SECTION 6 WORK EQUIPMENT

GROUP 1 STRUCTURE AND FUNCTION

1. HYDRAULIC SYSTEM OUTLINE

The loader hydraulic system is a pilot operated, open center system which is supplied with flow from the fixed displacement main hydraulic pump.
The pilot control system is a low pressure, closed center hydraulic system which is supplied with flow from main pump.

The loader system components are :

- Main pump
- Main control valve
- Bucket cylinder
- Boom cylinders
- Pilot supply unit
- Remote control valve(Pilot control valve)
- Safety valve

The pilot supply unit consists of the pressure reducing valve, relief valve and accumulator.

Flow from the steering pump not used by the steering system leaves the flow amplifier EF port.
It flows to the inlet port plate of a mono block type main control valve.

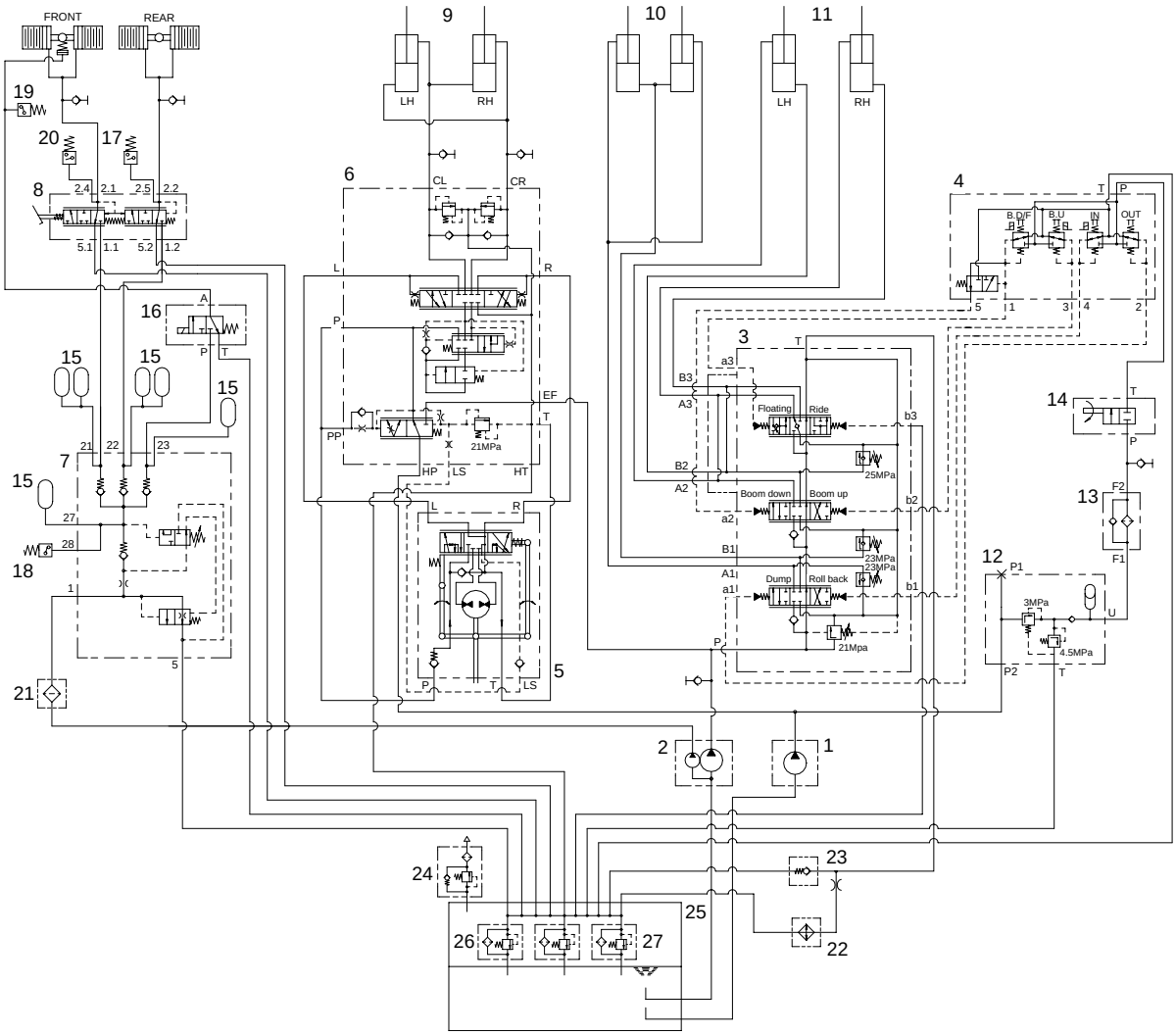
The main control valve is a tandem version spool type, open center valve which routes flow to the boom, bucket or auxiliary cylinders(Not shown) when the respective spools are shifted.

Flow from the steering pump is routed to the pilot supply unit where the steering pump outlet pressure is reduced to pilot circuit pressure. The pilot supply unit flow to the remote control valve.
The remote control valve routed flow to either end of each spool valve section in the main control valve to control spool stroke.

A accumulator mounted on pilot supply unit supplies a secondary pressure source to operated remote control valve so the boom can be lowered if the engine is off.

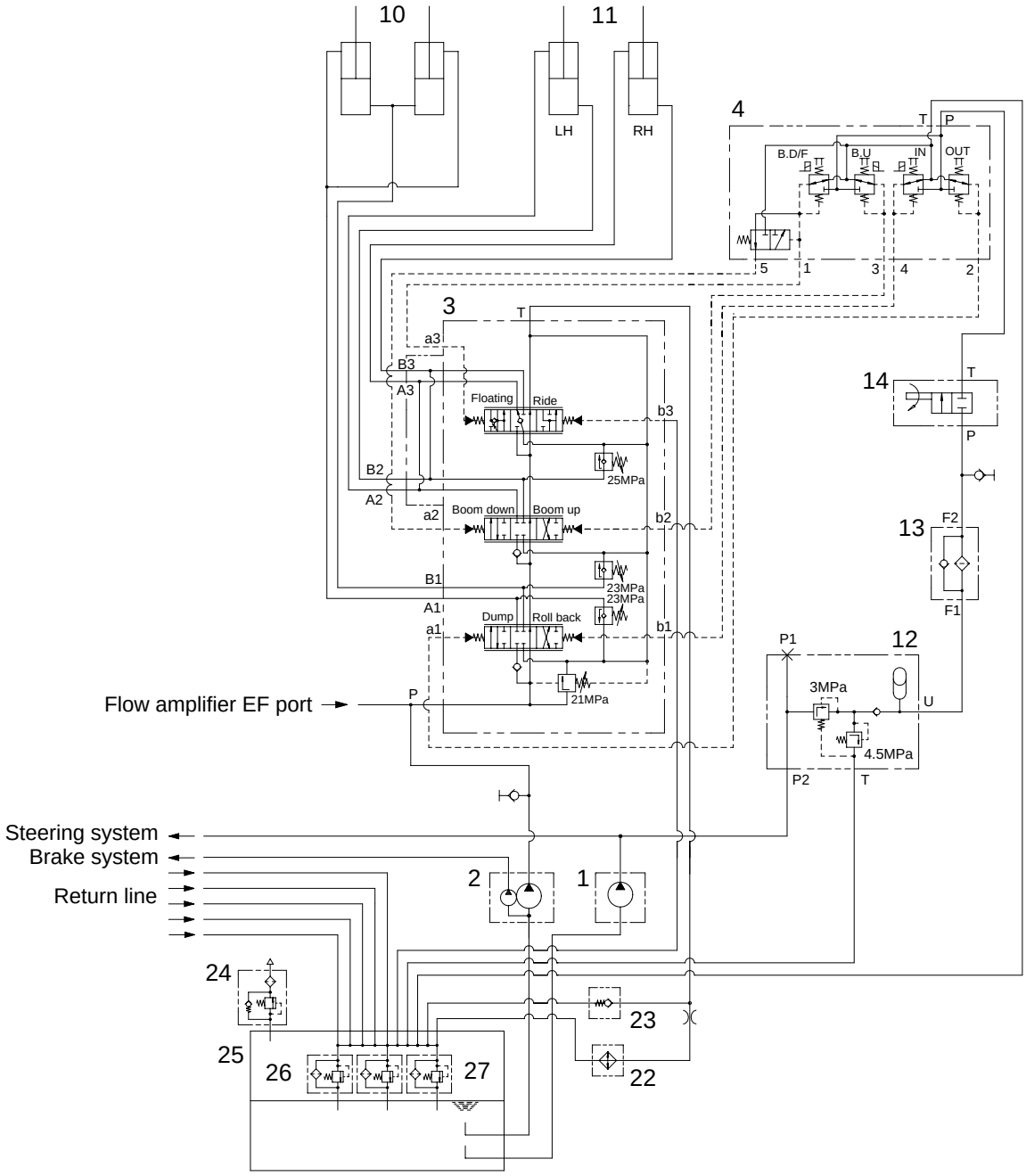
The return circuit for the main hydraulic system have return filter inside the hydraulic tank. The return filter uses a filter element and a bypass valve. The bypass valve is located in the upside of filter.

2. HYDRAULIC CIRCUIT



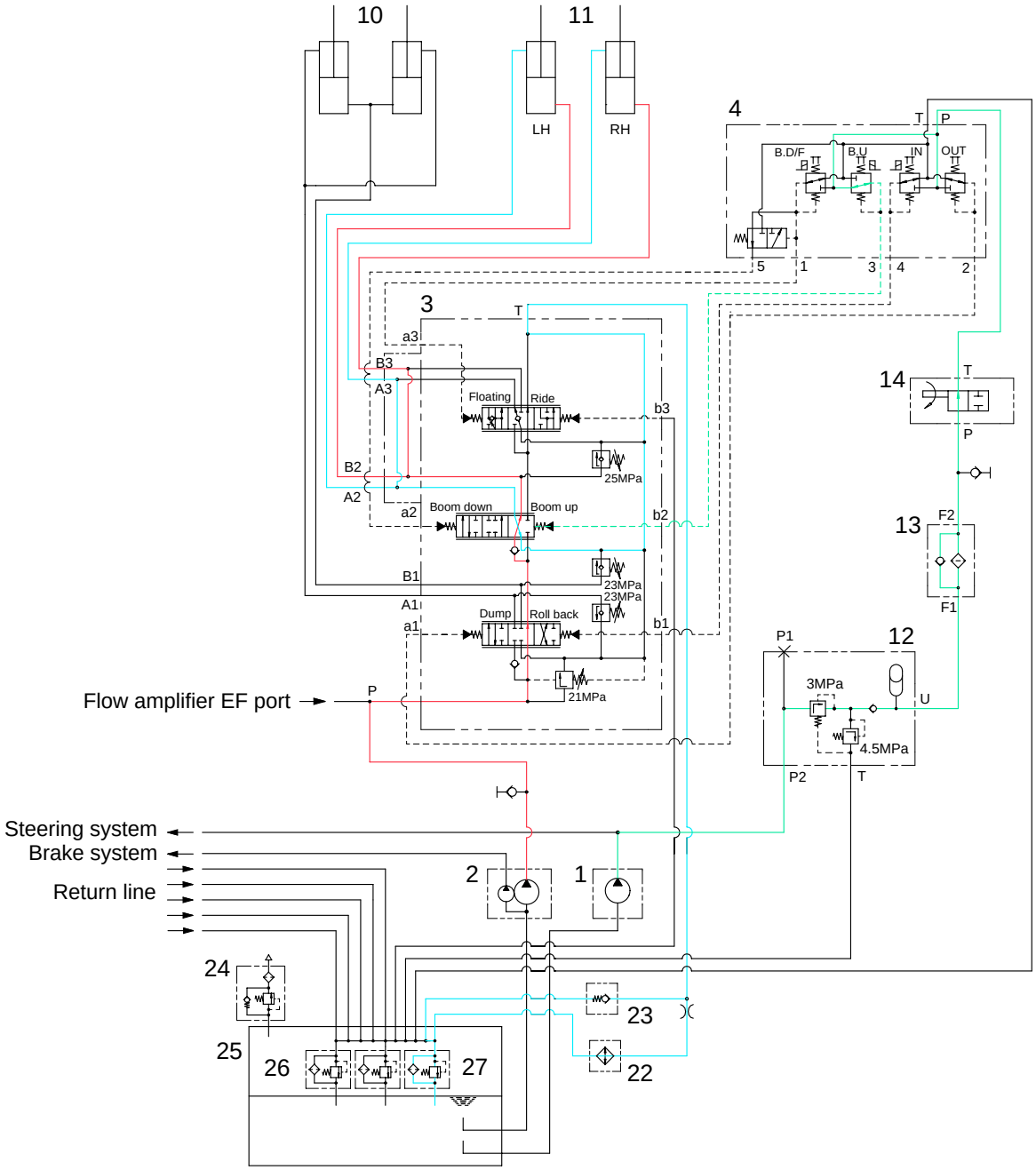
1	Steering pump	10	Bucket cylinder	19	Pressure switch
2	Main pump	11	Boom cylinder	20	Pressure switch
3	Main control valve	12	Pilot supply unit	21	Line filter
4	Remote control valve	13	Line filter	22	Oil cooler
5	Steering unit	14	Safety valve	23	Check valve
6	Flow amplifier	15	Accumulator	24	Air breather
7	Cut off valve	16	Solenoid valve	25	Hydraulic tank
8	Brake valve	17	Pressure switch	26	Return filter
9	Steering cylinder	18	Pressure switch	27	Bypass valve

3. WORK EQUIPMENT HYDRAULIC CIRCUIT



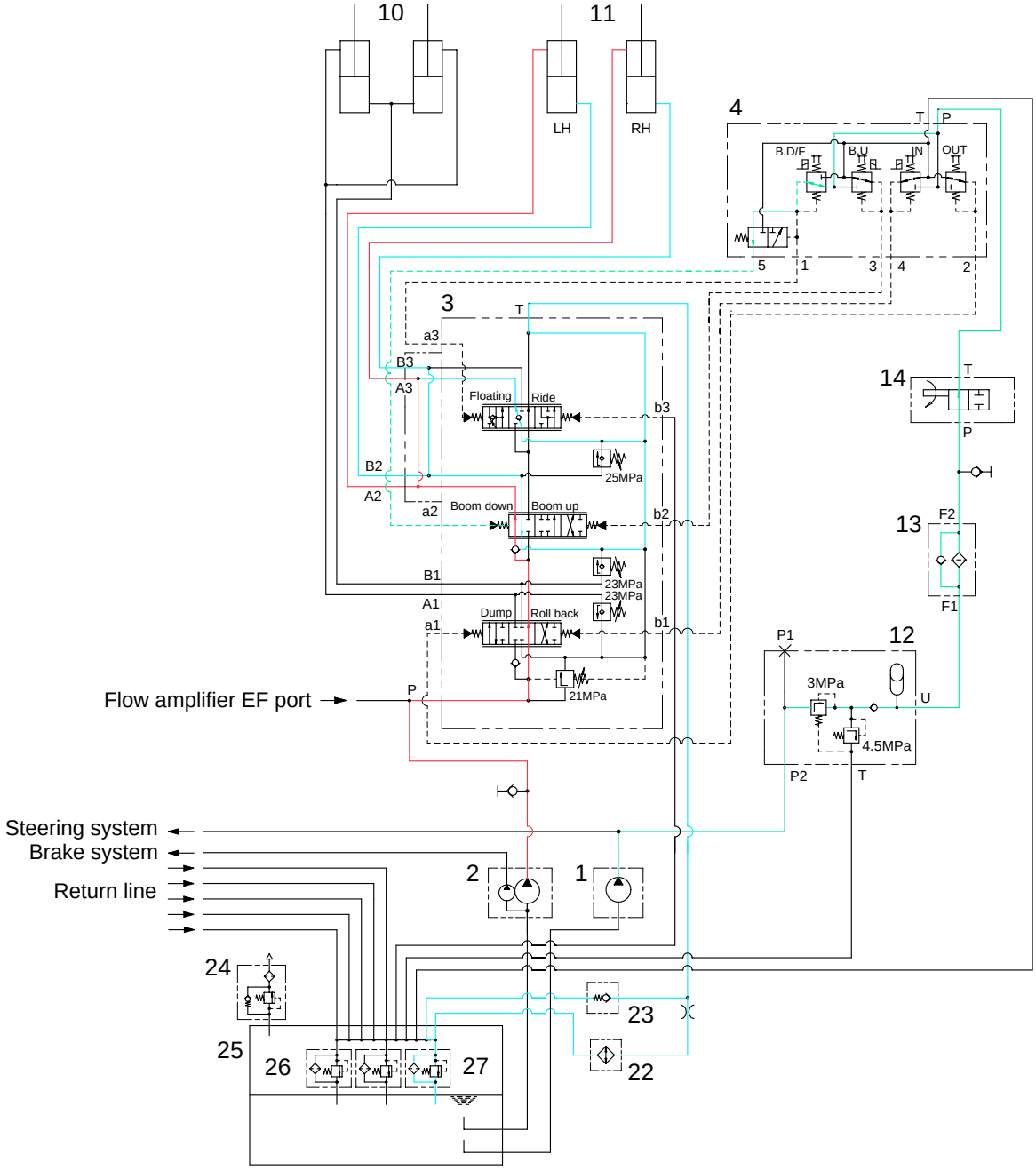
1	Steering pump	11	Boom cylinder	23	Check valve
2	Main pump	12	Pilot supply unit	24	Air breather
3	Main control valve	13	Line filter	25	Hydraulic tank
4	Remote control valve	14	Safety valve	26	Return filter
10	Bucket cylinder	22	Oil cooler	27	Check valve

1) WHEN THE RCV LEVER IS IN THE RAISE POSITION



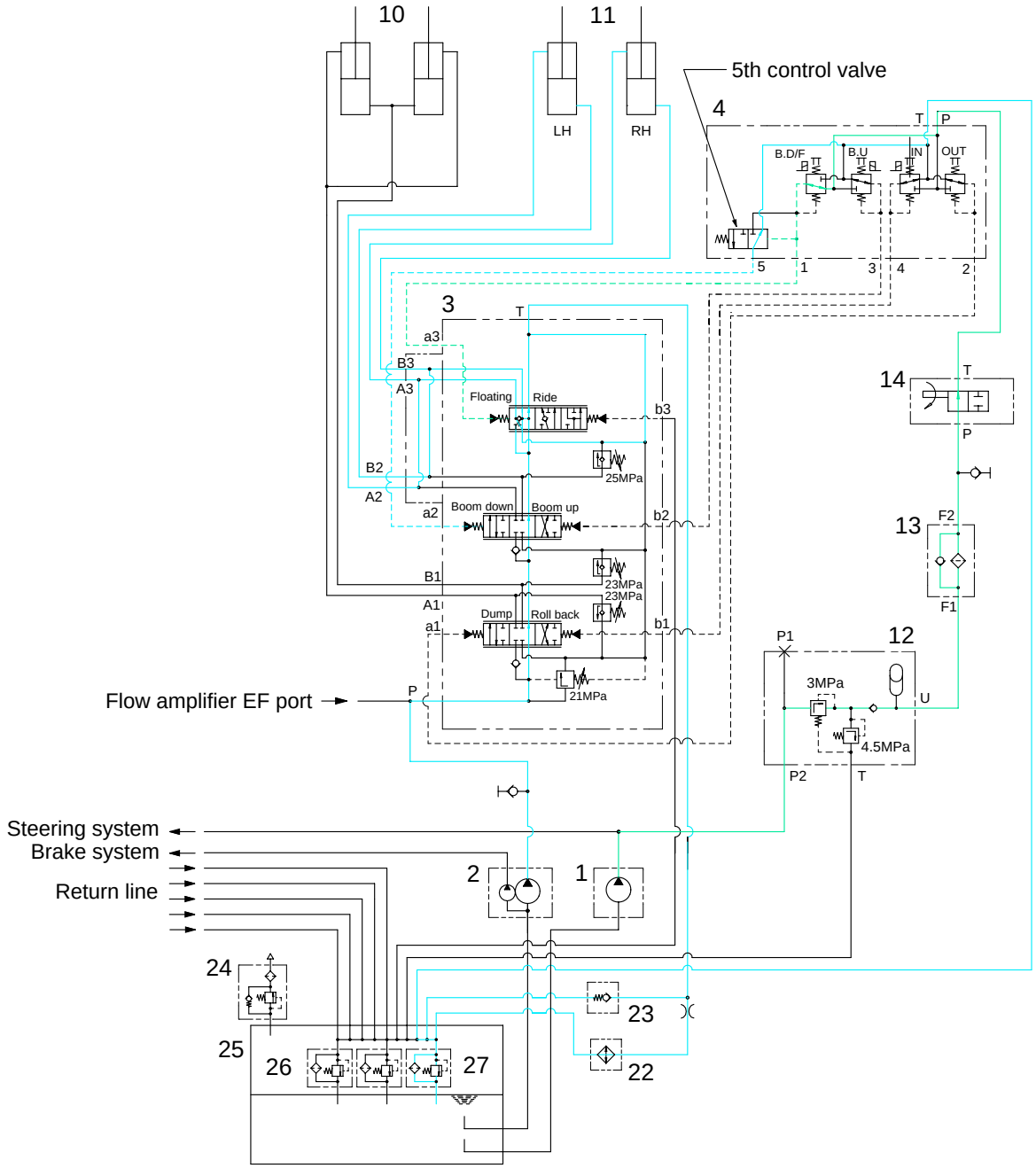
- When the RCV lever(4) is pulled back, the boom spool on the second block is moved to raise position by pilot oil pressure from port 3 of RCV.
- The oil from main pump(2) flows into main control valve(3) and then goes to the large chamber of boom cylinder (11) by pushing the load check valve of the boom spool through center bypass circuit of the bucket spool.
- The oil from the small chamber of boom cylinder(11) returns to hydraulic oil tank(25) through the boom spool at the same time.
- When this happens, the boom goes up.

2) WHEN THE RCV LEVER IS IN THE LOWER POSITION



- When the RCV lever(4) is pushed forward, the boom spool on the second block is moved to lower position by pilot pressure from port 5 of RCV.
- The oil from main pump(2) flows into main control valve and then goes to small chamber of boom cylinder(11) by pushing the load check valve of the boom spool through center bypass circuit of the bucket spool.
- The oil returned from large chamber of boom cylinder(11) returns to hydraulic tank(25) through the boom spool at the same time.
- When the lowering speed of boom is faster, the return oil from the large chamber of boom cylinder combines with the oil from the pump through the boom float spool on the third block, and flows into the small chamber of the cylinder.
  This prevents cylinder cavitation by the negative pressure when the pump flow cannot match the boom down speed.

3) WHEN THE RCV LEVER IS IN THE FLOAT POSITION

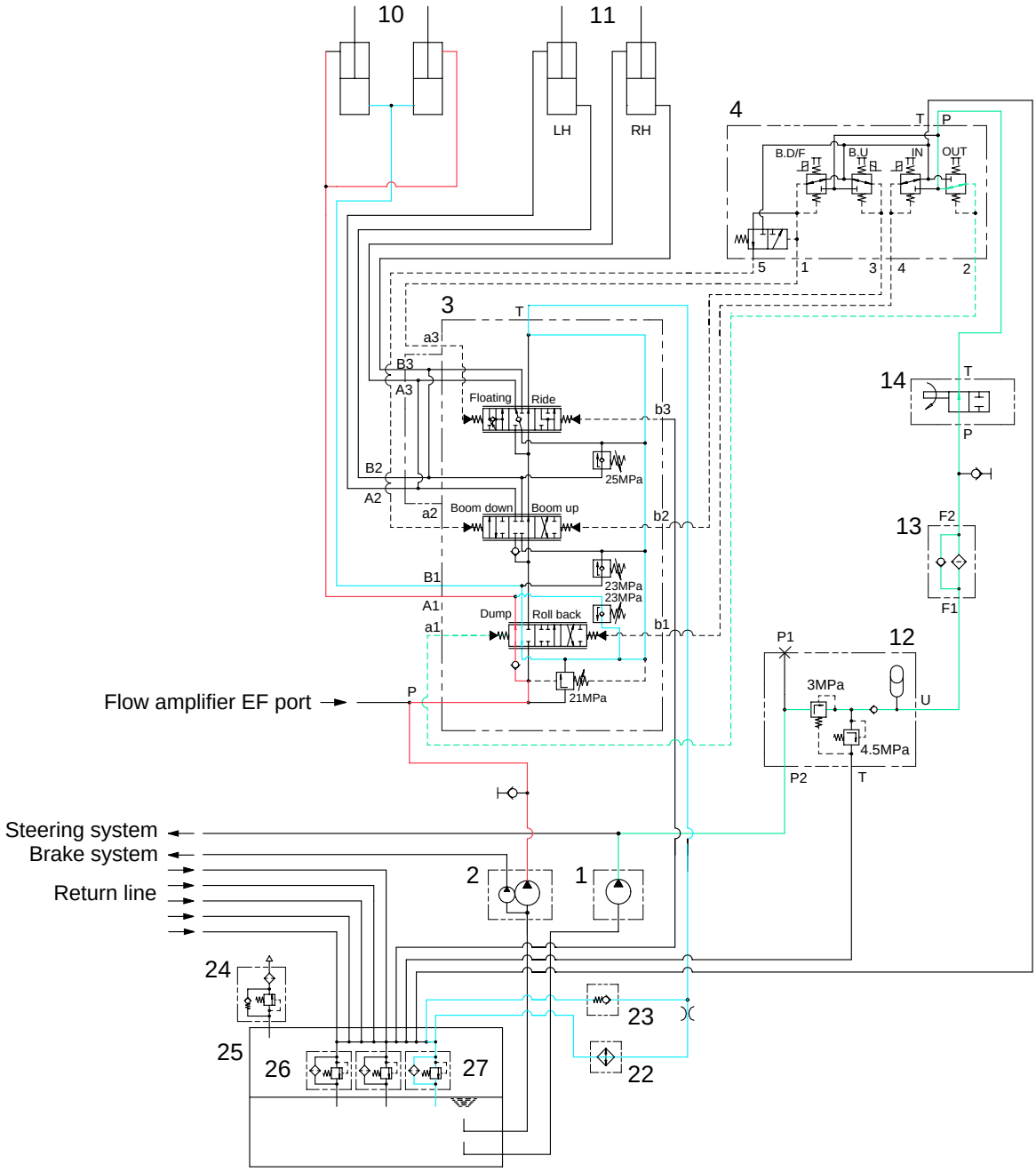


· When the RCV lever(4) is pushed further forward from the lower position, the boom down pilot port(5) is connected with tank port(T) by shift of 5th control valve. Thus, the boom spool is return to neutral position and the boom float spool is moved to float position by pilot oil pressure from port 1 of RCV.

· The work ports(A3), (B3), (A2), (B2) and the small chamber and the large chamber are connected to the return passage, so the boom will be lowered due to it's own weight.

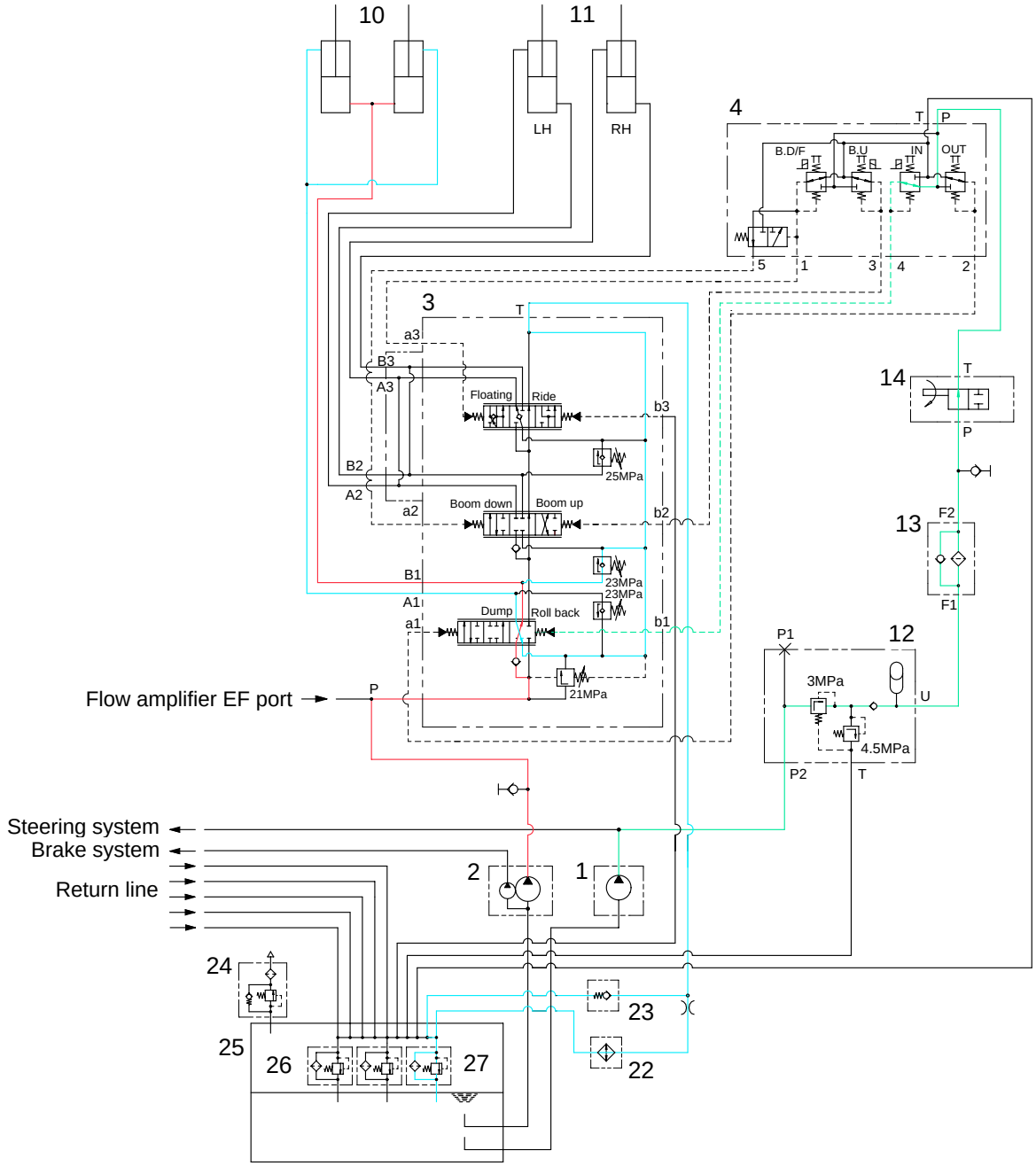
· In this condition, when the bucket is in contact with the ground, it can be move up and down in accordance with the shape of the ground.

4) WHEN THE RCV LEVER IS IN THE DUMP POSITION



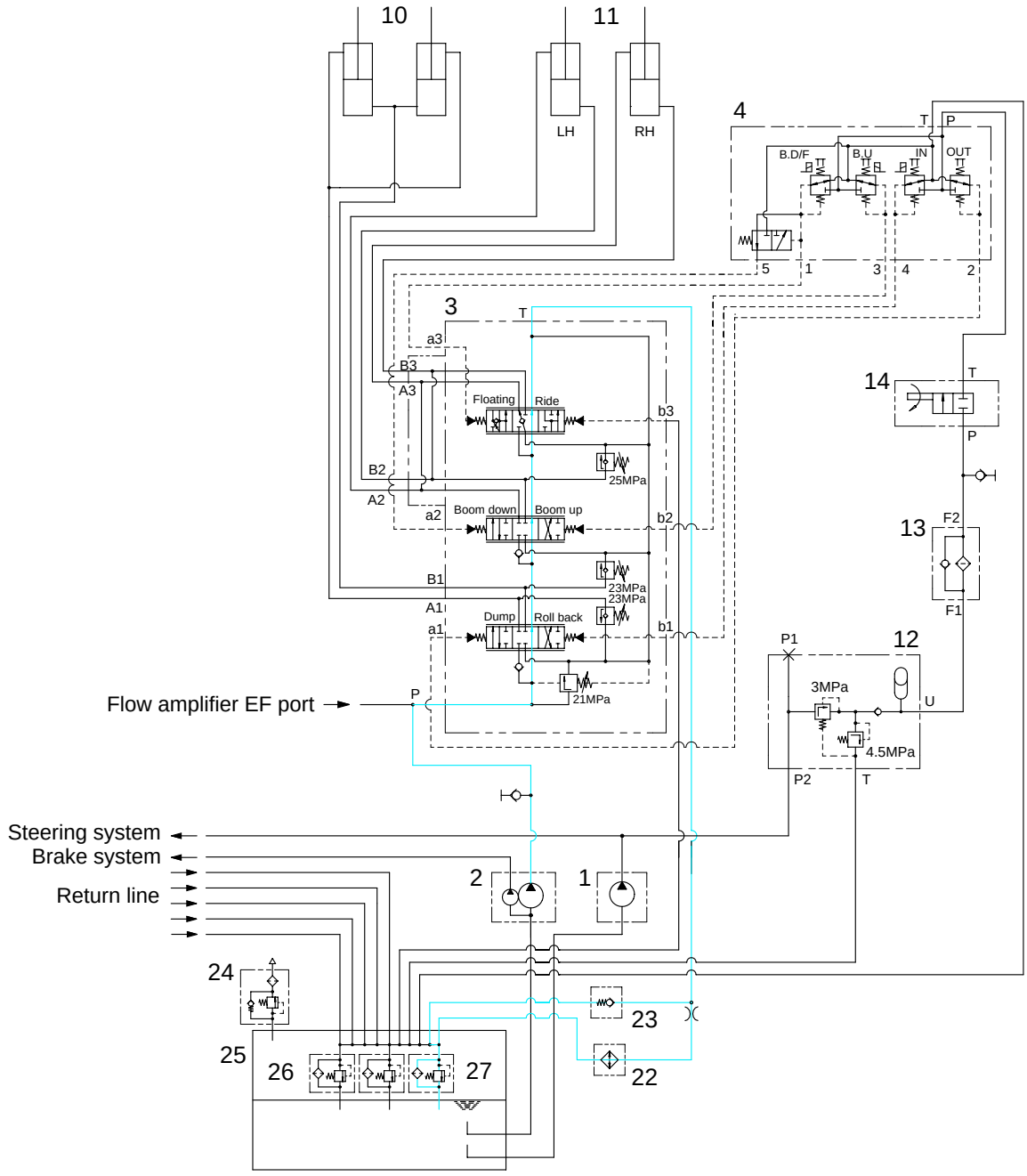
- If the RCV lever(4) is pushed right, the bucket spool on the first block is moved to dump position by pilot oil pressure from port 2 of RCV.
- The oil from main pump(2) flows into main control valve(3) and then goes to the small chamber of bucket cylinder(10) by pushing the load check valve of the bucket spool.
- The oil at the large chamber of bucket cylinder(10) returns to hydraulic tank(25) through the bucket spool.
- When this happens, the bucket is dumped.
- When the dumping speed of bucket is faster, the oil returned from the large chamber of bucket cylinder combines with the oil from the pump, and flows into the small chamber of the cylinder.
  This prevents cylinder cavitation by the negative pressure when the pump flow cannot match the bucket dump speed.

5) WHEN THE RCV LEVER IS IN THE ROLL BACK(Retract) POSITION



- If the RCV lever(4) is pulled left, the bucket spool on the first block is moved to roll back position by pilot oil pressure from port 4 of RCV.
- The oil from main pump(2) flows into main control valve(3) and then goes to the large chamber of bucket cylinder by pushing the load check valve of the bucket spool.
- The oil at the chamber of bucket cylinder(10) returns to hydraulic tank(25) through the bucket spool.
- When this happens, the bucket roll back.
- When the rolling speed of bucket is faster, the return oil from the small chamber of bucket cylinder combines with the oil from the pump, and flows into the large chamber of the cylinder.
  This prevents cylinder cavitation by the negative pressure when the pump flow cannot match the bucket rolling speed.

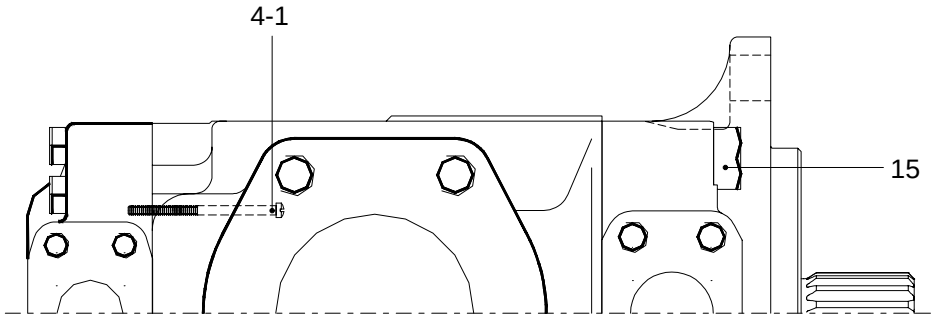
6) WHEN THE RCV LEVER IS IN THE HOLD POSITION

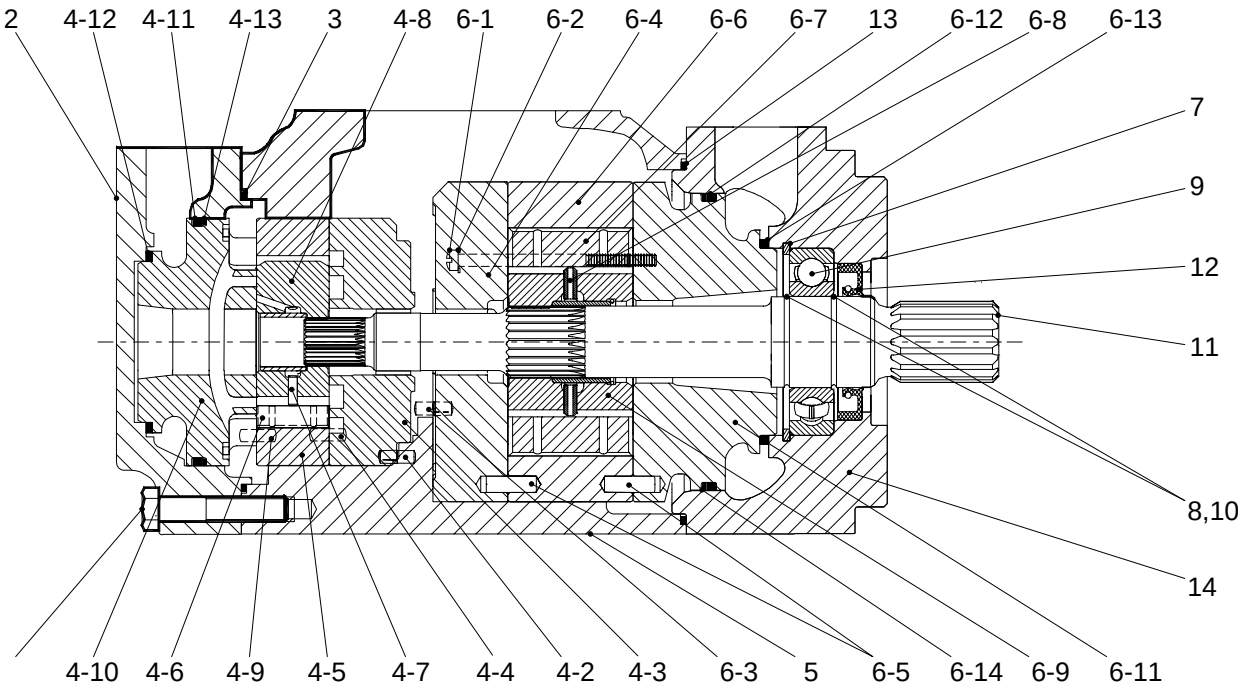


- The oil from main pump(2) flows into main control valve(3).
- In this time, the bucket spool, the boom spool and the boom float spool are in neutral position, then the oil supplied to main control valve(3) returns into hydraulic tank(25) through center bypass circuit of each spool.
- In this condition, each cylinder keeps the neutral position, so the boom and the bucket is holded.

4. MAIN PUMP OPERATION

1) STRUCTURE



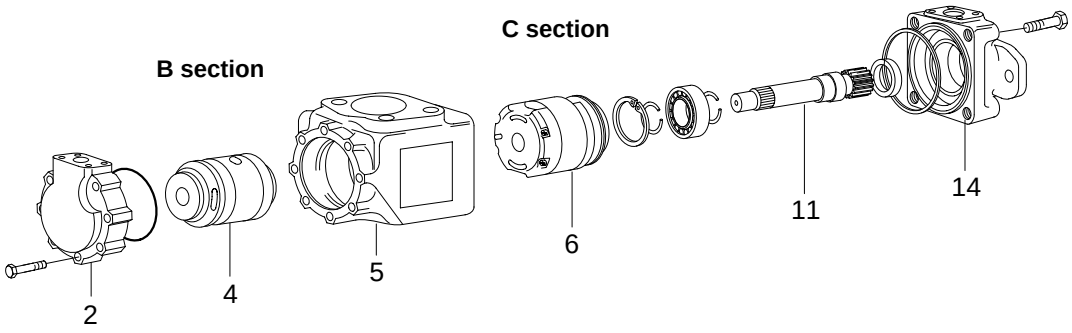


1	Cap screw	4-12	Seal	6-11	Pressure pin
2	End cap	4-13	Back up ring	6-12	Seal
3	Seal	5	Center housing	6-13	Seal
4-1	Screw	6-1	Screw	6-14	Back up ring
4-2	Lock pin	6-2	Lock washer	7	Internal snap ring
4-3	Port plate	6-3	Lock pin	8	External snap ring
4-4	Dowel pin	6-4	Port plate	9	Ball bearing
4-5	Cam ring	6-5	Dowel pin	10	External snap ring
4-6	Vane	6-6	Cam ring	11	Splined shaft
4-7	Vane holdout pin	6-7	Vane	12	Shaft seal
4-8	Rotor assy	6-8	Vane holdout pin	13	Seal
4-9	Dowel pin	6-9	Rotor assy	14	Mounting cap
4-10	Pressure plate	6-10	Dowel pin	15	Cap screw
4-11	Seal				

2) DESCRIPTION

The main vane pump consist of six basic components : end cap(2), **B** section unitlzed cartridge(4) consisting of ; rotor, vanes, vane holdout pins, cam ring, port plate, and pressure plate, center, housing(5), **D** section unitlzed cartridge(6) consisting of ; rotor, vanes, vane holdout pins, cam ring, port plate, pressure plate, shaft(11) and bearing and mounting cap(14).

The main vane pump features the use of unitized pumping cartridge for both the **D** and **B** pump section. The unitized cartridge assemblies are pretested and provide for ease of disassembly and assembly in the event it becomes necessary or desirable to make repairs, overhaul or revise the flow delivery.



3) OPERATION

The pumping operation of this unit(each cartridge) is obtained by providing a fixed interior cam surface and a rotating inner member(rotor) containing vanes which held in contact with the inner cam surface. As the rotor is rotated by the drive shaft, the vanes are urged outward against the outward sloping cam surface, forming a cavity at the inlet ports of the port plates. Atmospheric pressure and suction created by the expanding cavity between the rotating vanes fill the inlet cavity with fluid.

As the rotation continues and the vanes that had previously moved outward and now have fluid trapped between them and the port plates, follow the inward slope of the cam which decreases the cavity containing the trapped fluid and discharges the fluid at system pressure through the pressure port openings in the port plates.

The rotating portion of the unitized cartridges feature the use of pressure actuated vanes which are urged against the cam ring by pins located in the bottom of each rotor vane slot. Initial force to bring the vanes in contact with the cam ring contour during start up is provided by centrifugal force. When pumping operation starts and pressure is established, fluid under pressure fills the pin cavity through the feed holes.

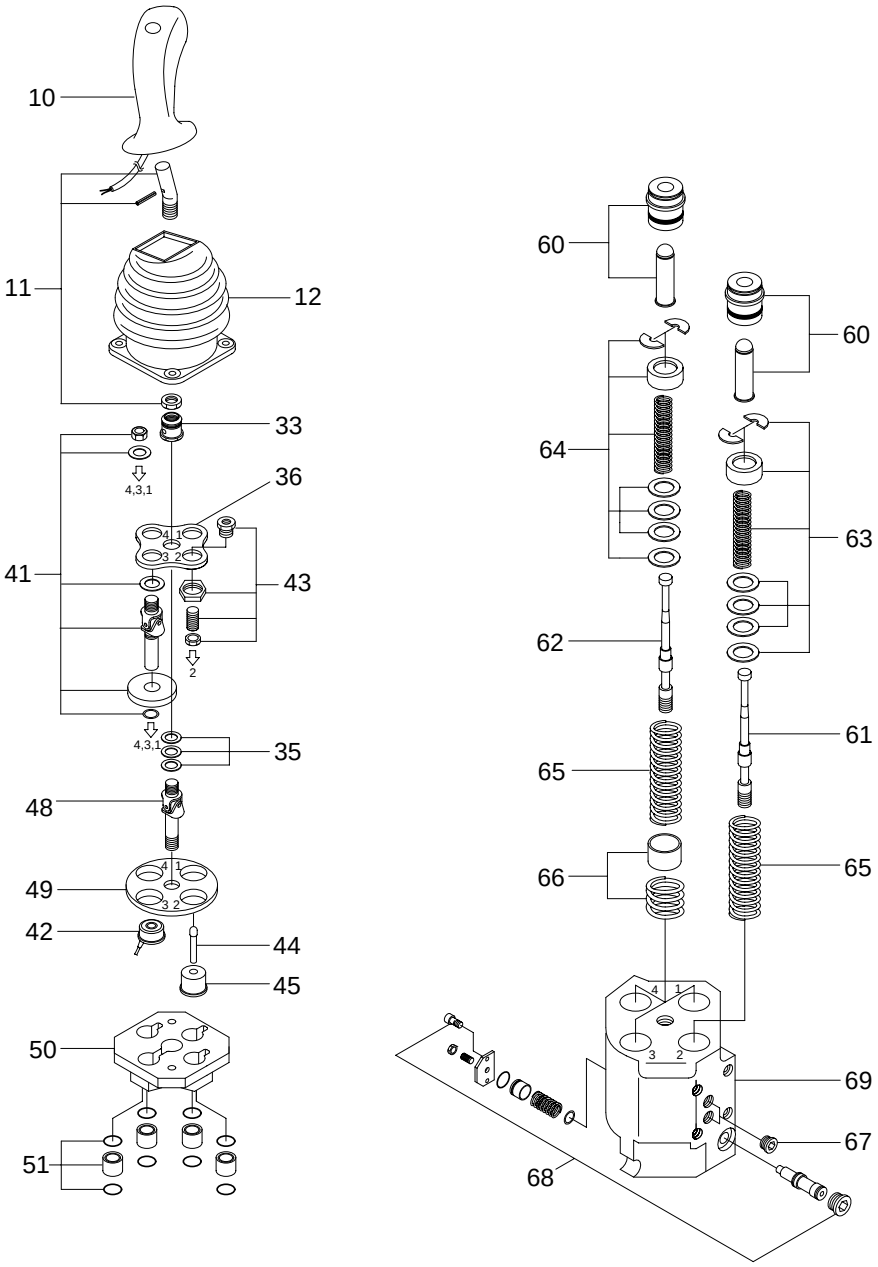
The feed holes open to the pressure port twice every revolution. All other times they are closed off by the port plate. This pressure under the pin provides the force necessary to keep the vanes in contact with the cam contour.

※ When operating the pump at the maximum outlet pressure, the pump shaft rotation should not be allowed to fall below 600rpm in order to maintain proper vane to cam ring contact.

The inlet or suction flow for both the **D** cartridge and **B** cartridge feeds through a common 3 port in the center housing, through the large ports of each port plate for each cartridge and through the center hole in the suction zone of each cam ring.

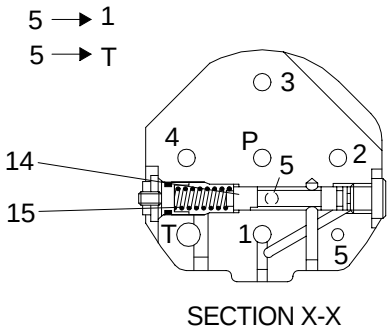
5. REMOTE CONTROL VALVE

1) STRUCTURE

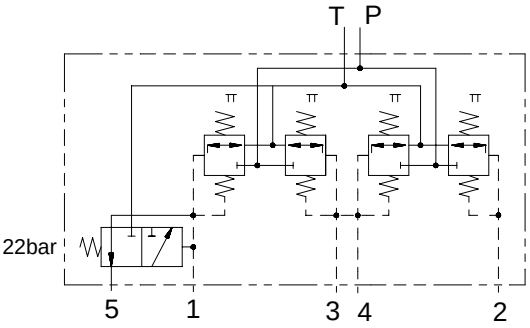


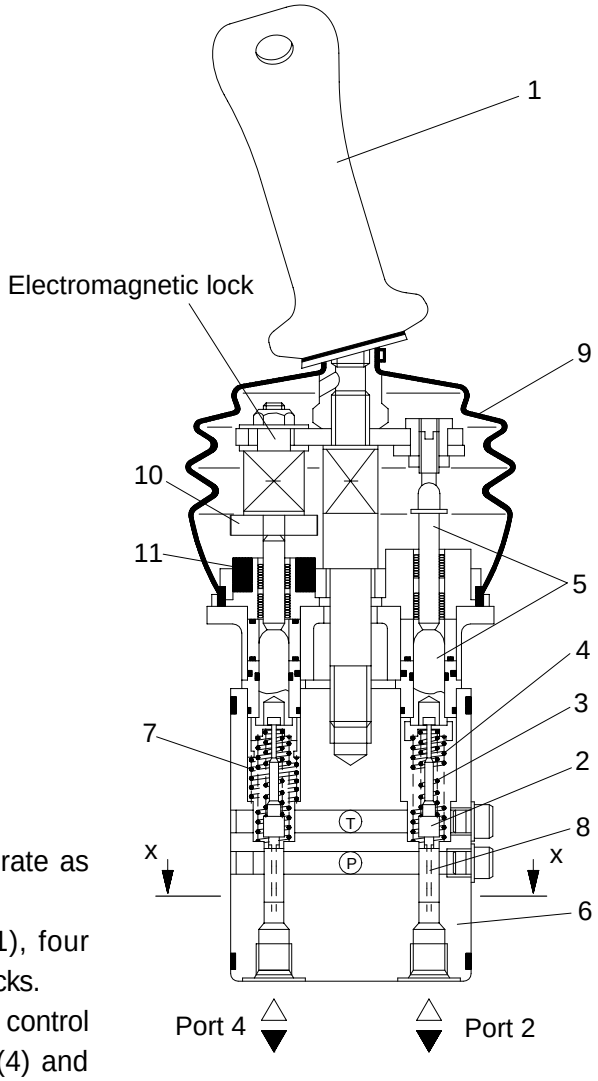
10	Handle	44	Intermediary plunger	63	Regulating sub assy
11	Lever kit	45	Plunger guide assy	64	Regulating sub assy
12	Bellows	48	Joint	65	Spring set
33	Nut	49	Flange	66	Frefeel point kit
35	Shim kit	50	Electric bracket	67	Plug kit
36	Bracket	51	Bushing kit	68	5th control port kit
41	Joint kit	60	Plunger kit	69	Body
42	Solenoid complete	61	Spool		
43	Plunger kit	62	Spool		

2) OPERATION



SECTION X-X





(1) Hydraulic functional principle

Pilot devices with end position locks operate as direct operated pressure reducing valves.

They basically comprise control lever(1), four pressure reducing valves, housing(6) and locks.

Each pressure reducing valve comprises control spool(2), control spring(3), return spring(4) and push rod(5).

At rest control lever(1) is held in its neutral position by return springs(4). Ports(1, 2, 3, 4) are connected to tank port T via bore(8).

When control lever(1) is deflected push rod(5) is pressed against return spring(4) and control spring(3).

Control spring(3) initially moves control spool(2) downwards and closes the connection between the relevant port and tank port T. At the same time the relevant port is connected to port P via bore(8). The closed loop control phase starts, as soon as control spool(2) finds its balance between the force from control spring(3) and the force, which results from the hydraulic pressure in the relevant port(port 1, 2, 3 or 4).

Due to the interaction between control spool(2) and control spring(3) the pressure in the relevant port is proportional to the stroke of push rod(5) and hence to the position of control lever(1).

This closed loop pressure control dependent on the position of the control lever and the characteristics of the control spring permits the proportional hydraulic control of the main directional valve.

Rubber sleeve(9) protects the mechanical components in the housing from contamination.

(2) End position lock

Only those control ports, for which it is necessary to hold the control lever in a deflected position are equipped with end position locks.

Electromagnetic lock

An additional spring(7) under push rod(5) warns, due to the increase in force which is required to keep this spring compressed, that the stroke of push rod(5) and control lever(1) is nearly at its end.

Once this point has been exceeded ring(10) is placed in contact with solenoid armature(11).

If the solenoid is energized, control lever(1) is held in its end position by means of the electromagnetic force.

The lock is released automatically when the solenoid is deenergized.

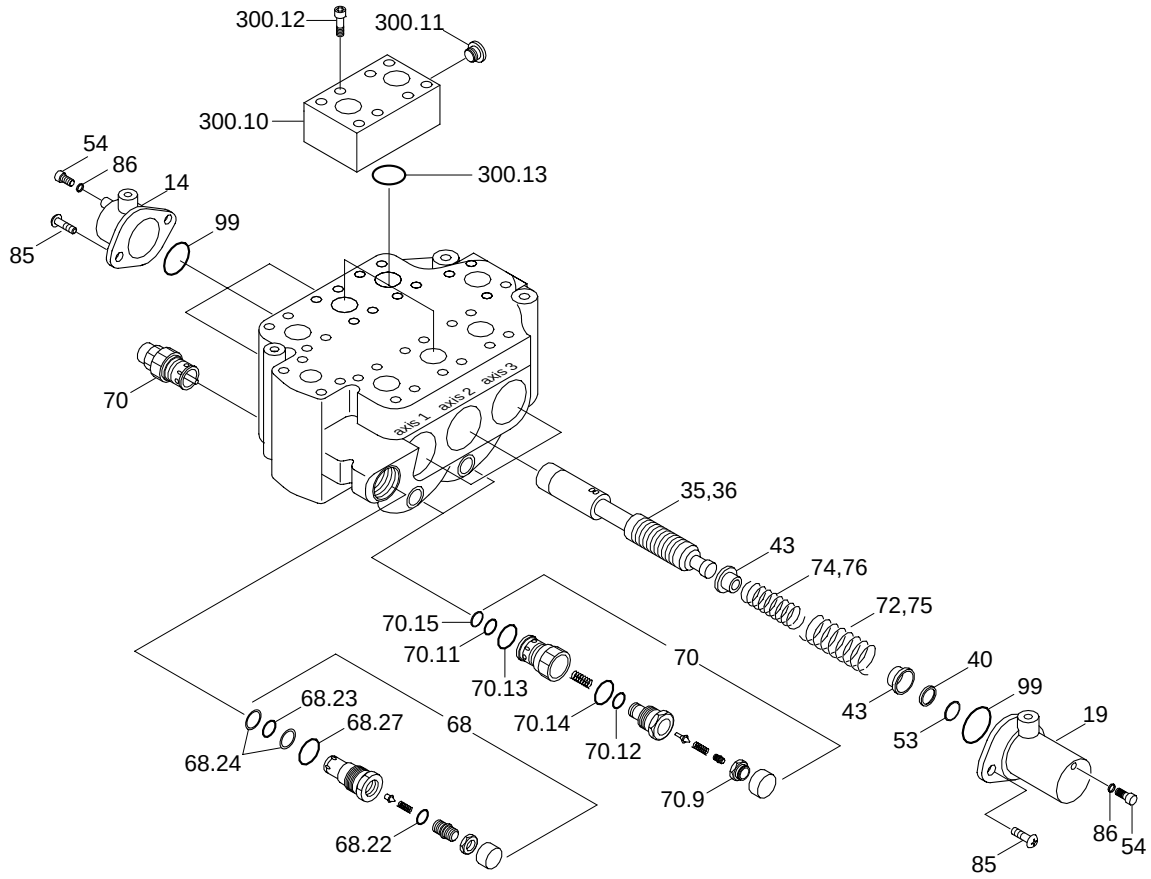
(3) Fifth control port

This remote control valve is equipped with a fifth control port, which is used to control the boom floating function. This function may be operated by moving spool(14) against spring(15) under the influence of the pressure acting in port 1.

As soon as this pressure reaches 22bar, control port 5 is connected with T.

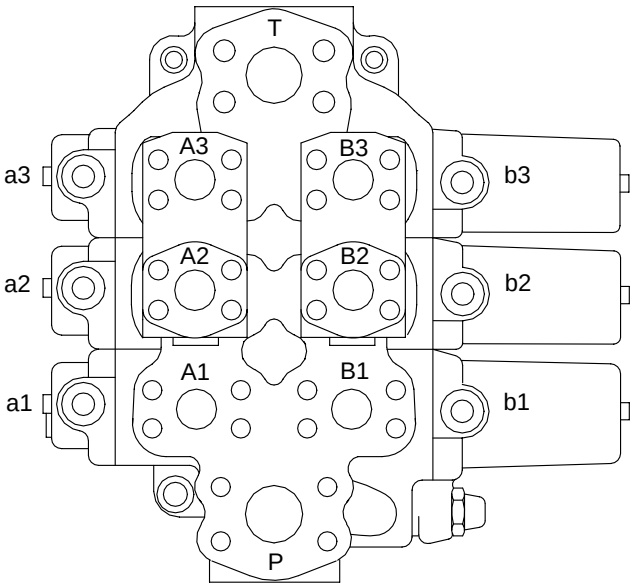
6. MAIN CONTROL VALVE

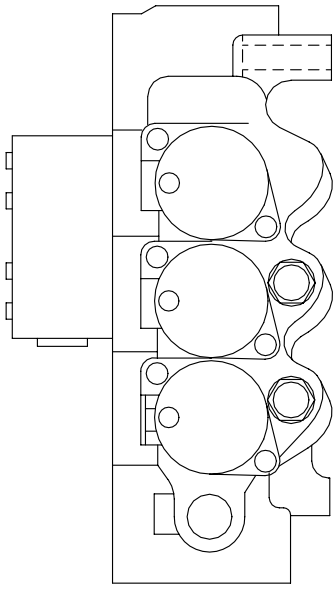
1) STRUCTURE

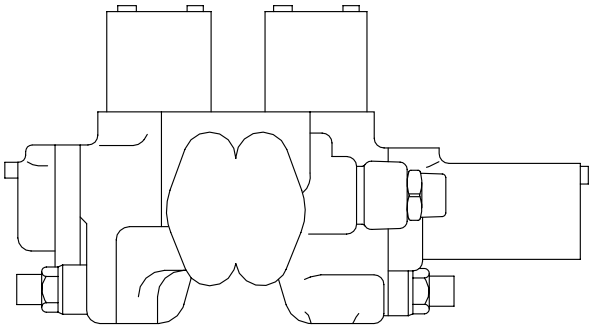


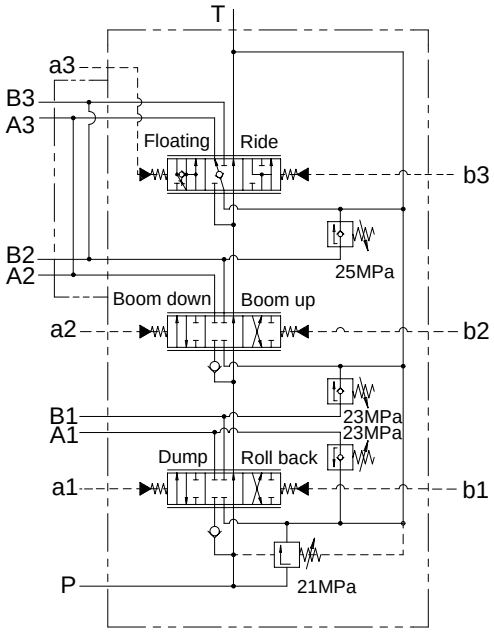
11	Housing	68.23	O-ring	74	Spring(Axis 1,2)
14	Short cover	68.24	Thrust ring	75	Spring(Axis 3)
19	Long cover	68.27	O-ring	76	Spring(Axis 3)
35	Spool(Axis 1,2)	70	Overload relief valve	85	Screw
36	Spool(Axis 3)	70.9	Seal	86	Seal ring
40	Ring	70.11	O-ring	99	O-ring
43	Spring retainer	70.12	Piston seal	300	Plate
53	Snap ring	70.13	O-ring	300.10	Plate
54	Bleed screw	70.14	O-ring	300.11	Locking screw
68	Main relief valve	70.15	Thrust ring	300.12	Bolt
68.22	O-ring	72	Spring(Axis 1,2)	300.13	O-ring

STRUCTURE





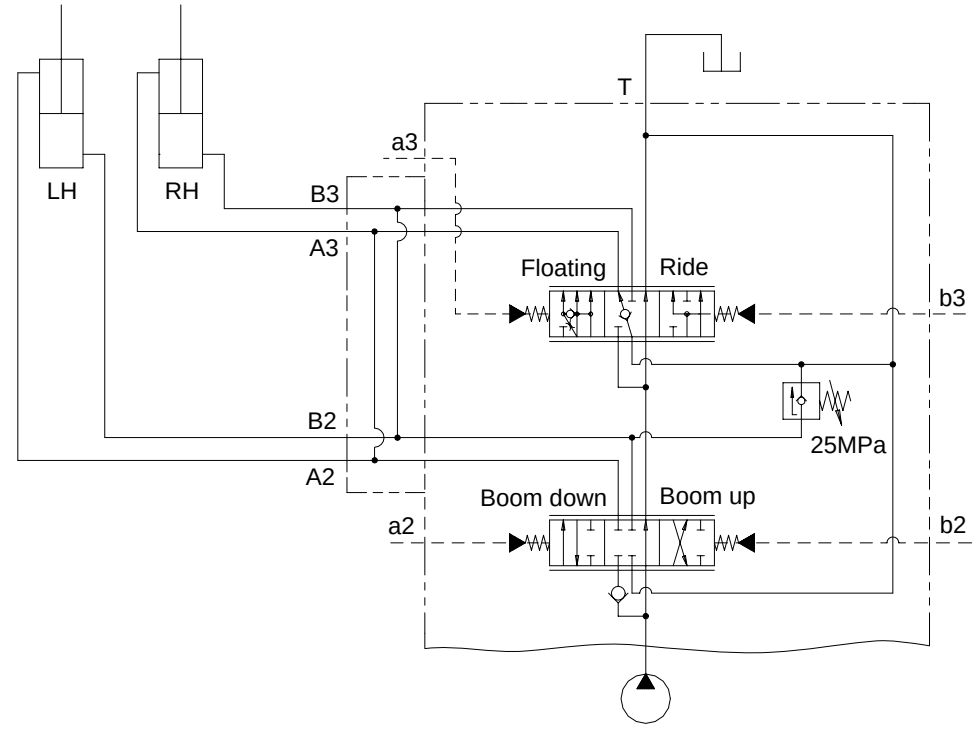


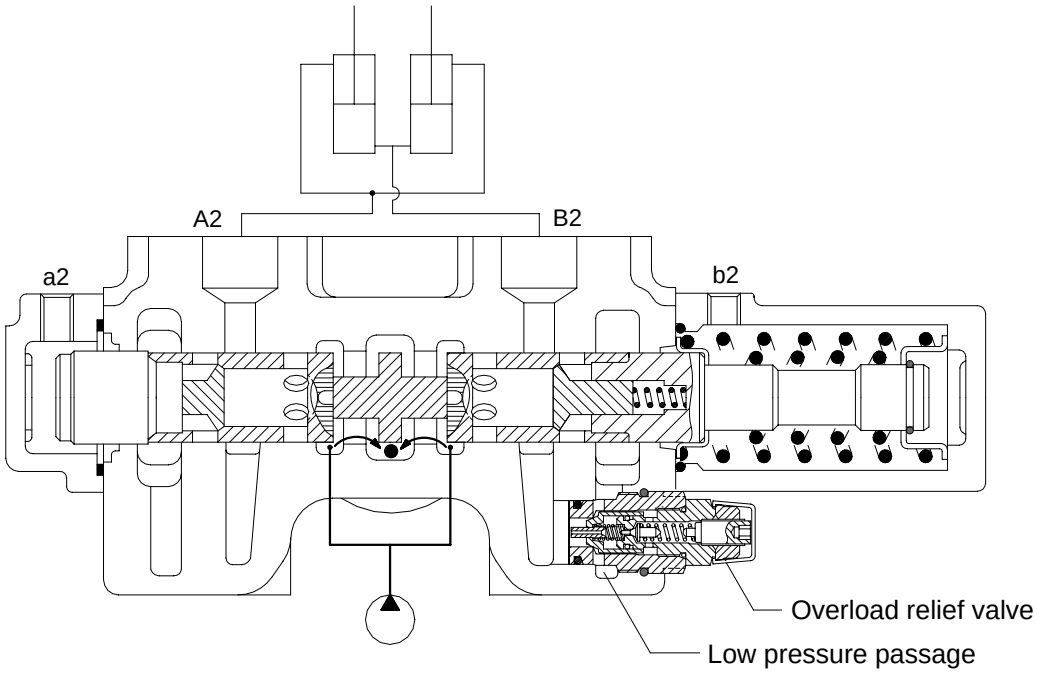


Port	Port name	Port size
P	From main pump	SAE 6000psi 1 1/2"
T	To hydraulic tank	SAE 6000psi 1 1/2"
A_1, B_1	To bucket cylinder port	SAE 6000psi 1 1/4"
A_3, B_3, A_2, B_2	To boom cylinder port	SAE 6000psi 1 1/4"
a_1, b_1	Bucket pilot port	PF 1/4
a_2, a_3, b_2, b_3	Boom pilot port	PF 1/4

2) BOOM SECTION OPERATION

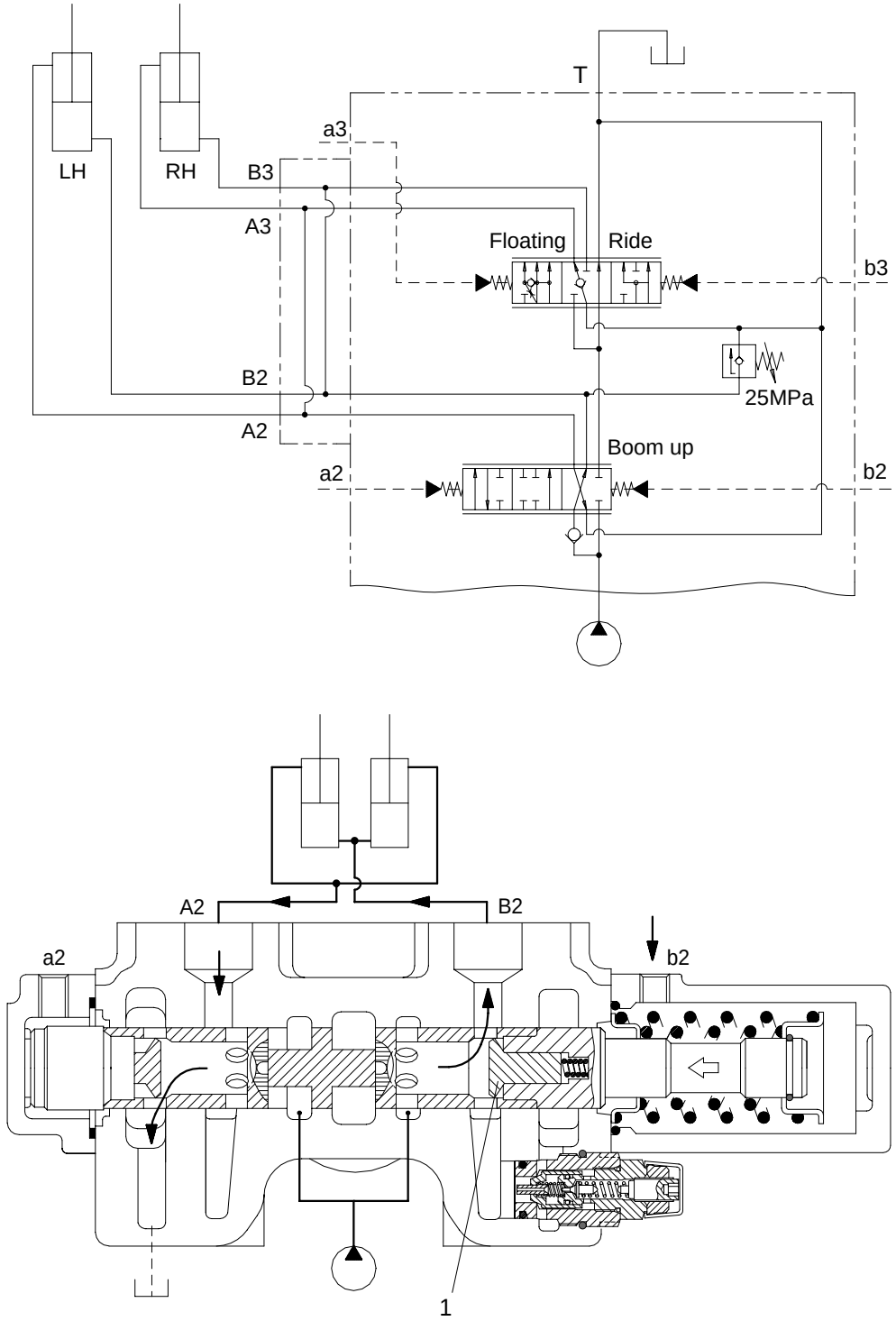
(1) Spool in neutral





If the remote control valve is not operated, the oil supplied from the pump port passes through the neutral passage to the low pressure passage at the outlet section, and then returns to the tank port.

(2) Boom raise position



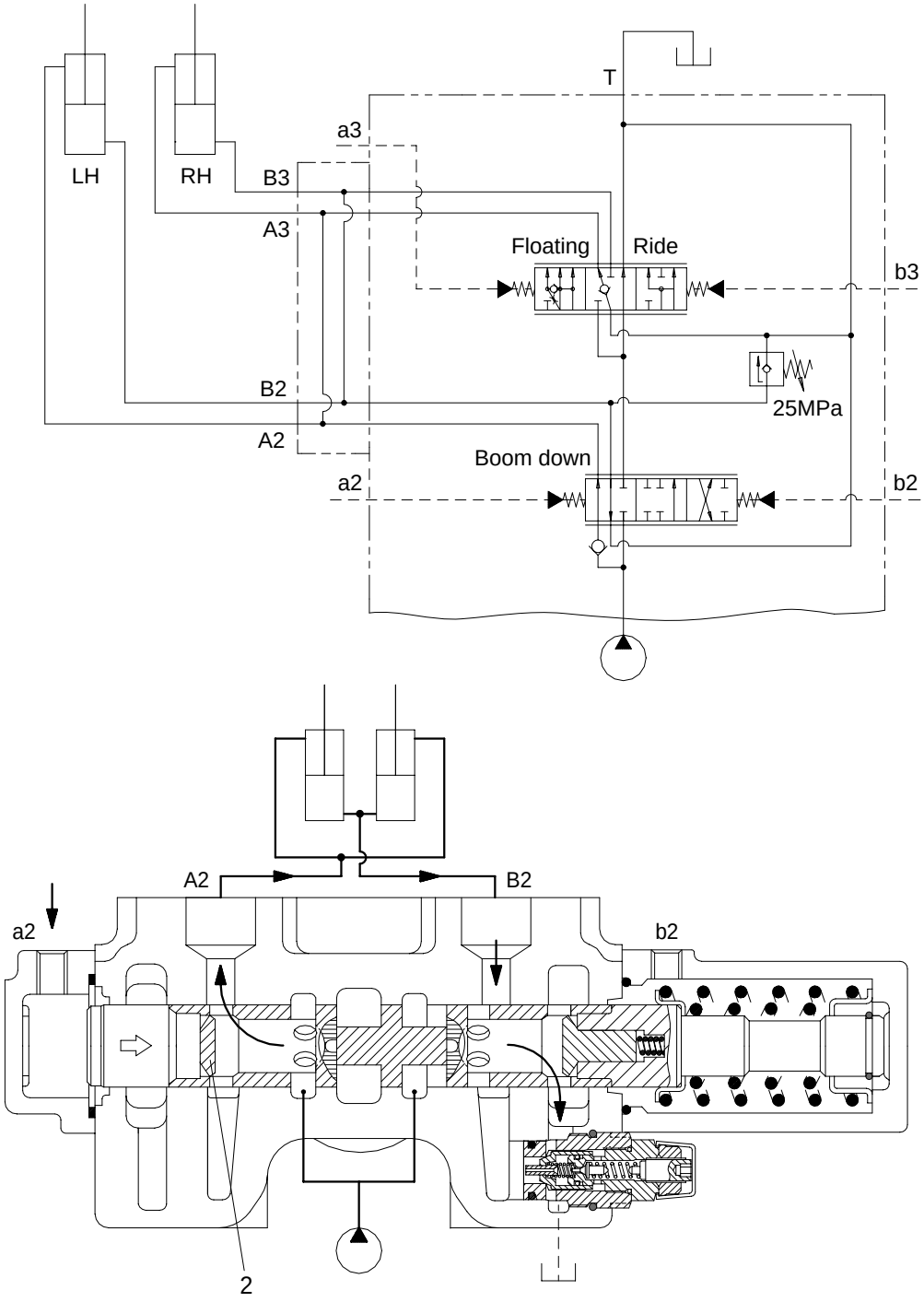
When the pilot pressure from remote control valve is supplied to the pilot port(b2), the spool moves to the left and the neutral passage is closed.

The oil supplied from the pump pushes up the load check valve(1) and flow into boom cylinder port(B2, B3).

The pump pressure reaches proportionally the load of cylinder and fine control finished by shut off of the neutral passage.

The return oil from cylinder port(A2, A3) flows into the tank via the low pressure passage.

(3) Boom lower position



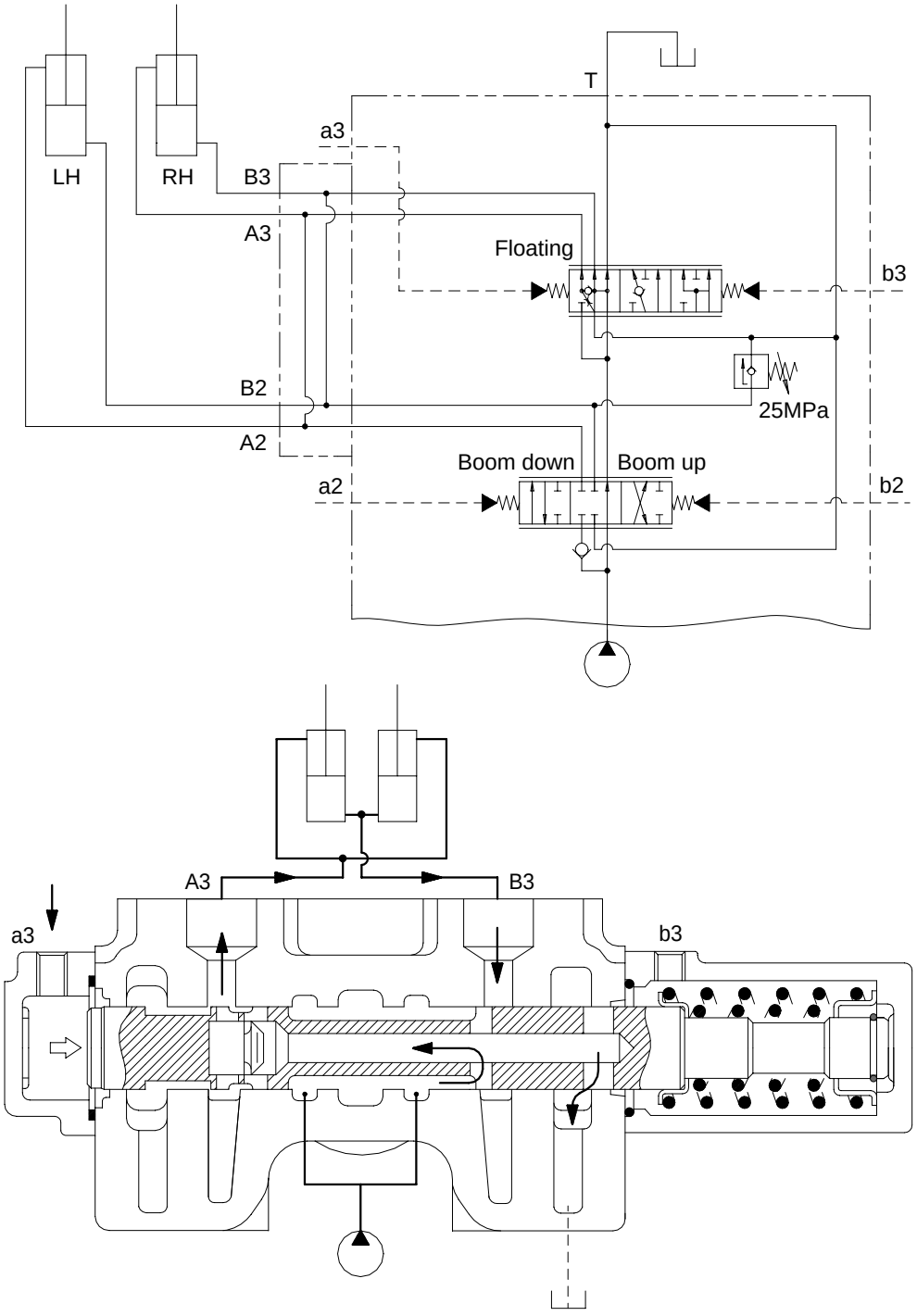
When the pilot pressure from remote control valve is supplied to the pilot port(a2), the spool moves to the right and the neutral passage is closed.

The oil supplied from the pump pushes up the load check valve(2) and flow into boom cylinder port(A2, A3).

The pump pressure reaches proportionally the load of cylinder and fine control finished by shut off of the neutral passage.

The return oil from cylinder port(B2, B3) flows into the tank via the low pressure passage.

(4) Boom float position



If the operator overrides the additional spring(7) in the RCV lower position, the pilot pressure from remote control valve rises further and then the boom float spool is pushed to the end position, opening up the neutral passage to tank and simultaneously(A2, A3), (B2, B3) 隊 T.

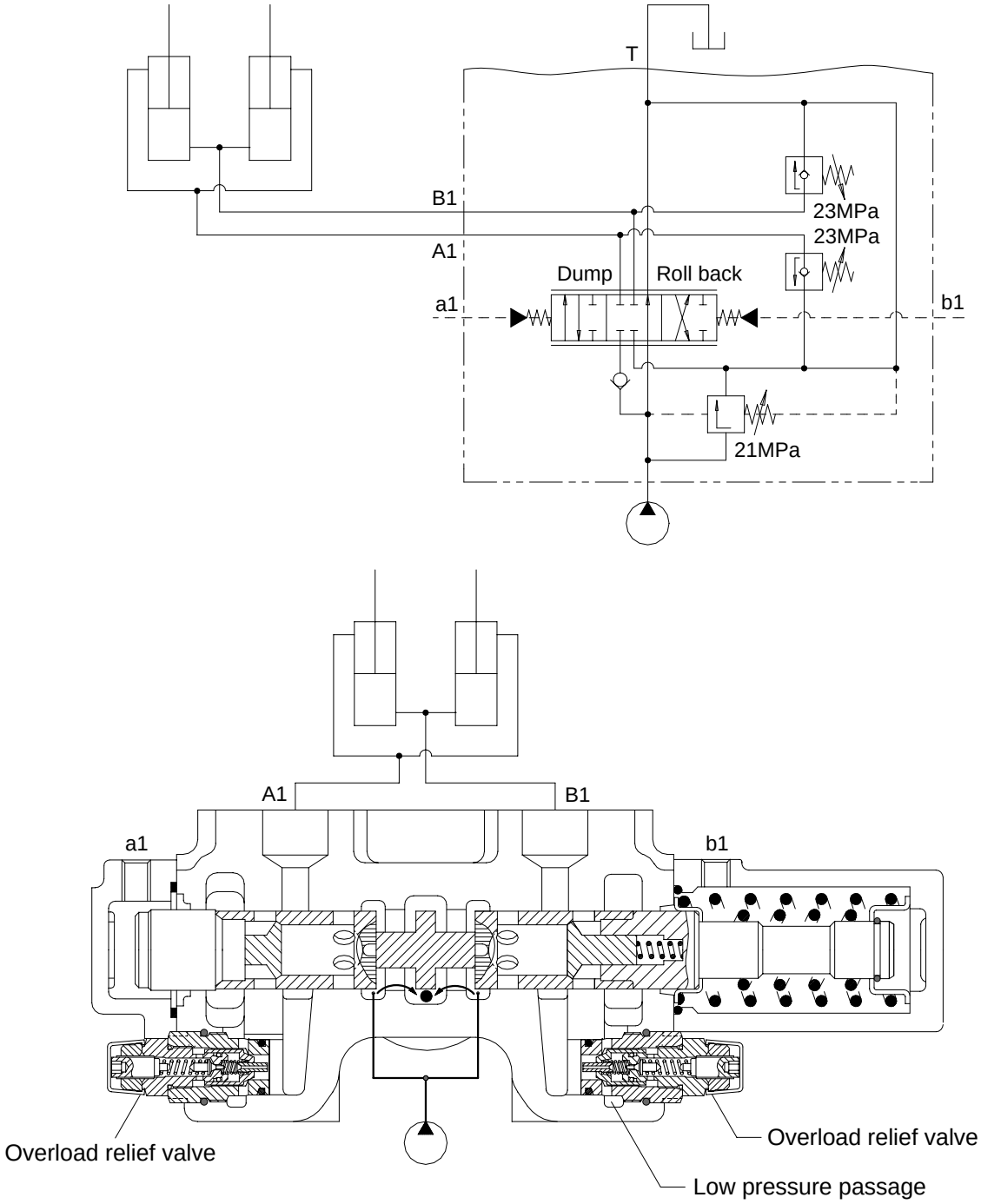
Parallel the boom down spool will be released to neutral, became of moving spool in the remote control valve at 22bar(Refer to page 6-13).

In float position the boom drops quickly due to its own weight.

When the bucket touches the ground and the wheeled loader is moving, the bucket raised or lowered following the unevenness of the ground due to the (A2, A3), (B2, B3) 隊 T connecting.

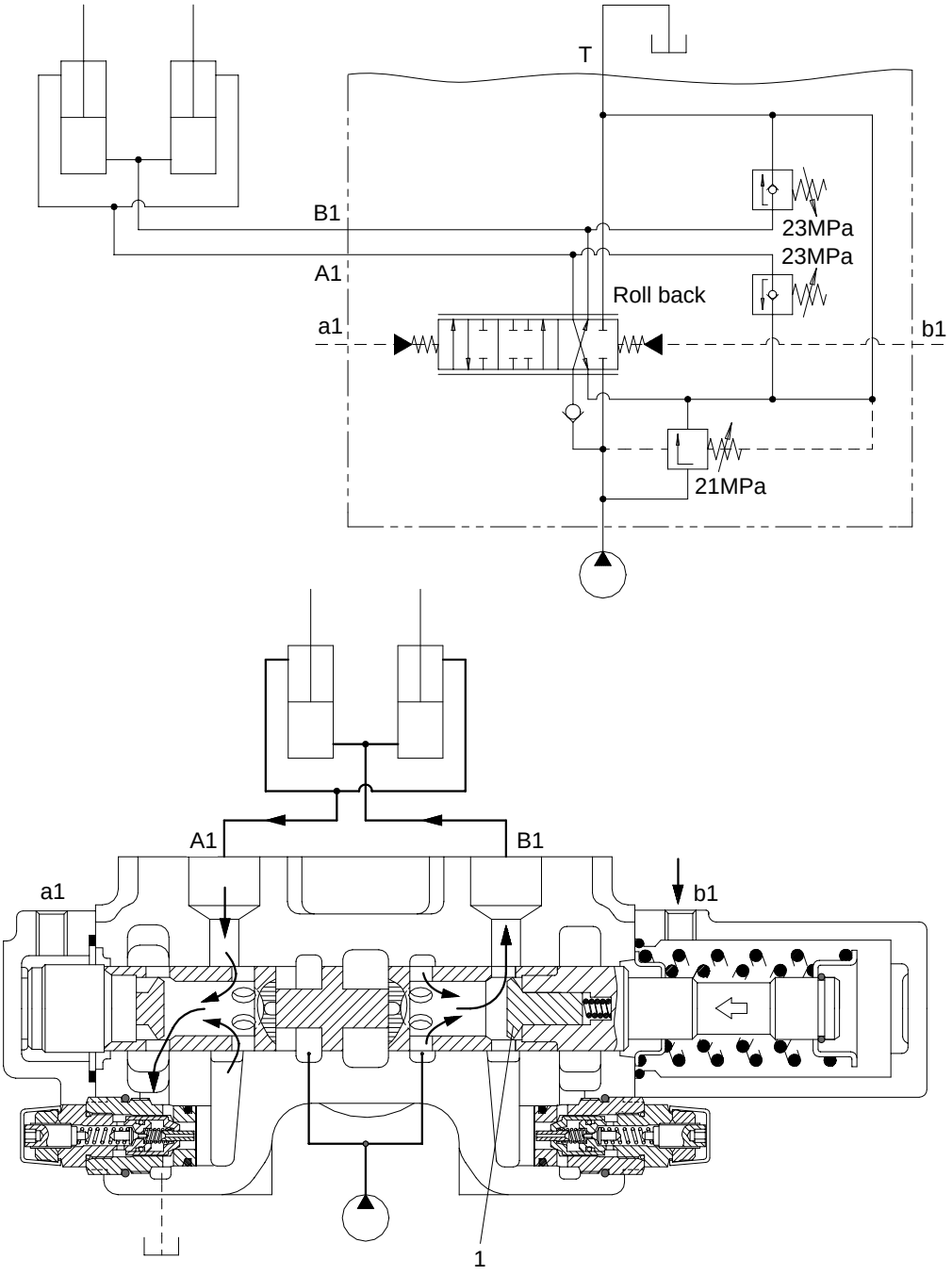
3) BUCKET SECTION OPERATION

(1) Spool in neutral



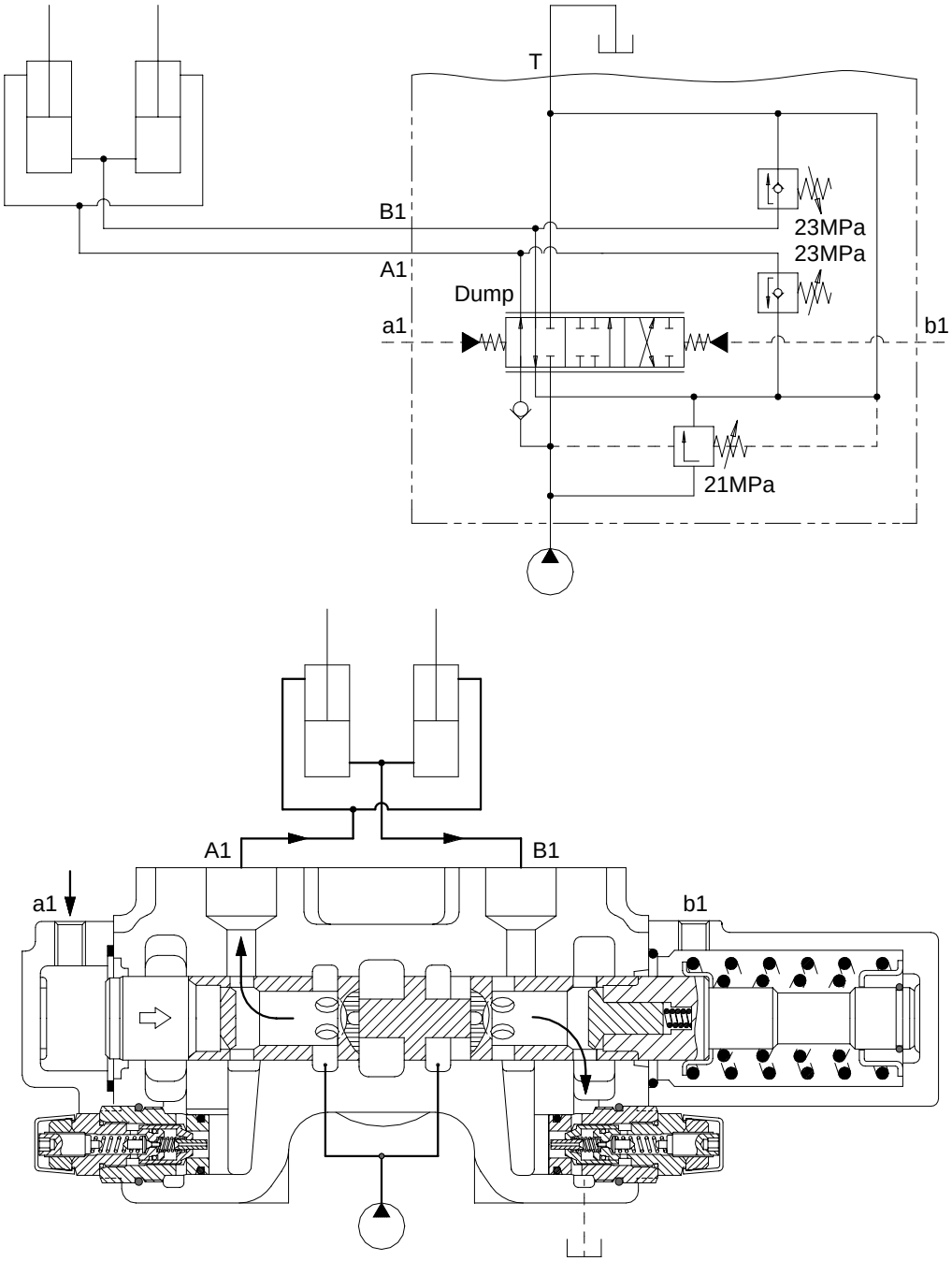
If the remote control valve is not operated, the oil supplied from the pump port passage through the neutral passage to the low pressure passage at the outlet section, and then return to the tank port.

(2) Retract (Roll back) position



When the pilot pressure from remote control valve is supplied to the pilot port(b1), the spool moves to the left and the neutral passage is closed.
The oil supplied from the pump pushes up the load check valve(1) and flow into boom cylinder port(B1).
The pump pressure reaches proportionally the load of cylinder and fine control finished by shut off of the neutral passage.
The return oil from cylinder port(A1) flows into the tank via the low pressure passage.

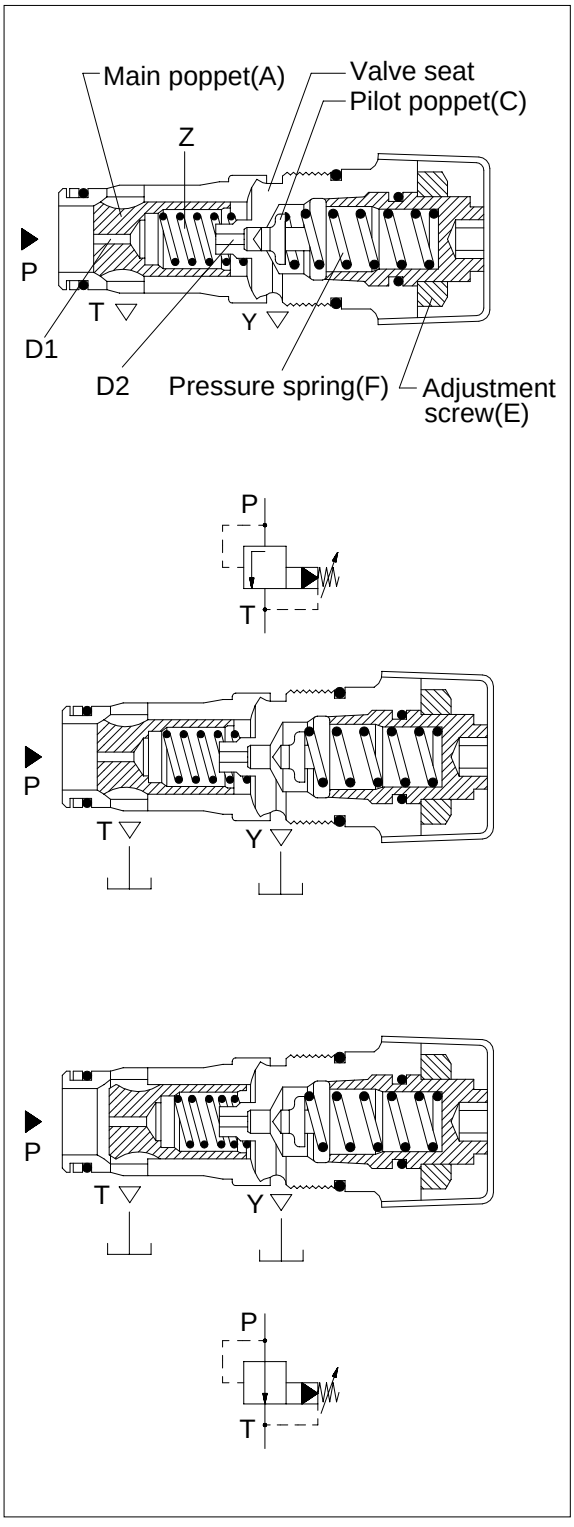
(3) Dump position



When the pilot pressure from remote control valve is supplied to the pilot port(a1), the spool moves to the right and the neutral passage is closed.
The oil supplied from the pump pushes up the load check valve(1) and flow into boom cylinder port(A1).
The pump pressure reaches proportionally the load of cylinder and fine control finished by shut off of the neutral passage.
The return oil from cylinder port(B1) flows into the tank via the low pressure passage.

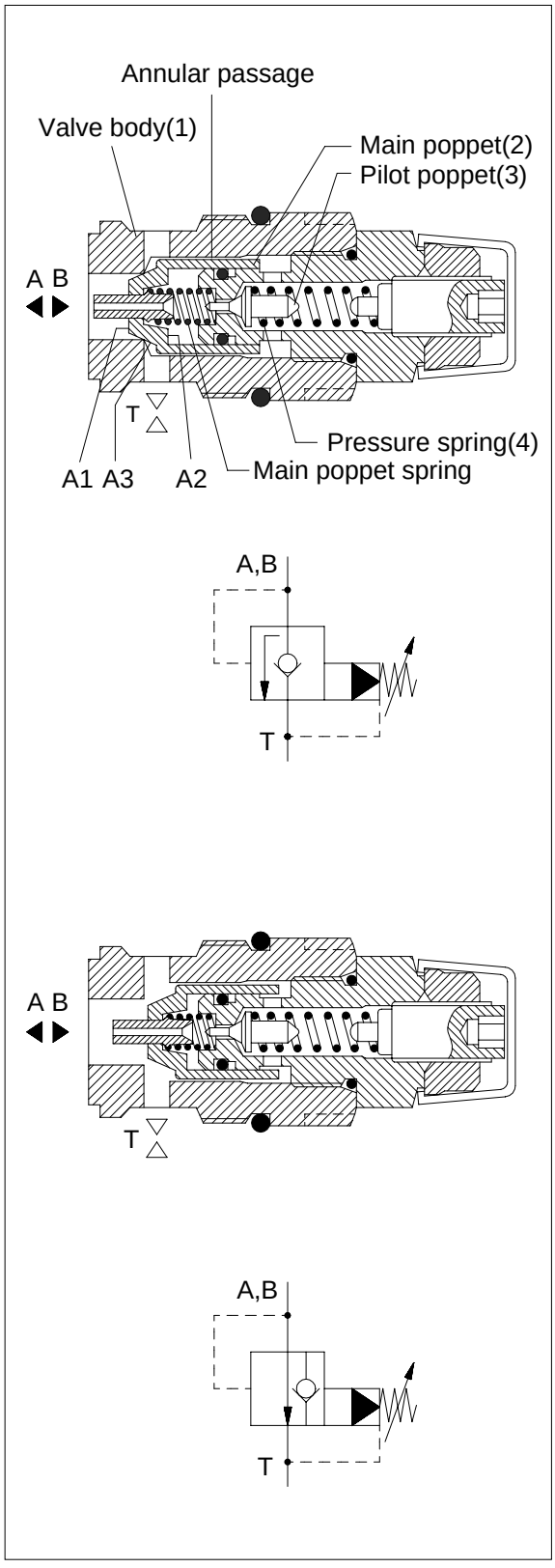
3) MAIN RELIEF VALVE

- The main relief valve is installed at the inlet of the main control valve. When the oil goes above the set pressure, the relief valve drains the oil to the tank.
  In this way, it sets the maximum pressure in the hydraulic circuit and protects the circuit.
- The valve poppet(C) is connected via the throttle drillings(D1) and (D2) with the P port.
  If static pressure increases above the set pressure value, the valve poppet(C) opens and allows oil to flow freely to tank(Y). This oil generates a pressure drop in the spring chamber of the main poppet, the closing force of the spring(Z) is cancelled, and the main poppet(A) opens to allow the pump flow to flow to tank(T).
  Damped opening and closing is obtained by the throttled volumetric change.
- The set pressure can be varied by changing the tension of pressure spring(F). To change the set pressure, remove cap nut, loosen lock nut and turn adjustments screw(E) and follows.



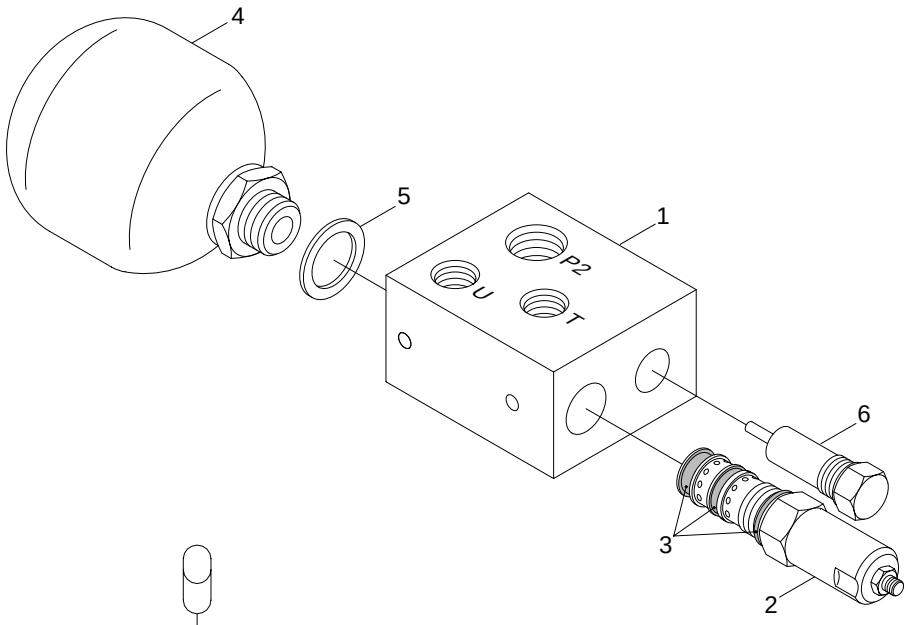
4) OVERLOAD RELIEF VALVE

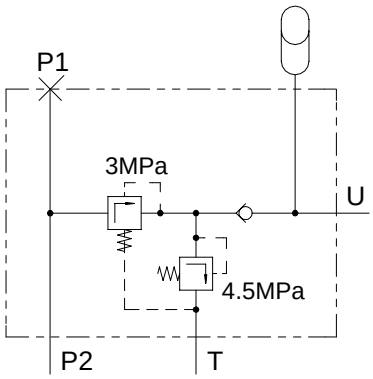
- The overload relief valve(Combined relief/ anticavition valve) is in the boom cylinder and bucket cylinder circuit in the main control valve.
  If shock causes any abnormally high pressure in the cylinder when the main valves is at neutral, the overload relief valve releases the abnormal pressure and protects the cylinder from damage.
- During normal operation, the poppet(2) is positioned against the body(1) to seal the workport(A) oil from the return(T) passage.
- As the circuit pressure approach the relief pressure setting, the pressure forces the pilot poppet(3) off its seat and allows oil to flow freely via the annular passage to tank.
  This oil generates a pressure drop in the spring chamber of the main poppet(2), the closing force of the spring(4) is cancelled. The main poppet(2) opens to allow flow from P to T.
- If cavitation in the workport occurs, the oil pressure in the workport drop below return pressure.
  Tank line return pressure oil works against the shoulder(A3) of the poppet to force it open against the spring and the workport pressure at (A2)-(A1).



7. PILOT OIL SUPPLY UNIT

1) STRUCTURE





HYDRAULIC CIRCUIT

Port	Port name	Port size
P2	From main pump	3/4-16UNF
P1	Pluging	3/4-16UNF
U	Supply to RCV lever	9/16-18UNF
T	To hydraulic tank	9/16-18UNF

1 Manifold complete
2 Reducing valve
3 Seal kit
4 Accumulator
5 Gasket
6 Relife valve

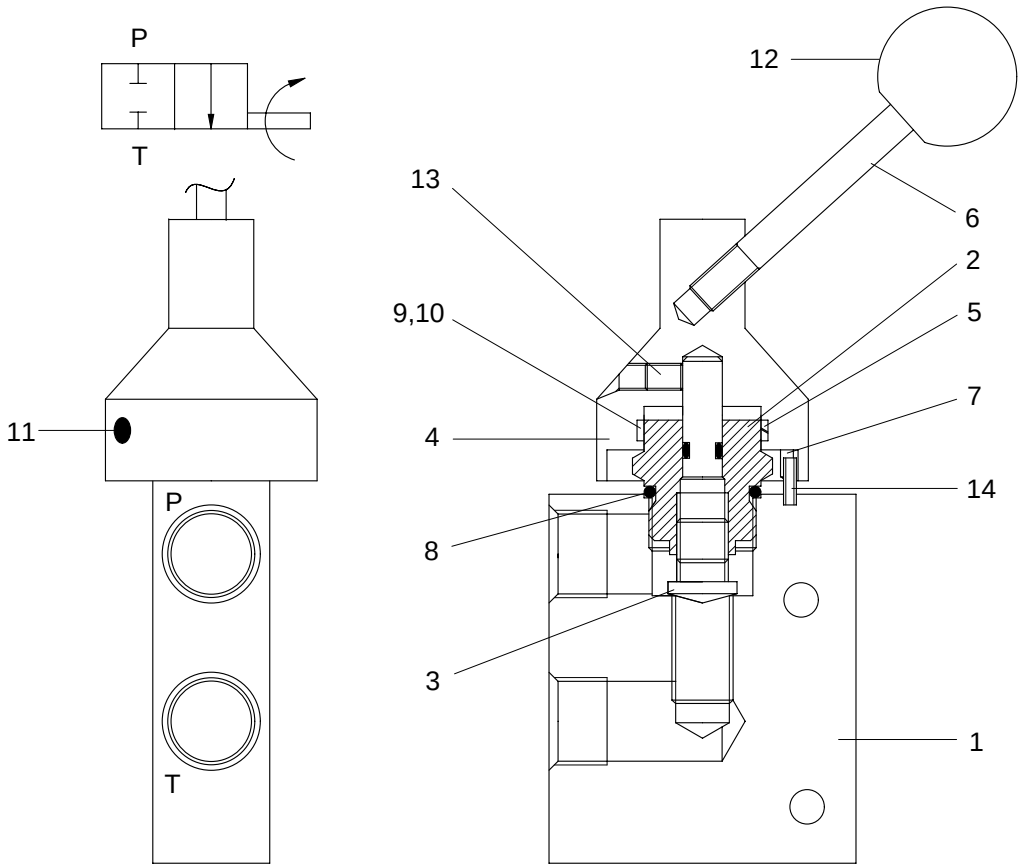
(2) OPERATION

The pilot supply manifold reduces the pressure from the high pressure circuit to a low pressure circuit in order to supply the remote control valve.
The accumulator satisfies short term peak power demands and is a source of emergency power in case of main circuit pressure failures.
The unit consists of the housing, the accumulator(4), the relief valve(6), the check valve and the reducing valve(2).
The flow path is from the high pressure circuit through port P2 to the pressure reducing valve(2). The pressure is reduced in the reducing valve(2) and oil passes the check valve into the accumulator(4) and to the port U, which is connected with the remote control valve.
The pressure relief valve(6) protects the pilot circuit in case of the reducing valve(2) failures or external increase of pressure.

8. SAFETY VALVE UNIT

1) STRUCTURE

The safety valve locks or permits pilot oil flew to the main control valve operation.



1	Body	6	Handle	11	Spring plunger
2	Retainer	7	Spring ring	12	Knob
3	Adjust stem	8	O-ring	13	Socket set screw
4	Housing	9	O-ring	14	Spring pin
5	Clutch ring	10	Back up ring		

9. BOOM AND BUCKET CYLINDER

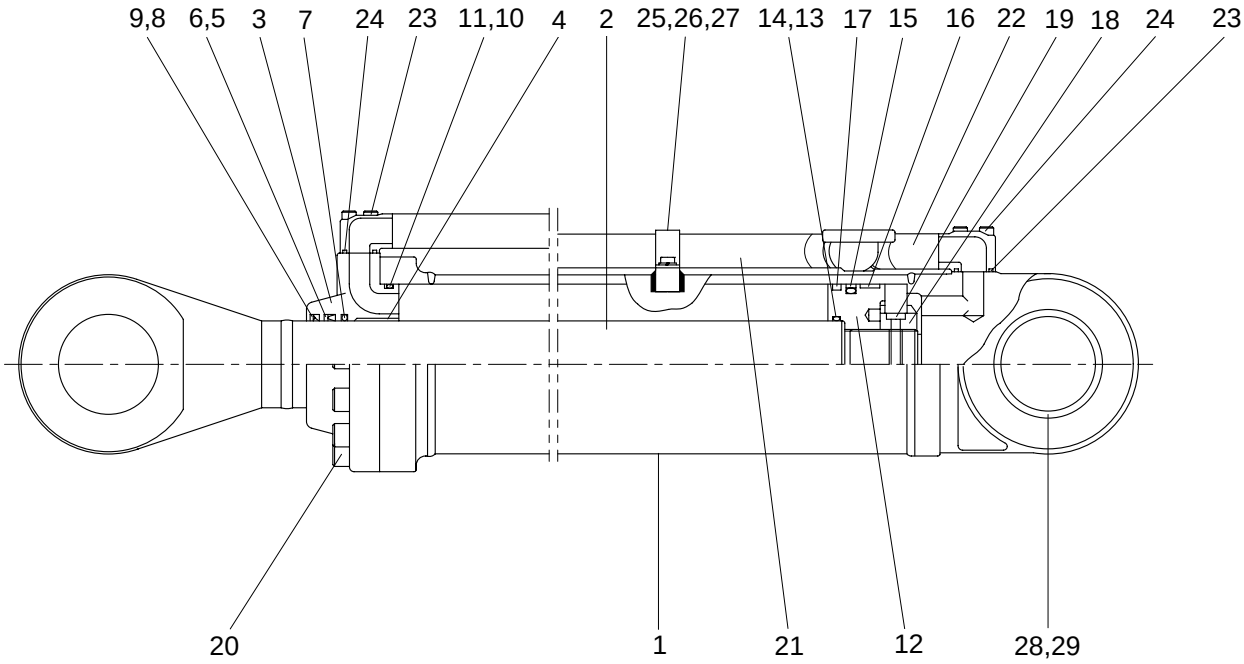
The boom cylinders and the bucket cylinders are two unit. They use a bolt on rod guide.

The piston(12) threads on to the rod(2) and is retained by a nut(18) and set screw(19).

The piston seals against the tube(1) with piston seal(15). Two wear rings(16) are located on each side of the piston seal.

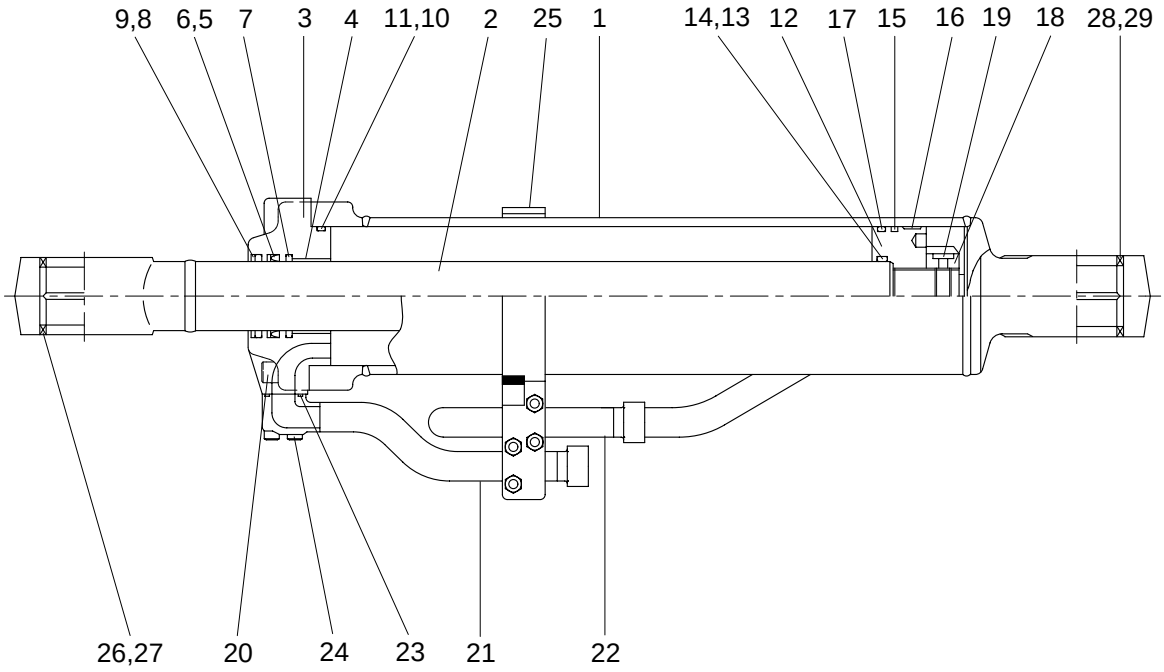
The gland(3, the rod guide) seals against the tube with an O-ring(10). The cylinder thread seals against the rod with a lip type buffer ring(7) and a rod seal(5). A dust wiper(8) cleans the rod when it is retracted.

1) BOOM CYLINDER



1	Tube assy	11	Back up ring	21	Pipe assy
2	Rod assy	12	Piston	22	Pipe assy
3	Gland	13	O-ring	23	O-ring
4	Bushing	14	Back up ring	24	Bolt
5	Rod seal	15	Piston seal	25	Clamp
6	Back up ring	16	Wear ring	26	Bolt
7	Buffer ring	17	Dust ring	27	Spring washer
8	Dust wiper	18	Lock nut	28	Bushing
9	Snap ring	19	Set screw	29	Dust seal
10	O-ring	20	Bolt		

2) BUCKET CYLINDER

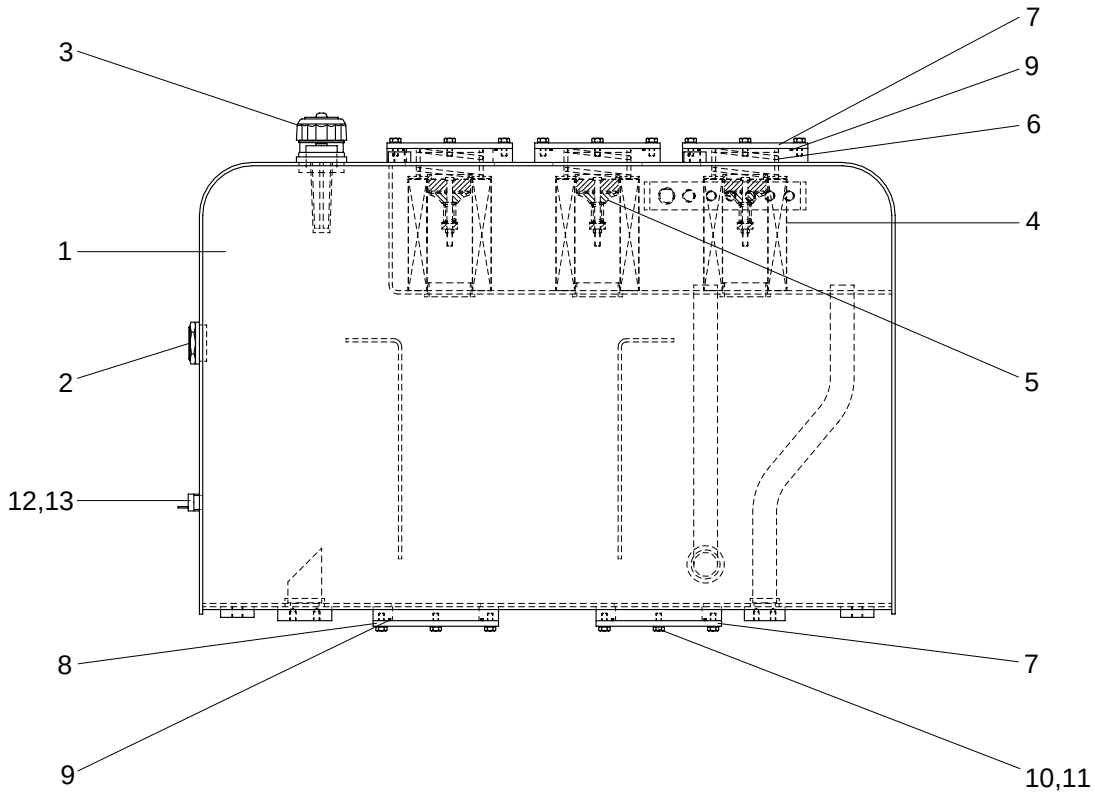


1	Tube assy	11	Back up ring	21	Pipe assy
2	Rod assy	12	Piston	22	Pipe assy
3	Gland	13	O-ring	23	O-ring
4	Bushing	14	Back up ring	24	Bolt
5	Rod seal	15	Piston seal	25	Band assy
6	Back up ring	16	Wear ring	26	Bushing
7	Buffer ring	17	Dust ring	27	Dust seal
8	Dust wiper	18	Lock nut	28	Bushing
9	Snap ring	19	Set screw	29	Dust seal
10	O-ring	20	Bolt		

10. HYDRAULIC OIL TANK

1) STRUCTURE

- The oil from the hydraulic tank is sent from the pump through control valve to the cylinders. In the return circuit, the oil from various parts merges.
- A part of oil is cooled in the oil cooler, passes through the hydraulic filter and returns to the hydraulic tank(1).
- If the hydraulic return oil filter becomes clogged, return filter bypass valve(5) acts to allow the oil to return directly to the hydraulic tank(1). This prevents damage to the hydraulic filter(4). The bypass valve(5) is also actuated when negative pressure is generated in the circuit.



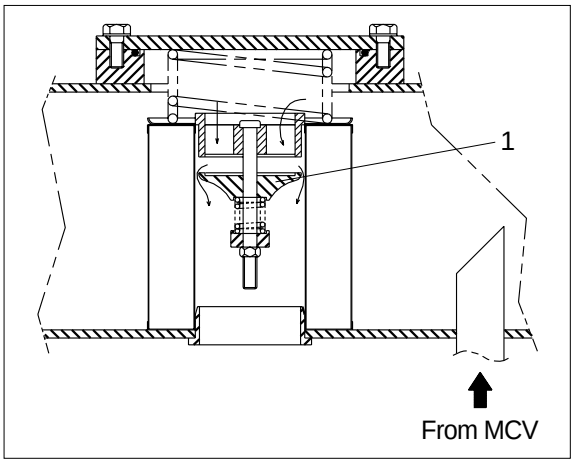
1	Hydraulic tank	6	Spring	11	Spring washer
2	Level gauge	7	Cover	12	Overheat switch
3	Air breather	8	Cover wa	13	O-ring
4	Element	9	O-ring		
5	Bypass valve	10	Bolt		

2) RETURN OIL FILTER BYPASS VALVE

(1) When the filter is clogged

Bypass valve(1) is opened and the oil returns directly to the tank without passing through the filter.

Bypass valve set pressure : 1.36kg/cm^2 (19.3psi)



3) AIR BREATHER

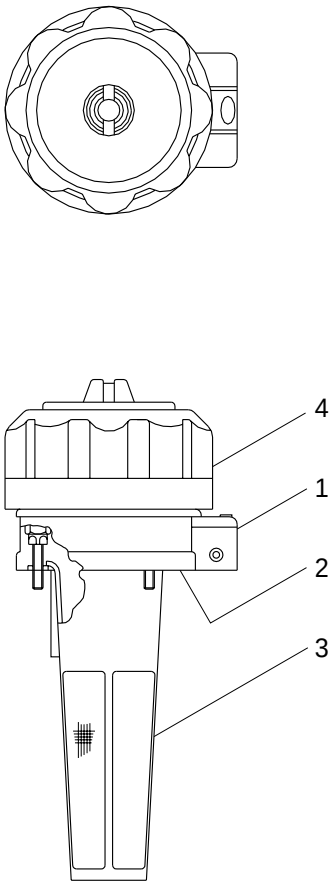
The air breather is equipped with the capacity to perform three functions simultaneously-as an air filter, breathing valve, and as a lubrication opening.

(1) Preventing negative pressure inside the tank

The tank is a pressurized sealed type, so negative pressure is formed inside the hydraulic tank when the oil level drops during operations. When this happens, the difference in pressure between the tank and the outside atmospheric pressure opens the poppet in the breather, and air from the outside is let into the tank or prevent negative pressure.

(2) Preventing excessive pressure inside the tank

When the hydraulic cylinder is being used, the oil level in the hydraulic system increases and as temperature rises. If the hydraulic pressure rises above the set pressure, breather is actuated to release the hydraulic pressure inside the tank.

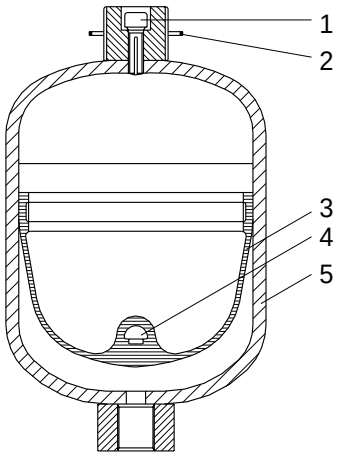


1	Body	3	Strainer
2	Element	4	Cap

11. ACCUMULATOR

The accumulator is installed at the pilot oil supply unit. When the boom is left the raised position, and the control levers are operated with the engine stopped the pressure of the compressed nitrogen gas inside the accumulator sends pilot pressure to the control valve to actuate it and allow the boom and bucket to come down under their own weight.

Type of gas	Nitrogen gas(N_2)
Volume of gas	0.75 ℓ (0.2 U.S.gal)
Charging pressure of gas	16kg/cm²(228psi)
Max actuating pressure	30kg/cm²(427psi)



1 Screw plug
2 Sealing ring
3 Diaphragm
4 Closure button
5 Steel pressure vessel