

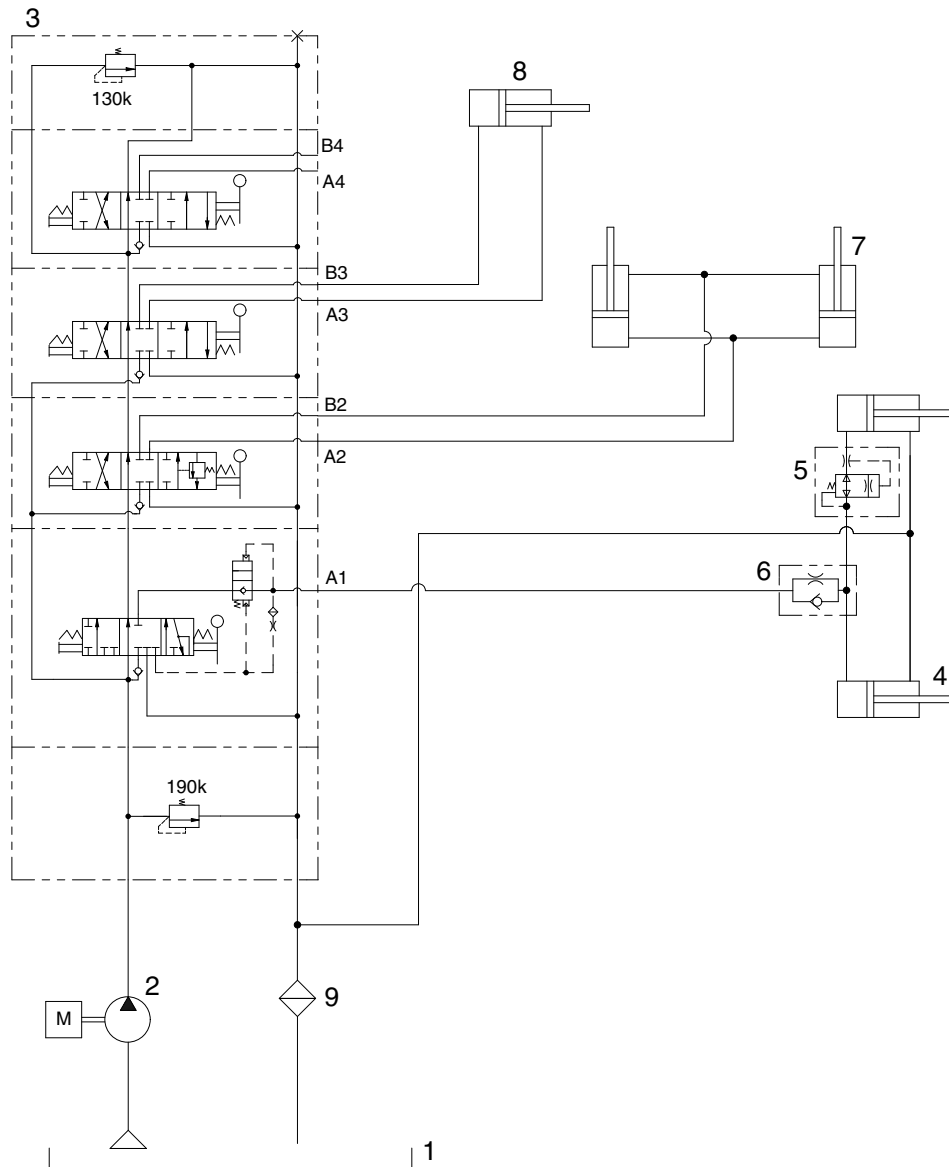
SECTION 6 HYDRAULIC SYSTEM

Group 1	Structure and function	6-1
Group 2	Operational checks and troubleshooting	6-21
Group 3	Disassembly and assembly	6-25

SECTION 6 HYDRAULIC SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

1. HYDRAULIC CIRCUIT

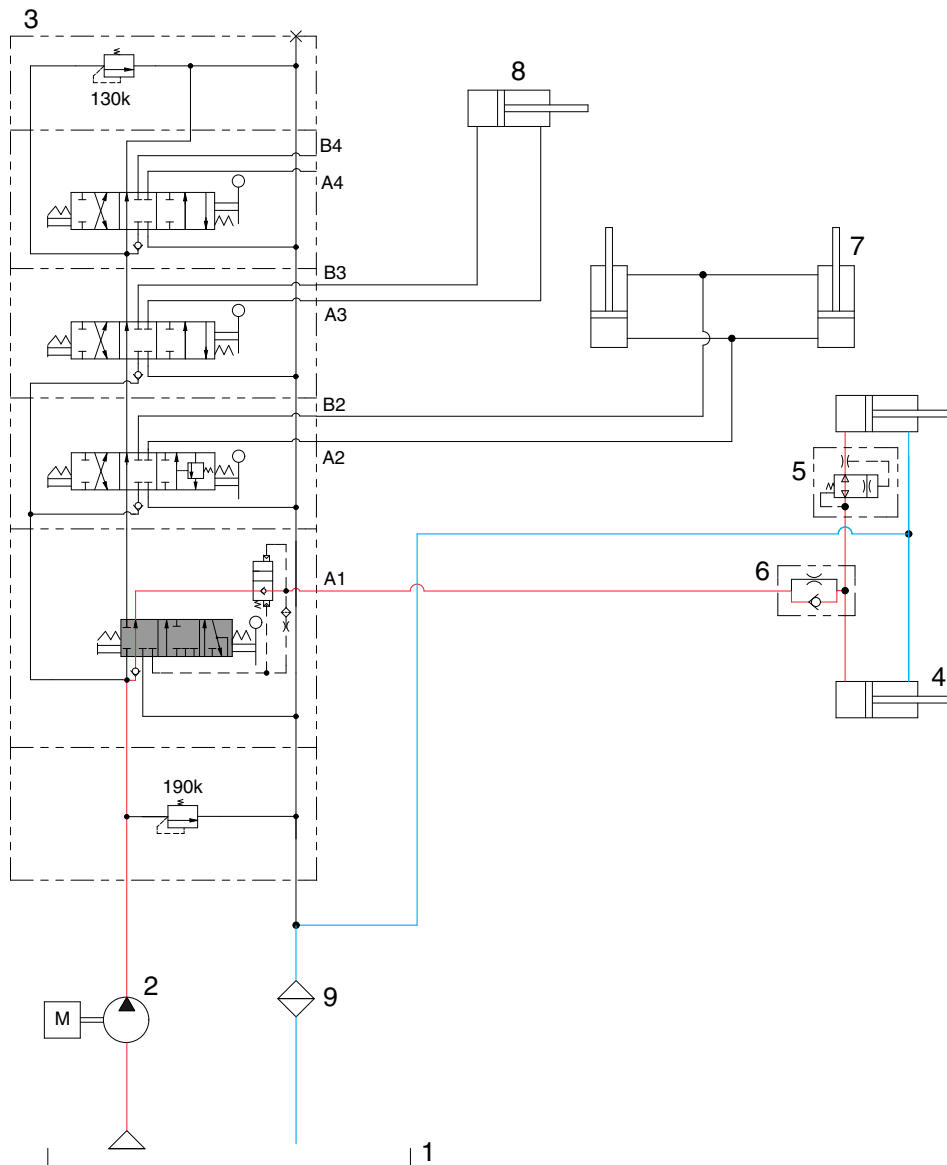


15BR9EHS01

- | | | | |
|---|--------------------|---|--------------------|
| 1 | Hydraulic tank | 6 | Down control valve |
| 2 | Hydraulic pump | 7 | Tilt cylinder |
| 3 | Main control valve | 8 | Reach cylinder |
| 4 | Lift cylinder | 9 | Return filter |
| 5 | Down safety valve | | |

※ The circuit diagram may differ from the equipment, so please check before a repair.

1) WHEN THE LIFT CONTROL LEVER IS IN THE LIFT POSITION



15BR9EHS02

When the lift control lever is pulled back, the spool on the first block is moves to lift position.

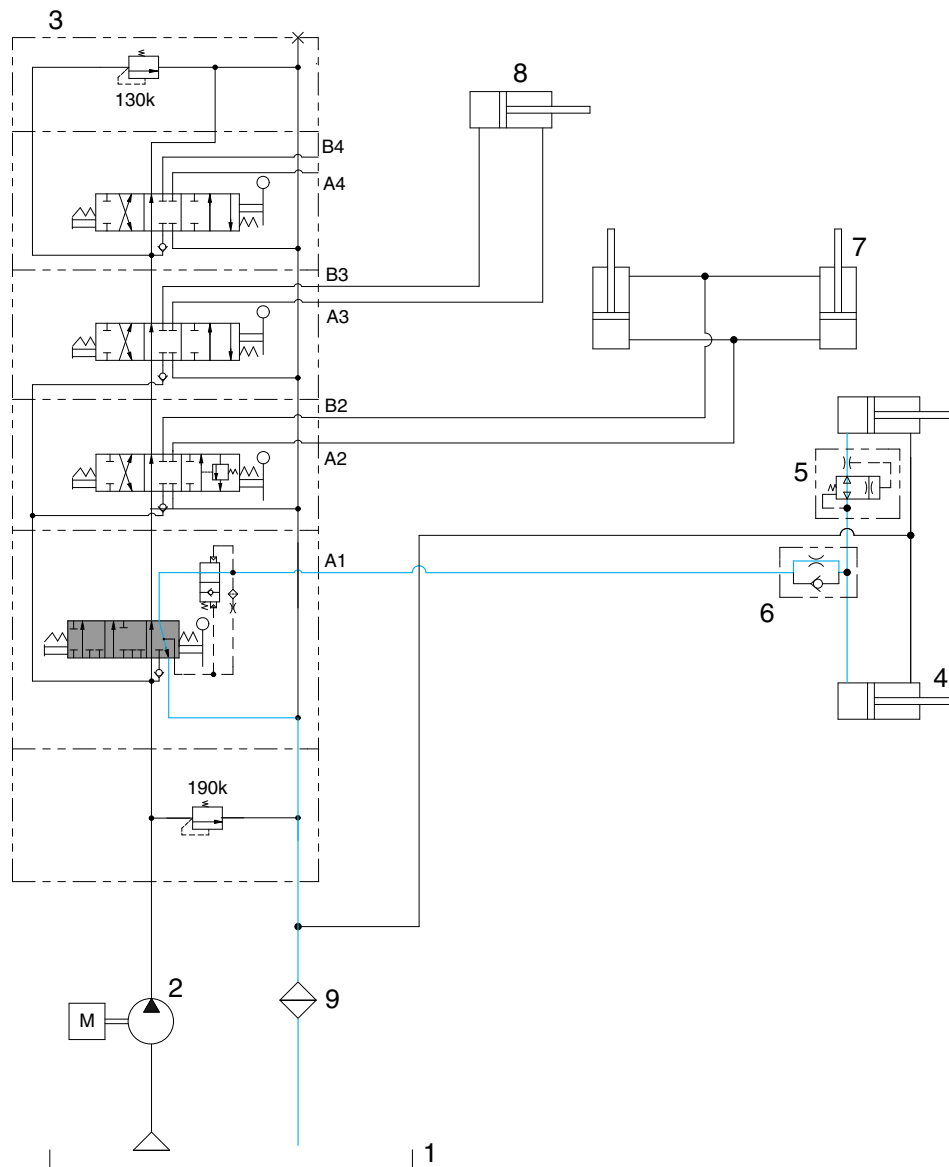
The oil from hydraulic gear pump (2) flows into main control valve (3) and then goes to the large chamber of lift cylinder (4) by pushing the load check valve of the spool.

The oil from the small chamber of lift cylinder (4) returns to hydraulic oil tank (1) at the same time.

When this happens, the forks go up.

※ The circuit diagram may differ from the equipment, so please check before a repair.

2) WHEN THE LIFT CONTROL LEVER IS IN THE LOWER POSITION

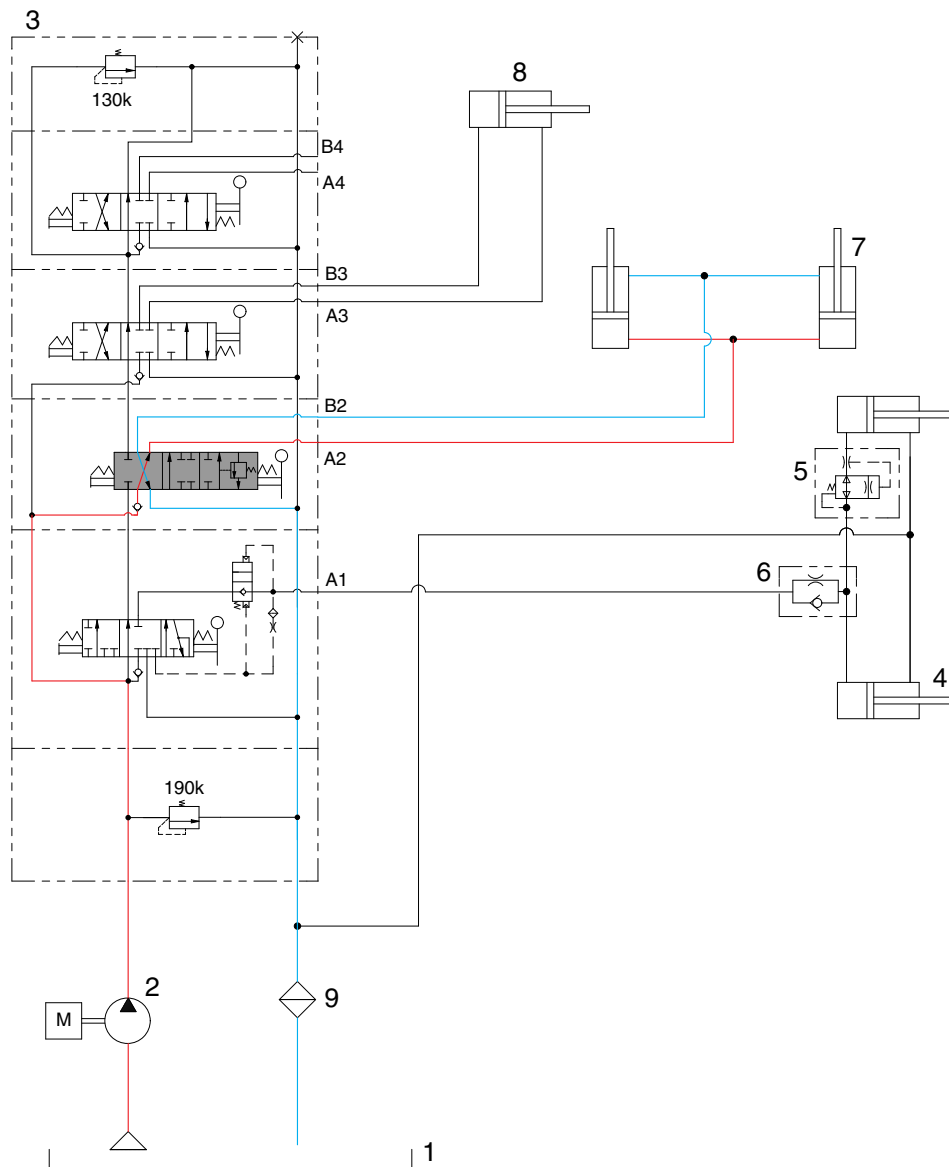


15BR9EHS03

When the lift control is pushed forward, the spool on the first block is moved to lower position. The work port (1B) and the small chamber and the large chamber are connected to the return passage, so the lift will be lowered due to its own weight.

※ The circuit diagram may differ from the equipment, so please check before a repair.

3) WHEN THE TILT CONTROL LEVER IS IN THE Backward POSITION



15BR9EHS04

When the tilt control lever is pulled back, the spool on the second block is moved to tilt backward position.

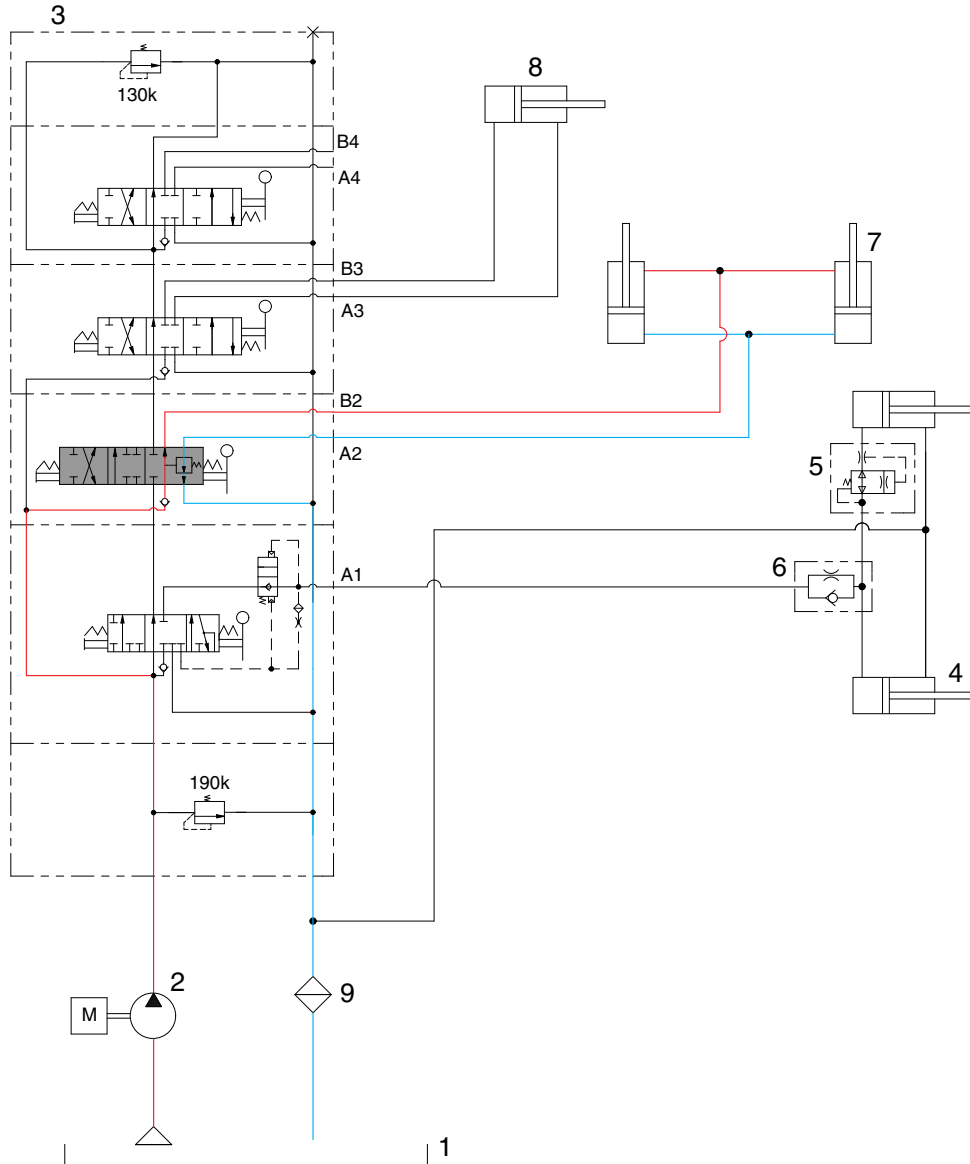
The oil from hydraulic gear pump (2) flows into main control valve (3) and then goes to the large chamber of tilt cylinder (7) by pushing the load check valve of the spool.

The oil at the small chamber of tilt cylinder (7) returns to hydraulic tank (1) at the same time.

When this happens, the mast tilt backward.

※ The circuit diagram may differ from the equipment, so please check before a repair.

4) WHEN THE TILT CONTROL LEVER IS IN THE ForWARD POSITION



15BR9EHS05

When the tilt control lever is pushed forward, the spool on the second block is moved to tilt forward position.

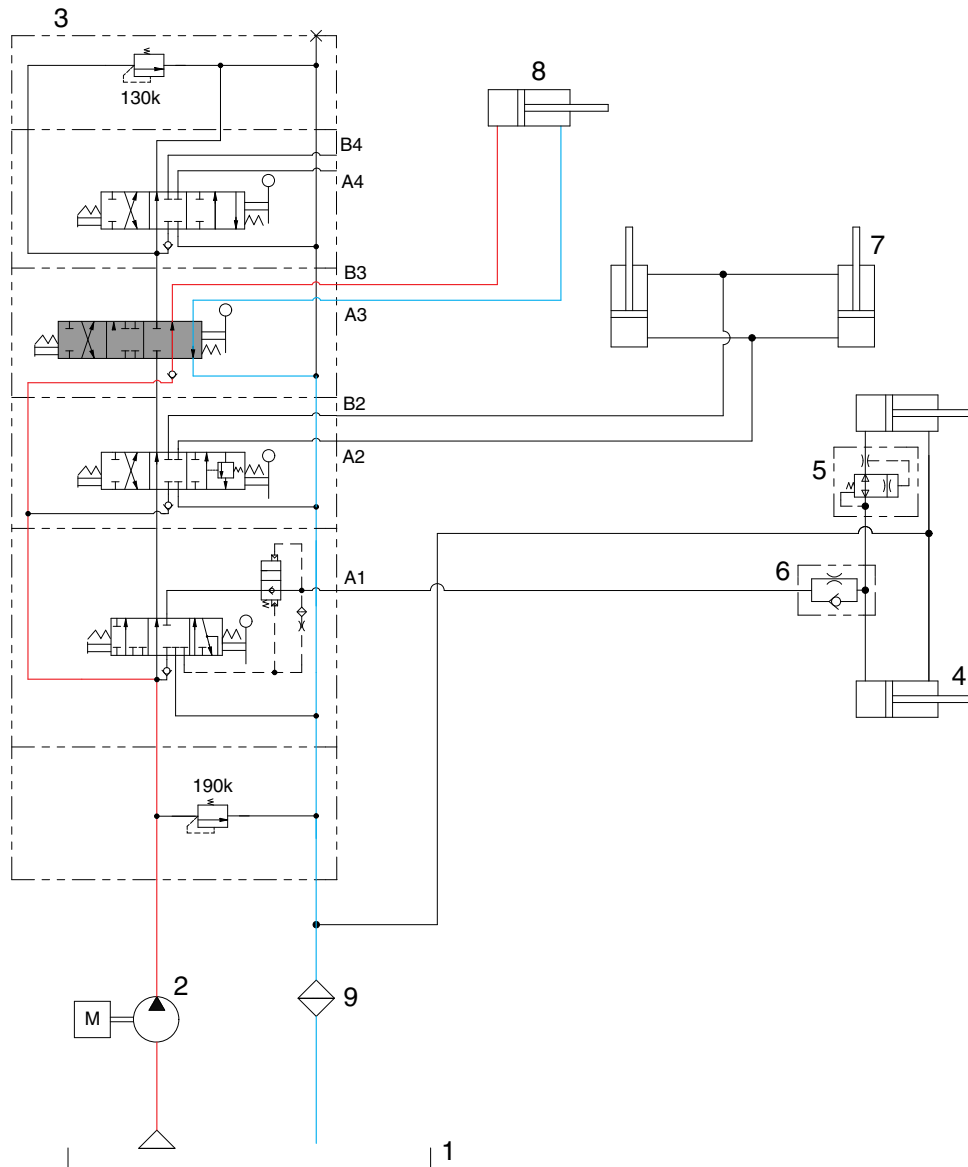
The oil from hydraulic gear pump (2) flows into main control valve (3) and then goes to the small chamber of tilt cylinder (7) by pushing the load check valve of spool.

The oil at the large chamber of tilt cylinder (7) returns to hydraulic tank (1) at the same time.

When this happens, the mast tilt forward.

※ The circuit diagram may differ from the equipment, so please check before a repair.

5) WHEN THE REACH CONTROL LEVER IS IN THE forWARD POSITION



15BR9EHS06

When the reach control lever is pushed forward, the spool on the third block is moved to reach forward position.

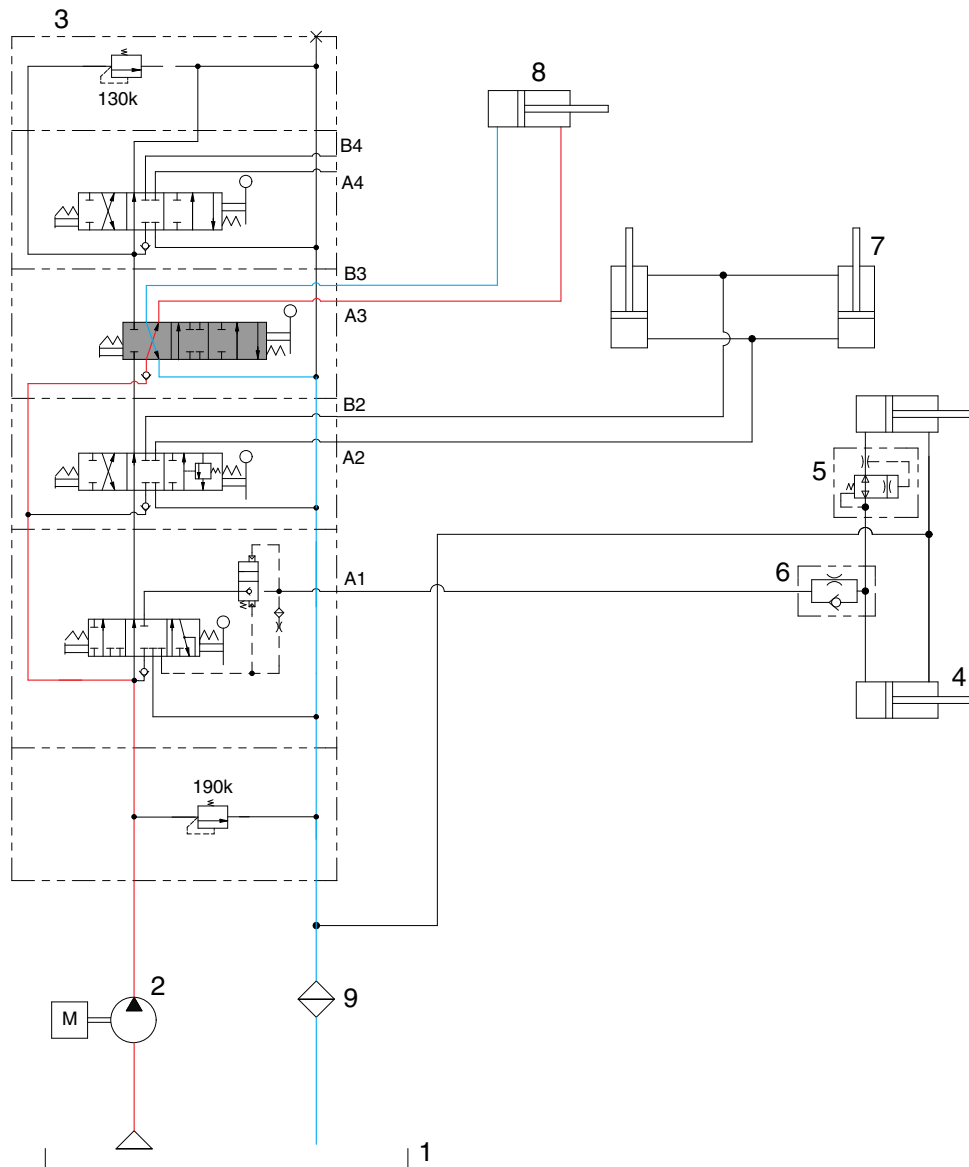
The oil from hydraulic gear pump (2) flows into main control valve (3) and then goes to the large chamber of reach cylinder (8) by pushing the load check valve of spool.

The oil at the small chamber of reach cylinder (8) returns to hydraulic tank (1) at the same time.

When this happens, the mast reaches forward.

※ The circuit diagram may differ from the equipment, so please check before a repair.

6) WHEN THE REACH CONTROL LEVER IS IN THE BACKWARD POSITION



15BR9EHS07

When the reach control lever is pulled backward, the spool on the third block is moved to reach backward position.

The oil from hydraulic gear pump (2) flows into main control valve (3) and then goes to the small chamber of reach cylinder (8) by pushing the load check valve of spool.

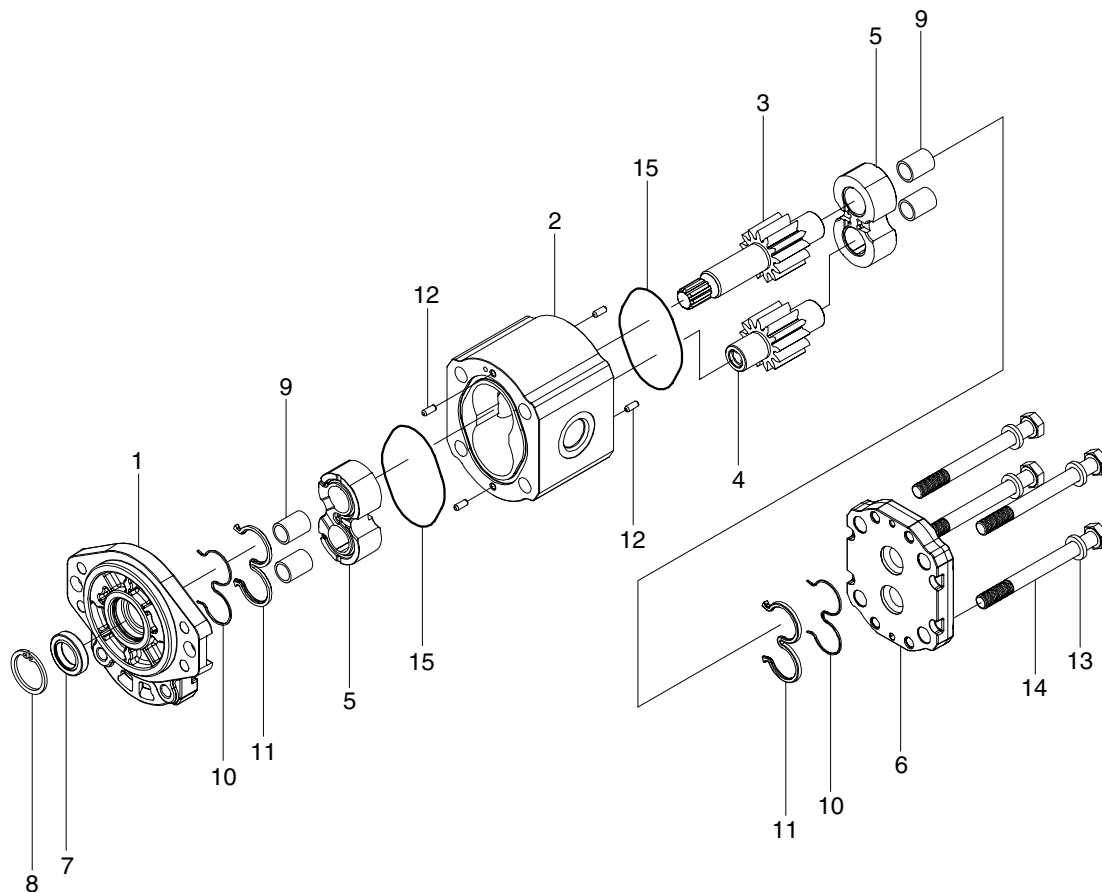
The oil at the large chamber of reach cylinder (8) returns to hydraulic tank (1) at the same time.

When this happens, the mast reaches backward.

※ The circuit diagram may differ from the equipment, so please check before a repair.

2. HYDRAULIC GEAR PUMP

1) STRUCTURE



15BR9EHS19A

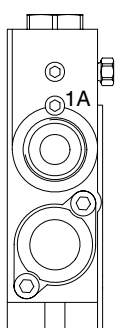
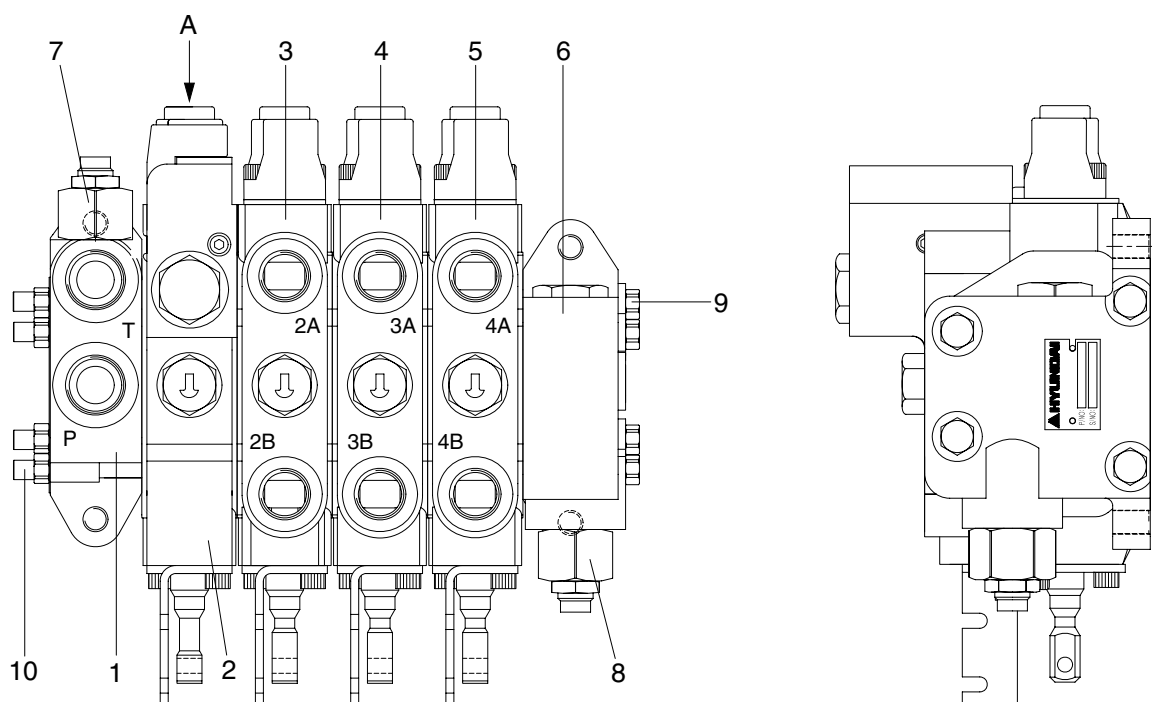
- | | | | | | |
|---|-------------|----|------------|----|----------------|
| 1 | Housing | 6 | Rear cover | 11 | E back up ring |
| 2 | Body | 7 | Oil seal | 12 | S pin |
| 3 | Drive gear | 8 | Snap ring | 13 | Washer |
| 4 | Idler shaft | 9 | Du bush | 14 | Bolt |
| 5 | Side plate | 10 | E seal | 15 | Square seal |

2) OPERATION

This pump comprises of an rear cover, a body, bushings and a housing bolted together with bolts. The gear journals are supported in side plate within pressure balanced bushings to give high volumetric and mechanical efficiencies.

3. MAIN CONTROL VALVE

1) STRUCTURE (4 Spool)



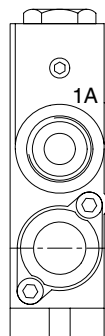
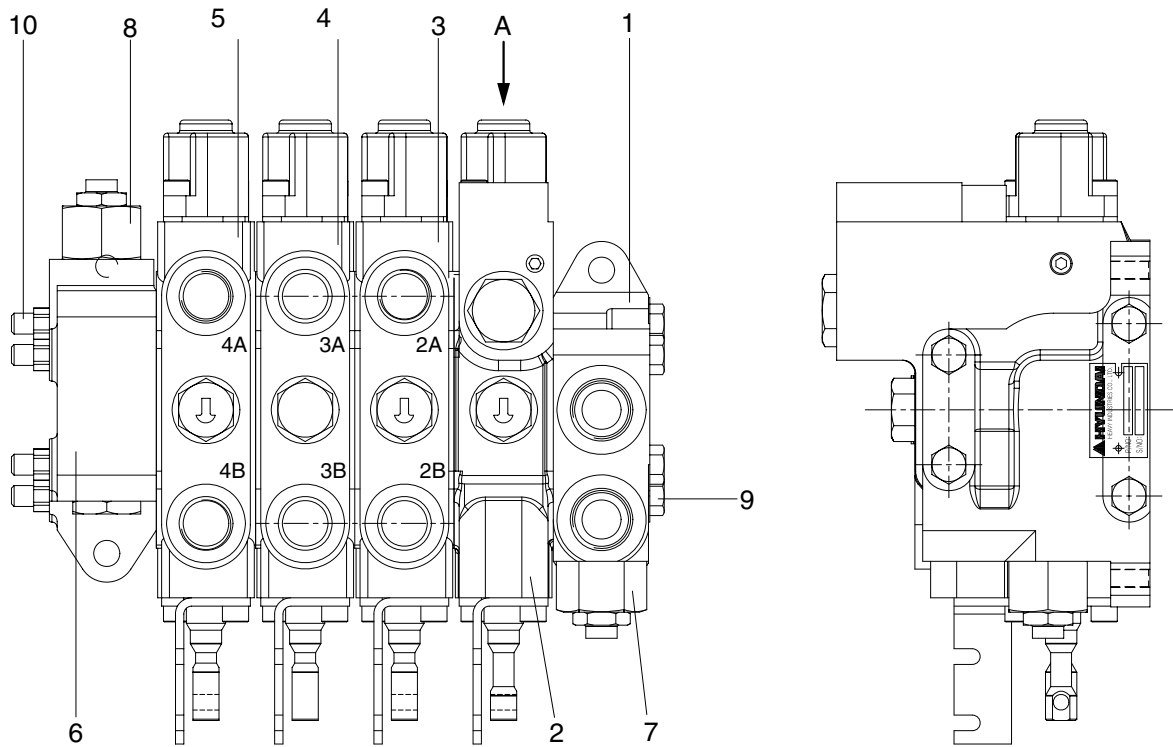
VIEW A

Port name	Size	Port
Inlet port	7/8-14UNF	P
Outlet port	7/8-14UNF	T
Work port	7/8-14UNF	1A
Work port	3/4-16UNF	2A, 2B, 3A, 3B, 4A, 4B

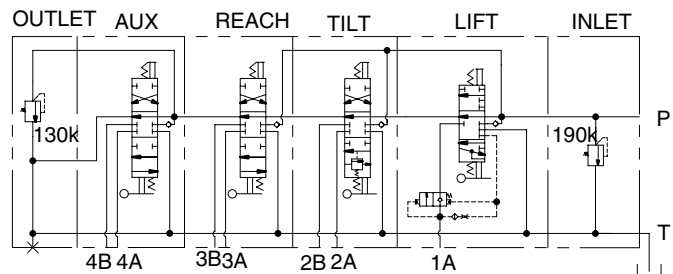
15BR9EHS08

- | | |
|--------------------|-------------------------------|
| 1 Inlet block assy | 6 Outlet block assy |
| 2 Lift block assy | 7 Main relief valve assy |
| 3 Tilt block assy | 8 Auxiliary relief valve assy |
| 4 Reach block assy | 9 Long bolt |
| 5 Aux block assy | 10 Nut |

2) STRUCTURE (4 Spool, Reverse)



VIEW A



Port name	Size	Port
Inlet port	7/8-14UNF	P
Outlet port	7/8-14UNF	T
Work port	7/8-14UNF	1A
Work port	3/4-16UNF	2A, 2B, 3A, 3B, 4A, 4B

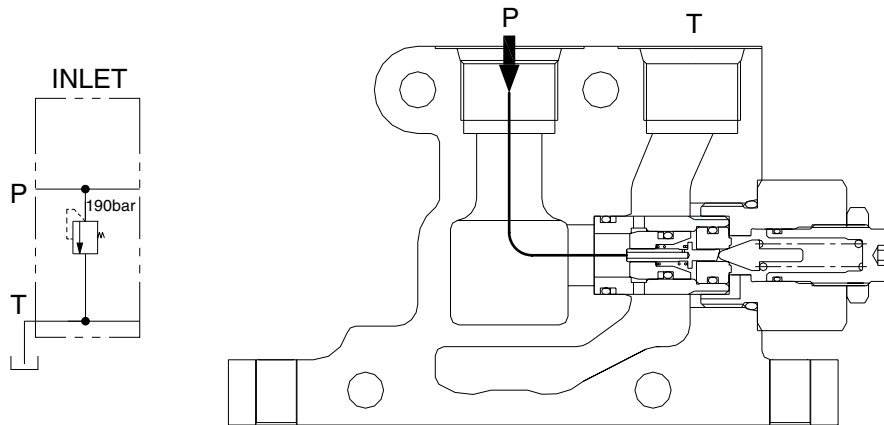
15BR9EHS08R

- | | |
|--------------------|-------------------------------|
| 1 Inlet block assy | 6 Outlet block assy |
| 2 Lift block assy | 7 Main relief valve assy |
| 3 Tilt block assy | 8 Auxiliary relief valve assy |
| 4 Reach block assy | 9 Long bolt |
| 5 Aux block assy | 10 Nut |

3) INLET SECTION

(1) Operation

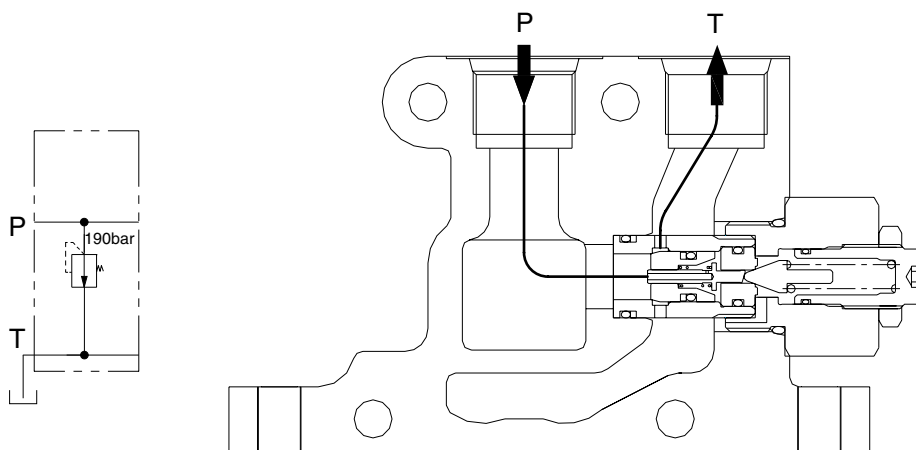
The inlet section contains the pump inlet connection and main relief valve.



22B7HS09

(2) Operation of relief valve at setting pressure

When the pressure at inlet reaches to setting pressure, the pilot poppet which is in the main relief valve is opened by pressure. At this condition the flow divert from the pump directly to the outlet tank.



22B7HS10

4) LIFT SECTION

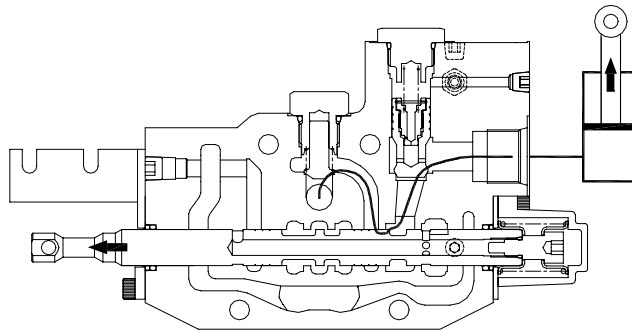
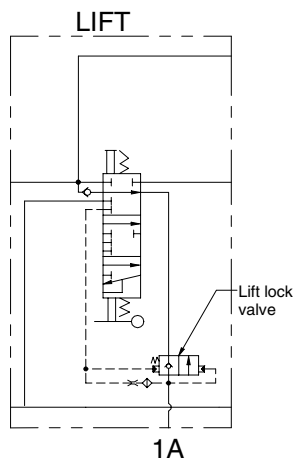
(1) Operation

The lift section has a single work port to direct flow to the lift cylinder. Only one work port is used, because the lift cylinder is single-acting (gravity returns the mast to the lowered position).

The lift section also contains part of the components which comprise the safety features. There is a lift lock check valve. At the neutral position, pressures in the lock valve are equalized across the lift lock poppet. In this manner, the spring bias keeps the lift lock valve closed and prevents lowering of the mast.

① Lifting

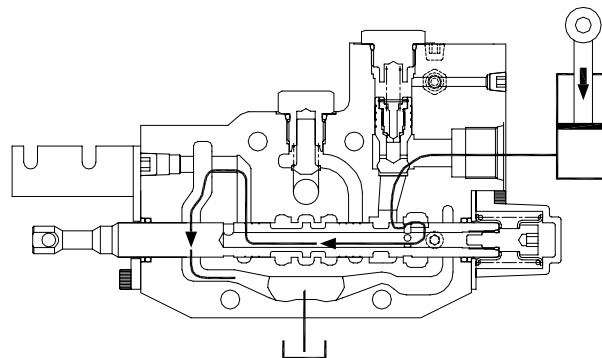
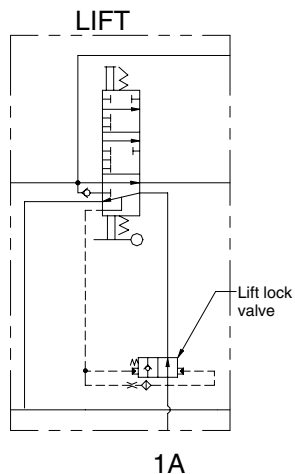
When the operator shifts the lever backwards, the spool is extended out of the valve, and this opens the internal fluid passages that lift the mast. Oil flows through the high pressure parallel cavity, past the load check valve, through the spool metering notches, past the lift lock check valve, and to the head side of the lift cylinder.



BR7HS11S

② Lowering

When the seated operator shifts the lever forwards, the spool retracts into the valve, and the oil is directed from the cylinder, past the lift lock check valve, past the spool metering notches, and to the common tank cavity.



BR7HS12S

Pressure is limited by the main relief valve.

5) TILT SECTION

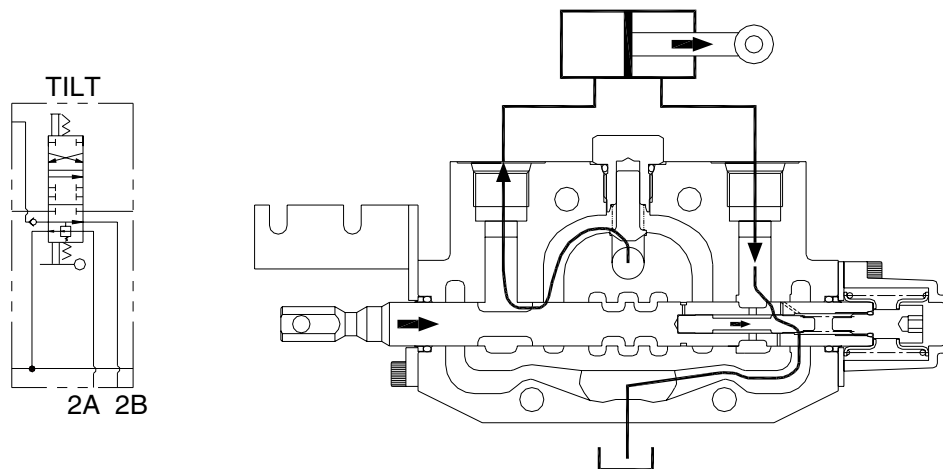
(1) Operation

The tilt spool contains an internal plunger which acts to stop tilt forward actuation when the battery power is off.

① Tilt forward

When the seated operator shifts the lever forward, pressure is applied to the head of the tilt cylinder, and the forks tilt forward. Oil is directed from the high pressure parallel passage past the load check valve, past the spool metering notches, and towards the cylinder head.

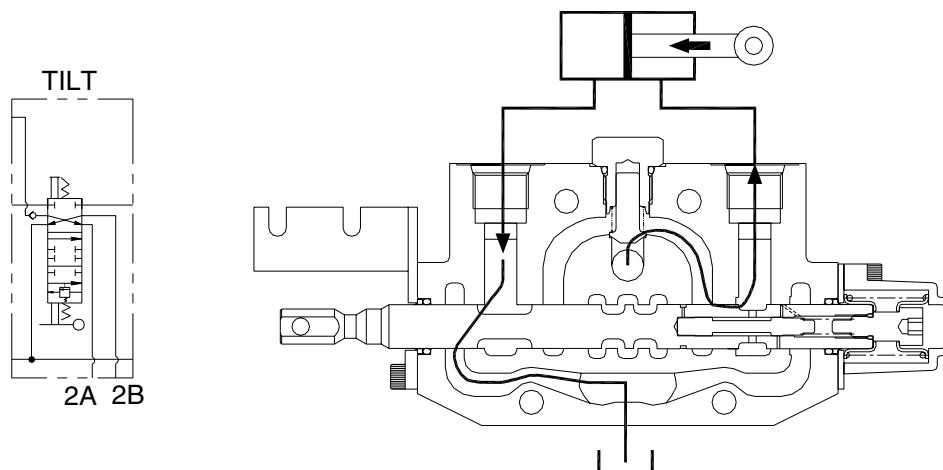
Simultaneously, the high pressure acts upon the end of the tilt lock plunger to move it towards the spring end of the spool. This plunger movement opens additional spool metering notches which control oil flow from the rod end of the cylinder to the tank return line.



22B7HS13

② Tilt back

When the seated operator shifts the lever back, the high pressure oil from the parallel passage is directed past the load check valve, past the spool metering notches, and to the rod side of the cylinder. Exhaust oil from the head side of the cylinder is directed past the spool metering notches to tank.



22B7HS14

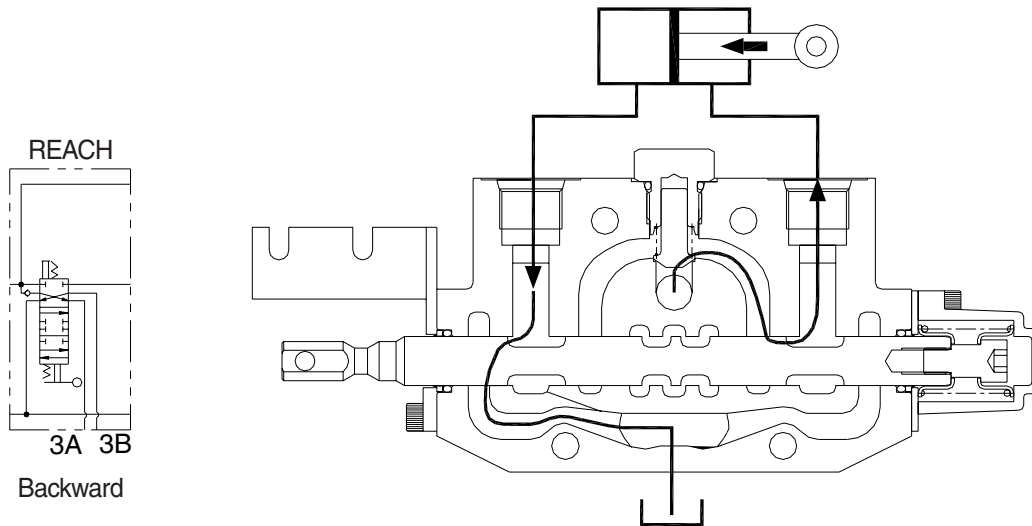
Pressure is limited by the main relief valve.

6) REACH SECTIONS

(1) Operation

① Reach back

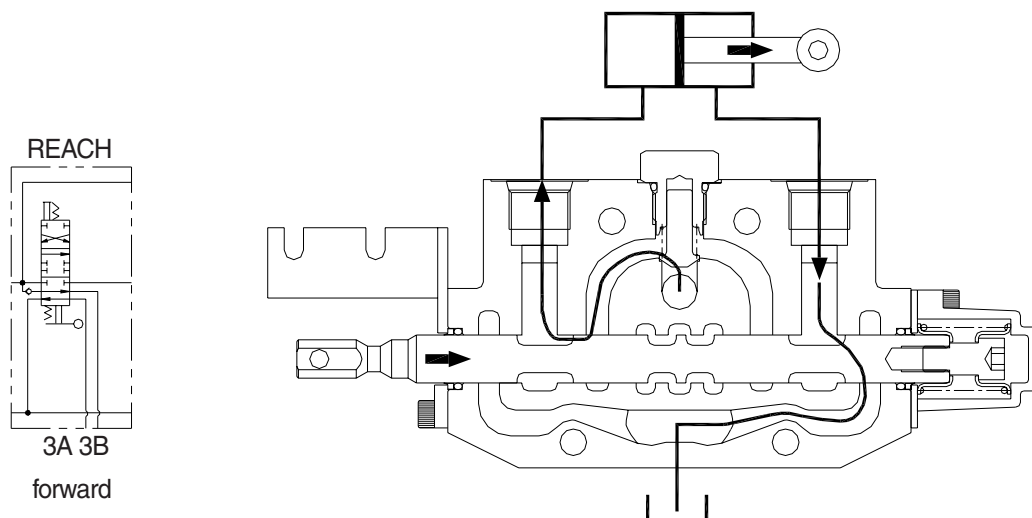
When the seated operator shifts the lever back, the high pressure oil from the parallel passage is directed past the load check valve, past the spool metering notches, and to the rod side of the cylinder. Exhaust oil from the head side of the cylinder is directed past the spool metering notches to tank.



BR7HS15R

② Reach forward

When the seated operator shifts the lever forward, pressure is applied to the head of the reach cylinder, and the forks tilt forward. Oil is directed from the high pressure parallel passage past the load check valve, past the spool metering notches, and towards the cylinder head.



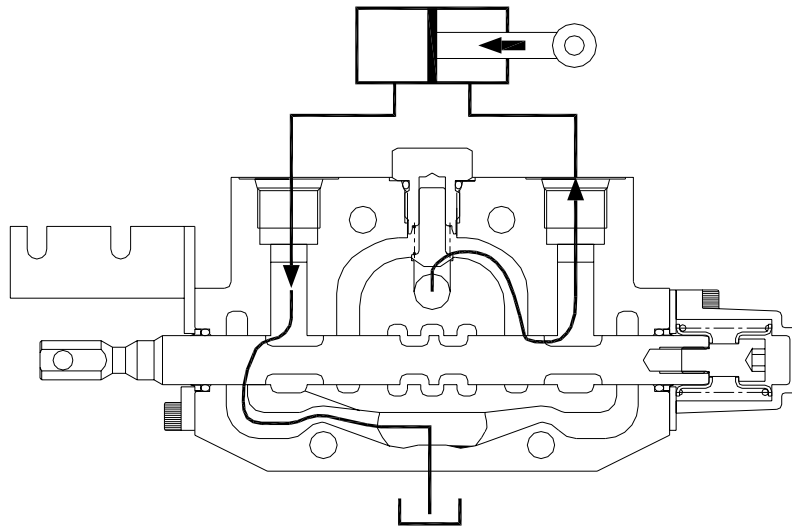
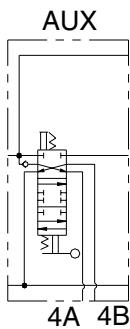
BR7HS16R

Pressure is limited by the main relief valve.

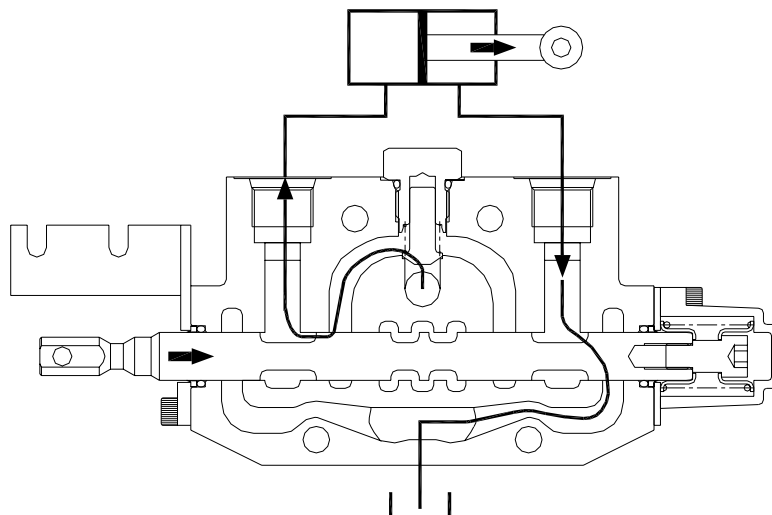
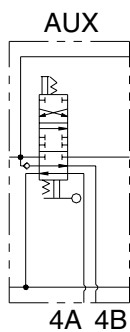
7) AUXILIARY SECTION

(1) Operation

Many different functions can be controlled by the auxiliary spool sections. In general, one work port is pressurized by high pressure oil from the parallel passage, past the load check valve, past the metering notches, and to the cylinder. Simultaneously, oil from the other work port is directed across the spool metering notches to tank.



BR7HS15



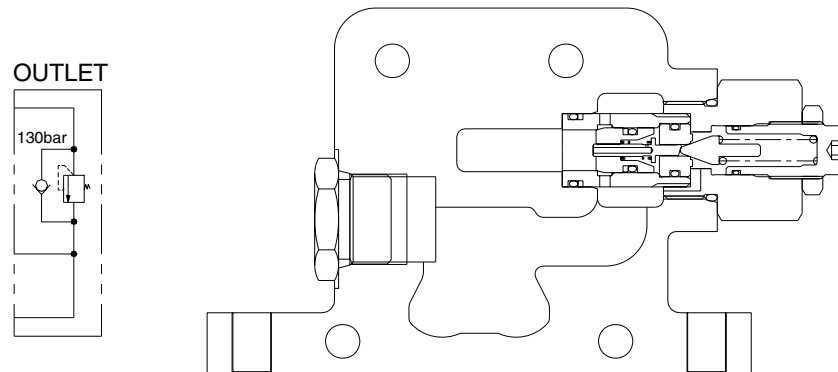
BR7HS16

Pressure is limited by the secondary main relief valve.

8) OUTLET SECTION

(1) Operation

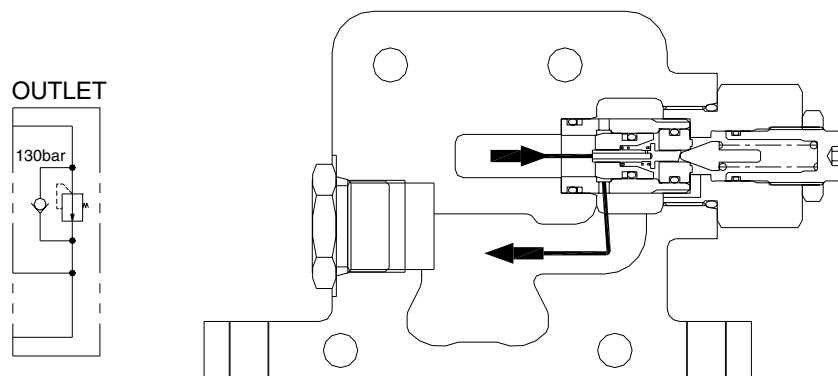
The outlet section contains the tank port and the secondary relief valve (with built-in anti-cavitation feature).



22B7HS17

(2) Operation of relief valve at setting pressure

When the pressure at outlet reaches to setting pressure, the pilot poppet which is in the main relief valve is opened by pressure. At this condition the flow divert from the pump directly to the tank line.

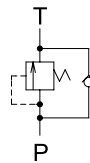
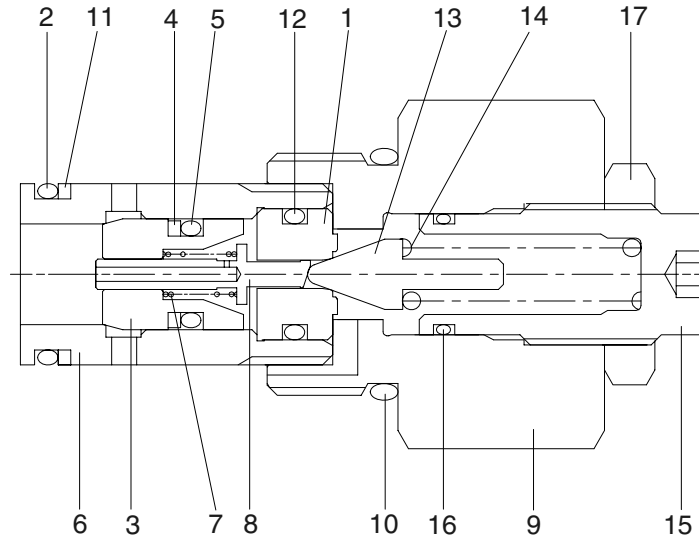


22B7HS18

9) MAIN RELIEF VALVE

This valve is a type of pilot piston to prevent hydraulic components and pipes from being broken by high pressure so, it keeps under pressure limited.

Relief valve pressure varies by 130 kgf/cm² in accordance with 1 revolution of adjust bolt.



- Main relief valve : 190 kgf/cm²
- Secondary main relief valve : 130 kgf/cm²
(For 4 spool only)

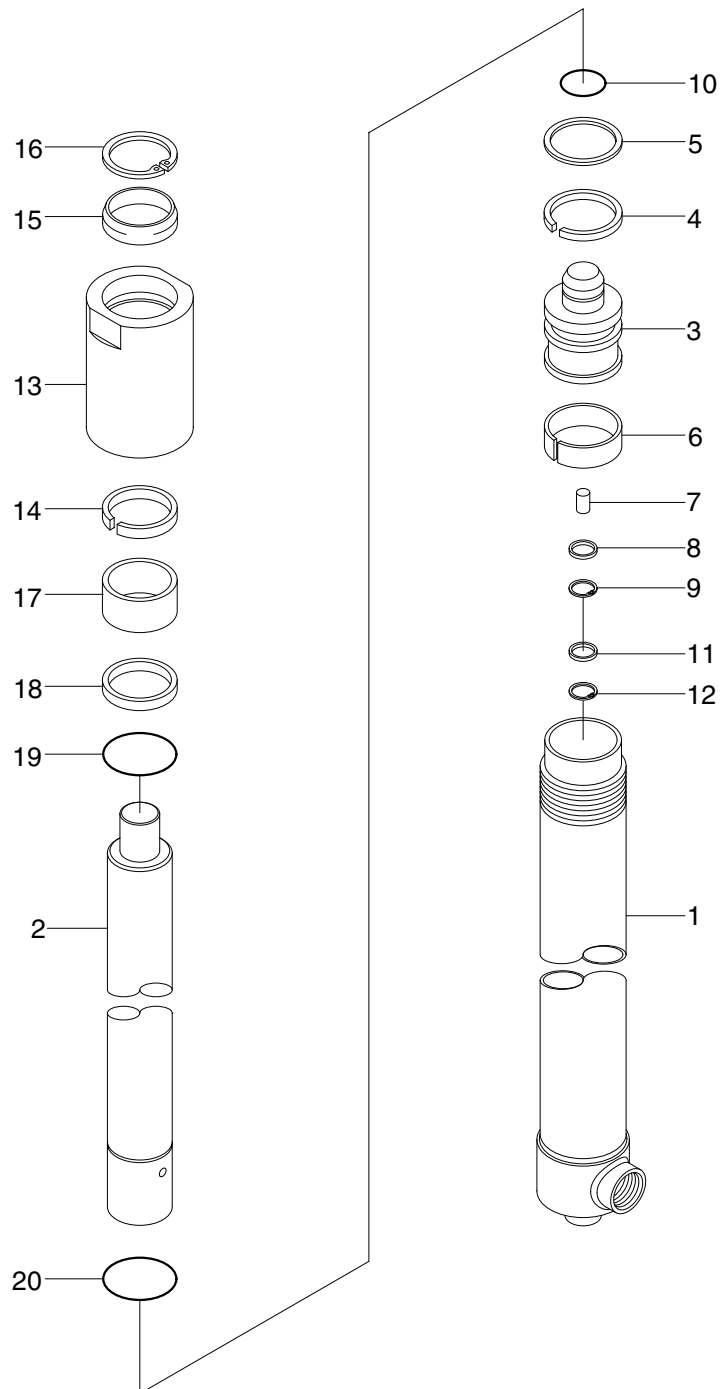
- NOTE : 1) Max. pressure of relief valve : 250 kgf/cm²
- 2) Used pressure of hyd control valve : 190 kgf/cm²

15BR9EHS20A

1 Pilot seat	7 Main spring	13 Pilot poppet
2 O-ring	8 Piston	14 Pilot spring
3 Main poppet	9 Body	15 Adjust screw
4 Back up ring	10 O-ring	16 O-ring
5 O-ring	11 Back up ring	17 Lock nut
6 Socket	12 O-ring	

4. LIFT CYLINDER

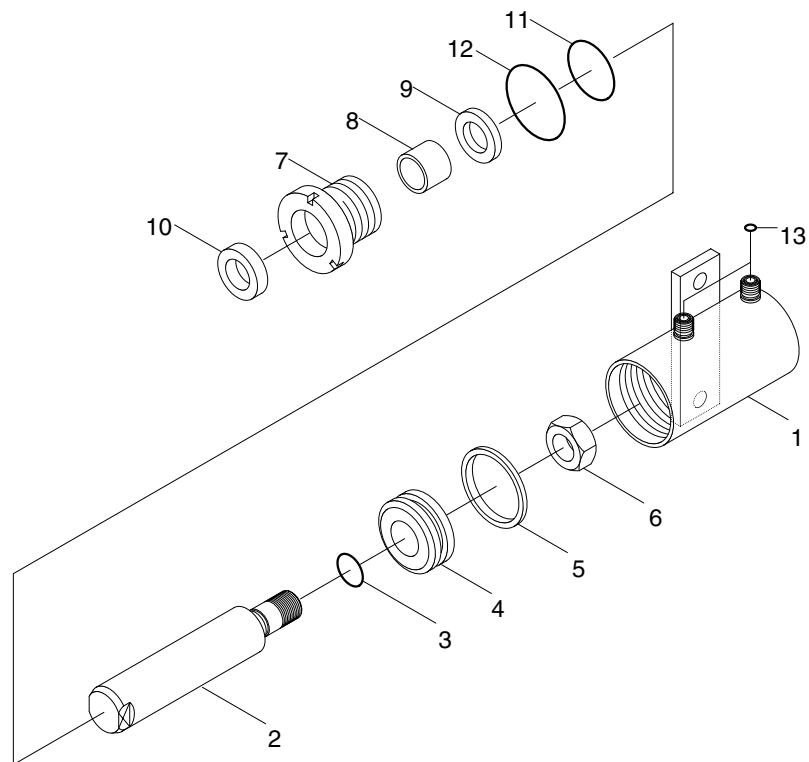
1) V-MAST



18BR9HS33

- | | | | | | |
|---|--------------|----|----------------|----|----------------|
| 1 | Tube assy | 8 | Spacer | 15 | Dust wiper |
| 2 | Rod | 9 | Retaining ring | 16 | Retaining ring |
| 3 | Piston | 10 | Stop ring | 17 | Rod bush |
| 4 | U-packing | 11 | Cushion seal | 18 | Spacer |
| 5 | Back up ring | 12 | Retaining ring | 19 | O-ring |
| 6 | Wear ring | 13 | Rod cover | 20 | Stop ring |
| 7 | Check valve | 14 | U-packing | | |

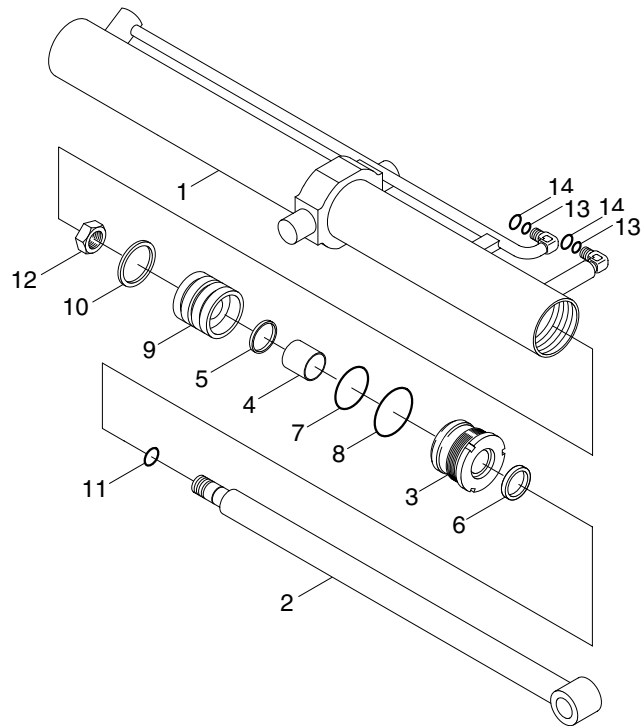
5. TILT CYLINDER



15BR9EHS19

- | | | | | | |
|---|---------------|----|------------|----|--------|
| 1 | Tube assembly | 6 | Nylon nut | 11 | O-ring |
| 2 | Rod | 7 | Gland | 12 | O-ring |
| 3 | O-ring | 8 | DU bushing | 13 | O-ring |
| 4 | Piston | 9 | Rod seal | | |
| 5 | Piston seal | 10 | Dust wiper | | |

6. REACH CYLINDER



15BR9EHS14

- | | | | | | |
|---|---------------|----|-------------|----|---------------|
| 1 | Tube assembly | 6 | Dust wiper | 11 | O-ring |
| 2 | Rod assembly | 7 | O-ring | 12 | Nylon hex nut |
| 3 | Rod cover | 8 | O-ring | 13 | O-ring |
| 4 | Rod bush | 9 | Piston | 14 | O-ring |
| 5 | U packing | 10 | Piston seal | | |

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. OPERATIONAL CHECKS

1) CHECK ITEM

- (1) Check visually for deformation, cracks or damage of rod.
- (2) Load maximum load, set mast vertical and raise 1m from ground. Wait for 2 minutes and measure hydraulic drift (amount forks move down and amount mast tilts forward).

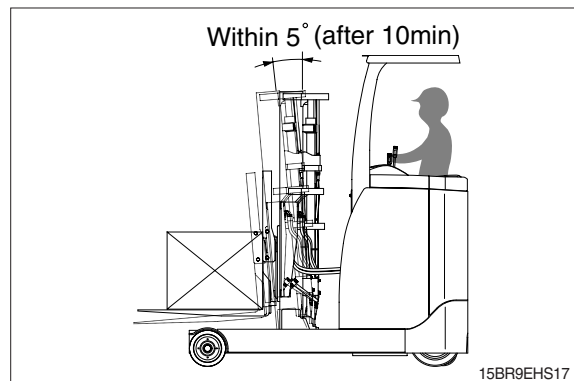
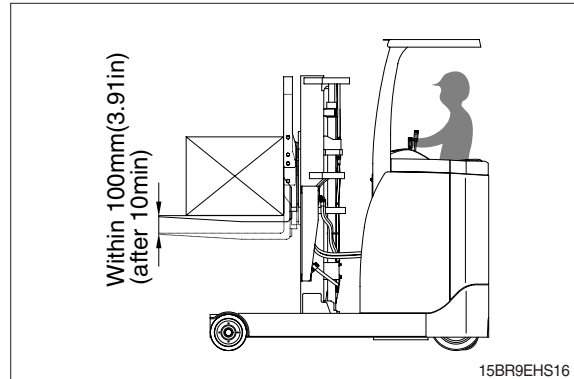
· Hydraulic drift

- Down (Downward movement of forks)
: Within 100 mm (3.9 in)
- Forward (Extension of tilt cylinder)
: Within 5°

If the hydraulic drift is more than the specified value, replace the control valve or cylinder packing.

- (3) Check that clearance between tilt cylinder bushing and mounting pin is within standard range.

	mm (in)
Standard	Under 0.6 (0.02)



2) CHECK AND SUPPLY HYDRAULIC OIL

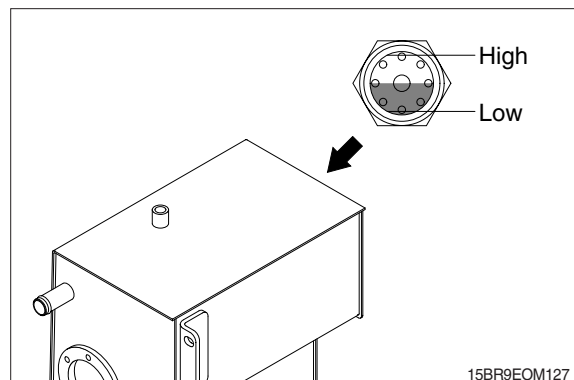
Check the hydraulic sump tank fluid level. Correct fluid level is important for proper system operation. Low fluid level can cause pump damage.

Hydraulic fluid expands as its temperature rises. Therefore, it is preferable to check the fluid level at operating temperature (after approximately 30 minutes of truck operation).

To check the fluid level, first park the truck on a level surface and apply the parking brake.

Put the mast upright in a vertical position and lower the fork carriage fully down. Check the hydraulic oil level. Keep the oil level above the LOW mark by adding recommended hydraulic fluid only, as required. **Do not overfill.**

Check the condition of the hydraulic fluid (age, color or clarity, contamination). Change (replace) the oil as necessary.



3) CONTROL VALVE

- (1) Raise forks to maximum height and measure oil pressure. Check that oil pressure.

- 15BR-9E : 190 kgf/cm² (2700 psi)

2. TROUBLESHOOTING

1) SYSTEM

Problem	Cause	Remedy
Large fork lowering speed	<ul style="list-style-type: none"> Seal inside control valve defective. Oil leaks from joint or hose. Seal inside cylinder defective. 	<ul style="list-style-type: none"> Replace spool or valve body. Replace. Replace packing.
Large spontaneous tilt of mast	<ul style="list-style-type: none"> Tilting backward : Check valve defective. Tilting forward : tilt lock valve defective. Oil leaks from joint or hose. Seal inside cylinder defective. 	<ul style="list-style-type: none"> Clean or replace. Clean or replace. Replace. Replace seal.
Slow fork lifting or slow mast tilting	<ul style="list-style-type: none"> Lack of hydraulic oil. Hydraulic oil mixed with air. Oil leaks from joint or hose. Excessive restriction of oil flow on pump suction side. Relief valve fails to keep specified pressure. Poor sealing inside cylinder. High hydraulic oil viscosity. Mast fails to move smoothly. Oil leaks from lift control valve spool. Oil leaks from tilt control valve spool. 	<ul style="list-style-type: none"> Add oil. Bleed air. Replace. Clean filter. Adjust relief valve. Replace packing. Change to SAE10W, class CD engine oil. Adjust roll to rail clearance. Replace spool or valve body. Replace spool or valve body.
Hydraulic system makes abnormal sounds	<ul style="list-style-type: none"> Excessive restriction of oil flow pump suction side. Gear or bearing in hydraulic pump defective. 	<ul style="list-style-type: none"> Clean filter. Replace gear or bearing.
Control valve lever is locked	<ul style="list-style-type: none"> Foreign matter jammed between spool and valve body. Valve body defective. 	<ul style="list-style-type: none"> Clean. Tighten body mounting bolts uniformly.
High oil temperature	<ul style="list-style-type: none"> Lack of hydraulic oil. High oil viscosity. Oil filter clogged. 	<ul style="list-style-type: none"> Add oil. Change to SAE10W, class CD engine oil. Clean filter.

2) HYDRAULIC GEAR PUMP

Problem	Cause	Remedy
Pump does not develop full pressure	<ul style="list-style-type: none"> • System relief valve set too low or leaking. • Oil viscosity too low. • Pump is worn out. 	<ul style="list-style-type: none"> • Check system relief valve for proper setting. • Change to proper viscosity oil. • Repair or replace pump.
Pump will not pump oil	<ul style="list-style-type: none"> • Reservoir low or empty. • Suction strainer clogged. 	<ul style="list-style-type: none"> • Fill reservoir to proper level. • Clean suction strainer.
Noisy pump caused by cavitation	<ul style="list-style-type: none"> • Oil too thick. • Oil filter plugged. • Suction line plugged or too small. 	<ul style="list-style-type: none"> • Change to proper viscosity. • Clean filters. • Clean line and check for proper size.
Oil heating	<ul style="list-style-type: none"> • Oil supply low. • Contaminated oil. • Setting of relief valve too high or too low. • Oil viscosity too low. 	<ul style="list-style-type: none"> • Fill reservoir to proper level. • Drain reservoir and refill with clean oil. • Set to correct pressure. • Drain reservoir and fill with proper viscosity.
Foaming oil	<ul style="list-style-type: none"> • Low oil level. • Air leaking into suction line. • Wrong kind of oil. 	<ul style="list-style-type: none"> • Fill reservoir to proper level. • Tighten fittings, check condition of line. • Drain reservoir, fill with non-foaming oil.
Shaft seal leakage	<ul style="list-style-type: none"> • Worn shaft seal. • Worn shaft in seal area. 	<ul style="list-style-type: none"> • Replace shaft seal. • Replace drive shaft and seal.

3) MAIN RELIEF VALVE

Problem	Cause	Remedy
Can't get pressure	<ul style="list-style-type: none"> • Poppet D, E or K stuck open or contamination under seat. 	<ul style="list-style-type: none"> • Check for foreign matter between poppets D, E or K and their mating parts. Parts must slide freely.
Erratic pressure	<ul style="list-style-type: none"> • Pilot poppet seat damaged. • Poppet C sticking in D. 	<ul style="list-style-type: none"> • Replace the relief valve. • Clean and remove surface marks for free movement.
Pressure setting not correct	<ul style="list-style-type: none"> • Normal wear. Lock nut & adjust screw loose. 	<ul style="list-style-type: none"> • See ★How to set pressure on work main relief.
Leaks	<ul style="list-style-type: none"> • Damaged seats. • Worn O-rings. • Parts sticking due to contamination. 	<ul style="list-style-type: none"> • Replace the relief valve. • Install seal and spring kit. • Disassemble and clean.

★ A good pressure gauge must be installed in the line which is in communication with the main relief. A load must be applied in a manner to reach the set pressure of the main relief unit. Then, follow these steps:

- Loosen lock nut.
- Set adjusting nut to desired pressure setting.
- If desired pressure setting cannot be achieved, tighten or loosen the adjusting screw as required.
- Tighten lock nut.
- Retest in similar manner as above.

4) LIFT CYLINDER

Problem	Cause	Remedy
Oil leaks out from rod cover through rod	<ul style="list-style-type: none"> • Foreign matters on packing. • Unallowable score on rod. • Unusual distortion of dust seal. • Chrome plating is striped. 	<ul style="list-style-type: none"> • Replace packing. • Smooth rod surface with an oil stone. • Replace dust seal. • Replace rod.
Oil leaks out from cylinder rod cover thread	<ul style="list-style-type: none"> • O-ring damaged. 	<ul style="list-style-type: none"> • Replace O-ring.
Rod spontaneously retract	<ul style="list-style-type: none"> • Scores on inner surface of tube. • Unallowable score on the inner surface of tube. • Foreign matters in piston seal. 	<ul style="list-style-type: none"> • Smooth rod surface with an oil stone. • Replace cylinder tube. • Replace piston seal.
Wear (clearance between cylinder tube and wear ring)	<ul style="list-style-type: none"> • Excessive clearance between cylinder tube and wear ring. 	<ul style="list-style-type: none"> • Replace wear ring.
Abnormal noise is produced during tilting operation	<ul style="list-style-type: none"> • Insufficient lubrication of anchor pin or worn bushing and pin. • Bent tilt cylinder rod. 	<ul style="list-style-type: none"> • Lubricate or replace. • Replace.

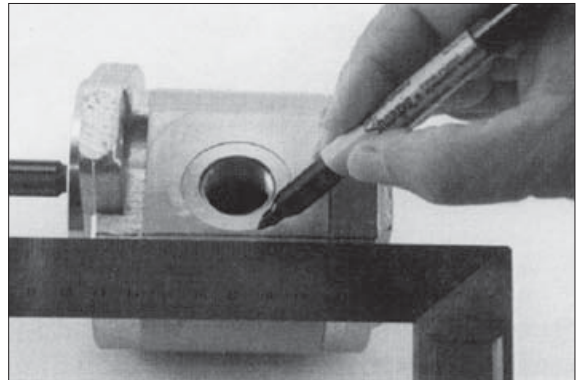
GROUP 3 DISASSEMBLY AND ASSEMBLY

1. HYDRAULIC GEAR PUMP

※ **Tools required**

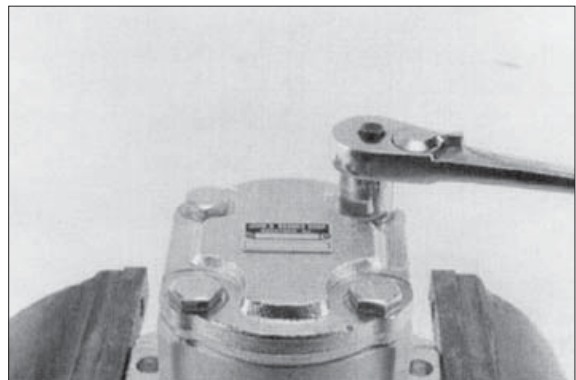
- Metric socket set
- Internal snap ring pliers
- Shaft seal sleeve
- Torque wrench

- (1) It is very important to work in a clean work area when repairing hydraulic products. Plug ports and wash exterior of pump with a proper cleaning solvent before continuing.
- (2) Remove port plugs and drain oil from pump.
- (3) Use a permanent marker pen to mark a line across the mounting flange, gear housing and end cover. This will assure proper reassembly and rotation of pump.
- (4) Remove key from drive shaft if applicable.



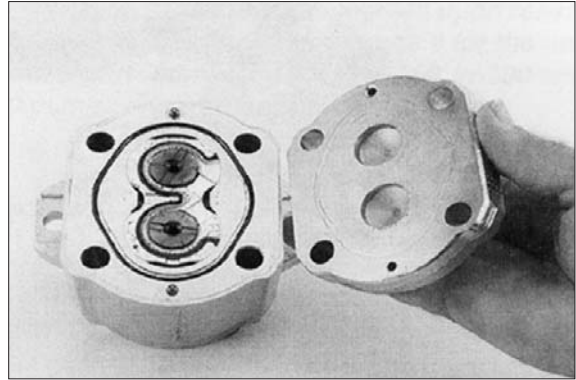
PUMP 01

- (5) Clamp mounting flange in a protected jaw vise with pump shaft facing down.
- (6) Loosen the four metric hexagon head bolts.
- (7) Remove pump from vise and place on clean work bench, remove the four hexagon head bolts and spacers applicable.



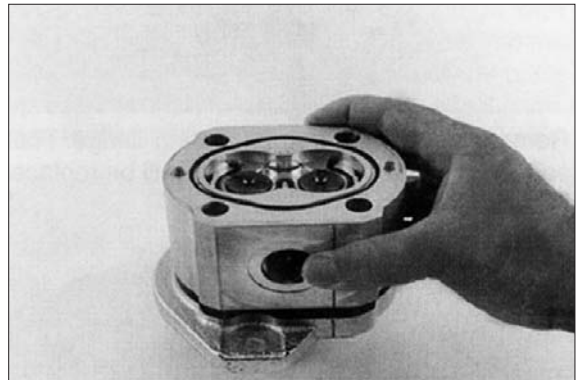
PUMP 02

(8) Lift and remove end cover.



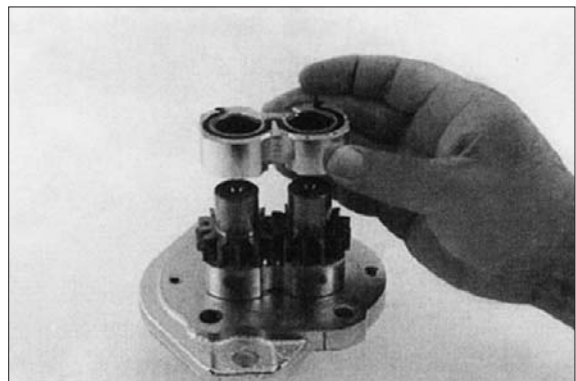
PUMP 03

(9) Carefully remove gear housing and place on work bench. Make sure the rear bearing block remains on the drive and idler shafts.



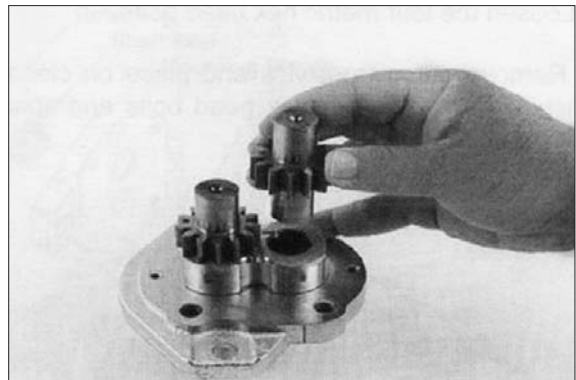
PUMP 04

(10) Remove rear bearing block from drive and idler shafts.



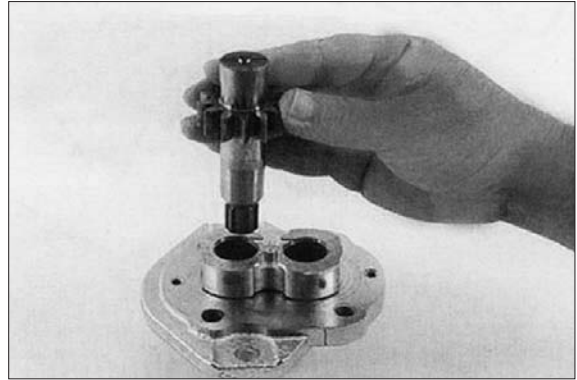
PUMP 05

(11) Remove idler shaft from bearing block.



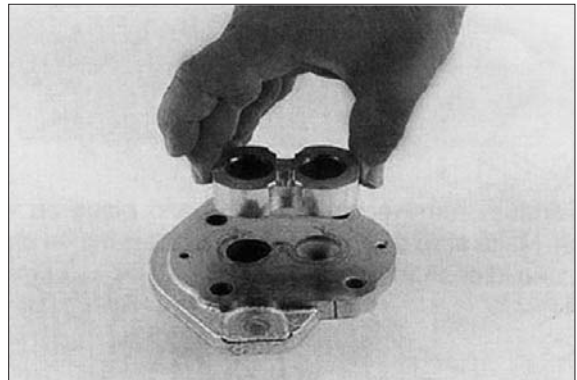
PUMP 06

- (12) Remove drive shaft from mounting flange.
There is no need to protect the shaft seal
as it will be replaced as a new item.



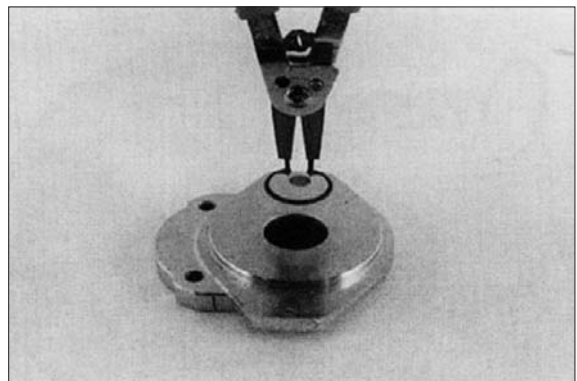
PUMP 07

- (13) Remove the front bearing block.



PUMP 08

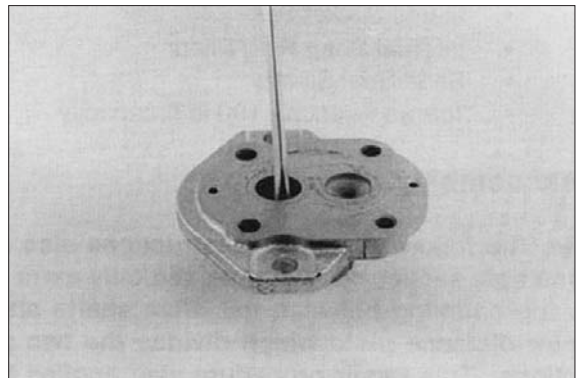
- (14) Turn mounting flange over, with shaft seal up, and remove the retaining ring with proper snap ring pliers.



PUMP 09

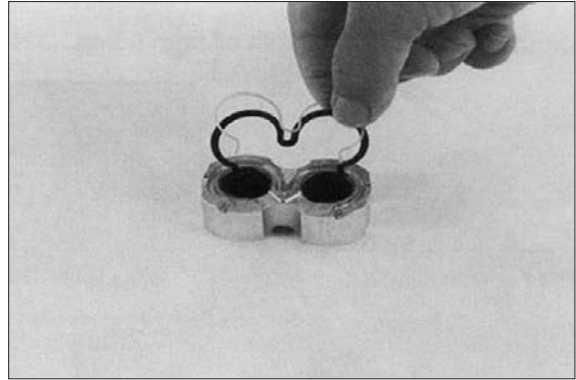
- (15) Remove the oil seal from mounting flange,
be careful not to mar or scratch the seal
bore.

- (16) Remove the dowel pins from the gear
housing. Do not lose pins.



PUMP 10

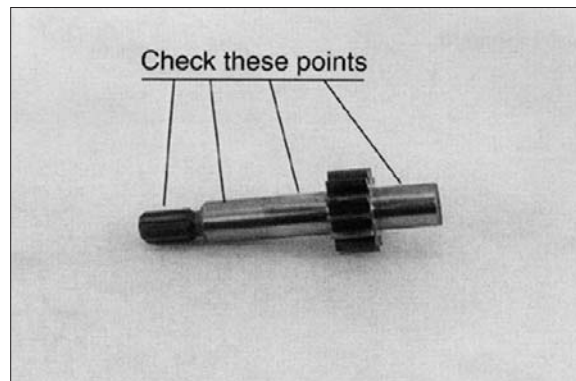
- (17) Remove seals from both bearing blocks and discard.



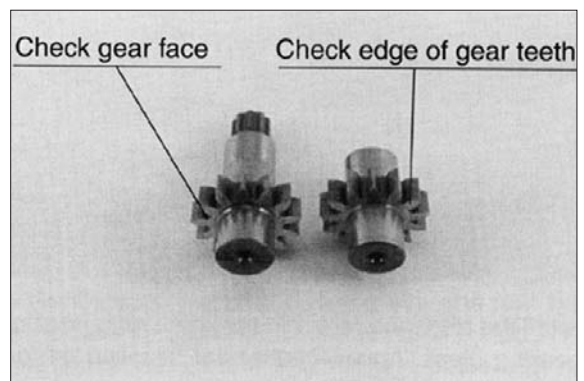
PUMP 11

2) INSPECT PARTS FOR WEAR

- (1) Clean and dry all parts thoroughly prior to inspection. It is not necessary to inspect the seals as they will be replaced as new items.
- (2) Check drive shaft spline for twisted or broken teeth, check keyed drive shaft for broken or chipped keyway. No marks or grooves on shaft in seal area, some discoloration of shaft is allowable.
- (3) Inspect both the drive gear shaft and idler gear shafts at the bearing points and seal area for rough surfaces and excessive wear.
- (4) Inspect gear face for scoring or excessive wear. If the face edge of gear teeth are sharp, they will mill into the bearing blocks. If wear has occurred, the parts are unusable.



PUMP 12



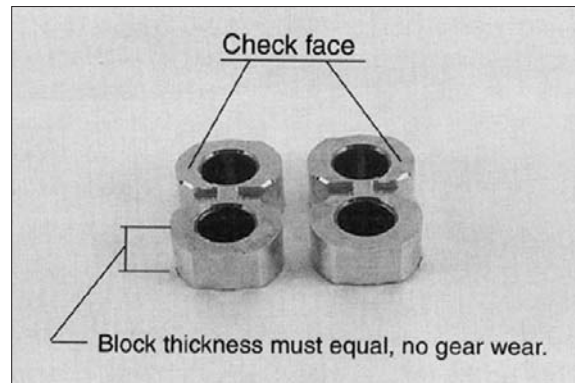
PUMP 13

- (5) Inspect bearing blocks for excessive wear or scoring on the surfaces which are in contact with the gears. Also inspect the bearings for excessive wear or scoring.
- (6) Inspect the area inside the gear housing. It is normal for the surface inside the gear housing to show a clean "wipe" on the inside surface on the intake side. There should not be excessive wear or deep scratches and gouges.

※ **General information**

It is important that the relationship of the mounting flange, bearing blocks and gear housing is correct. Failure to properly assemble this pump will result with little or no flow at rated pressure.

- ※ **This pump is not bi-rotational.**

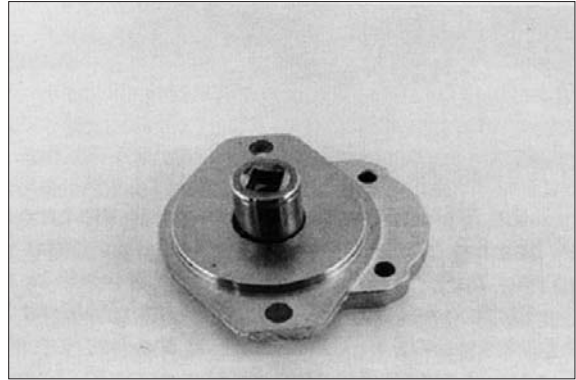


PUMP 14

3) ASSEMBLY

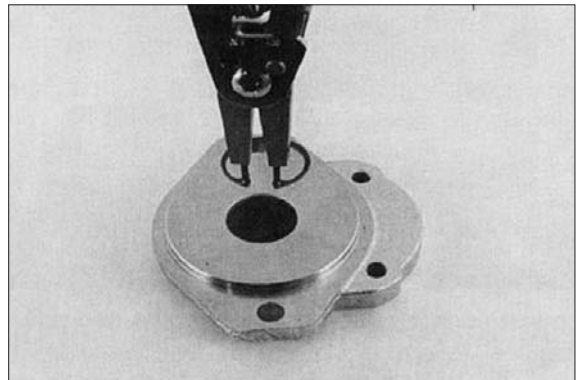
※ **New seals should be installed upon reassembly of pump.**

- (1) Install new shaft seal in mounting flange with part number side facing outboard. Press the seal into the seal bore until the seal reaches the bottom of the bore. Uniform pressure must be used to prevent misalignment or damage to the seal.



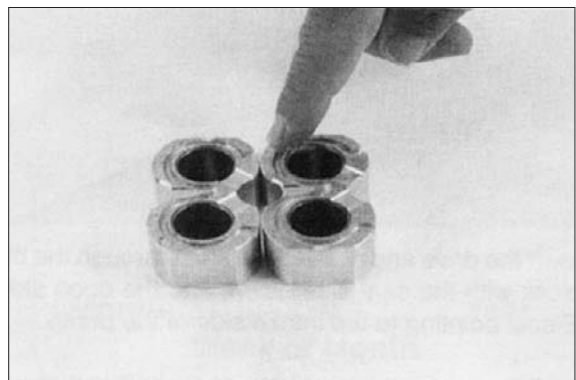
PUMP 15

- (2) Install retaining ring in groove in seal bore of mounting flange.



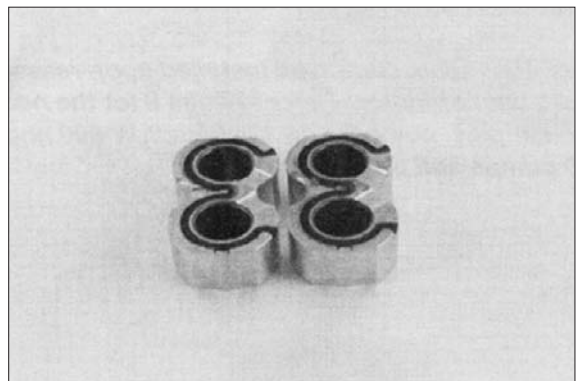
PUMP 16

- (3) Place front and back bearing blocks on a clean surface with the E-seal grooves facing up. Apply a light coating of petroleum jelly in the grooves. Also coat the E-seal and backup with the petroleum jelly, this will help keep the seals in place during assembly.



PUMP 17

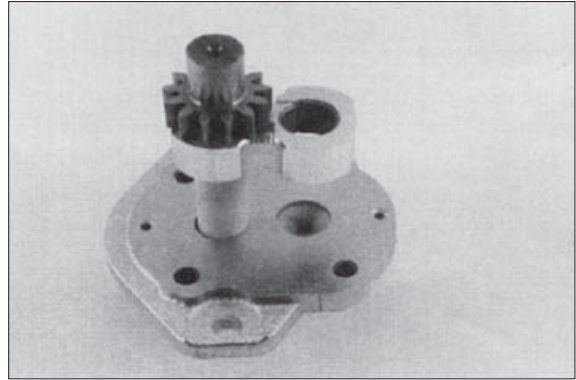
- (4) Place the E-seals, flat side outward, into the grooves in both bearing blocks. Follow by carefully placing the backup ring, flat side outward, in the groove made by the E-seal and the groove in the bearing block.
- (5) Place mounting flange, with shaft seal side down, on a clean flat surface.
- (6) Apply a light coating of petroleum jelly to the exposed face of the front bearing block.



PUMP 18

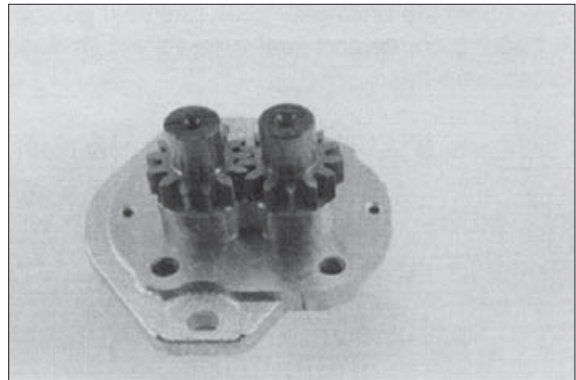
- (7) Insert the drive end of the drive shaft through the bearing block with the seal side down, and the open side of the E-seal pointing to the intake side of the pump.

- (8) Install the seal sleeve over the drive shaft and carefully slide the drive shaft through the shaft seal. Remove the seal sleeve from shaft.



PUMP 19

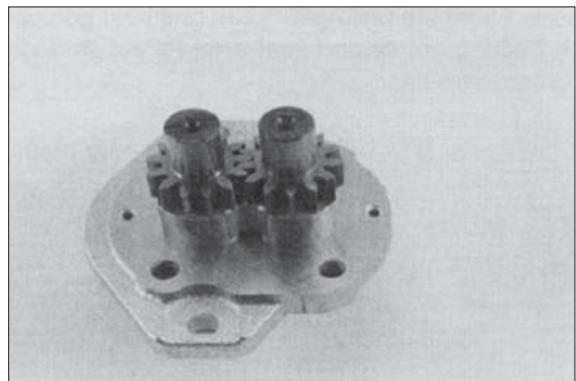
- (9) Install the idler gear shaft in the remaining position in the bearing block. Apply a light coat of clean oil to the face of the drive and idler gears.



PUMP 20

- (10) Pick up the rear bearing block, with seal side up and with open end of the E-seal facing the intake side of the pump, place over the drive and idler gear shafts.

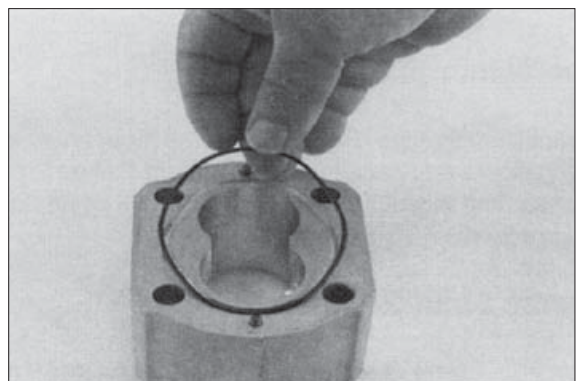
- (11) Install two dowel pins in the holes in the mounting flange or two long dowel pins through gear housing if pump is a multiple section pump.



PUMP 21

- (12) To install the O-rings in the gear housing, apply a light coating of petroleum jelly in the grooves on both sides of the gear housing.

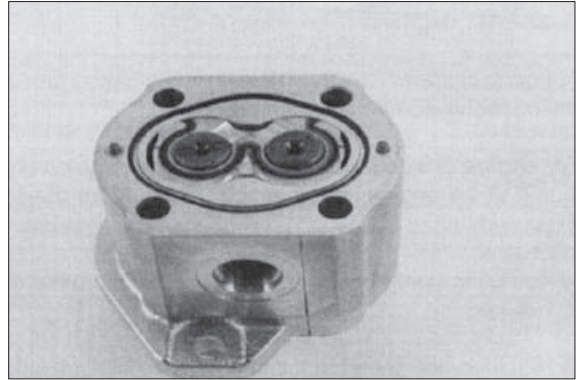
Also coat the new O-ring and install them in the grooves.



PUMP 22

- (13) Gently slide the gear housing over the rear bearing block assembly, slide housing down until the housing engages the dowel pins. Press firmly in place with hands, do not force or use any tool.

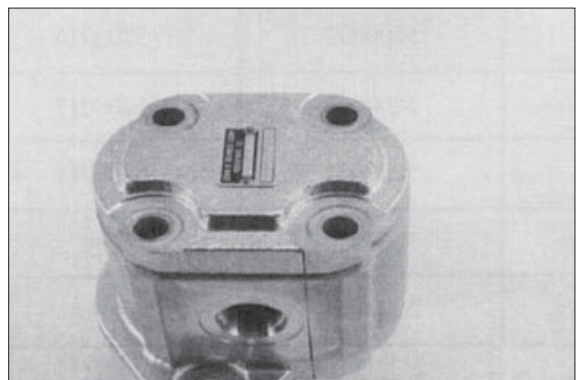
Check to make sure the intake port in the housing is on the same side as the open end of the E-seal and that the marked lines on the mounting flange and gear housing are in alignment.



PUMP 23

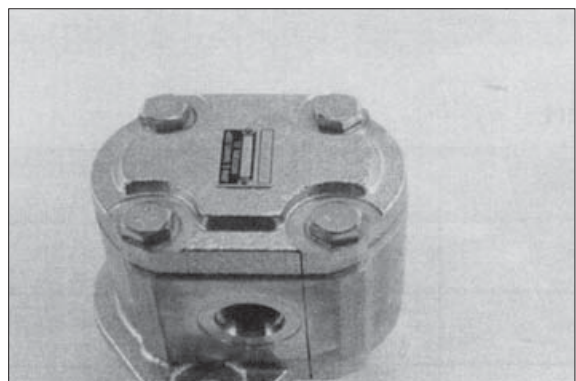
- (14) The surface of the rear bearing block should be slightly below the face of the gear housing. If the bearing block sits higher than the rear face of the gear housing then the E-seal or O-ring have shifted out of the groove. If this is the case, remove the gear housing and check for proper seal installation.

- (15) Install the two remaining dowel pins in the rear of the gear housing and place the end cover over the back of the pump.



PUMP 24

- (16) Install the four spacers and hexagon head bolts through the bolt holes in the end cover, hand tighten.



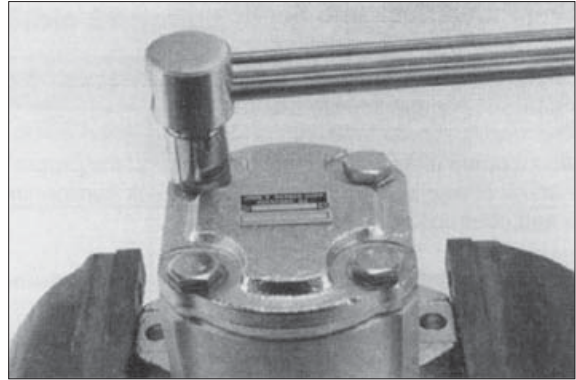
PUMP 25

(17) Place mounting flange of the pump back in the protected jawed vise and alternately torque the bolts.

- Tighten torque : 6~7 kgf · m
(43.4~50.6 lbf · ft)

(18) Remove pump from vise.

(19) Place a small amount of clean oil in the inlet of the pump and rotate the drive shaft away from the inlet one revolution. If the drive shaft binds, disassemble the pump and check for assembly problems, then reassemble the pump.



PUMP 26

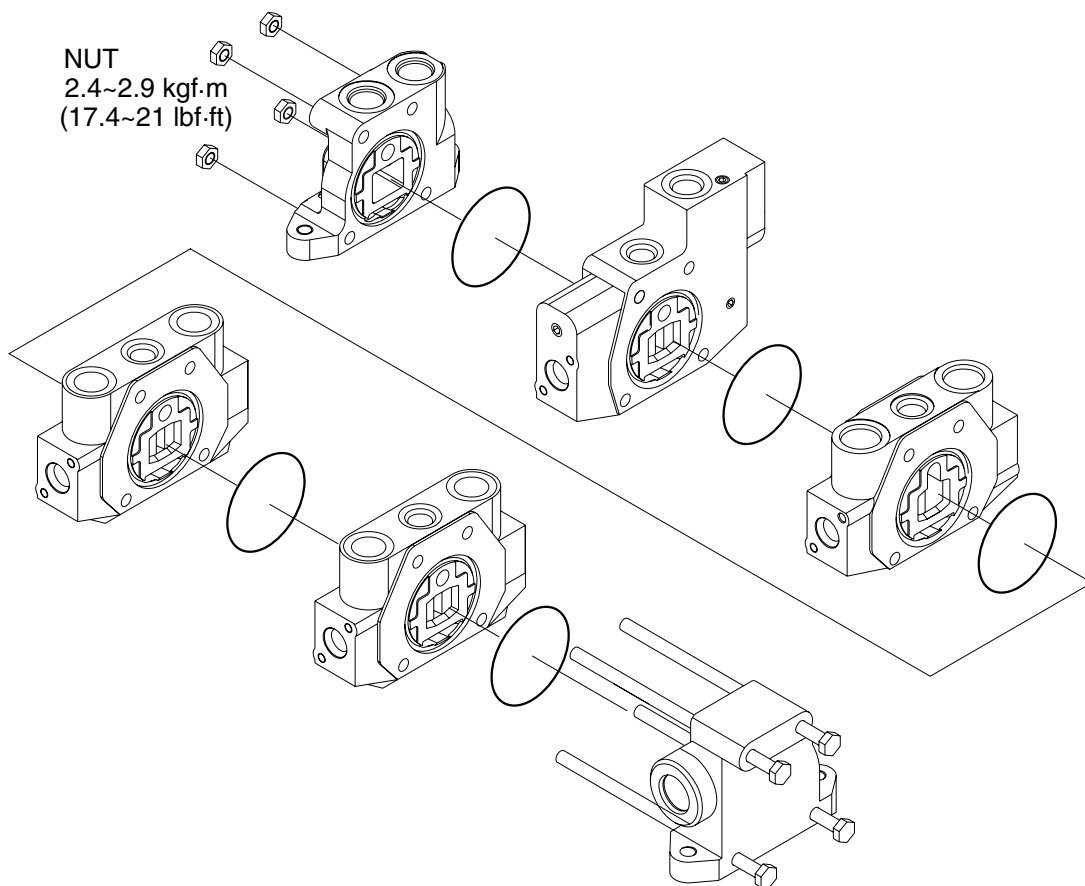
2. MAIN CONTROL VALVE

1) ASSEMBLY

(1) General

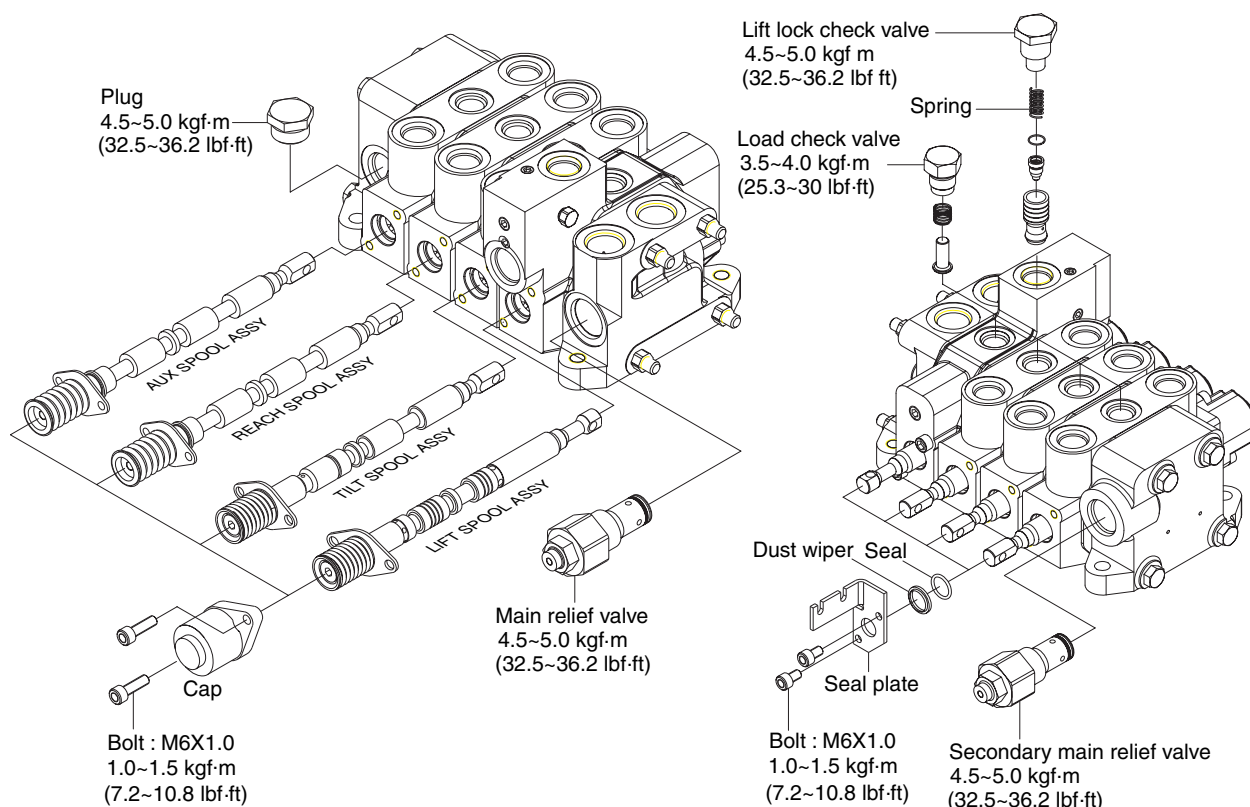
- ① Ensure that the assembly area will be clean and free of contamination.
- ② Use a flat (within 0.2 mm) work surface when bolting the valve sections together.
- ③ Use calibrated torque wrenches and instrumentation.
- ④ The formal Bills of Material, descriptions, and views are found in the attached documentation.
- ⑤ Additional auxiliary valve sections may be added to the main control valve in a similar manner as indicated below, as approved by the O.E.M.

(2) Block subassembly



22B7HS21

- ① Attach all the O-rings to the appropriate grooves between the spool sections.
- ② Stack the valve sections such that all the work ports are facing up, the spool ends are all in the same direction, and they are resting on a flat (within 0.2 mm), uniform surface.
- ③ Insert all the tie rods through the drilled holes in each of the housings.
- ④ Press the sections together, being carefully not to damage sealing surfaces or seals.
- ⑤ Install nuts to both ends of all tie rods and progressively torque in a circular pattern until reaching a torque of 2.4~2.9 kgf · m (17.4~21 lbf · ft) on all tie rods. Periodically, make sure that the valve remains flat while applying torque.



18BR9HS25

(3) Inlet section

- ① Install the main relief valve assembly into the lower side cavity of the inlet section, as illustrated.
Torque to 4.5~5.0 kgf · m (32.5~36.2 lbf · ft).
- ② Install the plug assembly in the tank port of the inlet section.
Torque to 4.5~5.0 kgf · m (32.5~36.2 lbf · ft)

(4) Lift section

- ① The spool assembly should already consist of the lift spool, the return spring, one spring seat on either end of the spring, the seal plate, a spool seal, and a dust wiper. All of these are assembled on the end of the spool opposite the clevis.
- ② Insert the clevis end of the spool into the right-hand side of the spool bore(the tallest end of the housing). Place the spool cap over the spool and spring assembly and connect the cap to the housing using two bolts. Torque both bolts alternatively until a torque of 1.0~1.5 kgf · m (7.2~10.8 lbf · ft) is reached on both bolts.
- ③ Install the second spool seal and dust wiper over the clevis end of the spool and retain with a seal plate and two bolts. Torque both bolts alternatively until a torque of 1.0~1.5 kgf · m (7.2~10.8 lbf · ft) is reached on both bolts.
- ④ The load check assembly is inserted into the top center cavity. Torque to 3.5~4.0 kgf · m (25.3~30 lbf · ft)
- ⑤ Install the lift lock check valve assembly in the remaining open cavity in the top of the housing.
Torque to 4.5~5.0 kgf · m (32.5~36.2 lbf · ft)

(5) Tilt section

- ① The spool assembly should already consist of the tilt spool(with tilt plunger and spring inserted into the bore on the spring end), the return spring, one spring seat on either end of the spring, the seal plate, a spool seal, and a dust wiper. All of these are assembled on the end of the spool opposite the clevis.
- ② Insert the clevis end of the spool into the right-hand side of the spool bore(the tallest end of the housing). Place the spool cap over the spool and spring assembly and connect the cap to the housing using two bolts. Torque both bolts alternatively until a torque of 1.0~1.5 kgf · m (7.2~10.8 lbf · ft) is reached on both bolts.
- ③ Install the second spool seal and dust wiper over the clevis end of the spool and retain with a seal plate and two bolts. Torque both bolts alternatively until a torque of 1.0~1.5 kgf · m (7.2~10.8 lbf · ft) is reached on both bolts.
- ④ The load check assembly is inserted into the top center cavity.
Torque to 3.5~4.0 kgf · m (25.3~30 lbf · ft).
- ⑤ Install the anti-cavitation check valve in the housing cavity on the clevis end directly above the spool assembly. Torque to 4.5~5.0 kgf · m (32.5~36.2 lbf · ft).
- ⑥ Install the plug in the housing cavity above the spool assembly.
Torque to 3.5~4.0kgf · m (25.3~30 lbf · ft).

(6) Reach section

- ※ Same procedure for all aux sections, but spool assembly components may vary.
- ① The spool assembly should already consist of the proper reach spool, the return spring, one spring seat on either end of the spring, the seal plate, a spool seal, and a dust wiper. All of these are assembled on the end of the spool opposite the clevis.
 - ② Insert the clevis end of the spool into the right-hand side of the spool bore (the tallest end of the housing). Place the spool cap over the spool and spring assembly and connect the cap to the housing using two bolts. Torque both bolts alternatively until a torque of 1.0~1.5 kgf · m (7.2~10.8 lbf · ft) is reached on both bolts.
 - ③ Install the second spool seal and dust wiper over the clevis end of the spool and retain with a seal plate and two bolts. Torque both bolts alternatively until a torque of 1.0~1.5 kgf · m (7.2~10.8 lbf · ft) is reached on both bolts.
 - ④ The load check assembly is inserted into the top center cavity.
Torque to 3.5~4.0kgf · m (25.3~30lbf · ft).

(7) Auxiliary section

※ Same procedure for all aux sections, but spool assembly components may vary.

- ① The spool assembly should already consist of the proper aux spool, the return spring, one spring seat on either end of the spring, the seal plate, a spool seal, and a dust wiper. All of these are assembled on the end of the spool opposite the clevis.
- ② Insert the clevis end of the spool into the right-hand side of the spool bore (the tallest end of the housing). Place the spool cap over the spool and spring assembly and connect the cap to the housing using two bolts. Torque both bolts alternatively until a torque of 1.0~1.5 kgf · m (7.2~10.8 lbf · ft) is reached on both bolts.
- ③ Install the second spool seal and dust wiper over the clevis end of the spool and retain with a seal plate and two bolts. Torque both bolts alternatively until a torque of 1.0~1.5 kgf · m (7.2~10.8 lbf · ft) is reached on both bolts.
- ④ The load check assembly is inserted into the top center cavity.
Torque to 3.5~4.0 kgf · m (25.3~30 lbf · ft).

(8) Outlet section

- ① Install the secondary main relief valve into the cavity on the clevis end of the housing.
Torque to 4.5~5.0 kgf · m (32.5~36.2 lbf · ft)

2) DISASSEMBLY

(1) General

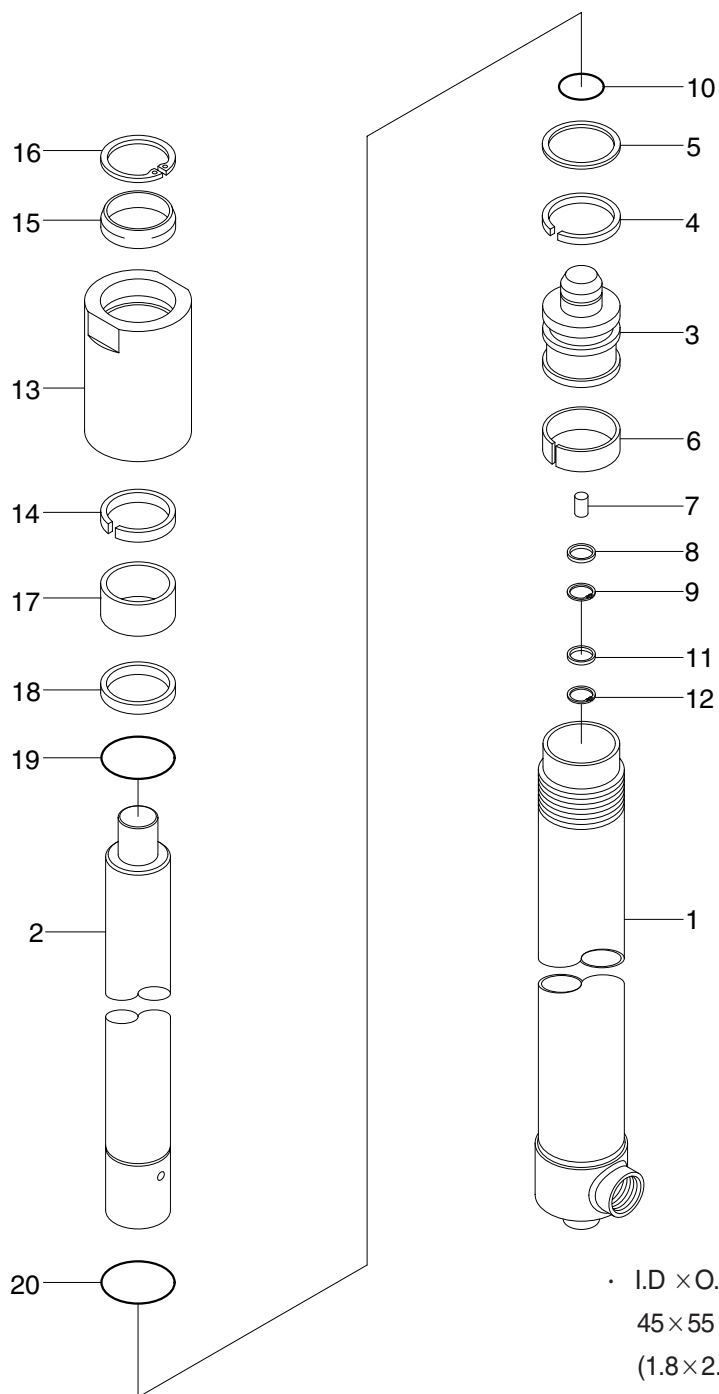
- ① Subassemblies (such as relief valves, check valves, and spools) may be removed without having to loosen the tie rods and disassembling the entire valve.
- ② Disassemble the valve sections on a flat working surface.
- ③ Ensure that the disassembly area will be clean and free of contamination.
- ④ Keep the disassembly area neat to avoid loss or damage of parts.

(2) Disassembly

- ① Loosen the tie rod nuts and remove the tie rods from the valve sections.
- ② Remove O-rings between valve sections and set aside to avoid damage.
- ③ Spools, relief valves, load check valves, lift lock poppet, solenoid valves, and plugs can all be removed from the valve sections. Refer to the associated assembly procedures, above, for specific torque and handling details. Inspect and repair or replace the assemblies as complete units, as may be necessary.
- ④ Valve components are precision items, and care must be taken when handling them to avoid damage or the introduction of contamination that could adversely affect performance.

3. LIFT CYLINDER

1) STRUCTURE



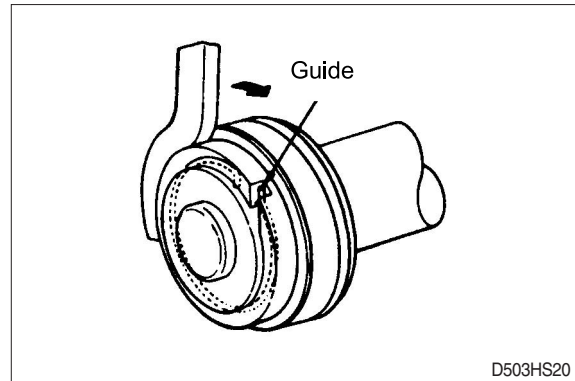
- I.D × O.D × Stroke (standard)
45 × 55 × 1645 mm
(1.8 × 2.2 × 65 in)
- Rod O.D : 35 mm (1.4 in)

18BR9HS33

- | | | |
|----------------|-------------------|-------------------|
| 1 Tube assy | 8 Spacer | 15 Dust wiper |
| 2 Rod | 9 Retaining ring | 16 Retaining ring |
| 3 Piston | 10 Stop ring | 17 Rod bush |
| 4 U-packing | 11 Cushion seal | 18 Spacer |
| 5 Back up ring | 12 Retaining ring | 19 O-ring |
| 6 Wear ring | 13 Rod cover | 20 Stop ring |
| 7 Check valve | 14 U-packing | |

2) DISASSEMBLY

- (1) Hold the cylinder tube in a vice, loosen the cylinder head and remove it.
Remove the spacer from the cylinder tube and knock out the bushing. Hook a wrench in the hole in the retainer at the piston end and turn. Lever up the edge of the guide, then turn the guide in again and the guide can be removed.



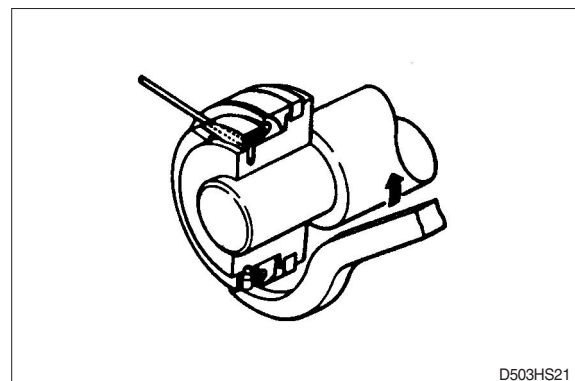
3) CHECK AND INSPECTION

mm (in)

Check item	Standard size	Repair limit	Remedy
Clearance between cylinder rod & bushing	0.072~0.288 (0.003~0.011)	0.5 (0.020)	Replace bushing
Clearance between piston ring & tube	0.05~0.030 (0.002~0.012)	0.5 (0.020)	Replace piston ring

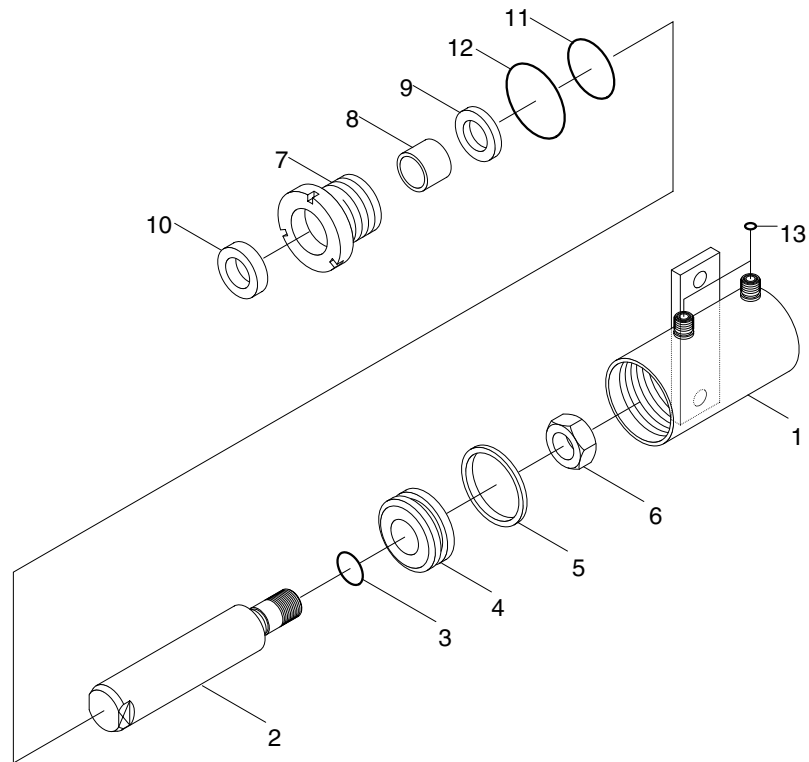
4) ASSEMBLY

- (1) Soak the piston ring in hydraulic oil at a temperature of 40 to 50°C, expand the inside diameter and assemble on the piston. Install a piston seal.
Bend the edge of the guide and rotate it to install the guide completely.



4. TILT CYLINDER

1) STRUCTURE



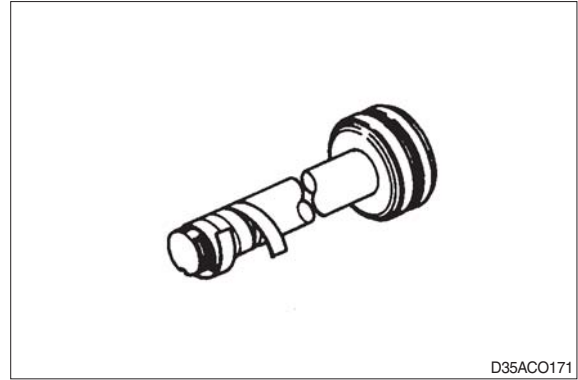
15BR9EHS19

- | | | | | | |
|---|---------------|----|------------|----|--------|
| 1 | Tube assembly | 6 | Nylon nut | 11 | O-ring |
| 2 | Rod | 7 | Gland | 12 | O-ring |
| 3 | O-ring | 8 | DU bushing | 13 | O-ring |
| 4 | Piston | 9 | Rod seal | | |
| 5 | Piston seal | 10 | Dust wiper | | |

2) DISASSEMBLY

- (1) Hold the parallel parts of the cylinder tube bottom in a vice and mark the rod head end to show how much it is screwed in, then remove the rod head. Next, hook a wrench into the notch at the cylinder head and remove the cylinder head from cylinder tube.

When doing this, wind tape round the threaded part of the rod and be careful not to damage the dust seal and rod seal inside cylinder head.



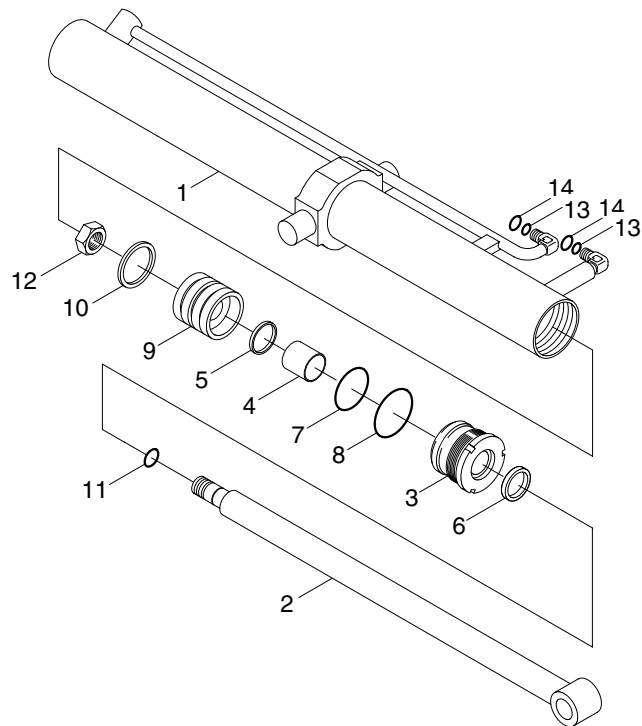
3) CHECK AND INSPECTION

mm (in)

Check item	Standard size	Repair limit	Remedy
Clearance between cylinder rod & bushing	0.072~0.288 (0.003~0.011)	0.5 (0.020)	Replace bushing
Clearance between rod head bushing & pin	0.10~0.35 (0.004~0.014)	0.6 (0.024)	Replace bushing

5. REACH CYLINDER

1) STRUCTURE



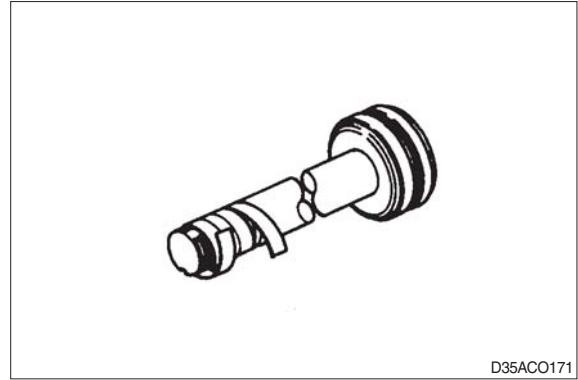
15BR9EHS14

- | | | | | | |
|---|---------------|----|-------------|----|---------------|
| 1 | Tube assembly | 6 | Dust wiper | 11 | O-ring |
| 2 | Rod assembly | 7 | O-ring | 12 | Nylon hex nut |
| 3 | Rod cover | 8 | O-ring | 13 | O-ring |
| 4 | Rod bush | 9 | Piston | 14 | O-ring |
| 5 | U packing | 10 | Piston seal | | |

2) DISASSEMBLY

- (1) Hold the parallel parts of the cylinder tube bottom in a vice and mark the rod head end to show how much it is screwed in, then remove the rod head. Next, hook a wrench into the notch at the cylinder head and remove the cylinder head from cylinder tube.

When doing this, wind tape round the threaded part of the rod and be careful not to damage the dust seal and rod seal inside cylinder head.



3) CHECK AND INSPECTION

mm (in)

Check item	Standard size	Repair limit	Remedy
Clearance between cylinder rod & bushing	0.072~0.288 (0.003~0.011)	0.5 (0.020)	Replace bushing
Clearance between rod head bushing & pin	0.10~0.35 (0.004~0.014)	0.6 (0.024)	Replace bushing