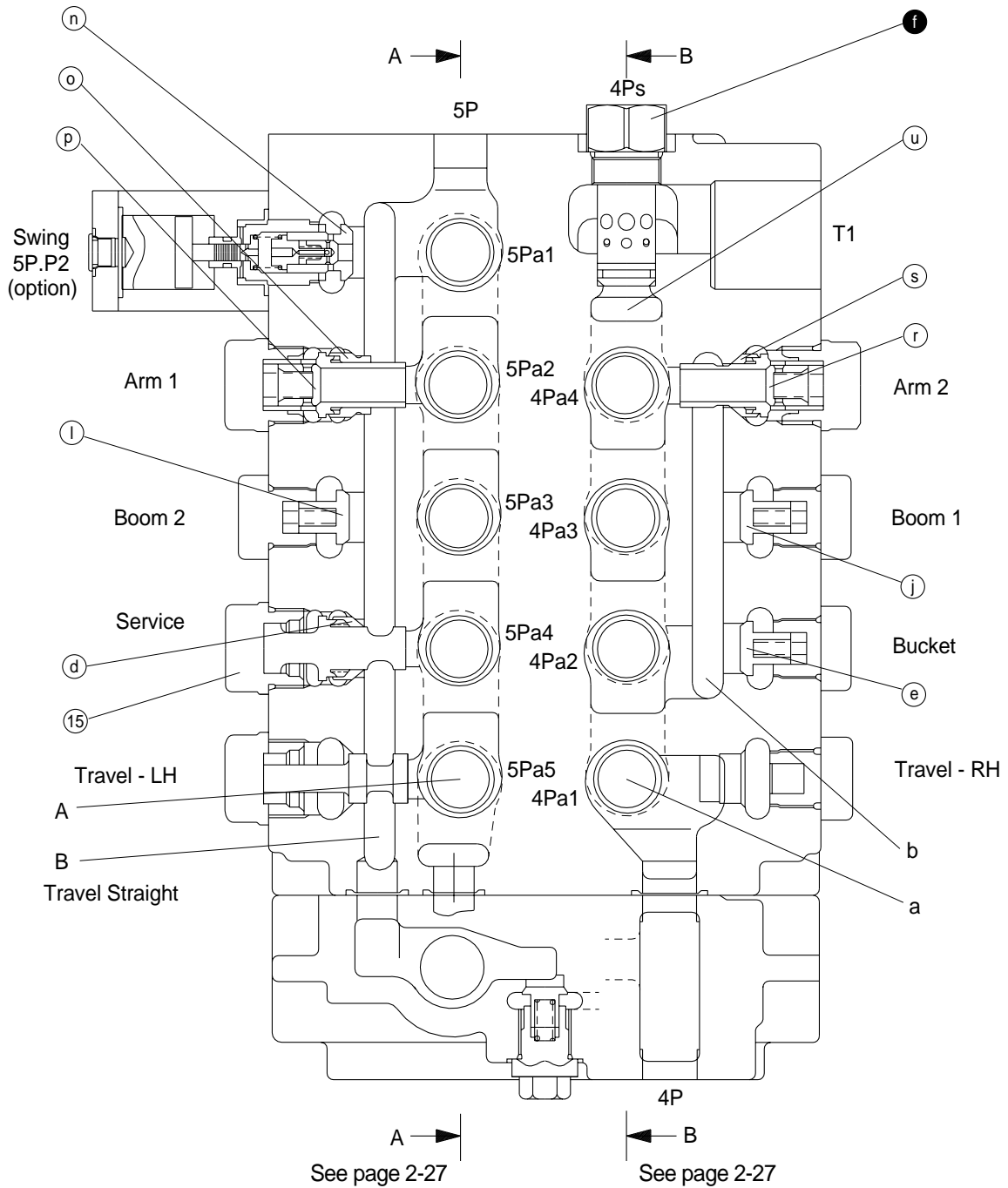
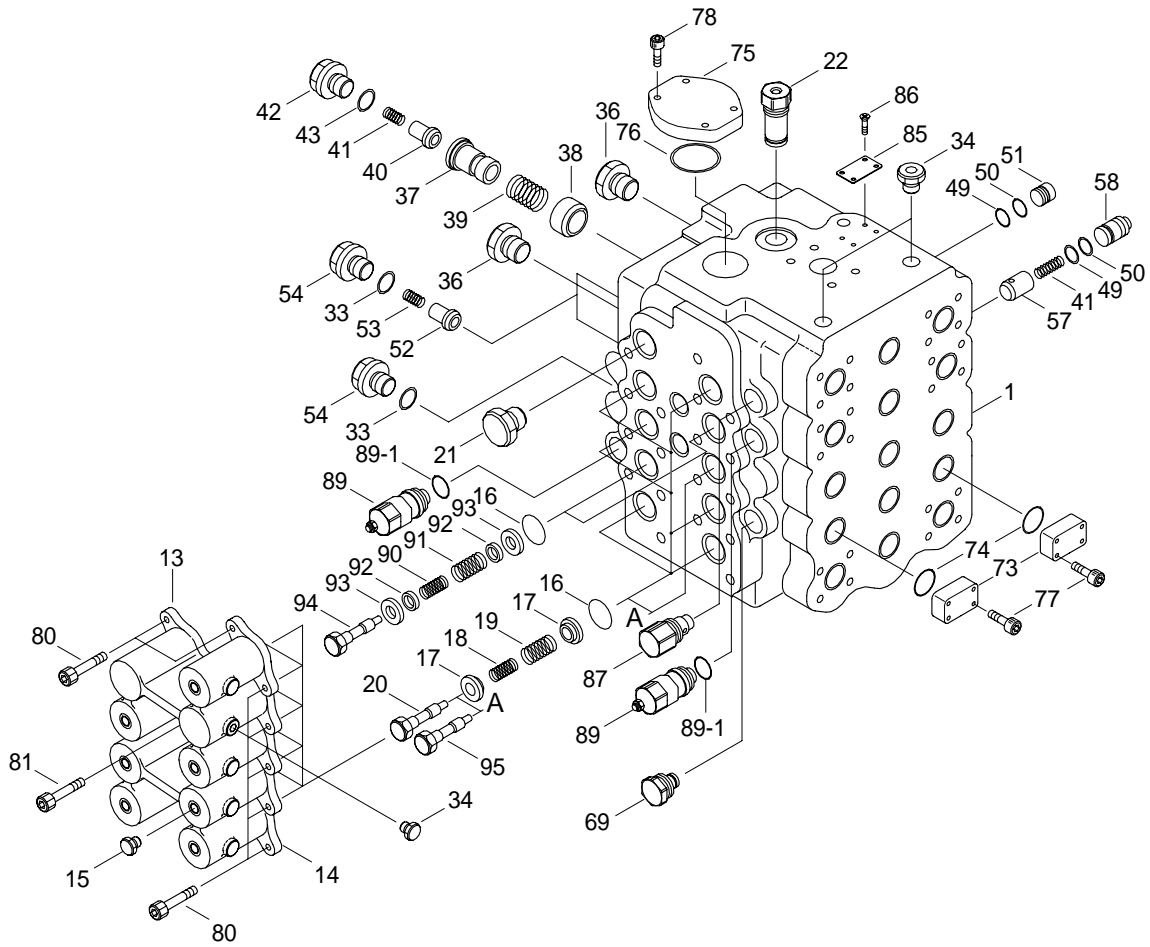


GROUP 2 MAIN CONTROL VALVE

1. STRUCTURE

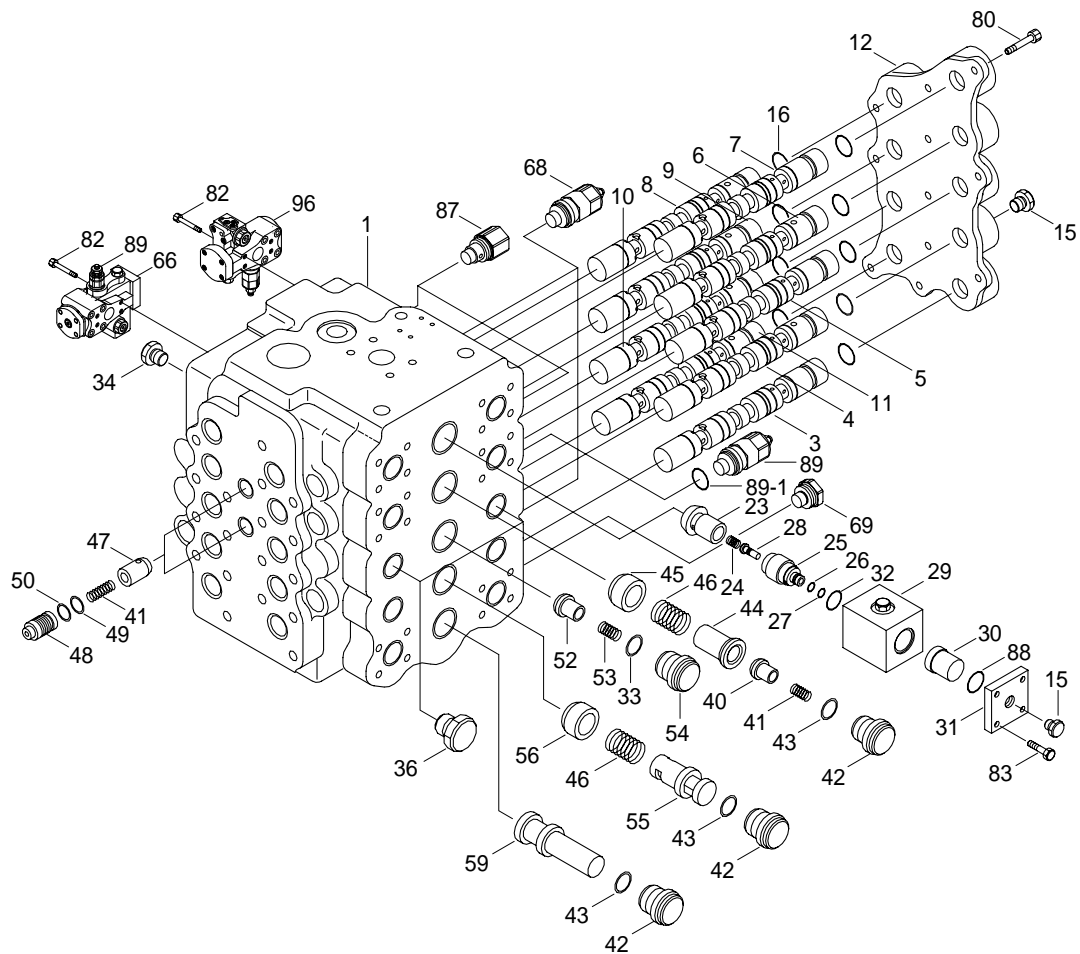


STRUCTURE



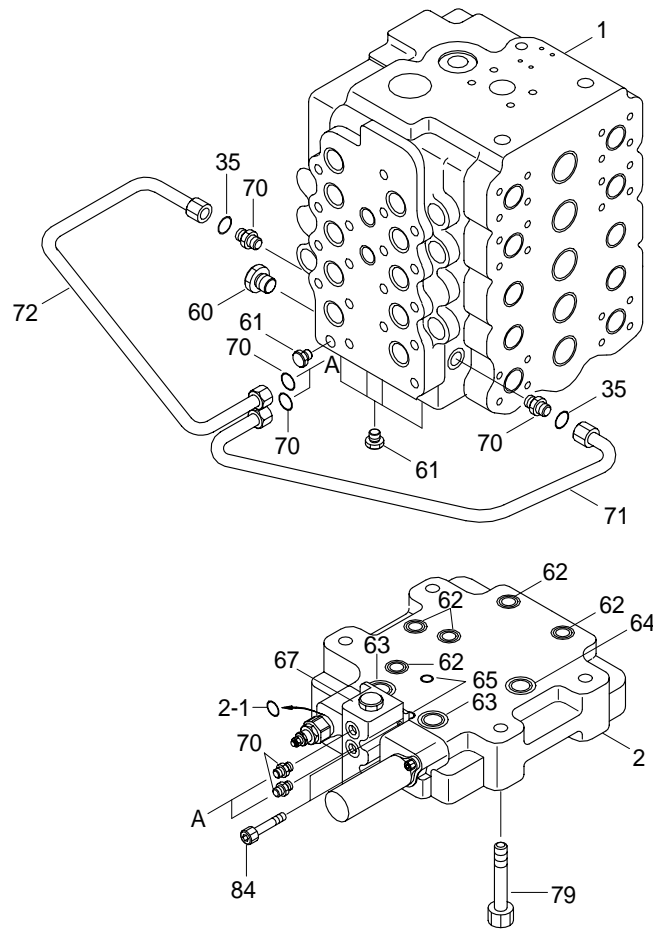
| | | | | | |
|----|-------------------|----|-------------|------|---------------------|
| 1 | Valve housing | 39 | Spring | 75 | Flange cap |
| 13 | Long cap | 40 | Poppet | 76 | O-ring |
| 14 | Long cap | 41 | Spring | 77 | Socket bolt |
| 15 | Plug assy | 42 | Plug | 78 | Socket bolt |
| 16 | O-ring | 43 | O-ring | 80 | Socket bolt |
| 17 | Spring seat | 49 | O-ring | 81 | Socket bolt |
| 18 | Spring | 50 | Backup ring | 85 | Name plate |
| 19 | Spring | 51 | Plug | 86 | Screw drive |
| 20 | End spool | 52 | Poppet | 87 | Antivoid valve assy |
| 21 | Plug assy | 53 | Spring | 89 | Relief valve assy |
| 22 | Relief valve assy | 54 | Plug | 89-1 | O-ring |
| 33 | O-ring | 57 | Poppet | 90 | Spring |
| 34 | Plug assy | 58 | Plug | 91 | Spring |
| 36 | Plug assy | 69 | Plug | 92 | Spring seat |
| 37 | Sleeve | 73 | Flange cap | 93 | Spring seat |
| 38 | Poppet | 74 | O-ring | 94 | Spool end |
| | | | | 95 | Spool end |

STRUCTURE



| | | | | | |
|----|------------------|----|-------------|------|----------------------|
| 1 | Valve housing | 29 | Body | 51 | Plug |
| 3 | Travel spool(LH) | 30 | Piston | 52 | Poppet |
| 4 | Option spool | 31 | Flange | 53 | Spring |
| 5 | Boom 2 spool | 32 | O-ring | 54 | Plug |
| 6 | Arm 1 spool | 33 | O-ring | 55 | Sleeve |
| 7 | Swing spool | 34 | Plug assy | 56 | Poppet |
| 8 | Arm 2 spool | 36 | Plug assy | 59 | Sleeve |
| 9 | Boom 1 spool | 40 | Poppet | 66 | Antidrift valve assy |
| 10 | Bucket spool | 41 | Spring | 68 | Relief valve assy |
| 11 | Travel spool(RH) | 42 | Plug | 69 | Plug assy |
| 12 | Short cap | 43 | O-ring | 80 | Socket bolt |
| 15 | Plug assy | 44 | Sleeve | 82 | Socket bolt |
| 16 | O-ring | 45 | Poppet | 83 | Socket bolt |
| 23 | Poppet assy | 46 | Spring | 87 | Antivoid valve assy |
| 24 | Spring | 47 | Poppet | 88 | O-ring |
| 25 | Sleeve | 48 | Plug | 89 | Relief valve assy |
| 26 | O-ring | 49 | O-ring | 89-1 | O-ring |
| 27 | Backup ring | 50 | Backup ring | 96 | Antidrift valve assy |
| 28 | Piston | | | | |

STRUCTURE



| | | | | | |
|-----|----------------|----|-------------|----|-------------|
| 1 | Valve housing | 62 | O-ring | 71 | Pipe |
| 2 | Side body assy | 63 | O-ring | 72 | Pipe |
| 2-1 | O-ring | 64 | O-ring | 79 | Socket bolt |
| 35 | O-ring | 65 | O-ring | 84 | Socket bolt |
| 60 | Plug assy | 67 | Pilot valve | | |
| 61 | Plug | 70 | Joint | | |

3. OPERATION

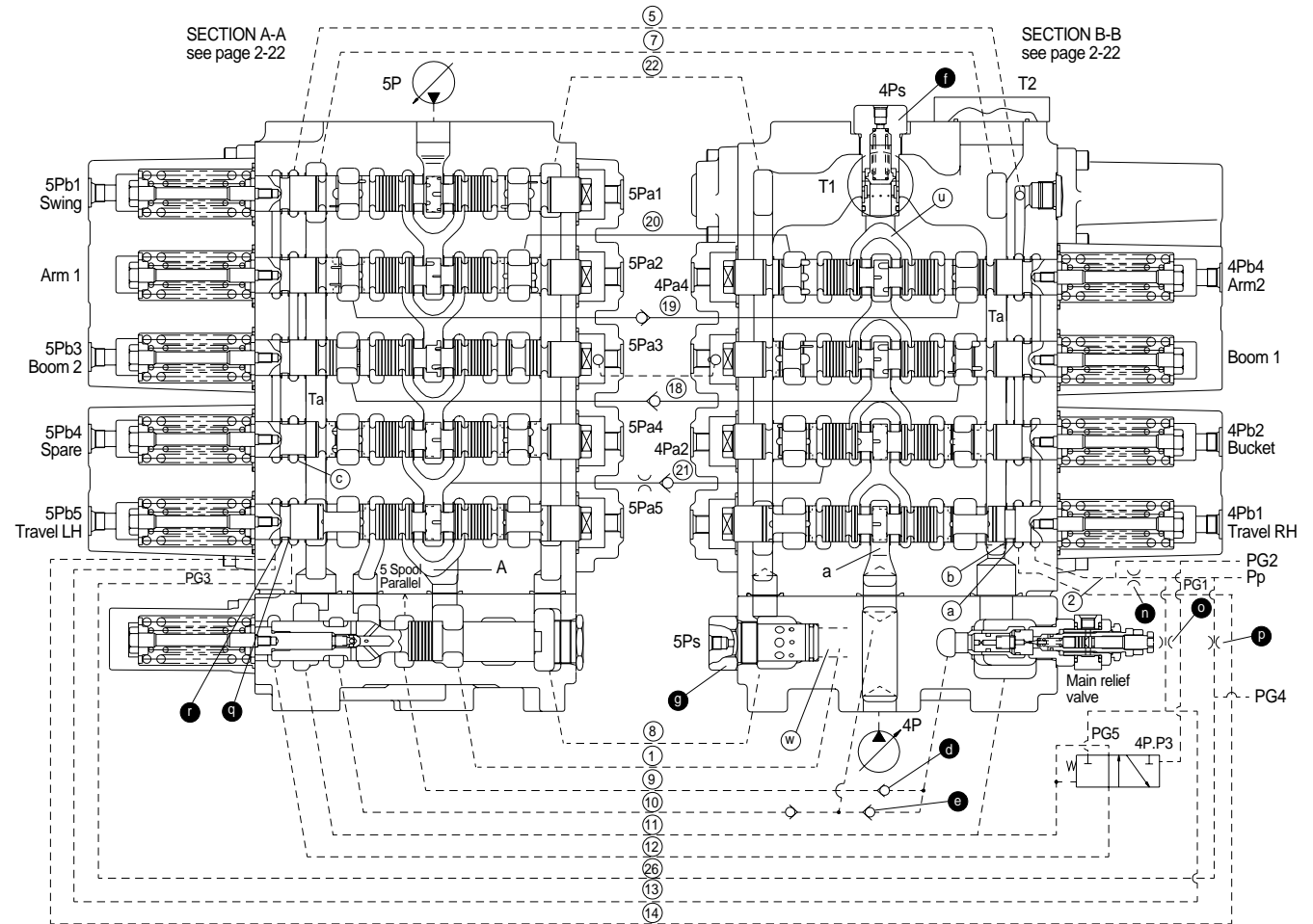
1) ALL SPOOL NEUTRAL

(1) Neutral passage

- Oil from pump P2 fed into control valve's 4P port and goes through neutral passage(a) to negative control relief valve(●); and then oil returns to port T1 and T2 via tank passage of 4 spool side.
- Oil from pump P1 fed into control valve's 5P port and goes through neutral passage(A) and passage(1) of side body inside to negative control relief valve(●); and then oil returns to port T1 and T2 via tank passage of 4 spool side.
- The pressure of passage(⊕, ⊗) sends signal to pump via port 4Ps, [5Ps]; and control the discharge of pump P1 and P2. Negative control.
- When a large amount of oil flows the neutral passage, the low pressure relief valve is operated. As a result, the shock pressure of port 4Ps and 5Ps is prevented. See operation of low relief valve.

(2) Signal passage

- Oil of port Pp from signal pressure, flows into passage(14) via orifice(●), land(●, ●); and then returns to the tank passage via land(⊙, ⊙). At the same time, after passing through passage(13) to passage(14), oil returns to the tank passage via land(⊙, ⊙).
- Meanwhile, some of oil from port Pp flows into passage(2) via orifice(●); and then returns to tank passage via signal land of both 4 spool and 5 spool side and signal land(⊙) of service spool.



2) SINGLE OPERATION

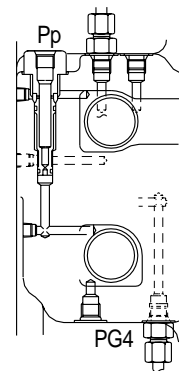
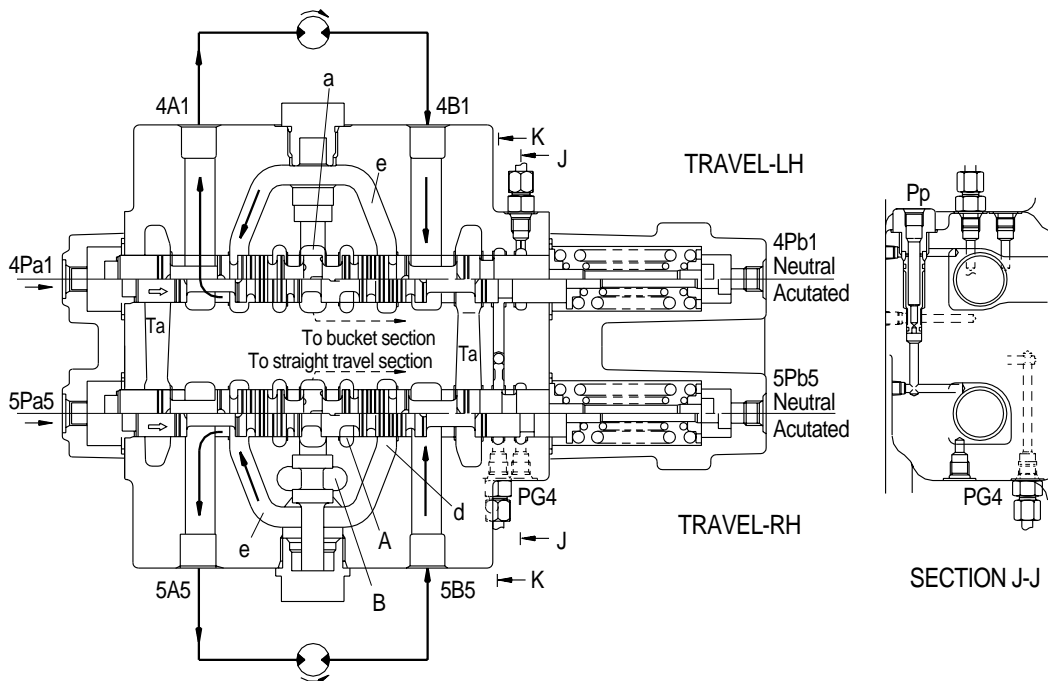
(1) Operation of travel spool

When the LH travel spool is pushed to the right by the pilot pressure of port 4Pa1, the neutral passage(a) is closed, and the oil discharged from pump P2 flows into cylinder port 4A1.

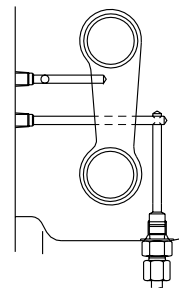
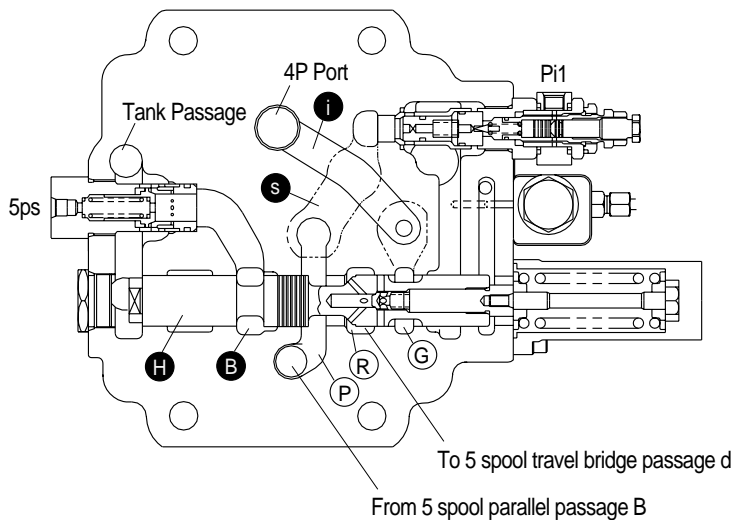
The oil from cylinder port 4B1 returns to the tank via the low pressure passage(Ta).

Also, the RH travel spool is pushed to the right by the pilot pressure of port 5Pa5, the oil discharged from pump P1 through parallel passage(B), passage(Ⓟ) of side body assembly, passage(Ⓡ) of straight travel spool land to travel bridge passage(d) of 5 spool ; and then oil flows into cylinder port 5A5 via passage(e).

The oil from cylinder port 5B5 returns to the tank via the low pressure passage(Ta).



SECTION J-J

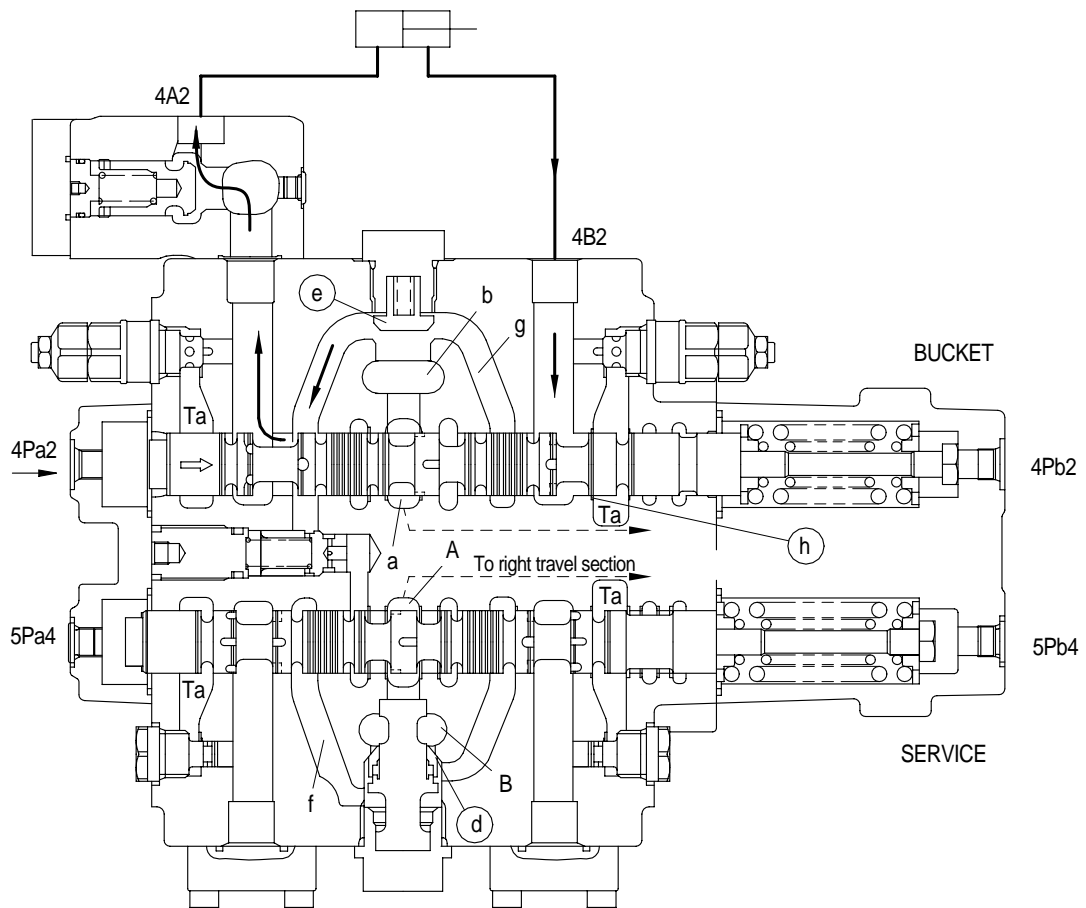


SECTION K-K

(2) Operation of bucket spool

When the bucket spool is pushed to the right by the pilot pressure of port(4Pa2), the neutral passage(a) is closed, the oil discharged from pump P2 pushes up the load check valve(Ⓓ) through parallel passage(b) and flows into cylinder port 4A2.

The oil from cylinder port 4B2 returns to the tank via the low pressure passage(Ta).

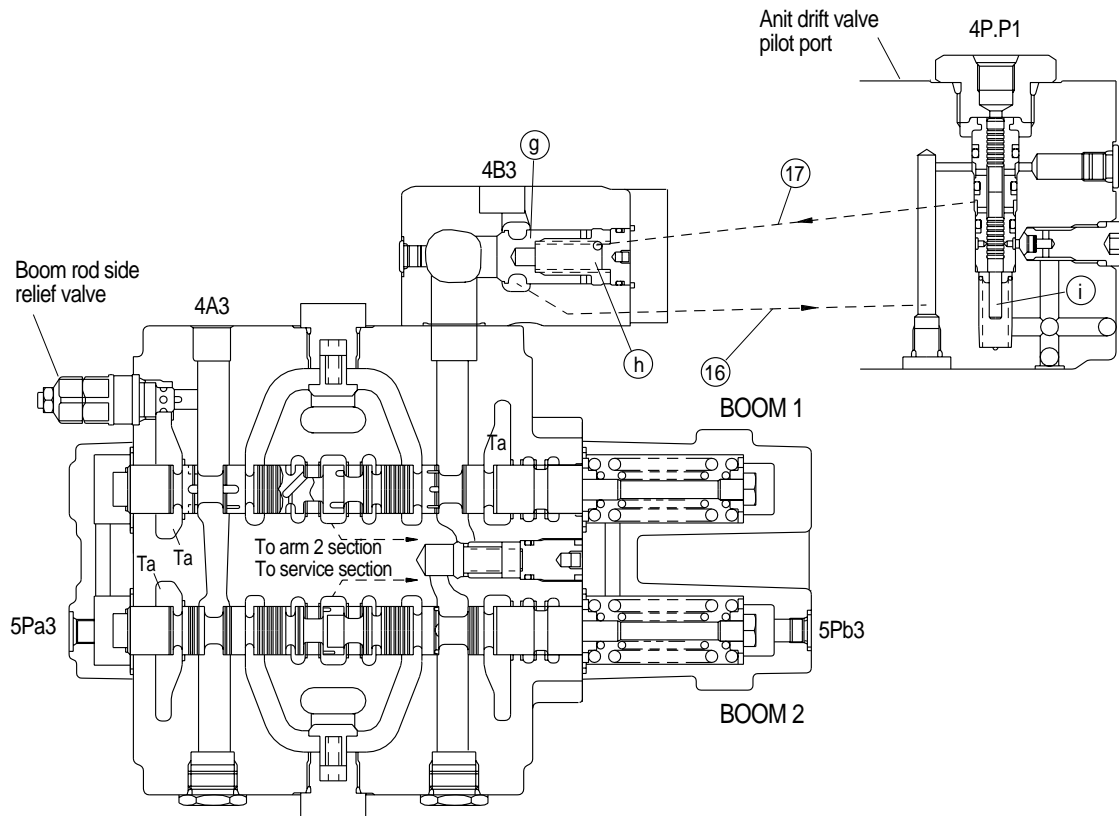


(3) Operation of boom spool

① Neutral

This valve is providing the anti-drift valve on the cylinder bottom side of boom 1 section.

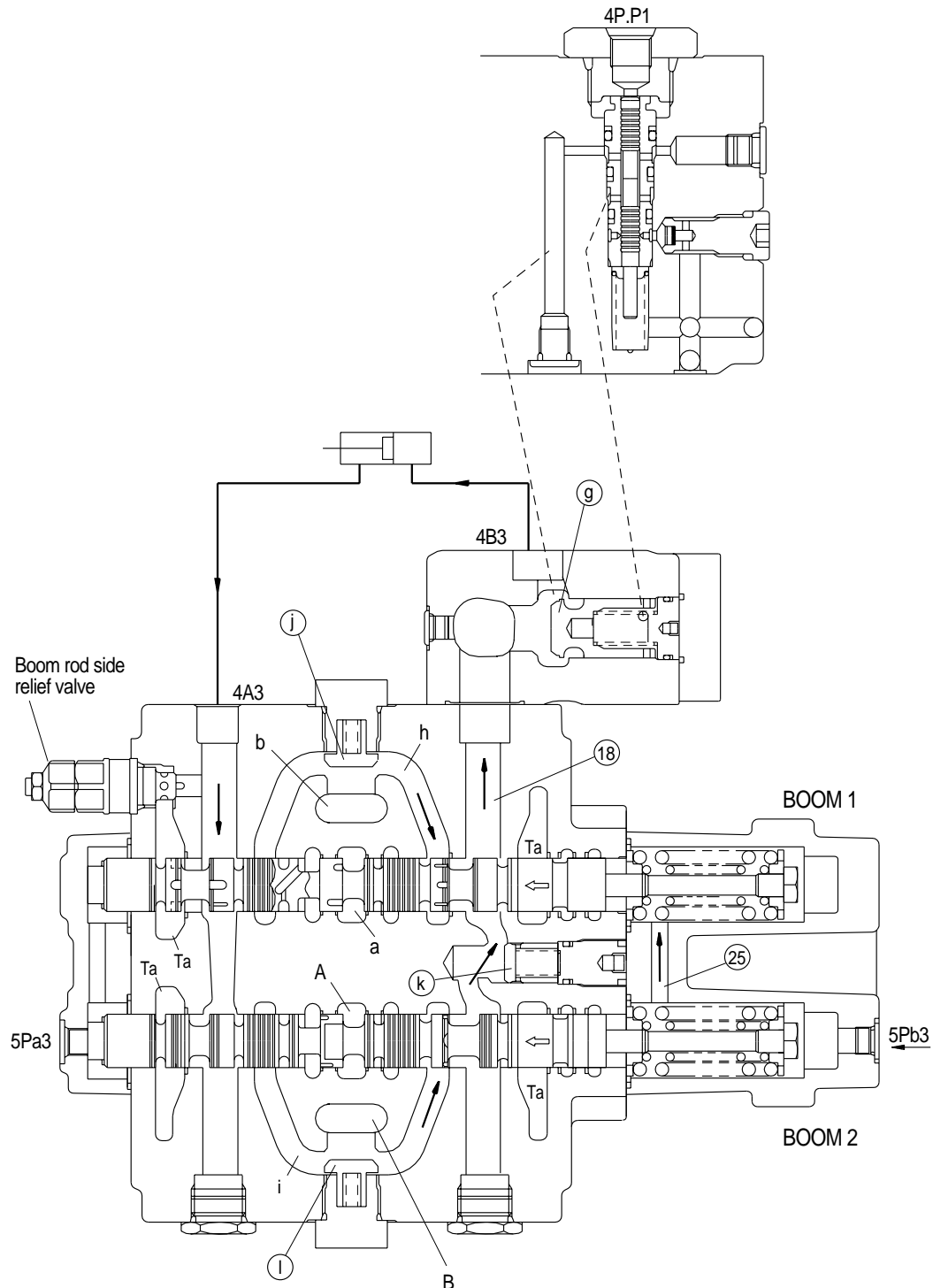
In neutral, the poppet(⑨) is seated by the pressure of spring chamber(⑈) because the oil from the port 4B3 is connection with spring chamber(⑈) via passage(16), spool(①) and passage (17).



② Boom up (flow summation)

When the boom 1 spool is pushed to the left by the pilot pressure of port 5Pb3 via passage(25), the neutral passage(a) is closed, the oil discharged from pump P2 pushes up the load check valve(Ⓣ) via parallel passage(b), passes through passage(h) and pushes open the poppet(Ⓞ) of anti drift valve ; and then flows into cylinder port 4B3. At the same time, the boom 2 spool is pushed to the left, the neutral passage(A) is closed, the oil discharged from pump P1 pushes up the load check valve(Ⓛ) via parallel passage(B), and pushes up the check valve(Ⓚ) via passage (i) ; and then joins to the passage(18).

The return oil from cylinder port(4A3) flows into the tank via the low pressure passage(Ta).



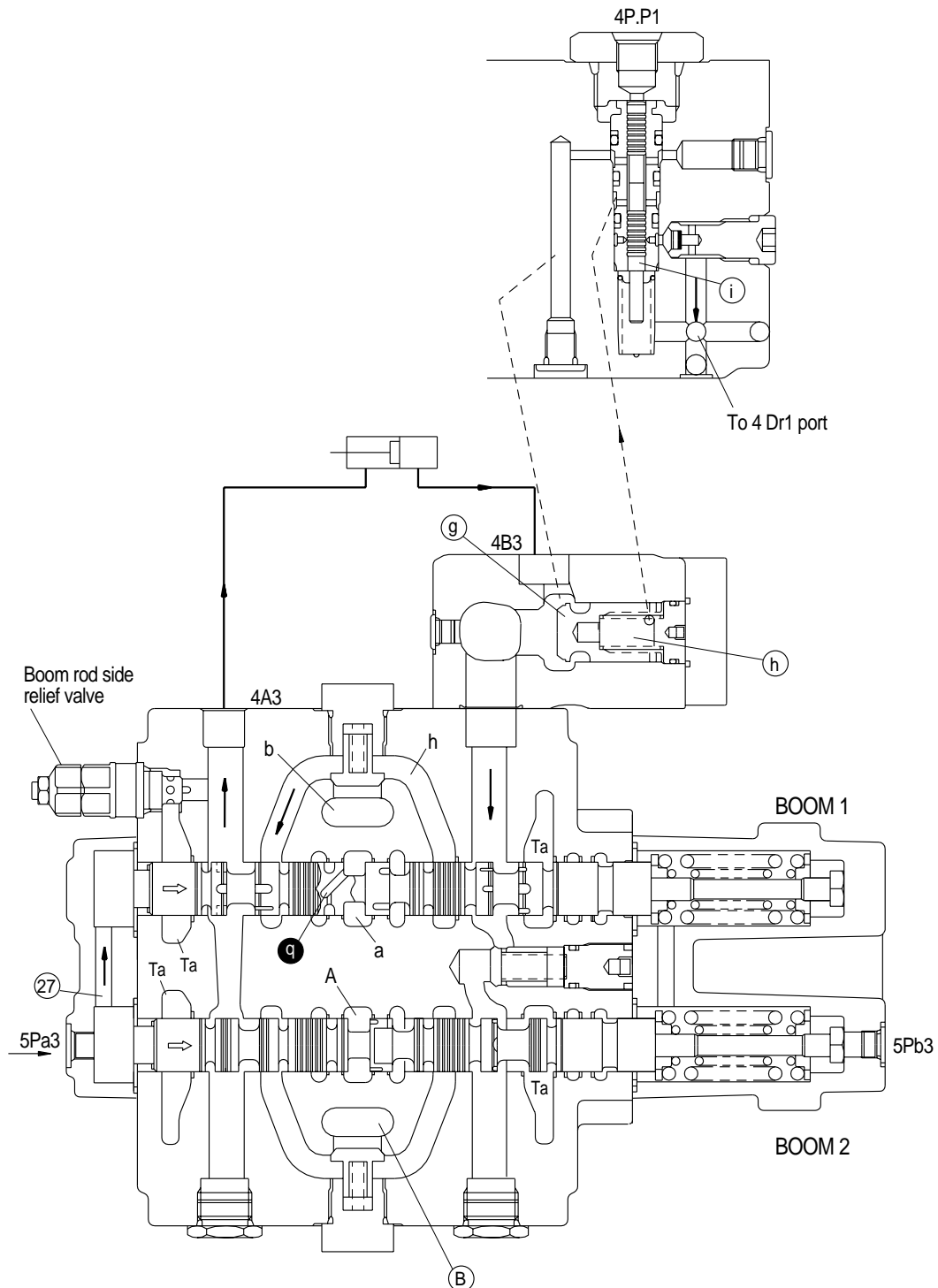
③ Boom down

When the boom 1 spool is pushed to the right by the pilot pressure of port 5Pa3, the neutral passage(a) flows into partly downward via drilled passage(㉑); this controls the speed.

The oil discharged from pump P2 pushes up the load check valve(㉒) via parallel passage(b) and flows into cylinder port 4A3.

At the same time, the spool(㉓) of anti-drift valve pushes down because pilot pressure port 5Pa connected with port 4P. P1.

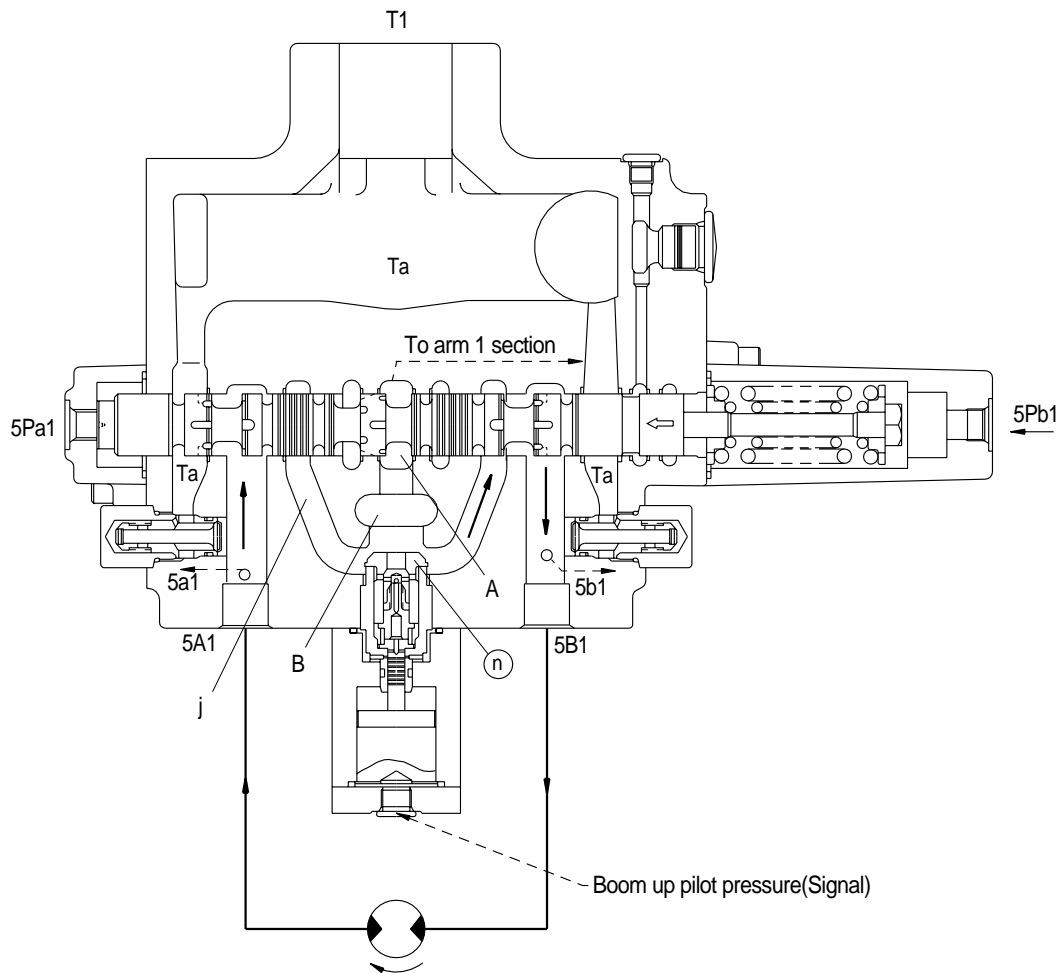
Which release the pressure of spring chamber(㉔), the poppet(㉕) is opened; and then the oil from cylinder port 4B3 returns to the tank via the low pressure passage(Ta).



(4) Operation of swing spool

When the swing spool is pushed to the left by the pilot pressure of port 5Pb1, the neutral passage (A) is closed, the oil discharged from pump P1 pushes up the load check valve(Ⓝ) via parallel passage(B), passes through passage(j) and then flows into cylinder port(5B1).

The oil from cylinder port 5A1 returns to the tank via the low pressure passage(Ta).



(5) Operation of arm spool

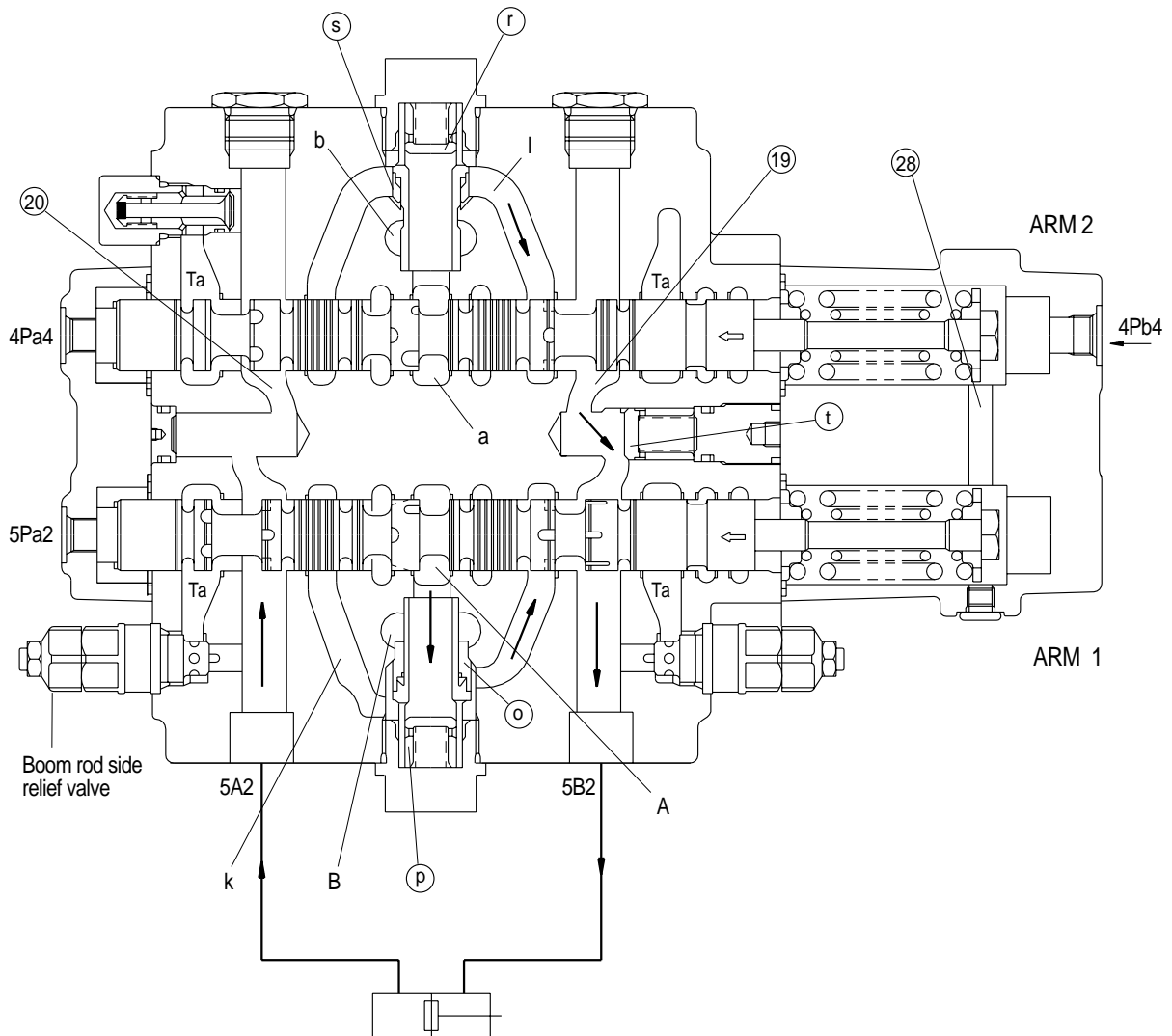
① Arm out (flow summation)

When the arm spool 1 is pushed to the left by pilot pressure of port 4Pb4 via passage(28), the neutral passage(A) is closed, the oil discharged from pump P1 pushes up parallel check valve(ⓐ) through parallel passage(B) and pushes open the tandem check valve(Ⓟ) through neutral passage(A); and then oil flows into cylinder port 5B2 via passage(K).

At the same time, the arm 2 spool is pushed to the left, the neutral passage(A) is closed, the oil discharged from pump P2 pushes up the tandem check valve(Ⓡ) through neutral passage(a) and the parallel check valve(Ⓢ) through parallel passage(b).

The oil passes through passage(l) and passage(19), pushes up the check valve(Ⓣ) and then joins to the flows from pump P1.

The oil from cylinder port 5A2 returns to the tank via the low pressure passage(Ta).

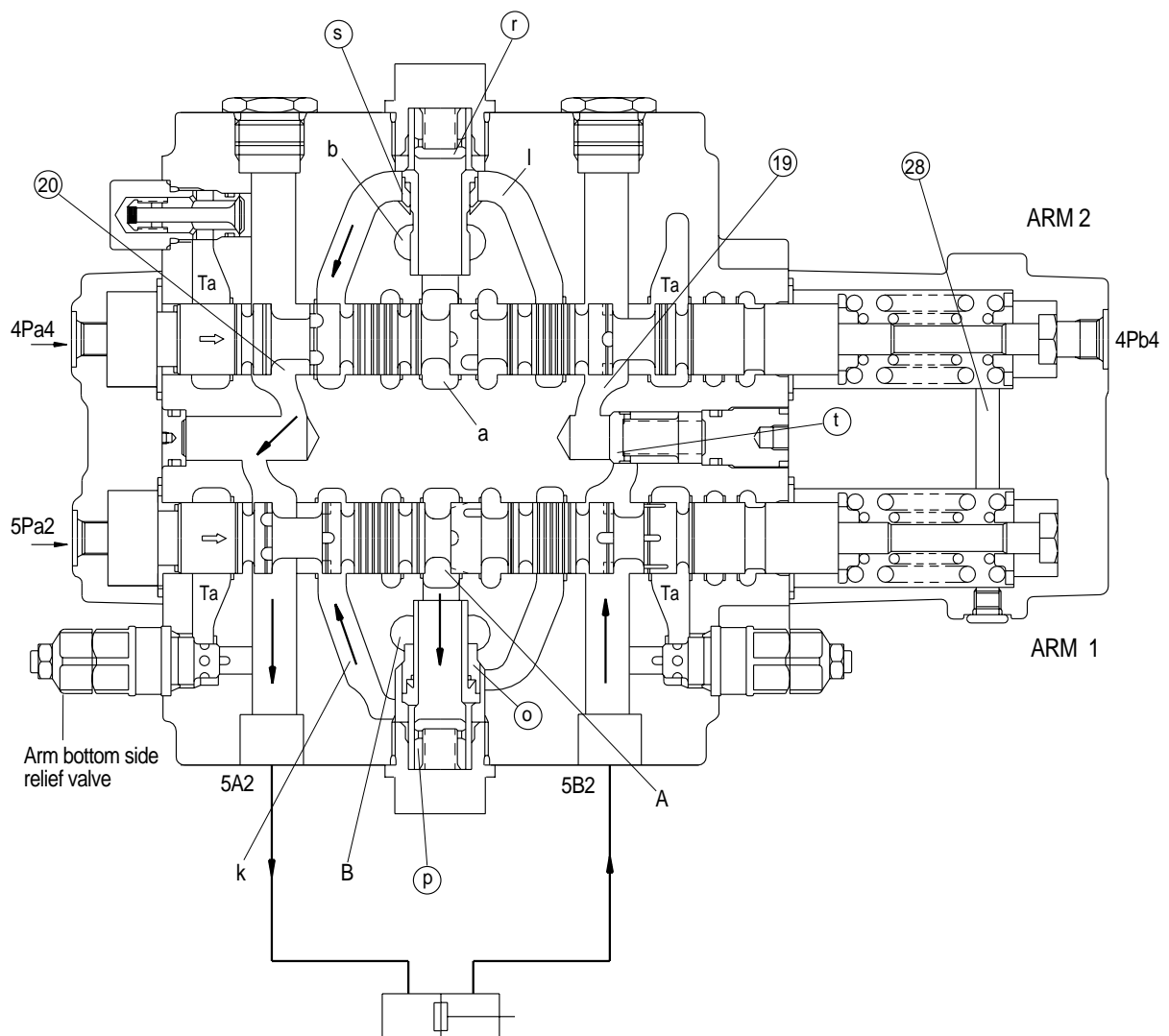


② **Arm in (flow summation)**

When the arm spool is pushed to the right by pilot pressure of port 5Pa2, the neutral passage (A) is closed, the oil discharged from pump P1, pushes up parallel check valve(⊙) through parallel passage(B) and tandem check valve(⊖) through neutral passage(A); and then oil flows into cylinder port 5A2 via passage(K).

Also, the port 4Pa4 is connected with the port 5Pa2 the arm 2 spool is pushed to the right simultaneously the arm 1 spool and the neutral passage(a) is closed. The oil discharged from pump P2 pushes up the tandem check valve(⊖) through neutral passage(a) and the parallel check valve(⊙) through parallel passage(b); and then joins to the flows from pump P1.

The oil from cylinder port 5B2 returns to the tank via the low pressure passage(Ta).



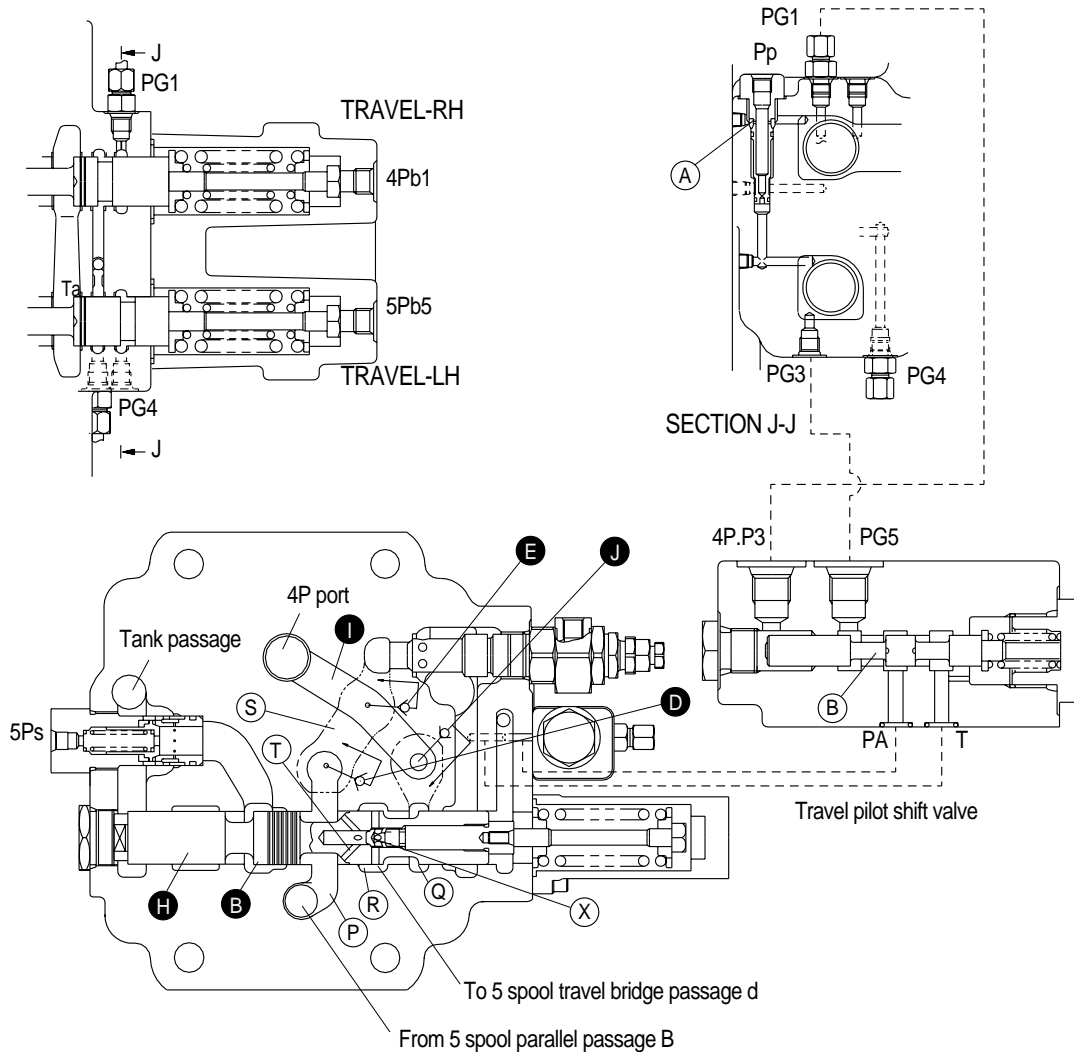
(6) Relief valve, anti-void valve

① Main relief valve

The oil from the pump P1 is flows through 5 spool parallel passage(B), passage(Ⓟ) of side body assembly and check valve(ⓓ) to the main relief valves entrance.

The oil from the pump P2 is flows through passage(Ⓛ) and check valve(ⓔ) to the relief valves entrance.

This main relief valve keeps the setting pressure of pump P1 and P2.



② Over load relief valve

Over load relief valves are provided each cylinder ports of boom 1, arm 1 and bucket.

These prevents the abnormal high pressure of actuators by external force.

Also, over load relief valves setting pressure is lower than main relief valve, controls the high pressure of pump P1 and P2.

When the pressure of cylinder ports create back pressure, this valve opens allowing oil from tank to cylinder port; and then prevents cavitation.

③ Anti-void valve

Anti-void valves are provided both cylinder ports of arm and swing.

When the pressure of cylinder ports lower than that of tank passage, oil of tank passage flows into cylinder ports; and then prevents cavitation.

3) COMBINED OPERATION

(1) Travel combined operation

When travel(forward, reverse and spin turn) and front attachment(except travel section) functions are operated, the oil of port Pp flows into port 4 P.P3 of straight travel pilot operation valve through port PG1 and then the spool(ⓑ) is pushed to the right.

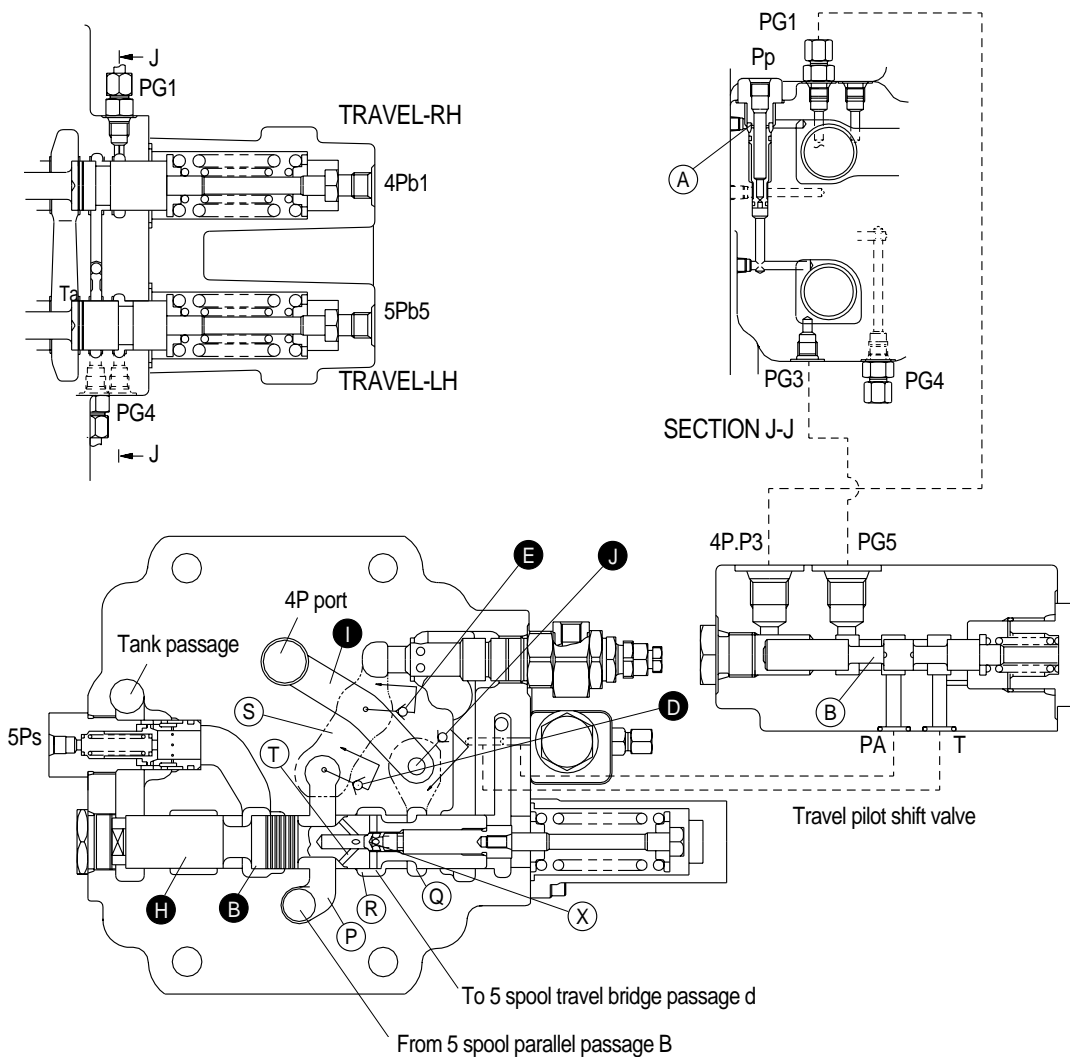
Also the oil of port Pp flows into spring chamber of straight travel spool(ⓑ) via ports PG3, PG5 and PA.

According to the above operation the spool(ⓑ) is pushed to the left by the raise of spring chamber pressure; and then the oil discharged from pump P2 is flows into travel line of 4 spool side. Also, the oil flows through passage(ⓐ), passage(ⓑ) by pushes opens poppet(ⓓ) and passage(ⓓ) to passage(d) of 5 spools side travel line. This keeps the straight travel.

Meanwhile, the oil discharged from pump P1 is flows into operated section of actuator within 5 spools side(from swing to service).

Also, the oil flows through partly parallel passage(B) of 5 spool side, passage(ⓑ) of side body assembly, orifice(ⓓ) of straight travel spool, and passage(ⓓ) to bridge passage(d) of 5 spools travel line.

This orifice(ⓓ) maintains the operating pressure actuators except travelling and reduce the shock of travel speed reduction.

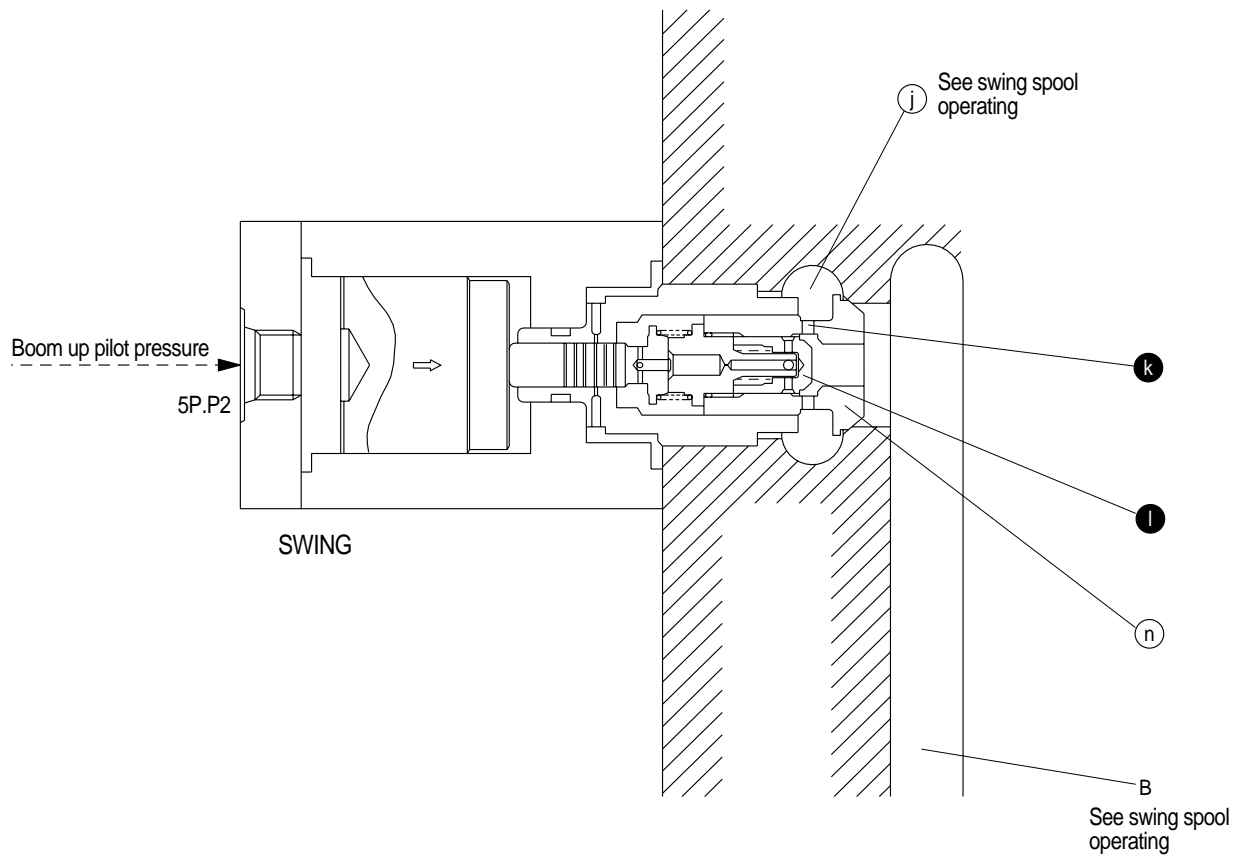


(2) Priority circuit

① Boom priority circuit (option)

When swing and boom up functions are operated, the poppet(n) is seated by pressure of port 5P.P2 and the only poppet(l) opened; and then oil flows easily to the boom section because of the orifice(k).

As a result, boom and swing simultaneous operation is ensured even if lower load of swing section.



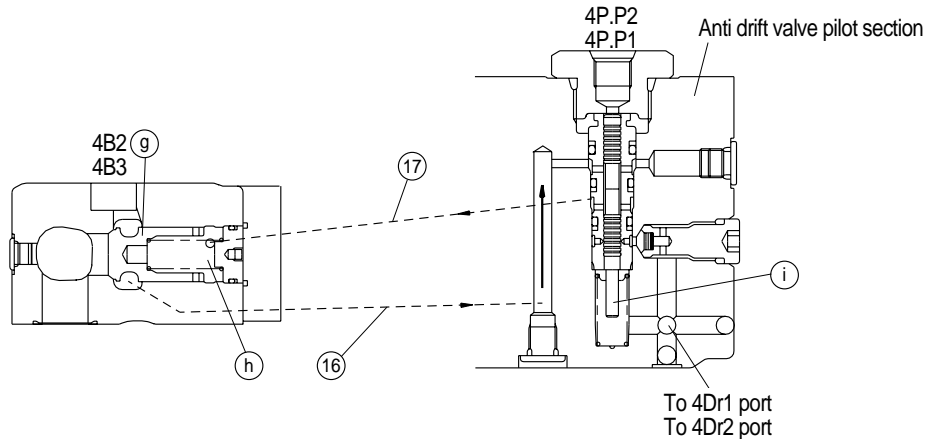
(3) Anti-drift valve(boom and bucket section)

Anti-drift valve is provided the boom and bucket bottom side of cylinder port for prevention of self drifting by boom weight or bucket loads.

① When neutral

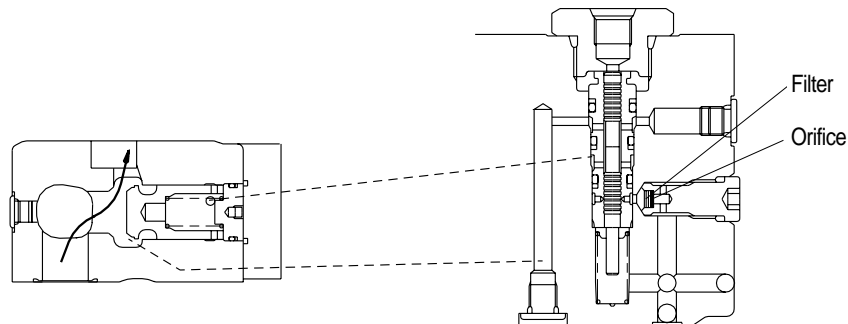
The oil from cylinder port flows into spring chamber(Ⓜ) via passage(16) and(17).

Because of the difference of poppet area and spring force, the poppet(Ⓞ) is seated.



② When boom up or bucket in

The oil from pump flows into cylinder by pushes open the poppet(Ⓞ).

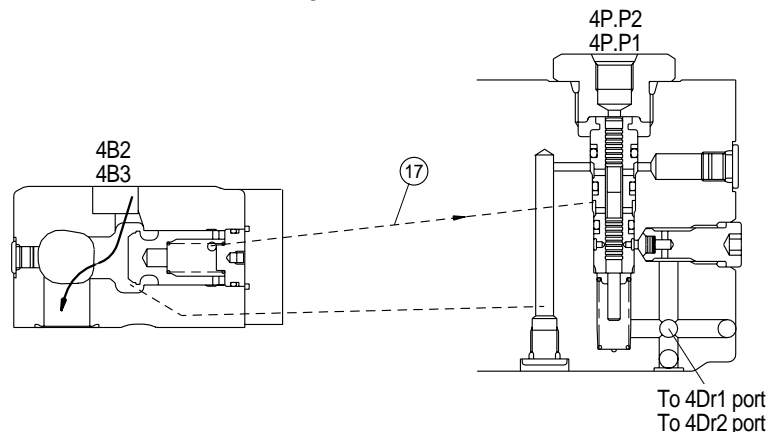


③ When boom down or bucket out

The spool(Ⓜ) is pushed down by the pressure of 4P.P1 or 4P.P2. Then the oil of spring chamber(Ⓜ) flows into drain port 4Dr1 or 4Dr2 and pushes open poppet(Ⓞ).

As a result, the oil from cylinder port returns to tank through the boom 1 spool or bucket spool.

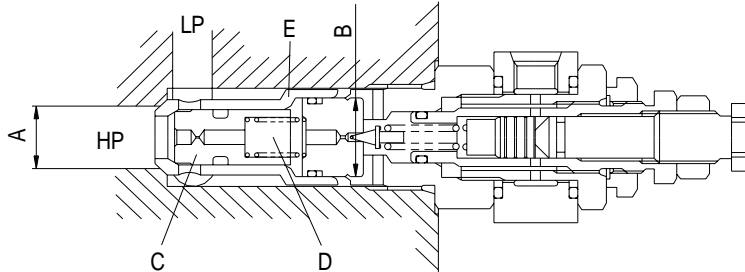
Also, filter and orifice are provided between spool(Ⓜ) and drain port 4Dr1 or 4Dr2. The orifice release the shock of machine starting.



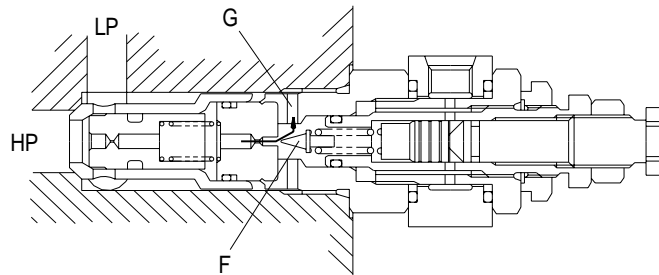
4) RELIEF VALVE OPERATION

(1) Main relief valve

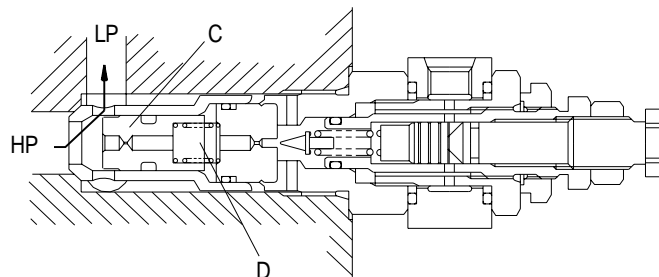
- ① This relief valve is built-in between the neutral passage(HP) and low pressure passage(LP), and the pressure oil fills up chamber(D) inside via orifice of main poppet(C).
Thus the sleeve(E) and the main poppet(C) are securely seated by difference area of A and B.



- ② When the pressure in neutral passage(HP) reaches the setting force of spring, pilot poppet(F) is opened.
The oil flows around poppet and into the low pressure passage(LP) via hole(G).

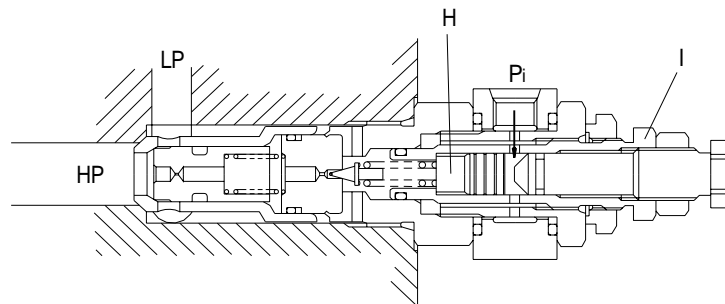


- ③ When above flow is formed, the pilot poppet is opened; the pressure of chamber(D) drops, the main poppet(C) is opened and then the oil directly flows into the low pressure passage(LP).



- ④ High pressure setting pilot signal(Pi) : ON

The piston(H) moves to left by pilot pressure(Pi); set pressure of spring rises, making high pressure setting.

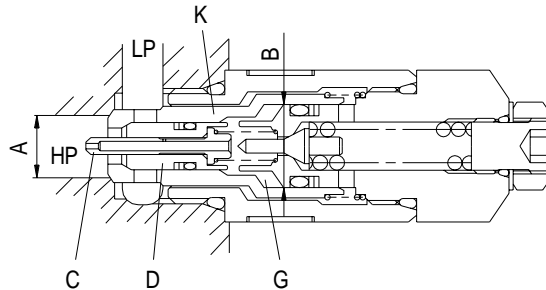


(2) Overload relief valve

① Overload working operation

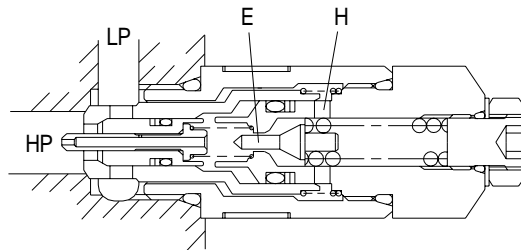
- This relief valve is built-in the cylinder port(HP) and the low pressure(LP), and the pressure oil fills up chamber(G) inside via hole of piston(C).

Thus the sleeve(K) and the main poppet(D) are securely seated by difference area of A and B.



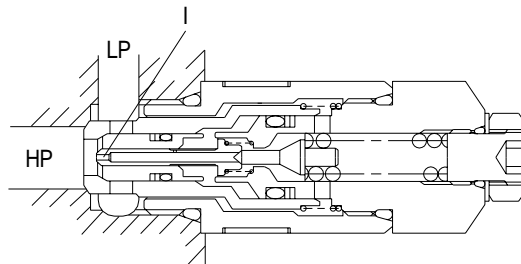
- When the pressure in cylinder port(HP) reaches the setting force of spring, the pilot poppet(E) is opened.

The oil flows around poppet and into the low pressure passage(LP) via hole(H).



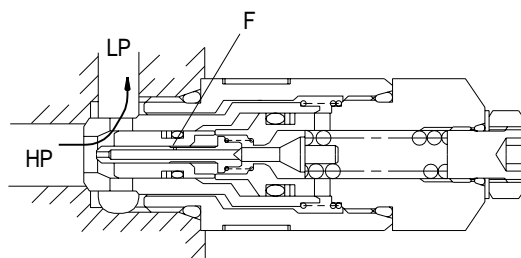
- When above flow is formed, the pilot poppet(E) is opened.

The pressure drops before and behind orifice(I); piston(C) moves to right and the piston(C) is seated at the tip of poppet(E).



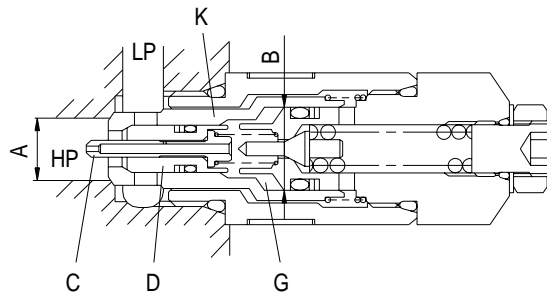
- The oil flow from the high pressure passage(HP) to the poppet(D) behind is only around poppet and orifice(F); then the high pressure passage(HP) is higher than the poppet(D) behind pressure.

Thus the poppet(D) is pushed open and the oil directly flows into low pressure passage(LP).

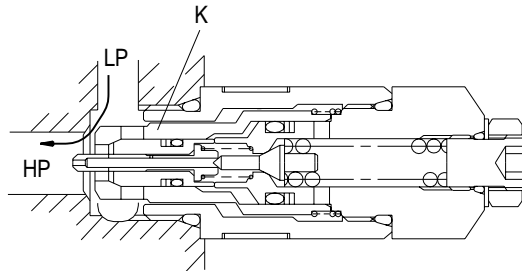


② Make up operation

- This relief valve is built-in the cylinder port(HP) and the low pressure passage(LP), and the pressure oil fills up chamber(G) inside via hole of piston(C).
Thus the sleeve(K) and the main poppet(D) are securely seated by difference area of A and B.

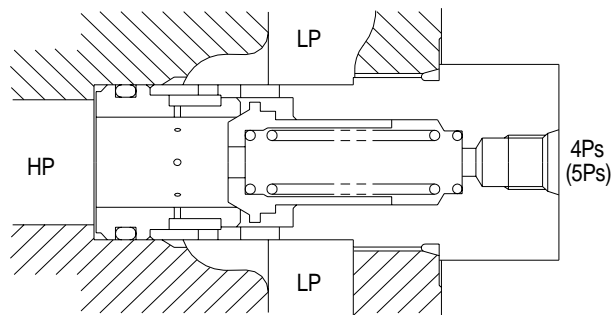


- When the cylinder port pressure(HP) drops(closer to negative pressure) until the cylinder port pressure is lower than the low pressure passage(LP), the sleeve(K) opens by difference area of A and B.
Then the low pressure passage oil flows into cylinder port(HP) in order to prevent cavitation.



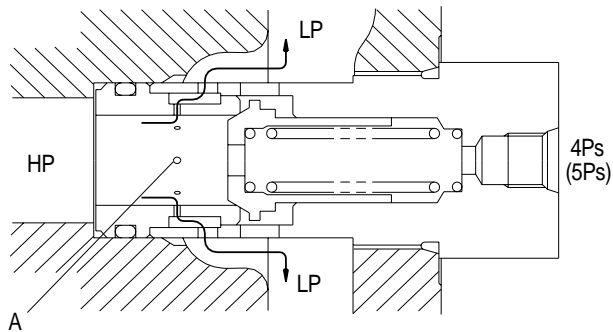
(3) Low pressure relief valve

① When pump does not operational



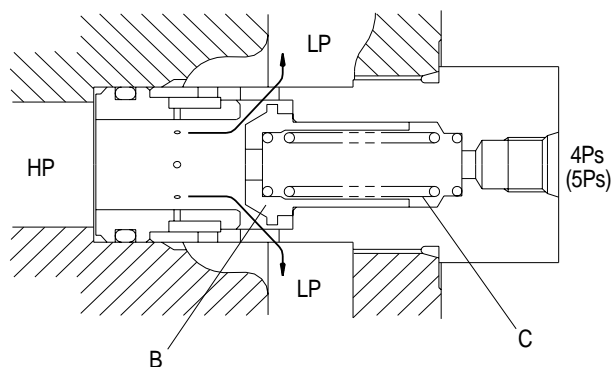
② When spool neutral

The neutral passage(HP) oil flows into the low pressure passage(LP) via signal orifice(S).
The signal port 4Ps(5Ps) pressure is raise by negative control orifice(A).



③ Operation of low pressure relief

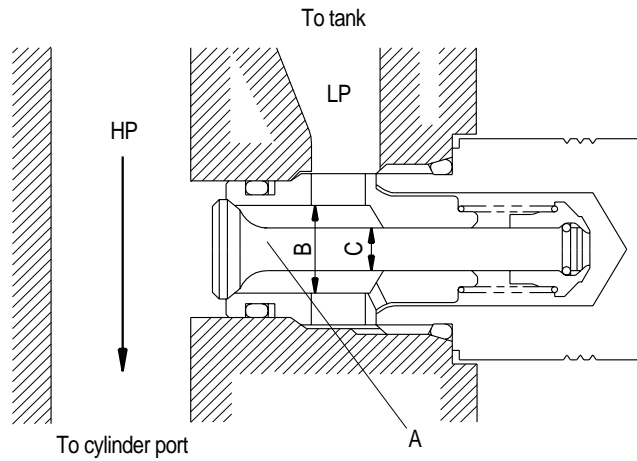
When the oil pressure neutral passage(HP) reaches the setting force of spring, the poppet is pushes open; the oil directly flows through passage(HP) to passage(LP) in order to prevent abnormal pressure.



(4) Anti-void valve

① Normal

The cylinder port pressure(HP) is higher than the tank passage pressure(LP), the poppet(A) is securely seated by difference area of B and C, and spring force.



② Make up operation

When the cylinder port pressure(HP) drops to the negative pressure, the tank pressure(LP) is applied the around area of B-C and overcomes spring force; the poppet(A) pushes open. Thus the oil of tank flows into cylinder port in order to prevent cavitation.

