

## SECTION 6 WORK EQUIPMENT

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# 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 the first(Steering) 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 main hydraulic pump not used by the steering system leaves the steering valve(EHPS) 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.

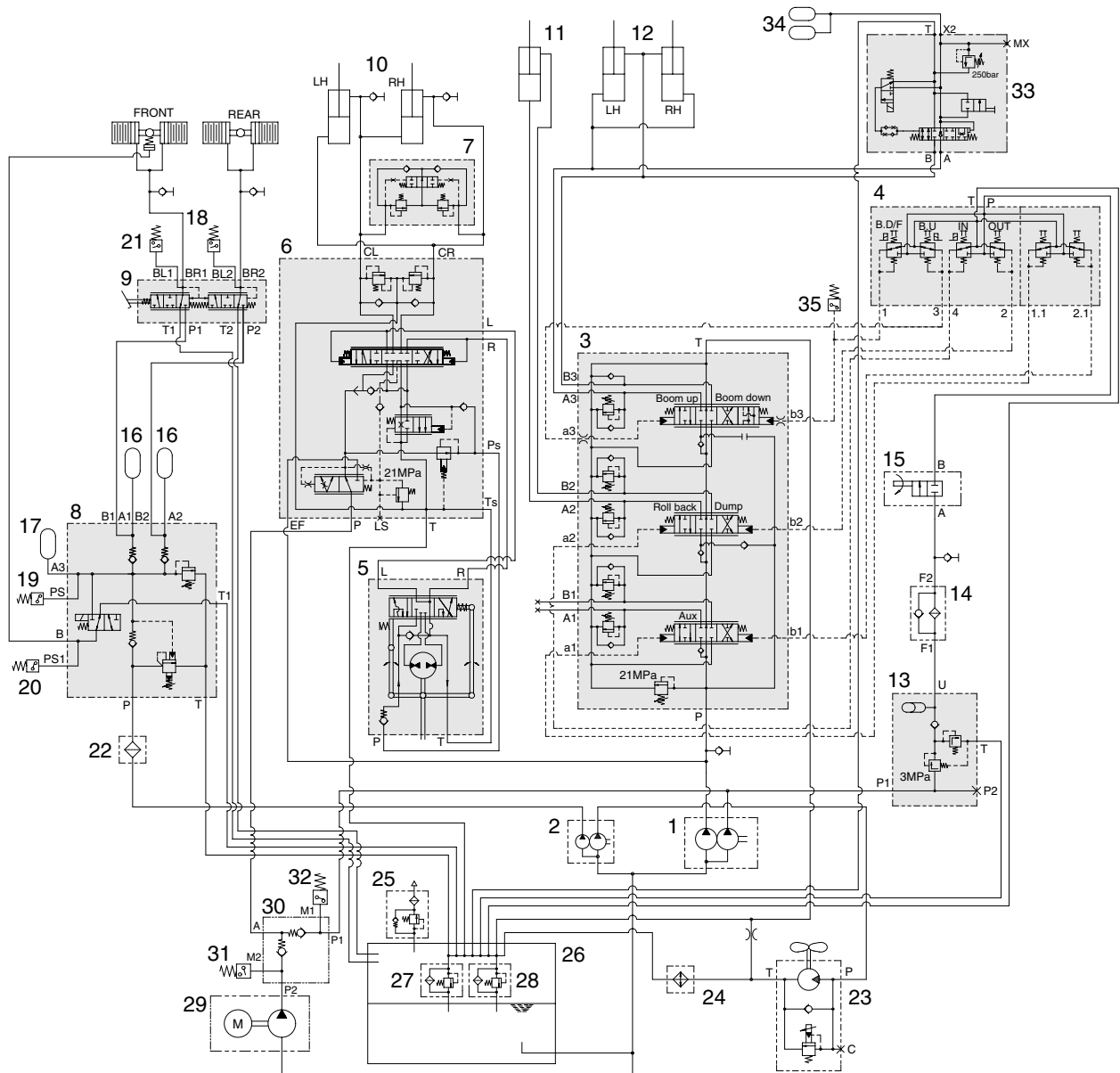
Flow from the steering pump is routed to the pilot supply unit where the steering pump outlet pressure is reduced to pilot circuit pressure. The pilot supply unit flow to the remote control valve.

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



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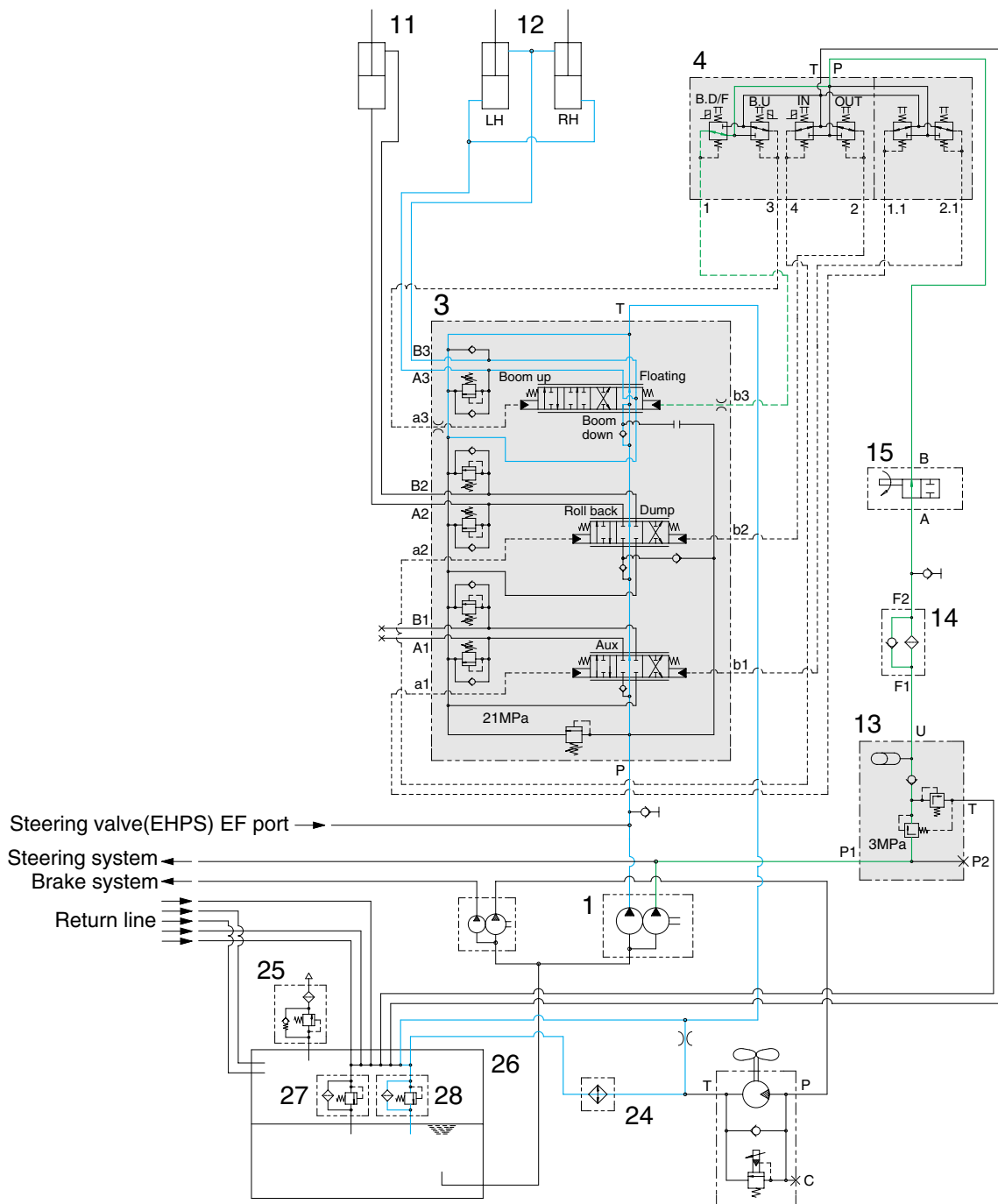
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|----|----------------------|----|-------------------|----|------------------------------|
| 1  | Main pump            | 13 | Pilot supply unit | 25 | Air breather                 |
| 2  | Fan & brake pump     | 14 | Line filter       | 26 | Hydraulic tank               |
| 3  | Main control valve   | 15 | Safety valve      | 27 | Return filter                |
| 4  | Remote control valve | 16 | Accumulator       | 28 | Bypass valve                 |
| 5  | Steering unit        | 17 | Accumulator       | 29 | Pump motor(Optional)         |
| 6  | Steering valve(EHPS) | 18 | Pressure switch   | 30 | Check valve(Optional)        |
| 7  | Cushion valve        | 19 | Pressure switch   | 31 | Pressure switch(Optional)    |
| 8  | Cut off valve        | 20 | Pressure switch   | 32 | Pressure switch(Optional)    |
| 9  | Brake valve          | 21 | Pressure switch   | 33 | Ride control valve(Optional) |
| 10 | Steering cylinder    | 22 | Line filter       | 34 | Accumulator(Optional)        |
| 11 | Bucket cylinder      | 23 | Fan motor         | 35 | Pressure switch(Optional)    |
| 12 | Boom cylinder        | 24 | Oil cooler        |    |                              |







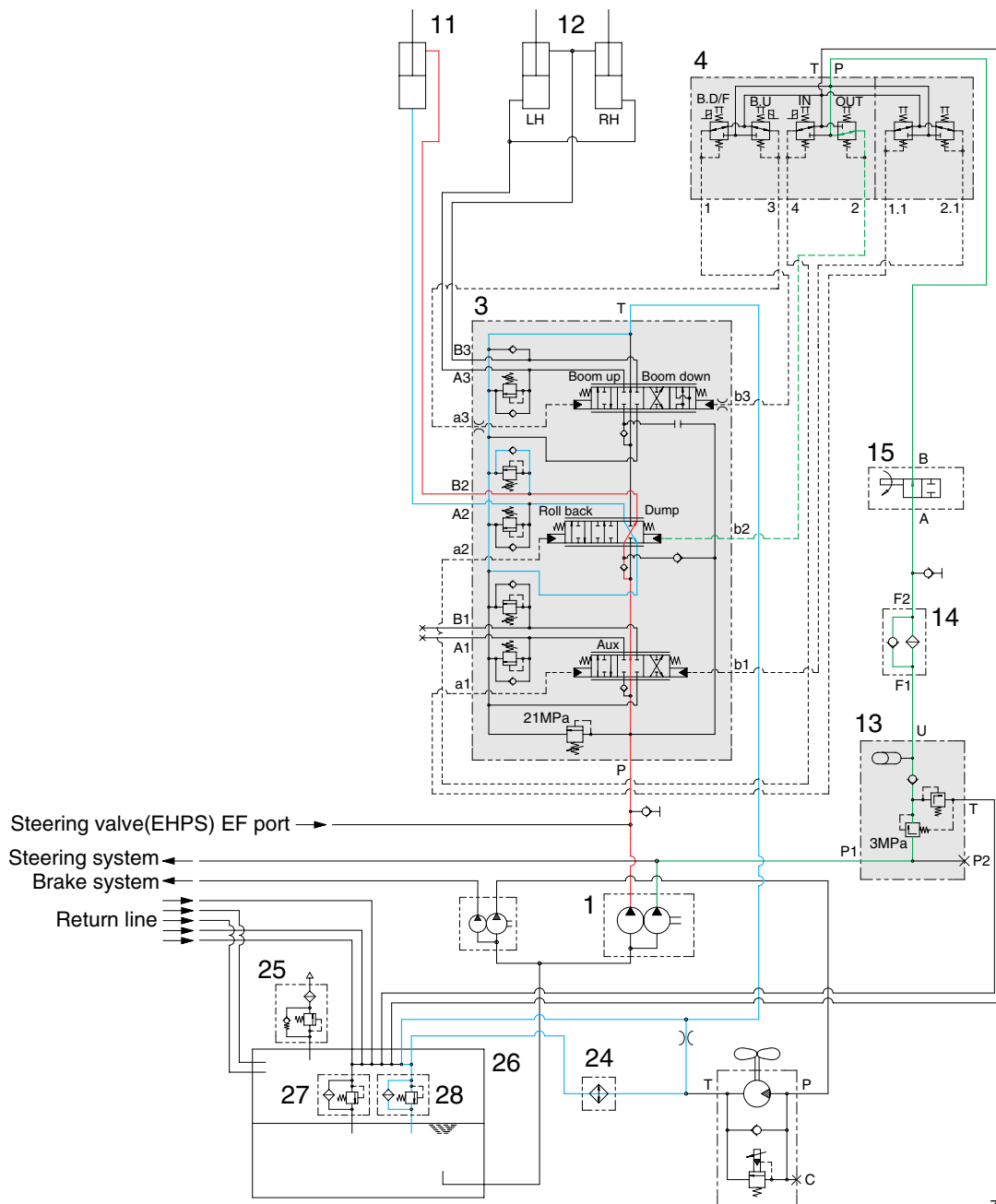
### 3) WHEN THE RCV LEVER IS IN THE FLOAT POSITION



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- When the RCV lever(4) is pushed further forward from the lower position, the pitot pressure reaches to 13~15bar, then the boom spool is moved to floating position.
- The work ports(A3), (B3) 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

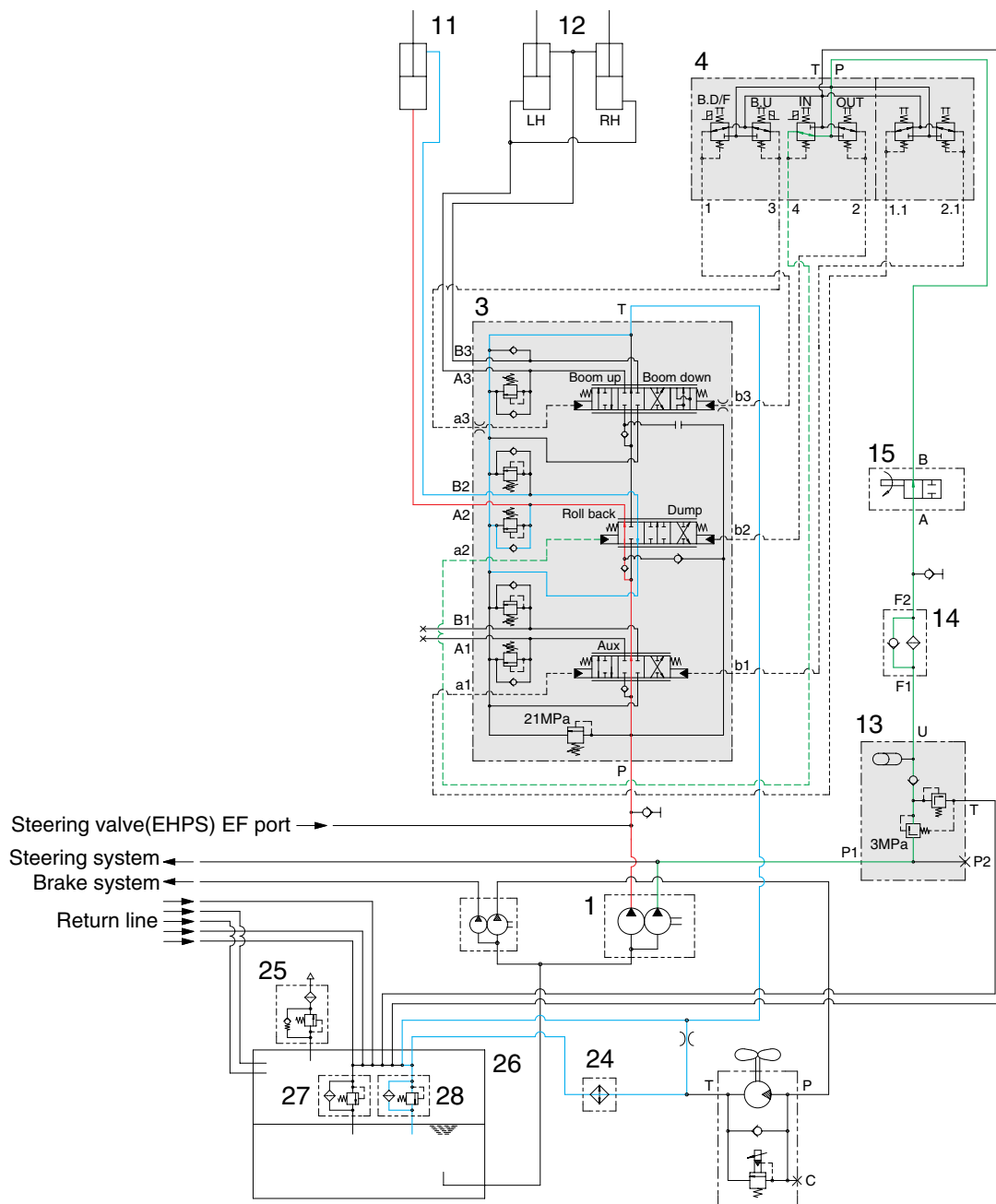


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- If the RCV lever(4) is pushed right, the bucket spool is moved to dump position by pilot oil pressure from port 2 of RCV.
- The oil from main pump(1) flows into main control valve(3) and then goes to the small chamber of bucket cylinder(11) by pushing the load check valve of the bucket spool.
- The oil at the large chamber of bucket cylinder(11) returns to hydraulic tank(26) 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.



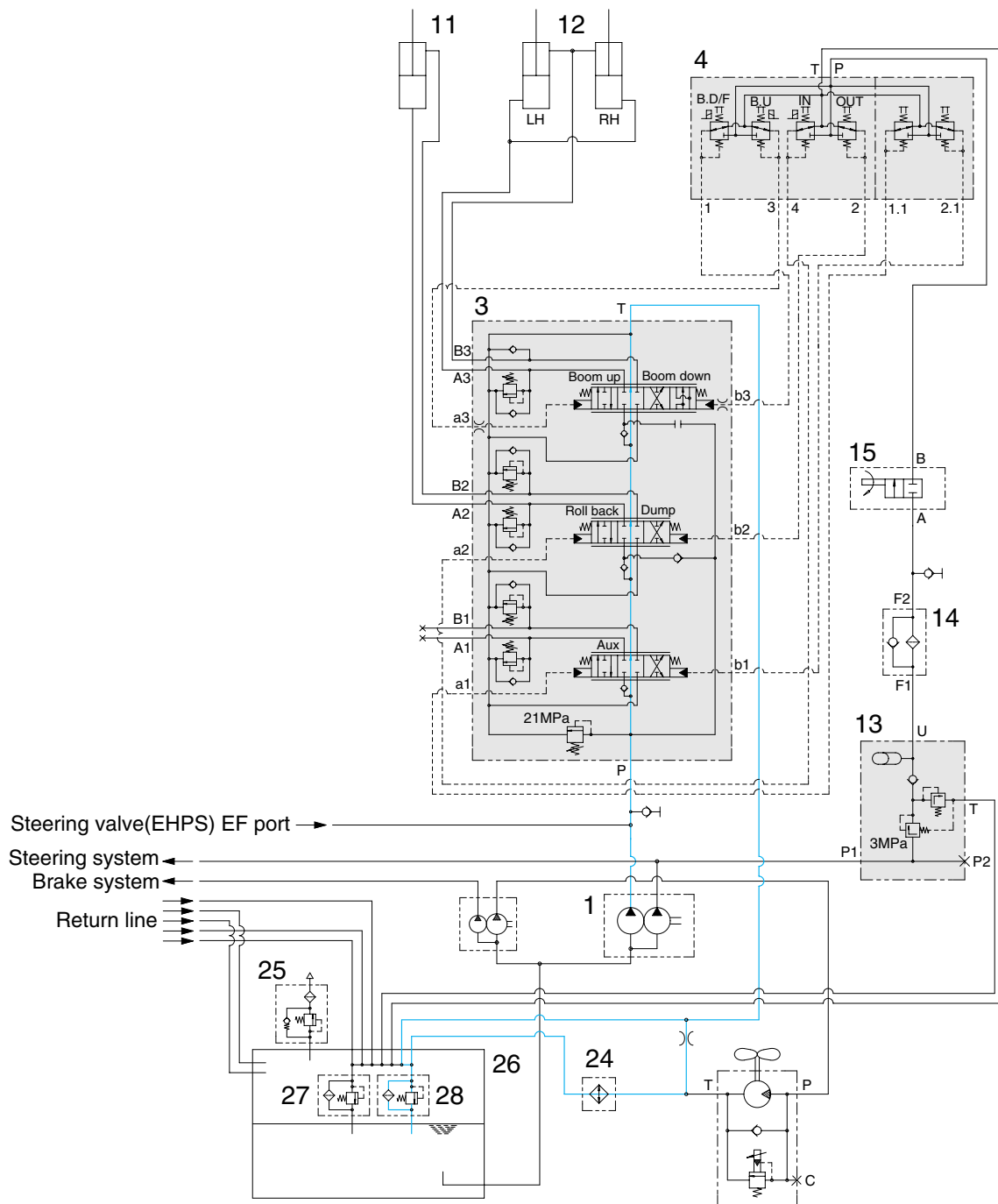
## 5) WHEN THE RCV LEVER IS IN THE ROLL BACK(retract) POSITION



7607WE07

- If the RCV lever(4) is pulled left, the bucket spool is moved to roll back position by pilot oil pressure from port 4 of RCV.
- The oil from main pump(1) 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(11) returns to hydraulic tank(26) 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

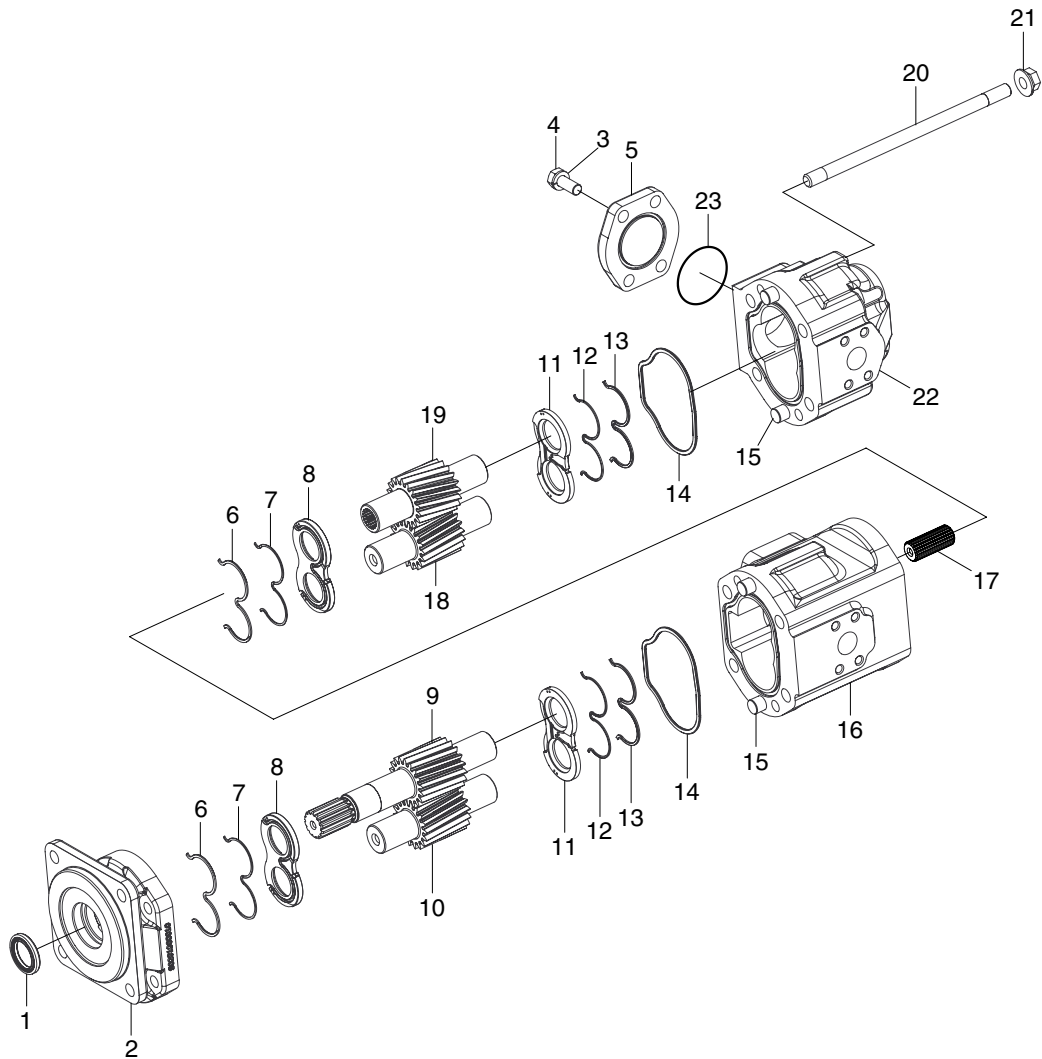


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- The oil from main pump(1) flows into main control valve(3).
- In this time, the bucket spool, the boom spool and the boom float spool are in neutral position, then the oil supplied to main control valve(3) returns into hydraulic tank(26) through center bypass circuit of each spool.
- In this condition, each cylinder keeps the neutral position, so the boom and the bucket is held.

## 4. MAIN PUMP

### 1) STRUCTURE



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- |   |              |    |                   |    |                  |
|---|--------------|----|-------------------|----|------------------|
| 1 | Shaft seal   | 9  | Front drive gear  | 17 | Spline coupling  |
| 2 | Adapter      | 10 | Front driven gear | 18 | Rear driven gear |
| 3 | Washer       | 11 | Wearplate         | 19 | Rear drive gear  |
| 4 | Bolt         | 12 | O-ring seal       | 20 | Stud             |
| 5 | Flange       | 13 | Back up seal      | 21 | Flanged nut      |
| 6 | Back up seal | 14 | Interface seal    | 22 | Rear body        |
| 7 | O-ring seal  | 15 | Dowel             | 23 | O-ring           |
| 8 | Wearplate    | 16 | Front body        |    |                  |

## 2) OPERATION

The main hydraulic pump is a fixed displacement gear type pump. The pump is drive at engine speed by the transmission. The pump shafts are supported by shaft seal(1) adapter(2), front body(16) and rear body(22). The wearplate(8, 11) are located between the gear surface and adapter(1), rear body(22) and front body(16).

As the drive gear(9) and (19) turns the idler gears(10, 18), the gear teeth come out of mesh. Oil flows from the hydraulic tank through the inlet into the cavity between the gear teeth. As the gears continue to rotate, the oil becomes trapped between the gear teeth and front body(16).

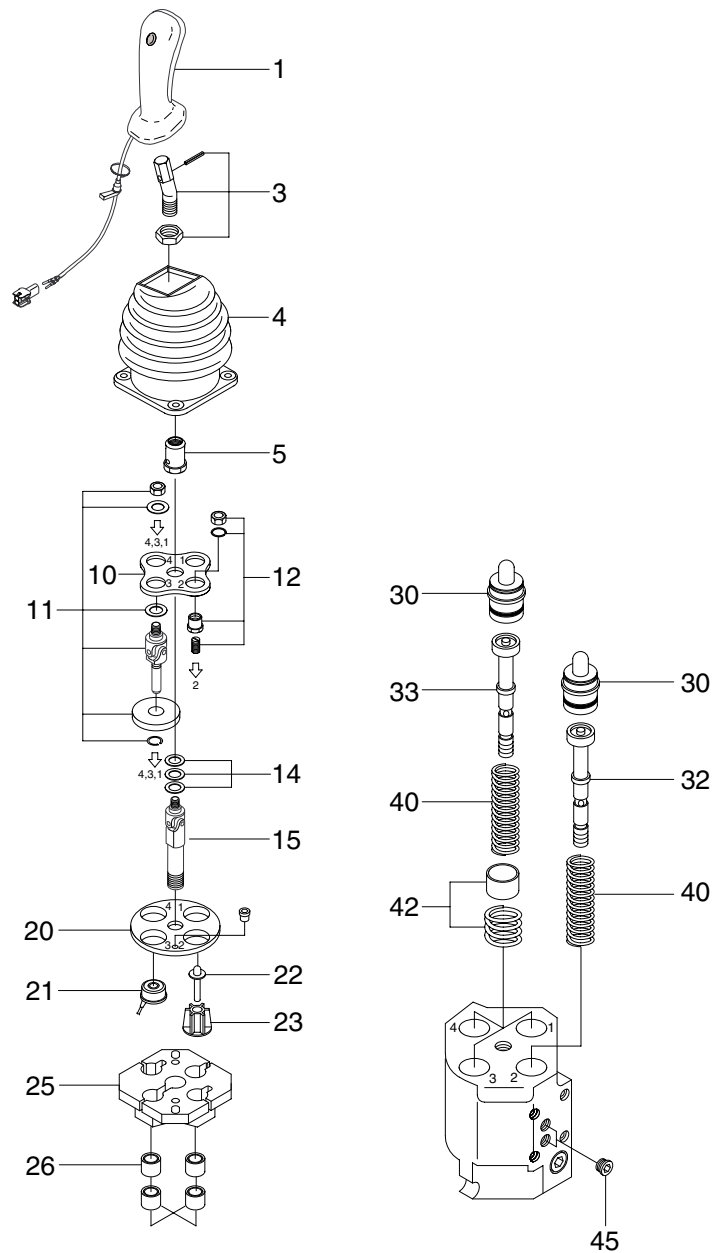
The trapped oil is then carried to the pump outlet. Oil is forced out the outlet to supply the hydraulic function. As the gears re-mesh, they form a seal to prevent oil from flowing between the gears and back to the inlet.

The pump uses outlet pressure oil to load the wearplate(8, 11) against the gear faces. This controls internal leakage to maintain pump displacement.

Outlet pressure fills the area bounded by the pressure balance moulded seals(6, 7) to force the wearplate against the high pressure area or the gear faces.

## 5. REMOTE CONTROL VALVE

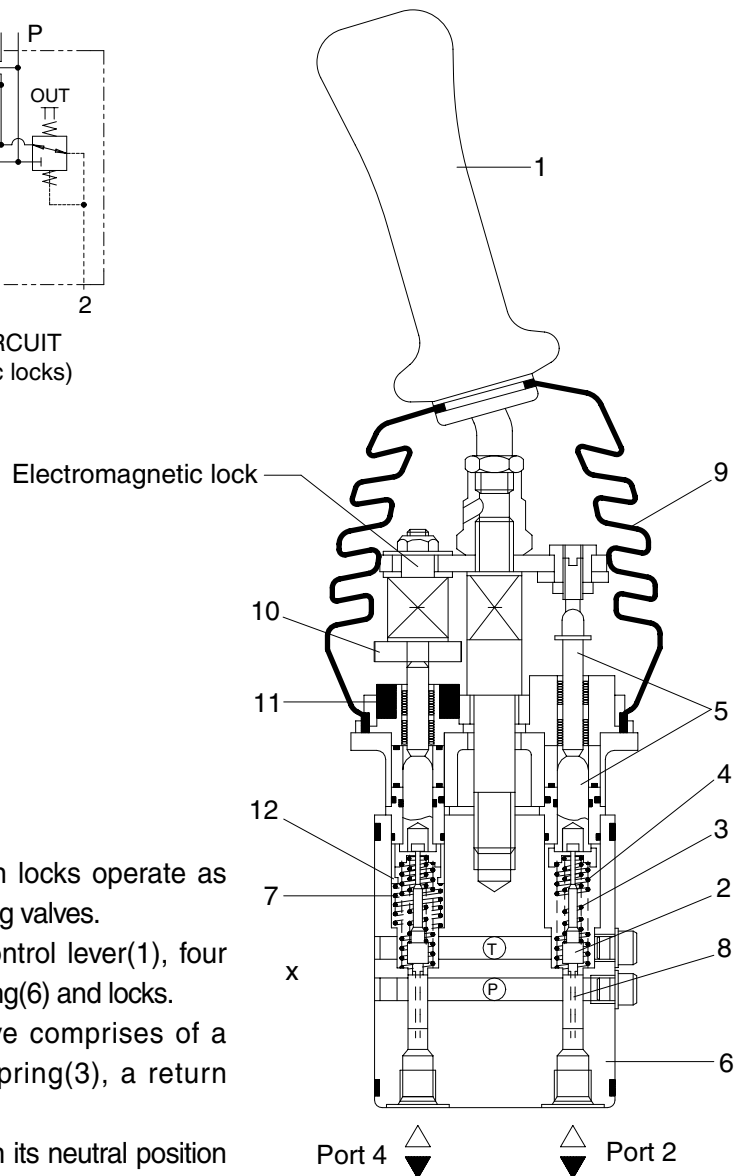
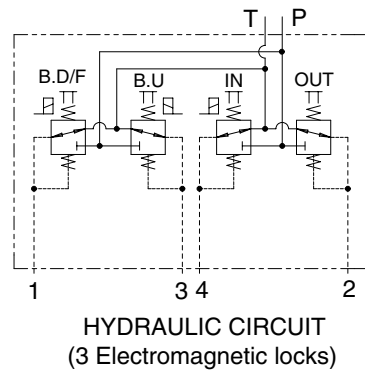
### 1) STRUCTURE



- |    |             |    |                   |    |                   |
|----|-------------|----|-------------------|----|-------------------|
| 1  | Handle      | 14 | Shim set          | 26 | Bushing kit       |
| 3  | Lever kit   | 15 | Joint             | 30 | Plunger kit       |
| 4  | Bellows     | 20 | Flange            | 32 | Regulating unit   |
| 5  | Nut         | 21 | Solenoid complete | 33 | Regulating unit   |
| 10 | Bracket     | 22 | Plunger kit       | 40 | Spring set        |
| 11 | Detent kit  | 23 | Plunger guide     | 42 | Prefeel point kit |
| 12 | Plunger kit | 25 | Electric bracket  | 45 | Plug set          |

7707WE11

## 2) OPERATION



7707WE12

### (1) Hydraulic functional principle

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

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

Each pressure reducing valve comprises of a control spool(2), a control spring(3), a return spring(4) a plunger(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 drilling(8).

When control lever(1) is deflected, plunger(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 drilling(8). The 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(ports 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 plunger(5) and hence to the position of control lever(1).

This pressure control which is dependent on the position of the control lever and the characteristics of the control spring permits the proportional hydraulic control of the main directional valves and high response valves for hydraulic pumps.

A rubber bellows(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**

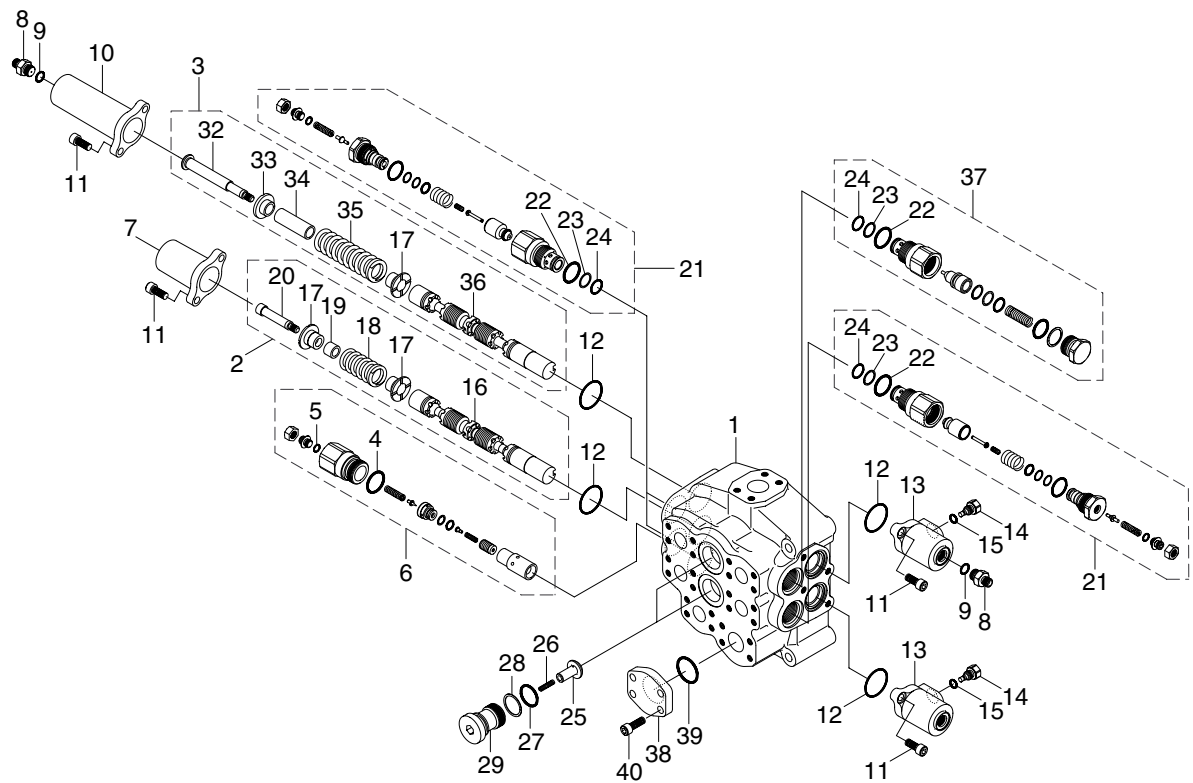
An additional spring(7), which is fitted below an additional plate(12) warns, by means of an increased force, which is required for compressing this spring, that the plunger(5) and the control lever(1) have almost reached their end position.

When this threshold is overcome, a ring(10) contacts the solenoid armature(11); if the solenoid is energized, then control lever(1) is held in its end position by magnetic force.

This lock is released automatically when the solenoid is deenergized.

## 6. MAIN CONTROL VALVE

### 1) STRUCTURE

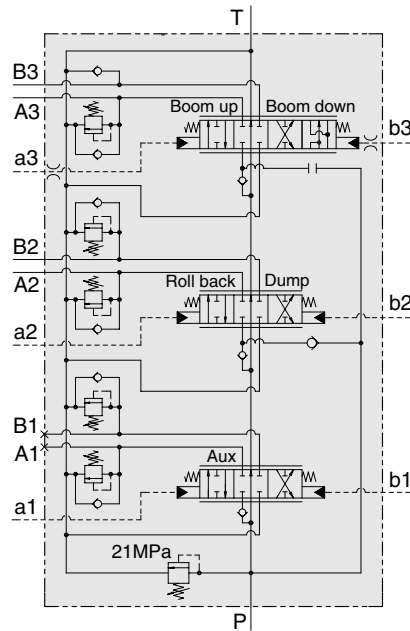
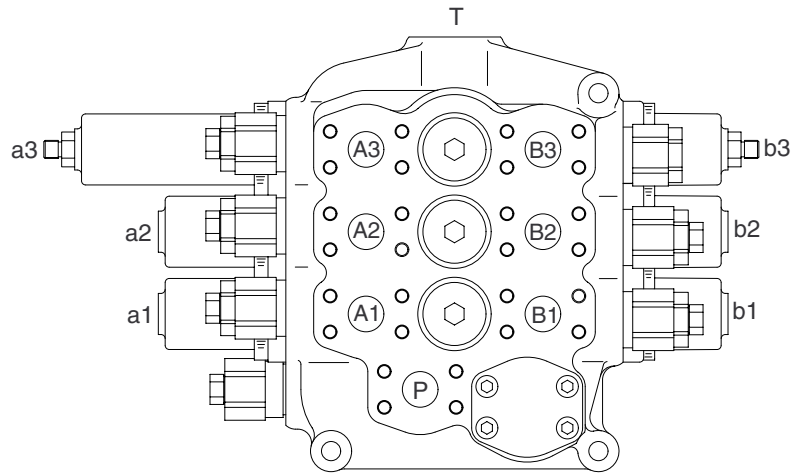
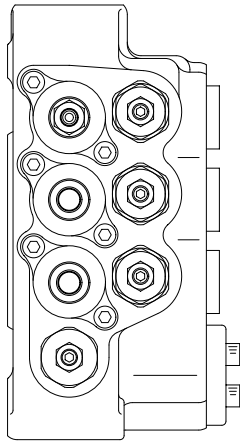


7607WE09

1	Housing assembly	14	Plug	27	O-ring
2	Plunger assembly	15	O-ring	28	Back up ring
3	Plunger assembly	16	Plunger	29	Cap
4	O-ring	17	Guide	32	Cap
5	O-ring	18	Spring	33	Guide
6	Main relief assembly	19	Spacer	34	Spacer
7	Cover	20	Nipple	35	Spring
8	Nipple	21	Port relief assembly	36	Plunger
9	O-ring	22	O-ring	37	Make up assembly
10	Cover	23	Back up ring	38	Cover
11	Socket bolt	24	O-ring	39	O-ring
12	O-ring	25	Check	40	Bolt
13	cover	26	Spring		



# STRUCTURE



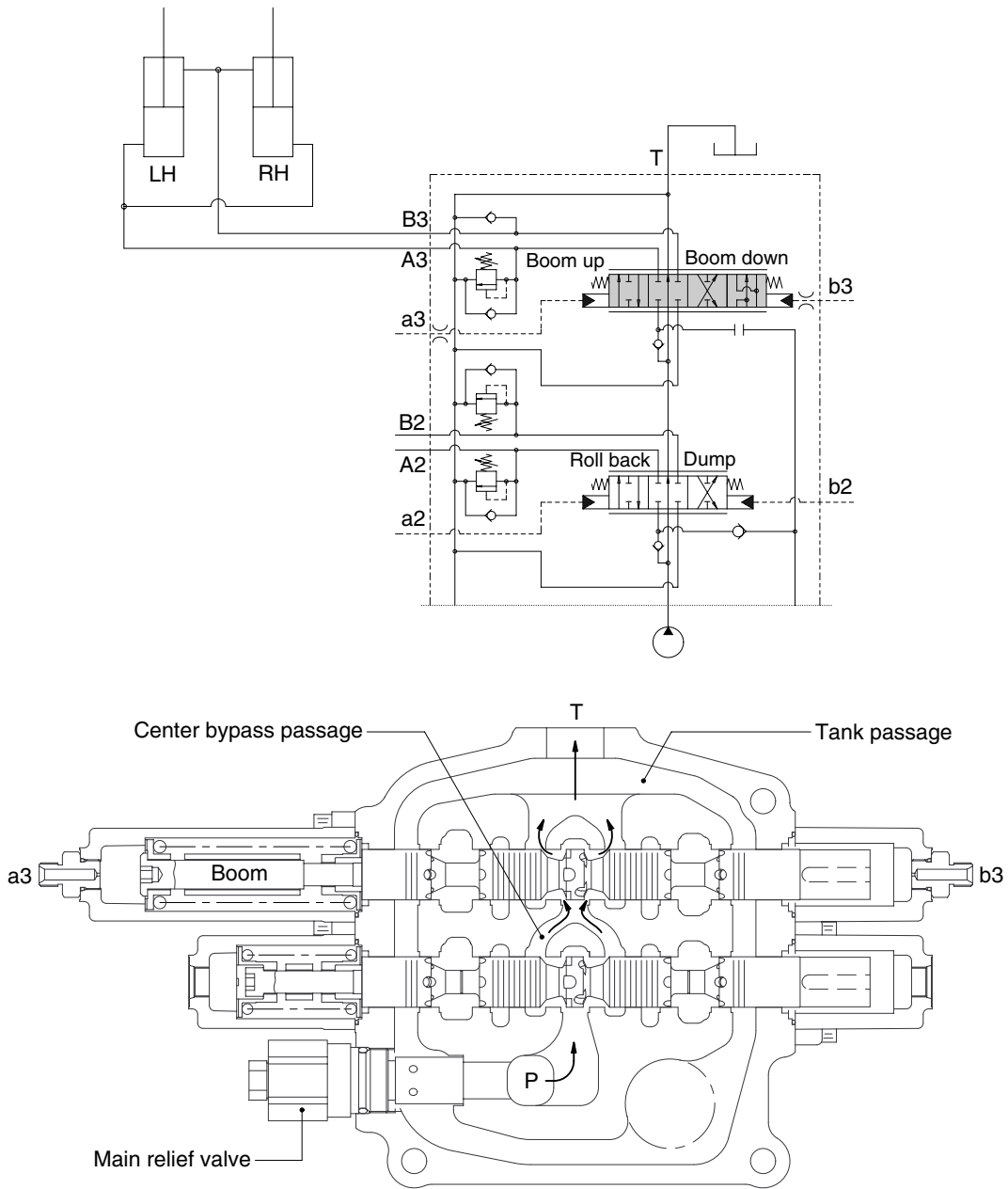
Hydraulic circuit

7607WE10

Port	Port name	Port size
P	From main pump	1" Split flange
T	To hydraulic tank	1-1/4" Split flange
A2, B2	To bucket cylinder port	1" Split flange
A3, B3	To boom cylinder port	1" Split flange
a3, b3	Boom pilot port	PF 3/8" Fitting
a2, b2	Bucket pilot port	PF 3/8 O-ring boss

## 2) BOOM SECTION OPERATION

### (1) Spool in neutral

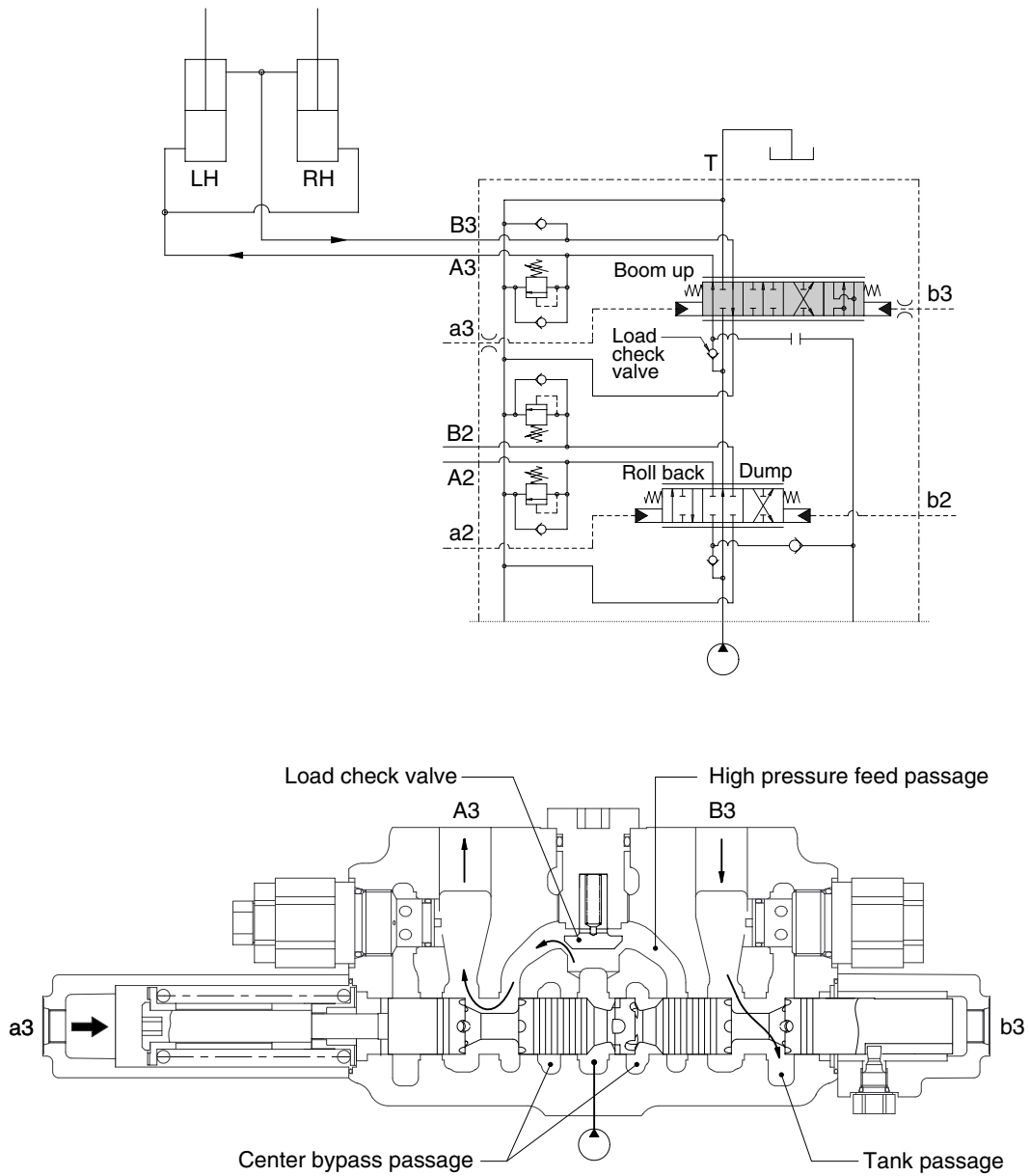


7607WE11

When the boom plunger is in neutral position, oil from the pump flows to the tank through the center bypass line.

The cylinder port(A3, B3) are shut off from the high pressure feed passage and tank passage by the boom plunger.

(2) Boom raise position



7607WE12

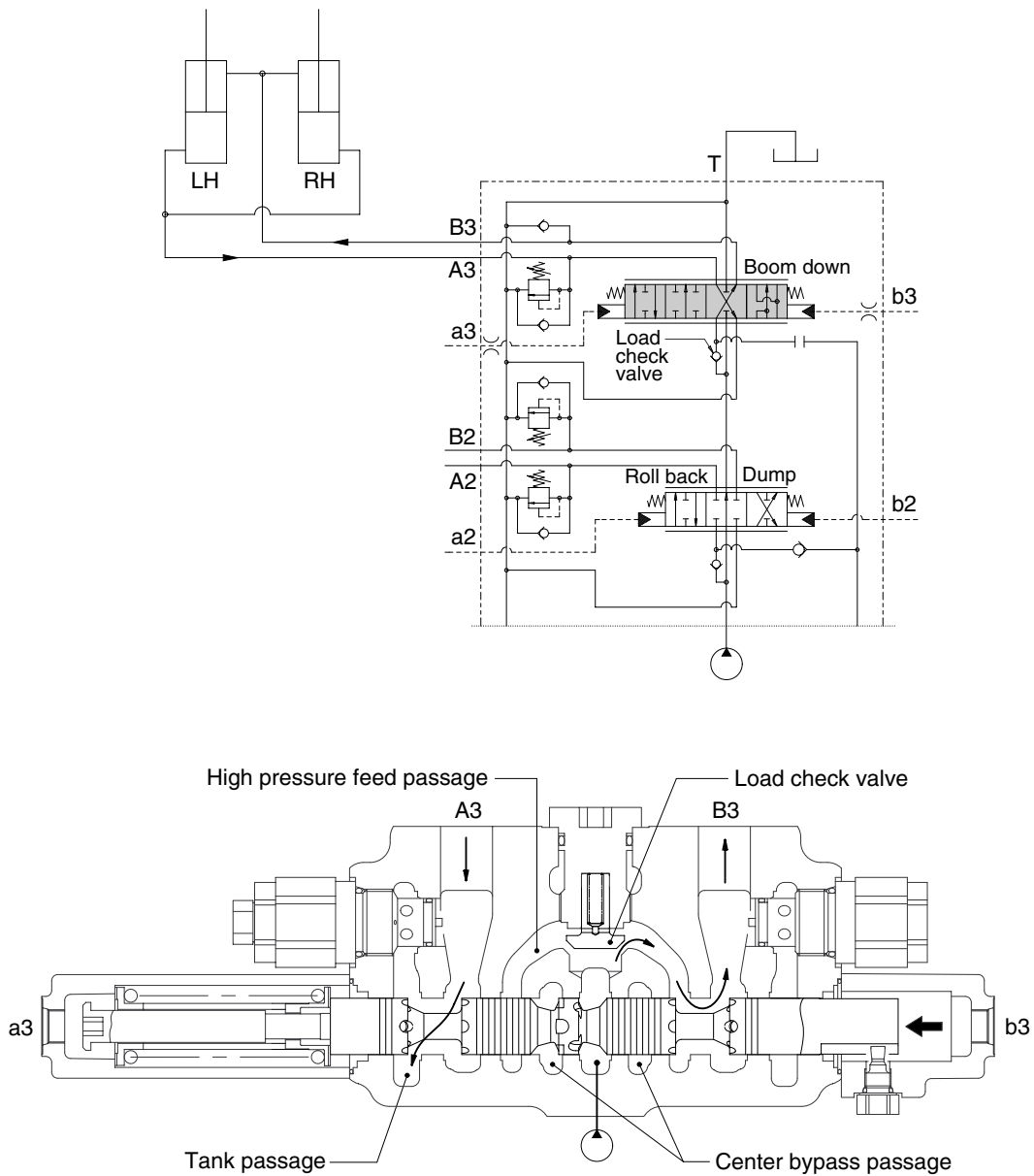
When the pilot pressure is led to the port(a3), the boom plunger is switched, and shut off center bypass passage.

Oil from the pump flows to the cylinder port(A3) through the load check valve and oil from the cylinder flows into the tank passage through the cylinder port(B3).

※ **Load check valve**

When the load pressure is higher than the pump pressure, the load check shuts off the passage between the high pressure feed passage and the center bypass passage and prevents the reverse flow from the cylinder.

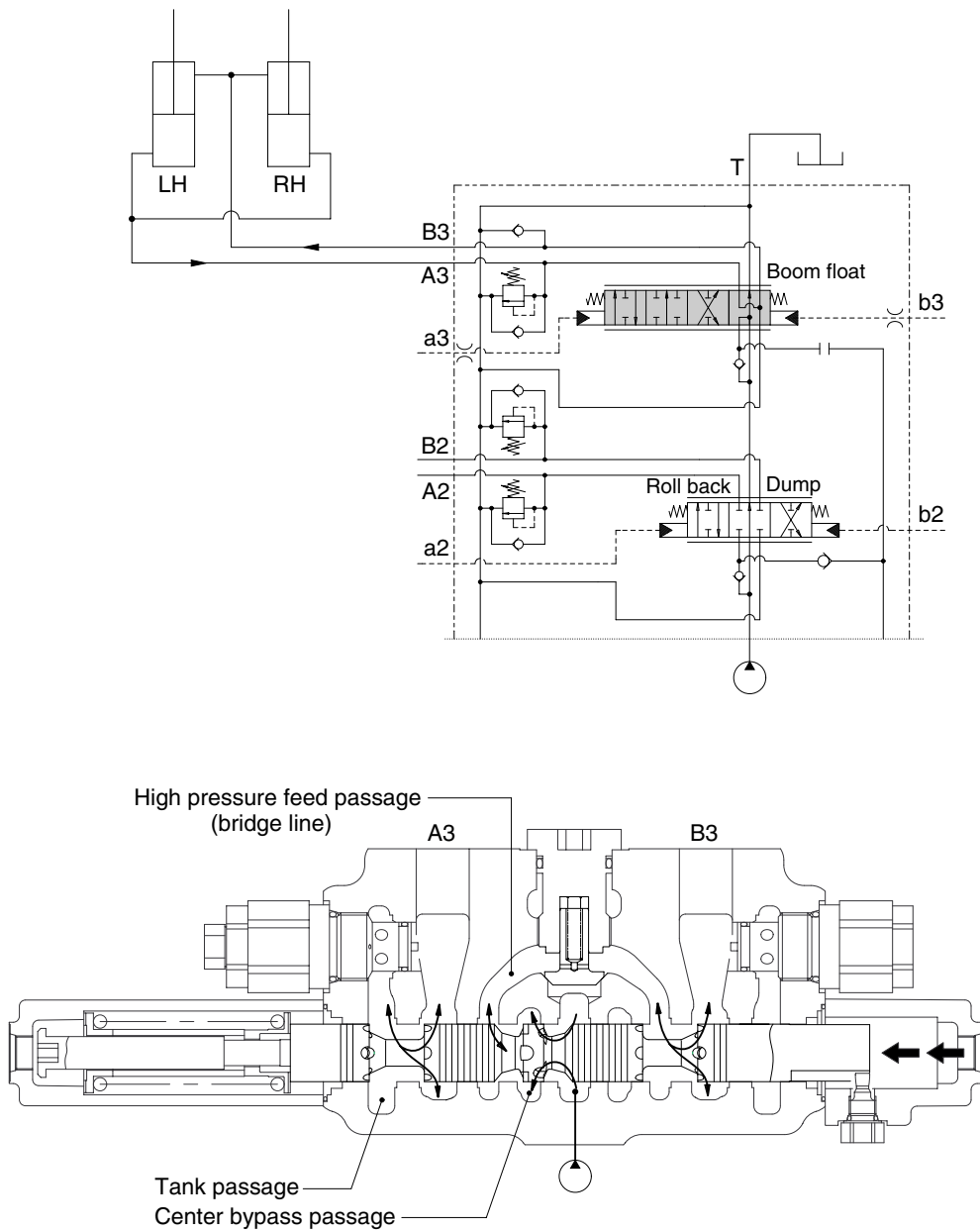
(3) Boom lower position



7607WE13

When the pilot pressure is led to the port(b3), the boom plunger is switched, and shut off center bypass passage. Oil from the pump flows to the cylinder port(B3), through the load check valve and oil from the cylinder flows into the tank passage through the cylinder port(A3).

#### (4) Boom float position



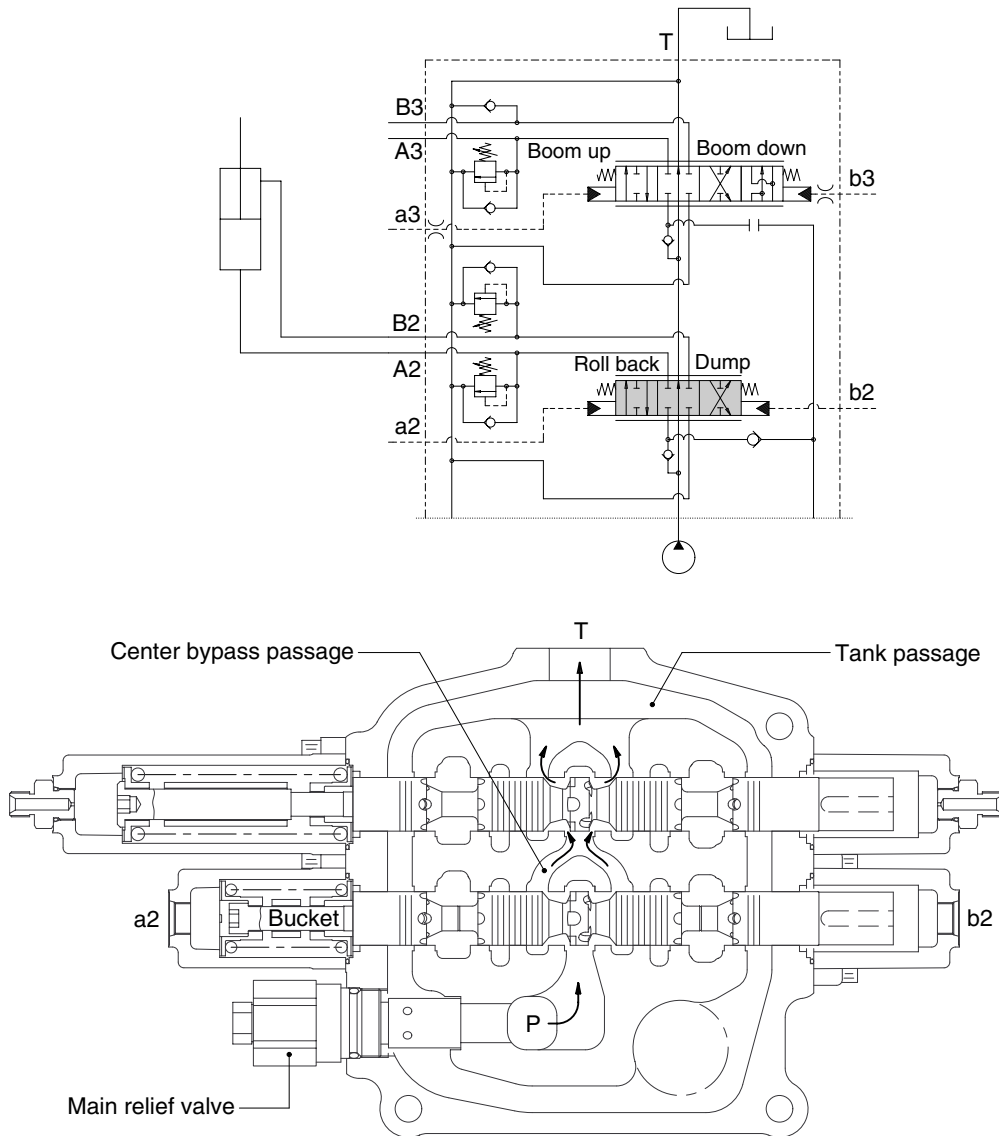
7607WE14

When the boom plunger is located in float position, the oil from the pump flows to the tank through the center bypass line.

The cylinder port(A3) is connected to the tank passage, and the cylinder port(B3) is connected to the tank passage through the bridge line. And then the both cylinder port is in float condition.

### 3) BUCKET SECTION OPERATION

#### (1) Spool in neutral

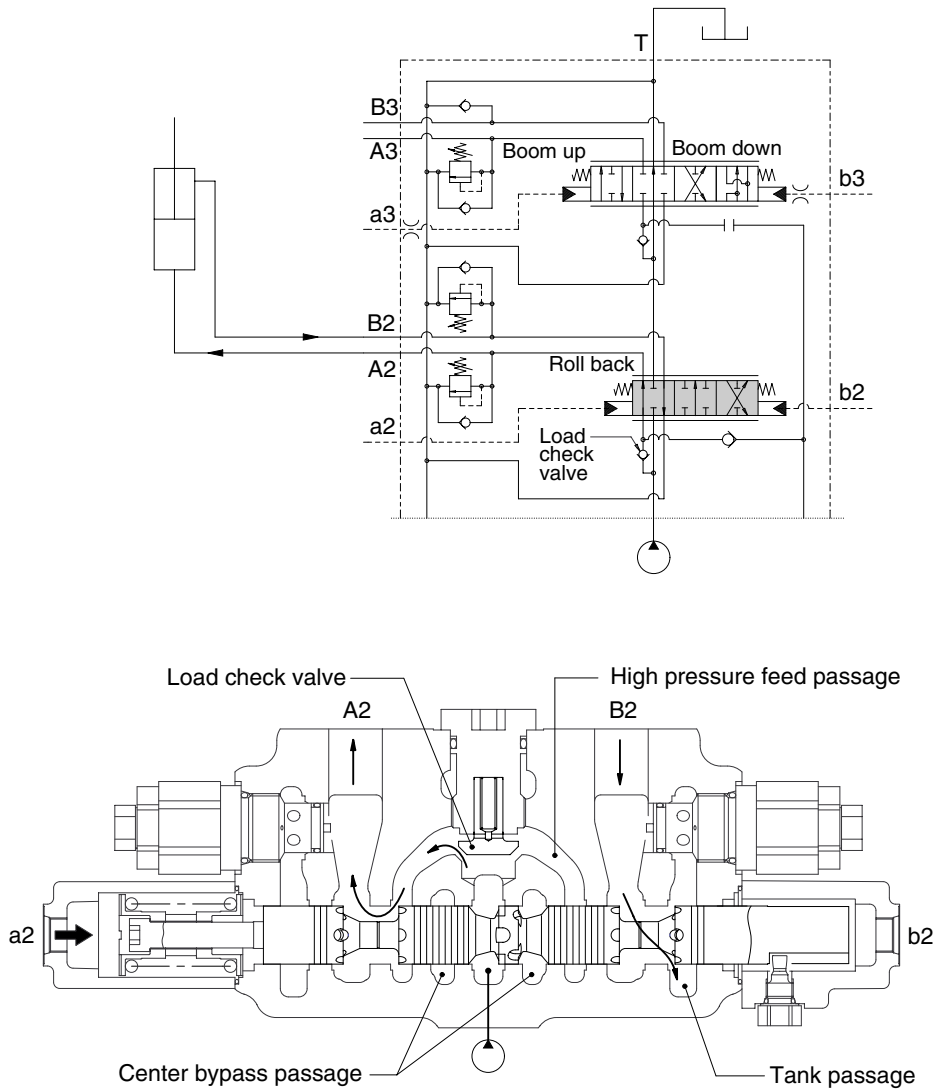


7607WE15

When the bucket plunger is in neutral position, oil from the pump flows to the tank through the center bypass line.

To cylinder port(A2, B2) are shut off from the high pressure feed passage and tank passage by the bucket plunger.

(2) Bucket rollback position



7607WE16

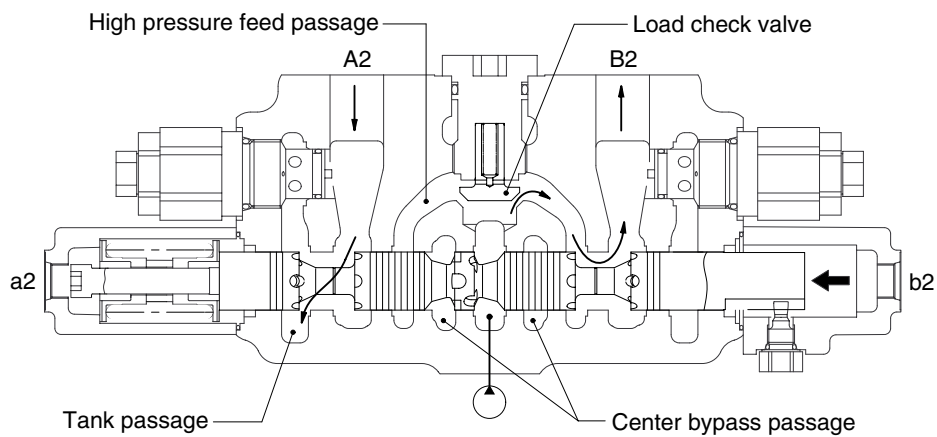
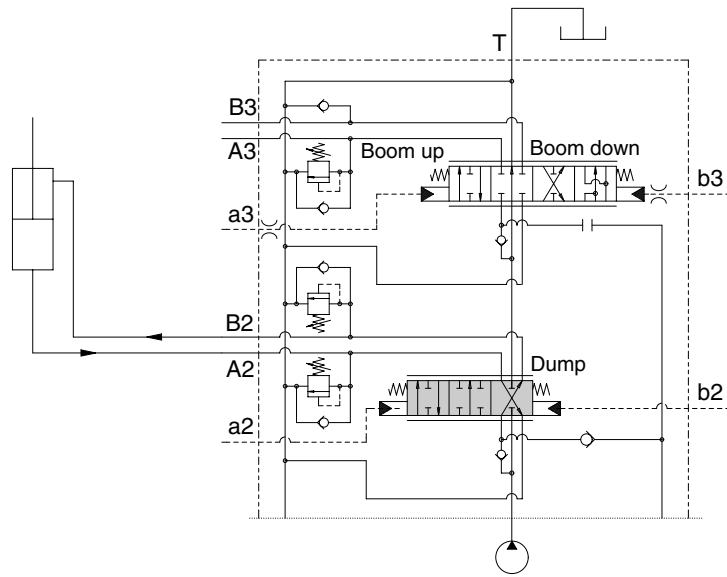
When the pilot pressure is led to the port(a2), the bucket plunger is switched, and shut off center bypass passage.

Oil from the pump flows to the cylinder port(A2) through the load check valve and oil from the cylinder flows into the tank passage through the cylinder port(B2).

※ Load check valve

When the load pressure is higher than the pump pressure, the load check shuts off the passage between the high pressure feed passage and the center bypass passage and prevents the reverse flow from the cylinder.

(3) Bucket dump position



7607WE17

When the pilot pressure is led to the port(b2), the bucket plunger is switched, and shut off center bypass passage.

Oil from the pump flows to the cylinder port(B2) through the load check valve and oil from the cylinder flows into the tank passage through the cylinder port(A2).

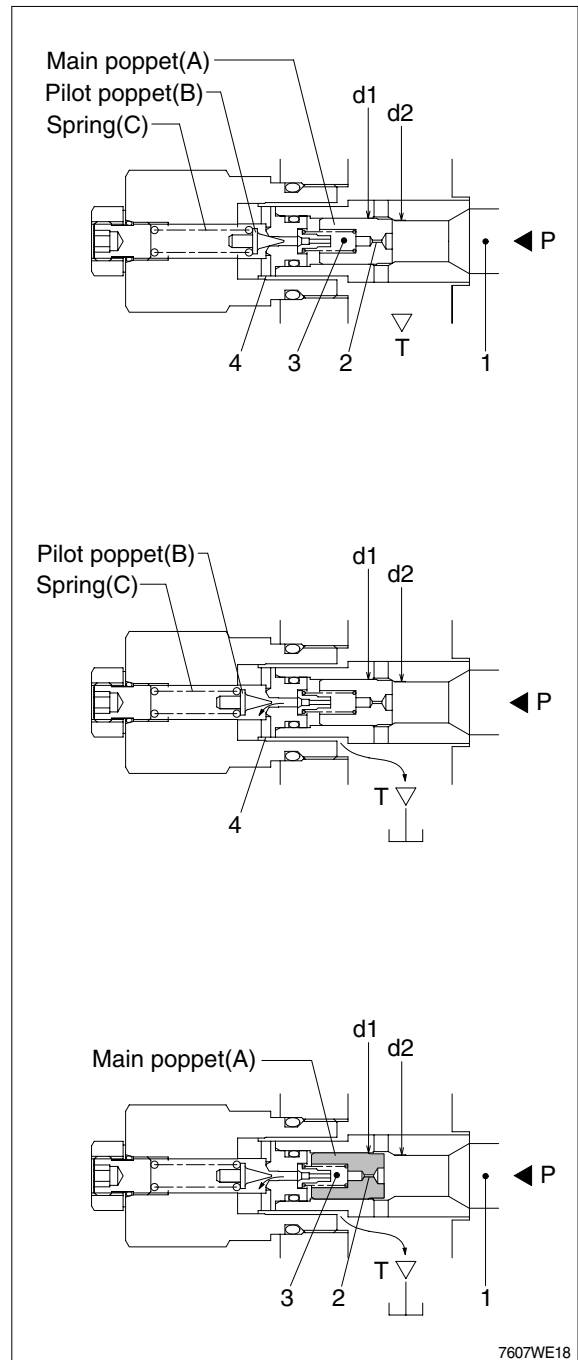


#### 4) MAIN RELIEF VALVE

- The relief valve is installed between pump circuit and tank circuit in the main control valve housing and keeps system pressure to setting pressure.
- Oil from the pump port(P) enters into the chamber(3) through the orifice(2) of the main poppet(A).  
As  $d_2 < d_1$ , main poppet(A) is securely seated.

- When the pressure reaches the preset force of the spring(C), the pilot poppet(B) opens. Oil flow around pilot poppet(B) and flows into the tank passage(T) through the side hole(4).

- As oil flows from the pump port(P) to the tank passage(T) through the orifice(2) of the main poppet(A), the pressure of the chamber(3) comes to lower than that of the pump port.  
Then the main poppet(A) is lifted and pressured oil flows into the tank passage.

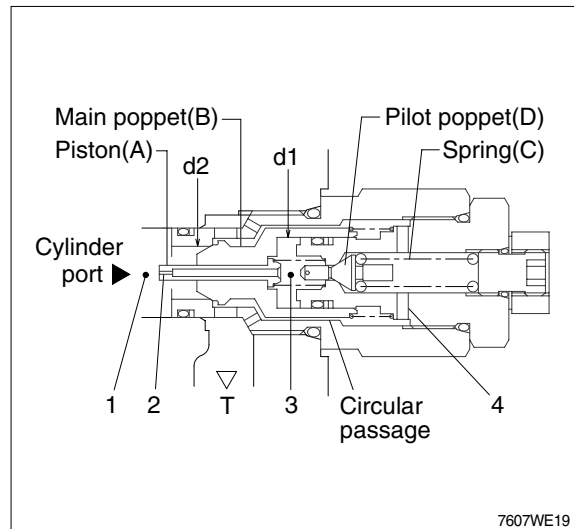


## 5) PORT RELIEF VALVE

The port relief valve is installed between cylinder port and tank passage.

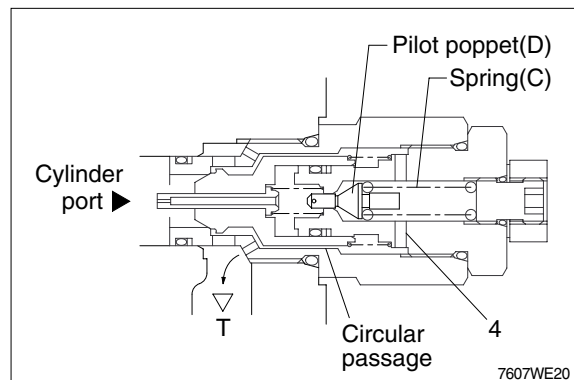
It protects the actuator from abnormal pressure, due to outer force or sudden block of cylinder pressure.

The port relief valve is the type of built-in make-up function.

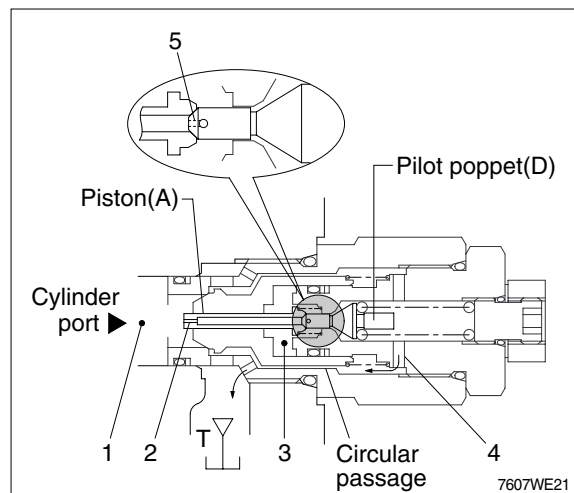


### (1) Overload relief function

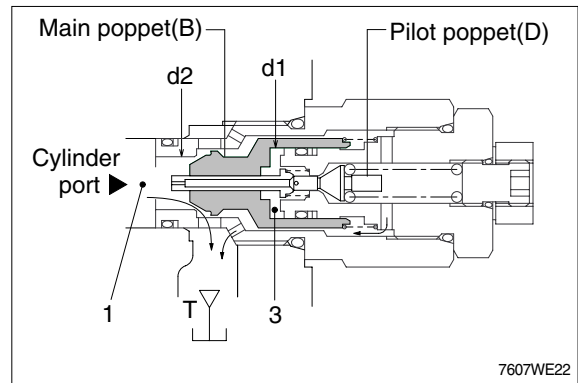
- ① When the pressure reaches the preset force of the spring (C), the pilot poppet (D) is lifted and pressured oil flows into the tank passage.



- ② As oil flows from the cylinder port to the tank passage through the orifice (2) of the piston (A), the pressure of the chamber (3) comes to lower than that of the cylinder port. Then the piston (A) is lifted and seated to the pilot poppet (D). Oil from the cylinder port flows to the tank passage through the orifice (5) of the pilot poppet (D), side hole (4) and the circular passage.

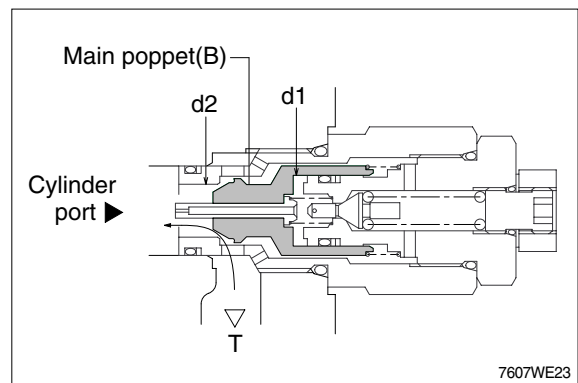


- ③ Oil from the cylinder port flows to the tank passage. As the pressure of the chamber(3) comes to lower still more, the main poppet(B) is lifted and pressured oil flows into the tank passage.



**(2) Make-up function**

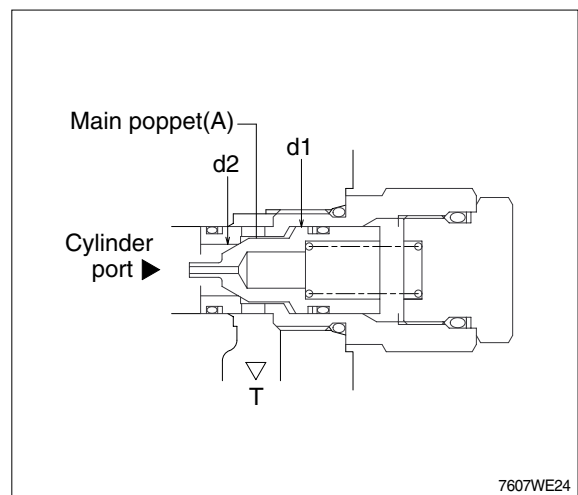
As the cylinder port pressure is normally higher than the tank passage pressure and  $d2 < d1$ , the poppet(B) is securely seated. When the cylinder port pressure comes to lower than the tank passage pressure (closer to negative pressure), the poppet(B) opens receiving the tank passage pressure for the difference in area between  $d2$  and  $d1$  oil from the tank passage flows to the cylinder port in order to prevent cavitation.



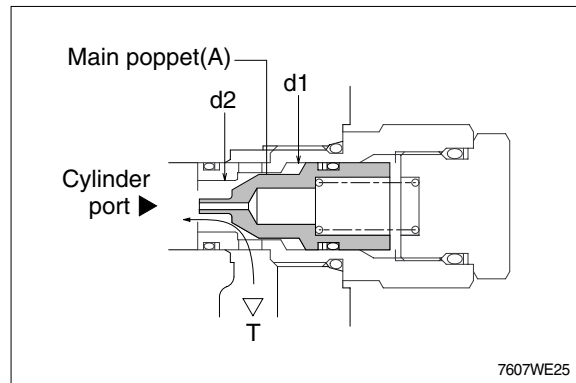
**6) MAKE UP VALVE**

The make-up valve is installed between the cylinder port and the tank passage. When the cylinder port pressure comes to lower than the tank passage pressure, then make-up valve supplies the oil to the cylinder port from the tank passage, and prevents cavitation.

- (1) As the cylinder port pressure is normally higher than the tank passage pressure and  $d2 < d1$ , the poppet(A) is securely seated.

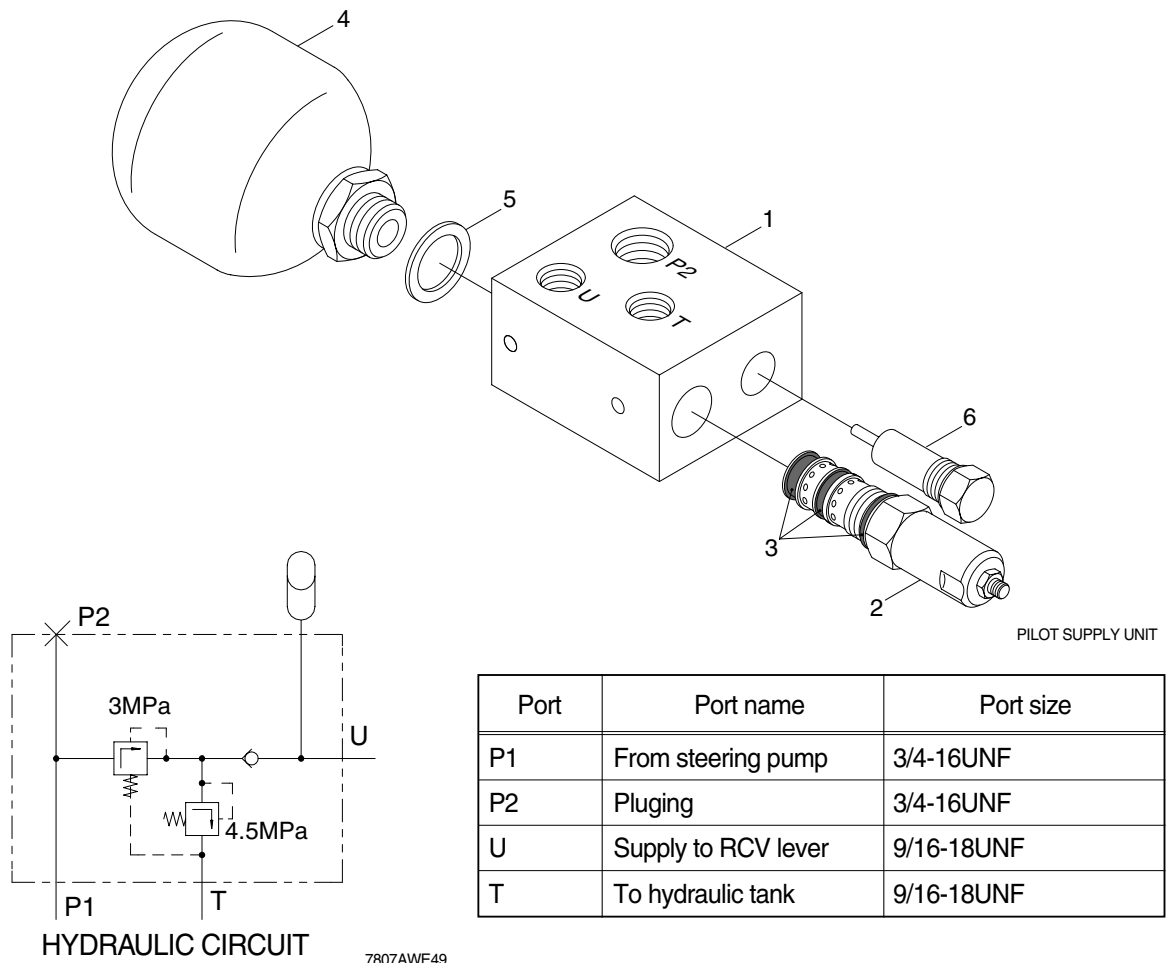


(2) When the cylinder port pressure comes to lower than the tank passage pressure (closer to negative pressure), the poppet (A) opens receiving the tank passage pressure for the difference in area between  $d_2$  and  $d_1$ . Oil from the tank passage flows to the cylinder port in order to prevent cavitation.



## 7. PILOT OIL SUPPLY UNIT

### 1) STRUCTURE



- |   |                   |   |              |
|---|-------------------|---|--------------|
| 1 | Manifold complete | 4 | Accumulator  |
| 2 | Reducing valve    | 5 | Gasket       |
| 3 | Seal kit          | 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. BOOM AND BUCKET CYLINDER

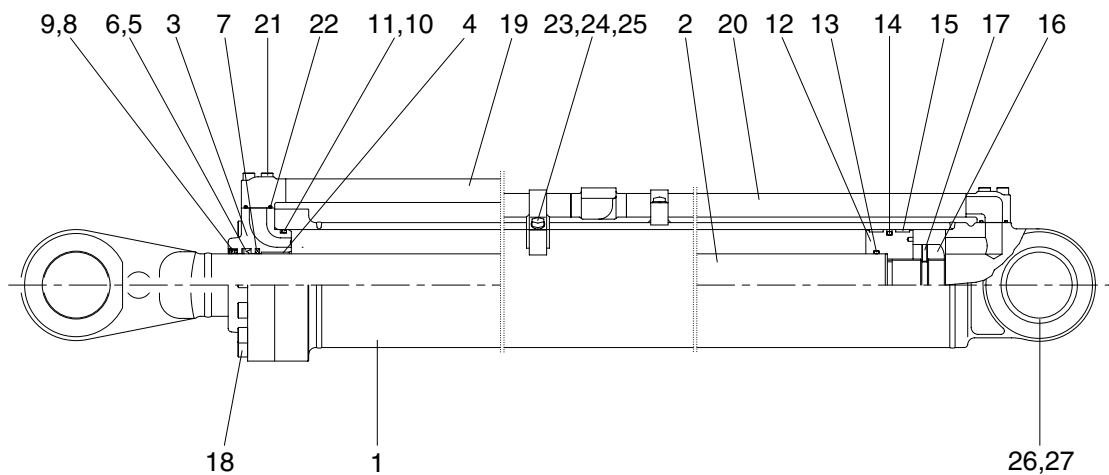
The boom cylinders are two unit and the bucket cylinder is one unit. They use a bolt on rod guide.

The piston(12) threads on to the rod(2) and is retained by a nut(16) and set screw(17).

The piston seals against the tube(1) with piston seal(14). Two wear rings(15) 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.

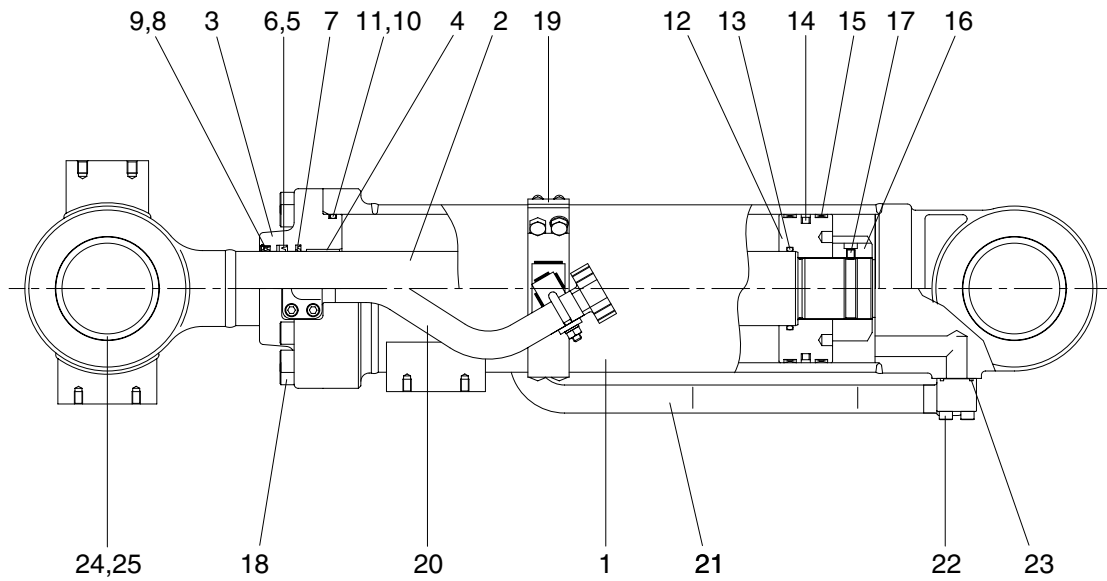
### 1) BOOM CYLINDER



7607WE26

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

## 2) BUCKET CYLINDER



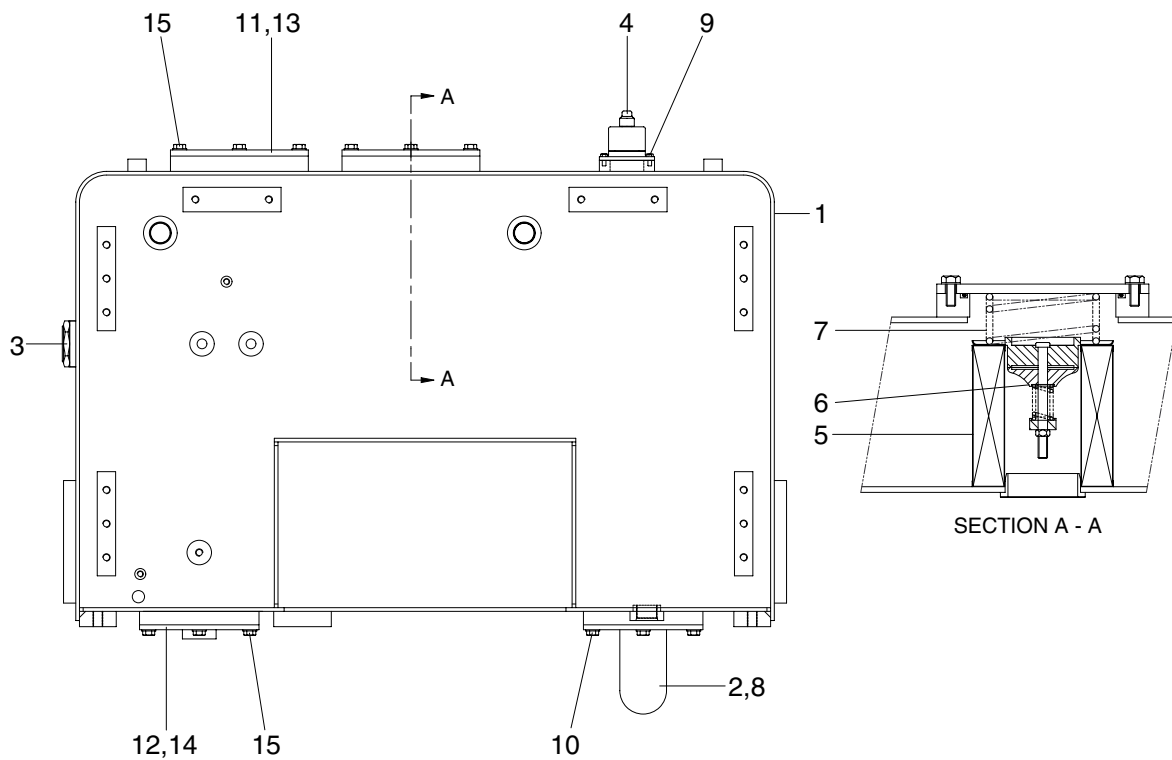
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- |   |               |    |              |    |               |
|---|---------------|----|--------------|----|---------------|
| 1 | Tube assembly | 10 | O-ring       | 18 | Bolt          |
| 2 | Rod assembly  | 11 | Back up ring | 19 | Band assembly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

## 9. HYDRAULIC OIL TANK

### 1) STRUCTURE

- The oil from the hydraulic tank is sent from the pump through main 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(6) acts to allow the oil to return directly to the hydraulic tank(1). This prevents damage to the hydraulic filter(5). The bypass valve(6) is also actuated when negative pressure is generated in the circuit.



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1	Hydraulic tank wa	9	Socket bolt
2	Pipe wa	10	Bolt
3	Sight gauge	11	Cover
4	Air breather	12	Cover
5	Element assembly	13	O-ring
6	Bypass valve	14	O-ring
7	Spring	15	Bolt
8	O-ring		

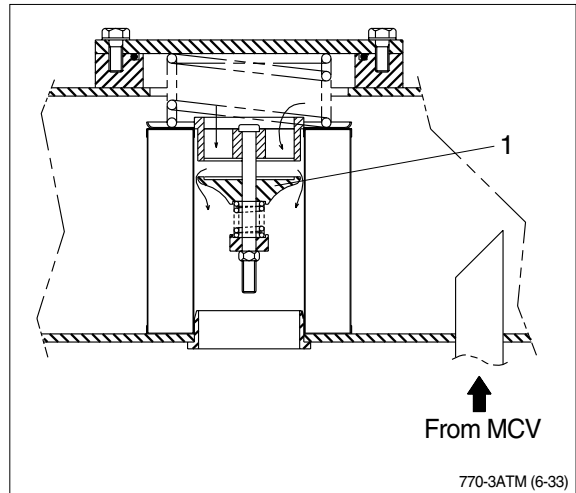


## 2) RETURN OIL FILTER BYPASS VALVE

### (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<sup>2</sup>  
(19.3psi)



### 3) AIR BREATHER

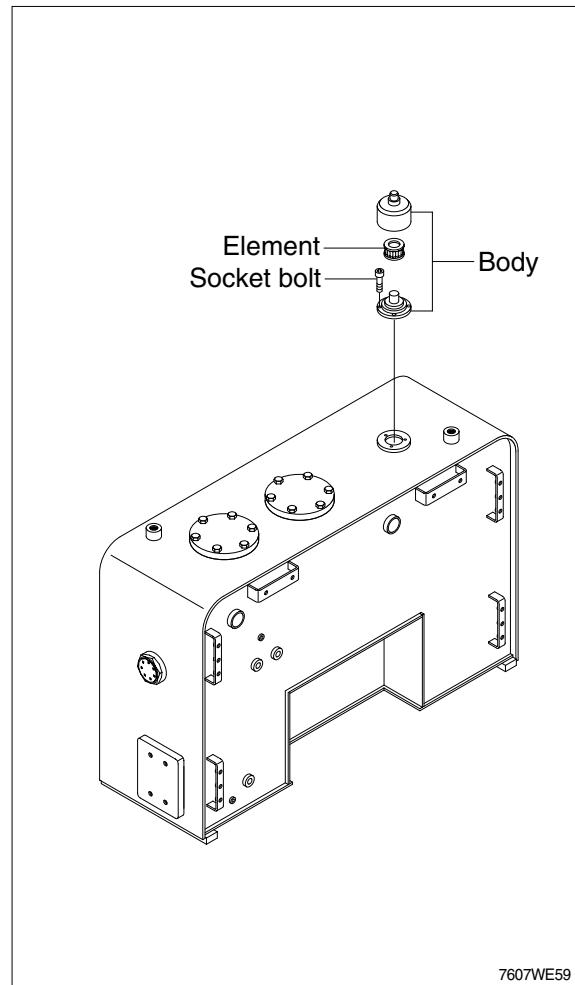
The air breather is equipped with the capacity to perform three functions simultaneously-as an air filter, breathing valve, and as a lubrication opening.

#### (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.



## 10. 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 <sub>2</sub> )
Volume of gas	0.75 l (0.2 U.S.gal)
Charging pressure of gas	16kg/cm <sup>2</sup> (228psi)
Max actuating pressure	128kg/cm <sup>2</sup> (1820psi)

