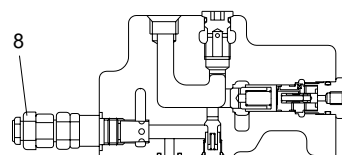


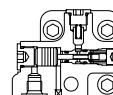
GROUP 2 MAIN CONTROL VALVE

1. STRUCTURE

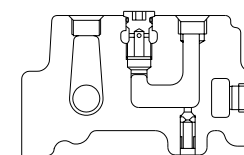
- 1 Plunger
- 2 Center bypass valve
- 3 Foot relief valve
- 4 Center bypass valve
- 5 Boom load holding valve
- 6 Logic check valve
- 7 Straight travel valve
- 8 Main relief valve
- 9 Over load relief valve
- 10 Arm regeneration valve



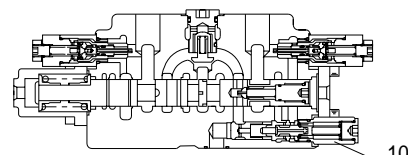
Section F-F



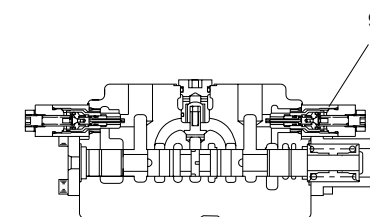
Section Z-Z



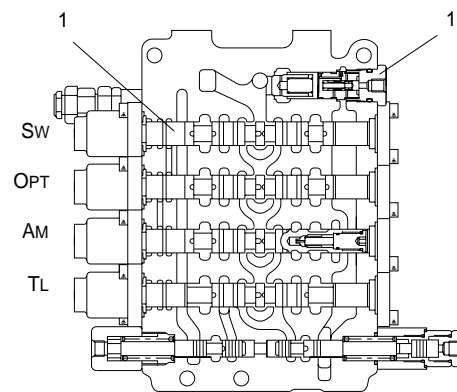
Section K-K



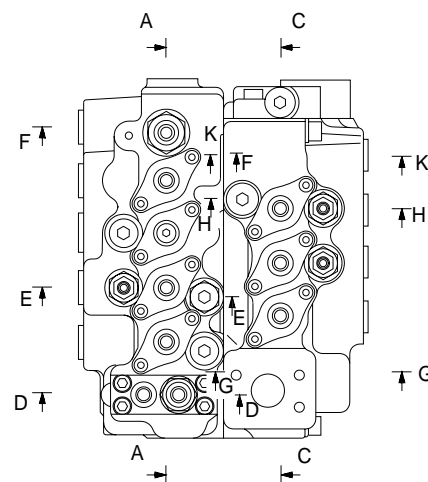
Section E-E



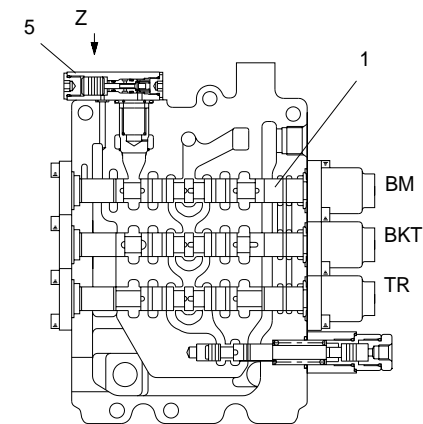
Section H-H



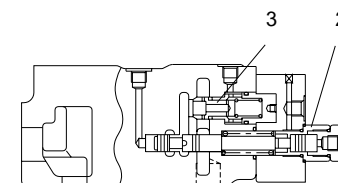
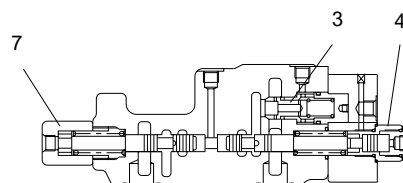
Section A-A



Section D-D

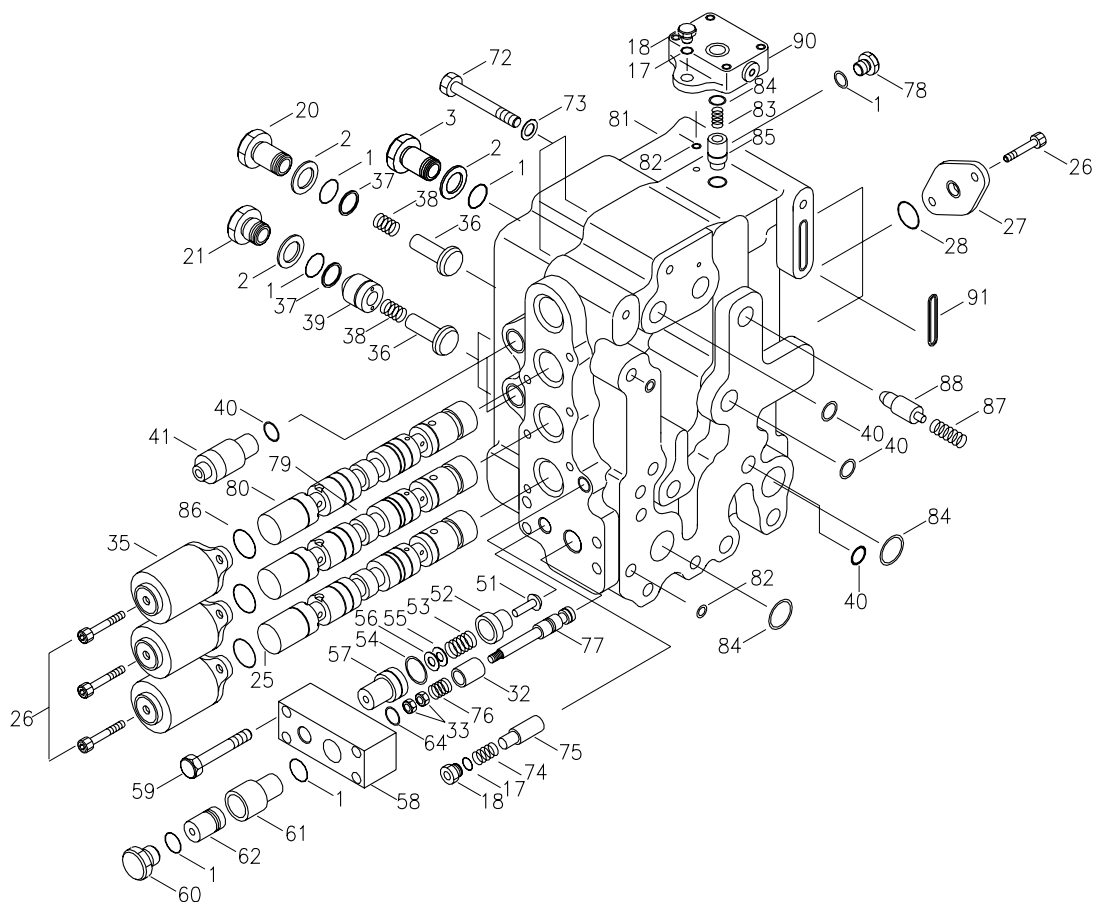


Section C-C



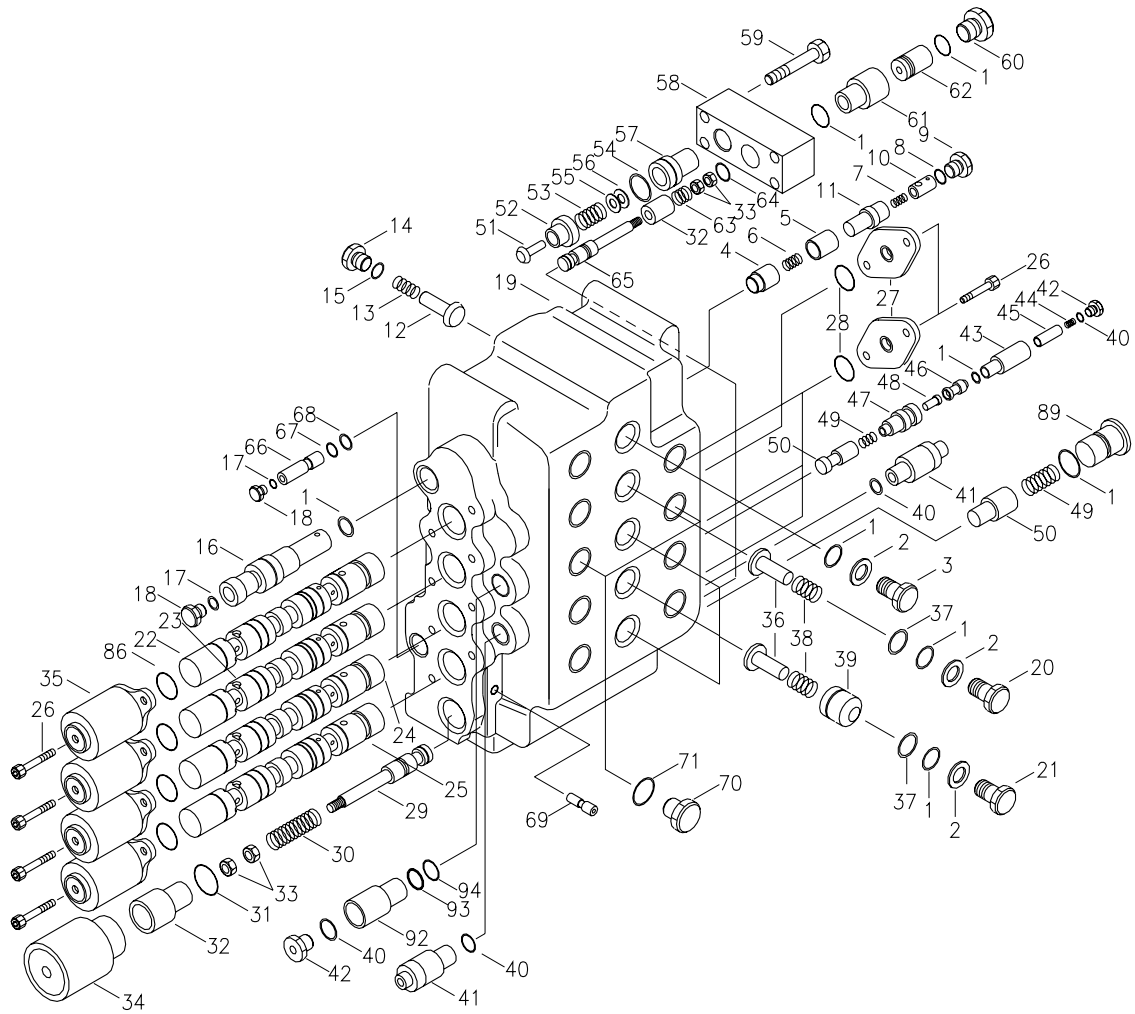
Section G-G

STRUCTURE



1	O-ring	21	Cap	41	Over load assy
2	Back-up ring	22	Plunger T assy	42	Cap
3	Cap	23	Plunger D assy	43	Cap
4	Check	24	Plunger A assy	44	Spring
5	Piston	25	Plunger M assy	45	Spring guide
6	Spring	26	Hex socket head bolt	46	Spool
7	Spring	27	Retainer	47	Sleeve
8	O-ring	28	O-ring	48	Piston
9	Cap	29	Spool	49	Spring
10	Piston	30	Spring	50	Check
11	Sleeve	31	O-ring	51	Poppet
12	Check	32	Spring guide	52	Sleeve
13	Spring	33	Hex nut	53	Spring
14	Cap	34	Cap	54	O-ring
15	O-ring	35	Cover	55	Shim
16	Main relief assy	36	Check	56	Shim
17	O-ring	37	Nylon chip	57	Spring guide
18	Cap	38	Spring	58	Cover
19	Housing	39	Check	59	Hex socket head bolt
20	Cap	40	O-ring	60	Cap

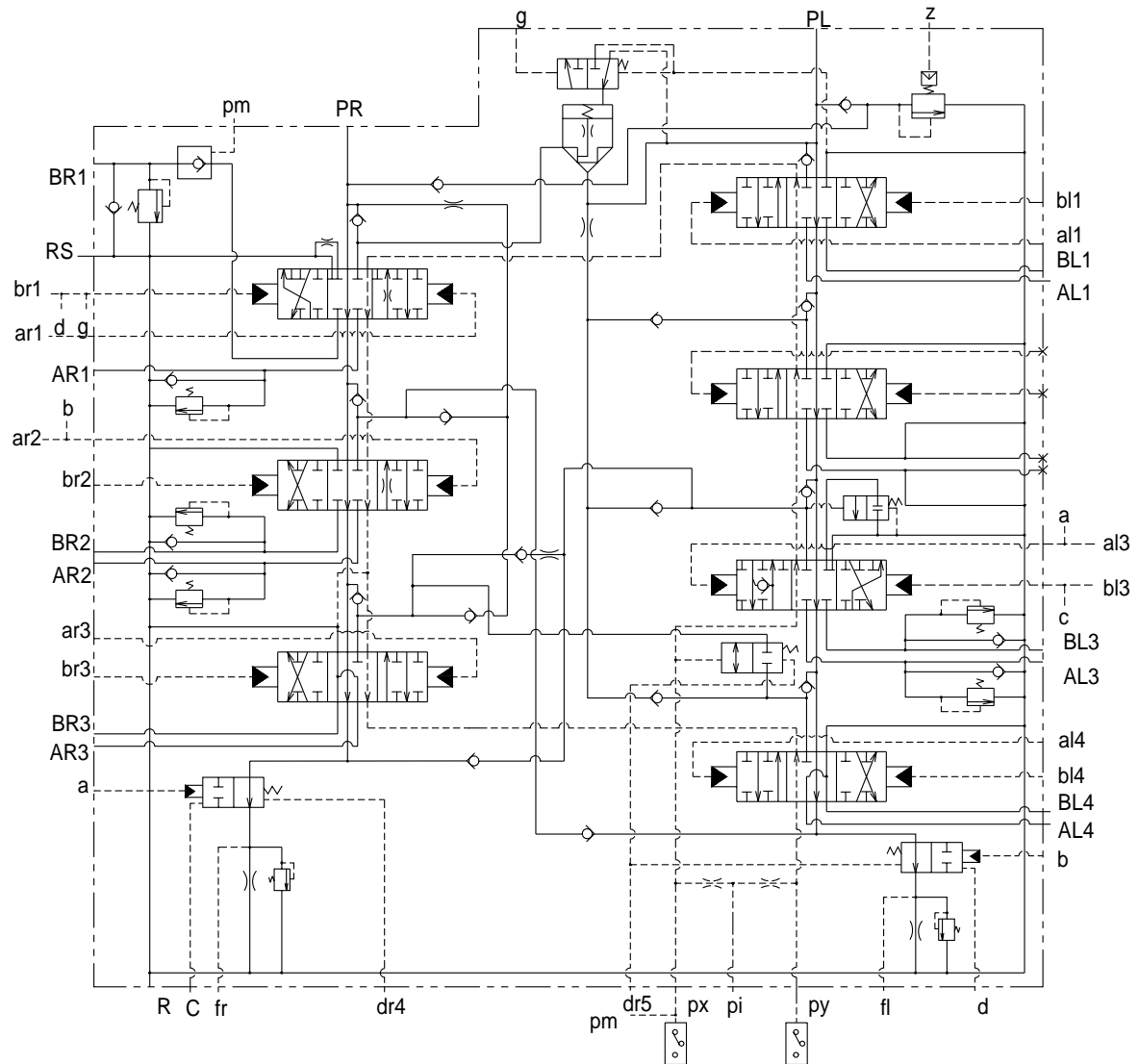
STRUCTURE



61	Cap	73	Spring washer	85	Poppet
62	Piston	74	Spring	86	O-ring
63	Spring	75	Check	87	Spring
64	O-ring	76	Spring	88	Check
65	Spool	77	Spool	89	Cap
66	Orifice	78	Cap	90	Cover assy
67	O-ring	79	Plunger C1 assy	91	O-ring
68	Back-up ring	80	Plunger B1 assy	92	Plug
69	Orifice	81	Housing	93	Back-up ring
70	Cap	82	O-ring	94	O-ring
71	O-ring	83	Spring		
72	Hex socket head bolt	84	O-ring		

2. FUNCTION

1) HYDRAULIC CIRCUIT DIAGRAM



2) BASIC OPERATION

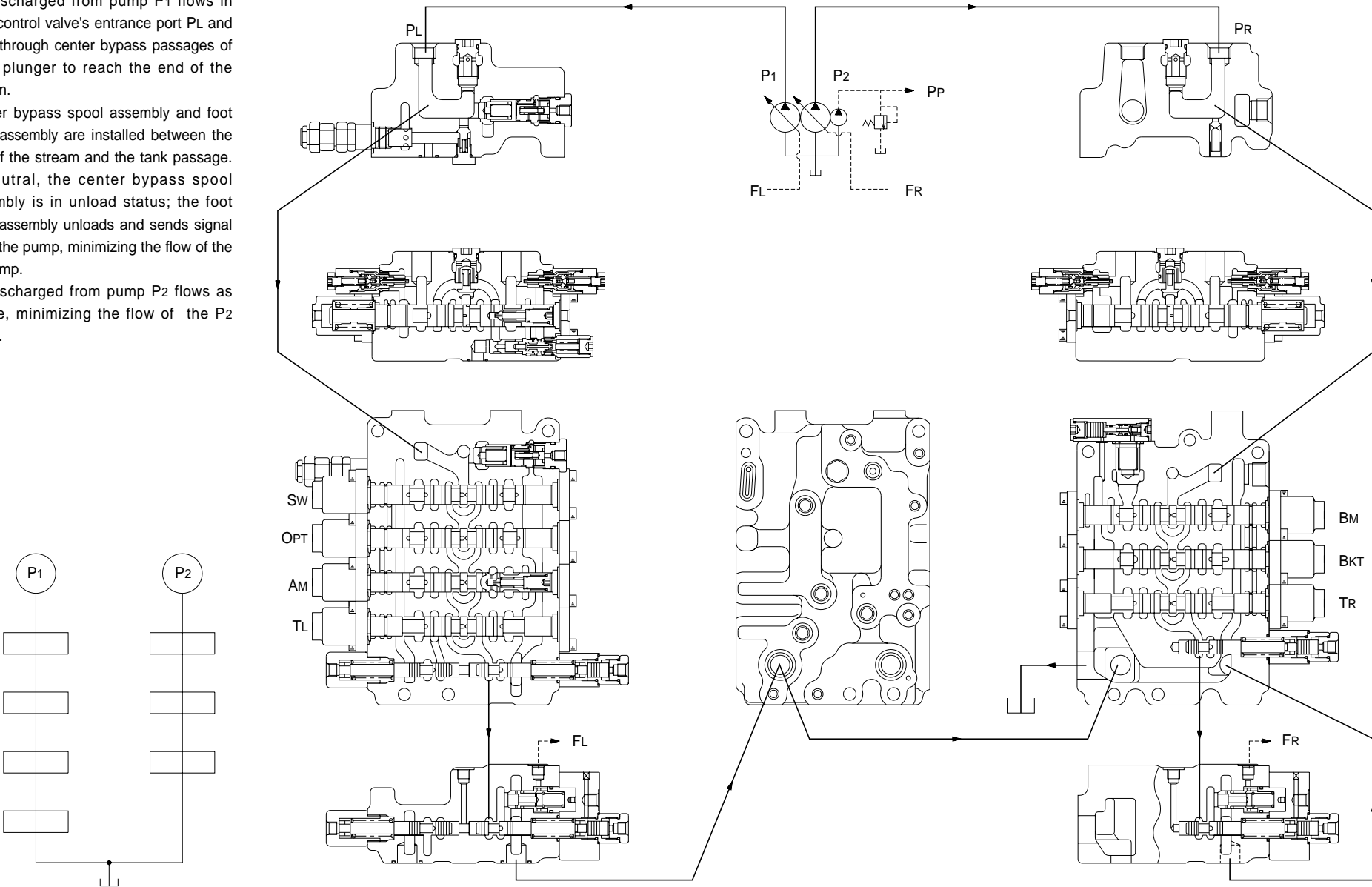
(1) Neutral circuit

Oil discharged from pump P1 flows in from control valve's entrance port PL and goes through center bypass passages of each plunger to reach the end of the stream.

Center bypass spool assembly and foot relief assembly are installed between the end of the stream and the tank passage.

In neutral, the center bypass spool assembly is in unload status; the foot relief assembly unloads and sends signal FL to the pump, minimizing the flow of the P1 pump.

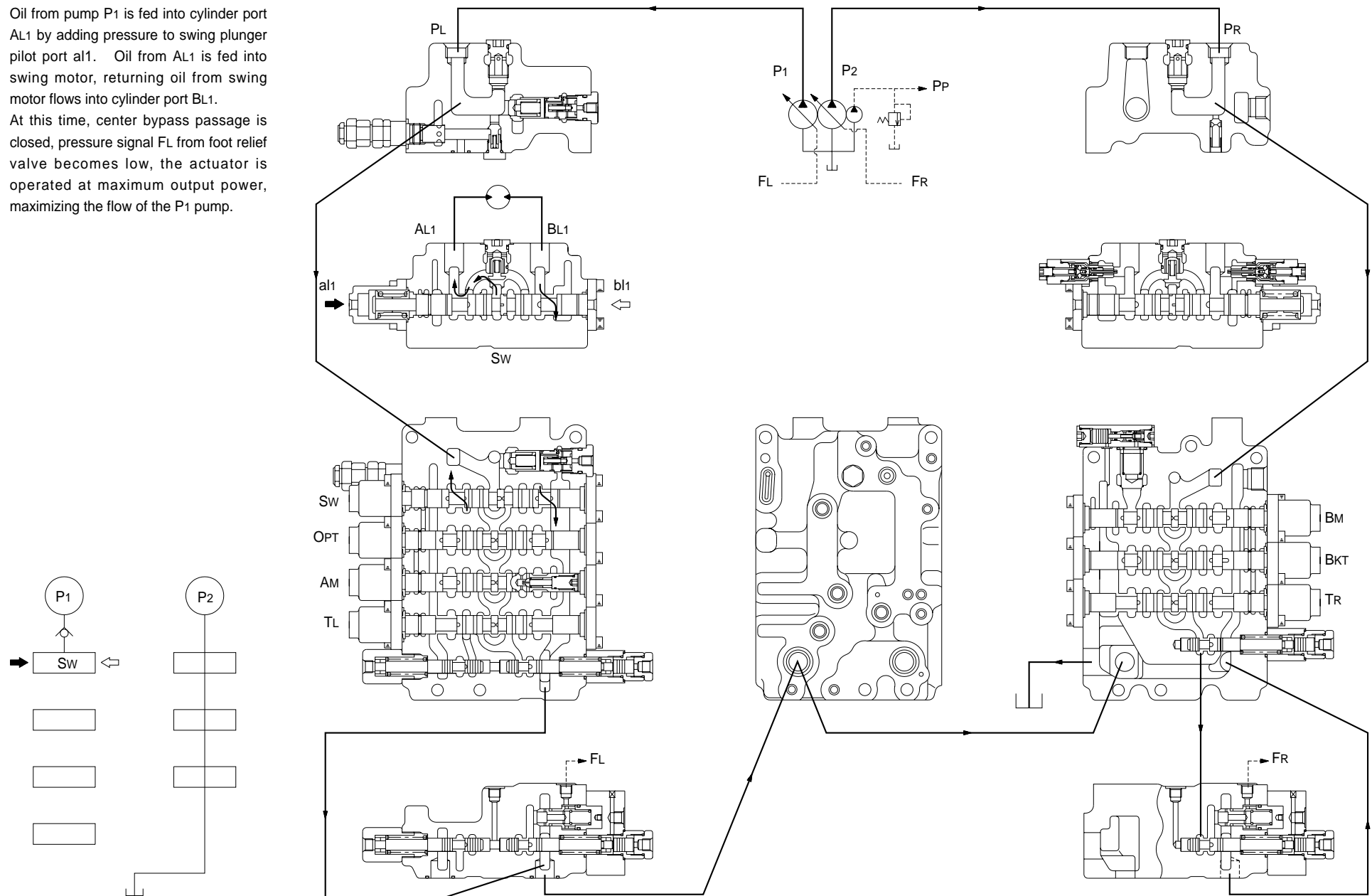
Oil discharged from pump P2 flows as above, minimizing the flow of the P2 pump.



(2) Swing operation circuit

Oil from pump P1 is fed into cylinder port AL1 by adding pressure to swing plunger pilot port al1. Oil from AL1 is fed into swing motor, returning oil from swing motor flows into cylinder port BL1.

At this time, center bypass passage is closed, pressure signal FL from foot relief valve becomes low, the actuator is operated at maximum output power, maximizing the flow of the P1 pump.



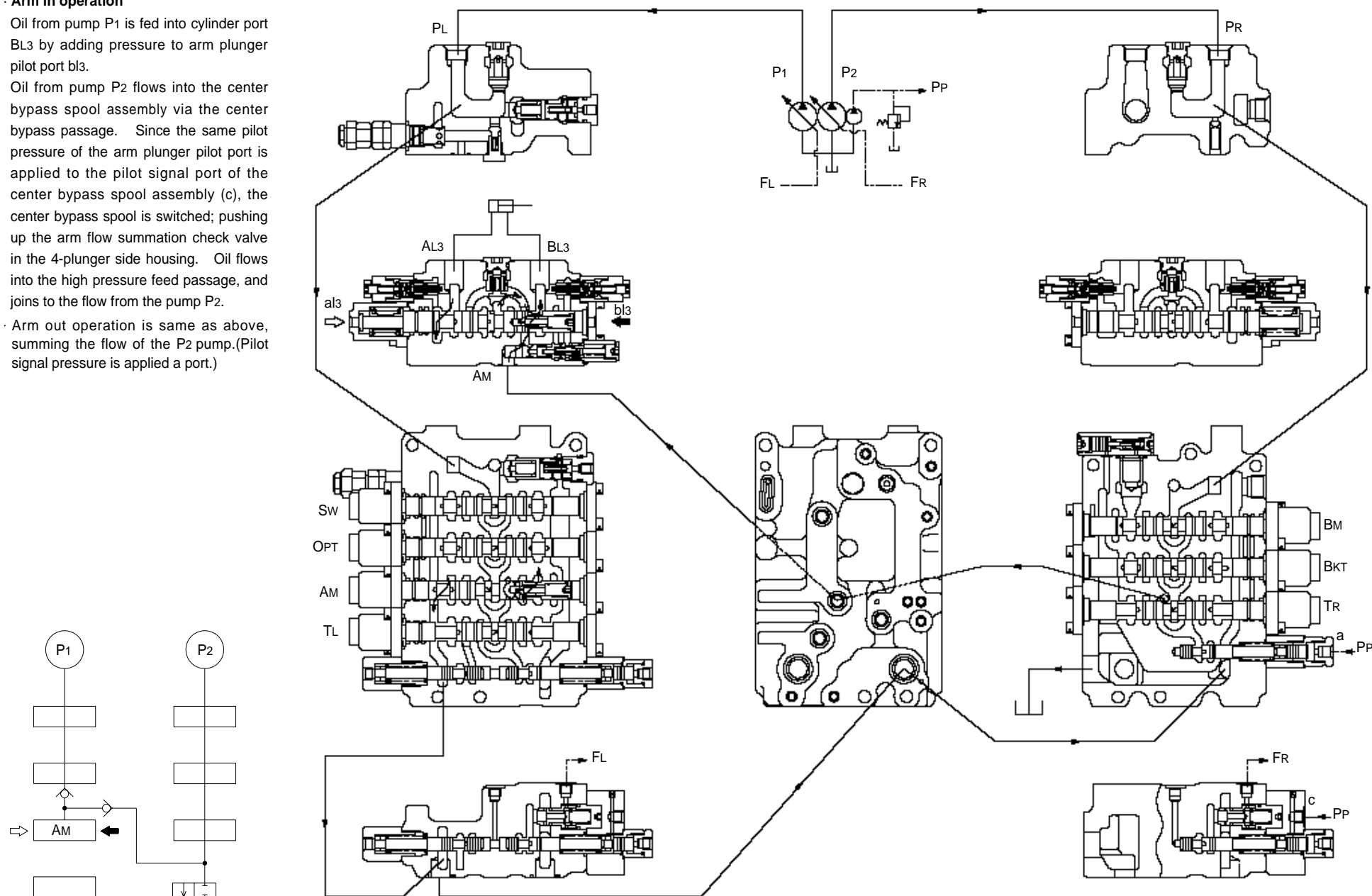
(3) Arm flow summation circuit

· Arm in operation

Oil from pump P1 is fed into cylinder port BL3 by adding pressure to arm plunger pilot port bl3.

Oil from pump P2 flows into the center bypass spool assembly via the center bypass passage. Since the same pilot pressure of the arm plunger pilot port is applied to the pilot signal port of the center bypass spool assembly (c), the center bypass spool is switched; pushing up the arm flow summation check valve in the 4-plunger side housing. Oil flows into the high pressure feed passage, and joins to the flow from the pump P2.

· Arm out operation is same as above, summing the flow of the P2 pump. (Pilot signal pressure is applied a port.)

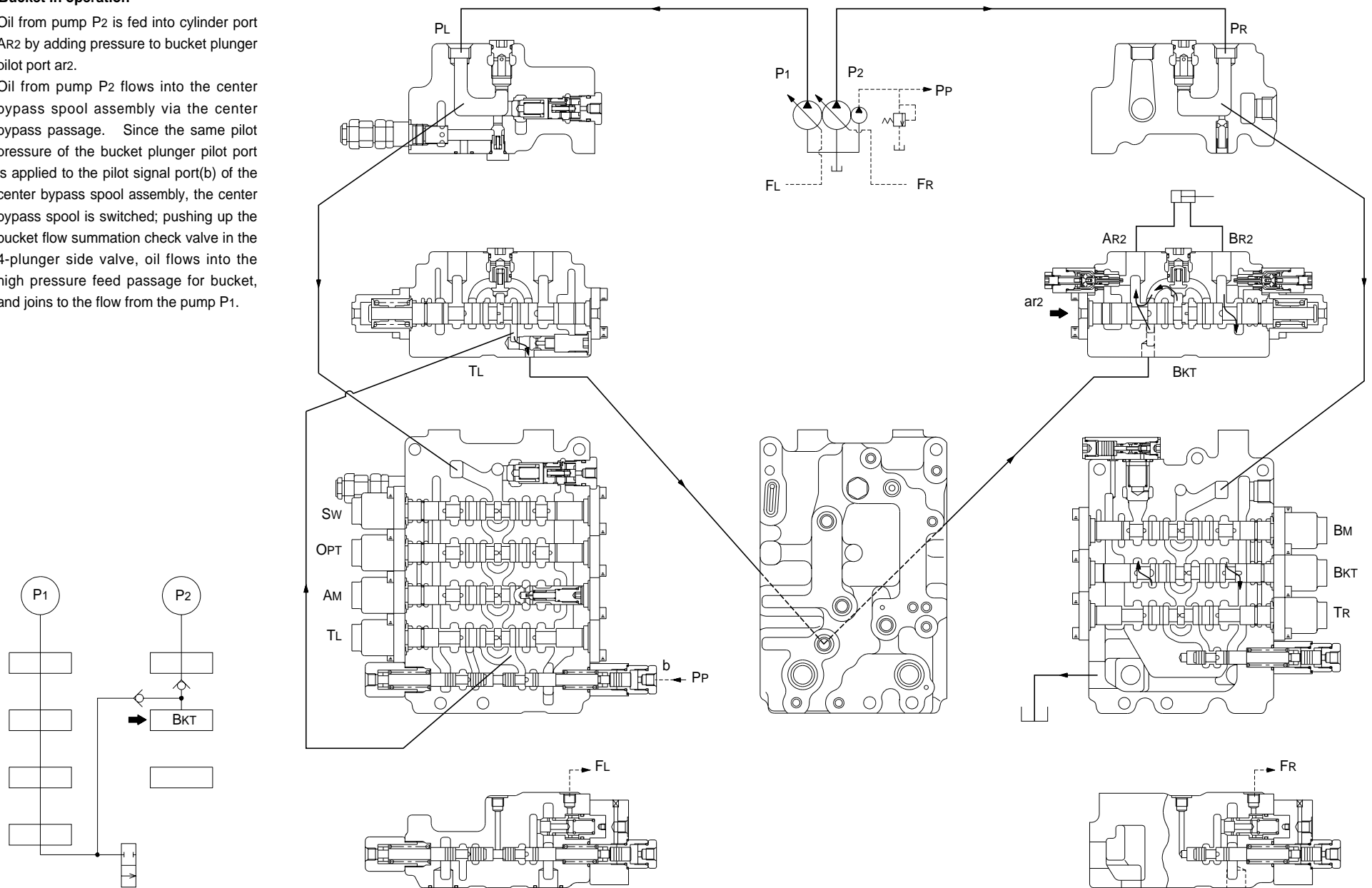


(4) Bucket flow summation circuit

· Bucket in operation

Oil from pump P2 is fed into cylinder port AR2 by adding pressure to bucket plunger pilot port ar2.

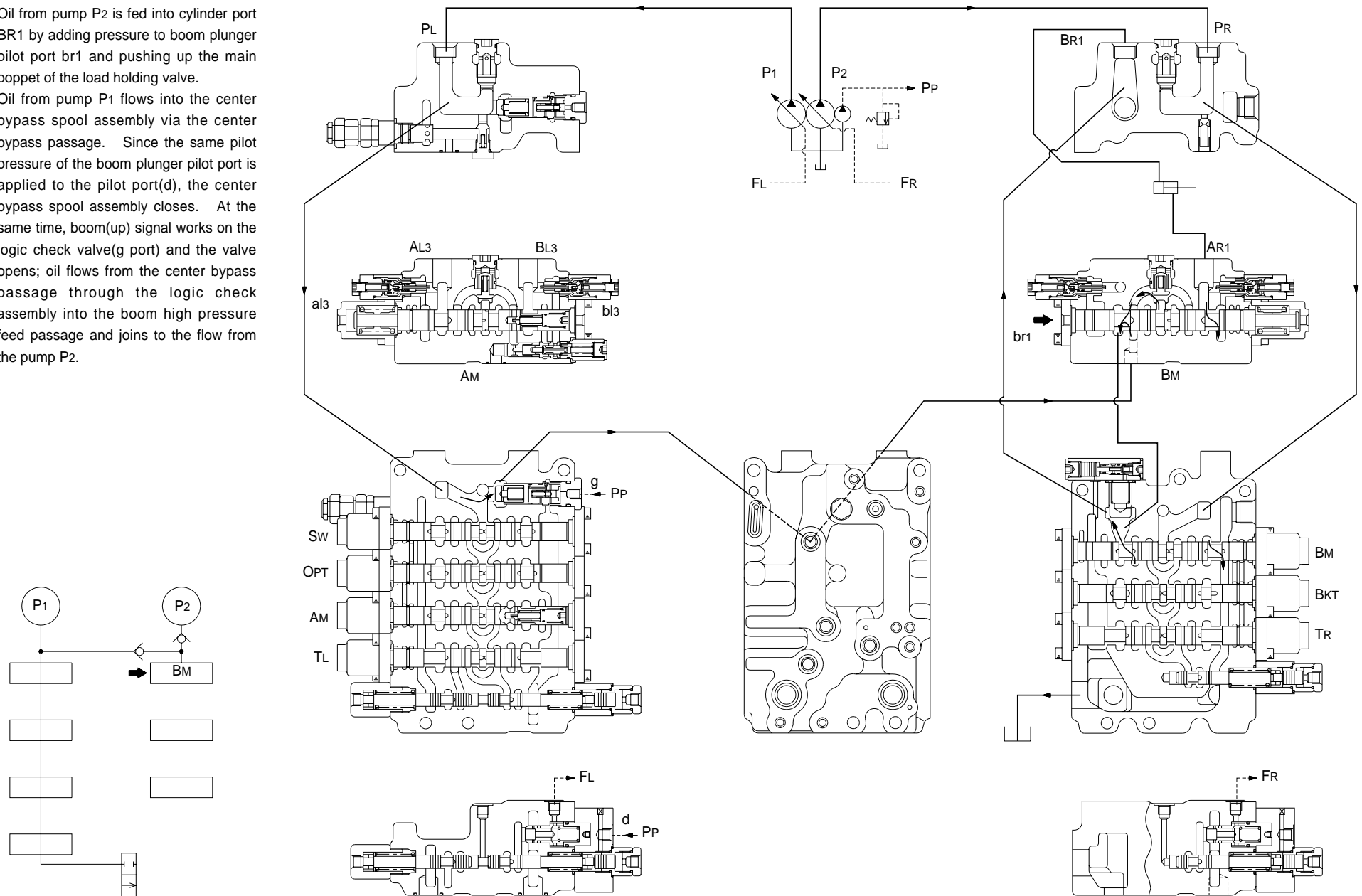
Oil from pump P2 flows into the center bypass spool assembly via the center bypass passage. Since the same pilot pressure of the bucket plunger pilot port is applied to the pilot signal port(b) of the center bypass spool assembly, the center bypass spool is switched; pushing up the bucket flow summation check valve in the 4-plunger side valve, oil flows into the high pressure feed passage for bucket, and joins to the flow from the pump P1.



(5) Boom up flow summation circuit

Oil from pump P2 is fed into cylinder port BR1 by adding pressure to boom plunger pilot port br1 and pushing up the main poppet of the load holding valve.

Oil from pump P1 flows into the center bypass spool assembly via the center bypass passage. Since the same pilot pressure of the boom plunger pilot port is applied to the pilot port(d), the center bypass spool assembly closes. At the same time, boom(up) signal works on the logic check valve(g port) and the valve opens; oil flows from the center bypass passage through the logic check assembly into the boom high pressure feed passage and joins to the flow from the pump P2.



(6) Swing priority circuit

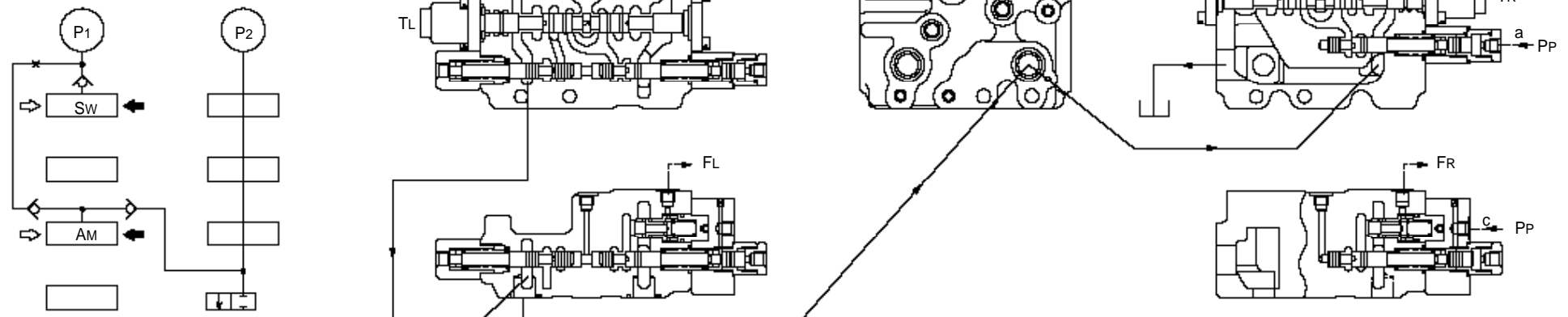
· Swing and Arm out operation.

Oil from pump P1 is fed into swing cylinder port BL1 by adding pressure to swing plunger pilot port bl1.

In case of simultaneous operation of swing and arm out, the delivery oil from pump P1 for swing is also supplied to arm cylinder port BL3 via the orifice and through the parallel feed passage. This orifice ensures swing drive pressure in case of low arm load.

Oil from pump P2 flows into the center bypass spool assembly via the center bypass passage. Since the same pilot pressure of the arm plunger pilot port is applied to the pilot signal port(a), the center bypass spool assembly is switched; pushing up the arm flow summation check valve, the oil flow from pump P1 joins to the flow from the pump P2 that is fed through the orifice and the parallel feed passage.

· Swing and arm in operation same as above.
(Pilot signal pressure is applied c port.)



(7) Travel priority circuit

This circuit keeps straight travel in case of simultaneous operation of other actuators (SW, AM, BKT, BM) during a straight travel.

- ① During straight travel by operating left/right travel plunger (TL, TR):
Oil from pump P1 is fed into cylinder port BL4 by the operation of TL plunger.

Oil from pump P2 is fed into cylinder port BR3 by the operation of TR plunger.

Thus, straight travel is performed separately with pump P1 driving rightward travel (TL) and pump P2 driving leftward travel (TR)

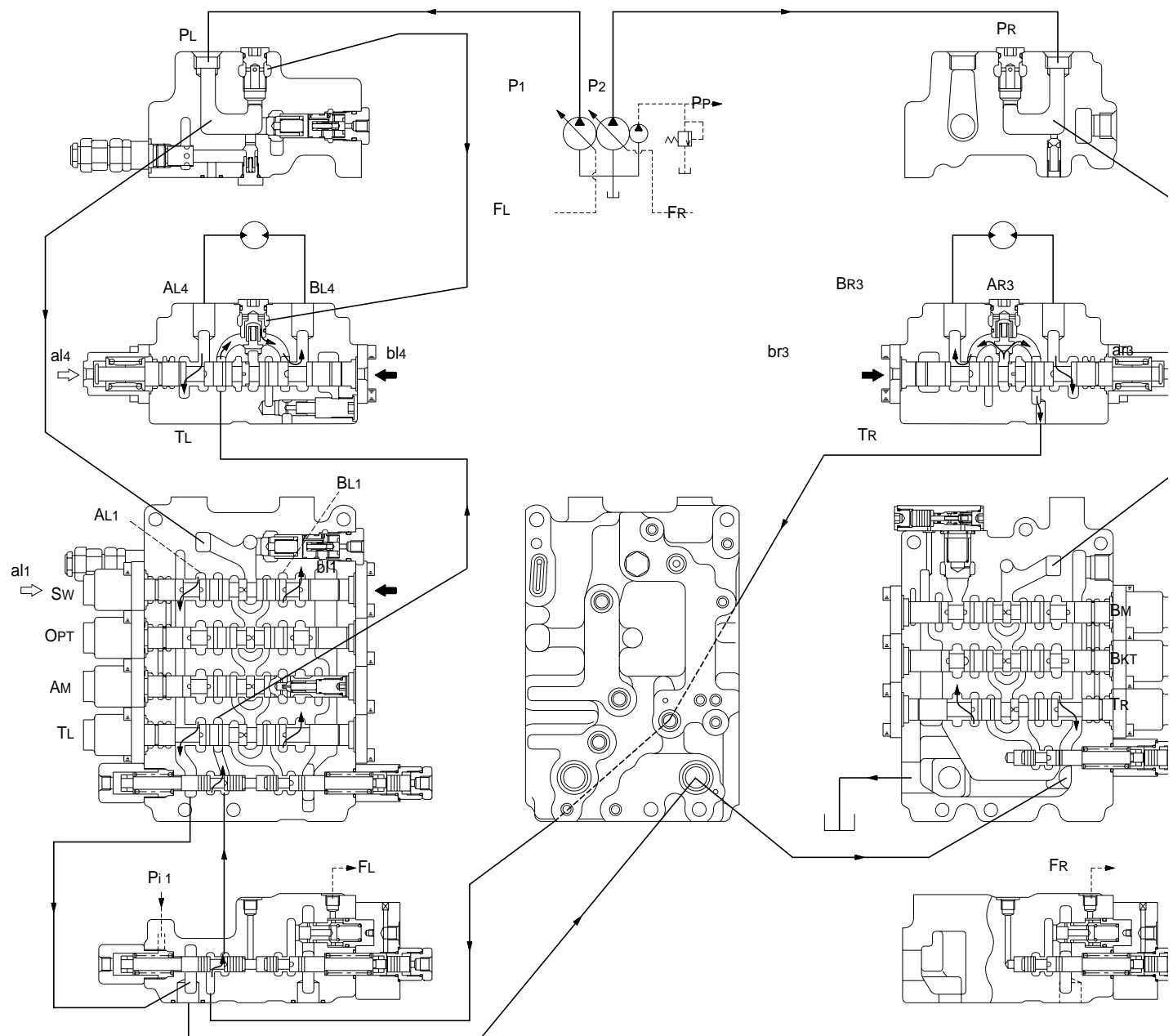
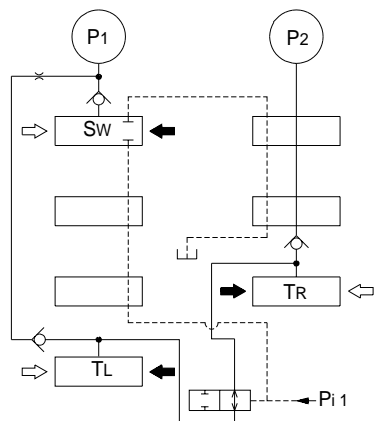
- ② In case of a swing operation during straight travel for instance:

At the beginning of swing plunger stroke the pilot signal line inside the control valve is blocked and the signal pressure makes the connection between the feed passages of right and left travel plungers (TL, TR) by switching selector valve (P1 port). When the swing plunger is completely switched, oil discharged from pump P1 preferentially flows into swing motor which is positioned upstream.

Thus, simultaneous operation of swing and straight travel is made possible as oil from pump P1 is fed to swing and oil from pump P2 is fed to right travel (TR) and left travel (TL).

The orifice at the upstream of the parallel feed passage sends surplus oil of swing to right and left travel (TL, TR) to avoid abrupt change of the vehicle speed.

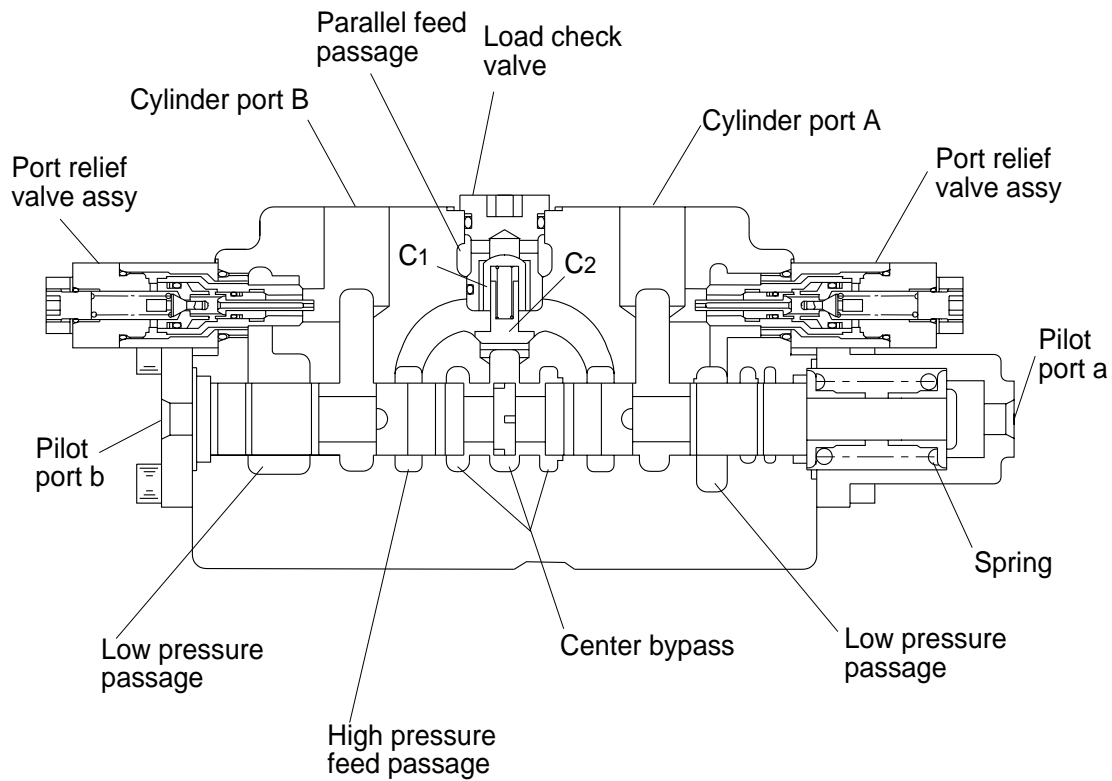
The basic operation is same with swing even in the case of other actuators on upper frame of machine during straight travel.



3) OPERATIONAL DESCRIPTION OF CONTROL VALVE

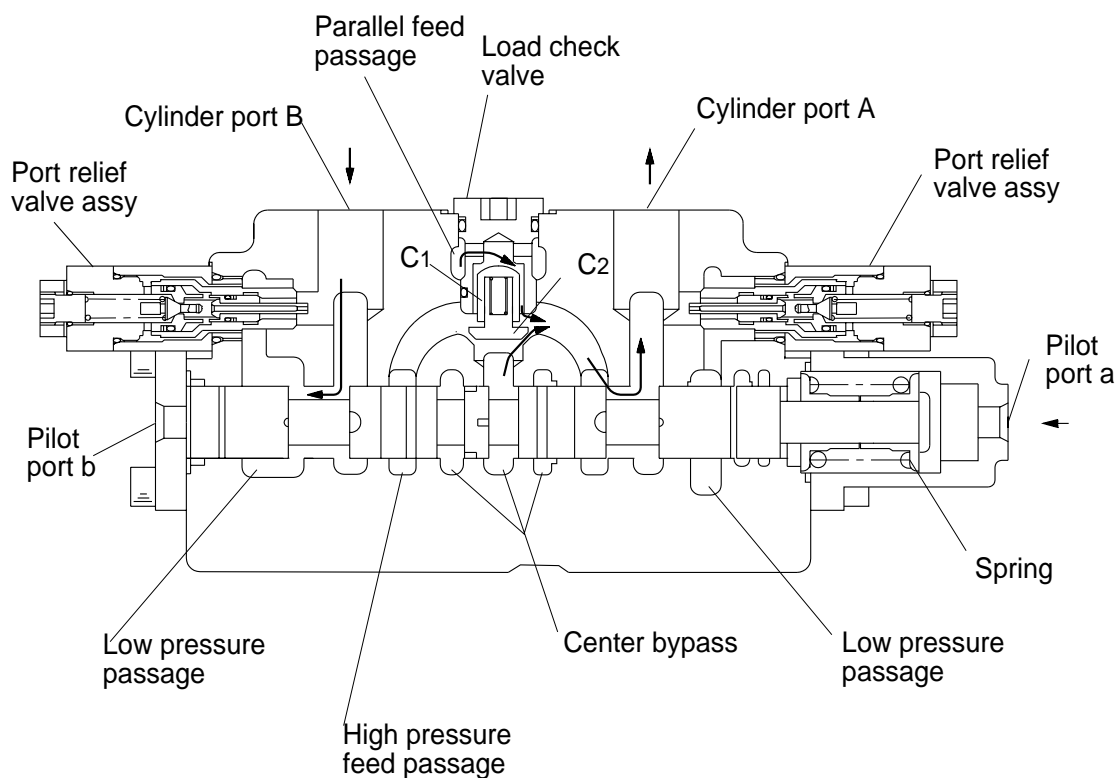
(1) Plunger operation

① Neutral position of plunger



In neutral, spring sets the plunger at the neutral position; the high pressure feed passage is shut off by the plunger; oil from the pump flows through the center bypass.

② Operation of plunger



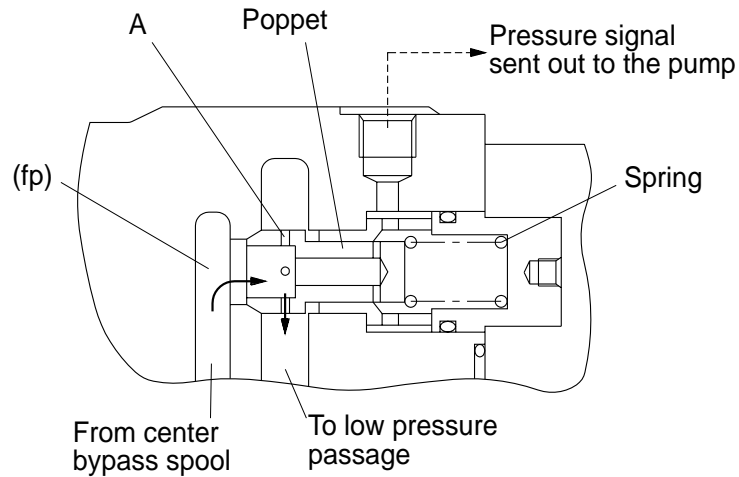
When actuated (pressure is applied to pilot port a), the plunger moves to the left; the center bypass is shut off; oil from the center bypass pushes up the check valve C2 and flows into cylinder port A via the high pressure feed passage. Meanwhile, oil from the parallel feed passage pushes down check valve C1 and flows into cylinder port A via the high pressure feed passage.

The return oil from cylinder port B flows into the tank via the low pressure feed passage.

※ Reversed when pressure is applied to pilot port b.

(2) Foot relief valve operation

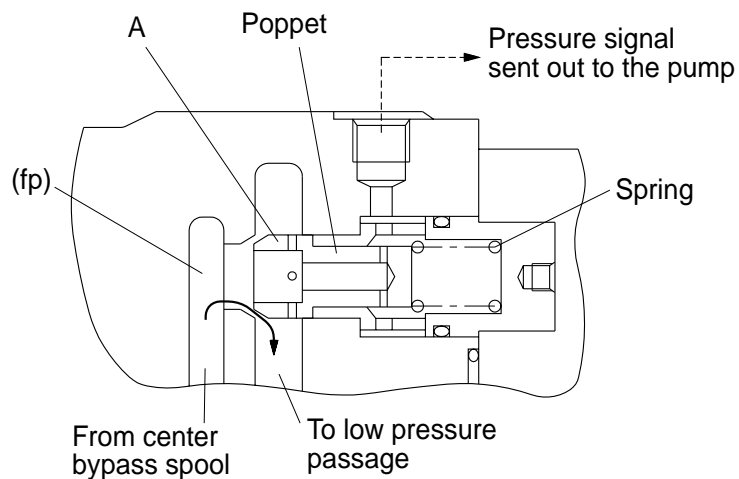
① f_p is lower than spring force



Oil from the center bypass spool valve flows into the tank via orifice(A) of poppet.

Pressure f_p generated by orifice(A) is led to the pump, to control the pump delivery flow.

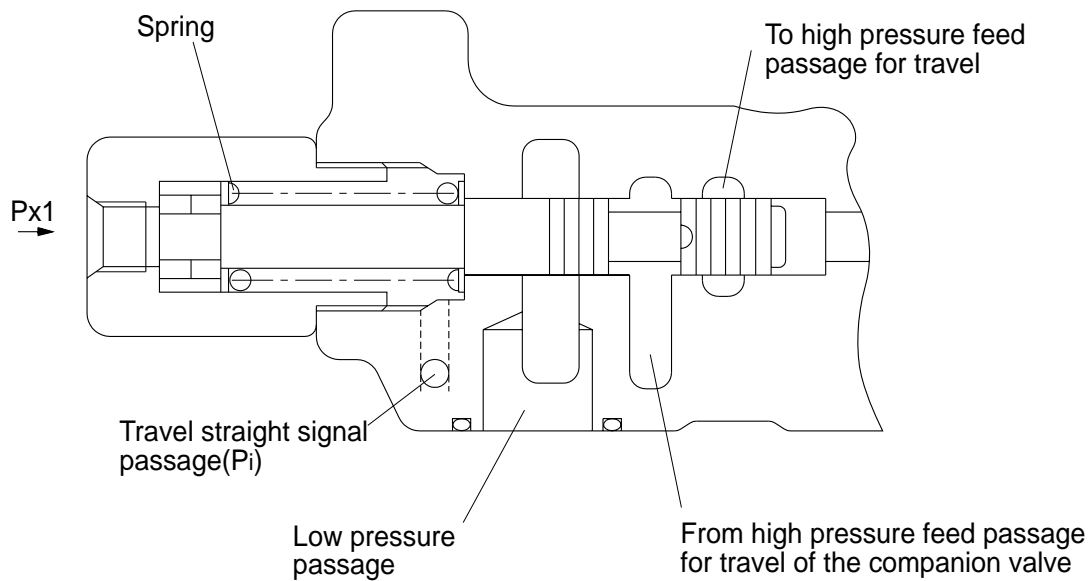
② f_p is higher than spring force



If a large amount flows due to delayed pump response, etc., and pressure f_p reaches the preset spring force, then the poppet is lifted and functions as a relief valve.

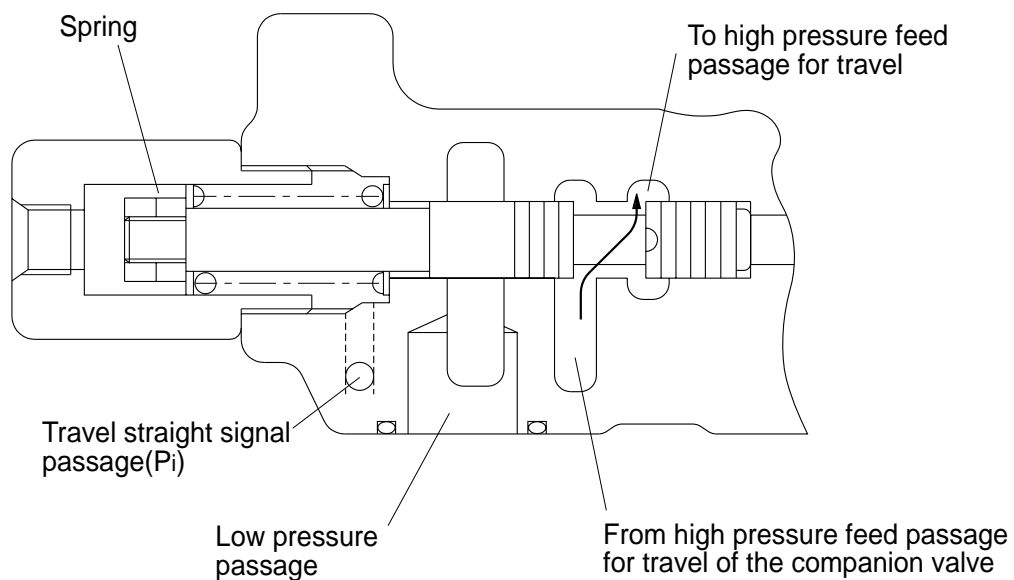
(3) Selector valve operation

① Straight travel signal : ON



If any actuator is operated when traveling, pilot pressure(p_i) reaches a spring force, the spool(A) moves to the right the high pressure passage for travel of the companion valve(TL) and the high pressure passage for travel(TR) are connected, and equal amount of oil flows to TR and TL.

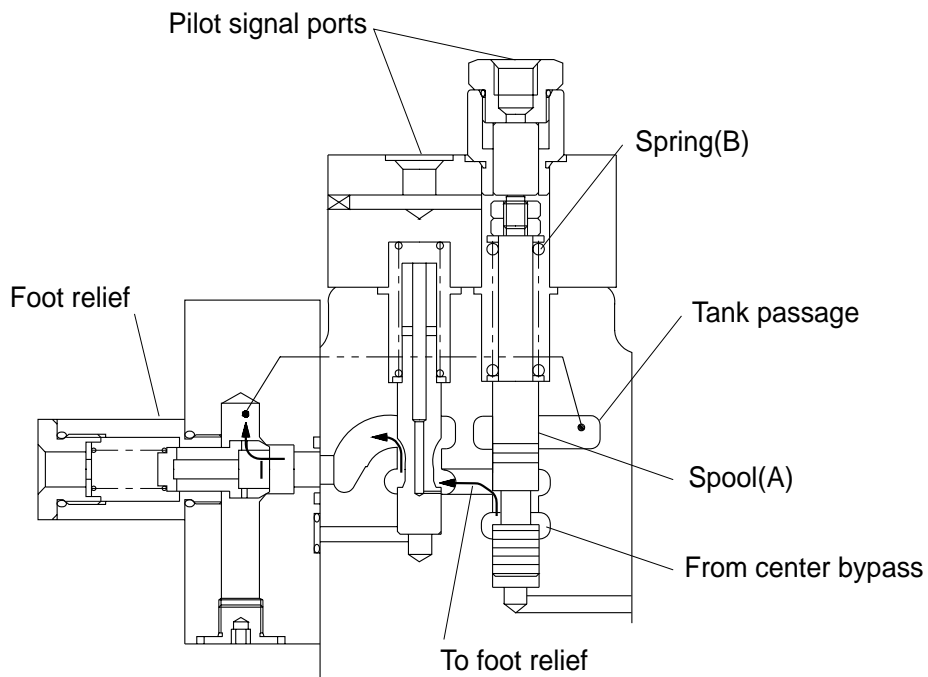
② Straight travel signal : OFF



The spring sets spool in position; which shuts off the high pressure feed passages of TR and TL.

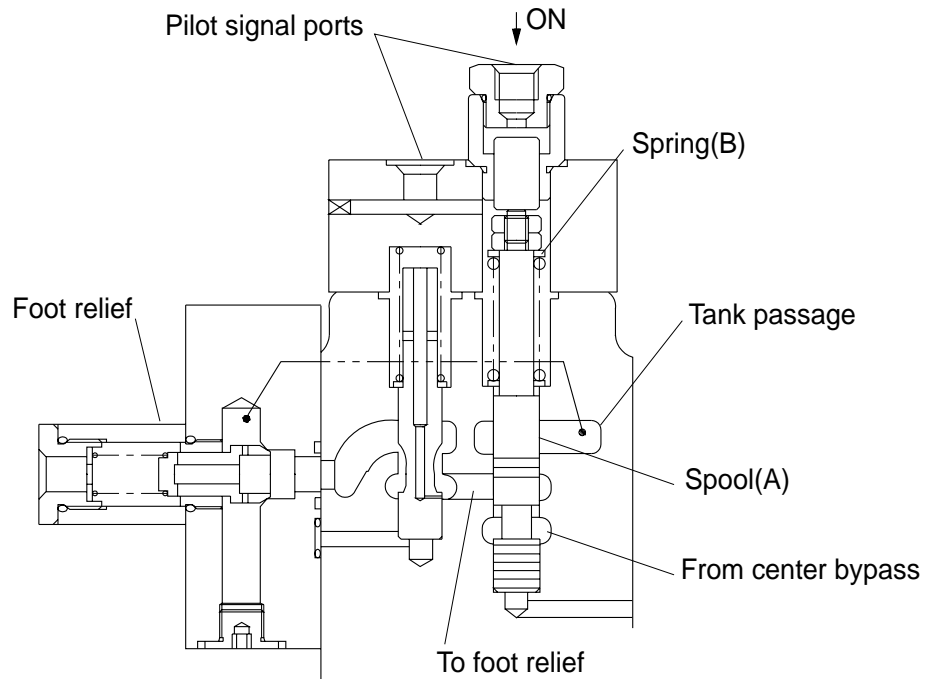
(4) Center bypass spool operation

① Pilot pressure signal : OFF



Spring(B) sets spool(A) in position; oil from center bypass flows into the tank passage via the foot relief valve.

② Pilot pressure signal : ON

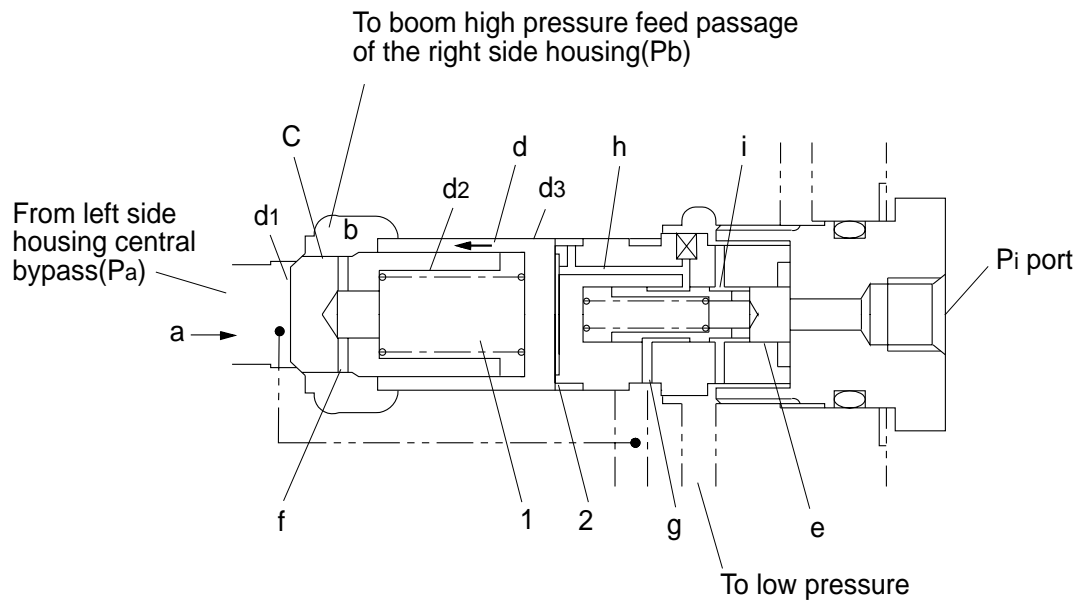


When pilot pressure reaches a preset spring force, the spool moves down and shuts off the flow through the center bypass.

(5) Logic check valve operation

① Boom down or neutral

when boom up pilot pressure is not supplied to Pi port



Spring force sets piston (e) in the shown position;

Pressure in the passage a (P_a) enters chamber (2) via passage (g) and passage (h).

Pressure in the passage b (P_b) enters chamber (1) via passage (f).

If $P_a > P_b$

Piston (d) is moved to left by the force of d_3 area $\times (P_a - P_b)$. Also, check valve (c) is seated by the movement of piston (d) and passage from a to b is blocked, because $d_1 < d_3$.

If $P_a < P_b$

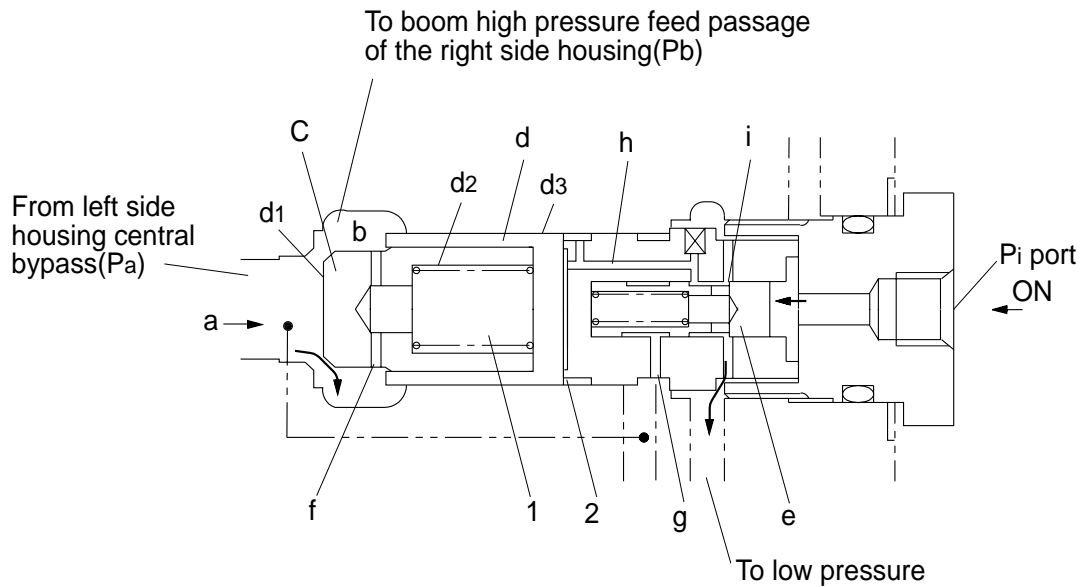
Passage from b to a is blocked by the check valve (c).

② Boom up

When boom up pilot pressure is supplied to Pi port

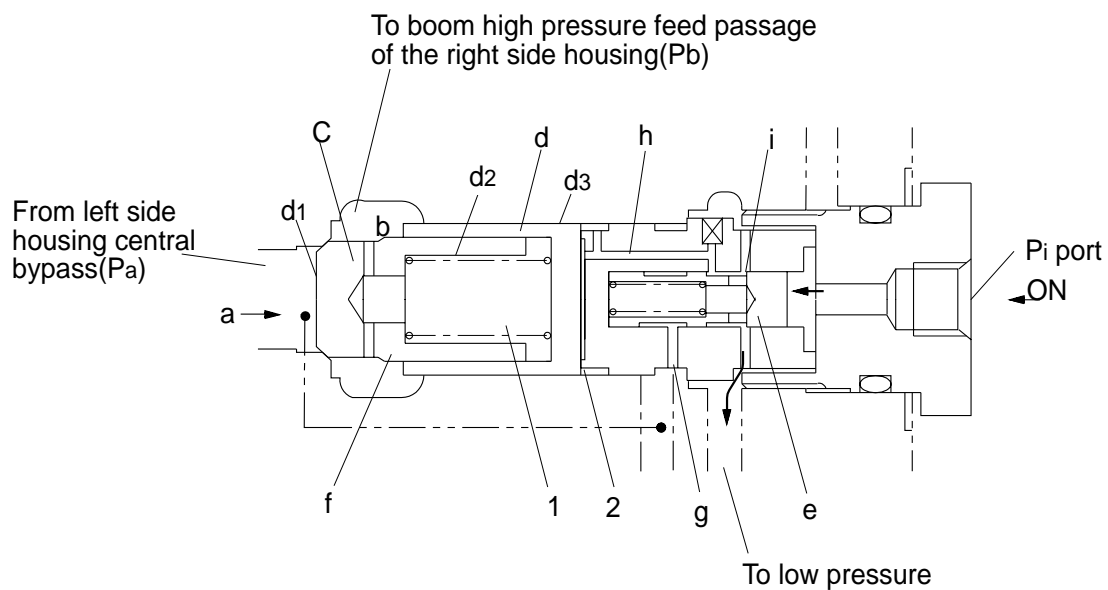
Piston (e) moves to left; passage (h) is shut off from passage (g); passage (h) and passage (i) are connected; chamber (2) is connected to the low pressure circuit.

When $P_a > P_b$



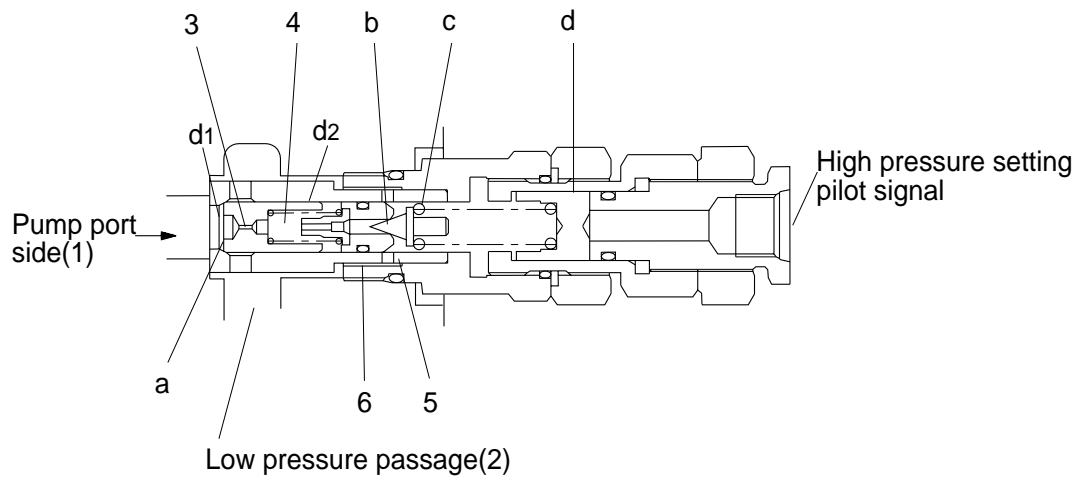
Spring force sets piston (d) at the shown position; check valve (c) is lifted; oil flows through from a to b.

When $P_a < P_b$

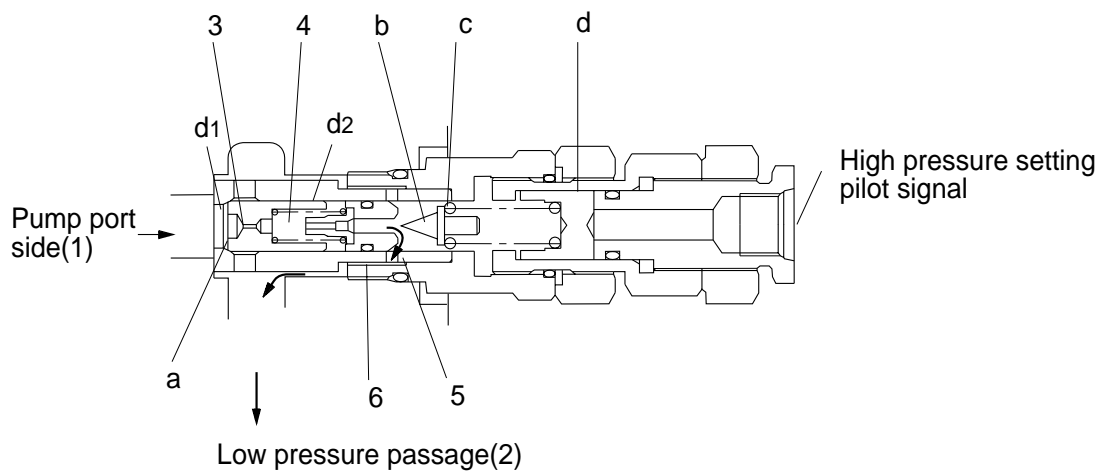


Passage from b to a is blocked by the check valve (c), because $d_1 < d_2$

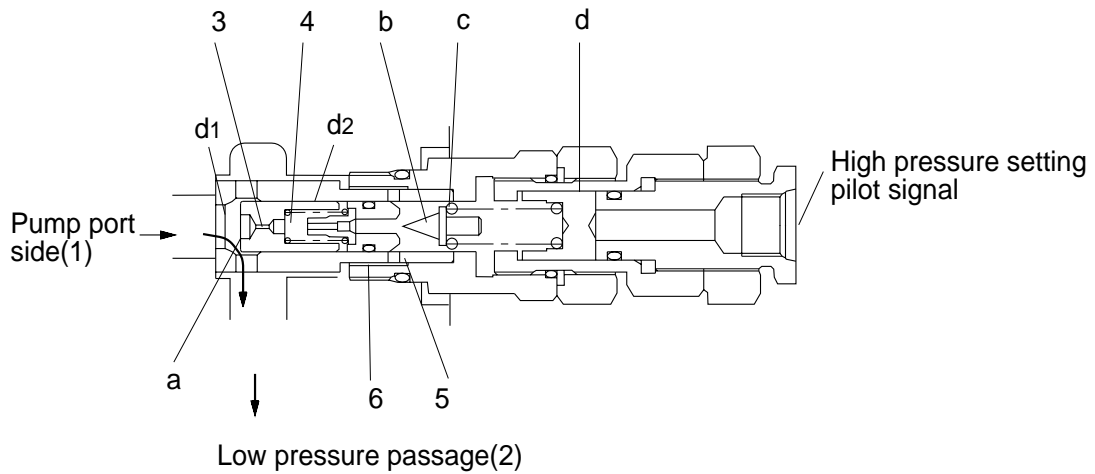
(6) Main relief valve operation



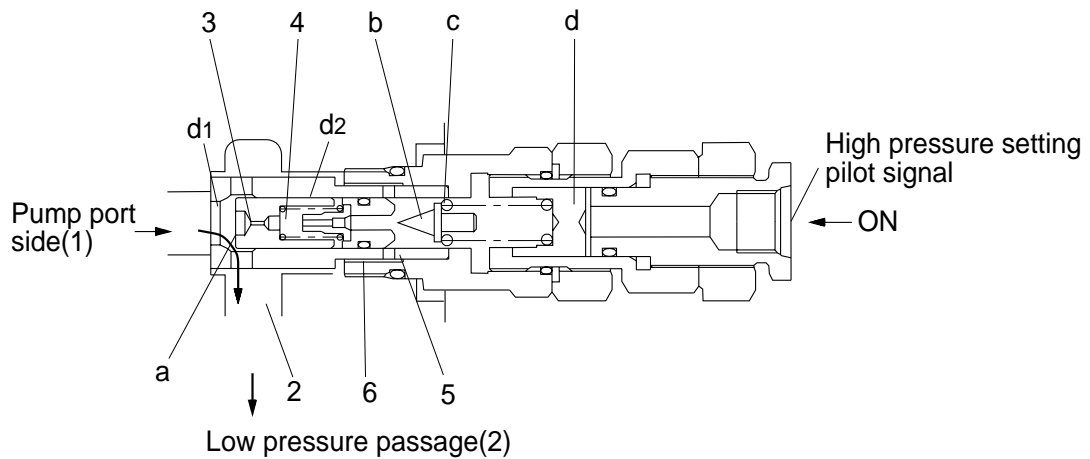
This relief valve is built-in between the pump port side (1) and low pressure passage (2). Hydraulic oil from the pump port side enters chamber (4) via orifice (3) of poppet (a). Because $d1 < d2$, poppet (a) is securely seated.



When hydraulic oil reaches the pressure preset by spring (c), pilot poppet (b) opens; oil flows around poppet (b) and into the low pressure passage via side hole (5) and passage (6).



When the above oil flow is formed, pressure drops before and behind orifice (3); when pressure of chamber (1) x area d1 is larger than pressure of chamber (4) x area d2, poppet (a) is lifted and hydraulic oil flows into the low pressure passage(2).

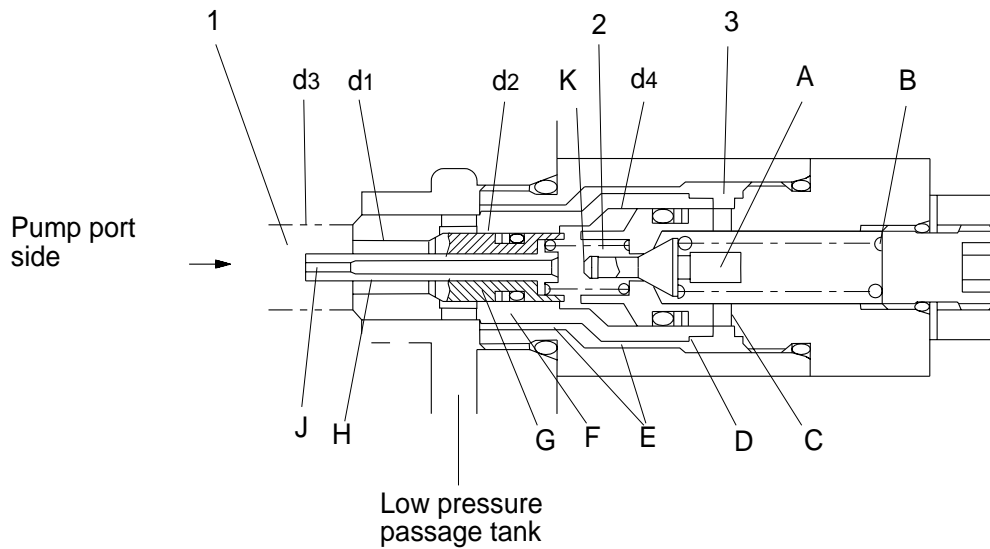


High pressure setting pilot signal : ON

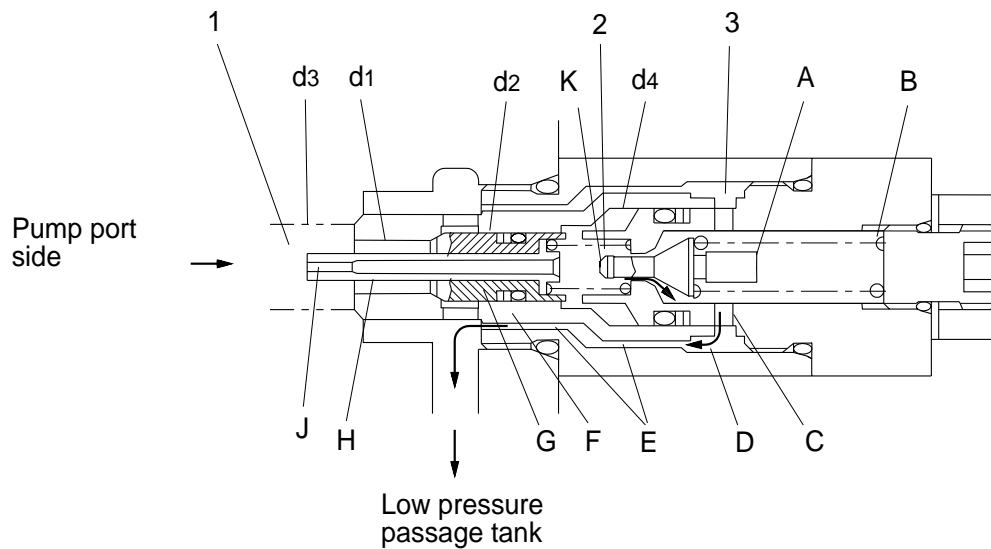
Piston (d) moves to left; set pressure of spring (c) rises, making high pressure setting.

(7) Overload relief valve operation

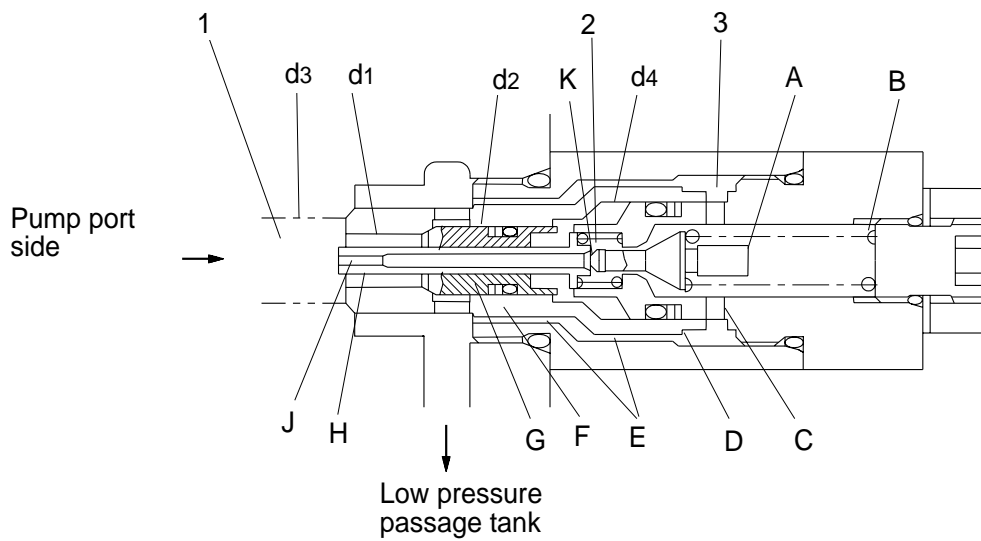
① Overload working operation



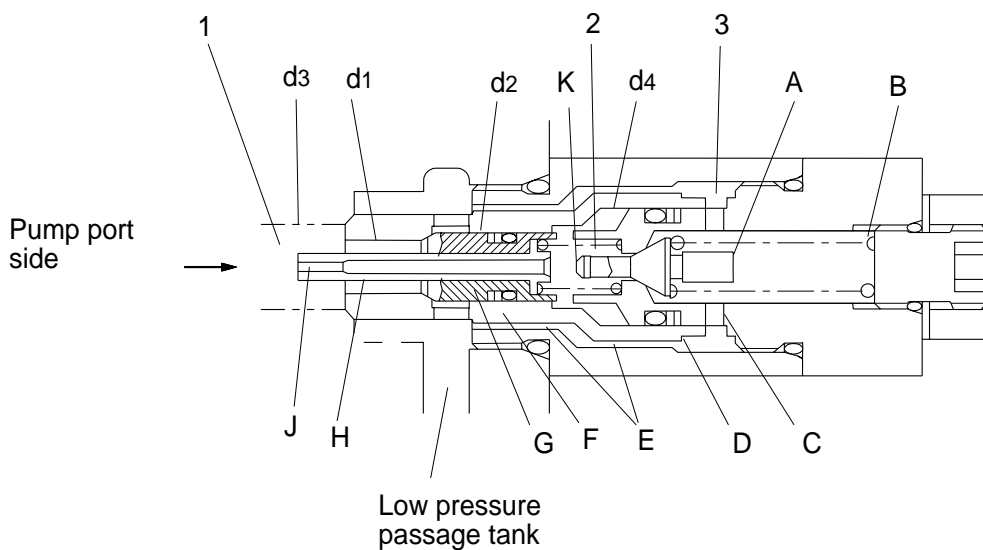
Hydraulic oil from cylinder port enters chamber (2) via orifice (J) of piston (H). Because $d_1 < d_2$ and $d_3 < d_4$, poppets (G) and (F) are securely seated.



When hydraulic pressure reaches the preset force of spring (B), poppet (A) opens; oil flows around poppet (A) and into the low pressure passage via side hole (C) and passage (E).

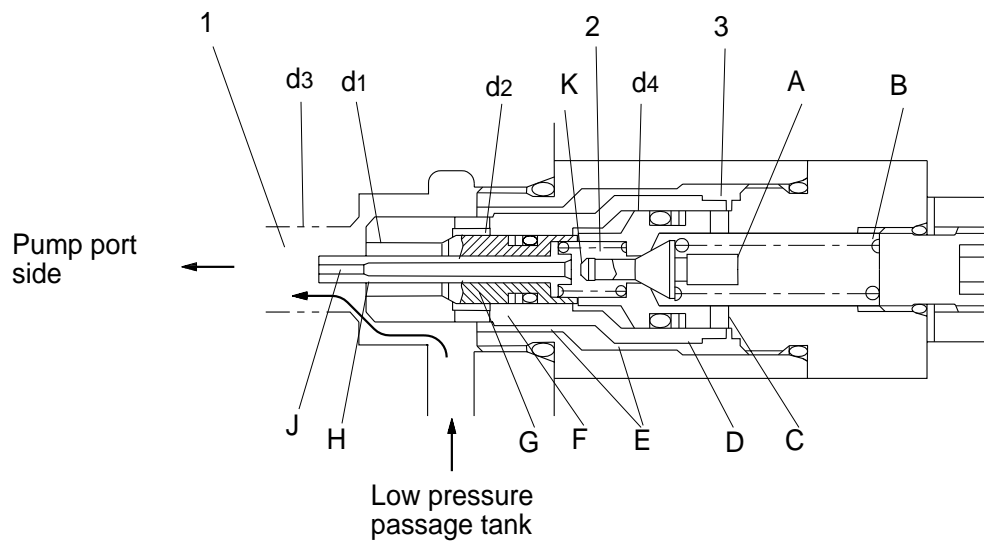


Oil flow is formed; pressure drops before and behind orifice (J); piston (H) moves to right and seats at the tip of poppet (A).

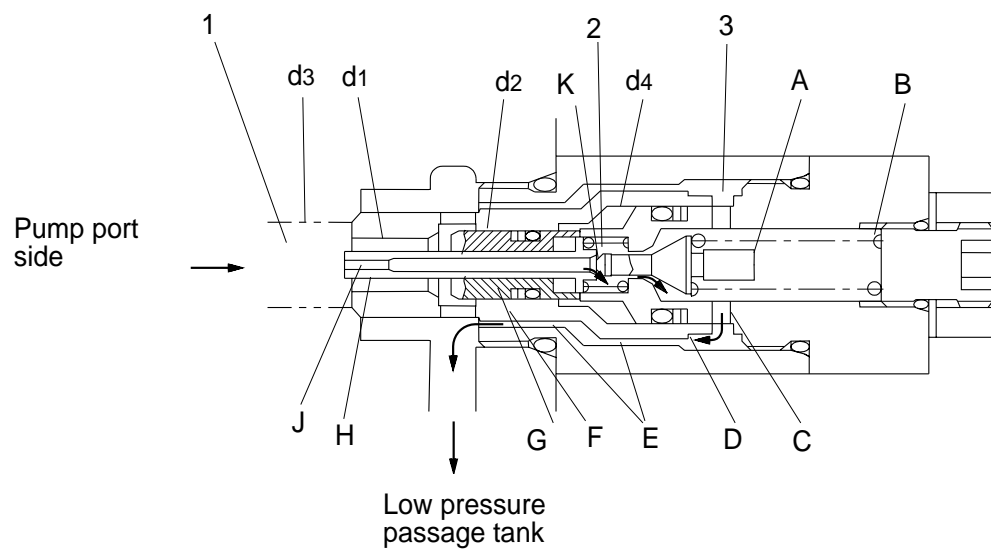


Hydraulic oil from chamber (1) enters chamber (2) via throttle (K) at the tip of poppet (A); it flows around poppet (A) and into the low pressure passage via side hole (C) and passage (E). Pressure drops before and behind throttle (K), making pressure of chamber (1) x area d_1 > pressure of chamber (2) x area d_2 ; poppet (G) is lifted and hydraulic oil flows into the low pressure passage.

② Make up operation



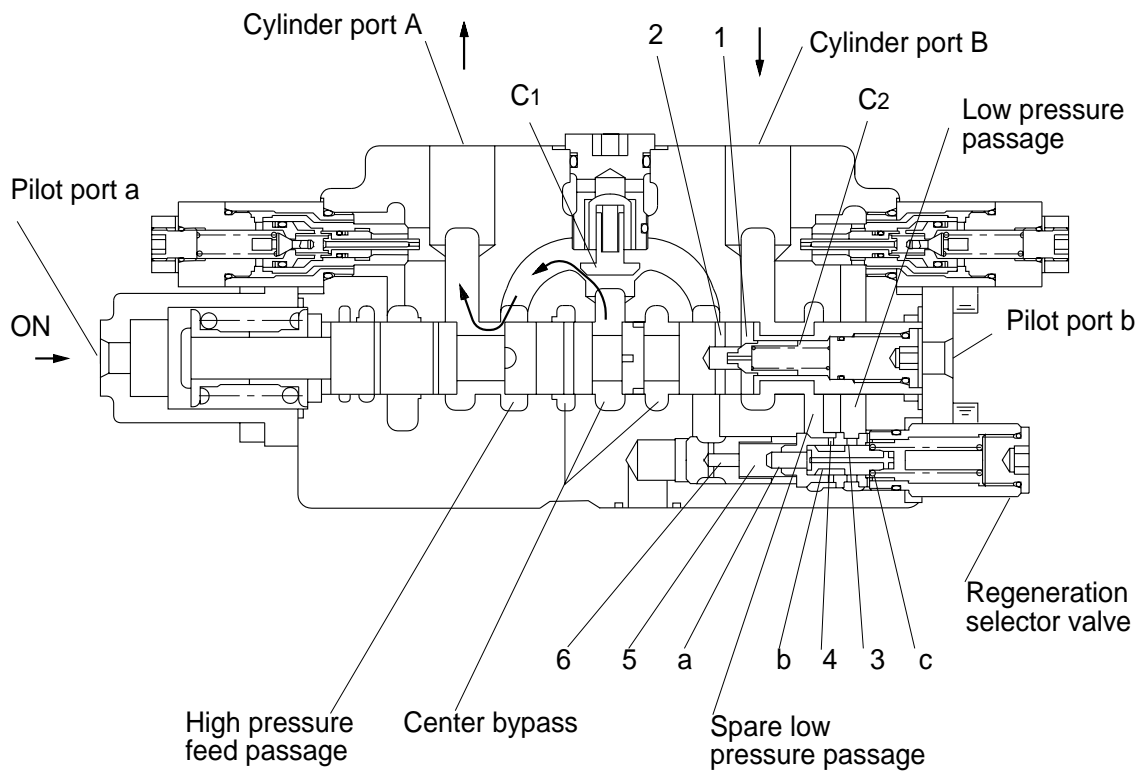
Poppet (F) is securely seated because the cylinder port pressure is normally higher than the tank pressure and $d3 < d4$.



When the cylinder port pressure drops (closer to negative pressure) until the cylinder port pressure is lower than the tank pressure, poppet (F) opens receiving the tank pressure for the difference in area between $d3$ and $d4$; oil flows from the tank passage to the cylinder port in order to prevent cavitation.

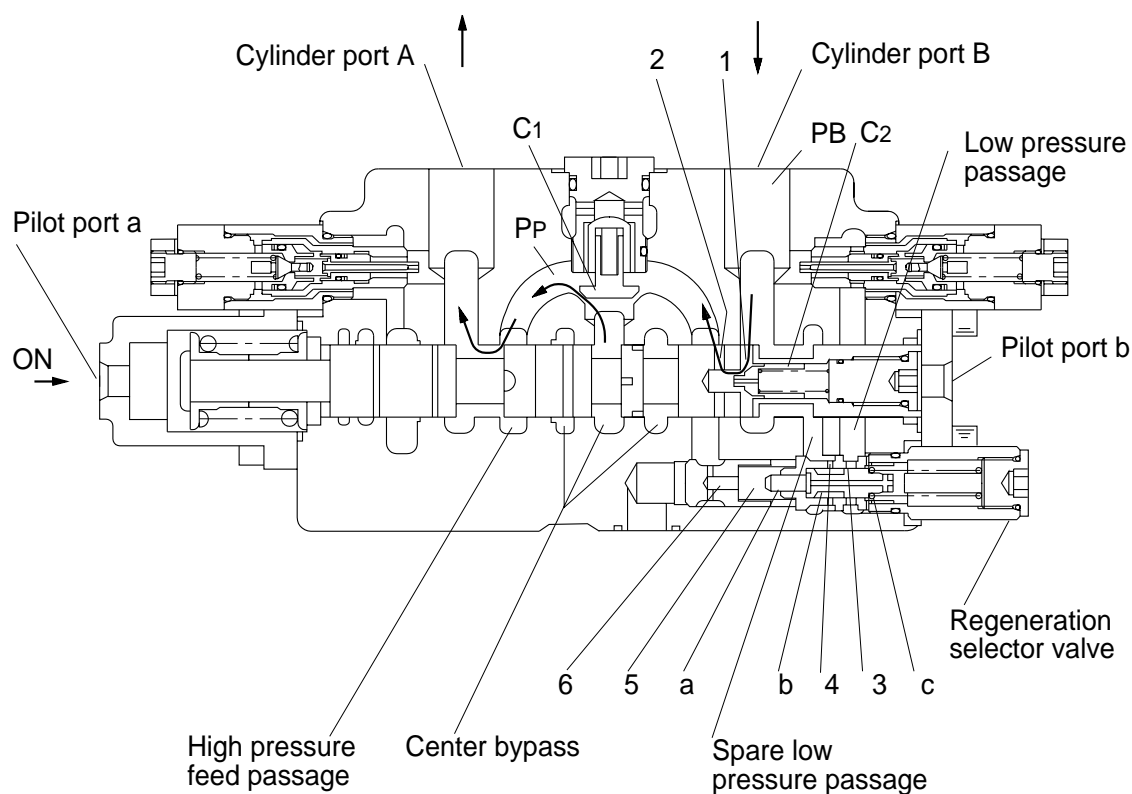
(8) Arm regeneration circuit

① Arm operation



When pressure is applied to pilot port a of the arm plunger, the plunger moves to right as shown; the center bypass passage is shut off; oil from the center bypass pushes up check valve(c1) and flows into cylinder port A via the high pressure feed passage.

② PP is lower than PB

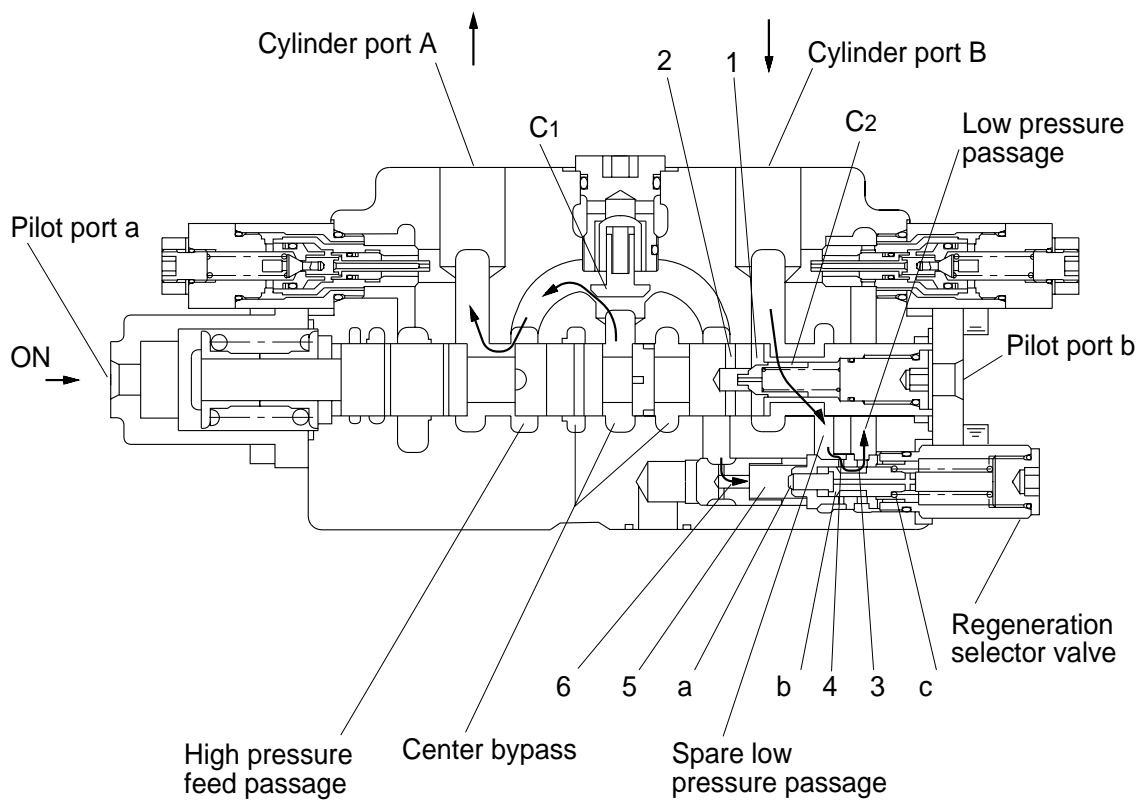


PP : Pressure of high pressure supply passage

PB : Pressure on cylinder port B side

Return oil from cylinder port B pushes up check valve (c2) in the plunger; it flows into cylinder port A after returning to the high pressure feed passage via passage (1) and (2). At this time, the regeneration selector valve is at the shown position; as passage (3) is shut off from passage(4), return oil from cylinder port B does not flow into the low pressure passage.

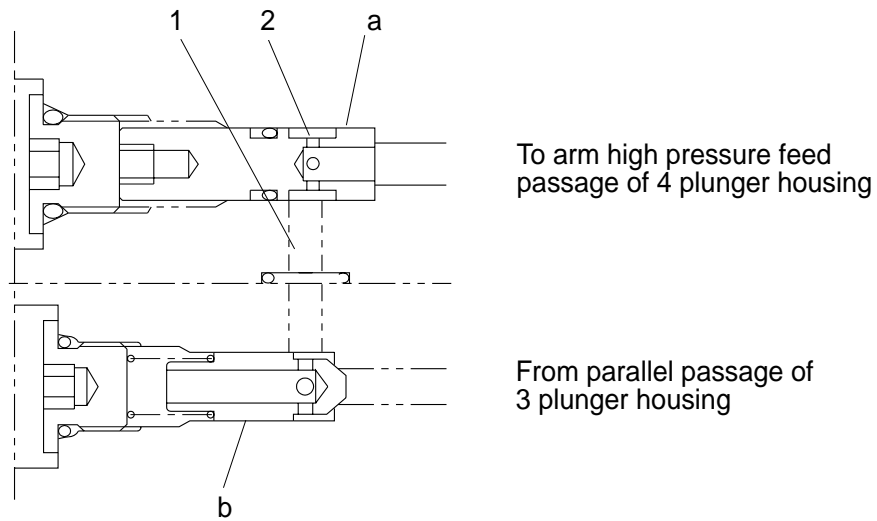
③ PP is higher than PB



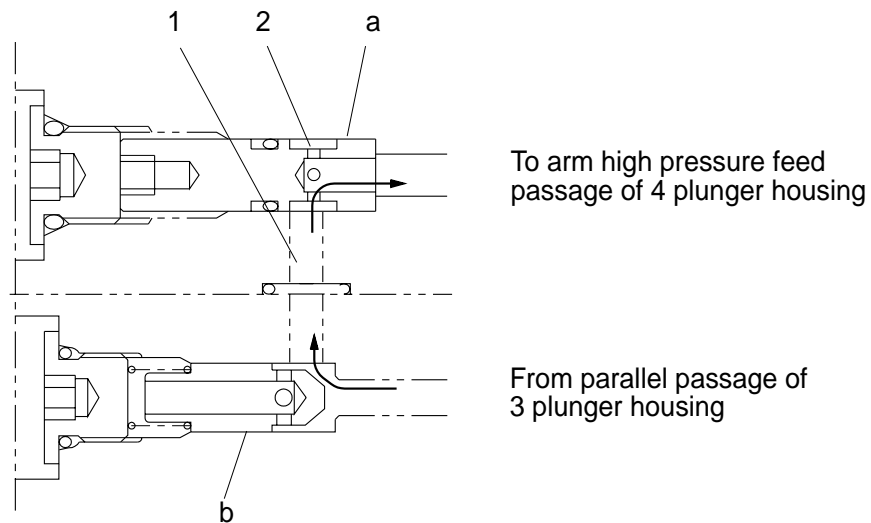
Return oil from cylinder port B is shut off by check valve (c2) in the plunger and passage (2) is blocked from passage (1). Pressure of high pressure feed passage PP is led into chamber (5) via passage (6). When pressure PP rises higher than the preset pressure of spring (c), piston (a) and spool(b) move to right; passage (3) and passage (4) are connected; return oil from cylinder port B flows into low pressure passage via spare low pressure passage, passage (4) and passage (3).

(9) Internal parallel circuit

Neutral position



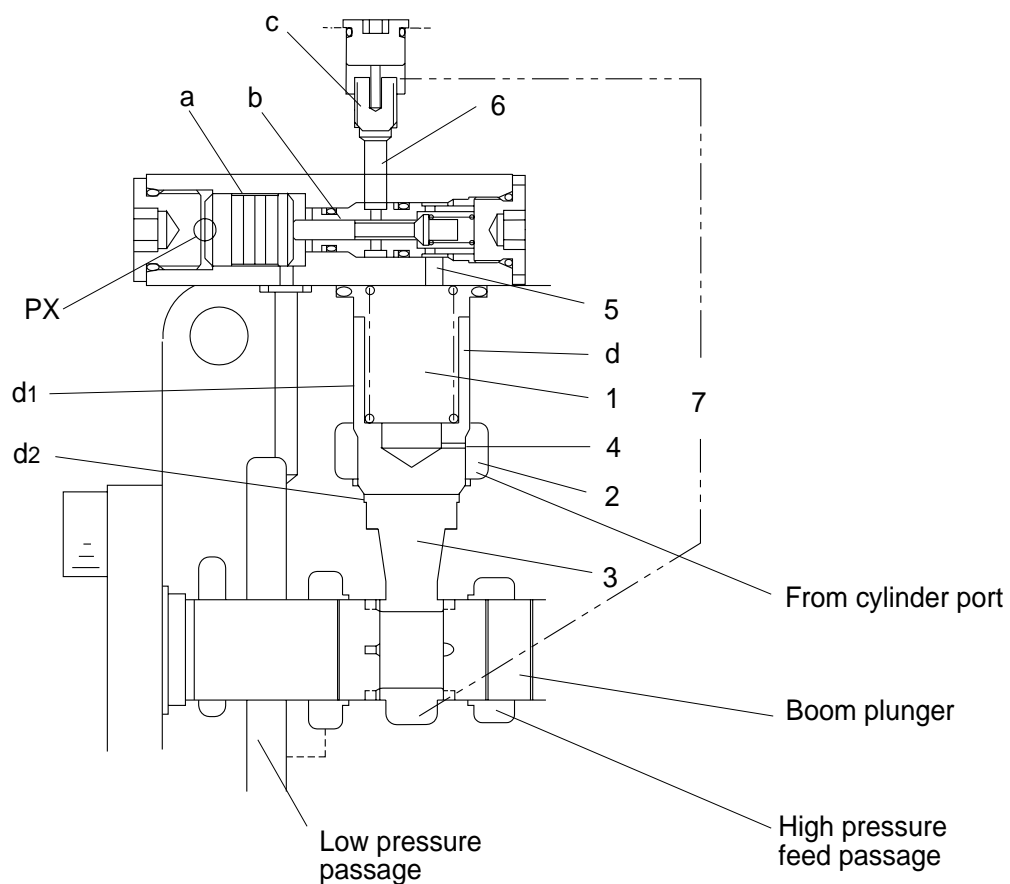
Operation



When arm plunger of 4-plunger side is activated, oil from parallel passage of 3-plunger housing pushes up check valve(b); it flows into the high pressure feed passage of the arm plunger via passage (1) and through passage (2) of orifice (a).

(10) Load holding valve operation

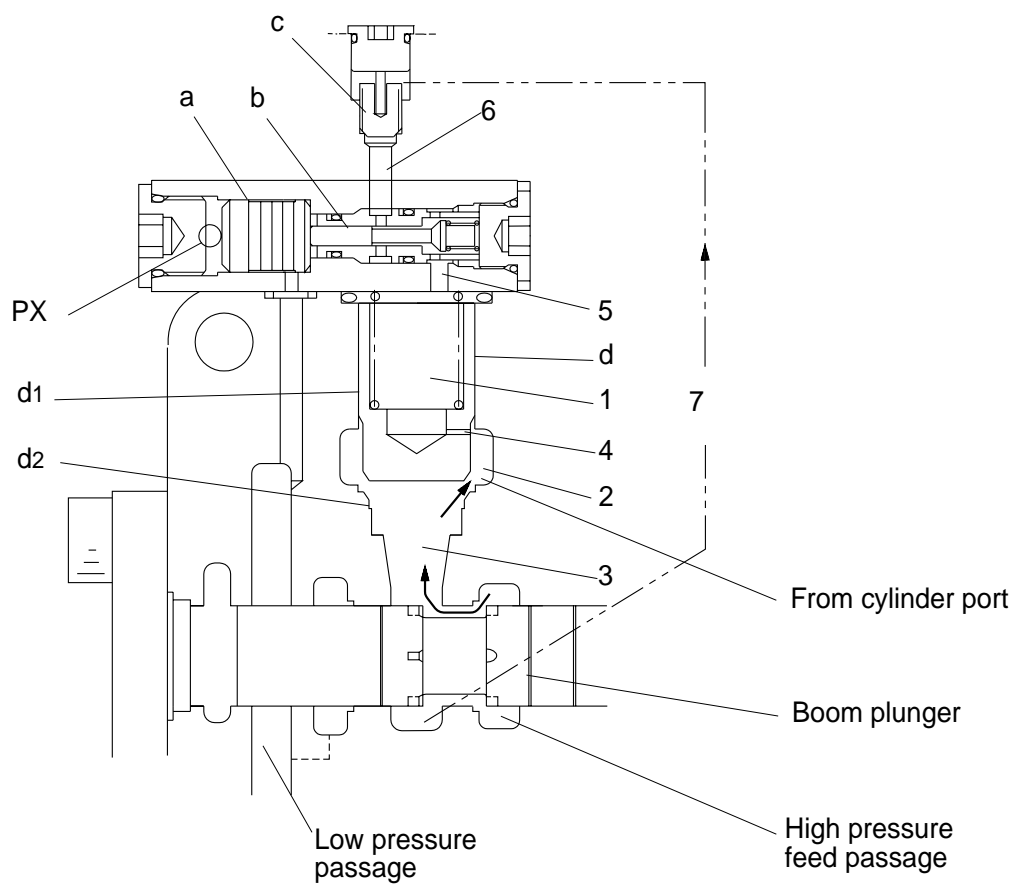
① When the plunger is in neutral (Px pilot signal : OFF)



Piston (a) and poppet (b) are in the status as shown; passages (5) and (6) are shut off by poppet (b).

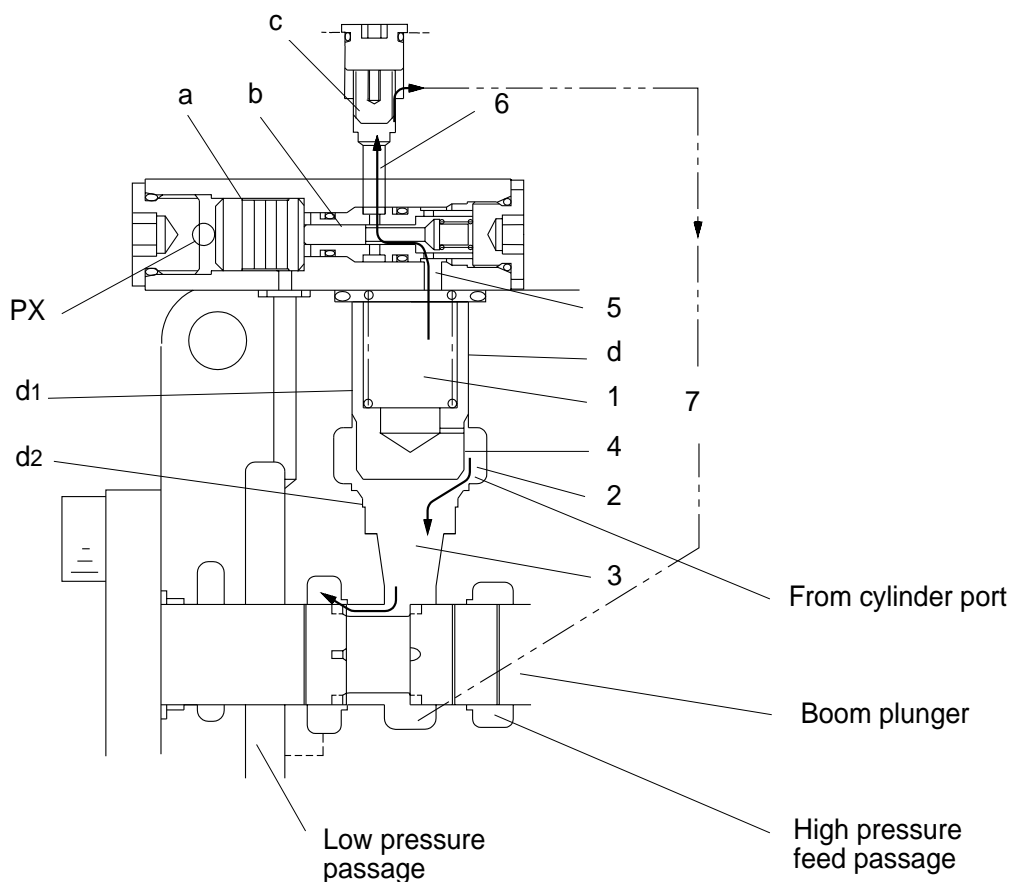
Therefore, the pressure of chamber (1) becomes PC as it is connected with chamber (2) via orifice (4). Since $d_1 > d_2$, poppet (d) is seated and chambers (2) and (3) are completely blocked.

② If P_c is lower than P_v (in the case of Boom UP)



Because check valve (c) is seated, passages (6) and (7) are shut off. Therefore, the pressure of chamber (1) becomes P_c as it is connected to chamber (2) via orifice (4); poppet (d) is pushed up; oil from high pressure feed passage flows into the cylinder port.

③ When the plunger is in operation (Px pilot signal: ON) : Boom down operation



Piston (a) moves to right; poppet (b) opens; passages (5) and (6) are connected.

If pressure PC of cylinder port chamber (2) is higher than pressure PV of chamber (3) (in the case of Boom Down) oil from chamber (1) pushes up check valve (c) via passages (5) and (6) and enters chamber (3) through passage (7). Chamber (3) is connected with the low pressure passage because the boom plunger is moved to left. Therefore, pressure PC is applied to (area d1- area d2), pushing up poppet(d), and oil from the cylinder port flows into the low pressure passage.