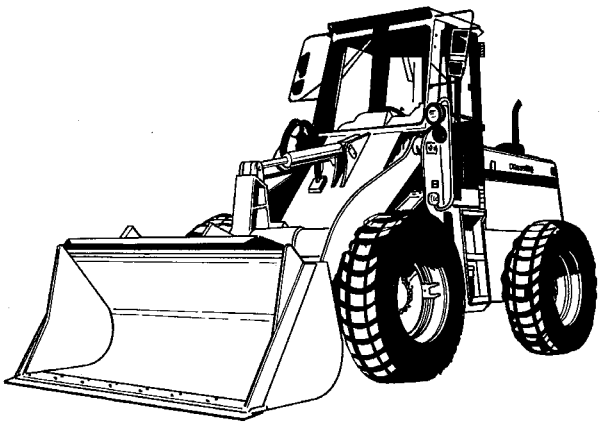
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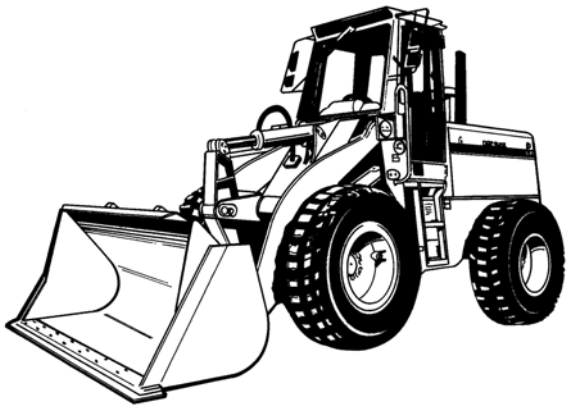
SERVICE MANUAL

515G 520G

SERIAL NUMBER 93501 AND UP



SERIAL NUMBER 83501 AND UP



DRESSTA

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SECTION 1

INTRODUCTION

SAFETY PRECAUTIONS

1. GENERAL

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

Throughout this manual the use of the terms „left", „right", „front" and „rear" must be understood to avoid confusion when following instructions. These terms indicate the side of the vehicle when facing forward in the operator's seat.

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

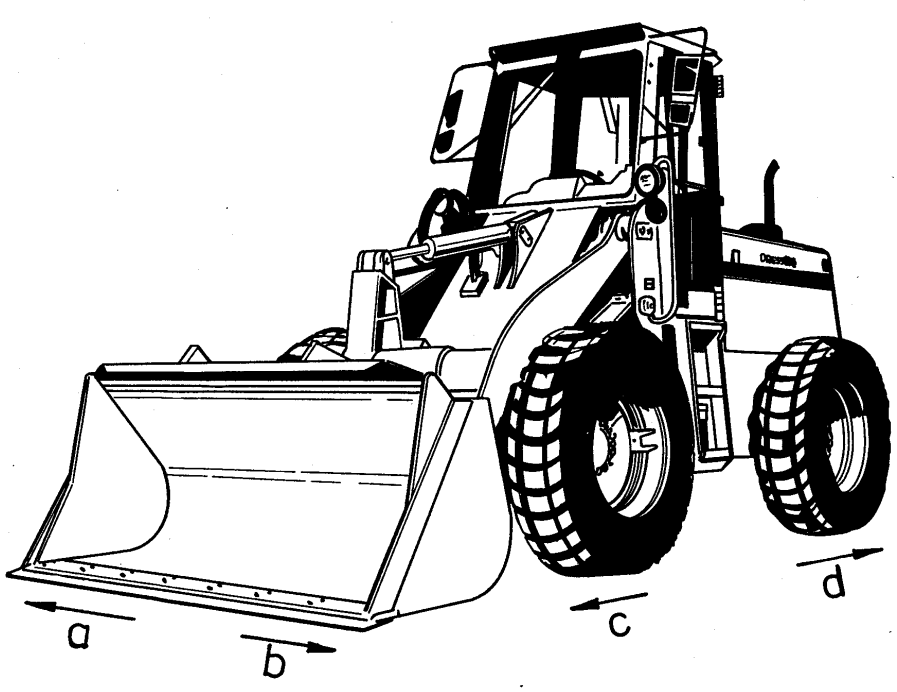


Fig. 1.1. Series G Wheel Loader (Left Front View)

a. Right Hand Side of the Machine
b. Left Hand Side of the Machine
c. Front of the Machine
d. Rear of the Machine

WORK SAFELY - FOLLOW THESE RULES

The following symbols and text in bold are used throughout this manual to call your attention to instruction concerning your personal safety.

This symbol is used throughout this manual to call your attention to warnings to instructions concerning personal safety. Carefully observe and follow these precautions. Be certain anyone operating or servicing this machine is aware of the safety rules. Failure to follow these precautions can result in serious injury or death.

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

INTRODUCTION

SAFETY PRECAUTIONS



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



CAUTION! This symbol and text in bold letters is used throughout this Manual indicates an emergency, which is not avoided may result in minor injury.

Warning and information terms relating to text that may influence efficiency of the machine and possible material losses.

In this manual two terms are used relating to possibility of damage of assemblies of the machine or affecting its efficiency and service time prior to repair are written in normal an italics.

IMPORTANT: *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. Failure to follow such instructions may result in damage of the machine and heavy material losses.*

NOTE: *This sign and text in normal 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.*

Personnel Precautions

1. Operating and servicing this machine can be hazardous if performed improperly.
2. Only trained and authorized personnel should be allowed to operate and service this machine.
3. Read all warning decals before starting, operating, maintaining or repairing this machine.
4. DO NOT wear jewelry or loose fitting or hanging clothing because they could catch on moving parts and cause injury or death. Wear proper safety equipment, such as a hard hat, rough-soled work shoes or safety shoes, ear protectors, reflective vests, respirators, safety glasses, goggles and heavy gloves. Consult your employer for specific requirements.
5. DO NOT jump on or off the machine. Keep two hands and one foot, or two feet and one hand, in contact with the steps and handholds at all times. Place objects on machine from ground level before climbing on. Always face the machine when climbing on or off to reduce the chances of slipping and injury.
6. Think before you act. Careful operators and service personnel are the best insurance against accidents.
7. Do not rush. Hurrying can lead to accidents. Haste, carelessness and lack of training are the primary causes of equipment-related injuries.

Machine Precautions

1. Carefully evaluate your application's particular safety needs. Each machine application can have unique requirements. You may need such attachments as: air conditioning, spark arrestor, fire suppression system, rotating beacon, additional lights, central lubrication system and communication radios.
2. Be sure the machine has the correct equipment required by local rules and regulations.
3. A rollover protective structure ROPS with a seat belt and falling objects protective structure FOPS are required in almost all applications. DO NOT operate this machine without a ROPS-FOPS cab.

SAFETY PRECAUTIONS

4. It is recommended that the machine be equipped with a fully charged fire extinguisher. Personnel should be instructed in proper usage. Recharge immediately after use.
5. If the machine will be used for tree removal or site clearing, install approved operator protection. Consult your Construction Equipment Distributor for information.
6. If the machine will be working under conditions of flying combustible material, install screens and guards to reduce the chance of fire.
7. If the machine will be driven on the roads, equip it with rear view mirror(s) and the necessary signal lights.
8. If the machine is equipped with a suction fan (or a reversible fan in the suction position), check the engine exhaust system periodically for leaks. Exhaust gases are dangerous to the operator. On machines equipped with a cab, keep a vent open to outside air.
9. Keep shields and guard in place for your protection. Be sure to replace them after servicing the machine.
10. A first-aid kit should be available in case of an injury.
11. When transporting the machine, use caution when loading and unloading it. Load and unload the machine in a level area which fully supports the machine and transport vehicle. Block the transport vehicle so it cannot move. Use loading ramps of adequate strength, low angle and proper height. Keep the trailer bed and the machine's tires clean of clay, oil and other slippery materials. Lock the machine's frames together with the frame locking bar and pins. Apply the machine's parking brake. Block the tires and securely tie down the machine to the trailer bed.

2. OPERATION

Before Starting

Before entering the operator's compartment, walk completely around the machine and clear the area of personnel and obstructions.

1. Perform a visual check of the machine before starting the engine. Look for such things as missing protective devices, leaks, improper fluid levels, trash buildup and loose, damaged or missing parts. DO NOT start the engine until any unsafe conditions are corrected.
2. Before operating the machine, check that the frame locking bar and pins are in the storage position on the rear frame. A broken or lost frame locking bar or pins should be replaced immediately so that this device is always available for use.
3. Be sure all filler caps, dipsticks, plugs, latches, service doors, etc., are secure before starting.
4. BE SURE the operator's compartment, mounting steps and handholds are free of oil, grease, snow, ice, mud and foreign objects to reduce the possibility of slipping and injury. Repair any damaged steps or handholds. Remove or secure all maintenance and personal items which might interfere with the operator or jam the controls.
5. Do not use the machine's controls or hoses as handholds when climbing on or off the machine. Controls and hoses can move and do not provide solid support. Movement of the controls may cause unexpected machine movement and injury.
6. Understand all control functions before starting the engine.
7. Know the alternate exit routes from the operator's compartment for use in an emergency.
8. The operator must be alert, physically fit and free from the influences of alcohol, drugs and medications that might affect his eyesight, hearing or reactions.
9. 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.

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Startup

1. Never start the engine indoors unless proper exhaust ventilation is provided to remove deadly exhaust gases. Open the building doors before startup. Once the engine is running, move the machine outdoors as soon as possible. Exhaust gases are hazardous and can cause unconsciousness and death.
2. Sit in the operator's seat before operating any controls. Keep hands and footwear free of grease, water and mud to insure positive control movement.
3. Before starting the engine or when machine is standing with the engine running: place the transmission shifter in neutral position (N), apply the parking brake and lower any raised equipment.
4. DO NOT SMOKE when using the ether injector. Do not use the ether injector when air temperature is above freezing [0ºC]. Follow the correct method for starting the engine. Refer to "Starting the Engine", in the OPERATOR'S MANUAL.
5. Do not adjust the seatbelt while the machine is moving because a loss of control may result. Stop the machine, apply the parking brake and then adjust the seat. Never wear the seat belt across the abdomen.
6. Use of the seat belt with the ROPS is strongly recommended. In the event of a rollover, stay with the machine. Experience has shown this will reduce the chance and seriousness of injury.
7. Before moving the machine, check the brakes, steering, attachment controls and safety devices. DO NOT operate the machine until any unsafe conditions have been corrected.
8. Sit in the operator's seat and before moving the machine, sound the horn to warn nearby personnel.
9. Release the parking brake before moving the machine. The brake could burn or be damaged if the machine is driven with it applied.
10. Turn off the defroster fan before adjusting it to avoid injury.
11. Only the operator should be on the machine when it is moving. Never haul passengers be sure the cab door(s) is securely latched.
12. Use caution and follow the manufacturer's instructions when using external heaters to warm the power train in cold weather.

General Operating Precautions

1. Stay alert and aware of what you are doing. Use common sense. Do not operate when fatigued or ill. Know your machine and its capabilities. Use the machine only for its intended purpose. For your safety, read the OPERATOR'S MANUAL carefully and follow all instructions and precautions.
2. Do not operate the machine in closed areas without proper exhaust ventilation to remove toxic exhaust gases. Exhaust gases are hazardous and can cause unconsciousness and death.
3. Maintain clear vision of all work and travel areas. Keep windows and mirror clean and repair immediately if damaged.
4. Look in the intended travel direction to be sure personnel and allied equipment do not interfere with the machine's work pattern. Do not operate if exposed personnel enter the immediate work area.
5. Turn on the machine's lights at night and times of poor visibility to see and be seen.
6. DO NOT adjust the seat while the machine is moving because a loss of control may result. Stop the machine, apply the parking brake and then adjust the seat.

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7. Keep head, limbs and body inside the operator's compartment at all times because of the chance of being injured by hazards outside the operator's compartment.
8. NEVER allow anyone near the center articulation pivot. If the machine turned, they could be crushed.
9. NEVER allow anyone to stand on the ladder when the bucket is raised or the machine is moving or turning to prevent injury from falling, crushing or from falling material.
10. NEVER get on or off the machine while it is moving because serious injury or death could result.
11. After starting and while operating, observe instruments and warning lights frequently. Investigate any unusual indications or noises in the machine.
12. If the engine has a tendency to stall, investigate immediately. Do not operate the machine until the cause has been corrected.
13. Wear ear protective equipment, per local regulations.

Driving the Machine

1. Carry the bucket low for maximum visibility and stability when traveling.
2. Before operating in areas with overhead obstructions, carefully check overhead clearance. Obstructions, such as guy wires, power lines, tree branches, bridges and building doors could cause a rollover accident.
3. Drive slow enough to insure complete control. Slow down when traveling in congested areas or on mud, ice or other slippery surfaces. Keep a safe distance away from other vehicles, according to the load and ground conditions.
4. Whenever possible avoid crossing obstacles, such as ridges, curbs, logs and rocks. If you cannot avoid them, reduce speed and cross at an angle. Ease up to the break over point, pass the balance point slowly and ease down on the other side.
5. Cross ditches and gullies slowly and at an angle after checking that the ground will safely support the machine.
6. Avoid sidehill travel whenever possible. Drive straight up and down the hill. If the machine starts slipping sideways, turn downhill immediately.
7. Stop, look and listen before entering a highway. Stay on the right side of the road. Slow down and switch on the turn signal when turning into byway.
8. Never shift the transmission into neutral position (N) when traveling downhill. The machine could go out of control or the power train could be damaged when the transmission is shifted into gear again.
9. Do not overspeed the engine. Excessive speeds can be hazardous and harmful to the power train. Select the proper gear before starting downhill. Control speed with the brakes, engine and transmission.
10. Never use the bucket as a brake except in an emergency. It might catch on the ground and result in personal injury.
11. If the ground driven steering light comes on, IMMEDIATELY stop the machine in a safe place. Shut off the engine and apply the parking brake. Correct the cause before operating again.
12. If the brake system warning light or buzzer comes on during operation, IMMEDIATELY stop the machine in a safe place. Apply the parking brake. Correct the cause before operating again.
13. Know the traffic flow pattern of the job site. Obey flagmen, signs and signals.
14. Give the right-of-way to loaded machines. On narrow or hilly roads, loaded machines should stay next to the high wall.
15. Keep the machine as close to the side of the road as safely possible to leave room for oncoming and passing vehicles.
16. Pass other vehicles only when the road is clear and the machine has enough distance and reserve power to pass.

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SAFETY PRECAUTIONS

Operating the Attachments

1. Check the work area for hazardous conditions. Be alert for soft ground conditions, especially when working on slopes, near drop-offs or excavations or on fill material, which could lead to sudden tipping of the machine.
2. Keep the work area free from obstructions and as smooth as possible.
3. Know the locations of underground cables, water mains, gas lines, etc. A broken gas line or electrical cable could cause personal injury or death.
4. Avoid operating too close to an overhang, deep ditch or excavation because the machine's weight and vibration may cause the edge to collapse and result in personal injury. If this cannot be avoided, use extra caution and face the machine toward the edge while operating.
5. Avoid undercutting high banks because the bank may cave in. Ramp up and remove the top layers first.
6. Trucks should be loaded from the driver's side whenever possible. When the truck is being loaded, be sure the driver either stays in the cab (on cab-protected trucks) or away from the truck and loader.
7. When loading trucks, be careful not to hit the truck with the loader or its bucket.
8. Use extra caution when moving with the bucket raised to minimize the chance of machine upset.
9. DO NOT swing a load over the heads of other workers or a truck cab.
10. If the loader begins in tip over because of an overload, IMMEDIATELY lower the bucket to regain stability.
11. There is no substitute for good judgment when working on a slope. Slope operation should be limited by ground and traction conditions, the load being carried and the speed of the machine.
12. NEVER operate sideways on a steep slope because a rollover and serious injury could result.
13. Using the loader to carry large objects which do not fit into the bucket is NOT recommended.
14. Handling large objects can be extremely dangerous because the objects may roll or slide down the boom onto the operator. Never lift large objects higher than the operator unless the machine has a device which prevents the objects from falling back onto the operator.
15. When pushing over trees, the machine must have approved operator protection. Back away immediately when the tree starts to fall. Use extreme care when pushing over trees with dead branches which may fall. To reduce the chances of machine upset, never allow the machine to climb up the root structure.

Pulling/Towing

1. For your safety, never push or tow a disabled machine farther than absolutely necessary to load it onto a truck.
2. When using a chain or cable, be sure it is strong enough for the expected load and properly secured to the drawbar pin.
3. Hitch only to the drawbar pin - NEVER HIGHER. Machine upset can result if pulling from the wrong location.
4. When pulling, position the machine so that the chain or cable aligns with the long axis of the machine.
5. Inspect chains and cable for flaws before using. Avoid kinking. Do not pull with a kinked chain or cable because the high stresses could cause a failure in the kinked area. Wear heavy gloves when handling chain or cable.
6. When pulling with a chain or cable, take up the slack slowly to avoid jerking. A chain or cable which fails under load can whip and cause serious injury. STAND CLEAR. DO NOT PULL OR TOW UNLESS THE OPERATOR'S COMPARTMENT IS GUARDED AGAINST OR OUT OF REACH OF A WHIPPING CHAIN OR CABLE.

SAFETY PRECAUTIONS

Shutdown

1. Never leave the machine with the engine running or the bucket raised. When parking the machine, shut off the engine, lower the bucket to the ground, switch the transmission shifter in neutral position (N), apply the parking brake, turn off the electrical system master switch and starting switch and remove the keys to prevent accidental engine starting.
2. Even with the engine off raised boom will drop whenever the control lever is moved to "LOWER" or "FLOAT". ALWAYS lower the boom when parking the machine.
3. If the loader is equipped with a multi-purpose bucket, close the clam before dismounting.
4. Park the machine in a non-traffic area. If parking in 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.
5. Avoid parking on a slope because unexpected machine movement may occur. If necessary to park on a slope, park at a right angle to the slope and block the tires.
6. Always lock the machine, including any anti-vandalism attachments, when leaving it unattended.

3. MAINTENANCE AND REPAIR

General Machine Precautions

1. Constantly be aware of dangers involved in working on the machine and take proper precautions. It is not possible to anticipate all conceivable ways or conditions under which this machine may be serviced or to provide precautions for all the possible hazards that may result. Safety is always the most important rule. Standard and accepted safety precautions and equipment should be used.
2. Do not attempt repairs you do not understand and do not know the remedy. Consult your Construction Equipment Distributor for information and service if required.
3. NEVER run the engine when cleaning or lubricating the machine because serious injury could result from contacting moving parts.
4. Before servicing the machine, BE SURE the engine is off, the bucket is lowered to the ground, the transmission shifter is in neutral position (N), the parking brake is applied, the electrical system master switch and starting switch are turned to the OFF position and the keys are removed to prevent accidental engine starting. Tag the machine per local regulations.
5. Before working on the engine or electrical system, disconnect the negative (ground) battery cable. Tag the cable and controls to warn against starting.
6. Before working under the machine, block the tires to prevent machine movement.
7. ALWAYS lock the frames together before working near the center of the machine. If the frames move, serious injury or death could result.
8. NEVER stand near the bucket or tires while the engine is running.
9. During servicing, DO NOT allow anyone in the operator's compartment who is not trained and assisting in the servicing.
10. When it is necessary to make any checks or adjustments with the engine running, use two people. A trained operator must be at the controls to safeguard the mechanic making the checks or adjustments. BE SURE the transmission shifter is in neutral position (N), the parking brake is applied and the frames are locked together.
11. BE SURE the engine hood or access door(s) is secured in the open position during service work in the engine compartment. Unexpected closing could cause injury.
12. NEVER remove any guards or shields with the engine running because of the danger of contacting rotating parts.
13. When service requires access to areas that cannot be reached from the ground or a service platform on the machine, use a ladder or platform which meets proper requirements.
14. Use only approved parts specified in PARTS CATALOG for repairs and maintenance. Failure to do so could compromise personal safety, machine performance and reliability.

SAFETY PRECAUTIONS

15. This machine is assembled using high strength fasteners. Replacement fasteners must be of the same size and strength as the originals. DO NOT SUBSTITUTE. Refer to the PARTS CATALOG for this machine. Tighten fasteners to the proper torque. Refer to STANDARD TORQUES in this Section.
16. Replace any missing or defaced decals. When parts which have decals on them are replaced, be sure to install new decals. New decals are available from your Construction Equipment Distributor.
17. NEVER adjust relief valves higher than the specified pressure because this may damage the machine and lead to an injury. When checking pressures, use the correct gauge for the expected pressure.

General Work Precautions

1. Keep work area clean and dry. Remove water and oil spills immediately to reduce the chance of slipping and injury.
2. Do not pile up oily or greasy rags; they are a fire hazard. Store them in an approved, closed metal container.
3. Use a non-toxic, non-flammable commercial solvent for cleaning parts, unless otherwise specified.
4. Avoid use of gasoline, diesel fuel, kerosene or other flammable solvents for cleaning parts. NEVER place these solvents in an open pan.
5. Corrosion inhibitors are volatile and flammable. Use them only in a well ventilated area. Keep flames and sparks away. DO NOT SMOKE. Store container in a cool, well ventilated place.
6. Avoid prolonged exposure to volatile corrosion inhibitors because eye and skin irritation may occur.
7. 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.
8. Wear goggles with side protection when using air or water under pressure to clean parts. Use nozzles to limit air pressure to 200 kPa.
9. When cutting, grinding, pounding, prying or whenever material could fly or fall, wear proper protective equipment such as goggles, hard hat, safety shoes and heavy gloves. Many of the machine's parts are hardened and can chip.
10. Wear gloves and goggles when draining hot fluids.
11. 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.
12. If necessary to do welding on the machine, attach the ground cable close to the weld area. Do not attach the ground cable where the current can flow through bearings or mounting pads because this will damage the parts. ALWAYS turn off the electrical master switch.
13. Use extra caution when jacking up the machine. Jacking up the machine can be hazardous if performed improperly. Use jacking equipment of sufficient capacity. Be sure the jacking points are strong enough to support the machine. Be sure the jack is stable and well supported. Before jacking up the machine, block the tires which will not be lifted. Lock the frames together with the locking bar and pins. If the rear tires are being lifted, block the rear axle to prevent if from pivoting unexpectedly. DO NOT run the engine with the machine on jacks. For your safety, transfer the weight of the machine to approved blocks before servicing the machine.
14. Use the proper tool for the job. Be sure all tools are in good condition. Do not use tools which are worn, bent or have mushroomed heads because they can lead to injury.
15. Never align holes with fingers or hands. Use the proper aligning tool to avoid injury.
16. Remove sharp edges and burrs from reworked parts.
17. Do not carry loose objects in pockets because they might catch on the machine and result in a fall or injury.

SAFETY PRECAUTIONS

18. Use only properly grounded auxiliary power sources for chargers, heaters electric drills and similar equipment to reduce the chance of electrical shock.
19. Lift and handle all heavy parts with lifting devices of adequate capacity. Prior to lifting make sure the part lifted is properly secured in hooks of the lifting sling. Use lifting eyes provided if required. Clear the area of nearby personnel.
20. DO NOT use the loader bucket or forks to lift personnel or as a work platform. Mechanical failure or human error could cause unexpected movement of the attachment and serious injury or death.

Attachments

1. For your protection, keep head, body, hands and fingers away from the bucket and loader linkage when they are in a raised position, unless they are securely blocked.
2. When replacing cutting edges and teeth, securely block the bucket for your protection.
3. To install and remove bucket teeth, use a non-ferrous hammer.

Brakes

1. Block the tires to prevent sudden movement of the machine before servicing the brakes.
2. Test the parking brake periodically. If the parking brake does not hold the machine, correct the cause as soon as possible. Until the cause is corrected, park the machine on level ground and block the tires to prevent it from moving.
3. When testing the parking brake, be sure the area near the machine is clear of personnel and obstructions because the machine may move during the test.
4. Air in the hydraulic brake lines reduces the brake's effectiveness. Whenever brake lines have been disturbed or if the brakes feel effective or spongy, bleed the brakes to remove entrapped air, refer to OPERATOR'S MANUAL. Consult your Construction Equipment Distributor for information if in doubt.
5. Wear goggles when adding brake fluid or bleeding the brakes. Brake fluid can cause serious eye injury. In case of eye contact, flush eyes thoroughly with water and get prompt medical attention.

Cab/ROPS-FOPS

1. Do not attempt to repair a ROPS-FOPS cab after an accident. Repaired structures do not provide the original strength and protection. Contact the Authorized Distributor of Construction Equipment for information on the cab replacement. Do not operate the machine again until the cab has been replaced.
2. Do not cut, grind, weld or drill holes in the ROPS-FOPS cab because this could weaken the structure or affect its energy absorption capability.
3. Periodically inspect the cab for fatigue cracks. Cracks indicate a weakened structure which should be replaced for your protection.
4. Do not use bleach, dye or solvents on the seat belt because this may weaken the webbing and result in personal injury. Clean the seat belt with warm water and a mild detergent. Replace belts which have worn, frayed, torn, faded, stiff or rotted webbing.
5. Do not service the air conditioning system unless you are completely familiar with air conditioning and the safety precautions for handling liquid refrigerant which can cause sever frostbite. Contact your Construction Equipment Distributor.

Cooling

1. Hot, scalding coolant can spray out if the radiator cap is removed suddenly. Relieve system pressure by slowly turning cap to the first notch or lifting the safety lever (if equipped). Remove the cap ONLY after the pressure is relieved.
2. Use extreme caution when adding coolant to a hot radiator to avoid being burned. Wear gloves and goggles and keep face away from the filler neck.

INTRODUCTION

SAFETY PRECAUTIONS

Electrical

1. Batteries give off a highly flammable gas. DO NOT SMOKE or allow sparks or open flame near the batteries because a fire or explosion could result.
2. BE SURE the electrical system master switch is off when connecting or disconnecting batteries to minimize the chance of sparks and explosion.
3. DO NOT allow metal tools or a jumper cable clamp to contact the positive battery terminal and any other metal on the machine. The resulting sparks could cause an explosion.
4. When the charge in the machine's batteries is to low to crank the engine, a booster battery can be used to help start the engine. Connect the positive cable of the booster battery to the cranking motor and connect the negative (ground) cable of the booster battery to the machine frame. Be sure the negative cable is 300 [mm] or more away from the battery. ALWAYS connect the ground cable last and disconnect it first to avoid sparks near the battery. The parking brake should be applied, and transmission shifter in neutral position.
5. Use only a booster battery with the same voltage as the battery in the machine. DO NOT jump a frozen battery because it might explode. Be sure the fluid levels are proper. For added safety, cover batteries with a damp cloth before attaching cables.
6. NEVER check the battery charge by placing a metal object across the terminals. The sparks could cause a battery explosion. Use a voltmeter or hydrometer to measure charge.
7. Battery acid causes severe burns. Avoid contact with eyes, skin or clothing. Wear goggles, rubber gloves and apron. If skin contact occurs, flush with water. If eye contact occurs, flush with water for 15 minutes and get prompt medical attention.
8. The engine can be started with the transmission in gear if the neutral start switch is bypassed. Do not connect across the terminals on the starter motor. Attach booster batteries as directed in this manual.
9. DO NOT charge batteries in a closed area. Provide proper ventilation to guard against explosion of an accumulation of the gas given off in the charging process.

Engine

1. Do not rework or modify the engine flywheel because this could weaken it and lead to a failure.
2. Keep the engine exhaust manifold(s) and exhaust system clear of combustible material to reduce the chance of fire.
3. Be sure that fuel lines connections between the priming pump and the fuel injection pump are tightened. If it is not tight, it will leak fuel and cause a fire hazard.
4. Ether starting fluid is highly flammable. Follow the precautions on the container. An explosion can result if sparks or flame contact the ether in the container or if the container is stored where the temperature exceeds the temperature listed on the container. Observe the following precautions:
    a. Follow the correct method for starting the engine. Refer to "Starting the Engine", in the OPERATOR'S MANUAL.
    b. Do not use the ether injector when the air temperature is above freezing 0 [°C].
    c. DO NOT SMOKE when using ether starting fluid.
    d. For your safety, remove the ether container when welding, grinding or using a torch on the machine.
    e. Do not let ether contact your skin because it can cause frostbite.
    f. Do not breathe the hazardous ether vapor.
    g. Keep the fluid containers out of the reach of children.
    h. NEVER puncture the fluid container or put it into a fire. Dispose of empty containers properly.
    i. DO NOT store fluid containers in the operator's compartment.

SAFETY PRECAUTIONS

Fuel System

1. DO NOT SMOKE while filling the fuel tank or servicing the fuel system because a fire or explosion could result.
2. NEVER remove the fuel filler cap or fill the fuel tank while the engine is running or when the machine is indoors. The fumes are hazardous and a spark or flame could cause a fire or explosion.
3. When filling the fuel tank, place the fuel nozzle against the side of the filler neck to reduce the chances of static electricity sparks.
4. NEVER mix gasoline, gasohol or alcohol with diesel fuel. This creates a fire or explosion hazard which could result in personal injury or death.

Hydraulics

1. For your safety, lower the bucket before servicing the machine. Be sure no one is standing near the bucket when it is being lowered.
2. NEVER work or walk under a raised bucket without proper blocking.
3. Before working on the hydraulic system, be sure the system pressure is relieved by moving the control levers in all directions with the engine off.
4. Hydraulic oil escaping under pressure from a very small hole can be almost invisible, yet have sufficient force to penetrate the skin. Use a piece of card board or wood to search for suspected leaks. If injured by escaping oil, see a doctor immediately because of the possibility of serious infection or reaction to the oil.

Tires and Rims

1. Tire and rim repairs MUST be done by specially trained people using special safety tools. An improperly repaired tire or rim can separate suddenly and cause serious injury.
2. NEVER inflate a flat tire without inspecting the tire, rim and wheel for damage. Be sure all components are properly assembled. Unmounted tires being inflated or deflated should be placed in a tire safety cage. Inflate the tire as described in SERVICE MANUAL and check that all components are properly seated. NEVER stand directly in front of a tire and rim assembly while inflating. Use a clip-on air chuck with a hose long enough to allow the person inflating the tire to stand to the side. Serious injury could result if the tire and rim were to separate.

SHIPPING SPECIFICATIONS

4. DIMENSIONS

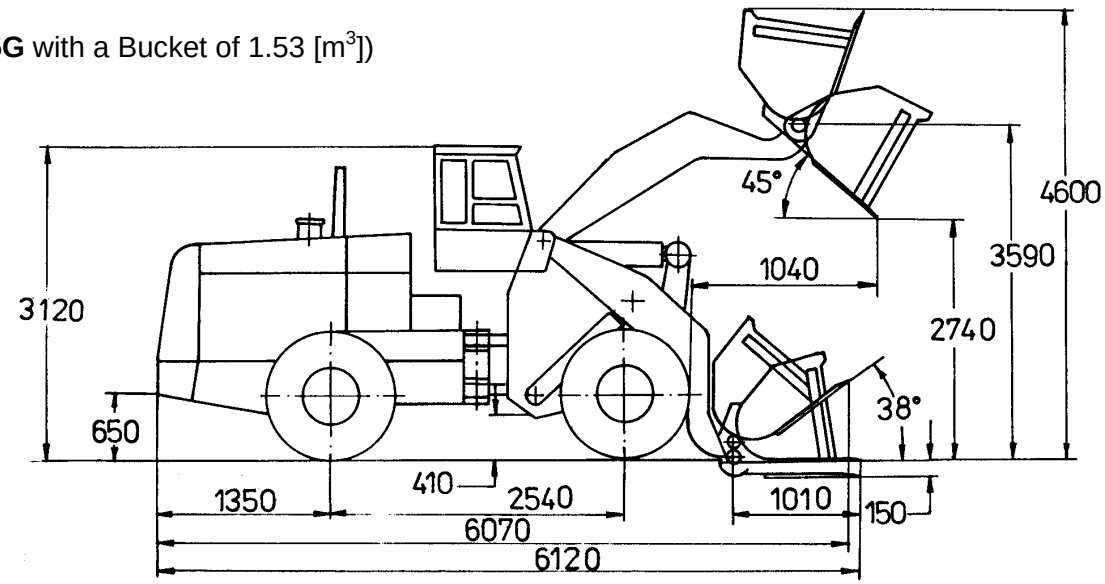
Specification	515G	520G
Height to top of cab ROPS-FOPS	3120 [mm]	3260 [mm]
Overall length with bucket on ground	6120 [mm]	6580 [mm]
Overall length with bucket at carry position	6070 [mm]	6550 [mm]
Width w/bucket	2390 [mm]	2590 [mm]
Width w/o bucket	2350 [mm]	2390 [mm]
Wheelbase	2540 [mm]	2770 [mm]
Ground clearance	410 [mm]	396 [mm]
Dump clearance per SAE*	2740 [mm]	2820 [mm]
Reach at maximum height and 45° dump angle per SAE*	1040 [mm]	1020 [mm]
Maximum Lifting Height	4600 [mm]	5050 [mm]
Weight	9500 [kg]	11000 [kg]

*) may vary depending on wheel size.

INTRODUCTION

SHIPPING SPECIFICATIONS

515G with a Bucket of 1.53 [m^3])



520G with a Bucket of 1.91 [m^3])

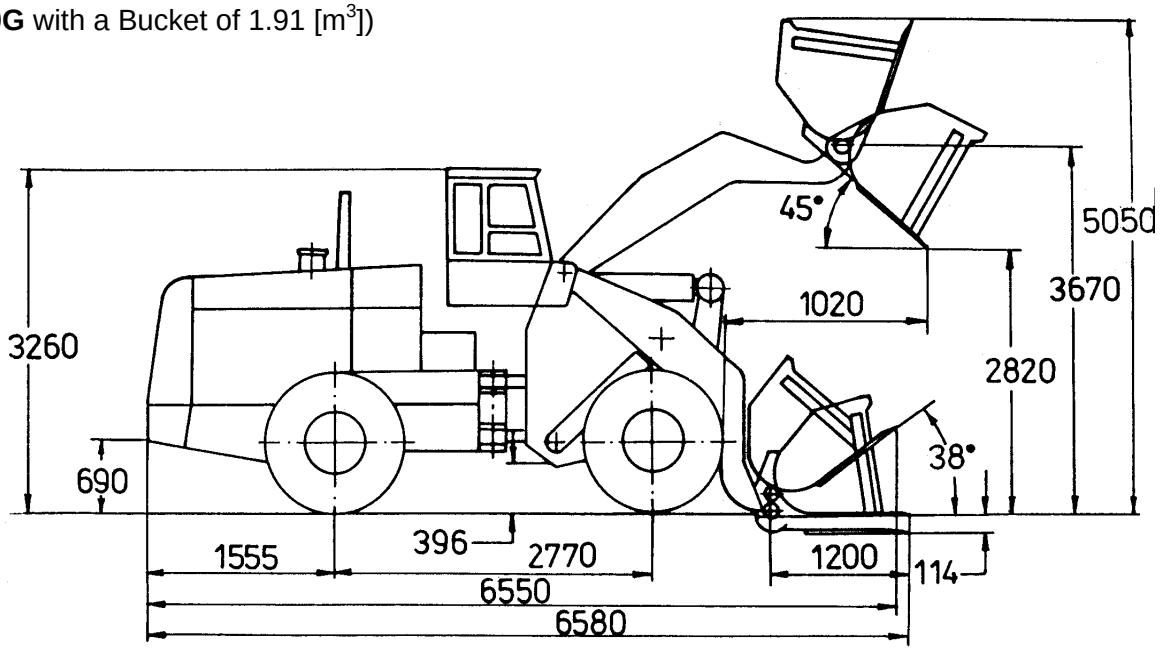


Fig. 1.2. General Dimensions for the standard configuration of 515G, 520G wheel loaders equipped with ROPS-FOPS cab, standard bucket with cutting edge and standard tires

SHIPPING SPECIFICATIONS

5. SYSTEM REFILL AND SERVICE CAPACITIES

Specification	515G		520G	
	Refill [l]	Service [l]	Refill [l]	Service [l]
Axle (each)	15		16.5	
Engine lubrication system (with filter)	16.4		16.4	
Engine crankcase	14.4		14.4	
Cooling system	23		24	
Braking system	3.8		3.8	
Hydraulic system (loader and steering)	76		105	
Hydraulic reservoir		49		70
Transmission system	27		30	
Transmission		18		22
Fuel Tank	132.5		172	
Washing fluid reservoir	3.8		3.8	
Air conditioner	1.22 [kg]		1.22 [kg]	

SERVICE INFORMATION

6. SPARE PARTS

Always use genuine spare parts. All spare are listed in PARTS CATALOG and available through your Constriction Equipment distributor.

7. SERIAL NUMBERS

Machine Serial Number Plate (2, Fig. 1.3) is located on the LH side of the operator's cab and Stamped Machine Serial Number (3), is located on the LH side of the rear frame.



Fig. 1.3. Location of Machine and ROPS-FOPS Cab Serial Numbers Plates

1. ROPS-FOPS Serial Number Plate
2. Machine Serial Number Plate
3. Stamped Machine Serial Number

INTRODUCTION

SERVICE INFORMATION

The ROPS-FOPS Serial Number Plate (1) is secured on the LH side of the operator's cab. Serial Numbers of main subcontracted assemblies are stamped on manufacturer plate or directly on the said assemblies.

The engine serial number is located under the RH guard and is stamped on the serial number plate on the left hand side of the engine (see Fig. 1.4.). When ordering parts or requesting information specify relevant part numbers from PARTS CATALOG and specify machine serial number. Spare parts are available directly at Construction Equipment Distributor.

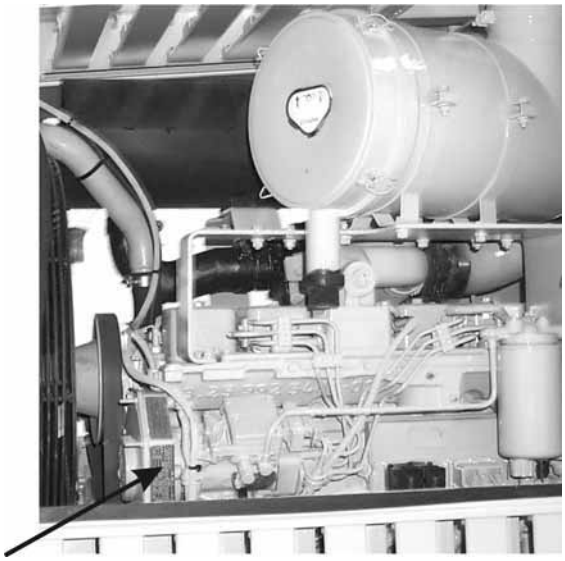


Fig. 1.4. Location of Engine Serial Number Plate

The engine serial number plate provides detailed engine data as: Engine Serial No (1, Fig. 1.5) and Parts Checklist No (CPL) (2), Engine Model (3) and Rated HP and RPM (4)

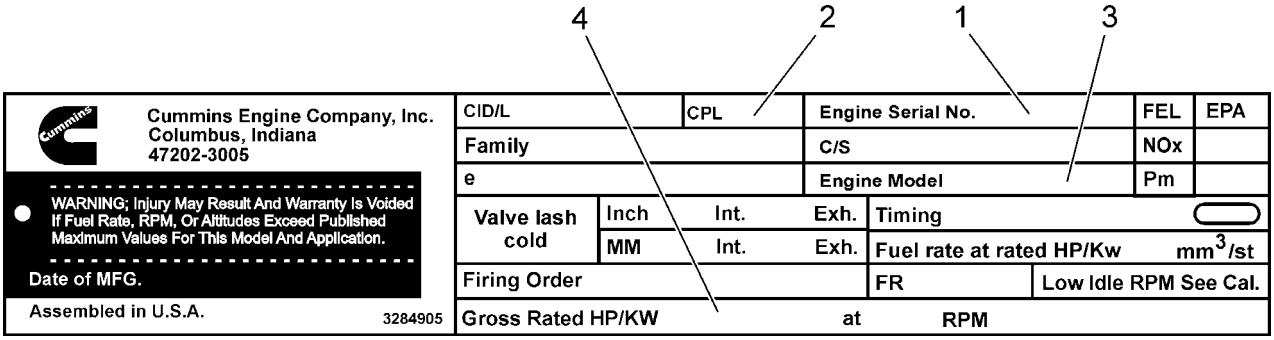


Fig. 1.5. Engine Serial Number Plate

1. Engine No
2. Parts Checklist No (CPL)
3. Engine Model
4. Rated HP and RPM

SERVICE INFORMATION

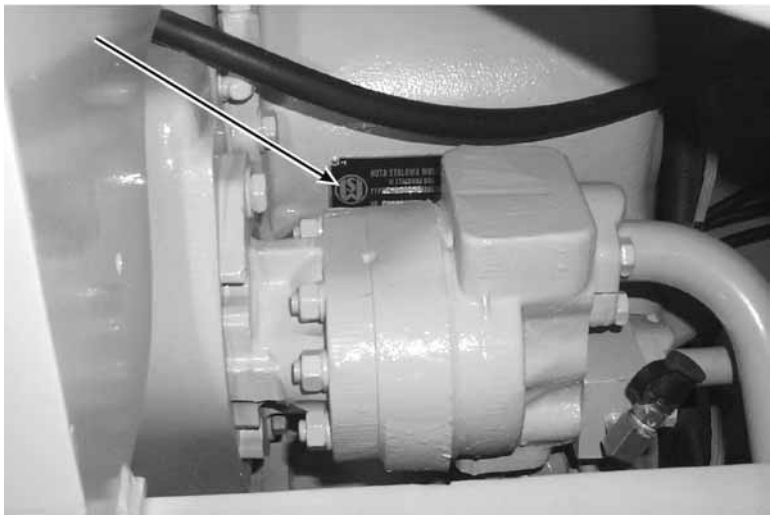


Fig. 1.6. Location of Transmission Serial Number Plate

The transmission serial number is located on the RH machine side and is stamped on a serial number plate, on the upper RH side of the transmission housing (Fig. 1.6).

8. INSPECTION AND REPAIR

The following notes should be used as a general guide to inspection and repair. Where a special procedure is necessary for a component or assembly, full details will be found in the relevant paragraph of the group.

Bearings

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

Pins and Bushings

Inspect for damage and check with mating parts for excessive wear.

Clevises and Pins

Check with mating parts for excessive wear.

Gaskets and Seals

Always use new seals and gaskets during assembly or 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 grease prior to installation. Felt dust seals must be soaked in light oil before assembly.
Do not "roll" an O-ring during installation. To correctly install the O-ring, position the ring at one point and, using a blunt narrow tool, stretch the O-ring into position. Do not stretch the O-ring any more than is required for proper installation.

Gears and Splines

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 carborundum stone, but care must be taken so that only the burr is removed, and that the gear or spline profile is not changed.

INTRODUCTION

SERVICE INFORMATION

Welds

Check all welded assemblies for cracks, twisting and misalignment.

Castings

Check castings for cracks and distortion.

Fuel Tanks and Reservoirs

Check for leaks and corrosion.

Pipes and Hoses

Check unions for leaks. Ensure that threads are undamaged. Check steel pipes for cracks and chafing. Check hoses for chafing, twisting or perishing, etc.

Lubricating Fittings

Ensure that these are undamaged and correctly installed. Check that grease galleries are clear.

Relief Valves

Before commencing work on the equipment hydraulic system, check that the relief valves are opening at their correct pressures. The pressures are listed, and information on how to check and adjust relief valve pressures is available in the "HYDRAULICS" section.

Lubrication

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

LOCTITE USAGE

LOCTITE is designed for the permanent locking and sealing of threaded fasteners. The product cures when confined in the absence of air between close fitting metal or plastic surfaces and prevents loosening and leakage from shock and vibration. The thixotropic nature of LOCTITE reduces the migration of liquid product after application to the substrate. Loctite anaerobic adhesive/sealant can be used in conjunction with all metals, glass, ceramics and many thermoset plastics such as phenolic, polyester, etc.

9. SURFACE PREPARATION

Directions for use

Determine if the substrates to be bonded are made from an *active* or an *inactive* material. LOCTITE will react faster with *active* metals. While *inactive* metals will require the use of a primer (activator) to obtain maximum strength and cure speed at room temperature.

Active Metals	Inactive Metals
Steel	Stainless Steel
Copper	Nickel
Brass	Zinc
Manganese	Cadmium
Bronze	Pure Aluminum
Titanium	Bright Platings
Aluminum Alloy	Anodized Surface

SERVICE INFORMATION

Plain and Phosphate Coated Parts

For best results, clean all surfaces (external and internal) with a cleaning solvent such as LOCTITE ODC Free Cleaner & Degreaser and allow to dry. Normal shop practice of cleaning or degreasing is adequate. Phosphate and oiled hardware is used in the "as received" condition provided it is dry to the touch.

Detailed information on surface preparation are provided on the box by the manufacturer of the compound.

Inactive Metal Parts or for Rapid Curing of the Compound

At least one of the mating surfaces should be degreased with a cleaning solution to which the activator has been added. Allow surfaces to dry for 30 second to 5 minutes before applying compound. If the metal is unknown, it is recommended to use LOCTITE Activator No 7471 or 7649 and allow 30 seconds to dry.

Detailed information on surface preparation is provided on the box by the manufacturer of the primer (activator).

Drawbar Studs or Special Stud Applications

Degrease parts with a cleaning solution to which the activator has been added: Mating parts must be cleaned as for plain and phosphate coated parts. 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.

10. APPLICATION

Bolt and Pipe Threads

Fill the first 2 to 3 leading threads in area of engagement with compound. For large quantities of bolts, compound may be applied by tumbling method (refer to manufacturer's instructions).
Use Loctite pipe sealant to prevent galling on pipe threads and fittings. For detailed information on application, usage and setting time refer to manufacturer’s instruction on the box of the compound.

Studs

Fill full length of thread with one strip on diameters up to 25 [mm], two strips 180 degrees apart on diameters up to 51 [mm], and three strips 120 degrees apart on diameters over 51 [mm].

In all cases, apply one strip into tapped holes. On thru holes apply several drops of the product onto the bolt at the nut engagement area, and on blind hole applications - apply enough compound to fill the bottom 2 to 3 threads of engagement, then insert stud. If engagement length exceeds one diameter, use proportionally more compound. For non-seated studs (studs that can go deeper in hole than required) turn stud one turn deeper than required. After bubbling stops, apply a ring of compound around at top of hole, then turn back to required height.

Primers

Loctite primers (activators) are designed to promote adhesion of one and two component adhesives and sealants to a range surfaces and to promote the speed of cure of Loctite anaerobic adhesives and sealants. It is especially recommended for applications with passive metals or inert surfaces and with large bond gaps.

LOCTITE USAGE

1. Ensure that surfaces are clean and dry before use. Brush on the primer on both mating surfaces to be bonded.
2. Allow the solvent time to evaporate under good ventilation (approx. 5 min.).
3. After priming, parts should be bonded within one hour. Contamination of the surface before bonding should be prevented.
4. Apply the Loctite polyurethane product to one surface and assemble parts immediately.
5. Use of activator is particularly recommended for cure conditions below 10 [°C].

NOTE: *The carrying solvent can affect certain plastics or coatings. It is recommended to check all surfaces for compatibility before use. Assemble and tighten as usual. When tightening to established torque values, torque compensation is not required.*



CAUTION! The primer is classified as being HIGHLY FLAMMABLE. Special care must be taken to avoid contact of the primer or its vapor with naked flame or any electrical equipment that is not flame proofed.

Face Sealant

For liquid sealant, spread an even coat (1 cc per 260 cm^2) on one of the mating surfaces. Assemble and tighten bolts. For gel sealant, apply as continuous bead (approximate 1 cc per 500 linear mm) to surface of one mating face.

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

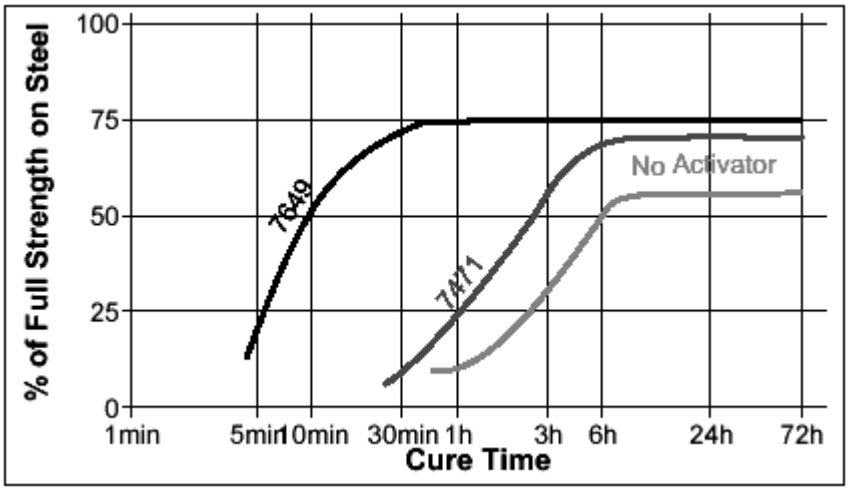
11. SETTING TIME (Before Placing In Operation)

Normal time for compound grades without use on 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.

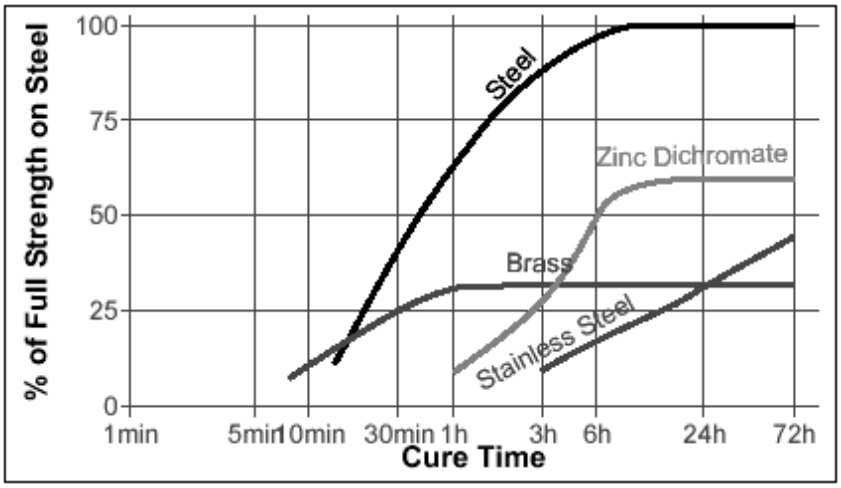
Other base metals will provide more or less catalytic effect on cure. Primed surfaces 2 to 6 hours. This may be speeded by pretreating mating surfaces with special primers (activators).

Some metals (such as zinc and cadmium plate, anodized aluminum, and passivated stainless steel) are inactive an require heat or primer to cure the compound (See Fig.1.7). A fast curing type primer will fix parts for normal handling in 10 to 15 minutes and will achieve 75 [°C] of ultimate strength in 1 hour and full cure in 2 to 4 hours.

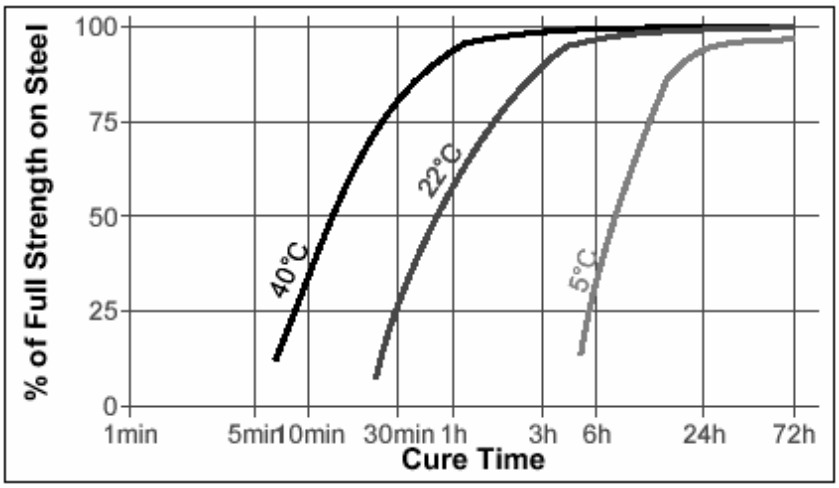
LOCTITE USAGE



Cure Speed vs. Activator



Cure Speed vs. Substrate



Cure Speed vs. Temperature

Fig. 1.7. Typical Curing Performance

LOCTITE USAGE

12. REMOVAL

Remove with standard hand tools. In rare instances where hand tools do not work because of excessive engagement length or when we can't removed parts apply localized heat to nut or bolt to approximately 230 [°C]. Disassemble while hot.

For Cleanup

Cured product can be removed with a combination of soaking in a solvent and mechanical abrasion such as a wire brush.

13. APPLICATION 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, the 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 TORQUE VALUES

Recommended torque, Newton meters, for all Standard Application Nuts and Bolts, provided:

All thread surfaces are clean and lubricated with engine oil.

Joints are rigid, that is, no gaskets or compressible materials are used.

When reusing nuts or bolts, use minimum torque values.

The following torque values should be used in cases where „special torque values" are not given.

Modifying Factors

For various fasteners surface coating, multiply the standard torque by factors listed bellow:

0.65 - when finished jam nuts are used.

0.70 - when Molykote, white lead or similar mixtures are used as lubricants.

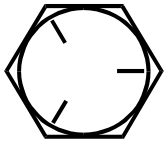
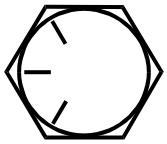
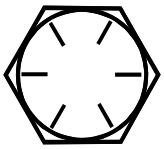
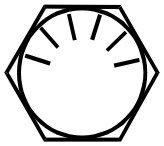
0.75 - when parkerized (phosphate coated) bolts or nuts are used.

0.85 - when cadmium plated bolts or nuts and zinc bolts w/waxed zinc nuts are used.

0.90 - when hardened surfaces are used under the nut or bolt head.

STANDARD TORQUE VALUES

14. 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 InchThread	Six radial lines on top and none on side of head. Medium carbon or carbon alloy steel quenched and tempered.	
Type 8.2 InchThread	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 TORQUE VALUES

15. TORQUE VALUES FOR STANDARD METRIC FASTENERS

Nominal Thread Diameter [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

Tighten standard metric hardware fasteners to torque value as provided in the chart prior to use. 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.

16. TORQUE VALUES FOR STANDARD ENGLISH FASTENERS

The following chart provides the tightening torques for general purpose applications using original equipment standard hardware as listed in the Parts Catalog for the machine involved. 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. Phosphate coated bolts used in tapped holes in steel or gray iron and phosphate coated bolts used with phosphate coated prevailing torque nuts.

STANDARD TORQUE VALUES

Nominal Thread Diameter [cal]	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

17. TORQUE VALUES FOR STANDARD 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. Overtorquing bolts will damage the flanges and/or bolts, which may cause leakage.

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

*) Inside diameter of hydraulic tube or hose fitting.

STANDARD TORQUE VALUES

18. TORQUE VALUES FOR HYDRAULIC TUBES AND FITTINGS

The torque figures are recommended for plain, cadmium or zinc plated fittings, dry or wet installations. Torque values are not recommended for tubes of wall thickness of 0.9 [mm] or below.

Size	Tubing O.D.	Thread Size [inch]	Torque Values [Nm]	
			37[°] Flared Fittings	„O" Ring Boss Plugs and Swivel Nuts, 37[°] -Flared
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÷41
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

19. TORQUE VALUES FOR 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	Tightening Torque [Nm]	
	Radiator, Air Cleaner, Boots, Etc.	Hydraulic System
"T" Bolt (Any Diameter)	6.2÷7.3	—
Worm Drive - 1-3/4 inch Open Diameter and Under	2.2÷3.3	4.5÷5.6
Worm Drive - Over 1-3/4 inch Open Diameter	4.5÷5.6	—
Worm Drive - All "Ultra-Tite"	10.7÷11.8	4.5÷5.6

STANDARD TORQUE VALUES

20. TORQUE VALUES FOR AIR CONDITIONING TUBES AND FITTINGS

Swaged 45[°] connections.

Size		Tightening Torques for Materials [Nm]			
Connection	Thread[inch]	Steel-steel	Bronze-bronze	Copper-steel	Aluminum-steel
1/4	7/16-20	16÷23	15÷20	15÷20	12÷18
3/8	5/8-18	27÷33	23÷38	23÷38	20÷25
1/2	3/4-16	47÷54	38÷46	38÷46	28÷36
5/8	7/8-14	61÷68	45÷53	45÷53	34÷42
3/4	1-1/16-12	72÷80	49÷57	49÷57	45÷53
3/4	1-1/16-14	72÷80	49÷57	49÷57	45÷53

21. TORQUE VALUES FOR AIR CONDITIONING O-RING CONNECTIONS

Size		Torque Values for Materials [Nm]
Connection	Thread [inch]	Steel-steel
1/4	7/16-20	15÷25
3/8	5/8-18	27÷33
1/2	3/4-16	40÷48
5/8	7/8-14	47÷54
3/4	1-1/16-12	54÷61
3/4	1-1/16-14	54÷61

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BRAKES

BRAKES

SECTION 4

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1. SERVICE/SPECIAL TOOLS

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3. Piston installing special tool 21.261.0162
4. Piston installing special tool 21.261.0153
5. Brake piston pressure checking tool set.....PLT-859-1/D

MASTER BRAKES

2. DESCRIPTION AND OPERATION

Four wet disc brakes are used to stop the machine. A brake assembly is located between each of the axle planetaries and the differential. The brakes are hydraulically applied.

Only in machine 520G, transmission pressure in the brake pump booster, assist to develop oil flow in the brake pump, when the brake pedal is depressed.

The parking brake is the drum type, which is mounted on the front drive axle. A lever located in the operator's compartment applies this brake.

The description to Fig.4.1 and Fig.4.2:

1. Bleeder
2. Differential Valve
3. Pressure Differential Switch
4. Brake Pump
5. Brake Pump Booster (only for 520G)
6. Brake Pedals
7. Parking Brake
8. Front Brake Line
9. Rear Brake Line

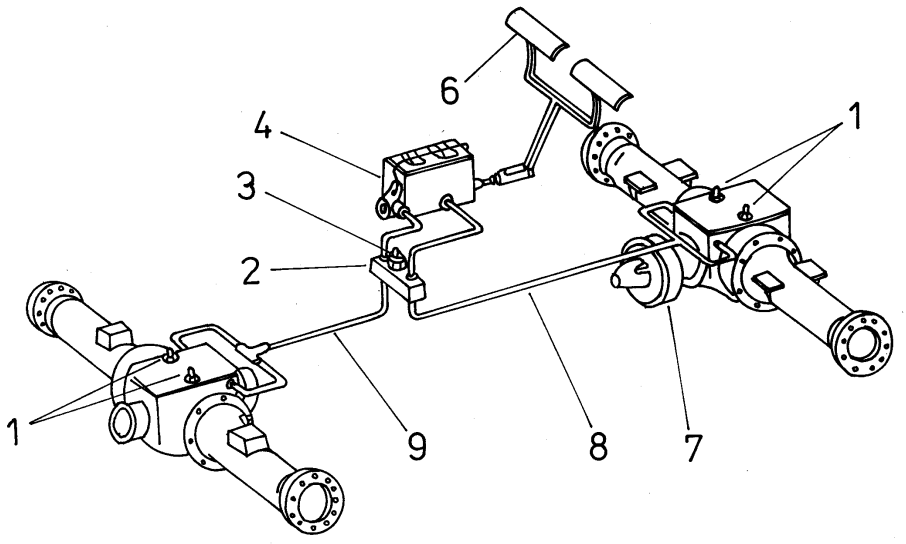


Fig. 4.1. 515G Machine Braking System

BRAKES

MASTER BRAKES

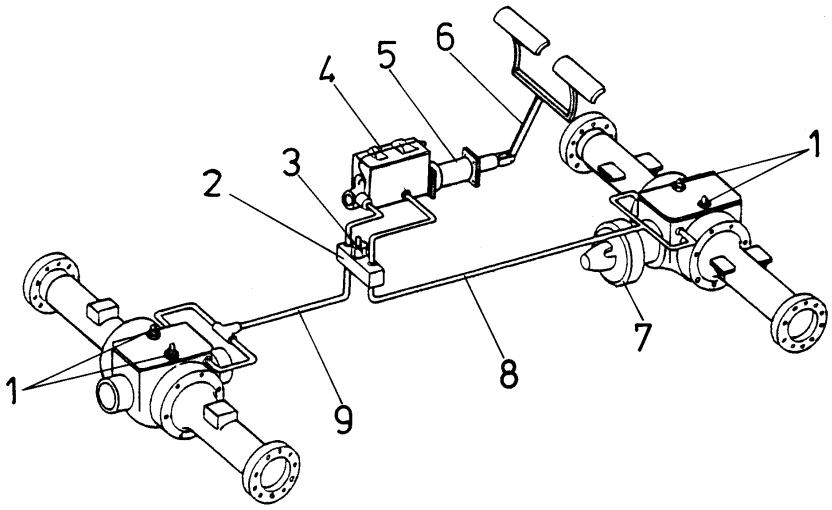


Fig. 4.2. 520G Machine Braking System

Only for 515G: When either of two brake pedals (6, Fig. 4.1) is depressed the brake linkage will move a spool in the brake pump (4).

Only for 520G: When either of two brake pedals (6, Fig. 4.2) is depressed the brake linkage will move a spool in the brake pump booster (5). The brake pump booster (5) meters the main pressure and hydraulically moves the pistons in the brake pump (4).

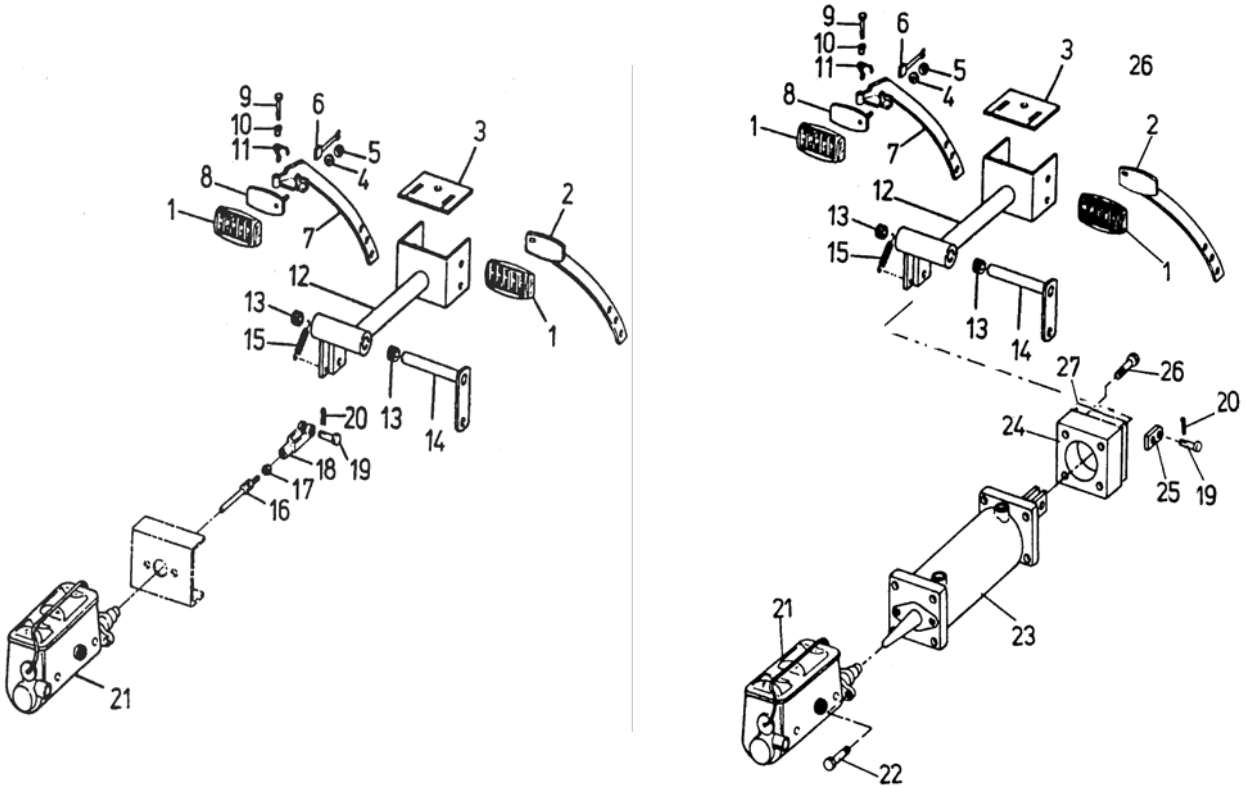
The brake pump (4, Fig. 4.1 and 4.2) pistons will force oil to through the two brake lines (8 and 9) to the front and the rear drive axle brakes. A differential valve (2) senses the pressure in each of the brake lines. If a pressure differential is felt, the pressure differential switch (3) will complete an electrical circuit and a light will turn on to indicate a problem. If the problem should occur in one of the brake circuits, the other will still function to stop the machine.

The oil directed to the brakes will move the brake piston and apply the brakes. If the left brake pedal is depressed, a switch on the pedal will also disconnect the transmission.

MASTER BRAKE PEDALS LINKAGE

The master brake system consists with two pedals (2, 7, Fig.4.3). As the brake pedal (2) is pressed the brake pump (21) is released to apply position, through brake arm assy (12) (and brake pump booster (23) – **520G only**). When transmission disconnect pedal lever (7) is pressed, operating is identical like for pedal (2), additionally the transmission disconnect switch (6) is activated. In this case while brake is on, at the same time the transmission is disconnected. After the pedal is released from apply position, spring (15) forces its return to neutral position.

MASTER BRAKES



Loader 515G **Loader 520G**

Fig. 4.3 Master Brake Pedals Linkage

1. Pedal Pad
2. Brake Pedal
3. Pedal Arm Pad
4. Hardened Washer
5. Lock Nut
6. Transmission Disconnect Switch
7. Transmission Disconnect Pedal Lever
8. Pedal Plate
9. Pin
10. Sleeve
11. Spring
12. Brake Arm Assy
13. Roller Bearing
14. Pin and Lock Plate
15. Spring
16. Brake Pump Rod
17. Nut
18. Fork
19. Pin
20. Cotter Pin
21. Brake Pump
22. Bolt
23. Brake Pump Booster
24. Plate
25. Plate
26. Bolt – 4 pcs
27. Shim(s)

IMPORTANT: *ONLY FOR 520G. If pedals linkage or brake pump booster (23) was removed, during reassembly always ensure that the gap between cab floor and pedal arm pad (3) equals to 2 ±1 [mm]. Establish proper gap by shimming brake pump booster (23) with shim(s) (27). The shim(s) (27) is to be placed between plate (24) and front frame.*

3. SPECIFICATION

Inner disc ring	Steel; sides must be parallel within 0.10 [mm] and flat within 0.15 [mm].
Outer disc ring	Cast iron; sides must be parallel and flat within 0.10 [mm].
Brake disc	Steel bonded with friction material; sides must be parallel within 0.10 [mm] and flat within 0.25 [mm].
Minimal brake disc lining thickness	0.7 [mm]
Gap between cab floor and pedal arm pad (520G only)	2 ±1 [mm]

BRAKES

MASTER BRAKES

4. SERVICE DIAGNOSIS

COMPLAINT	
PROBABLE CAUSE	**REMARKS**
Inadequate Braking (Buzzer Signal ON and Master Brake Warning Lamp Lights)	
1. Brake fluid level too low	1. Check brake fluid level. Refer to the OPERATOR'S MANUAL.
2. Leakage in brake system	2. Check brake system for leakage.
3. Air in brake system	3. Bleed the system. Refer to the OPERATOR'S MANUAL.
4. Improper brake fluid used	4. Flush the system and change fluid. Refer to the OPERATOR'S MANUAL.
5. Brake piston seal rings worn	5. Perform brake piston pressure test.
6. Brake pump faulty	6. Repair or replace.
Inadequate Braking (Buzzer Signal OFF and Master Brake Warning Lamp does not Light)	
1. Master brake system warning light	1. Check the bulb and electrical connection. Refer to Section 8.
2. Pressure differential switch faulty	2. Check the switch. Refer to Section 8.
3. Brake disc(s) worn	3. Replace worn disc(s).
4. Brake pump booster faulty (520G)	4. Repair or replace.
Master Brake Operates on Its Own (no Need to Depress the Pedal-only for 520G)	
1. The gap between cab floor and pedal arm pad against the rules.	1. Check and correct the gap. Refer to MASTER BRAKE PEDALS LINKAGE in this Section
2. Brake pump booster faulty	2. Repair or replace.

5. TESTS

Master Brakes Operational Test



WARNING! A change in vehicle braking characteristics or warning light and buzzer signal may indicate malfunction in one of two brake systems. Although the brakes may continue to function, the vehicle should not be operated until the necessary repairs have been made and both front and rear axle systems are operating normally. Always check the vehicle master and parking brakes after performing brake work and before returning the vehicle to service.

NOTE: *When checking brake operation the machine should be parked on level ground.*

1. Start and operate the engine at low idle for a few minutes to warm up the engine.
2. Fully depress and hold the brake pedal. Be sure the parking brake is released.



WARNING! Be sure the area in front of the machine is clear of personnel and obstructions because the machine may move forward during this test.

3. While depressing the brake pedal place the transmission shifter in forward, and into second gear, and depress the engine accelerator pedal until it is fully applied.

WARNING! If the machine starts to move forward, fully release the accelerator pedal. Do not hold the machine in this stall condition for more than ten seconds.

4. If the master brakes do not hold the machine stationary during this test, stops the engine and refer to SERVICE DIAGNOSIS in this section.
5. After correcting deficiencies of the master brake system, recheck the system by repeating all steps.

Brake Piston Pressure Test (Fig. 4.4)

NOTE: *Use only "DEXRON II E" fluid in the brake system.*

1. Disconnect the brake tube at the connector (5) at the brake of the axle to be checked.
2. Install the brake piston pressure checking tool set (6) to the axle but do not tighten the hose (4) to connector (5).

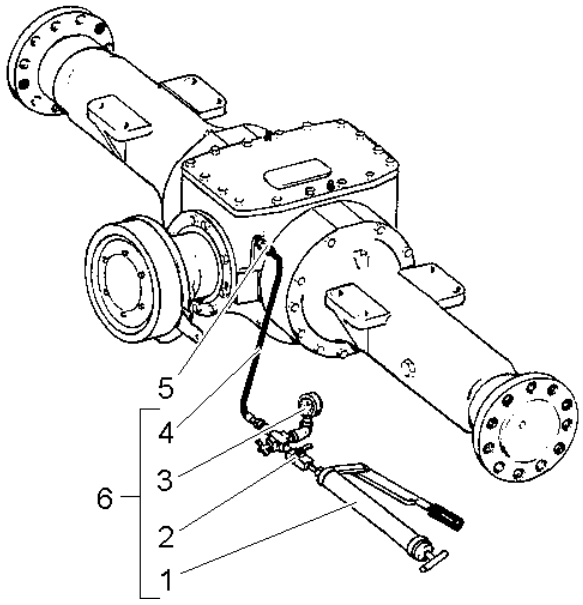


Fig. 4.4. Brake Piston Pressure Test

1. Hydraulic Hand Pump
2. Shut-off Valve
3. Pressure Gauge
4. Hose
5. Connector
6. Brake Piston Pressure Checking Tool Set

3. Bleed the air out of the hose (4) with gauge (3), valve (2) and pump (1). Than tighten the hose (4) to connector (5).
4. Pressure the brake to 1.4 [MPa] and close the valve (2). Open the valve (2) after 5 minutes.
5. Pressure the brake to 6 [MPa] and close the valve (2). Observe drop pressure after 5 minutes.
6. The maximum pressure drop is 0.1 [MPa] within 5 minutes. If pressure drop is bigger than maximum, replace brake piston seal rings or bearing retainer seal ring.

7. Bleed remaining pressure with the valve on the gauge (3) tee before disconnecting the brake piston pressure checking tool set (6) from connector (5). Disconnect hose (4) from connector (5).
8. Reconnect the brake tube to connector (5) and bleed the brakes.

6. REMOVAL AND DISASSEMBLY

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 electrical system master switch is off and the keys are removed from master switch and from starting switch.

WARNING! Always lock the frames together before working near the center of the machine. If the frames move, serious injury or death could result.

NOTE: *It is necessary to remove the complete axle in order to service the front axle brakes. Only the axle shaft assemblies need to be removed for rear axle brake service.*

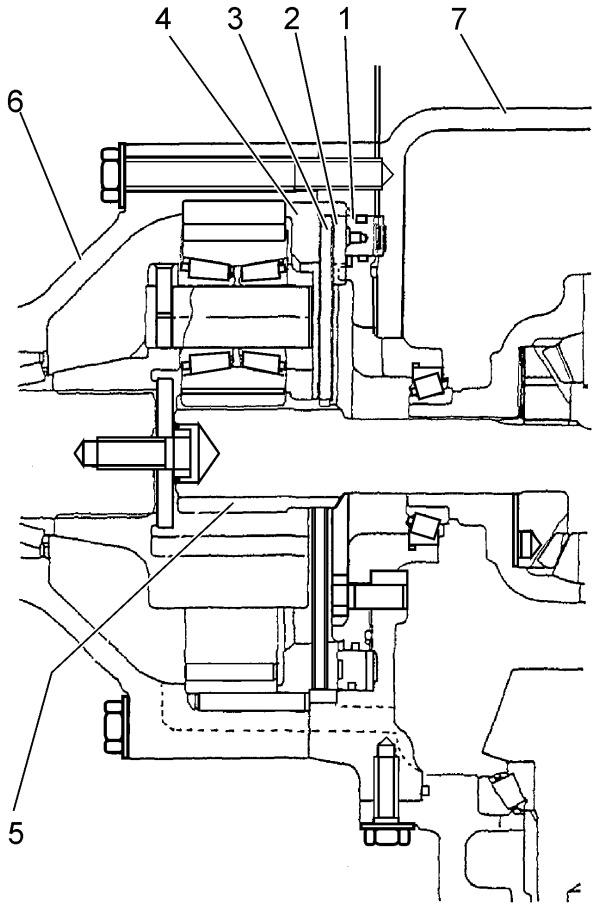


Fig. 4.5. Service Brake (only 515G)

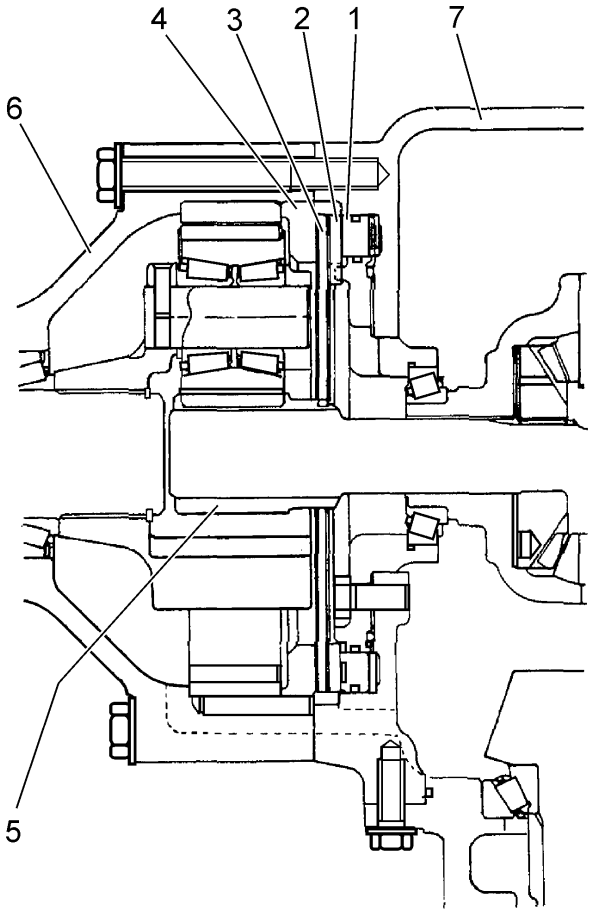


Fig. 4.6. Service Brake (only 520G)

1. Brake Piston
2. Brake Plate
3. Brake Disc
4. Thrust Plate
5. Axle Shaft
6. Axle Shaft Housing
7. Differential Housing

MASTER BRAKES

FRONT AXLE ONLY

1. Remove the drive axle from the machine as described under DRIVE AXLES in Section 7D.
2. Remove the axle shaft housing assy from the differential housing as described under DRIVE AXLES in Section 7D.
3. Using a pry bar (1, Fig. 4.7), remove thrust plate (2) from the axle shaft housing (3).
4. Remove axle shaft (1, Fig. 4.8) with the brake disc (2) from differential housing (3). Remove brake disc (2) from the shaft (1).

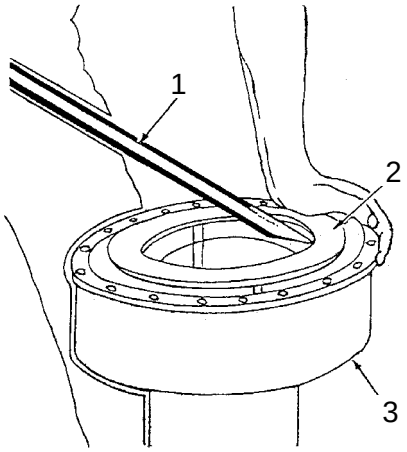


Fig. 4.7. Removing the Thrust Plate

1. Pry Bar
2. Thrust Plate
3. Drive Axle Shaft Housing

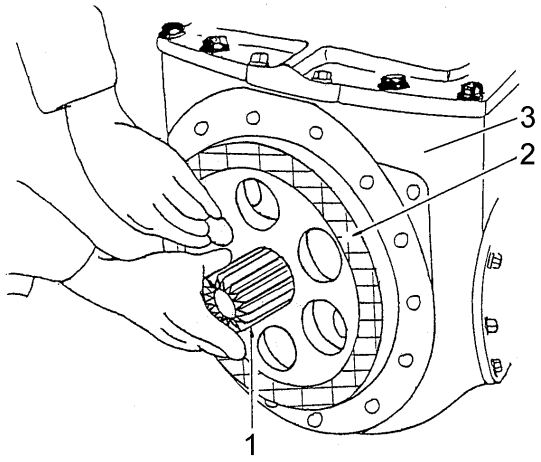


Fig. 4.8. Removing the Axle Shaft and Brake Disc

1. Axle Shaft
2. Brake Disc
3. Differential Housing

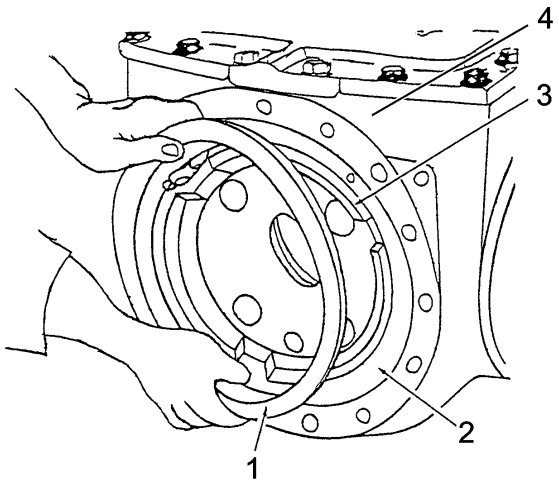


Fig. 4.9. Removing the Brake Plate

1. Brake Plate
2. Brake Piston
3. Bearing Retainer
4. Drive Axle Shaft Housing

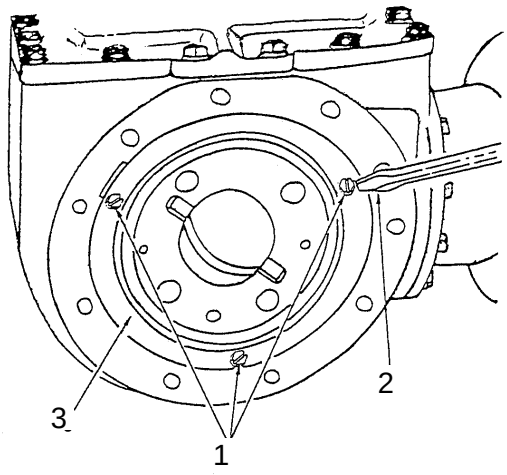


Fig. 4.10. Removing the Brake Piston

1. Slotted Screws
2. Screwdriver
3. Brake Piston

5. Remove brake plate (1, Fig. 4.9) from the differential housing (4).
6. Install three bolts (1, Fig. 4.10) in the three tapped holes provided in the brake piston (3). Using a screwdriver (2) pry on the underside of the screw heads equally all the way around to remove the brake piston (3).
7. Remove O-ring (2, Fig. 4.11) from the brake piston (3), using pick tool (1).

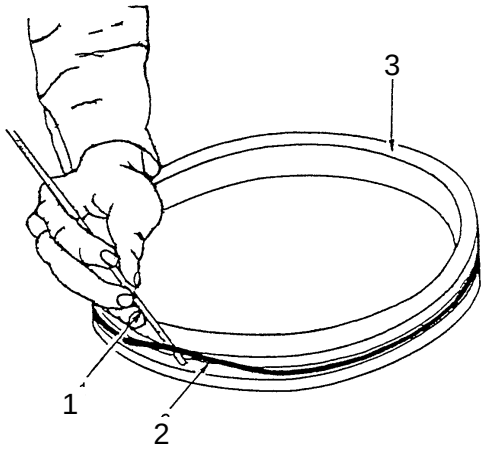


Fig. 4.11. Removing the O-ring from the Brake Piston

1. Pick Tool
2. O-ring
3. Brake Piston

7. INSPECTION AND REPAIR

1. Thoroughly clean all parts in a commercial solvent and dry with compressed air.
2. Discard the brake piston O-ring and replace with new.
3. Inspect the thrust plate and brake plate for flatness and parallelism. Parallelism can be checked by measuring thickness at four and more equally spaced points around the braking surface of the plates. All measurements must be made at the same distance from the outer edge of the plates. The plates should be replaced if variations in thickness exceed specifications.
4. Inspect the brake disc for condition of lining and for flatness and parallelism. The brake disc should be replaced if lining is worn out or the flatness and parallelism exceed the specifications.
5. Inspect the brake piston for scoring, pitting and corrosion. The piston must be replaced if there is any visible damage or wear.
6. Inspect the brake piston cavity in the differential housing for damage and wear. Light defects can be removed by rotating crocus cloth around the bore. Do not use any other type of abrasive.

8. REASSEMBLY AND INSTALLATION

1. Install the new O-ring (1, Fig.4.12) on the brake piston (2).
2. Replace the bearing retainer O-ring (1, Fig. 4.13).

NOTE: *Before installing the brake piston, thoroughly lubricate the piston O-ring and bearing retainer O-ring with oil.*

3. Position the brake piston in the brake piston cavity making sure that the three tapped holes (2, Fig. 4.14) are facing outward.
4. **Only for 515G**: Install special tool 21.261.0153 (1, Fig. 4.15) using four of the bolts (2) used for mounting the axle shaft housing assy (6, Fig. 4.5) to differential housing (7).
5. **Only for 520G**: Install special tool 21.261.0162 (1, Fig. 4.15) using four of the bolts (2) used for mounting the axle shaft housing assy (6, Fig. 4.6) to differential housing (7).
6. Push the brake piston (1) in until the brake piston (1) bottoms.
7. Install the brake plate (1, Fig. 4.9) in the differential housing (4).
8. Install thrust plate (2, Fig.4.7) to the axle shaft housing assy (3).
9. Install axle shaft housing assy to the differential housing as described in Section 7D.
10. Check the brake piston for leakage. Refer to TESTS in this Section.

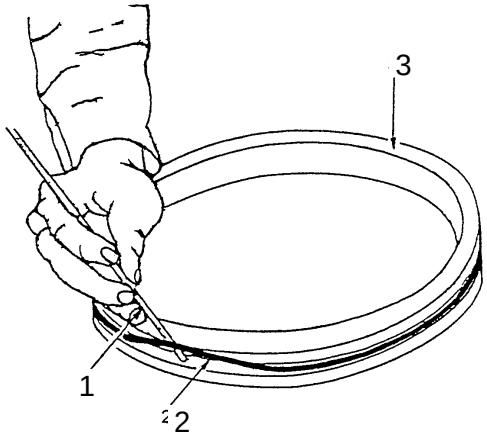


Fig. 4.12. Installing the Brake Piston O-ring

1. Pick Tool
2. O-ring
3. Brake Piston

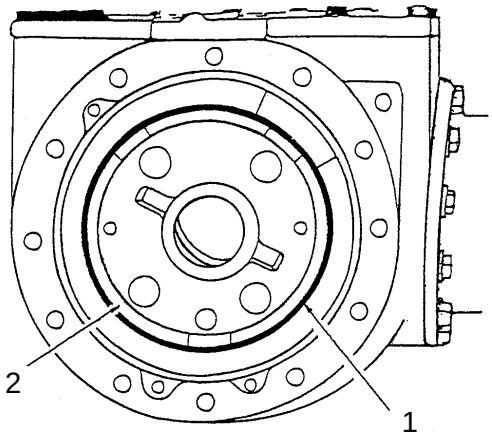


Fig. 4.13. Installing Bearing Retainer O-ring

1. O-ring
2. Bearing Retainer

NOTE: *Before installing the brake piston, thoroughly lubricate the piston O-ring and bearing retainer O-ring with oil.*

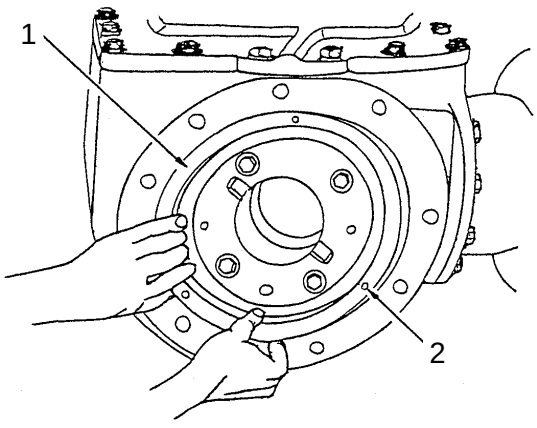


Fig. 4.14. Positioning the Brake Piston

1. Brake Piston
2. Tapped Hole

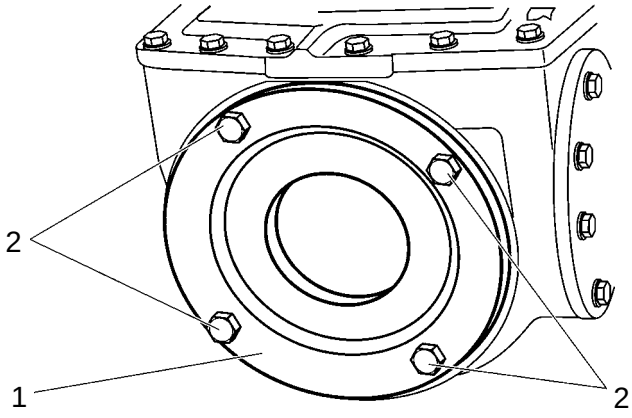


Fig. 4.15. Piston Installing Tool

1. Special Tool
2. Bolts

PARKING BRAKE

9. DESCRIPTION AND OPERATION

The parking brake is mounted on the front differential housing. It is drum type, actuated by hand lever in the operator's compartment. When the brake lever is pulled, the linkage moves the brake shoes against the drum to stop the drive shafts. Both the front and rear shafts will be stopped as they are connected through the transmission output shaft.

10. SPECIFICATION

Minimal permissible brake shoes thickness	4 [mm]
Parking brake drum mounting bolts	100÷125 [Nm]
Brake/lever housing assy mounting bolts	100÷125 [Nm]
Differential yoke mounting bolt	250÷300 [Nm]

Spring Test Load Data

Total number of coils	24
Free length	102 [mm]
Test length	156 [mm]
Test load pressure (pull)	350 [Nm]

11. TEST AND ADJUSTMENT

Parking Brake Test



WARNING! When testing the parking brake, be sure that area near the machine is clear of personnel and obstructions because the machine may move during this test.

1. Start and operate the engine at low idle for a few minutes to warm up the engine.
2. Engage the parking brake, if earlier was not engaged.
3. With the master brake engaged, place the transmission shifter in the third gear "FORWARD".
4. Release the master brake and gradually increase the engine speed to maximum. The parking brake should holds the machine stationary.

IMPORTANT: *Do not test the brake for more than 10 seconds.*

5. If parking brake does not hold the machine stationary, release the accelerator pedal, apply the master brakes, place the transmission shifter in "NEUTRAL", lower the bucket to the ground and stop the engine. Adjust the parking brake.

Parking Brake Adjustment

6. The parking brake is adjusted by changing the position of the clevis at the end of control cable. Adjust the clevis to take up all of the slack in the control cable. After that repeat steps 1÷5.
7. If further adjustment is impossible and parking brake does not hold the machine stationary, check the parking brake condition. Refer to INSPECTION AND REPAIR under PARKING BRAKE in this section.

PARKING BRAKE

WARNING! If the parking brake does not hold machine, correct the cause as soon as possible. Until the cause is corrected, park the machine on level ground and block the tires to prevent it from moving.

Parking Brake Shoes Burnish Procedure

WARNING! Operator must be wearing seat belts during burnish procedure to prevent injury during sudden stops.

1. Drive the machine forward in 1st range at full throttle until maximum speed 8.5 [km] is obtained, apply parking brake and continue to drive for 3 to 5 [m]. Allow the brake to cool down for a period of 3 to 5 minutes. Repeat these procedures for a total of six brake applications. Stop the machine.
2. Perform the parking brake test as described above.

12. DISASSEMBLY (Fig. 4.16)

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 electrical system master switch is off and the keys are removed from master switch and from starting switch.

WARNING! Always lock the frames together before working near the center of the machine. If the frames move, serious injury or death could result.

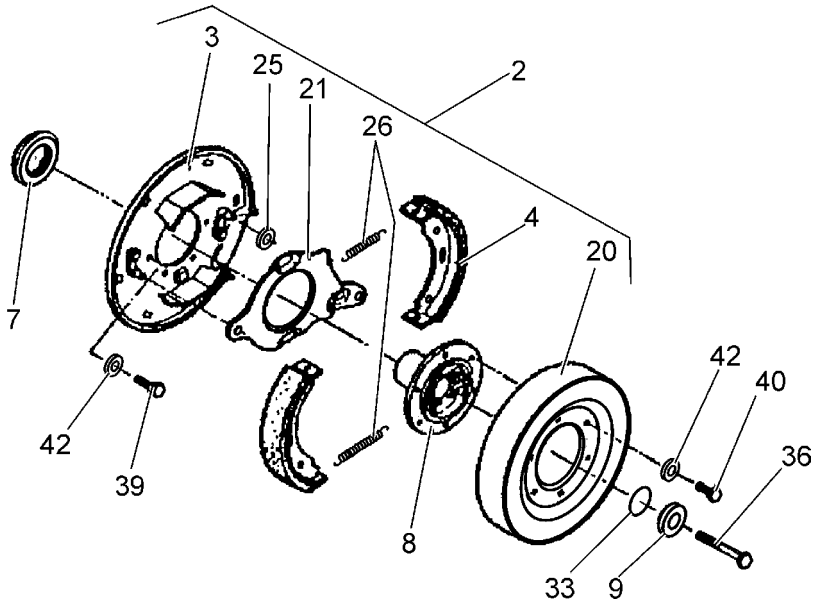


Fig. 4.16. Parking Brake Exploded View

2. Parking Brake	8. Yoke	25. Washer	39. Bolt
3. Brake/Lever Housing Assy	9. Washer	26. Springs	40. Bolt
4. Brake Shoe Assy	20. Brake Drum	33. O-ring	
7. Retainer	21. Brake Cross Lever	36. Bolt	

PARKING BRAKE

1. Place the parking brake lever in the released position, after adequately blocking the wheels.
2. Remove the hanger bearing to front axle drive shaft as described under DRIVE SHAFTS in Section 7D.
3. Unscrew bolts (40) with washers (42) and remove the drum (20) from yoke (8).
4. Remove springs (26) from the brake shoes (4). Remove the brake shoes (4).
5. Remove bolt (36), washer (9), O-ring (33) and yoke (8).
6. Remove brake cross lever (21) and washer (25) from brake/lever housing assy (3).
7. Unscrew bolts (39) with washers (42) and remove housing assy (3).

13. INSPECTION AND REPAIR

1. Inspect the brake shoes and replace them if the brake shoes are grease soaked or worn.
2. Check the condition of the brake shoe return springs. If they are damage or not fall within the specifications described in “SPECIFICATIONS” they must be replaced.
3. Clean all metal parts in a commercial cleaning solvent and dry with compressed air.
4. Inspect the brake drum for cracks, wear and warpage.

14. REASSEMBLY (Fig. 4.16)

1. Install housing assy (3) to retainer (7) and torque the bolts (39) with washers (42) to 100÷125 [Nm].
2. Install brake cross lever (21) with washers (25) to housing assy (3). Install springs (26) and brake shoes (4) to brake cross lever (21).
3. Install joke (8) and O-ring (33) on the pinion shaft. Use LOCTITE 262 to the bolt (36) and torque it with washer (9) to 250÷300 [Nm].
4. Install drum (20) on the yoke (8). Torque the bolts (40) with washers (42) to 100÷125 [Nm].
5. Install the hanger bearing to front axle drive shaft as described under DRIVE SHAFTS in Section 7D.
6. Reconnect control cable to brake cross lever (21) using pin. Secure it using washer and cotter pin.
7. Adjust the parking brake. Refer to TEST AND ADJUSTMENT under PARKING BRAKE in this section.

15. DESCRIPTION AND OPERATION (Fig. 4.17)

The brake pump is situated under cab on the left side of machine.

The brake pump is of the split reservoir pressure balanced type. The large reservoir chamber supplies the front brake circuit and the small reservoir chamber supplies the rear brake circuit.

Only for 515G: When the brake pedal is pushed, the brake arm assy pushes piston assy (9) in.

Only for 520G: When the brake pedal is pushed, the brake arm assy pushes piston of the brake pump booster. This piston pushes piston assy (9) in.

BRAKE PUMP

The movement of the piston assy (9) closes off the port to the large reservoir and starts to pressurize the oil to the front brake circuit. This pressurized oil also acts on the right side of the piston assy (16) and pushes it. The piston assy (16) movement closes off the port to the small reservoir and pressurized the oil to the rear brake circuit. Since both ends of the piston assy (16) have the same area, the pressure to the front brake circuit will be the same as the pressure to the rear brake circuit.

Should a failure occur in the front brake circuit and no pressure be developed to the front brakes, the mechanical movement of the piston assy (9) will mechanically push the piston assy (16) through the spring retainer (11). This feature insures one circuit to function even if the other circuit has a complete hydraulic failure.

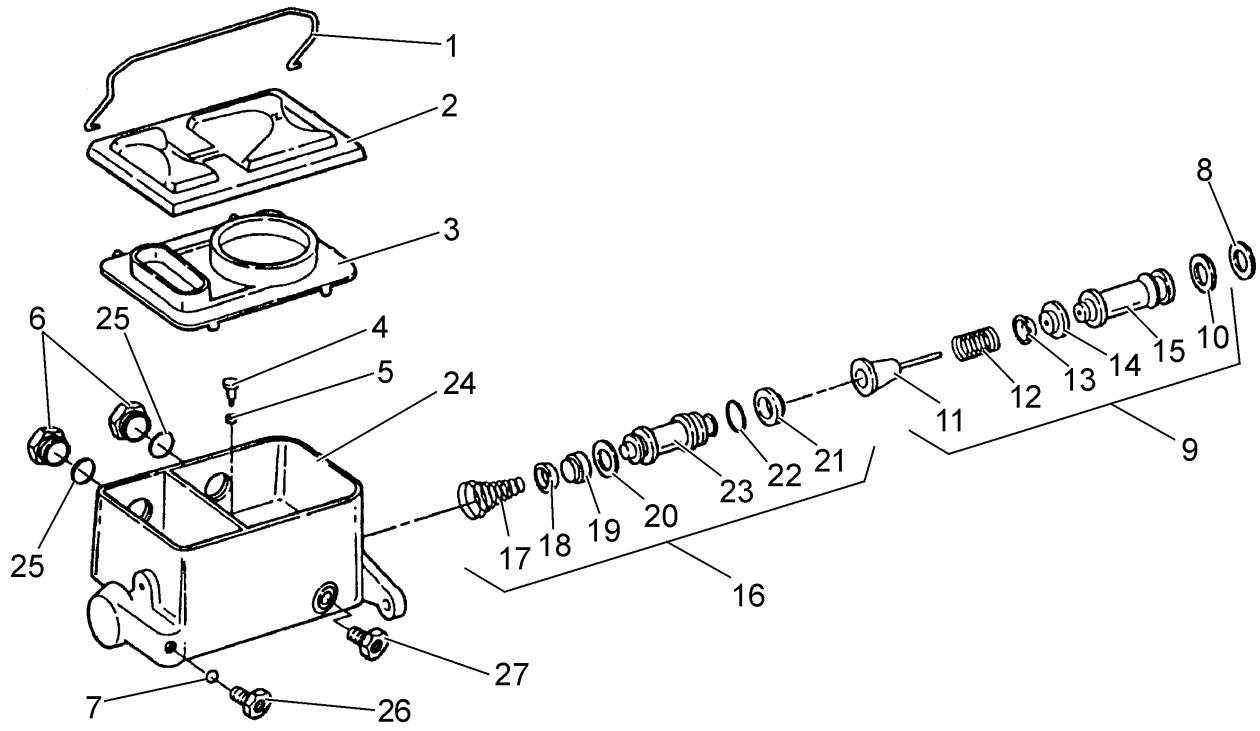


Fig. 4.17. Brake Pump Exploded View

1. Rod
2. Cover
3. Diaphragm
4. Plug
5. Gasket
6. Gauges
7. Gasket
8. Snap Ring
9. Piston Assy
10. Gasket
11. Spring Retainer
12. Spring
13. Guard
14. Cup
15. Piston
16. Piston Assy
17. Spring
18. Guard
19. Cup
20. Sleeve
21. Cup
22. O-ring
23. Piston
24. Housing
25. O-ring
26. Connector
27. Connector

BRAKES

BRAKE PUMP

16. REMOVAL AND DISASSEMBLY

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 electrical system master switch is off and the keys are removed from master switch and from starting switch.

WARNING! Always lock the frames together before working near the center of the machine. If the frames move, serious injury or death could result.

1. Disconnect and drain the front and the rear brake circuit lines (3 and 4, Fig. 4.18 and Fig. 4.19) from the brake pump (1).
2. **Only for 515G:** Remove two bolts (2) securing the brake pump (1) to the front frame and remove the brake pump (1).
3. **Only for 520G:** Remove two bolts (2, Fig. 4.19) securing the brake pump (1) to the brake pump booster (5) and remove the brake pump (1).



Fig. 4.18. Brake Pump (515G)

1. Brake Pump
2. Bolt
3. Front Brake Circuit
4. Rear Brake Circuit

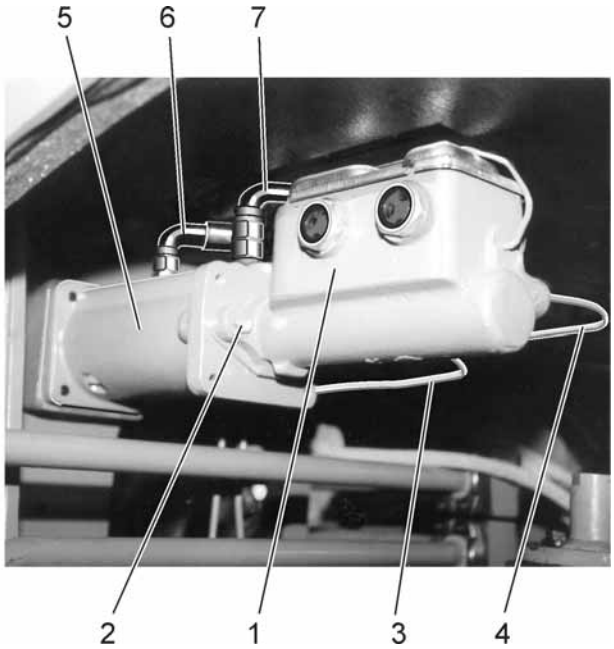


Fig. 4.19. Brake Pump (520G)

1. Brake Pump
2. Bolt
3. Front Brake Circuit
4. Rear Brake Circuit
5. Brake Pump Booster
6. Hose
7. Hose

4. Remove rod (1, Fig. 4.17) from the cover (2). Lift up the cover (2) and the diaphragm (3).
5. Drain remaining fluid from the housing (24).
6. Remove the plug (4) and gasket (5) from the bottom of the housing (24).
7. Remove the snap ring (8) from the bore of the housing (24). Than remove the piston assy (9) and piston assy (16). The pistons are only serviced as assemblies.

BRAKE PUMP

17. INSPECTION AND REPAIR

1. Inspect piston assy seals for wearing, scoring or other damage. Check the passages in the piston that they are open. The pistons must be replaced as an assemblies.
2. Check the housing bore for scoring or signs of wear.
3. Check to be sure that the holes in the bottom of the housing are open.

18. REASSEMBLY AND INSTALATION

1. Coat housing (24, Fig. 4.17) bore and piston assemblies (9 and 16) with “DEXRON II E” fluid. Then install piston assy (16) and piston assy (9).
2. Install the snap ring (8) in the housing bore to retain the piston.
3. Install gasket (5) and plug (4) into the bottom of the housing (24).
4. **Only for 515G:** Place brake pump (1, Fig. 4.18) against front frame bracket and install the two bolts (2).

   Only for 520G: Place brake pump (1, Fig. 4.19) against the booster (5) and install the two bolts (2).
5. Connect the front and the rear brake circuit lines (3 and 4) and fill the brake pump (1) (refer to the OPERATOR’S MANUAL).
6. Install the diaphragm (3) and cover (2) on the housing (24). Then bleed the both brake circuits, refer to the OPERATOR’S MANUAL for this procedure.

BRAKE PUMP BOOSTER (only 520G)

19. DESCRIPTION AND OPERATION

Brake pump booster is situated under cab on the left side of machine. It is mounted on the front frame.

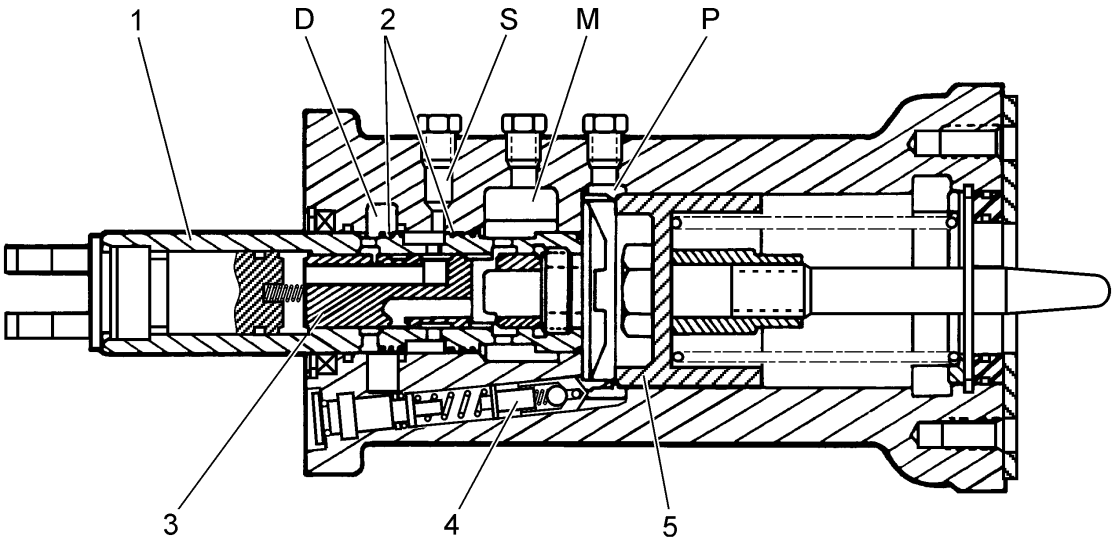


Fig. 4.20. Brake Pump Booster

1. Signal Spool
2. Spiral Grooves
3. Metering Spool
4. Dampening Plunger
5. Piston and Bolt

D, M, P, S - Chambers

BRAKE PUMP BOOSTER (only 520G)

The signal spool (1, Fig. 4.20) is mechanically actuated by the brake arm assy. The metering spool (3) is housed within signal spool (1). This spool controls the flow of oil to push on the dampening plunger (4) depending on the position of the signal spool (1). The oil, which pushes on the dampening plunger assembly, actuates the master cylinder, which pressurized the brakes.

The dampening plunger (4) mechanically limits the speed with which the signal spool (1) can return from the actuated position. It also counters the hydraulic impulses created as the metering spool (3) moves back and forth.

In brake pump booster neutral position oil from the priority valve enters chamber (M). From chamber (M) oil flows through spiral grooves (2) to the chamber (S) and through passages in metering spool (3) to chamber (D). Chamber (D) is drained to the transmission sump.

The brake pump booster is shown in the position with no oil flow to it. The key to how this valve varies the pressure in chamber (P) from about 40 [kPa] in brake release position to 2400 [kPa] in the full brake apply position is the two sets of spiral grooves (2) on the outside diameter of the signal spool (1).

The set of spiral grooves (2) on the right side of the signal spool (1) meters the oil allowed to flow from chamber (M) to chamber (S). The further the signal spool (1) is moved to the right the more oil is allowed to flow from the chamber (M) to chamber (S). Likewise the left-hand set of spiral grooves meter the oil allowed to flow from chamber (S) to the drain port (D). The further the signal spool (1) is moved to the right the less oil allowed to flow from chamber (S) to drain. This allows a higher pressure to build in chamber (S) as the signal spool (1) is moved in.

Upon start up the engine, the metering spool (3) is positioned fully to the right by the force of the spring. With the metering spool shifted to the right, the oil in chamber (M) can flow through the signal spool (1) and metering spool (3) to chamber (P). As pressure builds in chamber (P) to 40 [kPa], the metering spool (3) will be forced to the left, which cuts off the oil flow into chamber (P). Should more than the 40 [kPa] occur in chamber (P), the metering spool spring is compressed more by the spool moving further to the left. When moved completely leftward, a passage in metering spool (3) allows the excess flow in chamber (P) to escape to the drain port (D). The metering spool (3) will shuttle back and forth controlling the oil from chamber (M) into chamber (P) and the oil from chamber (P) out to drain to maintain the 40 [kPa] pressure in chamber (P).

When the brake pedal is pushed to apply the brakes, the linkage in turn pushes the signal spool (1) into the booster housing. As the signal spool (1) is pushed in, less oil is allowed to escape to drain and pressure will build in chamber (S).

A pressure increase in chamber (S) will force the metering spool (3) to the right. The metering spool (3) will allow additional oil to flow from chamber (M) into chamber (P) until enough pressure is built to overcome the pressure in chamber (S) and a force of the metering spool spring. Thus, the higher the pressure in chamber (P), the further the piston (5) will move to the right and the more the brake pump is actuated.

When the brake pedal is released, the signal spool (1) is moved back out of the booster housing. Now chamber (S) is additionally opened to drain which reduces the pressure in chamber (S). The pressure of the oil in chamber (P) will now overcome the force of the spring and push the metering spool (3) to the left which in turn dumps the excess flow in chamber (P) to drain. With less pressure in chamber (P), piston (5) will return to the left because of spring effort, which reduces the stroke of the brake pump and releases the brakes.

Should the transmission hydraulics be lost, the brake system will still operate only without a hydraulic assist. When the pedal is depressed, the signal spool (1) will mechanically contact the piston (5) and actuate the brake pump.

BRAKE PUMP BOOSTER (only 520G)

20. SPECIFICATION (Fig. 4.22)

Diameter of signal spool	34.91 [mm]
Diameter of piston	57.13 [mm]
Maximal stroke of signal spool	61 [mm]
Maximal stroke of piston	57 [mm]

Special Torques

Signal spool connector	54-66 [Nm]
Piston nut	147÷166 [Nm]
Metering spool plug	54-66 [Nm]

Spring Test Load Data

Piston Spring (15)

Total number of coils	8.7
Free length	139.8 [mm]
Test length	89 [mm]
Test load pressure	156 [N]

Metering Spool Spring (7)

Total number of coils	13
Free length	22 [mm]
Test length	16.1 [mm]
Test load pressure	15.1 [N]

Ball Spring (30)

Total number of coils	11
Free length	12 [mm]
Test length	9.7 [mm]
Test load pressure	0.28 [N]

Piston Spring (28)

Total number of coils	14.5
Free length	42 [mm]
Test length	15.2 [mm]
Test load pressure	16.4 [N]

21. REMOVAL



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 electrical system master switch is off and the keys are removed from master switch and from starting switch.



WARNING! Always lock the frames together before working near the center of the machine. If the frames move, serious injury or death could result.

BRAKE PUMP BOOSTER (only 520G)

1. Remove the brake pump. Refer to BRAKE PUMP in this Section.
2. Disconnect the brake linkage at the front of the brake booster.
3. Disconnect two hoses (6 and 7, Fig. 4.18 and 4.19) from brake booster.
4. Unscrew the four bolts (26, Fig.4.24) securing the brake booster (23) to front frame.
5. Remove the brake booster (23), plate (24) and shim(s) (27).

22. DISASSEMBLY (Fig. 4.21)

1. Remove the washer (24) and guide (23) with O-rings (21 and 22) from housing (1).
2. Using pliers RSKn-200 remove the retaining ring (17), being careful to slowly release the tension of the spring (15) on washer (16). Remove the spring (15) and washer (16).
3. Push the connector (9) into the housing (1) and remove the piston (12) assy and signal spool (4) assy. Then remove the retaining ring (3) from housing (1), using pliers RSKn-200. Remove the seal ring (2) from the housing (1).
4. Remove the nut (14) from the bolt (13). Then remove the piston (12).
5. Remove the plug (6) from the signal spool (4). Then remove the metering spool (5) and spring (7) from inside the signal spool (4).
6. Remove the connector (9) and O-rings (8 and 11) from the signal spool (4).
7. Unscrew the plug (19) with O-ring (18) and remove parts (18, 25, 26, 27, 28, 29, 30, 31 and 32) from housing (1).
8. Remove the plugs (20).

23. INSPECTION AND REPAIR

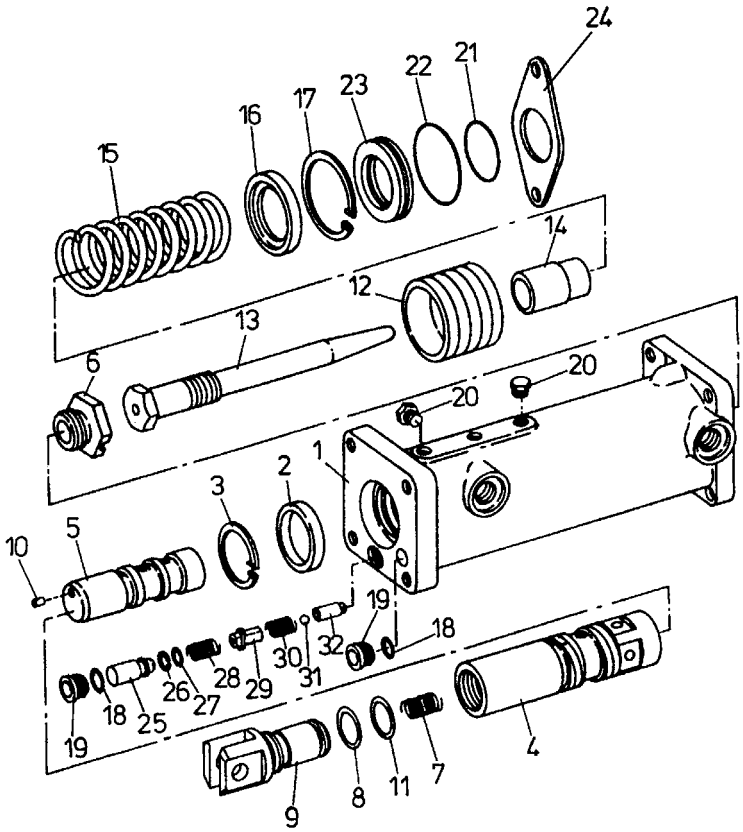


Fig. 4.21. Brake Pump Booster Exploded View

BRAKE PUMP BOOSTER (only 520G)

Description to Fig. 4.21 and 4.22

1. Housing	9. Connector	17. Retaining Ring	25. Piston
2. Seal Ring	10. Plug	18. O-ring	26. Back-up Ring
3. Retaining Ring	11. O-ring	19. Plug	27. O-ring
4. Signal Spool	12. Piston	20. Plugs	28. Spring
5. Metering Spool	13. Bolt	21. O-ring	29. Socket
6. Plug	14. Nut	22. O-ring	30. Spring
7. Spring	15. Spring	23. Guide	31. Ball
8. O-ring	16. Washer	24. Washer	32. Piston

1. Replace all seal rings and O-rings.
2. Check the pistons and the spools for scoring and wear.
3. Check the housing bore for wear. Clean all passages in the housing and the spools.
4. Inspect the ball (31, Fig. 4.21).
5. Check the parts according to SPECIFICATION.

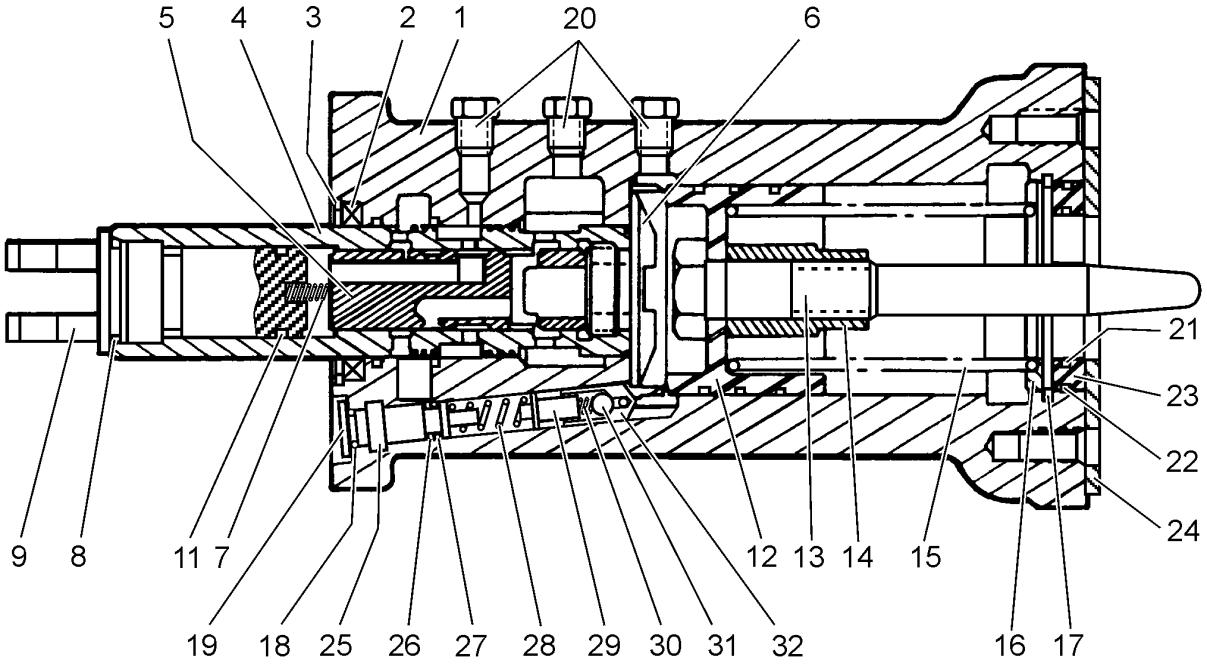


Fig. 4.22. Brake Pump Booster Cross Section

24. REASSEMBLY (Fig. 4.21)

1. Install parts (32, 31, 30, 29, 28, 27, 26 and 25) in housing (1) and install plug (19) with O-ring (18).
2. Use Loctite 242 to the connector (9) and install it with O-rings (8 and 11) in signal spool (4). Torque the connector (9) to 54÷66 [Nm].
3. Install the spring (7) and the metering spool (5) into the signal spool (4). Apply Loctite 242 to the threads of the plug (6) and install into the signal spool (4). Torque the plug to 54÷66 [Nm]. Remove the excess Loctite 242 from the signal spool (4) and install into the housing (1).
4. Place the bolt (13) through the piston (12). Apply Loctite 242 to the first 2÷3 threads on the bolt (13) and install the nut (14). Torque the nut to 147-166 [Nm]. Install the spring (15) on the bolt (13).

5. Install seal ring (2) in housing (1) and secure with the retaining ring (3), using pliers RSKn-200.
6. Install the piston (12) with bolt (13), nut (14) and spring (15) into housing (1). Place washer (16) over spring (15) and secure with the retaining ring (17), using pliers RSKn-200.
7. Install guide (23) with O-rings (21 and 22) in housing (1). Place washer (24) onto housing (1).
8. Install the plugs (20) in housing (1).

25. INSTALLATION

IMPORTANT: *Before installing brake pump booster (5, Fig.4.19) refer to MASTER BRAKE PEDALS LINKAGE in this SECTION, for master brake pedals clearance proper adjustment.*

1. Place the plate (24, Fig.4.3) with shim(s) (27) and brake pump booster (23) up to the front frame and secure with the four mounting bolts (26)
2. Reconnect two hoses (6 and 7, Fig. 4.19) to brake pump booster (5).
3. Reconnect the brake linkage to the signal spool connector at the front of the brake booster (5).
4. Install the brake pump. Refer to BRAKE PUMP in this Section.
5. Check brake system for proper operation. Refer to TEST under MASTER BRAKES in this section.

DIFFERENTIAL VALVE

26. DESCRIPTION AND OPERATION

The differential valve is located on the front frame under cab. The valve is connected to the brake tubes (5). This valve monitors the pressure, which builds in each of the brake circuits (front and rear). With the pressure equal in the two circuits, the spool (7) will remain centered by the springs (6). If a pressure differential should occur, that is pressure builds in one circuit only, the higher pressure will shift the spool (7) towards the side, which has lower pressure.

With the spool (7) shifted the plunger spring (1) will push the plunger (3) down into the groove area of the spool (7). The plunger (3) will touch the contact (4) and complete an electrical circuit through the terminal (2). A master brake warning light on the instrument panel will alert the operator of a problem in the braking hydraulic system.

This plunger (3) does not reset automatically. The light will remain ON from the time the pressure loss first occurs until the system repaired and the plunger (3) is manually reset. To reset the plunger (3), remove the switch (9) and reinstall after the spool is centered. Always check the operation of the switch (9) when removed.

The switch (9) must be removed when bleeding the brakes. Bleeding will cause a pressure differential and the spool will shift. If the switch is left in, the pin will be damaged when the spool is returned to the center position. The O-rings (8) located on each end of the spool (7) will prevent leakage when the switch (9) is removed. The switch (9) and the valve are serviced as a complete assembly.

DIFFERENTIAL VALVE

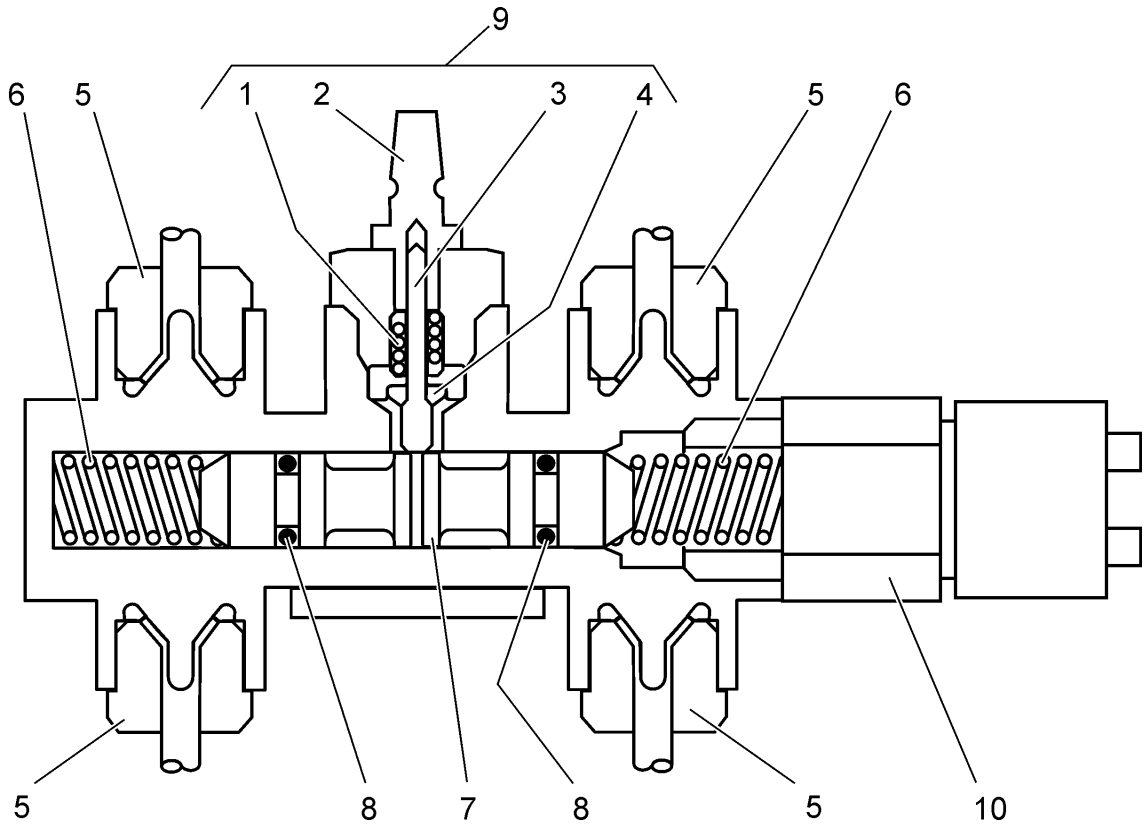


Fig. 4.22. Differential Valve

1. Spring
2. Terminal
3. Plunger
4. Contact
5. Brake Tube
6. Spring
7. Spool
8. O-ring
9. Differential Pressure Switch
10. Stop Lights Switch

SECTION 5

STEERING

STEERING

SECTION 5

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1. DESCRIPTION

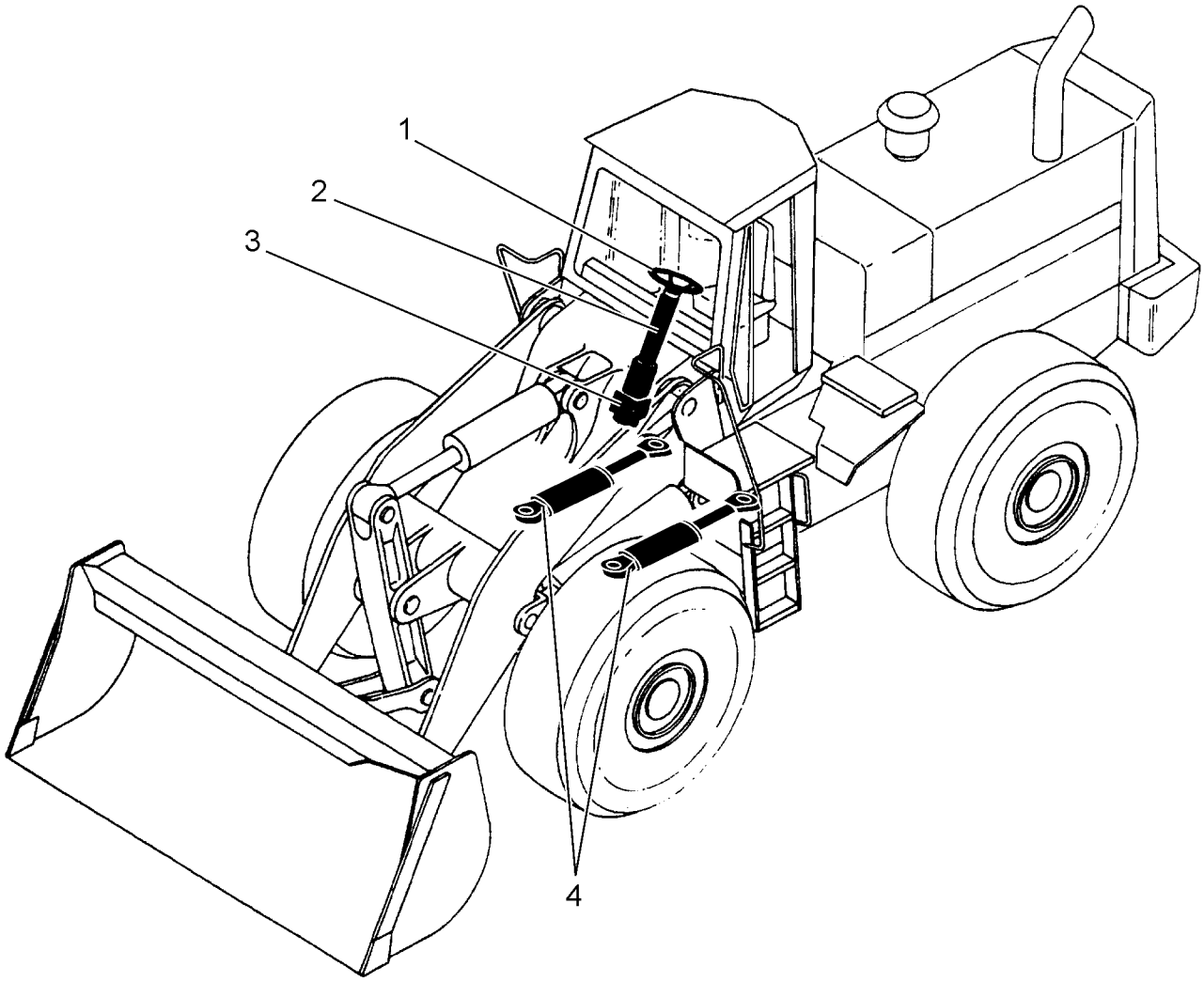


Fig. 5.1. Steering System Details

1. Steering Wheel
2. Steering Column Assy
3. Steering Control Valve
4. Steering Cylinders

The machine steering system is a manually controlled hydraulic system, which provides smooth steering at any engine speed with tiltable and telescopic steering column for operator efficiency. Articulated front and rear frames make possible left and right 40° articulation and 4.70[m] - (515G), 5.05[m] - (520G) turning radius outside of the tires. Generally the steering system consists of hydraulic components and mechanical linkage. Mechanical linkage of the steering system consists of the steering wheel (1) and steering column assy (2). The steering control valve (3, Fig. 5.1), two steering cylinder (4) and some special valves are hydraulic components. Hydraulic portion of the steering system is explained in more details in SECTION 10 “HYDRAULICS”. Refer to SECTION 10B “VALVES” for detailed description and service manuals of the steering control valve (3) and other steering system valves. Refer to SECTION 10C “CYLINDERS” for detailed description and service manual of the steering cylinders (4).

2. SPECIFICATIONS

Special Torques

Steering wheel nut..... 48 [Nm]

3. SERVICE DIAGNOSIS

NOTE: *The following service diagnosis pertains to the mechanical portion of the steering system. For diagnosis of the hydraulic portion of the steering system, refer to Section 10, "HYDRAULICS".*

COMPLAINT	
PROBABLE CAUSE	**REMEDY**
High Steering Column Shaft Effort	
1. Problem in hydraulic system.	1. Refer to steering system diagnosis in Section 10 „HYDRAULICS”.
2. Tires not inflated properly.	2. Refer to specification in Section 15, "WHEELS".
3. Steering column bearings worn or damaged	3. Replace steering column bearings.
4. Tight or damaged steering column shaft universal joint.	4. Replace steering column.
5. Hinge pin bearings worn.	5. Replace bearings. Refer to Section 9, “FRAME”.
Steering Wheel Not Locking in Any Tilt Position	
1. Catch and/ or tooth segment worn or damaged.	1. Replace catch assy.
2. Catch spring weak or broken.	2. Replace catch spring.
3. Lever assy details failed or damaged.	3. Repair or replace lever assy.
Steering Wheel Fails to Return to Top Tilt Position	
1. Tilt return springs are to weak or broken.	1. Replace tilt return springs.
2. Lever assy details failed or damaged.	2. Repair or replace lever assy.
Steering Column Not Locking in Any Position	
1. Steering column seized or dirt.	1. Clean, repair or replace steering column.
2. Telescope spring weak or broken.	2. Replace telescope spring.
3. Lever assy details failed or damaged.	3. Repair or replace lever assy.

4. REMOVAL

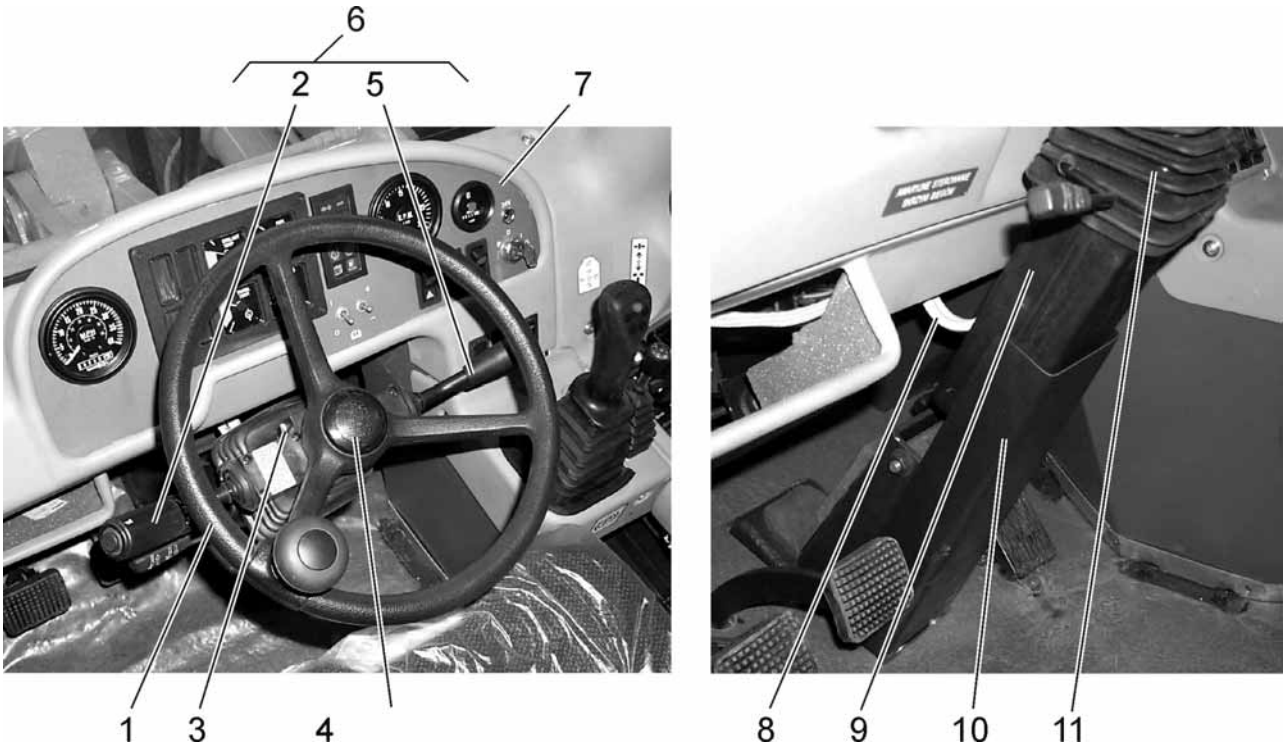


Fig. 5.2. Steering Column Guard Removal

1. Steering Wheel
2. Transmission Shifter
3. Bolt ÷ 2 pcs
4. Steering Wheel Cover
5. Turn Signal Switch
6. Switch Assy
7. Instrument Panel
8. Harness
9. Steering Column Assy
10. Steering Column Guard
11. Rubber Boot

WARNING! Before attempt to service the machine, BE SURE the engine is stopped, the bucket is lowered to the ground, transmission shifter is in neutral position (N), parking brake applied, the master switch turned to the OFF position and the keys are taken out from both the electric master switch and starting switch to prevent accidental engine starting. Place in visible warning notice in the cab.

1. Disconnect harness (8, Fig. 5.2) plugs of the switch assy (6), from the cab electrical installation socket under instrument panel (7).
2. Remove steering wheel cover (1, Fig. 5.3).
3. Unscrew and remove steering wheel nut (2A) from the steering column assy (4) shaft end. Remove steering wheel (2) from the steering column assy (4) shaft end using suitable driver.
4. Remove two bolts (3, Fig. 5.2) mounting switch assy (6) to the steering column assy (9).
5. Remove transmission shifter (2) and turn signal switch (5) with its harness and plugs.
6. Remove four screws with washers (2, Fig. 5.4) mounting steering column guard (3) to the operator platform bracket (4). Remove steering column guard (3).
7. Unscrew two bolts with washer and remove band (7, Fig. 5.3) mounting steering column assy (4) to the clip (6).
8. Remove four bolts with washers (6, Fig. 5.4) mounting steering column assy (7) lower flange to the operator platform bracket (4). Free steering column (4, Fig. 5.3) lower shaft splined end from the steering control valve (8) and take the steering column out of the machine.

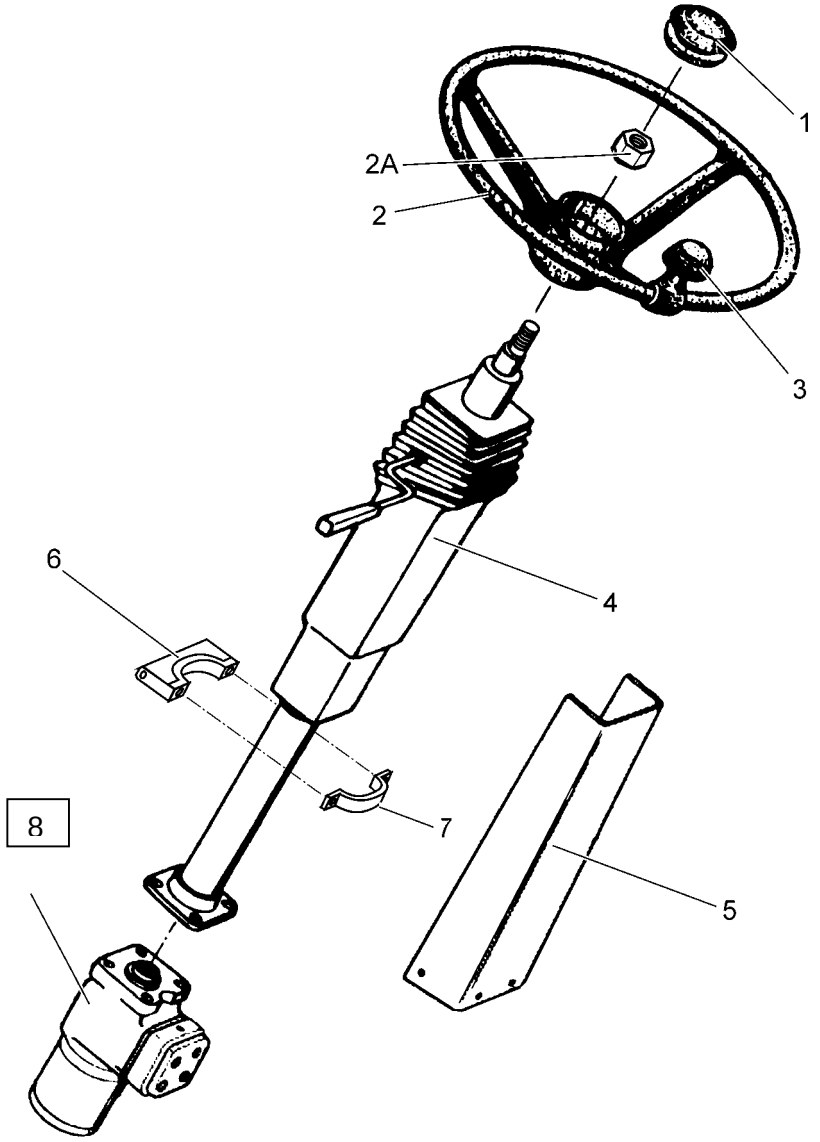


Fig. 5.3. Steering System Mechanical Linkage

1. Cover
2. Steering Wheel
2A. Steering Wheel Nut
3. Knob
4. Steering Column Assy
5. Steering Column Guard
6. Clip
7. Band with Bolts and Washer
8. Steering Column Valve

5. DISASSEMBLE, INSPECTION, REPAIR AND REASSEMBLE

1. Remove clamp strip (18, Fig. 5.5) and screw (17) from the cover (16). Remove halves of the cover (16) from the steering column (27).
2. Referring to the diagnosis chart check for excessive wear or damage steering column assy components:
   - lever assy - (1)
   - catch assy - (20)
   - springs set - (10)
   - bearings - (14 and 26)
   - steering column - (27)

3. Repair or replace excessive worn or damaged parts.
4. Install halves of the cover (16) onto steering column (27). Install clamp strip (18) and screw (17) on the cover (16).

6. INSTALLATION

1. Slide the steering column assy (4, Fig. 5.3) lower shaft end into steering control valve (8) splined bore.
2. Align steering column assy (7, Fig.5.4) lower flange bore with bores in the operator platform bracket (4) and install bolts with washers (6) mounting lower flange to the operator cab floor (5).
3. Install band (7, Fig.5.3) and tighten bolt with washer (8).

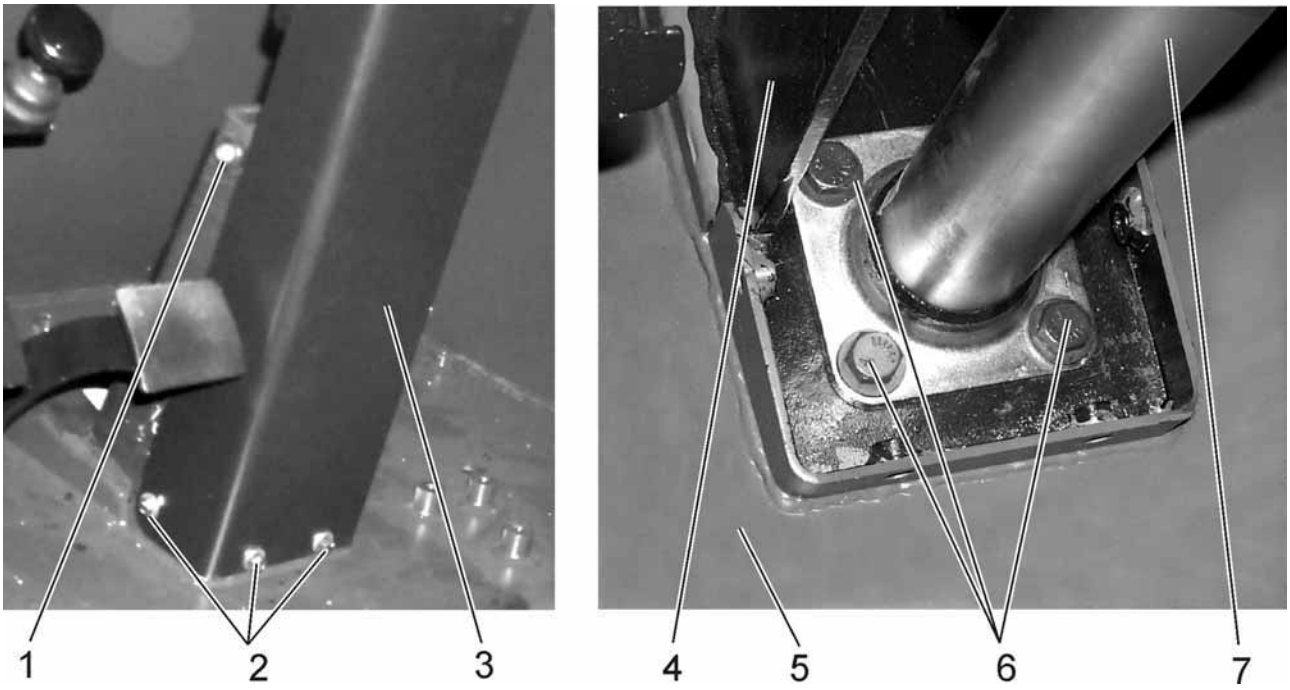


Fig. 5.4. Steering Column Mounting Points

1. Bolt, Nut with Washer
2. Screws - 4 pcs
3. Steering Column Guard
4. Platform Bracket
5. Cab Floor
6. Bolts with Washers – 4 pcs
7. Steering Column Assy

4. Install four screws with washers (2, Fig. 5.4) mounting steering column guard (3) to the operator platform bracket (4).
5. Install transmission shifter (2, Fig. 5.2) of the switch assy (6) with its harness and plug on the steering column assy (9).
6. Install turn signal switch (5) of the switch assy (6) with its harness and plug on the steering column assy (9).
7. Install and tighten two bolts (3) mounting switch assy (6) to the steering column assy (4).
8. Install steering wheel (2, Fig. 5.3) onto steering column assy (4) shaft end.
9. Install steering wheel nut (2A) onto steering column assy (4) shaft end. Torque the nut to 48 [Nm].

10. Install steering wheel cover (1).
11. Reconnect harnesses (8, Fig. 5.2) plugs of the switch assembly (6) to the cab electrical installation sockets under instrument panel (7).

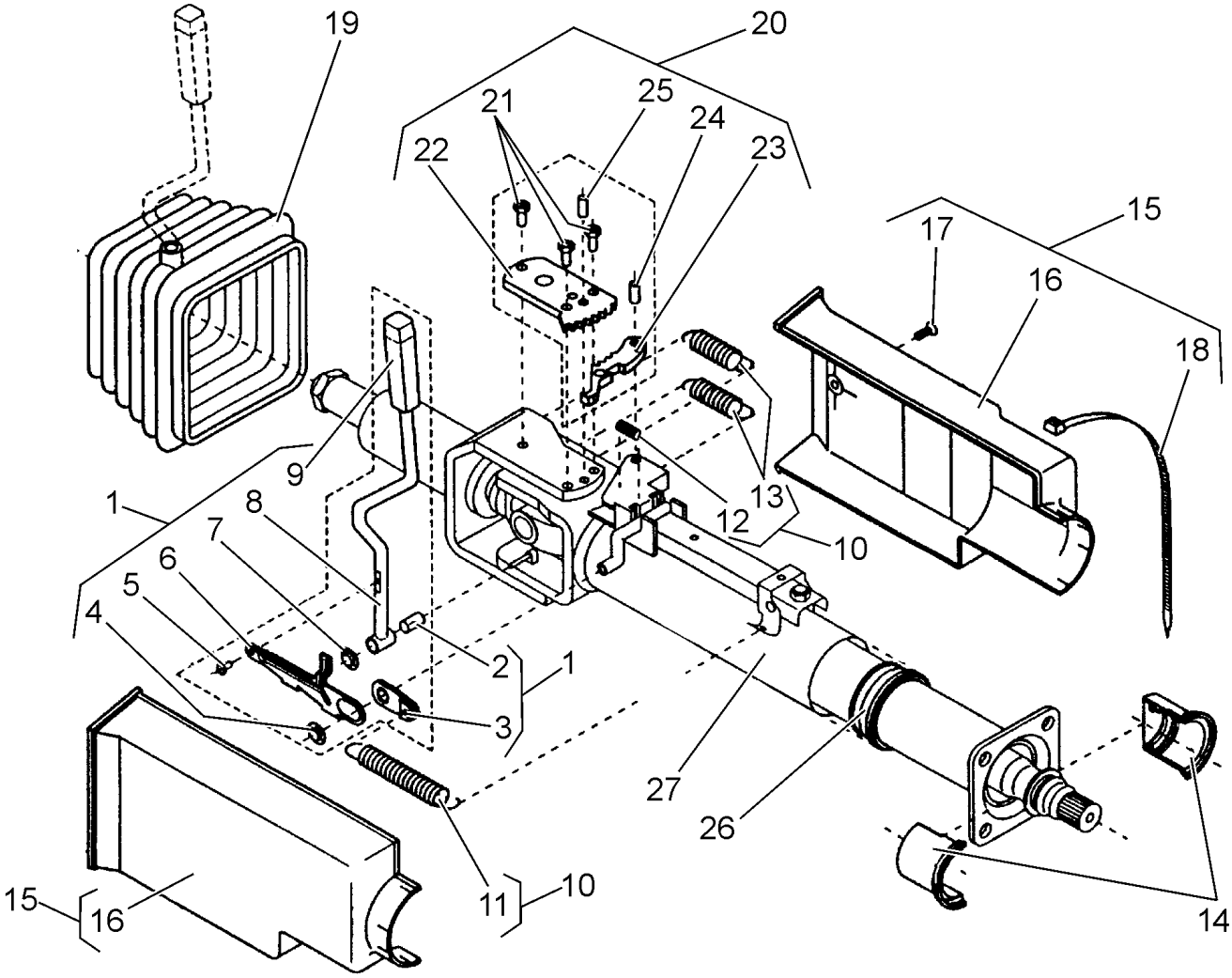


Fig. 5.5. Steering Column Assy Exploded View

1. Lever Assy
2. Lever Bearing
3. Connector
4. Lock Washer
5. Rivet
6. Pitman Arm
7. Lock Washer
8. Lever
9. Handle
10. Springs Set
11. Telescope Spring
12. Catch Spring
13. Tilt Return Springs
14. Axial Bearing
15. Cover Assy
16. Cover
17. Screw
18. Clamp Strip
19. Rubber Boot
20. Catch Assy
21. Screw
22. Tooth Segment
23. Catch
24. Pin
25. Pin
26. Telescope Bearing
27. Steering Column

SECTION 6

COOLING SYSTEM

COOLING SYSTEM

SECTION 6

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COOLING SYSTEM

1. DESCRIPTION

Three cooling systems are used on this machine. Systems use the modular radiator, which is mounted on rear frame of the machine. First system cools engine coolant, second system cools the transmission system oil used in drive train components. Third system cools the oil used in the steering and hydraulic system components. Air flow through the modular radiator is provided by the belt driven blower fan.

Engine Cooling System

Engine cooling system is pressure, closed-type with one water-to-air radiator that permits to operate under different angles without loss of coolant through the overflow tube. The cooling system permits to operate at higher engine temperatures without risk of coolant boiling. Information on cooling system is contained in 515G, 520G Wheel Loaders Operator's Manual and Operation and Maintenance Manual Industrial QSB-3.9-30, QSB4.5-30 and QSB-5.9-30 Series Engines, Bulletin No 4021388. Information on repair of subassemblies of engine cooling system is given in 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, steering and torque converter.

Hydraulic Oil Cooling System

The system uses an oil-to-air heat transfer type oil cooler to cool the oil used in the hydraulic and steering system components.

2. OPERATION

Engine Cooling System (Fig. 6.1)

To engine block mounted belt driven centrifugal coolant pump (1), draws coolant and forces it through engine oil cooler cavity (2) to cylinder block (3). The coolant then circulates around each cylinder and crosses the block to the fuel pump side. Coolant then flows up into the cylinder head (5), crosses over the valve bridges, provides cooling to injectors, and to the exhaust manifold side of engine to the thermostat housing (8). Cylinder head cavity is vented to the deaerating tank (18) with hose (6).

When the engine is below operating temperature, the thermostat is closed, which prevents circulation of low temperature coolant through the radiator core (14). Coolant flows back to the coolant pump inlet through internal passage (9) in the cylinder block.

When the operating temperature is reached, the thermostat opens, blocking internal passage (9) and opens the outlet (7) to the radiator. Hot coolant flows to top of the radiator core, then through core tubes to bottom and coolant pump inlet through tube (11). Air flowing through the radiator core carries away heat to the atmosphere. Air flow is forced by the belt driven blower fan (12) from the engine.

Radiator core (14) has integrated deaerating tank (18) on the top, equipped with the coolant level sight gauge (15), overfill hose (16) and pressure cap (17), also coolant drain hose (13) on the bottom to empty the system.

Radiator cap (17) is automotive type and is equipped with two valves, pressure and negative pressure valve to maintain correct pressure in deaerating tank (18).

Hot coolant is used also to the cab compartment heating flowing through heat exchanger (4) mounted in the cab.

The engine must never be operated without a thermostat. Without thermostat the coolant will recirculate, bypassing the radiator, causing the engine to overheat.

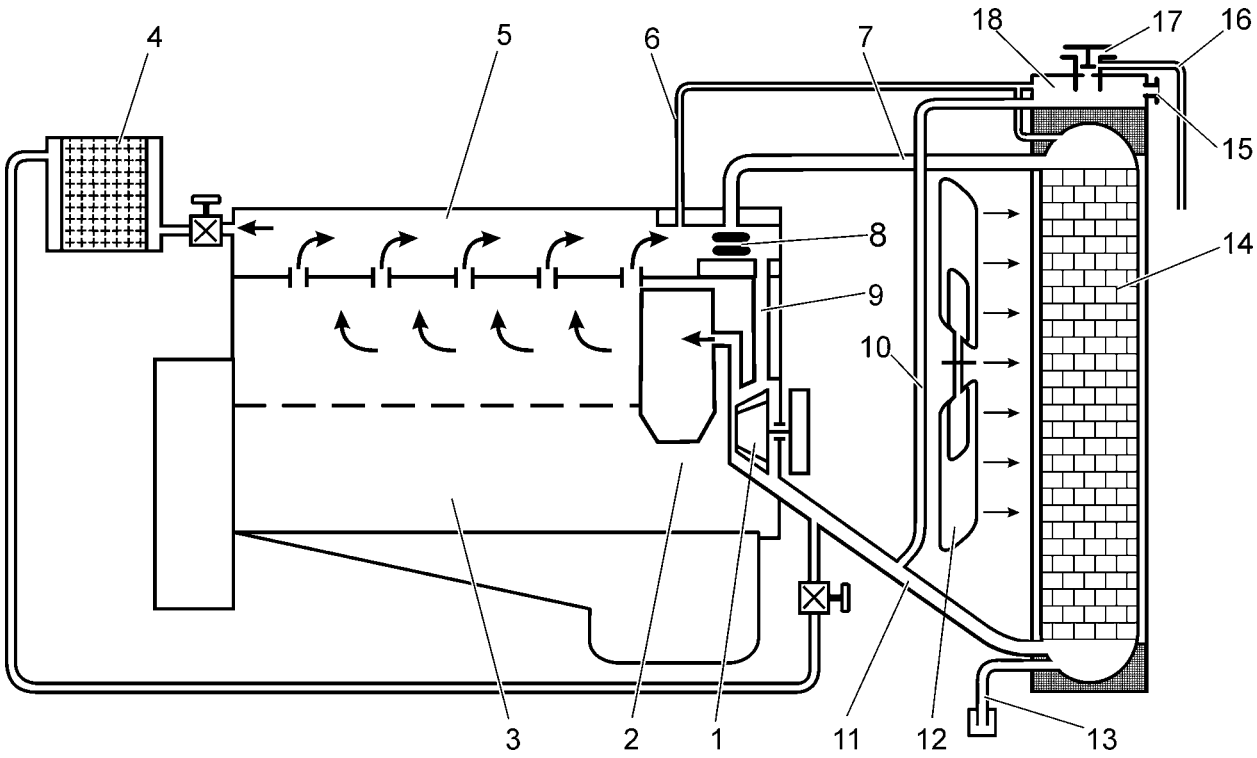


Fig. 6.1. Cooling System, Flow Diagram

1. Coolant Pump
2. Engine Oil Cooler Cavity
3. Cylinder Block
4. Cab Heat Exchanger
5. Cylinder Head
6. Vent Hose
7. Outlet Tube
8. Thermostat Housing
9. Internal Passage
10. Fill Hose
11. Inlet Tube
12. Fan
13. Drain Hose.
14. Radiator Core
15. Coolant Level Sight Gauge
16. Overfill Hose
17. Pressure Cap
18. Deaerating Tank

Drive Train Oil Cooling System

The oil used in the torque converter, transmission (and brake pump booster in 520G) is directed to the inlet port of oil cooler located in left side of engine cooler as it leaves the torque converter. Heat is transferred away to atmosphere by air flowing through the radiator core. Then oil is directed to the pressure regulator valve port.

Hydraulic Oil Cooling System

The oil from the hydraulic equipment control valve and steering control assy is directed to the return line connected to the inlet port of oil cooler located in right side of engine cooler. Heat is transferred away to atmosphere by air flowing through the radiator core. Then oil is directed to the return filter and oil reservoir.

3. SPECIFICATIONS

Special Torques

Radiator guard mounting bolts . . . . . 98 - 118 [Nm]

Specified torque value refers to lubricated nuts with SAE 30 oil.

NOTE: *Except for special torques, for all bolts and nuts use standard torque values specified in Section 1.*

Engine Cooling System

Capacity:
515G . . . . . 23 [l]
520G . . . . . 24 [l]
Coolant pump type . . . . . impeller, centrifugal
Thermostat modulating range . . . . . 82 – 93 [°C]
Minimum recommended coolant temperature in radiator top tank. . . . . 70 [°C]
Maximum allowable top tank temperature . . . . . 102 [°C]
Pressure cap at 99 [°C]:
515G . . . . . 90 [kPa]
520G . . . . . 100 [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 . . . . . 1.5 [MPa]

Hydraulic oil cooler

Type . . . . . oil-to-air
Core . . . . . replaceable, with air fins, bar and plate type vertical tubes
Test pressure . . . . . 1.5 [MPa]

COOLING SYSTEM

4. SERVICE DIAGNOSIS

Engine 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 adjuster. Refer to Operation and Maintenance Manual QSB Series Engines.
4. Fan blades damaged.	Replace fan.

Engine cooling system

Overheating due to poor circulation	
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. Refer to Troubleshooting and Repair QSB Series Engines Manual
4. Faulty coolant temperature sensor or gauge.	Replace coolant temperature sensor or gauge.
5. Restriction in radiator core.	Drain the system. Flush core or clean.
6. Damaged coolant pump.	Replace pump. Refer to Troubleshooting and Repair QSB Series Engines Manual.
Internal leakage of engine oil to coolant	
1. Incorrectly tightened cylinder head.	Tighten cylinder head. Refer to Troubleshooting and Repair QSB Series Engines Manual
2. Damaged engine oil cooler.	Remove oil cooler, test for leaks. Refer to Troubleshooting and Repair QSB Series Engines 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 temperature sensor or gauge.
2. Extremely cold weather.	Cover radiator. Restrict air flow through the radiator.
3. Thermostat inoperative.	Check, replace thermostat.

Drive train cooling system

Drive train system overheating	
1. Drive train oil overheating.	Refer to SERVICE DIAGNOSIS - Section 7.
External leakage of transmission oil	
1. Damaged drive train system oil cooler.	Remove drive train oil cooler. Conduct pressure test of oil cooler, remove leakages or replace.

Hydraulic cooling system

Hydraulic system overheating	
1. Hydraulic oil overheating.	Refer to SERVICE DIAGNOSIS - Section 10.
External leakage of hydraulic oil	
1. Damaged hydraulic system oil cooler.	Remove hydraulic oil cooler. Conduct pressure test of oil cooler, remove leakages or replace.

5. DESCRIPTION

515G – Radiators assy is hanged on two vertical brackets welded to side surface of transmission oil cooler and hydraulic oil cooler. Brackets are mounted to the radiator guard assy with bolts.

520G – Radiators assy is mounted on the two horizontal brackets welded to side surface of transmission oil cooler and hydraulic oil cooler. Brackets are bolted to the frame. Additionally radiators assy is supported with the bars on both sides to the frame.

6. REMOVAL

515G

1. Position the machine so hoist or other lifting device can be used to remove radiator.

WARNING! Make sure the bucket is lowered on the ground and hand brake applied.

WARNING! Turn the starting switch and master switch to the "OFF" position and take the keys out to prevent inadvertent starting.

2. Open the radiators guard and battery cover (3, Fig. 6.2), disconnect negative (-) and positive (+) cable from battery and ground wires (5) from the frame. Disconnect wire harness plug (4).

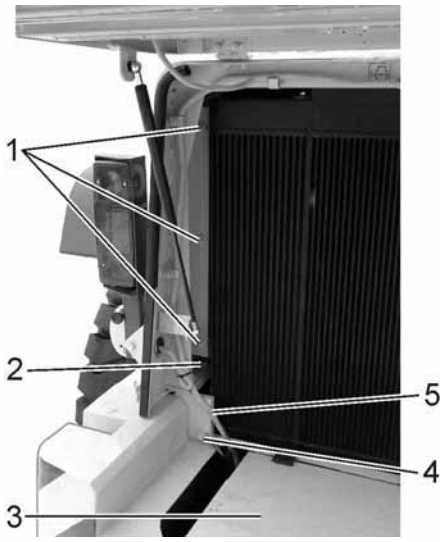


Fig. 6.2. Radiator's Guard Disassembly Points 515G

1. Radiators Assy Brackets Bolts
2. Radiators Assy Guard Bolts
3. Battery Cover
4. Rear Lamps Wire Harness Plug
5. Ground Wires

3. Open engine guards assy (3, Fig. 6.3). Remove precleaner (1), and exhaust pipe (2).

4. Remove bolts fastening engine guards assy (3) to hydraulic reservoir and radiators guard (4). Remove gas spring on both sides. Attach slings and carefully lift the engine guards assy (3). Remove bolts securing lower cover (5) to frame and take it out of the frame.



Fig. 6.3. Engine and Radiators Assy Guards 515G

1. Air Precleaner
2. Exhaust Pipe
3. Engine Guards Assy
4. Radiators Guards Assy
5. Lower Cover

5. Drain the engine cooling system as described in Operator's Manual.

6. Remove hose (1, Fig. 6.4) from hydraulic oil cooler.

IMPORTANT: *Disconnected hydraulic 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 into critical components of the machine.*

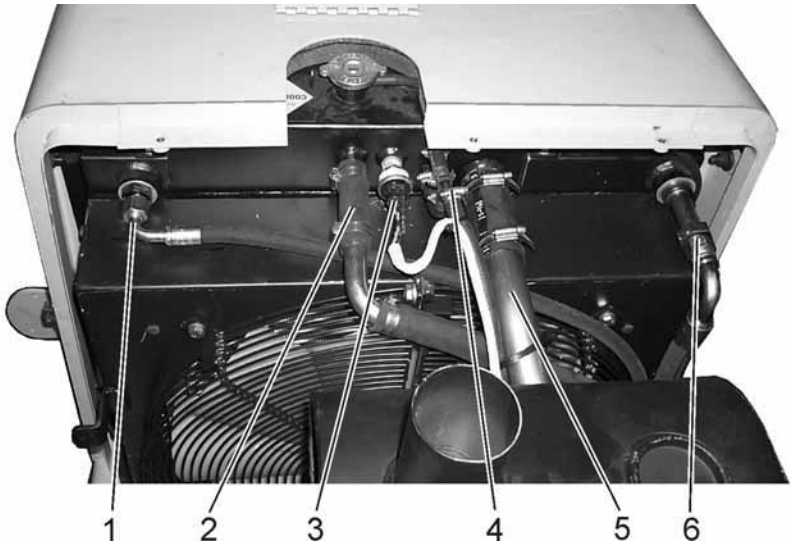


Fig. 6.4. Radiator Assy Disassembly Points 515G

1. Hydraulic System Oil Cooler Hose(outlet)
2. Engine Cooling System Fill Hose
3. Coolant Level Switch
4. Engine Vent Hose
5. Coolant Inlet Tube
6. Drive Train System Oil Cooler Hose (outlet)

7. Disconnect plug from the coolant level switch (3, Fig. 6.4). Remove wire harness from the strip and secure it out of the frame.
8. Loosen the clamp, remove engine cooling system venting hose (4).
9. Loosen the clamp, remove coolant inlet tube (5).
10. Remove hose (6) from drive train oil cooler.

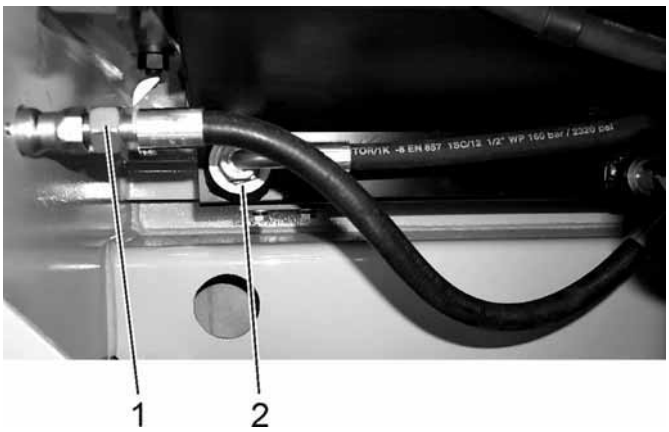


Fig. 6.5. Radiators Assy Disassembly Points 515G / 520G (bottom view)

1. Engine Cooling System Drain Hose
2. Hydraulic System Oil Cooler Hose (inlet)

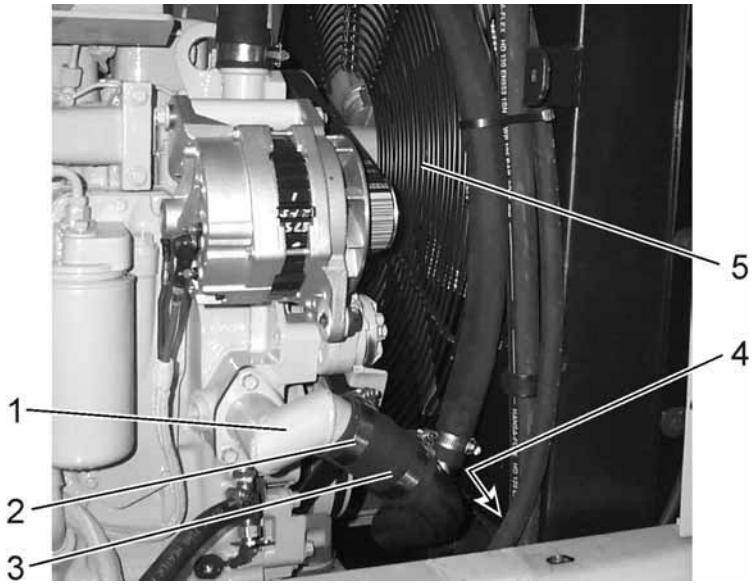


Fig. 6.6. Disassembly 515G (LH)

1. Elbow
2. Clamp
3. Hose
4. Drive Train System Oil Cooler Hose (inlet)
5. Fan Guard

11. Remove cooling system drain hose (1, Fig. 6.5).
12. Remove hose (2) from hydraulic oil cooler.
13. Remove both parts of fan guard (5, Fig. 6.6).
14. Loosen the clamp (2), remove hose (3) from elbow (1).
15. Remove hose (4) from drive train oil cooler.

COOLING SYSTEM

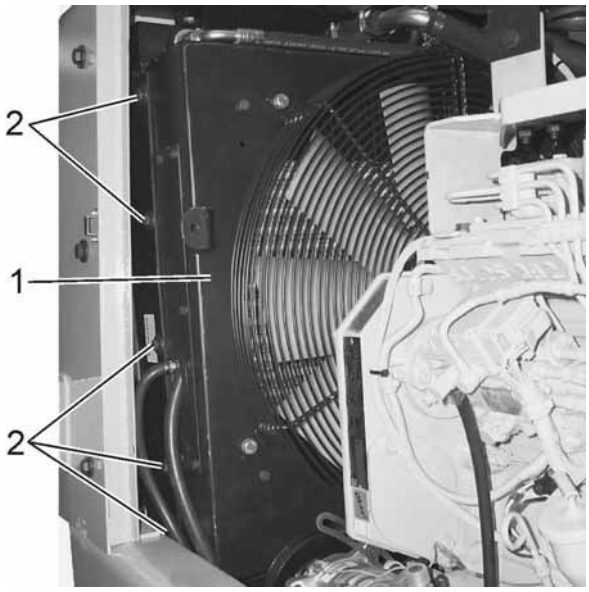


Fig. 6.7. A/C System Disassembly 515G

1. Fan Shroud 2. Bolts

16. MACHINES EQUIPPED WITH A/C SYSTEM: Loosen clamp, remove engine cooling system fill hose (2, Fig. 6.4). Remove bolts (2, Fig. 6.7) securing fan shroud (1) to radiator. Secure shroud with A/C system condenser on frame.

IMPORTANT: *DO NOT remove condenser hoses. Failure to observe will cause the refrigerant to escape and the system refilling with the refrigerant will be required.*

17. Attach slings to radiators guards (4, 6.3). Remove bolts (2, Fig. 6.2) securing guards to the frame (on both sides of the frame). Lift and move the assembly backward to separate hose (3, Fig. 6.6) from the elbow (1). Lift radiators guard assy off the frame and place in the vertical position in the rack. Remove slings.
18. Remove bolts (1, Fig 6.2) securing the radiator to the brackets, remove radiator from the radiators guards.

520G

1. Position the machine so hoist or other lifting device can be used to remove radiator.

WARNING! Make sure the bucket is lowered on the ground and hand brake applied.

WARNING! Turn the starting switch and master switch to the "OFF" position and take the keys out to prevent inadvertent starting.

2. Open the radiators guard and battery cover (2, Fig. 6.8), disconnect negative (-) and positive (+) cable from battery and ground wire (4) from the frame. Disconnect wire harness plug (3).
3. Open engine guards assy (2, Fig. 6.9). Remove precleaner (1).
4. Remove bolts fastening engine guards assy (2) to hydraulic reservoir and radiators guard (3). Remove gas spring on both sides. Attach slings and carefully lift the engine guards assy (2). Remove bolts securing lower cover (4) to frame and take it out of the frame.

5. Attach slings to radiators guards assy (3). Remove bolt (1, Fig. 6.8) securing radiator guard to frame (on both sides of the frame). Remove guards assy and place on level ground to prevent warping. Remove slings.

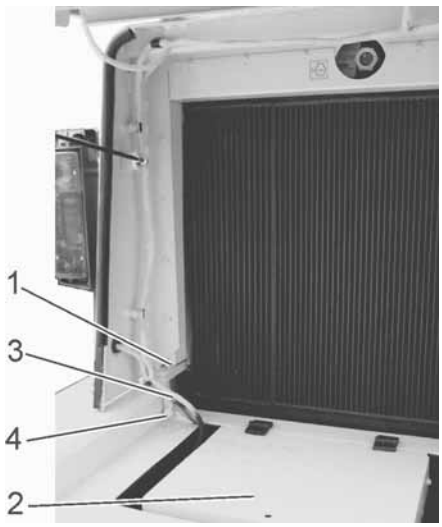


Fig. 6.8. Radiators Guards Disassembly Points 520G

1. Radiators Guards Bolts
2. Battery Cover
3. Rear Lamps Wire Harness Plug
4. Ground wire



Fig. 6.9. Engine and Radiators Assy Guards 520G

1. Air Precleaner
2. Engine Guards Assy
3. Radiators Guards Assy
4. Lower Cover

6. Drain the engine cooling system as described in Operator's Manual.
7. Remove hose (1, Fig. 6.10) from hydraulic oil cooler.

IMPORTANT: *Disconnected hydraulic 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 into critical components of the machine.*

8. Disconnect plug from the coolant level switch (3). Remove wire harness from the strip and secure it out of the frame.
9. Loosen the clamp, remove engine cooling system venting hose (4).
10. Loosen the clamp, remove coolant inlet tube (5).

COOLING SYSTEM

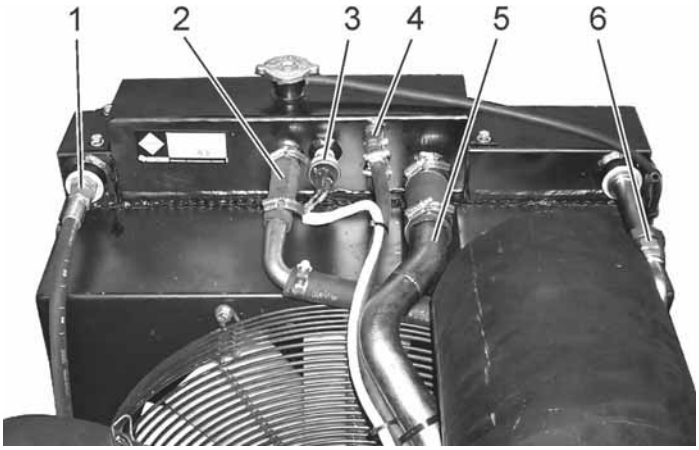


Fig. 6.10. Radiator Connections 520G

1. Hydraulic System Oil Cooler Hose (outlet)
2. Engine Cooling System Fill Hose
3. Coolant Level Switch
4. Engine Venting Hose
5. Coolant Inlet Tube
6. Drive Train System Oil Cooler Hose (outlet)

11. Remove hose (6) from drive train oil cooler.
12. Remove fan guard (10, Fig. 6.11).
13. Remove cooling system drain hose (1, Fig. 6.5).
14. Remove hose (2) from hydraulic oil cooler.

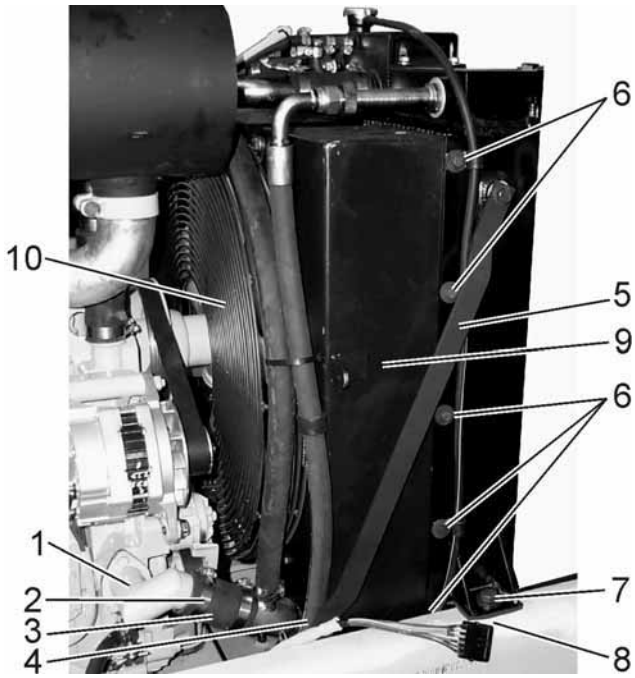


Fig. 6.11. Radiator Connections 520G

1. Elbow
2. Clamp
3. Hose
4. Drive Train System Oil Cooler Hose (inlet)
5. Bar
6. Fan Shroud Bolts
7. Bolt
8. Rubber Pad
9. Fan Shroud
10. Fan Guard

15. Loosen the clamp (2, Fig. 6.11) remove hose (3) from elbow (1).
16. Remove hose (4, Fig. 6.11) from drive train oil cooler.
17. Remove radiator bar (5) from both sides of the radiator.

18. MACHINES EQUIPPED WITH A/C SYSTEM: Loosen clamp, remove engine cooling system fill hose (2, Fig. 6.10). Remove bolts (6, Fig. 6.11) securing fan shroud (9) to radiator. Secure shroud with A/C system condenser on frame.

IMPORTANT: *DO NOT remove condenser hoses. Failure to observe will cause the refrigerant to escape and the system refilling with the refrigerant will be required.*

19. Attach slings to radiators assy. Remove bolts (7) securing radiator to the frame. Lift and move the assembly backward to separate hose (3) from the elbow (1). Lift radiator off the frame and place in the horizontal position on the wooden block. Remove slings. Remove rubber pad (8).

7. RADIATORS ASSY DISASSEMBLY (Refer to Fig. 6.12)

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

Hydraulic oil cooler removing

1. Position assy horizontally on the wooden block.
2. Remove bolts (2) securing cooler (1) to the cooler (4) and plate (7).
3. Remove cooler (1).

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

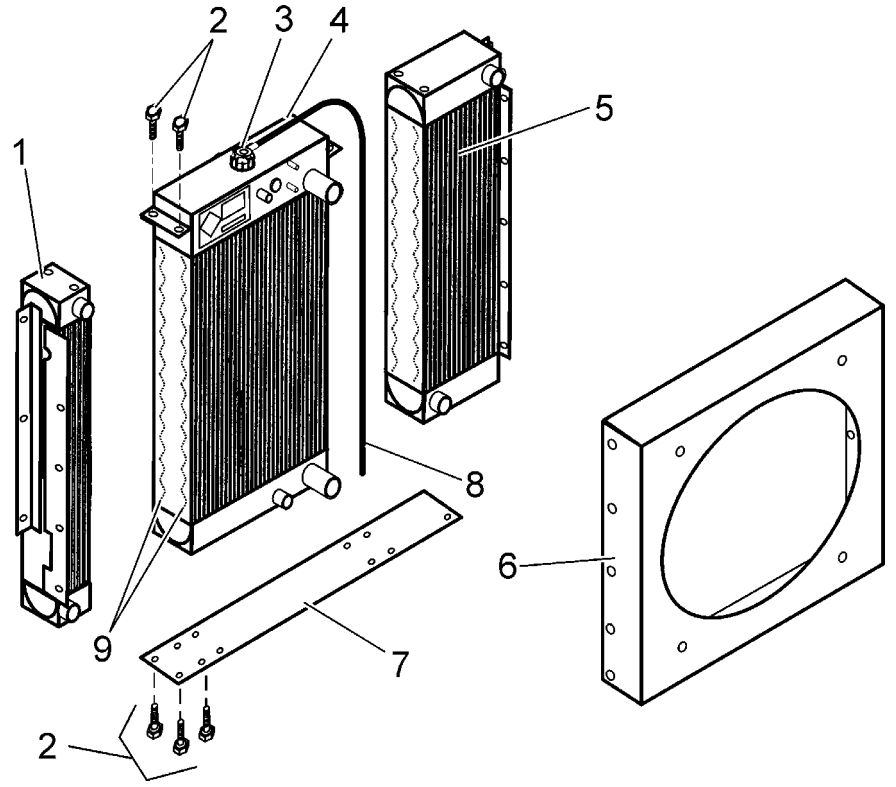
8. INSPECTION AND REPAIR (Refer to Fig. 6.12)

1. Examine coolers (1,4 and 5) for damage. Straighten bent fins if possible to avoid air flow restrictions. Clean coolers outside with compressed air or water with additives non aggressive for aluminum. The direction of cleaning stream should be parallel to the fins in order to avoid damage.
2. Inspect particular coolers for cracks. Perform pressure test if necessary.
3. Inspect all linking hoses for cracks or rupture and install new when in doubt.
4. Inspect the radiator cap (3).
5. Check and repair fan shroud (6) for cracks and hardware.
6. Check fan blades for cracks and other damage. Do not repair. Replace for new one.
7. Check and replace overflow hose (8) if clogged.

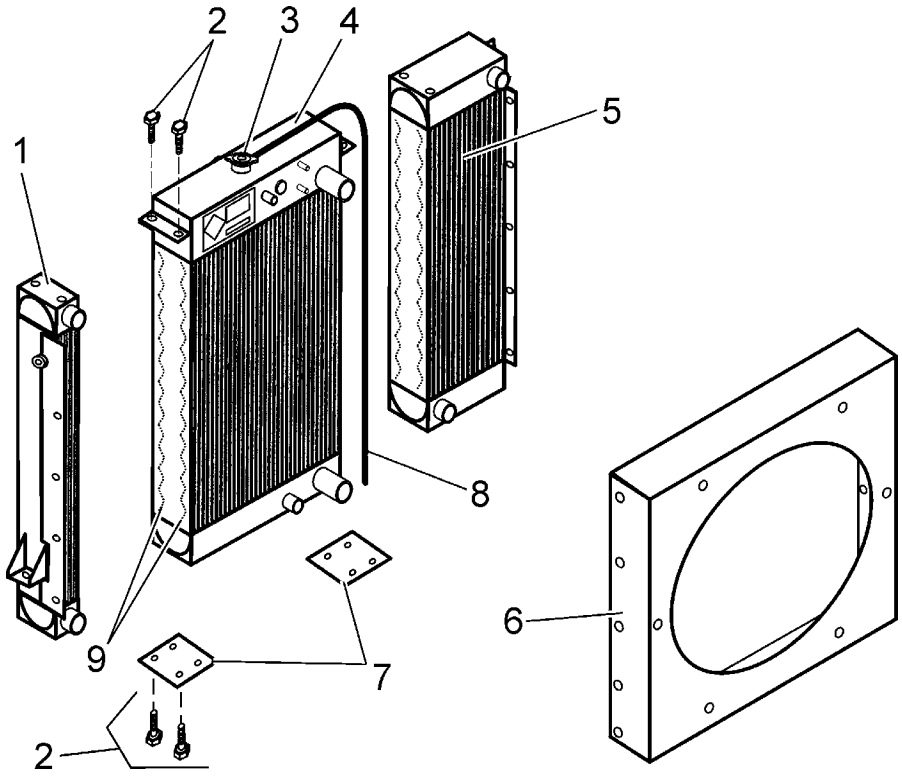
NOTE: *Elements (cores) of the radiator assy, are mounted (welded) and have to be replaced by new if unrepairable.*

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

COOLING SYSTEM



515G



520G

Fig. 6.12. Radiators Assy with Shroud

1. Hydraulic Oil Cooler
2. Bolts
3. Radiator Cap
4. Engine Cooler
5. Drive Train Oil Cooler
6. Fan Shroud
7. Plate Bottom
8. Overflow Hose
9. Rubber Seal

9. REASSEMBLE (Refer to Fig. 6.12)

Hydraulic oil cooler mounting

1. Apply a rubber seal (9) into the slot between cooler (4). Position cooler (1) on place, install bolts (2) securing to the cooler (4).
2. Tighten all bolts with care. Apply standard torques values for aluminum

10. INSTALLATION

515G

1. Position the radiators in the radiators guard. Install radiators assy to the brackets with the bolts (1, Fig. 6.2).
2. Attach slings to radiators guards assy (4, Fig. 6.3). Position assembly on the frame, moving forward to install hose (3, Fig. 6.6) on the elbow (1), tighten clamp (2). Install bolts (2, Fig. 6.2) securing guards assy to the frame. Tighten the bolts to 98 - 118 [Nm]. Remove slings.
3. Reinstall hose (4, Fig. 6.6) to drive train oil cooler.
4. MACHINES EQUIPPED WITH A/C SYSTEM: Position fan shroud (1, Fig. 6.7) with A/C system condenser and secure assy to the radiators with the bolts (2) on both sides. Reinstall engine cooling system fill hose (2, Fig. 6.4). Tighten the clamp.

NOTE: *Check the gap between fan shroud and fan blades is equal.*

5. Reinstall both parts of fan guard (5, Fig. 6.6).
6. Reinstall hose (2, Fig. 6.5) to hydraulic oil cooler.
7. Reinstall cooling system drain hose (1).
8. Reinstall hose (6, Fig. 6.4) to drive train oil cooler.
9. Reinstall coolant inlet tube (5), tighten the clamp.
10. Reinstall engine cooling system venting hose (4), tighten the clamp.
11. Reconnect plug to the coolant level switch (3, Fig. 6.4). Secure wire harness with the strip.
12. Reinstall hose (1) to hydraulic oil cooler.
13. Refill the engine cooling system with the coolant as described in Operator's Manual.
14. Install lower cover (5, Fig. 6.3) on both sides of the frame.
15. Open the radiators guard and battery cover (3, Fig. 6.2), reconnect positive (+) and negative cable (-) to battery and ground wires (5) to the frame. Reconnect wire harness plug (4).
16. Start the engine, check all disconnected previously connections for leakage. Stop the engine.
17. Attach slings, lift and position the engine guards assy (3, Fig. 6.3). Install the bolts fastening engine guards assy (3) to hydraulic reservoir and radiators guards (4). Reinstall gas springs on both sides of the guards. Remove slings.
18. Install precleaner (1), and exhaust pipe (2). Close the engine guards.

520G

1. Attach slings to radiators assy. Position radiators assy on the frame, moving forward to install hose (3, Fig. 6.11) on the elbow (1), tighten clamp (2). Insert rubber pad (8) and install bolts (7) securing radiator to the frame. Remove slings.
2. Reinstall hose (4) to drive train oil cooler.
3. MACHINES EQUIPPED WITH A/C SYSTEM: Position fan shroud (9) with A/C system condenser and secure assy to the radiators with the bolts (6). Reinstall cooling system fill hose (2, Fig. 6. 10). Tighten the clamp.

NOTE: *Check the gap between fan shroud and fan blades is equal.*

4. Install radiator bar (5, Fig. 6. 11) on both sides of the radiator.
5. Reinstall fan guard (10).
6. Reinstall hose (2, Fig. 6.5) to hydraulic oil cooler.
7. Reinstall cooling system drain hose (1).
8. Reinstall hose (6, Fig. 6.10) to drive train oil cooler.
9. Reinstall coolant inlet tube (5), tighten the clamp
10. Reinstall engine cooling system venting hose (4), tighten the clamp
11. Reconnect plug to the coolant level switch (3). Secure wire harness with the strip.
12. Reinstall hose (1) to hydraulic oil cooler.
13. Refill the engine cooling system with the coolant as described in Operator’s Manual.
14. Install lower cover (4, Fig. 6.9) on both sides of the frame.
15. Open the battery cover (2, Fig. 6.8), reconnect positive (+) and negative cable (-) to battery.
16. Start the engine, check all disconnected previously connections for leakage. Stop the engine.
17. Attach slings to radiators guards assy (3, Fig. 6.9). Position the radiators guards assy on the frame, install the bolt (1, Fig. 6.8) securing assy to frame (on both sides). Tighten the bolt to 98 - 118 [Nm]. Install ground wire (4) to the frame and reconnect wire harness plug (3).
18. Attach slings to the engine guards assy (2, Fig. 6.9), lift and position guards assy, install the bolts fastening it to hydraulic reservoir and radiators guards (3). Reinstall gas springs on both sides of the guards. Remove slings.
19. Reinstall precleaner (1, Fig. 6.9).

SECTION 7

DRIVE TRAIN

DRIVE TRAIN

CONTENS

SERVICE/SPECIAL TOOLS

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7. Checking Transmission and Torque Converter Pressures 8
8. Torque Converter Stall Speed Check 10

SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS

1. Pressure gauge ..... OEM 1212

GENERAL

2. DESCRIPTION

Power from the engine is transmitted through a flywheel to the torque converter and then is carried by a drive shaft to the transmission. The transmission transmits this power through two drive shafts to the front and rear axles.

This machine is equipped with a single stage, single phase torque converter and with a power shift transmission allowing the machine to operate in three speeds forward and three speeds in reverse.

3. HYDRAULIC OIL FLOW (Fig. 7.1)

The hydraulic oil flow through the transmission and torque converter is managed by a cascading system of pressures. There is main oil pressure which operates at 2050 ÷ 2345 [kPa], lube pressure at 60 ÷ 250 [kPa] and converter pressure oil operating at (285 ÷ 580 [kPa] for 515G and 280 ÷ 480 [kPa] for 520G).

Priorities are established according to the pressure requirements of each component. When main pressure requirements are met, oil spills over-cascades-into the converter circuit. Excess from the converter cascades into the lube circuit.

The transmission sump is the source of supply for the oil in the transmission/torque converter system. A positive displacement, single element gear type hydraulic pump supplies the flow in the circuit. This drive train pump is mounted on the transmission and operating whenever the engine is running.

MAIN PRESSURE OIL: Oil in the transmission sump flows through strainer (5) to the drive train pump (6). Oil from the pump (6) is directed through the pressure filter (7). The filter is equipped with a by-pass valve (19), which opens at 310 ÷ 380 [kPa] pressure differential.

Only in machine 520G oil from the filter is directed to the brake pump booster (16) and to the priority valve (8). In this way brake system is constantly supplied. When the oil pressure is build up to 2050 ÷ 2345 [kPa] in the circuit, the priority valve (8) spool will be moved to the right and it will allow pump flow to enter the circuit.

Oil from the priority valve (8) is directed to the pressure regulator valve (10) and control valve (11).

In machine 515G oil from the filter is directed to the pressure regulator valve (10) and control valve (11).

When the directional spool (15) is in the neutral position, the main oil pressure is blocked at this point. If the spool is in the forward or reverse position, main pressure oil is directed to engage the forward (F) or reverse (R) clutch. Oil at the range spool (14) is directed to engage the first, second or third gear range clutch.

GENERAL

CONVERTER PRESSURE OIL: When the main pressure oil requirements are met, pressure is build up to 2050 ÷ 2345 [kPa] in the circuit, pressure regulator valve (10) spool (M) will be moved up and it will allow pump flow to enter the converter circuit. For oil flow through the torque converter (18), refer to Section 7B.

Oil on the output side of the torque converter is directed to the oil cooler (9) and then to the pressure regulator valve (10) where it becomes part of the lubrication circuit.

LUBE PRESSURE OIL: When the converter circuit pressure has been satisfied, pressure will build up to (285 ÷ 480 [kPa] for 520G and 285 ÷ 580 [kPa] for 515G) in the circuit, to allow oil to enter the lubrication circuit, where it joins the flow from the oil cooler.

Lube oil is directed to lubricate all disengaged clutch packs. When the lube circuit is satisfied, pressure will build up to 60 ÷ 250 [kPa] in a circuit, allowing excessive pressure oil returns to the transmission sump.

4. SPECIFICATIONS

Transmission type .....Countershaft, constant mesh
Torque converter type .....Single stage, single phase

Pressure oil filter:

Type ..... Spin on replaceable element
By-pass .....Opens at 310÷380 [kPa] pressure differential

Oil sump:

Type .....Internal (in transmission)

Oil cooler .....mounted, oil-to-water type heat exchanger

Machine Model	**515G**	**520G**
Drive train system capacity [l]	27	30
Drive train pump output rating at 2500 [RPM] [l/min]	94.5	94.5

PRESSURES (at pressure regulator valve)

Machine Model	**515G**	**520G**
Main [kPa]	2050÷2345	2050÷2345
Torque Converter [kPa]	285÷580	285÷480
Lube [kPa]	60÷250	60÷250

STALL SPEED

Machine Model	**515G**	**520G**
Converter only [RPM]	2450÷2660	2450÷2660
Hydraulic only [RPM]	2450÷2660	2450÷2700
Converter and hydraulic [RPM]	1900÷2200	1970÷2200

GENERAL

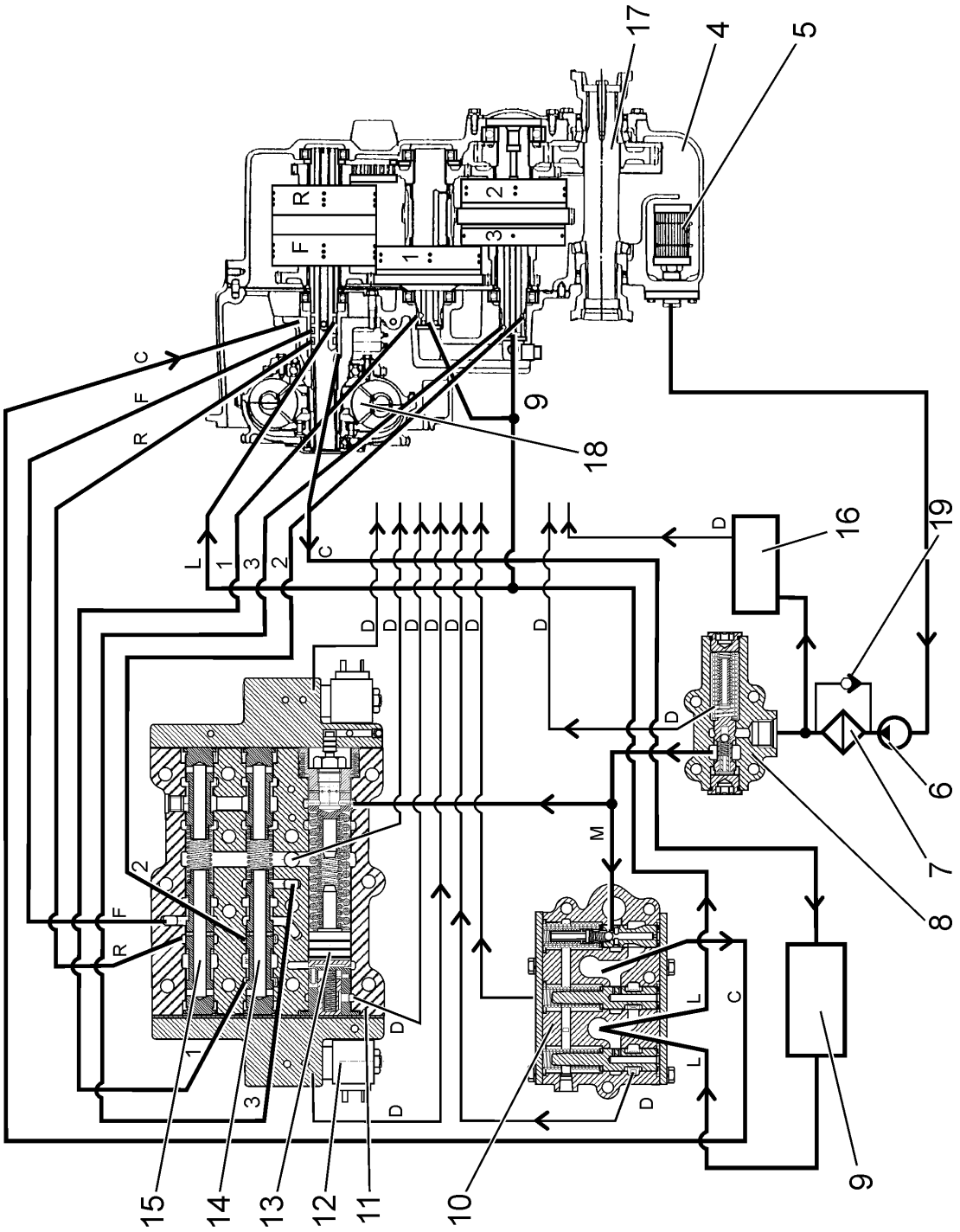


Fig. 7.1. Hydraulic Oil Flow

1. 1st Gear Clutch
2. 2nd Gear Clutch
3. 3rd Gear Clutch
4. Transmission
5. Suction Strainer
6. Drive Train Pump
7. Pressure Filter
8. Priority Valve (520G only)
9. Oil Cooler
10. Pressure Regulator Valve
11. Control Valve
12. Solenoid Valve
13. Modulation Spool
14. Range Spools
15. Directional Spools
16. Brake Pump Booster (520G only)
17. Output Shaft
18. Torque Converter
19. By-pass -210 ÷ 380 [kPa]

C. Torque Converter Oil Pressure
D Drain
F. Forward Clutch Pack
L Lubrication Pressure
M. Main Oil Pressure
R. Reverse Clutch Pack

DRIVE TRAIN

GENERAL

5. SERVICE DIAGNOSIS

COMPLAINT	
PROBABLE CAUSE	**REMARKS**
Excessive Noise	
1. Low oil level	1. Correct oil level. Refer to Operator's Manual.
2. Loose transmission mountings	2. Tighten all bolts. Refer to Special Torques in SPECIFICATIONS in Section 7C.
3. Drive shafts need lubrication	3. Grease all shafts at lube fittings.
4. Restriction in suction side of drive train pump causing cavitation	4. Inspect supply hose and sump suction strainer.
5. Internal mechanical damage	5. Drain transmission oil sump and inspect oil for problem evidence (metal chips, charcoal, etc.). Analyze the evidence for cause (bearing failure, clutch plate facing, etc.). Repair. Flush oil cooler, radiator and all system hoses. Clean breather and sump strainer. Refill system with clean oil.
Severe Vibration	
1. Low oil level	1. Correct oil level. Refer to Operator's Manual
2. Loose or poorly aligned drive train components	2. Check and tighten all mounting bolts throughout entire drive train.
3. Drive shaft slip splines need lube	3. Coat shaft splines liberally with grease.
4. Universal joints worn	4. Repair or replace. Refer to Section 7D.
5. Excessive end play in transmission output shaft	5. Check and adjust end play. Refer to Section 7C REASSEMBLY under TRANSMISSION.
High Oil Temperature (Gauge and Light on Dash)	
1. Improper vehicle operation	1. Operate in proper gear range. Refer to Operator's Manual.
2. Dirty radiator or cooler	2. Clean radiator. Refer to Operator's Manual.
3. Clogged transmission suction strainer	3. Clean the strainer. Refer to Operator's Manual.
4. Faulty gauge or light on dash; faulty sensor or switch on converter	4. Check wiring; replace faulty components.
5. Foamed oil	5a. Too much oil in sump. Drain to proper level. 5b. Check for air leak in pump suction line.
6. Faulty cooling circuit	6a. Check air flow through cooler; check for clogged or damaged cooler and radiator hoses. 6b. Check for internal restrictions in cooler and radiator.
7. Torque converter oil pressure abnormal	7. Refer to CHECKING TRANSMISSION AND TORQUE CONVERTER PRESSURES in this Section.
8. Low oil flow through system	8. Refer to CHECKING CHARGING PUPM FLOW RATE in this Section.

GENERAL

Slow or Erratic Clutch Engagement	
1. Low transmission oil pressures	1. Refer to CHECKING TRANSMISSION AND TORQUE CONVERTER PRESSURES in this Section.
2. Control valve malfunction	2. Check control valve. Install new valve body gasket
3. Internal leakage in the clutch pack and/or shaft	3. Refer to CHECKING TRANSMISSION AND TORQUE CONVERTER PRESSURES in this Section.
Loss of Power	
1. Low oil level	1. Check oil level. Refer to Operator's Manual.
2. Brakes dragging	2. Refer to SERVICE DIAGNOSIS in Section 4 BRAKES and Section 7D DRIVE AXLE.
3. Low engine output	3. Perform stall speed test. Refer to TORQUE CONVERTER STALL SPEED CHECK
4. Main pressure spool of pressure regulator valve stuck open (stall speed to high)	4. Refer to CHECKING TRANSMISSION AND TORQUE CONVERTER PRESSURES in this Section.
5. Torque converter internal leakage	5. Refer to CHECKING TRANSMISSION AND TORQUE CONVERTER PRESSURES in this Section.
6. Charging pump malfunction	6. Refer to CHECKING THE CHARGING PUMP FLOW RATE in this Section.
Loss of Drive	
1. No oil in transmission	1. Check for leakage and refill.
2. Low main oil pressure	2. Refer to CHECKING TRANSMISSION AND TORQUE CONVERTER PRESSURES in this Section.
3. Transmission disconnect circuit malfunction	3. Refer to SERVICE DIAGNOSIS in Section 4 and to ELECTRICAL in Section 8.
Loss of Drive in One Direction	
1. Solenoid valve malfunction	1. Check the solenoid valve. Refer to Section 8.
2. Internal leakage in the clutch pack and/or shaft	2. Check directional pack pressures. Refer to CHECKING TRANSMISSION AND TORQUE CONVERTER PRESSURES in this Section.
Loss of Drive in One Speed Range	
1. Solenoid valve malfunction	1. Check the solenoid valve. Refer to Section 8.
2. Internal leakage in the clutch pack	2. Check range pack pressures. Refer to CHECKING TRANSMISSION AND TORQUE CONVERTER PRESSURES in this Section.
Knocking while travel changes	
1. Drive shafts splines backlash	1. Replace worn or damaged parts
2. Transmission output shaft spline backlash	2. Repair transmission

TESTS AND CHECKS

6. CHECKING THE CHARGING PUMP FLOW RATE

NOTE: *Before checking pump output, be sure the hydraulic reservoir is filled to the correct level and with the proper oil as described in the OPERATOR"S MANUAL.*

NOTE: *The following checks should be performed with the engine running at full throttle and oil at operating temperature, i.e. 50 ÷ 120 [°C]. To obtain operating temperature start the engine, shift to third forward with the food brake applied until the temperature gauge pointer reaches the high side. Than shift to neutral until the temperature gauge pointer drops to the midpoint. Repeat this procedure until the midpoint will be in green range.*

Pump failure is most easily discovered by signs such as noise or leakage at the pump housing. If no external signs are present, a flowmeter should be used to check the pump output.

1. Place a hydraulic flow meter with capacity of at least 200 [l/min] on/at the machine.
2. Unscrew bolts and remove cover under drive train pump. Disconnect the pump to pressure filter hose at the pump outlet port. Connect the flowmeter into system at the inlet line from the pump (6, Fig. 7.1) to the pressure filter (7).

WARNING! Be sure the area in front and behind the machine is clear of personnel and obstructions. DO NOT allow anyone near the tires or on the access ladders during the test.

IMPORTANT*: The adjustable restrictor in the flowmeter must be completely open during this entire test or the pump could be severely damaged.*

3. Start the engine. With the transmission in neutral, accelerate to full throttle and record the liters per minute flow meter reading.
4. Refer to SPECIFICATIONS for normal pump capacity. If the test result meet specifications, the pump is functioning properly.
5. If the results do not meet specifications, check for:
   a. RESTRICTION IN SUCTION SIDE OF DRIVE TRAIN PUMP: Inspect sump suction strainer. Refer to Operator's Manuals.
   b. DRIVE TRAIN PUMP MALFUNCTION: Overhaul pump.
6. Stop the engine. Disconnect the flow meter. Reconnect the pump to pressure filter hose at the pump outlet port. Install cover under drive train pump and torque the bolts.

7. CHECKING TRANSMISSION AND TORQUE CONVERTER PRESSURES (Fig. 7.2)

NOTE: *The following checks should be performed with the engine running at full throttle and oil at operating temperature, i.e. 50÷120 [°C]. To obtain operating temperature start the engine, shift to third forward with the food brake applied until the temperature gauge pointer reaches the high side. Than shift to neutral until the temperature gauge pointer drops to the midpoint. Repeat this procedure until the midpoint will be in green range.*

WARNING! Be sure the area in front and behind the machine is clear of personnel and obstructions as the machine may move during this test. DO NOT allow anyone near the tires or on the access ladders during the test.

TESTS AND CHECKS

1. Shut off the engine and apply the parking brake.
2. Remove caps from quick disconnect fittings.



Fig. 7.2. Pressure Gauge Check Points on the L.H. Side Rear Frame

M – Main Oil Pressure
C – Torque Converter Oil Pressure
L – Lube Oil Pressure

3. Connect the pressure gauge OEM 1212 to the measuring point (M,). Run the engine at full throttle and note pressure gauge readings when the transmission controls are in positions: neutral, first, second and third gear forward and first, second and third gear reverse. Repeat this procedure for measuring points (C and L). The readings should be the pressures as shown in the below chart.

GEAR RANGE	All readings are given in [kPa]			
	MAIN (M)	CONVERTER (C) 515G	CONVERTER (C) 520G	LUBE (L)
Neutral	2050 ÷2345	280 ÷ 580	285 ÷ 480	60 ÷ 250
Forward First	2050 ÷2345	280 ÷ 580	285 ÷ 480	60 ÷ 250
Forward Second	2050 ÷2345	280 ÷ 580	285 ÷ 480	60 ÷ 250
Forward third	2050 ÷2345	280 ÷ 580	285 ÷ 480	60 ÷ 250
Reverse first	2050 ÷2345	280 ÷ 580	285 ÷ 480	60 ÷ 250
Reverse second	2050 ÷2345	280 ÷ 580	285 ÷ 480	60 ÷ 250
Reverse third	2050 ÷2345	280 ÷ 580	285 ÷ 480	60 ÷ 250

4. If pressures do not meet specifications, refer to the following PRESSURE DIAGNOSTIC CHART.

DRIVE TRAIN

TESTS AND CHECKS

TRANSMISSION AND TORQUE CONVERTER DIAGNOSTIC CHART

COMPLAINT	
PROBABLE CAUSE	**REMEDY**
Low main oil pressure	
1. Low oil level.	1. Check oil level. Refer to OPERATOR'S MANUAL.
2. Leaking suction lines.	2. Apply shave cream to all suction connections and tighten the connections where cream disappears.
3. Clogged strainer in transmission.	3. Clean or replace strainer. Refer to OPERATOR'S MANUAL.
4. Fatigued main spool springs in pressure regulator valve.	4. Check spring and shim. Refer to PRESSURE REGULATOR VALVE in Section 7C.
5. Excessive wear or scoring main spool assy in pressure regulator valve.	5. Refer to PRESSURE REGULATOR VALVE in Section 7C.
6. Worn charging pump.	6. Refer to CHECKING CHARGING PUMP FLOW RATE in this Section.
High main pressure	
1. Stuck main spool.	1. Check main spool. Refer to PRESSURE REGULATOR VALVE in Section 7C.
Low converter pressure	
1. Low main oil pressure.	1. Refer to first complaint above.
2. Excessive wear or scoring torque converter spool in pressure regulator valve.	2. Check converter spool. Refer to PRESSURE REGULATOR VALVE in Section 7C.
3. Fatigued converter spool spring in pressure regulator valve.	3. Check converter spool spring. Refer to PRESSURE REGULATOR VALVE in Section 7C.
4. Internal leak in torque converter.	4. Refer to CHECKING TRANSMISSION AND TORQUE CONVERTER PRESSURES in this Section.
5. Worn charging pump.	5. Refer to CHECKING CHARGING PUMP FLOW RATE in this Section.
High converter pressure	
1. Clogged oil cooler. 2. Restricted cooler or radiator oil lines.	1, 2. Refer to COOLING SYSTEM, Section 6.
Low transmission lubrication oil pressure	
1. Low converter oil pressure.	1. Refer to third complaint above.
2. Excessive wear or scoring lubrication spool in pressure regulator valve.	2. Check lubrication spool. Refer to PRESSURE REGULATOR VALVE in Section 7C.
3. Fatigued lubrication spool spring in pressure regulator valve.	3. Check lubrication spool spring. Refer to PRESSURE REGULATOR VALVE in Section 7C.
Low or zero each directional and range engagement pressure	
1. Low main oil pressure.	1. Refer to first complaint above.
2. Transmission disconnect switch malfunction.	2. Refer to ELECTRICAL, Section 8

TESTS AND CHECKS

8. TORQUE CONVERTER STALL SPEED CHECK

WARNING! Be sure the area in front and behind the machine is clear of personnel and obstructions as the machine may move during this test. DO NOT allow anyone near the tires or on the access ladders during the test.

1. Start the engine and bring the engine and torque converter to operating temperatures (green area of the temperature gauges on the dash).
2. With the engine speed at full throttle and foot brake applied, shift the transmission into third forward and record the stall speed RPM. Shut off the engine and apply the parking brake.
3. If the converter stall speed does not meet specifications, refer to the following chart.

TORQUE CONVERTER STALL SPEED DIAGNOSTIC CHART

COMPLAINT	
PROBABLE CAUSE	**REMEDY**
Stall speed too high	
1. Engine injection pump defective or improper adjusted.	1. Refer to ENGINE, Section 12.
2. Low main oil pressure.	2. Refer to CHECKING TRANSMISSION AND TORQUE CONVERTER PRESSURES in this Section.
3. Clutch pack excessive wear.	3. Refer to TRANSMISSION, Section 7C.
Stall speed too low	
1. Too low engine power.	1. Refer to ENGINE, Section 12.

SECTION 7B

TORQUE CONVERTER

TORQUE CONVERTER

CONTENTS

SERVICE/SPECIAL TOOLS

1.Service/Special Tools 3

GENERAL

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TORQUE CONVERTER

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SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS

1. Jack screw.....½”-13x2-½”
2. Eyebolt .....½”–13x1-¼”
3. Eyebolt .....5/15”-18x ½”

GENERAL

2. DESCRIPTION (Refer to Fig. 7B.1 and Fig. 7B.2)

The torque converter is a single stage, single phase, rotating housing type unit. It is an integral part of the transmission assembly and is bolted directly to the engine flywheel drive ring.

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.

The converter has three basic parts. The impeller (6) is bolted to the converter drive housing (15) and the drive housing is driven by the engine flywheel. The stator (12) is splined to the stationary sleeve assy (1) and contains a row of stationary blades, sometimes called guide blades or reactor blades. The turbine (14) is splined to the transmission output shaft. These three parts, when assembled in place, form a torque transmitting unit. This unit is filled with fluid and held at a constant pressure during operation to suppress vacuum pockets which form at the blades under high fluid velocities. There is no direct mechanical connection between the impeller and turbine or stator.

3. OPERATION (Refer to Fig. 7B.1)

When the engine is operating, the flywheel drive ring gear rotates the impeller (6) at flywheel speed. Oil is supplied to the converter through drilled passages in the sleeve assy at the center of the rotating impeller. As the impeller rotates, the ring of fins act as a centrifugal pump as the fins eject the oil around the internal arc of the drive housing (15) at a high velocity:

The ejected oil from the impeller (6) strikes the blades of the turbine (14). The force of this oil puts the turbine in rotational motion. The turbine is spline-mounted on the converter output/transmission input shaft. The rotational force picked up by the turbine is transferred through this shaft directly into the transmission.

The stator (12) is a stationary component which re-directs oil from the turbine (14) blades back to the impeller (6) fins, completing the hydraulic loop and establishing vortex flow and increasing torque output. The stator is mounted to the sleeve assembly (1), which is bolted to the inside of the transmission converter housing. Oil for lube and converter operation is drawn from the sump at the bottom of the transmission and delivered by the charging pump to the converter.

The charging pump for converter oil is driven by an accessory drive gear mounted at the rear of the impeller. The double hydraulic pump is also driven by the accessory drive gear. The flow from the sump to the converter and from the converter back into the lubricating system is covered in SECTION 7C. Also covered in SECTION 7C is the procedure for checking the pressures in the transmission/converter circuit.

TORQUE CONVERTER

GENERAL

Description to Fig. 7B.1 and 7B.2:

1. Sleeve Assy
2. Sleeve
3. Ball
4. Ball
5. Seal Ring
6. Impeller
7. Ball Bearing
8. Drive Gear
9. Bolt
10. Flat Washer
11. Retaining Ring
12. Stator
13. Retaining Ring
14. Turbine
15. Drive Housing
16. Ball Bearing W/Retaining Ring
17. Ball Bearing
18. Retaining Ring
19. Retaining Ring
20. Bolt
21. Flat Washer
22. Front Cover
23. Bolt
24. Flat Washer

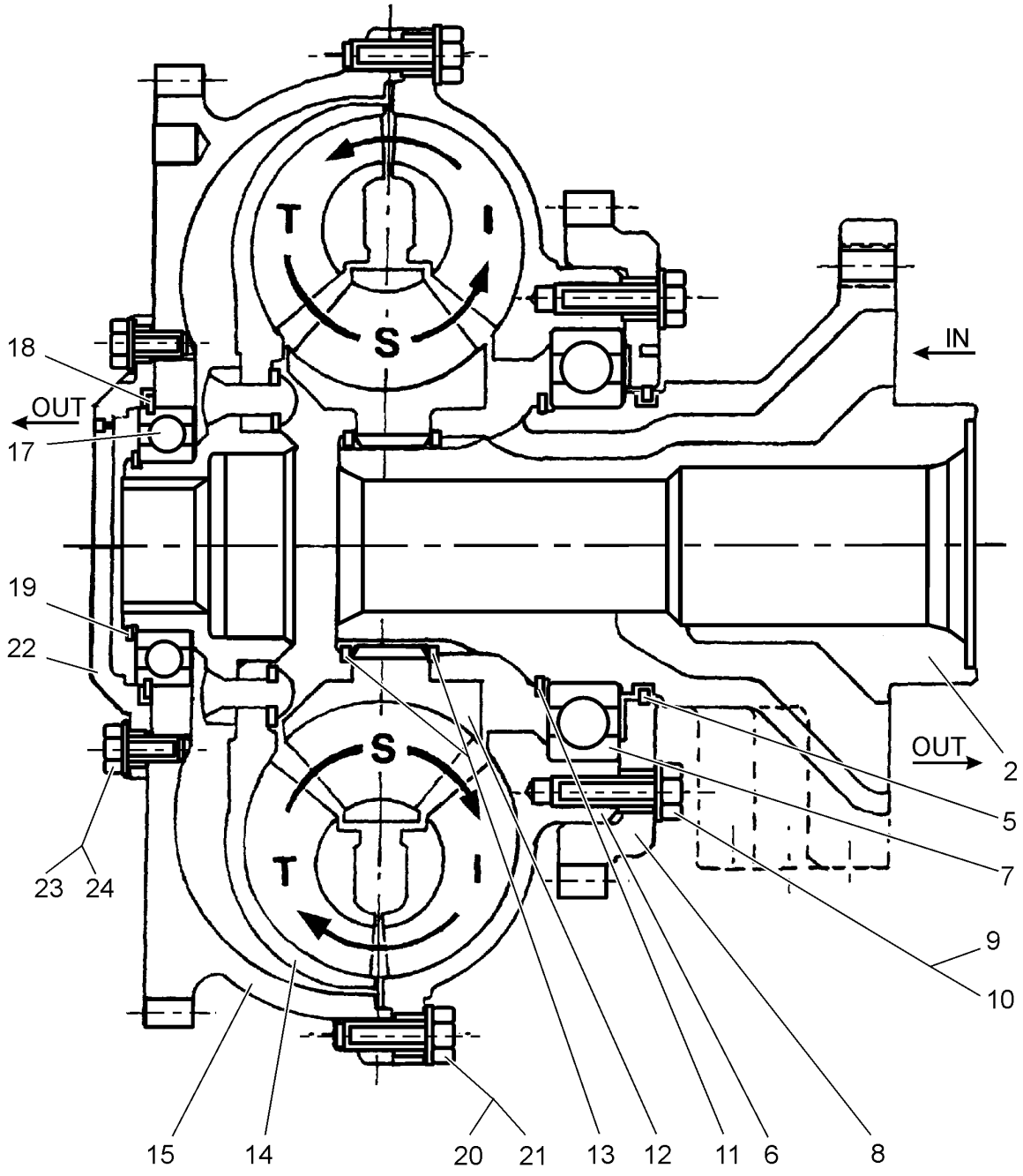


Fig. 7B.1. Cross Section of Torque Converter

GENERAL

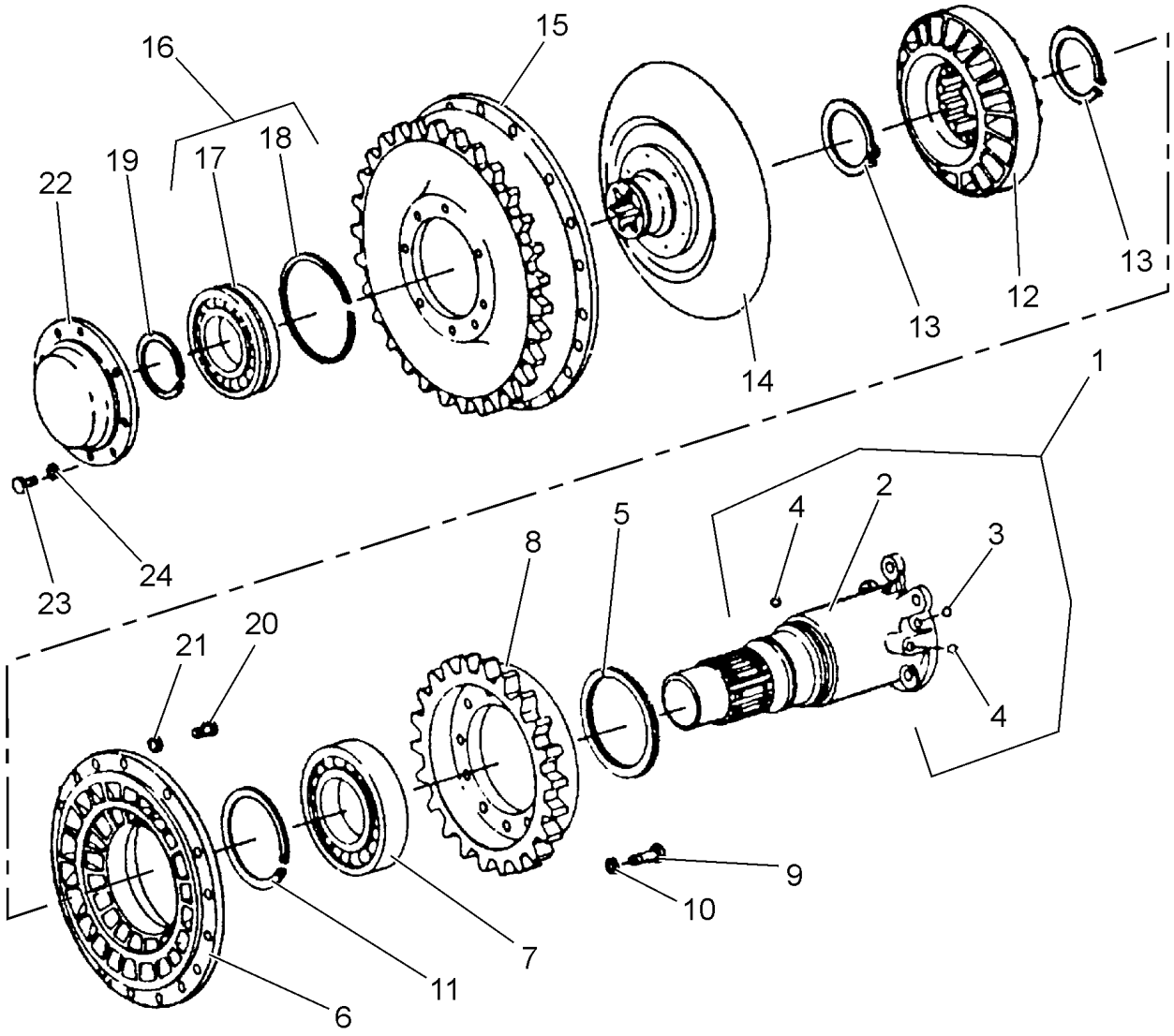


Fig. 7B.2. Exploded View of Torque Converter

4. SPECIFICATIONS

Torque converter to transmission housing bolts.....92 [Nm]
Impeller to drive housing bolts.....34÷42 [Nm]
Drive gear to impeller bolts.....34÷42 [Nm]
Front cover to drive housing bolts .....19÷23 [Nm]

TORQUE CONVERTER

GENERAL

5. SERVICE DIAGNOSIS

NOTE: *When an operator complaint is made that affects the converter/transmission hydraulic system, it is recommended that the service diagnosis in SECTION 7C, "TRANSMISSION" also be reviewed to aid in isolating the cause of the problem.*

COMPLAINT	
PROBABLE CAUSE	**REMEDY**
Loss of Power	
1. Machine brakes dragging	1. Check the operation of the service and parking brake
2. Engine problem	2. Refer to the Engine Diagnostic Manual
NOTE: *Loss of power in only one direction or speed range indicates a transmission problem*	
High Torque Converter Oil Temperature (Gauge on Dash)	
1. Faulty temperature gauge or sending unit	1. Replace
2. Improper machine operation	2. Operate in the proper gear range. Refer to the Operator's Manual
3. Low oil level	3. Fill to proper level. Refer to the Operator's Manual. Check for external leakage
4. High Oil level	4. Can be detected by foamed oil
NOTE: *If foaming of the oil still occurs after the proper level is established, check for an air leak between the transmission sump and charging pump. Refer to "TEST AND ADJUSTMENTS."*	
5. Torque Converter Overheating See SERVICE DIAGNOSIS in SECTION 7	5. Check the condition of the pump and replace if necessary. Refer to "TEST AND ADJUSTMENTS" under "CHARGING PUMP"
6. Loss of Power see SERVICE DIAGNOSIS in SECTION 7	6. Isolate problem and clean, replace or repair parts as necessary. Refer to "CONVERTER LEAKAGE CHECK" under "TESTS AND ADJUSTMENTS
Excessive Noise	
1. Flywheel drive ring bolts loose	1. Replace drive ring and bolts
2. Worn teeth on drive housing or drive ring	2. Replace rotating drive or drive ring
3. Bearing failure	3. Overhaul torque converter

6. TEST AND ADJUSTMENTS



CAUTION! Apply the parking brake. Lock the frame halves in the straight position with the frame locking bar. Adequately block the machine to prevent movement.

Suction Line Leak Check

1. Coat all suction lines and connections with shaving cream.
2. Operate the machine in neutral and observe the shaving cream.
3. If a leak is present, a crater will form in the shaving cream at the location of the leak.

TORQUE CONVERTER

7. REMOVAL

1. Remove the transmission as described under "TRANSMISSION"
2. Steam clean the transmission to remove external dirt.
3. Remove the converter charging pump-to-sump strainer tube.
4. Attach a hoist with lifting device to the torque converter as shown in Fig. 7B.3.
5. Remove the converter housing to transmission mounting bolts.
6. Install a jack screw ½"-13x2-½" (2) in the hole provided and separate the converter from the transmission.
7. Cover the transmission to protect against the entry of dirt.

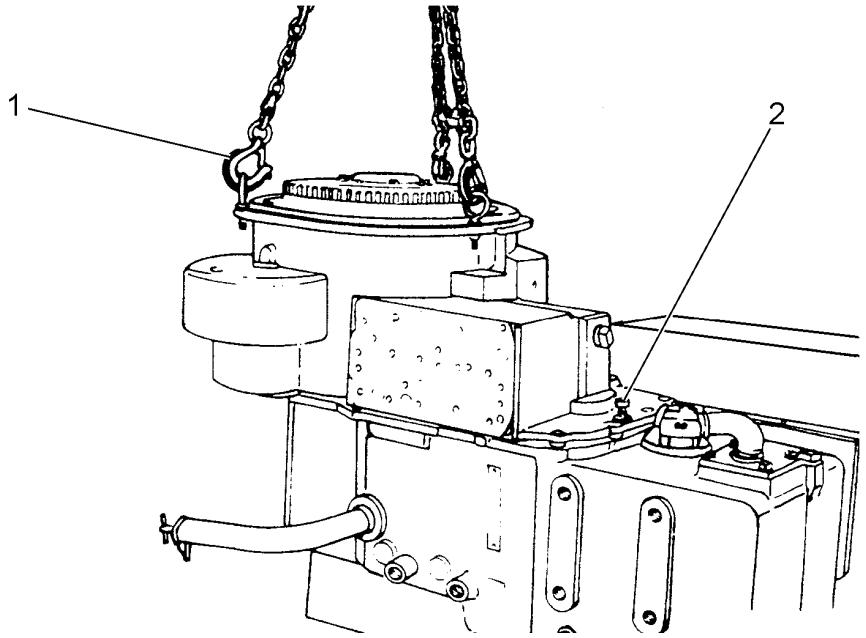


Fig. 7B.3. Separating the Torque Converter from the Transmission

1. Lifting Device
2. Jack Screw

8. DISASSEMBLY (Fig. 7B.1 and 7B.2)

1. Remove the converter charging pump and the double hydraulic supply pump from the converter.
2. Remove the bolts securing sleeve assy (1) to the converter housing.
3. Remove front cover (22). Attach and secure a lifting device using two removed bolts to the impeller/turbine assembly as shown in Fig. 7B.4. Lift the assembly from the housing.
4. Match mark drive housing (15) with impeller (6). Attach the lifting device to eye bolts as shown in Fig. 7B.5. Remove bolts (20) and separates the drive housing and impeller. It may be necessary to tap the drive case with a soft faced hammer as shown in Fig. 7B.5.
5. Remove the retaining ring (18) that retains bearing (17) to drive housing (15). Separate the drive housing from turbine (14).
6. Remove retaining ring (19). Using a puller remove bearing (17) from the turbine as shown in Fig. 7B 6.

TORQUE CONVERTER

TORQUE CONVERTER

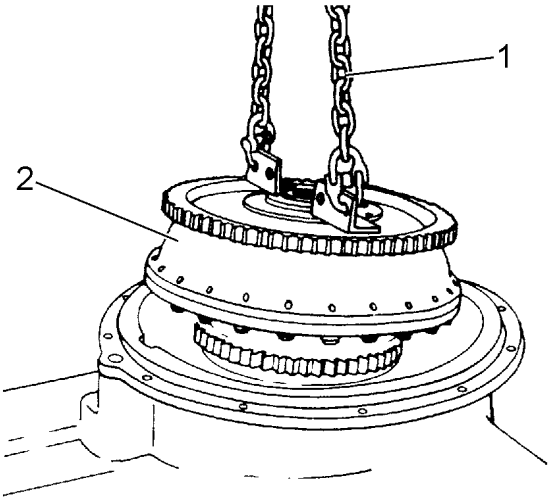


Fig. 7B.4. Removing Impeller/Turbine Assembly

1. Lifting Device
2. Impeller/Turbine Assembly

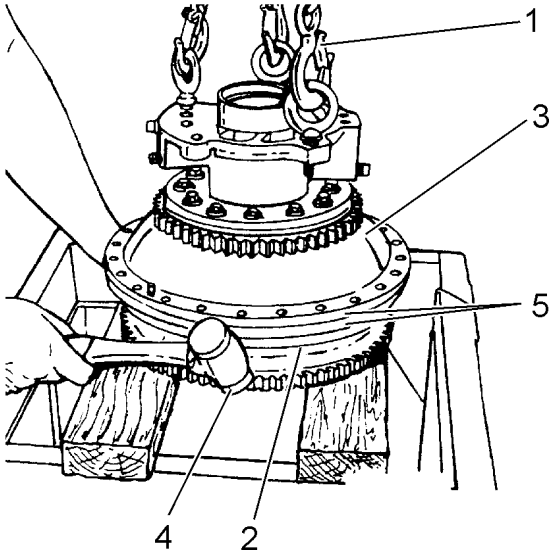


Fig. 7B.5. Separating Drive Housing and Impeller

1. Lifting Device
2. Drive Housing
3. Impeller
4. Soft Faced Hammer

7. Remove retaining ring (13), stator (12), retaining ring (13) and retaining ring (11) from the sleeve assy (1).
8. Remove bolts (9) and separate impeller (6) from drive gear (8).

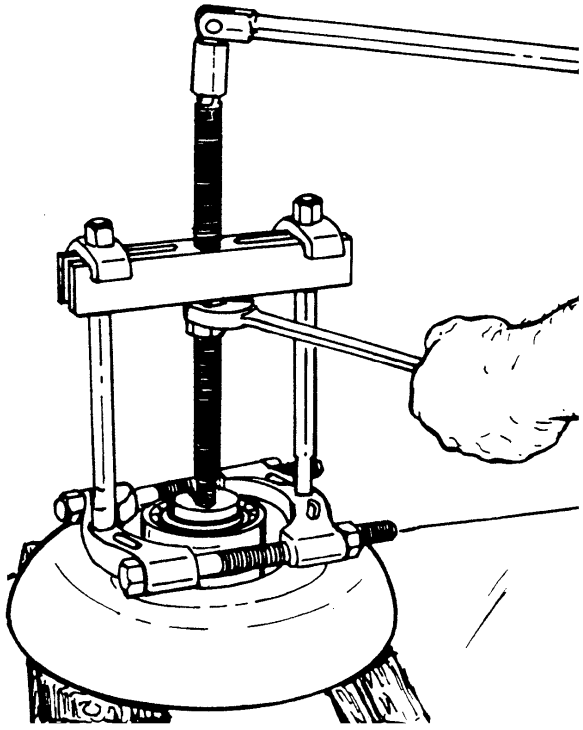


Fig. 7B.6. Removing Turbine Bearing

TORQUE CONVERTER

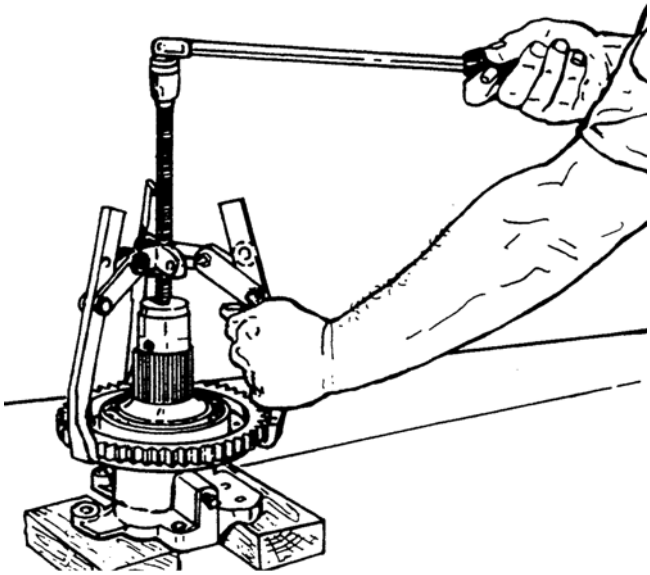


Fig. 7B.7. Removing Drive Gear and Bearing

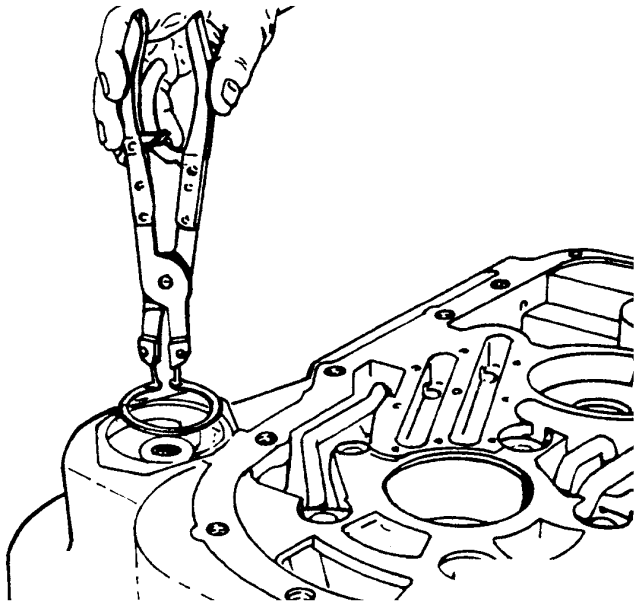


Fig. 7B.8. Removing Drive Gear Hub Retaining Ring

9. Using a puller remove bearing (7) and the drive gear together as shown in Fig. 7B.7.
10. Remove seal ring (5).
11. Remove the retaining ring securing the converter charging pump drive gear hub. Refer to Fig. 7B.8.
12. Lift the hub from the gear.
13. Remove the bolt securing the drive gear bearing retainer. Refer to Fig. 7B.9.
14. Remove the drive gear as shown in Fig. 7B.10.

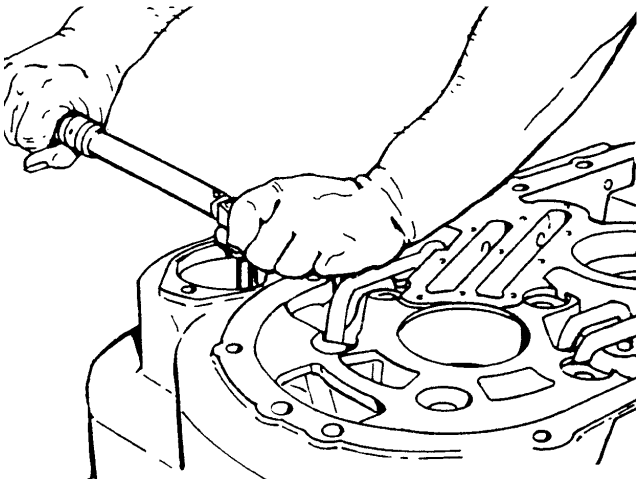


Fig. 7B.9. Removing Bearing Retainer Bolt

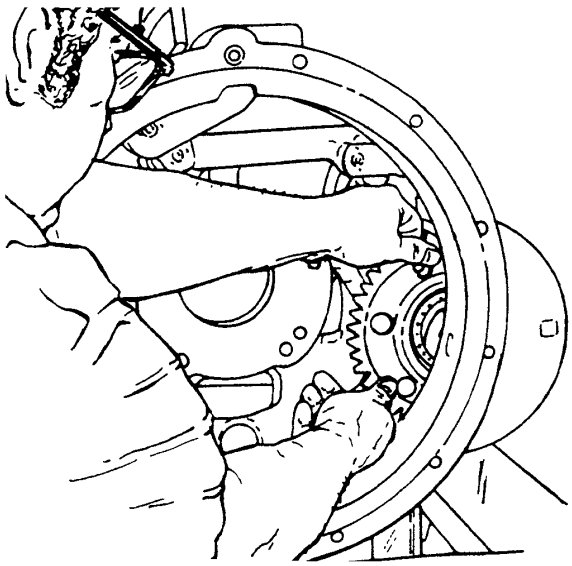


Fig. 7B.10. Removing Drive Gear

15. Press the bearing retainer (1, Fig. 7B.11) from bearing (3).
16. Remove snap ring (2) and press the bearing from the drive gear (4).
17. Remove and disassemble the loader hydraulic supply pumps drive gear in the same manner as the converter charging pump drive gear.
18. Remove seal ring (1, Fig. 7B.12) and O-ring (2) from the converter housing.

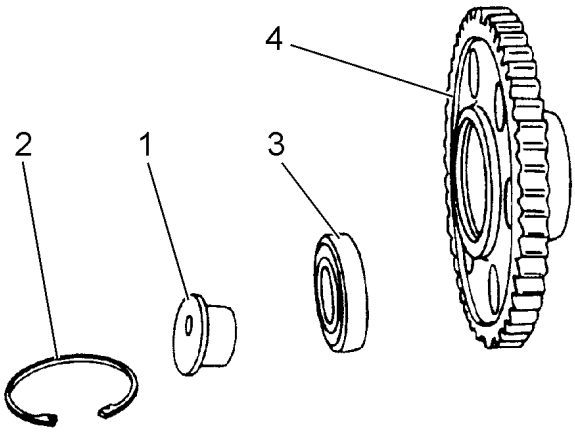


Fig. 7B.11. Accessory Drive Gear Assembly

1. Bearing Retainer
2. Snap Ring
3. Bearing
4. Drive Gear

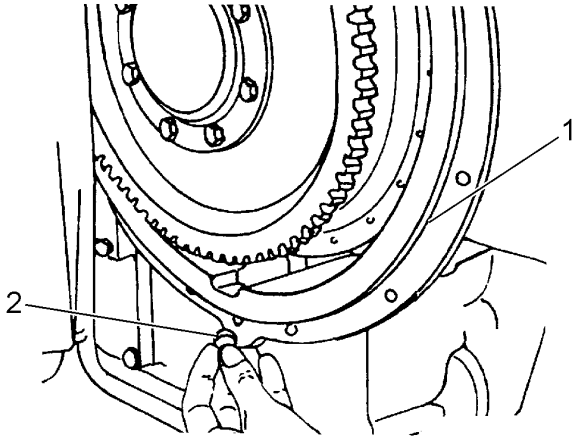


Fig. 7B.12. Converter Housing Seal Ring and O-Ring

1. Seal Ring
2. O-Ring

9. INSPECTION AND REPAIR

1. Clean all parts thoroughly in a commercial cleaning solvent and dry with compressed air. Be sure to flush the housing tubes thoroughly.
2. Discard all gaskets, seals and O-rings and replace with new.
3. Inspect bearings for flaking, cracks, scoring, nicks or excessive wear. Replace if necessary.
4. Inspect cast parts for cracks. Check bearing bores for wear, grooves and scratches. Replace all cracked or worn parts.
5. Inspect gear teeth for damage. Remove minor burrs with a fine stone or file.

10. REASSEMBLY (Fig. 7B.1 and 7B.2)

1. Coat seal ring (5) with grease and install on sleeve (2).

NOTE: *Lubricate all parts while assembling.*

2. Install drive gear (8) on the sleeve assy (1) as shown in Fig. 7B.13.
3. Install bearing (7). It is recommended that the bearing be heated to facilitate installation. Install retaining ring (11). Refer to Fig. 7B.14.

TORQUE CONVERTER

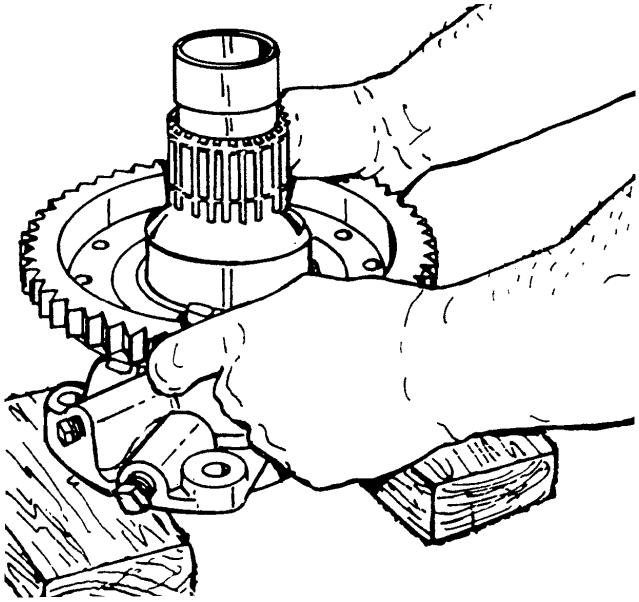


Fig. 7B.13. Installing Drive Gear on Sleeve

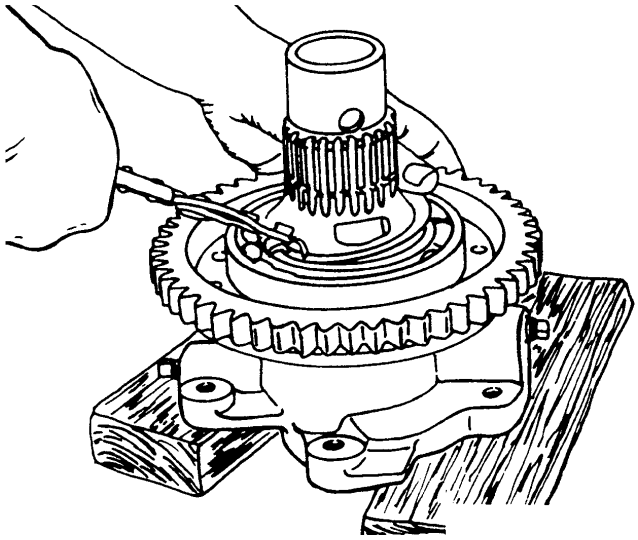


Fig. 7B.14. Installing Bearing Retaining Ring

4. Install two dowels in impeller (6) as shown in Fig.7B.15. Install the impeller (6), retaining ring (13), stator (12) and retaining ring (13) on the sleeve assy (1).
5. Remove the aligning dowels from the impeller (6). Install mounting hardware (9 and 10). Torque the bolts to 34÷42 [Nm].

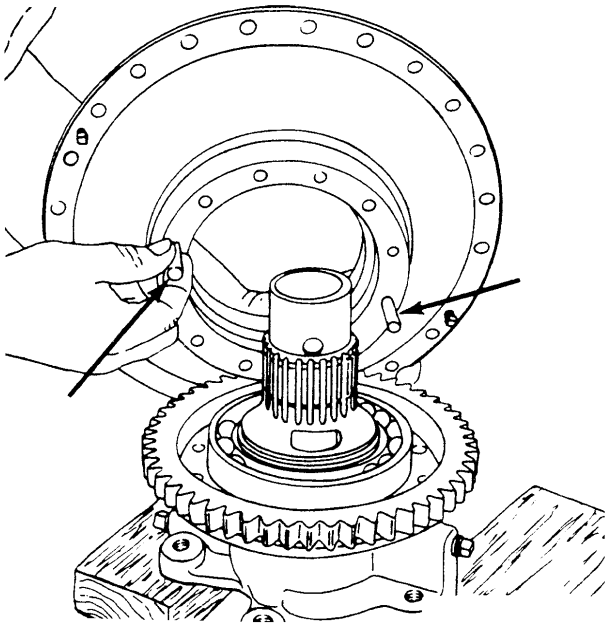


Fig. 7B.15. Aligning Dowels for Impeller Installation

TORQUE CONVERTER

TORQUE CONVERTER

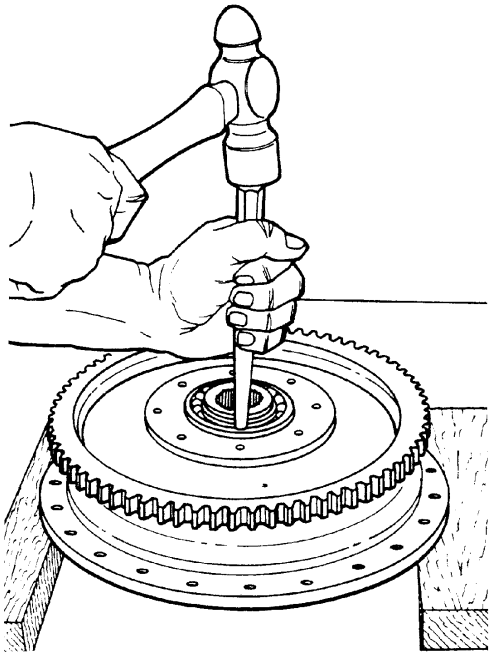


Fig. 7B.16. Seating Turbine Bearing Retaining Ring

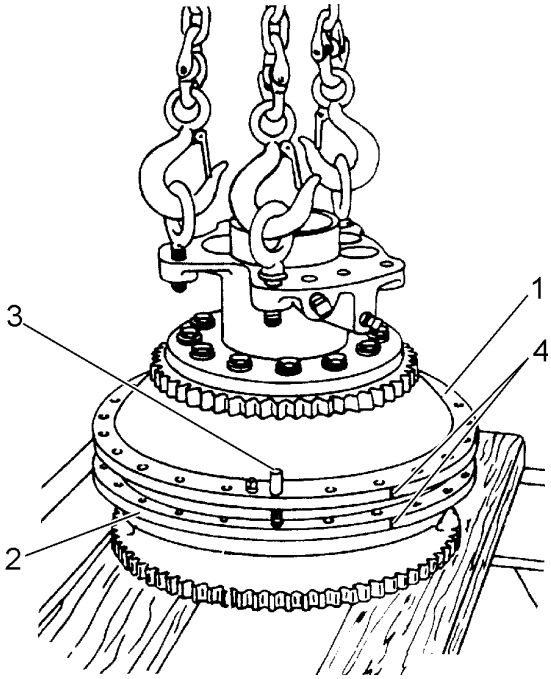


Fig. 7B.17. Assembling Impeller and Drive Housing

1. Impeller
2. Drive Housing
3. Aligning Dowel
4. Match Mark

6. Install bearing (16) on the turbine (14). It is recommended that the bearing be heated to facilitate installation.
7. Place drive housing (15) over the turbine and secure with retaining ring (18). Be sure the retaining ring is fully seated in the bearing by tapping it with a punch as shown in Fig. 7B.16.
8. Install aligning dowels in impeller (6). Assemble the impeller using eyebolt ½"-13x1-¼" to the drive housing (15); be sure the match marks are aligned. Refer to Fig. 7B.17.
9. Remove the aligning dowels and install mounting hardware (20 and 21). Torque the bolts to 34÷42 [Nm].
10. Install retaining ring (19) and front cover (22). Secure the cover with mounting hardware (23 and 24). Torque the bolts to 19÷23 [Nm].
11. Install aligning dowels in the sleeve (2) and install the turbine impeller assembly using eyebolt 5/15"-18x ½". Refer to Fig. 7B.18. It may be necessary to rotate the accessory gears so they mesh with the drive gear.
12. Remove the aligning dowels and install the sleeve mounting bolts. Torque the bolts to 92 [Nm].
13. If removed, install cover (2, Fig. 7B.19) with a new gasket (3). Use LOCTITE 262 and torque bolts (1) to 11÷13 [Nm].
14. Using new O-rings install the converter charging pump and the double hydraulic supply pump. Torque the bolts to 34÷42 [Nm].
15. Install converter housing seal ring (1) Fig. 7B.12 and O-ring (2).

TORQUE CONVERTER

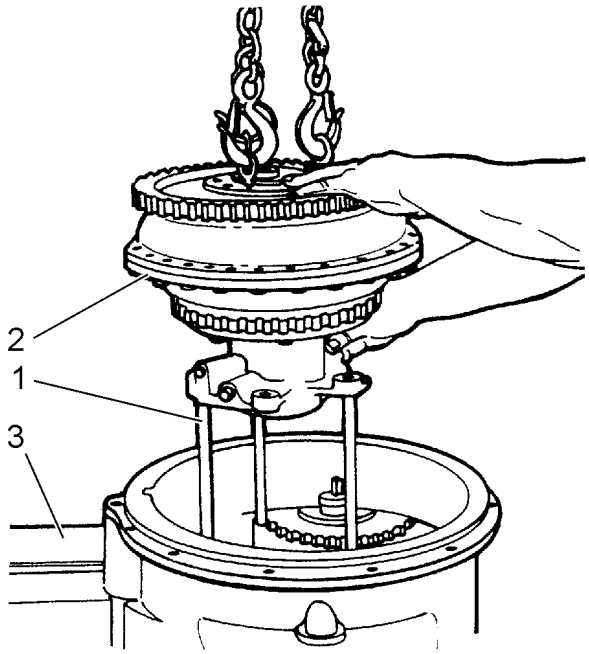


Fig. 7B.18. Installing Turbine/Impeller Assembly

1. Aligning Dowels
2. Turbine/Impeller Assembly
3. Torque Converter Housing

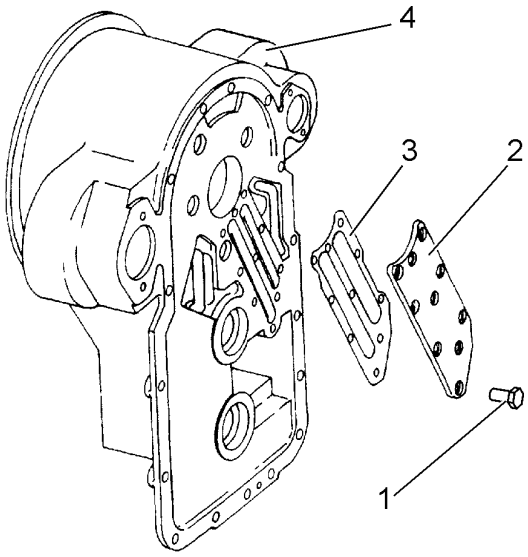


Fig. 7B.19. Torque Converter Housing

1. Bolt
2. Cover
3. Gasket
4. Housing

11. INSTALLATION

1. Replace the clutch pack shaft seal rings as described in SECTION 7C, "TRANSMISSION".
2. Apply LOCTITE 515 to the mating surfaces of the transmission housing and converter housing. Torque the bolts to 85÷100 [Nm].
3. Lubricate the clutch pack shaft seal rings with grease.
4. Install the sump strainer to converter charging pump tube.
5. Install the transmission assembly in the machine as described in SECTION 7C, "TRANSMISSION".

SECTION 7C

TRANSMISSION

TRANSMISSION

SECTION 7C

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PRESSURE REGULATOR VALVE (520G ONLY)

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SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS

1. Bearing cup driver tool..... 21.547.0131
2. Seal ring driver tool 8N54-78/95-130
3. Clutch shaft driver tool..... 21.547.0076
4. Bearing driver tool 21.547.0123
5. Retaining ring pliers.....RSKm-200
6. Retaining ring pliers.....RSKn-200
7. Two cap screws.....1/4x2-1/2 ["]

GENERAL

2. DESCRIPTION

The transmission and torque converter is an integral unit mounted to the rear of the engine and to the rear frame of the machine.

The transmission is three speeds, full power shift, constant mesh and counter design. The major components of the transmission are: the directional clutch, gear range (1) clutch, gear range (2/3) clutch, reverse idler gear and output shaft.

3. THEORY OF OPERATION

The rotational torque picked up by torque converter is delivered directly to the transmission by the converter output/transmission input shaft (8, Fig. 7C.1).

All three clutches are similar in design and operation. The following is a description of the directional clutch (5).

The housing and cylinder are welded together making the drum clutch, which is shrink fitted on the shaft.

The separator plates (14, Fig. 7C.2) are splined to the shaft causing the shaft and separator plates to rotate together. The friction discs (12) positioned between separator plates (14) are splined to the forward driver gear (2) or the reverse driver gear (3). These gears are free to rotate on the shaft.

Description to Fig. 7C.1:

1. Torque Converter
2. Housing with Tubes
3. Dowel Pin
4. Forward Driver Gear
5. Directional Clutch
6. Housing with Shaft
7. Reverse Driver Gear
8. Input Shaft
9. Reverse Idler Gear
10. Gear Range (1) Clutch
11. Gear Range (1) Drum
12. Gear
13. Gear
14. Gear Range (2/3) Clutch
15. Cover
16. Gear
17. Gear
18. Bolt
19. Yoke
20. Gear
21. Strainer
22. Output shaft
23. Yoke
24. Torque Converter Mounting Bolts
25. Gear Shroud

GENERAL

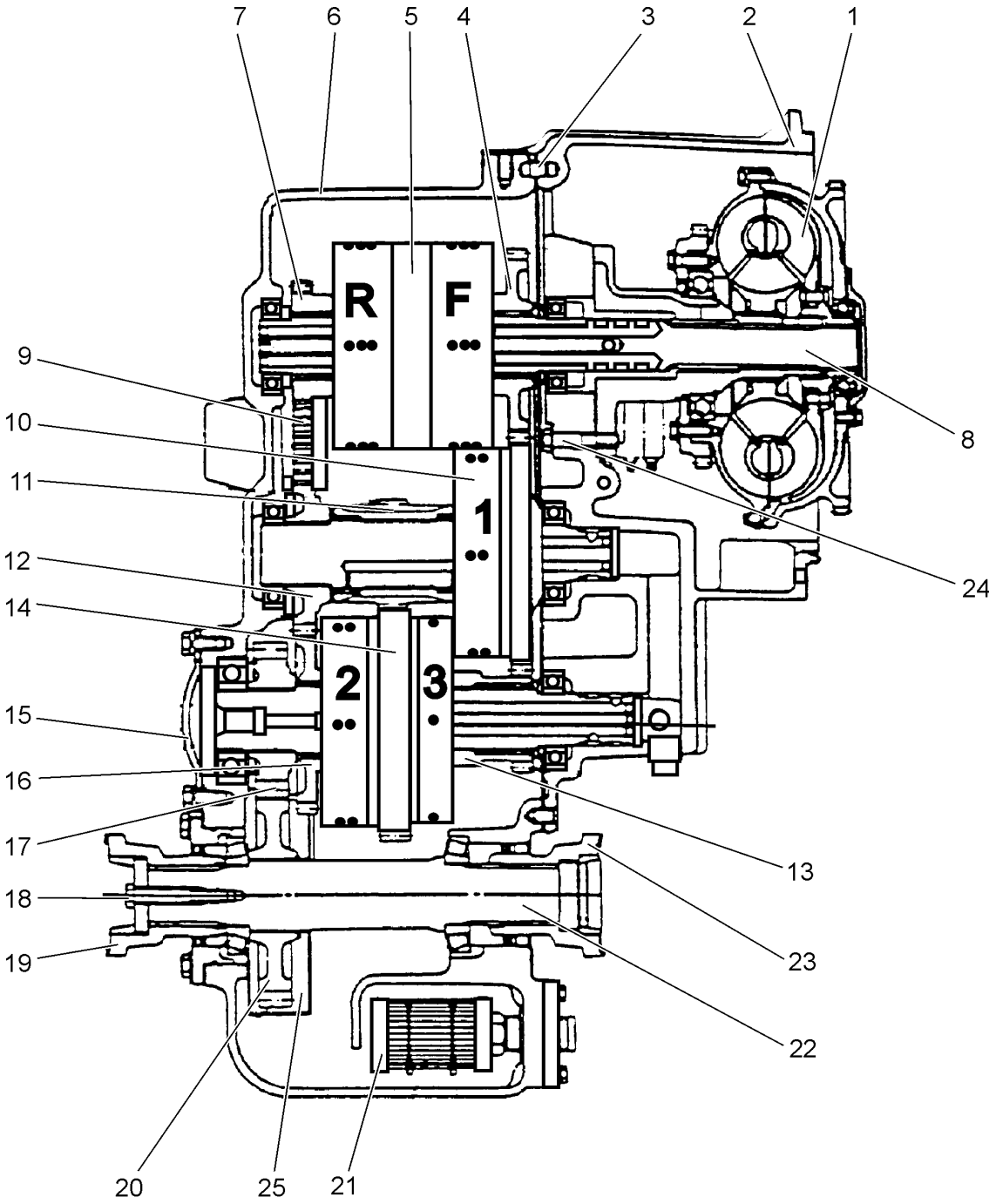


Fig. 7C.1. Transmission/Torque Converter Cross Section

When the transmission is in neutral the spring rings (16) retract the directional piston (9) and separate the separator plates from the friction discs.

When the transmission is in forward, oil enters behind the directional piston from oil passage (B) in the input shaft, actuating the piston. This couples the forward clutch separator plates with the friction discs causing the forward driver gear (2) to rotate clutch drum/shaft (1). Then shifted to "reverse" oil is delivered through passage (C) causing reverse driver gear (3) to engage with the shaft in the same manner.

The oil flowing through passage (A) lubricates bearings (4) and aids in cooling the clutches.

GENERAL

When first speed is selected, power is delivered to the output shaft (22, Fig. 7C.1) through the gear located between the second and third clutches, to the output shaft. Under this condition the gears (13 and 16) free wheel on shaft.

When second speed is selected the clutch on the rear of shaft is engaged and power is transmitted to the output shaft through the gear (16). The forward clutch on shaft engages when third is selected transmitting power through gear (13). Refer to Fig. 7C.3 for a power flow diagram of each speed. Refer to TORQUE CONVERTER for a description of the torque converter function.

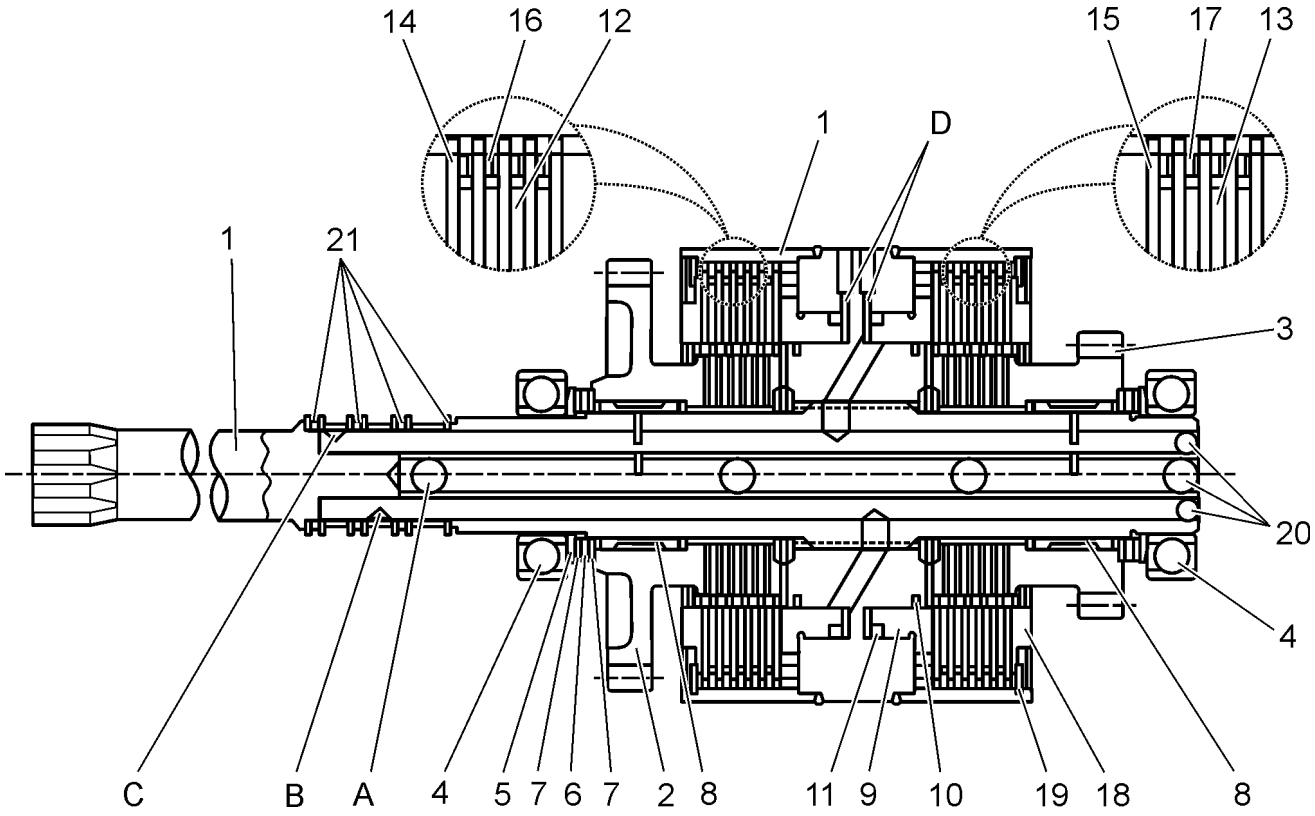


Fig. 7C.2. Directional Clutch Pack Assembly Cross Section

1. Clutch Drum/Shaft
2. Forward Driver Gear
3. Reverse Driver Gear
4. Ball Bearing
5. Thrust Washer
6. Thrust Bearing
7. Thrust Ring
8. Needle Bearing
9. Directional Piston
10. Seal Ring
11. Seal Ring
12. Friction Disc
13. Friction Disc
14. Separator plate
15. Separator plate
16. Spring Ring
17. Spring Ring
18. Clutch Support Plate
19. Retaining Ring
20. Ball
21. Seal Ring

A. Lube Oil Inlet
B. Oil Passage for Forward Clutch
C. Oil Passage for Reverse Clutch

4. SPECIFICATION

Transmission

Transmission type ..... Countershaft, constant mesh
Speeds ..... Three forward, three reverse
Clutches..... Multiple disc, oil cooled

Directional Clutch

Reverse clutch
- Number of friction discs (internally splined clutch plates) 9
- Number of separator plates (externally splined clutch plates) 10
- Number of spring rings 18
- Thickness of friction disc..... 1.73÷1.88 [mm]
- Thickness of separator plate..... 1.63÷1.73 [mm]

Forward clutch
- Number of friction discs (internally splined clutch plates) 9
- Number of separator plates (externally splined clutch plates) 10
- Number of spring rings 18
- Thickness of friction disc..... 1.73÷1.88 [mm]
- Thickness of separator plate..... 1.63÷1.73 [mm]

Range Clutch

First speed clutch
- Number of friction discs (internally splined clutch plates) 5
- Number of separator plates (externally splined clutch plates) 6
- Number of spring rings 10
- Thickness of friction disc..... 1.73÷1.88 [mm]
- Thickness of separator plate..... 1.63÷1.73 [mm]

Second speed clutch
- Number of friction discs (internally splined clutch plates) 6
- Number of separator plates (externally splined clutch plates) 7
- Number of spring rings 12
- Thickness of friction disc..... 1.73÷1.88 [mm]
- Thickness of separator plate..... 1.63÷1.73 [mm]

Third speed clutch
- Number of friction discs (internally splined clutch plates) 3
- Number of separator plates (externally splined clutch plates) 4
- Number of spring rings 6
- Thickness of friction disc..... 1.73÷1.88 [mm]
- Thickness of separator plate..... 1.63÷1.73 [mm]

Special Bolt and Nut Torque Data

Transmission bracket to frame fastening bolts ..... 250÷300 [Nm]
Transmission bracket to transmission fastening bolts ..... 140÷170 [Nm]
Transmission housing mounting bolts..... 85÷100 [Nm]
Transmission to engine mounting bolts ..... 40÷50 [Nm]
Yoke retainer nut..... 100÷120 [Nm]

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

GENERAL

Springs

	Free Length [mm]	Text Length [mm]	Test Load [N]	Number of Coils
Pressures Regulator Valve				
Lube Spool Spring	67.06	50.80	65÷78	11
Torque Converter Spool Spring	64.77	50.80	169÷195	10
Main Spool Ball Spring	21.13	15.42	75÷84	7
Main Spool Inner Spring	49.6	35.10	193÷207	12.5
Main Spool Outer Spring	80.82	52.45	483÷527	12.5
Control Valve				
Emergency Control Spring	62.71	25.27	98÷107	12
Return Spring	71.27	47.09	114÷126	11.5
Return Spring	64.67	47.09	98	10.5
Inner Spring	92.63	70.15	556÷614	18
Outer Spring	96.14	73.71	1085÷1147	12.5
Regulator Spool Spring	41.17	16.99	376÷416	4
Ball Spring	17.60	10.59	0.5÷0.7	20
Pressure Regulator Valve				
Inner Spring	66.22	46.56	228÷242	15
Outer Spring	89.45	61.54	560÷586	14.5
Ball Spring	23.37	13.97	22÷27	12

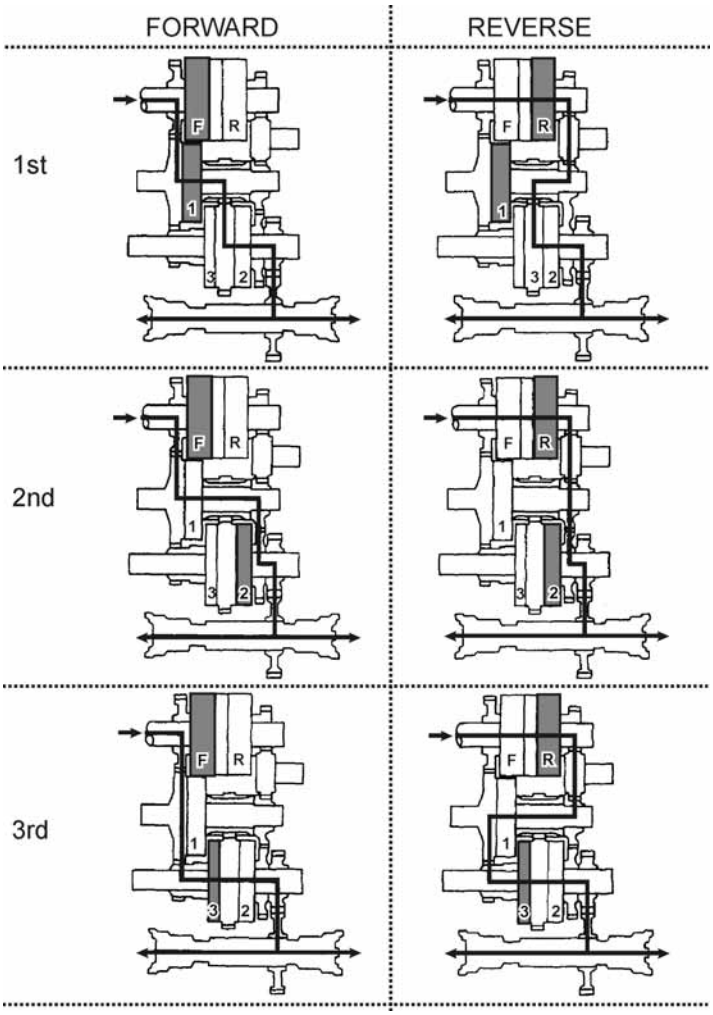


Fig. 7C.3. Transmission Power Flow

TRANSMISSION

5. REMOVAL

WARNING! Before servicing the machine be sure the bucket is lowered, the engine is off, the parking brake is applied, the transmission shifter is locked in neutral (N), the electrical system master switch is off and the keys are removed from master switch and from starting switch.

WARNING! Always lock the frames together before working near the center of the machine. If the frames move, serious injury or death could result.

IMPORTANT: *Before removing the transmission, check all oil pressures as described in Section 7, CHECKING TRANSMISSION AND TORQUE CONVERTER PRESSURES.*

IMPORTANT: *Disconnected 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 as this could introduce foreign material into the system. Tag all disconnected lines for ease of correct installation.*

NOTE: *The engine and transmission combined weights approximately 1000 [kg].*

1. Remove the transmission lower guard from under machine. Remove the transmission upper guards.
2. Drain the oil from the hydraulic reservoir and the transmission. Refer to the OPERATOR'S MANUAL for these procedures.
3. Remove pre-cleaner assy (1, Fig. 7C.4) and exhaust outer tube (9).

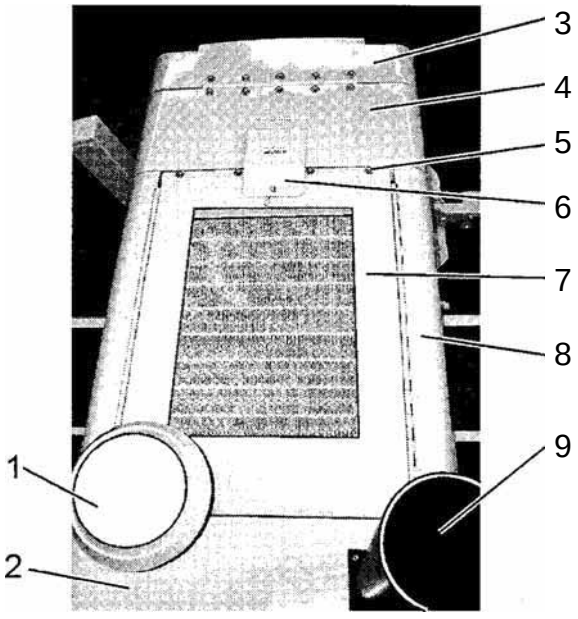


Fig. 7C.4. Engine Compartment Hood

1. Pre-cleaner Assy
2. Hydraulic Reservoir
3. Rear Guard
4. Radiator Guard
5. Bolt
6. Cover
7. Upper Guard
8. Guard
9. Exhaust Outer Tube

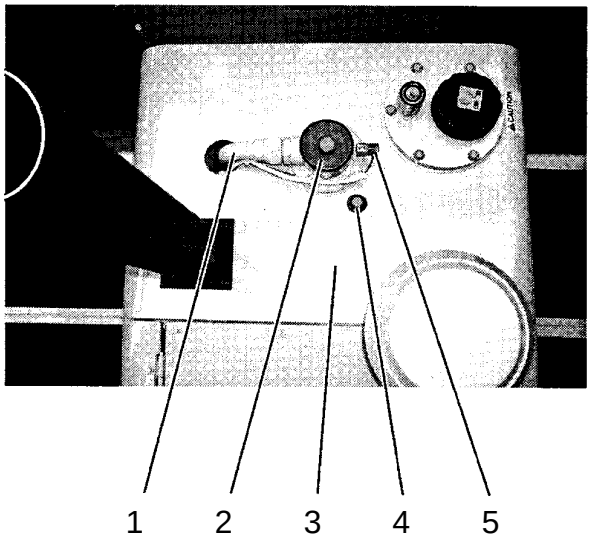


Fig. 7C.5. Hydraulic Reservoir

1. Inlet Tube
2. Return Oil Filter
3. Hydraulic Reservoir
4. Filter Contamination Switch
5. Bolt and Washer

TRANSMISSION

4. Disconnect two gas springs from the hydraulic reservoir (2) and two gas springs from the radiator guard (4). Open the cover (6) and unscrew bolts (5) and remove upper guard (7) with two guards (8). Remove radiator guard (4) with rear guard (3) from machine.
5. MACHINES EQUIPPED WITH ETHER START: Disconnect two cables from solenoid valve.
6. Disconnect the hydraulic reservoir inlet tube (1, Fig. 7C.5) at the reservoir return filter (2) and the outlet tube at the bottom of the reservoir (3). Disconnect cable from the switch (4). Disconnect the tubes at the double hydraulic pump (1, Fig. 7C.6).
7. Remove the bolt and washer (5, Fig. 7C.5) from the top of the hydraulic reservoir (3) and install a lifting eyebolt in the threaded hole ¾"-10UNC-2B. Secure a hoist to the lifting eye and remove the slack. Remove mounting hardware and lift the hydraulic reservoir (3) from the machine.
8. Disconnect the tubes from the drive train pump (3, Fig. 7C.6). Unscrew the bolts and remove double hydraulic pump (1), drive train pump (3) and filler tube (6) from the transmission (2).

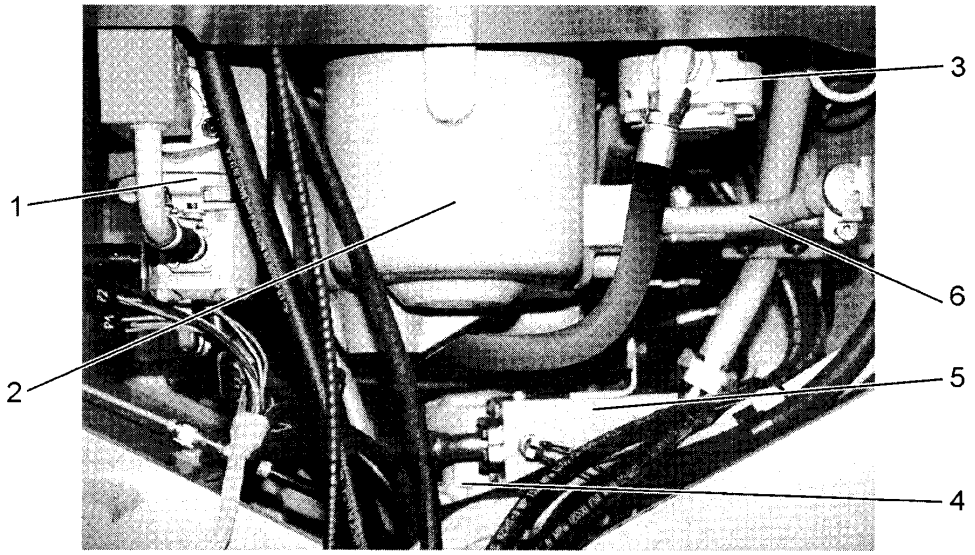


Fig. 7C.6. Hydraulic Pump and Drive Train Pump

1. Hydraulic Pump
2. Transmission
3. Drive Train Pump
4. Ground Driven Steering Pump
5. Block
6. Filler Tube

9. Disconnect the oil cooler hoses, and all wires from the transmission. Tag the wires for correct installation.
10. Disconnect the brake booster hoses (only 520G).
11. Disconnect the drive shafts as described in Section 7D.
12. MACHINES EQUIPPED WITH GROUND DRIVEN STEERING: Disconnect hoses from ground driven steering pump (4) and from the block (5). Remove block (5) with bracket and pump (4).
13. Install a lifting eyebolt in the threaded hole ¾"-10UNC-2B located in the top of the transmission housing.
14. Remove bolts securing the transmission brackets to the rear frame. Remove radiators assy and engine with transmission from the machine as described in Section 12.
15. Remove bolts securing the transmission to the engine flywheel housing. Move the transmission away from the engine. Cover the engine flywheel housing to prevent the entry of dirt.

TRANSMISSION

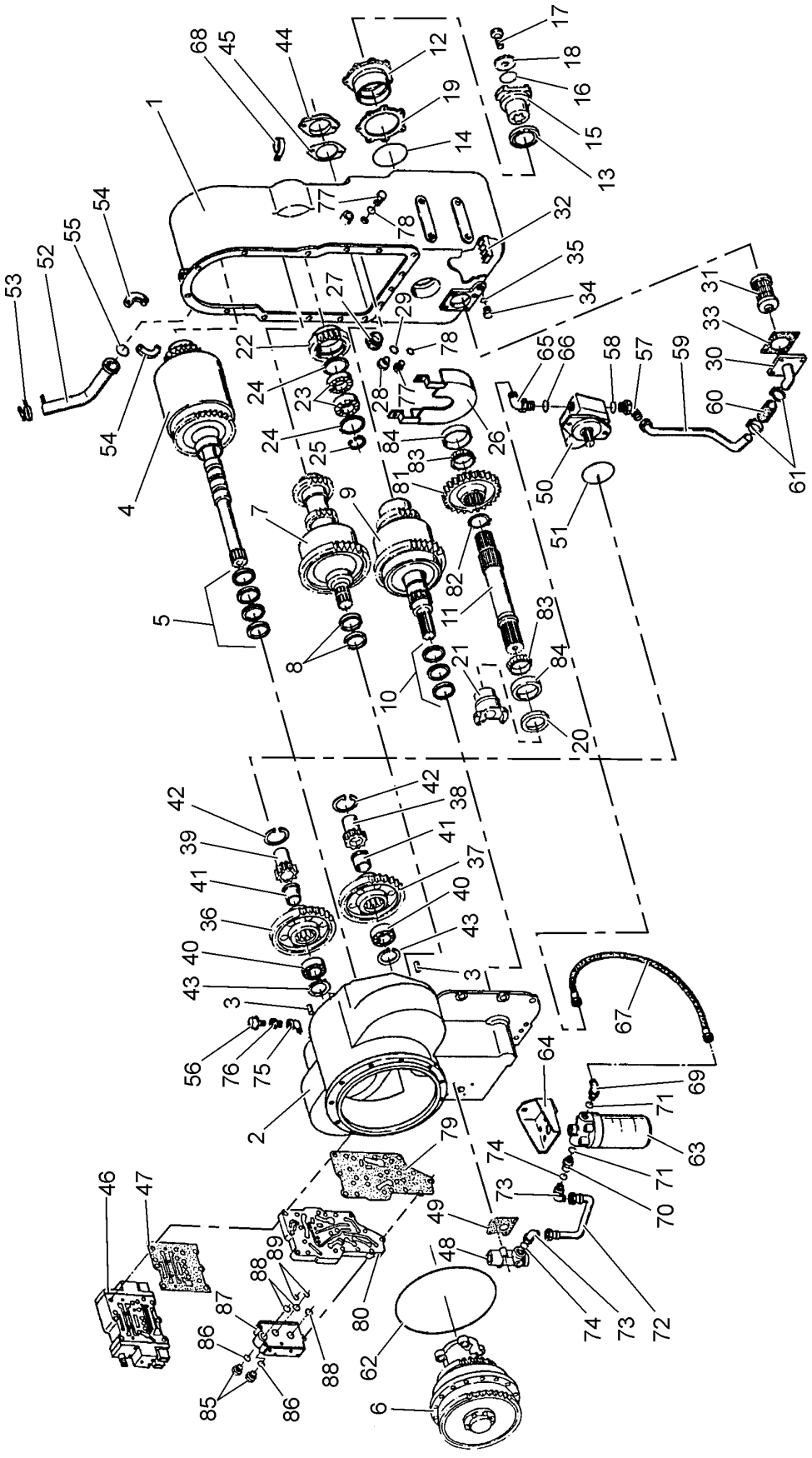


Fig. 7C.7. Transmission/Torque Converter Exploded View

TRANSMISSION

Description to Fig. 7C.7:

1. Housing with Shaft
2. Housing with Tubes
3. Dowel Pin
4. Directional Clutch
5. Seal Ring
6. Torque Converter
7. Gear Range (1) Clutch
8. Seal Ring
9. Gear Range (2)/(3) Clutch
10. Seal Ring
11. Output shaft
12. Cover
13. Seal Ring
14. O-ring
15. Yoke
16. O-ring
17. Bolt
18. Plate
19. Shims
20. Seal Ring
21. Yoke
22. Reverse Idler Gear
23. Ball Bearing
24. Retaining Ring
25. Retaining Ring
26. Gear Shroud
27. Sight Gauge
28. Sight Gauge
29. O-ring
30. Connector
31. Strainer
32. Magnet
33. Gasket
34. Plug
35. O-ring
36. Gear
37. Gear
38. Pump Shaft
39. Pump Shaft
40. Ball Bearing
41. Sleeve
42. Retaining Ring
43. Retaining Ring
44. Cover
45. Gasket
46. Control Valve
47. Gasket
48. Pressure Regulator Valve
49. Gasket
50. Drive Train Pump
51. O-ring
52. Filler Tube
53. Filler Cup
54. Split Flange
55. O-ring
56. Breather
57. Elbow
58. O-ring
59. Suction Tube
60. Connecting Hose
61. Clamp
62. O-ring
63. Pressure Filter
64. Bracket
65. Elbow
66. O-ring
67. Hose
68. Clip
69. Elbow
70. Connector
71. O-ring
72. Tube
73. Elbow
74. O-ring
75. Elbow
76. Connector
77. Plug
78. O-ring
79. Gasket
80. Plate Assy
81. Gear
82. Retaining Ring
83. Bearing Cone
84. Bearing Cup
85. Plug
86. O-ring
87. Pressures Regulator Valve
88. O-ring
89. O-ring

6. DISASSEMBLY (Fig. 7C.7)

Basic Transmission Disassembly

1. Steam clean the transmission to remove all external dirt.
2. Secure the transmission in a suitable work stand.
3. Remove transmission mounting brackets. Remove two split flange (54), filler tube (52) with O-ring (55) and filler cup (53).
4. Disconnect hose (67) from the pump (50). Disconnect tube (72) from the pressure regulator valve (48). Remove pressure regulator valve (48) with gasket (49).
5. Remove pressure filter (63) with bracket (64), tube (72) and hose (67).
6. Remove control valve (46) with gasket (47) and pressures regulator valve (87).
7. Remove O-rings (88 and 89) and plate assy (80) with gasket (79). Remove breather (56).
8. Unscrew bolt (17) and remove plate (18), O-ring (16) and yoke (15).
9. Remove tube (59) with hose (60) and clamps (61) from connector (30) and pump (50).
10. Unscrew two bolts and remove drive train pump (50) with O-ring (51) from housing (2).
11. Place the transmission in a horizontal position, torque converter upward.
12. Secure a hoist with lifting device (1, Fig. 7C.8) to the torque converter. Remove the converter mounting bolts. One of them use as a jack screw (2) and install as shown on Fig. 7C.8 and separate the torque converter (6, Fig. 7C.7) with housing (2) from the transmission. Lift this assembly and move it to a clean area.

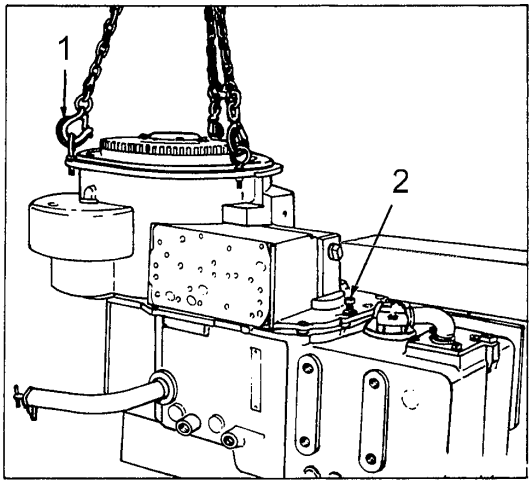


Fig. 7C.8. Removing the Torque Converter

1. Lifting Device
2. Jack Screw

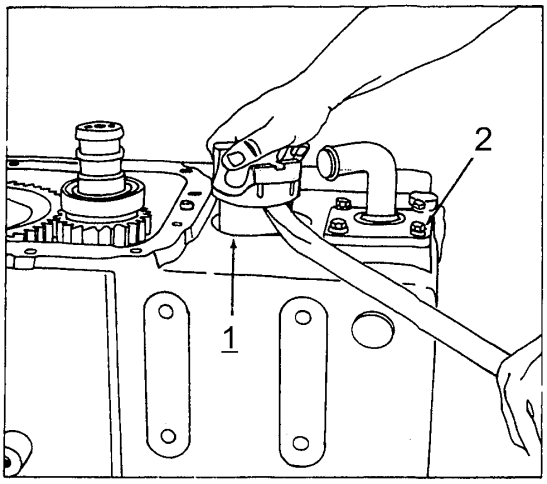


Fig. 7C.9. Removing Output Shaft Yoke and Sump Strainer

1. Yoke
2. Connector

13. Remove retaining ring (42), using pliers RSKm-200 and remove pump shaft (39). Unscrew bolt with washer and remove gear (36). Remove the sleeve (41) and remove retaining ring (43), using pliers RSKn-200. Remove ball bearing (40) from gear (36).
14. Remove the output shaft yoke (1, Fig. 7C.9) and seal ring (20, Fig. 7C.7) form housing (1). Remove connector (2) with gasket (33, Fig. 7C.7) and strainer (31) form housing (1).
15. Lift the gear range (1) clutch (7, Fig. 7C.7) slightly and remove the directional clutch (4). Lift the gear range (2/3) clutch slightly and remove the gear range (1) clutch. Remove the gear range (2/3) clutch last. Remove and wash the magnet (32).
16. Remove the retaining ring (25) using pliers RSKm-200 from the reverse idler gear shaft. Refer to Fig. 7C.10.
17. Using a bearing puller remove the reverse idler gear (22, Fig. 7C.7). Refer to Fig. 7C.11.

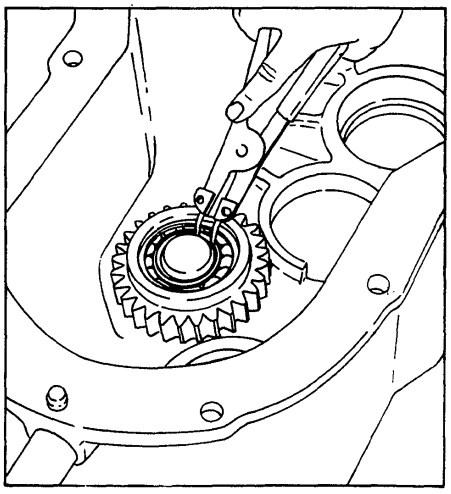


Fig. 7C.10. Removing Reverse Idler Gear Retaining Ring

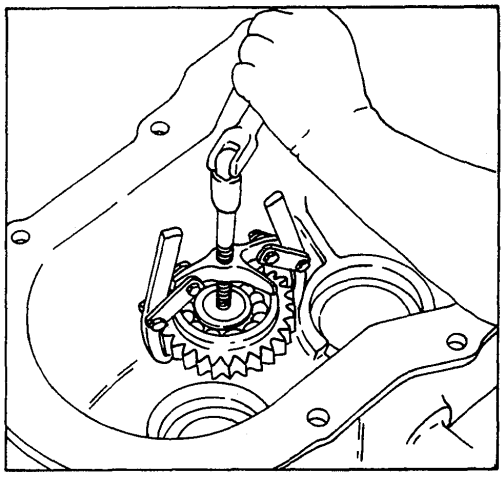


Fig. 7C.11. Removing Reverse Idler Gear

18. Remove two retaining rings (24, Fig. 7C.7) securing the bearings in the reverse idler gear (22). Press two bearings (23) from the gear (22) as shown in Fig. 7C.12.
19. Remove the cover (12, Fig. 7C.7) with shims (19), O-ring (14) and bearing cup (84). Remove output shaft gear shroud (1, Fig. 7C.13).

TRANSMISSION

20. While holding the output shaft (2) remove retaining ring (3) using pliers RSKm-200. Push the shaft through the gear until it clears the top of the housing. Tilt the shaft and gear towards the open portion of the housing and lift it out.
21. Remove two bearing cones (83, Fig. 7C.7) and gear (81) from the shaft (11) as shown in Fig. 7C.14.
22. Remove the bearing cups (84, Fig. 7C.7) from the housing (1) and from the cover (12). Tag the corresponding bearing cones and cups.

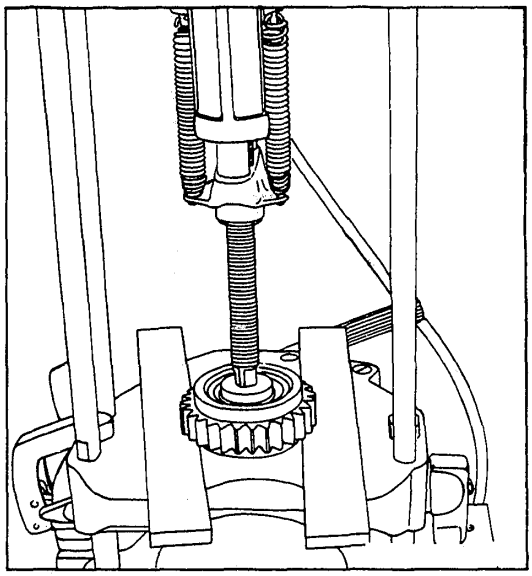


Fig. 7C.12. Removing Reverse Idler Gear Bearings

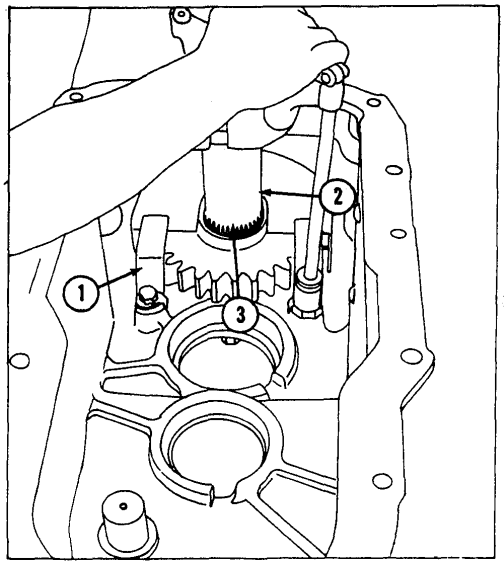


Fig. 7C.13. Output Shaft and Gear Shroud Removal

1. Gear Shroud
2. Output Shaft
3. Retaining Ring

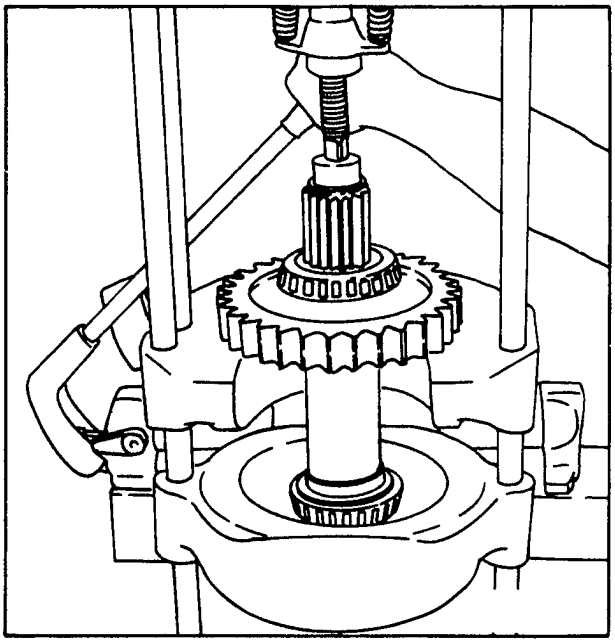


Fig. 7C.14. Output Shaft Cones and Gear Removal

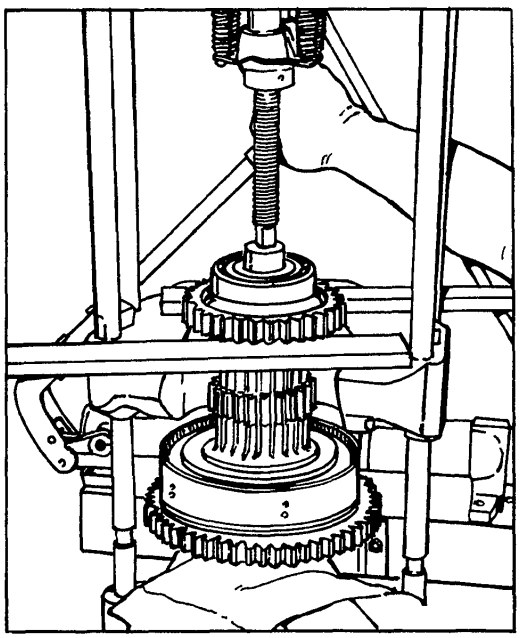


Fig. 7C.15. Removing Forward Driver Gear and Bearing

TRANSMISSION

Directional Clutch Assembly (Fig. 7C.16 and 7C.16A)

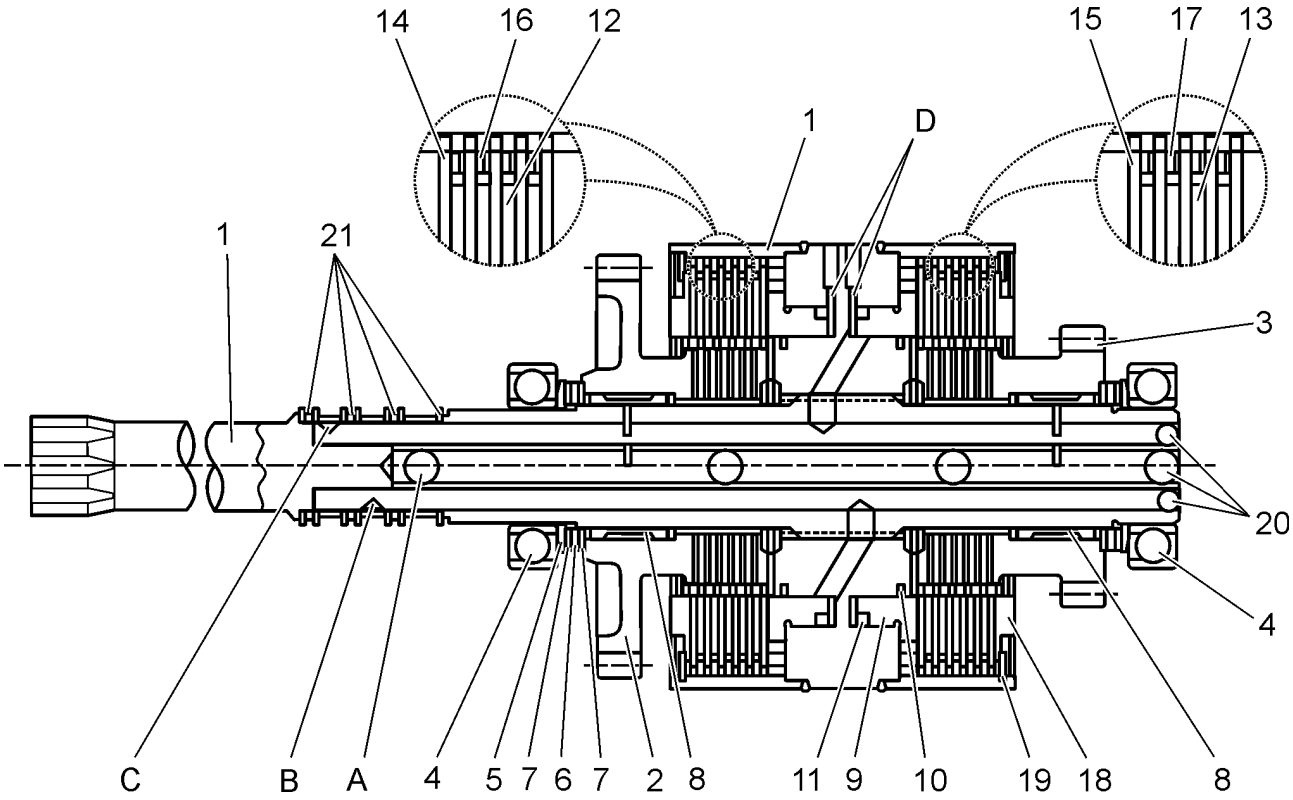


Fig. 7C.16. Directional Clutch Cross Section

IMPORTANT: *The following procedure covers disassembly of the forward clutch first.*

1. Place the clutch pack assembly in a suitable work stand.
2. Remove four seal rings (21). Using a puller as shown in Fig. 7C.17 remove ball bearing (4).
3. Remove thrust washer (5), two thrust rings (7), thrust bearing (6) and forward driver gear (2). Separate needle bearing (8) from the gear (2).
4. Using two "C" clamps as shown in Fig. 7C.18, compress the clutch pack slightly. Remove retaining ring (19).

Description to Fig. 7C.16 and 7C.16A:

1. Clutch Drum/Shaft
2. Forward Driver Gear
3. Reverse Driver Gear
4. Ball Bearing
5. Thrust Washer
6. Thrust Bearing
7. Thrust Ring
8. Needle Bearing
9. Directional Piston
10. Seal Ring
11. Seal Ring
12. Friction Disc
13. Friction Disc
14. Separator plate
15. Separator plate
16. Spring Ring
17. Spring Ring
18. Clutch Support Plate
19. Retaining Ring
20. Ball
21. Seal Rings

A. Lube Oil Inlet
B. Oil Passage for Forward Clutch
C. Oil Passage for Reverse Clutch
D. Oil Drain Hole

TRANSMISSION

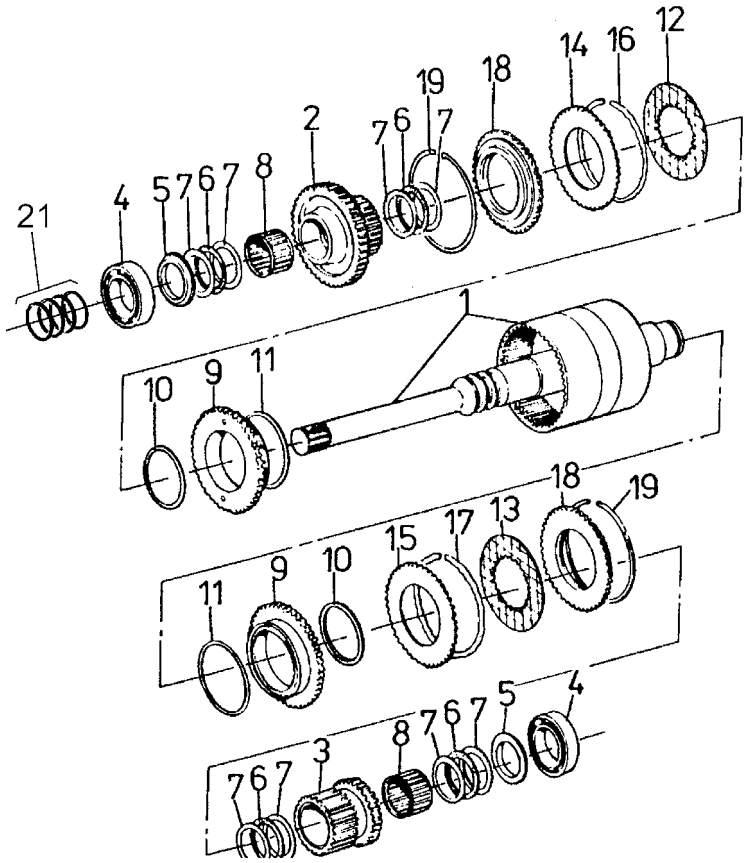


Fig. 7C.16A. Directional Clutch Exploded View

5. Release the "C" clamps and remove the clutch support plate (18), separator plates (14), spring rings (16), friction discs (12), thrust rings (7) and thrust bearing (6).

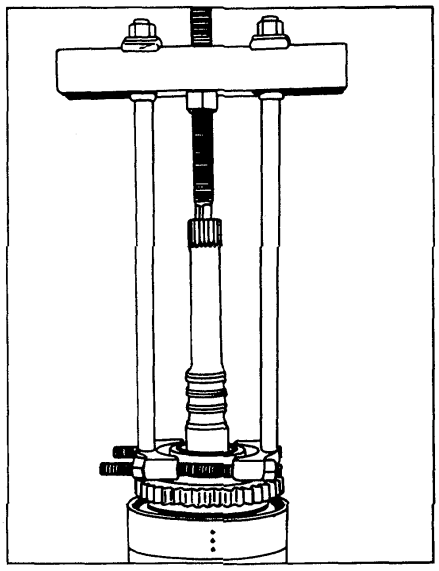


Fig. 7C.17. Removing Bearing from Shaft

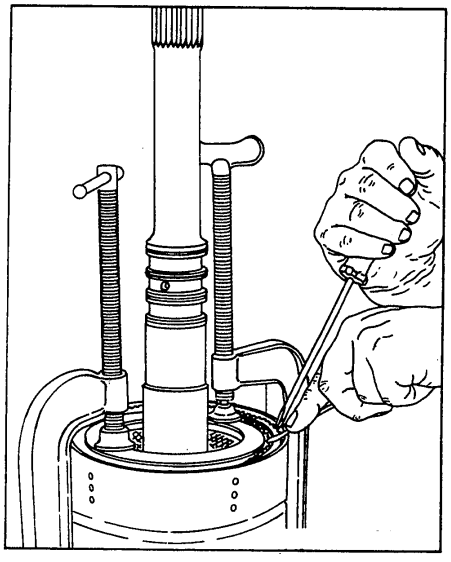


Fig. 7C.18. Removing Clutch Pack Retaining Ring

6. Install two 1/4x2-1/2" cap screws in piston (9) and pry the piston upward as shown in Fig. 7C.19. We can also remove the piston using compressed air. Apply compressed air in the hole (B, Fig. 7C.16) to remove piston (9).
7. Remove seal ring (11) from the piston (9) and seal ring (10) from the inside of the clutch drum/shaft (1).
8. Turn the clutch drum/shaft over and disassemble the reverse clutch in the same manner as the forward clutch.

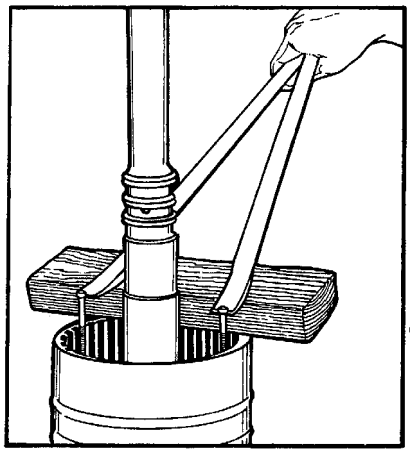


Fig. 7C.19. Removing Clutch Piston

Gear Range (2/3) Clutch Assembly (Fig. 7C.20)

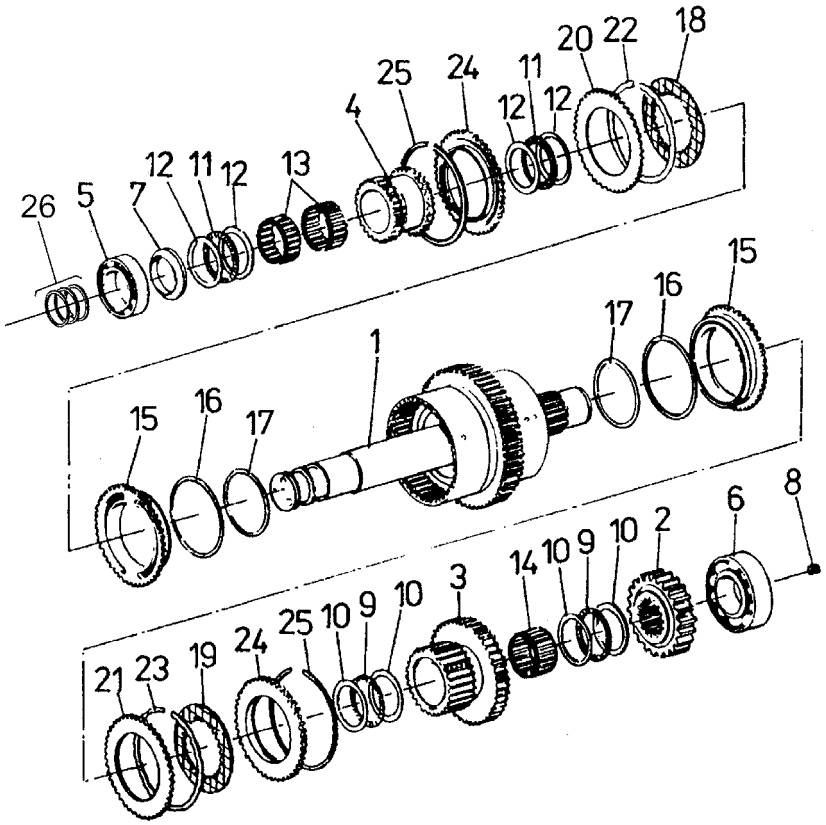


Fig. 7C.20. Gear Range (2/3) Clutch Exploded View

TRANSMISSION

Description to Fig. 7C.20:

1. Clutch Drum/Shaft
2. Gear
3. Gear
4. Gear
5. Ball Bearing
6. Ball Bearing
7. Thrust Washer
8. Screw
9. Thrust Bearing
10. Thrust Ring
11. Thrust Bearing
12. Thrust Ring
13. Needle Bearing
14. Needle Bearing
15. Piston
16. Seal Ring
17. Seal Ring
18. Friction Disc
19. Friction Disc
20. Separator plate
21. Separator plate
22. Spring Ring
23. Spring Ring
24. Clutch Support Plate
25. Retaining Ring
26. Seal Rings

IMPORTANT: *The following procedure covers reassembly of the third gear clutch first.*

1. Place the clutch assembly in a suitable work stand.
2. Remove three seal rings (26). Using a puller as shown in Fig. 7C.21 remove ball bearing (5).
3. Remove thrust washer (7), two thrust rings (12), thrust bearing (11), and gear (4). Separate two needle bearings (13) from the gear (4).
4. Using two "C" clamps as shown in Fig. 7C.22, compress the clutch pack slightly. Remove retaining ring (25).

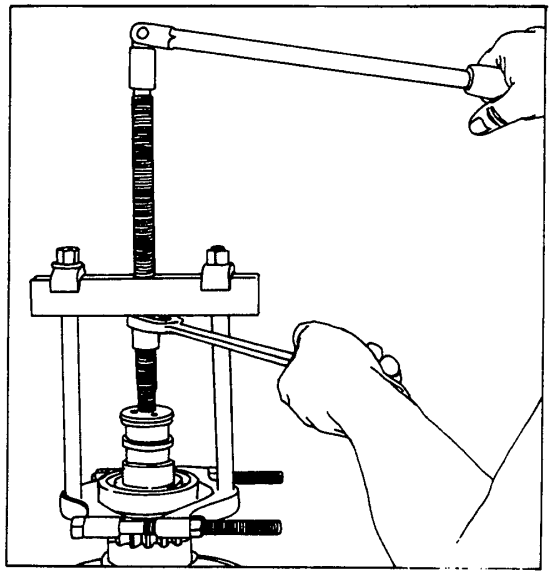


Fig. 7C.21. Removing Bearing from Shaft

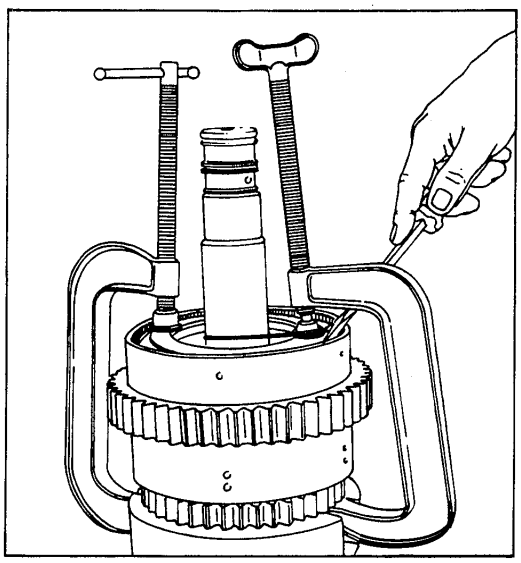


Fig. 7C.22. Removing Clutch Pack Retaining Ring

5. Release the "C" clamps and remove clutch support plate (24), separator plates (20), spring rings (22), friction discs (18), thrust rings (12) and thrust bearing (11).
6. Install two 1/4" cap screws in piston (15). Pry the piston upward as shown in Fig. 7C.23. We can also remove the piston using compressed air. Apply compressed air in the hole located as the nearer to the end of the shaft. It will remove the piston (15) out.
7. Remove seal ring (16) from the piston (15) and seal ring (17) from the inside of the shaft/drum clutch.
8. Turn the shaft over and disassemble the second gear clutch in the same manner as the third gear clutch.

TRANSMISSION

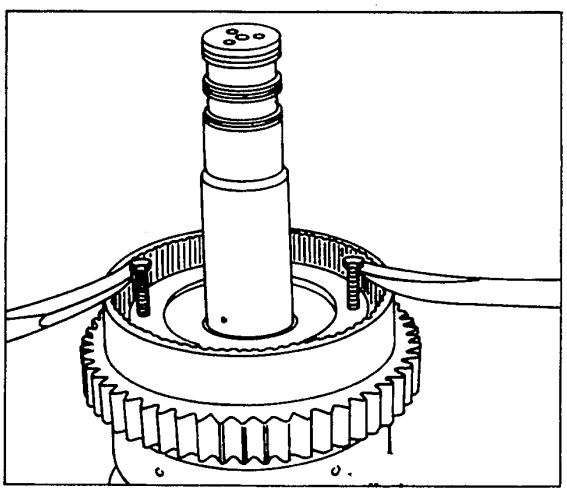


Fig. 7C.23. Removing Clutch Piston

Gear Range (1) Clutch Assembly (Fig. 7C.24)

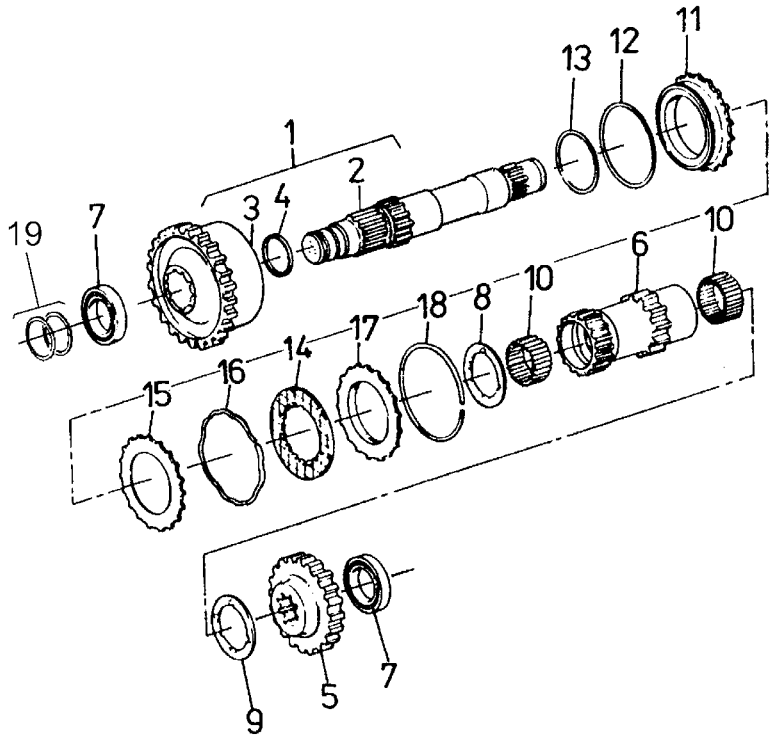


Fig. 7C.24. Gear Range (1) Clutch Exploded View

1. Clutch Drum/Shaft
2. Shaft
3. Gear Range (1) Clutch
4. Spacer Ring
5. Gear
6. Gear
7. Ball Bearing
8. Thrust Washer
9. Thrust Washer
10. Needle Bearing
11. Piston
12. Seal Ring
13. Seal Ring
14. Friction Disc
15. Separator plate
16. Spring Ring
17. Clutch Support Plate
18. Retaining Ring
19. Seal Rings

TRANSMISSION

1. Remove ball bearing (7) and gear (5) together from the drum/shaft (1) as shown in Fig. 7C.25. Remove thrust washer (9).
2. Remove the gear (6) and two needle bearings (10).
3. Place the clutch drum/shaft assembly in a suitable work stand.
4. Using two “C” clamps as shown in Fig. 7C.26, compress the clutch pack slightly. Remove retaining ring (18).
5. Release the “C” clamps and remove the clutch support plate (17), separator plates (15), spring rings (16), friction discs (14), thrust washer (8) and spacer ring (4).

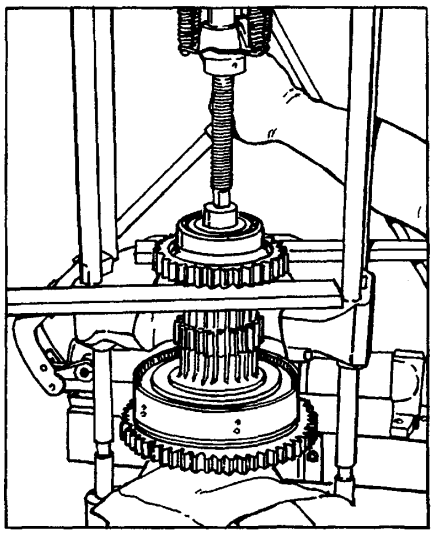


Fig. 7C.25. Removing Gear with Bearing

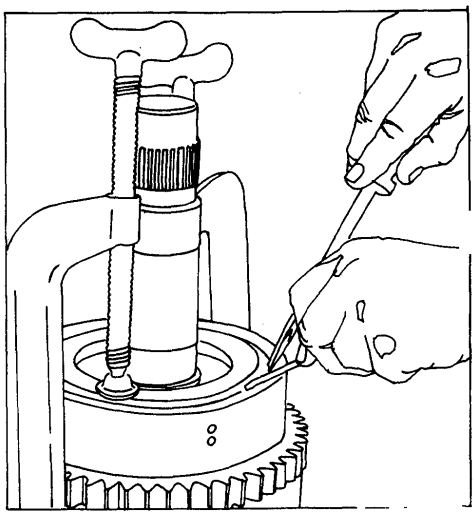


Fig. 7C.26. Removing Retaining Ring

6. Install two 1/4" cap screws in piston (11). Pry the piston upward as shown in Fig. 7C.27. We can also remove the piston using compressed air. Apply compressed air in the hole to remove piston (11).
7. Remove seal ring (12) from the piston (11) and seal ring (13) from the inside of the clutch drum.

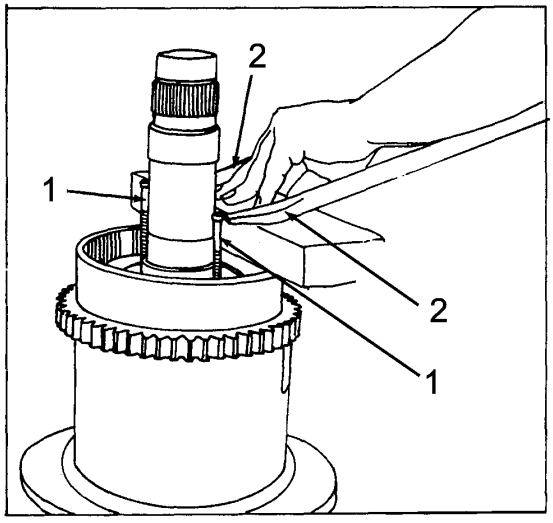


Fig. 7C.27. Removing Clutch Piston

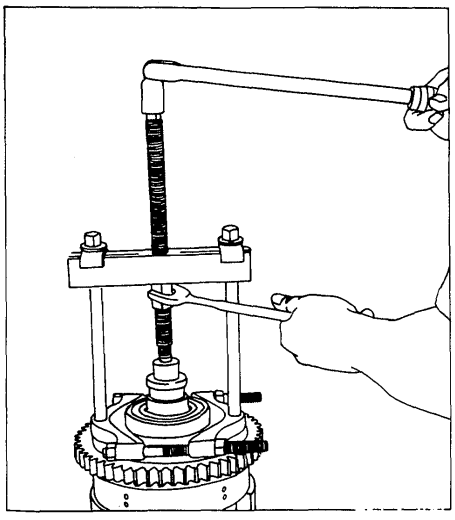


Fig. 7C.28. Removing Bearing from Shaft

1. Cap Screw
2. Pry Bar

8. Turn the clutch drum/shaft over and remove seal rings (19).
9. Using a puller as shown in Fig. 7C.28 remove ball bearing (7). Remove spacer ring (4).

7. INSPECTION AND REPAIR

1. Discard all gaskets, O-rings and seal rings and replace with new.
2. Clean all parts in a commercial solvent and dry with compressed air. Be sure to flush clutch pack oil passages but do not remove the balls from the end of the shafts.
3. Inspect bearings for flaking, cracks, scoring, nicks or excessive wear. Replace if necessary.
4. Inspect the gears for worn, chipped or broken teeth. Replace if wear is excessive or teeth are damaged.
5. Inspect the splines on the shafts for wear. Replace shafts if wear is excessive. Slight burrs can be smoothed down with a stone.
6. Flush all oil passages of shafts. Be sure all lube holes are clean and free of obstruction.
7. Inspect the clutch plates for excessive wear or warpage and replace if necessary.
8. Check the spring rings for damage and fatigue. If they do not fall within the tolerance given in Paragraph 4, SPECIFICATIONS, they must be replaced.

8. REASSEMBLY

IMPORTANT: *Before reassembly, prelubricate all machined parts with transmission oil.*

Gear Range (1) Clutch Reassembly (Fig. 7C.24)

1. Install seal ring (12) into the piston (11) and seal ring (13) into gear range (1) clutch (3) with a pick as shown in Fig. 7C.29 and 7C.30. Extra care should be taken as the seal rings can be easily damaged.

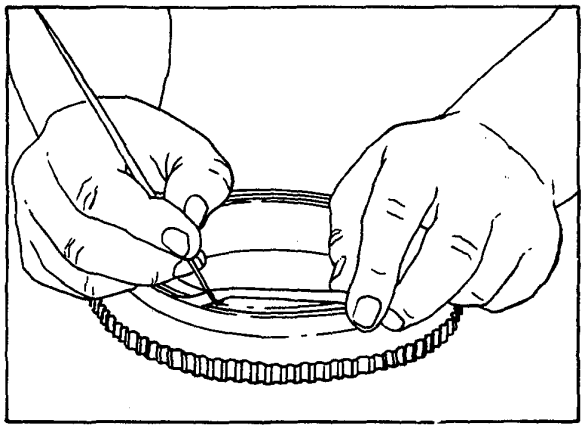


Fig. 7C.29. Installing Seal Ring in Piston

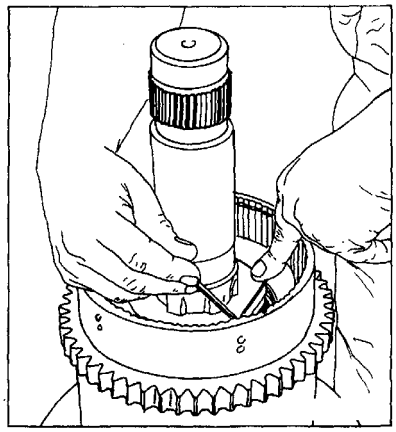


Fig. 7C.30. Installing Seal Ring in Drum

2. Install piston (11) in the gear range (1) clutch (3), taping it down evenly unit it bottoms.
3. Soak friction discs (14) in clean transmission oil for a minimum of two minutes. Do not stack the discs while soaking, as this will not allow a thorough distribution of oil across the disc.
4. Starting with a separator plate (15), stack the spring ring (22), friction disc (14), spring ring (16) and the separator plate (15) onto the clutch drum/shaft (1). Continue this sequence until the stack reaches the rim of the drum; then install the clutch aligning pins as shown in Fig. 7C.31. Continue stacking the discs and spring rings until all of them are in place.

TRANSMISSION

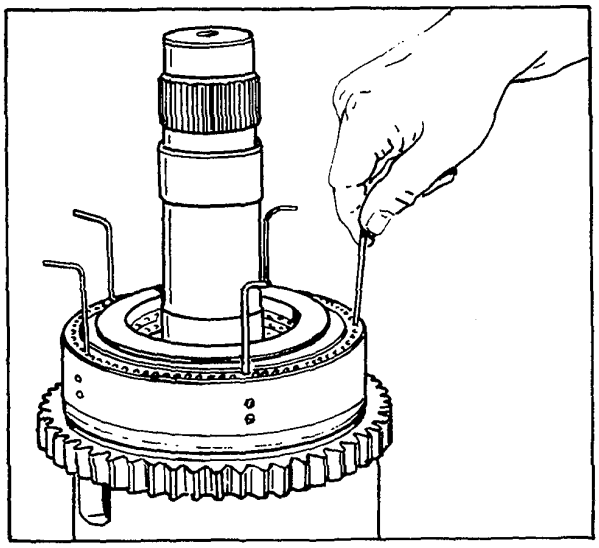


Fig. 7C.31. Installing Clutch Aligning Pins

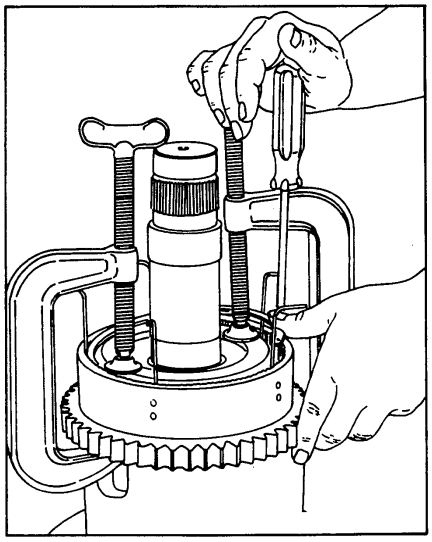


Fig. 7C.32. Installing Clutch Pack Retaining Ring

NOTE: *The range (1) clutch has six (6) separator plates, ten (10) spring rings, and five (5) friction discs.*

5. Position clutch support plate (17) on clutch discs. Compress the clutch assembly with two "C" clamps and install retaining ring (18). Refer to Fig. 7C.32.
6. Remove the clutch aligning pins from the pack as shown in Fig. 7C.33. Remove the "C" clamps.
7. Install thrust washer (8), needle bearings (10) and gear (6). Refer to Fig. 7C.34.

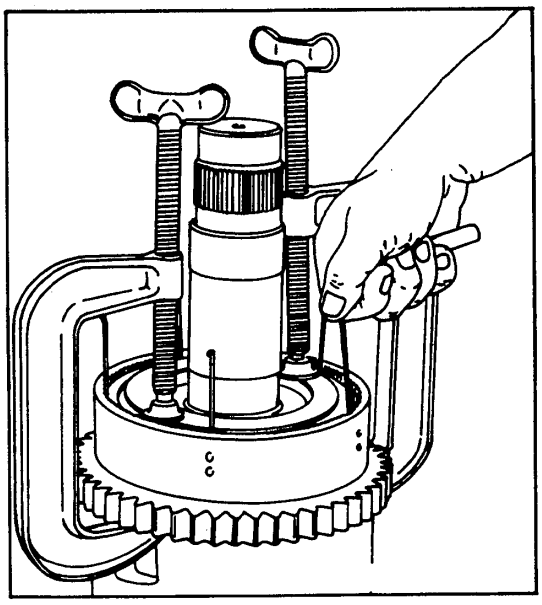


Fig. 7C.33. Removing Clutch Aligning Pins

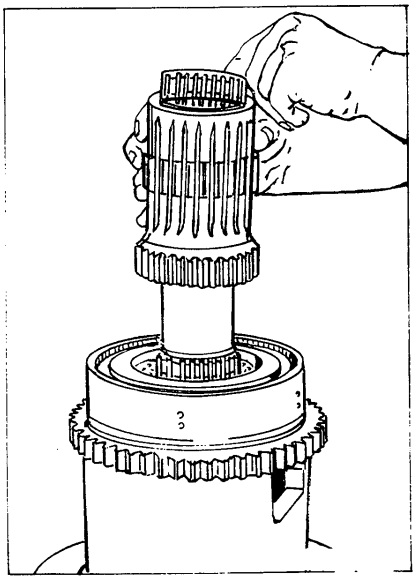


Fig. 7C.34. Installing Gear and Bearings

8. Install the thrust washer (9) gear (5) and ball bearing (7). Install second ball bearing (7). It is recommended that the bearings be heated to 80÷90 [°C] to facilitate installation.
9. Check the clearance between thrust washer (9) and gear (5) with a feeler gauge. There must be a clearance of 0.21-0.87 [mm]. If clearance do not meet above value, replace the clutch drum/shaft (1).
10. Install two seal rings (19). Extra care should be taken as the seal rings can be easily damaged.

Gear Range (2/3) Clutch Reassembly (Fig. 7C.20)

IMPORTANT: *Before reassembly, prelubricate all machined parts with transmission oil.*

IMPORTANT: *The following procedure covers reassembly of the third gear clutch first.*

1. Install the seal ring (16) into the piston (15) and seal ring (17) into clutch drum/shaft (1) with a pick as shown in Fig.7C.29 and 7C.30. Extra care should be taken as the seal rings can be easily damaged.
2. Install clutch piston (15) in the clutch drum/shaft (1), tapping it down evenly until it bottoms. Install two thrust rings (12) and thrust bearing (11).
3. Soak friction discs (18) in clean transmission system hydraulic oil for a minimum of two minutes. Do not stack the discs while soaking, as this will not allow a thorough distribution of oil across the disc.

NOTE: *Be sure to observe the differences in quantities of separator plates, spring rings, and friction discs within the second gear and third gear clutches for ease in reassembly. The third gear clutch has three (3) separator plates, six (6) spring rings, and three (3) friction discs. The second gear clutch has seven (7) separator plates, twelve (12) spring rings, and six (6) friction discs.*

4. Starting with a separator plate (20), stack the spring ring (22), friction disc (18), spring ring (22) and the separator plate (20) onto the clutch drum/shaft (1). Continue this sequence until the stack reaches the rim of the drum; then install the clutch aligning pins as shown in Fig. 7C.31. Continue stacking the discs and spring rings until all of them are in place.
5. Position the clutch support plate (24) on the clutch discs. Compress the clutch assembly with two "C" clamps and install retaining ring (25), as shown in Fig. 7C.32.
6. Remove the clutch aligning pins as shown in Fig. 7C.33. Remove the "C" clamps.
7. Install gear (4) and two needle bearings (13). Install two thrust rings (12) and thrust bearing (11).
8. Install thrust washer (7) and ball bearing (5). It is recommended that the bearing be heated to 80÷90 [°C] to facilitate installation.
9. Check the clearance between thrust washer (7) and thrust ring (12) with a feeler gauge. There must be a clearance of 0.03÷1.16 [mm]. Check the clearance between gear (2) and thrust ring (10). There must be a clearance of 0.06÷0.73 [mm].
   If the clearance do not meet above value, replace the clutch drum/shaft. (1).
10. Install tree seal rings (26). Extra care should be taken as the seal rings can be easily damaged.
11. Reassemble the second clutch in the same manner as the third clutch.

TRANSMISSION

Directional Clutch Reassembly (Fig. 7C.16 and 16A)

IMPORTANT: *Before reassembly, prelubricate all machined parts with transmission oil.*

IMPORTANT: *The following procedure covers reassembly of the* forward *gear clutch first.*

1. Install seal ring (10) in the piston (9) and seal ring (11) in the clutch drum/shaft (1) with a pick as shown in Fig. 7C.29 and 7C.30. Extra care should be taken as the seal rings can be easily damaged.
2. Install the piston (9) in the clutch drum/shaft (1), tapping it down evenly until it bottoms. Install two thrust rings (7) and thrust bearing (6).
3. Soak friction discs (12) in clean transmission system hydraulic oil for a minimum of two minutes. Do not stack the discs while soaking, as this will not allow a thorough distribution of oil across the disc.

NOTE: *The forward clutch has ten (10) separator plates, eighteen (18) spring rings, and nine (9) friction discs. The reverse clutch has ten (10) separator plates, eighteen (18) spring rings, and nine (9) friction discs.*

4. Starting with a separator plate (14), stack the spring ring (16), friction disc (12), spring ring (16) and the separator plate (14) onto the clutch drum/shaft (1). Continue this sequence until the stack reaches the rim of the drum; then install the clutch aligning pins as shown in Fig. 7C.31. Continue stacking the discs and spring rings until all of them are in place.
5. Position the clutch support plate (18) on the clutch discs. Compress the clutch assembly with two "C" clamps and install retaining ring (19). Refer to Fig. 7C.32.
6. Remove the clutch aligning pins as shown in Fig. 7C.33. Remove the "C" clamps.
7. Install the forward driver gear (2) and needle bearing (8). Install two thrust rings (7) and thrust bearing (6).
8. Install thrust washer (5) and ball bearing (4). It is recommended that the bearing be heated to 80÷90 [°C] to facilitate installation.
9. Check the clearance between thrust washer (5) and thrust ring (7) with a feeler gauge. There must be a clearance of 0.03÷1.16 [mm].
   Check the clearance between washer (5) and ball bearing (4) with a feeler gauge. There must be a clearance of 0.06÷0.73 [mm].
   If clearance do not meet above value, replace the clutch drum/shaft. (1).
10. Install four seal rings (20). Extra care should be taken as the seal rings can be easily damaged.
11. Reassemble the reverse clutch in the same manner as the forward clutch.

Basic Transmission Reassembly (Fig. 7C.7)

1. Press bearings (23, Fig. 7C.35) with retaining rings (24) one at a time in reverse idler gear (22).
2. Heat the reverse idler gear assembly to 90÷100 [°C] and install it on the shaft in the housing. Refer to Fig. 7C.36. Secure the reverse idler gear assembly with the retaining ring (25), using pliers RSKn-200.
3. Install bearing cup (84) in the housing (1, Fig. 7C.7) and in the cover (12) using bearing cup driver tool 21.547.0131. Install magnet (32) in the housing (1).
4. Put gear (81) on the output shaft. Install retaining ring (82) on the output shaft (11) using pliers RSKm-200. Install bearing cones (83) on the output shaft. Refer to Fig. 7C.37. It is recommended that the bearing cone be heated to 80÷90 [°C] to facilitate installation.

5. Place gear shroud (26) on the gear (81). Install the output shaft (11) in housing (1), slide the gear (81) onto its splines and secure the gear with retaining ring (82) using pliers RSKm-200.

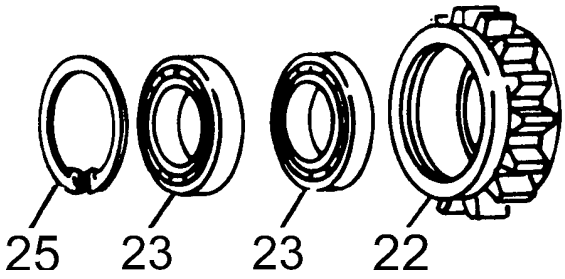


Fig. 7C.35. Assembling Reverse Idler Gear

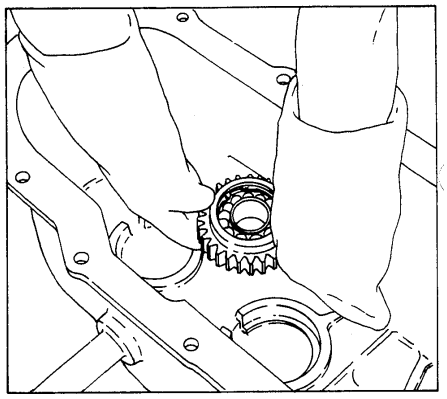


Fig. 7C.36. Installing Reverse Idler Gear

22. Reverse Idler Gear
22. Ball Bearing
25. Retaining Ring

6. Secure the gear shroud to the housing. Torque the bolts to 85÷100 [Nm].
7. Install the cover (12) and shims (19). Install three of the retainer mounting bolts 120° apart and torque to 85÷100 [Nm]. Install the yoke (15) with plate (18) and torque the bolt (17) to 100÷120 [Nm]. Rotate and tap the shaft down using a plastic mallet.
8. Mount a dial indicator on the housing (1), place the indicator pointer on the end of the yoke (15) and set the indicator at zero. With a lever or hoist raise the yoke (15) with output shaft, noting the vertical movement of end play.
9. Remove the yoke (15) and cover (12). Add or remove shims (19) to achieve the desired end play 0.13÷0.23 [mm].
10. Install seal ring (13) in cover (12) to depth of 2÷4 [mm] from the outside surface of the cover using seal ring driver tool 8N54-78/95-130. Install the cover (12) with O-ring (14) and shims (19). Torque the bolts to 85÷100 [Nm].
11. Install the yoke (15), O-ring (16) and plate (18), refer to Fig. 7C.38. Torque the bolt (17) to 100÷120 [Nm]. Rotate and tap the output shaft down using a plastic mallet and recheck end play setting. End play should be 0.13÷0.23 [mm].
12. Install seal ring (20) in housing (1) to depth of 2÷4 [mm] from the outside surface of the housing using seal ring driver tool 8N54-78/95-130.
13. Move the gear range (2/3) clutch (9) towards the bottom of the housing (1), turn output shaft gear with a pry bar to mesh with the clutch shaft gear. Tap the top of the clutch shaft with a clutch shaft driver tool 21.547.0076 to seat the bearings in housing (1).
14. Move the directional clutch (4) towards the bottom of the housing (1), turn the idler gear (22) with a pry bar to mesh with the clutch gear. Tap the top of the clutch shaft with a clutch shaft driver tool 21.547.0076 to seat the bearings in housing (1).
15. Move the gear range (1) clutch (7) towards the bottom of the housing (1), turn the idler and output shaft gears with a pry bar to mesh with the clutch gears. Tap the top of the clutch shaft with a clutch shaft driver tool 21.547.0076 to seat the bearings in housing (1).

TRANSMISSION

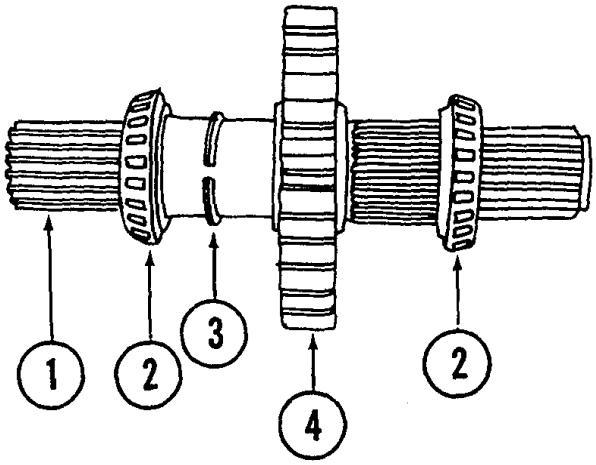


Fig. 7C.37. Initial Assembly the Output Shaft

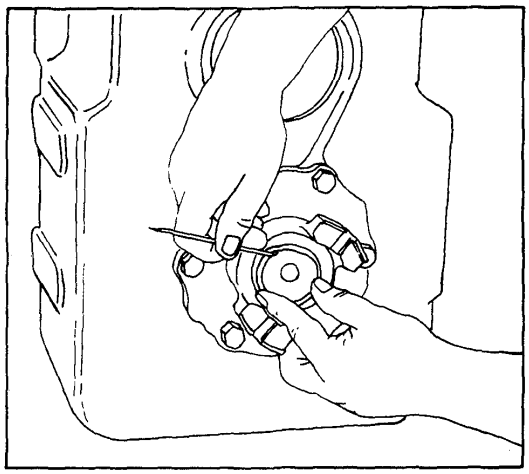


Fig. 7C.38. Installing Output Shaft Yoke O-ring

1. Output shaft
2. Bearing Cone
3. Retaining Ring
4. Gear

16. Install ball bearing (40) in gear (36) using bearing driver tool 21.547.0123. It is recommended that the bearing be heated to 90 [°C] to facilitate installation. Install retaining ring (43) in gear (36) using pliers RSKn-200. Install gear assy with sleeve (41) to housing (2). Torque bolt with washer to 38÷40 [Nm]. Put pump shaft (39) only in gear (36) and secure with retaining ring (42) using pliers RSKn-200. Repeat this procedure for gear (37). Put pump shaft (38) only in gear (37) and secure with retaining ring (42) using pliers RSKn-200.
17. Check the clutch shaft seal rings to be sure they fit tightly in their grooves.
18. Apply Loctite 515 to the mating surfaces of the transmission housing (1) and the torque converter housing (2). Torque mounting bolts to 85÷100 [Nm].
19. Install of 100 to 130 [mm] two aligning studs in housing (2). Move the torque converter (6) into position on the aligning studs toward to housing (2) until the torque converter gear meshes with pumps gears. Lubricate the directional clutch seal rings with clean transmission system hydraulic oil and lower the torque converter (6) onto the transmission. Install the torque converter mounting bolts and torque to 85-100 [Nm].
20. Install strainer (31) and connector (30) with new gasket (33). Torque the bolts to 38 [Nm]. Install suction tube (59) with hose (60) and clamps (61) to the connector (30).
21. Install the drive train pump (50) with O-ring (51) to the housing (2). Torque the bolts to 38÷40 [Nm],
22. Install plate assy (80) with gasket (79) to housing (2). Apply Loctite 242 to the thread and torque four bolts to 42 [Nm].
23. Install O-rings (88 and 89) to the plate assy (80). Install pressures regulator valve (87) with O-rings (86) to plate assy (80). Apply Loctite 242 to the bolts thread and torque the bolts to 42 [Nm].
24. Install control valve (46) with gasket (47) to plate assy (80). Apply Loctite 242 to the thread and torque the bolts to 42 [Nm].
25. Install filter (63) with the bracket (64) to housing (2) and torque the bolts to 92 [Nm].
26. Install pressure regulator valve (48) with new gasket (49) to housing (2). Apply Loctite 242 to the thread and torque the bolts to 38 [Nm].
27. Install yoke (21) on output shaft.
28. Install two brackets to housing (1). Torque the bolts with washer and plate to 140÷170 [Nm].
29. Install O-ring (62) on the housing (2).

TRANSMISSION

9. INSTALLATION

1. Remove the protective covering placed over the engine flywheel housing and secure the transmission to engine. Torque mounting bolts to 40÷50 [Nm].
2. Install radiators assy and engine with transmission to rear frame as described in Section 12. Install the transmission mounting bolts and the engine mounting bolts. Torque the transmission bolts to 250÷300 [Nm] and the engine bolts to 140÷170 [Nm].
3. MACHINES EQUIPPED WITH GROUND DRIVEN STEERING: Install the block (5) with bracket to the transmission (2). Install the pump (4) to the transmission (2) and torque the bolts to 80-100 [Nm]. Reconnect hoses to ground driven steering pump (4, Fig. 7C.6) and to the block (5).
4. Reconnect the oil cooler hoses and all wires to the transmission.
5. Reconnect the brake booster hoses (only 520G).
6. Connect the drive shafts as described in Section 7D.
7. Install double hydraulic pump (1, Fig. 7C.6), drive train pump (3) and filler tube (6) to the transmission (2). Torque the bolts to 80÷100 [Nm]. Reconnect the tubes to drive train pump (3) and to double hydraulic pump (1).
8. Install a lifting eyebolt in the threaded hole ¾ -10UNC-2B. Secure a hoist to the lifting eye and remove the slack. Lift the hydraulic reservoir (3, Fig. 7C.5) and install it to the rear frame. Remove the eyebolt from the top of the hydraulic reservoir (3) and install bolt (5) with washer.
9. Reconnect the hydraulic reservoir inlet tube (1) to the reservoir return filter (2) and the outlet tube to the bottom of the reservoir (3). Reconnect cable to the switch (4). Reconnect the tubes to double hydraulic pump.
10. Install upper guard (7, Fig. 7C.4) with two guards (8). Close the cover (6). Reconnect two gas springs to the hydraulic reservoir (2) and two gas springs to the radiator guard (5).
11. Install pre-cleaner assy (1) and exhaust outer tube (9).
12. MACHINES EQUIPPED WITH ETHER START: Reconnect two cables to solenoid valve.
13. Fill the hydraulic reservoir and the transmission. Refer to the OPERATOR'S MANUAL for these procedures.
14. Check the oil pressures as described in "CHECKING TRANSMISSION AND TORQUE CONVERTER PRESSURES" in Section 7. Check for leaks.
15. Install the transmission lower guard to under machine. Install the transmission upper guards.

PRESSURE REGULATOR VALVE (520G ONLY)

10. REMOVAL AND DISASSEMBLY (Fig. 7C.39 and 7C.40)



WARNING! Before servicing the machine be sure the bucket is lowered, the engine is off, the parking brake is applied, the transmission shifter is locked in neutral (N), the electrical system master switch is off and the keys are removed from master switch and from starting switch.



WARNING! Always lock the frames together before working near the center of the machine. If the frames move, serious injury or death could result.

IMPORTANT: *Disconnected 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 as this could introduce foreign material into the system. Tag all disconnected lines for ease of correct installation.*

PRESSURE REGULATOR VALVE (520G ONLY)

1. Remove the transmission lower guard from under machine.
2. Disconnect the pressure regulator valve supply hose and the booster valve supply hose from pressure regulator valve.
3. Unscrew mounting bolts and remove pressure regulator valve with gasket.
4. Unscrew plug (1) with O-ring (2) and remove springs (3 and 4), valve pin (5) and washer (6).
5. Unscrew second plug (1) with O-ring (2) and remove piston assy (13).
6. Remove pin (9), sleeve (12), spring (11) and ball (10) from piston (8).

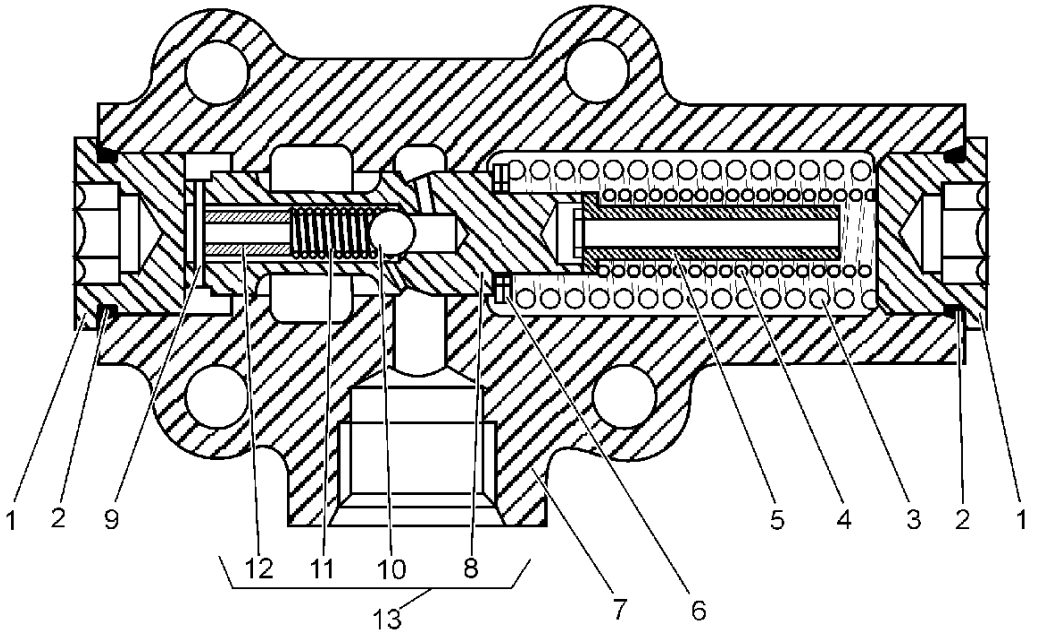


Fig. 7C.39. Pressure Regulator Valve Cross Section

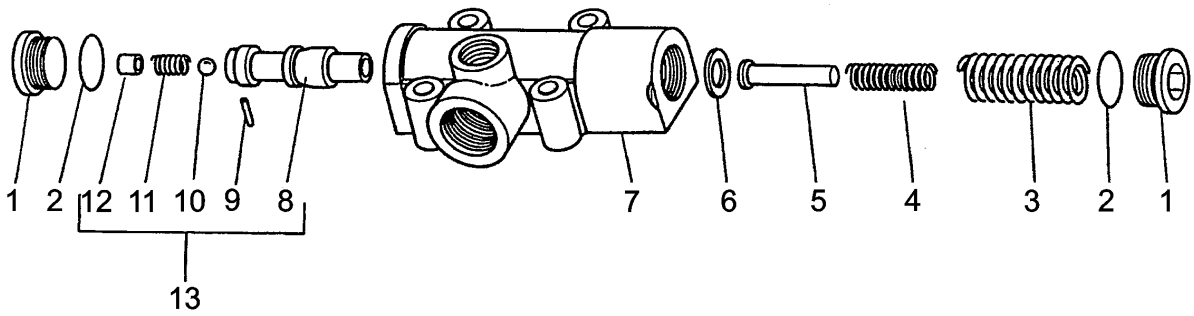


Fig. 7C.40. Pressure Regulator Valve Exploded View

1. Plug
2. O-ring
3. Outer Spring
4. Inner Spring
5. Valve Pin
6. Washer
7. Housing
8. Piston
9. Pin
10. Ball
11. Spring
12. Sleeve
13. Piston Assy

11. 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 housing are clean and free of obstruction.
2. Inspect the parts for excessive wear and replace if necessary.
3. Inspect the condition of the springs. If they are damaged or not fall within the specifications shown in Paragraph 4, SPECIFICATIONS, they must be replaced.

PRESSURE REGULATOR VALVE (520G ONLY)

12. RESASSEMBLY AND INSTALLATION (Fig. 7C.39 and 7C.40)

1. Install ball (10), spring (11), sleeve (12) and pin (9) in piston (8).
2. Install piston assy (13) and plug (1) with O-ring (2) in housing (7).
3. Install washer (6), springs (3 and 4), valve pin (5) and plug (1) with O-ring (2) in housing (7).
4. Install pressure regulator valve with new gasket to transmission housing. Apply Loctite 242 to the thread and torque the bolts to 38 [Nm].
5. Reconnect the pressure regulator valve supply hose and the booster valve supply hose.
6. Install the transmission lower guard to under machine.

13. REMOVAL AND DISASSEMBLY (Fig. 7C.41 and 7C.42)

WARNING! Before servicing the machine be sure the bucket is lowered, the engine is off, the parking brake is applied, the transmission shifter is locked in neutral (N), the electrical system master switch is off and the keys are removed from master switch and from starting switch.

WARNING! Always lock the frames together before working near the center of the machine. If the frames move, serious injury or death could result.

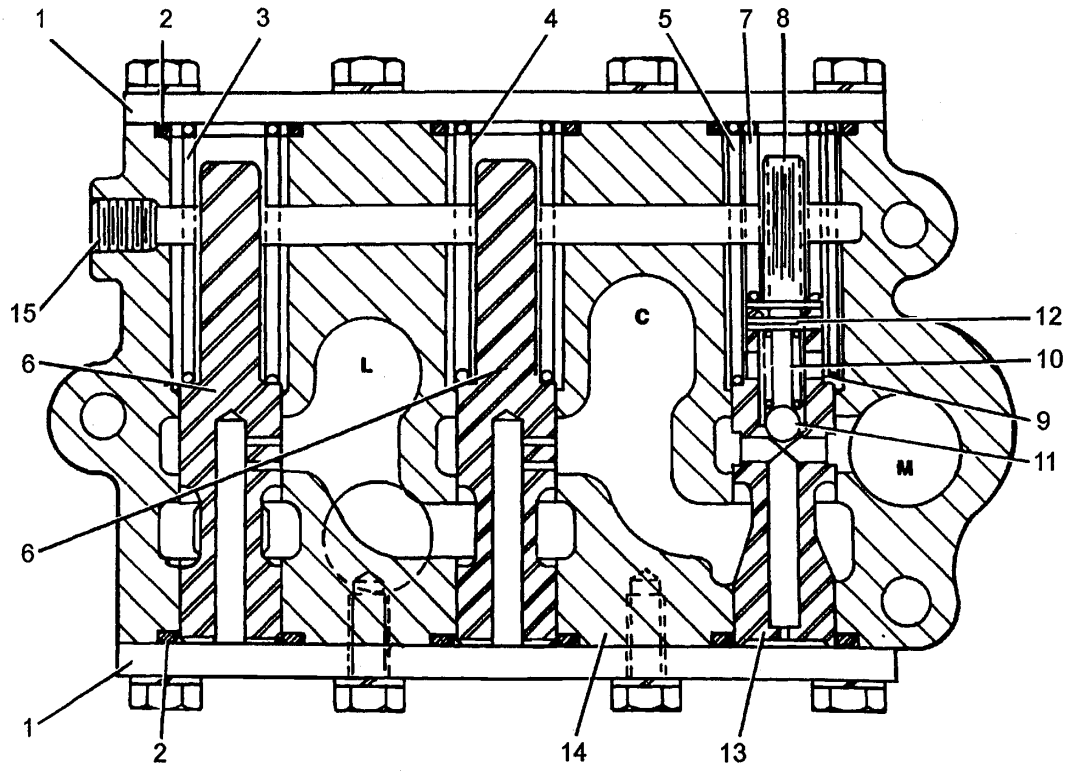


Fig. 7C.41. Pressures Regulator Valve Cross Section

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

PRESSURE REGULATOR VALVE (520G ONLY)

IMPORTANT: *Disconnected 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 as this could introduce foreign material into the system. Tag all disconnected lines for ease of correct installation.*

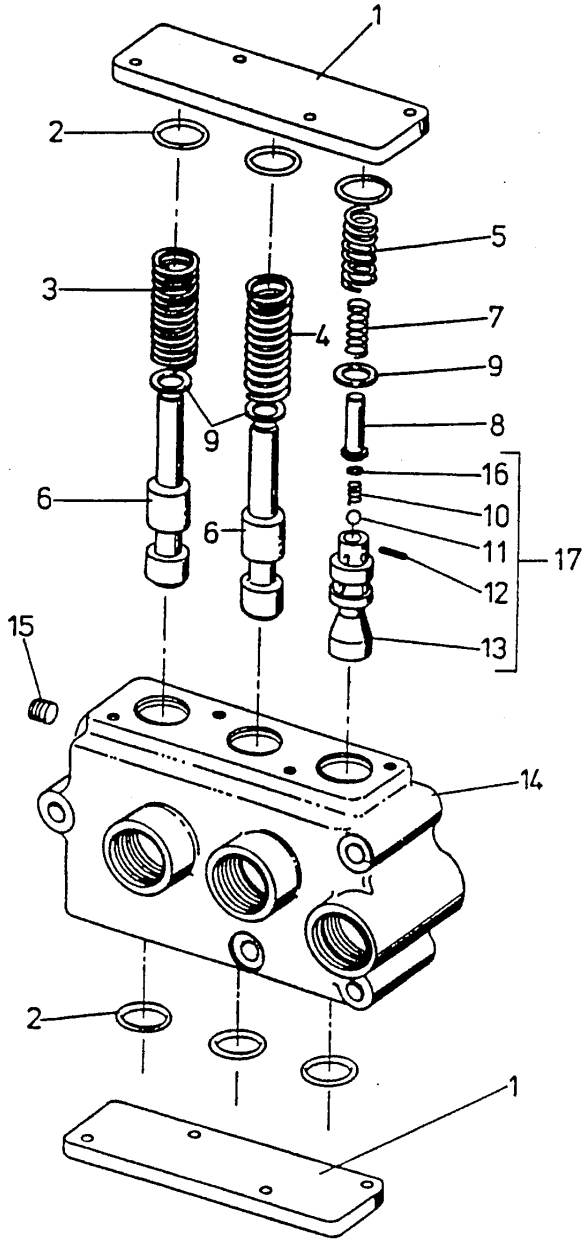


Fig. 7C.42. Pressures Regulator Valve Exploded View

1. Cover
2. O-ring
3. Lube Spool Spring
4. Spool Spring
5. Main Spool Outer Spring
6. Lube/Torque Converter Spool
7. Main Spool Inner Spring
8. Spring Guide
9. Shim
10. Ball Spring
11. Ball
12. Spring Pin
13. Main Spool
14. Valve Housing
15. Port Plug
16. Washer
17. Main Spool Assy

PRESSURE REGULATOR VALVE (520G ONLY)

1. Remove the transmission lower guard from under machine.
2. Disconnect the hoses at pressures regulator valve.
3. Remove the bolts and washers securing the valve to the plate assy. Remove the valve assembly and five O-rings.
4. Disassemble component parts in the sequence (1, 2, 3, 4, 5, 7, 9, 8, 6, and 17).

NOTE: *When removing springs and shims from the valve housing, tag them according to their location.*

5. Remove from main spool assy (17) component parts (12, 16, 10, 11) of spool (13) in numerical sequence.
6. If necessary remove port plug (15) from the valve housing (14).

14. INSPECTION AND REPAIR

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

15. REASSEMBLY AND INSTALLATION (Fig. 7C.41 and 7C.42)

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

1. Apply LOCTITE pipe sealant HVV (UNFILLED) to plug (15) and install in the valve housing (14) if removed.
2. Reassemble component parts (12, 16, 10 and 11) of spool (13) in reverse numerical order.
3. Reassemble component parts in the sequence (17, 6, 8, 9, 7, 5, 4, 3, 2, 1). Tighten the bolts securing covers (1).

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

4. Position the valve and O-rings on the plate assy and secure with bolts and washers. Apply Loctite 242 to the thread and torque the bolts to 42 [Nm].
5. Reconnect hoses to the pressures regulator valve.
6. Start the engine and check connections for leaks.
7. Check the oil pressures as describe in SECTION 7.
8. Install the transmission lower guard to under machine.

TRANSMISSION CONTROL VALVE

16. DESCRIPTION (Fig. 7C.43)

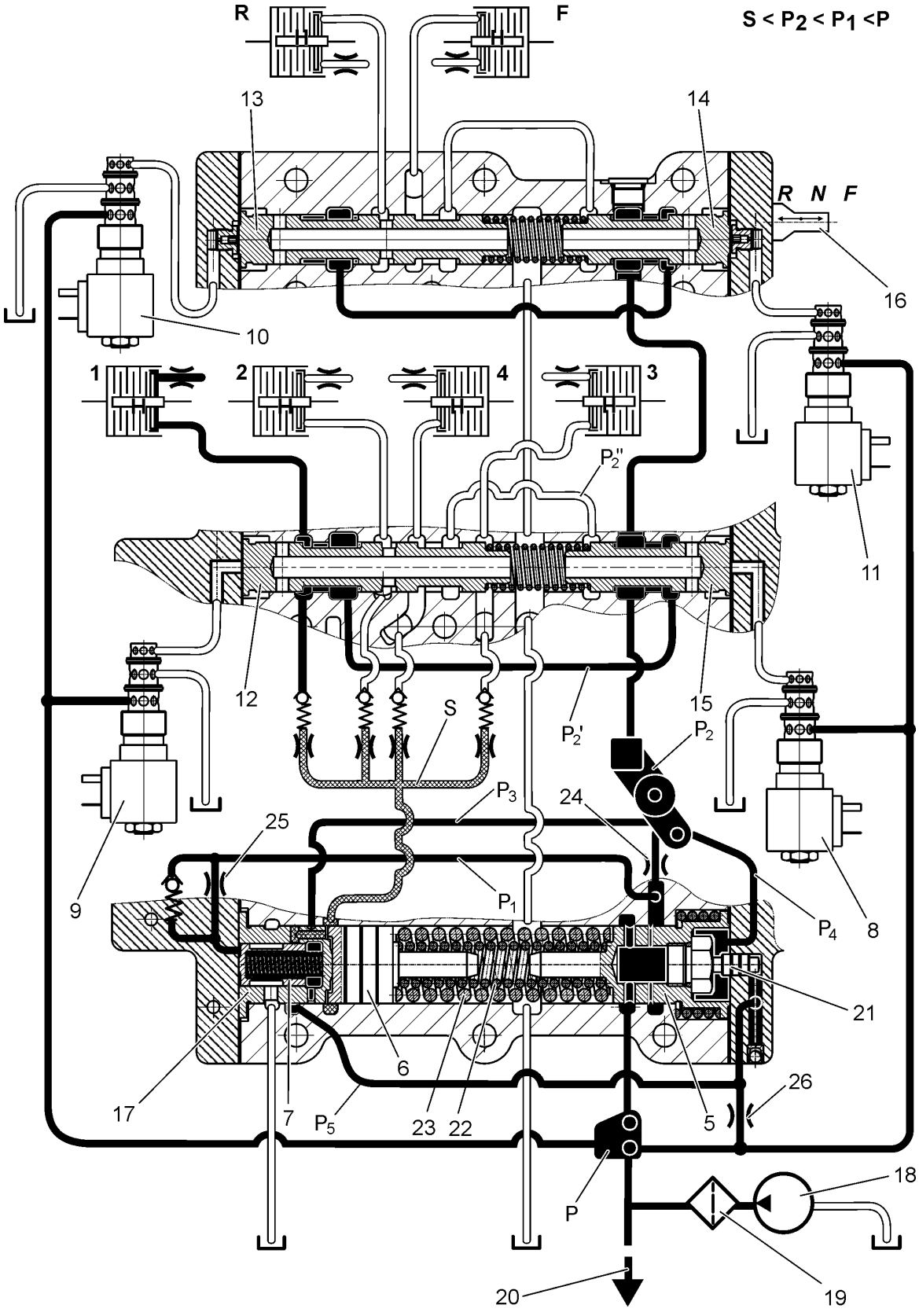


Fig. 7C.43. Transmission Control Valve in "Neutral" with Engine Running

TRANSMISSION CONTROL VALVE

Description to Fig. 7C.43:

1. First Clutch
2. Second Clutch
3. Third Clutch
4. Not used in this machine
5. Regulator Spool
6. Modulator Spool
7. Spool
8. Solenoid Valve (B)
9. Solenoid Valve (A)
10. Solenoid Valve (R)
11. Solenoid Valve (F)
12. Selector Long Spool
13. Selector Long Spool
14. Selector Short Spool
15. Selector Short Spool
16. Spool
17. Spool Sleeve
18. Drive Train Pump
19. Pressure Oil Filter
20. To Pressures regulator valve
21. Spool
22. Inner Spring
23. Outer Spring
24. Orifice
25. Orifice
26. Orifice

F. Forward Clutch
R. Rear Clutch
P, P1, P2, P2', P2", S - Passages

NEUTRAL POSITION – 1ST GEAR CLUTCH FILL

Solenoid valves coils are disenergized with the transmission shifter at neutral position.
Drive train pump (18) oil enters pressure regulator valve (20) section through pressure oil filter (19) and controls the main pressure "M", among others. Next, "M" oil pressure enters passage (P) that is within a control valve. The oil, from (P) passage, flows into closed cavities of four solenoid valves (8, 9, 10 and 11) and into both, cavity (P5) and a right-hand spool cavity trough orifice (26). The same "M" oil pressure from (P) passage flows though larger openings into regulator spool (5) and exits the spool through smaller openings entering (P1) passage, and next, into passages (P2, P3 and P4) trough orifice (24). Regulator spool (5) serves to reduce both the oil pressure and volume which feeds the clutch pack.
The oil from passage (P2) fills closed spools (13 and 14) cavities and fills 1st gear pack (1) through spool (15 and 12).
The same oil flows under spool (7) from the spool left hand side through passage (P1). Both spool (7) and modulator spool (6) modulate the 1st gear clutch (1) engagement pressure ensuring the smooth gear engagement. Spool (7) in its right slide movement covers one by one spool sleeve (17) openings at the same time draining (S) passage.
A given gear engagement pressure modulation take place at every gear or travel direction change. Modulator spool (6) at its right extreme position terminates the modulation operation. At this point, spool (7) slides left and covers passage (S) draining openings.

1ST GEAR FORWARD ENGAGEMENT

With the transmission shifter at 1st gear forward solenoid valve (11) is energized. This causes solenoid valve (11) spool to move and the oil from (P5) passage to enter the cavity of selector short spool (14) right side. Selector short spool (14) compressing the spring shifts to the left, causing the oil to fill forward (F) clutch cavity.
The (F) clutch engagement is accompanied by clutch engagement oil modulation which goes in a similar way to that of 1st gear (1) engagement at neutral position.

3RD GEAR FORWARD ENGAGEMENT

With the transmission shifter at 3rd gear forward, three solenoid valves (8, 9 and 11) are energized. Solenoid valve (11) engages the forward (F) clutch in a similar way to that of 1st gear. Solenoid valve (9) provides (P) passage oil flow to a cavity of left-hand side selector long spool (12) resulting in the spool displacement to the right. Similarly, solenoid valve (8) provides (P) passage connection to a cavity of right-hand side selector short spool (15) resulting in the spool displacement to the left. The spring located between the two spools (12 and 15) sets both limits to the spools approach displacement and locks the spools in their positions.
This selector long spool (12) position cuts the 1st gear clutch (1) from passage (P5) and provides its connection to the drain. Selector short spool (15) cuts the 2nd gear clutch (2) from passage (P2) and provides its connection to the drain through (P2') passage. The same spool (15) provides oil flow from (P2) passage to (P2") passage and fills the 3rd gear clutch (3) with oil trough selector long spool (12).

TRANSMISSION CONTROL VALVE

Both, the (F and 3) clutches engagement is accompanied by clutch engagement oil modulation which goes in a similar way to that of 1st gear (1) engagement at neutral position.

EMERGENCY GEAR ENGAGEMENT

If it is impossible to engage a gear with a transmission shifter, a gear can be emergency engaged. To do this, manually displace spool (16) from its neutral position to forward or reverse travel. This will engage a (F) forward or (R) reverse clutch and a gear clutch (1, 2 or 3) and will provide the machine with emergency travel on a short distance.

17. REMOVAL AND DISASSEMBLY (Fig. 7C.44 and 7C.45)

WARNING! Before servicing the machine be sure the bucket is lowered, the engine is off, the parking brake is applied, the transmission shifter is locked in neutral (N), the electrical system master switch is off and the keys are removed from master switch and from starting switch.

WARNING! Always lock the frames together before working near the center of the machine. If the frames move, serious injury or death could result.

IMPORTANT: *Disconnected 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 as this could introduce foreign material into the system. Tag all disconnected lines for ease of correct installation.*

1. Remove the transmission lower guard from under machine.
2. Disconnect the hoses at control valve.
3. Disconnect the control cable from the spool (18).
4. Remove the bolts and washers securing the valve to the plate assy. Remove the valve assembly and gasket.
5. Unscrew the nut and remove solenoid valve (22A) coil and cartridge. Remove solenoid valves (22B, 22F and 22R) in the same manner as solenoid valve (22A).
6. Unscrew the bolts and remove covers (1 and 21) with gaskets (3).

NOTE: *When removing spools, springs and orifices from valve housing, tag them according to their location.*

7. Remove spools (9 and 17), springs (10) and spool (18). Remove modulator spool (23).
8. Remove spool (39), spring (38), spool sleeve (37), modulator spool (36), outer spring (35), inner spring (20), regulator spool (26) and spring (27).
9. If necessary remove plug (24) with O-ring (25) from regulator spool (26).
10. If necessary remove cover (33), gasket (32), orifices (30 and 31), springs (29) and ball (28).
11. If necessary remove plugs (2, 13 and 14).

TRANSMISSION CONTROL VALVE

18. INSPECTION AND REPAIR

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

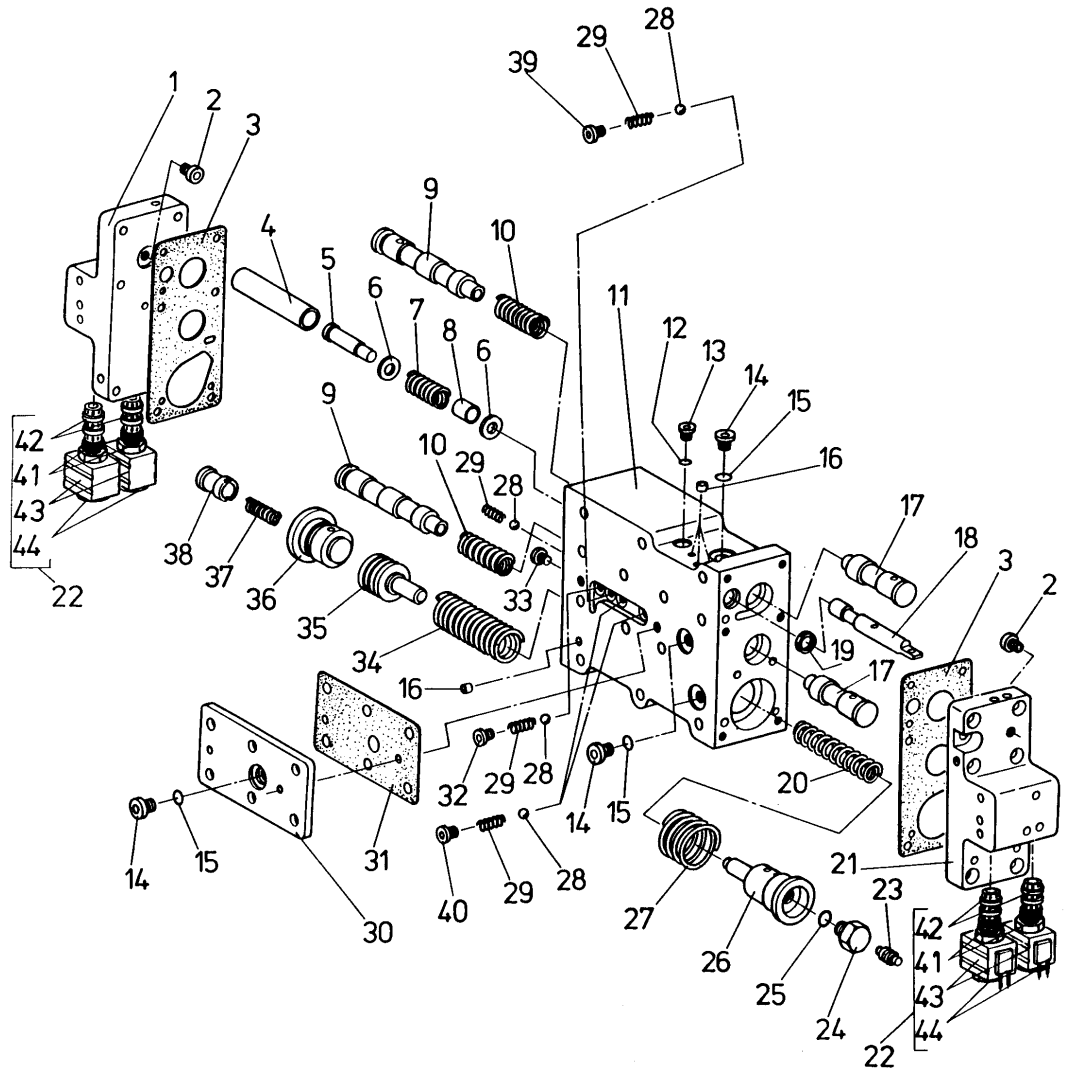


Fig. 7C.44. Control Valve Exploded View

1. L.H. Cover Assy
2. Plug
3. L.H. Cover Gasket
4. Spacer Sleeve
5. Bolt
6. Hardened Washer
7. Spring
8. Sleeve
9. Selector Long Spool
10. Return Spring
11. Valve Body
12. O-ring
13. Plug
14. Plug
15. O-ring
16. Plug
17. Selector Short Spool
18. Spool
19. Wiper Ring
20. Inner Spring
21. R.H. Cover Assy
22. Solenoid Valve
23. Modulator Spool
24. Plug
25. O-ring
26. Regulator Spool
27. Spring
28. Ball
29. Spring
30. Orifice
31. Orifice
32. Gasket
33. Cover
34. Plug
35. Outer Spring
36. Modulator Spool
37. Spool Sleeve
38. Spring
39. Spool
40. Cartridge
40. Solenoid
41. Nut
42. O-Ring

TRANSMISSION CONTROL VALVE

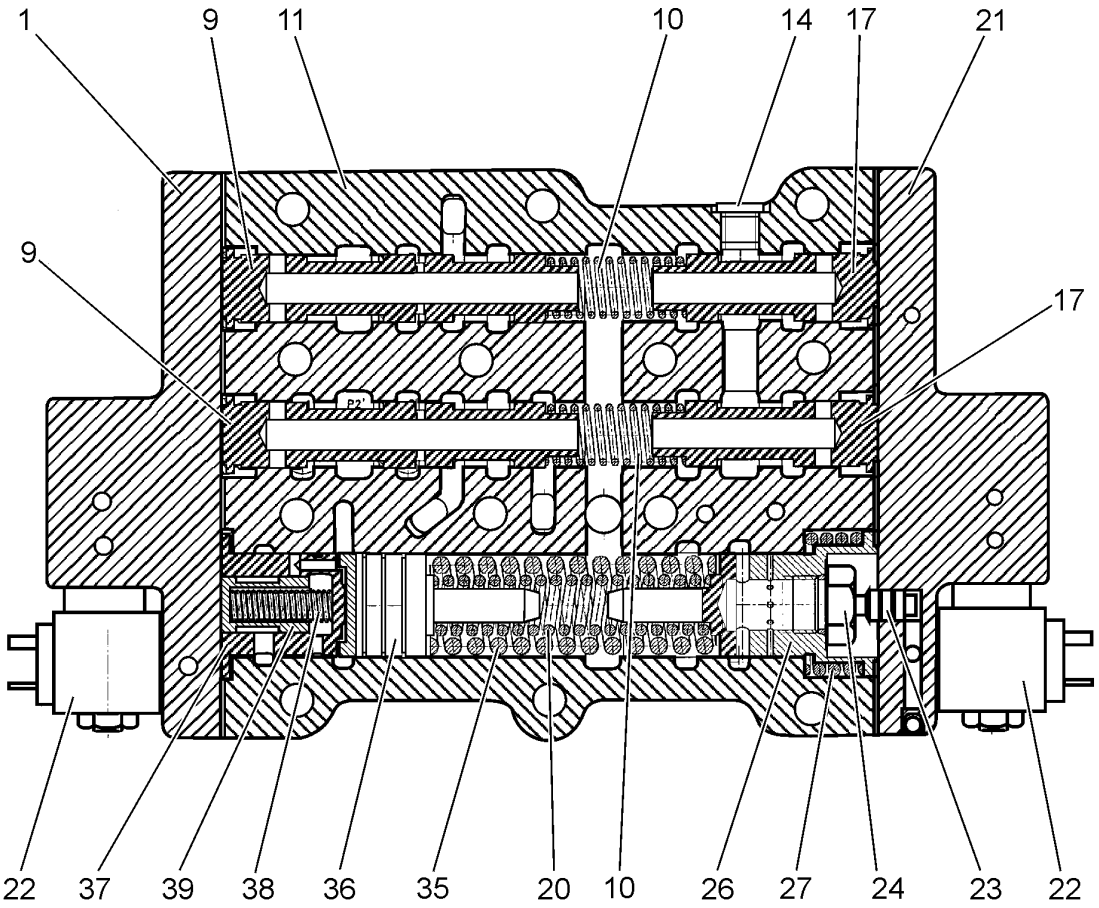


Fig. 7C.45. Control Valve Cross Section

1. L.H. Cover Assy
9. Selector Long Spool
10. Return Spring
11. Valve Body
14. Plug
17. Selector Short Spool
21. R.H. Cover Assy
22. Solenoid Valve
23. Modulator Spool
24. Plug
26. Regulator Spool
27. Spring
35. Outer Spring
36. Modulator Spool
37. Spool Sleeve
38. Spring
39. Spool

19. REASSEMBLY AND INSTALLATION (Fig. 7C.44 and 7C.45)

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

1. Install balls (28), spring (29) and orifices (30 and 31) in the valve body (11) if removed. Install cover (33), gasket (32) and plug (14) with O-ring (15). Tighten the bolts securing cover (33).
2. Install plug (24) with O-ring (25) in regulator spool (26).

NOTE: Be sure *springs and spools are assembled in the correct bore of the valve.*

3. Install regulator spool (26) with spring (27).
4. Install outer spring (35), inner spring (20), modulator spool (36), spool sleeve (37) and spool (39) with spring (38).

TRANSMISSION CONTROL VALVE

5. Install selector short spools (17), springs (10), selector long spools (9) and spool (18).
6. Install solenoid valve (22A) cartridge and torque it to 20÷24 [Nm]. Install solenoid valve (22A) coil and torque the nut to 4÷5 [Nm].
7. Install covers (1 and 21) with gaskets (3) to the valve body. Tighten the bolts securing covers (1 and 21).
8. Install plugs (2) and plugs (13 and 14) with O-rings (12 and 15) to valve body (11).
9. Position the valve and gasket on the plate assy and secure with bolts and washers. Apply Loctite 242 to the thread and torque the bolts to 34÷42 [Nm].
10. Reconnect the control cable to the spool (18).
11. Reconnect the control valve supply hose.
12. . Install the transmission lower guard to under machine.

SECTION 7D

DRIVE AXLE AND DIFFERENTIAL

DRIVE AXLE AND DIFFERENTIAL SECTION 7D

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SERVICE/SPECIAL TOOLS

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3. Seal ring driver tool 21.547.0098
4. Seal ring driver tool 21.547.0089
5. Bearing driver tool 8N54-82/100-190
6. Axle shaft bearing preload checking tool adapter socket 21.282.0175
7. Axle shaft bearing preload checking tool 21.263.0045
8. Axle shaft bearing preload checking tool adapter socket 21.282.0173
9. Axle shaft bearing preload checking tool 21.249.0019
10. Retaining ring pliers RSKm-200
11. Retaining ring pliers RSKn-200
12. Bearing cup driver tool 21.547.0131
13. Bearing cone driver tool 8N54-60/72-170
14. Bearing cone driver tool 8N54-50/65-200
15. Seal ring driver tool 8N54-65/90-55
16. Bearing cone driver tool 8N54-65/75-150
17. Bearing cup driver tool 21.547.0012
18. Dimension (C) measuring special tool 21.282.0159
19. Bolster trunnion bearing driver tool 1.547.0387
20. Pinion shaft bearings preload tool 21.282.0172
21. Disc gear free rolling torque checking tool 21.282.0160

GENERAL

2. DESCRIPTION AND OPERATION

This section covers the drive shafts, hanger bearing, planetary gear, wheel hub and service brake. For a detailed description of these components refer to the pertinent heading in this section.

Power is delivered from the engine (1) to the torque converter and transmission (2 and 3), then through drive shafts (4, 6 and 8) to the front and rear drive axles (7 and 9) and wheels.

The front drive axle (7) is remotely connected by the transmission to hanger bearing shaft (4), hanger bearing (5) and the hanger bearing to front drive axle shaft (6). The rear drive axle (9) is connected directly to the transmission by the transmission to rear drive axle shaft (8).

3. DESCRIPTION AND OPERATION

This machine uses three drive shafts: transmission to rear drive axle (8, Fig. 7D.1), transmission to hanger bearing (4) and hanger bearing to front axle (6).

The purpose of the drive shafts is to transmit power. An articulated joint located at each end of the shaft permits pivoting in all directions and adjusts for any misalignment between components. The function of the drive shafts is to transmit power from the transmission to front and rear drive axles.

DRIVE AXLE AND DIFFERENTIAL

DRIVE SHAFTS

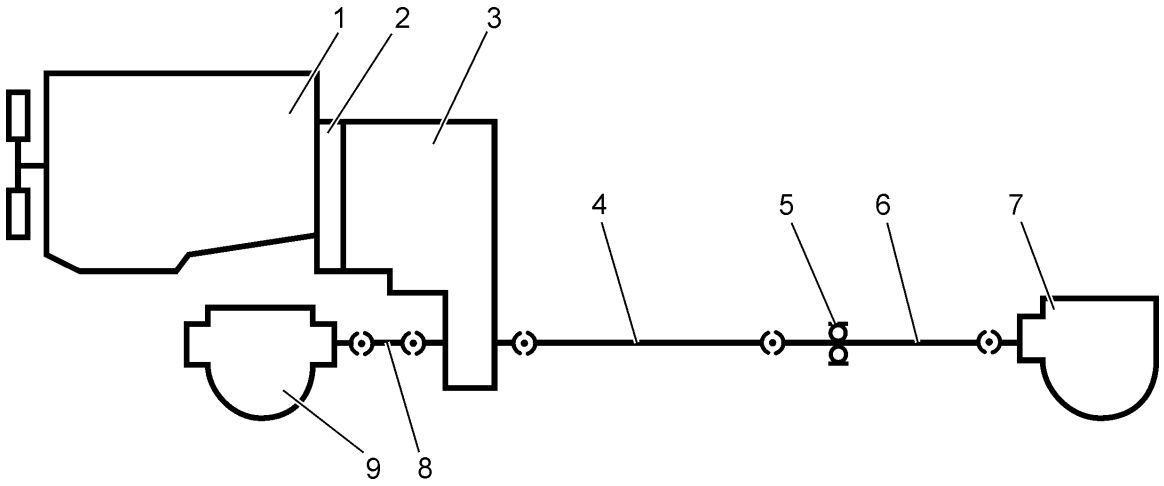


Fig. 7D.1. Power Flow From Engine to Drive Axles

1. Engine
2. Torque Converter
3. Transmission
4. Transmission to Hanger Bearing Shaft
5. Hanger Bearing
6. Hanger Bearing to Front Drive Axle Shaft
7. Front Drive Axle
8. Transmission to Rear Drive Axle Shaft
9. Rear Drive Axle

While in operation, the shafts are subjected to a constant strain, and it is important that they be correctly installed and maintained to lengthen their service.
The drive shaft consists of a universal joint at each end, which permits the shafts to rotate at a small angle in any direction. The front drive shafts also have a slip joint that allows the shafts to telescope and compensate for changes in distance between the transmission and drive axle.

4. SPECIFICATION

Drive shaft yoke mounting bolts ..... 66÷73 [Nm]
Hanger bearing to front axle drive shaft yoke mounting bolt ..... 250÷300 [Nm]

5. SERVICE DIAGNOSIS

COMPLAINT	
PROBABLE CAUSE	**REMARKS**
Noise	
1. Lack of lubricant	1. See Note A below
2. Backlash	2. See Note B below
3. Yoke(s) loose	3. See Note B below
4. Yoke shaft splines worn	4. See Note B below
Vibration	
1. Drive shaft sprung or bent	1. Replace drive shaft
2. Yoke(s) loose	2. Tighten mounting bolts
3. Articulated joint bearings not properly seated or worn	3. Disassemble and correct at fault or replace articulated joint
4. Excessive end play in transmission output shaft	4. Check and adjust end play. Refer to TRANSMISSION in Section 7C

DRIVE SHAFTS

A. Inspect the undercarriage and notice if grease is being thrown at the slip joints and articulated joints. Tighten retainer cap and lubricate slip joint. If grease still extrudes, replace washers in the retainer cap assembly. If grease is being thrown out at the articulated joints, remove the drive shaft and replace the bearing seals or replace the articulated joints, if the bearings are worn.
B. Use small pry bar to check the articulated joints and yokes for looseness and for play. If able to move either or both flanges back and forth, tighten the mounting bolts at the articulated joints and yokes. Using two pry bars, insert a bar between the articulated joint and the shaft (one on each side), if backlash is present upon twisting the shaft in ether direction, the splines are worn and the drive shaft must be replaced.

6. REMOVAL

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 electrical system master switch is off and the keys are removed from master switch and from starting switch.

WARNING! Always lock the frames together before working near the center of the machine. If the frames move, serious injury or death could result.

Transmission to Rear Axle Drive Shaft (Fig. 7D.2)

1. Remove the rear axle yoke mounting bolts (3) and the transmission output yoke mounting bolts (5).

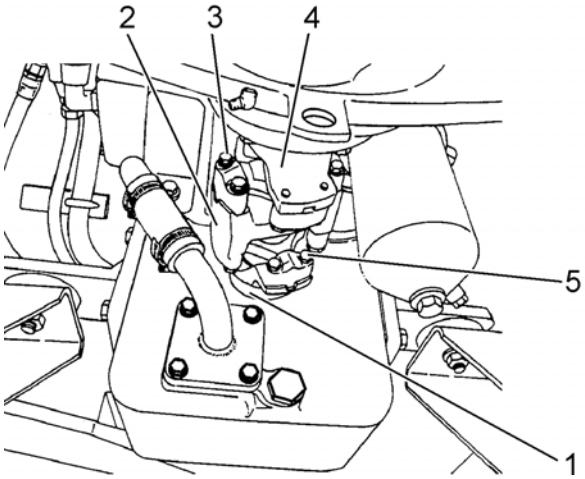


Fig. 7D.2. Transmission to Rear Axle Drive Shaft Disconnect Points

1. Transmission Rear Output Yoke
2. Transmission to Rear Axle Drive Shaft
3. Rear Axle Yoke Mounting Bolts
4. Rear Axle Yoke
5. Transmission Output Yoke Mounting Bolts

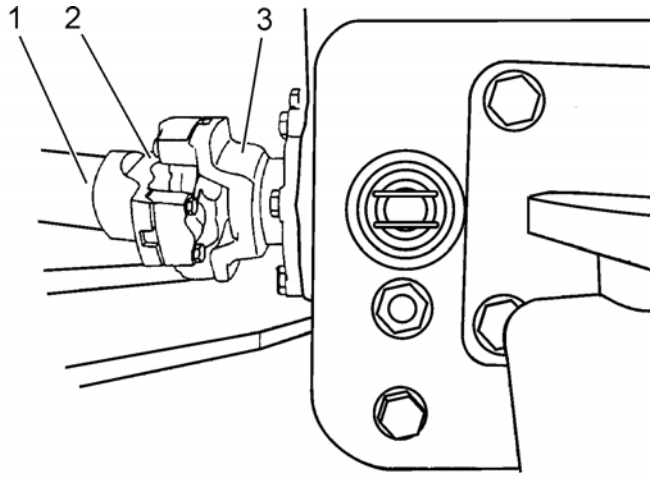


Fig. 7D.3. Drive Shaft Disconnect Point at Transmission Output Yoke

1. Transmission to Hanger Bearing Drive Shaft
2. Transmission Yoke Mounting Bolts
3. Transmission Front Output Yoke

DRIVE SHAFTS

2. Tap the drive shaft away from the rear axle yoke. This causes the transmission output yoke (1) to slide into the transmission, giving enough clearance for the drive shaft bearings to be disconnected from their respective pilots and key seats in the rear axle yoke.
3. Unseat the bearings from the transmission yoke. It might also be necessary to tap the top of the bearings slightly, in order to release them from their respective pilots and key seats in the yoke.
4. Remove the drive shaft from the machine.

IMPORTANT: *Mark the spider and bearing caps before removal to maintain established wear pattern and ease of correct reinstallation.*

Transmission to Hanger Bearing Drive Shaft (Fig. 7D.3)

1. Remove the transmission yoke mounting bolts (2).
2. Unseat the bearings from the transmission output yoke (3). It might also be necessary to tap the top of the bearings slightly, in order to release them from their respective pilots and key seats in the yoke.
3. Using a pry bar, apply inward leverage to the telescoping slip yoke. This will compress the shaft assembly in the slip joint thus giving clearance for the drive shaft bearings to be disconnected from their respective pilots and key seats in the yoke.
4. Remove the spline shaft mounting bolts (1, Fig. 7D.4). Unseat the bearings from the yoke and remove the drive shaft from the machine.

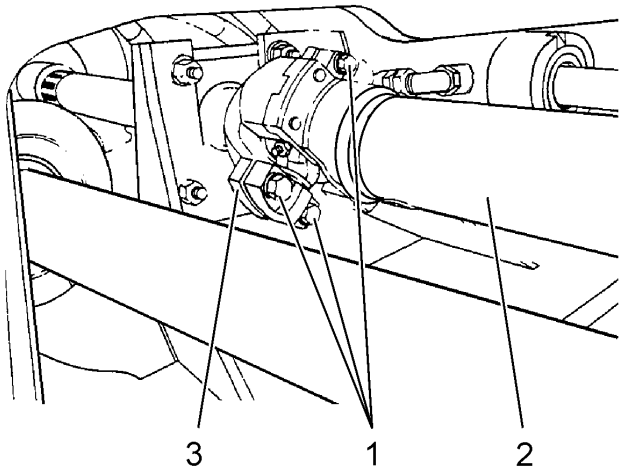


Fig. 7D.4. Drive Shaft Disconnect Point at Spline Shaft Yoke

1. Spline Shaft Yoke Mounting Bolts
2. Transmission to Hanger Bearing Drive Shaft
3. Spline Shaft Yoke

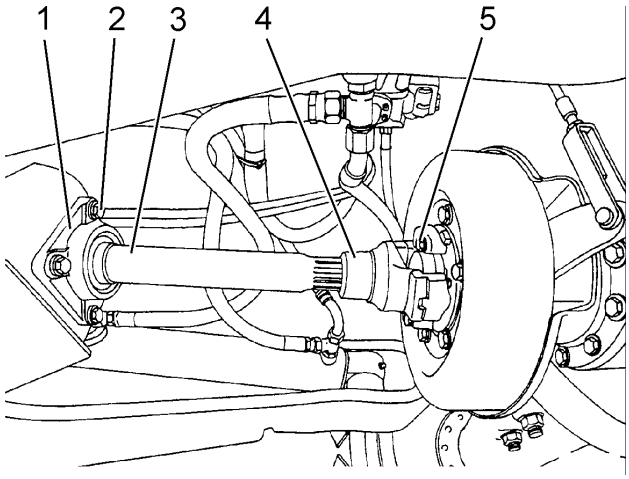


Fig. 7D.5.Hanger Bearing to Front Axle Drive Shaft Disconnect Points

1. Hanger Bearing Flange
2. Hanger Bearing Flange Mounting Bolts
3. Spline Shaft
4. Spline Shaft Yoke
5. Front Axle Yoke Mounting Bolts

Hanger Bearing to Front Axle Drive Shaft

NOTE: *For faster and more efficient removal and installation the spline shaft should be removed with the yokes and hanger bearing as an assembly.*

DRIVE SHAFTS

1. Remove the spline shaft yoke mounting bolts (1, Fig. 7D.4). Unseat the bearings from the yoke. Disconnect the spline shaft yoke from the transmission to hanger bearing drive shaft yoke.
2. Remove front axle yoke mounting bolts (5, Fig. 7D.5). Unseat the bearings from the yoke (4). Slide the spline shaft yoke back away from the front axle yoke.
3. Remove the hanger bearing flange mounting bolts (2), washers and nuts. Remove the spline shaft, yokes and hanger bearing as an assembly from the machine.

7. DISASSEMBLY

Transmission to Rear Axle Drive Shaft (Fig. 7D.6)

1. Mark the bearing caps and spiders before disassembly to maintain established wear pattern and ease of correct reassembly.
2. Remove the articulated joint bolts (3).
3. Separate the articulated joints (1) from the yoke (4). It may be necessary to tap the top of the bearings lightly with a plastic hammer in order to release them from their respective pilots and key seats in the yokes.

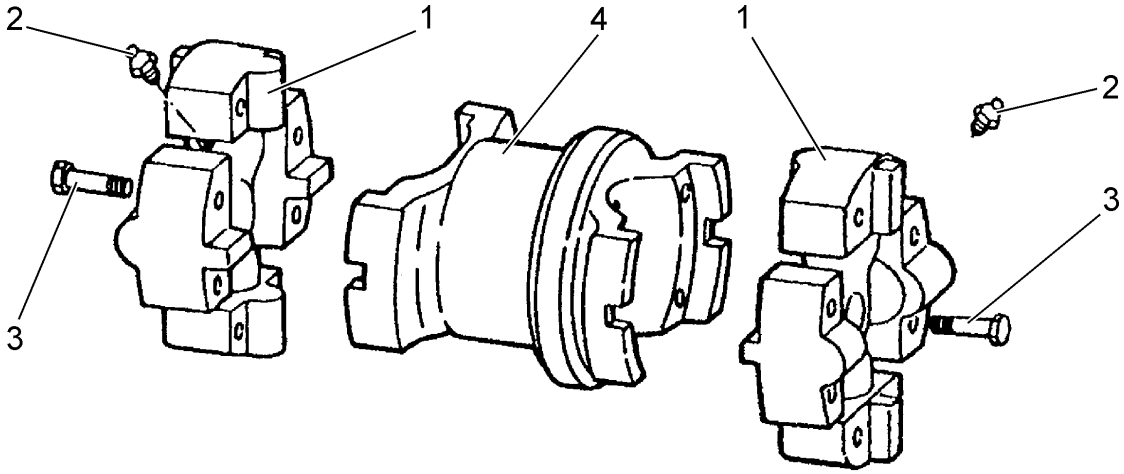


Fig. 7D.6. Transmission to Rear Axle Drive Shaft

1. Articulated Joints
2. Lubrication Fittings
3. Bolts
4. Yoke

Transmission to Hanger Bearing Drive Shaft (Fig. 7D.7)

1. Mark the bearing caps and spiders before disassembling and tag each assembly to maintain the established wear pattern and ease of correct reassembly.
2. Remove the articulated joint bolts (2).
3. Separate the articulated joints (3) from the yoke (10) and spline shaft (9). It may be necessary to tap the top of the bearings lightly with a plastic hammer in order to release them from their respective pilots and key seats in the yokes.
4. Punch mark yoke (10) and spline shaft (9) so they will be reassembled in the same alignment.
5. Unscrew retainer cup (6) and slide it back on spline shaft (9).
6. Separate the yoke (10) from the spline shaft (9).
7. Remove washer (8), felt seal (7) and the second washer (8) from the retainer cup (6).

DRIVE AXLE AND DIFFERENTIAL

DRIVE SHAFTS

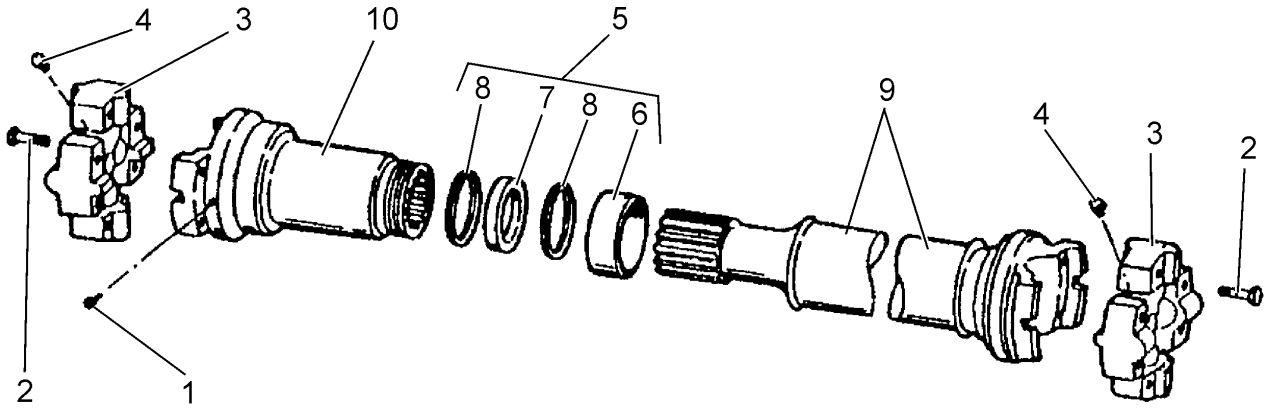


Fig. 7D.7. Transmission to Hanger Bearing Drive Shaft

1. Lubrication Fitting
2. Bolts
3. Articulated Joints
4. Lubrication Fittings
5. Retainer Cup Assy
6. Retainer Cup
7. Felt Seal
8. Washer
9. Spline Shaft
10. Yoke

Hanger Bearing to Front Axle Drive Shaft (Fig. 7D.8)

1. Remove the articulated joint (7) bolts.
2. Separate the articulated joint (7) from the yoke (1). It may be necessary to tap the top of the bearings lightly with a plastic hammer in order to release them from their respective pilots and key seats in the yoke.
3. Remove yoke (1) from the shaft (2).

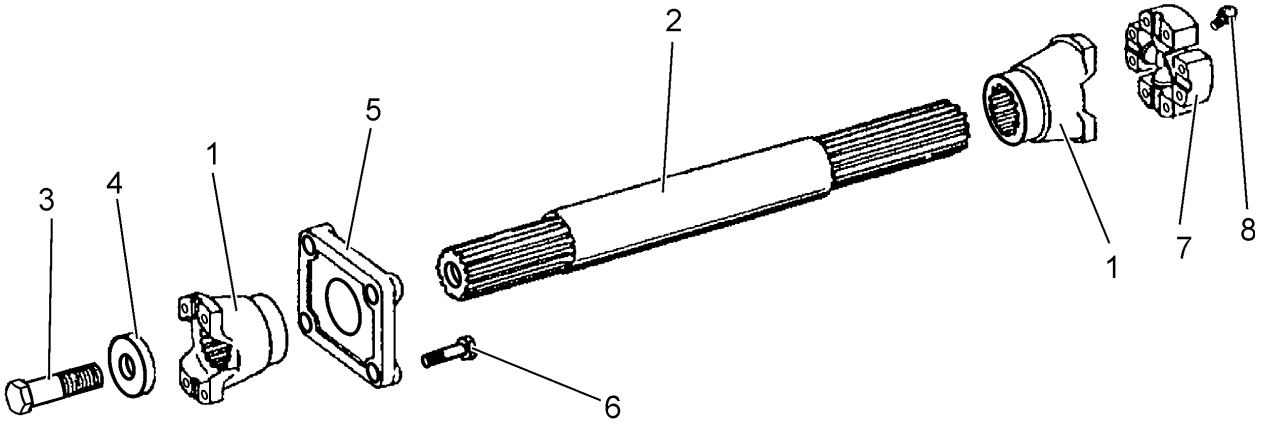


Fig. 7D.8. Hanger Bearing to Front Axle Drive Shaft

1. Yokes
2. Shaft
3. Bolt
4. Washer
5. Flanged Bearing
6. Bolt
7. Articulated Joint
8. Lubrication Fitting

4. Remove bolt (3) and washer (4). Remove yoke (1) from the spline shaft (2).
5. Unscrew the screws in the flanged bearing (5). Press the flanged bearing (5) from the shaft (2) as shown in Fig. 7D.9.

DRIVE SHAFTS

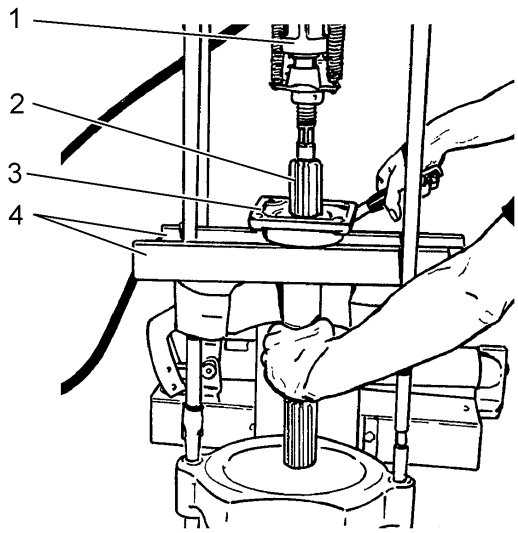


Fig. 7D.9. Removing Hanger Bearing from Spline Shaft

1. Hydraulic Ram
2. Spline Shaft
3. Hanger Bearing
4. Supports

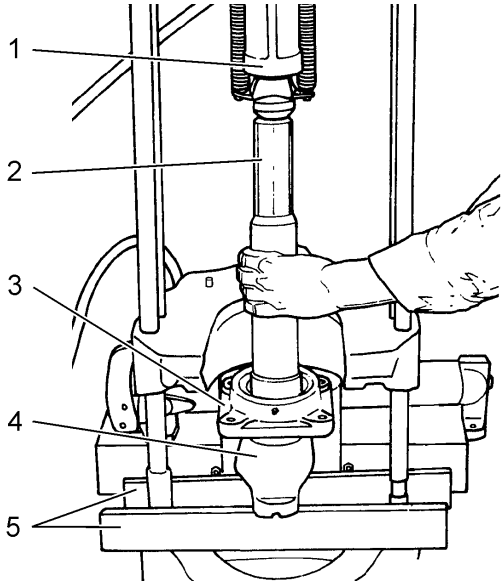


Fig. 7D.10. Pressing Hanger Bearing on Drive Shaft

1. Hydraulic Ram
2. Spline Shaft
3. Hanger Bearing
4. Yoke
5. Supports

8. INSPECTION AND REPAIR

1. Clean all parts thoroughly in a commercial solvent and dry with compressed air.
2. Remove all burrs and rough spots from the yoke flanges and from slip joint splines. Use a fine tooth file or a fine stone.
3. Inspect the drive shafts for signs of torsional fractures or other indications of impending failure.
4. Place the bearing assemblies on the spider and check for wear. If they are worn, replace the articulated joint.
5. Check all lubrication fittings and grease passages for restrictions.

9. REASSEMBLY

NOTE: *For easier scheduled maintenance of the drive shafts, assemble articulated joint to the drive shaft with the lubrication fittings in the same position.*

Transmission to Rear Axle Drive Shaft (Fig. 7D.6)

1. Installs articulated joint (1) on each end of shaft (4). Be sure the bearings are seated properly, it may be necessary to tap the bearing lightly into their key seats with a plastic hammer. Torque bolts (3) to 66÷73 [Nm].
2. Drive shaft must be fully lubricated as described in the OPERATOR'S MANUAL before the machine is moved.

Transmission to Hanger Bearing Drive Shaft (Fig. 7D.7)

1. Place the retainer cup (6) and then the felt seal (7) with the washers (8) on each side over the spline shaft (9). Coat the shaft splines liberally with grease.
2. Slide the yoke (10) onto the spline shaft (9) aligning the punch marks made at disassembly. Screw the retainer cup (6) onto the yoke (10) and tighten securely.

DRIVE SHAFTS

3. Install the articulated joint (3) to the spline shaft (9) and to the yoke (10). Be sure the bearings are seated properly, it may be necessary to tap the bearings with plastic hammer into their key seats. Torque bolts (2) to 66÷73 [Nm].
4. Place the drive shaft in position between the mating yokes on the machine being sure the keys on the caps are piloted into the mating yoke grooves before tightening bolts. Bearing caps may be tapped lightly to seat assembly, but do not force bearing caps that do not seat properly.
5. Torque all mounting bolts to 66÷73 [Nm].
6. Drive shaft must be fully lubricated as described in the OPERATOR'S MANUAL before the machine is moved.

Hanger Bearing to Front Axle Drive Shaft (Fig. 7D.8)

1. Slide hanger bearing (5) and yoke (1) onto the end of shaft (2). Press the hanger bearing (5) onto shaft (2), using the yoke (1) as a support as shown in Fig. 7D.10.
   The hanger bearing should be pressed until it bottoms out on the shoulder of the shaft (2). Remove the shaft from the press.
2. Remove the yoke (1) and apply a coat of grease on the splines of both ends of the shaft (2).
3. Install two yokes (1) on the shaft (2), being sure they are installed on the same plane. Secure yoke (1) with washer (4) and bolt (3). Torque the bolt to 250÷300 [Nm].
4. Install articulated joint (7) on yoke (1). Be sure the bearings are seated properly, it may be necessary to tap the bearings with plastic hammer into their key seats. Torque bolts to 66÷73 [Nm].
5. Drive shaft must be fully lubricated as described in the OPERATOR'S MANUAL before the machine is moved.

10. DESCRIPTION AND OPERATION

The front axle is bolted to the front frame, and the rear axle is bolted to an oscillating cradle called a bolster, which is pinned to the rear frame. All components of both axles are similar with the exception of a parking brake mounted to the front axle differential. Both axles consist of a differential, two axle shafts, one pair of disc brakes, and two planetaries.

The axle assemblies accomplish three main functions: they change the direction of the input torque from the drive shaft, sending it 90 degrees to the right and left; they increase the input torque through reduction gearing, and they provide a means of securing the wheels and supporting the machine.

Both axles are full floating and double reduction. Full floating means that none of the weight is supported by, or transmitted to the axle shafts. All weight on the axles is supported by the wheels, the bearings and the axle housing. The first reduction occurs in the differential between the pinion shaft and disc gear. The second gear reduction takes place in the planetary housing where the planet gear multiply the input torque from the axle shaft.

11. SPECIFICATION

Special torques:

Front drive axle mounting bolts ..... 780÷960 [Nm]
Rear drive axle bolster trunnion mounting bolts ..... 340÷420 [Nm]
Axle shaft housing mounting bolts ..... 250÷310 [Nm]
Wheel mounting bolts ..... 780÷960 [Nm]

DRIVE AXLES

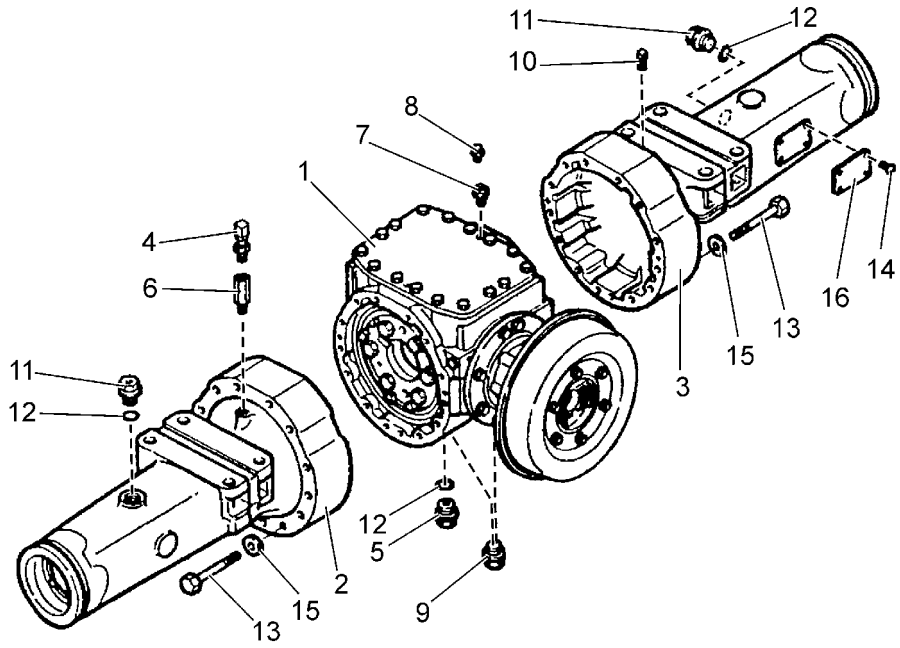


Fig. 7D.11. Front Axle

1. Differential Assy
2. Housing Assy L.H.
3. Housing Assy R.H.
4. Breather
5. Magnetic Plug
6. Connector
7. Breathers
8. Caps
9. Magnetic Plugs
10. Plug
11. Plugs
12. O-rings
13. Bolts
14. Rivet
15. Washers
16. Identification Plate

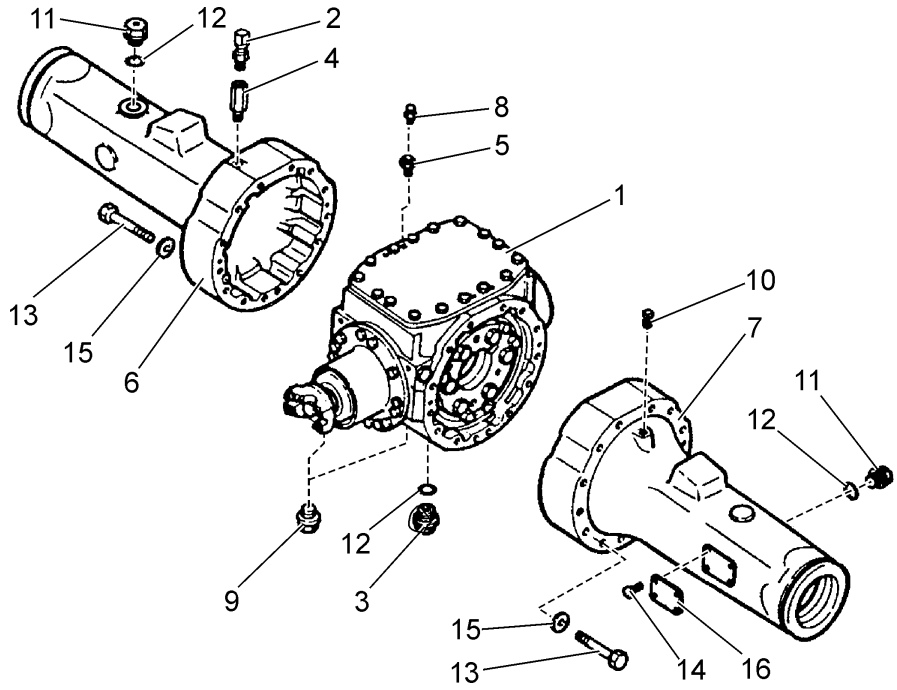


Fig. 7D.12. Rear Axle

1. Differential Assy
2. Breather
3. Magnetic Plug
4. Connector
5. Breathers
6. Housing Assy L.H.
7. Housing Assy R.H.
8. Caps
9. Magnetic Plugs
10. Plug
11. Plugs
12. O-rings
13. Bolts
14. Rivet
15. Washers
16. Identification Plate

DRIVE AXLE AND DIFFERENTIAL

DRIVE AXLES

12. SERVICE DIAGNOSIS

NOTE: *Axle noise may be isolated within the axle by jacking up the machine so the tires clear the ground. If the noise is in one axle, disconnect the drive shaft of the opposite axle at the transmission. Now the noise may be isolated with only the noisy axle turning. Run the engine at a moderate speed with the transmission in first gear. Both wheels must be off the ground to prevent damage to the differential*.

COMPLAINT	
PROBABLE CAUSE	**REMARKS**
Excessive Noise	
1. Incorrect lubricant, or level too low	1. Refer to **Loss of Lubricant** complaint
2. Bearing scored or damaged	2. Replace bearings
3. Sun gear teeth worn or damaged	3. Replace axle shaft. Check planetary gear
4. Planetary gears or ring gear worn or damaged	4. Replace planet and/or ring gear. Check sun gear teeth for damage
5. Planetary bearings damaged	5. Replace bearings
Loss of Lubricant	
1. Lubricant level to high	1. Drain to correct level. Refer to Operator's Manual.
2. Lubricant foams due to incorrect type	2. Drain and fill with correct type and viscosity of oil. Refer to Operator's Manual.
3. Lubricant leaks at wheel mounting flange	3. Replace seal
4. Lubricant leaks at differential housing	4. Remove differential housing and replace seal ring
Wheel Drags	
1. Service brake problem	1. Check for proper condition of service brake parts. Refer to SERVICE DIAGNOSIS under MASTER BRAKE in Section 4.
Brake does not work properly	
1. Brake disc worn	1. Check the brake disc. Refer to Operator's Manual.
2. Brake piston seals worn	2. Replace seals as necessary. Refer to MASTER BRAKE in Section 4.

DRIVE AXLES

13. REMOVAL

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 electrical system master switch is off and the keys are removed from master switch and from starting switch.

NOTE: *The machine weights over 9500 [kg] for 515G and 11000 [kg] for 520G. Adequate lifting and blocking equipment must be available before beginning axle removal.*

WARNING! Use extra caution when jacking up the machine. Jacking up the machine can be hazardous if performed improperly. Use jacking equipment of sufficient capacity. Be sure the jacking points are strong enough to support the machine. Be sure the jack is stable and well supported. Before jacking up the machine, block the tires, which will not be lifted. Lock the frames together with the locking bar and pins. If the rear tires are being lifted, block the rear axle to prevent it from pivoting unexpectedly. DO NOT run the engine with the machine on jacks. For your safety, transfer the weight of the machine to approved blocks before servicing the machine.
Lift and handle all heavy parts with lifting devices of adequate capacity. Secure parts with proper slings and hooks. Use lifting eyes provided. Warn nearby personnel to stand clear. For your safety, whenever using blocking for support, use proper and approved blocks.

IMPORTANT: *Disconnected 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 as this could introduce foreign material into the system. Tag all disconnected lines for ease of correct installation.*

1. Park the machine on a level surface. Install the frame locking bar so that frame halves are in a straight ahead position.
2. Loosen, but do not remove the wheel mounting bolts.
3. Drain the axle assembly as described in the OPERATOR'S MANUAL.

FRONT AXLE ONLY

4. Raise front wheels off the ground by placing the bucket on ground or suitable blocks and placing boom in LOWER and then HOLD.
5. Block the machine on substantial wood timbers placed under the horizontal portion of front frame in front of center hinge pin.
6. Lower machine onto blocks by putting boom into RAISE. Front tires should be just off the ground.
7. After resting boom/bucket weight on ground, shut off engine.
8. Remove hanger bearing to front axle drive shaft. Refer to DRIVE SHAFTS in this section.
9. Attach a suitable hoist and sling to the wheels. Remove the mounting bolts and remove the wheels from both ends of the axle.

NOTE: *Complete front axle weight is 600 [kg].*

DRIVE AXLE AND DIFFERENTIAL

DRIVE AXLES

10. Disconnect the hydraulic brake tubing on both sides of the differential housing.
11. Disconnect the parking brake linkage at the parking brake. This will allow the brake assembly to come off with the axle.
12. With the axle assembly adequately supported, remove the axle mounting hardware and remove from the machine and lower the axle to the floor. Refer to Fig. 7D.13. Place the axle assembly in a suitable work stand with the differential positioned upward.

REAR AXLE ONLY

13. Jack up the rear of the machine. Block the machine on supports or substantial wood timbers, placed under the horizontal portion of rear frame. Refer to Fig. 7D.14.
14. Remove transmission to rear axle drive shaft. Refer to DRIVE SHAFTS in this section.

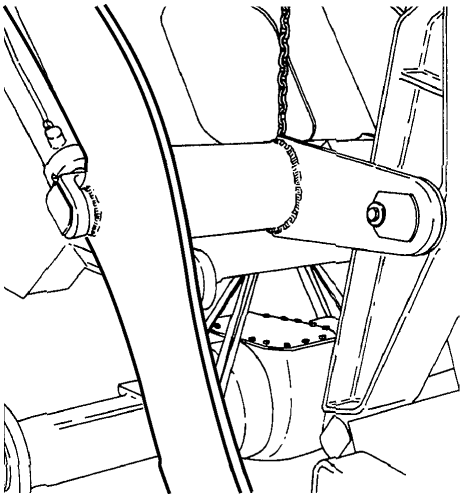


Fig. 7D.13. Removing Front Axle

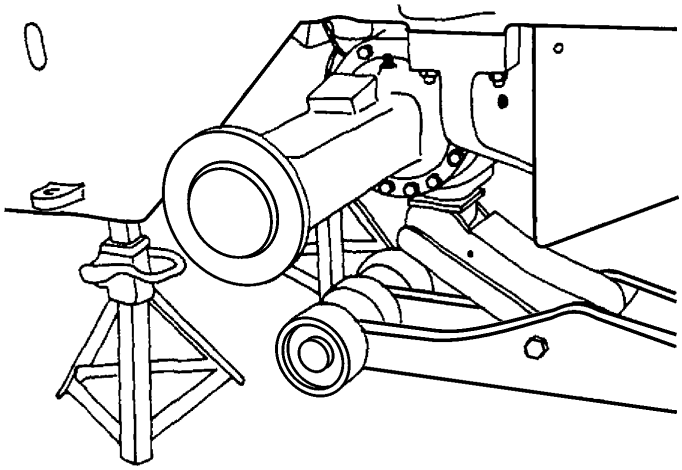


Fig. 7D.14. Axle Mounting and Jack Position

15. Position a mobile floor jack under the center of the axle as shown in Fig. 7D.14. Remove the bolts securing the axle rear bolster trunnion (6, Fig. 7D.15 or 7D.17) and the axle front bolster trunnion (7) to the rear frame.
16. Remove the drive axle with the front and rear bolster trunnions attached. Remove the trunnion thrust cap (1), shims (2), and thrust disc (3) from the axle rear bolster trunnion (6). Lower the drive axle on the ground carefully.

Only 515G (Fig. 7D.15 and 7D.16)

17. Remove washer (8) from rear bolster trunnion (6). Remove rear bolster trunnion (6) from the drive axle and remove strip (4) and O-ring (5) from the rear bolster trunnion (6). Remove the yoke from front side of the drive axle. Remove front bolster trunnion (7) from the drive axle. Remove strip (4) and two O-rings (5) from the front bolster trunnion (7).

Only 520G (Fig. 7D.17 and 7D.18)

18. Remove rear bolster trunnion (6) from the drive axle and remove rear bearing (4) from the rear bolster trunnion (6) if necessary.
    Remove the yoke (10) from front side of the drive axle. Remove front bolster trunnion (7) from the drive axle. Remove two front bearings (9) from the front bolster trunnion (7).
19. Remove bushings (5 and 8) from drive axle if necessary.

DRIVE AXLES

REMOVAL - Continued

20. To remove all or any of the components from the axle assembly, refer to the pertinent heading in this section for the desired component.

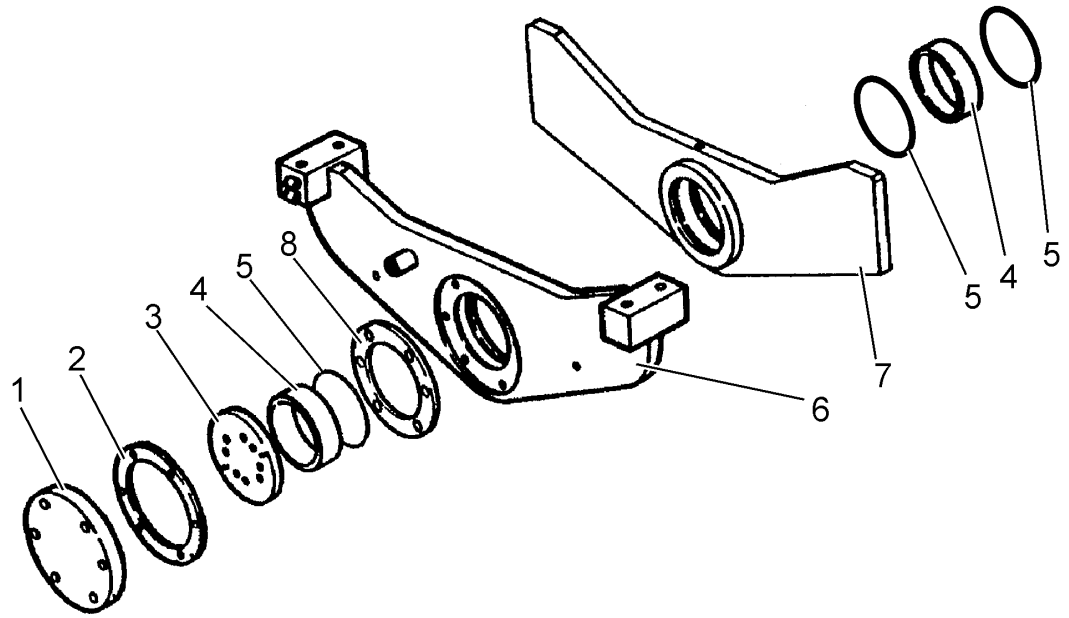


Fig. 7D.15. Bolster Rear Axle Exploded View (515G)

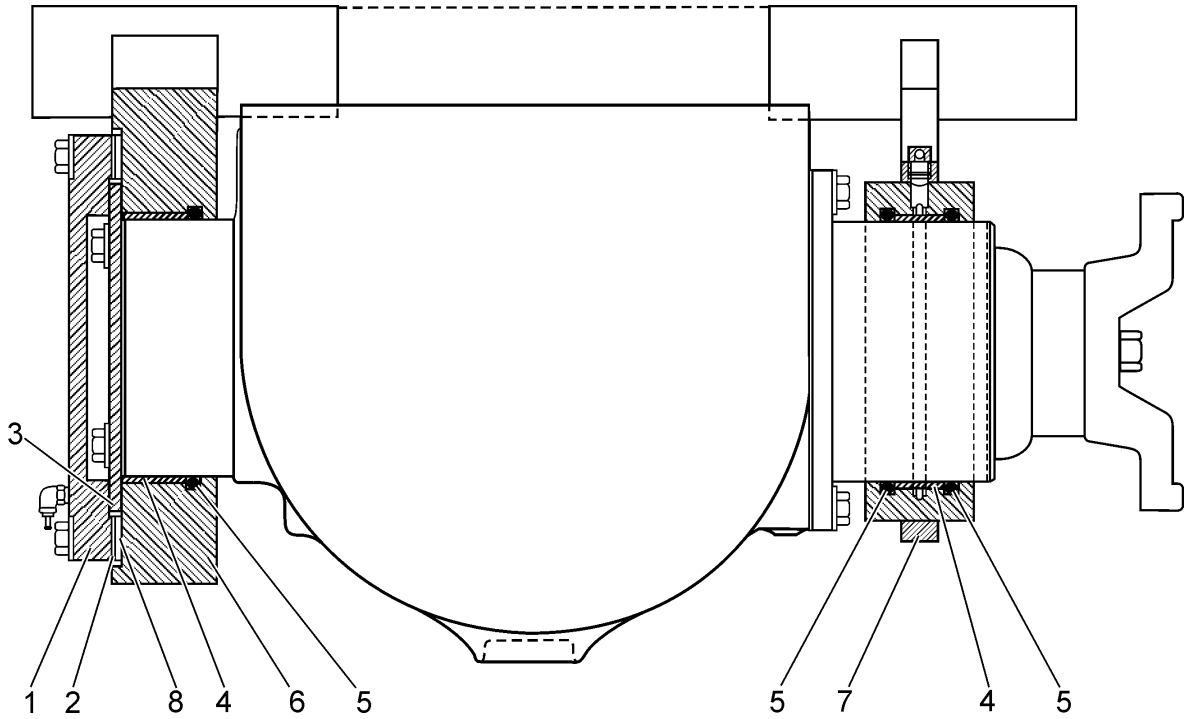


Fig. 7D.16. Bolster Rear Axle Cross Section (515G)

1. Trunnion Thrust Cap
2. Shim(s)
3. Thrust Disc
4. Strip
5. O-rings
6. Axle Rear Bolster Trunnion
7. Axle Front Bolster Trunnion
8. Washer

DRIVE AXLE AND DIFFERENTIAL

DRIVE AXLES

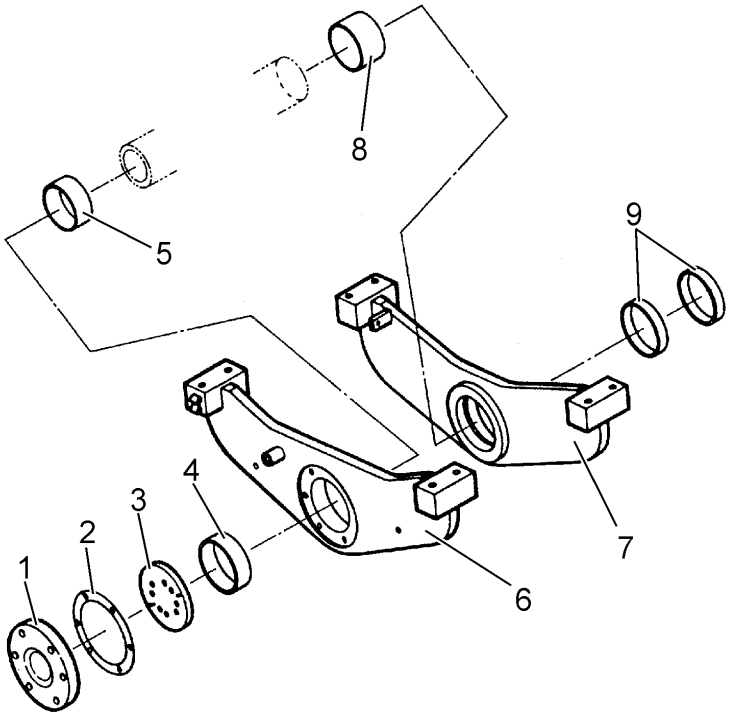


Fig. 7D.17. Bolster Rear Axle Exploded View (520G)

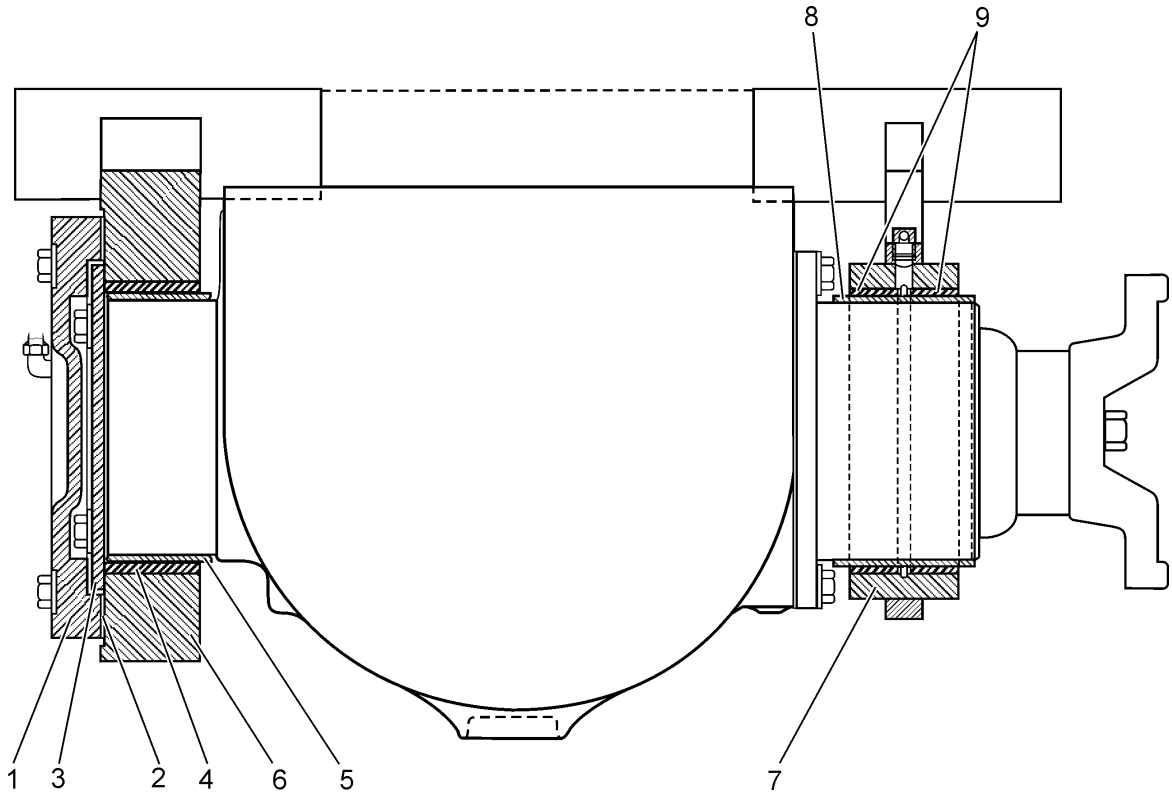


Fig. 7D.18. Bolster Rear Axle Cross Section (520G)

1. Trunnion Thrust Cap
2. Shim(s)
3. Thrust Disc
4. Rear Bearing
5. Split Rear Bushing
6. Axle Rear Bolster Trunnion
7. Axle Front Bolster Trunnion
8. Split Front Bushing
9. Front Bearings

DRIVE AXLES

14. INSTALLATION

FRONT AXLE

1. To install the components removed from the axle assembly, refer to the instructions under the pertinent heading in this section.

NOTE: *If the differential was removed, be sure the axle housing is positioned in the work stand with the bowl opening up to allow the differential to be lowered into position with a hoist and chain*.

2. Position the axle under the machine. Install the mounting hardware and torque the bolts to 780÷960 [Nm].
3. Install hanger bearing to front axle drive shaft. Refer to DRIVE SHAFTS in this section.
4. Connect the parking brake linkage.
5. Connect the hydraulic brake tubing to the axle differential housing. Bleed the brakes as described in OPERATOR'S MANUAL.
6. Install the wheels to both sides of the axle. Install and tighten the mounting bolts, then lower the wheels to the ground and torque bolts to 780÷960 [Nm].
7. Fill the axle assembly with oil as described in the OPERATOR'S MANUAL.
8. Adjust the parking brake as described under PARKING BRAKE in Section 4.

REAR AXLE

9. To install the components removed from the axle assembly, refer to the instructions under the pertinent heading in this section.

NOTE: *If the differential was removed, be sure the axle housing is positioned in the work stand with the bowl opening up to allow the differential to be lowered into position with a hoist and chain*.

NOTE: *Coat drive axles trunnions with grease LITOMOS EP-23 while assembling.*

515G Only (Fig. 7D.15 and 7D.16)

10. Install two O-rings (5) and strip (4) into front bolster trunnion (7). Install O-ring (5) and strip (4) into rear bolster trunnion (6). Be sure the chamfer on strip (4) is on the lead in side for the axle.
11. Install the front bolster trunnion (7) on drive axle. Position the rear axle on a floor jack. Raise the axle up and secure the bolster trunnion (7) to the rear frame being careful not to damage the O-rings (5). Torque the mounting bolts to 340÷420 [Nm]. Install yoke, O-ring and washer on the pinion shaft and torque the mounting bolt to 250÷300 [Nm]. Hold the wheel mounting flange while torquing the bolt.

520G Only (Fig. 7D.17 and 7D.18)

12. Preheat rear bolster trunnion opening to 55÷60 [°C]. Froze the rear bearing (4) to -5 [°C] and install it in the rear bolster trunnion (6) using bearing driver tool 1.547.0387. Preheat rear bushing (5) to 90÷100 [°C] and install it on the drive axle using soft hammer. Install rear bolster trunnion (6) on the drive axle.
13. Preheat front bolster trunnion opening to 55÷60 [°C]. Froze two front bearings (9) to -5 [°C]. Install two front bearings (9) to the front bolster trunnion (7) using bearing driver tool 1.547.0387. Install the front bolster trunnion (7) on drive axle. Install yoke, O-ring and washer on the pinion shaft, torque the mounting bolt to 250÷300 [Nm]. Hold the wheel mounting flange while torquing the bolt. Preheat front bushing (8) to 90÷100 [°C] and install it on the drive axle using soft hammer.
14. Position the rear axle on a floor jack. Raise the axle up and secure the bolster trunnions (6 and 7) to the rear frame. Torque the mounting bolts to 340÷420 [Nm].

DRIVE AXLES

INSTALLATION – Continued

15. Move the axle rearward as far as it will go and install thrust disc (3, Fig. 7D.16 and 7D.18) on the axle rear bolster trunnion (6) as shown in Fig. 7D.19. Torque the bolts to 85÷100 [Nm]. Remove the floor jack.

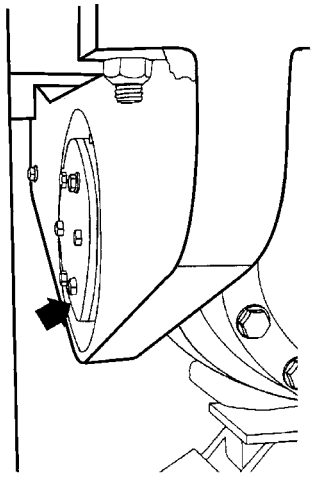


Fig. 7D.19. Trunnion Thrust Disc

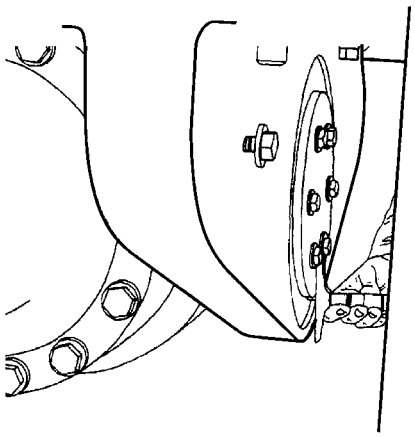


Fig. 7D.20. Measuring Distance from Thrust Disc to Rear Bolster Trunnion

16. Using a pry bar between the rear bolster trunnion (6) and the axle move axle forward as far as it will go.
17. Measure the distance from the top surface of the thrust disc (3) to the machined surface of the bolster trunnion (6) as shown in Fig. 7D.20. Take several measurements and record them.
18. Measure the depth of the step in the trunnion thrust cup (1) as shown in Fig. 7D.21. Take several measurements around the cup and record them.
19. Subtract the smallest measurement taken in step 18 from the largest measurement in step 17. Add 0.13÷0.38 [mm] to the remainder. This figure is a total thickness of shims required between the bolster trunnion (6) and thrust cup (1).
20. Install shims (2) and trunnion thrust cap (1) to rear bolster trunnion (6). Torque the bolts to 80÷100 [Nm].
21. Install transmission to rear axle drive shaft. Refer to DRIVE SHAFTS in this section.
22. Lubricate the rear axle bolster pivots as described in the OPERATOR'S MANUAL.

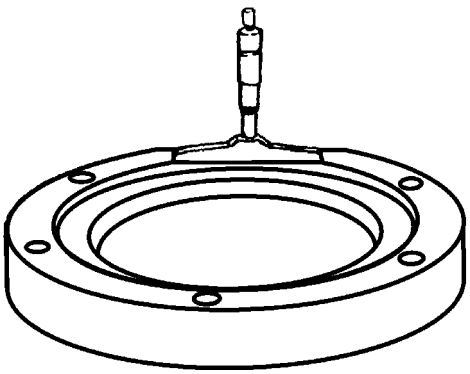


Fig. 7D.21. Measuring Depth of Step in Trunnion Thrust Cap

DRIVE AXLES

23. Connect the hydraulic brake tubing to the axle differential housing. Bleed the brakes as described in OPERATOR'S MANUAL.
24. Install the wheels to both sides of the axle. Install and tighten the mounting bolts, then lower the wheels to the ground and torque bolts to 780-960 [Nm].
25. Fill the axle assembly with oil as described in the Operator's Manual.

PLANETARY GEAR

15. DESCRIPTION (Fig. 7D.22 and 7D.23)

The carrier assemblies (1) are located on either side of the differential assembly, on the inboard end of each axle shaft. Each planetary gear consists of a carrier (16), three planetary gears (9) and a ring gear (14). In the center of the planetary assembly is the sun gear, which is integral with the axle shaft (4).

The axle shaft (4) (sun gear) is meshed with the planetary gears (9). On the outside of the carrier (16) planetary gears (9) are meshed with the ring gear (14), which is held stationary in the axle housing (6).

The planetary axle shaft (7) attains drive from the bevel side gear of the differential assembly through axle shaft (4) and carrier assy (1). The rotating axle shaft (4) (sun gear) causes the planetary gears (9) to turn in the carrier (16). The planetary gears (9) turn against the stationary ring gear (14). The rotation of the planetary gears (9) set the carrier (16) in motion. This causes the axle shaft (7), to which the carrier (16) is splined, to rotate and drive the wheels.

16. SPECIFICATION

Axle Shaft Free Rolling Torque .....4÷10 [Nm]

Special torques:

Axle housing to differential assy housing mounting bolts.....250÷310 [Nm]
Carrier assy to axle shaft mounting bolt.....240÷300 [Nm]

17. REMOVAL AND DISASSEMBLY

1. Remove drive axle as described in DRIVE AXLE in this section.
2. Clean all parts thoroughly to prevent the entry of dirt while disassembling.
3. Place the drive axle on a suitable stand or workbench.
4. Mark the axle housing to aid in determining the left and right housing when assembling to the differential housing.
5. Attach the hoist and sling (A, Fig.7D.26) to axle housing. Remove two housing mounting bolts (opposite each other) and install two threaded dowels (B) of the same diameter as removed mounting bolts. Remove the remaining bolts and separate the axle housing (6) from the differential assy (C).
6. Pry thrust plate (15, Fig.7D.27) from the axle housing (6).

DRIVE AXLE AND DIFFERENTIAL

PLANETARY GEAR

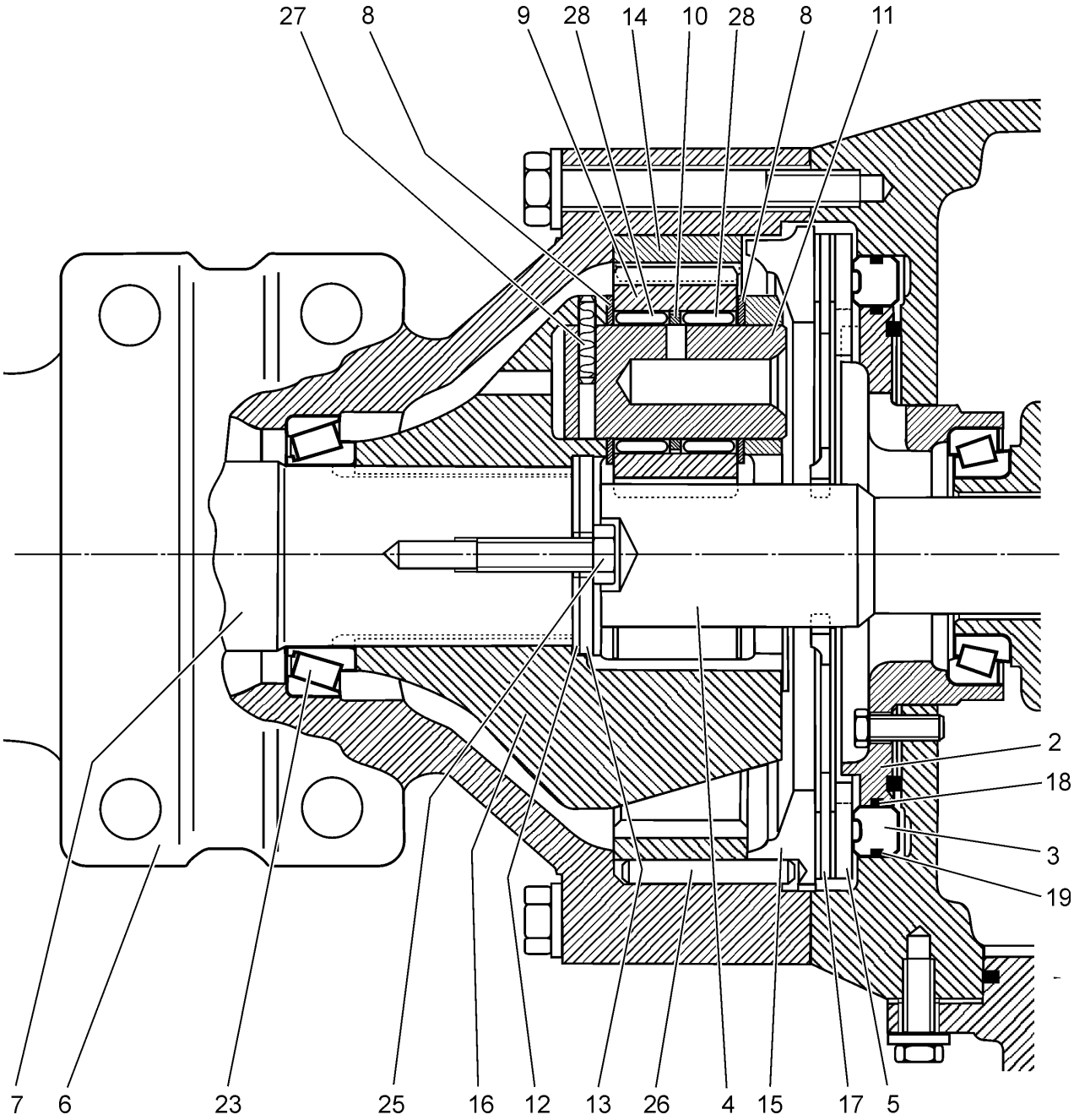


Fig. 7D.22. Front Axle Planetary Cross Section (515G)

2. Bearing Retainer
3. Brake Piston
4. Axle Shaft
5. Brake Plate
6. Axle Housing
7. Axle Shaft
8. Thrust Washers
9. Planetary Gear
10. Spacer Ring
11. Pin
12. Shim(s)
13. Spacer Washer
14. Ring Gear
15. Thrust Plate
16. Carrier
17. Brake Disc
18. Seal Ring
19. Seal Ring
22. Tapered Bearing
23. Tapered Bearing
25. Bolt
26. Pin
27. Spring Pin
28. Needles

PLANETARY GEAR

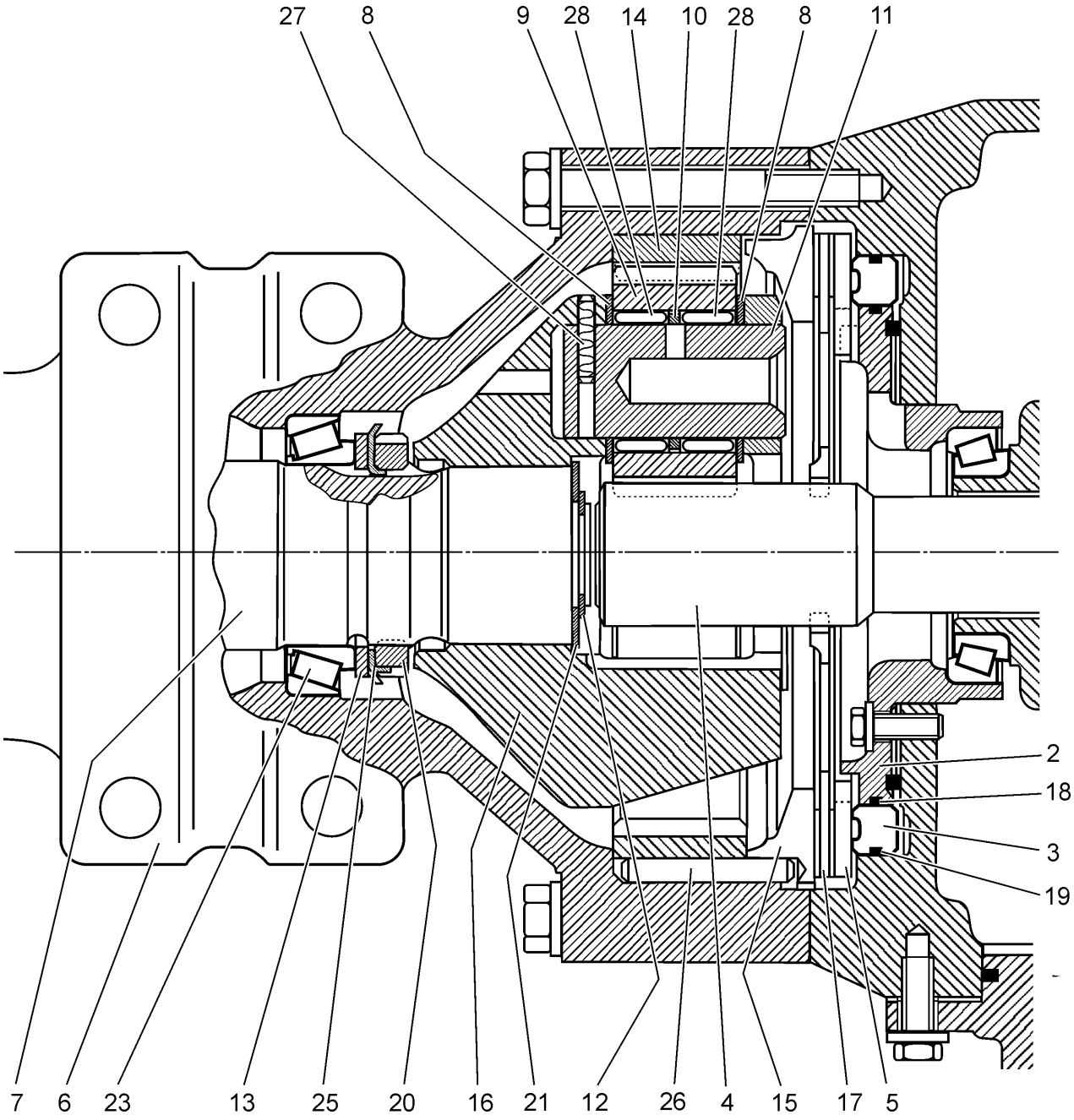


Fig. 7D.23. Front Axle Planetary Cross Section (520G)

2. Bearing Retainer
3. Brake Piston
4. Axle Shaft
5. Brake Plate
6. Axle Housing
7. Axle Shaft
8. Thrust Washers
9. Planetary Gear
10. Spacer Ring
11. Pin
12. Retaining Ring
13. Spacer Washer
14. Ring Gear
15. Thrust Plate
16. Carrier
17. Brake Disc
18. Seal Ring
19. Seal Ring
20. Bearing Nut
21. Washer
23. Tapered Bearing
25. Tab Washer
26. Pin
27. Spring Pin
28. Needles

DRIVE AXLE AND DIFFERENTIAL

PLANETARY GEAR

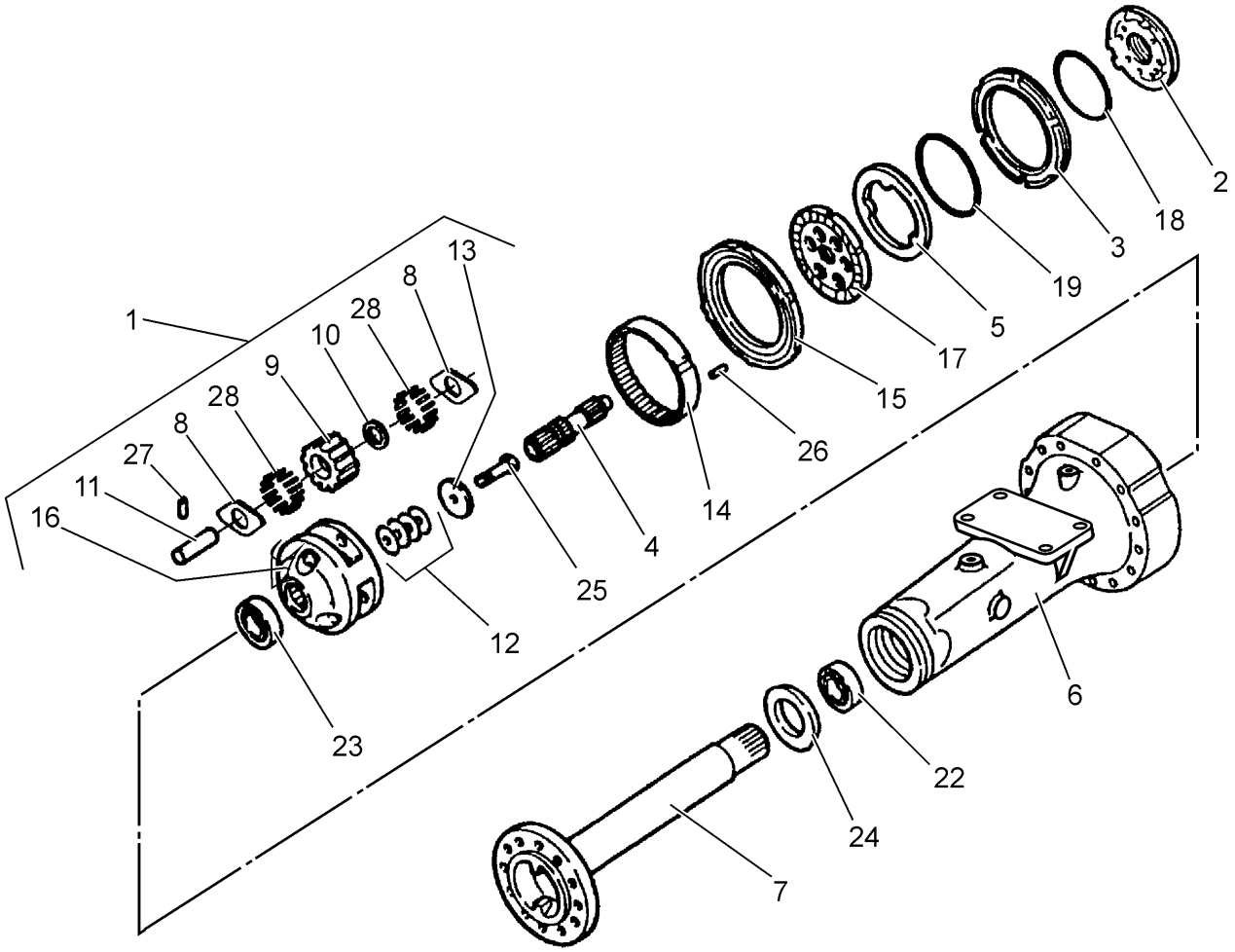


Fig. 7D.24. Front Axle Housing Assembly Exploded View (515G)

1. Carrier Assy
2. Bearing Retainer
3. Brake Piston
4. Axle Shaft
5. Brake Plate
6. Axle Housing L.H.
7. Axle Shaft
8. Thrust Washers
9. Planetary Gear
10. Spacer Ring
11. Pin
12. Shim(s)
13. Spacer Washer
14. Ring Gear
15. Thrust Plate
16. Carrier
17. Brake Disc
18. Seal Ring
19. Seal Ring
20. Tapered Bearing
21. Tapered Bearing
22. Seal Ring
23. Bolt
24. Pin
25. Spring Pin
26. Needles

Only 515G (Fig. 7D.24)

7. Remove bolt (25), spacer washer (13), shims (12) and carrier assy (1) from axle shaft (7).

Only 520G (Fig. 7D.25)

8. Remove retaining ring (12), washer (21) and carrier assy (1) from axle shaft (7).
9. Bend tang on tab washer (25) down; then remove nut (20), tab washer (25) and spacer washer (13) from the axle shaft (7).

PLANETARY GEAR

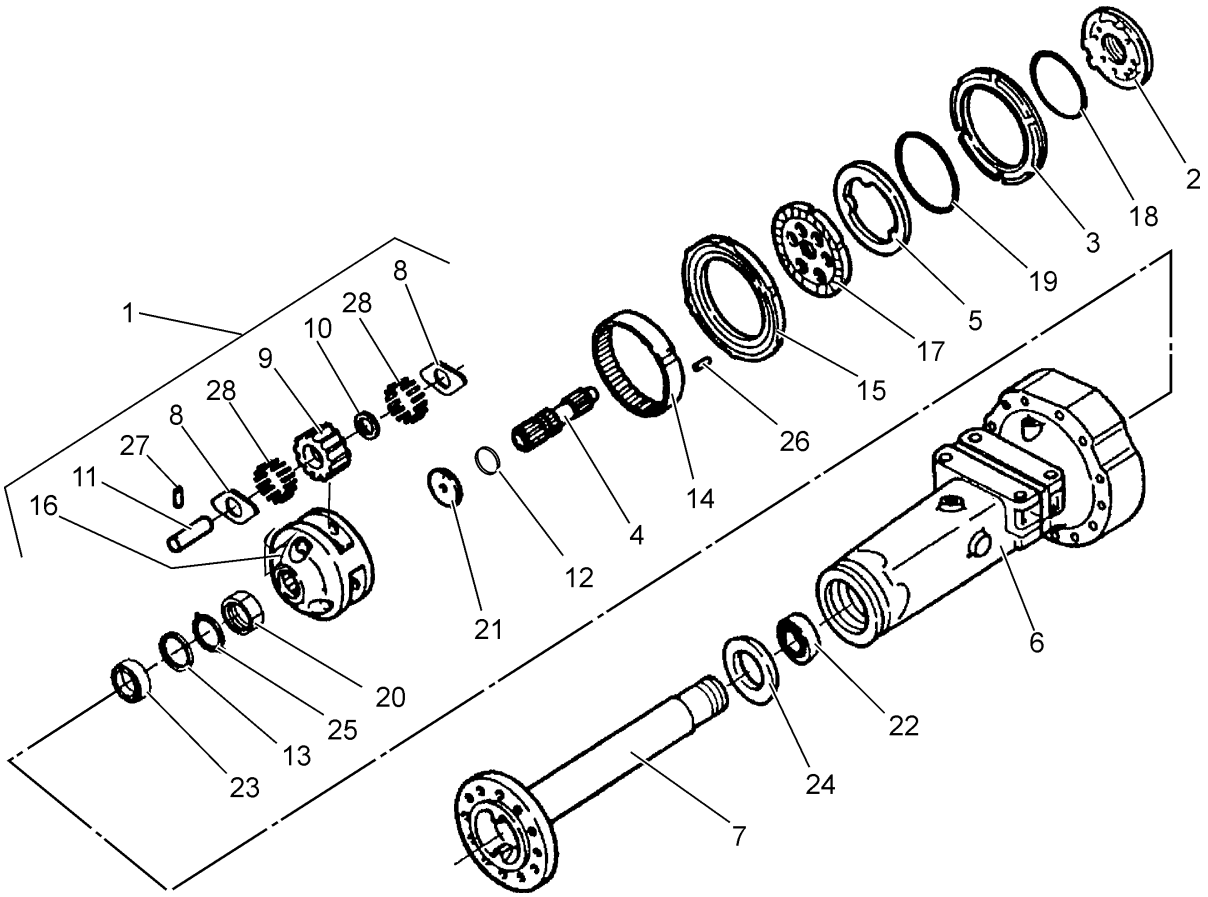


Fig. 7D.25. Front Axle Housing Assembly Exploded View (520G)

1. Carrier Assy
2. Bearing Retainer
3. Brake Piston
4. Axle Shaft
5. Brake Plate
6. Axle Housing L.H.
7. Axle Shaft
8. Thrust Washers
9. Planetary Gear
10. Spacer Ring
11. Pin
12. Retaining Ring
13. Spacer Washer
14. Ring Gear
15. Thrust Plate
16. Carrier
17. Brake Disc
18. Seal Ring
19. Seal Ring
20. Bearing Nut
21. Washer
22. Tapered Bearing
23. Tapered Bearing
24. Seal Ring
25. Washer
26. Pin
27. Spring Pin
28. Needles

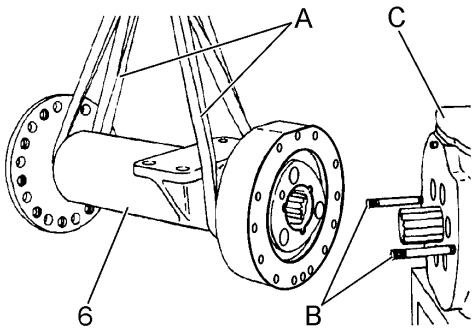


Fig. 7D.26. Separating Axle Shaft Assembly from Differential

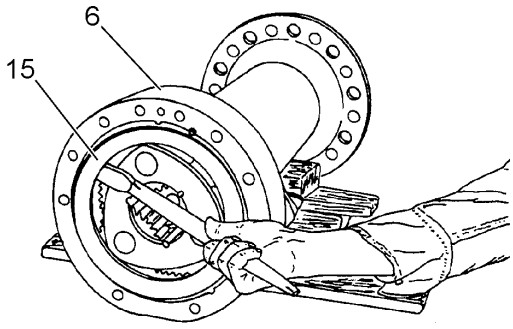


Fig. 7D.27. Removing Thrust Plate from Axle Housing

A. Sling
B. Dowels
C. Differential Assy
6. Axle Housing
15. Thrust Plate

PLANETARY GEAR

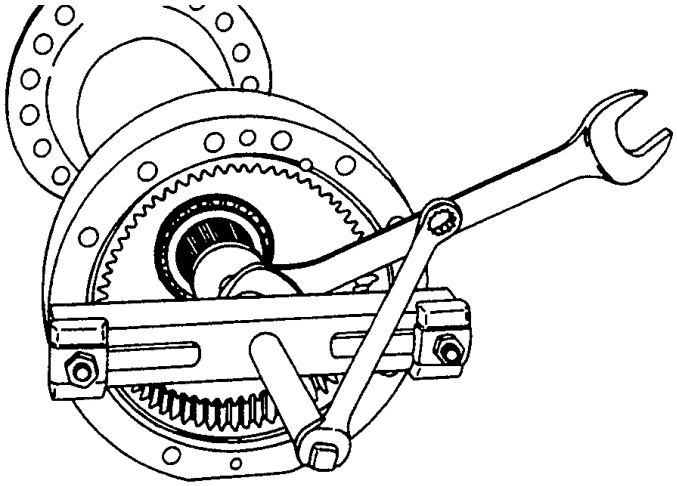


Fig. 7D.28. Pushing Axle Shaft from Axle Housing

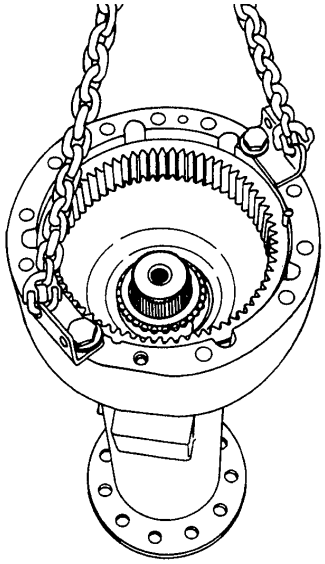


Fig. 7D.29. Lifting Axle Housing from Axle Shaft

REMOVAL AND DISASSEMBLY – Continued

10. Push the axle shaft (7, Fig. 7D.24 and 7D.25) from the housing (6) until free. Use a pusher arrangement as shown in Fig. 7D.28. Remove tapered bearing (23) cone.
11. Lift the axle housing (6) from the axle shaft (7) as shown in Fig. 7D.29.
12. Pull ring gear (14) with pins (26) from the axle housing (6), as shown in Fig. 7D.30

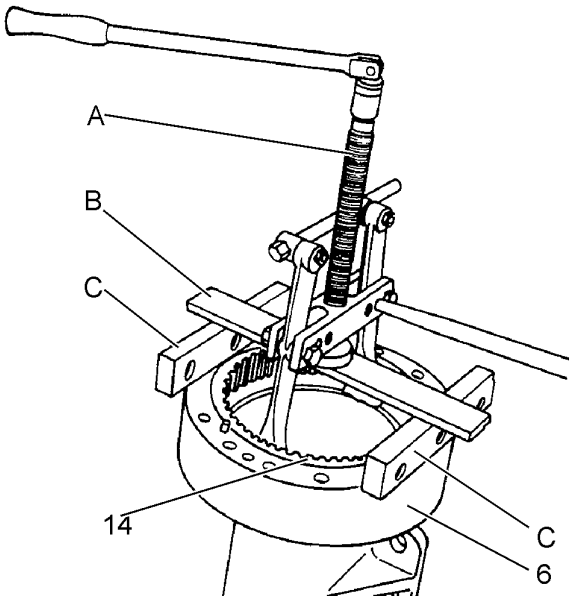


Fig. 7D.30. Pulling Ring Gear from Axle Housing

A. Puller
B. Adapter Bars
C. Support
6. Axle Housing
14. Ring Gear

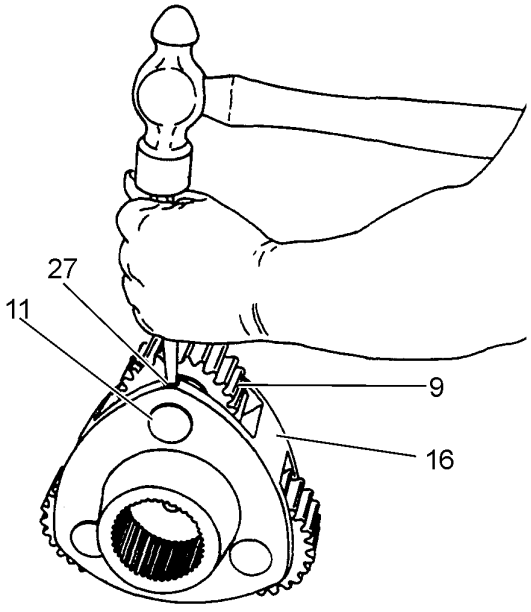


Fig. 7D.31. Driving Spring Pin into

9. Planetary Gear
11. Pin
16. Carrier
27. Spring Pin

PLANETARY GEAR

13. Remove tapered bearing (22) cone then remove seal ring (24) from axle shaft (7).
14. Remove tapered bearings (22 and 23) cups from axle housing (6).
15. Drive the spring pin (27) from the carrier (16) into the pin (11) as shown in Fig. 7D.31. Press the pin (11) from the carrier (16) and remove planetary gear (9), needles (28), spacer ring (10) and thrust washers (8). Keep the gear and its needles together. Remove spring pin (27) from the pin (11). Repeat this procedure to remove the remaining two pins (11).

18. INSPECTION AND REPAIR

1. Clean all parts in a commercial cleaning solvent and dry with compressed air.
2. Inspect gears for wear or damage. Replace gears, which are pitted, galled, worn or chipped.
3. Inspect bearings, replace if pitted, distorted or damaged in any way.
4. Discard seals and replace with new.
5. Check brake wear. Refer to Section 4 BRAKES.

19. REASSEMBLY AND INSTALLATION

1. Coat seal ring (24, Fig. 7D.24 and 7D.25) with grease and install it on the axle shaft (7), using seal ring driver tool 21.549.0127. Preheat bearing (22) cone to 90÷100 [°C] and install it on the axle shaft (7), using bearing driver tool 21.547.0184.
2. Press bearing (22 and 23) cups into the axle housing (6).
3. Install ring gear (14) and pins (26) into axle housing (6) as shown in Fig. 7D.32. Froze the ring gear (14) to –30 [°C] before installing if necessary.
4. Lower the axle housing (6) over the axle shaft (7) as shown in Fig. 7D.33. Carefully guide the housing over the seal ring to prevent damage. Preheat bearing (23) cone to 90÷100 [°C] and install it on the axle shaft (7), using bearing driver tool 8N54-82/100-190.

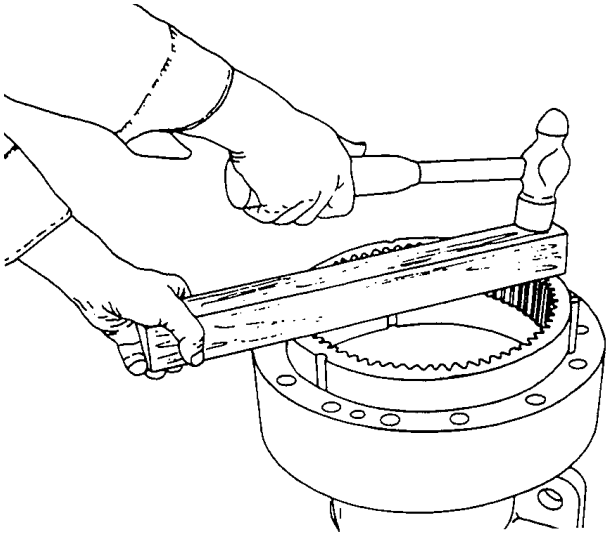


Fig. 7D.32. Installing Ring Gear

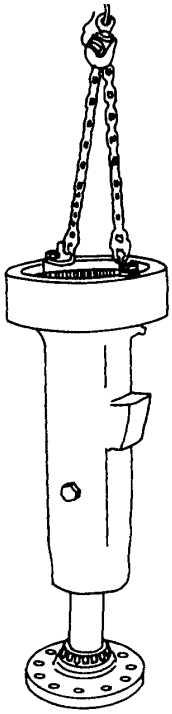


Fig. 7D.33. Lowering Axle Housing Over Axle Shaft

PLANETARY GEAR

Only 515G (Fig. 7D.24)

5. Measure the thickness of thrust washer (13) in three places. Accuracy of measurement must be 0.01 [mm]. Divide this measurement by three to obtain the average value. Record the result.
6. Install carrier (16) and thrust washer (13) on axle shaft (7). Torque the bolt (25) to 55÷60 [Nm].
7. Unscrew the bolt (25) and torque it to 4 [Nm].
8. Measure the distance from the surface of the thrust washer (13) to the surface of the axle shaft (7) by three openings in the thrust washer (13). Accuracy of measurement must be 0.01 [mm]. The diameter of each opening in the thrust washer is 8 [mm]. Divide this measurement by three to obtain the average value. Record the result.
9. Subtract the thickness of thrust washer (13) obtained in step 5 from the distance obtained in step 8. The difference gives the thickness of shims (12). Select the set of shims (12).
10. Unscrew bolt (25) with thrust washer (13) and remove carrier (16) from axle shaft (7).

Only 520G (Fig. 7D.25)

11. Install spacer washer (13), tab washer (25) and bearing nut (20) on the axle shaft (7). Tighten the bearing nut (20) on the shaft to the properly seat the bearings (22 and 23), then loosen the bearing nut (20).
12. Torque bearing nut (20) lightly. Using special tools 21.282.0175 and 21.263.0045 check the axle shaft (7) free rolling torque. Refer to Fig. 7D.35. The free rolling torque should range between 4÷10 [Nm]. If the initial rolling torque readings fall outside this range, unscrew or screw the bearing nut (20) until the correct reading is achieved.
13. After obtaining correct adjustment, advance bearing nut (20) to the nearest tang locking slot and bend tang of tab washer (25) up into the slot.

REASSEMBLY AND INSTALLATION – Continued (Fig. 7D.24 and 7D.25)

14. Coat planetary gear hole with grease. Put spacer ring (10) and needles (28) into the planetary gear (9). Remove excess grease.

NOTE: *Do not install needles into the planetary gear unless they are in set. Needles come in sets.*

15. Place the planetary gear assy with thrust washer (8) to the carrier (16). Place second thrust washer (8) between planetary gear (9) and carrier (16).

NOTE: *Do not install the planetary gear into the carrier unless they are in set. A set consists of three planetary gears.*

16. Place the first pin (11) in the carrier (16) making sure the spring pin hole is aligned with carrier hole as shown in Fig. 7D.34. Install spring pin (27) so it is flush with the carrier.

NOTE: *When properly installed, the planetary gears must be turnable by hand.*

17. Repeat steps 14 to 16 to install the remaining two planetary gears (9).

Only 515G (Fig. 7D.24)

18. Install the carrier assy (1), shims (12) and thrust washer (13) on the axle shaft (7). Use LOCTITE 262 and torque the bolt (25) to 240÷300 [Nm].
19. Check free rotation torque of the axle shaft (7) using special tool 21.282.0173 and 21.263.0045. Refer to Fig. 7D.36. This torque should be about 4÷10 [Nm]. If the torque is bigger (smaller) than 4÷10 [Nm], use bigger (smaller) pack of shims (12) and recheck free rotation torque again.

PLANETARY GEAR

Only 520G (Fig. 7D.25)

20. Install the carrier assy (1) and washer (21) on the axle shaft (7) and secure it with the retainer ring (12), using pliers RSKm-200.

REASSEMBLY AND INSTALLATION – Continued (Fig. 7D.24 and 7D.25)

21. Install the thrust plate (15).

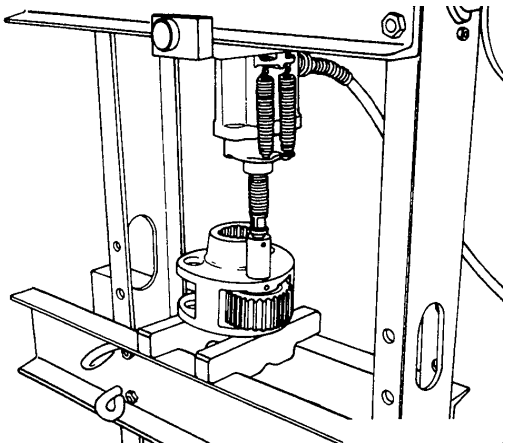


Fig. 7D.34. Installing Planetary Gear Pin

22. Apply Loctite 120 to the mating surfaces of the axle shaft housing (6) and differential assy housing.
23. Guide the axle shaft housing assembly over the dowels previously installed in the differential housing as shown in Fig. 7D.26.
24. Install the mounting bolts and torque to 250÷310 [Nm]. Remove the dowels and install the remaining two bolts using the same torque value.
25. Install drive axle as described in DRIVE AXLE in this section.

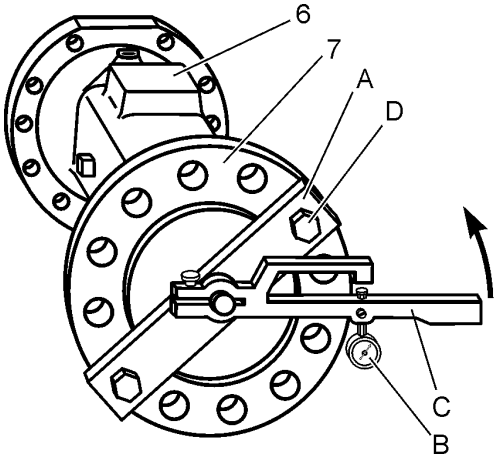


Fig. 7D.35.Checking Axle Shaft Free Rolling Torque (520G)

A. Special Tool 21.263.0175
B. Dial Indicator
C. Special Tool 21.282.0045
D. Bolt with Nut
6. Axle Housing
7. Axle Shaft

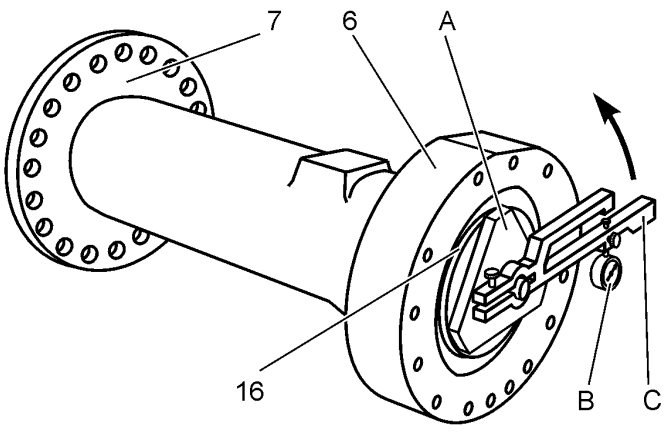


Fig. 7D.36. Checking Axle Shaft Free Rolling Torque (515G)

A. Special Tool 21.282.0173
B. Dial Indicator
C. Special Tool 21.282.0045
6. Axle Housing
7. Axle Shaft
16. Carrier

DRIVE AXLE AND DIFFERENTIAL

DIFFERENTIAL

20. DESCRIPTION (Fig. 7D.37)

The differential is bolted to the center of the axle housing. The front and rear axle differentials are the same except that the parking brake is mounted to the front differential housing. The differentials receive torque through an input yoke (2) connected to a drive shaft.

The three functions of the differential are: to change the direction of the input torque from the drive shaft, sending it 90 degrees to the right and left, to provide the first torque multiplication in the double reduction axle assembly, and to allow one drive wheel to rotate at a different speed than the opposite wheel.

Basically, the differential consists of a disc gear (11), pinion shaft (10), two crowns (14) and four planetary gears (15). A thrust washer (9) is located between the planetary gear carrier (4) and crown (14). The crown and planetary gears are held to the planetary gear carrier (4) and disc gear (11), which rotate on the tapered bearings (23). A thrust washer (12) is located between the disc gear (11) and crown (14). The pinion shaft (10) is supported in the bearing retainer (17) by two tapered bearings (24 and 26). Shims (21) and (13) are used to set the proper pinion shaft mounting distance and pinion-to-disc gear backlash.

21. OPERATION (Fig. 7D.37)

Drive line torque supplied to the input yoke (2) is transmitted to the pinion shaft (10). As the pinion shaft rotates it drives the mating disc gear (11) and its attached carrier (4). Due to disc gear configuration it rotates to 90 degrees to the direction of pinion shaft rotation. Also, because the pinion is considerably smaller than the disc gear, gear reductions accomplished resulting in an increase in torque.

When both wheels are free to turn under equal resistant loads, the differential bevel disc gear and the four planetary gears act as one rigid unit, transmitting torque to both of the splined crowns. The disc gears, being splined to the axle shafts, then drive both wheels with the same torque at identical speeds. In this instance, the planetary gears do not rotate on their axis therefore, the crowns rotate at the same rpm as the disc gear.

When the resistance on one drive wheel exceeds the resistance on the other, or when the machine makes a turn, the disc gear continues to revolve but the crowns cease to act as a unit with the disc gear. The planetary gears now turn on their own axis and permit one drive wheel to rotate faster than the other. It follows that as one drive wheel slows down, the speed of the other drive wheel is proportionally increased. This permits the machine to make a sharp turn without dragging one drive wheel.

22. SPECIFICATION

Disc gear backlash ..... 0.18÷0.29 [Nm]
Pinion shaft free torque ..... 1÷3 [Nm]
Disc gear free torque ..... 1.3÷4 [Nm]

Special torques:

Disc gear mounting bolts ..... 285÷310 [Nm]
Pinion shaft bearing retainer mounting bolts ..... 100÷125 [Nm]
Yoke mounting bolt ..... 250÷300 [Nm]
Differential bearing retainer mounting bolts ..... 100÷125 [Nm]

DIFFERENTIAL

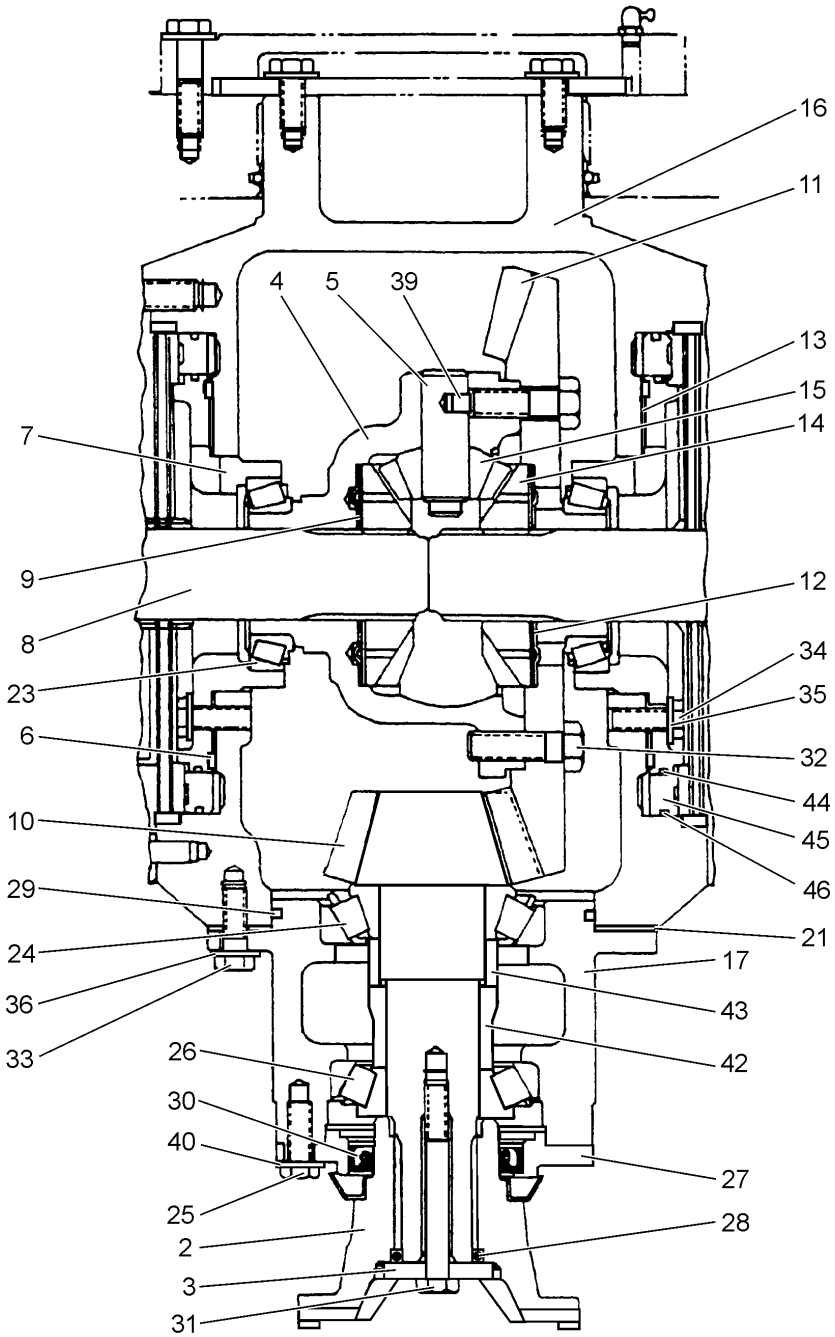


Fig. 7D.37. Rear Axle Differential Assembly Cross Section (520G)

2. Yoke Assy
3. Washer
4. Planetary Gear Carrier
5. Planetary Gear Shaft
6. Seal Ring
7. Bearing Retainer
8. Axle Shaft
9. Thrust Washer (K)
10. Pinion Shaft
11. Disc Gear
12. Thrust Washer (T)
13. Shim(s)
14. Crown
15. Planetary Gear
16. Differential Assy Housing
17. Bearing Retainer
19. Guard
21. Shim(s)
23. Tapered Bearing
24. Tapered Bearing
25. Bolt
26. Tapered Bearing
27. Retainer
28. O-ring
29. O-ring
30. Seal Ring
31. Bolt
32. Bolt
33. Bolt
34. Bolt
35. Washer
36. Washer
39. Pin
40. Spring Washer
42. Spacer Sleeve
43. Spacer Sleeve
44. Seal Ring
45. Brake Piston
46. Seal Ring

DRIVE AXLE AND DIFFERENTIAL

DIFFERENTIAL

23. SERVICE DIAGNOSIS

NOTE: *To check for a damaged differential, jack up and block the machine so all wheels are clear of the ground and run the power train in first gear at moderate speed.*

NOTE: *If a failure should occur in the differential, the machine should not be operated under its own power. If the machine must be moved, disconnect the drive shaft at the transmission or remove the shaft completely. The machine may be driven a short distance with one axle if the drive shaft is removed from the noisy axle or differential.*

COMPLAINT	
PROBABLE CAUSE	REMARKS
Loss of Lubricant	
1. Lubricant above specified level	1. Drain to correct level. Refer to the OPERATOR'S MANUAL.
2. Foaming due to incorrect grade or type of lubricant	2. Fill with correct lubricant. Refer to OPERATOR'S MANUAL.
3. Leakage around input yoke	3. Replace pinion shaft seal ring.
4. Leakage between bearing retainer and differential assy housing	4. Replace O-ring.
5. Axle leakage	5. Refer to SERVICE DIAGNOSIS under DRIVE AXLE in this Section.
Differential Overheats	
1. Incorrect lubricant or level too low	1. Refer to **Loss of Lubricant** complaint.
2. Carrier bearings adjusted too tight	2. Readjust bearings to the proper preload.
3. Pinion and disc gear adjustment too tight	3. Readjust pinion and disc gear backlash.
4. Excessive wear in gears	4. Check gears for excessive wear or scoring. Replace as necessary.
Continual Noise	
1. Incorrect lubricant or level too low	1. Refer to **Loss of Lubricant** complaint.
2. Pinion or carrier bearings worn or loose	2. Replace bearings.
3. Gear teeth excessively worn or damaged	3. Replace gears.
4. Unmatched pinion and disc gear	4. Replace with new matched pinion and disc gear.
5. Pinion and disc gear adjustment too tight (not enough backlash)	5. Readjust pinion and disc gear backlash.
Intermittent Noise	
1. Incorrect lubricant or level too low	1. Refer to **Loss of Lubricant** complaint.
2. Loose or broken differential bearings	2. Check all bearings. Replace pinion and/or carrier bearings.
Noise on Coast	
1. Pinion or carrier bearing damaged	1. Replace bearings.
2. Pinion gear and disc gear backlash adjustment too loose	2. Readjust pinion and disc gear backlash.
3. Excessive pinion shaft end play	3. Replace parts as necessary.

DIFFERENTIAL

COMPLAINT	
PROBABLE CAUSE	REMARKS
Noise on Turns	
1. Differential planetary gears or/and crowns defective	1. Check the drive axle for alignment. Check the planetary gears, thrust washers (T) and (K) and tapered bearings. Replace if necessary.
2. Worn pinion gears or planetary gears	2. Replace pinion or planetary gears, thrust washers and bearings.

24. REMOVAL AND DISASSEMBLY

1. Drain the axle assembly as described in the OPERATOR'S MANUAL.
2. Remove the drive axle to be serviced as described in DRIVE AXLES in this Section.
3. Remove left and right axle housing assy as described in PLANETARY GEAR in this Section.

FRONT AXLE (Fig. 7D.40)

4. Unscrew a bolt (36) and remove washer (9), O-ring (33), and brake drum (20) with yoke (8). Unscrew bolts (39) with washers (42) and remove brake housing (3) with washer (25), brake cross lever (21), brake shoes assy (4) and springs (26). Unscrew bolts (40) with washers (42) and remove yoke (8) from brake drum (20).
5. Remove the axle shafts (15), brake discs (17, Fig. 7D.24 and 7D.25), brake plates (5) and brake pistons (3) with seal rings (19) as described in MASTER BRAKE in Section 4.
6. Unscrew bolts (38, Fig. 7D.40) with washers (42) and remove bearing retainer (6) with O-ring (34) and shims (23) from the differential assy housing (5) as shown in Fig. 7D.38. Remove O-ring (34) and shims (23) from the bearing retainer (6).

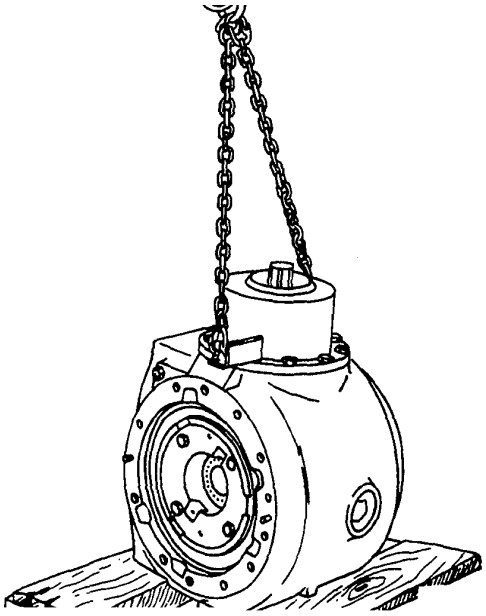


Fig. 7D.38. Lifting Bearing Retainer Assembly

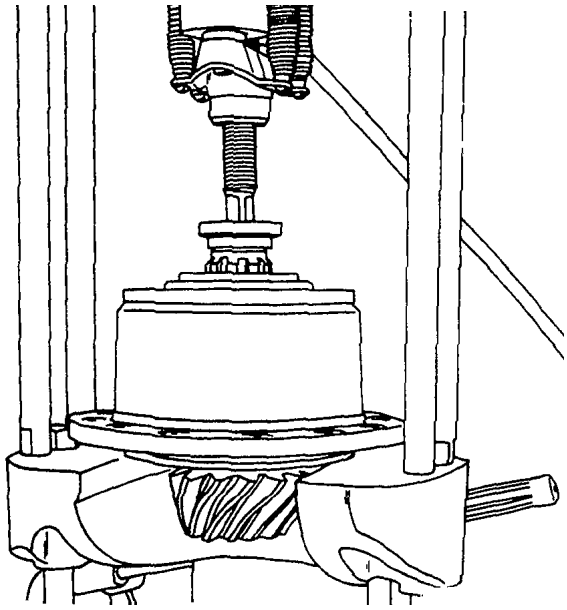


Fig. 7D.39. Removing Pinion Shaft from Bearing Retainer

DRIVE AXLE AND DIFFERENTIAL

DIFFERENTIAL

7. Remove retainer (7) from bearing retainer (6). Remove seal ring (35) from retainer (7).
8. Press pinion shaft (17) from the bearing retainer (6) as shown in Fig. 7D.39. Take bearing (32) cone out. Slide sleeves (46 and 47) out from pinion shaft (17).
9. Remove bearings (31 and 32) cups from bearing retainer (6).
10. Remove bearing (31) cone from pinion shaft (17) as shown in Fig. 7D.41.

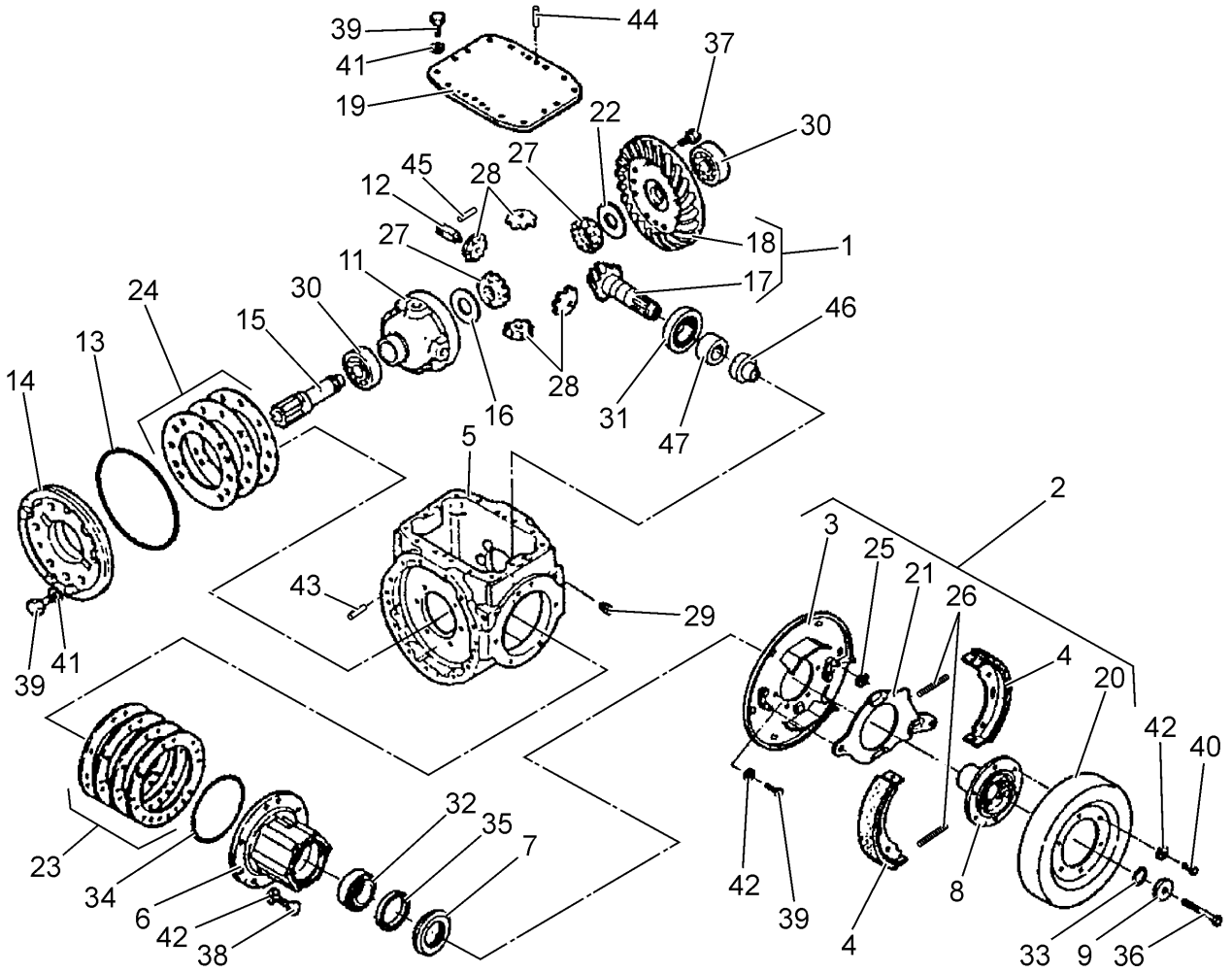


Fig. 7D.40. Front Axle Differential Assembly

1. Main Drive Gears Assy
2. Parking Brake
3. Brake/Lever Housing Assy
4. Brake Shoe Assy
5. Differential Assy Housing
6. Bearing Retainer
7. Retainer
8. Yoke
9. Washer
11. Planetary Gear Carrier
12. Planetary Gear Shaft
13. Seal Ring
14. Bearing Retainer
15. Axle Shaft
16. Thrust Washer (K)
17. Pinion Shaft
18. Disc Gear
19. Cover
20. Brake Drum
21. Brake Cross Lever
22. Thrust Washer (T)
23. Shim(s)
24. Shim(s)
25. Washer
26. Spring
27. Crowns
28. Planetary Gears
29. Plug
30. Tapered Bearing
31. Tapered Bearing
32. Tapered Bearing
33. Oring
34. Oring
35. Seal Ring
36. Bolt
37. Bolt
38. Bolt
39. Bolts
40. Bolt
41. Washer
42. Washers
43. Pin
44. Pin
45. Pin
46. Spacer Sleeve
47. Spacer Sleeve

DIFFERENTIAL

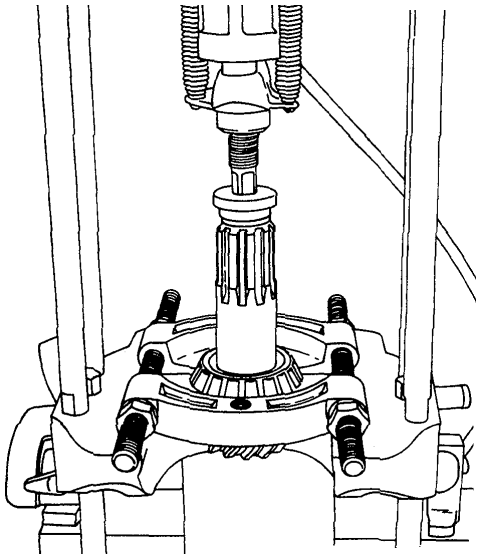


Fig. 7D.41. Removing Pinion Shaft Bearing Cone

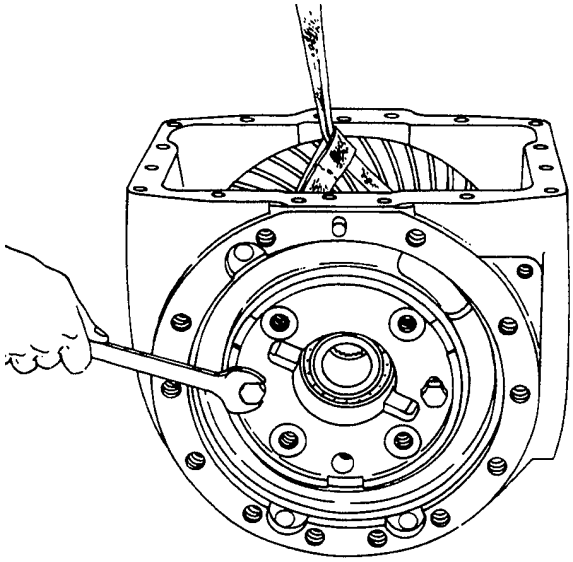


Fig. 7D.42. Removing Bearing Retainers

11. Unscrew bolts (39) with washers (41) and remove cover (19) and pins (44) from the top of the differential assy housing (5).
12. Attach a hoist and sling around the planetary gear carrier (11) and remove the slack. Unscrew bolts (39) with washers (41) securing the bearing retainers (14) with shims (24) to the differential assy housing (5) as shown in Fig. 7D.42.
13. Remove the bearing retainers (14) from both sides of the differential assy housing (5). Remove shims (24) and seal rings (13) from bearing retainers (14).
14. Lift the differential carrier with disc gear as one assembly from the differential assy housing (5). Refer to Fig. 7D.43.

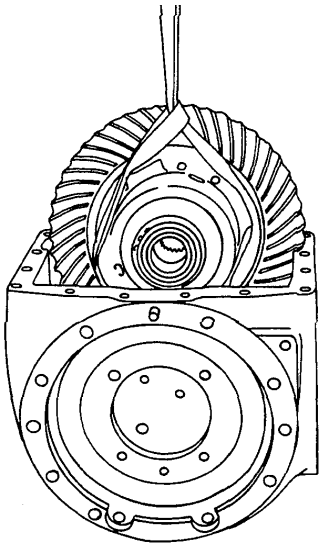


Fig. 7D.43. Removing Differential Carrier with Disc Gear

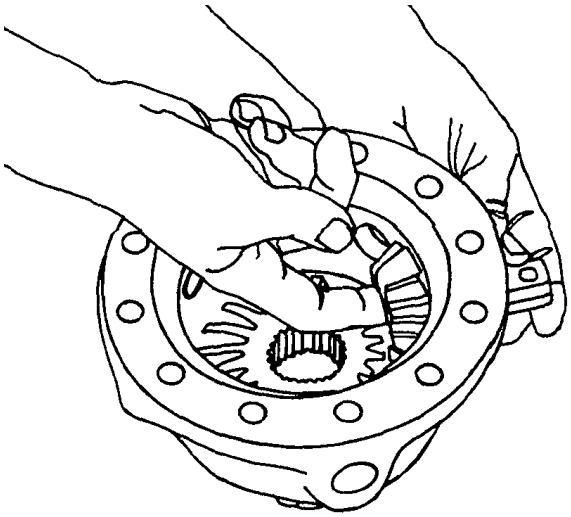


Fig. 7D.44. Removing Planetary Gear Shafts

DIFFERENTIAL

15. Unscrew the bolts (37) securing the carrier (11) to disc gear (18). Remove the carrier (11), being careful not to drop the crown (27) and thrust washers (16 and 22).
16. Remove crown (27) and thrust washer (16) from the carrier (11). Remove crown (27) and thrust washer (22) from disc gear (18). Remove pins (45) from the carrier (11). Remove planetary gears (28) by pushing shafts (12) from the inside of the carrier (11) out as shown in Fig. 7D.44.
17. Remove bearing (30) cone from the carrier (11) as shown in Fig. 7D.45. Remove bearing (30) cone from the disc gear (18) in the same manner. Remove bearing (30) cups from the bearing retainers (14). Tag the corresponding cups and cones for correct reassembly.

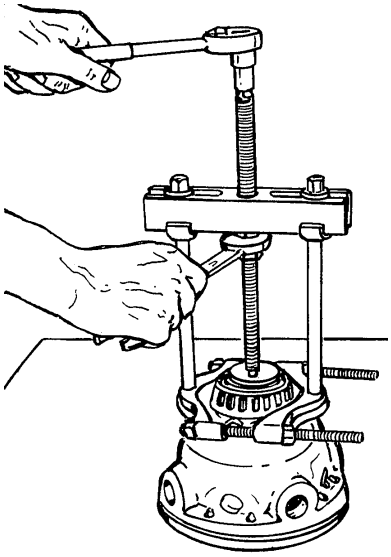


Fig. 7D.45. Removing Bearing Cone from Carrier

REAR AXLE

Only 515G (Fig. 7D.46)

1. Unscrew a bolt (29) and remove washer (3), O-ring (26) and yoke assy (2).
2. Remove the axle shafts (8), brake discs (17, 7D.24), brake plates (5) and brake pistons (3) with seal rings (19) as described in MASTER BRAKE in Section 4.
3. Unscrew bolts (31, Fig. 7D.46) with washers (34) and remove bearing retainer (17) with O-ring (27) and shims (21) from the differential assy housing (16) as shown in Fig. 7D.38. Remove O-ring (27) and shims (21) from the bearing retainer (17).
4. Press pinion shaft (10) from the bearing retainer (17) as shown in Fig. 7D.39. Remove seal ring (28) from bearing retainer (17). Take bearing (25) cone out. Slide sleeves (39 and 40) out from pinion shaft (10).
5. Remove bearings (24 and 25) cups from bearing retainer (17).
6. Remove bearing (24) cone from pinion shaft (10) as shown in Fig. 7D.41.
7. Unscrew bolts (32) with washers (33) and remove cover (20) and pins (36) from the top of the differential assy housing (16).
8. Attach a hoist and sling around the planetary gear carrier (4) and remove the slack. Unscrew bolts (32) securing the bearing retainers (7) to the differential assy housing (16) as shown in Fig. 7D.42.
9. Remove the bearing retainers (7) from both sides of the differential assy housing (16). Remove shims (13) and seal rings (6) from bearing retainers (7).

DIFFERENTIAL

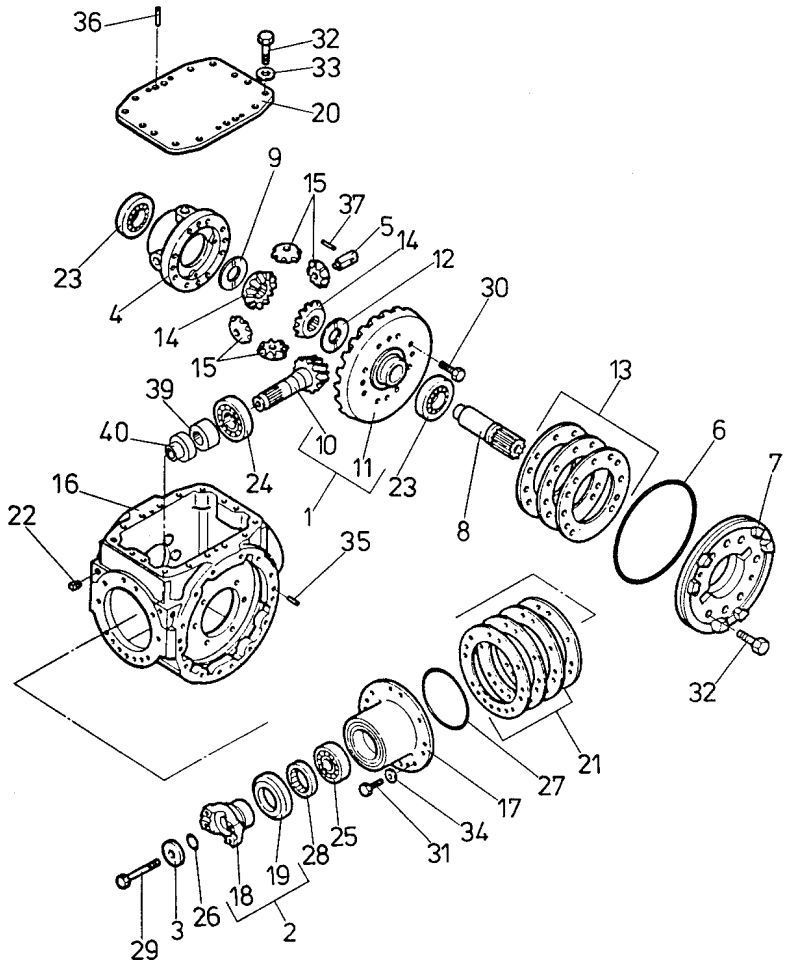


Fig. 7D.46. Rear Axle Differential Assembly Exploded View (515G)

1. Main Drive Gears Assy	11. Disc Gear	21. Shim(s)	31. Bolt
2. Yoke Assy	12. Thrust Washer (T)	22. Plug	32. Bolts
3. Washer	13. Shim(s)	23. Tapered Bearing	33. Washer
4. Planetary Gear Carrier	14. Crowns	24. Tapered Bearing	34. Washer
5. Planetary Gear Shaft	15. Planetary Gears	25. Tapered Bearing	35. Pin
6. Seal Ring	16. Differential Assy Housing	26. O-ring	36. Pin
7. Bearing Retainer	17. Bearing Retainer	27. O-ring	37. Pin
8. Axle Shaft	18. Yoke	28. Seal Ring	39. Spacer Sleeve
9. Thrust Washer (K)	19. Guard	29. Bolt	40. Spacer Sleeve
10. Pinion Shaft	20. Cover	30. Bolt	

10. Lift the differential carrier with disc gear as one assembly from the differential assy housing (16). Refer to Fig. 7D.43.
11. Unscrew the bolts (30) securing the carrier (4) to disc gear (11). Remove the carrier (4), being careful not to drop crowns (14) and thrust washers (9 and 12).
12. Remove crown (14) and thrust washer (9) from the carrier (4). Remove crown (14) and thrust washer (12) from disc gear (11). Remove pins (37) from the carrier (4). Remove planetary gears (15) by pushing shafts (5) from the inside of the carrier (4) out as shown in Fig. 7D.44.
13. Remove bearing (23) cone from the carrier (4) as shown in Fig. 7D.45. Remove bearing (23) cone from the disc gear (11) in the same manner. Remove bearing (23) cups from the bearing retainers (7). Tag the corresponding cups and cones for correct reassembly.

DRIVE AXLE AND DIFFERENTIAL

DIFFERENTIAL

Only 520G (Fig. 7D.47)

1. Unscrew a bolt (31) and remove washer (3), O-ring (28) and yoke assy (2).
2. Remove the axle shafts (8), brake discs (17, 7D.25), brake plates (5) and brake pistons (3) with seal rings (19) as described in MASTER BRAKE in Section 4.

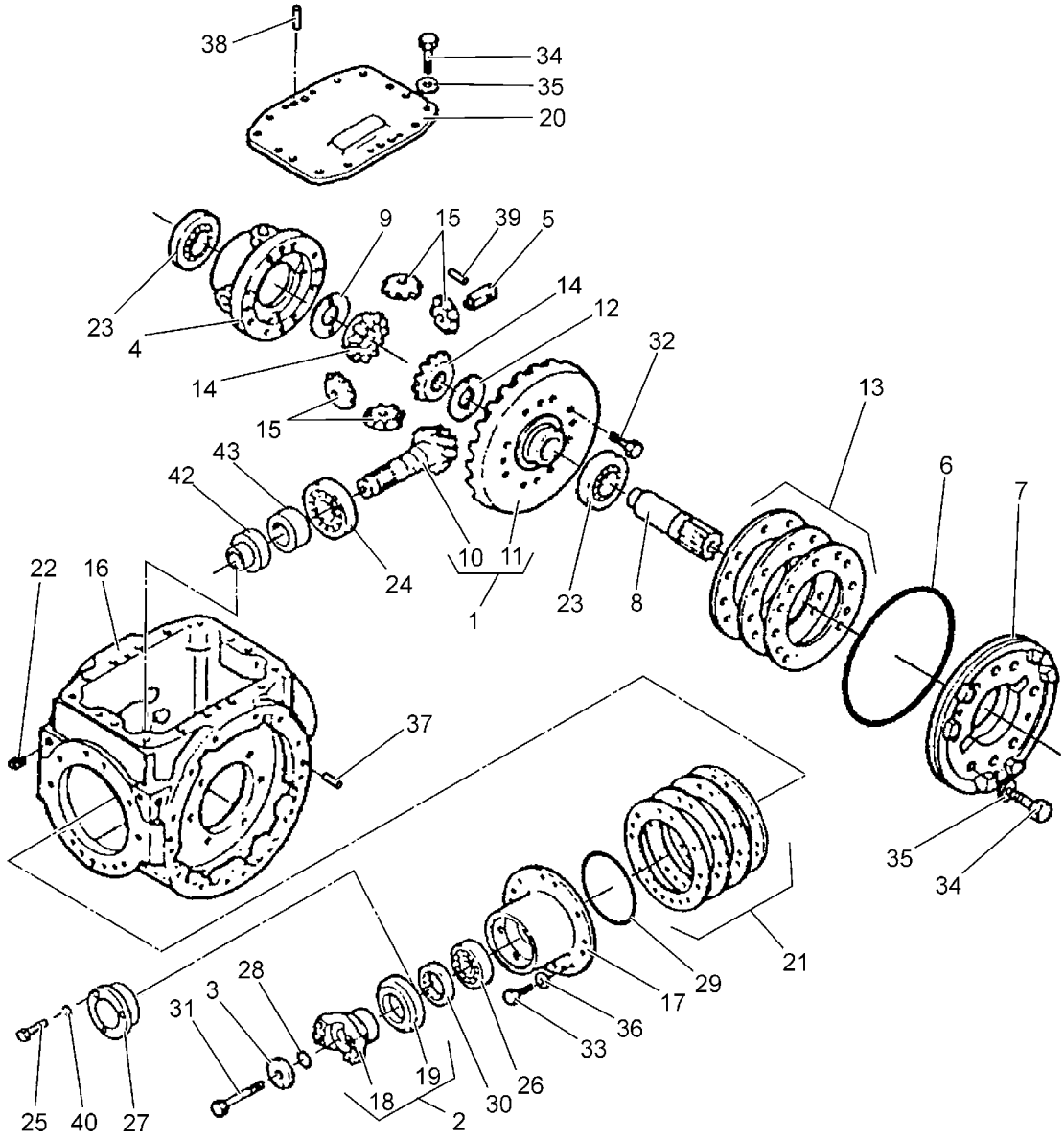


Fig. 7D.47. Rear Axle Differential Assembly Exploded View (520G)

1. Main Drive Gears Assy
2. Yoke Assy
3. Washer
4. Planetary Gear Carrier
5. Planetary Gear Shaft
6. Seal Ring
7. Bearing Retainer
8. Axle Shaft
9. Thrust Washer (K)
10. Pinion Shaft
11. Disc Gear
12. Thrust Washer (T)
13. Shim(s)
14. Crowns
15. Planetary Gears
16. Differential Assy Housing
17. Bearing Retainer
18. Yoke
19. Guard
20. Cover
21. Shim(s)
22. Plug
23. Tapered Bearing
24. Tapered Bearing
25. Bolt
26. Tapered Bearing
27. Retainer
28. O-ring
29. O-ring
30. Seal Ring
31. Bolt
32. Bolt
33. Bolt
34. Bolts
35. Washers
36. Washer
37. Pin
38. Pin
39. Pin
40. Spring Washer
42. Spacer Sleeve
43. Spacer Sleeve

DIFFERENTIAL

3. Unscrew bolts (33, Fig. 7D.47) with washers (36) and remove bearing retainer (17) with O-ring (29) and shims (21) from the differential assy housing (16) as shown in Fig. 7D.38. Remove O-ring (29) and shims (21) from the bearing retainer (17).
4. Unscrew bolts (25) with washers (40) and remove retainer (27) with seal ring (30) from bearing retainer (17). Remove seal ring (30) from retainer (27).
5. Press pinion shaft (10) from the bearing retainer (17) as shown in Fig. 7D.39. Take bearing (26) cone out. Slide sleeves (42 and 43) out from pinion shaft (10).
6. Remove bearings (24 and 26) cups from bearing retainer (17).
7. Remove bearing (24) cone from pinion shaft (10) as shown in Fig. 7D.41.
8. Unscrew bolts (34) with washers (35) and remove cover (20) and pins (38) from the top of the differential assy housing (16).
9. Attach a hoist and sling around the planetary gear carrier (4) and remove the slack. Unscrew bolts (34) with washers (35) securing the bearing retainers (7) to the differential assy housing (16) as shown in Fig. 7D.42.
10. Remove the bearing retainers (7) from both sides of the differential assy housing (16). Remove shims (13) and seal rings (6) from bearing retainers (7).
11. Lift the differential carrier with disc gear as one assembly from the differential assy housing (16). Refer to Fig. 7D.43.
12. Unscrew the bolts (32) securing the carrier (4) to disc gear (11). Remove the carrier (4), being careful not to drop the crowns (14) and thrust washers (9 and 12).
13. Remove crown (14) and thrust washer (9) from the carrier (4). Remove crown (14) and thrust washer (12) from disc gear (11). Remove pins (39) from the carrier (4). Remove planetary gears (15) by pushing shafts (5) from the inside of the carrier (4) out as shown in Fig. 7D.44.
14. Remove bearing (23) cone from the carrier (4) as shown in Fig. 7D.45. Remove bearing (23) cone from the disc gear (11) in the same manner. Remove bearing (23) cups from the bearing retainers (7). Tag the corresponding cups and cones for correct reassembly.

25. INSPECTION AND REPAIR

1. Clean all parts in a commercial cleaning solvent and dry with compressed air.
2. Inspect gears for wear or damage. Replace gears, which are pitted, galled, worn or chipped.
3. Inspect bearings, replace if pitted, distorted or damaged in any way.
4. Discard seals and replace with new.
5. Check brake wear. Refer to Section 4 BRAKES.

26. REASSEMBLY AND INSTALLATION

NOTE: *Lubricate all parts while assembling.*

FRONT AXLE (Fig. 7D.40)

1. Install bearing (31) cup into bearing retainer (6), using bearing cup driver tool 21.547.0098.
2. Install bearing (32) cup into bearing retainer (6), using bearing cup driver tool 21.547.0131.

NOTE: *For machine 515G use special tool 21.217.0080. For machine 520G use special tool 21.282.0172.*

DIFFERENTIAL

Spacer Sleeves Selection Procedure (Fig. 7D.48)

3. Install bearing (32) cone on special tool (D).
4. Install bearing retainer (6) with bearings (31 and 32) cups on special tool (D).
5. Install special tool sleeve (B) on special tool (D) base pin.
6. Install bearing cone on bearing (31) cup and hang load (A) on the special tool (D) lever.
7. Install magnetic base dial indicator (C) with dial tip resting on the special tool sleeve (B) and zero dial indicator (C).
8. Lift special tool sleeve (B) with your hand until it bottoms on bearing (31) cone. Note the dial indicator reading equal to the (X) in Fig. 7D.48. Add 45.9 [mm] -for 520G or 10 [mm] -for 515G to measured (X) and note the result.
9. For distance obtained in step 8 select the set of two spacer sleeves (46 and 47) with an accuracy of ±0.02 [mm], refer to Table 1 or Table 2 depending of machine type.
10. Remove dial indicator (C) from the special tool (D).
11. Unload the special tool (D) lever and swing the lever away.
12. Remove the special tool sleeve (B) with bearing (31) cone on it from bearing retainer (6).
13. Take bearing retainer (6) out from the special tool (D) base pin.
14. Take bearing (32) cone out from the special tool (D) base pin.
15. Preheat bearing (31, Fig. 7D.40) cone to 80÷90 [°C] and install it on the pinion shaft (17), using bearing cone driver tool 8N54-60/72-170. Install spacer sleeves (46 and 47) on the pinion shaft (17).
16. Install pinion shaft (17) with bearing (31) cone and spacer sleeves (46 and 47) into bearing retainer (6).
17. Preheat bearing (32) cone to 80÷90 [°C] and install it on the pinion shaft (17), using bearing cone driver tool 8N54-50/65-200.

NOTE: *Lubricate bearings (31 and 32) with oil.*

Sleeves Part Numbers		Dimension
47	46	[mm]
425-07-3092	425-07-3089	53.50±0.02
	425-07-3090	53.44±0.02
	425-07-3091	53.38±0.02
425-07-3093	425-07-3089	53.32±0.02
	425-07-3090	53.26±0.02
	425-07-3091	53.20±0.02
425-07-3094	425-07-3089	53.14±0.02
	425-07-3090	53.08±0.02
	425-07-3091	53.02±0.02
425-07-3103	425-07-3089	52.96±0.02
	425-07-3090	52.90±0.02
	425-07-3091	52.84±0.02

Table 1. Dimensions and Sleeves Parts Numbers (for 515G, see Fig. 7D.40)

DIFFERENTIAL

Sleeves Part Numbers		Dimension
46	47	[mm]
429-07-3041	429-07-3038	46.80±0.02
	429-07-3039	46.74±0.02
	429-07-3040	46.68±0.02
429-07-3035	429-07-3038	46.62±0.02
	429-07-3039	46.56±0.02
	429-07-3040	46.50±0.02
429-07-3036	429-07-3038	46.44±0.02
	429-07-3039	46.38±0.02
	429-07-3040	46.32±0.02
429-07-3037	429-07-3038	46.26±0.02
	429-07-3039	46.20±0.02
	429-07-3040	46.14±0.02

Table 2. Dimensions and Sleeves Parts Numbers (for 520G, see Fig. 7D.40)

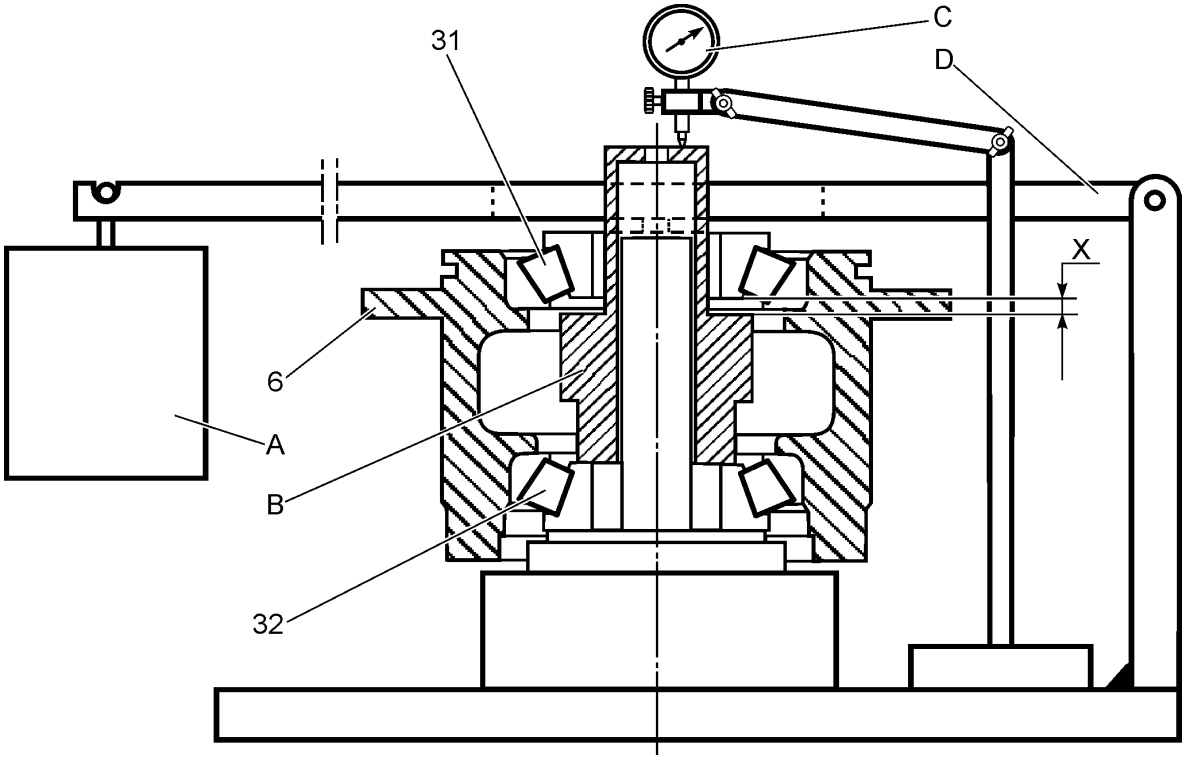


Fig. 7D.48. Front Axle Pinion Shaft Bearings Preload Special Tool

6. Bearing Retainer
31. Tapered Bearing
32. Tapered Bearing
A. Special Tool Load
B. Special Tool Sleeve
C. Dial Indicator with Magnetic Base
D. Special Tool
X. Distance Between Bearing Cone and Special Tool Sleeve

DIFFERENTIAL

18. Install the joke (8) on the pinion shaft (17) and torque the bolt (36) with washer (9) to 245÷300 [Nm].
19. Check free rotation torque of the pinion shaft (17). This torque should be about 1-3 [Nm]. If the torque is bigger than 1-3 [Nm], use smaller total dimension spacer sleeves (46 and 47) set, refer to Table 1. If the torque is smaller than 1-3 [Nm], use bigger total dimension spacer sleeves (46 and 47) set, refer to Table 1.
    If the free rotation torque of the pinion shaft meets specification (1÷3 [Nm]) skip items 20, 21, 22 and 23 and proceed with item 24 and following. Otherwise proceed with items 20, 21, 22, 23 and following.
20. Unscrew bolt (36) with washer (9) and remove joke (8) from the pinion shaft (17).
21. Press pinion shaft (17) with bearing (31) cone and spacer sleeves (46 and 47) from bearing retainer (6). Refer to Fig. 7D.39.
22. Install pinion shaft (17) with bearing (31) cone and spacer sleeves (46 and 47) obtained in step 19 into bearing retainer (6).
23. Preheat bearing (32) cone to 80÷90 [°C] and install it on the pinion shaft (17), using bearing cone driver tool 8N54-50/65-200.
24. Install seal ring (35) in retainer (7), using seal ring driver tool 8N54-65/90-55. Coat the space between lips of seal ring (35) with grease LITOMOS EP-23.
25. Install the housing assy (3) with washer (25), brake cross lever (21), brake shoes assy (4) and springs (26) to retainer (7) and torque bolts (39) with washers (42) to 100÷125 [Nm]. Apply Loctite 120 to the mating surfaces of the retainer (7) and bearing retainer (6).
26. Install joke (8) and O-ring (33) on the pinion shaft (17). Use LOCTITE 262 to the bolt (36) and torque it with washer (9) to 250-300 [Nm].
27. Read the value of mounting distance (B, Fig. 7D.49) and record it. The mounting distance (B) value is stamped on the pinion gear.
28. Install pinion shaft assy to differential assy housing (5, Fig. 7D.40) without O-ring (34) and shims (23). Torque the bolts (38) with washers (42) to 100÷125 [Nm].

First way of dimension (C) obtaining

29. Measure the dimension (C, Fig. 7D.49) using special tool 21.282.0159 and record it.

Second way of dimension (C) obtaining

30. Put tool shaft (F) into differential assy housing hole as shown in Fig. 7D.49. Measure the distance (A) between tool shaft (F) and the face of pinion shaft (17). Record the result.
31. Remove tool shaft (F) from the housing (17). Measure diameter (E) of shaft (F) and record it.
32. Measure diameter (D) of one of the housing (17) hole and divide this measurement in half to obtain the radius of hole, and record the radius D/2 dimension to be used in later calculation.
33. Subtract the dimension (E) recorded in step 31 from dimension (A) measured in step 30:

$$A–E=H$$

34. Add the dimension (H) recorded in step 33 to dimension D/2 obtained in step 32:

$$H+D/2=C$$

35. Subtract the dimension (C) obtained in step 34 from mounting distance (B) obtained in step 27. The difference between dimensions (C) and (B) gives the thickness of shims (23, Fig. 7D.40).
36. Select the set of shims (23) with tolerance ±0.025 [mm]. Unscrew bolts (38) with washers (42) and remove pinion shaft assy from differential assy housing (5).
37. Install thrust washer (16) and crown (27) into carrier (11). Install planetary gear shafts (12) in carrier (11) and secure they using pins (45). Install planetary gears (28) on the shafts (12).

DIFFERENTIAL

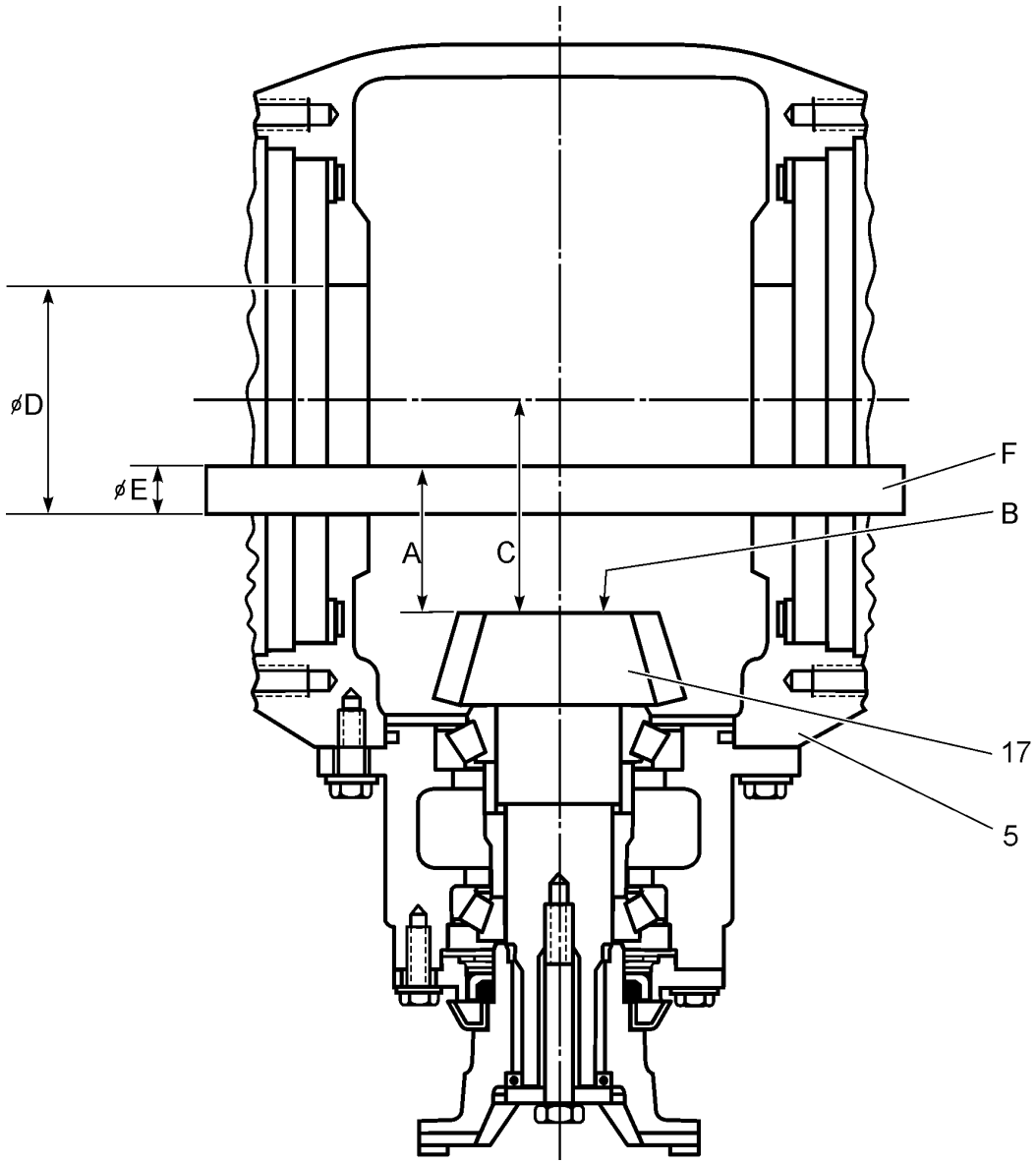


Fig. 7D.49. Dimension (C) Obtaining (Front Axle)

A. Rear Dimension
B. Location of Mounting Distance Stamped on Pinion Shaft
C. Dimension to be obtained
D. Housing Hole Diameter
E. Shaft Diameter
F. Tool Shaft
5. Differential Assy Housing
17. Pinion Shaft

38. Correct tooth contact will result as shown in Fig. 7D.53. Figures 7D.54 through 7D.57 show improper or incorrect tooth contact. To correct such conditions, readjust disc gear and pinion as described on the right side of Figures 7D.54 through 7D.57.

NOTE: *Beside obtaining the correct tooth contact for new gear set, the following disc gear and pinion adjustments can be made to bring the tooth contact back to the original wear pattern for used gear sets.*

DIFFERENTIAL

39. Install crown (27) and thrust washer (22) to carrier (11). Install disc gear (18) on the carrier (11). Use LOCTITE 262 and torque the bolts (37) to 285÷310 [Nm].
40. Preheat bearings (30) cones to 80÷90 [°C] and install them on the carrier (11) and disc gear (18), using bearing cone driver tool 8N54-65/75-150.
41. Install bearings (30) cups in bearing retainers (14), using bearing cup driver tool 21.547.0012.
42. Install disc gear and differential carrier assembly in the differential assy housing (5). Install bearing retainers (14) without shims (24) and seal rings (13). Torque the bolts (39) in bearing retainer (14) closer to disc gear (18) to 60 [Nm].
43. Torque the bolts (39) in second bearing retainer (14) to 4 [Nm]. Using a feeler gauge as shown in Fig. 7D.51, measure the gap remaining between bearing retainer (14) and the housing (5). Take a measurement at both slots in the retainer (14). Add results of measurements and divide by two. Record the result.
44. Make up the pack of shims (24) using the measurement made in step 42. Evenly divide the shims (24) between two. Select the pack of shims (24) with tolerance ±0.04 [mm]. The result is the pack of shims (24) needed to install under each bearing retainer (14).

NOTE: *Maximum thickness of the one side shims pack is 1.28 [mm].*

45. Unscrew the bolts (39) and remove bearing retainers (14) from housing (5).
46. Install bearing retainers (14) with shims (24) to housing (5) and torque the bolts (39) with washers (41) to 100÷125 [Nm].
47. Check the free rolling torque at the disc gear (18), using special tool 21.282.0160. The free rolling torque should be 1.3÷4.0 [Nm], what corresponds to a force of 7.4÷24.0 [N] applied at a diameter equal to 340 [mm] for 520G and 330 [mm] for 515G.
48. Unscrew the bolts (39) with washers (41) and remove bearing retainers (14) with shims (24). Install seal ring (13) on the bearing retainer (14). Install bearing retainer (14) with shims (24) to housing (5) and torque the bolts (39) with washers (41) to 100÷125 [Nm]. Second bearing retainer (14) installation should be conducted in the same manner as for first bearing retainer (14).
49. Lubricate the O-ring (34) with grease LITOMOS EP-23. Install O-ring (34) on the bearing retainer (6). Install pinion shaft assy to differential assy housing (5) with O-ring (34). Install shims (23) as shown in Fig. 7D.50. Torque the bolts (38) with washers (42) to 100÷125 [Nm].
50. Attach a dial indicator to the housing (5) as shown in Fig. 7D.52. While holding the pinion shaft stationary, check the disc gear backlash with the dial indicator. Make this check in four different positions on the gear to determine smallest backlash. Record the result.
51. If the backlash was higher than 0.18÷0.29 [mm], shims (24) should be taken from under bearing retainer (14) and transferred to second bearing retainer (14) located closer to disc gear (18), until this specification is met. Do not change the total number of shims (24), or the bearing preload will be changed.
    If the backlash was less than the specification, reverse the procedure by transferring shims (24) from under bearing retainer (14) located closer to disc gear (18) to second retainer (14).
52. After the correct pinion shaft mounting distance and backlash have been established, check for correct tooth. Apply a coat of zinc white or carbon blacks to the disc gear teeth. While applying resistance to the disc gear, rotate the pinion shaft to obtain a tooth pattern. Observe the size, shape and location of the bare area caused by the tooth contact.

NOTE: *When tooth marks are obtained by hand, they are apt to be rather small and favor the toe of the gear. However, under an actual operating load, the contact area will spread out and move toward the rear of the tooth; the higher the load, the greater becomes the contact area.*

DIFFERENTIAL

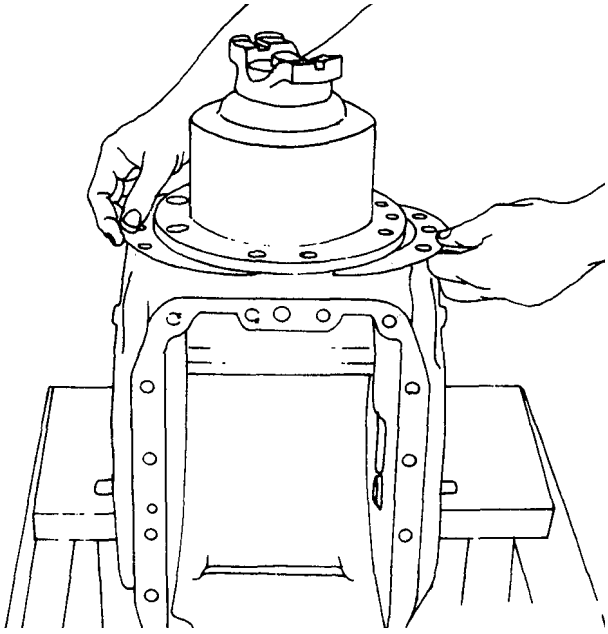


Fig. 7D.50. Installing Pinion Shaft Retainer Shims

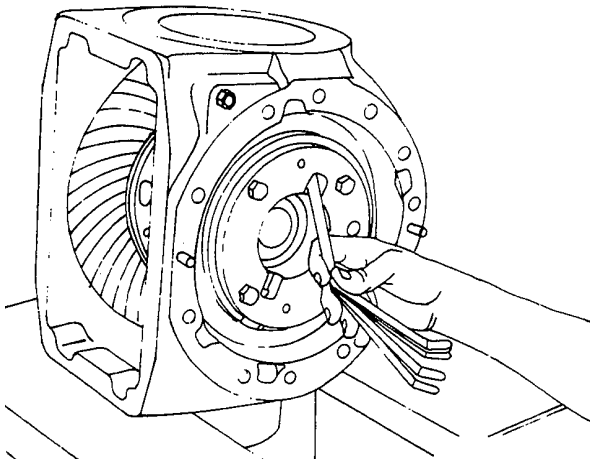


Fig. 7D.51. Measuring Gap Between Bearing Retainer and Housing

53. Unscrew the bolts (39) with washers (41). Use LOCTITE 262 and torque the bolts (39) with washer (41) to 100÷125 [Nm].
54. Install seal ring (44, Fig. 7D.37) on bearing retainer (7). Install seal ring (46) on brake piston (45). Install the brake piston (45), axle shaft (8), brake plate and brake disc to the housing (16).

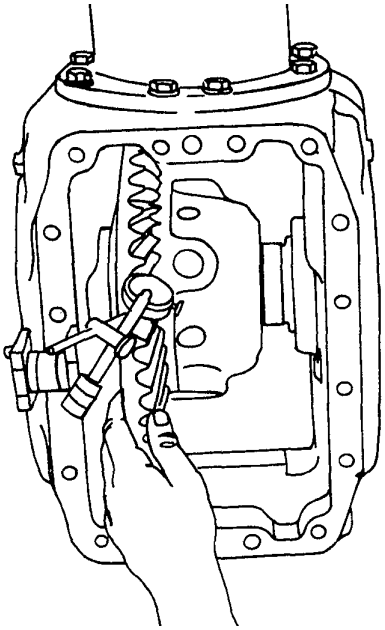


Fig. 7D.52. Checking Disc Gear Backlash

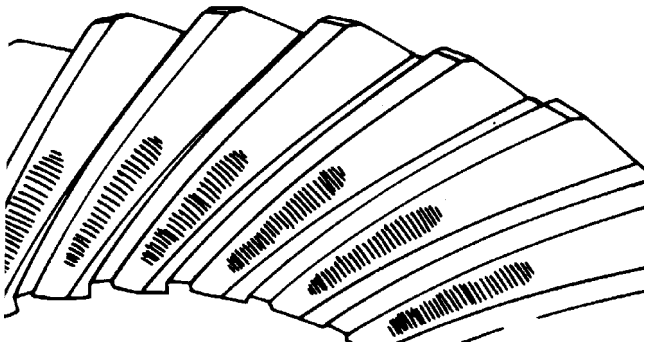
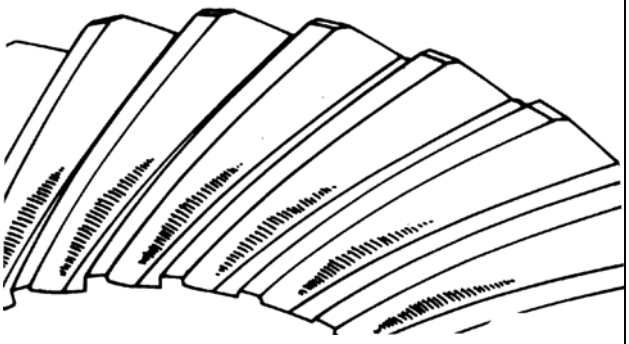
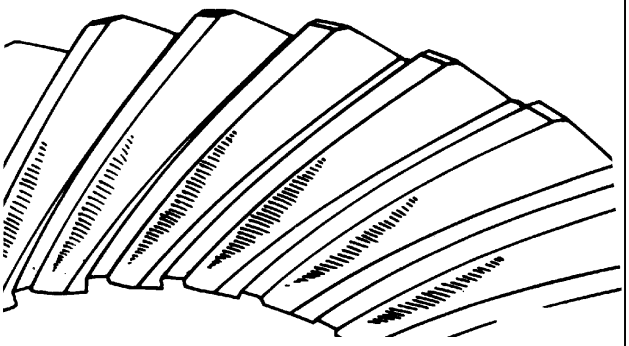
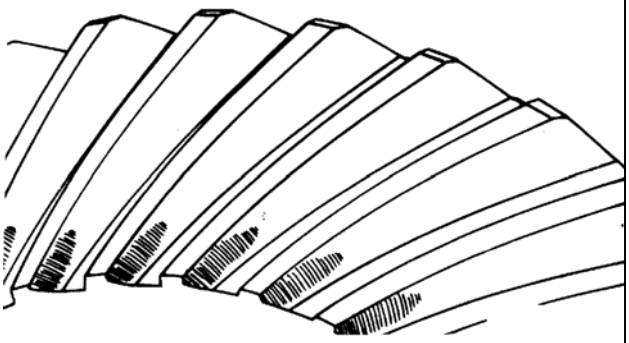
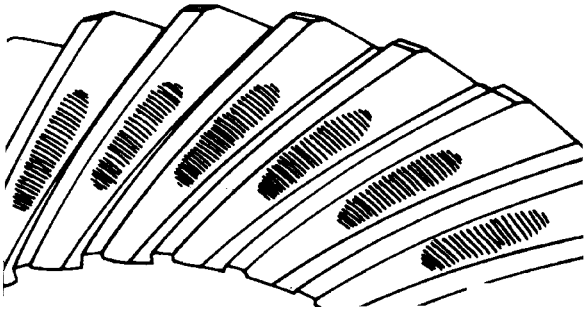


Fig. 7D.53. Correct Gear Tooth Contact

DIFFERENTIAL

If the tooth marking is across the length of the tooth, but narrow and low on the flank the teeth will gall or score. This type of contact causes excessive wear and noise. CORRECTING LOW NARROW CONTACT: Move the pinion away from the center of the disc gear by adding shims under the pinion shaft bearing retainer. Readjust the backlash	 Fig. 7D.54. Low Narrow Contact
If the tooth marking is across the length of the tooth, narrow and high on the tooth face, the teeth will roll over or gall. This type of contact causes excessive wear and noise. CORRECTING HIGH NARROW CONTACT: Move the pinion in toward the center of the disc gear by removing shims from under the pinion shaft bearing retainer. Readjust the backlash.	 Fig. 7D.55. High Narrow Contact
If the tooth marking is too heavy on the toe of the tooth, the tooth edges might chip and damage, or excessive wear will result. CORRECTING SHORT TOE CONTACT: Move the disc gear away from the pinion. However, this adjustment might increase the backlash beyond acceptable limits. If such is the case, it will be necessary to move the pinion in toward the gear by removing shims from under the pinion shaft bearing retainer.	 Fig. 7D.56. Short Toe Contact
If the tooth marking is too heavy on the hell of the tooth, the tooth edges might chip and damage or excessive wear will result. CORRECTING SHORT HEEL CONTACT: Move the disc gear in toward the pinion. However, this adjustment may decrease the backlash. If such is the case, it will be necessary to move pinion away from the center of the disc gear by adding shims under the pinion shaft bearing retainer	 Fig. 7D.57. Short Heel Contact

DIFFERENTIAL

55. Install left and right axle housing assy to differential assy as described in PLANETARY GEAR in this Section.
56. Install two pins (44, Fig. 7D.40) in differential assy housing (5). Apply Loctite 120 to the matching surfaces of the differential assy housing (5) and cover (19). Install cover (19) on the top of differential assy housing (5) and torque the bolts (39) with washers (41) to 100÷125 [Nm].
57. Install drive axle as described in DRIVE AXLE in this section.

REAR AXLE - Only 515G

1. Install bearing (24, Fig. 7D.46) cup into bearing retainer (17), using bearing cup driver tool 21.547.0098.
2. Install bearing (25) cup into bearing retainer (17), using bearing cup driver tool 21.547.0131.

Spacer Sleeves Selection Procedure

3. Install bearing (25, Fig. 7D.58) cone on special tool (D).

NOTE: *For machine 515G use special tool 21.217.0080.*

4. Install bearing retainer (17) with bearing (24 and 25) cups on special tool (D).
5. Install special tool sleeve (B) on special tool (D) base pin.
6. Install bearing (24) cone on bearing (24) cup.
7. Install magnetic base dial indicator (C) with dial tip resting on the special tool sleeve (B) and zero dial indicator (C).

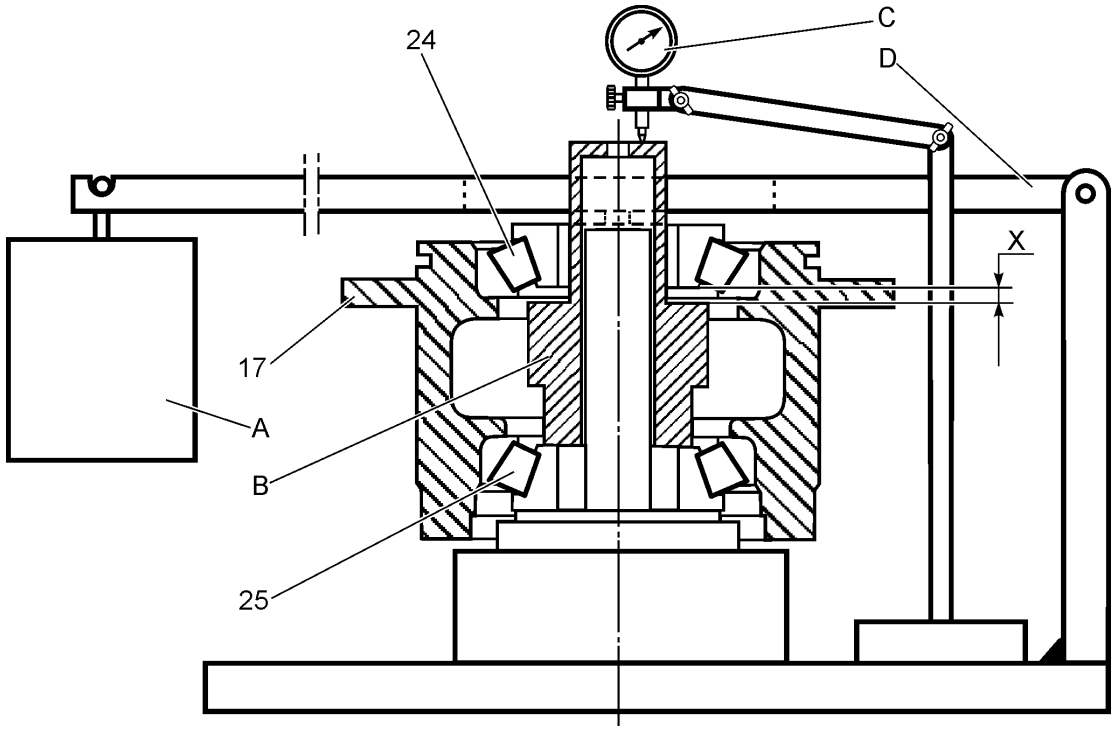


Fig. 7D.58. Rear Axle Pinion Shaft Bearings Preload Special Tool (515G)

17. Bearing Retainer
24. Tapered Bearing
25. Tapered Bearing
A. Special Tool Load
B. Special Tool Sleeve
C. Dial Indicator with Magnetic Base
D. Special Tool
X. Distance Between Bearing Cone and Special Tool Sleeve

DIFFERENTIAL

8. Lift special tool sleeve (B) with your hand until it bottoms on bearing (24) cone. Note the dial indicator reading equal to the (X). Add 10 [mm] to measured (X) and note the result.
9. For distance obtained in step 8 select the set of two spacer sleeves (39 and 40, Fig. 7D.46) with an accuracy of ±0.02 [mm], refer to Table 3.
10. Remove dial indicator (C, Fig. 7D.58) from the special tool (D).
11. Unload the special tool (D) lever and swing the lever away.
12. Remove the special tool sleeve (B) with bearing (24) cone on it from bearing retainer (17).
13. Remove bearing retainer (17) from the special tool (D) base pin.
14. Remove bearing (25) cone from the special tool (D) base pin.

Sleeves Part Numbers		Dimension
40	39	[mm]
425-07-3092	425-07-3089	53.50±0.02
	425-07-3090	53.44±0.02
	425-07-3091	53.38±0.02
425-07-3093	425-07-3089	53.32±0.02
	425-07-3090	53.26±0.02
	425-07-3091	53.20±0.02
425-07-3094	425-07-3089	53.14±0.02
	425-07-3090	53.08±0.02
	425-07-3091	53.02±0.02
429-07-3103	425-07-3089	52.96±0.02
	425-07-3090	52.90±0.02
	425-07-3091	52.84±0.02

Table 3. Dimensions and Sleeves Parts Numbers (for 515G, see Fig. 7D.46)

15. Preheat bearing (24, Fig. 7D.46) cone to 80÷90 [°C] and install it on the pinion shaft (10), using bearing cone driver tool 8N54-60/72-170. Install spacer sleeves (39 and 40) on the pinion shaft (10).
16. Install pinion shaft (10) with bearing (24) cone and spacer sleeves (39 and 40) into bearing retainer (17).
17. Preheat bearing (25) cone to 80÷90 [°C] and install it on the pinion shaft (10), using bearing cone driver tool 8N54-50/65-200.

NOTE: *Lubricate bearings (24 and 25) with oil.*

18. Install the joke assy (2) on the pinion shaft (10) and torque the bolt (29) with washer (3) to 245-300 [Nm].
19. Check free rotation torque of the pinion shaft (10). This torque should be about 1÷3 [Nm]. If the torque is bigger than 1÷3 [Nm], use smaller total dimension spacer sleeves (39 and 40) set, refer to Table 3. If the torque is smaller than 1÷3 [Nm], use bigger total dimension spacer sleeves (39 and 40) set, refer to Table 3.
    If the free rotation torque of the pinion shaft meets specification (1÷3 [Nm]) skip items 21, 22 and proceed with item 23 and following. Otherwise proceed with items 20, 21, 22 and following.

DIFFERENTIAL

20. Unscrew bolt (29) with washer (3) and remove joke assy (2) from the pinion shaft (10).
21. Install pinion shaft (10) with bearing (24) cone and spacer sleeves (39 and 40) obtained in step 19 into bearing retainer (17).
22. Preheat bearing (25) cone to 80÷90 [°C] and install it on the pinion shaft (10), using bearing cone driver tool 8N54-50/65-200.
23. Install seal ring (28) to bearing retainer (17) using seal ring driver tool 8N54-65/90-55.
24. Install the joke assy (2) and O-ring (26) on the pinion shaft (10). Use Loctite 262 to the bolt (29) and torque it with washer (3) to 250÷300 [Nm].
25. Read the value of mounting distance (B, Fig. 7D.59) and record it. The mounting distance (B) value is stamped on the pinion gear.
26. Install pinion shaft assy to differential assy housing (16, Fig. 7D.46) without O-ring (27) and shims (21). Torque the bolts (31) with washers (34) to 100÷125 [Nm].

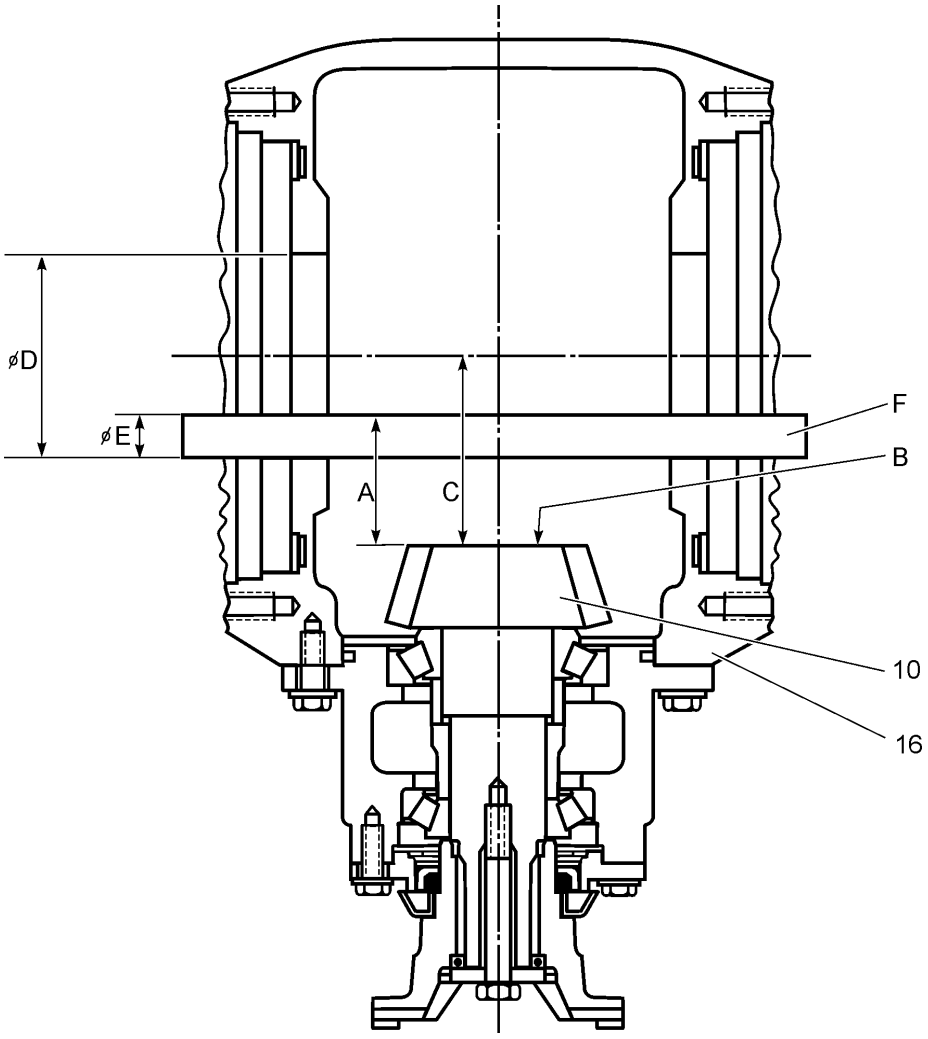


Fig. 7D.59. Dimension (C) Obtaining (Rear Axle)

A. Rear Dimension
B. Location of Mounting Distance Stamped on Pinion Shaft
C. Dimension to be obtained
D. Housing Hole Diameter
E. Shaft Diameter
F. Tool Shaft
10. Pinion Shaft
16. Differential Assy Housing

DIFFERENTIAL

First way of dimension (C) obtaining

27. Measure the dimension (C, Fig. 7D.59) using special tool 21.282.0159 and record it.

Second way of dimension (C) obtaining

28. Put tool shaft (F) into differential assy housing hole as shown in Fig. 7D.59. Measure the distance (A) between shaft (F) and the face of pinion shaft (10) and record the result.
29. Remove tool shaft (F) from the housing (16). Measure diameter (E) of shaft (F) and record it.
30. Measure diameter (D) of one of the housing (16) hole and divide this measurement in half to obtain the radius of hole, and record the radius D/2 dimension to be used in later calculation.
31. Subtract the dimension (E) recorded in step 29 from dimension (A) measured in step 28:

$$A–E=H$$

32. Add the dimension (H) recorded in step 31 to dimension D/2 obtained in step 30:

$$H+D/2=C$$

33. Subtract the dimension (C) obtained in step 32 from mounting distance (B) obtained in step 25. The difference between dimensions (C) and (B) gives the thickness of shims (21, Fig. 7D.46).
34. Select the set of shims (21) with tolerance ±0.025 [mm]. Unscrew bolts (31) with washers (34) and remove pinion shaft assy from differential assy housing (16).
35. Install thrust washer (9) and crown (14) into carrier (4). Install planetary gear shafts (5) in carrier (4) and secure they using pins (37). Install planetary gears (15) on the shafts (5).
36. Install crown (14) and thrust washer (12) to carrier (4). Install disc gear (11) on the carrier (4). Use LOCTITE 262 and torque the bolts (30) to 285÷310 [Nm].
37. Preheat bearings (23) cones to 80÷90 [°C] and install them on the carrier (4) and disc gear (11), using bearing cone driver tool 8N54-65/75-150.
38. Install bearings (23) cups in bearing retainers (7), using bearing cup driver tool 21.547.0012.
39. Install disc gear and differential carrier assembly in the differential assy housing (16). Install bearing retainers (7) without shims (13) and seal rings (6). Torque the bolts (32) in bearing retainer (7) closer to disc gear (11) to 60 [Nm].
40. Torque the bolts (32) in second bearing retainer (7) to 4 [Nm]. Using a feeler gauge as shown in Fig. 7D.51, measure the gap remaining between bearing retainer (7) and the housing (16). Take a measurement at both slots in the retainer (7). Add results of measurements and divide by two. Record the result.
41. Make up the pack of shims (13) using the measurement recorded in step 40. Evenly divide the shims (13) between two. Select the pack of shims (13) with tolerance ±0.04 [mm]. The result is the pack of shims (13) needed to install under each bearing retainers (7).

NOTE: *Maximum thickness of the one side shims pack is 1.28 [mm].*

42. Unscrew the bolts (32) and remove bearing retainers (7) from housing (16).
43. Install bearing retainers (7) with shims (13) to housing (16) and torque the bolts (34) with washers (35) to 100÷125 [Nm].
44. Check the free rolling torque at the disc gear (11), using special tool 21.282.0160. The free rolling torque should be 1.3÷4 [Nm], what corresponds to a force of 7.4÷24 [N] applied at a diameter equal to 330 [mm]
45. Unscrew the bolts (32) and remove bearing retainer (7) with shims (13). Install seal ring (6) on the bearing retainer (7). Install bearing retainer (7) with shims (13) to housing (16) and torque the bolts (32) to 100÷125 [Nm]. Second retainer (7) installation should be conducted in the same manner as for first bearing retainer (7).

DIFFERENTIAL

46. Lubricate the O-ring (27) with grease LITOMOS EP-23. Install O-ring (27) on the bearing retainer (17). Install pinion shaft assy to differential assy housing (16) with O-ring (27). Install shims (21) as shown in Fig. 7D.50. Torque the bolts (31) with washers (34) to 100÷125 [Nm].
47. Attach a dial indicator to the housing (16) as shown in Fig. 7D.52. While holding the pinion shaft stationary, check the disc gear backlash with the dial indicator. Make this check in four different positions on the gear to determine smallest backlash. Record the result.
48. If the backlash was higher than 0.18÷0.29 [mm], shims (13) should be taken from under bearing retainer (7) and transferred to second bearing retainer (7) located closer to disc gear (11), until this specification is met. Do not change the total number of shims (13), or the bearing preload will be changed.
    If the backlash was less than the specification, reverse the procedure by transferring shims (13) from under bearing retainer (7) located closer to disc gear (11) to second retainer (7).
49. After the correct pinion shaft mounting distance and backlash have been established, check for correct tooth contact. Apply a coat of zinc white or carbon blacks to the disc gear teeth. While applying resistance to the disc gear, rotate the pinion shaft to obtain a tooth pattern. Observe the size, shape and location of the bare area caused by the tooth contact.

NOTE: *When tooth marks are obtained by hand, they are apt to be rather small and favor the toe of the gear. However, under an actual operating load, the contact area will spread out and move toward the rear of the tooth; the higher the load, the greater becomes the contact area.*

50. Correct tooth contact will result as shown in Fig. 7D.53. Figures 7D.54 through 7D.57 show improper or incorrect tooth contact. To correct such conditions, readjust disc gear and pinion as described on the right side of Figures 7D.54 through 7D.57.

NOTE: *Beside obtaining the correct tooth contact for new gear set, the following disc gear and pinion adjustments can be made to bring the tooth contact back to the original wear pattern for used gear sets.*

51. Unscrew the bolts (32). Use LOCTITE 262 and torque the bolts (32) to 100÷125 [Nm].
52. Install seal ring (44, Fig. 7D.37) on bearing retainer (7). Install seal ring (46) on brake piston (45). Install brake piston (45), axle shaft (8), brake plate and brake disc to the housing (16).
53. Install left and right axle housing assy to differential assy as described in PLANETARY GEAR in this Section.
54. Install two pins (36, Fig. 7D.46) in differential assy housing (16). Apply Loctite 120 to the matching surfaces of the differential assy housing (16) and cover (20). Install cover (20) on the top of differential assy housing (16) and torque the bolts (32) with washers (33) to 100÷125 [Nm].
55. Install drive axle as described in DRIVE AXLE in this section.

REAR AXLE - Only 520G

1. Press bearing (24, Fig. 7D.47) cup into bearing retainer (17), using bearing cup driver tool 21.547.0098.
2. Press bearing (26) cup into bearing retainer (17), using bearing cup driver tool 21.547.0131.

Spacer Sleeves Selection Procedure

3. Install bearing (26, Fig. 7D.60) cone on special tool (D).

NOTE: *For machine 520G use special tool 21.282.0172.*

4. Install bearing retainer (17) with bearing (24 and 26) cups on special tool (D).
5. Install special tool sleeve (B) on special tool (D) base pin.

DIFFERENTIAL

6. Install bearing (24) cone on bearing (24) cup.
7. Install magnetic base dial indicator (C) with dial tip resting on the special tool sleeve (B) and zero dial indicator.
8. Lift special tool sleeve (B) with your hand until it bottoms on bearing (24) cone. Note the dial indicator reading equal to the (X). Add 45.9 [mm] to measured (X) and note the result.
9. For distance obtained in step 8 select the set of two spacer sleeves (42 and 43, Fig. 7D.47) with an accuracy of ±0.02 [mm], refer to Table 4.
10. Remove dial indicator (C, Fig. 7D.60) from the special tool (D).
11. Unload the special tool (D) lever and swing the lever away.
12. Remove the special tool sleeve (B) with bearing (24) cone on it from bearing retainer (17).
13. Remove bearing retainer (17) from the special tool (D) base pin.
14. Remove bearing (26) cone from the special tool (D) base pin.
15. Preheat bearing (24, Fig. 7D.47) cone to 80÷90 [°C] and install it on the pinion shaft (10), using bearing cone driver tool 8N54-60/72-170. Install spacer sleeves (42 and 43) on the pinion shaft (10).
16. Install pinion shaft (10) with bearing (24) cone and spacer sleeves (42 and 43) into bearing retainer (17).

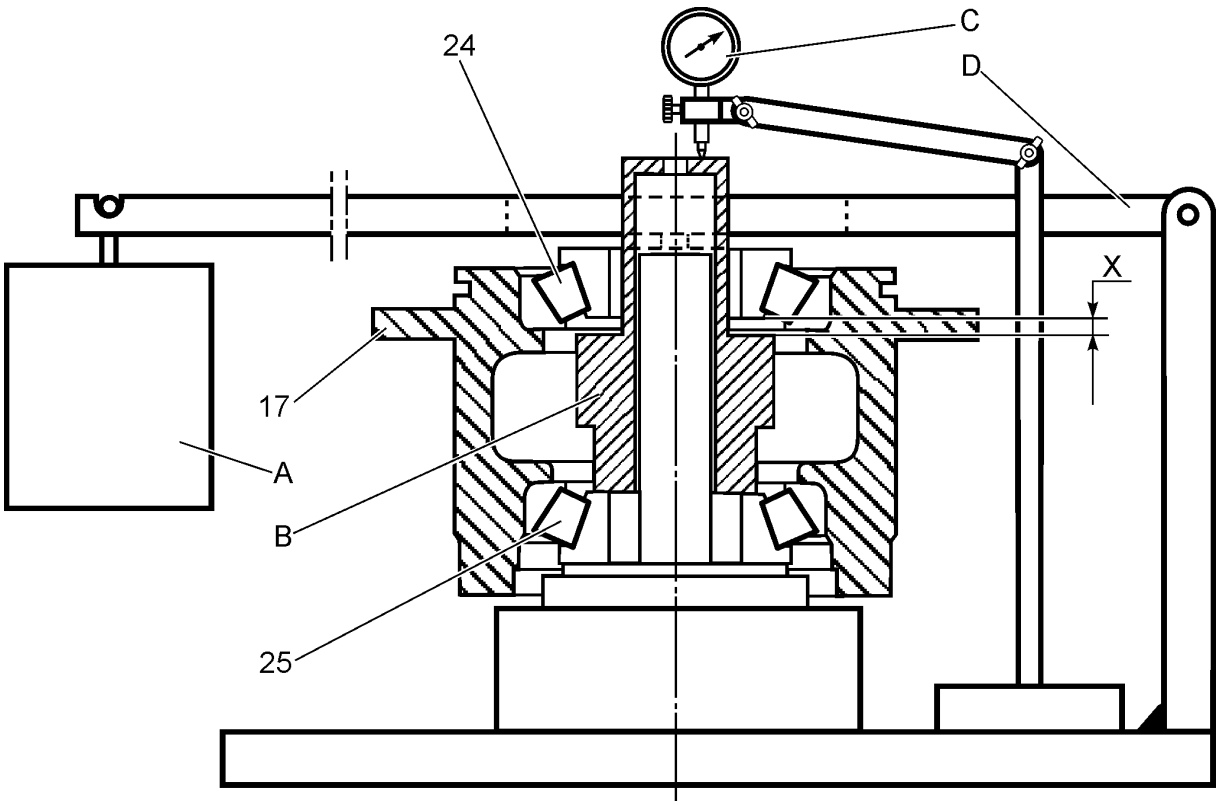


Fig. 7D.60. Rear Axle Pinion Shaft Bearings Preload Special Tool (520G)

17. Bearing Retainer
24. Tapered Bearing
26. Tapered Bearing
A. Special Tool Load
B. Special Tool Sleeve
C. Dial Indicator with Magnetic Base
D. Special Tool
X. Distance Between Bearing Cone and Special Tool Sleeve

DIFFERENTIAL

17. Preheat bearing (26) cone to 80÷90 [°C] and install it on the pinion shaft (10), using bearing cone driver tool 8N54-50/65-200.

NOTE: *Lubricate bearings (24 and 26) with oil.*

18. Install the joke assy (2) on the pinion shaft (10) and torque the bolt (31) with washer (3) to 245÷300 [Nm].
19. Check free rotation torque of the pinion shaft (10). This torque should be about 1-3 [Nm]. If the torque is bigger than 1-3 [Nm], use smaller total dimension spacer sleeves (42 and 43) set, refer to Table 4. If the torque is smaller than 1÷3 [Nm], use bigger total dimension spacer sleeves (42 and 43) set, refer to Table 4. If the free rotation torque of the pinion shaft meets specification (1÷3 [Nm]) skip items 20, 21, 22 and 23 and proceed with item 24 and following. Otherwise proceed with items 20, 21, 22, 23 and following.
20. Unscrew bolt (31) with washer (3) and remove joke assy (2) from the pinion shaft (10).
21. Remove pinion shaft (10) with bearing (24) cone and spacer sleeves (42 and 43) from bearing retainer (17).
22. Install pinion shaft (10) with bearing (24) cone and spacer sleeves (42 and 43) obtained in step 19 into bearing retainer (17).

Sleeves Part Numbers		Dimension
42	43	[mm]
429-07-3041	429-07-3038	46.80±0.02
	429-07-3039	46.74±0.02
	429-07-3040	46.68±0.02
429-07-3035	429-07-3038	46.62±0.02
	429-07-3039	46.56±0.02
	429-07-3040	46.50±0.02
429-07-3036	429-07-3038	46.44±0.02
	429-07-3039	46.38±0.02
	429-07-3040	46.32±0.02
429-07-3037	429-07-3038	46.26±0.02
	429-07-3039	46.20±0.02
	429-07-3040	46.14±0.02

Table 4. Dimensions and Sleeves Parts Numbers (for 520G, Fig. 7D.47)

23. Preheat bearing (26) cone to 80÷90 [°C] and install it on the pinion shaft (10), using bearing cone driver tool 8N54-50/65-200.
24. Install seal ring (30) in retainer (27), using seal ring driver tool 8N54-65/90-55. Coat the space between lips of seal ring (30) with grease LITOMOS EP-23.
25. Install the retainer (27) with seal ring (30) to bearing retainer (17) and torque mounting bolts (25) with spring washers (40) to 100÷125 [Nm]. Apply Loctite 120 to the mating surfaces of the retainer (27) and bearing retainer (17).
26. Install the joke assy (2) and O-ring (28) on the pinion shaft (10) and torque the bolt (31) with washer (3) to 250÷300 [Nm].
27. Read the value of mounting distance (B, Fig. 7D.59) and record it. The mounting distance (B) value is stamped on the pinion gear.
28. Install pinion shaft assy to differential assy housing (16, Fig. 7D.47) without O-ring (29) and shims (21). Torque the bolts (33) with washers (36) to 100÷125 [Nm].

DIFFERENTIAL

First way of dimension (C) obtaining

29. Measure the dimension (C, Fig. 7D.59) using special tool 21.282.0159 and record it.

Second way of dimension (C) obtaining

30. Put shaft (F) into differential assy housing hole as shown in Fig. 7D.59. Measure the distance (A) between shaft (F) and the face of pinion shaft (10) and record the result.
31. Remove shaft (F) from the housing (16). Measure diameter (E) of shaft (F) and record it.
32. Measure diameter (D) of one of the housing (16) hole and divide this measurement in half to obtain the radius of hole, and record the radius D/2 dimension to be used in later calculation.
33. Subtract the dimension (E) recorded in step 31 from dimension (A) measured in step 30.

$$A–E=H$$

34. Add the dimension (H) recorded in step 33 to dimension D/2 obtained in step 32:

$$H+D/2=C$$

35. Subtract the dimension (C) obtained in step 34 from mounting distance (B) obtained in step 27. The difference between dimensions (C) and (B) gives the thickness of shims (21, Fig. 7D.47).
36. Select the set of shims (21) with tolerance ±0.025 [mm]. Unscrew bolts (33) with washers (36) and remove pinion shaft assy from differential assy housing (16).
37. Install thrust washer (9) and crown (14) into carrier (4). Install planetary gear shafts (5) in carrier (4) and secure they using pins (39). Install planetary gears (15) on the shafts (5).
38. Install crown (14) and thrust washer (12) to carrier (4). Install disc gear (11) on the carrier (4). Use LOCTITE 262 and torque the bolts (32) to 285÷310 [Nm].
39. Preheat bearings (23) cones to 80÷90 [°C] and install them on the carrier (4) and disc gear (11), using bearing cone driver tool 8N54-65/75-150.
40. Install bearings (23) cups in bearing retainers (7), using bearing cup driver tool 21.547.0012.
41. Install disc gear and differential carrier assembly in the differential assy housing (16). Install bearing retainers (7) without shims (13) and seal rings (6). Torque the bolts (34) in bearing retainer (7) closer to disc gear (11) to 60 [Nm].
42. Torque the bolts (34) in second bearing retainer (7) to 4 [Nm]. Using a feeler gauge as shown in Fig. 7D.51, measure the gap remaining between bearing retainer (7, Fig. 7D.47) and the housing (16). Take a measurement at both slots in the retainer (7). Add results of measurements and divide by two. Record the result.
43. Make up the pack of shims (13) using the measurement recorded in step 42. Evenly divide the shims (13) between two. Select the pack of shims (13) with tolerance ±0.04 [mm]. The result is the pack of shims (13) needed to install under each bearing retainer (7).

NOTE: *Maximum thickness of the one side shims pack is 1.28 [mm].*

44. Unscrew the bolts (34) and remove bearing retainers (7) from housing (16).
45. Install bearing retainers (7) with shims (13) to housing (16) and torque the bolts (34) with washers (35) to 100÷125 [Nm].
46. Check the free rolling torque at the disc gear (11), using special tool 21.282.0160. The free rolling torque should be 1.3÷4 [Nm], what corresponds to a force of 7.4÷24 [N] applied at a diameter equal to 340 [mm].
47. Unscrew the bolts (34) with washers (35) and remove bearing retainer (7) with shims (13). Install seal ring (6) on the bearing retainer (7). Install bearing retainer (7) with shims (13) to housing (16) and torque the bolts (34) with washers (35) to 100÷125 [Nm]. Second retainer (7) installation should be conducted in the same manner as for first bearing retainer (7).

DIFFERENTIAL

48. Lubricate the O-ring (29) with grease LITOMOS EP-23. Install O-ring (29) on the bearing retainer (17). Install pinion shaft assy to differential assy housing (16) with O-ring (29). Install shims (21) as shown in Fig. 7D.50. Torque the bolts (33) with washers (36) to 100÷125 [Nm].
49. Attach a dial indicator to the housing (16) as shown in Fig. 7D.52. While holding the pinion shaft stationary, check the disc gear backlash with the dial indicator. Make this check in four different positions on the gear to determine smallest backlash. Record the result.
50. If the backlash was higher than 0.18÷0.29 [mm], shims (13) should be taken from under bearing retainer (7) and transferred to second bearing retainer (7) located closer to disc gear (11), until this specification is met. Do not change the total number of shims (13), or the bearing preload will be changed.
    If the backlash was less than the specification, reverse the procedure by transferring shims (13) from under bearing retainer (7) located closer to disc gear (11) to second retainer (7).
51. After the correct pinion shaft mounting distance and backlash have been established, check for correct tooth contact. Apply a coat of zinc white or carbon blacks to the disc gear teeth. While applying resistance to the disc gear, rotate the pinion shaft to obtain a tooth pattern. Observe the size, shape and location of the bare area caused by the tooth contact.

NOTE: *When tooth marks are obtained by hand, they are apt to be rather small and favor the toe of the gear. However, under an actual operating load, the contact area will spread out and move toward the rear of the tooth; the higher the load, the greater becomes the contact area.*

52. Correct tooth contact will result as shown in Fig. 7D.53. Figures 7D.54 through 7D.57 show improper or incorrect tooth contact. To correct such conditions, readjust disc gear and pinion as described on the right side of Figures 7D.54 through 7D.57.

NOTE: *Beside obtaining the correct tooth contact for new gear set, the following disc gear and pinion adjustments can be made to bring the tooth contact back to the original wear pattern for used gear sets.*

53. Unscrew the bolts (34, Fig. 7D.47) with washers (35). Use LOCTITE 262 and torque the bolts (34) with washer (35) to 100÷125 [Nm].
54. Install seal ring (44, Fig. 7D.37) on bearing retainer (7). Install seal ring (46) on brake piston (45). Install brake piston (45), axle shaft (8), brake plate and brake disc to the housing (16).
55. Install left and right axle housing assy to differential assy as described in PLANETARY GEAR in this Section.
56. Install two pins (38, Fig. 7D.47) in differential assy housing (16). Apply Loctite 120 to the matching surfaces of the differential assy housing (16) and cover (20). Install cover (20) on the top of differential assy housing (16) and torque the bolts (34) with washers (35) to 100÷125 [Nm].
57. Install drive axle as described in DRIVE AXLE in this section.

SECTION 8

ELECTRICAL

ELECTRICAL

SECTION 8

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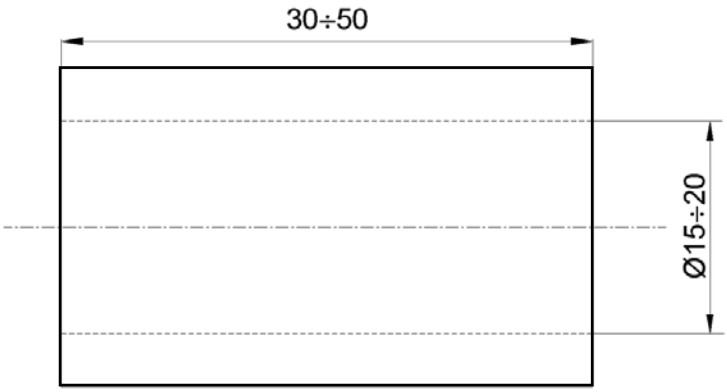
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SERVICE / SPECIAL TOOLS

1. SERVICE / SPECIAL TOOLS

DESCRIPTION	TOOL NUMBER
Bearing puller set	95720-00051
Volt / Ammeter	OEM – 1047
Electronic Battery Tester	15 – 550
Circuit Tester	Any suitable
Vernier caliper	Any suitable
Dial Gauge	Any suitable
Torque wrench ½''	0 ÷ 300 [Nm]
Socket set ½''	Any suitable
Screwdriver set	Any suitable
Plastic hammer	Any suitable
Sandpaper	No.400 or higher
Plastic hammer	Any suitable
Spacer	Fig. 8.A



Steel 25 per PN-93/H-84019

Fig. 8.A. Spacer

GENERAL

2. DESCRIPTION

The electrical system is a 24 [V] negative ground system. All electrical service is controlled by a master disconnect switch which is located on the L.H. side of the rear frame bulkhead. The master switch is installed on the positive side of the electrical circuit, and is used to cut out the electrical power. The loaders are equipped with two 12 [V] batteries connected in series to produce 24 [V].

Engine electronics is protected with fuses (5, 8, 9, 10, 11, 12, Fig. 8.2). All other electrical circuits are protected by automatic reset circuit breakers. In the event of a short circuit or ground, the breaker will open the circuit before damage occurs and will continue to open and close until the trouble clears or turning off the circuit.

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.

ELECTRICAL

GENERAL

***IMPORTANT**: Never disconnect the alternator, master switch or batteries while the engine is running.*

Surfaces under all terminals must be clean, and good electrical connections must be established after assembly. All clips must grip cables tightly to prevent vibration and rapid cable wear.

CAUTION! When installing batteries, be sure to connect the cable from the master switch to the positive (+) 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. LOADER ELECTRICAL SYSTEM

3A. MACHINE WIRING SYSTEM (FIG. 8.1)

Electrical machine system consists of starting circuit, charging circuit, control circuit and auxiliary circuit.

Starting Circuit

The starting circuit contains the batteries (1 and 2, Fig. 8.2), master switch (3), breaker (37), starting switch (57, Fig. 8.1), transmission shifter (80) startup relay (40, Fig. 8.2), starter solenoid and cranking motor (4). The master switch is located on the positive side of the batteries and must be in the "ON" position to complete the battery circuit for starting power. Power is available at the startup relay whenever the master switch is in the "ON" position and the transmission shifter lever is in the neutral position allowing the power to flow on an actuate the starter. When the starting key is turned, power flows to the startup relay. When actuated, the coil of the relay closes the contacts, connecting the larger power line from the battery to the starter solenoid. When the solenoid is actuated, it draws its spool in, engaging the drive gear for the starter and connecting the battery cable to the starter motor for cranking. Both the startup relay and starter solenoid are spring tensioned to remain in the "disengaged" position. When the starting switch is released, one by one units are released, breaking the circuit.

Charging Circuit

The charging circuit contains the alternator (14, Fig. 8.2) and the batteries (1 and 2). Once the engine is running, the alternator output is used to supply the power demands as well as recharge the batteries. An integral regulator is located in alternator itself. The integral regulator senses the entire system draw and compensates by increasing or decreasing the voltage output.

Control Circuit

The circuit is used for transmission electric control. It includes the transmission shifter (80), relays (81) and transmission control solenoid valves (37). After the starting switch is turn on when transmission shifter is in neutral position, the electric power, passing thru the fuse (6 [A]), will flow to the transmission shifter (80) movable contacts. All solenoid valves (F, R, A, B) are in their neutral positions. The first gear is hydraulically engaged. The machine will not move.

WIRING DIAGRAMS

Once the machine is controlled for the forward travel, the RNF relay will be energized and thru its contacts the F solenoid valve will be activated. The machine will move forward in first gear. With the transmission shifter moved for the reverse travel, the RNR relay will be energized and thru its contacts the R solenoid valve will be activated. The machine will be move to the rear in the first gear. At the same time both the back-up alarm and stop lamps will be energized thru the R1 relay.

If the machine moves either forward (F) or backward (R) with the transmission shifter moved to the second gear, the A solenoid valve thru the KD relay contacts will be closed. The machine will travel in the second gear. If the machine moves either forward (F) or backward (R) with the transmission shifter moved to the third gear, the A solenoid valve thru the KD relay contacts will be energized. At the same time the B solenoid valve, directly thru the transmission shifter (80) will be energized. The machine will travel in the third gear. While the machine moves the KD4 relay will activate. This will cause timer (f) ground circuit to open and disable the kick-down

If the gear kick-down button (68D) from the second to first gear is activated, both the KD3 relay coil and the timer (t) will be energized. The timer (t) will cause KD3 relay to remain energized. KD3 relay will activate KD2 relay that open the KD relay contacts and in turn will deenergize solenoid valve (A). The machine will move in the first gear. This condition will continue until kick-down button (68D) is depress again, then KD3 relay will deactivate KD2 relay that will closed the KD relay contacts and the A solenoid valve will be energized. The machine will revert to the second gear.

If kick-down button (68D) is depressed with the machine roading in the third gear, there is no gear reduction. The KD relay is still energized similarly the transmission shifter (80) and consequently, the A and B solenoid valves.

If while the machine is roading, the brake and transmission disconnect pedal is activated, then the transmission disconnect switch (38) will energized the RNF and RNR relays coil and thru its contacts will open the A and B solenoid valves. The machine is braked with the transmission disconnected until the brake and transmission disconnect pedal is released.

Auxiliary Circuits

This circuits supplies power to the lights, lock electromagnets, boom float and kick-down electromagnets, warning lights and instruments circuits. Additional circuits as, air conditioner and/or cab heater or ride stabilizing system (If equipped). Automatic reset circuit breakers are used to protect them.

3B. ENGINE CONTROL WIRING SYSTEM (Fig. 8.2)

Electronic Control Module – ECM (6) controls the engine. ECM is supply from the batteries (1, 2) through the fuses (8 to 12). Starting switch (15) in its activated position provides power to the engine warning lamps (24 to 28) and to tachometer (36). Diagnostics for accelerator pedal-APS (Accelerator Position Sensor) (20) and IVS (Idle Validation Switch) (21) is described in Section 12 POWER. Diagnostics for ECM (6) is described in Troubleshooting and Repair Manual Electronic Control System ISB an QSB 5.9 Engines Bulletin 4021456 vol. 1 and 2.

ELECTRICAL

WIRING DIAGRAMS

The description to Fig. 8.1:

1. Rear Left Turn Signal Lamp
2. Rear Left Parking Lamp
3. Left Stop Lamp
4. Back-up Lamp
5. Rear Working Lamp
6. Back-up Alarm
7. Right Stop Lamp
8. Rear Right Parking Lamp
9. Rear Right Turn Signal Lamp
10. Connector (to Engine)
17. Fuel Level Sensor
23. Speedometer Sensor
24. Tachometer Sensor
29. Torque Converter Temperature Sensor
31. Power to Cab
32. T/C Temperature Warning Light Switch
33. Hydraulic Oil Temperature Warning Light Switch
34. Transmission Oil Filter Warning Light Switch
35. Hydraulic Oil Filter Warning Light Switch
36. Ground Drive Steering Warning Light Switch
37. Transmission Solenoid Valves
38. Transmission Disconnect Switch
39. Service Brake System Control Warning Light Switch
40. Stop Light Switch
41. Instrument panel connector
42. Parking Brake Warning Light Switch
43. Hazard Warning Signal Flasher
44. Warning Lights Diodes
45. Alarm Buzzer
46. Hazard Warning Signal Switch
47. Turn Signal Switch
48. Turn Signal Flasher
49. Automatic Reset Circuit Breakers
50. Cluster Warning Lights
51. Hourmeter
52. Cluster Gauge
54. Portable Lamp Receptacle
55. Speedometer
57. Starting Switch
58. Parking and Low Beam Lights Switch
59. Work Lights Switch
60. Front Left Turn Signal Lamp
61. Front Left Parking Lamp
62. Low Beam Headlamps
63. Horn

64.* High Beam Headlamps
69. Front Work Lamps
70. Front RH Turn Signal Lamps
71. Front RH Parking Lamp
72. Bucket Leveler Electromagnet

68A. Boom Kick-out Electromagnet
68B. Pilot Valves Lock Solenoid Valve
68C. Quickcoupling Lock Solenoid Valve
68D. Kick-down Button (from second to first gear and vice versa)

69. Boom Float Electromagnet
70. Boom Kick-out Proximity Switch
71. Bucket Leveler Proximity Switch
72. Pilot Lock Solenoid Valve Switch
73. Quickcoupling Lock Switch

74.* Heated Windows
75. Tachometer
76. Flashing Warning Lamp
77. Flashing Warning Lamp Switch

78.* Heated Window Switch
79. Turn Signal Signal Light
80. Transmission Shifter and Horn Switch
81. Transmission Relays

82* RCS Speed On Relay
83* RCS Solenoid Valve
84* RCS Switch

WIRE COLOR CODE:

R – red	O – orange
T – light brown	P – pink
W – white	V – violet
Y – yellow	DB – dark blue
B – black	LB – light blue
BR – dark gray	DG – dark green
G – gray	LG – light green

CLUSTER WARNING LIGHTS (item 50 above):

A. Transmission Filter Clogging Warning Light
B. Hydraulic Filter Clogging Warning Light
C. Air Cleaner Clogging Warning Light
E.* Hydraulic Oil Temperature Warning Light

CLUSTER GAUGE (item 52 above):

A. Low Engine Oil Pressure Warning Light
B. Ground Driven Steering Warning Light
C. Parking Brake Warning Light
D. Engine Coolant Temperature Warning Light
E. Inoperative Service Brake Warning Light
F. Torque Converter Oil Temperature Warning Light
H. Engine Coolant Temperature Gauge
J. Torque Converter Oil Temperature Gauge
K. Fuel Level Gauge
L. Cluster Gauge Illumination Lights
M. Voltmeter

RELAYS (item 81 above)

R1 – Lights and Backup Signal
RNR – Disconnecting Forward Drive
RNF – Disconnecting Rearward Drive
S – Horn Warning Signals
KD, KD1 to KD4 – Gear Relays
t – Timer

* Optional attachment equipped on order.

NOTE: *The wiring diagram represents the system inactive, i.e. while the machine is parked and the electric system master switch is off.*

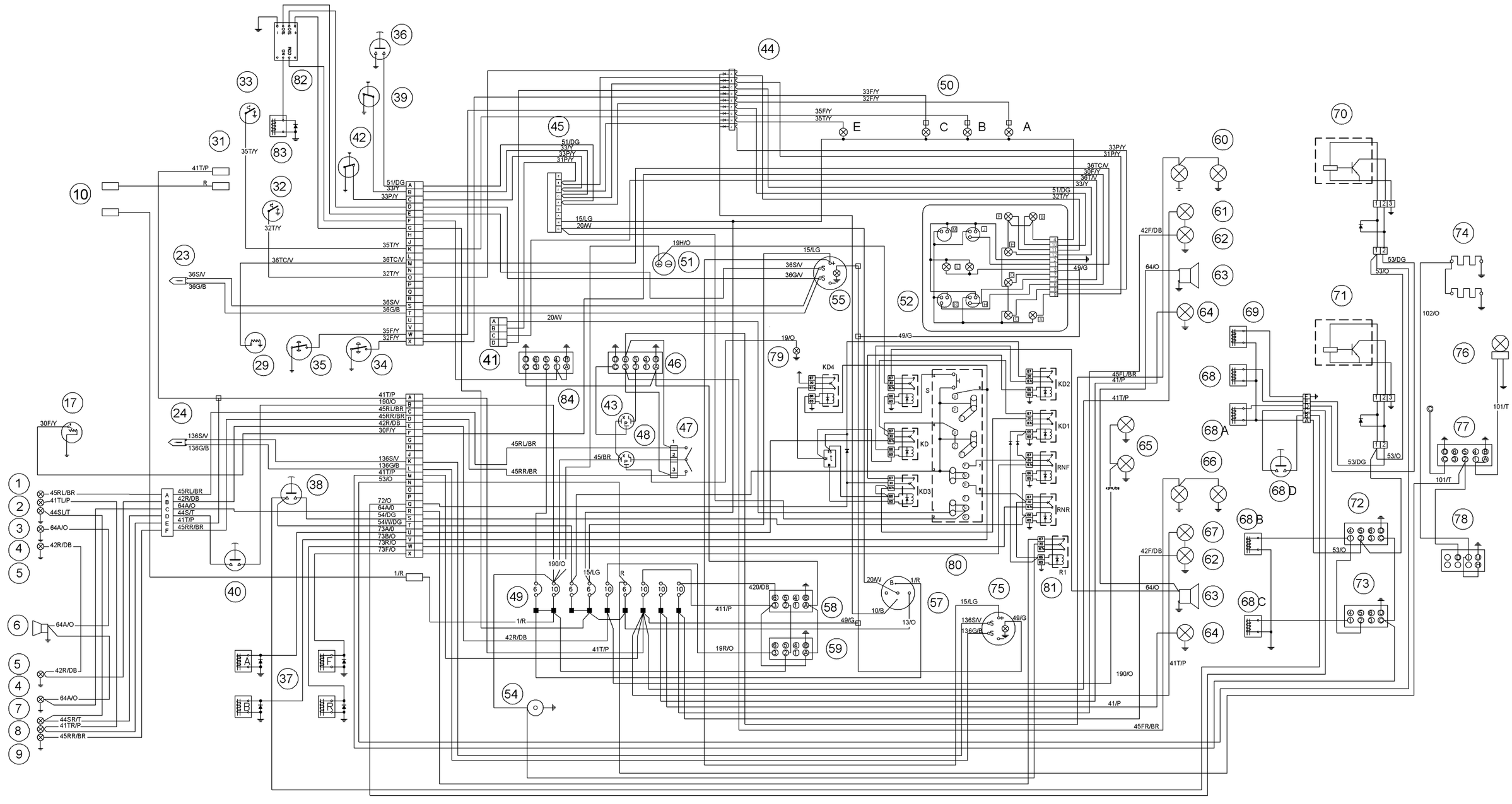


Fig. 8.1. Machine Wiring Diagram

WIRING DIAGRAMS

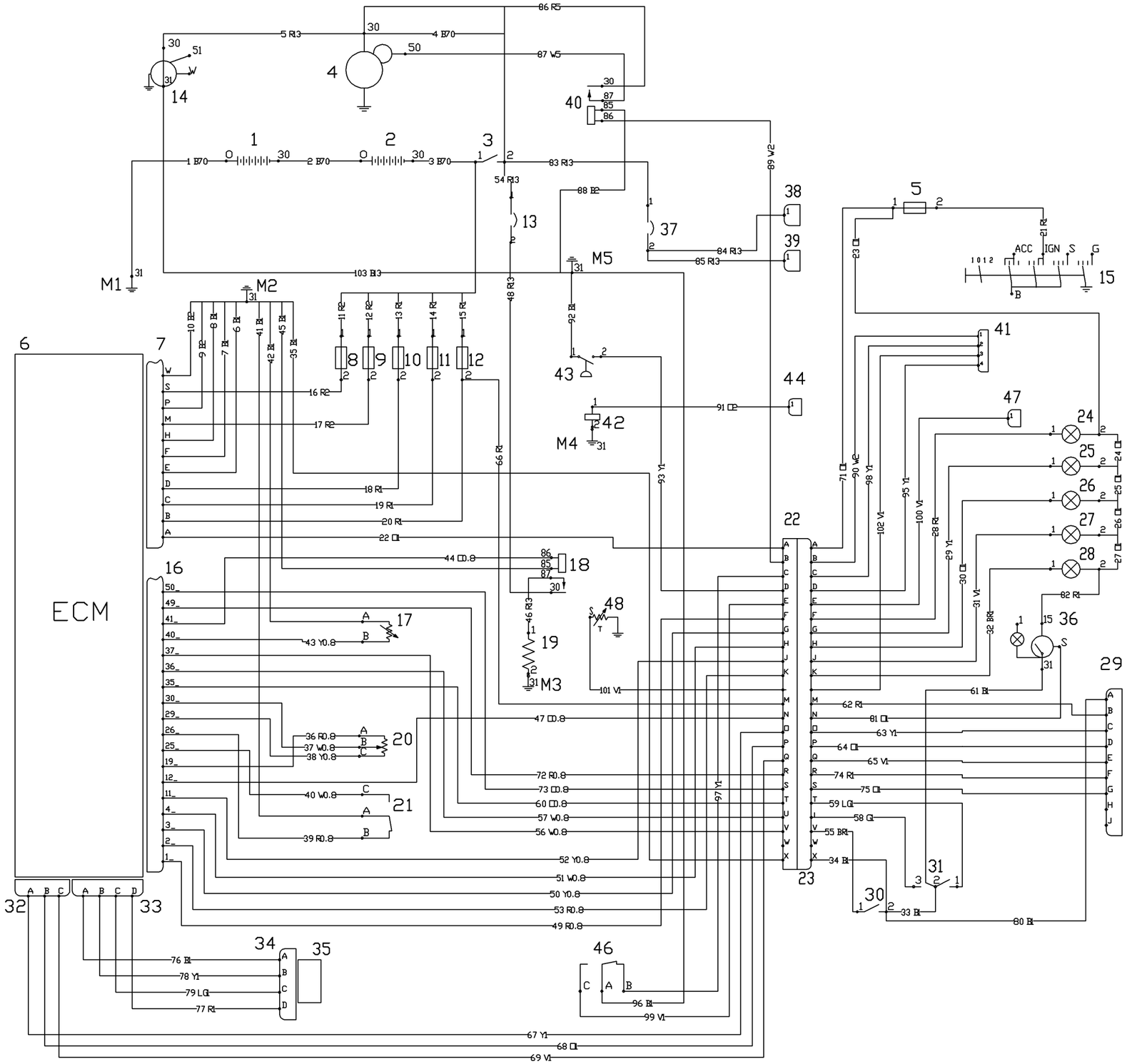


Fig. 8.2. Engine Wiring Diagram

WIRING DIAGRAMS

Description to Fig. 8.2:

1, 2. Battery
3. Master Switch
4. Cranking Motor
5. Fuse 5 [A]
6. ECM Electronic Controller
7. 23 Pin Power Connector
8. Fuse 10 [A]
9. Fuse 10 [A]
10. Fuse 8 [A]
11. Fuse 8 [A]
12. Fuse 8 [A]
13. Automatic Reset Circuit Breaker 125 [A]
14. Alternator
15. Starting Switch
16. 50 Pin Control Connector
17. WIF Sensor
18. Engine Inlet Air Heater Relay
19. Engine Inlet Air Heater
20. Accelerator Pedal Position Potentiometer
21. Low Engine RPM Signal Switch (IVS) - at Accelerator Pedal to ECM
22. Instrument Panel Connector
23. Instrument Panel Connector
24. STOP Warning Light (red)
25. Warning Light (orange)
26. Warning Light (orange)
27. Engine Inlet Air Heater Signal Light
28. WIF Warning Light
29. Test Connector
30. Engine ECM Memory Activation Diagnostics Switch
31. Engine ECM Failure Code Display and Intermediate Speed Control (ISC) Momentary Switch
32. Connector
33. Connector
34. Connector
35. Coolant Level Sensor
36. Tachometer
37. Automatic Reset Circuit Breaker 80 [A]
38. Power Connector
39. Cab Connector
40. Startup Electromagnetic Switch
41. Instrument Panel Connector
42. Air Conditioner Compressor Clutch
43. Air Cleaner Clogging Warning Light Switch
44. Cab Connector
46. Low Engine Oil Pressure and Hourmeter Warning Light Switch
47. Hourmeter
48. Engine Coolant Temperature Sensor

4. CAB ELECTRICAL SYSTEM (Fig. 8.3)

This system contains automatic reset circuit breaker, switches, windshield wipers and washer pumps, cab fan, lamps and air conditioner.

The cab electrical system is connecting to the loader electrical system with three leads:

- supply lead for all receivers in the cab “1R“
- lead for all switches illumination in the cab “LIGHT”
- pilot lead for air conditioner compressor clutch “66C/O”

The description to Fig. 8.3:

1. Front Wiper Motor
2. Cab Lights
3. Windshield Defroster Fan
4. Rear Window Washer Pump
5. Front Window Washer Pump
6. Rear Wiper Motor
7. Air Conditioner and Heater Supply Connector
8. Top Work Lamps
9. Automatic Reset Circuit Breaker
10. Rear Window Washer Pump Switch
11. Rear Wipers Motor Switch
12. Windshield Defroster Fan Motor Switch
13. Windshield Washer Pump Switch
14. Front Wiper Motor Switch
15. Heater/Air Conditioner Switch
16. Heater Fan Motor
17. Thermostat
18. Air Conditioner High Pressure Switch
19. Air Conditioner Low Pressure Switch
20. Heater Fan Motor Switch
21. Relay
22. Resistor

WIRING DIAGRAMS

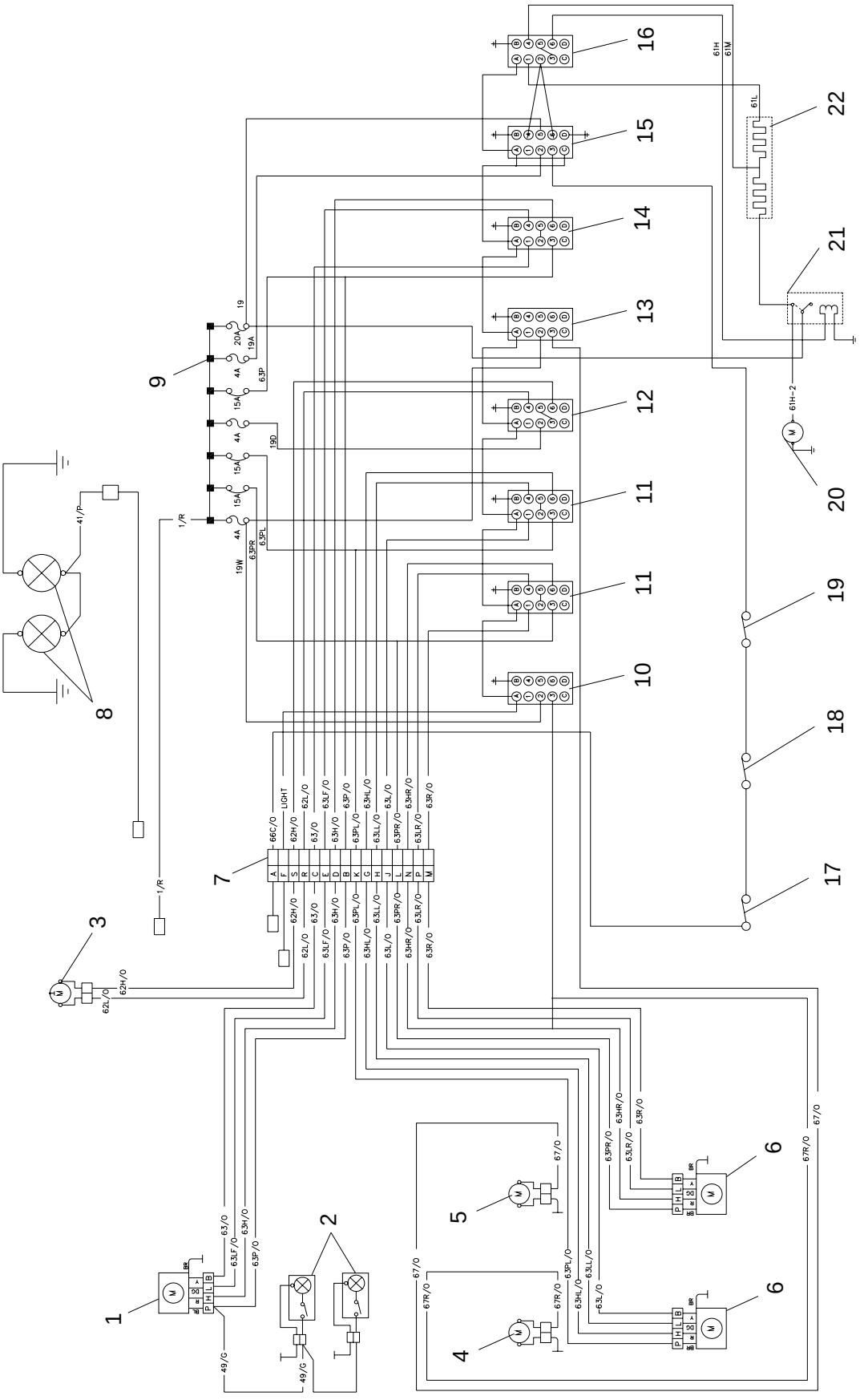


Fig. 8.3. Cab Wiring Diagram

ELECTRICAL

WIRING DIAGRAMS

5. SERVICE DIAGNOSIS

When performing any service diagnosis on the electrical system, refer to the wiring diagrams 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 diagrams.



WARNING! Avoid accidental engine starting. Tag the steering wheel 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.	1. Check the condition of each battery. Refer to ”Testing and Maintenance the Battery” in this Section.
2. Dirty or loose power cable connections for cranking motor winding.	2. Clean all connections and tighten.
3. Defective master switch, starting switch, transmission shifter, magnetic switch, cranking motor solenoid switch, cranking motor.	3. 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 3A.
Boom Kick-out or Bucket Leveler not Functioning Properly	
1. Proximity switch gap out of adjustment.	1. Refer to OPERATOR’S MANUAL for adjustment procedure.
2. Faulty proximity switch, electromagnet, wiring.	2. Using a voltmeter or check lamp for voltage beginning at the voltage source.
3. Mechanical problem in pilot control valve.	3. Refer to Section 10B ”VALVES”.
Machine not drive	
1. Problem in transmission shifter power circuit.	1. Check a circuit from starting switch by 6A breaker to transmission shifter, using a voltmeter or check lamp.
2. Faulty (closed) transmission disconnect switch.	2. Change the switch.
One direction is missing	
1. Faulty F or R solenoid valve.	1. Check for voltage coil and change the coil or the solenoid valve.
2. Faulty RNF or RNR relay.	2. Change the relay.
3. Faulty transmission shifter.	3. Change the shifter.

WIRING DIAGRAMS

COMPLAINT	
PROBABLE CAUSE	**REMEDY**
One or two gears are missing	
1. Faulty A or B solenoid valve.	1. Check for voltage coil and change the coil or the solenoid valve.
2. Faulty KD relay.	2. Change the relay.
3. Faulty transmission shifter.	3. Repair or change the shifter.
No gear reduction	
1. Faulty reduction gear button.	1. Change the button.
2. Faulty KD, KD2 or KD3 relay.	2. Change the relay.
3. Faulty timer (t).	3. Change the timer.

NOTE: *For electrical switches location on the machine refer to their system.*

ALTERNATOR

6. DESCRIPTION

CHARGING SYSTEM

An alternator is a voltage-creating machine. The voltage regulator limits the maximum voltage that the alternator will produce at the output terminal (1, Fig. 8.4) by controlling the magnetic field present in the rotor. The voltage produced allows current to flow to satisfy the electrical loads placed on the system, up to a maximum current characteristic of the alternator design.

Schematic of the alternator circuit is shown in Fig. 8.5. With the alternator rotor turning, magnetic fields around the rotor induce voltages in the stator windings. The faster the rotor turns, the higher the induced voltage will be. The voltages at start-up are generated by residual magnetism in the rotor. The auto start and trio assembly feature assures turn on below idle or cut in speed in system.

As speed and output increase, voltage available at the trio assembly becomes sufficient to supply field current for normal operation. When the output voltage exceeds the battery voltage, the alternator begins to drive the system voltage.

While the system voltage is below the voltage regulator setting, the regulator turns on the field current through the rotor and allows the alternator to produce as much output as possible for the alternator speed (rpm), temperature and system voltage. When the voltage setting is reached, the regulator turns the field current off. When the field current is turned off, the magnetic field in the rotor collapses and the alternator output voltage begins to fall. The falling voltage causes the regulator to turn the field current back on and the magnetic field to rebuild. This switching action of the regulator continues rapidly, keeping the output and system voltage very close to the voltage setting. This will continue unless the electrical demands of the system cause the system voltage to fall below the voltage setting.

ALTERNATOR

Should this happen, the regulator will again allow full field current to flow so that the maximum output of the alternator at the given speed, temperature and systems voltage is realized.

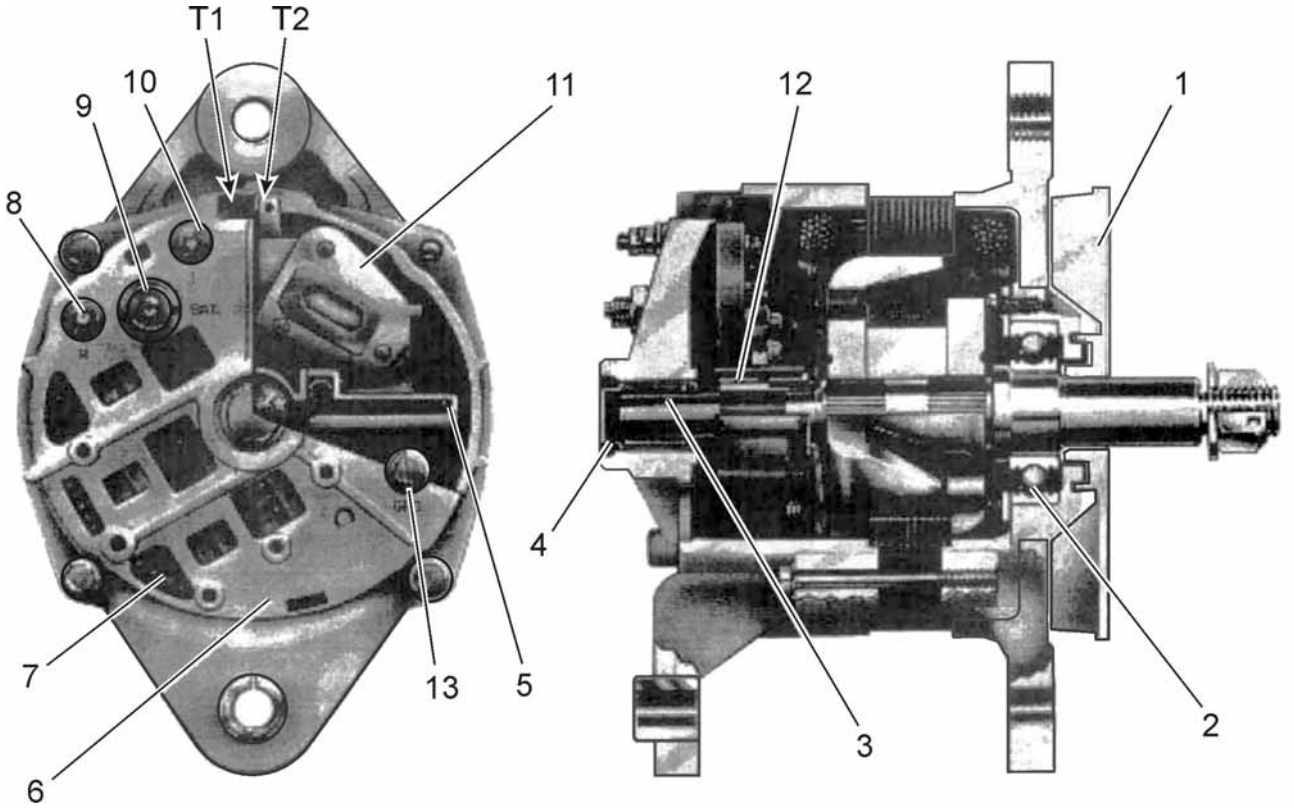


Fig. 8.4A. Cross Sectional View

1. Die Cast Aluminum Fan
2. Heavy-Duty Polyacrylate Sealed Ball Bearing Assembly
3. Heavy-Duty Polyacrylate Sealed Roller Bearing
4. Large Grease Reservoir
5. Radial Brush Assembly
6. Auto Start and Trio Assembly System
7. Rectifier Bridge
8. Relay Terminal
9. Output Terminal
10. Indicator Light Terminal
11. Solid State Regulator
12. Rotor and Slip Ring Assembly
13. Threaded Hole for Grounding

T1. Terminal #1 - Indicator Light or Resistance Wire (3-Wire System)
T2. Terminal #2 -Voltage Sense (3-Wire System)

ALTERNATOR

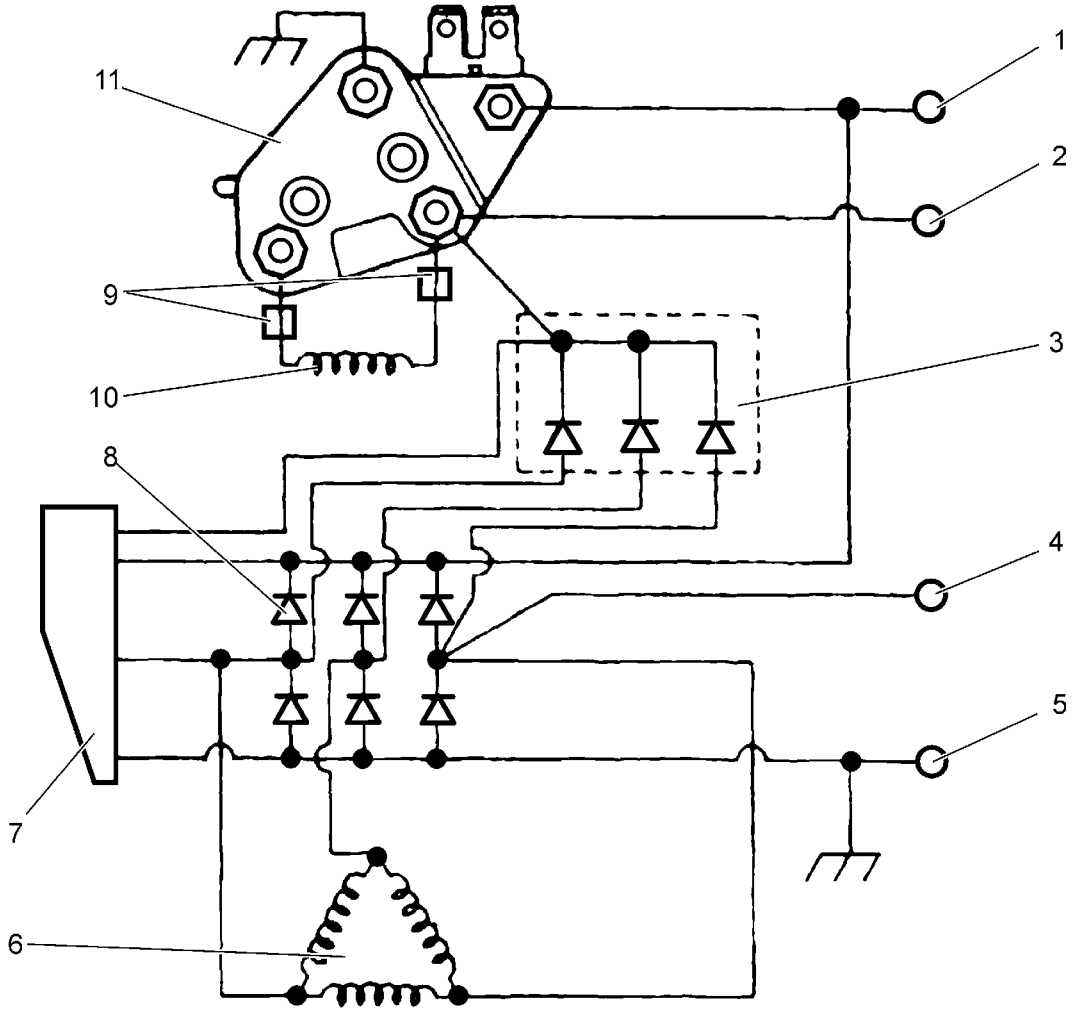


Fig. 8.5. Alternator Schematic

1. Output Terminal
2. Indicator Light Terminal
3. Diode Trio
4. Relay Terminal
5. Ground
6. Stator
7. Auto Start and Trio Assembly
8. Rectifier (bridge)
9. Brushes
10. Rotor (field)
11. Regulator

7. SPECIFICATIONS

Manufacturer type ..... Delco Remy 22SI 24 [V] /70 [A]
Adjusted voltage at external temp.26.7 [°C] ..... 27.4 ± 0.4 [V]
Adjusted load parallel to the battery ..... 2 [kW]
Permissible voltage change at 5000 [RPM] and load (5 - 95 [%]) max of current ..... 0.5 [V]
Rotor Field Coil Specifications at 26.7 [°C] ..... 9.3÷10.0 [Ω]
2.4÷2.6 [A]
Cold current output at 1600 [RPM] ..... 15 [A]
at 5000 [RPM] ..... 70 [A]
Weight ..... 6.3 [kg]

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8. TROUBLESHOOTING AND TESTS

SYSTEMS WITHOUT INDICATOR LIGHT

TROUBLESHOOTING

Trouble in the charging system will normally be indicated by one of the following:

- Undercharged or overcharged battery.
- Short life of light bulbs or other electric equipment caused by abnormally high system voltage.
- System voltmeter readings outside normal range.

Diagnose system as follows (refer to Fig. 8.6).

Test Equipment Needed:

- Belt Tension Gage
- Battery State-of-Charge Indicator
- Voltmeter

1. Check electrical system wiring and battery terminals for poor connections or other obvious conditions that might result in shorts, opens, grounds, or high resistance. Correct as necessary.
2. Check alternator drive belt for proper tension. If belt is defective, replace it. Refer to OPERATORS MANUAL.
3. Check battery (or batteries) for state-of-charge. If low, recharge according to SERVICE MANUAL SPECIFICATIONS and load test to establish serviceability. Further diagnostic tests require a known good, fully charged battery for accurate results.

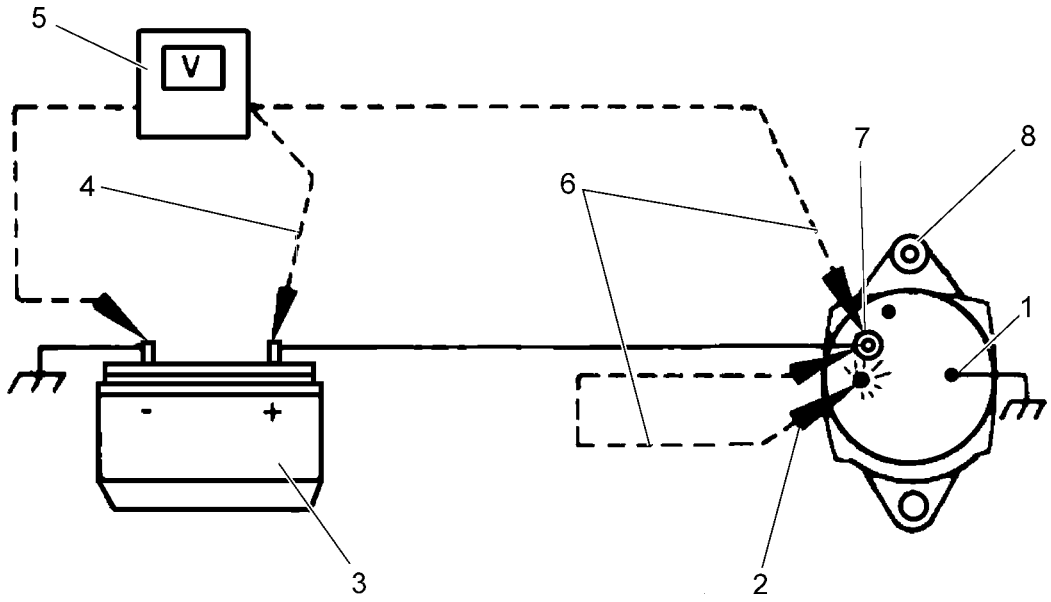


Fig. 8.6. Troubleshooting a System

1. Alternator Ground Terminal
2. Magnetizing Jumper Lead (touch briefly to relay terminal “R”)
3. Battery
4. Steps 4, 5
5. Voltmeter
6. Steps 6, 7
7. Alternator Battery Terminal
8. Alternator

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4. If battery (3) is undercharged, and system voltmeter shows operating voltage below acceptable range.

   With engine stopped and all electrical loads turned off, use voltmeter (5) to check voltage across battery terminals. Record voltage.

   Start engine and run at moderate speed. Check voltage across battery terminals with engine running.

- If voltage reading at battery terminals is different from reading showing at system voltmeter locate and correct cause of incorrect reading,
- If voltage is lower than reading previously recorded with engine stopped, there is no alternator output. Proceed to Section below "NO OUTPUT",
- If voltage is higher than previous reading with engine stopped, alternator output is present. Proceed to Section below "RATED OUTPUT CHECK",

5. If battery is overcharged (as evidenced by excessive water use or electrolyte spewing from battery vents), light bulbs or other electrical equipment have shortened life due to suspected high system voltage, or system voltmeter reads above normal range.

   With fully charged battery, engine running at moderate speed and all electrical loads off, use voltmeter to check voltage at battery terminals.

   Readings should be stable, between 27÷28 [V] and in no case go above 31 [V].

- If voltage is erratic or goes above 31 [V], replace regulator as described under " INTEGRAL CHARGING SYSTEM REPAIR " and test field coil for shorts.
- If conditions have not been found that might prevent the alternator from turning on, remove alternator from engine in accordance with engine manufacturer's instructions and proceed to "INTEGRAL CHARGING SYSTEM REPAIR ".

NO OUTPUT (Fig.8.6)

Test Equipment Needed:

- Voltmeter
- Jumper Lead (18 ga. min; no fuse)

NOTE: *The alternator (8) must be connected to a battery (3) for the voltage sensing circuit to allow initial turn-on. When properly connected and system checks indicate a "no output" condition, use the following steps to determine if the alternator requires repair:*

6. Battery positive voltage at the battery terminal (7) and residual magnetism in rotor are necessary for alternator (8) ten turn on. Use voltmeter (5) to verify that battery voltage is present at alternator battery terminal (7). If not, locate and correct cause of voltage loss.
7. Residual magnetism in the rotor is sometimes lost during servicing of the alternator. To remagnetize the rotor, make sure the normal connections are made to the alternator battery terminal (7) and to the ground terminal (1) circuit. Momentarily connect a jumper lead (2) from battery positive to the alternator relay terminal. This will cause field current to momentarily flow through the rotor in the proper direction and restore magnetism. Recheck alternator (8) for output.

RATED OUTPUT CHECK

Test Equipment Needed:

- Voltmeter
- Ammeter (current capability at least 15 [A] higher than alternator rating)
- Variable Carbon Pile Load Test

ALTERNATOR

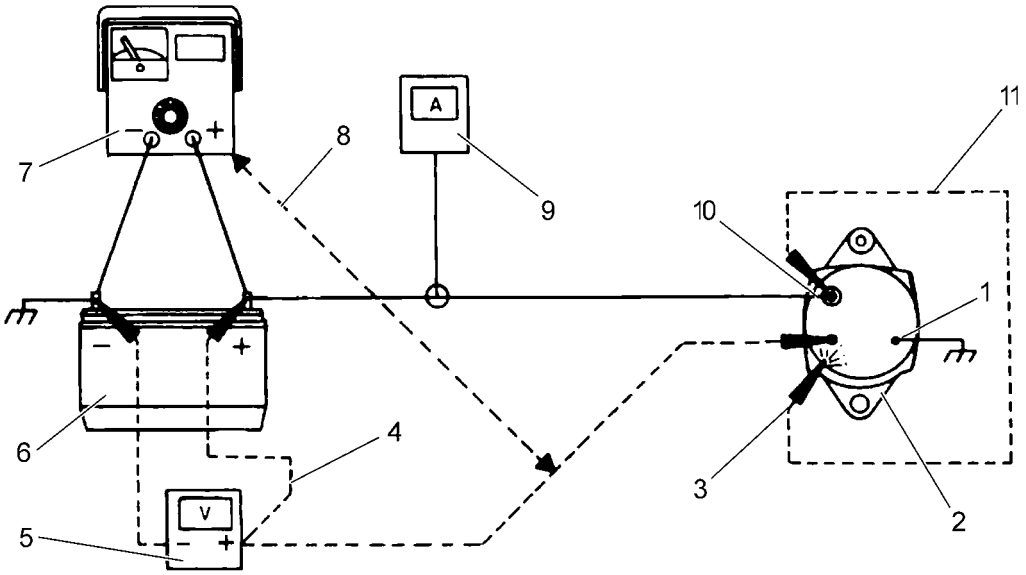


Fig. 8.7. Rated Output Check

1. Alternator Ground Terminal
2. Alternator
3. Magnetizing Jumper Lead (touch briefly to relay terminal “R”)
4. Steps 13, 15
5. Voltmeter
6. Battery
7. Carbon Pile Load Test
8. Step 16
9. Ammeter
10. Alternator Battery Terminal
11. Step 7

CAUTION! Failure to disconnect negative battery cable at battery before removing or attaching alternator battery terminal lead may result in an injury. If a tool is shorted at alternator battery terminal, the tool can quickly heat enough to cause a skin burn.

8. Refer to Fig. 8.7 for test equipment hookups as described in following steps. If inductive pick-up (clamp on) type ammeter is used, place current clamp on alternator output lead and skip to step 4. If series ammeter is used, disconnect negative battery cable at battery.
9. Install ammeter (9) in series with alternator battery terminal (10).
10. Reconnect negative battery cable at battery.
11. **NOTICE:** When a 12 [V] carbon pile load test is used to diagnose a 24 [V] system, attach load test only to 12 [V] potential in battery pack. Attaching a 12 [V] load test to a 24 [V] potential will damage the load test. With load turned off, attach carbon pile load test across battery.
12. Attach voltmeter (5) negative to grounded negative battery terminal. Leave positive meter lead open for checks at various points.
13. Check and record voltage at battery positive terminal. For multi-battery systems, check positive voltage of battery set connected as if in battery charging mode.
14. With all system electrical loads off, start engine and run at moderate speed [RPM].
15. Recheck voltage at battery positive terminal. Voltage should be higher than previous reading, but below 31 [V].
    - If reading is lower than previous reading, refer to " NO OUTPUT" (See in this Section above),
    - If reading is higher than 31 [V], refer to step 5 on “SYSTEMS WITHOUT INDICATOR LIGHT” (See in this Section above).
16. Turn carbon pile load (7) on and adjust to obtain maximum alternator output on ammeter (9). Record maximum ampere output. With alternator (2) still running at maximum output, check and record voltage drop in ground circuit between alternator housing and battery negative terminal. Turn carbon pile load (7) off.

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Maximum ampere output should be within 15 [A] of output rating as listed in "Specifications" Section of this manual. Voltage drop should be 0.5 [V] or less.

- If ground circuit voltage drop is over 0.5 [V], clean and tighten all ground circuit connections. If this does not correct excessive voltage drop, check ground circuit cables for improper sizing or high resistance conditions. Correct as necessary,
- If within 15 [A] of rating, alternator (2) is good. Look elsewhere for cause of problem,
- If more than 15 [A] below rating, repair or replace alternator (2).

9. REMOVAL (Fig. 8.8)

WARNING! Before working on any part of the electrical system, turn the master switch in the OFF position and take keys out from both the electric master switch and starting switch to prevent accidental engine starting.

1. Unlock and open upper L.H. side engine guard.
2. Unscrew ground screw (3) and remove ground cable from the alternator (6) ground terminal (3).
3. Unscrew output terminal (1) screw and remove output terminal lead from the alternator (6).
4. Remove lock bolt (7) and raise alternator to reduce V-belt (9) tension. Remove V-Belt (9) from alternator (6) drive pulley (10).

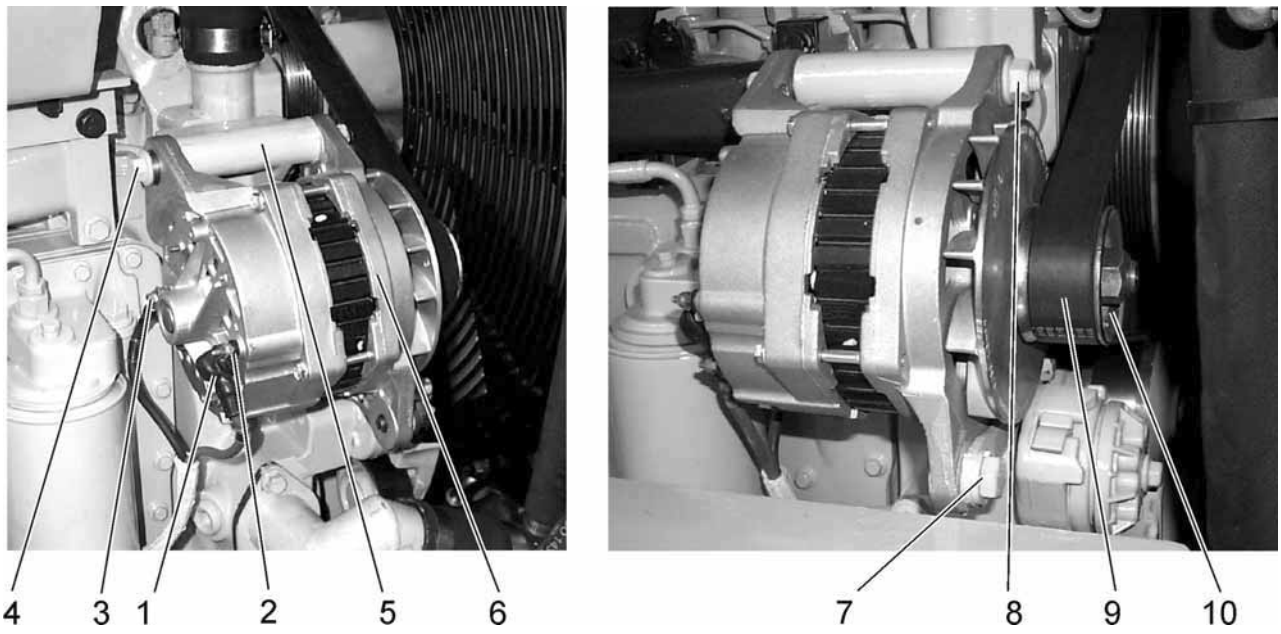


Fig. 8.8. Alternator Location and Disconnect Points

1. Output Terminal (Positive)
2. Relay Terminal
3. Ground Screw (Terminal)
4. Bolt with Washer
5. Bracket
6. Alternator
7. Lock Bolt (V-Belt tension)
8. Nut with Washer
9. V-Belt
10. Drive Pulley

5. Remove nut with washer (8) and take bolt (4) out from the alternator (6) housing eyes and engine bracket (5) hole.
6. Remove alternator (1) out of the machine.

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10. INTEGRAL CHARGING SYSTEM REPAIR

NOTE: *Specificated below alternator parts No. are used during repair descriptions. These parts No. are different them No. of parts given in Loader Parts Catalog.*

NOTE: *Always reinstall fasteners at original location. If necessary to replace fasteners, use only correct part number or equivalent.*

- If correct part number is not available, use only equal size and strength. For alternator internal fasteners, refer to PARTS CATALOG,
- Fasteners that are NOT to be reused will be noted in procedure,
- Fasteners requiring thread locking compound will be noted in procedure,
- Use specified torque values when shown.

Alternator Parts

Part No.	Name	Qty.	Part No.	Name	Qty.
1.	Slip Ring End Housing	1	135.	• Washer	1
2.	Roller Bearing Assembly	1	136.	• Terminal Stud	1
3.	Drive End Housing	1	137.	• Insulator	1
4.	Ball Bearing Assembly	1	138.	• Cap (Not Shown)	N/A
5.	Regulator	1			
6.	Auto Star and Trio Assembly	1	**14.**	Indicator Terminal Package	1
7.	Rectifier Assembly	1	141.	• Hexagon Nut	1
8.	Rotor Assembly	1	142.	• Washer	1
9.	Stator Assembly	1	143,	• Nut Assembly	1
10.	Brush Holder Assembly	1	144.	• Connector	1
11.	Fan	1	145.	• Washer	1
12.	Output Terminal Package	1	146.	• Terminal Stud	1
13.	Relay Terminal Package	1	147.	• Insulator	1
14.	Indicator Terminal Package	1			
15.	Hardware Package (Not Shown)	N/A	**15.**	Hardware Package	1
			151.	• Bolt, Thru	4
12.	Output Terminal Package	1	152.	• Nut, Rectifier Assembly	3
121.	• Nut	1	153.	• Screw and Washer Assembly	3
122.	• Washer	1	154.	• Screw, Insulated Rectifier	1
123.	• Nut	1	155.	• Screw, Insulated Regulator	2
124.	• Connector	1	156.	• Cover	1
125.	• Terminal Stud	1	157.	• Nut Assembly	1
126,	• Insulator	1	158.	• Screw and Washer Assembly	1
			159.	• Screw Assembly	1
13.	Relay Terminal Package	1	160.	• Washer	1
131.	• Hexagon Nut	1	161.	• Bushing	I
132.	• Washer	1	162.	• Hexagon Nut	1
133.	• Nut Assembly	1	163.	• Washer	1
134.	• Connector	1	164.	• Screw and Washer Assembly	3
			165.	• Retainer Plate	1

ALTERNATOR

IMPORTANT: *Using or replacing fasteners in any other manner could result in part or system damage. If diagnosis determines that alternator repair is needed, remove alternator from engine.*

1. Place alignment mark across slip ring end housing (1, Fig. 8.9) and drive end frame (3) for reassembly after unit repair.
2. Remove 4 thru bolts (151, Fig. 8.10) from frame (3) and housing (1).

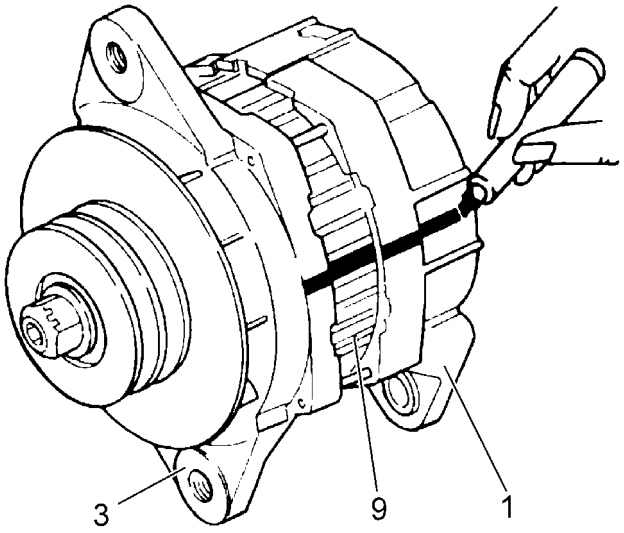


Fig. 8.9. Marking Alignment for Reassembly

1. Housing 3. Frame 9. Stator

3. Separate frame (3) (with rotor) from housing (1) (with stator). If necessary, carefully pry frame from edge of stator with screwdriver. After separation, place tape over brush holder assembly (10, Fig. 8.11) opening inside unit to prevent dirt from entering bearing during checks.

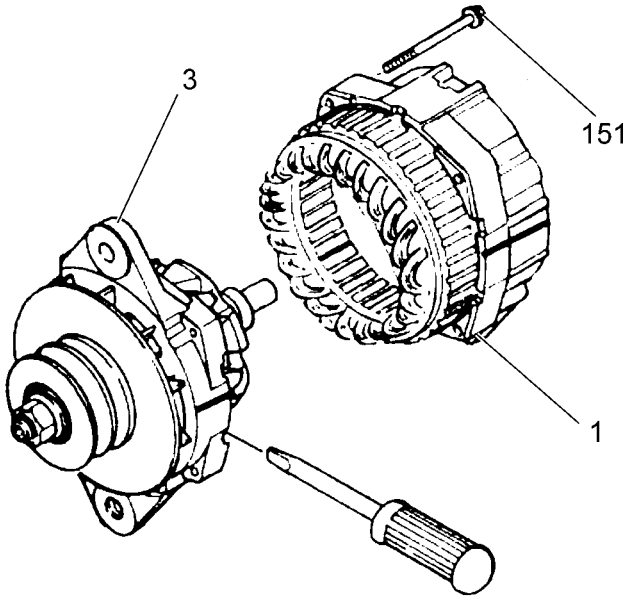


Fig. 8.10. Disassembly of Alternator

1. Housing (with stator) 3. Frame (with rotor) 151. Thru Bolts (4 pcs)

ALTERNATOR

Test Equipment Needed:

- Ohmmeter
- 110 [V] Test Lamp (optional)

HOUSING AND COMPONENTS

4. Inspect housing (1, Fig. 8.11) for loose connections or other obvious conditions. Correct as necessary. If none are found, proceed with housing checks.
5. Remove three rectifier assembly nuts (152) to disconnect stator (9). Lift stator from housing (1). If necessary, carefully pry stator away from housing with screwdriver.
6. Inspect stator winding for a dark, burned appearance. View winding from inside of unit - black paint on outside of windings does not indicate burned windings. If all windings are uniform in color and varnish covering is not flaking off, proceed with electrical check. If some windings are dark and others are light, a shorted, open or grounded condition is indicated. Replace the stator.

NOTE: *The stator should also be replaced if the windings are uniformly dark and burned, with the varnish coating flaking off to expose bare wires.*

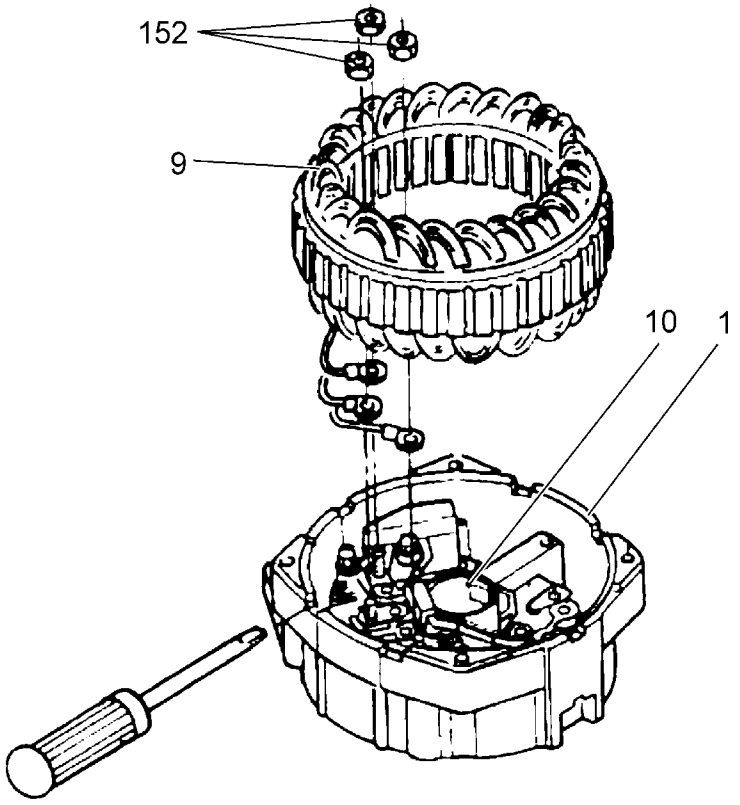


Fig. 8.11. Removing Stator

1. Housing
9. Stator
10. Brush Holder Assembly
152. Nuts, Rectifier Assembly (3 Pcs.)

ALTERNATOR

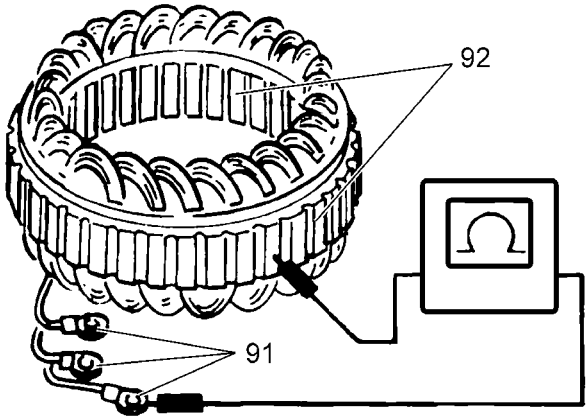


Fig. 8.12. Electrical Check of Stator

91. Stator Leads
92. Stator Laminations

7. Perform electrical check on staler. Use ohmmeter or 110 [V] test lamp. There should be no continuity between any of the stator leads (91, Fig. 8.12) and the stator laminations (92).
   - If continuity is present, windings are grounded. Replace stator,
   - If there is no continuity, stator is probably good. However, there is no service electrical check for shorted or open delta stator windings. If all other electrical checks arc normal and the alternator did not produce within 15 [A] of the rated output, a shorted or open stator in indicated and the stator is to be replaced.

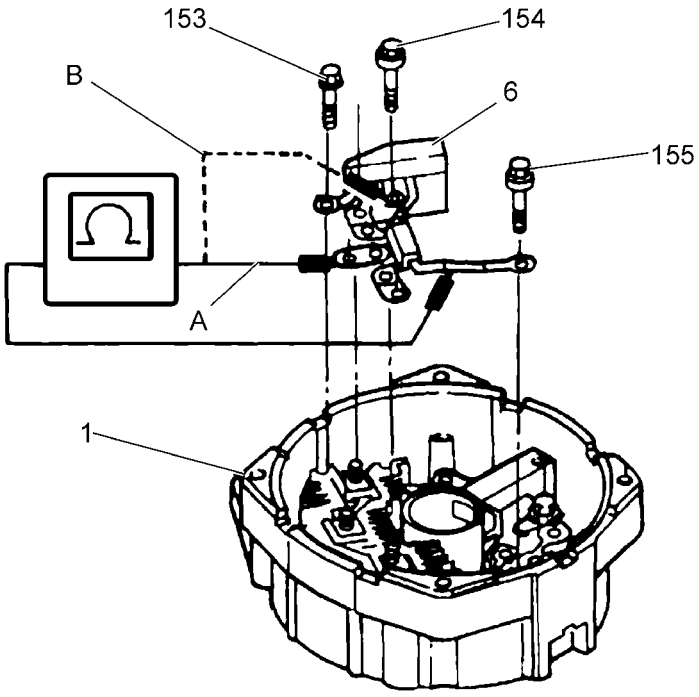


Fig. 8.13. Check of Auto Start & Trio Assembly

1. Housing
6. Auto Start and Trio Assembly
153. Screw And Washer Assembly
154. Insulated Rectifier Screw
155. Insulated Regulator Screw

A. Step – 9
B. Step – 10

8. Remove one insulated regulator screw (155, Fig. 8.13), one screw and washer assembly (153) and insulated rectifier screw (154), to disconnect auto start and trio assembly (6). Lift trio assembly from housing (1) assembly.

NOTE: *Wherever "Ohmmeter" is specified for use when checking diodes, the "Diode Test Functions" setting should be used for "Digital Type" multimeters.*

9. Use ohmmeter to check diode trio in assembly. Place negative ohmmeter lead on regulator strap and use positive ohmmeter lead to check for continuity to each of the three rectifier straps. All three readings should indicate continuity. Reverse the ohmmeter leads and perform checks again. Readings should all indicate open circuits.
   - If all readings are proper, diode trio is good,
   - If any reading is wrong, replace auto start and trio assembly (6).

10. Use ohmmeter to check auto start and trio assembly (6). Place negative lead of ohmmeter on regulator strap and positive lead to auto start and trio assembly B+ terminal. The meter should indicate open circuit. Reverse the ohmmeter leads and the reading should indicate continuity.
    - If either reading is incorrect, replace the auto start and trio assembly (6),
    - If both readings are correct continue to Step 11.

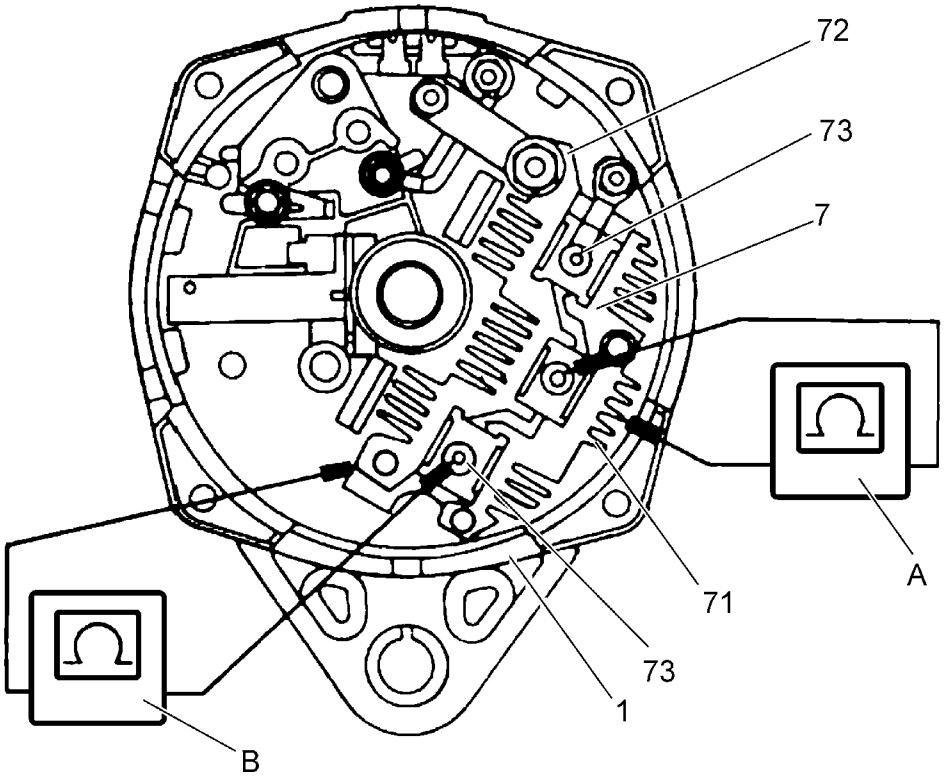


Fig. 8.14. Electrical Check of Rectifier Bridge

1. Housing
7. Rectifier Assembly
71. Ground Heat Sink
72. Insulated Heat Sink
73. Diode Clips
A. Step – 11A
B. Step – 11B

ALTERNATOR

11. Use ohmmeter to check rectifier assembly (7, Fig. 8.14) Rectifier assembly may be checked in the housing (1) without disassembly. Check six diodes as follows:

A. Place negative ohmmeter lead on grounded heat sink (71). Touch positive ohmmeter lead firmly to metal diode clips (73) that surround each of the three threaded studs. All three readings should be the same, and indicate open circuits. Switch leads and repeat. All three new readings should indicate continuity.

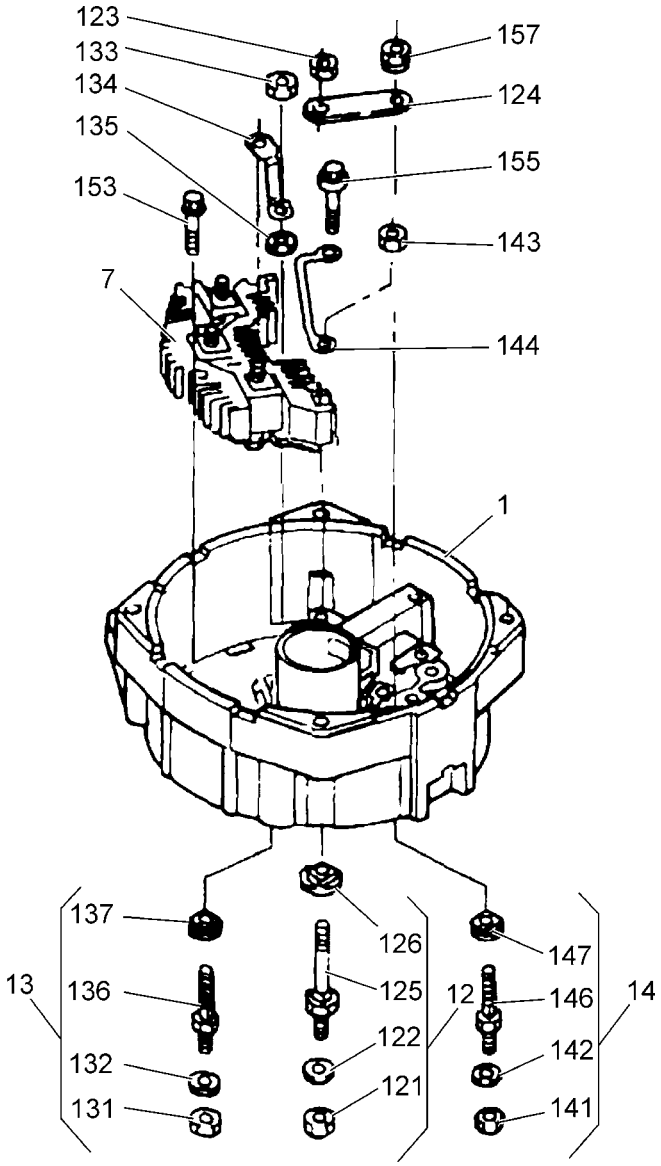


Fig. 8.15. Removing Rectifier Assembly

1. Housing
7. Rectifier Assembly
12. Output Terminal Assy
13. Relay Terminal Assy
14. Indicator Light Assy
121. Nut
122. Washer
123. Nut Assembly
124. Connector
125. Terminal Nut
141. Nut
145. Washer
134. Connector
135. Washer
136. Terminal Stud
137. Insulator
126. Insulator
131. Nut
132. Washer
133. Nut Assembly
143. Nut Assembly
144. Connector
146. Terminal Stud
147. Insulator
153. Screw and Lock Washer Assembly
155. Screw, Insulated Regulator
157. Nut Assembly

B. Repeat checks using (positive) insulated heat sink (72). With negative ohmmeter lead on insulated heat sink, all three readings should indicate continuity. Switch leads and repeat. All three new readings should indicate open circuits.

- If all readings are correct, the rectifier assembly is good,
- If any reading is wrong, an open or shorted diode is indicated and rectifier assembly (7, Fig. 8.15) should be replaced. Remove nut (123), nut assembly (157) and connector (124) from terminal stud (125). Remove nut assembly (133), connector (134), washer (135) and screw and lock washer assembly (153). Lift rectifier assembly (7) from housing (1),
- Remove nut assembly (143) and connector (144) as necessary for clearance.

NOTE: *Hold brushes in retracted position and insert brush pin to keep brushes in retracted position. (Refer to Fig. 8.29).*

12. Brush holder assembly (10, Fig. 8.16) must be removed to service brushes or regulator (5). Remove cover (156) and insulated regulator screw (155). Remove screw and washer assembly (158). Lift brush holder assembly (10) from housing. Remove washers (145, 160) with care to prevent contamination of bearing grease. Place tape over bearing to keep dirt out.
13. Inspect brushes and brush holder assembly (10) for wear, cracks, broken leads or other damage. If damaged replace with a new brush holder assembly.

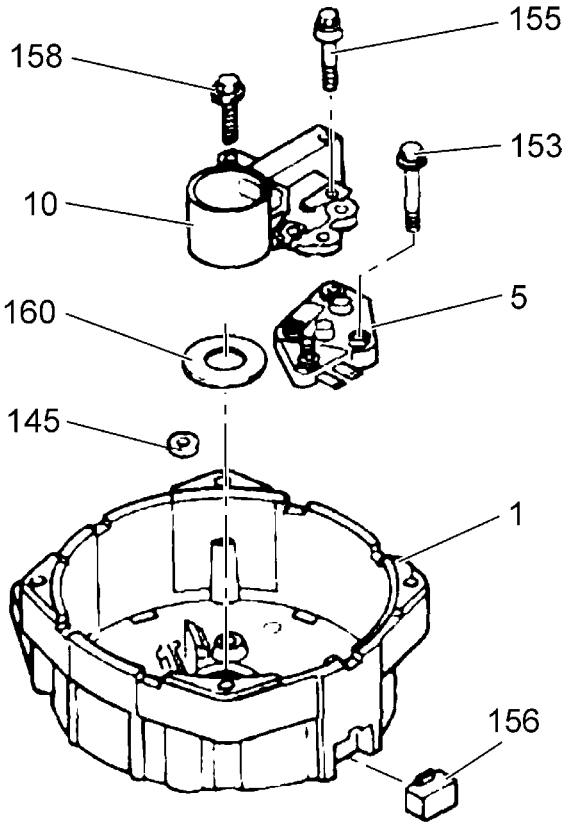


Fig. 8.16. Removing Brush Holder Disassembly

1. Housing	145. Washer	156. Cover
5. Regulator	153. Screw and Lock Washer Assembly	158. Screw And Washer Assembly
10. Brush Holder Assembly	155. Screw, Insulated Regulator	160. Washer

ALTERNATOR

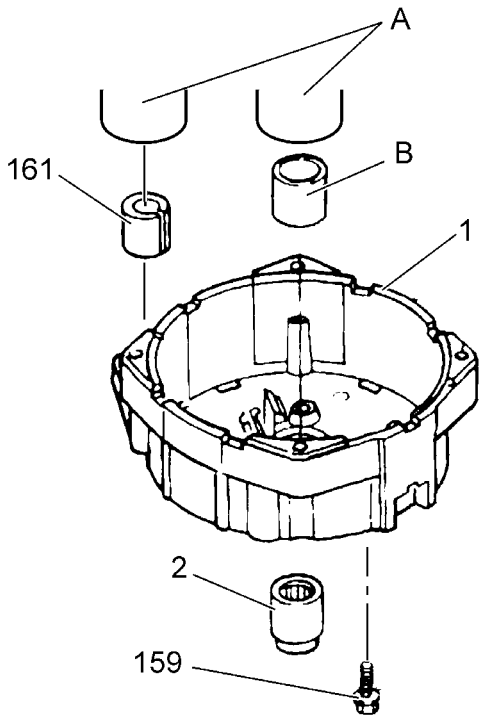


Fig. 8.17. Removing Bearing and Bushing

1. Housing
2. Roller Bearing Assembly
159. Screw Assembly
161. Bushing

A. Arbor Press
B. Tube

14. Remove remaining screw and lock washer assembly (153) attaching regulator (5). If previous checks lead to an instruction to replace the regulator, replace it. If it is not known whether regulator is good, use an approved tester for SI-type regulators. Always check field coil for shorts when replacing regulator.
15. Remove protective tape and check roller bearing assembly (2, Fig. 8.17) in housing (1). Bearing is permanently lubricated; do not add grease. If bearing is dry or damaged, replace bearing. To remove bearing, use tube slightly smaller than opening in housing (1) and press bearing through to inside of housing (See Fig. 8.17 and refer to Fig. 8.20). If bearing is not replaced, put tape back over bearing.
16. Remove screw assembly (159, Fig. 8.17) and press bushing (161) from housing (1) if required.

FRAME AND COMPONENTS

17. Use ohmmeter to check rotor (8, Fig. 8.18) field resistance. Place ohmmeter leads on the two slip rings on the rotor shaft to make this check.

NOTE: *A 12 [V] battery, voltmeter and ammeter may be used to check rotor current draw to specifications. Read the meters quickly. Core resistance will change as the core heats up from the current flow.*

Refer to SPECIFICATIONS for proper value. Also use ohmmeter to check for a grounded field by touching one lead (A) to a slip ring (81) and one lead (B) to rotor (8) frame assembly. Reading should be infinite (open) to show that field is not grounded. If field resistance is outside specifications or if field is grounded, replace rotor assembly (8).

ALTERNATOR

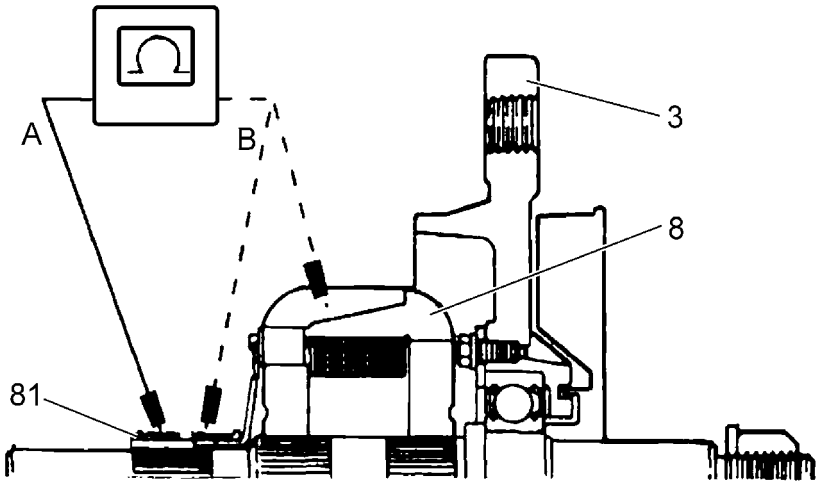


Fig. 8.18. Electrical Check of Rotor

3. Frame
8. Rotor Assembly
81. Slip Ring
A, B. Leads

18. Hold frame (3, Fig. 8.19) and spin rotor assembly (8) by hand to see that it spins freely in ball bearing assembly (4). Bearing is permanently lubricated; do not add grease. If movement is rough or wobbly, replace bearing.
19. Remove hexagon nut (162) by placing 5/16" hexagonal wrench (B) in end of rotor assembly (8) shaft to hold while removing nut (162) with open end wrench (C) turn nut counterclockwise to remove. If hex wrench (B) is not available, wrap rotor assembly (8) in shop cloth and place in vise, tightening just enough to hold while removing hexagon nut (162).
20. Lift washer (163), pulley (A) and fan (11) from rotor assembly (8) shaft and remove rotor assembly (8) from frame (3) assembly ball bearing.
    If rotor checked good electrically (step 17 above), inspect slip rings. If rough or out of round, turn in lathe, removing only enough material to make rings smooth and round. Maximum indicator reading for roundness is 0.025 [mm]. Finish with 600 grain polishing cloth. Blow away all copper dust. Clean shaft of any grease that may have accumulated copper dust.
21. Remove three screw and washer assemblies (164) and retainer plate (165) from frame (3).
22. Inspect ball bearing assembly (4). If bearing appears dry or if rotor assembly (8) did not turn smoothly when checked during frame disassembly, remove and replace bearing. Bearing is permanently lubricated. Do not attempt to add grease.

11. REASSEMBLY

FRAME AND COMPONENTS

1. Install ball bearing assembly (4, Fig.8.19), retainer plate (165) to frame (3) with three screw and washer assemblies (164). Torque screws to 3.0 [Nm].
2. Carefully slide rotor assembly (8) into housing (3) assembly.
3. Install fan (11), pulley, washer (163), and hexagon nut (162) onto rotor assembly (8) shaft.

NOTE: *Hold shaft with 5/16" hexagonal wrench (B) in socket end or wrap rotor assembly in shop cloth and tighten in vice just enough to hold while tightening hexagon nut (162).*

4. Tighten hexagon nut (162) to 100 [Nm].

ALTERNATOR

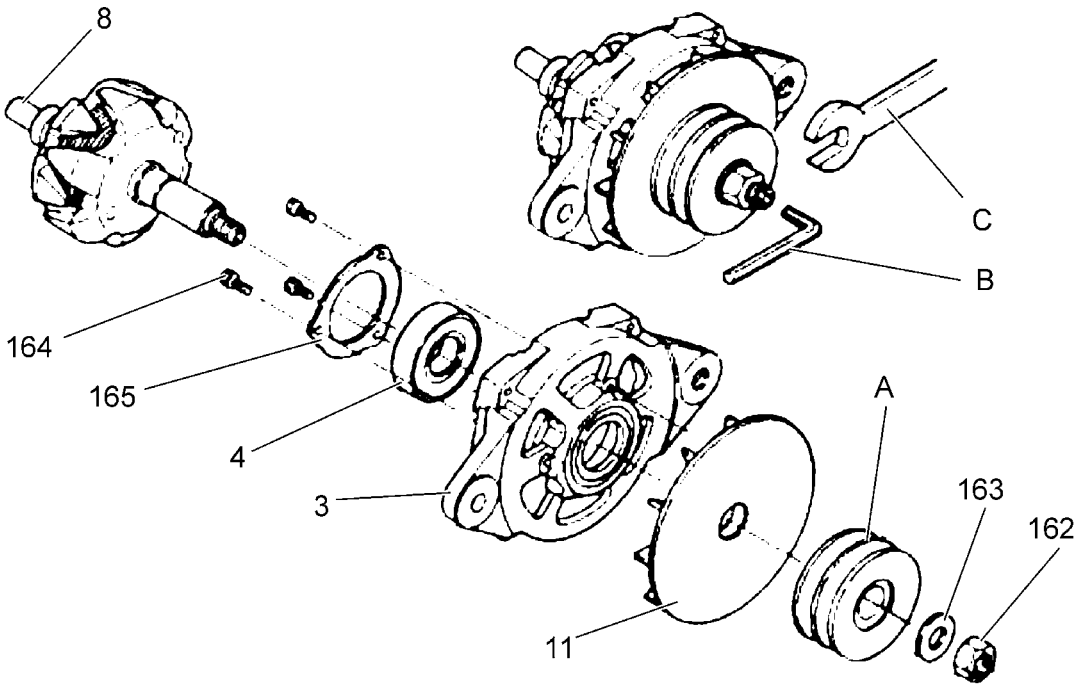
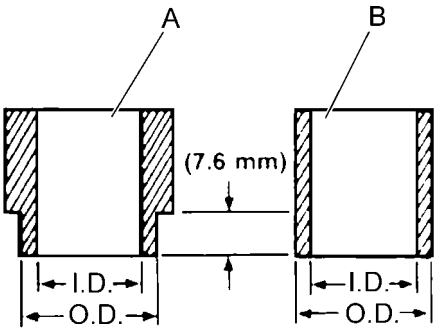


Fig. 8.19. Shaft Pulley Nut Removal

3. Frame
4. Ball Bearing Assembly
8. Rotor Assembly
11. Fan
162. Hexagon Nut
163. Washer
164. Screw and Washer Assembly (3 pcs)
165. Retainer Plate
A. Pulley
B. Hexagonal Wrench
C. Open End Wrench



O.D. max.	– 25.5 [mm]
I.D. min.	– 19.0 [mm]
DEPTH (mark)	– 7.6 [mm]

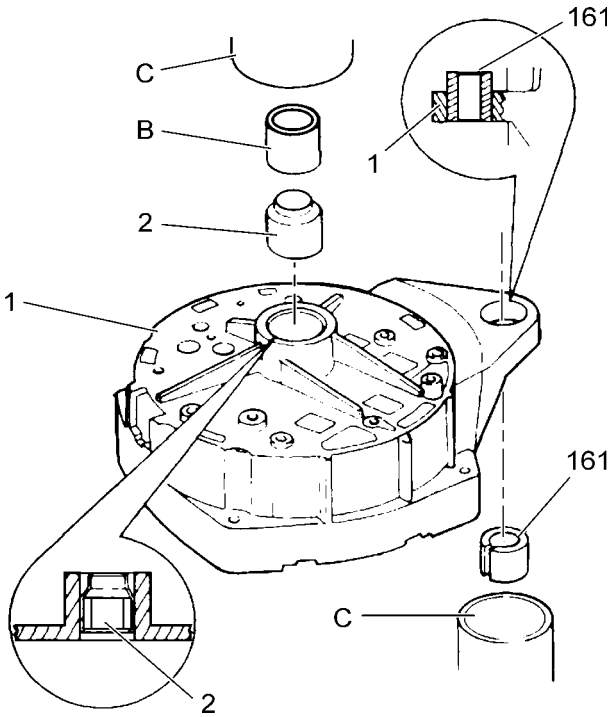


Fig. 8.20. Bearing and Bushing

1. Housing
2. Bearing Assembly
161. Bushing
A. Machined Tool
B. Tube
C. Arbor press

ALTERNATOR

HOUSING AND COMPONENTS

5. Lightly lubricate outside surface of bushing (161, Fig. 8.20). Press bushing into hole in lug on housing (1). Install bushing flush with inside of lug to allow maximum distance between two hinge lugs for mounting. Final position of hinge bushing will be adjusted during installation.
6. Install roller bearing assembly (2) into housing (1). Use suitable tube (B) or tool to press roller bearing in position, flush with outside lip of housing. Cover opening in bearing with piece of tape to prevent dirt from entering during rest of procedure.

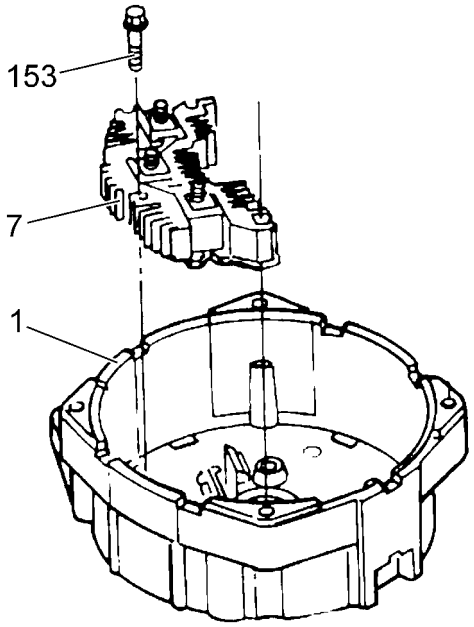


Fig. 8.21. Installing Rectifier Assembly

1. Housing 7. Rectifier Assembly 153. Screw and Washer Assembly

7. Place rectifier assembly (7, Fig. 8.21) to housing (1) assembly and install one screw and washer assembly (153) through rectifier assembly grounded heat sink into housing. Finger tighten.
8. Inspect regulator mounting area in housing (1) assembly for presence of grease or dirt. Good electrical contact is necessary in this area.

***IMPORTANT*:** *Do not immerse or wet regulator (5, Fig. 8.22) with solvent. Internal damage to regulator could result.*

9. Clean regulator mounting bosses in housing (1) assembly, metal base plate and contact rings on regulator (5) by wiping with clean, dry cloth.
10. Install regulator (5) to housing (1) assembly, with screw and washer assembly (153). Finger tighten.

NOTE: *Remove the tape previously installed over the roller bearing assembly (2, Fig. 8.23).*

11. Install felt washer (160) so the hole is centered over the roller bearing assembly (2).
12. Install brush holder assembly (10) with screw and washer assembly (158) and insulated regulator screw (155) nearest housing. Finger tighten.
13. Place tape over brush holder assembly (10) opening to protect bearing from dirt.

ALTERNATOR

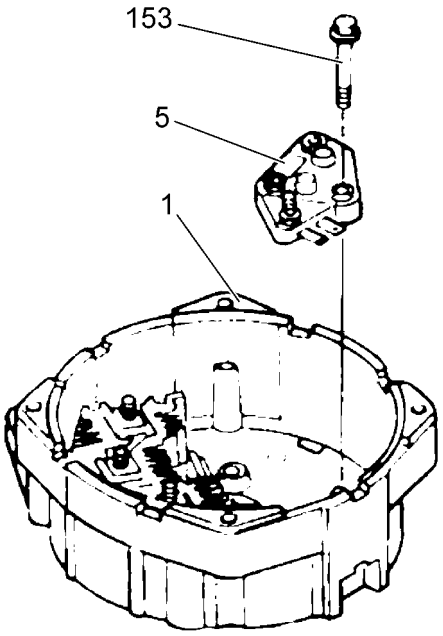


Fig. 8.22. Installing Regulator

1. Housing
5. Regulator
153. Screw and Washer Assembly

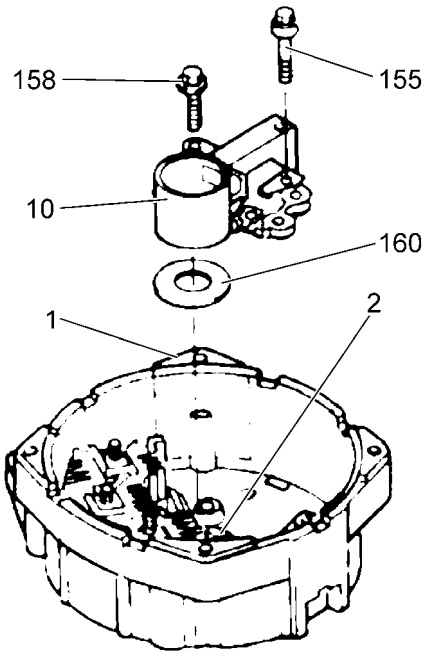


Fig. 8.23. Installing Brush Holder Assembly

1. Housing
2. Roller Bearing Assembly
10. Brush Holder Assembly
155. Screw, Insulated Regulator
158. Screw and Washer Assembly
160. Felt Washer

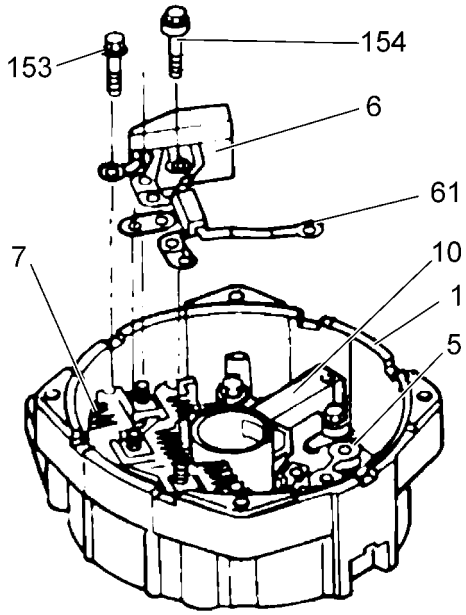


Fig. 8.24. Installing Auto-Start and Trio Assembly

1. Housing
5. Regulator
6. Auto Start and Trio Assembly
7. Rectifier Assembly
10. Brush Holder Assembly
61. Long Connector Strap
153. Screw and Washer Assembly
154. Screw, Insulated Rectifier

ALTERNATOR

14. Install auto start and trio assembly (6, Fig. 8.24) onto three threaded studs on rectifier assembly (7). Position auto start and trio assembly (6) with long connector strap (61) over closest mounting hole in brush holder (10) and regulator (5).
15. Install screw and washer assembly (153) and insulated rectifier screw (154) through auto start and trio assembly (6). Finger tighten.
16. Install insulator (126, Fig. 8.25) into battery terminal hole in housing (1) assembly from the outside. Be sure square flange on insulator is seated in hole. Put terminal stud (125) through hole in insulator and add connector (124) and finger tighten nut (123) over exposed terminal stud (125) threads in rectifier assembly (7).
17. Put connector (124) exposed hole over threaded stud of regulator (5) and add nut (157). Finger tighten.
18. Install insulator (137) into relay terminal hole in housing (1) from outside. Be sure square flange on insulator is seated in hole. Put terminal stud (136) through hole in insulator and add washer (135), connector (134) and finger tighten nut (133) overexposed terminal stud threads in rectifier assembly (7).

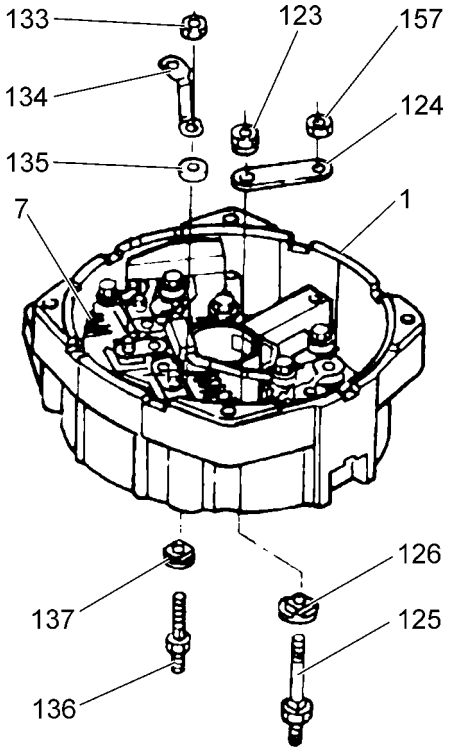


Fig. 8.25. Installing Output and Relay Terminal

1. Housing
7. Rectifier Assembly
123. Nut
124. Connector
125. Terminal Stud
126. Insulator
133. Nut Assembly
134. Connector
135. Washer
136. Terminal Stud
137. Insulator

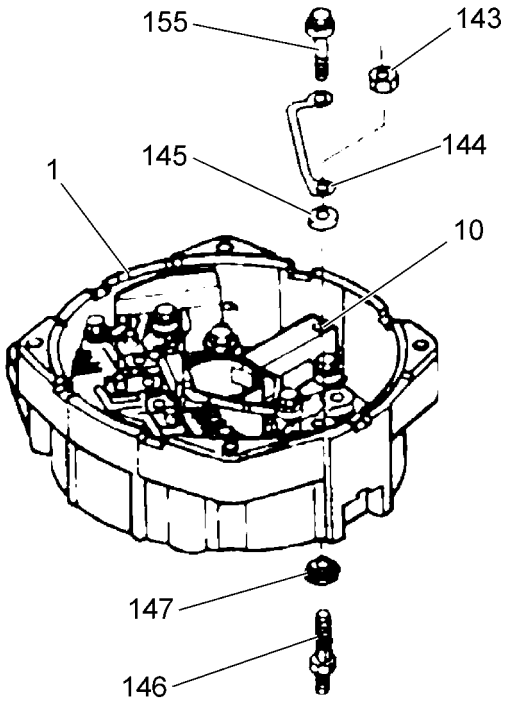


Fig. 8.26. Installing Indicator Terminal and Sense Connector

1. Housing
10. Brush Holder Assembly
143. Nut Assembly
144. Connector
145. Washer
146. Terminal Stud
147. Insulator
155. Insulated Regulator Screw

ALTERNATOR

19. Install insulator (147, Fig. 8.26) into indicator terminal hole in housing (1) assembly from the outside. Be sure square flange on insulator is seated in hole. Put terminal stud (146) through hole in insulator and add washer (145), connector (144) and finger tighten nut (143) over exposed terminal stud (146) threads inside housing (1) assembly. Position other end of connector (144) over remaining mounting hole in brush holder assembly (10).
20. Install insulated regulator screw (155) through long connector strap (61, Fig. 8.24) of auto start and trio assembly (6) and exposed hole of connector (144, Fig. 8.26) into remaining mounting hole in brush holder assembly (10). Finger tighten.

NOTE: *Secure housing component fasteners in following order (See Fig. 8.27 and Special Torque below).*

Special Torques:

1. Nut (123) to 5.5 [Nm].
2. Rectifier assembly (7) attaching screw and washer assembly (153) (2 places) to 3.0 [Nm].
3. Insulated rectifier screw (154) to 2.5 [Nm].
4. Relay and indicator terminal nut assemblies (133, 143) to 2.5 [Nm]. It may be necessary to hold terminals on outside while tightening.
5. Screw and washer assembly (153) to ground the regulator (5) to 2.0 [Nm].
6. Insulated regulator screws (155) (2 places) to 2.0 [Nm].
7. Nut assembly (157) to 2.5 [Nm].
8. Screw and washer assembly (158) to 2.0 [Nm].

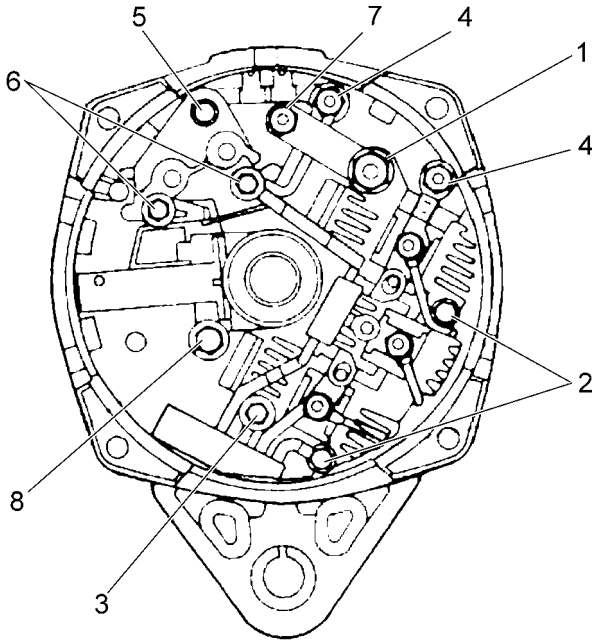


Fig. 8.27. Fastener Tightening Order (Steps 1 to 8 above)

21. Install stator (9, Fig. 8.28) to housing (1) assembly, placing three phase leads over three threaded studs on rectifier assembly (7). Be sure stator is sealed in register around edge of housing.
22. Tighten rectifier assembly nuts (152) to three threaded studs on rectifier assembly (7) to 2.5 [Nm].
23. Clean brushes in brush holder assembly (10) by removing tape and wiping brushes with clean soft cloth. Contact surfaces of brushes must be free of grease and other contaminants.

ALTERNATOR

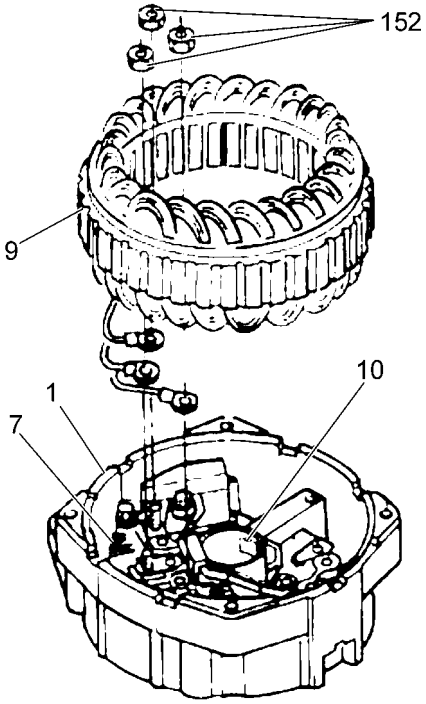


Fig. 8.28. Installing Stator

1. Housing
7. Rectifier Assembly
9. Stator Assembly
10. Brush Holder assembly
152. Nut, Rectifier Assembly (3 pcs.)

24. Install pin (A, Fig. 8.29) (or straightened paper clip) through housing (1) assembly to hold brushes in retracted position.

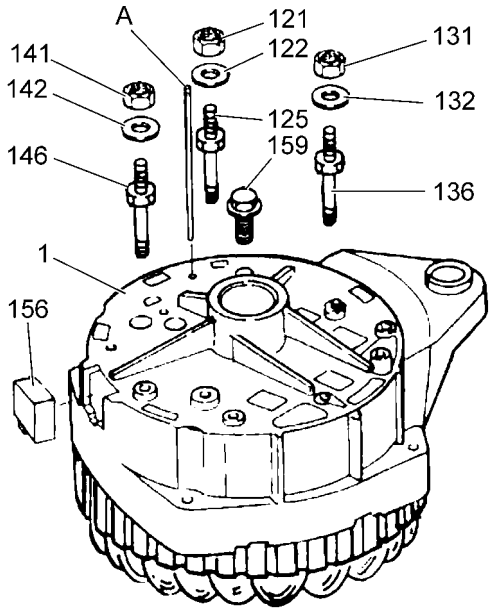


Fig. 8.29. Brush Pin and Hardware

1. Housing
121. Nut
122. Washer
125. Terminal Stud
131. Nut
132. Washer
136. Terminal Stud
141. Nut
142. Washer
146. Terminal Stud
156. Cover
159. Screw Assembly
A. Pin

ALTERNATOR

25. Install cover (156) onto regulator terminals hole.
26. Install and finger tighten:

- washer (122) and nut (121) onto battery terminal stud (125),
- washer (132) and nut (131) onto relay terminal stud (136),
- washer (142) and nut (141) to indicator terminal stud (146),
- screw assembly (159) into ground terminal hole in housing.

27. Clean slip rings on rotor assembly (8, Fig. 8.30) shaft (if not previously cleaned) by spinning rotor while holding 500 grain polishing cloth or 600 grit sandpaper around slip rings. Blow away all copper dust.
28. Clean rotor assembly shaft where it will slip into housing roller bearing assembly by wiping with soft cloth. Shaft must be free of dirt, copper dust and other foreign material.

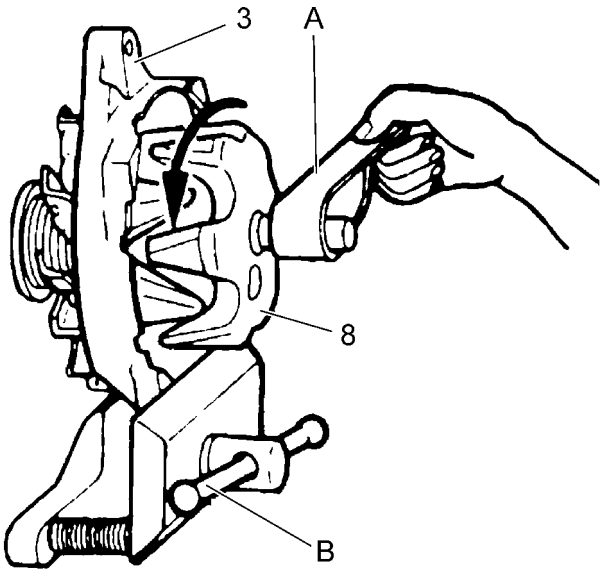


Fig. 8.30. Cleaning Slip Rings

3. Frame
8. Rotor Assembly
A. 500 Grain Polishing Cloth (over slip rings)
B. Vise

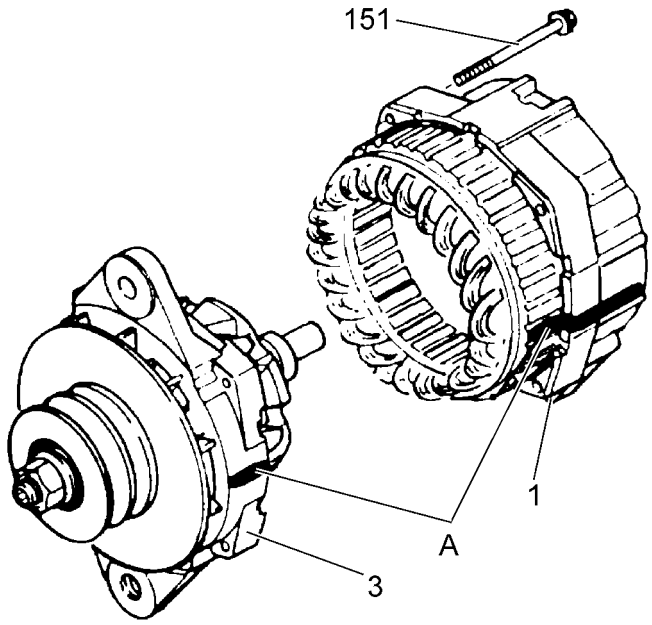


Fig. 8.31. Final Unit Assembly

1. Housing assembly
3. Frame assembly
151. Thru Bolts (4 Required)
A. Align Scribe Marks

29. Install frame assembly (3, Fig. 8.31) to housing assembly (1), aligning marks (A) made earlier on housing and frame. If mark was lost due to part replacement, use mark on old pan or match mounting lugs to application to determine proper frame orientation.
30. Slide thru bolts (151) through 4 holes in housing (1) and frame (3), finger tighten.
31. Tighten thru bolts (151) to 11.0 [Nm].
32. Remove brush pin (A, Fig. 8.29) from housing (1) assembly to release brushes onto slip rings inside unit.

ALTERNATOR

12. ALTERNATOR BENCHTEST

Test Equipment Needed:

- Alternator Test Stand (5000 [RPM] capability, minimum 5 [HP]),
- Battery or Battery Set (fully charged),
- Variable Carbon Pile Load Test,
- Ammeter (current capability at least 15 [A] higher than alternator rating),
- Voltmeter,
- Ohmmeter.

This bench test procedure is used to verify that the alternator is functioning properly prior to installation on the vehicle. The test checks the alternator output in the same manner as the Rated Output Check covered earlier in the "Troubleshooting" procedure. If bench test equipment is not available, install the alternator on the engine and repeat the Rated Output Check to verify alternator operation. If bench test equipment is available, proceed as follows:

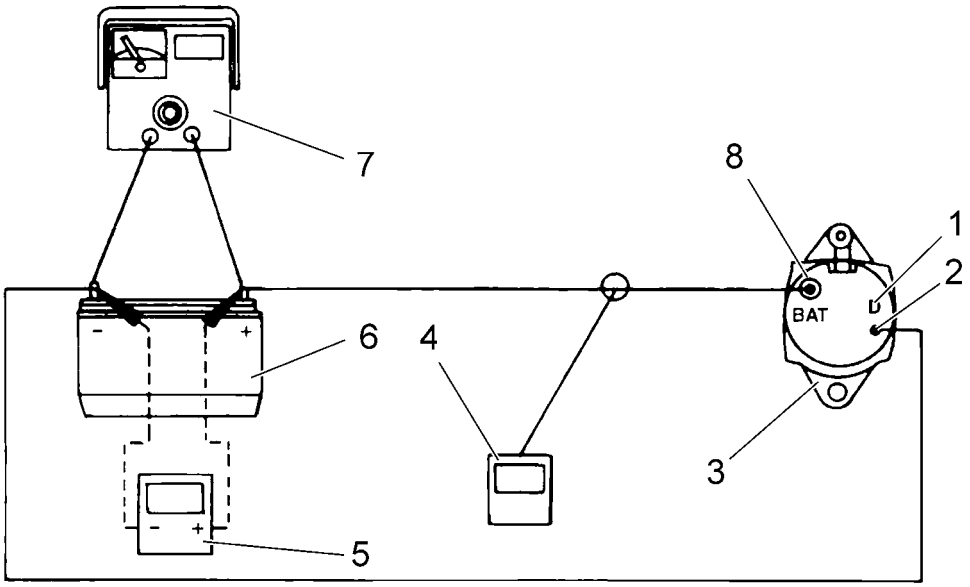


Fig. 8.32. Alternator Bench Test

1. Shaped Test Hole "D"
2. Ground Connection At Alternator
3. Alternator
4. Ammeter
5. Voltmeter
6. Battery
7. Carbon Pile Load Test
8. Alternator Battery Terminal (BAT)

1. Mount alternator (3, Fig. 8.32) in suitable test stand, according to test stand manufacturer's instructions. Test stand must be capable of driving alternator at speeds up to 5000 [RPM].

IMPORTANT: *When a 12 [V] carbon pile load test (7) is used to diagnose a 24 [V] system, attach load test (7) only to 12 [V] potential in battery set. Attaching a 12 [V] load test to a 24 [V] potential will damage the carbon pile load test (7).*

NOTE: *Battery (6) or battery set must be fully charged for test results to be valid.*

2. With carbon pile load (7) turned off and with battery (6) or battery set fully charged. Battery voltage and ground polarity must be same as system in which alternator is used. Check and record battery voltage before proceeding with test.

ALTERNATOR

3. With carbon pile load (7) "off" start test stand and slowly increase alternator (3) speed to 5000 [RPM]. Observe voltmeter (5).

- It voltage does not increase but remains at or below previous reading (step 2), there is no alternator (3) output. Skip to step 5,
- If voltage increases above 31 [V], voltage is uncontrolled. Recheck alternator (3) for proper assembly, assure that test tab in "D" Shaped Test Hole (1) is not grounded. If alternator (3) has been assembled properly, replace regulator as described under “Integral Charging System Repair” and test field coil for shorts or grounds,
- If voltage is proper, proceed to next step.

4. With alternator (3) running at about 5000 [rpm], turn on carbon pile load (7) and adjust to obtain maximum alternator (3) output on ammeter (4).

- If ammeter reading is within 15 [A] of cold output shown under alternator specifications, then alternator is good,
- Turn off carbon pile (7) and stop test stand,
- If ammeter (4) reading is more than 15 [A] below the specification, alternator is not operating properly.

IMPORTANT: *Do not insert screwdriver more than 3/4" into "D" shaped test hole during this step. The grounding tab on the brush holder assembly is reached at this distance. Inserting the screwdriver deeper may result in internal damage to the alternator.*

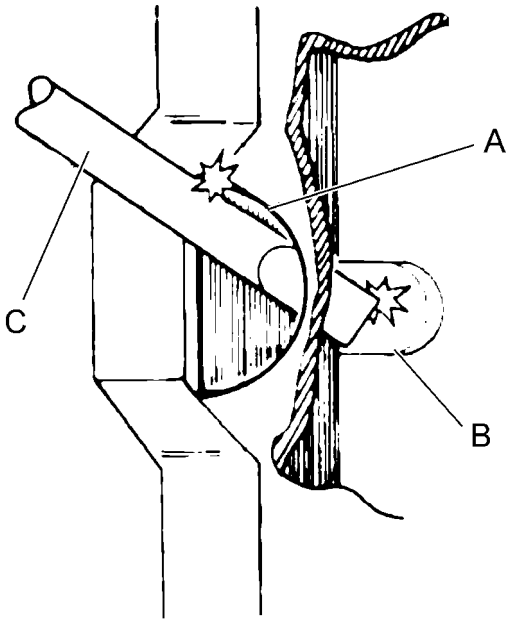


Fig. 8.33. Using Test Hole

A. "D" Shaped Test Hole in Housing
B. Test Tab On Brush Clip Inside Unit
C. Screwdriver (tilted to touch test tab and edges of test hole at same time)

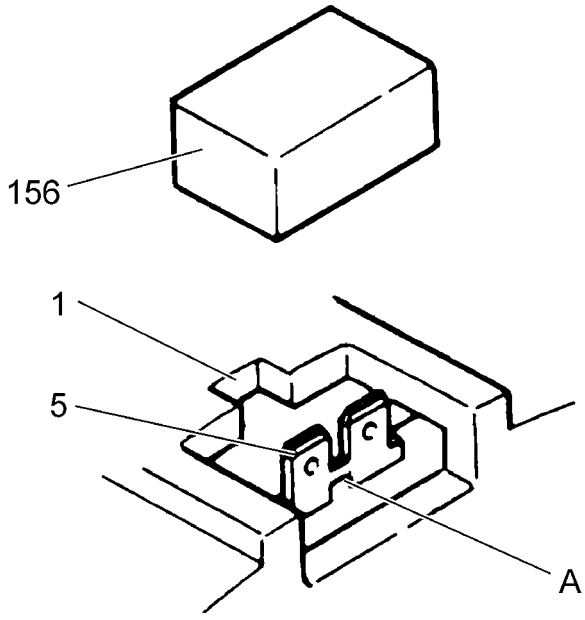


Fig. 8.34. Checking 1-Wire Regulator Terminals

1. Housing
5. Regulator Terminal
156. Cover
A. Connector

5. Test hole (A, Fig. 8.33) is provided in housing to allow direct grounding of rotor field circuit. Grounding the brush tab inside this hole bypasses the regulator and turns the alternator on in "full field" mode. If the alternator output is proper with the brush tab grounded, the previous low output is due to conditions within the regulator. Because the voltage is not regulated and can exceed 16 [V] in full field mode, the test hole should be used only for bench test procedures. Remagnetize rotor as shown in "NO OUTPUT" (see page 9 in this Section).

- Insert screwdriver (C) straight into test hole (A) in housing assembly to make contact with tab on brush clip (B). Tilt handle slightly to ground tab to housing at edge of test hole and hold. Again adjust carbon pile (7, Fig.8.32) to obtain maximum output on ammeter (4) without allowing voltage on voltmeter (5) to rise above 30 [V]. Record reading then turn off carbon pile and stop test stand,
- If there is still no output, refer to "INTEGRAL CHARGING SYSTEM REPAIR" and check rotor and brushes for an open circuit. Be sure that brushes are assembled properly and in contact with the slip rings. Check internal electrical connections to be sure grounding and insulated mounting screws are installed in the proper locations.

6. For a one-wire system only, remove the cover (156, Fig. 34) from the regulator terminal (5) and verify that there is a connector (A) between the regulator terminals (5). If not, replace regulator as described under “INTEGRAL CHARGING SYSTEM REPAIR”.

- If the output is now within 15 [A] of the cold output (See in SPECIFICATIONS), but was not when checked per step 4, check the regulator mounting to assure that grounding and insulated mounting screws are installed in the proper location. If assembly is proper, replace regulator as described under "INTEGRAL CHARGING SYSTEM REPAIR",
- If there is some alternator output, but it is still more than 15 [A] below the cold output specification, check the rotor field, brushes, stator, diode trio, and rectifier bridge as described under " INTEGRAL CHARGING SYSTEM REPAIR".

13. INSTALATION (FIG. 8.8)

1. Place the alternator (6) in the way that the alternator housing eyes align engine bracket (5) bore.
2. Install bolt (4) through alternator housing eyes and engine bracket (5) bore. Install nut with washer (8).
3. Install V-belt (9) onto alternator drive pulley.
4. Adjust proper V-belt (9) tension and protect it with lock bolt (7). For tension checking refer to the OPERATORS’S MANUAL.
5. Install output terminal (1) lead and its nut. Torque the nut.
6. Install ground lead with ground screw (3).
7. Close and lock upper L.H. side engine guard.

BATTERIES

14. SAFETY PRECAUTIONS

a. Handling Battery Acid

1. When working with acid, wear a face shield, protective clothing, galoshes, 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.

15. DESCRIPTION

A loader is equipped with two 12 [V] maintenance free batteries (2, Fig. 8.35) connected in series supply the 24 [V]. They are located in the battery compartment are the loader rear in the counterweight (9) recess and held in place with the mounting bar (5). Access to the batteries is gained by raising the radiator guard and the batteries cover (1). The cables (3, 4, 6) are nutted (7) and protected with cap (8).

BATTERIES

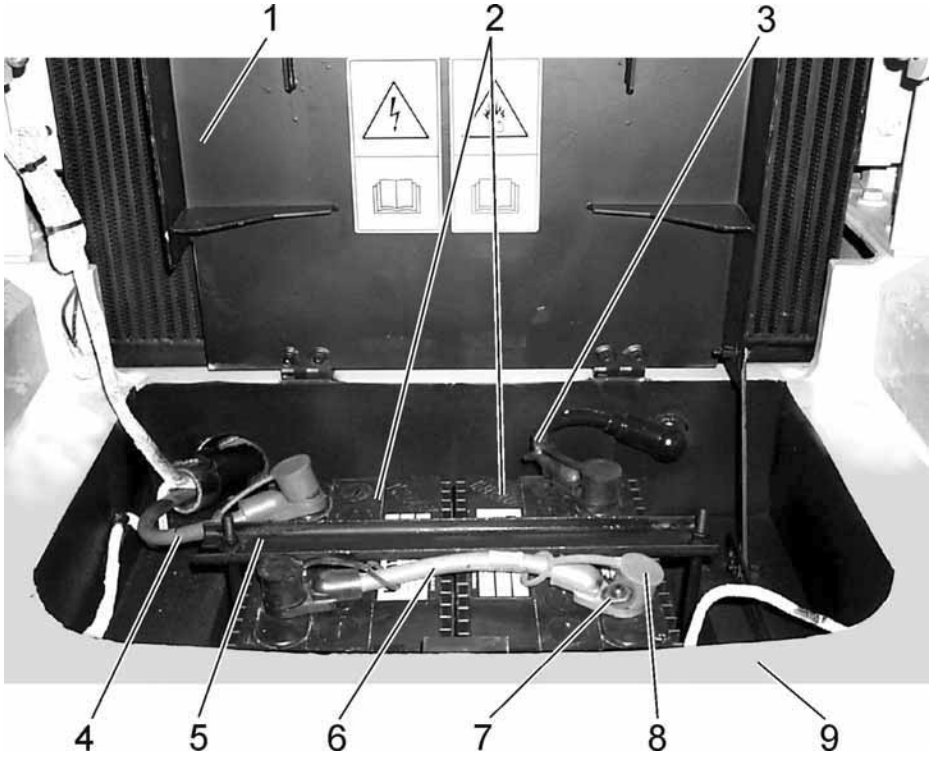


Fig. 8.35. The Batteries Mounting

1. Cover
2. Battery
3. Battery Cable (-)
4. Battery Cable (+)
5. Mounting Bar
6. Battery Cable (+ / -)
7. Nut
8. Cap
9. Counterweight

16. 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 [V]
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

BATTERIES

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]).

17. 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 ranges. 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.

b. The State of Charge Batteries at Various Climate

The state OFF charge batteries at various climates 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

c. Arctic Climate

Batteries used in arctic climate use stronger electrolyte of 1.290 to 1.300. Higher specific gravity decreases the service life of the battery.

As the battery approaches the discharged condition, the easier it is for its electrolyte to freeze.

d. Electrolyte Freezing Point

Electrolyte freezing point shows chart below.

Freezing point [°C]	Specific gravity
-10	1.120
-27	1.200
-54	1.255
-65	1.270

BATTERIES

18. 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 a 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. Brighten terminal contact surfaces with steel wool or a stiff brush. 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 12.2 [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 test leads to the terminals and applying a load 475 [A] (1/2 of the Cold Cranking Amperes at -18 [°C]) rating of the battery for 15 seconds. The battery can be tested with the Electronic Battery Tester, number 15-550, or carbon pile load tester. Proceed to Load Procedure.
4. If the stabilized voltage of the battery was 12.4 [V] or above when it was first examined, proceed to Load Procedure.

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.

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 475 [A] (1/2 of the Cold Cranking Amperes at -18 [°C]) rating of the battery. Read voltage after 15 seconds with load connected, remove load. Estimate or measure battery temperature and compare voltage reading with the Voltage Chart.

BATTERIES

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

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, states of charge of batteries vary. Time and attention must be given to batteries during any charging process.

The charge a battery 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.

19. BATTERY CHARGING GUIDE

Recommended Rate and Time for Fully Discharged Condition

Rated Battery Capacity	Charge	
Above 126 to 170 Minutes	2.75 hours at 30 Amperes	3 hours at 25 Amperes
	4 hours at 20 Amperes	5.5 hours at 15 Amperes

Determine the state-of-charge of the battery with a hydrometer or open circuit voltmeter. The best method of making certain a battery is fully charged, is to measure the specific gravity of a cell once per hour. The battery is fully charged when the cells are gassing freely at low charging rate and less than 0.003 change in specific gravity occurs over a three-hour period.

When any battery is being charged, periodically measure the temperature of the electrolyte, if the temperature exceeds 52 [°C], or if violent gassing or spewing of electrolyte occurs, the charging rate must be reduced or temporarily halted.

BATTERIES

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.

20. 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 [V] 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.

21. 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 [V] 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 [A] to an out point of 10.5 [V].

22. 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].

BATTERIES

23. DRY CHARGE ACTIVATION

1. Before attempting to activate a battery read and understands 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 soake plates. Add additional electrolyte to proper level. It is recommended wait for 3 hours after filling of battery.
5. Charge battery no more than 7 [A] for 30 minutes. Battery is ready if specific gravity is 1.250 or more at temperature 15.5 [°C]
6. Check electrolyte level and add distillated water if need.
7. Dry charged batteries may be placed in service immediately after activation. However, to insure good performance these additional steps are recommended.

   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 [V] this indicates a reverse cell, an "open" circuit or a shorted cell, and the battery should be replaced.

24. TYPICAL CAUSES 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.

BATTERIES

25. VISUAL INSPECTION OF BATTERY

a. Inspection Before Disassembly

The following will describe a procedure, which could be used to make an internal examination of a battery, which has failed. First, the battery is fully charged: at least an attempt is made to fully charge it. The specific gravity of the electrolyte in each cell is recorded. The battery open circuit voltage is recorded. All cell voltages should be recorded. The battery is allowed to stand for three days and the specific gravity readings are recorded a second time. An excessive specific gravity drop (35 points) in one or more cells is an indication that shorts exist in those cells. If two adjacent cells have gravity readings considerably lower than the others, it is a good indication that electrical leakage exists between the two cells and is discharging them. If the container and/or cover is cracked it could be due to abuse (an impact blow), freezing or the battery exploded. High temperatures may permit the container to bulge.

b. Inspection After Disassembly

The next step is to pour the electrolyte from the battery and remove the cover by sawed off the battery with a hacksaw or band saw. The next step is to cut the intercell connections. This can be done with a bolt cutter. The elements can now be lifted from the container. Remove the element from the cell with the lowest specific gravity electrolyte. Squeeze the element gently and let excess acid drain from it. Examine the sides of the element for treeing shorts between positive and negative plates. These are generally caused by misalignment of the plates and separators. Check for broken or bent grid frames shorting against an adjacent plate. Look under the plate straps to see if there is a lead rundown from the strap to a plate beneath it. Determine if the top of a grid frame has broken and moved upward until it is shorting against a plate strap. Remove the plates from the plate strap with a hacksaw.

1. POSITIVE PLATE; If the plate has a distinct zone of white sulfate near the top this was caused by a low electrolyte level. Restoring the electrolyte level will not help the sulfated area. Uniform shedding over the entire surface of the positive plates is normal for a battery after long service. When material has shed from the plate in small chunks, it could be due to vibration, too high a charging rate on a sulfated plate, or the battery freezing while it was discharged. Continued overcharging oxidizes the positive grids and reduces the cross-section of the wires. If the plate is hard when scratched, or has areas of white sulfate on it, the battery has stood in a discharged condition.
2. NEGATIVE PLATES; The sponge lead of the negative plate is normally a slate gray color. If you rub the back of your thumbnail or a spatula across a good negative plate, this will create a path of metallic sheen. If a metallic sheen is not created, the negative material is inactive. A partially charged negative plate has sandy appearance. If the negative plate material of a fully charged battery appears sandy, the plates are worthless. This condition may result from operation of the battery while the element was shorted. It can be caused by high gravity acid and high temperature conditions prevail for some time, the negative plate material may become soft. If negative plates have a white discoloration, it is probably due to an accumulation of lead sulfate. The sulfate could result from a low electrolyte level or being in a low state of charge for a considerable length of time. Negative plates that are severely cracked can be the cause of failure. This is typically caused by many repeated, shallow discharge-recharge cycles. The positive plates may eventually be destroyed by the overcharging, although the prime reason for the battery failure could have been the negative plates.
3. SEPARATORS; Hold the separators in front of a bright light and visually inspect for holes, dendrites, or active material through the pores of the separator web, or other visible damage.

CRANKING MOTOR

26. DESCRIPTION

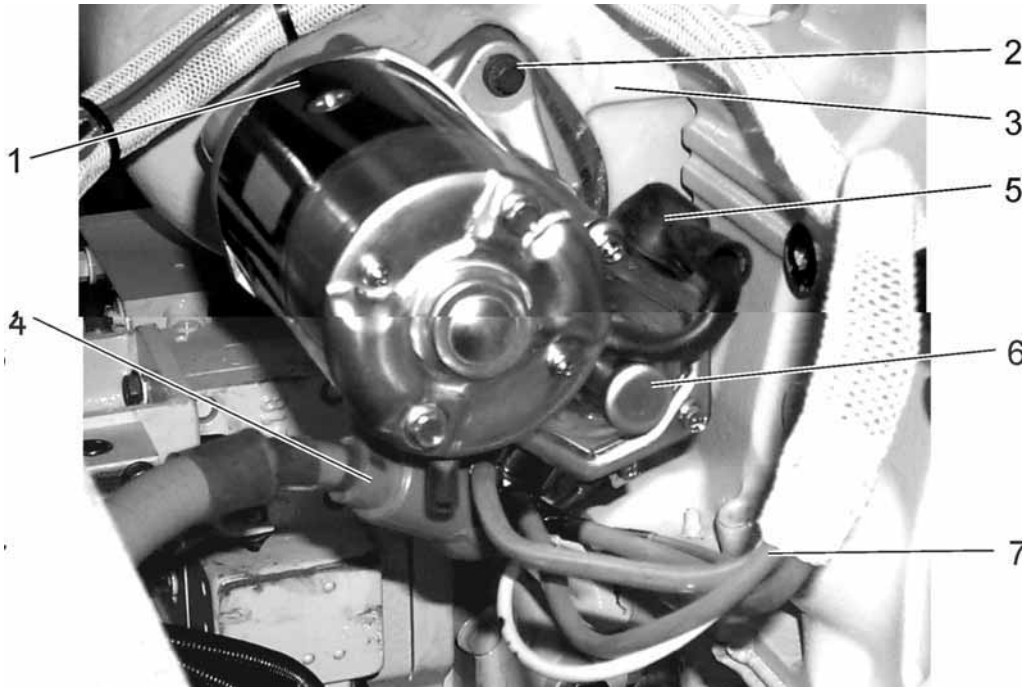


Fig. 8.36. Cranking Motor Location and Disconnect Points (L.H. side View)

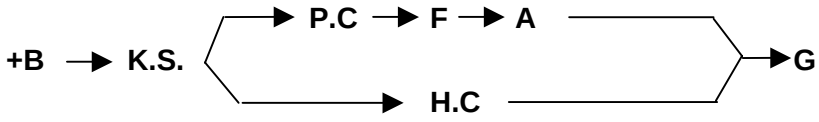
1. Cranking Motor
2. Bolt with Washer
3. Engine Flywheel Housing
4. Battery (+) Cable
5. Ground Cable
6. Solenoid Switch
7. Harness (Cab, Alternator and Cranking Motor Solenoid Switch Leads)

The reduction type R cranking motor consists of the motor, reduction gear set, overrunning clutch and magnetic switch. The cranking motor (1, Fig. 8.36) is located on the L.H. side of the machine and mounted on the engine flywheel housing (3) mounting pad together with spacer and gasket.

27. OPERATION (FIG. 8.37)

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.

CRANKING MOTOR

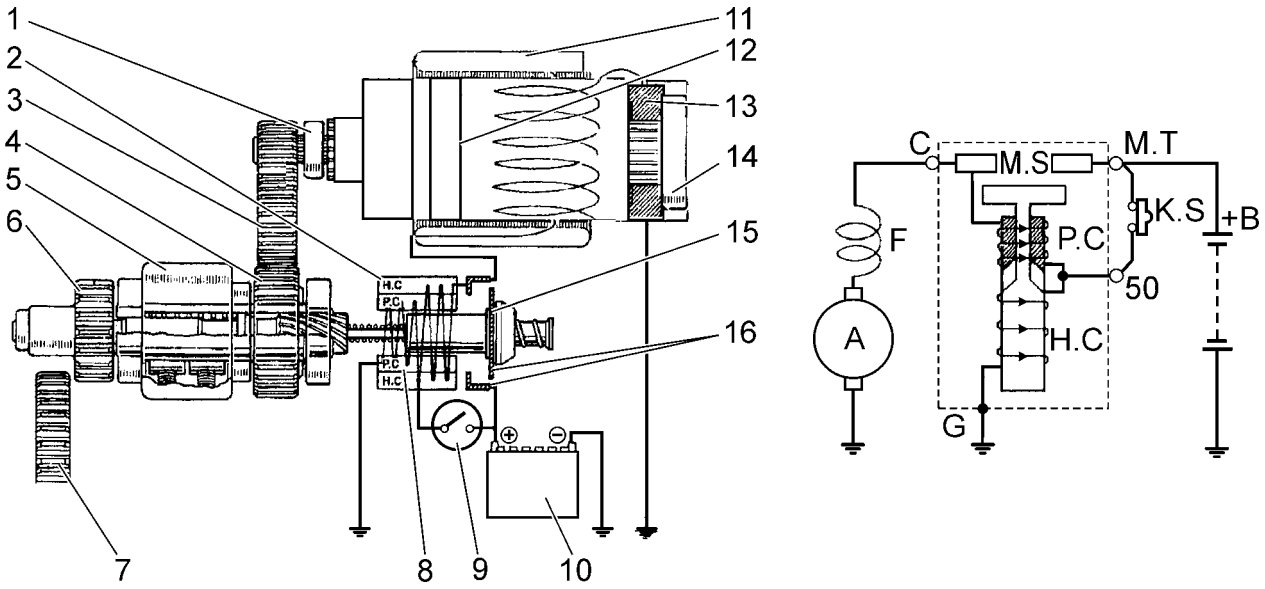


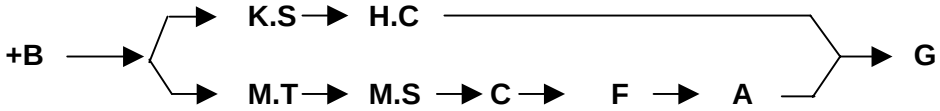
Fig. 8.37. Cranking Motor Cross Section and Circuit Diagram

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.

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.

CRANKING MOTOR

28. SPECIFICATIONS

General

Manufacturer type ..... Denso, D79 / R Type
Power ..... 4.5 [kW]
Voltage ..... 24 [V]
Rotation (viewed from pinion) ..... Clockwise
Field coil out diameter ..... 90 [mm]
Time rating ..... 30 [sec]

Pinion gear

Number of teeth 10
Module pitch ..... (8)

No-load test

Voltage/max. current amperage ..... 23.0 [V] /90 [A]
Min. speed ..... 3500 [Rpm]

Load test

Voltage/max. current amperage ..... 17.0 [V] /530 [A]
Min. speed ..... 950 [Rpm]
Min. torque ..... 40 [Nm]

Lock test

Voltage/max. current amperage ..... 6 [V] /900 [A]
Min. torque ..... 50 [Nm]

Commutator outer diameter

Standard ..... 36 [mm]
Service limit ..... 35 [mm]

Resistance

Output terminal ..... 35 [mΩ]
Pilot terminal ..... 2 [mΩ]

Brush length

Standard ..... 20.5 [mm]
Service limit ..... 18.3 [mm]

Special Torques

Nose housing bolts ..... 190 ÷ 250 [Nm]
Output and ground terminal ..... 24 [Nm]
Pilot terminal ..... 4.6 [Nm]

29. 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.*

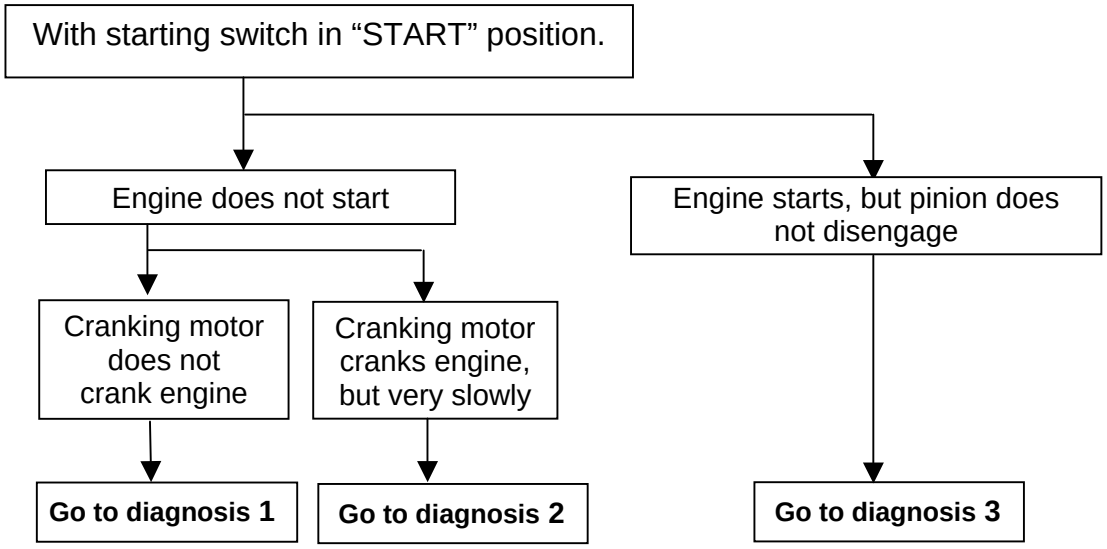


CAUTION! Do not disconnect or short any lead wire while cranking motor is operating.

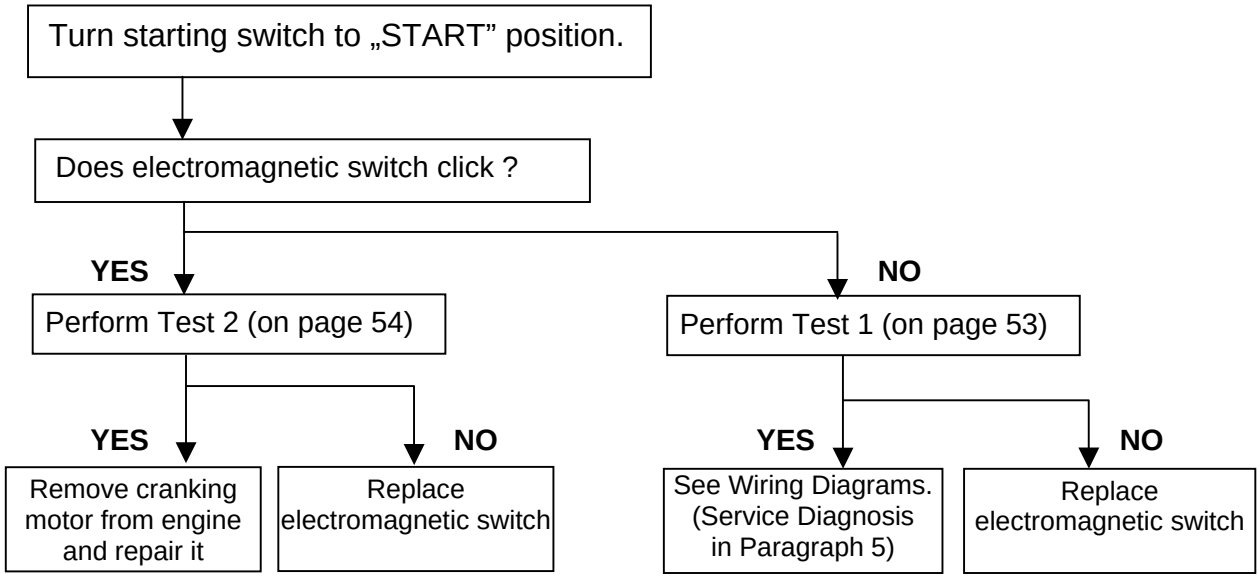
ELECTRICAL

CRANKING MOTOR

DIAGNOSTIC CHART

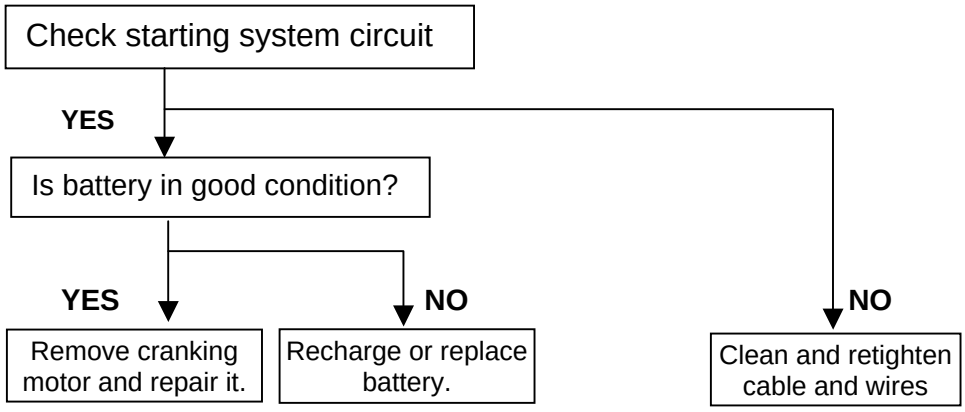


DIAGNOSIS 1

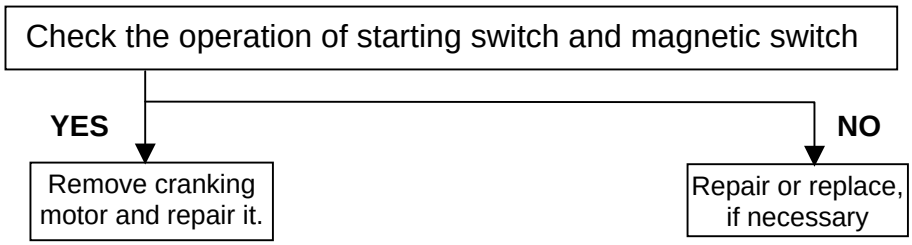


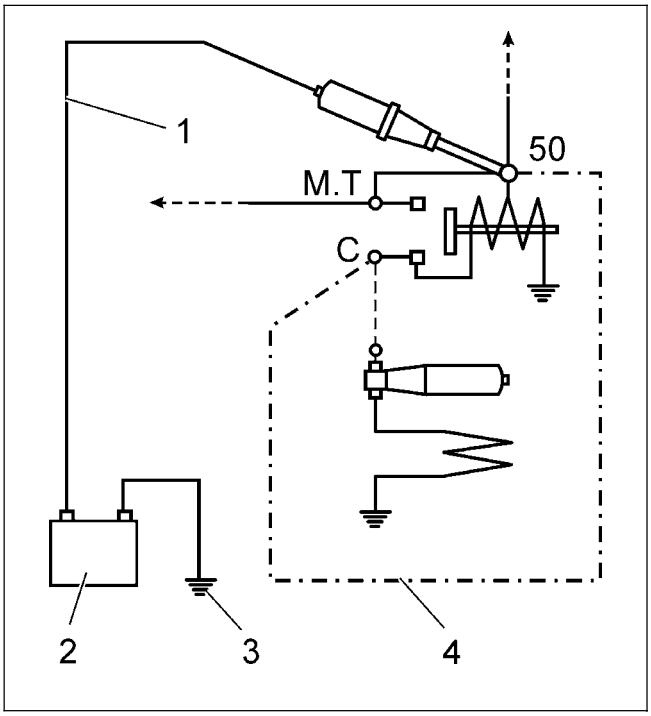
CRANKING MOTOR

DIAGNOSIS 2



DIAGNOSIS 3





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.

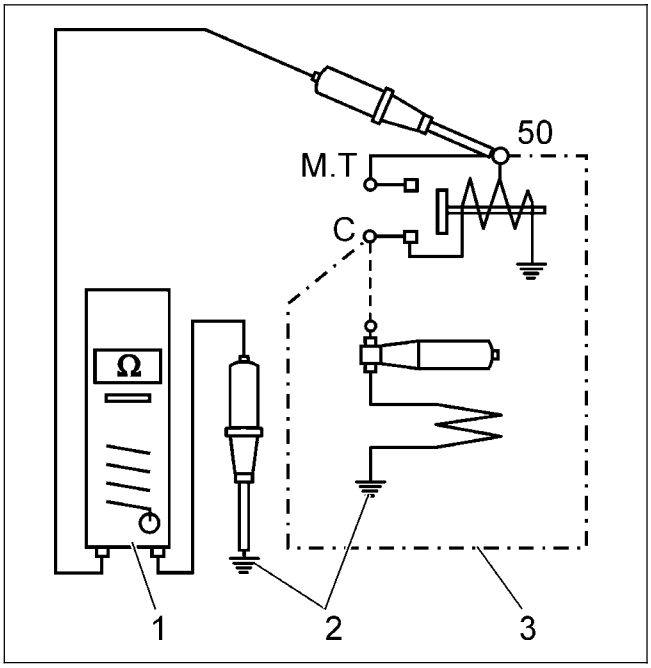
If the electromagnetic switch operates, probable cause of cranking motor failure is in the electrical starting circuit.

CRANKING MOTOR

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

30. REMOVAL (FIG. 8.36)

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 L.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.

CRANKING MOTOR

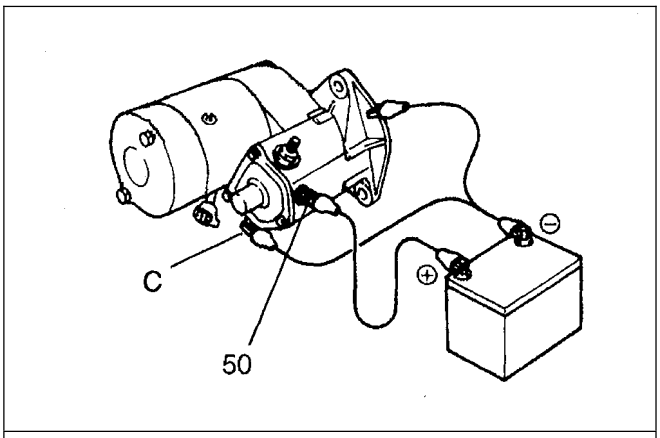
31. TESTS

NOTE*: Before disassembling the cranking motor below described inspection and tests should be performed.*

1. VISUAL INSPECTION

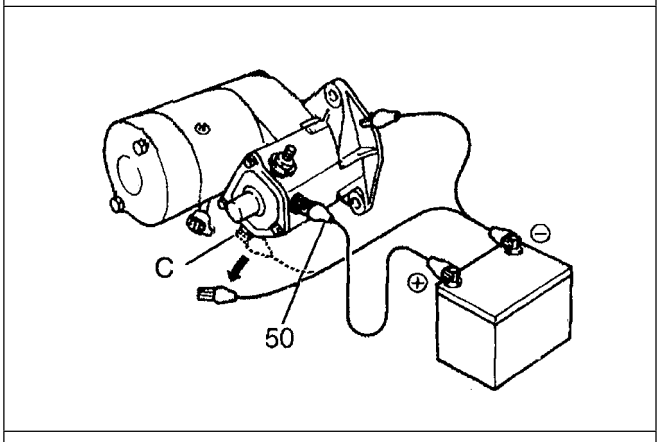
With the cranking motor removed from the engine, check armature for freedom of rotation by prying the pinion gear with a screwdriver. If the armature does not turn freely, the cranking motor should be disassembled and repaired. However, if the armature does rotate freely, the motor should be given a 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.*



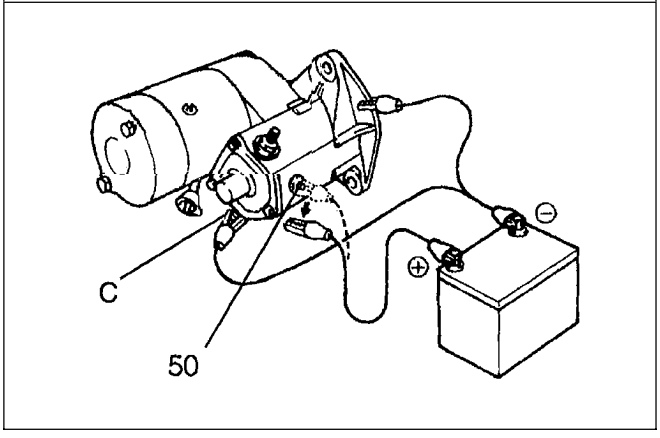
2. PULL-IN TEST

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.



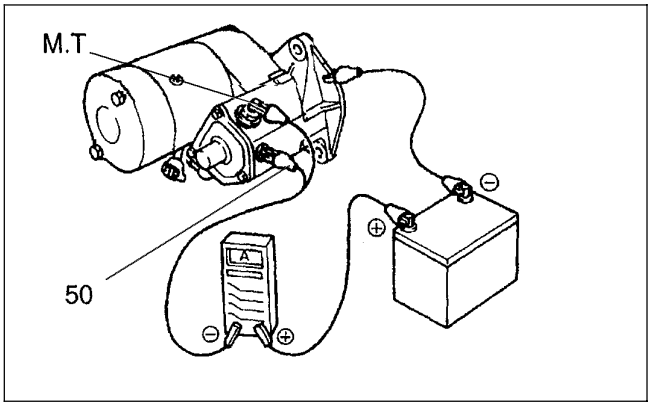
4. INSPECT PLUNGER RETURN
(Solenoid Coil Balance check).

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

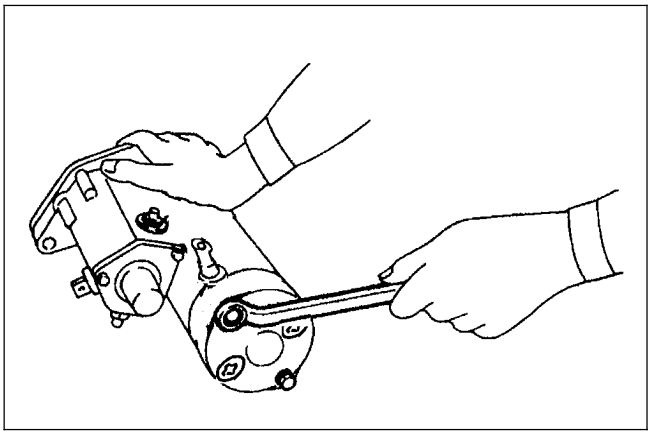
5. NO-LOAD PERFORMANCE TEST

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).



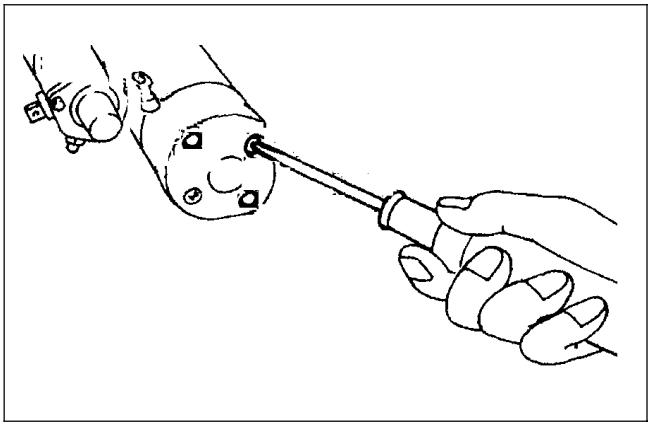
32. DISASSEMBLY (FIG. 8.37)

1. Remove the two bolts (30) from the cranking motor guard (23).



NOTE: *Appling locating marks to the field coil (1), electromagnetic switch (13) housing (12) and guard (23) before removing the parts will make it easier to reinstall them.*

2. Remove two bolts (31).
3. Remove the guard (23) from the cranking motor.



CRANKING MOTOR

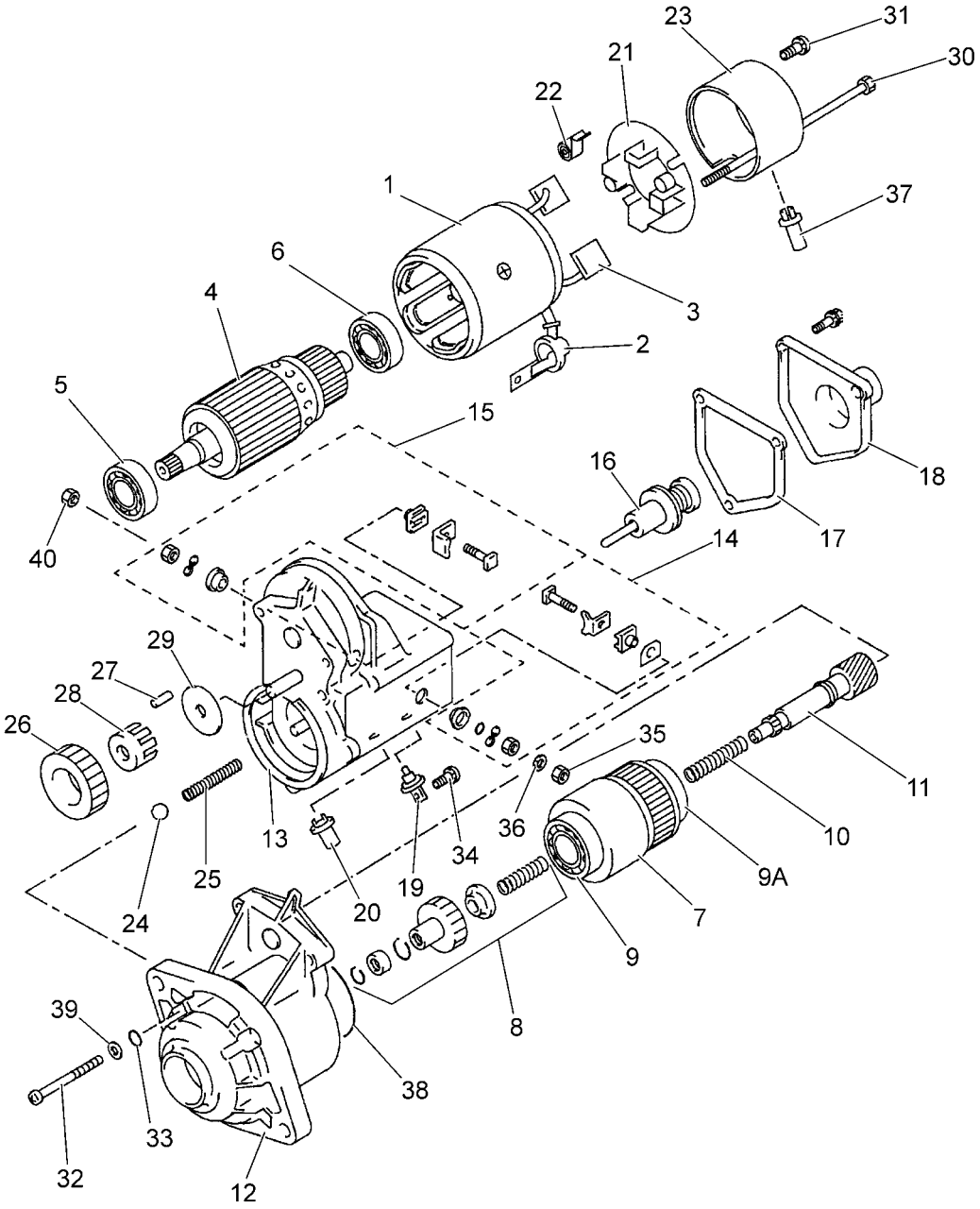


Fig. 8.37. Cranking Motor Exploded View

1. Field Coil
2. Cover
3. Brush Set
4. Motor Armature
5. Ball Bearing
6. Ball Bearing
7. Gear Clutch
8. Gear Assy
9. Ball Bearing
9a. Ball Bearing
10. Spring
11. Shaft
12. Housing
13. Electromagnetic Switch
14. Terminal Set
15. Terminal Set
16. Switch Core Assy
17. Seal
18. Switch
19. Special Bolt
20. Insulator
21. Brush Plate
22. Brush Spring
23. Guard
24. Steel Ball
25. Spring
26. Gear
27. Clutch Shaft
28. Spacer Ring
29. Spacer Ring
30. Bolt
31. Bolt
32. Bolt
33. O-Ring
34. Bolt with Washer
35. Nut
36. Spring Washer
37. Cover
38. O-Ring
39. Washer
40. Nut

CRANKING MOTOR

4. Using a screwdriver, carefully push from both side the brush springs (38A, Fig. 8.38) 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).

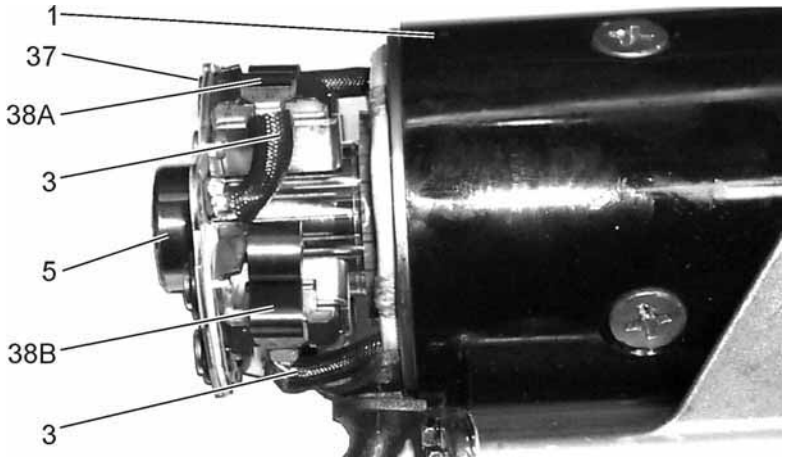
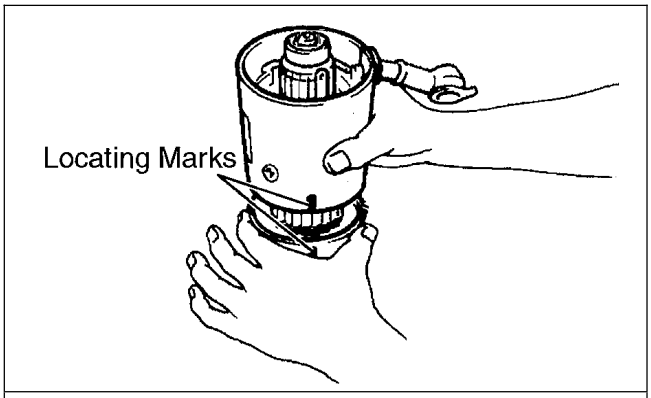


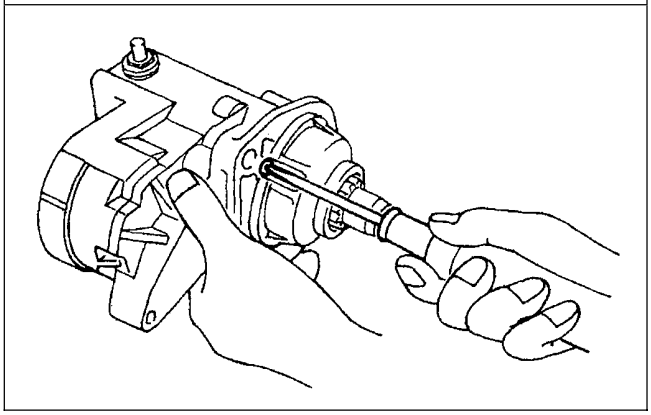
Fig. 8.38. Cranking Motor View

1. Field Coil
3. Brush Set
5. Ball Bearing
37. Brush Plate
38A. Brush spring (Brush -)
38B. Brush spring (Brush+)

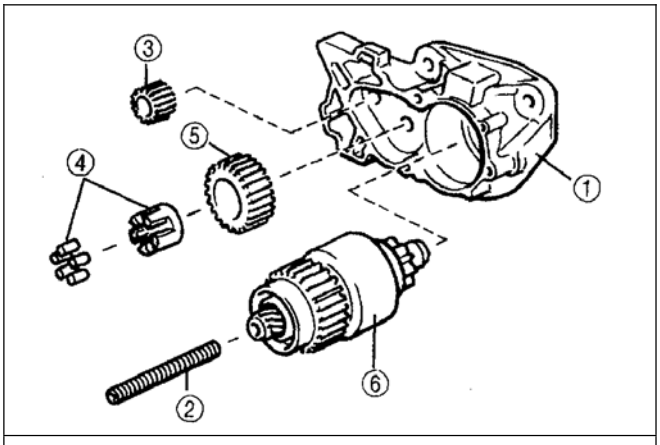
6. Carefully pull out the field coil (1, Fig. 8.37) and remove motor armature (4) using a plastic hammer.



7. Remove the three bolts (32), washers (39) and discard the O-rings (33) from the cranking motor housing (12).

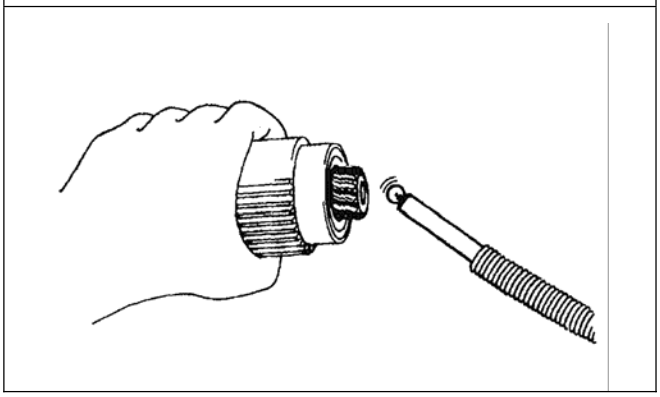


CRANKING MOTOR



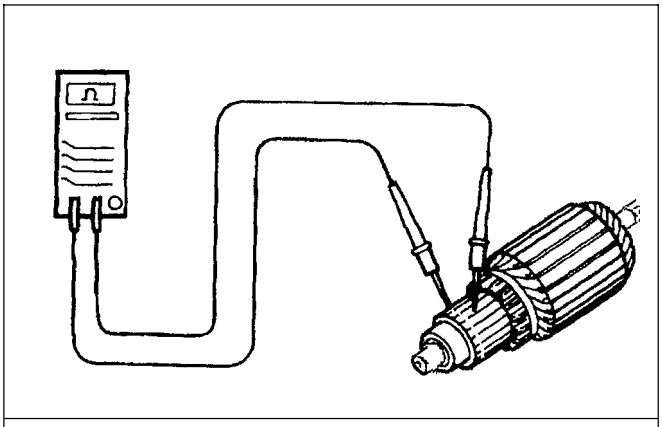
8. Remove the following parts from the cranking motor housing (12):

① Housing
② Spring
③ Drive Gear
④ Retainer and Clutch Rollers
⑤ Pinion Gear
⑥ Clutch Assy



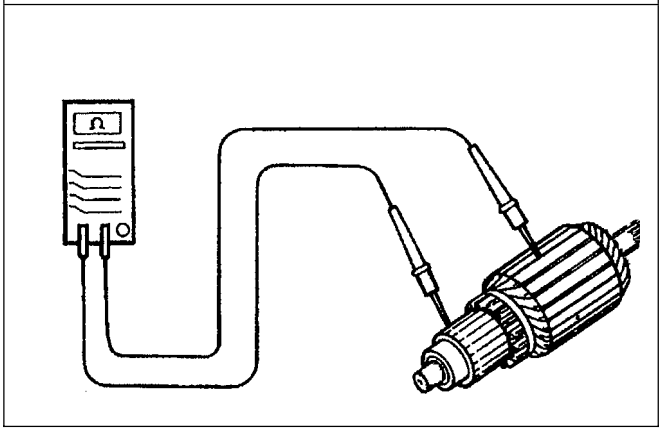
9. Using a small round magnet, remove the steel ball (24) from overrunning clutch shaft hole.

33. 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.

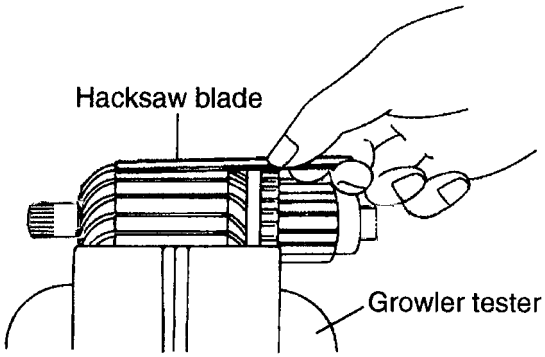
ELECTRICAL

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.

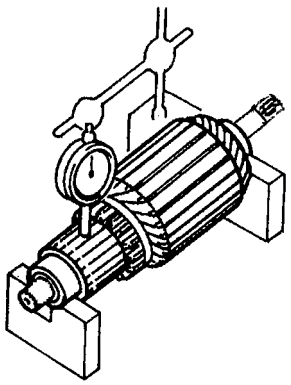
If the surface is dirty or burnt, clean it with sand paper No.400 or on a lathe.

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.

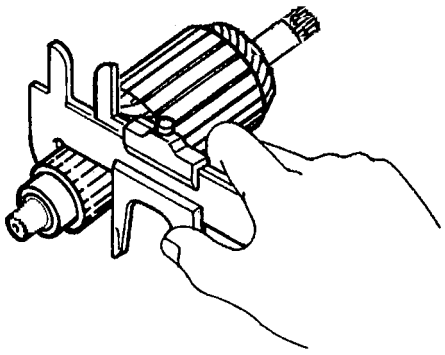


6. INSPECT COMMUTATOR DIAMETER.

Using a vernier or dial caliper, measure the commutator diameter.

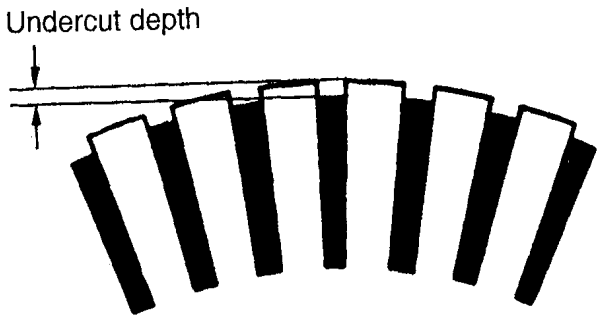
Standard dia. – 36 [mm]
Minimum dia. – 35 [mm]

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.

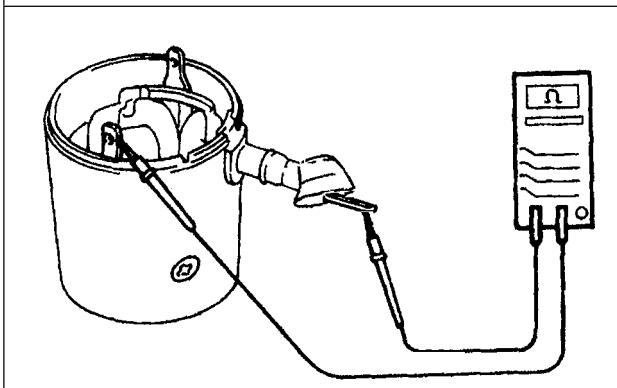
CRANKING MOTOR



7. INSPECT UNDERCUT DEPTH OF THE COMMUTATOR.

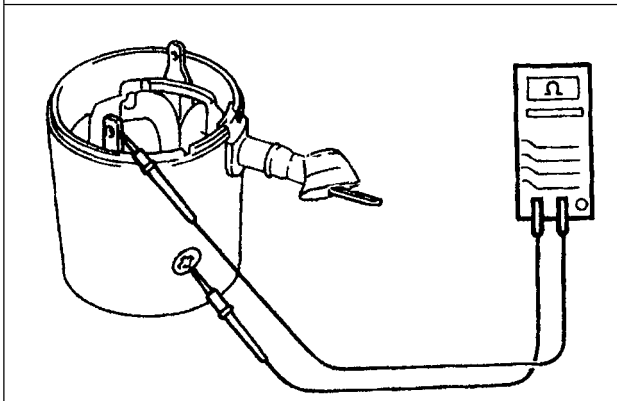
Check that the undercut depth is clean and free of foreign materials.

Standard undercut depth: 0.7÷0.9 [mm]



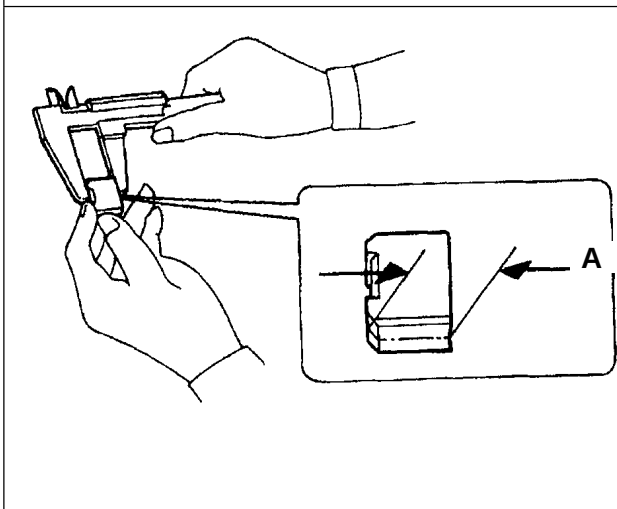
8. INSPECT FIELD COIL FOR OPEN CIRCUIT.

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.

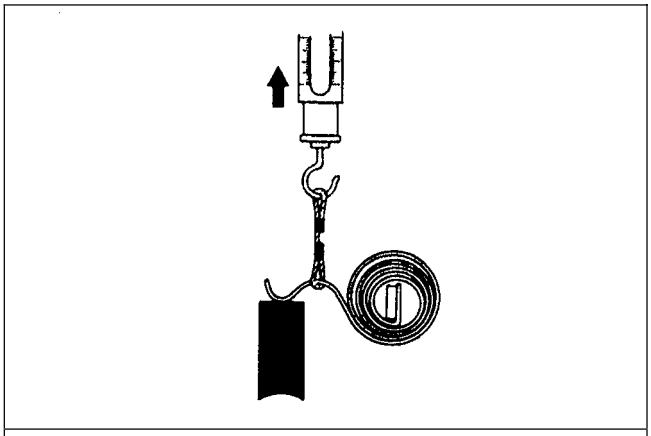
CRANKING MOTOR

12. INSPECT BRUSH SPRING LOAD.

Take the pull scale reading the instant the brush spring separates from the brush.

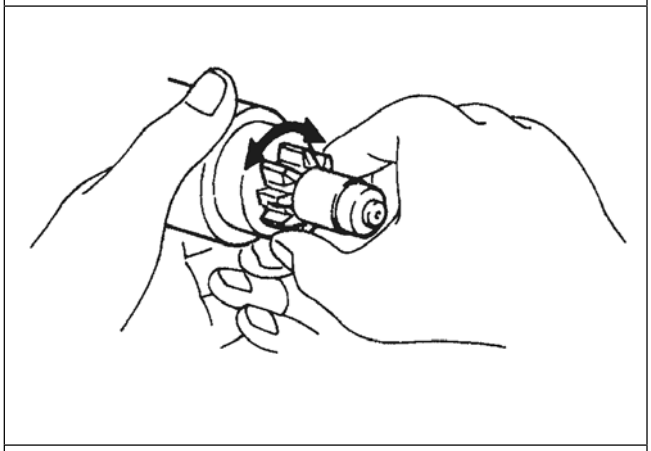
Spring installed load: 30÷40 [N]

If the installed load is not within specification, replace the brush springs.



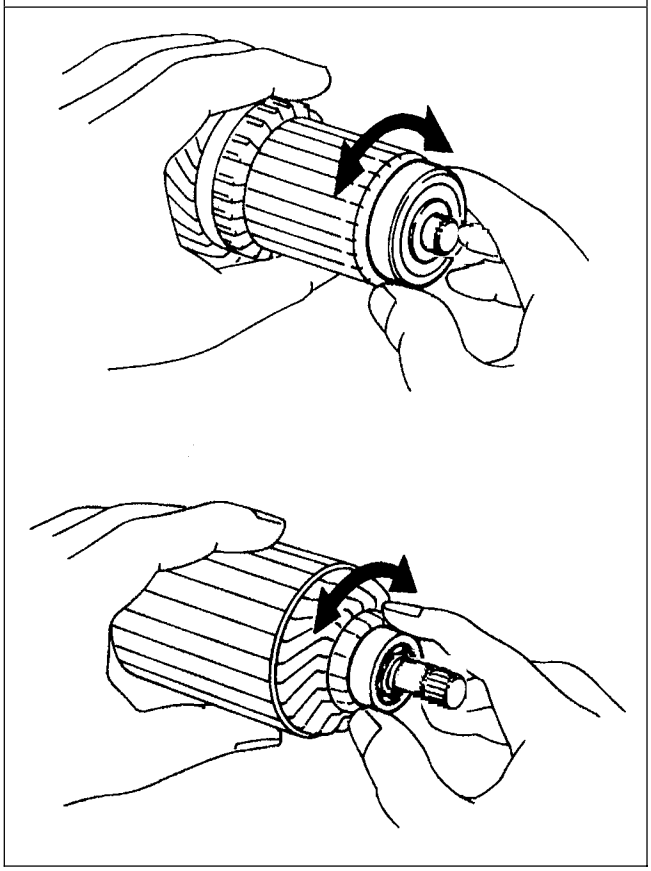
13. INSPECT CLUTCH PINION GEAR.

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.

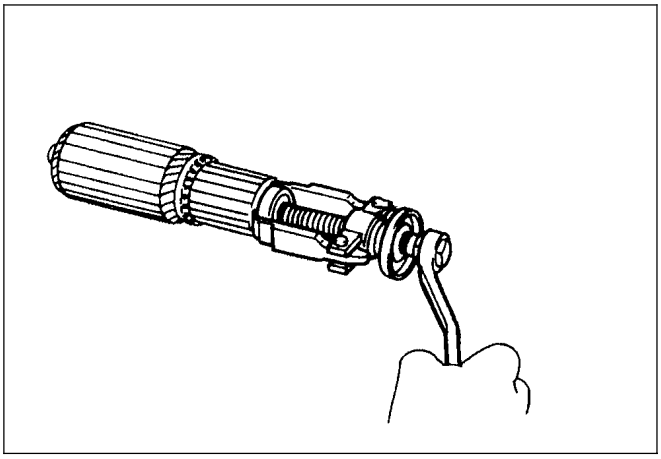


14. INSPECT FRONT AND REAR BEARINGS.

Rotate the bearing by hand while applying inward force. If the bearing sticks or does not rotate smoothly, replace the bearing.



CRANKING MOTOR

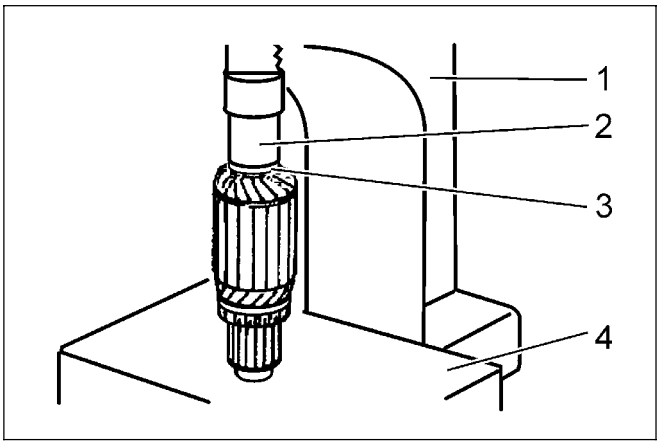


16. IF NECESSARY, REPLACE BEARINGS

a - Using a bearing puller, remove the bearing from both sides.

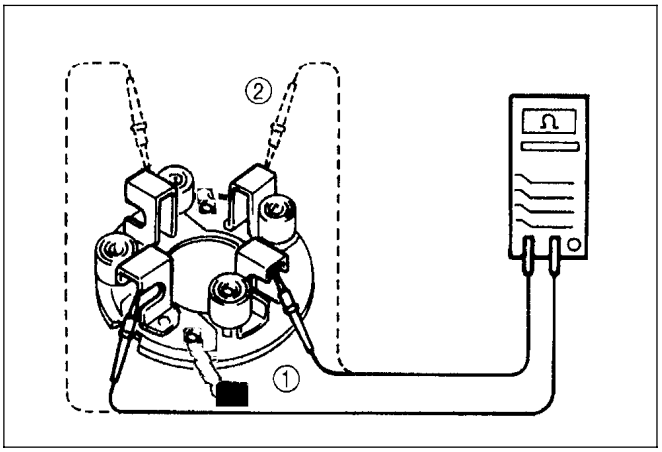
NOTE: *Make sure that the base (4) of press (1) is secure and flat. Use a spacer (2) that is similar to the size shown in Fig. 8.A. For example, a 17 mm socket is suitable. Make sure the bearing (3) is properly installed on the armature shaft.*

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.*



1. Press
2. Spacer
3. Bearing
4. Base

b - Using a press and spacer, press in a new bearing on both sides.



15. INSPECT BRUSH HOLDER INSULATION.

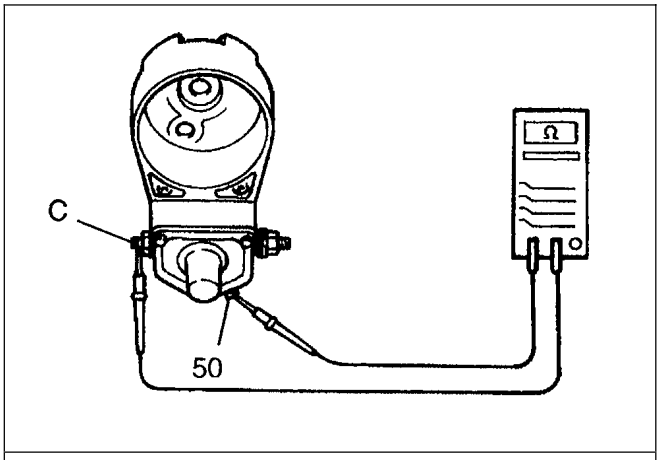
Using an ohmmeter, check for no continuity between the positive (+) and negative (-) brush holders. If there is continuity, replace the brush holder.

NOTE: *Do the inspection at locations 1 and 2 as shown above.*

CRANKING MOTOR

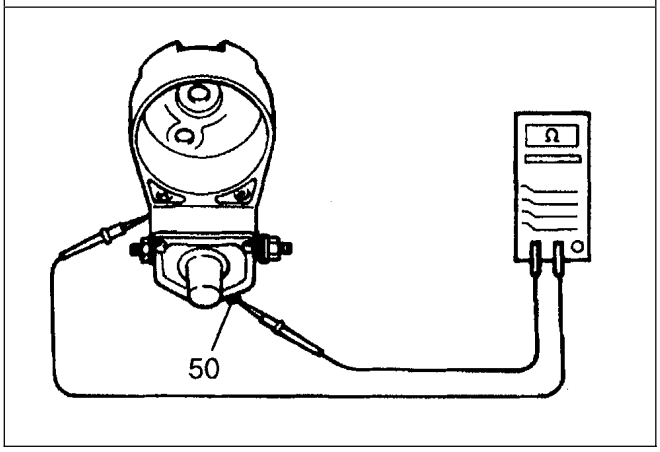
16. INSPECT PULL-IN COIL FOR OPEN CIRCUIT.

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.

34. REASSEMBLY (FIG. 8.37)

1. Apply high temperature grease per HMS B27-0004 to the armature bearings (5, 6) and using a press, install motor armature (4) into the electromagnetic switch (13) housing.

NOTE: *Rotate the motor armature (4) and check that it is pressed straight into it. If the motor armature (4) 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 (13) housing, carefully slide the field coil (1) on the motor armature (4).
3. Align the claw of the brush plate (21) with its groove of the field coil (1) and place the brush plate (21) onto the field coil (1).
4. Using a screwdriver, hold the brush spring (22) back and connect the brush into the brush plate (21). Connect the four brushes (3).

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 (23), with two bolts (30). Tighten to torque 10÷18 [Nm].
6. Install two bolts (31) on the guard (23) and tighten them.
7. Apply grease to the steel ball (24), and insert it into the overrunning clutch shaft (11) hole.
8. Apply grease to the spring (25) and insert it into the electromagnetic switch (13) hole.
9. Place the following parts in position on the cranking motor housing (12). Refer to 33. DISASSEMBLY, Step 8.

   ⑥ Clutch Assy
   ⑤ Pinion Gear
   ④ Retainer and Clutch Rollers
   ③ Drive Gear

10. Install new O-ring (38), the cranking motor housing (12).
11. Install three bolts (32) with new O-rings (33) and washers (39) and tighten them.

35. INSTALLATION (FIG. 8.35)

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).

SECTION 9

FRAME

FRAME

SECTION 9

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SERVICE/SPECIAL TOOLS

1. Service/Special Tools 3

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2. Description and Operation 3
3. Specification 4
4. Inspection and Repair 5

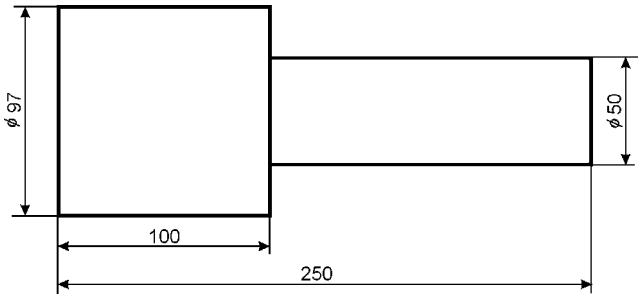
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6. Inspection and Repair 12
7. Reassembly 12

SERVICE/SPECIAL TOOLS

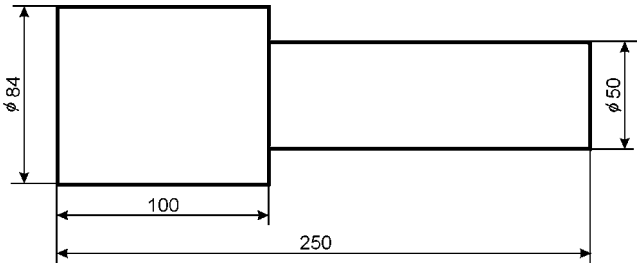
1. SERVICE/SPECIAL TOOLS

Description	P/N of instrument/tool
1. Copper hammer	1.519.0149
2. Copper hammer	1.519.0750
3. Mallet	Fig.9.1
4. Mallet	Fig.9.2



Steel 25 per PN-93/H-84019

Fig. 9.1



Steel 25 per PN-93/H-84019

Fig. 9.2

GENERAL

WARNING! Before attempt to service the machine, BE SURE the engine is stopped, the bucket is lowered to the ground, transmission shifter is in neutral position (N), parking brake applied, the master switch turned to the OFF position and the keys are taken out from both the electric master switch and starting switch to prevent accidental engine starting. Place in visible warning notice in the cab.

2. DESCRIPTION AND OPERATION

The chassis of the machine is basically two frames which articulate at their center connection. The front frame provides the mount for the controls, front axle and operator's compartment. Seated here, the operator is always in line with the bucket, allowing a greater degree of control and operating accuracy.

The rear frame provides a platform the mounting for the, engine, radiator, torque converter, transmission, rear axle and equipment and drive hydraulic system reservoir and fuel tank.

The front and rear frames are each composed of many smaller items (as steel sheets, ribs, flat bars, brackets, etc) welded together to form a single rigid assembly.

In addition to their center hinge pins, the outer edges of the frame sections are linked together by a pair of steering cylinders. As one cylinder extends, the opposite contracts, pivoting the frame sections on the hinge pins and steering the machine. This type of articulated steering has definite advantages, it eliminates the need of a steering axle with its additional parts, eliminates the drag link and tie rod, and allows the rear wheels to track in the path of the front wheels.

This latter item insures a much shorter turning radius than that afforded by the more conventional rigid frame and steering axle type.

FRAME

GENERAL

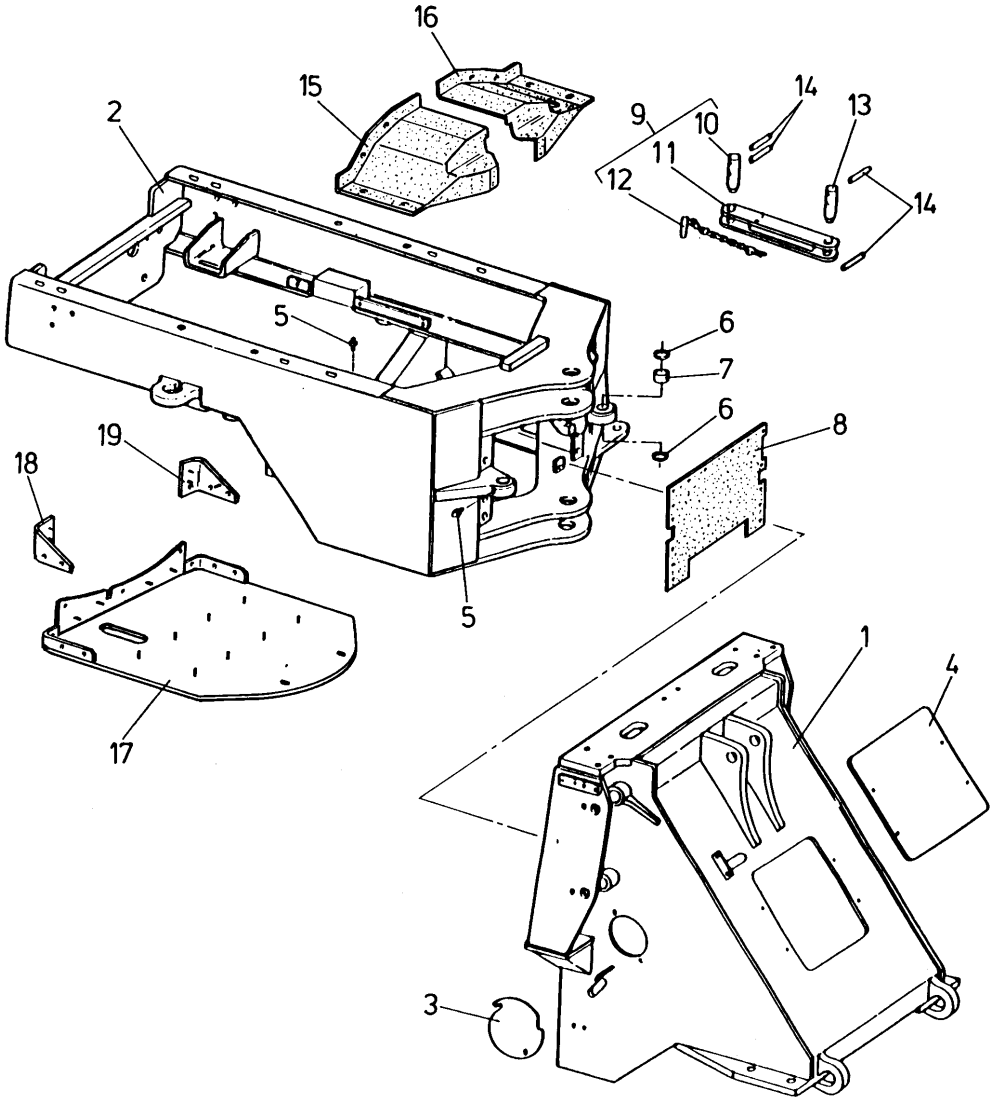


Fig. 9.3. Front and Rear Frame (515G)

1. Frame Front
2. Frame Rear
3. Cover
4. Plate
5. Lubrication Fitting
6. Seal Ring
7. Bushing
8. Rubber Bulkhead
9. Link Assy
10. Pin
11. Locking Bar
12. Pin w/Chain
13. Pin
14. Spring Pin
15. Upper RH Guard
16. Upper LH Guard
17. Transmission Guard
18. Lower R.H Guard
19. Lower L.H Guard

GENERAL

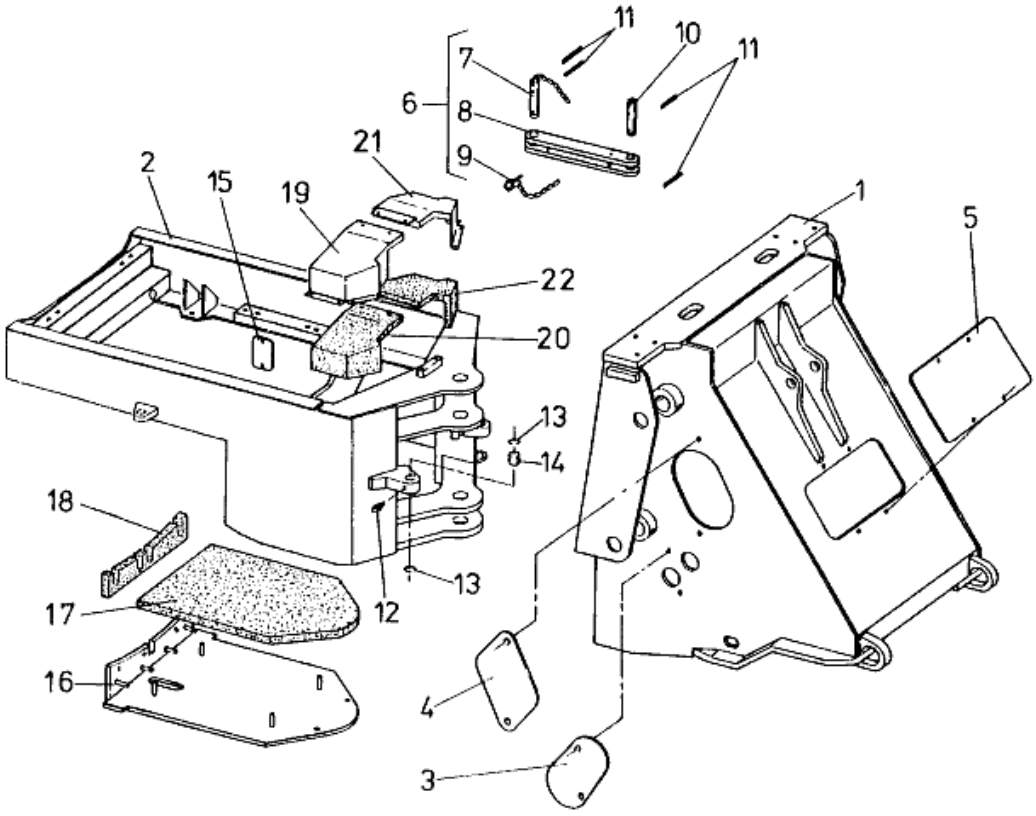


Fig. 9.3A. Front and Rear Frame (520G)

1. Frame Front
2. Frame Rear
3. Cover
4. Plate
5. Plate
6. Link Assy
7. Pin
8. Locking Bar
9. Pin w/Chain
10. Pin
11. Spring Pin
12. Lubrication Fitting
13. Seal Ring
14. Bushing
15. Plate
16. Lower Guard
17. Insulation
18. Insulation
19. Guard R.H.
20. Insulation R.H.
21. Guard L.H.
22. Insulation L.H.

3. SPECIFICATIONS

Special Torques

Upper hinge (Fig. 9.7)

Retainer plate to rear frame mounting bolt (2) (Loctite 262 applied).....92 [Nm]
Lock nut (13) .....475 [Nm]
Bearing retainer plate mounting bolt (7). (Loctite 262 applied) .....46 [Nm]

Lower hinge (Fig. 9.8)

Retainer plate to rear frame mounting bolt (6) (Loctite 262 applied).....46 [Nm]

All remaining

Battery box to frame mounting bolts.....110 [Nm]
Counterweight mounting bolts.....380 [Nm]

FRAME

GENERAL

4. INSPECTION AND REPAIR



DANGER! Before attempt to check amount of wear of center hinges, make sure area close to the machine is clear of personnel. Inspection of frame center hinges must be made by two servicemen.

Inspection of frames

A periodic inspection of the frames should be made to detect weld cracks, broken welds or damaged brackets. Special attention should be given to the hinge pin assemblies being sure they are properly centered and seals and bearings are in good condition.

To keep rust and corrosion to a minimum, periodic painting of abrasions and bare metal is recommended.

Inspection and repair must be performed in Service Facility if the following are damaged:

- Center hinge brackets of frames,
- Front frame steel sheets, close to boom and steering, boom and bucket hydraulic cylinders journals,
- Transmission and engine mounting brackets.

Welding



CAUTION! 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.

For successful welding repairs, welding personnel must have proper qualifications, i.e. 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. Frame components are made of carbon steel of good weldability. Any repair welding performed on the front and rear frames must be classified as a critical weld. Special attention must be given to the size, strength and surface quality of the repair.

If necessary to do welding on the machine, attach the ground cable close to the weld area. Do not attach the ground cable where the current can flow through bearing or mounting pads because this will damage the parts.

Inspection of center hinges



DANGER! Before attempt to service the machine close to center hinge area, always secure the frame halves in the straight position with the frame locking bar to prevent machine movement as it may cause serious injury or death.

1. Position the machine on a level and compacted ground.
2. Start the engine and operate the boom and bucket levers to bring oil in equipment system to operating temperature.

GENERAL

3. Lower the boom so that bucket rest flat on the ground and then power the booms down until the front tires are raised off the ground. Then raise the boom so that lower the machine on the ground and the bucket is off the ground.
4. When performing operations specified in item 3, the other person should observe center hinges from safe distance. Knocking and rasping sounds as well as excessive clearance in hinge pin indicate excessive wear.

In any knocking, rasping or clearance are found in center hinges, check torque of center hinge mounting bolts and repeat above specified inspection procedure for frame center hinges.

Torques for center hinge mounting bolts are specified in SPECIFICATIONS in this Section. If after tightening to required torque knocking, rasping or clearance continue to occur, center hinges must be repaired.

CENTER HINGE PINS



WARNING! Before attempt to service the center hinge pins, BE SURE the engine is stopped, the bucket is lowered to the ground, transmission shifter is in neutral position (N), parking brake applied, the master switch turned to the OFF position and the keys are taken out from both the electric master switch and starting switch to prevent accidental engine starting. Place in visible warning notice in the cab.



DANGER! Before attempt to service the machine close to center hinge area, always secure the frame halves in the straight position with the frame locking bar to prevent machine movement as it may cause serious injury or death.

5. REMOVAL AND DISASSEMBLY

If bearings are damaged and need to be replaced, it is not necessary to remove drive train components installed within frames as engines, torque converter, front and rear drive axle, working system components.

The above specified components should be removed for frame repair.

To remove center hinges follow the below specified procedure:

1. Position the machine in the straight ahead position on level ground under a hoist capable of supporting the rear portion of the rear frame when separated from the front frame. If a floor support is used for the rear frame, it must be such that the rear frame can be moved from the front frame to ensure a suitable space for further operations. Clearance between frames is needed to remove the bearings from the frame. Block the front frame up so it will drop once unpinned from the rear frame.



WARNING! : The machine weight is about 9500 [kg], – 515G, 11000 [kg] – 520G. Adequate lifting and blocking equipment must be available before beginning this procedure. Use extra caution when jacking up the machine. Jacking up the machine can be hazardous if performed improperly.
DO NOT run the engine with the machine on jacks. For your safety, transfer the weight of the machine to approved block, before servicing the machine (Fig. 9.4)

FRAME

CENTER HINGE PINS

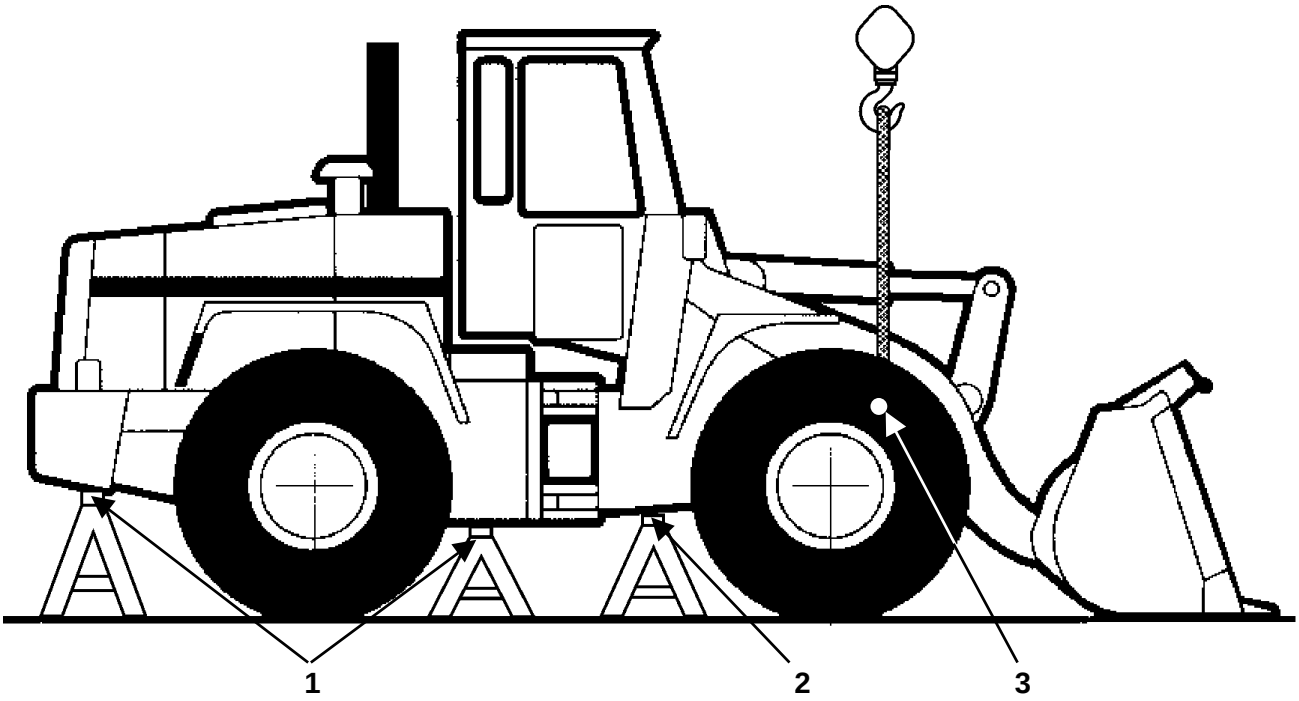


Fig. 9.4. Machine Support Point

1 ,2. Trestles

3. Lifting Eye

IMPORTANT: *Disconnected hydraulic lines must be capped with the correct size plastic caps. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Tag all disconnected lines to facilitate proper installation.*

2. Place wheel loader on trestles (place trestles under rear frame in two support point) (1, Fig. 9.4).
3. Drain the hydraulic reservoir. Refer to the OPERATOR'S MANUAL for this procedure.
4. Remove the bracket (8, Fig. 9.6) to facilitate dismounting houses and harness.
5. Remove the cab. Refer to Section 13
6. Disconnect all electric, hydraulic lines connecting front frame subassemblies to those of rear frame.

WARNING! When performing service with brake fluid use eye protection. Wear goggles when adding brake fluid, venting brakes and performing other service with brake fluid.

7. Disconnect brake line and plug the pipe with the cap.
8. Disconnect the accelerator pedal cable. Refer to Section 12
9. Disconnect the transmission emergency control cable from the cab side

CENTER HINGE PINS

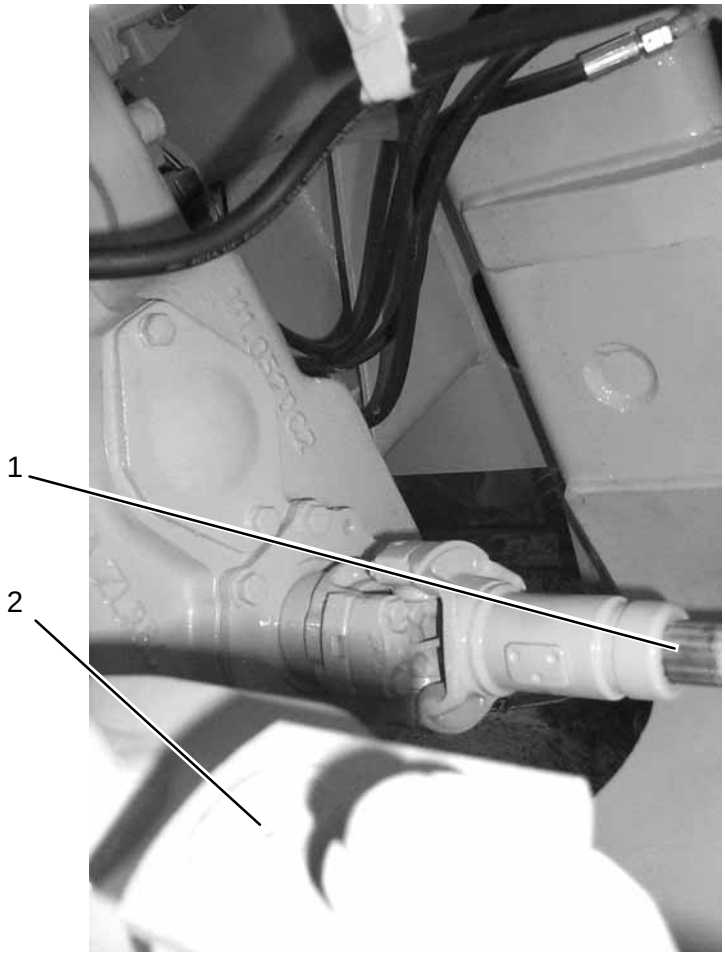


Fig. 9.5. Frame Disconnect Points
(R.H. side of the lower hinge area shown)

1. Rear Frame Bracket (Steering Cylinder)
2. Transmission to Drive Shaft Support Drive Shaft

10. Remove pins and disconnect steering cylinders (4, 5). Refer to Section 10C.
11. Remove the transmission to drive shafts support drive shaft (2), which passes directly over the lower hinge (1). Refer to Section 7D, for removal procedure.
12. Attach a suitable hoist to lifting eye (3, Fig. 9.4) of front frame, remove the slack and put the trestle (2) under front frame.
13. Remove bolt (2, Fig. 9.7) and nut (13) from the upper hinge and bolt (6, Fig. 9.8) with washer (7) and bushing (5) from the lower hinge.

FRAME

CENTER HINGE PINS

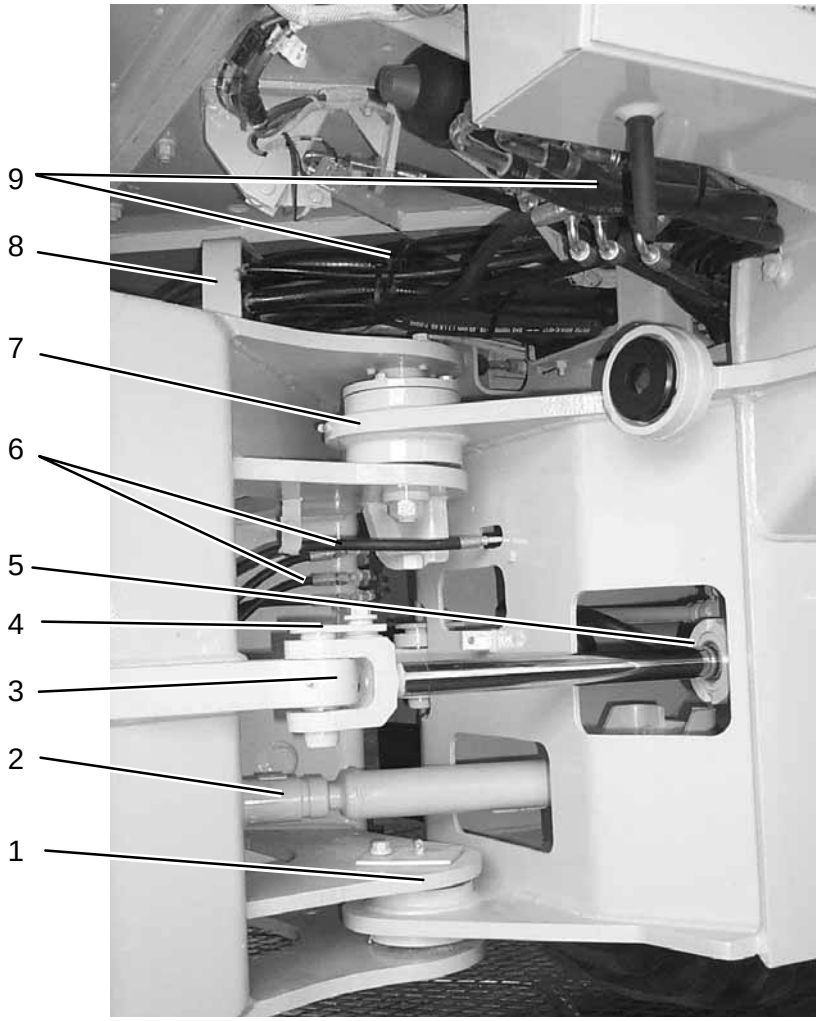


Fig. 9.6. Frame Disconnect Points
(R.H. side of the hinges area shown)

1. Lower Hinge
2. Transmission to Drive Shafts Support Drive Shaft
3. Rear Frame Bracket
4. Pin
5. Steering Cylinder
6. Hoses
7. Upper Hinge
8. Hoses and Harness Support Bracket
9. Hoses

515G (Fig. 9.7)

B. Rear Frame Bore Diameter (Upper)..... 69.85 ± 0.05 [mm]
C. Pin Bearing Diameter..... 49.93 – 0.05 [mm]
D. Rear Frame Bore Diameter (Lower) ..... 50.05 ± 0.05 [mm]
E. Front Frame Bearing Bore Diameter..... 104.93 ± 0.05 [mm]

CENTER HINGE PINS

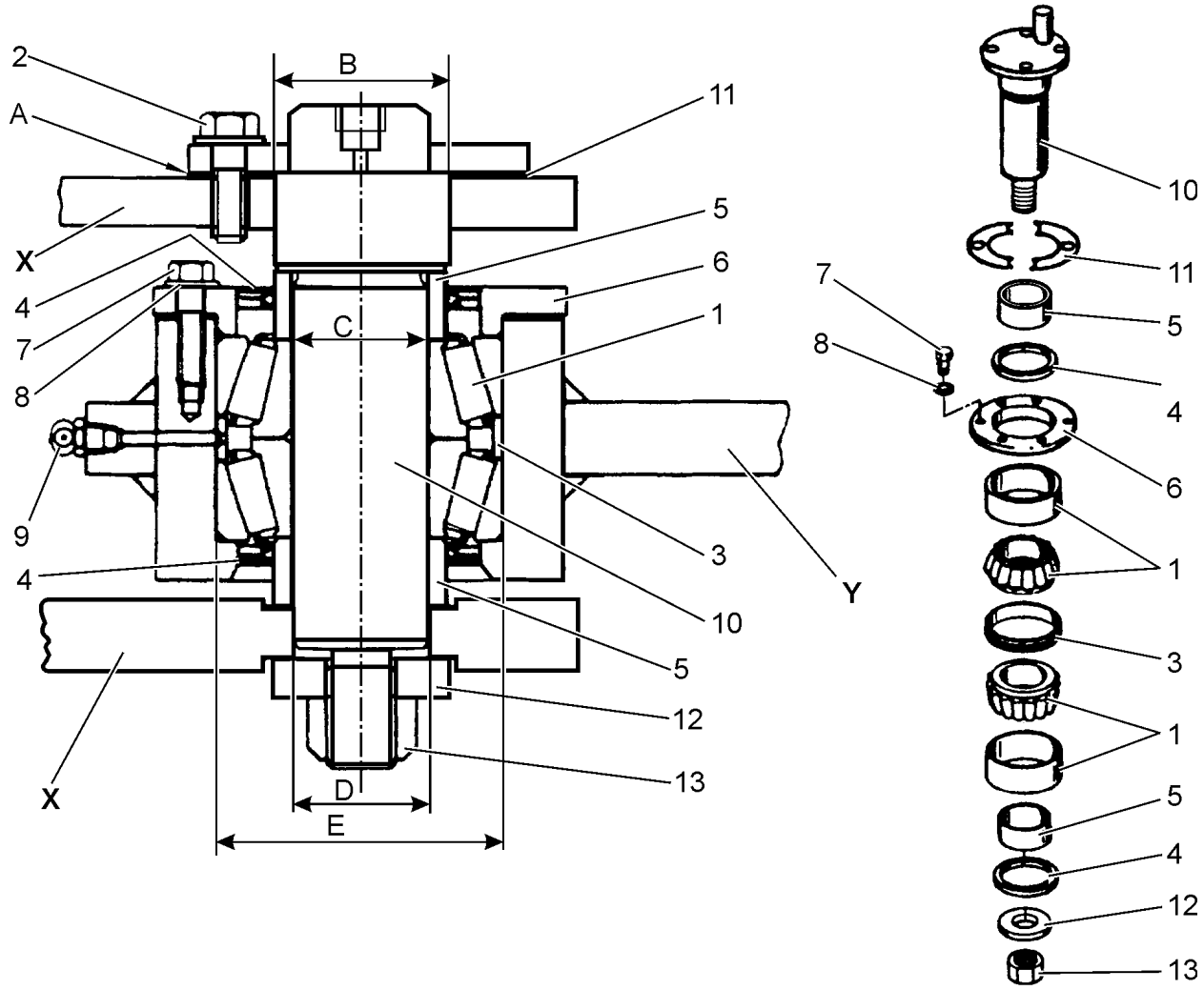


Fig. 9.7. Upper Hinge Assembly

1. Bearing
2. Bolt
3. Spacer Sleeve
4. Seal Ring
5. Bushing
6. Retainer Plate
7. Bolt
8. Hardened Washer
9. Lubrication Fitting
10. Hinge Pin Assy
11. Shim
12. Washer
13. Lock Nut

X. Rear Frame
Y. Front Frame
A. Gap

520G (Fig. 9.7)

B. Rear Frame Bore Diameter (Upper) ..... 80.50 ± 0.05 [mm]
C. Pin Bearing Diameter .....64.93 – 0.05 [mm]
D. Rear Frame Bore Diameter (Lower) ..... 65.08 ± 0.05 [mm]
E. Front Frame Bearing Bore Diameter ..... 119.93 ± 0.05 [mm]

CENTER HINGE PINS

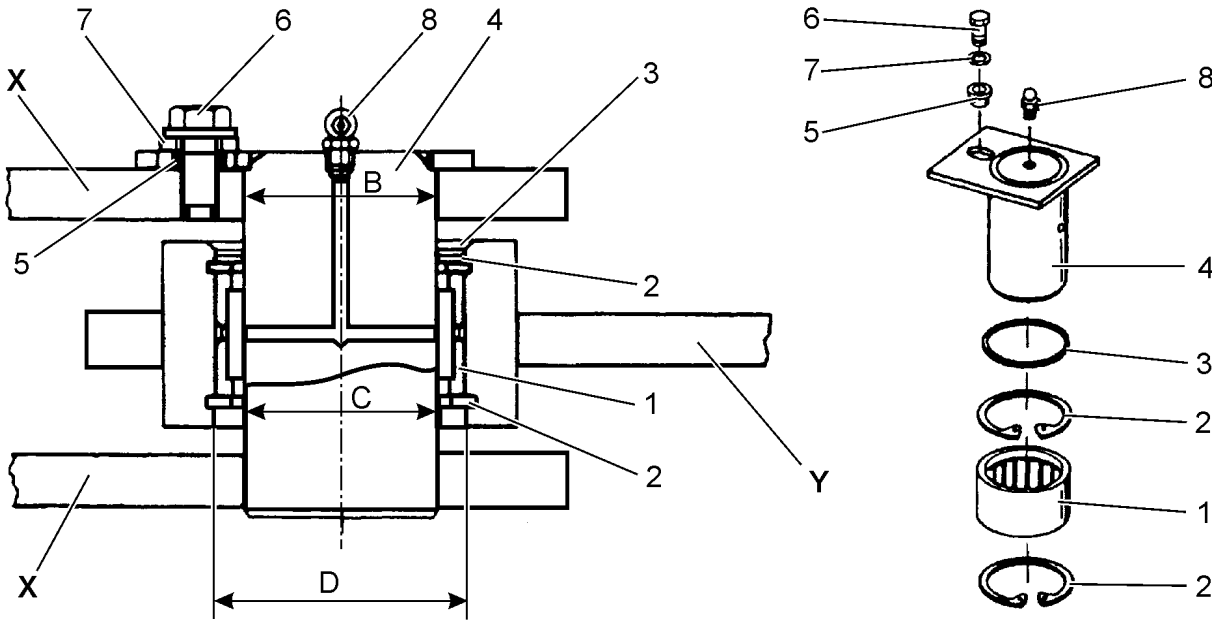


Fig. 9.8. Lower Hinge Assembly

1. Bearing
2. Retaining Ring
3. Washer
4. Hinge Pin Assy
5. Bushing
6. Bolt
7. Hardened Washer
8. Lubrication Fitting
X. Rear Frame
Y. Front Frame

B. Rear Frame Pin Bore Diameter..... 69,85 ± 0.05 [mm]
C. Pin Bearing Diameter..... 69,80 – 0.05 [mm]
D. Front Frame Bearing Bore Diameter..... 88,90 ± 0.05 [mm]

NOTE: *During the frames separating, observe the electrical harness, all hoses and cable for tension.*

14. Remove pin (10, Fig. 9.7) from upper and (4, Fig. 9.8) from lower hinge, using copper hammer 1.519.750. Separate the rear frame from the front frame.
15. Remove bolts (7, Fig. 9.7) with washers (8), tap out retainer plate (6).
16. Remove seal rings (4) and bushings (5).
17. Tap out tapered roller bearings (1), spacer sleeve (3), from the upper hinge, using copper hammer 1.519.0750 and mallet Fig. 9.1.
18. Remove washer (3, Fig. 9.8),) retaining rings (2) from lower hinge. Tap out needle roller (1), using copper hammer 1.519.0750 and mallet Fig. 9.2.

CENTER HINGE PINS

6. INSPECTION AND REPAIR

1. It is recommended that all new seal rings and bearings be installed when the frames are disassembled.
2. Wash all parts in a suitable solvent and air dry. Lubricate machined surfaces of usable parts to protect them.
3. Inspect the bushings for wear and replace if necessary.
4. Check all parts for scratches or grooves. Shallow scratches can be polished out with fine emery cloth and oil so a smooth surface is presented to the packing.
5. Inspect all seal ring grooves for scratches or other damage.
6. Inspect tapped holes for damaged threads.
7. Check diameter of bores in lower and upper hinge frames.
8. Check diameter of the lower hinge pin and upper hinge pin.

7. REASSEMBLY

1. Apply Litmos EP23 grease on bearing bore in upper and lower hinge. Fill the bearings with the same grease
2. Pack bearings (1, Fig. 9.7) and spacer sleeve (3) using copper hammer 1.519.0149 and mallet Fig. 9.1 and assemble the retainer plate (6) in the front frame.
3. Install new seal rings (4) and bushings (5) in the upper hinge
4. Tighten bolt (7) with washer (8) to torque of 46 [Nm] using Loctite 262 sealant
5. In the lower hinge, install bearing (1, Fig. 9.8) using copper hammer 1.519.0149 and mallet Fig. 9.2.
6. Install retaining rings (2) and new washer (3)
7. Join front and rear frames. Apply Litmos EP23 grease on pins (10, Fig. 9.7) tap it in upper hinge and (4, Fig. 9.8) and tap it in lower hinge using copper hammer 1.519.0149.
8. Install nut (13, Fig. 9.7) with washer (12) in upper hinge. Using a feeler gauge measure the gap at point “A“.
9. Loosen nut (13) and install shims (11) (as necessary to equal the measurement taken in Step 8. One shim is 0.4 [mm].
10. Install bolts (2) with washers, tighten to torque of 92 [Nm] using Loctite 262 sealant and nut (13) with washer (12) to torque of 475 [Nm] using Loctite 262 sealant.
11. In the lower hinge install bushing (5, Fig. 9.8), washer (7) and tighten bolt (6) to torque of 46 [Nm] using Loctite 262 sealant.
12. Remove trestle and slings of hoisting equipment from lifting eyes of front frame.
13. Reinstall the transmission to drive shafts support drive shaft (1, Fig. 9.5). Refer to Section 7D.
13. Reinstall steering cylinders. Refer to Section 10C.
14. Reinstall the cab. Refer to Section 13.
15. Connect all electric, hydraulic lines, hoses disconnected during disassembly and connect to the support bracket (8, Fig. 9.6). Refer to the related sections in the manual for special torques and adjustments.
16. Connect brake line, fill and vent the system. Refer to the OPERATOR’S MANUAL for this procedure.
17. If the accelerator pedal cable was disconnected during frame separation. Refer to Section12 for proper adjustment.

CENTER HINGE PINS

18. Remove rear frame from trestles using suitable hoisting equipment Fig. 9.4.
19. Refill the hydraulic reservoir as described in the OPERATOR'S MANUAL.
20. Lubricate the center hinge pins as described in the OPERATOR'S MANUAL.
21. Start the engine and build up pressure in the hydraulic system. Check the following: machine articulation, hydraulic leakage at the disconnected points performed for frame separation, proper hinge assembly installation (refer to INSPECTION AND REPAIR in this Section).

SECTION 10

HYDRAULICS

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SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS

1. Three Range Pressure Gauge 1212
2. Quick Disconnect 864-01-0059

GENERAL

2. DESCRIPTION AND OPERATION

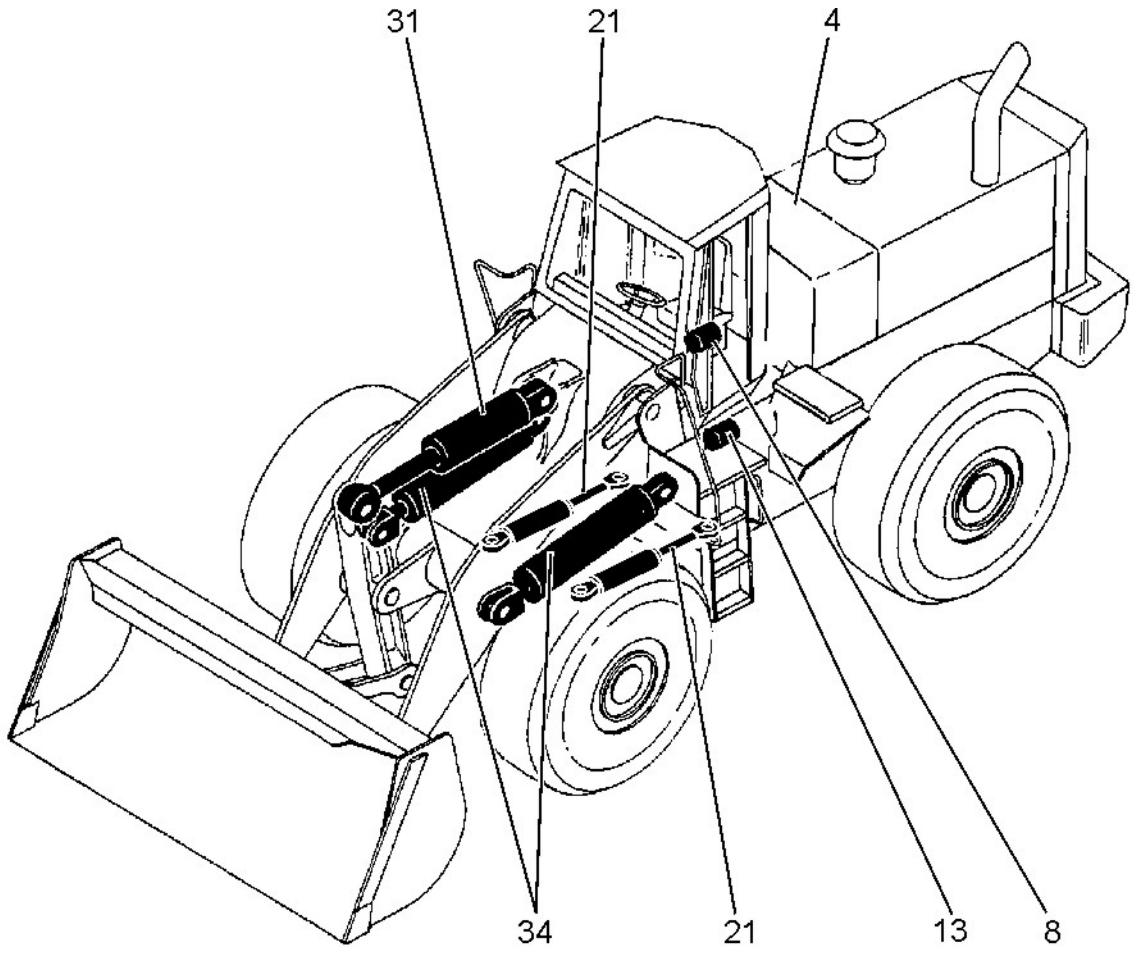


Fig. 10.1. Hydraulic Components

4. Hydraulic Reservoir
8. Hydraulic Pump
13. Ground Driven Steering Pump
21. Steering Cylinder
31. Bucket Cylinder
34. Boom Cylinders

HYDRAULICS

GENERAL

General (Fig. 10.2 and 10.3)
The hydraulic system generally consists of the steering and loader equipment components. The steering and loader equipment systems consist of the common components: hydraulic reservoir (4) with return filter (1), hydraulic pump (8), check valve (9), priority valve (14) and Oil cooler (44). The hydraulic reservoir (4), located behind of the cab is source of oil supply for the steering system and for the loader equipment system. This reservoir is pressurized type, which provides oil flow through a suction strainers (5) to the inlet port of the hydraulic pump (8) and ground driven steering system pump (13).

Following, is a general description of the loader equipment and steering system components. For a detailed description of each of these components, refer to the pertinent sub-section in this section.

Steering System – 520G (Fig. 10.3)
Generally, the steering system consists of the hydraulic reservoir (4) with return filter (1), the hydraulic pump (8) mounted on the torque converter, the check valve (9), the priority valve (14), steering control valve (17), two steering cylinders (21) and oil cooler (44).

The hydraulic oil from the reservoir (4) enters the hydraulic pump (8), from where it flows through check valve (9) and priority valve (14) to the steering control valve (17). Steering control valve (17) located under floorboard is attached to steering column. This valve is basically an orbital type pump, which creates pilot flow to left or to right steering cylinder (21), as the steering wheel is turned. The steering cylinders (21) are anchored on each side inside the front frame with the piston rods connected to the rear frame. When the steering wheel is turned, the steering control valve (17) directs pressurized oil to the both of steering cylinders (21). The displaced oil in each cylinder is forced through the oil cooler (44), return filter (1) and into the hydraulic reservoir (4) to begin the cycle again.

The hydraulic pump (4) provides oil flow through priority valve (14) not only to the steering control valve (17), but to the loader equipment control valve (24) also. The output from the pump supplies the steering control valve (17) first and then, the loader equipment control valve (24). This priority flow of oil is accomplished by the priority valve (14), which is located on the front frame.

When the steering wheel is turned oil is directed from the steering control valve (17) to the end of one steering cylinder (21) and to the opposite end of the other steering cylinder (21). This causes one cylinder to extend while the other retracts. Since the steering cylinders are mounted between the front and rear frames, this action causes the frames to pivot on the center hinge assembly, drawing the frames together on one side pushing them apart on the other. When a machine is moving through a turn, this opposing action of the steering cylinders causes the front and rear wheels to track each other.

Oil which is being displaced by the steering cylinders (21) is returned to the steering control valve (17). The return oil flows from the steering control valve to the oil cooler (44) and return filter (1) before entering the hydraulic reservoir (4). If the oil cooler (44) is clogged, an oil cooler check valve (45) will open and allow the excess flow to by-pass the cooler directly to the return filter (1). In this same manner, when return filter (1) is clogged, a return filter check valve (2) will open and allow the excess flow to by-pass the filter and return directly to the reservoir (4).

The steering system pressure is checked at the quick disconnect (7) mounted in the hydraulic pump (8) outlet port and limited to 16.5÷17.5 [MPa] by the system relief valve (15) located in the priority valve (14).

GENERAL

Ground Driven Steering System (Fig. 10.2 and 10.3)

Ground driven steering system is provided as an optional attachment. It allows the operator controlling the machine with engine failure or at other times when hydraulic pump is inoperative.

This auxiliary system consists of a common hydraulic reservoir (4), a ground driven steering pump (13) mounted on the front of the transmission, ground driven steering pump stopping and activate spools (11 and 12) mounted on the ground driven steering pump (13), and ground driven steering system warning light switch (10). The switch (10) electrically activates a warning light and a buzzer in the cab when the ground driven steering system is operative.

This auxiliary system is called a ground driven steering system because, in the event of a power failure while the machine is rolling, the rotation of the tires sends a driving force back through the wheels, axle shafts, differentials, and drive shafts to set the output shaft and the second and third gear clutch pack shaft in the transmission in motion.

With the ground driven steering pump (13) splined to the clutch pack shaft, enough rotation is produced for the pump to deliver a small quantity of oil for limited steering.

GROUND DRIVEN STEERING OFF

When the ground driven steering system is not operable, oil flows through the steering system in the same way as described under “Steering System”. The check valve (9) allows free flow from the hydraulic pump (8) into the steering control valve (17). The switch (10) is off now.

At the same time, pressurized oil flows through check valve (9) to two hoses connected to the both sides of the ground driven steering stopping spool (11). Stopping spool (11) is mounted on the front side of the ground driven steering pump (13). The pressure moves stopping spool (11) against the spring to allow oil to flow from output to input side of the ground driven steering pump (13) and from reservoir (4) to input side of the ground driven steering pump (13).

GROUND DRIVEN STEERING ON

When for any reason, the hydraulic pump (8) fails to produce enough oil flow for the steering system, the pressures in the hoses connected to the both sides of the ground driven steering stopping spool (11) will drop. This lack of pressure allows a spring to shift the stopping spool (11) and oil can not flow through stopping spool (11). Now oil flows from the hydraulic reservoir (4) to activate spool (12), corresponding to the inlet side of the ground driven steering pump (13). Oil flows from the pump (13) through the one of check valve of ground driven steering assy and priority valve (14) to steering control valve (17). At the steering control valve (17), the oil is available to be directed to the one of steering cylinders (21). The volume of oil produced by the ground driven steering pump is sufficient for limited steering of the machine in the event of power failure. The switch (10) is in position ON.

Description to Fig. 10.2:

1. Return Filter
4. Hydraulic Reservoir
5. Suction Strainers
6. Pilot Block
7. Hydraulic and Pilot Pressure Quickcoupling
8. Hydraulic Pump
9. Check Valve
10. *Ground Driven Steering System Warning Light Switch
11. *Ground Driven Steering Pump Stopping Spool (normal steering)
12. *Ground Driven Steering Pump Activate Spool (emergency steering)
13. Ground Driven Steering Pump
14. Priority Valve
17. Steering Control Valve
21. Steering Cylinders
24. Equipment Control Valve
28. Attachment and Quickcoupling Cylinders
31. Bucket Cylinder
34. Boom Cylinders
37. Boom Emergency Lowering Valve
38. Throttle and Check Valves
39. Boom and Bucket Pilot Valve
40. Attachment and Quickcoupling Pilot Valve
41. Hydraulic Accumulator
44. Oil Cooler
46. Ride Control Block
45. Block with Hydraulic Accumulators

* - if equipped

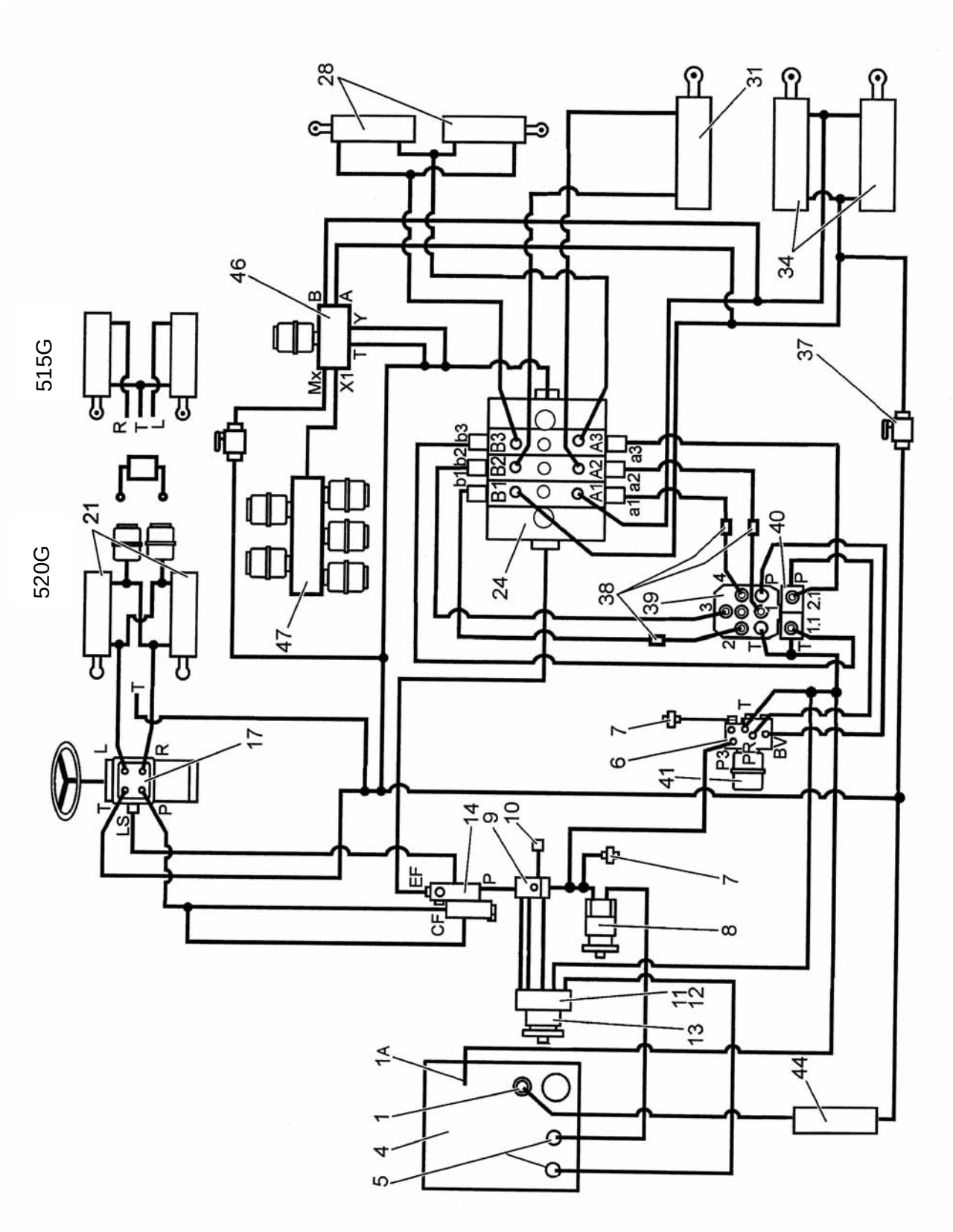


Fig. 10.2. Hydraulic System Schematic with RSM (3-spool Control Valve)

GENERAL

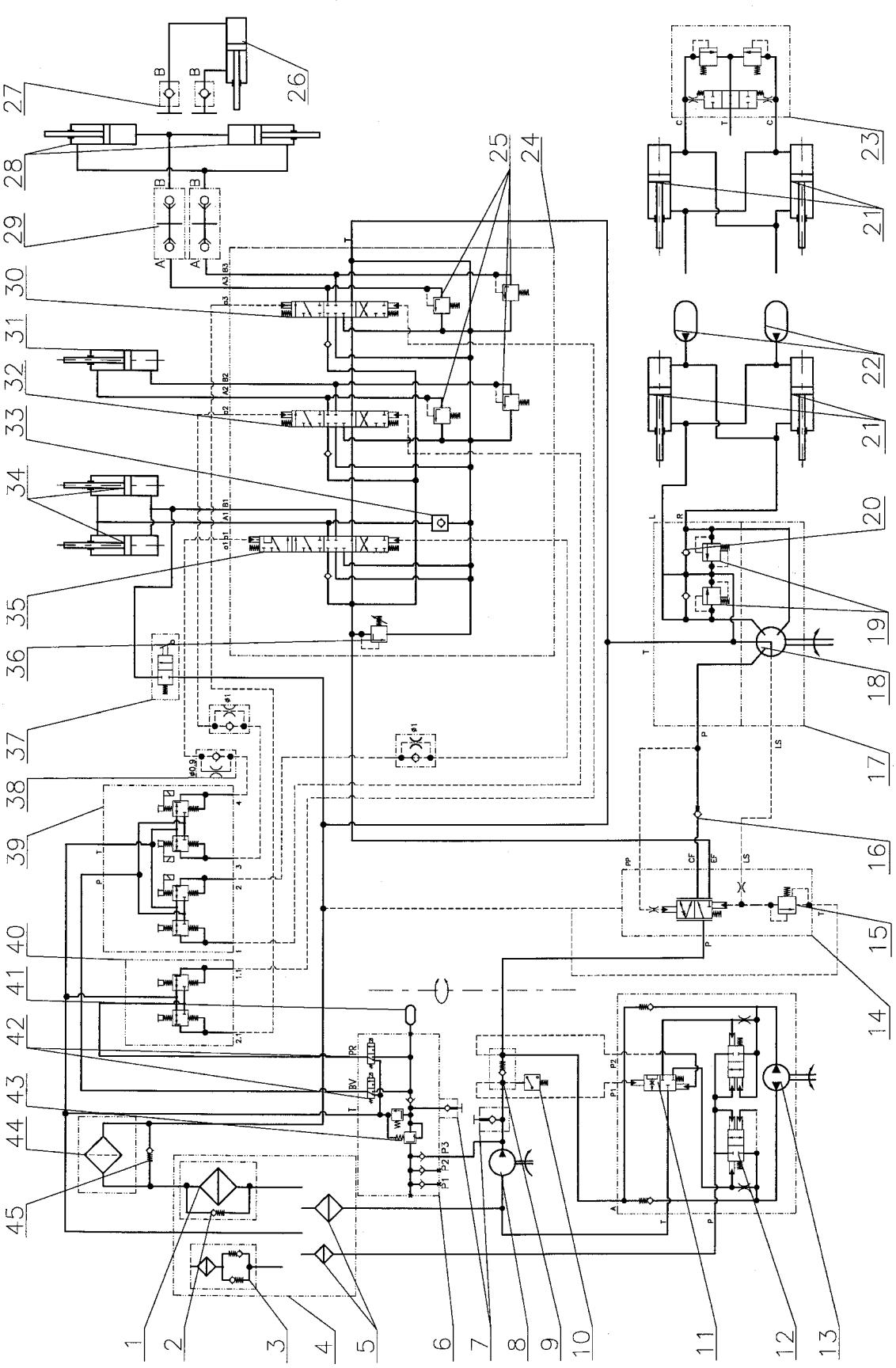


Fig. 10.3. Hydraulic System Diagram for Machine 520G (3-spool Control Valve)

GENERAL

Description to Fig. 10.3:

1. Return Filter
2. Return Filter Check Valve
3. Reservoir Breather with Filter
4. Hydraulic Reservoir
5. Suction Strainers
6. Pilot Block
7. Hydraulic and Pilot Pressure Quickcoupling
8. Hydraulic Pump
9. Check Valve
10. Ground Driven Steering System Warning Light Switch
11. Ground Driven Steering Pump Stopping Spool (normal steering)
12. Ground Driven Steering Pump Activate Spool (emergency steering)
13. Ground Driven Steering Pump
14. Priority Valve
15. Steering Relief Valve (16.5÷17.5 [MPa])
16. Check Valve
17. Steering Control Valve
18. Gerotor Pump
19. Circuit Shock Valves (20 [MPa])
20. Circuit Anticavitation Valves
21. Steering Cylinders
22. Hydraulic Accumulators*
23. Cushion Valve*
24. Equipmennt Control Valve
25. Bucket Cylinder, Quickcoupling and Attachment Shock Valves (24 [MPa])
26. Attachment Cylinder
27. Quick Disconnect Couplers (male connector, type B)
28. Quickcoupling Cylinders
29. Quick Disconnect Couplers (female connector, type A, male connector, type B)
30. Attachment and Quickcoupling Cylinders Spool
31. Bucket Cylinder
32. Bucket Cylinder Spool
33. Anticavitation Valve
34. Boom Cylinders
35. Boom Cylinders Spool
36. Hydraulic Relief Valve (19.5÷21.5 [MPa])
37. Boom Emergency Lowering Valve
38. Throttle and Check Valves (3 pcs)
39. Boom and Bucket Pilot Valve
40. Attachment and Quickcoupling Pilot Valve
41. Hydraulic Accumulator
42. Pilot Valves Lock Solenoid Valves
43. Pilot Pressure Regulator (3÷3.2 [MPa])
44. Oil Cooler
45. Check Valve (0.15 [MPa])

* - alternative

Loader Equipment System

520G (Fig. 10.3)

Loader equipment system includes loader equipment and pilot circuits. Generally, the hydraulic portion of the loader equipment system consists of the hydraulic reservoir (4) with return filter (1), the hydraulic pump (8) mounted on the torque converter, the check valve (9), the priority valve (14), control valve (24) two boom cylinders (34), bucket cylinder (31), attachment cylinder (26) (if equipped) and oil cooler (44). The pilot circuit consists of the hydraulic reservoir (4) with return filter (1), the hydraulic pump (8) mounted on the torque converter, pilot block (6), hydraulic accumulator (41), boom and bucket pilot control valve (39) and attachment and quickcoupling pilot valve (40).

Pilot block (6) is located on the right side of cab and mounted under the operator's cab platform. This valve is used to supply the boom and bucket pilot valve (39) and also attachment and quickcoupling pilot valve (40) (if equipped), which in turns controls the boom cylinders spool (35), bucket cylinder spool (32) and attachment and quickcoupling cylinder spool (30) (if equipped).

The boom and bucket pilot control valve (39), which is connected mechanically to the boom and bucket control lever in the cab, hydraulically controls the movement of the spools in the control valve (24). The boom and bucket pilot control valve (39) directs the oil to control valve (24) directly or by throttle and check valves (38) used to ensure smooth movement of the hydraulic cylinders.

The spools in the control valve (24) direct the oil entering control valve (24) port to extend or retract the boom cylinders (34) or the bucket cylinder (31). The boom and bucket control lever has four positions for boom operation: raise, hold, lower, float and three positions for bucket operation: roll back, hold and dump.

GENERAL

Pilot pressure regulator (43) is located in pilot block (6). This valve controls oil pressure in the pilot circuit, which is used to operate the equipment control valve (24) functions.

Pilot valves lock solenoid valves (42) are used to lock the pilot valves (39 and 40) in neutral position.

Boom emergency lowering valve (37) located inside R.H. side of front frame is for hand controlling of lowering boom cylinders when the engine is off or hydraulic system is not functioning properly.

Bucket cylinder, quickcoupling and attachment shock valves (25) protects the bucket and attachment cylinders from outside forces when the control valve (24) is in neutral position.

The boom and bucket cylinders are double acting in that oil is directed into the cylinder end or the rod end to move the piston rod in the direction desired. The displaced oil on the opposite side of the piston is directed back into the return circuit and to the hydraulic reservoir (4). Boom cylinders (34) are mounted on each side of the front frame with the piston rods connected to the loader boom assembly. Bucket cylinder (31) is pivoted from the front upper portion of the front frame, with the piston rod connected to the linkage, which controls the bucket position.

The boom has an electrically operated boom kick-out control system which stops the boom's rise at any preset height automatically. The bucket has an electrically operated bucket leveling system, which stops the bucket at a preset loading angle automatically.

Pressure in the loader equipment system is checked at quick disconnect (7) mounted in the hydraulic pump (8) outlet port. The loader equipment system pressure is limited to 19.5÷21.5 [MPa] by the relief valve (36) located in the equipment control valve (24).

Pressure in the pilot circuit is checked at quick disconnect (7) mounted in the pilot block (6).

The pilot system pressure is limited to 3÷3.2 [MPa] by the pilot pressure regulator (43) located in the pilot block (6).

Steering and loader equipment systems share common oil cooler (44). The oil cooler is integrated with the loader radiator.

515G (Fig. 10.4)

The 515G machine has the same hydraulic system as the 520G with the following exceptions described below:

PILOT SYSTEM: throttle valves (34) openings have different diameters.

STEERING SYSTEM: check valve (16, Fig. 10.3) has been incorporated into the steering control valve (13, Fig. 10.4) and has not been placed between the priority valve (10) and steering control valve (13).

The relief valve (15, Fig. 10.3) has been incorporated into the steering control valve (13, Fig. 10.4) and has not been incorporated into the priority valve (10).

The steering control valve (13) is equipped with double metering pump (14 and15).

The steering cylinders (19) have different connection. It means that in turn only one steering cylinder is fed from the cylinder overside.

The steering cylinders (19) have not been provided with hydraulic accumulators (22, Fig. 10.3) or with cushion valves (23).

Machine 515G is not equipped with ground driven steering system:

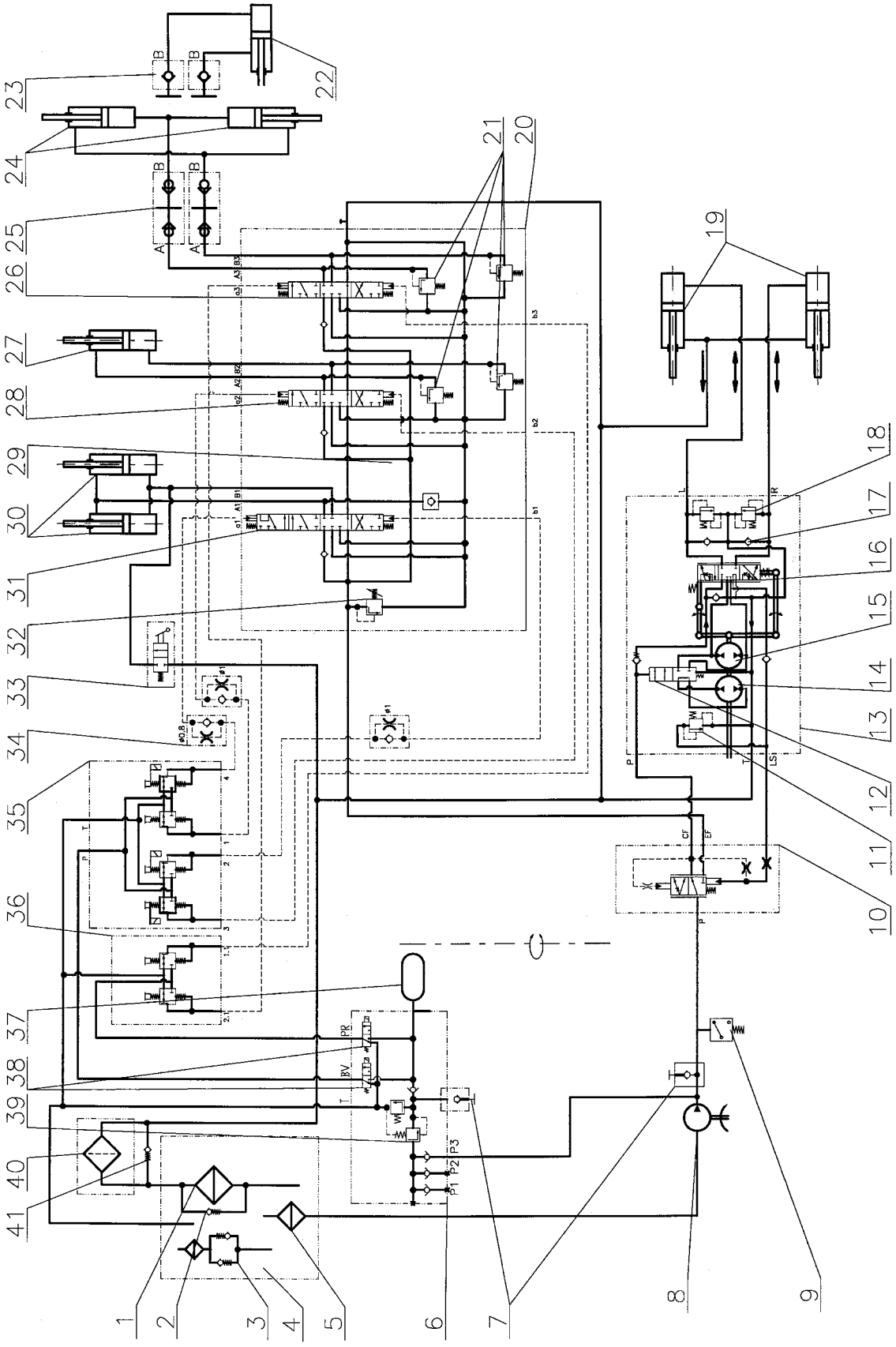


Fig. 10.4. Hydraulic System Diagram for Machine 515G (3-spool Control Valve)

GENERAL

Description to Fig. 10.4:

1. Return Filter
2. Return Filter Check Valve
3. Reservoir Breather with Filter
4. Hydraulic Reservoir
5. Suction Strainers
6. Pilot Block
7. Hydraulic and Pilot Pressure Quickcoupling
8. Hydraulic Pump
9. Steering System No Operating Warning Light Switch
10. Priority Valve
11. Steering Relief Valve (19.5÷21.5 [MPa])
12. Main Metering Pump Stopping Spool
13. Steering Control Valve
14. Main Metering Pump
15. Auxiliary Metering Pump
16. Steering Control Valve Spool and Sleeve
17. Circuit Anticavitation Valve
18. Circuit Shock Valve (24 [MPa])
19. Steering Cylinders
20. Equipment Control Valve
21. Bucket Cylinder, Quickcoupling and Attachment Shock Valves (24 [MPa])
22. Attachment Cylinder
23. Quick Disconnect Coupler (male connector, type B)
24. Quickcoupling Cylinders
25. Quick Disconnect Coupler (female connector, type A, male connector, type B)
26. Attachment and Quickcoupling Cylinders Spool
27. Bucket Cylinder
28. Bucket Cylinder Spool
29. Anticavitation Valve
30. Boom Cylinders
31. Boom Cylinders Spool
32. Hydraulic Relief Valve (19.5÷21.5 [MPa])
33. Boom Emergency Lowering Valve
34. Throttle and Check Valves
35. Boom and Bucket Pilot Valve
36. Attachment and Quickcoupling Pilot Valve
37. Hydraulic Accumulator
38. Pilot Valves Lock Solenoid Valves
39. Pilot Pressure Regulator (3÷3.2 [MPa])
40. Oil Cooler
41. Check Valve (0.15 [MPa])

3. SPECIFICATION

Operating Pressures

Machine Model	**515G**	**520G**
Steering system pressure [MPa]	19.5÷21.5	16.5÷17.5
Loader equipment system pressure [MPa]	19.5÷21.5	19.5÷21.5
Pilot Pressure [MPa]	3.0÷3.2	3.0÷3.2

Operating Time – At full throttle with bucket empty

Machine Model	**515G**	**520G**
Boom raise [s]	5.5	5.9
Boom lower [s]	3.5	3.7
Bucket closing (roll back) [s]	1.5	1.5
Bucket opening (dump) [s]	1.4	1.4

4. SERVICE DIAGNOSIS

The first step to proper service diagnosis is to verify the operator's complaint. If possible, the machine should be operated by service person to determine if the problem is a system or a circuit problem.

By performing the "LOADER EQUIPMENT SYSTEM PERFORMANCE TEST" and the "STEERING SYSTEM PERFORMANCE TEST" in this section, a component be eliminated as a cause of the problem being encountered.

NOTE: *Before performing any tests, check all hydraulic connections and lines for external leakage or damage. Also check the hydraulic reservoir oil level and the type of oil being used. Refer to the OPERATOR'S MANUAL for the correct specifications.*

Hydraulic System

NOTE: *The following service diagnosis is common for loader equipment and steering systems.*

COMPLAINT	
PROBABLE CAUSE	**REMARKS**
Noisy Operation	
1. Oil level too low	1. Fill hydraulic reservoir to appropriate level. Refer to the OPERATOR'S MANUAL.
2. Oil grade wrong.	2. Replace the oil for correct oil grade. Refer to the OPERATOR'S MANUAL.
3. Hydraulic reservoir breather clogged.	3. Clean or replace.
4. Partially restricted pump inlet.	4. Check reservoir strainer for restriction.
Hydraulic Oil Foamy	
1. Oil grade wrong.	1. Replace the oil for correct oil grade. Refer to the OPERATOR'S MANUAL.
2. Oil level too low	2. Fill hydraulic reservoir to appropriate level. Refer to the OPERATOR'S MANUAL.
3. Air in circuit	3. Check connections. Remove leakages.
Slow Motion In Hydraulic (Steering and Loader Equipment) System	
1. Oil level low.	1. Fill hydraulic reservoir to appropriate level. Refer to OPERATOR'S MANUAL.
2. Restricted hydraulic pump suction strainer.	2. Clean the suction strainer.
3. Steering and loader equipment system pump malfunction.	3. Repair or replace the pump. Refer to Section 10A.

GENERAL

Steering System

COMPLAINT	
PROBABLE CAUSE	**REMARKS**
Steering inoperative while roading and parking (oil pressure low)	
1. Oil level too low – equipment system inoperative too.	1. Fill hydraulic reservoir to appropriate level. Refer to the OPERATOR'S MANUAL.
2. Relief valve damaged or spoiled.	2. Repair or clean relief valve Refer to STEERING CONTROL VALVE in Section 10B
Steering inoperative or weak while parking (oil pressure low)	
1. Steering and loader equipment system pump damaged – equipment system inoperative too.	1. Repair or replace pump.
2. Steering cylinder leaking.	2. Repair or replace steering cylinder.
Steering obstructed – loader manoeuverability unaffected (oil pressure O.K.)	
1. Steering control valve components friction high.	1. Replace worn components.
2. Steering control valve bearings failed.	2. Replace bearings.
Steering wheel will not return to neutral position, tendency to "motoring"	
1. Steering control valve springs broken.	1. Replace springs.
2. Steering control valve spool and sleeve seized.	2. Clean spool and sleeve or replace with new ones.
No end stop in both directions (oil pressure low)	
1. Relief valve problem.	1. Repair or replace relief valve. Refer to STEERING CONTROL VALVE in Section 10B
2. Steering cylinder damaged.	2. Repair or replace steering cylinder. Refer to Section 10C
3. Steering control valve gerotor gears worn.	3. Replace gerotor gears set.
4. Steering control valve leaks heavy.	4. Replace steering control valve.
No end stop in one direction (oil pressure low in this direction)	
1. Shock & anti-cavitation valve failed.	1. Clean or replace valve. Refer to STEERING CONTROL VALVE in Section 10B
Steering wheel jerky	
1. See **No end stop in both directions.**	
2. Steering control valve cardan shaft and gerotor gears set installed wrongly.	2. Control valve to be installed correctly.
3. Steering control valve springs too weak or broken.	3. Replace springs.
Steering Wheel Excessive Free Movement (in neutral position)	
1. Steering control valve cardan shaft fork worn.	1. Replace shaft.
2. Steering control valve springs broken or fatigued.	2. Replace springs.
3. Steering control valve cardan shaft or sleeve splines worn.	3. Replace worn parts.

HYDRAULICS

GENERAL

Loader Equipment System

COMPLAINT	
PROBABLE CAUSE	**REMARKS**
No loader equipment motions	
1. Pilot valve lock solenoid valve system faulty.	1. Check the voltage at solenoid.
2. Pilot block faulty.	2. Refer to ”PILOT BLOCK” in Section10B.
3. Hydraulic pump malfunction.	3. Refer to ” STEERING AND EQUIPMENT PUMP” in Section 10A.
No response or slow one motion	
1. Pilot control valve section problem.	1. Refer to ”PILOT CONTROL VALVE” in Section 10B.
2. Equipment control valve spool binding.	2. Clean all foreign material until spool moves freely. Refer to ”EQUIPMENT CONTROL VALVE” in Section 10B.
Weak loader equipment system (low oil pressure)	
1. Control valve relief valve malfunction – steering oil pressure is O.K.	1. Refer to ”LOADER EQUIPMENT SYSTEM PRESSURE CHECK” in this Section.
2. Hydraulic pump malfunction – low steering oil pressure.	2. Repair or replace the pump. Refer to “STEERING AND EQUIPMENT PUMP” in Section 10A.
Bucket cylinder drifts	
1. Bucket shock valve malfunction.	1. Refer to ”CONTROL VALVE” in Section 10B.
2. Bucket cylinder leakage.	2. Refer to ”BUCKET CYLINDER LEAKAGE TEST” in Section 10C.
3. Control valve bucket section leakage.	3. Overhaul control valve. Refer to “CONTROL VALVE” in Section 10B.
Boom cylinders drifts	
1. One of boom cylinder leakage.	1. Refer to ”BOOM CYLINDER LEAKAGE TEST” in Section 10C.
2. Control valve boom section leakage.	2. Overhaul control valve. Refer to “CONTROL VALVE” in Section 10B.
Pilot control valve lever(s) doesn’t hold in the neutral position	
1. Pilot control valve malfunction.	1. Refer to ”PILOT CONTROL VALVE” in Section 10B.

Additional Service Diagnosis for Loader Equipped with Ground Driven Steering System

Ground driven steering system warning light glows with engine operative	
1. Electrical problem- steering system correct.	1. Check switch and electrical wire for short circuit.
2. Broken hydraulic pump (steering and equipment system no operative)	2. Repair or replace pump.

GENERAL

COMPLAINT	
PROBABLE CAUSE	**REMARKS**
Ground driven steering system warning light fails to glow with the system operative (while roading with engine shut down)	
1. Warning light bulb failed.	1. Replace bulb.
2. Ground driven system switch or wiring connectors open circuit.	2. Restore circuitry integrity or replace switch.
Ground driven steering system fails to operate with engine shut down	
1. Ground driven steering valve on the ground driven pump failed.	1. Repair or replace valve (check valve spool, check valves and seals for operation).
2. Broken ground driven steering pump.	2. Repair or replace pump.

TESTS AND CHECKS

5. GROUND DRIVEN STEERING SYSTEM PERFORMANCE TEST (if equipped)



WARNING! Be sure the area in front and behind the machine is clear of personnel and obstructions. DO NOT allow anyone near the tires or on the access ladders during the test.

1. Operate the machine to warm up the hydraulic oil.
2. Position the bucket slightly off the ground, lock pilot equipment system and shift the transmission into forward.
3. Release the parking brake and accelerate the engine.
4. With the machine moving between 8÷16 [km/h] turn the engine off. Check the ground driven steering warning light to make sure it lights up and the warning alarm sound is less than two seconds.
5. When the warning light is “ON”, turn the steering wheel in both directions. Be certain the machine has steering response in both directions.
6. Stop the machine, apply the parking brake and shift the transmission to neutral. Position the machine in the straight ahead position, lower the bucket to the ground and stop the engine.
7. If the machine performs as previously described, the ground driven steering system is working properly.
8. If the test results indicate a system deficiency determine and correct the cause.

6. STEERING SYSTEM PERFORMANCE TEST



WARNING! Be sure the area in front and behind the machine is clear of personnel and obstructions. DO NOT allow anyone near the tires or on the access ladders during this test.

NOTE: *Performing test will require two people, one person to operate the machine, the second person to time the machine’s performance.*

1. Check the steering stop pads. Be sure the steering wheel stops turning left or right before the frame halves hit the stop pads. The clearance between stop pads should be 15÷25 [mm].
2. Operate the machine to warm up the hydraulic oil.

TESTS AND CHECKS

3. Raise the bucket slightly off the ground and turn the steering wheel to the left until the machine stops articulating.
4. Accelerate the engine to full throttle. The test will consist of three full articulations. The observer should record the time it takes to articulate the machine from left to right, back to left and back to right again.
5. Decelerate to low idle and position the machine in the straight ahead position. Lower the bucket to the ground and stop the engine.
6. To arrive at the steering response time, divide the results obtained in Step four by three.
7. The steering response time should be a maximum of 3.2 ÷3.6 [s]. If the machine articulates to this specification, it is loader equipment properly.
8. If the test results indicate that the response time is longer than the specification, refer to SERVICE DIAGNOSIS, **Slow motion in hydraulic (steering and loader equipment) systems** in this Section.

7. LOADER EQUIPMENT SYSTEM PERFORMANCE TEST



WARNING! Be sure the area in front and behind the machine is clear of personnel and obstructions. DO NOT allow anyone near the tires or on the access ladders during this test.

NOTE: *Performing test will require two people, one person to operate the machine, the second person to time the machine's performance.*

1. Operate the machine to warm up the hydraulic oil.
2. With the bucket empty, slowly depress the accelerator until the engine reaches full throttle. Raise the boom from the ground to its full height and record the time. Lower the boom to the ground and record the time. Decelerate the engine to low idle.
3. Raise the bucket off the ground and place the bucket in the "DUMP" position. Slowly depress the accelerator until the engine reaches full throttle. Shift the bucket control lever to the "ROLLBACK" position and roll back the bucket. Record the time it takes for the bucket to roll back. Now shift the bucket control lever to the "DUMP" position and dump the bucket. Record the time. Slowly decelerate the engine until it is operating a low idle. Position the bucket so it is parallel to the ground and lower the bucket to the ground.
4. The test results should be as follows:
5. If the recorded data corresponds with the preceding specifications, the hydraulic pump on the machine is functioning properly.
6. If the test results do not correspond to these specifications, follow the instruction in Steps 7 or 8.
7. If both the boom and bucket circuits are slow:
   a. The steering and loader equipment system pump may be malfunctioning or inefficient. This can be verified following the "STEERING SYSTEM PERFORMANCE TEST" in this Section.
   b. The system relief valve in the control valve is malfunctioning. Refer to the "LOADER EQUIPMENT SYSTEM PRESSURE CHECK" in this Section.
8. If only one circuit is slow and this circuit cylinder drifts, it is probably due to leakage in the cylinder. The first refer to the appropriate cylinder "LEAKAGE TEST" in Section 10C, due to the leakage in shock valve or in the control valve spool.
9. Check operation and if needed adjust automatic boom kick-out. Refer to the "OPERATOR'S MANUAL" for this procedure.
10. Check operation and if needed adjust automatic bucket leveler. Refer to the "OPERATOR'S MANUAL" for this procedure.

TESTS AND CHECKS

8. STEERING SYSTEM PRESSURE TEST

WARNING! Be sure the area in front and behind the machine is clear of personnel and obstructions. DO NOT allow anyone near the tires or on the access ladders during this test.

1. Operate the machine to warm up the hydraulic oil.
2. Connect the pressure gauge OEM 1212 to the hydraulic system pressure check point (3, Fig. 10.5). The gauge hose should be long enough to allow the gauge to reach into the cab Pressure gauge connection point (quick disconnect) is at the hydraulic pomp oil outlet port.
3. Start the engine and operate at high idle. Turn the steering wheel into a full left turn position. Record the reading on the gauge. Turn the steering wheel into a full right turn position. Record the reading on the gauge. Return the steering wheel to the straight ahead position. Stop the engine.
4. The steering system relief valve should open in both directions at 19.5÷21.5 [MPa] for 515G. For 520G it should open at 16.5÷17.5 [MPa]. If the results meet this specification, the steering system functioning properly.
5. If the test results do not meet the specification:
   - Steering both directions: refer to SYSTEM DIAGNOSIS in this Section.
   - Steering one direction only: a circuit shock and anti-cavitation valve malfunctions and calls for repair or replacement. Refer to STEERING CONTROL VALVE in Section 10B.
6. If the system does not perform well, refer to STEERING SYSTEM PERFORMANCE TEST and SYSTEM DIAGNOSIS in this Section.
7. Disconnect the pressure gauge from the hydraulic pressure check point and install the cap on quick disconnect.

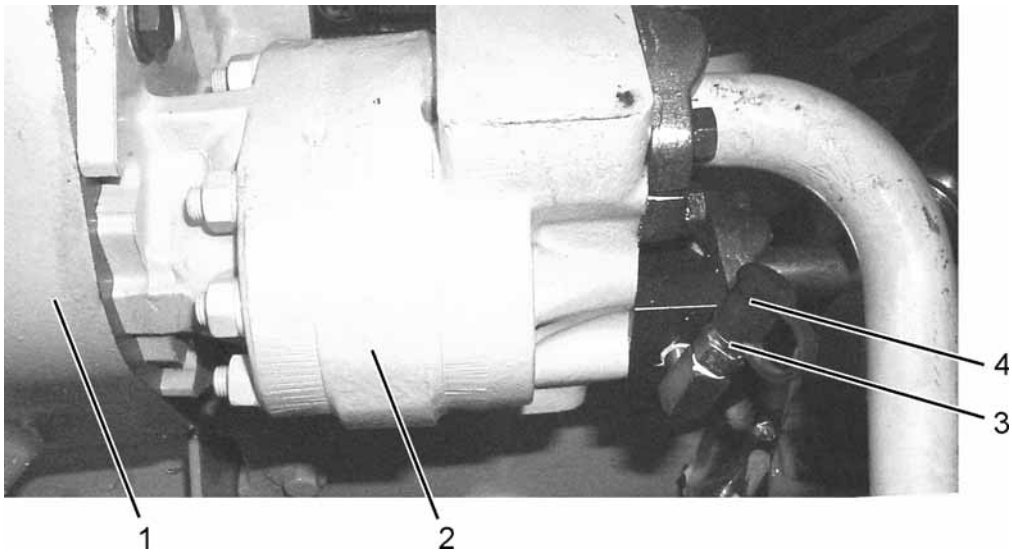


Fig. 10.5. Hydraulic System (R.H. Side View)

1. Gear Box
2. Hydraulic Pump
3. Hydraulic System Pressure Check Point
4. Cap

HYDRAULICS

TESTS AND CHECKS

9. LOADER EQUIPMENT SYSTEM PRESSURE TEST



WARNING! Be sure the area in front and behind the machine is clear of personnel and obstructions. DO NOT allow anyone near the tires or on the access ladders during this test.

NOTE: *Before proceeding with checking the hydraulic systems pressures relieve the remaining pressures. Particular attention should be given to the hydraulic accumulator pressure relieve. To relieve hydraulic systems pressures cycle the pilot control valve lever several times.*

NOTE: *Performing test will require two people, one person to operate the machine, the second person to time the machine's performance.*

1. Operate the machine to warm up the hydraulic oil.
2. Connect the pressure gauge OEM 1212 to the hydraulic system pressure check point (3, Fig. 10.5). Pressure gauge connection point (quick disconnect) is at the hydraulic pomp oil outlet port.
3. Accelerate the engine to full throttle and rise the boom to its maximum height. While having the boom pilot control lever in the boom raise position, take a pressure gauge reading for relief valve crack open pressure. Lower the bucket until it take a position about 1 [m] over the ground, and have the bucket pilot control lever in the bucket roll back position. Notice the gauge reading.
4. The control valve relief valve should have its crack open pressure for both boom and bucket hydraulic cylinders at their extreme positions ranging from 19.5 to 21.5 [MPa].
5. If any pressures gauge reading fails to meet the criteria from item 4 above, it means:
   - If both boom and bucket pressures feature lower reading at the engine at full throttle, and steering oil pressure is O.K., the loader equipment system control valve relief valve needs checking. To do this, refer to CONTROL VALVE in Section 10B.
   - The steering and loader equipment system pump is worn when low oil pressure exists for both hydraulic circuits only at engine low idle.
   - If pressures gauge reading of either boom raise or bucket rolling is lower than above, the loader equipment system circuit needs checking as per what was given for SYSTEM DIAGNOSIS in this Section
6. Disconnect the pressure gauge from the hydraulic pressure check point and install the cap on quick disconnect.

10. SUCTION LINE LEAKAGE TEST

1. Apply shaving cream to all the suction lines.
2. Start the engine and operate the hydraulic system. Observe the shaving cream.
3. If leak is present, a crater will form in the shaving cream at the location of the leak.

SECTION 10A

PUMPS

PUMPS

SECTION 10A

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SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS

Description.....**P/N of instrument/tool**

1. Socket set (3/8” drive) .....
2. Socket set (1/2” drive) .....
3. Torque wrench (3/8” drive) .....6÷30 [Nm]
4. Torque wrench (1/2” drive) .....50÷300 [Nm]
5. Tongs RSKm-200
6. Plastic hammer.....

GENERAL

2. DESCRIPTION AND OPERATIONS

The hydraulics system consists of the drive train pump, steering and loader equipment pump and ground driven steering pump (if equipped). The drive train pump is mounted to the front LH side of the torque converter and steering and loader equipment pump is mounted to the front RH side of the torque converter. The ground driven steering pump is mounted to the front transmission, above the output shaft.

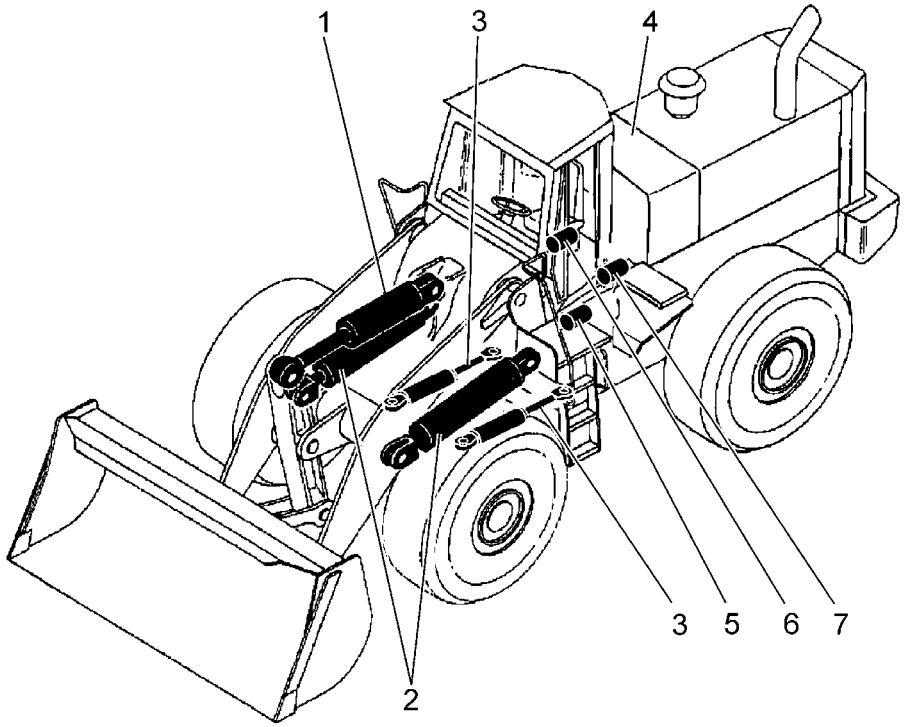


Fig. 10A.1. The Pump Location

1. Bucket Cylinder
2. Boom Cylinders
3. Steering Cylinders
4. Hydraulic Reservoir
5. Ground Driven Steering Pump
6. Steering and Loader Equipment Pump
7. Drive Train Pump

PUMPS

DRIVE TRAIN PUMP

3. DESCRIPTION AND OPERATIONS.

The drive train pump (7, Fig. 10A.1) is a single element gear type pump, mounted to the front left side of the torque converter. It's delivered together with transmission. The pump is used to supply pressurized oil to control the transmission hydraulic system and to lubricate transmission components. The upper driven gear inside the torque converter drives the drive train pump through a spline connection. The pump operates continually when the engine is running.

4. SPECIFICATIONS

Type ..... positive displacement, single element, gear

Rated capacity at 2500 engine [RPM] ..... 94.5 [l/min]
Main pressure .....2.05 ÷ 2.35 [MPa]

Special Torques
Pump housing mounting bolts ..... 160 [Nm]

5. SERVICE DIAGNOSIS

COMPLAINT	
PROBABLE CAUSE	**REMARKS**
Pump does not develop full pressure.	
1. Transmission hydraulic system problems. 2. Oil viscosity too low (oil too thin). 3. Pump is worn out. 4. Seal Retainer O-ring pinched. 5. Shaft seal leakage.	1. Refer to SECTION 7C. 2. Change to proper viscosity oil. 3. Repair or replace pump. 4. Disassemble pump and check O-ring. 5. Replace drive shaft or seal.
Pump will not pump oil.	
1. Transmission low or empty. 2. Suction strainer clogged.	1. Fill transmission to proper level. 2. Clean suction strainer.
Noisy pump caused by cavitation.	
1. Oil too thick. 2. Oil suction filter plugged. 3. Suction line plugged.	1. Change to proper viscosity. 2. Clean filter. 3. Clean line.
Oil heating.	
1. Oil supply low. 2. Contaminated oil. 3. Oil viscosity too low.	1. Fill transmission to proper level. 2. Drain transmission and refill with clean oil. 3. Drain transmission and fill with proper viscosity.
Foaming oil.	
1. Low oil level. 2. Air leaking into suction line. 3. Wrong kind of oil.	1. Fill transmission to proper level. 2. Tighten fittings, check size and condition of line. 3. Drain transmission, fill with non-foaming oil.

DRIVE TRAIN PUMP

6. FLOW TEST

Pump failure is most easily discovered by signs such as noise or leakage at the pump housing. If no external signs are present, a flowmeter should be used to check the pump output.

NOTE: *Before checking pump output, be sure the transmission is filled to the correct level and with the proper oil as described in the OPERATOR'S MANUAL.*

1. Unscrew bolts with washers (3, Fig. 10A.2) and remove the guard (1) from LH side of the machine.

NOTE: *Before disconnecting hoses from the pump place a suitable container for oil drains.*

2. To check pump output, disconnect output hose (2, Fig. 10A.3) at the pump outlet port. Connect a hydraulic flowmeter to the output port.
3. Start the engine and warm the hydraulic oil to operating temperature.

IMPORTANT: *If the hydraulic flowmeter has been connected before the oil warm up procedure, be sure the adjustable flow orifice valve of the flowmeter is completely open during the warm up period otherwise, severe pump damage could result.*



Fig. 10A.2. Preparation for Drive Train Pump Removal (515G L.H side view)

1. Guard
2. Operator Cab
3. Mounting Bolts with Washers

4. Accelerate the engine to 2500 [RPM]. Set the adjuster flow orifice valve of the flowmeter to a pressure of 2.05÷2.35 [MPa] and observe the flow rate of the pump. Stop the engine.

5. Rated capacity of the pump is 94.5 [l/min] at 2500 engine [RPM] and 2.05÷2.35 [MPa]. The pump is considered acceptable if the flow rate did not drop more than 10% from the rated capacity.
6. If the pump does not provide the specified flow rate, replace or repair the pump.
7. Disconnect the flowmeter. Reconnect the hose (2) to the pump outlet port.

7. REMOVAL

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.

DANGER! Always lock the frames together before working near the center of the machine. If frames move, serious injury or death could result.

IMPORTANT: *Disconnected hydraulic lines must be capped with the correct size plastic caps. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Tag all disconnected lines to facilitate proper installation.*

1. Unscrew bolts with washers (3, Fig. 10A.2) and remove the guard (1) from LH side of the machine.



Fig. 10A.3. Drive Train Pump Disconnecting Points

1. Transmission
2. Outlet Hose
3. Oil Level Gauge Dipstick
4. Mounting Bolt with Washer – 2 pcs
5. Drive Train Pump
6. Inlet Tube

DRIVE TRAIN PUMP

NOTE: *Before disconnecting hoses from the pump place a suitable container for oil drains.*

2. Disconnect the outlet hose (2, Fig. 10A.3.) from the top and the inlet tube (6) from the bottom of the pump (5).
3. Attach a hoist sling to pump (5). The hoist must be installed to give the best possible balance. Place tension on the hoist.
4. Remove two mounting bolts with washers (4) securing pump (5) and move the pump rearward to free the pump drive shaft from the drive gear inside the torque converter and lift it out of machine.
5. Remove and discard the pump mounting O-ring.
6. Cover the opening mounting hole to protect the system from dirtiness.

8. DISASSEMBLY (FIG. 10A.4)

1. Clean the exterior of the pump with solvent before beginning disassembly.
2. Position the pump on a bench having a clean work area so the drive shaft is pointing up. Index mark the front cover (4), housing (8) and rear cover (11) to retain correct relationship during reassembly.

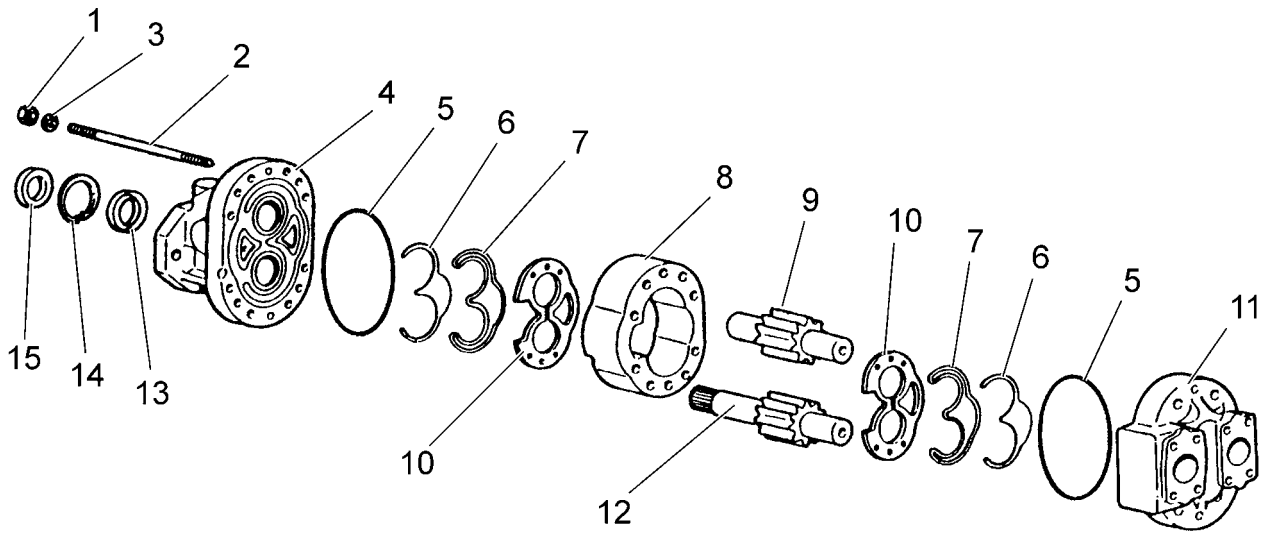


Fig. 10A.4. Exploded View of Drive Train Pump

1. Nuts
2. Studs
3. Washers
4. Front Cover
5. O-Ring
6. Seal Gland
7. Seal Retainer
8. Housing
9. Driven Gear
10. Wear Plate
11. Rear Cover
12. Drive Gear
13. Shaft Seal
14. Retaining Ring
15. Shaft Seal

3. Clamp pump across protected ports in large vise or holding fixture with shaft end up. Loosen and remove the nuts (1) and washers (3) from the stud bolts (2).
4. Remove pump from vise and place on clean work-bench. Use a plastic mallet to separate the front cover (4) from the pump. The two dowel pins (16, Fig. 10A.5) which align the front cover, housing and rear cover are a tight fit and will require the use of the plastic mallet to separate these parts.

DRIVE TRAIN PUMP

IMPORTANT: *Do not pry front cover (4), housing (8) and rear cover (11) apart with a screwdriver or other similar tool, as such action can damage machined sealing surfaces.*

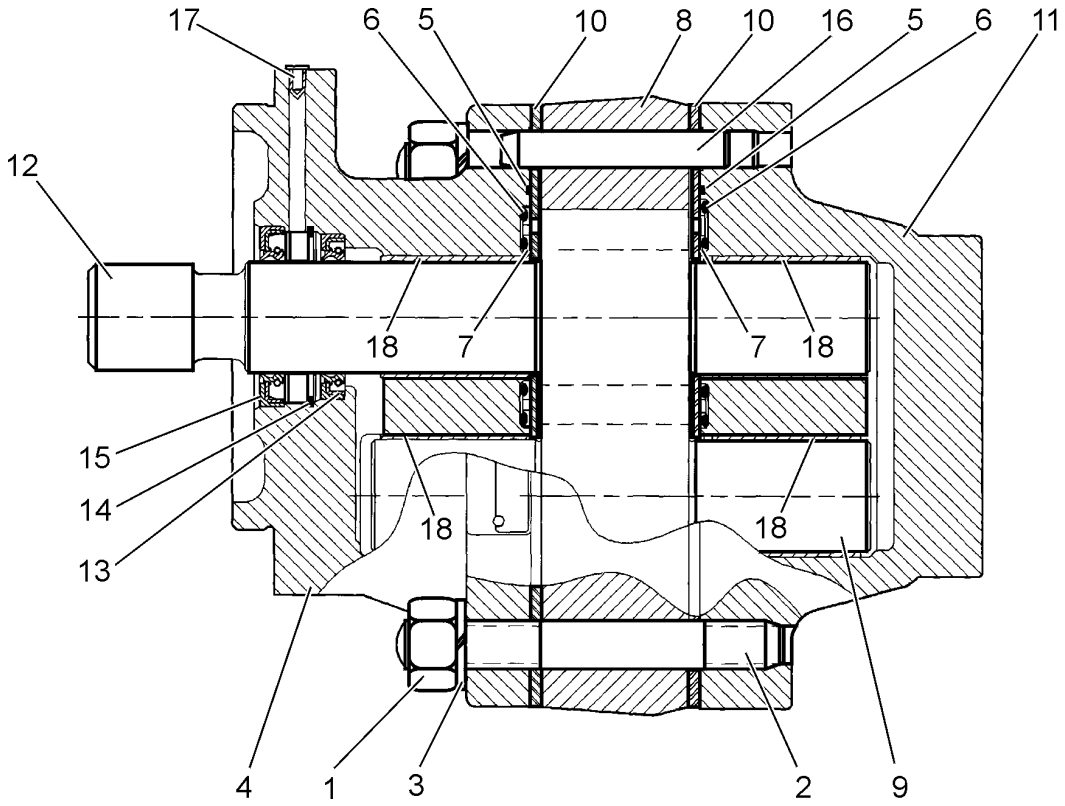


Fig. 10A.5. Cross Section View of Hydraulic Gear Pump

1. Nut	7. Seal Retainers	13. Shaft Seal
2. Stud	8. Housing	14. Retaining Ring
3. Washer	9. Driven Gear	15. Shaft Seal
4. Front Cover	10. Wear Plates	16. Dowel Pin
5. O-Ring	11. Rear Cover	17. Rubber Plug
6. Seal Glands	12. Drive Gear	18. Bearings

5. Remove front cover (4, if need use the puller as shown in Fig. 10A.6), wear plate (10), seal retainer (7) seal gland (6) and O-ring (5) from the front cover (4).
6. Remove and discard shaft seals (13, 15), retaining ring (14) from the front cover (4) using tongs RSKm-200, and the rubber plug (17) from seal weep hole in front cover (4). If necessary remove the bearings (18, Fig. 10A.5) from front cover (4).

NOTE: *If gears are to be reused, they should be marked before removal to ensure replacement in same position (See Fig. 10A.7).*

7. Carefully remove drive and driven gears (9, 12), housing (8) from pump and place on work bench.
8. Remove wear plate (10), seal retainer (7), seal gland (6) and O-ring (5) from the rear cover (11).
9. If necessary, remove the bearings (18, Fig. 10A.5) from the rear cover (11).

DRIVE TRAIN PUMP

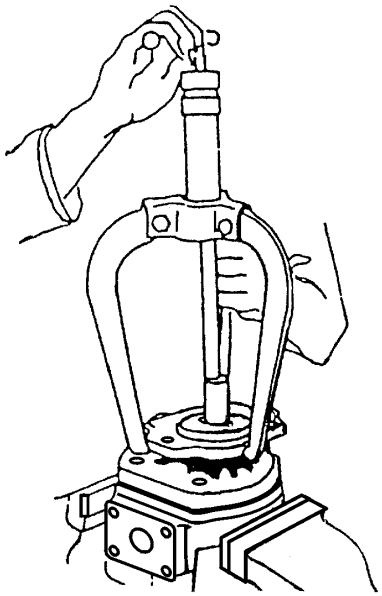


Fig. 10A.6. Removing Front Cover

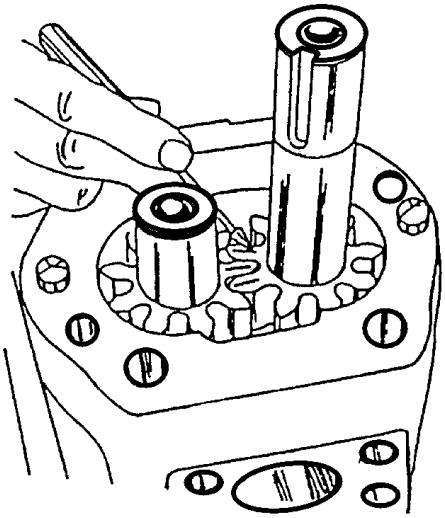


Fig. 10A.7. Index Marking Gears

9. INSPECTION AND REPAIR

1. It is recommended that new O-rings, seal shafts, seal glands and seal retainers be installed when the equipment pump is disassembled.
2. Clean all metal parts in a suitable solvent and dry with compressed air thoroughly prior to inspection.
3. It is not necessary to inspect the seals, as they will be replaced as new items.
4. Check drive gear spline for twisted or broken teeth, nicks or excessive wear. Inspect gear journals for scratches and discoloration. Any discoloration of shaft (1, Fig.10A.8) requires replacement of both gears. Inspect gear teeth for spalding, scratches or excessive wear. Replace if necessary. Light stoning of teeth to remove sharp edges is permissable.
5. Inspect gear face (2) of both the drive gear and driven gear for scoring, if excessive wear. If the face edge of gear teeth (3) is sharp, they will mill into the wear plates. If wear on the face of the gears has occurred, the gears must be replaced.
6. Inspect bearings in front cover and rear cover for excessive wear, scoring, flaking or movement of bearings.

NOTE: *Always replace bearings if a gear set is replaced or vice versa.*

7. Inspect the gear pockets inside the housing. It is normal for the surface inside the gear housing to show a clean ”wipe” on the inside gear pocket wall on the intake side. There should not be excessive wear or deep scratches and gouges.
8. Inspect bronze side of both wear plates (Fig. 10A.9) for erosion, pitting, scratches or scoring, replace if damaged.

DRIVE TRAIN PUMP

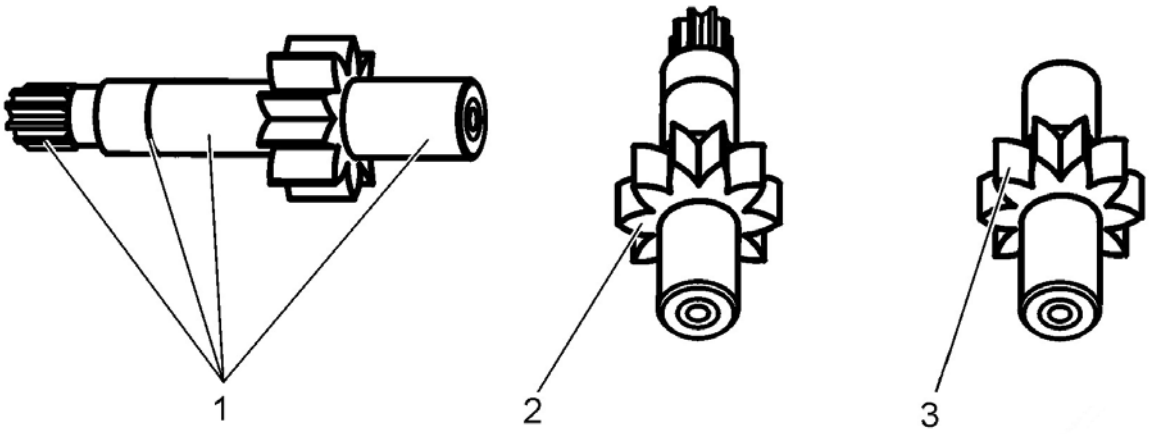


Fig. 10A.8. Drive and Driven Shaft Gear

1. Check Points
2. Check Gear Face
3. Check Edge of Gear Teeth

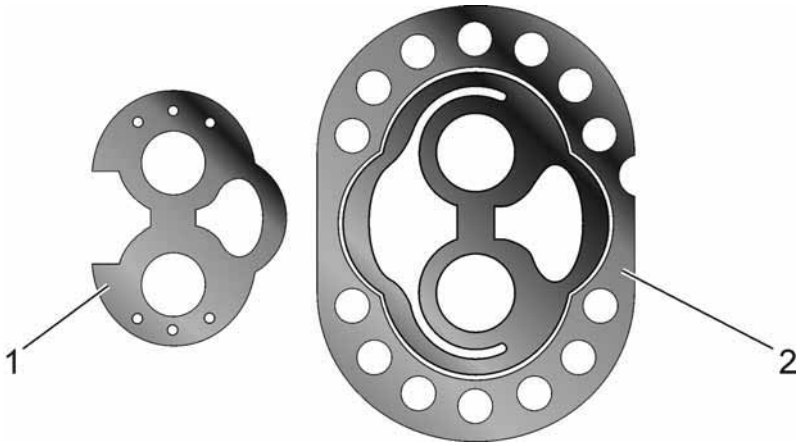


Fig. 10A.9. Wear plates

1. Drive Train Pump Wear Plate
2. Steering and Equipment Pump Wear Plate

10. REASSEMBLY

NOTE: *Upon reassembly of pump, all parts should be lightly oiled with clean hydraulic oil. Use small amounts of graphite grease to hold seal retainer and seal in place during assembly.*

1. If removed, install new bearings (18, Fig. 10A.5) using an arbor press or bearing driver, so the bearing flush with the face of the front cover (4, Fig. 10A.4) and rear cover (11).
2. Install a new inner shaft seal (13) in front cover (4), make sure the spring loaded member of shaft seal faces the inside of pump. Press the seal into the seal bore until the seal reaches the bottom of the bore. Uniform pressure must be used to prevent misalignment or damage to the seal. Coat seal land with graphite grease after installation.
3. Install retaining ring (14) in front cover (4) using tongs RSKm-200.

DRIVE TRAIN PUMP

4. Install a new outer shaft seal (15) in front cover (4), make sure the spring loaded member of shaft seal faces the inside of pump. Uniform pressure must be used to prevent misalignment or damage to the seal. Press until seal is seated properly.
5. Place rear cover (11) on clean work-bench witch seal cavity area facing up. Coat seal cavity with grease to hold seals in place. Coat the seal gland (6) and plastic seal retainer (7) with graphite grease. Carefully install the seal gland (6) in the groove of the seal retainer (7), make sure the seal gland (6) is seated completely in the seal retainer (7).
6. Install the assembled seal gland (6) and seal retainer (7) in the cavity in the rear cover (11). Carefully press this assembly in place until it is firmly seated in the machined recess. This is important for proper installation of the bronze wear plate (10).
7. Apply a light coating of graphite grease to the O-ring (5) and carefully install in groove of rear cover (11). Be very careful that the O-ring (5) does not twist in the groove, it must be flat in the groove or the pump will leak at this seam.
8. Lubricate the bronze face of the wear plate (10) and install over the seal retainer (7). When properly placed the bronze face will be next to the gears and flush with the surface of the rear cover (11).
9. Install the studs (2) in the rear cover (11). The course thread end of the studs (2) thread into the rear cover (11). Torque studs to 35÷45 [Nm].
10. Install housing (8) over studs (2), make very sure the notches are in alignment with the notch in the rear cover (11). It may be necessary to use a plastic mallet to seal the housing (8) due to the tight fit of the dowel pins. Hold the wear plate (10) in position while tapping housing (8).
11. Lubricate the drive gear (12) and driven gear (9) and install the gears in the proper bearings (18) in the rear cover (11). Align marked gear teeth at this time.
12. Place front cover (4) on clean work-bench with seal cavity area facing up. Coat seal cavity with graphite grease to hold seals in place.
13. Coat the seal gland (6) and plastic seal retainer (7) with graphite grease. Carefully install the seal gland (6) in the groove of the seal retainer (7), make sure the seal gland (6) is seated completely in the seal retainer (7).
14. Install the assembled seal gland (6) and seal retainer (7) in the cavity of the front cover (4). Carefully press this assembly in place until it is firmly seated in the machined recess. This is important for proper installation of the bronze wear plate (10).
15. Apply a light coating of graphite grease to the O-ring (5) and carefully install in groove of the front cover (4). Be very careful that the O-ring (5) does not twist in the groove, it must be flat in the groove or the pump will leak at this seam.
16. Lubricate the steel side of the bronze wear plate (10) with graphite grease and install over the seal retainer (7). When properly positioned, the bronze face will be next to the gears and flush with the surface to the front cover (4).
17. Place a seal sleeve or tape over drive shaft end and very carefully slide front cover (4) over drive gear (12) and studs (2).
18. Engage front cover (4) over dowel pins (16, Fig. 10A.5) and press firmly until front cover (4, Fig. 10A.4) is fully seated against housing (8). Make sure all notches are in alignment, if not pump is incorrectly assembled. Make sure all seals and wear plates have stayed in their proper position.
19. Install washers (3) and nuts (1) on studs (2). Torque the nuts to 90÷100 [Nm].
20. Place a small amount of clean oil in the inlet of the pump and rotate the drive shaft away from the inlet one revolution. The breakaway torque to turn the drive shaft must not exceed 47 [Nm] after assembly.

DRIVE TRAIN PUMP

11. INSTALLATION (FIG. 10A.10)

1. Position a new mounting O-ring on the front of the pump.
2. Attach a hoist sling to pump (5). The hoist must be installed to give the best possible balance. Place tension on the hoist.
3. Position drive train pump (5) and install into torque converter aligning pump shaft splines with converter drive gear. To secure to torque converter, install mounting bolts with washers (3), using Loctite 592 sealant and torque mounting bolts to 160 [Nm].
4. Reconnect the inlet tube (2) to the bottom of the pump and tighten them.
5. Fill the pump with the same oil as used in the transmission. Refer to the OPERATOR'S MANUAL for oil specifications.
6. Reconnect the outlet hose (1), fasten to elbow on the top of the pump.

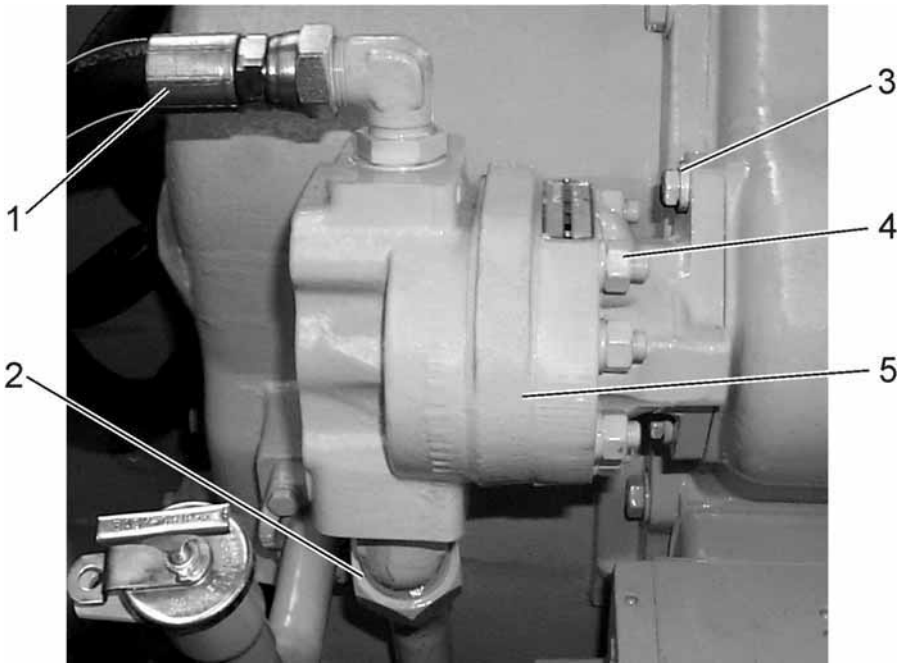


Fig. 10A.10. Drive Train Pump View

1. Outlet Hose
2. Inlet Tube
3. Bolt with Washer – 2 pcs
4. Nut – 8 pcs
5. Drive Train Pump

7. Fill the transmission with oil. Refer to the OPERATOR'S MANUAL for oil specifications and procedure.
8. Start the engine and check for oil leaks. Check the pump inlet line for air leaks and stop the engine.
9. Install the guard (1, Fig. 10A.2) of the LH side of the machine and to secure it install bolts with washers (3).

STEERING AND EQUIPMENT PUMP

12. DESCRIPTION AND OPERATION

The steering and equipment pump (6, Fig. 10A.1) is a single element gear type pump is flange mounted to the front right side of the torque converter. The upper driven gear inside the torque converter drives the steering and loader equipment pump through a spline connection. The pump operates continually when the engine is running.

Oil from the hydraulic reservoir flows through the inlet tube (3, Fig. 10A.12) and enters at the upper port of the steering and loader equipment pump (2). The oil exits through outlet port at the pump (2) lower port and flows through outlet hose (8) to the priority valve inlet port. For machines equipped with ground driven steering system (520G) there is the ground driven steering check valve. The second line is used to supply pressurized oil through outlet hose (8) to inlet the pilot block.

13. SPECIFICATIONS

	515G	520G
Type	Positive displacement, single element, gear	
Rated capacity at 2500 engine [RPM]	121.5 [l/min]	157.5 [l/min]
Main pressure	19.5÷21.5 [MPa]	
Pilot pressure	3.0÷3.2 [MPa]	

Special Torque

Pump housing mounting bolts .....160 [Nm]
Pump flange stud nuts - 515G.....90÷100 [Nm]
Pump flange stud nuts - 520G.....200÷210 [Nm]
Pump inlet port bolts - 515G.....50÷60 [Nm]
Pump inlet port bolts - 520G.....60÷80 [Nm]
Pump outlet port bolts .....35÷40 [Nm]

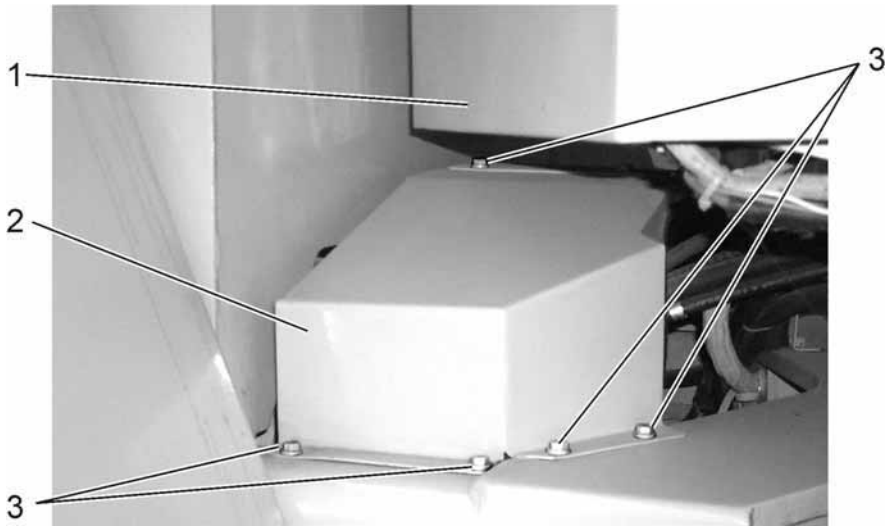


Fig. 10A.11. Preparation for Steering and Equipment Pump Removal (520G R.H. side view)

1. Operator Cab
2. Guard
3. Mounting Bolts with Washers

STEERING AND EQUIPMENT PUMP

14. SERVICE DIAGNOSIS

Service diagnosis is similar to the point 5. SERVICE DIAGNOSIS in this Section. For pump trouble connected to hydraulic system refer to Section 10.

15. FLOW TEST

Pump failure is most easily discovered by signs such as noise or leakage at the pump housing. If no external signs are present, a flowmeter should be used to check the pump output.

NOTE: *Before checking pump output, be sure the hydraulic reservoir is filled to the correct level and with the proper oil as described in the OPERATOR'S MANUAL.*

1. Unscrew bolts with washers (3, Fig. 10A.10) and remove the guard (2) from RH side of the machine.

NOTE: *Before disconnecting hoses from the pump place a suitable container for oil drains.*

2. To check pump output, disconnect outlet hose (8, Fig. 10A.12) at the pump outlet port or at the control valve inlet port. Connect a hydraulic flowmeter.
3. Start the engine and warm the hydraulic oil to operating temperature.

IMPORTANT: *If the hydraulic flowmeter has been connected before the oil warm up procedure, be sure the adjustable flow orifice valve of the flowmeter is completely open during the warm up period otherwise, severe pump damage could result.*

4. Accelerate the engine to 2500 [RPM]. Set the adjuster flow orifice valve of the flowmeter to a pressure of 19.5÷21.0 [MPa] and observe the flow rate of the pump. Stop the engine.
5. The pump is considered acceptable if the flow rate did not drop more than 10% from the rated capacity (See SPECIFICATIONS).
6. If the pump does not provide the specified flow rate, replace or repair the pump.
7. Disconnect the flowmeter. Reconnect the outlet hose (8).

16. REMOVAL



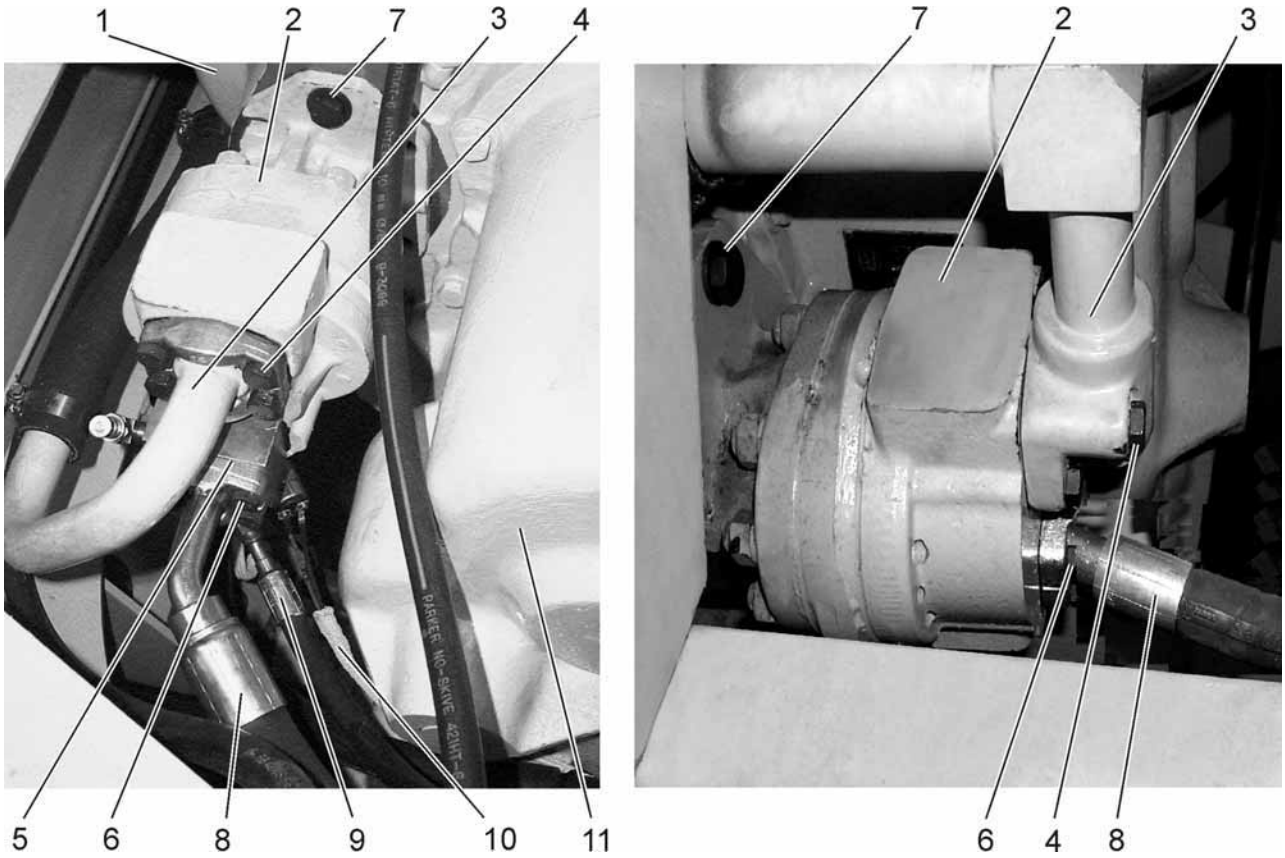
WARNING! Before servicing the machine be sure the bucket is lowered, the engine is off, the parking brake is applied, the transmission shifter is in neutral(N), the electric system master switch is OFF and the keys both from the master switch and the starting switch are removed.



DANGER! Always lock the frames together before working near the center of the machine. If frames move, serious injury or death could result.

IMPORTANT: *Disconnected hydraulic lines must be capped with the correct size plastic caps. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Tag all disconnected lines to facilitate proper installation.*

STEERING AND EQUIPMENT PUMP



515G **520G**

Fig. 10A.12. Steering and Equipment Pump Location and Piping

1. Torque Converter
2. Steering and Equipment Pump
3. Inlet Tube
4. Bolts with Washers – 4 pcs
5. Hydraulic Block with System Pressure Check Point
6. Bolts with Washers – 4 pcs
7. Bolts with Washers – 2 pcs
8. Outlet Hose
9. Outlet Hose to Pilot Block
10. Harness
11. Transmission

1. Drain the hydraulic reservoir oil as described in the OPERATOR'S MANUAL.
2. Unscrew bolts with washers (3, Fig. 10A.11) and remove the guard (2) from RH side of the machine.

NOTE: *Before disconnecting hoses from the pump place a suitable container for oil drains.*

3. Unscrew four bolts with washers (4, Fig. 10A.12) and disconnect the inlet tube (3) from the bottom of the pump (2).
4. Unscrew four bolts with washers (6) and disconnect outlet hose (8) of the pump (2).
5. **For 515G only** - Remove block (5) and discard the block mounting seal, disconnect the outlet hose to pilot block (9) and harness (10) of the pump (2).
6. Attach a hoist sling to steering and equipment pump (2). The hoist must be installed to give the best possible balance. Place tension on the hoist.

7. Remove the mounting bolts with washer (7) securing pump (2) and move the pump rearward to free the pump drive shaft from the drive gear inside the torque converter (1) and lift it out of machine.
8. Remove and discard the pump mounting O-ring.
9. Cover the opening mounting hole to protect the system from dirtiness.

17. DISASSEMBLY

See to 8. DISASSEMBLY.

5. Remove front cover (4, if need use the puller as shown in Fig. 10A.6), wear plate (10, FIG. 10A.13), seal retainer (7) seal gland (6) and two O-rings (5) from the front cover (4).
8. Remove O-ring (16), wear plate (10), seal retainer (7), seal gland (6) and second O-ring (16) from the rear cover (11).

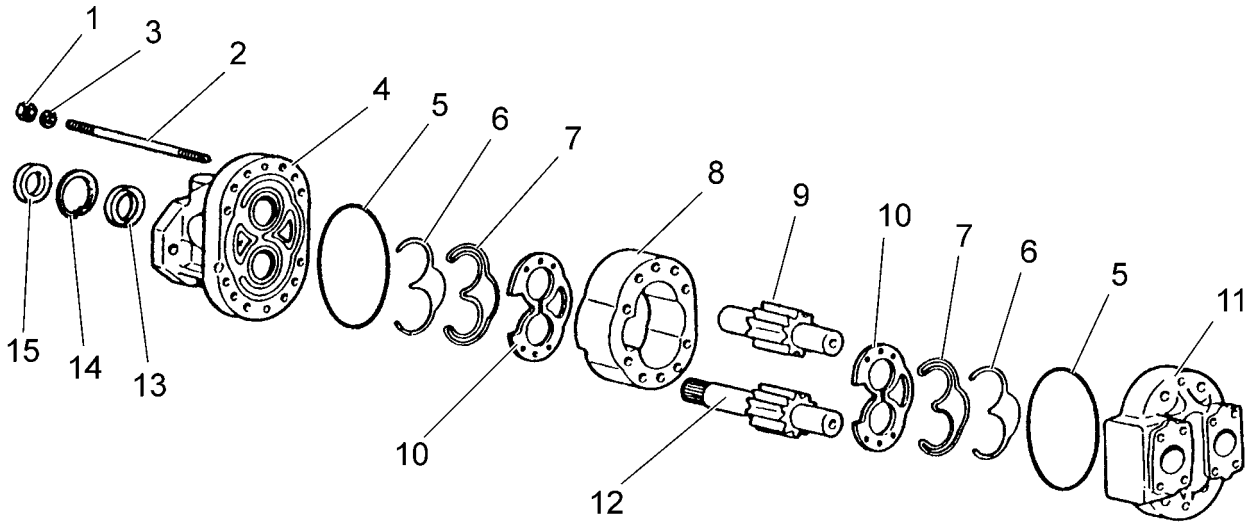


Fig. 10A.13. Exploded View of Steering and Equipment Pump

1. Nuts
2. Studs
3. Washers
4. Front Cover
5. O-Ring
6. Seal Gland
7. Seal Retainer
8. Housing
9. Driven Gear
10. Wear Plate
11. Rear Cover
12. Drive Gear
13. Shaft Seal
14. Retaining Ring
15. Shaft Seal
16. O-Ring

18. INSPECTION AND REPAIR

See to 9. INSPECTION AND REPAIR.

STEERING AND EQUIPMENT PUMP

19. REASSEMBLY (Fig. 10A.13)

See 10. REASSEMBLY and 13. SPECIFICATIONS for special torque.

7. Apply a light coating of graphite grease to the O-ring (16) and carefully install in groove of the rear cover (11). Be very careful that the O-ring (16) does not twist in the groove, it must be flat in the groove or the pump will leak at this seam.
8. Lubricate the bronze face of the wear plate (10), install over the seal retainer (7). When properly placed the bronze face will be next to the gears and flush with the surface of the rear cover (11). Apply a light coating of graphite grease to second O-ring (16) and carefully install in groove of the wear plate (10).
16. Lubricate the steel side of the bronze wear plate (10) with graphite grease and install over the seal retainer (7) and O-ring (5). When properly positioned, the bronze face will be next to the gears and flush with the surface to the front cover (4). In the groove of the wear plate (10) install second O-ring (5).
19. Install washers (3) and nuts (1) on studs (2). Torque the nuts (See SPECIFICATIONS for Special Torque).

20. INSTALLATION (Fig. 10A.12)

1. Install a new mounting O-ring on the front of the pump.
2. Attach a hoist sling to pump (2). The hoist must be installed to give the best possible balance. Place tension on the hoist.
3. Position steering and equipment pump (2) and install into torque converter (1) aligning pump shaft splines with converter drive gear.
4. Install mounting bolts with washers (7) using Loctite 592 sealant to secure to torque converter. Tighten mounting bolts to 160 [Nm].
5. **For 515G only** - Reconnect the outlet hose to pilot block (9) and harness (10) to the connection port and the block (5).
6. Install outlet hose (8), torque four mounting bolts (6) to 35 ÷ 40 [Nm].
7. Fill the pump with the same oil as used in the hydraulic reservoir. Refer to the OPERATOR'S MANUAL for oil specifications.
8. Reconnect the inlet tube (3) to the pump (2). Torque four mounting bolts (4) (see SPECIFICATIONS for Special Torque).
9. Fill the hydraulic reservoir with oil. Refer to the OPERATOR'S MANUAL for oil specifications and procedure.
10. Start the engine and check for oil leaks. Check the pump inlet line for air leaks. Stop the engine.
11. Install the guard (2, Fig. 10A.11) of the RH side of the machine and to secure it install bolts with washers (3).

GROUND DRIVEN STEERING PUMP (If equipped)

21. DESCRIPTION AND OPERATION

The ground driven steering pump block (Fig. 10A.14) consists of a single element gear type pump (3) with rear mountings. These mountings are used to attach valve assy (5). The outlet of this pump is used to supply a limited volume of hydraulic oil to the steering system by ground driven steering check valve (4) when the steering and loader equipment pump (2) does not supply sufficient oil for steering control. The ground driven steering pump (3) is mounted on the front of the transmission, above the output shaft (10). The pump drive shaft is splined with the internal splines on the end of the second and third gear clutch shaft.

The oil to the ground driven steering pump is delivered from the hydraulic reservoir. This oil enters through the inlet tube (8) on the front of the pump block and exits through the outlet tube (6) on the left side of the pump block from where its sent to the ground driven steering check valve (4).

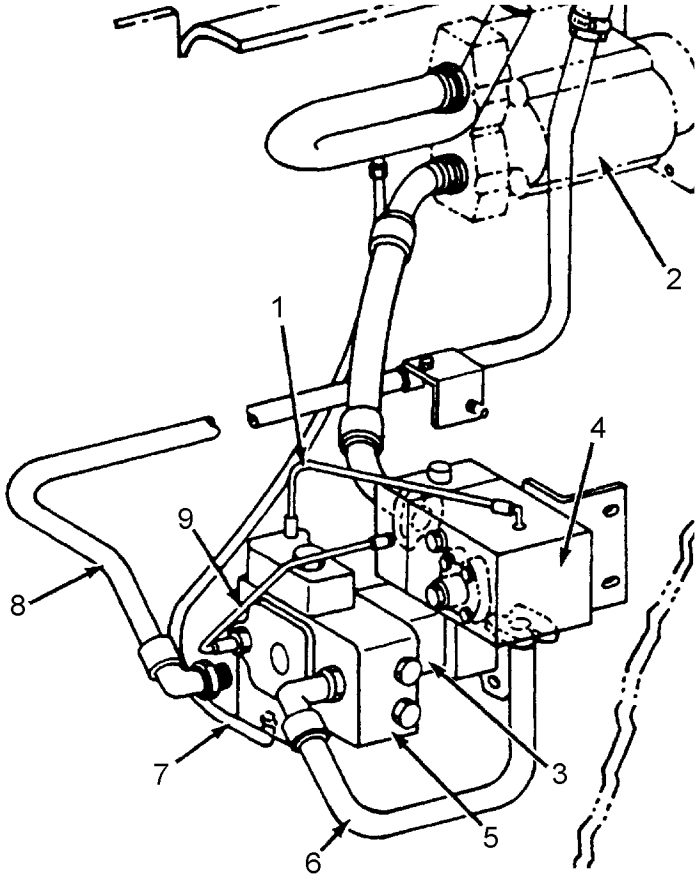


Fig. 10A.14. Ground Driven Steering Pump Block Piping

1. Check Valve Outlet Signal Pressure Hose
2. Steering and Equipment Pump
3. Ground Driven Steering Pump
4. Check Valve
5. Valve Assy
6. Outlet Tube
7. Drain Hose
8. Inlet Tube
9. Check Valve Inlet Signal Pressure Hose

The ground driven steering pump (3) receives pilot oil pressure from the check valve (4) at the two signal pressure ports located on the front right side and the top valve assy (5). The valve assy signal pressure ports are connected through hoses (1, 9) to the check valve (4) and they're for the operation of a signal pressure plunger, which determines the pump (3) operating mode of on or off.

GROUND DRIVEN STEERING PUMP (If equipped)

The direction of pump rotation changes when the direction of the transmission output shaft rotation changes. This change in gear rotation requires switching the functions of the inlet and outlet sides of the pump. Inlet oil is directed by check poppets inside the valve assy (5) to whichever side of the gear set that's functioning as the inlet side (according to the direction of rotation). A second set of check poppets direct oil to the outlet port of the pump.

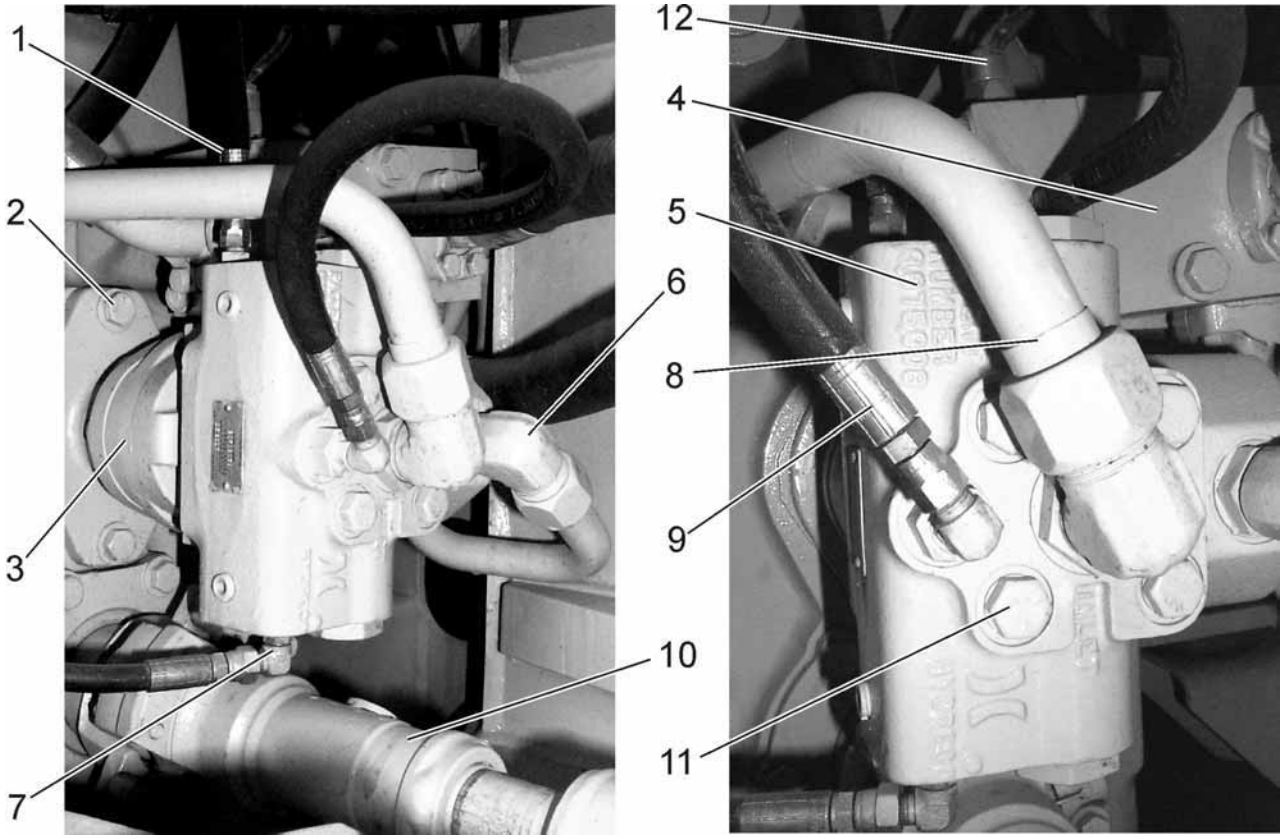


Fig. 10A.15. Ground Driven Steering Pump Block Disconnecting Points

1. Signal Pressure Hose
2. Bolts with Washer – 2 pcs
3. Ground Driven Steering Pump
4. Check Valve
5. Valve Assy
6. Outlet Tube
7. Drain Hose
8. Inlet Tube
9. Signal Pressure Hose
10. Output Shaft
11. Bolts with Washers – 4 pcs
12. Ground Driven Light Switch

22. SPECIFICATIONS

Type ..... single element, gear
Rated capacity at 600 rpm and 0 MPa ..... 14.4 [l/min]
Rated capacity at 1800 rpm and 0 MPa ..... 43.5 [l/min]

Special Torque

Pump housing mounting bolts ..... 150÷160 [Nm]
Valve housing to pump mounting bolts ..... 40 [Nm]
Pump inlet tube nut ..... 110÷120 [Nm]
Pump outlet tube nut ..... 80÷95 [Nm]
Signal pressure hoses nut ..... 8÷13 [Nm]

GROUND DRIVEN STEERING PUMP (If equipped)

DESCRIPTION	No. of Coils	Free Length	Test Length	Test Load Pressure
Outlet check valve spring	13	44.5 [mm]	22.2 [mm]	15.6 [N]
Signal pressure spring	23.6	55.6 [mm]	26.9 [mm]	31 [N]

23. REMOVAL

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.*



WARNING! Be sure the bucket is lowered to the ground, the parking brake is ON and turn the master switch to the OFF position and take out the key from the master switch and starting switch to prevent accidental starting.



WARNING! Always lock the frames together before working near the center of the machine. If the frames move, serious injury or death could result.

1. Drain the oil from the hydraulic reservoir. Refer to the OPERATOR'S MANUAL for this procedure.

NOTE: *Before disconnecting hoses from the pump and valves place a suitable container for oil drain.*

2. Disconnect the drain hose (7, Fig. 10A.15), two signal pressure hoses (1, 9), inlet tube (8) and outlet tube (6) from the ground driven steering pump valve assy (5).
3. Attach a hoist sling to the ground driven steering pump block. The hoist must be installed to give the best possible balance. Place tension on the hoist.
4. Remove two mounting bolts with washers (2) securing pump (3) and move the pump block rearward to free the pump drive shaft from the drive gear inside the transmission and lift it out of machine.
5. Remove and discard the pump mounting gasket and install temporary cover with gasket on the transmission front cover mounting pad. If equipped, use original cover and gasket (See "TRANSMISSION", Section 7C).
6. Thoroughly clean the exterior of the pump block with a suitable solvent to remove accumulated grime. Dry with compressed air.
7. Index mark the mounting adapter (1, Fig. 10A.16), front cover (4), housing (13) and rear cover (14) to retain the correct relationship during reassembly.
8. Remove four mounting bolts with washers (11, Fig. 10A.15) and separate valve assy (5) from the ground driven steering pump (3).
9. Remove two O-rings (19 and 26, Fig. 10A.16).

GROUND DRIVEN STEERING PUMP (If equipped)

24. DISASSEMBLY (Fig. 10A.16)

Ground Driven Steering Pump Assembly

1. Position the ground driven steering pump on a bench having a clean work area so the drive shaft is pointing up.
2. Remove the mounting adapter (1) and adapter gasket (2).

***IMPORTANT**: Do not pry the pump bodies and mounting flange apart with a screwdriver or other similar tool, as such action can damage machined sealing surfaces.*

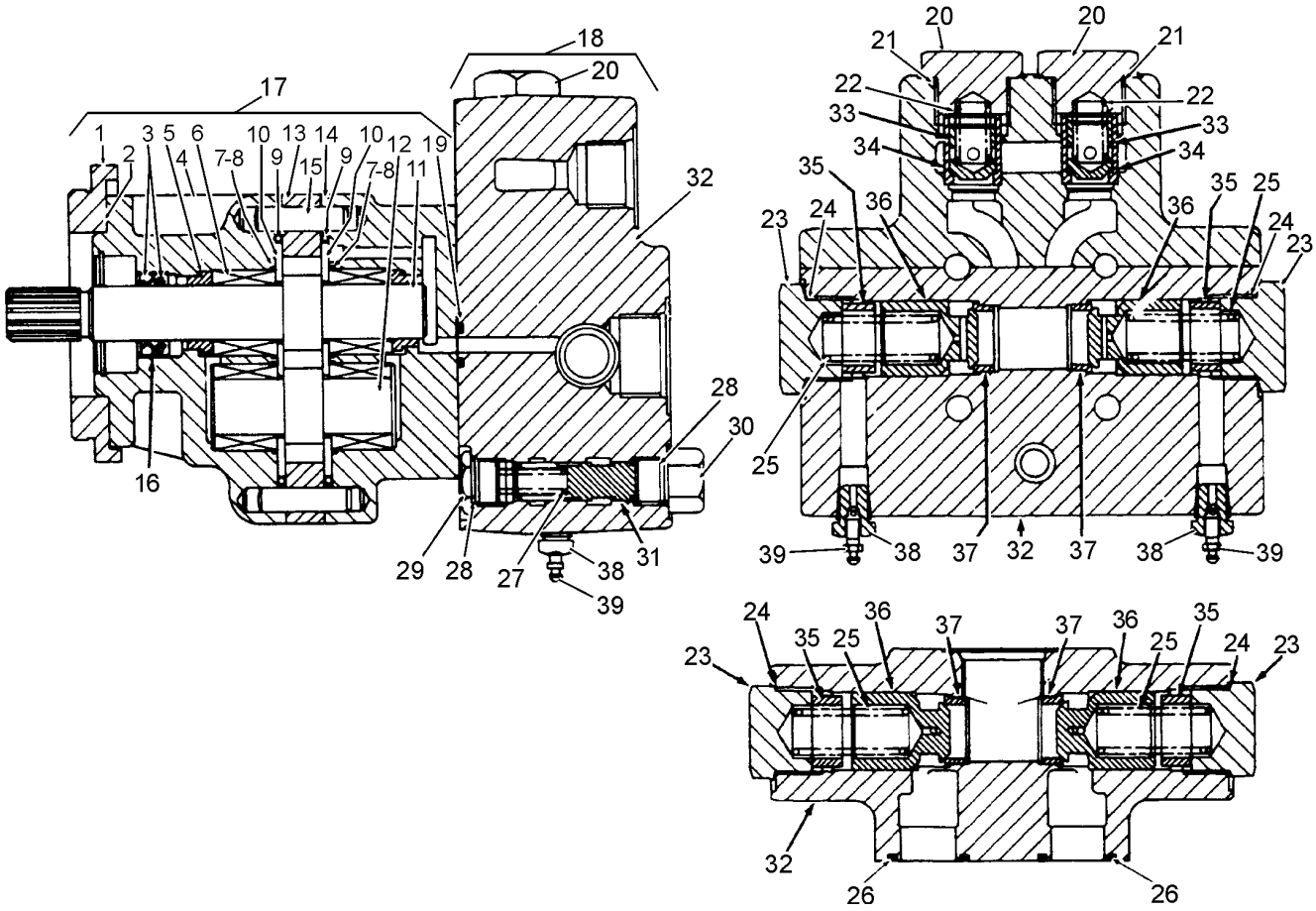


Fig. 10A.16. Sectional View of Ground Driven Steering Pump Block.

1. Pump Mounting Adapter
2. Adapter Gasket
3. Retaining Rings
4. Front Cover
5. Seal (both sides)
6. Bearing
7. O-Ring
8. Seal Ring
9. O-Ring
10. Wear Plate
11. Drive Gear
12. Driven Gear
13. Housing
14. Rear Cover
15. Dowel Pin
16. Seal
17. Pump Assy
18. Valve Assy
19. O-Ring
20. Plug
21. O-Ring
22. Spring
23. Plug
24. O-Ring
25. Spring
26. O-Ring
27. Spring
28. O-Ring
29. Plug
30. Plug
31. Spool - Signal Pressure
32. Valve Housing
33. Outlet Check Valve Poppets
34. Seals
35. Spacer Sleeves
36. Inlet Check Valve Poppet
37. Check Valve Seat
38. Air Bleeder Plug
39. Screws with Cap

GROUND DRIVEN STEERING PUMP (If equipped)

3. Remove the front cover (4) from the housing (13). A tap with a soft mallet may be necessary to free the cover from the dowel pins (15).
4. Remove the O-ring (9) and the wear plate (10) from the front cover (4).
5. Mark the gear teeth of drive and driven gears (11, 12) as shown in Fig. 10A.7 to ensure replacement in the same position. Remove the shafts with gears.
6. Lift up slightly the housing (13), remove O-ring (9), wear plate (10) from the rear cover.
7. Remove the O-ring (7) and seal rings (8) from both seal plates.
8. If necessary, remove the bearings (6) using a suitable bearing puller from both covers. Remove the backup rings (5).
9. Remove the retaining rings (3) and seal (16) from the front cover using tongs RSKm-200. Use care in the removal of these parts to avoid damaging the seal bore area.
10. Don't remove the dowel pins (15) unless replacement is necessary.

Valve Assembly

11. Remove the outlet plugs (20), springs (22) and poppet (33). Remove O-rings (21)
12. Remove the inlet plugs (23), springs (25), spacer sleeve (35) and poppet (36). Remove the O-ring (24).
13. Remove plug (29), spring (27), spool (31) and plug (30) from the valve housing (32).
14. Remove two O-rings (28) from the plug (30).
15. Remove the two caps and screws (39) and the two air bleeder plugs (38)

25. INSPECTION AND REPAIR

1. Discard all O-rings, backup rings, seal rings, gaskets, spacer plate and the shafts seals. These parts should be replaced with new whenever the pump is service.
2. Clean all metal parts in a suitable solvent and dry with compressed air thoroughly prior to inspection.
3. Inspect the wear plates for grooves or wear. If grooved or if the bronze plating is worn through, replace the wear plate.
4. Check, drive gear spline for twisted or broken teeth, nicks or excessive wear.
5. Inspect gear journals for scratches and discoloration. Any discoloration of shaft (1, Fig. 10A.8) requires replacement of gears. Inspect gear teeth for spalding, scratches or excessive wear. Replace if necessary. Light stoning of teeth to remove sharp edges is permissable.
6. Inspect gear face (2) of both the drive gear and driven gear for scoring or excessive wear. If the face edge of gear teeth (3) is sharp, they will mill into the wear plates. If wear on the face of the gears has occurred, the gears must be replaced.
7. Inspect bearings in front and rear covers for excessive wear, scoring, flaking or movement of bearings.

NOTE: *Always replace bearings if a gear set is replaced or vice versa.*

8. Inspect the gear pockets inside the housing (13, Fig. 10A.16). It is normal for the surface inside the gear housing to show a clean "wipe" on the inside gear pocket wall on the intake side. There should not be excessive wear or deep scratches and gouges.
9. Inspect the pump sections for cracks and replace as necessary.
10. Inspect check valve springs for damage, distortion or weakness. Springs meeting the requirements shown in SPECIFICATIONS, should function properly. Springs not meeting the requirements should be replaced.

GROUND DRIVEN STEERING PUMP (If equipped)

11. Pay special attention to the condition of sliding surfaces of spools, valve seats and poppet sealing edge. Any scratches are inadmissible. Check spool, poppets for free movement in their bores of the housing. If either the parts is grooved or damaged or if does not move freely, the valve assembly should be replaced.
12. Clean thoroughly and check air bleeder plugs, spacer sleeves, inlet and outlet plugs. Parts with traces of corrosion or wear replace for new ones

26. REASSEMBLY (Fig. 10A.16)

NOTE: *Before reassembly of pump, all parts should be lightly oiled with clean hydraulic oil. Lubricate the component parts with the same oil as used in the hydraulic system. Use small amounts of graphite grease to hold seal retainer and seal in place during assembly.*

1. Reassemble the component parts of the valve assy (18) in the reverse order they were disassembled, position it on a bench having a clean work area and cover the opening mounting hole to protect the system from dirtiness.
2. If removed, into the front and rear covers install the backup rings (5) and the bearings (6), using an arbor press or a suitable bearing driver, so they are flush to a maximum of 0.13 [mm] below the pump cover face.
3. Press the shaft seal (3) spring lip end first, install the retaining ring (16) using tongs RSKm-200 and press second shaft seal (3) into the front cover (4).

IMPORTANT*: Press only on the metal surfaces of oil seals.*

4. Install seal rings (8) into the front and rear cover.
5. Apply a light coating of graphite grease to the O-rings (7, 9) and carefully install in groove into rear cover (14). Be very careful that the O-ring does not twist in the groove, it must be flat in the groove or the pump will leak at this seam.
6. Lubricate the bronze face of the wear plate (10), install over the seal ring (7). When properly placed the bronze face will be next to the gears and flush with the surface of the rear cover (14).
7. Install housing (13) make very sure the notches are in alignment with the notch in the rear cover (14). It may be necessary to use a plastic mallet to seat the housing (13) due to the tight fit of the dowel pins (15). Hold the wear plate (10) in position while tapping housing (13).
8. Lubricate the drive gear (11) and driven gear (12) and install the gears in the proper bearings in the rear cover (14). Align marked gear teeth at this time.
9. Apply a light coating of graphite grease to the O-rings (7, 9) and carefully install in groove into front cover (4). Be very careful that the O-ring does not twist in the groove, it must be flat in the groove or the pump will leak at this seam.
10. Lubricate the steel side of the bronze wear plate (10) with graphite grease and install over the seal ring (8). When properly positioned, the bronze face will be next to the gears and flush with the surface to the front cover (4).
11. Place a seal sleeve or tape over drive shaft end and very carefully slide front cover (4) over drive gear (11). Engage front cover (4) over dowel pins (15).
12. Press firmly until front cover (4) is fully seated against housing (13). Make sure all notches are in alignment, if not pump is incorrectly assembled. Make sure all seals and wear plates have stayed in their proper position.

13. Install O-rings (19, 26) in groove into valve assy (18), be very careful that the O-rings does not twist in the groove.
14. Install four mounting bolts (11, Fig. 10A.15) into valve assy (18) and carefully slide pump assy (17) over bolts. Tighten the mounting bolts to torque 40 Nm.
15. Place a small amount of clean oil in the inlet of the pump and rotate the drive shaft away from the inlet one revolution. No binding should be evident during this operation.

27. INSTALLATION

1. Position a new mounting adapter gasket (2, Fig. 10A.16) on the front of the pump.
2. Attach a hoist sling to ground driven steering pump block. The hoist must be installed to give the best possible balance. Place tension on the hoist.
3. Position pump block and install into the transmission front cover mounting pad, aligning pump shaft splines with transmission drive gear.
4. Using Loctite 592 sealant, install mounting bolts with washers (2, Fig. 10A.15) and tighten to 150÷160 [Nm] to secure to transmission.
5. Reconnect and reinstall the hydraulics tubes and hoses to the pump block in the reverse order disconnected and removed (See to SPECIFICATIONS for Special torque).
6. Fill the pump with the same oil as used in the hydraulic reservoir. Refer to the OPERATOR'S MANUAL for oil specifications.
7. Fill the hydraulic reservoir with oil. Refer to the OPERATOR'S MANUAL for oil specifications and procedure.
8. Start the engine and check for oil leaks. Check the pump inlet line for air leaks. Stop the engine.

SECTION 10B

VALVES

VALVES

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SECTION 10B

VALVES

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SPECIAL TOOLS AND INSTRUMENTS

1. SPECIAL TOOLS AND INSTRUMENTS

Description	P/N of instrument/tool
1. Assembly tool for seal kit	SJ 150N4014-1
2. Assembly tool for lip seal	SJ 150-9000-17
3. Cardan shaft mounting forks	SJ 150-9000-3
4. Assembly tool for wiper ring	SJ 150-9000-22
5. Holding tool	SJ 150-9000-08
6. Pressure gauge	OEM 1212

STEERING CONTROL VALVE

2. DESCRIPTION

515G – STEERING UNIT (Fig. 10B.1)

It is a load sensing steering unit consisting of a steering spool and sleeve (2), a activation spool (4) and two metering pump (3, 5) (rotary meters). The activation spool (4) determines whether one or both pumps are active. The two metering pumps (3, 5) are mechanically connected, so the oil flow to the steering cylinders is proportional to the angular movement of the steering wheel.

When the pump pressure on the steering unit exceeds 0.7 [MPa], the oil flow from both metering pumps (3, 5) is available for steering. When the pump pressure is less than 0.4 [MPa], the oil flow for steering is available only from main metering pump (3) (emergency steering). This makes high manual steering pressure possible.

This steering unit gives the facilities manual steering without emergency steering pump for smaller loaders.

520G – STEERING UNIT (Fig. 10B.2)

It is a load sensing steering unit specially developed for large displacements in order to minimize flow loss. It is therefore extremely suitable for larger loaders. The steering unit consists of a steering spool and sleeve (4) and a gear set (5), rotary meter. The gear set meters the oil flow to the steering cylinder in proportion to the angular rotation of the steering wheel. If the oil flow from the steering system pump is too small, the steering unit can function as a manual pump. Manual steering can only be used for a limited control of the vehicle if a sudden drop of pump pressure or flow occurs. Under normal operating where the steering pump supplies an adequate oil flow at the required pressure, the maximum torque on the steering wheel will not exceed 4 [Nm]. If the oil flow from the steering system pump or ground drive steering pump fails or is too small, the maximum torque on the steering wheel will not exceed 120 [Nm]. For safety and operators comfort on 520G loader is installed ground drive steering pump (emergency pump) – refer to Section 10A.

This steering unit gives the low steering torque 0.8 to 3.0 [Nm] in normal steering situations.

VALVES

STEERING CONTROL VALVE

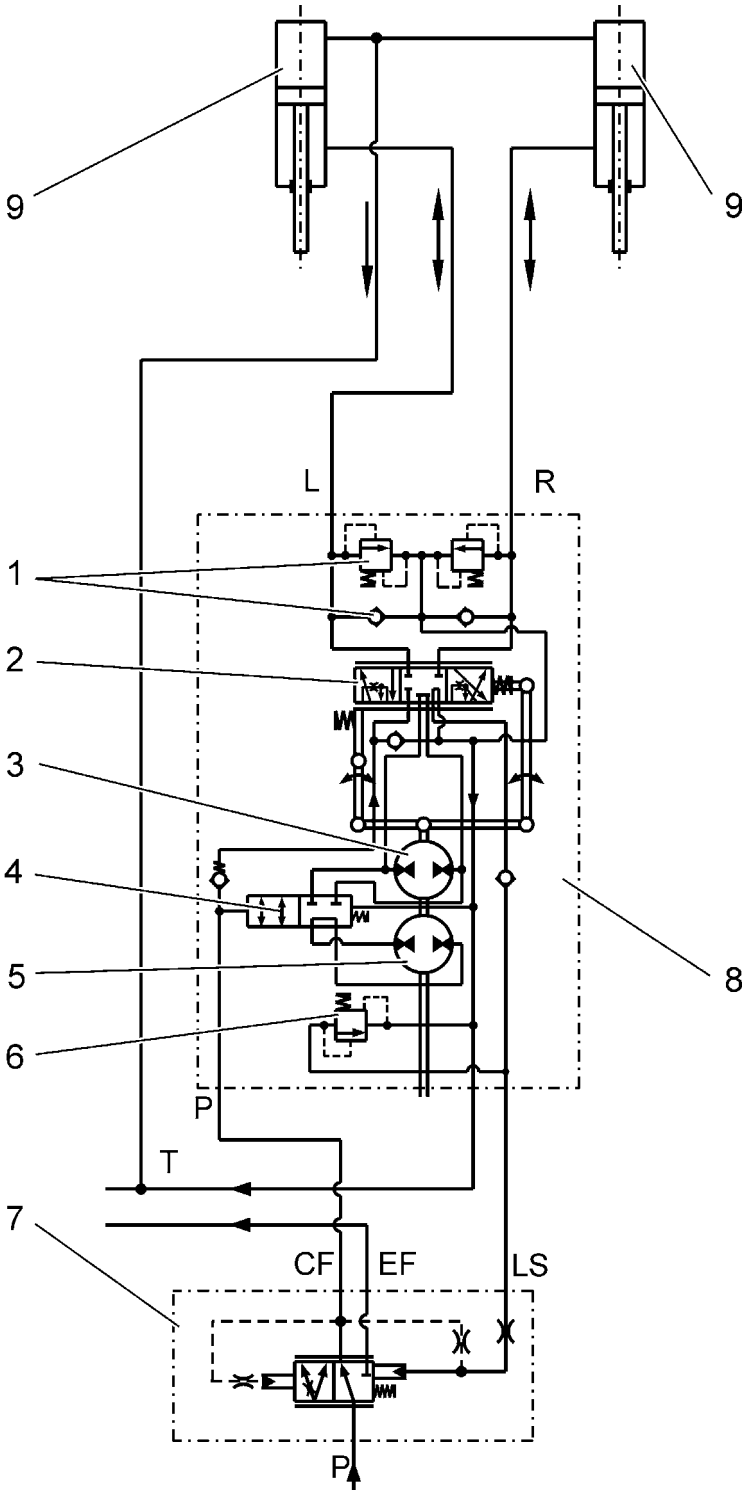


Fig. 10B.1. Steering Unit Diagram – 515G

1. Circuit Shock Valve with Anticavitation Valve 24 [MPa]
2. Steering Spool and Sleeve
3. Main Metering Pump (Gear Set)
4. Activation Spool
5. Auxiliary Metering Pump (Gear Set)
6. Relief Valve 19.5÷21.5 [MPa]
7. Priority Valve
8. Steering Control Valve
9. Steering Cylinder

STEERING CONTROL VALVE

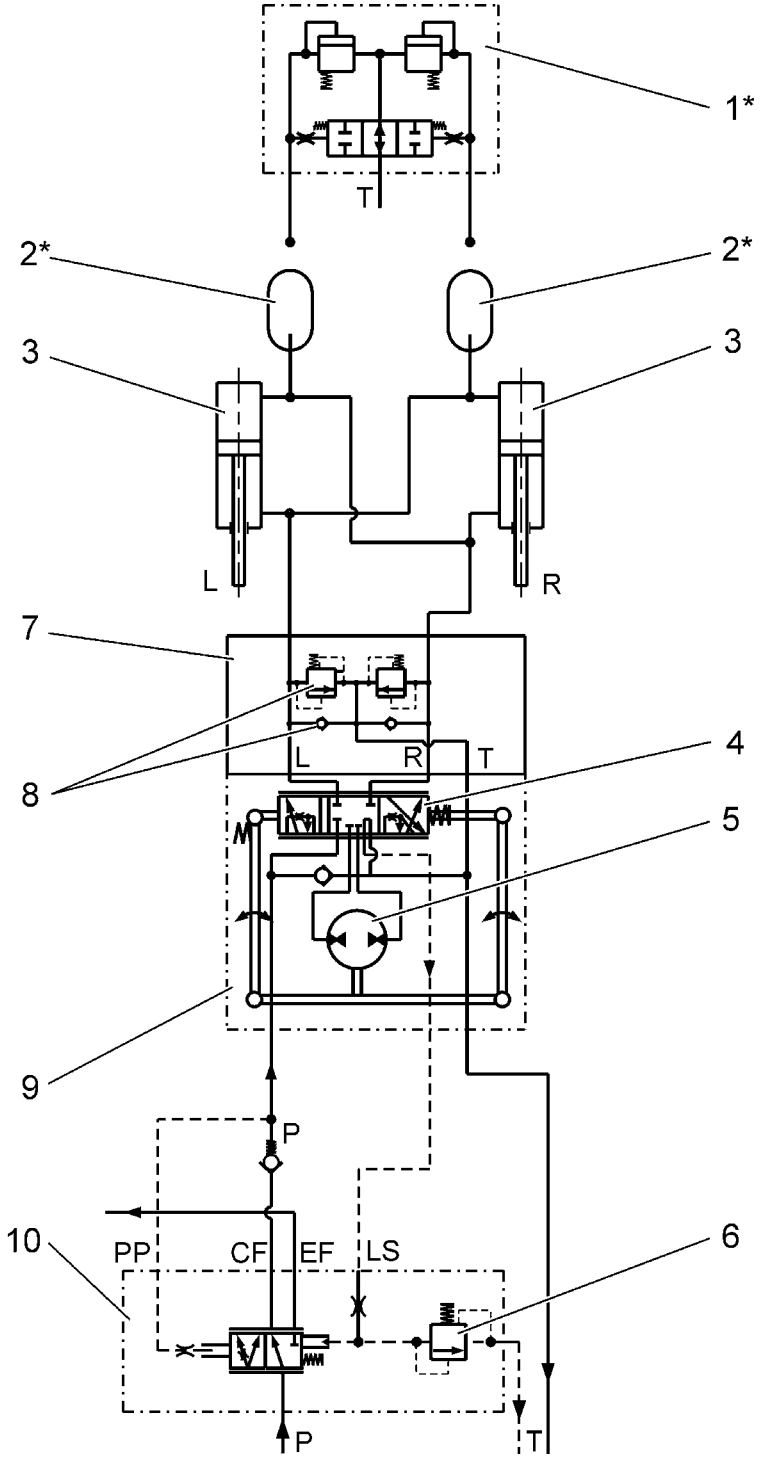


Fig. 10B.2. Steering Unit Diagram (Type with Valve Block) – 520G

1. *Cushion Valve
2. *Hydraulic Accumulator
3. Steering Cylinder
4. Steering Control Valve Spool and Sleeve
5. Gear Set
6. Relief Valve 16.5÷17.5 [MPa]
7. Valve Block
8. Circuit Shock Valve with Anticavitation Valve 20 [MPa]
9. Steering Control Valve
10. Priority Valve

* - alternative

STEERING CONTROL VALVE

VALVE BLOCK (520G ONLY)

On steering control valve (9, Fig. 10B.2), which is without incorporated valve functions, is flange mounting the valve block (7).

The valve block is supplied with two shock valves with anticavitation valves (2, Fig. 10B.2A). The shock valves (2, Fig. 10B.2B) protect valve block and steering unit against shock from external forces on the steering cylinder. Anticavitation valves (1) limit the maximum pressure drop from L to T and from R to T passages.

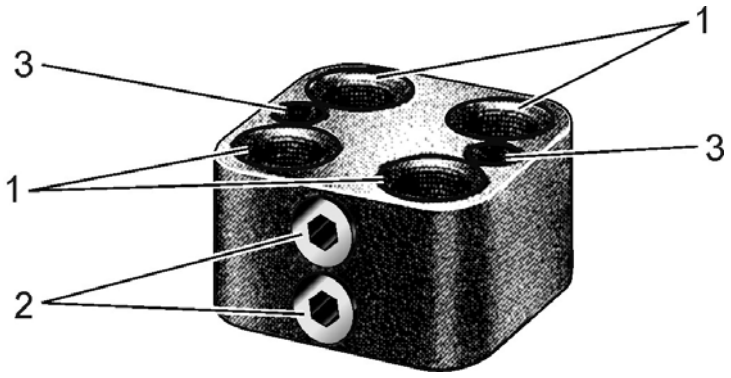


Fig. 10B.2A. View of Valve Block

1. Connection Ports
2. Shock Valve with Anticavitation Valve
3. Mounting hole

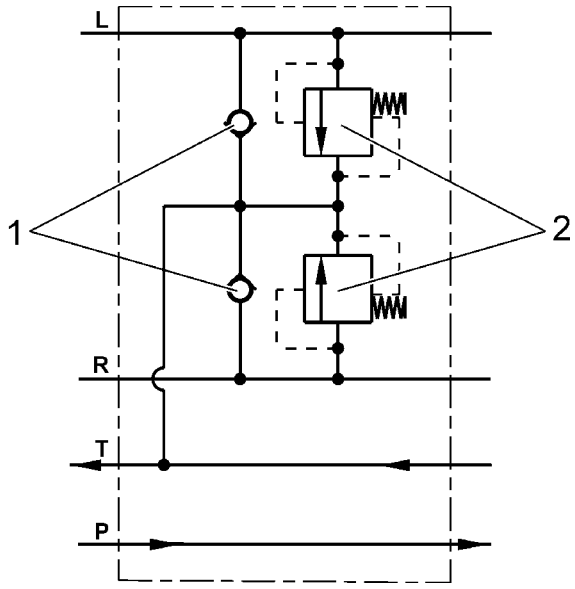


Fig. 10B.2B. System Diagram of Valve Block

1. Anticavitation Valve
2. Shock Valve

STEERING CONTROL VALVE

3. OPERATION (Fig. 10B.3 and 10B.4)

Steering control valve is steering servomechanism with hydraulic feedback. The valve consists of the following main assemblies: housing (7a), rotary sleeve (7b), spool (7c) – connected with steering wheel and gerotor gear set (14a and 14b). Spool (7c) is connected with sleeve (7b), by spring kit (6). Sleeve (7b) is connected by means of pin (5) with Cardan shaft (10), driving inner gerotor gear (14a).

In neutral position spool (7c) is positioned against sleeve (7b) so that oil flow from pump to hydraulic cylinders through gerotor gear set is closed. Rotation of steering wheel e.g. to the right causes spool (7c) to rotate in relation to sleeve (7b) within range of pin (5) connection clearance.

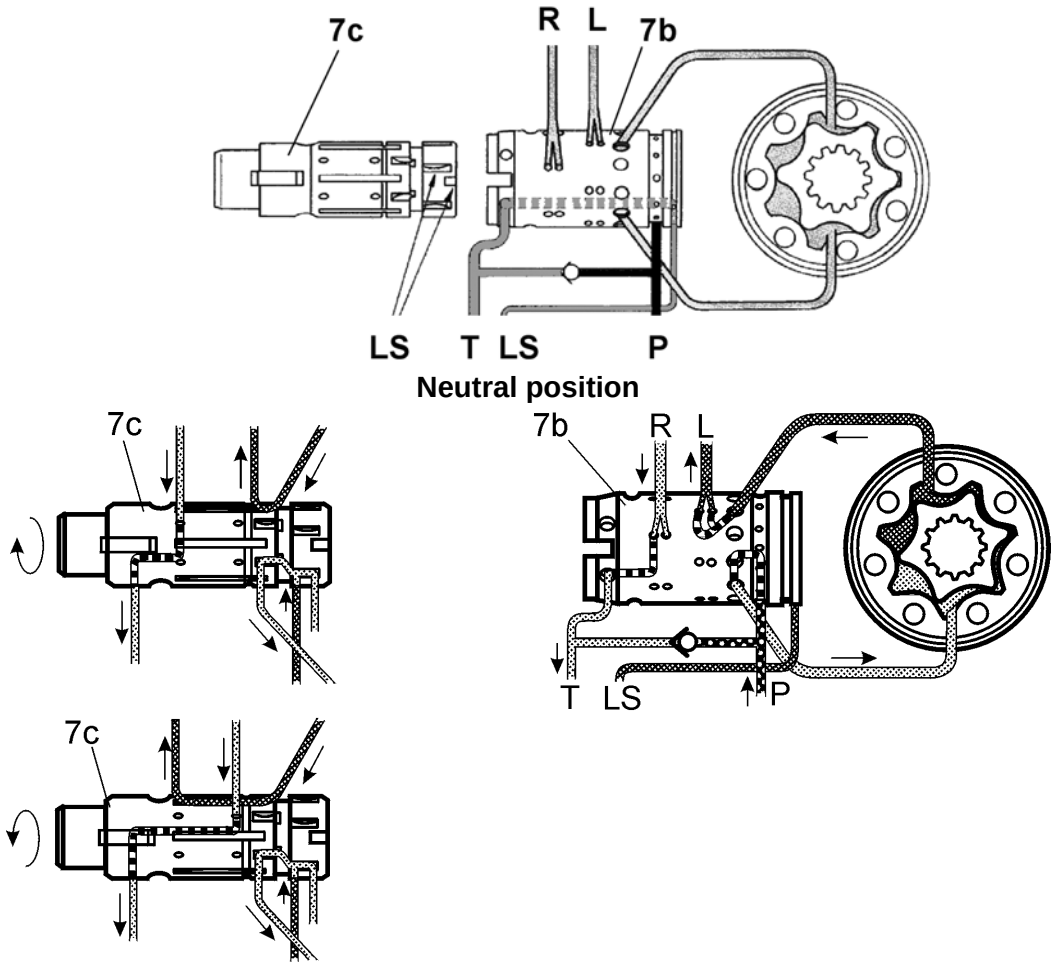


Fig. 10B.3. Steering Control Valve

7b. Sleeve
7c. Spool
R. Connection to Cylinder
L. Connection to Cylinder
P Connection to Pump thru Priority Valve
LS. Connection to Priority Valve
T. Connection to Reservoir

Rotation of spool (7c) in relation to sleeve (7b) causes springs (6) to compress, which tend to place sleeve (7b) in neutral position. Rotation of spool (7c) in relation to sleeve (7b) results in interconnection of cavity (P) and (LS). Sleeve (7b) through pin (5) and Cardan shaft (10) is connected with inner gerotor gear (14a).

STEERING CONTROL VALVE

Oil flowing through gerotor gear set (14a and 14b) turns inner gear (14a) – outer gear (14b) is fixed to the housing – and this gear through Cardan shaft (10) and pin (5) turns sleeve (7b) closing oil supply to gerotor gear set (14a and 14b).
Neutral position is attained, i.e. end of steering cylinder travel. Compressed springs (6) help to attain that position.

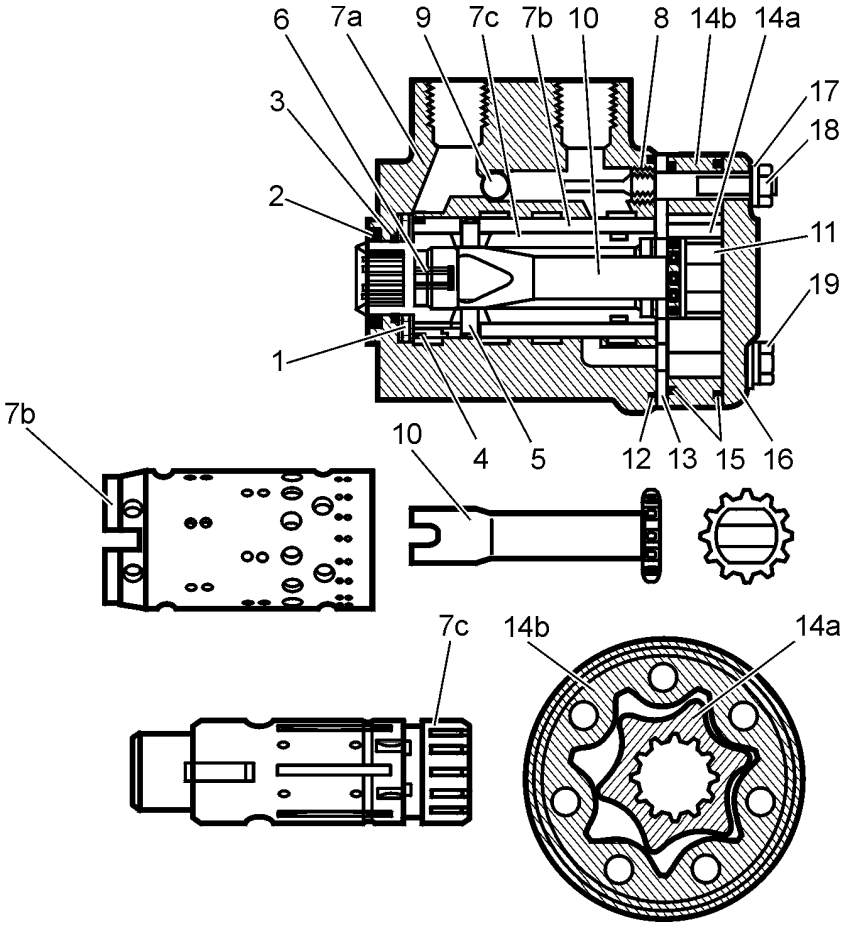


Fig. 10B.4. Steering Control Valve

1. Bearing Assy
2. Wiper Ring
3. Seal Kit
4. Ring
5. Pin
6. Spring Kit

7a. Housing
7b. Sleeve
7c. Spool
8. Threaded Sleeve
9. Ball Valve
10. Cardan Shaft
11. Spacer
12. O-ring
13. Separator Plate

14a. Inner Gerotor Gear
14b. Outer Gerotor Gear
15. O-ring
16. Cover
17. Washer
18. Special Bolt
19. Bolt

Gerotor gear set during operation of ground driven steering (emergency steering) e.g. with damaged steering pump, ground driven steering pump or engine may substitute for ground driven steering pump. In such a case when steering wheel is turned by the operator, spool (7c) is turned until it rests on pin (5). Then spool (7c) together with sleeve (7b), pin (5) and Cardan shaft (10) starts to rotate. Cardan shaft drives inner gerotor gear (14a), which delivers oil to steering system. In such a case oil from reservoir is drawn through ball valve (9). Oil pressure with manual steering (emergency steering) amounts to 2.2 [MPa] assuming that maximum force that may exert average operator on steering wheel is 120 [Nm].

STEERING CONTROL VALVE

4. SPECIFICATIONS

Main date		**515G**	**520G**
Displacement manual steering mode	[l/min]	7*	
Displacement normal steering mode	[l/min]	39*	63*
Rated oil flow at 100 RPM	[l/min]	39	63
Relief Valve Opening Pressure	[MPa]	19.5÷21.5	(16.5÷17.5)**
Shock Valve Opening Pressure	[MPa]	24	(20)***
Special torque			
Cover mounting bolts	[Nm]	30 ±6	30 ±6
Valve Block mounting bolts	[Nm]	65 ±5	65 ±5

* - at 100 rpm
** - incorporated into Priority Valve
*** - incorporated into Valve Block

5. SHOCK VALVE, ANTICAVITATION VALVE, RELIEF VALVE, TEST AND ADJUSTMENT



WARNING! Before starting the test make sure the area in front and behind the machine is clear of personnel and obstructions. Do not allow anyone near the tires or on the access ladders during this test. Oil flowing under pressure may cause severe injury.

NOTE: Performing test will require two people. One person to operate the machine, the second person to time the machine's performance. Tests should be conducted on level and smooth surface.

SHOCK VALVE AND ANTICAVITATION VALVE

Steering circuit shock valve and anticavitation valve tests and adjustment cannot be made on the machine. It should be done at specially adapted bench to control the input flow.

NOTE: *If special stand is not available it is preferable to replace damaged shock valve for new ones.*

- Shock valve must be set to opening pressure (see SPECIFICATIONS)
- Anticavitation valve is non-adjustable.

RELIEF VALVE (FOR 515G ONLY)

1. Lift the bucket off the ground. Place the machine in straight forward position and shut off the engine.
2. Perform operation described in STEERING SYSTEM PRESSURE TEST in Section 10.
3. If adjustment of relief valve (2, Fig. 10B.6) is required, follow the below procedure:
   a. Lift floor mat from cab floor (4) and remove steering column guard (Refer to Section 5).
   b. Unscrew the plug (5, Fig. 10B - See REASSEMBLY FOR LOADER 515G) using 8 [mm] hexagon socket spanner and remove washer (4).
   c. Rotate the adjusting screw (3) using 8 [mm] hexagon socket spanner 1/8 of a turn. Turn the screw clockwise to increase the pressure and counterclockwise to decrease the pressure. Hold the adjusting screw in this position.

d. Start the engine and perform operations specified in STEERING SYSTEM PRESSURE TEST in Section 10. The steering system relief valve should open in both directions at 19.5÷21.5 [MPa].
e. When the correct relief setting has been obtained install new washer (4) and torque the plug (5) to 50 Nm.
f. Repeat Step (d) once more to be sure the position of the adjusting screw has not changed.

6. REMOVAL

WARNING! Before attempt to removal, make sure the engine is stopped, the bucket is lowered to the ground, transmission shifter is in neutral position (N), parking brake applied, wheels are blocked with wedges and the master switch turned to the off position and the keys are taken out from both the electric master switch and starting switch to prevent accidental engine starting.

IMPORTANT: *Disconnected hydraulic lines must be capped with the correct size plastic caps. If plastic caps are not available use clean corks or self-adhesive tape. Openings must never be plugged with rags. This practice could easily introduce dirt or lint in to critical components of the machine. Tag disconnected hydraulic lines.*

1. Raise the bucket off the ground. Place the machine in straight forward position.
2. Shut off the engine and turn several times steering wheel to the right and to the left to relieve oil pressure remaining in steering system and lock the frames with locking bar.
3. Remove two bolts with washers (4, Fig. 10B.5) securing the right side inspection cover (3) to the front frame and remove the cover (3).

NOTE: *Before disconnecting hoses from steering control valve (10), place a suitable container for oil drains from the steering control valve and hoses.*

4. Prior to disconnection any hoses from the steering control valve (10) drain the hydraulic reservoir (Refer to the OPERATOR'S MANUAL in Section 5 for this procedure).

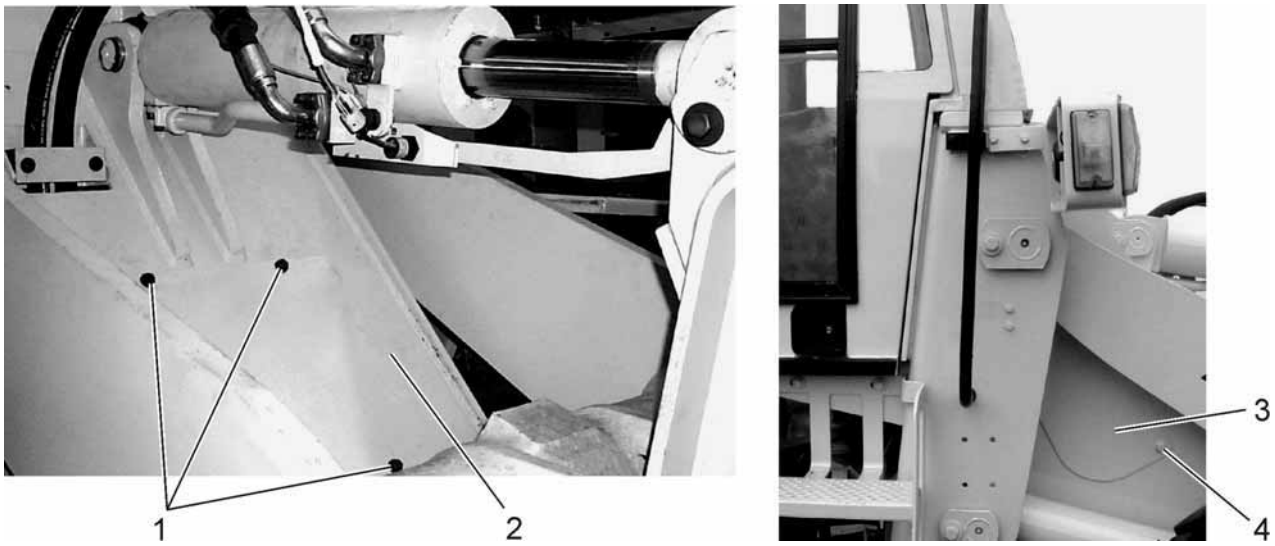
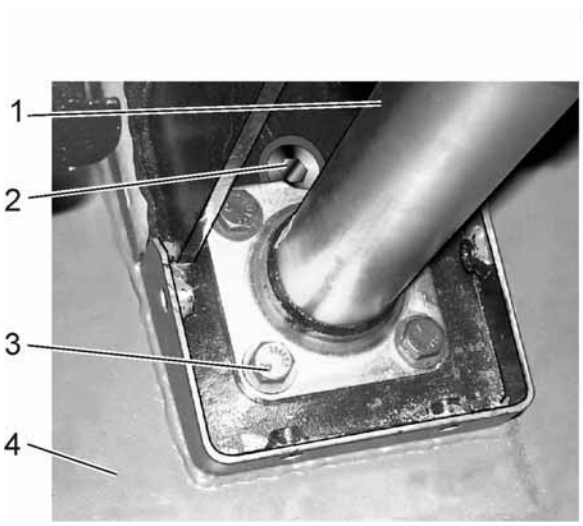


Fig. 10B.5. Access to Hydraulic Valves

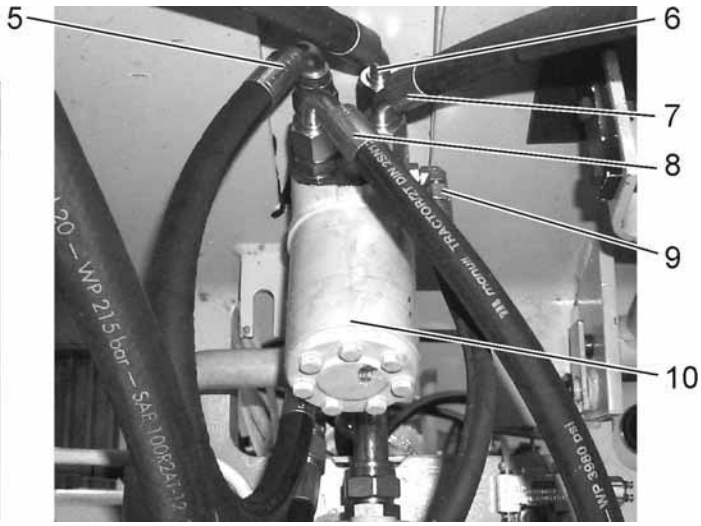
1. Bolt with Washer (4 pcs)
2. Front Inspection Cover
3. Right Hand Side Inspection Cover
4. Bolt with Washer (2 pcs).

STEERING CONTROL VALVE

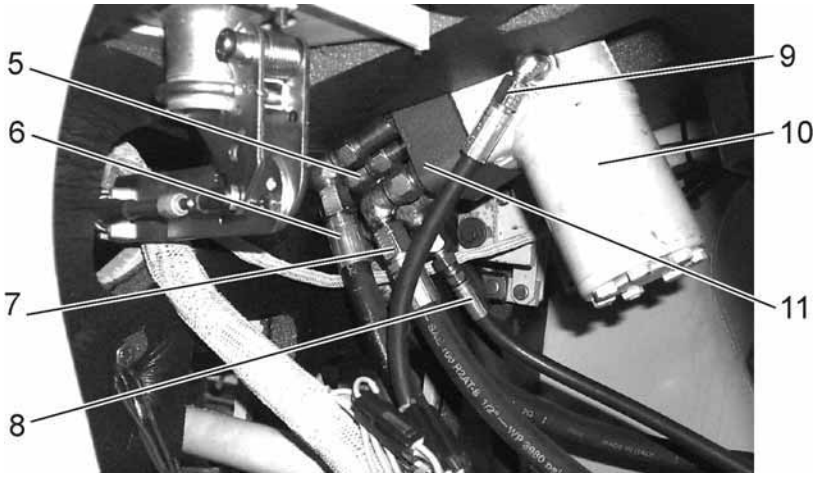
5. Disconnect hose (9, Fig. 10B.6) from port (LS), hose (7) from port (R), hose (6) from port (L), and hose (5) from port (T) and mark them.
6. Lift floor mat from cab floor (4) and remove steering column guard (Refer to Section 5).
7. Unscrew four bolts with washers (3) that secure steering control valve (10) and steering column (1) to the cab floor (4). Before bolts unscrewing protect valve (10) against falling down.
8. Free steering control valve (10)) from the steering column (1) lower shaft splined end and take the steering control valve out of the machine.
9. Remove connectors with washers from steering control valve (10).



View from the Cab



View under the Cab (515G)



View under the Cab (520G)

Fig. 10B.6. Steering Control Valve Mounting and Connection Points

1. Steering Column
2. Relief Valve (for 515G only)
3. Bolt with Washer
4. Cab Floor
5. Hose (T)
6. Hose (L)
7. Hose (R)
8. Hose (P)
9. Hose (LS)
10. Steering Control Valve
11. Valve Block

STEERING CONTROL VALVE

7. DISASSEMBLY

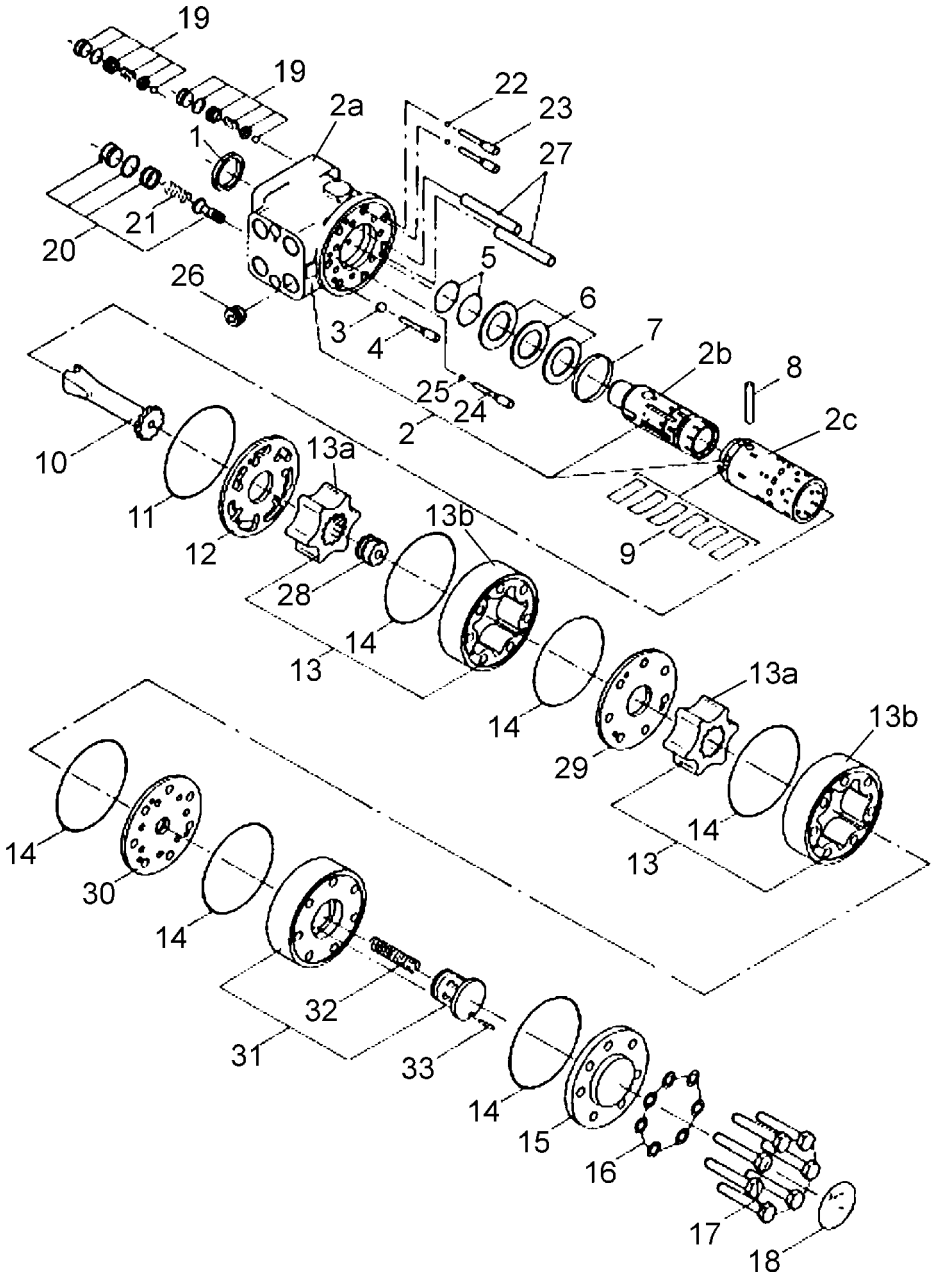


Fig. 10B.7. Steering Control Valve (515G)

1. Wiper Ring
2. Housing, Spool and Sleeve
2a. Housing
2b. Spool
2c. Sleeve
3. Ball
4. Pin
5. Seal Kit (Seal, O-ring, Lip Seal)
6. Bearing Assy
7. Ring
8. Pin
9. Springs Set
10. Cardan Shaft
11. O-Ring
12. Separator Plate
13. Gears Set
13a. Inner Gerotor Gear
13b. Outer Gerotor Gear
14. O-ring
15. Cover
16. Washers
17. Bolts
18. Identification Plate
19. Shock Valve
20. Relief Valve
21. Spring
22. Balls
23. Pins
24. Pin
25. Ball
26. Check Valve
27. Roll Pins
28. Cardan Shaft
29. Separator Plate
30. Separator Plate
31. Valve Assy
32. Spring
33. Pin

STEERING CONTROL VALVE

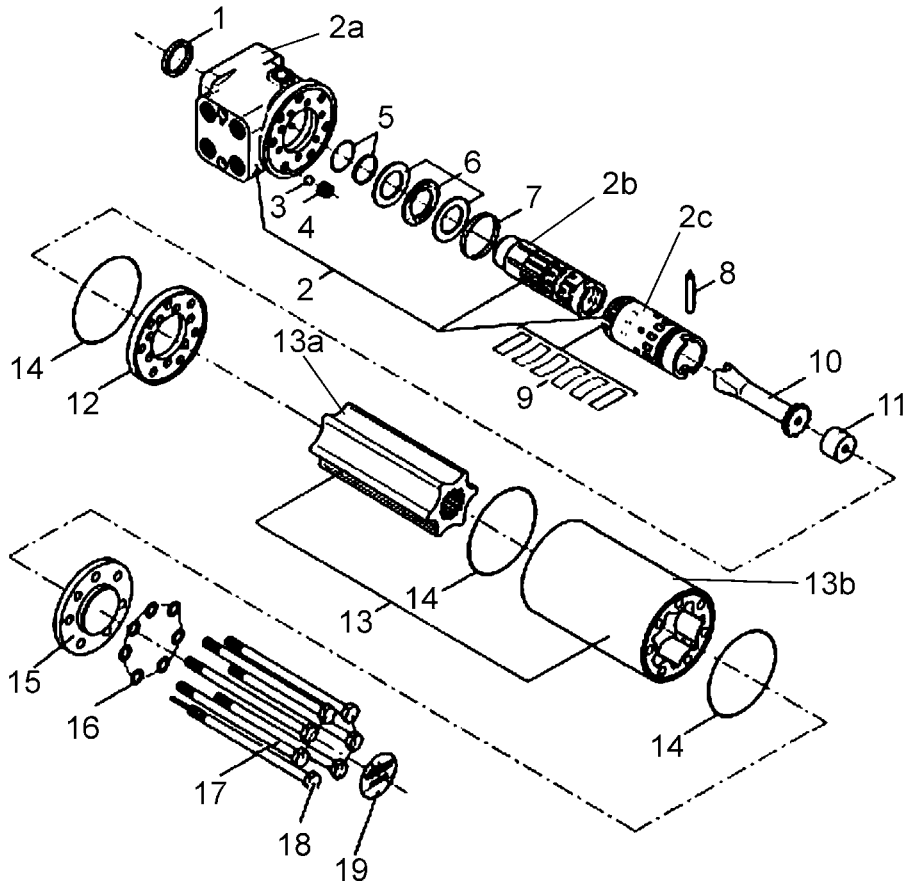


Fig. 10B.8. Steering Control Valve (520G)

1. Wiper Ring
2. Housing, Spool and Sleeve
2a. Housing
2b. Spool
2c. Sleeve
3. Ball
4. Threaded Sleeve
5. Seal Kit (Seal, O-ring, Lip Seal)
6. Bearing Assy
7. Ring
8. Pin
9. Springs Set
10. Cardan Shaft
11. Spacer
12. Intermediate Plate
13. Gears Set
13a. Inner Gerotor Gear
13b. Outer Gerotor Gear
14. O-ring
15. Cover
16. Washers
17. Bolts
18. Special Bolt
19. Identification Plate

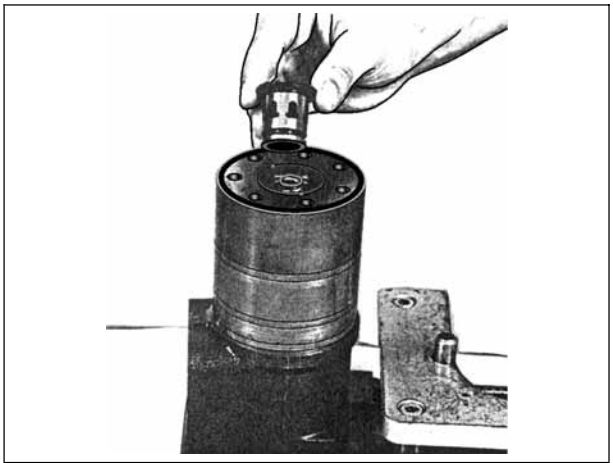
7.A. DISASSEMBLY FOR LOADER 515G (Fig. 10B.7).



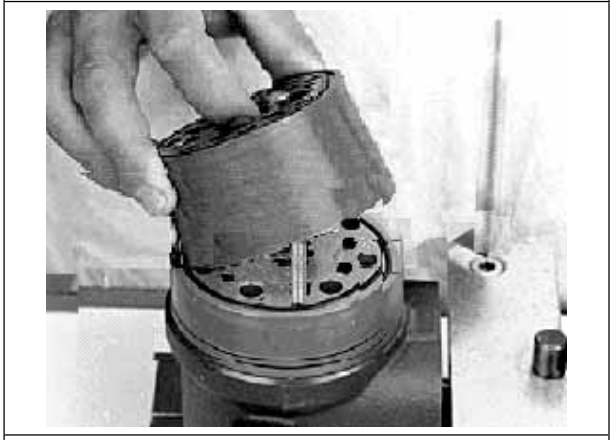
1. Fasten control valve in the holding tool SJ 150-9000-08. Unscrew seven bolts (17), remove washers (16) and cover (15).

STEERING Control VALVE

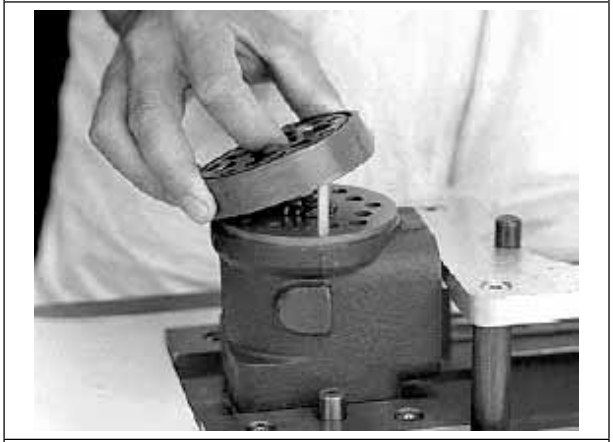
2. Lift off valve assy (31), take out spring (32), the pin (33)) and remove O-ring (14).



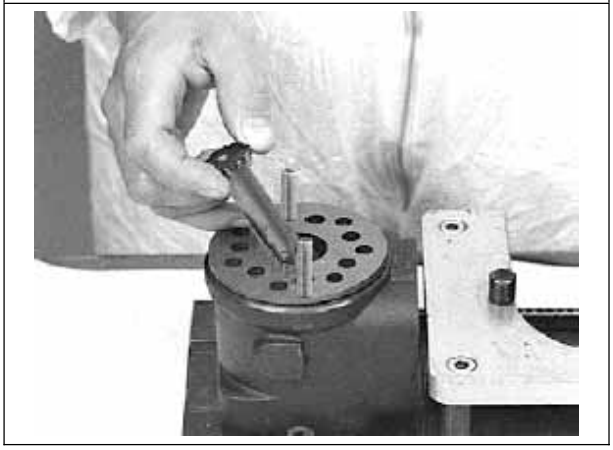
3. Lift off the separator plate (30), set gear (13) with Cardan shaft (28) and remove its O-rings (14).



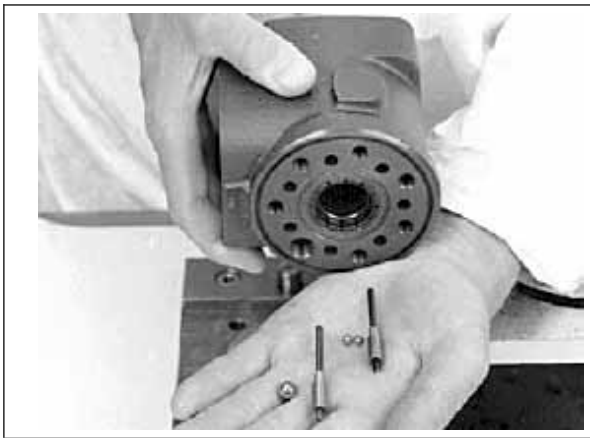
4. Lift separator plate (29) and second set gear (13), remove its O-rings (14)



5. Remove Cardan shaft (10), lift off the separator plate (12), O-ring (11) and remove two roll pins (27).

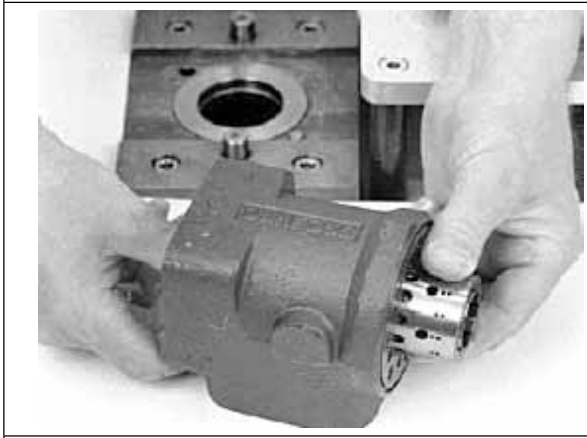


STEERING CONTROL VALVE



Unscrew two threaded pins (4 and 24) and shake out the balls (3 and 25).

6. Remove two pins (23) and shake out the balls (22).



7. Remove housing (2a) from holding tool SJ 150-9000-08. Press spool (2b) inwards and sleeve (2c). Ring (7), bearing assy (6) will be pushed out of the housing (2a) together.



8. Take ring (7), bearing assy (6) from sleeve and spool. The outer (thin) bearing race can sometimes “stick” in the housing, therefore check that it has come out.

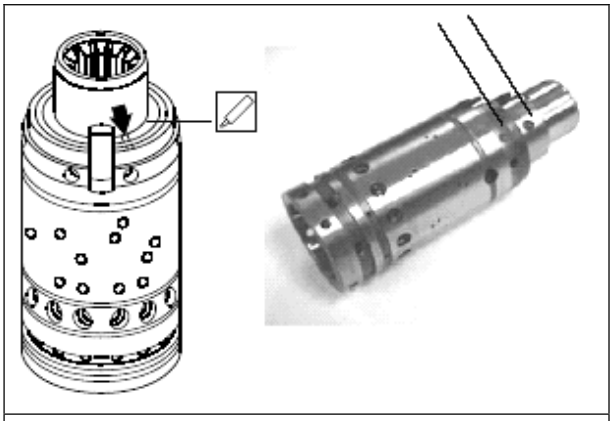


9. Push out pin (8) connecting spool (2b) with sleeve (2c).

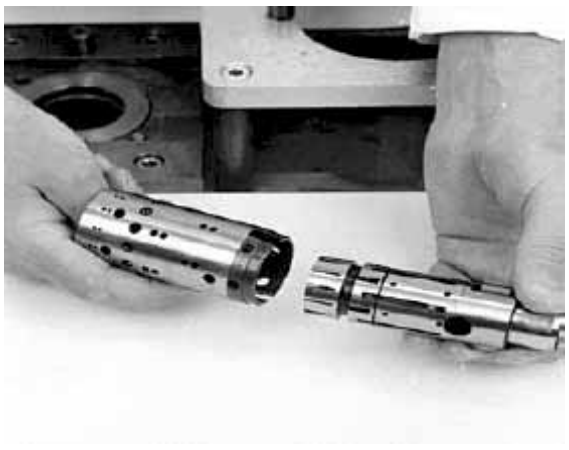
VALVES

STEERING CONTROL VALVE

NOTE: *A small mark has been made with a pumice stone on both spool and sleeve close to one of the slots for the neutral position springs (see drawing). If the mark is not visible, remember to leave a mark of your own on sleeve and spool before the neutral position springs are dismantled.*



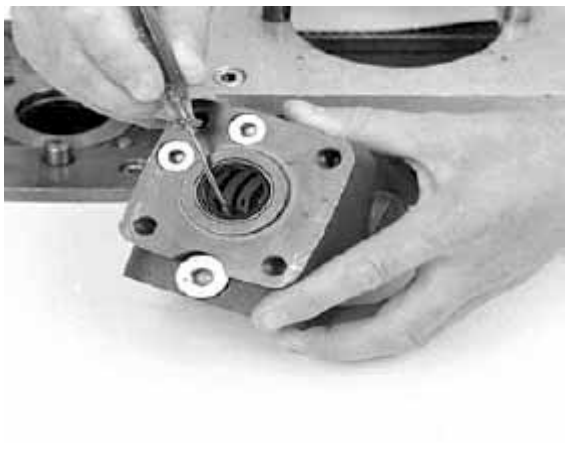
10. Carefully slide out spool (2b) from sleeve (2c).



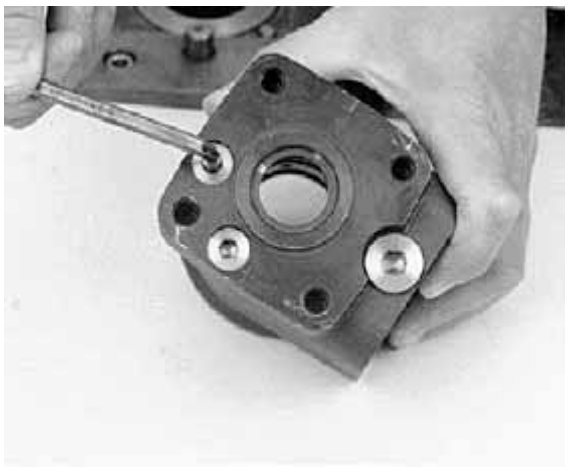
11. Remove return springs set (9) from groove in spool (2b).



12. Remove seals (5) and wiper ring (1).



STEERING CONTROL VALVE



DISASSEMBLY OF SHOCK VALVE ASSY (Fig. A.) – If needed.

13. Unscrew plugs (6) using a 6 [mm] hexagon socket spanner from two shock valves and remove washers (5).



14. Unscrew adjusting screws (4) using a 6 [mm] hexagon socket spanner and shake out the two springs (3) with valve cone seats (2) and two valve balls (1) into your hand. The valve seats are bonded into the housing and cannot be removed.

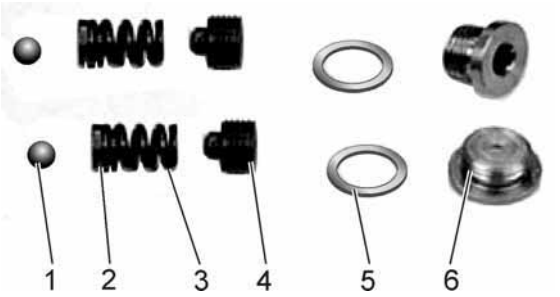
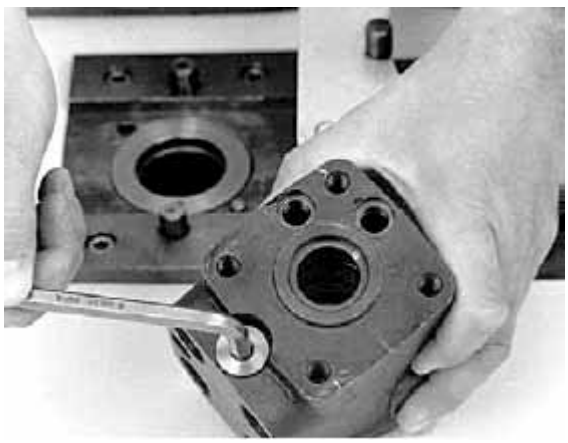


Fig .A.

SHOCK VALVE ASSY

1. Ball
2. Valve Cone Seat
3. Spring
4. Adjusting Screw
5. Washer
6. Plug

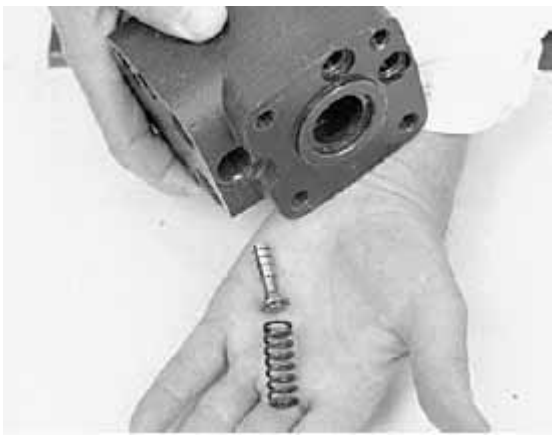


DISASSEMBLY OF RELIEF VALVE ASSY (Fig .B.) – If needed.

15. Unscrew plug (5) using an 8 [mm] hexagon socket spanner and remove washer (4) from relief valve.

STEERING CONTROL VALVE

16. Unscrew adjusting screw (3) using an 8 [mm] hexagon socket spanner and shake out spring (2) and piston (1).



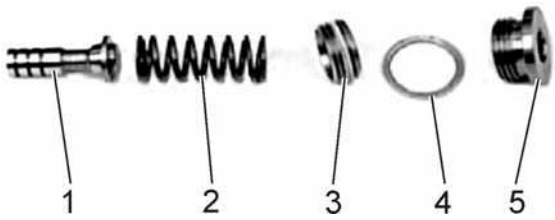


Fig .B.

RELIEF VALVE ASSY
1. Piston
2. Spring
3. Adjusting Screw
4. Washer
5. Plug

17. Remove check valve (26, Fig.10B.7).

7.B. DISASSEMBLY FOR LOADER 520G (FIG. 10B.8).

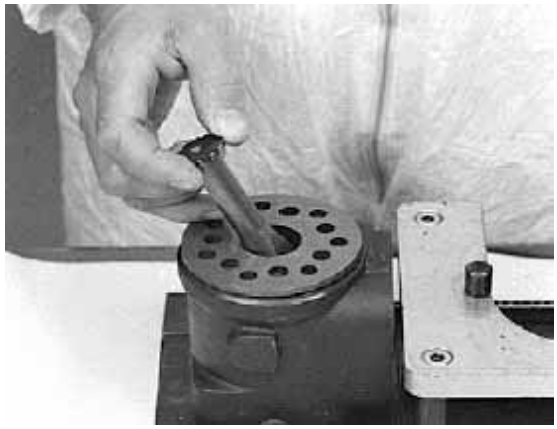
1. Unscrew two bolts with washer secure the valve block (11, Fig. 10B.6) to steering control valve (10), remove valve block (11).
2. Fasten steering control valve in the holding tool SJ 150-9000-08. Unscrew six bolts (17) plus special bolt (18). Remove washers (16) and cover (15)



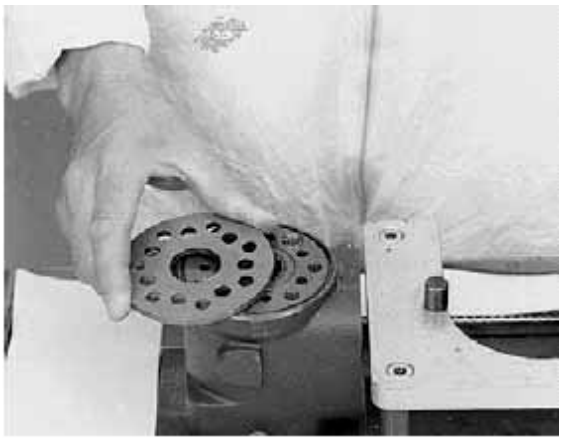
STEERING CONTROL VALVE



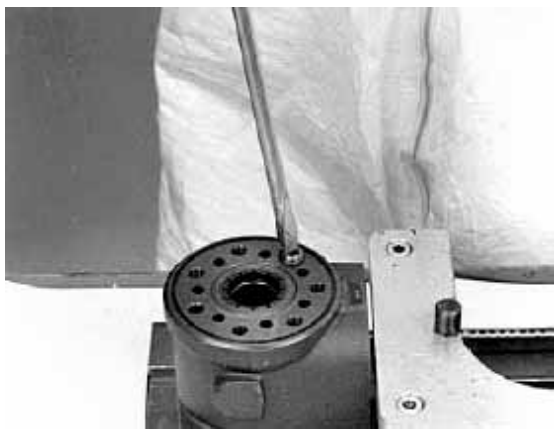
3. Lift set gear (13) with spacer (11) if fitted, remove its O-rings (14).



4. Remove Cardan shaft (10).



5. Lift off the intermediate plate (12) and O-ring (14).



6. Use a 2 [mm] Allen key to unscrew the threaded sleeve (4) and shake out ball (3).

STEERING CONTROL VALVE

7. Disassembly housing spool and sleeve (2). Refer to 7A. DISASSEMBLY FOR LOADER 515G - step 8 ÷13.

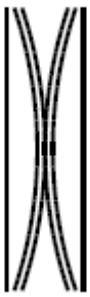
8. INSPECTION AND REPAIR

1. Wash thoroughly all parts and check for scores, nicks, fractures (particularly sliding surfaces of spools and valves as well as bores in valve body).
2. Check all parts carefully and make any replacements necessary.
3. Replace all seals and washers for new ones.
4. Select correct springs.
5. Lubricate all parts with hydraulic oil before installation.

9. REASSEMBLY

9.A. REASSEMBLY FOR LOADER 515G (Fig. 10B.7)

1. Place the two flat neutral position springs (9) in the slot. Place the curved springs between the flat ones and press them into place.



2. Line up the spring set (9).





STEERING CONTROL VALVE



3. Guide the spool (2b) into the sleeve (2c). Make sure that spool and sleeve are placed correctly in relation to the small marks marked before disassembling.



4. Press the springs (9) together and push the neutral position springs into place in the sleeve (2c).



5. Line up the springs and centre them.



6. Guide the ring (7) down over the sleeve (2c). The ring should be able to move - free of springs.

STEERING CONTROL VALVE

7. Fit the cross pin (8) into the spool and sleeve.



8. Fit bearing assy (6) races and needle bearings as shown below on the Fig .C.



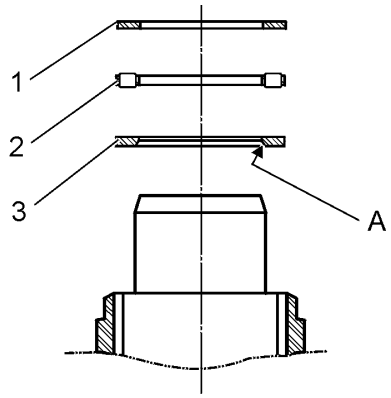


Fig .C.

Description to Fig.C:

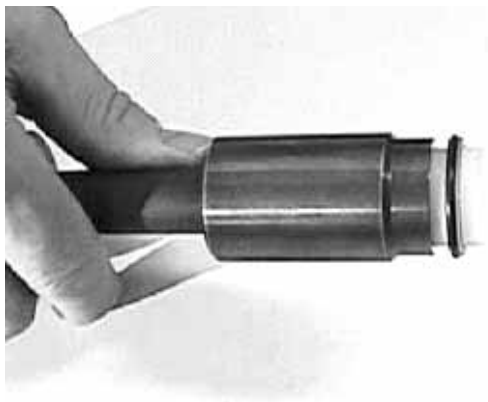
1. Outer bearing race
2. Needle bearing
3. Inner bearing race

A - The inside chamfer on the inner bearing race must face the inner spool.

9. Turn the steering unit until the bore is horizontal. Guide the outer part of the assembly tool SJ 150N4014-1 into the bore for the spool and sleeve.



STEERING CONTROL VALVE



REASSEMBLY FOR SEAL KIT (Seal, O-ring)

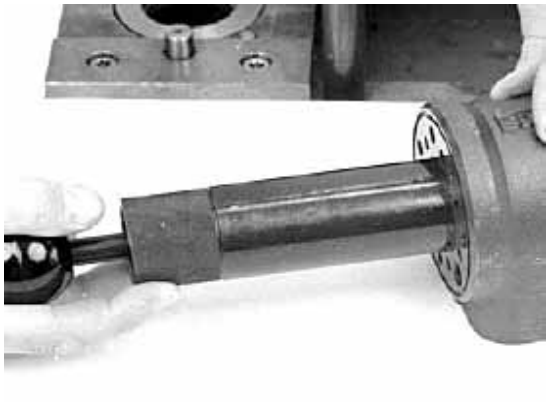
10. Lubricate seal and O-ring (5) with hydraulic oil and place them on the inner part of the assembly tool SJ 150N4014-1.



11. Hold the outer part of the assembly tool in the bottom of the steering unit housing and guide the inner part of the tool right to the bottom.



12. Press and turn the seal and O-ring (5) into position in the housing.

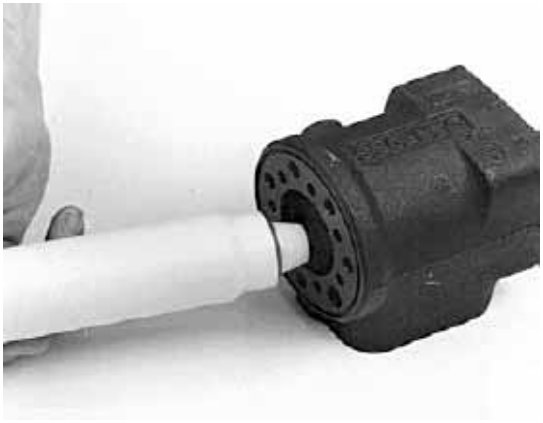


13. Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide from the inner part in the bore.

STEERING CONTROL VALVE

REASSEMBLY FOR LIP SEAL

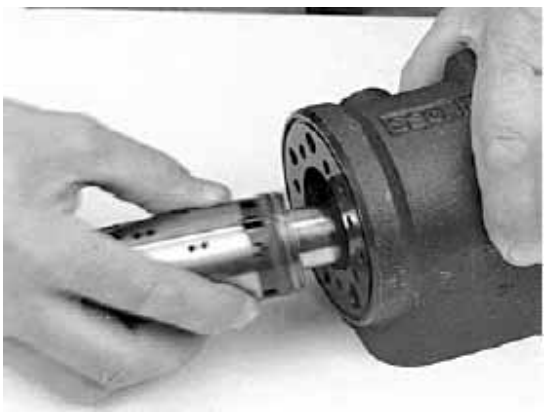
14. Lubricate the lip seal (5) with hydraulic oil and place it on the assembly tool SJ 150-9000-17.



15. Guide the assembly tool SJ 150-9000-17 right to the bottom. Press and turn the lip seal (5) into place in the housing.



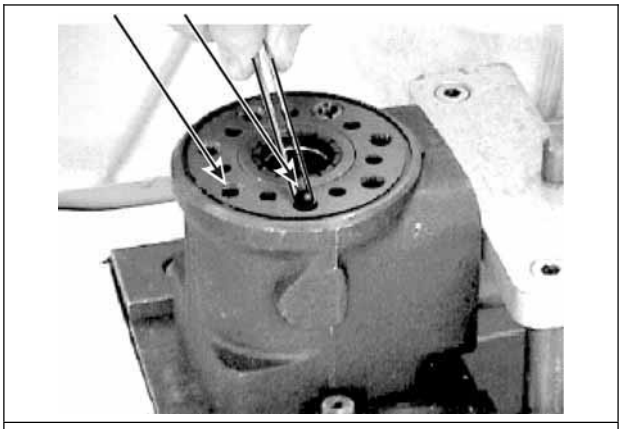
16. With a light turning movement, guide the spool and sleeve into the bore.



17. The spool set will push out the assembly tool guide. The seal kit (5) is now in position.



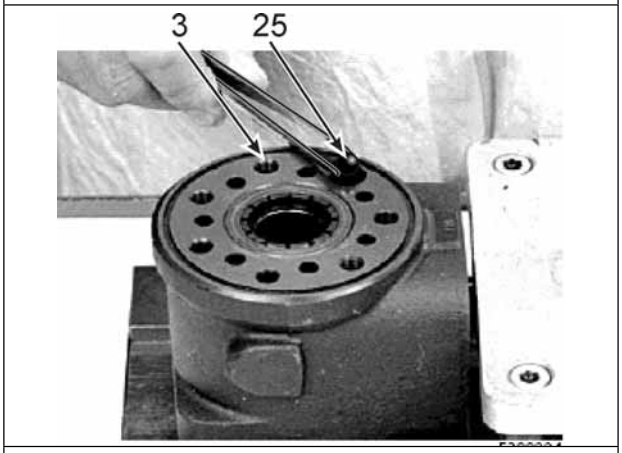
STEERING CONTROL VALVE



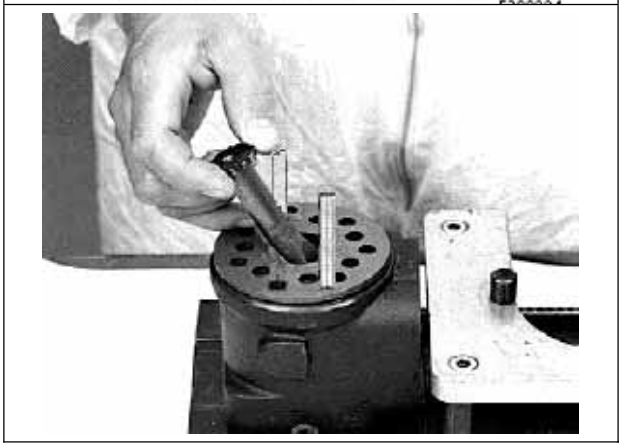
18. Turn the steering unit until the bore is vertical again Fasten control valve in the holding SJ 150-9000-08. Put the balls (22) into the holes indicated by the arrows.



19. Place a new pins (23) in the same two holes.



20. Place a balls (3, 25) in the two holes indicated by the arrows. Mount the threaded pins (4 and 24) in the same holes. Tightening torque 1 ±0.1 [Nm].

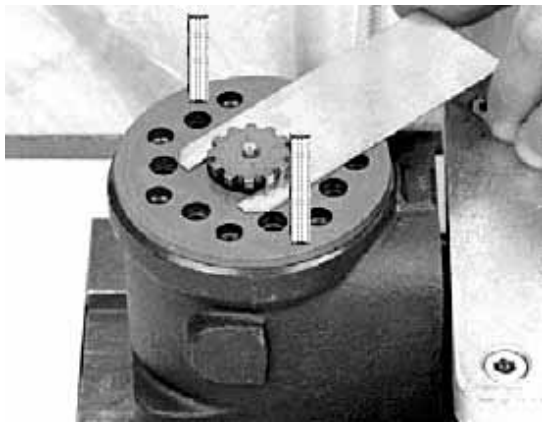


21. Mount the roll pins (27). Grease the O-ring (11) with mineral oil approx. viscosity 500 [cSt] at 20 [°C] and place into the groove.

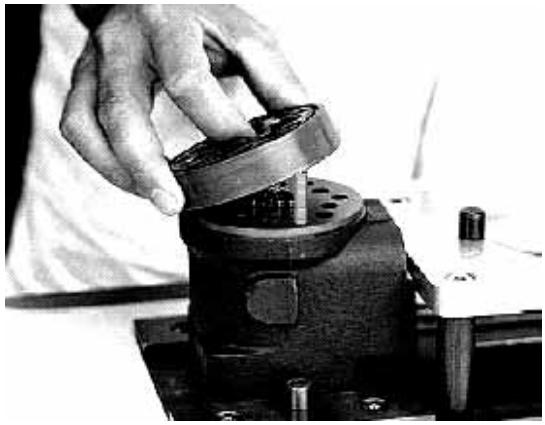
22. Place over the pins separator plate (12), guide the Cardan shaft (10) down into the bore so that the slot is parallel with the connection flange.

STEERING CONTROL VALVE

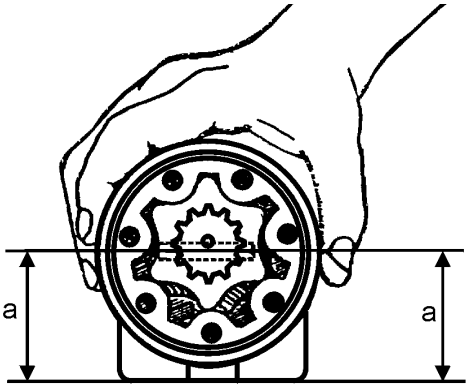
23. Place the Cardan shaft (10) as shown - so that it is held in position by the mounting fork SJ 150-9000-3.



24. Grease the two O-rings (14) with mineral oil approx. viscosity 500 [cSt] at 20 [°C] and place them in the two grooves in the outer gerotor gear (13b). Fit the gear set (13) on the Cardan shaft (10).

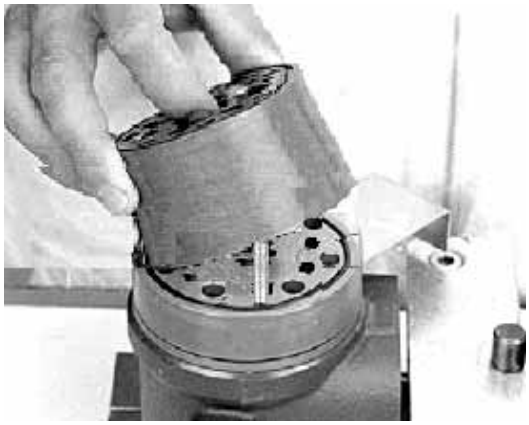


IMPORTANT: *Fit the inner gerotor gear (13a) and Cardan shaft (10) so that a tooth base in the gear is positioned in relation to the shaft slot as shown below. Turn outer gerotor gear (13b) so that seven trough holes are aligned with holes in the housing.*

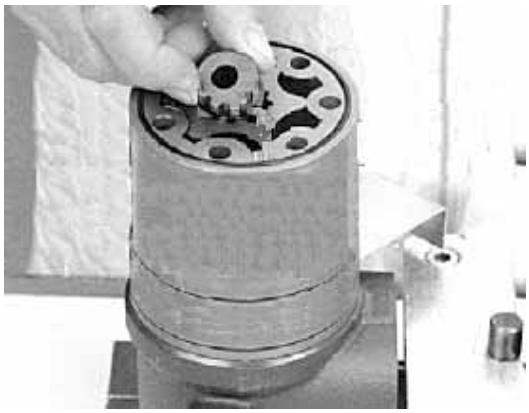




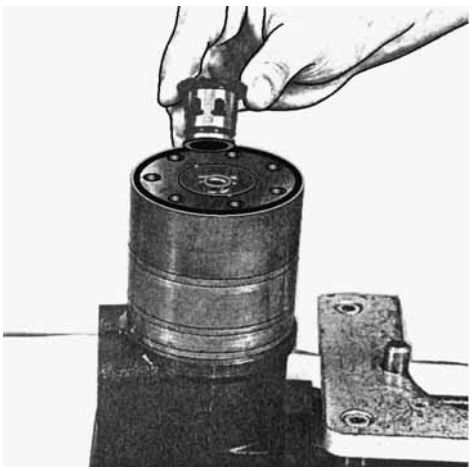
STEERING CONTROL VALVE



25. Place the separator plate (29), grease the two O-rings (14) with mineral oil approx. viscosity 500 [cSt] at 20 [°C] and place them in the two grooves in the outer Gerotor gear. Place second set gear (13).



26. Place the Cardan shaft (28) into the inner gerotor gear (13a).



27. Install valve assy (31), spring (32) and the pin (33). Grease the O-ring (14) with mineral oil approx. viscosity 500 [cSt] at 20 [°C] and place them into valve assy (31) groove.



28. Place cover (15) in position. Fit the seven bolts (17) with washers (16) and insert them. Cross-tighten all the screws with a torque of 30 ±6 [Nm]

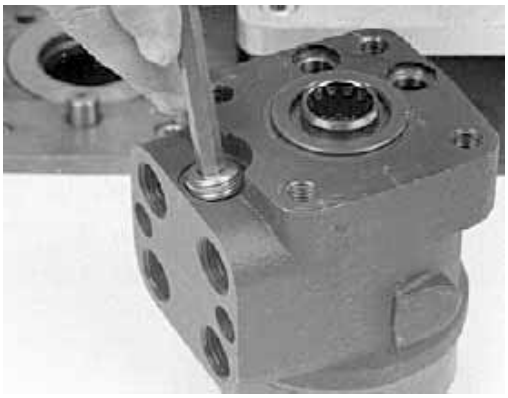
STEERING CONTROL VALVE

29. For assembly of the relief valve (19) (Refer to 7.A. DISASSEMBLY FOR LOADER 515G, Fig.B.), fit the piston (1) and spring (2).

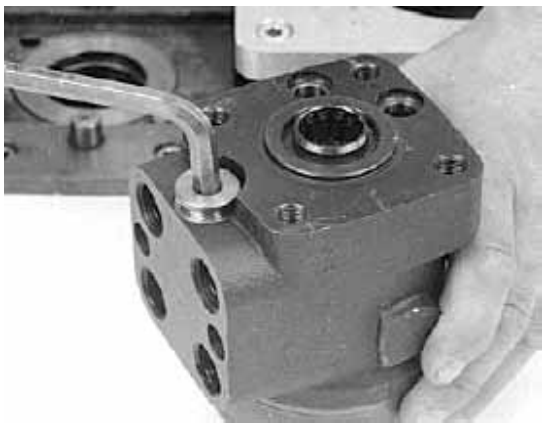




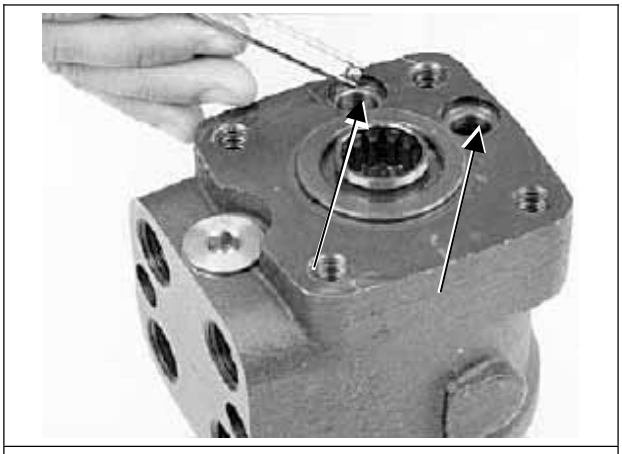
30. Screw in the adjusting screw (3) with an 8 mm hexagon socket spanner. Don't tight the spring. The pressure setting will be done after valve installation on the machine (Refer to RELIEF VALVE, SHOCK VALVE AND ANTICAVITATION VALVE TEST AND ADJUSTMENT for Loader 515G in this Section)



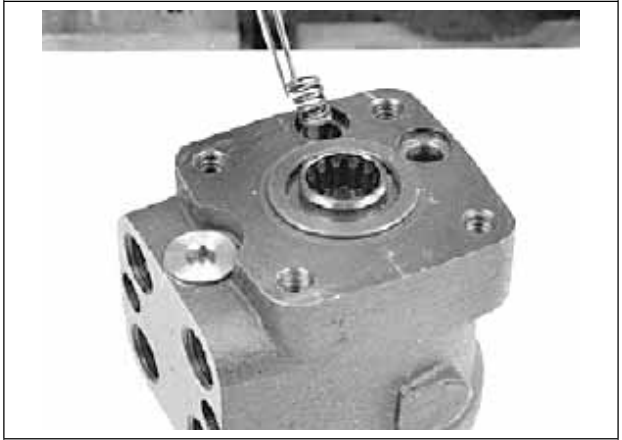
31. Screw plug (5) with washer (4) into the housing using an 8 mm hexagon socket spanner. Tightening torque 50 ±10 [Nm].



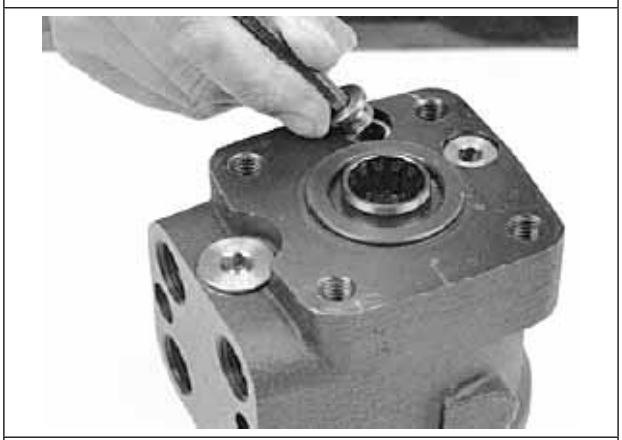
STEERING CONTROL VALVE



32. For assembly of the shock valves (19) - if removed, put a ball (1) (Refer to 7.A. DISASSEMBLY FOR LOADER 515G, Fig .A.) in the two holes indicated by the arrows.



33. Place spring (3) with valve cone (2) over the two ball (1). Screw in the adjusting screw (4) using a 6 mm hexagon socket spanner. Make the pressure setting (Refer to RELIEF VALVE, SHOCK VALVE AND ANTICAVITATION VALVE TEST AND ADJUSTMENT - for Loader 515G in this Section)



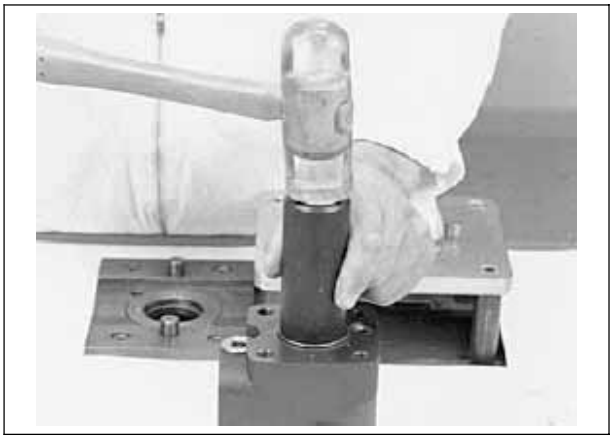
34. Screw plug (6) with washer (5) into the two shock valves and tighten them with a torque of 30+10 [Nm] using a 6 mm hexagon socket spanner.



35. Place the wiper ring (1) in the housing. The wiper ring must be placed only after the pressure relief valve and shock valves have been fitted.

STEERING CONTROL VALVE

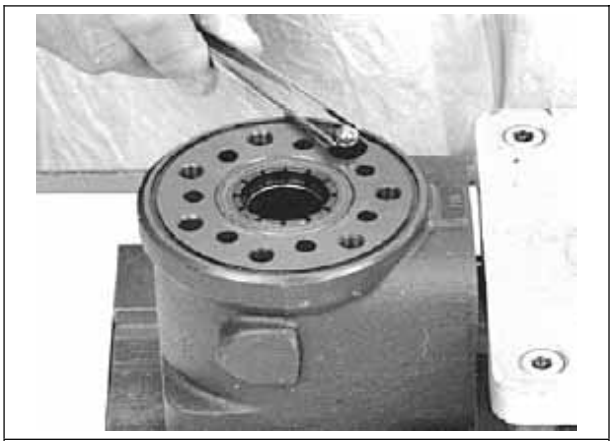
36. Fit the wiper ring (1) in the housing using special tool SJ 150-9000-22 and a plastic hammer.



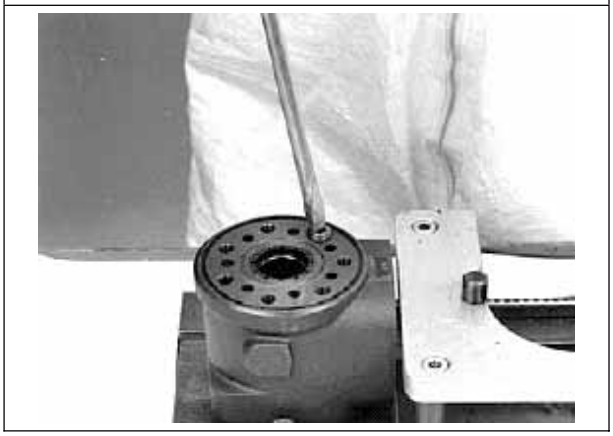
9.B. REASSEMBLY FOR LOADER 520G (Fig. 10B.8)

1. Install housing spool and sleeve (2) (Refer to 9.A.REASSEMBLY FOR LOADER 515G, Step 1÷17)

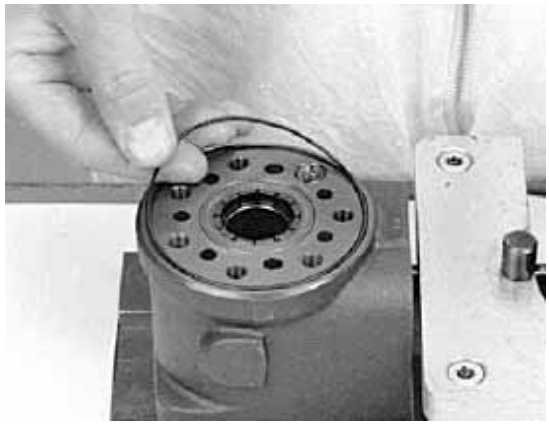
2. Turn the steering unit until the bore is vertical again. Fasten control valve in the holding SJ 150-9000-08. Put the ball (3) into the hole.



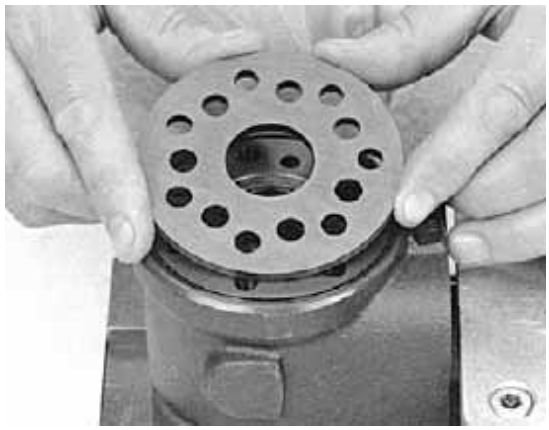
3. Screw the threaded sleeve (4) lightly into the valve bore. The top of the sleeve must lie just below the surface of the housing.



STEERING CONTROL VALVE



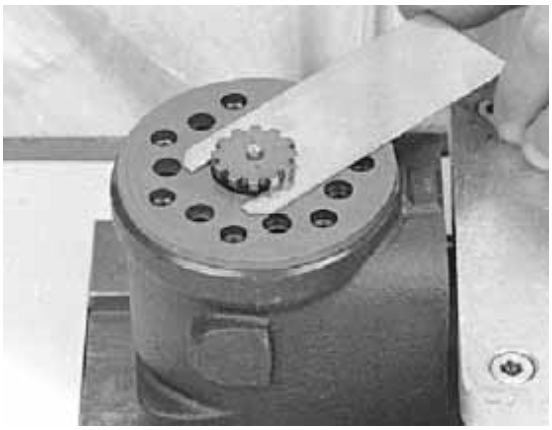
4. Grease the O-ring (14) with mineral oil approx. viscosity 500 [cSt] at 20 [°C] and place it in the groove.



5. Place the intermediate plate (12) so that the channel holes match the holes in the housing.



6. Guide the Cardan shaft (10) down into the bore so that the slot is parallel with the connection flange.



7. Place the Cardan shaft (10) as shown, so that it is held in position by the mounting fork SJ 150-9000-3.

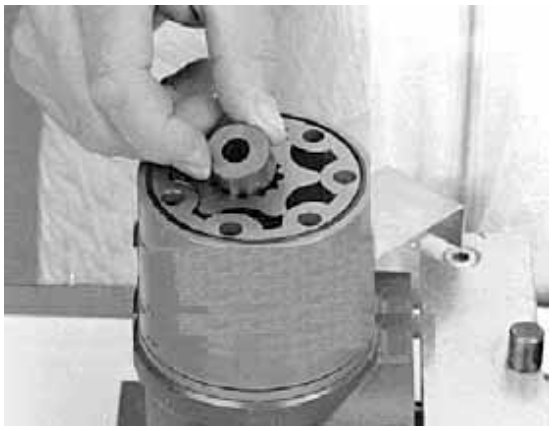
STEERING CONTROL VALVE

8. Grease the two O-rings (14) with mineral oil approx. viscosity 500 [cSt] at 20 [°C] and place them in the two grooves in the outer gerotor gear (13b). Fit the gear set (13) on the Cardan shaft (10).

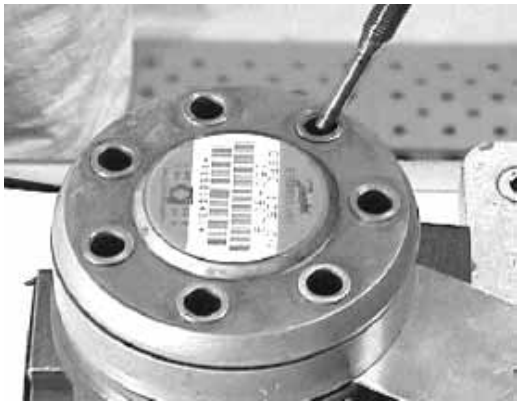


***IMPORTANT**: For fitting the inner gerotor gear (13a) and Cardan shaft (10) (Refer to 9.A. REASSEMBLY FOR LOADER 515G - step 24).*

9. Fit the spacer (11) into the inner gerotor gear (13a).



10. Place the end cover (15) in position and fit the special bolt (18) with washer (16) and place it in the hole shown.



STEERING CONTROL VALVE



11. Fit the six bolts (17) with washers (16) and insert them. Cross-tighten all the bolts with a torque of 30 ±6 [Nm].

12. Install wiper ring (1) (Refer to 9.A. REASSEMBLY FOR LOADER 515G, step 35 and 36).
13. Install the valve block (11, Fig. 10B.6) with its O-rings to steering control valve (10).
14. Insert two bolts and tighten them to torque 65 ± 5 [Nm].

10. INSTALLATION

WARNING! Before attempt to removal, make sure the engine is stopped, the bucket is lowered to the ground, transmission shifter is in neutral position (N), parking brake applied, wheels are blocked with wedges and the master switch turned to the off position and the keys are taken out from both the electric master switch and starting switch to prevent accidental engine starting.

IMPORTANT: *Before installation remove all plastic caps or rubber plugs if used.*

1. **For 520G only** - Install valve block (11, Fig. 10B.6) on the steering control valve (10) and align valve block bores with bores in the steering control valve. Place two mounting bolts in the bore and tighten them
2. Install connectors with washers to the steering control valve (10).
3. Install steering control valve (10) under operators cab. Slide control valve (10) splined bore on the steering column (1) lower shaft end and protect it against falling down.
4. Align steering control valve (10) flange bores with bores in the cab floor (4) and with flange bores in the steering column (1) lover shaft end.
5. Install four bolts with washers (3) to secure steering control valve (10) and to the steering column (1). Tighten the bolts.
6. Connect hose (5) to port (T), hose (8) to port (P) hose (6) to port (L), hose (7) to port (R), and hose (9) to port (LS) on the steering control valve (10).
7. Fill the reservoir with oil (Refer to the OPERATOR'S MANUAL, Section 5 for this procedure). Unlock frame locking bar.
8. Start the engine. Operate the machine to warm up the hydraulic oil to operating temperature and check if loader system operates correctly and check for leaks.
9. **For 515G only** - If necessary perform adjustment of relief valve (2) as describes in this Section. Shut off the engine.
10. Install steering column guard (Refer to Section 5).
11. Place the right side inspection cover (3, Fig. 10B.5) on the machine and install two bolts with washers (4) securing the right side inspection cover (3) to the front frame.

PRIORITY VALVE

11. DESCRIPTION AND OPERATION

Priority valve is mounted within machine front frame on the center bracket under the steering control valve. It is used for system where the steering system and working hydraulics are supplied with oil from just one pump, and where the steering system has the highest priority. The priority valve is in-line installed between pump and steering unit.
When the steering wheel is turned, the oil flow is distributed in the priority valve in such a way that the oil flow necessary for steering is led to the steering unit through the CF (controlled flow) connection (Fig. 10B.1, 10B.2). The remaining oil flow is available for the working hydraulics through the EF (excess flow) connection. The distribution is controlled by the LS pilot from the steering unit, so that the oil flow to the steering unit is always determined by the actual steering rate.

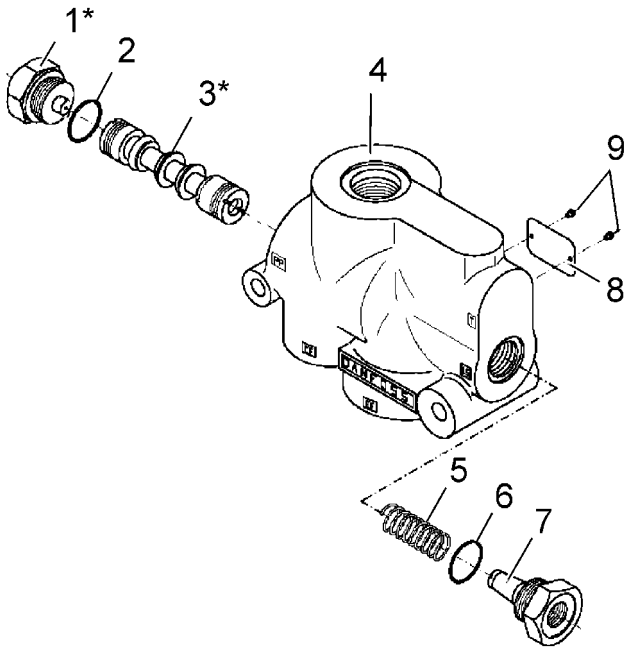


Fig. 10B.9. Priority Valve for 515G

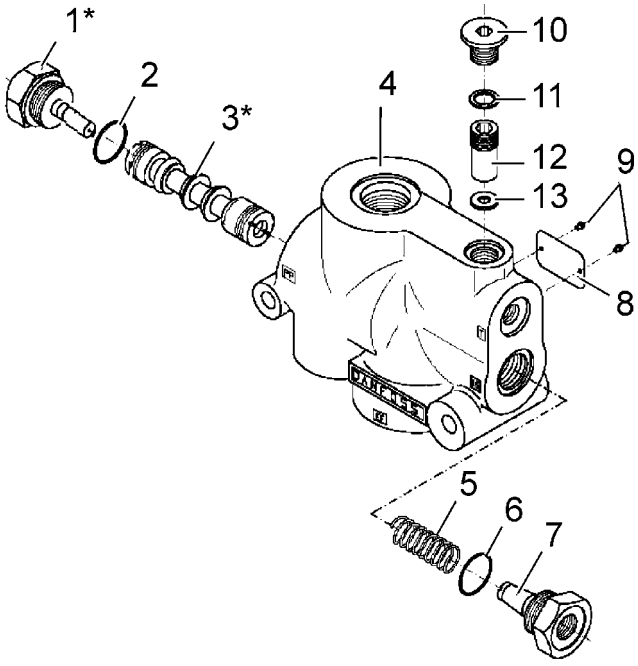


Fig. 10B.10. Priority Valve for 520G

1. Plug *
2. O-Ring
3. Spool *
4. Valve Housing
5. Spring
6. O-Ring
7. Outer Plug
8. Identification Plate
9. Screw
10. Plug
11. Seal Ring
12. Relief Valve
13. Seal

* - Inner plug (1) with inner spool (3) - For loader 515G
Outer plug (1) with outer spool (3) - For loader 520G

PRIORITY VALVE

For loader 515G (Fig. 10B.9) priority valve without pilot pressure relief valve is used in connection with steering unit with pilot pressure relief valve (Fig. 10B.1).

For loader 520G priority valve (Fig. 10B.10) with pilot pressure relief valve is used in connection with steering unit without pilot pressure relief valve (Fig. 10B.2).
The pilot pressure relief valve operates with the priority valve spool to limit the maximum steering pressure P-T measured across the steering unit ports, to protects the steering unit against excessive pressure.

12. SPECIFICATIONS

Relief Valve Opening Pressure - 520G ..... 16.5 ÷ 17.5 [MPa]
Control Spring Pressure - 520G ..... 0.7 [MPa]
Control Spring Pressure - 515G ..... 0.4 [MPa]

The pilot pressure relief valve is set when an oil flow of 80 l/min is supplied to priority valve.

13. RELIEF VALVE TEST AND ADJUSTMENT (520G ONLY)



WARNING! Before starting the test make sure the area in front and behind the machine is clear of personnel and obstructions. Do not allow anyone near the tires or on the access ladders during this test. Oil flowing under pressure may cause severe injury.

NOTE: *Performing test will require two people. One person to operate the machine, the second person to time the machine's performance. Tests should be conducted on level and smooth surface.*

1. Lift the bucket off the ground. Place the machine in straight forward position and shut off the engine.
2. Perform operation described in STEERING SYSTEM PRESSURE TEST in Section 10.
3. If adjustment of relief valve (12, Fig. 10B.10) is required, follow the below procedure:
   a. Remove two bolts with washers (3, Fig. 10B.5) securing the left hand side inspection cover (4) to the front frame and remove the cover (4).
   b. The relief valve (8, Fig. 10B.11) is mounted on the bottom of priority valve.
   c. Unscrew the plug (10, Fig. 10B.10) using 8 [mm] hexagon socket spanner and remove seal ring (11).
   d. Screw out pressure relief valve (12) using 10 [mm] hexagon socket spanner.
   e. Hold the pressure relief valve (12) firmly with the multigrip pliers and rotate the adjusting screw using 5 [mm] hexagon socket spanner 1/8 of a turn. Turn the screw clockwise to increase the pressure and counterclockwise to decrease the pressure. Hold the adjusting screw in this position.
   f. Install relief valve (12) into priority valve holes
   g. Start the engine and perform operations specified in STEERING SYSTEM PRESSURE TEST in Section 10. The steering system relief valve should open at 16.5 ÷17.5 [MPa].
   h. When the correct relief valve (12) setting has been obtained, tighten it to torque 30 [Nm].
   i. Install new seal ring (11) and torque the plug (10) to 50 [Nm].
   j. Repeat Step (g) once more to be sure the position of the adjusting screw has not changed.

VALVES

PRIORITY VALVE

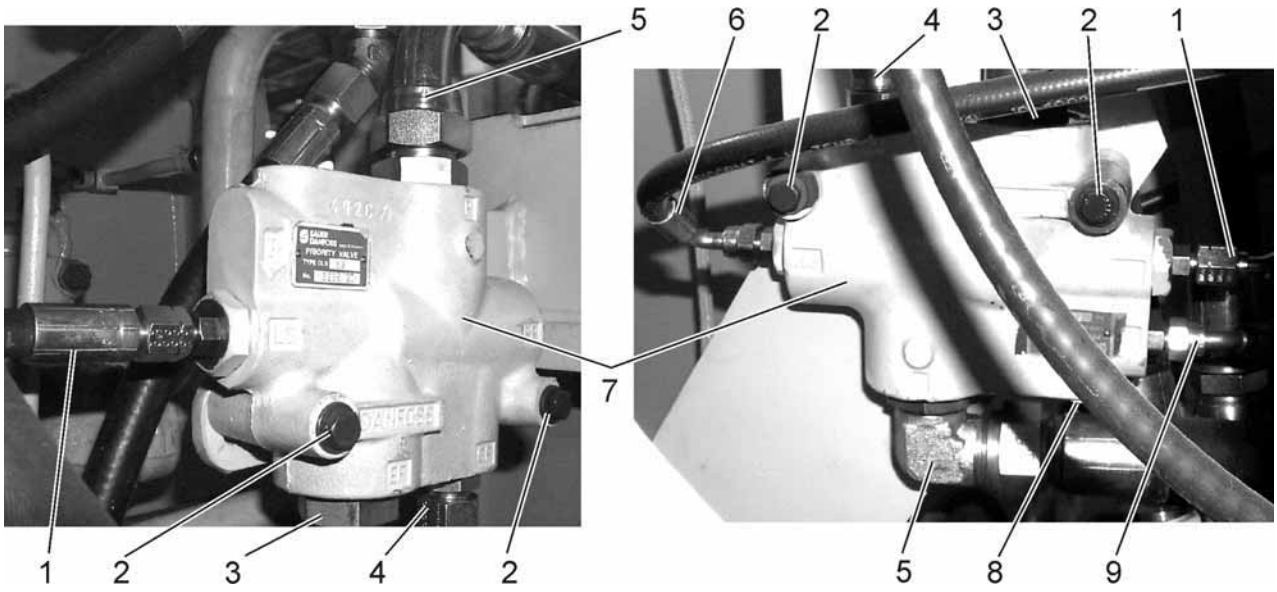
14. REMOVAL

WARNING! Before attempt to removal, make sure the engine is stopped, the bucket is lowered to the ground, transmission shifter is in neutral position (N), parking brake applied, wheels are blocked with wedges and the master switch turned to the off position and the keys are taken out from both the electric master switch and starting switch to prevent accidental 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 as this could introduce foreign material into the system. Tag all disconnected lines for ease of correct installation.*

1. Raise the bucket off the ground. Place the machine in straight forward position.
2. Shut off the engine and turn several times steering wheel to the right and to the left to relieve oil pressure remaining in steering system and lock the frames with locking bar.
3. Remove four bolts with washers (1, Fig. 10B.5) securing the front inspection cover (2) to the front frame and remove the cover (2).

NOTE: *Before disconnecting hoses from priority valve place a suitable container for oil drains from the valve.*



515G 520G

Fig. 10B.11. Priority Valve Mounting and Connection Points

1. Hose to LS Connection
2. Bolt with Washer
3. Hose to EF Connection
4. Hose to CF Connection
5. Hose to P Connection
6. Hose to PP Connection (520G only)
7. Housing
8. Relief Valve (520G only)
9. Hose to T Connection (520G only)

PRIORITY VALVE

4. Prior to disconnection any hoses from the priority valve (Fig. 10B.11), drain the hydraulic reservoir (Refer to the OPERATOR'S MANUAL, Section 5 for this procedure).
5. Disconnect all hoses from priority valve. Attach a suitable hoist and sling to the priority valve and remove the slack.
6. Unscrew two bolts with washers (2), wait until the oil drains from priority valve and remove it from the machine.

15. DISASSEMBLY (Fig. 10B.9 and 10B.10)

1. Clean the exterior of the priority valve to remove all dirt and grease.
2. **For 515G only** - Screw out from the PP connection port inner plug (1) and remove O-ring (2).

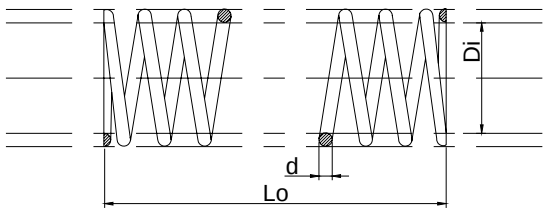
   For 520G only - Screw out from the PP connection port outer plug (1) and remove O-ring (2).
3. Screw out from the LS connection port outer plug (7) and remove O-ring (6). Take out the spring (5).
4. Press out the spool (3) using the nylon pin.
5. **For 520G only** - Unscrew plug (10) using 8 [mm] hexagon socket spanner and remove seal ring (11). Screw out the pressure relief valve (12) using 10 [mm] hexagon socket spanner and remove seal (13).

16. INSPECTION AND REPAIR

1. Wash thoroughly all parts in kerosene.
2. Check all parts carefully for scores, nicks, fractures and make any replacements necessary.
3. Replace all seals and washers for new ones.

NOTE: *The control spring pressure can be altered by replacing the spring (5) (See TABLE 1 below). Replace name plate so that code no. and control spring pressure match each other again.*

TABLE 1



Control Spring Pressure [MPa]	d [mm]	Di [mm]	Lo [mm]
0.4	2.5	12.5	50
0.7	3.0	12.5	50
1.0	3.2	12.5	50

4. Select correct spring (5) see SPECFICATIONS.
5. Lubricate all parts with hydraulic oil before installation.

PRIORITY VALVE

17. REASSEMBLY (Fig. 10B.9 and 10B.10)

1. Guide the spool (3) into the bore LS connection. Use the nylon pin to center the spool (3) in the bore.
2. Guide the spring (5) and plug (7) with O-ring (6) into the bore LS connection.
3. **For 515G only** - Install in the PP connection port inner plug (1) with O-ring (2) and in the LS connection port outer plug (7) tighten them to torque 60 [Nm].

Step 4 ÷6 for 520G only.

4. Install in the PP connection port outer plug (1) with O-ring (2) and in the LS connection port outer plug (7) tighten them to torque 60 [Nm].
5. Install the seal (13) and the pressure relief valve (12) and tighten it to torque 30 [Nm].
6. Install seal ring (11) and plug (10) and tighten to torque 50 [Nm].

18. INSTALLATION (Fig. 10B.11)

1. Using a suitable hoist and sling, place priority valve on the machine and tighten it with two bolts with washers (2).
2. Reconnect all hoses (1, 3, 4, 5, 6, 9) to priority valve connector ports in accordance with previous identification mark.
3. Fill the reservoir with oil (Refer to the OPERATOR'S MANUAL, Section 5 for this procedure).
4. Unlock frame locking bar.
5. Start the engine. Operate the machine to warm up the hydraulic oil to operating temperature and check if loader system operates correctly and check for leaks.
6. **For 520G only** - If necessary perform adjustment of relief valve (8) as describes in this Section.
7. Shut off the engine
8. Using hoisting equipment place the front inspection cover (2, Fig. 10B.5) on the machine and install four bolts with washers (1) securing the inspection cover (2) to the front frame.

EQUIPMENT CONTROL VALVE

19. DESCRIPTION AND OPERATION (Fig. 10B.12)

Equipment control valve consists of sections assy, which are worked in parallel circuit. When the spool (POS.1, POS.2) is operated it intercepts the switch gallery by diverting the flow of oil to A or B sides of inner passage. If two or more spools are actuated at the same time, the oil will power the inner passages that has the lower load by selecting the path with the least resistance by throttling the spools. The flow of oil can be divided between two or more inner passages of both sides (A, B).

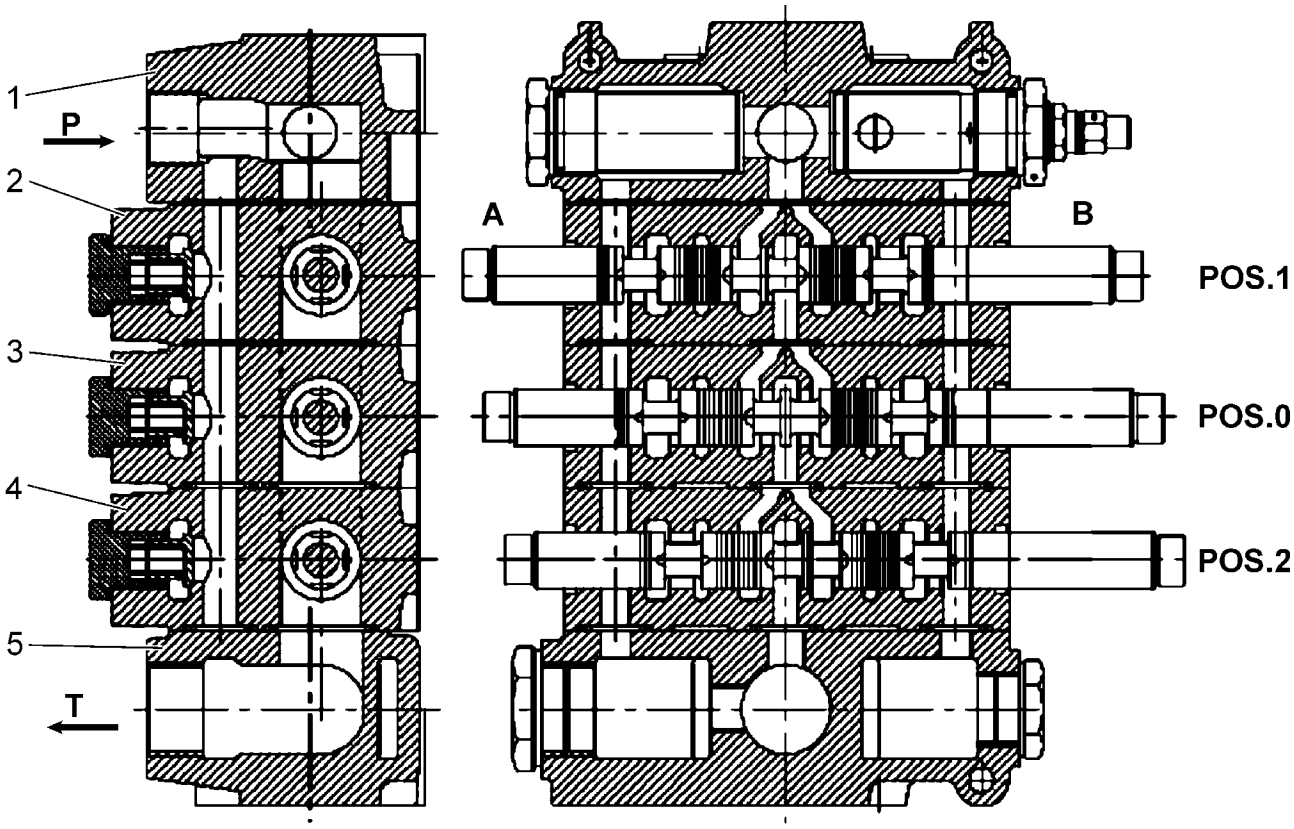


Fig. 10B.12 Equipment Control Valve (cross section)

1. Inlet Section Assy
2. Auxiliary Equipment Section Assy (3-spool only)
3. Bucket Section Assy
4. Boom Section Assy
5. Outlet Section Assy

POS.1, POS.2 - Operating Position
POS.0 - Neutral Position
P - From Pump
T - To Tank (Reservoir)

Control valve (2-spool) consists generally of four sections: inlet section assy (1), bucket section assy (3), boom section assy (4) and outlet section assy (5).
Control valve (3-spool) consists of additional second auxiliary equipment section assy (2).

Inlet section assy (Fig. 10B.13) includes the following assemblies:

- plug assy
- flange assy
- relief valve

EQUIPMENT CONTROL VALVE

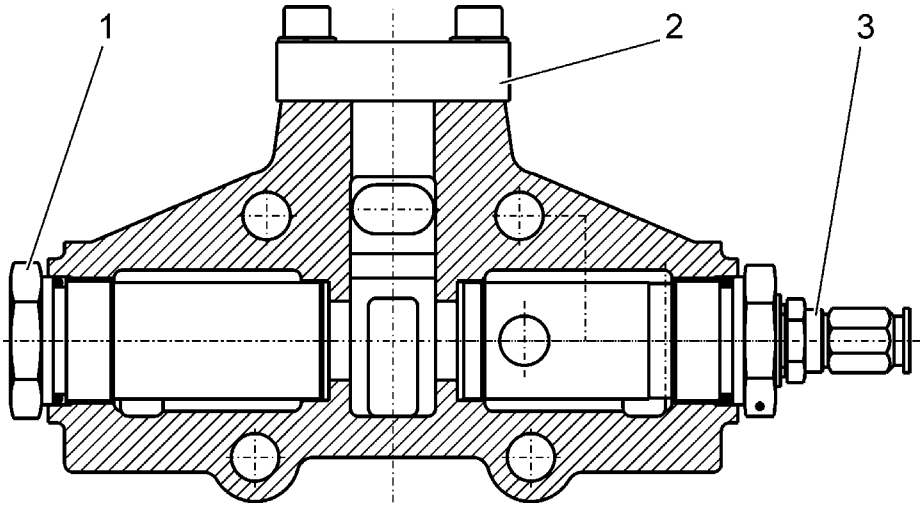


Fig. 10B.13. Inlet Section Assy (cross section)

1. Plug Assy
2. Flange Assy
3. Relief Valve

To the flange assy (2) is connected hose (9, Fig. 10B.17) supplying the oil from hydraulic pump. The oil flows through the internal passages into the sections (2, 3 and 4, Fig. 10B.12) and is returned through outlet section (Fig. 10B.16) to the hydraulic reservoir.
Relief valve (3) is mounted on the inlet section, and protects loader equipment system against excessive pressure rise, which may buildup e.g. when pistons in cylinders attain their limit position or in case of excessive external resistance. Pressure rise, will result in opening of relief valve and redirecting oil to reservoir (See SPECIFICATIONS in this Section).

Bucket Section Assy (Fig. 10B.14) includes the following assemblies:

- caps kit (pilot port)
- two shock valves
- check valve
- spool

EQUIPMENT CONTROL VALVE

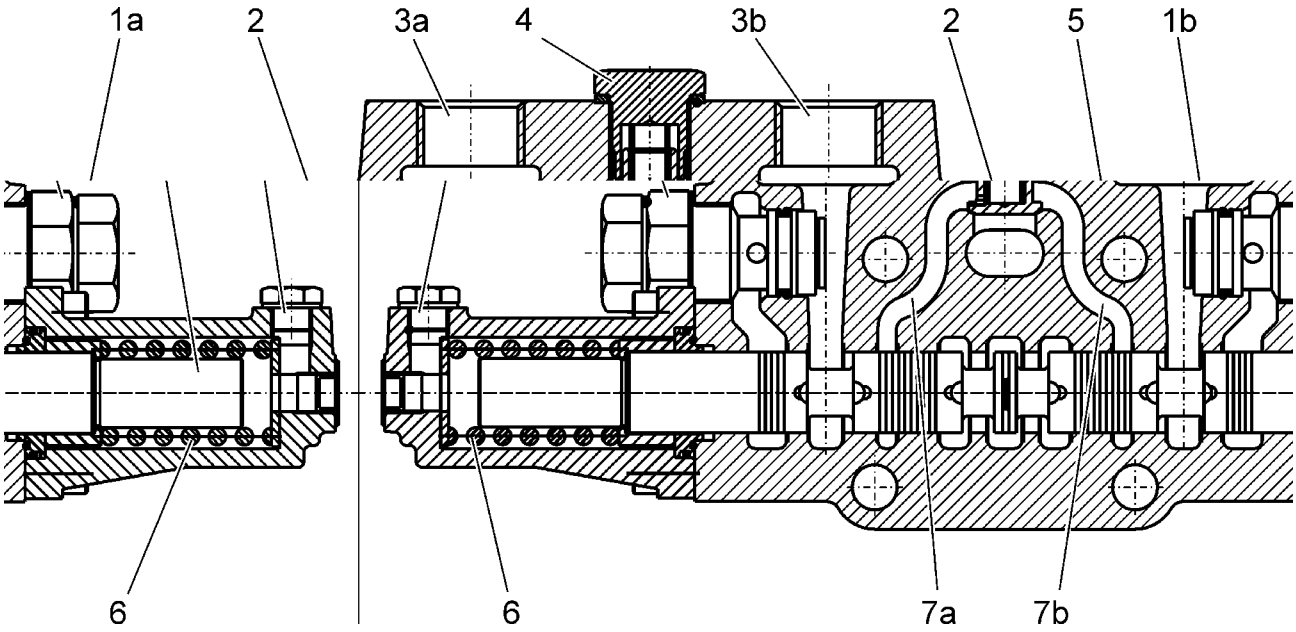


Fig. 10B.14. Bucket/Auxiliary Equipment Section Assy (cross section)

1a. Caps Kit (Pilot Port)
1b. Caps Kit (Pilot Port)
2. Shock Valve
3a. Port (to Rod Side)
3b. Port (to Head Side)
4. Check Valve
5. Spool
6. Spring
7a. Center Passage
7b. Center Passage

The spool (5) has three positions: neutral and operating positions at both sides of the spool (bucket rollback and bucket dump). It is shifted by pilot pressure delivered to pilot ports (1a or 1b) from the pilot circuit. When the oil is delivered through the pilot control valve to the pilot port (1a), pressurized oil pushes the spool (5) to the right position. Then center passage (7a) is opening and the oil through the rod side port (3a) flows to the bucket cylinder (dump position). The return oil from the head side of the bucket cylinder passes through the port (3b). The oil then flows back to the hydraulic reservoir. When the oil is delivered to the pilot port (1b) pressurized oil pushes the spool (5) to the left position, then the oil flows through center passage (7b), head side port (3b) to the bucket cylinder (rollback position). The return oil from the rod side of the bucket cylinder passes through the port (3a) to the hydraulic reservoir.
Neutral position provides centering assy with springs (6) then the ports (3a, 3b) are closed and the oil returns to the hydraulic reservoir.

Check valve (4) installed on the oil supply line protect against oil backflow from hydraulic cylinder when spool is shifted. In oil outlet passages (3a, 3b) from control valve housing to bucket cylinder, two shock valves (2) are installed. They protect bucket circuit against overload due to oil pressure rise resulting from external factors, e.g. when bucket hits in an obstacle during transportation cycle with bucket loaded or overloading of the bucket due to landslide when bank loading. Pressure rise, will result in opening of shock valve and redirecting oil to reservoir (See SPECIFICATIONS in this Section)

Auxiliary Equipment Section Assy (Fig. 10B.14)

Structure and operation on this section are identical as Bucket Section Assy.

EQUIPMENT CONTROL VALVE

Boom section assy (Fig. 10B.15) includes the following assemblies:

- caps kit (pilot port)
- anticavitation valve
- check valve
- plug assy
- spool

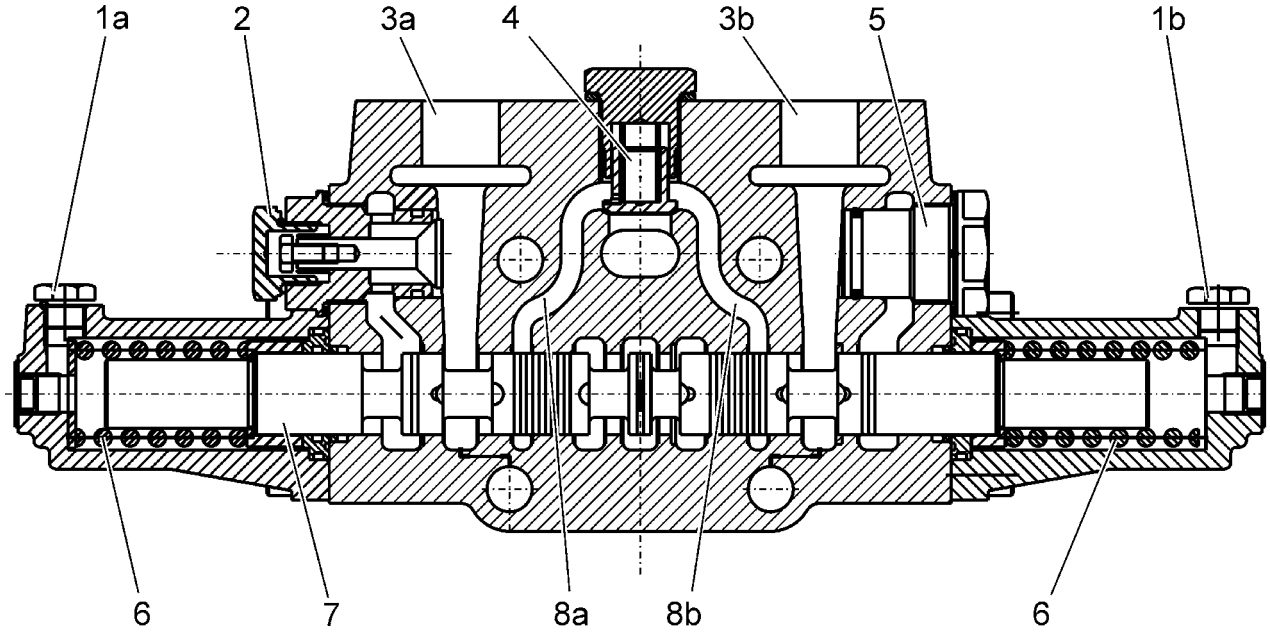


Fig. 10B.15. Boom Section Assy (cross section)

1a. Caps Kit (Pilot Port)
1b. Caps Kit (Pilot Port)
2. Anticavitation Valve
3a. Port (to Rod Side)
3b. Port (to Head Side)
4. Check Valve
5. Plug Assy
6. Spring
7. Spool
8a. Center Passage
8b. Center Passage

The spool (6) has four positions: neutral, boom raise, boom lower and float. In boom raise position the oil is delivered through the pilot control valve to the pilot port (1b) then pressurized oil pushes the spool (5) to the left position and oil flows through center passage (8b), port (3b) to the head side of the boom cylinder. The return oil from the rod side of the boom cylinder passes through port (3a) to the hydraulic reservoir. The oil supply to the pilot port (1a) depending on the pilot control valve position (Refer to the OPERATOR'S MANUAL, Section 4) pushes the spool (5) to the right position (boom lower) or right end position (boom float).

In the boom lower position the oil flows through center passage (8a) and port (3a) to the rod side of the boom cylinder. The return oil from the head side of the boom cylinder passes through port (3b) to the hydraulic reservoir.

In the boom float positions the oil from hydraulic pump is returned through the center passage (8a, 8b) to the hydraulic reservoir and it's also available at the ports (3a, 3b). Center passages (8a, 8b) are interconnected with ports (3a, 3b). All the interconnected oil passages and ports causes that oil under external forces may relocate from one space of hydraulic cylinder to the other.

EQUIPMENT CONTROL VALVE

As a result the boom is placed in float position, raises and lowers according to terrain relief on which wheel loader is operating. The anticavitation valve (2) prevents cavitation in piston overside of boom circuit.

NOTE: *In the float position solenoid latch in the valve locks the lever in detented position. The return to neutral position must be done manually (Refer to OPERATOR'S MANUAL, Section 4).*

Neutral position provides centering assy with springs (6), then the ports (3a, 3b) are closed and the oil returns to the hydraulic reservoir.

Outlet section assy (Fig. 10B.16) includes the following assemblies:

- flange assy
- plug assy

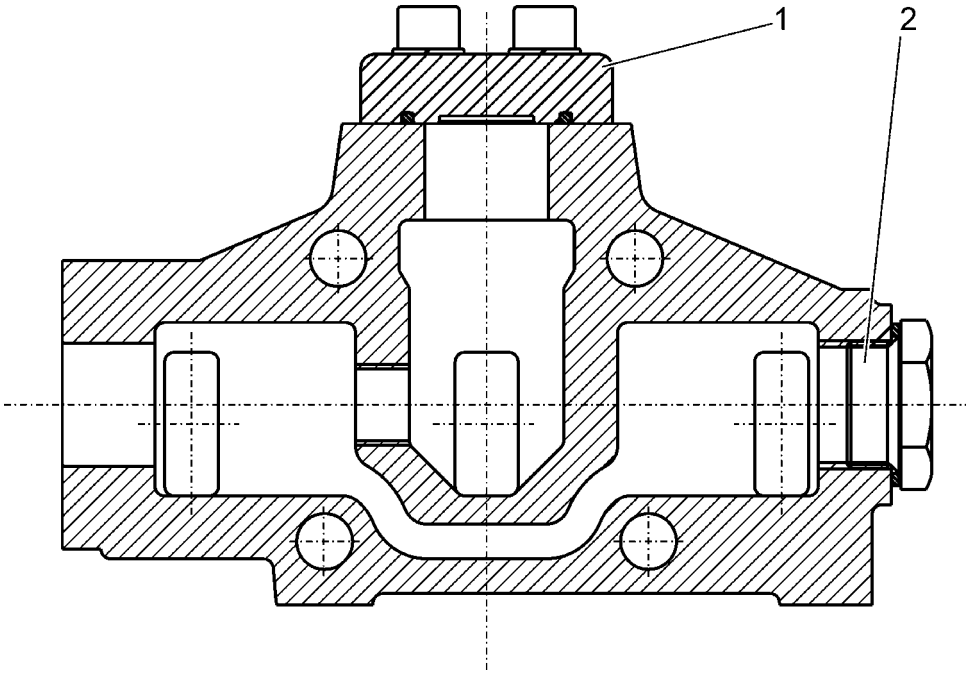


Fig. 10B.16. Outlet Section Assy (cross section)

1. Flange Assy
2. Plug Assy

To the flange assy (1) is connected the outlet pipe (14, Fig. 10B.17), through that excess oil is to pipe away to the hydraulic reservoir.

20. SPECIFICATIONS

Opening Pressure

Relief Valve ..... 19.5 ÷ 21.5 [MPa]

Shock Valve ..... 24 [MPa]

EQUIPMENT CONTROL VALVE

21. SHOCK VALVE, ANTICAVITATION VALVE AND RELIEF VALVE TEST AND ADJUSTMENT

SHOCK VALVE AND ANTICAVITATION VALVE

Shock valves (3, Fig. 10B.17) test and adjustment cannot be made on the machine. It should be done at specially adapted bench to control the input flow.

NOTE: *If special stand is not available it is preferable to replace damaged shock valve for new ones.*

- Shock valve must be set to pressure of 24 [MPa].
- Anticavitation valve is non-adjustable.

RELIEF VALVE

WARNING! Be sure the area in front and behind the machine is clear of personnel and obstructions. Do not allow anyone near the tires or on the access ladders during this test and adjustment.

1. Perform operations specified in LOADER EQUIPMENT SYSTEM PRESSURE TEST in Section 10.
2. If adjustment of relief valve (11, Fig.10B.17) is required, follow the below procedure.
3. Lower the bucket to the ground to get access to the front inspection cover (2, Fig.10B.5). Shut off the engine and lock frames with locking bar.

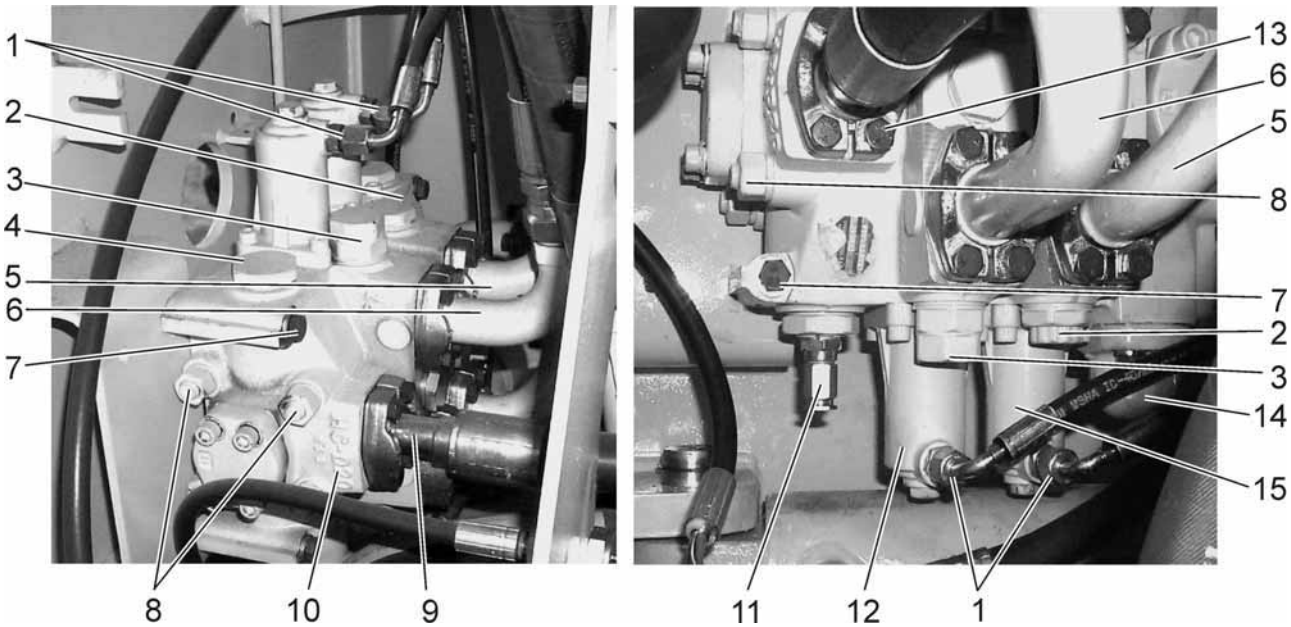


Fig. 10B.17. Equipment Control Valve Mounting and Connection Points

1. Pilot Pressure Houses
2. Anticavitation Valve
3. Shock Valve
4. Plug Assy
5. Boom Section Pipe
6. Bucket Section Pipe
7. Bolt with Spring Washer
8. (Studs, Nuts, Washers) Kits
9. Supply Hose
10. Inlet Section Assy
11. Relief Valve
12. Bucket Section Assy
13. Bolt with Washer
14. Outlet Pipe
15. Boom Section Assy
16. Bracket

EQUIPMENT CONTROL VALVE

4. Unscrew four bolts with washers (1) and remove front cover (2).
5. Remove the dome nut of control valve relief valve (11, Fig. 10B.17) securing adjusting screw.

NOTE: *Performing test will require two people, one person to operate the machine, the second person to time the machine's performance.*

6. Start the engine. Hydraulic oil should be at 40 [°C] or warmer. Run the engine at maximum speed and move bucket to its full „roll back" position. Turn the adjusting screw "IN" to increase, or "OUT" to decrease relief valve pressure at full engine RPM. Adjust oil pressure with adjusting screw to 19.5÷21.5 [MPa].
7. Install dome nut of relief valve (11) and recheck pressure setting; refer to LOADER EQUIPMENT SYSTEM PRESSURE CHECK in Section 10.
8. Lower the bucket to the ground and shut off the engine.
9. Install front inspection cover (2, Fig. 10B.5) and tighten with four bolts with washer (1). Unlock frame locking bar.

22. REMOVAL (Fig.10B.17)

WARNING! Before servicing the machine be sure the bucket is lowered to the sturdy wooden or concrete blocks, 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.

IMPORTANT: *Disconnected hydraulic lines must be capped with the correct size plastic caps. If plastic caps are not available use clean corks or self-adhesive tape. Openings must never be plugged with rags. This practice could easily introduce dirt or lint in to critical components of the machine. Tag disconnected hydraulic lines.*

1. Prior to disconnection any tubes or hoses from the control valve, drain the hydraulic reservoir (Refer to the OPERATOR'S MANUAL, Section 5 for this procedure).
2. Remove bolts with washers (13), split flanges with O-rings and disconnect supply hose (9).
3. Remove bolts with washers and remove the outlet pipe (14).
4. Remove bolts with spring washers and split flange with O-ring and disconnect return pipes (5, 6).
5. Disconnect pilot pressure hoses (1) from control valve:
   - 2 spool control valve - four hoses from bucket and boom spool ports
   - 3 spool control valve - six hoses from auxiliary equipment, bucket and boom spool ports
6. Attach a hoist sling to the equipment control valve. The hoist must be installed to give the best possible balance. Remove hoist sling sag.
7. Remove four bolts with washers (7) mounting control valve to the bracket (16).
8. Move the control valve rearward to free the control valve from the bracket and lift it out of machine.
9. Cover the opening mounting hole to protect the system from dirtiness.

23. DISASSEMBLY AND REASSEMBLY

1. Clean the exterior of the control valve to remove all dirt and grease. Place the control valve into locally made appropriate sturdy stand to fasten it.
2. Remove four nuts with washers (5, Fig. 10B.18) from the studs.

EQUIPMENT CONTROL VALVE

***IMPORTANT**: Do not pry any sections apart with a screwdriver or other similar tool, as such action can damage machined sealing surfaces.*

3. Use a plastic mallet to separate the section, next slide off the section and discard its seals (13). In the same manner remove the sections in the following order: inlet section (4), auxiliary equipment section (1, for 3 spool control valve only), bucket section (8), boom section (9) and outlet section (12), to proceed identical for all sections.
4. Before disassembly any sections place in a suitable vice to fasten it.

INLET SECTION ASSY (4)

5. Remove plug assy (3) and relief valve (7).
6. For reassembly the sequence should be reversed.
7. Torque settings during reassembly:
   - the plug to 90÷100 [Nm]
   - the relief valve cap 145÷160 [Nm]

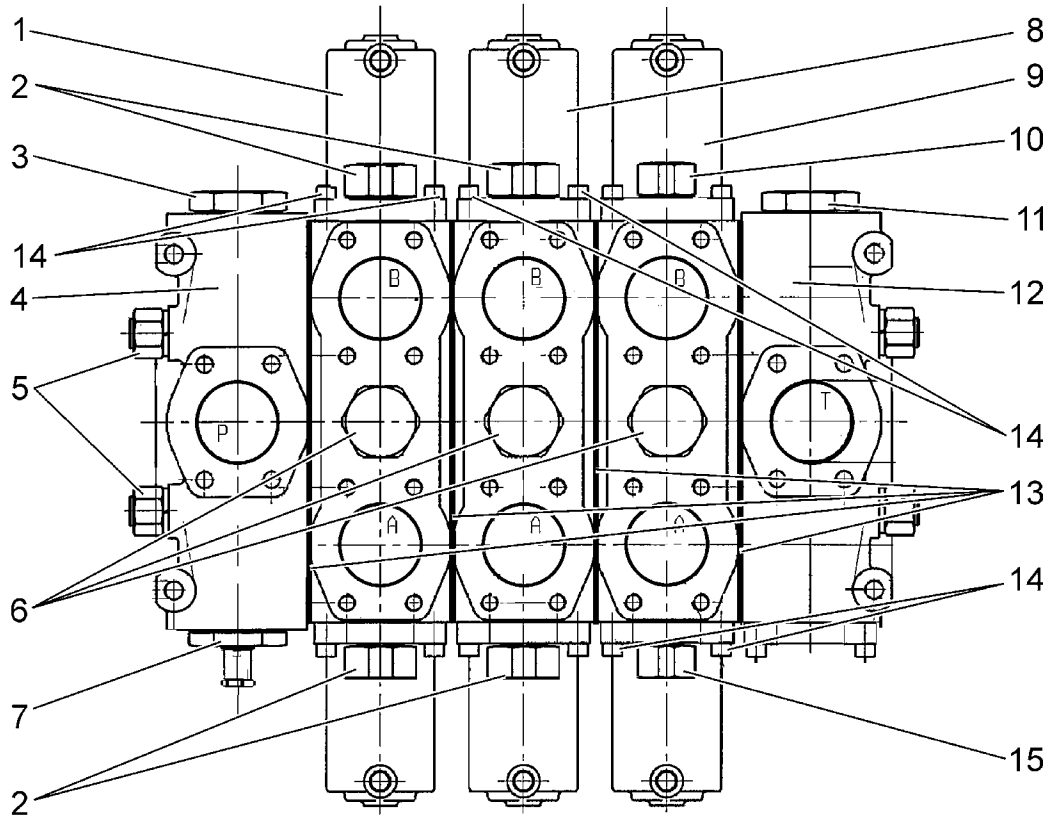


Fig. 10B.18. Control Valve (3 Spool)

1. Auxiliary Equipment Section Assy
2. Shock Valves
3. Plug Assy
4. Inlet Section Assy
5. (Stud, Nuts, Washers) Kits
6. Check Valves
7. Relief Valve
8. Bucket Section Assy
9. Boom Section Assy
10. Anticavitation Valve
11. Plug Assy
12. Outlet Section Assy
13. Seal (Between Sections)
14. Bolt with Washer
15. Plug Assy

EQUIPMENT CONTROL VALVE

AUXILIARY EQUIPMENT (1) AND BUCKET SECTION ASSY (8)

8. Remove two shock valves (2) and check valve (6).
9. For reassembly the sequence should be reversed.

NOTE: *Adjust reassembled shock valves to a pressure of 22.5÷24.5 [MPa] on special testing bench, before valve reinstallation into auxiliary equipment or bucket section assy.*

10. Torque settings during reassembly:
    - the shock valve sleeve to 30÷35 [Nm]
    - the shock valve cap to 4.5÷5.5 [Nm]
    - the check valve cap to 90÷100 [Nm]

BOOM SECTION ASSY (9)

11. Remove anticavitation valves (10) and check valve (6).
12. Remove plug assy (15).
13. For reassembly the sequence should be reversed.
14. Torque settings during reassembly:
    - the anticavitation sleeve to 30÷35 [Nm]
    - the anticavitation cap to 4.5÷5.5 [Nm]
    - the check valve cap to 90÷100 [Nm]
    - the plug assy (15) to 90÷100 [Nm]

OUTLET SECTION ASSY (12)

15. Remove plug assy (11).
16. For reassembly the sequence should be reversed.
17. Torque the plug assy (11) to 90÷100 [Nm].

24. INSPECTION AND REPAIR

1. Clean thoroughly all parts with kerosene or diesel oil.
2. Check all parts for nicks, fractures (particularly sliding surfaces of valves and housing).
3. Blow all valve passages with clean air.
4. Replace all seals and O-rings for new ones.
5. Lubricate all parts with hydraulic oil before installation

25. INSTALLATION

1. Slide on the sections with new seal (13) in reverse order: outlet section (12), boom section (9), bucket section (8), auxiliary equipment section (1, for 3 spool control valve only), inlet section (4) on the studs (5).
2. Install nuts with washers (5) on the studs and tighten to 110 [Nm].
3. Attach a hoist sling to equipment control valve. The hoist must be installed to give the best possible balance.
4. Position control valve and install into front frame bracket (16, Fig. 10B.17) aligning control valve holes with bracket (16) holes.
5. Install mounting bolts with washers (7) to secure to the bracket (16). Tighten the bolts.
6. Reconnect outlet pipe (14) and tighten bolts.
7. Reconnect pipes (5, 6) with their split flanges and O-rings and tighten bolts with spring washers to 35÷40 [Nm].
8. Reconnect pilot pressure hoses (1) to the control valve and tighten them.

EQUIPMENT CONTROL VALVE

9. Install supply hose (9) with split flanges and O-ring. Tighten the bolts with spring washer to 35÷40 [Nm].
10. Fill the reservoir with oil (Refer to the OPERATOR'S MANUAL, Section 5 for this procedure). Unlock frame locking bar
11. Start the engine. Operate the machine to warm up the hydraulic oil to operating temperature and check if loader system operates correctly and check for leaks.

PILOT BLOCK

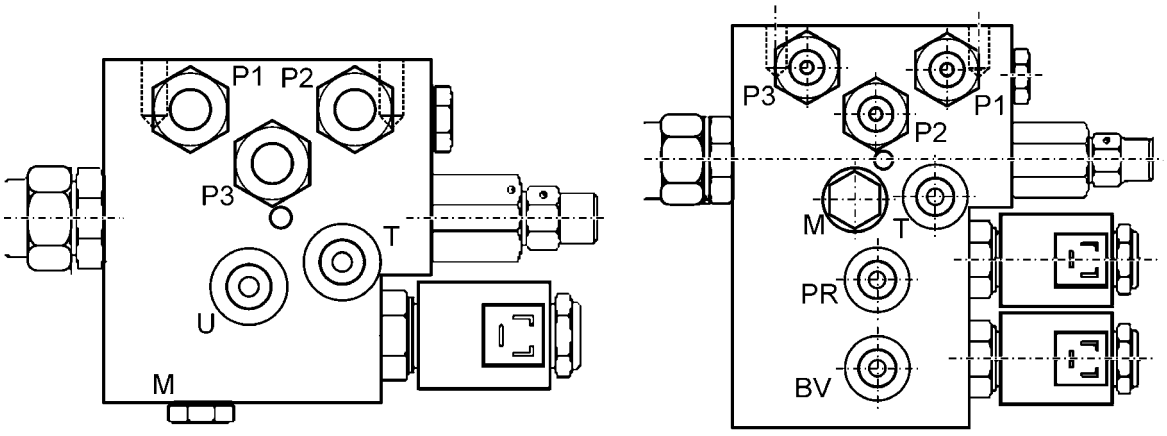
26. SPECIFICATIONS

PILOT PRESSURE REGULATOR

Operating Pressure ..... 3.0 ÷ 3.2 [MPa]

27. DESCRIPTION AND OPERATION

The pilot block consist of the gas accumulator (1, Fig. 10B.20), check valve (2), pressure regulator valve (6), three-way valve(s) (4) and solenoid(s) (5, 5A).
The purpose of supply the pilot block is to fit hydraulic remote controls in a hydraulic system working at high pressure with reduced flow at low pressure. Operating principle is that of a direct acting pressure reducing valve. High pressure fluid from the main circuit is routed through ports (P1, P2 and P3, Fig. 10B.19). Pressure is decreased to the operating pressure (see SPECIFICATIONS) required for supplying the hydraulic controls by means of a pressure regulator valve that directs the necessary fluid to the control via ports (U, PR, BV).



For 2 Spool Control Valve For 3 Spool Control Valve

Fig. 10B.19. Pilot Block Ports Location

Pilot block is fitted with an accumulator (1, Fig. 10B.20), which satisfies short term peak power demands and is a source of emergency power should the main circuit pressure fail. To avoid the accumulator discharge, low pressure circuit is protected both by the adjustable relief valve (7) inside the cartridge of the pressure regulator valve (6) and the check valves (2). To start the hydraulic system, a backpressure of at least 1 [MPa] on service ports (P1, P2, P3) has to be applied when the accumulator is discharged.

PILOT BLOCK

When solenoid (5) is activated, then three-way valve (4) cuts off the supply pressure of equipment pilot control. In this case equipment control lever is locked and the equipment system is inoperative. When solenoid (5A) is activated, then three-way valve (4A) cuts off the supply pressure to auxiliary equipment pilot control. In this case auxiliary equipment control lever is locked and the auxiliary system is inoperative. Pilot block (Fig. 10B.21) is located under the operator platform on the right hand side of machine and bolted to the bracket (2) with two bolts with washers (1). It may be installed in any mounting position but the accumulator should be as far as possible from heat sources.

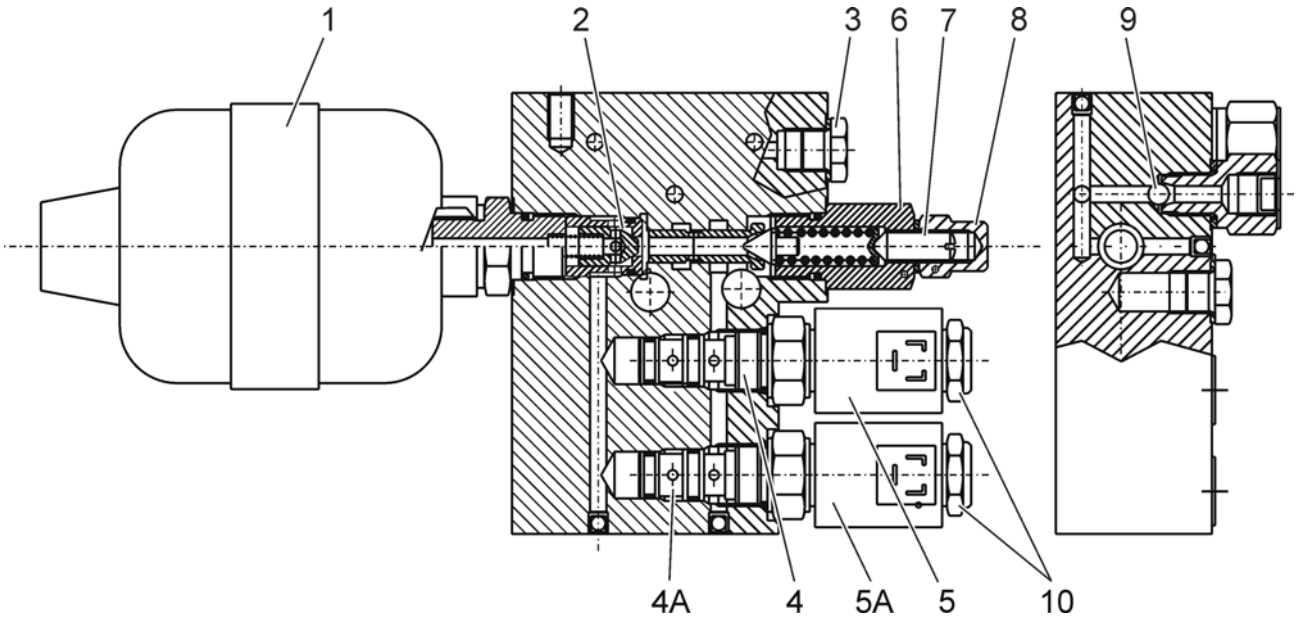


Fig. 10B.20. Pilot Block Cross Section (for 3 spool control valve)

1. Gas Accumulator
2. Check Valve Assy
3. Plug
4. Three-Way Valve

4A. Three-Way Valve – for 3 spool only

5. Solenoid for Equipment

5A Solenoid for Auxiliary Equipment or Quickcoupling – for 3 spool control valve only

6. Pressure Regulator Valve
7. Relief Valve (with Adjusting Screw)
8. Dome Nut
9. Check Valve Assy
10. Caps

28. PRESSURE REGULATOR VALVE TEST AND ADJUSTMENT

WARNING! Be sure the area in front and behind the machine is clear of personnel and obstructions. DO NOT allow anyone near the tires or on the access ladders during this test.

NOTE: *Performing test will require two people, one person to operate the machine, the second person to time the machine's performance.*

1. Operate the machine to warm up the hydraulic oil. Lock the frames with locking bar.
2. Connect the pressure gauge OEM 1212 to the pressure check point (quick disconnect) (5, Fig. 10B.21) is at the pilot block outlet port M.

PILOT BLOCK

3. Accelerate the engine and operate of pilot control valve several times. Leave the pilot control lever in the neutral position and notice the gauge reading.
4. The pressure gauge should be reading 3.0 ÷ 3.2 [MPa]. If pressure reading is different, adjust pressure regulator valve (6, Fig. 10B.20). For this purpose proceed as follows:
   a) remove dome nut (8) securing relief valve adjusting screw (7)
   b) turn the adjusting screw (7) “IN” to increase, or “OUT” to decrease pressure
   c) read pressure at pressure gauge, if not satisfy repeat steps (b) until reach 3.2 [MPa]
   d) shut off the engine
   e) install dome nut (8) and tighten it
5. Disconnect the pressure gauge from the hydraulic pressure check point and install the cap on quick disconnect.
6. Unlock frame locking bar.

29. REMOVAL



WARNING! Before attempt to removal, make sure the engine is stopped, the bucket is lowered to the ground, transmission shifter is in neutral position (N), parking brake applied, wheels are blocked with wedges and the master switch turned to the off position and the keys are taken out from both the electric master switch and starting switch to prevent accidental engine starting.

IMPORTANT: *Disconnected hydraulic lines must be capped with the correct size plastic caps. If plastic caps are not available use clean corks or self-adhesive tape. Openings must never be plugged with rags. This practice could easily introduce dirt or lint in to critical components of the machine. Tag disconnected hydraulic lines.*

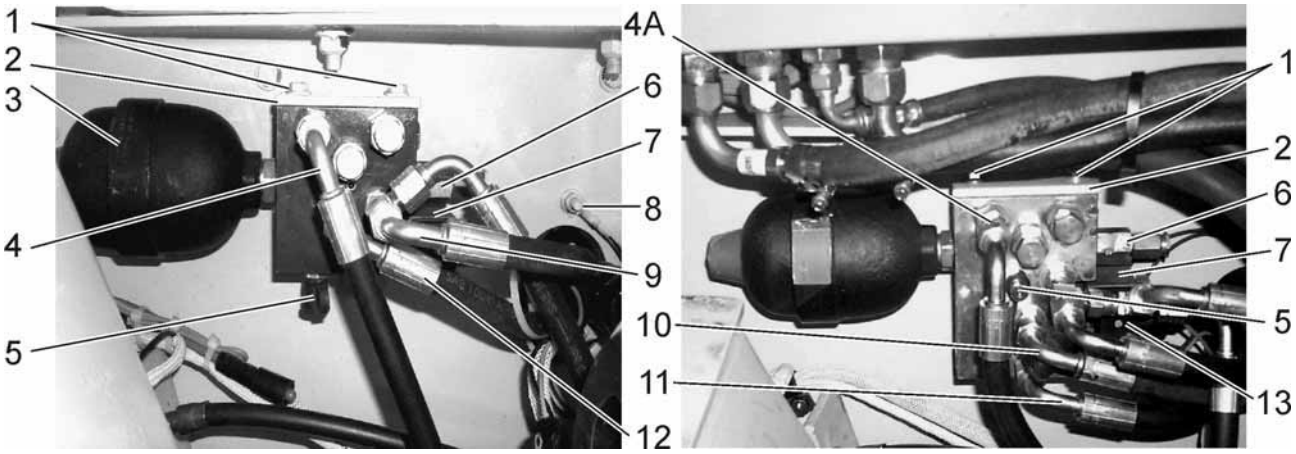
NOTE: *Before disconnecting hoses from pilot block (Fig. 10B.21), place a suitable container for oil drains from the pilot block and hoses.*

1. Prior to disconnection any tubes or hoses from the pilot valve, drain the hydraulic reservoir (Refer to the OPERATOR’S MANUAL, Section 5 for this procedure). Lock the frames with locking bar.
2. **For 2 Spool Control Valve.** Remove supply hose (4) from port P1, drain hose (9) from port T, pilot pressure hose (12) from port.
2. **For 3 Spool Control Valve.** Remove supply hose (4) from port P3, drain hose (9) from port T, pilot pressure hose (11) from port BV and pilot pressure hose (10) from port PR.
3. Disconnect ground wire (8).
4. Remove screw securing connector(s) to the pilot valve lock solenoid(s) (7).
5. Unplug wire harness connector(s) (13) from the pilot valve lock solenoid(s).
6. Unscrew two bolts with washers (1) mounting pilot block to the bracket (2). Remove pilot block from the machine.
7. Cover the opening mounting hole to protect the system from dirtiness.

PILOT BLOCK

30. DISASSEMBLY

1. Remove gas accumulator (1, Fig. 10B.20) and check valve assy (2).
2. Remove check valve assy (9).
3. Remove pressure regulator valve (6).
4. Remove cap (10), slide off solenoid (5) and solenoid (5A, for 3 spool control valve only).
5. Remove three way valve (4) and three way valve (4A, for 3 spool control valve only).
6. Remove valve (quick disconnect) (5, Fig. 10B.21) from port M.



For 2 Spool Control Valve For 3 Spool Control Valve

Fig. 10B.21. Pilot Block Mounting and Connection Ports

1. Bolt with Washer
2. Bracket
3. Gas Accumulator
4. Supply Hose – P1 port
4A. Supply Hose – P3 port
5. Pressure Check Point (quick disconnect) - M port
6. Pressure Regulator Valve
7. Pilot Valve Lock Solenoid(s)
8. Ground Wire
9. Drain Hose - T port
10. Pilot Pressure Hose - PR port
11. Pilot Pressure Hose - BV port
12. Pilot Pressure Hose - U port
13. Wire Harness Conector(s)

31. INSPECTION AND REPAIR

1. Clean thoroughly all parts with kerosene or diesel oil.
2. Check all parts for nicks, fractures (particularly sliding surfaces of valves and inner surfaces of housing).
3. Blow all valve passages with clean air.
4. Replace all seals and O-rings for new ones.
5. Lubricate all parts with hydraulic oil before installation.

32. REASSEMBLY

1. Install check valve assy (9, Fig. 10B.20).
2. Install pressure regulator valve (6).
3. Install three way valve (4) and three way valve (4A, for 3 spool control valve only).

4. Carefully slide on solenoid (5) and solenoid (5A, for 3 spool control valve only) on the three way valve core.
5. Install cap (10) and tighten it.
6. Install valve to port M (quick disconnect) (5, Fig. 10B.21).
7. Install check valve assy (2) and gas accumulator (1).

33. INSTALLATION

1. Install pilot block under operator's cab on the right hand side of machine, aligning pilot valve holes with bracket (2, Fig. 10B.21) holes.
2. Tighten two bolts with washers (1) securing pilot block to the bracket (2).
3. Reconnect ground wire (8), wire harness connector(s) (13).
4. Install screw (s) secure connector(s) to the pilot valve lock solenoid(s) (7).
5. **For 2 Spool Control Valve.** Connect pilot pressure hose (12) to port U, drain hose (9) to port T and supply hose (4) to port P1.
5. **For 3 Spool Control Valve.** Connect pilot pressure hose (10) to port PR, pilot pressure hose (10) to port BV, drain hose (9) to port T and supply hose (4) to port P3.
6. Fill the reservoir with oil (Refer to the OPERATOR'S MANUAL, Section 5 for this procedure).
7. Unlock frame locking bar.
8. Start the engine and check if loader system operates correctly and check for leaks.
9. If needed, perform pressure control valve adjustment, in the way described under PRESSURE CONTROL VAVE TEST AND ADJUSTMENT in this Section.

SECTION 10C

CYLINDERS

CYLINDERS

SECTION 10C

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SPECIAL TOOLS AND INSTRUMENTS

1. SPECIAL TOOLS AND INSTRUMENTS

Description	No of instrument/tool
1. Torque multiplier	1.543.0058
2. Torque wrench 0 ÷ 4000 [Nm]	1.543.0026
3. Torque wrench	1.549.0043
4. Torque wrench	1.549.0037
5. Steering cylinder gland nut socket	1.541.0381
6. Bucket cylinder gland nut socket	1.541.0400
7. Boom cylinder 515G gland nut socket	1.541.0409
8. Boom cylinder 520G gland nut socket	1.541.0383
9. Steering cylinder piston nut socket	8N40M-41/19-65
10. Bucket cylinder piston nut socket	8N40M-61/40
11. Steering cylinder bushing driver ∅ 50 x 10.6 with flange ∅ 68 x 10 [mm]	Locally manufactured
12. Bucket cylinder bushing driver ∅ 62 x 10.6 with flange ∅ 80 x 10 [mm]	Locally manufactured
13. Boom cylinder bushing driver ∅ 65 x 10.6 with flange ∅ 83 x 10 [mm]	Locally manufactured
14. Bucket cylinder wiper ring driver	1.547.0292 No 5
15. Boom cylinder wiper ring driver	1.547.0292 No 2
16. Piston seal compressing tool	1.549.0176
17. Copper hammer	1.519.0750

GENERAL

2. DESCRIPTION AND OPERATION

The machine hydraulic system includes two steering cylinders (1, Fig. 10C.1), two boom cylinders (8) and a bucket cylinder (14). The pair of steering cylinders with pins (7) and with pins (16), spacer sleeve (6) and seal rings (2), links the two sides of the front and rear machine frames. The pair of the boom cylinders (8) with pins (11) and with pins (9), seal rings (12) and shims links the outer edges of the boom to front frame. Movements of each boom cylinder rod within the housing causes the boom to articulate at boom pins and enables boom to rise and to lower. The bucket cylinder (14) with pins (15) and seal rings (12) links the bucket linkage and front frame. As the bucket cylinder extends or contracts, the bucket rolls back or dumps. For detailed description refer to BUCKET LINKAGE in Section 17. Each cylinder pin or cylinder eye is provided with lubrication fitting (3, 10 respectively), they are installed in easier available points.

CYLINDERS

GENERAL

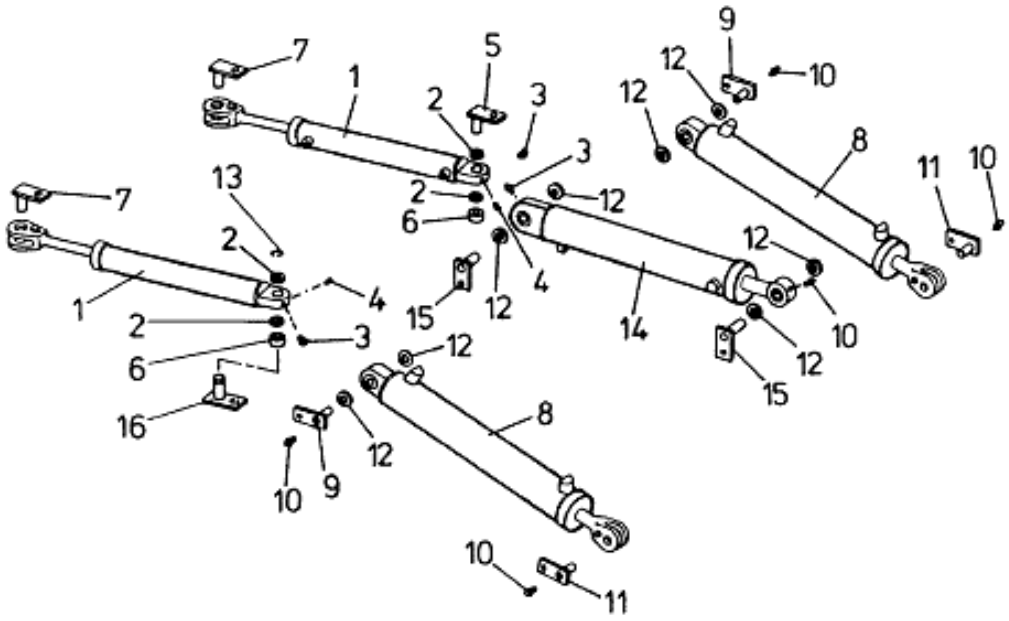


Fig. 10C.1. Hydraulic Cylinders Mounting

1. Steering Cylinders
2. Seal Ring
3. Lubrication Fitting
4. Plug
5. Welded Pin
6. Spacer sleeve
7. Welded Pin
8. Boom Cylinders
9. Welded Pin with Shim(s)
10. Lubrication Fitting
11. Welded Pin with Shim(s)
12. Seal Ring
13. Retaining Ring
14. Bucket Cylinder
15. Welded Pin (with Shims for 515G only)
16. Welded Pin

STEERING CYLINDERS

3. DESCRIPTION AND OPERATION

Steering system of the machine includes two single stage type, double acting hydraulic cylinders (1, Fig.10C.1). They are mounted on the right and left hand side of the machine. Each cylinder end at cylinder housing side is attached to front frame, and at piston rod end to rear frame. Movement of cylinder rod within the housing cause frames to articulate at hinge pin and enables turning to the left and right.

4. SPECIFICATIONS

Cylinder bore ..... 76.2 [mm]

Cylinder stroke..... 412.7 [mm]

Diameter of mounting holes..... 38.33 ±0.03 [mm]

Pin diameter ..... 38.1 –0.025 [mm]

Special Torques

Cylinder gland nut ..... 1280 ±70 [Nm]

Cylinder rod nut ..... 500 ±40 [Nm]

STEERING CYLINDERS

5. LEAKAGE TEST

WARNING! Before starting the test make sure the area in front and behind the machine is clear of personnel and obstructions. Do not allow anyone near the tires or on the access ladders during this test. Oil flowing under pressure may cause severe injury.

NOTE: *Performing test will require two people, one person to operate the machine, the second person to time the machine's performance. Tests should be conducted on level and smooth surface. Tag all disconnected lines for ease of correct installation.*

1. Start the engine. Operate the machine to warm up the hydraulic oil to operating temperature.
2. Raise the bucket off the ground. Place the machine in straight forward position and lock the frames with locking bar (1, Fig. 10C.2).
3. Apply parking brake.
4. Shut off the engine and turn several times steering wheel to the right and to the left to relieve oil pressure remaining in steering system.
5. Remove four bolts securing front inspection cover to front frame and remove the cover.

NOTE: *Before disconnecting hoses from steering cylinder place a suitable container for oil drains from the cylinder.*

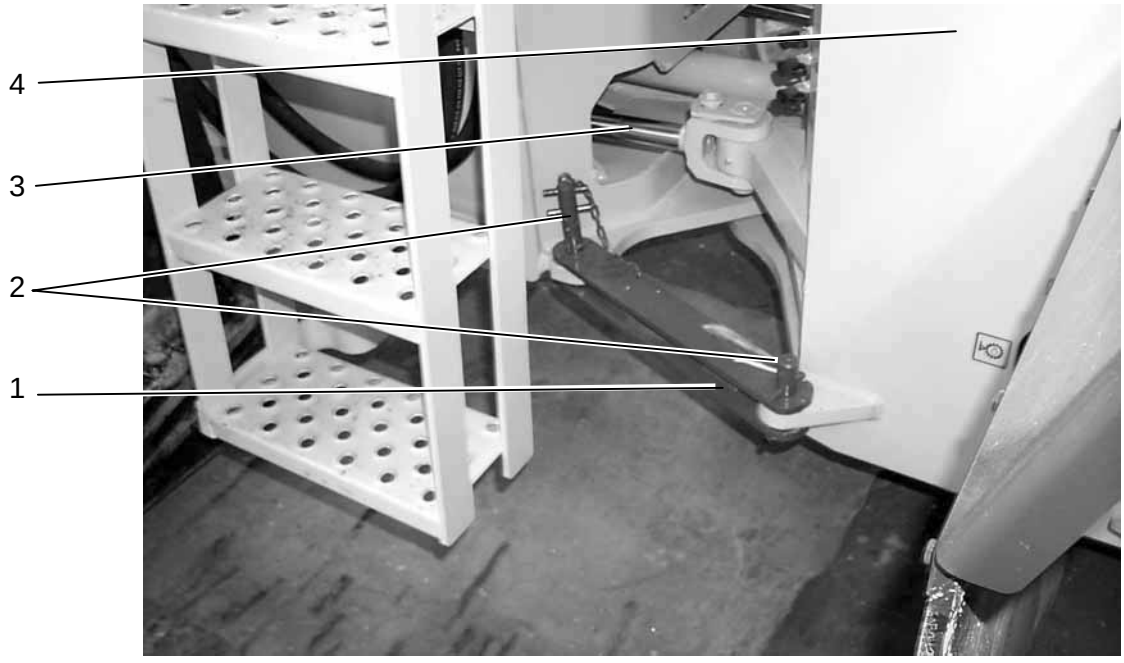


Fig. 10C.2. Locking Front and Rear Frames

1. Locking bar
2. Pins
3. Steering Cylinder Piston Rod
4. Rear Frame

STEERING CYLINDERS

6. Disconnect hydraulic hose with relative connector from the L.H. steering cylinder piston rod side (3, Fig.10C.3), wait until the oil drain and cap end of the hose with correct diameter plastic cap.
7. Start the engine and turn the steering wheel completely to the right.
8. Observe if oil flows from the disconnected elbow. If so, it means the L.H. steering cylinder piston seal or housing is damaged (scratches, deformation).
9. Leaks on gland indicate damaged seals of cylinder gland.
10. Shut off the engine, remove plastic cap from hose. Connect to the cylinder previously disconnected hose.
11. To check other steering cylinder, follow the procedure for the opposite machine side.
12. Unlock machine frames removing locking bar (1, Fig. 10C.2).

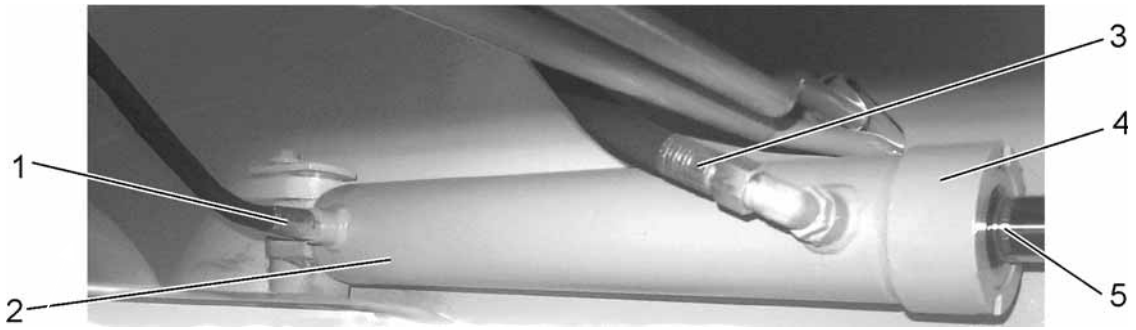


Fig. 10C.3. L.H. Steering Cylinder Disconnect Points.

1. Hose (Cylinder Housing Support Side).
2. Cylinder Housing
3. Hose with Elbow (Piston Rod Support Side).
4. Gland Nut
5. Piston Rod

6. REMOVAL

WARNING! Before attempt to removal, make sure the engine is stopped, the bucket is lowered to the ground, transmission shifter is in neutral position (N), parking brake applied, wheels are blocked with wedges and the master switch turned to the OFF position and the keys are taken out from both the electric master switch and starting switch to prevent accidental 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 as this could introduce foreign material into the system. Tag all disconnected lines for ease of correct installation.*

1. Lower the bucket to the ground. Place the machine in straight forward position and lock the frames with locking bar (1, Fig. 10C.2) and pins (2).
2. Shut off the engine and turn several times steering wheel to the right and to the left to relieve oil pressure remaining in steering system.
3. Remove four bolts securing the front inspection cover to the front frame and remove the cover.

STEERING CYLINDERS

NOTE: *Before disconnecting hoses from steering cylinder place a suitable container for oil drains from the cylinder.*

4. Disconnect hydraulic hoses (1, 3 Fig. 10C.3), from the cylinder housing (2). Attach a suitable hoist and sling to the cylinder and remove the slack.
5. Remove bolt with washer (2, Fig. 10C.4) and pin (4), securing steering cylinder rod (1, Fig. 10C.4) to the rear frame, bolt with washer (4, Fig. 10C.5) and pin (3), securing cylinder housing (2, Fig. 10C.5) to the front frame using copper hammer 1.519.0750.
6. Wait until the oil drain from steering cylinder and remove it from the machine using hoisting equipment.
7. Follow above procedure to remove other steering cylinder if needed.

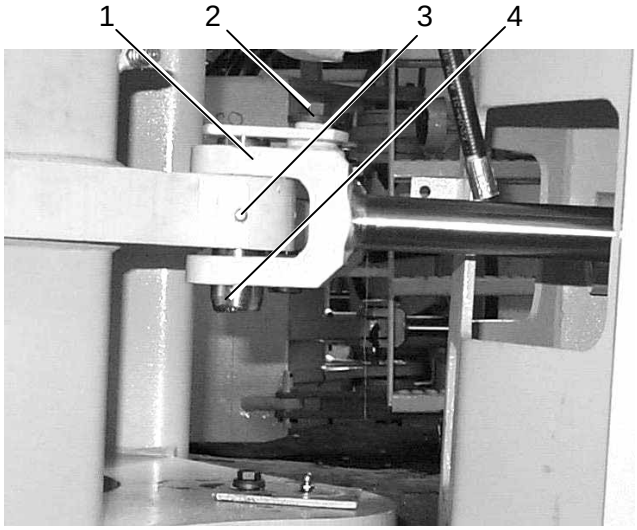


Fig. 10C.4. L.H. Steering Cylinders Rod Side

1. Piston Rod
2. Bolt with Washer
3. Lubrication Fitting
4. Pin

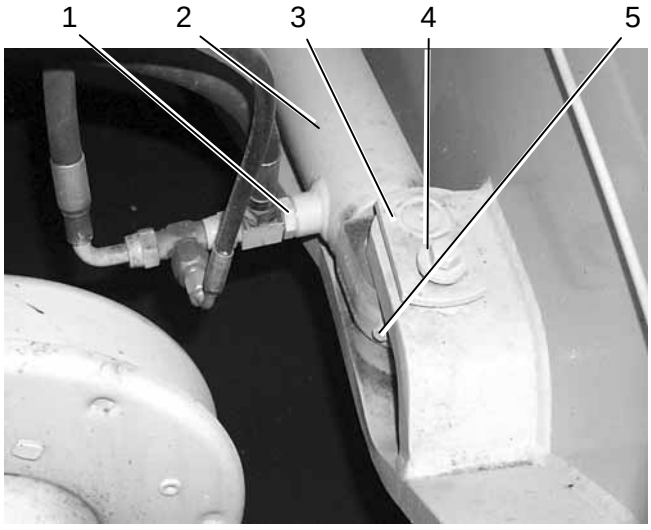


Fig. 10C.5. R.H. Steering Cylinders Housing Side

1. Connecting Port
2. Cylinder Housing
3. Pin
4. Bolt with Washer
5. Lubrication Fitting

7. DISASSEMBLY (Fig. 10C.6)

1. Clean the exterior of the steering cylinder to remove all dirt and grease. Place the steering cylinder into cylinder assembly / disassembly stand No 1.549.0112 or local made appropriate sturdy stand to fasten steering cylinder and block turn of the steering cylinder housing.
2. Using torque multiplier No 1.543.0058 and socket No 1.541.0381 unscrew gland nut (18).
3. Remove piston rod (3), together with gland (6), piston (5), gland nut (18) and all piston and gland seals from the steering cylinder housing (1).
4. Fasten piston rod (3) blocking its turn, unscrew piston nut (4) from the piston rod and remove piston (5) with seals.
5. Remove seals (9, 10) and O-ring (11) from the piston (5).

CYLINDERS

STEERING CYLINDERS

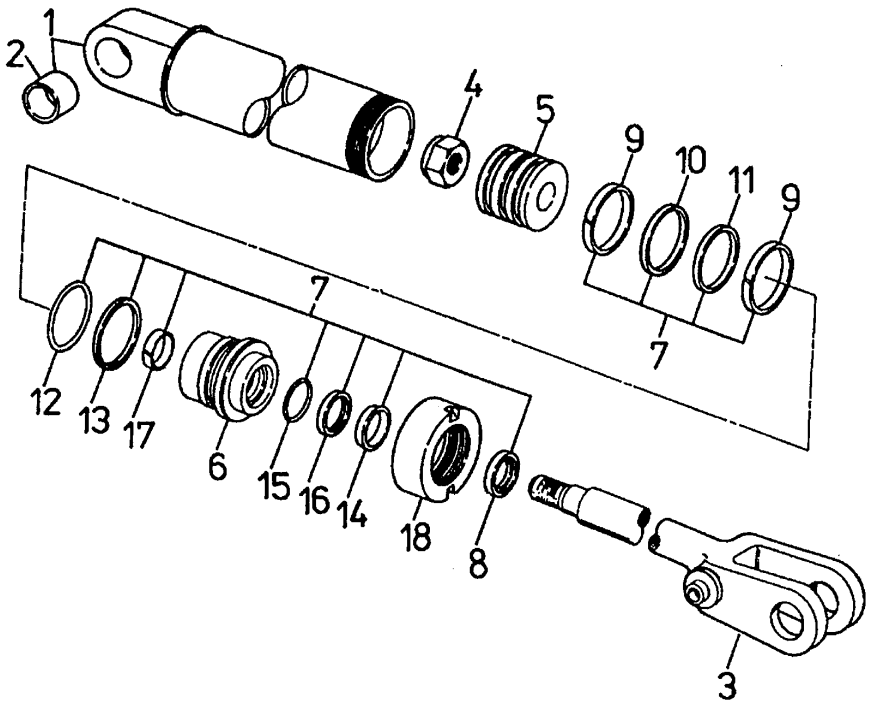


Fig. 10C.6. Steering Cylinder Exploded View

1. Cylinder Housing
2. Bushing
3. Piston Rod
4. Piston Nut
5. Piston
6. Gland
7. Kit Seal
8. Wiper Ring
9. Wear Ring
10. Seal Ring
11. O-Ring
12. O-Ring
13. Thrust Ring
14. Seal Ring
15. O-Ring
16. Buffer Ring
17. Wear Ring
18. Gland Nut

6. Remove gland (6) from the piston rod (3) and remove from its outer groove O-ring (12), thrust ring (13) and its inner bore seals (8, 14, 16, 17, 15).
7. Remove gland nut (18) from the piston rod.
8. Remove seal rings (2, Fig. 10C.1) from the cylinder housing (1).

NOTE: *Use a press of 100 [Ton] in capacity and driver ∅50 [mm]* (See SPECIAL TOOLS) *to press the bushing (2) out.*

9. Remove bushing (2, Fig. 10C.6), if required,
10. Follow this procedure for disassembly of the other steering cylinder.

STEERING CYLINDERS

8. INSPECTION AND REPAIR

1. It is recommended that all new O-rings, buffer and thrust rings, wiper ring, wear rings and seals be installed when the cylinder is disassembled.
2. Wash all parts in a suitable solvent and air dry. Lubricate machined surfaces of usable parts to protect them.
3. Inspect the cylinder housing for roundness through its length. If a tight spot is noticed when removing the piston, the area of binding should be given particular attention. A cylinder housing that is out-of-round should be replaced.
4. Check the cylinder housing and piston rod for scratches or grooves. Shallow scratches can be polished out with fine emery cloth and oil so a smooth surface is presented to the packing.
5. Inspect all sealing ring grooves for scratches, burrs or other damage. „Dress-up" grooves or replace part as necessary.
6. Check the diameter of mounting pins and mounting holes in cylinder housing and piston rod end. Dimensions measured must conform to dimensions specified in "SPECIFICATIONS" Replace defective parts for new ones.

9. REASSEMBLY (Fig. 10C.6)

NOTE: *For reassembly use only new seals without signs of wear. Lubricate all seals before installation.*

NOTE: *Use a press of 100 [Ton] in capacity and driver ∅50 [mm]* (See SPECIAL TOOLS) *to press the bushings (2) into the cylinder housing (1).*

1. Install bushing (2), if removed.

NOTE: *Install the buffer ring (16) with the step-cut side facing toward the piston.*

2. Install buffer ring (16) with O-ring (15), wear ring (17), rod seal ring (14) and wiper ring (8) into gland (6) bore grooves.
3. Install thrust ring (13) and O-ring (12) into gland (6) outer groove.
4. Heat the piston seal ring (10) to 40 [°C] in oil to improve its pliability.

NOTE: *Exercise extra caution not to scratch the piston seal ring (10) in any local area when installing the ring over major diameter of the piston.*

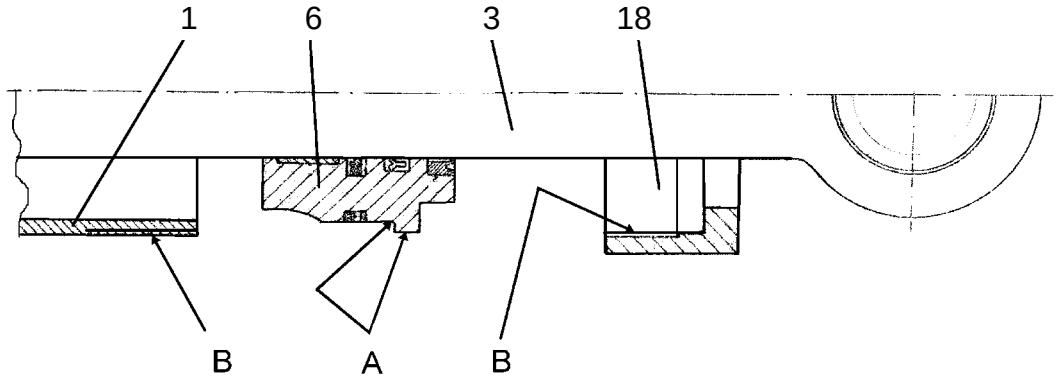


Fig. 10C.7. Gland and Gland Nut Installation

1. Cylinder Housing	6. Gland	A. High-Temperature Grease per HMS B27-0004
3. Piston Rod	18. Gland Nut	B. Loctite 569 Apply Places

5. Install O-ring (11) into piston (5) center groove, then install preheated piston seal ring (10).
6. After installation, compress the piston seal ring (10) into the groove using seals compressing tool No 1.549.0176 to help the normal seal material contraction process. Allow the seal to remain clamped for one-half hour or more, if possible, before final assembly of the piston into cylinder housing (1) bore.
7. Install two wear rings (9) into piston grooves.
8. Install gland nut (18), gland (6) together with all its seals and piston (5) together with all its seals on piston rod (3).
9. Fasten piston rod blocking its turn, install piston nut (4) on the piston rod threaded end and torque the nut to 500±40 [Nm] using torque wrench 1.549.0037 with socket No 8N40M-41/19-65.
9. Coat piston (5) and cylinder housing (1) bore contact surfaces with oil. Slide piston rod (3) together with piston (5) and all its seal rings into cylinder housing (1).
10. Coat gland (6) surfaces (A, Fig. 10C.7) with high-temperature grease per HMS B27-0004 and slide gland into cylinder housing (1) bore.
11. Place the steering cylinder into cylinder assembly/disassembly stand No 1.549.0112 or local made appropriate sturdy stand to fasten steering cylinder and block turn of the steering cylinder housing.
12. Apply a strip of Loctite 569 across the width of gland nut (18) thread and cylinder housing (1) end thread (B, Fig. 10C.7). Thread gland nut (18) on cylinder housing (1) end torque to 1280±70 [Nm] using torque multiplier No 1.543.0058 with socket 1.541.0381.
13. Remove steering cylinder from the stand and install seal rings (2, Fig. 10C.1) into cylinder housing hole.
14. Follow this procedure for reassembly of the other steering cylinder, if required.

10. INSTALLATION

IMPORTANT: *Before installation remove all plastic caps or rubber plugs if used.*

1. Using a suitable hoist and sling, place steering cylinder on the machine so that mounting hole of end of cylinder housing is aligned with mounting holes in the front frame bracket.
2. Apply grease on mating surface of pin (3, Fig. 10C.5) and install with seal rings (2, Fig. 10C.1) to end of the steering cylinder. Secure pin (3, Fig. 10C.5) and tighten bolt with washer (4) to torque 100÷150 [Nm].
3. Reconnect hoses (1 and 3, Fig. 10C.3) to the cylinder housing connecting ports in accordance with previous identification mark.
4. Start the engine and turn steering wheel, so that of the extended piston rod end be aligned with the rear frame opening center line.
5. Apply grease on mating surface of pin (4, Fig. 10C.4) and install to end the piston rod. Secure pin (4) and tighten bolt and washer (2) to torque 100÷150 [Nm].
6. Follow this procedure to install other side steering cylinder if required.
7. Remove locking bar and pin from the front frame (1, Fig. 10C.2).
8. Start the engine. Operate the machine to warm up the hydraulic oil to operating temperature. Turn several times steering wheel to the right and to the left to bleed steering system.
9. Check all connection for leakage and check the oil level in the hydraulic reservoir and fill as necessary. Refer to the OPERATOR'S MANUAL for oil specifications and procedure.

STEERING CYLINDERS

10. Perform STEERING SYSTEM PERFORMANCE TEST described in Section 10. Shut off the engine.
11. Install inspection cover on front frame of the machine and install four mounting bolts.

BUCKET CYLINDER

11. DESCRIPTION AND OPERATION

For bucket control (dump and roll back) is used one single stage type, double acting hydraulic cylinder. Cylinder is mounted with cylinder housing end to upper part of front frame and the piston rod end is attached to upper end of lever assy, which is connected in the center to the boom arm.

12. SPECIFICATIONS

	515G	520G
Cylinder bore	139.7 [mm]	152.4 [mm]
Cylinder stroke	415	485
Dia. of mounting holes	51.03 ±0.025 [mm]	63.69 ±0.06 [mm]
Dia. of pins	50.80 –0.04 [mm]	63.69 –0.06 [mm]

Special torques:

Piston Nut..... 2500 ±130 [Nm]
Gland Cover Mounting Bolts .....46 [Nm]

13. LEAKAGE TEST



WARNING! Before starting the test make sure the area in front and behind the machine is clear of personnel and obstructions. Do not allow anyone near the tires or on the access ladders during this test. Oil flowing under pressure may cause severe injury.

NOTE: *Performing test will require two people, one person to operate the machine, the second person to time the machine's performance. Tests should be conducted on level and smooth surface.*

1. Start the engine. Operate the machine to warm up the hydraulic oil to operating temperature.
2. Raise the bucket off the ground. Place the machine in straight forward position.
3. Dump the bucket completely and shut off the engine. Apply parking brake.

NOTE: *Before disconnected hoses from bucked cylinder place a suitable container for oil drains from the cylinder.*

BUCKET CYLINDER

4. Remove four bolts and split flange (4, Fig. 10C.8) from the bucket cylinder (3). Disconnect lower hose (2) and cap end of hose with correct diameter plastic cap.

CAUTION! High pressure oil. Be sure to place the bucket and boom control lever in the "DUMP" position. If placed in the "ROLL BACK" position, high pressure hydraulic oil will be directed out the plugged hydraulic hose and eject the plug.

5. Start the engine; place the boom and bucket control lever in "dump" position. Run the engine at high speed and observe if oil flows through opening connection port and/ or from the gland wiper ring (8).
6. If there is substantial oil leak, it means that piston seal or housing is damaged (scratches, deformation). Such piston must be replaced.
7. Leaks on gland wiper seal (8, Fig. 10C.8) indicate damaged seals of cylinder gland.
8. Place the bucket control lever in "neutral" position and shut off the engine.
9. Remove plastic cap from the end of the hose (2). Reconnect hose (2), install split flange (4) with four bolts on the tube end block. Tighten the bolts.

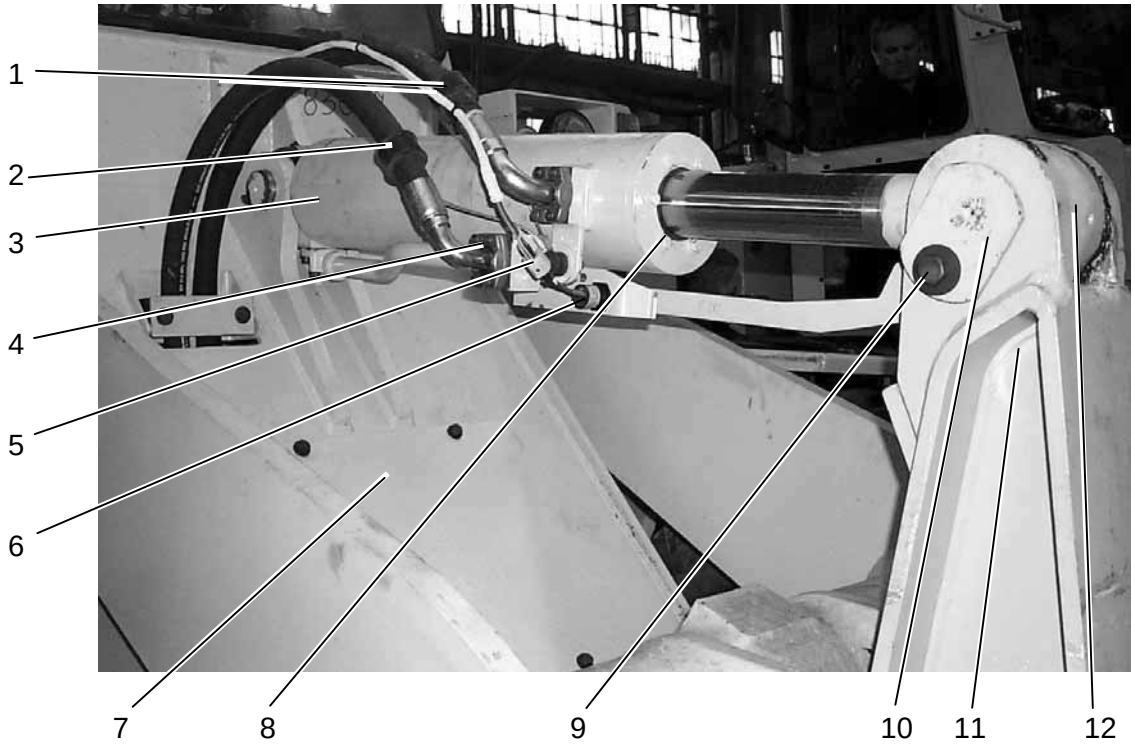


Fig. 10C.8. Bucket Cylinder Disconnect Points (R.H. side View).

1. Hydraulic Hose (supplying oil from piston rod)
2. Hydraulic Hose (supplying oil above piston)
3. Bucket Cylinder
4. Split Flange with 4 Bolts
5. Harness
6. Automatic Bucket Leveler Proximity Switch
7. Inspection Cover with 4 Bolts and Washers
8. Gland Wiper Ring
9. Bolt with Washer
10. Pin
11. Lever Assy
12. Piston Rod

BUCKET CYLINDER

14. REMOVAL

WARNING! Before attempt to removal make sure the engine is stopped, bucket is lowered to the ground, transmission lever in neutral position (N), parking brake applied, wheels blocked with wedges and turn the master switch to the OFF position and take out the key from the master switch and starting switch to prevent accidental starting.

IMPORTANT: *Disconnected hydraulic lines must be capped with the correct size plastic caps. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags as this could introduce foreign material into the system. Tag all disconnected lines for ease of correct installation.*

1. Lower the bucket on the ground.

NOTE: *Before disconnected hoses from bucked cylinder place a suitable container for oil drains from the cylinder.*

2. Mark and disconnect hoses (1, 2, Fig. 10C.8) from bucket cylinder (3).
3. Remove two bolts with washers (4, Fig. 10C.9) and move the bracket (3) together with the automatic bucket leveler proximity switch (6) and harness (5, Fig. 10C.8) aside of the bucket cylinder.
4. Attach a suitable hoist and sling to the bucket cylinder.
5. Remove bolt with washer (9, Fig. 10C.8), tap out pin (10) (with shims for 515G, if mounted), using copper hammer 1.519.0750 and disconnect the piston rod (12) end from the bellcrank lever (11).
6. Follow this procedure to remove pin (5, Fig. 10C.9) of the front frame, slide bucket cylinder eyes from the brackets.

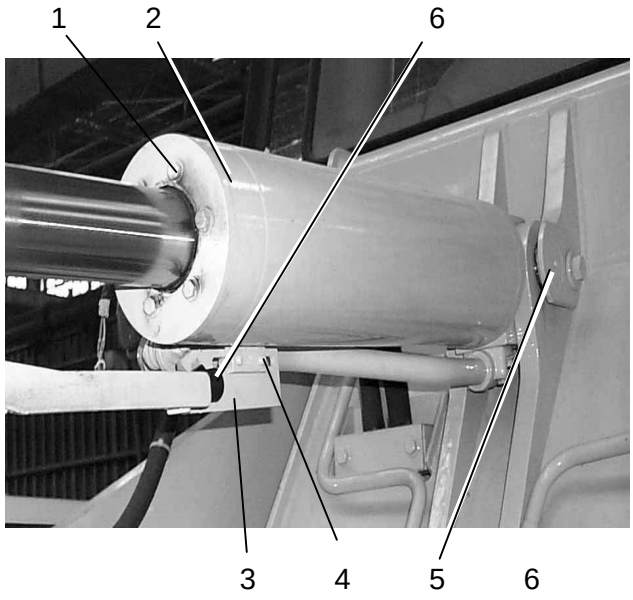


Fig.10C.9. Bucket Cylinder Disconnect Points (L.H. side View).

1. Bolt with Washer
2. Cover
3. Bracket
4. Bolt with Washer
5. Pin
6. Automatic Bucket Leveler Proximity Switch

CYLINDERS

BUCKET CYLINDER

15. DISASSEMBLY (Fig. 10C.10)

1. Clean the exterior of the bucked cylinder to remove all dirt and grease and place cylinder housing (3) into the local made appropriate sturdy stand to fasten and block turn of the bucket cylinder.
2. Remove six bolts with washers (1, Fig. 10C.9) and move cover (6, Fig. 10C.10) away from the cylinder housing (3). Push gland (21) inside the cylinder housing and remove three-piece lock segment (7).
3. Remove piston rod (1), together with piston (4) and gland (21). Fasten piston rod blocking its turn, unscrew piston nut (5) from the piston rod and remove piston (4).

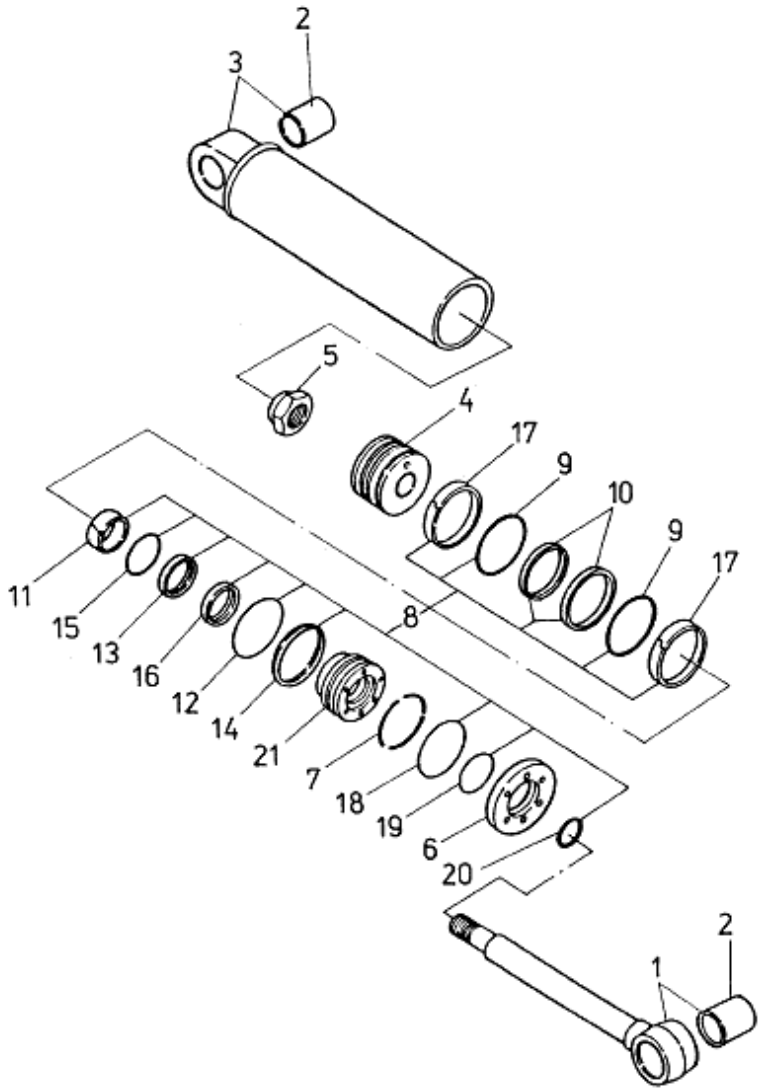


Fig. 10C.10. Bucket Cylinder Exploded View

1. Piston Rod
2. Bushing
3. Cylinder Housing
4. Piston
5. Piston Nut
6. Cover
7. Ring
8. Repair Set
9. O-Ring
10. Piston Seal
11. Wear Ring
12. O-Ring
13. Thrust Ring
14. Buffer Ring
15. O-Ring
16. Rod Seal Ring
17. Ring Wear
18. O-Ring
19. O-Ring
20. Wiper Ring
21. Gland

BUCKET CYLINDER

4. Remove from gland O-ring (12), buffer ring (14) and take out its inner seals (11, 13, 15, 16).
5. Remove seal rings (12, Fig. 10C.1) from the both side of the bucket cylinder ends.

NOTE: *Use a press of 100 [Ton] in capacity and driver ∅62 [mm] (See SPECIAL TOOLS) to press the bushings (2, Fig. 10C.10) out.*

6. Remove bushings (2) out, if required.
7. Remove two wear rings (17) from piston (13) and piston seal (10) and two O-rings (9).
8. Take gland (21) with O-rings (18, 19), wiper ring (20) and cover (6) out from piston rod (1).

16. INSPECTION AND REPAIR

1. It is recommended that all new O-rings, buffer and thrust, wiper rings, wear rings and seals be installed when the cylinder is disassembled.
2. Wash all parts in a suitable solvent and air dry. Lubricate machined surfaces of usable parts to protect them.
3. Inspect the cylinder housing for roundness through its length. If a tight spot is noticed when removing the piston, the area of binding should be given particular attention. A cylinder housing that is out-of-round should be replaced.
4. Check the cylinder housing and piston rod for scratches or grooves. Shallow scratches can be polished out with fine emery cloth and oil so a smooth surface is presented to the packing.
5. Inspect all sealing ring grooves for scratches, burrs or other damage. „Dress-up" grooves or replace part as necessary.
6. Check the diameter of mounting pins and mounting holes in cylinder housing and piston rod end. Dimensions measured must conform to dimensions specified in "SPECIFICATIONS. Replace defective parts for new ones.

17. REASSEMBLY (Fig. 10C.10)

NOTE: *For reassembly use only new seal without signs of wear. Lubricate all seals before installation.*

NOTE: *Use a press 100 [Ton] in capacity and driver ∅62 [mm] (See SPECIAL TOOLS) to press the bushings (2) into the both side of the bucket cylinder ends.*

1. If removed, install bushing (2) into piston rod (1) eye bore and bushing (4) into cylinder housing (3).
2. Install wiper ring (20), lips facing out, into cover (6) using driver 1.547.0292 No 5 and slide cover (6) and two O-rings (18, 19) onto piston rod (1).
3. Coat the bores and grooves of gland (21) with grease. Install rod seal ring (16), O-ring (15), thrust ring (13) and wear ring (11). Do not use a screwdriver, as it will damage seal.
4. Install buffer ring (14) and O- ring (12) into outer gland. Coat piston rod (1) with hydraulic oil and slide into gland bore.

NOTE: *Exercise extra caution not to scratch the piston seal rings (10) in any local area when installing the ring over major diameter of the piston.*

5. Heat the piston seal ring (10) to 40 [°C] in oil to improve its pliability.

6. Install preheated two piston seal rings (10), two O-rings (9). After installation, compress the piston seal rings (10) into the groove using seals compressing tool No 1.549.0176 to help the normal seal material contraction process. Allow the seal to remain clamped for one-half hour or more, if possible, before final assembly of the piston into cylinder housing (1) bore.
7. Slide two wear rings (17) into piston (4) grooves.
8. Slide piston (4) into piston rod (1) and fasten piston rod blocking its turn. Install piston nut (5) and torque the nut to 2500±130[Nm] using torque wrench 1.543.0043 and socket No 8N40M-61/40.
9. Coat piston (4) and cylinder housing (3) bore contact surfaces with oil. Slide piston rod (1) together with piston (4) and all its seal rings into cylinder housing.
10. Fill cavity between gland (21) surfaces side facing toward the cylinder housing (3) with high-temperature grease per HMS B27-0004 (A, Fig. 10C.7) and slide gland into cylinder.
11. Push gland (21) into cylinder housing (3) and drive in just below lock ring groove in the cylinder housing. Install three-piece lock segment (7) in the groove and pull gland (21) until it bottoms on lock segment.
12. Install O-rings (18, 19) into the groove between gland surface and cylinder housing. Move cover (6) to cylinder housing (3) and install by tightening six bolts with washers (1, Fig. 10C.9) to torque of 46 [Nm].
13. Install seal rings (12, Fig. 10C.1) into the both side of the bucket cylinder ends.

18. INSTALLATION

IMPORTANT: *Before installation remove all plastic caps or rubber plugs if used.*

1. Using hoisting equipment and slings, handle bucket cylinder so that mounting holes of front frame and of lever fork are aligned. The cylinder should be positioned with hydraulic ports right side (See Fig. 10C.8).
2. **For 515G only** – Before install pin (5, Fig. 10.C.9) select thickness of shims pack so that end of bucket cylinder clearance in cylinder mounting bracket is max. 1 [mm]. Follow this procedure before install pin (10, Fig. 10C.8) into piston rod bucket cylinder.
3. Apply grease on pin (5, Fig. 10C.9) and install it together with shims and seal rings (12, Fig. 10C.1) into mounting holes of front frame using copper hammer 1.519.0750. Secure the entire assembly tighten bolt with washer (4, Fig.10C.9) to torque of 300÷350 [Nm].
4. Reconnect hoses (1, 2 Fig. 10C.8.) to bucket cylinder (3), in accordance with previous identification mark.
5. Start the engine. Use the bucket and boom control lever to slowly extend or retract the cylinder until the piston rod (12, Fig. 10C.8) eye lines up with mounting holes in the lever assy (11) fork.
6. Follow this procedure and install pin (10, Fig. 10C.8), to secure the entire assembly tighten bolt with washer (9, Fig. 10C.8) to torque of 300÷350 [Nm].
7. Install the bracket (3, Fig. 10C.9) together with the automatic bucket leveler proximity switch (6) and harness (5, Fig. 10C.8) on the bucket cylinder (3). Automatic bucket leveler function and its adjustment are in detail described in the OPERATOR'S MANUAL.
8. Check all connection for leakage Check the oil level in the hydraulic reservoir and fill as necessary, Refer to the OPERATOR'S MANUAL for oil specifications and procedure.

BOOM CYLINDERS

19. DESCRIPTION AND OPERATION

For boom raise and lower are used two single stage type, double acting cylinders. Hydraulic cylinders are mounted with one end to lower part of front frame and to boom arms at piston rod side. Each boom cylinder housing end is mounted to the front frame and the rod end is mounted to the underside of the boom arm.

20. SPECIFICATIONS

	515G	520G
Cylinder bore	114.3 [mm]	114.3 [mm]
Cylinder stroke	567	835
Dia. of mounting holes	57.38 ±0.025 [mm]	63.75 ±0.025 [mm]
Dia. of pins	57.13 –0.02 [mm]	63.50 –0.05 [mm]
Special torques:		
Gland Nut	3250 ±100 [Nm]	3300 ±100 [Nm]
Piston Nut	1600 ±50 [Nm]	1600 ±50 [Nm]

21. LEAKAGE TEST (Fig. 10C.11)

WARNING! Before starting the test make sure the area in front and behind the machine is clear of personnel and obstructions. Do not allow anyone near the tires or on the access ladders during this test. Oil flowing under pressure may cause severe injury.

NOTE: *Performing test will require two people, one person to operate the machine, the second person to time the machine's performance. Tests should be conducted on level and smooth surface.*

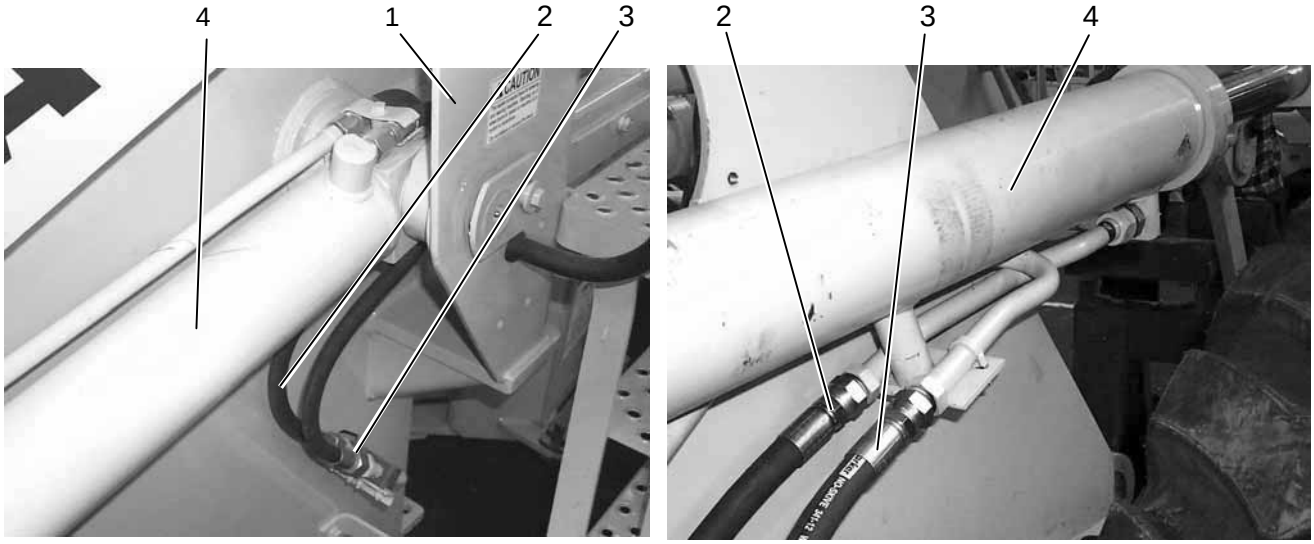
1. Start the engine. Operate the machine to warm up the hydraulic oil to operating temperature.
2. Install the wedges under the rear tires to prevent machine movement and place the empty bucket in the "DUMP" position and lower it to the ground.
3. Place the boom and bucket control lever in the "LOWER" position to raise the front of the machine off the ground 300÷400 mm. Place timbers under each front tire and lower the machine onto the timbers.
4. Apply parking brake. Raise the boom slightly, roll back the bucket and lower the boom so that, piston rods are completely retracted. Shut off the engine.

NOTE: *Before disconnected hoses from bucked cylinder place a suitable container for oil drains from the cylinder.*

5. Remove (at one side of the machine) hose (3) from boom cylinder (4), supplying oil from piston rod. Cap end of the opening hose with correct diameter plastic cap.

CAUTION! High pressure oil. Be sure to place the boom control lever in the "LOWER" position. If placed in the "RAISE" position, high pressure hydraulic oil will be directed out the plugged hydraulic hose and eject the plug.

6. With engine at high speed place the boom control lever in „lower" position. Observe if oil flows through hydraulic hose connection port in cylinder. If there is substantial oil leak, it means that piston seal or housing is damaged (scratches, deformation). Such piston must be replaced.
7. Leaks at gland indicate that cylinder gland seals are damaged.
8. Move boom control lever in "neutral" position and shut off the engine.
9. Reconnect hose (3) to connector port of boom cylinder (4).
10. Follow this procedure to test other boom cylinder.
11. Rise a little boom and remove blocking from the under bucket and tires. Operate the boom up and down several times to expel all air and to check the operation of the cylinder. Check all connection for leakage.



515G (L.H. View) 520G (R.H. View)

Fig. 10C.11. Boom Cylinder Disconnect Points

1. Front Frame
2. House with Fitting (supplying oil below piston)
3. House with Fitting (supplying oil from piston rod)
4. Boom Cylinder

22. REMOVAL

WARNING! Before attempt to removal make sure the engine is stopped, bucket is lowered to the ground, transmission lever in neutral position (N), parking brake applied, wheels blocked with wedges and turn the master switch to the OFF position and take out the key from the master switch and starting switch to prevent accidental starting.

BOOM CYLINDERS

IMPORTANT: *Disconnected hydraulic lines must be capped with the correct size plastic caps. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components. Tag all disconnected lines to facilitate proper installation.*

1. Raise the boom and bucket about 300 [mm] off the ground, keeping the bottom of the bucket horizontal.
2. Place blocking under the bucket and lower the bucket onto the blocking. This will keep the boom cylinder rod ends slightly extended so that when the rod end pins are removed, the cylinders can be retracted enough to clear the boom arms.
3. Attach a suitable hoist and sling to the boom cylinder. The hoist must be installed to give the best possible balance. Place tension on the hoist.
4. Remove bolt with washer (5, Fig. 10C.12) of pin (4). Tap out pins (4), using copper hammer 1.519.0750 and remove shims (if mounted). Start the engine and shift control lever in the ”LOWER” position to retract the piston rod (6). Return the control lever to ”HOLD” and shut off the engine.

NOTE: *Before disconnected hoses from boom cylinder place a suitable container for oil drains from the cylinder.*

5. Disconnect hoses (2, 3, Fig. 10C.11) from boom cylinder (4). Cap end of the opening hose with correct diameter plastic cap.
6. Remove bolt with washer (3, Fig. 10C.12) of pin (2). Tap out pins (2), using copper hammer 1.519.0750 and remove shims (if mounted).
7. Follow this procedure to remove other boom cylinder.

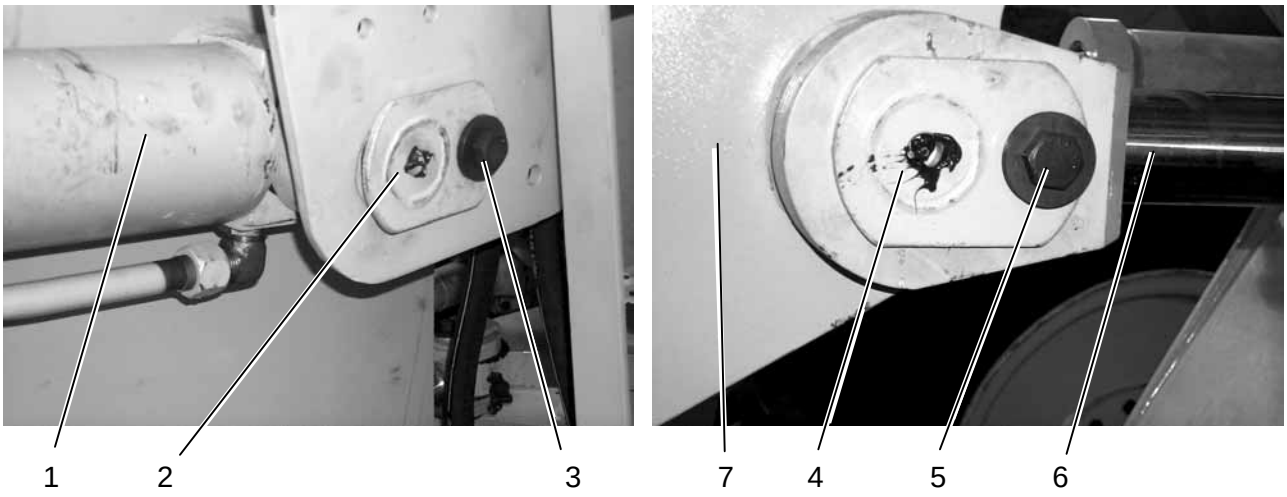


Fig. 10C.12. Supporting Boom for Removal of Boom Cylinders (L.H. View)

1. Cylinder Housing
2. Pin
3. Bolt with Washer
4. Pin
5. Bolt with Washer
6. Boom Cylinder Piston Rod
7. Boom Arm

BOOM CYLINDERS

23. DISASSEMBLY (Fig. 10C.13)

1. Clean the exterior of the boom cylinder to remove all dirt and grease and place the cylinder housing into cylinder assembly/disassembly stand No 1.549.0112 to fasten and block turn of the boom cylinder housing.
2. Unscrew gland nut (14) using torque wrench No 1.543.0026 and socket (See SPECIAL TOOLS) from cylinder housing (1) and remove piston rod (6), together with gland (10), piston (3) from cylinder housing.
3. Fasten piston rod (6) blocking its turn, unscrew piston nut (2) from the piston rod using torque multiplier No 1.543.0058 and socket 8N40M-61/25-75 remove piston (3), gland (10) and gland nut (14).
4. Remove wear rings (4), seal ring (5) from the piston (3).
5. Remove from gland (10) outer O-ring (7), thrust ring (8) and its inner seals (9, 11, 12, 13,15).

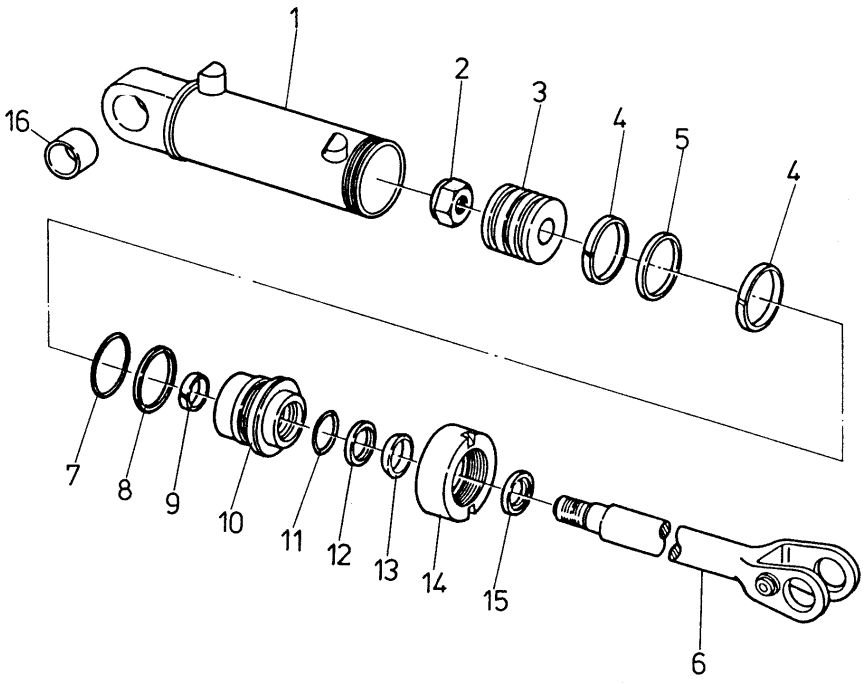


Fig. 10C.13. Boom Cylinder Exploded View

1. Cylinder Housing
2. Piston Nut
3. Piston
4. Wear Ring
5. Piston Seal Ring
6. Piston Rod
7. O-Ring
8. Thrust Ring
9. Wear Ring
10. Gland
11. O-Ring
12. Buffer Ring
13. Rod Seal Ring
14. Gland Nut
15. Wiper Ring
16. Bushing

6. Remove seal rings (12, Fig. 10C.1) from the cylinder housing end.

NOTE: *Use a press of 100 [Ton] in capacity and driver ∅65 [mm]* (See SPECIAL TOOLS) *to press the bushings (16, Fig. 10C.13) out.*

7. Remove bushing (16) from the cylinder housing (1), if required.
8. Follow this procedure for disassembly of the other boom cylinder.

BOOM CYLINDERS

24. INSPECTION AND REPAIR

1. It is recommended that all new O-rings, wiper rings, buffer rings, wear rings and seals installed when the cylinder is disassembled.
2. Wash all parts in a suitable solvent and air dry. Lubricate machined surfaces of usable parts to protect them.
3. Inspect the cylinder housing for roundness through its length. If a tight spot is noticed when removing the piston, the area of binding should be given particular attention. A cylinder housing that is out-of-round should be replaced.
4. Check the cylinder housing and piston rod for scratches or grooves. Shallow scratches can be polished out with fine emery cloth and oil so a smooth surface is presented to the packing.
5. Inspect all sealing ring grooves for scratches, burrs or other damage. „Dress-up" grooves or replace part as necessary.
6. Check the diameter of mounting pins and mounting holes in cylinder housing and piston rod end. Dimensions measured must conform to dimensions specified in "SPECIFICATIONS". Replace defective parts for new ones.

25. REASSEMBLY (Fig. 10C.13)

NOTE: *For reassembly use only new seal without signs of wear. Lubricate all seals before installation.*

NOTE: *Use a press 100 [Ton] in capacity and driver ∅ 65 [mm] (See SPECIAL TOOLS) to press the bushing (16) into the both side of the boom cylinder ends.*

1. Install bushing (16) (if removed) into the both side of the bucket cylinder (1) ends.

NOTE: *Install the buffer ring (12) with the step-cut side facing toward the piston.*

2. Install buffer ring (12) with O-ring (11), rod seal ring (13), wear ring (9) and wiper ring (15) using driver 1.547.0292 No 2 until bottoms its shoulders into gland (10) groove. Install into gland (10) outer groove thrust ring (8) and O-ring (7).
3. Heat the piston seal ring (5) to 40 [°C] in oil to improve its pliability.
4. Install preheated piston seal ring (5). After installation, compress the piston seal ring (5) into the groove using seals compressing tool No 1.549.0176 to help the normal seal material contraction process. Allow the seal to remain clamped for one-half hour or more, if possible, before final assembly of the piston into cylinder housing (1) bore.

NOTE: *Exercise extra caution not to scratch the piston seal ring (5) in any local area when installing the ring over major diameter of the piston.*

5. Install two wear rings (4) into piston (3).
6. Fasten piston rod (6) blocking its turn, slide gland nut (14), gland (10) and piston (3) together with all its seals.
7. Install piston nut (2) on the piston rod threaded end and torque the nut to1600±50 [Nm] using torque wrench 1.543.0058 and socket 8N40M-61/25-75.
8. Coat piston (3) and cylinder housing bore contact surfaces with oil. Slide piston rod (6) together with piston (3) into cylinder housing.

9. Fill cavity between gland (10) surfaces side facing toward the cylinder housing with high-temperature grease per HMS B27-0004 (A, Fig. 10C.5) and slide gland into cylinder housing (1) bore.
10. Apply a strip of Loctite 569 across the width of gland nut (14) thread and cylinder housing (1) end thread (B, Fig. 10C.5). Torque gland nut to using torque wrench No 1.543.0026 (See SPECIFICATION for Sockets and Special Torque).
11. Remove boom cylinder from the stand and install seal rings (12, Fig. 10C.1) into the cylinder housing end
12. Follow this procedure for reassembly of the other boom cylinder.

26. INSTALLATION

IMPORTANT: *Before installation remove all plastic caps or rubber plugs if used.*

1. Use hoisting equipment and slings handle boom cylinder. Position boom cylinder (4, Fig. 10C.11) so that mounting hole of cylinder and front frame (1) are aligned. The cylinder should be positioned with hydraulic ports up (for 515G) and down (for 520G).
2. Select thickness of shims pack so that end of boom cylinder in mounting bracket (Fig. 10C.12) will be max.1 [mm].
3. Apply grease on pin (2, Fig. 10C.12), and install it together with shims, seal rings (12, Fig. 10C.1) in the mounting hole, used copper hammer 1.519.0750.
4. Secure pin (2, Fig. 10C.12) with bolt with washer (3) and torque the bolt to 100÷150 [Nm] - (515G) and 300 ÷ 350 [Nm] - (520G).
5. Install hydraulic hoses (2 and 3, Fig. 10C.11), in accordance with previous identification mark.
6. Start the engine. Place the boom and bucket control lever in ”RAISE” position to slowly extend the boom cylinder piston rod (6, Fig. 10C.12) until the rod eye fork lines up with the mounting hole in the boom arm (7).
7. Follow this procedure (item 2 and 3 above) to install pin (4, Fig. 10C.12) together with shims and bolt with washer (5). Secure pin (4) to torque the bolt to 100÷150 [Nm] - (for 515G) and 300 ÷ 350 [Nm] - (for 520G).
8. Start the engine, raise a boom and remove blocking from the under bucket.
9. Raise and lower the boom several times to fill the hydraulic system with oil. Check all connection for leakage.
10. The above procedure is just the same for both boom cylinders.
11. Check the oil level in the hydraulic reservoir and fill as necessary. Refer to the OPERATOR’S MANUAL for oil specifications and procedure.

SECTION 10E

RESERVOIRS AND FILTERS

RESERVOIRS AND FILTERS

CONTENTS

1. Description and Operation 3
2. Specifications 4
3. Removal 5
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5. Inspection and Repair 7
6. Reassembly 8
7. Installation 9

1. DESCRIPTION AND OPERATION

Hydraulic reservoir is constructed within the upper right hand side of the bulkhead assembly (1, Fig. 10E.1). The reservoir acts as a storage tank for the majority of the steering and loader equipment hydraulic system oil. The remainder of oil fills the lines and system components. On the front side of the reservoir is a sight gauge (2). This gauge allows the fluid level in the reservoir to be checked without opening the reservoir filler cap (6).

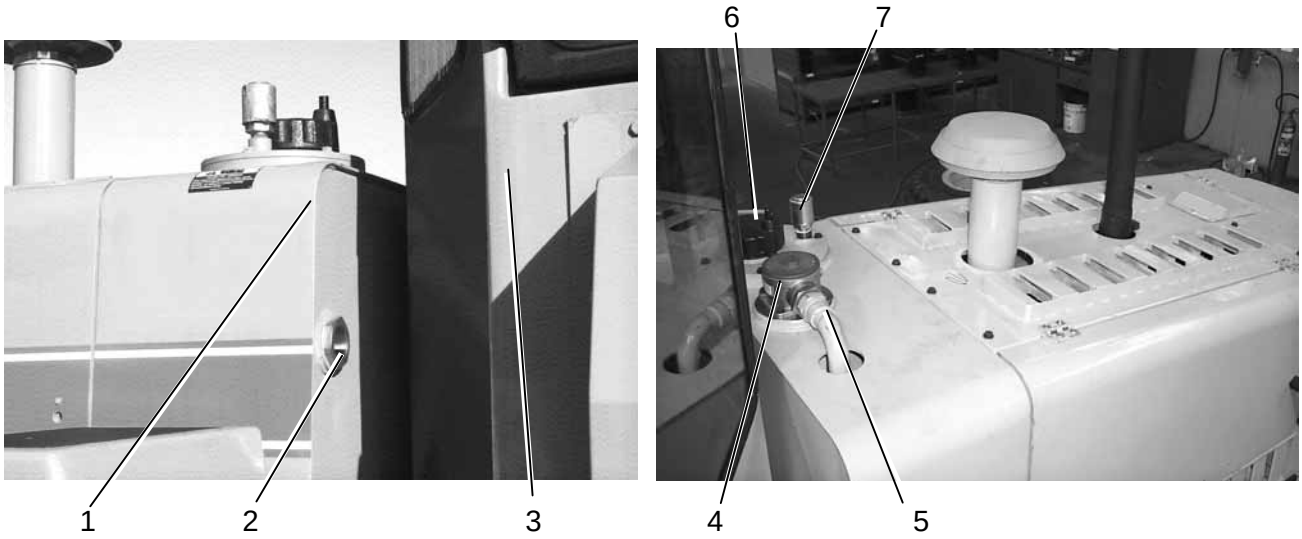


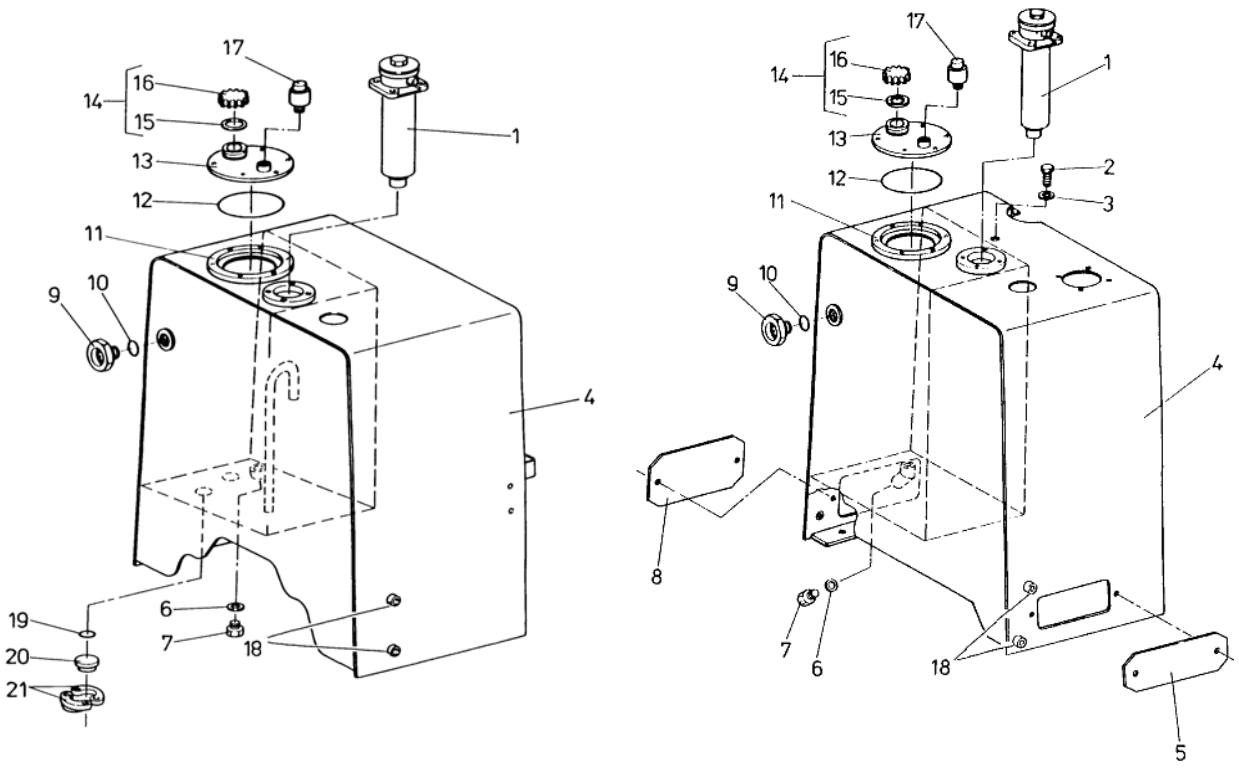
Fig. 10E.1. Hydraulic Reservoir (R.H. view and Top view)

1. Bulkhead Assy
2. Sight Gauge
3. Operator Cab
4. Return Filter
5. Oil Return Pipe
6. Filler Cup
7. Vacuum Pressure Relief Valve (with Filter)

Equipment and steering system share one oil reservoir. Hydraulic reservoir (4, Fig. 10E.2) is a welded assembly from steel sheets. In upper part of the reservoir is located return filter (1) and reservoir cover (13) with located on the top, filler cap assy (14) and vacuum pressure relief valve (17). Filler oil filter (11) consisting of strainer, to clean the oil when reservoir is filled. In lower part of the reservoir is located a drain valve (7) and various ports for suction lines. The oil stored inside the reservoir is drawn over the suction ports and is delivered to the steering and equipment pump and ground driven steering pump (if equipped). The oil continues its flow through the system. The returning oil enters the return filter (1) through the filter head (4, Fig. 10E.4), passes through filter element (7) and flows to the reservoir. In filter head (4) is threaded control oil switch (9). If filter element is dirty, control oil switch (9) closes circuit of warning light, to activate filter warning light at instrument control panel. It means that filter element (7) must be replaced.

The return filter is equipped for by-pass valve (10) to prevent filter assy from to high oil pressure build. When the oil filter becomes clogged or when the oil is cold, oil pressure build into the return filter. Once a pressure differential of 200 [kPa] is reached, the oil pressure opens by-pass valve (10), which passes oil into the hydraulic reservoir.

A combination vacuum pressure relief valve (17, Fig. 10E.2) mounted on top reservoir cover (13) is used to clean air and maintain a head of pressure in the reservoir. If the pressure in the reservoir rises above 200 [kPa], the excess pressure will be bled off to atmosphere. If the pressure falls below 2 [kPa], the valve will function to allow air at atmospheric pressure to enter the reservoir.



515G 520G

Fig. 10E.2. Exploded View of Hydraulic Reservoir

1. Return Filter
2. Bolt
3. Hardened Washer
4. Hydraulic Reservoir
5. Plate
6. Seal
7. Drain Valve
8. Plate
9. Sight Gauge
10. O-Ring
11. Filler Oil Filter
12. O-Ring
13. Reservoir Cover
14. Filler Cup Assy
15. Seal
16. Filler Cap
17. Vacuum Pressure Relief Valve (with Filter)
18. Mounting Holes
19. O-ring
20. Plug
21. Split Flange

2. SPECIFICATIONS

Machine Model	**515E**	**520E**
Hydraulic reservoir capacity	49 [l]	70 [l]
Return filter by-pass valve Operating pressure (max) ..... 1000 [kPa] Opening pressure ..... 200 [kPa]		
Vacuum pressure relief valve Pressure (cracking) ..... 200 [kPa] Vacuum (cracking) ..... 0÷2 [kPa]		
Filter element ..... 10 micron		

Special Torques

Oil filter cover (with oil applied to the gasket) ..... 27 [Nm]
Sight gauge ..... 250÷280 [Nm]

3. REMOVAL

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.

WARNING! This machine has a pressurized hydraulic reservoir. Loosen the filler cap slowly to relieve the pressure before disassembly of any hydraulic system component. Do not overfill.

IMPORTANT: *Disconnected hydraulic lines must be capped with the correct size plastic caps. If plastic caps are not available use clean corks or self-adhesive tape. Openings must never be plugged with rags. This practice could easily introduce dirt or lint in to critical components of the machine.*

1. Lower the bucket to the ground. Place the machine in straight forward position and lock the frames with locking bar.
2. Remove the filler cap (16, Fig.10E.2) slowly, to relieve any pressure in the reservoir (4).

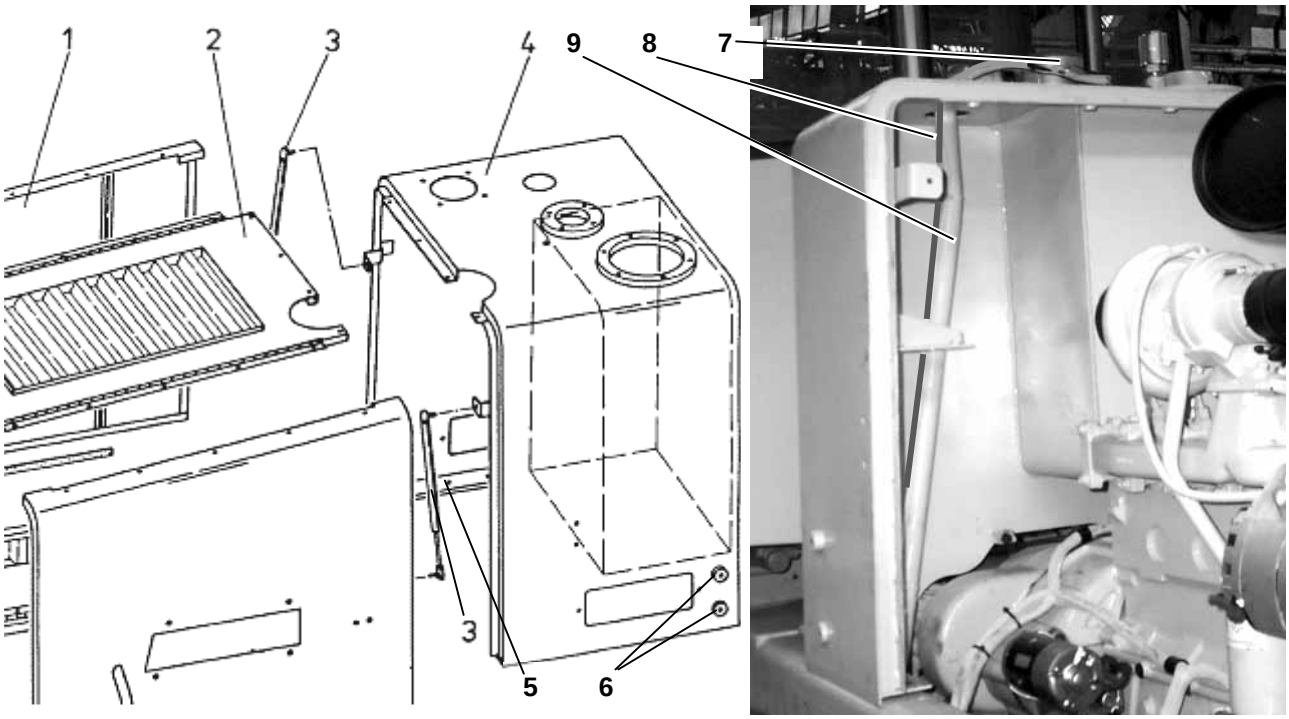


Fig. 10E.3. Disconnecting Point of Hydraulic Reservoir

1. Guard L.H
2. Upper Guard
3. Gas Springs
4. Reservoir
5. Mounting Hole (to Rear Frame)
6. Mounting Holes (to Fender)
7. Return Filter
8. Wire (to Filter Control Oil Switch)
9. Return Pipe

NOTE: *Before removing any components from the hydraulic reservoir, clean the top surface of the reservoir and the components to be dismantled with a commercial cleaning solvent.*

NOTE: *It is not necessary to drain the reservoir to replace the return filter or vacuum pressure relief valve. The oil level is below those parts and so the oil will not flow out of the reservoir while the elements are being removed.*

NOTE: *Before disconnecting hoses from hydraulic reservoir place a suitable container for oil drains.*

3. Drain the hydraulic reservoir. Refer to the OPERATOR'S MANUAL for this procedure.
4. Disconnect oil return pipe (9, Fig. 10E.3) from the bottom of the reservoir.
5. Disconnect the hydraulic lines from the bottom of the reservoir. Cap the reservoir ports to prevent entry of dirt.
6. Unplug wire (8) from the connector from the bottom of the reservoir.
7. Attach a hoist sling to the reservoir (4). The hoist must be installed to give the best possible balance.
8. Disconnect gas springs (3) and remove front fenders from both side of reservoir.
9. Unscrew the bolts with washers securing the reservoir to the rear frame and to upper guard (2)
10. Remove reservoir from the machine.

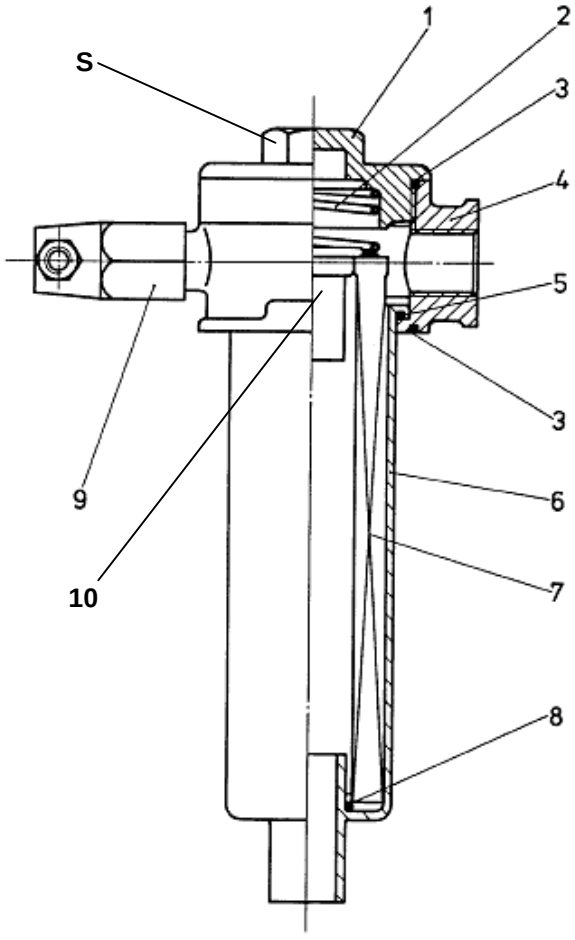


Fig. 10E.4. Return Filter Assy

1. Cover
2. Spring
3. O-ring
4. Head
5. O-ring
6. Filter Body
7. Filter Element
8. O-ring
9. Filter Control Oil Switch
10. By-pass Valve

S = 30 [mm]

4. DISASSEMBLY

1. Disconnect oil return pipe (6, Fig. 10E.1) from return filter (4).
2. Unplug wire from the filter control oil switch (5).
3. Unscrew four bolts with washer and remove return filter (1, Fig. 10E.2).

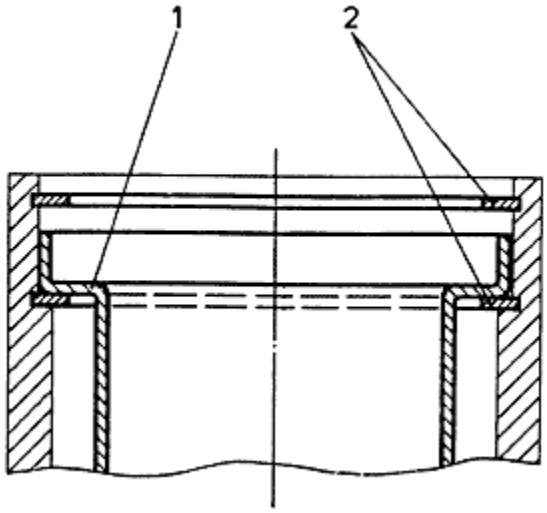


Fig. 10E.5. Filler Oil Filter (cross section)

1. Strainer
2. Retaining Rings

4. Remove the drain valve (7) and seal (6) from the bottom of the reservoir.
5. If necessary, remove the sight gauge (9) and O-ring (10) from the reservoir.
5. Unscrew cover (1, Fig. 10E.4) from filter header (4), remove spring (2), by-pass valve (10), filter element (7) and O-rings (3, 5, and 8). If necessary remove the filter control oil switch (9).
6. Unscrew bolts with washers and remove the reservoir cover (13, Fig. 10E.2) with O-ring (12) from reservoir (4).
7. If necessary unscrew the vacuum pressure relief valve (17) from cover (13) and remove retaining ring (6, Fig. 10E.6), cover (7) ceramic filter (8), cap (9) spring (10), ring (11) sleeve (12) and seal rings (2).
8. From sleeve (12) remove seal ring (3), lock ring (4), pilot bar (15), spring (14), vacuum poppet (13) and seal ring (5).
9. Remove retaining rings (2, Fig. 10E.5) and pull out strainer (1).

5. INSPECTION AND REPAIR

NOTE: *All parts must be thoroughly cleaned and kept clean during inspection and assembly. The close tolerance of the parts makes this requirement very important. Clean all removed parts using a commercial solvent that is compatible with the system fluid. Compressed air may be used in cleaning but it must be filtered to remove water and contamination.*

1. Install drain valve (7, Fig. 10E.2) with seal (6). Fill small amount of solvent into the reservoir (4). Then, clean the inside of the reservoir using a brush fastened to bar of sufficient length through filler oil filter mounting hole or return filter mounting hole (after removal of strainer and filter).

2. Be sure to clean the screens in the bottom of the reservoir and drain dirty solvent to suitable container. Check the reservoir for leaks, corrosion, fractures and deformations.

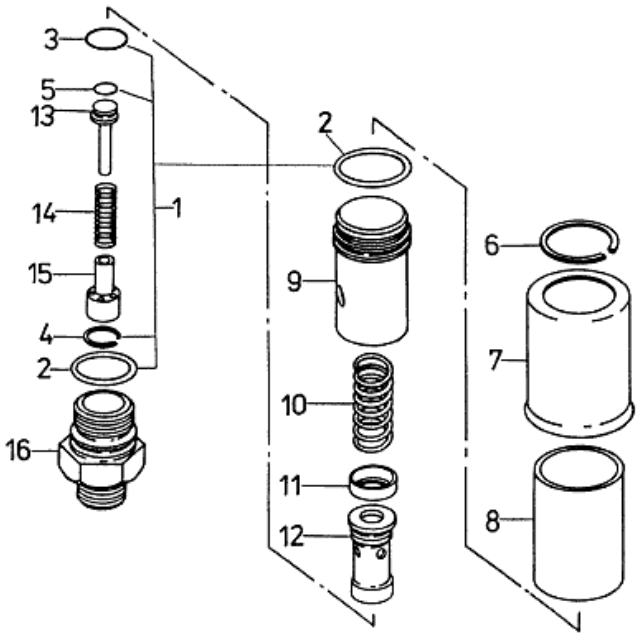


Fig. 10E.6. Sectional View of Vacuum Pressure Relief Valve

1. Valve Set
2. Seal Ring
3. Seal Ring
4. Lock Ring
5. Seal Ring
6. Retaining Ring
7. Cover
8. Ceramic Filter
9. Cap
10. Spring
11. Ring
12. Sleeve
13. Vacuum Poppet
14. Spring
15. Pilot Bar
16. Valve Housing

3. Clean strainer (1, Fig. 10E.5) in a commercial solvent and dry with compressed air or replace it if damaged.
4. Remove filter element (7, Fig. 10E.4) and replace it with a new one. Refer to the OPERATOR'S MANUAL for this procedure.
5. Clean housing of return filter. Check the condition of return filter by-pass valve and filter control oil switch in filter head.
6. If vacuum pressure relief valve (Fig. 10E.6) is disassembled, clean and dry all parts thoroughly. Check all parts and pay special attention to the condition of sliding surfaces of poppet (13) and sleeve (12), any scratches are inadmissible. Clean or replace ceramic filter (8). If either the parts is grooved or damaged or if does not move freely, the valve assembly should be replaced.
7. Replace all seals for new ones.

6. REASSEMBLY

1. Install strainer (1, Fig. 10E.5) into the filler oil filter and secure with retaining rings (2).
2. Install new filter element (7, Fig. 10E.4) with O-rings (8 and 5) to filter body (6).
3. Install by-pass valve (10), spring (2) and tighten cover (1) with O-ring (3) oil applied to torque 27 [Nm]. If removed install filter control oil switch (9).
4. Install the return filter (1, Fig. 10E.2) to the reservoir (4) and fasten with four bolts with washers.
5. Install the oil return pipe (5, Fig. 10E.1) to the return filter (4) and tighten them.

6. Connect the wire (8, Fig. 10E.3) to the filter control oil switch (9, Fig. 10E.4).
7. Install reservoir cover (13, Fig. 10E.2) with O-ring (12) and fasten with six bolts with washers.
8. Reassembly the remaining components parts of the vacuum pressure relief valve (17) in reverse order they were disassembled (See 4. DISASSEMBLY above).
9. On the reservoir cover (13) install vacuum pressure relief valve (17).
10. Install sight gauge (9) together with O-ring (10) in reservoir (4), if removed previously and tighten it to torque 250÷280 [Nm].
11. If removed, install drain valve (7) with seal (6) to the bottom of reservoir (4).

7. INSTALLATION

IMPORTANT: *Prior to installation remove all plastic or rubber plugs, if used.*

1. Attach a hoist sling to the reservoir (4, Fig. 10E.3). The hoist must be installed to give the best possible balance. Place tension on the hoist.
2. Install reservoir (4) to the rear frame and to upper guard (2), fasten with bolts with washers.
3. Install front fenders and connect gas springs (3) to both side of reservoir (4).
4. Connect oil return pipe (9) to the bottom of the reservoir.
5. Connect all the hydraulic lines to the top and bottom of the reservoir and tighten them.
6. Connect wire (8) to the filter control oil switch of the return filter (7).
7. Fill the system with fresh oil. Refer to the OPERATOR'S MANUAL for this procedure.
8. Start the engine, move the hydraulic controls in all directions and visually check hoses and connections for leakage.
9. Check oil level, refer to the OPERATOR'S MANUAL.

SECTION 12

POWER

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1. DESCRIPTION

The machines 515G and 520G are powered by QSB-5.9-30 Cummins Engine, six cylinder turbocharged diesel engine. This engine is a high speed, four cycle, two valves per cylinder type, using a 24 [V] direct starting system. The engine has direct injection electronically controlled fuel system.

For further information subject the engines refer to the Maintenance Manual Industrial QSB3.9-30, QSB4.5-30 and QSB5.9-30 Series Engines, Bulletin No 4021388. Information on repair of subassemblies of engine is given in Troubleshooting and Repair Manual Industrial QSB-3.9-30, QSB4.5-30 and QSB-5.9-30 Series Engines, Bulletin No 4021398.

2. SPECIFICATIONS

Special Bolt and Nut Torque Data

Air cleaner hose clamps . . . . . 10 – 12 [Nm]

Alternator terminals:

No.10-24 ground terminal . . . . . 1.7 – 2.8 [Nm]
¼" -28 positive terminal . . . . . 6 – 8 [Nm]

Battery terminals . . . . . 34 – 42 [Nm]

Cranking motor:

M10 x 1.25 magnetic switch terminal . . . . . 1.8 – 2.5 [Nm]

Transmission housing to engine flywheel housing bolt . . . . . 42 – 50 [Nm]
Front engine support to frame bolt . . . . . 135 – 165 [Nm]
Gear ring to the flywheel . . . . . 35 – 42 [Nm]

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

NOTE: *Except for the special torques shown, all bolts and nuts are to be given a standard torque. Refer to the „STANDARD TORQUE DATA CHART" in Section 1, „GENERAL".*

3. AIR INDUCTION SYSTEM TEST

1. Remove the end cover from the air cleaner.
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.
3. Remove the air cleaner warning light switch (1, Fig. 12.1). Tee in a 0 to 100 [kPa] pressure gauge.
4. Remove any of the plug (1, Fig. 12.2) from the intake manifold. Connect a manually regulated compressed air supply.
5. Adjust the air regulator until the pressure gauge registers 20 [kPa]. If pressure cannot be reached, it may be necessary to rotate the engine crankshaft over slightly until a minimal leakage occurs past the engine valves.

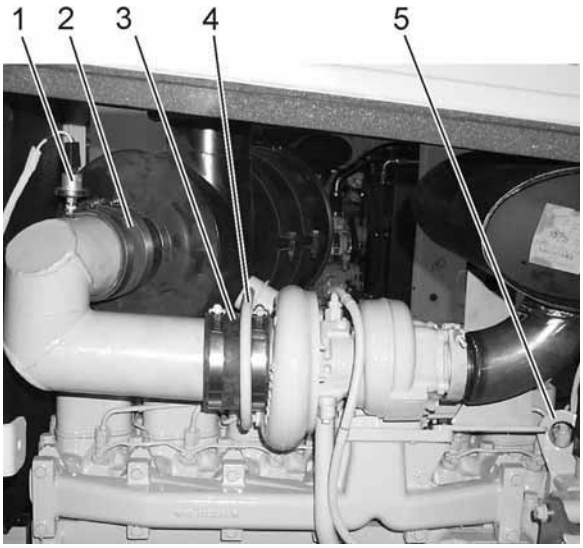
6. Using a soap solution and a paint brush, coat the following areas and check for leaks:

   a. Air cleaner body outlet (2, Fig. 12.1) surfaces around the pipe connections
   b. Clamped hose connections (3) between air cleaner outlet and turbocharger.
   c. Turbocharger connections to cylinder head and west-gate actuator connection (4).

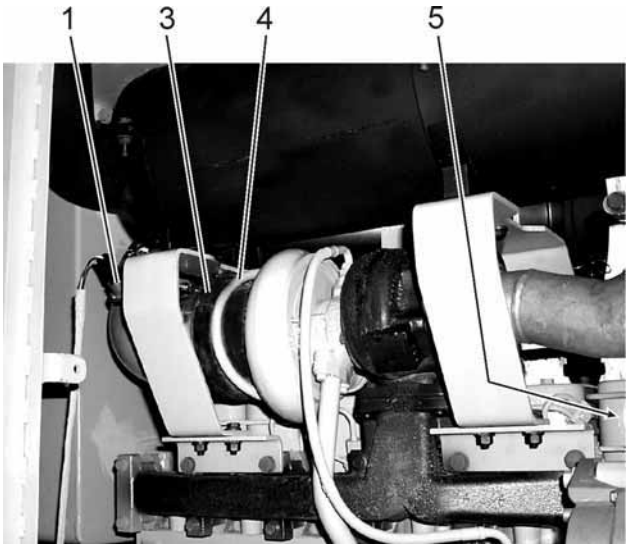
7. No leakage is permitted between the air cleaner and suction side of the turbocharger and turbocharger, cylinder head connection. If leakage is detected, tighten hose clamps. If leakage still persists, remove the parts to determine cause. Replace parts as necessary and retest.

8. Reinstall the air cleaner warning light switch (1) and plug (1, Fig. 12. 2).

9. Remove the filter elements and remove the duct tape. Inspect the seals for damage. Reinstall both elements and the end cover.



515G



520G

Fig. 12.1. Air Induction System Check Points.

1. Air Cleaner Warning Light Switch
2. Air Cleaner Body Outlet
3. Turbocharger Connection
4. West-Gate Actuator Connection
5. Engine lifting Bracket (front)

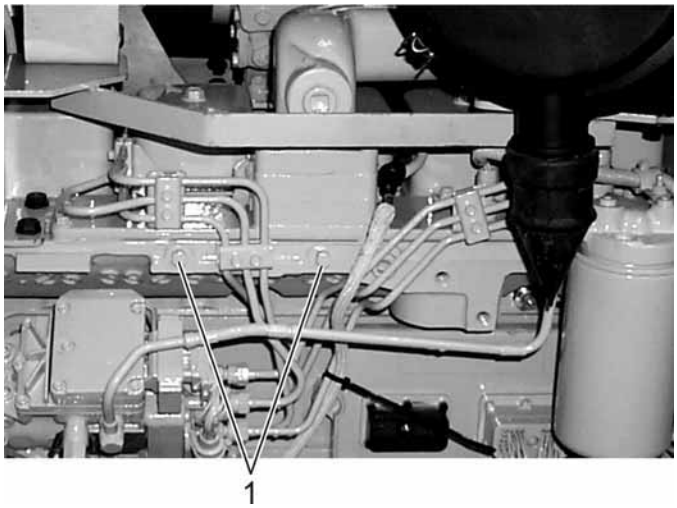


Fig. 12.2. Compressed Air Fill Points .

1. 1/8 NPT Plug

4. ENGINE CONTROL CHECKING

WARNING! The following checking procedures are to be performed with the engine stopped unless otherwise stated. Whenever it is necessary to have the engine running, be sure the transmission lever is in „neutral" (N) position and parking brake in applied position.

General

The QSB5.9-30 engine is controlled by the APS (Accelerator Position Sensor) mounted in the accelerator pedal, connected by OEM (Original Equipment Manufacturer) wire harness to the (Electronic Control Module).
The APS sends a signal which determines the desired engine speed to the ECM, when the operator pushes on the accelerator pedal.
The accelerator pedal does not require any mechanical adjustment. In case of malfunction the fault code (i.e. 131 or 132) will be displayed.

Remove all dirt accumulation from the accelerator pedal.

After checking has been performed, machine must be checked out in actual operation for proper functioning.

WARNING! For your personal protection never perform 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 kit, or during measurement engine speed, be careful not to touch any high temperature parts or rotating parts.

Engine Running

1. With accelerator pedal fully released, check to make sure engine is running at designated low idle speed 700 - 1000 [RPM].
2. With accelerator pedal fully depressed, check to make sure engine is running at designated high idle speed for 515G - 2580 - 2760 [RPM], for 520G – 2600 – 2750 [RPM].
3. If designated speeds are not within specification check accelerator pedal and OEM harness.

NOTE: *If designated speeds can not be reached, contact with nearest Cummins Authorized Service.*

Engine not Running

Accelerator Position Sensor (APS) and Idle Validation Switch (IVS) Circuit Checking (Refer Fig. 12.3)

NOTE: *When making engine connection test, the starting switch MUST be in „OFF" position and all test points MUST be feed into, leaving all engine sensors properly installed in their respective ports and electronically connected to the ECM. If any sensors are disconnected during engine operation, a fault code 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 checking, switch key to the "ON" position. Check that there are not throttle position sensor fault code(s) (refer to Diagnostic Fault Codes in Engine Operation Maintenance Manual).

1. Disconnect 50 pin connector (1) from the ECM. Dry connector by using electrical contact cleaner P/N 3824510.
2. Inspect the APS 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), of 50 pin connector (1) are as follows (refer to wiring diagram):

Potentiometer circuit (APS):
- from pin No. 29 to pin No. 19 - pedal depressed or released . . . . . 2000 to 3000 [Ω]
- from pin No. 29 to pin No. 30 - pedal released . . . . . 1500 to 3000 [Ω]
- from pin No. 29 to pin No. 30 - pedal depressed . . . . . 200 to 1500 [Ω]
- from pin No. 30 to engine block ground. . . . . more than 100 [kΩ]
- from pin No. 29 and 19 to all pins of 50 and 22-pin connectors . . . . . more than 100 [kΩ]

Switch circuit (IVS) :
- from pin No. 25 to pin No. 26 - pedal depressed . . . . . less than 125 [Ω]
- from pin No. 25 to pin No. 26 - pedal released . . . . . less than 125 [Ω]
- from pin No. 25 and 26 - to engine block ground . . . . . more than 100 [kΩ]
- open circuit of the harness . . . . . less than 10 [Ω]

Foot pedal operating range . . . . . released 45 degree
. . . . . depressed 17 degree

4. If the resistance values are not within the specification the potentiometer, switch or wire harness has failed. Replace the potentiometer, switch or wire harness.

5. Before reconnect connectors (1 and 2), 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.*

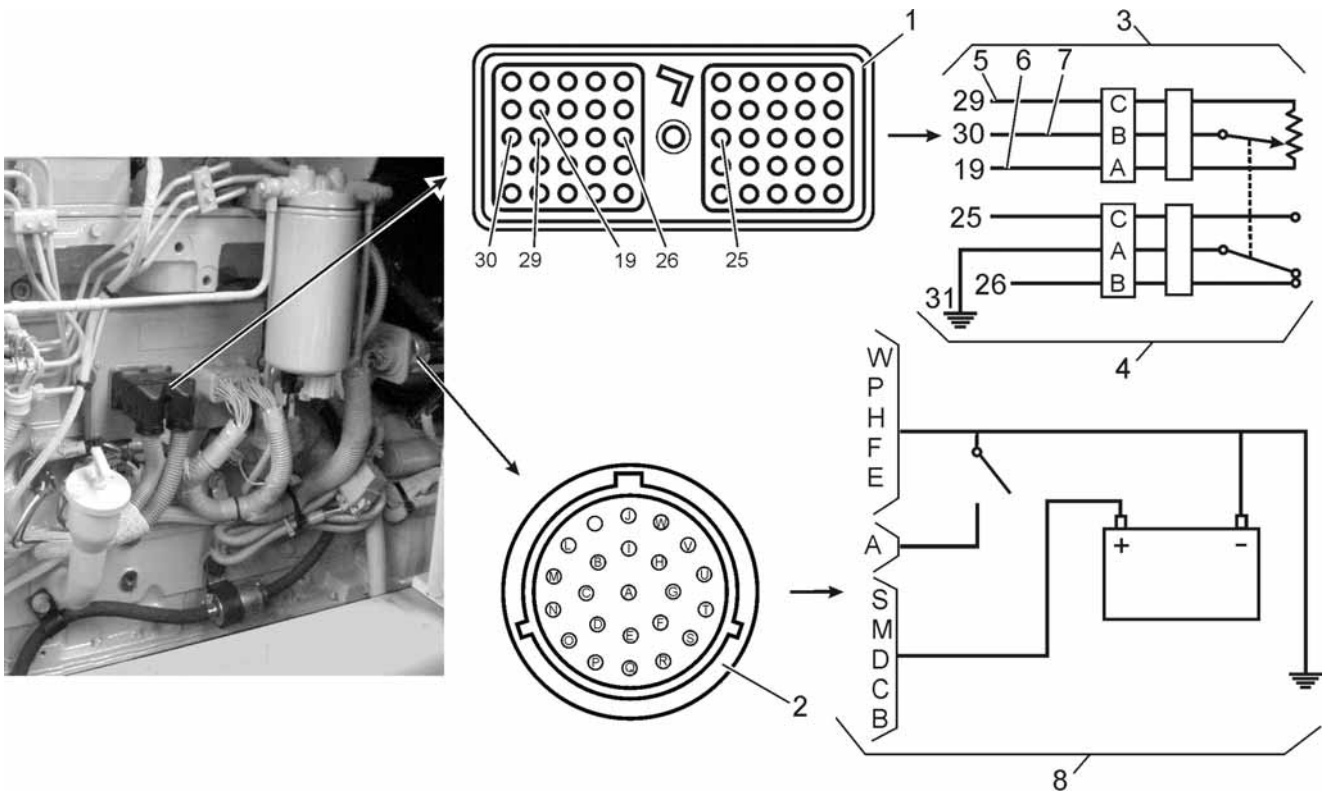


Fig. 12.3. Engine Control Interface Connectors

1. 50 Pin Connector (view of harness connector)
2. 22 Pin Connector
3. Potentiometer Circuit (TPS)
4. Switch Circuit (IVS)
5. Pin No 29 + 5VDC Supply
6. Pin No 19 Signal
7. Pin No 30 Return
8. OEM Harness

NOTE: *If accelerator pedal is changed or after calibration downloaded depress pedal (key switch ON) through its complete travel 3 times. This procedure calibrates the new potentiometer with the ECM.*

After checking has been performed, machine must be checked out in actual operation for proper functioning.

NOTE: *If designated engine speeds are not achieved contact witch Authorized Cummins Service.*

5. REMOVAL

1. Position the machine in a place which makes it possible to use a lifting device for lifting of disassembled assemblies.
2. Turn the electrical master switch to the „OFF" position. Lower the bucket on the ground.

WARNING! Make sure the bucket is lowered on the ground and hand brake applied.

WARNING! Before working on the machine turn both the starting switch and electrical master switch to the "OFF" position and the take keys out to prevent accidental starting.

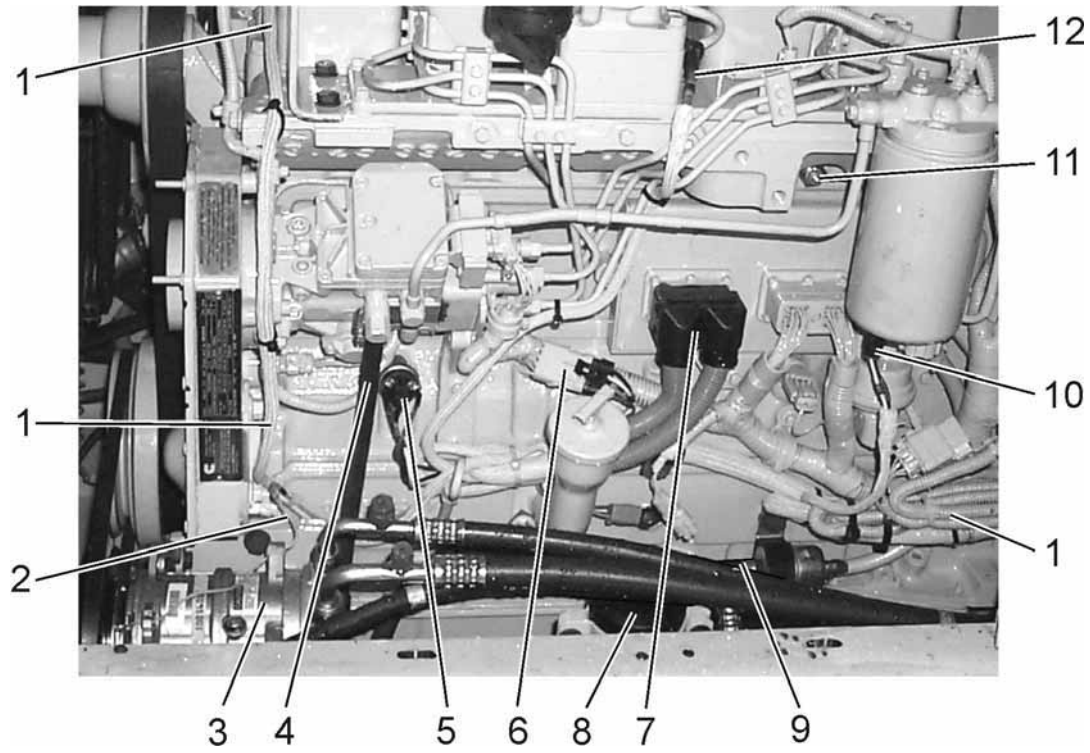


Fig. 12.4. Engine Disconnecting Points (515G RH Side)

1. Wire Harness (OEM)
2. Magnetic Clutch Wire
3. A/C System Compressor
4. Fuel Return Hose
5. Hourmeter Switch
6. Coolant Level Sensor Wire Harness Plug
7. ECM Wire Harness Plug
8. A/C System Dryer
9. Fuel Supply Hose
10. WIF Sensor
11. Coolant Temperature Sensor
12. Engine Inlet Air Heater

3. Remove radiator assy rear enclosure as described in section 6 COOLING SYSTEM, REMOVAL item 2 to 17.

4. MACHINES EQUIPPED WITH A/C SYSTEM: Disconnect wire (2, Fig. 12.4) from the magnetic clutch of the A/C system compressor (3). Remove compressor and dryer (8) from the bracket and secure it out of the frame with attached hoses and condenser previously disassembled.

NOTE: *Do not disconnect the hoses from the condenser, compressor and dryer. Disconnecting the hoses causes gas escape out of air conditioner system.*

5. Remove fuel injection pump return hose (4).
6. Remove fuel supply hose (9) from the fuel strainer filter.
7. Remove wires from the engine hourmeter switch (5).
8. Disconnect wire harness plug (7) from the ECM.
9. Disconnect coolant level sensor wire harness plug (6) from the engine wire harness.
10. Disconnect wire harness plug from the WIF sensor (10)

NOTE: *Protect disconnected plugs against grease, dirt and water.*

11. Disconnect wire from the coolant temperature sensor (11).
12. Remove wire harness (1) from the clips securing it to the engine and secure out of the frame

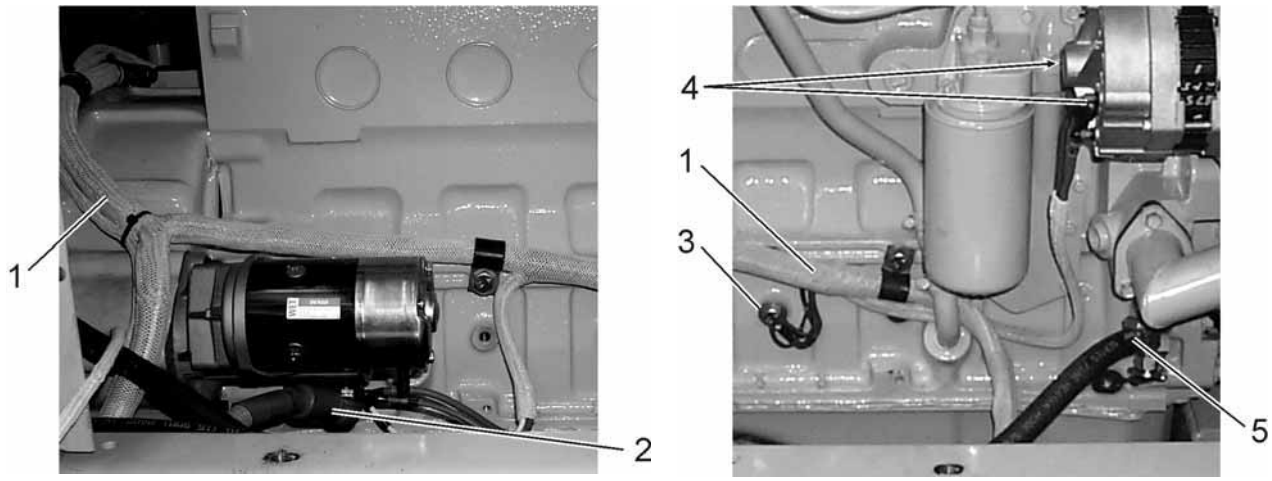


Fig. 12.5. Engine Disconnecting Points (520G LH Side)

1. Wire Harness
2. Positive Cables (+)
3. Ground Wires (-)
4. Alternator Positive and Negative Wires
5. Cab Heater Return Hose

13. Remove positive and negative wires (4, Fig. 12.5) from the alternator terminals.
14. Remove ground wires (3) from the engine block.
15. Remove positive cables (2) from the cranking motor.
16. Remove wire harness (1) from the clips and secure out of the frame.
17. Remove bolt securing ground cable to the engine flywheel housing on the bottom.
18. Loose the clamp and remove cab heater return hose (5).

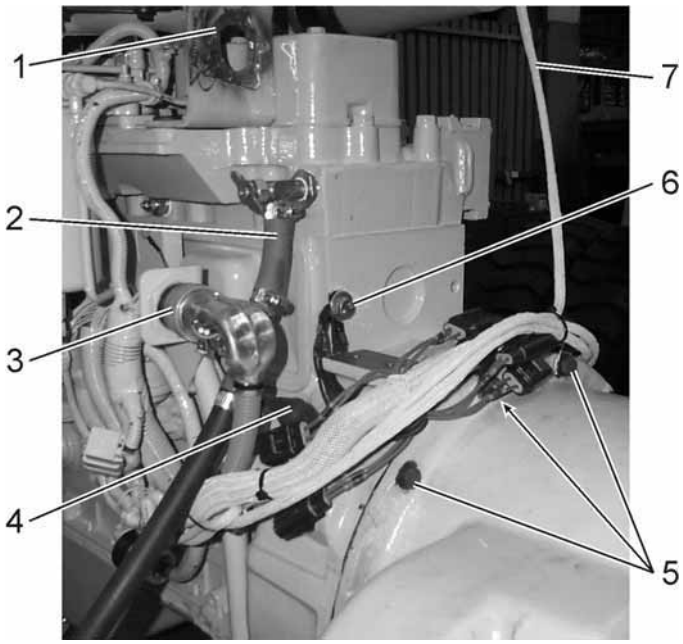


Fig. 12.6. Engine Disassembly Points (515G).

1. Rear Lifting Bracket
2. Cab Heater Supply Hose
3. OEM Wire Harness Plug
4. Tachometer Sensor
5. Bolts
6. Ground Wires (-)
7. Air Cleaner Warning Light Switch

19. Disconnect OEM wire harness plug (3, Fig. 12.6).
20. Remove wire from the engine tachometer sensor (4).
21. Remove ground wires (6) from the engine block.
22. Remove wire from the air cleaner service warning light switch (7).
23. Loose the clamp and remove cab heater supply hose (2).
24. Remove bolt (1, Fig. 12.7) and attach the oil drain hose (2) to engine with the wire.

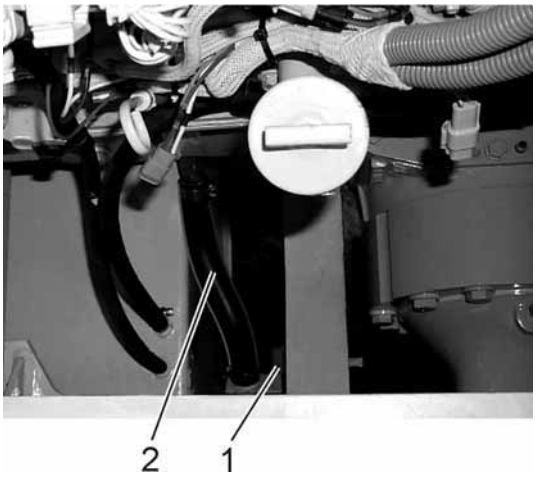


Fig. 12.7. Engine Oil Drain Hose RH Side (520G)

1. Bolt
2. Engine Oil Drain Hose

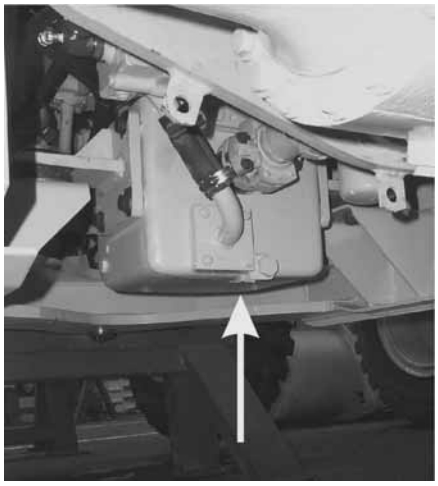


Fig. 12.8. Transmission Support Point (520G)

25. Support the transmission assy in the bottom (Fig. 12.8) for maintaining position after engine separation. Use wood block and hydraulic jack.

26. Attach the hoist to the engine lifting bracket (5, Fig. 12.1) (1, Fig. 12.6) and tighten.

NOTE: *To give access to the front engine lifting bracket of 515G machine the exhaust muffler has to bee removed.*

27. Remove bolts (1, Fig. 12.9) securing engine bracket to the frame.

28. Remove bolts (5, Fig. 12.6) securing engine flywheel housing to transmission housing.

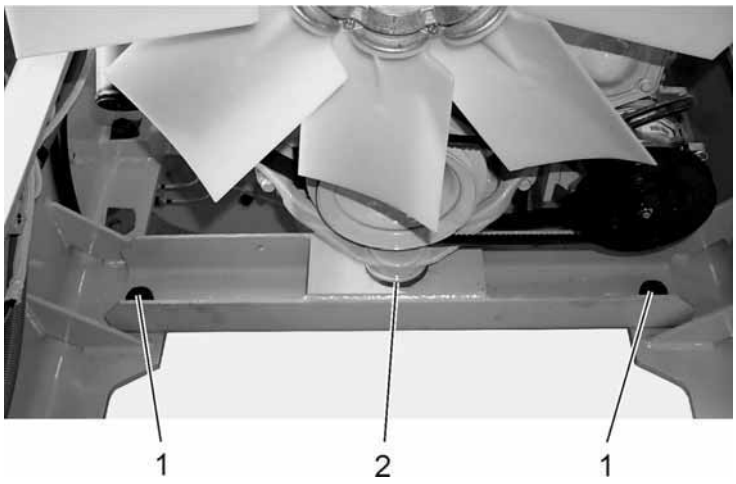


Fig. 12.9. Engine Bracket (515G)
1. Bolts 2. Rubber Shock Absorber

WARNING! The dry weight of engine is 480 [kg]. The engine lifting equipment must be designed to lift the engine safely .

29. Make a visual inspection around engine to be sure that all disconnects required for the engine removal have been made. Guide engine to rear to separate from torque converter. Lift engine assy from the frame. Position engine into the suitable engine support stand.

NOTE: *After engine is removed from machine, it should be placed on a prepared block frame support.*

6. ENGINE REPAIR

For detailed information pertaining to maintenance or engine repair, refer to the Maintenance Manual Industrial QSB-3.9-30,QSB4.5-30 and QSB-5.9-30 Series Engines, Bulletin No 4021388. Information on repair of subassemblies of engine is given in Troubleshooting and Repair Manual Industrial QSB-3.9-30,QSB4.5-30 and QSB-5.9-30 Series Engines, Bulletin No 4021398.

7. INSTALLATION

IMPORTANT: *Check that the rubber shock absorber (2, Fig. 12.9) in front engine brackets is in good condition. Replace for new one if cracked or worn before engine mounting.*

IMPORTANT: *If the flywheel gear ring meshing the torque converter gear has been removed, during reassembly apply LOCTITE 262 to the bolts securing the gear ring to the flywheel and torque them to 37 - 41 [Nm].*

1. Insert two aligning studs in flywheel housing upper holes.
2. Install new seal ring in the transmission housing groove.

IMPORTANT: *Whenever a seal ring is required at a disconnected line, it is recommended that a new seal ring be installed.*



WARNING! The dry weight of engine is 480 [kg]. The engine lifting equipment must be designed to lift the engine safely .

3. Install an engine lifting attachment to the engine lifting brackets (5, Fig. 12.1) (1, Fig. 12.6). Hoist the engine above rear frame. Lower and guide the engine to introduce the studs into the transmission housing upper holes, to position until transmission housing is properly seated in flywheel housing. Remove studs.

IMPORTANT: *As transmission housing enters flywheel housing, be sure seal ring is properly seated in groove of converter housing.*

NOTE: *If gear of the converter is not seated into engine flywheel, use tool P/N 3824591 to turn the crankshaft of engine until the torque converter gear is properly inserted in the flywheel.*

4. Install all bolts (5, Fig. 12.6) securing transmission housing to the engine flywheel housing. Torque all bolts to 42 to 50 [Nm].
5. Install bolts (1, Fig. 12.9) securing engine bracket to frame. Torque bolts to 135 to 165 [Nm]. Remove lifting attachment.
6. Remove the hydraulic jack and wood block supporting transmission in the bottom (Fig. 12.8).
7. Reinstall oil drain hose (2, Fig.12. 7) with the bolt (1).
8. Reinstall cab heater supply hose (2, Fig. 12.6).
9. Reconnect the air cleaner service warning light switch wire (7, Fig. 12.6) to the switch.
10. Reinstall ground wires (6) to the engine block.
11. Reinstall wire to the engine tachometer sensor (4).
12. Reconnect OEM wire harness plug (3).

NOTE: *Plug have to be dry and clean. Use the use electrical contact cleaner P/N 3824510.*

13. Reinstall cab heater return hose (5, Fig. 12.5).
14. Reinstall ground cable to the engine flywheel housing on the bottom with the bolt.
15. Route wire harness (1) and secure with the clips to engine.
16. Reinstall positive cables (2) to the cranking motor.
17. Reinstall ground wires (3) to the engine block.
18. Reinstall positive and negative wires (4) to the alternator terminals.
19. Route wire harness (1, Fig. 12.4) and secure to the engine with the clips.
20. Reconnect wire to the coolant temperature sensor (11).
21. Reconnect wire harness plug to the WIF sensor (10)
22. Reconnect coolant level sensor wire harness plug (6) to the engine wire harness.
23. Reconnect wire harness plug (7) to the ECM.

NOTE: *Plug have to be dry and clean. Use the use electrical contact cleaner P/N 3824510.*

23. Reconnect wires to the engine hourmeter switch (5).
24. Reinstall fuel supply hose (9) to the fuel strainer filter.
25. Reinstall fuel injection pump return hose (4).
26. MACHINES EQUIPPED WITH A/C SYSTEM: Install A/C system compressor (3) and dryer (8) to the bracket with attached hoses. Reconnect wire (2) to the magnetic clutch of the compressor. Tighten and check the belt tension, refer to OPERATORS MANUAL.
27. Install radiator assy rear enclosure as described in section 6 COOLING SYSTEM, INSTALLATION (item 2 to 18 refer to 515G) (item 2 to19 refer to 520G).
28. If necessary, check and perform engine control system as described in Par. 4, „ENGINE CONTROL CHECKING”.

SECTION 13

SUPERSTRUCTURE

SUPERSTRUCTURE

SECTION 13

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1. DESCRIPTION

The 515G and 520G series loaders are equipped with 6-sided, single-door ROPS-FOPS cab or ROPS-FOPS only structure with canopy. The both cabs are mounted to the two machined surfaces of the front frame with the bolts. The operator's compartment is fully protected by ROPS - FOPS (the structure protecting against rolling over of machine and falling rocks).

2. SPECIFICATIONS

Special Torques

Cab (ROPS-FOPS structure) to-Frame Mounting Bolts . . . . . 290 - 350 [Nm]
Ladder and Platform Mounting Bolts . . . . . 100 - 120 [Nm]
Steering Wheel Nut . . . . . 44 - 54 [Nm]

Specified torque value refers to lubricated nuts with SAE 30 oil.

NOTE: *Except for special torques, for all bolts and nuts use standard torque values specified in Section 1.*

3. CAB REMOVAL

1. Place the machine on the suitable place where it is possible to use hoisting equipment for cab removal and lock the frames together with a locking bar.

WARNING! Make sure the bucket is lowered on the ground and parking brake applied.

WARNING! Before working on the machine turn both the starting switch and electrical master switch to the "OFF" position and take the keys out to prevent accidental starting.

2. Disconnect cab supply wire connector (1, Fig. 13.1) and wires connector (2) from under the cab.

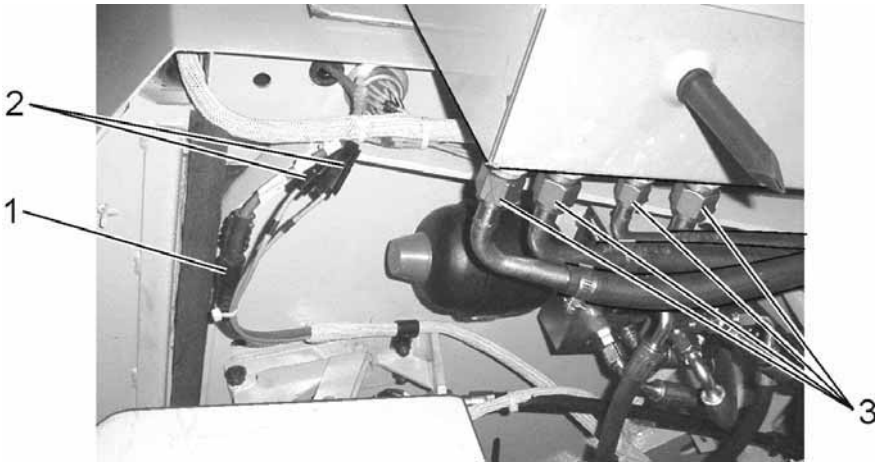


Fig. 13.1. Under Cab Disconnecting Points

1. Wire Connector 2. Wires Connector 3. A/C Heater Hoses

3. Remove the cab linings (1, Fig. 13.2) to gain access to the A/C-heater assy mounting nuts (5).
4. Remove the electrical plug (2, Fig. 13.2), remove cab supply wire (3) and wire harness (4) from openings.

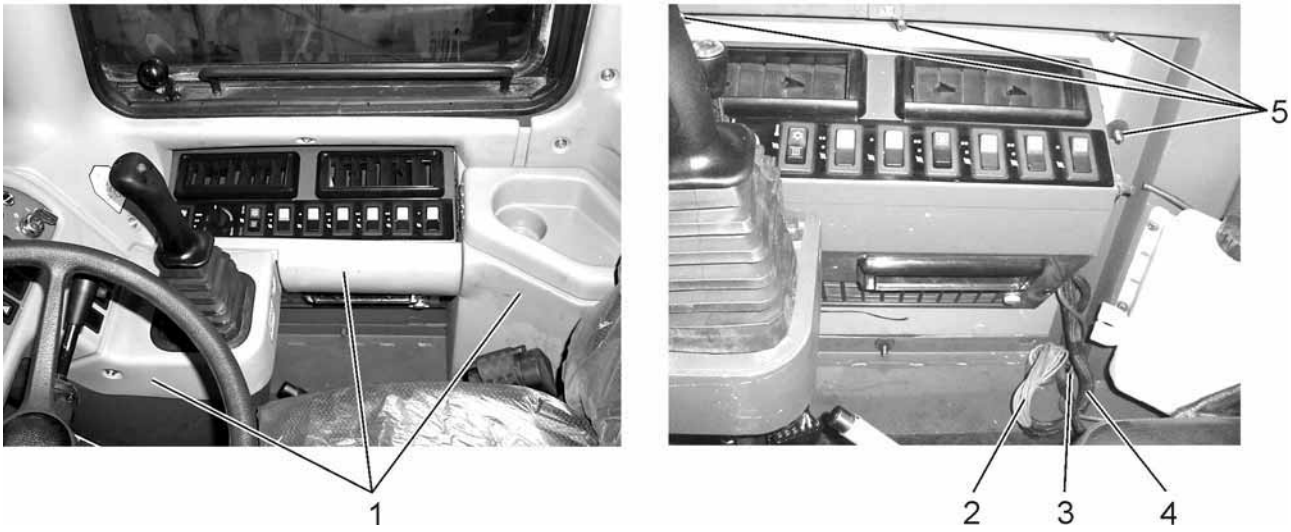


Fig. 13.2. A/C-Heater Removing

1. Cab Linings
2. Electrical Plug
3. Cab Supply Wire
4. Wire Harness
5. Nuts

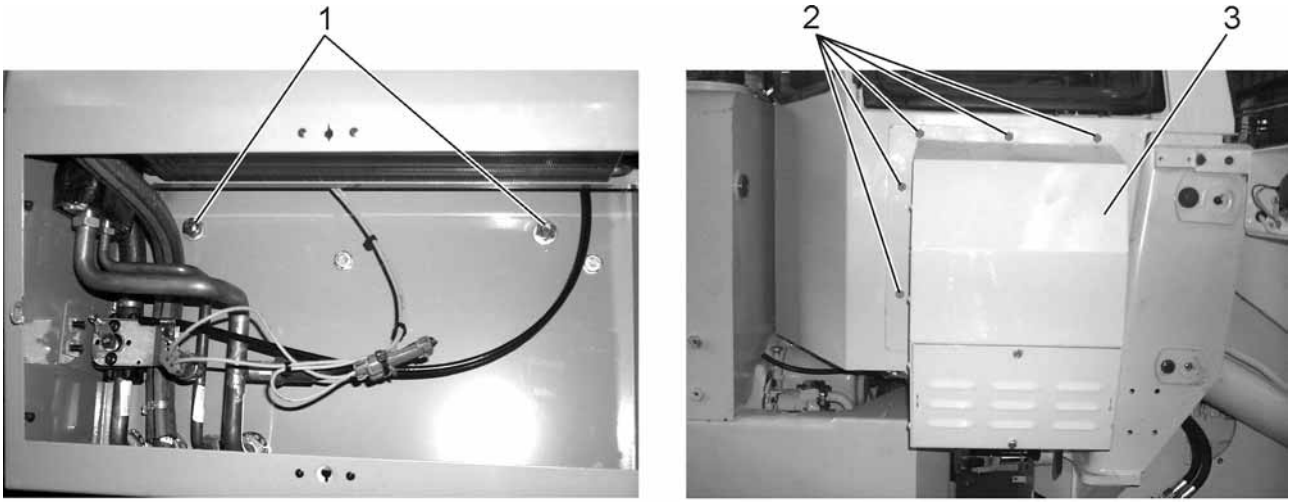


Fig. 13.3. A/C-Heater Removing

1. Bolts
2. Bolts
3. A/C Heater Assy

5. Remove cab air filter and bolts (1, Fig. 13.3) securing A/C-heater to cab.
6. Remove bolts (2, Fig. 13.3) securing A/C-heater (3) to the cab. Separate assy with attached hoses from the cab and secure to the RH frame. Protect A/C-heater control panel against damage.

NOTE: *Do not disconnect the hoses (3, Fig. 13.1) from the A/C-heater. Disconnecting the hoses causes gas escape out of A/C system.*

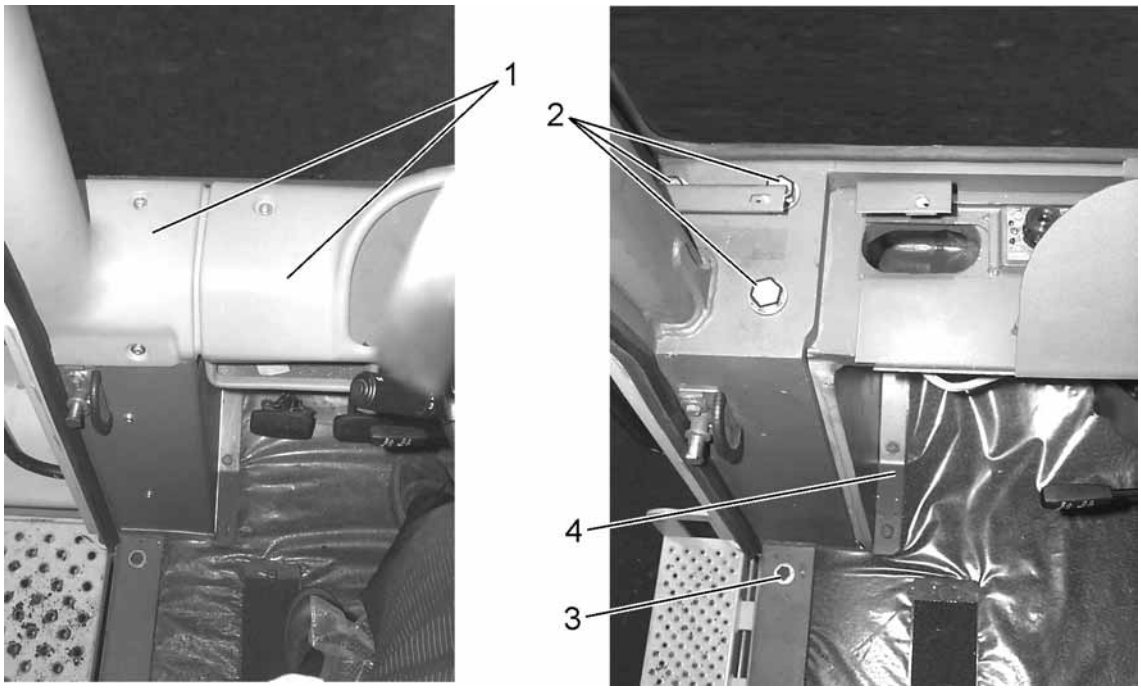


Fig. 13.4. Cab Mounting Bolts (Inside Cab)

1. Cab Lining
2. Cab Mounting Bolts
3. Bolt
4. Bar

7. Remove bolts (3, Fig. 13.4) securing cab to the platform on both sides of cab.
8. Attach the hoist to the cab lifting points (1, Fig. 13.5) on the top and remove slag.
9. Remove cab linings (1, Fig. 13.4) on both sides. Remove cab mounting bolts (2) on both sides of the cab. Guide cab backward to separate from the platform. Lift the cab and position on prepared place in vertical.

WARNING! The weight of cab assy is 400 [kg]. The lifting equipment must be designed to safely lift the cab assy.



Fig. 13.5. Cab Lifting

1. RH Side Cab Lifting Point

SUPERSTRUCTURE

4. PLATFORM REMOVAL

1. Block the tires of machine. Release the parking brake. Remove pin (1, Fig. 13.6), remove nut (5) and remove control cable (6) from the bracket.
2. Loosen the nut (2, Fig. 13.6), remove switch (3) from the bracket with attached wires.
3. Detach wire harness from the clip (4, Fig. 13.6).

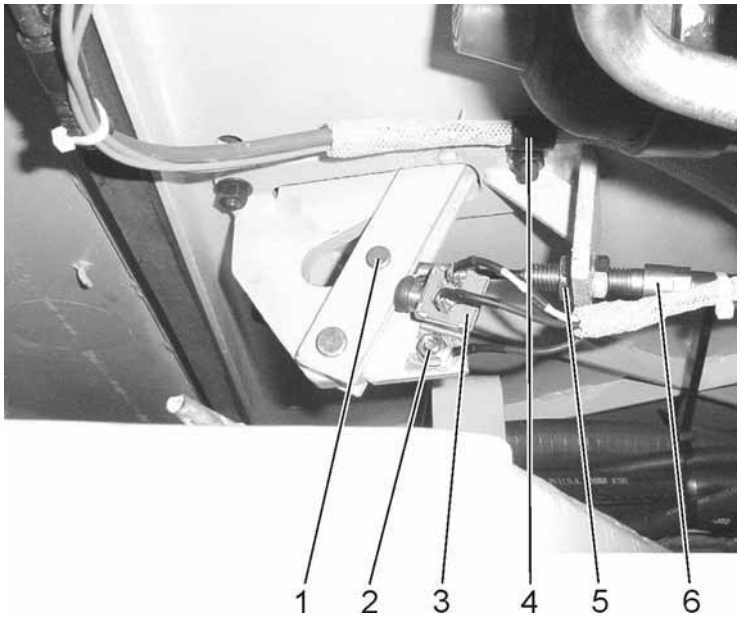


Fig. 13.6. Parking Brake Cable and Switch (RH Under Platform)

1. Pin	3. Switch	5. Nut
2. Nut	4. Clip	6. Control Cable

4. Remove supply hose (1, Fig. 13.7) from the pilot supply valve.

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 system components. Also tag all disconnected lines and wires for easier installation.*

5. Remove hydraulic hose (2, Fig. 13.7) from the pilot supply valve. Remove disconnected hose thru the platform hole and secure it above the platform.
6. MACHINES WITH 3 – SECTION CONTROL VALVE: Remove hydraulic hose (2A, Fig. 13.7) from the pilot supply valve. Remove disconnected hose thru the platform hole and secure them above the platform
7. Remove drain hose (4, Fig. 13.7) from the pilot supply valve and clamp it to the hydraulic oil reservoir.

IMPORTANT: *Place disconnected hose end higher than hydraulic oil reservoir level to prevent the oil from escaping and clamp it to a suitable oil reservoir bracket.*

8. Remove drain hoses (3, Fig. 13.7) from the pilot supply valve. Remove disconnected hoses thru the platform hole and secure them above the platform.
9. Unplug the wire harness connectors from the pilot valve lock solenoids (5, Fig. 13.7).
10. Remove ground wire (6, Fig. 13.7) from the platform.

11. Unplug the wire harness connector (1, Fig. 13.8) from the pilot valve and wire harness (2) from the pilot and quick coupling solenoids valves lock switches. Remove disconnected harness thru the platform hole and secure it below the platform.
12. MACHINES WITH 3 – SECTION CONTROL VALVE: Remove hydraulic hoses (3, Fig. 13.8) from the pilot control valve. Remove disconnected hoses thru the platform hole and secure them below the platform.
13. Remove four hydraulic hoses (4, Fig. 13.8) from the boom and bucket pilot valve. Remove disconnected hoses thru the platform hole and secure them below the platform.

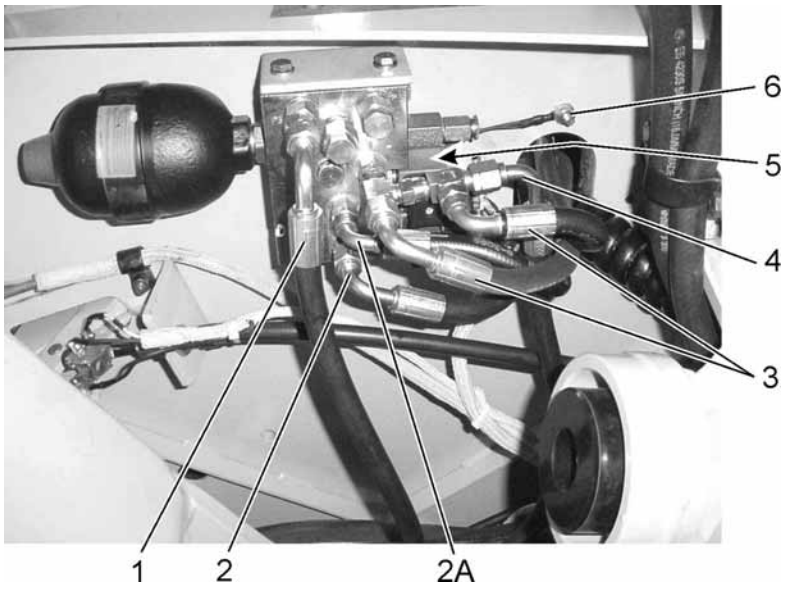


Fig. 13.7. Pilot Supply Valve and Solenoid Valve Block (RH Under Platform)

1. Supply Hose
2. Hydraulic Hose
2A. Hydraulic Hose
3. Drain Hoses
4. Drain Hose
5. Pilot Valves Lock Solenoids
6. Ground Wire

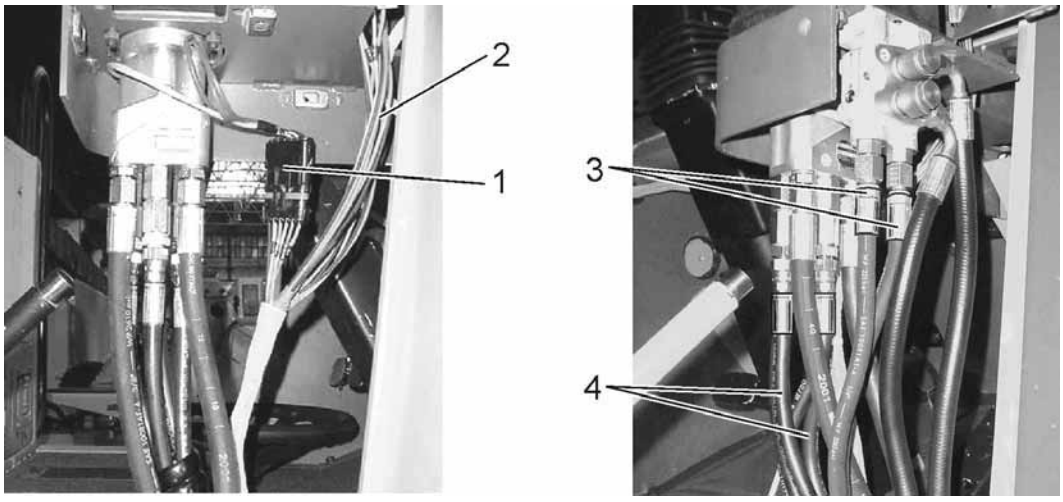


Fig. 13.8. Boom and Bucket Pilot Valve Disassembly Points

1. Pilot Valve Wire Harness Connector
2. Pilot and Quick Coupling Solenoids Lock Switches Wire Harness
3. Hydraulic Hoses
4. Hydraulic Hoses

14. Remove bolts securing platform to ladder.
15. Remove bar (4, Fig. 13.4) securing floor mat to front frame on both sides.

16. Thread lift wires strong enough thru hole (2, Fig. 13.9) to hoist the platform on both sides. Attach a hoist to the lift wires and remove slag. Remove bolts (1) securing platform to front frame on both sides. Lift the platform and position on a prepared place.

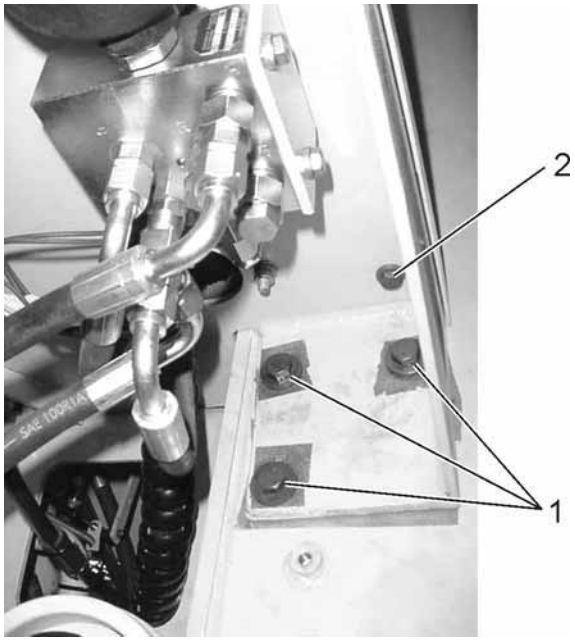


Fig. 13.9. Platform Assy Disassembly Points
1. Platform to Frame Mounting Bolts 2. Hole

5. CAB WINDOW GLASS REPLACEMENT (Refer to Fig. 13.10)

1. Starting at the seam of the weather stripping, pull out the edge of seal lip (B) with a window molding tool. Pull the molding tool around the window through groove (A) to release the seal.
2. Carefully push the top of the glass or window towards the seal lip of the weather stripping until the top edge is free from the stripping. Remove the glass or window.
3. Remove the weather stripping from the window frame and clean thoroughly.
4. If necessary, replace the weather stripping as follows:
   A. Starting at the bottom and center of the window frame, press groove (D) of the weather stripping around the sheet metal.
   B. After the stripping is installed, tap against the sheet metal, especially in the corners, to insure a snug fit.
   C. Cut off excess stripping leaving approximately 9.5 [mm] past the starting point to avoid a gap in the seam after the glass or window is installed.
   D. Force the overlapped stripping down from an even seam. If an even seam cannot be obtained, cut off more stripping from one end.
5. Liberally coat groove (C) of the weather stripping with a mild soap and water solution.
6. Place the bottom edge of the glass or window in groove (C). While applying a downward and inward pressure on the glass or window, pry the outer lip of groove (C) around the edge of the glass or window.

IMPORTANT: *Work carefully, do not exert excessive pressure on the edge of the glass.*

7. Liberally coat groove (A) with a mild soap and water solution. Using the window molding tool, force seal lip (B) into through the groove forcing the seal lip inward.

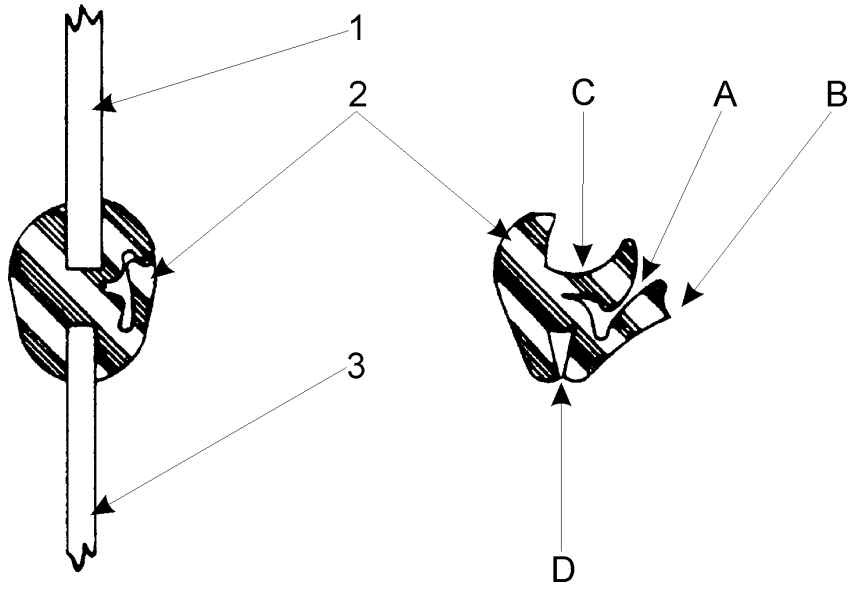


Fig. 13.10. Section View of Glass or Window and Weather Stripping

1. Glass or Window
2. Weather Stripping
3. Cab Sheet Metal

A. Seal Lip Groove
B. Seal Lip
C. Glass Groove
D. Sheet Metal Groove

6. INSPECTION AND REPAIR

1. Check the cab assy for cracks.

WARNING! Do not attempt to repair a rollover protective structure ROPS-FOPS after an accident. Repaired structure do not provide the original strength and protection. Contact your Construction Equipment Distributor for information on ROPS-FOPS replacement. Do not operate the machine again until the ROPS-FOPS has been replaced.

WARNING! Do not cut, grind, weld or drill holes in the ROPS because this could weaken the structure or affect its energy absorbing capability. Periodically inspect the ROPS-FOPS for fatigue cracks. Cracks indicate a weakened structure which should be replaced for your protection.

2. Check and complete the lacking insulation's elements of cab and platform.
3. Inspect the electrical harness for damage and repair if necessary.
4. Clean and cover contact surfaces of cab and front frame with grease. Do not paint.

7. PLATFORM INSTALLATION

1. Thread lift wires strong enough thru hole (2, Fig. 13.9) to hoisting the platform, on both sides. Attach a hoist to the wires, lift the platform and position to align the openings in frame and platform. On both sides screw in the bolts (1) securing platform to front frame and tighten to 100 - 120 [Nm].
2. Install the bolts securing ladder to platform and tighten to 100 - 120 [Nm].
3. Install floor mat to front frame with the bar (4, Fig. 13.4) on both sides.
4. Guide thru the platform hole and install four hydraulic hoses (4, Fig. 13.8) to the boom and bucket pilot valve.
5. MACHINES WITH 3 – SECTION CONTROL VALVE: Guide thru the platform hole and install hydraulic hoses (3, Fig. 13.8) to the pilot control valve.
6. Guide thru the platform hole and reconnect the wire harness connectors to the pilot valve (1, Fig. 13.8) and wire harness (2) to the pilot and quick coupling solenoids valves lock switches.
7. Install ground wire (6, Fig. 13.7) to the platform.
8. Reconnect the wire harness connectors to the pilot valve lock solenoids (5, Fig. 13.7).
9. Guide thru the platform hole and install drain hoses (3, Fig.13.7) to the pilot supply valve.
10. Install drain hose (4, Fig. 13.7) to the pilot supply valve.
11. Guide thru the platform hole and install hydraulic hose (2, Fig. 13.7) to the pilot supply valve.
12. MACHINES WITH 3 – SECTION CONTROL VALVE: Guide thru the platform hole and install hydraulic hose (2A, Fig. 13.7) from the pilot supply valve.
13. Install supply hose (1, Fig. 13.7) to the pilot supply valve.
14. Attach wire harness with the clip (4, Fig. 13.6).
15. Install switch (3, Fig. 13.6) with the nut (2) to the bracket.
16. Install the control cable (6, Fig. 13.6) to the bracket, tighten the nut (5). Install pin (1). Apply the parking brake and adjust if necessary. Refer to Operator's Manual. Remove the tires blocks.

8. CAB INSTALLATION

1. Attach the hoist to the cab lifting point (1, Fig. 13.5). Lift the cab and position over the transmission. Guide cab forward to contact with the frame.
2. Install cab to frame mounting bolts (2, Fig. 13.4) on both sides of the cab and tighten initially. Remove hoist. Tighten all bolts to 290 – 350 [Nm]. Install cab lining (1) on both sides.
3. Install bolt (3, Fig. 13.4) securing cab to the platform on both sides of cab.
4. Position A/C-heater assy (3, Fig. 13.3) in cab opening. Install the bolts (2) securing A/C-heater to the cab.
5. Install bolts (1, Fig. 13.3) securing A/C-heater to cab. Reinstall cab air filter.
6. Plug in the electrical plug (2, Fig. 13.2). Introduce wire harness (4) and cab power supply wire (3) to openings. Guide wire harness under the cab. Install cab linings (1).
7. Reconnect cab supply wire connector (1, Fig. 13.1) and wires connector (2) from under the cab.
8. Before starting the machine check the operation of the windshield wipers, washers, fan, A/C heater.

SECTION 15

WHEELS

WHEELS

SECTION 15

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1. SPECIAL TOOLS AND INSTRUMENTS

Description	P/N of instrument/tool
1. Tire band puller	1.559.0338
2. “KE-2” tools set for tire removal	67096-67
3. Wheel servicing tooling	SICAM - TCS 52 NW
4. Large bore adaptor for inflation	854-04-0204

2. DESCRIPTION

Depending on required equipment the machines includes tubeless tires installed on single-piece or three-piece rims. The three-piece rim has tapered bead seat ring secured against slipping out with locking ring installed in rim groove. Tire pressure through rim flange and tapered bead seat ring presses locking ring in rim’s groove to prevent uncontrolled slipping of tire. Such design enables to inflate the tire before installing the wheel to the drive axle. Wheel is mounted to drive axle with bolts. Tire thread pattern varies depending on type of ground.

Additional information on tires is included in Operator’s Manual.

3. SPECIFICATIONS

Wheel and Rims

Type of Tires	515G	515GH	520G
Standard-tubeless	18.4x24 10 PR (G15)	17.5x25 12 PR (L3)	17.5x25 12 PR (L3)
Optional-tubeless (for sandy soil)	17.5x25 12 PR (L2)	17.5x25 12 PR (L2)	17.5x25 12 PR (L2)
Optional-tubeless (for sandy soil)	15.5x25 12 PR (L2)	17.5x25 16 PR (L3)	20.5x25 12 PR (L2)
Optional-tubeless (for rocky ground)	17.5x25 12 PR (L3)		20.5x25 12 PR (L3)
Optional-tubeless (for rocky ground)	15.5x25 12 PR (L3)		17.5x25 16 PR (L3)
Optional-tubeless (for rocky ground)	15.5x25 16 PR (L3)		17.5x25 20 PR (L3)

Inflation Pressure (standard and optional tires)

18.4x24 10 PR – 0.220 [MPa]	20.5x25 12 PR – 0.250 [MPa]	17.5x25 16 PR – 0.375 [MPa]
17.5x25 12 PR – 0.350 [MPa]	15.5x25 12 PR – 0.375 [MPa]	Radial tires – 0.350 [MPa]

Type of Rims

Size of Rims	515G	515GH	520G
Standard	W1GLx24	14 x 25	14x25
Optional	12x25		14.5x25
Optional	14x25		17x25

Special Torques

Valve to rim mounting nut . . . . . 19 - 22 [Nm]
Valve core to valve base mounting . . . . . 7.7 – 8.8 [Nm]
Wheel mounting bolts . . . . . 870 - 920 [Nm]

Specified torque value refers to lubricated nuts with SAE 30 oil.

NOTE: *Except for special torques, for all bolts and nuts use standard torque values specified in Section 1.*

4. CHECKING FOR LEAKS

Once The Tyre Has Been Fitted

Wheel with Single-Piece Rim (Fig. 15.1)

Use a paint brush and soapy water to detect possible leakage from either the valve or the tyre.

1. Valve leakage:
   a) valve core (1)
   b) valve core housing to valve base connection (2)
   c) valve base with rim connection (3)
2. Tyre leakage:
   a) around the bead areas between the sidewalls and rim flanges (4)

A continuous flow of air bubbles means there is a leak.

NOTE: The valve cap is vital to ensure that the valve remains clean and leak proof and works efficiently.

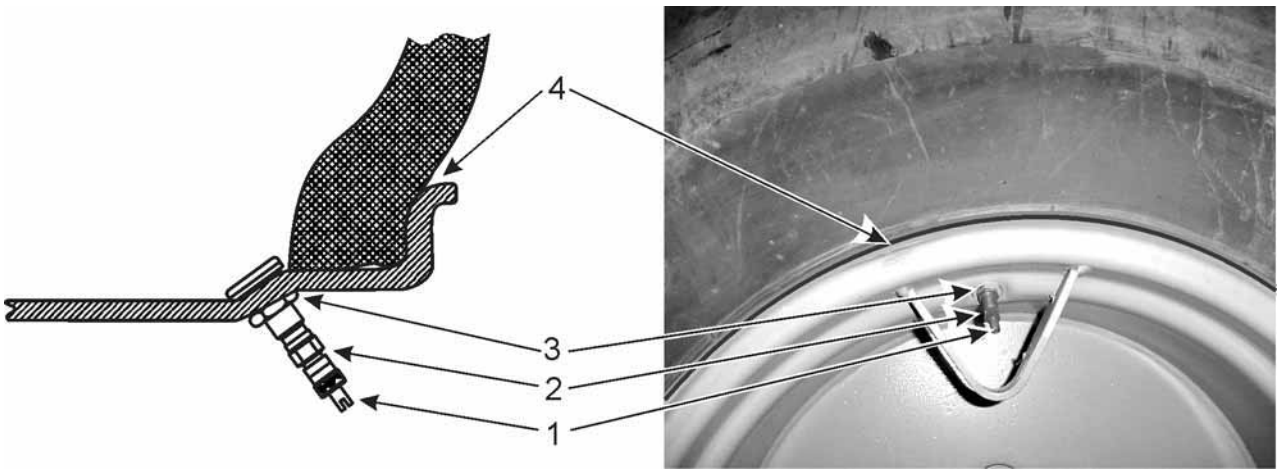


Fig. 15.1. Wheel with Single-Piece Rim Areas to Inspect

Wheel with Three-Piece Rim (Fig. 15.2)

Use a paint brush and soapy water to detect possible leakage from either the valve or the tyre.

1. Valve leakage:
    a) valve core (1)
    b) valve base with rim connection (2)
2. Tyre leakage:
    a) around the bead areas between the sidewalls and rim flanges (3)
    b) between the tapered bead seat ring and the locking ring (4)

A continuous flow of air bubbles means there is a leak.

NOTE: *The valve cap is vital to ensure that the valve remains clean and leak proof and work efficiently*.

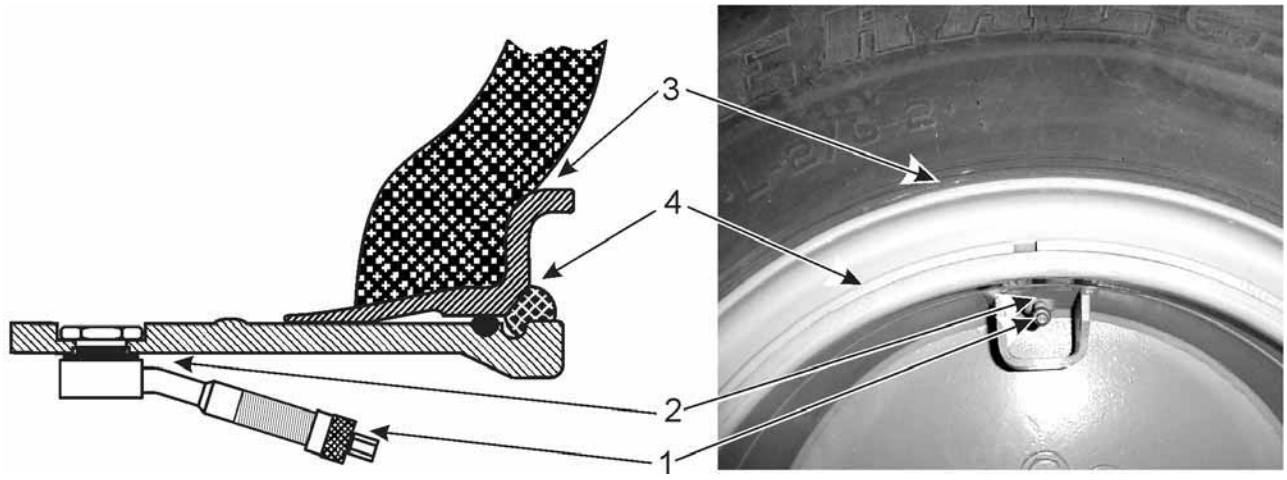


Fig. 15.2. Wheel with Three-Piece Rim Areas to Inspect

Leakage During Tire Service

If there is any abnormal drop in pressure during service then the leak must be located before the tyre is removed.

Once the check described above has been carried out, the tread and sidewalls must be washed.

Then sponge the tyre down with soapy water, paying particular attention to any cuts.

NOTE: *Underinflation affects a tyre performances reduction.*

5. WHEEL REMOVAL

1. Position the machine in a level surface which makes it possible to use wheel disassemble device and crane or hydraulic jack for lifting the machine.
2. Install the frame locking bar so that frame halves are in a straight ahead position Apply the parking brake.

DANGER! Always lock the frames together before working near the center of the machine. If the frames move, serious injury or death could result.

3. Turn the master switch to OFF position.

WARNING! Before servicing the machine be sure the bucket is lowered, the engine is off, the transmission shifter is in neutral (N), the electrical system master switch is off and the keys are removed from master switch and from starting switch.

4. Block the tires, which will not be lifted*.*
5. Loose, but do not remove the wheel mounting nuts.
6. Use crane or hydraulic jack for lift up the machine enough to separate serviced wheel off the ground. Lift the machine and place on the hardwood block or trestles in proper points, points of support must be selected on rear axle (Fig. 15.3), or front frame (Fig. 15.3A). For removal of rear or front wheel it is admissible to support the machine with front and/or rear tires blocked with wedges.

NOTE: *If servicing the front wheel it is possible to jack up the front axle by placing the bucket on ground or suitable blocks and shifting the boom lever in LOWER and then HOLD position. Lower machine onto blocks by shifting boom lever onto RAISE and shut off the engine*.

WARNING! Use extra caution when jacking up the machine. Jacking up the machine can be hazardous if performed improperly. Use jacking equipment of sufficient capacity. Be sure the jacking points are strong enough to support the machine. Be sure the jack is stable and well supported. Before jacking up the machine, block the tires, which will not be lifted. Lock the frames together with the locking bar and pins. If the rear tires are being lifted, block the rear axle to prevent it from pivoting unexpectedly. DO NOT run the engine with the machine on jacks. For your safety, transfer the weight of the machine to approved blocks before servicing the machine. Lift and handle all heavy parts with lifting devices of adequate capacity. Secure parts with proper slings and hooks. Use lifting eyes provided. Warn nearby personnel to stand clear.

7. Use the fork car or attach a suitable hoist and slings to the wheel to be removed and remove the slack (Fig. 15.4). Remove wheel mounting nuts and wheel.

WARNING! Use extra caution when removing wheel. Max weight of wheel is 300 [kg]. Hoisting equipment must conform to safety requirements.

NOTE: *Remove fender before attempt to remove wheel with hoisting equipment and slings*.

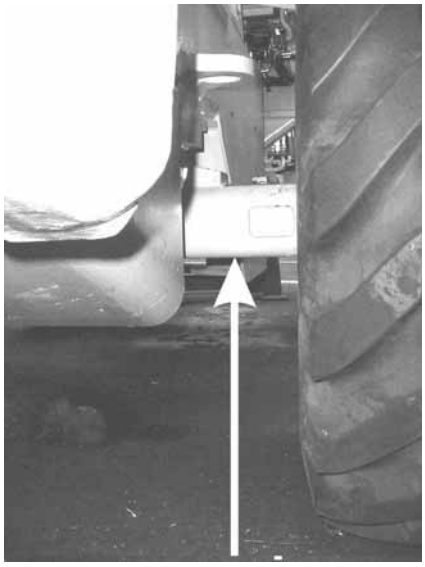


Fig. 15.3. Rear Axle Machine Support Point

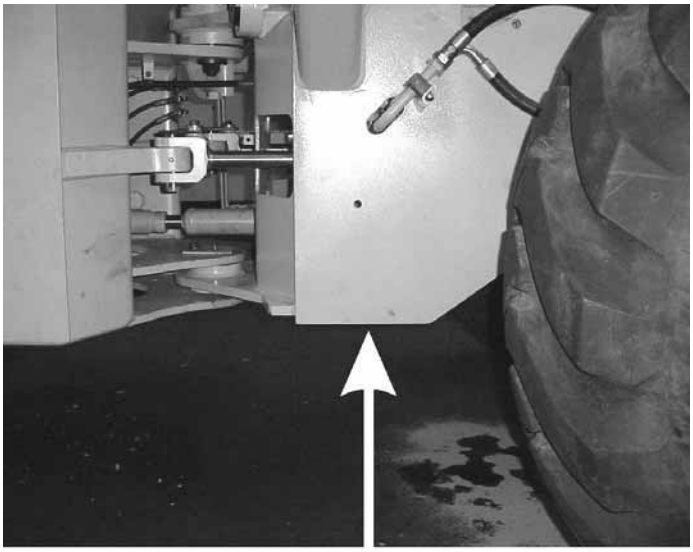


Fig. 15.3A. Front Frame Machine Support Point

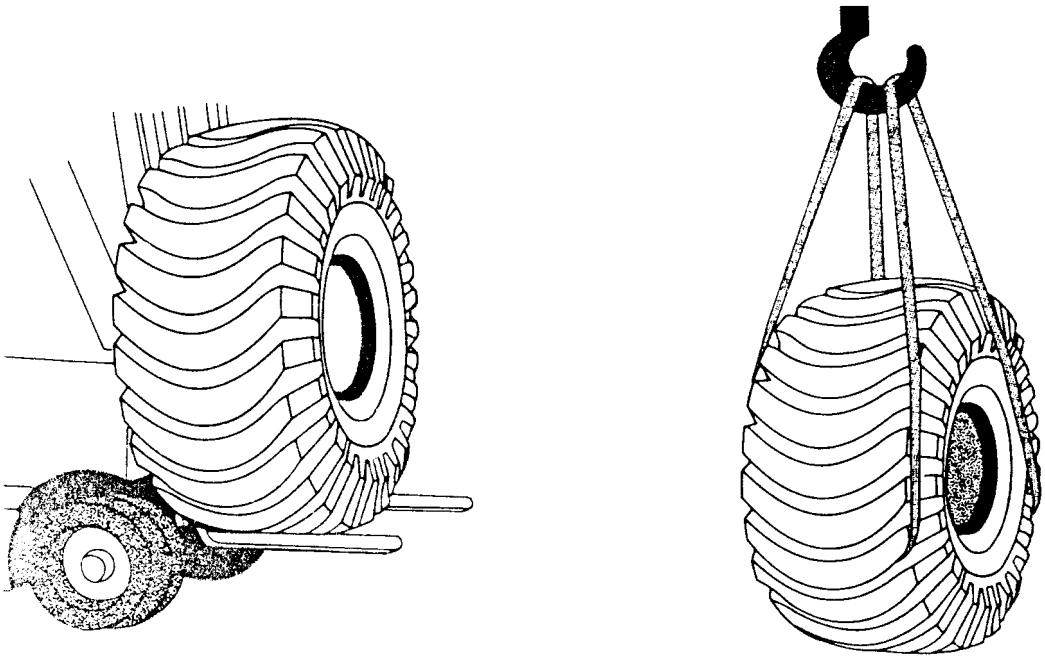


Fig. 15.4. Wheel Lifting Methods

6. TIRE REMOVAL

Wheel with Single-Piece Rim

NOTE: *Because of big size of wheel it is recommended to remove tire in specialized service facility equipped with large size tire removal equipment Fig. 15.5.*



Fig. 15.5. Large Size Tire Removal Operation Using the SICAM TCS 52 NW Wheel Servicing Tooling

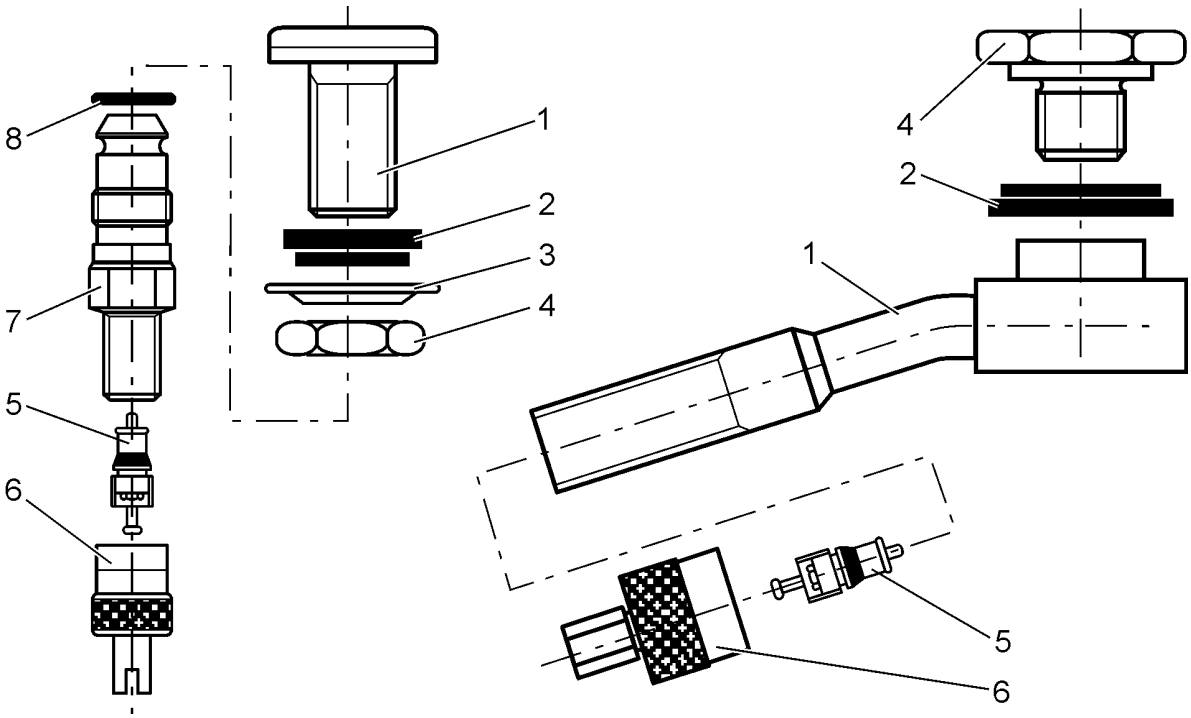


Fig. 15.6. Two Types Valves Assembly

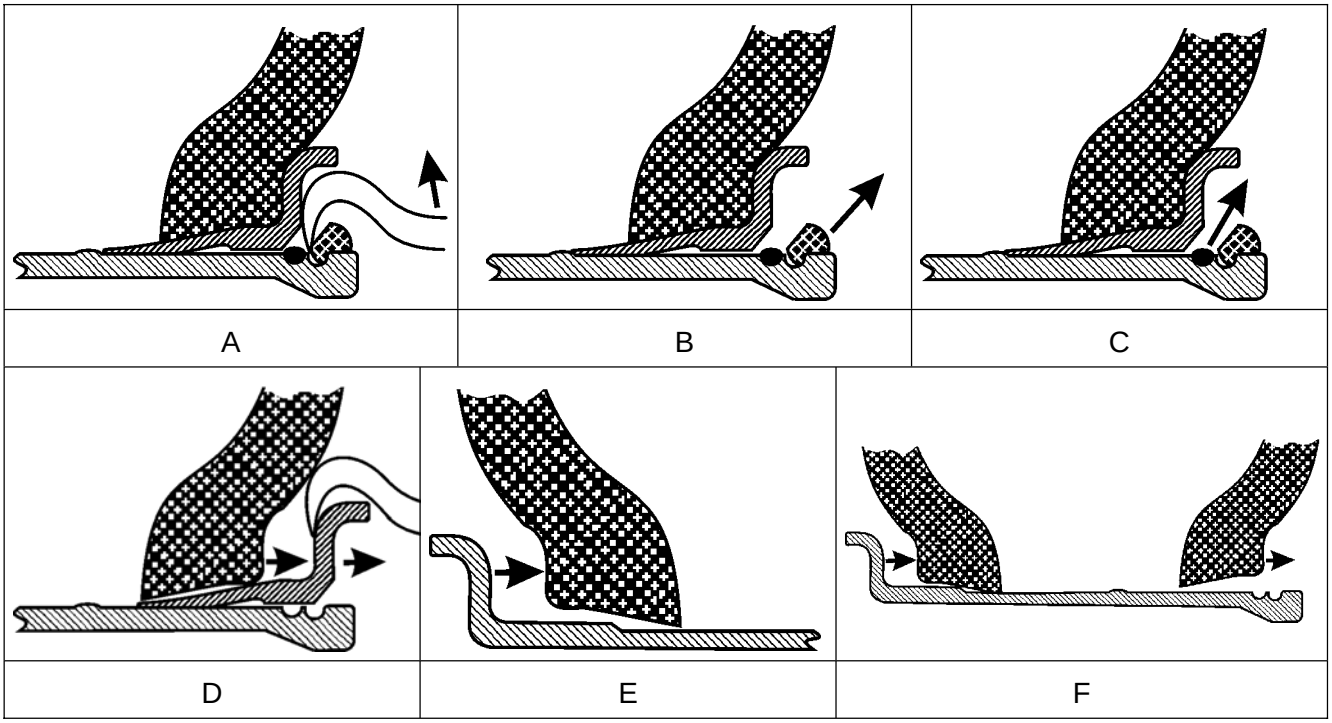
1. Valve Base
2. Rubber Grommet
3. Ring Washer
4. Rim Nut
5. Valve Core
6. Valve Cap
7. Valve Core Housing
8. O-ring

Wheel with Three-Piece Rim (Fig.15.7)

WARNING! It is forbidden to remove locking ring before deflating the tire completely.

NOTE: *Because of large size of wheel it is recommended to remove tire in specialized service facility equipped with big size tire removal equipment.*

Use "KE-2" tools set for tire removal.



Tire Removing Sequence

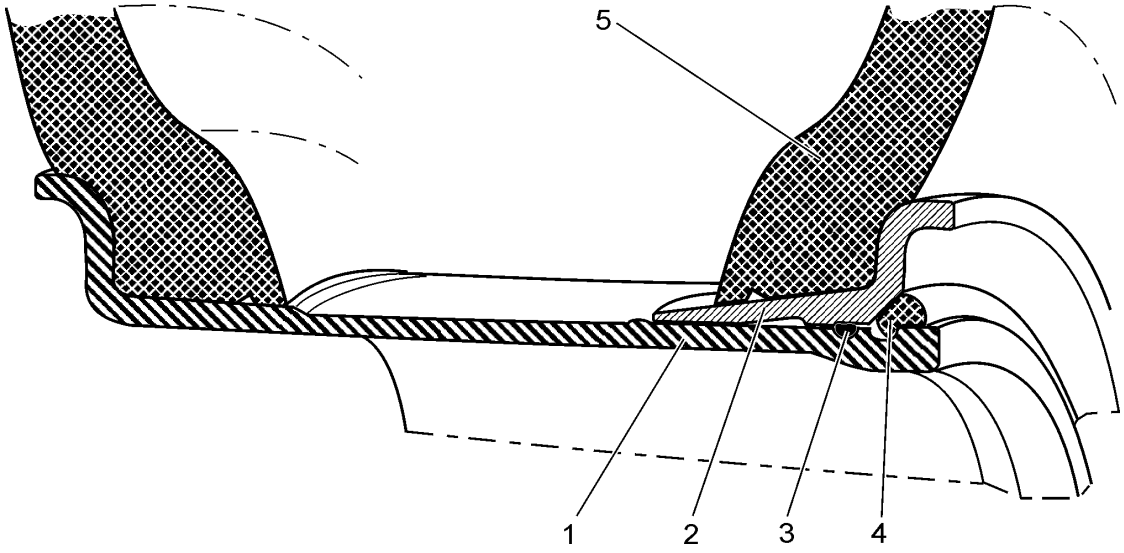


Fig. 15.7. Three-Piece Rim (cross-section)

1. Rim
2. Tapered Bead Seat Ring
3. O-Ring
4. Locking Ring
5. Tire

1. Place wheel on flat ground. Deflate tire completely. For this purpose remove valve cap (6, Fig. 15.6), remove valve core (5) from valve base (1).
2. Press on (A) the tapered bead seat ring (2) to expose the O-ring (3).
3. Hold back the tapered bead seat ring (2) to remove (B) locking ring (4) and take out (C) the O-ring (3).
4. Remove (D) tapered bead seat ring (2).
5. Turn the wheel. Pressing on (E) unseat the bead of tire (5).
6. Remove (F) rim (1) from the tire (5).

IMPORTANT: *Do not insert forks or wire ropes inside the tire hole for transporting. This may result in loss of tightness as sharp edges of forks or wire ropes may damage the tire edge.*

7. INSPECTION OF TIRE AND RIM

Before tire assembly clean and check thoroughly all components of wheel:

1. Clean and inspect the inside of the tire (1, Fig. 15.8) and bead (2).



Fig. 15.8. Tire Inspection Areas

2. Use wire brush or sandblast to free the rim (1, Fig. 15.9) of corrosion and contamination. Repaint the rim and removable components. Check joint (welded joint) of rim for fractures. Check tire contact surface (C) of rim for deep pinholes and surface irregularities which cause air leakage from the tire.

***IMPORTANT**: Never do any welding to the rim or wheel if the tyre has not been removed.*

***IMPORTANT:** Before cleaning rim with wire brush or sandblast, remove valve assy (1 and 7, Fig. 15.6) from the rim, or cover them.*

***IMPORTANT:** Clean thoroughly and check groove (A, Fig. 15.9) for fractures and pinholes that may cause incorrect seating of locking ring.*

NOTE: *Locking ring grove (A, Fig. 15.9) and O-ring grove (B) must be free of lacquer coating (cleaned to bare metal).*

3. Use wire brush or sandblast to free of corrosion, contamination and repaint of tapered bead seat ring (2, Fig. 15.9). Check tire contacting surface for deep pinholes or surface irregularities which cause air leakage of the tire.

4. Replace for new one O-ring (3, Fig. 15.9).

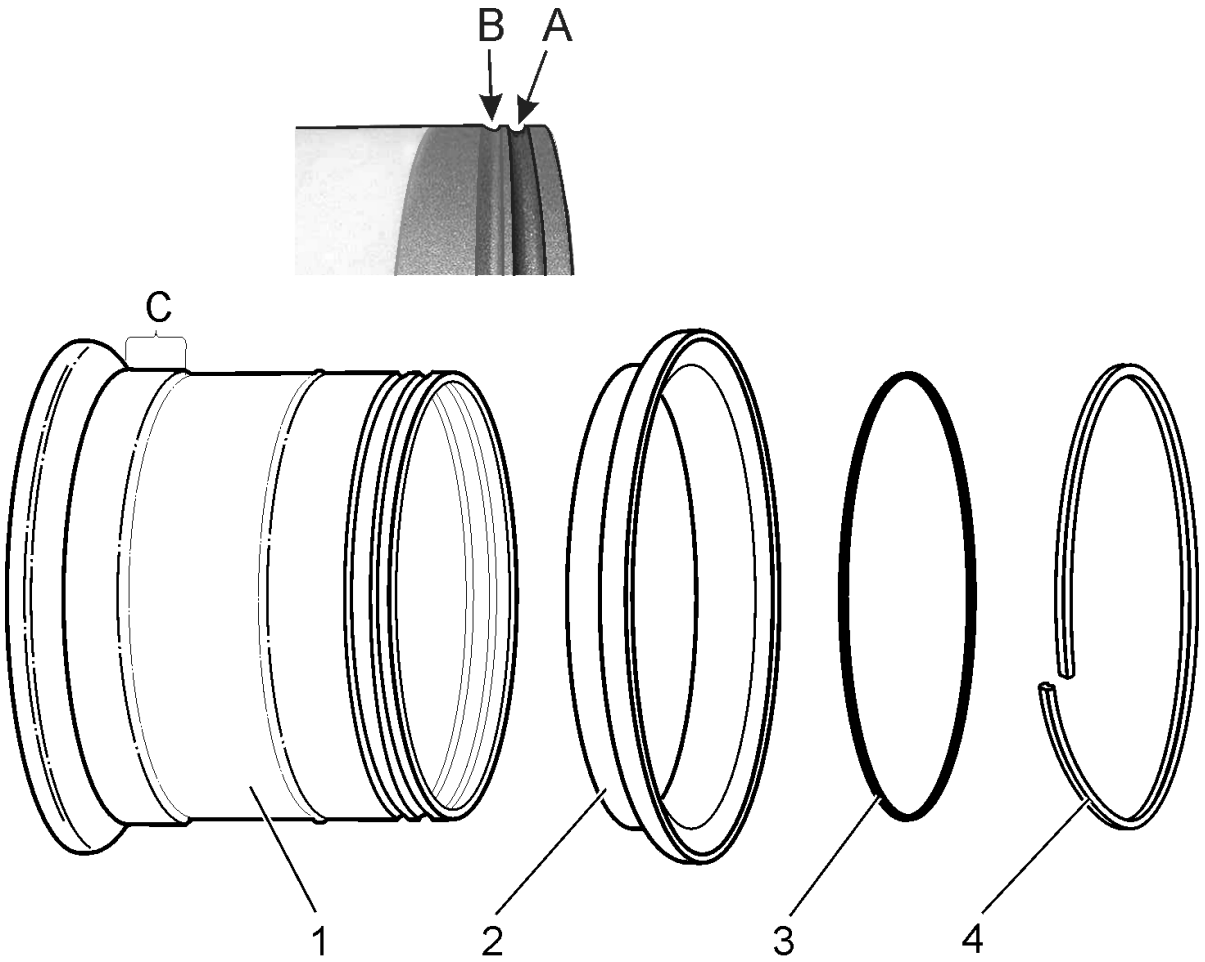


Fig. 15.9. Three-Piece Wheel Rim Assembly.

1. Rim
2. Tapered Bead Seat Ring
3. O-Ring
4. Locking Ring

A. Locking Ring Groove
B. O-Ring Groove
C. Tire Contacting Surface

5. Use wire brush or sandblast to free of corrosion, contamination and repaint of locking ring (4, Fig. 15.9). Check tire contacting surface for deep pinholes or surface irregularities which may cause incomplete seating of ring in rim groove.

WARNING: Deformed wheel rims with damaged lock ring groove and damaged lock ring should be rebuilt or replaced for new ones. Using non-genuine parts which do not ensure 100% safety for wheel assembly and usage may cause tire burst.

8. TIRE INSTALLATION

Wheel with Single-Piece Rim

NOTE: *Because of big size of wheel it is recommended to installing tire in specialized service facility equipped with large size tire removal equipment Fig. 15.10.*

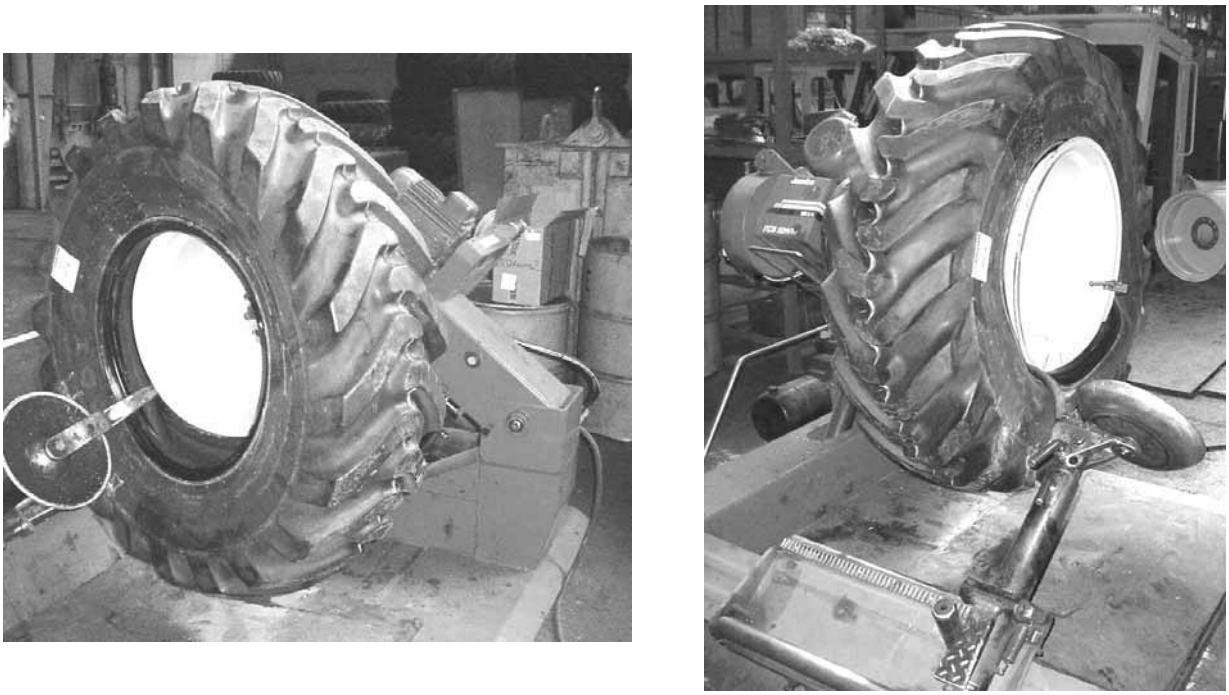


Fig.15.10. Large Size Tire Installing Operation Using the SICAM TCS 52 NW Wheel Servicing Tooling

Wheel with Three-Piece Rim (Fig.15.11)

Use "KE-2" tools set for tire mounting.

1. Install valve base (1, Fig. 15.6), grommet (2), ring washer (3) and nut (4) in rim hole (if removed). Torque rim nut (4) to 19 - 22 [Nm]. Clean O-ring (8), install the valve core housing (7) and torque it to 7.7 – 8.8 [Nm]. Install valve core (5) valve cap (6).

NOTE: *Tighten the nut (4, Fig. 15.6), not valve base. Do not overtighten the nuts.*

2. Position rim on the wooden cross shaped stand to keep the tyre off the ground.

3. Apply thin layer of lubricant for tire mounting on tire edge contacting with rims. Install tire (1) on rim (A).

IMPORTANT: *Some tires due to specific design and tire thread pattern, have specified by the manufacturer direction of rotation. Before installing tire on rim pay attention to identification marks on sides of the tire (arrow) which determine direction of rotation of tire when driving forward.*

4. Apply thin layer of lubricant for tire mounting on outer surface tapered bead seat ring (2). Put the tapered bead seat ring in place (C).
5. Push back (C) the bead seat ring to expose the O-ring groove. Put the O-ring (3) in place.

NOTE: *Make sure so the O-ring is clean, dry and is not twisted.*

IMPORTANT*: A new O-ring must be fitted each time a tire is hanged.*

6. Put the locking ring (4) in the grove (D).
7. Install puller 1.559.0338 to tire. Inflate tire to center it on the rim. Check rim that the locking ring are correctly positioned (E). Use large bore adaptor P/N 854-04-0204 for inflation to reduce valve diameter for easier inflation if necessary.



WARNING! Never inflate a flat tire without inspecting the tire, rim and wheel for damage. Be sure all components all properly assembled. Unmounted tires being inflated or deflated should be placed in a tire safety cage. Inflate the tire to 0.10 [MPa] and check that the all components are properly seated. Than continue to inflate to a pressure 0.075 [MPa] more than operating pressure described in Specification. Than deflate to operating pressure level. Never stand directly in front of a tire and rim assembly while inflating. Use a clip-on chuck with a hose long enough to allow the person inflating the tire to stand to the side. Serious injury could result if the tire and mounting were to separate.



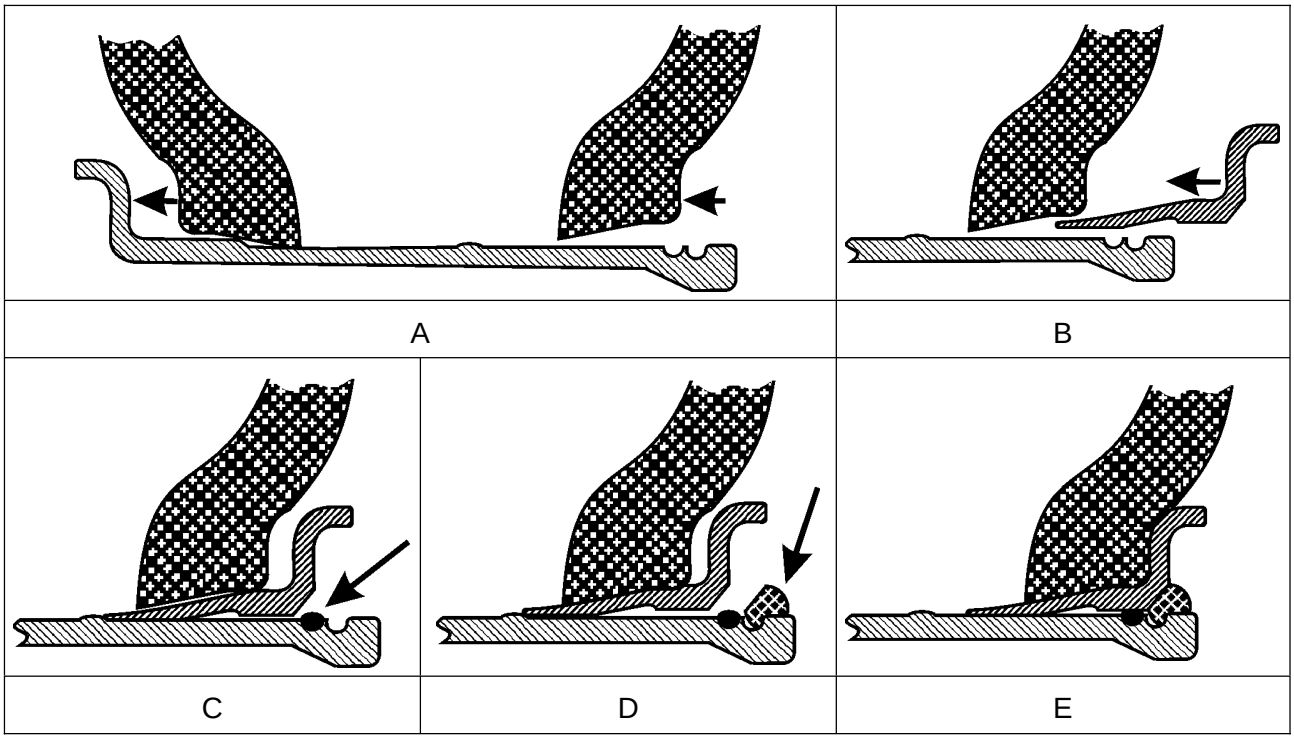
WARNING! New tubeless tires may be tied at perimeter with special band which facilitates pumping. Use extra caution when cutting the band or remove it with puller 1.559.0338 before tire pumping without cutting the band.

IMPORTANT: *Inflate the tire initially to app. 0.10 [MPa], and remove puller.*

IMPORTANT*: Never inflate the tire 0.35 [MPa] above inflation pressure to seat beads.*

8. Inflate tire to the required service pressure (see Specification). Check for any leakage. Install valve cap (6, Fig. 15.6).

IMPORTANT: *Operation of the machine with incorrect pressure in tires (depending on work place) may cause damage to tires or increased fuel consumption.*



Tire Installing Sequence

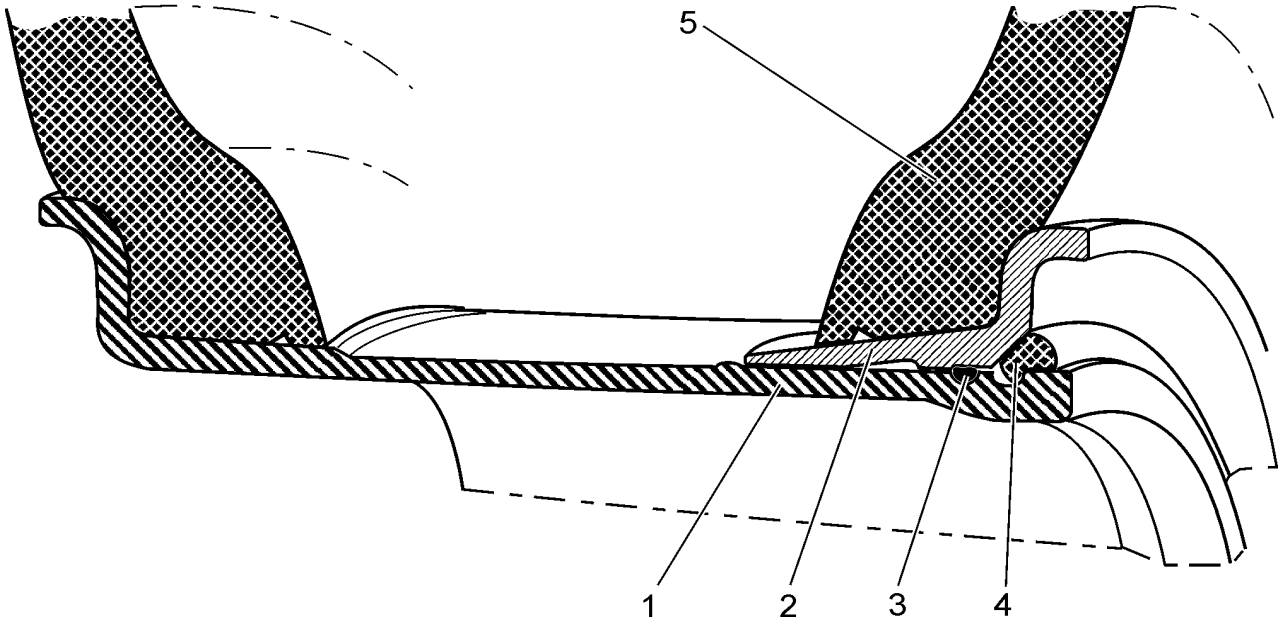


Fig. 15.11. Three-Piece Rim (cross-section)

1. Rim
2. Tapered Bead Seat Ring
3. O - Ring
4. Locking Ring
5. Tire

9. WHEEL INSTALLATION

1. Use a fork car or attach slings to wheel to be installed (Fig. 15.4). Install wheel on drive axle hub.

WARNING! Use extra caution when installing wheel. Max weight of wheel is 300 [kG]. Hoisting equipment must conform to safety requirements.

2. Install wheel mounting nuts and tighten finger tight.
3. Lift the machine with a crane or hydraulic jacks and remove hardwood block or trestles used to support the machine.

WARNING! Use extra caution when lifting the machine and removing supports. Hoisting equipment must conform to safety requirements.

4. Torque wheel mounting bolts to 870 - 920 [Nm].
5. Install wheel fender if removed.
6. Unlock machine frame halves.

SECTION 17

MOUNTED EQUIPMENT

CONTENTS

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GENERAL

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5. Specifications 6
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7. Inspection and Repair 10
8. Reassembly and Installation 10

SERVICE/SPECIAL TOOLS

1. SERVICE/SPECIAL TOOLS

Description	P/N of instrument/tool
1. Micrometer depth gauge	any suitable
2. Filler gauge	any suitable
3. Copper hammer	1.519.0142
4. Copper hammer	1.549.0060
5. Torque wrench (1/2” drive)	0 ÷ 500 [Nm]
6. Sling for boom and levers	K-0.6/0.5–3 or any suitable
7. Portable hydraulic ram 100 [ton]	OTC 1.815.0312 or any suitable with similar capacity
8. Set of discs for portable hydraulic ram	1.547.0396
9. Bucket link bushing driver	1.519.0658-N°1
10. Boom lower bushing driver 515G	1.547.0407
11. Boom lower bushing driver 520G	1.547.0403
12. Boom upper and middle bushing driver 515G	1.547.0408
13. Boom upper bushing driver 520G	1.547.0402
14. Boom middle bushing driver 520G	1.547.0405
15. Lever bushing driver	1.547.0407

GENERAL

2. SAFETY PRECAUTIONS



WARNING! Before servicing the machine, BE SURE the engine is off, the bucket is lowered to the ground, the transmission shifter is in neutral position (N), the parking brake is applied, the electrical system master switch is turned to the OFF position and the keys are removed from both the electrical system master switch and starting switch to prevent accidental engine starting. Place in visible warning notice in the cab.

Before working under the machine, block the tires to prevent machine movement.

ALWAYS lock the frames together before working near the center of the machine. If the frames move, serious injury or death could result.

NEVER stand near the bucket or tires while the engine is running.

Lift and handle all heavy parts with lifting devices of adequate capacity. Secure parts with proper slings and hooks. Use lifting eyes provided. Warn nearby personnel to stand clear.

For your safety, whenever using blocking for support, use sturdy hardwood or concrete blocks 300 x 300 x 600 [mm] before servicing the machine.

For your protection, keep head, body, hands and fingers away from the bucket and loader linkage when they are in a raised position, unless they are securely blocked. When replacing cutting edges and teeth, securely block the bucket for your protection.

MOUNTED EQUIPMENT

GENERAL

WARNING! For your safety, remove the ether container when welding, grinding or using a torch on the machine.

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.

To install and remove bucket teeth, use a nonferrous hammer. It is hazardous to hammer on the teeth. Wear safety glasses with side shields or goggles to reduce chances of injury.

For your protection, use EXTRA caution when adjusting the loader's bucket leveler or boom kick-out. Use two trained people and guard against accidental movement of the machine or loader linkage.

3. DESCRIPTION

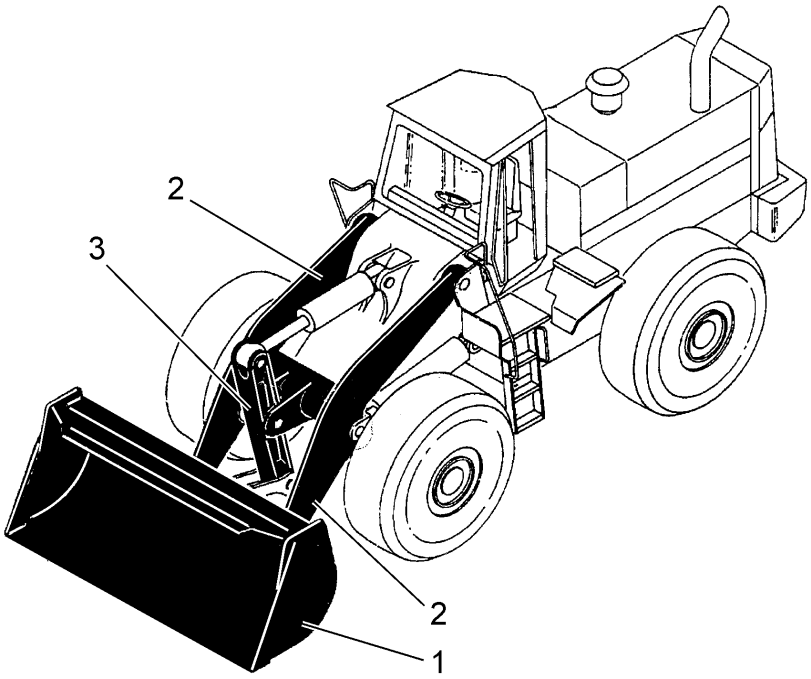


Fig. 17.1. Mounted Equipment

1. Bucket
2. Boom
3. Lever

Mounted equipment generally consists of the bucket (1), boom (2) and lever (3). Machine can be equipped with several kinds of buckets or grab, which are described in details in the OPERATOR'S MANUAL. For bucket removal and installation procedure refer to the OPERATOR'S MANUAL.

BOOM AND BUCKET LINKAGE

4. DESCRIPTION AND OPERATION

The boom assy (1, Fig. 17.2) consists of two lateral arms (2, Fig. 17.3) and tube with bracket (5) of bellcrank welded together. The boom assy connect the loader front frame with the bucket. Two upper pins (7, Fig. 17.2) connect the boom assy (1) to the loader front frame and ride on the bushings (1, Fig. 17.3) in the boom arms (2). Two lower pins (8, Fig. 17.2) connect the boom assy (1) to the bucket eyes and ride on bushings (4, Fig. 17.3) in the boom arms (2). The boom arms are raised and lowered by two boom cylinders (5, Fig. 17.2), each boom cylinder rod end pin rides on bushing (3, Fig. 17.3) in the boom assy (2).

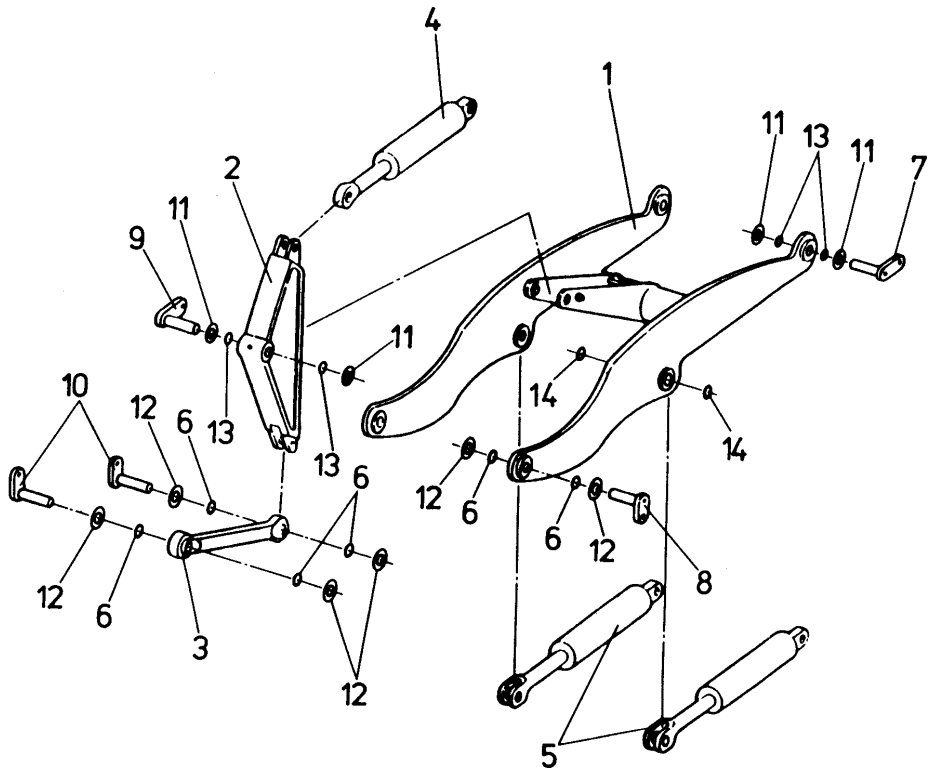


Fig. 17.2. Boom and Bucket Linkage

1. Boom Assy
2. Lever Assy
3. Bucket Link Assy
4. Bucket Cylinder
5. Boom Cylinders
6. Seal Rings
7. Welded Pin with Lubrication Fitting
8. Welded Pin with Lubrication Fitting
9. Welded Pin
10. Welded Pin
11. Shims
12. Shims
13. Seal Rings

The lever assy (2, Fig. 17.2) is pinned between bracket eyes (5, Fig. 17.3) with the pin (9, Fig. 17.2), which rides on the bushings (2, Fig. 17.4) in the lever (1). The upper end of the lever assy (2, Fig. 17.2) is pinned to the rod end of the bucket cylinder (4) by the pin (3, Fig. 17.6). The bushing and seal rings at this location are in the cylinder rod eye (see “BUCKET CYLINDER” in Section 10C for details).
The lower end of the lever assy (2, Fig. 17.2) is pinned to the bucket link assy (3) with pin (10). Second bucket link end is connected to the bucket eye with pin (8, Fig. 17.6). The pins (7 and 8) ride on the bushings (3, Fig. 17.5) in the bucket link (1) bores.

BOOM AND BUCKET LINKAGE

The seal rings (6 and 13, Fig. 17.2) are used for boom pivots, lever pivot and bucket link pivots to prevent dirt from entering the pins and damaging the bushings. At the boom to bucket connection, shims (11 and 12) are used to obtain proper alignment. The bucket cylinder (4), lever (2) and bucket link (3) form a "Z" bar linkage for bucket operation.

Several buckets are available for service. They are all of welded construction with a replaceable cutting edge and bucket teeth (if equipped).

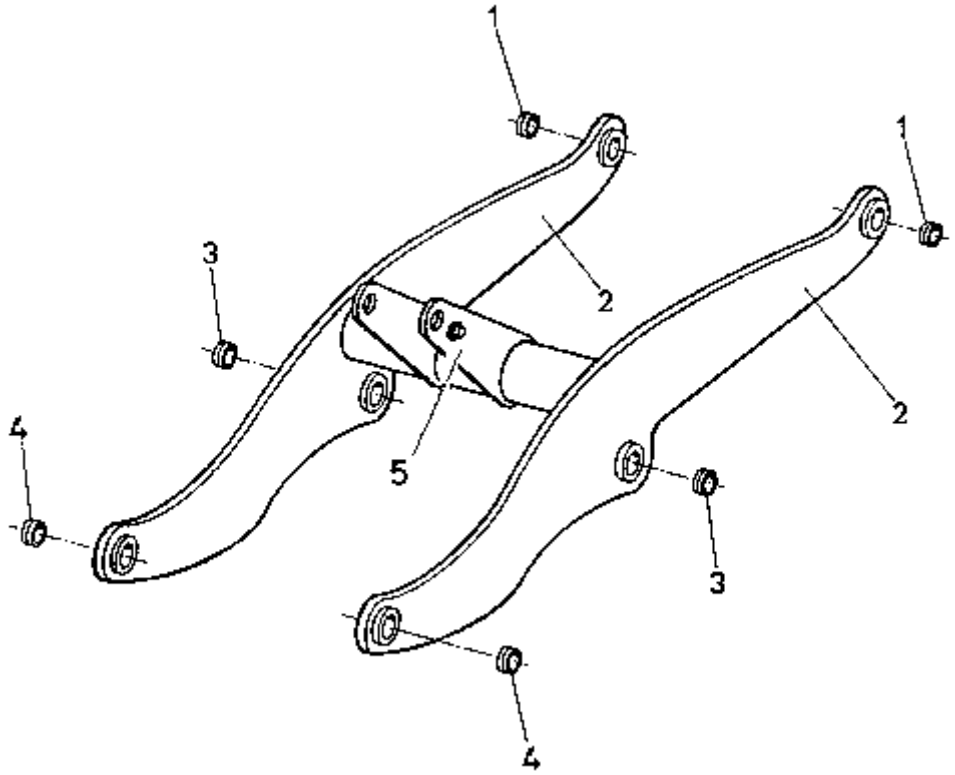


Fig. 17.3. Boom Assy

1. Bushing
2. Boom Arm
3. Bushing
4. Bushing
5. Tube with Bracket

5. SPECIFICATIONS

		Diameter of mounting holes	
		515G	520G
Boom	to Bucket *	51 +0.025	63,754 ± 0.025
	to Frame *	76.454 ± 0.025	76.454 ± 0.025
Lever	middle hole *	76.454 ± 0.025	76.754 ± 0.025
	to Bucket Link	50.99 ± 0.038	63,69 ± 0.055
Bucket Link *		51 +0.025	63,754 ± 0.025
Tube with Bracket		76.295 ± 0.035	76.295 ± 0.035

* - with bushing

BOOM AND BUCKET LINKAGE

Tolerances:

Bushing to thrust collar clearance ..... 0.13 ÷ 0.25 [mm]
Boom arm to bucket eye clearance..... 0.5 ÷ 1.5 [mm]

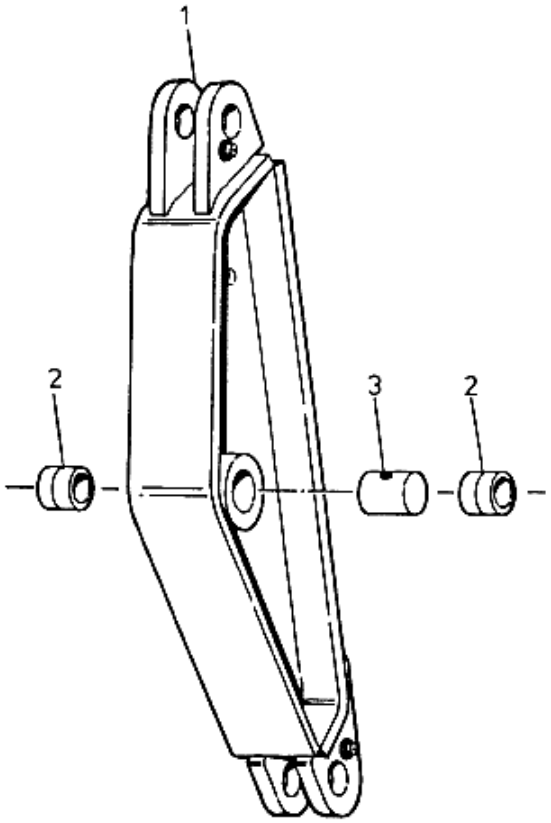


Fig. 17.4. Lever Assy

1. Lever
2. Bushing
3. Spacer Sleeve

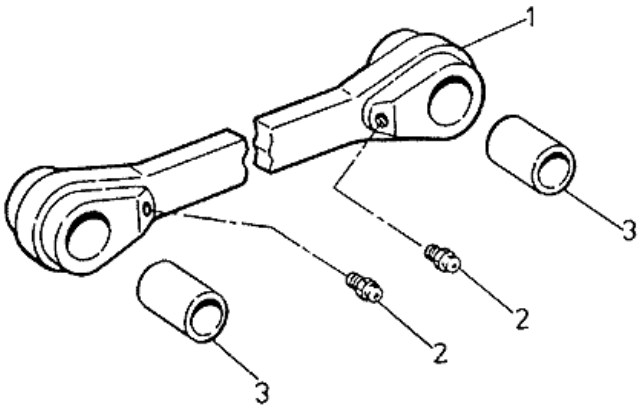


Fig. 17.5. Bucket Link Assy

1. Bucket Link
2. Lubrication Fitting
3. Bushing

6. REMOVAL AND DISASSEMBLY

WARNING! Refer to "Safety Precautions" in this Section.

Lever:

1. Lower the bucket (9, Fig. 17.6) to the ground level and block securely.
2. Attach a suitable hoist and sling to the bucket cylinder (1) rod end.
3. Unscrew bolt with washer (6) securing pin (3) to the lever (2).
4. Remove pin (3) with shims using copper hammer 1.519.0142 and retract the bucket cylinder (bucket cylinder removal details see in Section 10C).
5. Lower the bucket cylinder (1) rod end onto bellcrank (11) and detach sling.
6. Attach a hoist to the lever (2) upper fork bores and remove sling sag.

BOOM AND BUCKET LINKAGE

7. Block under the bucket link (10), unscrew the bolt with washer (6) securing pin (7) to the lever (2) and remove pin (7) using copper hammer 1.519.0142.
8. Unscrew the bolt with washer (6) securing the pin (4) to the lever (2) and remove the pin (4) with shims (11, Fig. 17.2) using copper hammer 1.519.0142. Lift the lever out of the machine.
9. Remove seal rings (13), if required replacement, remove the bushings (2, Fig. 17.4) with spacer sleeve (3) using portable hydraulic ram together with set of discs N°1.547.0396 and driver (see SPECIAL TOOLS).

Bucket Link:

1. Lower the bucket (9, Fig. 17.6) to the ground level and attach a hoist to the bucket link (10).
2. Unscrew the bolt with washer (6) securing the pins (8) to the bucket (9).
3. Remove pin (8) from the bucket eye with shims (12, Fig. 17.2) using copper hammer 1.519.0142.
4. Unscrew the bolt with washer (6, Fig. 17.6) securing the pins (7) to the lever (2) and remove pin (7) with shims (12, Fig. 17.2) using copper hammer 1.519.0142.
5. Lift the bucket link out of the machine and remove the seal rings (6) from their grooves in the bucket link eyes.
6. If bushings (3, Fig. 17.5) required replacement, remove the bushings, using driver 1.519.0658 N°1 and portable hydraulic ram 100 [T] together with set of discs N°1.547.0396. If required, remove two lubrication fittings (2) from the link (1).

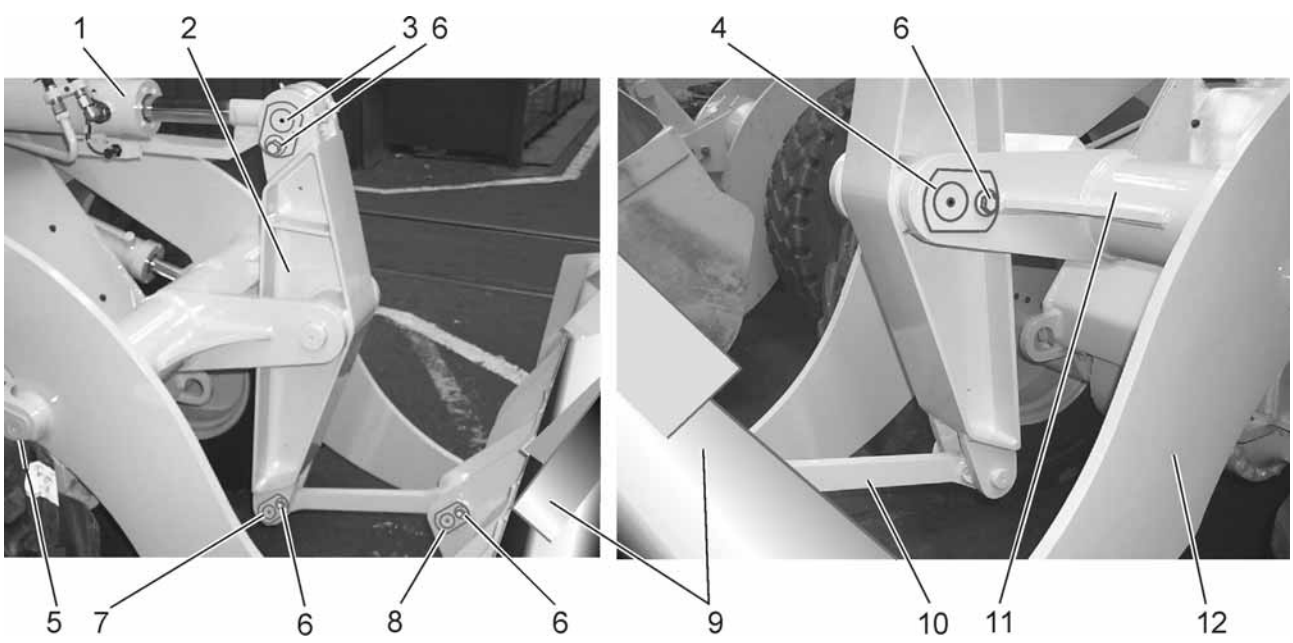


Fig. 17.6. Lever and Bucket Link Disconnect Points

1. Bucket Cylinder
2. Lever
3. Pin
4. Pin
5. Pin
6. Bolt with Washer
7. Pin
8. Pin
9. Bucket
10. Bucket Link Assy
11. Bellcrank
12. Boom

BOOM AND BUCKET LINKAGE

Boom Arms:

1. Lower the bucket to the ground level.
2. If loader equipped with automatic boom kick-out system (Fig. 17.8), remove its all mounting hardware located below the left boom arm, to prevent possible damage:
   – Undo connector (4, Fig. 17.8)
   – Unscrew plastic nut (1) mounting proximity switch (3) to the bracket (2)
   – Slide off proximity switch (3) from bracket (2) and protect it against damage.
3. Remove bolt with washer (6, Fig. 17.7) from the both of boom arms (1).
4. Remove pin (7) with shims (12) from the both of boom arms (1) using copper hammer 1.549.0060 and separate the bucket from the linkage.
5. Remove seal rings (6, Fig. 17.2) and raise the boom to the desired position and block securely.
6. Two bushings (4, Fig. 17.3) in each boom arm can then be pressed from position, using a portable hydraulic ram together with set of discs N°1.547.0396 and driver (see SPECIAL TOOLS).
7. To remove the boom arm upper bushings (1, Fig. 17.3), attach a suitable hoist and sling to the bellcrank (11, Fig.17.6) and unscrew the bolt with washer (4, Fig. 17.7) mounting pin (2) to the front frame (5) bracket eye.
8. Pull the pin (2) from position using portable hydraulic ram and remove shims (11, Fig 17.2). In the same manner remove other pin from the second boom arm.
9. Once the pins (2, Fig. 17.7) are removed use the boom cylinders (5) to raise the boom arms from the front frame brackets eyes and block the boom securely.
10. Remove seal rings (13) from the both of boom arms (1).
11. The two bushings (1, Fig. 17.3) in each boom arm can then be pressed from position using portable hydraulic ram together with set of discs N°1.547.0396 and driver (see SPECIAL TOOLS).

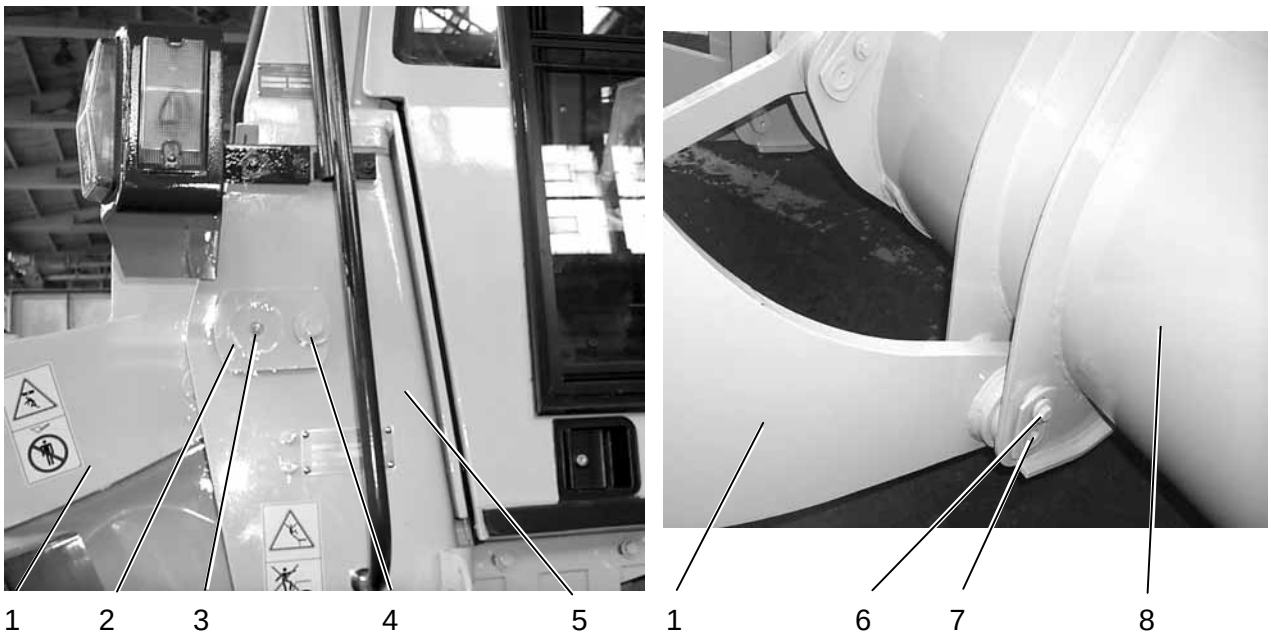


Fig. 17.7. Boom Arm Disconnect Points

1. Boom Arm
2. Pin
3. Lubrication Fitting
4. Bolt with Washer
5. Front Frame
6. Bolt with Washer
7. Pin with Lubrication Fitting
8. Bucket

BOOM AND BUCKET LINKAGE

12. To remove the boom center bushing (3, Fig. 17.3) lower the boom to the ground, attach a suitable hoist and sling to the boom cylinders (5, Fig. 17.2) rod end.
13. Remove the boom cylinder rod end pin (5, Fig. 17.6) in the same manner as described above (steps 3, 4), (removal details see “BOOM CYLINDERS” in Section 10C).
14. Remove the bushing (3, Fig. 17.3) using portable hydraulic ram together with set of discs N°1.547.0396 and driver (See SPECIAL TOOLS). Follow removing procedure for second bushing (4) in other boom arm if required.

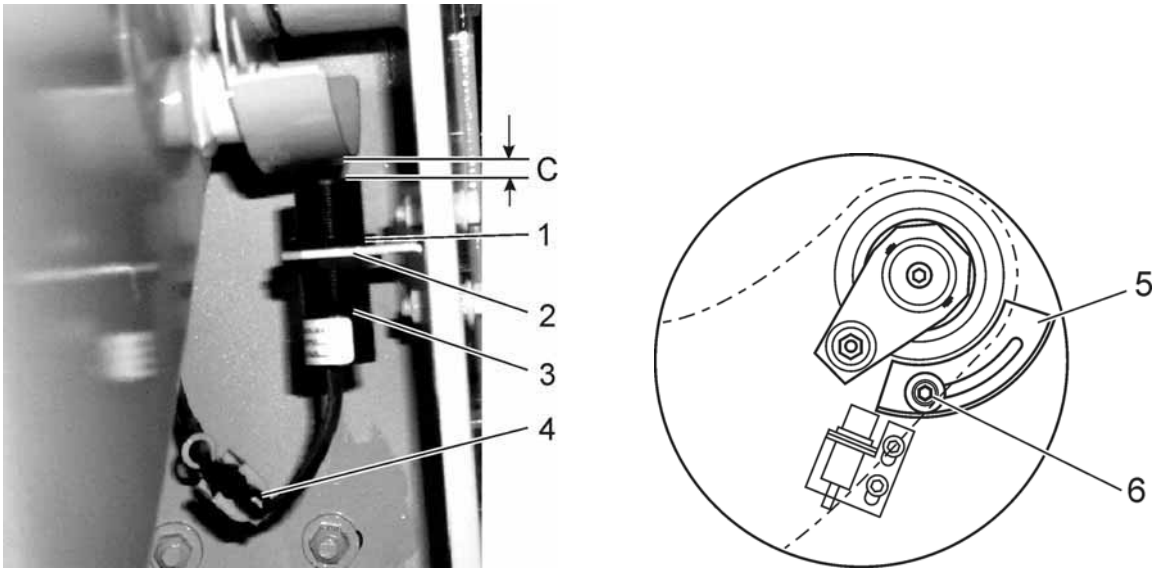


Fig. 17.8. Automatic Boom Kick-Out

1. Plastic nut
2. Bracket
3. Proximity Switch
4. Connector
5. Adjustment Plate
6. Locking Bolt

C – Plate-to-Switch Clearance

7. INSPECTION AND REPAIR

1. Check that all bucket teeth are secured to the bucket cutting edge. Replace teeth found to be worn excessively or cracked with new ones. Check that there are no missing bolts, nuts and washers that secure teeth to the bucket. Replace, if needed.
2. Replace with new ones excessively worn bucket cutting edges. To remove, use the acetylene burner and electric welding machine. Preheating to a temperature of 150÷200 [ºC] both the cutting edges and the immediate weld area before welding operation is recommended.
3. Check the holes for pins linking the bucket, boom, lever and bucket link. If the holes are out of dimension (refer to SPECIFICATION in this Section and Section 10C), restore them to their original shape through rebuilding and machining at Distributor of Construction Equipment.
4. Check for cracked welds that link boom components together, lever and bucket link. Remove cracked welds with a grinder or chisel and replace them with new ones of the same weld dimensions. Preheating before welding is recommended to 150÷200 [ºC].
5. Check the boom, lever and bucket link for proper shape and geometry (warpage). If permanent important deformation is encountered, damage parts replacement with a new one is recommended.

BOOM AND BUCKET LINKAGE

8. REASSEMBLY AND INSTALLATION

NOTE: *For ease of assembly, lubricate pivot pins generously with chassis grease prior to installation. Once installation is completed, lubricate linkage pin points through the lube fittings, using Multi Purpose Grease until grease appears.*

NOTE: *For removal of the boom it is necessary to use hoist of lifting capacity 2000 [kg].*

Boom Arms:

1. If removed, press two new bushings (1, Fig. 17.3) into each side of the boom bores use portable hydraulic ram with set of discs N°1.547.0396 and driver (See SPECIAL TOOLS). The edge of the bushing should be 10 [mm] from the outside surface of the arm boss.
2. Install the two new seal rings (13, Fig. 17.2) with the lips toward the outside and the inner face of the seals bottomed against the bushing.

NOTE: *Centering shims are available in 1 and 1.5 [mm] thickness.*

3. Attach a suitable hoist and raise boom assy (1) to a position so the boom assy and front frame eye bores are in alignment.
4. Apply grease on mating surface of pins (2, Fig. 17.7) and install with shims (11, Fig. 17.2) (shims are to be symmetrically at boom both sides). Shims are to be chosen in a way that the maximum total clearance (at boom both side) between the boom arms and the frame eye was not greater than 3.0 [mm] using copper hammer 1.519.0060.
5. Secure the pin (2, Fig. 17.7) with bolt with washer (4). If removed, install lubrication fitting (3) and through it lubricate pin (2).
6. Repeat steps 3÷5 for other boom arm.
7. If removed, press new bushings (3, Fig. 17.3) into boom arms (2) hole from the outer side. The edge of the bushing should be 10 [mm] from the outside surface of the arm boss. For bushing installation use portable hydraulic ram with set of discs N°1.547.0396 and driver (See SPECIAL TOOLS) and install seal rings (6, Fig. 17.2) so the lips are facing out..
8. Install pin (5) in this same manner as described above (steps 4, 5), securing boom cylinder (5) rod end to the boom arm (installation details see “BOOM CYLINDERS” in Section 10C).
9. Repeat steps 7, 8 for other boom arm.
10. If removed, press new bushing (4, Fig. 17.3) into boom arm (2) hole using portable hydraulic ram with set of discs N°1.547.0396 and driver (See SPECIAL TOOLS). The edge of the bushing should be 10 [mm] from the outside surface of the arm boss
11. Install two seal rings (6, Fig. 17.2) into the boom arm (2) lower bore so the lips are facing out.
12. Position the boom so the boom (1, Fig. 17.7) and bucket (8) eye bores are in alignment. Use the boom cylinders to align components.
13. Apply grease to mating surface of pin (8, Fig. 17.2) and install with shims (12) (shims are to be symmetrically at boom both sides). Shims are to be chosen in a way that the maximum total clearance (at boom both side) between the boom arm and the bucket eye was not greater than 3.0 [mm], using copper hammer 1.519.0060.
14. Secure the pin (7, Fig. 17.7) with bolt with washer (6). If removed, install lubrication fitting on the pin (7) and lubricate pin through the lubrication fitting.
15. Repeat steps 10÷14 for other boom arm.

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NOTE: *Plate-to-switch clearance (C, Fig. 17.8) necessary for the proper operation of the proximity switch is 7 to 8 [mm].*

16. If removed, reinstall all hardware of automatic boom kick-out.
    – Slide proximity switch (3) into bracket (2) hole and secure it with plastic nut (1)
    – Plug in proximity switch (3) to connector (4).

ADJUSTMENT OF AUTOMATIC BOOM KICK-OUT

WARNING! Use extra caution when adjusting loader's bucket leveler or boom kick-out. Use two trained people and guard against accidental movement of the machine or loader linkage. No personnel is allowed within the reach of loader linkage. Never work or walk under raised bucket without proper blocking.

To change the automatic boom kick-out position, raise the boom arms to the desired stopping height. Place the boom control lever in the "HOLD" position. Loosen locking bolt (6) on adjustment plate (5). Move adjustment plate (5) until it is just out of the magnetic field of proximity switch (3). Tighten locking bolt (6) on adjustment plate (5). Start the machine and test the adjustment. Repeat this procedure until the automatic kick-out height is obtained.

Lever:

1. If removed, install new bushings (2, Fig. 17.4) with spacer sleeve (3) into each side of the lever (1) bore using portable hydraulic ram with set of discs N°1.547.0396 and driver (See SPECIAL TOOLS).
2. The edge of the bushing should be 10 [mm] from the outside surface of the lever boss
3. Install two seal rings (13, Fig. 17.2) into the lever (2) bore so the lips are facing out. If removed, install lubrication fitting into its bore in the lever (2).
4. Attach a hoist to the upper fork of the lever and lift it into position to align lever bushings bore with boom (1) bracket bores.
5. Install pin (9) with shims (11) (shims are to be symmetrically at lever both sides). Shims are to be chosen in a way that the maximum total clearance (at lever both side) between the lever and the bracket eye was not greater than 3 [mm], using copper hammer 1.519.0142.
6. Install and tighten bolt with washer (6, Fig. 17.6) securing pin (4)
7. Detach a hoist from the lever upper fork and attach it to the bucket cylinder (1) rod. Lift and extend the bucket cylinder to align the lever upper fork bores with rod end bushing of the bucket cylinder. Install the bucket cylinder (1) in the manner described under "BUCKET CYLINDER" in Section 10C. Detach the hoist from the bucket cylinder rod.

Bucket Link:

1. If removed, install new bushings (3, Fig. 17.5) into both end bucket link (1) bore using driver 1.519.0658 N°1 and portable hydraulic ram with set of discs N°1.547.0396.
2. Press bushing (3) until it enters to a depth of 10 [mm] in relation to the bucket link (1) surface and install two seal rings (6, Fig. 17.2) into the bucket link (3) each bore so the lips are facing out.
3. If removed, install two lubrication fittings (2, Fig. 17.5) into their bores in the bucket link (1).
4. Attach a hoist to the end of the bucket link (10, Fig. 17.6) and lift it into position to align other end bushing bore with lever (2) lower fork bores so the lubrication fittings are upper of bucket link (10).

BOOM AND BUCKET LINKAGE

5. Install pin (7, Fig. 17.6) through lever (2) and bucket link (10) bores using copper hammer 1.519.0142 and secure the pin (7) with bolt with washer (6).
6. Detach a hoist from the link bore. Retract or extend bucket cylinder (1) to align the link (10) and bucket (9) eye bores. Make sure that seal rings (6, Fig. 17.2) remained firmly in their grooves in the bucket eye.
7. Install the pin (8, Fig. 17.6) through bucket (9) and bucket link (10) bores using copper hammer 1.519.0142 and secure the pin (8) with bolt with washer (6).
8. Lubricate all pivot points as described in the OPERATOR'S MANUAL.