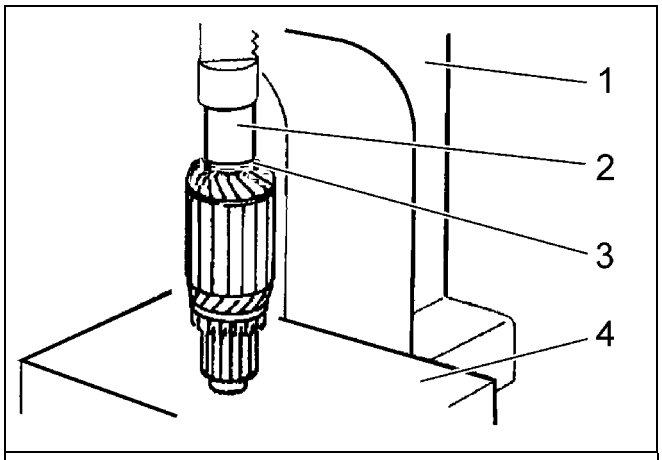


16. IF NECESSARY, REPLACE BEARINGS

a - Using a bearing puller, remove the bearing from both sides.

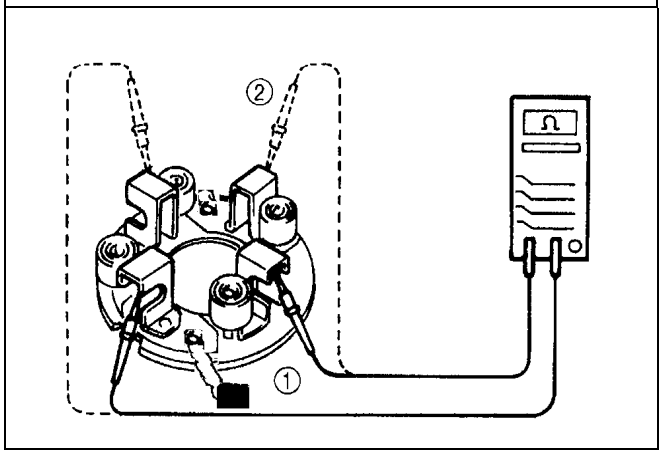
NOTE: *Make sure that the base (4) of press (1) is secure and flat. Use a spacer (2) that is similar to the size shown in Par.* 1. SERVICE SPECIAL TOOLS*. For example, a 17 mm socket is suitable. Make sure the bearing (3) is properly installed on the armature shaft.*

IMPORTANT: *Do not use a spacer (2) with an internal diameter greater than 20 [mm]. Using a spacer (2) longer than 50 [mm] may cause damage to the bearing.*



b - Using a press and spacer, press in a new bearing on both sides.

1. Press
2. Spacer
3. Bearing
4. Base



15. INSPECT BRUSH HOLDER INSULATION.

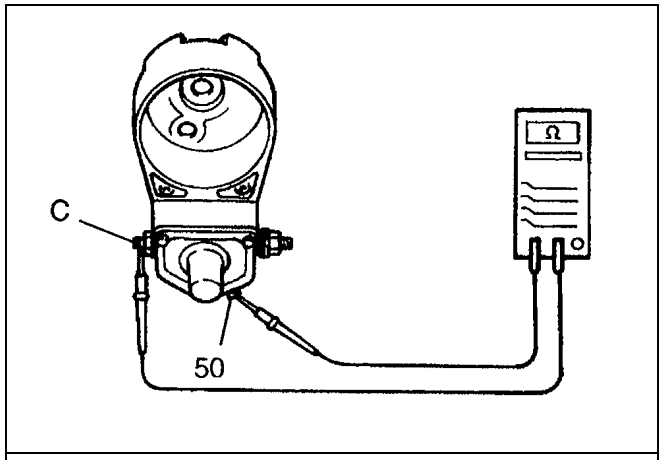
Using an ohmmeter, check for no continuity between the positive (+) and negative (-) brush holders. If there is continuity, replace the brush holder.

NOTE: *Do the inspection at locations 1 and 2 as shown above.*

CRANKING MOTOR

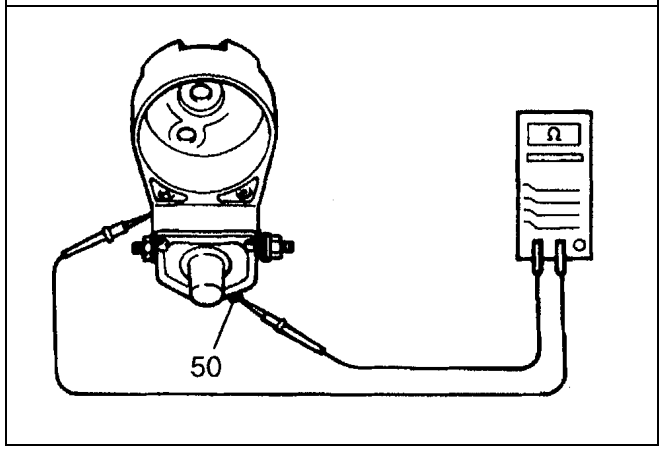
16. INSPECT PULL-IN COIL FOR OPEN CIRCUIT.

Using an ohmmeter, check for continuity between the 50 and C Terminals.
If there is no continuity, replace the electromagnetic switch.



17. INSPECT HOLD-IN COIL FOR OPEN CIRCUIT.

Using an ohmmeter, check for continuity between the 50 Terminal and the electromagnetic switch body.
If there is no continuity, replace the electromagnetic switch.



18. Inspect all parts e.g.(washers, bushings, spacer, bolts), if are showing signs of wear replace it. It is not necessary to inspect the O-rings and gaskets, as they will be replaced as new items.

14. REASSEMBLY (Fig. 8.15)

1. Apply high temperature grease per HMS B27-0004 to the armature bearings (4, 5) and using a press, install motor armature (3) into the electromagnetic switch (17) housing.

NOTE: *Rotate the motor armature (3) and check that it is pressed straight into it. If the motor armature (3) is pressed in while misaligned, it will make it difficult to assemble the cranking motor field coil (1) later.*

2. While aligning the locating marks on the field coil (1) and electromagnetic switch (17) housing, carefully slide the field coil (1) on the motor armature (3).
3. Align the claw of the brush plate (37) with its groove of the field coil (1) and place the brush plate (37) onto the field coil (1).
4. Using a screwdriver, hold the brush spring (38) back and connect the brush into the brush plate (37). Connect the four brushes.

CRANKING MOTOR

NOTE: *Check that the positive (+) lead wire is not grounded. Take care not to damage the lead wires or get oil on them.*

5. While aligning the locating mark (refer to DISASSEMBLY) install the guard (39), with two bolts (46). Tighten to torque 10÷18 [Nm].
6. Install two screws with washers (47) on the guard (39) and tighten them.
7. Apply grease to the steel ball (40), and insert it into the overrunning clutch shaft (15) hole.
8. Apply grease to the spring (41) and insert it into the electromagnetic switch (17) hole.
9. Place the following parts in position on the cranking motor housing (16), refer to 12. DISASSEMBLY p.8.

    6 Clutch Assy
    5 Pinion Gear
    4 Retainer and Clutch Rollers
    3 Drive Gear

10. Install new O-ring (55), the cranking motor housing (16).
11. Install three bolts (48) with new O-rings (54) and washers (53) and tighten them.

15. INSTALLATION (Fig. 8.5)

1. Install cranking motor (6) with new gasket and spacer on the engine flywheel housing (3) mounting pad.
2. Install cranking motor mounting bolts with washers (2) and tighten to torque 190÷250 [Nm].
3. Reconnect all electrical leads (4, 5 and 7) to the cranking motor (1) and to the solenoid switch (6) terminals and tighten them (see SPECIFICATIONS for Special Torque).

BATTERY

16. 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.

BATTERY

17. 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]).

18. 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

BATTERY

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

19. 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 350[A] for warm start battery or 475 [A] for cold start battery (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, 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.

c. Load Procedure

NOTE: *This procedure is valid only if the battery is at or above the state of charge specified in Electrolyte 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 350[A] for warm start battery or 475 [A] for cold start battery (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

20. BATTERY CHARGING GUIDE

Recommended Rate and Time for Fully Discharged Condition

Rated Battery Capacity	Charge	
170 Minutes Warm start	2.75 hours at 30 Amperes	4 hours at 20 Amperes
	3 hours at 25 Amperes	5.5 hours at 15 Amperes
190 Minutes Cold start	3.5 hours at 30 Amperes	5 hours at 20 Amperes
	4 hours at 25 Amperes	6.5 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.

21. 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

22. 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.

23. 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].

24. 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.

BATTERY

7. Dry charged batteries may be placed in service immediately after activation. However, to insure good performance these additional steps are recommended.
   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.

25. 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.

26. 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.

BATTERY

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.

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.

SECTION 9

FRAME

FRAME

SECTION 9

CONTENTS

GENERAL

1. DESCRIPTION 3
2. WELDING 4

FRAME

3. SPECIFICATION 5
4. MAINTENANCE 5
5. DISASSEMBLY 5
6. REASSEMBLY 8

ENGINE CRANKCASE GUARD

7. REMOVAL 11
8. INSTALLATION 11

TRANSMISSION CASE GUARD

9. REMOVAL 12
10. INSTALLATION 12

GENERAL

1. DESCRIPTION

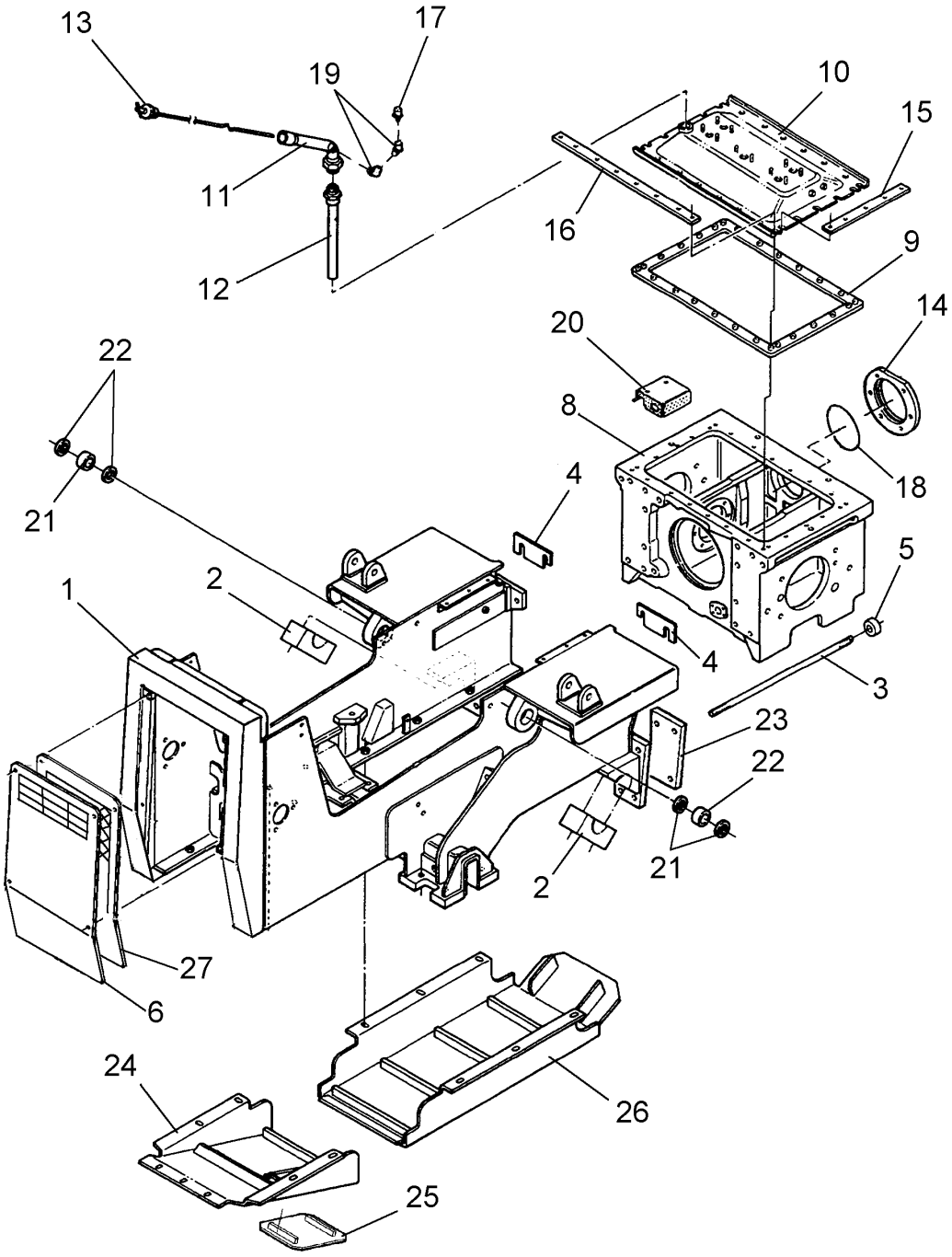


Fig. 9.1. Exploded View of Frame

1. Front Frame
2. Cover
3. Tie Bar
4. Mounting Shim
5. Spacer Sleeve
6. Radiator Door
8. Rear Frame
9. Cover Gasket
10. Rear Frame Cover
11. Upper Tube Assy
12. Lower Tube Assy
13. Oil Level Dipstick
14. PTO Cover
15. Side Bar
16. Front or Back Bar
17. Breather
18. O-Ring
19. Elbow
20. Rear Frame Sump Baffle
21. Non-Lube Bearing
22. Seal Ring
23. Spacer Plate (for TD-7M & TD-8M only)
24. Transmission Case Guard
25. Cover
26. Engine Crankcase Guard
27. Front Screen

FRAME

GENERAL

The front and rear frame provides solid support and protection for individual drive train components.

The front frame 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 frame 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 front frame 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

Torque Data

Tie Bar Mounting Bolts . . . . . .650 [Nm]
Front Frame Mounting Bolts . . . . . .730 [Nm]
Front Frame Safety Bolts . . . . . .13 [Nm]
Safety Bolt Lock Nut . . . . . .68 [Nm]

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.

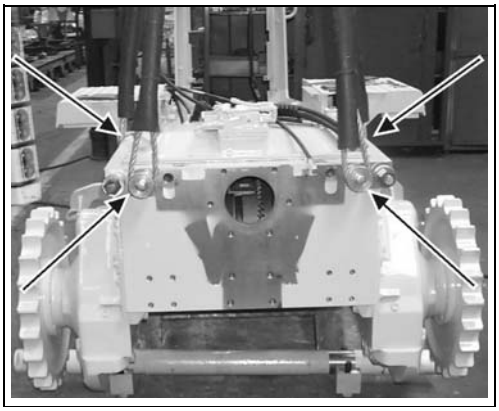
To keep rust and corrosion to a minimum, periodic painting of abrasions and bare metal is recommended.

5. DISASSEMBLY

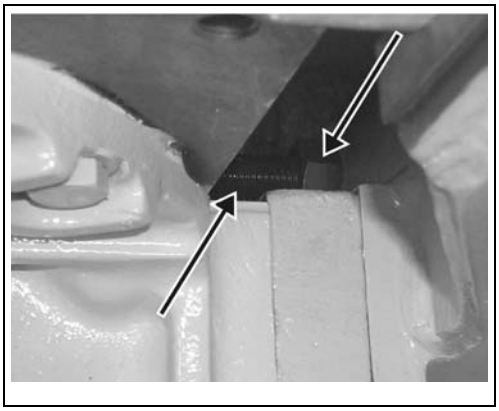
NOTE: *To separate front frame and rear frame remove required components according to REMOVAL in Section 7E, STEERING DRIVE.*

NOTE: *If front frame is replaced remove the engine with torque converter (refer to REMOVAL in Section 12, POWER) and mounted equipment.*

1. Screw in two 1-1/8NCx3 bolts in the back of rear frame and two 3/4NCx2-3/4 bolts at rear frame front part at the frame side. Install a sling to the rear frame and attach hoist to the sling.

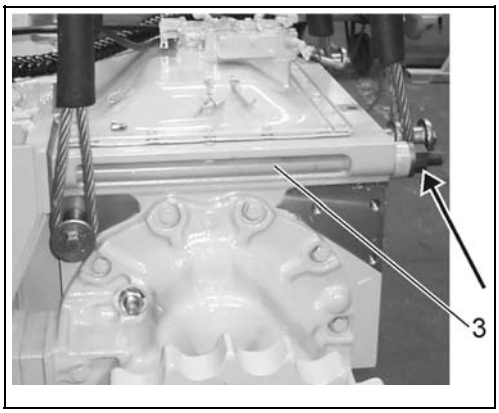


2. From under machine loosen safety bolt counter nuts and unscrew rear/front safety bolts. Leave the bolts with nuts in the front frame.

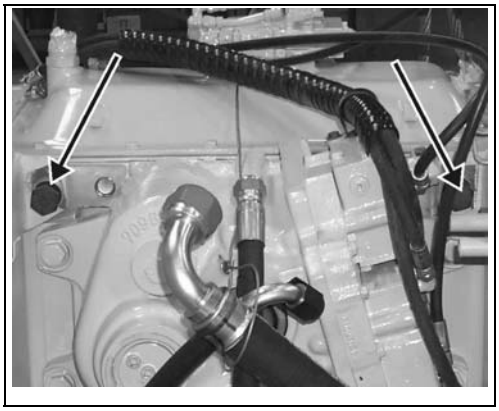


FRAME

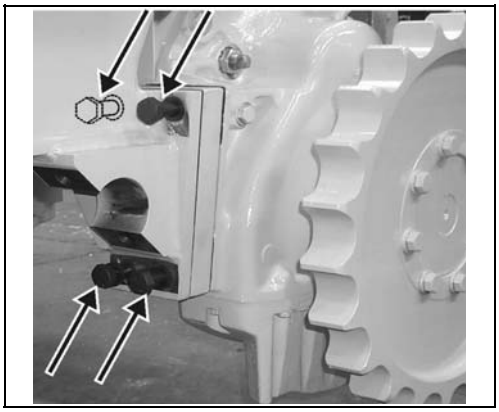
3. Loosen two tie bars (3) nuts at the back of rear frame.



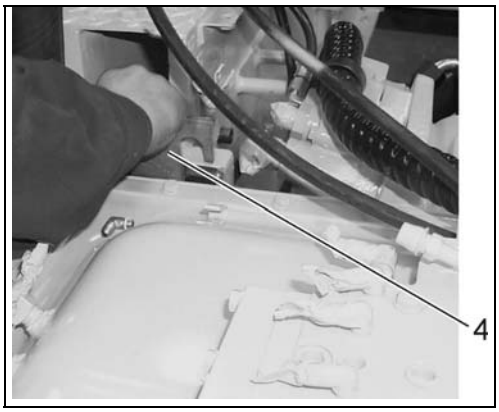
4. Loosen two front frame mounting bolts at top of front/rear frame.



5. Loosen final drive to front frame bolts at each side.



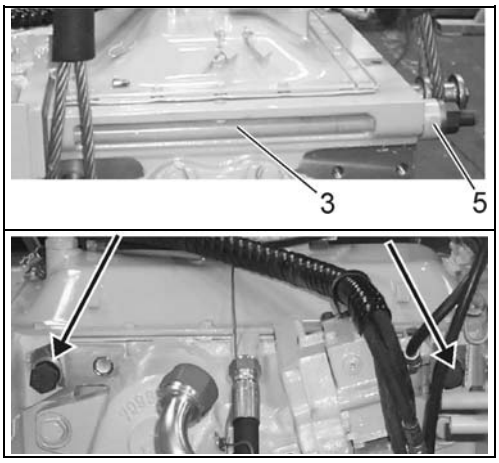
6. Remove shims (4). Retain shims (4) for proper assembly.



FRAME

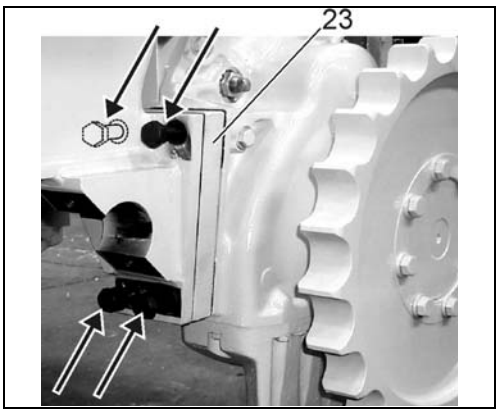
7. Remove tie bar nuts with washers and sleeves (5). Remove tie bars (3).

Remove two front frame mounting bolt at top of front/rear frame



8. Remove four final drive to front frame bolts at each side. Separate rear frame (8) from the front frame (1) and position it on a stand.

NOTE: *For TD-7M and TD-8M: Remove spacer plate (23) with final drive to front frame removing four bolts. Repeat for remaining side.*

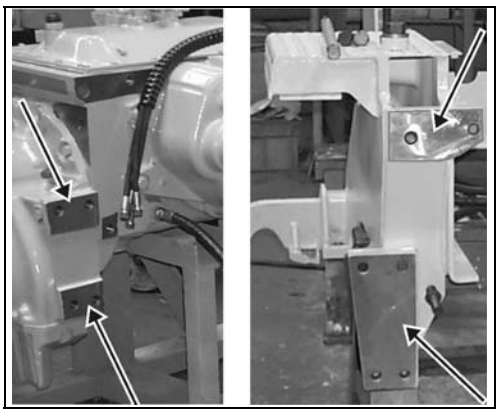


NOTE: *If rear frame is replaced remove steering drive assembly according to REMOVAL in STEERING DRIVE, Section 7E.*

FRAME

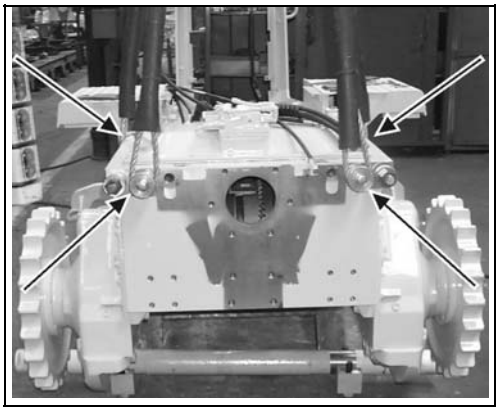
6. REASSEMBLY

1. Thoroughly clean all mounting surfaces of rear frame with final drives mounted (left) and front frame (right) in a suitable solvent.

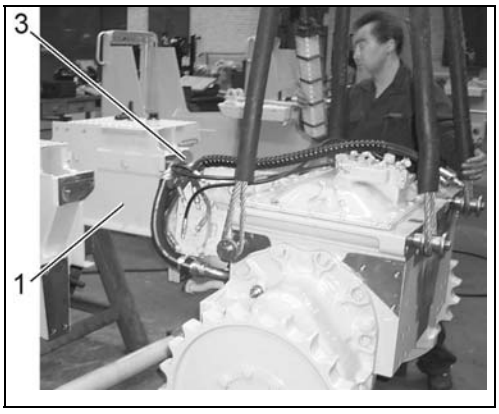


NOTE: *For TD-7M and TD-8M clean the spacer plates (23).*

2. Install a sling to the rear frame and attach hoist to the sling.



3. Install one tie bar (3) as a aligning stud. Raise the rear frame into position on the aligning tie bar.



NOTE: *For TD-7M and TD-8M install spacer plate (23) between final drive and from frame mating surfaces. Repeat for remaining side.*

FRAME

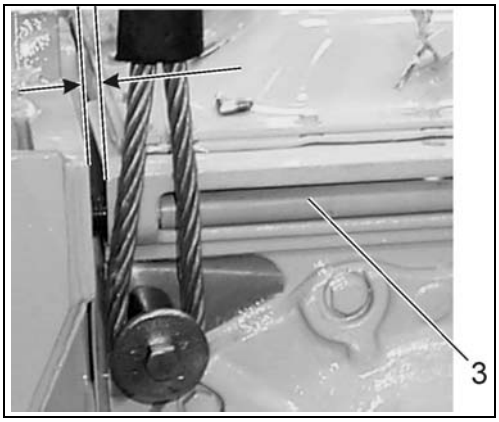
4. Secure the rear frame to the front frame using eight final drive to front frame bolts (four per each side). Preliminary torque the bolts to 136 [Nm].



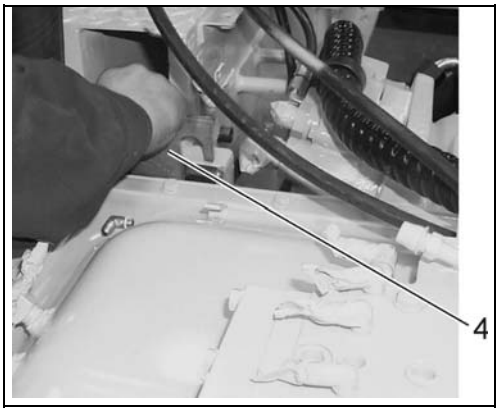
5. Measure and record distance between front frame surface to rear frame surface. Measure the distance in upper part of front/rear frame, close to tie bar (3) openings. Select shims pack (4) thickness in that way it should be larger 0.2 to 0.5 [mm] than measured distance between frames surfaces.

NOTE: *Repeat for remaining side. This procedure MUST be performed for both sides individually.*

NOTE: *If front and rear frames have not been replaced use previously removed shims (4) for each side for assembly.*



6. Install front frame mounting bolts and tire bars bolt using finger pressure. Screw two tie bars (3) in front frame (1) as fares it will go. Release four upper final drive to front frame bolts and install shim pack (4) in place.



7. Torque two front frame bolts in upper part of front/rear frame to 730 ± 10% [Nm].

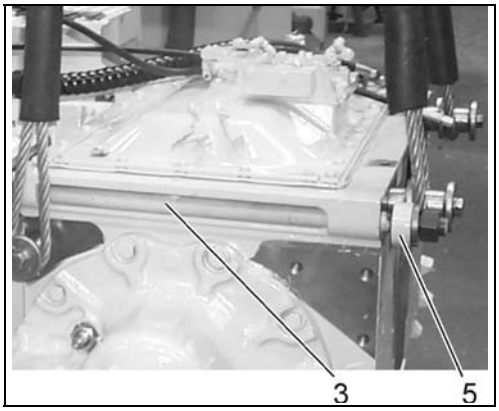


FRAME

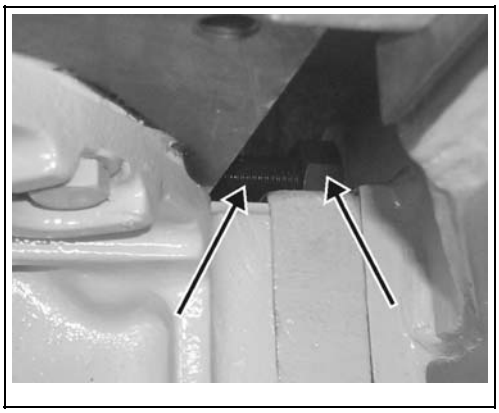
8. Torque eight final drive to front frame bolts to 730 ± 10% [Nm].



9. Coat tie bars (3) threads with engine oil or grease, install spacer sleeve (5) and tie bar lock nuts. Torque the nuts to 650 ± 10% [Nm].



10. From under the frame screw rear/front frame safety bolts into rear frame. Torque the bolts to 13 ± 10% [Nm]. Secure with safety bolt lock nuts. Torque the nuts to 68 ± 10% [Nm].



NOTE: *Install the engine according to INSTALLATION in POWER, Section 12, if removed. Install mounted equipment, if removed.*

NOTE: *Install steering drive assembly according to INSTALLATION in STEERING DRIVE, SECTION 7E, if removed.*

NOTE: *For installation other assemblies removed from rear and front frames refer to REASSEMBLY in STEERING DRIVE, Section 7E and follow steps from steering drive installation to end.*

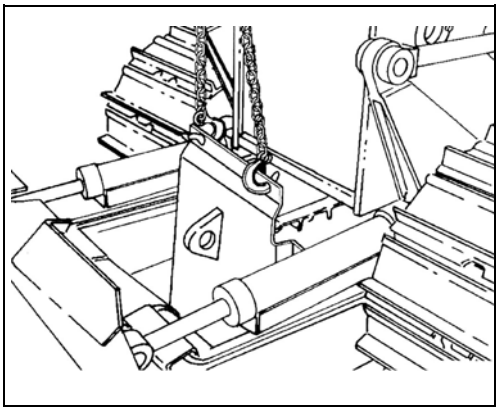
ENGINE CRANKCASE GUARD

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 lock lever is locked 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.

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

7. REMOVAL

1. Install a sling through the pull hook on the crankcase guard and position around the lift cylinder. Attach hoist to the sling.
2. From under the machine, carefully remove the hardware and slowly lower the guard to the ground. Pull the guard out the front of the machine, attach the hoist and remove.



Weight of engine crankcase guard . . . . . 53 [kg]

8. INSTALLATION

1. Carry out installation in the reverse order of removal.

FRAME

TRANSMISSION CASE GUARD

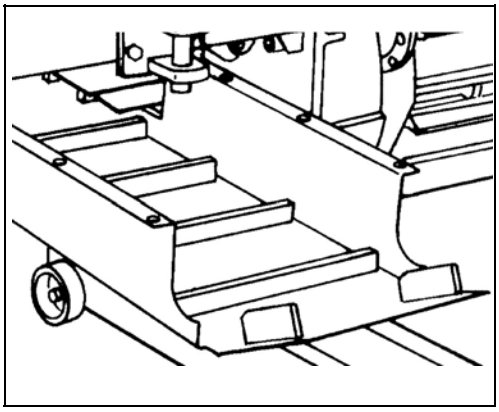
WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train control lock lever is locked and parking brake is set. The starting switch and the electrical system master switch are turned OFF, keys are removed and the controls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

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

9. REMOVAL

1. Using a rolling floor jack, remove the transmission guard from under the machine.

Weight of transmission case guard . . . . . 57 [kg]



10. INSTALLATION

1. Carry out installation in the reverse order of removal.

SECTION 10

HYDRAULICS

CONTENTS

GENERAL

1. DESCRIPTION 3
2. OPERATION 4
3. SPECIFICATIONS 5
4. SERVICE DIAGNOSIS 6

TESTS AND ADJUSTMENTS

5. RELIEF VALVE PRESSURE TEST 8
6. CYLINDER DRIFT TEST 10
7. CYLINDER TIME CYCLE 10
8. PISTON PACKING TEST 11
9. PRESSURE DIAGNOSTIC CHART 11

GENERAL

1. DESCRIPTION

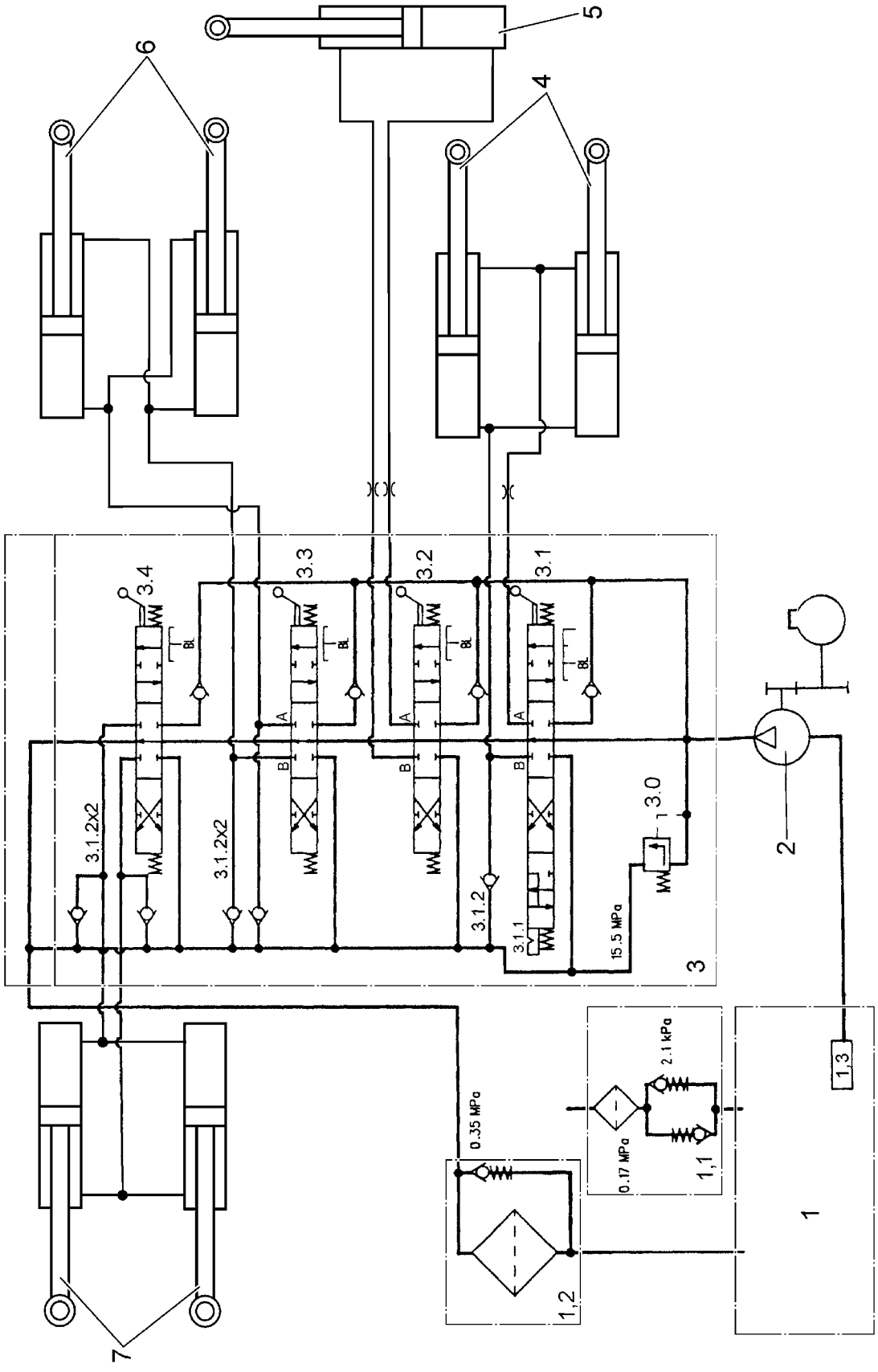


Fig. 10.1. Equipment Hydraulic System Diagram

GENERAL

Legend for Fig. 10.1.

1. Hydraulic Oil Reservoir
1.1. Breather
1.2. Suction Strainer
2. Equipment Hydraulic System Pump
3. Three or Four Section Control Valve
3.0. Relief Valve
3.1. Raise Section (First)
3.1.1. Float Position Latch
3.1.2. Anti-cavitation Valve
3.1.3. Load Check Valve
3.1.4. Orifice
3.1.5. Orifice
3.2. Tilt Section (Second)
3.3. Angling Section (Third)
3.4. Rear Mounted Equipment Section (Fourth)
4. Raise Hydraulic Cylinders
5. Tilt Hydraulic Cylinder
6. Angling Hydraulic Cylinders
7. Ripper Hydraulic Cylinders
8. Return Filter

The hydraulic system consists of a reservoir (1), gear pump (2), control valve (3), piping, cylinders (4,5 and 6) and return filter (8). A ripper attachment is available and consists of an additional valve section (3.4), cylinders (7) and piping.

2. OPERATION

The hydraulic reservoir (1), mounted next to the fuel tank, supplies oil through a suction strainer (1.2) to the gear pump (2). The pump is flange mounted at the left side of the torque converter and is driven by the converter accessory gear whenever the engine is running. Oil from the pump is directed to the inlet section of the control valve (3). When the valve is not actuated, oil will flow back to the reservoir (1) by return filter (8).

The reservoir is bolted to a bracket mounted to the rear main frame. It is equipped with a 100 mesh suction strainer (1.2), an external mounted return oil filter (8), incorporating a cold oil bypass valve and an external vacuum pressure relief breather (1.1). The breather will protect the pump from cavitating as well as maintaining pressure in the reservoir.

A positive displacement, single element, gear type hydraulic pump (2) is used to supply pressurized oil to the control valve (3). The pump operates continually while the engine is running, but is under load only when the control valve spool(s) is/are shifted from neutral. As oil is supplied to the pump, gear rotation forces pressurized oil to the outer diameter of the housing between the teeth. As pressurized oil exits the housing it is directed to the control valve.

The control valve (3) is mounted to a bracket in the right control console in front of the reservoir located on the right fender. This system utilizes either a three or four spool valve depending on whether or not a ripper is used. The valve is controlled by mechanical linkage between the control levers and the valve. Mechanical linkage controls the blade and ripper, if equipped.

The valve inlet cover contains an adjustable pilot operated pressure relief valve (3.0) which is used to by pass oil from the pump back to the reservoir when oil pressure exceeds the relief valve setting. The spools are spring centered, either three or four position type with the FLOAT position being detented. Incorporated in the valve section housing is a load check valve (3.1.3) which will assure smooth operation when the spool is moved from hold to an operating position. An anti-cavitation valve (3.1.2) is located in the blade lift (3.1), blade angle (3.3), and ripper section (3.4), if equipped, section housings. A three spool control valve is used on machines equipped with a six way blade. A four spool control valve is used on machines equipped with a six way blade and a ripper.

Six Way Blade: The first spool is used for the blade lift (3.1) and is a spring centered, four position type with FLOAT position being detented. The middle spool (3.2) is used for blade tilt. The third spool (3.3) is for blade angle. Both of the spools are spring centered, three position type. Incorporated in each valve section housing is a load check valve (3.1.3) which assures smooth operation when the spool is moved from hold to an operating position. An anti-cavitation valve (3.1.2) is located in the blade lift and angle valve section housings only.

GENERAL

Six Way Blade with Ripper: The first spool is used for the blade lift (3.1) and is a spring centered, four position type with FLOAT position being detented. The middle spool (3.2) is used for the blade tilt. The third spool (3.3) is for the blade angle. Both of the spools are spring centered, three position type. Incorporated in each valve section housing is a load check valve (3.1.3) which assures smooth operation when the spool is moved from hold to an operating position. An anti-cavitation valve (3.1.2) is located in the blade lift and angle valve section housings only. The fourth spool is for the ripper (3.4). The spool is a spring centered, three position type. Incorporated in the valve section housing is a load check valve (3.1.3) which assures smooth operation when the spool is moved from hold to an operating position. An anti-cavitation valve (3.1.2) is located in each end of the valve section housing.

Located in the blade lift rod end and blade tilt rod and head end connectors are orifice (3.1.5 or 3.1.4) which restrict the flow of oil. This gives the operator more precise control when lowering the blade and tilting the blade in either direction. As the oil flows to the tilt cylinder, the orifice button is forced against its seat forcing the oil to flow through the orifice only, restricting its flow. As oil returns, the orifice button is forced against its "legs" allowing the oil to flow thru the orifice and around the button sides to allow a greater flow preventing a void from forming.

3. SPECIFICATIONS

RESERVOIR

Reservoir Capacity	57.0 [dm^3]
Oil Capacity	36.0 [dm^3]
Air Capacity	21.0 [dm^3]
Suction Strainer	100 Mesh
Return Filter	15 µ Absolute
Vacuum Pressure Relief Valve :	
Vacuum	2.1 [kPa]
Pressure	0.17 [MPa]
Operating Temperature of Oil	82 to 88 [°C]

EQUIPMENT PUMP

Type	Positive Displacement, Single Element
Rated Capacity;	
TD7M and TD8M @ 1977 RPM	75.7 [l/min]
TD9M and TD10M @ 1819 RPM	70.0 [l/min]
Rated Capacity Pressure	6900 [kPa]

CONTROL VALVE

Main (System) Relief Valve Pressure	15.5 ± 0.34 [MPa]
Anti Cavitation Valve :	
First Spool	One @ Piston End of Cylinder
Third Spool	One @ Each End of Cylinder
Fourth Spool	One @ Each End of Cylinder
Load Check	One Each End of Each Spool

CYLINDERS

Lift Cylinder:

Quantity	Two
Bore Diameter	89 [mm]
Rod Diameter	44 [mm]
Stroke:	449 [mm]

GENERAL

Tilt Cylinder:
- Quantity..... One
- Bore Diameter..... 89 [mm]
- Rod Diameter..... 44 [mm]
- Stroke..... 144 [mm]

Angle Cylinders – TD-7M or TD-8M:
- Quantity..... Two
- Bore Diameter..... 76 [mm]
- Rod Diameter..... 38 [mm]
- Stroke..... 352 [mm]

Angle Cylinders – TD-9M or TD-10M:
- Quantity..... Two
- Bore Diameter..... 89 [mm]
- Rod Diameter..... 44 [mm]
- Stroke..... 352 [mm]

Ripper Cylinder:
- Quantity..... Two
- Bore Diameter..... 76 [mm]
- Rod Diameter..... 51 [mm]
- Stroke..... 173 [mm]

4. SERVICE DIAGNOSIS

This section has been prepared to serve as a guide in locating sources of problems that may be encountered with pumps, control valves and cylinders. 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 the predominant symptoms and their primary causes, based on our experience. When a number of possible causes of a complaint are given, they are listed in a logical sequence for checking and corrective action. Tests are given to further pinpoint the problem. Refer to hydraulic system diagram in this section.

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 reservoir breather filter.	Wash or change filter.
5. Air leakage into suction lines.	Apply shaving cream to all suction connections, and tighten where cream disappears.

GENERAL

All Circuits Weak and Slow	
1. Insufficient oil supply.	Refer to Noisy Operation - Oil Foaming.
2. Low relief valve pressure.	Refer to MAIN VALVE PRESSURE TEST.
3. Pump worn out.	Refer to CYLINDER CYCLE TIME TEST.
Pump Unusually Noisy	
1. Low supply of oil.	Fill to proper level. Refer to OPERATOR'S MANUAL.
2. Oil viscosity too dense.	Use recommended oil. Refer to OPERATOR'S MANUAL.
3. Dirty suction strainer or filter.	Clean strainer or filter.
4. Restriction in suction line.	Remove restriction.
5. Air leak in suction line.	Check for loose connections.
6. Oil temperature high causing vapor to form in oil.	Check entire circuit.
Pump Takes Too Long To Respond Or Fails To Respond	
1 . Low oil supply.	Fill to proper level. Refer to OPERATOR'S MANUAL.
2. Low relief valve pressure.	Refer to relief valve pressure test.
3. Pump worn or damaged.	Inspect, repair or replace.
Short Life Of Pump	
1. Aeration or cavitation.	Refer to Noisy Operation - Oil Foaming.
2. Relief valve pressure to high.	Refer to RELIEF VALVE PRESSURE TEST.
3. Pressure breather filter clogged.	Wash or change filter.
Boom or Ripper Cylinders Drift	
1. One of cylinders leaking.	Refer to CYLINDERS DRIFT TEST
2. Control valve section leakage	Refer to CYLINDERS DRIFT TEST
Blade Tilt Circuit Weak and/or Slow	
1. Cylinder leaking.	Refer to PISTON PACKING TEST.
2. Internal leak in control valve.	Refer to PISTON PACKING TEST.
Angle Circuit Weak and/or Slow	
1. One of cylinders leaking.	Refer to PISTON PACKING TEST.
2. Internal leak in control valve.	Refer to PISTON PACKING TEST.

GENERAL

Momentary Drop When Circuit Activated From Hold	
1. Scored or worn load check or seat in control valve.	Replace.
2. Load check in control valve held of its seat.	Clean system. Check for foreign material.
Oil Overheating	
1. Excessive feathering of controls.	Review operating instructions in OPERATOR'S MANUAL.
2. Oil level too low.	Fill to proper level. Refer to OPERATOR'S MANUAL.
3. Control linkage binding not restricting valve spool travel.	Repair.
4. Using very light oil in a hot climate.	Use recommended oil. Refer to OPERATOR'S MANUAL.
Short Life Of Pump	
1. Aeration or cavitation.	Refer to Noisy Operation - Oil Foaming.
2. Relief valve pressure to high.	Refer to RELIEF VALVE PRESSURE TEST.
3. Pressure breather filter clogged.	Wash or change filter.

TEST AND ADJUSTMENTS

5. RELIEF VALVE PRESSURE TEST

1. Remove the control valve cover from the right side of the machine. Connect a 30 [MPa] gauge to the quick disconnect fitting (1, Fig. 10.2) on the inlet tube.

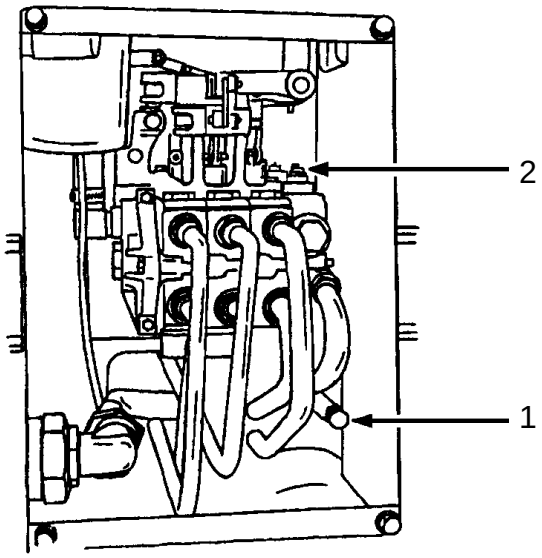


Fig. 10.2. Pressure Check Point

1. Quick Disconnect 2. Relief Valve

TEST AND ADJUSTMENTS

2. Pressure check should be performed with the oil at operating temperature. To bring the oil temperature up, move the control valve levers through all positions while the engine is at low idle and bottom the cylinders for a few seconds in each position. Repeat this procedure while gradually increasing engine speed.

NOTE: *Bottoming the cylinder for a short period of time will not damage the hydraulic system, but an extended period will produce excessive heat and result in an inaccurate gauge reading.*

3. Once operating temperature is reached, run the engine at full throttle and slowly move the tilt control lever until the cylinder is in an extreme position. Read and record the pressure on the test gauge at which the relief valve unloads. Then repeat this procedure with the angle control lever. Repeat this step with the engine running at low idle.

4. The pressure obtained in Step 3 should be 15.5 ± 0.34 [MPa], if the pressures are not proceed as follows:

   A. If both the low and high idle readings are the same but not as specified, the system is operating correctly but the relief valve must be adjusted. Proceed with Step 5.

   B. If the pressure is within 15.5 ± 0.34 [MPa] at high idle but cannot be reached at low idle, refer to the following PRESSURE DIAGNOSTIC CHART.

5. Loosen the jam nut (2, Fig. 10.3) and turn the adjusting screw (3), using a screwdriver, clockwise to increase the pressure or counterclockwise to decrease the pressure. After the correct pressure on the gauge is obtained, lock down the jam nut.

6. Remove the test gauge and install the control valve cover.

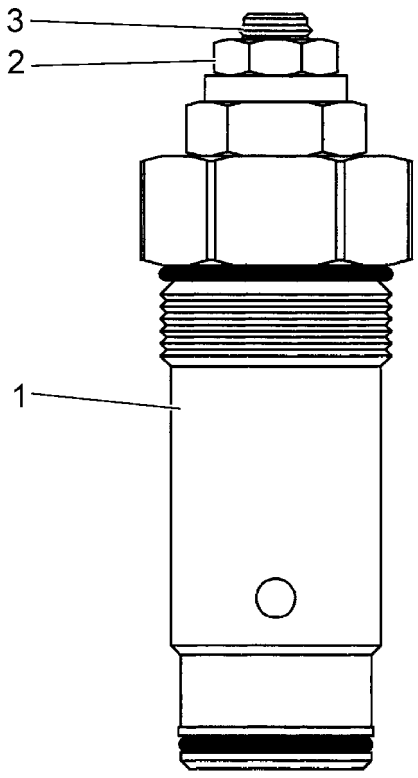


Fig. 10.3. System Relief Valve

1. System Relief Valve 2. Jam Nut 3. Adjusting Screw

6. CYLINDERS DRIFT TEST

The problem of cylinders drift can be traced to two main causes, internal or external leakage. External leakage is not detailed here, since it can be visually located. Internal leakage is not always readily pin pointed to its source and may require a series of tests to isolate the problem.

There are two places that might be a source of internal leakage; the cylinder might have leakage past the piston packing and/ or the control valve could leak at the spool.

Following is a series of tests developed to trace the source of internal leakage. Oil must be at operating temperature.

1. Fully raise the blade or ripper, move the blade or ripper lift lever to the HOLD position. Check for cylinders drift. The piston rods should not travel out of the cylinder no more than 8 [mm] per minute.

NOTE: *The 8 [mm] per minute figure represents accumulative allowable loss of control valve and cylinders combined.*

2. If the cylinder drift is more than 8 [mm] per minute, proceed as follows:

Lower the blade or ripper, relieve the pressure in the system as described In the Operator's Manual, Sections 2 and install a shut off valve at the raise port of both cylinders. Raise the blade or ripper, close the shut off valves and check for drift.

3. If the shutoff valves are not accessible, check the hydraulic cylinders following the procedure described below in PISTON PACKING TEST.

A. If the cylinders drift is more than 3 [mm] per minute, one of the cylinders is at fault.
B. If the cylinders drift is less than 3 [mm] per minute, the boom or ripper section of control valve is at fault.

4. When the preceding tests are completed, remove the shut off valves or plugs. Vent the hydraulic system and add oil as necessary. Refer to the OPERATOR'S MANUAL. Visually check for oil leakage.

7. CYLINDER TIME CYCLE

Before performing the cylinder time cycle test, perform the CYLINDER DRIFT TEST to insure that the control valve and the cylinders are performing satisfactorily.

If there is no excessive drift when the blade lift control is in the hold position, but slow load speed, slow response or low power is present in RAISE position, the problem could be either the hydraulic pump or the pressure relief valve.

Loss of flow can be caused by the pressure relief valve not sealing, allowing oil to flow into return to the reservoir passage. Refer to PRESSURE RELIEF VALVE TEST. To check the pump, the following time cycles should be observed when raising the blade.

1. Position the machine so the blade will not touch the ground in its fully lowered position.
2. Run the engine at full throttle.

3. Starting with the blade in its fully lowered position, put the control lever in RAISE and record the time it takes to reach the fully raised position. Repeat this procedure several times and then average time readings.

The lift cycle should take 3 seconds. If the average cycle time is more than 3 seconds, the pump should be inspected for replacement or repair.

NOTE: *This check should be made only when raising the blade.*

8. PISTON PACKING TEST

1. Position the machine so that the cylinder(s) to be tested can be completely extended.
2. Start the engine, completely extend the cylinder(s) and place the control lever in HOLD.
3. Stop the engine, disconnect, remove and plug the hydraulic line at the rod end of the cylinder(s).



WARNING! During next step, pressurized oil may be expelled from cylinder.

4. Hydraulically extend the cylinder(s) again and check the rod end port of the cylinder for oil flow. Flow should be minimal to none. If oil flow is present, remove and replace piston packing or repair/replace the cylinder(s).
5. If little or no oil coming from cylinder rod end the cylinder drops because port internal leakage is within control valve.

9. PRESSURE DIAGNOSTIC CHART

PROBLEM	PROBABLE CAUSE
1. Low relief pressure at low idle only and for one control valve section only.	Cylinders leaking. Refer to PISTON PACKING TEST.
2. Low relief pressure at low idle only when testing all control valve sections.	Worn pump. Refer to CYLINDER TIME CYCLE TEST.
3. Low relief pressure at high rpm when testing all control valve sections.	Relief valve faulty. Dismantle relief valve for inspection and repair.

SECTION 10A

PUMPS AND MOTORS

CONTENTS

EQUIPMENT PUMP

1. DESCRIPTION 3
2. OPERATION 3
3. SPECIFICATIONS 5
4. REMOVAL 5
5. DISASSEMBLY 6
6. INSPECTION AND REPAIR 10
7. REASSEMBLY 10
8. INSTALLATION 14

EQUIPMENT PUMP

1. DESCRIPTION

The equipment hydraulic pump is a single element fixed delivery gear type pump located on the left hand side of the torque converter.

2. OPERATION

The pump supplies oil for the equipment control valve and cylinders. Oil is gravity fed from the reservoir through the pump and outlet flow is directed to the valve.

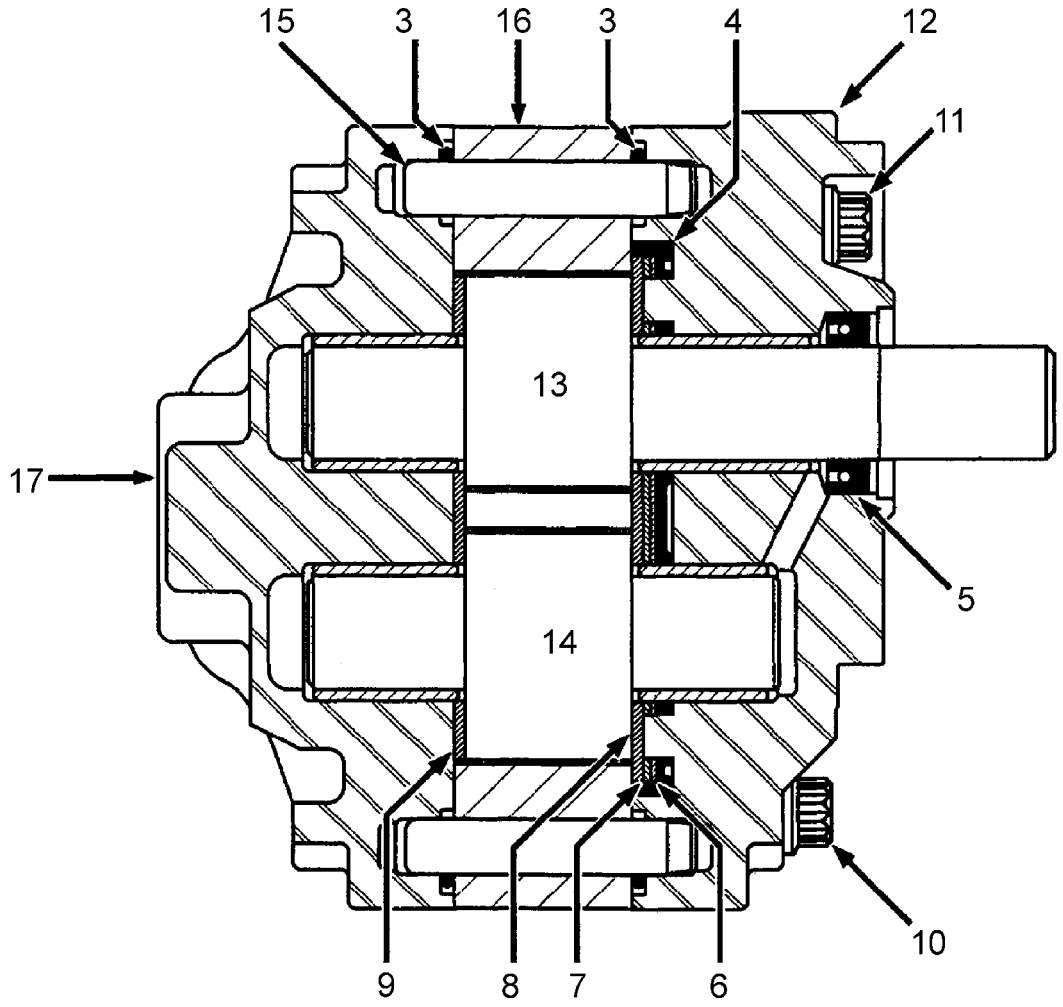


Fig. 10A.1. Cross Section View of Equipment Pump

Legend for Fig.'s 10A.1 and 10A.2

1. Check Ball Spring
2. Check Ball
3. O-Ring
4. Back Up Gasket
5. Shaft Seal Ring
6. Diaphragm Seal
7. Gasket
8. Diaphragm
9. Thrust Plate
10. Bolt
11. Bolt
12. Front Plate
13. Drive Gear
14. Driven Gear
15. Dowel Pin
16. Pump Housing
17. Rear Plate

PUMPS AND MOTORS

EQUIPMENT PUMP

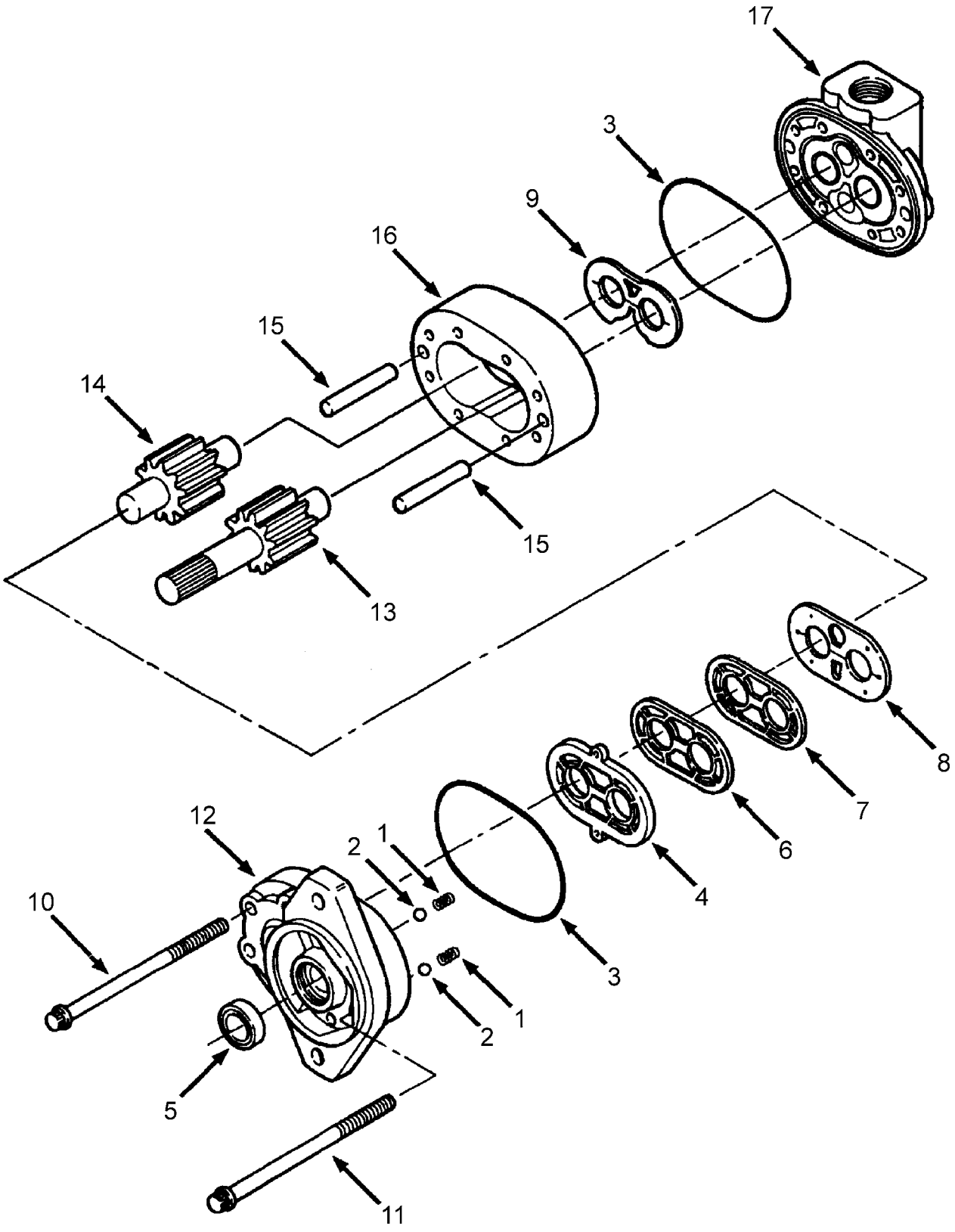


Fig. 10A.2. Exploded View of Equipment Pump

EQUIPMENT PUMP

3. SPECIFICATIONS

Type .....Single Element Fixed Delivery Gear Pump
Rated Capacity:
TD-7M and TD-8M @ 1977 RPM..... 75.7 [l/min]
TD-9M and TD-10M @ 1819 RPM..... 70.0 [l/min]
Rated Capacity Pressure .....6900 [kPa]
Pump Section Bolts Torque..... 54 to 68 [Nm]

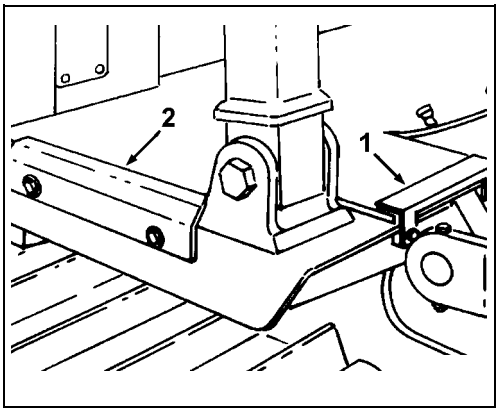
4. REMOVAL

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 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.

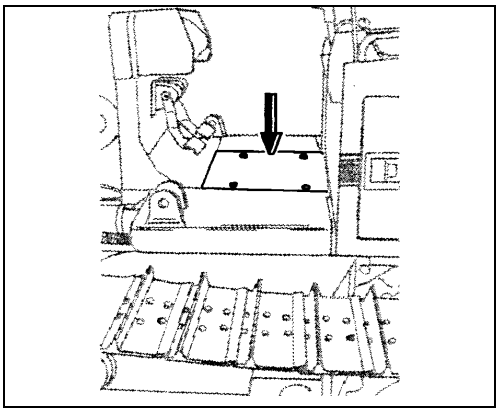
IMPORTANT: *Disconnected hydraulic lines must be capped with the correct size plastic cap. If these caps are not available, tape or clean rubber corks may be used. Hydraulic openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components of the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

1. Drain the hydraulic system. Refer to the OPERATOR'S MANUAL.

2. Remove the front (1) and side (2) floor mat retainer angles from each side of the machine.

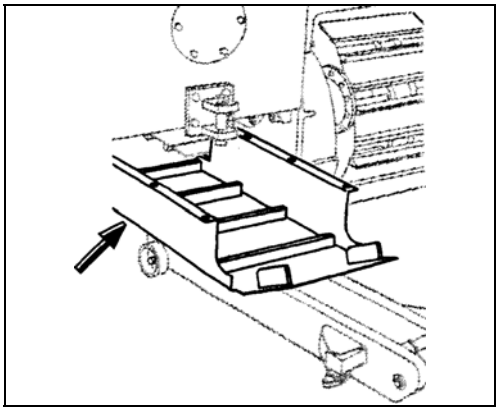


3. Remove operators compartment floor.

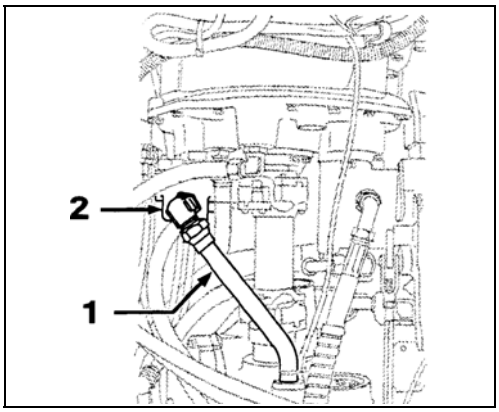


EQUIPMENT PUMP

4. Using rolling floor jack, remove transmission guard from under machine.



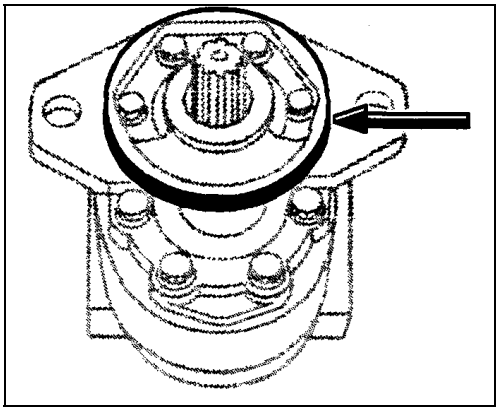
5. Disconnect and cap lines at top (1) and bottom of pump (2) and allow pump to drain into suitable container. Remove mounting hardware and lift the pump out of machine.



5. DISASSEMBLY

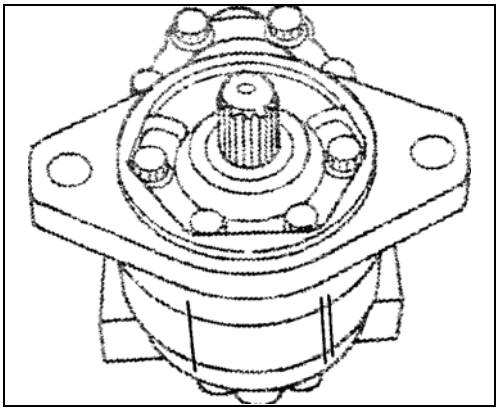
NOTE: *Callouts from cross section and exploded views (Fig.'s 10A.1 and 10A.2) correspond with callouts in following steps.*

1. Remove and discard mounting O-ring and replace with new.

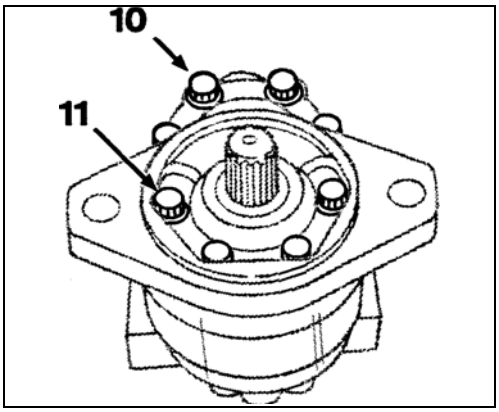


EQUIPMENT PUMP

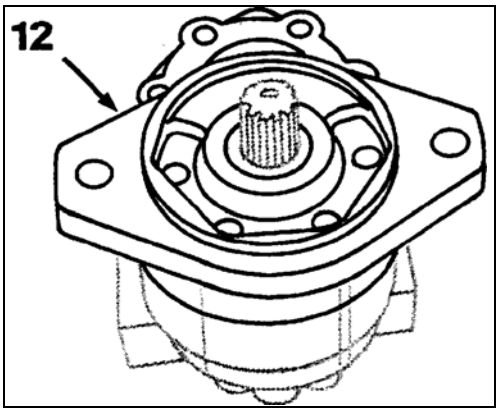
2. Thoroughly clean pump before disassembly. Match mark sections of pump as shown.



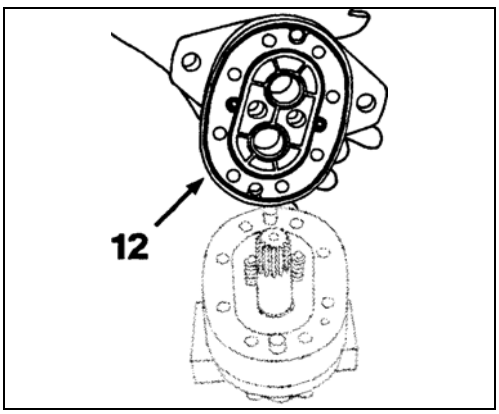
3. Remove mounting bolts (10 and 11).



4. Tap on front plate (12) to loosen from the dowel pins (15).

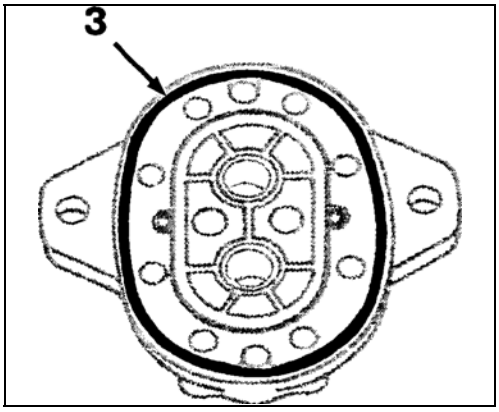


5. Remove front plate (12) from assembly.

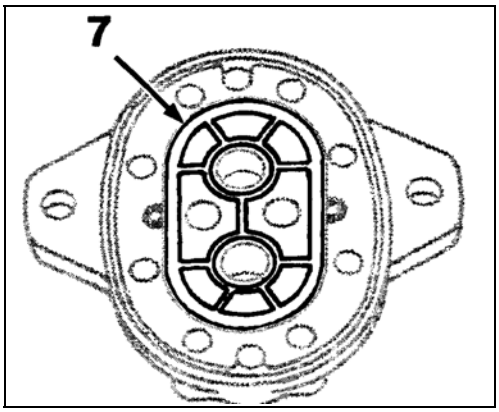


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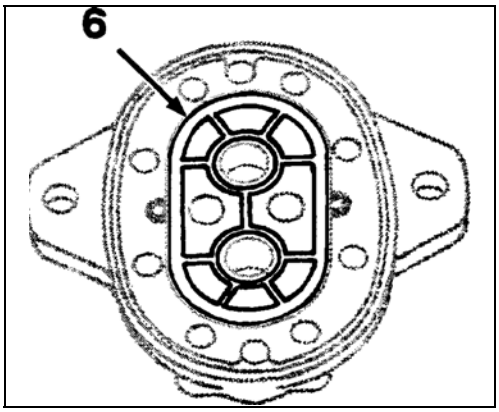
6. Remove the section O-ring (3) from the front plate (12).



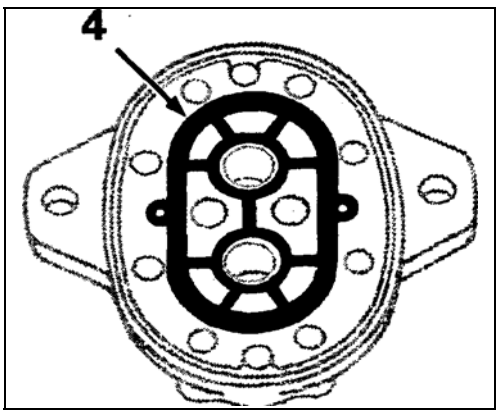
7. Remove the back up gasket (7) from the front plate (12).



8. Remove the diaphragm seal (6) from the front plate (12).

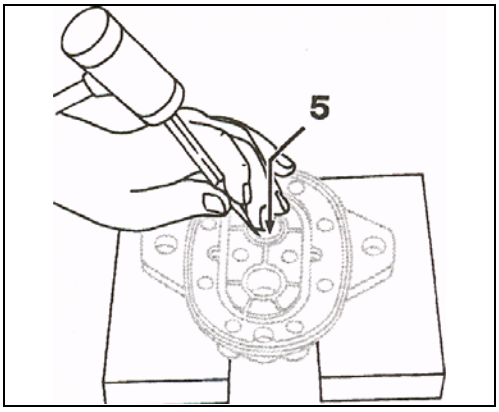


9. Remove the back up gasket (4) from the front plate (12).

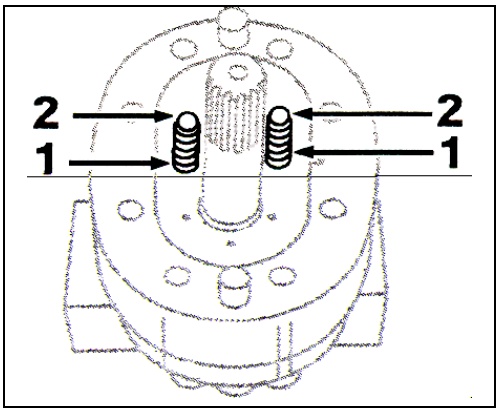


EQUIPMENT PUMP

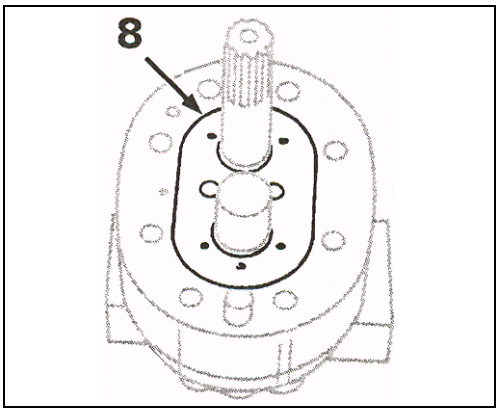
10. Turn the front plate (12) over and rest on wooden blocks. Using a punch drift, remove the seal ring (5) from the front plate.



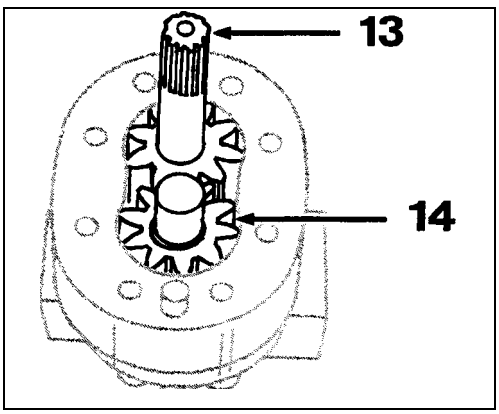
11. Remove the check balls (2) and springs (1).



12. Remove the diaphragm (8).

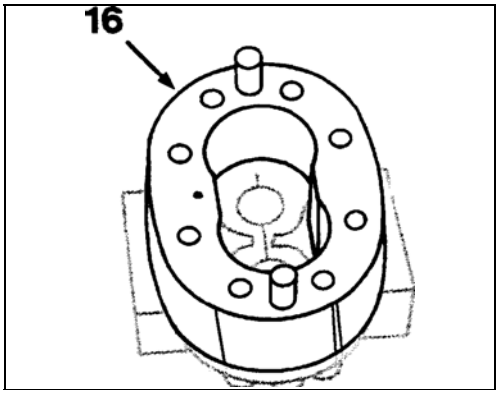


13. Remove the drive (13) and driven (14) gears.

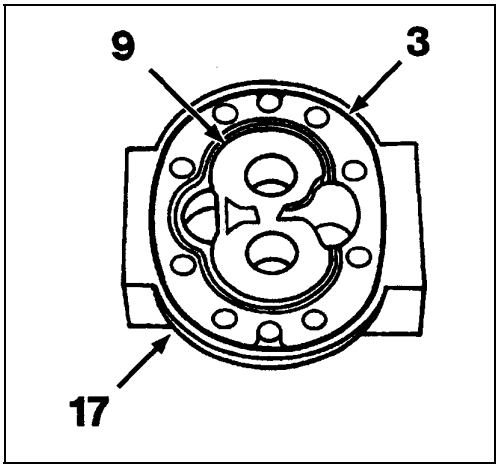


EQUIPMENT PUMP

14. Tap on the pump housing (16) to loosen from the dowel pins (15) and remove.



15. Remove the thrust plate (9) and section O-ring (3) from rear plate (17).



6. INSPECTION AND REPAIR

1. Tie bolts (10 and 11) and seal repair kit (1 through 9) are only serviced parts. If any other part other than these need replacement, replace complete pump.
2. Clean all parts and dry thoroughly with compressed air. Inspect edges and faces of gears for scoring or roughness. If possible, remove with carborundum stone. Inspect shaft and bushings for excessive wear. Inspect remaining parts for wear, cracks and breakage.

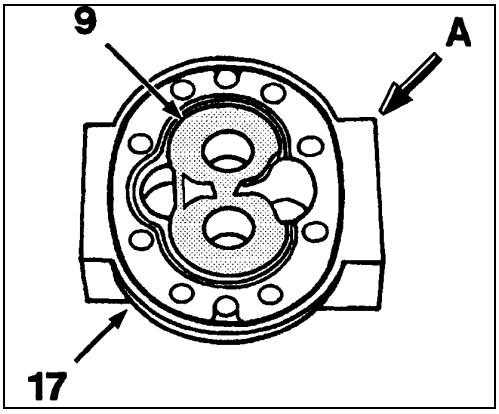
7. REASSEMBLY

NOTE: *Callouts from cross section and exploded views (Fig.'s 10A.1 and 10A.2) correspond with callouts in following steps.*

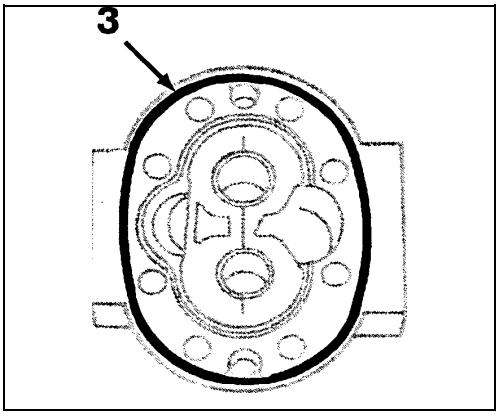
NOTE*: When reassembling pump, absolute cleanliness is a must to prevent premature failure. Lubricate all parts liberally as they are assembled with clean oil.*

EQUIPMENT PUMP

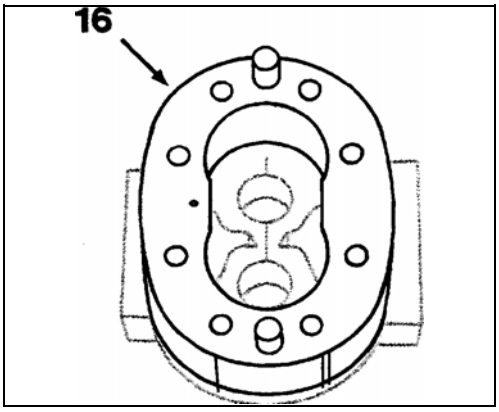
1. Install the thrust plate (9), bronze side up, with cut out towards suction port (A), large port, to rear plate (17).



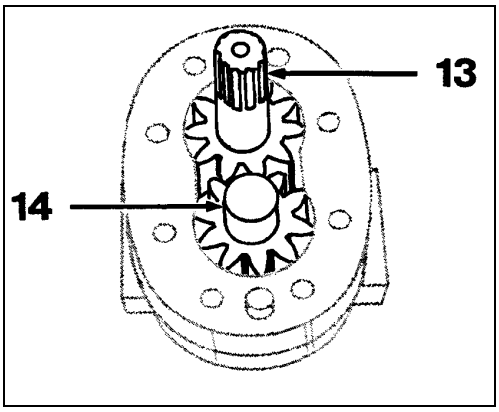
2. Coat the section O-ring (3) with amber grease and install to groove in the rear plate (17).



3. Aligning the match marks, install housing (16) to rear plate (17).

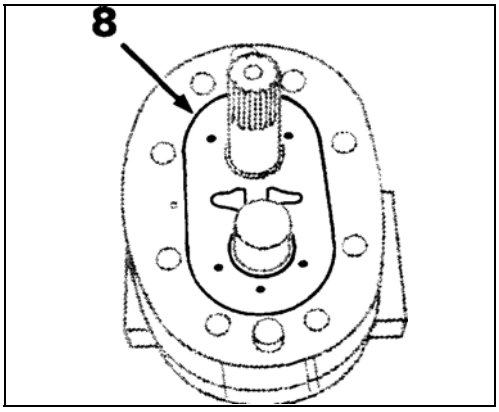


4. Install the drive (13) and driven (14) gears.

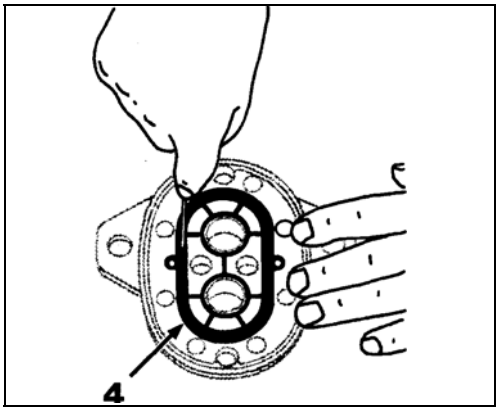


EQUIPMENT PUMP

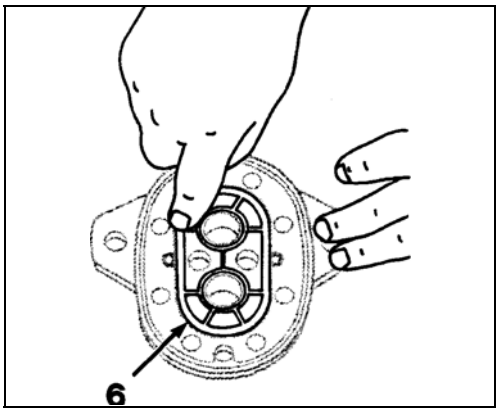
5. Install the diaphragm (8), bronze face down on gears.



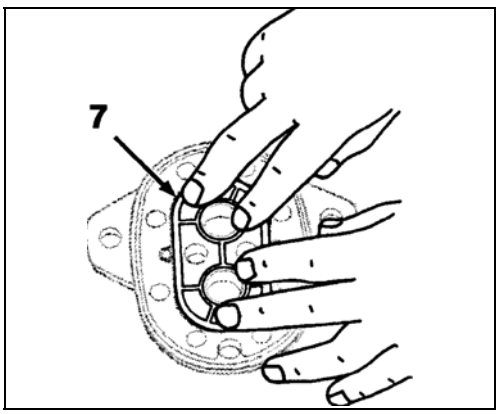
6. Using a dull tool, tuck the back up gasket (4) into the grooves of front plate (12) so the open part of "U" section is down.



7. Position diaphragm seal (6) over the back up gasket (4). Using a dull tool, carefully press the diaphragm seal into the gasket and bottom. Use air to blow any gasket particles which may have been trimmed off during the seating of the gasket.

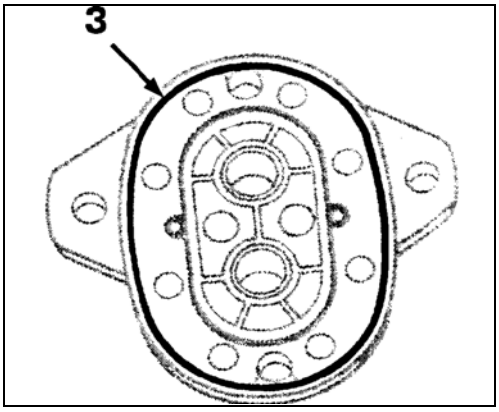


8. Install the gasket (7) in same manner as diaphragm seal (6). Installation is correct when, with the back up gasket and both diaphragm sea and gasket in position, the gasket (7) is below the top of back up gasket and even with the inside face of the front plate.

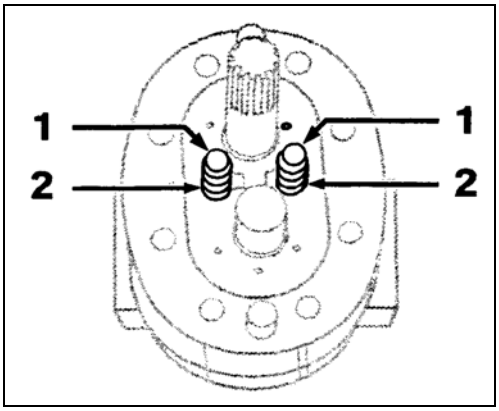


EQUIPMENT PUMP

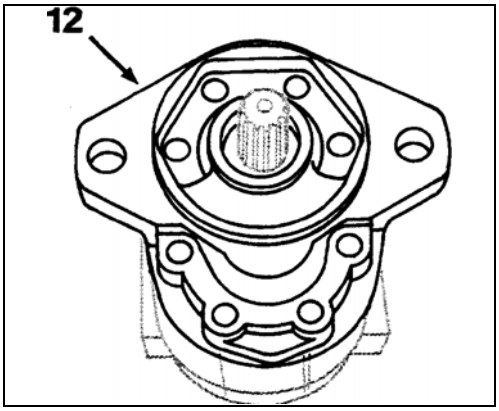
9. Coat the section O-ring (3) with amber grease and install to groove in front plate (12).



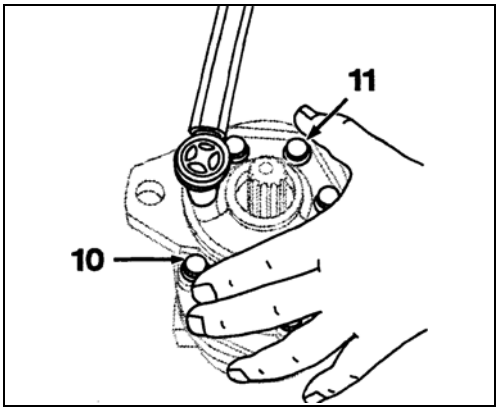
10. Install the springs (1), large end down, with check balls (2) to front diaphragm.



11. Aligning match marks, install the front plate (12) over the dowels to pump housing.

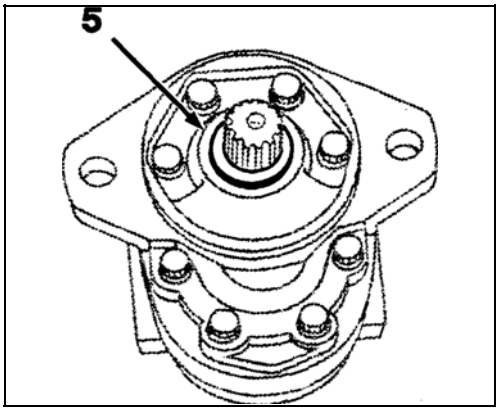


12. Install the mounting bolts (10 and 11) and torque to 54 to 68 [Nm].

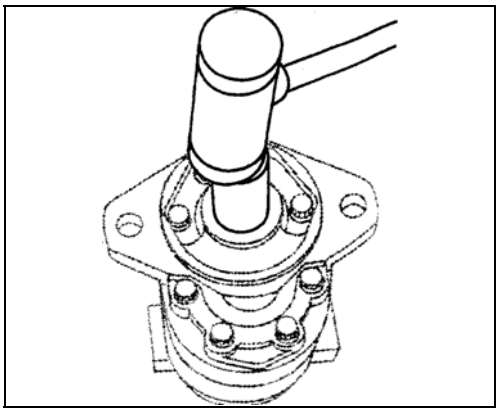


EQUIPMENT PUMP

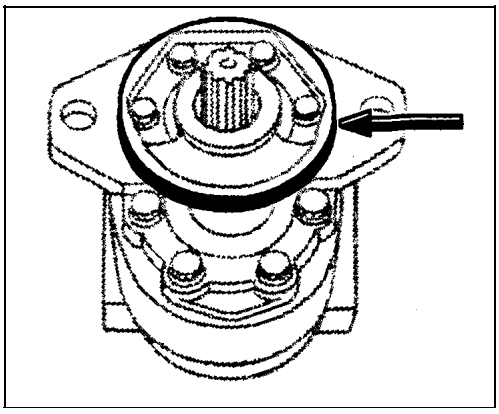
13. Start the seal ring (5) over the shaft into the front plate.



14. Using a deep well socket, bottom the seal (5) into front plate.

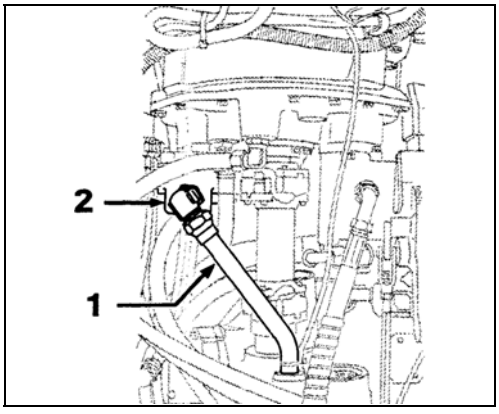


15. Install a new mounting O-ring to pump.



8. INSTALLATION

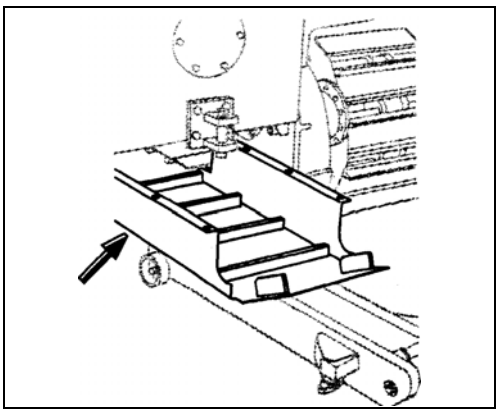
1. Install pump to torque converter being careful not to damage O-ring and secure with hardware. Torque bolts to 92 ± 10% [Nm]. Reconnect lines (1 and 2) at pump.



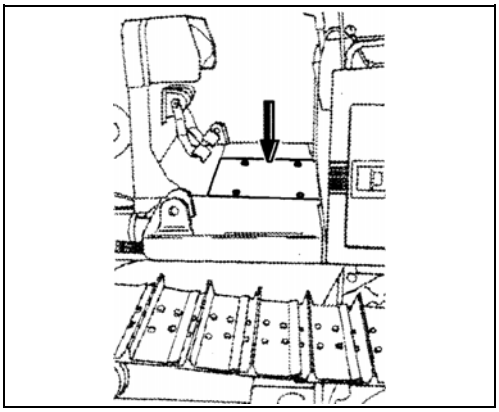
EQUIPMENT PUMP

2. Refill hydraulic reservoir as described in the OPERATION'S MANUAL.
3. Start the engine and check for external leaks in the hydraulic system. Stop the engine.
4. Check the oil level in hydraulic reservoir and add oil if necessary.

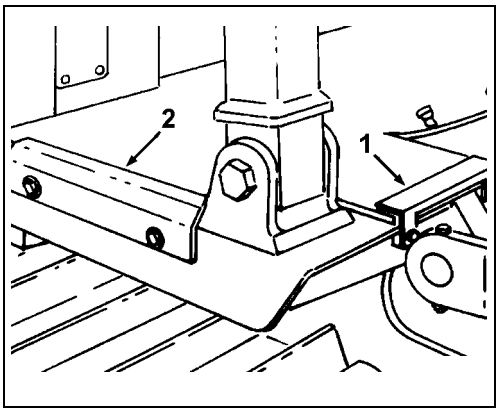
5. Using rolling floor jack, install transmission guard to machine and secure with hardware. Torque bolts to 92 ±10% [Nm].



6. Install operators compartment floor plate. Torque bolls to 38 ±10% [Nm].



7. Install the floor mat. Install the front (1) and side (2) floor mat retainer angles to each side of the machine.



SECTION 10B

VALVES

CONTENTS

CONTROL VALVE

1. SERVICE/SPECIAL TOOLS 3
2. DESCRIPTION 3
3. REMOVAL 3
4. INSTALLATION 11
5. DISASSEMBLY 12
6. REASSEMBLY 14
7. RELIEF VALVE 16
8. BLADE LIFT SECTION 20
9. BLADE TILT SECTION 26
10. BLADE ANGLE AND RIPPER SECTION 30

CONTROL VALVE

1. SERVICE/SPECIAL TOOLS

DESCRIPTION	TOOL NUMBER
Spool spring removing tool (retainer plate)	1299240H1

2. DESCRIPTION

The control valve is mounted to a bracket in the right control console in front of the reservoir located on the right fender.

This system utilizes either a three or four spool valve depending on whether or not a ripper is used. The valve is controlled by mechanical linkage between the control levers and the valve. Mechanical linkage controls the blade and ripper, if equipped.

The valve inlet cover contains an adjustable pilot operated pressure relief valve which is used to by pass oil from the pump back to the reservoir when oil pressure exceeds the relief valve setting. The spools are spring centered, either three or four position type with the FLOAT position being detented. Incorporated in the valve section housing is a load check valve which will assure smooth operation when the spool is moved from hold to an operating position. An anti-cavitation valve is located in the blade lift, blade angle, and ripper section, if equipped, section housings. A three spool control valve is used on machines equipped with a six way blade. A four spool control valve is used on machines equipped with a six way blade and a ripper.

Six Way Blade: The first spool is used for the blade lift and is a spring centered, four position type with FLOAT position being detented. The middle spool is used for blade tilt. The third spool is for blade angle. Both of the spools are spring centered, three position type. Incorporated in each valve section housing is a load check valve which assures smooth operation when the spool is moved from hold to an operating position. An anti-cavitation valve is located in the blade lift and angle valve section housings only.

Six Way Blade with Ripper: The first spool is used for the blade lift and is a spring centered, four position type with FLOAT position being detented. The middle spool is used for the blade tilt. The third spool is for the blade angle. Both of the spools are spring centered, three position type. Incorporated in each valve section housing is a load check valve which assures smooth operation when the spool is moved from hold to an operating position. An anti-cavitation valve is located in the blade lift and angle valve section housings only. The fourth spool is for the ripper. The spool is a spring centered, three position type. Incorporated in the valve section housing is a load check valve which assures smooth operation when the spool is moved from hold to an operating position. An anti-cavitation valve is located in each end of the valve section housing.

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 control lever is in NEUTRAL position, drive train lock lever is in ON 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.

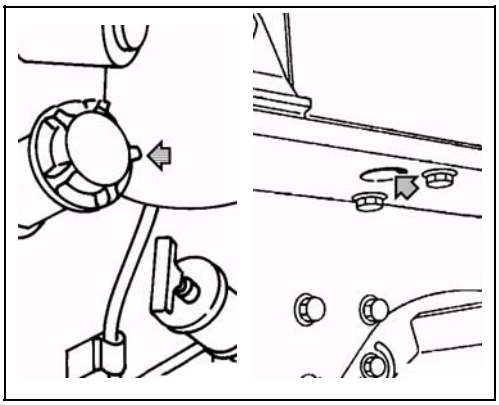
IMPORTANT: *Disconnected hydraulic lines must be capped with the correct size plastic cap. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Tag all disconnected lines to facilitate proper installation.*

VALVES

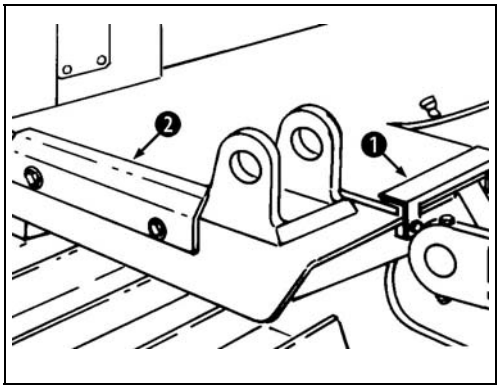
CONTROL VALVE

NOTE: *Refer to INSTALLATION for asterisked references in REMOVAL.*

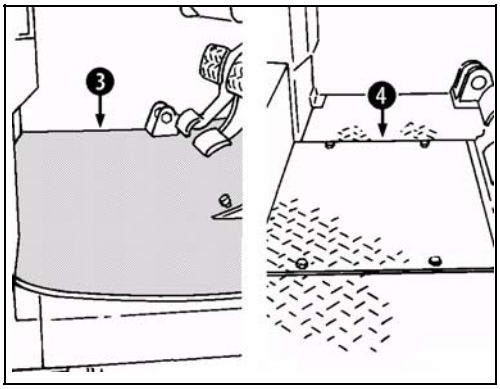
1. Remove ROPS structure; refer to Section 13, SUPERSTRUCTURE.
2. Drain the hydraulic system of oil as described in OPERATOR'S MANUAL.



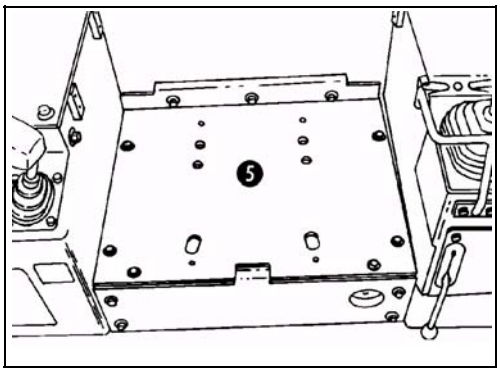
3. Remove the front (1) and side (2) floor mat retainer angles from each side of the machine



4. Remove the floor mat (3).
5. Remove the floor plate (4).

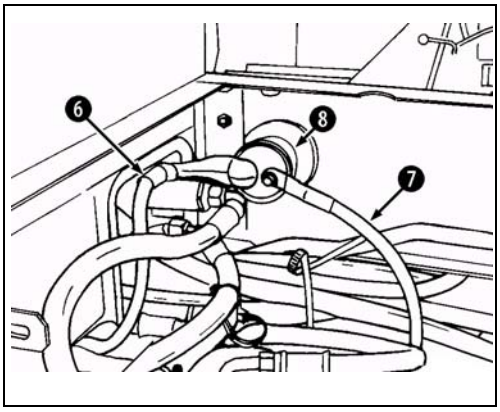


6. Remove operator's seat. Remove the seat platform (5).

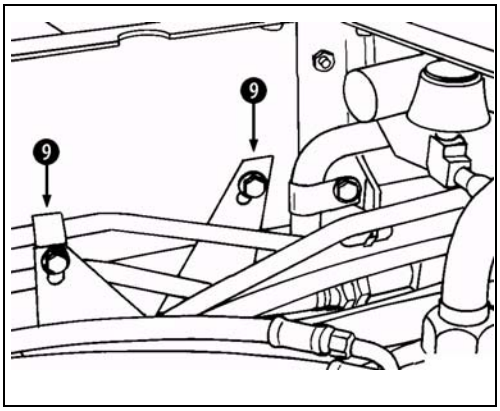


CONTROL VALVE

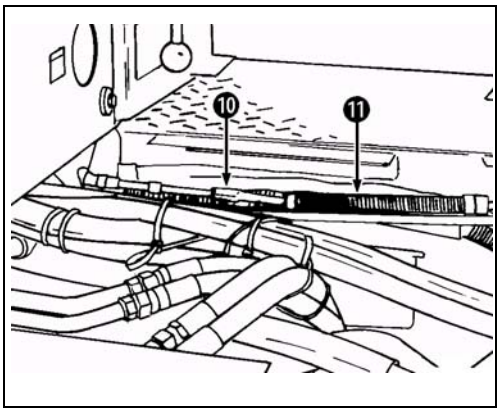
7. Disconnect the battery cable (6) and ground cable (7) from the disconnect switch (8). Remove the cable from the machine. **(*1) (*2)**



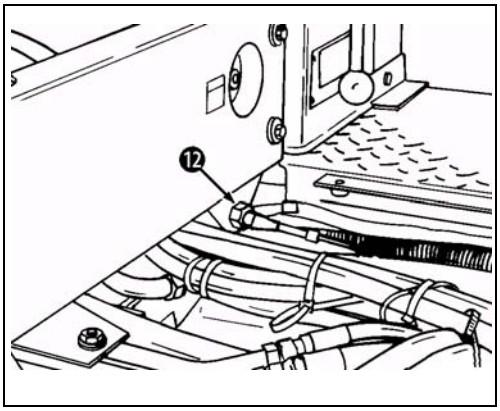
8. Release the tube brackets (9) from the front seat support.



9. Disconnect the control cable (10) from the over travel rod (11).



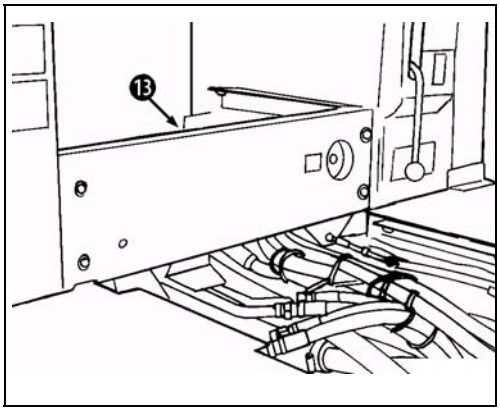
10. At the lower left side of the seat support disconnect the control cable (12) from the support.



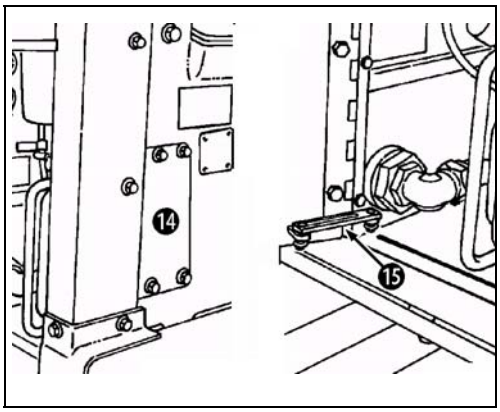
VALVES

CONTROL VALVE

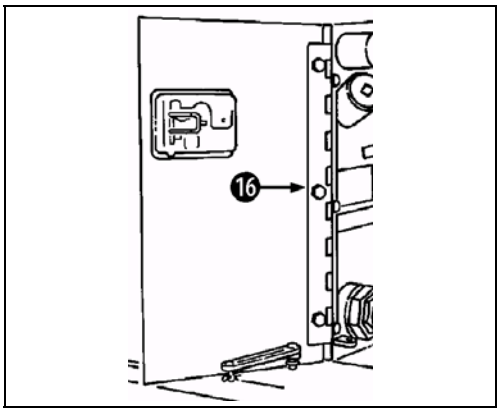
11. Remove the hardware and seat support (13) from the machine.



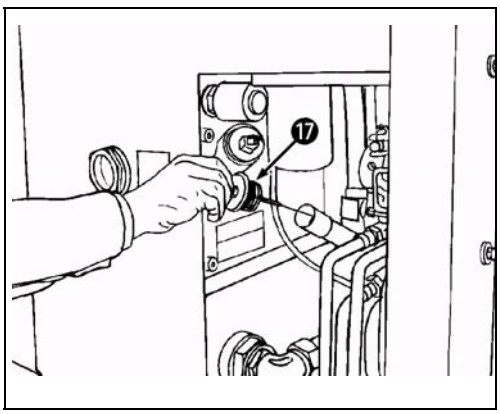
12. Remove the right front access cover (14).
13. Open the reservoir door. Disconnect the door lock (15) from inside the cavity.



14. Remove the door hinge (16) inside mounting hardware and lift the door from the machine.

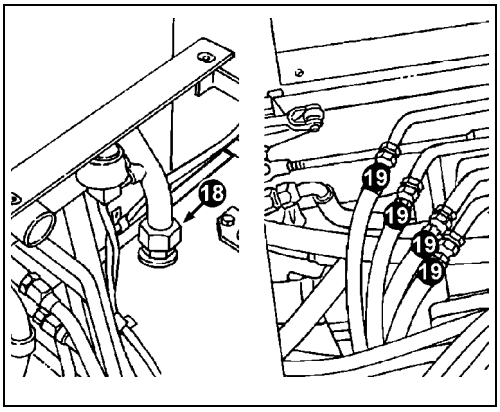


15. Remove the drive train dipstick (17).

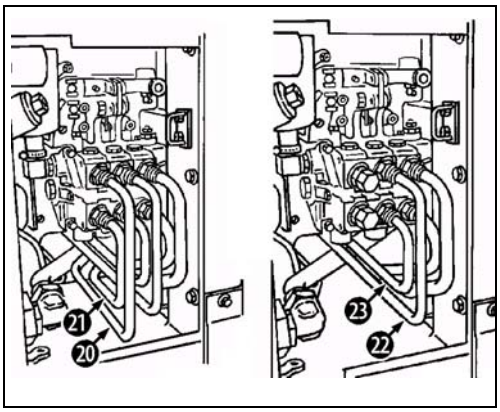


CONTROL VALVE

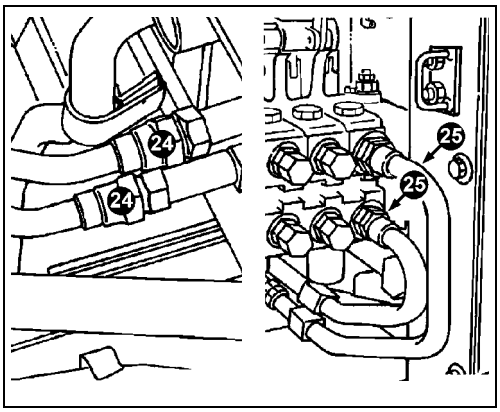
16. Remove the filler tube (18) from the rear cover and cap the opening.
17. Disconnect the four hoses (19) at the tubes.
18. RIPPER: Disconnect the hoses at the valve and position out of the way.



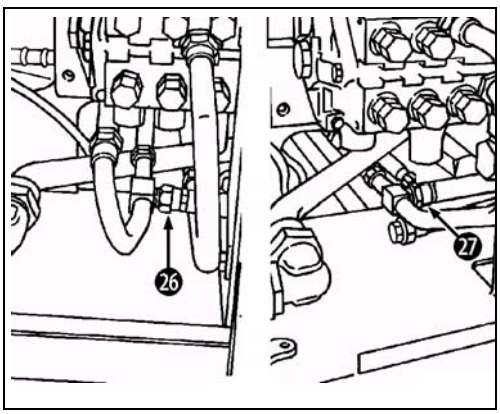
19. Disconnect the top tube (20) from the angle section valve and remove. Disconnect the bottom tube (21) from the angle section valve and remove.
20. Disconnect the top tube (22) from the tilt section valve and remove. Disconnect the bottom tube (23) from the tilt section valve and remove.



21. Disconnect the crossover tubes (24) from remaining the tubes from the control valve.
22. Disconnect the remaining tubes (25) at the control valve.



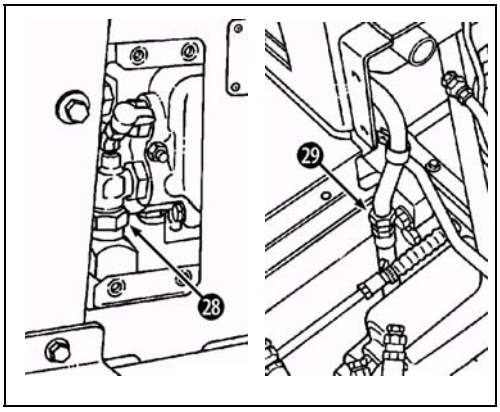
23. Pull the lower tube rearward and disconnect the right lift hose (26).
24. Pull the upper tube rearward and disconnect the right lift hose (27).



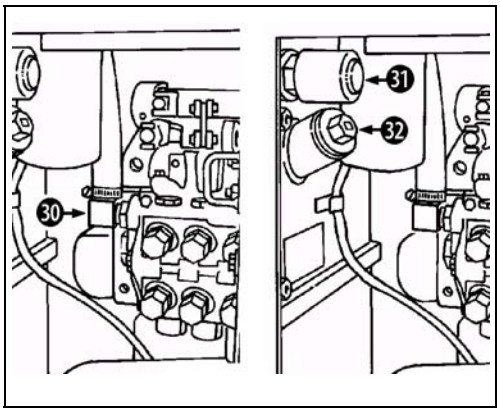
VALVES

CONTROL VALVE

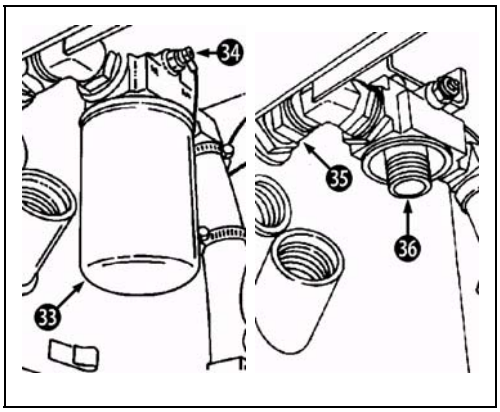
25. Through the access cover disconnect the inlet tube (28) at the elbow.
26. Disconnect the inlet tube (29) from the hose and remove.



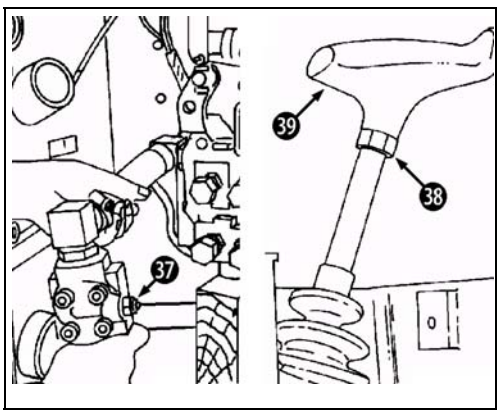
27. Loosen the jam nut at the outlet elbow (30).
28. Remove the reservoir breather (31) and filler cap (32).



29. Remove the filter element (33) and disconnect the switch lead (34) from the header. **(*3) (*4)**
30. Unbolt the header (36) from the bracket. Unthread the elbow (35) at the reservoir inlet.

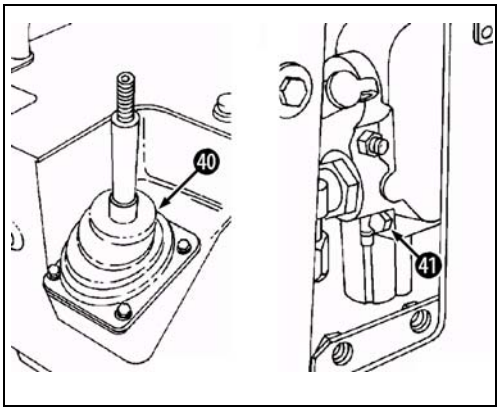


31. Rotate the filter header (37) down and remove it from the control valve outlet elbow.
32. Loosen the jam nut (38) under the lever handle (39). Remove the handle and jam nut from the lever.

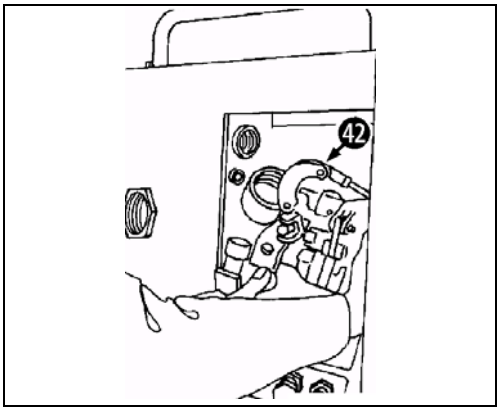


CONTROL VALVE

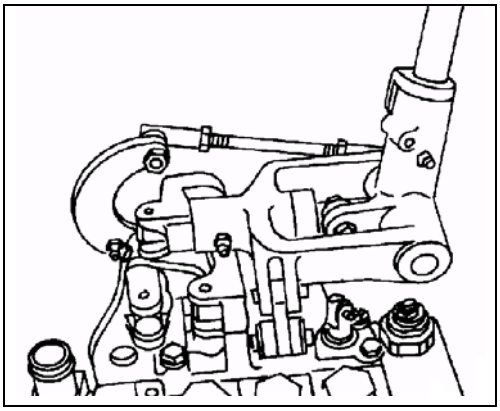
33. Remove the boot (40) and mounting hardware.
34. Remove the forward lower mounting bolt (41).



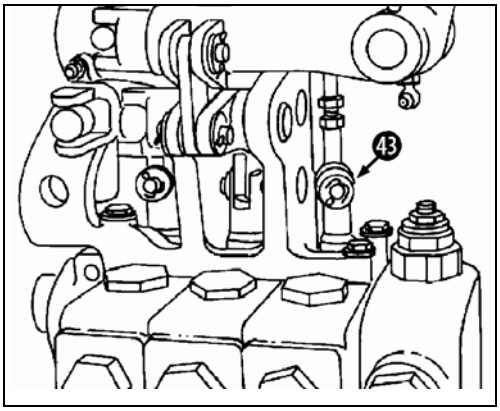
35. Remove the remaining hardware and carefully lift the control valve (42) from the machine.



36. Position the control valve in a vise



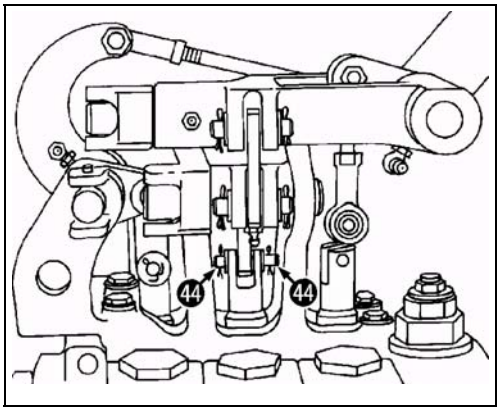
37. Disconnect the lift link (43) from the spool. Discard the cotter pin and replace with new.



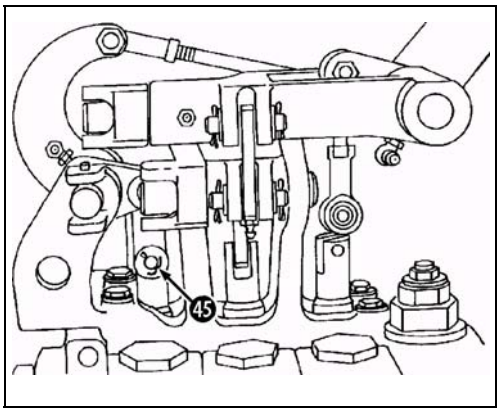
VALVES

CONTROL VALVE

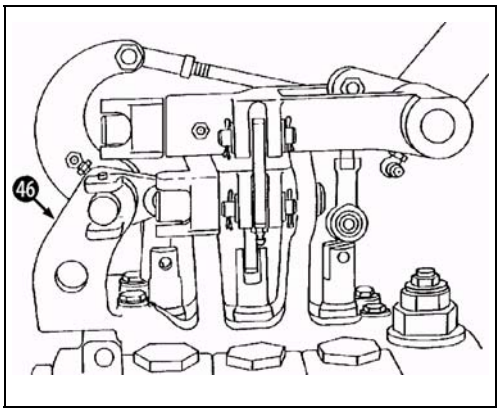
38. Disconnect the tilt link (44) from the spool. Discard the cotter pin and replace with new.



39. Disconnect the angle link (45) from the spool. Discard the cotter pin and replace with new.



40. Remove the mounting hardware and lift the linkage (46) out from the control valve. **(*5)**



CONTROL VALVE

4. INSTALLATION

1. Carry out installation in the reverse order of removal. Pay attention for following notes referring to adequate Steps in REMOVAL, CONTROL VALVE in this Section:

(*1) Step 7. Use Graffo *112X* Electrical Sealant (1270464H1) for cables at switch terminals.

(*2) Step 7. Terminal nuts torque 12 [Nm].

(*3) Step 29. Use Graffo *112X* Electrical Sealant (1270464H1) for header switch terminal.

NOTE: *Replace filter element with new, refer to the OPERATOR'S MANUAL.*

(*4) Step 29. Terminal nut torque 2 [Nm].

(*5) Step 40. Make sure that the spool seals are flush within their bores prior to installing lever linkage assembly.

2. Fill the hydraulic system as described in OPERATOR'S MANUAL.

3. Check oil level in reservoir and add as required, refer to the OPERATOR'S MANUAL. Slowly operate cylinder ten to twelve cycles to bleed out air. Recheck fluid level in reservoir and add as required.

CONTROL VALVE

5. DISASSEMBLY

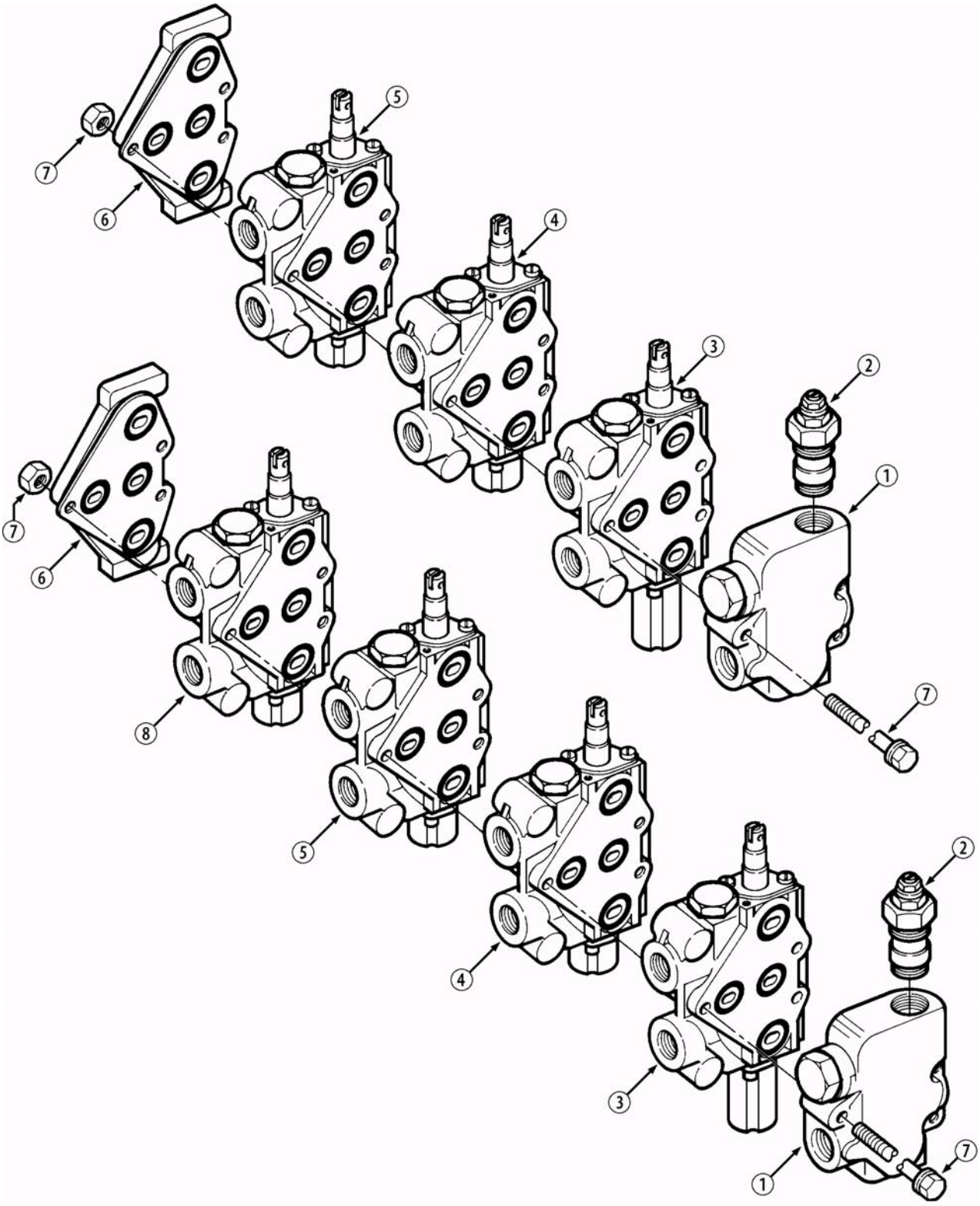


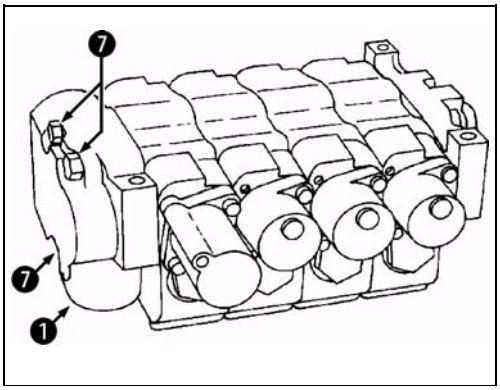
Fig. 10B.1. Exploded View of Three and Four Section Control Valve

1. Inlet Cover
2. Relief Valve
3. Blade Lift Section
4. Blade Tilt Section
5. Blade Angle Section
6. Outlet Cover
7. Bolts and Nuts
8. Ripper Section

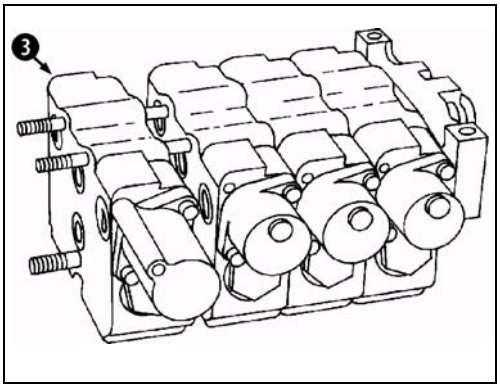
CONTROL VALVE

NOTE: *The callouts from the exploded view of control valve (Fig. 10B.1) correspond with the callouts in the following steps.*

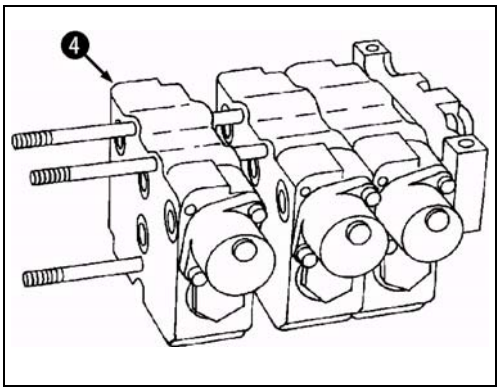
1. Position the control valve on a bench. Remove the nuts (7) and slide the inlet cover (1) off the tie bolts.



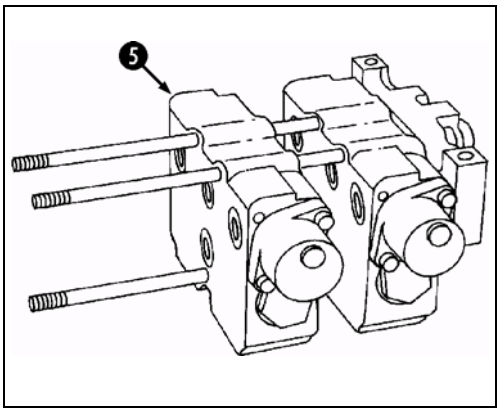
2. Slide the blade lift section (3) off the tie bolts. Remove and discard the between section O-rings.



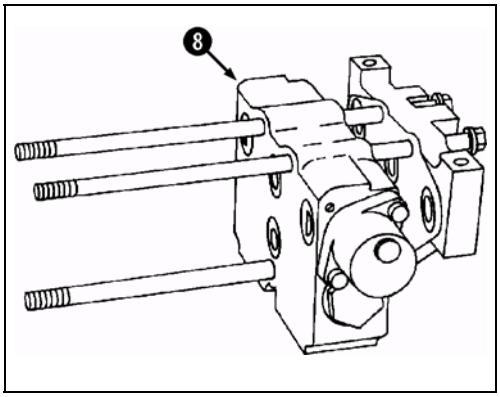
3. Slide the blade tilt section (4) off the tie bolts. Remove and discard the between section O-rings.



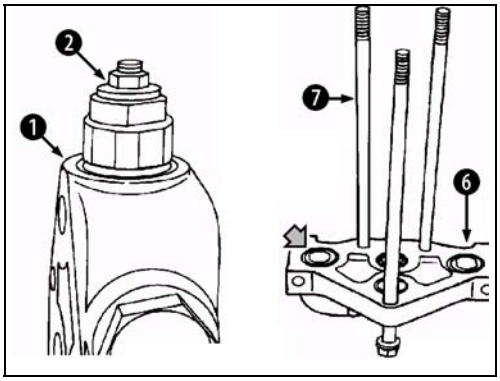
4. Slide the blade angle section (5) off the tie bolts. Remove and discard the between section O-rings.



5. If equipped, slide the ripper section (8) off the tie bolts. Remove and discard the between section O-rings.



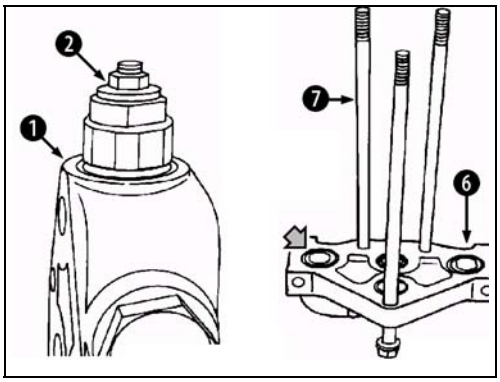
6. Remove the relief valve (2) from inlet cover (1).
7. Remove the tie bolts (7) from the outlet cover (6). Remove and discard the between section O-rings.



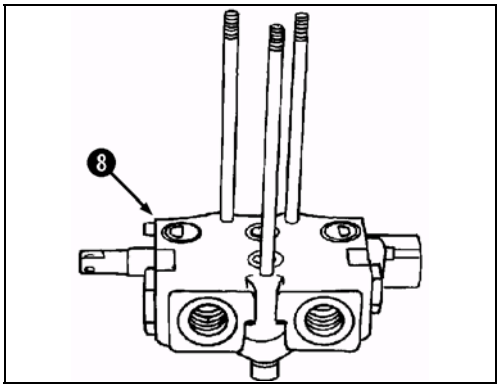
6. REASSEMBLY

NOTE: *The callouts from the exploded view of control valve (Fig. 10B.1) correspond with the callouts in the following steps.*

1. Install the relief valve (2) to the inlet cover (1).
   Torque the relief valve to 27 to 30 [Nm]
2. Position the outlet cover (6) with the tie bolts (7) facing up. Install a new between section seal kit.

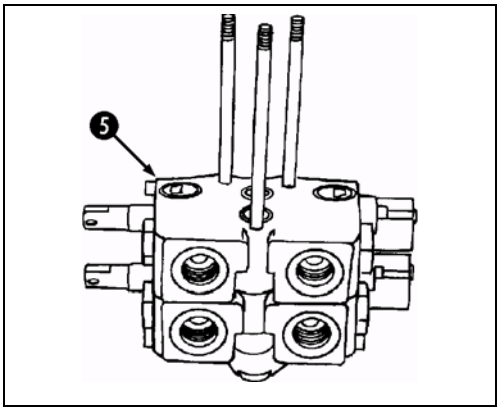


3. If equipped, install the ripper section (8) down over the bolts on the top of the end cover. Install a new between section seal kit.

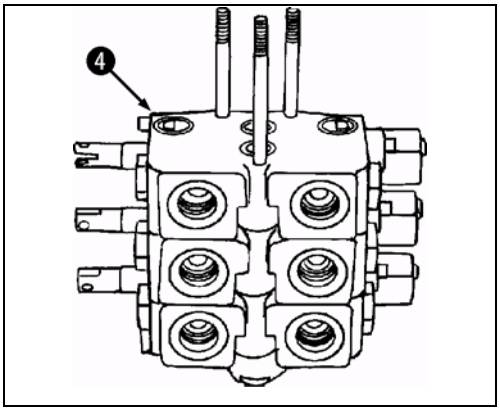


CONTROL VALVE

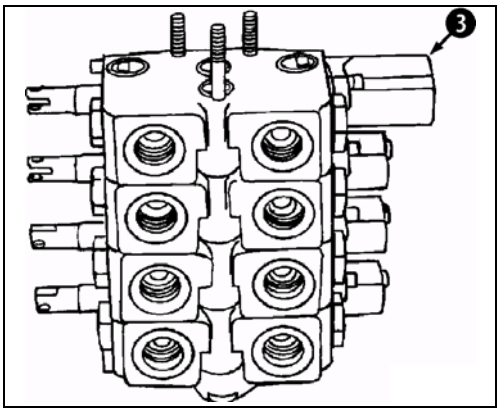
4. Install the blade angle section (5) down over the bolts. Install a new between section seal kit.



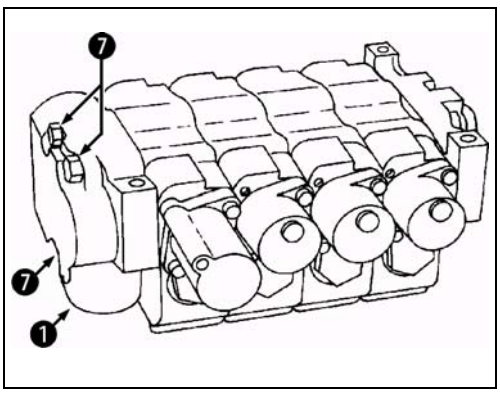
5. Install the blade tilt section (4) down over the bolts. Install a new between section seal kit.



6. Install the blade lift section (3) down over bolts. Install a new between section seal kit. Install the inlet cover (1) and secure with the nuts.



7. Install the inlet cover (1) and secure with the nuts (7).



CONTROL VALVE

7. RELIEF VALVE

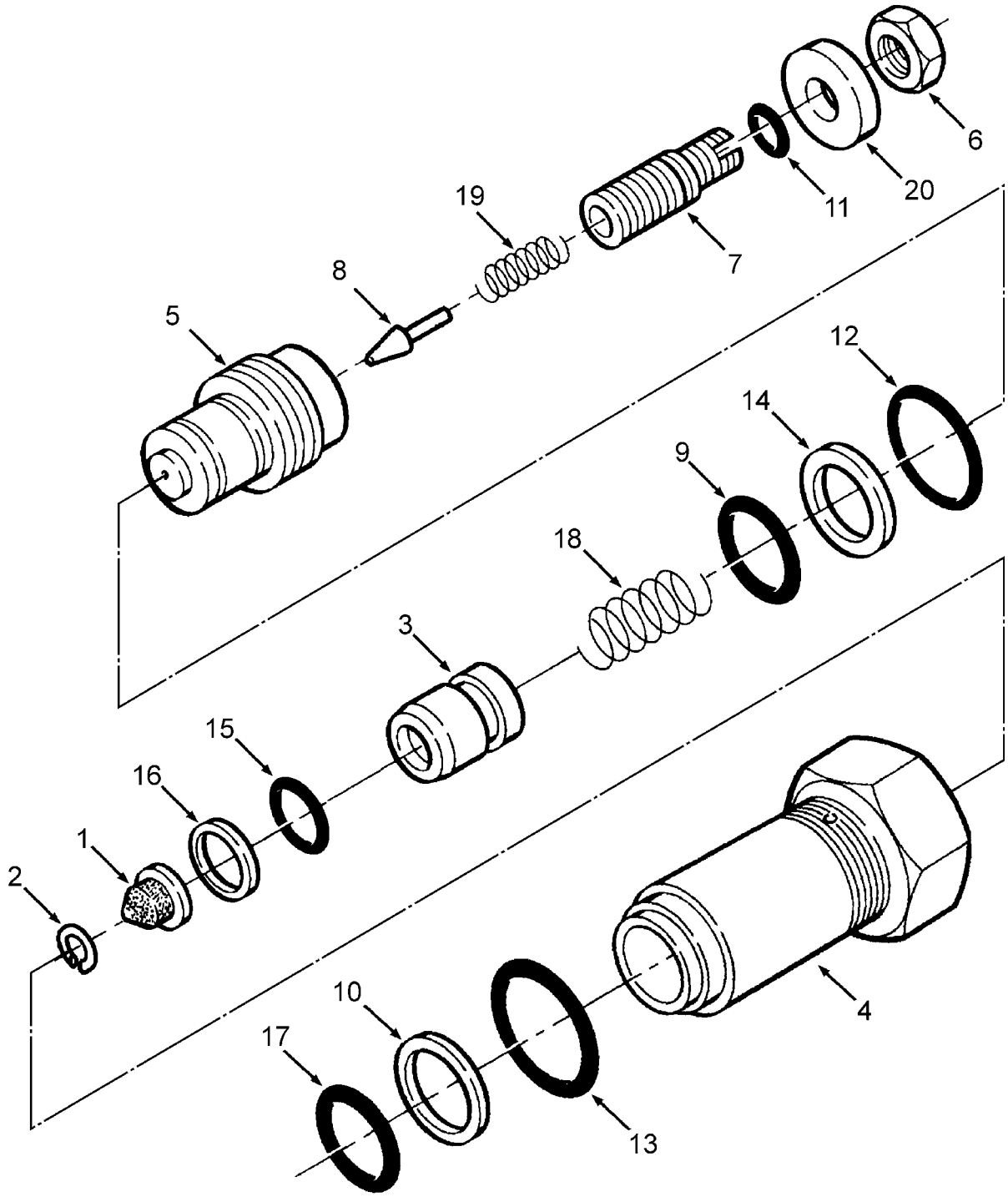


Fig. 10B.2. Exploded View of System Relief Valve

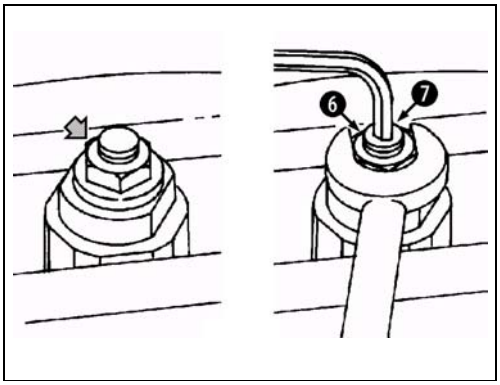
1. Filter Screen
2. Retaining Ring
3. Main Poppet
4. Valve Body
5. End Cap
6. Jam Nut
7. Adjusting Screw
8. Pilot Poppet
9. Seal Ring
10. Back Up Ring
11. Seal Ring
12. Seal Ring
13. Seal Ring
14. Back Up Ring
15. Seal Ring
16. Back Up Ring
17. Seal Ring
18. Main Poppet Spring
19. Pilot Poppet Spring
20. Flat Washer

CONTROL VALVE

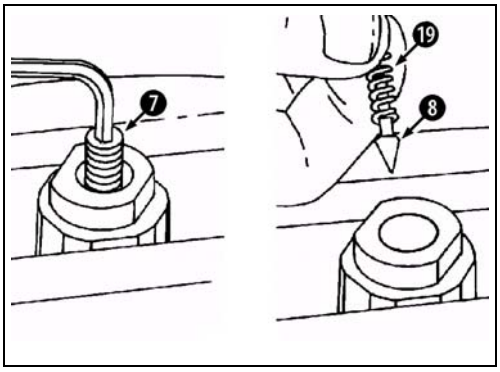
Disassembly

NOTE: *The callouts from the exploded view of system relief valve (Fig. 10B.2) correspond with the callouts in the following steps.*

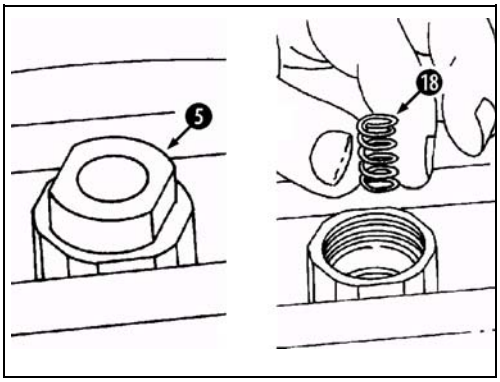
1. Position the relief valve in a vise, adjusting end up.
2. While holding the adjusting screw (7), remove the jam nut (6).



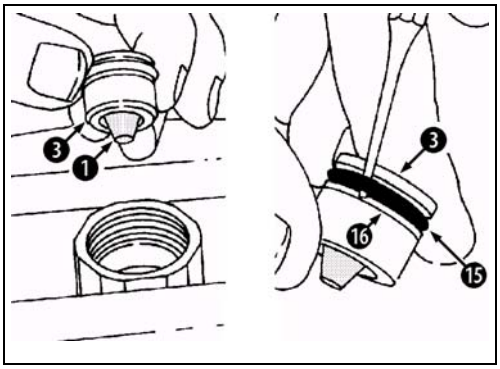
3. Remove the adjusting screw (7).
4. Remove the pilot poppet (8) and return spring (19).



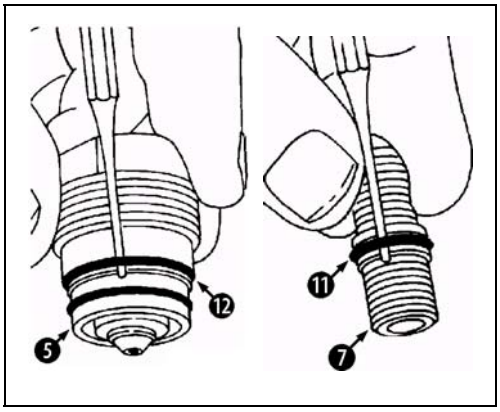
5. Remove the end cap (5).
6. Remove the main poppet spring (18).



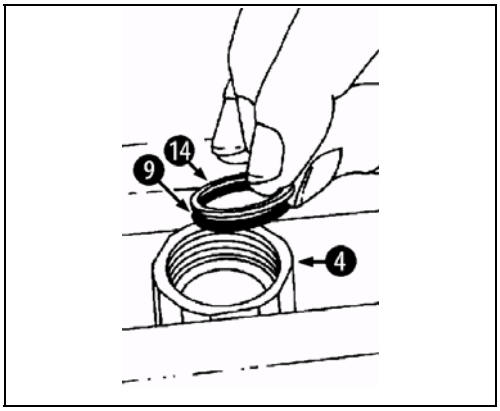
7. Remove the main poppet (3) with the filter screen (1). Check the condition of filter screen clean it or change.
8. Remove the seal ring (15) and back up ring (16) from the main poppet (3) and discard.



9. Remove the seal ring (12) from the end cap (5) and discard.
10. Remove the seal ring (11) from the adjusting screw (7) and discard.



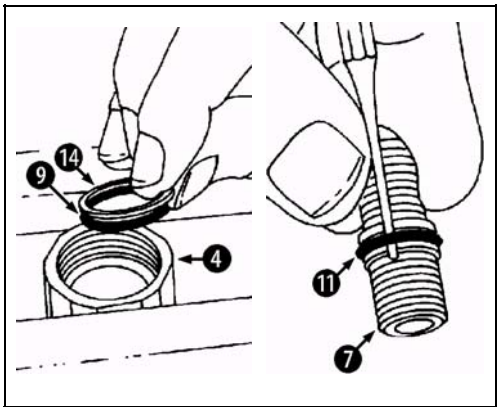
11. Remove the seal ring (9) and back up ring (14) from inside of the valve body (4) and discard. Remove the seal ring (13) at outside of the valve body (4) and discard.



Reassembly

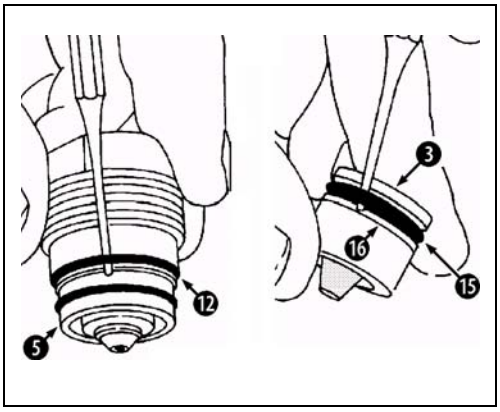
NOTE: *The callouts from the exploded view of system relief valve (Fig. 10B.2) correspond with the callouts in the following steps.*

1. Install a new seal ring (13) on the outside of the valve body (4). Install a new seal ring (9) and back up ring (14) down inside the valve body (4).
2. Install a new seal ring (11) to the adjusting screw (7).

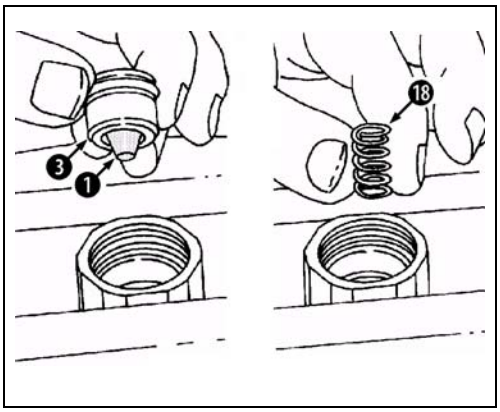


CONTROL VALVE

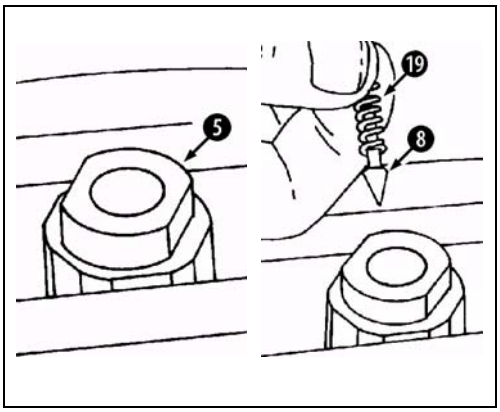
3. Install a new seal ring (12) to the end cap (5).
4. Install a new seal ring (15) and back up ring (16) to the main poppet (3).



5. Install the main poppet (3) with the filter screen (1) into the valve body.
6. Install the main poppet spring (18).



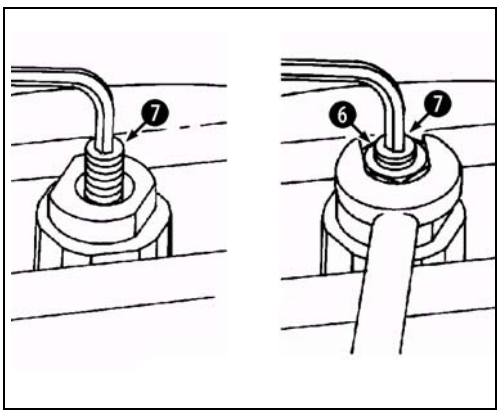
7. Install the end cap (5).
8. Install the pilot poppet (8) and spring (19).



9. Install the adjusting screw (7) halfway into the end cap.

NOTE: *The final adjustment of the system relief valve will have to be made with the control valve reinstalled into the machine. Refer to SECTION 10.*

10. While holding the adjusting screw (7), install the jam nut (6).



CONTROL VALVE

8. BLADE LIFT SECTION

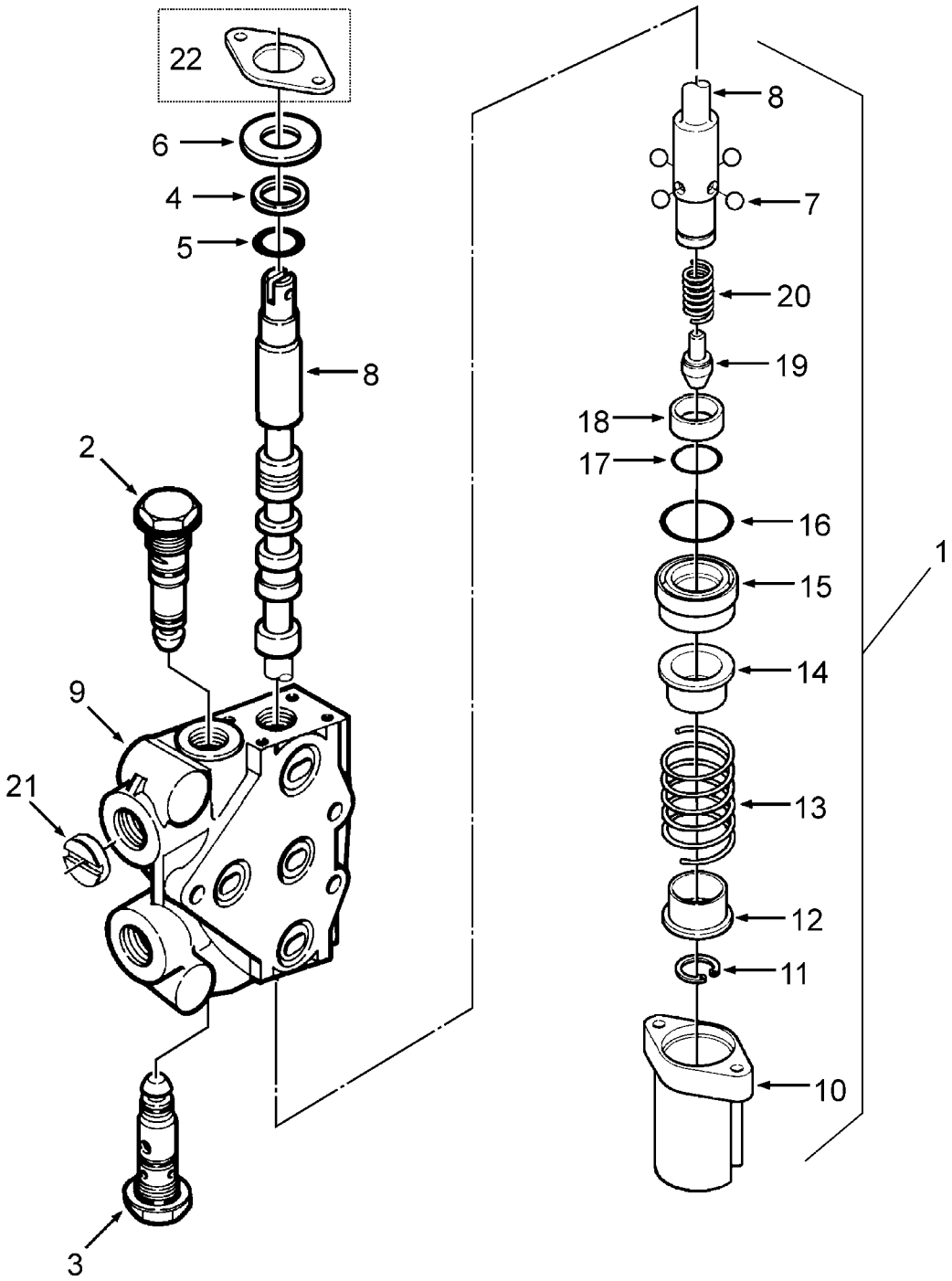


Fig. 10B.3 Exploded View of Blade Lift Section

1. Lift Spool Positioner
2. Load Check Valve
3. Anti Cavitation Valve
4. Back Up Ring
5. Seal Ring
6. Seal Retainer
7. Detent Ball
8. Blade Lift Spool
9. Section Housing
10. Positioner Cover
11. Retaining Ring
12. Spring Seat
13. Spool Spring
14. Spring Seat
15. Detent Sleeve
16. Seal Ring
17. Spool Seal
18. Retainer Sleeve
19. Ball Follower
20. Detent Spring
21. Orifice
22. Retainer Plate SEE NOTE 1

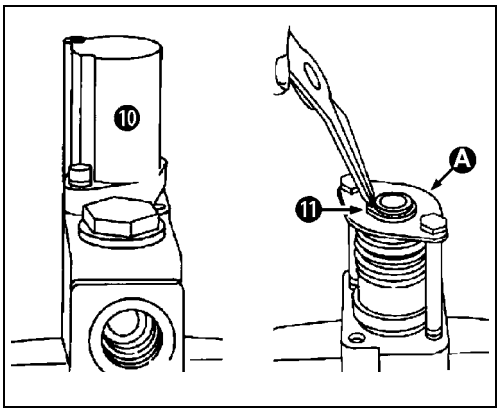
CONTROL VALVE

NOTE 1 *The valve section is shipped with this seal retainer plate mounted to the valve housing. Remove and retain as this plate can be used as the spring tool (refer to SERVICE/SPECIAL TOOLS for reference number). The linkage bracket is used to retain the seals on the spool side of the valve section after the complete valve bank has been assembled.*

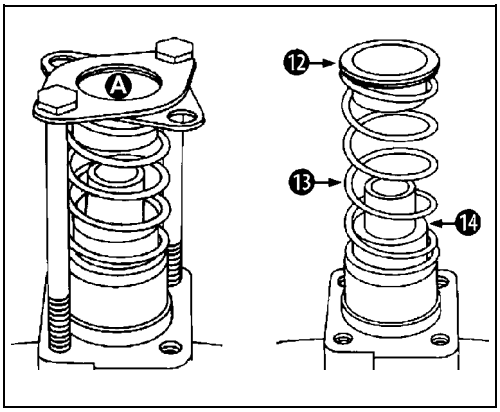
NOTE: *The callouts from the exploded view of blade lift section (Fig. 10B.3) correspond with the callouts in the following steps.*

Disassembly

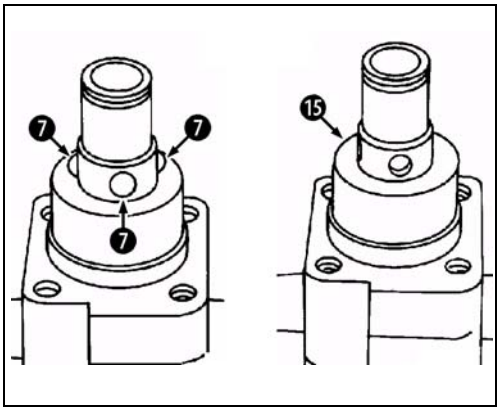
1. Position the valve section in a vise. Remove the hardware and positioner cover (10).
2. Install spring removing tool (A) (see SERVICE/SPECIAL TOOLS), over the spool spring seat (12) and secure with the bolts. Draw down evenly on the bolts until the retaining ring (11) is exposed, then remove the ring.



3. Install a second spring removing tool (A) with longer bolts. Remove the previous bolts. Slowly and evenly let off bolts until all tension on the spring (13) is relieved.
4. Remove the spool spring (13) with both spring seats (12 and 14).



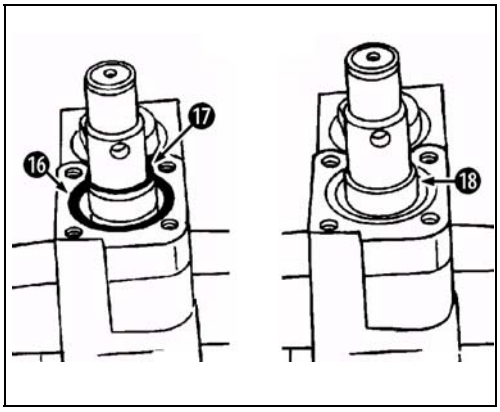
5. Remove the four detent balls (7).
6. Remove the detent sleeve (15).



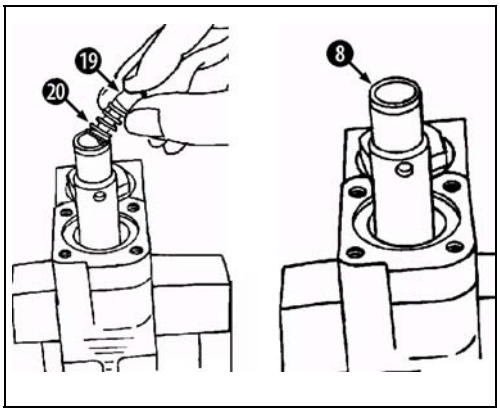
VALVES

CONTROL VALVE

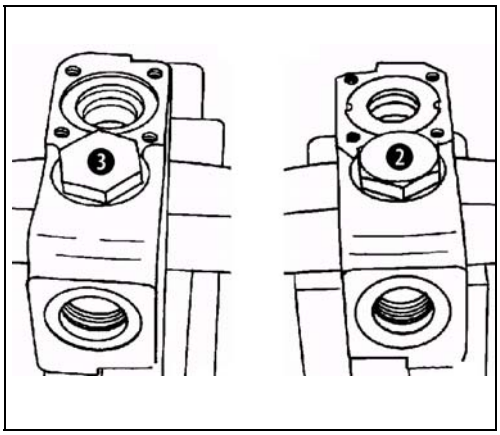
7. Remove the seal ring (16) and spool seal (17).
8. Remove the retainer sleeve (18).



9. Remove the detent ball follower (19) and the detent spring (20).
10. Remove the blade lift spool (8) from the section housing.



11. Remove the anti-cavitation valve (3) from the section housing.
12. Remove the load check valve (2) from the section housing.



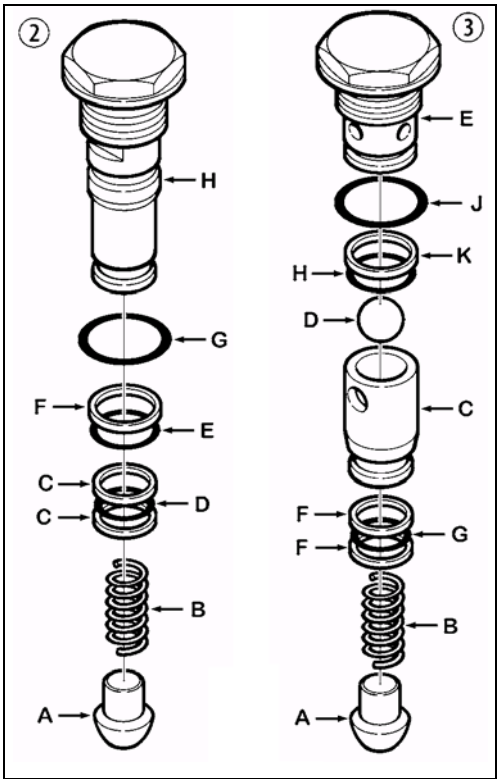
CONTROL VALVE

13. Disassemble the load check valve (2) as follows:

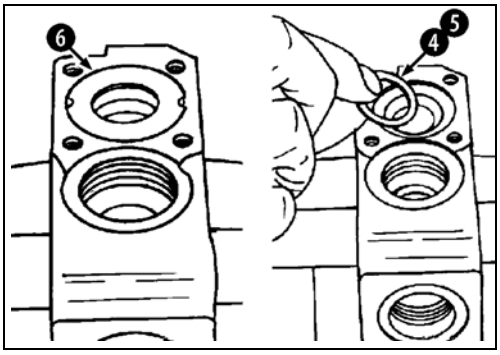
    Separate the check poppet (A) and poppet spring (B) from the body (H). Remove and discard all software (C through G). Replace with new.

14. Disassemble the anti-cavitation (3) as follows:

    Separate the check poppet (A), poppet spring (B), valve body (C) and check ball (D) from the valve plug (E). Remove and discard all software (F through K). Replace with new.



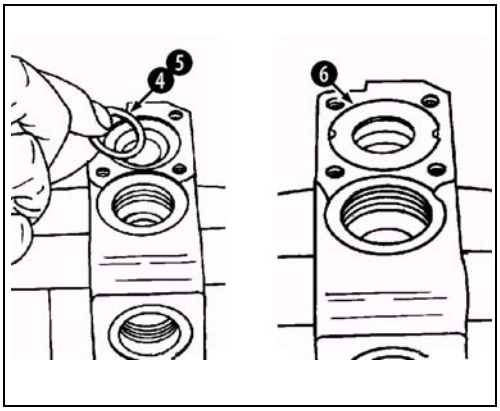
15. Remove the seal retainer (6).
16. Remove the seal ring (5) and back up ring (4).



Reassembly

NOTE: *The callouts from the exploded view of blade lift section (Fig. 10B.3) correspond with the callouts in the following steps.*

1. Install the seal ring (5) and back up ring (4). Install the seal retainer (6).

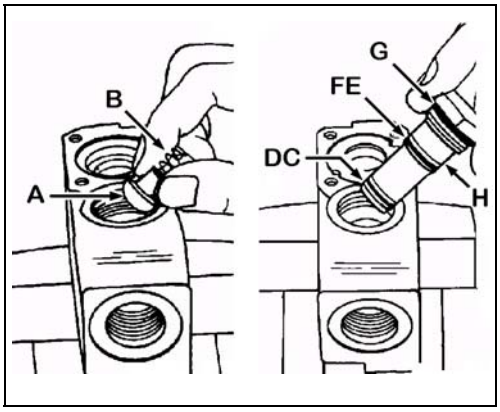


CONTROL VALVE

2. Install the load check valve (2) at the spool end as follows.

A. Install the check poppet (A) and the poppet spring (B) into the bore.

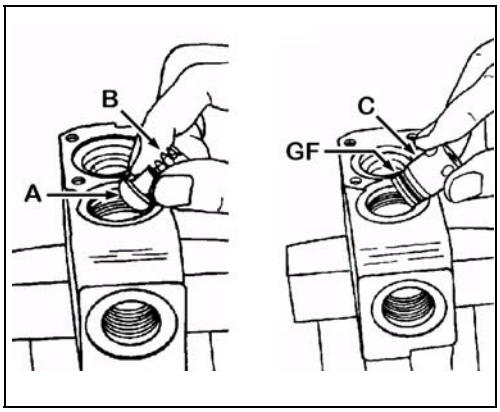
B. Install the valve body (H) with a new seal ring (G), back up ring (F), seal ring (E), back up rings (C) and seal ring (D) into the valve bore.



3. Install the anti-cavitation valve (3) at the housing end as follows.

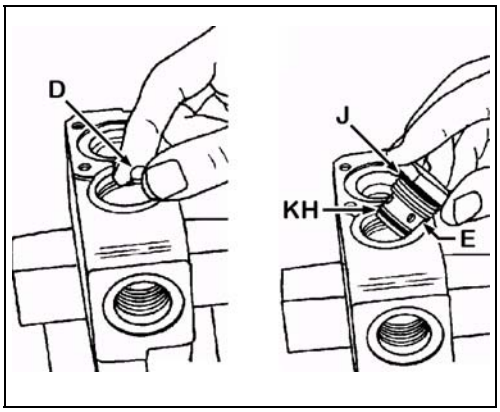
A. Install the check poppet (A) and the poppet spring (B) into the valve bore.

B. Install the valve body (C) with a new back up rings (F) and seal ring (G) into the valve bore.



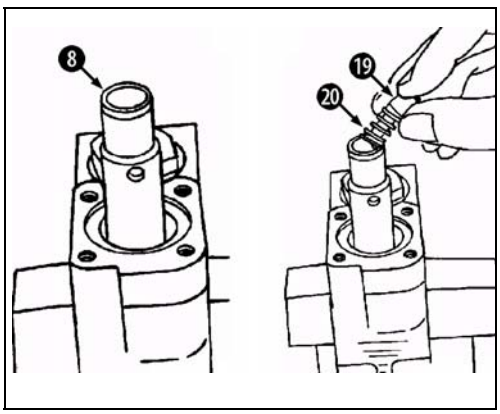
C. Install the check ball (D) into the valve body (C) in the valve bore.

D. Install the valve plug (E) with a new seal ring (J), back up ring (K) and seal ring (H) into valve bore.



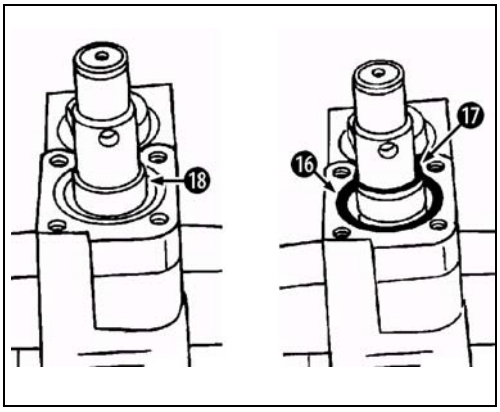
4. Install the blade lift spool (8) into the bore.

5. Install the detent ball follower (19) and detent spring (20).

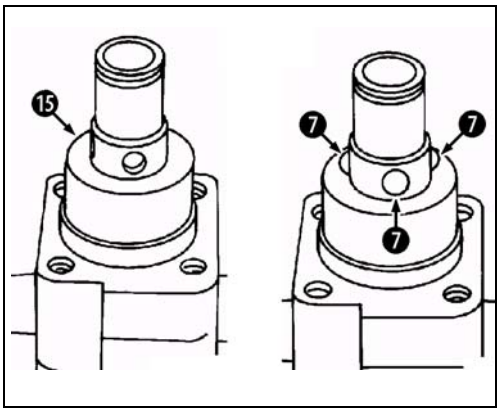


CONTROL VALVE

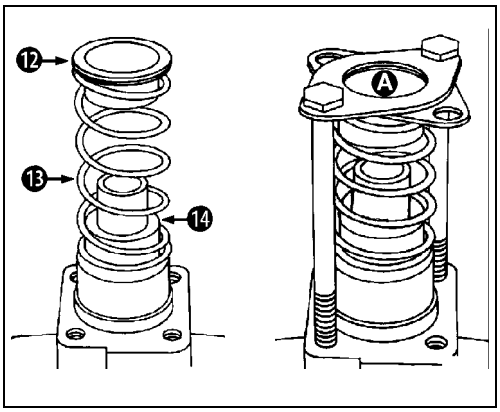
6. Install the retainer sleeve (18).
7. Install new seal ring (16) and spool seal (17).



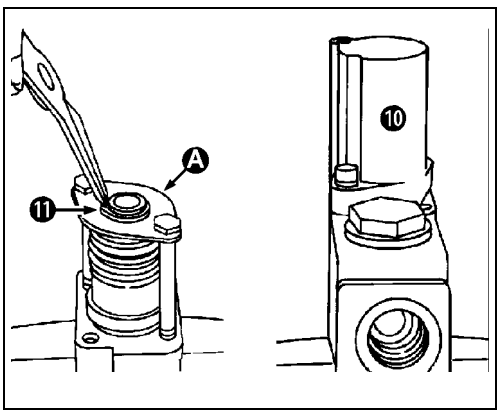
8. Install the detent sleeve (15) engaging the seal ring (16) in the bottom groove.
9. Coat the detent balls (7) with grease and position in the holes in the spool.



10. Position the spring seats (12) and (14) and spring (13) on the spool.
11. Install two retainer plates (A), see SERVICE/SPECIAL TOOLS, with long bolts as shown. Draw down evenly on the bolts until shorter bolts can be installed in the second plate. Remove the top plate and bolts.



12. Draw down evenly on the shorter bolts until the retaining ring groove is exposed. Install the retaining ring (11) and remove the plate (A) and bolts.
13. Install the positioner cover (10) and secure with the hardware.



CONTROL VALVE

9. BLADE TILT SECTION

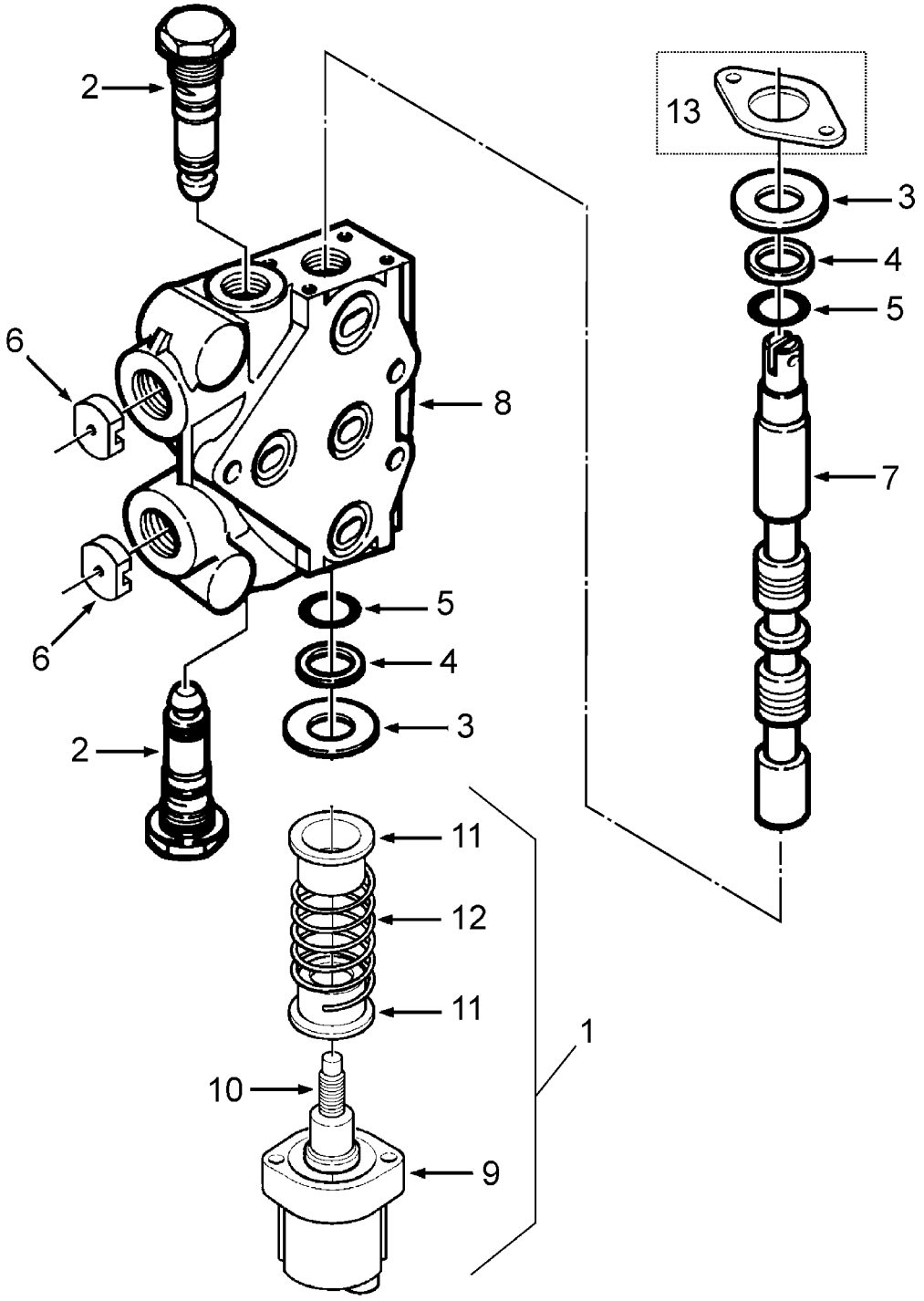


Fig.10B.4. Explode View of Blade Tilt Section

1. Spool Positioner Assy
2. Load Check Valve
3. Seal Retainer
4. Back Up Ring
5. Seal Ring
6. Orifice
7. Blade Tilt Spool
8. Section Hosing
9. Positioner Cover
10. Spool Collar
11. Spring Seat
12. Centering Spring
13. Retainer Plate SEE NOTE 1

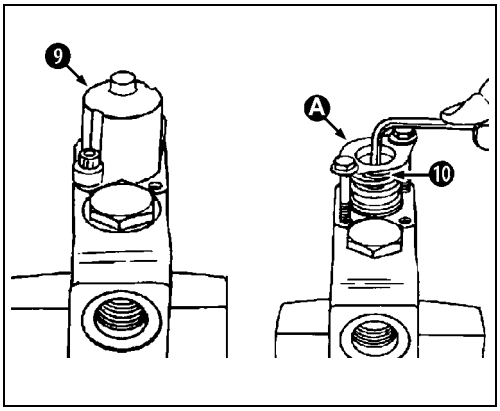
CONTROL VALVE

NOTE 1 *The valve section is shipped with this seal retaining plate mounted to the valve housing. Remove and retain as this plate can be used as the spring tool (refer to SERVICE/SPECIAL TOOLS for reference number). The linkage bracket is used to retain the seals on the spool side of the valve section after the complete valve bank has been assembled.*

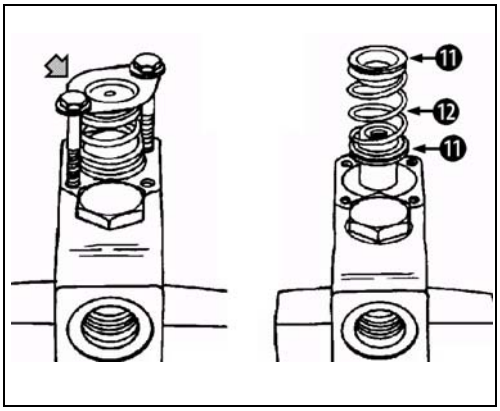
NOTE: *The callouts from the exploded view of blade tilt section (Fig. 10B.4) correspond with the callouts in the following steps.*

Disassembly

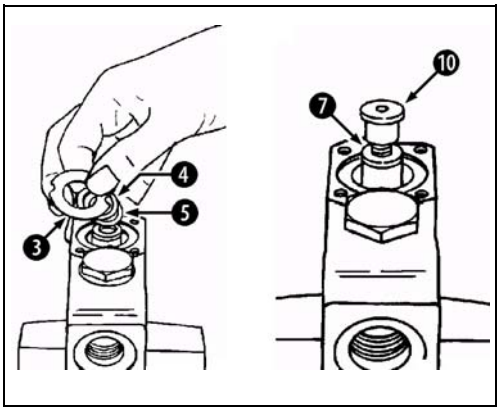
1. Position the blade tilt section in a vise. Remove the hardware and positioner cover (9).
2. Install retainer plate as spring removing tool (A) (see SERVICE/SPECIAL TOOLS) over the spring seat and secure with the bolts. Draw down evenly on the bolts until the spool collar (10) is free, then remove.



3. Slowly and evenly let off the bolts until all the tension on the spring is relieved.
4. Remove the spring seats (11) and centering spring (12).

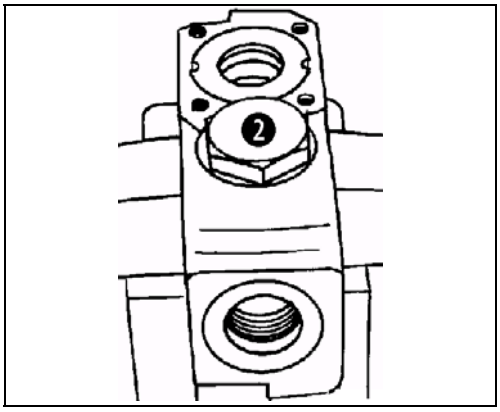


5. Remove the seal retainer (3), back up ring (4) and seal ring (5) at each end of the spool bore.
6. Insert the spool collar (10) to the spool (7) and remove.



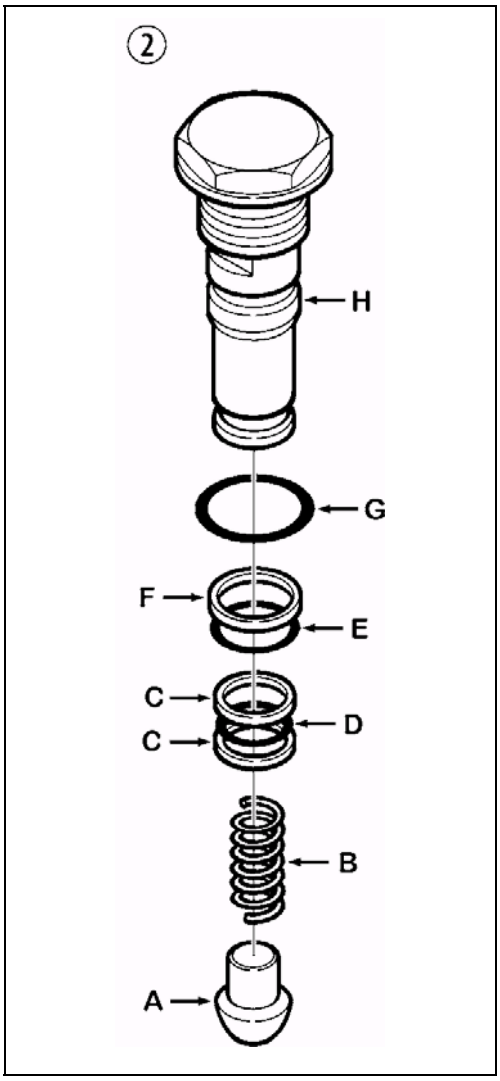
CONTROL VALVE

7. Remove the load check valve (2) from the valve body.



8. Disassemble the load check valve (2) as follows:

   Separate the check poppet (A) and poppet spring (B) from the body (H). Remove and discard all software (C through G). Replace with new.



CONTROL VALVE

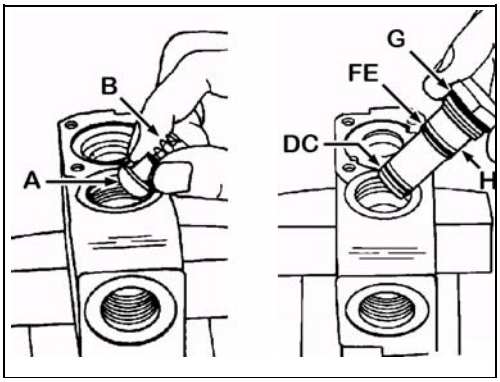
Reassembly

NOTE: *The callouts from the exploded view of blade lift section (Fig. 10B.4) correspond with the callouts in the following steps.*

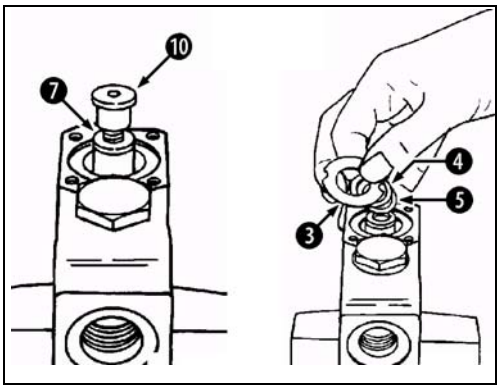
1. Install the load check valve (2) at each spool end as follows.

A. Install the check poppet (A) and the poppet spring (B) into the bore.

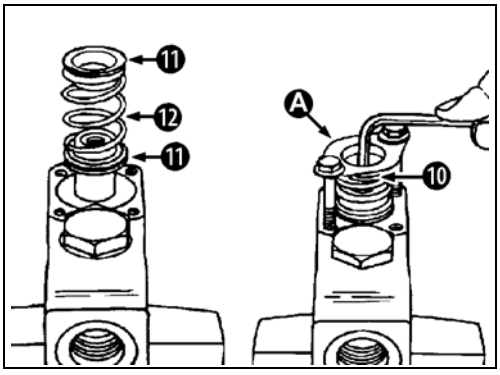
B. Install the valve body (H) with a new seal ring (G), back up ring (F), seal ring (E), back up rings (C) and seal ring (D) into the valve bore.



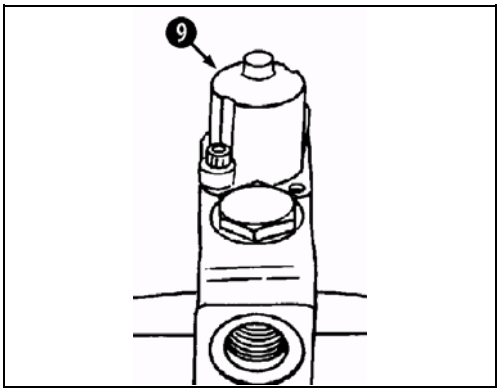
2. Insert the spool (7) into the bore and remove the collar (10).
3. Install a new seal ring (5), back up ring (4) and seal retainer (3) into each end of the spool bore.



4. Install the spring seats (11) and the centering spring (12) to the spool.
5. Install retainer plate (A) (see SERVICE/SPECIAL TOOLS), over the spring seat and secure with the bolts. Draw down evenly on the bolts until the spool collar (10) can be installed. Tighten the spool collar, then remove retaining the plate and bolts.



6. Install the positioner cover (9) and secure with the hardware.



CONTROL VALVE

10. BLADE ANGLE AND RIPPER SECTION

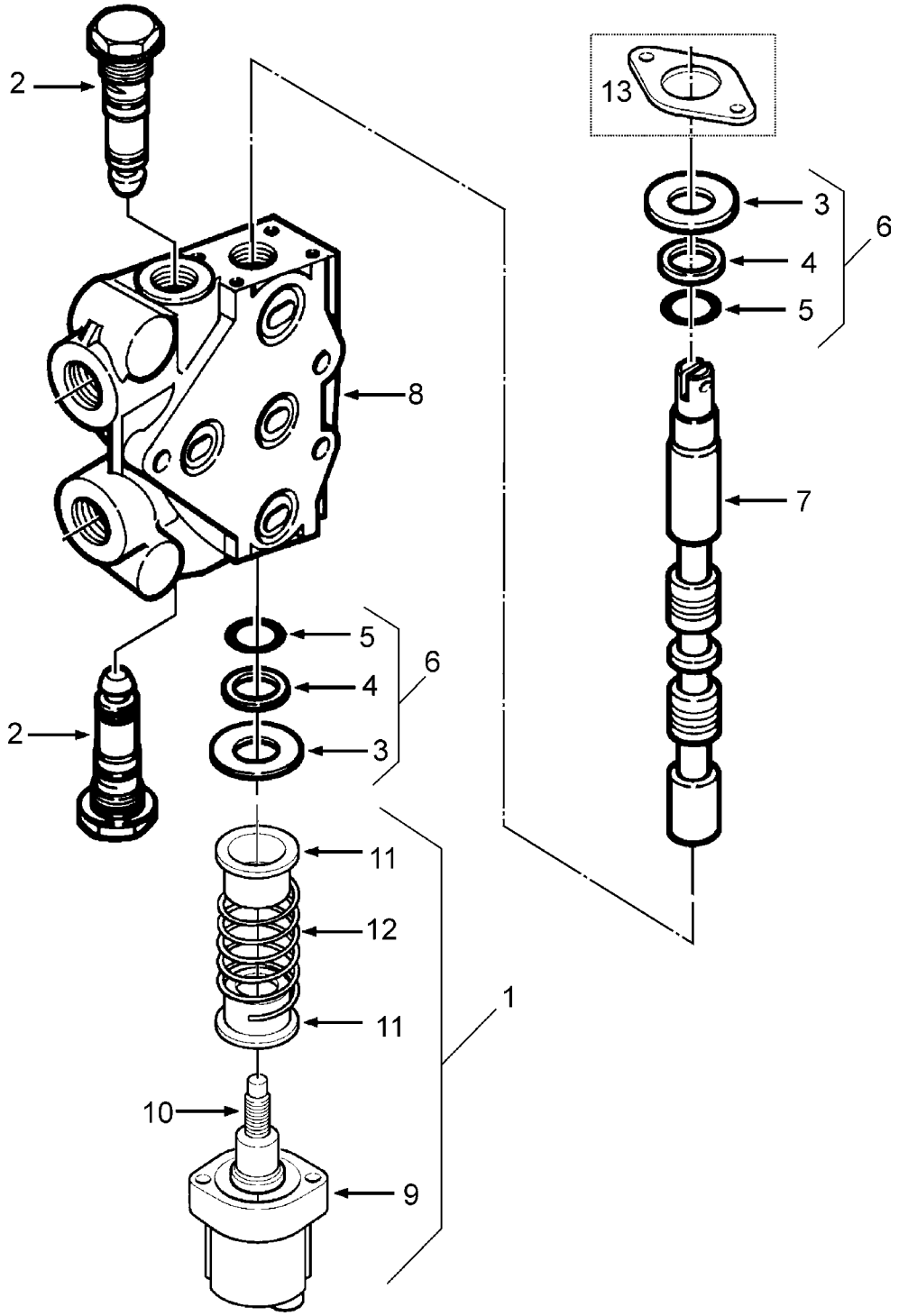


Fig. 10B.5. Exploded View of Blade Angle or Ripper Section

1. Spool Positioner Assy
2. Anti Cavitation Valve
3. Seal Retainer
4. Back Up Ring
5. Seal Ring
6. Seal Kit
7. Section Spool
8. Section Housing
9. Positioner Cover
10. Spool Collar
11. Spring Seat
12. Centering Spring
13. Retainer Plate SEE NOTE 1

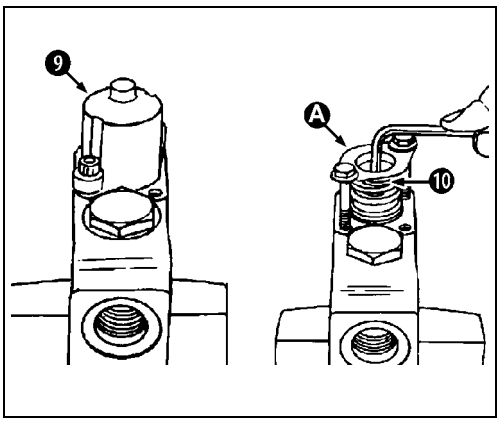
CONTROL VALVE

NOTE 1 *The valve section is shipped with this seal retainer plate mounted to the valve housing. Remove and retain as this plate can be used as the spring tool (refer to SERVICE/SPECIAL TOOLS for reference number). The linkage bracket is used to retain the seals on the spool side of the valve section after the complete valve bank has been assembled.*

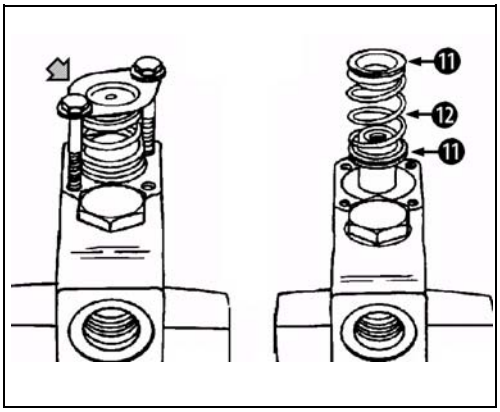
NOTE: *The callouts from the exploded view of blade lift section (Fig. 10B.5) correspond with the callouts in the following steps.*

Disassembly

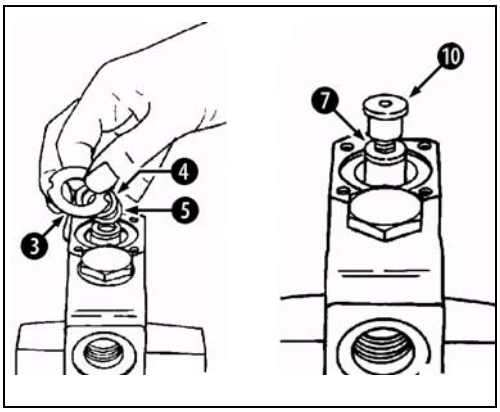
1. Position the blade tilt section in a vise. Remove the hardware and positioner cover (9).
2. Install spring removing tool (A) (see SERVICE/SPECIAL TOOLS), over the spring seat and secure with the bolts. Draw down evenly on the bolts until the spool collar (10) is free, then remove collar.



3. Slowly and evenly let off the bolts until all the tension on the spring is relieved.
4. Remove the spring seats (11) and the centering spring (12).



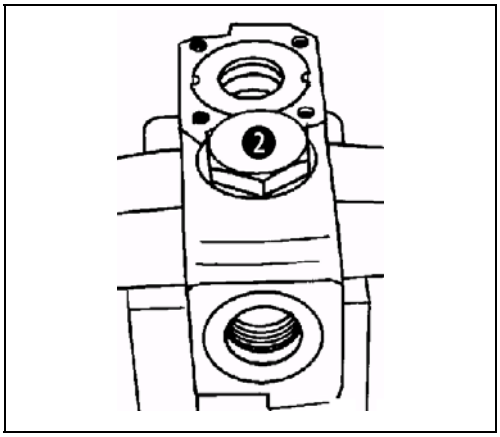
5. Remove the seal retainer (3), back up ring (4) and seal ring (5) at each end of the spool bore.
6. Insert the spool collar (10) to the spool (7) and remove.



VALVES

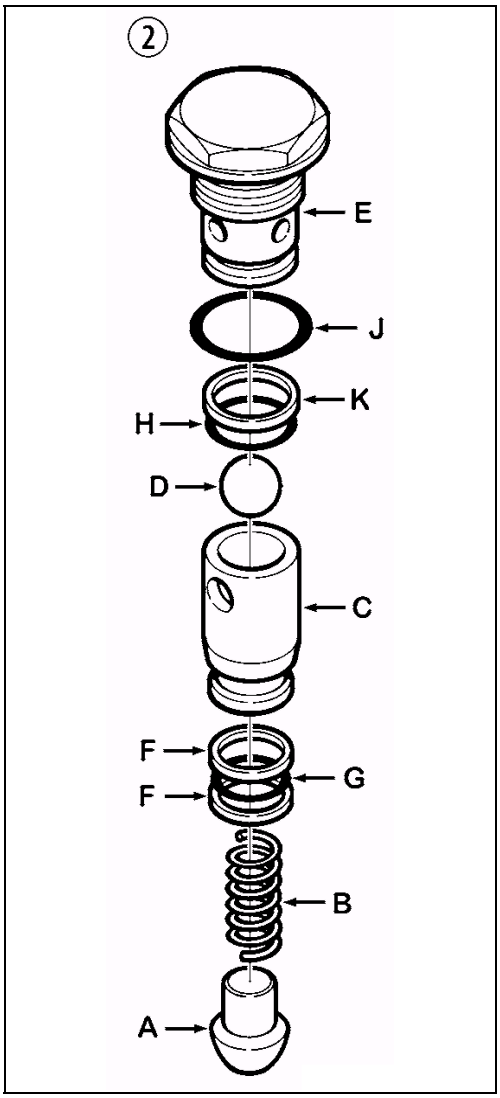
CONTROL VALVE

7. Remove the anti-cavitation valve (2) from each side of the valve body.



8. Disassemble the anti-cavitation (2) valve as follows:

   Separate the check poppet (A), poppet spring (B), valve body (C) and check ball (D) from the valve plug (E). Remove and discard all software (F through K). Replace with new.



CONTROL VALVE

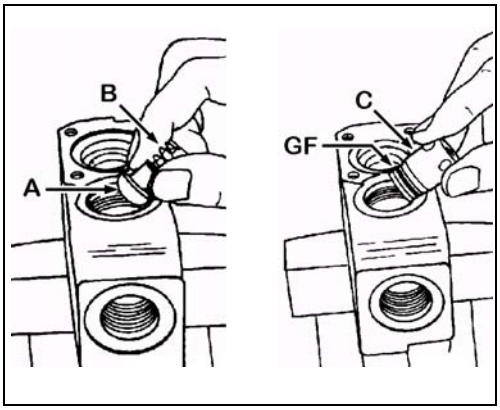
Reassembly

NOTE: *The callouts from the exploded view of blade lift section (Fig. 10B.5) correspond with the callouts in the following steps.*

1. Install the anti-cavitation valve (2) at each spool end as follows.

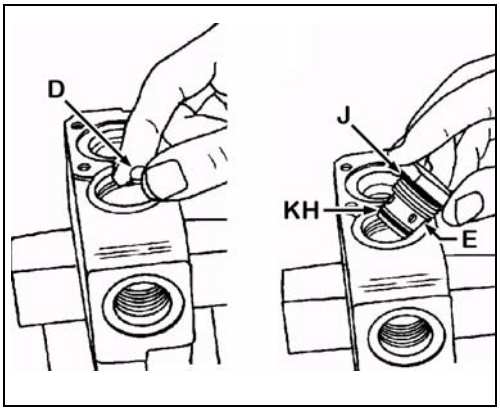
A. Install the check poppet (A) and the poppet spring (B) into the valve bore.

B. Install the valve body (C) with a new back up rings (F) and seal ring (G) into the valve bore.



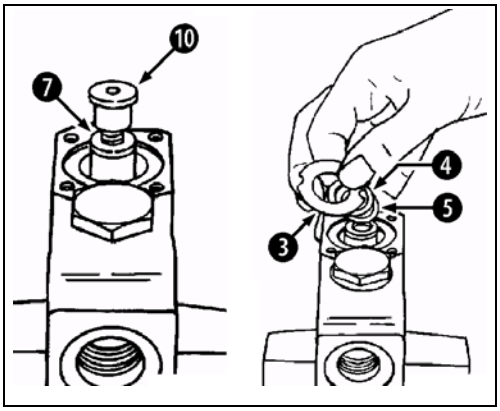
C. Install the check ball (D) into the valve body (C) in the valve bore.

D. Install the valve plug (E) with a new seal ring (J), back up ring (K) and seal ring (H) into valve bore.



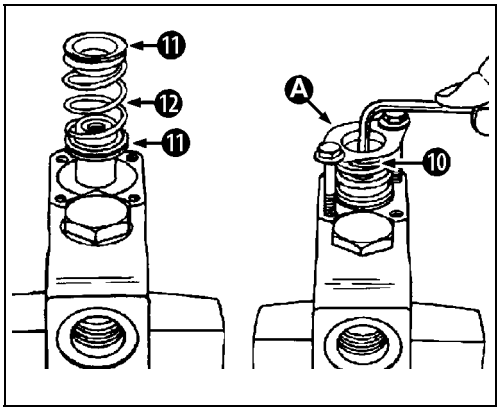
2. Insert the spool (7) into the bore and remove the collar (10).

3. Install a new seal ring (5), back up ring (4) and seal retainer (3) into each end of the spool bore.

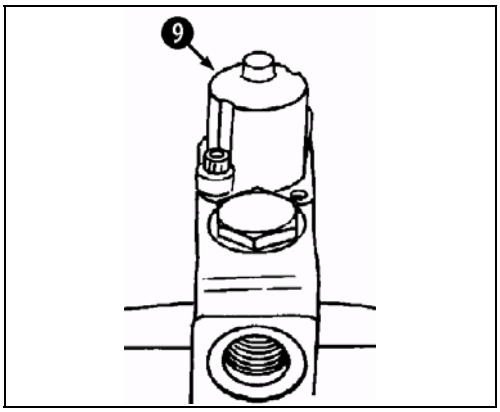


CONTROL VALVE

4. Install the spring seats (11) and the centering spring (12) to the spool.
5. Install retainer plate (A) (see SERVICE/SPECIAL TOOLS), over the spring seat and secure with the bolts. Draw down evenly on the bolts until the spool collar (10) can be installed. Tighten down the spool collar then remove the retaining plate and bolts.



6. Install the spool positioner cover (9) and secure with the hardware.



SECTION 10C

CYLINDERS

CYLINDERS

SECTION 10C

CONTENTS

SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS 3

BLADE CYLINDERS

2. DESCRIPTIONS AND OPERATIONS 3
3. SPECIFICATIONS 3
4. REMOVAL 4
5. DISASSEMBLY 6
6. INSPECTION AND REPAIR 11
7. REASSEMBLY 11
8. INSTALLATION 14

RIPPER CYLINDERS

9. SPECIFICATIONS 16
10. REMOVAL 16
11. DISASSEMBLY 17
12. INSPECTIONS AND REPAIR 22
13. REASSEMBLY 23
14. INSTALLATION 28

SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS

DESCRIPTION	TOOL NUMBER
Gland Nut Tool for Cylinders with 76.2 [mm] Diameter Pistons	1.541.0381
Gland Nut Tool for Cylinders with 88.9 [mm] Diameter Pistons	1.541.0371
Cylinder Rod Lock Nut Socket	8N40M-42,86/19-60
Gland Seal Ring Mounting Pliers	1.521.0052
Cylinder Piston Seal Ring Compressing Tool	1.549.0176
Cylinder Piston Seal Ring Compressing Sleeve for cylinders with 76.2 [mm] Diameter Pistons.	1.549.0179 Nr4

BLADE CYLINDERS

2. DESCRIPTION AND OPERATIONS

The blade lift, tilt or angle cylinders are a single stage double acting type. Hydraulic pressure is introduced through ports at either end of the cylinder to actuate the piston and rod.

3. SPECIFICATIONS

Bore and Stroke:

Lift Cylinder – ALL ..... 88.9 x 448 [mm]
Tilt Cylinder - ALL ..... 88.9 x 144 [mm]
Angle Cylinder – TD-7M or TD-8M ..... 76.2 x 352 [mm]
Angle Cylinder – TD-9M or TD-10M ..... 88.9 x 352 [mm]

Weights:

Lift Cylinder – TD-7M ..... = 33 [kg]
Lift Cylinder – TD-8M or TD-7M(LGP) ..... = 38 [kg]
Lift Cylinder – TD-9M or TD-10M ..... = 56 [kg]
Tilt Cylinder - ALL ..... = 29 k[g]
Angle Cylinder – TD-7M or TD-8M ..... = 27 [kg]
Angle Cylinder – TD-9M or TD-10M ..... = 32 [kg]

Torques:

Piston Lock Nut;
- Lift Cylinder – ALL ..... 600 to 650 [Nm]
- Tilt Cylinder – ALL ..... 600 to 650 [Nm]
- Angle Cylinder – TD-7M or TD-8M ..... 450 to 500 [Nm]
- Angle Cylinder – TD-9M or TD-10M ..... 600 to 650 [Nm]

Gland Nut:
- Lift Cylinder – ALL ..... 820 to 880 [Nm]
- Tilt Cylinder – ALL ..... 820 to 880 [Nm]
- Angle Cylinder – TD-7M or TD-8M ..... 620 to 680 [Nm]
- Angle Cylinder – TD-9M or TD-10M ..... 820 to 880 [Nm]

Seal Test Pressure ..... 21.0 [MPa]

CYLINDERS

BLADE CYLINDERS

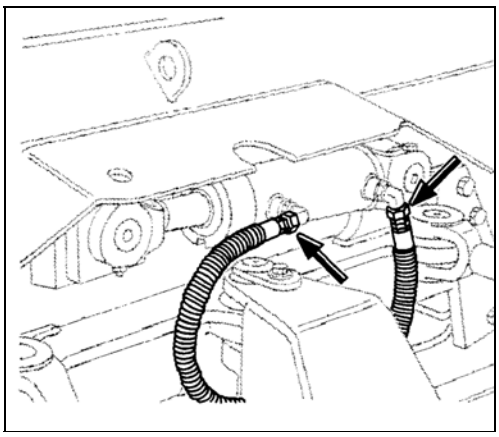
4. REMOVAL

NOTE: *REMOVAL OF THE CYLINDERS ARE SIMILAR WITH THE TILT CYLINDER SHOWN.*

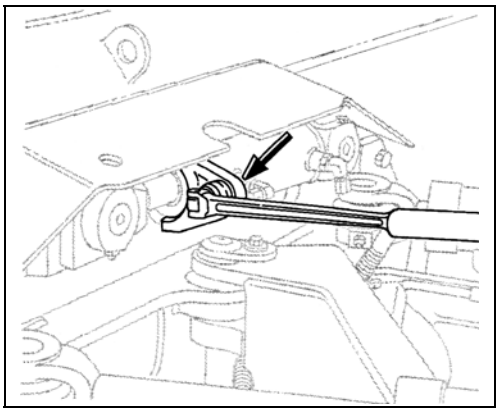
IMPORTANT: *Disconnected hydraulic lines must be capped with the correct size plastic cap. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Tag all disconnected lines to facilitate proper installation.*

WARNING! Before working 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.

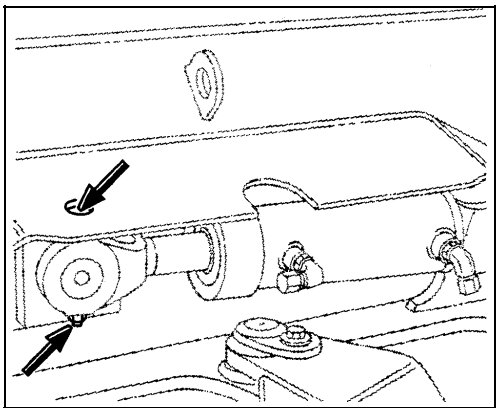
1. Operate equipment control lever to dissipate any pressure in the system. Disconnect and cap hoses at the cylinder. Allow the cylinder to drain into a suitable container.



2. Using gland nut tool, relieve torque on the gland nut. Refer to SERVICE/SPECIAL TOOLS for tool number.

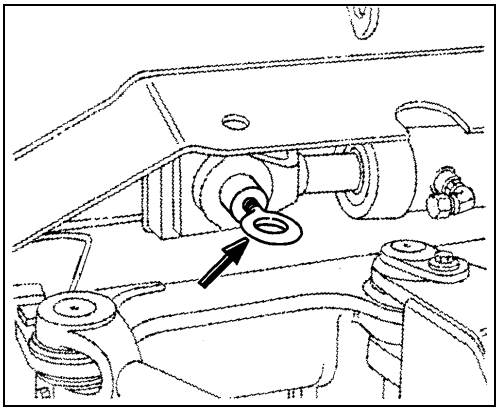


3. Remove the rod end anchor bolt.

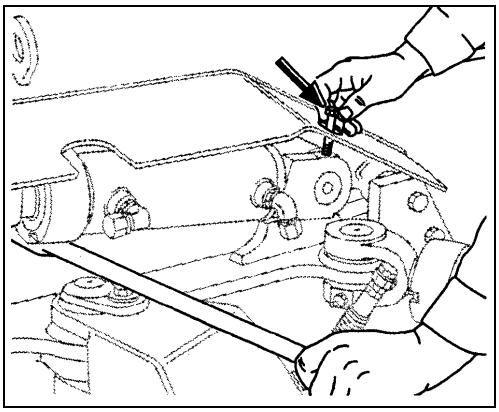


BLADE CYLINDERS

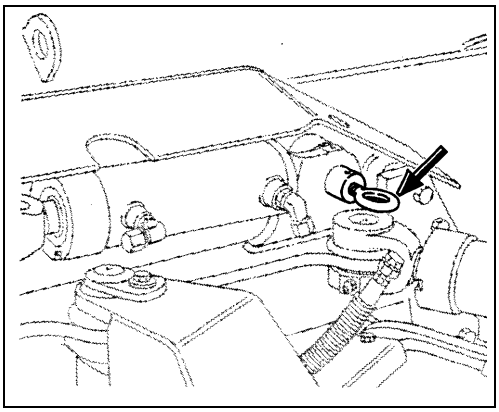
4. Using an eye bolt, remove the rod end pin.



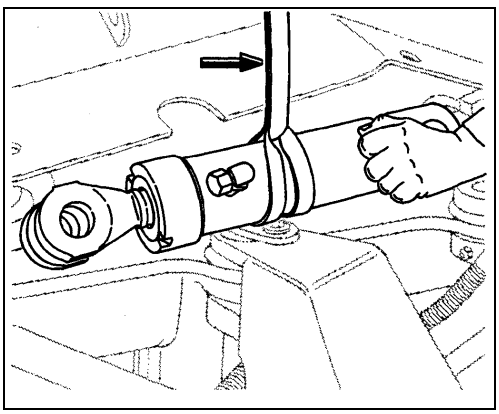
5. Remove the piston end anchor bolt. The cylinder may have to be jockeyed around to allow bolt clearance.



6. Using an eye bolt, remove the piston end pin.



7. Attach a hoist and sling to the cylinder and remove.



CYLINDERS

BLADE CYLINDERS

5. DISASSEMBLY

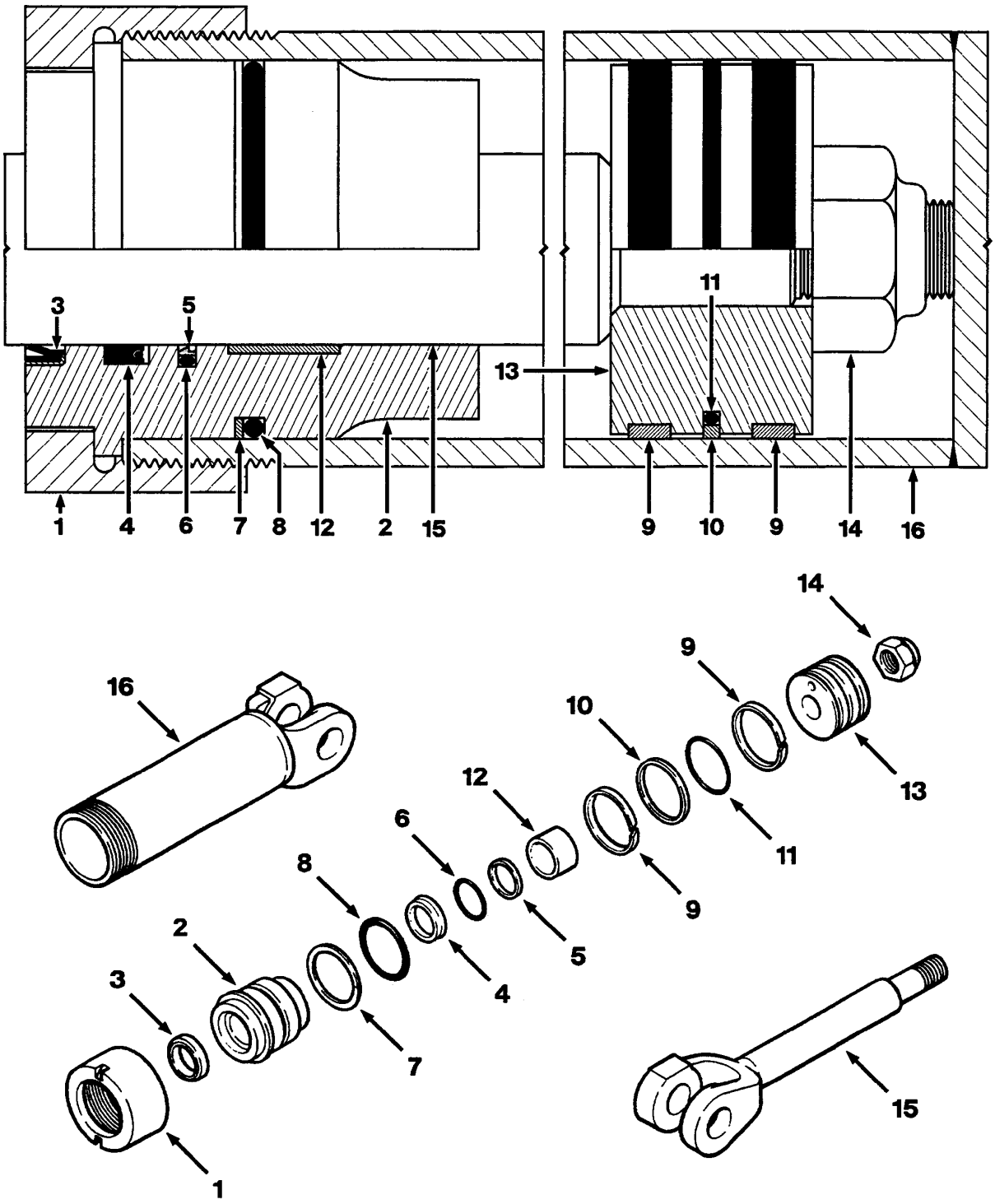


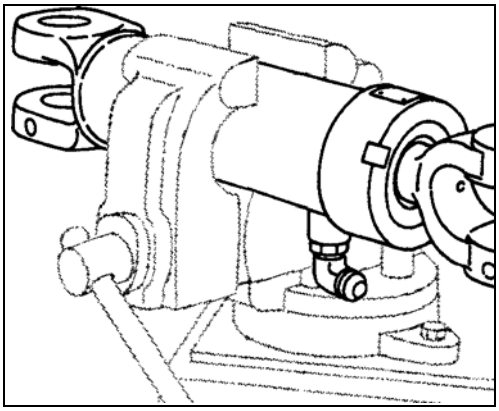
Fig. 10C.1. Cross Section and Exploded Views of Blade Lift, Tilt or Angle Cylinder

1. Gland Nut
2. Cylinder Gland
3. Wiper Ring
4. Seal Ring
5. Buffer Ring
6. O-Ring
7. Back Up Ring
8. O-Ring
9. Wear Ring
10. Seal Ring
11. O-Ring
12. Wear Ring
13. Cylinder Piston
14. Lock Nut
15. Cylinder Rod
16. Cylinder Housing

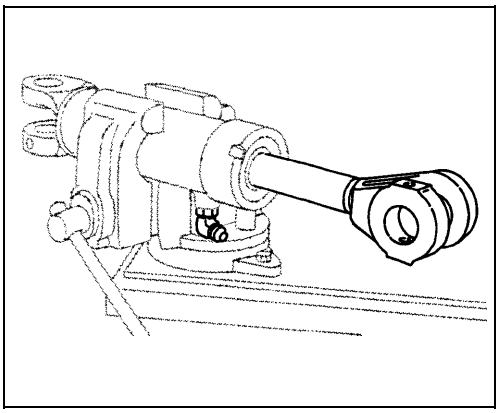
BLADE CYLINDERS

NOTE: *Callouts from exploded and cross section views (Fig. 10C.1) correspond with callouts in following steps.*

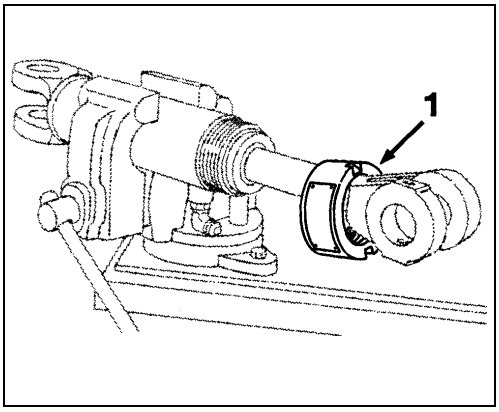
1. Mount the cylinder in a vise. Remove the port plugs and allow the oil to drain into a suitable container.



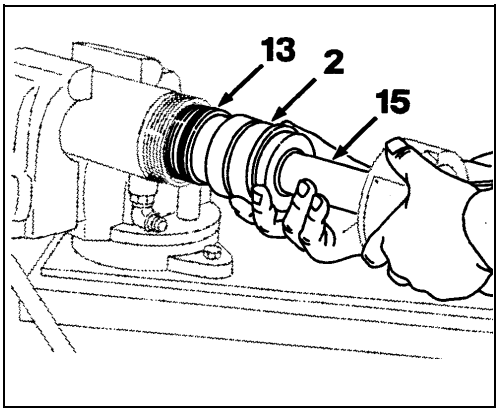
2. Extend the rod out to drain the remaining oil.



3. Unthread the gland nut (1) and position it out at the end of the rod.



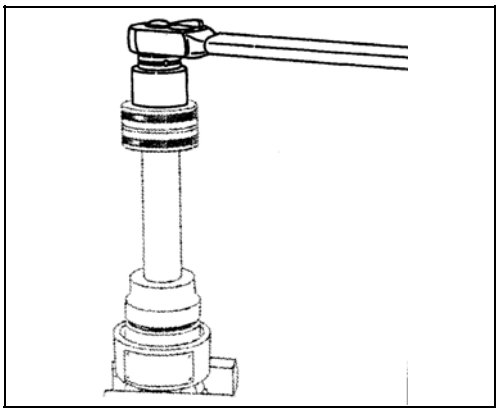
4. Pull the rod (15) with the gland (2) and the piston (13), out of the cylinder housing.



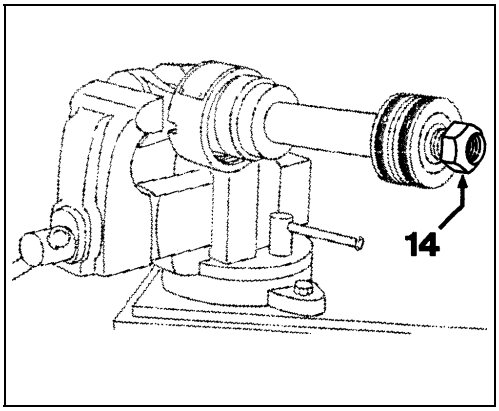
CYLINDERS

BLADE CYLINDERS

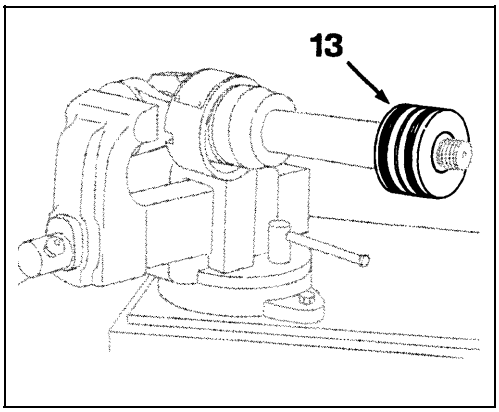
5. Position the rod in a vise. Break the torque on the piston lock nut.



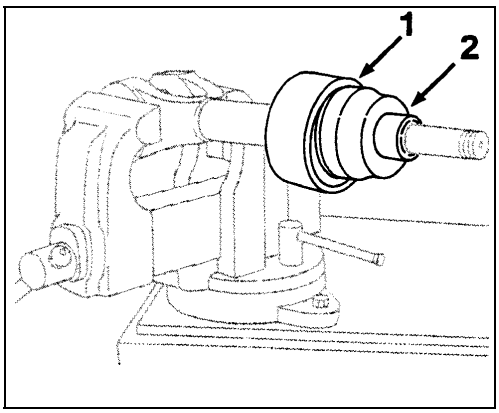
6. Remove the lock nut (14).



7. Remove the piston (13) from the rod.

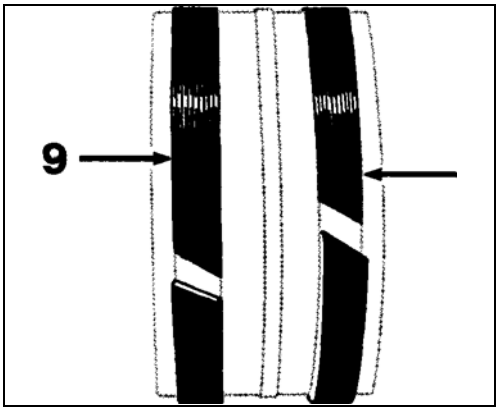


8. Remove the gland (2) and nut (1) from rod.

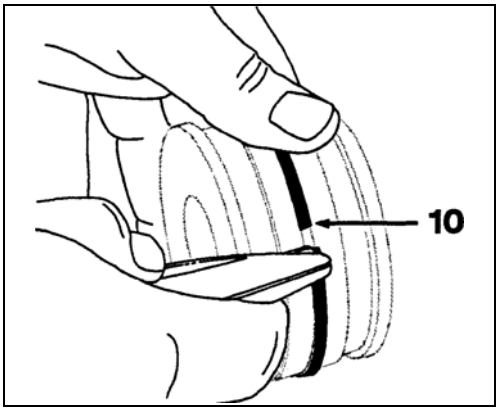


BLADE CYLINDERS

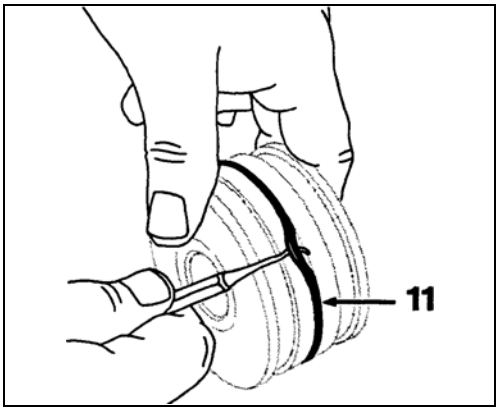
9. Remove and discard the wear rings (9) from the piston.



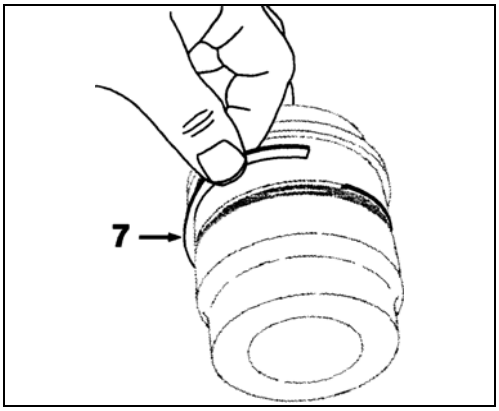
10. Cut the piston seal ring (10) and remove and discard.



11. Remove and discard the O-ring (11) from the piston.



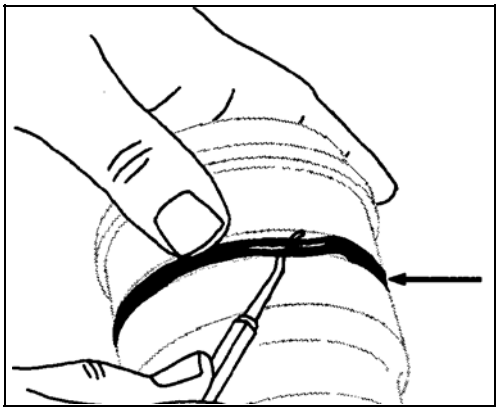
12. Remove and discard the back up ring (7) from the gland.



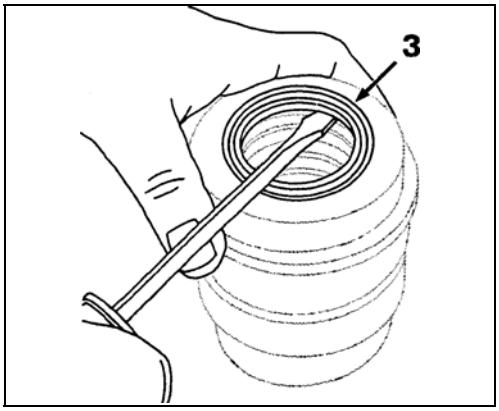
CYLINDERS

BLADE CYLINDERS

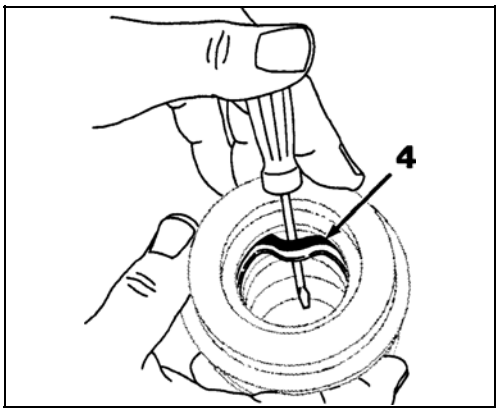
13. Remove and discard the O-ring (8) from the gland.



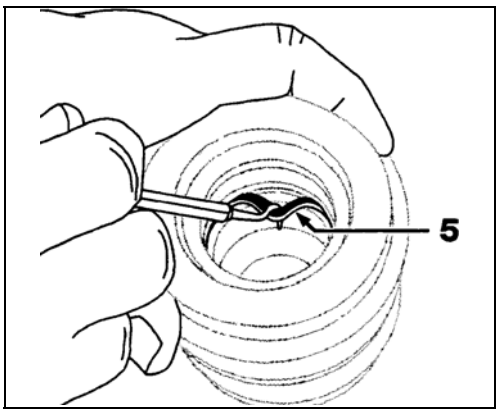
14. Pop out the wiper ring (3) from the gland and discard.



15. Remove and discard the seal ring (4) from the gland.

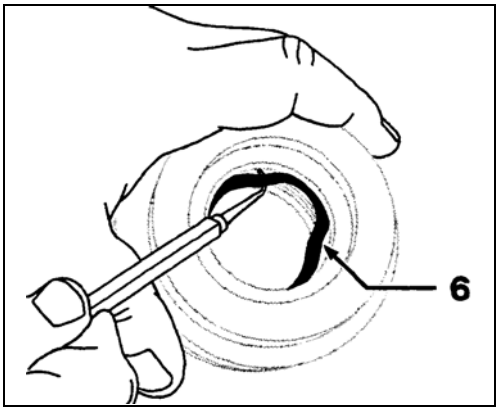


16. Remove and discard the buffer ring (5) from the gland.

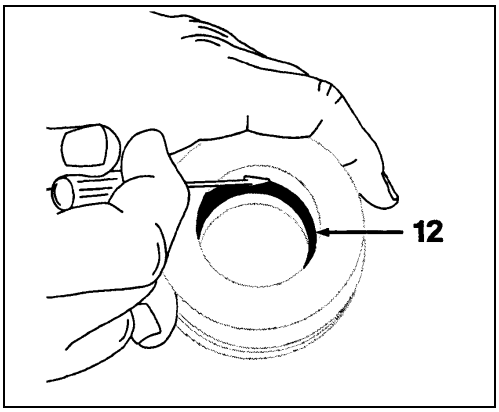


BLADE CYLINDERS

17. Remove and discard the O-ring (6) from the gland.



18. Remove and discard the wear ring (12) from the gland.



6. INSPECTION AND REPAIR

1. If not already done, discard all O-rings, seals and rings.
2. Clean all remaining parts in solvent and dry thoroughly with compressed air.
3. Inspect cylinder wall and rod for wear, scoring, scratches or grooves that may cause seal kit failure. Very slight scratches can be polished out with a fine emery cloth and oil so a smooth surface is presented to seal kit.
4. Inspect all parts for cracks and breakage and replace as necessary.

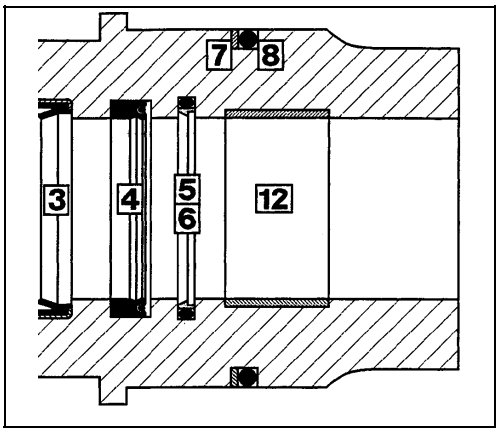
7. REASSEMBLY

NOTE: *Callouts from exploded and cross section views (Fig. 10C.1) correspond with callouts in following steps.*

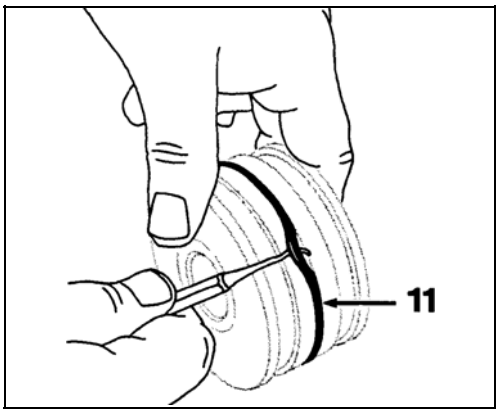
CYLINDERS

BLADE CYLINDERS

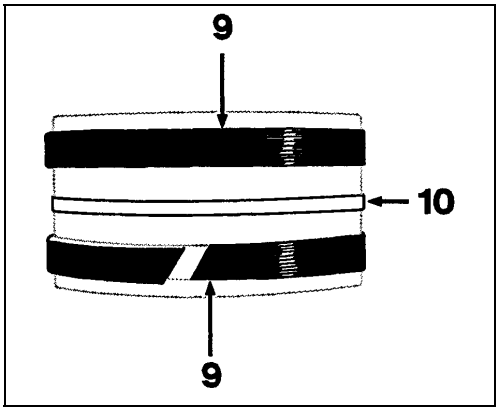
1. Install a new O-ring (6) into groove in the gland. Work the buffer ring (5), with lip facing in, into the groove under the O-ring. Install the wear ring (12) into the large groove in the gland. Install the seal ring (4) with expander (O-ring) facing towards wear ring. Squeeze sides of the seal using seal ring mounting pliers (refer to SERVICE/SPECIAL TOOLS for tool number) and start into the groove in the gland. Work the remainder in with thumbs. Start the wiper ring (3), lip facing out, in the gland bore and drive flush with the edge of the gland. Install the O-ring (8) and back up ring (7) into the outer groove on the gland.



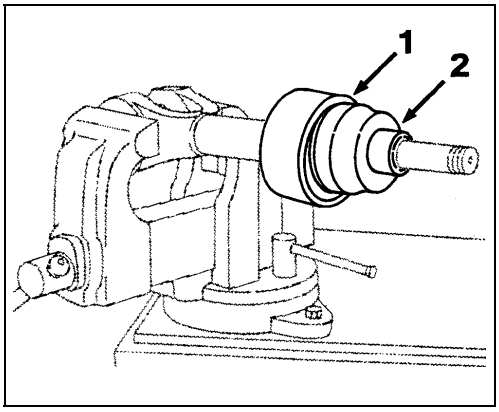
2. Install a new O-ring (11) into the piston.



3. For ease of assembly, soak the piston seal ring (10) in water heated to 80 to 90 [°C] until it is pliable. Install the heated seal ring into piston groove over the inner O-ring, using shim stock, wrapped around the end of the piston. Compress ring (10) using compressing sleeve or compressing tool in accordance with piston dimension; refer to SERVICE/SPECIAL TOOLS for tool number. Install the wear rings (9), slits 180 [°] apart, onto the piston.

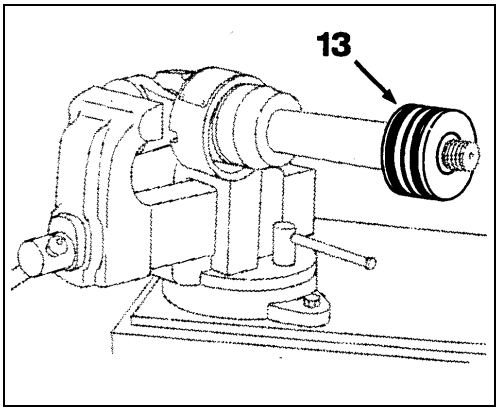


4. Install the gland nut (1) on rod. Coat the internal seals in the gland (2) with a liberal layer of clean oil. Install the gland to the rod being careful not to cut or clip internal seals.

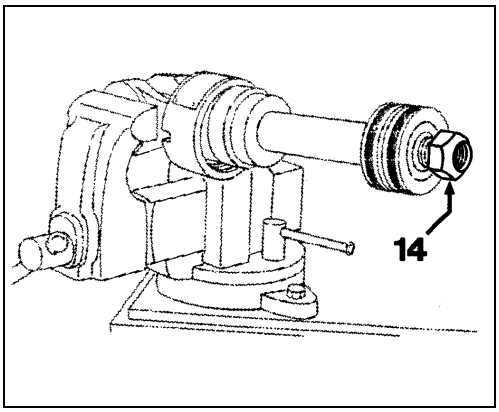


BLADE CYLINDERS

5. Install the piston (13) on the rod.

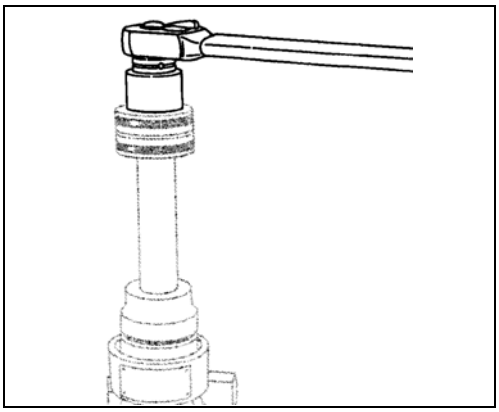


6. Install the lock nut (14) to the rod.

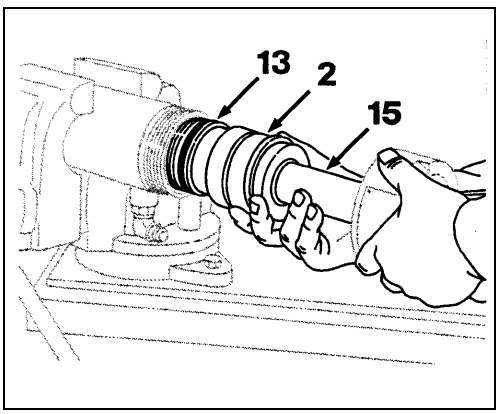


7. Reposition rod in a vise and torque the lock nut to value shown.

Lift cylinders - ALL	600 to 650 [Nm]
Tilt cylinders - ALL	600 to 650 [Nm]
Angle cylinders – TD-7M/TD-8M	450 to 500 [Nm]
Angle cylinders - TD9-M/TD-10M	600 to 650 [Nm]



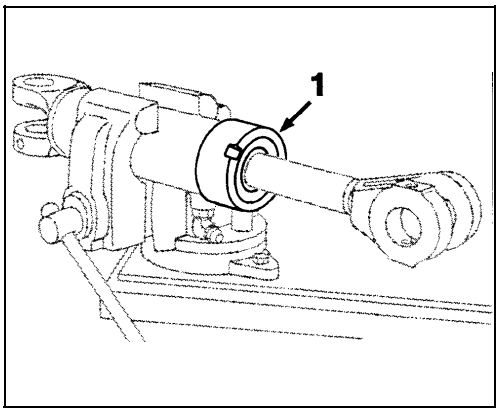
8. Coat the external seals on the piston (13) and the gland (2) with a layer of clean oil. Install rod assembly (15) into housing being careful not to cut or clip external seals.



CYLINDERS

BLADE CYLINDERS

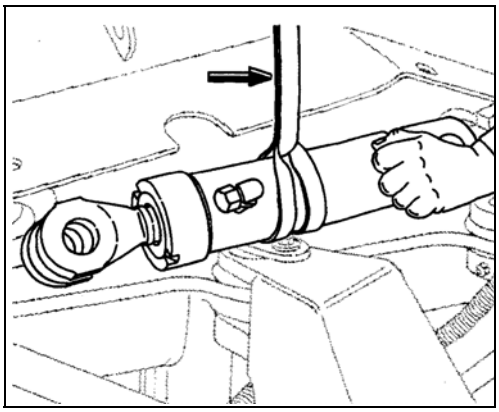
9. Thread the gland nut (1) hand tight to the housing. Position the cylinder in a holding fixture and using the gland nut tool, see SPECIAL/SERVICE TOOLS, torque the gland nut to value given in Paragraph 3, SPECIFICATIONS.



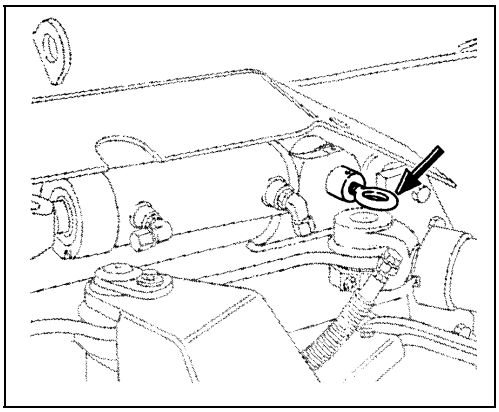
8. INSTALLATION

NOTE: *Installation of blade cylinders are similar with tilt cylinder shown.*

1. Using hoist and sling, position cylinder in place on machine.

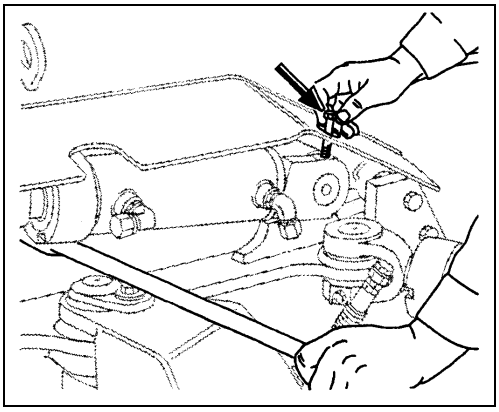


2. Install mounting pin using eye bolt to align anchor bolt mounting holes.

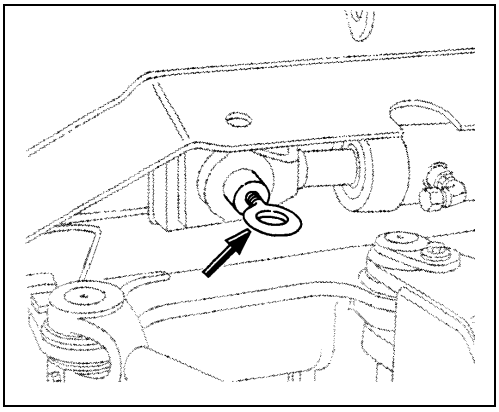


BLADE CYLINDERS

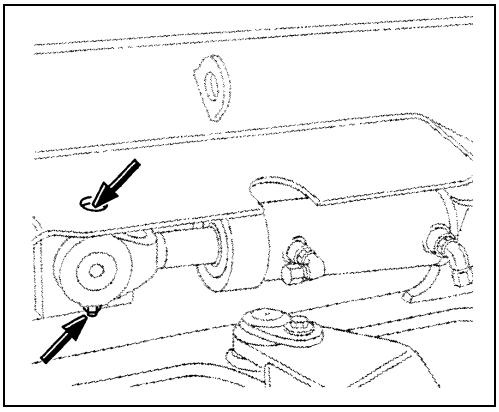
3. Install anchor bolt and secure with nut. Torque bolt to 60 ±10% [Nm].



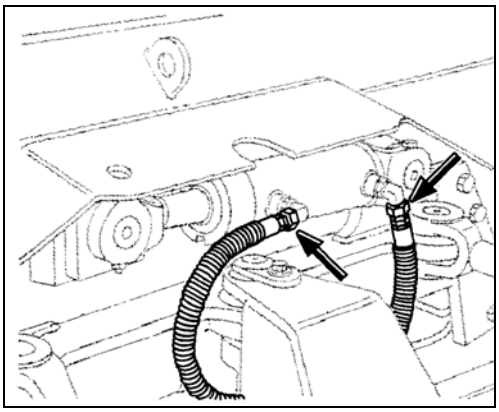
4. Install mounting pin using eye bolt to align anchor bolt mounting holes.



5. Install anchor bolt and secure with nut. Torque bolt to 60 ±10% [Nm].



6. Reconnect lines at cylinder. Check oil level in reservoir and add as required, refer to OPERATOR'S MANUAL. Slowly operate cylinder ten to twelve cycles to bleed out air. Recheck fluid level in reservoir and add as required.



RIPPER CYLINDERS

9. SPECIFICATIONS

Bore and Stroke	76.2 x 173 [mm]
Weights	31 [kg]
Torques - Piston Lock Nut	610 to 680 [Nm]
Seal Test Pressure	20.0 [MPa]

10. 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 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.

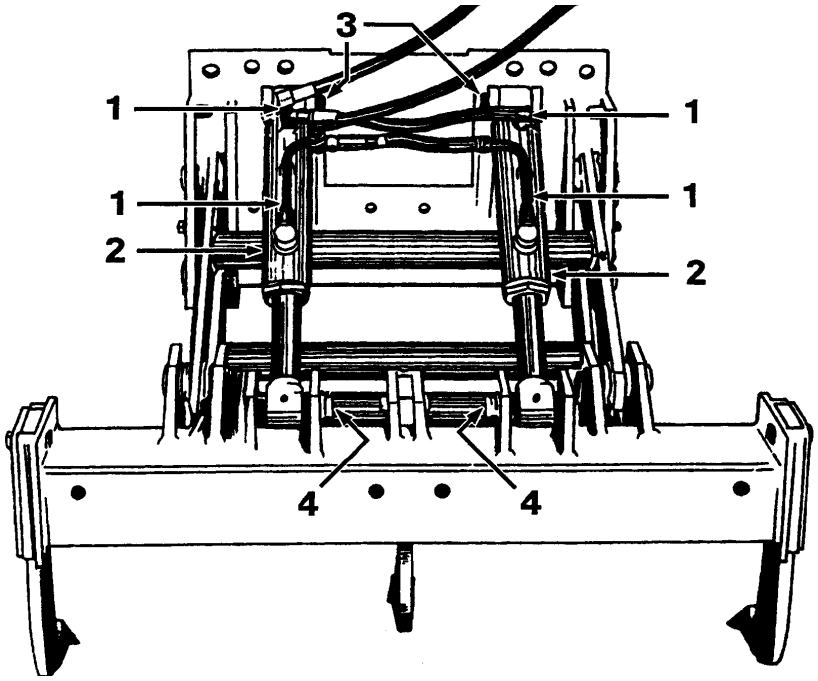


Fig. 10C.2. Ripper Cylinder Removal

1. Ripper Cylinder Hoses
2. Ripper Cylinder
3. Front Mounting Pin
4. Rear Mounting Pin

1. Operate the equipment control lever to relieve any pressure in the system.
2. Disconnect and cap the hoses (1, Fig. 10C.2) at the cylinder (2). Drain into a suitable container.
3. Attach a hoist and sling to the cylinder. Unscrew front mounting pin bolt and rear pin cotter. Remove the front (3) and rear (4) mounting pins from the cylinder and remove cylinder.

RIPPER CYLINDERS

11. DISASSEMBLY

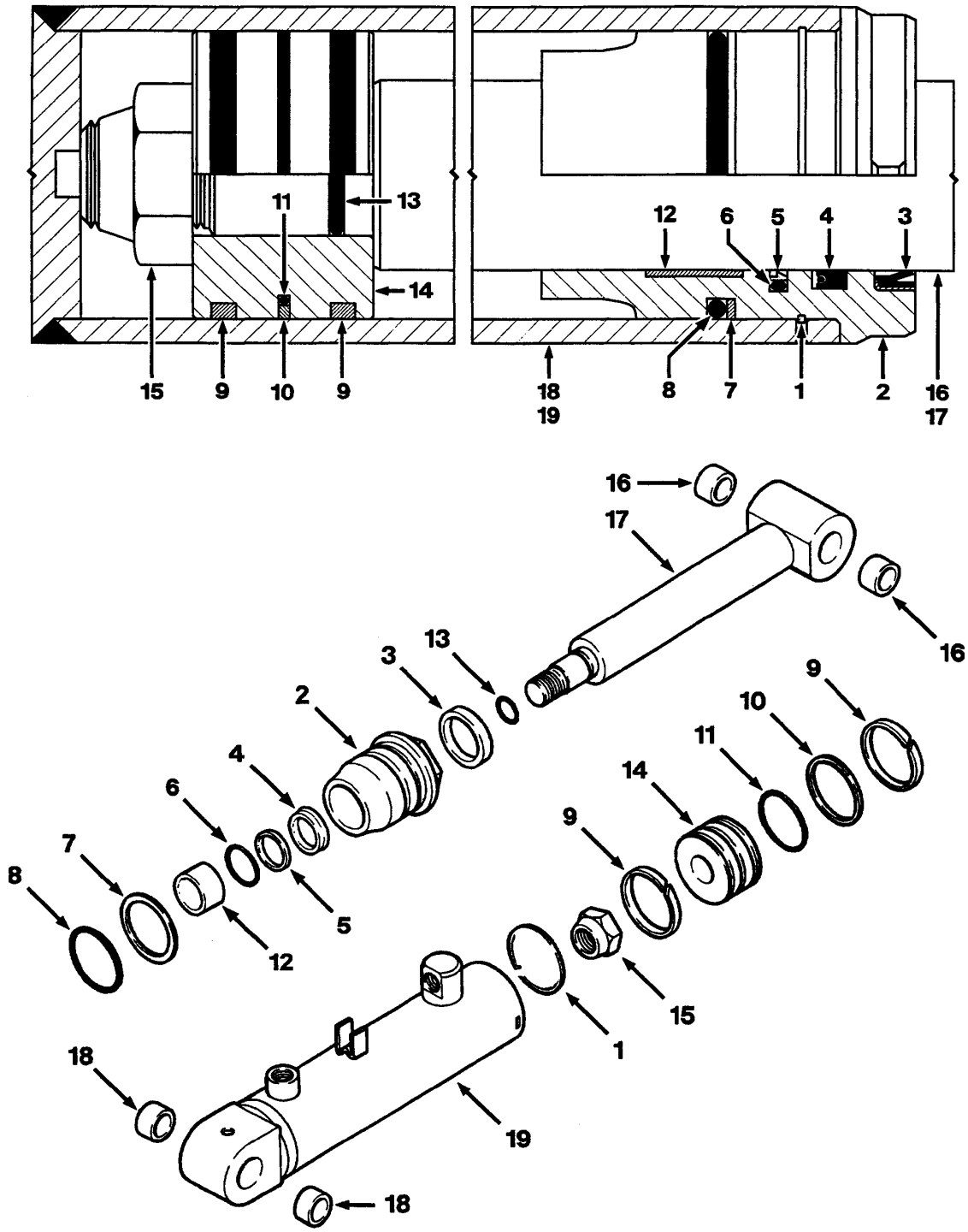


Fig. 10C.3. Cross Section and Exploded Views of Ripper Cylinder

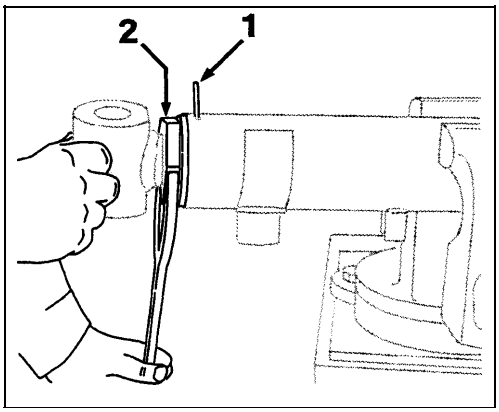
1. Retaining Ring
2. Cylinder Gland
3. Wiper Ring
4. Seal Ring
5. Buffer Ring
6. O-Ring
7. Back Up Ring
8. O-Ring
9. Wear Ring
10. Seal Ring
11. O-Ring
12. Wear Ring
13. O-Ring
14. Cylinder Piston
15. Lock Nut
16. Rod Bushing
17. Cylinder Rod
18. Bushing
19. Cylinder Housing

CYLINDERS

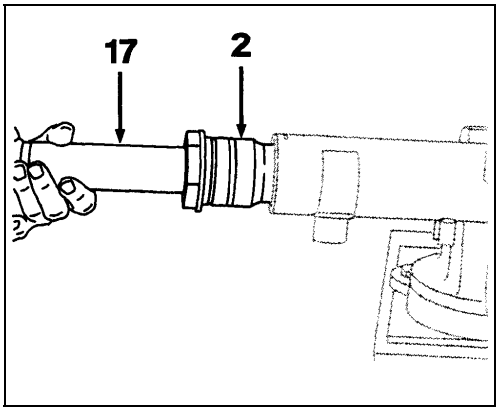
RIPPER CYLINDERS

NOTE: *Callouts from cross section and exploded views (Fig. 10C.3) correspond with callouts in following steps.*

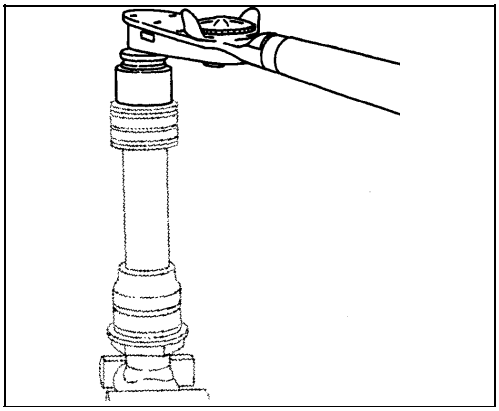
1. Position the cylinder in a vise. Pull out the rod to drain remaining oil into a suitable container. Using a 3 [in]. spanner wrench, rotate the gland (2) and remove the retaining ring (1).



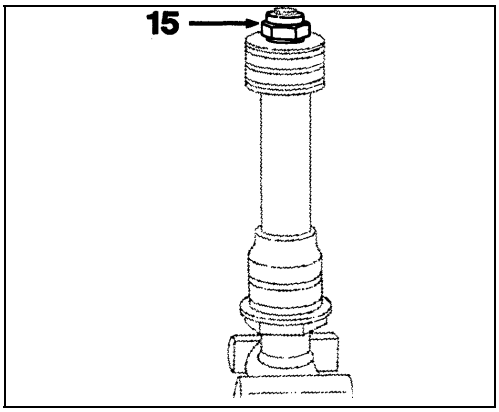
2. Pull out the rod (17) with the gland (2) and piston from the cylinder housing.



3. Position the piston rod in a vise vertically. Break the torque on the lock nut.

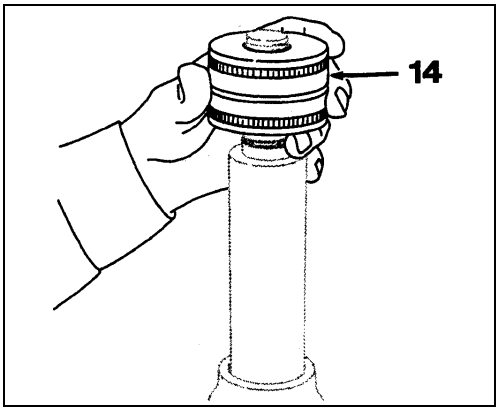


4. Remove the lock nut (15) from the rod.

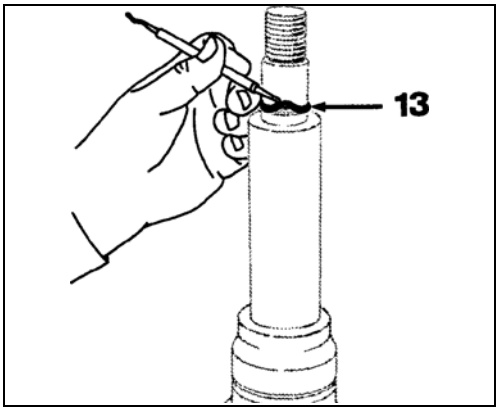


RIPPER CYLINDERS

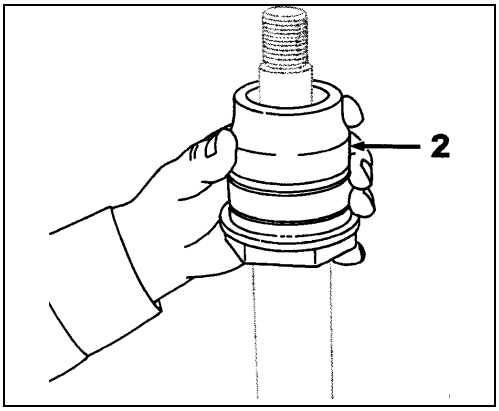
5. Remove the piston (14) from the rod.



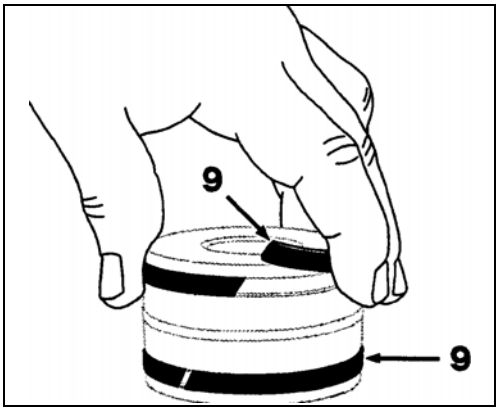
6. Remove and discard the piston O-ring (13) from the rod.



7. Remove the gland (2) from the rod.



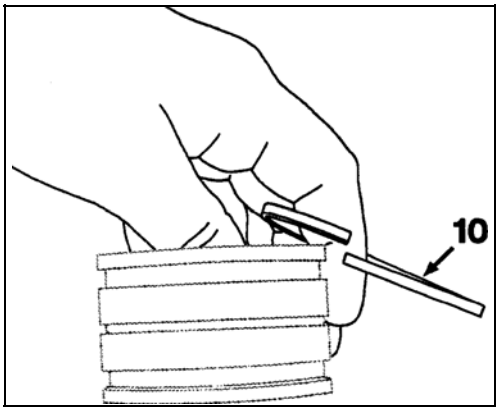
8. Remove and discard the wear rings (9) from the piston.



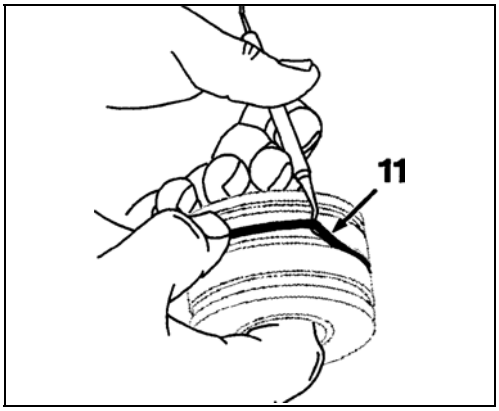
CYLINDERS

RIPPER CYLINDERS

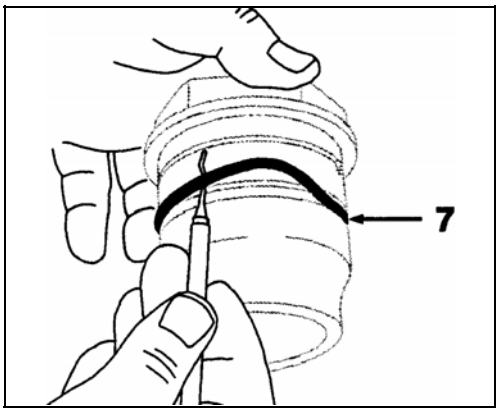
9. Cut, remove and discard the seal ring (10) from the piston.



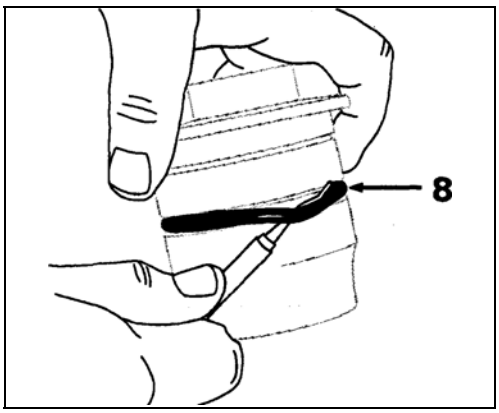
10. Remove and discard the O-ring (11) from the piston.



11. Remove and discard the back up ring (7) from the gland.

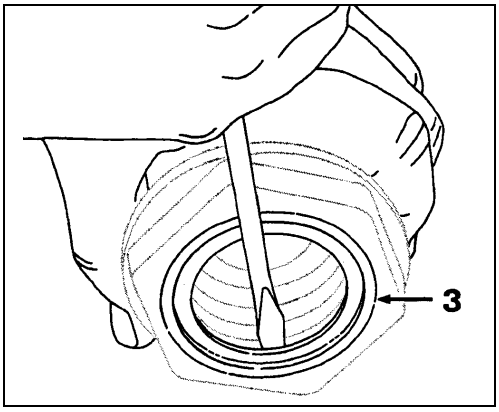


12. Remove and discard the O-ring (8) from the gland.

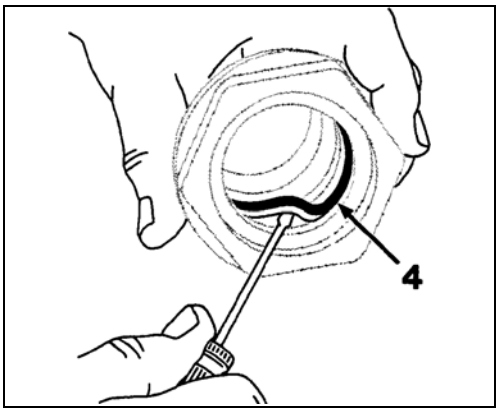


RIPPER CYLINDERS

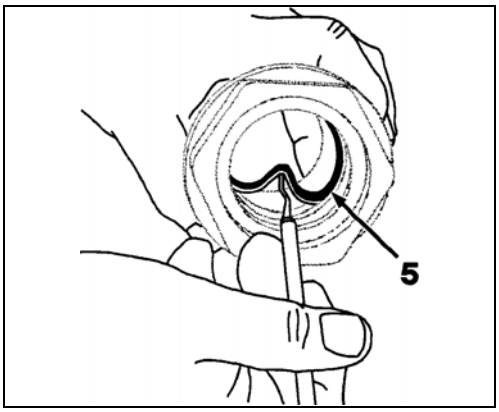
13. Pop out and discard the wiper ring (3) from the gland.



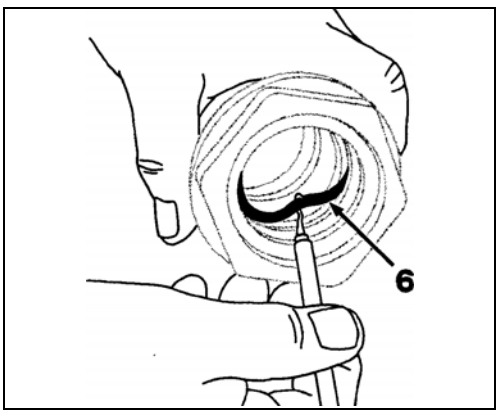
14. Remove and discard the seal ring (4) from the gland.



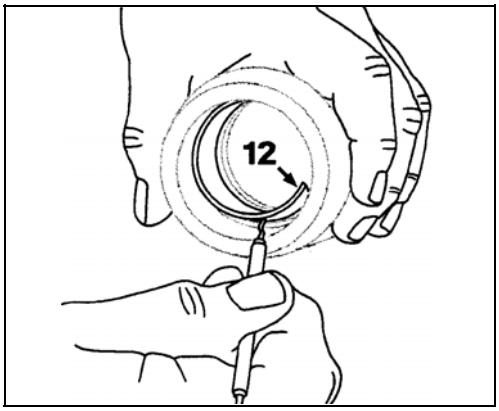
15. Remove and discard the buffer ring (5) from the gland.



16. Remove and discard the O-ring (6) from the gland.



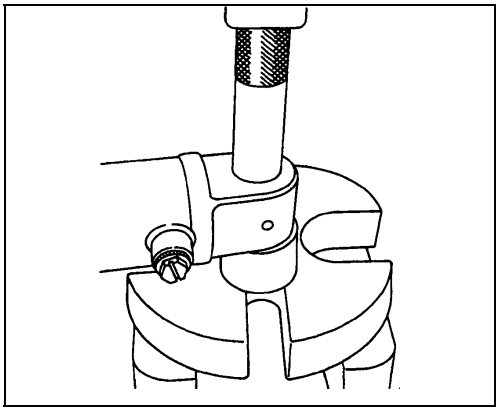
17. Remove and discard the wear ring (12) from the gland.



BUSHINGS

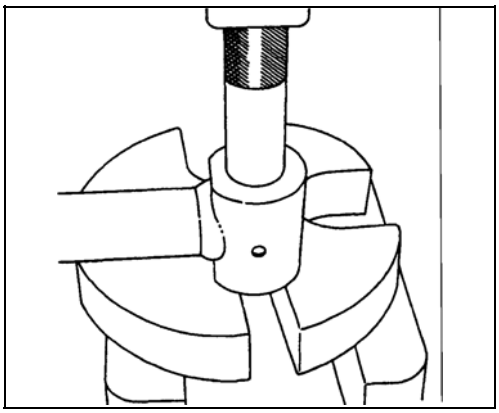
Cylinder Housing

Position the cylinder housing in a press and remove both bushings (18) at the same time.



Cylinder Rod

Position the rod in a press and remove both bushings (16) at the same time.



12. INSPECTION AND REPAIR

1. If not already done, discard all O-rings, seals and rings.
2. Clean all remaining parts in solvent and dry thoroughly with compressed air.
3. Inspect cylinder wall and rod for wear, scoring, scratches or grooves that may cause seal kit failure. Very slight scratches can be polished out with a fine emery cloth and oil so a smooth surface is presented to seal kit.
4. Inspect all parts for cracks and breakage and replace as necessary.

RIPPER CYLINDERS

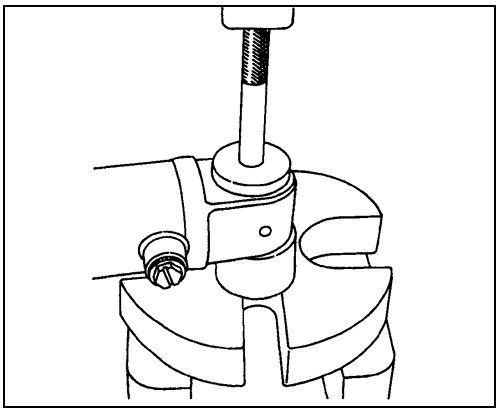
13. REASSEMBLY

NOTE: *Callouts from exploded and cross section views (Fig. 10C.3) correspond with callouts in the following steps.*

BUSHINGS

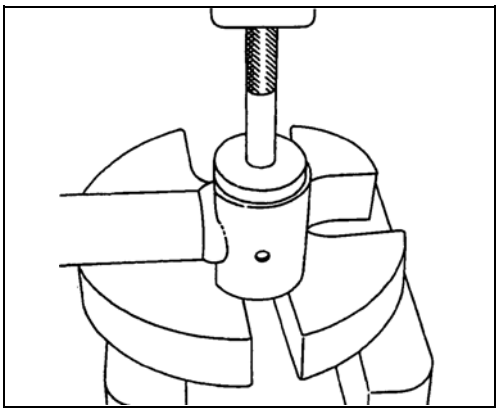
Cylinder Housing

Position bushing (18) in the housing and using suitable driver, press in flush with edge of housing. Turn over housing and repeat for remaining bushing.



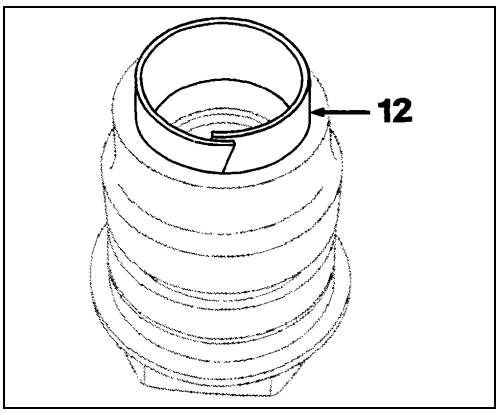
Cylinder Rod

Position bushing (16) in rod and using suitable driver, press in flush with edge of rod. Turn over rod and repeat for remaining bushing.



RIPPER CYLINDER

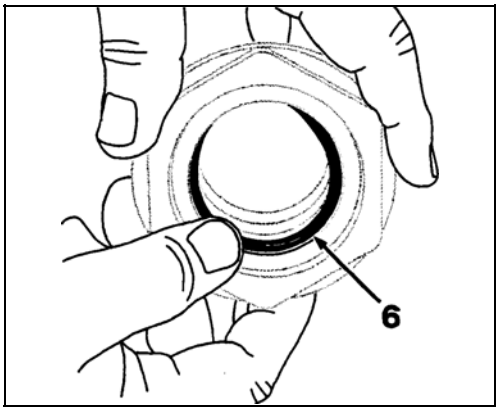
1. Install the wear ring (12) into the large groove in the gland.



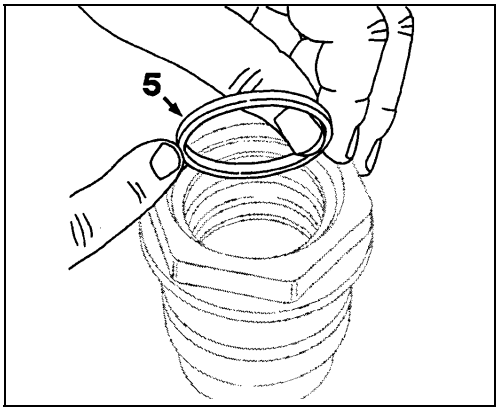
CYLINDERS

RIPPER CYLINDERS

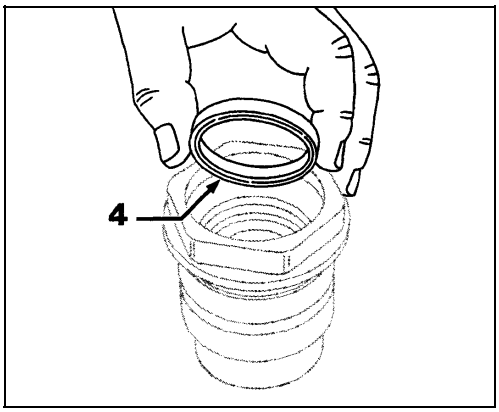
2. Install the O-ring (6) into the groove in the gland.



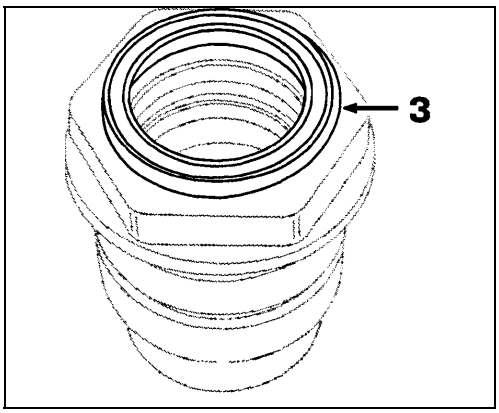
3. Work a new buffer ring (5), with lip facing in, into the groove under the O-ring.



4. Install the seal ring (4) with the expander (O-ring) facing towards the wear ring. Squeeze the sides of the seal using seal ring mounting pliers (refer to SERVICE/SPECIAL TOOLS for tool number) and start into the groove in the gland Work the remainder in with thumbs.

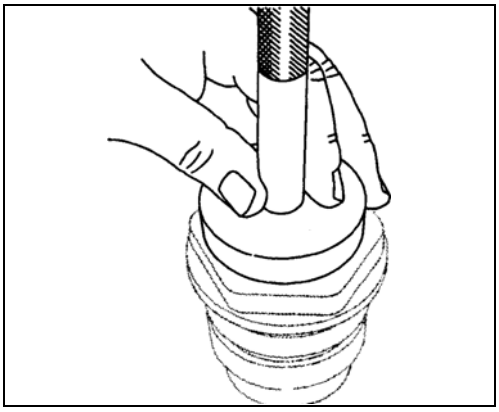


5. Start the wiper ring (3), lip facing out, in the gland bore.

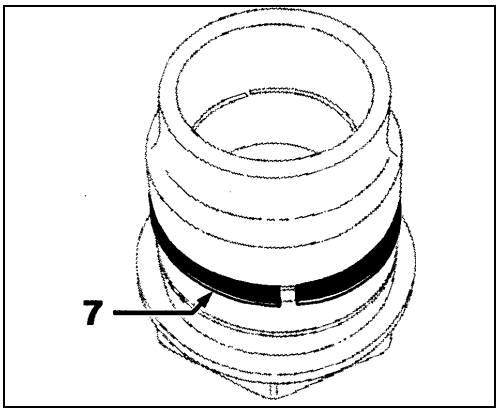


RIPPER CYLINDERS

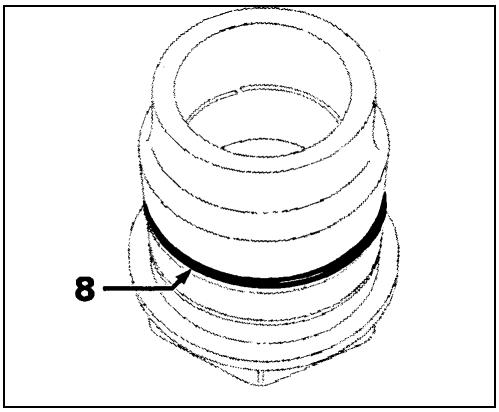
6. Drive the wiper seal flush with the edge of the gland.



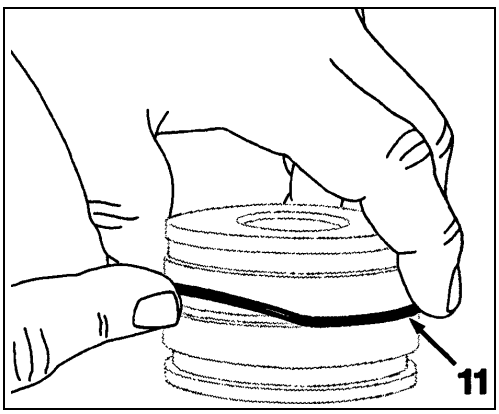
7. Install the back up ring (7) into the outer groove on the gland.



8. Install the O-ring (8) into the outer groove on the gland.



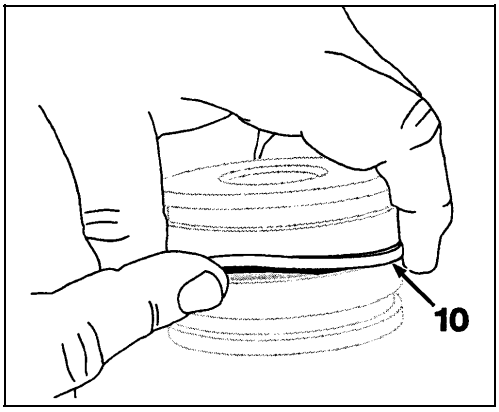
9. Install the O-ring (11) into the piston.



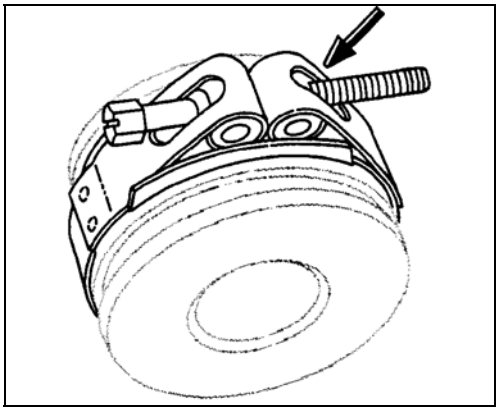
CYLINDERS

RIPPER CYLINDERS

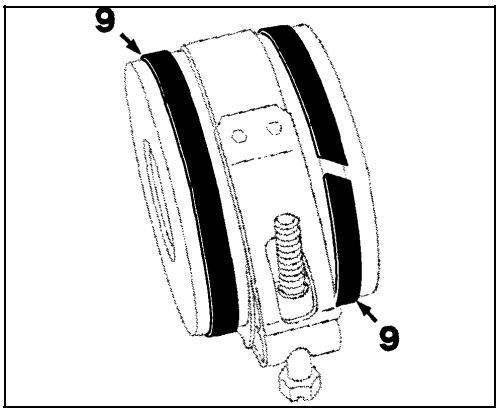
10. For ease of assembly, soak the piston seal ring (10) in water heated to 80 to 90 [°C] until it is pliable. Install the heated seal ring into the piston groove over the inner O-ring, using shim stock, wrapped around end of piston.



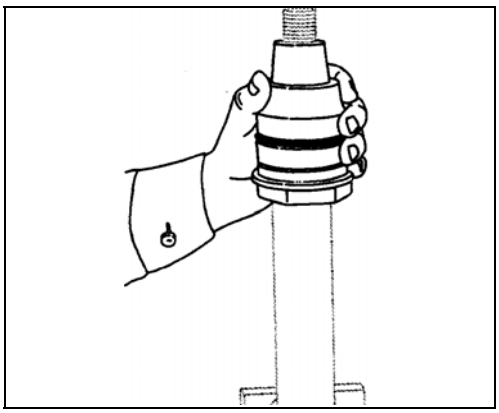
11. Compress the piston seal (10) using compressing sleeve or compressing tool; refer to SERVICE/SPECIAL TOOLS for tool number.



12. Install the wear rings (9), slits 180° apart, onto the piston.

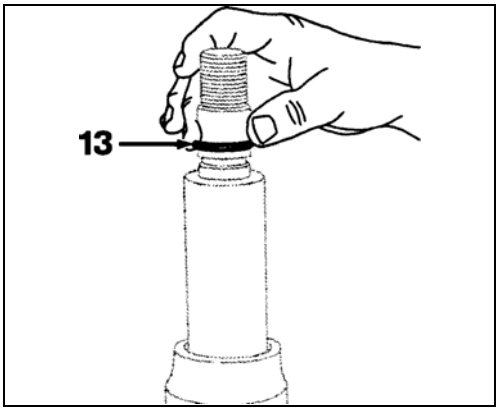


13. Coat the internal seals in the gland with a liberal layer of clean oil. Install the gland to the rod being careful not to cut or clip any of the internal seals.

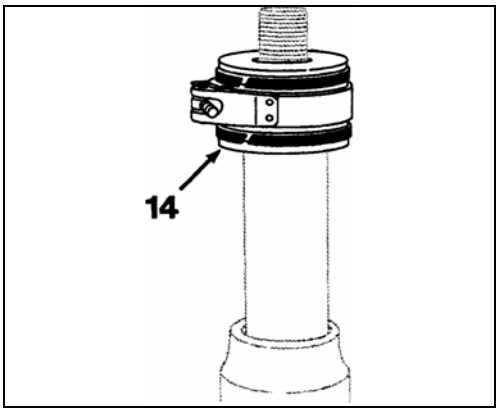


RIPPER CYLINDERS

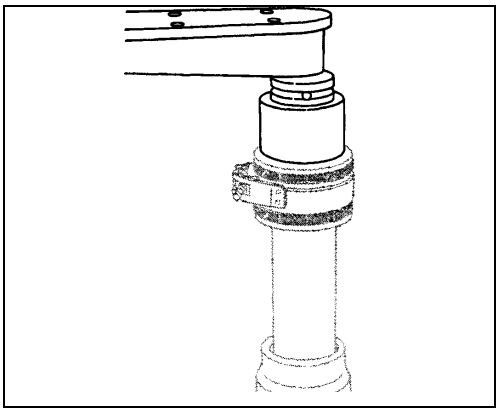
14. Install the piston O-ring (13) to the rod.



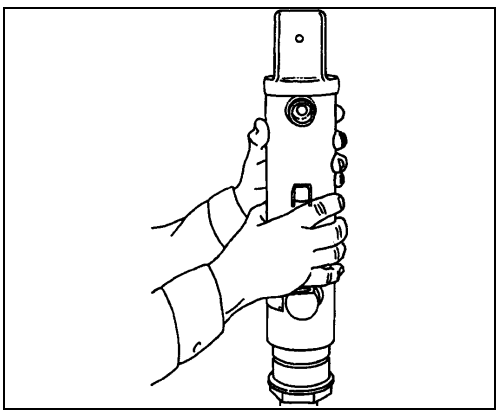
15. Install the piston (14) to the rod being careful not to clip or cut the O-ring on the rod.



16. Position the piston rod in a vise and install the lock nut to the rod and torque to 610 to 680 [Nm].

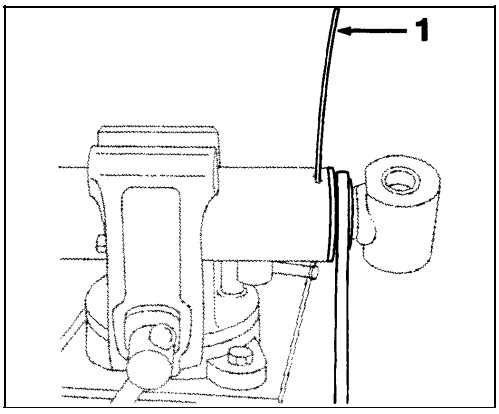


17. Coat the external seals on the piston and gland with a layer of clean oil. Install the housing onto the rod assembly being careful not to cut or clip the external seals.



RIPPER CYLINDERS

18. Align the gland nut groove with notch in cylinder housing. Insert the hooked end of the retaining ring (1) into the gland. Using 3 [in] spanner wrench, rotate gland to install retaining ring.



14. INSTALLATION

1. Attach hoist and sling to cylinder (2, Fig. 10C.4) and position in place.
2. Install front (3) and rear (4) mounting pins to cylinder; remove hoist. Secure rear pin with cotter and torque front mounting pin bolt to 92 ±10% [Nm].
3. Reconnect hoses (1) at cylinder.
4. Check oil level in reservoir and add as required, refer to OPERATOR'S MANUAL. Slowly operate cylinder ten to twelve cycles to bleed out air. Recheck fluid level in reservoir and add as required.

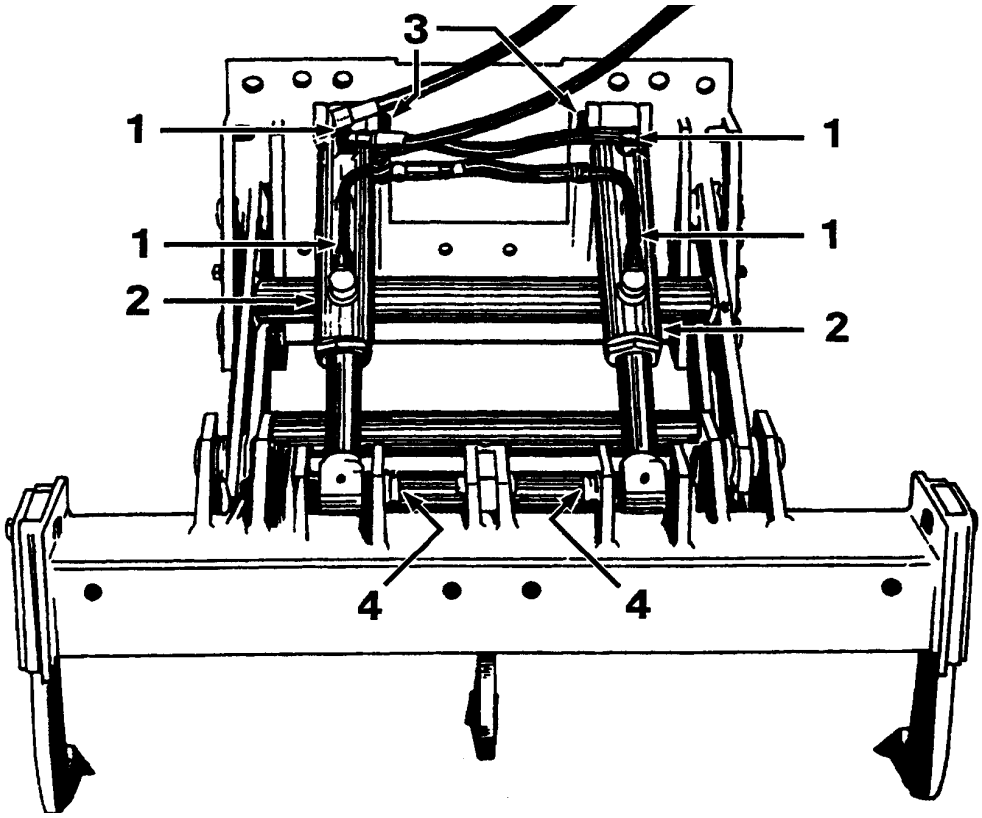


Fig. 10C.4. Ripper Cylinder Installation

1. Ripper Cylinder Hoses
2. Ripper Cylinder
3. Front Mounting Pin
4. Rear Mounting Pin

SECTION 10E

RESERVOIRS AND FILTERS

RESERVOIRS AND FILTERS

SECTION 10E

CONTENTS

HYDRAULIC RESERVOIR

1. DESCRIPTION AND MAINTENANCE 3

RESERVOIR BREATHER

2. DESCRIPTION AND MAINTENANCE 5

HYDRAULIC RESERVOIR

1. DESCRIPTION AND MAINTENANCE

The reservoir is bolted to the right fender next to the fuel tank. It is a one piece welded assembly with a strainer, reservoir, pressure relief valve, magnetic plug, a sight gauge and ports for the suction and return lines.

The reservoir acts as a storage tank for the dozer equipped hydraulic system oil. The remainder of oil fills the lines and system components.

For hydraulic system maintenance including hydraulic reservoir refer to OPERATOR'S MANUAL.

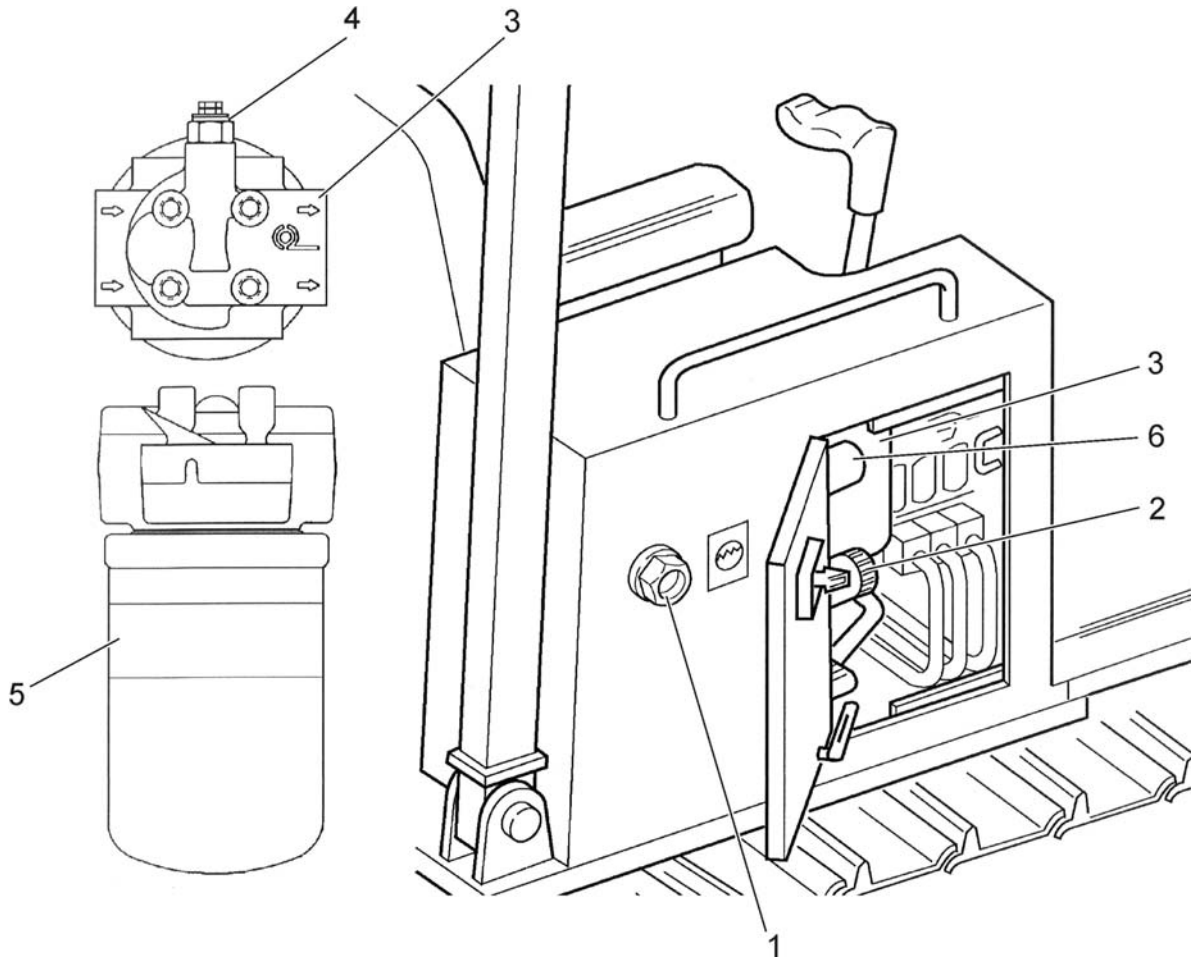


Fig. 10E.1 Reservoir and Return Filter

1. Sight Level Gauge
2. Oil Filler Cap
3. Return Filter
4. Service Indicator
5. Return Filter Element
6. Reservoir Breather

HYDRAULIC RESERVOIR

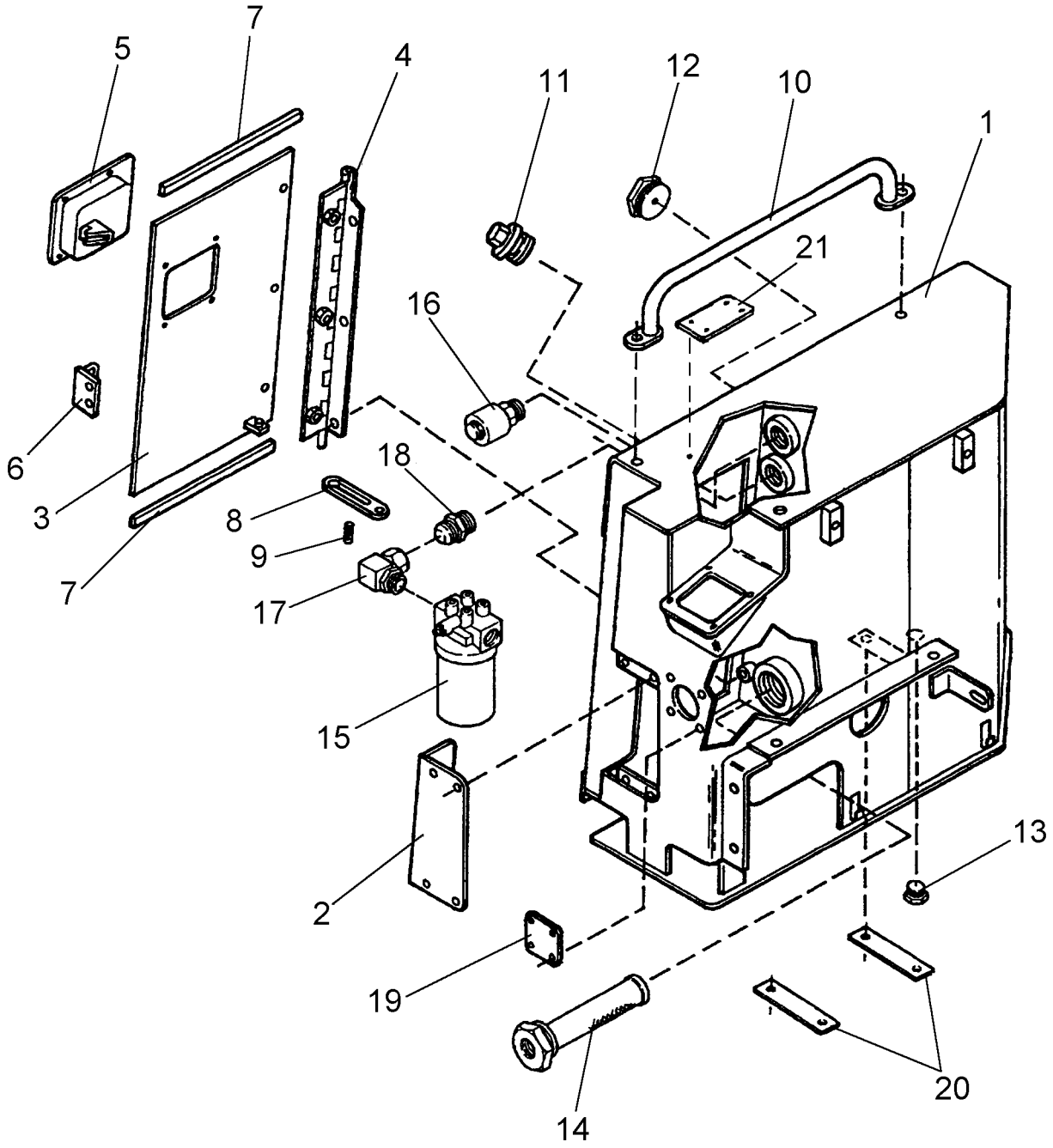


Fig. 10A.2. Exploded View of Equipment Pump

1. Welded Tank
2. Cover Assy
3. Reservoir Door
4. Door Hinge
5. Door Latch
6. Striker Weld
7. Door Seal
8. Door Latch Link
9. Spring
10. Handle
11. Plug
12. Sight Gauge
13. Plug
14. Strainer Element
15. Filter Assy
16. Breather Valve Assy
17. Elbow
18. Connector
19. Cover Plate
20. Shim
21. Plate

RESERVOIR BREATHER

2. DESCRIPTION AND MAINTENACE

The vacuum relief valve will protect the pumps from cavitation as well as maintaining pressure in the reservoir. Refer to OPERATOR'S MANUAL for maintenance service of this breather valve.

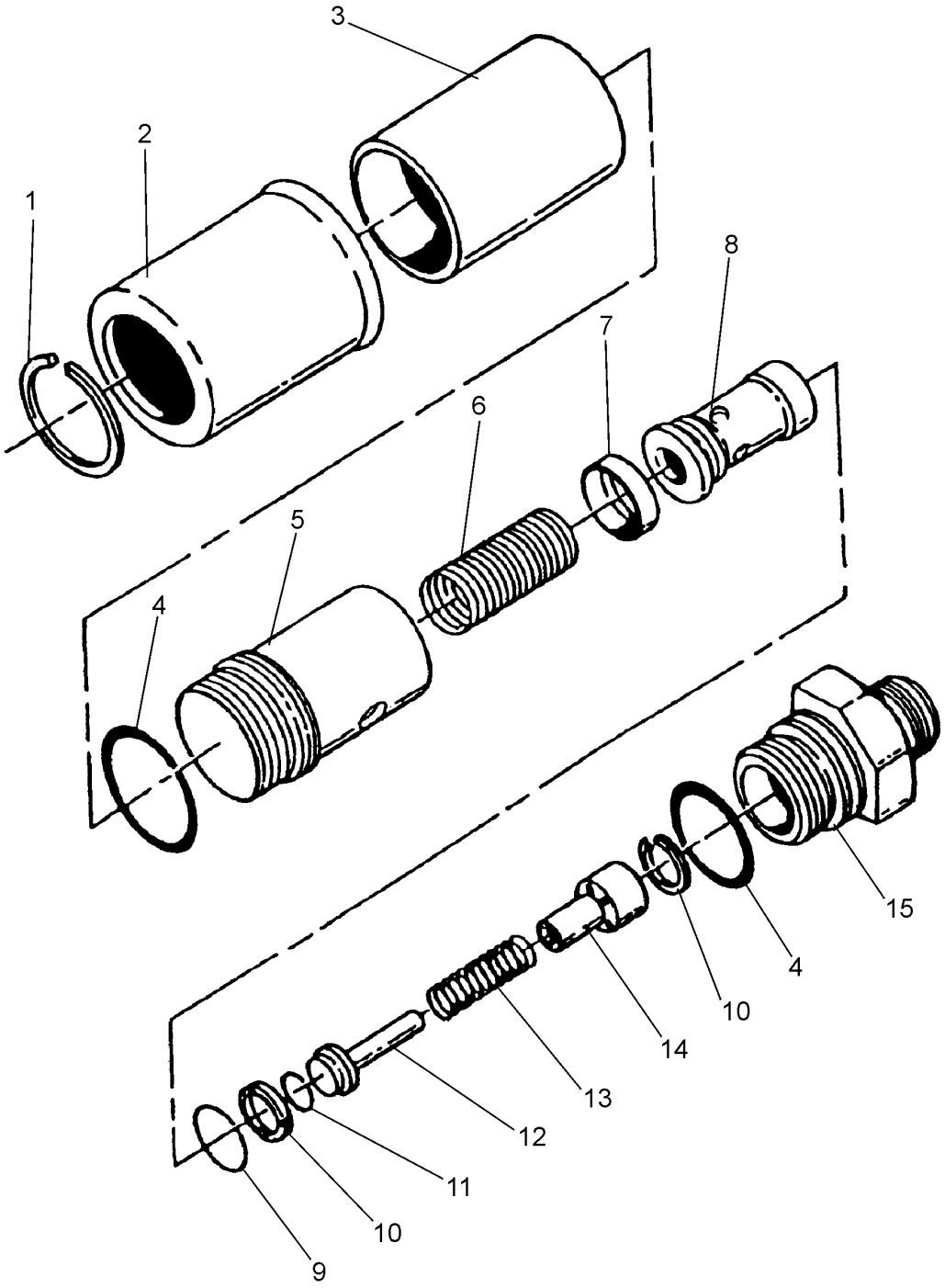


Fig. 10E.3. Exploded View of Reservoir Breather (Vacuum Pressure Relief Valve)

1. Retainer Ring
2. Cover
3. Ceramic Filter
4. Gasket
5. Cover
6. Spring
7. Retainer
8. Sleeve
9. O-Ring
10. Ring
11. O-Ring
12. Poppet
13. Poppet Spring
14. Poppet Guide
15. Valve Housing

SECTION 12

POWER

POWER

SECTION 12

CONTENTS

1. DESCRIPTION 3
2. SPECIFICATION 3
3. AIR INDUCTION SYSTEM TEST 4
4. ENGINE CONTROLS ADJUSTMENTS 5
5. REMOVAL 10
6. ENGINE REPAIR 15
7. INSTALLATION 15

1. SERVICE/SPECIAL TOOLS

DESCRIPTION	TOOL NUMBER
Torque Converter Lifting Eyebolt	M10
Engine Barring Tool	3824591

2. DESCRIPTION

The machines are powered by CUMMINS engine four cylinders, turbocharged (naturally aspirated in case of TD-7M), and they meet Tier 2 (Stage II) emission regulation for nonroad diesel engines. These engines are a high speed, four cycle, two valves in cylinder type, using a 12 [V] direct starting system. For the TD-7M, TD-8M and TD-9M there are the B4.5 series, mechanically controlled, equipped with DELPHI pump and direct injection fuel system. The TD-10M machine has QSB 4.5 series engine with electronically controlled BOSCH pump with direct injection fuel system.

3. SPECIFICATIONS

Special Bolt and Nut Torque Data

Air cleaner hose clamps	10 - 12 [Nm]
Air precleaner mounting clamp	14 - 20 [Nm]
Battery terminals	34 - 42 [Nm]
Engine to frame mounting bolts	410 - 500 [Nm]
Torque converter or main clutch to flywheel housing mounting bolts	40 - 45 [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 (Fig. 12.1)

1. Remove the end cover from the air cleaner.
2. Remove both filter elements from the air cleaner. Using duct tape, mask the outside diameter of the safety (small) element. Sealing must be air tight. Reinstall the tapped element only and cover.

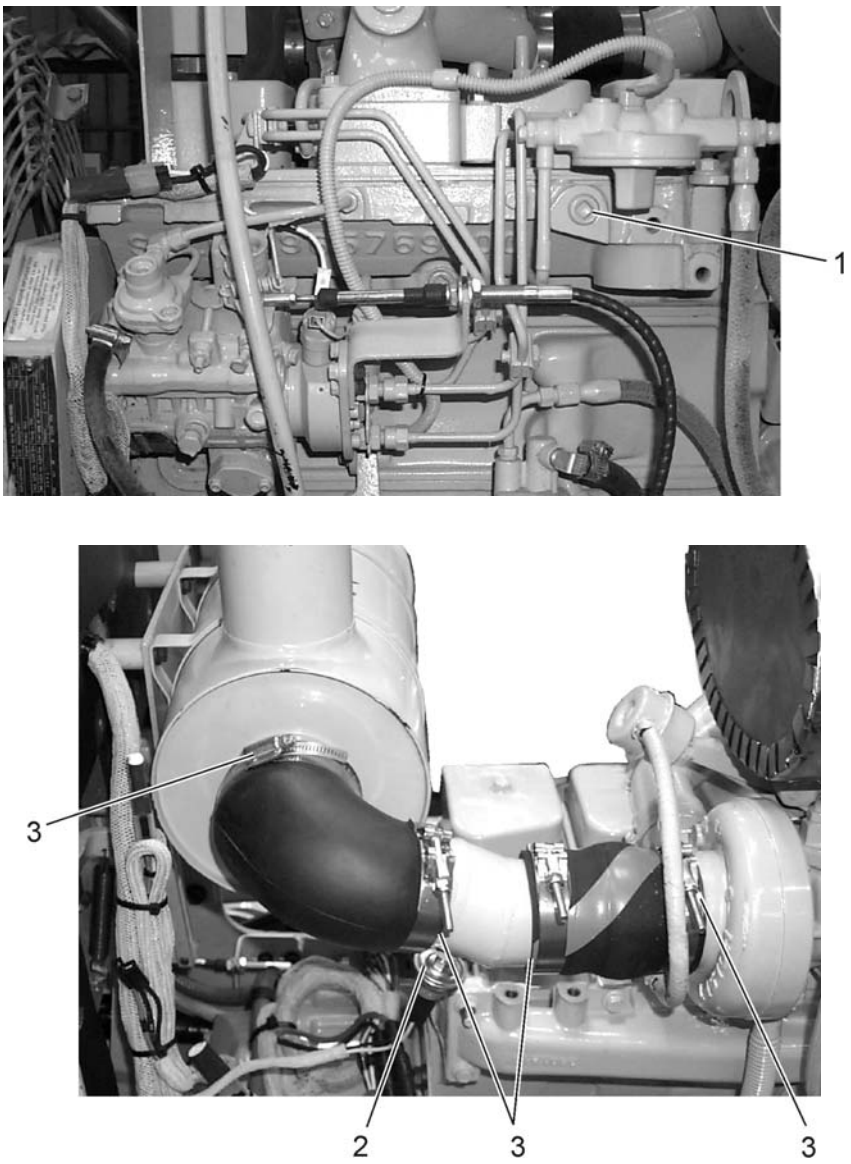


Fig. 12.1. Air Induction System Check Points

1. Plug 1/2 NPTF 2. Air Filter Warning Light Switch 3. Check Points

3. Remove the air filter warning light switch (2) at the air cleaner. Tee in a 0 to 100 [kPa] pressure gauge.
4. Remove plug (1) from the cylinder head. Connect a manually regulated compressed air supply.
5. Adjust the air regulator until the pressure gauge reads 20 [kPa]. If pressure cannot be achieved, it may be necessary to turn the engine crankshaft over slightly until a minimum leakage occurs past the engine valves.

6. Using a soap solution and paint brush, coat the following check points (3) and check for leaks:
   a. Air cleaner body surfaces adjacent to the outlet tube connections.
   b. Air crossover tube connection to intake manifold.
   c. All clamped hose connections between air cleaner outlet, including connections at turbocharger to intake manifold flange.
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.

4. ENGINE CONTROL 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 control lock lever is "ON" and parking brake is set and the brake pedal locked in applied position.

General

NOTE: *Engine 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, control cables, 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 engine shield (LH) and floor plate in operator's compartment.
2. Check that nuts (2, Fig. 12.3) securing cables (3) to the brackets (4) are not loosen.
3. Check that brake pedal return spring (1, Fig 12.2), decelerator pedal return spring (2) and decelerator override rod (spring) (3), are in position and are functional. Also check the override rods (4 and 5). Check the springs are not damaged or weakened.
4. Check that the control lever (1, Fig. 12.3) will move smoothly from LO to HI and LO position and has no resistance nor jam.

NOTE: *Engine control lever mechanism assy (5) has a spring set mechanism (catch) maintaining lever (1) in the HI position. The lever is remain in HI position when the decelerator pedal is applied as well. The force needed to overcome of the catch should be ca. 40 – 50 [Nm]. If necessary remove plug (6) and check the inner spring of catch for cracks.*
Two belleville springs mounted inside maintain lever (1) in intermediate positions.

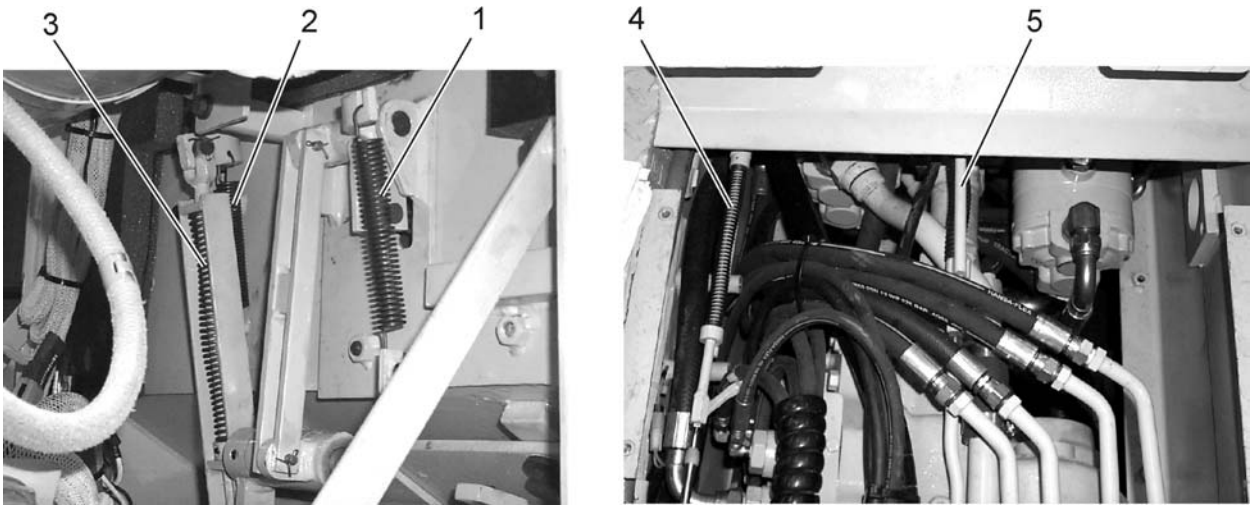


Fig. 12.2 Engine and Brake Control System Springs and Rods

1. Brake Pedal Return Spring
2. Decelerator Pedal Return Spring
3. Decelerator Override Rod
4. Engine Control Override Rod
5. Brake Pedal Override Rod

Engine control lever adjustments (refer to Fig. 12.3)

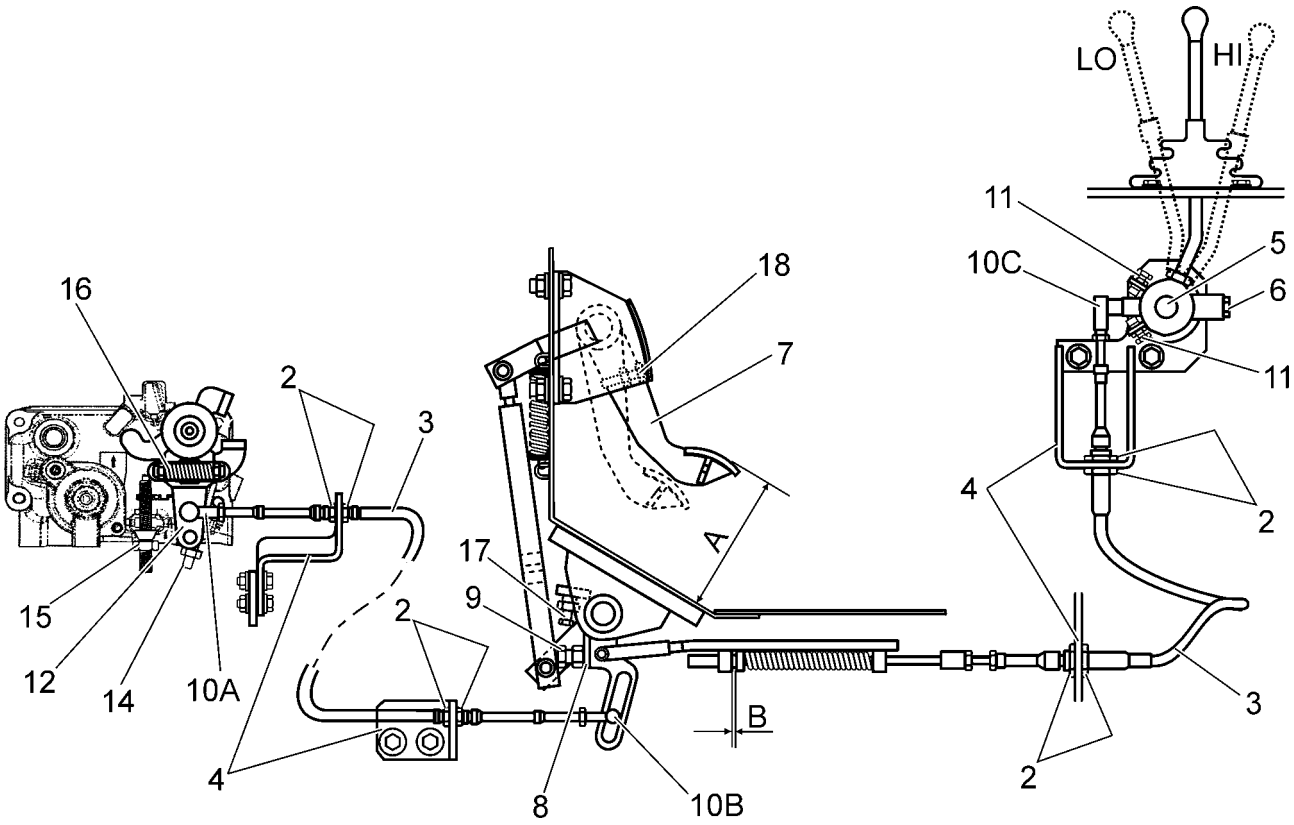
Engine Not Running

TD-7M, TD-8M and TD-9M

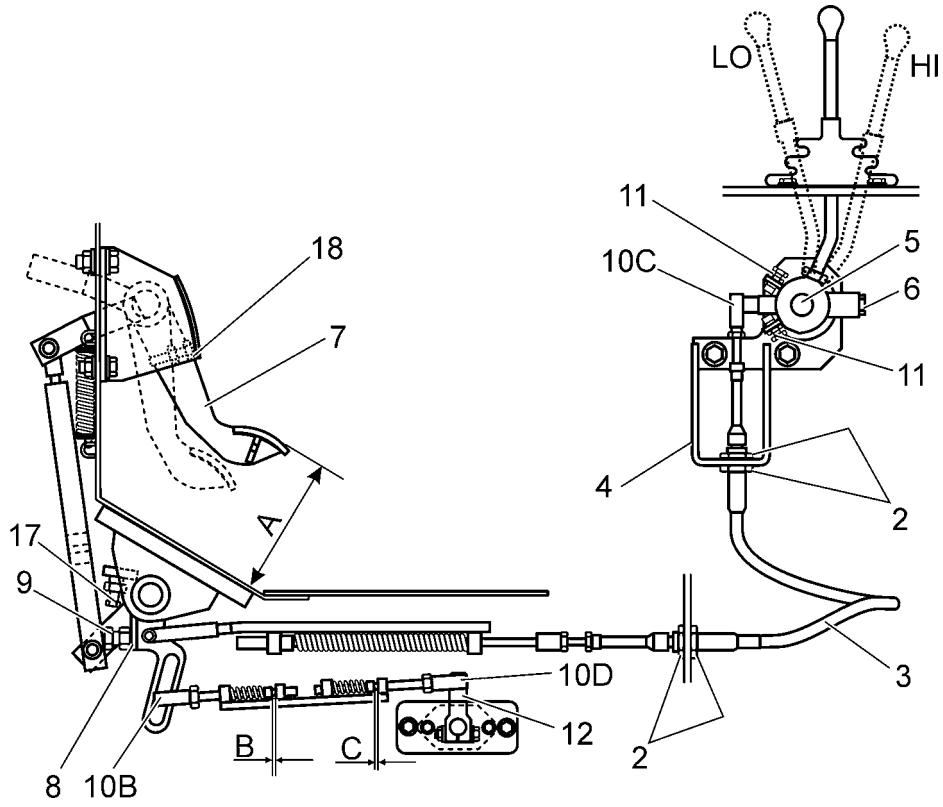
1. Disconnect ball joint (10A and 10C) from the lever.
2. Use bolts (11) to adjust the lever (1) movement in LO and HI positions.
3. Use bolt (18) to check and adjust decelerator pedal (7) in high (A) position.
4. Use bolt (9) to adjust lever arm (8) in vertical.
5. Move lever (1) to position LO, adjust cable (3) in the bracket (4) with nuts (2) if necessary and install ball joint (10C).
6. Adjust ball joint (10A) to align with hole of the fuel pump lever (12).
7. Move lever (1) to position HI. Shift fuel pump lever (12) to contact with engine high speed stop bolt (15). Ball joint (10A) is to be on the right of the hole of the fuel pump lever (12), so the spring (16) is lightly under tension after ball joint mounting.
8. Install ball join (10A) to the fuel pump lever (12).
9. If requirement of item 7 can not be met, change ball joint (10B) position.

TD-10M (mechanical parts)

1. Disconnect ball joint (10C and 10D) from the lever.
2. Use bolts (11) to adjust the lever (1) movement in LO and HI positions.
3. Use bolt (18) to check and adjust decelerator pedal (7) in high (A) position.
4. Use bolt (9) to adjust lever arm (8) in vertical.
5. Move lever (1) to position LO, adjust cable (3) in the bracket (4) with nuts (2) if necessary and install ball joint (10C).
6. Adjust the ball joint (10D) so the mounting bolt is not in alignment with lever hole (longer some 2 to 3 [mm]). Install ball joint (10D) to potentiometer lever (13) in HI position.
7. Shift the lever (1) into LO and HI position; check the gap B and C width which is to range from to 2 to 3 [mm]. If this requirement cannot be met, change ball joint (10B) position.



TD-7M, TD-8M, TD-9M Engine Control System



TD-10M Engine Control System

Fig. 12.3. Engine and Decelerator Pedal Controls

Legend for Fig. 12.3

1. Engine Control Lever
2. Lock Nut
3. Engine Control Cable
4. Bracket
5. Friction Mechanism Assy
6. Plug
7. Decelerator Pedal
8. Lever
9. Adjusting Bolt
10A. Ball Joint with Lock Nut
10B. Ball Joint with Lock Nut
10C. Ball Joint with Lock Nut
10D. Ball Joint with Lock Nut
11. Adjusting Bolt
12. Fuel Injection Pump Lever
13. Potentiometer Control Lever
14. Stop Bolt Low Idle
15. Stop Bolt High Idle
16. Fuel Pump Override Spring
17. Adjusting Bolt
18. Adjusting Bolt
A. Brake Pedal High 147 [mm
B. Gap 2 - 3 [mm]
C. Gap 2 - 3 [mm]

Brake pedal adjustment

For brake pedal adjustment procedure refer to Section 4 BRAKES.

With Engine Running

1. Start the engine. With control lever (1) in the rearmost position “HI”, make sure that engine is running at designated high idle speed in the machine:
   TD-7M 2610 - 2810 [RPM],
   TD-8M 2290 - 2490 [RPM],
   TD-9M 2290 - 2490 [RPM],
   TD-10M 2610 - 2810 [RPM].

2. With control lever (1) in the forward position “LO”, make sure that engine is running at designated low idle speed 900 - 950 [RPM] for all machines.

NOTE: *Machines with direct driving system (DD) low idle speed 1050 – 1150 [RPM].*

NOTE: *If specified speed cannot be reached by the rods adjustment, contact with Authorized Service of Construction Machines.*

Decelerator pedal adjustment

1. Place control lever (1) in “HI” position. Depress decelerator pedal (7), check if the specified decelerated engine speed is obtained 1200 - 1300 [RPM]. Adjust decelerator pedal (7) with adjusting bolt (17) if required. Stop the engine.

NOTE: *Force to depress decelerator pedal (7) should be 63 to 77 [N].*

TD 10M ENGINE CONTROL POTENTIOMETER CIRCUIT CHECK-IN (Fig. 12.4)

Engine not Running

General

NOTE: *When making engine connection test, the starting switch MUST be in the „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 will result. This fault code will derate the engine and will require resetting the ECM by a Cummins Authorized Service.*

Before performing the potentiometer circuit check, turn the key to the "ON" position. Check that there are not throttle position sensor fault code(s) (refer to Diagnostic Fault Codes in Operation and Maintenance Manual). Inspect visually wire harness and connectors for damage, or loose connection.

1. Disconnect 50 pin connector (1) from the ECM. Dry connector using electrical contact cleaner P/N 3824510.
2. Inspect the electrical harnesses are not damaged and the connectors pins are not corroded, bent or broken, pushed back or expanded.
3. Use the typical ohmmeter to measure if the resistances between potentiometer circuit wires (3) to 50 pin connector (1) are as follows (refer to wiring diagram):

   - from pin No. 29 to pin No. 19 - 2000 to 3000 [Ω]
   - from the power supply and the signal:
   - from pin No. 19 to pin No. 30 control lever position - low [RPM] 1500 to 3000 [Ω]
   - from pin No. 19 to pin No. 30 control lever position - high [RPM] 250 to 1500 [Ω]
   - from pin No. 19 to engine block ground – more than 100K [Ω]
   - from pin No. 29 and 30 to all pins of 50 pin connectors – more than 100K [Ω]

4. If the resistance values are not within the specification the potentiometer or wire harness has failed. Replace the potentiometer, repair or replace wire harness.
5. Before connector (1) reconnect, 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.*

After checking has been performed, machine must be checked out in actual operation for proper functioning.

NOTE: *If potentiometer is changed or after the calibration has been downloaded, move the engine control lever(1, Fig. 12.3) (key turned to ON) thought out its complete travel range 3 times. This procedure calibrates the new potentiometer with the ECM.*

NOTE: *If designated engine speeds are not achieved contact witch Authorized Cummins Service.*

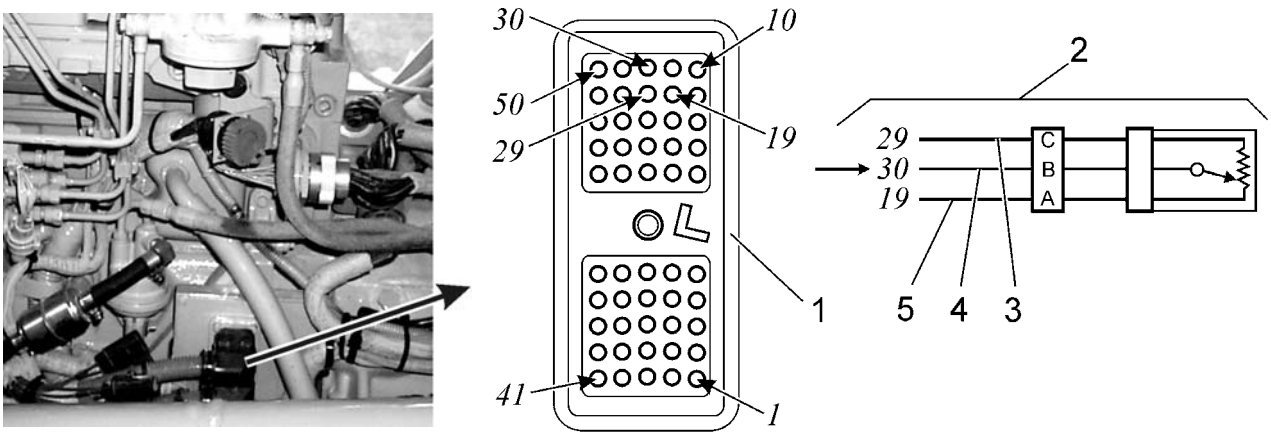


Fig. 12.4. Engine Control Interface Connector

1. 50 Pin Connector (view of harness connector)
2. Potentiometer Circuit
3. Pin No 29 + 5VDC Supply
4. Pin No 30 Signal
5. Pin No 19 Return

5. REMOVAL

1. Position the machine in a place which makes it possible to use lifting device for removing 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, the drive train lock control lever is locked 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.

2. Remove cab assy as described in Section 13 "CAB" items 3 to 12.
3. Disassemble engine radiator assy as described in Section 6 "COOLING SYSTEM" items 3 to 16 without items 8, 15 and 17.
4. Disconnect wire from the air filter warning light switch (2, Fig. 12.1).
5. Disconnect the ground cable (6, Fig. 12.5) from the frame.
6. Disconnect wire harness plug (5).
7. Disconnect electrical cables connectors (4) (positive and ground).
8. Remove electrical relays assy with the wires from the bracket (2).
9. Disconnect cab heater hoses (7, Fig. 12.5) and (7, Fig. 12.7).
10. Loosen the clamps (8, Fig. 12.5) and remove air intake tube assy (9).

IMPORTANT: *Cap the air filter and turbocharger openings with the correct size plastic cap or tape.*

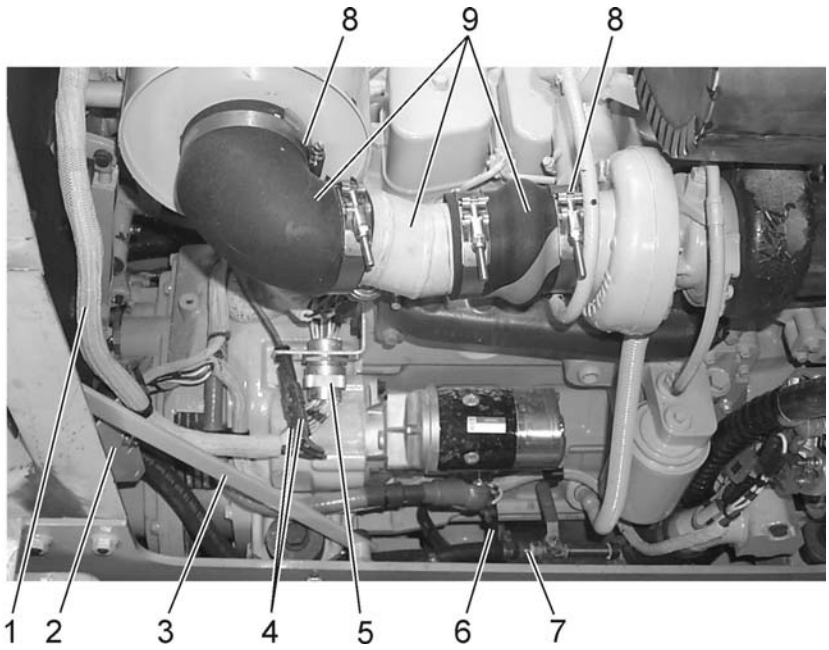


Fig. 12.5. Engine Disassembly Points (RH Side)

1. Wire Harness
2. Electrical Relays Assy Bracket
3. Mounting Bar
4. Positive and Ground Cable Connectors
5. Wire Harness Plug
6. Ground Cable
7. Cab Heater Hose (return)
8. Clamps
9. Air Intake Tube Assy

11. Remove bar (3, Fig. 12.5) on both sides of the dash board.
12. Remove fuel filter head (6, Fig. 12.7) from the dash board and attach it to the engine.
13. Remove cab floor plate. Remove ball joint (1 or 5, Fig. 12.6) and clevis (7, Fig. 12.6) from the control lever.
14. Remove brake system control rod (3, Fig. 12.6) from the lever.

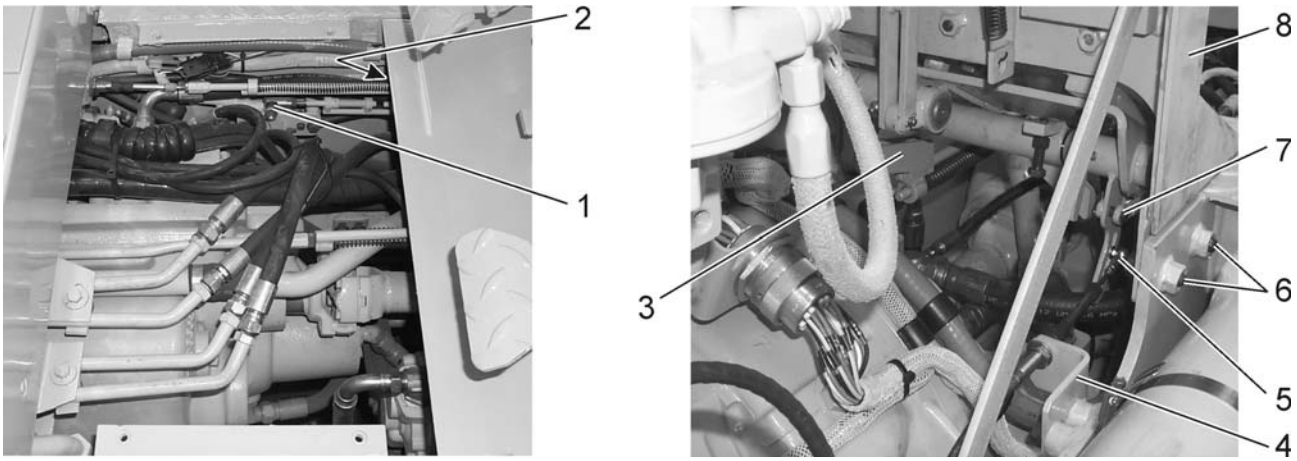
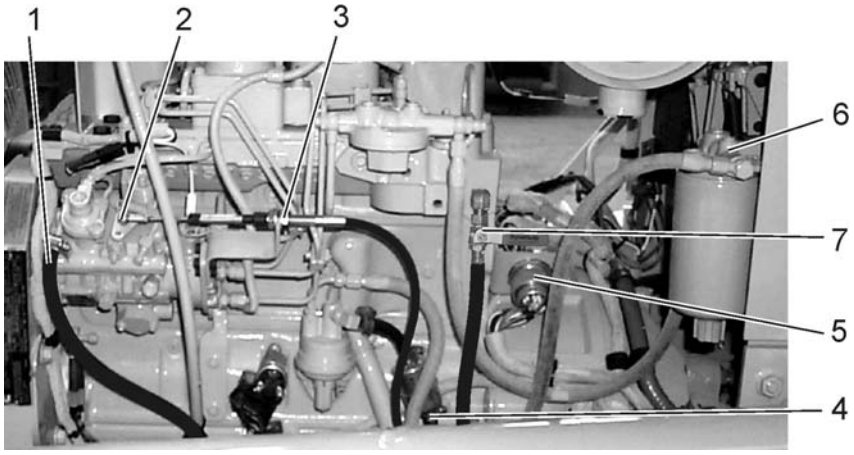
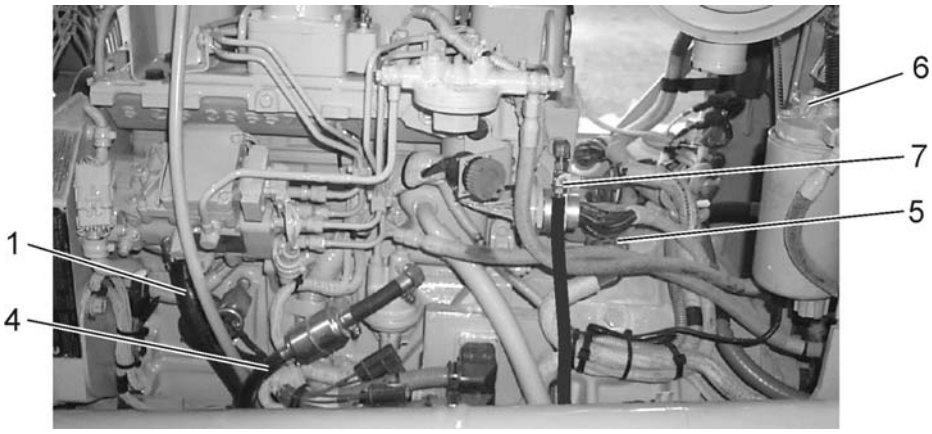


Fig. 12.6. Dash Board Disassembly Points (RH Side)

1. Ball Joint (TD-10M)
2. Dash Board Mounting Bolt
3. Brake Control Rod
4. Control Cable Bracket
5. Bal Joint (TD-7M, TD-8M, TD-9M)
6. Dash Board Mounting Bolts
7. Clevis
8. Dash Board



TD-7M, TD-8M, TD-9M



TD-10M

Fig. 12.7. Engine Disassembly Points (LH Side)

1. Fuel Hose (drain)
2. Ball Joint (TD-7M, TD-8M, TD-9M)
3. Nut
4. Fuel Hose (supply)
5. Wire Harness Plug
6. Fuel Filter Head
7. Cab Heater Hose (supply)

15. Remove bolts (2 and 6, Fig. 12.6) (on both sides) securing the dash board (8) to frame. Remove dash board to get access to the torque converter connection. Use lifting device.
16. MACHINES EQUIPPED WITH AIR CONDITIONER: Disconnect the wire from the magnetic clutch of the A/C compressor. Remove A/C compressor with attached hoses from the bracket and secure them out of the frame.
17. Close the valve under the fuel tank, remove fuel hoses (1 and 4, Fig. 12.7).

IMPORTANT: *Disconnected fuel lines must be capped with the correct size plastic cap, tape or clean rubber corks.*

18. Disconnect wire harness plug (5).
19. Remove ball joint (2), loosen nut (3) and remove control cable from the bracket. Remove bracket (4, Fig. 12.6) with the cable from the frame.

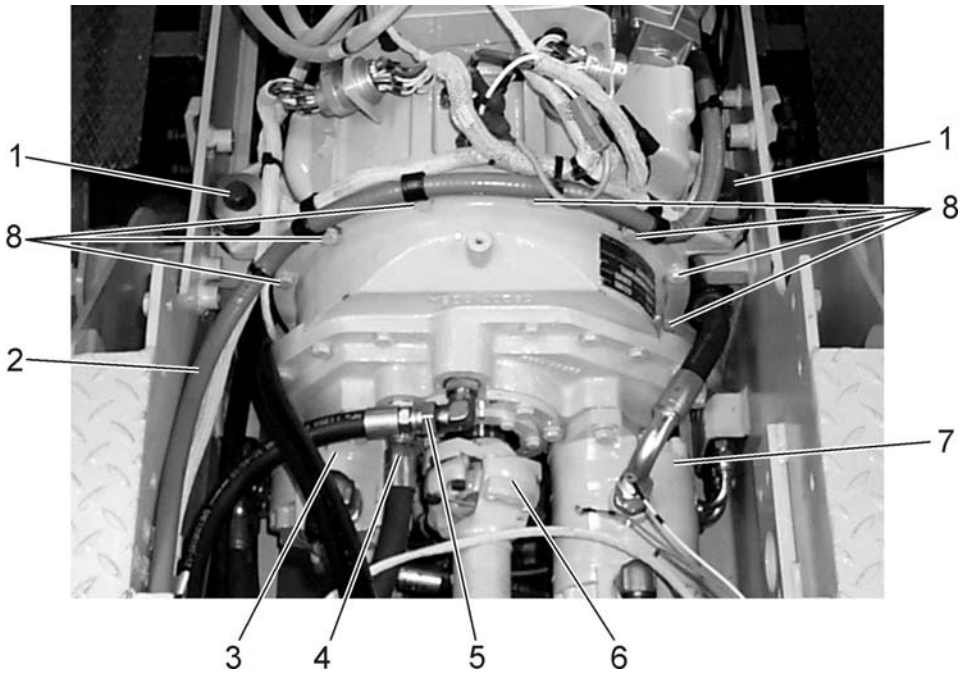


Fig. 12.8. Torque Converter Disconnecting Points (top view)

1. Engine Mounting Bolt (rear)
2. Cranking Motor Supply Cable
3. Equipment System Pump
4. Torque Converter Hydraulic Hose (inlet)
5. Torque Converter Drain Hose
6. Drive Shaft
7. Charge and Scavenge Pump (drive train)
8. Torque Converter to Engine Mounting Bolts

20. Remove cranking motor cable (2, Fig.12.8) (positive) from the battery terminal and attach it to the engine.
21. Remove torque converter drain hose (5).
22. Remove torque converter inlet hose (4).

IMPORTANT: *Disconnected hydraulic 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 openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Also tag all disconnected lines and wires for easier installation.*

23. Working under machine, remove transmission guard to get access to the torque converter compartment from the bottom.
24. Remove torque converter tube (1, Fig. 12.9).
25. Remove wire from the temperature sensor (2).
26. Remove bolts and separate equipment system pump (3, Fig. 12.8) from the torque converter. Wire the pump.
27. Remove bolts and separate charge and scavenge pump system pump (7) from the torque converter. Wire the pump.
28. Remove bolts securing drive shaft (6) to the output yoke of torque converter. Secure the drive shaft with wire.
29. Remove bolts (1) securing rear engine bracket to the frame.
30. Remove bolts securing front engine bracket to the frame (on both side of engine).

NOTE: *Remove fan drive belt and swing belt tensioner arm out and away to gain better access to the bolt mounting the front engine bracket to the frame.*

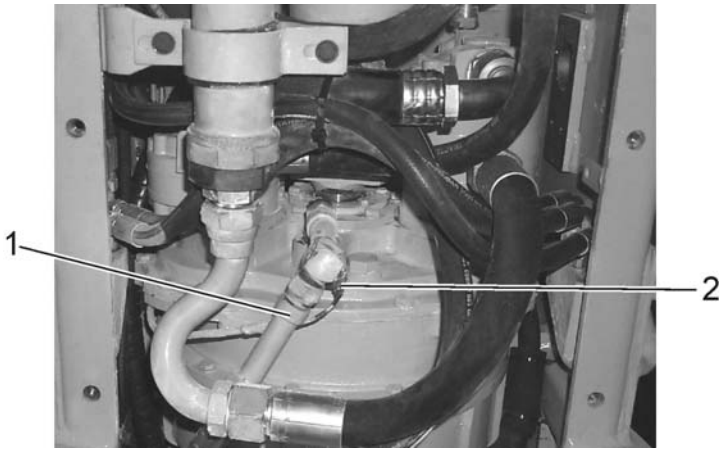


Fig. 12.9. Torque Converter Disconnecting Points (bottom view)

1. Torque Converter Tube (outlet) 2. Temperature Sensor

31. Install an engine lifting attachment to engine lifting brackets (1, Fig. 12.10). Make a visual inspection around engine and torque converter to be sure that all disconnects required for engine removal have been made. Lift the engine with torque converter assembly.

WARNING! The wet weight of the engine with torque converter is 450 [kg]. The engine lifting equipment must be designed to safely lift the engine.

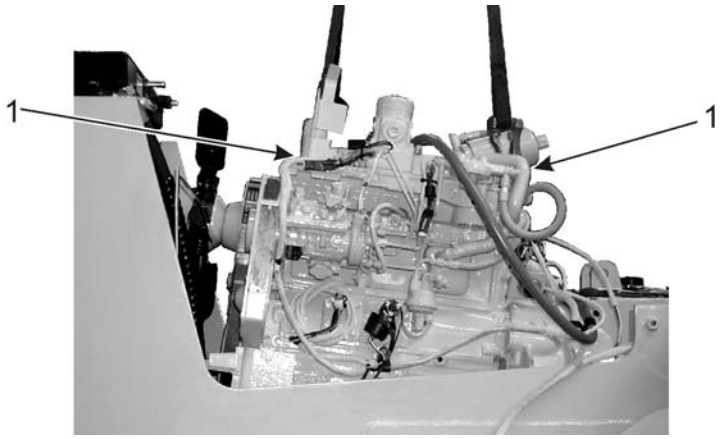


Fig. 12.10. Engine Assy Lifting (TD-8M)

1. Lifting Brackets

NOTE: *After engine is removed from machine, it should be placed on a prepared engine support stand.*

32. Position engine in to the suitable engine support stand.

NOTE: *MACHINES EQUIPPED WITH TORQUE CONVERTER: torque converter coupling disc is bolted to the flywheel thru the special opening in the flywheel housing. Remove coupling disc mounting bolts before torque converter removing. Refer to: TORQUE CONVERTER Section 7B.*

33. Install an M10 eye bolt to the torque converter or main clutch. Remove bolts (8, Fig. 12.8) and separate torque converter or main clutch from the engine.

6. ENGINE REPAIR

For detailed information pertaining to maintenance or engine repair, refer to: for the machines TD-7M, TD-8M and TD-9M – Operation and Maintenance Manual Industrial B3.9, B4.5 and B5.9 Series Engines Bulletin No. 4021389, B Series Shop Manual Bulletin No. 3666017 and Troubleshooting and Repair Manual B Series Bulletin No. 3666087, for the machine TD-10M - Operation and Maintenance Manual Industrial QSB3.9-30, QSB4.5-30 and QSB5.9-30 Series Engines Bulletin No 4021388, and Troubleshooting and Repair Manual Industrial QSB3.9-30, QSB4.5-30 and QSB5.9-30 Series Engines Bulletin No 4021398 also in Troubleshooting and Repair Manual Electronic Control System ISB and QSB5.9-30 Engines.

7. INSTALLATION

NOTE: *Check rubber shock absorbers in front and rear, replace if cracked or worn before engine mounting.*

1. Insert two M10 aligning studs in flywheel housing holes.
2. Install new sealing ring in the torque converter housing groove.
3. Install a lifting attachment to the torque converter lifting eye. Assemble torque converter to the flywheel housing of engine with bolts (8, Fig. 12.8). Torque mounting bolts to 180 – 200 [Nm].

NOTE: MACHINES EQUIPPED WITH TORQUE CONVERTER: *bolt torque converter coupling disc to the flywheel with the bolts thru the special hole in the flywheel housing after torque converter to the flywheel housing is mounted. Refer to: TORQUE CONVERTER Section 7B*.

WARNING! The wet weight of engine with torque converter is 450 kg. The engine lifting equipment must be designed to safely lift the engine.

4. Insert engine mounting bolts (1, Fig. 12.8) in rear and front to the holes of the engine brackets.
5. Install an engine lifting attachment to the lifting bracket (1, Fig. 12.10). Hoist and guide the engine above frame. Insert engine mounting bolts in the threaded holes and tighten by hand. Lower the engine on the frame supports, and torque mounting bolts. Torque rear engine mounting bolts to 410 – 500 [Nm]. Remove the engine lifting attachment.
6. Reinstall drive shaft (6, Fig. 12.8) to the output yoke of torque converter with the bolts.
7. Reinstall charge and scavenge pump system pump (7) to the torque converter with the bolts. Use a new O-ring.
8. Reinstall equipment system pump (3) to the torque converter with the bolts. Use a new O-ring.
9. Reconnect wire to the temperature sensor (2, Fig. 12.9).
10. Reinstall tube (1) to the torque converter.
11. Reinstall hose (4, Fig 12.8) to the torque converter.
12. Reinstall hose (5) to the torque converter.
13. Route cranking motor cable (2, Fig. 12.8) (positive) to the battery compartment. Reinstall cable to the battery terminal.
14. Reinstall bracket (4, Fig. 12.6) with the cable to the frame. Reinstall control cable to the bracket, tighten nut (3, Fig. 12.7). Reinstall bal joint (2) to the fuel injection pump lever.
15. Reconnect wire harness plug (5).
16. Reinstall fuel hoses (1 and 4). Open the valve under the fuel tank.

17. MACHINES EQUIPPED WITH AIR CONDITIONER: Reassemble A/C compressor to the bracket. Connect the wire to the magnetic clutch of the A/C compressor. Adjust correct belt tension. Refer to Operator's Manual.
18. Use lifting device and position dash board (8, Fig 12.6) on the frame. Reinstall bolts (2 and 6) (on both sides) securing the dash board to frame.
19. Reinstall brake system control rod (3) to the lever.
20. Reinstall ball joint (1 or 5) and clevis (7) to the lever.
21. Reinstall fuel filter head (6, Fig. 12.7) to the dash board.
22. Reinstall bar (3, Fig. 12.5) on both sides of the dash board.
23. Reinstall air intake tube assy (9, Fig. 12.5), tighten the clamps (8).
24. Reassemble cab heater hoses (7, Fig. 12.5) and (7, Fig. 12.7).
25. Reinstall electrical relays assy with the wires to the bracket (2, Fig. 12.5).
26. Reconnect electrical cables connectors (4) (positive and ground).
27. Reconnect wire harness plug (5).
28. Reconnect the ground cable (6) to the frame.
29. Reconnect wire to the air filter warning light switch (2, Fig. 12.1).
30. Reassemble engine radiator assy as described in Section 6 "COOLING SYSTEM" item 6 to 21.
31. Start the engine and check all disconnected previously lines for leakage.

NOTE: *Venting procedure of engine fuel system may be required if engine fails to start. Refer to Operator's Manual.*

32. Reassemble cab assy as described in Section 13 "CAB" items 1 to 8.
33. Working under machine, install transmission guard.
34. Perform adjustments as described in Par. 4, "ENGINE CONTROL ADJUSTMENTS" if necessary.
35. Reassemble the floor plate in the cab.

SECTION 13

SUPERSTRUCTURE

SUPERSTRUCTURE

SECTION 13

CONTENTS

1. DESCRIPTION 3
2. SPECIFICATION 3
3. CAB REMOVAL 3
4. INSPECTION 6
5. CAB REASSEMBLY 6

1. DESCRIPTION

The TD-7M, TD-8M, TD-9M and TD-10M dozers are equipped with structure ROPS/FOBS canopy or 6-sided, 2-door ROPS/FOBS cab symmetrically located on the machine. The ROPS and ROPS cab are installed to the left and right fenders with the bolts and shock absorber at four points. The fenders are mounted to the rear frame with the bolts.

The operator's compartment is fully protected by structure ROPS/FOBS or ROPS/FOBS cab (the structure protecting against rolling over of machine and falling rocks).

The structure ROPS and cab are easy removable for transport if required.

2. SPECIFICATION

Special Torque Data:
Battery Terminals . . . . . 31 [Nm]
ROPS or Cab to Fenders Mounting Bolts. . . . . 770 - 865 [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 lock control lever is locked 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. MACHINES EQUIPPED WITH A/C SYSTEM: Remove bolts and clips (1, Fig. 13.1) securing A/C system hoses to the cab structure. Disconnect A/C system quick couplings (2) and protect them against dirt.
4. Remove the screws (1, Fig. 13. 2), Remove control panel (2) from the cover. Disconnect heater control rod from the cab heater actuator.
5. Unscrew bolts (3) and remove rear cover (4).
6. Disconnect cab wire harness plug (5).

NOTE: *Disconnected electrical harnesses plugs must be protected against dirt, oil, grease and water.*

SUPERSTRUCTURE

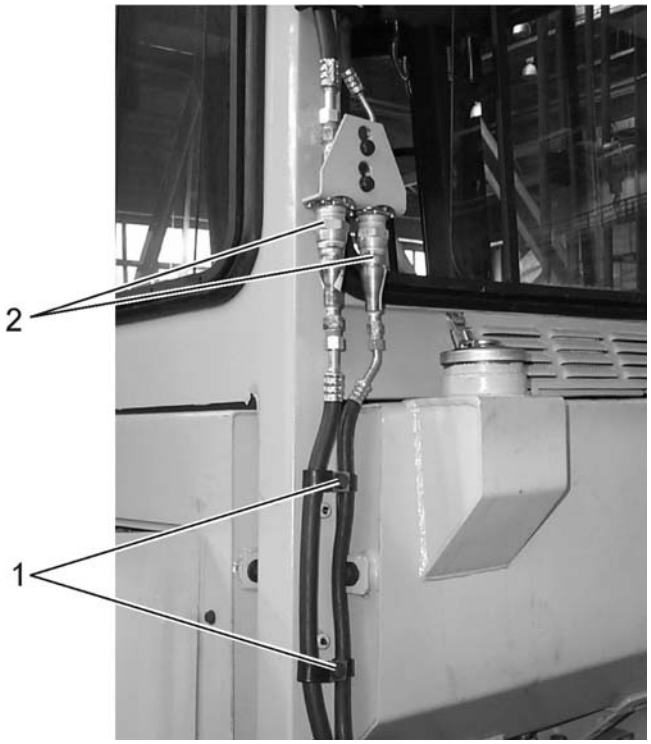


Fig. 13.1. A/C System Condenser Disconnecting Points

1. Bolts and Clips
2. A/C System Quick Couplings

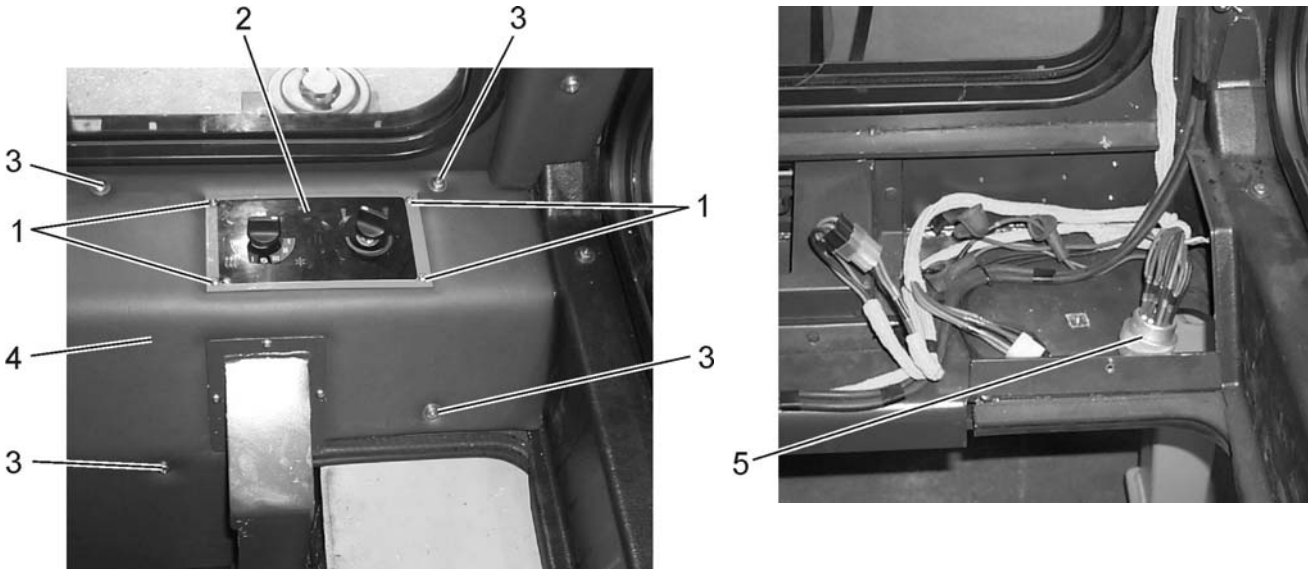


Fig. 13.2. Control System Disassembly Points

1. Screws
2. A/C Heater Control Panel
3. Bolts
4. Cab Rear Cover
5. Cab Wire Harness Plug

7. Attach the hoist to the cab lifting points (1, Fig. 13.3)
8. Remove the nuts (2, Fig. 13.4) and bolts (1) securing cab to the fenders in the rear.
9. Disconnect negative (-) and positive (+) cables from the battery terminals. Remove battery (3, Fig. 13.5) from the compartment.
10. Remove the nut and washer (2) and bolt (1) securing cab to the fender in front.



Fig. 13.3. Cab (RH side)

1. Lifting Points

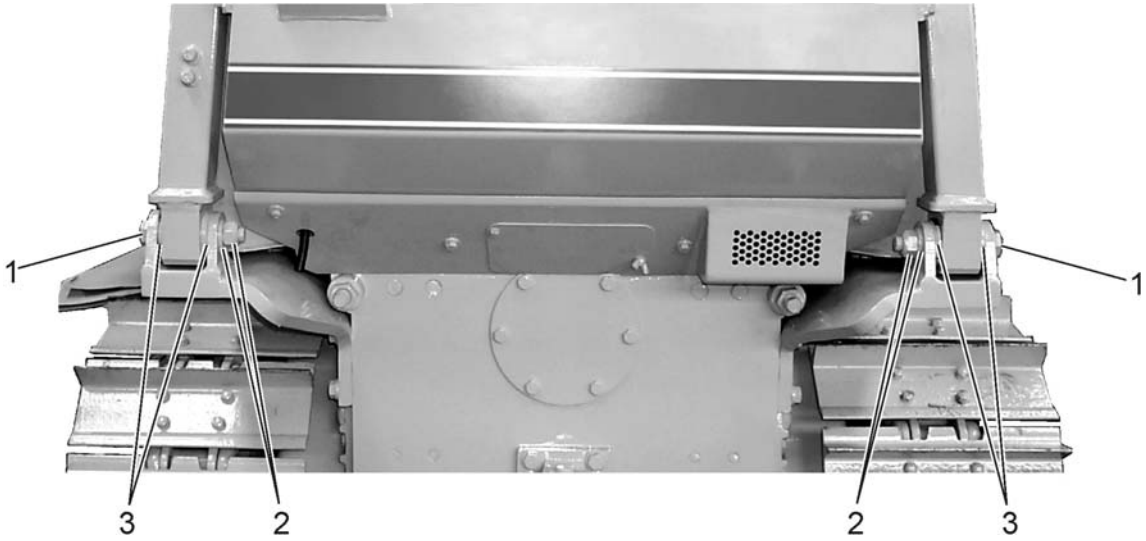


Fig. 13.4. Rear Suspension Points of Cab

1. Bolts
2. Nuts and Washers
3. Shims

11. Unscrew front bolt (4) and remove plate with thread (5).
12. Lift and remove the cab. Position cab assy in prepared stand.

NOTE: *Wire left and right shims (3, Fig. 13.4) to respective sides of the bracket for easy mounting. Do not change the shims due to different shim thickness.*

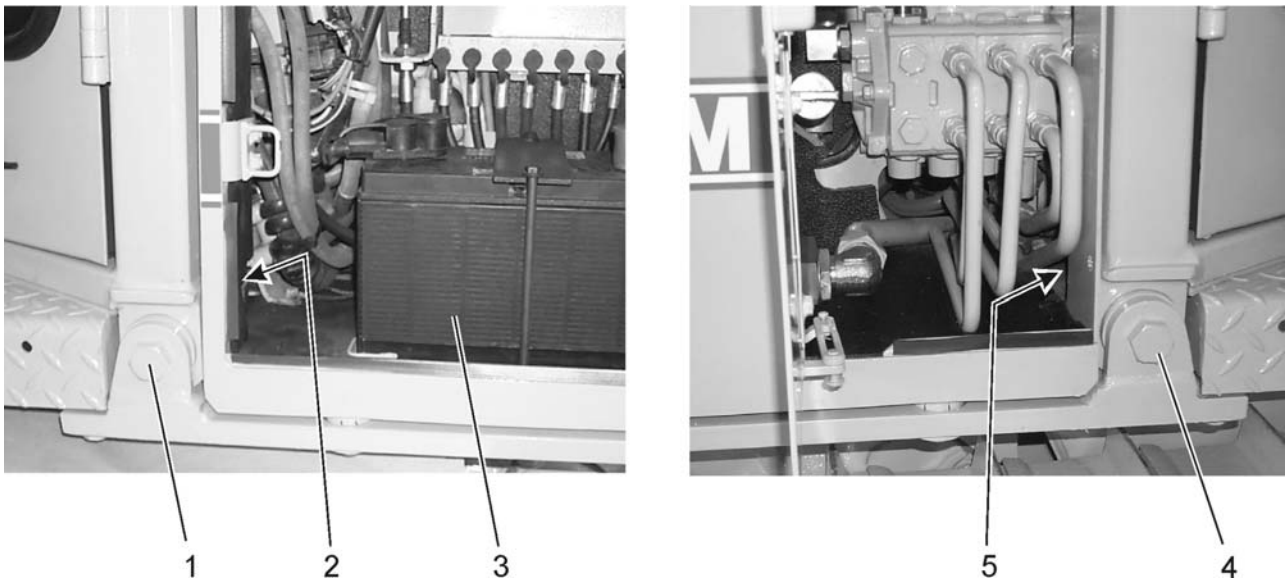


Fig. 13.5. Front Cab Mounting Points to Fenders (LH an RH side)

1. Bolt (LH)
2. Nut and Washer
3. Battery
4. Bolt (RH)
5. Plate with Thread

4. INSPECTION

1. Check the ROPS structure and cab for cracks.
2. Check and complete the lacking insulation's elements of cab.
3. Check and replace if necessary rubber shock absorbers (2, Fig. 13.6) of the cab.
4. Inspect the electrical harness and connection for damage and repair if necessary.

5. CAB REASSEMBLY

1. Attach the hoist to the cab lifting points (1, Fig. 13.3), position the cab on the fenders. Install bolts (1, Fig 13.4) and (1 and 4, Fig. 13.5). Install nut and washers (2, Fig. 13.4) and (2, Fig. 13.5). Install plate with thread (5). Tighten all bolts to 770 – 865 [Nm]. Remove hoist.

NOTE: *When positioning cab on the fenders check that left and right shims (1, Fig. 13.6) are on respective sides of the bracket.*

NOTE: *If the shims (1) have been worn or missing, replace for new ones proceed as follow:*

- *If the gap (A + B) is 3.5 – 4.5 [mm] use two shims P/N 776-13-1118*
- *If the gap (A + B) is 4.5 – 5.5 [mm] use shim P/N 776-13-1118 and shim P/N 776-13-1119*
- *If the gap (A + B) is 5.5 – 6.5 [mm] use two shims P/N 776-13-1119*

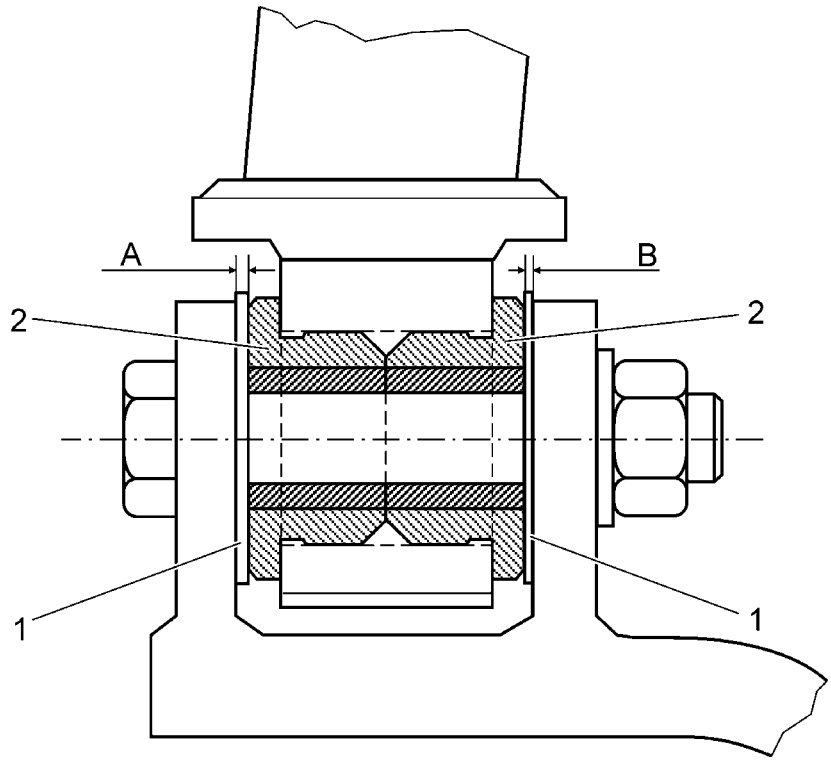


Fig. 13.6. Cab Mounting Point (cut view)

1. Shims
2. Rubber Shock Absorbers

3. Reconnect cab wire harness plug (5, Fig. 13.2).
4. Install rear cover (4) with the bolts (3).
5. Reconnect heater control rod to the cab heater actuator. Reinstall control panel (2) to the cover with screws (1).
6. Reinstall battery (3, Fig. 13.5) in the compartment. Reconnect positive (+) and negative (-) cables to the battery terminals.
7. MACHINES EQUIPPED WITH A/C SYSTEM: Reconnect A/C system quick couplings (2, Fig. 13.1). Install A/C system hoses to the cab structure with the bolts and clips (1).
8. Turn electrical master switch to „ON" position. Start the engine. Refer to Operator's Manual. Check the cab electrical systems, stop the engine.

SECTION 14

SUSPENSION

SUSPENSION

SECTION 14

CONTENTS

SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS 3

GENERAL

2. DESCRIPTION 3
3. SPECIFICATION 6
4. SERVICE DIAGNOSIS 9
5. CHECKING UNDERCARRIAGE WEAR 11

FRONT IDLER

6. REMOVAL 14
7. DISASSEMBLY 15
8. INSPECTION AND REPAIRS 21
9. REASSEMBLY 21
10. INSTALLATION 29

TRACK ADJUSTER

11. REMOVAL 35
12. DISASSEMBLY 36
13. INSPECTION AND REPAIRS 38
14. REASSEMBLY 39
15. INSTALLATION 40

TOP IDLER

16. REMOVAL 41
17. DISASSEMBLY 43
18. INSPECTION AND REPAIRS 48
19. REASSEMBLY 48
20. INSTALLATION 52

TRACK ROLLER

21. REMOVAL 53
22. DISASSEMBLY 55
23. INSPECTION AND REPAIRS 59
24. REASSEMBLY 62
25. INSTALLATION 66

METAL TYPE FACE SEALS

26. SEAL INSPECTION 67
27. SEAL INSTALLATION 68

TRACK FRAME

28. REMOVAL 69
29. INSTALLATION 71

TRACK SPRING

30. SPECIFICATIONS 71
31. REPLACEMENT 72

SECTION 14

SUSPENSION

EQUALIZER BAR

32. REMOVAL 81
33. INSTALLATION 83

PIVOT SHAFT

34. REPLACEMENT..... . 86

TRACK FRAME ALIGNMENT

35. TRACK FRAME ALIGNMENT 87

SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS

DESCRIPTION	TOOL NUMBER
Track Spring Kit	DR11-713
Containment Plate	DR11-713-1
Track Spring Bolt	DR11-713-2
Track Spring Bolt Nut (26 009 R1)	DR11-713-3
Ram Push Support	DR11-713-4
Push Rod	DR11-713-5
Bolt Collar	DR11-713-6
Track Spring Coffin	DR11-700-1
Pusher Plate	DR11-700-2
Spacer Bars	DR11-700-4
Spacer Bars	DR11-700-5

GENERAL

2. DESCRIPTION

Each track frame has five (TD-7M) or six (TD-8M, TD-9M or TD-10M) track rollers attached to it. 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 by the equalizer bar. The pivot shaft and equalizer bar are mounted in the main frame. A track adjuster and front idler 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. The top idler on each side is mounted in a bracket welded to the track frame.

SUSPENSION

GENERAL

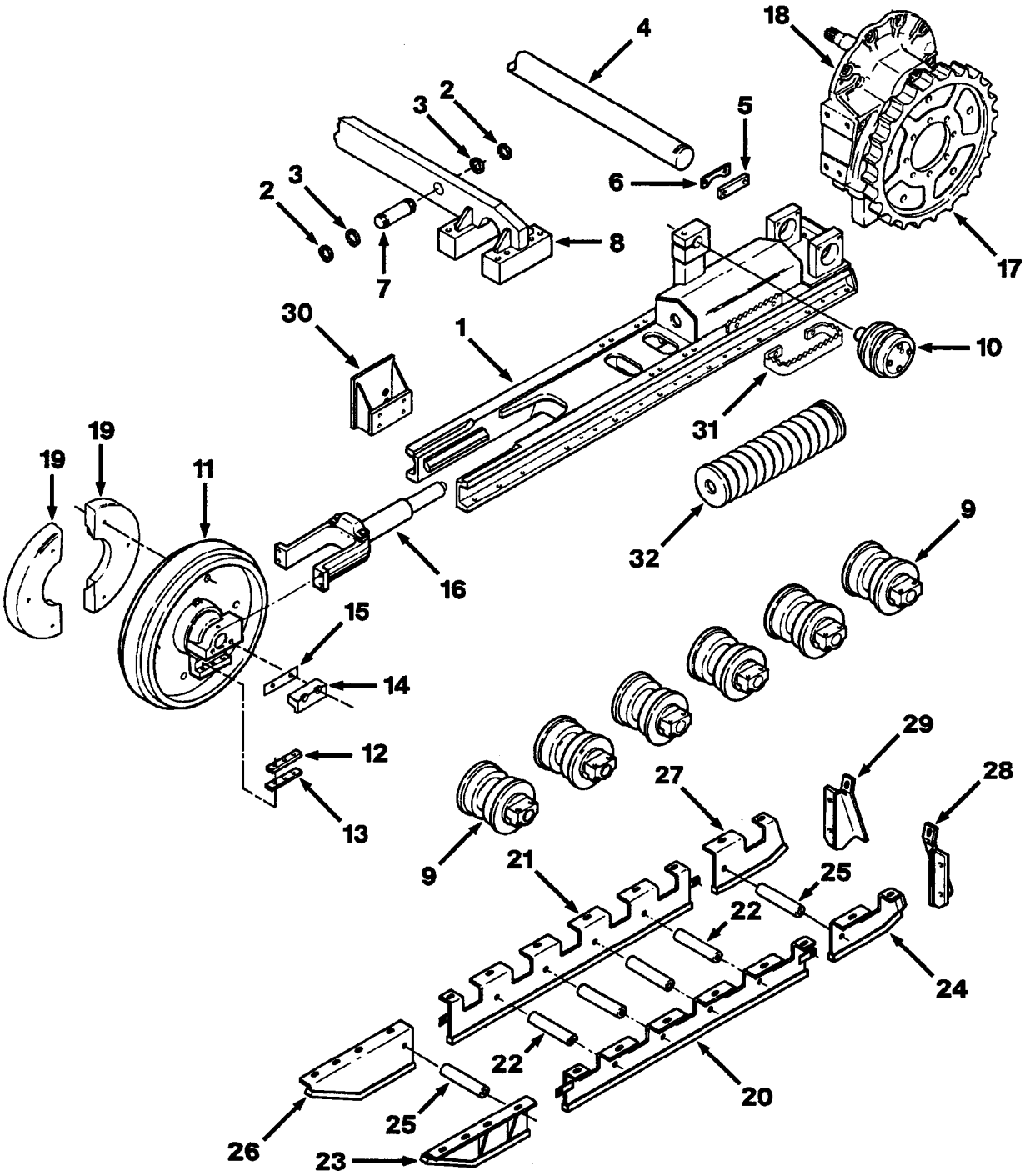


Fig. 14.1. Exploded View of Track Assembly

1. Track Frame
2. Retaining Ring
3. Ring Retainer
4. Pivot Shaft
5. Locking Plate
6. Locking Plate Shim
7. Mounting Pin
8. Equalizer Bar Assy
9. Track Roller
10. Top Idler
11. Front Idler
12. Wear Bar
13. Wear Bar Shim
14. Guide Plate
15. Guide Plate Shim
16. Track Adjuster
17. Drive Sprocket
18. Left Final Drive
19. Counterweight
20. Track Roller Shield L.H.
21. Track Roller Shield R.H.
22. Spacer Sleeve
23. Front Chain Guide L.H.
24. Rear Chain Guide L.H.
25. Spacer Sleeve
26. Front Chain Guide R.H.
27. Rear Chain Guide R.H.
28. Left Rock Deflector
29. Right Rock Deflector
30. C Frame Rub Bracket
31. Footstep
32. Track Spring

GENERAL

Front Idler

The front idler provides a freely rotating, guiding support for the track chain. The front 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 front idlers are heat treated steel castings and rotate around bushings. The front idlers are equipped with metal type face seals which maintain a leak and dirt proof seal.

Track Adjuster

The hydraulic track adjuster is contained in the front idler fork. Lubricant is introduced into the adjuster by the use of a lubrication fitting on top of the fork. This lubricant acting upon the piston and fork forces the idler fork and front idler forward for track chain adjustment.

Track Spring

A heavy coil spring is provided in each track frame . They permit the front idlers to recoil under shock loads and exert tension on the track in normal operation. 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 track adjusting rod bears against the track spring front seat.

Track Top Idler

The upper section of track chain between the sprocket and the front idler is supported by a top idler. The idlers are mounted in brackets which are welded to the track frame. The top idlers revolve around tapered roller bearings which ride on heat treated replaceable steel shafts. The idlers are sealed against leakage and dirt by a metal type face seal.

Track Top Roller

Track rollers are attached to the underside of the track frame and carry the weight of the machine. The rollers are heat treated steel forgings and rotate around bushings. The rollers are equipped with metal type face seals which maintain a leak and dirt proof seal. The rollers are single flange type.

Equalizer Bar

The equalizer bar is fitted with pins to the main frame. The ends of the equalizer bar are bolted to the track frames.

Pivot Shaft

The rear pivot shaft is a solid rigid type bar mounted to the main frame by the half cinch type blocks. The rear of the track frames mount to the pivot shaft.

Maintenance

The track links have only one wearing surface which contacts the track rollers, front idler and track idlers. It usually becomes necessary to replace the 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 wear on the outside of the bushings is visible. Wear on the pins and interior of the bushings is indicated by track stretch. The amount of wear can be determined by measuring the pitch length of the track chain under tension and comparing it with the allowable pitch lengths, refer to UNDERCARRIAGE COMPONENTS WEAR LIMIT DIMENSIONS in this Section.

SUSPENSION

GENERAL

3. SPECIFICATIONS

Front Idler

Weight:
- TD-7M . . . . . 91 [kg]
- TD-8M . . . . . 91 [kg]
- TD-9M . . . . . 134 [kg]
- TD-10M . . . . . 134 [kg]

Refill Capacity and Lubricant . . . . . See OPERATOR'S MANUAL
Bushing Installation Lube . . . . . Loctite #609
Drain Plug Threads. . . . . Loctite #592
Fork Mounting Bolts Torque . . . . . 134 [Nm]
Drain Plug Torque . . . . . 34 [Nm]
Thrust Plate Bolts Torque . . . . . .190 [Nm]

Track Adjuster

Type of Adjuster . . . . . Single Acting
Weight of Adjuster . . . . . 10 [kg]
Refill Lubricant . . . . . MPG (Refer to OPERATOR'S MANUAL)
Check Valve Torque . . . . . 68 [Nm]
Safety Relief Valve Torque . . . . . 68 [Nm]
Fork Bolts . . . . . .134 [Nm]

Top Idler

Weight of Top Idler . . . . . .15 [kg]
Refill Capacity and Lubricant . . . . . Refer to OPERATOR'S MANUAL
O-Ring Retention . . . . . MPG (Refer to OPERATOR'S MANUAL)
Drain Plug Threads . . . . . Loctite #592
Drain Plug Torque . . . . . 20 to 60 [Nm]

Track Roller

Weight of Roller:
TD-7M or TD-8M . . . . . 19.1 [kg]
TD-9M or TD-10M . . . . . 21.8 [kg]
Refill Lubricant and Capacity . . . . . Refer to OPERATOR'S MANUAL
Drain Plug Torque . . . . . 20 to 60 [Nm]
Track Roller and Shield Mounting Bolts. . . . . 270 [Nm]

Track Spring

TD-7M or TD-8M;

Track Spring:
Free Length. . . . . .536.0 [mm]
Test Length. . . . . .464.0 [mm]
Work Length . . . . . 406.0 to 464.0 [mm]
Test Load. . . . . 62.3 ± 10% [kN]
Number of Working Coils 10.44
Weight of Spring . . . . . 32.3 [kg]

GENERAL

TD-9M or TD-10M

Track Spring:

Free Length . . . . . 554.0 [mm]
Test Length . . . . . .442.0 [mm]
Work Length . . . . . 389.0 to 442.0 [mm]
Test Load . . . . . 82.8 ± 10% [kN]
Number of Working Coils 9
Weight of Spring . . . . . 40.8 [kg]

UNDERCARRIAGE COMPONENTS WEAR LIMIT DIMENSIONS

TD-7M OR TD-8M

STANDARD GROUSER HEIGHT			
100% REMAINING	52.1 [mm]	25% REMAINING	29.8 [mm]
75% REMAINING	44.7 [mm]	0% REMAINING	22.4 [mm]
50% REMAINING	37.3 [mm]	WEAR FACTOR	29.7 [mm]
LINK HEIGHT			
100% REMAINING	97.0 [mm]	25% REMAINING	91.0 [mm]
75% REMAINING	95.0 [mm]	0% REMAINING	89.0 [mm]
50% REMAINING	93.0 [mm]	WEAR FACTOR	8.0 [mm]
BUSHING OD - LUBRICATED TRACK SYSTEM			
100% REMAINING	53.6 [mm]	25% REMAINING	49.9 [mm]
75% REMAINING	52.4 [mm]	0% REMAINING	48.6 [mm]
50% REMAINING	51.1 [mm]	WEAR FACTOR	5.0 [mm]
INTERNAL PIN AND BUSHING WEAR (PITCH)			
100% REMAINING	659.4 [mm]	25% REMAINING	669.8 [mm]
75% REMAINING	662.9 [mm]	0% REMAINING	673.2 [mm]
50% REMAINING	666.3 [mm]	WEAR FACTOR	13.8 [mm]
FRONT IDLER FLANGE HEIGHT			
100% REMAINING	17.8 [mm]	25% REMAINING	22.3 [mm]
75% REMAINING	19.3 [mm]	0% REMAINING	23.8 [mm]
50% REMAINING	20.8 [mm]	WEAR FACTOR	6.0 [mm]
New Front Idler Flange Diameter	581.7 [mm]	New Front Idler Wear Diameter	546.1 [mm]
TRACK ROLLER DIAMETER			
100% REMAINING	175.0 [mm]	25% REMAINING	163.0 [mm]
75% REMAINING	171.0 [mm]	0% REMAINING	159.0 [mm]
50% REMAINING	167.0 [mm]	WEAR FACTOR	16.0 [mm]
TOP IDLER DIAMETER			
100% REMAINING	152.0 [mm]	25% REMAINING	142.7 [mm]
75% REMAINING	148.9 [mm]	0% REMAINING	139.6 [mm]
50% REMAINING	145.8 [mm]	WEAR FACTOR	12.4 [mm]

GENERAL

UNDERCARRIAGE COMPONENTS WEAR LIMIT DIMENSIONS

TD9-M OR TD10-M

STANDARD GROUSER HEIGHT			
100% REMAINING	52.1 [mm]	25% REMAINING	29.8 [mm]
75% REMAINING	44.7 [mm]	0% REMAINING	22.4 [mm]
50% REMAINING	37.3 [mm]	WEAR FACTOR	29.7 [mm]
LINK HEIGHT			
100% REMAINING	97.0 [mm]	25% REMAINING	91.0 [mm]
75% REMAINING	95.0 [mm]	0% REMAINING	89.0 [mm]
50% REMAINING	93.0 [mm]	WEAR FACTOR	8.0 [mm]
BUSHING OD - LUBRICATED TRACK SYSTEM			
100% REMAINING	53.6 [mm]	25% REMAINING	49.9 [mm]
75% REMAINING	52.4 [mm]	0% REMAINING	48.6 [mm]
50% REMAINING	51.1 [mm]	WEAR FACTOR	5.0 [mm]
INTERNAL PIN AND BUSHING WEAR (PITCH)			
100% REMAINING	659.4 [mm]	25% REMAINING	669.8 [mm]
75% REMAINING	662.9 [mm]	0% REMAINING	673.2 [mm]
50% REMAINING	666.3 [mm]	WEAR FACTOR	13.8 [mm]
FRONT IDLER FLANGE HEIGHT			
100% REMAINING	17.8 [mm]	25% REMAINING	22.3 [mm]
75% REMAINING	19.3 [mm]	0% REMAINING	23.8 [mm]
50% REMAINING	20.8 [mm]	WEAR FACTOR	6.0 [mm]
New Front Idler Flange Diameter	581.7 [mm]	New Front Idler Wear Diameter	546.1 [mm]
TRACK ROLLER DIAMETER			
100% REMAINING	187.4 [mm]	25% REMAINING	173.0 [mm]
75% REMAINING	182.6 [mm]	0% REMAINING	168.2 [mm]
50% REMAINING	177.8 [mm]	WEAR FACTOR	19.2 [mm]
TOP IDLER DIAMETER			
100% REMAINING	152.0 [mm]	25% REMAINING	142.7 [mm]
75% REMAINING	148.9 [mm]	0% REMAINING	139.6 [mm]
50% REMAINING	145.8 [mm]	WEAR FACTOR	12.4 [mm]

GENERAL

4. SERVICE DIAGNOSIS

GENERAL COMPLAINT	
PROBABLE CAUSE	**REMARKS**
Track Chain Comes Off During Operation	
1. Track chain loose.	Adjust tension. Refer to OPERATOR'S MANUAL.
2. Rocks or debris in track assembly.	Clean out all rocks and packed dirt from the chains, idlers, rollers and sprocket.
3. Front idler worn.	Inspect front idler for wear. Repair or replace as necessary.
4. Front idler misaligned.	Inspect idler for excessive wear or distortion. Repair or replace as necessary.
5. Worn sprocket teeth.	Replace sprocket and chain.
Machine Creeps To One Side	
1. Malfunction in drive system.	Refer to SECTION 7, DRIVE TRAIN.
2. One track loose.	Adjust track chain tension. Refer to OPERATOR'S MANUAL.
3. Track spring weak or broken.	Remove/check tension with SPECIFICATIONS or replace.
4. Brake in steering drive hanging up.	Check, refer to SECTION 4, BRAKES.
Excessive Or Uneven Wear Of Track and Components	
1. Improper track tension.	Adjust the track tension. Refer to OPERATOR'S MANUAL.
2. Damaged sprocket.	Replace sprocket.
3. Front idler misaligned.	Inspect idler for excessive wear and for distortion. Repair or replace as necessary.
4. Track frame misaligned.	Check for bent track frame, equalizer bar or pivot shaft. Replace parts as necessary.
Top Idlers Do Not Rotate	
1. Dirt or mud packed tight against idler	Remove dirt or mud.
2. Internal seizure.	Remove idler and inspect parts. Thoroughly clean and replace parts as necessary.

SUSPENSION

GENERAL

Track Rollers Do Not Rotate	
1. Dirt or mud packed tight against rollers.	Remove dirt or mud.
2. Internal seizure.	Remove rollers and inspect parts. Thoroughly clean and replace defective parts.
Front Idler Does Not Rotate	
1. Dirt or mud packed tight against front idlers.	Remove dirt or mud.
2. Internal seizure.	Remove idler and inspect parts. Thoroughly clean and replace defective parts.
Lubricant Leakage	
1. Leakage at track roller, top idler and/or front idler.	Remove faulty part. Inspect and repair or replace parts as necessary.
Machine Loses Power	
1. Track chains too tight.	Adjust track tension. Refer to the OPERATOR'S MANUAL.
Track Shoe Bolts Break	
1. Bolts not properly tightened.	Tighten bolts to proper torque. Refer to the OPERATOR'S MANUAL.
2. Bolt head snap off.	Track shoes out-of-flat. Replace track shoes.

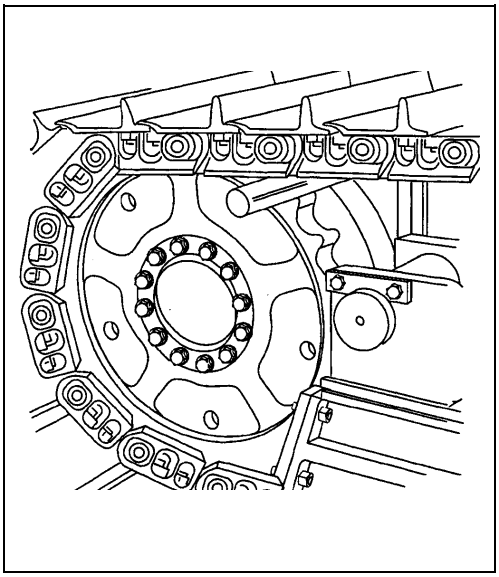
GENERAL

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 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.

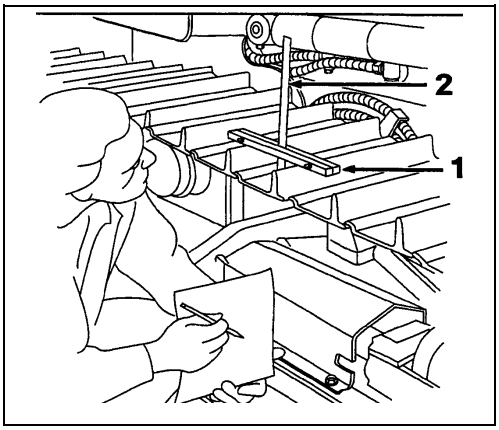
General

Track components have a certain dimension when new. As wear occurs dimensions will decrease (or increase in 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. For each component or condition, five different dimensions are given. 100% is dimension of component when new. 75%, 50% and 25% indicate % of wear remaining before a maintenance action should be taken. 0% is point at which either repairing must take place or components run to destruction. Before inspecting, chain tension on both sides must be tightened. To do this machine should be moved backward so sprocket can grab block and tighten chain. This pulls chain tight off top idler.



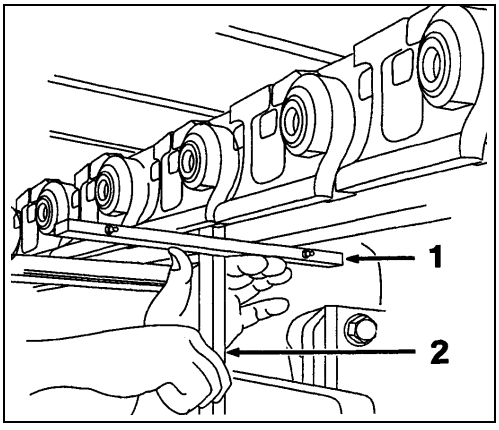
Track Shoe Grouser Height

Clean off all materials on shoe plate and grouser tops. Lay squeeze bar (1) across grousers approximately 1/4 of way in from end of shoe. Insert 300 [mm] scale (2) 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. Refer to SPECIFICATIONS in this Section.



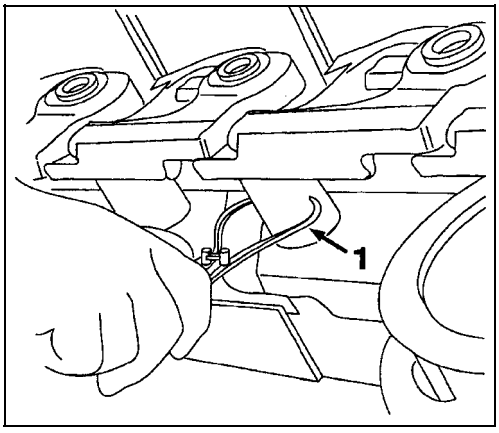
Link Height

Clean out all materials between links. Place squeeze bar (1) across center of links. Insert 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. Refer to SPECIFICATIONS in this Section.



GENERAL

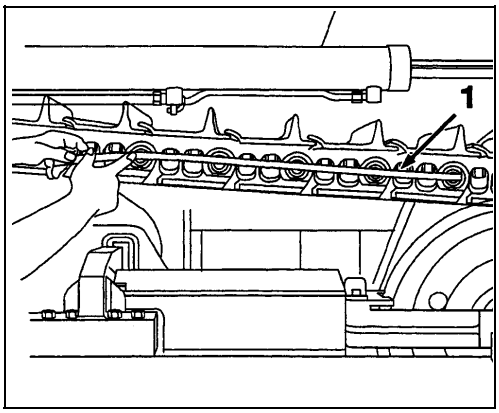
Bushing Outside Diameter



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 300 [mm] scale. Repeat on reverse drive side wear area. Measure two or more bushings to get an average. Refer to SPECIFICATIONS in this Section.

NOTE*: Whichever wear is greater, forward or reverse, determines percentage of wear remaining.*

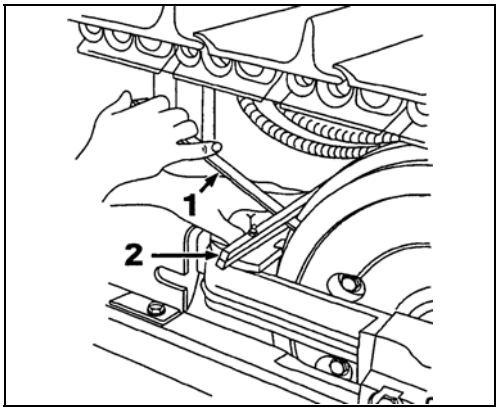
Internal Pin And Bushing Wear (Pitch)



NOTE: *To measure track pitch, chain must be tight.*

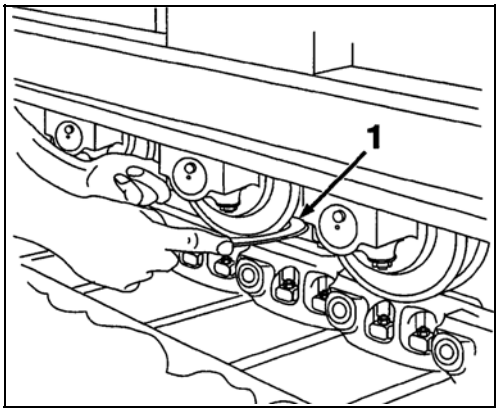
Place end of 3 [m] tape (1) on front of one track pin and measure length of four links to front of fifth track pin. Refer to SPECIFICATIONS in this Section.

Front Idler Flange Height



Insert 300 [mm] scale (1) in squeeze bar (2). Rest squeeze bar on top of flange and push scale down until it makes contact in middle of tread area as shown and take a reading. Refer to SPECIFICATIONS in this Section.

Track Roller Rolling Diameter

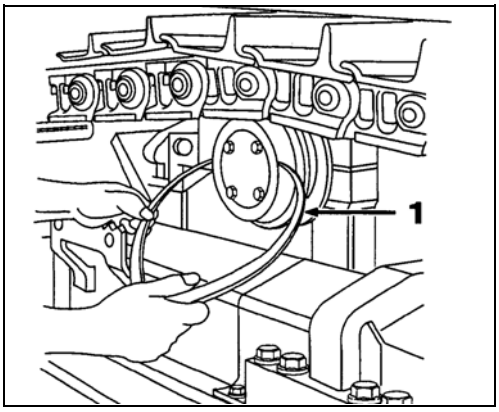


Place tips of 300 [mm] caliper (1) against tread area of roller. Adjust caliper so a slight drag is present when caliper is removed. Using 300 [mm] scale measure distance between caliper tips. Refer to SPECIFICATIONS in this Section. Repeat steps on remaining rollers.

GENERAL

Top Idler Rolling Diameter

Place tips 300 [mm] caliper (1) snugly around tread area of top idler and remove. Using 300 [mm] scale, measure distance between caliper tips. Refer to SPECIFICATIONS in this Section.

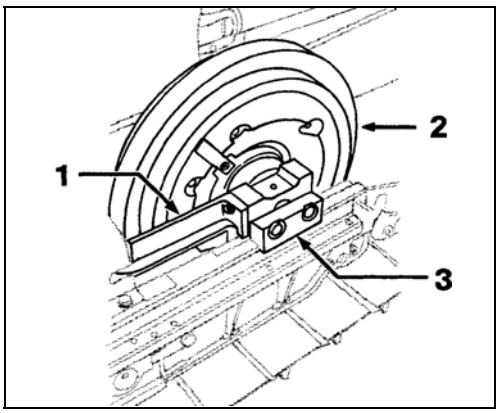


SUSPENSION

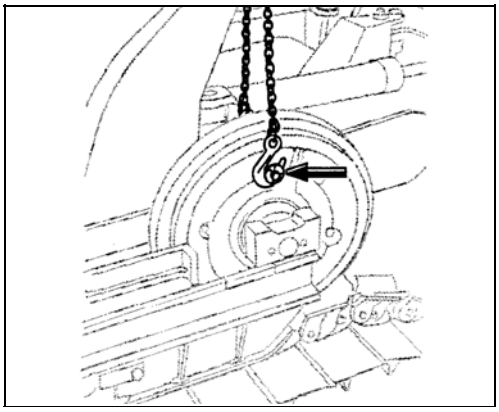
FRONT IDLER

6. REMOVAL

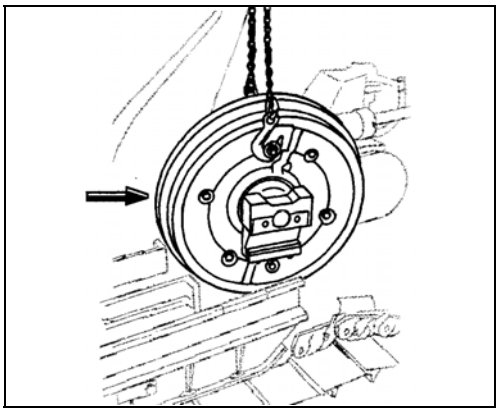
1. Remove track chain per SECTION 15. It is only necessary to lift chain free from front idler. Disconnect fork (1) from both sides of front idler (2). Remove thrust plates (3) and shims from both sides of front idler.



2. Remove one counterweight mounting bolt from both sides of front idler. Install a through bolts of sufficient length with large washers and nuts and connect hoist.

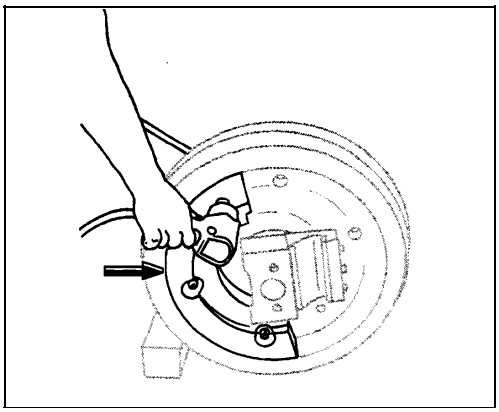


3. Slide front idler out from track frame and remove from machine.



1. Position front idler on ground with blocking. Remove counterweights.

NOTE: *Each counterweight weighs approximately 19 [kg].*



FRONT IDLER

7. DISASSEMBLY

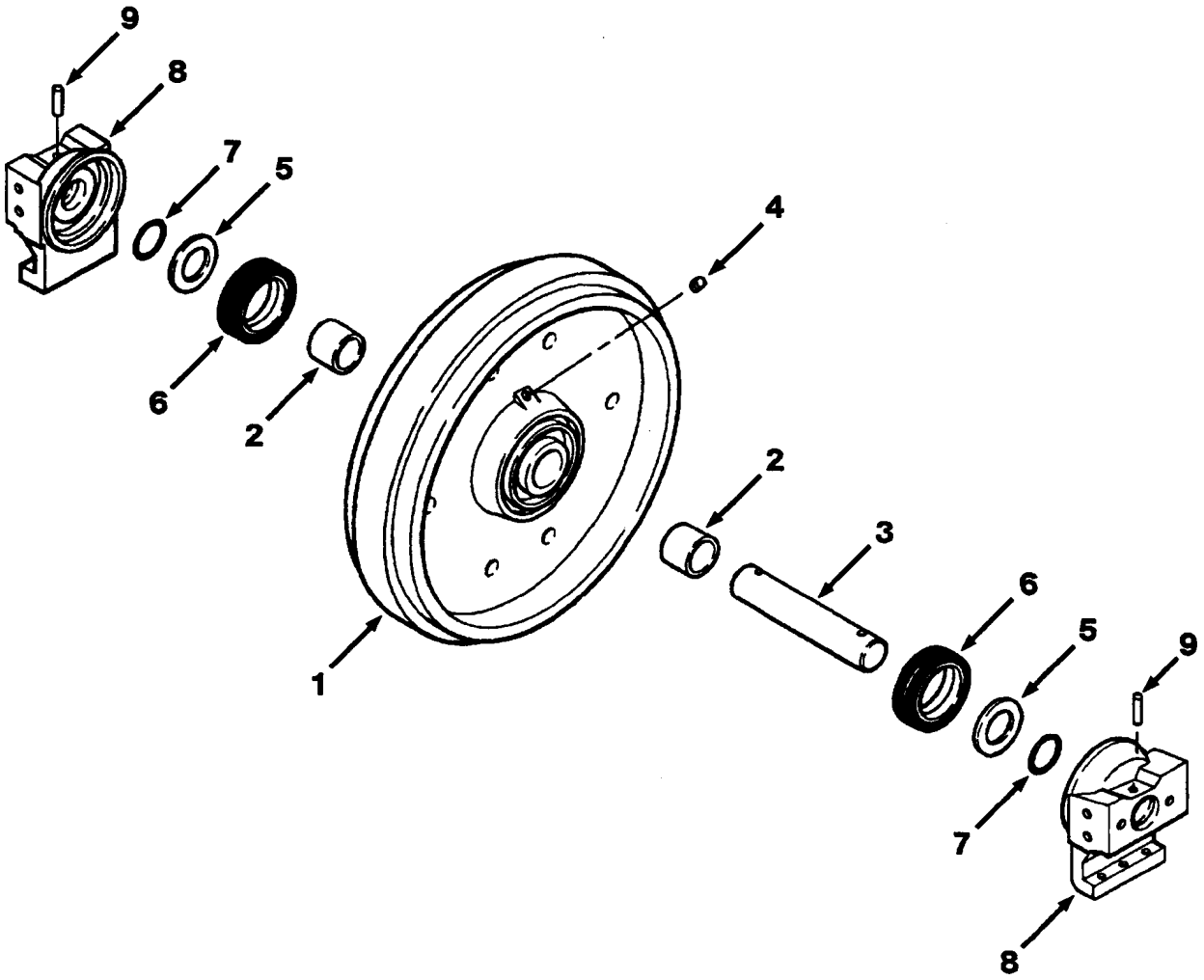


Fig. 14.2. Exploded View of Front Idler

Legend for Fig.'s 14.2 and 14.3

1. Front Idler
2. Bushing
3. Idler Shaft
4. Port Plug
5. Thrust Washer
6. Seal Kit
7. O-Ring
8. Mounting Bracket
9. Spring Pin

FRONT IDLER

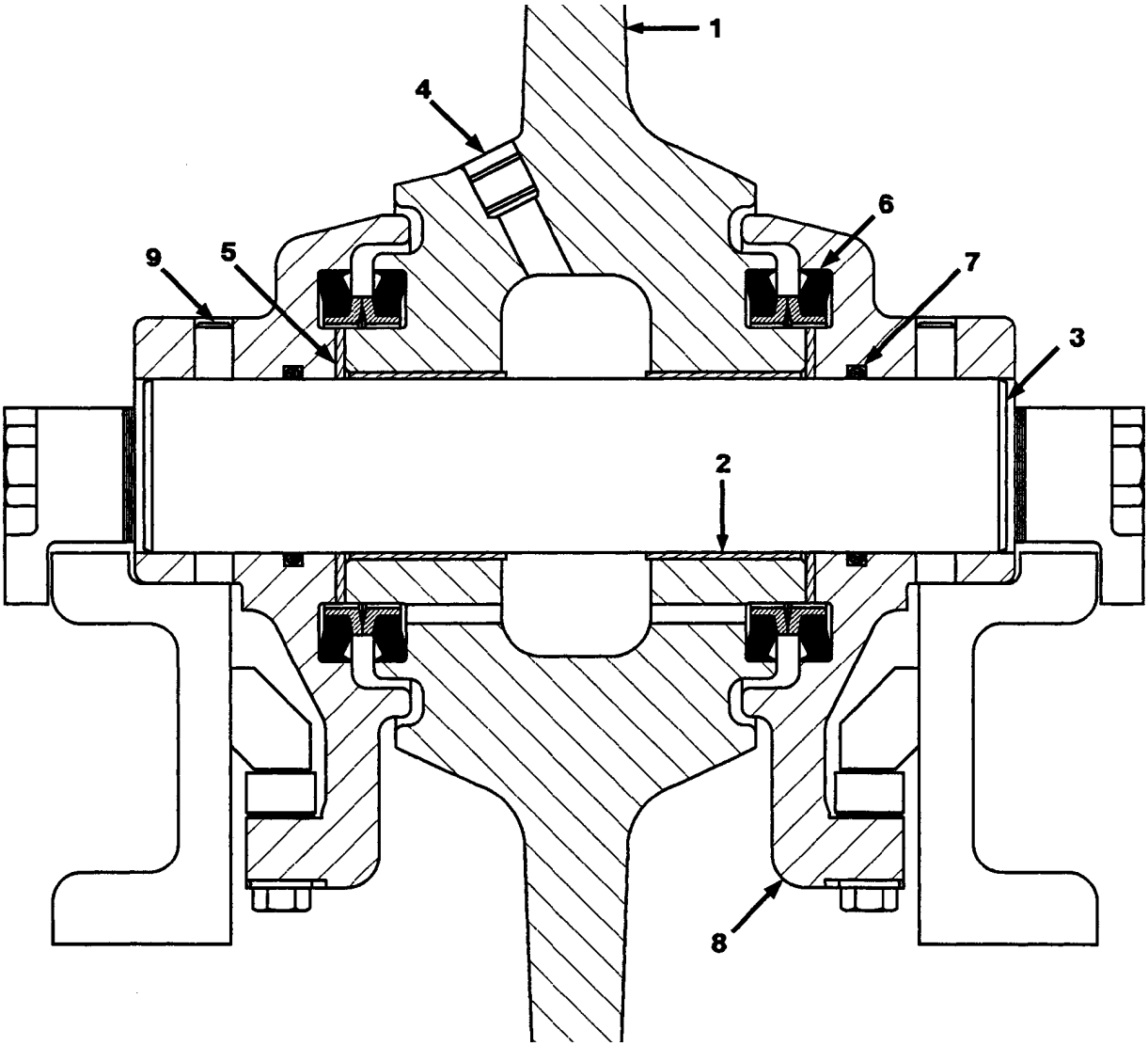
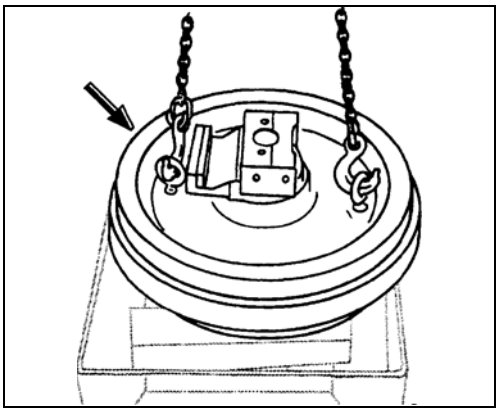


Fig. 14.3. Cross Section View of Front Idler

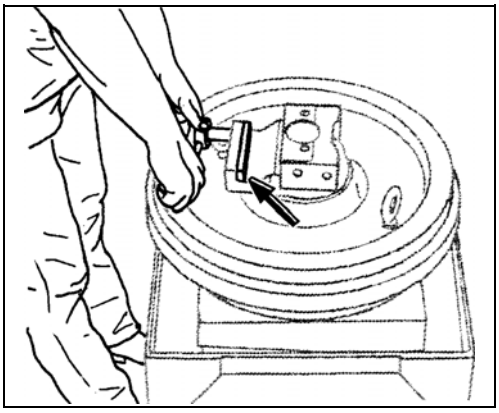
FRONT IDLER

NOTE: *Callouts from exploded and cross section views correspond with callouts in following steps.*

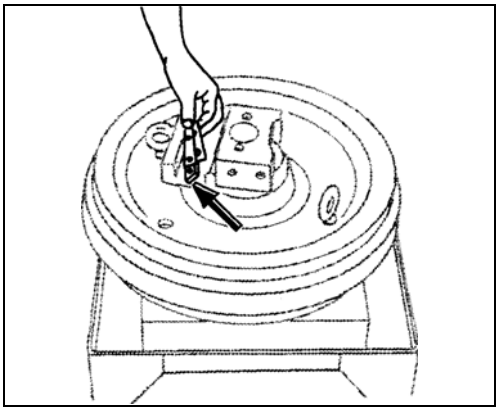
1. Using eye bolts and hoist, position front idler on work table.



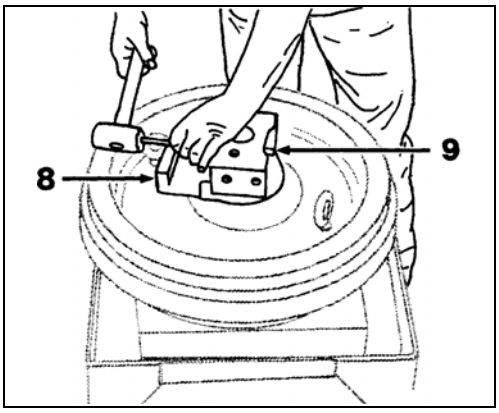
2. Remove bottom wear bar hardware.



3. Remove bottom wear bar and shims.



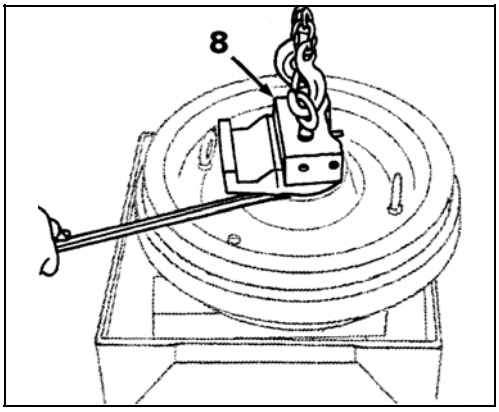
4. Drive spring pin (9) from mounting bracket (8).



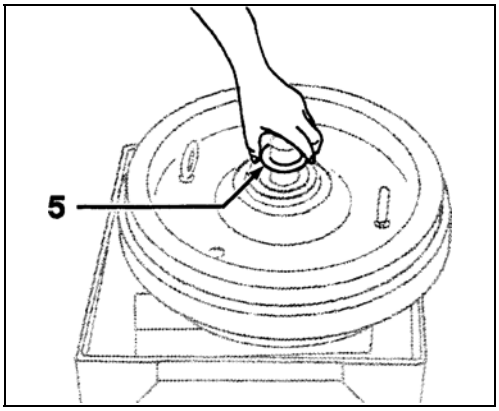
SUSPENSION

FRONT IDLER

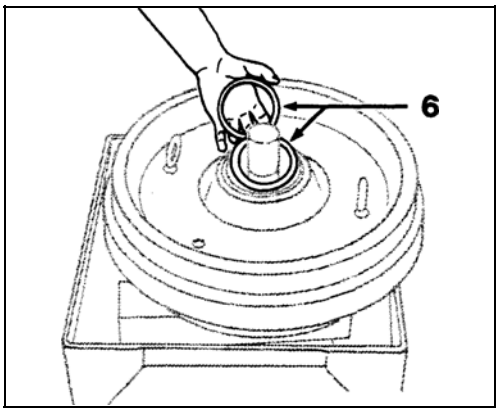
5. Attach eye bolts and hoist to mounting bracket (8). Pry up on support while carefully applying hoist. This is necessary to overcome drag caused by O-ring inside support.



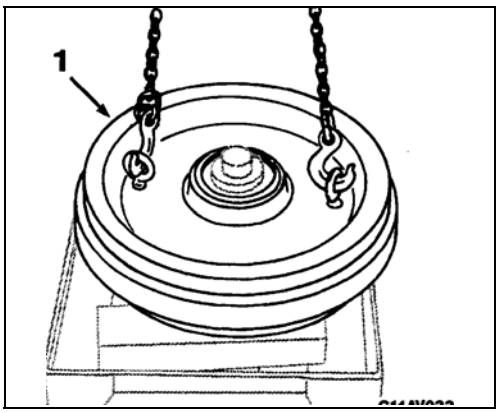
6. Remove thrust washer (5).



7. Remove seal half (6).

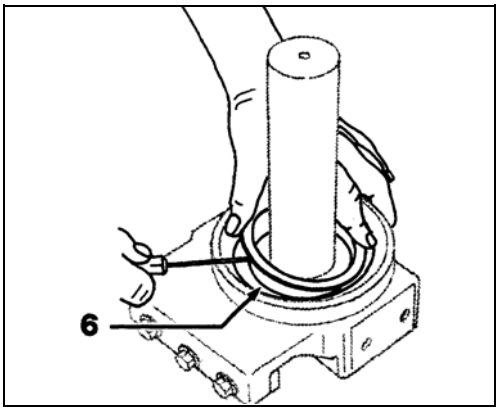


8. Using hoist and eye bolts, lift idler (1) from shaft. Remove seal half from upper and lower part of idler.

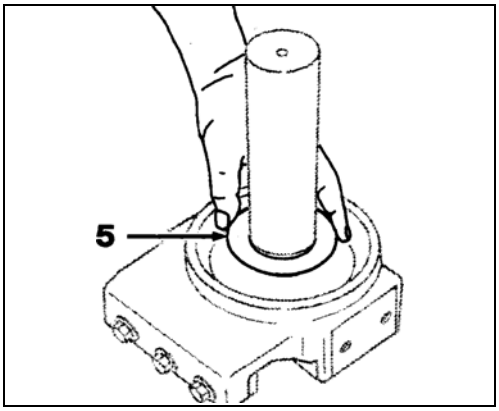


FRONT IDLER

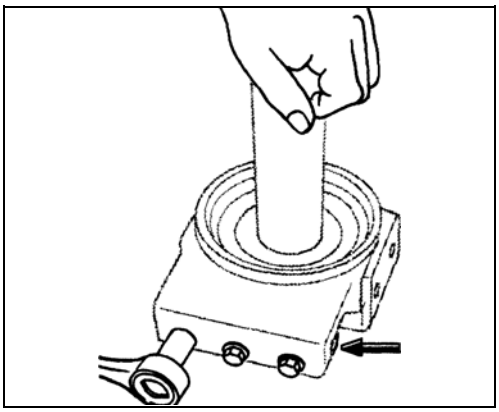
9. Remove seal half (6) from mounting bracket.



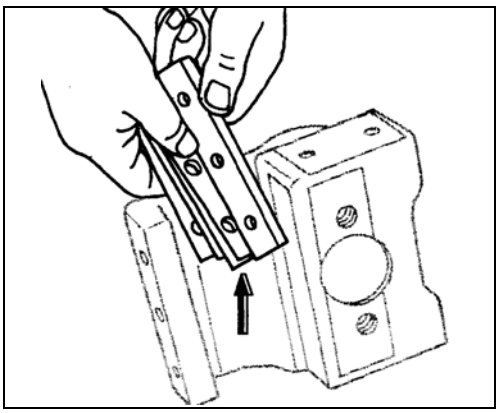
10. Remove thrust washer (5).



11. Remove the lower wear bar hardware.

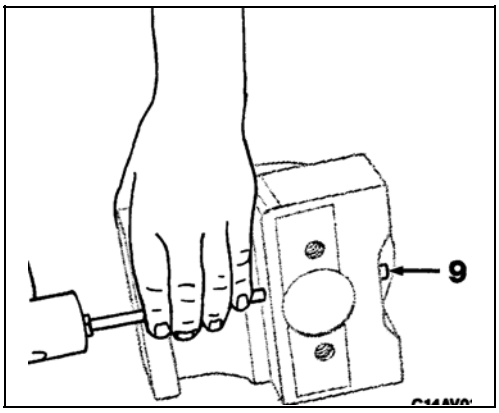


12. Remove the lower wear bar and shims.

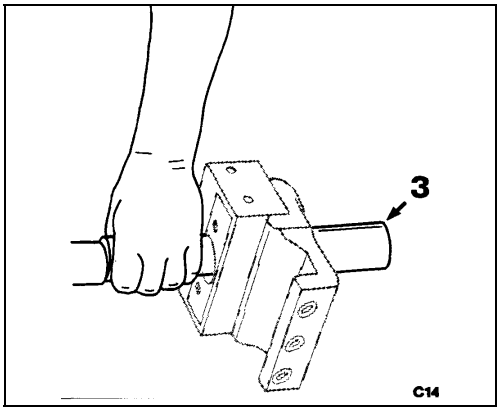


FRONT IDLER

13. Using a punch tool, drive spring pin (9) from mounting bracket (8).



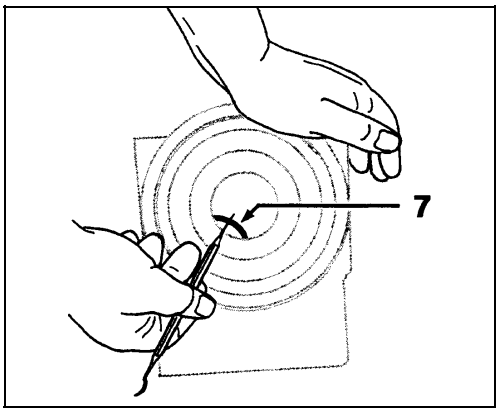
14. Drive the shaft (3) out from mounting bracket. This is necessary to overcome internal O-ring drag.



15. Remove and discard O-ring (7) from each mounting bracket.

NOTE: *Whenever a front idler is disassembled, used seals must pass an inspection or a new seal used. refer to METAL TYPE FACE SEALS in this Section.*

16. Remove the bushings from the idler body.



FRONT IDLER

8. INSPECTION AND REPAIRS

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. 14.4.
5. Inspect the blocks (8, Fig. 14.3) and guide bar for distortion or excessive wear, refer to SPECIFICATIONS in this Section. Replace if necessary.
6. Whenever a front idler is disassembled, used seals must pass an inspection or a new seal used. refer to METAL TYPE FACE SEALS in this SECTION.

9. REASSEMBLY

NOTE: *Callouts from exploded and cross section views correspond with callouts in following steps.*

A. Front Idler Bushing Installing

Remove the bushings in the idler body and replace with new. Degrease and dry the idler bore and bushing OD. Remove any Loctite residue from the idler bushing bores. Position the parts vertical and apply Loctite Primer T to both the idler bore and bushing OD. Allow the primer to dry as specified in the Loctite directions. Apply Loctite #609 retaining compound to both the entire idler bore and entire bushing OD using a brush. Position in press and install the bushings 0.8 [mm] below washer face surface within 3 [min] after the Loctite #609 is applied. A minimum press force of 6500 [kg] is required to install the bushing. Wipe off excess Loctite at both end of the bore. Repeat for remaining bushing. Allow the Loctite to cure as specified in the Loctite directions. Clean the inside of the idler and bushings as much as possible before installing the shaft and adding oil.

B. Front Idler Bushing Clearances

Discard thrust washers and replace with new. Inspect the condition and OD of idler shaft and replace as necessary. Coat the bushings and thrust washers with clean film of oil. Pin the shaft to one mounting bracket. Install the thrust washer onto the shaft. Insert the shaft through the idler, install the second thrust washer and secure with remaining mounting bracket. Position the idler on blocking so that the mounting brackets and shaft are free to rotate. Position a dial indicator on the idler body with the pointer on the end of shaft and set to zero. Pry up on the lower mounting bracket and record reading on the dial indicator. Repeat a few time and average the readings. Take out the idler from blocking. Remove upper bracket and thrust washer. Position a dial indicator on the idler body with the pointer on the upper shaft surface of the bushing and set to zero. Pry up on the shaft and record reading on the dial indicator. Repeat a few time and average the readings. The reading must be within clearances showed below. If not check the dimensions of all parts and repeat until the correct clearance is achieved. Disassemble the assembly after the clearance has been attained.

FRONT IDLER

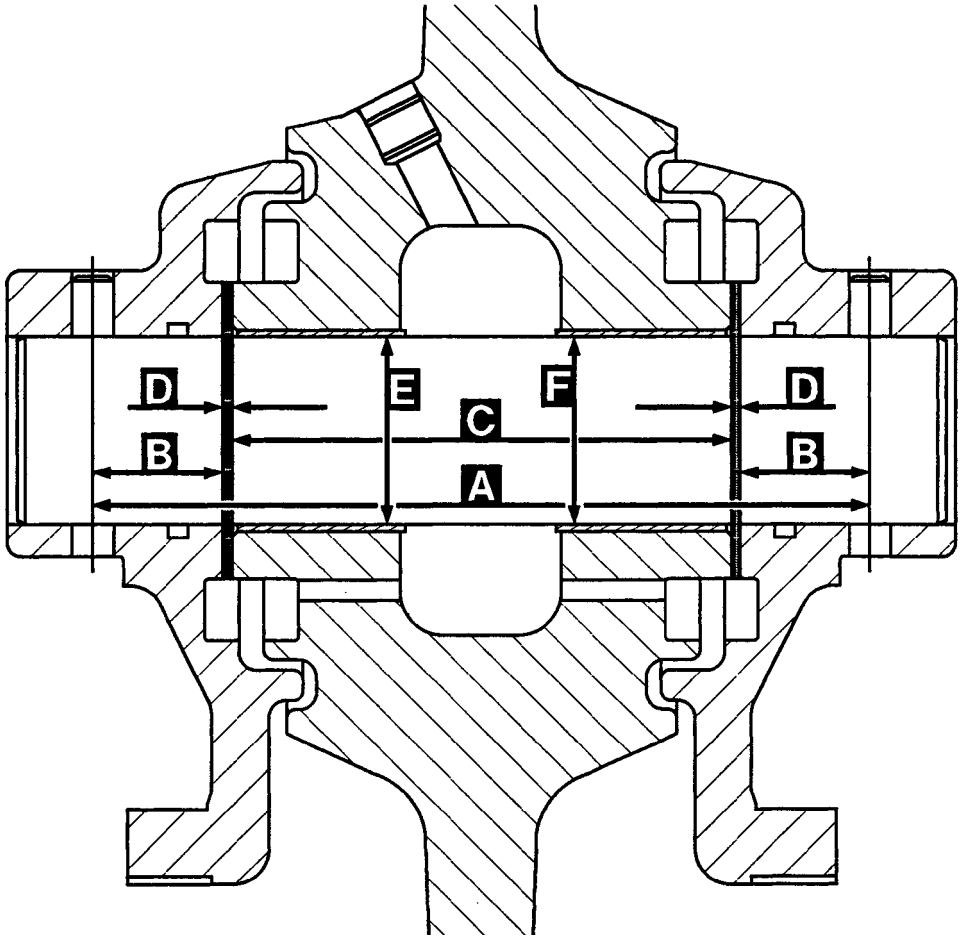


Fig. 14.4. Front Idler Bushing Clearances

TD7-M, TD-8M

	BUSHING END CLEARANCE	CLEARANCE [mm]
A	Pin to Pin Holes in Shaft	223.5 to 223.7
B	Pin Hole to Thrust Washer Face of Support x 2	74.1 to 74.4
C	Idler Hub Thrust Washer to Thrust Washer Face	144.3 to 144.6
D	Thrust Washer Thickness x 2	4.2 to 4.4
	Bushing End Clearance – **A** minus **B**, **C** and **D**	0.1 to 1.1

	DIAMETRAL OIL CLEARANCE	
E	Bushing Assembled Inside Diameter	44.50 to 44.58
F	Idler Shaft Diameter	44.25 to 44.30
	Diametral Oil Clearance - **E** minus **F**	0.20 to 0.33

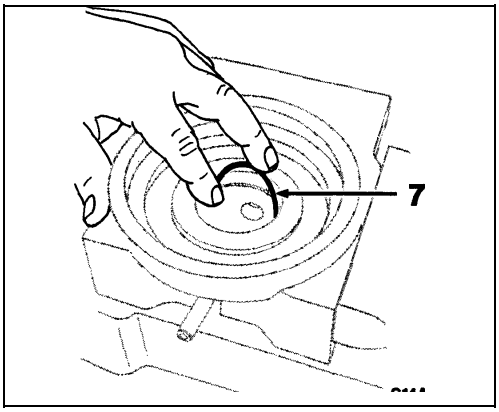
FRONT IDLER

TD9M, TD10M

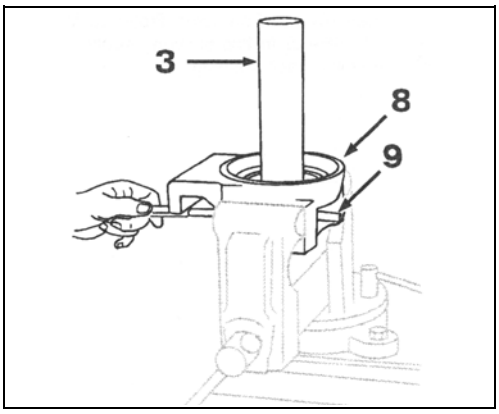
	BUSHING END CLEARANCE	CLEARANCE [mm]
A	Pin to Pin Holes in Shaft	233.6 to 233.8
B	Pin Hole to Thrust Washer Face of Support x 2	78.8 to 79.1
C	Idler Hub Thrust Washer to Thrust Washer Face	149.7 to 150.0
D	Thrust Washer Thickness x 2	4.2 to 4.4
	Bushing End Clearance – **A** minus **B**, **C** and **D**	0.1 to 1.1

	DIAMETRAL OIL CLEARANCE	
E	Bushing Assembled Inside Diameter	57.2 to 57.28
F	Idler Shaft Diameter	56.95 to 57.0
	Diametral Oil Clearance - **E** minus **F**	0.20 to 0.33

1. Install new O-ring (7) into mounting bracket and coat with amber grease. Apply a thin coat of "Never Seez" 999617R1 to shaft bore.

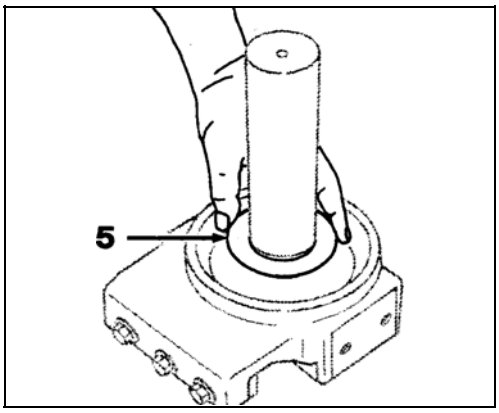


2. Install shaft (3) into mounting bracket (8) aligning pin hole with dowel. Secure shaft to support with spring pin (9).

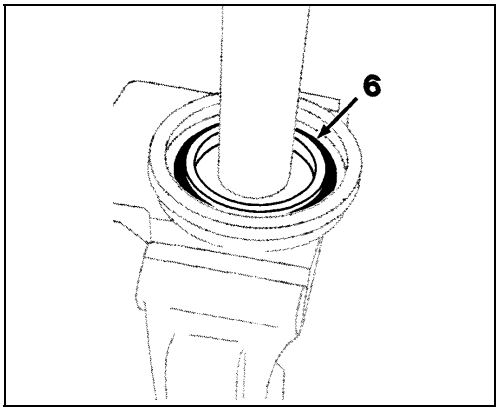


FRONT IDLER

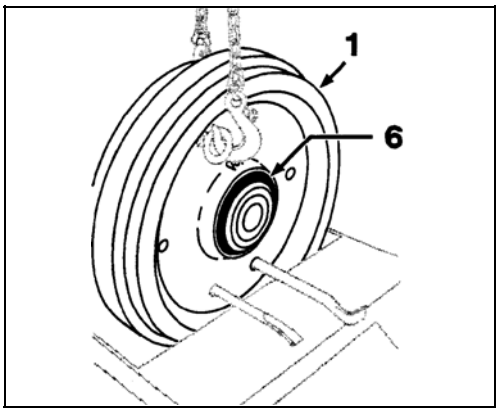
3. Coat the thrust washer (5) with a light film of clean oil and install on the shaft up against the support.



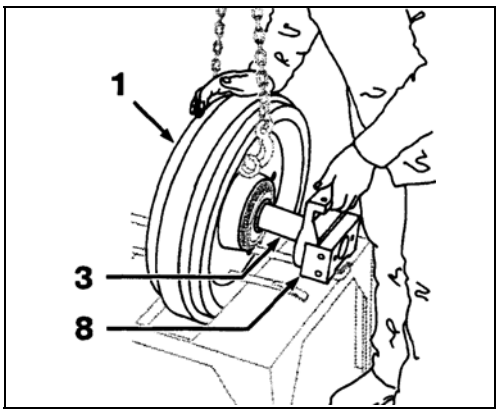
4. Install new seal half (6) into support. Refer to METAL TYPE FACE SEALS in this Section.



5. Position front idler (1) on work table as shown. Install new seal half (6) into front idler. Refer to METAL TYPE FACE SEALS in this Section. Apply a light film of clean oil to each bushing.

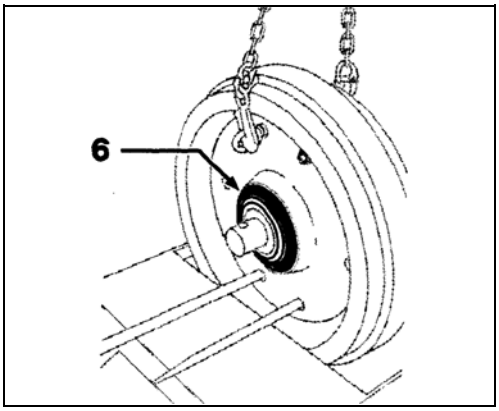


6. Install mounting bracket (8) with shaft (3) into front idler (1).

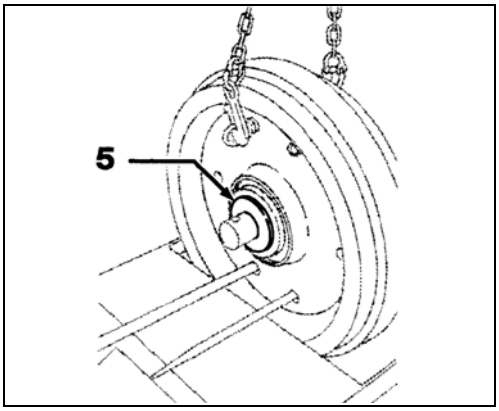


FRONT IDLER

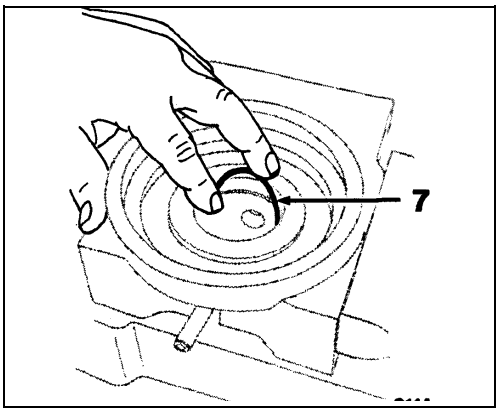
7. Install new seal half (6) into front idler. Refer to METAL TYPE FACE SEALS in this Section.



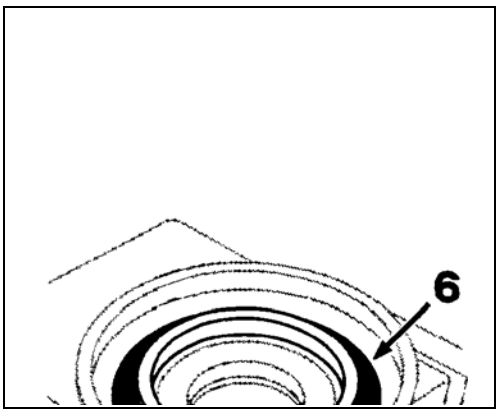
8. Coat thrust washer (5) with a light film of clean oil and install on shaft up against idler hub.



9. Install new O-ring (7) into mounting bracket and coat with amber grease. Apply a thin coat of "Never Seez" to shaft bore.



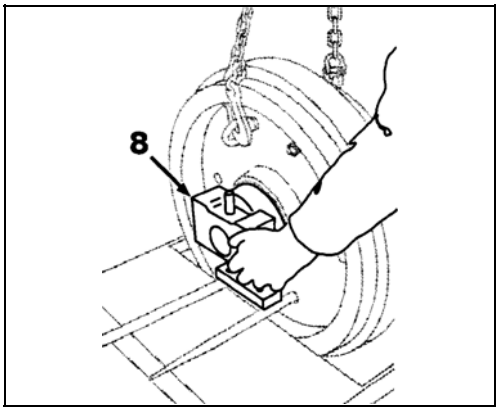
10. Install new seal half (6) into support. Refer to METAL TYPE FACE SEALS in this Section.



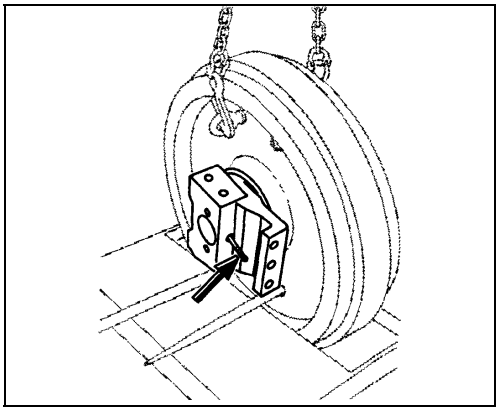
SUSPENSION

FRONT IDLER

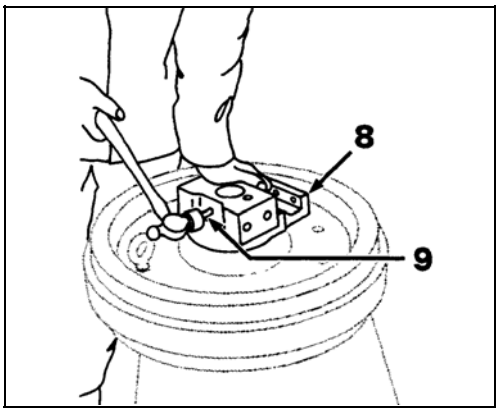
11. Install support (8) onto shaft.



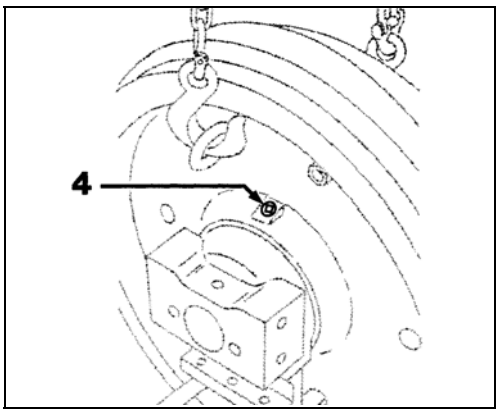
12. Reposition support to shaft and temporarily secure with aligning dowel.



13. Reposition idler as shown. Remove aligning dowel. Press down on support (8) while driving in spring pin (9). This will energize each seal.

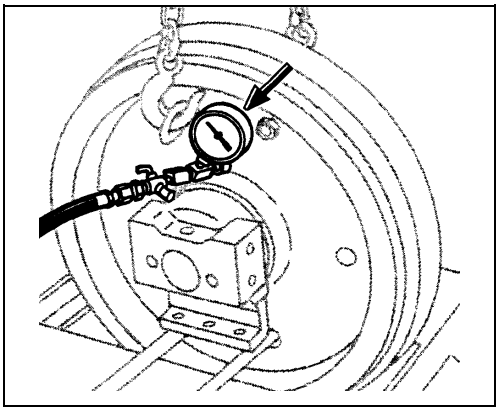


14. Remove filler plug (4).

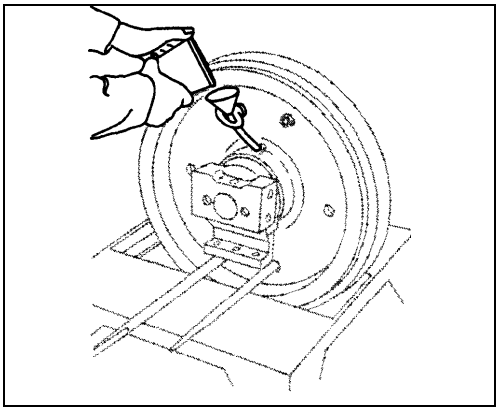


FRONT IDLER

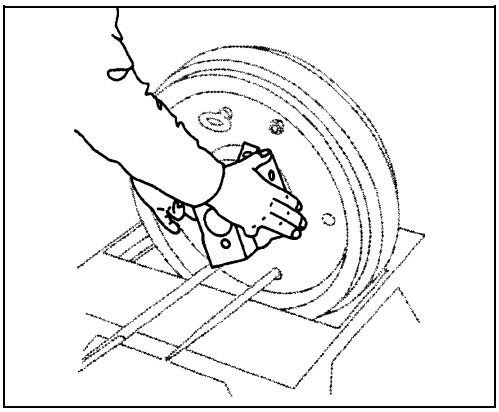
15. Fabricate an air pressure tester and connect to idler at fill plug hole. Slowly apply 20 to 35 [kPa] of air pressure to idler. Assembly must maintain this pressure for 10 to 20 [sec] with no drop in pressure.



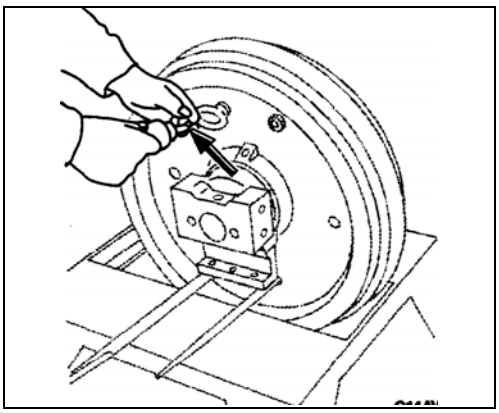
16. Fill idler with recommended oil, refer to OPERATOR'S MANUAL.



17. Rotate mounting bracket five to ten revolutions to distribute oil. Check level and add as required. Proper level is when fill hole at vertical, oil level should be at base of fill plug hole.

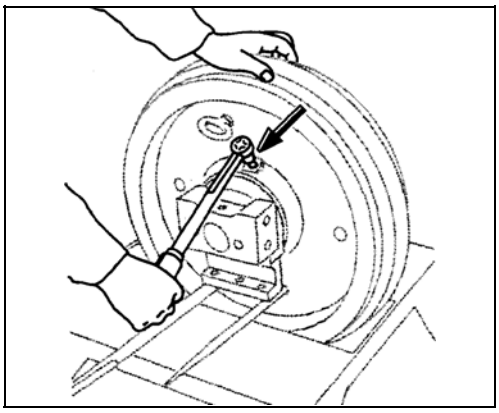


18. Coat fill plug with Loctite #592.

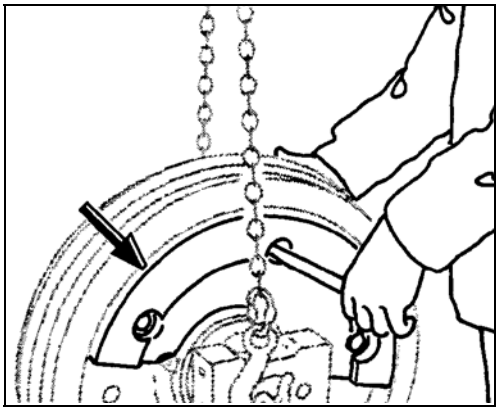


FRONT IDLER

19. Torque fill plug to 34 [Nm].



20. Install counterweights, at furthest outer point, and secure with hardware. Torque bolts to 92 ±10% [Nm].



FRONT IDLER

10. INSTALLATION

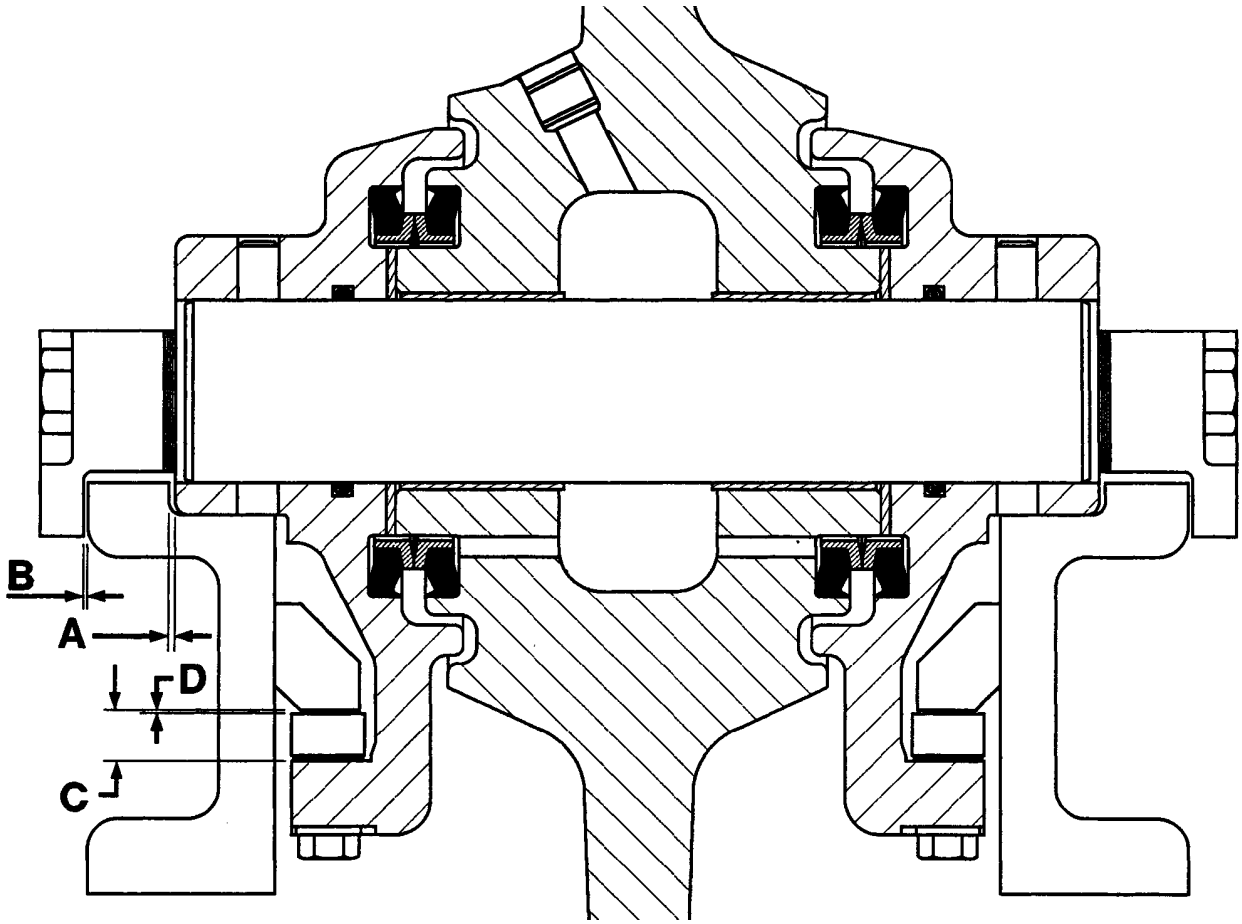
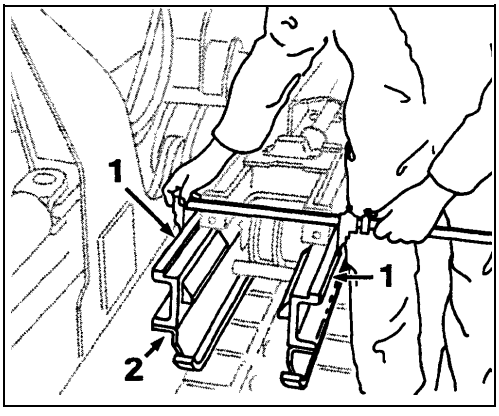


Fig. 14.5. Front Idler Installation

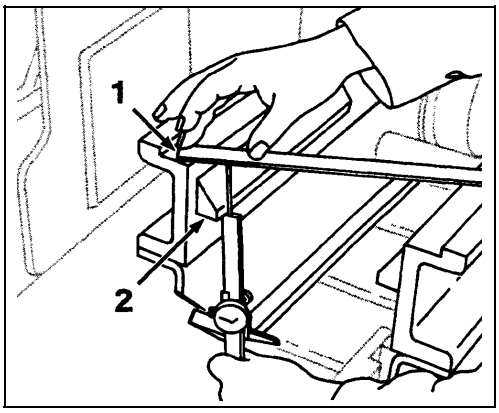
A	Roller Equalized Within Track Frame	Equalized
B	Thrust Plate to Track Frame Gap	0.15 to 0.76 [mm]
C	Distance Between Mounting Bracket and Track Frame Wear Bar	Measurement
D	Distance Between Track Frame and Wear Bar	0.15 to 1.00 [mm]

1. Measure distance between top outside edges (1) of track frame (2) at three places. Read, average and record measurements. This distance will be used in point 12, below.



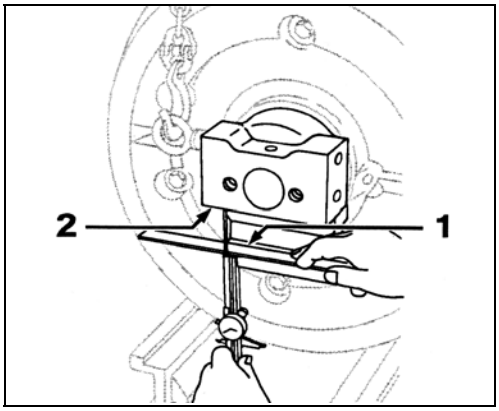
FRONT IDLER

2. Measure distance between track frame top slide rail (1) and bottom of track frame welded wear bar (2) at each end and center. Read, average and record measurements. Repeat for remaining side.



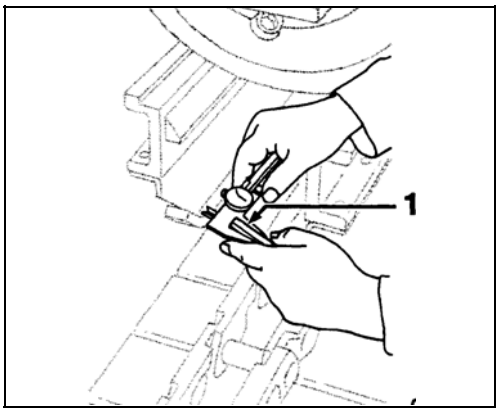
3. Measure distance between mounting bracket lower surface (1) and top surface of mounting bracket (2) at three places. Read, average and record measurements. Repeat for remaining side.

NOTE: *Fill port plug side is determined as outer side of front idler.*



4. Measure thickness of bolted wear bar (1) at three places. Read, average and record measurements. Repeat for remaining wear bar.

NOTE*: Keep readings from each side separate from each other.*



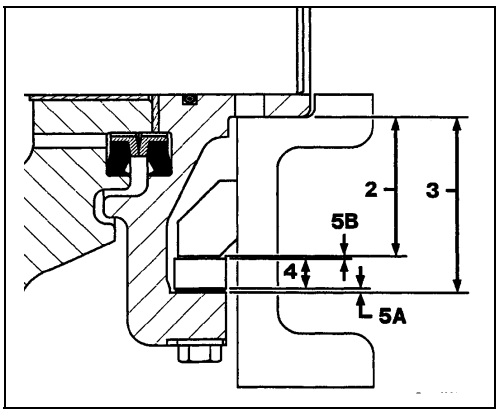
NOTE: *The callouts at right correspond with Steps 2 through 4.*

5. Determine each wear bar shim thickness as follows;

   A. Subtract averaged readings of Steps 2 and 4 from Step 3 and record clearance.

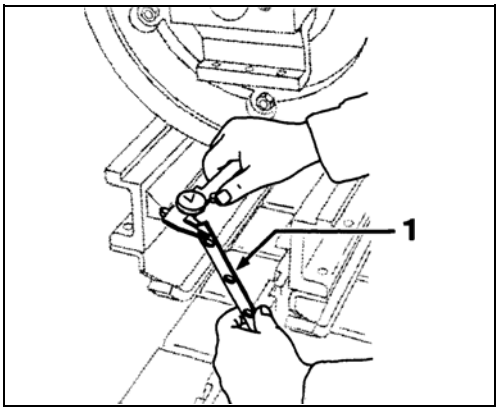
   B. Subtract 0.15 to 1.00 [mm] from clearance (A) to obtain shim thickness.

Repeat for remaining side.

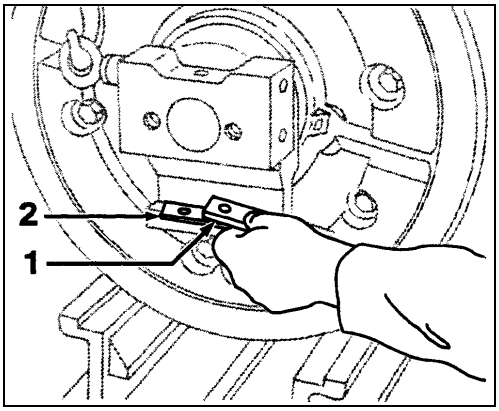


FRONT IDLER

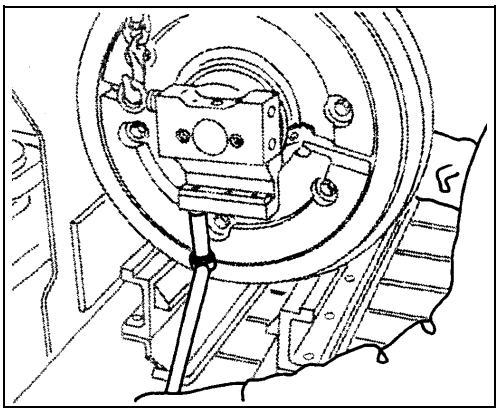
6. Measure shims (1) for thickness.



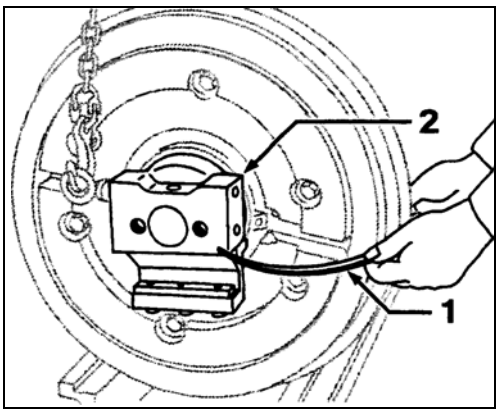
7. Install wear bar (1) and shims (2) and secure with hardware. Repeat for remaining side.



8. Torque bolts to 87 [Nm] on each side.

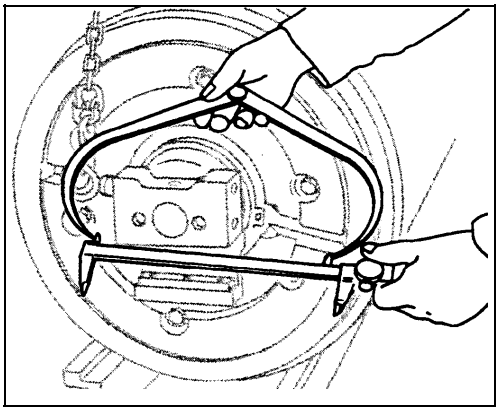


9. Using large outside calipers (1), measure distance between outside of mounting blocks (2) at front and rear.

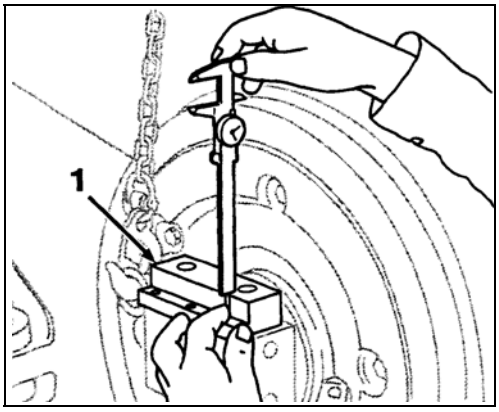


FRONT IDLER

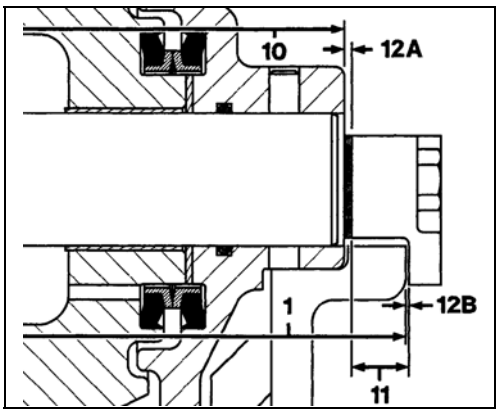
10. Read, average and record measurements.



11. Measure distance of stepped area of thrust plate (1) at three places. Read, average and record measurements.



NOTE: *The callouts at right correspond with Steps 1,10 and 11.*

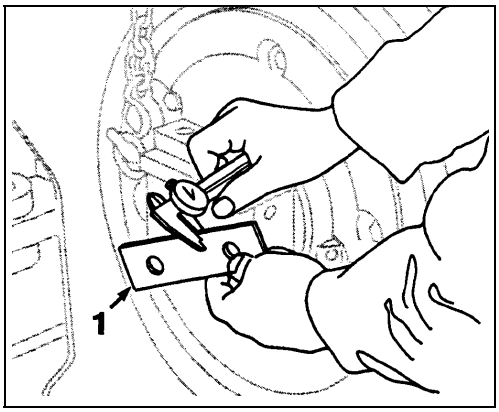


12. Determine thrust plate shim thickness as follows;

    A. Add averaged readings of Steps 10 and 11 (x2). Subtract this from averaged readings in Step 1 and record clearance.

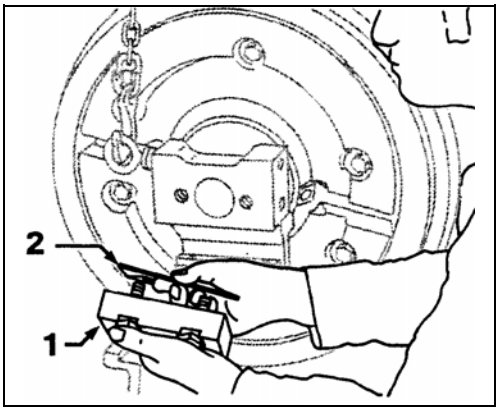
    B. Add 0.3 to 1.5 [mm] to clearance (A) to obtain shim thickness. Split shims evenly per side.

13. Measure shims (1) for thickness.

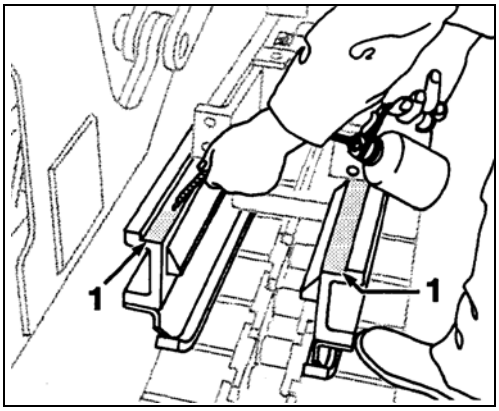


FRONT IDLER

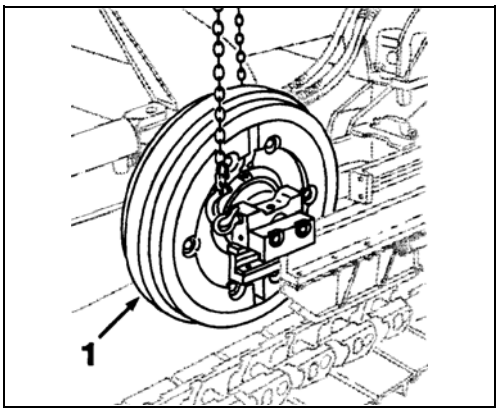
14. Install thrust plate (1) and shims (2) and secure with hardware. Repeat for remaining side.



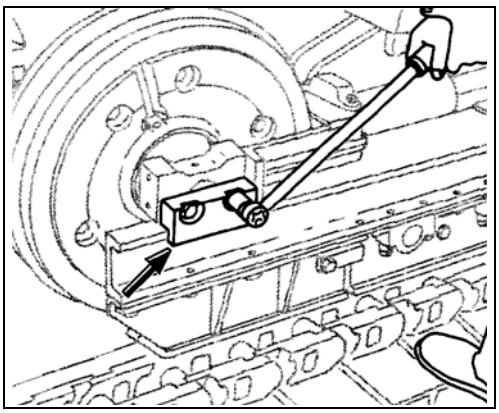
15. Apply thin coat of clean oil to each sliding surface (1) of track frame.



16. Install front idler (1) into track frame.

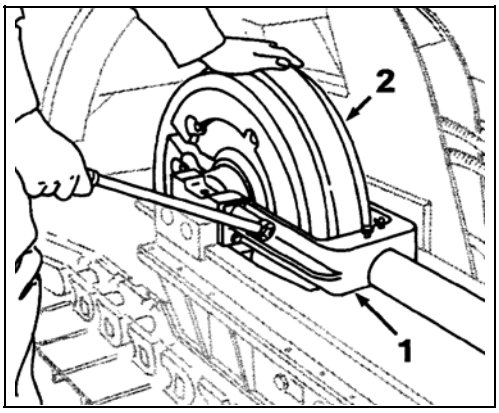


17. Torque thrust plate bolts to 190 [Nm] on each side.

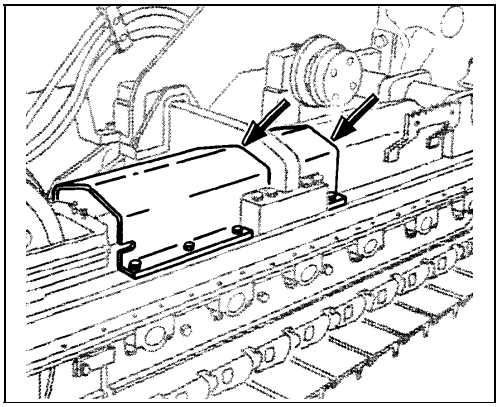


FRONT IDLER

18. Install track adjuster (1) to front idler (2) and secure with hardware. Torque bolts to 134 [Nm].



19. Install track frame covers and secure with hardware. Torque bolts to 92 ±10% [Nm].



20. Install track chain, refer to SECTION 15.

TRACK ADJUSTER

11. REMOVAL

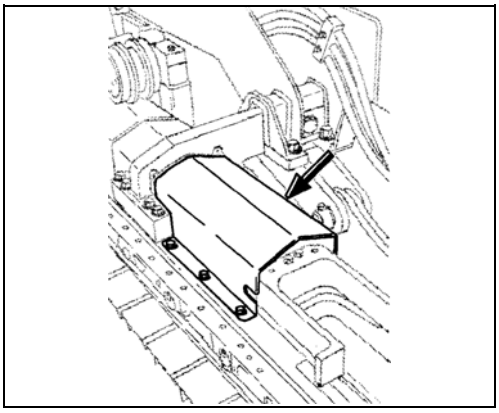
WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train control lever is locked in neutral position and parking brake is set. The starting switch and the electrical system master switch are turned OFF, keys are removed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

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.

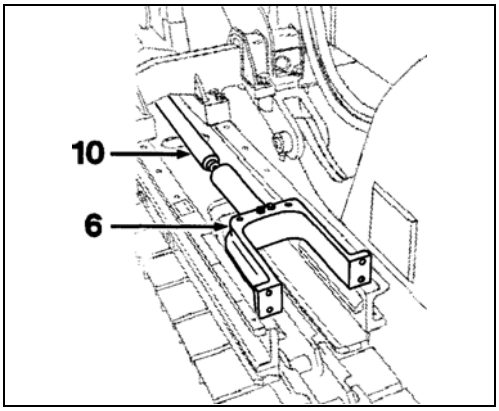
1. Remove the track chain as described in Section 15.
2. Remove the front idler, refer to REMOVAL, FRONT IDLER in this Section.

NOTE: *Callouts from exploded view (Fig. 14.6) correspond with callouts in following steps.*

3. Remove front frame cover.

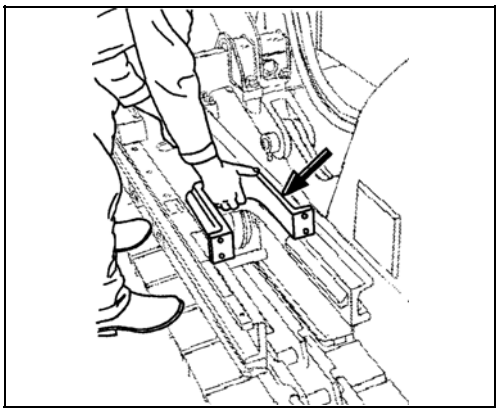


4. Separate fork (6) from rod (10).

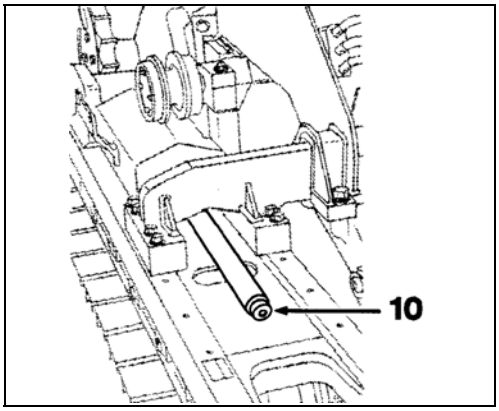


TRACK ADJUSTER

5. Remove fork from track frame.

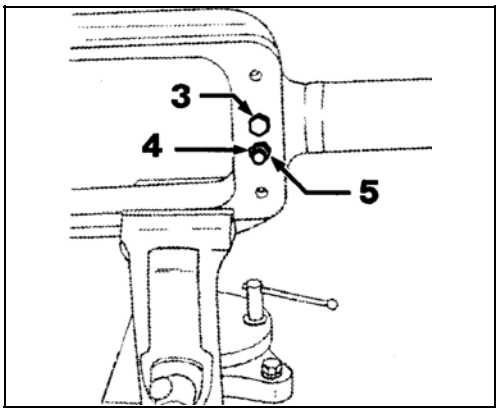


6. Release rod (10) from spring retainer and remove.



12. DISSASEMBLY

1. Remove check valve (5) with lube fitting (4) and relief valve (3).



TRACK ADJUSTER

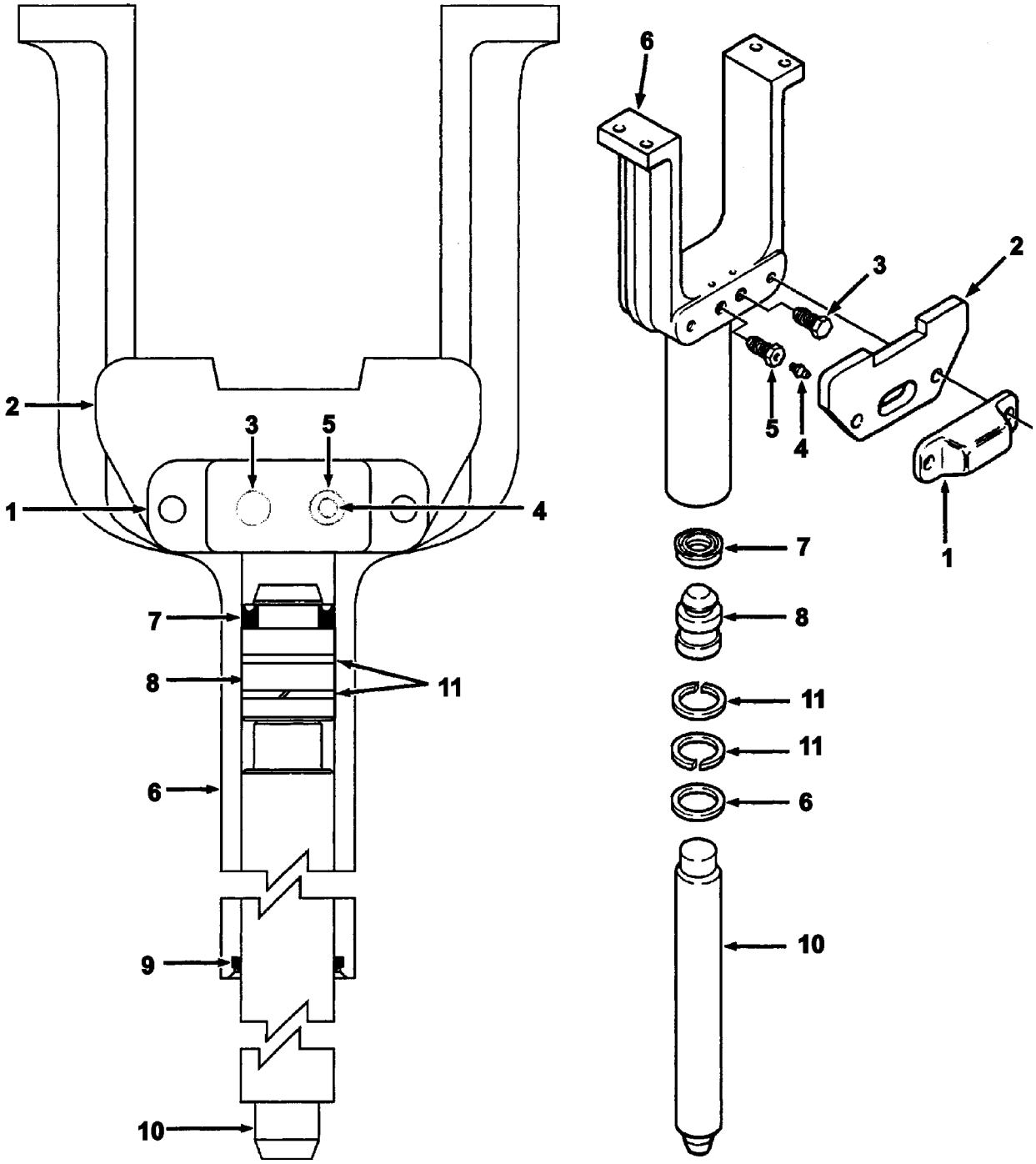
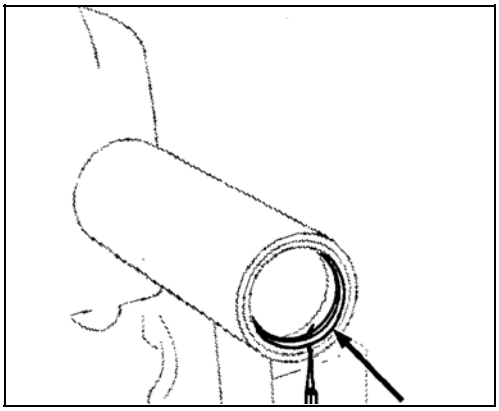


Fig. 14.6. Exploded and Cross Section Views of Track Adjuster

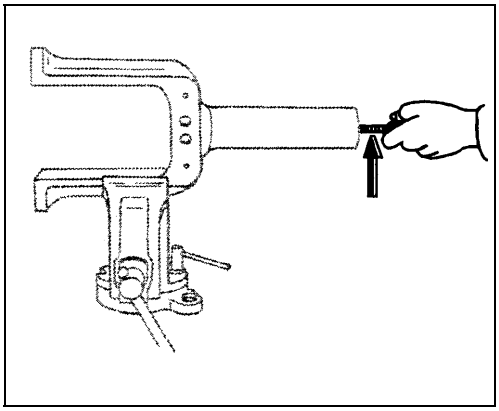
1. Adjuster Shield
2. Scraper Plate
3. Relief Valve
4. Lube Fitting
5. Ball Check Valve
6. Front Idler Fork
7. Seal Ring
8. Adjuster Piston
9. Wiper Ring
10. Adjuster Rod
11. Wear Rings

TRACK ADJUSTER

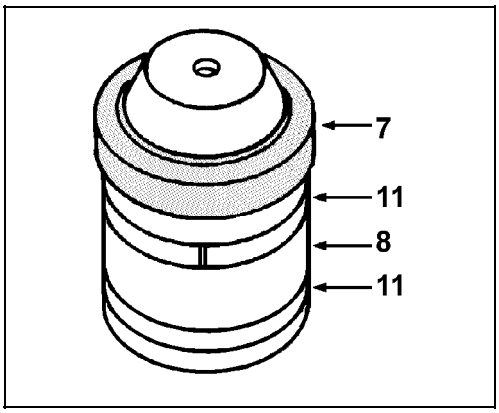
2. Remove wiper ring (9) from fork.



3. Install a ½ NC threaded rod into piston and remove from fork.



4. Remove seal ring (7) and wear rings (11) from piston (8).



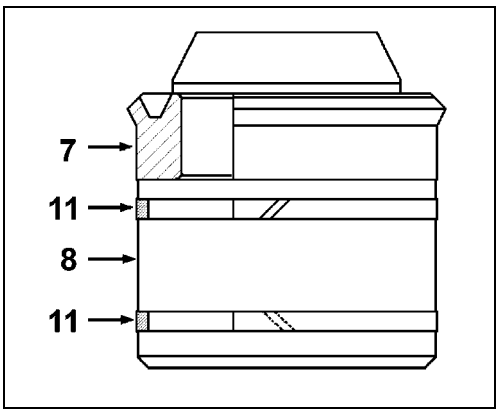
13. INSPECTION AND REPAIR

1. It is recommended that a new wear rings (11), wiper ring (9) and seal ring (7) 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 (6, 8 and 10) for excessive wear or damage and replace if necessary.

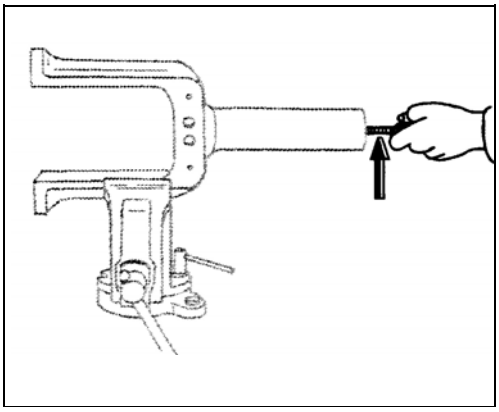
TRACK ADJUSTER

14. REASSEMBLY

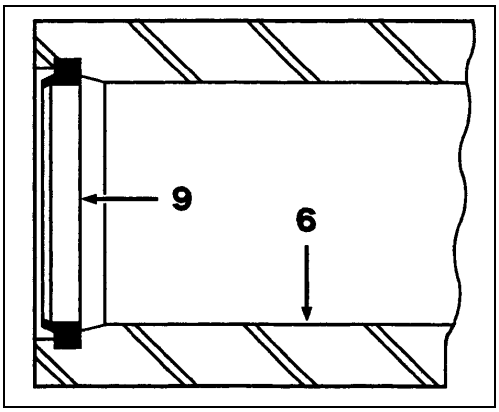
1. Install seal ring (7) to piston (8) with "U" portion of ring facing away from piston. Install wear rings (11) with slits 180 [°] apart.



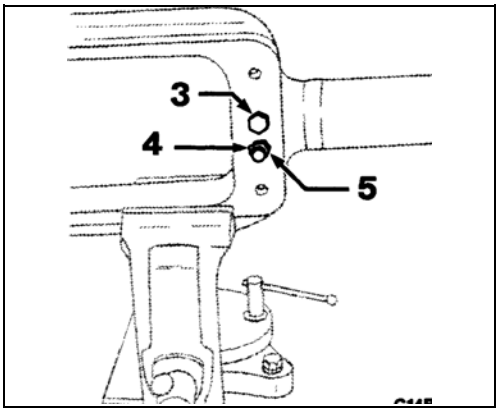
2. Coat seal ring and bore of fork with clean grease. Install a $^{1}/_{2}$ NC threaded rod into piston and insert into fork being careful not to cut or slice seal ring and wear rings on wiper ring groove.



3. Install wiper ring (9) into groove in fork (6) with lips facing out.



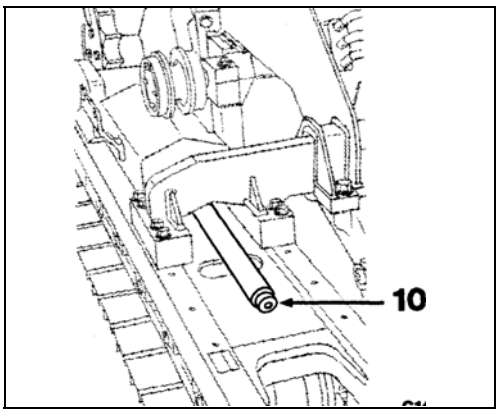
4. Install relief valve (3) and check valve (5) with lube fitting (4) to fork. Torque each to 68 [Nm].



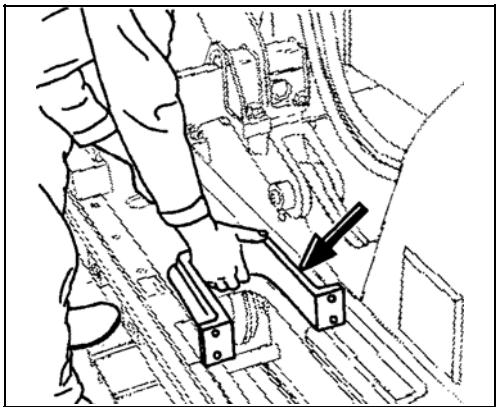
TRACK ADJUSTER

15. INSTALLATION

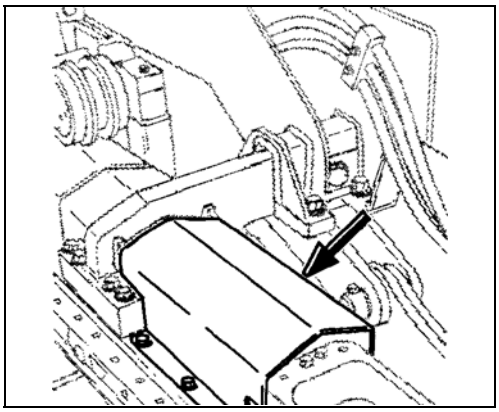
1. Position rod (10) in spring retainer and rest on track frame.



2. Position fork (6) and slide down on adjuster rod being careful not to cut or slice wiper ring.



3. Install track frame cover and secure with hardware. Torque bolts to 92 ±10% [Nm].



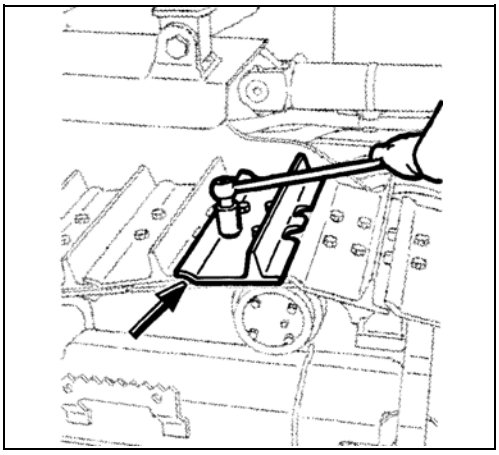
4. Install front idler, refer to FRONT IDLER in this Section
5. Install the track chain, refer to Section 15.
6. Adjust the track chain tension, refer to the ADJUSTING TRACK TENSION in Section 15.

TOP IDLER

16. REMOVAL

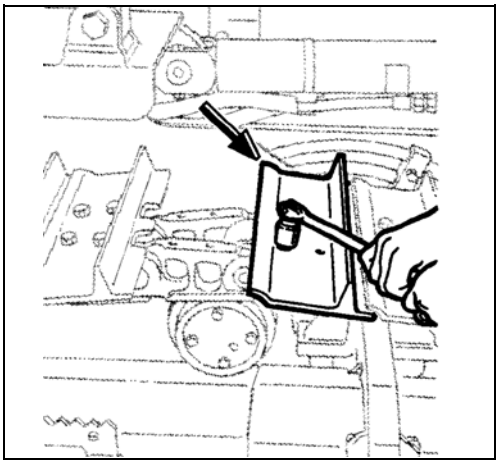
WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train control lever is locked in neutral position and parking brake is set. The starting switch and the electrical system master switch are turned OFF, keys are removed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

1. Relieve track tension, refer to SECTION 15. Remove track shoe to rear of top idler.

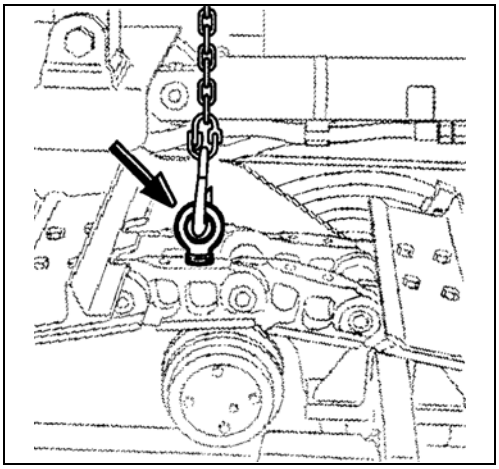


NOTE: *Make sure split link chain is not in the vicinity of top idler.*

2. Remove track shoe to front of top idler.

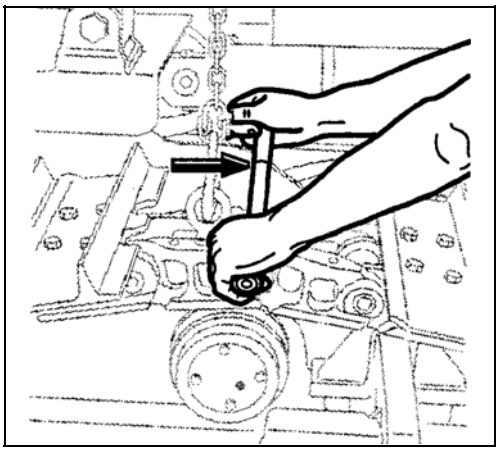


3. Attach hoist to chain and lift off of top idler.

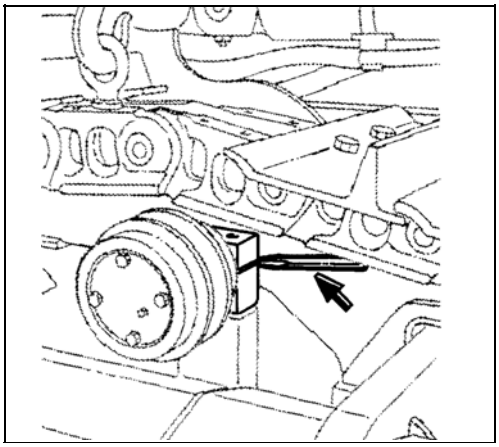


TOP IDLER

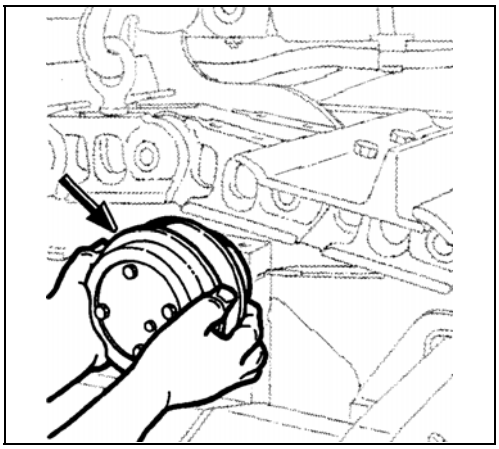
4. Between chain and frame, remove cinch mounting bolt from idler support.



5. Using a chisel, spread idler support for removal of idler.



6. Remove idler from support.



TOP IDLER

17. DISASSEMBLY

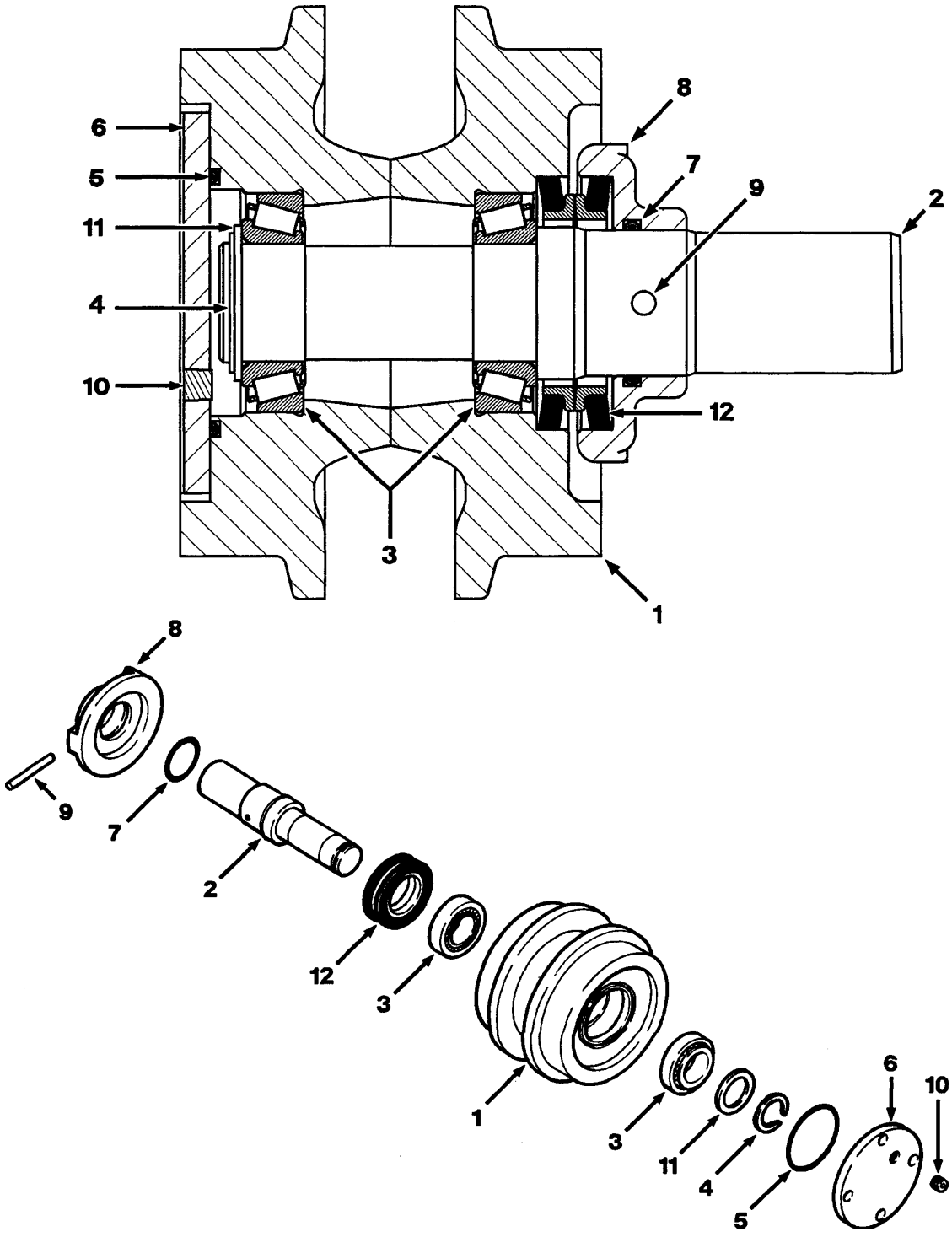


Fig. 14.7. Exploded and Cross Section Views of Top Idler

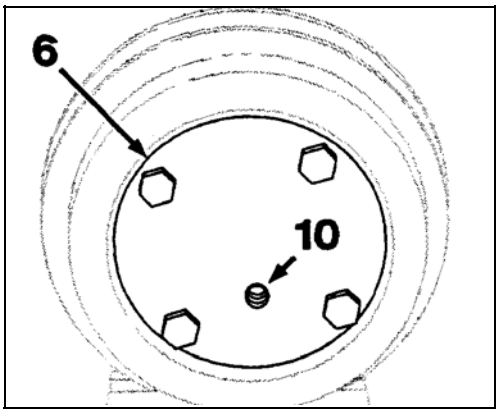
1. Top Idler Housing
2. Top Idler Shaft
3. Inner Bearing
4. Retaining Ring
5. O-Ring
6. End Cover
7. O-Ring
8. Retainer Cover
9. Spring Pin
10. Port Plug
11. Spacer Ring
12. Seal Kit

SUSPENSION

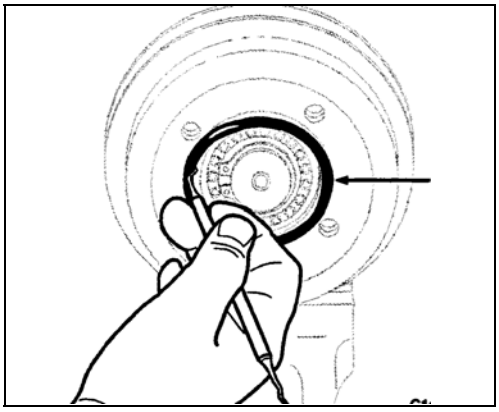
TOP IDLER

NOTE: *Callouts from exploded and cross section views (Fig. 14.7) correspond with callouts in following steps.*

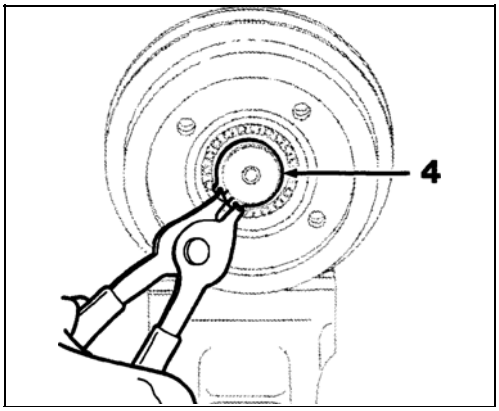
1. Position idler in vise. Remove plug (10) from cover and allow idler to drain. When drained, remove hardware and cover (6) from idler.



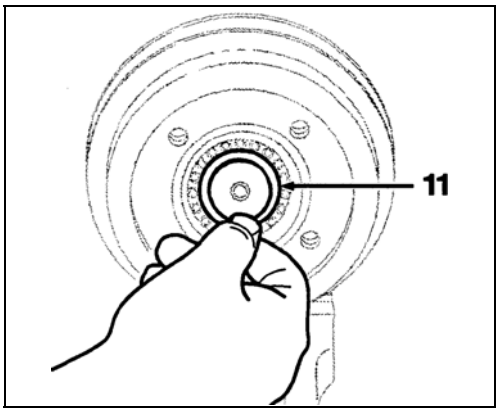
2. Remove O-ring (5) and discard.



3. Remove retaining ring (4) from shaft.

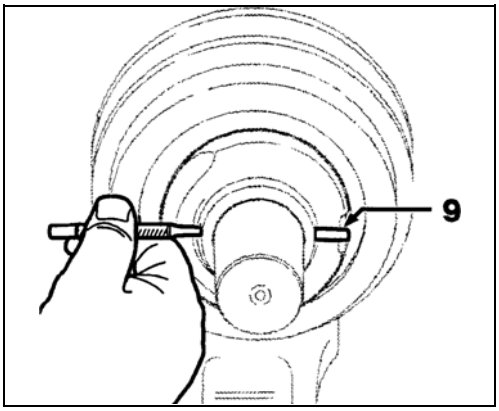


4. Remove spacer ring (11) from shaft.



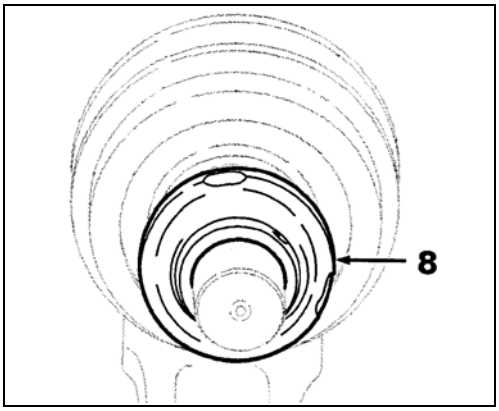
TOP IDLER

5. Turn assembly around in vise. Drive out spring pin (9) from retainer cover.

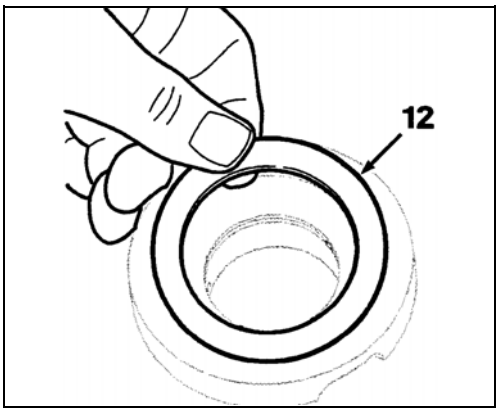


6. Remove retainer cover (8) from shaft.

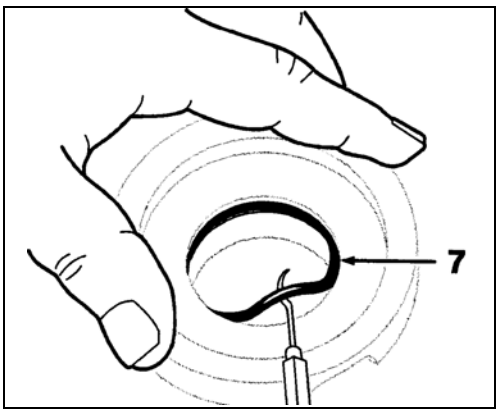
NOTE*: Metal portion of seal half will usually stay with shaft.*



7. Remove rubber portion of seal half (12) from retainer cover.



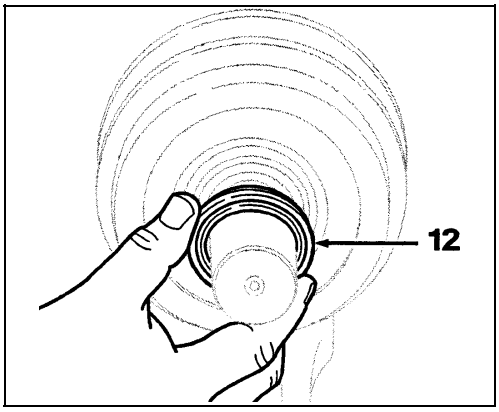
8. Remove O-ring (7) from retainer cover.



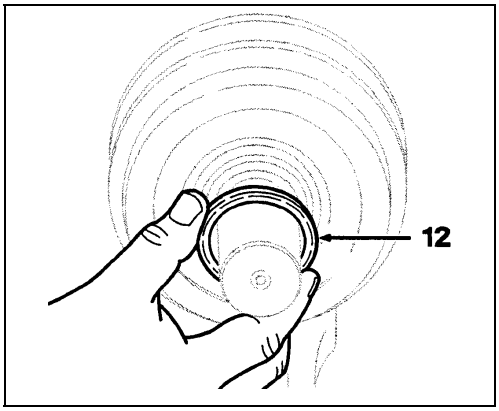
SUSPENSION

TOP IDLER

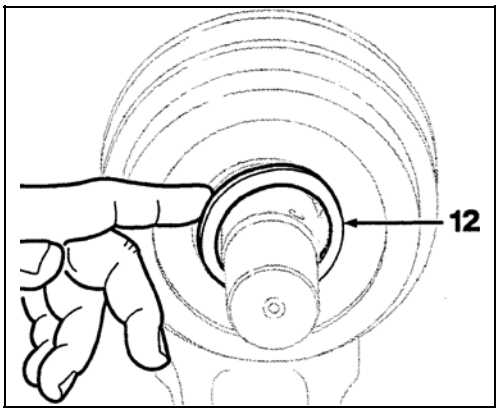
9. Remove metal portion of seal half (12) from shaft.



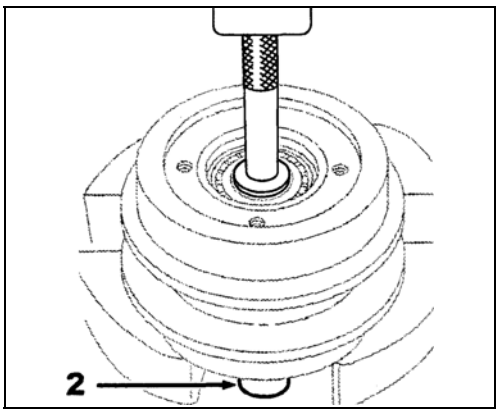
10. Remove metal portion of seal half (12) from idler body.



11. Remove rubber portion of seal half (12) from idler body.

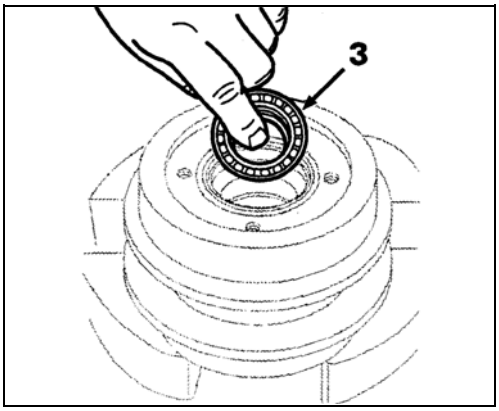


12. Position assembly in press, cover side up. Apply press and remove shaft (2) from idler body.

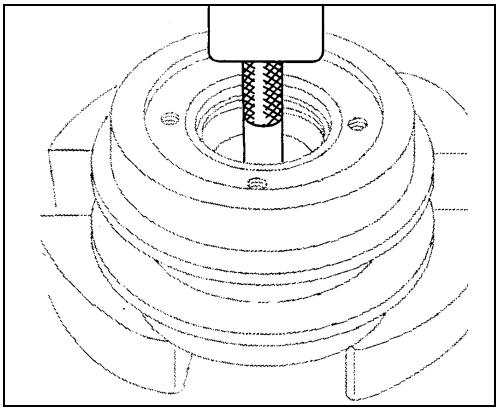


TOP IDLER

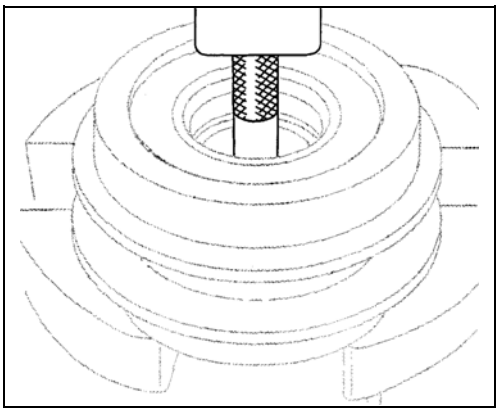
13. Remove loose bearing cone (3) from assembly.



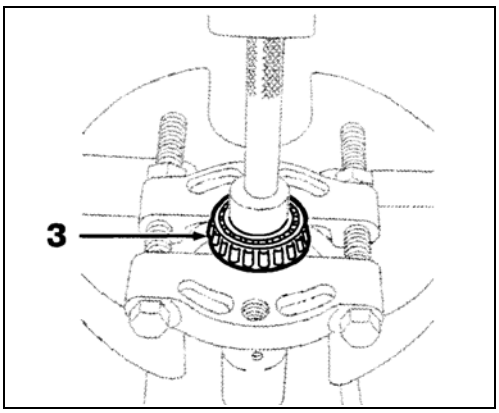
14. Using a suitable puller remove rear bearing cup from idler body.



15. Turn roller body over in press and remove remaining bearing cup.



16. Install puller arrangement and press bearing (3) off shaft.



TOP IDLER

18. INSPECTION AND REPAIR

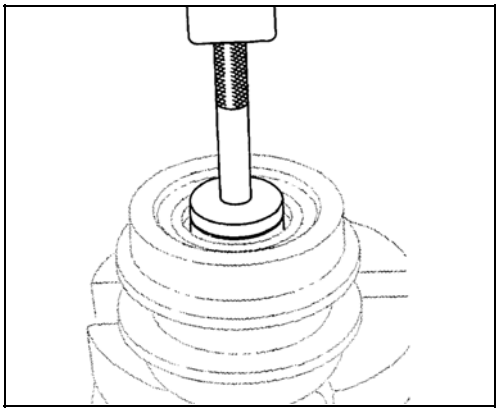
NOTE: *Clean all parts thoroughly in a dry cleaning solvent, especially the inside of the idler. Blow all parts dry with compressed air.*

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 housing 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. Whenever a top idler is disassembled, used seals must pass an inspection or a new seal used. refer to METAL TYPE FACE SEALS in this Section,

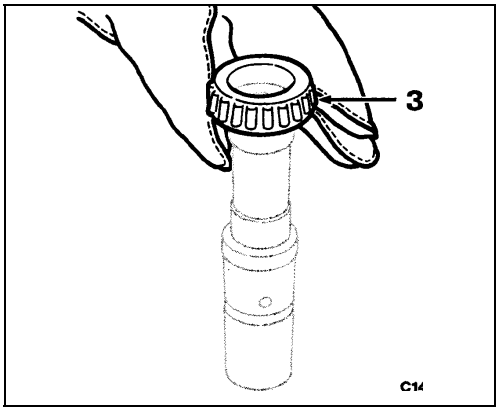
19. REASSEMBLY

NOTE: *Callouts from exploded and cross section views (Fig. 14.7) correspond with call-outs in following steps.*

1. Position idler body in press and bottom bearing cup. Turn idler body over and repeat for remaining bearing cup.

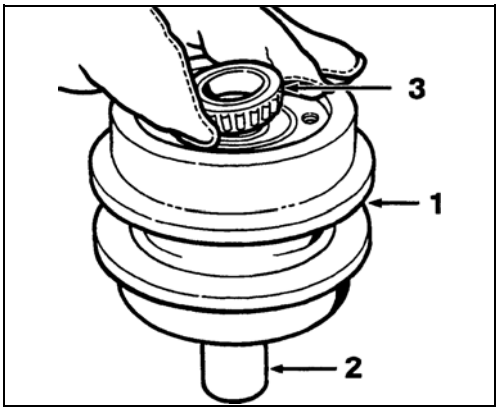


2. Heat bearing cone (3) to 135 [°C] for 45 [min]. Install on shaft and bottom. To insure cone is seated, keep pressure against cone until it cools.

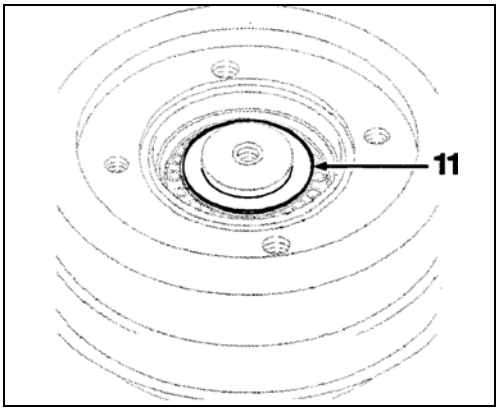


TOP IDLER

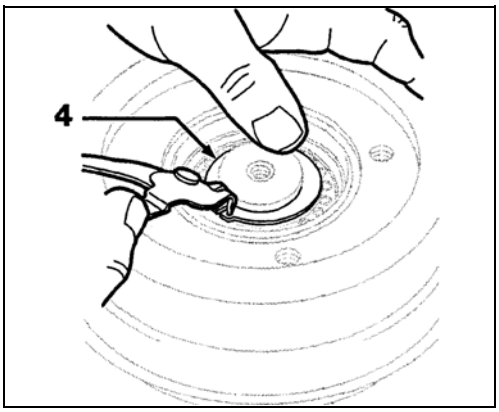
3. Install idler body (1) over shaft (2). Heat bearing cone (3) to 135 [°C] for 45 [min]. Install on shaft and bottom. To insure cone is seated, keep pressure against cone until it cools.



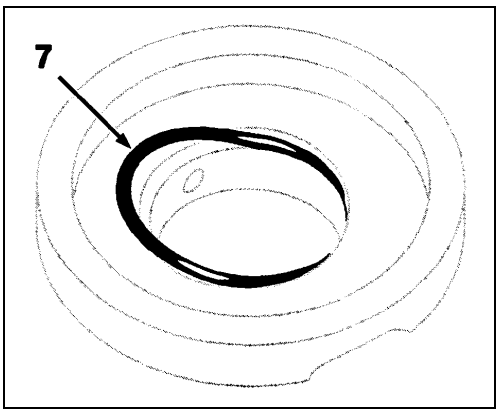
4. Install spacer ring (11) on shaft.



5. Install retaining ring (4) to shaft.

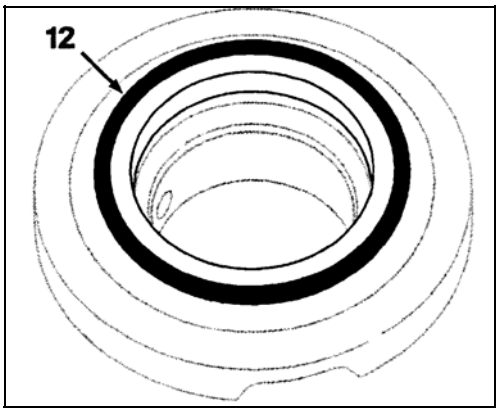


6. Install new O-ring (7) into retainer cover.

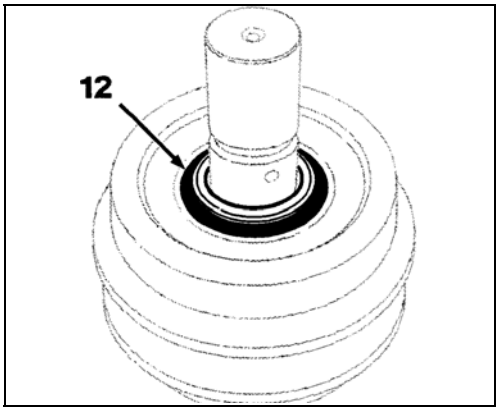


TOP IDLER

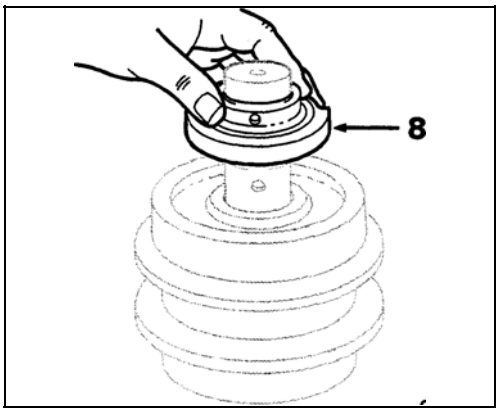
7. Install seal half (12) into retainer cover. Refer to METAL TYPE FACE SEALS in this Section.



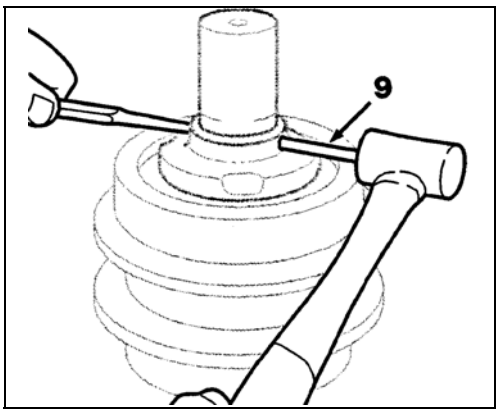
8. Install seal half (12) into idler body. Refer to METAL TYPE FACE SEALS in this Section.



9. Coat O-ring in retainer cover (8) with MPG and install on shaft.

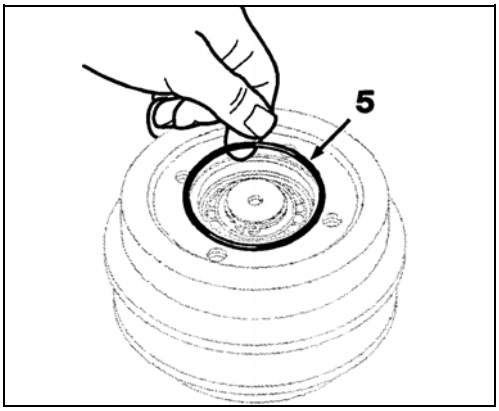


10. Using a dowel pin to load retainer cover, install spring pin (9).

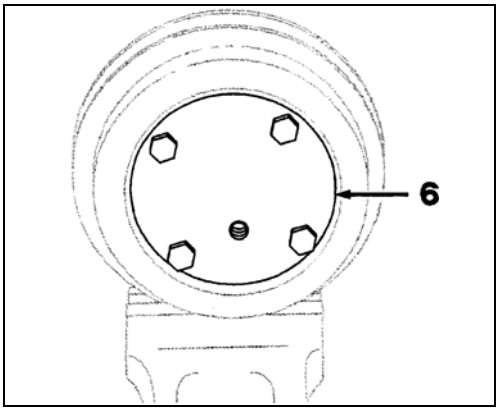


TOP IDLER

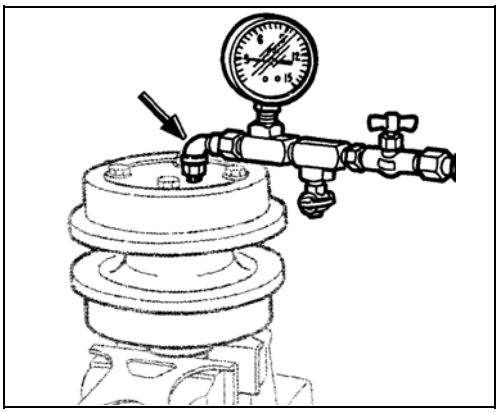
11. Install O-ring (5) into idler housing.



12. Install cover (6) and secure with hardware. Torque bolts to 38 ± 10%.[Nm].



13. Fabricate an air pressure tester and connect to top idler at fill plug hole.
    Slowly apply 20 to 35 [kPa] of air pressure to idler. Assembly must maintain this pressure for 10 to 20 [sec] with no drop in pressure.

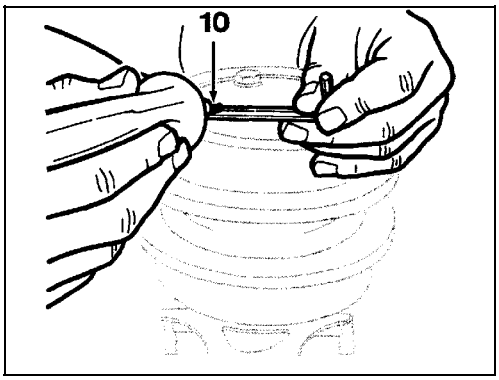


14. Fill top idler with recommended type and quantity of lubricant. Refer to OPERATOR'S MANUAL.

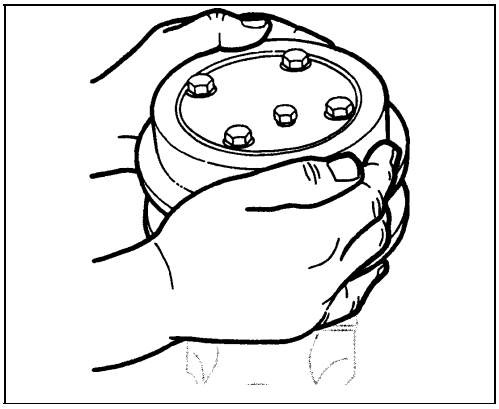


TOP IDLER

15. Apply Loctite #592 to fill plug (10) and install it. Torque plug to 20 to 60 [Nm].

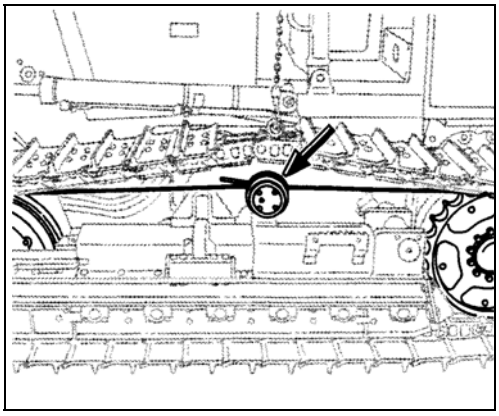


16. Rotate idler assembly five to ten revolutions to distribute lubricant.

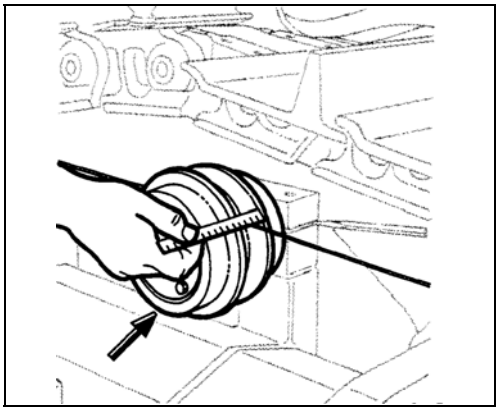


20. INSTALLATION

1. Install top idler into support. Run a string between center of front idler and center of sprocket.

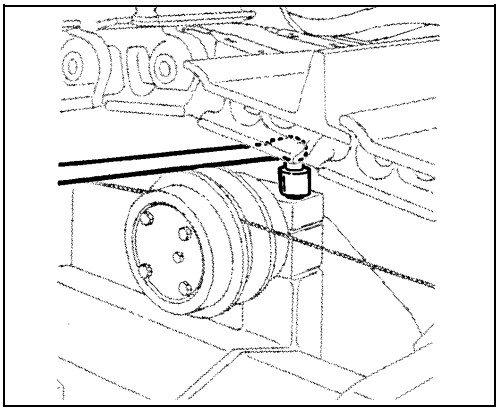


2. Center top idler along string. Remove chisel.



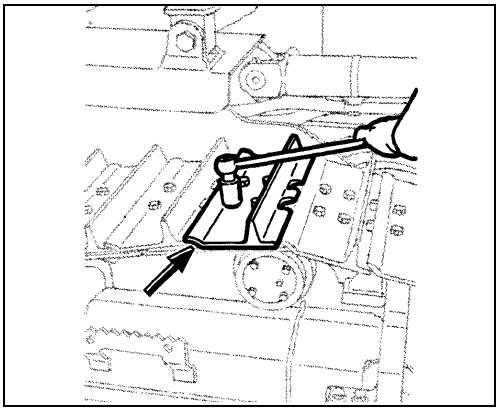
TOP IDLER

3. Install crimp mounting bolt and torque to 180 ± 10% [Nm]. Lower chain on top idler.



4. Install track shoes. Torques the bolts to 90 ± 20 [Nm] plus 120 [°].

   Bolts used for attaching the track shoes to the track chains are heat treated alloy bolts and will stand a considerable tightening strain. Ordinary bolts must not be used. The nuts must be assembled so that the washer face is not against the track link. The radius side of the nuts must be against the track link.



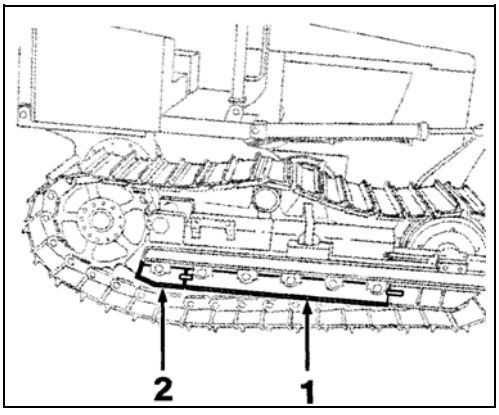
5. Adjust chain tension, refer to SECTION 15.

TRACK ROLLER

21. REMOVAL

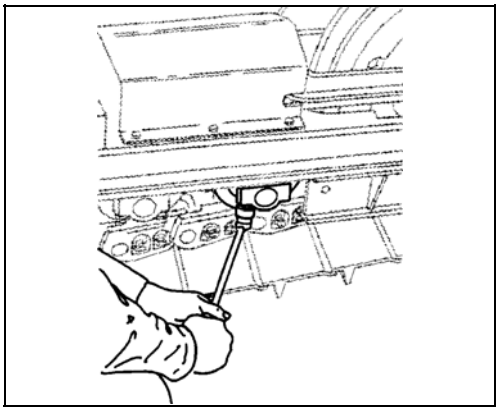
WARNING! Before working at the machine, be sure that the blade and ripper have been lowered to the ground, engine is OFF, the drive train control lever is locked in neutral position and parking brake is set. The starting switch and the electrical system master switch are turned OFF, keys are removed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

1. Release chain tension, refer to SECTION 15. Jack up machine approximately 150 [mm] off ground and install suitable stands under mainframe. Remove sprocket rock shields (1) and/or track roller shields (if necessary) (2) from track frame.

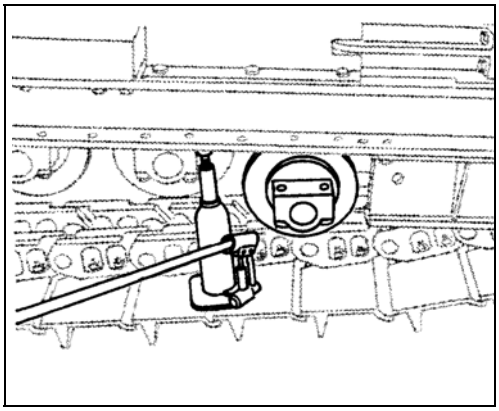


TRACK ROLLER

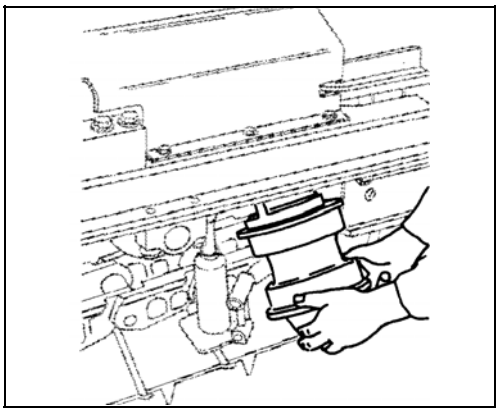
2. Remove bolts securing track roller shaft brackets to underside of track frame and remove roller. A tap with a soft hammer will usually free roller if it tends to stick in frame.



3. If there is not enough track chain slack to remove roller, position jack between chain and frame. Jack up until enough clearance is obtained to remove track roller.



4. Remove roller from track frame.



TRACK ROLLER

22. DISASSEMBLY

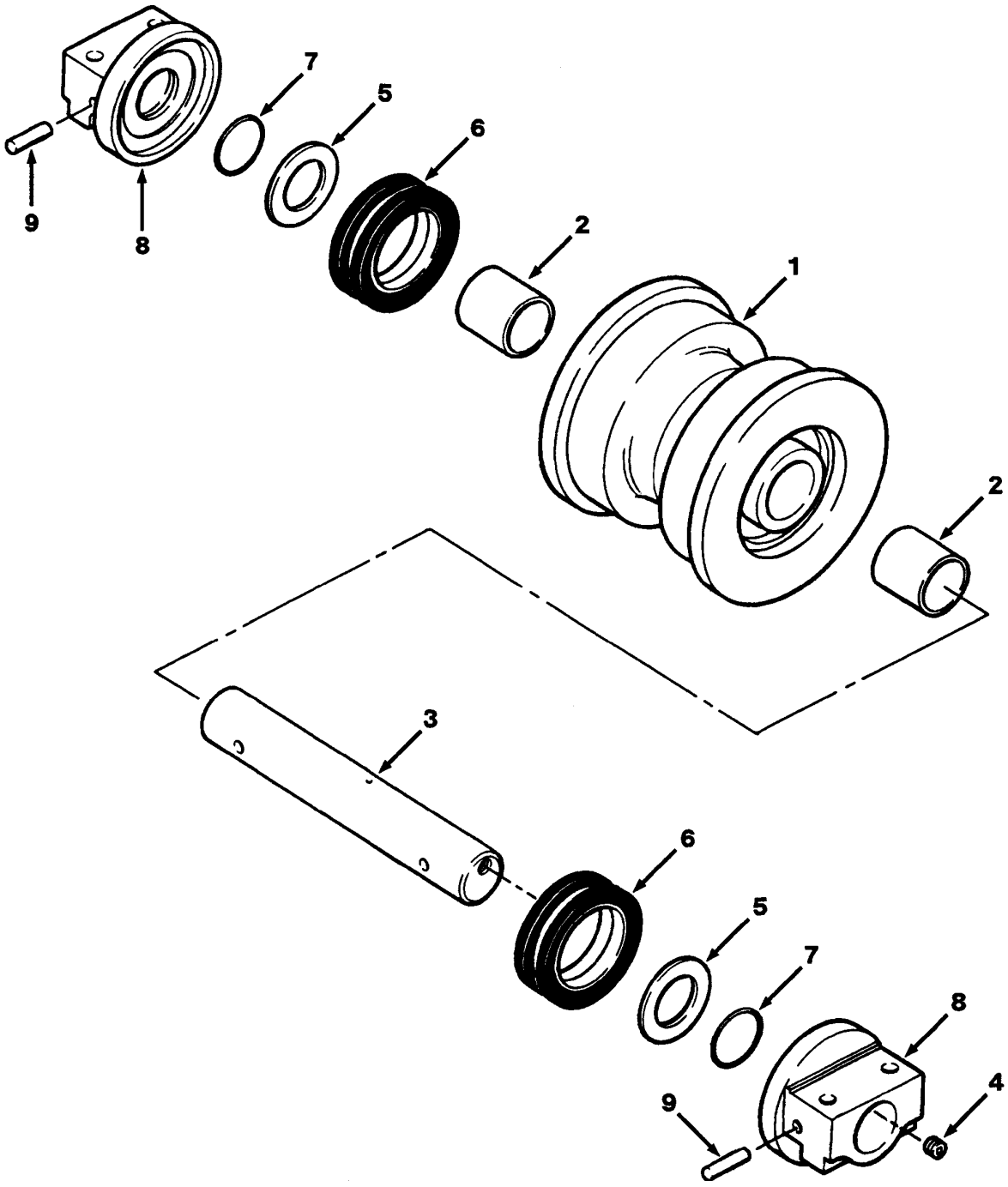


Fig. 14.8. Exploded View of Track Roller Legend for Exploded and Cross Section Views

Legend for Fig.'s 14.8 and 14.9

1. Track Roller Housing
2. Roller Housing Bushing
3. Track Roller Shaft
4. Port Plug
5. Thrust Washer
6. Seal Kit
7. O-Ring
8. Mounting Bracket
9. Spring Pin

TRACK ROLLER

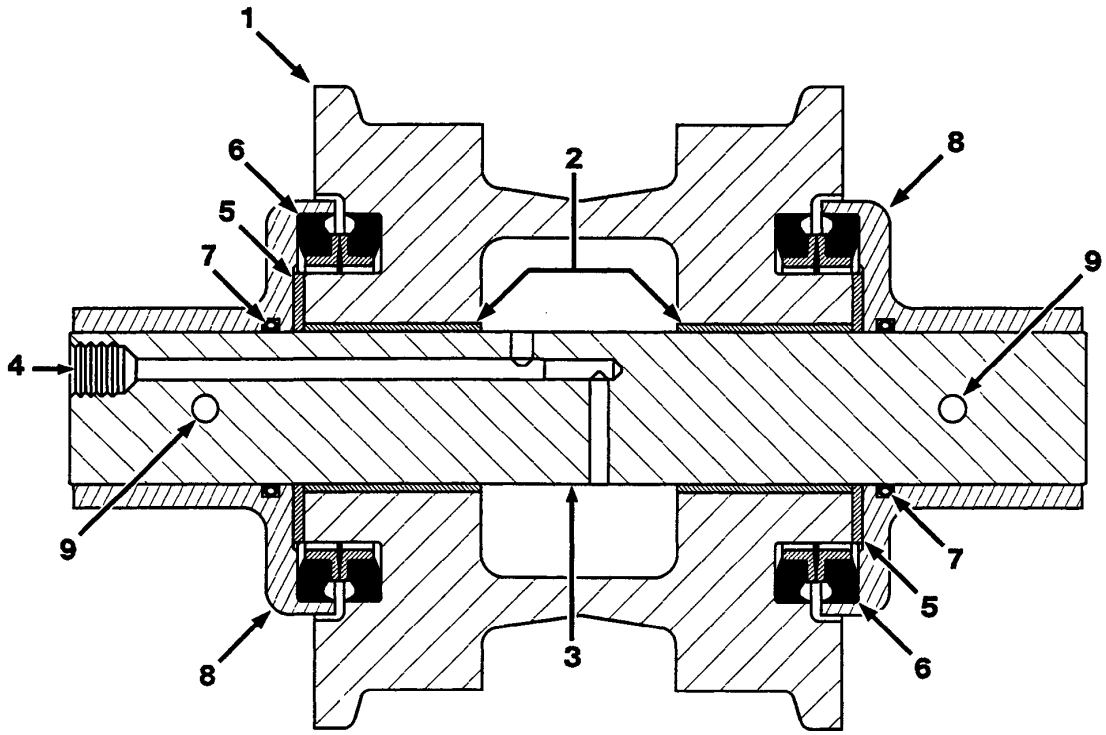
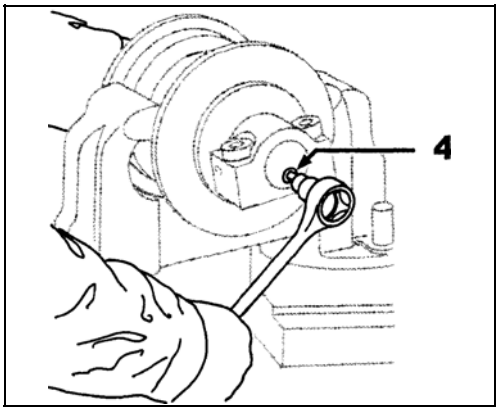


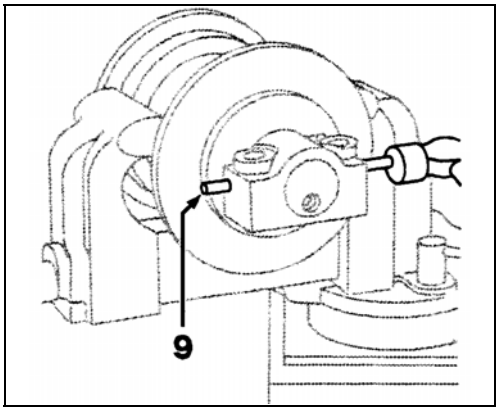
Fig. 14.9. Cross Section View of Track Roller

NOTE: *Callouts from exploded and cross section views (refer to Fig.'s 14.8 and 14.9) correspond with callouts in following steps.*

1. Remove drain plug (4) from roller shaft and drain into a suitable container.

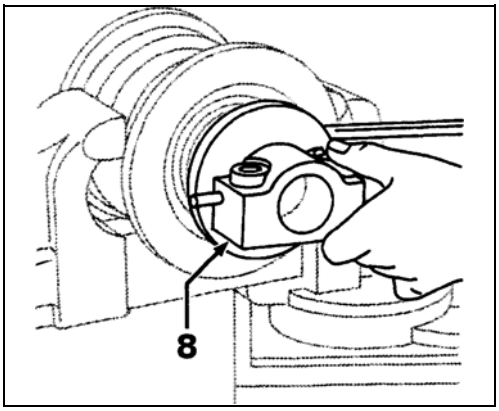


2. Drive out spring pin (9) securing mounting bracket to shaft.



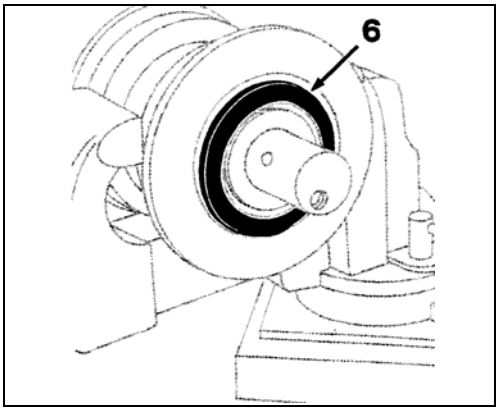
TRACK ROLLER

3. Remove mounting bracket (8) from shaft.

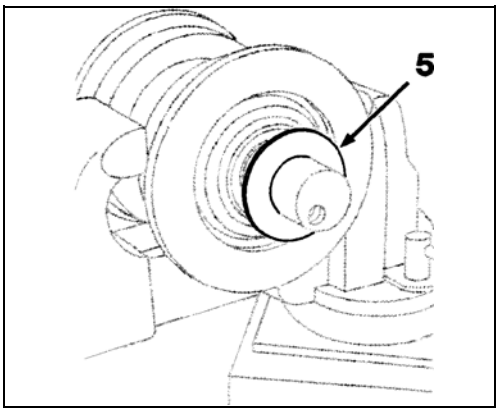


4. Remove outer half seal (6) from assembly. Refer to METAL TYPE FACE SEALS in this Section.

NOTE: *Keep original mated metal rings as a set. Do not mix a metal ring from one side of roller with other side.*

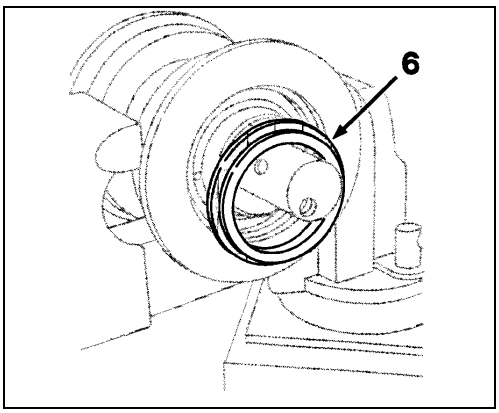


5. Remove thrust washer (5).



6. Remove inner half of seal (6) from assembly. Refer to METAL TYPE FACE SEALS in this Section.

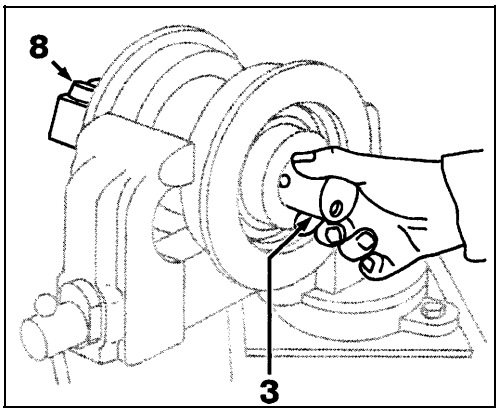
NOTE: *Keep original mated metal rings as a set. Do not mix a metal ring from one side of roller with other side.*



SUSPENSION

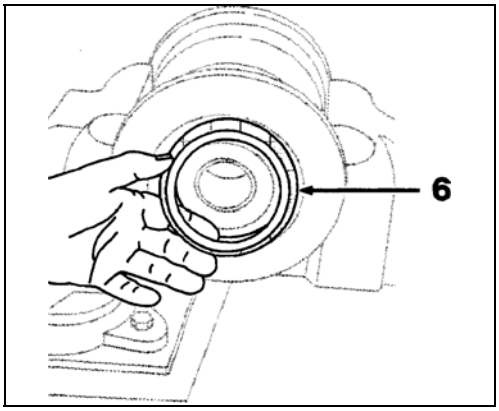
TRACK ROLLER

7. Remove shaft (3) with remaining mounting bracket (8).



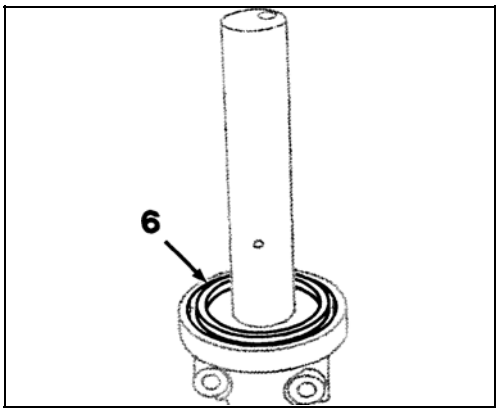
8. Remove inner half of seal (6) from roller housing. Refer to METAL TYPE FACE SEALS in this Section.

NOTE: *Keep original mated metal rings as a set. Do not mix a metal ring from one side of roller with other side.*

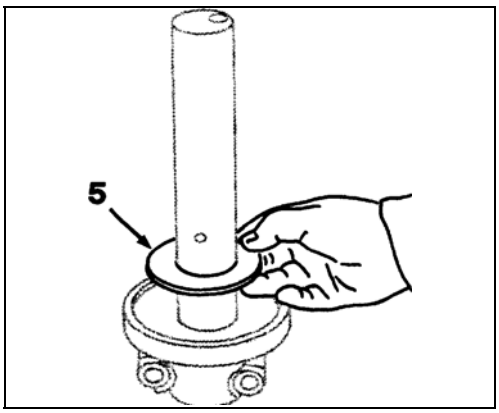


9. Remove outer half of seal (6) from mounting bracket. Refer to METAL TYPE FACE SEALS in this Section.

NOTE: *Keep original mated metal rings as a set. do not mix a metal ring from one side of roller with other side.*

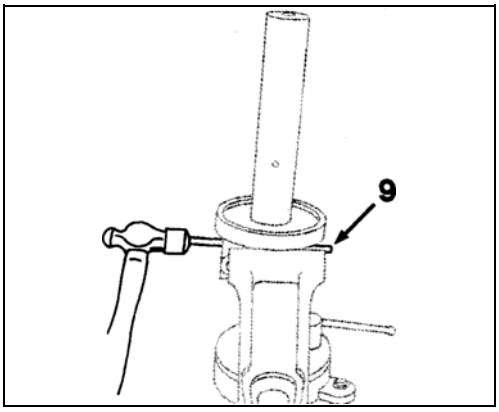


10. Remove thrust washer (5) from shaft.

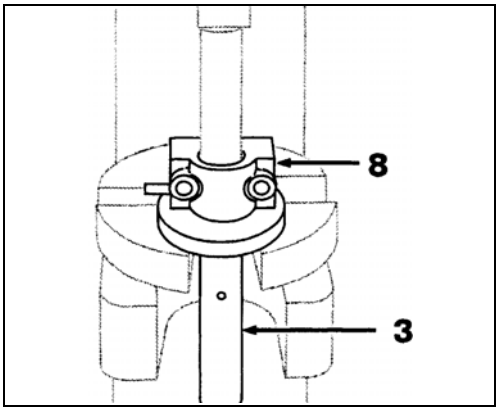


TRACK ROLLER

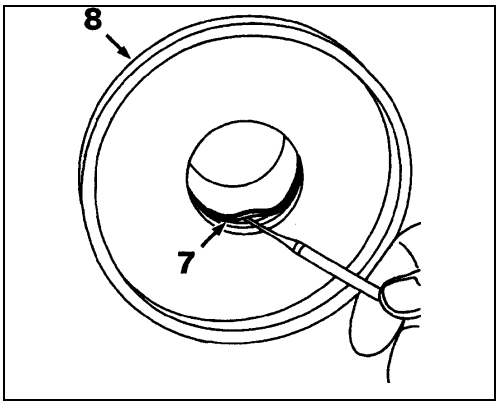
11. Drive spring pin (9) from mounting bracket.



12. Position shaft (3) and mounting bracket (8) in press and separate. This is required to overcome drag generated by internal O-ring.



13. Remove and discard O-ring (7) from each mounting bracket (8).



23. INSPECTION AND REPAIRS

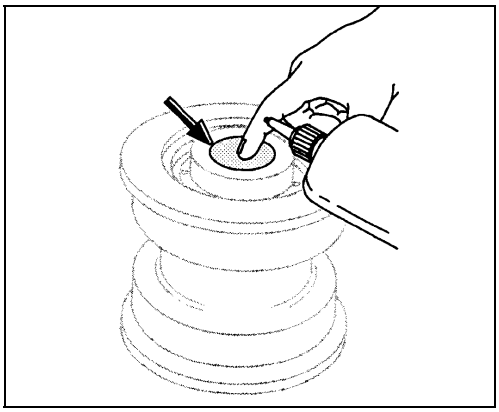
1. It is recommended that new O-rings be installed whenever the front idler is disassembled for service.
2. Wash all parts thoroughly in a suitable solvent. Dry thoroughly with compressed air. Wash all the bushings. Clean and flush out the bore of the track roller, as well as the oil passage in the roller shaft.
3. Inspect the roller shaft, bushings and rollers cracks, scores or excessive wear. Refer to REASSEMBLY, TRACK ROLLER in this Section.
4. Check the clearance limits given in Fig. 14.10.
6. Whenever a roller is disassembled, used seals must pass an inspection or a new seal used. Refer to METAL TYPE FACE SEALS in this Section.

TRACK ROLLER

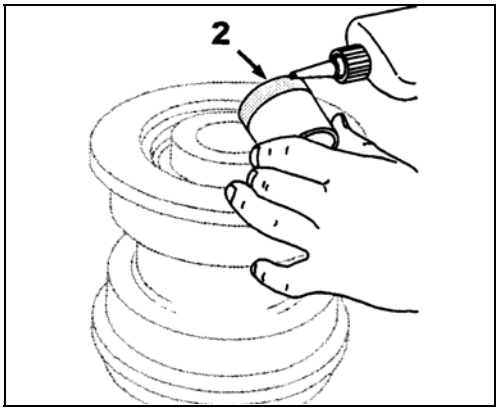
Track Roller Bushing Clearances

1. Remove the bushings in roller body and replace with new. Degrease and dry the roller bore ID and bushing OD. Remove any Loctite residue from the roller bushing bore. Position the parts vertically and apply Loctite Primer T to both the roller bore and bushing OD.

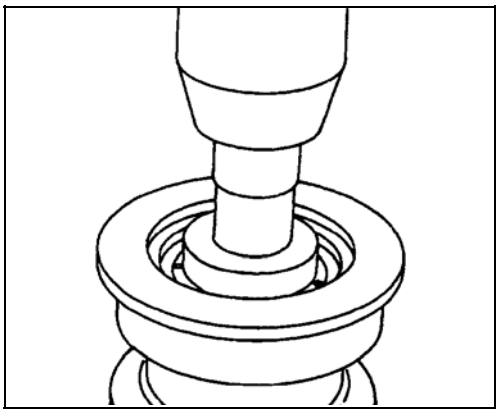
2. Coat 25 [mm] of outer idler hub bores with Loctite #609.



3. Coat 25 [mm] of leading edge of bushing (2) (edge which engages bore first) with Loctite #609.



4. Position in press and install bushings 0.8 [mm] below washer face surface within 3 [min] after Loctite #609 is applied. A minimum press force of 6500 [kg] is required to install bushing. Wipe off excess Loctite at both ends of the bore. Repeat for remaining bushing. Allow the Loctite to cure as specified in Loctite directions. Clean the inside of roller and bushings as much as possible before installing the shaft and adding oil.



5. Discard thrust washers and replace with new. Inspect the condition and OD of roller shaft and replace as necessary. Coat bushings and thrust washers with clean film of oil. Pin shaft to one mounting bracket. Install thrust washer onto shaft. Insert shaft through roller and secure with remaining mounting bracket. Position roller on blocking so that mounting brackets and shaft are free to rotate.
6. Position dial indicator on roller body with pointer on shaft and set to zero. Pry up on mounting bracket and record reading on dial indicator. Repeat a few time and average readings. Reading must be within specification. If not check dimensions of all parts and repeat until clearance is achieved. Disassemble assembly after clearance has been attained.

TRACK ROLLER

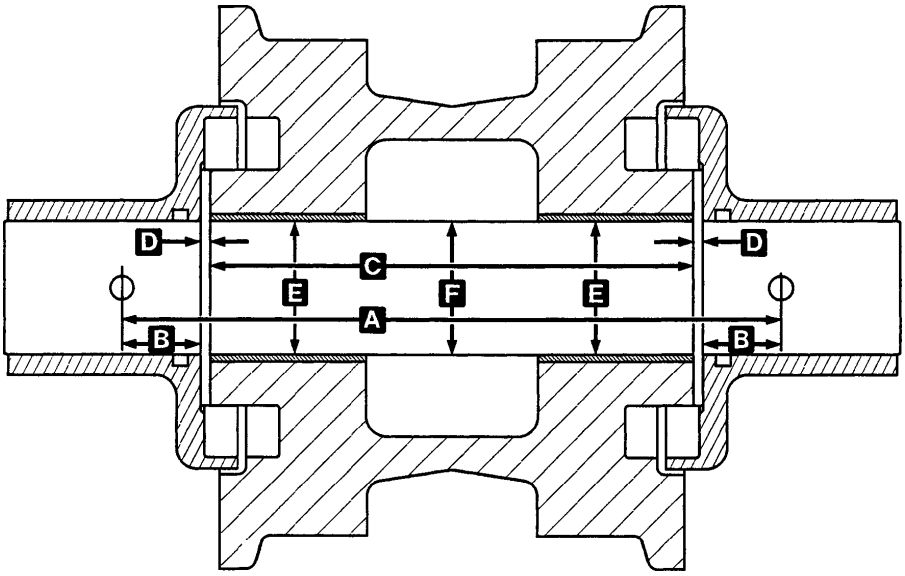


Fig. 14.10. Track Roller Clearances

TD7-M, TD-8M

	BUSHING END CLEARANCE	CLEARANCE [mm]
A	Pin to Pin Holes in Shaft	213.3 to 213.5
B	Pin Hole to Thrust Washer Face of Mounting Bracket x 2	37.7 to 38.2
C	Roller Hub Thrust Washer to Thrust Washer Face	170.2 to 170.5
D	Thrust Washer Thickness x 2	4.2 to 4.4
	Bushing End Clearance – **A** minus **B**, **C** and **D**	0.2 to 1.4

	DIAMETRAL OIL CLEARANCE	
E	Bushing Assembled Inside Diameter	44.5 to 44.63
F	Roller Shaft Diameter	44.25 to 44.3
	Diametral Oil Clearance - **E** minus **F**	0.2 to 0.38

TD-9M, TD-10M

	BUSHING END CLEARANCE	CLEARANCE [mm]
A	Pin to Pin Holes in Shaft	248.9 to 249.1
B	Pin Hole to Thrust Washer Face of Mounting Bracket x 2	61.0 to 61.5
C	Roller Hub Thrust Washer to Thrust Washer Face	182.5 to 182.8
D	Thrust Washer Thickness x 2	4.2 to 4.4
	Bushing End Clearance – **A** minus **B**, **C** and **D**	0.2 to 1.4

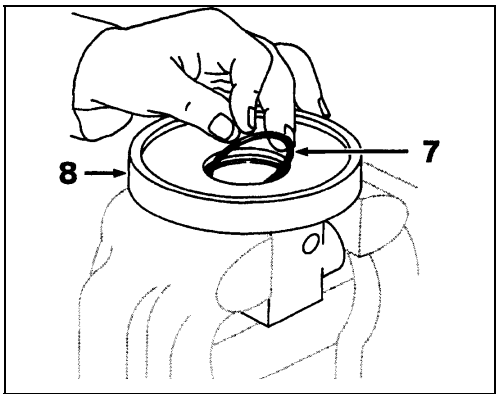
	DIAMETRAL OIL CLEARANCE	
E	Bushing Assembled Inside Diameter	50.85 to 50.98
F	Roller Shaft Diameter	50.6 to 50.65
	Diametral Oil Clearance - **E** minus **F**	0.2 to 0.38

TRACK ROLLER

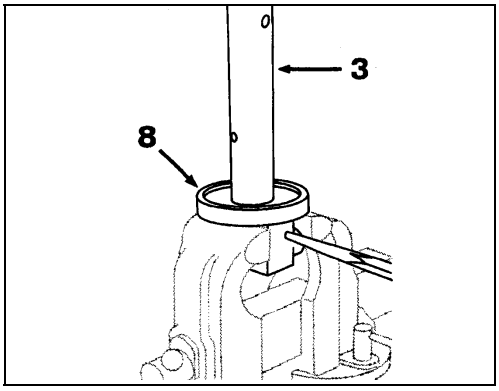
24. REASSEMBLY

NOTE: *Callouts from exploded and cross section views (Fig.'s 14.8 and 14.9) correspond with callouts in following steps.*

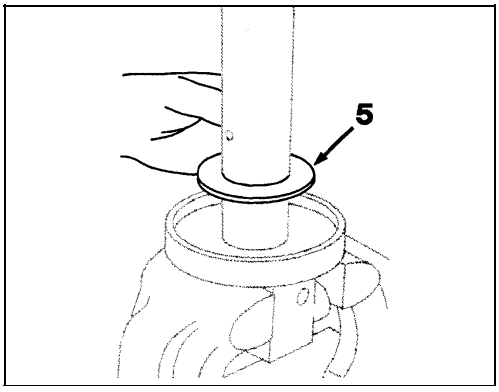
1. Position mounting bracket (8) in a vise. Install new O-ring (7) into bracket. Apply a thin coat of MPG to O-ring to aid in installation.



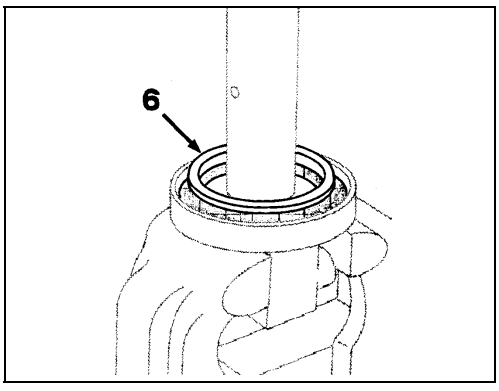
2. Install shaft (3) in bracket (8) and secure with spring pin. Be careful not to damage internal O-ring.



3. Install thrust washer (5) over shaft in bracket.

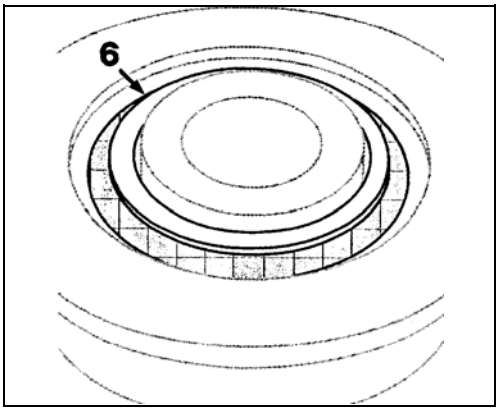


4. Install one half of seal (6) into bracket. Refer to METAL TYPE FACE SEAL in this Section.

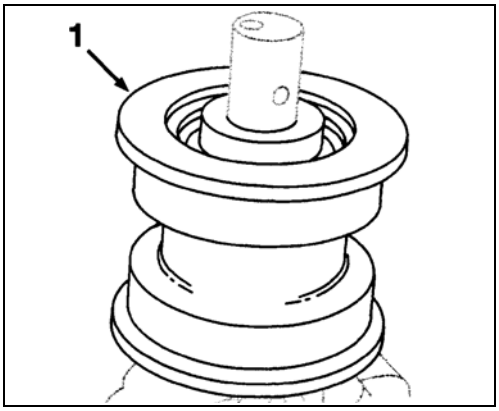


TRACK ROLLER

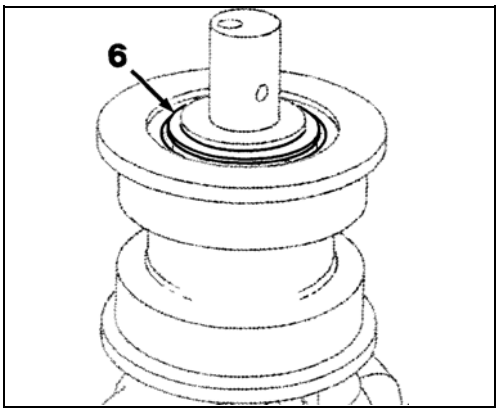
5. Install one half of seal (6) into roller housing. Refer to METAL TYPE FACE SEAL in this Section.



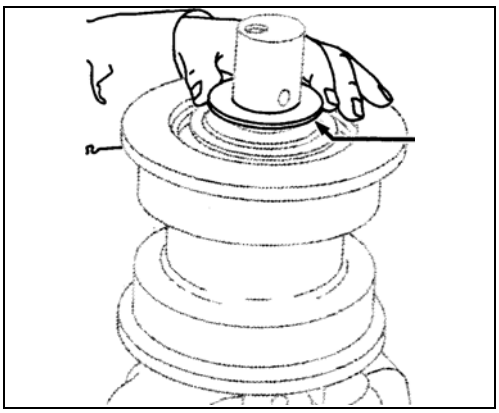
6. Install roller housing (1) over shaft.



7. Install one half of seal (6) into roller housing. Refer to METAL TYPE FACE SEAL in this Section.

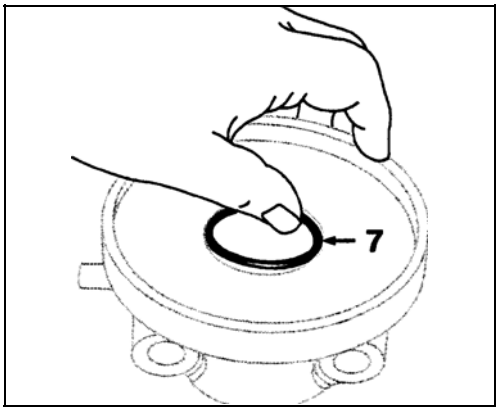


8. Install thrust washer (5) against roller housing.

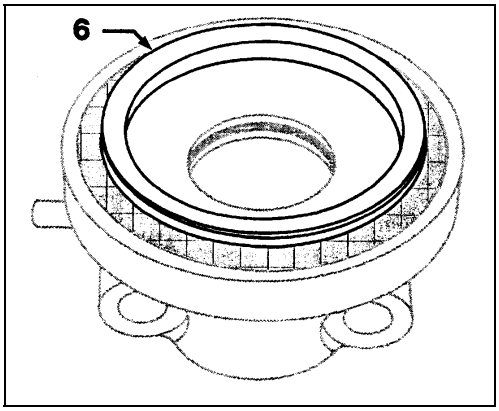


TRACK ROLLER

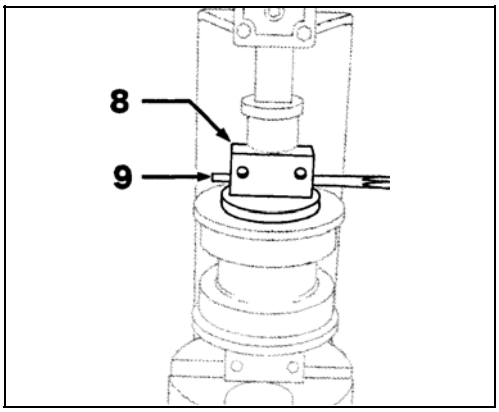
9. Install new O-ring (7) into bracket. Apply a thin coat of MPG to O-ring to aid in installation.



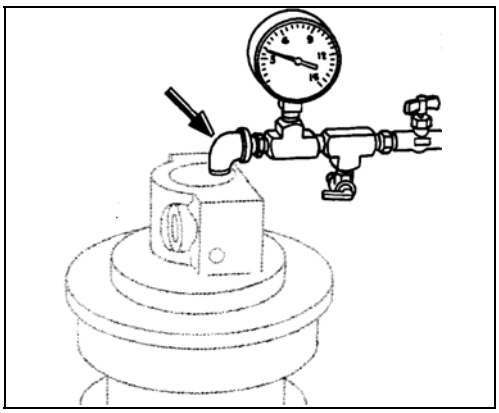
10. Install one half of seal (6) into mounting bracket. Refer to METAL TYPE FACE SEAL in this Section.



11. Position assembly in a press. Install remaining mounting bracket (8) on shaft. Apply press and align pin holes with dowel. Install spring pin (9).

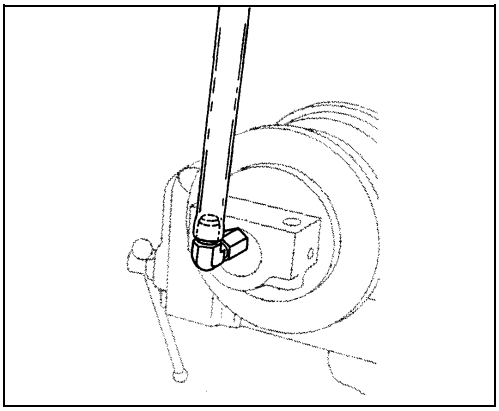


12. Fabricate an air pressure tester and connect to track roller at fill plug hole.
    Slowly apply 20 to 35 [kPa] of air pressure to roller. Assembly must maintain this pressure for 10 to 20 [sec] with no drop in pressure.

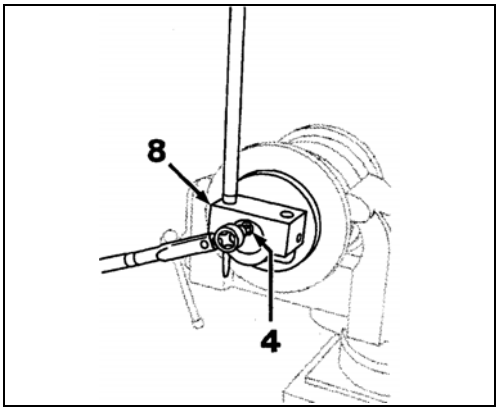


TRACK ROLLER

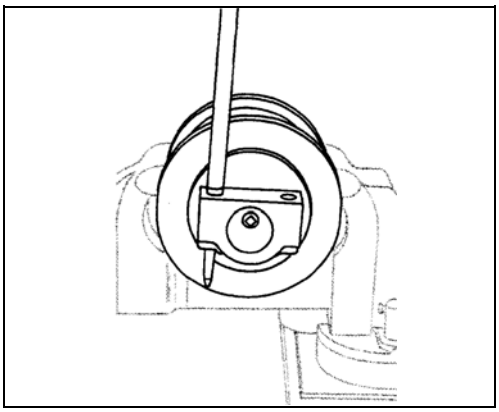
13. Fill track roller with recommended type and quantity of lubricant. Refer to OPERATOR'S MANUAL.



14. Apply Loctite #592 to fill plug (4) and install. Hold mounting bracket (8) with utility bar and torque plug to 20 to 60 [Nm].



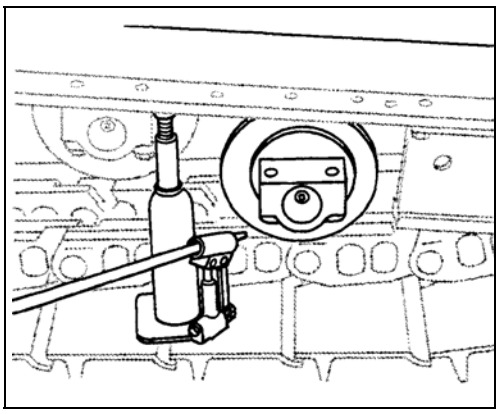
15. Using utility bar, rotate assembly ten to fifteen revolutions to insure initial sealing.



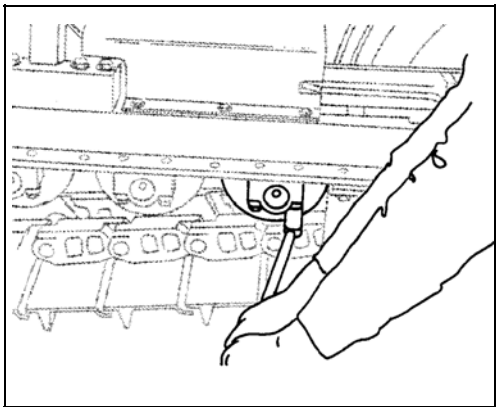
TRACK ROLLER

25. INSTALLATION

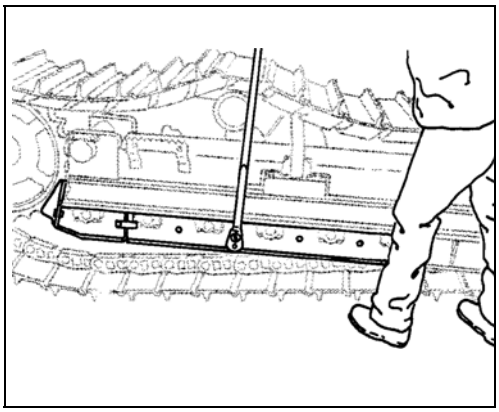
1. Place roller assembly in position under track frame with lube plug facing out. Secure roller to track frame by first installing forward bolts to bring bracket in contact with track frame, then install rear bolts.



2. Torque bolts to 135 [Nm] for TD7-M or TD-8M and 270 [Nm] for TD9-M or TD-10M. Remove any jacks between track chain and track frame.



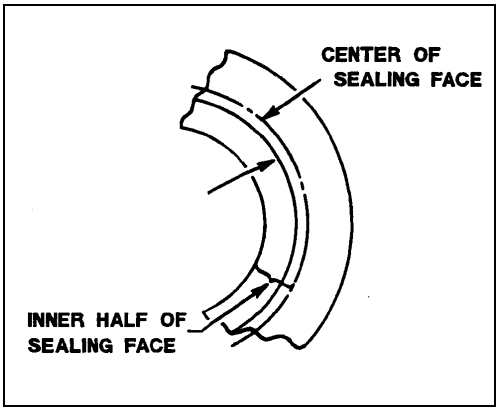
3. Install track roller shields to track frame and torque to 270 [Nm]. Install sprocket rock shields and torque bolts to 270 [Nm]. Remove stands from machine and lower to ground. Adjust track tension per SECTION 15.



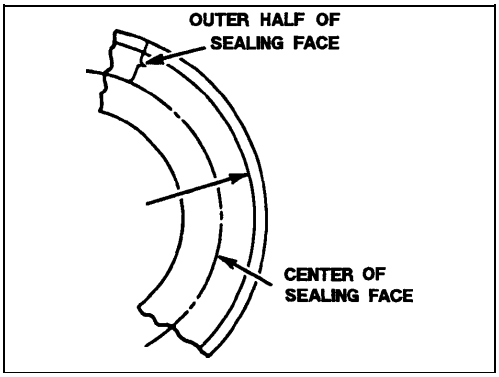
METAL TYPE FACE SEALS

26. SEAL INSPECTION

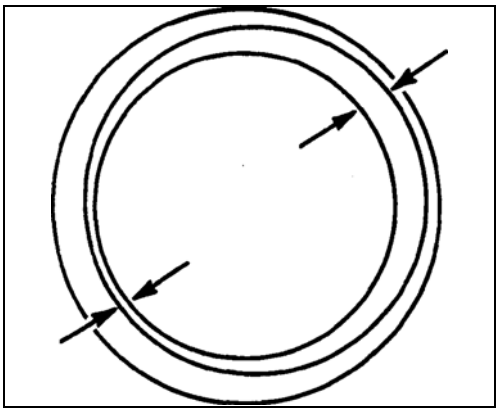
1. Check condition of rubber seal rings. If any sign of wear, scratches, nicks, cuts, etc. replace complete seal. Inspect condition of metal ring seal surfaces as follows. Highly polished surfaces of rings must be free of chips, pocks and deep scratches.



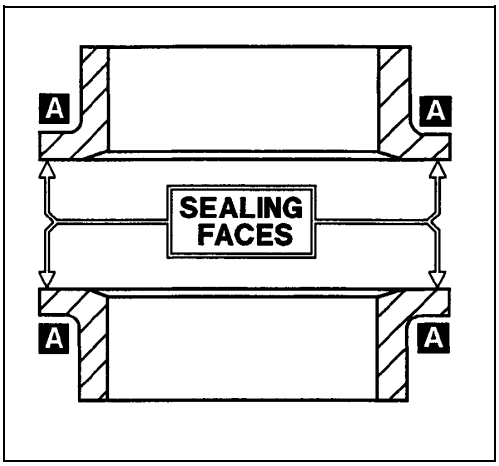
2. Narrow highly polished sealing bank must be within outer half of sealing face.



3. Narrow band must be uniform and concentric with ID and OD. If metal rings do not conform to these specifications, discard seal and replace with new.



4. If metal rings conform to specifications above, clean and check rings as follows.
   Remove any corrosion or hardened material that may exist on surface **A**. Use a scraper and/or any stiff bristled fiber brush to remove this material from entire surface. Wash 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. Apply a thin coat of clean SAE 30 oil on sealing face of metal rings. Do not allow oil to wet other surfaces. Slide sealing faces of two metal rings together. Bottom ring should cling to top ring for a minimum of two seconds when lifted by top ring. If they fail to cling, discard seal and replace with new.

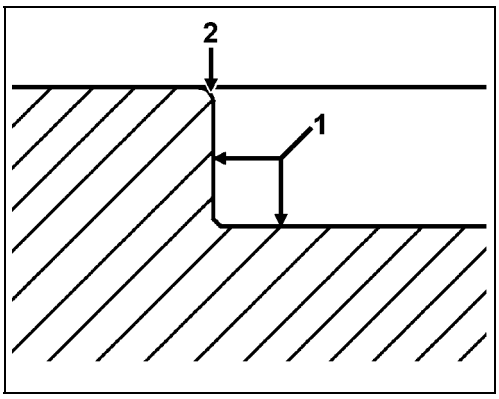


METAL TYPE FACE SEALS

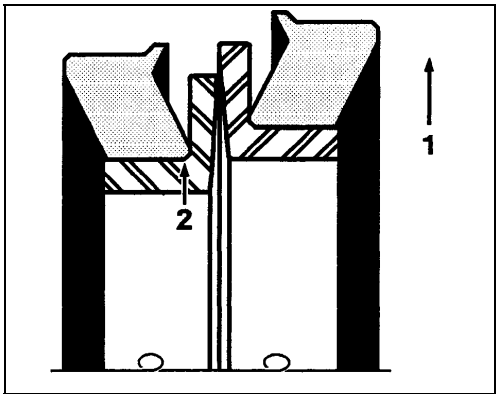
27. SEAL INSTALLATION

NOTE: *Cleanliness is critical when handling seals. never handle seal with greasy, oily or dirty hands. do not drop, bump or roughly handle seals.*

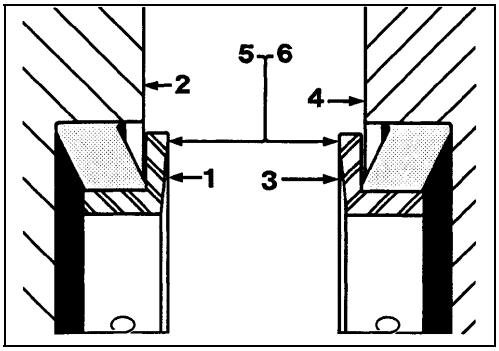
1. Brake shrinkable protector plastic. Remove any corrosion or hardened material that may exist on surface (1) that contact rubber rings. Use a non petroleum base solvent and wipe dry with a lint free wrapper. Make sure outer edge (2) is free of burrs.



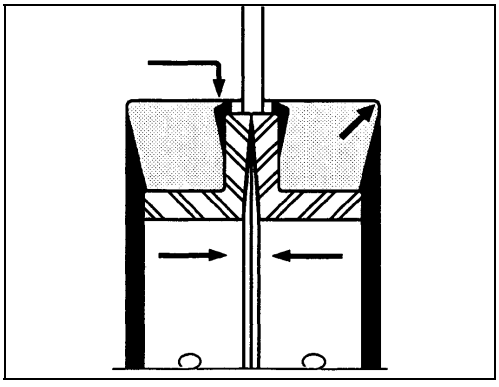
2. Carefully remove shrinkable plastic and gently "slide" (1) two seal halves apart. Be careful not to scratch or damage seal faces. Do not cut or damage rubber rings. Metal ring faces must not be damaged or contaminated. Check to be sure rubber rings are flush (2) against inside shoulder of metal ring.



3. Install one seal half (1) 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 (6), just enough to wet faces, of clean lubricant to seal faces of metal rings.



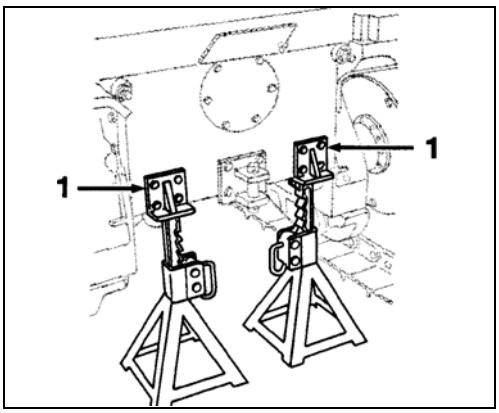
4. Final installation assembly will energize seal as shown, so that rubber rings load seal and drive mating metal rings together.



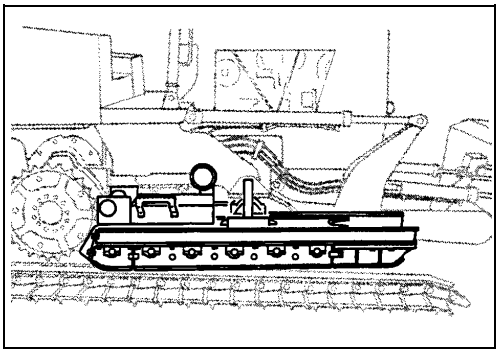
TRACK FRAME

28. REMOVAL

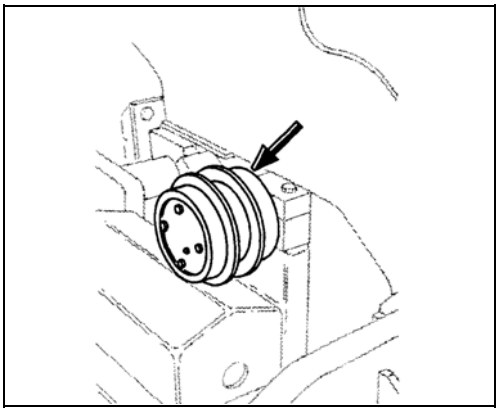
1. Raise machine and position on stands:
   Machine Rear; Install mounting blocks (1) to rear frame and position on stands.
   Machine Front; Install stands under the equalizer bar.



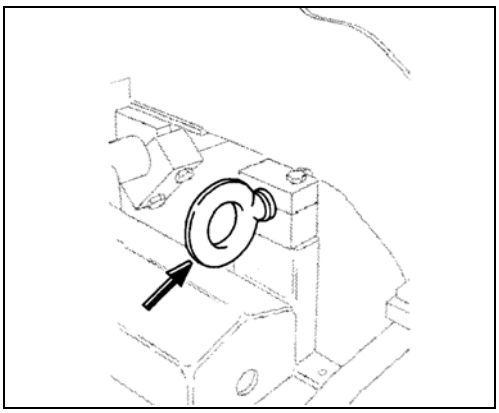
2. Remove track chain per SECTION 15. Remove front idler, track adjuster and covers per this section.



3. Remove top idler.

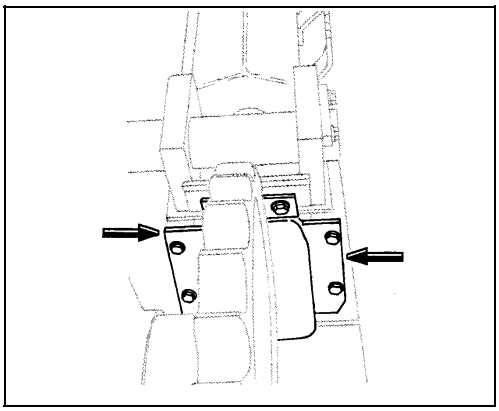


4. Install large eye bolt to idler mounting bracket and attach hoist.

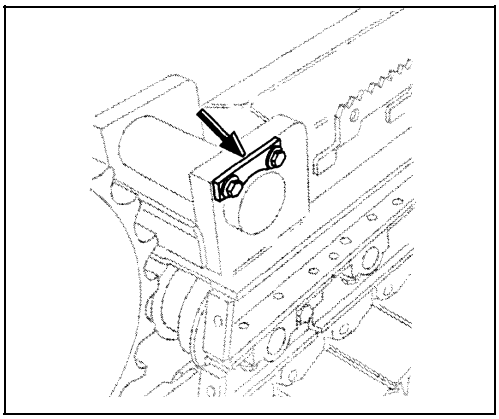


TRACK FRAME

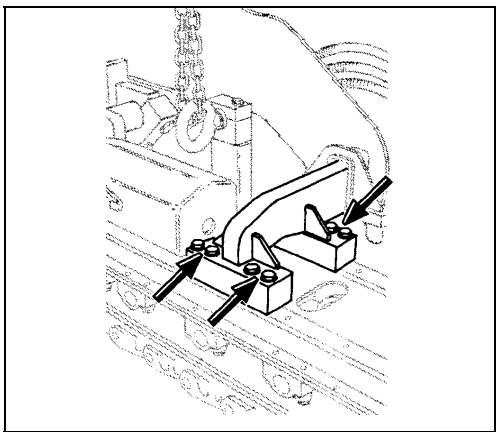
5. Remove inner and outer sprocket rock deflectors from rear of track frame.



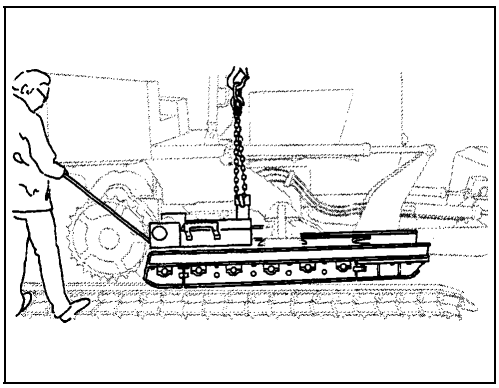
6. Remove pivot shaft bar locking plate and shims.



7. Remove equalizer bar mounting hardware.



8. Using hoist and pry bar, remove track frame from machine.



TRACK FRAME

29. INSTALLATION

1. Refer to TRACK FRAME ALIGNMENT in this Section.

TRACK SPRING

30. SPECIFICATIONS

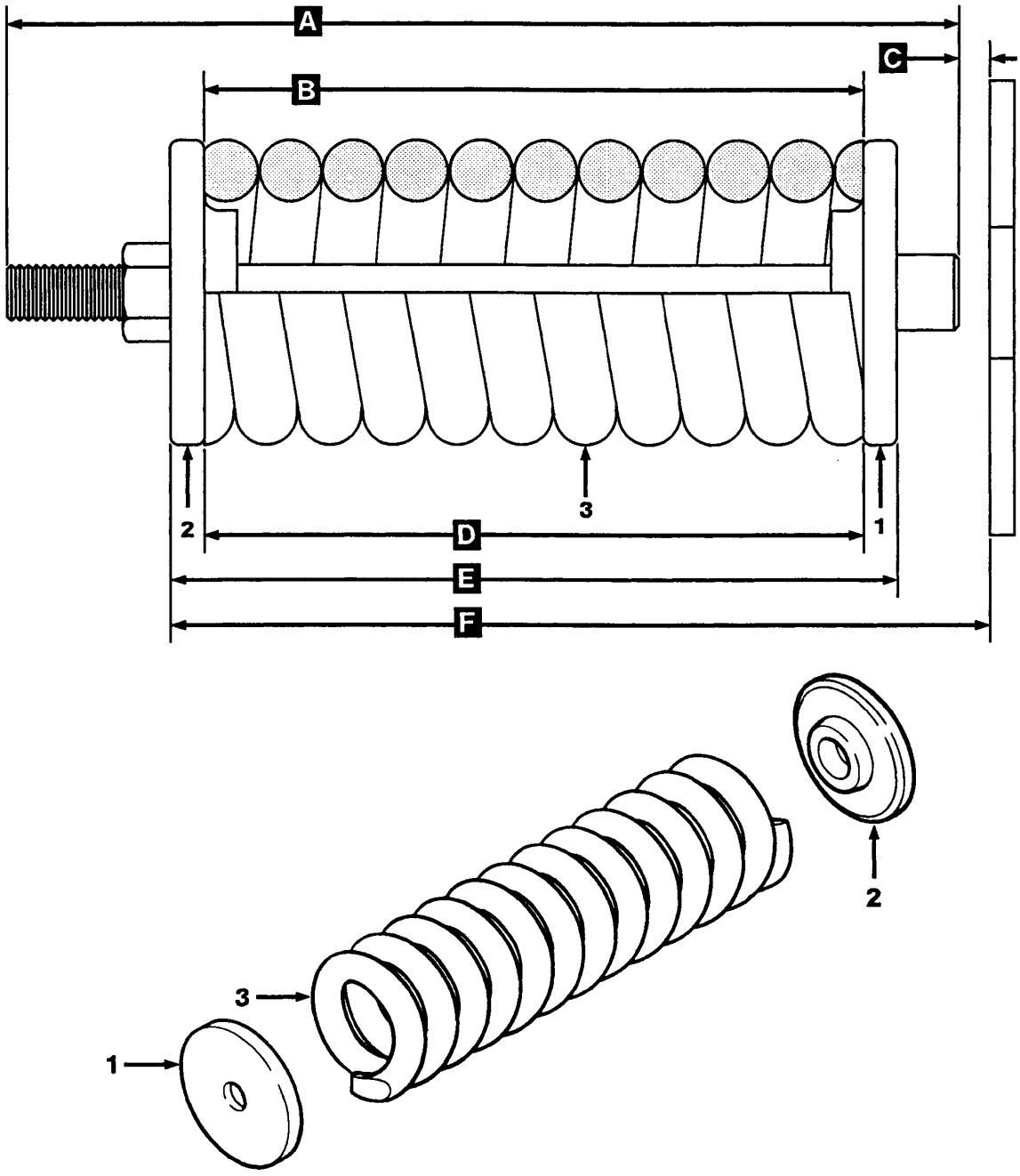


Fig. 14.12. Exploded and Cross Section Views of Spring in Track Frame

1. Front Spring Seat 2. Rear Spring Seat 3. Track Spring

TRACK SPRING

Track Spring (Refer to Fig. 14.12)

TD-7M or TD-8M;

A. Assembly Installation Length . . . . . .551. [mm]
B. Spring Solid Length. . . . . 406.0 [mm]
Solid Length Load . . . . . 122.7 [kN]
C. Tool Head to Bulkhead Clearance. . . . . 22.0 [mm]
D. Spring Free Length . . . . . 536.0 [mm]
E. Assembled Length. . . . . 439.0 [mm]
F. Assembled Length in Machine . . . . . 497.0 [mm]

TD-9M or TD-10M

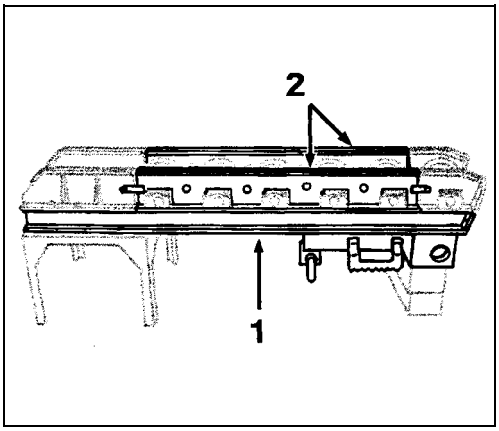
A. Assembly Installation Length. . . . . 551.0 [mm]
B. Spring Solid Length. . . . . 389 ± 5 [mm]
Solid Length Load . . . . . 128.2 [kN]
C. Tool Head to Bulkhead Clearance. . . . . 18.0 [mm]
D. Spring Free Length . . . . . .554.0 [mm]
E. Assembled Length. . . . . 427.0 [mm]
F. Assembled Length in Machine . . . . . 480.0 [mm]

31. REPLACEMENT

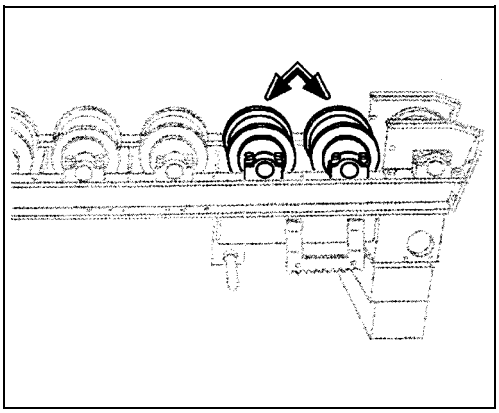
WARNING! Please observe all safety and precautionary standards as dictated by environment and work conditions under which equipment will be inspected, reworked and repaired. Consult SECTION 1 and your distributor on any and all questions regarding safety.

TRACK SPRING

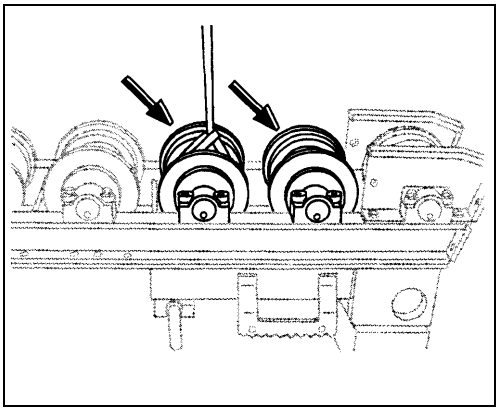
1. Remove track frame from machine as described in this section. Position frame (1) on suitable blocking as shown. Remove track roller shields (2).



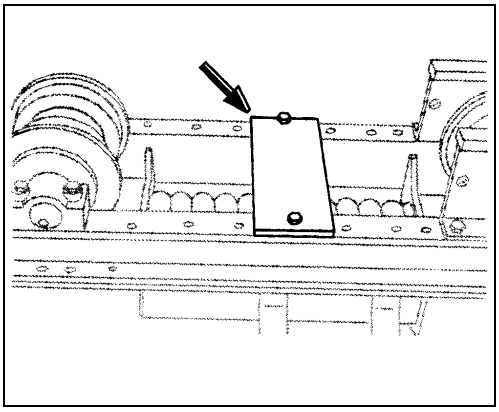
2. Remove hardware from 2nd and 3rd rear track roller.



3. Attach hoist and sling to rollers and remove.

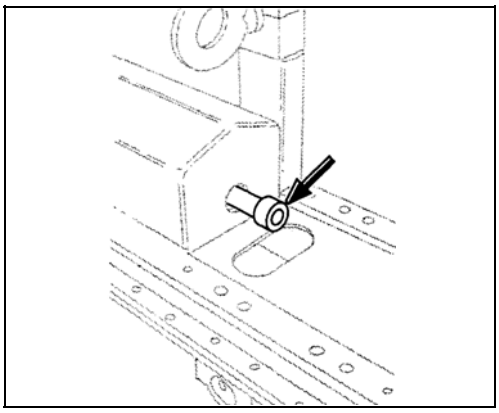


4. Install containment plate, DR11-713-1 (refer to SERVICE/ SPECIAL TOOLS in this Section), between track roller mounting surfaces.

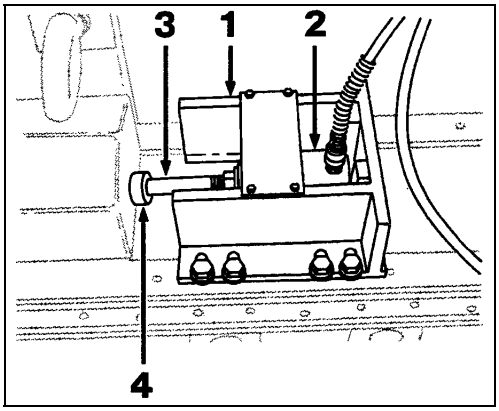


TRACK SPRING

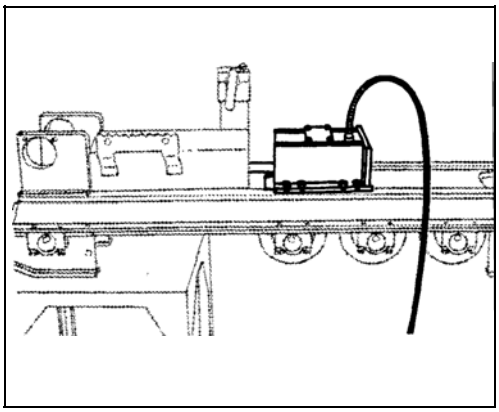
5. Insert spring bolt, DR11 -713-2 (refer to SERVICE /SPECIAL TOOLS in this Section), through housing and spring.



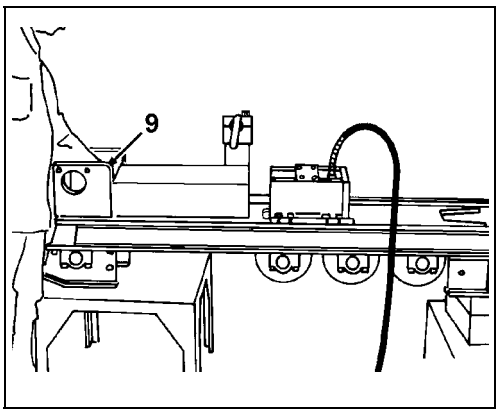
6. Install ram push support (1), DR11-713-4 (refer to SERVICE/SPECIAL TOOLS in this Section) to frame. Install ram (2) and connect push rod (3), DR11-713-5 (refer to SERVICE/SPECIAL TOOLS in this Section) to spring bolt (4).



7. Activate ram to compress spring.

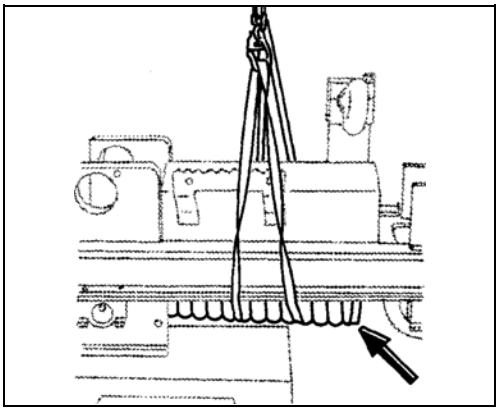


8. Install nut (9), DR11-713-3 (refer to SERVICE/ SPECIAL TOOLS in this Section), to spring bolt.

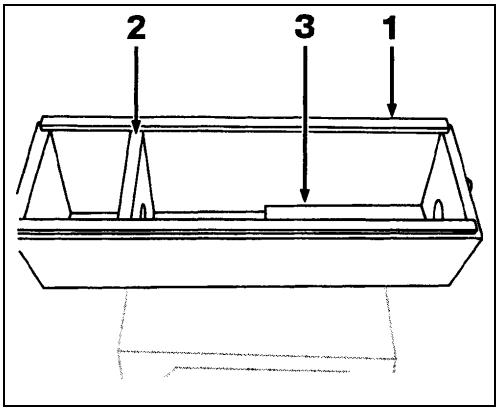


TRACK SPRING

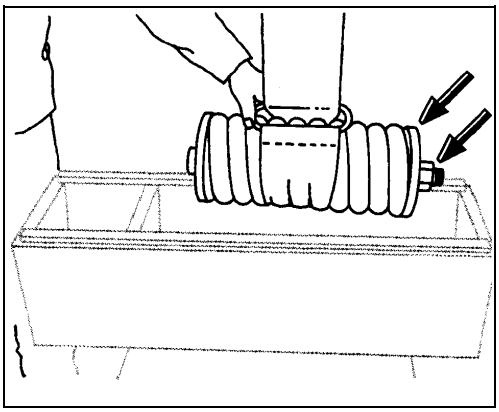
9. Remove containment plate from track frame. Position sling hoist to frame. Let off ram allowing sling to support track spring. Remove spring from frame.



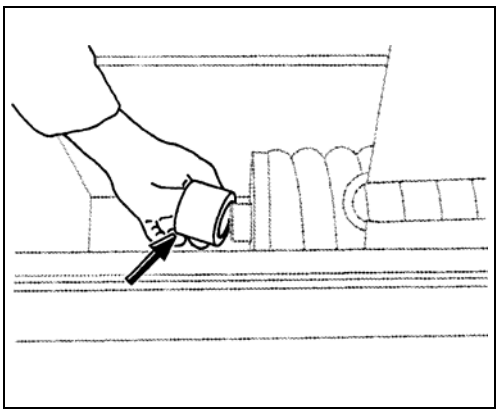
10. Position spring coffin (1), DR11-700-1 (refer to SERVICE/ SPECIAL TOOLS in this Section) with pusher plate (2), DR11-700-2 (refer to SERVICE/ SPECIAL TOOLS in this Section), on work table. Position blocking (3) so that spring bolt retainer nut will center through access hole.



11. Insert captured spring into coffin with nut end toward access hole.

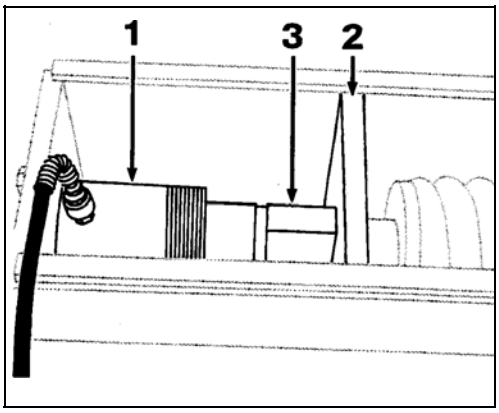


12. Install bolt collar, DR11-713-6 (refer to SERVICE/ SPECIAL TOOLS in this Section), to spring bolt head.

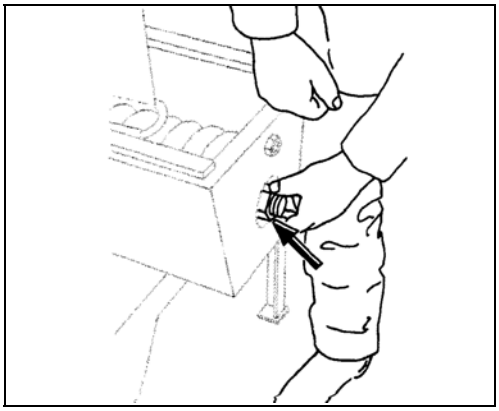


TRACK SPRING

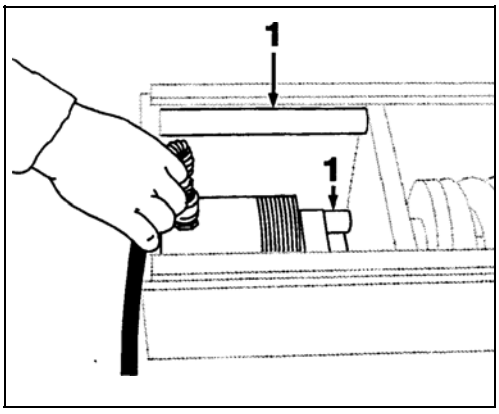
13. Position ram (1) in coffin and fully extend. Measure distance from stroked ram to pusher plate (2). Add blocking (3) 6.0 [mm] longer than measured distance. Destroke ram and add blocking. Stroke ram until spring bolt retainer nut is free of load.



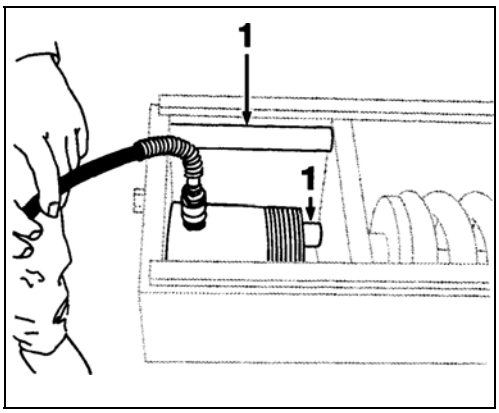
14. Remove spring bolt retainer nut.



15. Let off ram until spacer bars (1) DR11-700-4 (refer to SERVICE/ SPECIAL TOOLS in this Section), retain spring. Insert smaller blocking against ram. Engage ram and remove spacer bars.

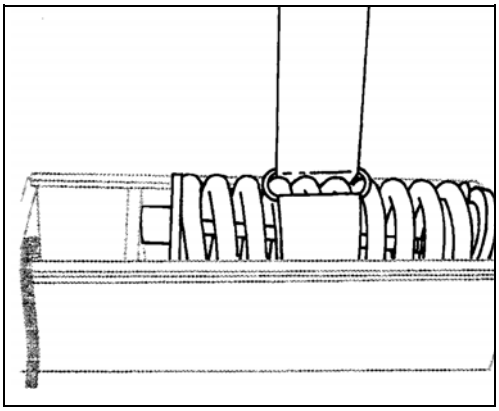


16. Let off ram until spacer bars (1) DR11-700-5 (refer to SERVICE/ SPECIAL TOOLS in this Section), retain spring. Remove blocking against ram. Engage ram and remove spacer bars.

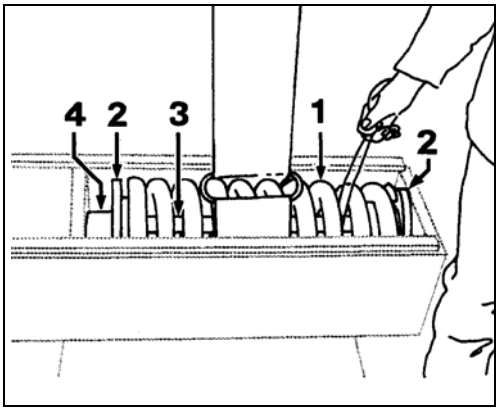


TRACK SPRING

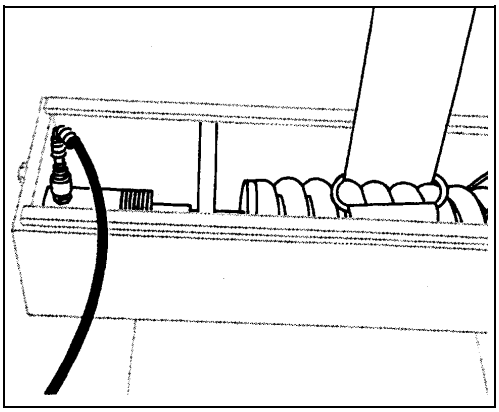
17. Slowly let off ram until spring decompresses. Install sling and remove from coffin.



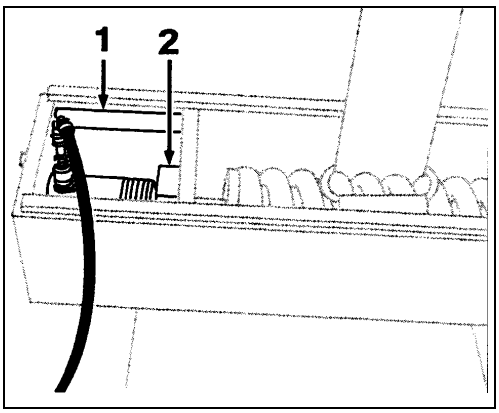
18. Install spring (1) with retainers (2), spring bolt (3) and bolt collar (4) into coffin. Center spring bolt with wire.



19. While supporting spring bolt, fully apply ram.



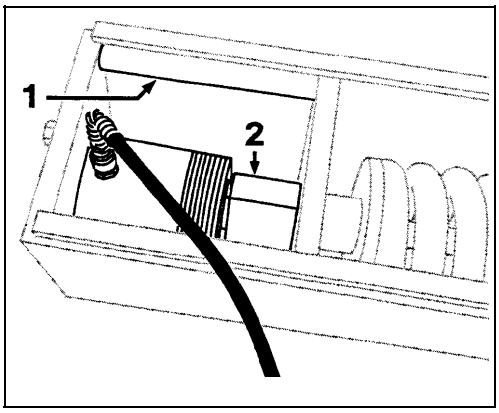
20. Install short spacer bars (1) and let off ram. Install blocking (2) and apply ram. Remove short spacer bars.



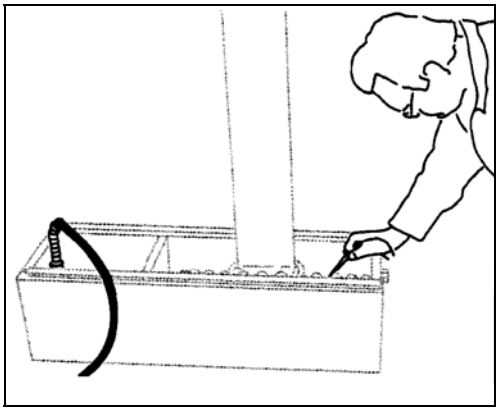
SUSPENSION

TRACK SPRING

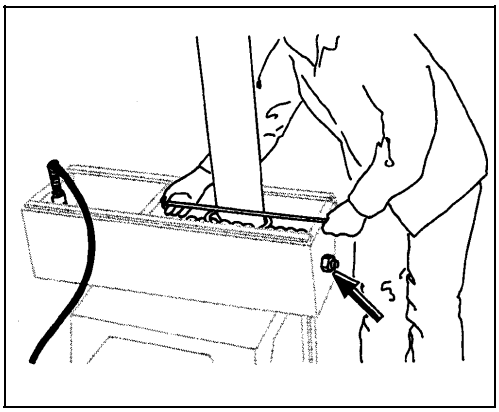
21. Install long spacer bars (1) and let off ram. Install blocking (2) and apply ram. Remove long spacer bars.



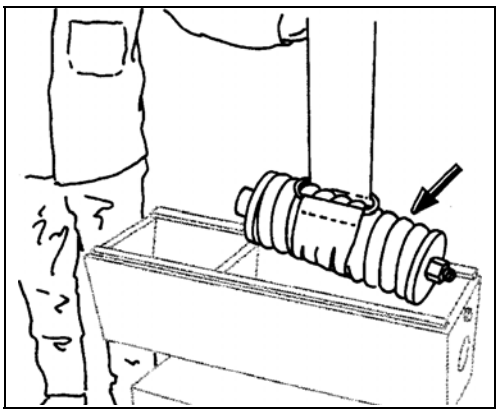
22. Apply ram directing spring bolt through access hole.



23. Install retainer nut. Compress spring until assembly installation length is attained. Refer to SPECIFICATIONS, TRACK SPRING in this Section.

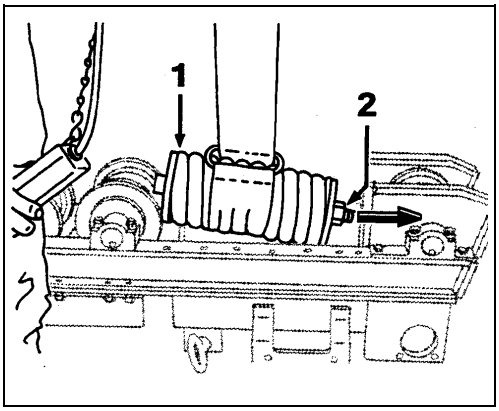


24. Remove captured spring from coffin.

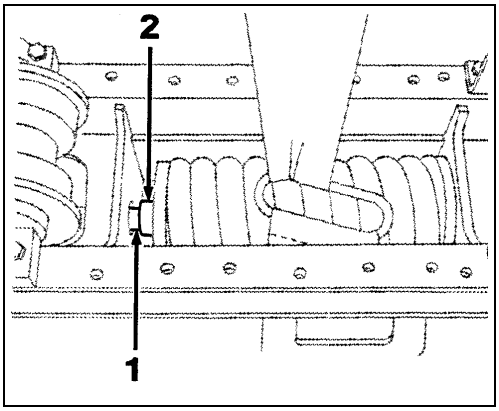


TRACK SPRING

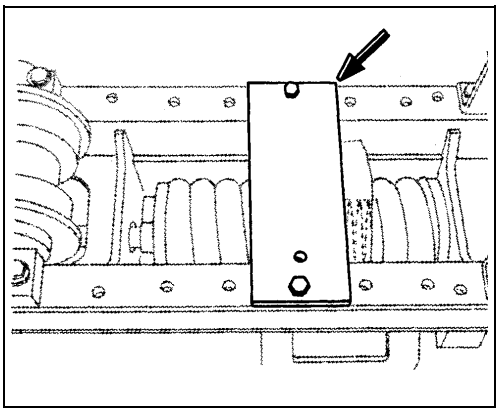
25. Install captured spring (1) into track frame with retainer nut (2) towards rear.



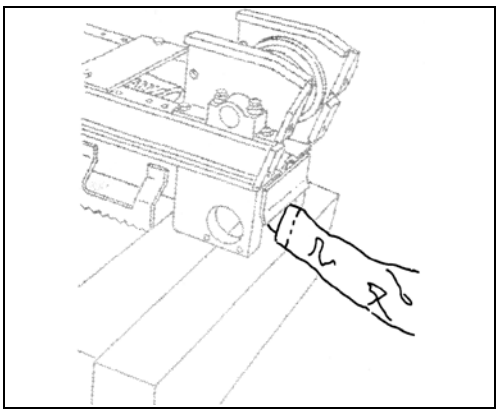
26. Apply ram to connect push rod (1) to spring bolt (2).



27. Install containment plate.



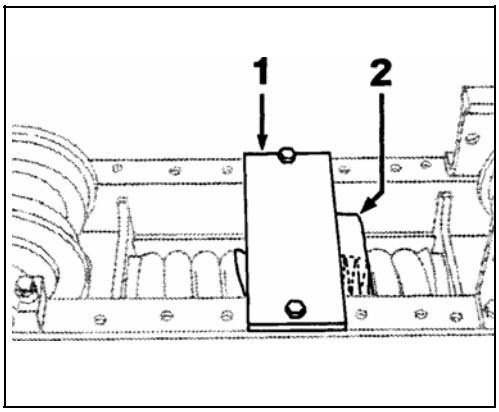
28. Apply ram and remove retainer nut from spring bolt. Slowly let off ram allowing spring to seat in track frame.



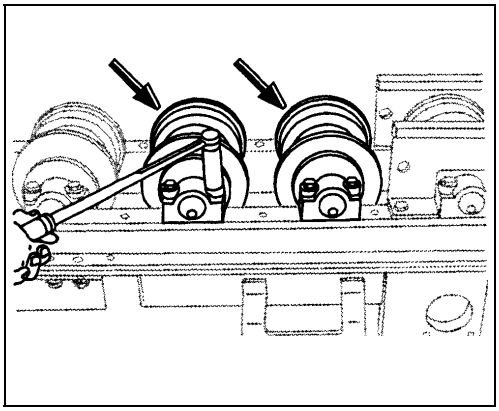
SUSPENSION

TRACK SPRING

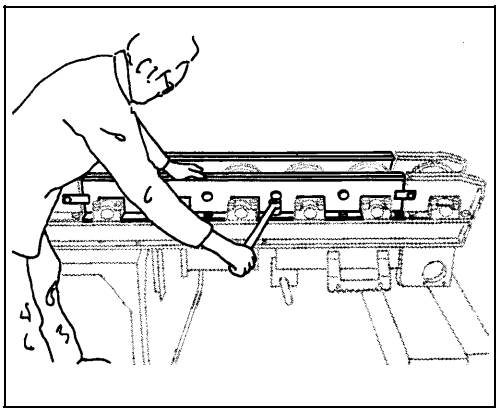
29. Remove containment plate (1) and lifting strap (2).



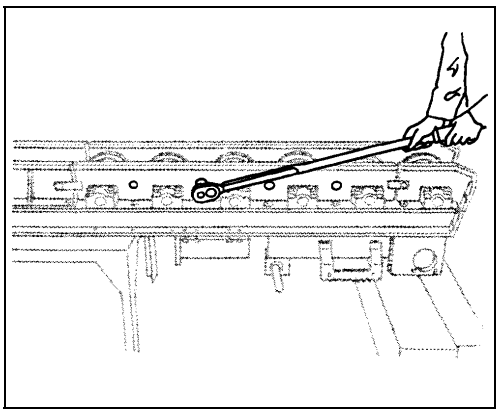
30. Install removed track rollers and secure with hard ware. Torque bolts to 135 [Nm] for TD7-M, TD8-M or 270 [Nm] for TD9-M, TD-10M.



31. Install track roller shields and secure with hardware. Torque shield to frame bolts to 270 [Nm].



32. Torque shield spacer bolts to 450 [Nm].



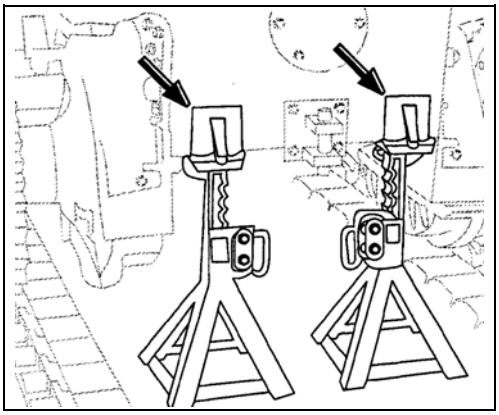
33. Install track frame, refer to TRACK FRAME in this Section.

EQUALIZER BAR

32. REMOVAL

1. Remove track frames from each side of machine. Refer to TRACK FRAME in this Section.

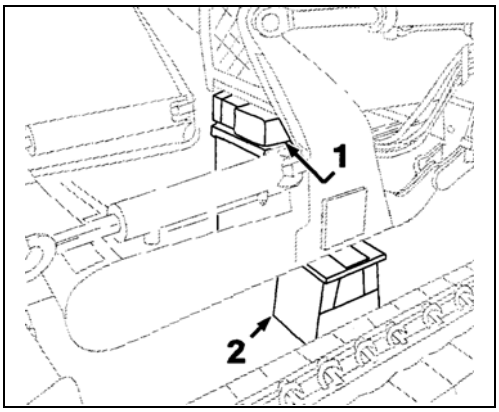
2. Install mounting blocks to the rear frame as shown and position on stand.



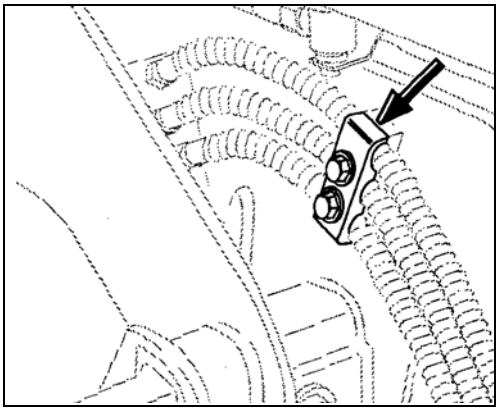
3. Position blocking (1) at front of machine under radiator guard portion of front frame.

   TD7-M; DO NOT block under C frame.

   TD-8M, TD-9M or TD-10M; Position blocking (2) under C frame on each side.

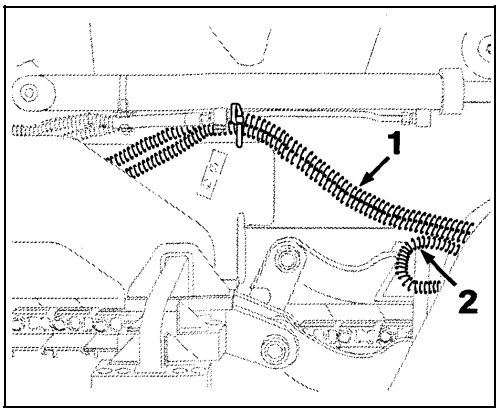


4. If equipped, remove hose clamps at each side of frame.



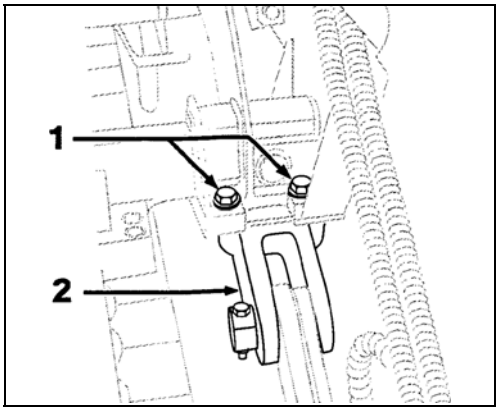
EQUALIZER BAR

5. On each side of machine, tie strap two top hoses (1) to lift cylinder tube. Disconnect and cap lower hose (2) and position out of way in C frame.

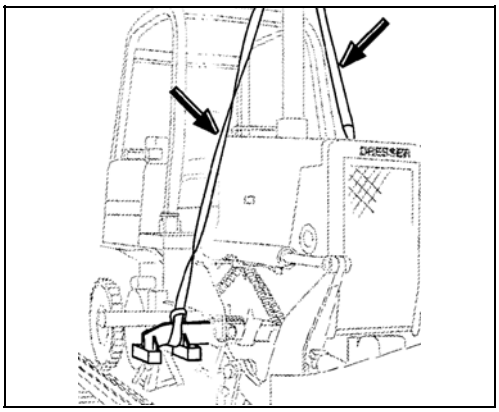


6. TD7-M; Position equipment lever in blade float (full forward). On each side of machine, attach lifting sling at C frame towers and connect to hoist. Remove hardware from C frame trunnions. Lower C frame using hoist.

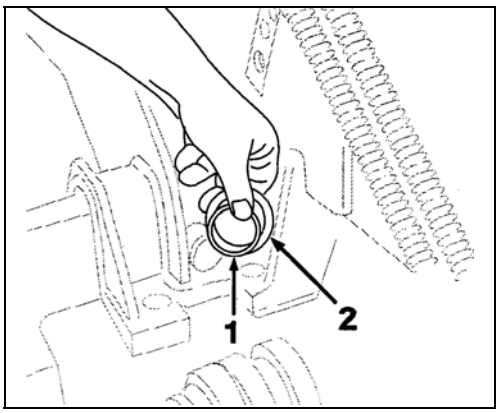
   TD-8M, TD-9M or TD-10M; On each side of machine, remove hardware (1) from C frame trunnions (2). Allow each trunnion to swing forward.



7. On each side of machine, attach lifting sling and hoist to equalizer bar.

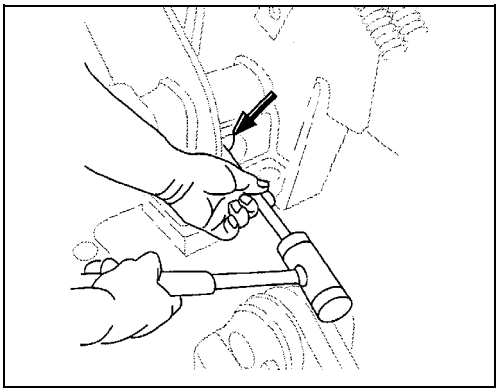


8. On each side of machine, remove retaining ring (1) and ring retainer (2) from mounting pin.

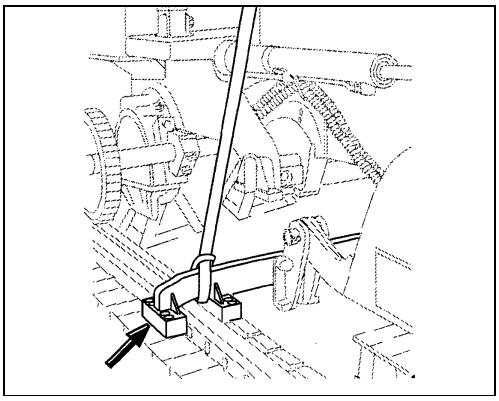


EQUALIZER BAR

9. On each side of machine, drive out mounting pin.

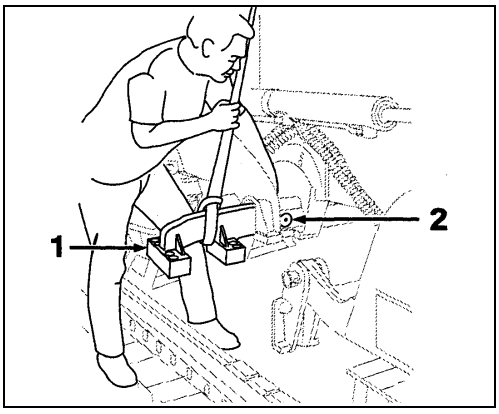


10. Lower equalizer bar and remove from machine.

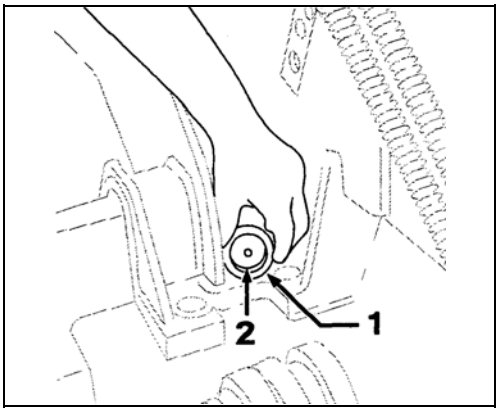


33. INSTALLATION

1. Position equalizer bar (1) into machine. Coat mounting pins (2) with "Never Seez" and install with rear ring retainer and retaining ring on each side of machine.



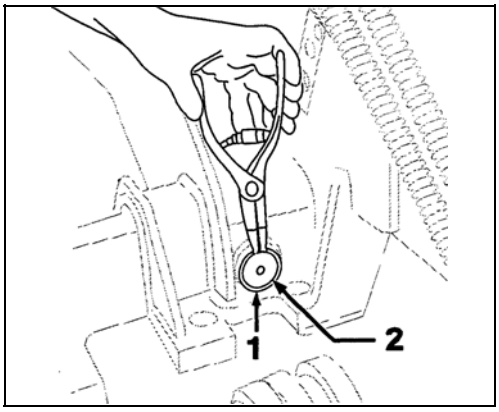
2. On each side of machine, install ring retainer (1) to mounting pin (2).



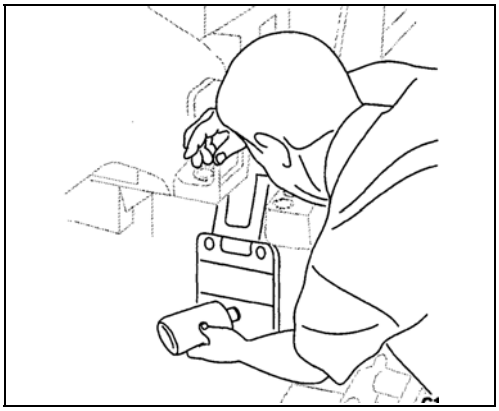
SUSPENSION

EQUALIZER BAR

3. On each side of machine, install retaining ring (1) to mounting pin (2).

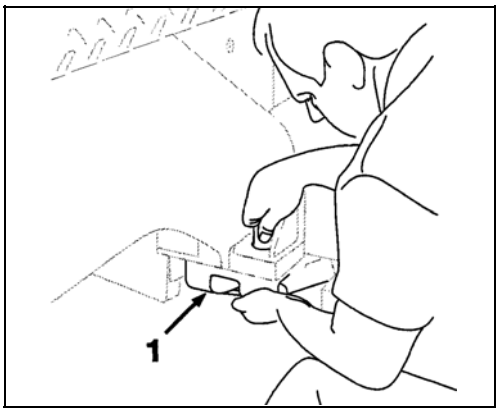


4. On each side of machine, apply Loctite Plastic Gasket or Loctite #568 to mounting surfaces of C frame trunnions.

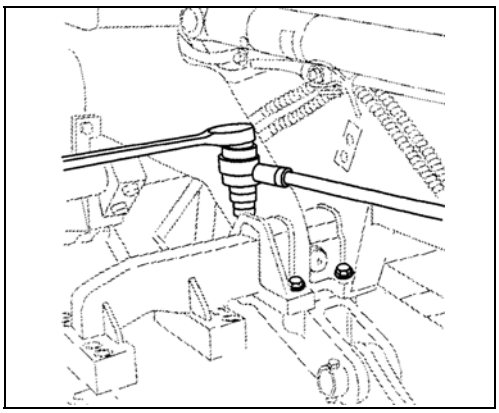


5. TD7-M; Using hoist and slings lift C frame and connect Trunnion with hardware on each side of machine.

   TD-8H or TD-9H; On each side of machine, rotate trunnion (1) in position and secure with hardware.

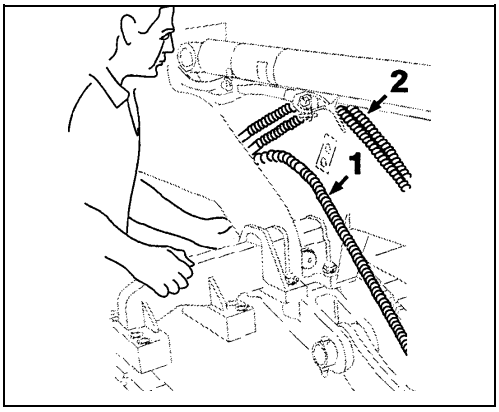


6. Torque trunnion mounting bolts to 920 [Nm].

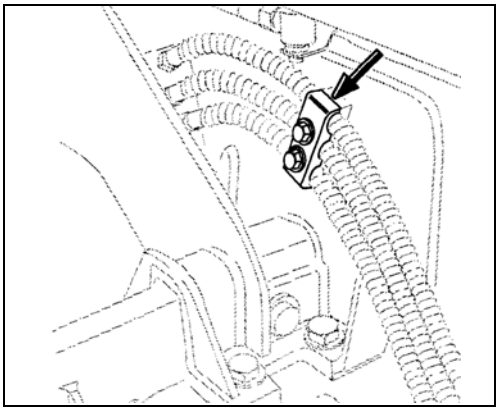


EQUALIZER BAR

7. On each side of machine, reconnect bottom hose (1) to manifold. Cut loose upper hoses (2).



8. If equipped, on each side of machine, install hose bracket and secure with hardware. Torque bolts to 92 ± 10% [Nm].



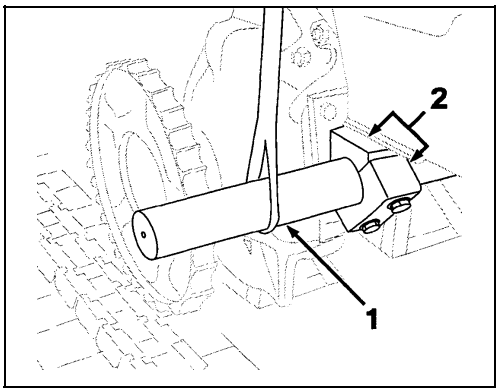
9. On each side of machine, install track frame. Refer to TRACK FRAME in this Section.

PIVOT SHAFT

34. REPLACEMENT

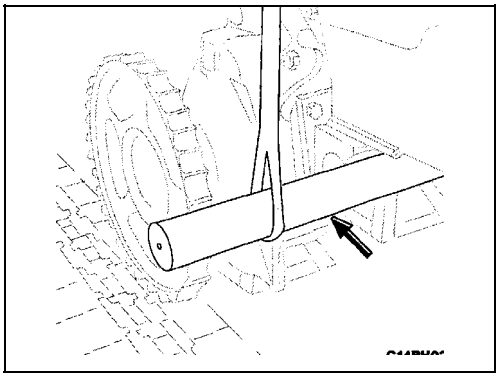
1. Remove track frames from each side of machine. Refer to TRACK FRAME in this Section.

2. On each side of machine, attach lifting slings and hoist to pivot shaft (1). Match mark half block (2) to welded block and remove hardware.



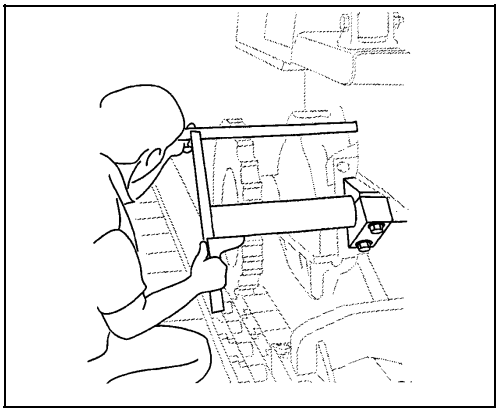
3. Remove pivot shaft from machine.

4. Position pivot shaft in place and loosely secure with half block and hardware.



5. On each side of machine, position pivot shaft at equally spaced positions and secure with hardware. Torque bolts to 780 ±10% [Nm].

NOTE: *When positioning pivot shaft , keep retaining slot in shaft horizontal*



6. On each side of machine, install track frame. Refer to TRACK FRAME in this Section.

TRACK FRAME ALIGNMENT

35. TRACK FRAME ALIGNMENT

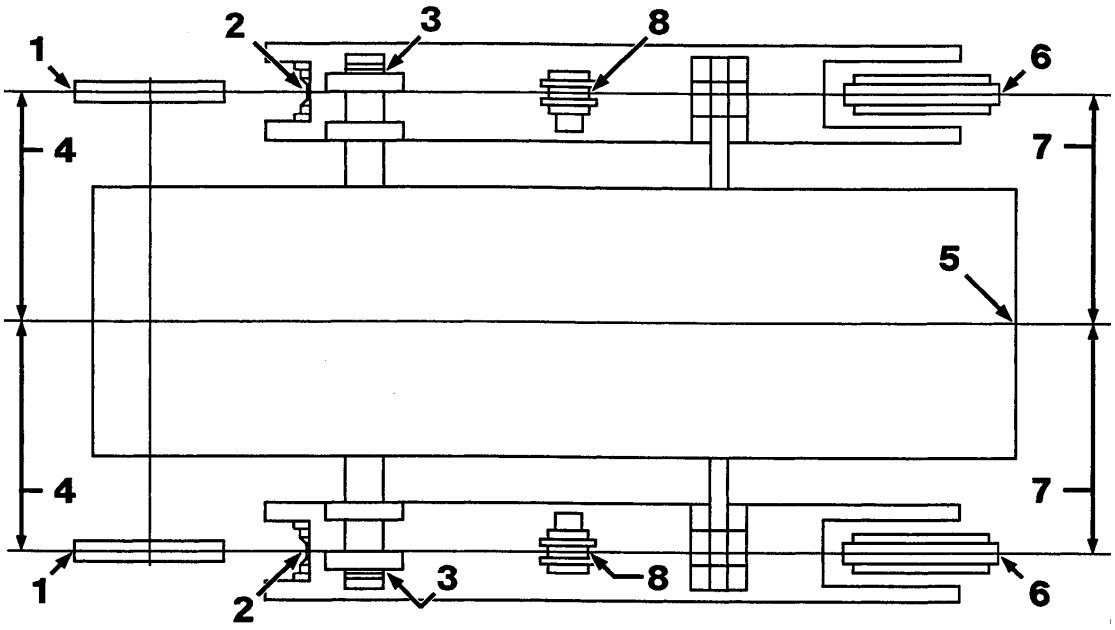
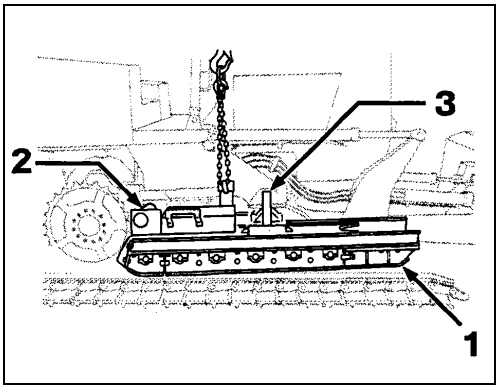


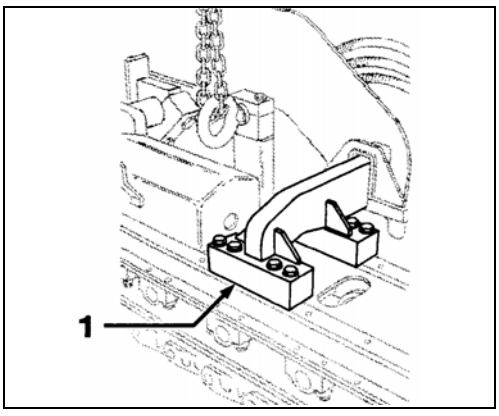
Fig. 14.5. Track Frame Alignment

1. Centerline of Sprocket
2. Centerline of Rear Roller to Sprocket
3. Required Shims and Lock Bar
4. Centerline of Machine to Sprocket
5. Front Centerline of Machine
6. Centerline of Front Idler
7. Centerline of Machine to Front Idler
8. Center of Top Idler To Sprocket and Front Idler

1. Position track frame (1) on pivot shaft (2) and move into place under equalizer bar (3).

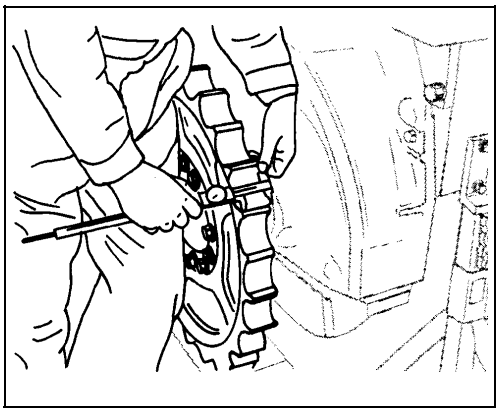


2. Attach track frame to equalizer bar (1) with hardware in a loose condition.

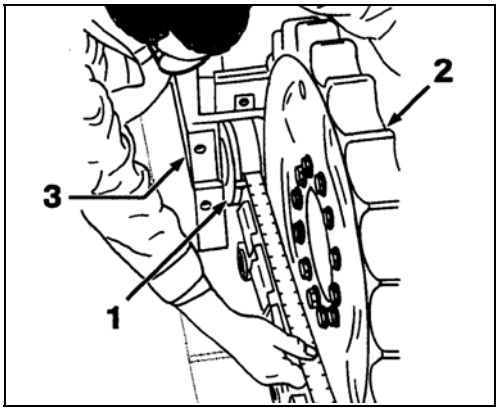


TRACK FRAME ALIGNMENT

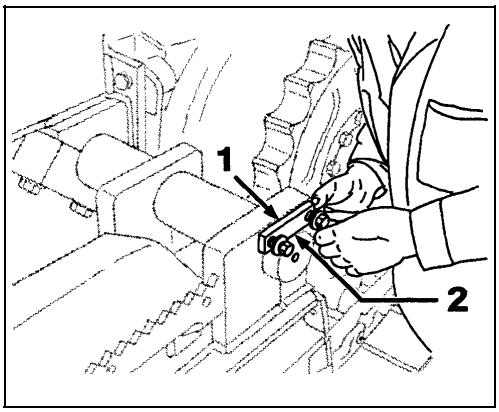
3. Determine center line of sprocket along five or six teeth. Average readings and record.



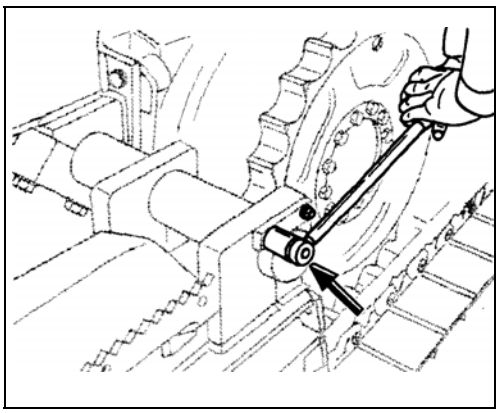
4. Center rear track roller (1) with sprocket (2) by moving track frame (3) in or out on pivot shaft.



5. Install required shims (1) and locking plate (2) and secure with hardware.

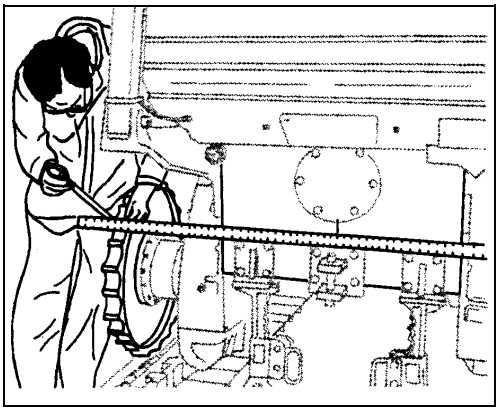


6. Torque locking plate bolts to 270 [Nm].

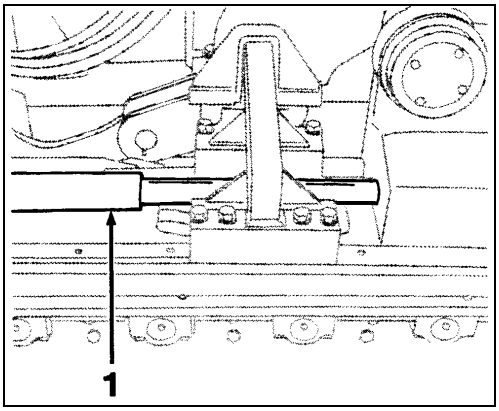


TRACK FRAME ALIGNMENT

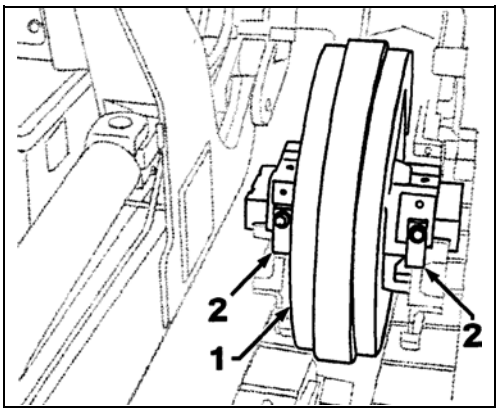
7. Measure and record dimension from centerline of machine to center line of sprocket.



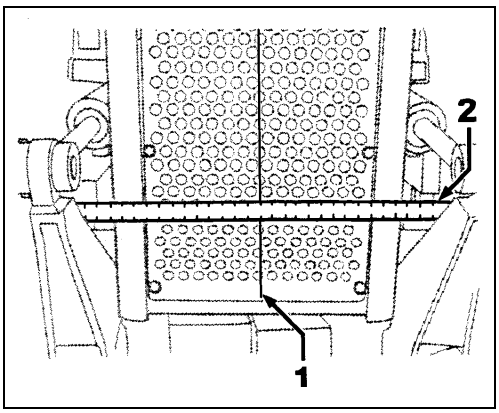
8. Install track adjuster (1) in track frame.



9. Install front idler (1) with keeper tabs (2), to track frame.

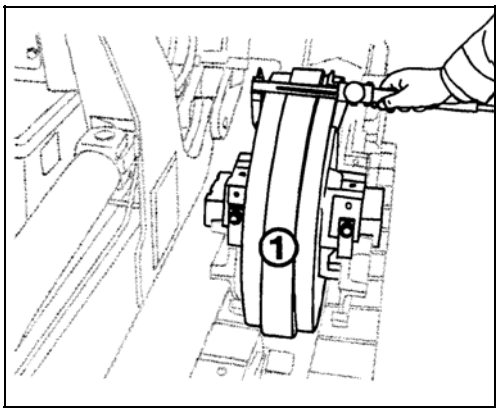


10. Determine front centerline (1) of machine and position large scale (2) through C frame out over front idler.

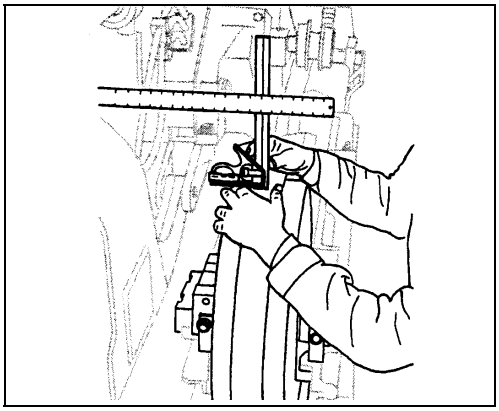


TRACK FRAME ALIGNMENT

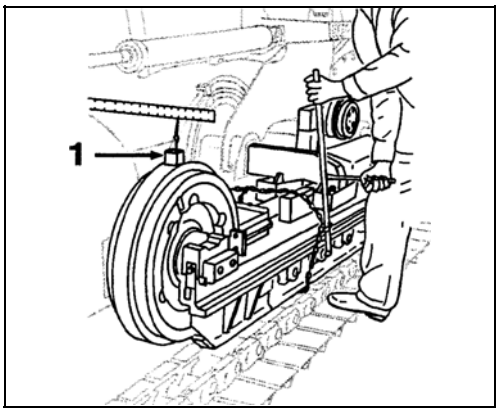
11. Determine centerline of front idler (1).



12. Determine amount of in or out movement of track frame from dimension attained in Step 7.

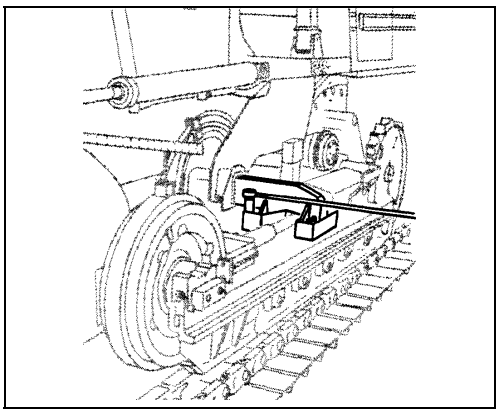


13. Using a magnetic base pointer (1) at centerline of front idler, move track frame in or out and snug up equalizer bar bolt when achieved.



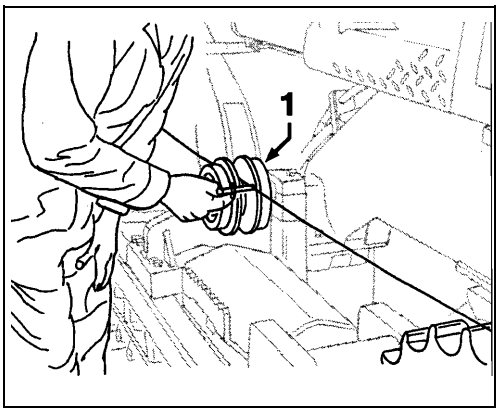
14. Torque equalizer bar bolts to 455 [Nm].

NOTE: *Remove tooling from front idler. Attach track adjuster to front idler and install track fame covers, refer to FRONT IDLER in this Section.*

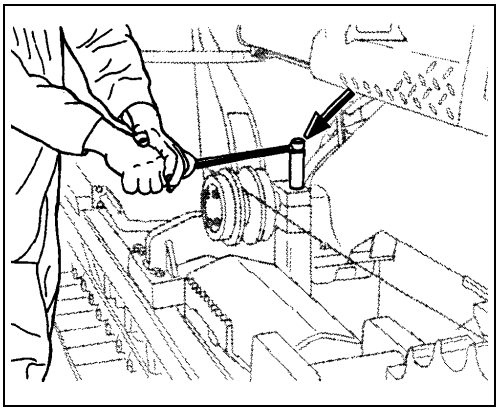


TRACK FRAME ALIGNMENT

15. Run a line between center of sprocket and front idler and center top idler (1).



16. Torque top idler mounting bolt to 180 ± 10% [Nm]. Repeat entire procedure for remaining side.



17. Install track chain and adjust. Refer to TRACK CHAIN in SECTION 15.

SECTION 15

TRACKS

TRACKS

SECTION 15

CONTENTS

SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS 3

TRACK CHAIN

2. DESCRIPTION 3
3. SPECIFICATIONS 3
4. MAINTENANCE 4
5. REMOVAL 5
6. INSTALLATION 5
7. COMPLETE CHAIN REBUILD 6
8. SINGLE TRACK CHAIN JOINT REBUILD 9

SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS

DESCRIPTION	TOOL NUMBER
Seal Tester and Lubricator	1262363H91
Vacuum Pump	5P2420
91 [Mg] Portable Track Press	DR11-802-2
Twin Head Hydraulic Track Table Press and Small Hydraulic Ram	Purchase Locally
Plug mounting tool	15.547.0007
Pin hole punching header	15.547.0008

TRACK CHAIN

2. DESCRIPTION (Fig.'s 15.1 and 15.2)

The interlocking type track chain consists of drop forged heat treated steel links (6 and 7) and drop forged heat treated split links (1, 2, 8 and 9) which are held together by bushings (3) and pins (4) to form a continuous chain. The bushings and pins are press fitted to the links, with the pins pivoting inside of the bushings. The pin has a hollow center which is used as a hydraulic reservoir. A cross drilled passage permits the oil to enter the bushings for lubrication of the pins, bushings and oil seals. The plug (10) retains the oil in the pin. Oil seal (11) seals against lubricant loss and prevents the entrance of contaminants.
The track shoes are mounted to the track links, and are held in place with heat treated dome head bolts with integral washers. The split links are bolted together with longer track shoe bolts to form a continuous chain.

3. SPECIFICATIONS

Number of Links (Including Split Master Link) - One Chain;
TD-7M 34
TD-8M 37
TD-9M 39
TD-10M 39

Undercarriage Components Wear Limit Dimensions ..... Refer to SECTION 14

Weight – TD-7M - One Complete Chain (Lubricated Track System):
With 381 [mm] (15 [in]) Shoes (STD) ..... 517 [kg]
With 381 [mm] (15 [in]) Mud Relief Shoes (STD) ..... 502 [kg]
With 432 [mm] (17 [in]) Shoes (STD) ..... 539 [kg]
With 610 [mm] (24 [in]) Shoes (LGP) ..... 693 [kg]
With 610 [mm] (24 [in]) Swamp Shoes (LGP)..... 772 [kg]
With 381 [mm] (15 [in]) Shoes (LT) ..... 563 [kg]
With 381 [mm] (15 [in]) Mud Relief Shoes (LT) ..... 546 [kg]
With 432 [mm] (17 [in]) Shoes (LT) ..... 586 [kg]

Weight – TD-8M - One Complete Chain:
With 381 [mm] (15 [in]) Shoes (STD) ..... 563 [kg]
With 381 [mm] (15 [in]) Mud Relief Shoes (STD) ..... 546 [kg]
With 432 [mm] (17 [in]) Shoes (STD) ..... 586 [kg]
With 610 [mm] (24 [in]) Shoes (LGP) ..... 693 [kg]
With 610 [mm] (24 [in]) Swamp Shoes (LGP)..... 772 [kg]

TRACK CHAIN

Weight – TD-9M - One Complete Chain:
With 457 [mm] (18 [in]) Shoes (STD) ..... 650 [kg]
With 457 [mm] (18 [in]) Mud Relief Shoes (STD) ..... 632 [kg]
With 508 [mm] (20 [in]) Shoes (STD) ..... 708 [kg]
With 610 [mm] (24 [in]) Shoes (LGP)..... 730 [kg]
With 610 [mm] (24 [in]) Swamp Shoes (LGP) ..... 814 [kg]

Weight – TD-10M - One Complete Chain:
With 508 [mm] (20 [in]) Shoes (STD) ..... 708 [kg]
With 610 [mm] (24 [in]) Shoes (LGP) ..... 730 [kg]
With 610 [mm] (24 [in]) Swamp Shoes (LGP) ..... 814 [kg]

Track shoe and split link bolts
Mounting moment . . . . . 90 ± 20 [Nm] plus 120 [°] of turn
Checking moment . . . . . 268 [Nm]

Track chain tension:
Lubricated tracks:
in normal . . . . . 38 - 64 [mm]
in mud or snow . . . . . 64 - 76 [mm]

4. 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 new and maximum allowable pitch lengths listed in SECTION 14. 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 becomes 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. Whenever new or rebuilt track chains are installed, the sprocket should also be replaced or interchanged to present the better side of teeth to the bushings. 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.

TRACK CHAIN

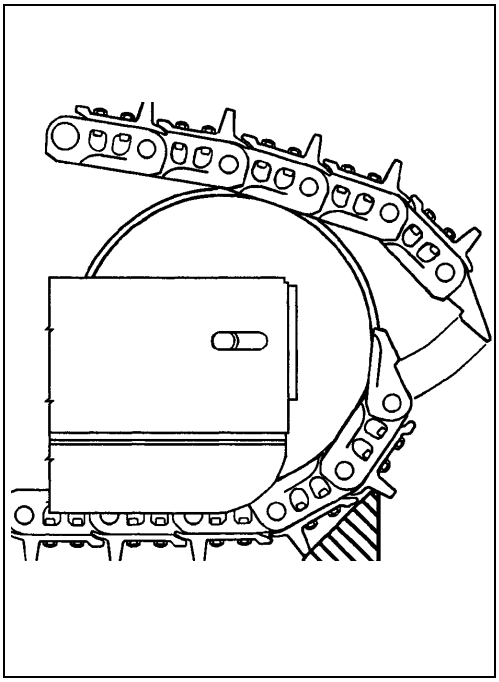
5. REMOVAL

1. Move machine forward until split link is on front lower half of front idler. Relieve track tension per OPERATIOR'S MANUAL. Block up under shoe and remove split link bolts and shoe.



WARNING! When split link bolts and track shoes are removed, chain is free to separate. Before disconnecting chain for any reason, be sure to relieve all track adjuster pressure. This must be done for safety reasons.

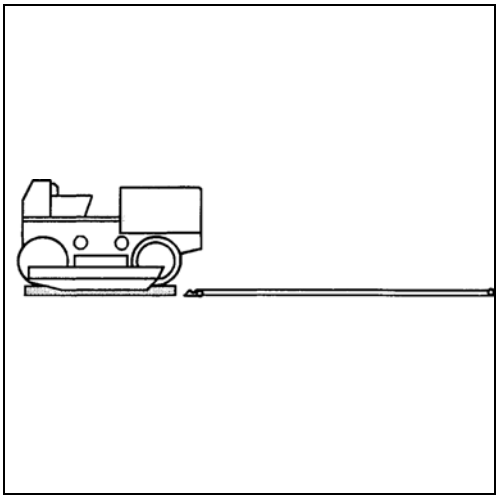
2. Move machine backward until sprocket is at end of chain. Place a plank flush against rear of chain when it is flat on ground. Plank should be approximately same thickness and width as chain and long enough so that entire machine can rest on plank. Move machine off chain and onto plank.



6. INSTALLATION

1. Position chain in front of plank with split link half with shoe surface against plank. If chain is reversed from position shown above, severe undercarriage wear will result. Block up front of chain. Drive machine forward onto chain. As sprocket passes end of chain, pull chain over sprocket and top idler. Stop machine when front idler contacts blocked up chain.

2. Be sure machined surfaces of split links are clean. Interlock split link halves in front of front idler. Align link side surfaces and install bolts to check alignment. Remove bolts. Install track shoe and bolts and torque to value given. Adjust track tension. Refer to OPERATOR'S MANUAL.



NOTE: *Two methods for repairing a chain are available. one method is to repair complete chain using a twin head table press. the other is to rebuild only leaking joints using portable 91 Mg track press.*

TRACK CHAIN

7. COMPLETE CHAIN REBUILD

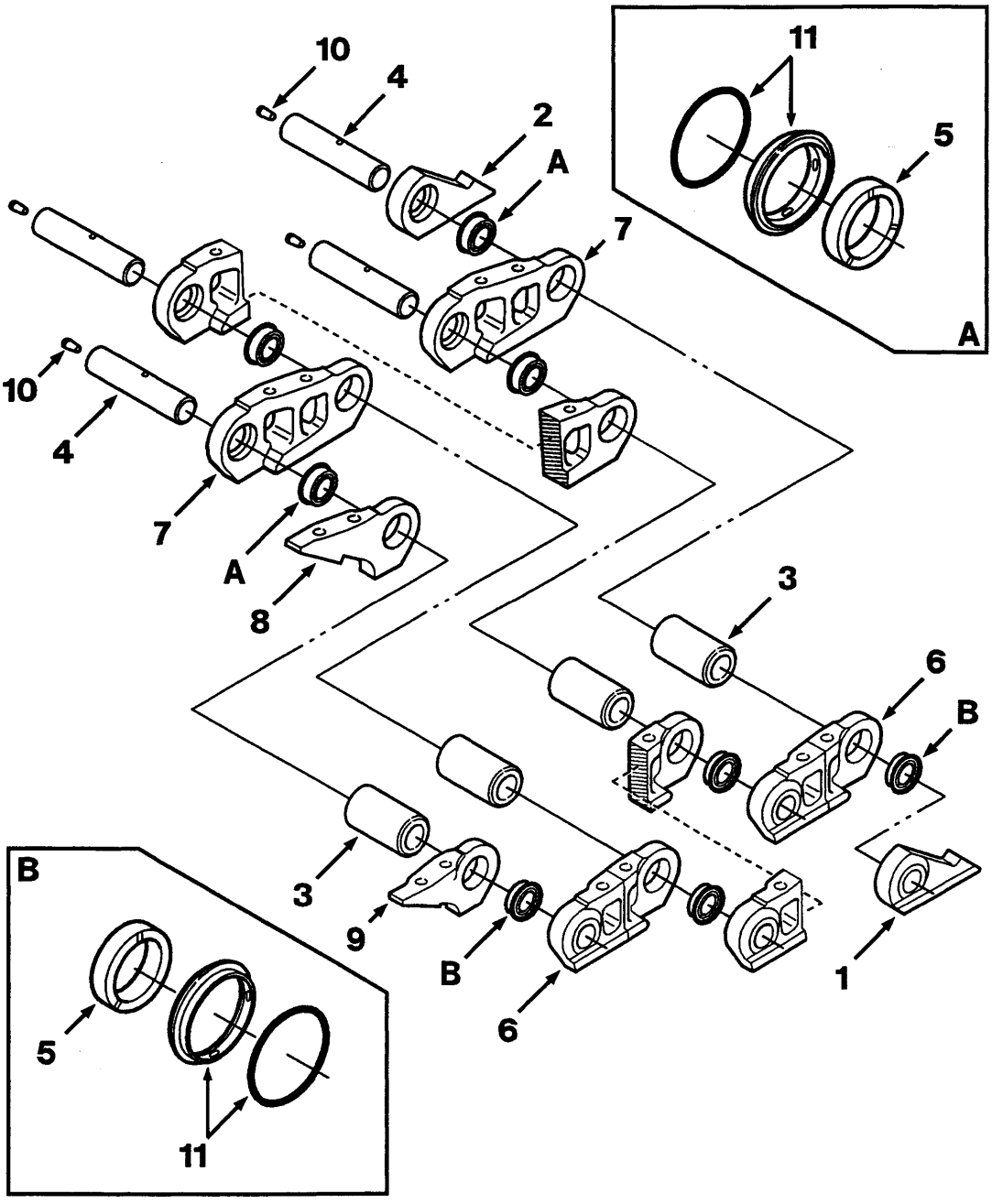


Fig. 15.1. Exploded View of Track Chain

Legend for Fig.'s 15.1 and 15.2

1. Master Split Link – Pin R.H. Down
2. Master Split Link-Pin L.H. Down
3. Link Bushing
4. Link Pin
5. Thrust Ring
6. Right Chain Link
7. Left Chain Link
8. Master Split Link – Bushing L.H. Upper
9. Master Split Link – Bushing R.H. Upper
10. Pin Plug
11. Chain Seal

TRACK CHAIN

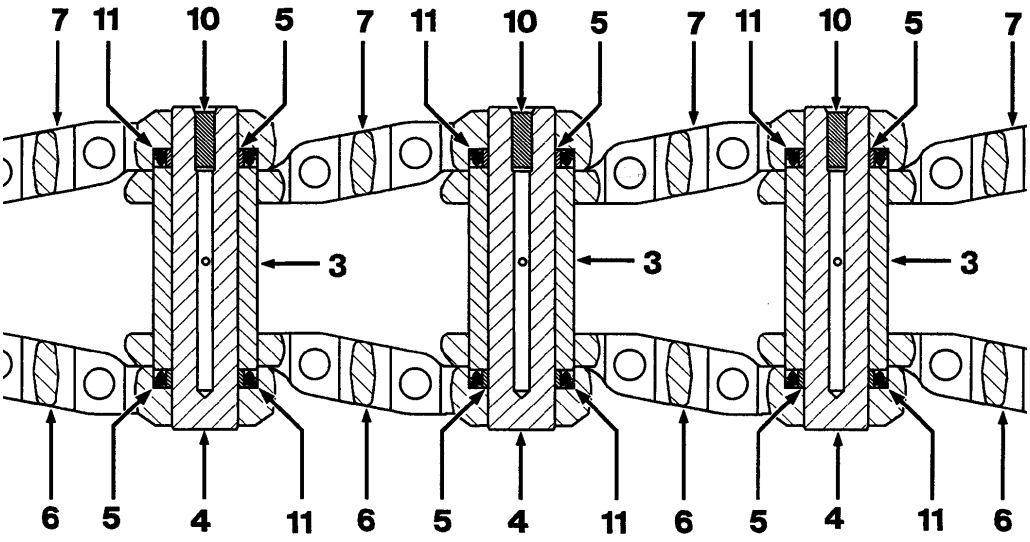


Fig. 15.2. Cross Section View of Track Chain

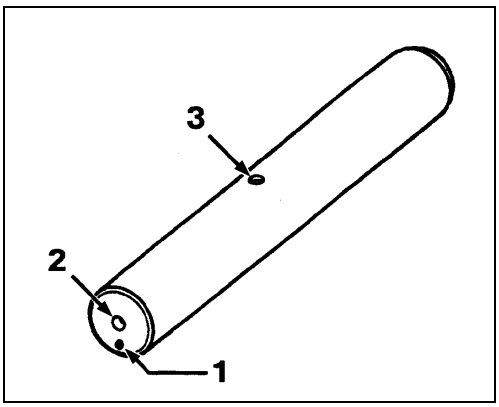
NOTE: *To repair or replace worn track pins, bushings or links, a hydraulic track press will be necessary. The operation and procedure instructions for each track press will vary, so specific disassembly instructions will be found with the manufacturer's operational instructions.*

Disassembly

1. Using a slow speed drill and a 12 [mm] drill bit, remove rubber plugs (10, Fig.'s 15.1 and 15.2) from pins (4). Position chain on track press so that bushing end (non threaded end) of split link (8 and 9) is toward rams. Remove track shoes.
2. Install disassembly adapters on ram heads. Advance track chain and lower table so split link drops into saddle. Press pin out of left link (8), then press pin out of right link (9). Remove loose split links from press.
3. Advance track chain so next link drops into saddle. Press pin (4) and bushing (3) out of right link (6), then press pin and bushing out of left link (7). Remove loose links, bushing and pin from press.
4. Repeat Step 3 with remaining sections of chain. Remove seals (11) from chain links.
5. Tag all mating parts to if need be installation.

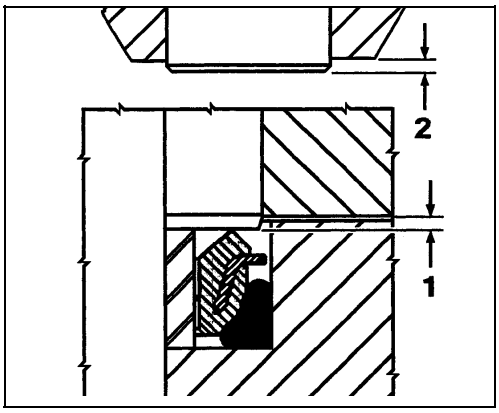
Reassembly

1. On new or reused pins, index a mark (1) on hole end (2) of pins on opposite side of lube hole (3).

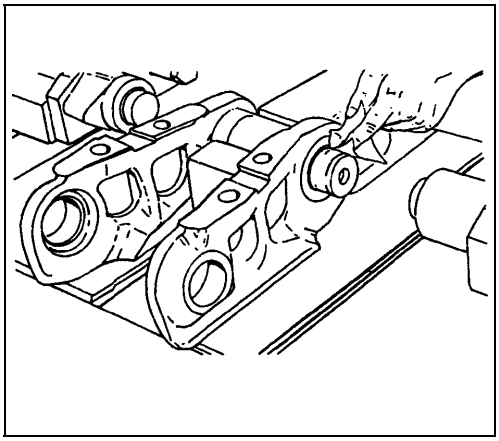


TRACK CHAIN

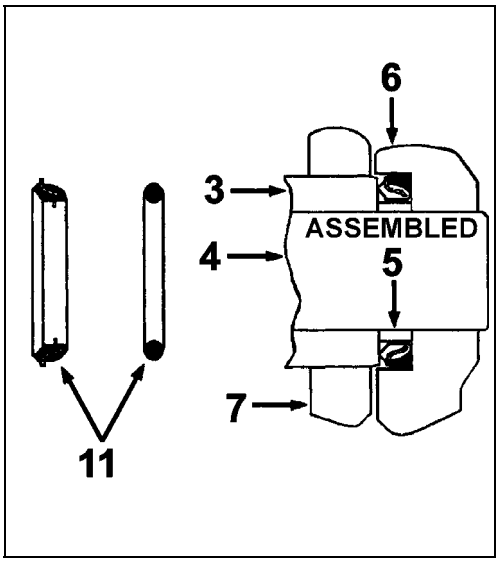
2. Adjust press to 365 [kN] generated force. Install assembly adapters on ram heads. Bolt halves of split links together and position them on press assembly adapters. Position a bushing in press saddle. Press links onto bushing to projection height of 1.45 [mm] (1 – after links assembly; 2 - before links assembly). Remove bolts securing two halves together.



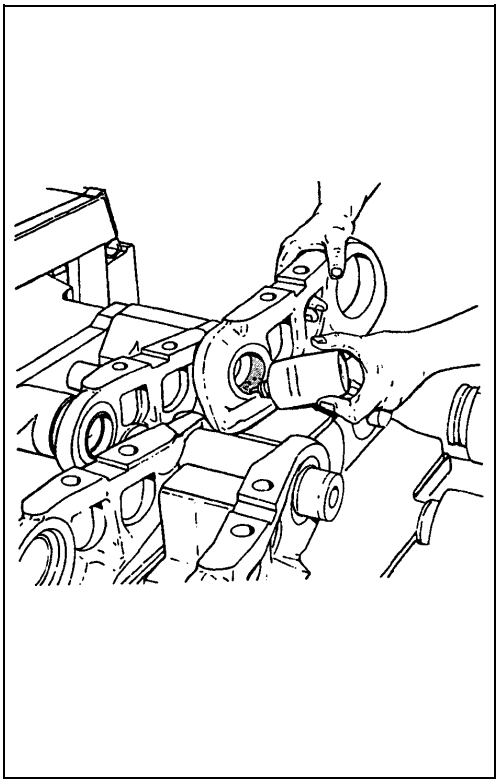
3. Advance chain on press and position a pin in assembled bushing. Apply a coat of oil on ends of bushing with tissue (not your fingers) being careful not to get it on pin surface. Position next bushing in press saddle.



4. Install O-rings and seals (11) and thrust rings (5) in counterbore of next chain links (6 and 7). Apply LOCTITE #680 sparingly in outer half of pin bore of links (6 and 7). Position links on press assembly adapters. Check that index mark is at bottom. All lube holes must face same direction. Press links (6 and 7) onto pins (4) and bushings (3) being sure that link counterbore and bushing face are seated against thrust ring (5). Do not exceed force indicated as this can damage spacer. 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). Tap it in until it is flush or slightly below chamfer of pin hole.



5. For final check of each seal use seal tester or vacuum pump (refer to SERVICE/SPECIAL TOOLS). 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 bubbles. After finding which side is leaking, joint must be rebuilt. If vacuum holds for 10 [sec], fill evacuated pin 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 using mounting tool (refer to SERVICE/SPECIAL TOOLS). 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) to prevent plug from escaping. Prepare chains for transport back to machine.

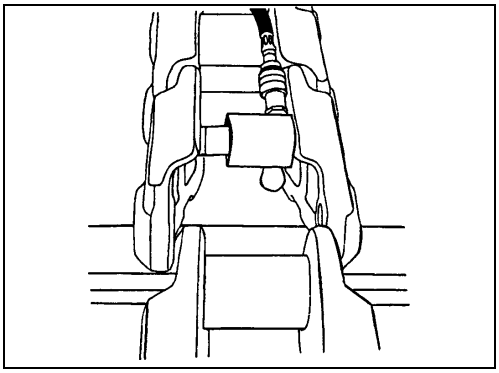


NOTE: *Once joint is lubricated, there is no way of checking for leaks.*

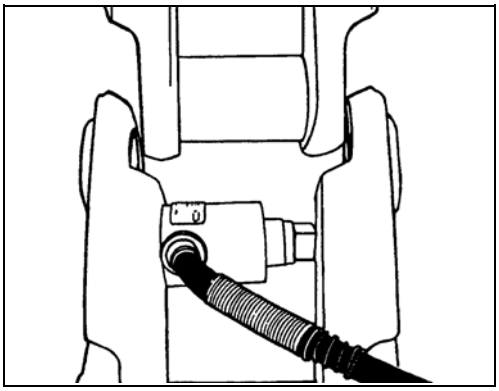
8. SINGLE TRACK CHAIN JOINT REBUILD

Disassembly

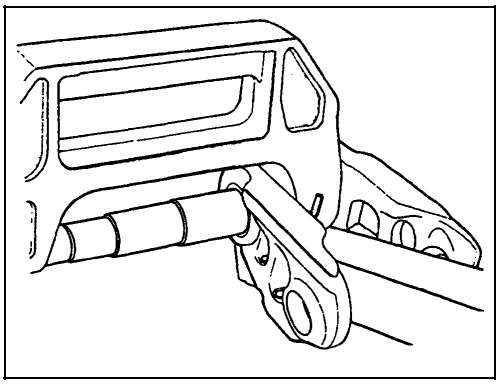
1. Using a slow speed drill and a 12 [mm] drill bit, remove rubber stopper from leaking joint pin.
2. Using press, secure aligning adapter in end of press C frame. Block chain off ground and position press over chain so that forcing pin will be against end of track pin opposite lube hole. Press pin from joint.
3. Using a small hydraulic ram, spread links about 6 [mm] and separate chain being careful not to damage seal. Remove oil seals and spacers from links.



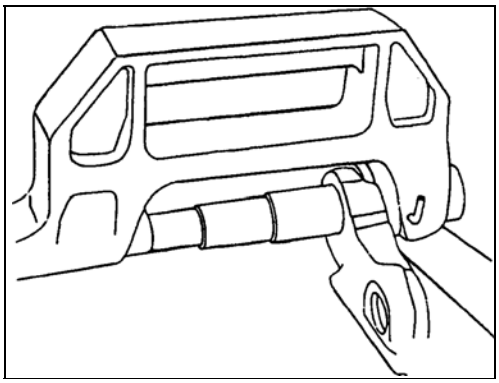
4. Inspect parts for wear, damage or improper assembly. If wear, damage or improper assembly is present, proceed with Step 5. If no wear damage or improper assembly is present, proceed to **Reassembly** in this Paragraph.
5. Drill out plug from next pin to right of leaking joint as described in Step 1. Block chain off ground and press pin out as described in Step 2.



6. Using small hydraulic ram, spread link about 6 [mm] and remove track link being careful not to damage seal. Remove oil seals and spacers from links.
7. Secure bushing disassembly adapter in end of press C frame. Position adapter in press C frame and adapter on ram. Remove aligning adapter from press C frame and install bushing adapter. Using press, remove long pin from threads of ram and thread short pin on ram. Position press over one side link. Using bushing pusher, press link off bushing.

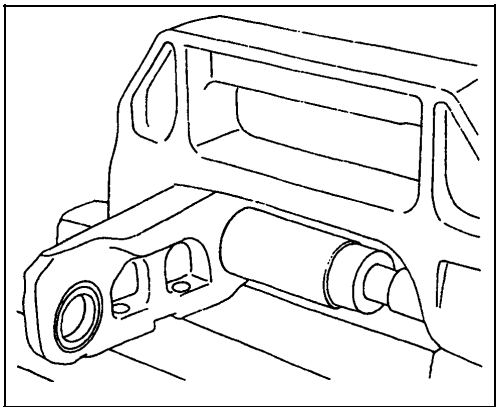


8. Turn link over and reposition press over remaining side link. Using bushing pusher, press link off bushing. Inspect parts for wear, damage or improper assembly. Discard any parts which would adversely affect rebuild.

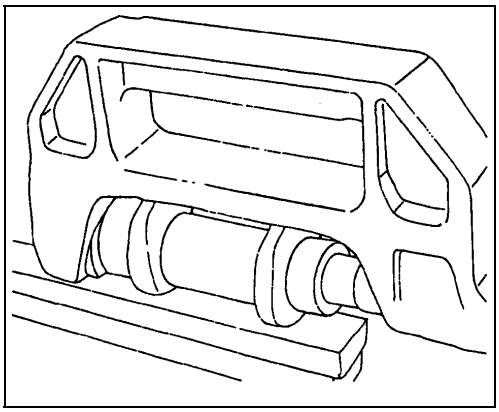


Reassembly

1. Dress up parts with emery cloth as required. Secure rear bushing assembly plate in press C frame. Position press over one link. Using bushing adapter, press new bushing in link until it bottoms against adapter.

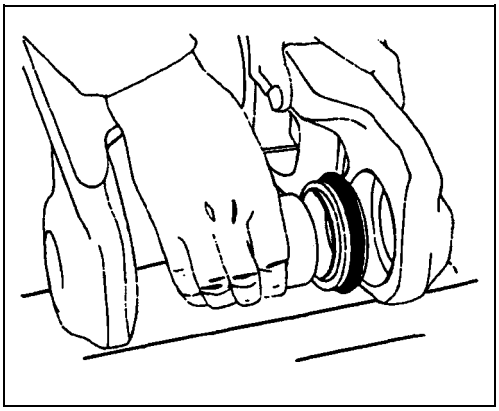


2. Turn link over and reposition press over second link. Using bushing installer, press bushing into second link until it bottoms against adapter. Be sure counterbores in links are clean.

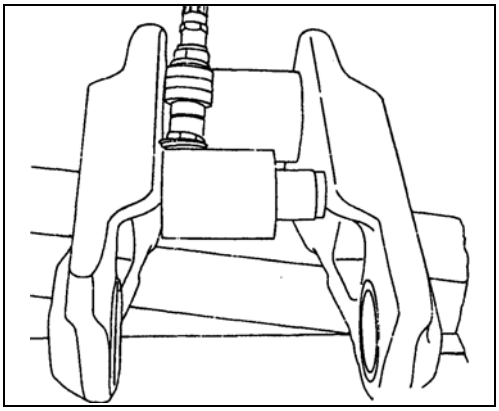


TRACK CHAIN

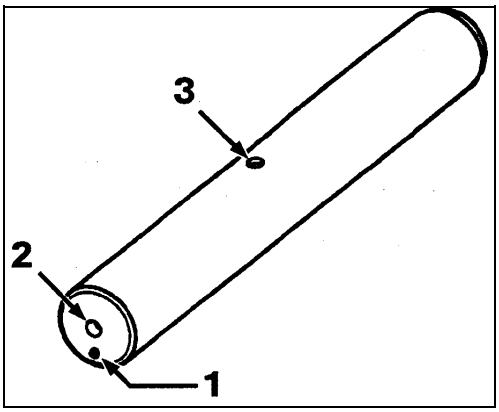
3. Install O-rings, seals and spacers in counterbores.



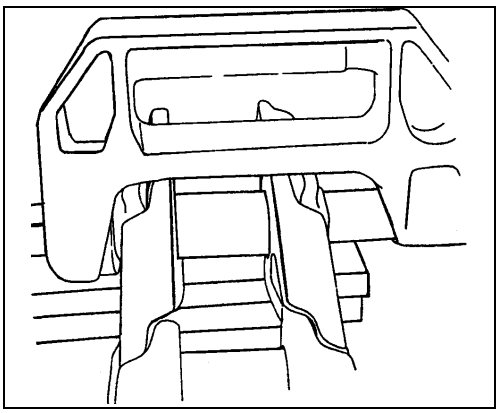
4. Using small hydraulic ram spread link about 6 [mm] and position link over next link being careful not to damage seals. Line up links and slip in forcing pin. Remove ram. Secure aligning adapter in end of press C frame and thread short pin on ram.



5. On new or REUSED pin, mark an index mark (1) on lube hole end of pin so that it is opposite from cross drilled hole (3). Position track pin in bore of press C frame so that lube hole (2) is facing out and index mark is opposite track shoes when installed.

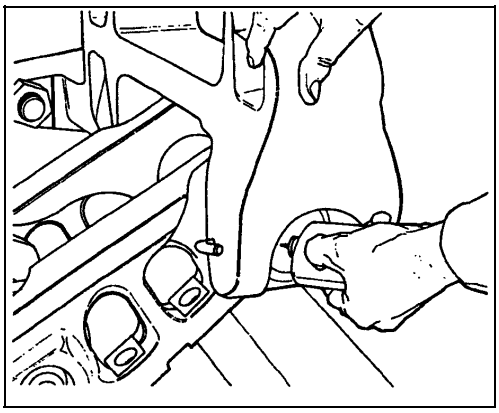


6. Position press over track. Press pin in, stopping before pin enters last link. Relieve pressure on press and remove forcing pin.

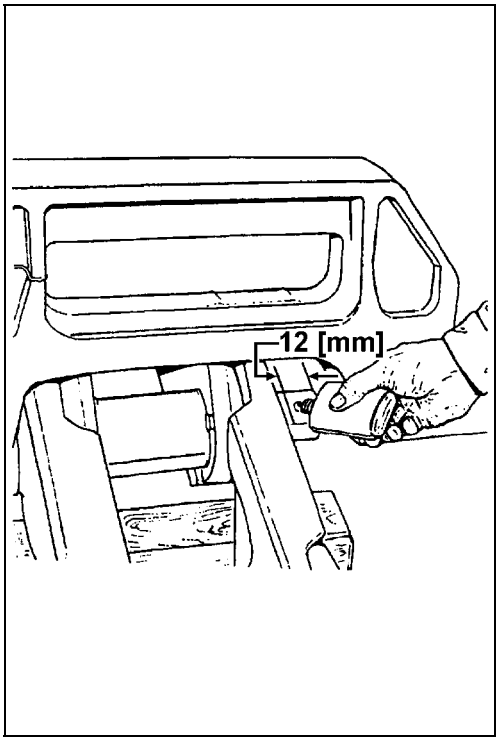


TRACK CHAIN

7. Apply LOCTITE #640 in outer half of bore of last link.



8. Apply LOCTITE #680 on O.D. of pin as shown. Push completely in. Repeat this step on next joint. Place a special purpose rubber plug in end of pin so that it is flush with or slightly below bottom of chamfer in hole (use mounting tool described in SERVICE/SPECIAL TOOLS) and insert lubricator nozzle of seal tester or vacuum pump (refer to SERVICE/SPECIAL TOOLS) into plug. Pull a vacuum of 70 ± 5 [kPa] and hold for 10 [sec] to check seals. In event vacuum cannot be held, either seal to bushing face or track pin to link pin boss mating surfaces are leaking. Joint must be rebuilt. If vacuum holds for 10 [sec], fill evacuated pin 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 using mounting tool (refer to SERVICE/SPECIAL TOOLS). 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) to prevent plug from escaping. Repeat this step on remaining pins.



SECTION 17

MOUNTED EQUIPMENT

MOUNTED EQUIPMENT

CONTENTS

C FRAME

1. C FRAME BUSHINGS 3
2. C FRAME PIN SHIMS 4
3. C FRAME RUB BRACKETS 5

ANGLING FRAME

4. BUSHING AND WEAR PLATE REPLACEMENT 7
5. ANGLING FRAME ADJUSTING 8

BLADE

6. BLADE BUSHINGS REPLACEMENT 9

C FRAME

1. C FRAME BUSHINGS

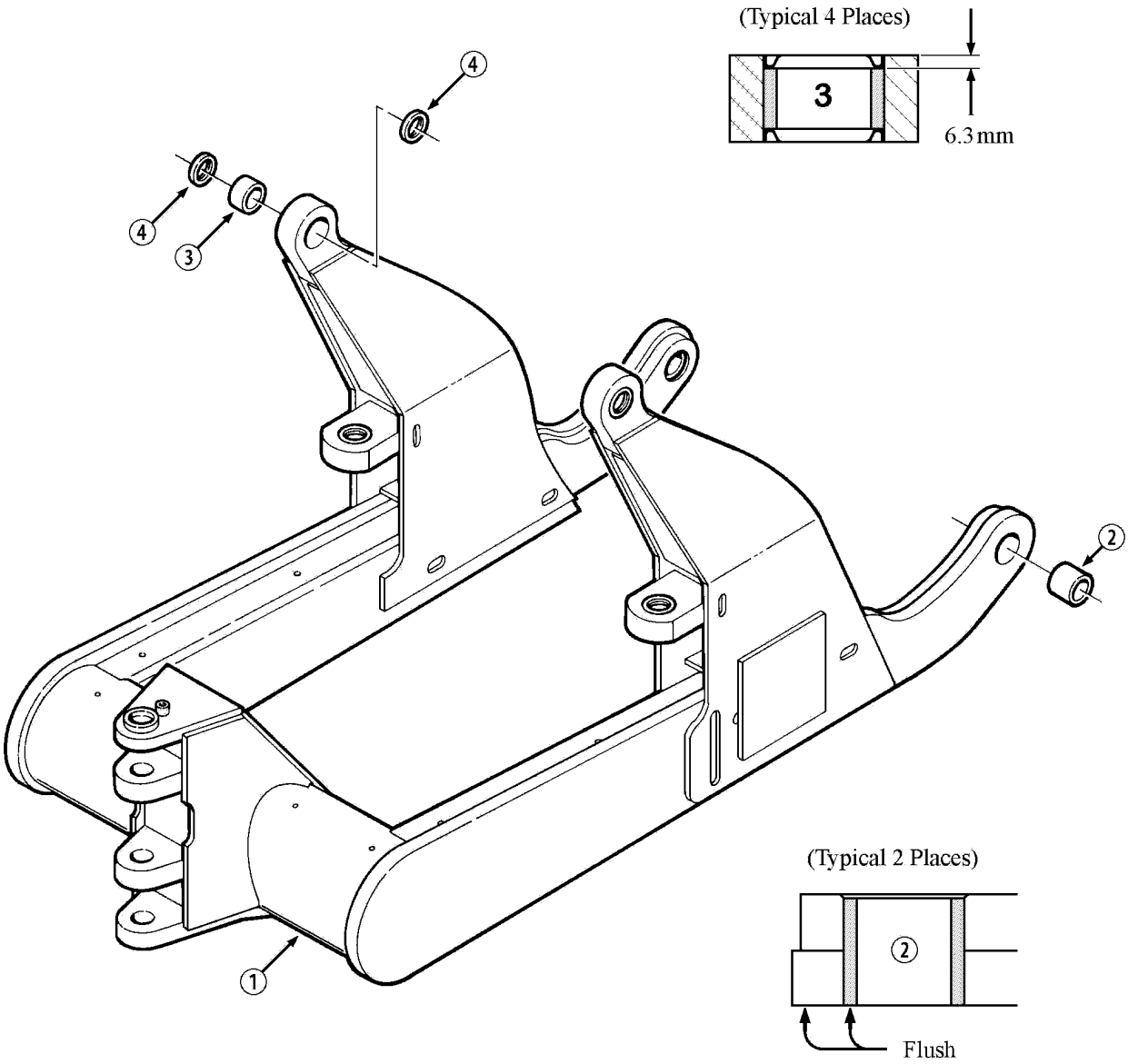


Fig. 17.1. C Frame with Bushings

1. C Frame
2. Trunnion Pin Bushing
3. Cylinder Pin Bushing
4. Pin Seal

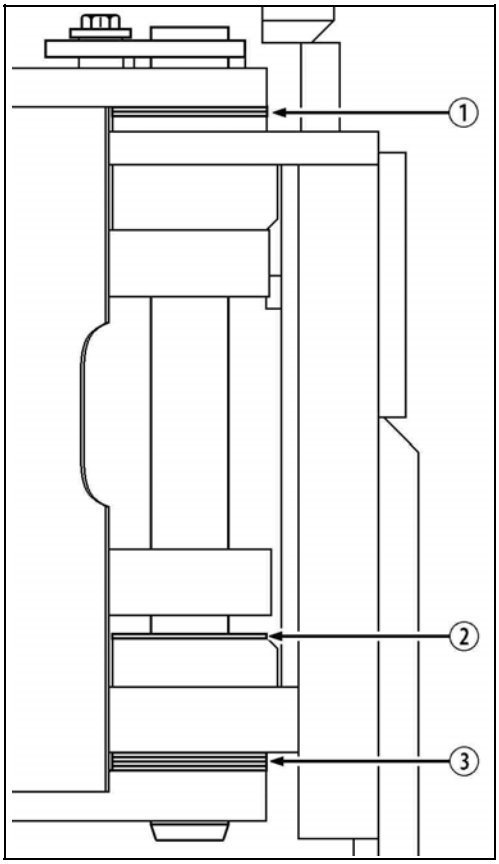
Disassembly and Assembly

1. Remove the old bushing (2) from the C frame (1). Press in a new bushing (2) flush with the outside edge of the C frame.
2. Remove and discard the pin seals (4), replace with new. Drive the old bushing (3) out. Position a new bushing in place and press in to the dimension shown. Install new pin seals (4) flush with the surface face by only driving in on the outer steel shells.

C FRAME

2. C FRAME PIN SHIMS

1. Shim the gap (1) between the angling frame and the C frame as required to minimize the gap to permit free movement without any binding. A minimum of one shim to a maximum of two shims are allowed.
2. Install the one shim (2) at this location.
3. Shim the gap (3) between the angling frame and the C frame as required to minimize the gap to permit free movement without any binding. A minimum of four shims to a maximum of six shims are allowed.

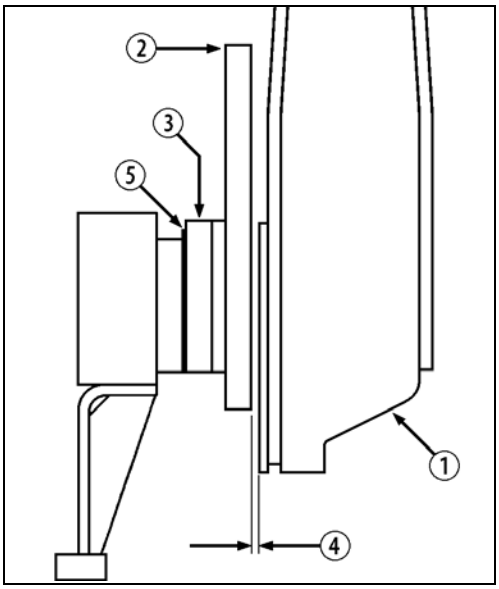


C FRAME

3. C FRAME RUB BRACKETS

TD-7M OR TD-8M

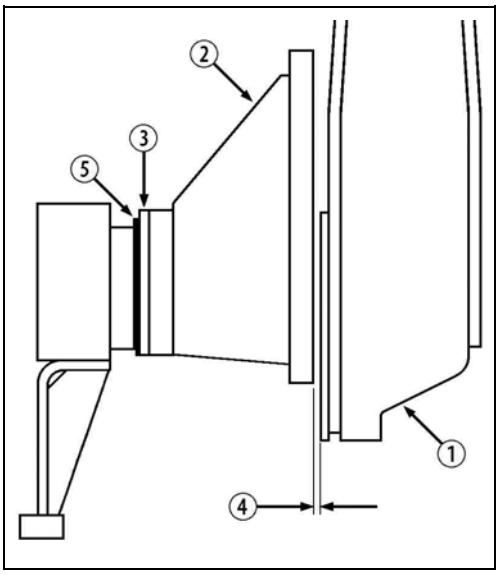
Center the C frame (1) on the machine. Bolt the rub bracket (2) and spacer plate (3) without the shims. Measure the gap (4) between the rub bracket and the C frame plate along the length. Install the shims (5) between the spacer plate and track frame mounting block to establish a nominal gap.



1. C Frame
2. Rub Bracket
3. Spacer Plate
4. Nominal Gap ……6.3 ±1.5 [mm]
5. Shims

TD-7M LGP OR TD-8M LGP

Center the C frame (1) on the machine. Bolt the rub bracket (2) and spacer plate (3) without the shims. Measure the gap (4) between the rub bracket and C frame plate along the length. Install the shims (5) between the spacer plate and the track frame mounting block to establish a nominal gap.



1. C Frame
2. Rub Bracket
3. Spacer Plate
4. Nominal Gap …… 6.3 ±1.5 [mm]
5. Shims

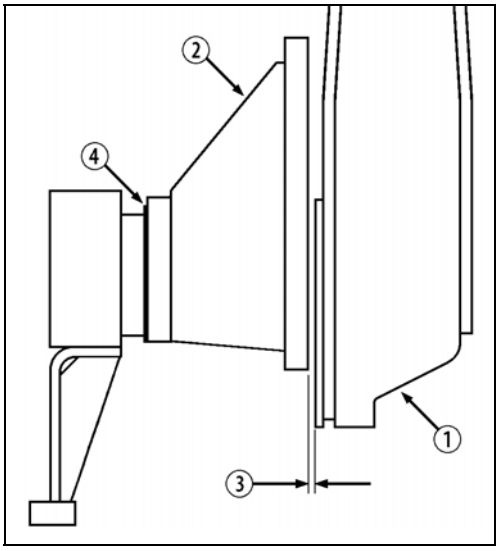
MOUNTED EQUIPMENT

C FRAME

TD-9M LGP OR TD-10M LGP

NOTE: *The TD-9M or TD-10M does not require rub brackets and shimming.*

Center the C frame (1) on the machine. Bolt the rub bracket (2) without the shims. Measure the gap (3) between the rub bracket and the C frame plate along the length. Install the shims (4) between the spacer plate and the track frame mounting block to establish a nominal gap.



1. C Frame
2. Rub Bracket
3. Nominal Gap …….. 6.3 ±1.5 [mm]
4. Shims

ANGLING FRAME

4. BUSHING AND WEAR PLATE REPLACEMENT

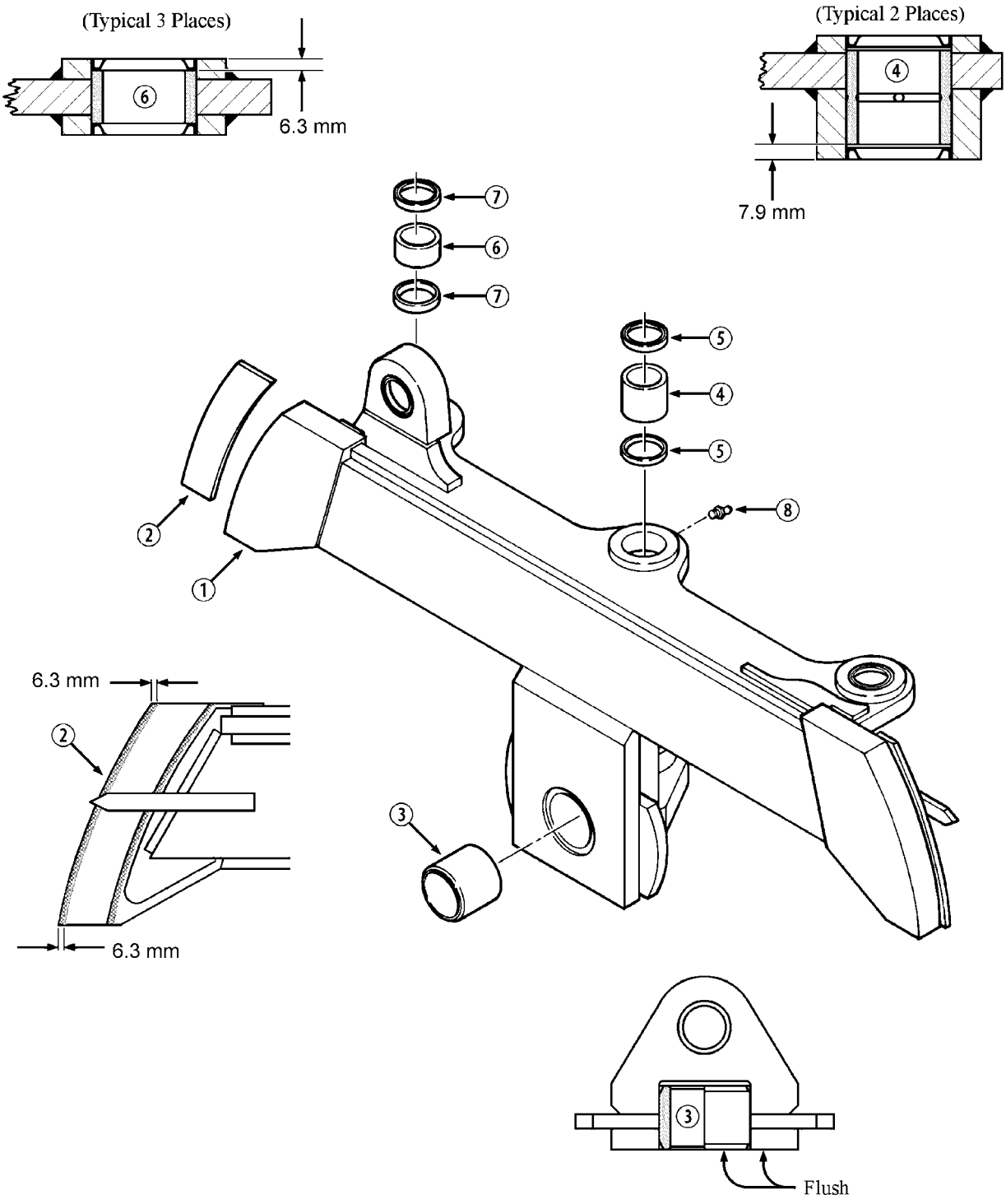


Fig. 17.2. Angling Frame with Bushings and Wear Plates

1. Angling Frame
2. Wear Plate
3. Angling Bushing
4. Blade Pin Bushing
5. Pin Seal Ring
6. Cylinder Bushing
7. Lube Fitting

ANGLING FRAME

NOTE: *Before performing any service on the angling frame, preview the general welding precautions in SECTION 1, INTRODUCTION.*

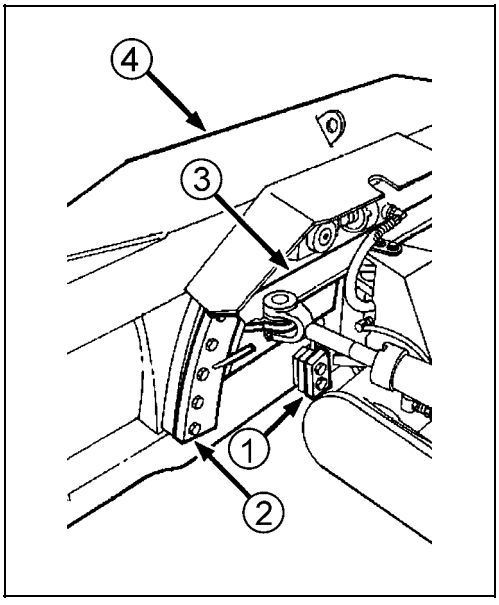
1. Using a cutting torch, remove the plate (2) weld. After cool down period grind off any remaining weld or excessive metal to provide a smooth surface for the new wear plate.
2. Position the new wear plate (2) to the angling frame (1) at the dimensions shown. Secure in place with C clamps. Weld a bead along the front outside edge and rear inside edge.
3. Remove the old bushing (3) from the frame. Press in a new bushing flush with the edges of the frame.
4. Remove and discard the blade pin seal rings (5), replace with new. Drive the old bushing (4) out. Position a new bushing in place and press in to the dimension shown. Install new pin seals flush with the surface face by only driving in on the outer steel shells.
5. Remove and discard the cylinder pin seals (75, replace with new. Drive the old bushing (6) out. Position a new bushing in place and press in to the dimension shown. Install new pin seals flush with the surface face by only driving in on outer the steel shells.

5. ANGLING FRAME ADJUSTING

Periodically or as required the lower (1) and upper (2) shims (both sides) may have to be removed to take up the wear between the angling frame (3) and the blade (4). The gap between the angling frame and the blade should not exceed 3 [mm] minimum gap.

The lower shim pack is to consist of no less than 1 shim and no more than 6 shims. The upper shim pack is to consist of no less than 2 shim and no more than 7 shims.

The gap should permit free movement between the angling frame and blade without any binding.



1. Lower Shim
2. Upper Shim
3. Angling Frame
4. Blade

BLADE

6. BLADE BUSHINGS REPLACEMENT

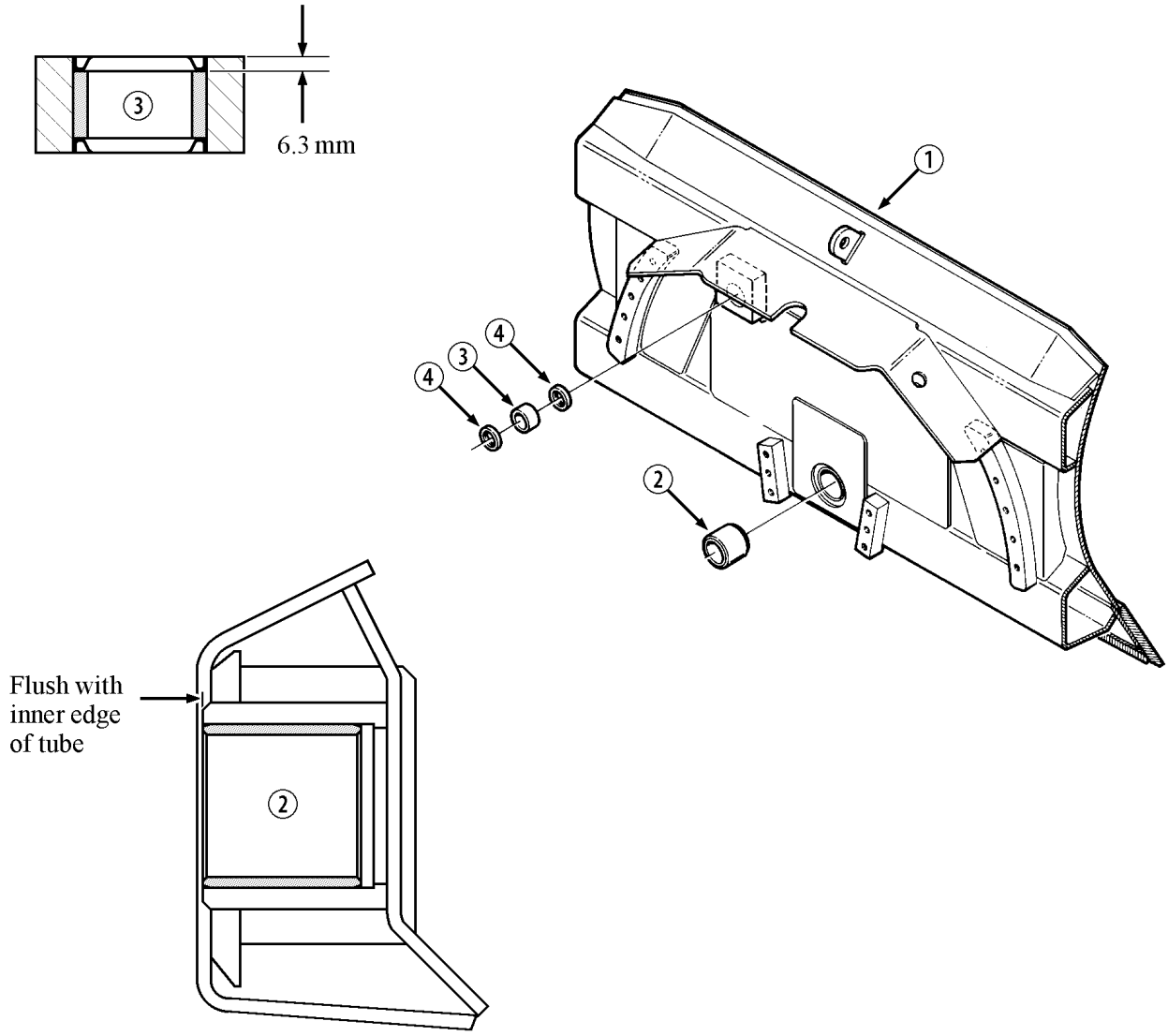


Fig. 17.3. Blade with Bushings

1. Blade
2. Trunnion Pin Bushing
3. Cylinder Pin Bushing
4. Pin Seal

1. Remove the old bushing (2) from the blade (1). Press in a new bushing flush with the inner edge of the tube in the blade.
2. Remove and discard the pin seals (4), replace with new. Drive the old bushing (3) out. Position a new bushing in place and press in to the dimension shown. Install new pin seals flush with the surface face by only driving in on the outer steel shells.