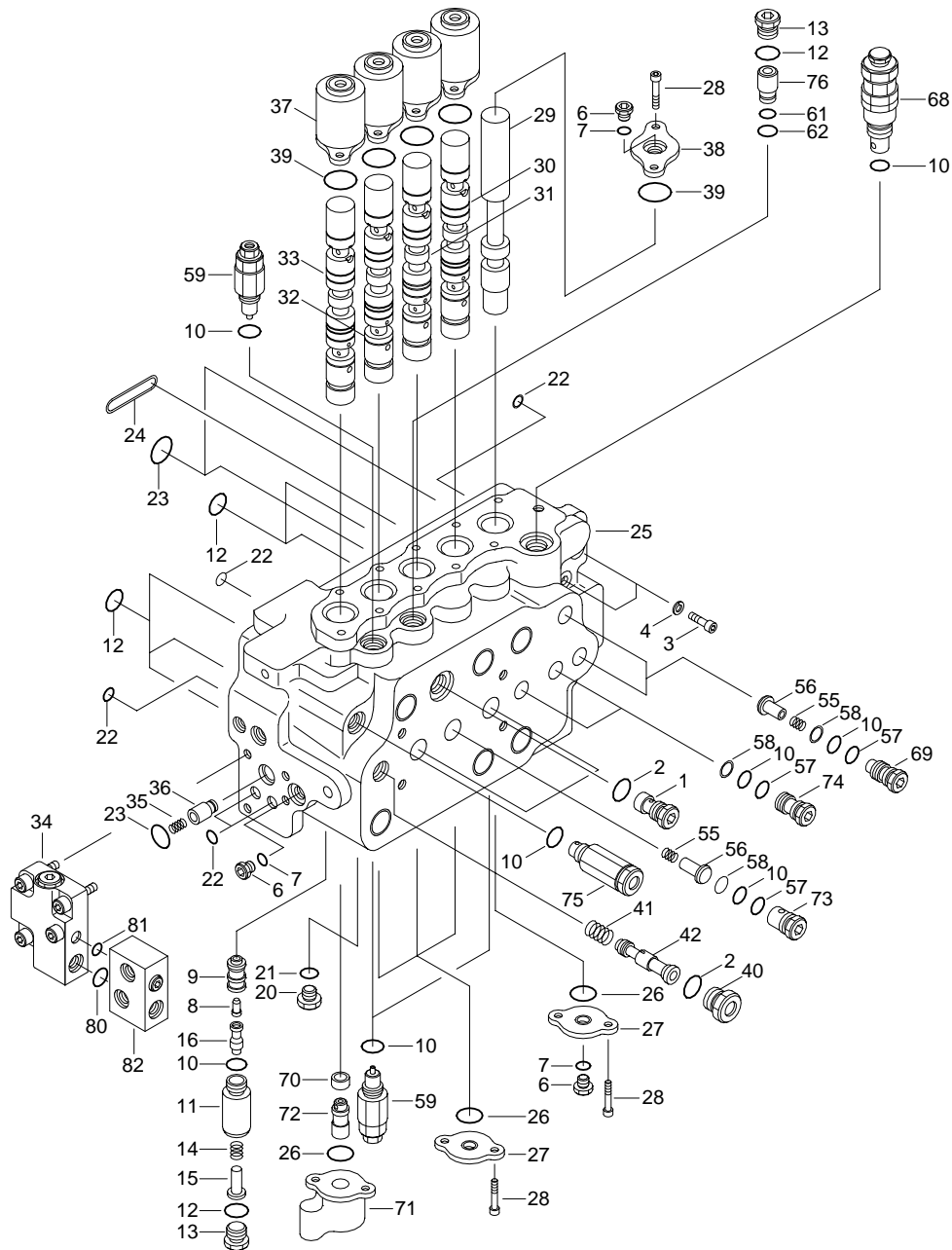


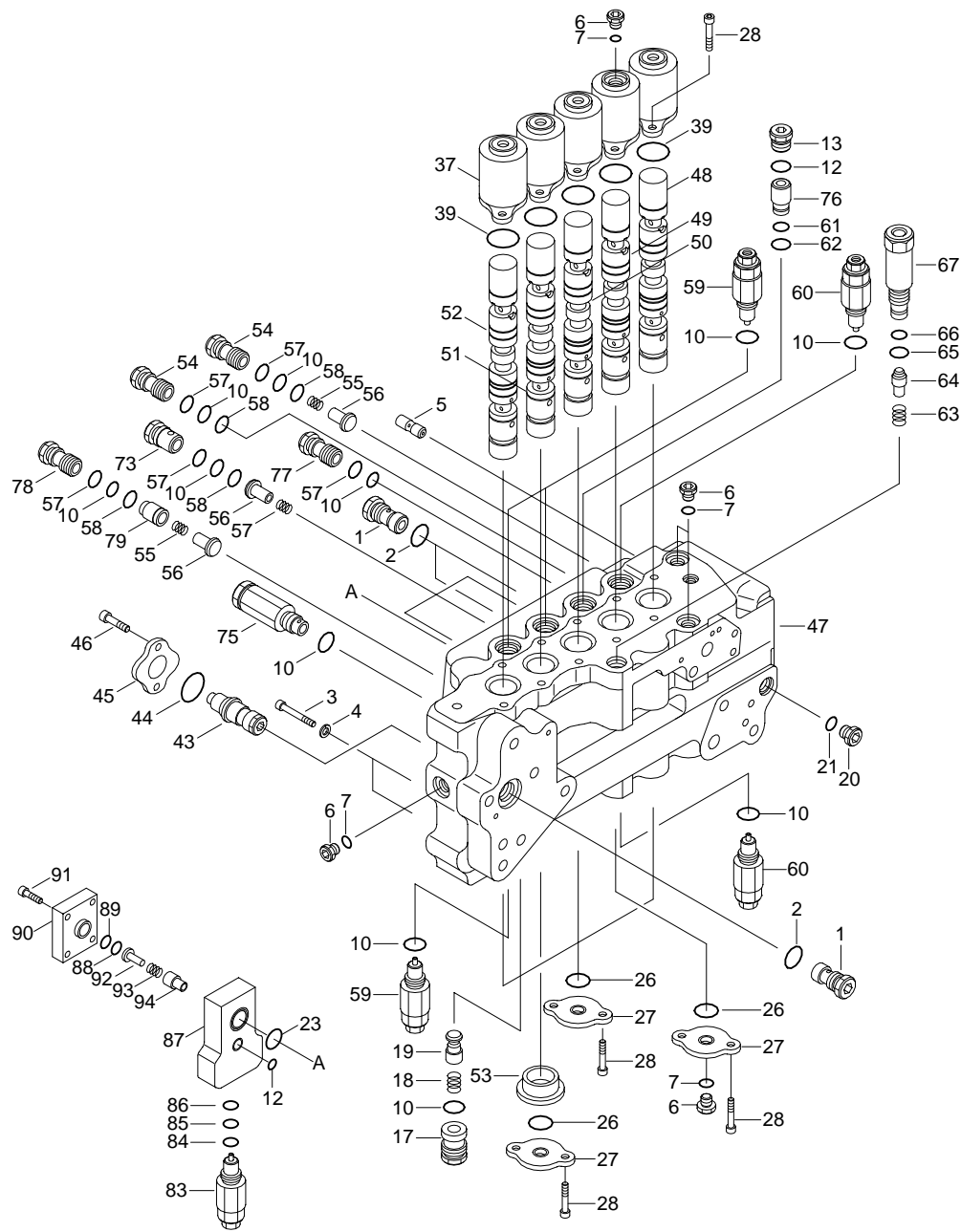
## GROUP 2 MAIN CONTROL VALVE

### 1. STRUCTURE(1/2)



- |    |               |    |              |    |                   |
|----|---------------|----|--------------|----|-------------------|
| 1  | Cap           | 14 | Spring       | 27 | Retainer          |
| 2  | O-ring        | 15 | Spring guide | 28 | Socket bolt       |
| 3  | Socket bolt   | 16 | Spool        | 29 | Spool             |
| 4  | Spring washer | 17 | Cap          | 30 | Plunger assy      |
| 5  | Orifice       | 18 | Spring       | 31 | Plunger assy(SW)  |
| 6  | Cap           | 19 | Check        | 32 | Plunger assy(BM2) |
| 7  | O-ring        | 20 | Cap          | 33 | Plunger assy(AM1) |
| 8  | Piston        | 21 | O-ring       | 34 | Cover assy        |
| 9  | Sleeve        | 22 | O-ring       | 35 | Spring            |
| 10 | O-ring        | 23 | O-ring       | 36 | Poppet            |
| 11 | Cap           | 24 | O-ring       | 37 | Cover             |
| 12 | O-ring        | 25 | Housing      | 38 | Retainer          |
| 13 | Cap           | 26 | O-ring       | 39 | O-ring            |

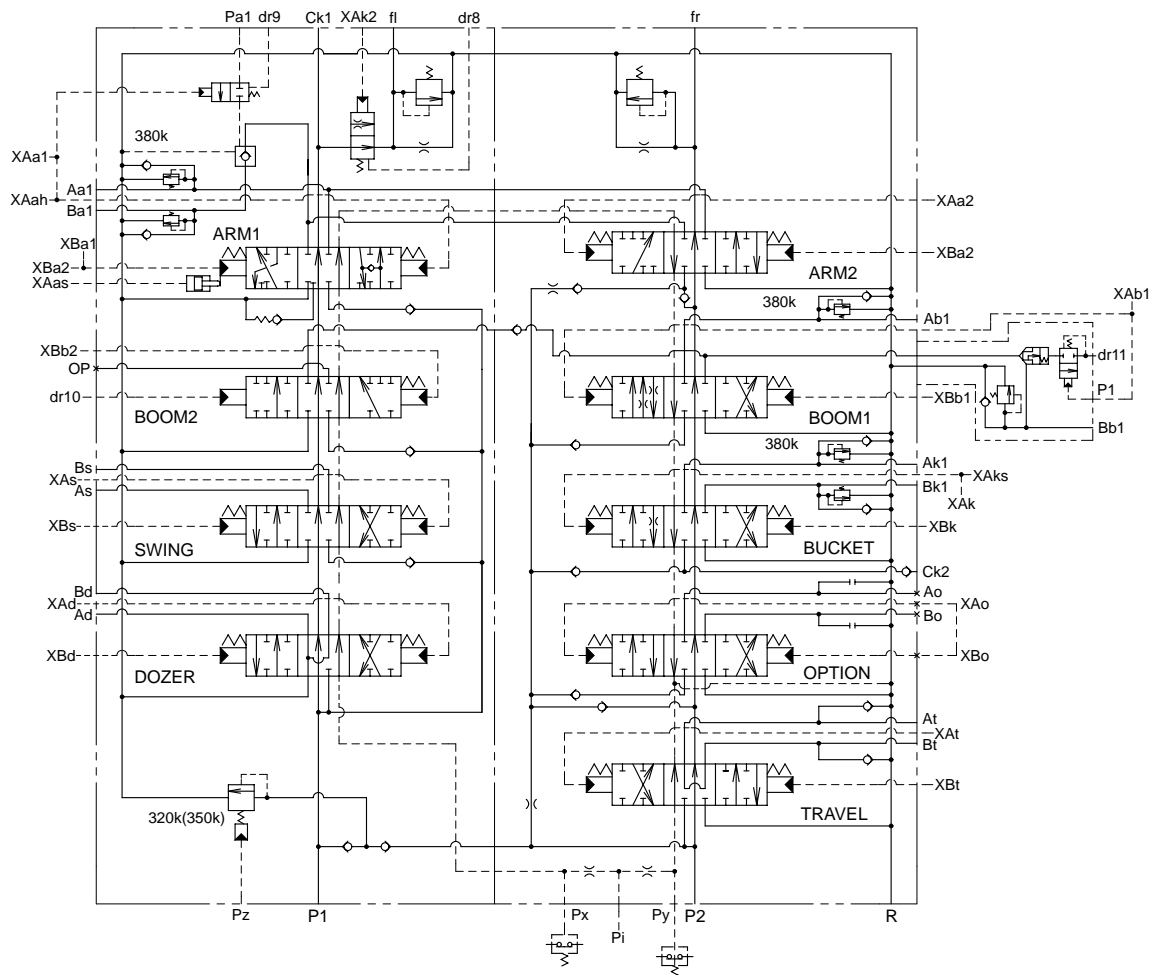
## STRUCTURE(2/2)



40	Cap	54	Cap	68	Main relief valve	82	Selector assy
41	Spring	55	Spring	69	Cap	83	Overload valve assy
42	Spool	56	Check	70	Spacer	84	O-ring
43	Plug	57	Back up ring	71	Cover	85	Back up ring
44	O-ring	58	Nylon chip	72	Piston	86	O-ring
45	Retainer	59	Overload valve assy	73	Cap	87	Manifold
46	Socket bolt	60	Make up valve	74	Cap	88	O-ring
47	Housing	61	Back up ring	75	Relief valve assy	89	Back up ring
48	Plunger(TR)	62	O-ring	76	Plug	90	Cover
49	Plunger(OPT)	63	Spring	77	Cap	91	Socket bolt
50	Plunger(BKT)	64	Check	78	Cap	92	Spring guide
51	Plunger assy(BM1)	65	O-ring	79	Check	93	Spring
52	Plunger assy(AM2)	66	Back up ring	80	O-ring	94	Poppet
53	Stopper	67	Cap	81	O-ring		

## 2. FUNCTION

### 1) HYDRAULIC CIRCUIT



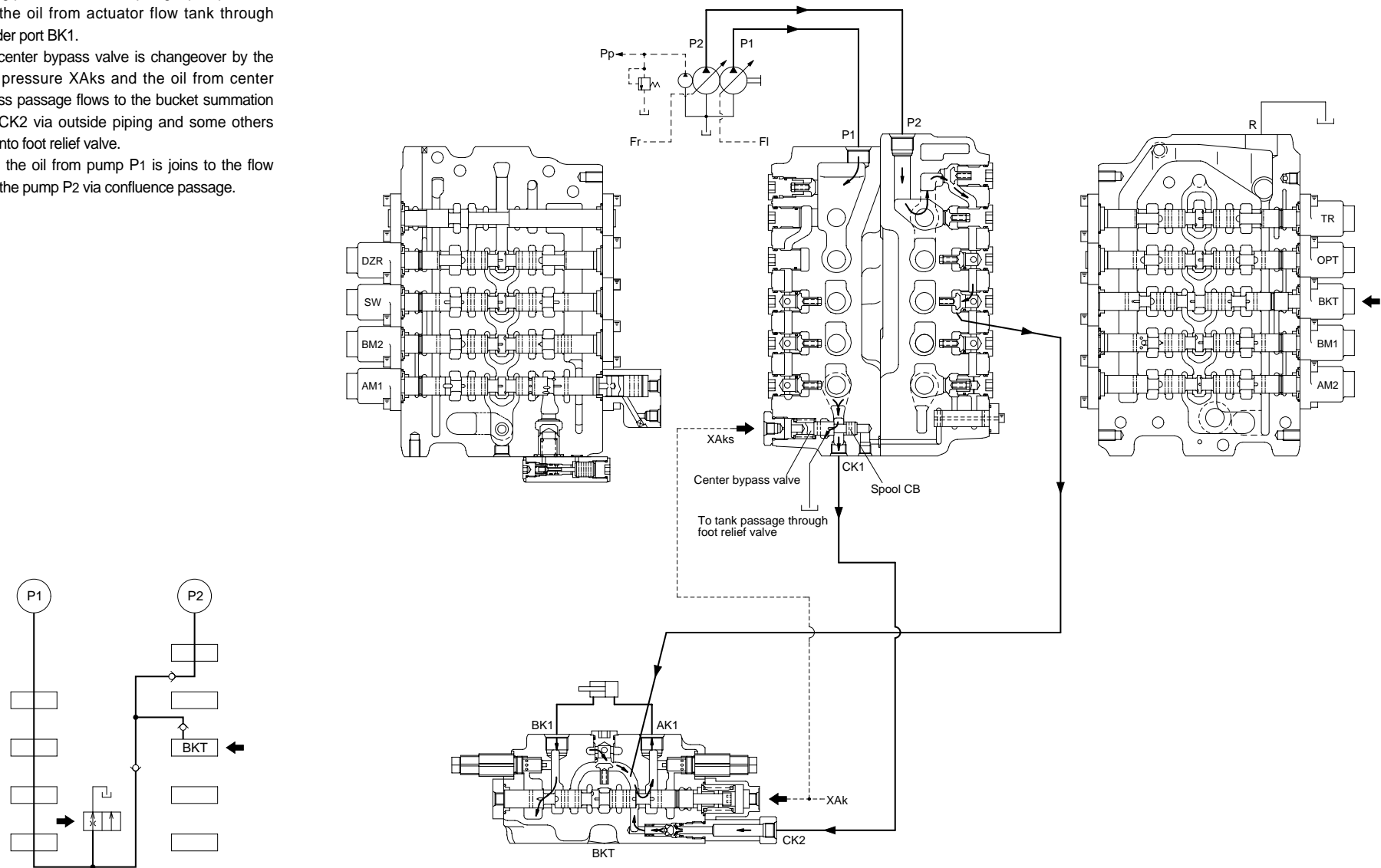
## 2) BASIC OPERATION

### (1) Bucket flow summation circuit

Oil from pump P2 is fed into cylinder port AK1 by adding pressure to bucket plunger pilot port XAk and the oil from actuator flow tank through cylinder port BK1.

The center bypass valve is changeover by the pilot pressure XAk and the oil from center bypass passage flows to the bucket summation port CK2 via outside piping and some others flow into foot relief valve.

Then the oil from pump P1 is joins to the flow from the pump P2 via confluence passage.



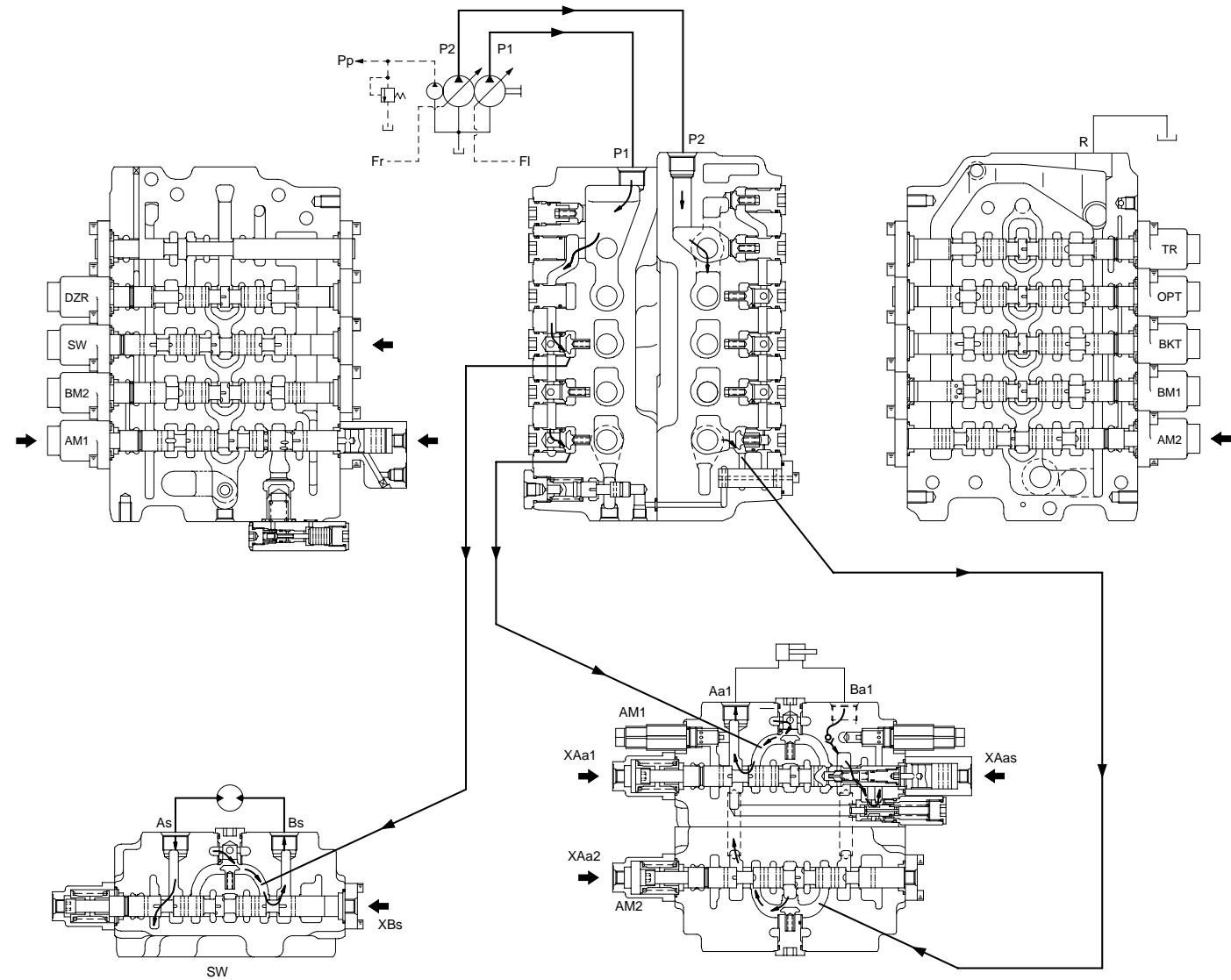
## (2) Swing priority circuit

Oil from pump P1 is fed into cylinder port Bs via center bypass passage by adding pressure to swing plunger pilot port XB<sub>s</sub>.

In case of simultaneous operation of swing and arm, the delivery oil from P1 for swing is also supplied to arm cylinder port Aa1.

Meanwhile the pilot oil from the swing shuttle valve flows into stroke limiter port XAas of arm spool, then the arm1 plunger does not full stroke.

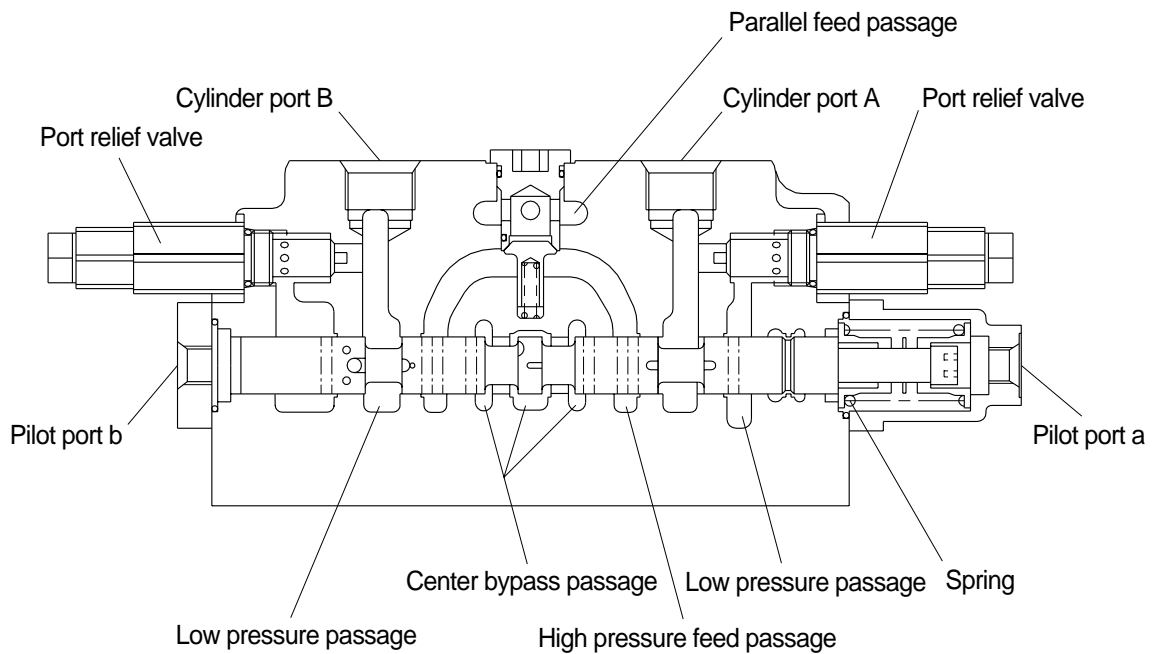
Consequently, the swing priority is maintained.



### 3) OPERATIONAL DESCRIPTION OF CONTROL VALVE

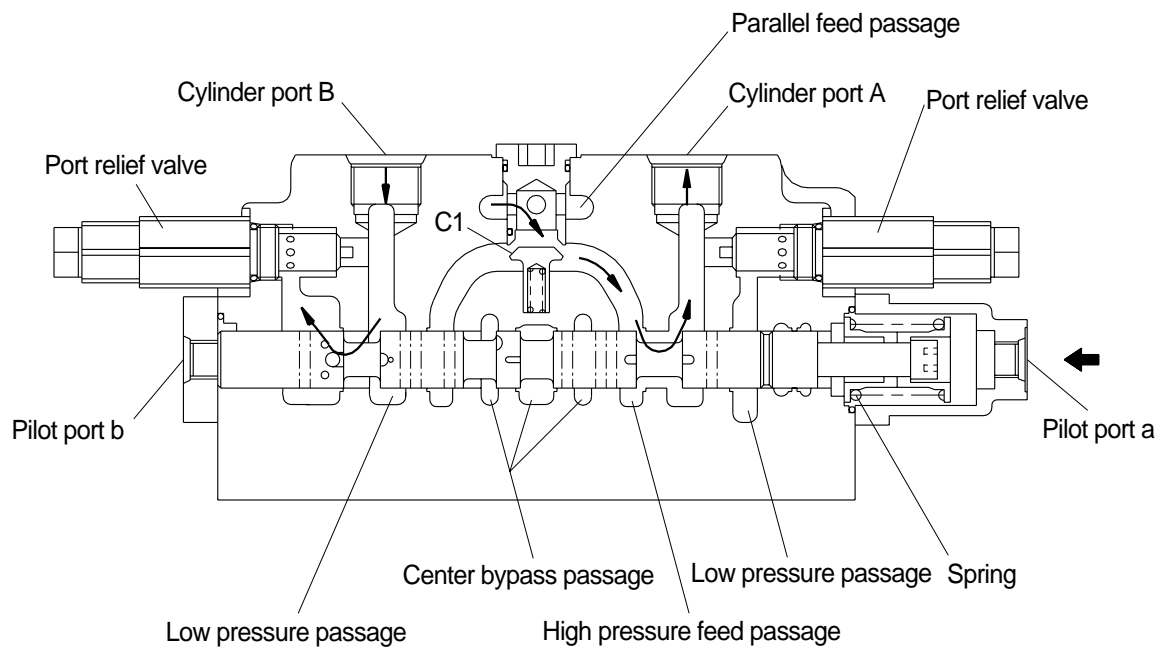
#### (1) Plunger operation

##### 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



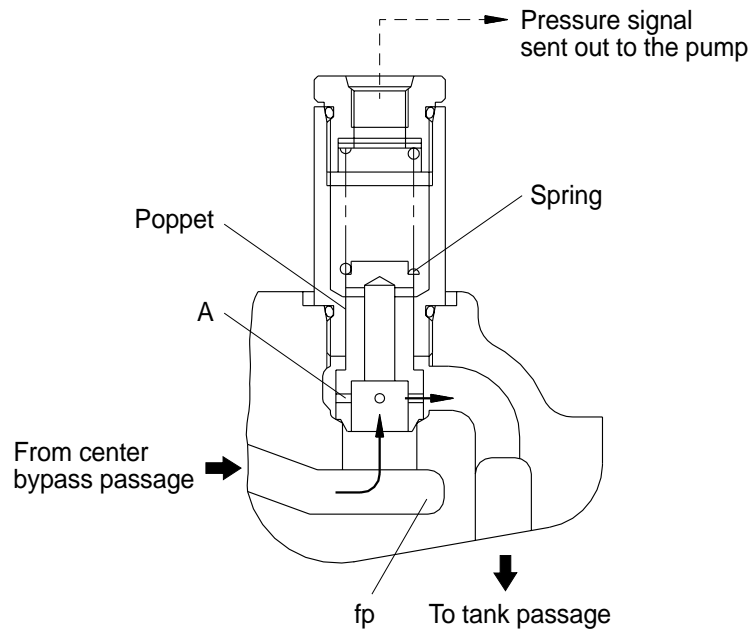
When actuated (Pressure is applied to pilot port a), the plunger moves to the left, the center bypass is shut off; Oil from the parallel feed passage opens the check valve C1 and flows into cylinder port A via the high pressure feed passage.

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

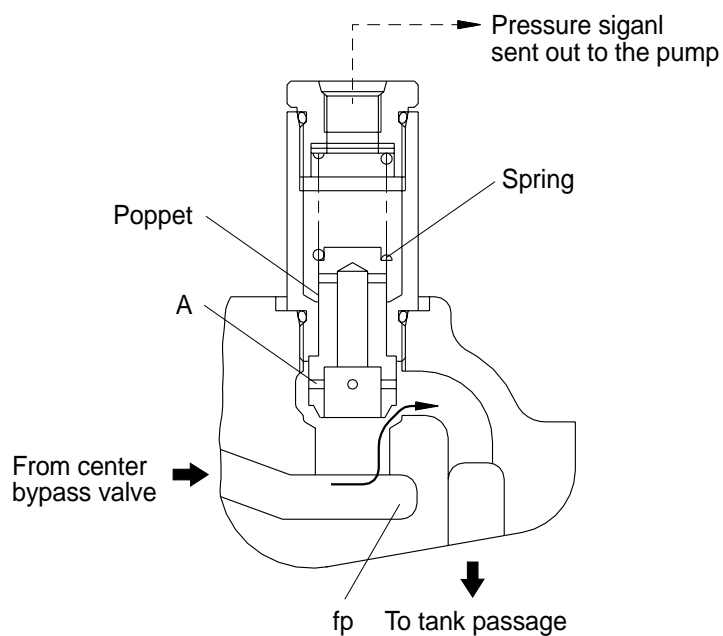
### ① $f_p$ is lower than spring force



Oil from the center bypass passage 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

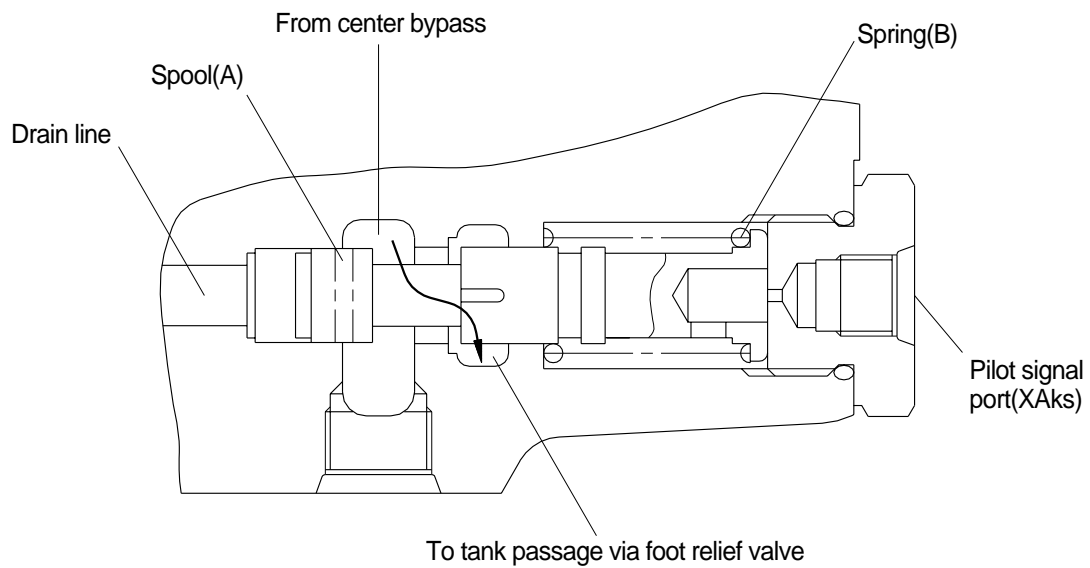


If a large amount flows due to delayed pump response, etc., and pressure  $f_p$  reaches the preset spring force, then the poppet is lifted and functions as a relief valve.



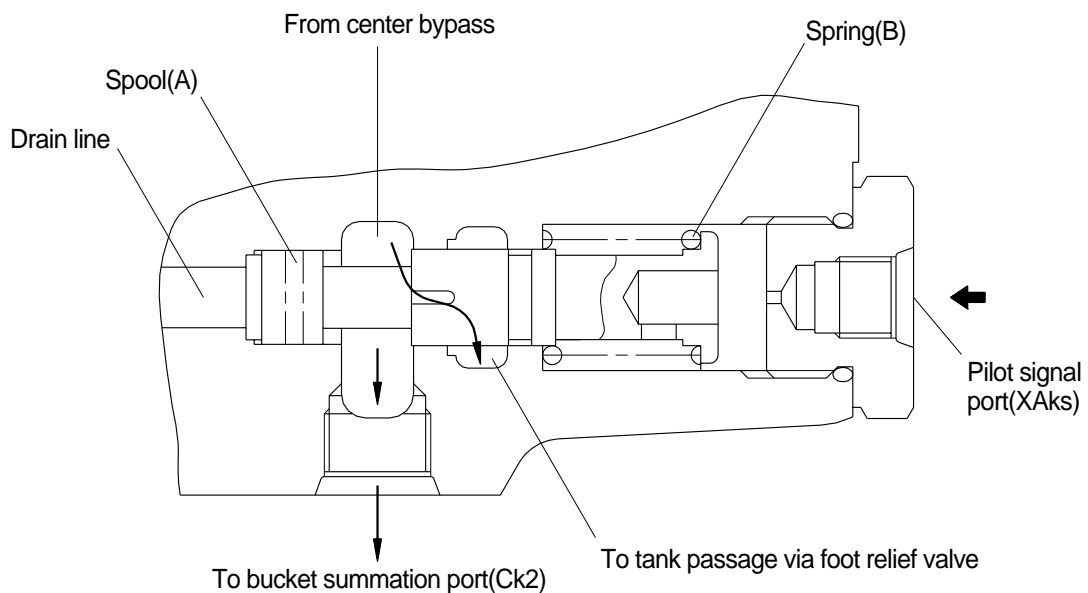
### (3) Center bypass valve operation

#### 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

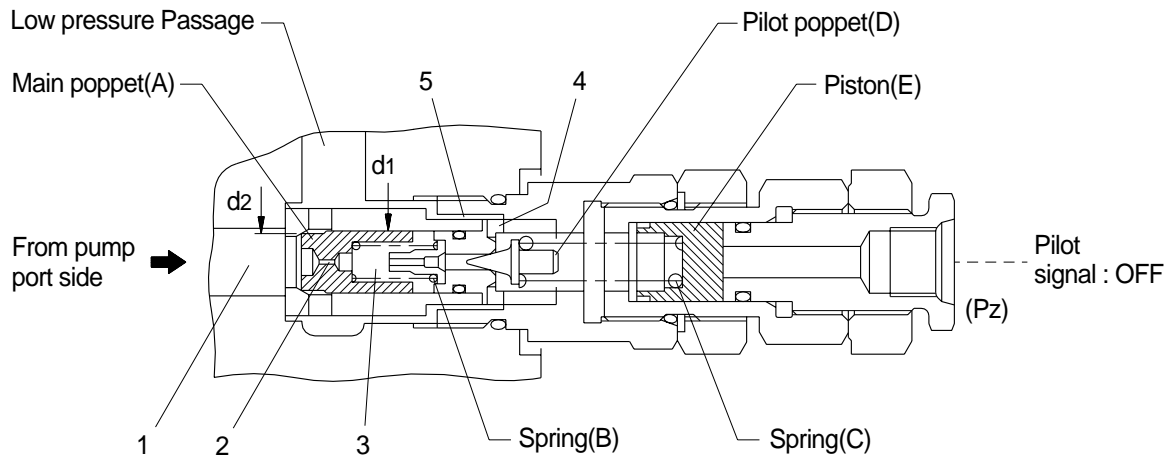


When pilot pressure reaches a preset spring force, the spool(A) moves left and orifices the flow to the foot relief valve.

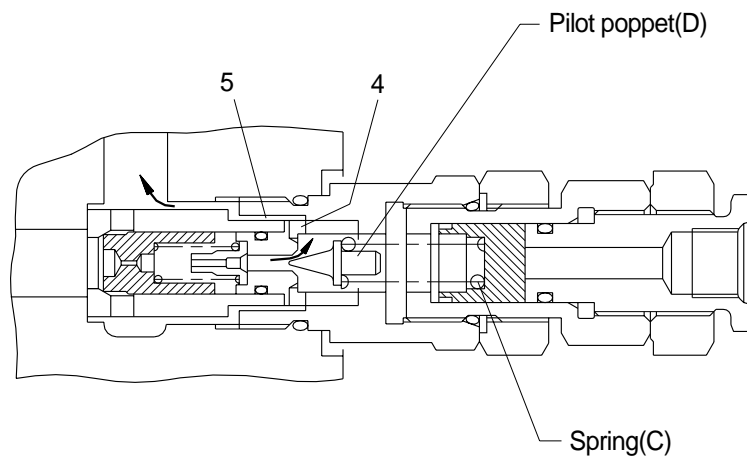
Then the oil from center bypass flow into bucket summation port Ck2 via out side piping.

#### (4) Main relief valve operation

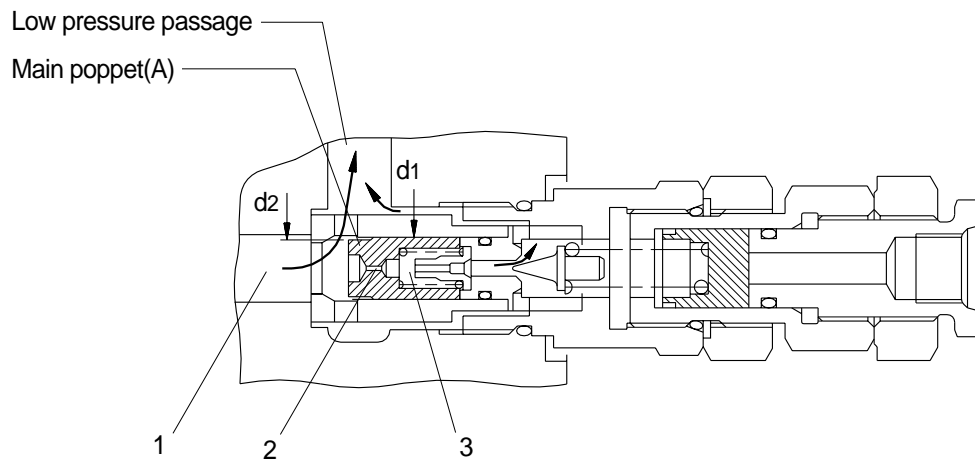
##### ① High pressure setting pilot signal : OFF



- A. This relief valve is built in between the pump port side(1) and low pressure passage.  
Piston(E) is seated right end by spring(C).  
Hydraulic oil from the pump port side enters chamber(3) via orifice(2) of main poppet(A).  
Because  $d2 < d1$ , main poppet(A) is securely seated.

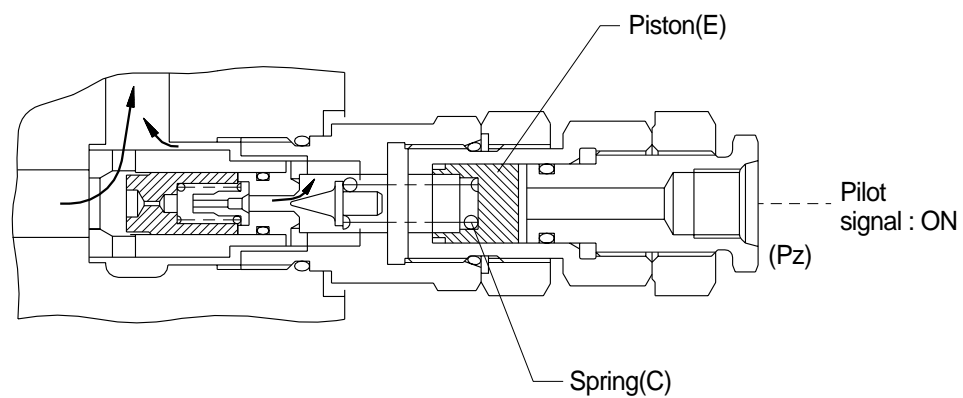


- B. When hydraulic oil reaches the pressure preset by spring(C), pilot poppet(D) opens; oil flows around poppet(D) and into the low pressure passage via side hole(4) and passage(5).



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

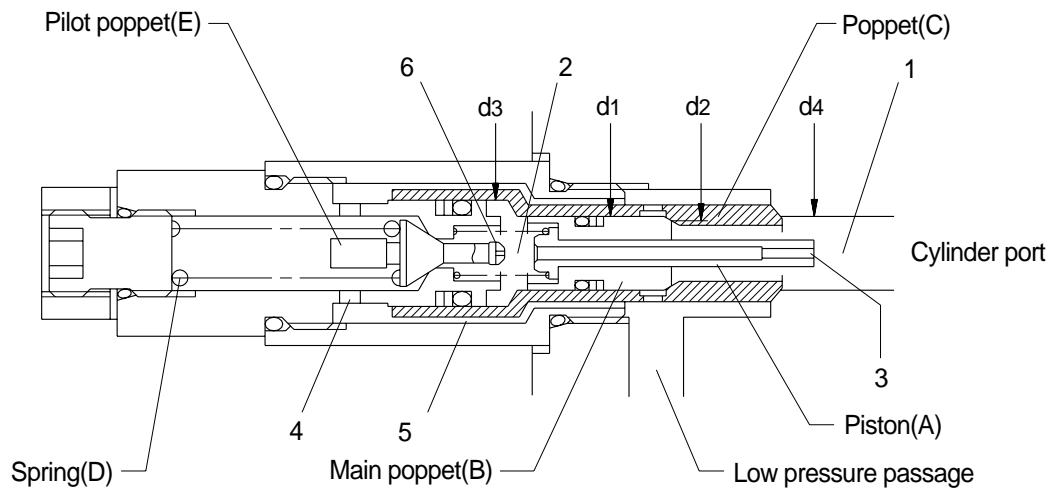
## ② High pressure setting pilot signal : ON



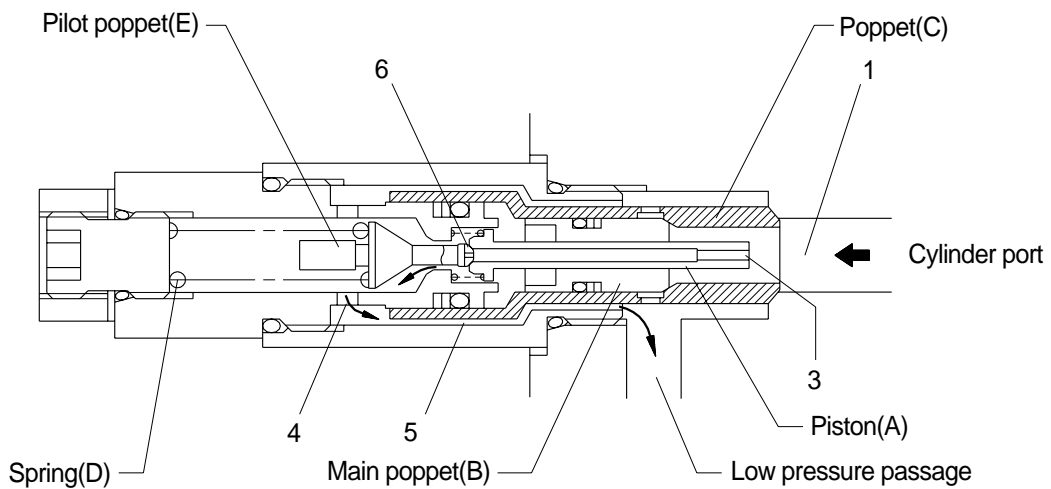
Piston(E) move to left by high pressure setting pilot signal ; Set pressure of spring(C) rises, making high pressure setting.

## (5) Overload relief valve operation

### ① Overload working operation



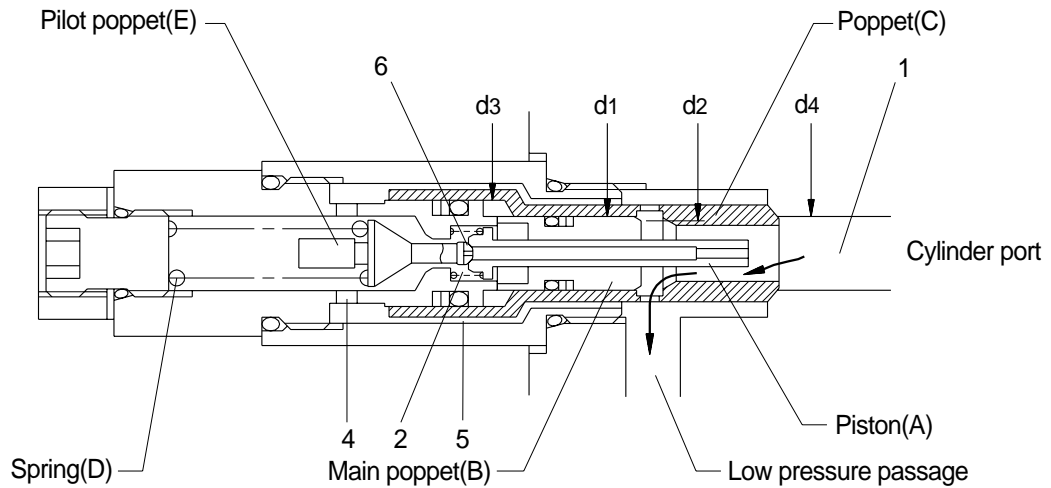
A. Hydraulic oil from cylinder port enters chamber(2) via orifice(3) of piston(A). Because  $d_1 > d_2$  and  $d_3 > d_4$ , main poppet(B) and poppet(C) are securely seated.



B. When hydraulic pressure reaches the preset force of spring(D), pilot poppet(E) opens ; Oil flows around pilot poppet(E) and into the low pressure passage via side hole(4) and passage(5).

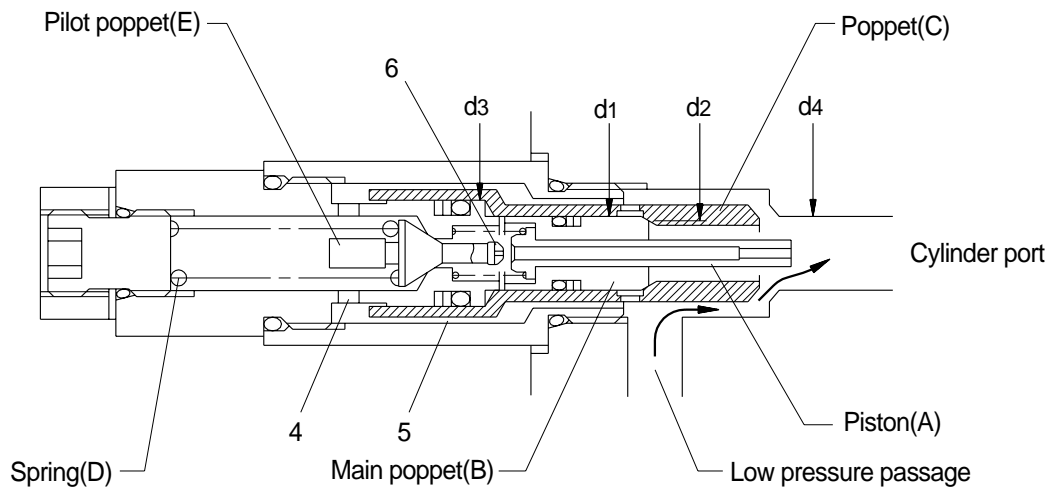
C. Oil flow is formed ; Pressure drops before and behind orifice(3) ; Piston(A) moves to left and seats at the tip of pilot poppet(E).

D. Hydraulic oil from chamber(1) enters chamber(2) via throttle(6) at the tip of pilot poppet(E) ; It flows into the low pressure passage via side hole(4) and passage(5).



E. Pressure drops before and behind throttle(6), making pressure of chamber(1) x area  $d_2$  > pressure of chamber(2) x area  $d_1$  ; Main poppet(B) is opened and hydraulic oil flows into the low pressure passage.

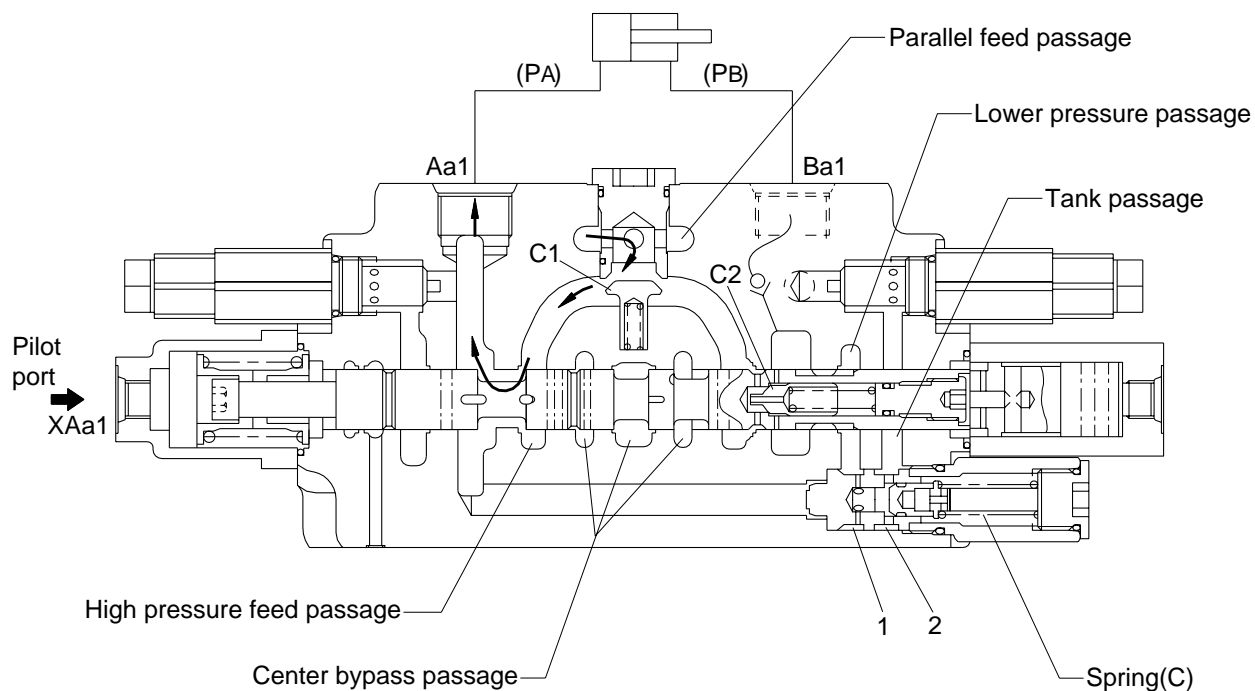
## ② Make up operation



- A. Poppet(C) is securely seated because the cylinder port pressure is normally higher than the tank pressure and  $d3 > d4$ .
- B. When the cylinder port pressure drops (closer to negative pressure) until the cylinder port pressure is lower than the tank pressure, poppet(C) opens receiving the tank pressure for the difference in area between  $d3$  and  $d4$ ; oil flows from the low pressure passage (Tank passage) to the cylinder port in order to prevent cavitation.

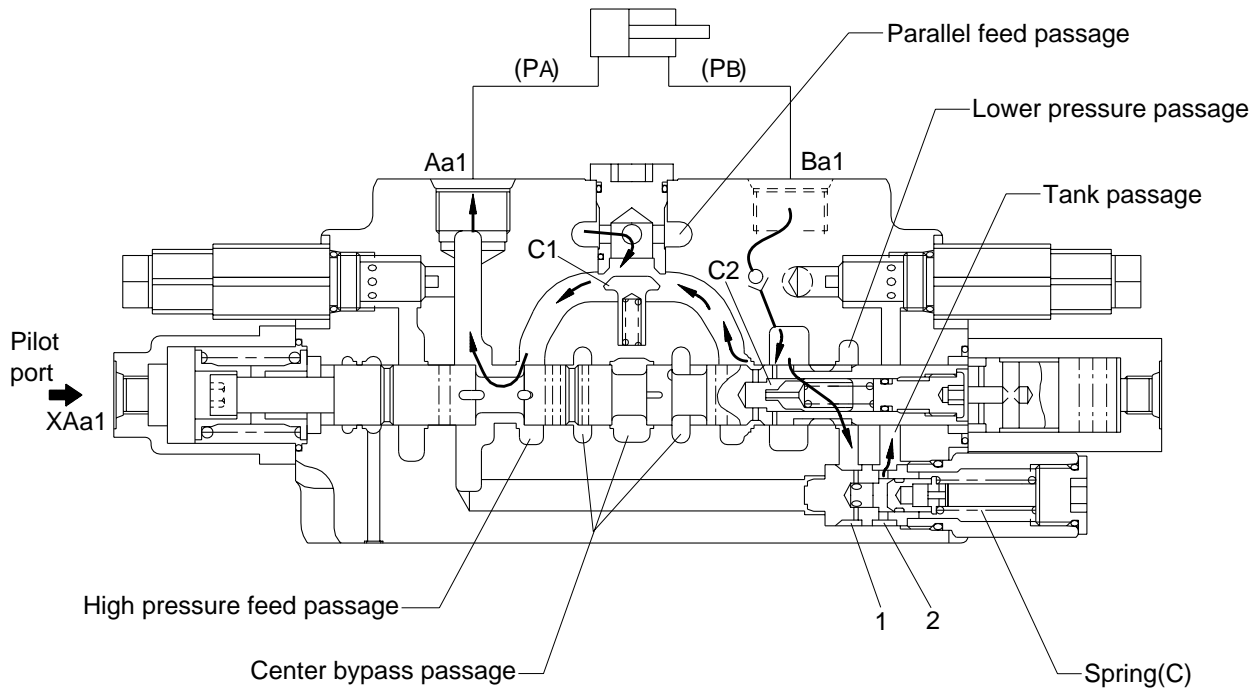
## (6) Arm regeneration operation

### ① Arm operation



When pressure is applied to pilot port XAa1 of the arm plunger(Arm clowding), the plunger moves to right as shown ; The center bypass passage is shut off ; Oil from the parallel feed passage opens check valve(C1) and flows into cylinder port Aa1(Head side) via the high pressure feed passage.

② PA is higher than PB



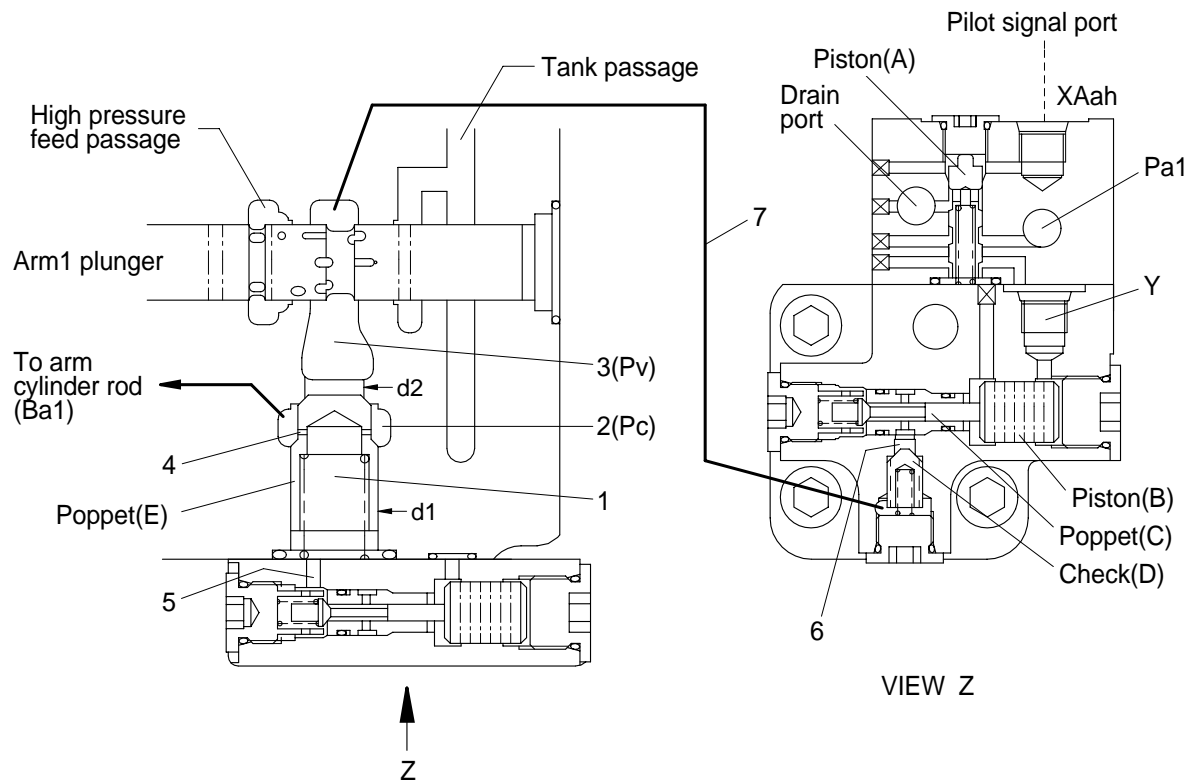
Return oil from cylinder rod side flow into tank passage via passage(1) and passage(2) in the regeneration selector as shown; The pressure rises higher than the preset pressure of spring then the check valve(C2) is opened.

Therefore, the return oil from cylinder rod side flows into cylinder head side via passage in the plunger and high pressure feed passage.



## (7) Arm holding valve operation

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



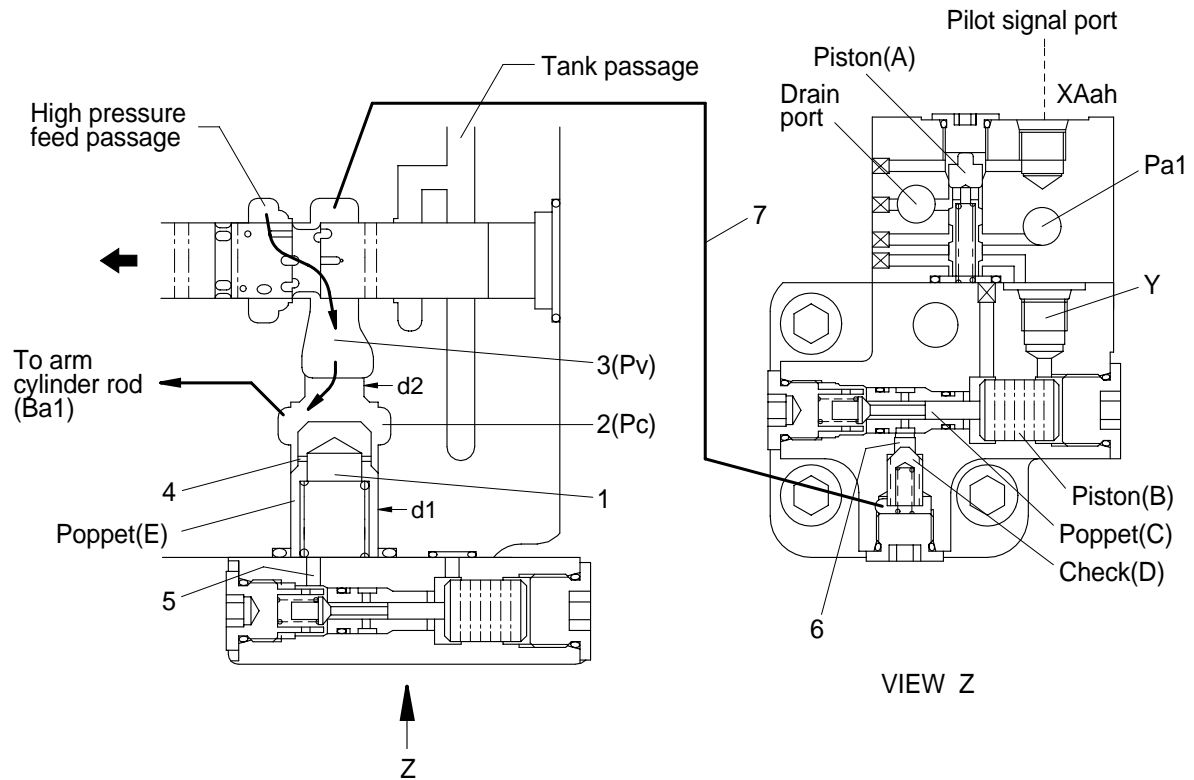
Piston(A) is in the status as shown ; Pressure signal(Pa1) and chamber(Y) are shut off.

Thus piston(B) and poppet(C) are in the status as shown; Passages(5) and (6) are shut off by poppet(C).

Therefore, the pressure of chamber(1) becomes pressure Pc as it is connected with chamber(2) via orifice(4). Since  $d1 > d2$ , poppet(E) is seated and chambers(2) and (3) are completely blocked.

② When the plunger is in operation

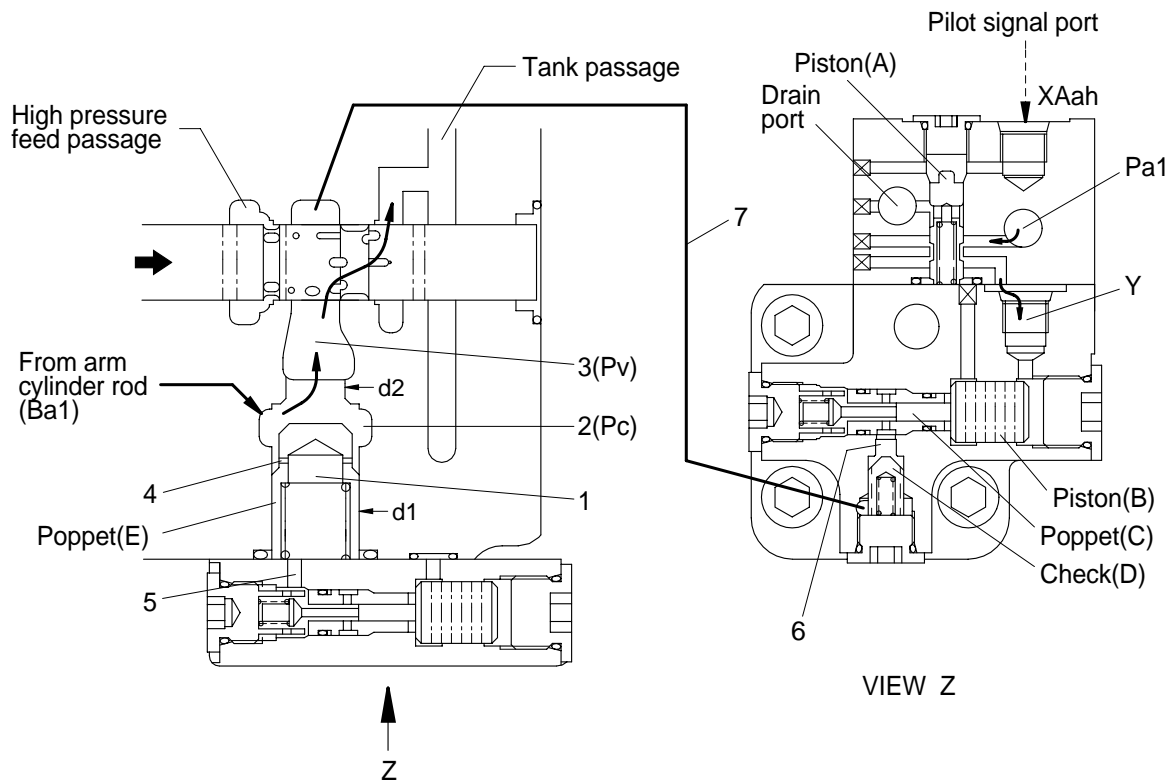
- If  $P_v$  is higher than  $P_c$  (In the case of arm out; XAah pilot signal : OFF)



When the plunger moves to left, the high pressure oil enters to chamber(3).

Therefore, the pressure of chamber(1) becomes  $P_c$  as it is connected to chamber(2) via orifice(4) ; Poppet(E) is opened ; Oil from high pressure feed passage flows into the cylinder rod side.

- If  $P_c$  is higher than  $P_v$  (In the case of arm in operation, XAah pilot signal : ON)



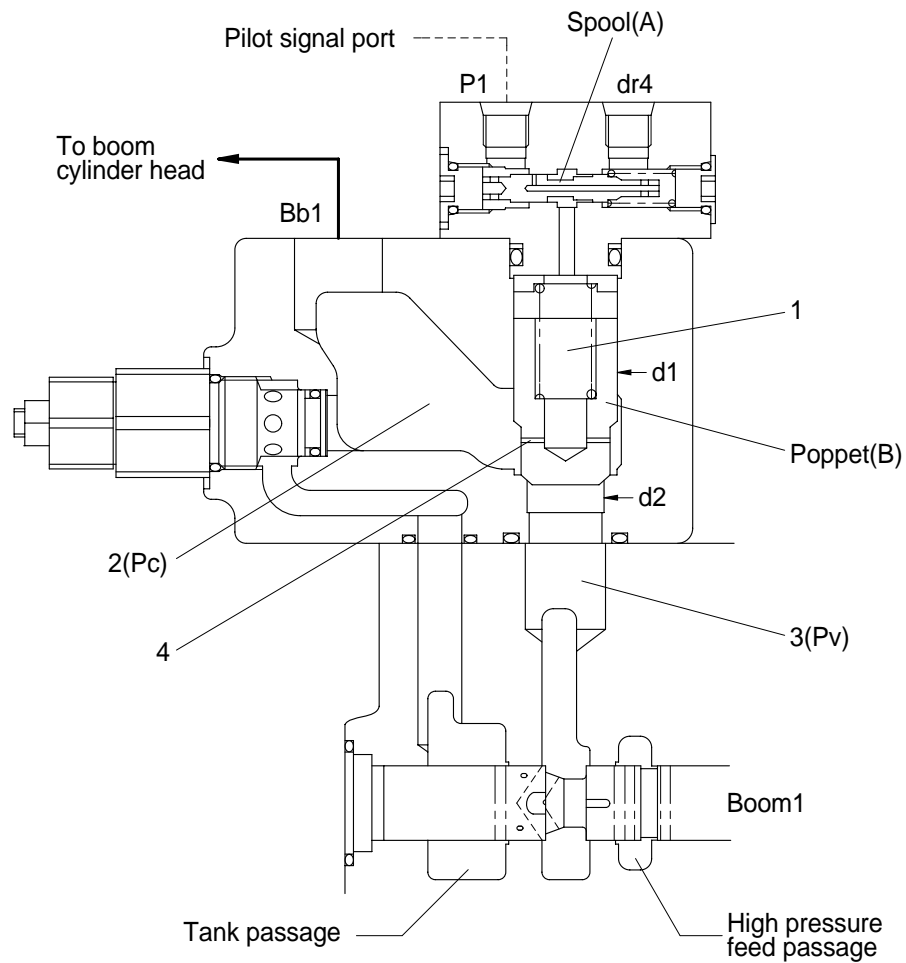
When the pressure of pilot signal enters, piston(A) moves to down.

When the pressure signal(Pa1) enters to chamber(Y), piston(B) moves to left and poppet(C) opens ; Passages(5) and (6) are connected.

If pressure  $P_c$  of cylinder port chamber(2) is higher than pressure  $P_v$  of chamber(3)(In the case of arm in operation) 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 tank passage because the arm plunger is moved to right. Therefore, pressure  $P_c$  is applied to(Area d1- area d2), pushing open poppet(E), and return oil from the cylinder rod side flows into the tank passage.

## (8) Boom holding valve operation

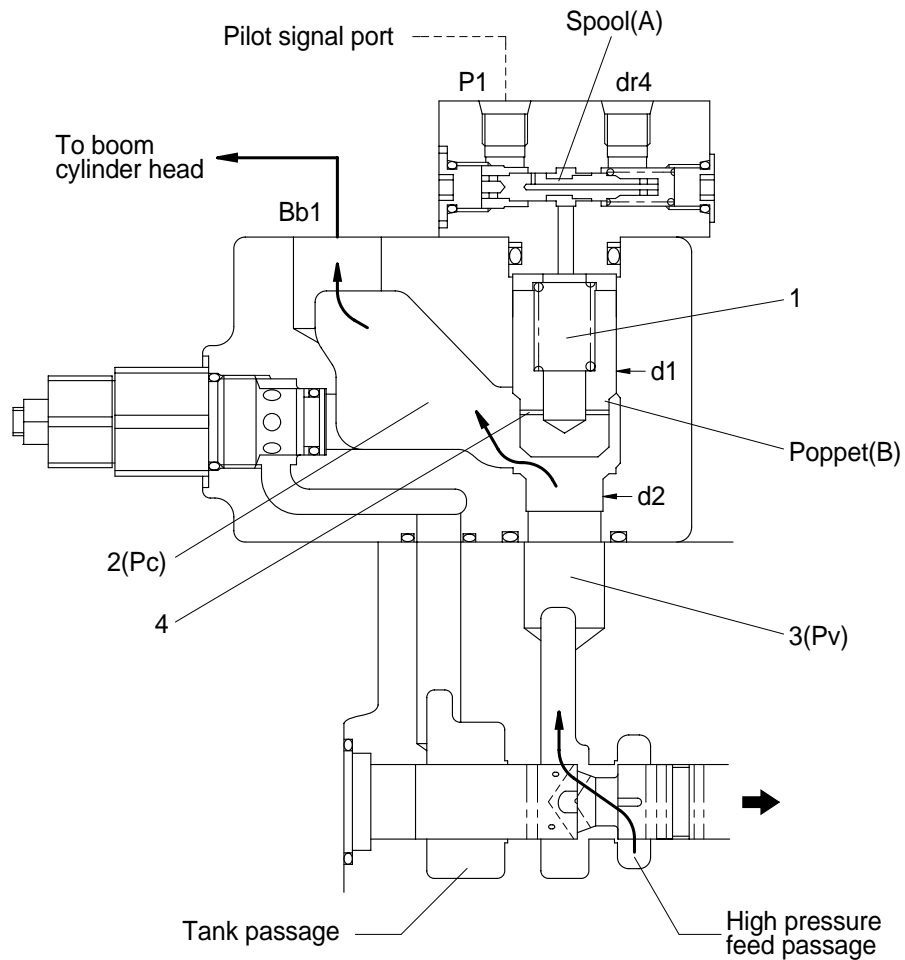
### ① When the plunger is in neutral(P1 pilot signal : OFF)



Spool(A) is in the status as shown ; Chamber(1) and drain port(dr4) are shut off by spool(A). Therefore, the pressure of chamber(1) becomes pressure  $P_c$  as it is connected with chamber(2) via orifice(4). Since  $d_1 > d_2$ , poppet(B) is seated and chambers(2) and (3) are completely blocked.

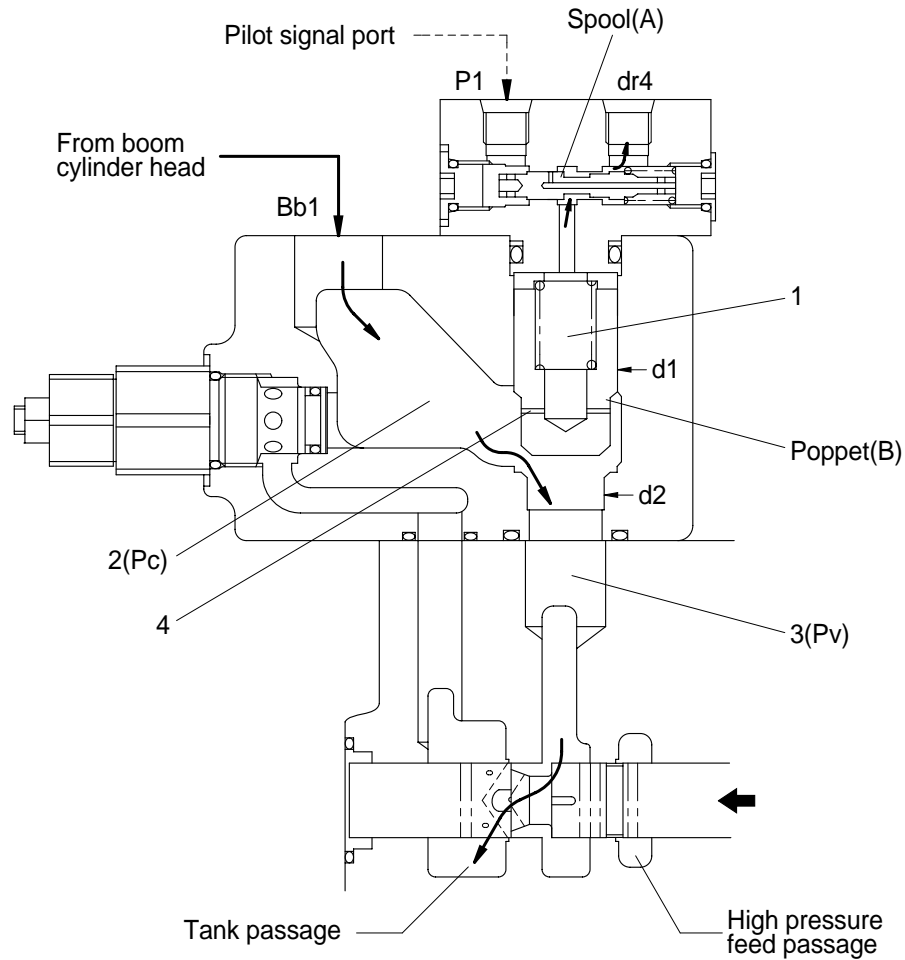
② When the plunger is in operation

- If  $P_v$  is higher than  $P_c$  (In the case of boom raise, P1 pilot signal : OFF)



When the plunger moves to right, the high pressure oil enters to chamber(3). Therefore, the pressure of chamber(1) becomes  $P_c$  as it is connected to chamber(2) via orifice(4) ; Poppet(B) is opened by pressure( $P_v$ ) of chamber(3) ; Oil from high pressure feed passage flows into the cylinder head side.

- If  $P_c$  is higher than  $P_v$  (In the case of boom down operation, P1 pilot signal : ON)



When plunger moves to left, chamber(3) is connected with tank passage. At the same time, spool(A) moves to right by the pressure of pilot signal ; Chamber(1) and drain port(dr4) are connected.

Therefore, pressure of chamber(1) becomes low ; Pressure  $P_c$  is applied to (Area  $d_1$  - area  $d_2$ ), pushing open poppet(B), and return oil from the cylinder head side flows into the tank passage.