YANMAR

SERVICE MANUAL

CRAWLER CARRIER

C50R-3C

FOREWORD

This service manual is intended for service engineers who maintain the YANMAR construction machinery, and describes the specifications, maintenance procedures of individual machine sections, and operational precautions.

Read this manual carefully and become familiar with your YANMAR machinery so that you will be able to quickly and accurately maintain and keep it in perfect working order throughout its life.

The dimensions and other values referred to in this manual are for your reference in servicing, and should not be considered as the values stipulated in the Inspection Standard.

This manual represents the most up-to-date information at the time of publication and is subject to change without notice to reflect specification changes for performance improvement or technological advancement, and/or correction of typographical errors. If you find any discrepancies between your machine and the information in this manual, obtain the most up-to-date information from our Customer Service Group.

You will be informed of major improvements and specification changes by delivery of the revised version of this manual.

We recommend that you read this manual together with:

1) C50R-3C Operation & Maintenance Manual
2) AI-4JJ1X Engine Operation Manual
3) C50R-3C Parts Catalog

Be sure to read carefully and fully understand the instructions and precautions given in this manual and on the labels on the machine before you start working.

The degrees of hazards caused by improper service are represented by the following warning words and symbols:

⚠ DANGER Indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury. This warning is used in safety messages and safety labels, and the necessary precautions are described.

⚠ WARNING Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury. This warning is used in safety messages and safety labels, and the necessary precautions are described.

⚠ CAUTION Indicates a potentially hazardous situation that, if not avoided, could result in minor or moderate injury or damage.

IMPORTANT Indicates a potentially hazardous situation that, if not avoided, could result in damage to or reduced life of the machine.

This service manual is intended for service engineers who maintain the Yanmar construction machinery. The safety signs given in this manual do not cover all the hazardous situations that may occur when using the machinery.

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CHAPTER 1

GENERAL CAUTIONS FOR MAINTENANCE WORK

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1-1. Correct Work

"Correct Work" means to complete the operation accurately in the quickest time while following the procedures and methods described for appropriate operations.
It is important to review and check the type of service (the components to be inspected, adjusted or disassembled, and procedures to be used), tools, instruments, materials and lubricants to be used, and the precautions to be taken before starting any operation.

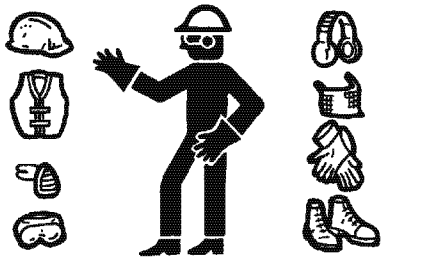
1-2. Safety Precautions

Follow safety rules at your workplace

- The operation and servicing of this machine is restricted to qualified persons.
- When operating or servicing the machine, follow all the safety rules, precautions and procedures.
- Any work performed by a team or with a signal person should be conducted in accordance with signals agreed on beforehand.

Wear proper clothing and safety items

- Do not wear loose clothing or jewelry that can be caught on the control levers and other machine parts. Also avoid wearing working clothes stained with oil as they can ignite.
- Be sure to wear a helmet, safety goggles, safety shoes, a mask, gloves and other protective items, as appropriate. Take particular precautions when generating metal debris, when striking metal objects with a hammer or when cleaning components with compressed air.
  Also make sure there are no persons near the machine.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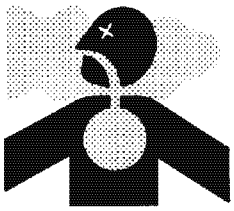
Use and inspect appropriate tools

- Using damaged or worn tools or using tools inappropriate for the required application is very dangerous, and may also cause damage to the machine. Make sure to use the tools that are appropriate for the specific job.
- Inspect the facilities and tools, especially hoisting and rigging tools, in advance.

Avoid harmful asbestos dust

- Air containing asbestos dust is carcinogenic and is hazardous to humans. Inhalation of the air may cause lung cancer. When handling materials that may contain asbestos, keep in mind that:
  - Compressed air must not be used for cleaning.
  - Water must be used to clean the machine to prevent asbestos from scattering in the air.
  - You must work on the windward side when operating the machine in a place where there may be asbestos dust.
  - You should wear an appropriate respirator as necessary.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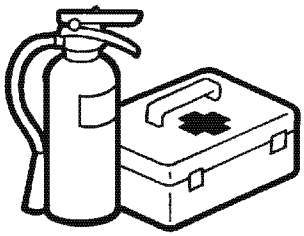
Keep a fire extinguisher and first aid kit handy

- The workplace must be provided with a fire extinguisher. Read instructions on the label to familiarize yourself with how to use it.
- Keep a first aid kit in a prescribed place.
- Know what to do in the event of a fire or an accident.
- Know who to contact in an emergency and keep emergency telephone numbers in a prominent place.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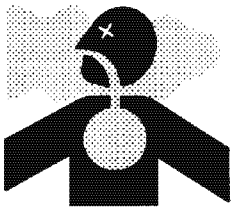
Provide adequate ventilation when working in an enclosed area

Engine exhaust fumes are harmful to the human body and their inhalation is extremely hazardous. When starting the engine in an enclosed area, open the windows and doors for ventilation. Also do not idle the engine unnecessarily or leave the engine running while the machine is not in use.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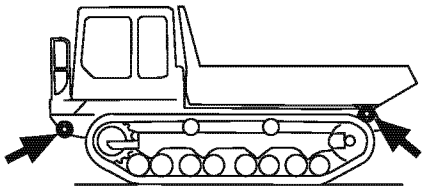
Hook the wire rope on the frame when towing

- Improper towing procedures can cause death or serious injury.
- When towing a machine with another machine, use a wire rope strong enough to sustain the machine weight.
- Never tow a machine on a slope.
- Do not use a towing rope that is kinked, distorted or damaged.
- Do not ride on the towing cable or on the wire rope.
- When connecting an object to be towed, make sure that no person enters the space between the machine and the object.
- Align the connection of an object to be towed and the towing part of the machine, and fix them before towing.



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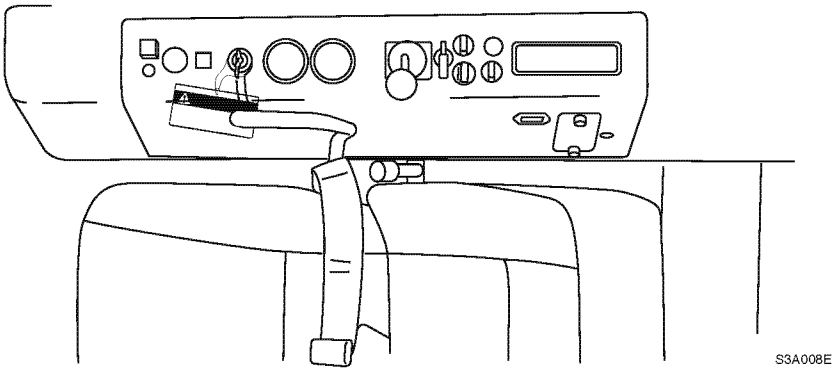
Attach the "SERVICING IN PROGRESS" tag to the starter switch

- If another person should start the engine or operate the control levers while service is in progress, the service personnel can sustain serious bodily injury.
  Always attach the "SERVICING IN PROGRESS" tag to the starter switch, while service is in progress. The "SERVICING IN PROGRESS" tag is enclosed with the Operation & Maintenance Manual, (Article number: 172660-03810).



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Keep unauthorized persons away

- Never admit any persons into the work area who are not taking part in the work. Be conscious of the safety of other persons.
  Be especially careful when grinding, welding, or using a large hammer.

Working under the machine

- Never perform service underneath the machine if it is not completely stable.
- Before performing service or repairs underneath the machine, be sure to apply blocks to the tracks to lock the tracks securely.
- To perform service or repairs with the wagon in the dump position, lock the dump lever and lock the wagon with the wagon stopper.


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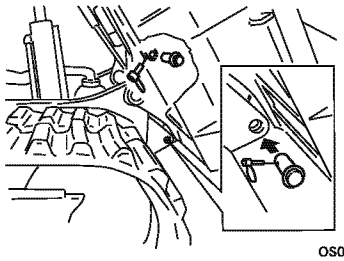
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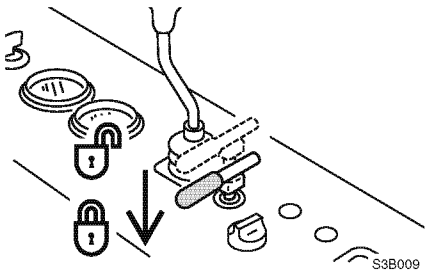
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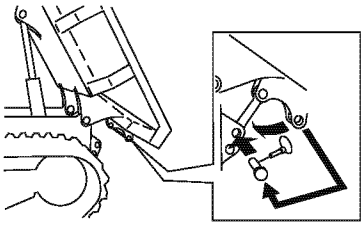
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When operating the crane

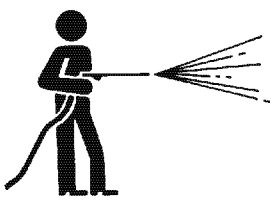
- The crane and the hoisting & rigging equipment must be operated by qualified operators.
- Never allow any persons to go beneath the lifted loads.
- When detaching a heavy component, first lift it with the crane as a safety support before removing its fixing bolts.

Stop the engine before beginning inspection and servicing

- Be sure to stop the engine before performing inspection and servicing.
- If necessary to perform service while running the engine, as when cleaning the inside of the radiator, be sure to set the lock levers to the lock position, lock the dump lever and do the job together with a partner. (One should take the operator's seat so that he or she can stop the engine at any time.) That person must be careful not to touch any levers in the operator's cab.
- Be extremely careful not to contact the moving fan or fan belt, or any hot surfaces.

Keep the machine clean

- Spilled oil or grease, or scattered parts are dangerous and can cause falls. Keep the machine clean.
- Getting water into the electrical system may cause it to malfunction, resulting in faulty operation of the machine. Also it may permit electrical leaks that could cause a fire or electric shocks.
- Never clean the sensors, connectors or the operator's seat with water or steam.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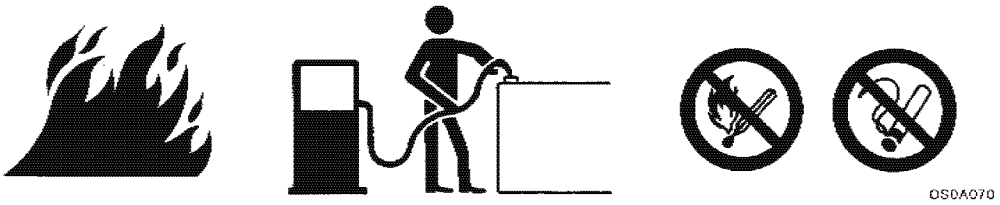
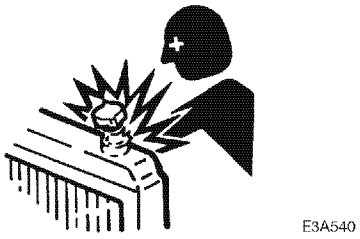
Precautions for fueling and oiling

- Spilled fuel and oil could cause a fire and they are dangerously slippery. Wipe up spills immediately.
- Close the fuel cap and oil cap securely.
- Never use fuel for cleaning.
- Provide good ventilation when replenishing fuel or oil.



Radiator cooling water level

- Before checking the radiator cooling water level, stop the engine and wait until the engine and the radiator have cooled down.
- Slowly loosen the cap to release the inner pressure before removing the cap.



Use an explosion-proof lighting source

- Use an explosion-proof lighting source when checking the fuel, the oil, the cooling water, or the battery electrolyte. Failure to use an explosion-proof lighting source may cause ignition to occur, inducing an explosion.

Precautions for handling battery

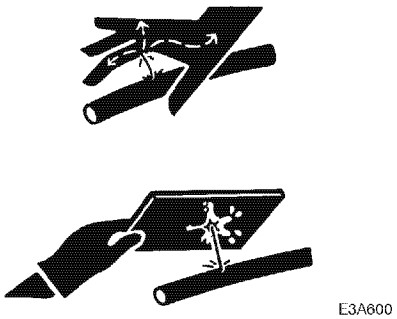
- When welding or repairing the electrical system, disconnect the negative terminal of the battery to interrupt the electric circuit.

Handling high-pressure hoses

- Leaks of fuel and oil could cause a fire.
- Do not bend a high-pressure hose forcibly, or strike it with a hard object. Because abnormally bent or damaged piping, tubes, and hoses easily burst under high pressure, never use them.
- Be sure to retighten or repair any loosened or damaged fuel hoses and hydraulic hoses. If oil or fuel leaks, a fire could be caused.

Be careful of hot oil under high-pressure

- The hydraulic system for the wagon operates under high pressure.
  When replenishing or draining hydraulic oil, or performing inspection or service, be sure to first relieve the high pressure.
- The emission of hot oil under high-pressure from a small leak could result in serious bodily injury.
  Wear safety goggles and thick gloves when checking for leaks. Use a piece of cardboard or a plywood block to detect emissions of hot oil.
  If the hot oil should contact your body, obtain prompt medical treatment.



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Be careful when servicing systems under high temperature and high pressure

- The engine cooling water and various lube oil systems are still under high temperature and pressure immediately after the engine has stopped. Removing caps, draining oil and water, or replacing filter elements at that time may cause a burn. Wait until the temperature drops, then begin servicing in accordance with the procedures described in this manual.

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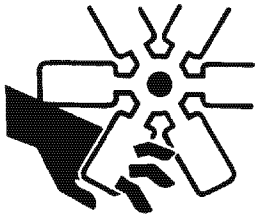
Rotating radiator fan and fan belt

- Never contact the rotating radiator fan or fan belt with any object.
- Contacting the rotating radiator fan or fan belt with any object can result in serious bodily injury.



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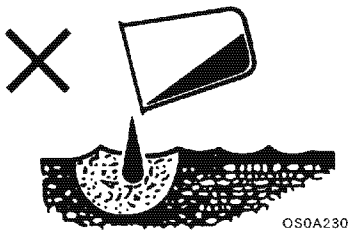
Processing wastes

- Do not dispose of waste oil in the sanitary sewer system.
- Always drain the oil from the machine into a secure container, and never directly to the ground.
- When disposing of toxic wastes such as fuel, oil, cooling water, solvent, filters, and spent batteries, comply with all applicable disposal regulations.



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1-3. Preparations

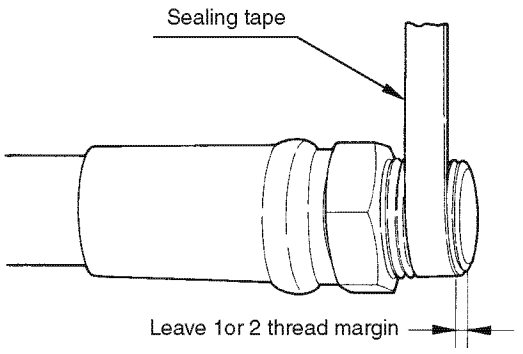
(1) Review the client service history for details of the most recent service (when the machine was last serviced, how long (months or hours) since the machine has operated since then, and any problems and their solutions at that time).
(2) Prepare the service tools, measuring instruments (which must be calibrated periodically), containers, and oils and greases required for servicing.
(3) Make sure that the related reference materials (this manual, Parts Catalogs, etc.) are ready at hand.

1-4. Cautions for Disassembly and Reassembly

(1) Clean the machine before disassembly operation.
(2) Before disassembly, check the machine conditions and record them.
- Model, Machine Serial Number, Hourmeter
- Reason for Repairs, Repair History
- Dirtiness of Filters
- Fuel and Oil Conditions
- Damage to each parts, etc.

(3) To make reassembly operations easy, make matching marks at the necessary points.
(4) Clean all disassembled parts and new parts, then arrange them in the proper sequence.
(5) Be sure to replace all seals and cotter pins, etc., with new parts.
(6) Keep parts which should not come in contact with oil and water separate from parts with oil on them.
- Electrical Parts, Rubber, V-Belts, etc.

(7) When installing bearings, bushings and oil seals, as a rule, use a press. When a hammer, etc., is used, it leaves bruises.
(8) Wipe all joining surfaces clean so that there is no dirt or dust adhering to them.
(9) Wrap seal tape from the front end, Wrapping it tight and leaving 1 or 2 threads bare, Overlap the tape by about 0.4 in. (10 mm).



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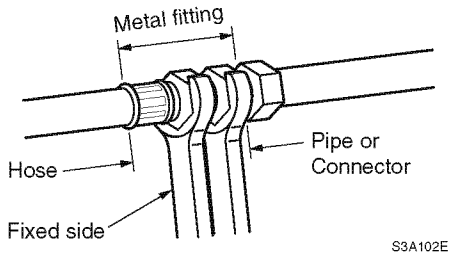
1-5. Cautions for Removal and Installation of Hydraulic Equipment

(1) Check that the hydraulic oil temperature is low enough.
(2) Release air from the hydraulic tank to prevent the hydraulic oil from flowing out.
(3) Be sure to plug open the ends of hydraulic components to prevent dust from entering.
(4) Be sure to wipe hydraulic oil from the hydraulic components so that it will not be mistaken for an oil leak.
(5) Take care not to damage the plating on the cylinder rod.
(6) Be sure to raise the bed and secure it by installing the bed stoppers before starting to detach or re-attach the hydraulic cylinder.
(7) Be sure to release air after installing the hydraulic cylinders.
- Run the engine at a low speed. Extend and retract the cylinders 4 to 5 times up to 2 to 3.9 in. (50 to 100 mm) from the end of the stroke. Then, fully extend and retract.

(8) Be sure to release air after installing the HST pump.

1-6. Cautions for Removal and Installation of Hydraulic Piping

(1) Installation of hydraulic hose.
Take care not to twist the hoses. For hoses with a metal fitting, use two wrenches to prevent twisting. Use one to fix the hose, and the other to tighten the fitting to the specified tightening torque. Carefully check that the hoses do not came in contact after tightening. If any contact is found, correct it or use tubes.

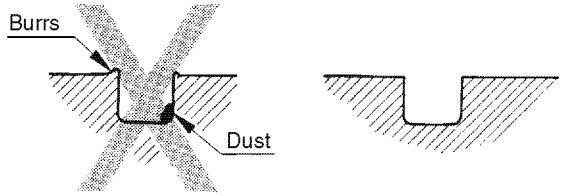


(2) When installing hoses, first tighten to the specified torque and then lossen them a little. Then retighten to the specified torque.
- Break in the installed parts before tightening (except those using seal tapes).

(3) When installing pipes, turn the nuts more 1/4 to 1/2 turn after they reach the sharp torque rise point.
(4) When installing or removing hoses, use two wrenches, one to fasten the hose and the other to tighten or lossen the hose to prevent twisting.
(5) Check for oil leakage by applying max. pressure 5 to 6 times after attaching hydraulic hoses or pipes.

1-7. Cautions for Handling Seals

(1) Clean the grooves for O-rings and if there is any ridge, etc., remove it.



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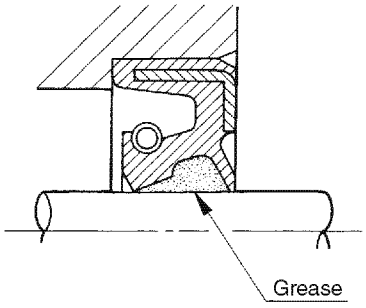
(2) Be careful not to twist O-rings. If an O-ring is twisted, remove the twist with the fingertips.
(3) During insertion, be careful not to damage the seal.
(4) Handling of Floating Seals
- Wipe all oil off the O-ring and housing of the floating seal.
- When assembling, apply a thin coating of gear oil to the contact surface of the housing.
- After assembly, turn the seal 2 or 3 times to get it to fit snugly.

(5) Apply grease to the lip of the oil seal.
- This is to prevent wear when it is first started up after assembly.



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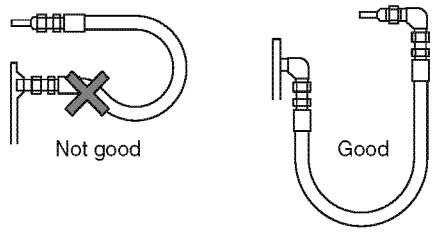
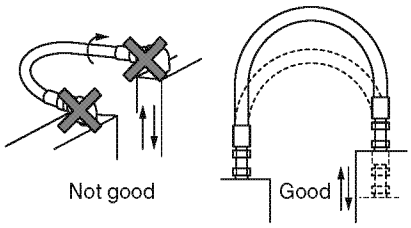
1-8. Correct Installation of Hydraulic Hose

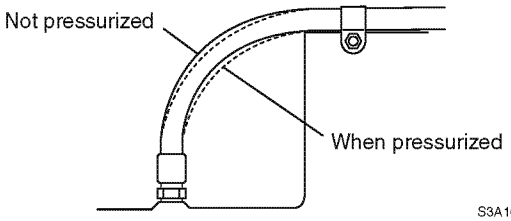
In order to mount the hydraulic hose most effectively and economically, observe the following cautions.



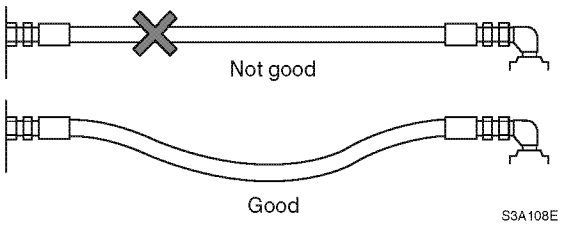
1. When a hose is used at the minimum bending radius, use elbows to avoid sharp bending.



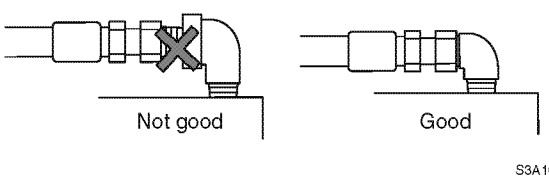
2. To prevent twisting, the hose should be bent in the same direction as it moves.



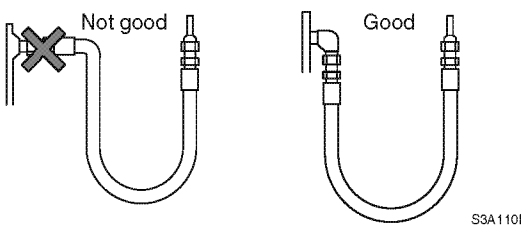
3. When the hose is pressurized, the hose length varies slightly at the bend. Allow this change to occur and do not try to fasten the bend.



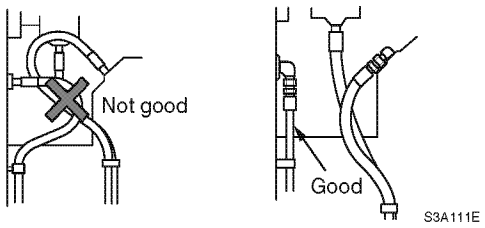
4. It is necessary for the hose to have ample slackness for elongation and contraction, because its length will change by +2 % to -4 % when used at high pressure.



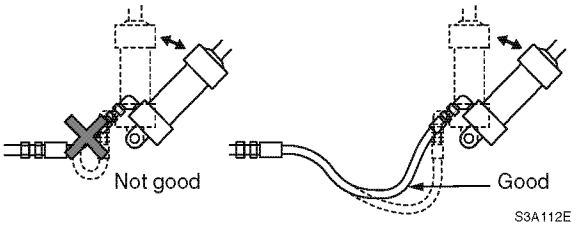
5. Use the proper adapters, not pipes, in order to reduce the number and length of joints and improve the external appearance.



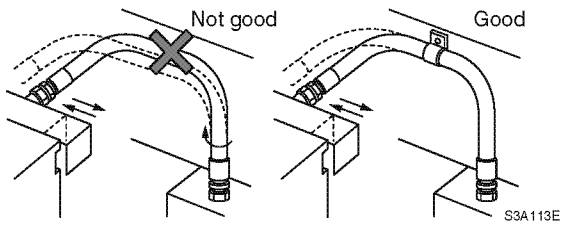
6. Use an elbow to prevent excessive twisting or bending of the hose.



7. Use adapters to make the hose as straight as possible. The outside appearance can be improved by avoiding the use of hoses that are too long.



8. The hose should be slightly longer than is absolutely necessary. The extra allows smoother movement of the hose and prevents sharp bending.

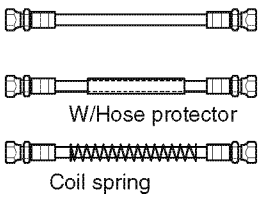
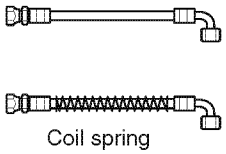
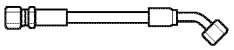
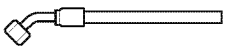
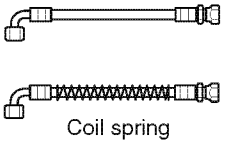
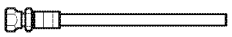


9. When a bent hose is attached to two different planes, fix as shown in the diagram to prevent twisting.

1-9. Types of Hydraulic Hoses

1. High-pressure and middle-pressure hoses

High-pressure and middle-pressure hoses are broadly classified according to their names and fitting sizes as shown in the table below:

Name	Fitting size	Rough sketch	Name	Fitting size	Rough sketch
G–G	G1/4 G3/8 G1/2 G3/4 G1	 S3A115E	G90–ø6.3 G90–ø9.5 G90–ø19	G1/4 G3/8 G3/4	 S3A119
G–G90	G1/4 G3/8 G1/2 G3/4 G1	 S3A116E	G–G45	G1/4 G3/8 G1/2 G3/4 G1	 S3A120
G45–ø9.5	G3/8	 S3A117	G90–G	G1/4 G3/8 G1/2 G3/4 G1	 S3A121E
G–ø6.3 G–ø19	G1/4 G3/4	 S3A118			

1-10. How to Release Air from Hydraulic Units

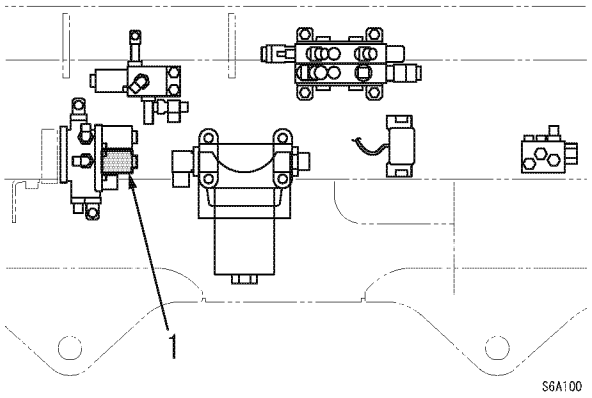
1-10-1. Releasing Air from the HST System

Before replacing the HST pump or supplying the hydraulic oil after repair, release air according to the following procedures. If unusual wear is found while disassembling, replace the hydraulic oil and the return filter.

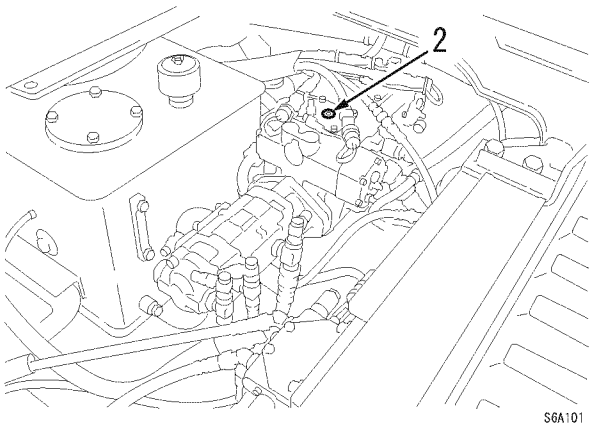
⚠ WARNING

Be sure to install the wagon stopper to hold the wagon when inspecting or servicing the machine with the wagon in the dump position.

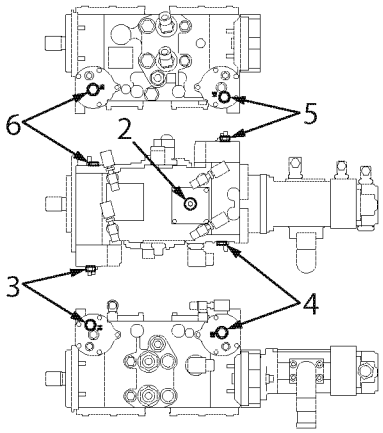
(1) Disconnect the harness of the solenoid valve (1) for the parking brake.
This is to keep the parking brake activated while operating the travel lever.
(2) Remove the air release plug (2) of the HST pump, fill the hydraulic oil in the housing, and tighten the air release plug (2).
(3) Loosen the air release plugs (3),(4),(5) and (6) of the remote piping.
(4) Start the engine, keep it idling, and operate the travel lever back and forth.
(5) When the hydraulic oil overflows through the holes for the air release plugs (3),(4),(5) and (6) tighten those plugs.
(6) Stop the engine, check for any oil leak, and inspect the hydraulic oil surface.
(7) Reconnect the harness of the solenoid valve (1).
(8) Restart the engine at 1500 to 1800 rpm, and repeat traveling forward and backward three or four times.
(9) Keep running the engine at the nominal rotation speed for a while, then stop the engine and inspect the oil surface of the hydraulic oil tank.



S6A100



S6A101



S6A102

1-10-2. Releasing Air from Hydraulic Cylinder

For releasing air from hydraulic cylinder, refer to section "1-5. Cautions for Removal and Installation of Hydraulic Equipment".

CHAPTER 2

TECHNICAL DATA

2-1. Specifications 2-1-1
2-2. Outside Drawing 2-2-1
2-3. Hydraulic Circuit Diagram 2-3-1
2-4. Electrical Circuit Diagram 2-4-1
2-5. Main Parts Mass Chart 2-5-1

2-1. Specifications

Main specifications of machine

Item		Unit	3-side flaps wagon		Scoop-end wagon		Swing wagon	
			Canopy	Cabin	Canopy	Cabin	Canopy	Cabin
Dimensions/Weight								
Overall length		in. (mm)	178.74 (4540)				183.07 (4650)	
Overall width		in. (mm)	78.74 (2000)					
Overall height		in. (mm)	105.32 (2675)	107.48 (2730)	105.32 (2675)	107.48 (2730)	105.32 (2675)	107.48 (2730)
Tumbler center distance		in. (mm)	125.59 (3190)					
Track gauge		in. (mm)	61.02 (1550)					
Minimum ground clearance		in. (mm)	17.13 (435)					
Machine mass		lbs. (kg)	11662 (5290)	12037 (5460)	11662 (5290)	12037 (5460)	12655 (5740)	13029 (5910)
Ground pressure	Unloaded	PSI (kPa)	2.6 (18.2)	2.7 (18.8)	2.6 (18.2)	2.7 (18.8)	2.9 (19.8)	3.0 (20.4)
	Loaded	PSI (kPa)	4.6 (31.4)	4.6 (31.4)	4.6 (31.4)	4.6 (31.4)	4.6 (31.4)	4.7 (32.4)
Traveling performance								
Travel speed	Forward	MPH (km/hr)	0 to 5.72 (0 to 9.2)					
	Reverse	MPH (km/hr)	0 to 5.72 (0 to 9.2)					
Min. turning radius		in. (mm)	——		——			
Work performance								
Max. load capacity		lbs. (kg)	8379 (3800)		8379 (3800)		7718 (3500)	
Wagon dimensions	Length	in. (mm)	98.43 (2500)		106.30 (2700)		102.36 (2600)	
	Width	in. (mm)	72.83 (1850)				70.87 (1800)	
	Height	in. (mm)	11.81 (300)				11.22 (285)	
Wagon capacity	Struck	cu. ft. (cu. m)	49.44 (1.4)		45.91 (1.3)		42.38 (1.2)	
	Heaped	cu. ft. (cu. m)	81.22 (2.3)		81.22 (2.3)		74.16 (2.1)	
Wagon floor face height		in. (mm)	42.52 (1080)				51.38 (1305)	
Dump angle		degree	65					
Dump clearance		in. (mm)	26.38 (670)		23.62 (600)		34.65 (880)	
Max. dump lift		lbf. (kN)	11431 (50.8)					
Max. possible dump inclination angle		degree	35					
Max. height when dumping		in. (mm)	137.01 (3480)				142.13 (3610)	

Hydraulic equipment

Item			Unit	3-side flaps wagon		Scoop-end wagon		Swing wagon	
				Canopy	Cabin	Canopy	Cabin	Canopy	Cabin
Hydraulic pump									
	Type		——	Tandem pumps (HST)					
	Drive mechanism		——	Mounted on the engine through CF coupling					
	Displacement		in^3/rev (cm^3/rev)	3.11 (51)					
	Max. no. of revolutions		rpm	3200					
	Max. working pressure		PSI (MPa)	5075 (35.0)					
	Pressure cut (PC) vave set pressure		PSI (MPa)	5003 (34.5)					
	Charge relief set pressure		PSI (MPa)	290 (2.0)					
	Charge pump	Type	——	Internal gear pump					
		Desplacement	in^3/rev (cm^3/rev)	1.70 (27.8)					
	Charge pump relief set pressure		PSI (MPa)	290 (2.0)					
	Working equipment pump	Type	——	Internal gear pump					
		Desplacement	in^3/rev (cm^3/rev)	0.84 (13.7)					
	Pilot pressure pump	Type	——	Internal gear pump					
		Desplacement	in^3/rev (cm^3/rev)	0.31 (5.1)					
Travel motor (Hydraulic motor)									
	Type		——	Variable displacement piston motor					
	Motor displacement		in^3/rev (cm^3/rev)	5.2 to 3.7 (84.4 to 60.1)					
	Low pressure relief valve set pressure		PSI (MPa)	355 (2.45)					
Reduction gears									
	Reduction gear ratio		——	1/23.168					
	Max. output revolution speed		rpm	80.7					
Brake									
	Parking brake torque (Hydraulic motor)		ft·lbf (N·m)	10083 (13671)					
	Brake release pressure		PSI (MPa)	160 (1.1)					
Swing motor (Hydraulic motor)									
	Type		——	Fixed displacement piston motor					
	Motor displacement		in^3/rev (cm^3/rev)	1.67 (27.4)					
	High pressure relief valve set pressure		PSI (MPa)	1784 (12.3)					
Reduction gears									
	Reduction gear ratio		——	1/22.7					
	Max. output revolution speed		rpm	——					
Brake									
	Parking brake torque (Hydraulic motor)		ft·lbf (N·m)	1324 (1796)					
	Brake release pressure		PSI (MPa)	290 (2.0)					

Undercarriage

Item		Unit	3-side flaps wagon		Scoop-end wagon		Swing wagon	
			Canopy	Cabin	Canopy	Cabin	Canopy	Cabin
Carrier roller	Suspension system	——	Rigid					
	Qty. (Each side)	Pcs.	1					
	Bearing type	——	Ball bearing (6206)					
	Sealing structure	——	Oil seal					
	Amount of lubricant	fl.oz. (mL)/Pc.	1.52 to 1.69 (45 to 50)					
Track roller	Suspension system	——	Oscillating					
	Qty. (Each side)	Pcs.	8					
	Bearing type	——	Roller bearing (32008JR)					
	Sealing structure	——	Floating seal					
	Amount of lubricant	fl.oz. (mL)/Pc.	5.41 (160)					
Idler	Qty. (Each side)	Pcs.	1					
	Bearing type	——	Roller bearing (32209JR)					
	Sealing structure	——	Floating seal					
	Amount of lubricant	fl.oz. (mL)/Pc.	5.75 (170)					
Sprocket	No. of teeth	——	17					
Crawler belt	Type	——	Endless chain					
	Shoe width	in. (mm)	17.72 (450)					
	Lug height	in. (mm)	1.18 (30)					
	Core pitch × No. of links	in. (mm)	4.33 × 2.91 (110 × 74)					
	Shoe (Each side)	——	——					
	Crawler drive mechanism	——	——					
Crawler adjusting mechanism		——	Hydraulic cylinder					

Engine

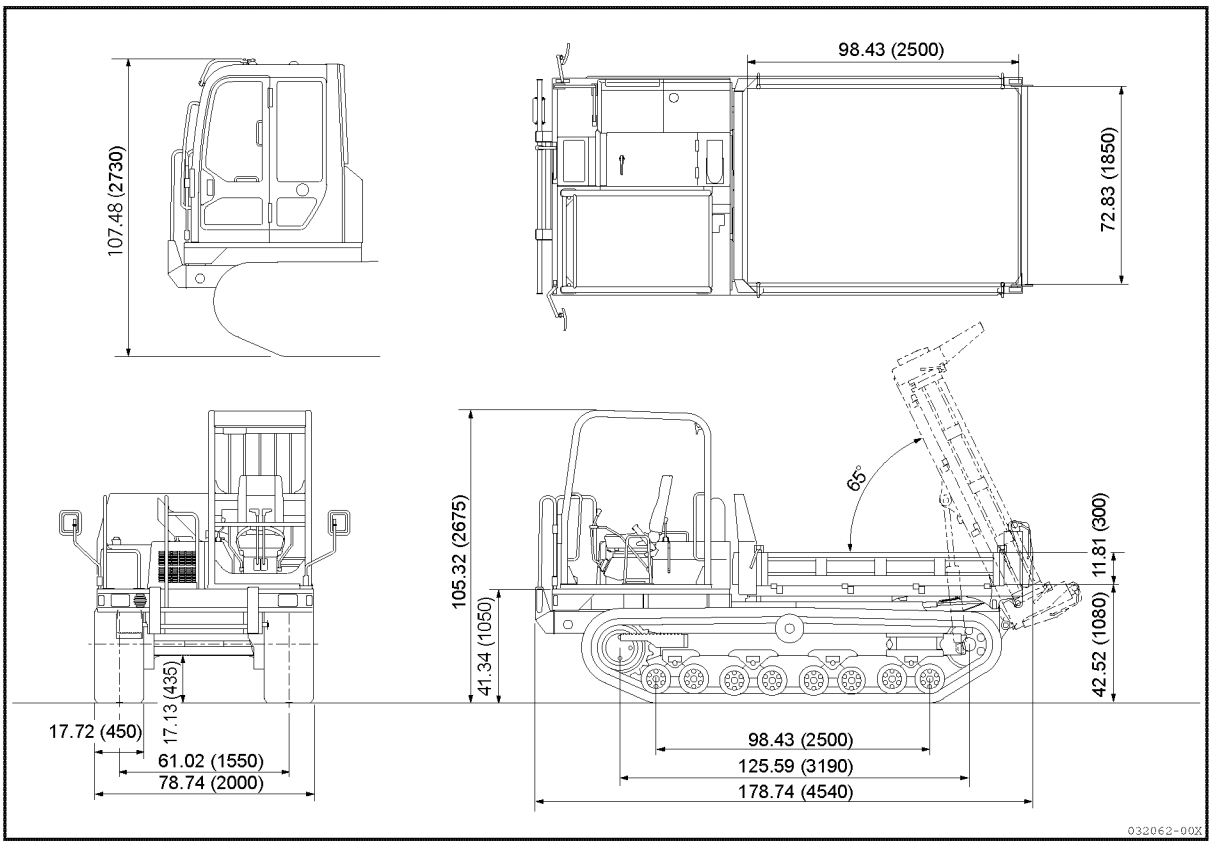
Item	Unit	3-side flaps wagon		Scoop-end wagon		Swing wagon	
		Canopy	Cabin	Canopy	Cabin	Canopy	Cabin
Engine model	——	4JJ1X					
Type	——	Vertical, water-cooled, 4-cycle diesel engine					
Combustion	——	Direct fuel injection					
Number of cylinders–Bore × Stroke	in. (mm)	4–3.76 × 4.13 (4-95.4 × 104.9)					
Total displacement	in^3 (mL)	183.01 (2999)					
Rated output/revs.	HP (kW) /rpm	96.5 (72)/2200					
Maximum torque/revs.	ft·lbf (N·m) /rpm	274 (372) / Approx.1600					
Specific fuel consumption	lb/hp·h (g/kW·h)	0.368 (224) or less					
Maximum no-load speed	rpm	2400					
Minimum no-load speed	rpm	1100					
Engine dry mass	lb (kg)	662 (300)					
Fuel system type							
Fuel injection pump	——	Common rail					
Filtration type	——	Paper filtering, full flow					
Governor	——	Electronic control					
Lubrication system							
Lubrication pump	——	Gear pump					
Filtration type	——	Paper filtering					
Cooling system							
Cooling system type	——	Water-cooled					
Radiator	——						
Type	——	Pressurized (with a pressure applying cap)					
Radiator cap Pressure	PSI (MPa)	14.5 (0.1)					
Fan	——	Resin, 550 dia. × 8 pcs.					
Air cleaner	——	Cyclonic					
Starting device	——	Electric type					
Starter							
Type	——						
Nominal rated output	V–kW	24-4.0					
Clutch type	——						
Alternator	——						
Nominal rated output	V–A	24-50					
Rated r.p.m.	rpm	5000					
Battery	——						
Type	——	80D23R					
Battery voltage 5 hrs rate capacity	V–A·h	12-54 × 2					
Cold starting aid	——						
Glow plug	V–A	23-3.5					

Electrical equipment

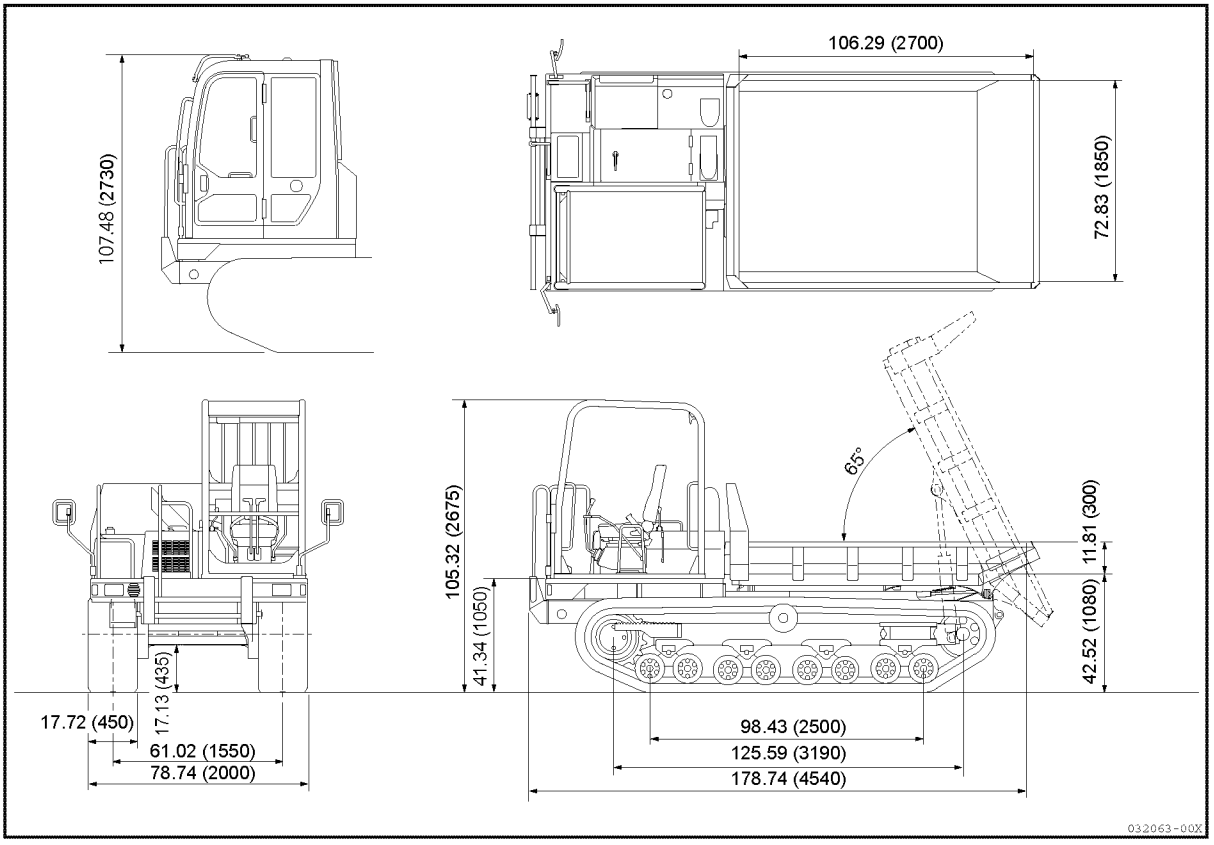
Item	Unit	3-side flaps wagon		Scoop-end wagon		Swing wagon	
		Canopy	Cabin	Canopy	Cabin	Canopy	Cabin
Hourmeter	V	24					
Horn	V–dB	24–110					
Fuse	A × Qty.	20×4, 15×1, 10×9					
Fuel meter lamp	V–W	24–3.4					
Water temperature meter lamp	V–W	24–1.5					
Monitor lamp	V	24					
Battery charge	V–W	24–1.5					
Engine oil pressure	V–W	24–1.5					
Water temperature	V–W	24–1.5					
Air cleaner	V–W	24–1.5					
Glow	V–W	24–1.5					
ECM	V–W	24–1.5					
Headlight	V–W	24–70					
Flasher lamp	V–W	24–25					
Backup buzzer	V–W	24–2.4					
Cigarette lighter socket	V–W	——					

2-2. Outside Drawing

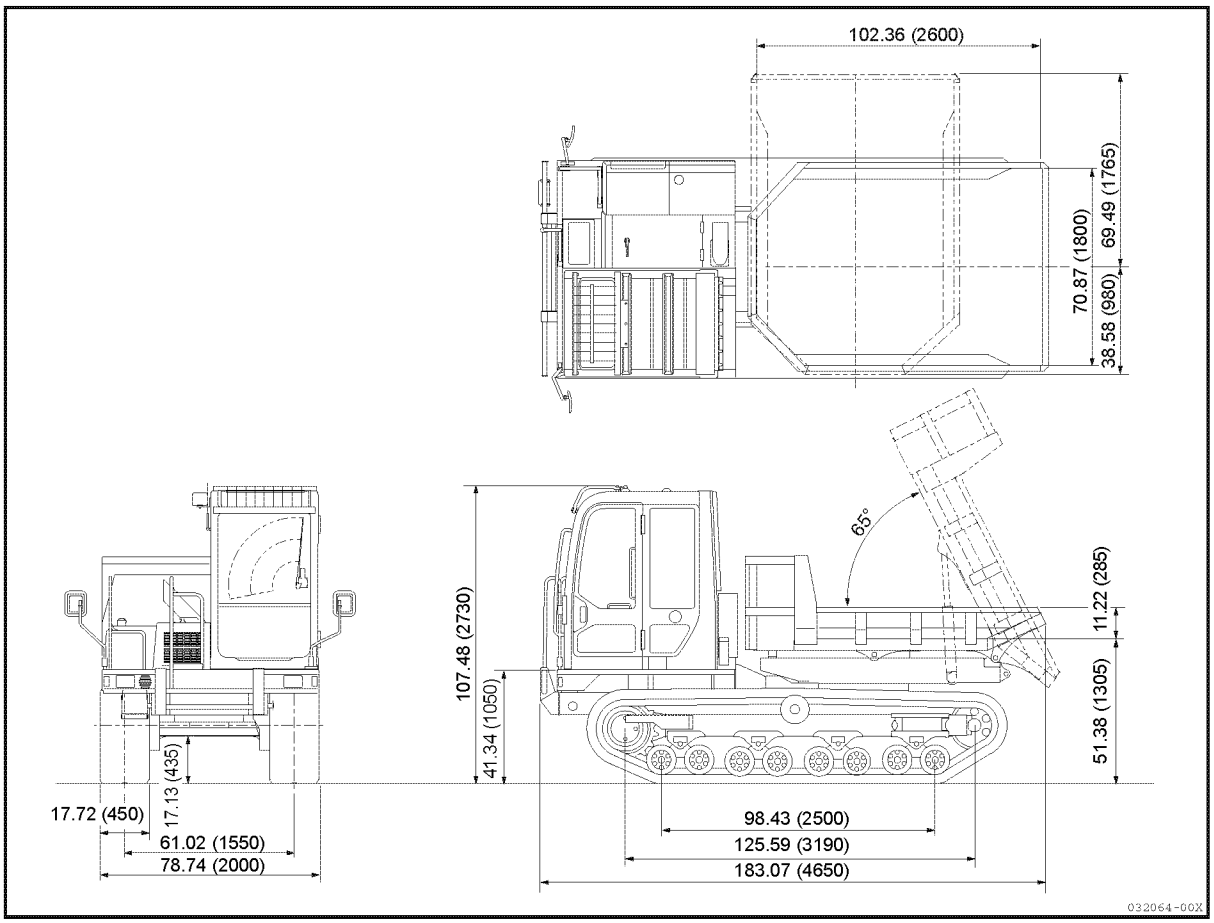
3-side flaps wagon model **Unit: in. (mm)**



Scoop-end wagon model **Unit: in. (mm)**



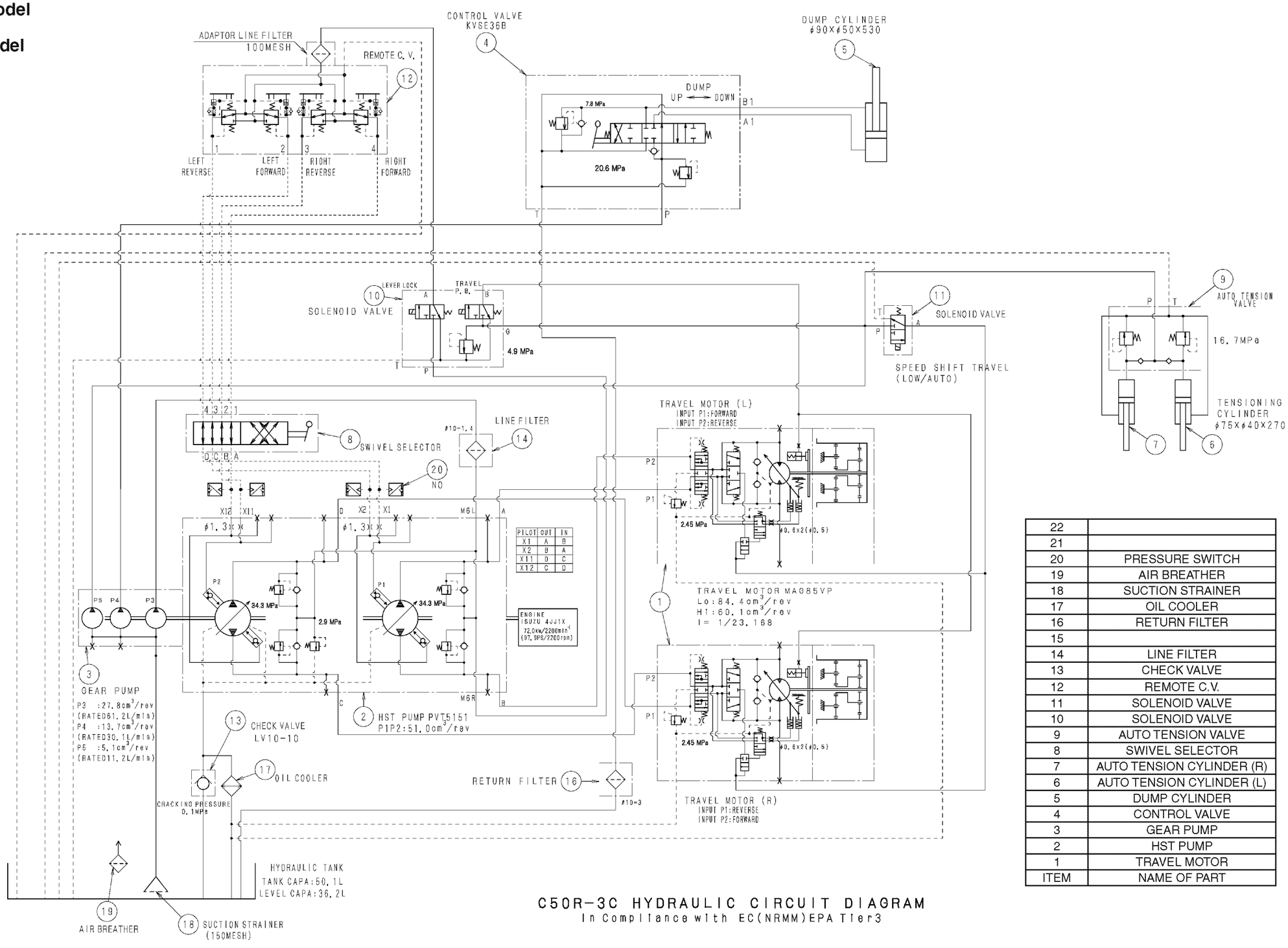
Swing wagon model **Unit: in. (mm)**



2-3. Hydraulic Circuit Diagram

3-side flaps wagon model

Scoop-end wagon model

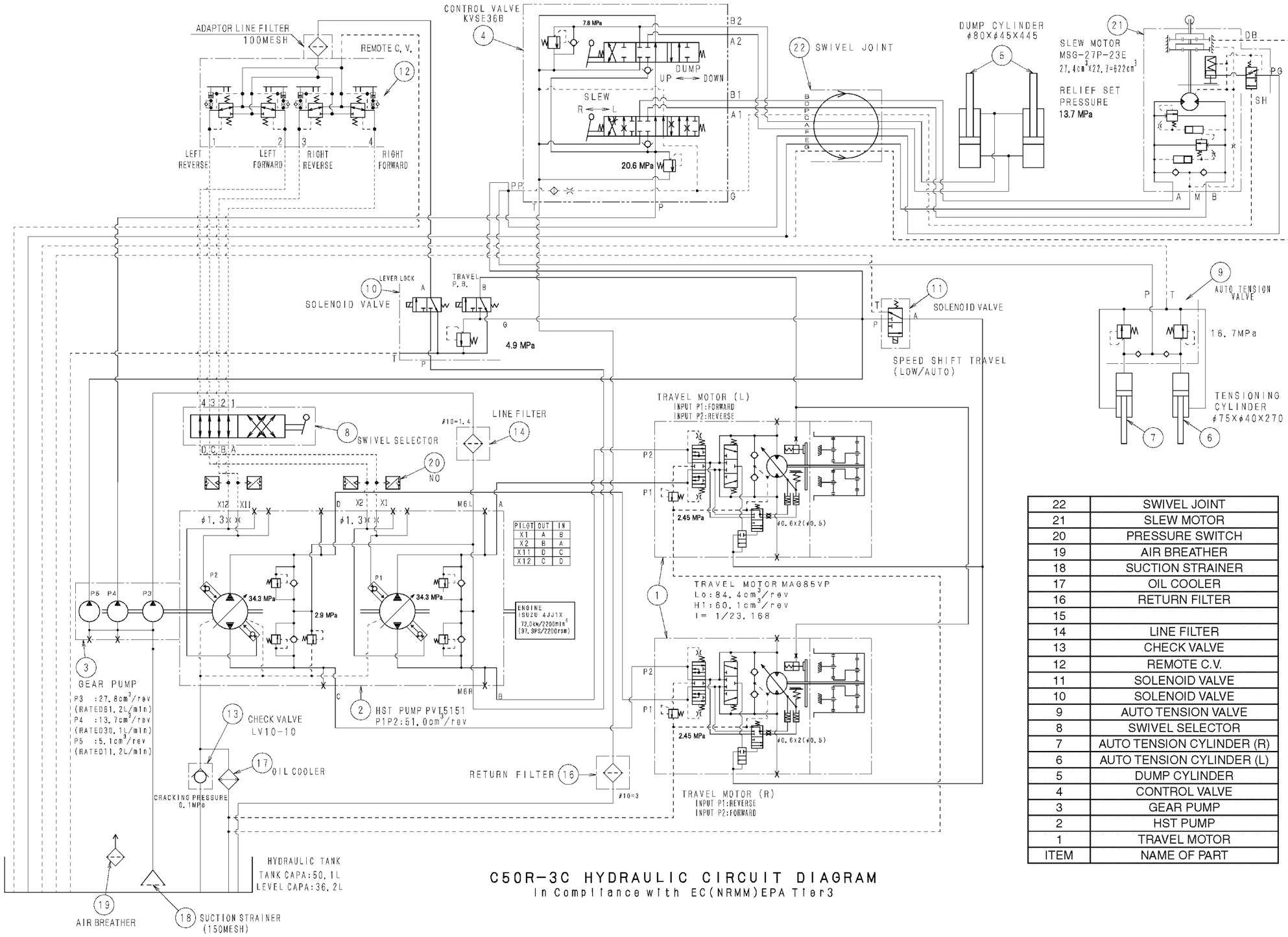


C50R-3C HYDRAULIC CIRCUIT DIAGRAM
In Compliance with EC(NRMM)EPA Tier3

S6B300

ITEM	NAME OF PART
22	
21	
20	PRESSURE SWITCH
19	AIR BREATHER
18	SUCTION STRAINER
17	OIL COOLER
16	RETURN FILTER
15	
14	LINE FILTER
13	CHECK VALVE
12	REMOTE C.V.
11	SOLENOID VALVE
10	SOLENOID VALVE
9	AUTO TENSION VALVE
8	SWIVEL SELECTOR
7	AUTO TENSION CYLINDER (R)
6	AUTO TENSION CYLINDER (L)
5	DUMP CYLINDER
4	CONTROL VALVE
3	GEAR PUMP
2	HST PUMP
1	TRAVEL MOTOR

Swing wagon model

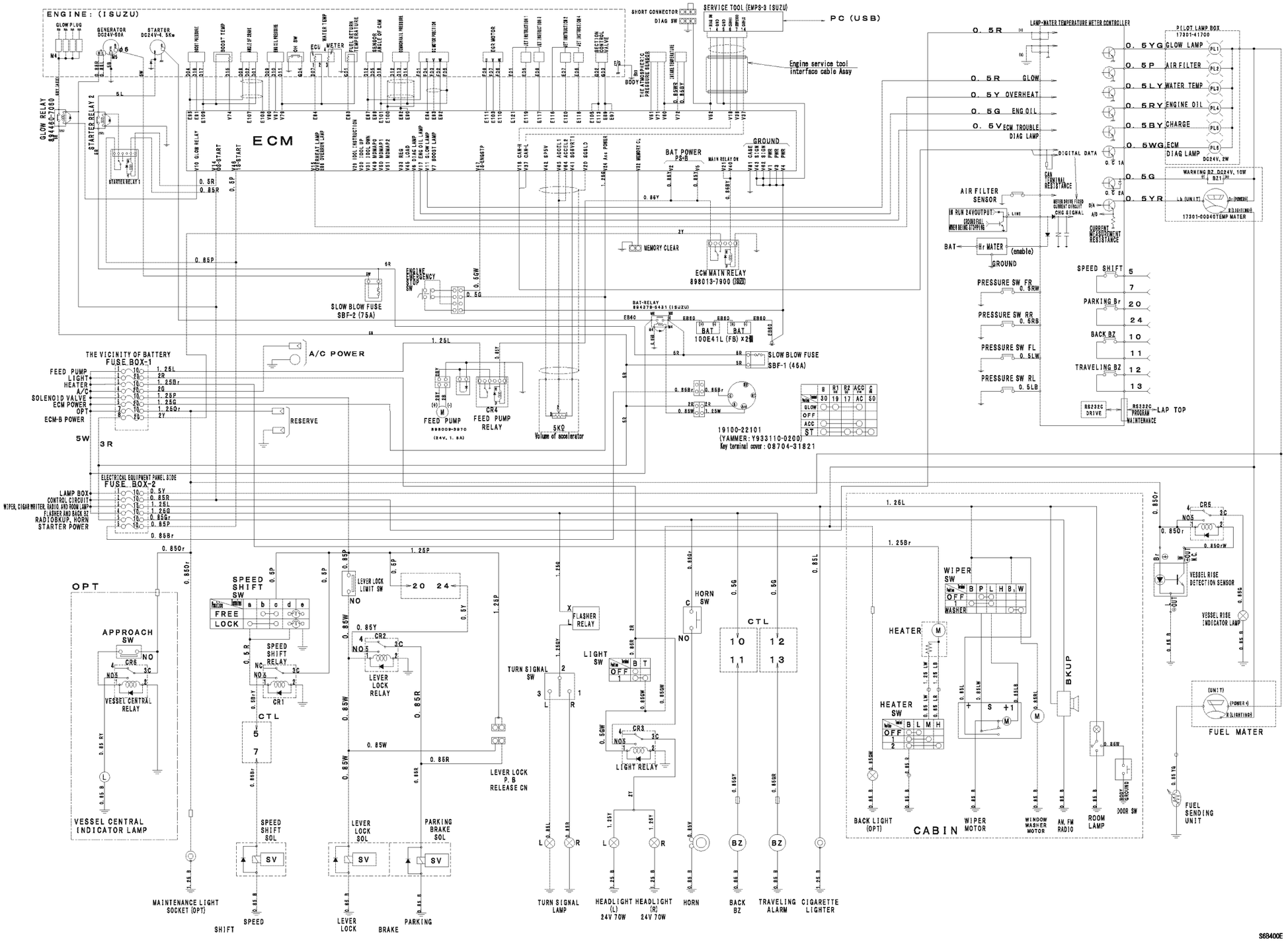


C50R-3C HYDRAULIC CIRCUIT DIAGRAM
In Compliance with EC(NRMM)EPA Tier3

ITEM	NAME OF PART
22	SWIVEL JOINT
21	SLEW MOTOR
20	PRESSURE SWITCH
19	AIR BREATHER
18	SUCTION STRAINER
17	OIL COOLER
16	RETURN FILTER
15	
14	LINE FILTER
13	CHECK VALVE
12	REMOTE C.V.
11	SOLENOID VALVE
10	SOLENOID VALVE
9	AUTO TENSION VALVE
8	SWIVEL SELECTOR
7	AUTO TENSION CYLINDER (R)
6	AUTO TENSION CYLINDER (L)
5	DUMP CYLINDER
4	CONTROL VALVE
3	GEAR PUMP
2	HST PUMP
1	TRAVEL MOTOR

S6B301

2-4. Electrical Circuit Diagram



2-5. Main Parts Mass Chart

[Mass/piece]

Item		Qty.	C50R-3C Unit	C50R-3C Mass
Lower frame		1	lbs. (kg)	1846/1786* (837/810*)
Upper frame		1	lbs. (kg)	461 (209)
Swing Bearing (Swing Wagon Model)		1	lbs. (kg)	225 (103)
Rubber crawler		2	lbs. (kg)	1080 (490)
Carrier roller		2	lbs. (kg)	22 (10)
Track roller		8	lbs. (kg)	168 (76)
Idler		2	lbs. (kg)	82 (37)
Crawler adjuster		2	lbs. (kg)	104 (47)
Travel drive assembly		2	lbs. (kg)	448 (203)
Engine		1	lbs. (kg)	662 (300)
Radiator and oil cooler		1	lbs. (kg)	110 (50)
Hydraulic pump drive assembly		1	lbs. (kg)	300 (136)
Operator seat + remoto control valve assembly		1 set	lbs. (kg)	139 (63)
Wagon	3-side flaps (2 sides + rear)	1	lbs. (kg)	1491 (676)
	Scoop-end		lbs. (kg)	1228 (557)
	Swing		lbs. (kg)	1281 (581)
Piping		1 set	lbs. (kg)	75 (34)
Hydraulic oil tank		1	lbs. (kg)	69 (31)
Fuel tank		1	lbs. (kg)	84 (38)
Covers		1	lbs. (kg)	198 (90)
Canopy		1	lbs. (kg)	309 (140)
Cabin		1	lbs. (kg)	540 (245)

CHAPTER 3

SERVICING STANDARDS

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3-1. Machine Performance

3-1-1. Reference Value Table

Item			Unit	Standard	Wear limit
Hydraulic oil pressure					
	Main pressure		PSI (MPa)	4980 $^{+87}_{0}$ (34.3 $^{+0.6}_{0}$)	←
	Charge pressure		PSI (MPa)	420 $^{+70}_{0}$ (2.9 $^{+0.5}_{0}$)	←
	Dump pressure		PSI (MPa)	2990 $^{+280}_{-70}$ (20.6 $^{+2.0}_{-0.5}$)	←
	Pilot pressure		PSI (MPa)	710 $^{+170}_{0}$ (4.9 $^{+1.2}_{0}$)	←
Travel					
	Travel speed (65.6 ft (20 m))		sec.	7.7 ±0.8	9.9
	Track deviation	Forward travel	in. (mm)	4.92 $^{0}_{-4.92}$ (125 $^{0}_{-125}$)	9.84 (250)
		Reverse travel	in. (mm)	4.92 $^{0}_{-4.92}$ (125 $^{0}_{-125}$)	9.84 (250)
Dump cylinder					
	Dump speed	Extended	sec.	6.2 ±0.6	7.8
		Retracted	sec.	4.3 ±0.6	5.6
Brake					
	Parking brake actuating time		sec.	2.5 $^{+1.0}_{-0.2}$	3.2
Swing					
	Swing speed	Right	sec.	6.9 ±1.3	9.1
		Left	sec.	6.9 ±1.3	9.1

3-1-2. Expendables

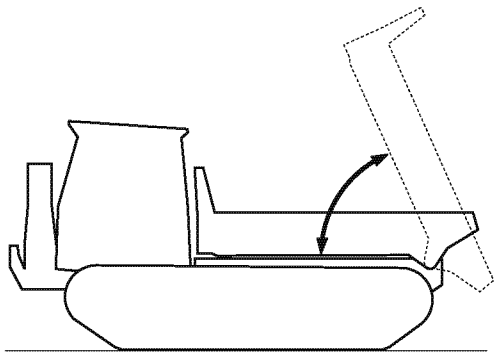
Parts inside the parenthesis should be replaced together.

Item	Part Name	Q'ty	Replacement interval
Pre-fuel filter	Filter element	1	Every 500 hrs.
Main fuel filter	Filter element	1	Every 500 hrs.
Engine oil filter	Filter element (including gasket)	1	Every 250 hrs.
Hydraulic oil tank line filter	Filter element	1	Every 500 hrs. (After first 250 hrs.)
Hydraulic oil tank return filter	Filter element (O-ring)	1	Every 1000 hrs. (After first 50 hrs.)
Air cleaner	Element subassembly: outer	1	——
	Element subassembly: inner		

3-1-3. Methods for Inspecting Performance

Dump cylinder speed

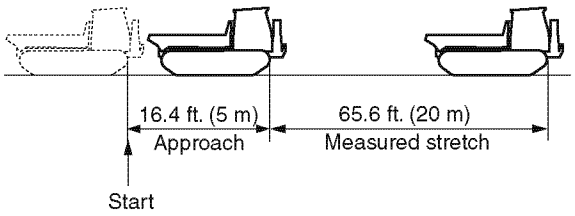
- Engine : Rated r.p.m.
- Hydraulic oil temp. : 122 to 140°F (50 to 60°C)
- Measurement posture : Make the dump cylinder fully retracted (fully extended).
- Measure the time required for the dump cylinder to be fully extended (fully retracted) from being fully retracted (fully extended).



S3C101

Travel speed (65.6 ft (20 m))

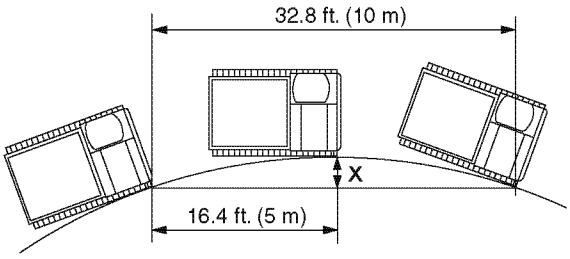
- Engine : Rated r.p.m.
- Hydraulic oil temp. : 122 to 140°F (50 to 60°C)
- Measurement posture : The level of the wagon should be lowered.
- Set machine in motion. Starting after a distance of 16.4 ft (5 m), measure the time required to travel 65.6 ft (20 m). Do this on level and solid ground.



S3C102E

Track deviation

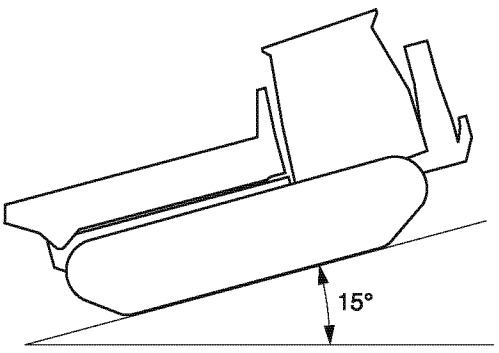
- Engine : Rated r.p.m.
- Hydraulic oil temp. : 122 to 140°F (50 to 60°C)
- Measurement posture : The level of the wagon should be lowered.
- Starting after an approach of 16.4 ft (5 m), drive the machine in a turn for 32.8 ft (10 m), then measure the distance of X (16.4 ft/5 m point). Do this on level and solid ground.



S3C103E

Parking brake actuating time

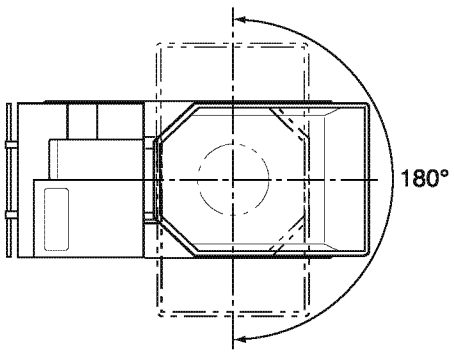
- Engine : Low idling
- Hydraulic oil temp. : 122 to 140°F (50 to 60°C)
- Gradient : 15 ±1.5 degrees
- Measurement posture : The level of the wagon should be lowered.
- Climb the slope forwards, release the travel lever, and measure the time required for the machine to stop.



S3C104

Swing time

- Engine : Rated r.p.m.
- Hydraulic oil temp. :122 to 140°F (50 to 60°C)
- Measurement posture : The level of the wagon should be lowered.
- Turn the wagon 90° to the left (or right) to hit the left (or right) stopper. Then turn the wagon 180° to the right (or left) to hit the right (or left) stopper, and measure the time required for the wagon to travel between the two stoppers.

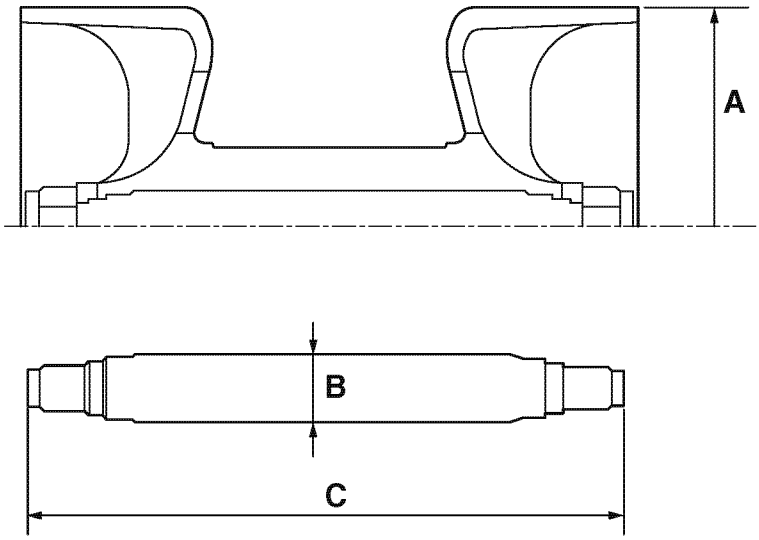
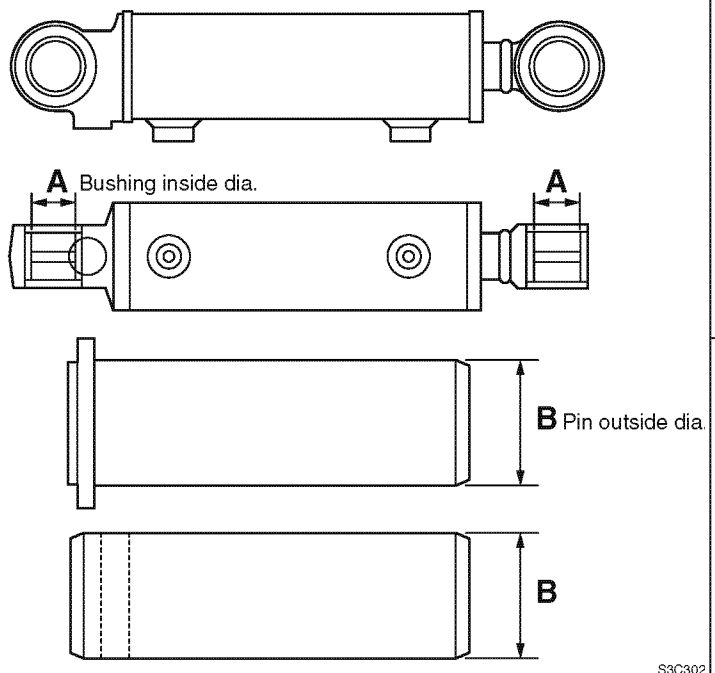


S3C105

3-3. Servicing Standards for Parts of Undercarriage

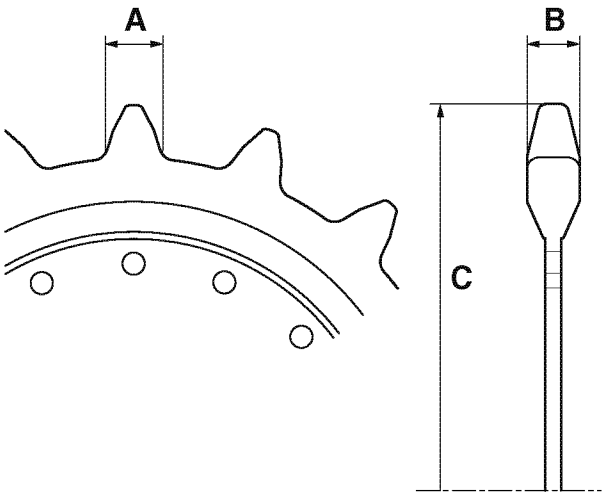
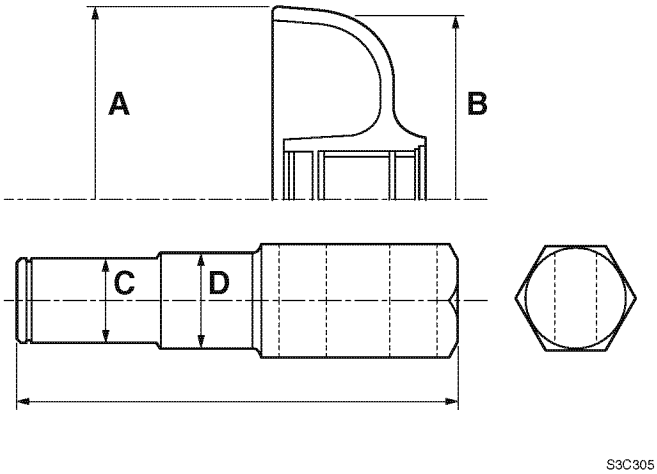
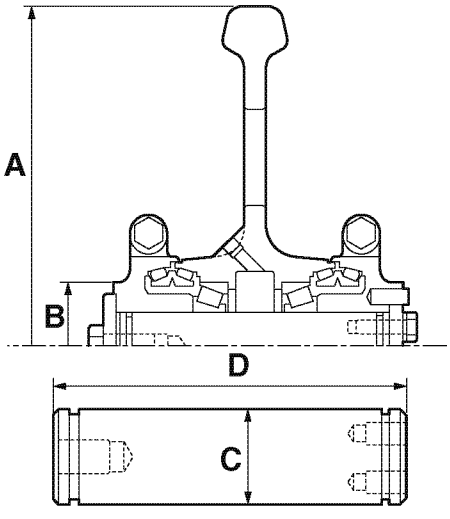
1. Undercarriage

Unit: in. (mm)

Applicable model		C50R-3C		
Part		Measuring position	Standard	Allowable limit
Track roller & shaft		A	ø10.63 (270)	ø10.24 (260)
		B	ø1.57 (40)	——
		C	13.43 (341)	——
Dump cylinder		A	ø1.97 (50) ø1.77 (45)*	ø2.01 (51) ø1.81 (46)*
		B	ø1.97 (50) ø1.77 (45)*	ø1.93 (49) ø1.73 (44)*

* : Swing wagon model

Unit: in. (mm)

Applicable model	C50R-3C		
Part	Measuring position	Standard	Allowable limit
Sprocket 	A	1.77 (45)	1.46 (37)
	B	1.69 (43)	——
	C	ø24.21 (615)	——
Carrier roller & shaft 	A	ø10.24 (260)	ø9.84 (250)
	B	ø9.69 (246)	——
	C	ø1.18 (30)	——
	D	ø1.38 (35)	——
Idler & shaft 	A	ø17.72 (450)	ø17.32 (440)
	B	ø3.35 (85)	——
	C	ø1.77 (45)	——
	D	7.20 (183)	——

3-4. Control Equipment

Item		Unit	Standard
Lever			
Lever operating force	Travel	lbf (N)	3.5 ±0.9 (15.7 ±3.9)
	Dump	lbf (N)	6.6 ±1.3 (29.4 ±5.9)
	Swing	lbf (N)	8.8 ±1.3 (39.2 ±5.9)
Lever play	Travel	in. (mm)	$0.28^{0}_{-0.28}$ (7^{0}_{-7})
	Dump	in. (mm)	0.59 ±0.2 (15 ±5)
	Swing	in. (mm)	0.59 ±0.2 (15 ±5)
Control valve			
Spool operating force	Dump	lbf (N)	15.7 to 19.8 (70 to 88)
	Swing	lbf (N)	18.2 to 24.7 (81 to 110)
Spool stroke		in. (mm)	0.28 (7)

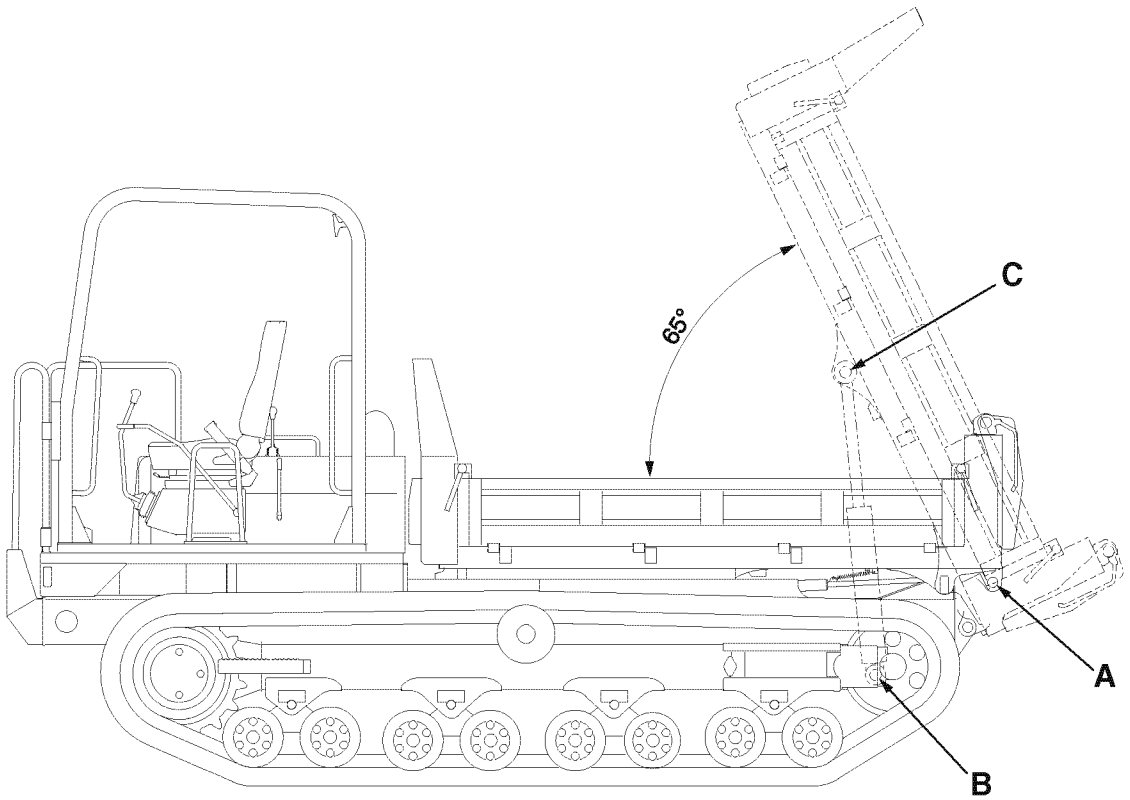
3-5. Hydraulic Equipment

3-5-1. Hydraulic Cylinder

Item	Unit	Standard
Dump cylinder (Standard type)		
Bore × Rod dia.	in. (mm)	3.54 × 1.97 (90 × 50)
Stroke	in. (mm)	20.87 ±0.08 (530 ±2.0)
Fully retracted (pitch)	in. (mm)	32.99 ±0.08 (838 ±2.0)
Piston nut tightening torque	ft·lbf (N·m)	760 to 832 (1030 to 1130)
Dump cylinder (Swing wagon type)		
Bore × Rod dia.	in. (mm)	3.15 × 1.77 (80 × 45)
Stroke	in. (mm)	17.52 ±0.08 (445 ±2.0)
Fully retracted (pitch)	in. (mm)	$28.74^{-0.12}_{-0.20}$ ($730^{-3.0}_{-5.0}$)
Piston nut tightening torque	ft·lbf (N·m)	651(883)
Tensioning cylinders (R), (L)		
Bore × Rod dia.	in. (mm)	2.95 × 1.57 (75 × 40)
Stroke	in. (mm)	10.63 ±0.08 (270 ±2)
Fully retracted (pitch)	in. (mm)	19.02 ±0.08 (483 ±2)
Piston tightening torque	ft·lbf (N·m)	520 (705)
Set screw tightening torque	ft·lbf (N·m)	5 (6.8)

3-6. Working Equipment

Clearance between pin and bushing



S3C601

Unit: in. (mm)

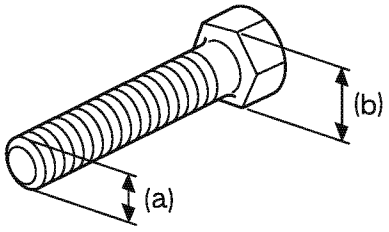
Code	Item	Judging criteria					Measures
		Basic dimension	Allowable limit		Standard clearance	Allowable clearance	
			Shaft	Hole			
A	Wagon & undercarriage frame	ø1.57 (40)	−0.0008 (−0.02) −0.0020 (−0.05)	+0.0009 (+0.024) +0.0044 (+0.112)	0.0173 to 0.0064 (0.44 to 0.162)	0.0394 (1.0)	Replace
B	Dump cylinder & undercarriage frame	ø1.97 (50)	−0.0008 (−0.02) −0.0020 (−0.05)	+0.0075 (+0.19) +0.0039 (+0.10)	0.0047 to 0.0094 (0.12 to 0.24)	0.0394 (1.0)	
C	Dump cylinder & wagon	ø1.97 (50)	−0.0008 (−0.02) −0.0020 (−0.05)	+0.0075 (+0.19) +0.0039 (+0.10)	0.0047 to 0.0094 (0.12 to 0.24)	0.0394 (1.0)	

3-7. Tightening Torque Table

3-7-1. Tightening Torque for Bolts and Nuts for Vehicle

1) General tightening points

Item	Head width (b) (mm)	Size (a) × Pitch (mm) (mm)	Tightening torque	
			ft·lbf	N·m
Coarse	10	M6 × 1.0	7.2 ±0.4	9.8 ±0.5
	12, 13	M8 × 1.25	16.6 ±0.8	22.6 ±1.1
	14, 17	M10 × 1.5	34.7 ±1.7	47.1 ±2.4
	17, 19	M12 × 1.75	61.5 ±3.0	83.4 ±4.1
	19, 22	M14 × 2.0	99.1 ±4.9	134.4 ±6.7
	22, 24	M16 × 2.0	153.3 ±7.7	207.9 ±10.4
	27, 30	M20 × 2.5	303.1 ±15.1	410.9 ±20.5
Fine	12, 13	M8 × 1.0	18.1 ±0.9	24.5 ±1.2
	14, 17	M10 × 1.25	36.9 ±1.8	50 ±2.5
	17, 19	M12 × 1.5	64.4 ±3.2	87.3 ±4.3
	19, 22	M14 × 1.5	99.9 ±5.0	135.3 ±6.8
	22, 24	M16 × 1.5	162.7 ±8.1	220.6 ±11
	27, 30	M20 × 1.5	333.4 ±16.6	452.1 ±22.6



S3C701

2) Special tightening points

Tightening point	Size × Pitch	Tightening torque ft·lbf (N·m)	Remarks
Drain bolt for carrier roller	M10 × 1.5	40.5 (55)	
Bots installing carrier roller	M16 × 1.5	188.8 (256)	
Nuts installing track roller	M27 × 1.5	217 to 238.7 (294 to 324)	Apply molybdenum disulfide grease to the spline. Apply spray-type grease to the nuts washers and screws.
Bolts installing track roller bracket	M12 × 1.5	75.2 (102)	Apply Three Bond #1324
Screws locking track roller installing nut	M8 × 1.25	8.7 (12)	
Bots installing upper frame	M14 × 2.0	115 (156)	
Bolts installing idler sealing cover	M12 × 1.75	71.6 (97)	Apply Three Bond #1324
Bolts installing idler plate	M10 × 1.5	40.5 (55)	Apply Three Bond #1324
Bolts adjusting idler rotating force	M16 × 2.0	14.5 (20)	
Bolts installing travel motor	M16 × 2.0	177.9 (241)	Apply Three Bond #1324
Bolts installing drive sprocket	M16 × 2.0	177.9 (241)	Apply Three Bond #1324
Bolts installing swing bearing to lower frame	M16 × 1.5	188.8 (256)	Apply Three Bond #1324
Bolts installing swing bearing to swing frame	M16 × 1.5	188.8 (256)	Apply Three Bond #1324
Bolts installing swivel joint	M14 × 1.5	116.5 (157)	Apply Three Bond #1324
Bolts installing swivel joint stopper	M14 × 1.5	116.5 (157)	Apply Three Bond #1324
Bolts installing swing motor	M16 × 1.5	188.8 (256)	Apply Three Bond #1324
Bolts installing engine mount (flywheel side)	M16 × 1.5	188.8 (256)	
Upper nuts installing engine mount vibration isolating rubber (fan side)	M16 × 2.0	177.9 (241)	
Lower nuts installing engine mount vibration isolating rubber (fan side)	M16 × 2.0	142.5 (193)	
Bolts installing engine feet (R.R.), (R.L.)	M12 × 1.75	71.6 (97)	
Nuts installing battery	M8 × 1.25	7.2 (9.8)	
Bolts installing compressor	M8 × 1.25	14.5 (19.6)	Apply Three Bond #1324
Nuts installing headlight	M8 × 1.5	14.5 (17.6 to 19.6)	attached to light
Nuts installing rear light plate	M8 × 1.25	14.5 (14.7 to 19.6)	attached to light
Nuts installing rear light	M8 × 1.0	7.2 (7.8 ~ 9.8)	attached to light
Return filter hose adapter	R1–G3/4	65.1 (88.3)	
Bolts installing HST pump	M16 × 1.5	188.8 (256)	
Bolts installing gear pump	3/8–16UNC	34.7 (47.1)	Apply Three Bond #1324
Bolts installing engine housing	M10 × 1.5	41.2 (56)	
Bolts installing CF coupling	M16 × 2.0	177.9 (241.2)	Specially coated bolt, attached with the coupling, to prevent the coupling from loosening. DO NOT use any other bolts.
Bolts installing hydraulic oil tank	M12 × 1.75	71.6 (97)	Apply Three Bond #1324
Bolts installing fuel tank	M10 × 1.5	34.7 (47)	Apply Three Bond #1324

Note:

- *In order to tighten bolts and nuts evenly, they should be tightened alternately on the upper and lower or right and left sides.*
- *All bolts and nuts shown in the above chart are for ISO strength category 10.9.*

3-7-2. Tightening Torque for Bolts and Nuts for Engine

ft·lbf (N·m)

Strength category	4.8 4T		7T	
Shape of bolt head	Hexagon head bolt	Flange bolt	Hexagon head bolt	Flange bolt
* M10 × 1.5	14.5 to 24.6 (19.6 to 33.3)	16.5 to 27.5 (22.3 to 37.2)	20.3 to 33.3 (27.5 to 45.1)	22.4 to 37.2 (30.3 to 50.4)
M12 × 1.25	36.2 to 54.3 (49.0 to 73.5)	40.5 to 60.8 (54.9 to 82.3)	44.9 to 67.3 (60.8 to 91.2)	50.3 to 75.4 (68.1 to 102.1)
* M12 × 1.75	33.3 to 50.6 (45.1 to 68.6)	37.6 to 56.5 (51.0 to 76.5)	42.0 to 62.2 (56.9 to 84.3)	46.3 to 69.4 (62.7 to 94.0)
M14 × 1.5	56.4 to 84.7 (76.5 to 114.7)	61.3 to 91.9 (83.0 to 124.5)	68.8 to 102.8 (93.2 to 139.3)	74.4 to 111.5 (100.8 to 151.1)
M14 × 2	52.9 to 78.9 (71.6 to 106.9)	57.0 to 85.5 (77.2 to 115.8)	65.2 to 97.0 (88.3 to 131.4)	70.1 to 105.0 (94.9 to 142.3)
M16 × 1.5	76.8 to 115.9 (104.0 to 157.0)	85.3 to 127.9 (115.6 to 173.3)	99.9 to 150.6 (135.3 to 204.0)	110.8 to 166.2 (150.1 to 225.2)
* M16 × 2	73.8 to 110.1 (100.0 to 149.1)	80.8 to 121.2 (109.4 to 164.2)	95.5 to 143.4 (129.4 to 194.2)	105.2 to 157.8 (142.5 to 213.8)
M18 × 1.5	111.5 to 166.5 (151.0 to 225.6)	-	144.1 to 216.4 (195.2 to 293.2)	-
* M18 × 2.5	111.5 to 166.5 (151.0 to 225.6)	-	144.8 to 217.2 (196.1 to 294.2)	-
M20 × 1.5	152.1 to 228.8 (206.0 to 310.0)	-	199.1 to 299.0 (269.7 to 405.0)	-
* M20 × 2.5	140.4 to 211.4 (190.2 to 286.4)	-	183.9 to 276.5 (249.1 to 374.6)	-
M22 × 1.5	185.4 to 305.5 (251.1 to 413.8)	-	267.8 to 401.8 (362.8 to 544.3)	-
* M22 × 2.5	160.7 to 241.7 (217.7 to 327.5)	-	249.7 to 374.2 (338.3 to 507.0)	-
M24 × 2	264.9 to 398.2 (358.9 to 539.4)	-	317.8 to 524.8 (430.5 to 711.0)	-
* M24 × 3	249.7 to 374.2 (338.3 to 507.0)	-	299.7 to 448.8 (406.0 to 608.0)	-

Note:

Items indicated with an asterisk mark shall be used to internal threads of soft material such as casting or the like.

ft·lbf (N·m)

Strength category	8.8		9.8 9T	
Shape of bolt head	Hexagon head bolt	Flange bolt	Hexagon head bolt	Flange bolt
M6 × 1	4.1 to 8.3 (5.6 to 11.2)	4.9 to 9.0 (6.6 to 12.2)	-	-
M8 × 1.25	9.9 to 19.0 (13.4 to 25.7)	11.3 to 21.0 (15.3 to 28.4)	12.3 to 22.4 (16.7 to 30.4)	13.4 to 24.8 (18.1 to 33.6)

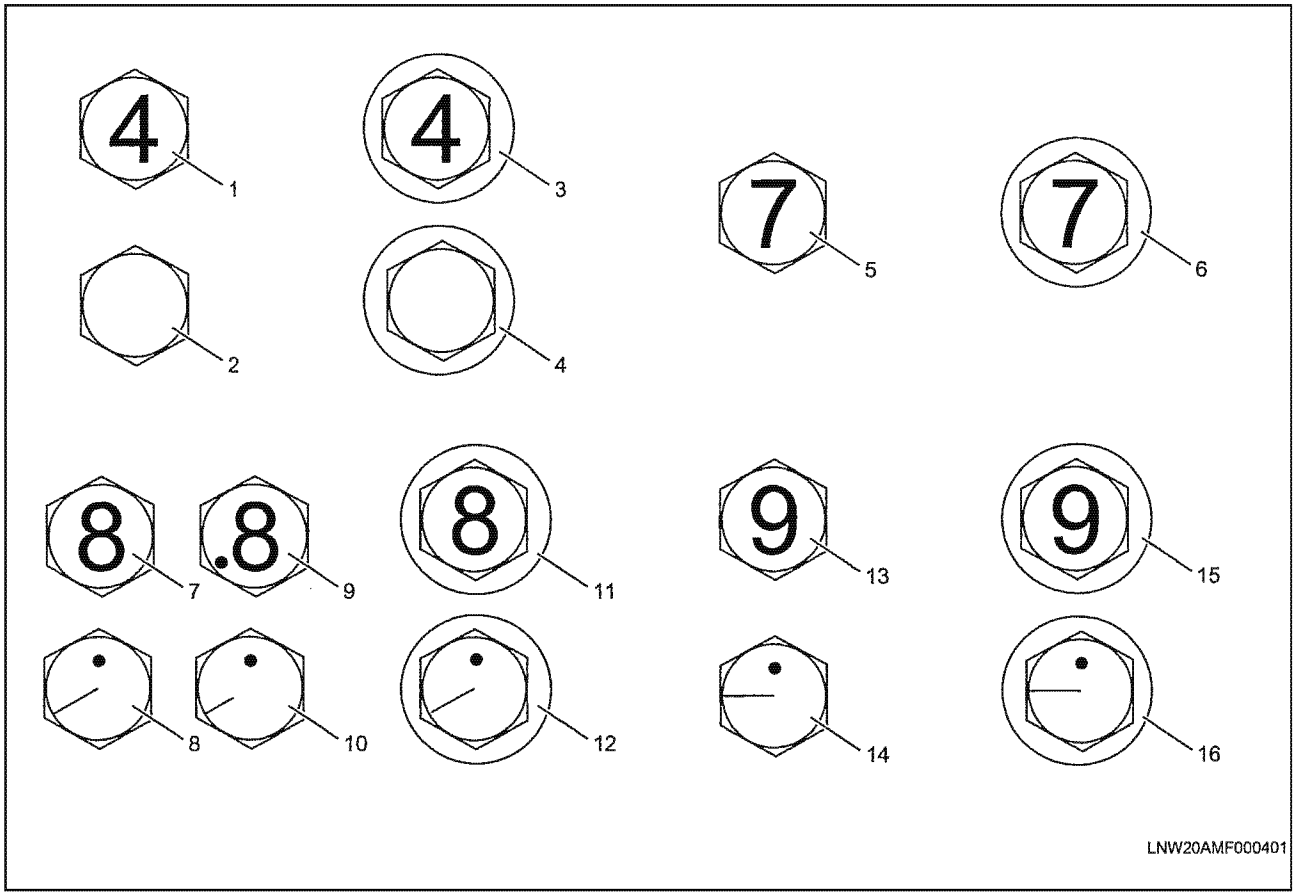
ft·lbf (N·m)

Strength category	8.8		9.8 9T	
Shape of bolt head	Hexagon head bolt	Flange bolt	Hexagon head bolt	Flange bolt
M10 × 1.25	23.1 to 38.8 (31.3 to 52.5)	26.1 to 44.1 (35.4 to 59.8)	27.5 to 46.4 (37.3 to 62.8)	31.2 to 52.0 (42.3 to 70.5)
* M10 × 1.5	23.1 to 37.9 (31.3 to 51.4)	25.5 to 42.4 (34.5 to 57.5)	26.8 to 44.1 (36.3 to 59.8)	29.6 to 49.4 (40.1 to 66.9)
M12 × 1.25	51.2 to 76.8 (69.3 to 104.0)	57.4 to 86.0 (77.7 to 116.5)	55.7 to 84.0 (75.5 to 113.8)	62.7 to 94.1 (85.0 to 127.5)
* M12 × 1.75	47.8 to 70.9 (64.8 to 96.1)	52.7 to 79.1 (71.4 to 107.2)	52.9 to 78.9 (71.6 to 106.9)	58.7 to 88.0 (79.5 to 119.2)
M14 × 1.5	78.4 to 117.2 (106.2 to 158.8)	84.8 to 127.2 (114.9 to 172.3)	84.0 to 125.9 (113.8 to 170.6)	91.1 to 136.6 (123.4 to 185.1)
* M14 × 2	74.3 to 110.6 (100.6 to 149.8)	79.9 to 119.7 (108.2 to 162.2)	78.9 to 118.1 (106.9 to 160.0)	85.3 to 127.9 (115.5 to 173.3)
M16 × 1.5	113.9 to 171.6 (154.3 to 232.5)	126.3 to 189.5 (171.1 to 256.7)	118.1 to 177.4 (160.0 to 240.3)	130.6 to 195.8 (176.9 to 265.3)
* M16 × 2	109.0 to 163.4 (147.6 to 221.4)	120.0 to 180.0 (162.5 to 243.8)	112.9 to 169.4 (153.0 to 229.5)	124.4 to 186.5 (168.5 to 252.7)
M18 × 1.5	164.2 to 246.8 (222.5 to 334.3)	-	169.4 to 254.8 (229.5 to 345.2)	-
* M18 × 2.5	165.1 to 247.6 (223.6 to 335.4)	-	170.1 to 255.6 (230.5 to 346.2)	-
M20 × 1.5	226.9 to 340.8 (307.4 to 461.7)	-	233.9 to 351.1 (316.8 to 475.6)	-
* M20 × 2.5	209.6 to 348.5 (284.0 to 472.1)	-	216.4 to 325.0 (293.2 to 440.3)	-
M22 × 1.5	305.3 to 458.0 (413.6 to 620.5)	-	313.4 to 469.8 (424.6 to 636.5)	-
* M22 × 2.5	284.7 to 426.7 (385.7 to 578.0)	-	291.0 to 437.2 (394.2 to 592.3)	-
M24 × 2	362.3 to 598.3 (490.8 to 810.5)	-	409.0 to 613.1 (554.1 to 830.6)	-
* M24 × 3	341.6 to 511.6 (462.8 to 693.1)	-	384.4 to 576.9 (520.7 to 781.6)	-

Note:

Items indicated with an asterisk mark shall be used to internal threads of soft material such as casting or the like.

Indication of standard bolt head on engine



Name

1. Hexagon head bolt (4.8, 4T)
2. Hexagon head bolt (4.8, 4T)
3. Flange bolt (4.8, 4T)
4. Flange bolt (4.8, 4T)
5. Hexagon head bolt (7T)
6. Flange bolt (7T)
7. Hexagon head bolt (Thermal refining 8.8)
8. Hexagon head bolt (Thermal refining 8.8)
9. Hexagon head bolt (Non-thermal refining 8.8)
10. Hexagon head bolt (Non-thermal refining 8.8)
11. Flange bolt (8.8)
12. Flange bolt (8.8)
13. Hexagon head bolt (9.8, 9T)
14. Hexagon head bolt (9.8, 9T)
15. Flange bolt (9.8, 9T)
16. Flange bolt (9.8, 9T)

Flare nut

	Diameter of pipe	Tightening torque (ft·lbf (N·m)) (for medium and large-sized vehicles)	Flare nut width across flats (in.(mm))	
			Old	New
Tightening torque for flare nut (service standard value)	ø4.76 mm	9.4 to 13.7 (12.8 to 18.6)	0.6 (14)	0.6 (14)
	ø6.35 mm	17.3 to 36.2 (23.5 to 49)	0.7 (17)	0.7 (17)
	ø8.0 mm	17.3 to 36.2 (23.5 to 49.0)	0.7 (19)	0.7 (17)
	ø10.0 mm	32.6 to 68.8 (44.1 to 93.2)	0.9 (22)	0.7 (19)
	ø12.0 mm	43.4 to 101.3 (58.8 to 137.3)	1.1 (27)	0.9 (24)
	ø15.0 mm	57.9 to 115.8 (78.5 to 156.9)	1.2 (30)	1.2 (30)

Taper thread for connector (brass)

ft·lbf (N·m)

Size	PT (R) 1/8	PT (R) 1/4	PT (R) 3/8	PT (R) 1/12
Tightening torque	1.5 to 10.9 (2.0 to 14.7)	3.6 to 11.6 (4.9 to 15.7)	7.2 to 12.3 (9.8 to 16.7)	7.2 to 13.1 (9.8 to 17.7)

Type of special tool

A. Basic tool

Be sure to use this "standard tool" at the time of servicing.

B. Recommended tool

The general-purpose tool available in the market can be used at the time of servicing. However, use this "recommended tool" as much as possible in order to maintain efficiency and safety of operation.

C. Setting tool

Although it may reduce efficiency of servicing, the general-purpose tool available in the market can be used as a substitute of "setting tool".

CHAPTER 4

ENGINE SERVICING PROCEDURE

For information on how to service the engine,
refer to "ISUZU 4JJ1X WORK SHOP MANUAL" attached on this manual.

CHAPTER 5

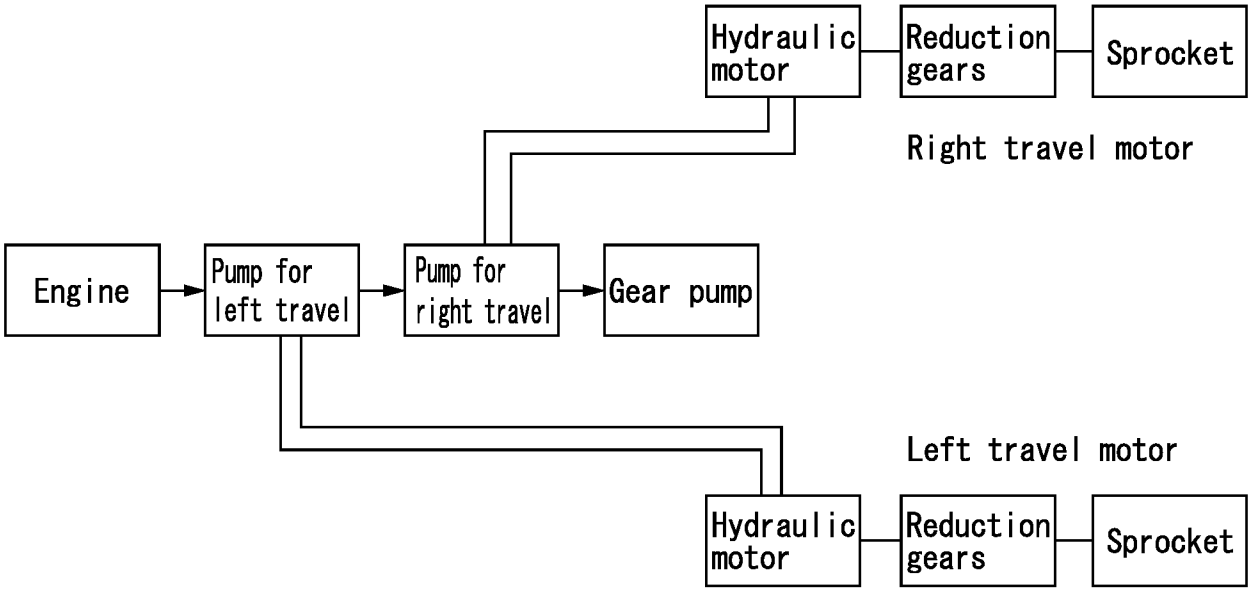
STRUCTURE AND OPERATING PRINCIPLES

5-1. Components and Names.....5-1-1
5-2. Power Transmission Mechanism 5-1-1
5-3. Electrical Equipment of the Machine 5-3-1
5-3-1. Parts Layout of Electrical Equipment.....5-3-1
5-4. Descriptions of Engine Start/Stop Circuit 5-4-1
5-5. Descriptions of Charging Circuit and Power Generating Circuit.....5-4-1
5-6. Parts Layout of the Hydraulic Equipment 5-6-1

5-1. Components and Names

5-2. Power Transmission Mechanism

The engine drives the hydraulic pump, and its discharge oil drives the hydraulic motor. The closed circuit is configured so that the return oil from the hydraulic motor directly goes back to the hydraulic pump.

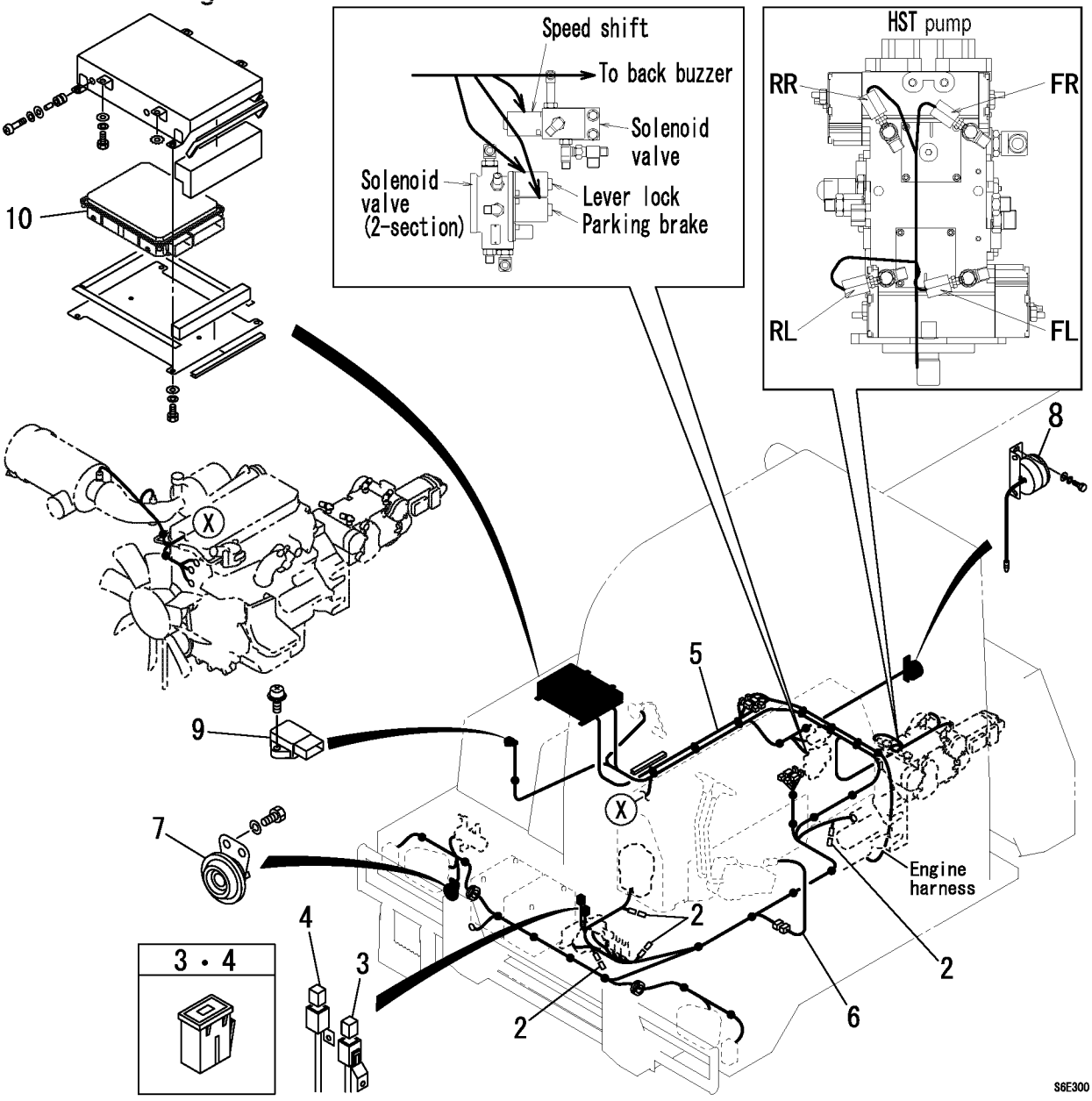


S6E200

5-3. Electrical Equipment of the Machine

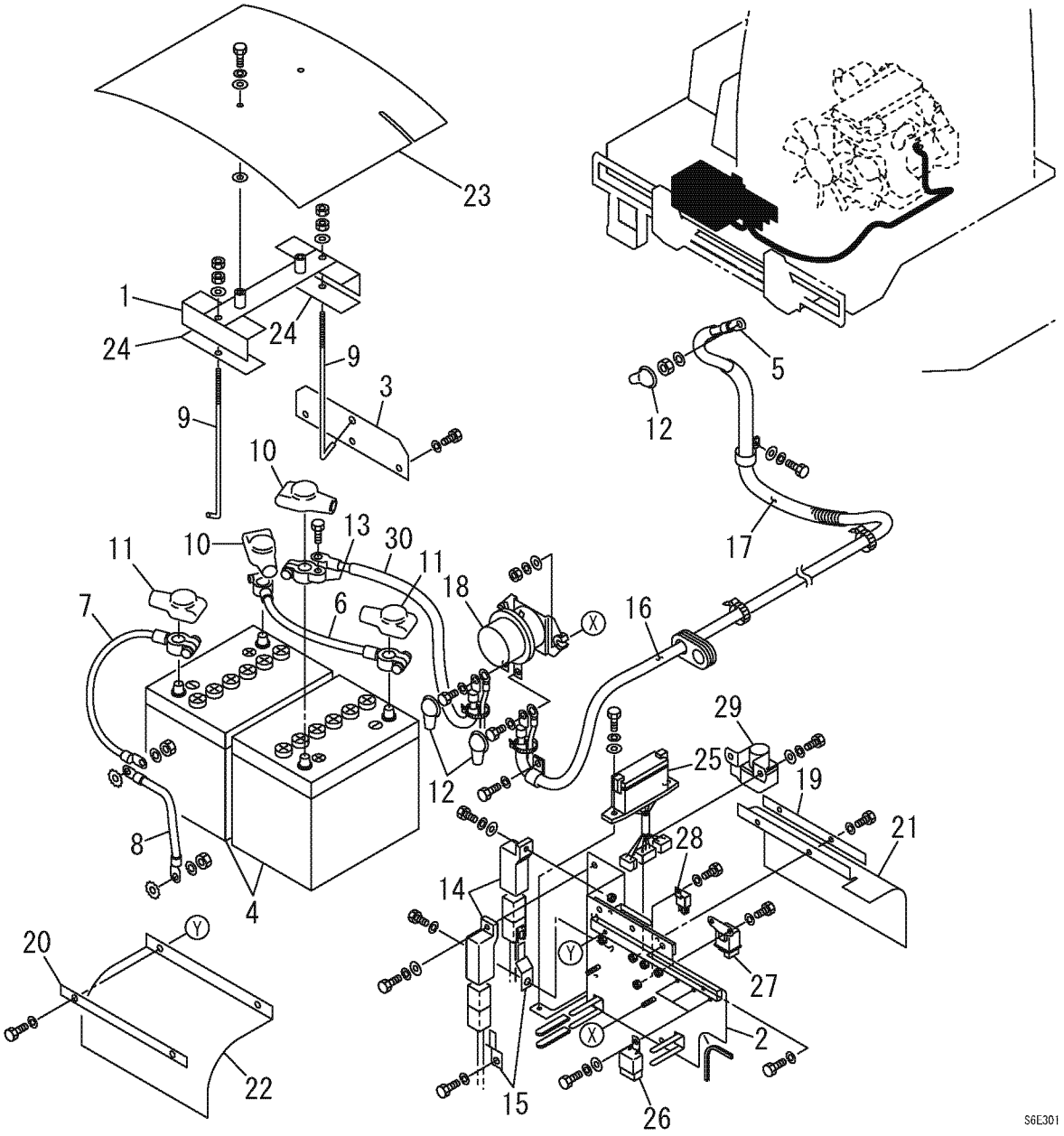
5-3-1. Parts Layout of Electrical Equipment

1. Electrical wiring



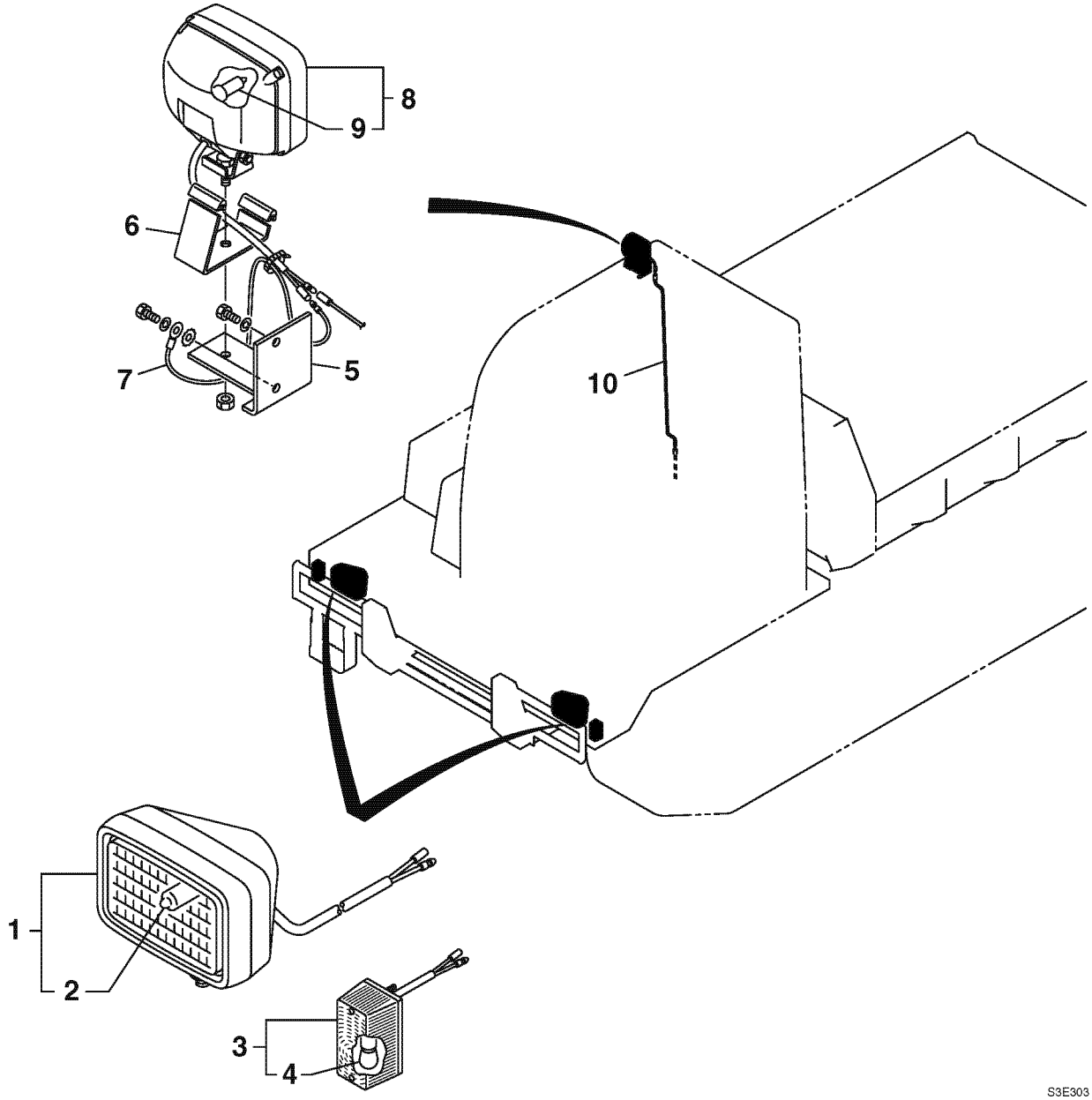
No.	Part name	No.	Part name
1	Wire harness	6	Wire harness
2	Diode	7	Horn
3	Fusible link	8	Back alarm
4	Fusible link	9	Atmospheric pressure sensor
5	Wire harness	10	ECM

2. Battery



No.	Part name	No.	Part name	No.	Part name
1	Battery clamp	11	Terminal cover	21	Rubber plate
2	Bracket	12	Terminal cap	22	Rubber plate
3	Bracket	13	Battery terminal	23	Sheet
4	Battery	14	Water cover	24	Rubber plate
5	Battery cable	15	Clip	25	Fuse box
6	Battery cable	16	Corrugated tube	26	CA relay
7	Battery ground cable	17	Spiral tube	27	Glow relay
8	Battery ground cable	18	Battery relay	28	Main relay
9	Hook bolt	19	Plate	29	Starter relay
10	Terminal cover	20	Plate	30	Battery cable

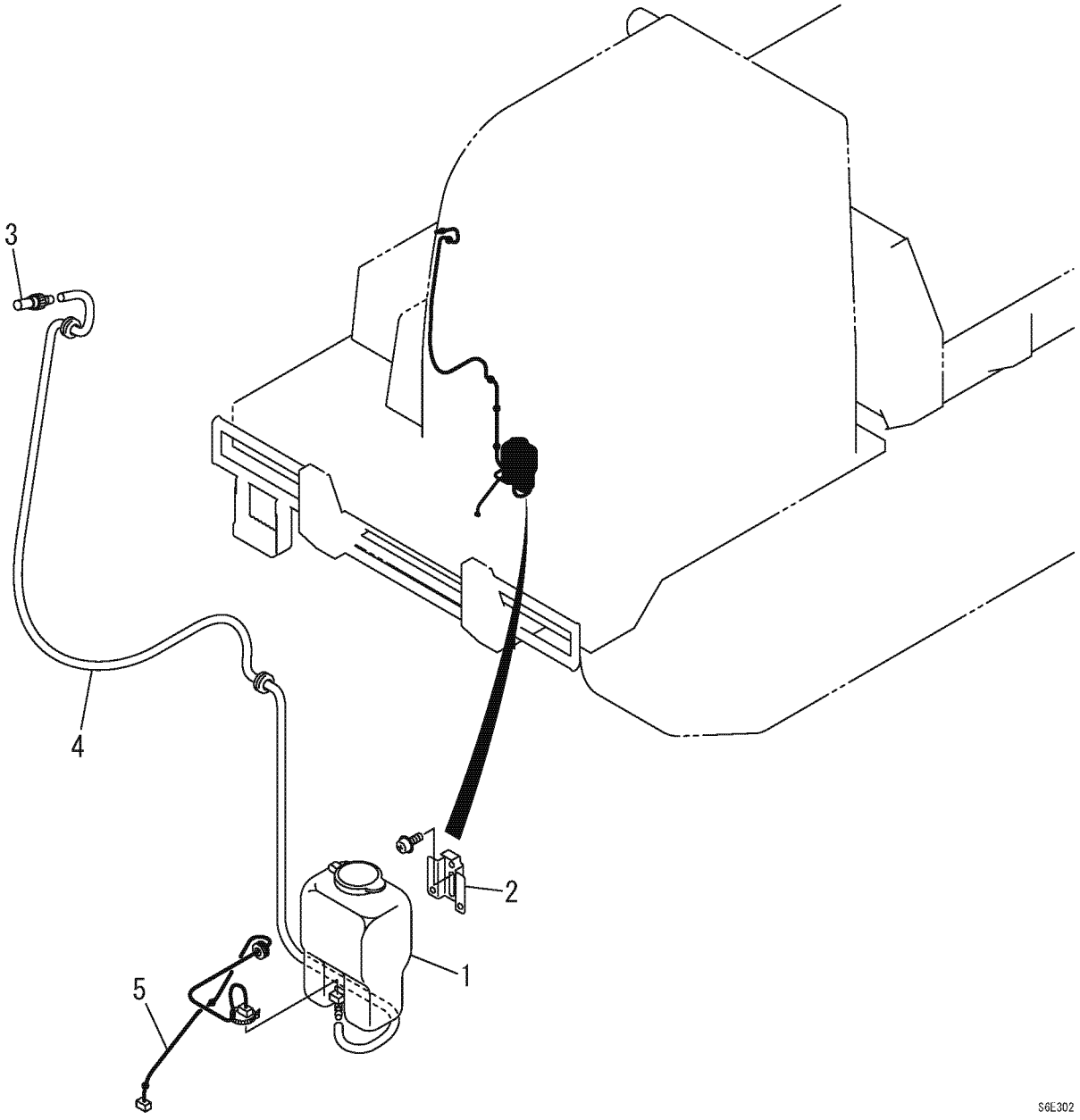
3. Headlights, flasher & working lamp



S3E303

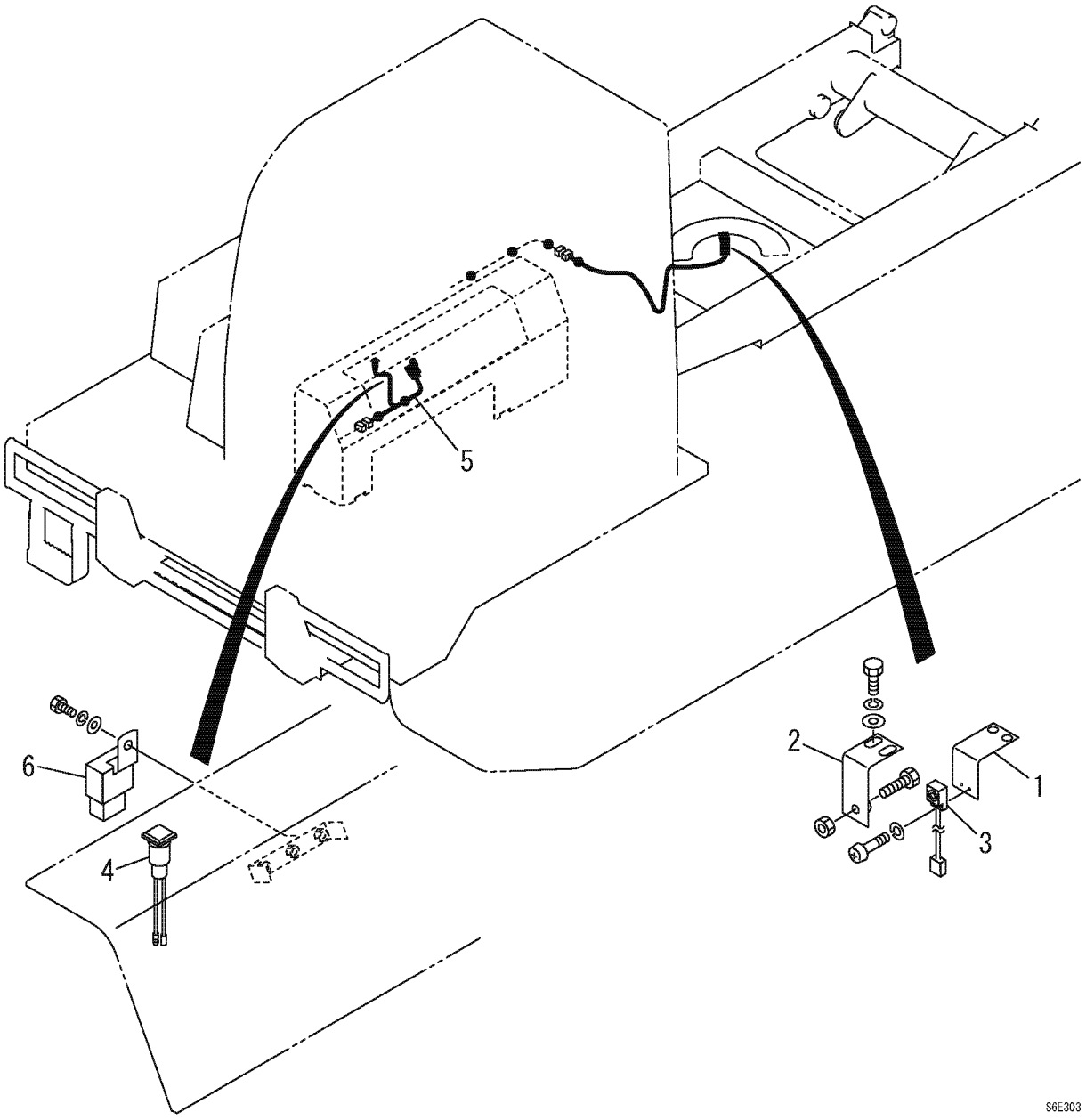
No.	Part	No.	Part
1	Headlight	6	Plate
2	Bulb	7	Wire harness
3	Flasher	8	Working lamp
4	Bulb	9	Bulb
5	Plate	10	Wire harness

4. Windshield washer



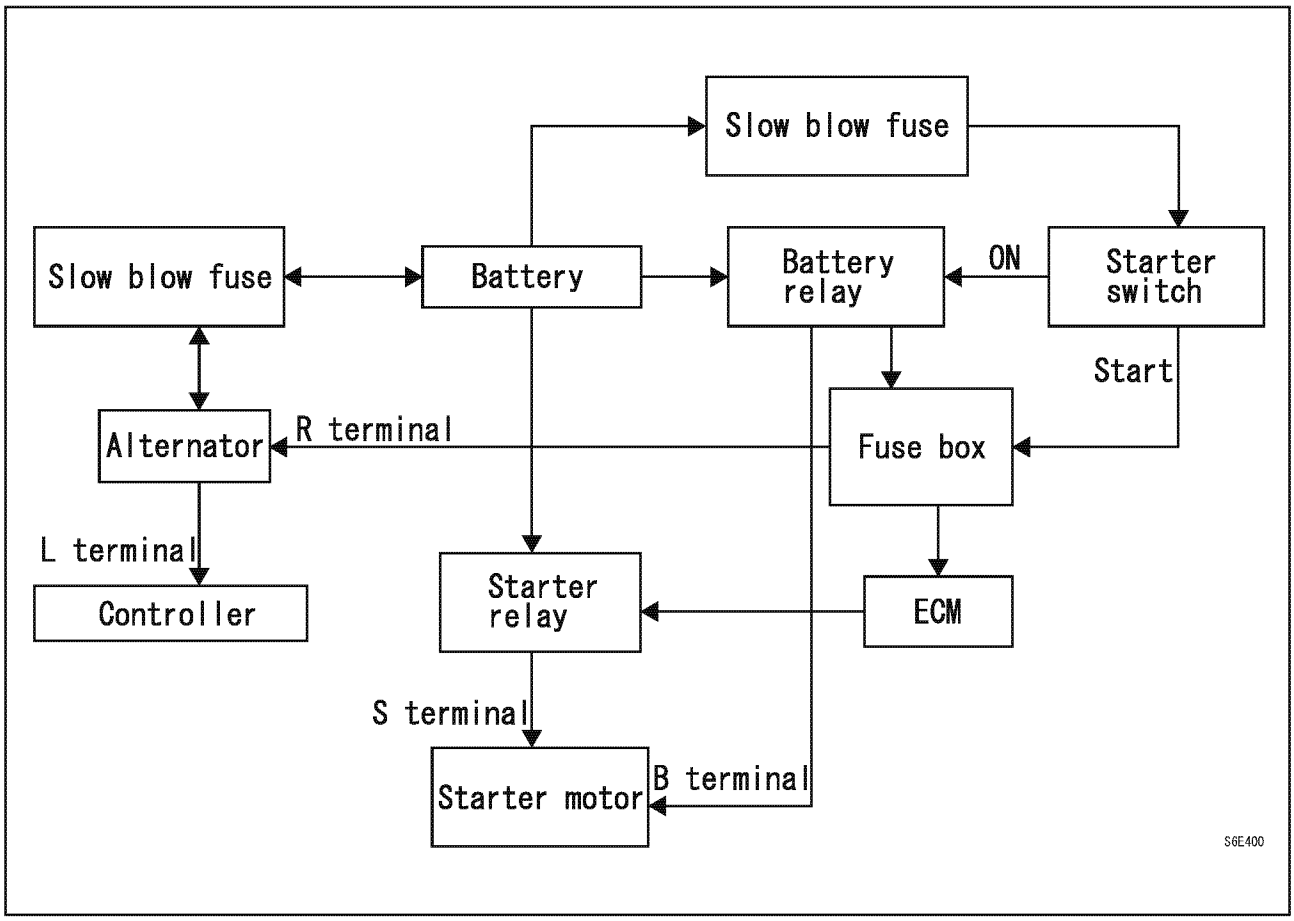
No.	Part
1	Washer tank
2	Bracket
3	Nozzle
4	Washer hose
5	Wire harness

5. Wagon center indicating lamp (for th swing wagon type)



No.	Part	No.	Part
1	Bracket	5	Wire harness
2	Bracket	6	Relay
3	Proximity switch		
4	Wagon center indicating lamp		

5-4. Explanation of starting and stopping engine circuit



1. Starting the engine

When the starter switch is turned to the "ON" position from the "OFF" position, the battery relay is connected and current flows to the ECM from the battery through the battery relay and fuse box. As a result, the fuel pipe of fuel injection pump opens.

When the starter switch is turned to the "START" position from the "ON" position, current flows to the ECM from the starter switch through the fuse box. Detecting this current, the ECM operates the starter relay and send current to the S terminal of starter motor. As a result, the starter motor rotates to start the engine.

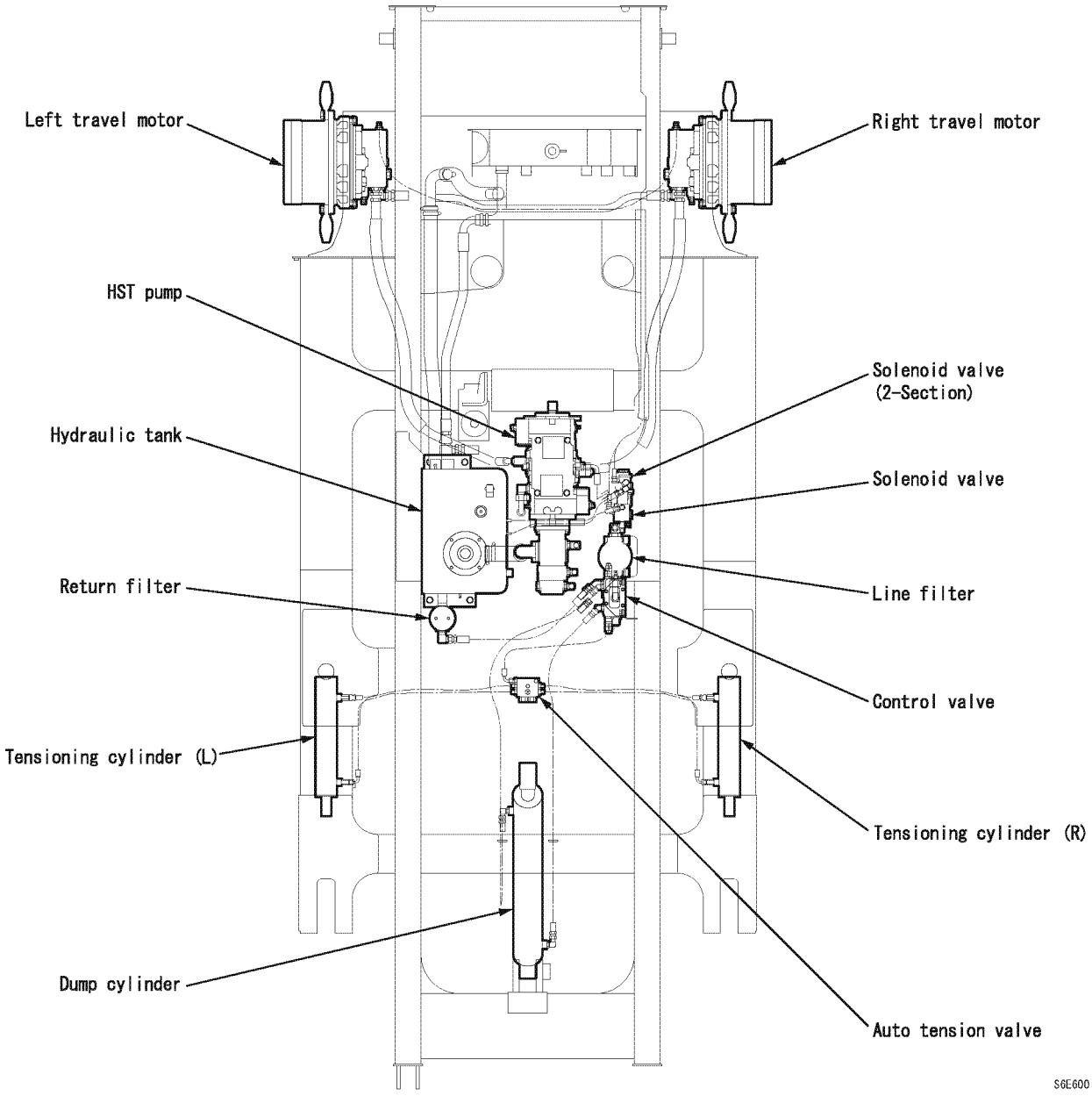
2. Stopping the engine

When the starter switch is turned to the "OFF" position from the "ON" position, the fuel pipe of fuel injection pump is closed by the ECM to stop the engine.

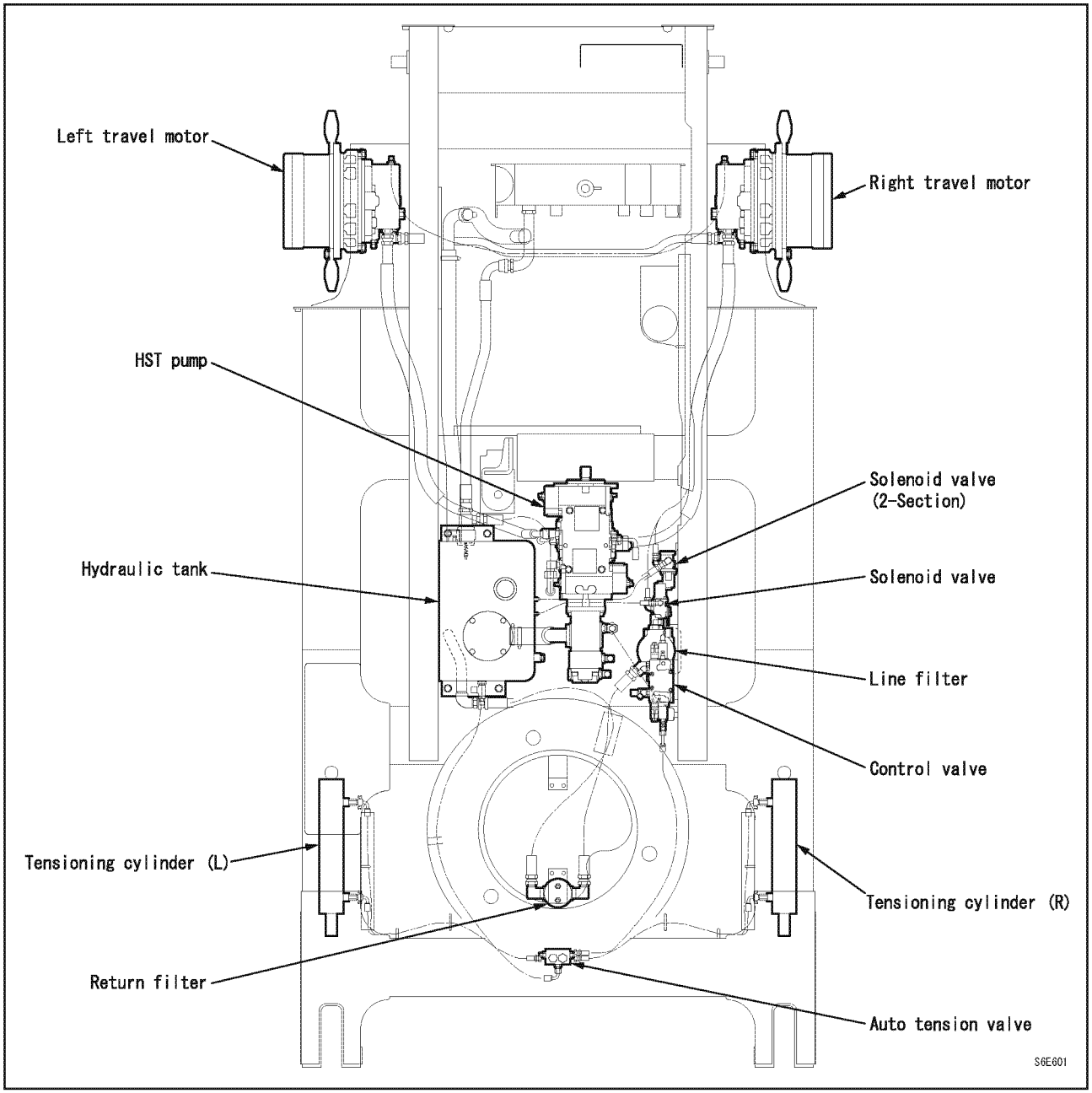
5-5. Explanation of charging and generation

When the engine starts and its speed increases, the generator starts generation. At this time, the signal from the generator inputs the controller through the L terminal.
On the other hand, the generation pressure from the generator charges the battery through the fusible link.

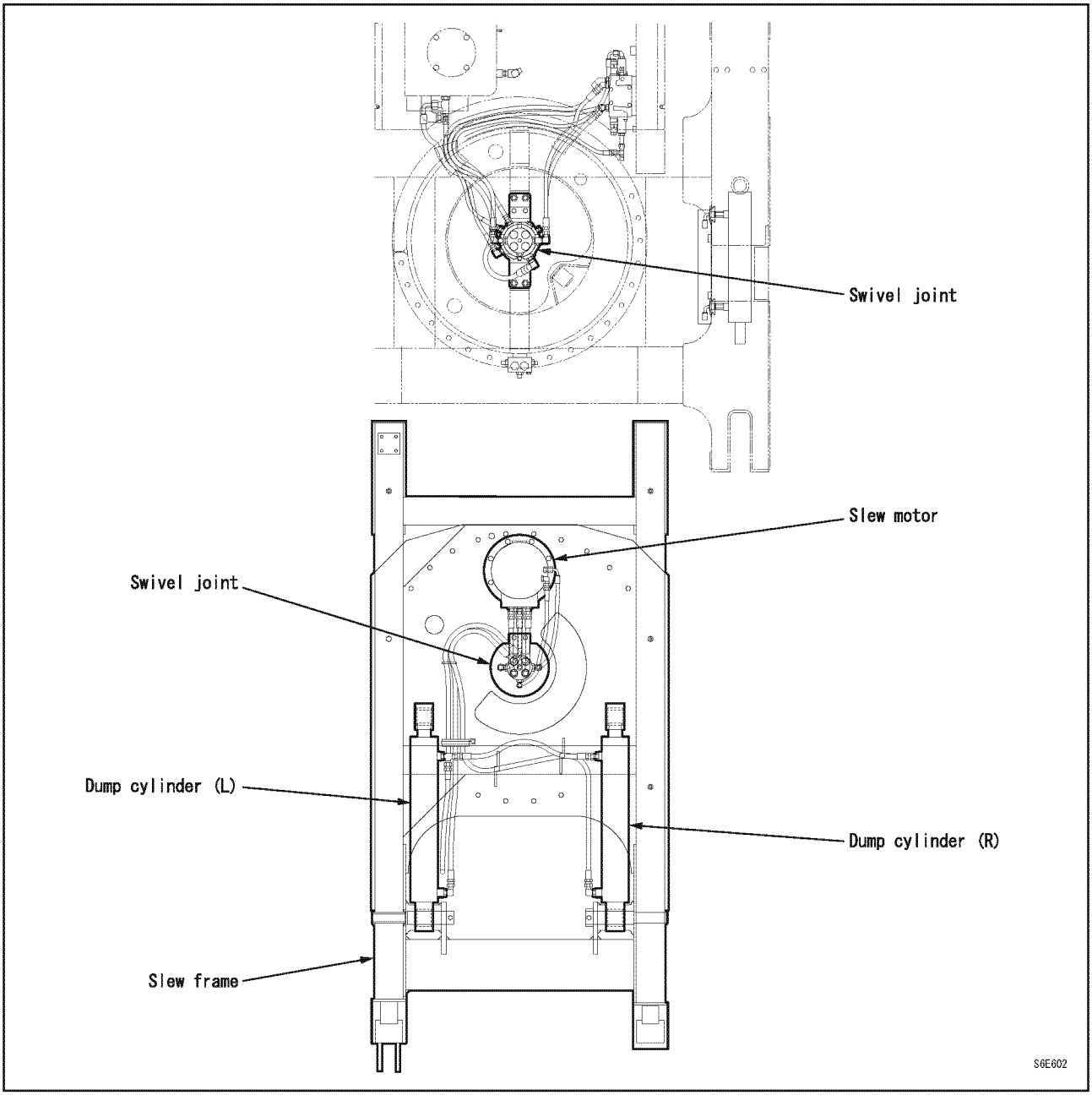
5-6. Parts Layout of the Hydraulic Equipment



Swing type


Left travel motor
Right travel motor
HST pump
Solenoid valve
(2-Section)
Hydraulic tank
Solenoid valve
Line filter
Control valve
Tensioning cylinder (L)
Tensioning cylinder (R)
Return filter
Auto tension valve
S6E601

Swing dump


Swivel joint
Slew motor
Swivel joint
Dump cylinder (L)
Dump cylinder (R)
Slew frame
S6E602

CHAPTER 6

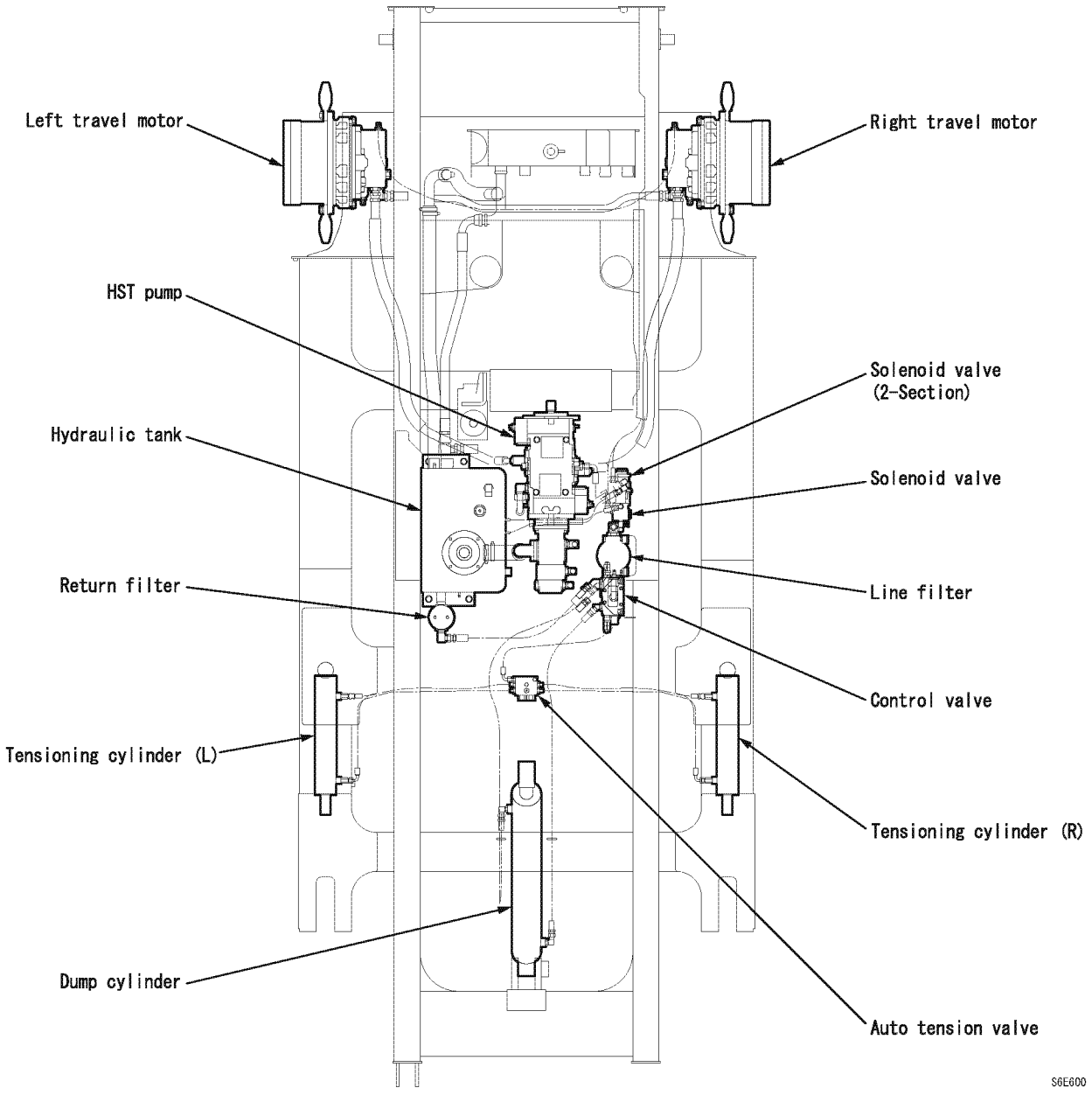
HYDRAULIC SYSTEM

6-1. Outline 6-1-1
6-3. Hydraulic Pump 6-3-1
6-4. Gear Pump 6-4-1
6-5. Travel Motor 6-5-1
6-6. Swing Motor 6-6-1
6-7. Control Valve 6-7-1
6-8. Remote Control Valve 6-8-1
6-9. Swivel Selector 6-9-1
6-10. Swivel Joint 6-10-1
6-11. Dump Cylinder (Standard Type) 6-11-1
6-12. Dump Cylinder (Swing Wagon Type) 6-12-1
6-13. Pressure Adjustments 6-13-1
6-14. Precautions in Case of Hydraulic Source Failures 6-14-1

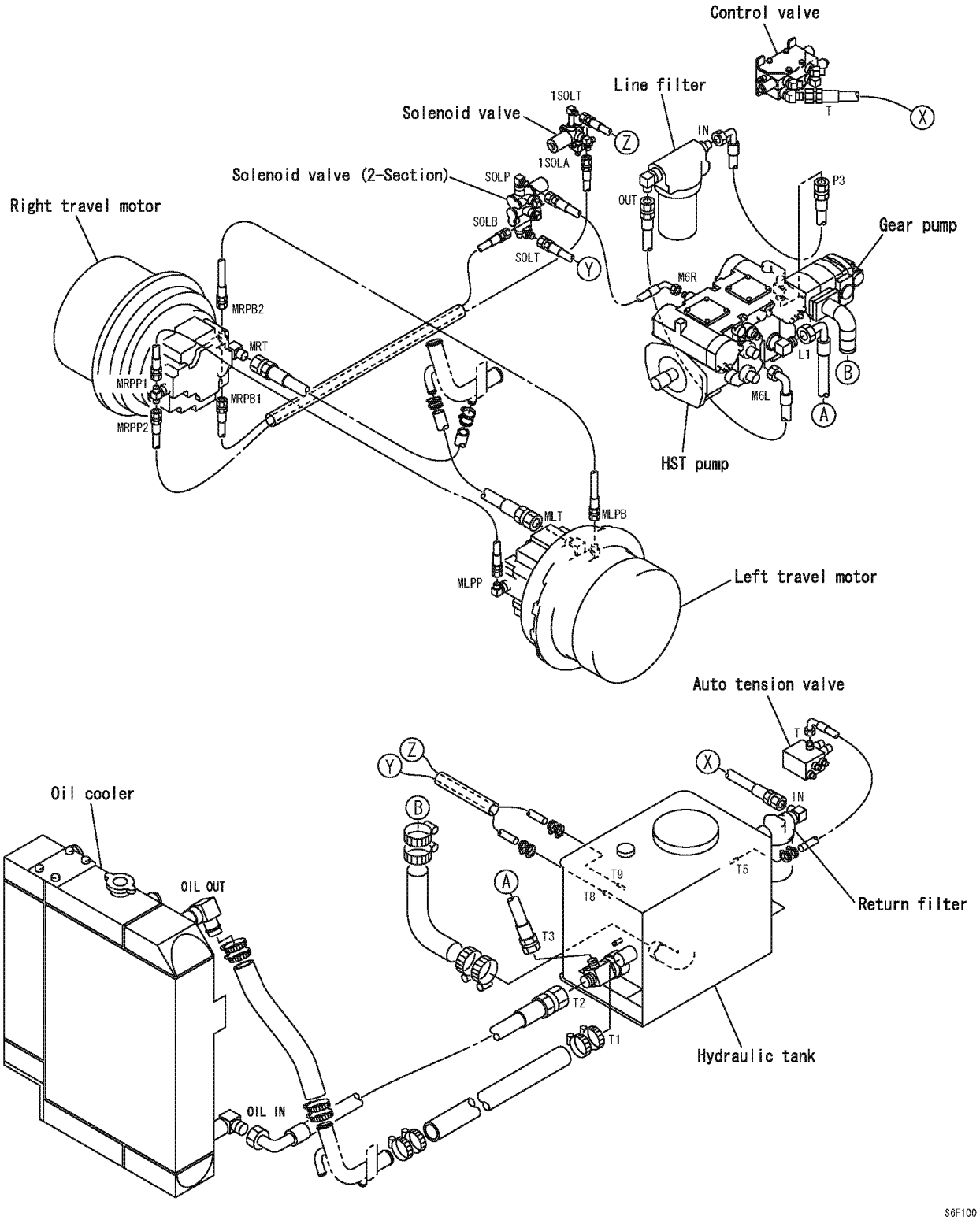
6-1. Outline

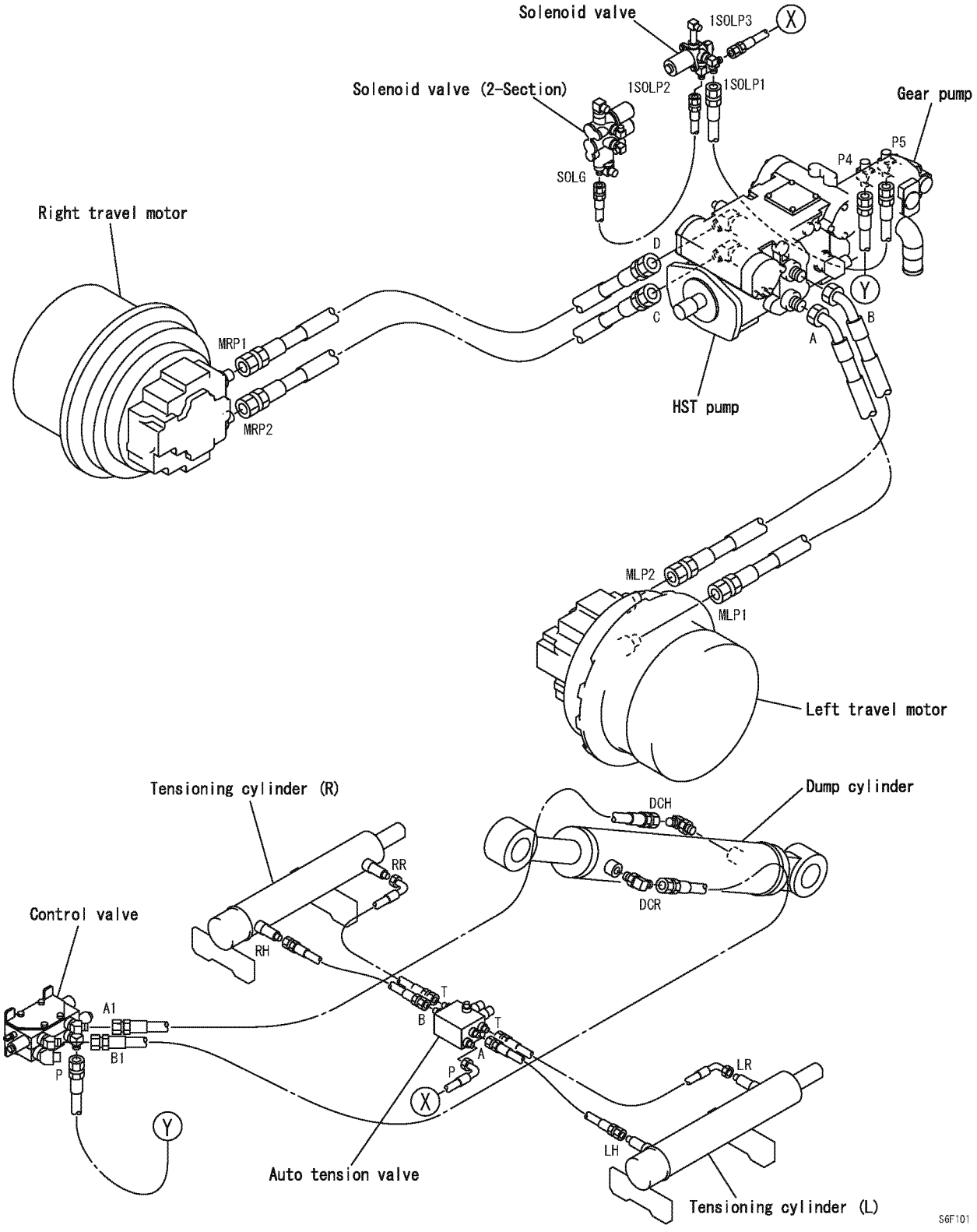
This machine employs a hydrostatic transmission (HST) system, which controls the pilot valve to vary the pump discharge rate to smoothly change the travel motor speed from 0 through the maximum. Two swash plate type variable displacement pumps, each for right and left travel motors, are installed as a tandem piston pump. The charge pump and the dump-operating pump are gear pumps, and the right and left travel motors are swash plate piston motors.

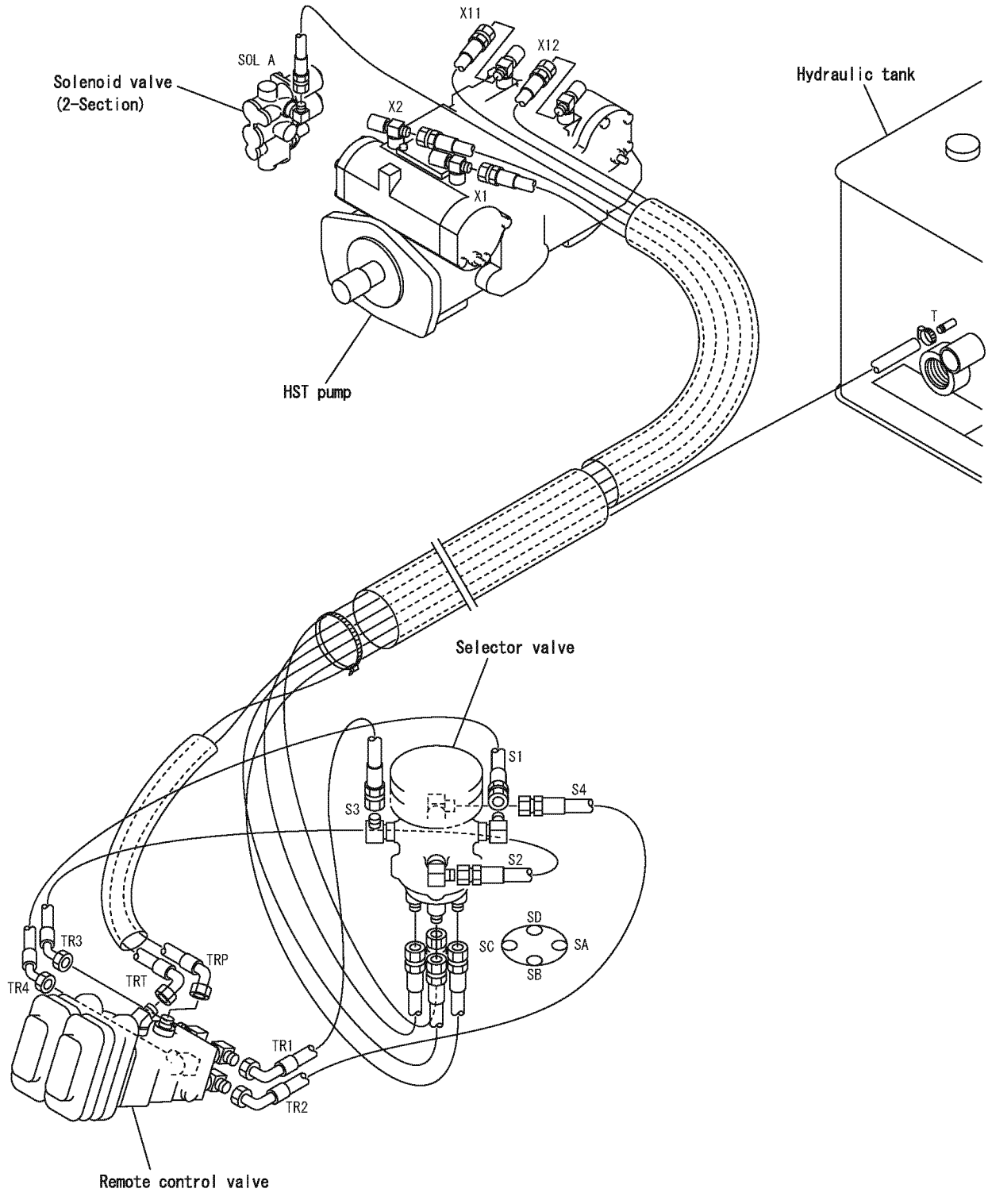
Layout of the hydraulic system



1. Hydraulic piping

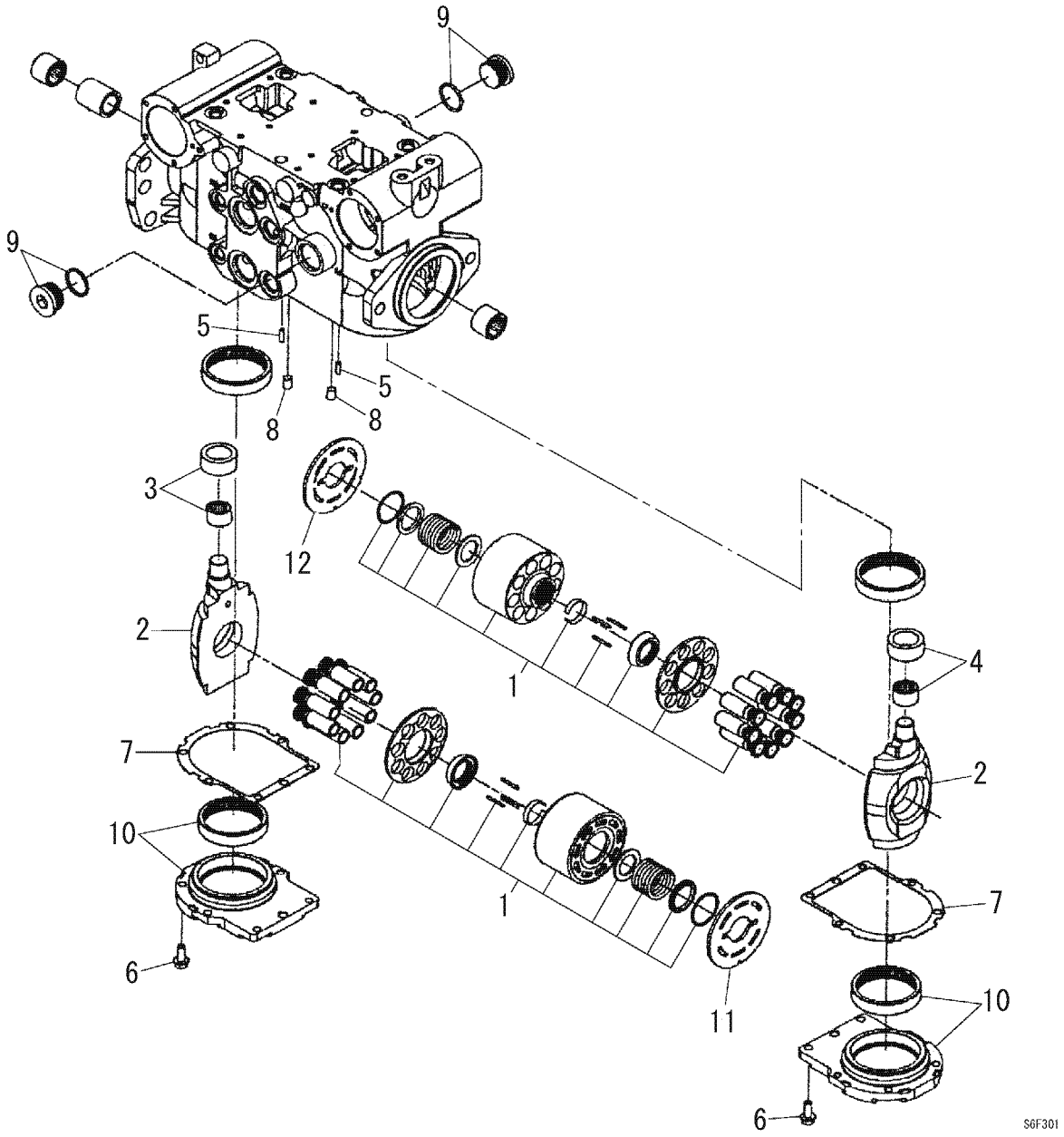



Solenoid valve
1SOLP3
X
Solenoid valve (2-Section)
1SOLP2
1SOLP1
Gear pump
P5
P4
SOLG
Right travel motor
D
C
Y
B
A
MRP1
MRP2
HST pump
MLP2
MLP1
Left travel motor
Tensioning cylinder (R)
Dump cylinder
DCH
RR
DCR
Control valve
RH
T
A1
B
T
B1
A
P
P
X
Y
LR
LH
Auto tension valve
Tensioning cylinder (L)
S6F101

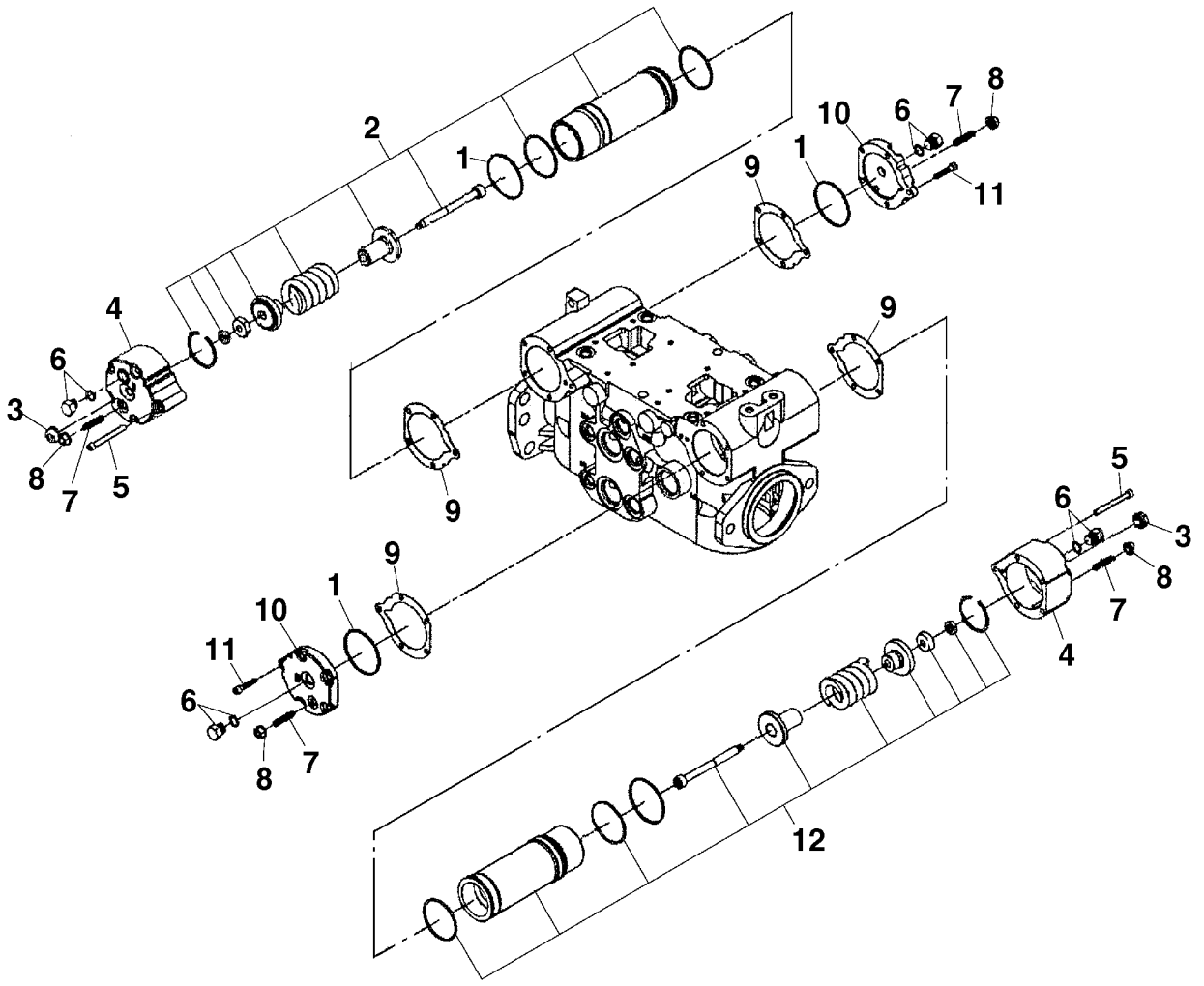

X11
X12
SOL A
Solenoid valve
(2-Section)
X2
X1
Hydraulic tank
T
HST pump
Selector valve
S1
S4
S3
S2
SD
SC
SA
SB
TR3
TRP
TR4
TRT
TR1
TR2
Remote control valve
S6F102

6-3. Hydraulic Pump

1. Construction

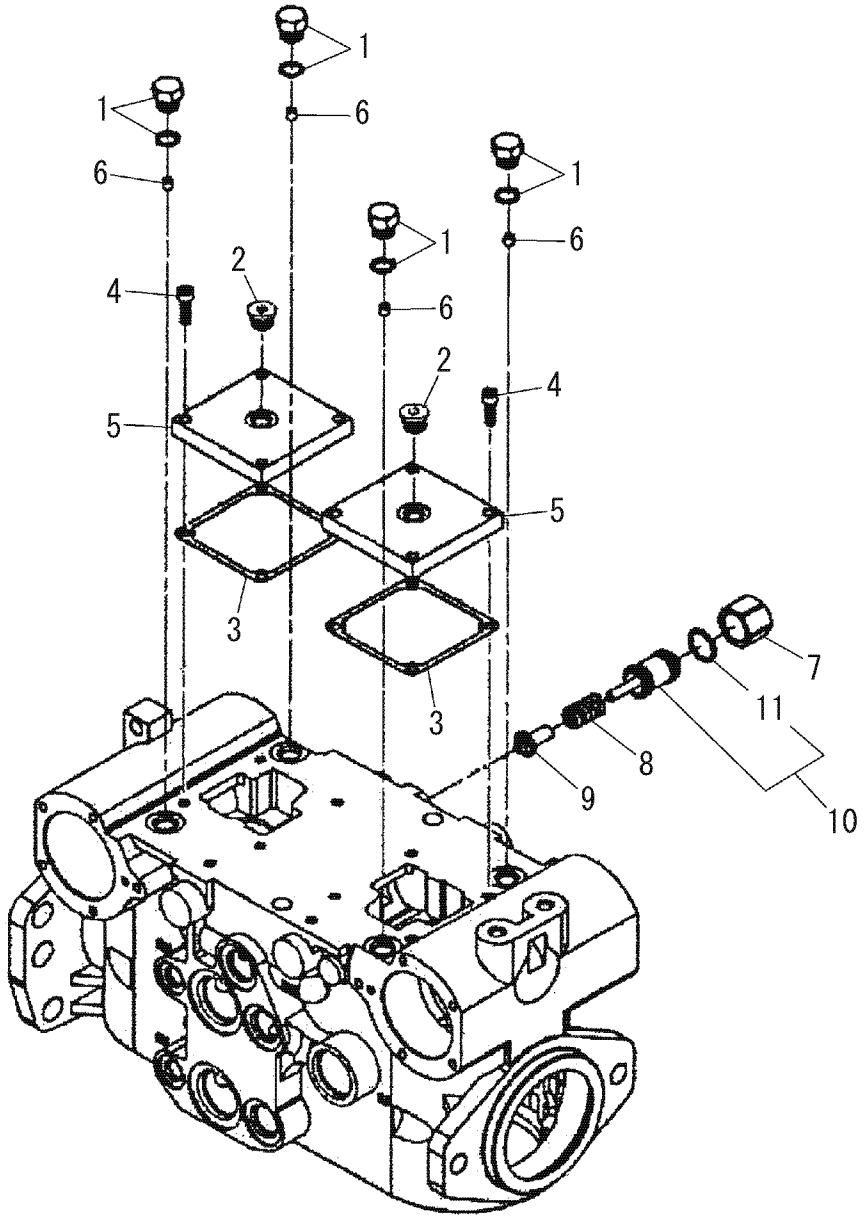


No.	Part	Q'ty	No.	Part	Q'ty
1	Cylinder Block Kit	2	7	Gasket	2
2	Swash Plate	2	8	Pin	2
3	Bearing Assy	1	9	Plug Assy	2
4	Bearing Assy	1	10	Cover Assy	2
5	Pin	2	11	Plate	1
6	Screw	12	12	Plate	1



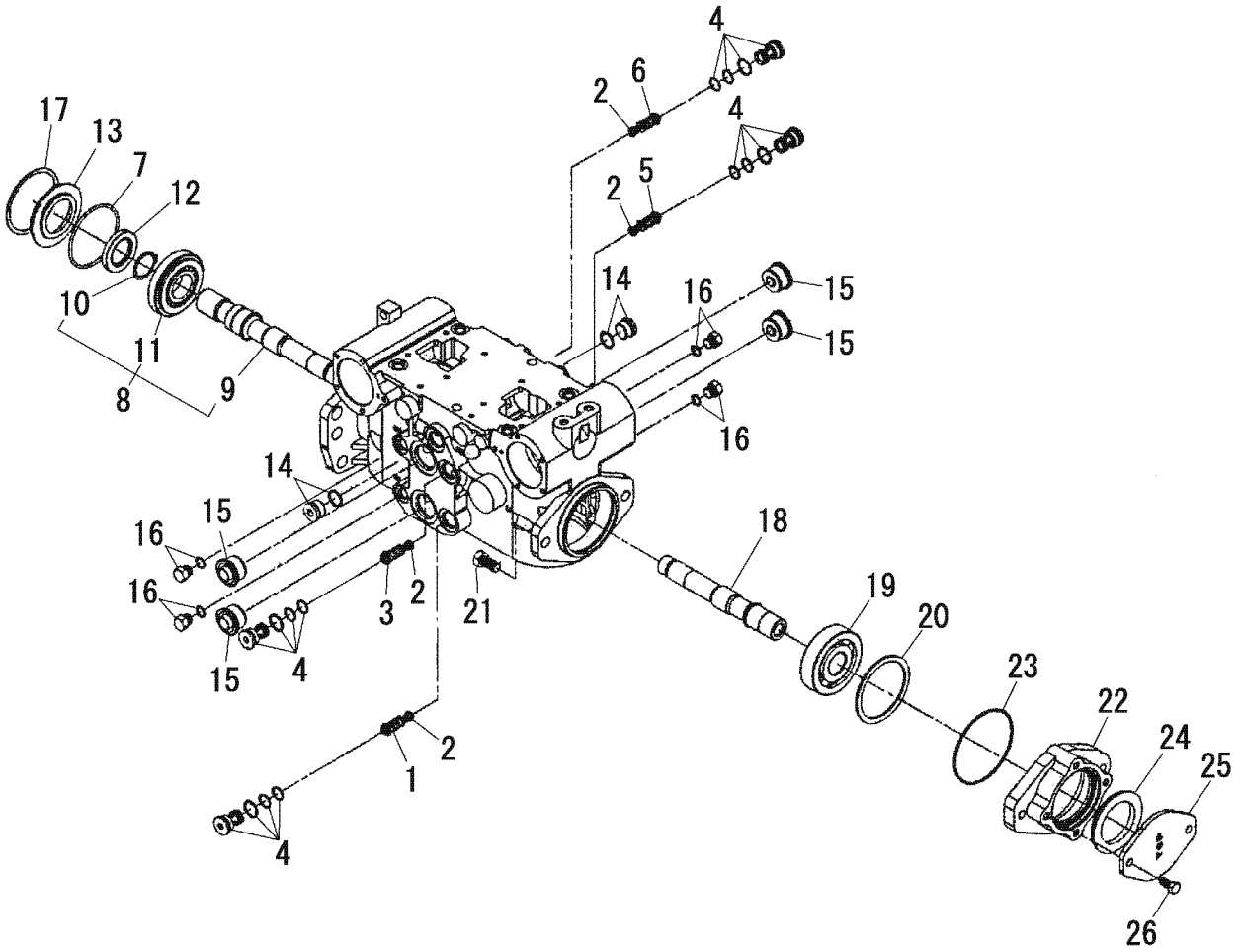
S6F302

No.	Part	Q'ty	No.	Part	Q'ty
1	Back-up ring	4	8	Nut	4
2	Piston assy	1	9	Gasket	4
3	Nut	2	10	Cover	2
4	Cover	2	11	Cap screw	10
5	Cap screw	10	12	Piston assy	1
6	Plug assy	4			
7	Screw	4			



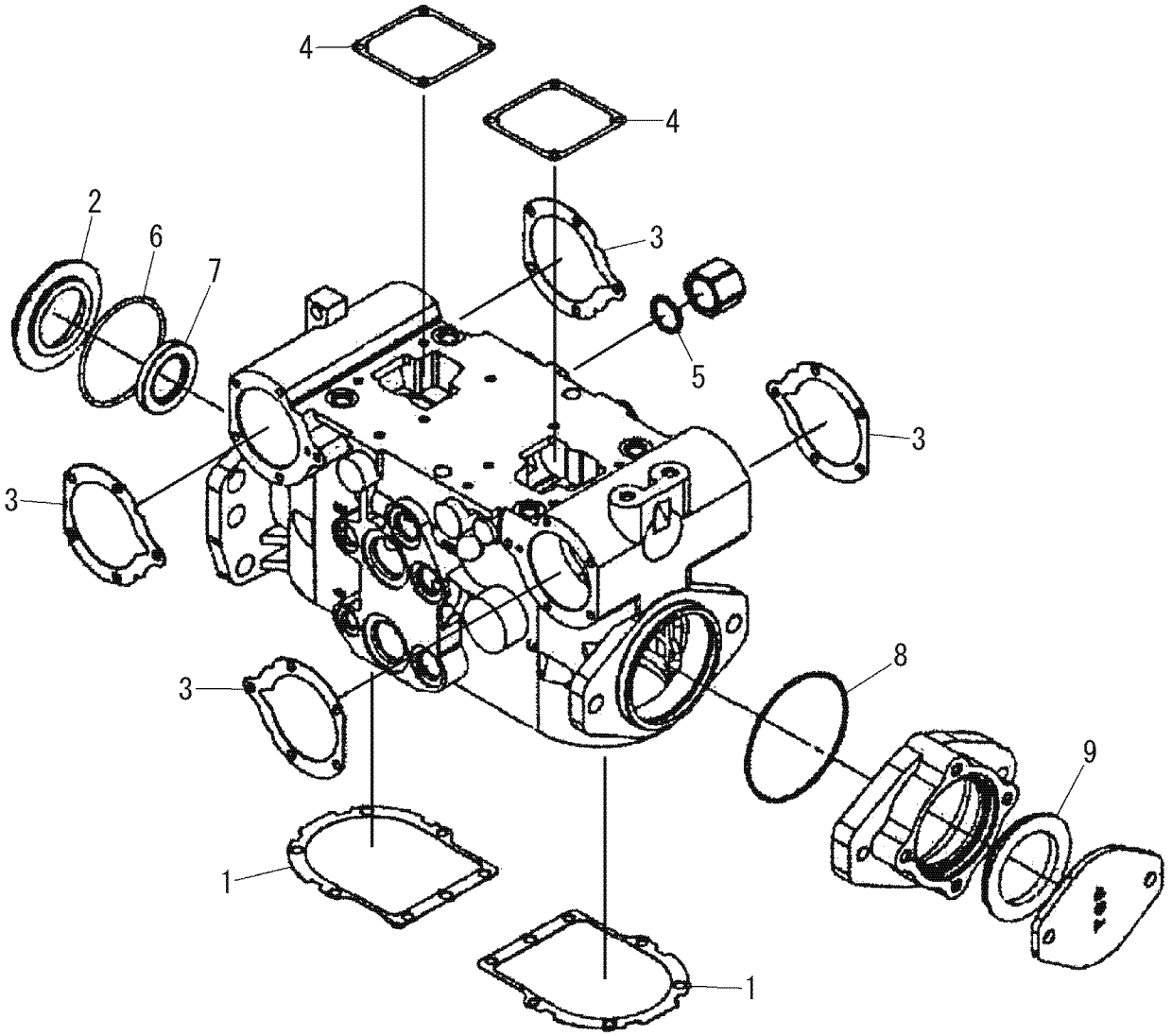
S6F303

No.	Part	Q'ty	No.	Part	Q'ty
1	Plug assy	4	7	Nut	1
2	Plug assy	2	8	Spring	1
3	Gasket	2	9	Poppet	1
4	Cap screw	8	10	Plug	1
5	Cover	2	11	O-ring	1
6	Orifice	2			



S6F304

No.	Part	Q'ty	No.	Part	Q'ty	No.	Part	Q'ty
1	SCR valve assy A (front)	1	10	Snap ring	1	19	Bearing assy	1
2	Spring	4	11	Bearing assy	1	20	Snap ring	1
3	SCR valve assy B (front)	1	12	Oil seal	1	21	Cap screw	2
4	Plug assy	4	13	Carrier seal	1	22	Adapter	1
5	SCR valve assy C (rear)	1	14	Plug	2	23	O-ring	1
6	SCR valve assy D (rear)	1	15	Plug	4	24	Seal	1
7	O-ring	1	16	Plug assy	4	25	Plate	1
8	Shaft assy	1	17	Snap ring	1	26	Cap screw	2
9	Shaft	1	18	Shaft	1			



S6F305

No.	Part	Q'ty	No.	Part	Q'ty
1	Gasket	2	6	O-Ring	1
2	Carrier seal	1	7	Oil Seal	1
3	Gasket	4	8	O-Ring	1
4	Gasket	2	9	Seal	1
5	O-Ring	1			

2. Operation

The pump covered here is a tandem pump for hydrostatic transmission. When combined together with an HST travel motor, the speed of the motor may be controlled from a speed of 0 to the specified maximum, in smooth gradations and without the switching of gears.

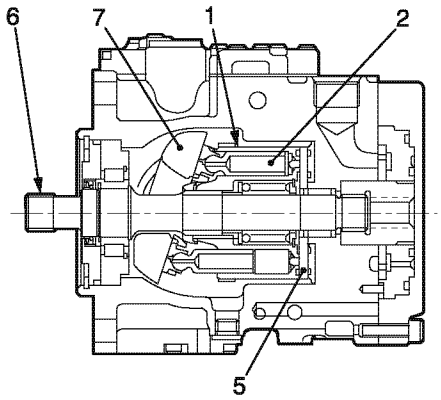
1) Hydraulic pump

Cylinder block (1) has been constructed with nine pistons (2) built in, and the end surface comes in contact with the valve plate (5) containing intake port (3) and outlet port (4). Cylinder block (1) rotates freely and is connected to drive shaft (6) via the spline. Swash plate (7), on the other hand, is connected to the housing and tilted somewhat, and piston (2) is constructed to follow swash plate (7) in its rotation.

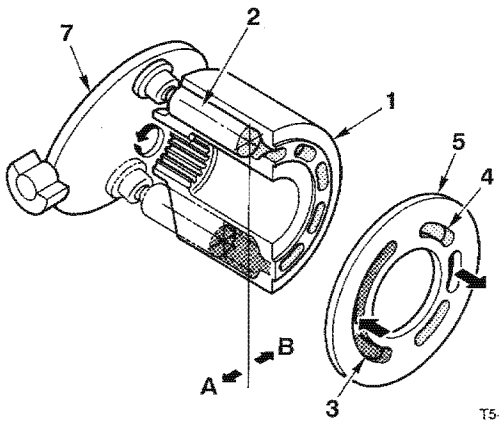
Rotating drive shaft (6) at this point causes cylinder block (1) to rotate, causes piston (2) connection to cylinder block (1) to follow along with swash plate (7) to move in a back -and forth motion, and causes the intake and outlet pumps to begin working.

Thus the nine pistons (2) perform approximately a single intake (A) or outlet (B) sweep for each rotation of cylinder (1), and operating drive shaft (6) in continuous rotations allows you to perform a continuous stream of intake and outlet operations.

Note that since the sweep capacity of piston (2) depends on the degree of tilt of swash plate (7), the tilt of the plate may be changed to modify the total quantity of outlet.



T6D108

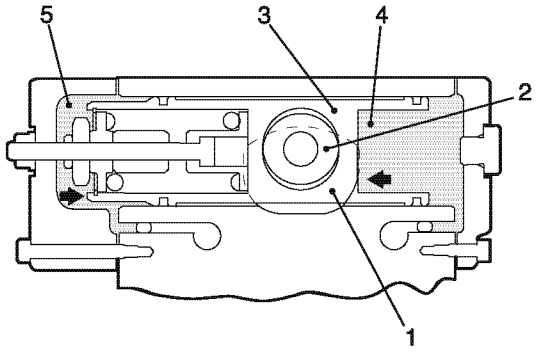


T5-D104

2) Displacement control

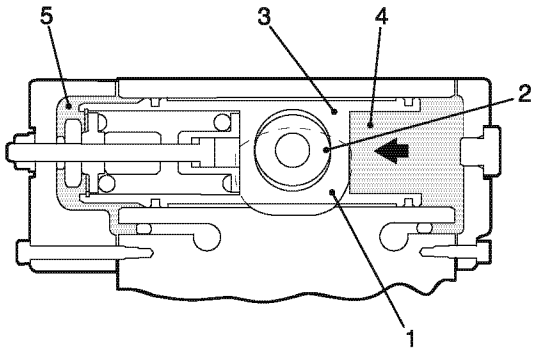
Bearings are attached to both sides of swash plate (1), the swash plate is connected to the housing so that the degree of tilt may be changed, and piston (2) is used to link the swash plate with control cylinder (3).

When the swash plate (1) is at the neutral position, the right and left spring chambers (4 and 5) are connected with the tank circuit, thus the control cylinder (3) stands still at the neutral position.



T6D109

Once directed to chamber (4), the pilot pressure moves control cylinder (3) to the left. Since swash plate (1) is connected by piston (2) to control cylinder (3), the mechanism tilts to match the degree of stroke for control cylinder (3), and the pump begins to exhaust.
Thus the pumping capacity of the pump may be controlled by the pilot pressure to control the speed of the travel motor in smooth gradations and without the switching of gears.



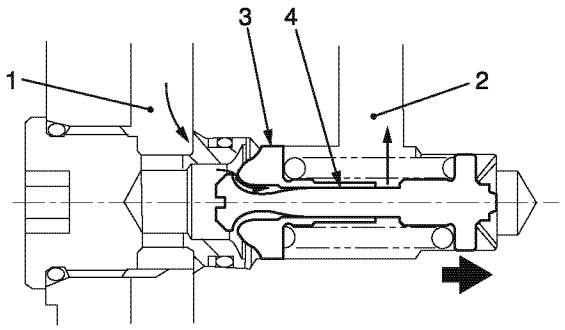
T6D110

3) Charge check and high pressure relief valve assembly

This valve has two functions: a charge check valve and a high-pressure relief valve. The charge check valve function supplies the closed circuit with the oil from the charge pump to replenish the oil flushed into the tank by the flushing valve. The high pressure relief valve function prevents the hydraulic circuit from being damaged by the increased pressure due to the oil supplied from the pump in succession and keeps the hydraulic circuit at an appropriate pressure.

Charge check valve

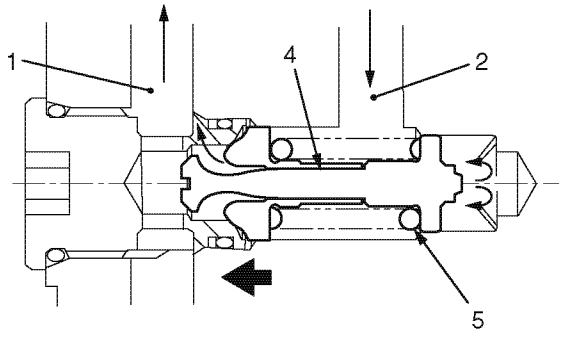
If the pressure in the charge circuit (1) becomes higher than that in the closed circuit (2), a gap is generated between the check valve (4) and the spring holder (3) and so the oil flows into the closed circuit (2).



T6D114

High pressure relief valve

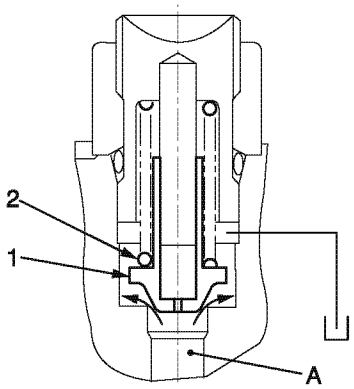
If the pressure in the closed circuit (2) becomes higher than the force exerted by the spring (5), the check valve (4) is moved to the left and so the oil flows into the charge circuit (1).



T6D115

4) Charge relief valve

The charge relief valve keeps the charge supplied from the charge pump at a steady and constant level. The oil from the charge pump reaches chamber A. When the pressure in chamber A increases to the point where it exceeds the force exerted by spring (2) holding down relief valve (1), it moves relief valve (1) and the oil runs out of the tank.



T6D116

3. Disassembly and assembly

OVERVIEW

⚠ Warning

Use of components that do not comply with rework specifications may result in loss of performance, which may constitute a safety hazard. Do not reuse components that don't comply to given specifications: replace with genuine Sauer-Danfoss service parts.

GENERAL INSTRUCTIONS

Follow these general procedures when repairing 4T variable displacement closed circuit pumps.

 *Remove the unit*

Prior to performing major repairs, remove the unit from the vehicle/machine. Chock the wheels on the vehicle or lock the mechanism to inhibit movement. Be aware that hydraulic fluid may be under high pressure and / or hot. Inspect the outside of the pump and fittings for damage. Cap hoses and plug ports after removal to prevent contamination.

 *Keep it clean*

Cleanliness is a primary means of assuring satisfactory pump life, on either new or repaired units. Clean the outside of the pump thoroughly before disassembly. Take care to avoid contamination of the system ports. Cleaning parts using a clean solvent wash and air drying is usually adequate.

As with any precision equipment, keep all parts free of foreign materials and chemicals. Protect all exposed sealing surfaces and open cavities from damage and foreign material. If left unattended, cover the pump with a protective layer of plastic.

 *Lubricate moving parts*

During assembly, coat all moving parts with a film of clean hydraulic oil. This assures that these parts are lubricated during start-up.

 *Replace all O-rings and gaskets*

Sauer-Danfoss recommends you replace all O-rings, seals, and gaskets during repair. Lightly lubricate all O-rings with clean petroleum jelly prior to assembly. Use grease that dissolves in hydraulic fluid.

 *Secure the unit*

For major repair, place the unit in a stable position with the shaft pointing downward. It is necessary to secure the pump while removing and torquing some fasteners.

SAFETY PRECAUTIONS

Always consider safety precautions before beginning a service procedure. Protect yourself and others from injury. Take the following general precautions whenever servicing a hydraulic system.

Unintended machine movement

⚠ Warning

Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. To protect against unintended movement, secure the machine or disable/disconnect the mechanism while servicing.

Flammable cleaning solvents

⚠ Warning

Some cleaning solvents are flammable. To avoid possible fire, do not use cleaning solvents in an area where a source of ignition may be present.

Fluid under pressure

⚠ Warning

Escaping hydraulic fluid under pressure can have sufficient force to penetrate your skin causing serious injury and/or infection. This fluid may also be hot enough to cause burns. Use caution when dealing with hydraulic fluid under pressure. Relieve pressure in the system before removing hoses, fittings, gauges, or components. Never use your hand or any other body part to check for leaks in a pressurized line. Seek medical attention immediately if you are cut by hydraulic fluid.

Personal safety

⚠ Warning

Protect yourself from injury. Use proper safety equipment, including safety glasses, at all times.

SYMBOLS USED IN THIS SECTION


WARNING may result in injury


CAUTION may result in damage to product or property


Reusable part


Non-reusable part, use a new part


Non-removable item


Option – either part may exist


Measurement required


Flatness specification


Parallelism specification


External hex head


Internal hex head


Torx head


O-ring boss port


Pressure measurement / gauge location or specification


Tip, helpful suggestion


Lubricate with hydraulic fluid


Apply grease / petroleum jelly


Apply locking compound


Inspect for wear or damage


Clean area or part


Be careful not to scratch or damage


Note correct orientation


Mark orientation for reinstallation


Torque specification


Press in – press fit

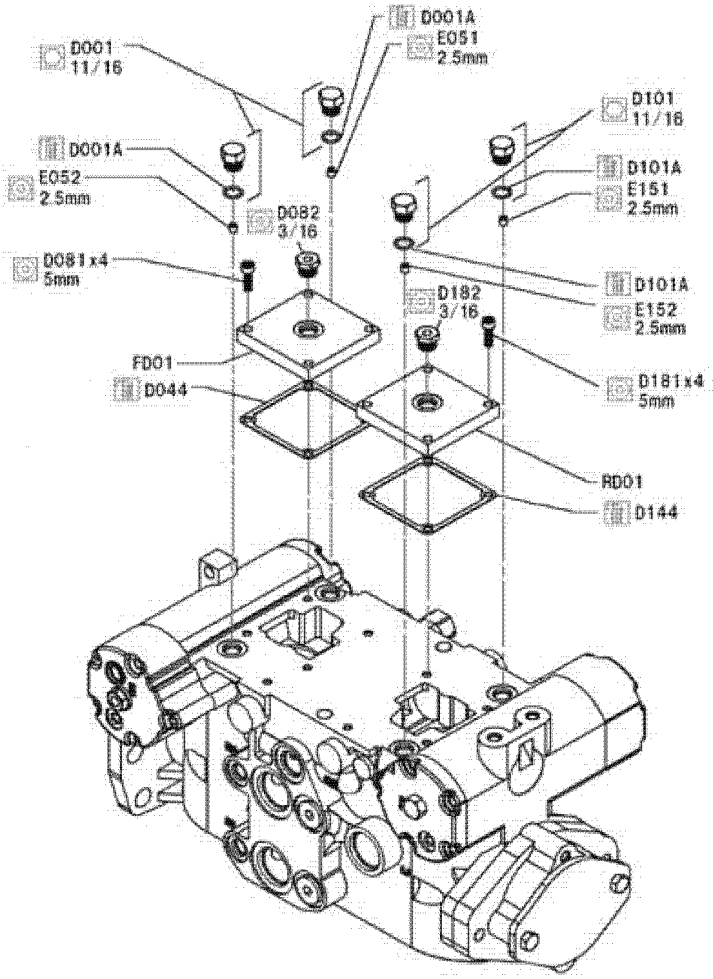

Pull out with tool – press fit


Cover splines with installation sleeve

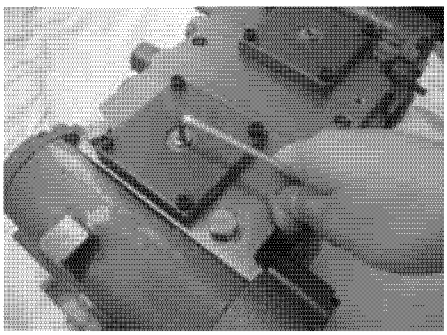
REMOVE ORIFICE AND CONTROL COVER

If necessary, remove orifices and control covers.

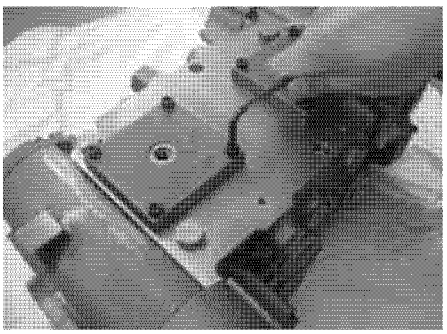
Removing orifices and control covers



1. Using a 3/16 in. internal HEX wrench, remove plug sockets (D082 and D182). (If necessary, usually not)

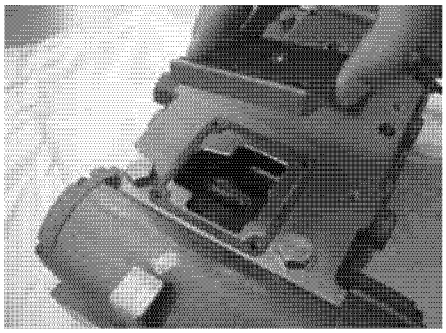


2. Using a 5mm internal HEX wrench, remove four screws for each control cover. (D081 and D181).

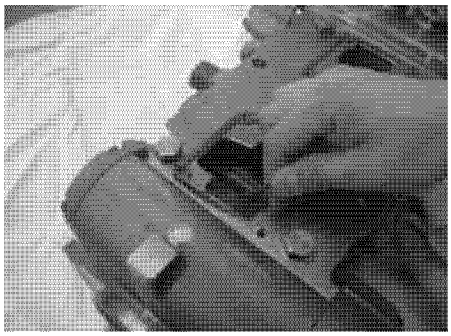


REMOVE ORIFICE AND CONTROL COVER (continued)

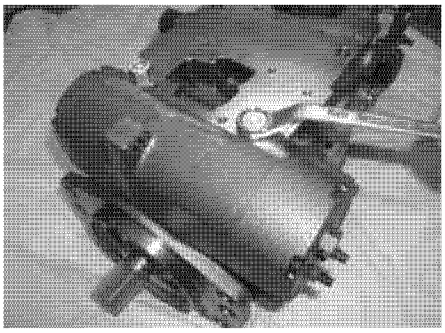
3. Remove control covers (FD01 and RD01).



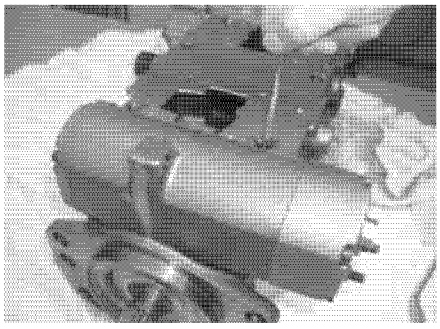
4. Remove gaskets (D044 and D144).



5. Using a 11/16 in. HEX wrench, remove plug assemblies (D001 and D101)

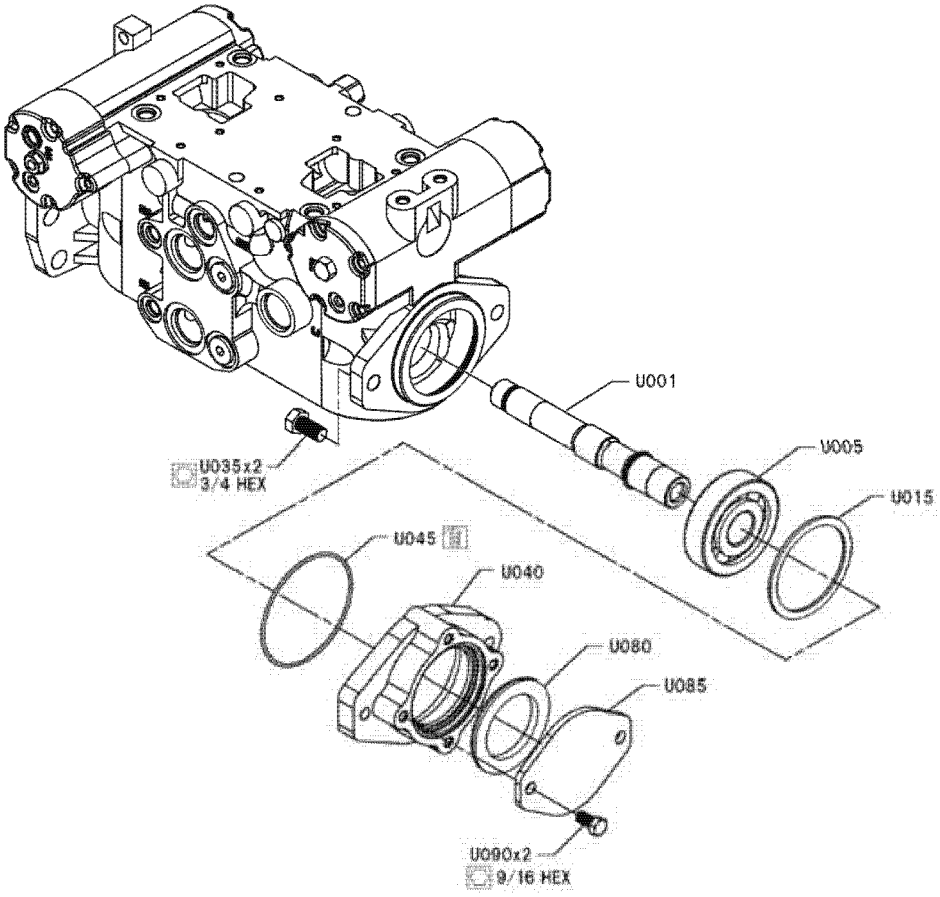


6. Using a 2.5 mm internal HEX wrench, remove orifices (E051,E052 and E151, E152) from the housing (D001 and D101).

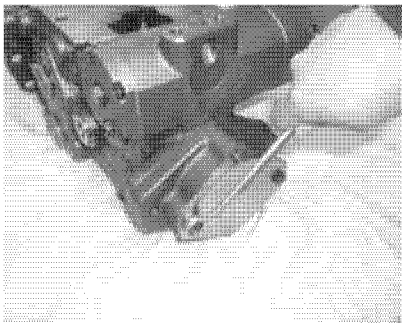


REMOVE REAR SHAFT, BEARING, AND SEAL

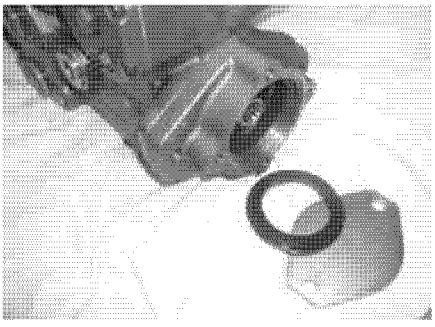
Removing rear shaft, bearing, and seal



1. Remove the gear pump.
2. If no gear pump is present, remove shipping cover (U085).
3. Using a 9/16 in. HEX wrench, remove screws (U090).

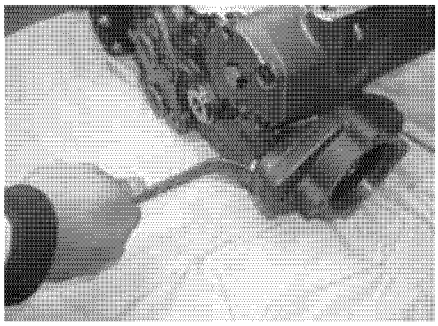


4. Remove Pad seal(U080) and shipping cover (U085).

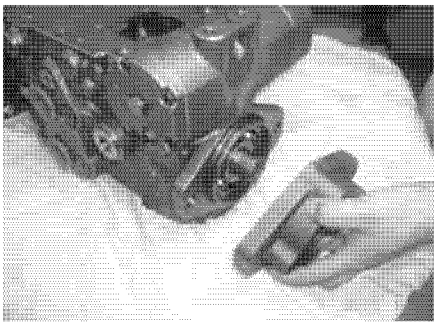


REMOVE REAR SHAFT, BEARING, AND SEAL (continued)

5. Using a 3/4 in. HEX wrench, remove screws (U035).

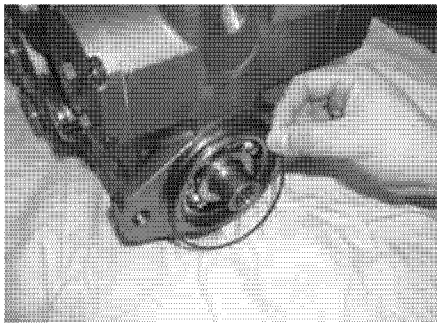


6. Remove auxiliary pad (U040).

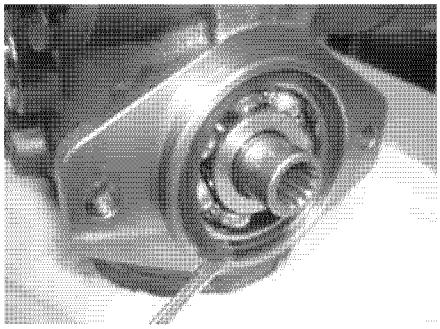


7. Remove and discard O-ring (U045)

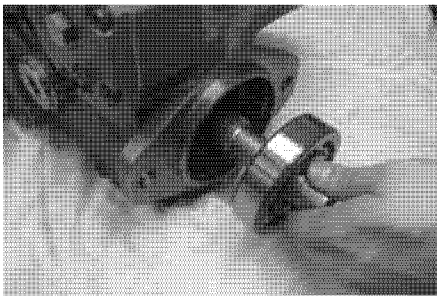
● Caution
Do not scratch the housing or shaft.



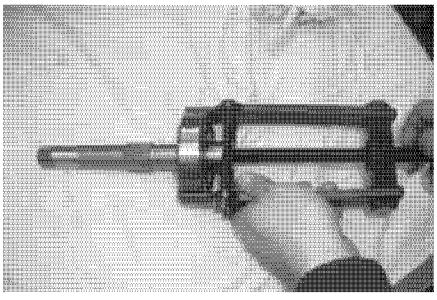
8. Using a standard screw driver, remove spiral retaining ring (U015).●



9. Remove shaft(U001) with bearing from housing.

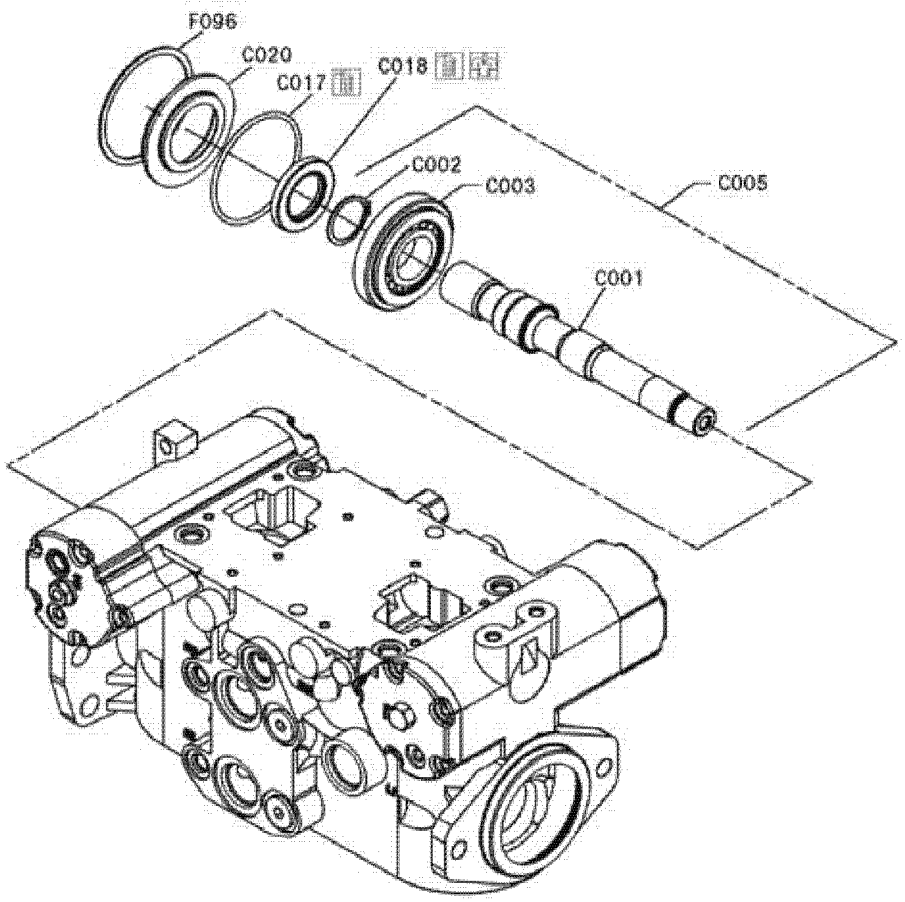


10. Remove bearing (U005) from shaft.

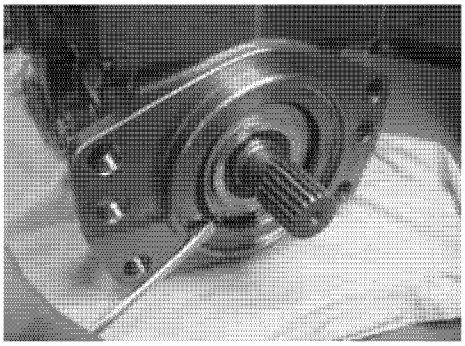


REMOVE FRONT SHAFT, BEARING, AND SEAL

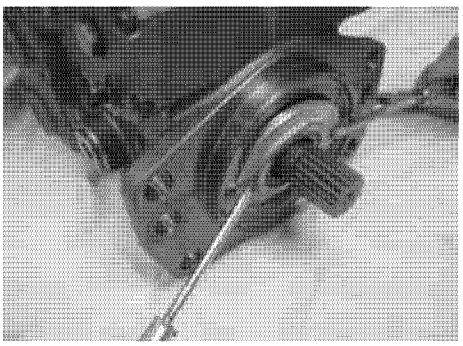
Removing front shaft, bearing, and seal



1. Using standard screw driver, remove spiral retaining ring (F096).

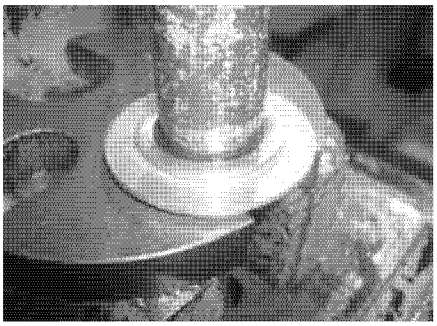


2. Using two standard screw drivers, remove shaft seal carrier (C020).

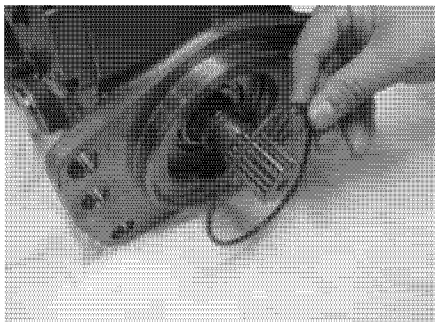


REMOVE FRONT SHAFT, BEARING, AND SEAL (continued)

3. Press out the oil seal(C018) from the seal carrier(C020). Discard the seal.

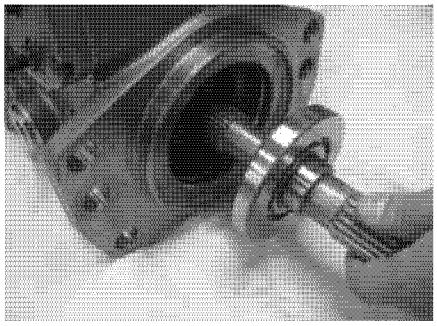


4. Remove and discard O-ring(C017).

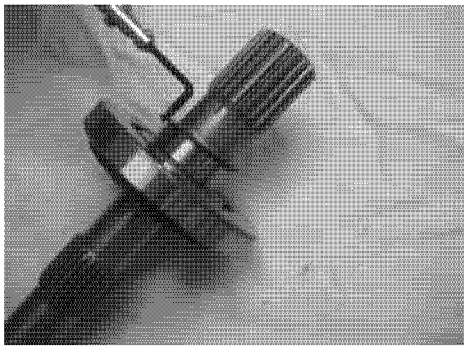


5. Remove shaft(C001) with bearing from housing. ●

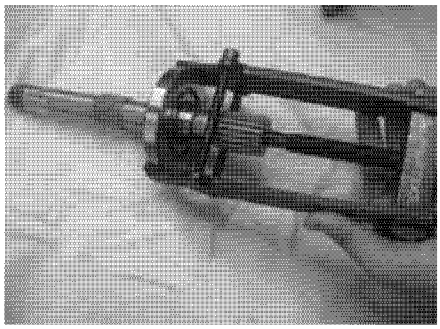
● Caution
Do not allow loose shaft to damage internal machined surfaces of pump.



6. Using snap-ring pliers, remove retaining ring(C002). ●

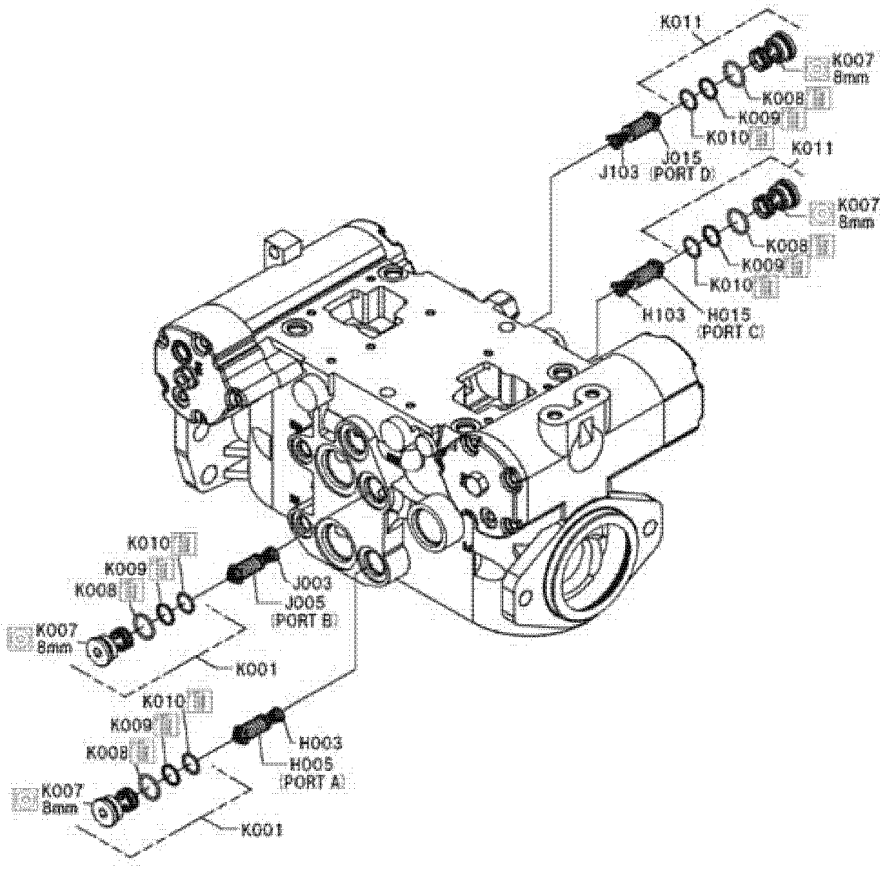


7. Remove bearing (U003) from shaft(U001).

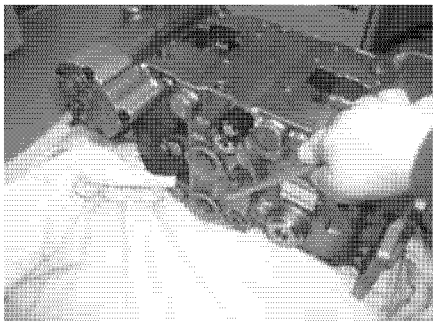


REMOVE SYSTEM CHECK/ RELIEF(SCR) VALVE

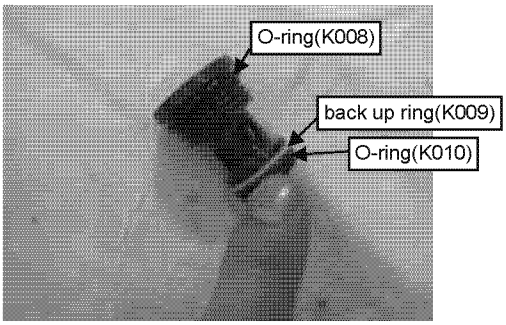
Removing SCR valve assembly



1. Using an 8mm internal hex wrench, remove four valve plugs (K001, K011).

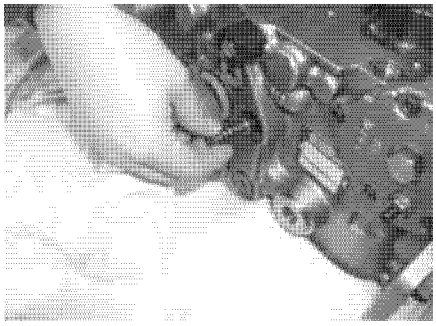


2. Remove and discard O-rings (K008, K010) and backup ring (K009).

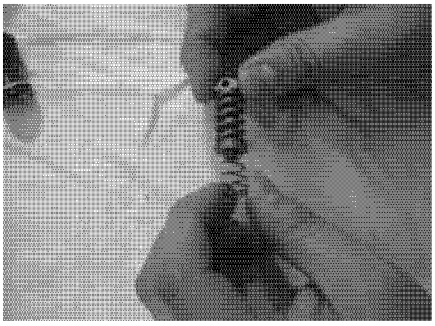


**REMOVE SYSTEM CHECK/
RELIEF(SCR) VALVE (continued)**

3. Remove SCR valves.
(H005, H015 and J005, J015)

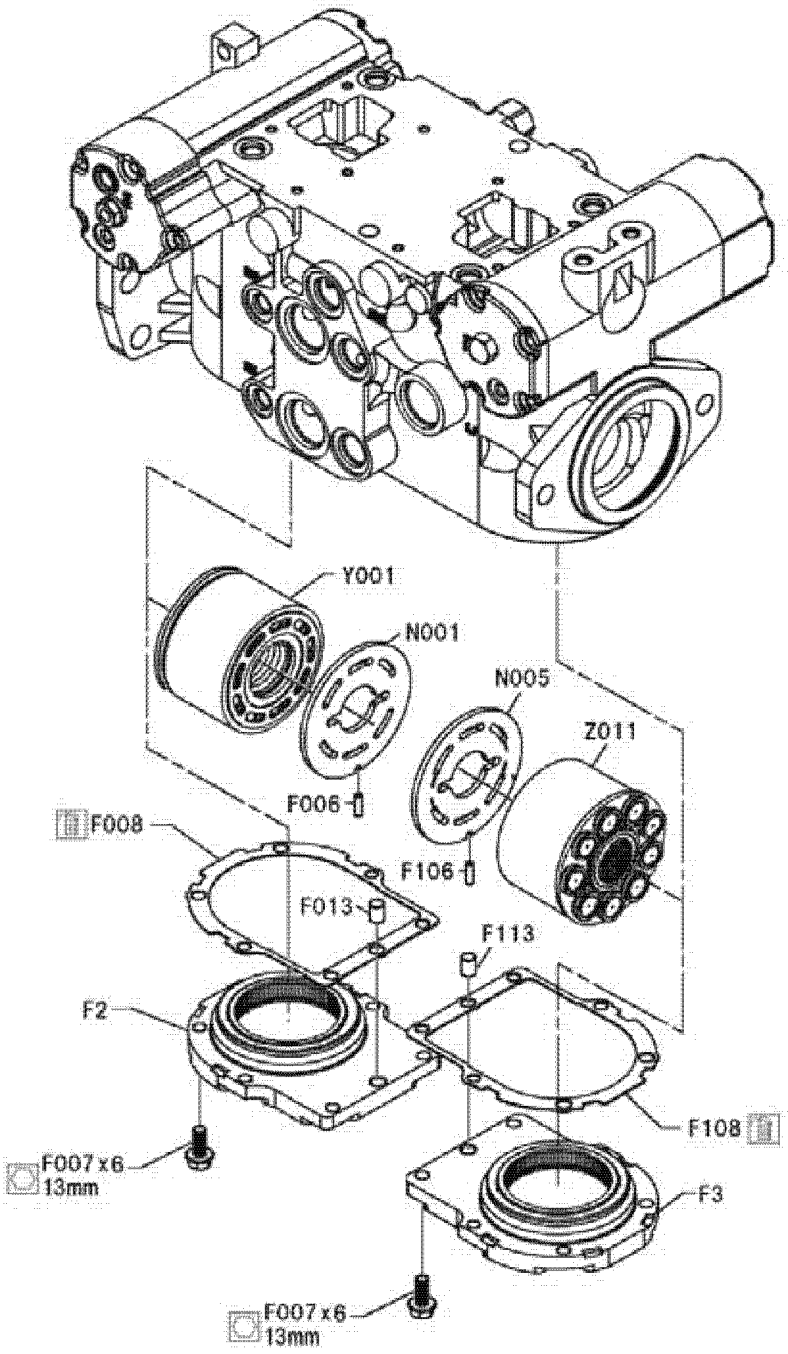


4. If necessary, remove springs.
(H003, H103 and J003, J103)



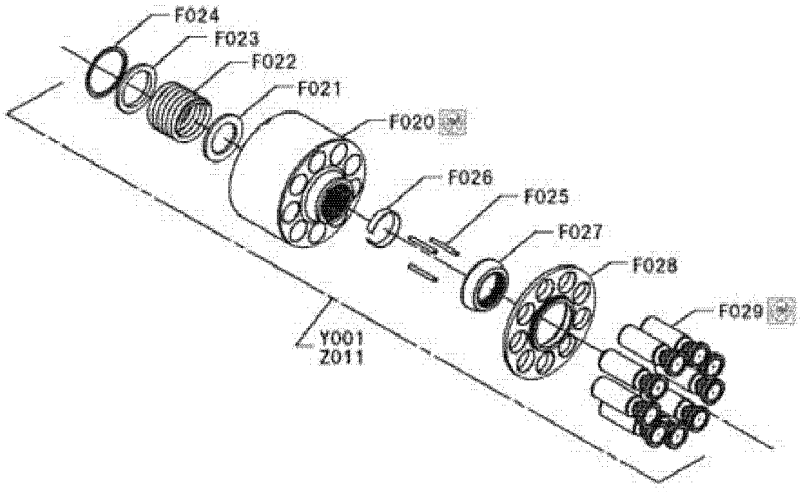
REMOVE CYLINDER BLOCK ASSEMBLY AND SIDECOVER

Removing cylinder block assembly and side cover

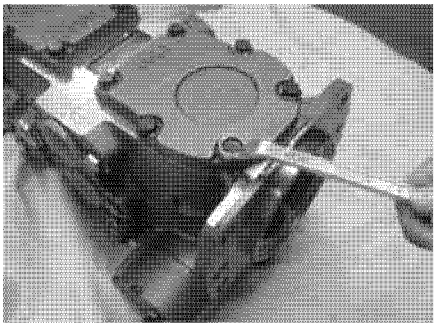


REMOVE CYLINDER BLOCK ASSEMBLY AND SIDECOVER (continued)

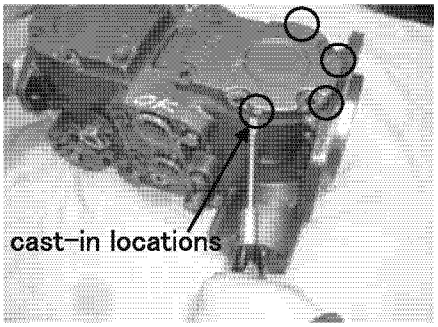
Disassemble cylinder block assembly



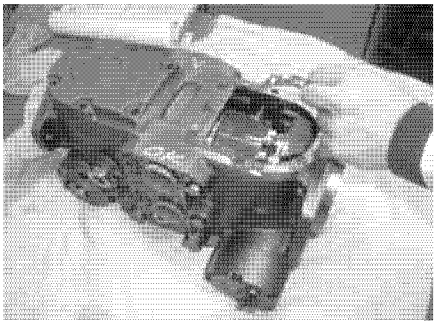
1. Using 13mm socket wrench, remove six screws (F007, F107) from each side cover.



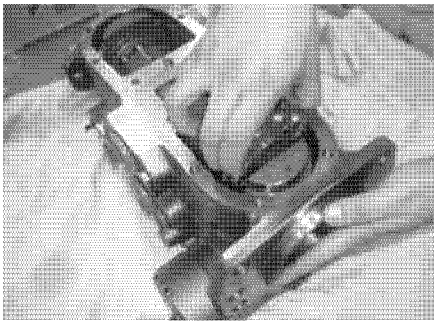
2. Using a standard screw driver, remove side cover (F2,F3). Use the cast-in locations for removal.



3. Remove and discard gasket (F008, F108).

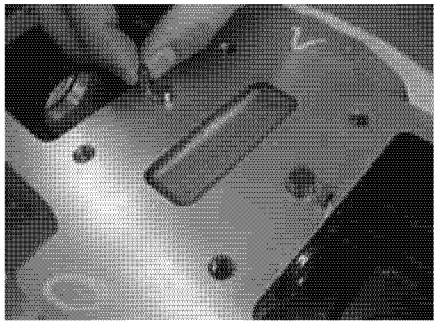


4. Remove the cylinder block kit (Y001, Z011) and valve plate (N001, N005) from the housing.

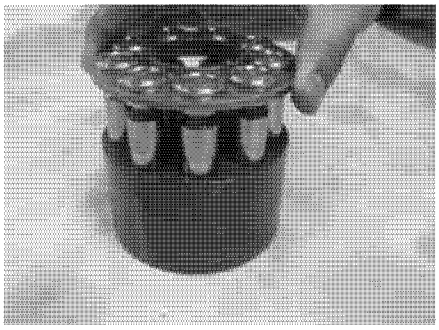


REMOVE CYLINDER BLOCK ASSEMBLY AND SIDECOVER (continued)

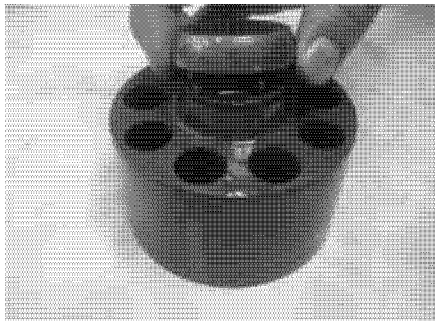
5. Remove the pins (F006, F106, F013, F113).



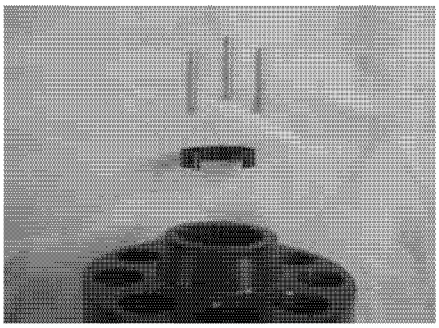
6. Remove the slipper retainer (F028) with the pistons (F029).



7. Remove the ball guide (F027).



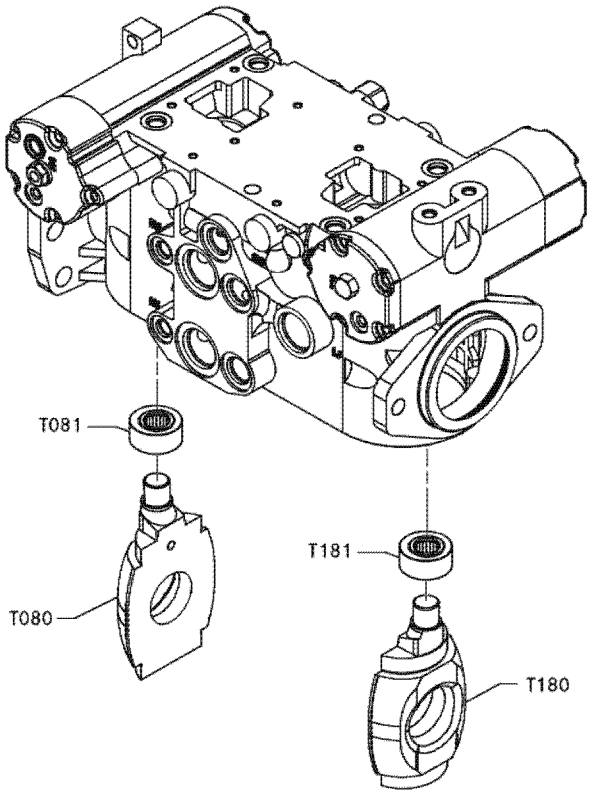
8. Remove the 3 hold down pins (F025) and pin retainer (F026).



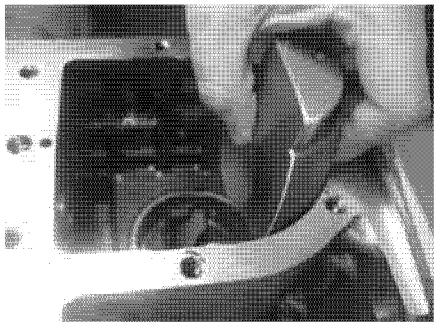
The pistons are not selectively fitted, however, units with high hourly usage may develop wear patterns. Number the pistons and bores for reassembly if reusing the parts.

REMOVE SWASHPLATE AND CAM FOLLOWER ASSEMBLY

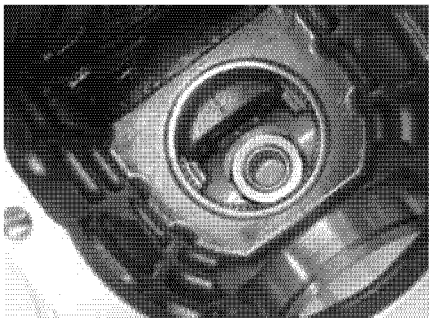
Removing swashplate and cam follower assembly



1. Remove swashplate (T080, T180).

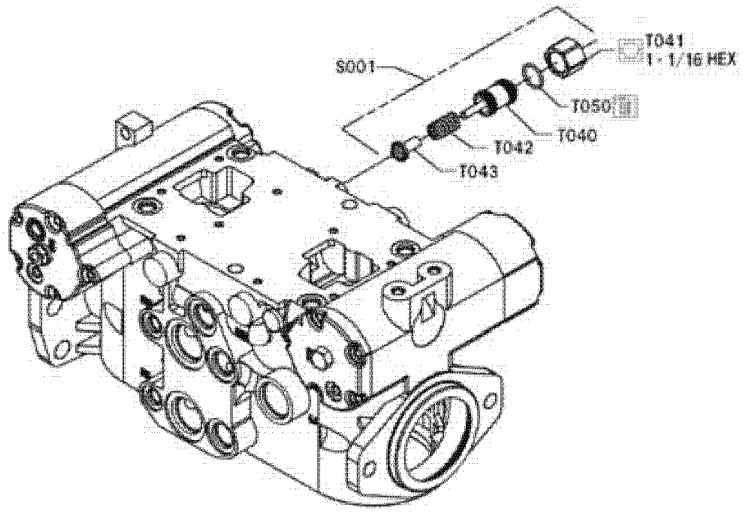


2. Remove cam follower assembly (T081, T181).



REMOVE CHARGE PRESSURE RELIEF (CPR) VALVE

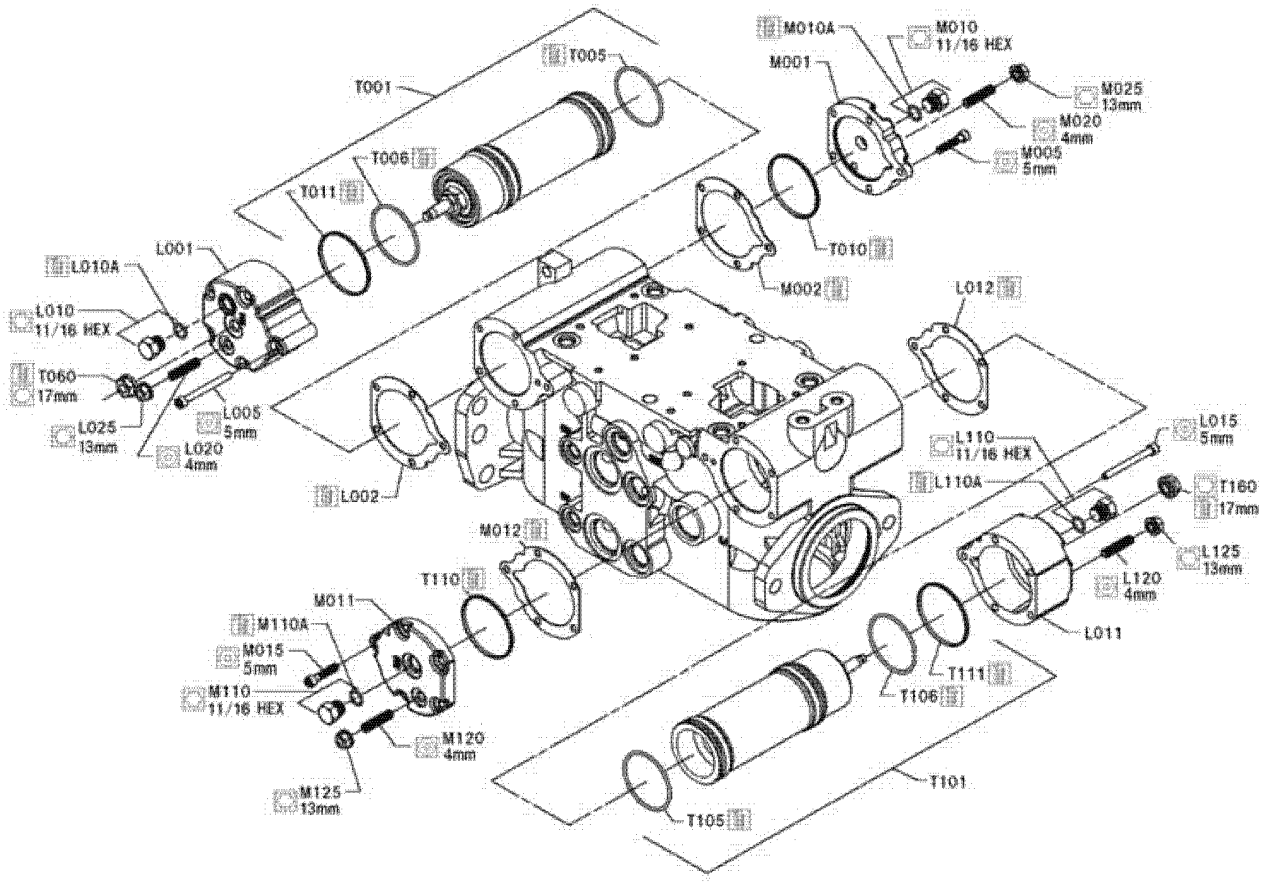
Removing CPR valve



1. Using a 1-1/16 in. HEX wrench, remove the locknut (T041).
2. Using a 1/2 in. HEX wrench, remove the adjustment plug (T040). Remove the O-ring from the plug (T050) and discard.
3. Remove the spring (T042) and poppet (T043) from the housing.

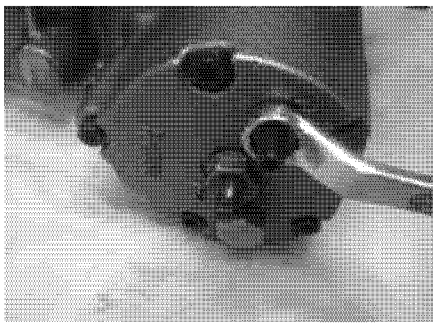
REMOVE SERVO PISTON, COVERS AND DISPLACEMENT LIMITERS

Removing servo piston, covers, and displacement limiters

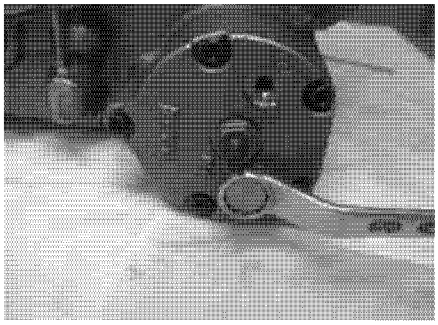


REMOVE SERVO PISTON, COVERS AND DISPLACEMENT LIMITERS (continued)

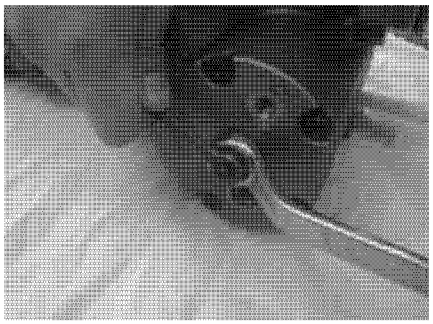
1. If necessary, using a 13mm wrench, remove displacement limiter locknuts (L025, L125). Remove adjustment screws (L020, L120) from servo covers.



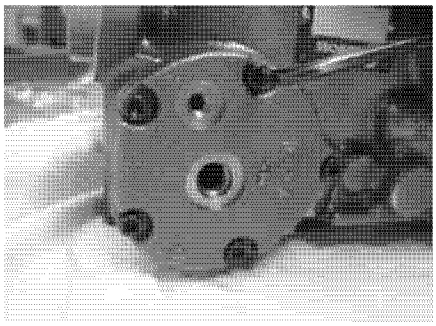
2. If necessary, using a 11/16 in. wrench, remove plugs (L010, M010, L110, M110) and discard O-rings (L010A, M010A, L110A, M110A).



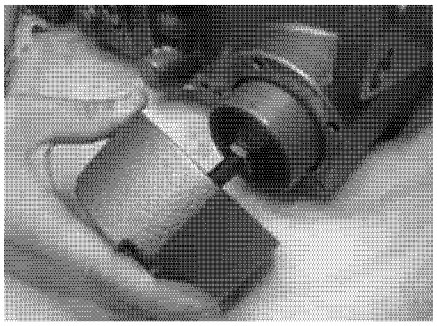
3. Using 7mm and 13 mm wrench, remove seal nut (T060, T160) and discard.



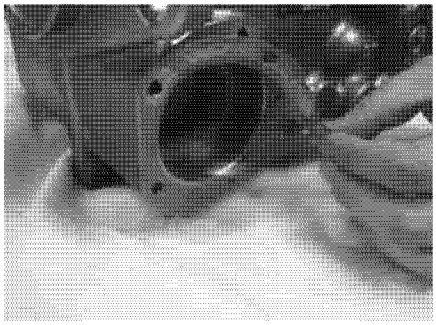
4. Using a 5mm internal HEX wrench, remove five screws (L005, M005, L015, M015) from each side cover.



5. Remove servo cover (M001, M011) from housing. And remove servo cover (L001, L011) from piston.



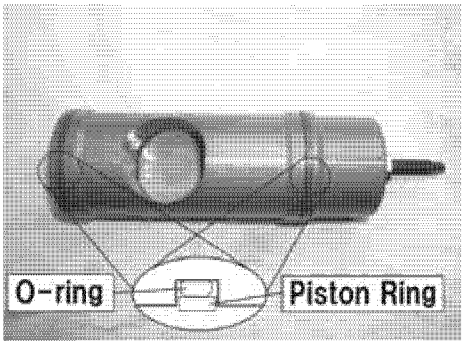
6. Remove gaskets (L002, M002, L012, M012) from servo cover.



REMOVE SERVO PISTON, COVERS AND DISPLACEMENT LIMITERS (continued)

7. Remove piston being careful not to damage servo piston bore in housing.

8. Remove and discard O-rings (T005, T006, T105, T106) and piston ring (T010, T011, T110, T111).



OVERVIEW

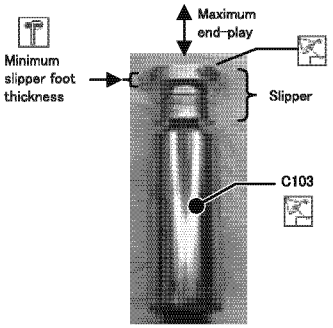
After disassembly, wash all parts (including the auxiliary pad and housing) thoroughly with clean solvent and allow to air dry. Blow out oil passages in the housing and pad with compressed air. Conduct inspection in a clean area and keep all parts free from contamination. Clean and dry parts again after any rework or resurfacing.

PISTONS AND SLIPPERS

Inspect the pistons for damage and discoloration. Discolored pistons may indicate excessive heat/friction; do not reuse.

Inspect the running surface of the slippers. Replace any piston assemblies with scored or excessively rounded slipper edges. Measure the slipper foot thickness. Replace any piston assemblies with excessively worn slippers. Check the slipper axial end-play. Replace any piston assemblies with excessive end-play.

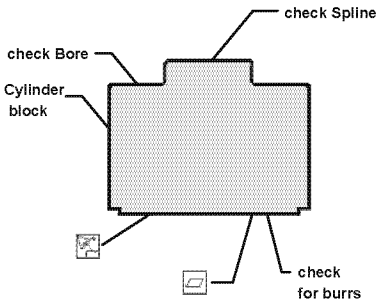
Inspect pistons

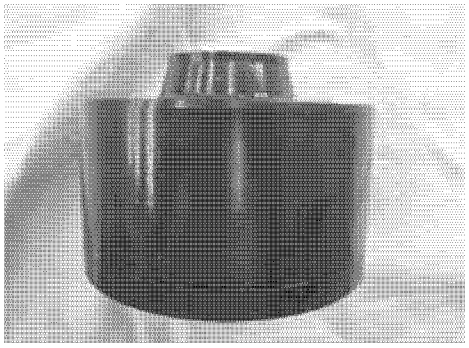


CYLINDER BLOCK

Examine the running face of the cylinder block. The surface should be smooth and free of nicks and burrs. Remove any burrs. Ensure that no scratches or grooves exist; these may drastically reduce output flow and life of pump.
Inspect block bores for scoring;
Replace cylinder block if bores show damage or discoloration.
Inspect the spline of cylinder block for scratches and damages.
Replace cylinder block, if necessary.

Inspect Cylinder block





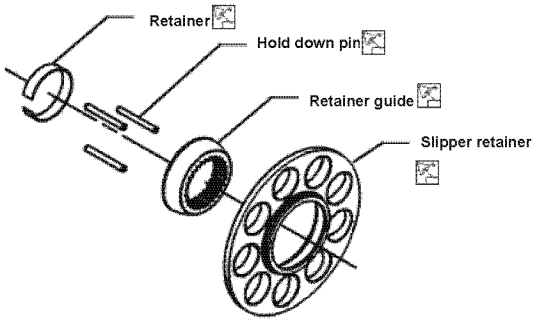
FRONT AND REAR SHAFT

Check to see that the shaft and its splines are straight and free of damage or heavy wear. Inspect the shaft sealing surface. Replace the shaft if a groove exists at the sealing land surface that may let dirt into or hydraulic fluid out of the unit.
Clean the sealing area with a nonabrasive material if necessary. Lubricate the shaft with a light coat of hydraulic fluid before re-assembly.

RETAINER GUIDE, SLIPPER RETAINER, AND HOLDDOWN PINS

Ensure the retainer guide is free of nicks and scratches, and not excessively scored. Examine for discoloration that may indicate excessive heat or friction.
The slipper retainer should be flat, and slippers should fit in the retainer with minimal side play. Place the hold-down pins on a flat surface and roll them to make sure they are straight.
Discard and replace any damaged parts.

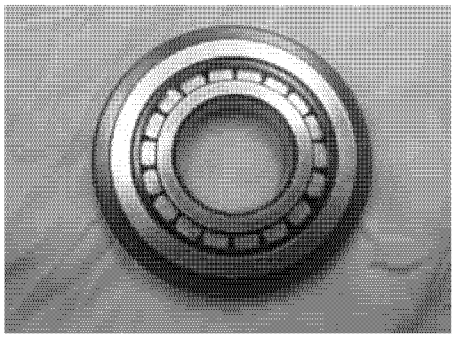
Inspect retainer guide, hold down pins, and retainer



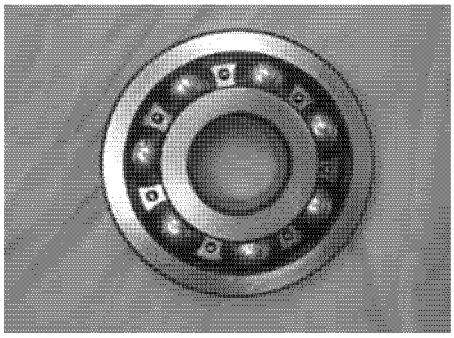
SHAFT BEARING

Clean bearing with a solvent and lubricate with hydraulic fluid.
Inspect for wear, or pitting. If bearing is worn or does not rotate smoothly, replace it.

Inspect shaft bearing



(front shaft bearing)

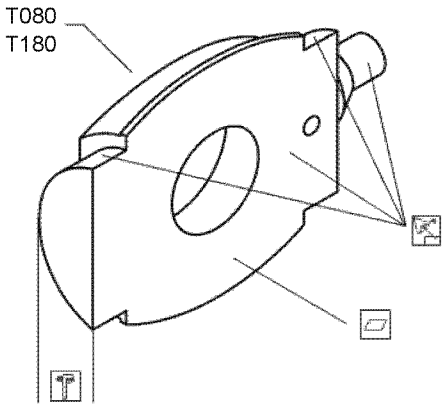


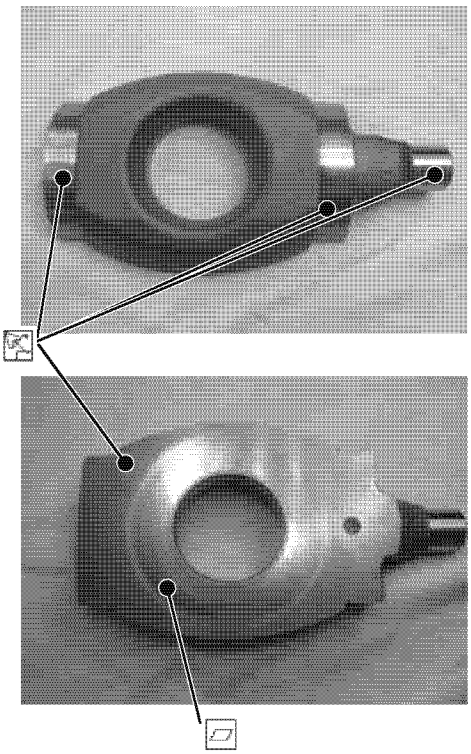
(rear shaft bearing)

SWASHPLATE

Carefully inspect each machined surface of the swashplate for wear. All swash plate machine surfaces should be smooth. Inspect the swashplate's slipper running face for flatness and brass transfer. Excessive brass transfer from slippers may indicate that the piston assemblies should be replaced. Check the journals for scratches and measure thickness across journals. Replace swashplate if necessary

Inspect swashplate





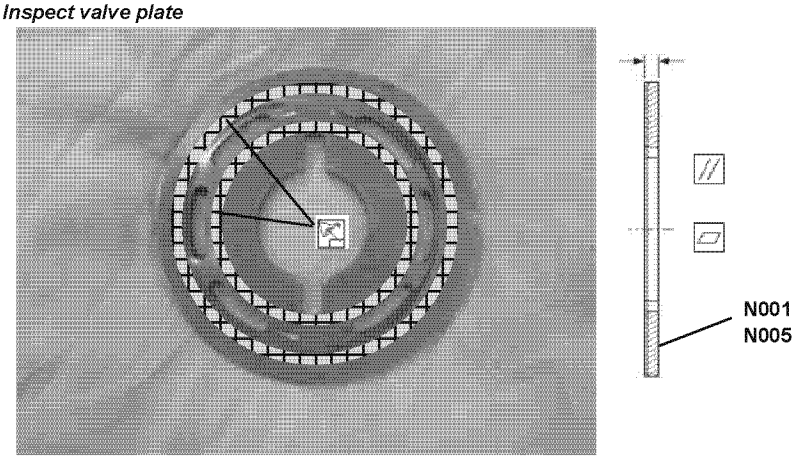
VALVE PLATE

Inspect the valve plate for scratches and grooves. Check the plate for evidence of any cavitation along the running face of the valve plate. If pitting from cavitation exists, replace the valve plate. Check for excess wear on the brass running face. If you observe any discoloration or burn marks, replace the valve plate.

Run your fingernail or pencil tip across the diameter of the sealing land surface (see picture). You should feel no deep or outstanding grooves.
These may decrease pump flow. Replace if grooves or nicks are present.
Inspect the mating surfaces of the endcap and valve plate for any possible contamination; even a few thousandths of an inch may affect pump operation.

Inspect the thickness of the valve plate.
Appearance should be flat and smooth on both the running face and the bottom surface.
We recommend a magnetic particle inspection to detect cracks.
Replace the valve plate if any cracks exist.

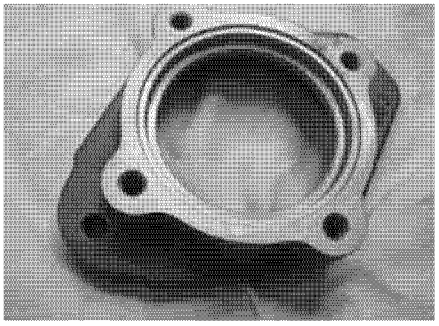
Inspect valve plate



AUXILIARY PAD

Inspect the auxiliary pad.
Inspect all machined surfaces for scratches or pits.

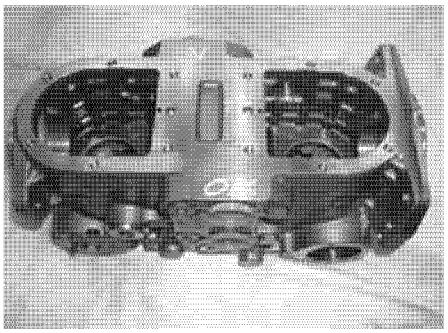
Inspect auxiliary pad

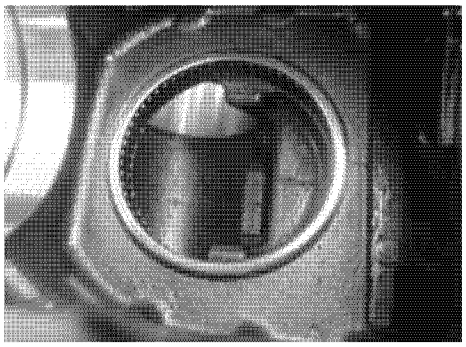


HOUSING

Inspect the housing to ensure that it is clean and free of foreign material. Inspect the swashplate bearing surfaces.

Inspect housing

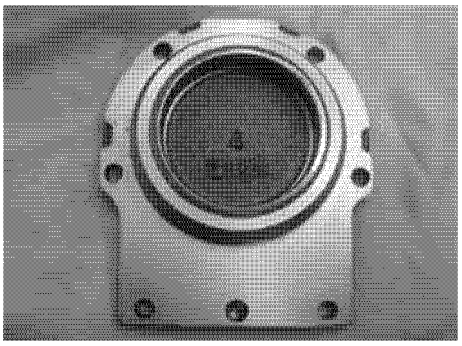




SIDECOVER

Inspect the side cover to ensure that it is clean and free of foreign material. Inspect the swashplate bearing surfaces.

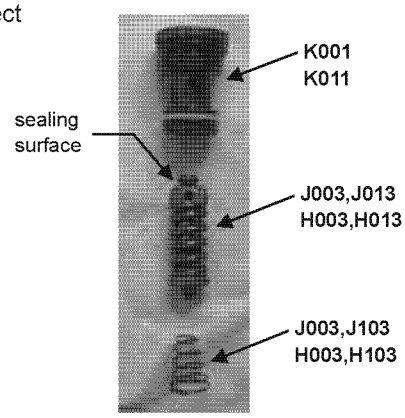
Inspect sidecover



SYSTEM CHECK/RELIEF (SCR)VALVE

Clean and inspect the SCR valves. Inspect the springs. Check the sealing surfaces of the poppet and seat-plug for wear or scratches. Replace as necessary.

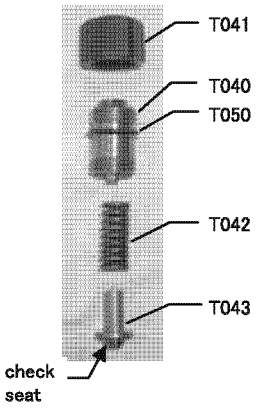
Inspect SCR valve



CHARGE PRESSURE RELIEF (CPR) VALVE

Inspect poppet and seat in housing for damage or foreign material. Inspect relief valve plug for damage or wear. Replace all parts that show wear or damage.

Inspect charge pressure relief valve

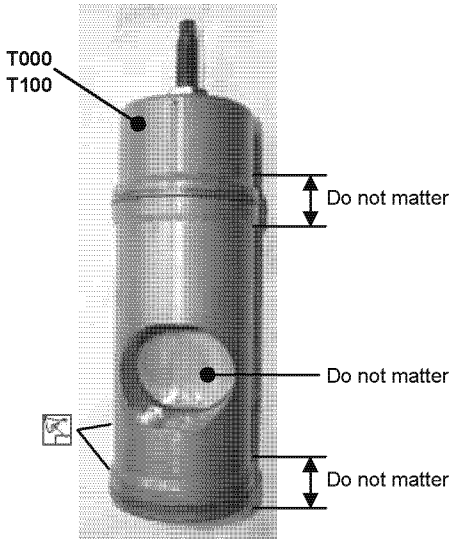


SERVO PISTON ASSEMBLY

Inspect servo piston for wear or damage. Replace assembly if necessary.

Do not disassemble servo piston. Replace whole assembly if necessary

Inspect servo piston assembly

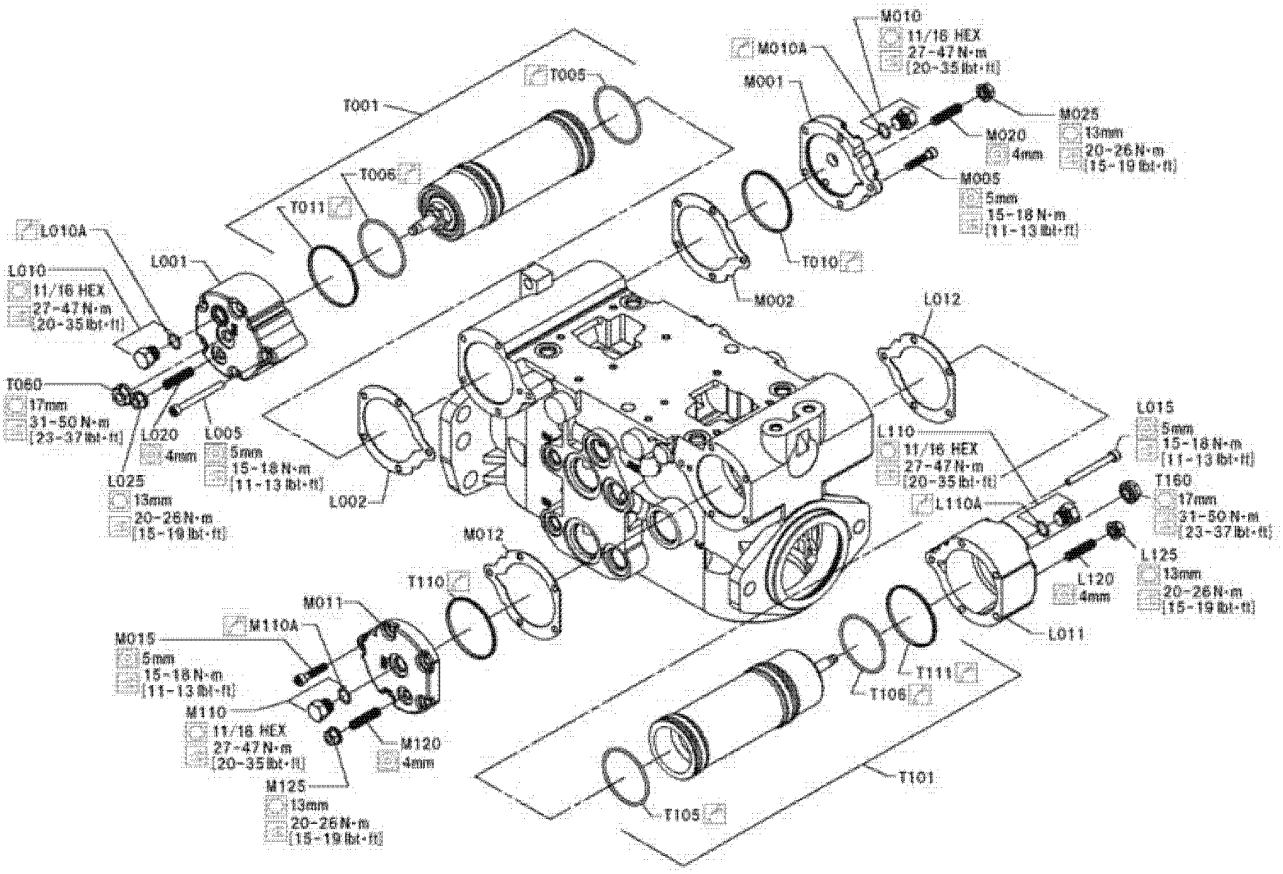


OVERVIEW

The following section describes assembly procedures for the 4T axial piston pumps. After assembly, adjust the pump according to the settings listed on the model code stamped on the serial number plate. Make adjustments with pump running on an appropriate test stand.

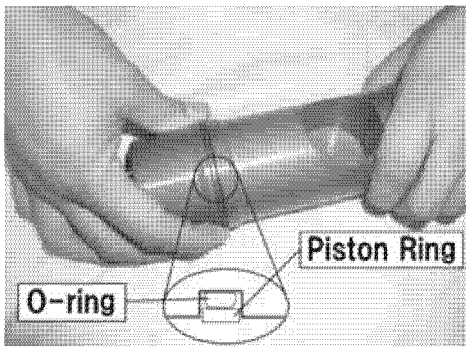
INSTALL SERVO PISTON, COVERS AND DISPLACEMENT LIMITERS

installing servo piston, covers, and displacement limiters

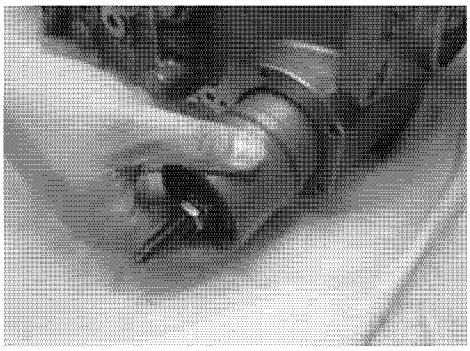


INSTALL SERVO PISTON, COVERS AND DISPLACEMENT LIMITERS (continued)

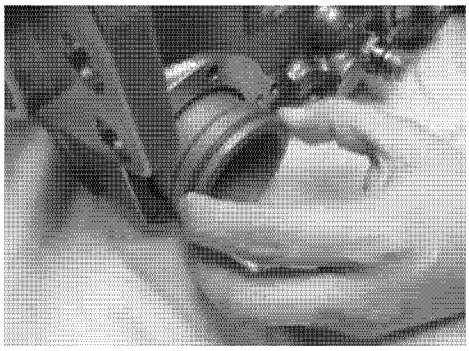
1. Lubricate and install O-rings (T005, T006, T105, T106) into the grooves on the servo piston. Install piston ring(T011, T111) to the neutral adjustment screw end of the piston. Stretch piston ring over O-ring.



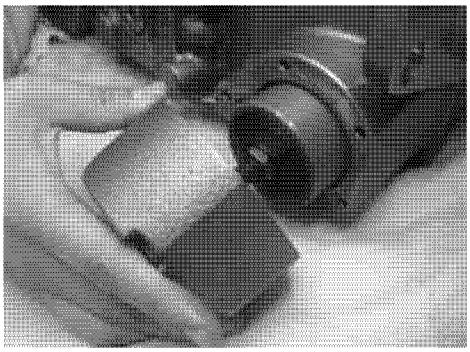
2. Orient the side cover side up. Carefully insert servo piston assembly without scratching inside of pump. Take care not to damage the piston ring doing installation.



3. Push servo assembly through housing. Install piston ring (T010, T110) to other side of piston. Stretch piston ring over O-ring. Center servo piston in housing. Take care not to damage the piston ring doing installation.

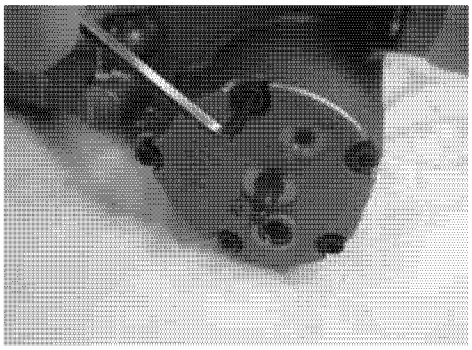


4. Install servo cover gasket (L002, L012). Thread the servo cover (L001, L011) onto the neutral adjustment screw until it contacts the housing. Align holes.

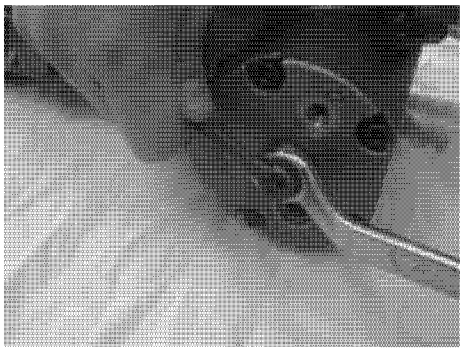


INSTALL SERVO PISTON, COVERS AND DISPLACEMENT LIMITERS (continued)

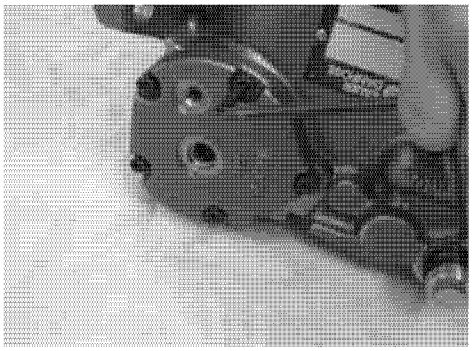
5. Using a 5mm internal HEX wrench, install and torque screws (L005, L015) 15-18 N•m [11-13 lbf•ft].



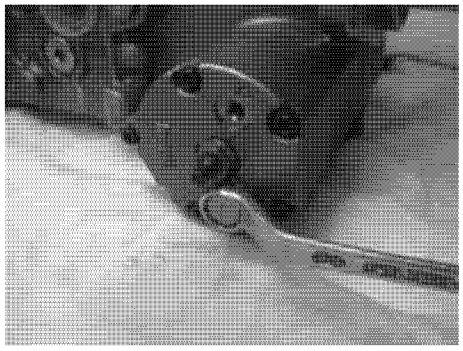
6. Using 7mm HEX and 17 mm wrench, install and torque seal nut (T060, T160) 31-50 N•m [23-37 lbf•ft].



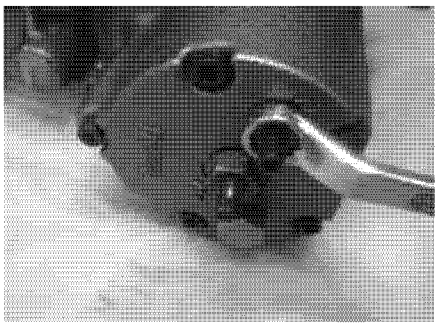
7. Install other servo cover gasket (M002, M012) and servo cover (M001, M011). Install and torque screws (M005, M015) 15-18 N•m [11-13 lbf•ft] using a 5mm internal HEX wrench.



8. Lubricate and install O-rings (L010A, L110A, M010A, M110A) and using an 11/16 HEX wrench, install and torque plugs (L010, L110, M010, M110) to 27-47 N•m [20-35 lbf•ft].



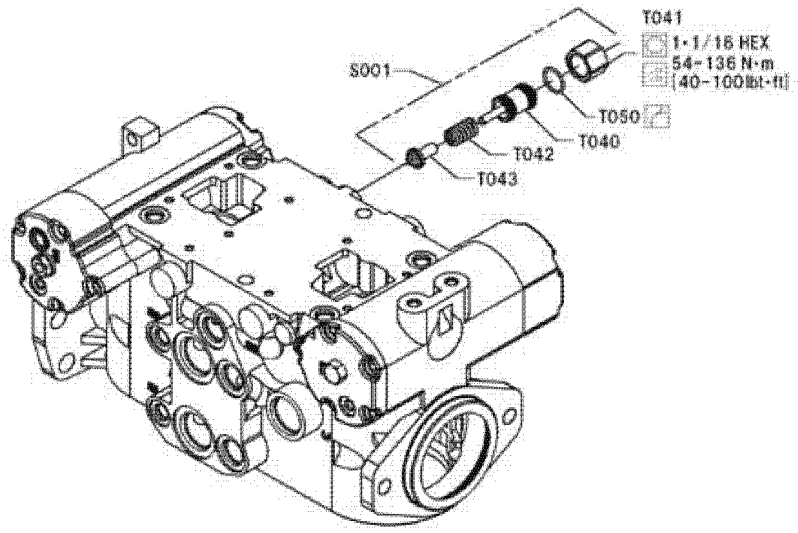
9. If necessary, install displacement limiters (L020, L120, M020, M120) and locknuts (L025, L125, M025, M125) to both sides. Install adjustment screws so screws extend several threads into the cover, you will set displacement later. Torque the locknuts to 20-26 N•m [15-19 lbf•ft] using a 13mm wrench.



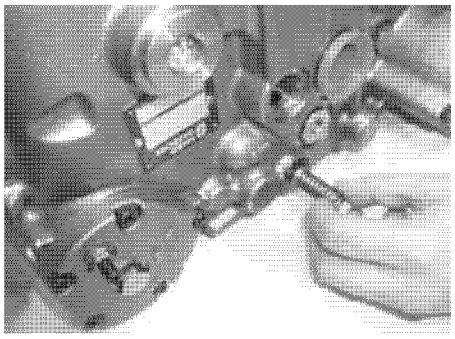
INSTALL CHARGE PRESSURE RELIEF (CPR) VALVE

After assembly, charge relief valve requires adjustment.

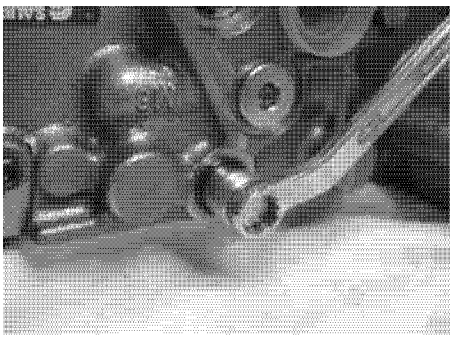
Installing CPR valve



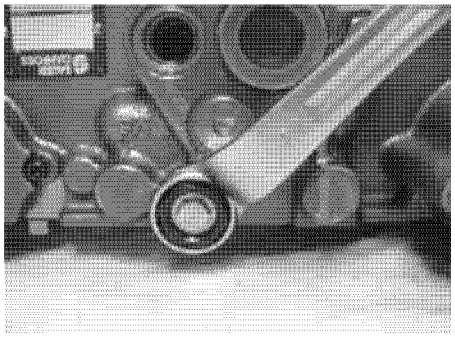
1. Install the poppet (T043) and spring (T042) into the housing cavity.



2. Install a new O-ring (T050) on the adjustment plug (T040), using a 1/2 in. HEX wrench.
Install the adjustment plug.

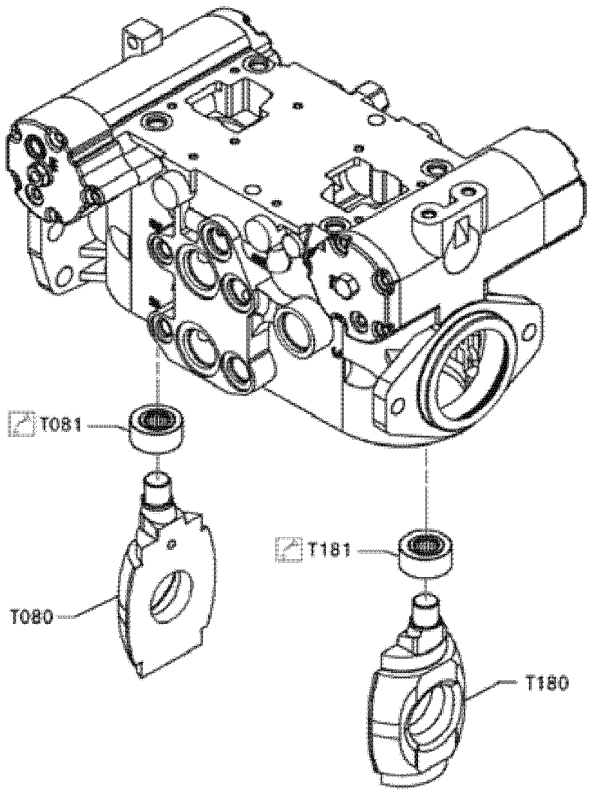


3. Using a 1-1/16 in. HEX wrench, torque the locknut (T041) 54-136 N•m [40-100 lbf•ft].

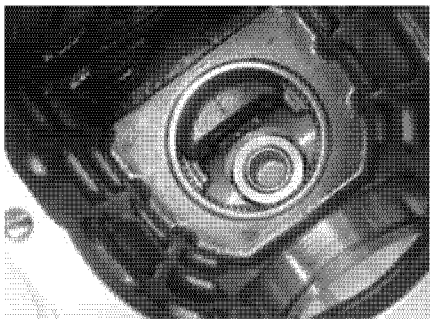


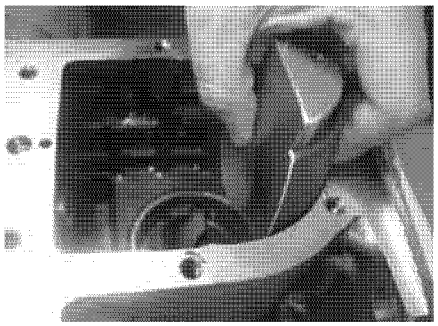
INSTALL SWASHPLATE AND CAM FOLLOWER BEARING ASSEMBLY

Installing swashplate removal and cam follower bearing assembly



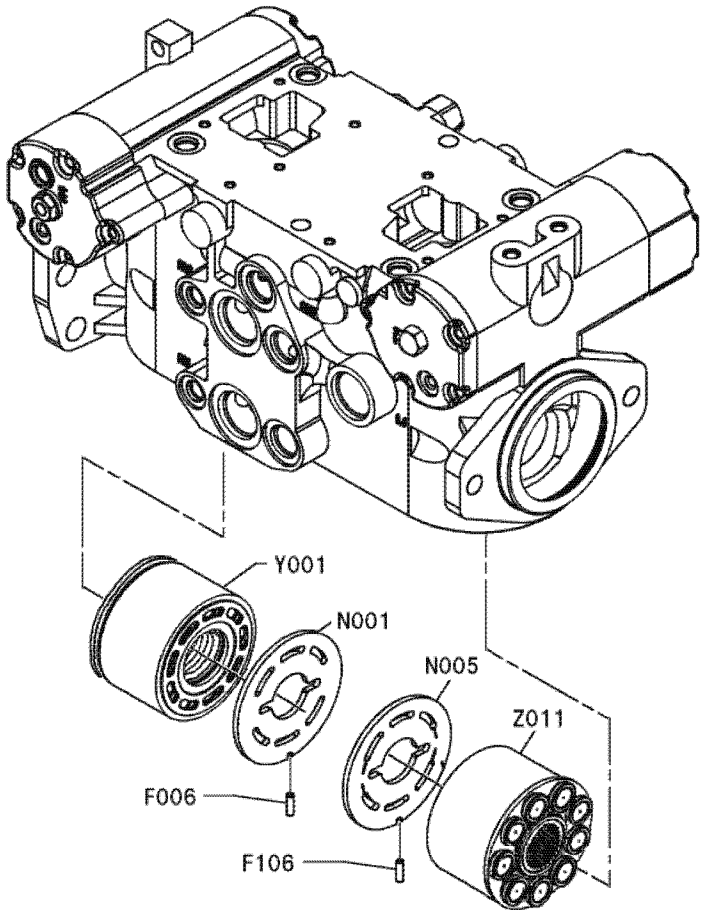
1. Lubricate and install cam follower bearing assembly(T081,T181) and swashplate(T080, T180) Orient the cam follower assembly so the numbers on the bearing are visible after installing into the servo piston.
   For ease of assembly, rotate servo piston so the cam follower bearing is perpendicular to shaft centerline.



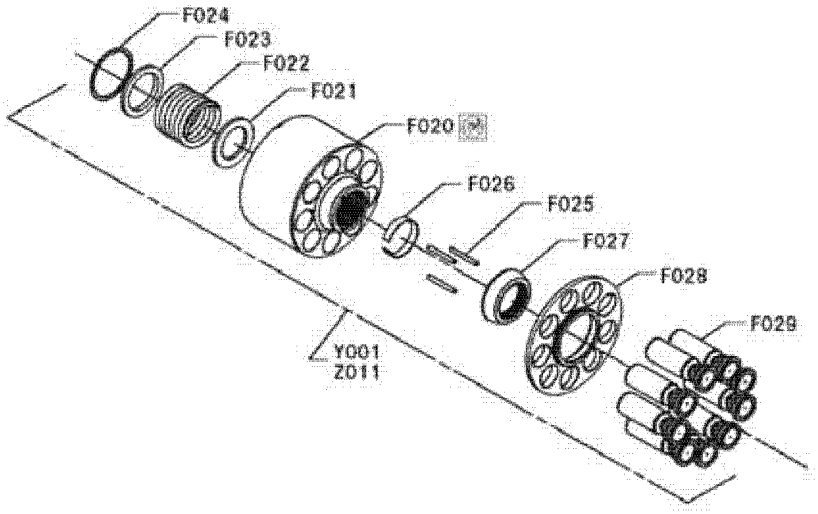


INSTALL CYLINDER BLOCK ASSEMBLY AND VALVE PLATE

Installing cylinder block and valve plate



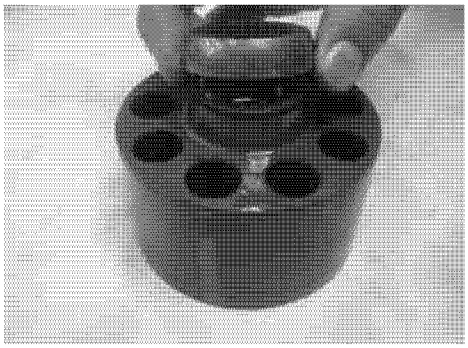
Disassemble cylinder block



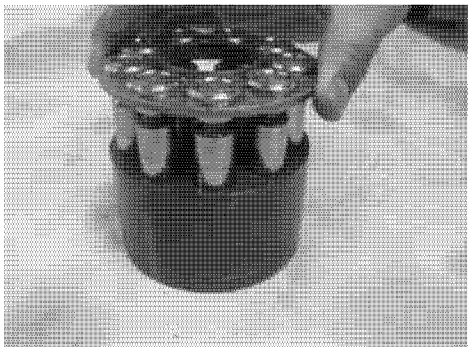
INSTALL CYLINDER BLOCK ASSEMBLY AND VALVE PLATE (continued)

Be sure to install the slipper retainer (F028) so it mates correctly with the ball guide (F027) (concave side of the slipper retainer against the convex side of the ball guide).

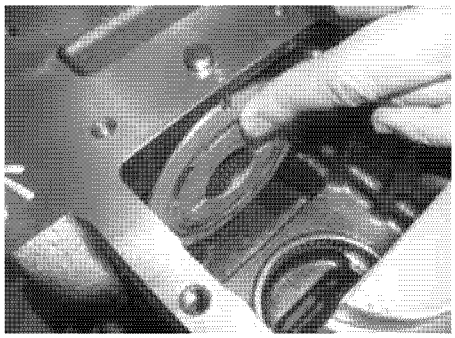
1. Install the hold-down pins (F025), hold down pin retainer (F026), and ball guide (F027) to the cylinder block.



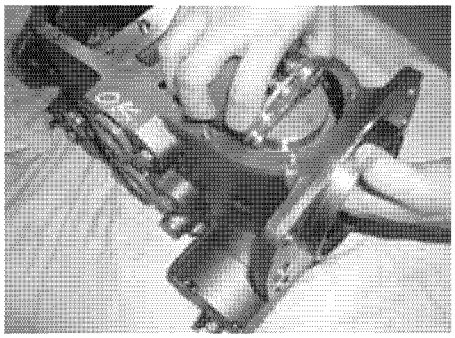
2. Install the pistons (F029) to the slipper retainer (F028). Install the piston and retainer assembly into the cylinder block. Ensure the concave surface of the retainer seats on the ball guide (F027). If you're reusing the pistons, install them to the original block bores. Lubricate the pistons, slippers, retainer, and ball guide before assembly. Set the cylinder kit aside on a clean surface until needed.



3. Install the valve plate (N001, N005) with the pin(F006,F106). ●

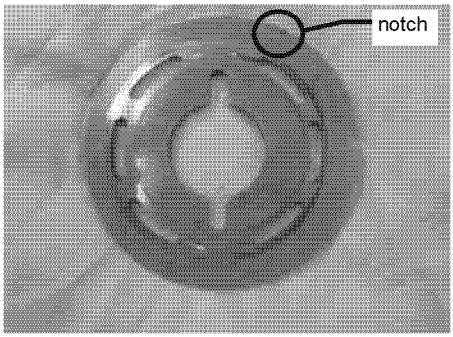


4. Install cylinder block kit (Y001, Z011) into the housing.

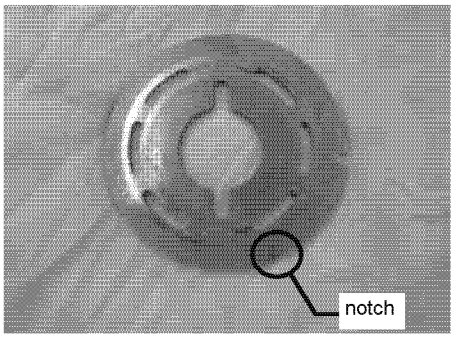


Note: The front pump valve plate will be the same direction, (CW or CCW), as the input shaft rotation. The rear pump valve plate will be the opposite rotation direction from the front pump.

N001 valve plate for CW

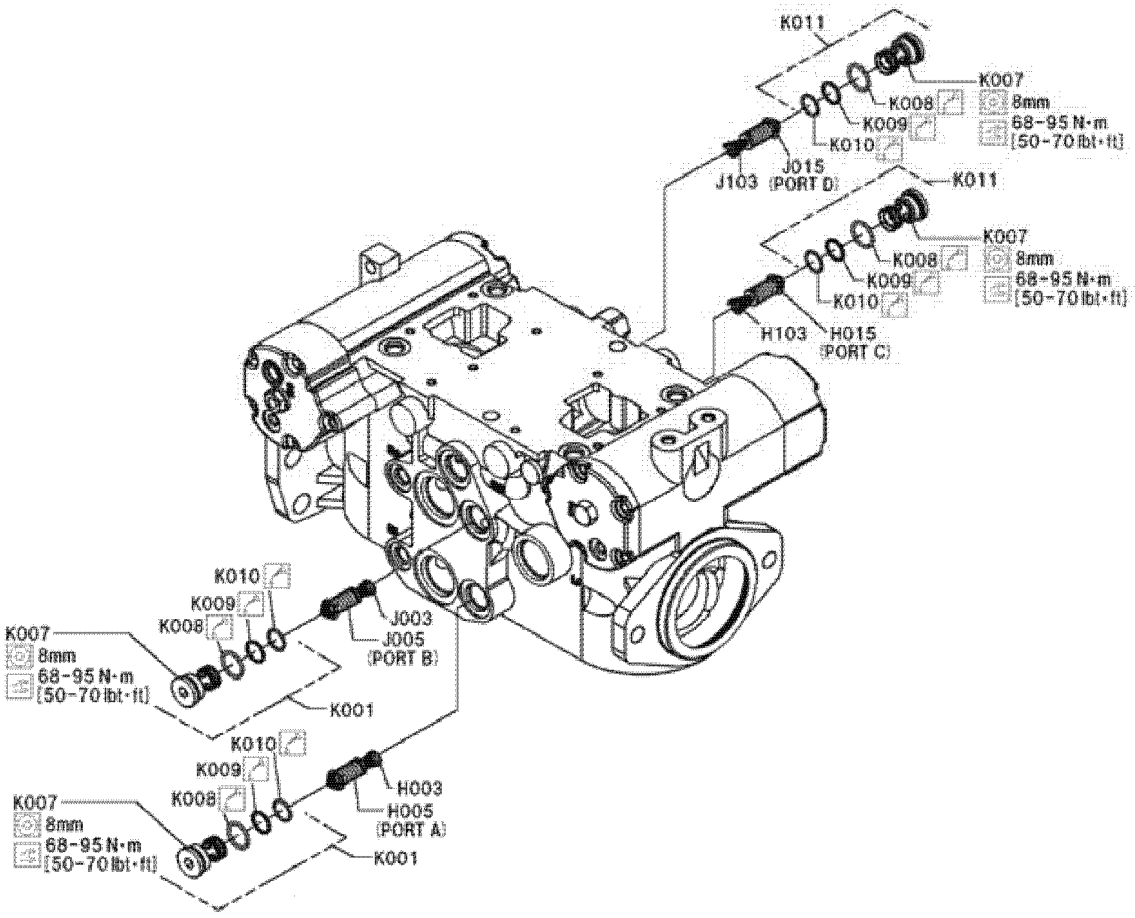


N005 valve plate for CCW

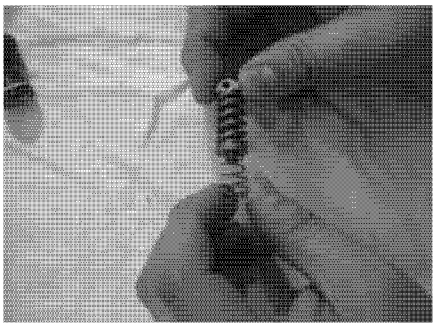


INSTALL SYSTEM CHECK/ RELIEF (SCR) VALVE

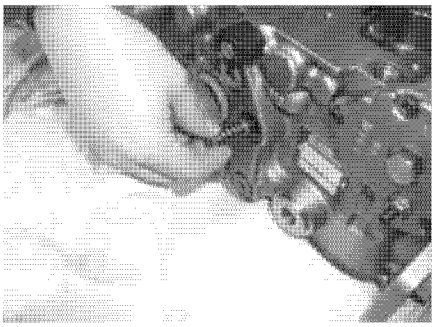
Installing SCR valve assembly



1. Attach springs (H003, H103 and J003, J103) onto SCR valves (H005, H015 and J005, J015).

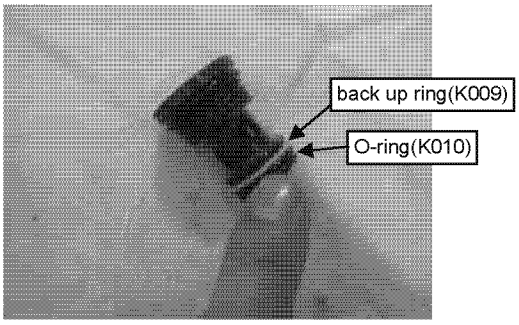


2. Lubricate and install SCR valves.

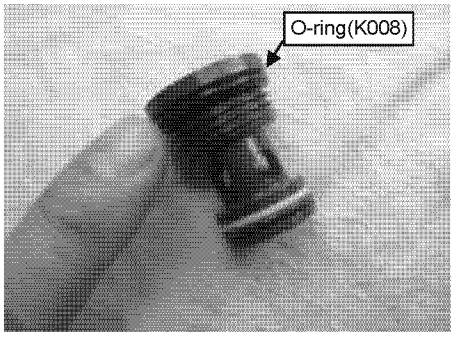


INSTALL SYSTEM CHECK/ RELIEF (SCR) VALVE (continued)

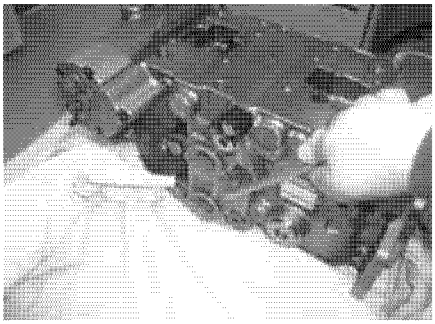
3. Lubricate and install new O-rings (K010) and new back up rings(K009).



4. Lubricate and install new O-rings (K008) on valve seat plugs.

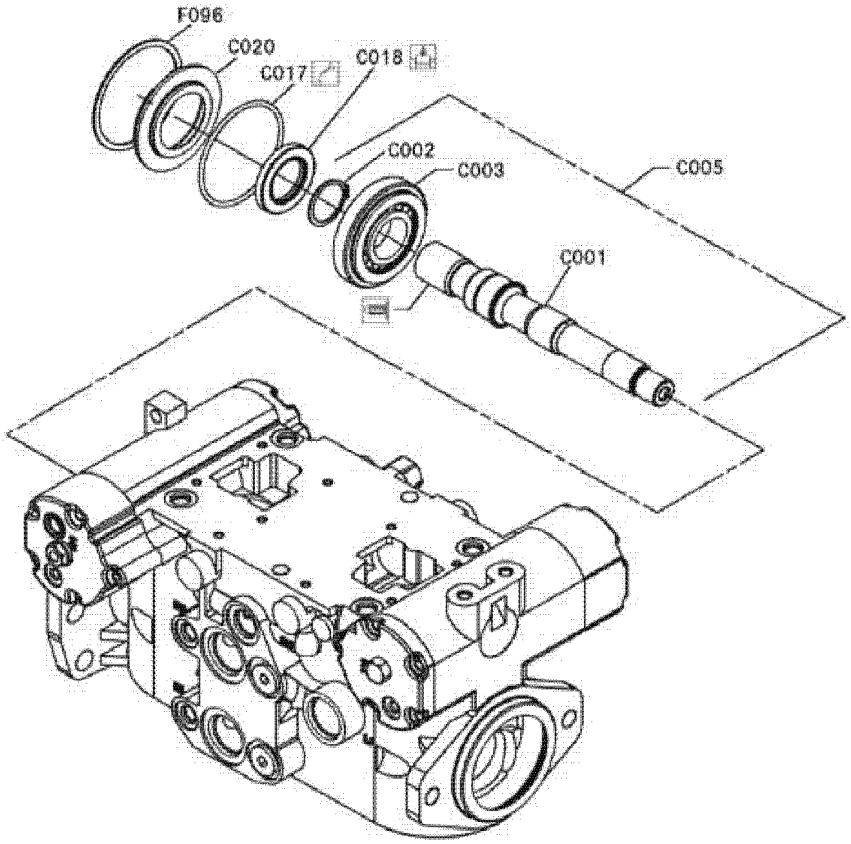


5. Using an 8mm internal HEX wrench, torque valve seat plug(K001) to 68-95 N•m [50-70 lbf•ft].



INSTALL FRONT SHAFT, BEARING, AND SEAL

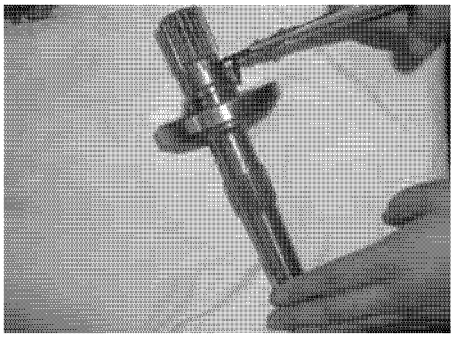
Installing Shaft, bearing, and seal



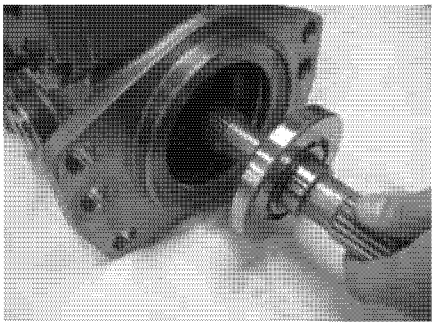
1. Lubricate and press bearing (C003) on shaft.

● Caution
Do not scratch the housing or shaft.

2. Install retaining ring (C002) using snap ring pliers.

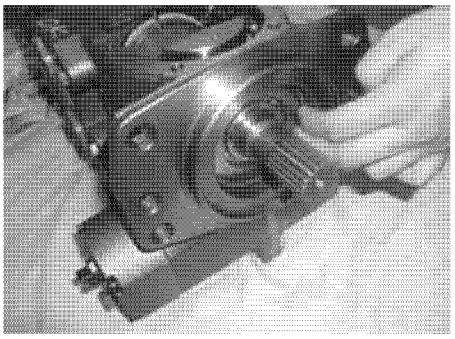


3. Install shaft with bearing into housing. ●

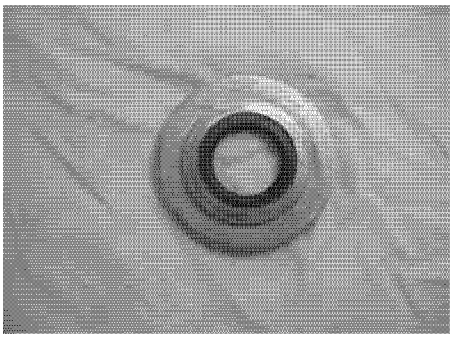


INSTALL FRONT SHAFT, BEARING, AND SEAL (continued)

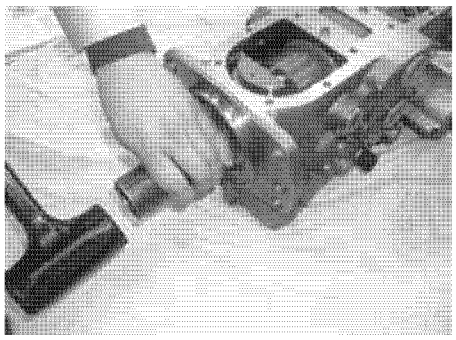
4. Lubricate and install O-ring (C017) into housing.



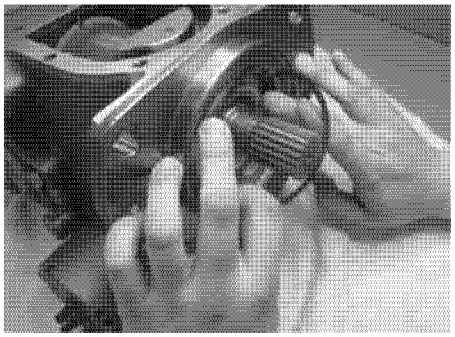
5. Press lip seal (C018) into seal carrier (C020).
Take care not to crush the seal.●



6. Cover shaft splines with an installation sleeve and evenly press seal carrier assembly into housing.
Install shaft seal carrier (C020) and lip seal (C018).

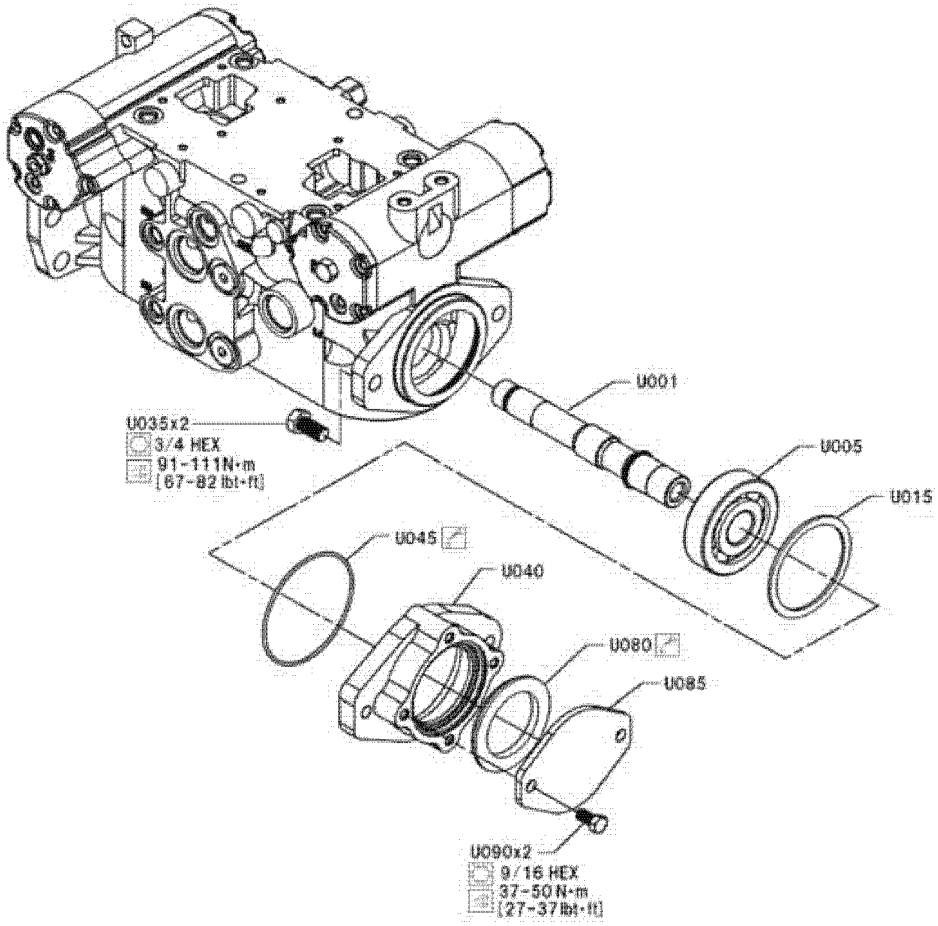


7. Install spiral retaining ring (F096).



INSTALL REAR SHAFT, BEARING, AND SEAL

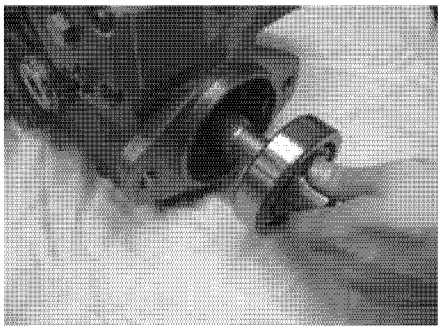
Installing rear shaft, bearing, and seal



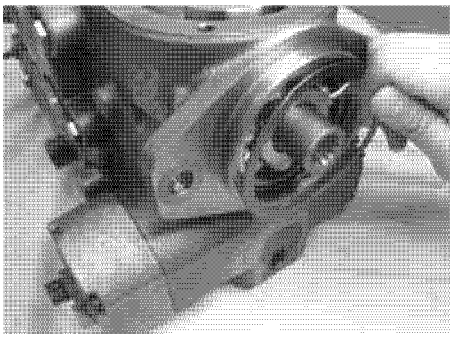
1. Lubricate and install bearing (U005) on shaft.

● Caution
Do not scratch the housing or shaft.

2. Install shaft with bearing, into housing.

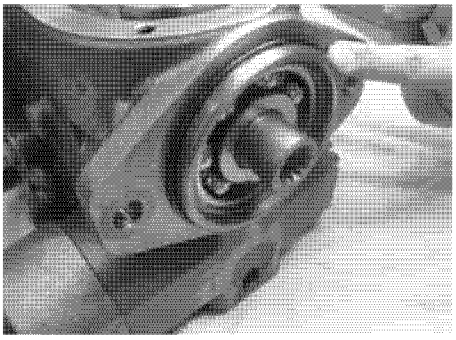


3. Install spiral retaining ring (U015).●

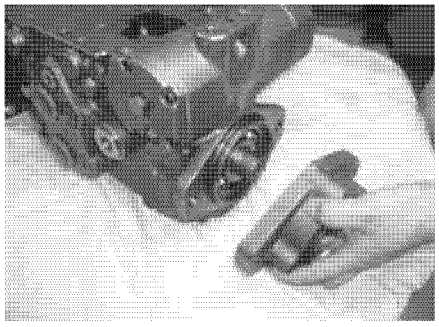


INSTALL REAR SHAFT, BEARING, AND SEAL (continued)

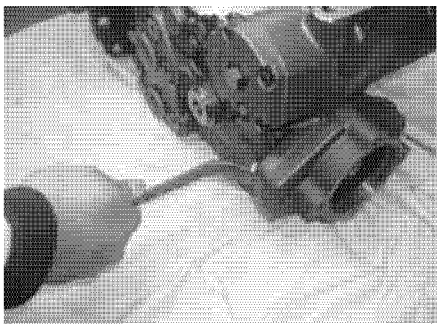
4. Lubricate and install O-ring (U045) on housing.



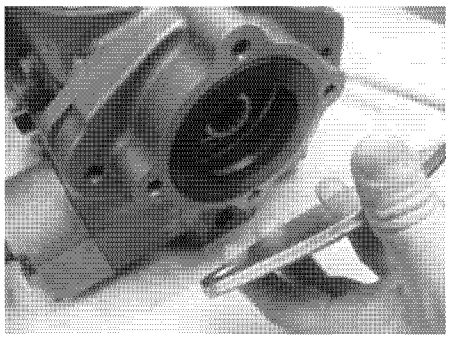
5. Install auxiliary pad (U040).



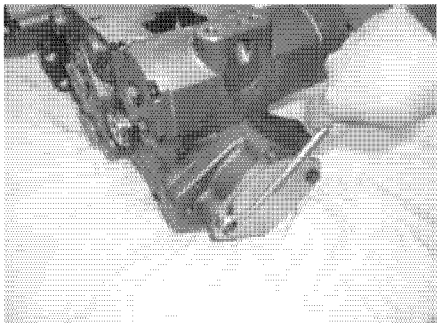
6. Using a 3/4 in. HEX wrench, install screws (U035). Torque screws to 91-111 N•m [67-82 lbf•ft].



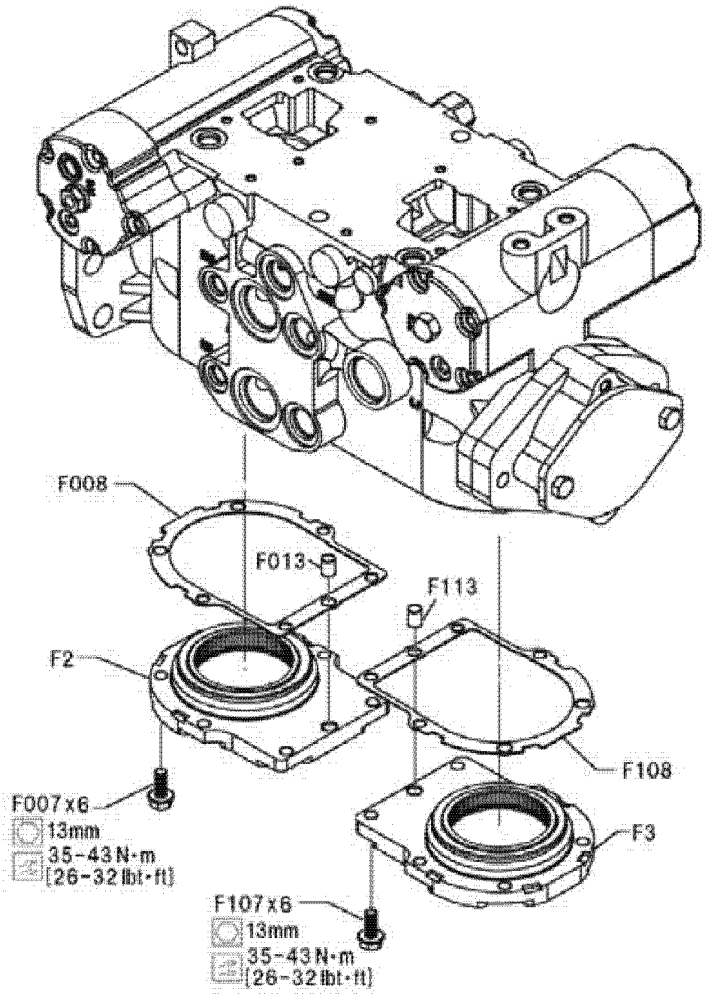
7. If necessary, lubricate and install Pad seal (U080) and shipping cover (U085).



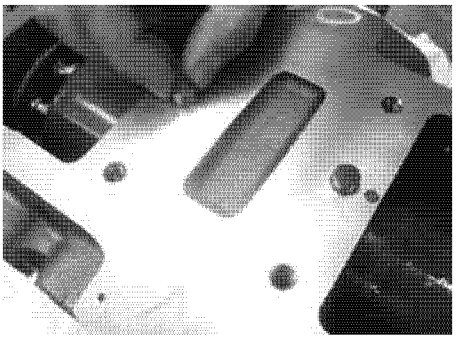
8. If necessary, using a 9/16 in. HEX wrench, install screws (U090). Torque screws to 37-50 N•m [27-37 lbf•ft].



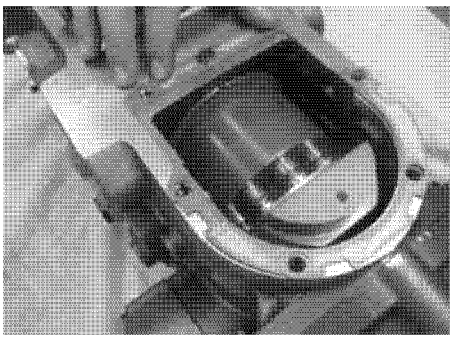
INSTALL SIDE COVER *Installing side cover*



1. Install the pin(F013,F113).

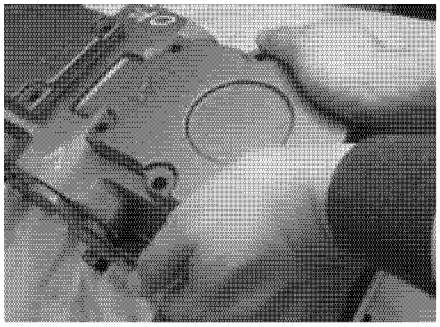


2. Install side cover gasket (F008, F108).

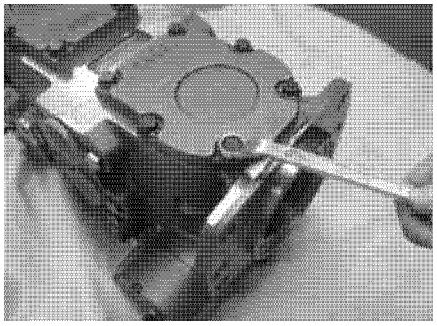


INSTALL SIDE COVER (continued)

3. Install side cover (F2, F3). Ensure the swashplate sets into the cradle bearings in the housing and side cover.

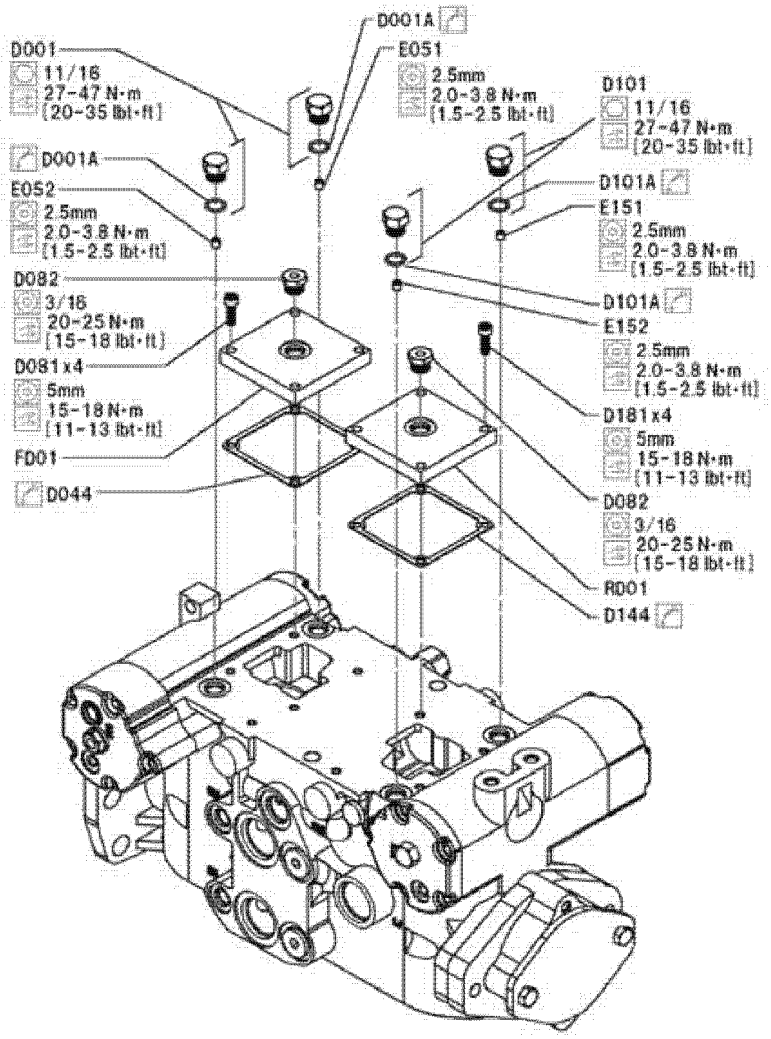


4. Using a 13mm HEX wrench, install six screws (F007, F107) for each cover and torque to 35-43 N•m [26-32 lbf•ft].

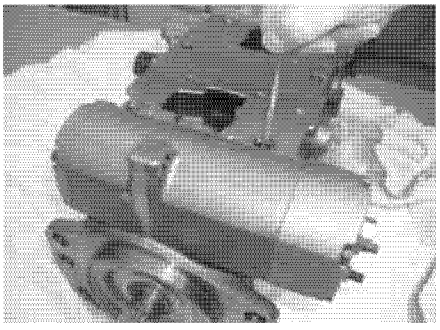


INSTALL ORIFICE AND CONTROL COVER

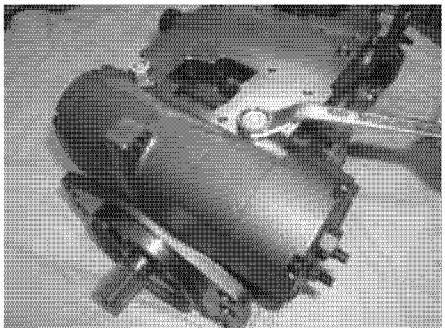
Installing orifice and control cover



1. If necessary, using a 2.5mm internal HEX wrench, install orifices (E051, E052, E151, E152). and torque to 2.0-3.8 N•m [1.5-2.5 lbf•ft].

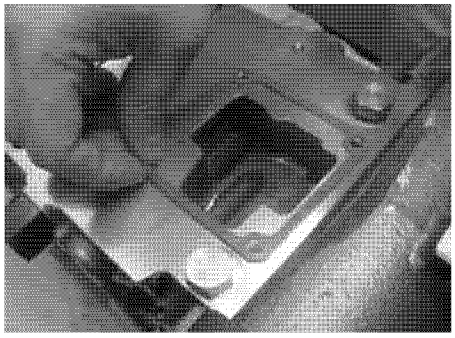


2. Using an 11/16 in. HEX wrench, install screws (D001, D101). Torque plugs to 27-47 N•m [20-35 lbf•ft].

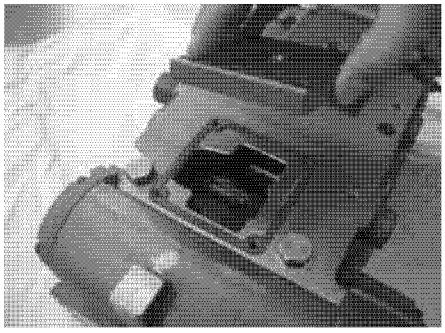


INSTALL ORIFICE AND CONTROL COVER (continued)

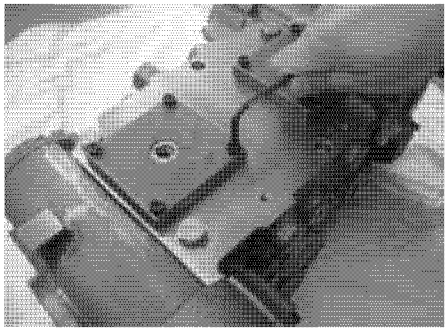
3. Install gaskets (D044 and D144).



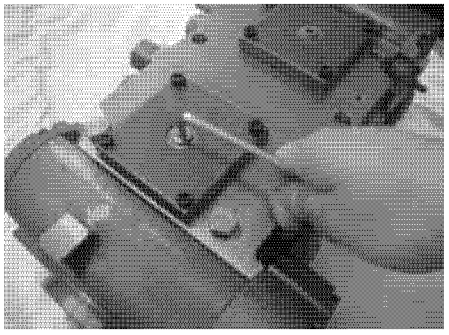
4. Install control cover (FD01, RD01).



5. Using a 5mm HEX wrench, install screws. (D081, D181) Torque screws to 15-18 N•m [11-13 lbf•ft].



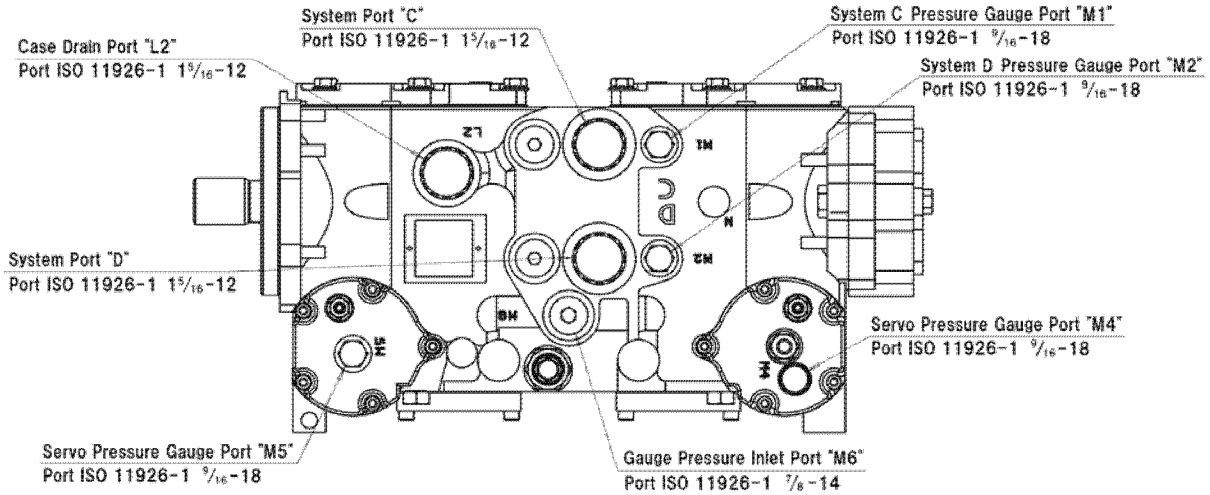
6. Using a 3/16 in. HEX wrench, install plug (D082 and D182). Torque plugs to 20-25 N•m [15-18 lbf•ft].

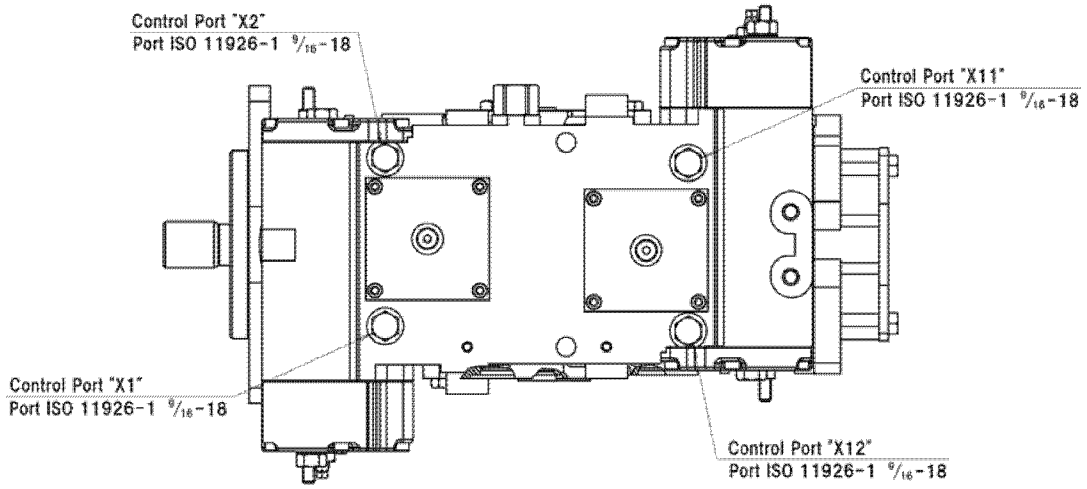


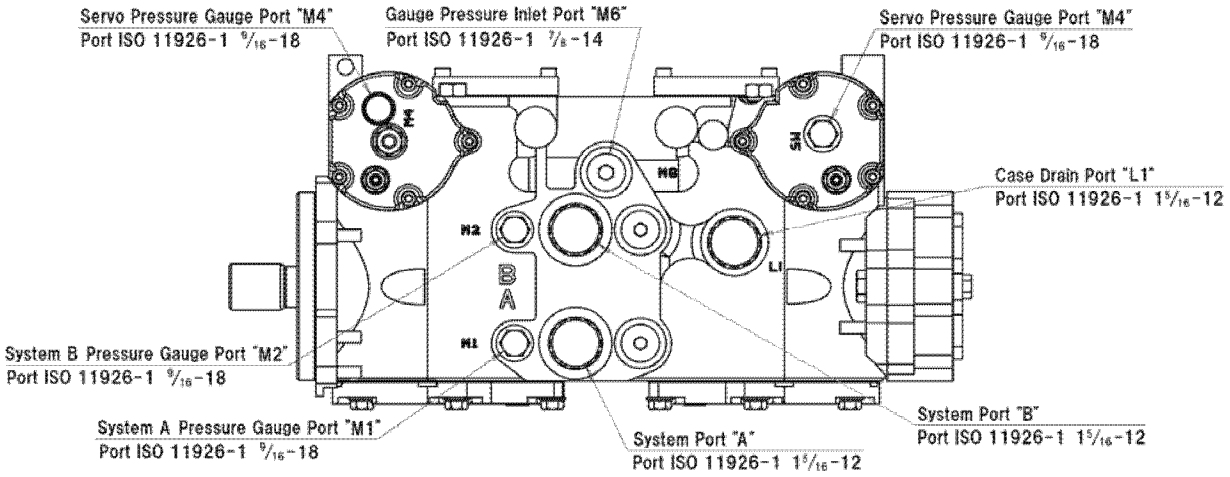
PORT SIZE

Port	Description	Sizes
A	System Port "A"	$1^{5}/_{16}$ - 12
B	System Port "B"	$1^{5}/_{16}$ - 12
C	System Port "C"	$1^{5}/_{16}$ - 12
D	System Port "D"	$1^{5}/_{16}$ - 12
L1	Case Drain Port "L1"	$1^{5}/_{16}$ - 12
L2	Case Drain Port "L2"	$1^{5}/_{16}$ - 12
M1	System "A" Pressure Gauge Port "M1"	$^{9}/_{16}$ - 18
M2	System "B" Pressure Gauge Port "M2"	$^{9}/_{16}$ - 18
M1	System "C" Pressure Gauge Port "M1"	$^{9}/_{16}$ - 18
M2	System "D" Pressure Gauge Port "M2"	$^{9}/_{16}$ - 18
M4 x2	Servo Pressure Gauge Port "M4"	$^{9}/_{16}$ - 18
M5 x2	Servo Pressure Gauge Port "M5"	$^{9}/_{16}$ - 18
M6 x2	Charge Pressure Inlet Port "M6"	$^{7}/_{8}$ - 14
X1	Control Port "X1"	$^{9}/_{16}$ - 18
X2	Control Port "X2"	$^{9}/_{16}$ - 18
X11	Control Port "X11"	$^{9}/_{16}$ - 18
X12	Control Port "X12"	$^{9}/_{16}$ - 18

PORT SIZE (continued) *Port locations*







PART SIZE AND TORQUE CHART

Plug

Item	Description	Screw Size	Head Size	Torque N·m [ft·lb]	Quantity
D001	Plug	9/16 -18	11/16 in. HEX	27-47 [20-35]	2
D082	Plug	7/16 -20	3/18 in. internal HEX	20-25 [15-18]	1
D101	Plug	9/16 -18	11/16 in. HEX	27-47 [20-35]	2
D182	Plug	7/16 -20	3/18 in. internal HEX	20-25 [15-18]	1
E051	NFPH Orifice	M 6 X 6	2.5mm internal HEX	2.0-3.8 [1.5-2.5]	1
E052	NFPH Orifice	M 6 X 6	2.5mm internal HEX	2.0-3.8 [1.5-2.5]	1
E151	NFPH Orifice	M 6 X 6	2.5mm internal HEX	2.0-3.8 [1.5-2.5]	1
E152	NFPH Orifice	M 6 X 6	2.5mm internal HEX	2.0-3.8 [1.5-2.5]	1
F093	Plug	9/16 -18	11/16 in. HEX	27-47 [20-35]	1
F094	Plug	9/16 -18	11/16 in. HEX	27-47 [20-35]	1
F193	Plug	9/16 -18	11/16 in. HEX	27-47 [20-35]	1
F194	Plug	9/16 -18	11/16 in. HEX	27-47 [20-35]	1
K007	SCR Plug	7/8 -14	8mm internal HEX	68-95 [50-70]	4
L010	Plug	9/16 -18	11/16 in. HEX	27-47 [20-35]	1
L110	Plug	9/16 -18	11/16 in. HEX	27-47 [20-35]	1
M010	Plug	9/16 -18	11/16 in. HEX	27-47 [20-35]	1
M110	Plug	9/16 -18	11/16 in. HEX	27-47 [20-35]	1
T041	CPRV Plug	7/8 -14	1·1/16 in. HEX	54-136 [40-100]	1

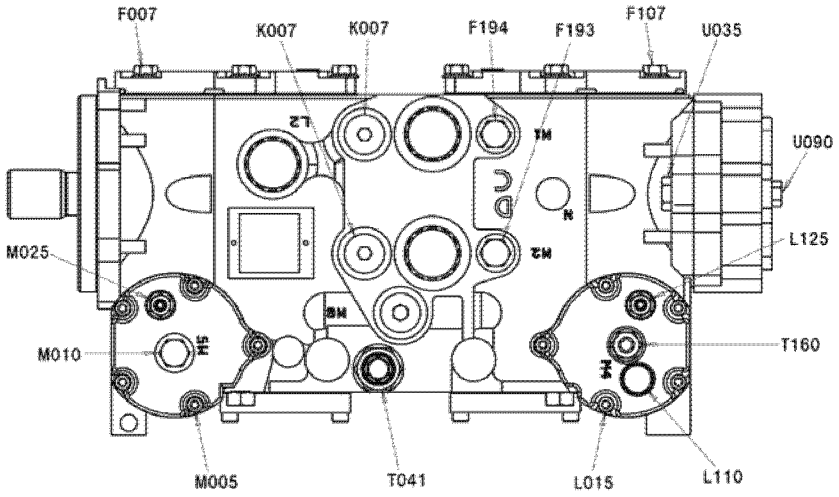
Screw

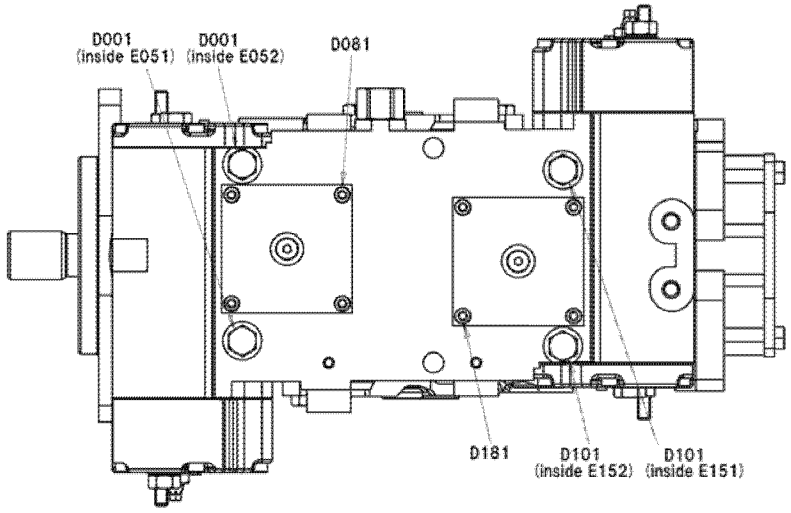
Item	Description	Screw Size	Head Size	Torque N·m [ft·lb]	Quantity
D081	NFPH Window Cover Screw	M 6 X 20	5mm internal HEX	15-18 [11-13]	4
D181	NFPH Window Cover Screw	M 6 X 20	5mm internal HEX	15-18 [11-13]	4
F007	Side Cover Screw	M 8 X 20	13mm HEX	35-43 [26-32]	6
F107	Side Cover Screw	M 8 X 20	13mm HEX	35-43 [26-32]	6
L005	Servo Screw	M 6 X 60	5mm internal HEX	15-18 [11-13]	5
L015	Servo Screw	M 6 X 60	5mm internal HEX	15-18 [11-13]	5
M005	Servo Screw	M 6 X 30	5mm internal HEX	15-18 [11-13]	5
M015	Servo Screw	M 6 X 30	5mm internal HEX	15-18 [11-13]	5
U035	Adapter Flange Bolt	1/2 -13	3/4 in. HEX	91-111 [67-82]	2
U090	A-Pad Bolt	3/8 -16	9/16 in. HEX	37-50 [27-37]	2

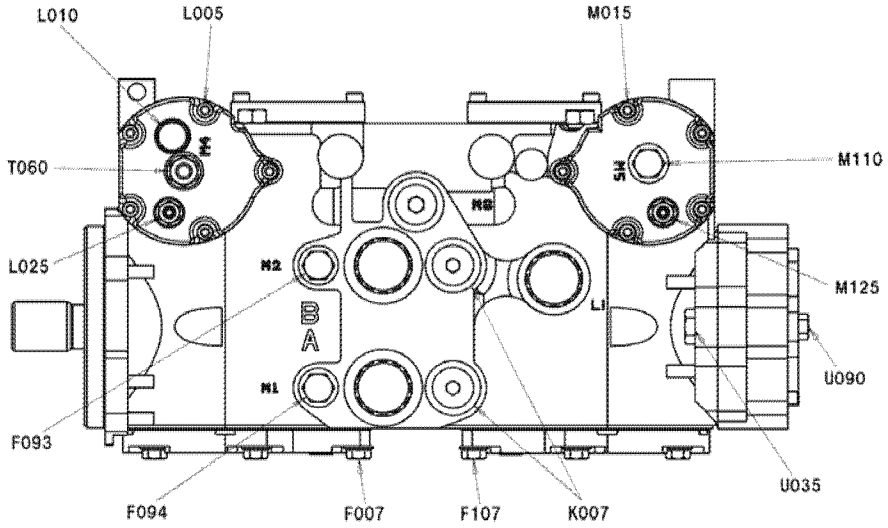
Nut

Item	Description	Screw Size	Head Size	Torque N·m [ft·lb]	Quantity
L025	Displacement Limiter Seal Nut	M 8	13mm HEX	20-26 [15-19]	1
L125	Displacement Limiter Seal Nut	M 8	13mm HEX	20-26 [15-19]	1
M025	Displacement Limiter Seal Nut	M 8	13mm HEX	20-26 [15-19]	1
M125	Displacement Limiter Seal Nut	M 8	13mm HEX	20-26 [15-19]	1
T060	Seal Nut	M 10	17mm HEX	31-50 [23-37]	1
T160	Seal Nut	M 10	17mm HEX	31-50 [23-37]	1

PART LOCATIONS

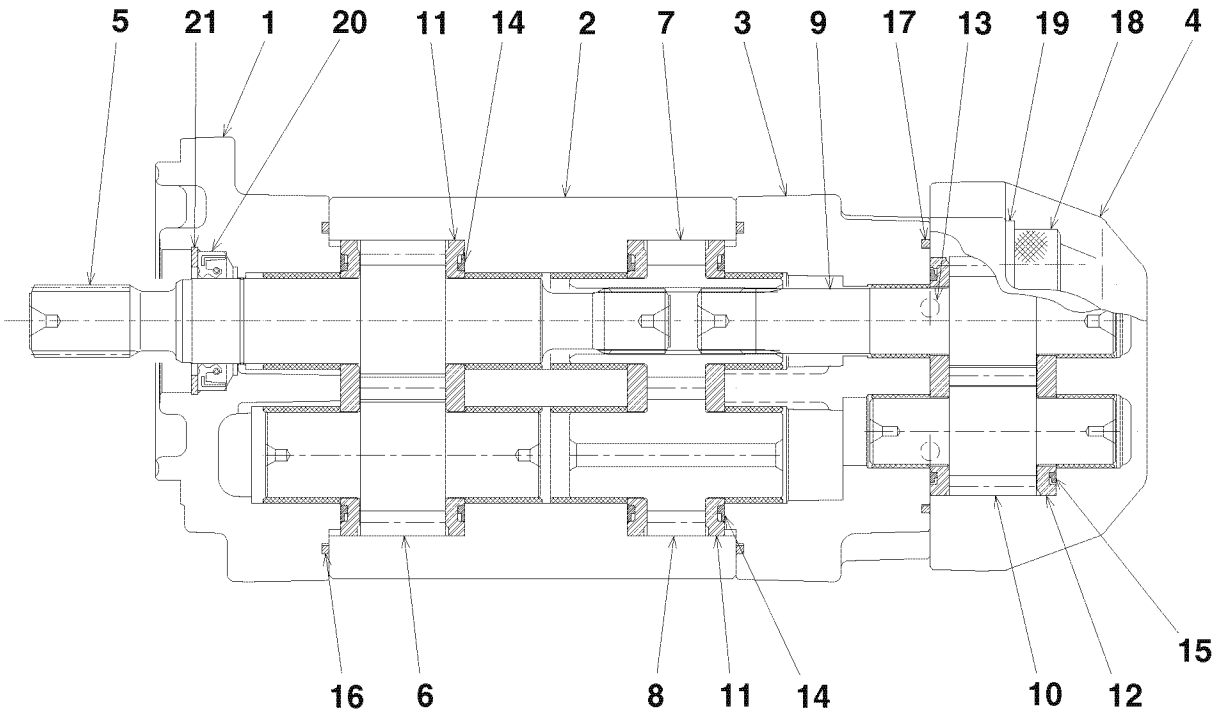






6-4. Gear Pump

1. Construction

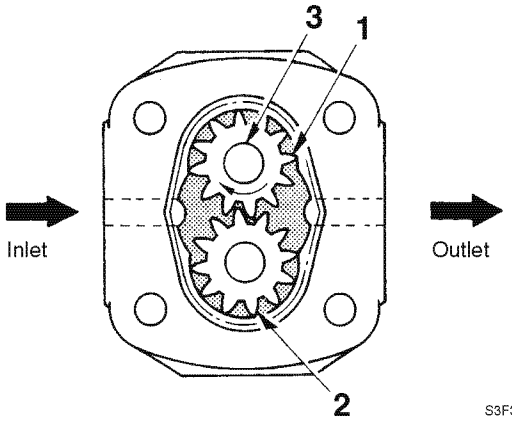


S3F350

No.	Part	Q'ty	No.	Part	Q'ty	No.	Part	Q'ty
1	Flange	1	8	Driven gear	1	15	Gasket	2
2	Front housing	1	9	Drive gear	1	16	Gasket	2
3	Adapter plate	1	10	Driven gear	1	17	Gasket	1
4	Rear housing	1	11	Bushing	4	18	Cap screw	4
5	Drive gear	1	12	Bushing	2	19	Washer	4
6	Driven gear	1	13	Steel ball	2	20	Oil seal	1
7	Drive gear	1	14	Gasket	4	21	Snap ring	1

2. Opration

The gear pump consists of a single gear case, inside of which is a drive gear (1) and a driven gear (2) engaged with each other. By turning the drive shaft (3), the space between the case and the gears is filled with oil. This oil is thus sent through the pump from the inlet to the outlet.



S3F351E

3. Disassembly and assembly

1) Precautions in disassembly and assembly

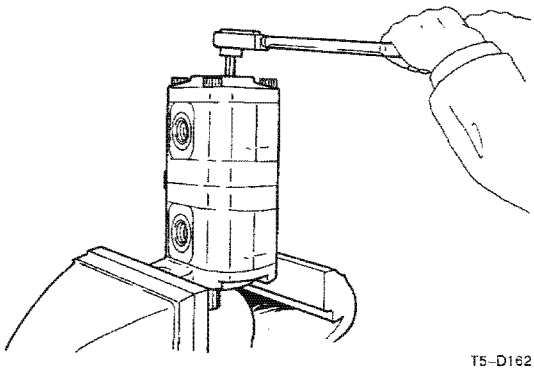
1. Carry out disassembly and assembly operations in a clean place and provide clean containers to place the disassembled parts in.
2. Before disassembly, clean around the ports and remove the paint from each joint using a wire brush.
3. Clean each of the disassembled parts with a cleaning oil.
4. Make match marks on each part so that they will be assembled in the same positions when assembled.
5. Replace all seals with new ones each time the unit is disassembled, coating them lightly with grease.
6. Check each part to make sure there is no abnormal wear or seizing and use sandpaper, etc. to remove any burrs, sharp edges, etc.
7. Adjust adjustment screws only when required.

In the following, disassembling procedures of the gear pump will be described. For reassembling, follow these procedures in reverse order.

2) Disassembly

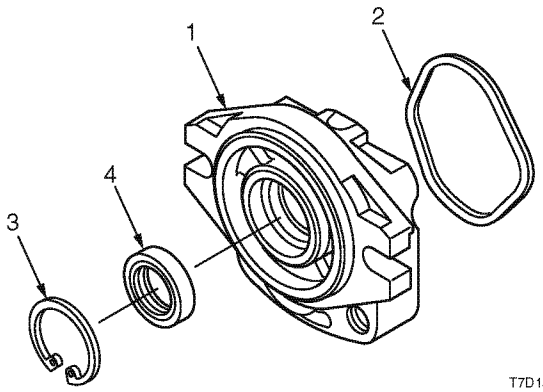
(1) Remove the four cap screws.
- Attach mating marks on individual parts for later reassembling.

Tightening torque: 65.1 to 72.3 ft·lbf (88.2 to 98.1 N·m)


T5-D162

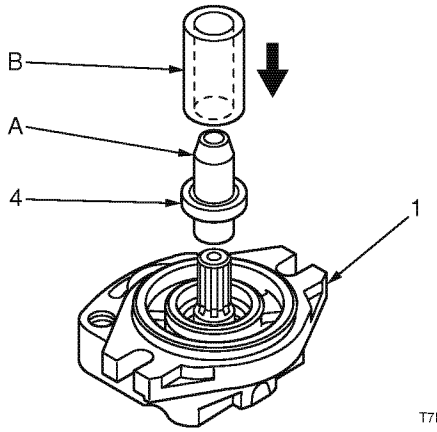
(2) Remove the flange (1).

(3) Remove the gasket (2) from the flange (1).



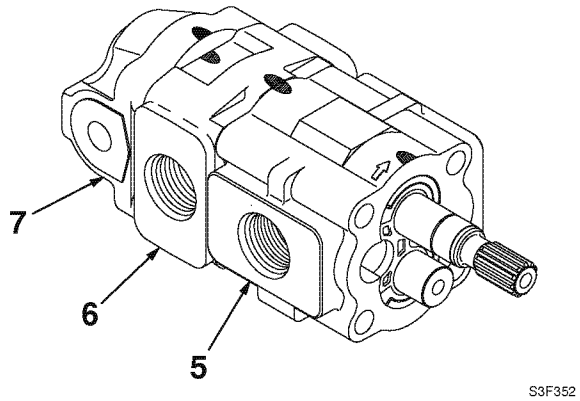
T7D151

(4) Remove the snap ring (3) and the oil seal (4) from the flange.
- Take care not to damage the flange.
- When reassembling, use the jigs A and B to install the oil seal.



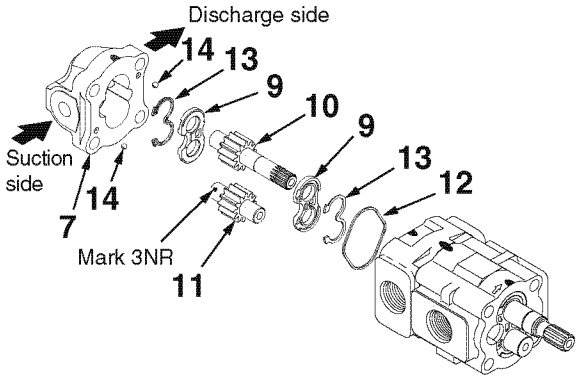
T7D152

(5) Remove the front housing (5), the adapter plate (6), and the rear housing (7).



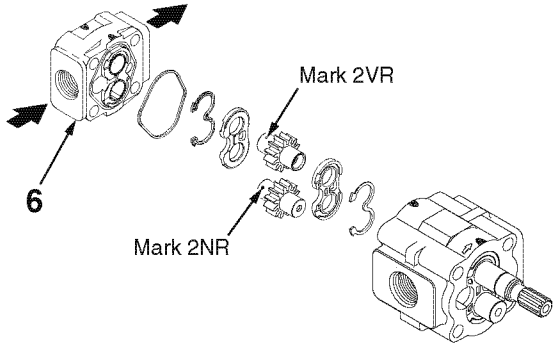
S3F352

(6) Disassemble the rear pump as follows:
   a. Remove the bushing (9), the drive gear (10) and the driven gear (11).
      • When reassembling, insert the driven gear side with the mark "3NR" into the rear housing (7).
      • When reassembling, position the bushing (9) so that its flat surface without the groove for the gasket (13) faces the gear.
      • When reassembling, position the outlet port and the intake port properly.
   b. Remove the gasket (12), and remove the gasket (13) from the bushing (9).
      • When reassembling, use a new gasket.
      • When reassembling, secure the gasket with grease, and do not allow any warping or pinching.
   c. Remove the steel ball (14).
      • Take care not to lose the ball.



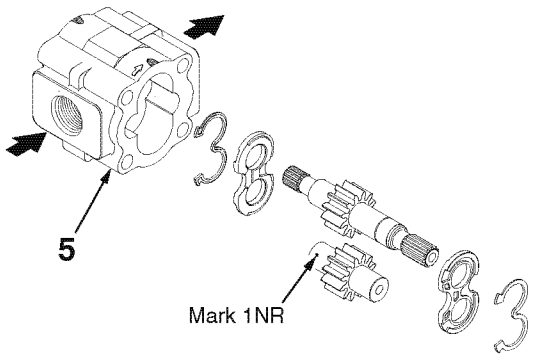
S3F353E

(7) Disassemble the center pump.
   • Follow the same procedure as disassembling of the rear pump.
   • When reassembling, insert the driven gear side with the mark "2NR" and the drive gear side with the mark "2VR" into the adapter plate (6) side.



S3F354E

(8) Disassemble the front pump.
   • Follow the same procedure as disassembling of the rear pump.
   • When reassembling, insert the driven gear side with the mark "1NR" into the front housing (5) side.



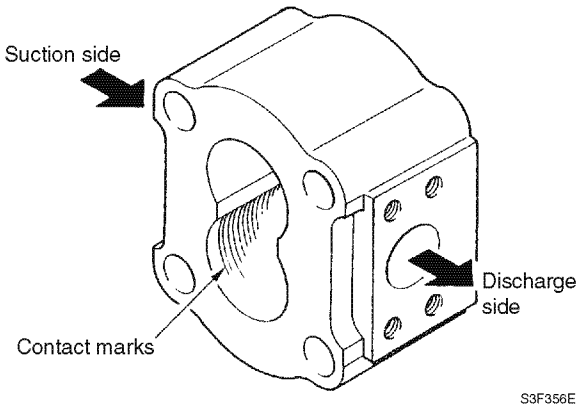
S3F355E

4. Inspection and adjustment

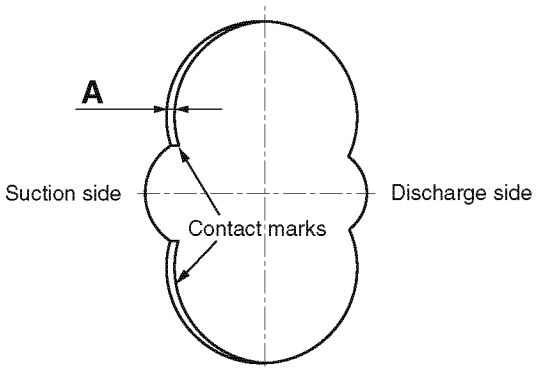
1) Checking parts

After checking the disassembled parts for dirt or discoloration, clean them with diesel fuel. However, do not let diesel fuel get on rubber parts. Check each part for the following points and if there is any trouble, repair or replace the part.

Housing



S3F356E



Depth of contact marks : A ≧ 0.0059 in. (0.15 mm) S3F357E

The gear pump is made so that the crests of the gear teeth make light contact with the housing walls as a means of increasing its efficiency. Therefore, contact marks can be seen near the inlet port in any pump that has been operated.

It is normal if the depth of the contact marks is within 0.004 in. (0.1 mm). If the depth exceeds the use limit in the above figure, replace the pump assembly.

Bushing

The ideal situation is for the sliding surfaces to have no roughness and for the inlet side half to be lustrous. Also, it is satisfactory if strong contact marks can be seen on the side surface on the suction side and minute contact marks can be seen on the discharge side.

- Contact marks can be seen on the sliding surface of the entire bearing inner diameter and it is so rough that it looks like it has been clawed.
- There is a large number of scratches around the circumference of the side surface and it is so rough that it looks like it has been clawed.
- There are marks from foreign matter biting into the sliding surface of the bearing inner diameter and the side surface.

Dirty hydraulic oil is one likely cause of such wear. In such a case, replace the hydraulic oil and flush out affected hydraulic circuit completely.

Other likely causes are as follows.

- Excessive load due to damage to the relief valve.
- Cavitaion or aeration.
- Hydraulic oil temperature is too high.
- Hydraulic oil is deteriorated.
- Hydraulic oil's viscosity is low.

If it is necessary to replace the bushings, this means that the gear shaft and gear side surfaces are also rough or worn severely, so replace the gears at the same time as the bushings are replaced.

Gear

Replace a gear if it is in the following condition.

(1) The shaft or the gear side surfaces ar so rough that they look like they have been clawed.
(2) There are cracks in the tooth roots and there is extreme abnormal wear in the tooth surfaces.

Seals

- Check seals for scratches in the seal surface, wear, deformation or deterioration of the rubber's elasticity. If a seal is abnormal, replace it.
- Replace when the hydraulic pump is disassembled.
- Check backup ring for scaling and cutting. If it is abnormal, replace it.

2) Test operation

The best method for testing the pump's operation is to mount it in a test stand. However, if that cannot be done, test it under the conditions it would be subjected to if it were installed in the machine.

Also, if any abnormal wear is discovered during disassembly, be sure to replace the hydraulic oil and return filter.

(1) Install a pressure gauge in the high pressure piping near the pump.
(2) Run the engine at 500 ~ 1,000 rpm and set the control valve in the neutral position.
(3) Run the pump for 10 minutes under the conditions in (2), then increase the engine's speed to 1,500 to 2,000 rpm and run it for another 10 minutes.
(4) Next, run the pump so that it reaches the rated pressure for 5 minutes at a time for each additional 280 to 430 psi (1.96 to 2.94 MPa) of pressure.

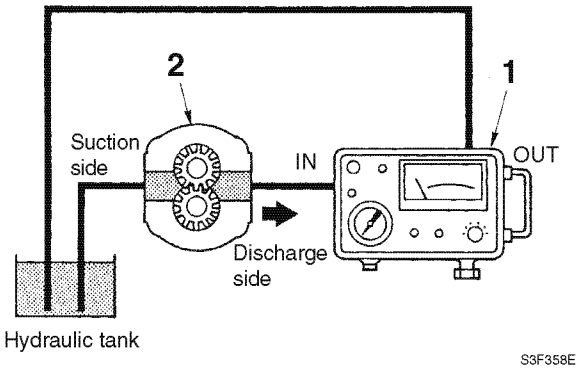
After operating each ciruit for about 5 minutes, replace the return filter or clean it.

In addition, during the process of raising the pressure, pay careful attention to the oil temperature, the pump's surface temperature and the operating noise. If the oil temperature or the pump's surface temperature become abnormally high, eliminate the load from the pump and let the temperature drop before resuming the test.

3) Measuring the discharge volume

After completing the test operation, measure the discharge volume.

(1) Connect a tester (1) to the discharge side of the pump (2).
    - There should be no mistakes made in the tester's pipe installation.
(2) Open the tester's loading valve and start the engine.
(3) Run the engine at the rated speed.
(4) Gradually close the loading valve and apply the rated pressure to the pump (2).
(5) Measure the discharge volume and the pump's speed (engine speed).



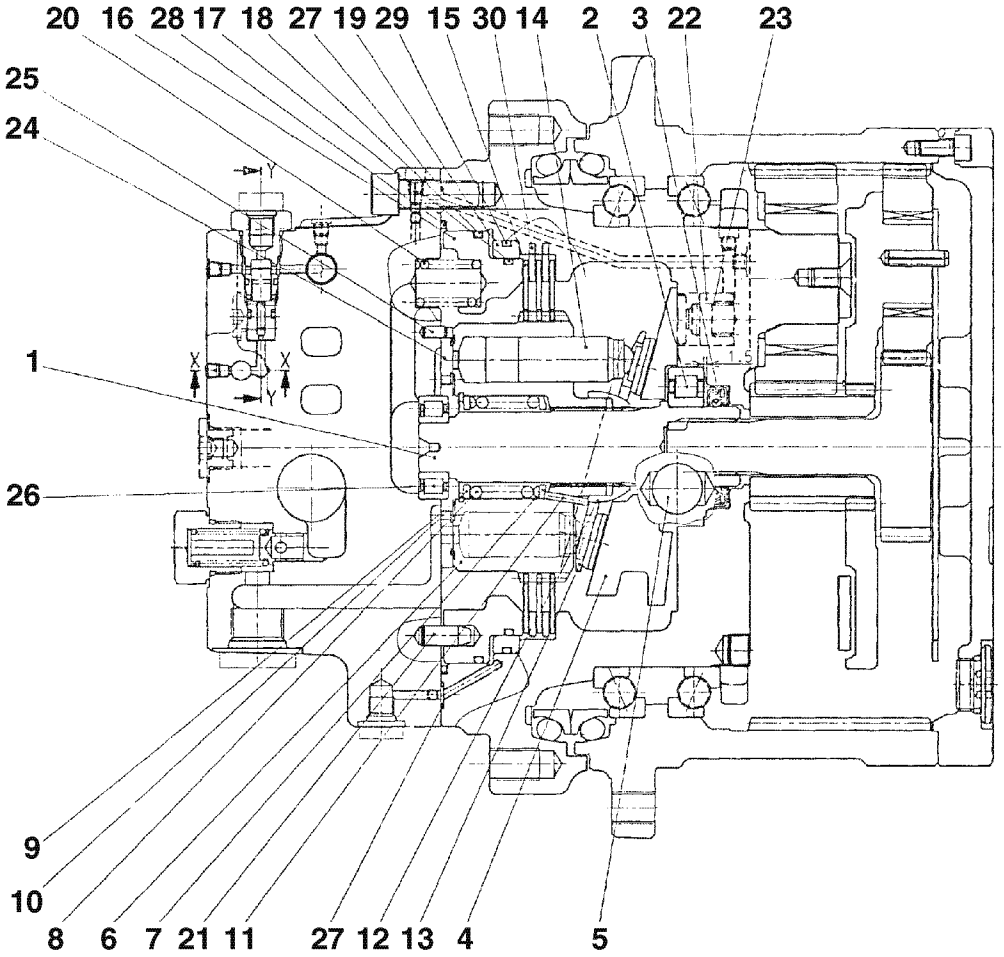
5. Troubleshooting

Trouble	Probable causes	Measures
Pump won't discharge.	• Direction of rotation is reversed. • Oil level in the tank is low. • Suction side pipe or suction filter is clogged. • Hydraulic oil's viscosity is too high. • Speed is low.	• Run the pump in the specified direction. • Replenish the oil to the specified level. • Clean the pipes. • Replace the hydraulic oil with oil of the proper viscosity. • Run the pump at the specified speed.
Noise level is high. Abnormal noise is generated.	• Suction side hose is crushed, the suction filter is clogged or cavitation is occurring. • Suction side joint is loose and air is being sucked in. • Hydraulic oil's viscosity is too high, and cavitation is occurring. • Pump and engine are out of center with respect to each other. • There are bubbles in the hydraulic oil.	• Remove the dirt or eliminate the crushed condition of the hose. • Tighten all the joint. • Replace the hydraulic oil with oil of the proper viscosity. • Correct the centering between the pump and engine. • Investigate the cause of the bubbles and correct it.
Oil leaks from oil seals.	• Oil seal is worn, damaged or deformed.	• Replace the oil seal.
Oil leaks from mating surfaces between housing and flange and between housing and cover.	• Body seal is damaged or worn by rubbing.	• Replace with a new part.
Discharge volume is low.	• Bushing seal is damaged. • Cavitation is occurring. • Aeration is occurring. • Viscosity of the hydraulic oil is too low.	• Replace the bushing. • Clean the suction filter and suction side piping. • Check for insufficient tightening of pipes, etc. and repair. • Replace the hydraulic oil with oil of the proper viscosity.

6-5. Travel Motor

1. Construction

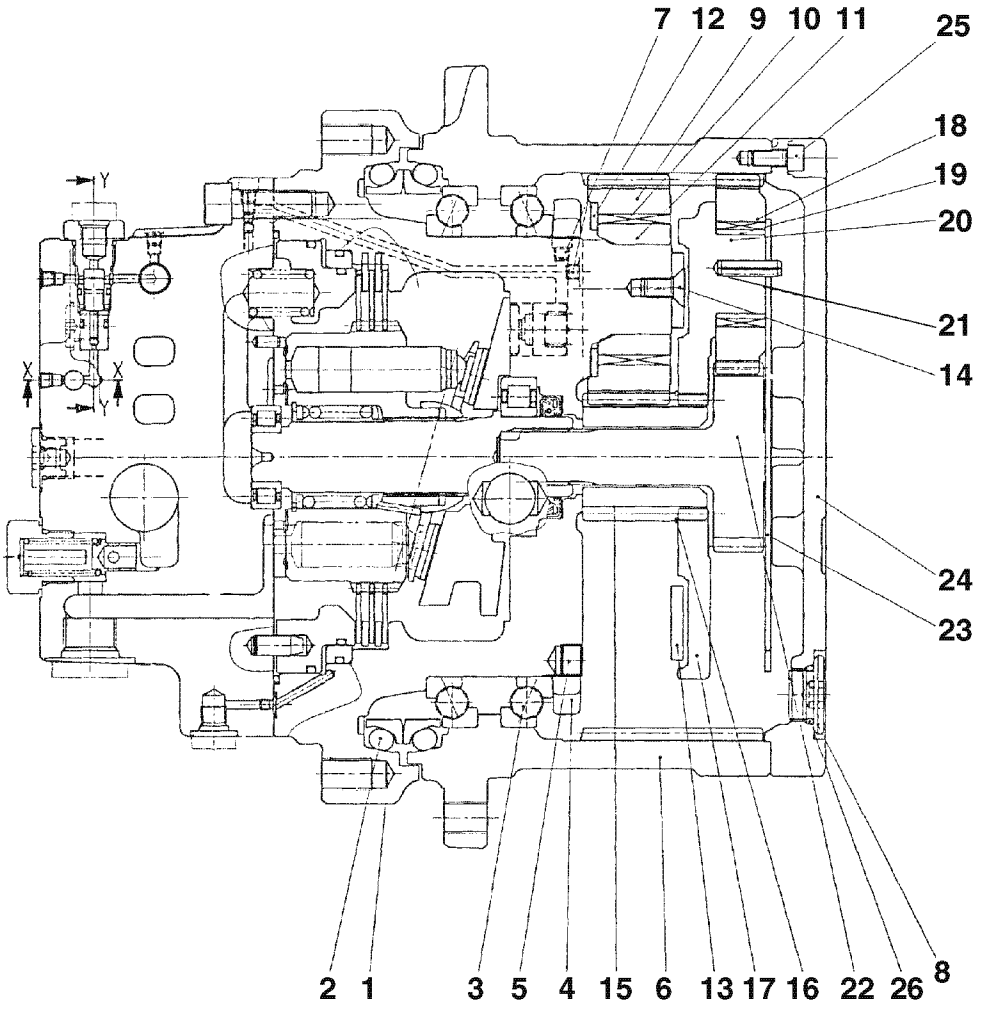
1) Hydraulic motor



S3F400

No.	Part	Q'ty	No.	Part	Q'ty	No.	Part	Q'ty
1	Shaft	1	11	Pin	3	21	Pin	4
2	Roller bearing	1	12	Guide	1	22	Piston assembly	2
3	Oil seal	1	13	Shoe holder	1	23	Spring	2
4	Swash plate	1	14	Piston assembly	9	24	Valve plate	1
5	Steel ball	2	15	Disc	3	25	Pin	1
6	Cylinder block	1	16	Brake piston	1	26	Roller bearing	1
7	Collar	1	17	O-ring	1	27	O-ring	4
8	Spring	1	18	O-ring	1	28	O-ring	1
9	Collar	1	19	Collar	1	29	O-ring	1
10	Snap ring	1	20	Spring	8	30	Friction disc	2

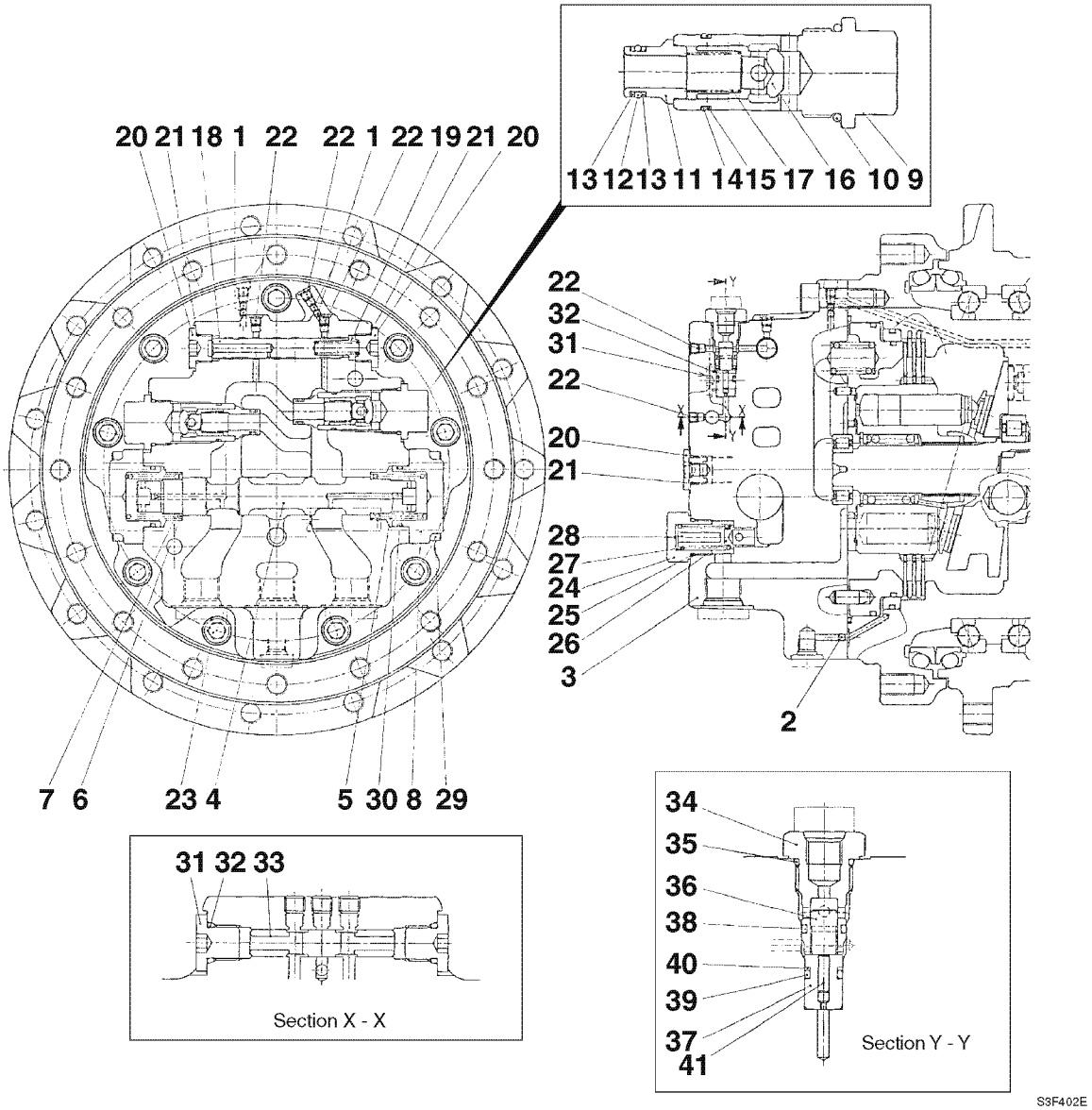
2) Reduction gear



S3F401

No.	Part	Q'ty	No.	Part	Q'ty	No.	Part	Q'ty
1	Flange holder	1	10	Needle bearing	4	19	Needle bearing	3
2	Floating seal	2	11	Floating bushing	4	20	Inner race	3
3	Angular bearing	2	12	Thrust washer	4	21	Spring pin	3
4	Ring nut	1	13	Thrust plate	1	22	Drive gear	1
5	Plug	4	14	Screw	4	23	Thrust plate	1
6	Housing	1	15	Sun gear	1	24	Cover	1
7	Plug	4	16	Snap ring	1	25	Cap screw	16
8	Plug	3	17	Holder	1	26	O-ring	3
9	Planetary gear B	4	18	Planetary gear A	3			

3) Flushing valve, automatic 2-speed switching and check valve



No.	Part	Q'ty	No.	Part	Q'ty	No.	Part	Q'ty
1	Orifice	4	15	Backup ring	1	29	Cap screw	8
2	Orifice	1	16	Check valve	1	30	O-ring	2
3	Base plate	1	17	Spring	1	31	Plug	4
4	Plunger	1	18	Spool	1	32	O-ring	4
5	Orifice	2	19	Spring	1	33	Spool	1
6	Spring seat	2	20	Plug	4	34	Plug	1
7	Spring	2	21	O-ring	4	35	O-ring	1
8	Flange	2	22	Plug	12	36	Spool	1
9	Plug	1	23	Cap screw	9	37	Collar	1
10	O-ring	1	24	Plug	1	38	O-ring	1
11	Collar	1	25	O-ring	1	39	O-ring	1
12	O-ring	1	26	Poppet	1	40	Backup ring	1
13	Backup ring	2	27	Spring	1	41	Pin	1
14	O-ring	1	28	Spring seat	1			

2. Operation

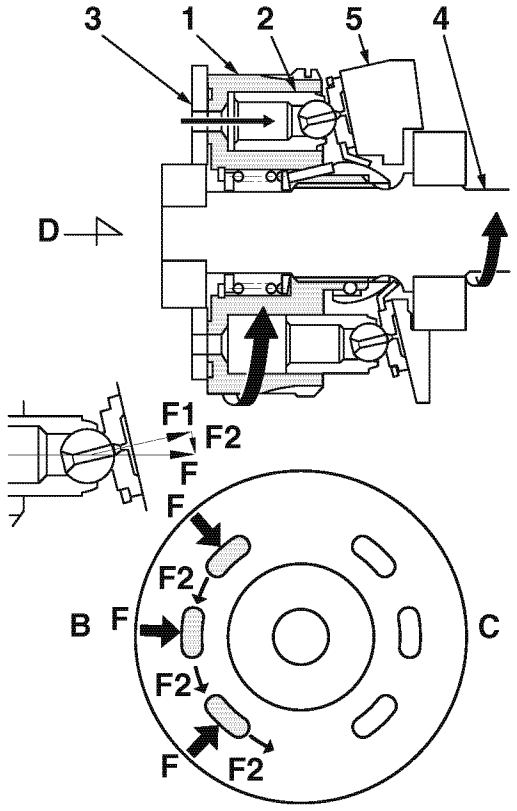
1) Hydraulic motor

9 pistons (2) are fitted in the cylinder block (1) and there is a valve plate (3) with two half moon ports, B and C in the end. Also, the cylinder block (1) rotates freely and is joined to the shaft (4) via the spline. On the other band, the swash plate (5) is fastened to the housing.

When high pressure oil is introduced into port B, one piston (2) makes contact and force F bears on the swash plate (5).

F = P × A P: Pressure A: Piston Sectional Area

The force F which the piston (2) applies to the swash plate (5) is divided into force F1, which pushes the plate, and force F2, which rotates the cylinder block (1). The total sum of the components in the direction of rotation of the high pressure side piston generates a rotational force in the cylinder block (1) and via the spline, torque is transmitted to the shaft (4), turning it. Conversely, if high pressure oil is introduced to port C, rotation is the reverse of the above.



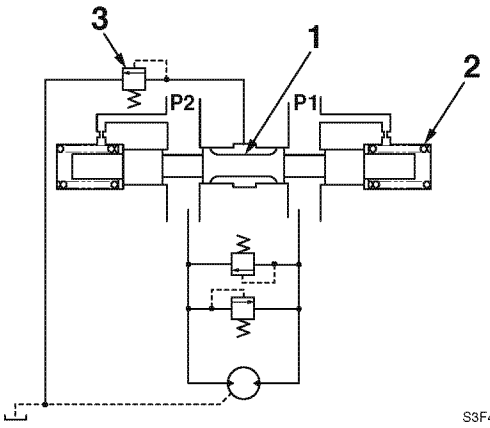
S3F403E

2) Flushing valve

This valve is used to replace the oil in the closed circuit with a new one to restrain the oil temperature increase and to remove the contaminants from the circuit.

When the travel stops, the ports P1 and P2 have no pressure, and the plunger (1) is placed at the neutral position by the spring (2).

At this time, the hydraulic channel to the low-pressure relief valve (3) is closed.



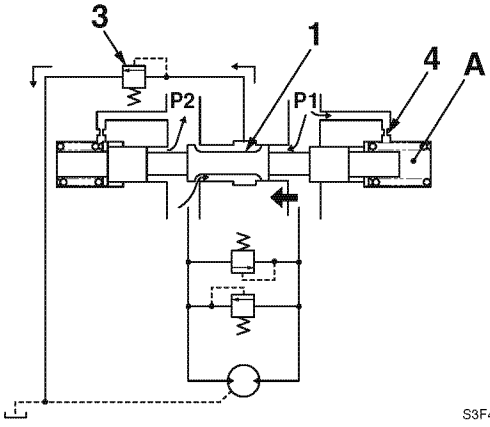
S3F404

When the pressure oil from the pump enters the port P1 during traveling, the oil flows into the chamber A through the orifice (4).

When the pressure in the chamber A becomes higher than the stipulated value, the plunger (1) moves to the left, opening the circuit to the low-pressure relief valve (3).

When the oil pressure at the port P2 becomes higher than the stipulated value for the low-pressure relief valve (3), the oil in the closed circuit partially returns from the low-pressure relief valve (3) to the tank.

When the oil in the closed circuit partially returns to the tank, the charge pump replenishes the lost oil in the closed circuit. Therefore, the oil in the closed circuit is continually replaced with new oil.

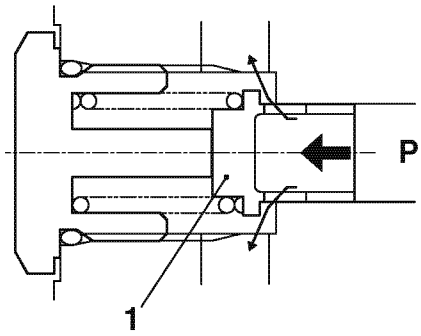


S3F405

3) Low-pressure relief valve

This valve releases the oil in the closed circuit from the flushing valve to the tank to keep the charge pressure of the charge pump constant.

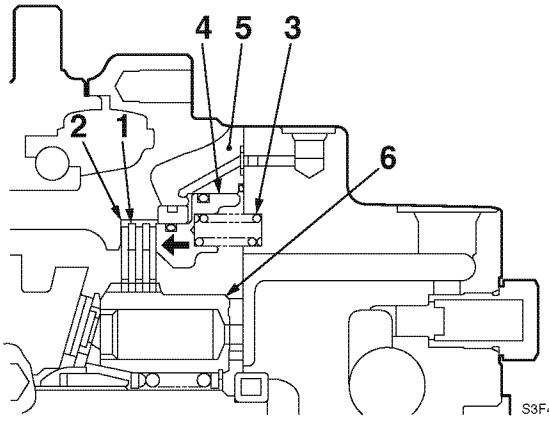
When the pressure at the port P becomes higher than the stipulated value, the poppet (1) moves to the left, allowing the oil from the port P to flow into the tank port.



S3F406

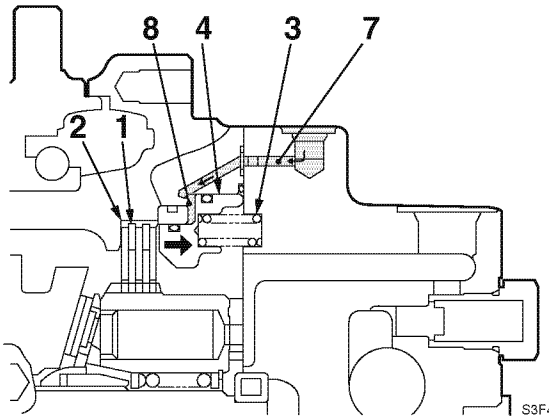
4) Parking brake

Friction disks (1) and disks (2) are connected via a spline. Friction disks (1) and disks (2) are held down against flange holder (5) by spring (3) with the power of the spring passing through brake piston (4). The friction between these disks generates brake torque and prevents cylinder block (6) from rotating.



S3F407

When hydraulic oil reaches the motor it flows out of release port (7) of the parking brake until it reaches brake piston chamber (8) and overcomes the force of the spring and causes brake piston (4) to move to the right. This opens up a space between friction disks (1) and (2), resulting in the parking brake being released. When the motor stops, oil stops running to release port (7) of the parking brake, resulting in the force of spring (3) causing the parking brake to engage.

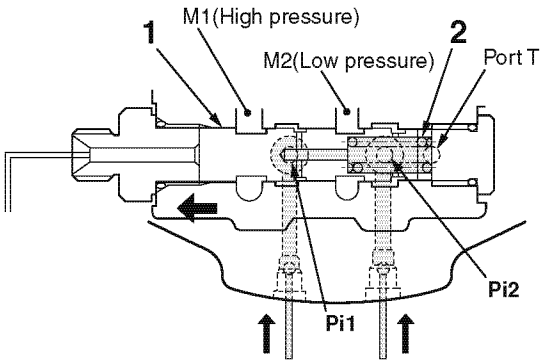


S3F408

5) 2-speed mechanism

2-speed control valve

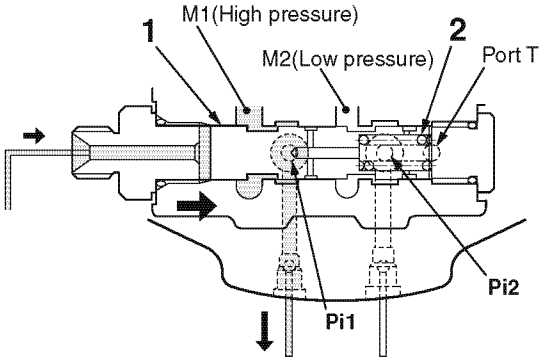
If high pressure oil is introduced into port M1 and the control valve is in the 1st speed position, the spool (1) is moved to the left position by the spring (2) and the swash plate control piston chambers connect with port T through the respective ports Pi1 and Pi2. For this reason, no force acts on the swash plate to push it up at the swash plate control position.



S3F409E

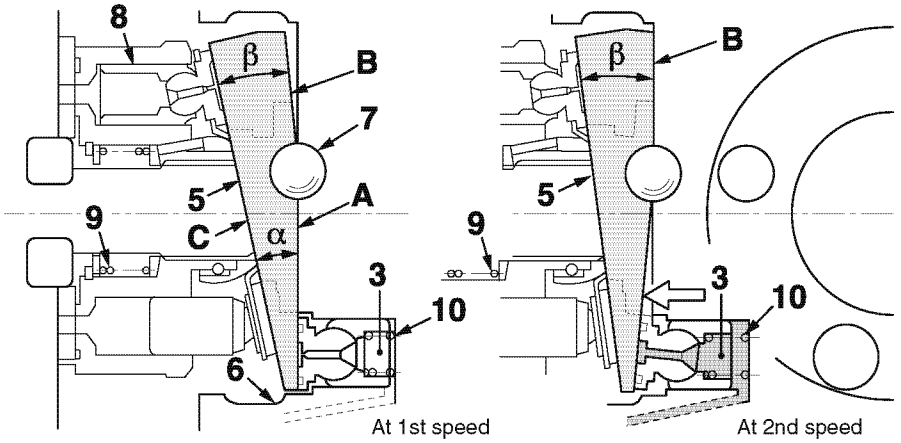
If the control valve is switched to the 2nd speed side position, hydraulic oil is introduced from the port to the spool (1) and the spool (1) switches to the right. As a result, some of the high pressure oil flows to the swash plate control piston chambers through port M1, port Pi1, port M2 and port Pi2, respectively, moving the pistons.

When the engine stops, no hydraulic oil comes, so the spool (1) returns to the 1st speed by the spring (2).



S3F410E

Swash plate



S3F457E

The swash plate (5) has 3 planes, A, B and C, as shown in the figure, and it is assembled in such a way that its angle of inclination in the flange holder (6) can varied by two balls (7). When the 2-speed control valve is switched to the 1st speed side, the swash plate control piston chamber (3) is connected to tank port and the swash plate (5) is stabilized at plane A, forming swash plate angle α, by the piston assembly (8) and the force of the springs (9), (10), achieving 1st speed (low speed) motor rotation.

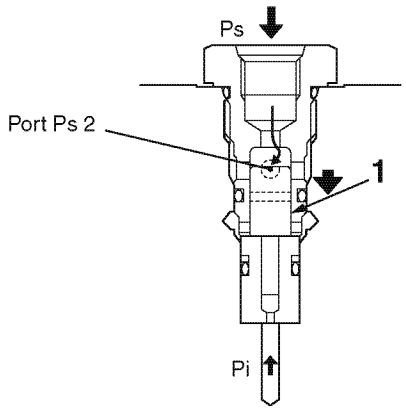
When the 2-speed control valve is switched to 2nd speed, the swash plate control piston chamber (3) is connected to the motor drive pressure port and the swash plate (5) stabilizes at plane B due to the equilibrium between the force of the springs (9), (10) and the force of the control piston, thus, assuming swash plate angle β. In this way, 2nd speed (High speed) motor rotation is achieved.

When the engine is stopped, the pilot pressure of the 2-speed control valve is cut off, so the swash plate (5) is stabilized at the swash plate a plane A by the force of the springs (9), (10), changing to the 1st speed side. For this reason, when starting, the motor also is in 1st speed.

6) Automatic 2-speed

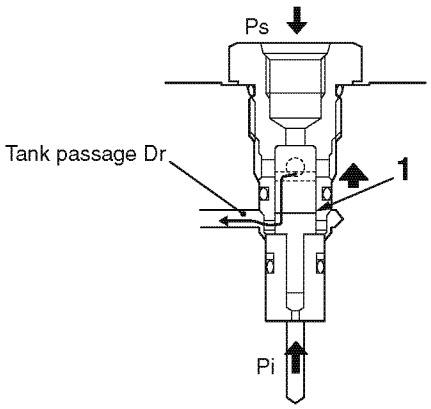
When the motor load is increased during the second speed, the motor is switched from the 2nd speed position to the 1st speed position.

When the pilot pressure is introduced to the port Ps, the pressure oil pushes down the spool (1). At this time, the pressure oil flows through the port Ps2 to the swash plate control piston chamber, switching the motor to the 2nd speed position.



S3F411E

When the motor load pressure Pi is increased to be higher than the pressure at the port Ps during the 2nd speed, the spool (1) moves upward. At this time, the pressure oil in the swash plate control piston chamber flows through the port Ps2 to the tank passage Dr, and the swash plate is switched to the 1st speed position.



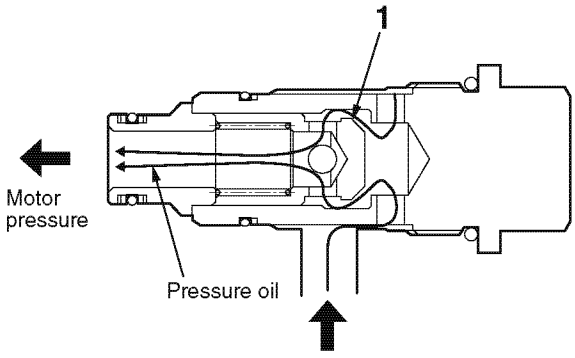
S3F412E

7) Check valve

When the hydraulic system is faulty, this valve prevents cavitation, enabling self-propelling.

During normal traveling, the check valve (1) is closed as the motor case inner pressure is higher than the motor inner pressure.

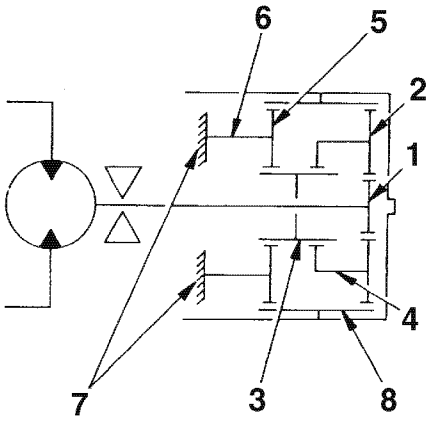
When the motor inner pressure becomes negative, a vacuum is generated. To prevent cavitation, the pressure oil in the motor case causes the check valve (1) to open and allows the oil to flow into the motor inner side to increase it's pressure.



S3F454E

8) Reduction gear operation

The reduction gear consists of a 2-stage planetary gear mechanism. The drive gear (1) is engaged with the 1st stage planetary gear A (2). The 2nd stage sun gear (3) is engaged with the holder (4) and 2nd stage planetary gear B (5) and the shaft (6) of planetary gear B (5) is fastened to the flange holder (7). Planetary gears A (2) and B (5) are also engaged with the ring gear (housing) (8).



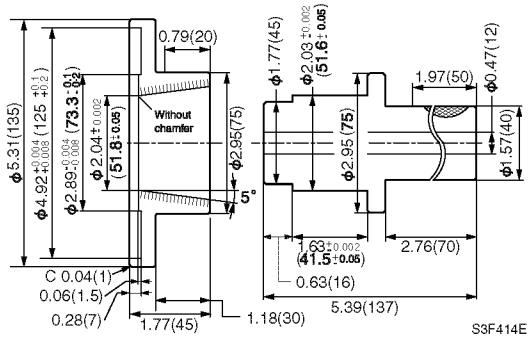
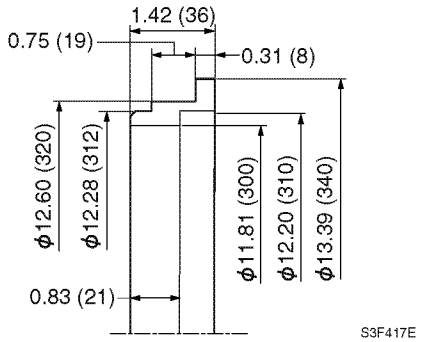
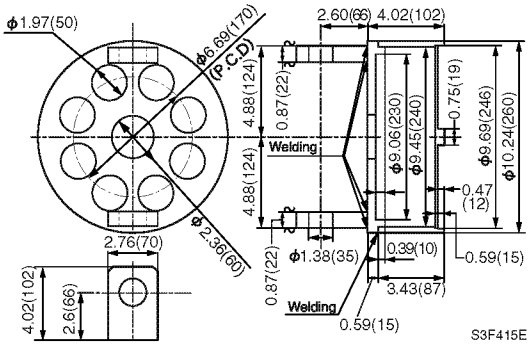
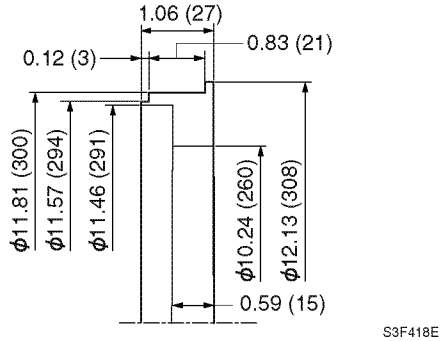
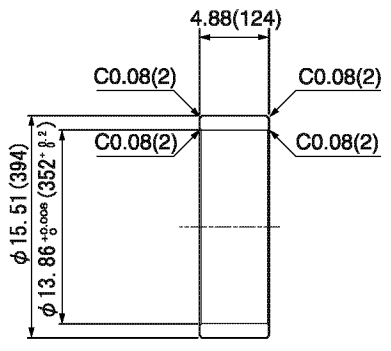
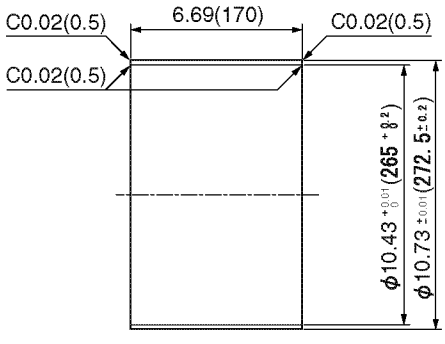
S3F413

Driving force from the hydraulic motor is transmitted to the drive gear and the speed is reduced by each of the gears. The driving force is then transmitted to the ring gear (housing) (8) via planetary gear B (5), fastened to the flange holder (7) at the final stage. (Torque is also transmitted from the 1st stage planetary gear A (2).)
Furthermore, the direction of output rotation is opposite that of input rotation.

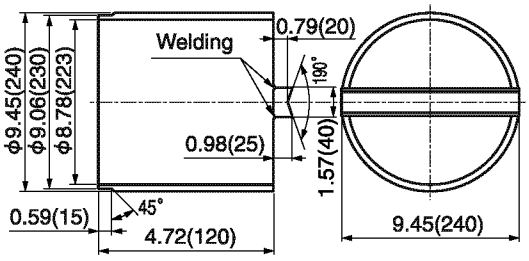
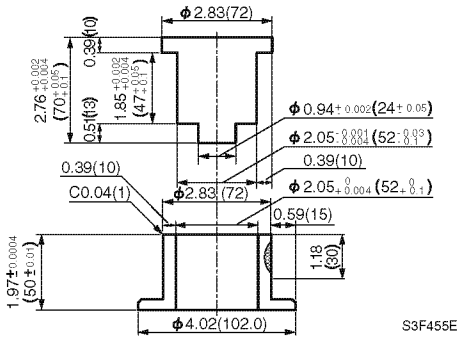
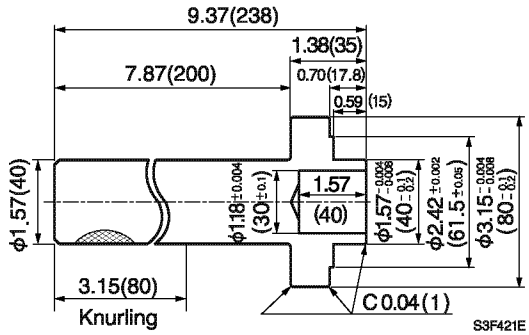
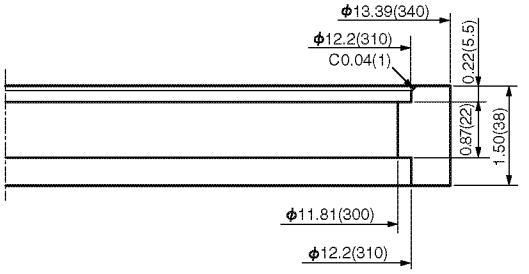
3. Disassembly and assembly

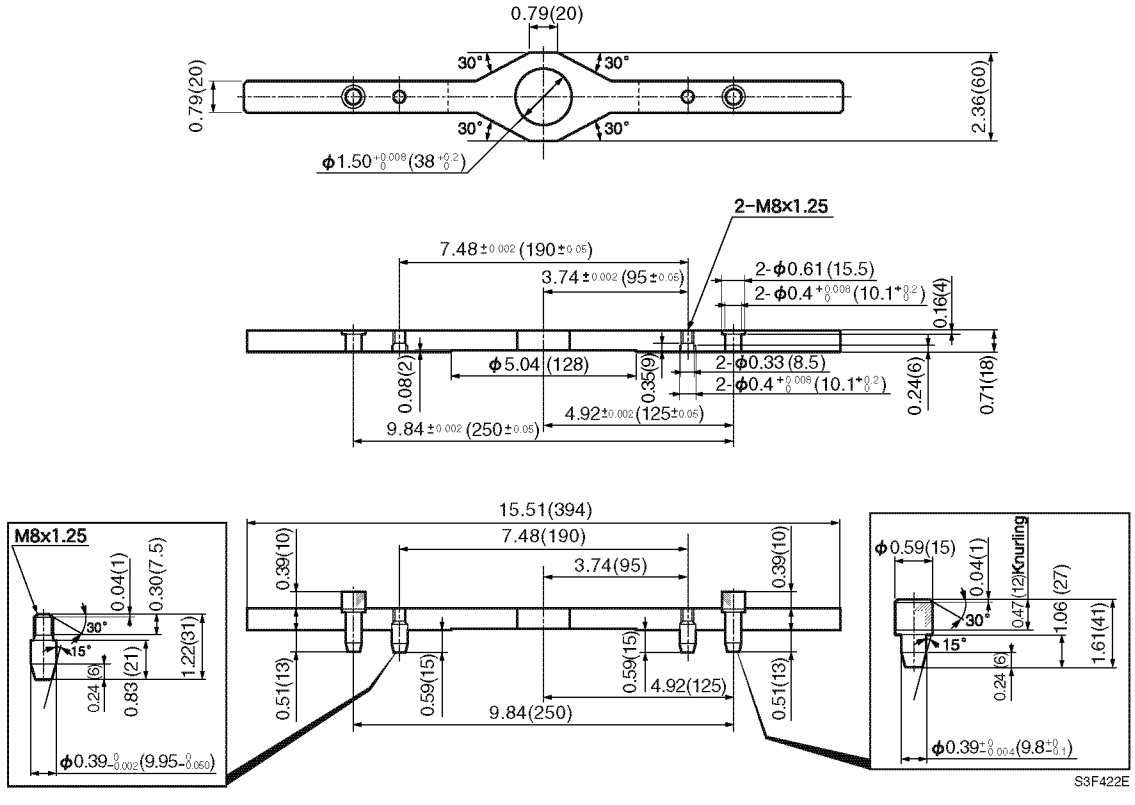
1) Table of special tools

Unit: in. (mm)

	Name, Dimension		Name, Dimension
1	Press-fit jig A  S3F414E	4	Installation jig D  S3F417E
2	Tightening jig B  S3F415E	5	Press-fit jig E  S3F418E
3	Removal jig C  S3F416E	6	Press-fit jig F  S3F419E

Unit: in. (mm)

	Name, Dimension		Name, Dimension
7	Press-fit jig G 	9	Press-fit jig I 
8	Press-fit jig H 	10	Installation jig J 

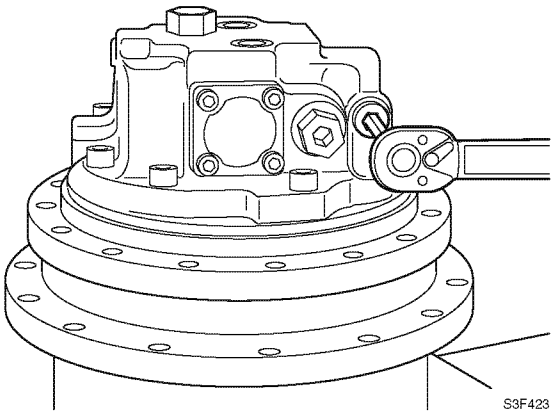
	Name, Dimension
11	Installation jig K 

2) Precautions in disassembly and assembly

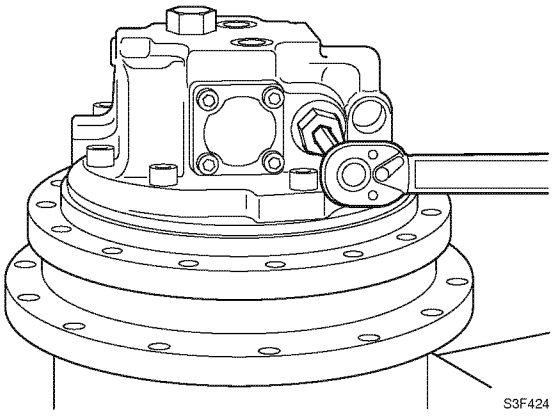
1. Carry out disassembly and assembly operations in a clean place and provide clean containers to place the disassembled parts in.
2. Before disassembly, clean around the ports and remove the paint from each joint using a wire brush.
3. Clean each of the disassembled parts with a cleaning oil.
4. Make match marks on each part so that they will be assembled in the same positions when assembled.
5. Replace all seals with new ones each time the unit is disassembled, coating them lightly with grease.
6. Check each part to make sure there is no abnormal wear or seizing and use sandpaper, etc. to remove any burrs, sharp edges, etc.
7. Adjust adjustment screws only when required.

3) Disassembly

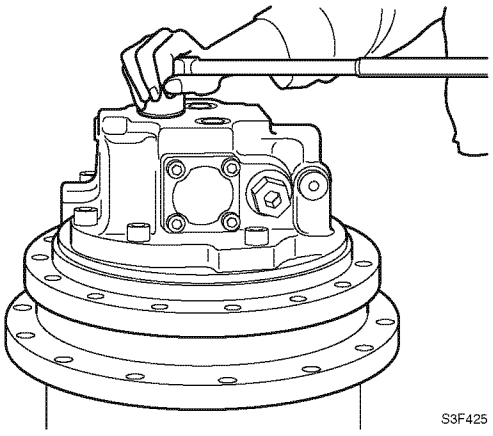
(1) Remove the plug, the spool, and the spring.
- Take care not to damage or scratch the components.


S3F423

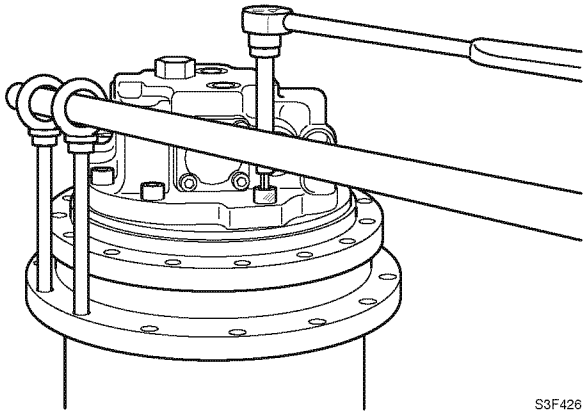
(2) Remove the relief valve assembly.


S3F424

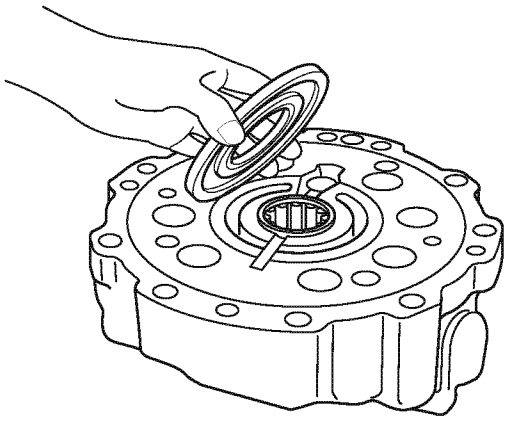
(3) Remove the plug, and then detach the spring sheet and the spring.


S3F425

(4) Remove the cap screw, and take out the base plate.
- Take care not to pull out the cylinder block.
- If the base plate is hard to remove, lightly tap it with a plastic hammer or lightly force it with a screwdriver.


S3F426

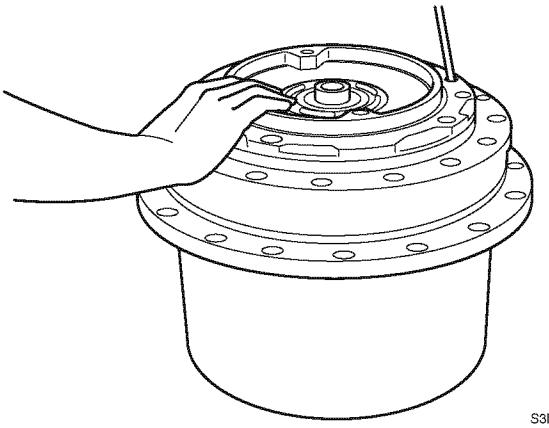
(5) Remove the valve plate, the O-ring, and the pin.
- When removing the pin, protect the perimeter by using waste or the like.


S3F427

(6) Blow compressed air from the parking brake release port to remove the brake piston.

⚠ WARNING

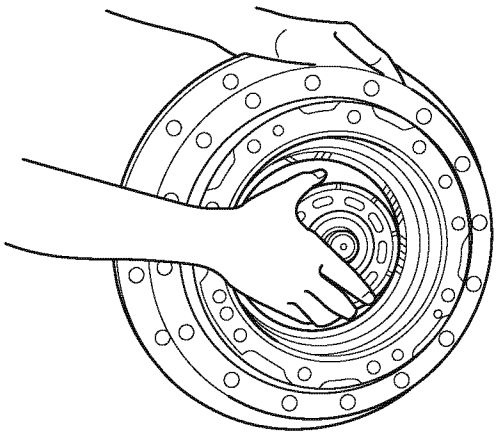
Always wear appropriate protective items such as safety goggles, as component parts can jump out and cause serious bodily injury.


S3F428

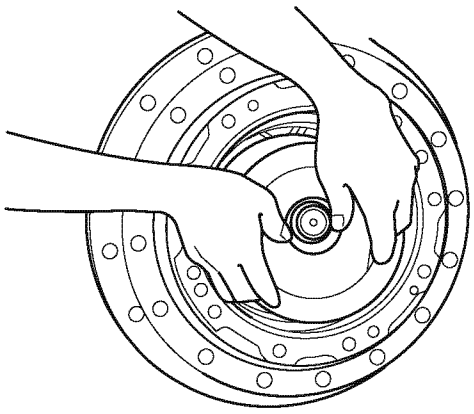
(7) Remove the collar.

(8) Remove the cylinder block, the pin, the guide, the shoe holder, and the piston assembly.
- Take care not to damage the sliding surface of the cylinder block.

(9) Remove the disk and the friction disk.


S3F429

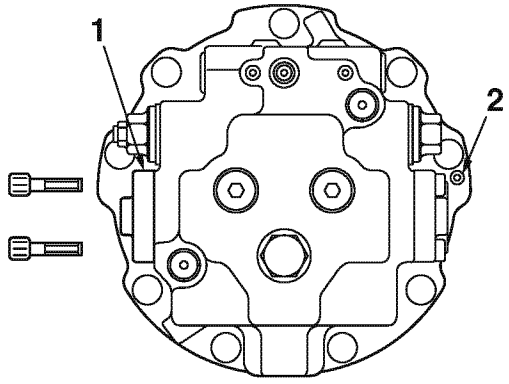
(10) Remove the swash plate, the steel ball, the piston, and the spring.



S3F430

(11) Remove the cap screw and the flange (1).
- In doing this, secure the base plate with a vise.

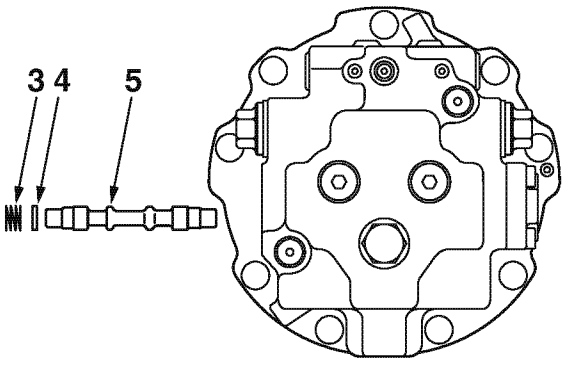
(12) Remove the plug (2).



S3F431

(13) Remove the spring (3) and the spring sheet (4).

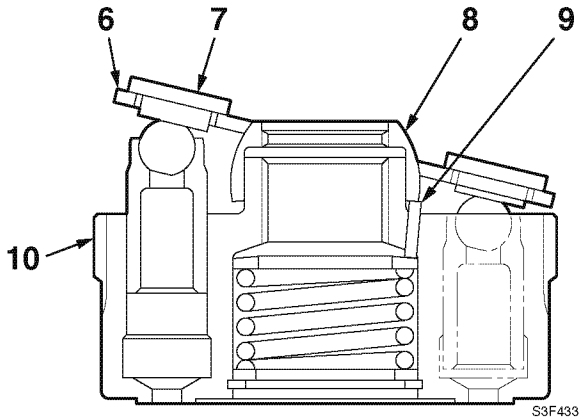
(14) Remove the plunger (5).
- Pull out the plunger by slowly turning it.
- Take care not to damage or scratch it.



S3F432

(15) Remove the shoe holder (6) and the piston assembly (7) from the cylinder block (10).

(16) Remove the guide (8) and the pin (9) from the cylinder block (10).



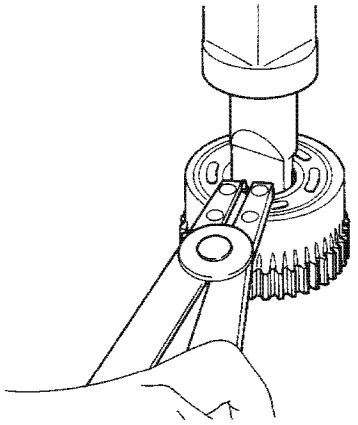
S3F433

(17) Remove the snap ring.

⚠ WARNING

Always wear appropriate protective items such as safety goggles, as component parts can jump out and cause serious bodily injury.

- Bend the snap ring by using the press-fit jig A and the press.



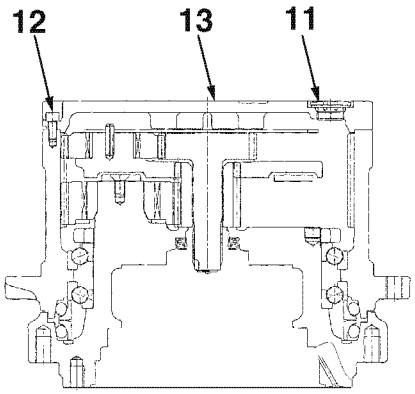
Y6--D580

(18) Remove the collar, the spring and the collar from the cylinder block.

(19) Remove the plug (11) and the Allen screw (12).

(20) Remove the cover (13).

- Tap the center of the cover with a plastic hammer to raise the cover and remove it.

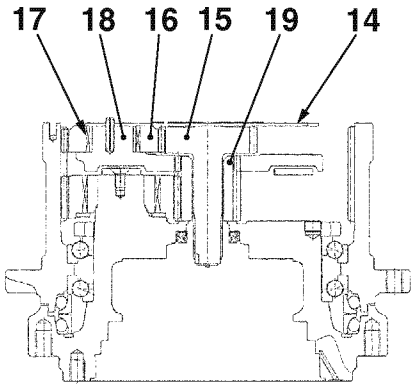


S3F434

(21) Remove the thrust plate (14) and the drive gear (15).

(22) Remove the planetary gear A (16) and the needle bearing (17).

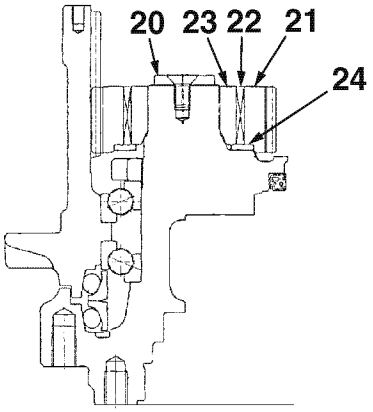
(23) Remove the holder (18) and the sun gear B (19).



S3F435

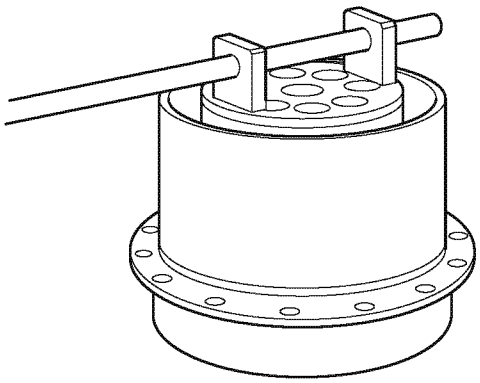
(24) Remove the screw and the thrust plate (20).

(25) Remove the planetary gear B (21), the needle bearing (22), the floating bush (23) and the thrust washer (24).



S3F436

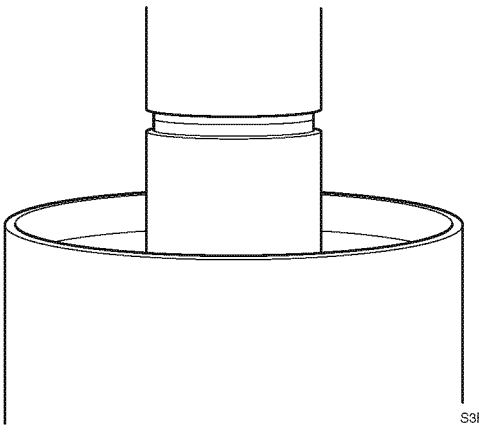
(26) Remove the plug and the ring nut.
- Use the tightening jig B.



S3F437

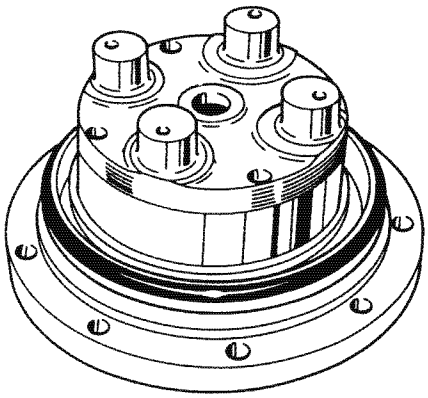
(27) Secure the reduction gear,
- Use the removal jig C.

(28) Place the plate on the flange holder, and remove the press-fitted angular bearing by pressing the flange holder using the press.



S3F438

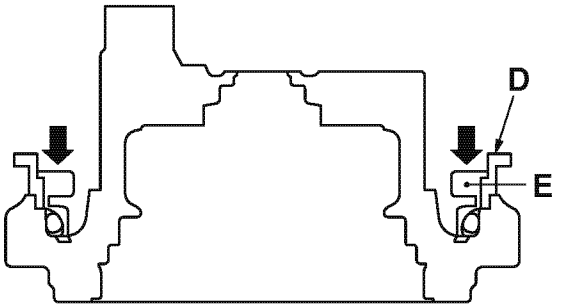
(29) Remove the inner ring assembly of the angular bearing assembly and the floating seal.



S3F439

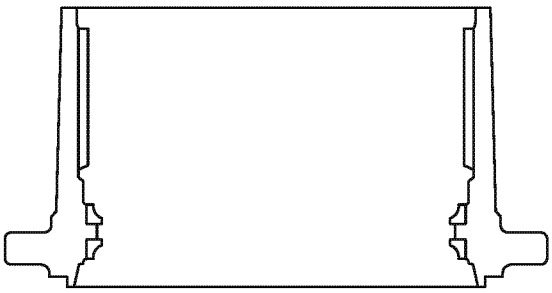
4) Assembly

(1) Attach the floating seal to the flange holder.
- Use the installation jig D and the press-fit jig E.
- Apply grease to the seal surface.
- Apply the load uniformly.



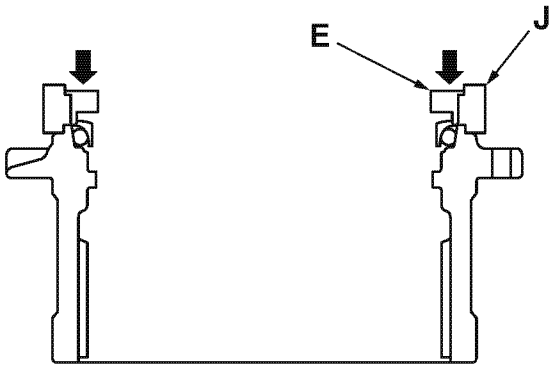
S3F440

(2) Secure the outer ring of the angular bearing to the housing.
- Use the press-fit jig F.



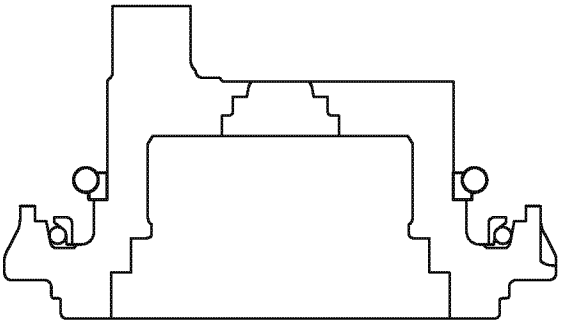
S3F441

(3) Apply grease to the other floating seal, and attach the seal to the housing.
- Use the installation jig J and the press-fit jig E.
- Apply grease to the seal surface.
- Apply the load uniformly.



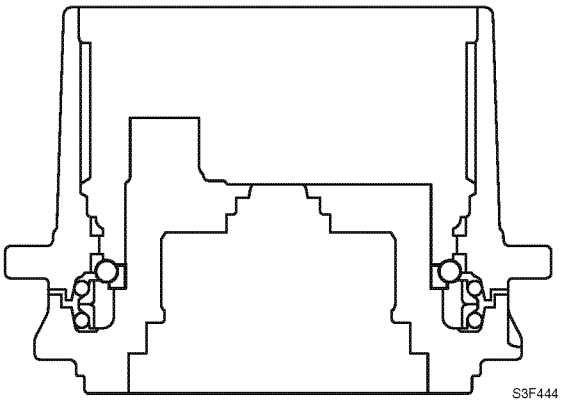
S3F442

(4) Press-fit the inner ring assembly of the angular bearing.
- Use the press-fit jig G.

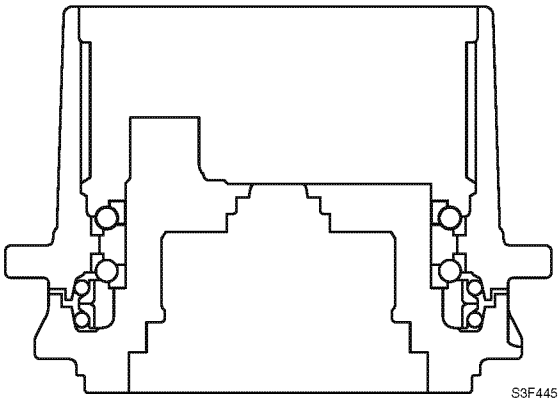


S3F443

(5) Install the flange holder to the housing.



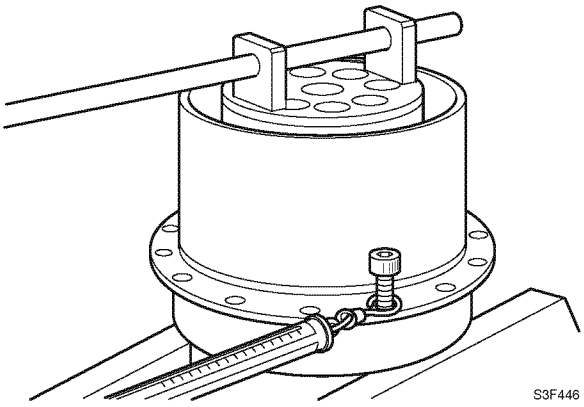
(6) Install the inner ring assembly of the angular bearing to the flange holder.
- Use the press-fit jig G.



(7) Tighten the ring nut.
- Use the tightening jig B.

a. Install the ring nut and the angular bearing without clearance between them, turn the housing several times, and then measure the load and make it the starting load F lbf (N).

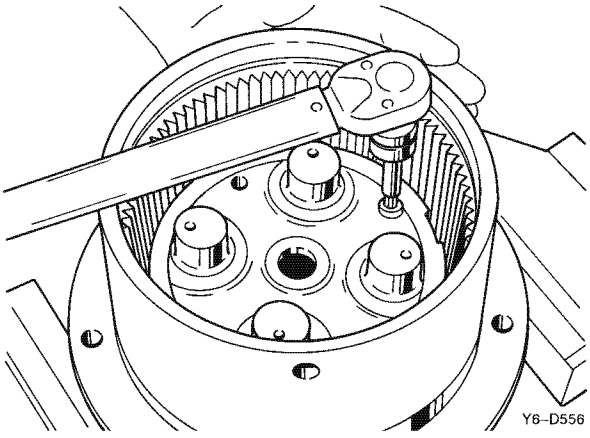
b. Tighten the ring nut and adjust the starting load to be between F+24.3 to 28.7 lbf (108 to 128 N).



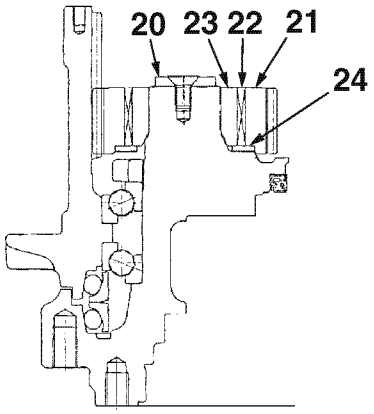
(8) Tighten the plug.
- No seal tape is required.

Tightening torque: 25.3 ±3.6 ft·lbf (34.3 ±4.9 N·m)

(9) Caulk the plug at two positions by using a punch.



(10) Install the thrust washer (24), the floating bush (23), the needle bearing (22) and the planetary gear B (21) to the flange holder.



S3F436

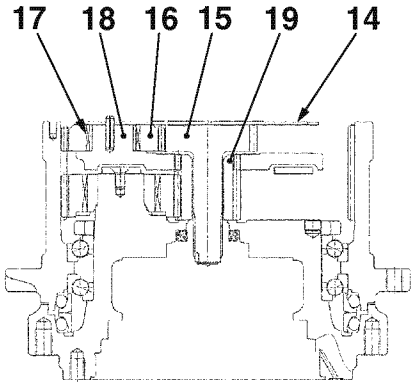
(11) Attach the thrust plate (20), apply threadlocker, and install to the screw section.
- Before applying threadlocker, fully degrease the screw section. Use activator for fast curing.

Tightening agent: Loctite #262
Tightening torque: 43.4 ±3.6 ft·lbf (58.8 ±4.9 N·m)

(12) Attach the snap ring to the sun gear B (19), and install the sun gear (19).

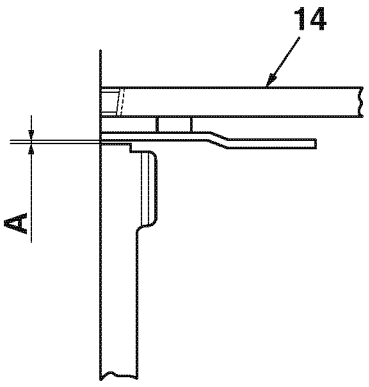
(13) Attach the inner race and the spring pin to the holder (18), and install the holder (18).

(14) Install the needle bearing (17), the planetary gear A (16) and the drive gear (15).



S3F435

(15) Install the thrust plate (14).
- Make sure the value A is 0.012 ~ 0.031 in. (0.3 ~ 0.8 mm).
- If the value A is not 0.012 ~ 0.031 in. (0.3 ~ 0.8 mm), select another thrust plate with the thickness (T) of 0.091 in. (2.3 mm), 0.110 in. (2.8 mm), or 0.126 in. (3.2 mm), and substitute it.



S3F447

(16) Apply liquid gasket over the perimeter of the mating surface of the cover (13) and the housing.

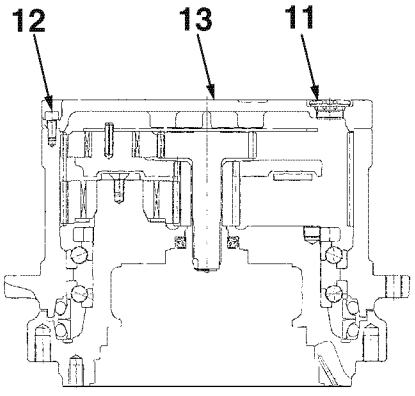
Liquid gasket: Three Bond #11041

(17) Install the cap screw (12) and apply threadlocker.

Tightening agent: Loctite #262
Tightening torque: 21.7 ±1.4 ft·lbf (29.4 ±2.0 N·m)

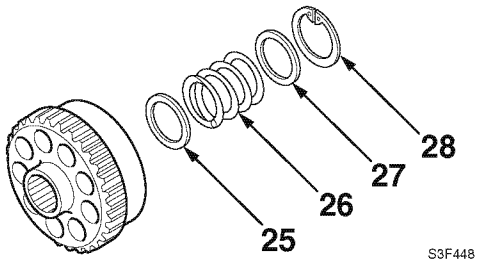
(18) Install the plug (11).
- Wind the seal tape around the plug.

Tightening torque: 115.7 ±5.8 ft·lbf (157 ±8.0 N·m)

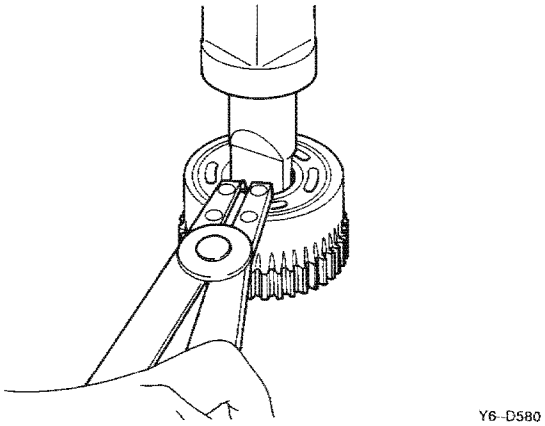


S3F434

(19) Attach the collar (25), the spring (26), and the collar (27) to the cylinder block, and then attach the snap ring (28).
- Use the press-fit jig A.

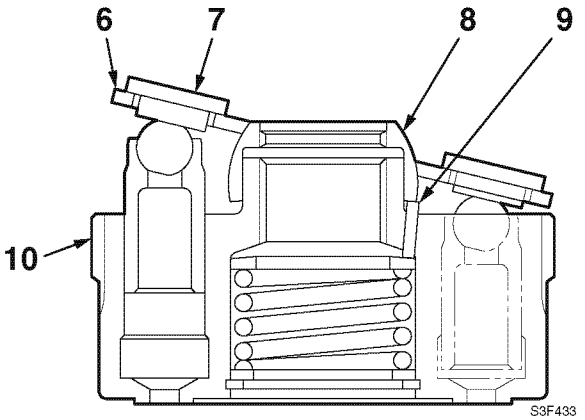


S3F448


Y6-D580

(20) Install the pin (9) into the three cylinder block holes.
- Apply grease to the pin.

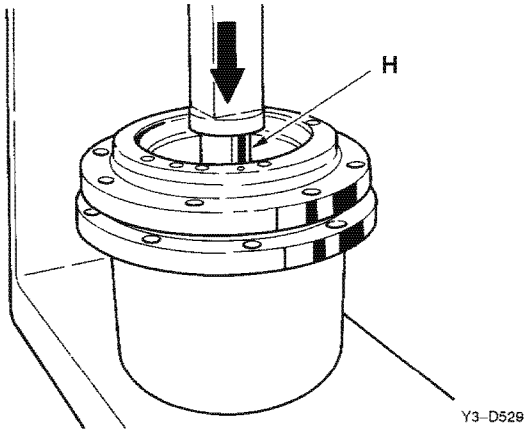
(21) Install the guide (8), the shoe holder (6), and the piston assembly to the cylinder block (10).
- Apply hydraulic oil to the perimeter of the piston assembly and into the cylinder block holes.



S3F433

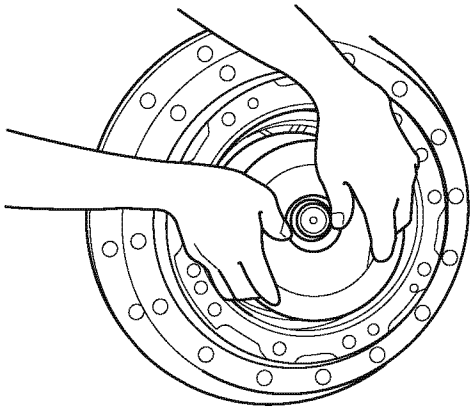
(22) Attach the oil seal to the flange holder.
- Use the press-fit jig H.

(23) Install the outer ring of the bearing.



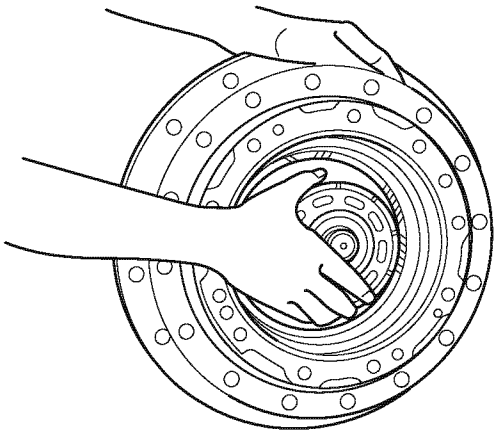
Y3-D529

(24) Install the shaft with the inner bearing ring press-fitted.
- Mate the shaft with the spline at the end of the drive gear.
- Apply grease to the oil seal lip, and slightly turn the shaft taking care not to damage the lip.

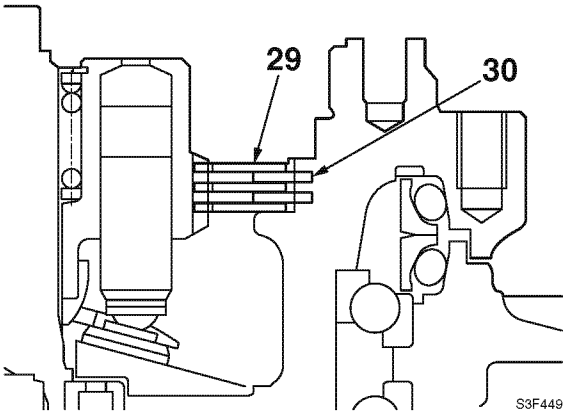

S3F430

(25) Install the steel ball, the spring, and the piston assembly.

(26) Install the swash plate.
- Mate the sphere and the steel ball.
- After the mating, be sure the swash plate smoothly tilts around the steel ball as the pivot, but does not rotate.


S3F429

(27) Install the cylinder block assembly, and then the disk (29) and the friction disk (30).
- Apply hydraulic oil to the swash plate.
- Make sure the cylinder block rotates smoothly, and the piston assembly is reciprocating.

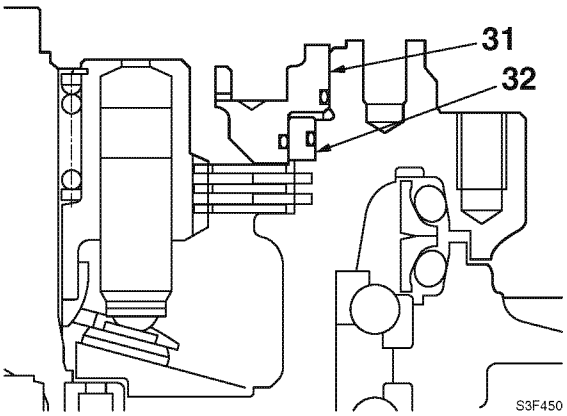


S3F449

(28) Attach the O-ring to the brake piston (31).
- Apply grease to the brake piston.

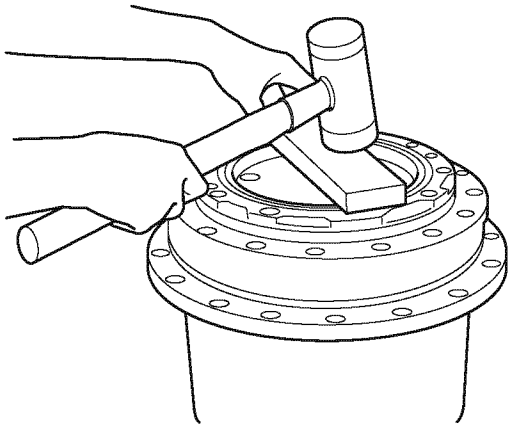
(29) Attach the O-ring to the collar (32), and install the collar (32) to the brake piston (31).

(30) Install the brake piston (31) to the flange holder.
- Align the brake piston pinhole with the flange holder pinhole.



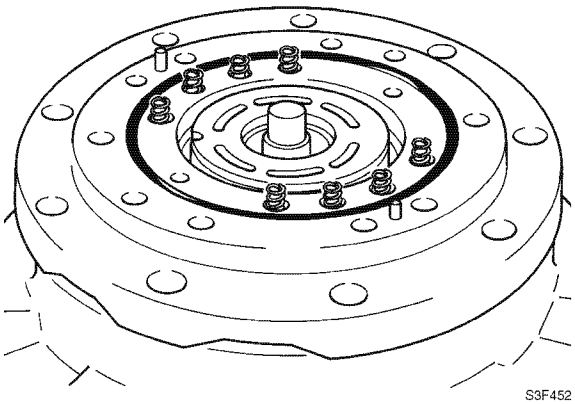
S3F450

(31) Position the brake piston.
- Put the installation jig K and tap it uniformly with a plastic hammer.


S3F451

(32) Install the eight springs to the brake piston.

(33) Attach the O-ring to the flange holder.

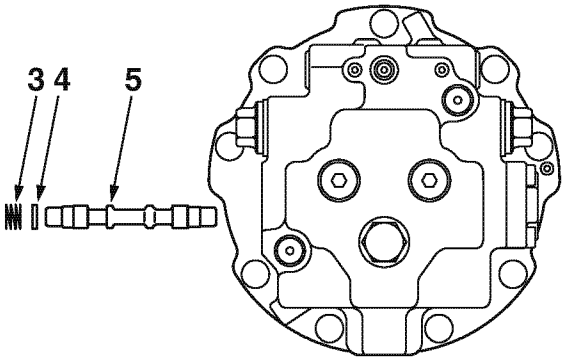


S3F452

(34) Install the plunger (5).

- Turn the plunger slowly to install it.

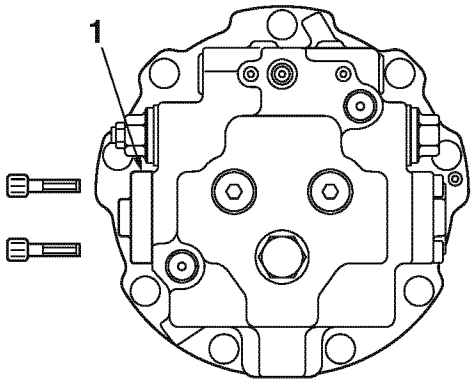
(35) Install the spring sheet (4) and the spring (3).



S3F432

(36) Install the flange (1) and the cap screws.

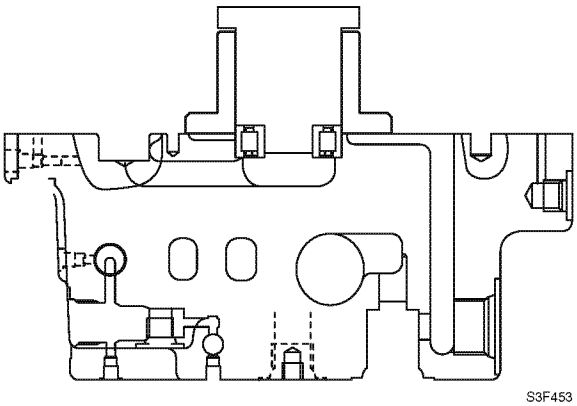
Tightening torque: 43.4 ±3.6 ft·lbf (58.8 ±4.9 N·m)



S3F458

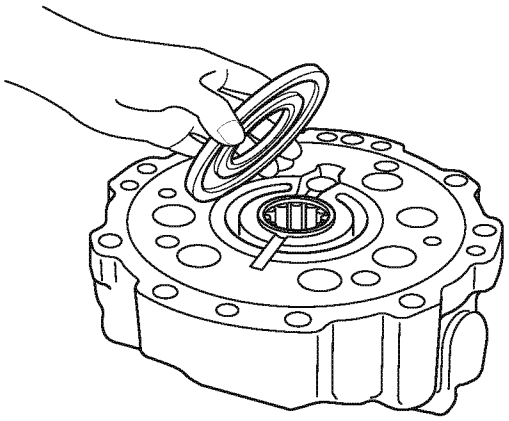
(37) Install the outer ring of the bearing.

- Use the press-fit jig I.



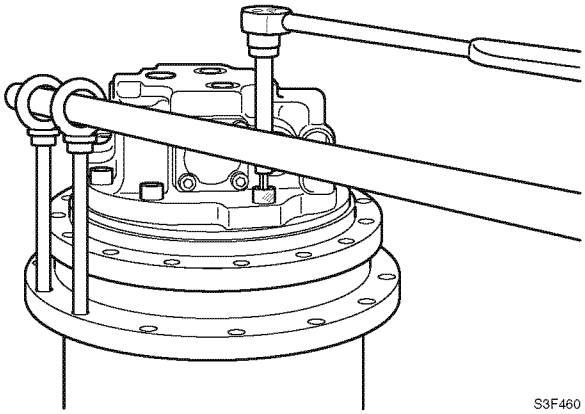
S3F453

(38) Install the pin, the O-ring, and the valve plate.
- Apply grease to the non-sliding surface of the valve plate and to the base plate.
- Take care not to damage the sliding surface of the valve plate.


S3F427

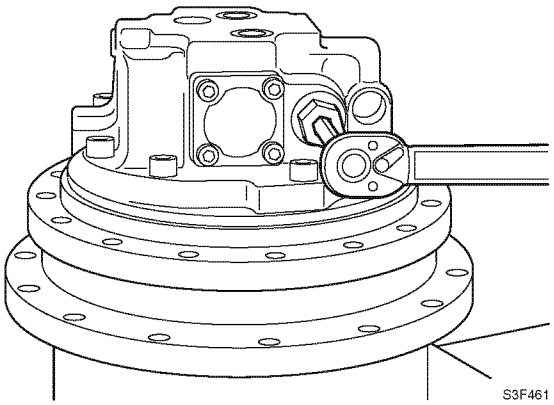
(39) Install the base plate and tighten it with the cap screws.

Tightening torque: 141 ±10.8 ft·lbf (191 ±15 N·m)


S3F460

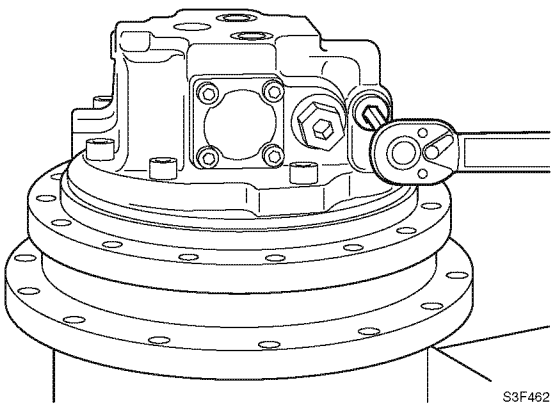
(40) Attach the O-ring and the backup ring to the relief valve assembly, and install the assembly.

Tightening torque: 170 ±10.8 ft·lbf (230 ±15 N·m)


S3F461

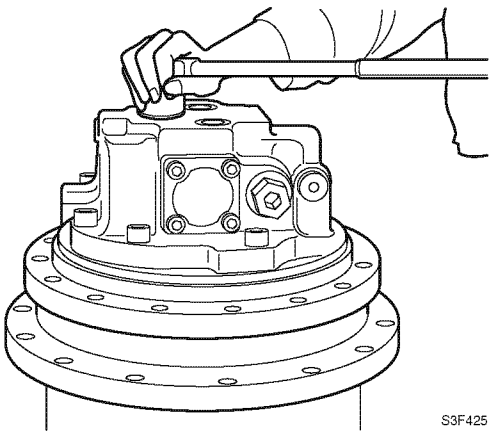
(41) Install the spool and the spring. Attach the O-ring to the plug and install the plug.

Tightening torque: 86.8 ±3.6 ft·lbf (118 ±4.9 N·m)


S3F462

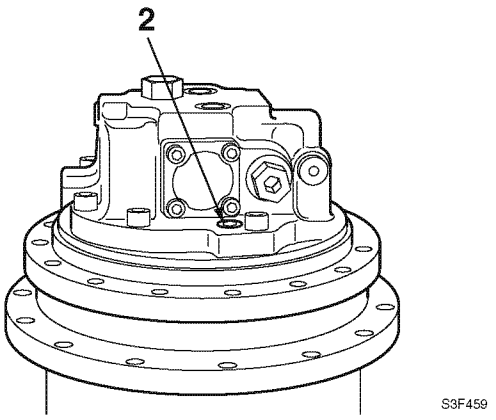
(42) Install the poppet, the spring and the spring sheet. Attach the O-ring to the plug, and install the plug.

Tightening torque: 61.5 ±3.6 ft·lbf (83.4 ±4.9 N·m)


S3F425

(43) Inject the stipulated volume of gear oil and tighten the plug (2).
- Wind the seal tape around the plug.

Oil type: SAE 90 (API Service Category GL-4 or above) Oil volume: 2.75 Qts. (2.6 L)
Tightening torque: 25.3 ±3.6 ft·lbf (34.5±4.9 N·m)



S3F459

4. Inspection and adjustment

1) Checking the parts

Parts	Inspection item	Inspection standard	Measures
Floating seal	Sliding surface	There should be no abnormal scratches, wear or seizing.	Replace
Angular bearing	Sliding surface	There should be no abnormal scratches, wear, flaking, etc. in the ball or race.	Replace
Planetary gears A, B	Surface of gear teeth	There should be no abnormal scratches, wear or flaking of the tooth surfaces (if there has been pitting which covers 10% or more of the engagement portion of the tooth surface).	Replace
	Front of needle bearing rotating surface.	There should be no abnormal scratches, wear or flaking of the rotating surface.	Replace
Needle bearing	Surface of needle bearing.	There should be no abnormal scratches, wear or flaking.	Replace
Thrust washer	Front of sliding surface	There should be no abnormal scratches, wear or seizing.	Replace
Housing, Sun gear, Drive gear	Front of gear tooth surfaces	There should be no abnormal scratches, wear or flaking in the tooth surfaces (if there has been pitting which covers 10% or more of the engagement portion of the tooth surface).	Replace
Thrust plate	Front of sliding surface.	There should be no abnormal scratches (0.0008 in. (0.02 mm) or greater), wear or seizing, etc.	Replace
O-ring	—	—	Replace
Shaft	Surface of oil seal.	There should be no scratches or abnormal wear.	Replace
Ball bearing	Front of sliding surface.	There should be no abnormal scratches, wear or flaking in the ball and race.	Replace
Oil seal	—	—	Replace
Swash plate	Front of the surface which slides with the sliding surface of the piston assembly.	There should be no abnormal scratches (0.0008 in. (0.02 mm) or greater), wear or seizing.	Repair by lapping (#1000) or replace.
Cylinder block	Clearance with the piston assembly.	0.0024 in. (0.06 mm) or greater	Repair with wrap (#1000) or replace the cylinder block and piston assembly at the same time.
	Front of the surface which slides with the valve plate.	There should be no abnormal scratches (0.0008 in. (0.02 mm) or greater), wear or seizing.	
Piston assembly	Clearance with cylinder block	0.0024 in. (0.06 mm) or greater	
	Front of the surface which slides with the swash plate.	There should be no abnormal scratches (0.0008 in. (0.02 mm) or greater), wear or seizing.	
	Clearance between piston and shoe.	0.0016 in. (0.04 mm) or greater	Replace
Valve plate	Front of the surface which slides with the spool.	There should be no abnormal scratches (0.0008 in. (0.02 mm) or greater), wear or seizing.	Repair by lapping (#1000) or replace.
Base plate	Front of the surface which slides with the spool.	There should be no abnormal scratches, wear or seizing.	Replace the base plate and the plunger at the same time.
Plunger	Front of the surface which slides with the base plate.	There should be no abnormal scratches, wear or seizing.	
	Front of the surface which slides with the check valve.	There should be no abnormal scratches, wear or seizing.	Replace the plunger and the check valve at the same time.
Check valve	Front of the surface which slides with the spool.	There should be no abnormal scratches, wear or seizing.	
	Surface of spool and seat.	There should be contact with the seat around the entire circumference.	

5. Troubleshooting

1) Hydraulic motor

Trouble	Probable causes	Measures
Does not move.	• Equipment other than the motor, counterbalance valve or speed reducer is malfunctioning.	• Check if the proper pressure is reached on the motor inlet port side, then check each device and repair if necessary.
	• Hydraulic oil is escaping due to abnormal wear of motor sliding parts. • Principal motor parts are malfunctioning due to damage.	• Replace the abnormally worn parts. • Replace the damaged parts.
Motor won't speed up.	• The proper volume of hydraulic oil is not being supplied to the motor due to the hydraulic pump, control valve, etc.	• Check if the proper pressure is reached on the motor inlet port side, then check each device and repair if necessary.
	• The motor's volumetric efficiency is dropping.	• Check if the sliding parts are abnormally worn, then repair or replace the worn parts.
Changes in rotational speed are great.	• High pressure hydraulic oil is leaking and flowing out of the drain port due to wear of the motor's sliding parts. • Bearings are worn.	• Replace the abnormally worn parts. • Replace the abnormally worn parts.
Oil leak	• The oil seal or O-ring is damaged.	• Replace the damaged oil seal or O-ring.
	• The pressure within the motor case is increased due to unusual wear of the sliding surface of the motor, and the oil seal is broken.	• Repair the motor and replace the oil seal.
	• The pressure within the piping is increased due to foreign matter clogging the drain piping, and the oil seal is broken.	• Clean the drain piping and replace the oil seal.

2) 2-speed control function

Trouble	Probable causes	Measures
Track deviation or travel speed is not switchable.	Plunger doesn't switch over. • Foreign matter is caught. • A spring is missing. • A spring is damaged.	• Remove the foreign matter and repair or replace the damaged parts. • Install the spring. • Replace the spring.
	• Oil leaks due to abnormal wear of the 2-speed control piston.	• Replace the 2-speed control piston.
	• The 2-speed control piston is missing.	• Install the 2-speed control piston.
	• The steel balls are abnormally worn.	• Replace the steel balls.

3) High pressure relief valve

Trouble	Probable causes	Measures
Does not move, or turning is slow.	Relief valve seat is faulty. • Foreign matter gets caught. • A spring is damaged.	• Remove the foreign matter and repair or replace the damaged parts. • Replace the spring
	The relief valve cracking pressure has dropped. • The spring is permanently deformed. • The poppet **orifice** is clogged up.	• Replace the relief valve assembly. • Clean it.
Valve doesn't stop, or stopping is slow.	The relief valve seat is faulty. • Foreign matter gets caught. • A spring is damaged.	• Remove the foreign matter and repair or replace the damaged parts. • Replace the spring.
	The relief valve cracking pressure has dropped. • Foreign matter gets caught. • A spring is damaged.	• Remove the foreign matter and repair or replace the damaged parts. • Replace the spring.
	The relief valve cracking pressure has dropped. • The spring is permanently deformed. • The poppet **orifice** is clogged up.	• Replace the relief valve assembly. • Clean it.

4) Low-pressure relief valve

Trouble	Probable causes	Measures
Speed cannot be accelerated.	Plunger is malfunctioning. • Foreign matter is caught. • Spring is damaged.	• Clear up the foreign matter, and repair or replace the damaged part. • Replace the spring.
Motor does not stop or takes a longer time to stop.	Plunger does not return. • Foreign matter is caught. • Spring is damaged.	• Clear up the foreign matter, and repair or replace the damaged part. • Replace the spring.
Oil temperature in the circuit is high.	Plunger is malfunctioning. • Foreign matter is caught. • **Orifice** is clogged.	• Clear up the foreign matter, and repair or replace the damaged part. • Clean the **orifice.**

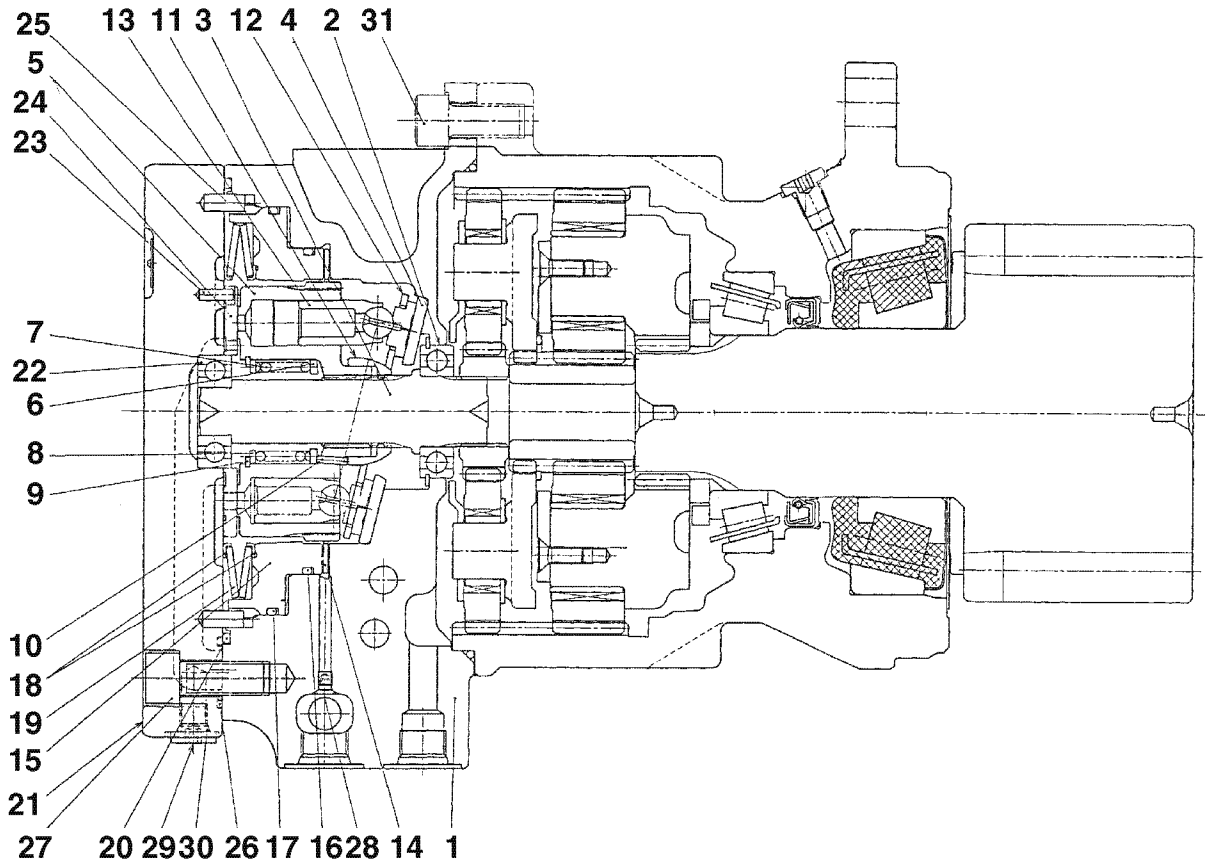
5) Parking brake

Trouble	Probable causes	Measures
Insufficient deceleration, or one-sided brake actuation.	• Disk is worn out. • Disk surface is faulty. • Spring is broken. • Manual brake release bolt is attached.	• Replace the disk. • Repair or replace the disk. • Replace the spring. • Remove the manual brake release bolt and install the plug.
Abnormal heating due to unreleased brake.	Brake release mechanism is malfunctioning. • Oil is leaking due to broken O-ring. • **Orifice** is clogged. • Brake release pilot pressure is not applied.	• Replace the O-ring. • Clean the **orifice.** • Make sure the stipulated pressure is applied to the pilot port, and then inspect individual components and repair or replace as appropriate.
Brake cannot be released manually.	• Manual brake release bolt is not tightened uniformly.	• Tighten the bolt uniformly.

6-6. Swing Motor

1. Construction

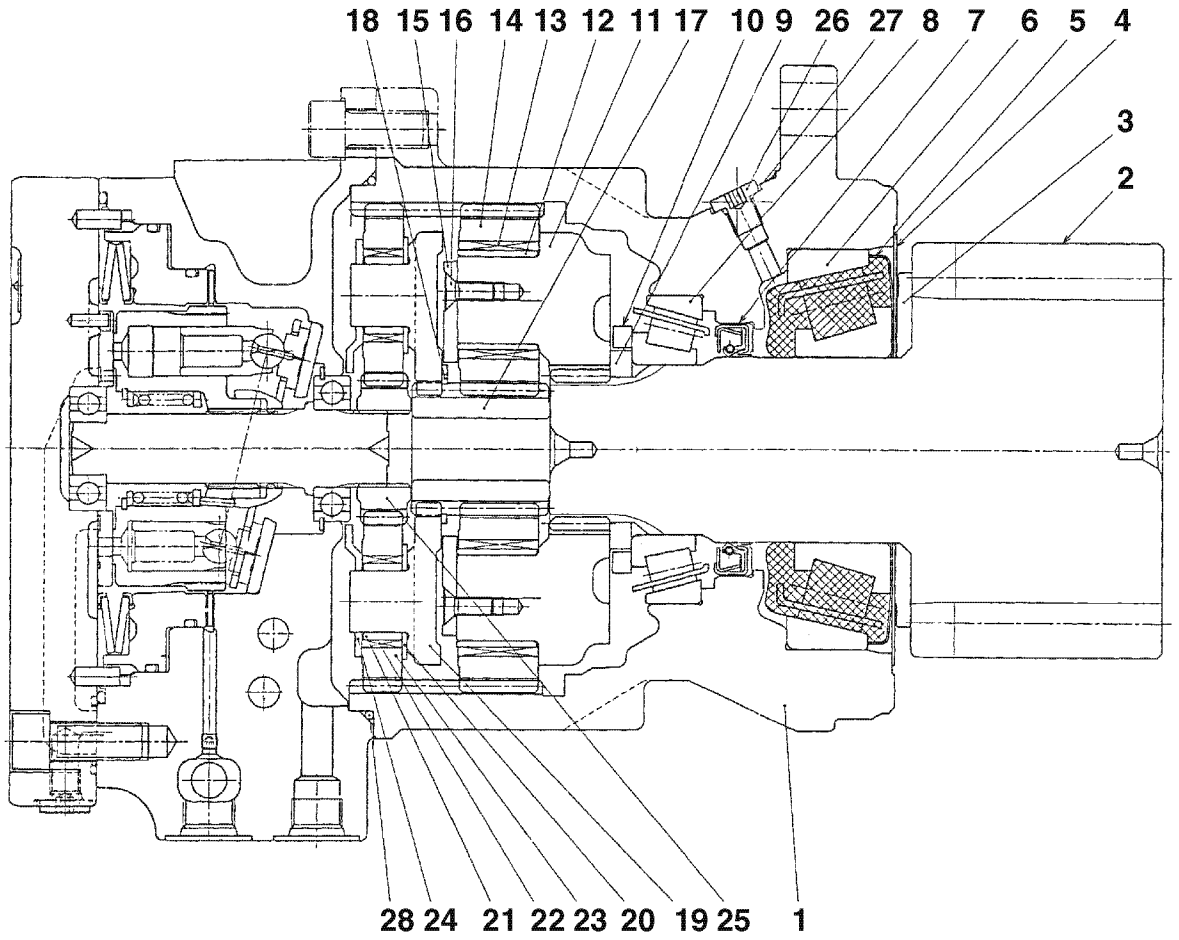
1) Hydraulic motor



S3F500

No.	Part	Q'ty	No.	Part	Q'ty	No.	Part	Q'ty
1	Housing	1	12	Shoe holder	1	23	Pin	1
2	Bearing	1	13	Piston assembly	9	24	Valve plate	1
3	Shaft	1	14	Disc	1	25	Pin	2
4	Swash plate	1	15	Brake piston	1	26	O-ring	2
5	Cylinder block	1	16	O-ring	1	27	Cap screw	5
6	Retainer	1	17	O-ring	1	28	Orifice	1
7	Spring	1	18	Spring seat	2	29	Plug	2
8	Retainer	1	19	Disc spring	1	30	O-ring	2
9	Snap ring	1	20	O-ring	1	31	Cap screw	2
10	Pin	3	21	Cover	1			
11	Guide	1	22	Bearing	1			

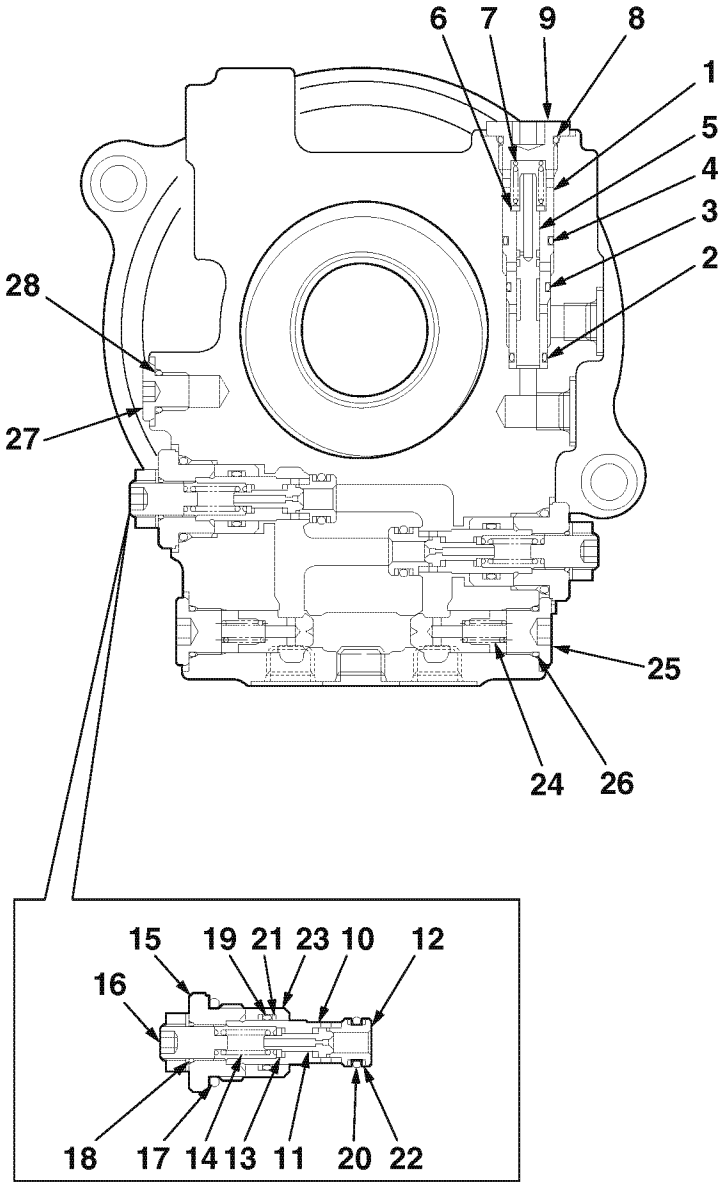
2) Reduction gear



S3F501

No.	Part	Q'ty	No.	Part	Q'ty	No.	Part	Q'ty
1	Housing	1	11	Carrier 2	1	21	Inner race	3
2	Shaft	1	12	Inner race	4	22	Needle bearing	3
3	Collar	1	13	Needle bearing	4	23	Planetary gear A	3
4	Plate	1	14	Planetary gear B	4	24	Thrust plate	1
5	Plate	1	15	Thrust plate	1	25	Drive gear	1
6	Bearing	1	16	Screw	4	26	Plug	1
7	Oil seal	1	17	Sun gear	1	27	O-ring	1
8	Bearing	1	18	Snap ring	1	28	O-ring	1
9	Plate	2	19	Carrier 1	1			
10	Collar	1	20	Thrust washer	3			

3) Brake valve



S3F502

No.	Part	Q'ty	No.	Part	Q'ty	No.	Part	Q'ty
1	Sleeve	1	11	Poppet	1	21	Backup ring	2
2	O-ring	1	12	Poppet seat	1	22	Backup ring	2
3	O-ring	1	13	Spring seat	1	23	Piston	1
4	O-ring	1	14	Spring	1	24	Spring	2
5	Spool	1	15	Plug	1	25	Plug	2
6	Washer	1	16	Adjuster	1	26	O-ring	2
7	Spring	1	17	O-ring	1	27	Plug	1
8	O-ring	1	18	O-ring	1	28	O-ring	1
9	Plug	1	19	O-ring	1			
10	Housing	1	20	O-ring	1			

2. Operation

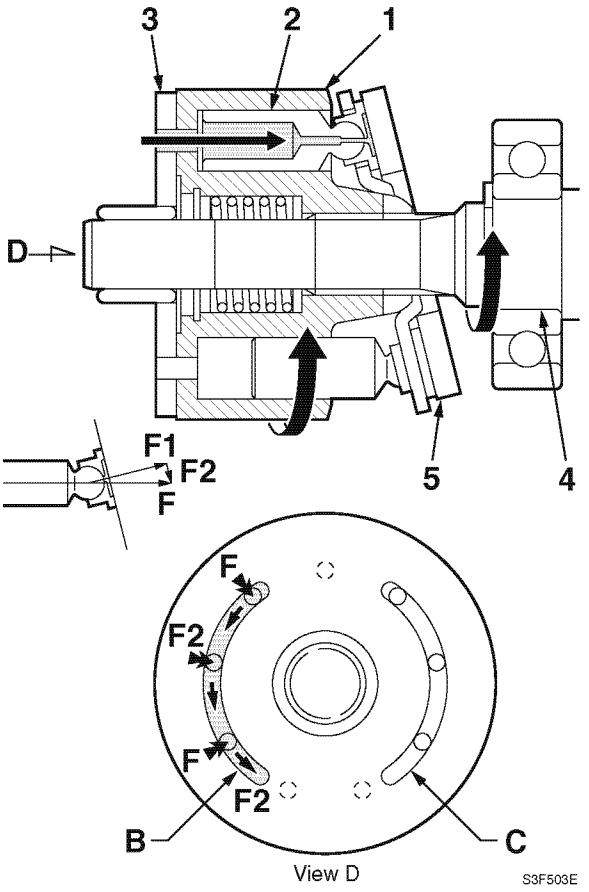
1) Hydraulic motor

9 pistons (2) are fitted in the cylinder block (1) and there is a valve plate (3) with two half moon ports, B and C in the end. Also, the cylinder block (1) rotates freely and is joined to the shaft (4) via the spline. On the other band, the swash plate (5) is fastened to the housing.

When high pressure oil is introduced into port B, one piston (2) makes contact and force F bears on the swash plate (5).

$F = P \times A$ P: Pressure A: Piston Sectional Area

The force F which the piston (2) applies to the swash plate (5) is divided into force F1, which pushes the plate, and force F2, which rotates the cylinder block (1). The total sum of the components in the direction of rotation of the high pressure side piston generates a rotational force in the cylinder block (1) and via the spline, torque is transmitted to the shaft (4), turning it. Conversely, if high pressure oil is introduced to port C, rotation is the reverse of the above.



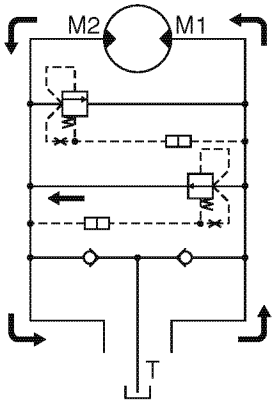
2) Relief valve operation 1

When the motor is started

When the motor is started, since the inertial load is great, the pressure of the oil required to accelerate it rises. If this pressure reaches the relief valve set pressure, the relief valve operates and oil returns to port M2.

In this way, the motor begins to turn as it relieves the relief valve, and as the rotational speed increases, the amount of relief decreases until it stops.

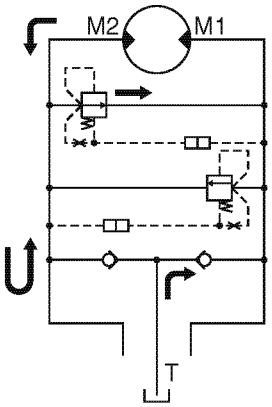
In this way, the shock during starting is absorbed.



When the motor is stopped

When the motor is stopped, the return circuit is closed off.

However, since the motor tends to want to continue rotating due to inertial energy, the pressure in port M2 rises. When this pressure reaches the relief valve's set pressure, the relief valve operates and oil flows to port M1. In this way, the flow of oil to port M1 prevents cavitation from occurring as it absorbs the shock during stopping.



3) Relief valve operation 2

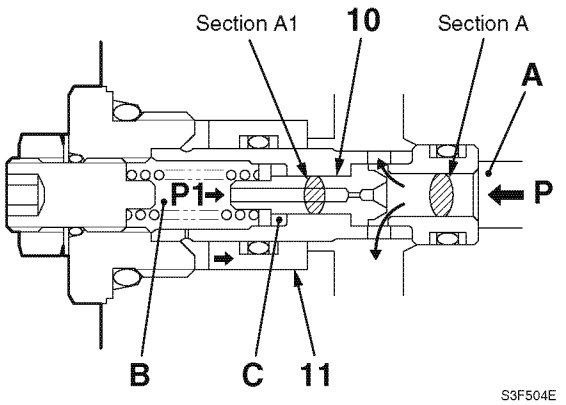
Since this relief valve has a shockless mechanism, it operates in 2 steps.

1st step

When relief valve operation starts, the pressure in chamber B (P1) is kept at a pressure which is lower than that in chamber C while the pressure in chamber A (P) becomes higher than the pressure of the oil flowing in.

At this time, there are two forces acting on the poppet (10), force (F), which attempts to move the poppet (10) to the left and force (F1) which pushes against the seat on the right side. Since F = P × A, F1 = P1 × A1, P > P1 and A > A1, the poppet (10) is moved to the left by this force "F – F1".

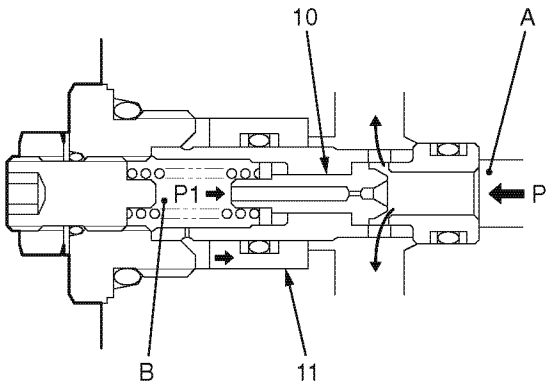
This opens a supply side circuit from chamber A and lets the pressure escape. That is, during the time piston (11) is moving to its stroke end, the relief valve operates at low pressure (about 1/3 the set pressure).



S3F504E

2nd step

When the piston (11) reaches the stroke end, the pressure in chamber B rises and the pressures in chamber A and chamber B equalize. At this time, the force moving the poppet (10) to the left side becomes "P = P1", so this becomes "A – A1" and the relief valve operates at the specified set pressure.



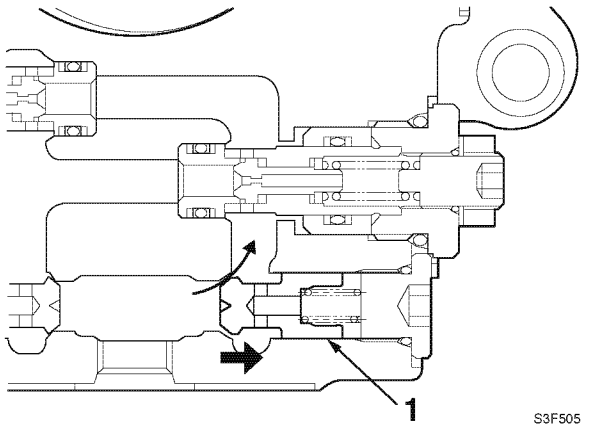
E5D636

4) Makeup valve

The makeup valve has two functions:

One function is to prevent abnormal operation of the swirling mechanism by preventing cavitation caused by overrun of the piston motor. The inertia of the swirling mechanism rotates the motor, pumping up the oil. When this rotational speed exceeds the rotational speed achieved by the oil volume supplied to the motor, the shortfall in oil volume is replenished through the makeup valve (1) to the motor main circuit to prevent a vacuum from being generated in the circuit.

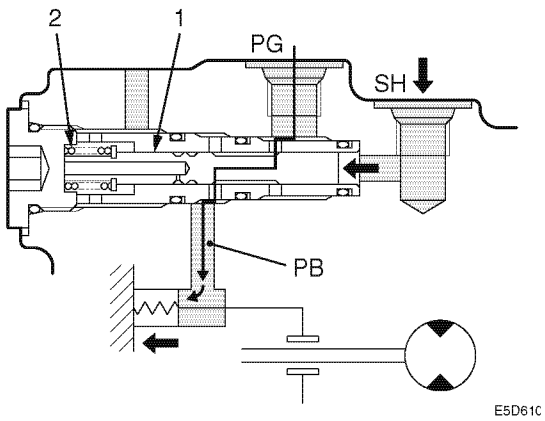
The other function is to obtain the normal braking function by keeping the circuit in the normal state. When the circuit between the motor and the control valve is closed, as in braking, the motor drain and the valve leak volume are replenished through the makeup valve (1) to prevent a vacuum from being generated in the circuit.



S3F505

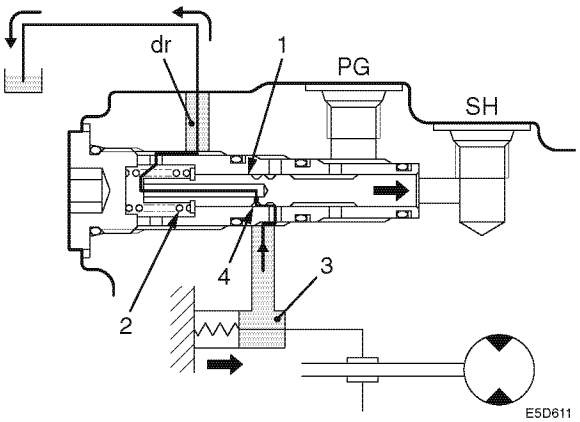
5) Timer valve

This function is used to prevent sudden operation of the parking brake when the motor is stopped.
At the time of parking brake operation, pressure oil from the port P4 is supplied at all times to the port PG, the valve spool (1) is pushed to the right by the force of the spring (2), and the port PG is closed.
When turning pilot pressure or arm pilot pressure is led to the port SH, the spool (1) is moved to the left against the force of the spring (2), and the port PG is opened. The pressure oil from the port PG passes through the hole at the center of the spool (1) and is led to the parking brake release port (PB), so that the parking brake is released.



E5D61C

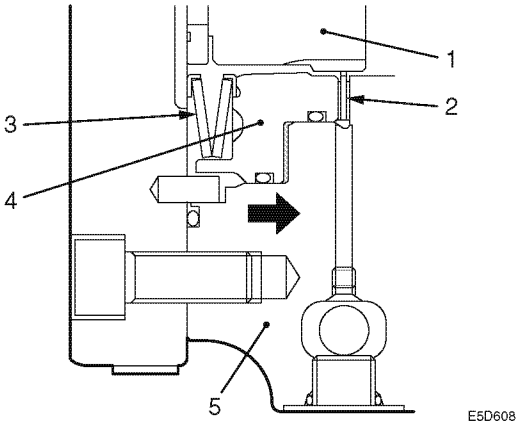
When the pilot pressure at the port SH disappears, the spool (1) is moved by the force of the spring (2) to the right, the port PG is closed, and the oil in the brake piston chamber (3) is prevented from escaping. The oil in the chamber flows gradually through the orifice (4) at the outer circumference of the spool (1) to the drain port dr, so that the parking brake is not applied rapidly, but after a certain time, just as if a timer were used.



E5D611

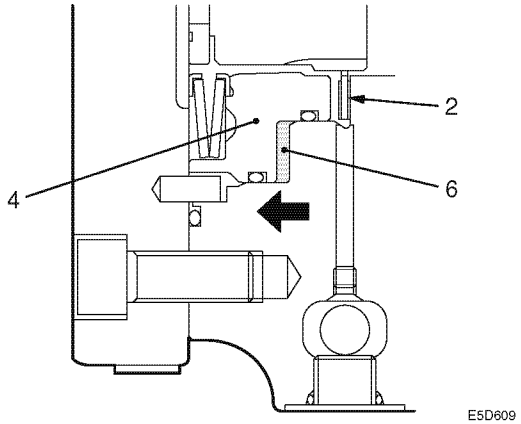
6) Parking brake

The cylinder block (1) and disc (2) are connected via a spline.
The disc (2) is pushed against the housing (5) by the force of the spring (3) via the brake piston (4) and brake force is generated by the friction force between the housing (5) and the brake piston (4) stopping the cylinder block (1) from turning.



E5D608

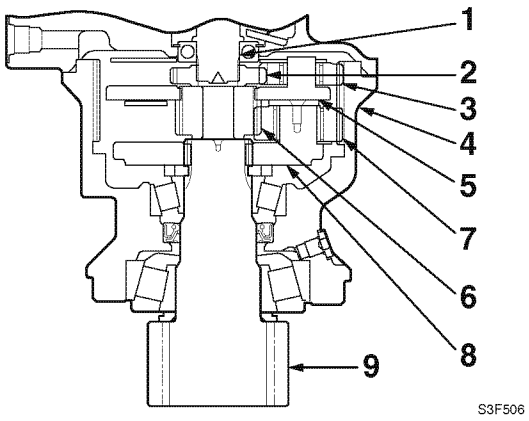
When the oil is introduced from the parking brake release port to the brake piston chamber (6), the oil pressure overpowers the spring force and moves the brake piston (4). This generates a clearance between the case and the disc (2) to release the parking brake.



E5D609

7) Reduction gear

The motor shaft (1) is coupled with the drive gear (2) through the spline. The driving force of the hydraulic motor is transmitted from the drive gear (2) to its mating planetary gear (3) that is also engaged with the ring gear of the housing (4) of the reduction gear. Therefore, the planetary gear (3) revolves along the ring gear while rotating on itself. The carrier (5) supports the planetary gear (3) via the bearing, and transmits the revolution of the planetary gear (3) to the sun gear (6) through the spline. The sun gear engages with the planetary gear (7) and transmits the rotational motion to it. The planetary gear (7) that is also engaged with the ring gear of the housing (4) revolves along the ring gear while rotating on itself. The carrier (8) supports the planetary gear (7) via the bearing, and transmits the revolution of the planetary gear (7) to the pinion shaft (9) coupled through the spline.



S3F506

3. Disassembly and assembly

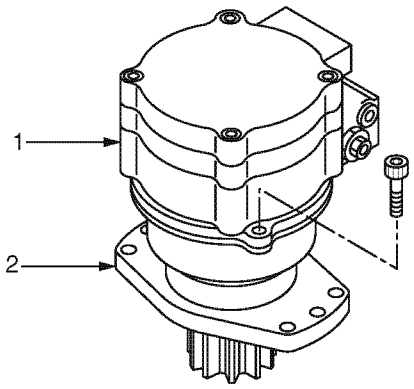
1) Precautions in disassembly and assembly

1. Carry out disassembly and assembly operations in a clean place and provide clean containers to place the disassembled parts in.
2. Before disassembly, clean around the ports and remove the paint from each joint using a wire brush.
3. Clean each of the disassembled parts with a cleaning oil.
4. Make match marks on each part so that they will be assembled in the same positions when assembled.
5. Replace all seals with new ones each time the unit is disassembled, coating them lightly with grease.
6. Check each part to make sure there is no abnormal wear or seizing and use sandpaper, etc. to remove any burrs, sharp edges, etc.
7. Adjust adjustment screws only when required.

2) Disassembly

Swing motor

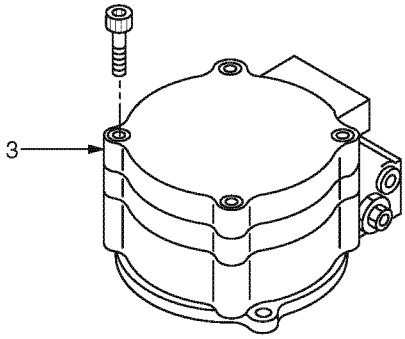
(1) Remove the cap screws to disassemble the slew motor into the hydraulic motor (1) and the reduction gear (2).
- Mark the mating position on both the hydraulic motor and the reduction gear so that they can be mated correctly when reassembling.
- Fix the hydraulic motor with a vise.



E5D612

Hydraulic motor

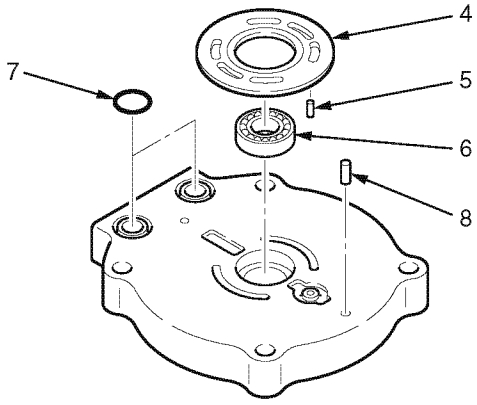
(1) Remove the cap screws and then the cover (3).
- Be careful not to drop the valve plate.



E5D613

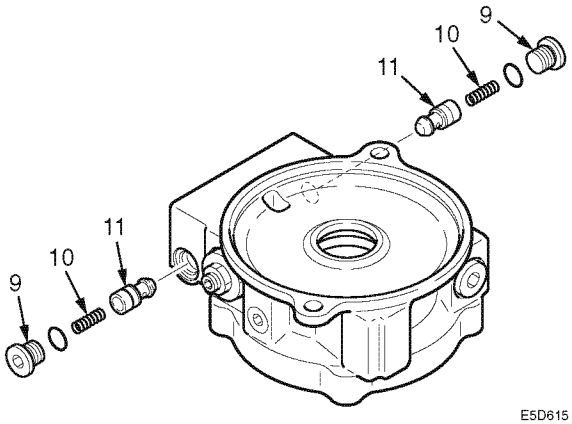
(2) Remove the valve plate (4) and pin (5) from the cover.

(3) Remove the bearing (6), O-ring (7) and pin (8) from the cover.



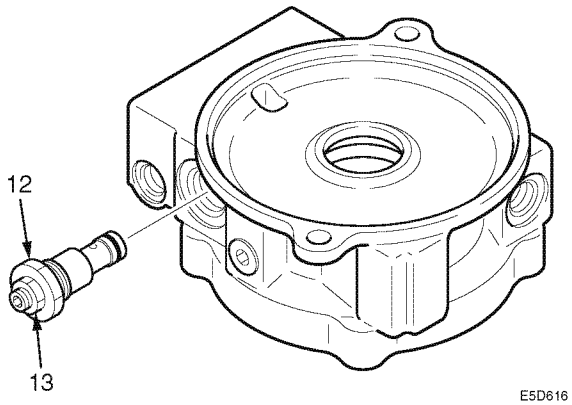
E5D614

(4) Remove the check valve.
a. Remove the plug (9).
b. Remove the spring (10) and check valve (11).



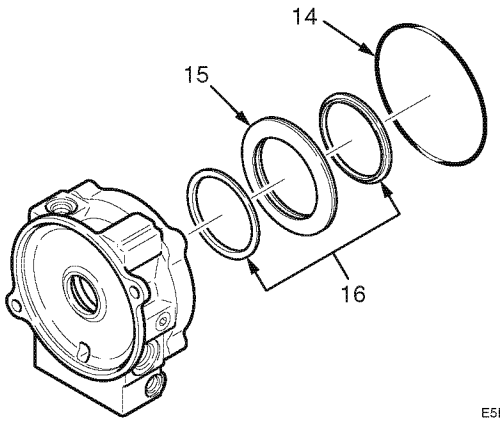
E5D615

(5) Loosen the plug (12) and remove the relief valve.
- Do not loosen the set screw nut (13).
- Do not disassemble the relief valve.



E5D616

(6) Remove the O-ring (14), disc spring (15) and spring sheet (16).



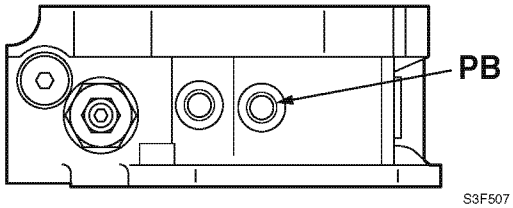
E5D617

(7) Remove the brake piston (17).

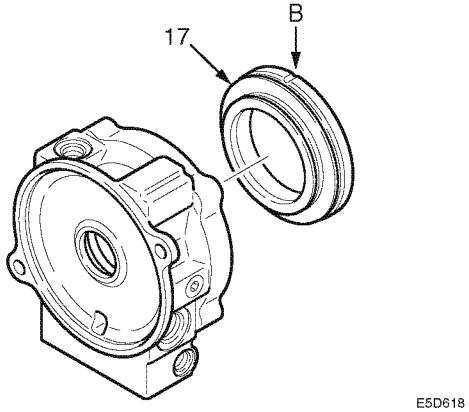
⚠ WARNING

Always wear appropriate protective items such as safety goggles, as component parts can jump out and cause serious bodily injury.

- Blow the air from the brake release port PB with care such that the brake piston does not protrude.
- The brake piston may become impossible to remove if the timer valve is removed before it.

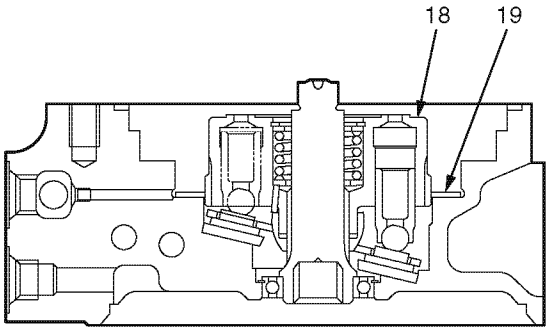


S3F507



E5D618

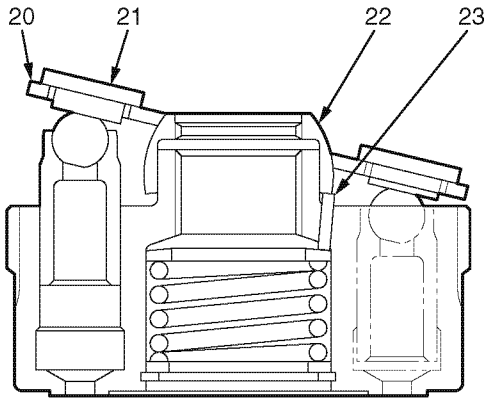
(8) Remove the cylinder block (18) and the disc (19).



E5D620

(9) Remove the shoe holder (20) and the piston assembly (21) from the cylinder block.

(10) Remove the guide (22) and pins (23) from the cylinder block.



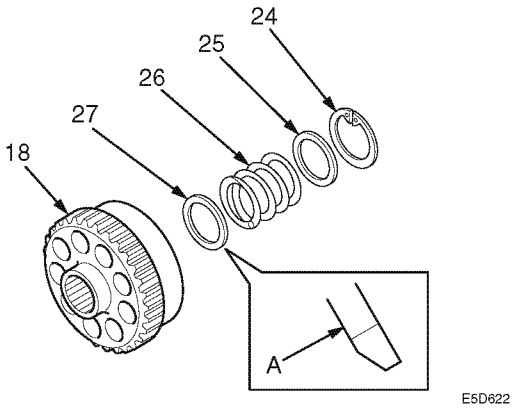
E5D621

(11) Remove the snap ring (24), retainer (25), spring (26) and retainer (27) from the cylinder block (18).

⚠ WARNING

Always wear appropriate protective items such as safety goggles, as component parts can jump out and cause serious bodily injury.

- The snap ring should be removed while pushing the retainer (25).

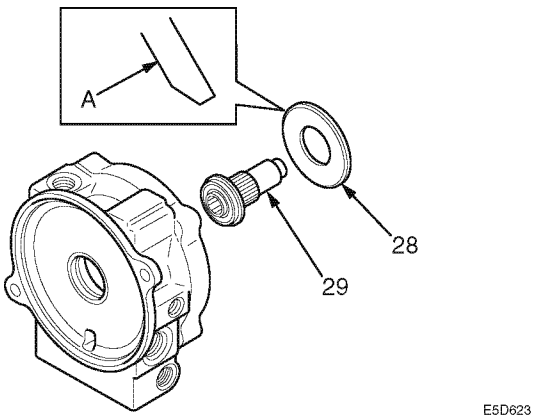


E5D622

(12) Remove the swash plate (28).

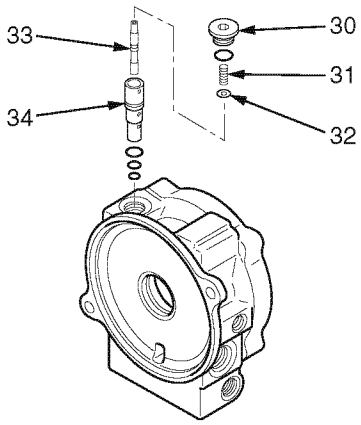
(13) Remove the shaft (29).

- Lightly tap the end face with a plastic hammer.



E5D623

(14) Disassemble the timer valve.
a. Remove the plug (30).
b. Remove the spring (31), washer (32) and spool (33).
c. Remove the sleeve (34).



E5D624

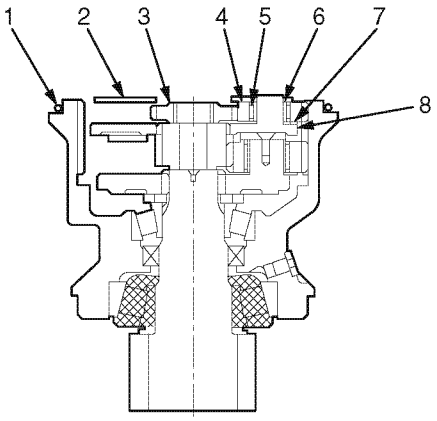
Reduction gear

(1) Remove the O-ring (1) and the thrust plate (2).

(2) Remove the drive gear (3).

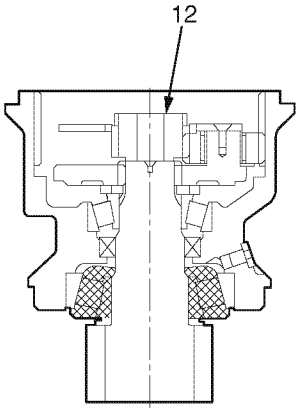
(3) Remove the planetary gear A (4), needles (5), inner race (6) and thrust washer (7) from the carrier 1 (8).

(4) Remove the carrier 1 (8).



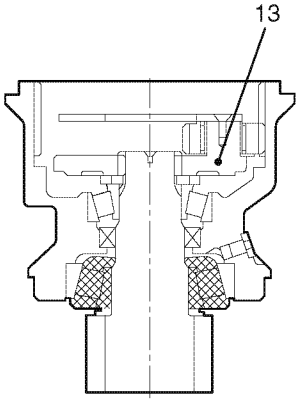
G4D608

(5) Remove the sun gear (12).



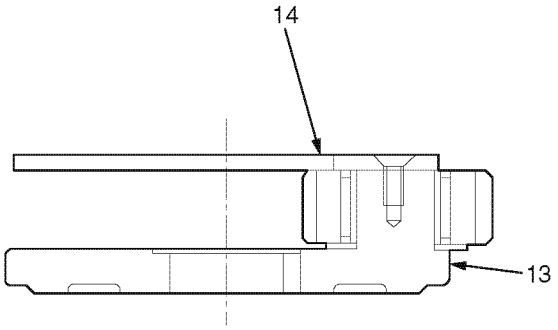
G4D609

(6) Remove the carrier 2 (13).



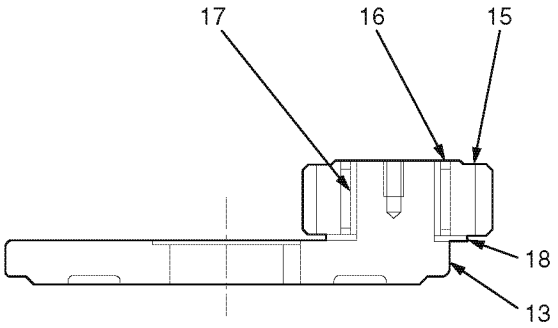
G4D610

(7) Loosen the screw and remove the thrust plate (14) from the carrier 2 (13).
- Secure the carrier 2 with a vise.
- To make the screw easier to remove, warm it with a drier as it is adhered with Loctite.



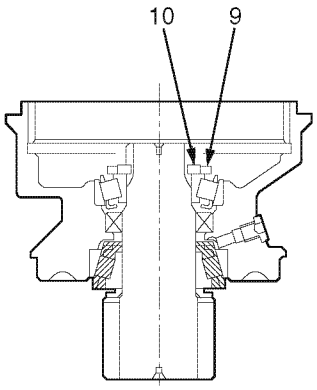
G4D611

(8) Remove the planetary gear B (15), needles (16), inner race (17) and thrust washer (18) from the carrier 2 (13).



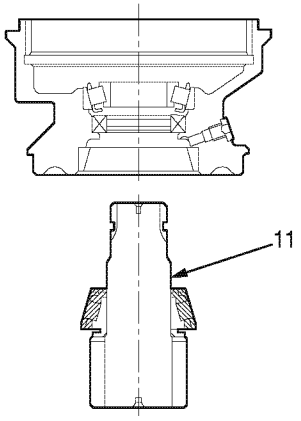
G4D612

(9) Remove the collar (9) and plate (10).



E5D626

(10) Remove the shaft (11).
- Be careful not to miss the shaft.
- If the shaft will not come out easily, lightly tap it with a plastic hammer.
- To replace the taper roller bearing or collar, the case assembly should be replaced.



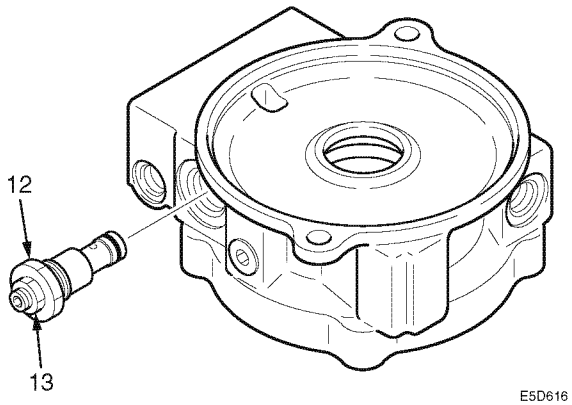
E5D627

3) Assembly

Hydraulic motor

(1) Mount the relief valve assembly.
- Tighten the plug (12).

Tightening torque: 116 ±7.2 ft·lbf (157 ±10 N·m)

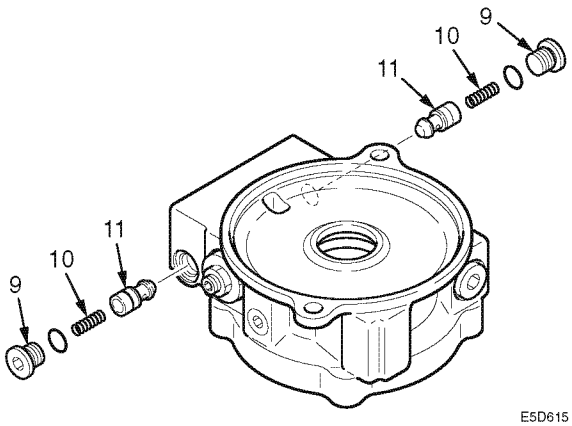


E5D616

(2) Install the check valve (11) and the spring (10) in the cover.

(3) Fit the O-ring to the plug (9) and mount them on the cover.

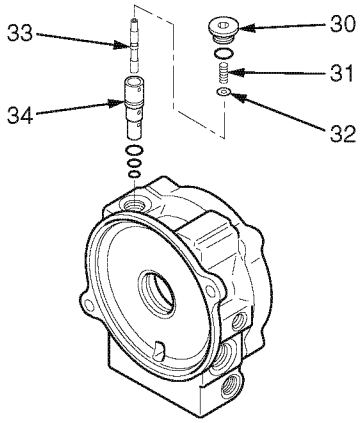
Tightening torque: 28.9 ±1.4 ft·lbf (39.2 ±2 N·m)



E5D615

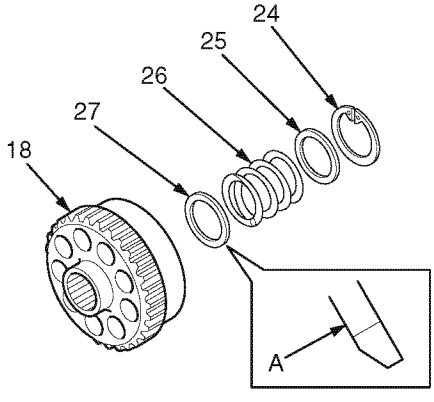
(4) Assemble the timer valve.
a. Fit the O-rings to the sleeve (34) and install them in the housing.
b. Fit the spool (33), washer (32) and spring (31) into the sleeve hole.
c. Mount the plug (30).

Tightening torque: 61.5 ±3.6 ft·lbf (84 ±5 N·m)



E5D624

(5) Mount the retainer (27), spring (26), retainer (25) and snap ring (24) on the cylinder block (18).
- The snap ring should be mounted while pushing the retainer (25).
- Position the retainer (27) so that the tapered (A) side faces the cylinder block.

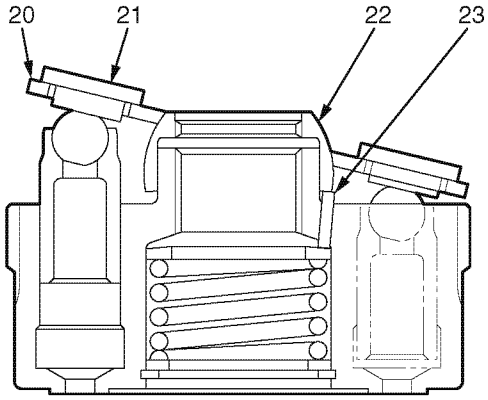


E5D622

(6) Mount the pins (23) on the cylinder block.
- Apply grease to the pins.

(7) Mount the guide (22).

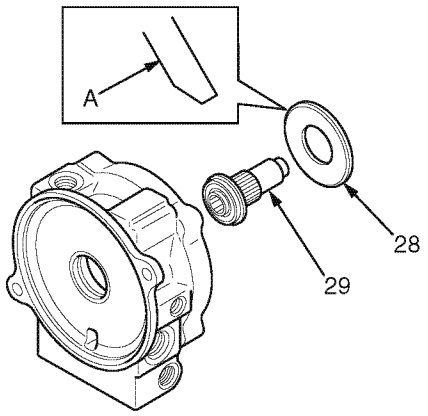
(8) Fit the piston assembly (21) to the shoe holder (20) and mount them on the cylinder block.
- Apply the hydraulic oil to the rotation section.



E5D621

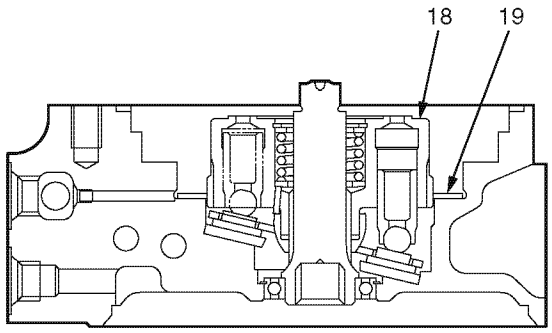
(9) Press fit the shaft (29) in the housing.

(10) Install the swash plate (28) in the housing.
- Apply grease to side A of the swash plate.



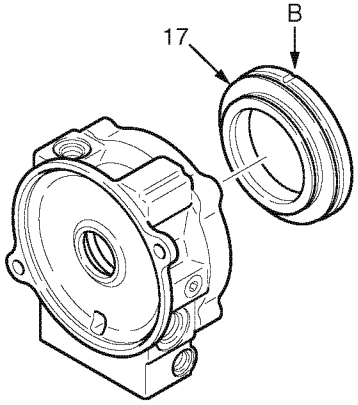
E5D623

(11) Install the cylinder block (18) and disc (19) in the housing.
- Be sure to position the pin (23) correctly.



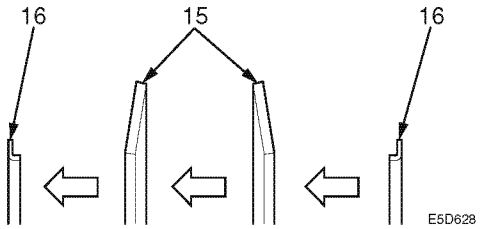
E5D62C

(12) Fit the O-rings to the brake piston (17) and install them in the housing.
- Position the pin hole (B) as shown in the figure.

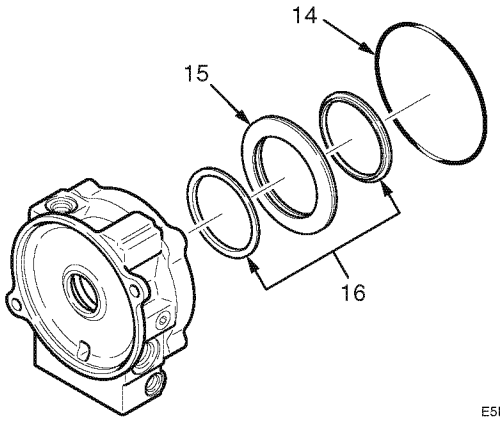


E5D618

(13) Install the spring sheet (16) and disc spring (15) in the housing.

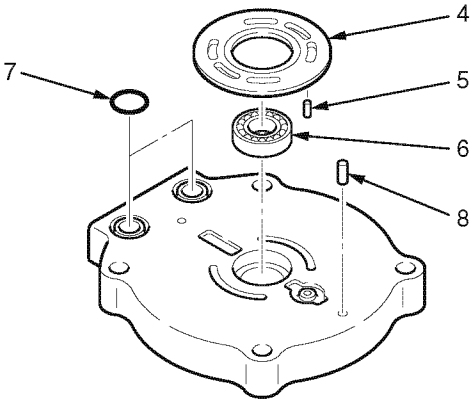


(14) Fit the O-ring (14) to the housing.



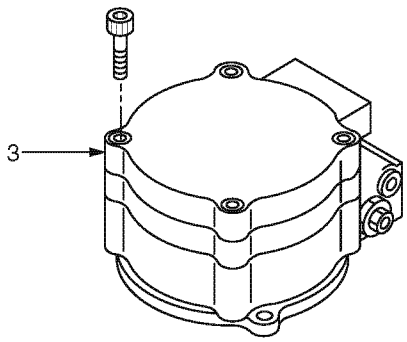
(15) Fit the pins (8), bearing (6) and O-rings (7) to the cover.
- Apply grease to the pins.

(16) Fit the pin (5) and valve plate (4) to the cover.
- Apply grease to the rear surface (cover side) of the valve plate to prevent the plate from dropping off.



(17) Mount the cover (3) on the housing and fix it with the cap screws.
- Be careful not to miss the pin and valve plate.

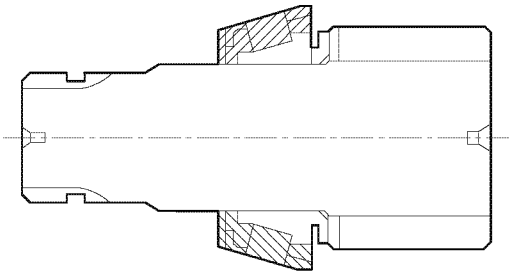
Tightening torque: 94.8 ±5.1 ft·lbf (128 ±7 N·m)



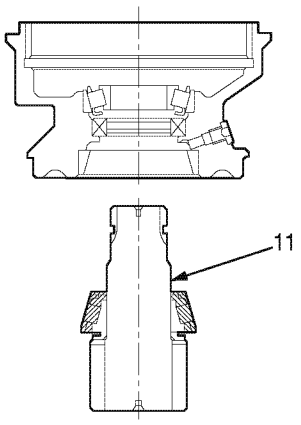
Reduction gears

(1) Put grease into the inner race of the taper roller bearing.

Grease type: Shell ALVANIA Grease

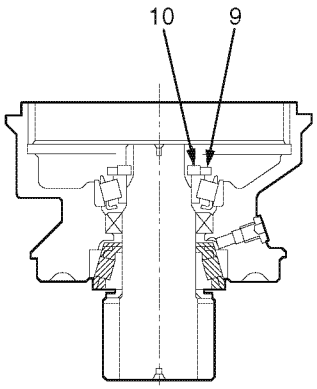


(2) Install the shaft (11) in the case.
- Apply grease to the lip of the oil seal.



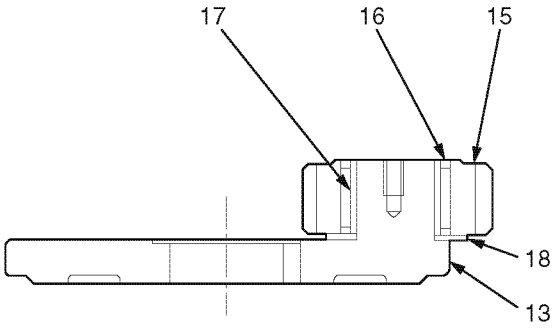
E5D627

(3) Mount the collar (9) and plate (10).



E5D626

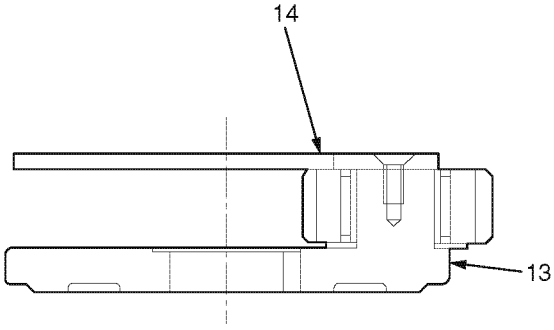
(4) Mount the thrust washer (18), the inner race (17), needles (16) and the planetary gear B (15) on the carrier 2 (13).



G4D612

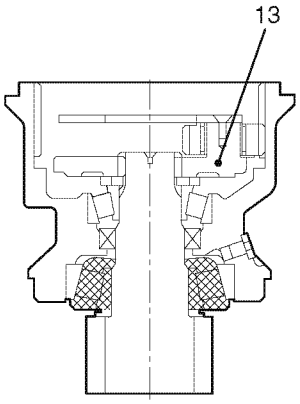
(5) Mount the thrust plate (14) and screw on the carrier 2 (13).

Tightening agent: Loctite #242
Tightening torque: 4.3 ±1.4 ft·lbf (6.1 ±2.0 N·m)



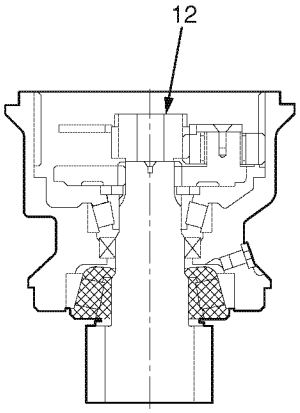
G4D611

(6) Mount the carrier 2 (13) in the case.



G4D610

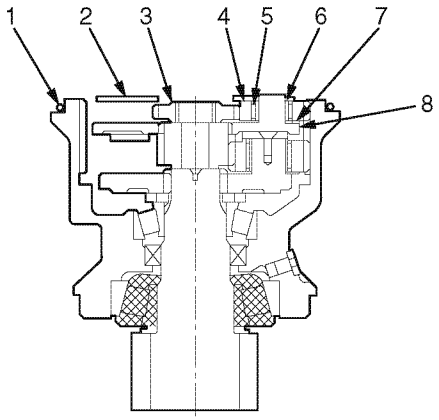
(7) Mount the sun gear (12).



G4D609

(8) Mount the carrier 1 (8).

(9) Mount the thrust washer (7), inner race (6), needles (5), planetary gear A (4), drive gear (3) and thrust plate (2) on the carrier 1 (8).

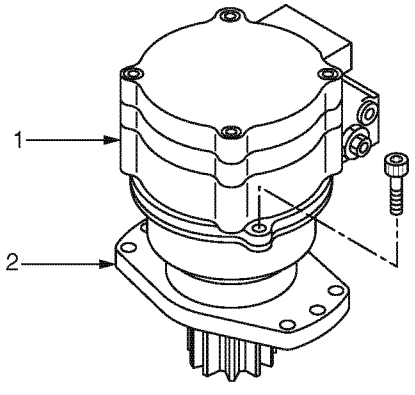


G4D608

Swing motor

(1) Unite the hydraulic motor (1) and the reduction gear (2) and fix them with the cap screws.

Tightening torque: 94.8 ±5.1 ft·lbf (128 ±7 N·m)



E5D612

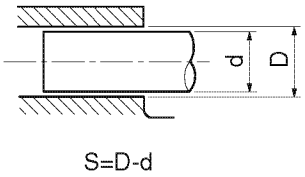
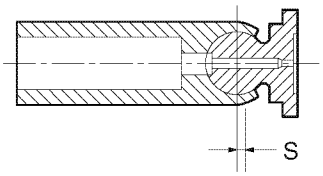
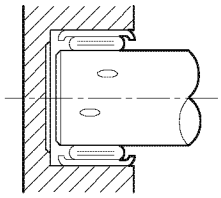
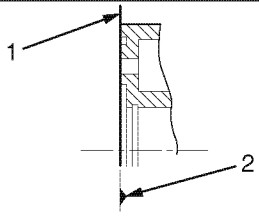
4. Inspection and adjustment

1) Checking the parts

Brake valve

Parts	Inspection standard	Measures
Check valve, piston	• Scratches in sliding portions are deep or roughness is severe. • The clearance with the cover is large. • Scratches in sliding portions are deep or seating is uneven.	• Replace • Replace • Replace
Cover	• Scratches in sliding portions are deep or roughness is severe. • There are scratches where oil leakage occurs.	• Replace • Replace
Relief valve assembly	• The set pressure drops abnormally low. • The set pressure is unstable and vibration occurs. • There is a lot of leakage due to faulty seating, etc.	• Replace • Replace • Replace
Spring	• Damaged or severely deformed.	• Replace

Hydraulic motor

Parts		Standard dimension	Recommended replacement value	Measures
Clearance (S) between piston and cylinder bore	 S=D-d E5D632	0.0008 in. (0.02 mm)	0.0016 in. (0.04 mm)	Replace cylinder block, swash plate assembly.
Clearance (S) between piston and shoe	 E5D633	0.006 in. (0.15 mm)	0.016 in. (0.4 mm)	Replace cylinder block, swash plate assembly.
Shaft and needle bearing rolling surface	 E5D634		Flaking or pitting in the rolling surface.	Replace shaft, port block assembly.
Cylinder block sliding surface (1)	 E5D635		Sliding surface is rough.	Carry out lap repairs (#1000 Powder) or replace.
Valve plate sliding surface (2)				Replace

Reduction gear

Parts	Inspection	Measures
Drive gear	• Gear tooth surfaces are pitted or separating, etc. • Clearance with motor joint is large due to spline wear.	• Replace • Replace
Lower case, internal gear	• Gear tooth surfaces are pitted or separating, etc.	• Replace
Planetary gear	• Gear tooth surfaces are pitted or separating, etc. • Needle rolling surfaces are pitted or separating, etc.	• Replace • Replace
Pinion	• Pitting or spalling is present on the surface of gear tooth. • Clearance with the shaft is large due to spline wear.	• Replace • Replace
Needle bearing, planetary shaft	• Needle and shaft rolling surfaces are pitted or separating, etc. • Pressure marks, etc. on needle and shaft rolling surfaces. • Bearing rotation is abnormal (abnormal noise, rotation not smooth, etc.).	• Replace • Replace • Replace
Carrier, shaft	• Clearance with planetary shaft is large.	• Replace
Shaft	• Clearance with pinion is large due to spline wear.	• Replace
Thrust washer	• Amount of wear is great.	• Replace
Ball bearing, roller bearing	• Rotation is abnormal (abnormal noise, rotation not smooth, etc.). • Flaking, separation, etc. on rolling surfaces. • Pressure marks, etc. on rolling surfaces.	• Replace • Replace • Replace
Collar, oil seal, O-ring	• Scratches, etc. exist which cause leaks.	• Replace

5. Troubleshooting

If there is an abnormal increase in noise or heat, this is an indication that trouble has occurred. When this type of condition is manifested, stop the machine immediately and search out the source of the trouble.
The following table shows a number of causes of general breakdowns that can be seen in the hydraulic circuits and indicates coutermeasures to take in each case.

Trouble	How/Where?	Probable causes	Measures
Motor does not start.	Pressure doesn't rise at the motor's inlet port.	• Relief valve's set pressure is low. • Pump is broken down. • Control valve is broken down.	• Set the pressure at the correct level. • Repair or replace the pump. • Repair or replace the control valve.
	Pressure rises at the motor's inlet port.	• The load is excessive. • Hydraulic motor is broken down. • Reduction gears are broken down.	• Lighten the load. • Repair or replace the hydraulic motor. • Repair or replace the reduction gears.
Motor's speed won't increase.	• Pump's discharge volume is insufficient. • Depends on the motor's function.	• Pump's drain amount is large. • The motor's volumetric capacity is dropping.	• Repair or replace the pump. • Replace the motor.
Oil is leaking.	• Oil is leaking from oil seals.	• Lip is cut or damaged.	• Replace the oil seal.
	• Oil is leaking from mating surfaces.	• Bolts are loose. • O-ring is cut or damaged. • Mating surface is scratched.	• Tighten the bolts. • Replace the O-ring. • Repair the surface with a grind stone or sand paper.
Motor makes abnormal noise.	• Noise in piping.	• Piping support is faulty.	• Clamp the piping.
The surface temperature of the reduction gears case becomes high.	• Lubricating oil	• Oil level is low. • Hydraulic oil is getting in.	• Replenish the oil. • Replace the reduction gears.
	• Gear unit	• Bearings are damaged. • Gear surfaces are damaged.	• Replace the reduction gears. • Replace the reduction gears.

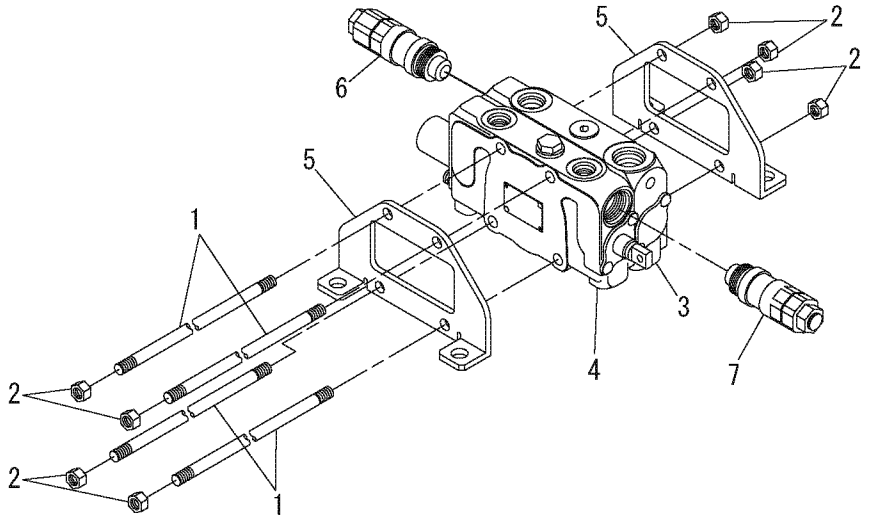
Parking brake and hydraulic timer

Trouble	Probable causes	Measures
The parking brake is not released.	• The brake releasing pressure PB (PG) or the valve switching signal pressure SH is not actuated, or the supply pressure is low.	• Adjust the pressure PB (PG) or SH.
	• The motor drain pressure is high.	• Measure the motor drain pressure and inspect the drain circuit for clogging. Repair it if necessary. • If the motor drain volume is abnormally large, inspect the motor and repair it if necessary.
	The timer valve is not switched. • Malfunction caused by abrasion or damage of the valve body or valve's sliding section. • Malfunction caused by entry of foreign matter into the valve body or valve's sliding section. • The spring is broken.	 • Repair or replace the damaged parts. • Repair or replace the damaged parts. • Replace the spring.
	The brake piston is not actuated. • The O-ring is broken. • The brake piston or the sliding section is worn or damaged. • Foreign matter has entered the piston's sliding section.	 • Replace the O-ring. • Repair or replace the damaged parts. • Clean the sliding section to remove the foreign matter.
The brake is not actuated.	• The disc lining is worn out.	• Replace the disc.
	• The spring of the piston section is sagging or broken.	• Repair or replace the spring.
	• The sliding section of the brake piston is faulty or unevenly worn, or the friction lining on the disc is deteriorated.	• Repair or replace the damaged parts. (Disc lining cannot be repaired.)
	The timer valve is not switched and the pressure within the cylinder is not released. • The spring of the valve section is sagging. • The signal pressure SH is supplied, or the signal system has high back pressure.	 • Replace the spring. • Inspect the pressure in the SH signal system, or adjust the back pressure to the stipulated value if it is too high.
	• The pressure in the cylinder is not released due to clogging of the orifice or filter.	• Clean or replace the filter or orifice.
The parking brake is not released, causing abnormal sound, vibration, shock, or abnormal heating.	• The brake piston is contacting the disc due to the low release pressure PB (PG).	• Adjust the PB (PG) supply pressure to the stipulated value.
	• The pressure within the cylinder is lowered due to abnormal abrasion or damage of the O-ring of the brake piston.	• Replace the O-ring.
	The hydraulic timer is faulty. The parking brake works as the dynamic brake because the timer's setting time is too early. • The orifice is not installed in place. • The valve sheet is faulty. • The spring is sagging or broken.	 • Install the orifice in place. • Repair or replace the valve sheet. • Replace the spring.

6-7. Control Valve

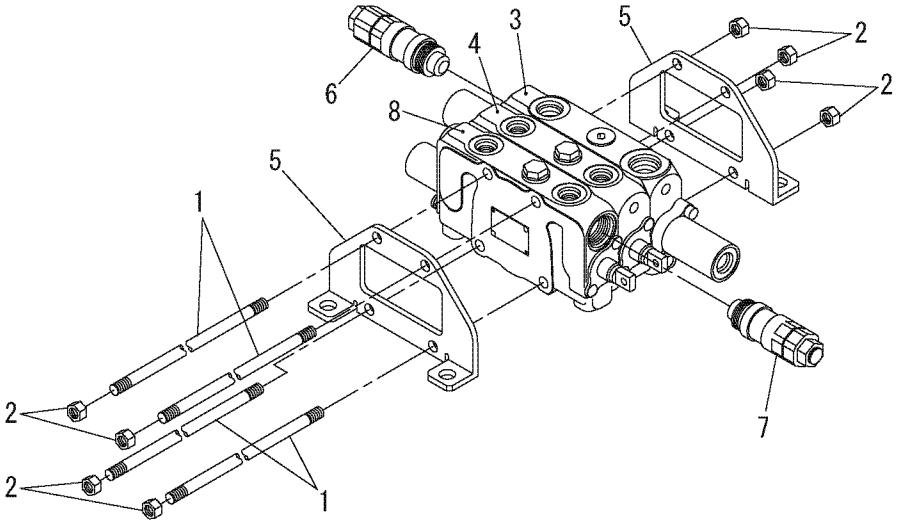
1. Construction

Standard type



S6F600

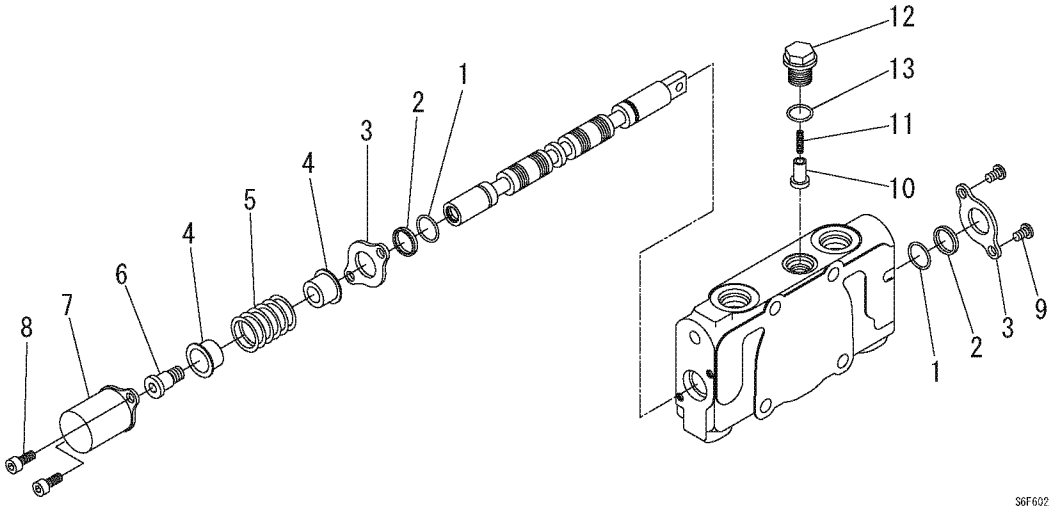
Swing wagon type



S6F601

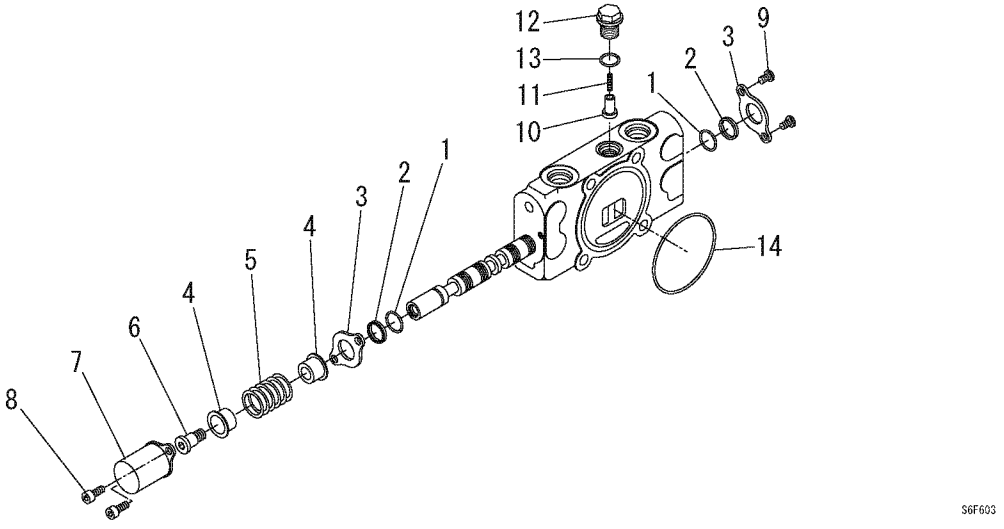
No.	Part	Q'ty	No.	Part	Q'ty
1	Tie rod	6	6	Main relief valve	1
2	Nut	3	7	Port relief valve	1
3	Inlet housing	1	8	Swing section	1
4	Dump section	1	9		
5	Plate	1			

Dump section



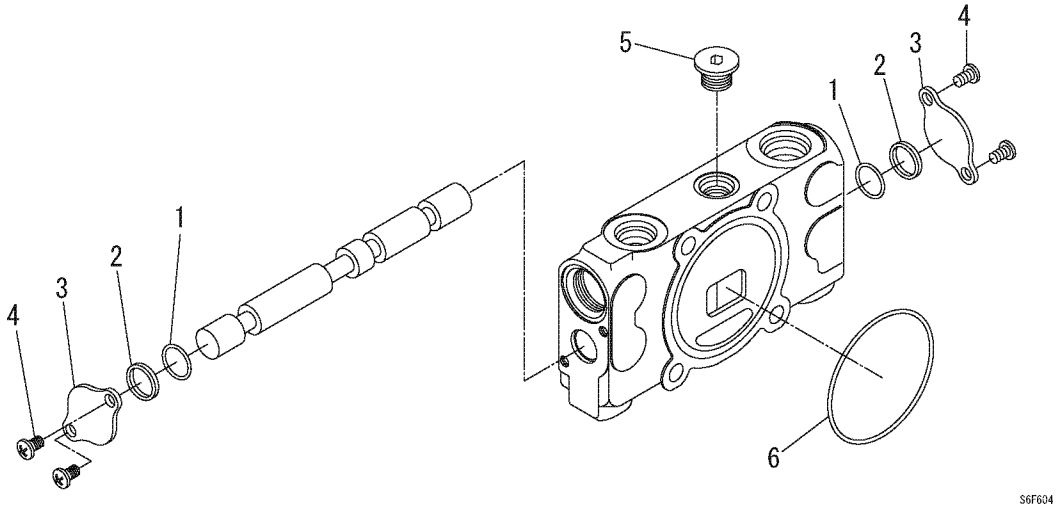
No.	Part	Q'ty	No.	Part	Q'ty
1	O-ring	2	8	Cap screw	2
2	Dust seal	2	9	Screw	2
3	Seal plate	2	10	Check valve	1
4	Spring seat	2	11	Spring	1
5	Spring	1	12	Plug	1
6	Cap screw	1	13	O-ring	1
7	Cover	1			

Swing section



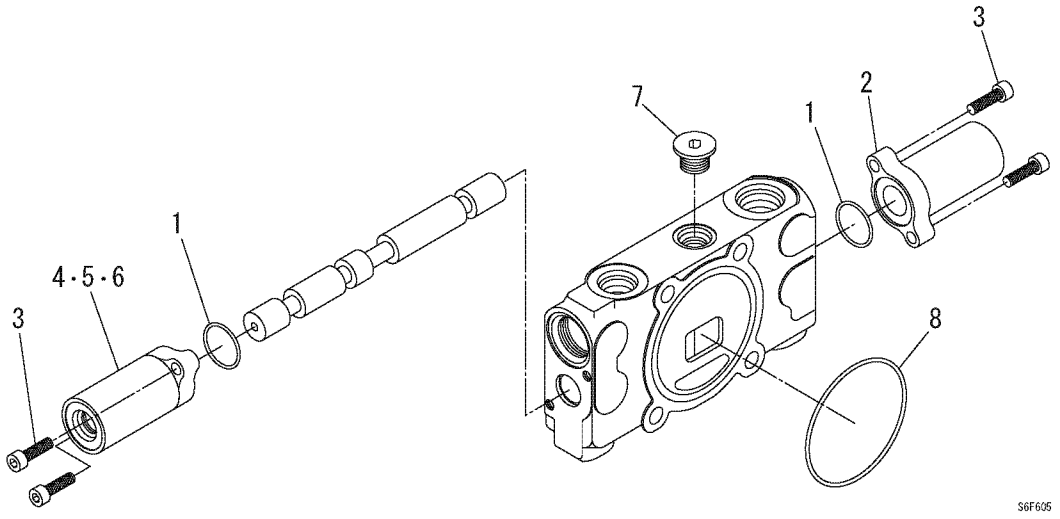
No.	Part	Q'ty	No.	Part	Q'ty
1	O-ring	2	8	Cap screw	2
2	Dust seal	2	9	Screw	2
3	Seal plate	2	10	Check valve	1
4	Spring seat	2	11	Spring	1
5	Spring	1	12	Plug	1
6	Cap screw	1	13	O-ring	1
7	Cover	1	14	O-ring	1

Inlet housing (Standard specification)



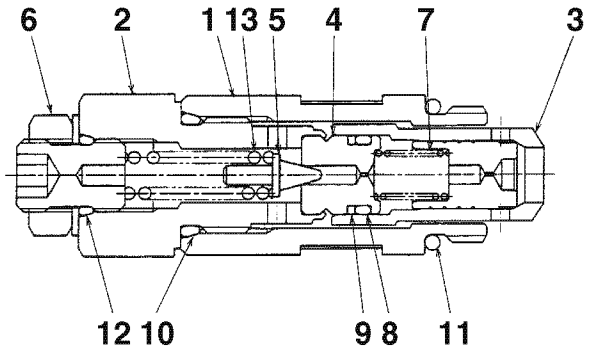
No.	Part	Q'ty
1	O-ring	2
2	Washer	2
3	Seal plate	2
4	Screw	4
5	Plug	1
6	O-ring	1

Inlet housing (Swing vessel specification)



No.	Part	Q'ty
1	O-ring	2
2	Cover	1
3	Cap screw	4
4	Cover	1
5	Filter	1
6	Washer	1
7	Plug	1
8	O-ring	1

Main relief valve



S3F605

No.	Part	Q'ty	No.	Part	Q'ty
1	Housing	1	7	Spring	1
2	Plug	1	8	O-ring	1
3	Sleeve	1	9	Backup ring	1
4	Seat	1	10	O-ring	1
5	Needle valve	1	11	O-ring	1
6	Lock nut	1	12	O-ring	1

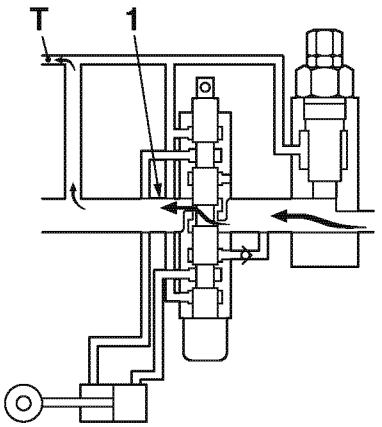
2. Operations

This valve controls the oil flow from the inlet housing to the dump section, and from the inlet section to the swing section (for the model with swing wagon) through the parallel passage to enable concurrent operations of those sections.

The valve for the swing section has a swing brake release signal section (inlet section). When the spool of the swing section is actuated (moved from the neutral position), the signal pressure for releasing the swing brake can be retrieved.

When the spool is in the neutral position

When the control valve spool is not moving, hydraulic oil flows through the center bypass passage (1) and then through the tank passage (T) in the arrow direction, returning to the tank.

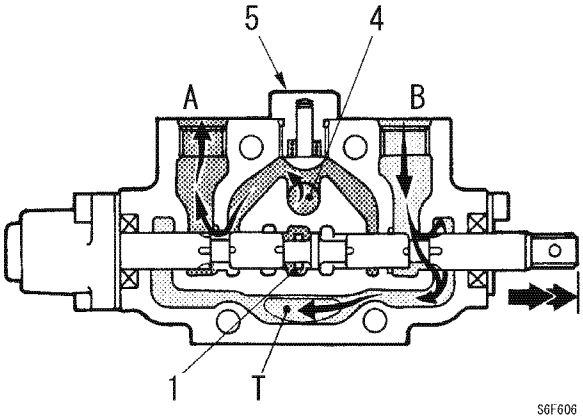


S3F606

When the spool is actuated

Explanation is given for the case where the spool is moved to the right.

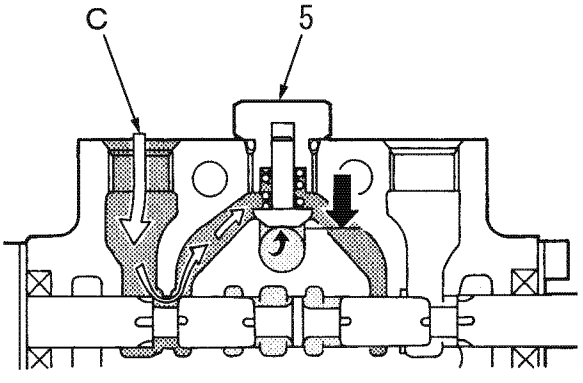
When the spool (2) is moved to the right, the center bypass passage (1) is closed and hydraulic oil entering from the pump passes through the load check valve (5) from the parallel passage (4), flowing from the A port to the actuator. On the other hand, oil returning from the B port flows through the tank circuit (T) and returns to the tank.



S6F606

Load check valve

This load check valve (5) prevents oil from flowing backward due to the load pressure (C) from the actuator port during switching of the spool.

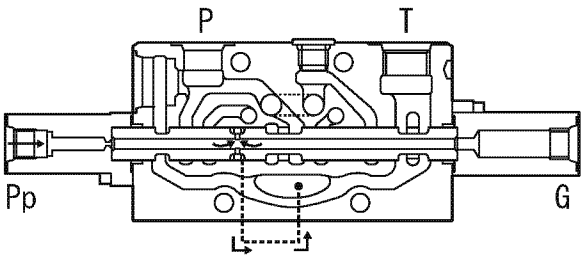


S6F607

1) Inlet section

When the swing section is at the neutral position:

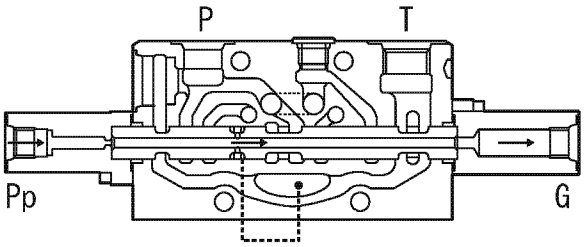
The hydraulic oil discharged from the pilot pressure pump flows through the port Pp into the spool and the signal passage in the swing section, and then flows into the return passage in the outlet section.



S6F608

When the swing section is actuated:

If the spool of the swing section is moved, the signal passage within the swing section is closed, blocking the flow, and the hydraulic oil discharged from the pilot pressure pump flows through the port Pp into the spool and is sent to the port G as the hydraulic oil for releasing the swing brake.



S6F609

2) Main relief valve

A main relief valve is mounted between the pump circuit and tank circuit of each inlet housing and serves to maintain the circuit pressure at the set value.

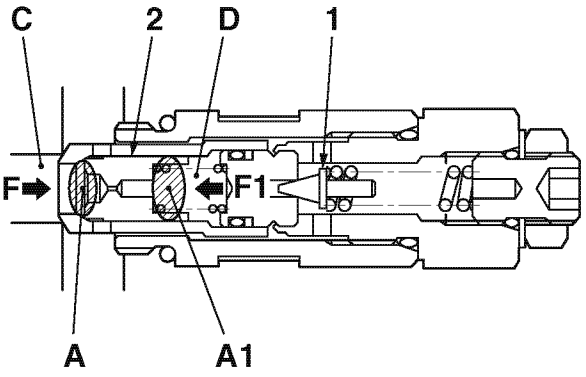
When the relief valve is not operating

When the pressure in the circuit is low with respect to the set value, the relief valve maintains equilibrium. Hydraulic oil from the pump passes through the orifice from chamber (C) and arrives at the spring chamber (D) and the needle valve (1). On the other hand, forces F and F1 are acting in the respective arrow directions on both sides of the main poppet (2).

$F = P \times A$ $F1 = P \times A1$

P: Pressure A, A1: Cross sectional area

Since the cross sectional area of A is less than that of A1, the main poppet (2) is pushed by the force "F1 – F" to the seat surface on the left side.

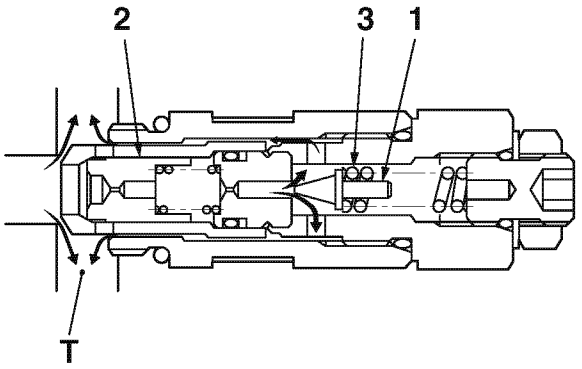


S3F611

When the relief valve is operating

If the circuit's pressure becomes greater than the set valve of the spring (3), the needle valve (1) is pushed to the right by hydraulic pressure and oil flows to the tank passage (T). When this happens, a pressure differential is generated between the two ends of orifice of the main poppet (2), and this hydraulic pressure pushes the main poppet toward the right. As a result, the pressurized oil in the circuit flows to the tank passage.

This operation maintains the pressure in the circuit at the set value.



S3F612

3) Port relief valve

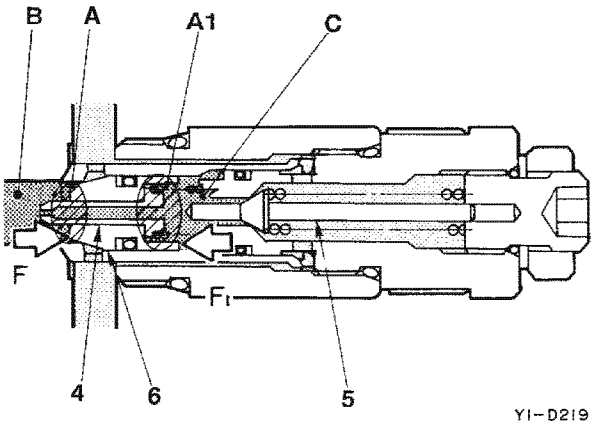
Relieving operation

When the pressure in the circuit is low with respect to the set valve, the relief valve is maintained at equilibrium. Pressure from the pump passes from chamber B to the orifice in piston (4), then reaches chamber C and the needle valve (5). On the other hand, forces F and F1 are acting in the arrow directions on both sides of the main poppet (6).

$F = P \times A$ $F1 = P \times A1$

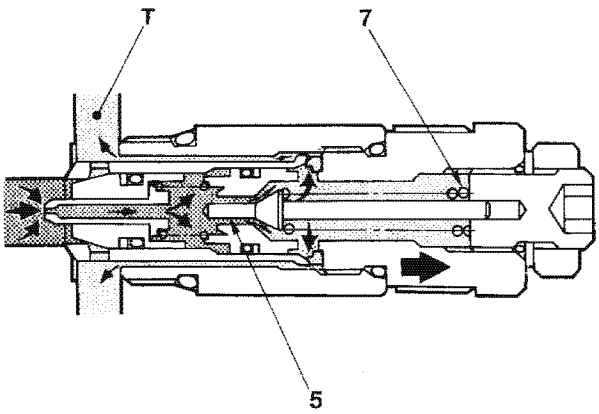
P: Pressure A, A1: Sectional area

Since the sectional area of A is less than that of A1, the main poppet (6) is pushed by the force "F1–F" to the seat surface on the left side.



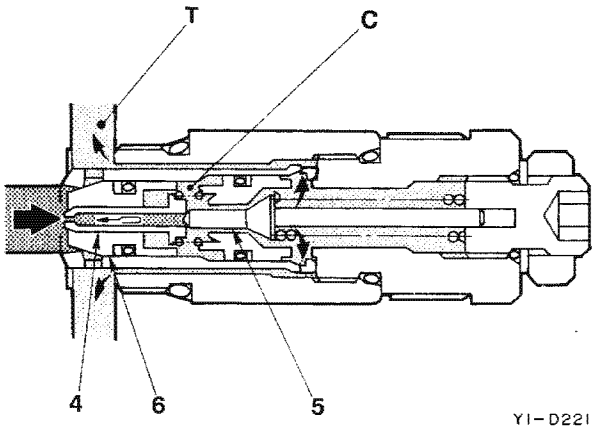
YI-D219

If the pressure in the circuit becomes higher than the force of the spring (7), the needle valve (5) is pushed to the right by hydraulic pressure, opening. Oil then flows around the circumference of the needle valve (5) and passes through the slits, flowing into the tank passage (T).

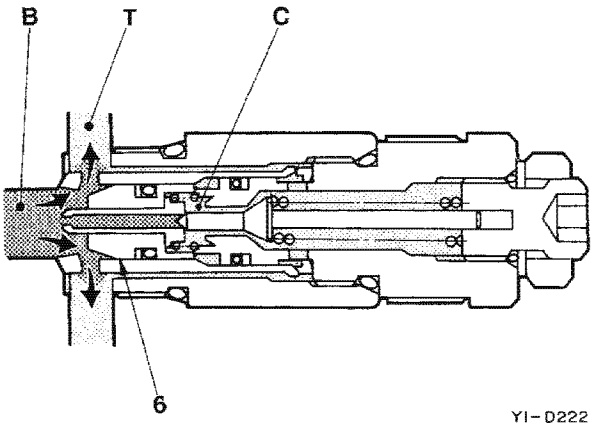


YI-D220

When the needle valve (5) opens, the pressure drops on the back side of the piston (4), pushing the piston (4) to be pushed to the right, seating with the needle valve (5). This shuts off the flow of hydraulic oil to the rear of the main poppet (6). As a result, the pressure in chamber C on the inside drops.



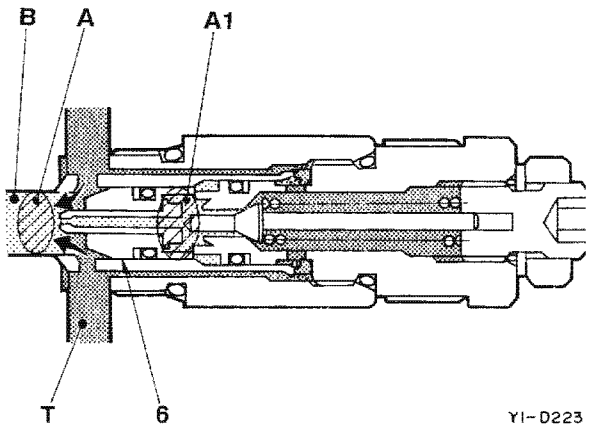
Compared to the chamber B side, the pressure in chamber C is low and there is no equilibrium in pressure. For this reason, the main poppet (6) opens and pressurized oil flows to the tank passage (T).



Suction operation

When the cylinder is operated at high speed, and the supply of oil cannot keep up with it, creating a vacuum in chamber B, oil is supplied from the tank side, preventing the occurrence of cavitation.

When the pressure in chamber B is lower than the pressure in the tank passage (T), the differences in the sectional areas A and A1 cause the main poppet (6) to open. Thus, sufficient oil from the tank passage (T) enters chamber B, filling the empty space.



3. Disassembly and assembly

1) Precautions in disassembly and assembly

1. Since all parts in control valves are precision machined, carry out disassembly and assembly operations in a clean place.
2. Before disassembly, clean the outside surfaces around the valves.
3. Clean each of the disassembled parts and apply clean hydraulic oil to them.
4. Apply hydraulic oil to sliding surfaces and apply a thin coating of grease to seals when assembling them.
5. Replace all seals with new ones each time the valves are disassembled.
6. Spools and section bodies are specially selected for a precise fit. Therefore, if any damage is found in either of these parts, replace the section assembly as a unit.
7. Be sure to number each section and spool to avoid mistakes during assembly.

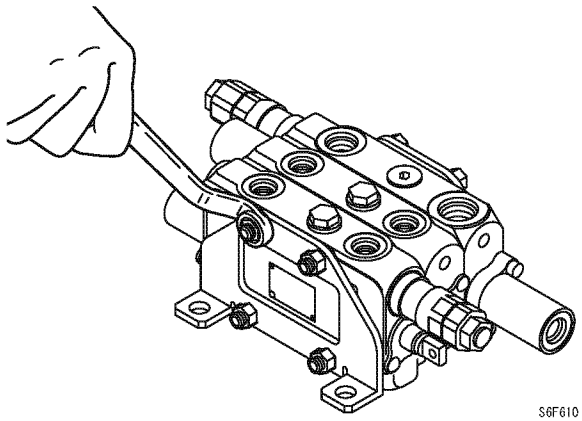
The disassembling procedures of the control valve are described below. For reassembling, follow these procedures in reverse order.

- Before disassembly, number each section and spool.

2) Disassembly

(1) Loosen the nuts and remove the tie rods, then remove the sections.

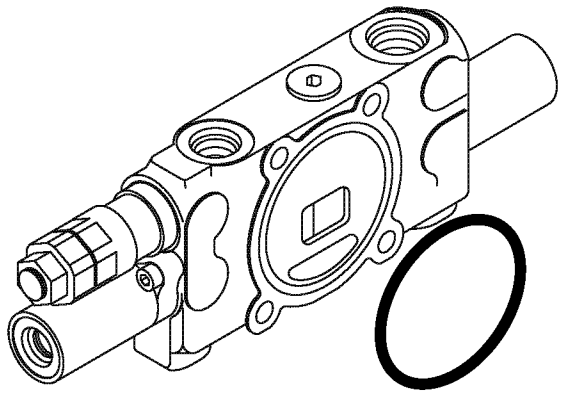
Tightening torque: 19.6 to 21.7 ft·lbf (26.5 to 29.4 N·m)



S6F610

(2) Remove the O-ring.

- The mating surfaces are metal seals, so be careful not to scratch, bruise or otherwise damage them.

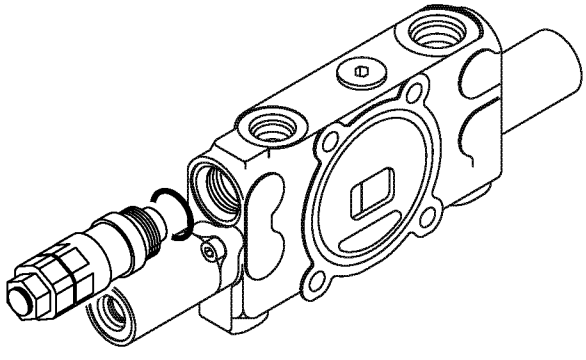


S6F617

(3) Remove the main relief valves and the port relief valves, then remove the O-rings from the relief valves.

- Do not disassemble the relief valves unless it is necessary.
- When using a spanner or adjustable wrench, be sure to attach it in the place shown in the figure at right.

Tightening torque: 50.9 to 57.6 ft·lbf (69 to 78 N·m)

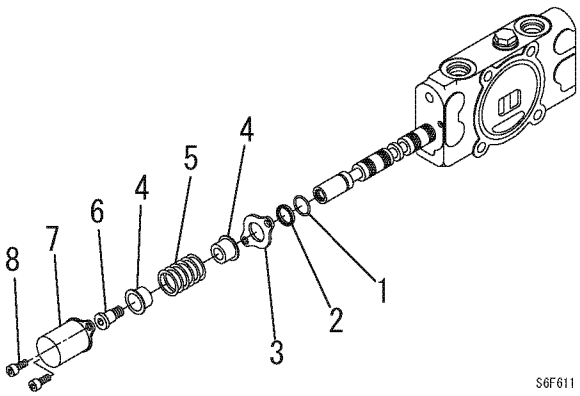


S6F618

Link type section

(1) Remove the cap screw (8), and then remove the cover (7) and the spool assembly.

Tightening torque: 5.4 ft·lbf (7.3 N·m)



S6F611

(2) Remove the screw (6) from the spool assembly. Fix the spool with a vice by using wood chips not to damage it.

⚠ WARNING

Always wear appropriate protective items such as safety goggles, as component parts can jump out.

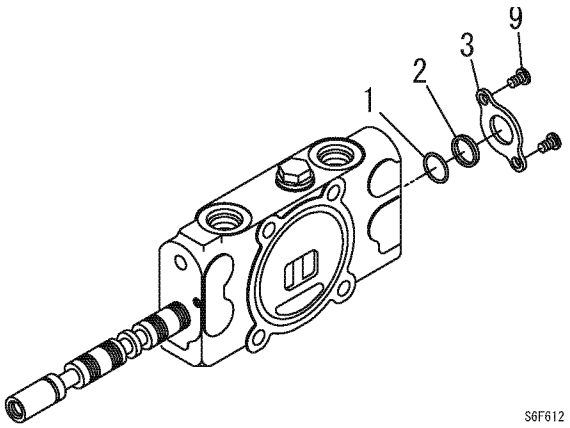
Tightening torque: 14.0 to 16.2 ft·lbf (19.0 to 22.0 N·m)

(3) Remove the spring seat (4), the spring (5), and the spring seat (4).

(4) Remove the seal plate (3), and then remove the dust seal (2) and the O-ring (1).

(5) Remove the screw (9), remove the seal plate (3), and then remove the dust seal (2) and the O-ring (1).

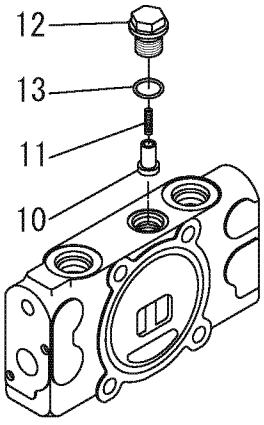
Tightening torque: 1.8 to 2.1 ft·lbf (2.5 to 2.9 N·m)



S6F612

(6) Remove the plug (12), the spring (11), and the check valve (12), and then remove the O-ring (13) from the plug (12).
Record the position of the check valve and the valve housing for reassembly.

Tightening torque: 21.7 ft·lbf (29.4 N·m)



S6F613

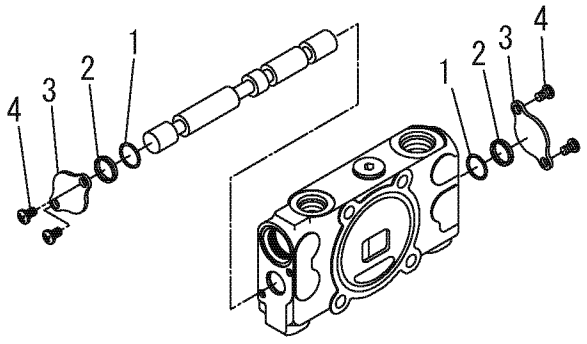
Inlet housing (standard specification)

(1) Remove the screw (4), and then remove the plate (3), the washer (3), the O-ring (1), and the spool.

Tightening torque: 1.8 to 2.1 ft·lbf (2.5 to 2.9 N·m)

(2) Remove the screw (4), and then remove the plate (3), the washer (3), and the O-ring (1).

Tightening torque: 1.8 to 2.1 ft·lbf (2.5 to 2.9 N·m)



S6F614

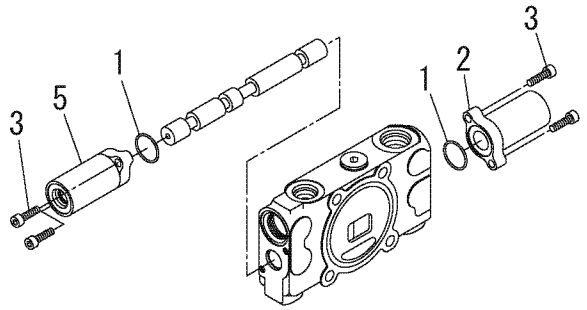
Inlet housing (swing vessel specification)

(1) Remove the cap screw (3), and then remove the cover (5), the O-ring (1), and the spool.

Tightening torque: 5.4 ft·lbf (7.3 N·m)

(2) Remove the cap screw (3), and then remove the cover (2) and the O-ring (1).

Tightening torque: 1.8 to 2.1 ft·lbf (2.5 to 2.9 N·m)

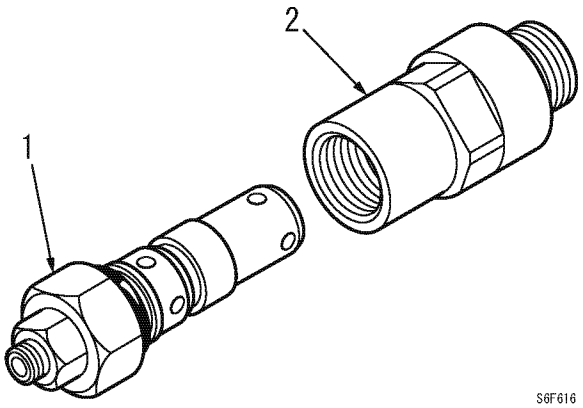


S6F615

Main relief valve

(1) Separate the plug assembly (1) from the housing assembly (2).

Tightening torque: 36.2 to 39.8 ft·lbf (49 to 54 N·m)

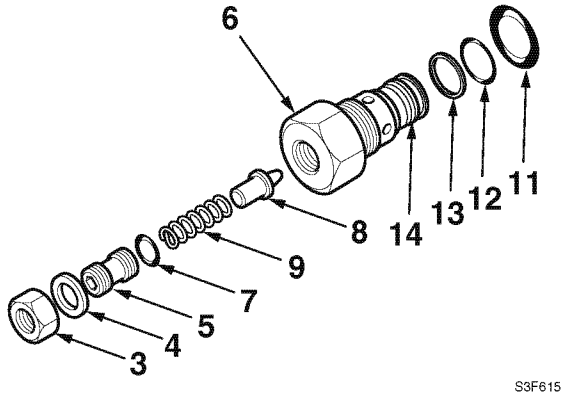


S6F616

(2) Disassemble the plug assembly (1).
   a. Remove the lock nut (3), washer (4) and set screw (5) from the plug (6), then remove the O-ring (7) from the set screw (5).
      • During assembly, after installing the set screw (5), lock the lock nut (3) temporarily, then tighten it after adjusting the pressure.

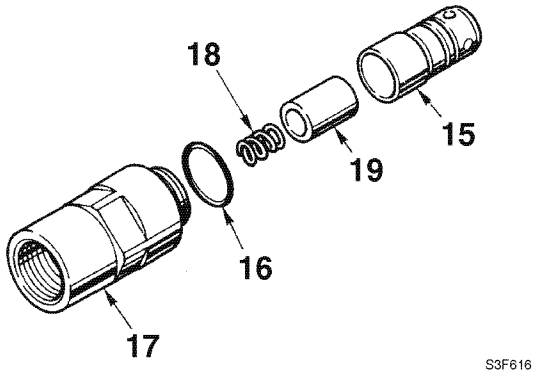
Tightening torque: 20.3 to 23.1 ft·lbf (27 to 31 N·m)

   b. Remove the needle valve (8) and spring (9), then remove the O-ring (11) from the plug (6).
   c. Remove the O-ring (12) and backup ring (13), then remove the seat (14).
      • Do not disassemble the sheet that is caulked by the plug.



S3F615

(3) Disassemble the housing assembly (2).
   a. Remove the sleeve (15) and O-ring (16) from the housing (17).
   b. Remove the spring (18) and main poppet (19) from the sleeve (15).



S3F616

4. Inspection and adjustment

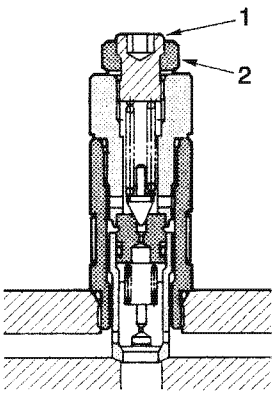
1) Checking the parts

Parts	Inspection standard	Measures
Housing, section body	• Scratches, rust, corrosion of the portion which slides against the spool. • Scratches, rust, corrosion of the seal pocket portion of the part that enters the spool. • Scratches, rust, corrosion of the port seal portion which is in contact with the O-ring. • Scratches, rust, corrosion of the seal portion of the relief valve, etc. • Other damage which could be a hindrance to correct function.	• Replace • Replace • Replace • Replace • Replace
Spool	• Scratch marks like being clawed around the outer circumference sliding portion. • Scratches on the portion that slides against the seals on both ends. • Spool not operating smoothly.	• Replace • Replace • Repair or replace.
Load check valve	• Imperfect sealing due to damage to the valve or spring. • Does not catch, but operates lightly when inserted in the section body and operated.	• Repair or replace. • Normal
Around springs	• Rust, corrosion, deformation, breakage or other marked damage to the spring, holder or cover.	• Replace
Around spool seal	• Oil leaking to the outside. • Rust, corrosion or deformation of the seal holder.	• Repair or replace. • Repair or replace.
Main relief valve, Port relief valve	• External rust, damage. • Damage to valve seat contact surface. • Damage to poppet contact surface. • Abnormality in the spring. • O-rings, backup rings, seals	• Replace • Replace • Replace • Replace • As a rule, all these should be replaced.

2) Adjusting the main relief valve pressure

(1) Install a pressure gauge in the following pressure sensor port.
(2) Run the pump at the rated speed.
(3) Operate the control valve's cylinder spool over its full stroke and read the value indicated by the pressure gauge.
(4) Turn the set screw (1) while watching the pressure gauge to adjust.
Turning it to the right increases the set pressure.
Turning it to the left decreases the set pressure.
(5) After completing the pressure adjustment, tighten the lock nut (2) while holding the set screw (1) so it won't turn.
Operate the relief valve again and check if the pressure is stabilized.

Tightening torque: 20.3 to 23.1 ft·lbf (27 to 31 N·m)



L2B017

5. Troubleshooting

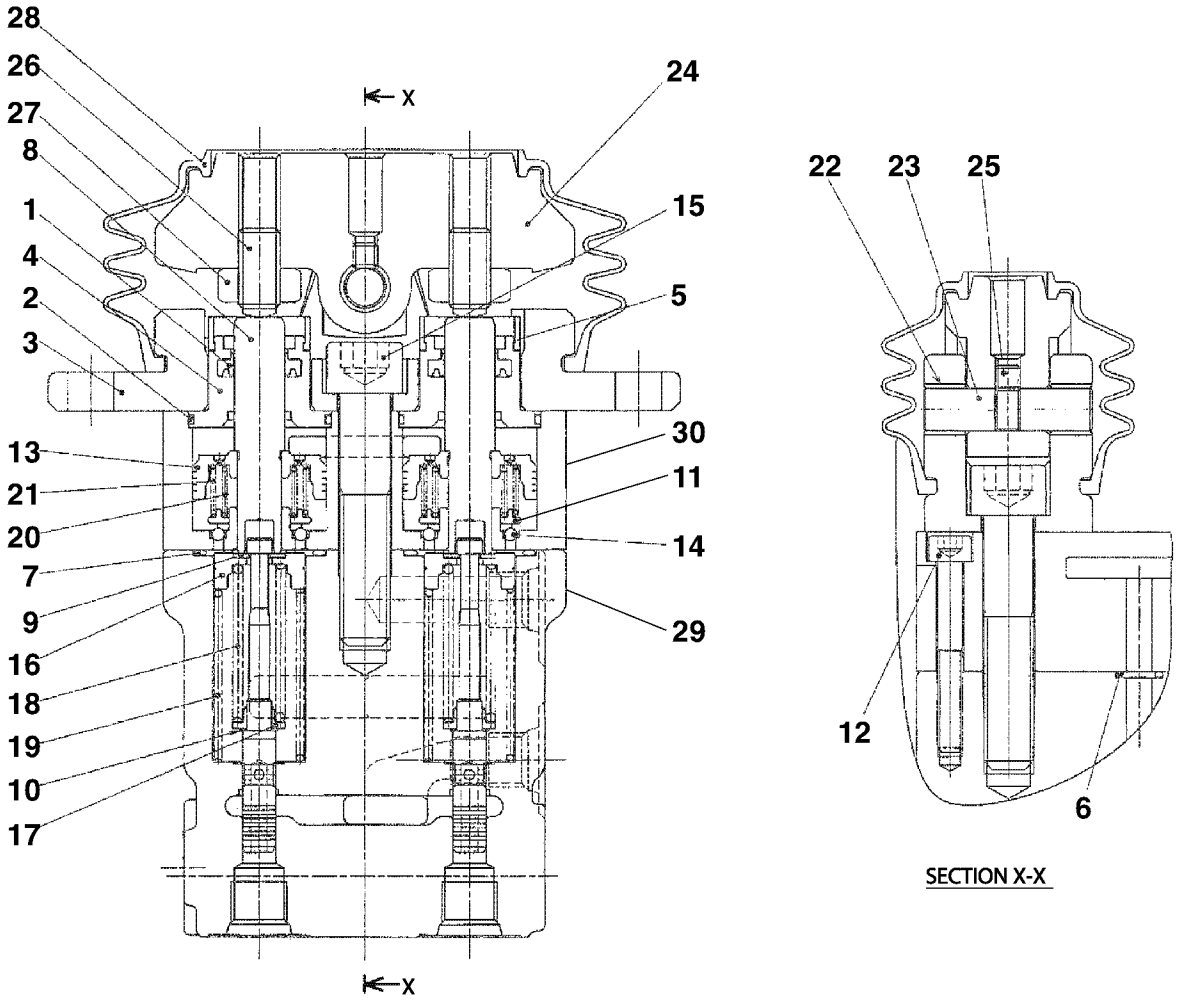
The following items are a list of all the problems that might occur individually, but in actual practice, 2 or 3 of these problems might occur simultaneously to compound the trouble. It is therefore desirable to proceed so that the causes can be eliminated one at a time.

Trouble	Probable causes	Measures
Oil leaks from spool seal.	• Seal is scratched or the seal lip is worn due to long use.	• Replace with a new part.
	• Spool's seal sliding portion was damaged by some external cause (bruise, scratch, etc.).	• Repair or replace the spool.
	• Seal bulged out and the cover was installed in a warped state.	• Return to the correct shape and check for eccentric wear of the seal lip.
	• Paint adhered to the sliding portion of the spool's seal portion during painting.	• Remove paint with paint thinner or remove it mechanically. However, at this time, be careful not to damage the spool surface or the seal lip.
	• Tank circuit's pressure became high and exceeded the pressure level that the seal was capable of withstanding.	• Eliminate the factors causing excessive flow resistance.
Spool's sliding is not smooth.	• Foreign matter is biting into the spool's sliding surface.	• Overhaul and repair or replace.
	• Oil film between the spool and body disappears due to abnormally high oil temperature.	• Use some method to lower the oil temperature or if the relief valve is operating frequently, investigate the cause and reduce the frequency.
	• Lubrication is improper due to deteriorating oil.	• This could be alleviated by simply replacing the hydraulic oil, or it could require an overhaul of the circuit.
	• Spool is worn from long use or due to pressure bearing on one side only.	• Check the spool's diameter and consider the necessity of replacement.
	• Spool is bent from externally applied pressure.	• Check the spool's straightness and other factors, then repair or replace.
	• Entire valve is strained due to strain in the installation face.	• Loosen the installation bolts, then cut the installation face and edge and check.
	• Valve was used at a pressure or a flow volume which was out of specification.	• In the case of pressure, check with a pressure gauge. In the case of flow volume, check by the actuator's speed of movement and the capacity.
	• Bolts used to assemble the valve were tightened excessively.	• Check if the assembly bolts are tightened to the specified torque. If the torque deviates markedly from the specified torque, tighten them again.
	• Oil is accumulating in the cover (the side with a spring or a detent) opposite the side where the spool operates.	• The spool is leaking oil, so when the spool moves, oil leaks from the cover. After confirming this, replace the seal.
Cylinder drops while shifting to a lift operation.	• Foreign matter is biting into the load check valve seat or large scratches were made by foreign matter biting into the valve's seat previously.	• Disassemble and check, then overhaul or replace.

Trouble	Probable causes	Measures
Can't be held in the spool neutral position (cylinder drops).	• Could be mistaken for a great amount of leakage in the cylinder.	• Check if it isn't just the cylinder's natural drop when the cylinder is held. If the problem is in the cylinder, disassemble and repair it.
	• The gap between the spool and body is large, so the amount of oil leaking from the spool is great.	• Replace the spool or replace the valve block assembly.
	• Spool won't return completely to the neutral position.	• Manually Operated : Check if there is something interfering with the link mechanism. Pilot Operated: Check the pilot pressure.
	• Foreign matter is biting into the port relief valve seat and oil is bypassing. Or a seat is damaged.	• Disassemble and check, then overhaul or replace.
The load won't move. (Pressure won't increase.)	• Foreign matter is biting into the relief valve seat and oil is bypassing. Or the seat is damaged.	• Disassemble and check, then overhaul or replace.
	• The relief valve's adjustment screw is loose.	• Try tightening the adjustment screw. If it is loose, correct the setting and tighten the lock nut securely.
	• Foreign matter is biting into the port relief valve seat and oil is bypassing. Or a seat is damaged.	• Disassemble and check, then overhaul or replace.
	• Spool stroke is not the specified stroke.	• Manually Operated: Check if there is something interfering with the link mechanism. Check if a pin or a pin hole in the link connection is worn. Pilot Operated: Check the pilot pressure.
	• Pump is damaged and no oil is discharged.	• Check if the pump is abnormal or not. If the pump is bad, replace it. Check if the cause of the abnormality is air being sucked in, deterioration of hydraulic oil or shafts not centered, etc.
Load doesn't move. (Pressure rises.)	• The load is too heavy.	• Compare with an object of the specified weight.
	• Mechanical resistance of connecting parts is great regardless of the hydraulic pressure in the operating unit.	• Check and replenish hydraulic oil, etc., modify or repair.
	• A large piece of foreign matter is trapped in the circuit or a pipe is bent, causing great resistance.	• Find the affected place and repair it.
	• Spool stroke is not the specified stroke.	• Check if there is something interfering with the link mechanism. Check if a pin or a pin hole in the link connection is worn or not.

6-8. Remote Control Valve

1. Construction



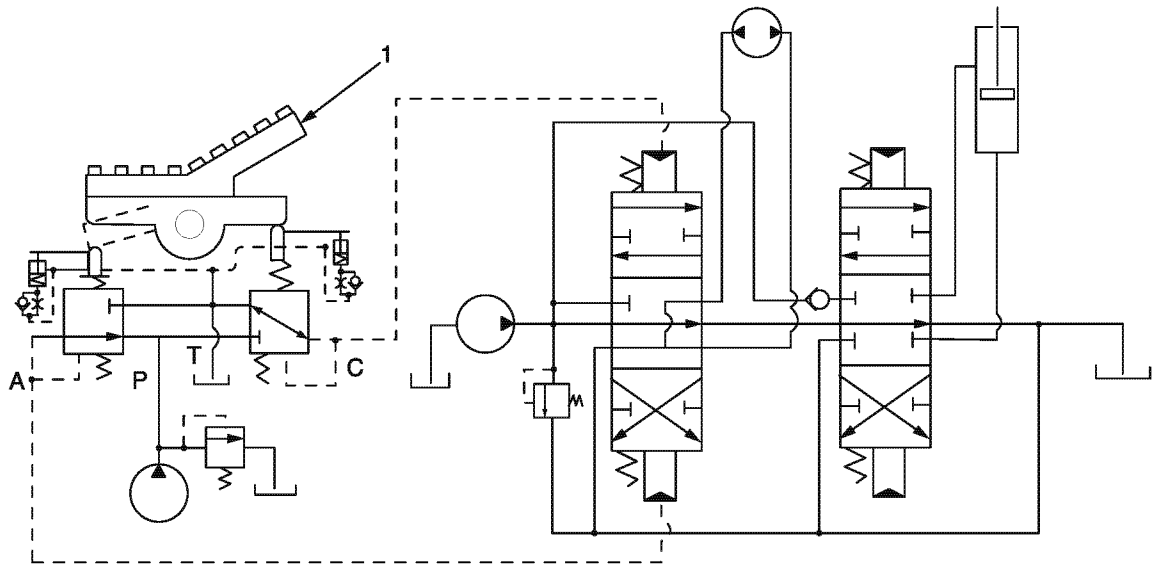
S6F650

No.	Part	Q'ty	No.	Part	Q'ty	No.	Part	Q'ty
1	Gasket	4	11	Holder	4	21	Spring	4
2	O-ring	4	12	Cap screw	2	22	Bushing	4
3	Cover	2	13	Piston	4	23	Shaft	2
4	Plug	4	14	Steel ball	12	24	Cam	2
5	Cup	4	15	Cap screw	2	25	Set screw	2
6	O-ring	2	16	Holder	4	26	Set screw	4
7	O-ring	4	17	Washer	4	27	Nut	4
8	Rod	4	18	Spring	4	28	Boots	2
9	Washer	8	19	Spring	4	29	Casing	1
10	Washer	4	20	Spring	4	30	Casing (damper)	1

2. Operation

The remote control valve casing contains a vertical shaft hole with a reducing valve incorporated into it. When the handle (1) is tilted, the push rod and spring seat are pushed down changing the secondary pressure spring's pressure.

The casing also contains an inlet port for hydraulic oil, port P (primary pressure), and an outlet port, port T (tank), and secondary pressure is taken from 4 ports, port 1, port 2, port 3 and port 4, on the bottom of the vertical shaft hole.



L3D302

When the Handle is in Neutral

In this case, the force of the secondary pressure setting spring, which determines the remote control valve's output pressure (secondary pressure), is not transmitted to the spool. Therefore, the spool is pushed up by the return spring and is in the output port C position shown above, with oil not flowing between port P and the output port C but flowing between the T port and output port C.

When the Handle is Tilted

When the handle (1) is tilted and the push rod is pushed, the spool moves downward and port P and port A are joined. The oil in the remote control valve pump flows out to port A, generating pressure.

(1) When the pressure in port A is the same as the set force of the spring (set pressure), there is a balance between the hydraulic pressure and the spring force.
(2) When the pressure in port A is greater than the set pressure, port A and port P close and port A and port T open.
(3) When the pressure at port A is lower than the set pressure, port A and port P open and port A and port T close.

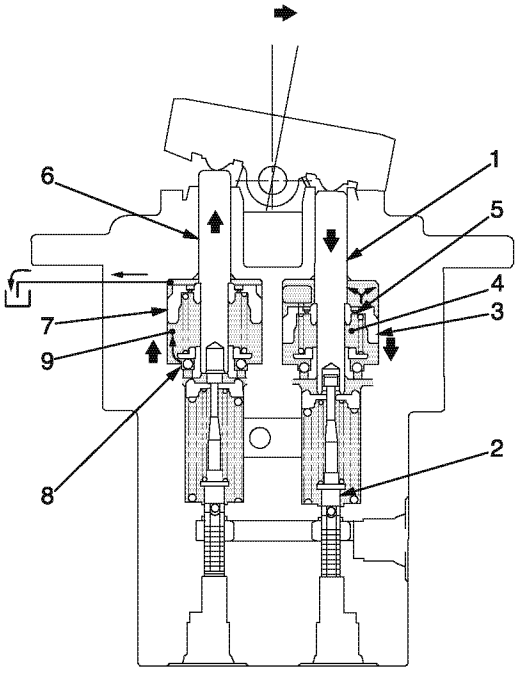
In this way, the secondary pressure is kept constant.

1) Damping mechanism

The damping feature prevents hunting due to insufficient oil supply when the remote control valve is operated suddenly.

When the handle is inclined and the push rod (1) on port 1 is pushed, the spool (2) and piston (3) are moved downward. At this time, the oil in the piston chamber (4) is damped out through the orifice (5) of the piston (3), generating pressure. This damping pressure prevents the push rod (1) from moving abruptly.

The push rod (6) on port 2 is moved upward via the piston (7) by the force exerted by the spring. Then, the oil in the tank chamber pushes up the ball (8) and flows into the piston chamber (9) to prevent the pressure in the piston chamber from becoming negative. The oil outside the piston chamber returns to the tank through the tank passage on the upper end of the casing.



L3D303

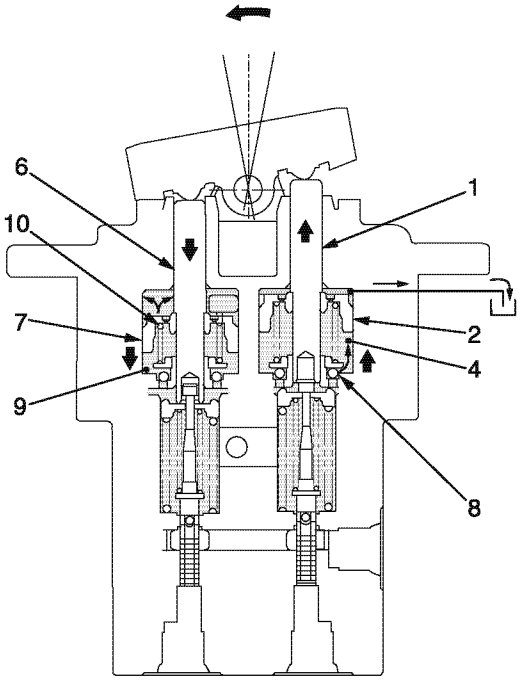
When the handle is inclined to the maximum and then to the reverse direction, the push rod (6) on port 2 is pushed down and the piston (7) moves downward.

Then the oil in the piston chamber (9) is damped out through the orifice (10) of the piston, generating pressure.

The push rod (1) on port 1 is moved upward via the piston (2) by the force exerted by the spring.

At this time, the oil in the tank passage pushes up the ball (8) and flows into the piston chamber (4) to prevent the pressure in the piston chamber from becoming negative. The oil outside the piston chamber returns to the tank through the passage connected to the tank on the upper end of the casing.

The mechanism has been designed so that operating the handle from any position activates the damping feature to prevent hunting.

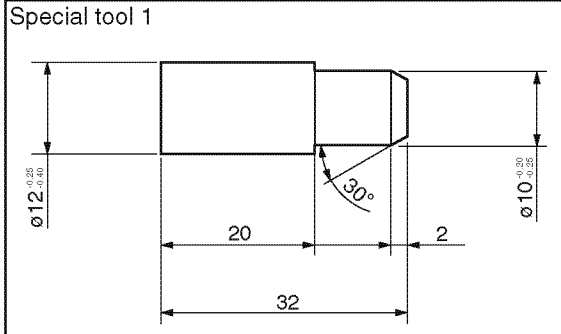


L3D304

3. Disassembly and Reassembly

1) Special tool table

(Unit: mm)

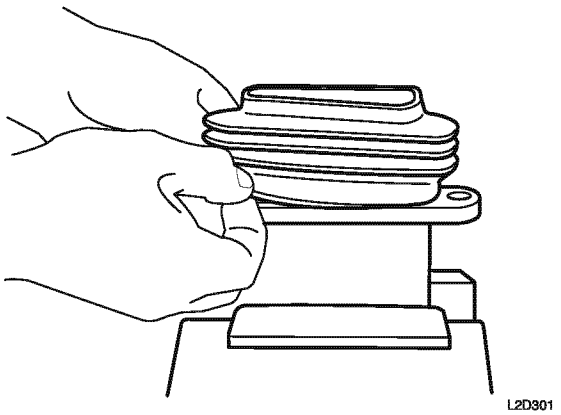
Name and dimension	Q'ty
Special tool 1 	1

2) Precautions for disassembly and reassembly

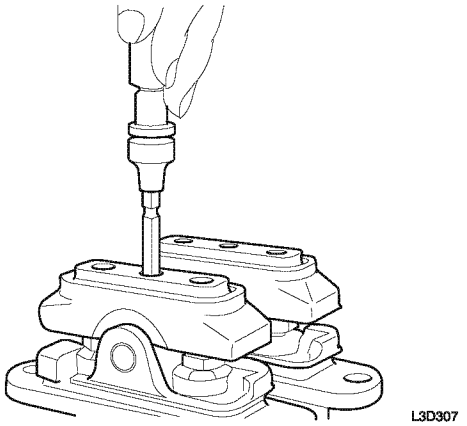
1. Perform disassembly and reassembly in a clean place and prepare a clean case for storing disassembled component parts.
2. Clean around the port before disassembly and remove the paint on moving parts with a wire brush.
3. Clean all disassembled parts with clean oil.
4. Make matching marks on component parts and align them at reassembly.
5. Replace all seals with new seals at each disassembly and apply grease thinly.
6. Inspect each component parts for abnormal wear and seizure. Remove flashes and burrs with sand paper.
7. Avoid adjusting each adjustment thread unless necessary.

3) Disassembly

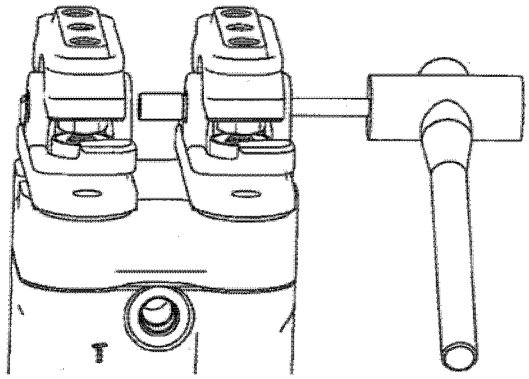
(1) Remove the cover (3) from the boots (28) upward.
Fix the remote control valve with a vice.



(2) Remove the set screw (25).
Care must be taken that Locktite 241 is applied and loosening torque is large.



(3) Remove the shaft (23) by touching it with a round bar (8mm or below) and hitting it lightly with a hammer.

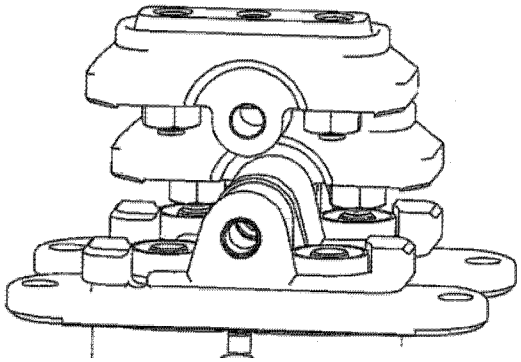

S6F654

(4) Remove the cam (24) while the set screw (26) and the lock nut (27) are attached.

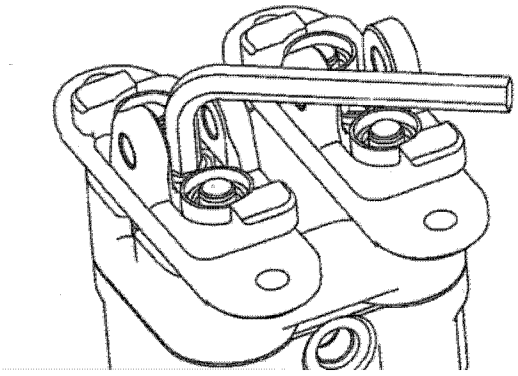
⚠ WARNING

Always wear appropriate protective items such as safety goggles, as the push rod (8) can jump out.

- Record the position of the cam (24) and cover (3).


S6F655

(5) Remove the cap screw (15).

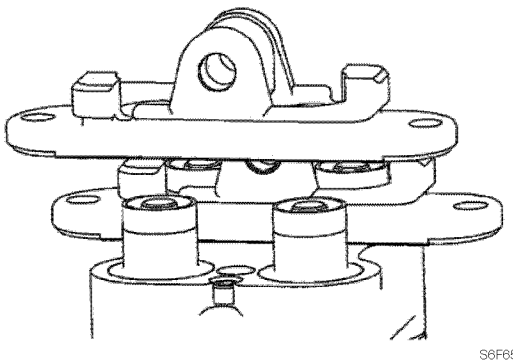

S6F656

(6) Remove the cover (3).

⚠ WARNING

Always wear appropriate protective items such as safety goggles, as the push rod (8) and the plug (4) can jump out.

- Record the position of the cover (3) and the casing (30).
- The plug (4) remains in the case due to movement resistance of the O-ring (2).

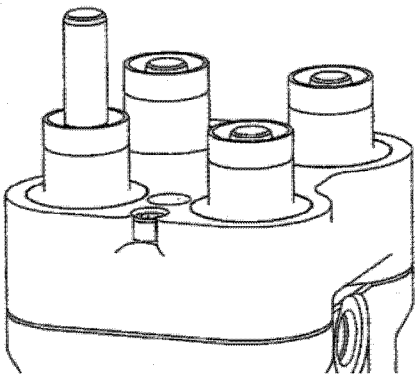

S6F657

(7) Remove the plug (4) from the push rod (8).

⚠ WARNING

Always wear appropriate protective items such as safety goggles, as the plug (4) can jump out.

- Do not damage the surface of push rod.
- Record the position of the plug and the push rod.



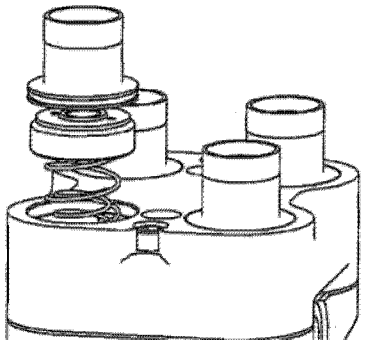
S6F658

(8) Remove the plug (4) while the grease cup (5) and the gasket (1) are attached.

⚠ WARNING

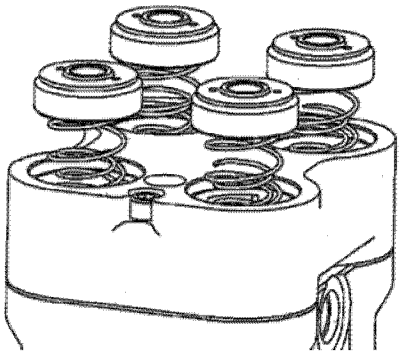
Always wear appropriate protective items such as safety goggles, as the piston (13) can jump out.

- Record the position of the plug and the casing hole.



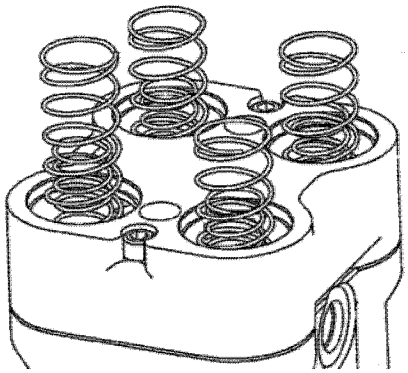
S6F659

(9) Remove the piston (13) from the casing (30).
- Record the position of the piston and the casing hole.



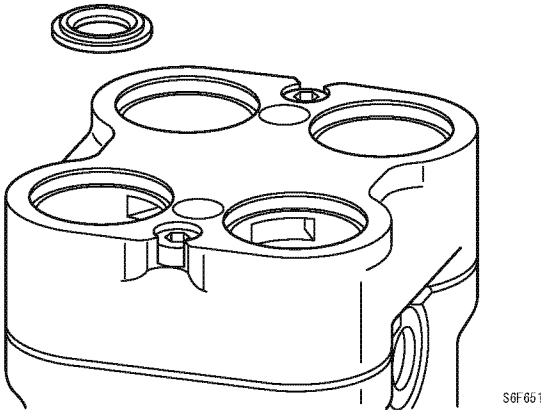
S6F660

(10) Remove the damping springs (20) and (21) from the casing (30).
- Record the position of the damping spring and the casing hole.

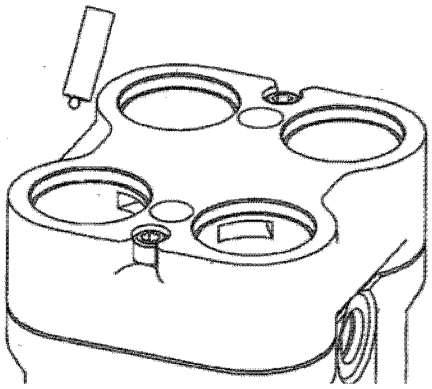


S6F661

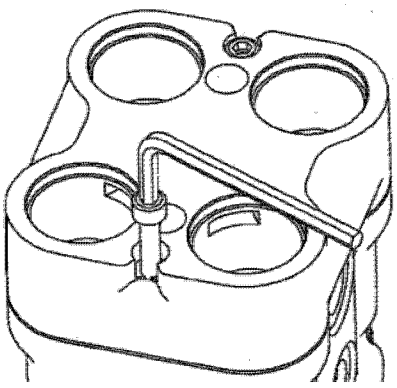
(11) Remove the holder (11) from the casing (30).
- Record the position of the holder and the casing hole.


S6F651

(12) Remove the steel ball with a magnet or the like.
- Care must be taken not to lose the steel ball.


S6F662

(13) Remove the cap screw (12).

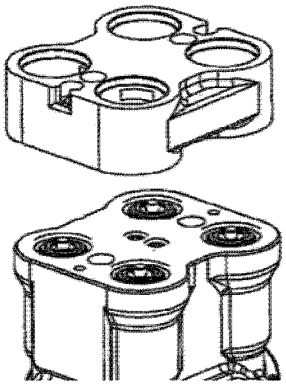

S6F663

(14) Remove the casing (30).

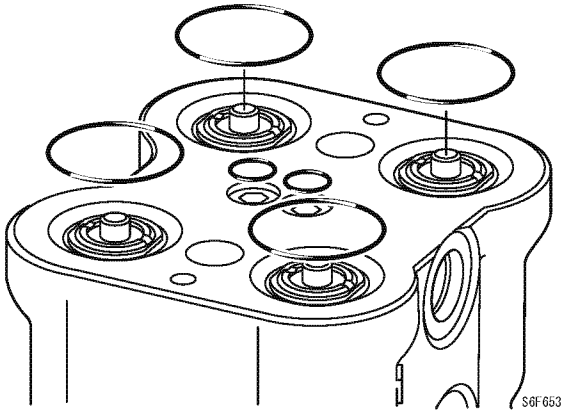
⚠ WARNING

Always wear appropriate protective items such as safety goggles, as the reducing valve assembly can jump out.

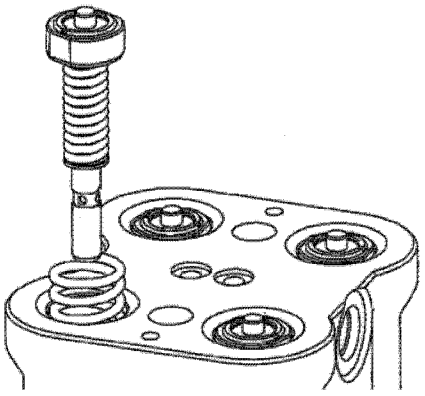
- Record the position of the casing (29) and the casing (30).

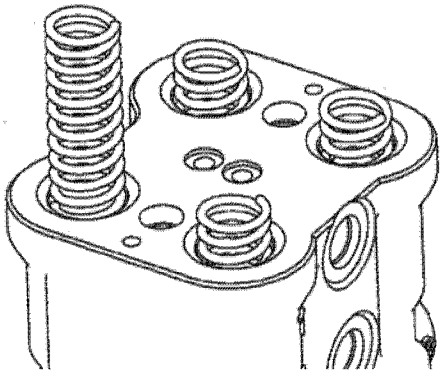

S6F664

(15) Remove the O-rings (6) and (7) from the casing (29).

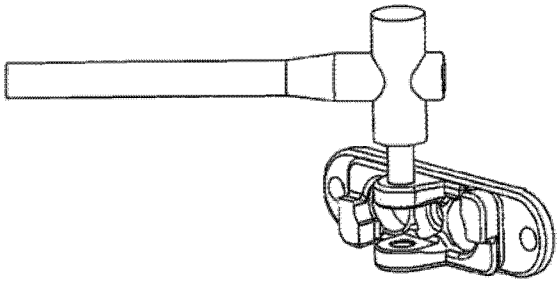


(16) Remove the reducing valve assembly and the return spring (19) from the casing (29).
- Record the position with the casing hole.

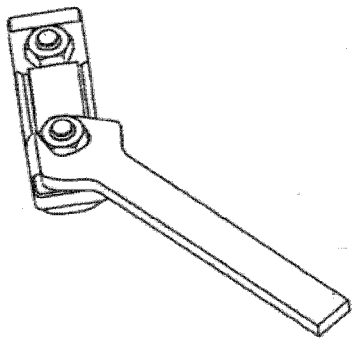




(17) Place the cover (3) horizontally on a flat table and remove the bushing by touching it with a special tool 1 and hitting it lightly with a hammer.

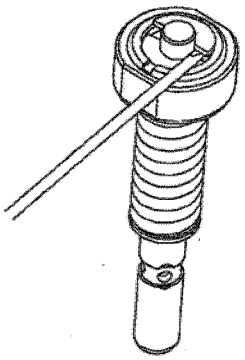


(18) Fix the cam assembly with a vice, loosen the lock nut (27), and remove the lock nut and the set screw (26).
- As the set screw requires neutral adjustment during reassembly, when the replacement of set screw is not needed, it will be handled as the cam assembly.



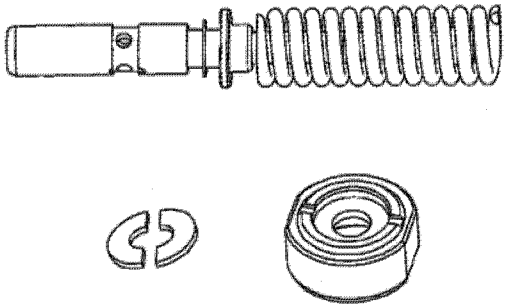
S6F668

(19) For disassembly of the reducing valve assembly, place the lower end of the spool vertically on a flat workbench, lower the holder (16), and remove two of the semicircle washer 1 (9) with the tip of a small-sized flathead screwdriver.
- Care must be taken not to damage the surface of spool.
- Do not lower the holder for more than 4mm.



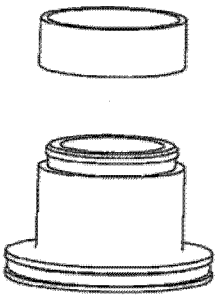
S6F669

(20) Separate the spool, the holder (16), the spring for secondary pressure setting (18), the washer 2 (10), and the washer 3 (17).
- It is handled as the assembly until reassembly.
- The washer 2 is for preset adjustment of the spring for secondary pressure setting, and its thickness is different by spool assembly. Also, it may not be used.



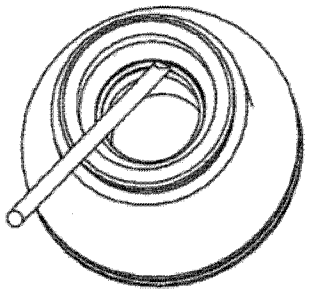
S6F670

(21) Remove the grease cup (5) from the plug (4).



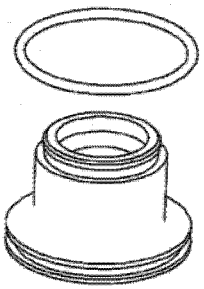
S6F671

(22) Remove the gasket (1) from the plug (4).
Remove it with a small-sized flathead screwdriver.
- Care must be taken not to damage the inner surface of plug.



S6F672

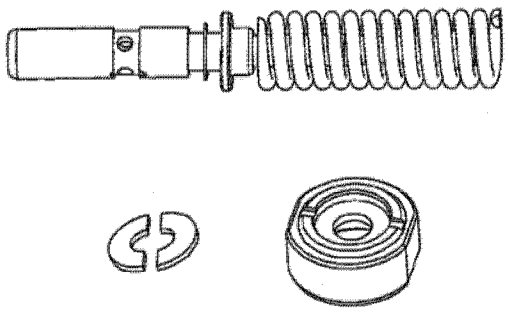
(23) Remove the O-ring (2) from the plug (4).



S6F673

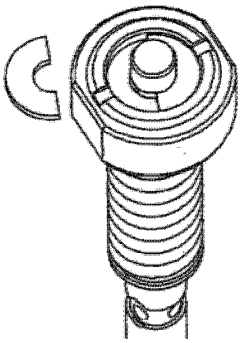
4) Reassembly

(1) Install the washer 3 (17), the washer 2 (10), the spring for secondary pressure setting (18), and the holder (16) to the spool in order.
- The washer 2 is for preset adjustment of the spring for secondary pressure setting, and its thickness is different by spool assembly. Also, it may not be used.



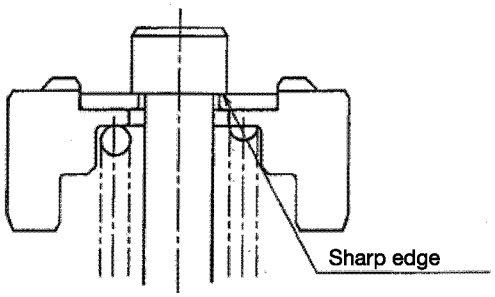
S6F670

(2) Place the lower end of the spool vertically on a flat workbench, push down the holder (16), and install two of the semicircle washer 1 (9) on the holder (16) while making sure they don't overlap.



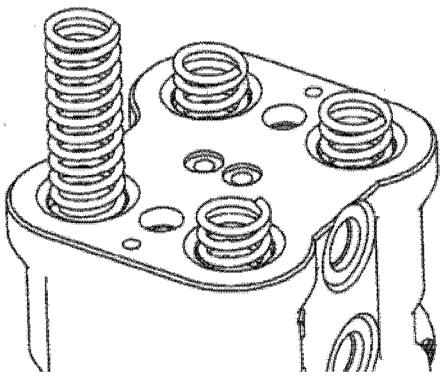
S6F674

- Install the washer 1 (9) with the sharp edge side on top while catching the head of spool.
- Do not lower the holder (16) for more than 4mm.



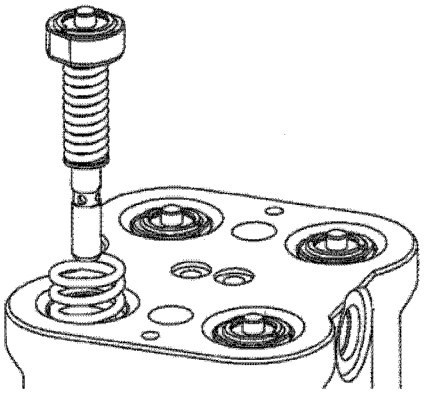
S6F675

(3) Install the return spring (19) to the casing (29).
- Install in the position before disassembly.

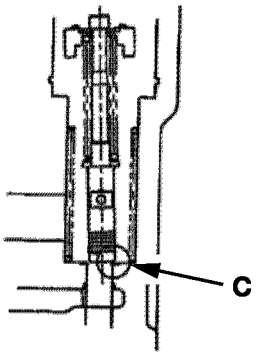


S6F666

(4) Install the reducing valve sub-assembly to the casing (29).
- Install in the position before disassembly.

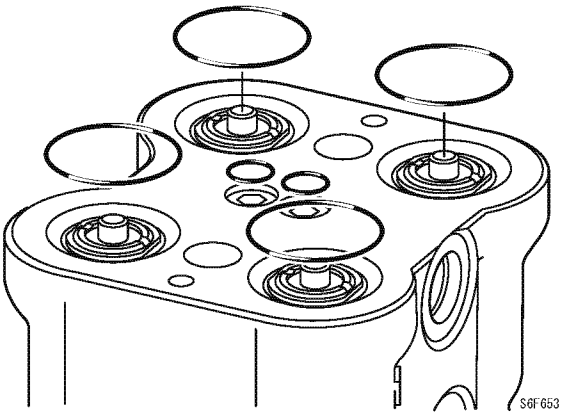

S6F665

- Care must be taken not to hit the corner (C) of the casing (29) with the lower end of the spool at the time of installing the reducing valve sub-assembly.



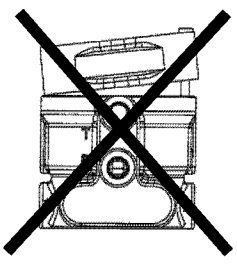
S6F676

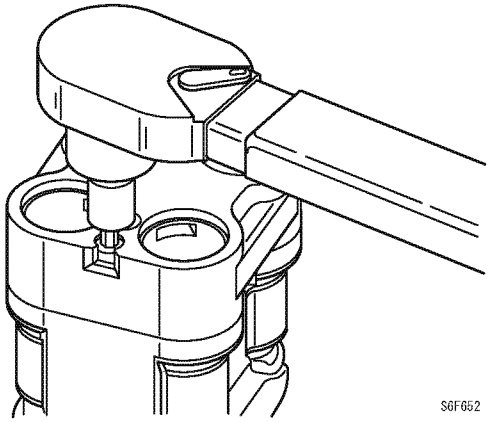
(5) Install the O-rings (6) and (7) to the casing (29).


S6F653

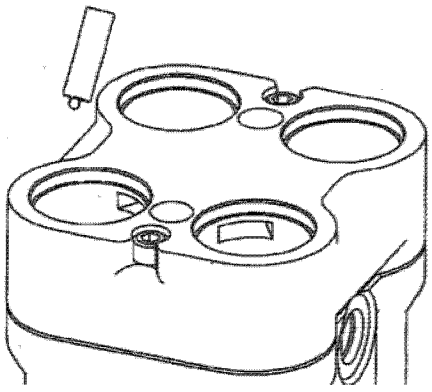
(6) Tighten the casing (30) and the casing (29) with the cap screw (12).
- Install in the position before disassembly.
- Tighten two pieces of the cap screw (12) evenly while keeping the casing (30) in the parallel condition.

Tightening torque: 5.8 to 7.2 ft·lbf (7.8 to 9.8 N·m)

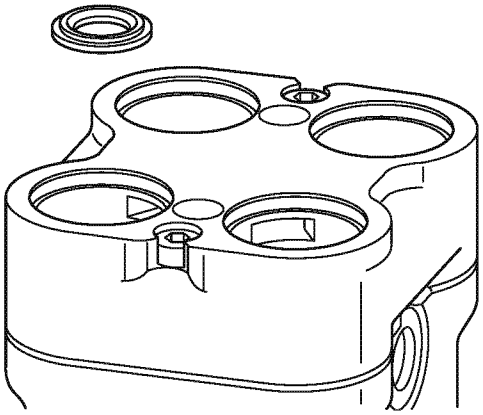

S6F694


S6F652

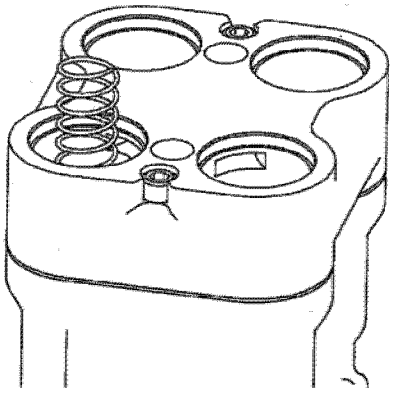
(7) Install the steel ball (14) to the casing (30) using a weak magnet or tweezers.
- Install in the position before disassembly.


S6F662

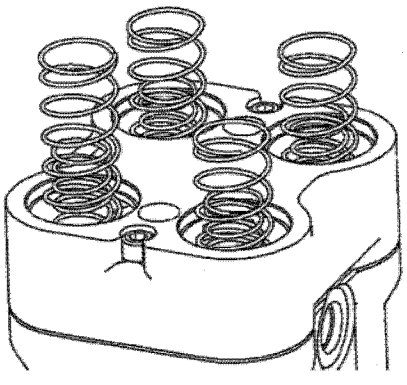
(8) Install the holder (11) to the bushing.
- Install in the position before disassembly.


S6F651

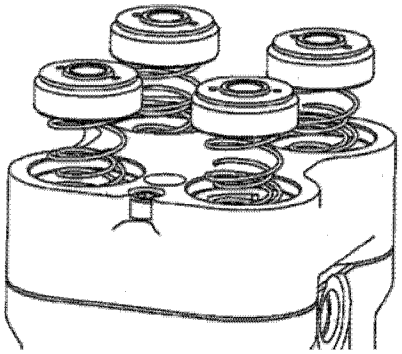
(9) Install the damping spring (20) to the casing (30).
- Install in the position before disassembly.


S6F677

(10) Install the damping spring (21) to the casing (30).
- Install in the position before disassembly.
- Care must be taken that the damping spring (20) is not being caught.

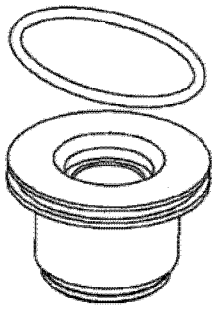

S6F661

(11) Install the piston (13).
- Install in the position before disassembly.



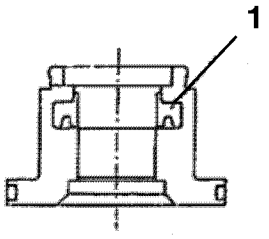
S6F660

(12) Install the O-ring (2) to the plug (4).

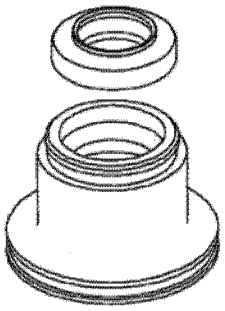


S6F678

(13) Install the gasket (1) to the plug (4).
- Care must be taken for the installation direction of gasket.
- Apply grease thinly to the gasket.

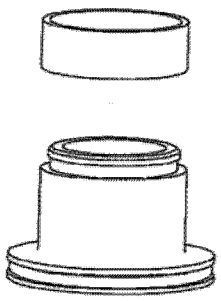


S6F695



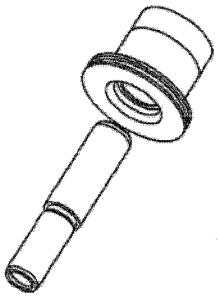
S6F679

(14) Install the grease cap (5) to the plug (4).



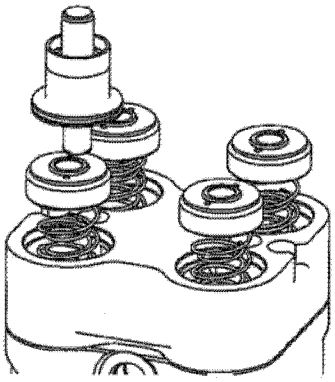
S6F671

(15) Install the push rod (8) to the plug (4).
- Apply hydraulic oil to the surface of push rod prior to installation.
- Do not insert it strongly, as the lip portion of gasket may be damaged.



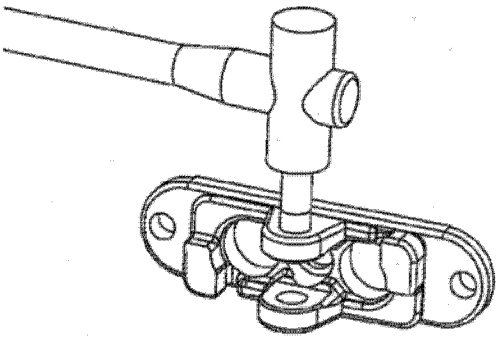
S6F680

(16) Install the push rod assembly to the casing.



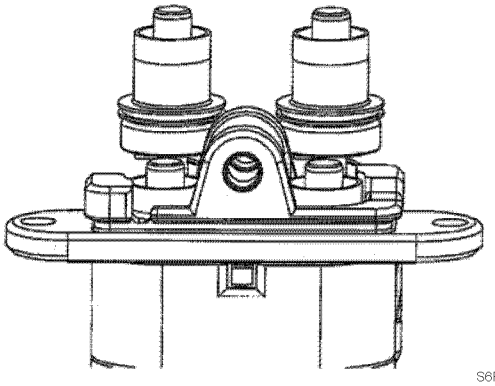
S6F681

(17) Press the bushing (22) using the special tool 1 to the cover (3) and press-fit it by hitting lightly with a hammer.
- Care must be taken that the bushing end can jump out from the inside of the cover.



S6F682

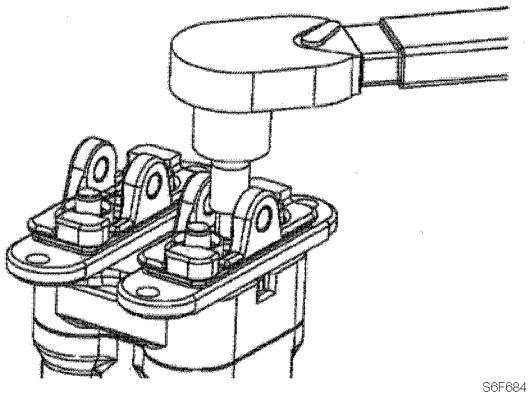
(18) Install the cover (3) to the casing.
- Install in the position before disassembly.
- Care must be taken that the cover can rise due to the damping springs (20) and (21).



S6F683

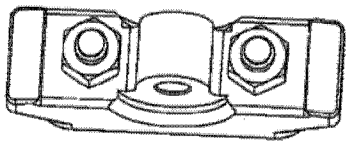
(19) Tighten the cap screw (15).
- Care must be taken so that the cover is level.

Tightening torque: 33.4 to 47.8 ft·lbf (45.2 to 64.8 N·m)



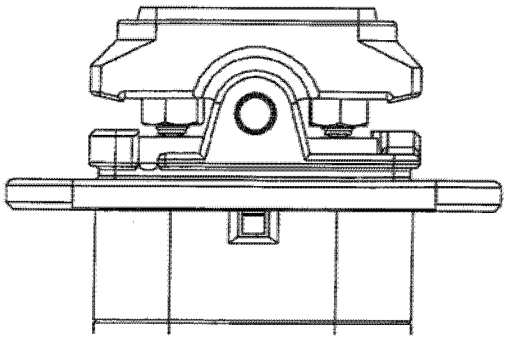
S6F684

(20) Assemble the set screw (26) and the lock nut (27) in the cam (24) temporarily.



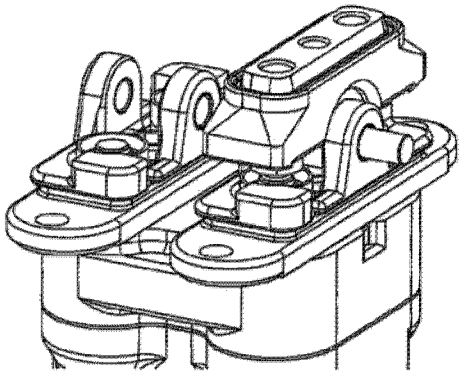
S6F685

(21) Install the cam (24) to the cover (3).
- Install in the position before disassembly.



S6F686

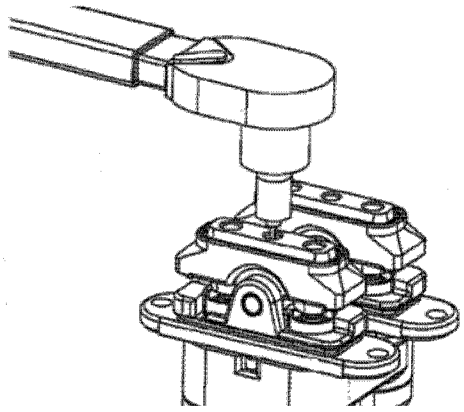
(22) Insert the shaft (23) from the outside while pressing the cam (24).



S6F687

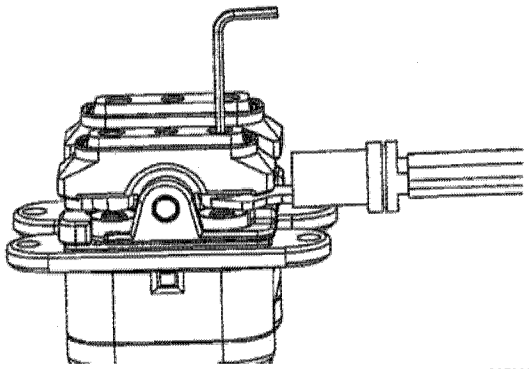
(23) Tighten the set screw (25).

Apply locking agent: Locktite 241
Tightening torque: 4.4 to 5.8 ft·lbf (5.9 to 7.9 N·m)

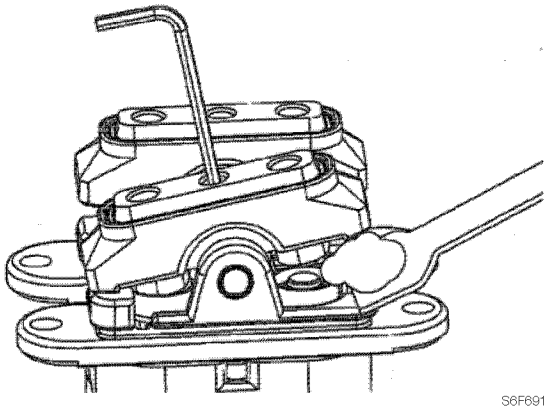

S6F689

(24) Adjust the height of the set screw (26) so that the upper surface of the cam (24) and the lower surface of the cover are level. Tighten the lock nut (27) after checking that there is no rattle in the neutral by turning the cam left and right.
- Care must be taken that rattle occurs in the neutral position by pushing in the push rod with the set screw too much, resulting in a sudden movement at the time of engine start.

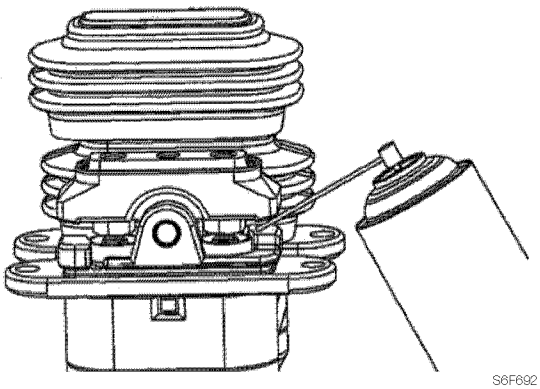
Tightening torque: 22.1 to 27.1 ft·lbf (29.9 to 36.7 N·m)


S6F690

(25) Incline the cam and apply grease to the top of the push rod and fill grease to the grease cap (5) of the plug (4).
- Avoid damaging the surface of the push rod and the plug by using a spatular item of soft material for applying and filling grease.


S6F691

(26) After engaging the upper end of the boot to the cam, engage the lower end of the boot to the groove of the cover.
- Apply antirust to the inner component parts of the boot by spraying prior to engaging the lower end of the boot to the groove of the cover.
- Care must be taken that the improper engagement of the boot and the groove and the twisted installation may result in deteriorated dust and water resistance.


S6F692

4. Inspection and adjustment

1) Checking the parts

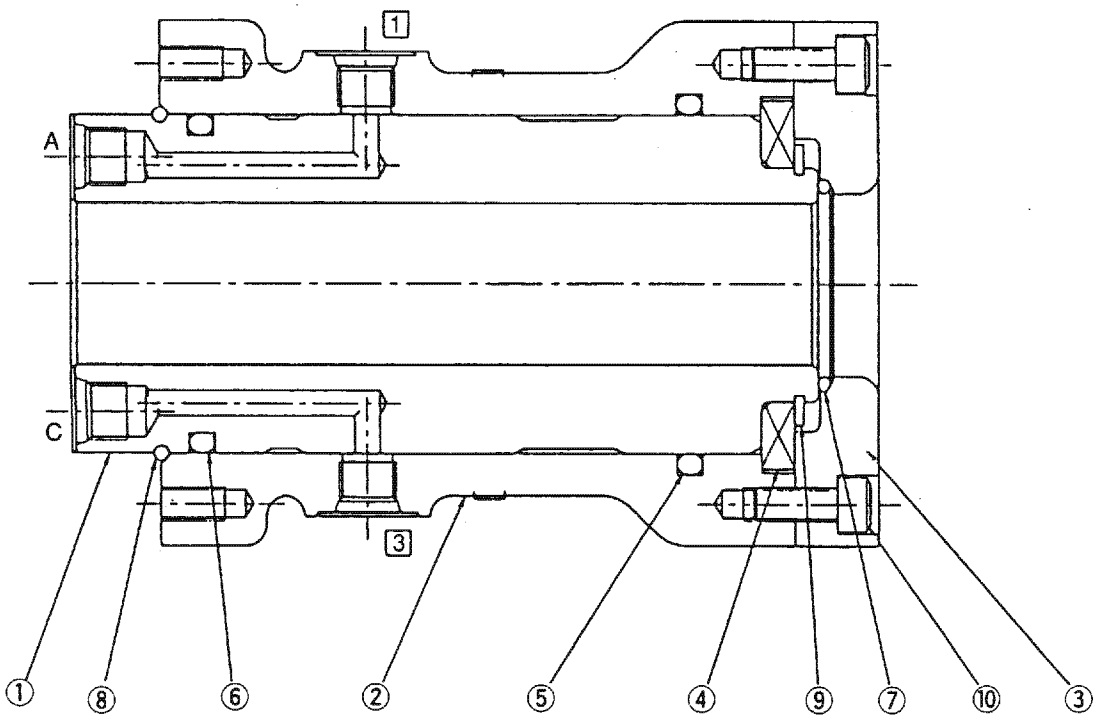
Parts	Inspection standard	Measures
O-ring	——	• Replace
Seal	——	• Replace
Seal washer	——	• Replace
Spool	• Wear on sliding portions is 0.0004 in. (10 μm) or greater compared to non-sliding portions • Scratches on sliding portions • Spool doesn't move smoothly	• Replace • Replace • Repair or replace
Push rod	• Front end is worn 0.039 in. (1 mm) or more • Scratches in the sliding portion	• Replace • Replace
Plug	• Seal is imperfect due to damage	• Repair or replace
Operating portion	• Tightening is loose at the pin, shaft or joint of the operating portion, with looseness of 0.079 in. (2 mm) or greater • Due to wear, etc. tightening is loose at the pin, shaft or joint of the operating portion, with looseness of 0.079 in. (2 mm) or greater	• Tighten to the specified torque • Replace
Casing, Port plate	• Scratches, rust or corrosion on the spool and sliding portion • Scratches, rust or corrosion on seal portions which come in contact with the O-ring	• Replace • Repair or replace

5. Troubleshooting

Trouble	Probable causes	Measures
Secondary pressure doesn't rise	• Primary pressure is insufficient • Spring is damaged or permanently deformed • The clearance between the spool and casing is abnormally large • There is looseness in the handle	• Keep the primary pressure • Replace the spring • Replace the spool and casing assembly • Disassemble and reassemble, or replace the handle
Secondary pressure doesn't stabilize	• Sliding parts are catching • Tank line pressure fluctuates • Air gets mixed into the piping	• Repair or replace • Remove the abnormal portions of the tank line • Operate the machine several times and bleed out the air
Secondary pressure is high	• Tank line pressure is high • Sliding parts are catching	• Remove the abnormal portions of the tank line • Repair or replace
Damping is impossible.	• There is air remaining in the piston chamber. • The sliding part is sticking. • The damping spring is sagging. • The clearance between the damping piston and the casing is abnormally large. • The check valve is malfunctioning. • The orifice of the damping piston is too large.	• Operate several times to bleed air. • Free stuck parts. • Replace with a new spring. • Replace the damping piston and casing assembly. • Disassemble the check valve for inspection. • Replace the damping piston.
Damping is small.	• The sliding part is sticking. • The orifice of the damping piston is clogged.	• Free stuck parts. • Repair or replace the damping piston.

6-9. Swivel Selector

1. Construction



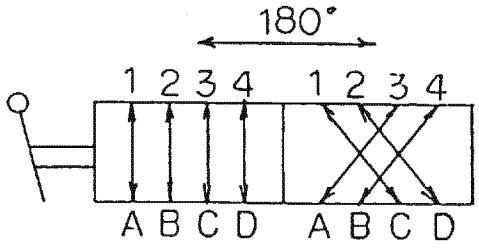
S3F700

No.	Part	Q'ty	No.	Part	Q'ty
1	Shaft	1	6	O-ring	1
2	Rotor	1	7	O-ring	1
3	Cover	1	8	O-ring	1
4	Thrust ring	1	9	Snap ring	1
5	O-ring	1	10	Cap screw	6

2. Operations

The swivel selector is a pilot valve that switches four ports in two patterns to change the oil flow direction by turning the rotor 180 degrees by the external rotational motion.

The rotary strokes of the shaft and the rotor are controlled by external operation. The main controller positions and secures the shaft and the rotor in two patterns for each 180 degrees. At this time, the oil flow can be switched in two patterns for each port according to the combination of the ports provided for the shaft and the rotor. The figure shows the hydraulic circuit.



S3F701

3. Disassembly and assembly

1) Precautions in disassembly and assembly

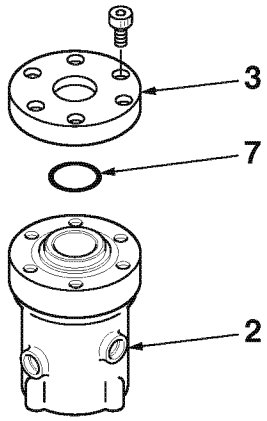
1. Carry out disassembly and assembly operations in a clean place and provide clean containers to place the disassembled parts in.
2. Before disassembly, clean around the ports and remove the paint from each joint using a wire brush.
3. Clean each of the disassembled parts with a cleaning oil.
4. Make match marks on each part so that they will be assembled in the same positions when assembled.
5. Replace all seals with new ones each time the unit is disassembled, coating them lightly with grease.
6. Check each part to make sure there is no abnormal wear or seizing and use sandpaper, etc. to remove any burrs, sharp edges, etc.

The disassembling procedures of the swivel selector are described below. For reassembling, follow these procedures in reverse order.

2) Disassembly

(1) Remove the hexagon head bolt and the cover (3).
- Degrease the joint surface of the hub (2) and the cover (3), and then apply liquid packing.
- When reassembling, fill grease in the gap between the hub (2) and the cover (3).
- When reassembling, make sure the shaft rotates smoothly.

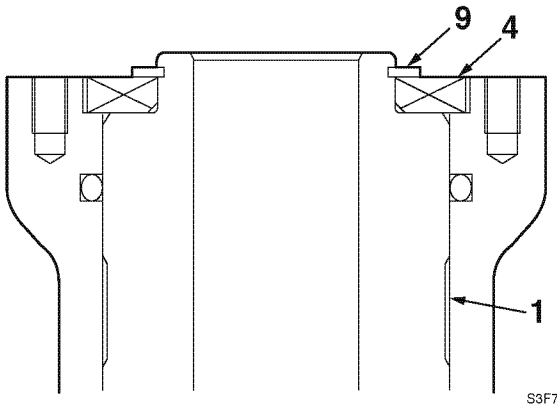
Tightening agent: Loctite #242
Tightening torque: 20.3 to 21.7 ft·lbf (27.4 to 29.4 N·m)



S3F702

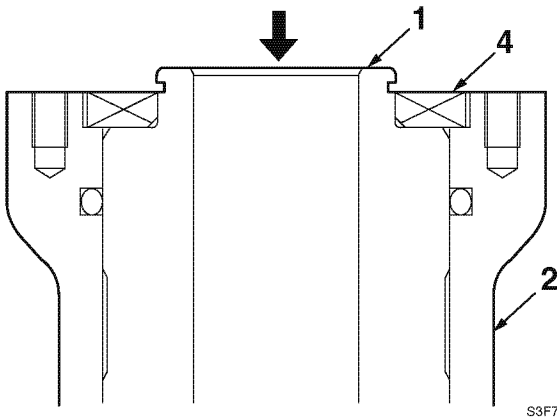
(2) Remove the O-ring (7).

(3) Remove the snap ring (9).
- When reassembling, install the curved side of the snap ring to the thrust ring side.



S3F703

(4) Pull out the shaft (1) partially from the hub (2), and remove the thrust ring (4).
- Tap the shaft with a plastic hammer to pull it out.
- When reassembling, install the chamfered side of the thrust ring to the shaft side.
- When reassembling, apply grease to the entire thrust ring.

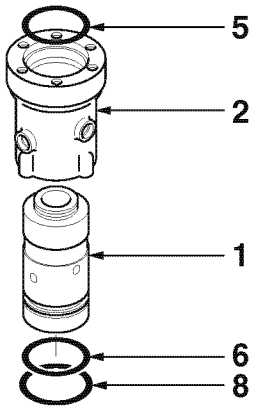


S3F704

(5) Remove the shaft (1) from the hub (2).
- Apply grease to the sliding surface of the shaft and the hub.
- When reassembling, tap the shaft lightly with a plastic hammer. Take care not to damage the seal.

(6) Remove the O-rings (6 and 8) from the shaft (1).

(7) Remove the O-ring (5) from the hub (6).
- Use a tool with a prong, such as an eyeleteer, to remove the O-ring.



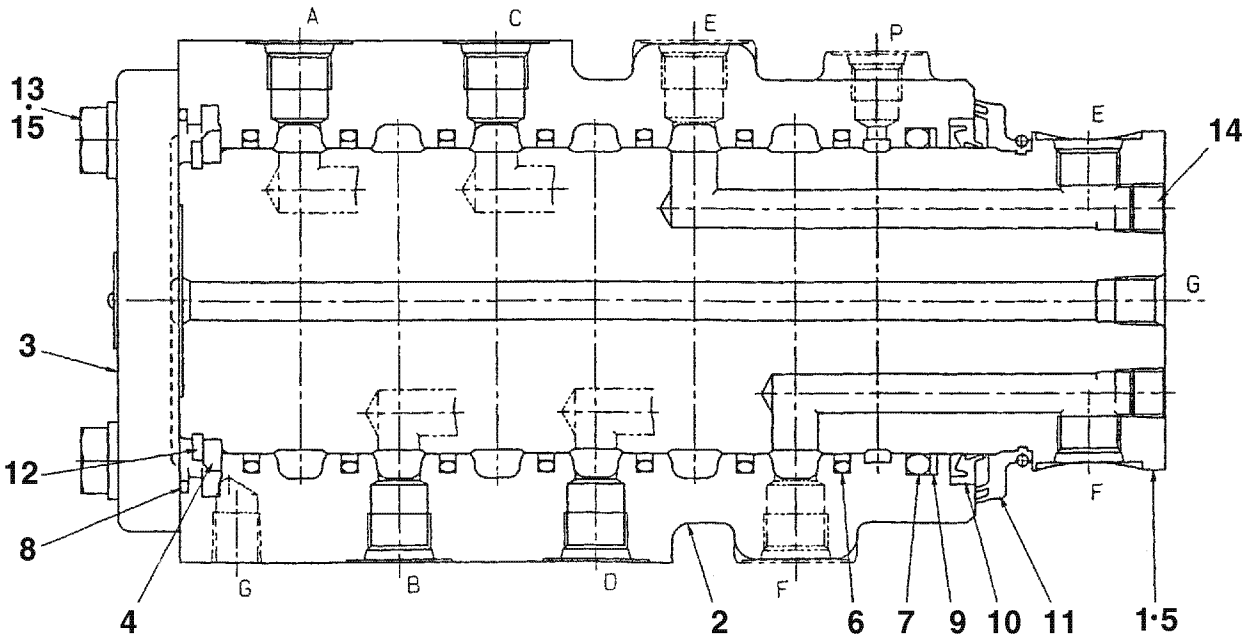
S3F705

4. Troubleshooting

Trouble	Probable causes	Measures
External oil leak	The O-ring is faulty or worn out.	Inspect the O-ring and replace it if necessary.
Internal oil leak	The sliding surface is heavily damaged or worn out.	Replace the assembly.
Stiff rotor	The friction between the rotor and the shaft caused a smearing.	Replace the assembly.
Rattling cover	The cap bolt is loosened or insufficiently tightened.	Re-tighten the bolt to the stipulated torque.

6-10. Swivel Joint

1. Construction



S3F750

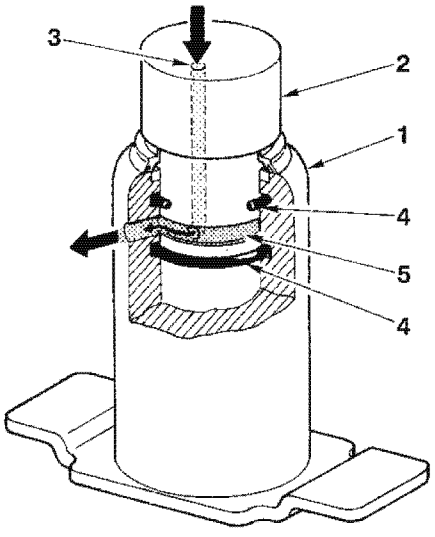
No.	Part	Q'ty	No.	Part	Q'ty	No.	Part	Q'ty
1	Shaft	1	6	Slipper seal	7	11	Dust seal	1
2	Hub	1	7	O-ring	1	12	Snap ring	1
3	Flange	1	8	O-ring	1	13	Bolt	4
4	Thrust ring	1	9	Backup ring	1	14	Plug	3
5	Pin	1	10	Dust seal	1	15	Spring washer	4

2. Operation

The swivel joint is mounted in the center of the wagon's slew axis. It serves the role of maintaining continuous connections in the hydraulic circuit regardless of the wagon's slew angle.

Above the hub (1) and shaft (2), which are capable of rotating together, ports (3) are included for oil for the necessary number of circuits only. The inner circumference surface of the hub and the outer circumference surface of the shaft, grooves are cut which serve as passages for hydraulic oil. Seals (4) are placed above and below these circumferential grooves.

Oil flowing in from a port flows constantly through this hydraulic passage (5) between the hub and shaft and the circuits can be connected without a break when the upper frame is slewing.

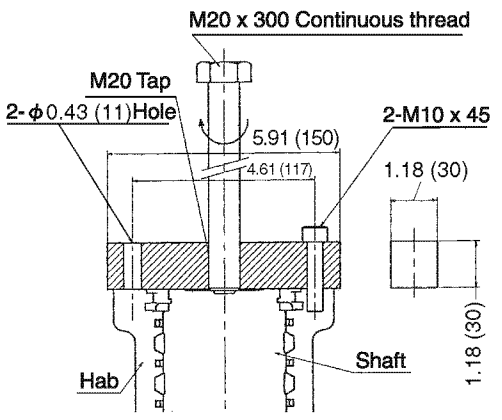


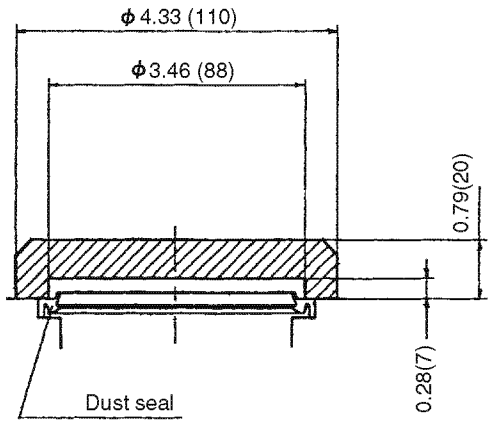
YI-D701

3. Disassembly and assembly

1) Table of special tools

Unit: in. (mm)

Name, Dimension	Q'ty
Removal jig A  	1

Name, Dimension	Q'ty
Press-fit jig B  	1

2) Precautions in disassembly and assembly

1. Carry out disassembly and assembly operations in a clean place and provide clean containers to place the disassembled parts in.
2. Before disassembly, clean around the ports and remove the paint from each joint using a wire brush.
3. Clean each of the disassembled parts with a cleaning oil.
4. Make match marks on each part so that they will be assembled in the same positions when assembled.
5. Replace all seals with new ones each time the unit is disassembled, coating them lightly with grease.
6. Check each part to make sure there is no abnormal wear or seizing and use sandpaper, etc. to remove any burrs, sharp edges, etc.

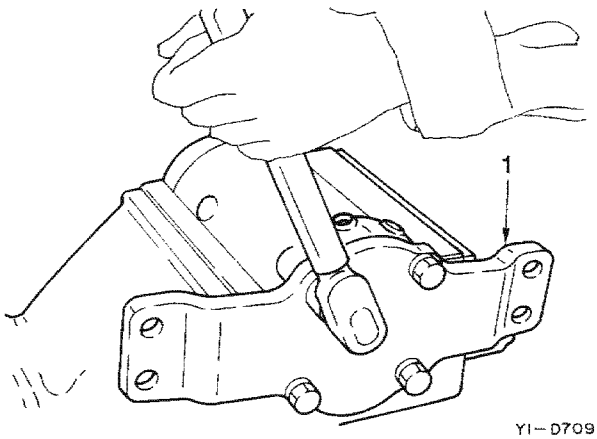
The disassembling procedures of the swivel joint are described below. For reassembling, follow these procedures in reverse order.

3) Disassembly

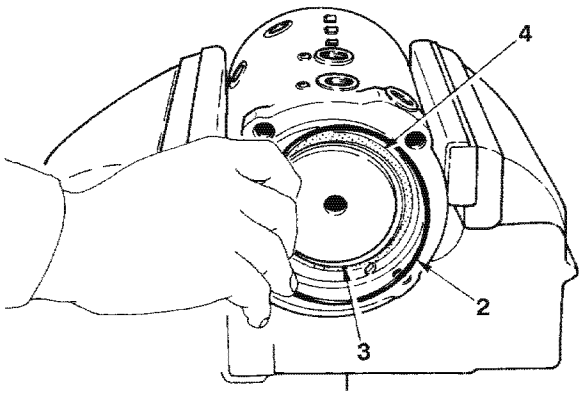
(1) Take out the bolts and remove the spring washers, then remove the flange (1) from the hub.

Tightening torque: 38.3 to 42.0 ft·lbf (52.0 to 56.8 N·m)

- During assembly, place a pipe on the stopper pin of the shaft and check if the shaft rotates.

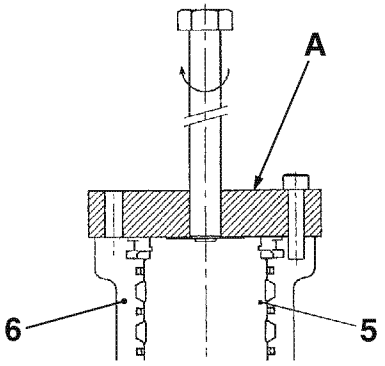


(2) Remove the O-ring (2), snap ring (3) and thrust ring (4).
- During assembly, make sure the snap ring fist securely in the groove.



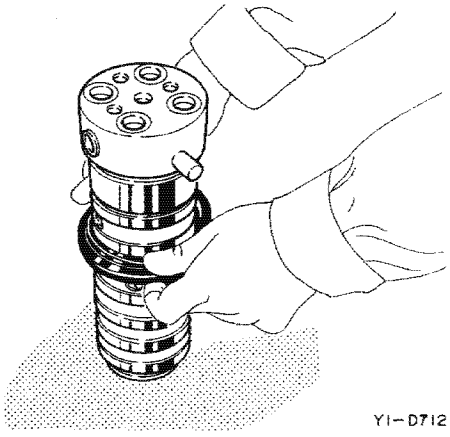
YI-D710

(3) Remove the shaft (5) from the hub (6).
- Attach the installation jig A as shown in the figure right, and tighten the bolt to remove the shaft.
- When reassembling, apply grease on the sliding part of the shaft and rotor and the dust seal.
- When reassembling, tap the shaft with a plastic hammer, taking care not to damage the seals.

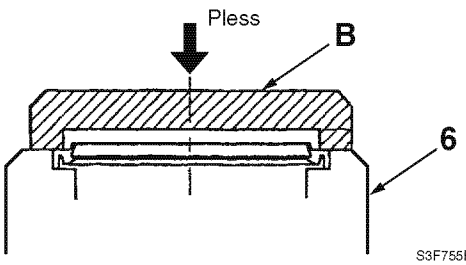


S3F753

(4) Remove the dust seal from the shaft.


YI-D712

(5) Remove the dust seal from the hub (6) with a flat head screwdriver.
- When reassembling, press-fit the dust seas by using a press-fit jig B.



S3F755E


S3F754

(6) Remove the seals from the inside diameter of the hub.
- Check the positions of the seals in the structural drawing.
- Use an O-ring tooth or eyeleteer with a sharp point on the end, etc.
- Do not deform or bend the slipper seal strongly in any one place.
- During assembly, O-rings should not be twisted when they are fitted in place.

4. Inspection and adjustment

1) Inspection procedure and treatment

Inspection interval	Place inspected	Inspection procedure	Measures
2,000 hrs.	Seals which prevent external leakage of hydraulic oil	Check if oil is leaking out	Replace the O-rings if there is leakage
4,000 hrs. Disassemble and check whether there is leakage or not	All seal parts	—	Replace all seal parts
	All sliding parts	Check for abnormal wear, scratches, corrosion, etc., due to seizing, biting of foreign matter, etc.	Treat in accordance with the use limit
When disassembling due to breakdown	All parts	Check for abnormal wear, scratches, corrosion, etc., due to seizing, biting of foreign matter, etc.	Treat in accordance with the use limit. However, replace the seal kit

2) Checking the parts

Hub, shaft

Parts	Inspection standard	Measures
Seal parts and sliding parts	• Parts which wear away due to wearing of surfaces which have undergone ultrasonic tempering, and parts which come off due to seizing, biting in of foreign matter, etc.	• Replace with new parts
Hub and shaft sliding parts other than seals	• Parts with abnormal wear or with scratches 0.004 in. (0.1 mm) deep or deeper due to seizing or biting in of foreign matter, etc.	• Replace with new parts
	• Parts with scratches less than 0.004 in. (0.1 mm) deep	• Repair with an oil stone
Portions which slide against the thrust ring	• Parts which are worn 0.020 in. (0.5 mm) or more, or abnormally worn parts	• Replace with new parts
	• Parts with less than 0.020 in. (0.5 mm) of wear	• Repair so that it is smooth
	• Parts with scratches due to seizing, biting in or foreign matter, etc., which are within the wear limit of 0.020 in. (0.5 mm) and which can be repaired	• Repair so that it is smooth

Flange

Parts	Inspection standard	Measures
Portions which slide against the shaft end	• Parts which are worn 0.020 in. (0.5 mm) or more, or abnormally worn parts	• Replace with new parts
	• Parts with less than 0.020 in. (0.5 mm) of wear	• Repair so that it is smooth
	• Parts with scratches due to seizing, biting in or foreign matter, etc., which are within the wear limit of 0.020 in. (0.5 mm) and which can be repaired	• Repair so that it is smooth

Thrust ring

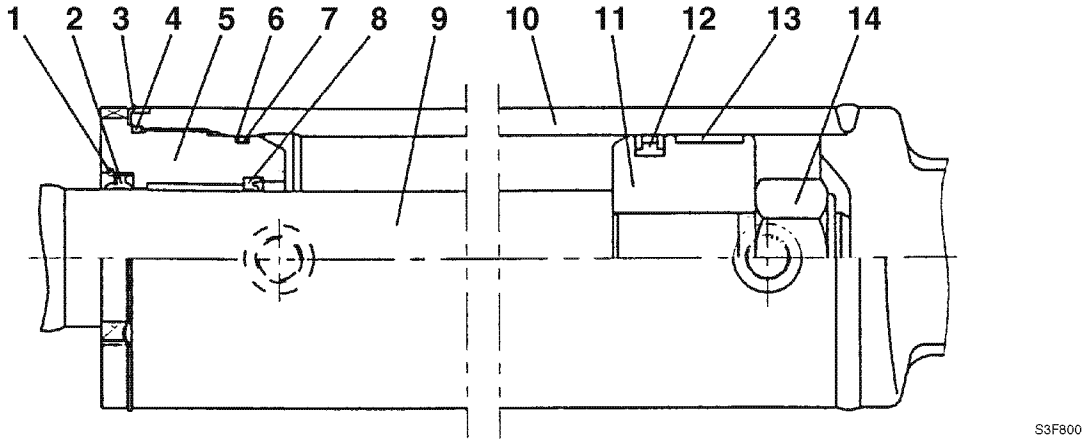
Inspection standard	Measures
• Parts which are worn 0.020 in. (0.5 mm) or more, or abnormally worn parts	• Replace with new parts
• Parts with less than 0.020 in. (0.5 mm) of wear	• Repair so that it is smooth
• Parts with scratches due to seizing, biting in or foreign matter, etc., which are within the wear limit of 0.020 in. (0.5 mm) and which can be repaired	• Repair so that it is smooth

5. Troubleshooting

Trouble	Probable causes	Measures
External oil leakage	• O-ring is defective	• Replace all the seal parts
Internal oil leakage	• Thrust ring is defective • Great wear on sliding surfaces	• Replace all the seal parts • Replace the assembly
Shaft sticks	• Shaft and hub are stuck together	• Carry out polishing and honing. If looseness and oil leakage are great, replace the assembly
Flange looseness	• Socket bolt tightening is insufficient	• Retighten to the specified torque

6-11. Dump Cylinder (Standard Type)

1. Construction



S3F800

No.	Part	Q'ty	No.	Part	Q'ty
1	Spring ring	1	8	ISI packing	1
2	DKB seal	1	9	Rod	1
3	Lock washer	1	10	Cylinder tube	1
4	O-ring	1	11	Piston	1
5	Head	1	12	Piston seal	1
6	Backup ring	1	13	Wear ring	1
7	O-ring	1	14	U-nut	1

2. Disassembly and assembly

1) Precautions in disassembly and assembly

1. Carry out disassembly and assembly operations in a clean place and provide clean containers to place the disassembled parts in.
2. Before disassembly, clean around the ports and remove the paint from each joint using a wire brush.
3. Clean each of the disassembled parts with a cleaning oil.
4. Make match marks on each part so that they will be assembled in the same positions when assembled.
5. Replace all seals with new ones each time the unit is disassembled, coating them lightly with grease.
6. Check each part to make sure there is no abnormal wear or seizing and use sandpaper, etc. to remove any burrs, sharp edges, etc.

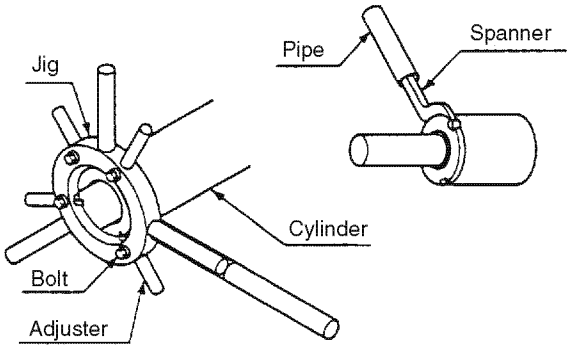
The disassembling procedures of the dump cylinder are described below. For reassembling, follow these procedures in reverse order.

2) Disassembly

(1) Drain the oil from the hydraulic cylinder.

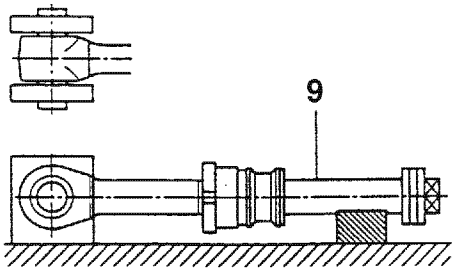
(2) Secure the cylinder by using the width across the flat or pinhole on the bottom side. Put the rod side on a timber.

(3) Raise the detent for the head lock washer and loosen the head (5).
- When loosening the head (5), use a hook wrench or a jig.
- Always use a new lock washer when reassembling



S3F801E

(4) Pull out the rod assembly (9) from the cylinder tube, and secure the assembly using the width across the flat or the pinhole.

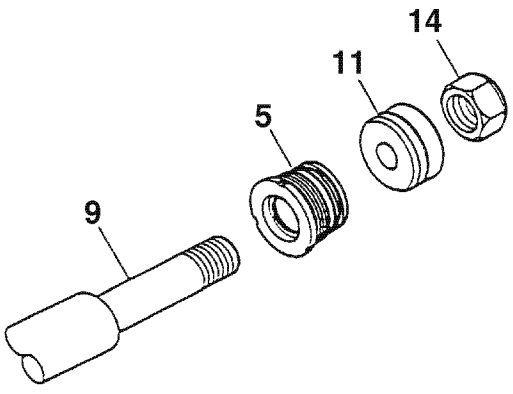


Fasten the piston rod assembly

S3F802E

(5) Remove the U nut (14), the piston (11), and the head (5), in this order.

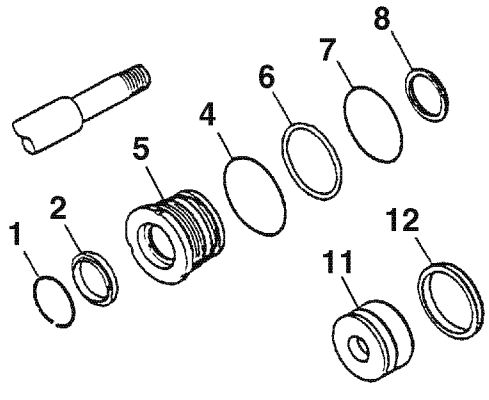
Tightening agent: Three Bond #1324
Tightening torque: 760 to 832 ft·lbf (1030 to 1130 N·m)



S3F803

(6) Remove the spring ring (1), the DKB dust seal (2), the O-rings (4 and 7), the backup ring (6), and the ISI packing (8) from the head (5).

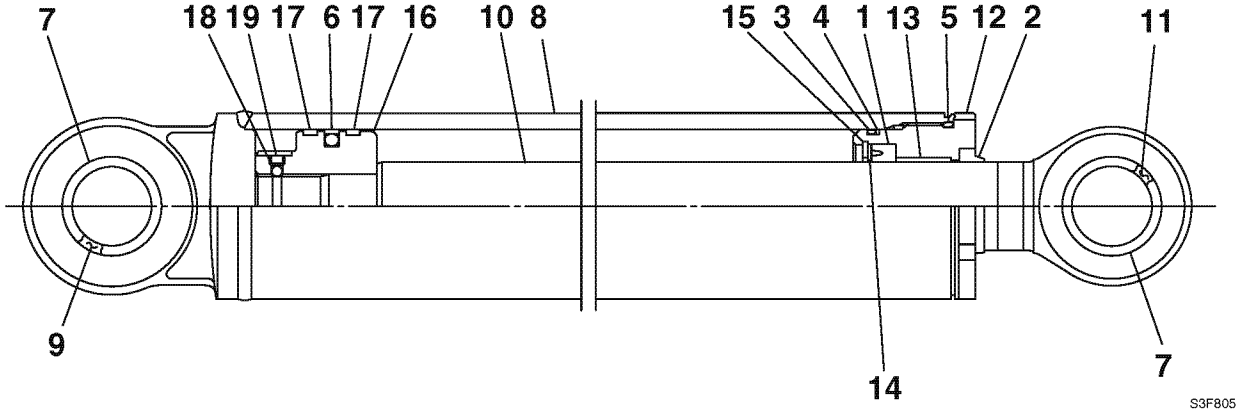
(7) Remove the piston seal (12) from the piston (11).
- Insert a tool with a prong through the O-ring and the piston seal (12) and lift it up, then insert a spatula to remove them.



S3F804

6-12. Dump Cylinder (Swing Wagon Type)

1. Construction

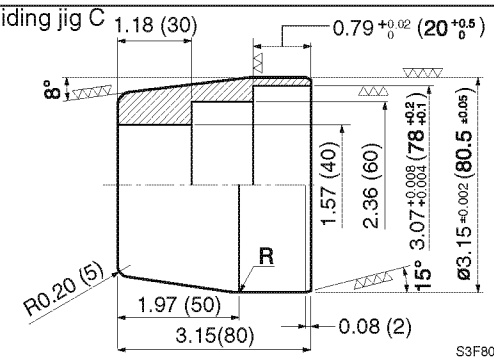


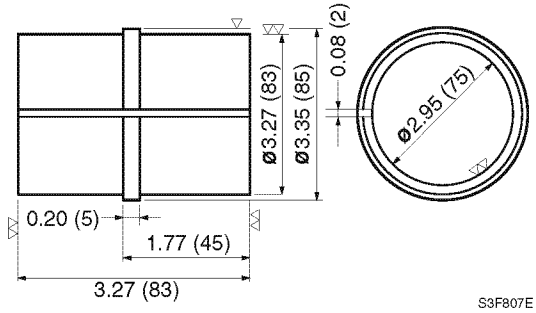
No.	Part	Q'ty	No.	Part	Q'ty	No.	Part	Q'ty
1	Piston packing	1	8	Cylinder tube	1	15	Snap ring	1
2	Dust seal	1	9	Bushing	1	16	Piston	1
3	O-ring	1	10	Rod	1	17	Wear ring	2
4	Backup ring	1	11	Bushing	1	18	Steel ball	1
5	O-ring	1	12	Head	1	19	Set screw	1
6	Piston packing	1	13	Bushing	1			
7	Dust seal	4	14	Packing holder	1			

2. Disassembly and assembly

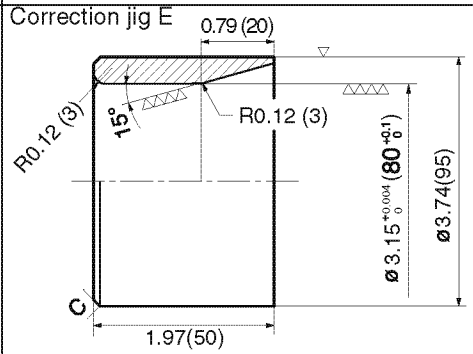
1) Table of special tools

Unit: in. (mm)

	Name, Dimension
1	Sliding jig C 

	Name, Dimension
2	Fitting jig D 

Unit: in. (mm)

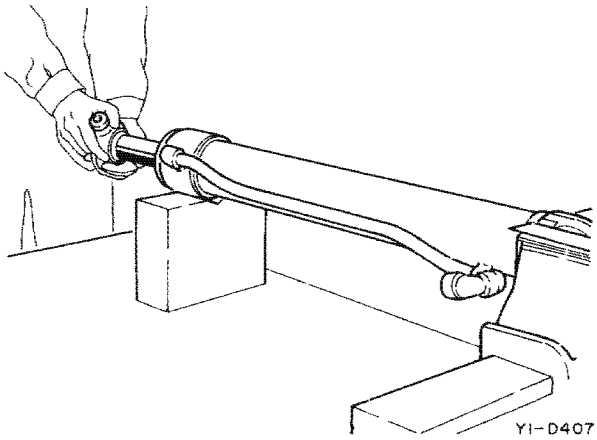
	Name, Dimension
3	Correction jig E 

2) Precautions in disassembly and assembly

1. Carry out disassembly and assembly operations in a clean place and provide clean containers to place the disassembled parts in.
2. Before disassembly, clean around the ports and remove the paint from each joint using a wire brush.
3. Clean each of the disassembled parts with a cleaning oil.
4. Make match marks on each part so that they will be assembled in the same positions when assembled.
5. Replace all seals with new ones each time the unit is disassembled, coating them lightly with grease.
6. Check each part to make sure there is no abnormal wear or seizing and use sandpaper, etc. to remove any burrs, sharp edges, etc.

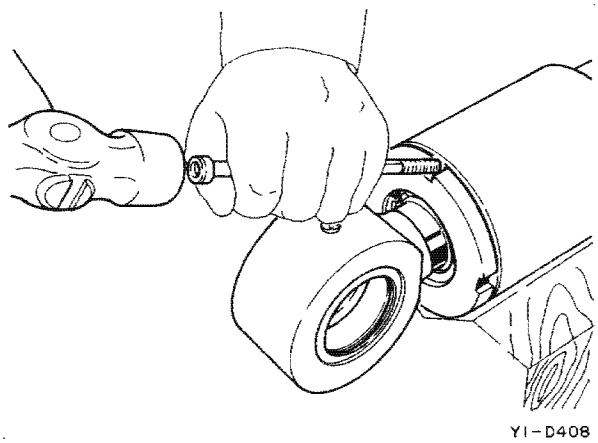
The disassembling procedures of the dump cylinder are described below. For reassembling, follow these procedures in reverse order.

(1) Fasten the tube so that it is flat.



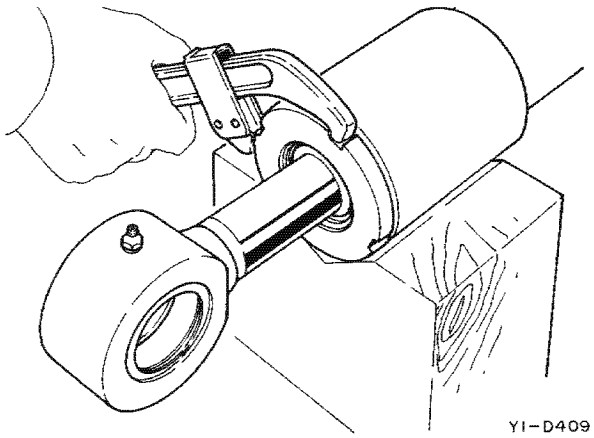
(2) Drain out hydraulic oil remaining in the cylinder.
- Move the piston rod gently to prevent the hydraulic oil from spraying out and scattering all over.

(3) Free the locked portion of the rod cover.
- Since the lock is integrated with the cylinder tube, be careful not to bend it or to scratch it when the lock is being freed.



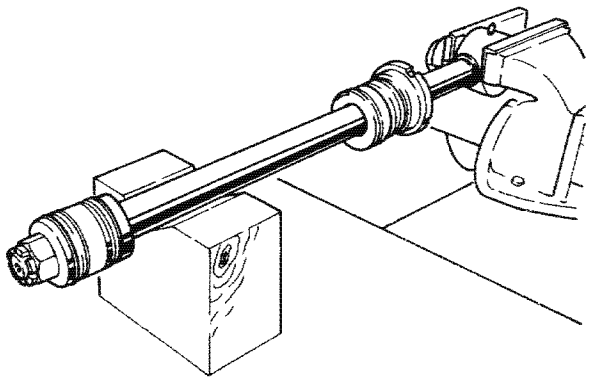
(4) Loosen the rod cover.
- The piston rod should be pulled out approximately 7.87 in. (200 mm) beforehand.
- Measures should be taken to prevent the piston rod from being hit.

Tightening torque: 246 ft·lbf (333 N·m)


YI-D409

(5) Take the piston rod assembly out or the tube.
- Pull it out straight to prevent the sliding surfaces from being scratched.

(6) Fasten the piston rod assembly securely in a level position.

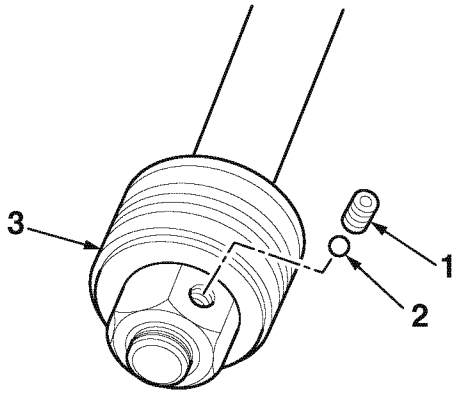

YI-D410

(7) Remove the piston.
a. Take out the set screw (1) and remove the ball (2).
- The set screw is staked at 2 places with a punch, so grind off the staked portions using a hand drill.
- When assembling, caulk the set screw at two places with a punch.

Tightening torque: 5.1 ft·lbf (6.8 N·m)

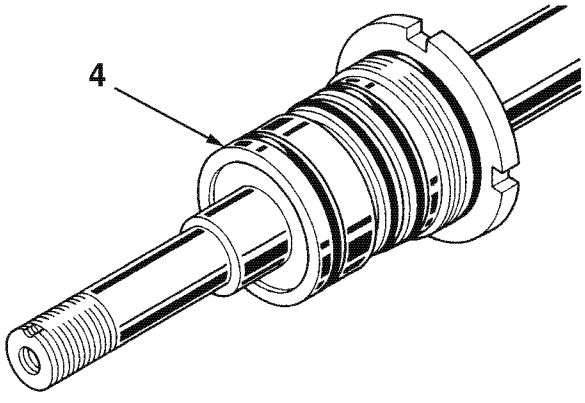
b. Remove the piston (3).

Tightening torque: 651 ft·lbf (883 N·m)



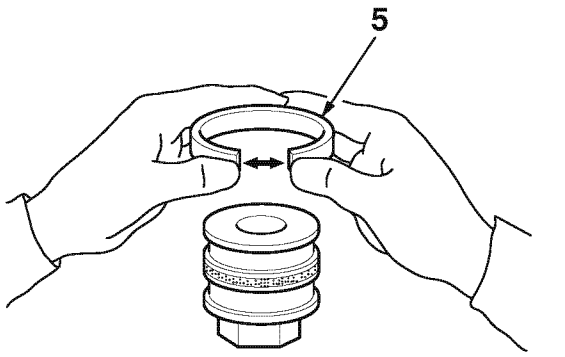
S3F809

(8) Remove the head (4).



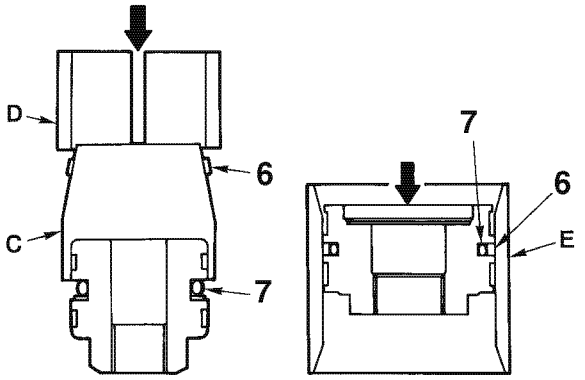
S3F810

(9) Remove the wear ring (5) from the piston.
- Spread the wear ring the minimum amount necessary and remove it in the axial direction.



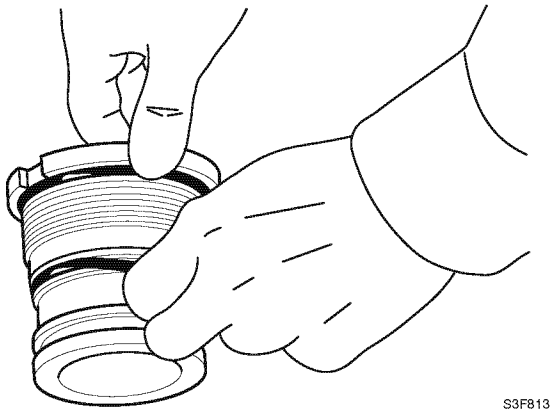
S3F811

(10) Remove the O-ring (7) and the slipper ring (6).
- Remove the slipper ring by breaking it or prying it with a flat head screwdriver.
- When reassembling, place the sliding jig C over the piston and push the slipper ring quickly by using the fitting jig D.
- When reassembling, correct the slipper ring by using the correction jig E, as the ring has been stretched during installation.



S3F812

(11) Remove the O-ring from the outer diameter of the head, then remove the backup ring.

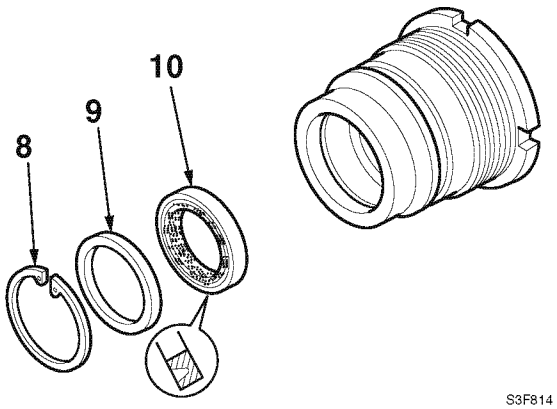


S3F813

(12) Remove the snap ring (8).

(13) Remove the packing holder (9).

(14) Remove the rod packing (10).



S3F814

6-13. Pressure Adjustments

1. Measuring the pressure

⚠ WARNING

- **Do not allow anyone except service persons to enter the measurement area as the engine is rotated when measuring the pressure. Also, make sure your co-workers are safe.**
- **The hydraulic oil and the tank are hot and under pressure at operating temperature.**
- **Do not allow hot oil and components to contact your skin.**
- **When removing the hydraulic hose, slowly loosen the hydraulic hose.**
- **Be sure to install the wagon stopper to hold the wagon when inspecting or servicing the machine with the wagon in the dump position.**

Measuring the main pressure (effective differential pressure)

Measure the actual pressure and the back pressure, and determine the effective differential pressure as the criteria by subtracting the measured back pressure value from the measured actual value.

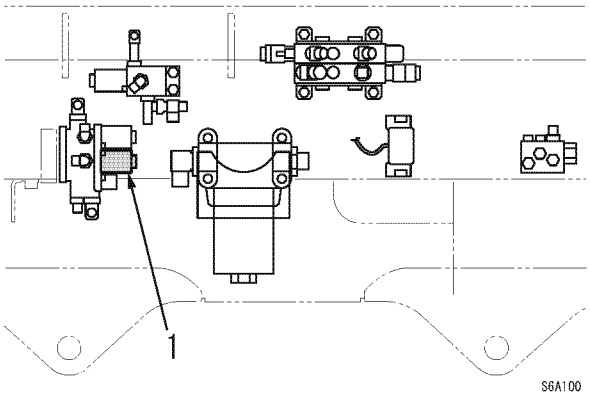
- Engine : Rated r.p.m.
- Hydraulic oil temp. : 122 to 140°F (50 to 60°C)

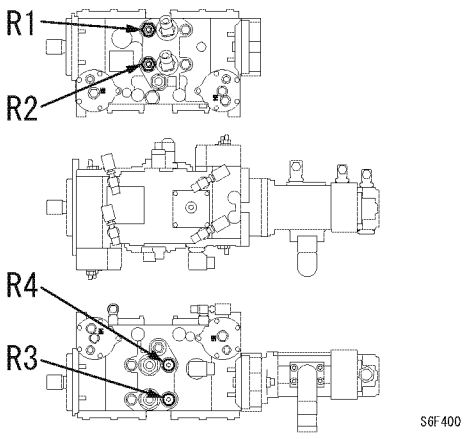
(1) Disconnect the harness of the solenoid valve (1) for the parking brake.
  - Make sure the parking brake is not released even if the travel lever is actuated.

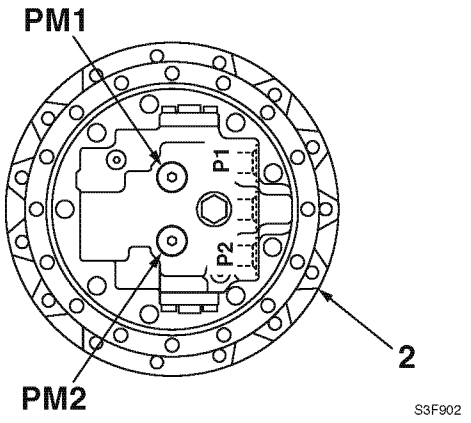
(2) Install the pressure gauge on the travel motor (2) of pressure detection port.

(3) Actuate the circuit to be measured and measure the pressure.

Actuated circuit		Pressure detection port		Relief valve
		Port location	Size	
Actual pressure value				
	Right travel (forward)	PM2	G1/2	R3
	Left travel (forward)	PM1	G1/2	R1
Back pressure value				
	Right travel (reverse)	PM1	G1/2	R4
	Left travel (reverse)	PM2	G1/2	R2



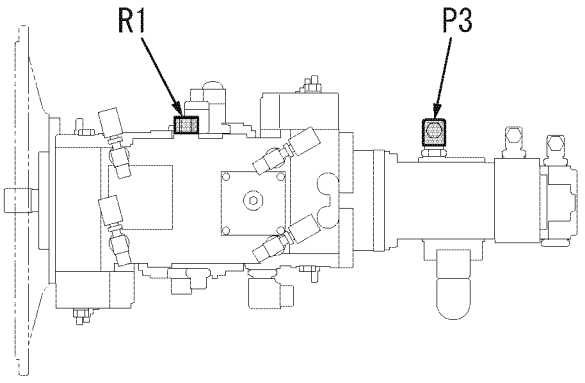




Charge pressure measurement

- Engine : Rated r.p.m.
- Hydraulic oil temp. : 122 to 140°F (50 to 60°C)
- Mount pressure gauge on the pressure detection port and measure the charge pressure.

Pressure detection port		Relief valve
Port position	Size	
P3	G1/4	R1



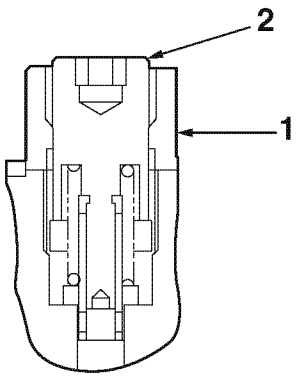
S6F401

Adjustment

(1) Loosen locknut (1), then begin adjusting pressure by turning setting screw (2).
Turning clockwise .....raises the set pressure.
Turning counterclockwise .....lowers the set pressure.

(2) In order to keep the setting screw from turning after pressure has been adjusted, tighten the locknut while at the same time holding the setting screw firmly in place.

(3) Operate the relief valve once more to confirm that the pressure that has been set it stabilized.

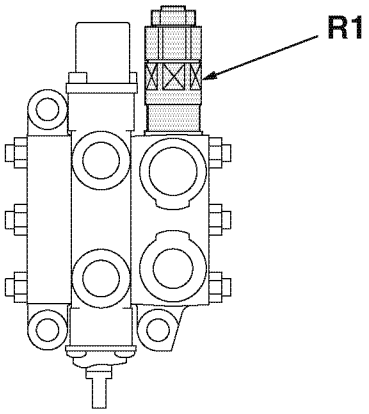


S3F904

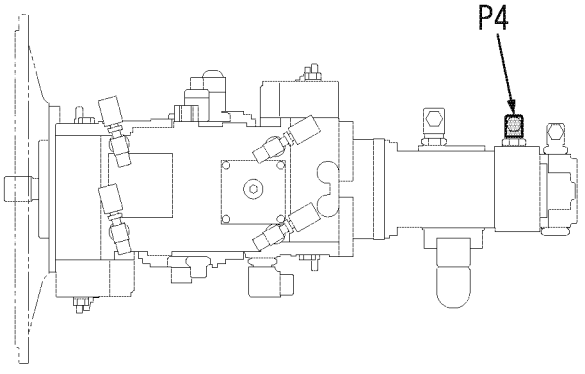
Dump pressure measurement

- Engine : Rated r.p.m.
- Hydraulic oil temp. : 122 to 140°F (50 to 60°C)
- Mount the pressure gauge on the pressure detection port, operate the desired hydraulic circuit and measure the relief pressure.

Circuit	Pressure detection port		Relief valve
	Port position	Size	
Dump	P4	G1/4	R1



S3F905



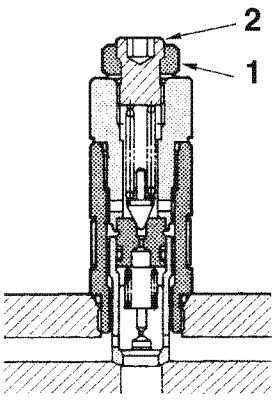
S6F402

Adjustment

(1) Loosen locknut (1), then begin adjusting pressure by turning setting screw (2).
Turning clockwise .....raises the set pressure.
Turning counterclockwise .....lowers the set pressure.

(2) In order to keep the setting screw from turning after pressure has been adjusted, tighten the locknut while at the same time holding the setting screw firmly in place.

(3) Operate the relief valve once more to confirm that the pressure that has been set it stabilized.

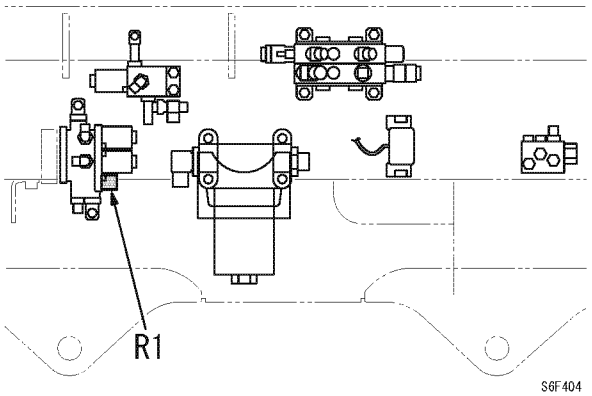


S3F909

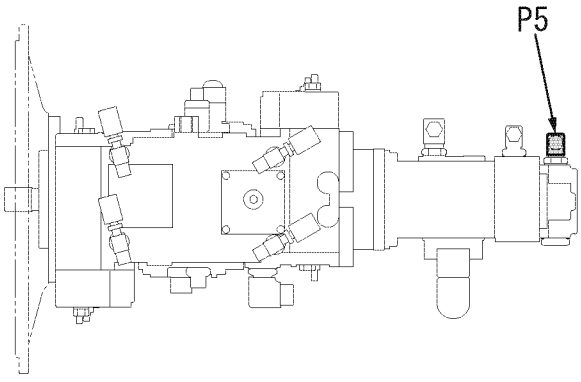
Pilot pressure measurement

- Engine : Rated r.p.m.
- Hydraulic oil temp. : 122 to 140°F (50 to 60°C)
- Mount pressure gauge on the pressure detection port and measure the pilot relief pressure.

Pressure detection port		Relief valve
Port position	Size	
P5	G1/4	R1



S6F404

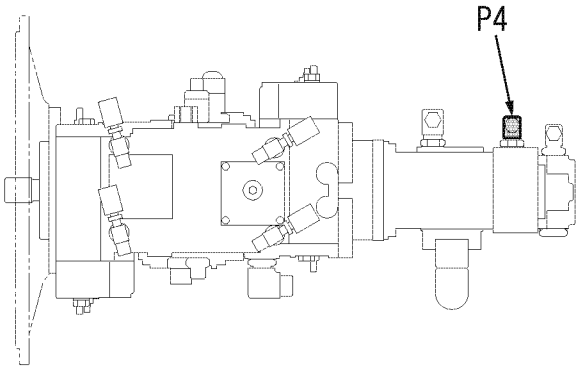


S6F403

Swing pressure measurement

- Engine : Rated r.p.m.
- Hydraulic oil temp. : 122 to 140°F (50 to 60°C)
- Mount the pressure gauge on the pressure detection port, operate the desired hydraulic circuit and measure the relief pressure.

Circuit	Pressure detection port		Relief valve
	Port position	Size	
Right swing	P4	G1/4	R1
Left swing	P4	G1/4	R2



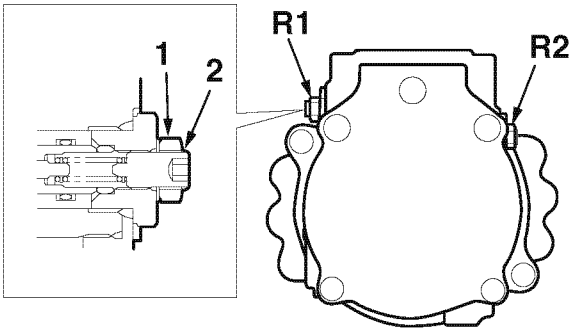
S6F402

Adjustment

(1) Loosen locknut (1), then begin adjusting pressure by turning setting screw (2).
Turning clockwise .....raises the set pressure.
Turning counterclockwise .....lowers the set pressure.

(2) In order to keep the setting screw from turning after pressure has been adjusted, tighten the locknut while at the same time holding the setting screw firmly in place.

(3) Operate the relief valve once more to confirm that the pressure that has been set it stabilized.



S3F908

6-14. Precautions in Case of Hydraulic Source Failures

1. Towing

When towing a machine whose hydraulic source is malfunctioning, bypass the high-pressure relief valve and release the parking brake of the travel motor of the machine to be towed as follows:

⚠ WARNING

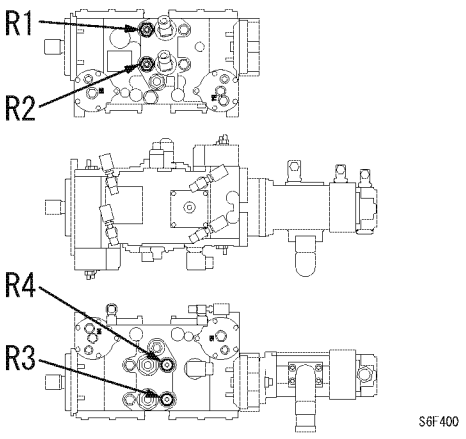
- **Improper towing procedures can cause death or serious injury.**
- **When towing a machine with another machine, use a wire rope strong enough to sustain the machine weight.**
- **Never tow a machine on a slope.**
- **Do not use a towing rope that is kinked, distorted or damaged.**
- **Do not ride on the towing cable or on the wire rope.**
- **When connecting an object to be towed, make sure that no person enters the space between the machine and the object.**
- **Align the connection of an object to be towed and the towing part of the machine, and fix them before towing.**

⚠ CAUTION

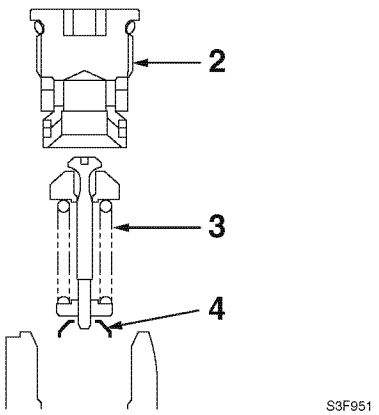
When moving a disabled machine with its parking brake released, let it travel very slowly and not more than a few meters. Never allow it to travel a long distance.

1) Bypassing the high-pressure relief valve

(1) Remove the valve sheets (2) of the relief valves R1, R2, R3, and R4 from the hydraulic pump.

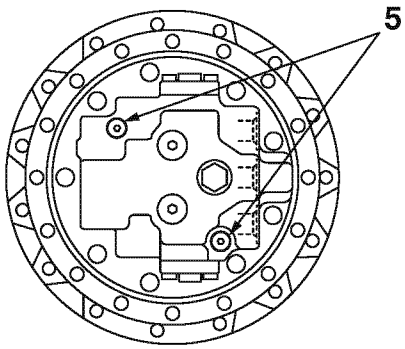


(2) Remove the valve assembly (3) and the conical spring (4).



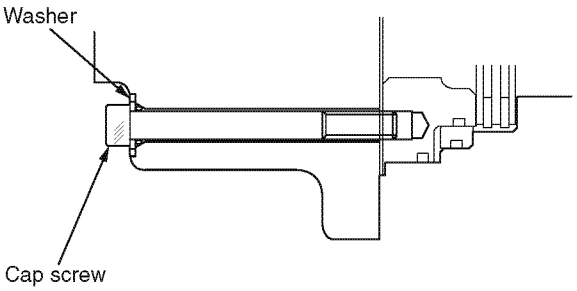
2) Releasing the parking brake

(1) Remove the plugs (5) from the parking brake release port of the travel motor.



S3F952

(2) Attach the two Allen bolts, each together with a flat washer, to the parking brake release port and release the parking brake.
- Flat washer: JIS B1256 round, cold-rolled steel, nominal dia. 0.4 in. (10 mm).
- Bolt: M10 × 1.5 × 110L
- The two Allen bolts should be tightened uniformly.

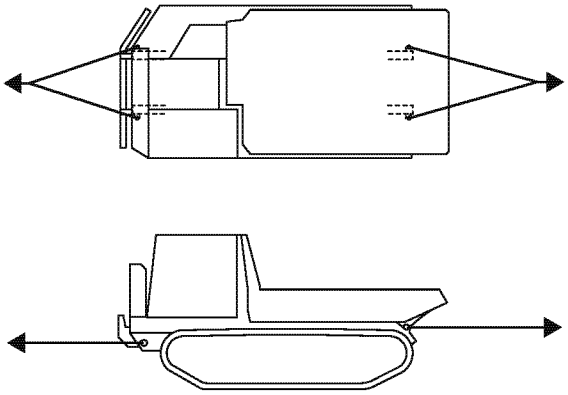


S3F953E

3) Towing

(1) Tie the wire rope as illustrated for towing.
- Use a wire rope that is strong enough for the weight of the vehicle to be towed.
- Align the coupling section of the vehicle to be towed and the towing section of the towing vehicle in tandem, and secure them.

(2) Upon completion of towing, put back all the components in place and actuate the parking brake.



S3F954

CHAPTER 7

SERVICE PROCEDURES FOR INDIVIDUAL COMPONENTS

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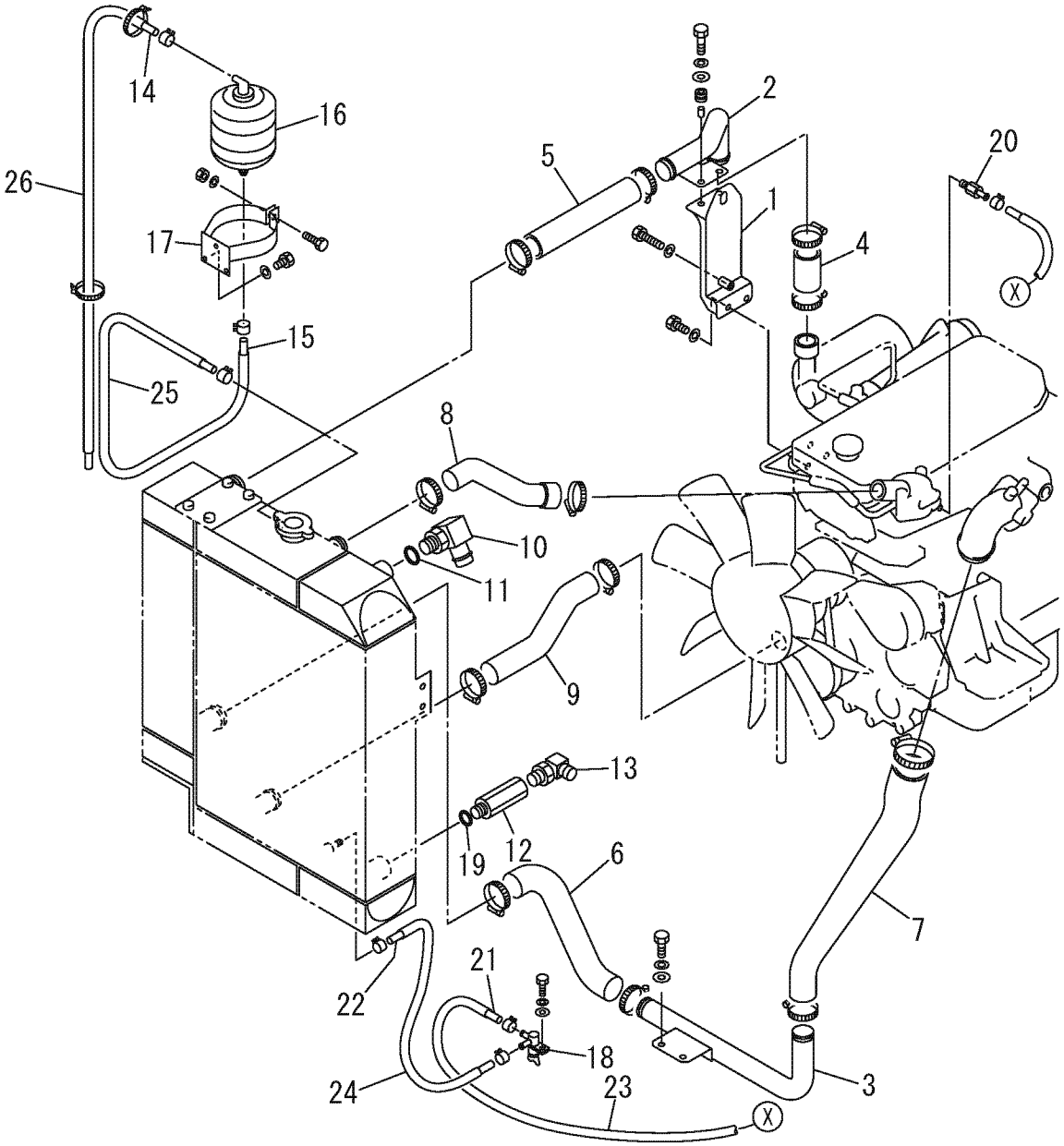
7-1. Engine Related Components

7-1-1. Radiator and Fan Belt

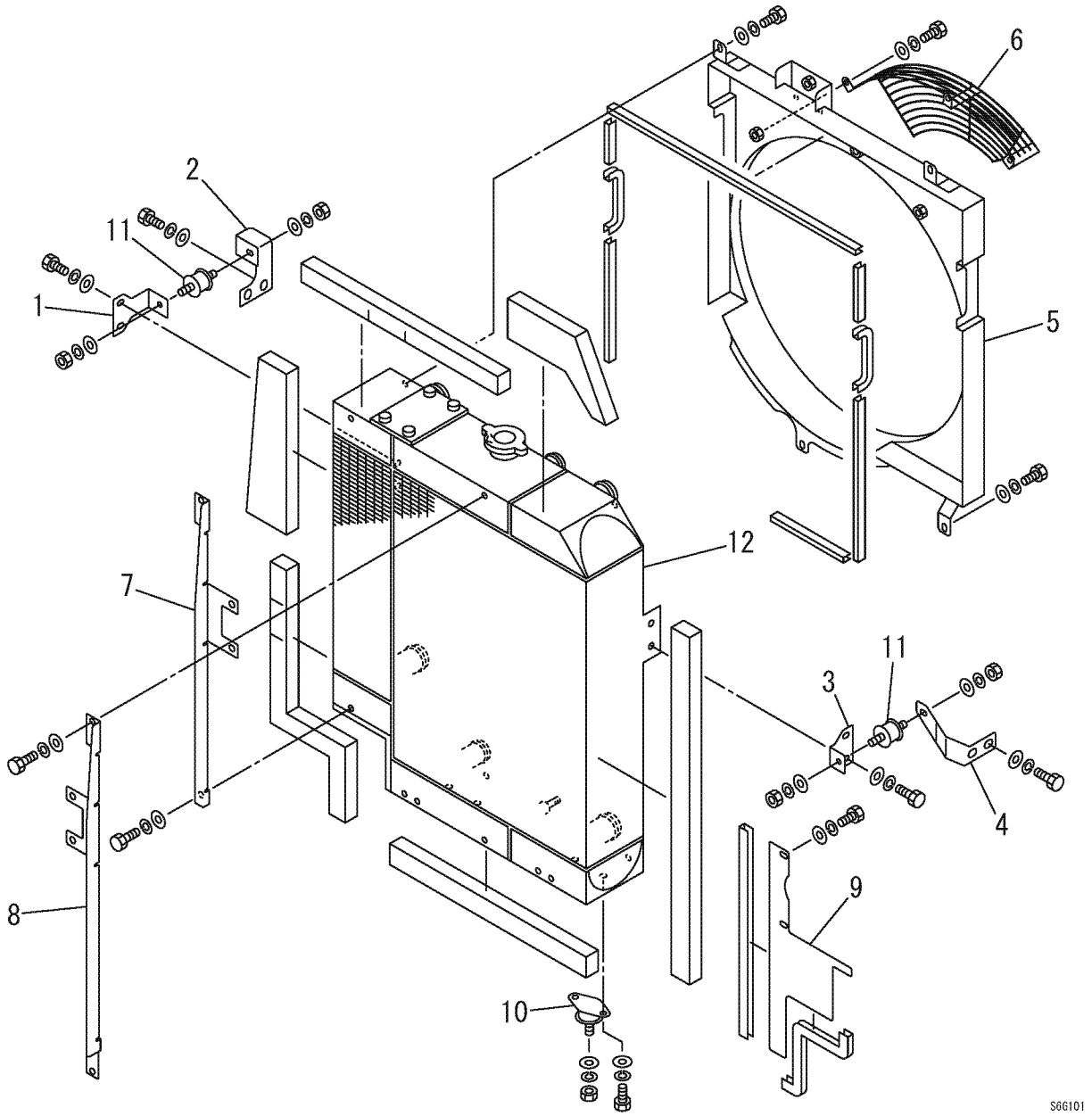
The coolant is heated while circulating through the water jacket (cylinder block) of the engine, and is forcibly cooled by the motor fan in the radiator.
The thermostat controls the water flow rate to flow into the radiator according to the temperature of the coolant.

1) Schematics



S6G100

No.	Part	No.	Part	No.	Part	No.	Part
1	Bracket	8	Hose	15	Hose	22	Hose
2	Pipe	9	Hose	16	Sub tank	23	Vinyl hose
3	Pipe	10	Elbow with washer	17	Bracket	24	Vinyl hose
4	Hose	11	O-ring	18	Cock	25	Vinyl hose
5	Hose	12	Bushing	19	O-ring	26	Vinyl hose
6	Hose	13	Elbow	20	Hose nipple		
7	Hose	14	Hose	21	Hose		

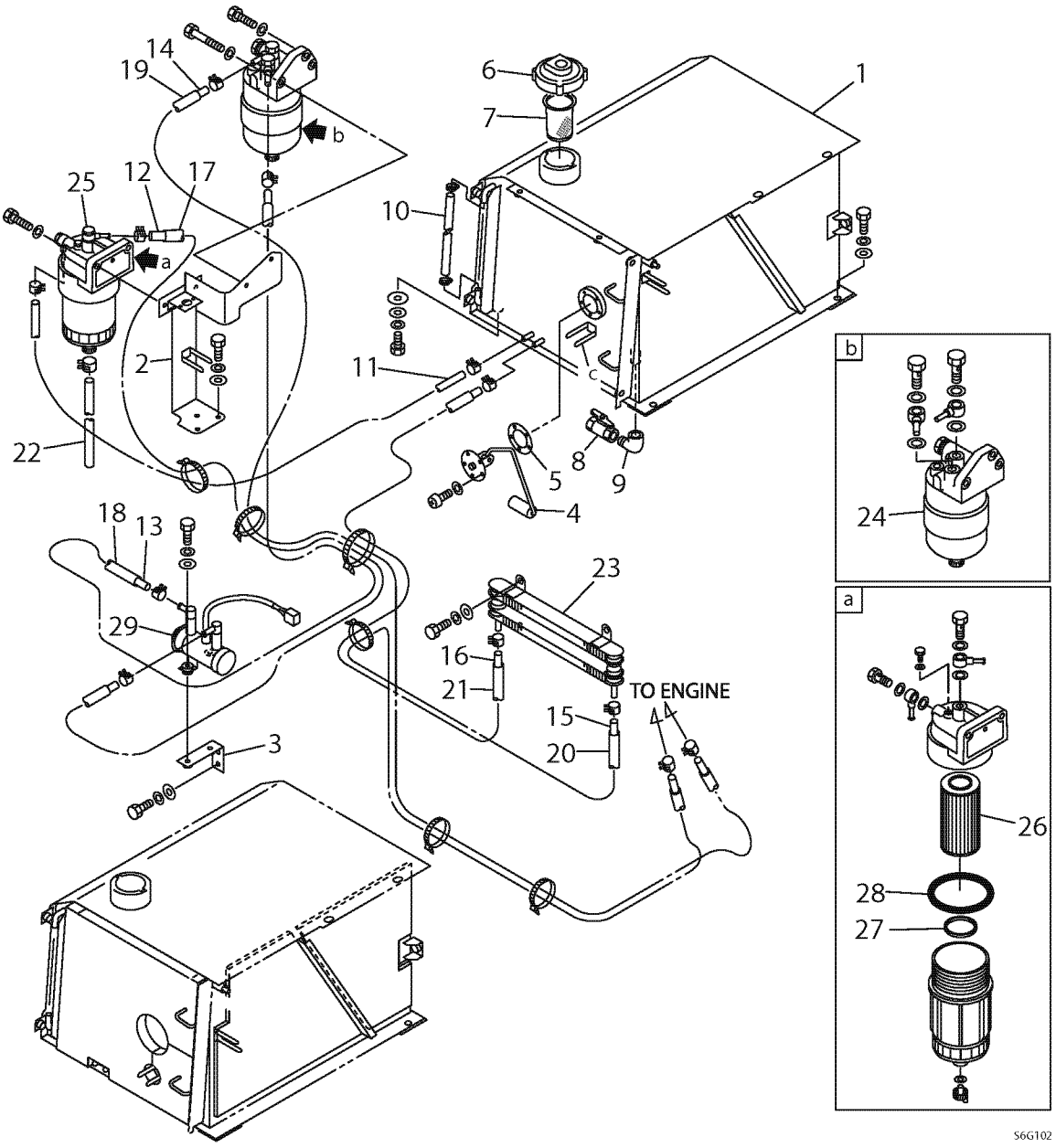


No.	Part	No.	Part
1	Radiator bracket (R)	7	Bracket (R)
2	Bracket (R)	8	Bracket (L)
3	Radiator bracket (L)	9	Plate
4	Bracket (L)	10	Vibration proof rubber
5	Shroud	11	Vibration proof rubber
6	Fan guard	12	RAD/HOC

7-1-2. Fuel Tank

The fuel tank stores the fuel, and mainly consists of a tank, a cap, a filter and a drain cock.

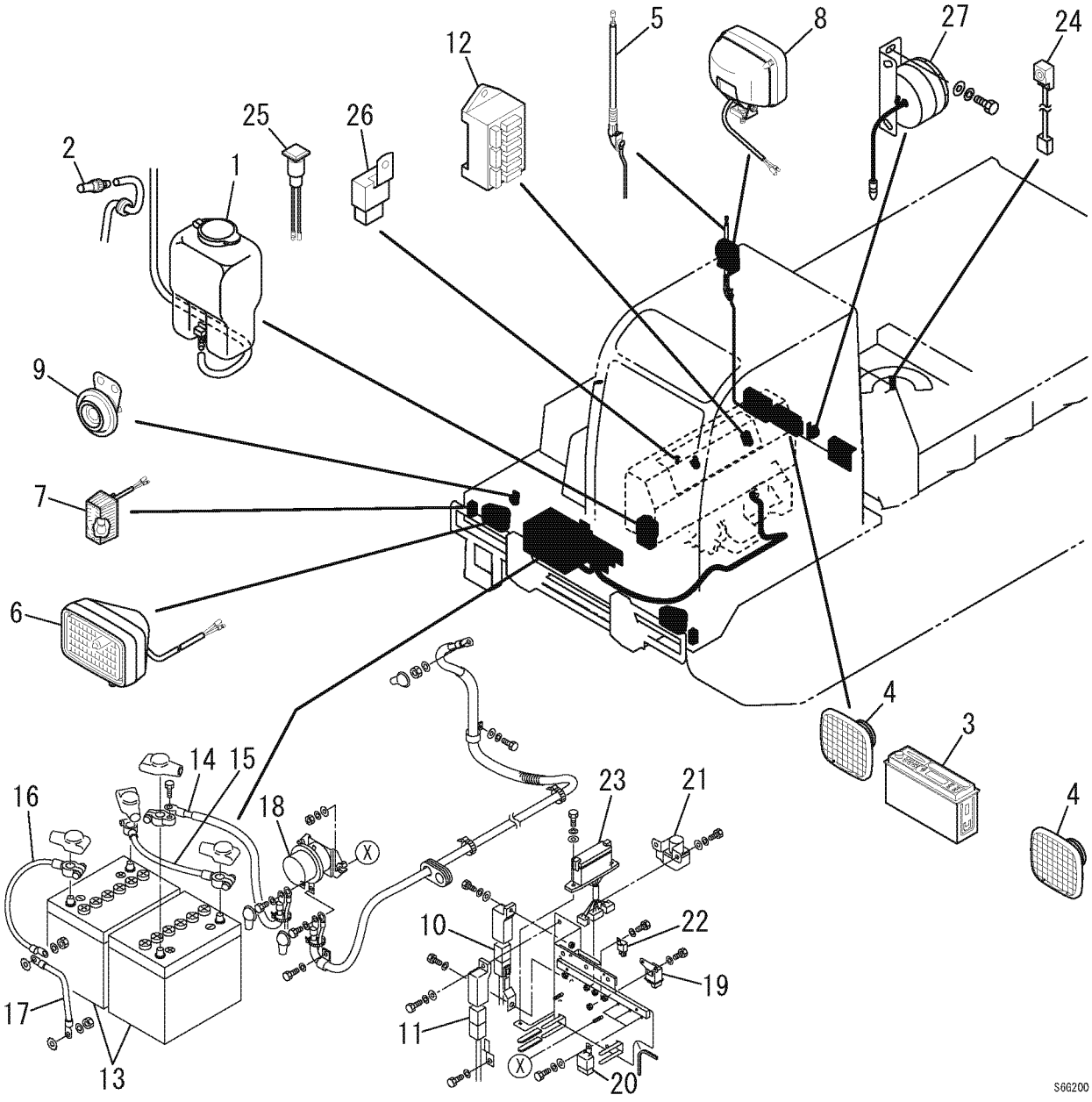
1) Schematics



No.	Part	No.	Part	No.	Part
1	Fuel tank	11	Fuel hose	21	Vinyl hose
2	Bracket	12	Fuel hose	22	Water hose
3	Bracket	13	Fuel hose	23	Fuel cooler
4	Level unit	14	Fuel hose	24	Fuel filter (main)
5	Gasket	15	Fuel hose	25	Fuel filter
6	Tank cap	16	Fuel hose	26	Element
7	Fuel filter	17	Vinyl hose	27	Ring
8	Ball valve	18	Vinyl hose	28	O-ring
9	Elbow	19	Vinyl hose	29	Fuel pump
10	Vinyl hose	20	Vinyl hose		

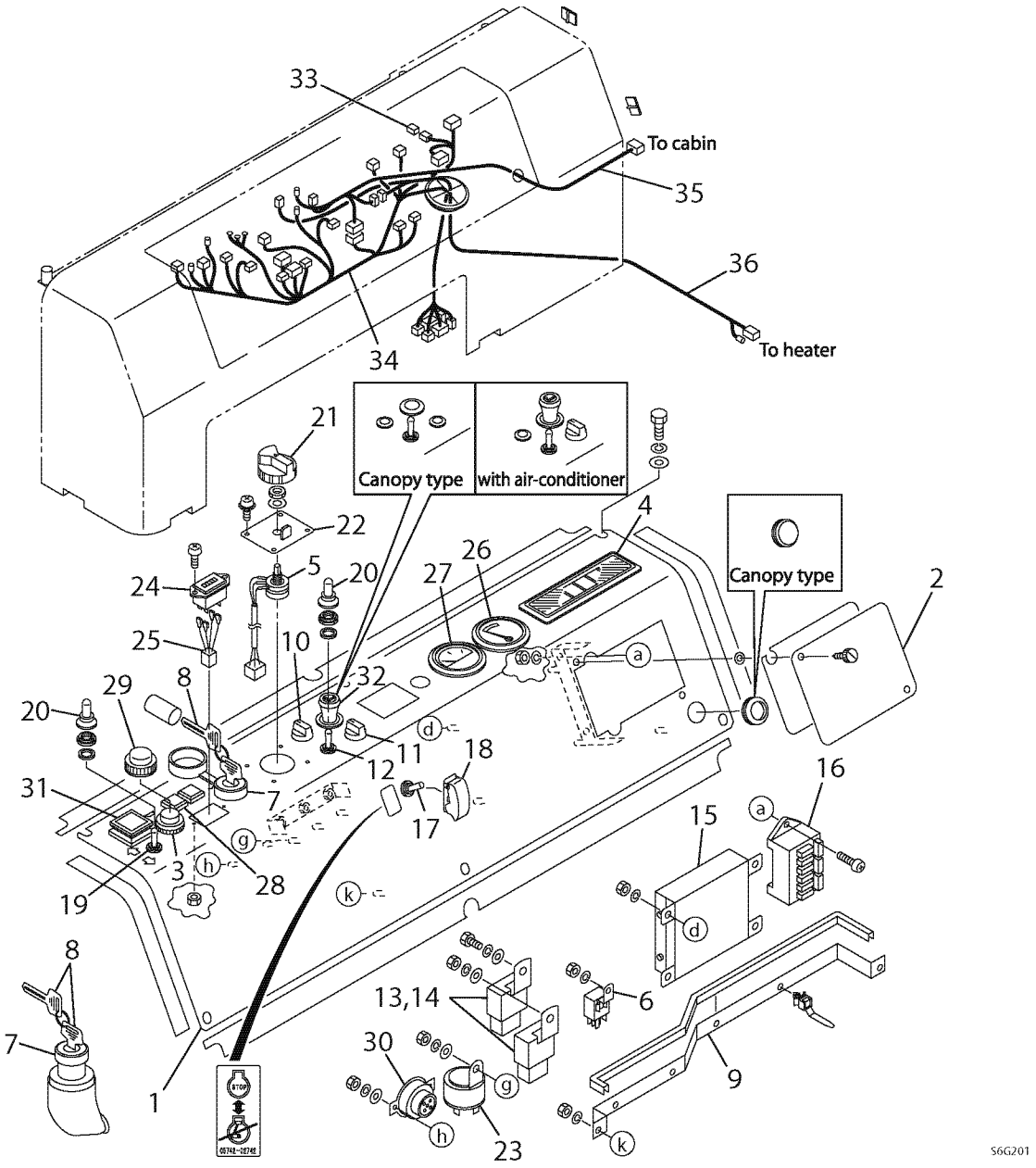
7-2. Electrical Equipments

7-2-1. Electrical Instruments and Names



No.	Part	No.	Part	No.	Part
1	Washer tank	10	Fusible link	19	Glow relay
2	Nozzle	11	Fusible link	20	CA relay
3	AM/FM radio	12	Fuse box	21	Starter relay
4	Speaker	13	Battery	22	Main relay
5	Antenna	14	Battery cable	23	Fuse box
6	Head light	15	Battery cable	24	Proximity switch
7	Turn signal light	16	Battery ground cable	25	Pilot lamp
8	Back light	17	Battery ground cable	26	Relay
9	Horn	18	Battery relay	27	Back alarm

7-2-2. Monitoring and Alarm System

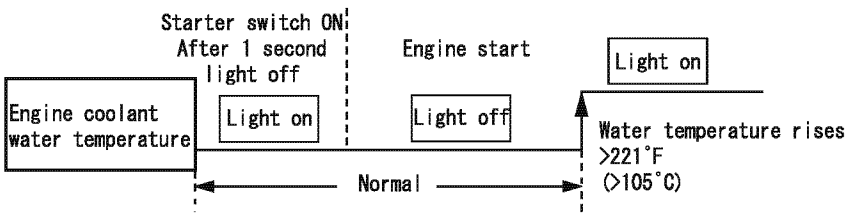


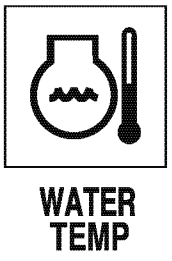
No.	Part	No.	Part	No.	Part
1	Cover	13	Travel speed change relay	25	Wire harness
2	Fuse cover	14	Wagon dump detection relay	26	Water temperature meter
3	Horn switch	15	Controller	27	Fuel meter
4	Pilot box	16	Fuse box	28	Pilot lamp
5	Variable resistor	17	Engine stop switch	29	Cover
6	Main relay	18	Cover	30	Buzzer
7	Starter switch	19	Flasher switch	31	Travel speed change switch
8	Key	20	Rubber cap	32	Cigar lighter
9	Plate	21	Knob	33	Resistor
10	Heater switch	22	Bracket	34	Wire harness
11	Wiper switch	23	Flasher relay	35	Wire harness
12	Light switch	24	Hour meter	36	Wire harness

1) Meters and gauges

(1) Water temp. alarm lamp

This lamp light and the buzzer sound when the coolant temperature rises abnormally.

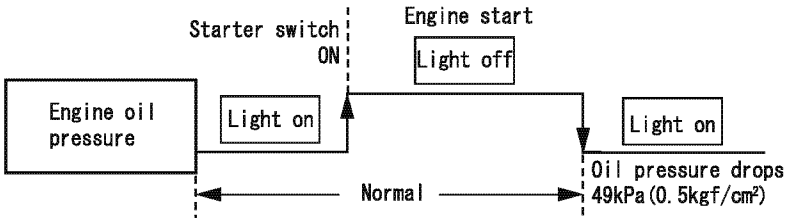


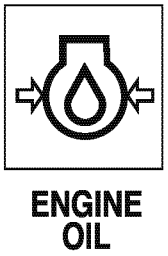


S6G207

(2) Engine oil pressure alarm lamp

This lamp light and the buzzer sound when the pressure of the engine oil falls below the stipulated value.

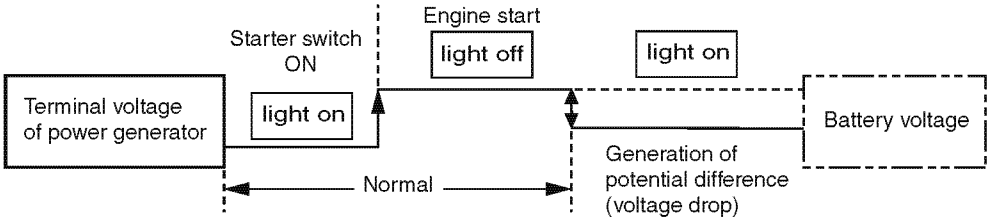


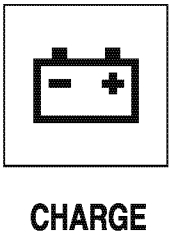


S6G208

(3) Battery charge alarm lamp

This lamp light and the buzzer sound when the battery voltage is not equal to the generator's output voltage.

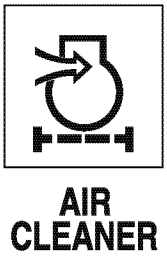




S3G205E

(4) Air cleaner alarm lamp

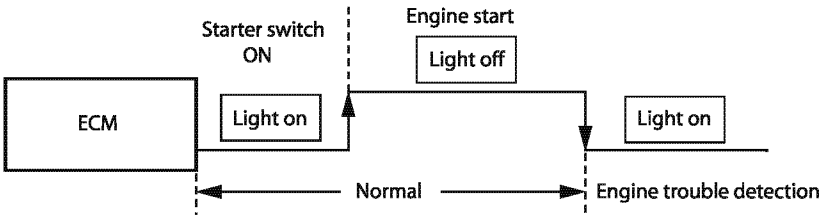
This lamp light and the buzzer sound when the air filter is clogged.



S3G206

(5) Engine trouble alarm lamp

When the ECM detects engine trouble, the lamp lits and the buzzer sounds.

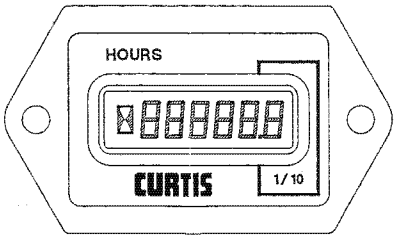


ECM

S6G202

(6) Hour meter

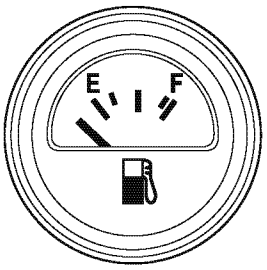
The hour meter advances while the engine is rotating. If the hour meter does not advance while the engine is rotating, the hour meter or the hour meter lead may be faulty.



S3G207

(7) Fuel meter

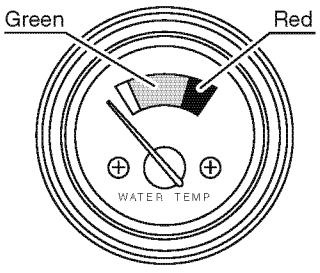
This indicates the fuel level in the tank regardless of whether the starter switch is on or off. "E" means the tank is empty.



S3G208

(8) Water temp. meter

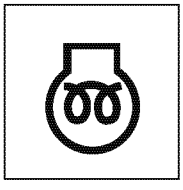
This indicates the engine coolant temperature.
If the indicator points to the green area, the temperature is normal.
If the indicator points to the red area, switch the engine to the low idling state and allow the indicator to return to the green area.



S3G209E

(9) Glow lamp

This indicates the warming up time of the engine under cold conditions. When the warming starts, the glow lamp lights. The lamp goes off after 15 seconds to inform the warming has been completed.

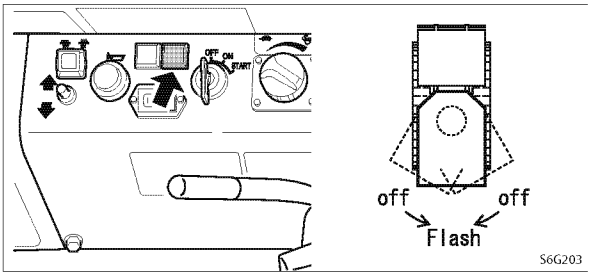


GLOW

S3G210

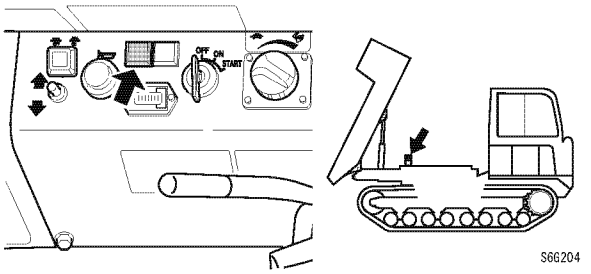
(10) Wagon center indicating lamp (for the swing wagon type)

This indicator turns on when the wagon aligns straight with the body, or goes off when the wagon swings to the right or left.



(11) Wagon dump indicator lamp

When the wagon is lifted and away from the sensor, it lits and when the wagon is lowered to the bottom, it lights out.

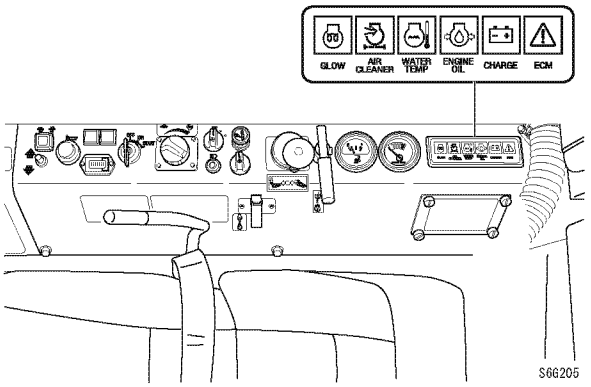


2) Performance of alarm sensor

- The alarm sensor is normal if all the alarm lamp turn on for about one second when the engine key is turned on. The engine oil pressure alarm lamp, the battery charge alarm lamp, and the engine trouble alarm lamp remain on until the engine actually starts.
- The alarm sensor is normal if all the warning lights are off while the engine is rotating.
- The alarm sensor is normal if the engine oil pressure alarm lamp, the battery charge alarm lamp, and the engine trouble alarm lamp turn on when the engine stops.
- If any of the alarm lamp turns on while the engine is rotating, the buzzer will sound.

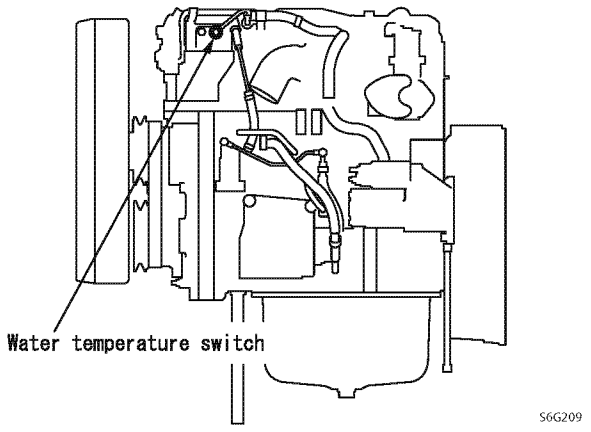
Major configuration

(1) Panel

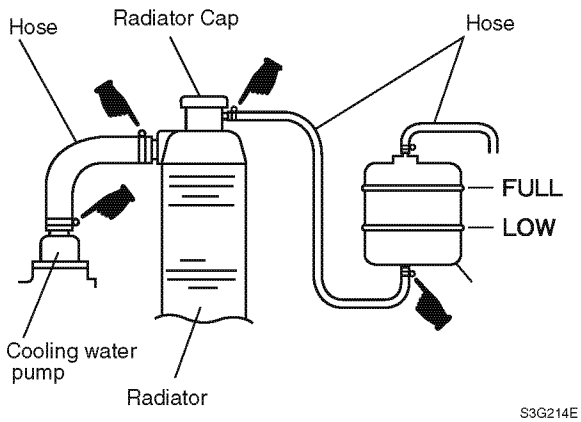


(2) Overheat sensor (CW switch)

Actuation temperature ON.....221°F (105°C)



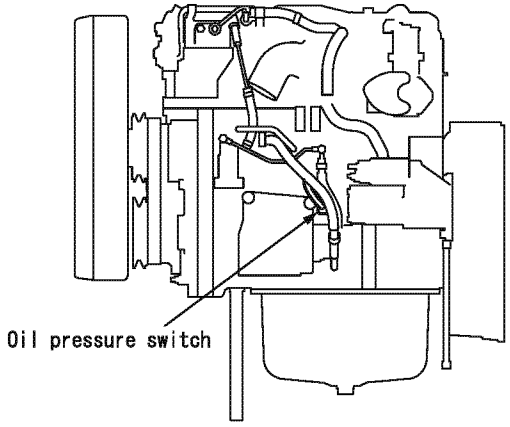
The water (low temperature) level in the tank before operation differs from the water (high temperature) level in the tank after operation. Therefore, check the water levels before and after operation. If there is no difference, inspect the section marked in this illustration for water leakage and tighten the clamp.



(3) Detection of engine oil pressure drop (LO switch)

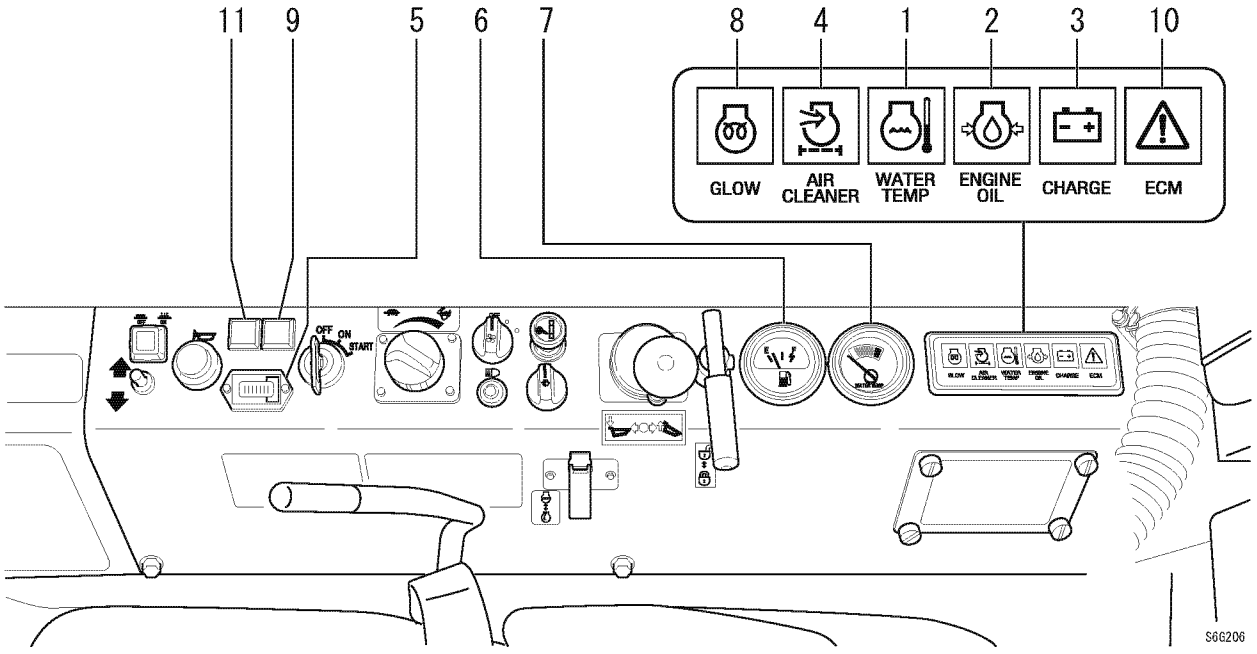
If this switch detects the pressure drop of the engine oil, the engine oil pilot lamp on the monitor is turned on and the alarm sounds.

Actuation pressure ON 7.11PSI (49kPa)



For safe operation, the operator needs to fully understand the conditions of the machine. The gauges and alarms are provided to help the operator notice any abnormal condition quickly while operating the machine.

Note: *Do not rely on the monitor too much. Be sure to do the routine inspection according to this Service Manual, using the monitor as a reference.*



No.	Part
1	Water temperature alarm lamp
2	Engine oil pressure alarm lamp
3	Battery charge alarm lamp
4	Air cleaner alarm lamp
5	Hour meter
6	Fuel meter
7	Water temperature meter
8	Glow lamp
9	Wagon center indicator lamp
10	Engine trouble alarm lamp
11	Wagon dump indicator lamp

7-3. Undercarriage

7-3-1. Removing and Installing the Crawler

1. Replacing the rubber crawler

⚠ WARNING

- **Be sure to do the replacement work on level ground.**
- **To replace the rubber crawler with a new one, work with a partner. You must operate the machine in response to signs from your partner.**
- **Because the rubber crawler is replaced with the machine in a raised position, there is a danger that the machine may accidentally fall. Do not move any parts other than the rubber crawler to be replaced in doing the job.**
- **When jacking up the machine, support it with safety blocks of sufficient strength to keep the balance of the machine body.**
- **The oil temperature is very high immediately after the machine stops operating. Be sure to do the work after the oil temperature lowers sufficiently.**
- **When removing the hydraulic hose, oil may spout out due to the high internal pressure. Loosen the hydraulic hose slowly to prevent high pressure oil from contacting your eyes or skin.**

- Prepare a ply.

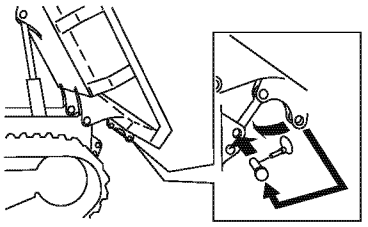
2. Removing and installing the rubber crawler

1) Removing

⚠ CAUTION

Take great care in handling rubber crawlers, because they are very heavy.

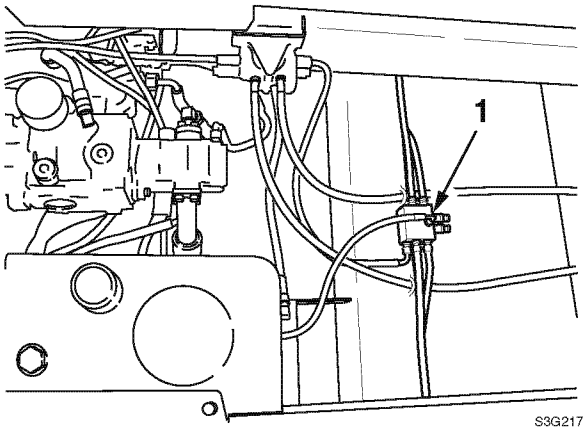
Important:
Use two wrenches to remove and install the hydraulic hose: use one wrench to hold the hose to prevent it from twisting, and the other one to remove or install the hose.


OS0A220

(1) Raise the wagon, position the dump lock lever at the locked position, and stop the engine.

(2) Secure the wagon with the wagon stoppers.

(3) Exchange the hydraulic hose of the crawler tensioning valve (1).



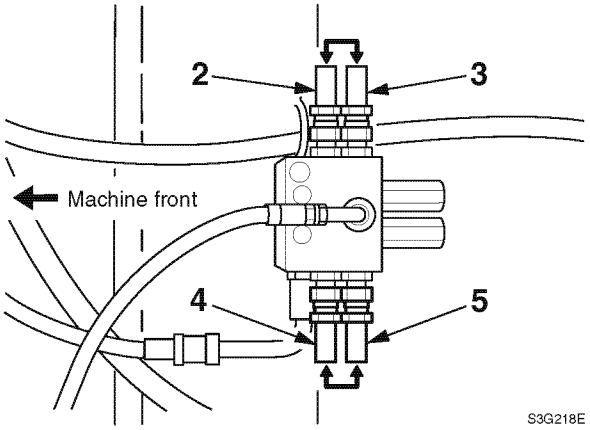
S3G217

By exchanging the hydraulic hose, the tensioning cylinder can be contracted or extended.
Right rubber crawler: Exchange the hydraulic hose (2) with the hydraulic hose (3).
Left rubber crawler: Exchange the hydraulic hose (4) with the hydraulic hose (5).

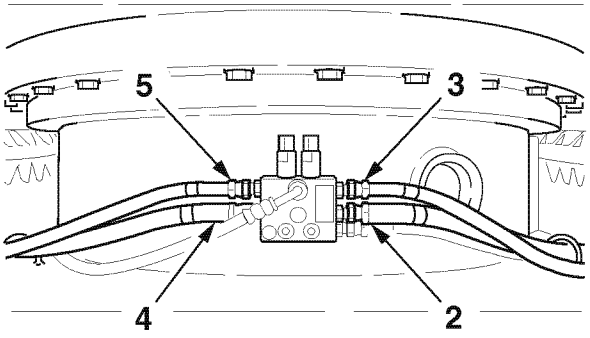
(4) Start the engine, contract the tensioning cylinder to the minimum, and stop the engine.

(5) Raise the bed until there is a clearance between the rubber crawler's grouser lug and the track roller, and support the bed with wooden blocks inserted under the frame.

(6) Remove the crawler from the idler side.



S3G218E



S3G219

2) Installing

⚠ CAUTION

Take great care in handling rubber crawlers, because they are very heavy.

(1) Let the rubber crawler engage with the sprocket and then put the other end of the crawler on the idler.

(2) Start the engine, and turn the rubber crawler slowly to install it on the idler by using the ply.

(3) Stop the engine, and make sure that the rubber crawler and the sprocket are properly engaged.

(4) Exchange the hydraulic hose of the crawler tensioning valve (1) by referring to step (3) on the previous page, and restore the original crawler.

(5) Start the engine and make sure the rubber crawler is properly functioning before lowering the bed.

(6) Inspect the hydraulic hose for oil leakage.

7-3-2. Disassembly and Assembly the Travel Motor

1) Disassembly

⚠ WARNING

- **Be sure to do the replacement work on level ground.**
- **The oil temperature is very high immediately after the machine stops operating. Be sure to do the work after the oil temperature lowers sufficiently.**
- **When removing the hydraulic hose, oil may spout out due to the high internal pressure. Loosen the hydraulic hose slowly to prevent high pressure oil from contacting your eyes or skin.**

⚠ CAUTION

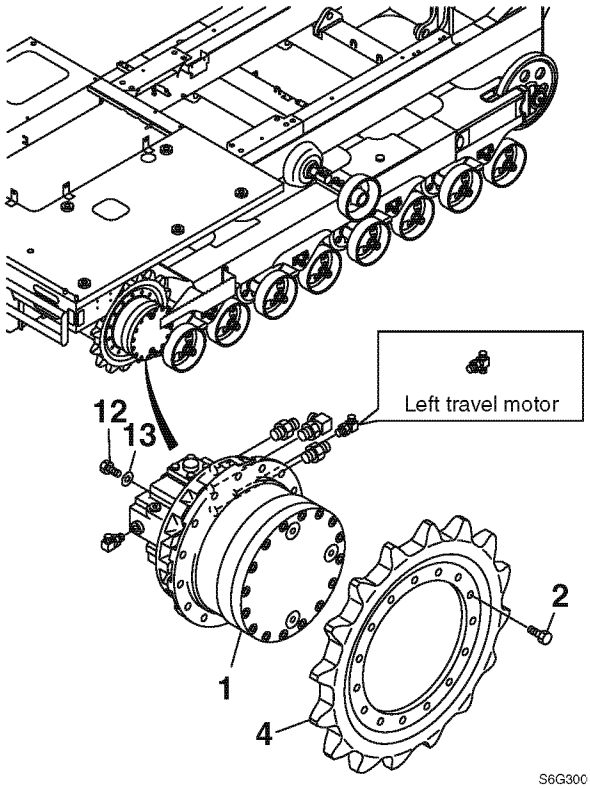
Take great care in handling travel motors, because they are very heavy.

(1) Remove the bolt (2), and then the sprocket (4) from the travel motor (1).

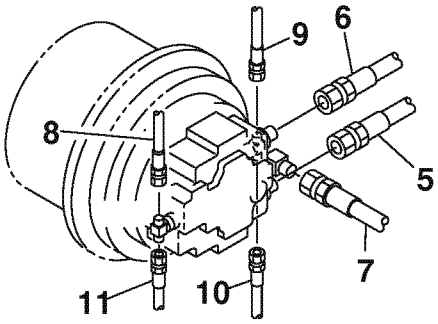
(2) Remove the high pressure hoses (5 and 6) from the travel motor (1).

(3) Remove the medium pressure hoses 7, 8, 9, 10 and 11 (right side hose only) from the travel motor (1).

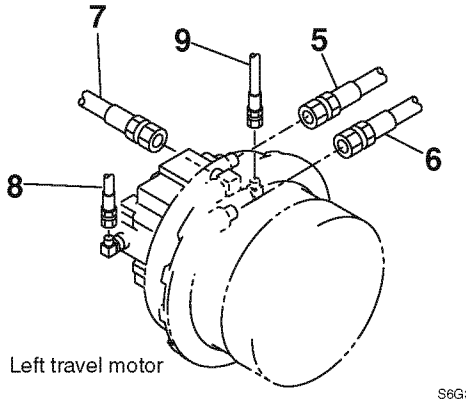
(4) Hang the travel motor (1) temporarily, and remove the bolt (12) and the washer (13) from the travel motor (1), and then remove the travel motor (1).



S6G300



Right travel motor



Left travel motor
S6G30

2) Assembly

(1) Clean the individual components except the seals.

(2) Install the travel motor (1) to the frame with the bolt (12) and the washer (13).

Tightening agent: Three Bond #1324 **Tightening torque: 177.9 ft·lbf (241 N·m)**

(3) Install the medium pressure hoses 7, 8, 9, 10 and 11(right side hose only) to the travel motor (1).

(4) Install the high pressure hoses (5 and 6) to the travel motor (1).

(5) Install the sprocket (4) to the travel motor (1) with the bolt (2).

Note: *Make sure that the sprocket installation surface is clean.*

Tightening agent: Three Bond #1324 **Tightening torque: 177.9 ft·lbf (241 N·m)**

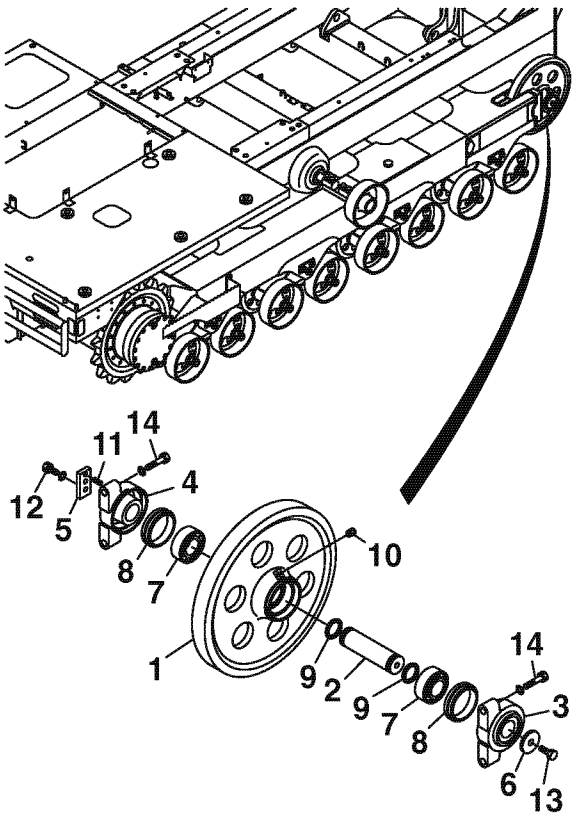
7-3-3. Disassembly and Assembly the Idler

⚠ WARNING

- **Be sure to do the replacement work on level ground.**
- **The oil temperature is very high immediately after the machine stops operating. Be sure to do the work after the oil temperature lowers sufficiently.**
- **When removing the hydraulic hose, oil may spout out due to the high internal pressure. Loosen the hydraulic hose slowly to prevent high pressure oil from contacting your eyes or skin.**

⚠ CAUTION

Take great care in handling idlers, because they are very heavy.



S3G331

1) Disassembly

(1) Hang the idler (1) temporarily, and remove the bolt (14) from the idler fork and then remove the idler assembly.

(2) Remove the plug (10) from the idler (1), and drain the oil.

(3) Remove the bolt with washer (13) from the idler shaft, and remove the plate (6) and the seal cover (3).

(4) Remove the bolt (12) from the idler shaft, and then remove the plate (5), the pin (11) and the seal cover (4).

(5) Pull out the shaft (2) from the idler (1) to the right or left.

(6) Remove the O-ring (9) from the shaft (2).

(7) Remove the floating seal (8) from the idler (1).

(8) Remove the bearing (7) from the idler (1).

No.	Part
1	Idler
2	Shaft
3	Seal cover
4	Seal cover
5	Plate
6	Plate
7	Bearing
8	Floating seal
9	O-ring
10	Plug
11	Spring pin
12	Bolt M10 × 30
13	Bolt M16 × 35
14	Bolt

2) Assembly

(1) Clean individual components except the seals.

(2) Install the bearing (7) on the idler (1).

(3) Press-fit half of the floating seal set (8) into the idler (1) on the seal cover (4) side.
Note:
a) Make sure the sheet surface of the floating seal and the surfaces of the seal covers (3 and 4) that contact the O-rings are free from grease or oil.
b) Apply a thin film of oil over the perimeter of the O-ring of the floating seal and clean it with a paper towel (do not use a rag).
c) Make sure the seat surface of the floating seal is level.

(4) Install the O-ring (9) on the shaft (2) on the side of the seal cover (4), and install it on the idler (1).
• Apply a thin film of grease to the perimeter of the O-ring.

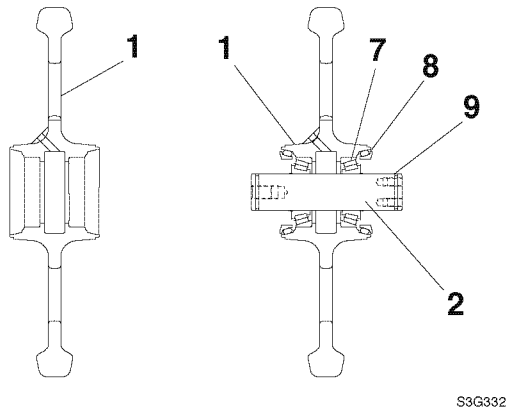
(5) Insert the remaining half of the floating seal set (8) into the seal cover (4).

(6) Install the seal cover (4), the pin (11), and the plate (5) on the shaft (2), and install the bolt (12).

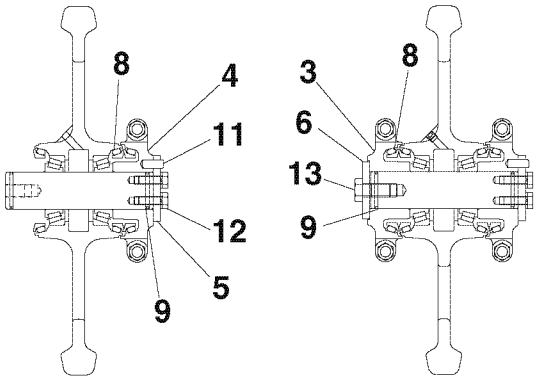
Tightening agent: Three Bond #1324
Tightening torque: 40.5 ft·lbf (55 N·m)

(7) Make the idler (1) reverse, and install the O-ring (9) on the shaft (2).

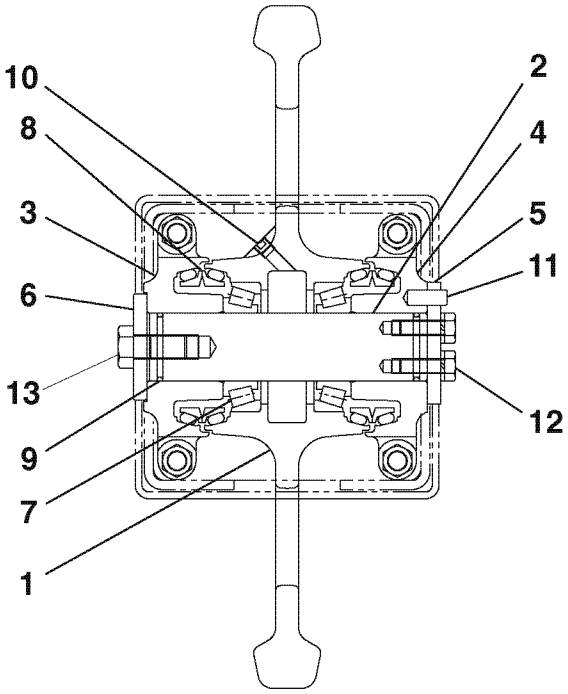
(8) Press-fit half of the floating seal set (8) into the idler (1) and the other half into the seal cover (3).



S3G332



S3G333

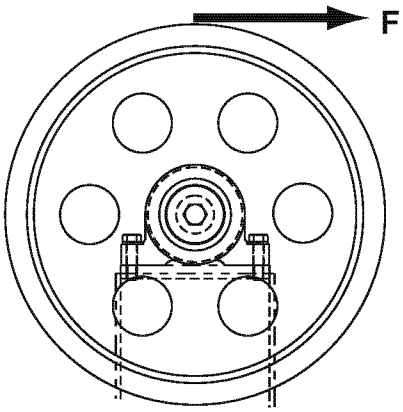


S3G334

(9) Install the seal cover (3) and the plate (6) on the shaft (2), and install the bolt (13), and then measure the rotational moment F of the idler.
- Make sure the rotation is smooth.

Tightening torque: 14.5 ft·lbf (20 N·m)

Idler's rotational moment F: 24.6 to 36.9 ft·lbf (33 to 50 N·m)



S3G335

(10) Inject the oil through the drain plug section.
- Oil type..... Mobil gear oil SHC680
- Oil volume..... 5.75 fl. oz. (170 mL)

(11) Wind the seal tape around the plug (10) and install it on the idler (1).

(12) Install the idler assembly on the idler fork, and install the bolt (14).

Tightening agent: Three Bond #1324
Tightening torque: 71.6 ft·lbf (97 N·m)

(13) Upon completion of installation, make sure the idler is operating smoothly and no oil is leaking.

7-3-4. Disassembly and Assembly the Carrier Roller

⚠ WARNING

- **Be sure to do the replacement work on level ground.**
- **The oil temperature is very high immediately after the machine stops operating. Be sure to do the work after the oil temperature lowers sufficiently.**

1) Disassembly

(1) Remove the bolt (13) from the bottom frame, and remove the carrier roller assembly.

(2) Remove the bolt (12) from the plate (4), and drain the oil.

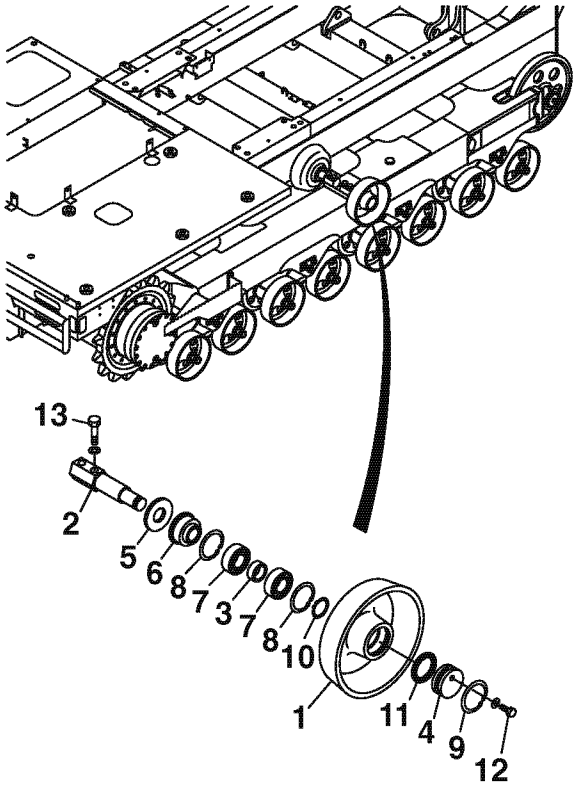
(3) Remove the snap ring (9) from the carrier roller (1).

(4) Remove the plate (4) from the carrier roller (1), and then remove the O-ring (11) from the plate (4).

(5) Remove the snap ring (10) from the carrier roller (1), and pull out the shaft (2).

(6) Remove the snap ring (8) from the carrier roller (1), and then remove the bearing (7), the collar (3), and the bearing (7).

(7) Remove the snap ring (8), the seal with shaft (6), and the seal cover (5) from the carrier roller (1).



S3G341

No.	Part
1	Carrier roller
2	Shaft
3	Collar
4	Plate
5	Seal cover
6	Shaft seal
7	Bearing
8	Snap ring
9	Snap ring
10	Snap ring
11	O-ring
12	Bolt
13	Bolt

2) Assembly

(1) Clean individual components except the seals.

(2) Install the snap ring (8) on the carrier roller (1).

(3) Install the bearing (7), the collar (3), and the bearing (7) on the carrier roller (1).

(4) Install the snap ring (8) on the carrier roller (1).

(5) Install the seal with shaft (6) on the carrier roller (1), and press-fit the seal cover (5) in place.

(6) Install the shaft (2) on the carrier roller (1), and install the snap ring (10).

(7) Inject oil into the carrier roller (1).
- Oil type..... Mobil gear oil SHC680
- Oil volume..... 1.52 to 1.69 fl. oz. (45 to 50 mL)

(8) Attach the O-ring (11) to the plate (4), and install them on the carrier roller (1).

(9) Install the snap ring (9) on the carrier roller (1).
- Mate the right side of the snap ring with the bearing side of the roller.

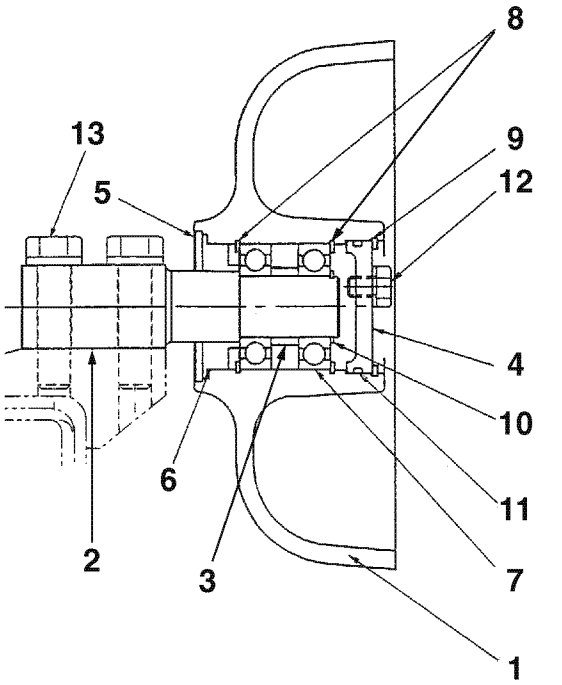
(10) Install and tighten the bolt (12) on the plate (4).

Tightening torque: 40.5 ±2 ft·lbf (54.9 ±2.7 N·m)

(11) Install the carrier roller (1) on the bottom frame, and tighten them with the bolt (13).

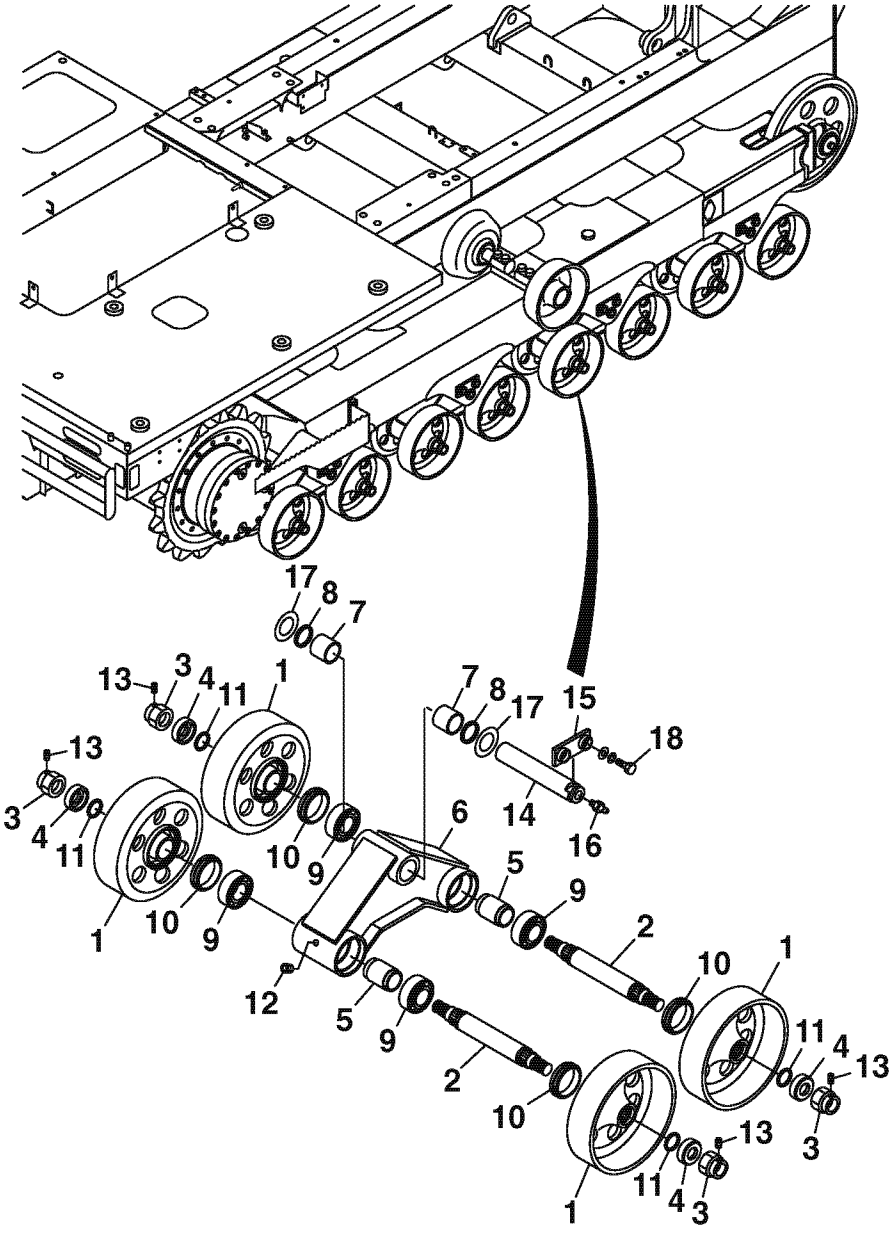
Tightening agent: Three Bond #1324
Tightening torque: 188.8 ±9.4 ft·lbf (256 ±12.7 N·m)

(12) Upon completion of reassembling, make sure that the carrier roller rotates smoothly.



S3G342

7-3-5. Disassembly and Assembly the Track Roller



S3G351

No.	Part	No.	Part	No.	Part
1	Track roller	7	Bushing	13	Set screw
2	Shaft	8	Dust seal	14	Center pin
3	Nut	9	Bearing	15	Plate
4	Plate	10	Floating seal	16	Grease nipple
5	Spacer	11	O-ring	17	Shim
6	Bracket	12	Plug	18	Bolt

1. Disassembly and assembly the track roller

⚠ WARNING

- **Be sure to do the replacement work on level ground.**
- **The oil temperature is very high immediately after the machine stops operating. Be sure to do the work after the oil temperature lowers sufficiently.**
- **When raising the vehicle, support it with a safety block.**

⚠ CAUTION

Take great care in handling track rollers, because they are very heavy.

1) Disassembly

(1) Select a flat and rigid place for operations.

(2) Loosen the tension of the rubber crawler to be disassembled.

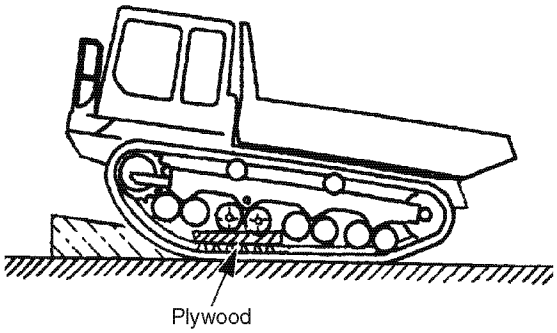
(3) Remove the bolt (18) and then the plate (15).

(4) Raise the front or the back of the vehicle, whichever is closer to the track roller to be disassembled, to loosen the rubber crawler.
- Raise the vehicle by supporting the other side of the rubber crawler with a robust inclined stand. Make sure the vehicle will not fall down.

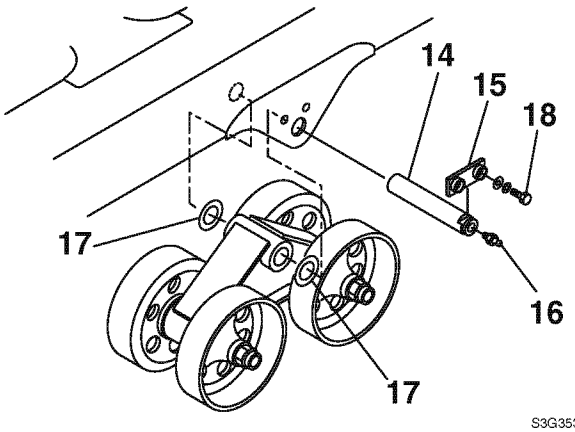
(5) Prepare plywood with enough strength and size, and insert it into the clearance generated by the loosened rubber crawler, between the upper edge of the lug and the track roller tread.
- Adjust the rubber crawler's tension so that the plywood fits in the clearance.
- Place the supports underneath the plywood to prevent it from inclining.

(6) Remove the center pin (14) by using a steel bar and a hammer.
- Use a steel bar whose diameter is larger than that of the grease nipple hole to avoid damaging the grease nipple.

(7) Remove the track roller assembly by sliding it on the plywood.
- Take care not to miss the shims (17).



S3G352E



S3G353

2) Assembly

⚠ WARNING

Never insert your finger into the pinholes to avoid bodily injury.
The alignment should be done visually.

(1) Place the plywood on the lug of the rubber crawler.

(2) Move the track roller assembly on the plywood to the installation position, and remove the plywood to station the track roller assembly on the rubber crawler.

(3) Mate the track roller pinholes with the frame pinholes, and install the shims (17) and the center pins (14).

(4) Install the plate (15).
- Do not allow any clearance between the lower surface of the plate (15) and the grooved bottom of the center pin (14).

(5) Apply the locking agent to the bolt (18) and install it.

Tightening agent: Three Bond #1324
Tightening torque: 75.2 ft·lbf (102 N·m)

(6) Inject grease into the grease nipple (16).

2. Disassembly and assembly the floating seal

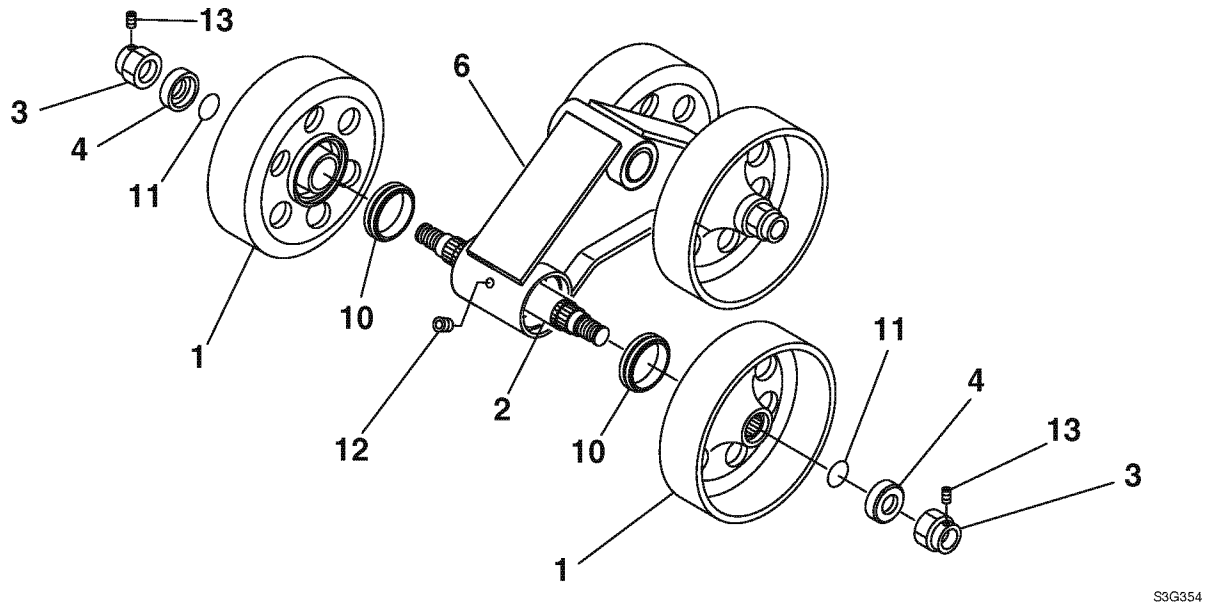
1) Disassembly

(1) Loosen the two plugs (12) on one side and drain the oil.

(2) Loosen the setscrew (13), and remove the nut (3) and the plate (4).

(3) Remove the track roller (1) and the O-ring (11).

(4) Remove the floating seal (10) from the track roller (1) and the bracket (6).



2) Assembly

(1) Clean individual parts, and press-fit the half of the floating seal set (10) into both sides of the bracket (6).
Note:
a) Make sure the seat surface of the floating seal (10) and the track roller (1) surface that contacts the O-ring are free from oil or grease.
b) Apply a thin film of oil along the perimeter of the O-ring of the floating seal (10) and clean it with a paper towel (do not use a rag).
c) Make sure the seat surface of the floating seal (10) is level.

(2) Press-fit the other half of the floating seal set (10) into the track roller (1).

(3) Apply molybdenum disulfide grease to both sides of the spline section of the shaft (2).

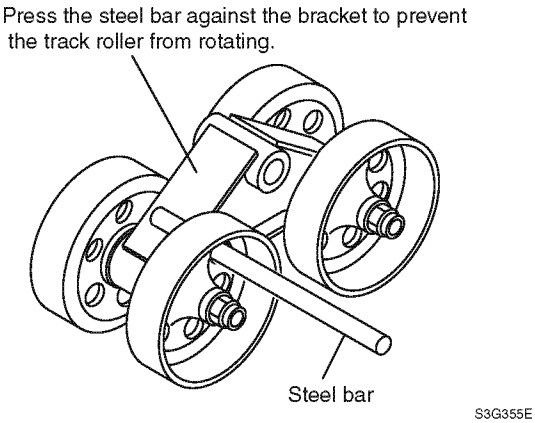
(4) Install the track rollers (1) on both sides of the shaft (2).

(5) Install the O-rings (11) on both sides of the shaft (2).
- Apply a thin film of grease along the perimeter of the O-ring.

(6) Install the plate (4) on both sides of the shaft (2) and temporarily tighten them with the nuts (3).
- Spray grease over the nut bearing surface and the screw section.

(7) Insert the steel bar into the track roller hole to prevent the track roller from rotating, and tighten it to the stipulated torque.

Tightening torque: 217 to 239 ft·lbf (294 to 324 N·m)



(8) Measure the roller's rotational moment, and make sure the rotation is smooth.
- If the roller's rotational moment is outside of the stipulated value or if the rotation is not smooth, reassemble the track roller again. If this does not work, re-disassemble the track roller again and inspect the spacers and bearings.
- Refer to Section "Disassembling and reassembling the track roller's spacers and bearings" for measurement of the roller's rotational moment.

(9) Secure the nut (3) with the setscrew (13).

Tightening torque: 8.7 ft·lbf (12 N·m)

(10) Wind the seal tape around the plug (12), and install them into the lower hole of the bracket (6).

(11) Inject the stipulated volume of oil through the upper hole of the bracket (6).
- Oil type..... Mobil gear oil SHC680
- Oil volume..... 5.41 fl. oz. (160 mL)

(12) Wind the seal tape around the plug (12), and install them into the upper hole of the bracket (6).

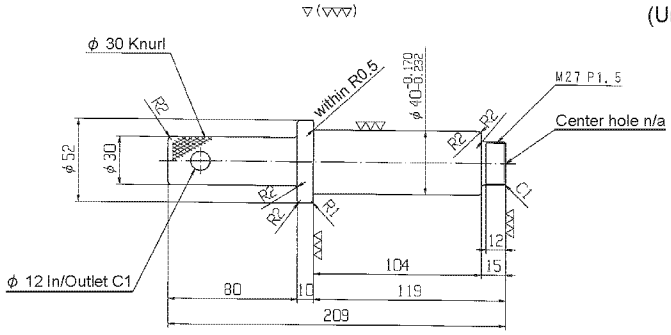
3. Disassembly and assembly the track roller's spacers and bearings

- The spacers and bearings should be replaced at the same time.
- The inner ring and outer ring of the bearing should be used as a pair. Do not mix with other pairs.

1) Special tool

(1) Spacer measurement jig (I)

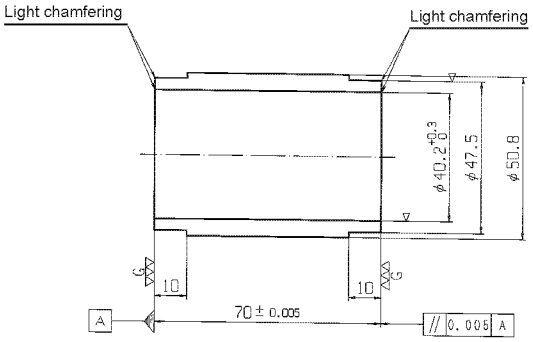
(Unit: mm)



Base: hardening tempering HRC 30-36

(2) Spacer measurement jig (II)

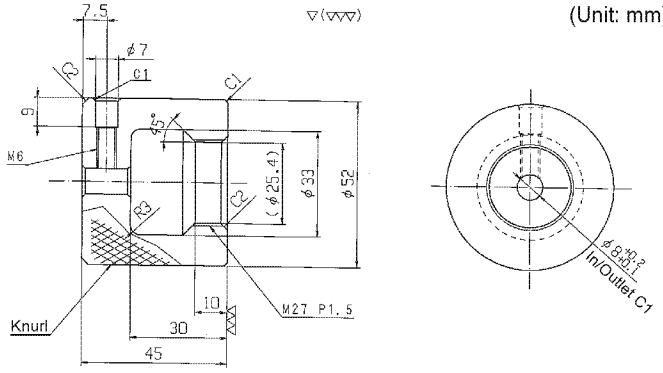
(Unit: mm)



Heat-treatment
Base: hardening tempering HRC 50 or higher

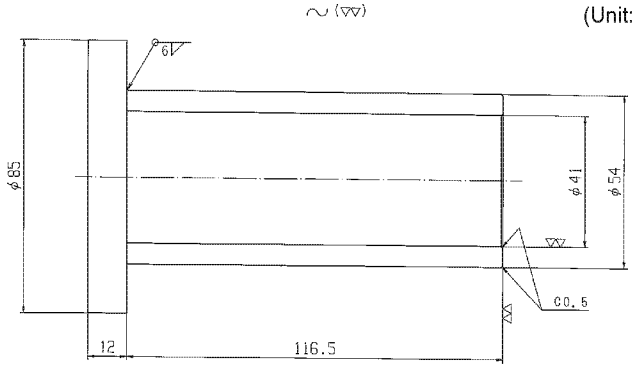
(3) Spacer measurement jig (III)

(Unit: mm)



(4) Bearing installation jig

(Unit: mm)



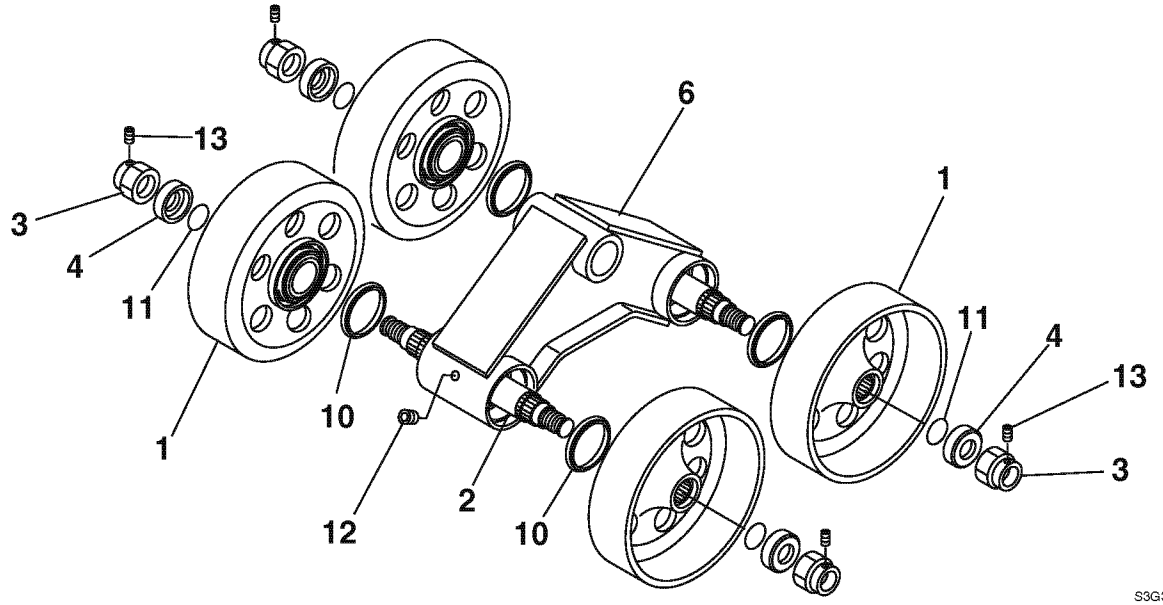
2) Disassembly

(1) Loosen the two plugs (12) on one side, and drain the oil.

(2) Loosen the setscrew (13), and remove the nut (3) and the plate (4).

(3) Remove the track roller (1) and the O-ring (11).

(4) Remove the half of the floating seal set (10) from both sides of the bracket (6).



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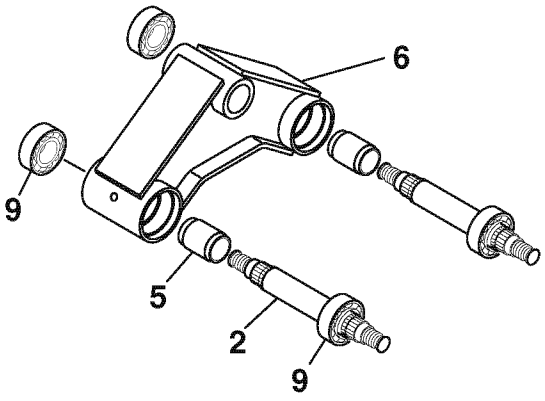
(5) Remove the shaft (2) from the bracket (6) by using the copper hammer.

(6) Remove the bearing (9) and the spacer (5) from the shaft (2).

(7) Remove the bearing (9) from the bracket (6).



S3G357

3) Assembly

(1) Install the bearing's inner ring, spacer measurement jig (II), and bearing's inner ring on the spacer measurement jig (I).

(2) Tighten the spacer measurement jig (III) against the spacer measurement jig (I).

(3) Adjust the dial gauge to point "0."

(4) Remove the spacer jigs (III and II), and the bearing's inner ring from the spacer measurement jig (I).

(5) Install the measured bearing's inner ring and outer ring on the bracket (6).

(6) Install the spacer measurement jig (I) on the bracket (6).

(7) Tighten the spacer measurement jig (III) against the spacer measurement jig (I).
Note: *The bearing and the spacer measurement jig should be positioned the same as when the dial gauge points at "0."*

(8) Record the reading of the dial gauge (deviation from the point 0).

(9) Remove the spacer measurement jigs (III and I) from the bracket (6).

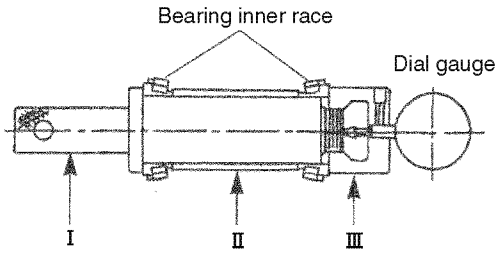
(10) Remove only the bearing's inner rings from both sides of the bracket.

(11) Install the bearing's inner ring on one side of the shaft by using a bearing press-fit jig.

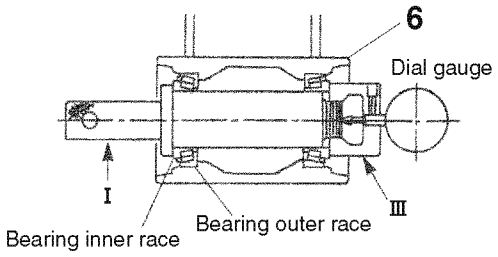
(12) Attach the shaft (2) to an installation jig.

(13) Install the bracket (6) on the shaft (2).

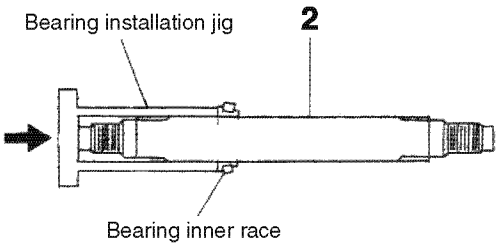
(14) Select a spacer (5) according to the measured value recorded in step (8).



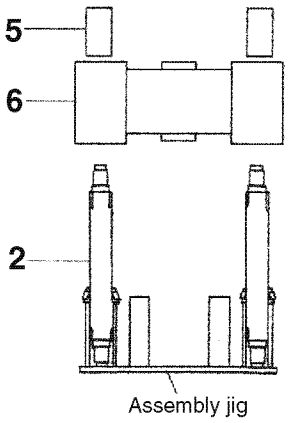
S3G358E



S3G359E



S3G360E



S3G361E

Measured value in. (mm)	Spacer part number
0.0020 to –0.0053 (0.050 to –0.135)	172660-37060
–0.0053 to –0.0126 (–0.135 to –0.320)	172660-37070
–0.0126 to –0.0199 (–0.320 to –0.505)	172660-37080
–0.0199 to –0.0272 (–0.505 to –0.690)	172660-37090

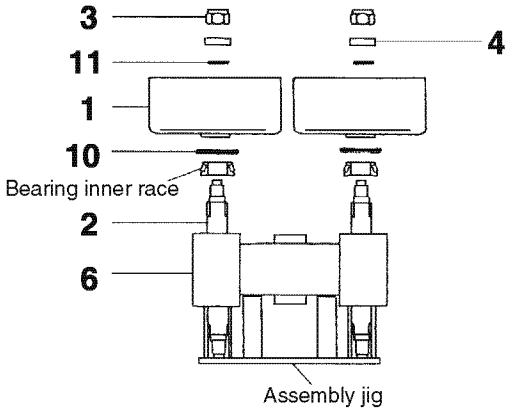
(15) Install the bearing's inner ring on the shaft (2).

(16) Press-fit the half of the floating seal set (10) into the bracket (6).
- Refer to Section "Disassembling and reassembling the floating seal" for press-fitting of the floating seal.

(17) Apply molybdenum disulfide grease to the spline section of the shaft (2).

(18) Install the track roller (1) on the shaft.

(19) Install the O-ring (11) on the shaft.



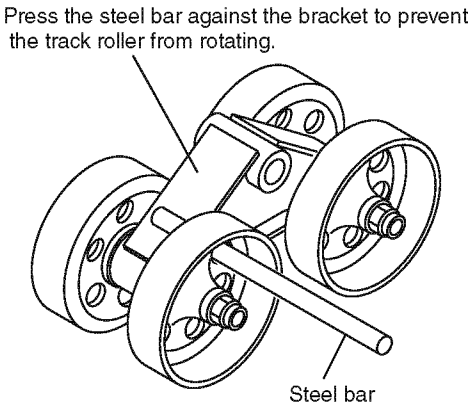
S3G362E

(20) Install the plate (4) on the shaft, and temporarily tighten it with the nut (3).
- Spray grease over the nut bearing surface and the screw section.

(21) Upon completion of the reassembling of one side of the track roller assembly, remove the assembly from the installation jig, and start installing the floating seal, the track roller, the O-ring, the plate, and the nut on the opposite side of the track roller.

(22) Insert the steel bar into the hole of the track roller to prevent the roller from rotating, and tighten it to the stipulated torque.

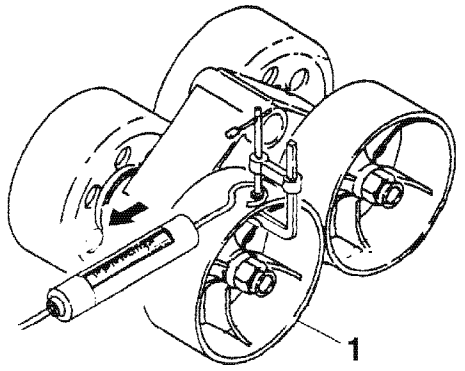
Tightening torque: 217 to 239 ft·lbf (294 to 324 N·m)



S3G355E

(23) Attach the clamp to the track roller, and measure the roller's rotational moment by a spring scale to inspect if the roller rotates smoothly.
- If the rotational moment is outside of the stipulated value or the roller does not rotate smoothly, reassemble again. If this does not work, disassemble the track roller again and replace the spacer.

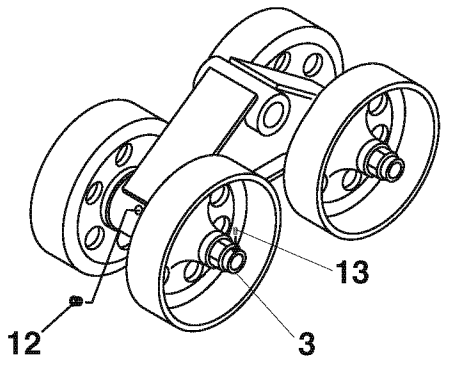
Roller's rotational moment: 28.9 to 43.4 ft·lbf (39 to 59 N·m)



S3G363

(24) Secure the nut (3) with the setscrew (13).

Tightening torque: 8.7 ft·lbf (12 N·m)



S3G364

(25) Wind the seal tape around the plug (12) and install them into the lower hole of the bracket (6). Inject the stipulated volume of oil from the upper hole of the bracket (6).
- Oil type..... Mobil gear oil SHC680
- Oil volume..... 5.41 fl. oz. (160 mL)

(26) Wind the seal tape around the plug (12) and install them into the upper hole of the bracket (6).

7-3-6. Installing the Floating Seal

(1) Clean, degrease, and dry the contact surface of the O-ring.

(2) The floating seal set (seal ring + O-ring) should be removed from the vacuum package immediately before installation.

(3) The floating seal set should be installed level on the housing.

(4) When inserting the floating seal set, be sure to use a cylindrical presser jig to hold down the O-ring.

(5) Upon insertion, make sure the inclination of the floating seal set is 0.04 in. (1 mm) or less.

7-3-7. Disassembly and Assembly the Shoe Tension Cylinder

⚠ WARNING

- **Be sure to do the replacement work on level ground.**
- **The oil temperature is very high immediately after the machine stops operating. Be sure to do the work after the oil temperature lowers sufficiently.**
- **When removing the hydraulic hose, oil may spout out due to the high internal pressure. Loosen the hydraulic hose slowly to prevent high pressure oil from contacting your eyes or skin.**

1) Disassembly

(1) Remove the idler assembly from the idler fork (5).

(2) Remove the bolt (1) from the lower frame, and remove the cover (2).

(3) Remove the pin (6) from the idler fork (5).

(4) Remove the idler fork (5) from the lower frame.

(5) Remove the bolt (3) from the lower frame, and remove the cover (4).

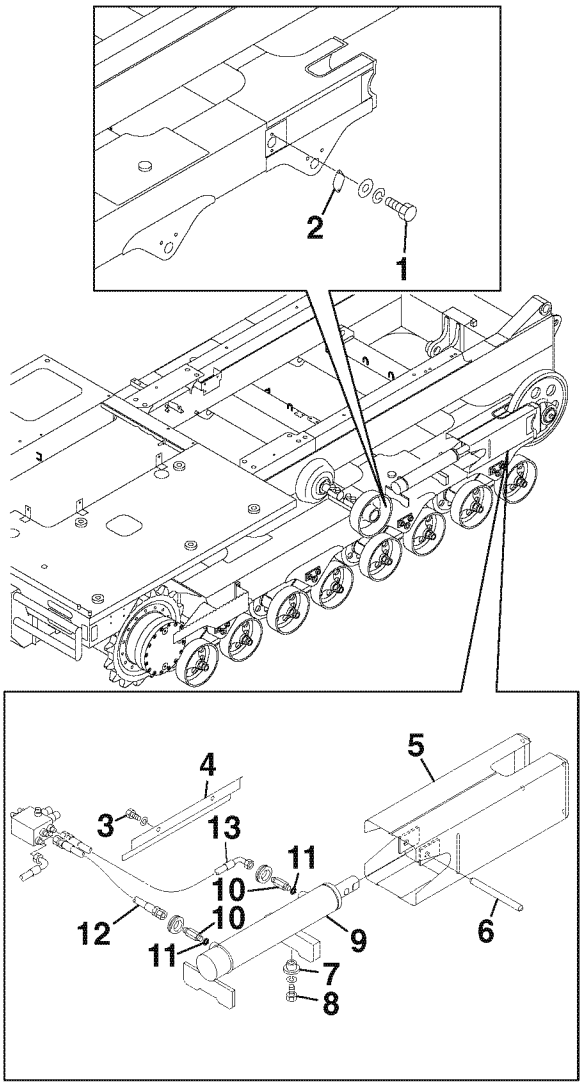
(6) Remove the high pressure hose (12), the medium-pressure hose (13), the hose adapter (10), and the O-ring (11) from the shoe tensioning cylinder (9).

(7) Remove the bolt (8) and the boss (7) from the shoe tensioning cylinder (9).

(8) Remove the shoe tensioning cylinder (9) from the lower frame.

2) Assembly

For reassembling, follow the disassembling procedures in reverse order.



S3G371

No.	Part
1	Bolt M8 × 14
2	Cover
3	Bolt M10 × 14
4	Cover
5	Idler fork
6	Pin
7	Boss
8	Bolt M14 × 40
9	Cylinder L
10	Hose adapter
11	O-ring
12	High pressure hose
13	Intermediate pressure hose

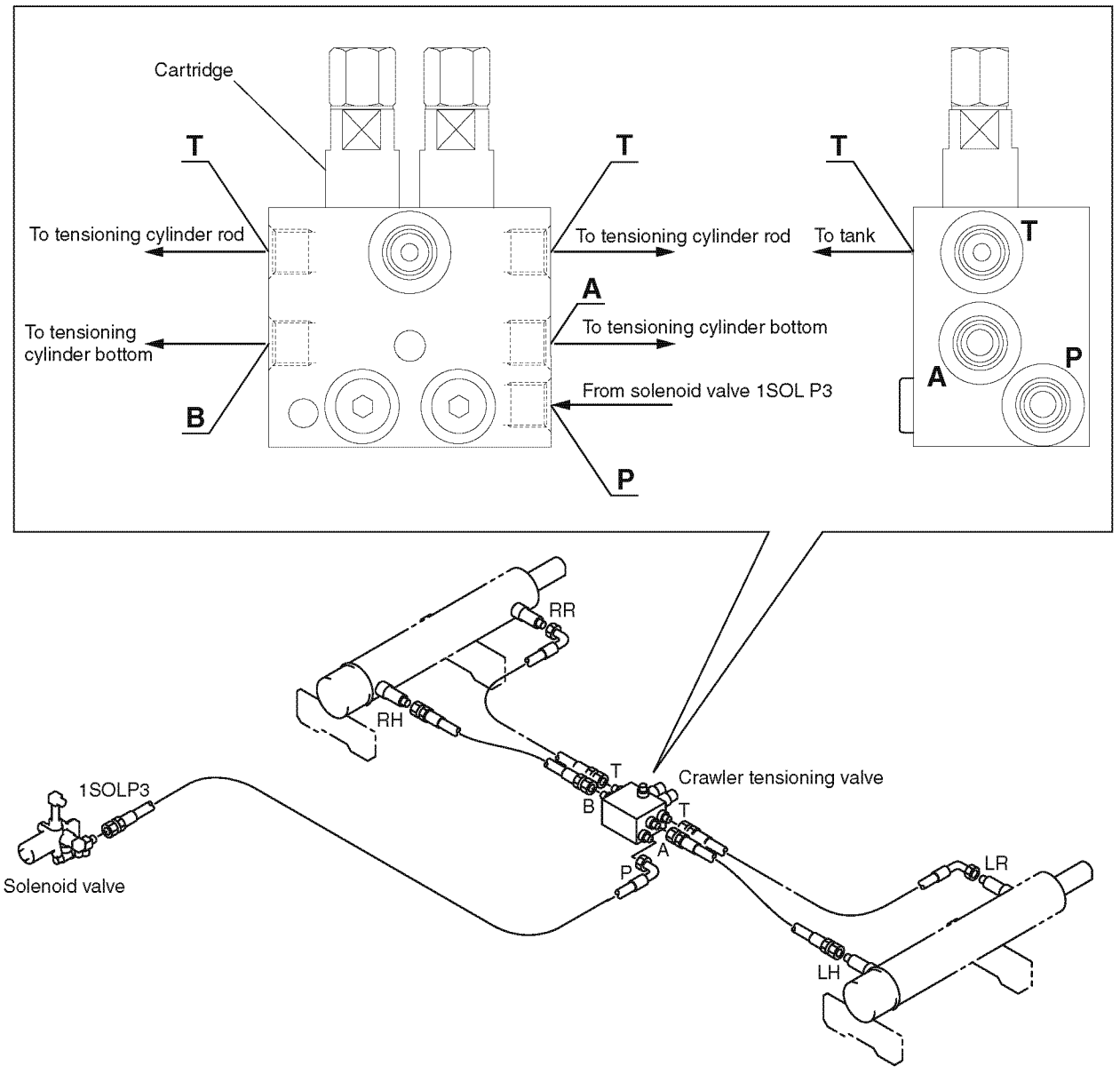
3) Adjusting the shoe tension at the crawler tensioning valve section

Loosening

(1) Loosen the cartridge of the relief valve. (When the valve is entirely loosened, the pressure is released.)
(2) Exchange the T port piping with the B port piping.
(3) Tighten the cartridge of the relief valve.
(4) Start the engine. Then the idler is actuated and loosens the shoe.

Tensioning

(1) Loosen the cartridge of the relief valve. (Release the pressure.)
(2) Exchange the T port piping with the B port piping. (Restore the original piping.)
(3) Tighten the cartridge of the relief valve.
(4) Start the engine. Then the idler is actuated and tensions the shoe.



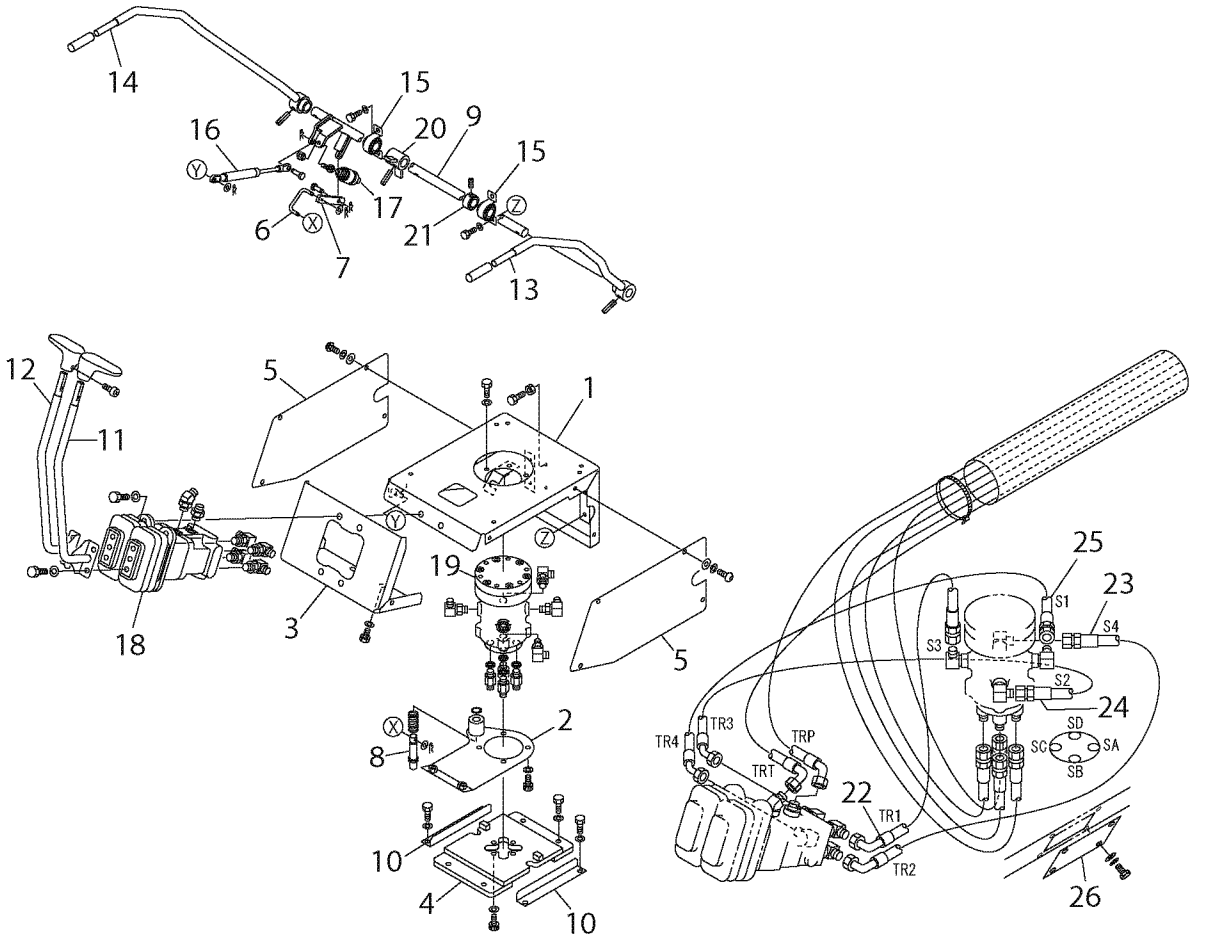
7-4. Control System

7-4-1. Travel Lever and Lock Lever

- The travel lever controls the forward and backward travels, spinning, and pivot turning. It can also control the travel speed by adjusting the movement of the lever.

The travel lever turns together with the operator's seat, enabling it to keep facing straight ahead in the travel direction. At this time, the selector valve does not block the oil from the remote control valve that is connected with the travel lever, permitting the HST pump to be controlled.

1) Configuration

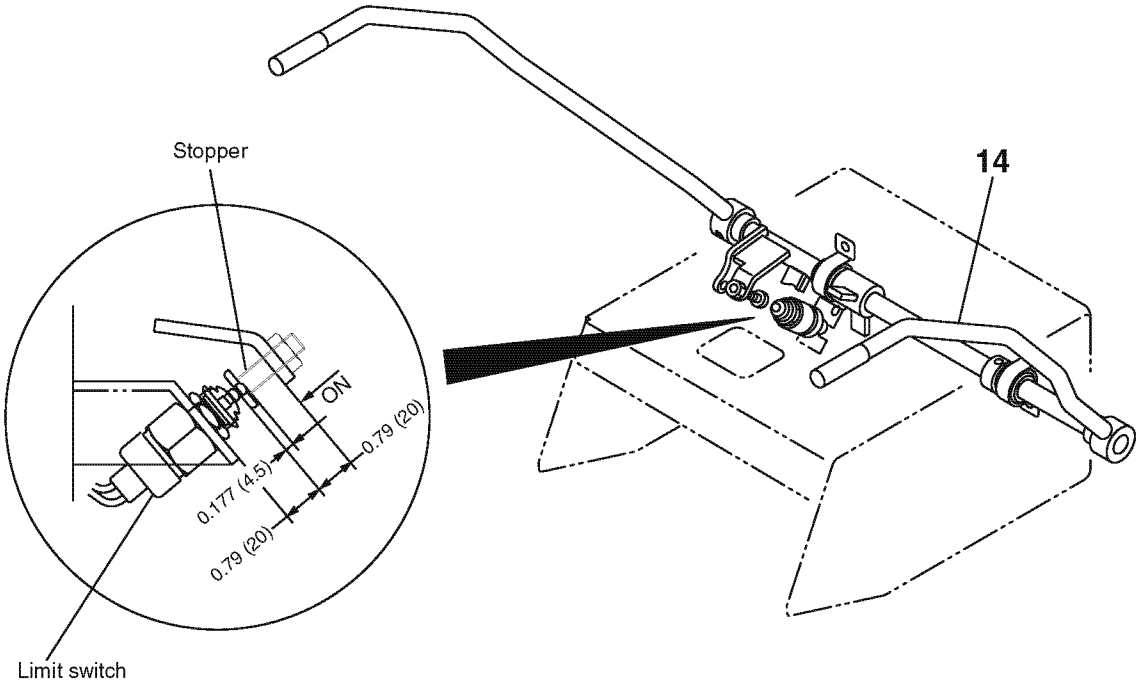


S6G400

No.	Part	No.	Part	No.	Part
1	Seat mount	10	Cover	19	Selector valve
2	Plate	11	Travel lever L	20	Stopper
3	Valve mount	12	Travel lever R	21	Stopper
4	Plate	13	Lever L	22	Intermediate pressure hose
5	Cover	14	Lever R	23	Intermediate pressure hose
6	Round bar	15	Mini-pillow	24	Intermediate pressure hose
7	Link	16	Gas spring	25	Intermediate pressure hose
8	Lock pin	17	Limit switch	26	Plate
9	Shaft	18	Remote control valve		

2) Adjusting the limit switch

The stroke of the limit switch is 0.31 in. (8 mm). The limit switch turns on at 0.12 in. (3 mm). Adjust the limit switch by inserting it by 0.18 in. (4.5 mm).

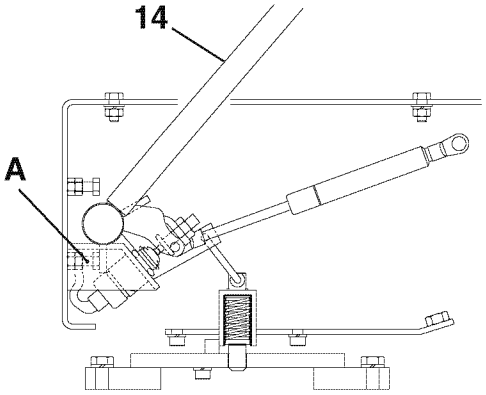


S3G412E

3) Adjusting the lock lever (seat reverse lever)

When turning the lock lever forward:

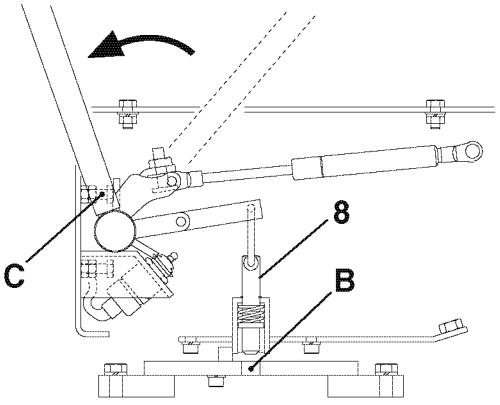
Turn the bolt (A) until the lock lever (14) handle becomes level.



S3G413

When turning the lock lever fully backward (when turning the seat in the reverse direction):

Turn the bolt (C) until the pin (8) is removed from the lock hole (B), turning the seat in the reverse direction.

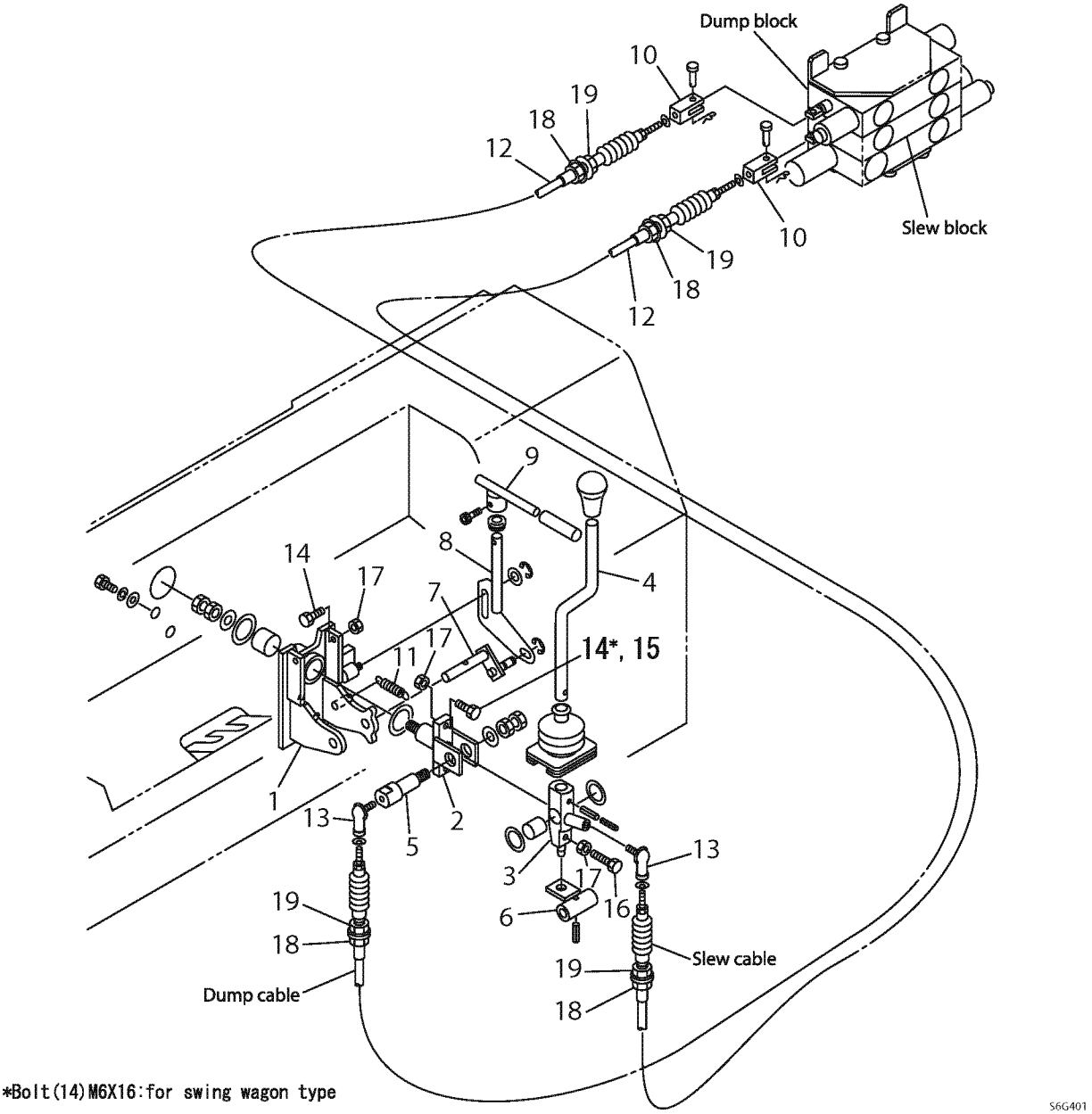


S3G414

7-4-2. Dump Lever

1) Configuration

Move the dump lever forward or backward to raise or lower the bed, respectively. With the swing wagon type models, the lever moves right or left to swing the bed.

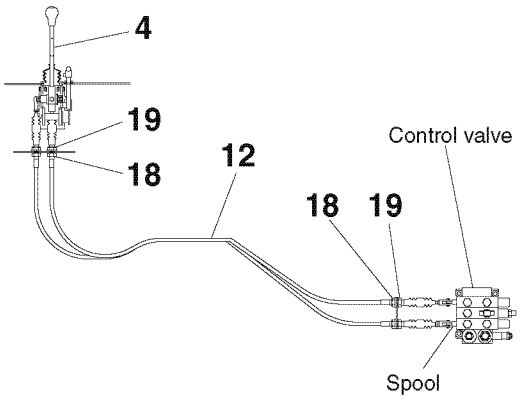


No.	Part	No.	Part	No.	Part
1	Bracket	8	Lock lever	15	Bolt M6 × 25
2	Arm	9	Handle	16	Bolt M6 × 35
3	Lever	10	Yoke	17	Nut
4	Dump lever	11	Spring	18	Nut
5	Lever shaft	12	Control cable	19	Nut
6	Lock arm	13	Rod end		
7	Lock arm pin	14	Bolt M6 × 16		

2) Adjusting the dump lever

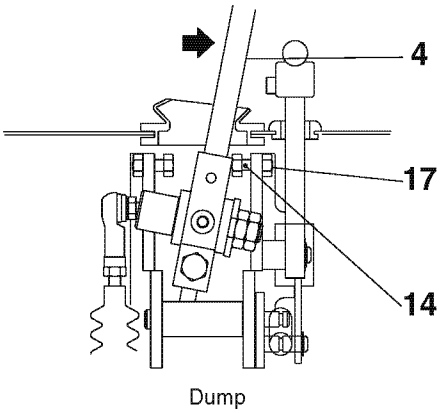
(1) Position the spool of the control valve at the "Neutral" position.

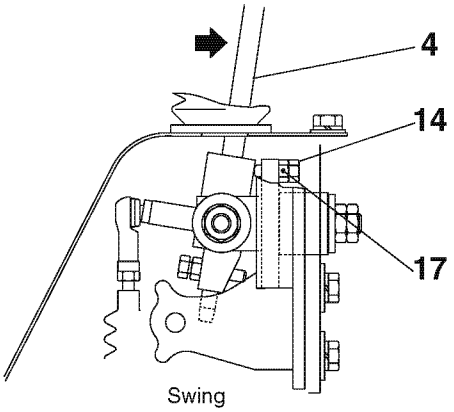
(2) Turn the nut (18) to position the dump lever (4) at the center of the stroke, and secure the control cable (12) with the nut (19).



S3G422E

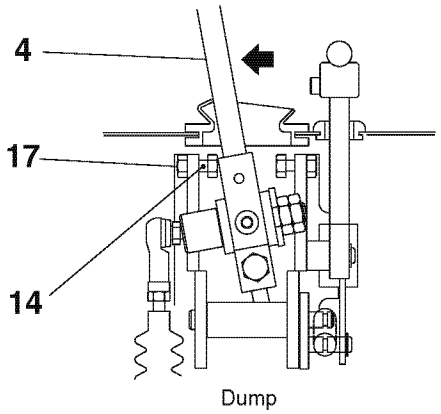
(3) Turn the dump lever (4) in the direction of the arrow (pushing side) till the stroke end of the lever, and secure it with the nut (17) so that the tip of the bolt (14) contacts the lever.

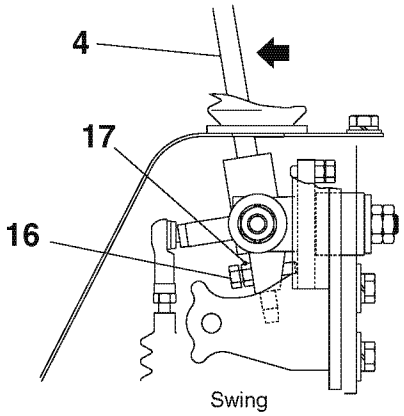




S3G423E

(4) Turn the dump lever (4) in the direction of the arrow (pulling side) till the stroke end of the lever, and secure it with the nut (17) so that the tip of the bolt (14) (dump) or (16) (swing) contacts the lever.





S3G424E

7-5. Hydraulic System

7-5-1. HST Pumping Section

The HST pump is coupled with and driven via the coupling, having a shock absorber, attached to the engine housing.

⚠ WARNING

- **Be sure to do the replacement work on level ground.**
- **Be sure to install the wagon stopper to hold the wagon when inspecting or servicing the machine with the wagon in the dump position.**
- **The oil temperature is very high immediately after the machine stops operating. Be sure to do the work after the oil temperature lowers sufficiently.**
- **When removing the hydraulic hose, oil may spout out due to the high internal pressure. Loosen the hydraulic hose slowly to prevent high pressure oil from contacting your eyes or skin.**

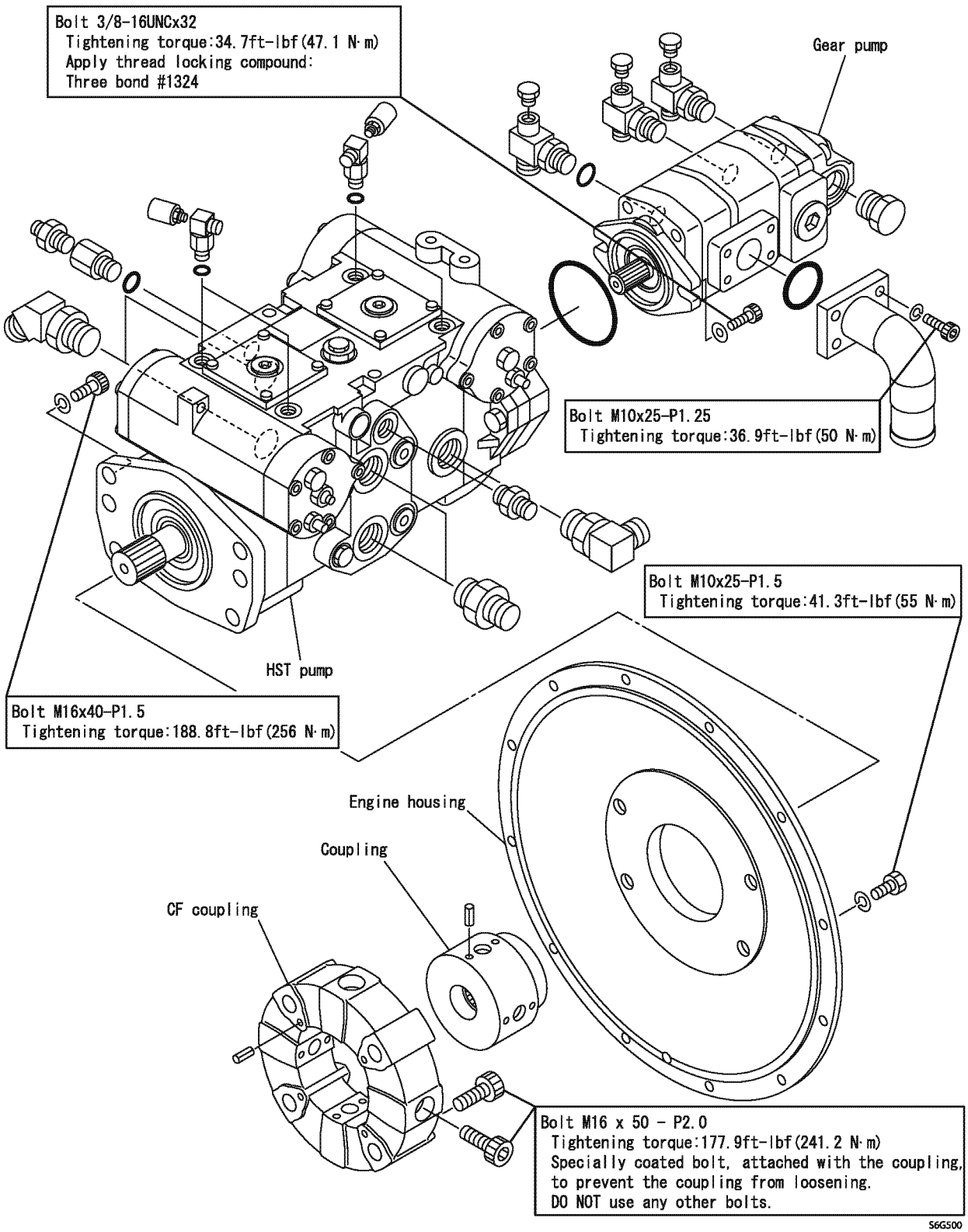
1. Precautions in assembly.

(1) Insert the spring pin into the coupling.
(2) Apply the locking agent: Three Bond (Three Bond #1324 or its equivalent) over the installation bolt of the CF coupling.
(3) Tighten the CF coupling uniformly when installing on the coupling or flange so that the CF coupling does not skew (make sure the centers meet).
(4) Tighten the engine housing uniformly.
(5) Install the HST pump on the engine housing.

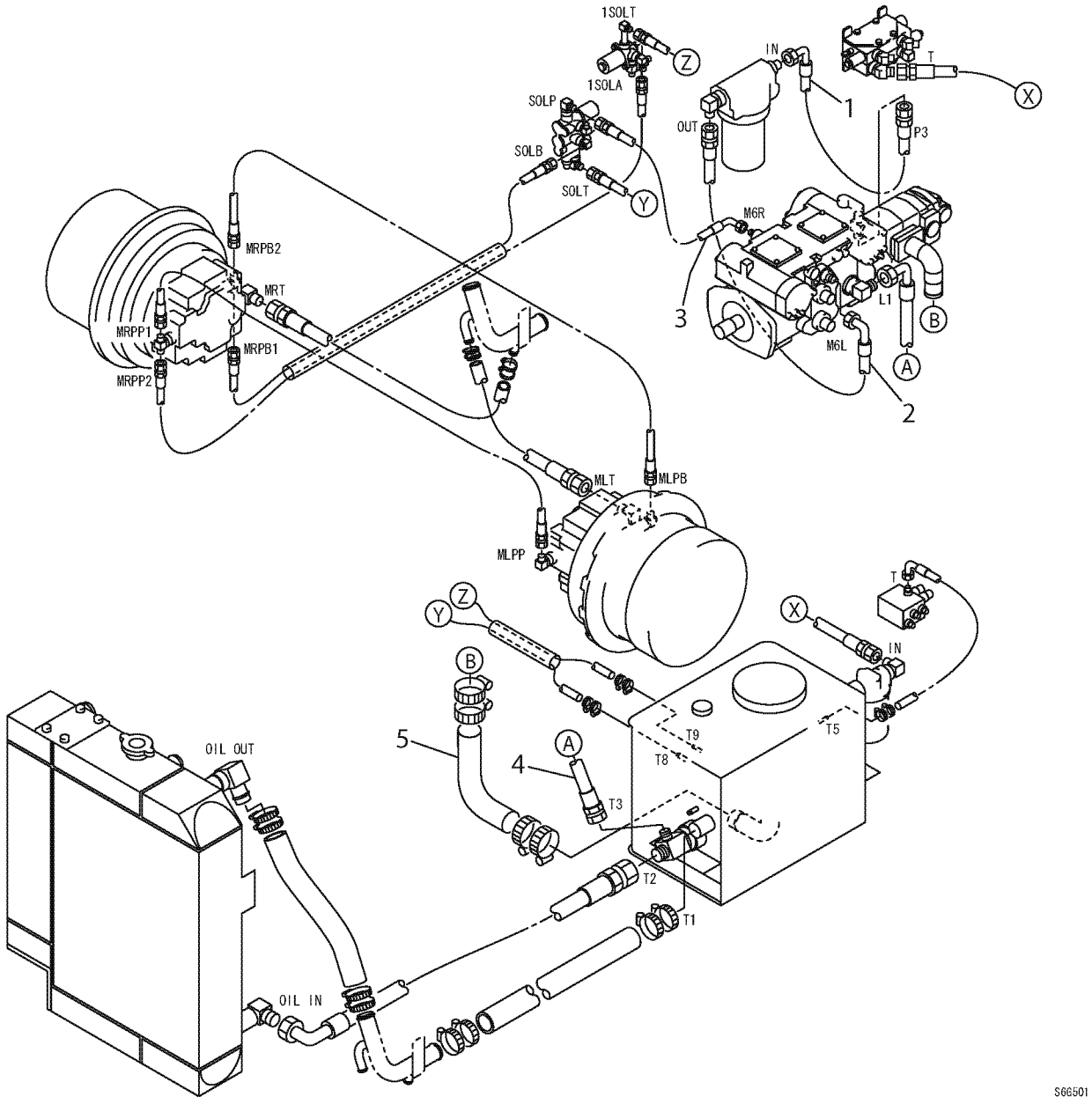
Note:

- *Apply molybdenum disulfide grease (General AD-2) over the shaft of the HST pump.*
- *Make sure the center of the coupling and that of the HST pump shaft meet when installing on the engine housing in a row.*

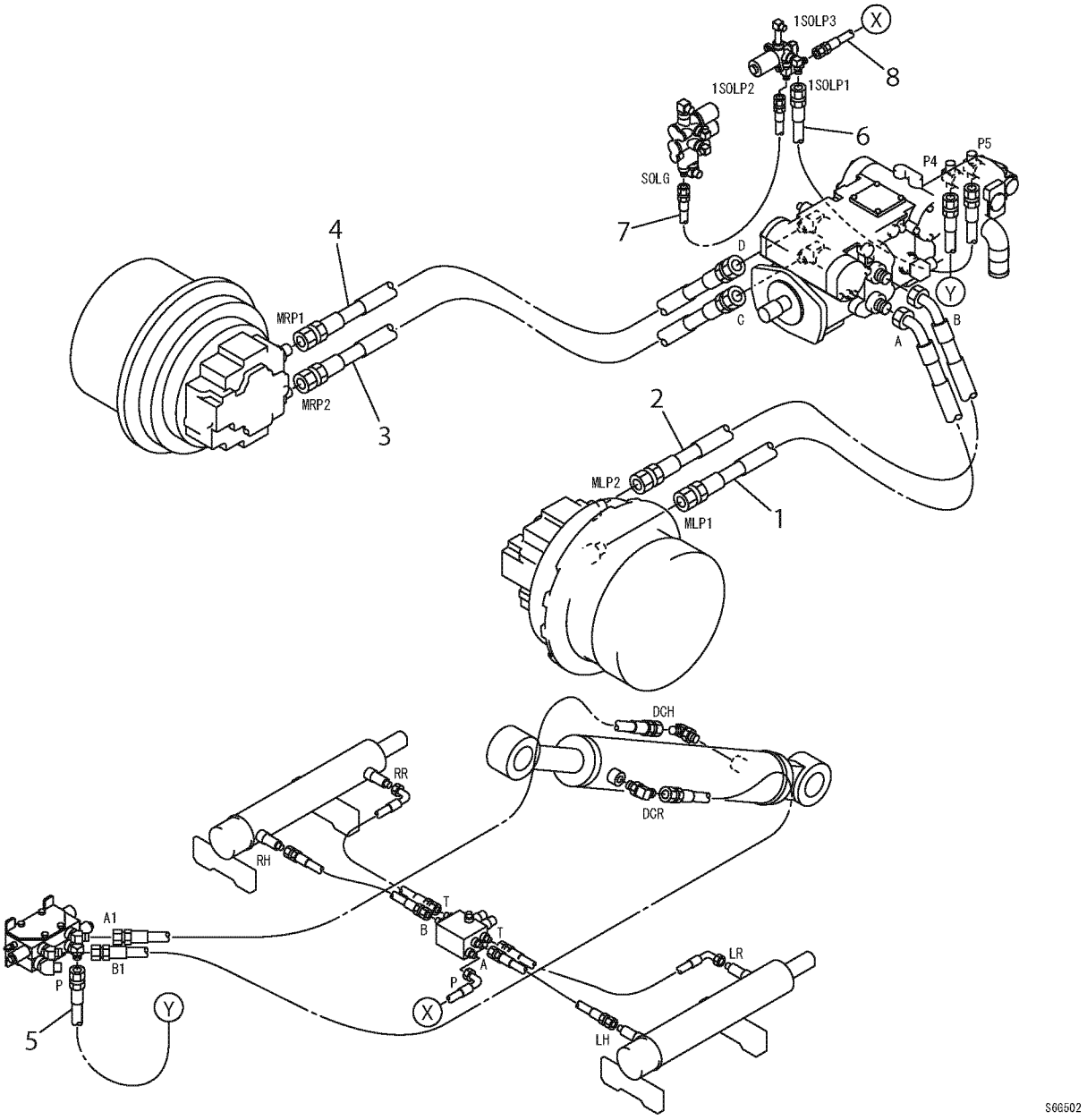
(6) Replace all the O-rings with new ones.
(7) Clean the joints using an air blower before installing them.


Bolt 3/8-16UNCx32
Tightening torque:34.7ft-lbf(47.1 N·m)
Apply thread locking compound:
Three bond #1324
Gear pump
Bolt M10x25-P1.25
Tightening torque:36.9ft-lbf(50 N·m)
Bolt M10x25-P1.5
Tightening torque:41.3ft-lbf(55 N·m)
HST pump
Bolt M16x40-P1.5
Tightening torque:188.8ft-lbf(256 N·m)
Engine housing
Coupling
CF coupling
Bolt M16 x 50 - P2.0
Tightening torque:177.9ft-lbf(241.2 N·m)
Specially coated bolt, attached with the coupling,
to prevent the coupling from loosening.
DO NOT use any other bolts.
S6G500

Hydraulic piping



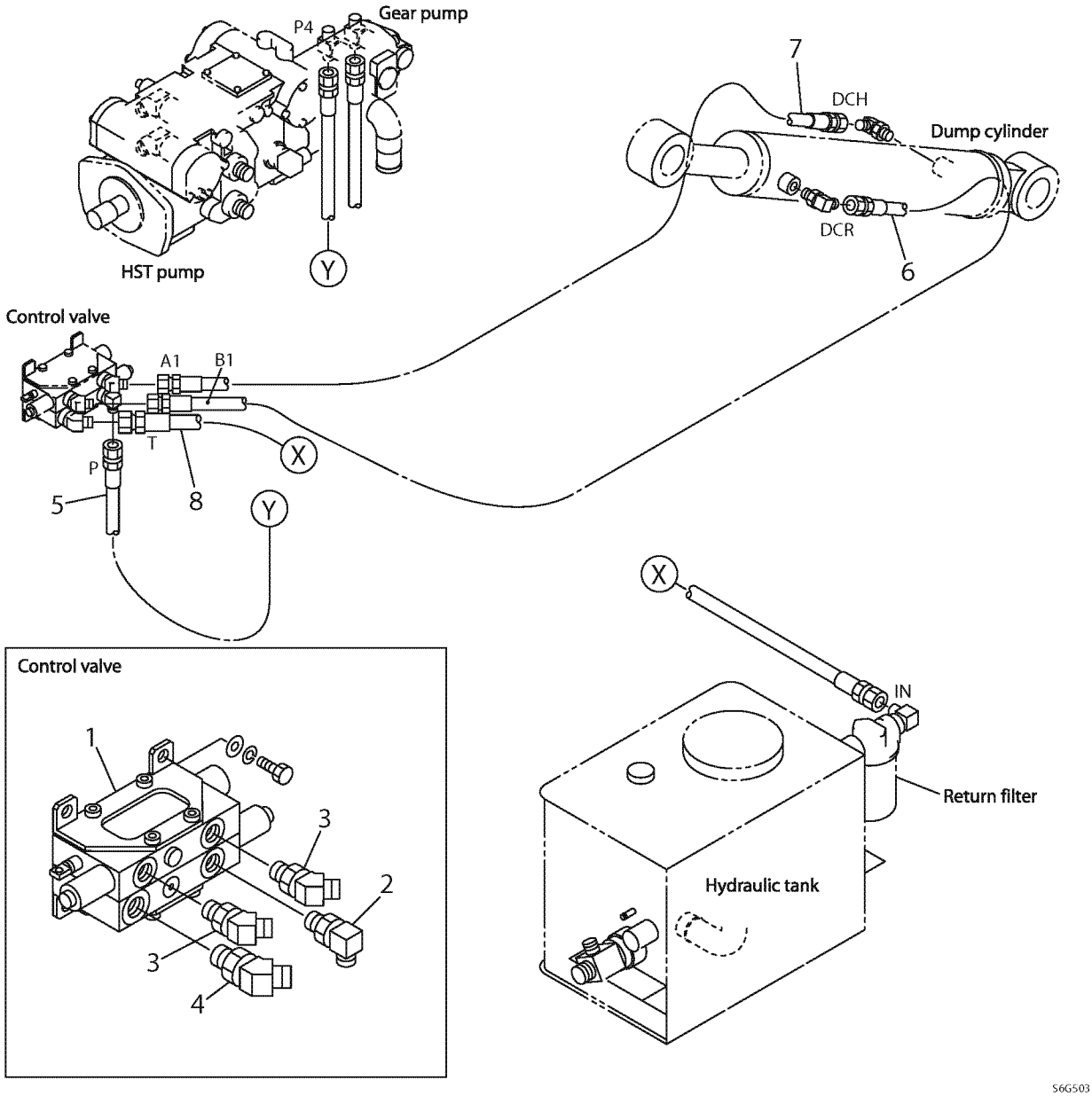
No.	Part
1	Intermediate pressure hose
2	Intermediate pressure hose
3	Intermediate pressure hose
4	Intermediate pressure hose
5	Suction hose



No.	Part	No.	Part
1	High pressure hose	5	High pressure hose
2	High pressure hose	6	Intermediate pressure hose
3	High pressure hose	7	Intermediate pressure hose
4	High pressure hose	8	Intermediate pressure hose

7-5-2. Control Valves

Control valves are used to control the direction, pressure and flow rate in the hydraulic circuits so that the hydraulic system operates as intended. They are largely classified into three types according to their functions: direction control valves, pressure control valves, and flow rate control valves.



No.	Part	No.	Part
1	Control valve	6	High pressure hose
2	90 deg. elbow	7	High pressure hose
3	Adapter union	8	Intermediate pressure hose
4	Hose adapter		
5	High pressure hose		

7-5-3. Disassembly and Assembly the Dump Cylinder

⚠ WARNING

- **Be sure to do the replacement work on level ground.**
- **Be sure to install the wagon stopper to hold the wagon when inspecting or servicing the machine with the wagon in the dump position.**
- **The oil temperature is very high immediately after the machine stops operating. Be sure to do the work after the oil temperature lowers sufficiently.**
- **When removing the hydraulic hose, oil may spout out due to the high internal pressure. Loosen the hydraulic hose slowly to prevent high pressure oil from contacting your eyes or skin.**

Disassembly

(1) Keep the vehicle level, raise the wagon, lock the dump lever, and stop the engine.

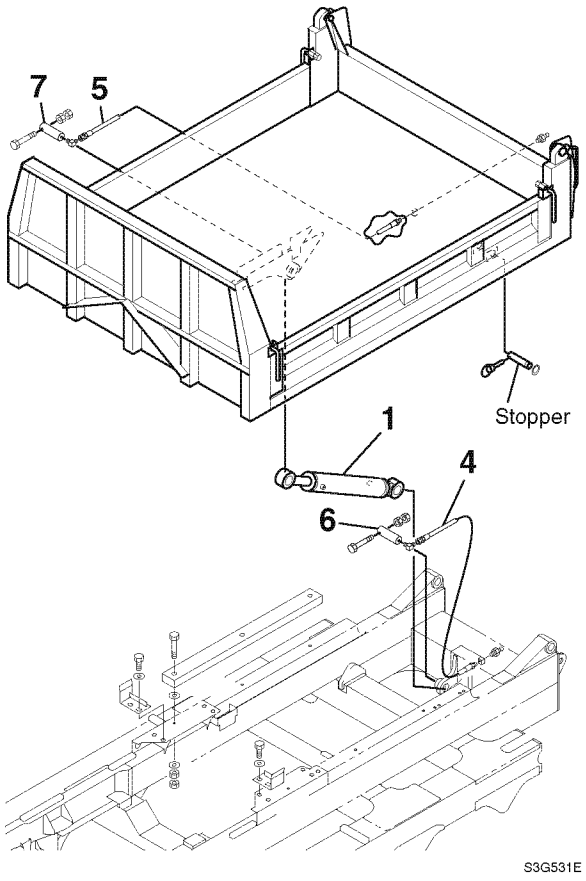
(2) Install the wagon stoppers, and further support the wagon with stands or other additional supports.

(3) Remove the hydraulic hoses (2 and 3), and grease pipings (4 and 5) from the dump cylinder (1).

(4) Suspend the dump cylinder (1), pull out the pins (6 and 7), and remove the dump cylinder (1).

Assembly

Follow the disassembling procedures in the reverse order.



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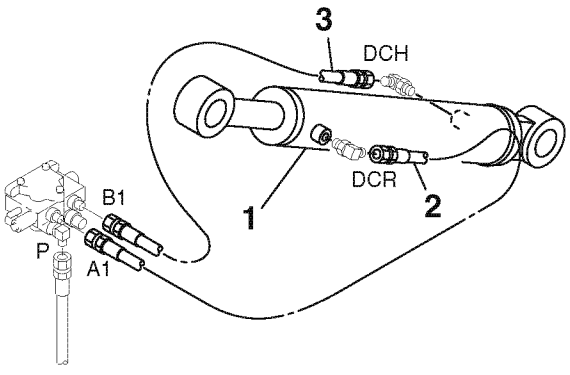


S3G532

No.	Part
1	Cylinder
2	High pressure hose
3	High pressure hose
4	Hose
5	Hose
6	Pin
7	Pin

7-5-4. Hydraulic Oil Tank

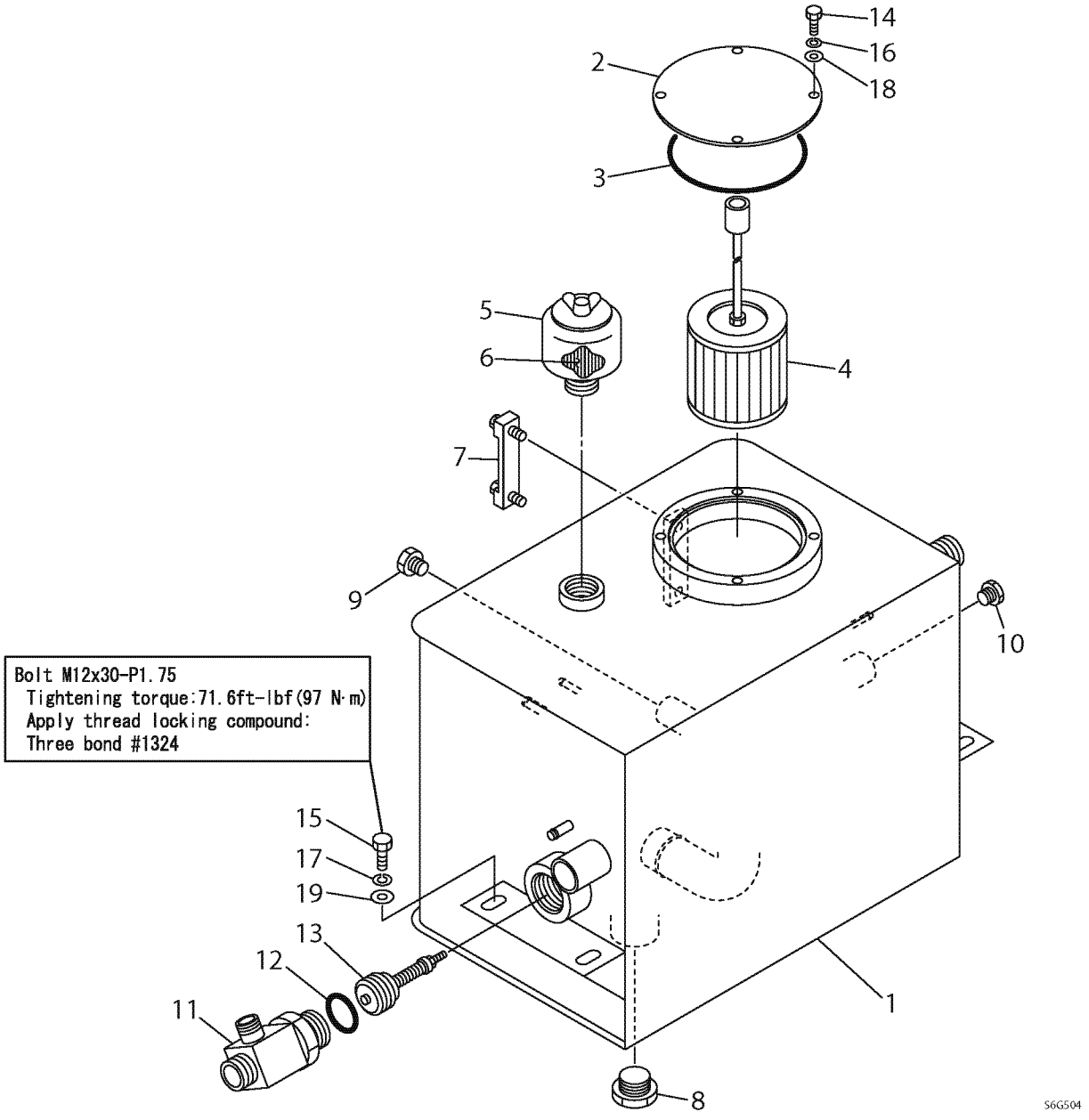
The hydraulic oil tank stores cooled clean hydraulic oil ready for supply whenever required. The tank also serves to settle foreign matter and bubbles in the oil.

1) Filter

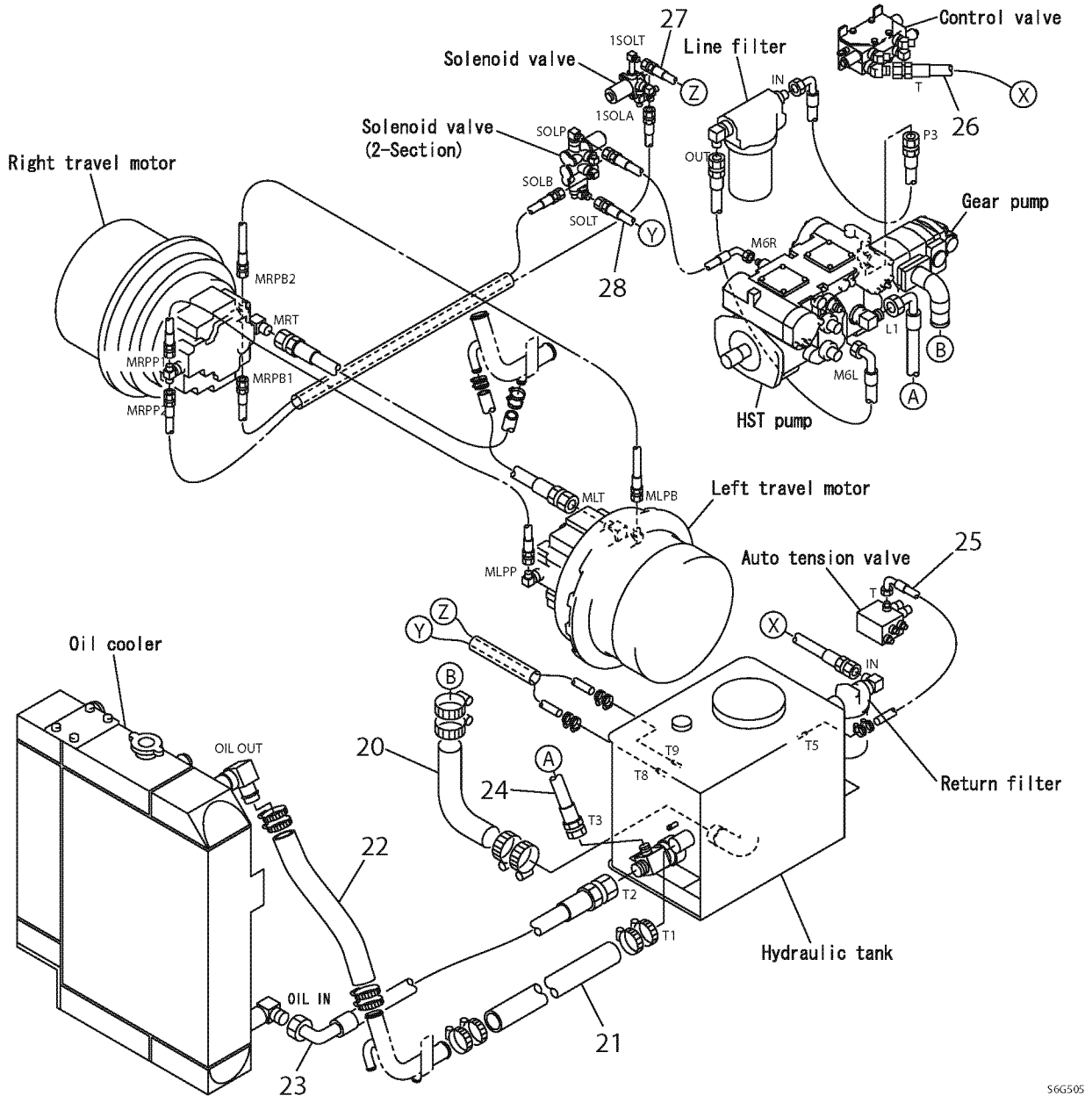
The filter removes foreign matter from the hydraulic oil in the circuit to supply clean oil to individual components to protect them and ensure their normal operations.

(1) Suction strainer
The suction strainer is attached to the piping on the intake side in the tank to prevent the pump from sucking up foreign matter in the hydraulic oil.

(2) Line filter
The line filter is provided in series with the charge circuit, and cleans the hydraulic oil to be supplied to the travel circuit (HST).



Hydraulic piping



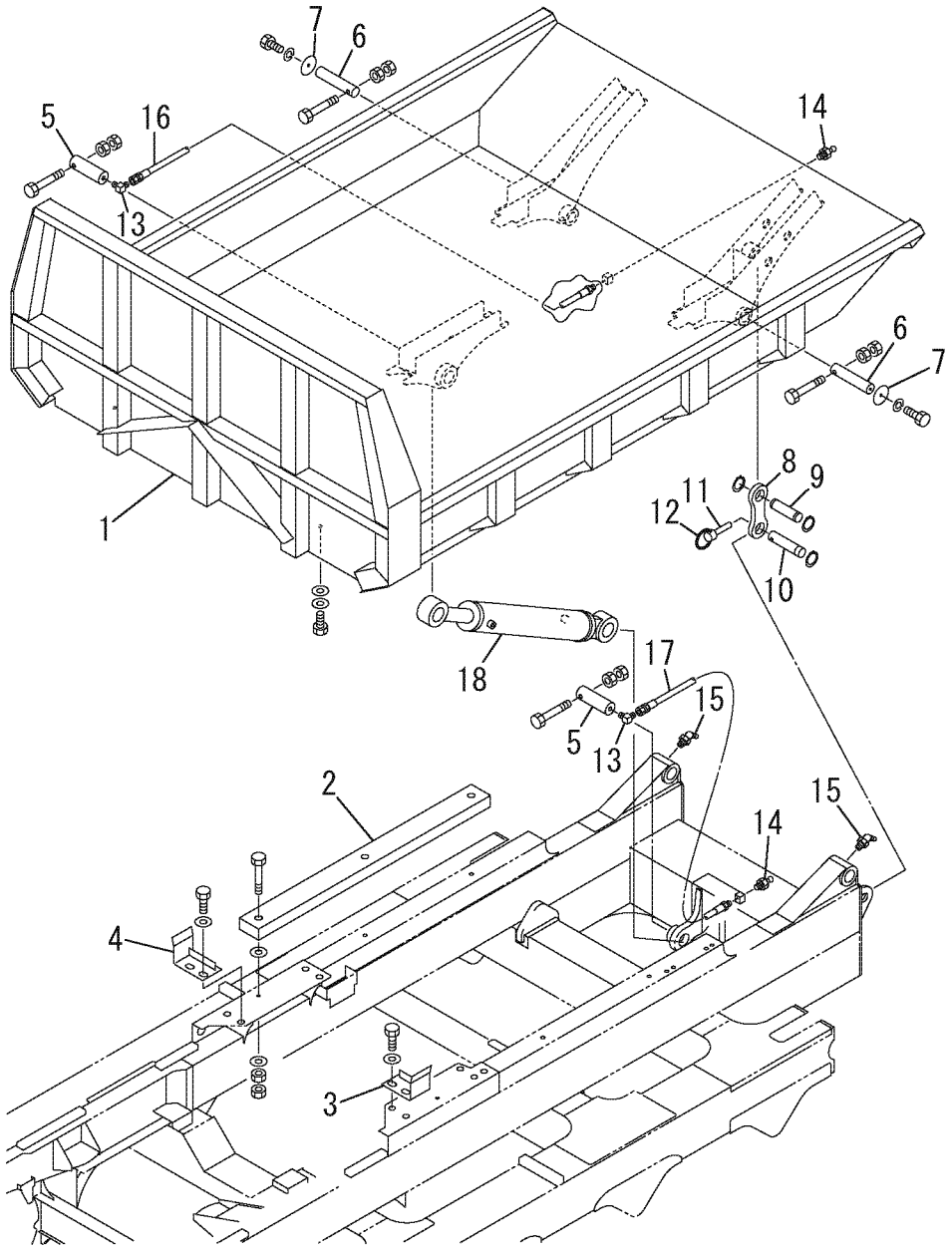
No.	Part	No.	Part	No.	Part
1	Hydraulic oil tank	11	Tee	21	Low pressure hose
2	Cover	12	O-ring	22	Low pressure hose
3	O-ring	13	Check valve	23	Intermediate pressure hose
4	Suction strainer	14	Bolt	24	Intermediate pressure hose
5	Air breather	15	Bolt	25	Intermediate pressure hose
6	Air breather filter	16	Spring washer	26	Intermediate pressure hose
7	Oil level gauge	17	Spring washer	27	Intermediate pressure hose
8	Plug	18	Plain washer	28	Intermediate pressure hose
9	Plug	19	Plain washer		
10	Plug	20	Suction hose		

7-6. Riggings

7-6-1. Wagon

This is a container used to continuously carry ores, coal, earth and sand, and gravel, and unload them by slanting itself.

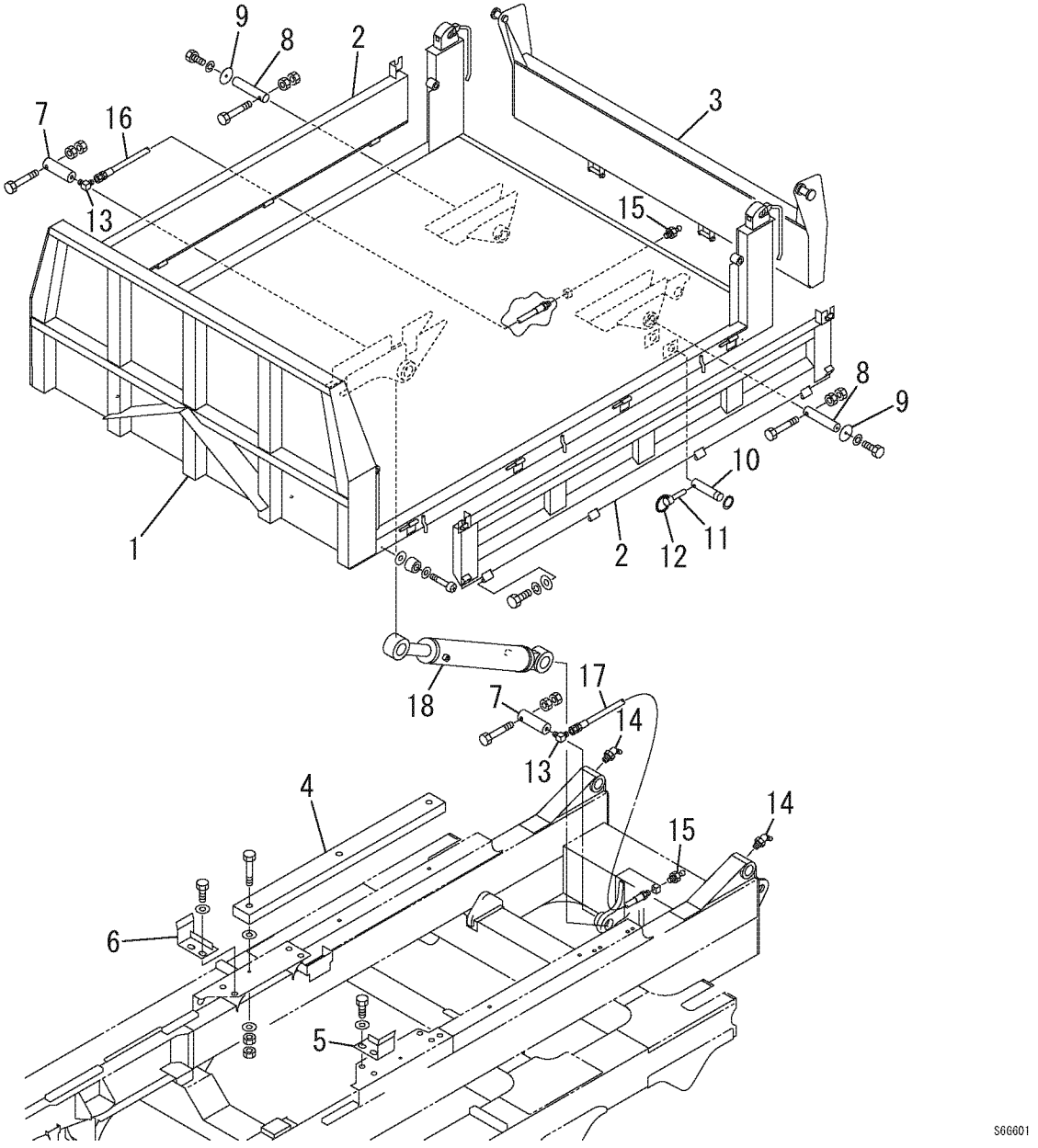
1. Scoop-end wagon



S6G600

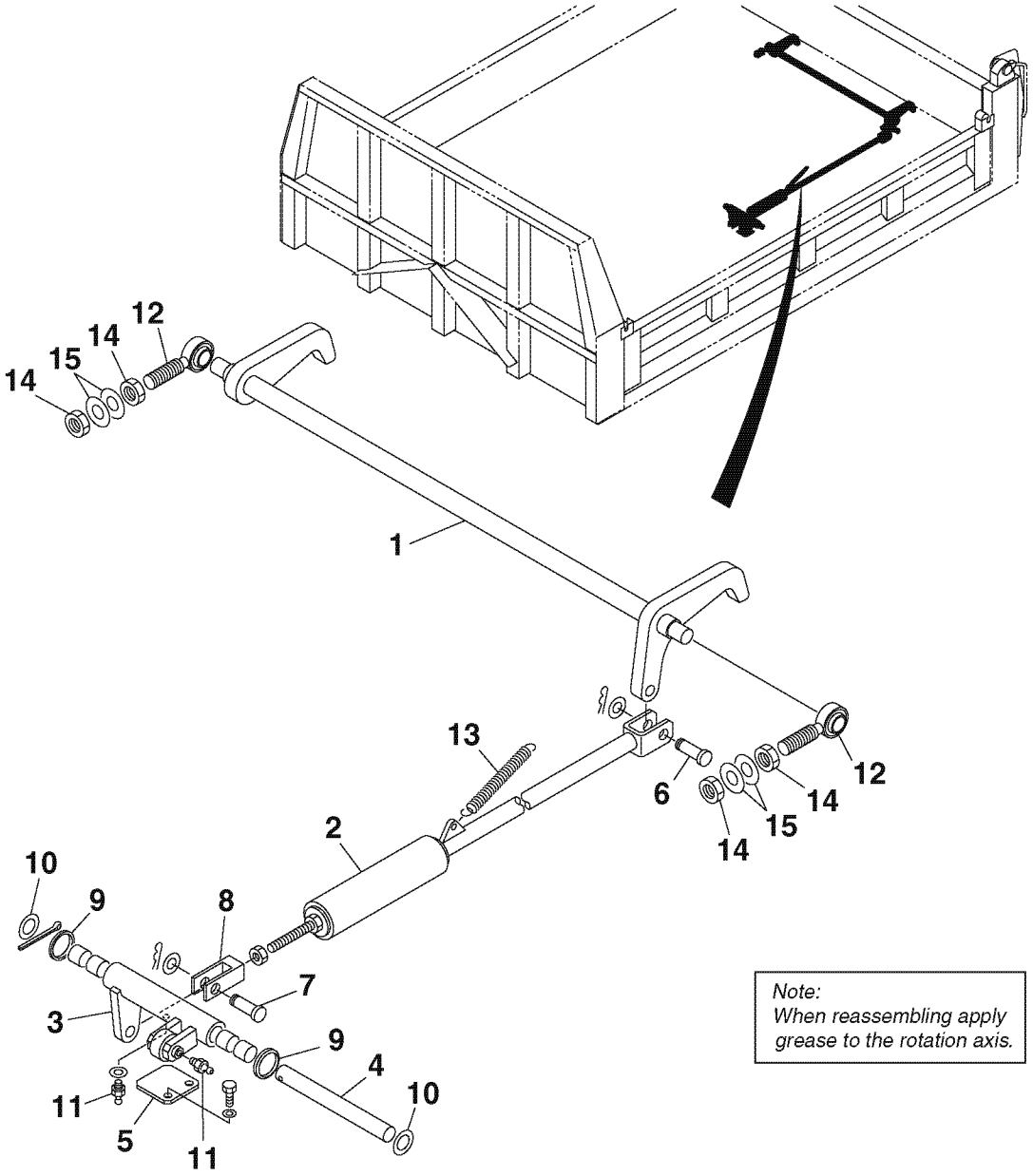
No.	Part	No.	Part	No.	Part
1	Scoop-end wagon	7	Plate	13	Hose adapter
2	Cushion	8	Plate	14	Grease nipple
3	Wagon lock L	9	Pin	15	Grease nipple
4	Wagon lock R	10	Pin	16	Hose
5	Pin	11	Pin	17	Hose
6	Pin	12	Ring	18	Dump cylinder

2. 3-side flaps wagon type



No.	Part	No.	Part	No.	Part
1	Dump body	7	Pin	13	Hose adapter
2	Side gate	8	Pin	14	Grease nipple
3	Rear gate	9	Plate	15	Grease nipple
4	Cushion	10	Pin	16	Hose
5	Wagon lock L	11	Pin	17	High pressure hose
6	Wagon lock R	12	Ring	18	Dump cylinder

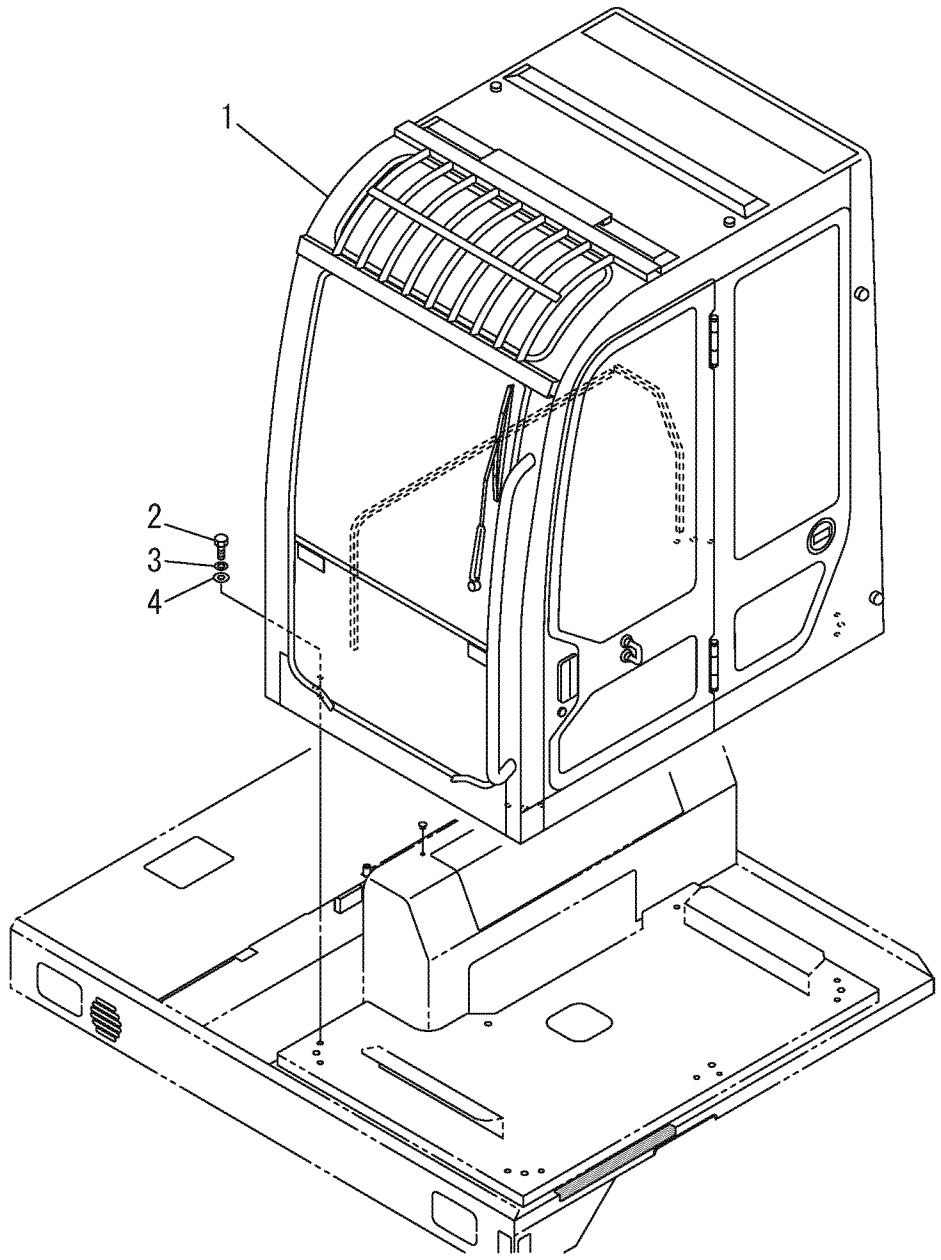
3. Rear link



S3G603E

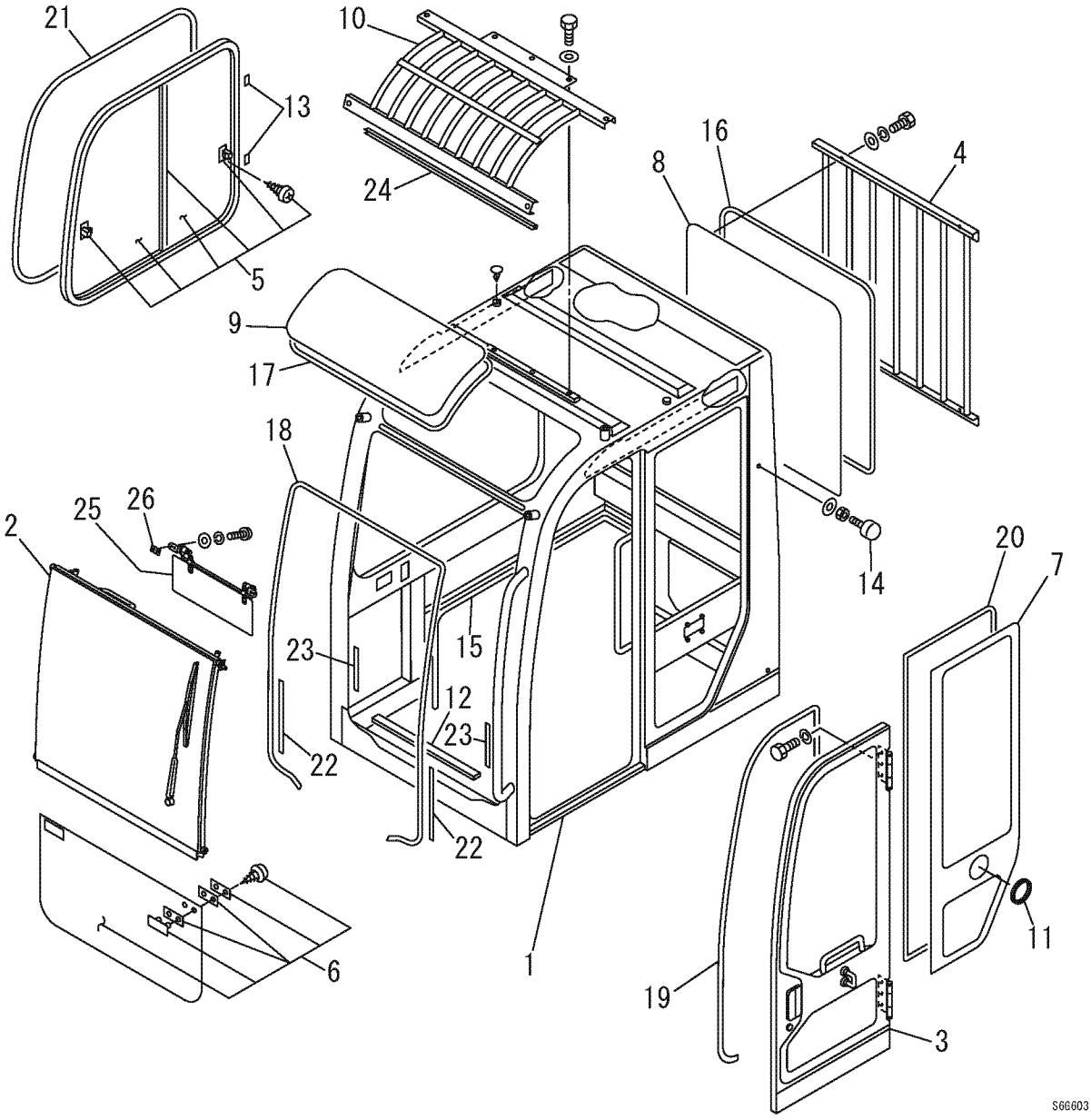
No.	Part	No.	Part	No.	Part
1	Hook lever	6	Pin	11	Grease nipple
2	Cushion spring assembly	7	Pin	12	Rod end
3	Lever	8	Yoke	13	Spring
4	Lever shaft	9	Dust seal	14	Nut
5	Plate	10	Washer	15	Plain washer

7-6-2. Cabin



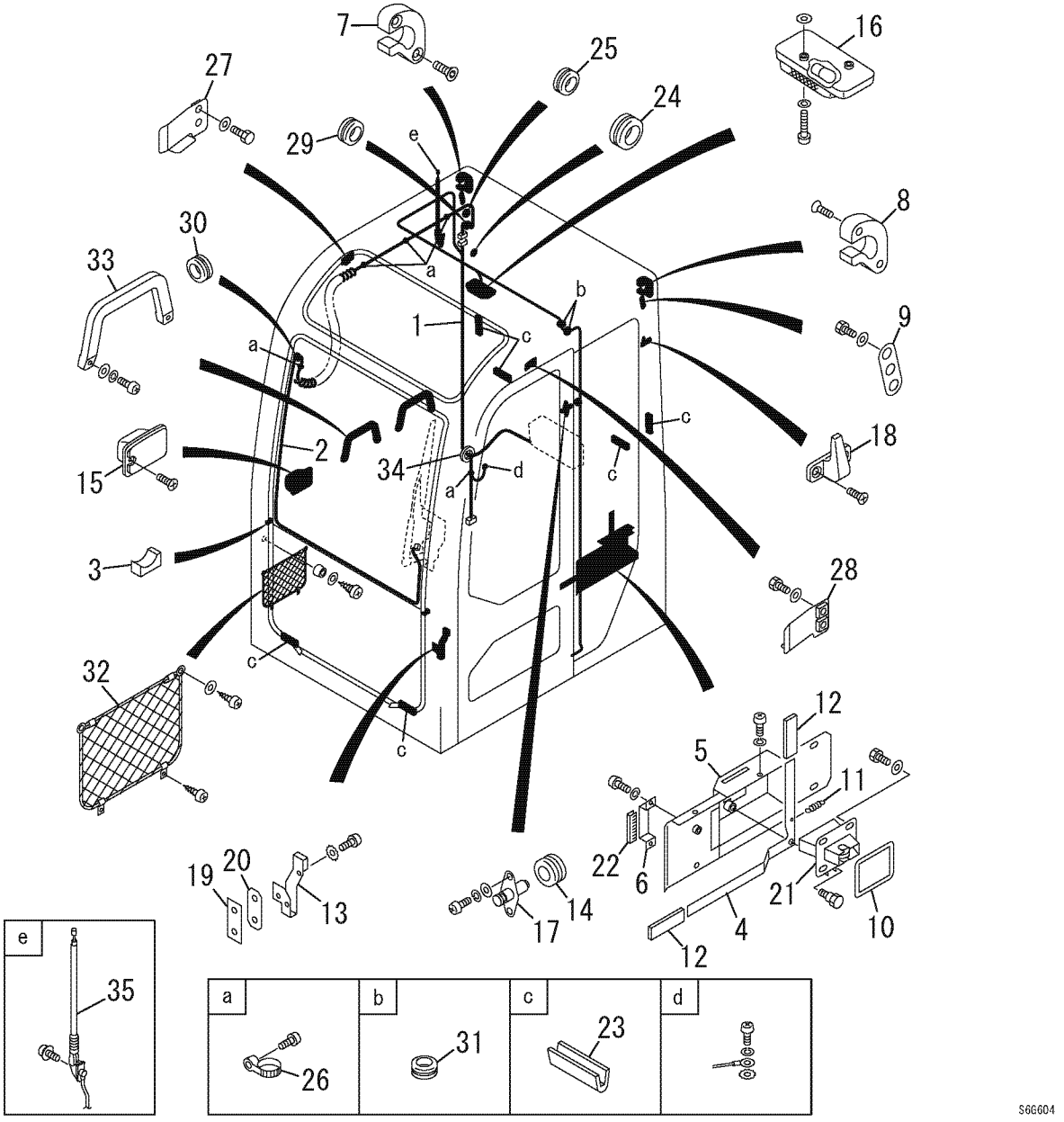
No.	Part
1	Cabin assembly
2	Bolt
3	Spring washer
4	Plain washer

Cabin (I)



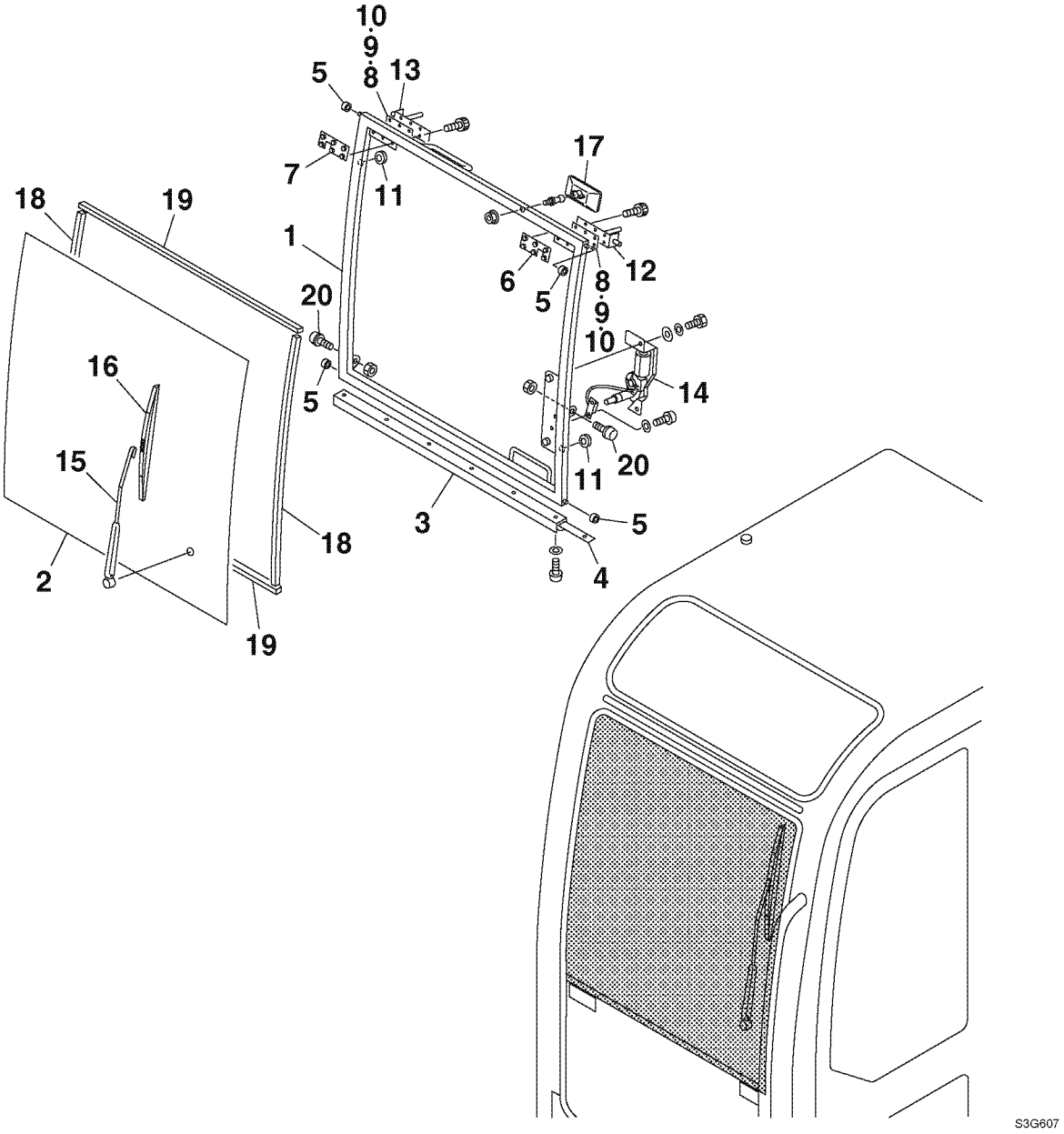
No.	Part	No.	Part	No.	Part
1	Cabin	10	Roof window guard	19	Sash rubber
2	Front sash	11	Grommet	20	Dam
3	Door assembly	12	Seal	21	Sash rubber
4	Rear guard	13	Spacer	22	Sash rubber
5	Side sash assembly	14	Rubber	23	Trim
6	Front glass assembly	15	H-rubber	24	Trim
7	Side glass	16	H-rubber	25	Sun visor assembly
8	Rear glass	17	H-rubber	26	Sheet
9	View roof	18	Sash rubber		

Cabin (II)



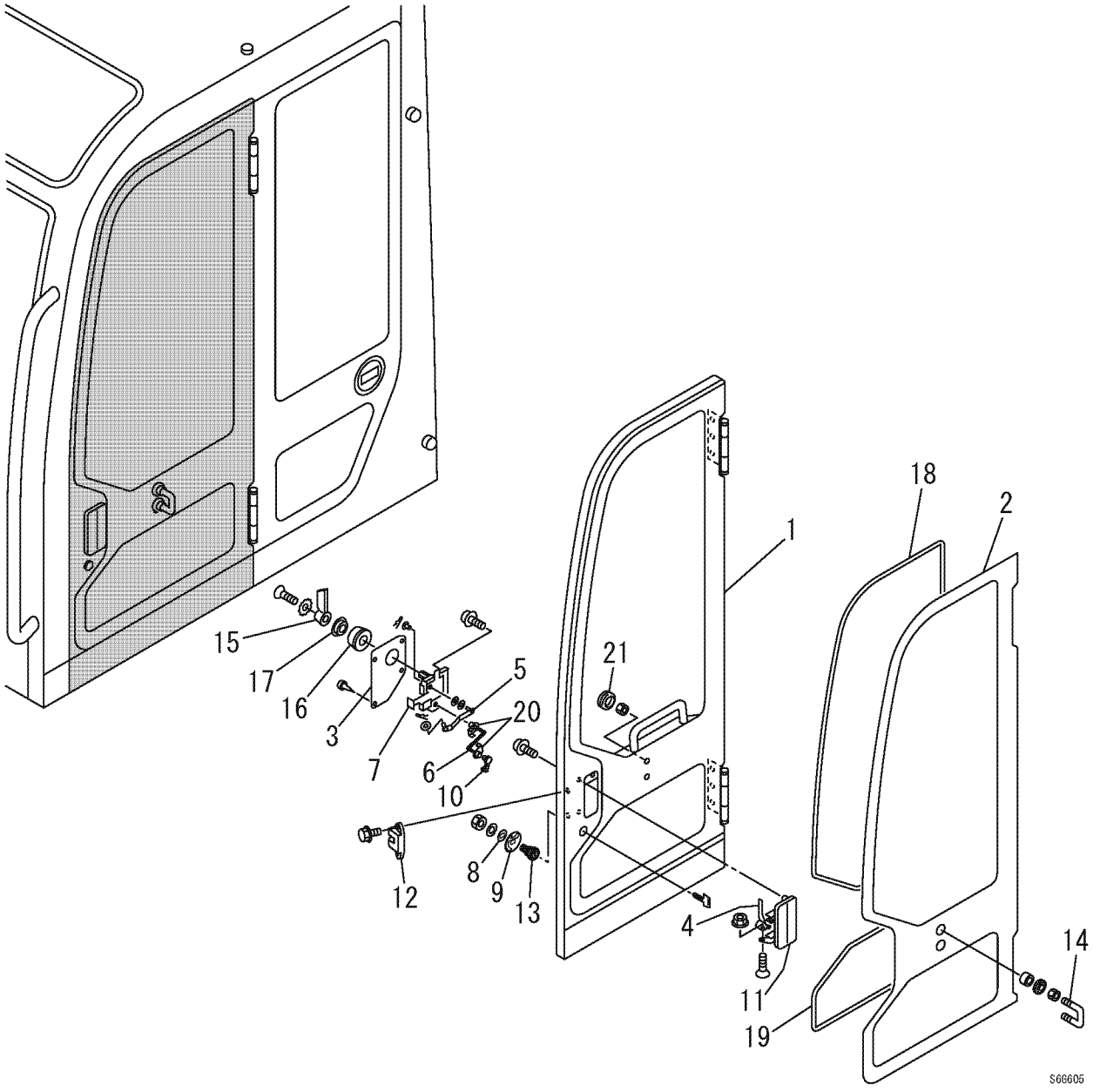
No.	Part	No.	Part	No.	Part
1	Wire harness	13	Striker	25	Grommet
2	Wire harness	14	Grommet	26	Band
3	Stopper	15	Ashtray	27	Plate R
4	Plate	16	Room lamp	28	Plate L
5	Cover	17	Switch	29	Grommet
6	Plate	18	Hunger	30	Grommet
7	Stopper R	19	Plate	31	Grommet
8	Stopper L	20	Packing	32	Pocket assembly
9	Plate	21	Lock	33	Grip
10	Seal	22	Seal trim	34	Grommet
11	Spring	23	Stopper	35	Antenna
12	Cover	24	Grommet		

Cabin (III)



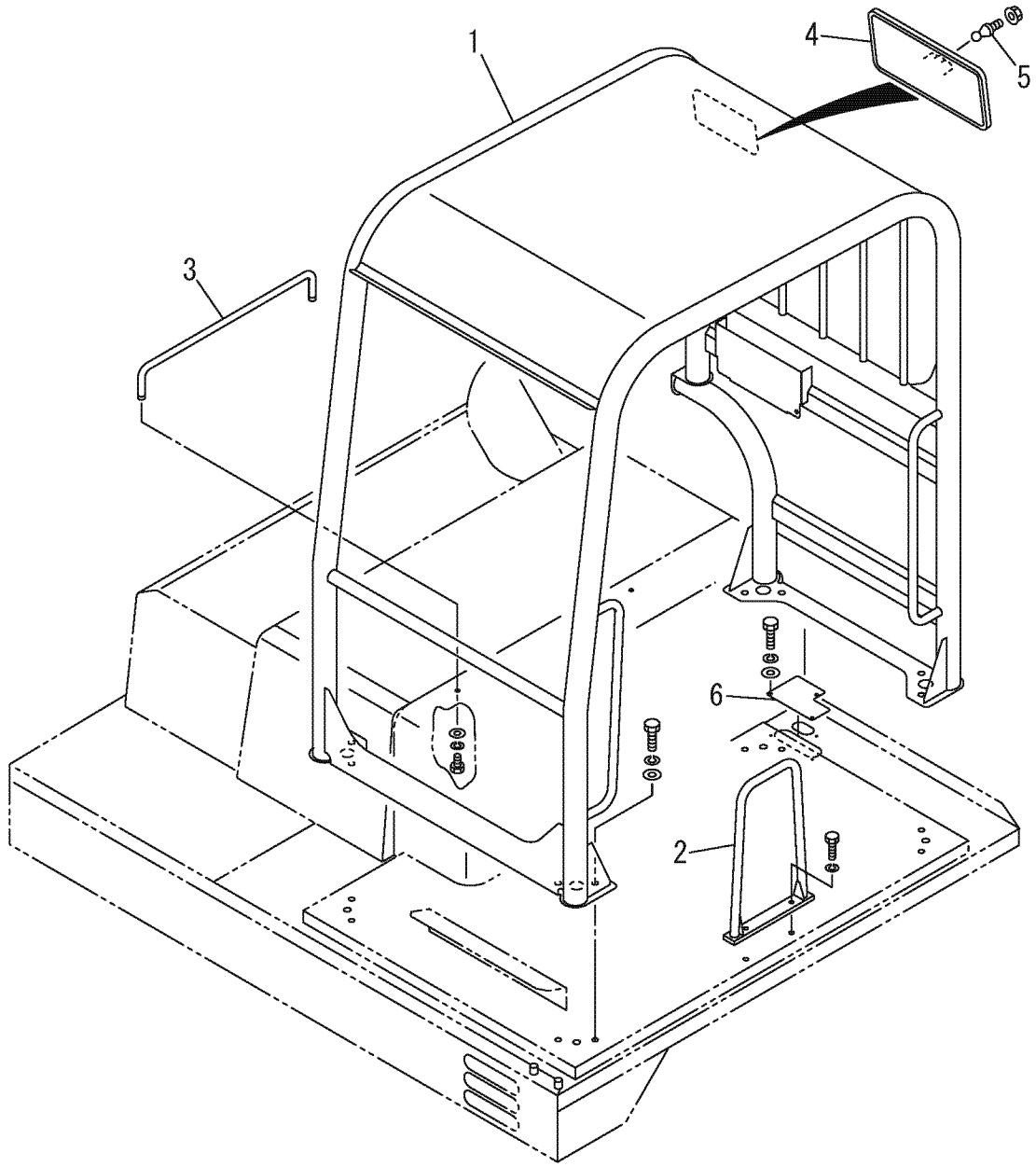
No.	Part	No.	Part	No.	Part
1	Front sash	8	Shim t=0.7 AR	15	Wiper arm
2	Glass	9	Shim t=1.2 AR	16	Blade
3	Seal	10	Shim t=1.6 AR	17	Mirror
4	Plate	11	Grommet	18	Dam
5	Roller	12	Latch L	19	Dam
6	Plate L	13	Latch R	20	Stopper
7	Plate R	14	Wiper motor		

Cabin (IV)



No.	Part	No.	Part	No.	Part
1	Door	9	Plate	17	Escutcheon
2	Glass	10	Holder	18	Dam
3	Cover	11	Handle	19	Dam
4	Plate	12	Lock	20	Snap
5	Plate	13	Key assembly	21	Grommet
6	Rod	14	Striker		
7	Control assembly	15	Handle		
8	Washer	16	Base		

7-6-3. Canopy



No.	Part
1	Canopy frame
2	Handrail
3	Hold bar
4	Room mirror
5	Pivot
6	Plate

Glass replacement procedure

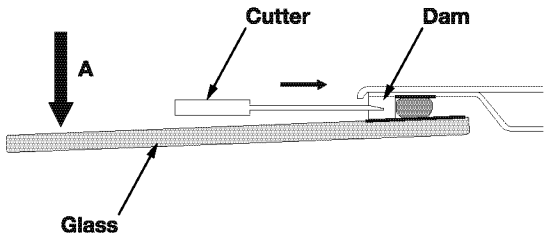
1) Removal of glass

(1) Cut off the dam and solid adhesive attached along the edge of the cabin unit opening portion.

⚠ WARNING

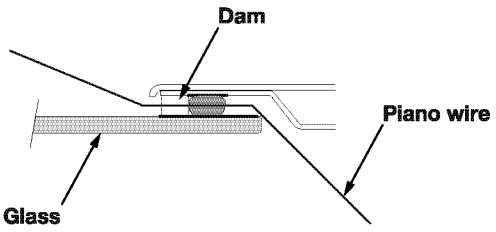
- **Care must be taken for handling the sharp tools for operation.**
- **Care must be taken for handling the damaged glass.**

(2) Insert the tool (cutter) to the desired position and cut off the dam and adhesive while pressing the glass in the direction of A.
  - Depending on the conditions such as presence and absence of obstacle and hardness of adhesion, select an appropriate tool (cutter for craft, piano wire, and special cutter).



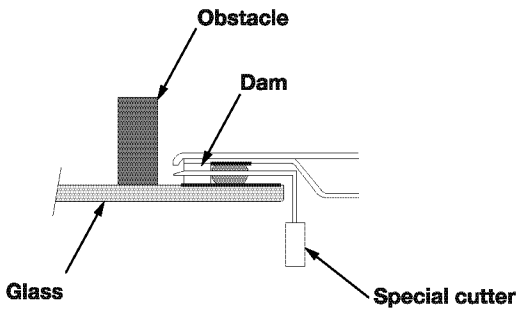
S6G607

(3) Eliminate the dam and adhesive attached on the cabin surface using a paddle or the like until the surface becomes smooth.



S6G608

(4) Smoothen the glass side surface.

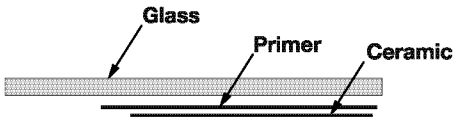


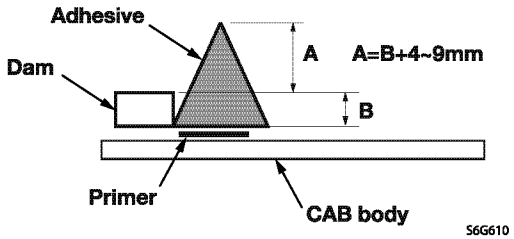
S6G609

2) Installation of glass

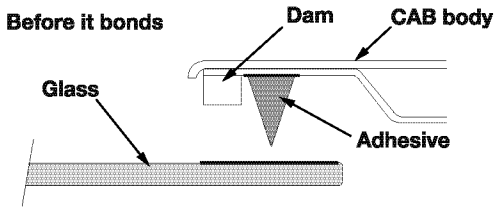
(1) Remove the grease, oil and dust attached on the primer coating surface (cabin side and glass side) with a rag containing detergent.
- Insufficient cleaning will result in adhesive failure.

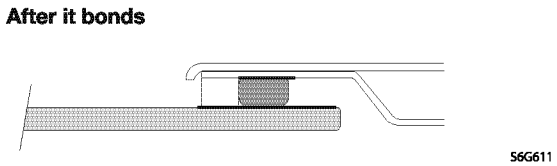
(2) Apply adhesive and paste the glass.
Adhesive: SUNSTAR 580 or its equivalent
- Check that the primer is coated on the adhesive coating surface.



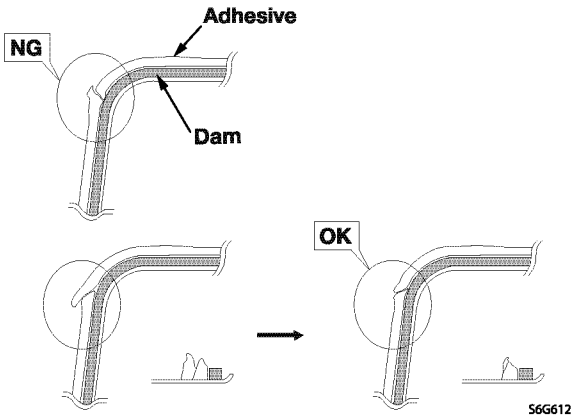


- Have the curing period for 24 hours after pasting the glass.





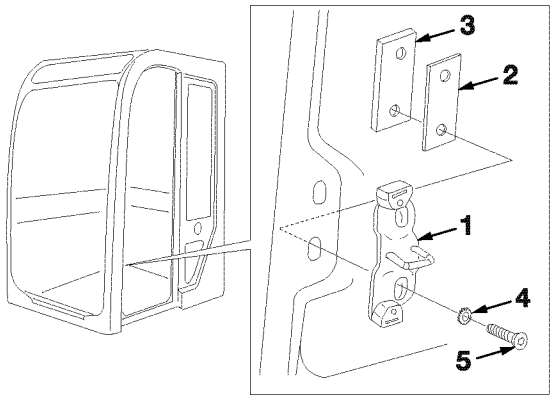
- Replenish the connecting portion from inside to avoid the connecting portion from facing upward.
- Make correction to avoid air accumulation at the time of the glass clamping using a paddle or the like.



Installing and adjusting the striker

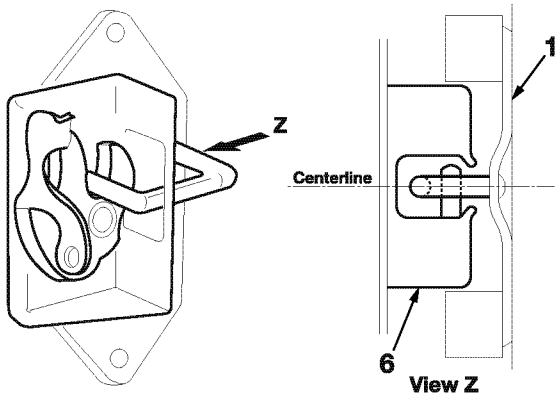
1) Installing and adjusting the striker

(1) Install the striker (1), the gasket (2), the plate (3), the toothed washer (4), and then install the bolt (5).



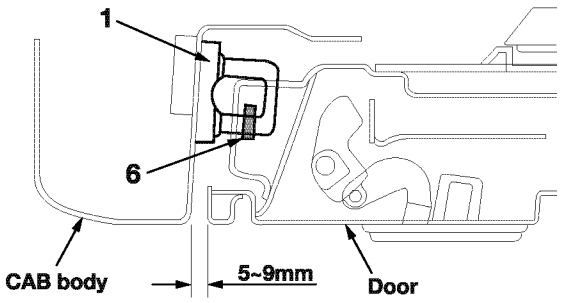
S6G613

- Install the striker (1) so that the round bar portion is positioned in the centerline of the door lock (6).



S6G614

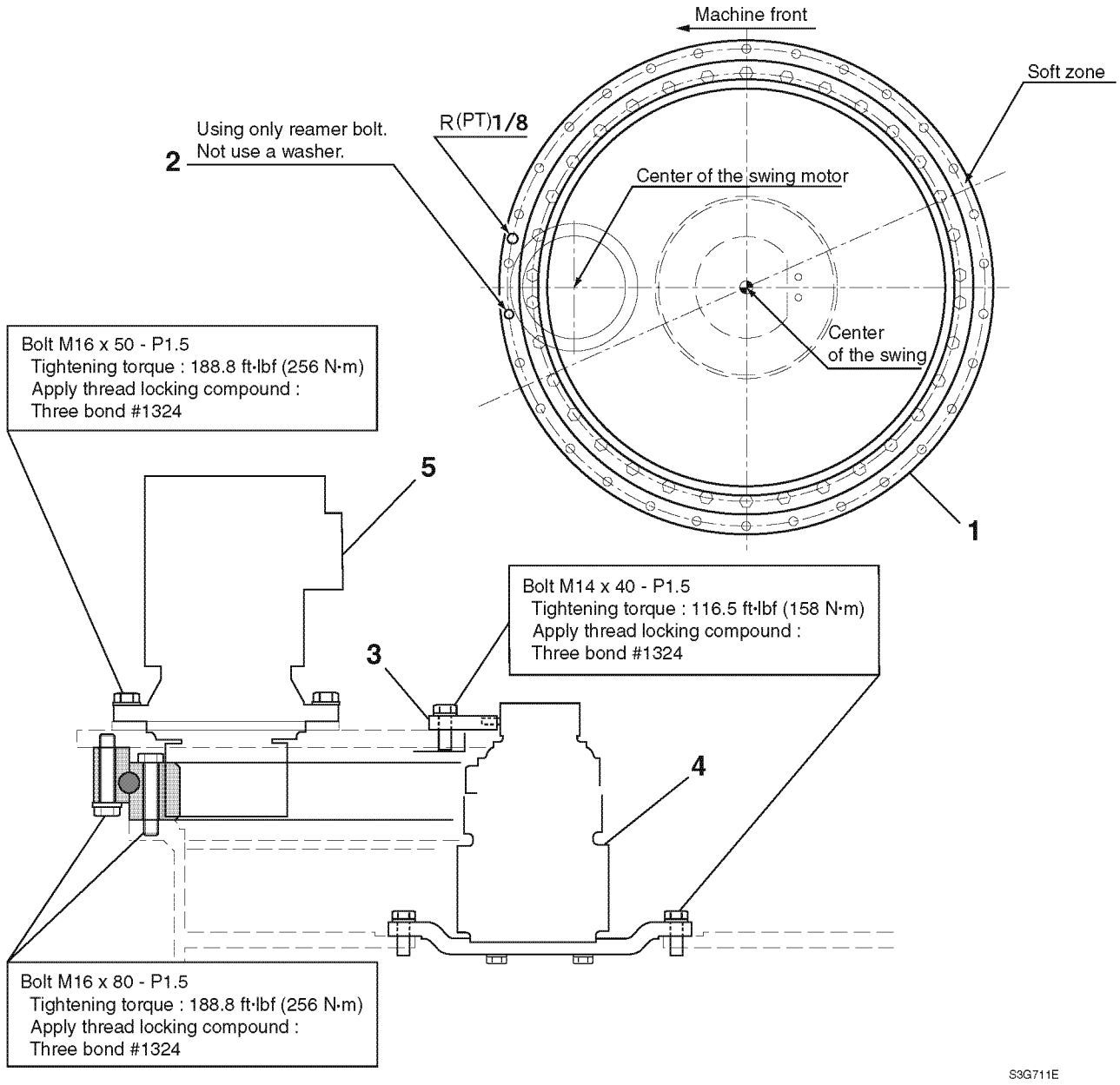
- Check that the clearance exists so that the claw portion of the door lock (6) isn't stranded on the round bar portion.
- Check that the clearance exists between the door and the cabin unit.
- Maintain the clearance by the shim adjustment, if it cannot be maintained.



S6G615

7-7. Swing Wagon

7-7-1. Disassembly and Assembly the Swing Motor



No.	Part
1	Swing bearing
2	Reamer bolt
3	Stopper
4	Swivel joint
5	Swing motor

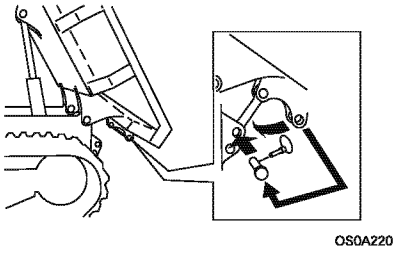
1) Disassembly

⚠ WARNING

- **Be sure to do the replacement work on level ground.**
- **Be sure to install the wagon stopper to hold the wagon when inspecting or servicing the machine with the wagon in the dump position.**
- **The oil temperature is very high immediately after the machine stops operating. Be sure to do the work after the oil temperature lowers sufficiently.**
- **When removing the hydraulic hose, oil may spout out due to the high internal pressure. Loosen the hydraulic hose slowly to prevent high pressure oil from contacting your eyes or skin.**

(1) Keep the vehicle level, raise the wagon, lock the dump lever, and stop the engine.

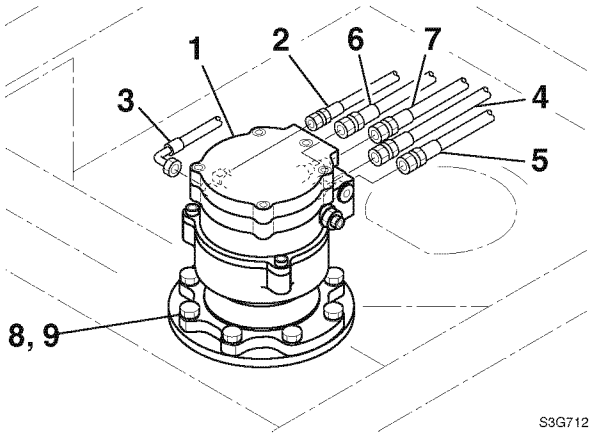
(2) Install the wagon stoppers and further secure the wagon with stands or other additional supports.



OS0A220

(3) Remove the medium pressure hoses (2, 3, and 4) and the high pressure hoses (5, 6, and 7) from the swing motor (1).

(4) Remove the installation bolt (8) and the washer (9), and suspend and remove the swing motor (1).
- Swing motor weight: 110 lbs. (51 kg)



S3G712

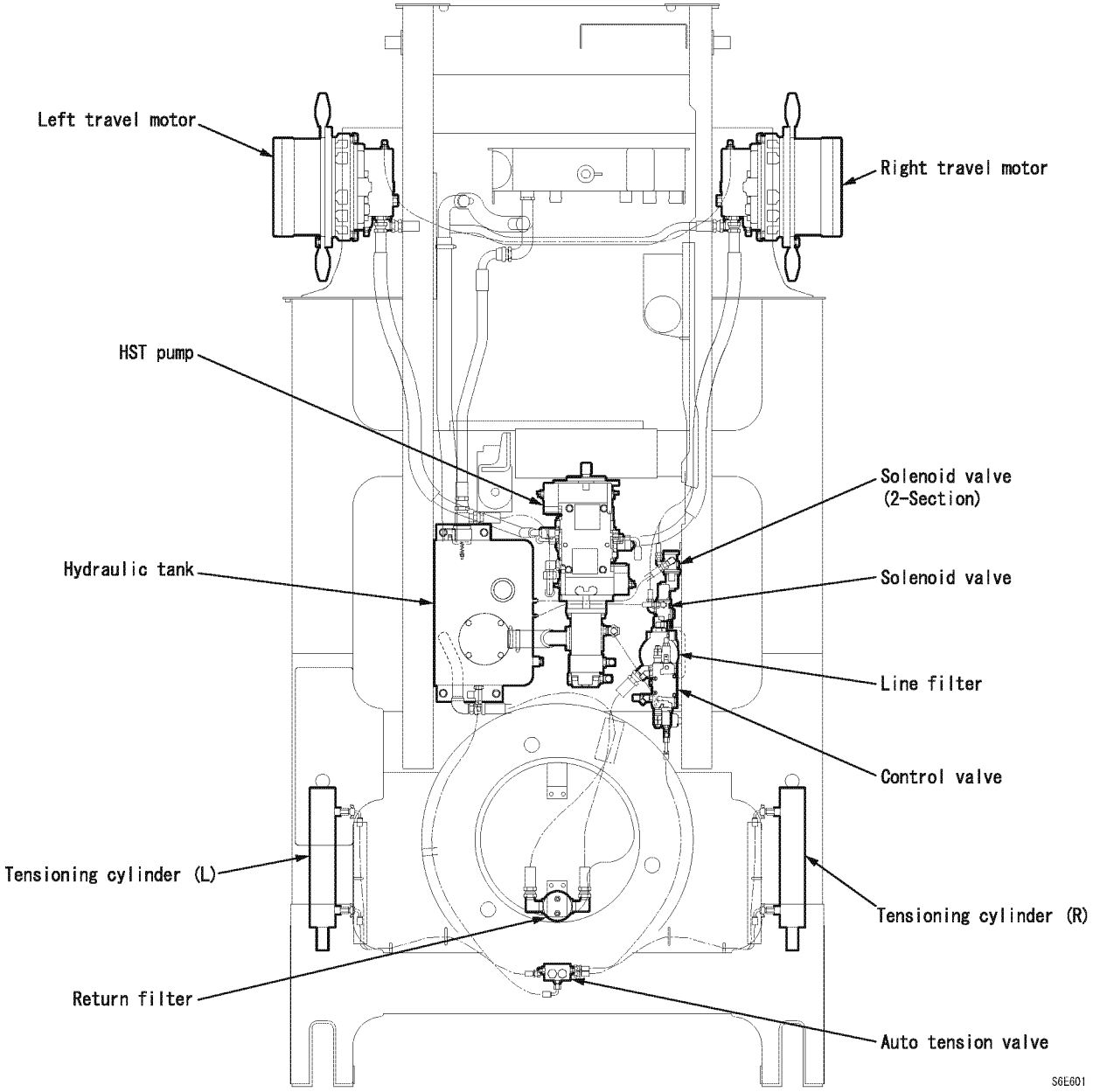
2) Assembly

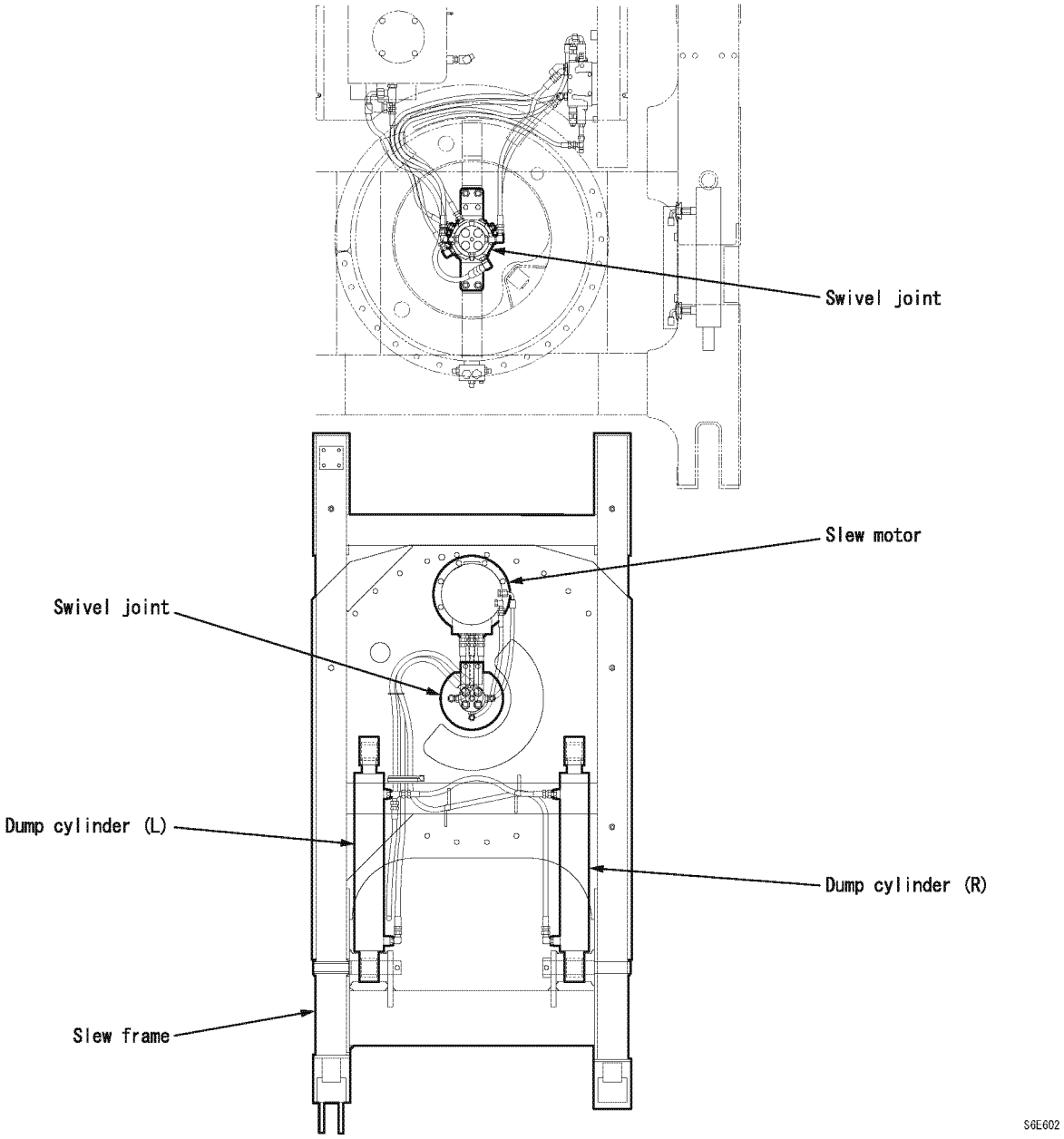
Follow the disassembling procedures in reverse order.
- When reassembling, apply the locking agent to the installation bolts of the swing motor.

Tightening agent: Three Bond #1324
Tightening torque: 188.8 ft·lbf (256 N·m)

7-7-2. Hydraulic System

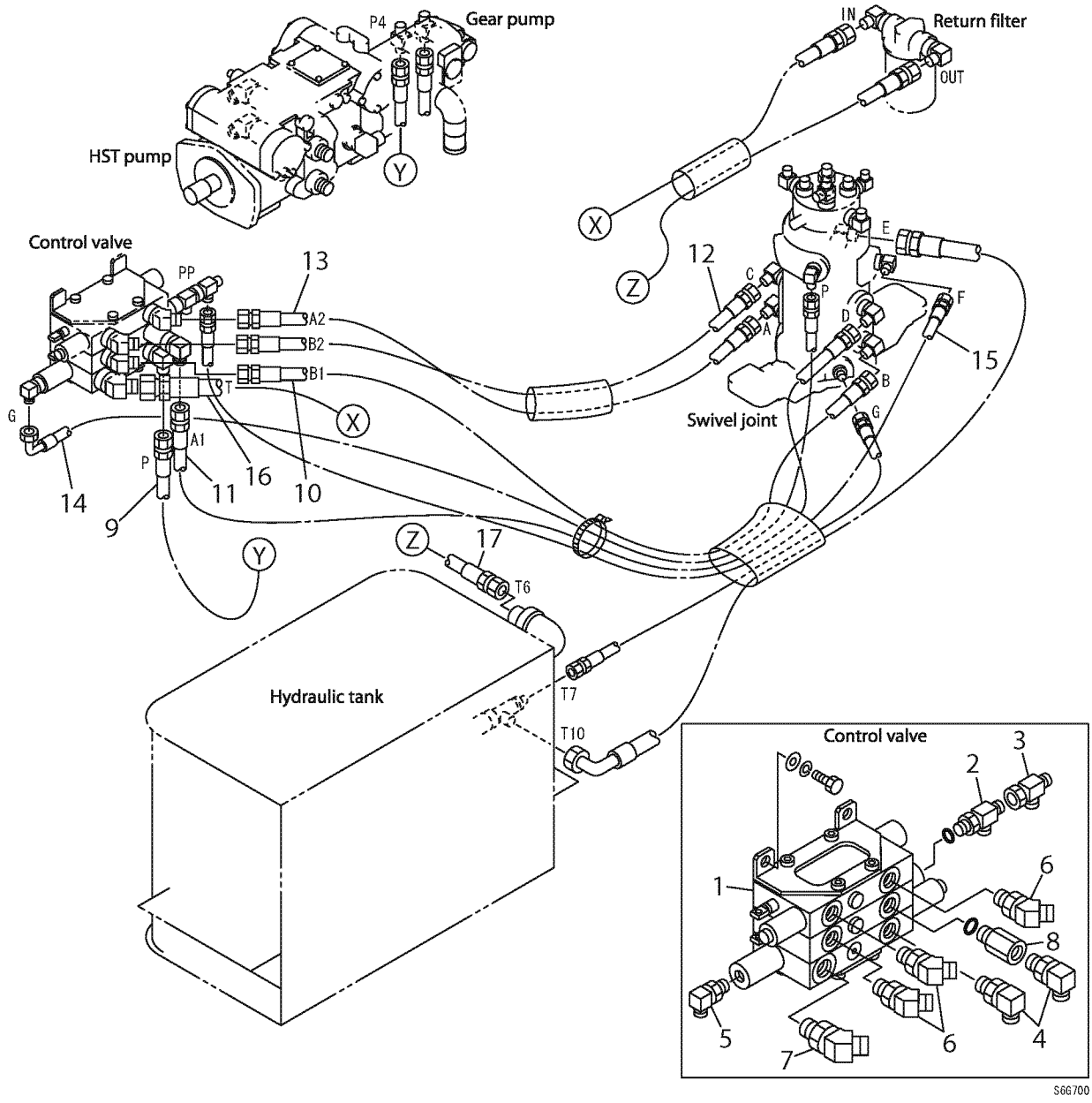
1. Layout of the hydraulic system




Swivel joint
Slew motor
Swivel joint
Dump cylinder (L)
Dump cylinder (R)
Slew frame
S6E602

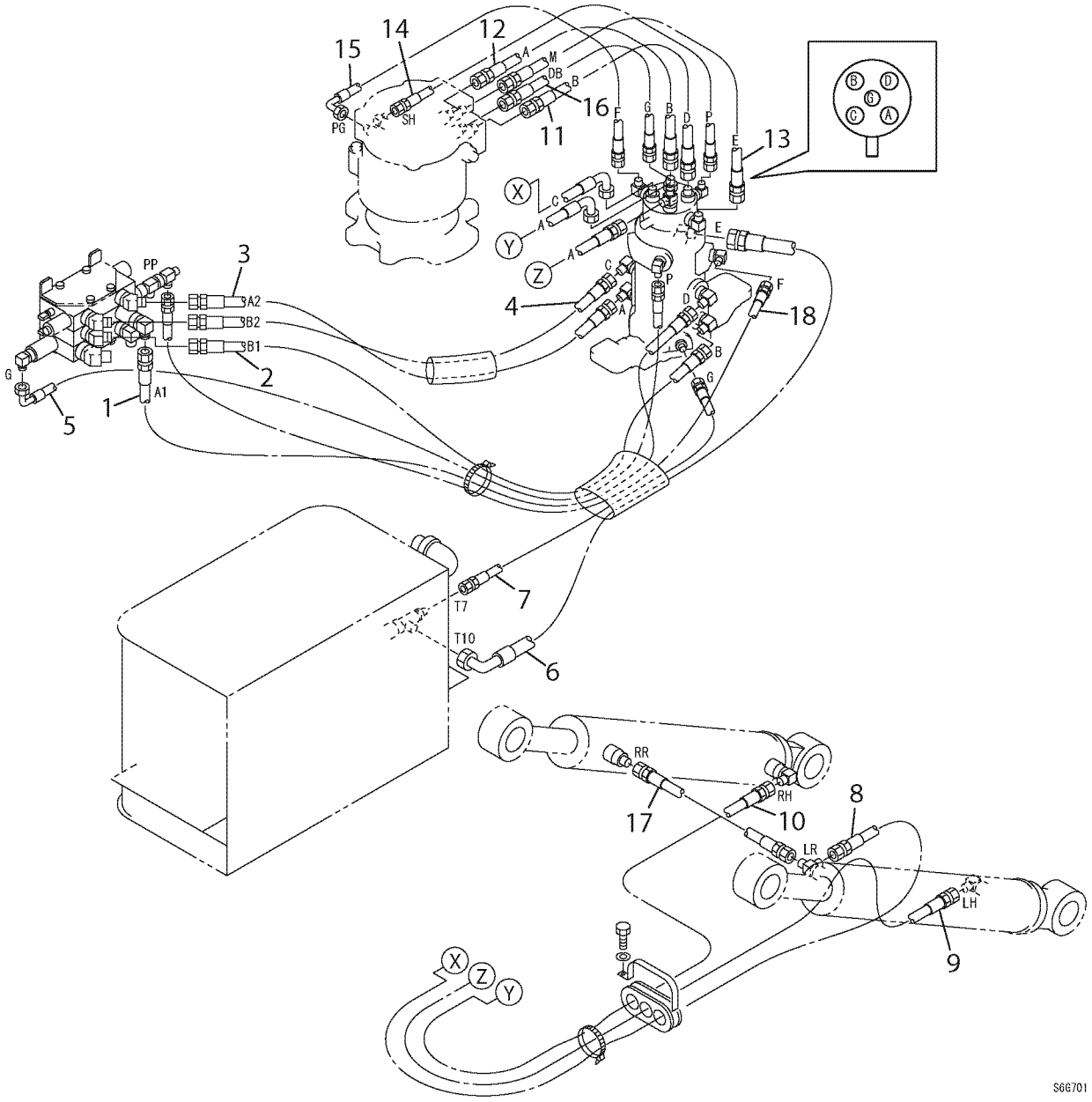
2. Control valves

Control valves are used to control the direction, pressure and flow rate in the hydraulic circuits so that the hydraulic system operates as intended. They are largely classified into three types according to their functions: direction control valves, pressure control valves, and flow rate control valves.



No.	Part	No.	Part	No.	Part
1	Control valve	7	45 deg. elbow	13	High pressure hose
2	Tee with washer	8	Bushing	14	Intermediate pressure hose
3	Tee	9	High pressure hose	15	Intermediate pressure hose
4	90 deg. elbow	10	High pressure hose	16	Intermediate pressure hose
5	90 deg. elbow	11	High pressure hose	17	Intermediate pressure hose
6	45 deg. elbow	12	High pressure hose		

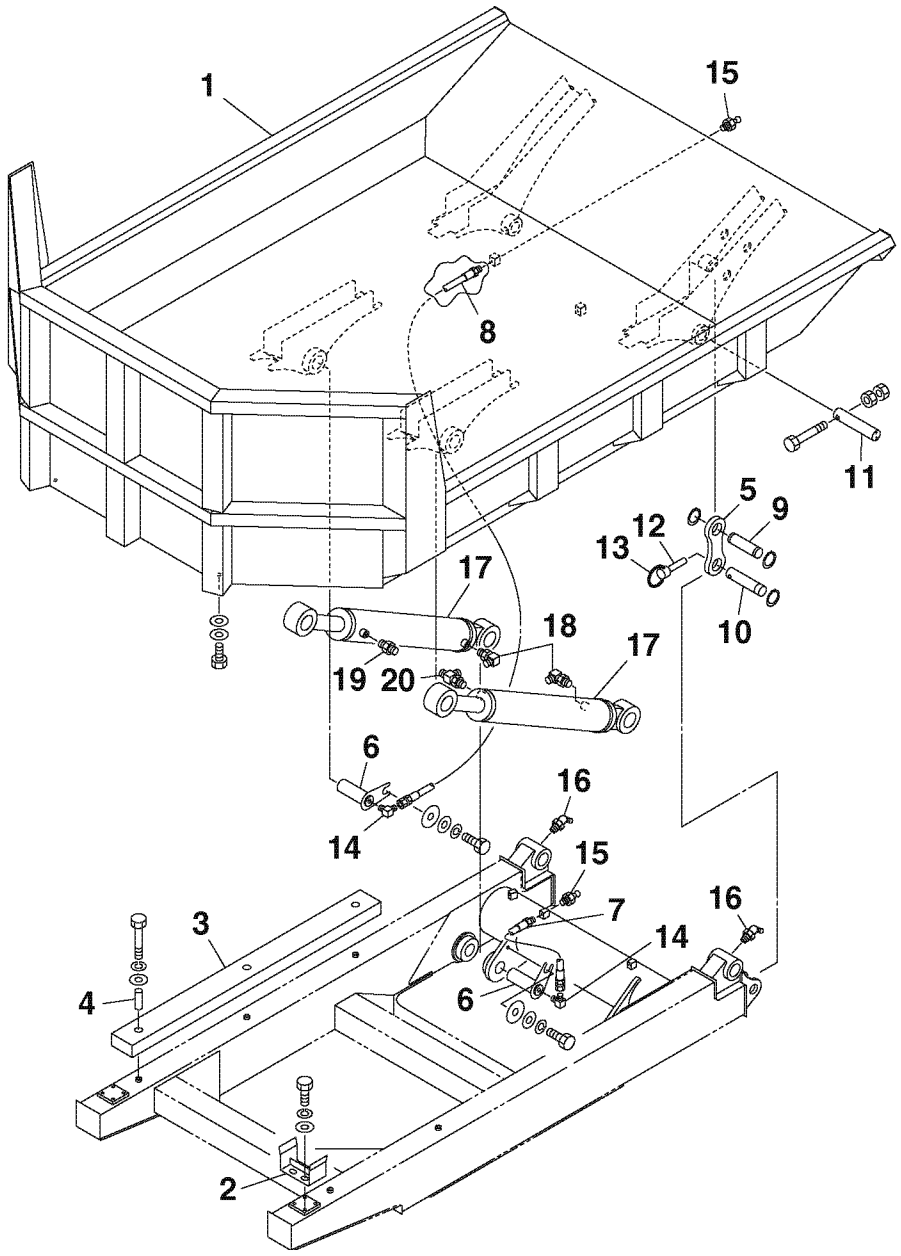
3. Swing motor, swivel joint, and dump cylinder



No.	Part	No.	Part	No.	Part
1	High pressure hose	7	Intermediate pressure hose	13	Intermediate pressure hose
2	High pressure hose	8	High pressure hose	14	Intermediate pressure hose
3	High pressure hose	9	High pressure hose	15	Intermediate pressure hose
4	High pressure hose	10	High pressure hose	16	Intermediate pressure hose
5	Intermediate pressure hose	11	High pressure hose	17	High pressure hose
6	Intermediate pressure hose	12	High pressure hose	18	Intermediate pressure hose

7-7-3. Riggings

Scoop-end wagon



S3G731

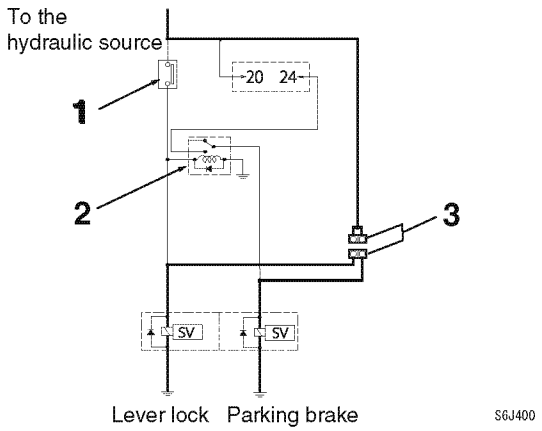
No.	Part	No.	Part	No.	Part
1	Scoop-end wagon	8	High pressure hose	15	Grease nipple
2	Wagon lock	9	Pin	16	Grease nipple
3	Cushion	10	Pin	17	Dump cylinder
4	Pipe	11	Pin	18	90 deg. elbow
5	Plate	12	Pin	19	Adapter union
6	Pin	13	Ring	20	Nipple
7	High pressure hose	14	Hose adapter		

7-8. Procedure for moving in emergency

1. If the hydraulic source operated

1) Releasing the Lever Lock and Parking Brake

Use this procedure when the lever lock or parking brake cannot be released (i.e. the machine cannot travel) due to a defect of the lever lock limit switch (1) or lever lock relay (2).
By connecting the release connector (3) , lever lock and parking brake can be released to move the machine to the safety place.

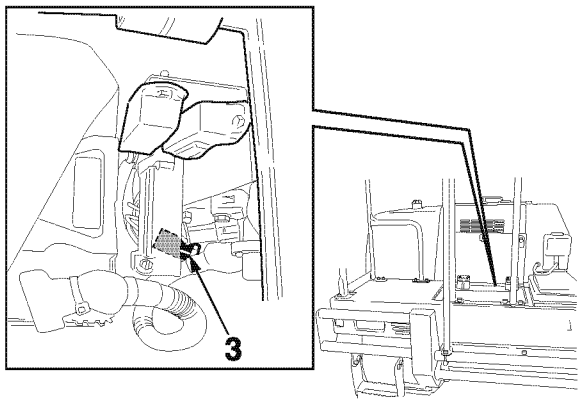


S6J400

⚠ WARNING

- **Do not connect the release connector except in emergency.**
- **After moving the machine, disconnect the release connector, and inspect and repair the lock lever limit switch and lever lock relay.**

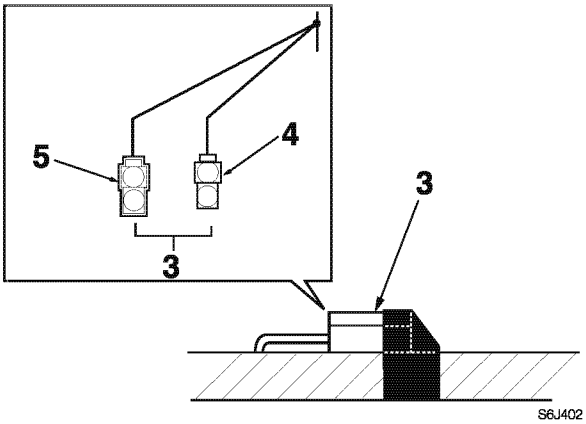
(1) Remove the release connector (3) from the wire harness.
- The release connector is attached with tape to the wire harness on the bottom of the battery relay.



S6J401

(2) Connect the 2P connector (4) and 2P connector (5) of the release connector (3).
- The electric power is supplied to lever lock and parking brake solenoids directly.

(3) After moving the machine to the safety place disconnect the 2P connector (4) and 2P connector (5) of the release connector (3).



S6J402

(4) Put the release connector (3) to the original position and attach it with tape.

(5) Inspect and repair the lever lock limit switch (1) and lever lock relay (2).

2. If the hydraulic source does not operate normally

If the hydraulic source does not operate normally,
refer to 6-14 Precautions in Case of Hydraulic Source Failures.