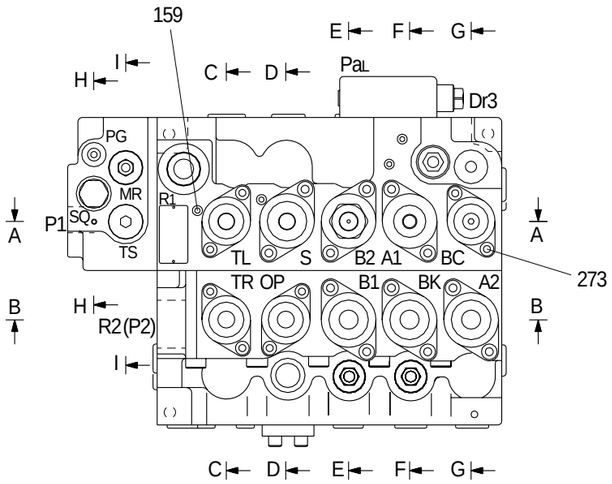
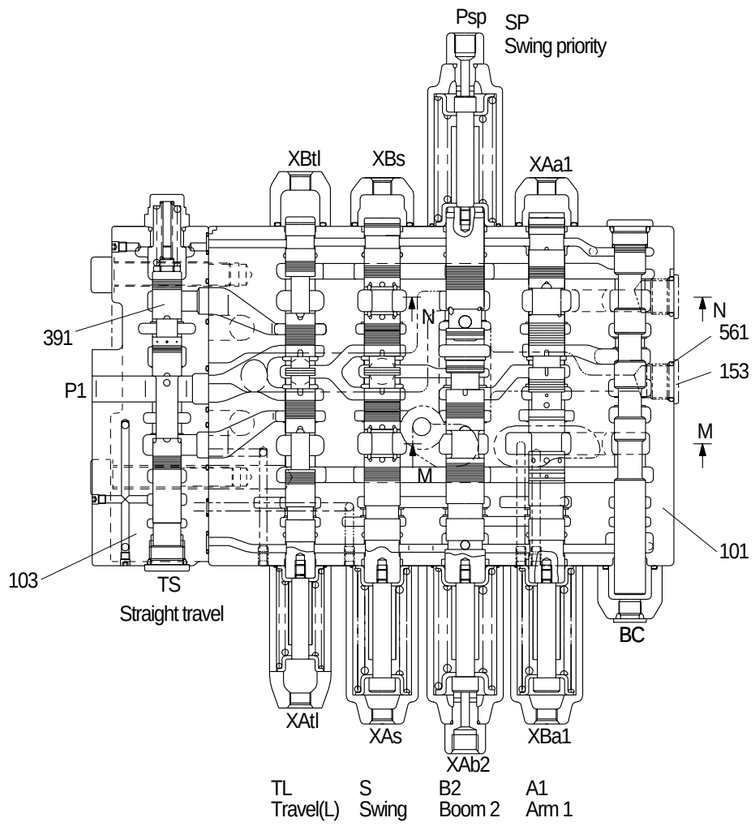
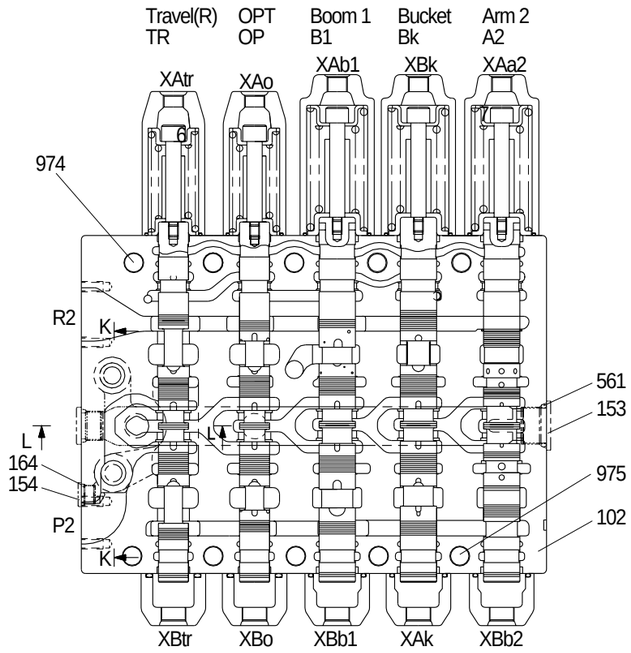
1. STRUCTURE

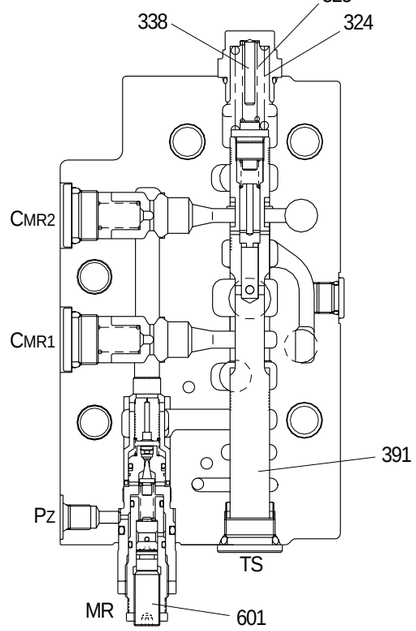




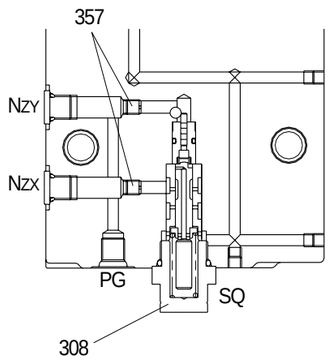
SECTION A-A



SECTION B-B



SECTION I-I



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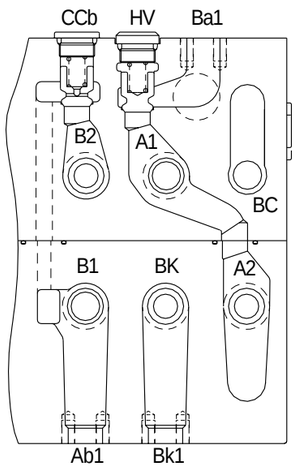
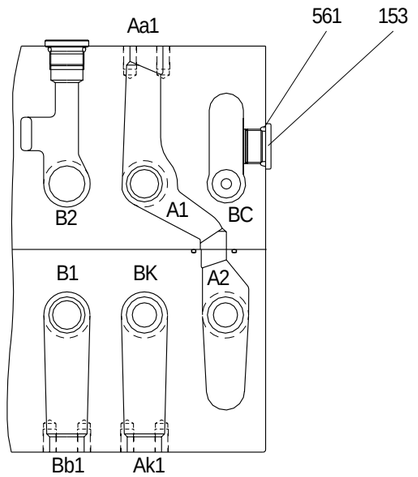
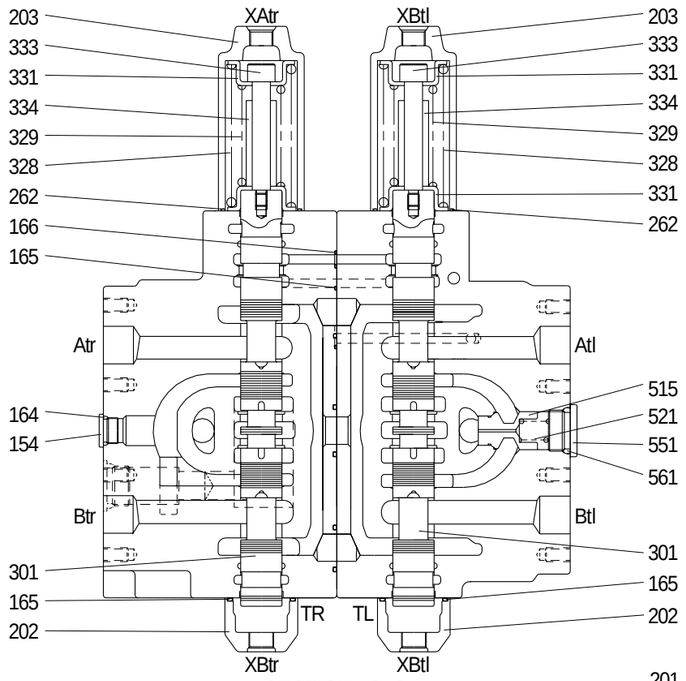


SECTION M-M

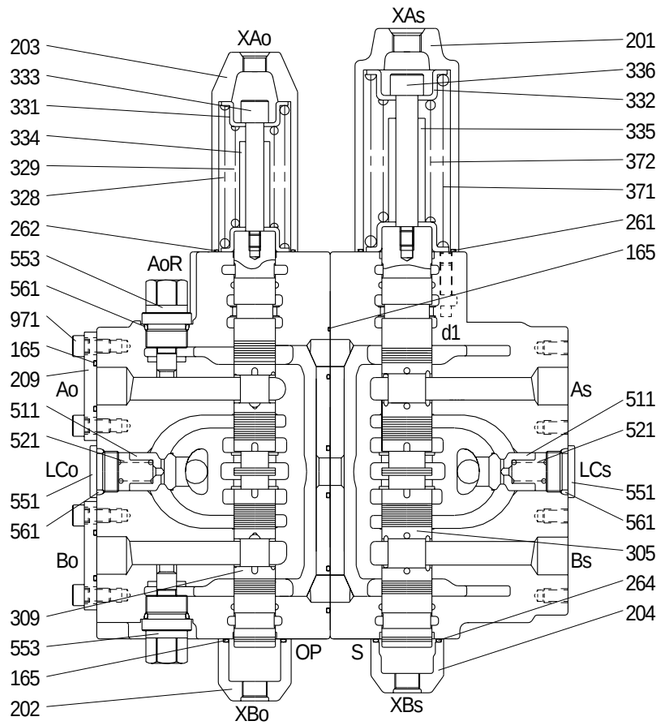


SECTION N-N

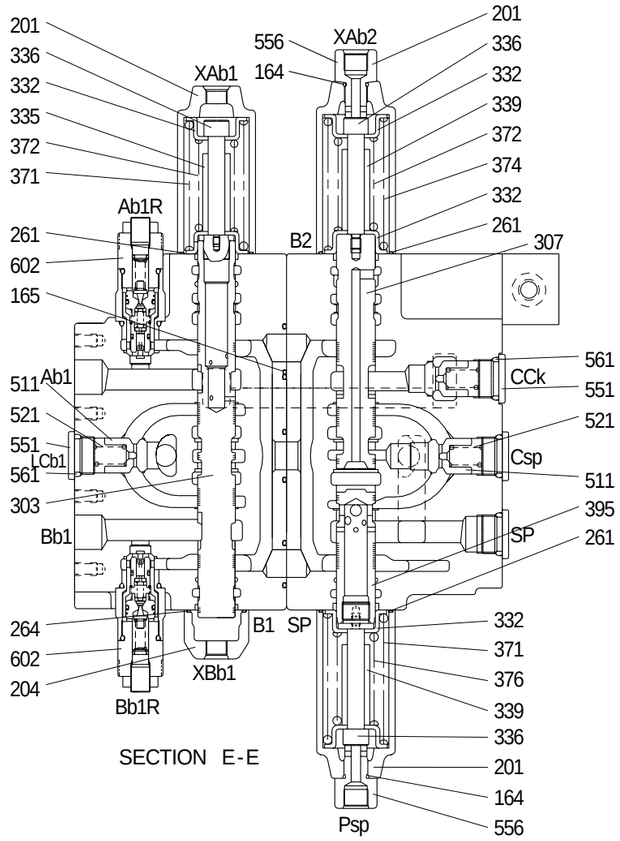
STRUCTURE



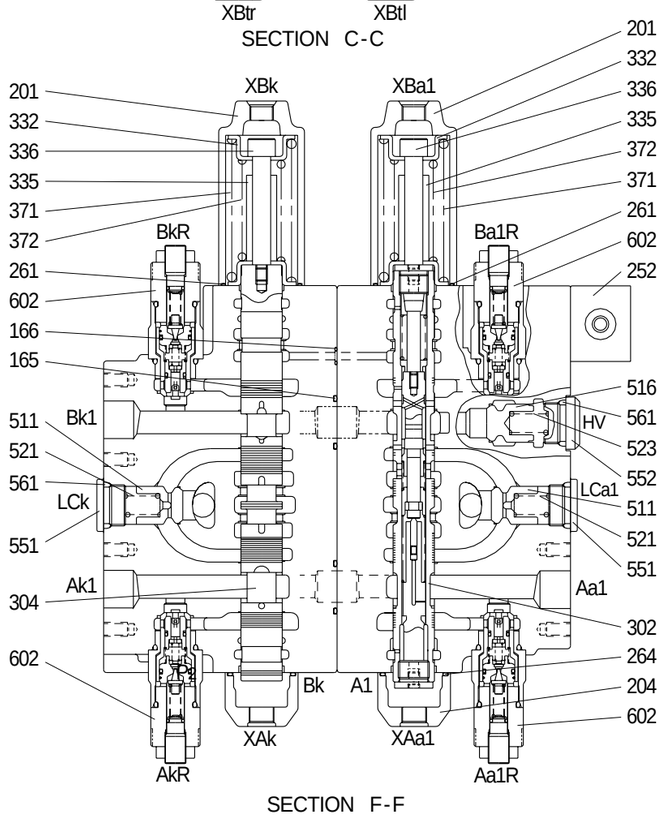
SECTION C-C



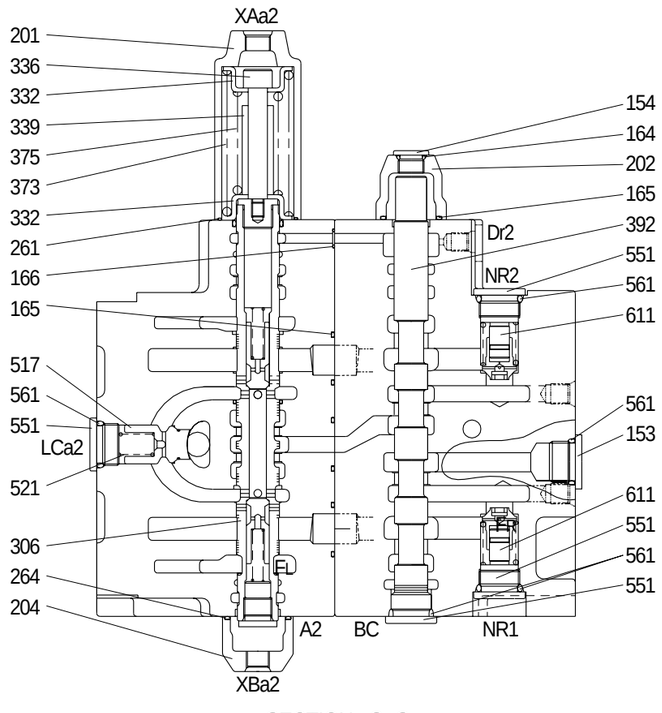
SECTION D-D



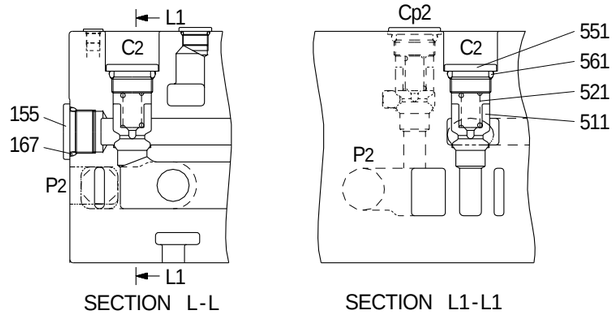
SECTION E-E



SECTION F-F

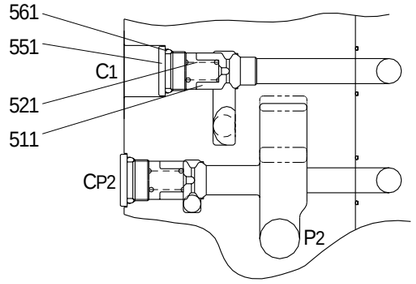


SECTION G-G



SECTION L-L

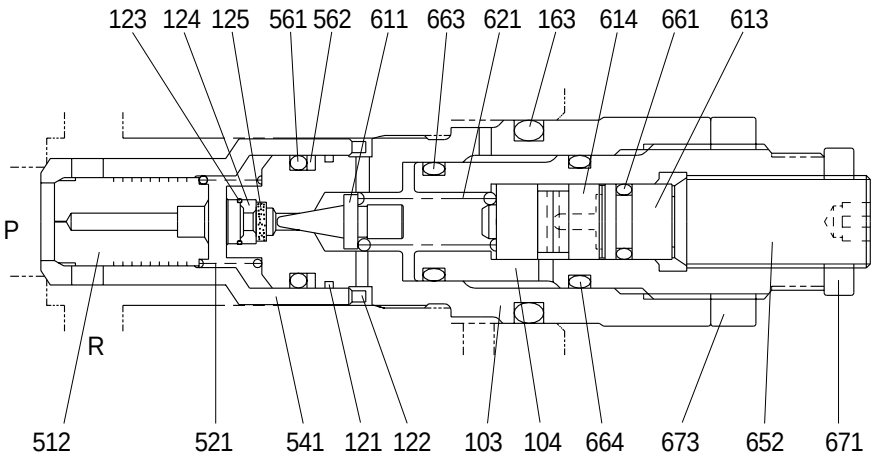
SECTION L1-L1



SECTION K-K

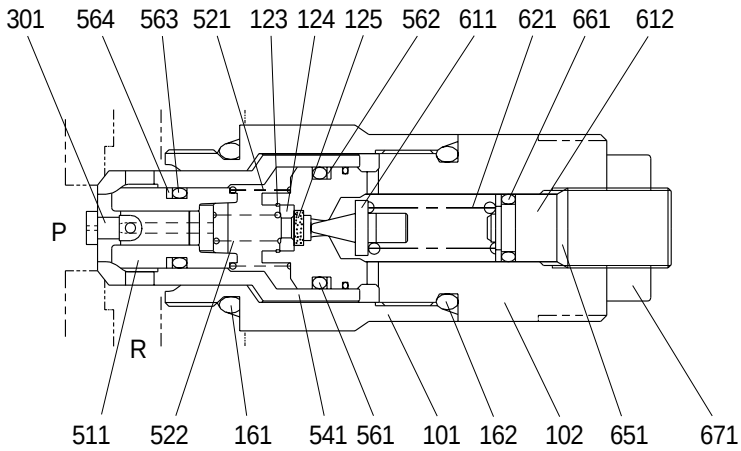
101	Casing A	303	Boom 1 spool	374	Spring
102	Casing B	304	Bucket spool	375	Spring
103	Staight travel valve block	305	Swing spool	376	Spring
153	Plug	306	Arm 2 spool assy	391	Staight travel spool assy
154	Plug	307	Boom 2 spool	392	Rod
155	Plug	308	Arm confluence seq assy	395	Swing priority spool
159	Plug	309	Option spool	511	Poppet
164	O-ring	324	Spring	515	Poppet
165	O-ring	325	Spring	516	Poppet
166	O-ring	328	Spring	517	Poppet
167	O-ring	329	Spring	521	Spring
201	Spring cover	331	Spring seat	523	Spring
202	Spool cover	332	Spring seat	551	Plug
203	Spring cover	333	Spacer bolt	552	Plug
204	Spool cover	334	Stopper	553	Plug
209	Flange	335	Stopper	556	Plug
252	Lock valve assy	336	Spacer bolt	561	O-ring
261	O-ring	338	Stopper	601	Main relief valve assy
262	O-ring	339	Stopper	602	Port relief valve assy
264	O-ring	357	Orifice	611	Nega control relief valve assy
273	Hexagon socket screw	371	Spring	971	Hexagon socket screw
301	Travel spool	372	Spring	974	Hexagon socket screw
302	Arm 1 spool assy	373	Spring	975	Hexagon socket screw

1) MAIN RELIEF VALVE



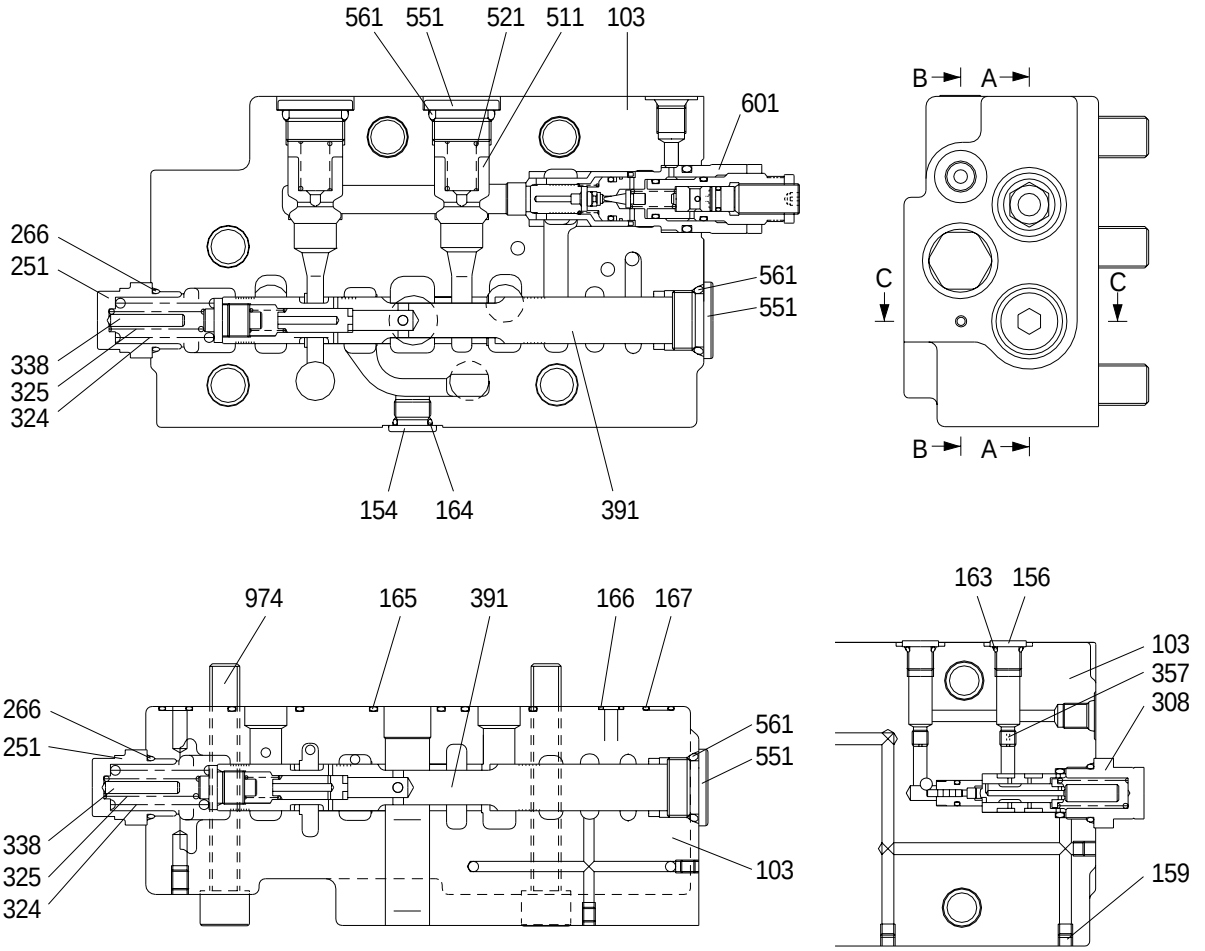
103	Plug	512	Plunger	621	Spring
104	Adjusting plug	521	Spring	652	Adjusting screw
121	O-ring	541	Seat	661	O-ring
122	Spacer	561	O-ring	663	O-ring
123	O-ring	562	Back up ring	664	O-ring
124	Filter stopper	611	Poppet	671	Lock nut
125	Filter	613	Stopper	673	Lock nut
163	O-ring	614	Piston		

2) PORT RELIEF VALVE



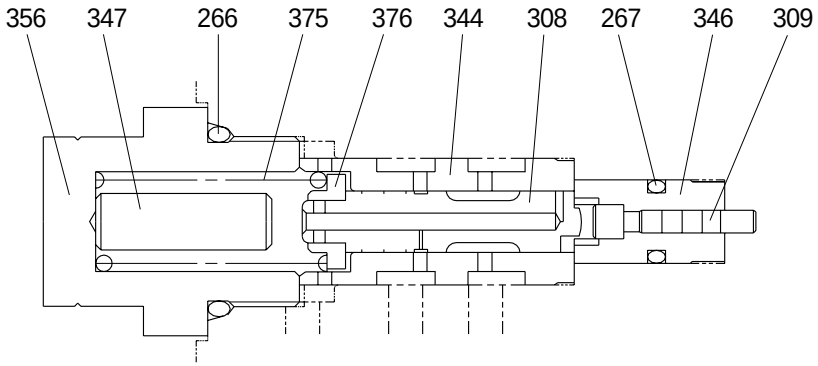
101	Body	511	Plunger	564	Back up ring
102	Plug	521	Spring	611	Poppet
123	O-ring	522	Spring	612	Spring seat
124	Filter stopper	541	Seat	621	Spring
125	Filter	561	O-ring	651	Adjusting screw
161	O-ring	562	Back up ring	661	O-ring
162	O-ring	563	O-ring	671	Lock nut
301	Piston				

3) STRAIGHT TRAVEL VALVE BLOCK



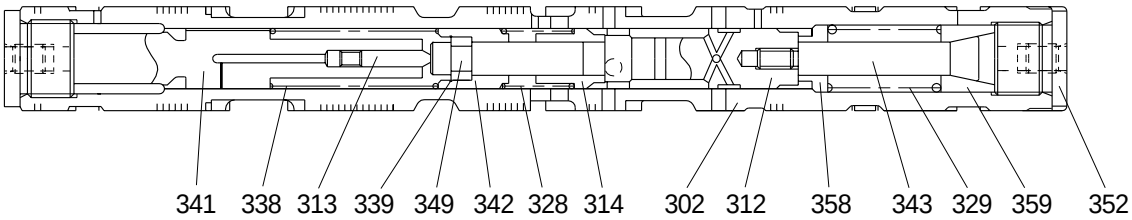
103	Straight travel block	167	O-ring	391	Straight travel spool assy
154	RO plug	251	Plug	511	Poppet
156	RO plug	266	O-ring	521	Spring
159	Plug	308	Sequence sub	551	Plug
163	O-ring	324	Spring	561	O-ring
164	O-ring	325	Spring	601	Main relief valve
165	O-ring	338	Stopper	974	Hexagon socket bolt
166	O-ring	357	Orifice		

· **Sequence sub(308)**



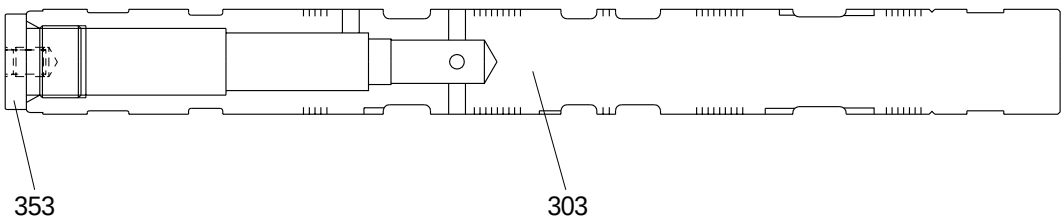
266	O-ring	344	Sleeve	356	Plug
267	O-ring	346	Bushing	375	Spring
308	Spool	347	Stopper	376	Spring seat
309	Piston				

4) ARM SPOOL



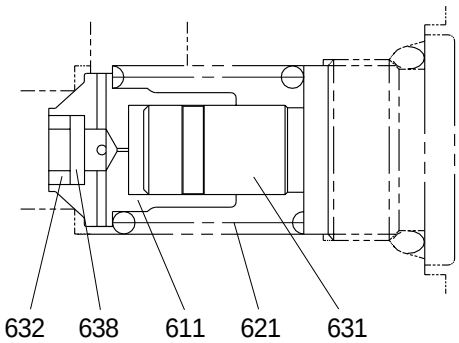
302	Spool	329	Spring A2	343	Spacer bolt
312	Sub spool	338	Spring	349	Stopper 1
313	Piston	339	C-ring	352	Plug
314	Sleeve 2	341	Plug	358	Spring seat
328	Spring A1	342	Sleeve 1	359	Spring seat

5) BOOM SPOOL



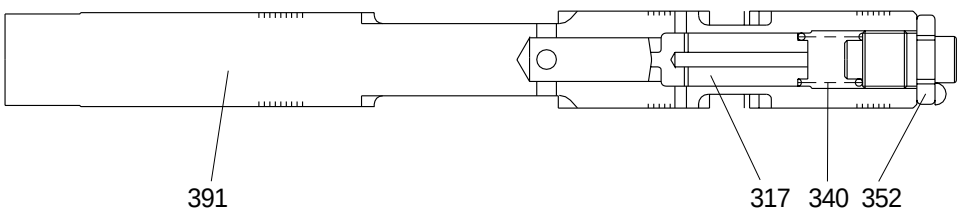
303	Spool	353	Plug

6) NEGATIVE CONTROL RELIEF VALVE



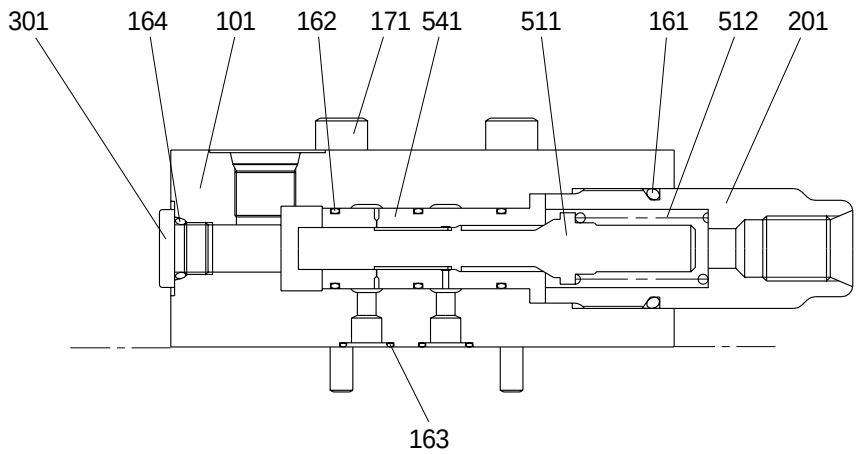
611	Poppet	631	Damping rod	638	Filter
621	Spring	632	Bushing		

7) STRAIGHT TRAVEL SPOOL



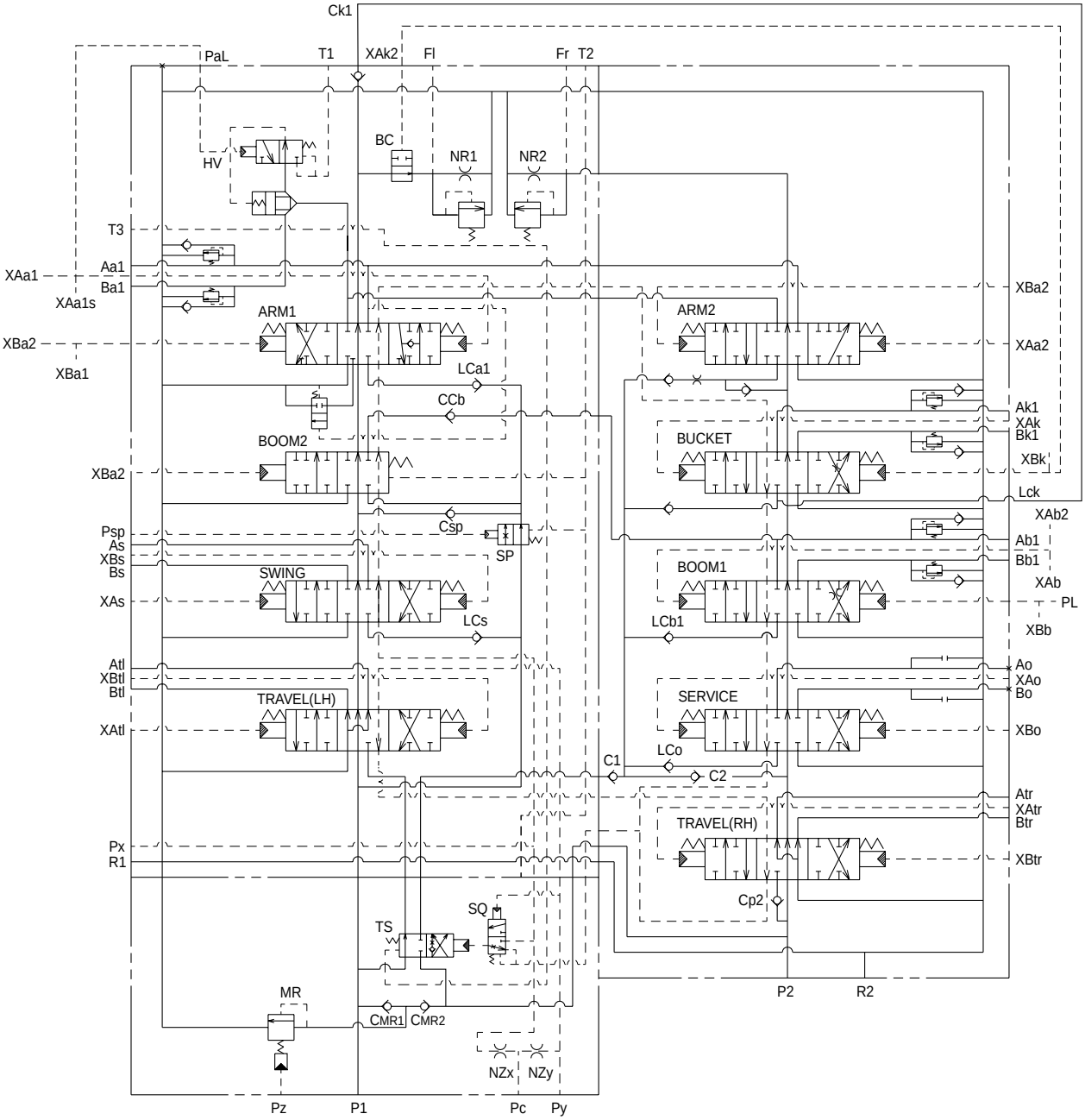
317	Plunger 3	352	Plug	391	Spool
340	Spring				

8) LOCK VALVE ASSEMBLY



101	Casing	164	O-ring	511	Spool
161	O-ring	171	Hexagon socket bolt	512	Spring
162	O-ring	201	Plug	541	Bushing
163	O-ring	301	Plug		

2. HYDRAULIC CIRCUIT



3. OPERATION

1) ALL SPOOL NEUTRAL

(1) Pilot circuit

The servo pressure oil enters through port P_G, passes through the orifice(357) and flows from the side bypass path(4) to the drain(Dr1). Therefore, the pressures at P_X and P_Y do not increase.

(2) Main circuit

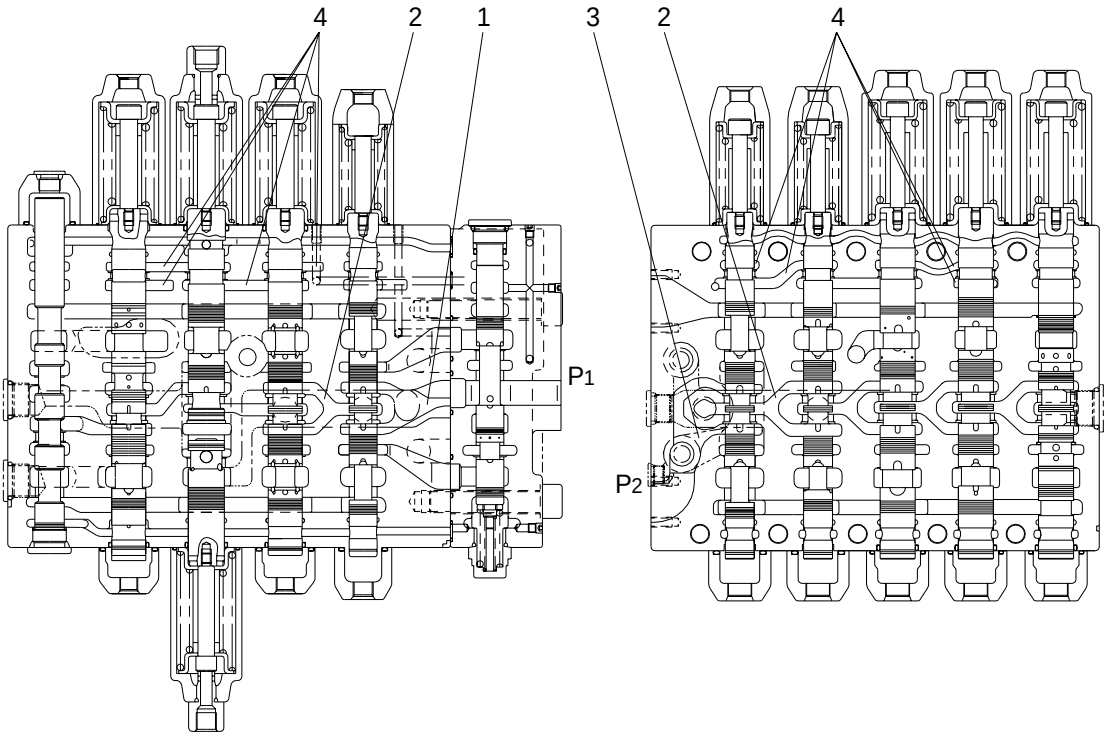
When all spools are in the neutral positions, the pressurized oil discharged from the hydraulic pump(P_1) passes through the main path(1), the bypass circuit(2) passing the spools for travel, swing, boom 2, and arm 1, and the arm 1 side negative control orifice, and returns to the hydraulic oil tank through the tank port(R_2).

The pressure upstream the arm 1 side negative control orifice(The negative control signal pressure) is led from port F_l to the regulator on the hydraulic pump(P_1) side, and controls the pump discharge flow rate to its minimum value.

The oil discharged from the hydraulic pump(P_2) passes through the main path(3), the bypass circuit(2) passing the spools for travel, option, boom 1, bucket, and arm 2 and the boom 1 side negative control orifice, and returns to the hydraulic oil tank through the tank port.

The pressure upstream the boom 1 side negative control orifice(The negative control signal pressure) is led from port F_r to the regulator on the hydraulic pump(P_2) side, and controls the pump discharge flow rate to its minimum value.

When any of nine main spools is changed over, the bypass circuit(2) is cut off and the hydraulic oil at port F_l or F_r in the negative control circuit is shut off.



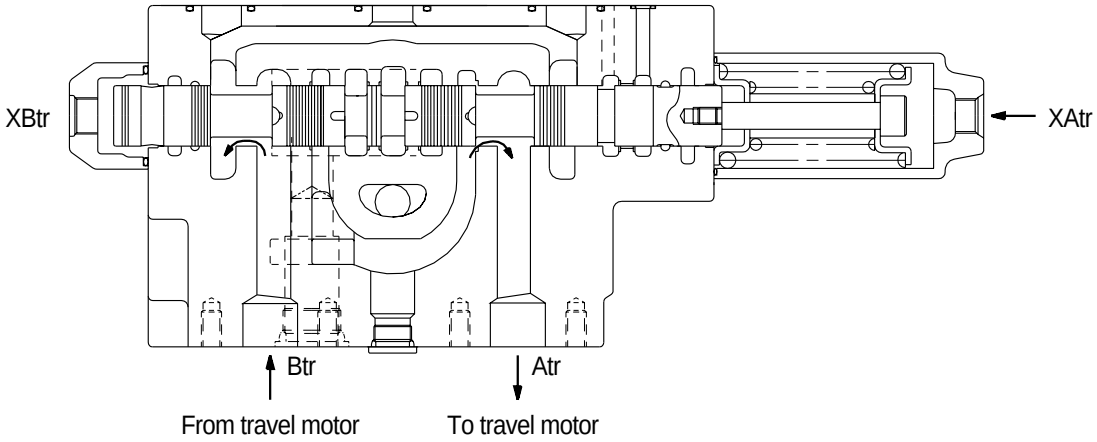
2) OPERATION OF TRAVEL SPOOL

(1) Pilot circuit

Since the travel spool(301) transfers and shuts off the side bypass path, the pressure at port P_Y increases.

(2) Main circuit

When pilot port XA_{tr} of the right travel spool is pressurized, the bypass circuit(2) in the boom 1 side is shut off and pressurized oil from port P_2 passes through port Atr and flows to the right travel motor. On the other hand the return oil from the travel motor passes through port B_{tr} and returns to the hydraulic oil tank through the tank port(R_2).



3) OPERATION OF ARM SPOOL

(1) Arm out

① **Pilot circuit**

Since the arm 1 spool(302) transfers and shuts off the side bypass path, the pressure at port P_X increases.

② **Main circuit**

During the arm out operation, the pilot pressure enters through ports XB_{a1} and XB_{a2}.

When the pressure enters through port XB_{a1}, the spool transfers in the left direction as shown in the figure.

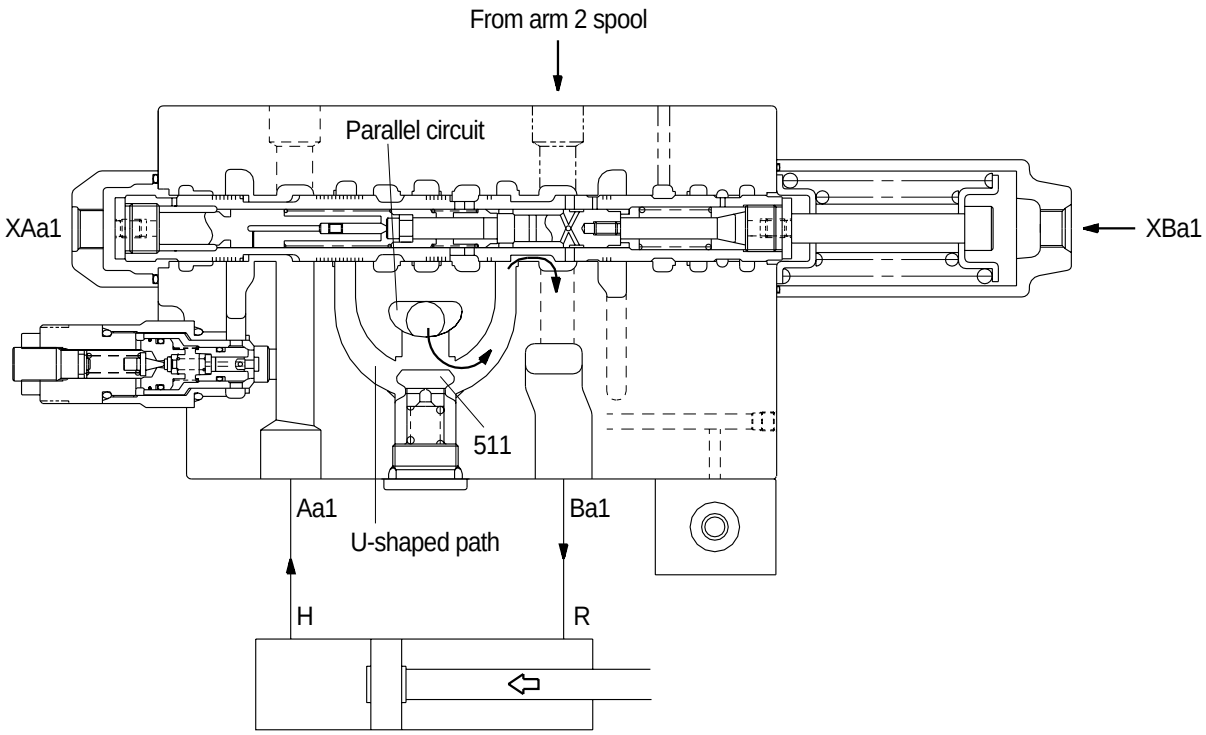
The hydraulic oil entering through port P_1 passes through the main path(1) and flows to the bypass circuit(2), but the bypass circuit is shut off due to transfer of the arm 1 spool.

Therefore, the hydraulic oil pushes open the check valve(511) from the parallel circuit and flows through the U-shaped path to the arm spool(302). Then, it flows around the periphery of the arm spool(302) to port B_{a1}, and is supplied to the arm cylinder rod side(R).

On the other hand, the oil entering through port P_2 passes in the main path(3), and flows into the bypass circuit(2), but the bypass circuit is shut off due to transfer of the arm 2 spool(306).

Therefore, the oil pushes open the check valve from the parallel circuit and flows through the U-shaped path to the arm spool(306). Then, it flows around the arm 2 spool in the inside path and joins into port B_{a1}.

Besides, the return oil from the arm cylinder head side(H) passes through port A_{a1} and returns the hydraulic oil tank through the tank port(R2).



(2) Arm in

① **Pilot circuit**

Since the arm 1 spool(302) transfers and shuts off the side bypass path, the pressure at port P_X increases. Then, the pressure enters also through port P_{aL} and the release signal is sent to the lock valve.

② **Main circuit**

During the arm in operation, the pilot pressure enters through ports XA_{a1} and XA_{a2}.

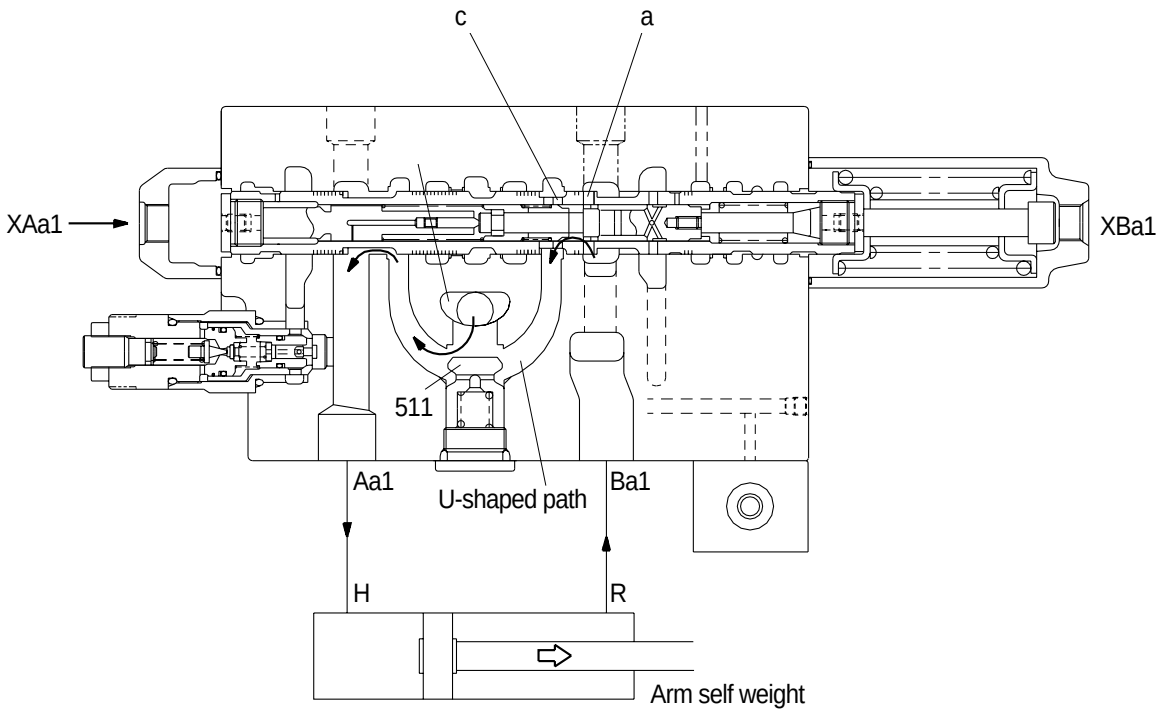
When the pressure enters through port XA_{a1}, the spool transfers in the right direction as shown in the figure.

· **During light load only**

The hydraulic oil entering through port P_1 passes through the main path(1) and flows to the bypass circuit(2), but the bypass circuit is shut off due to transfer of the arm 1 spool.

Therefore, the hydraulic oil pushes open the check valve(511) from the parallel circuit and flows through the U-shaped path to the arm spool(302). Then, it flows around the periphery of the arm spool to port A_{a1}, and is supplied to the arm cylinder head side(H).

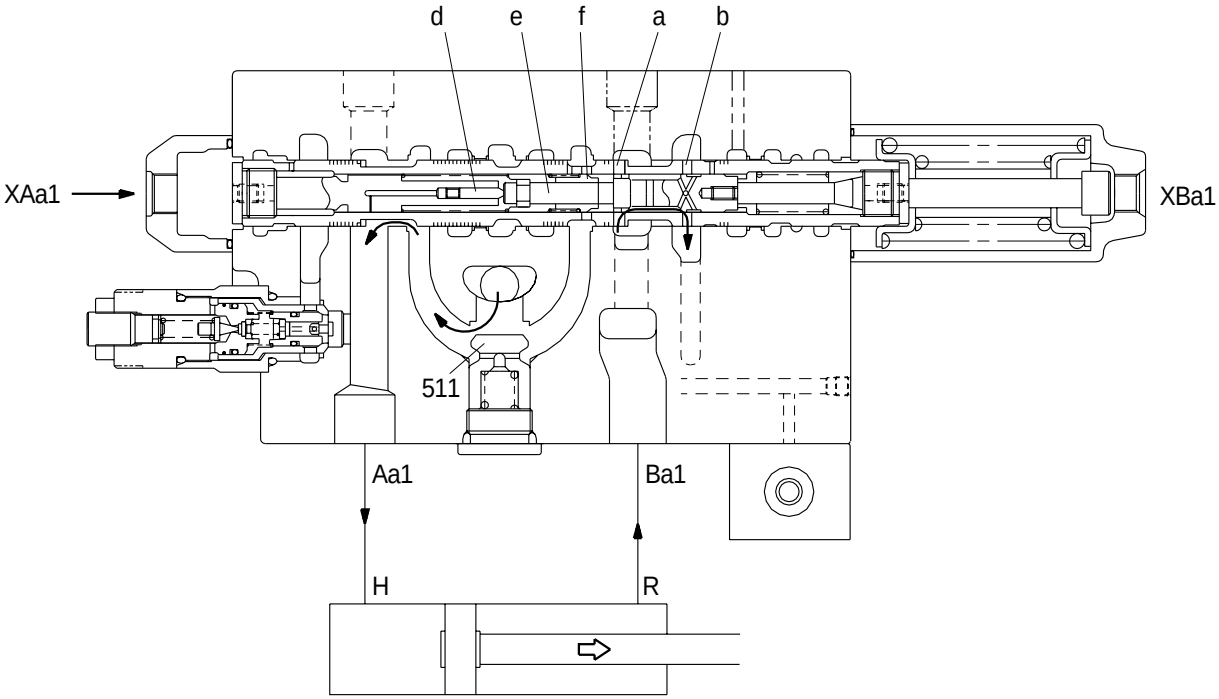
On the other hand, the return oil in the arm cylinder rod side(R) is pressurized self-weight of the arms and so on, and returns to port B_{a1}. The pressurized oil returning to port B_{a1} enters into the spool through the outside hole(a) of the arm spool(302). During a light load only, it pushes open the sleeve check valve, flows the U-shaped path reversely from the spool hole(c), and joins into port A_{a1}. This is called the arm regeneration function.



· **The pressure in the arm cylinder head side(H) increases.**

When the pressure in the arm cylinder head side(H) increases, the piston(d) and sub-spool(e) are transferred in the right direction, and at the same time the sleeve check valve(f) is closed by its back-pressure. This shuts off the arm regeneration function, and the return oil from the arm cylinder rod side(R) enters from port B_{a1} through the periphery hole(a) of the arm spool into the spool, flows out through the periphery hole(b) of the spool, flows out through the periphery hole (b) of the spool, and returns through the tank port(R_2) to the hydraulic oil tank.

On the other hand the pressurized oil entering through port P_2 joins into port A_{a1} through the inside path similarly to the case of the arm out operation.



4) OPERATION OF BOOM SPOOL

(1) Boom up

① **Pilot circuit**

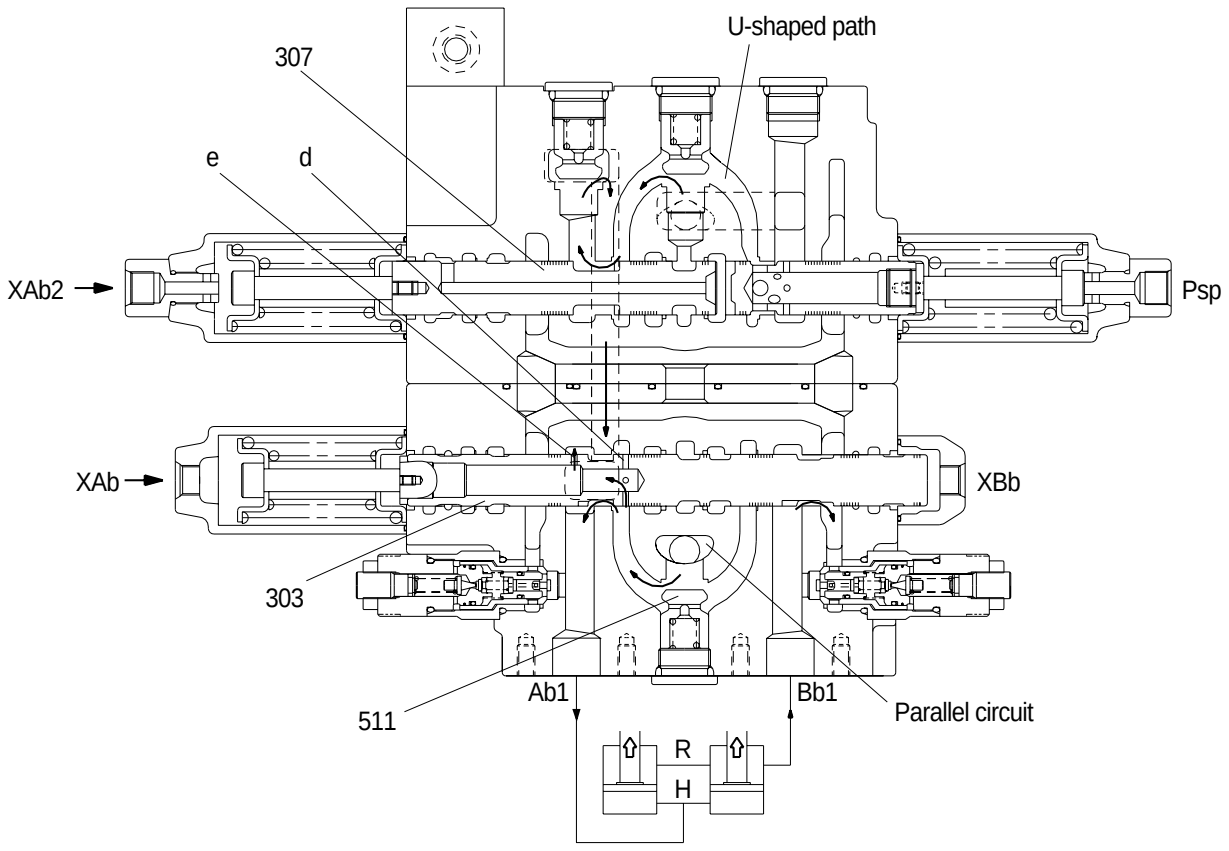
Since the boom 1 spool(303) and boom 2 spool(307) transfer and shut off the side bypass path, the pressure at port P_X increases.

② **Main circuit**

During the boom up operation, the pilot pressure enters through ports XA_b and moves the boom 1 spool in the right direction as shown in the figure. The pressurized oil entering through port P_2 passes through the main path(3) and flows to the bypass circuit(2), but the bypass circuit is shut off due to transfer of the boom 1 spool. Therefore, the pressurized oil flows into the parallel circuit, pushes open the check valve(511), and flows through U-shaped path to the boom 1 spool(303). When the stroke of the boom 1 spool is small, the oil enters through the periphery hole(d) of the spool to the inside of the spool, and flows out to port A_{b1} through the periphery hole(e).

When the stroke of the boom 1 spool is large, the oil flows out to port A_{b1} through the periphery of the spool.

At the same time the pilot pressure enters also through port XA_{b2} to transfer the boom 2 spool (307) in the right direction as shown in the figure. Though the pressurized oil enters into port P_1, the bypass path is shut off due to transfer of the boom 2 spool. Therefore, the oil flows in the parallel circuit, pushes open the check valve, and flows through the U-shaped path to the boom 2 spool. Then the oil passes through the notch of the boom 2 spool, pushes open the check valve, joints into port A_{b1} in the inside path, and is supplied to the boom cylinder head side (H). On the other hand the return oil from the boom cylinder rod side(R) enters through port B_{b1} and returns to the hydraulic oil tank through the tank port(R_2).



(2) Boom down

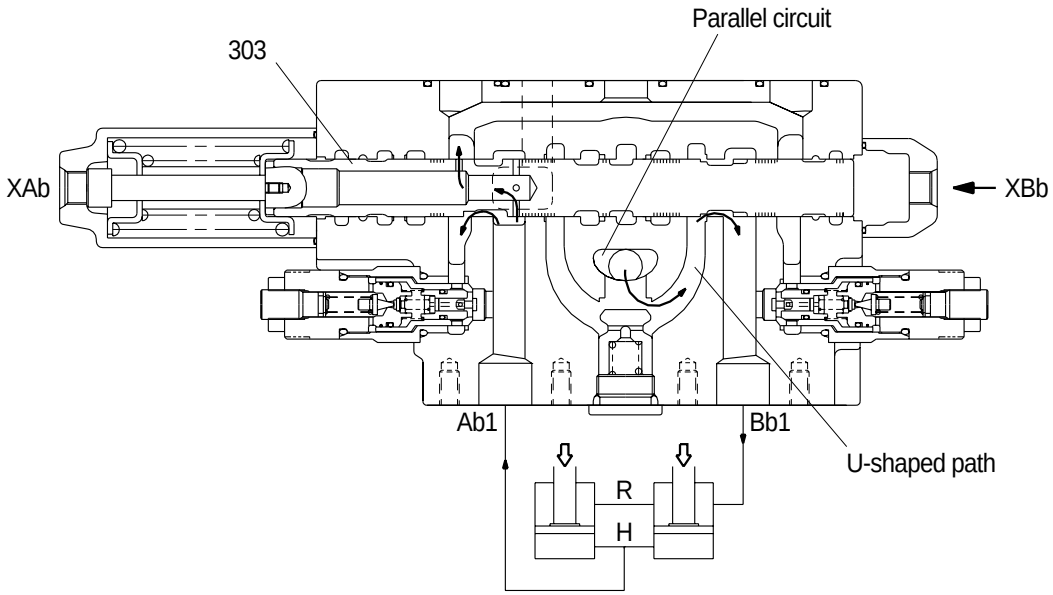
① **Pilot circuit**

Since the boom spool(303) transfers and shuts off the side bypass path, the pressure at port P_X increases.

② **Main circuit**

During the boom down operation, the pilot pressure enters through ports XB_b and transfers the boom spool in the left direction as shown in the figure. The pressurized oil entering through port P_2 passes through the main path(3) and flows to the bypass circuit(2), but the bypass circuit is shut off due to transfer of the boom spool. Therefore, the pressurized oil flows into the parallel circuit, pushes open the check valve, and flows through the U-shaped path to the boom spool(303). Then, it flows around the periphery of the boom spool to port B_{b1} and is supplied to the boom cylinder rod side(R).

On the other hand the return oil from the boom cylinder head side(H) returns to the hydraulic oil tank through the tank port(R_2).



5) OPERATION OF BUCKET SPOOL

(1) Bucket in

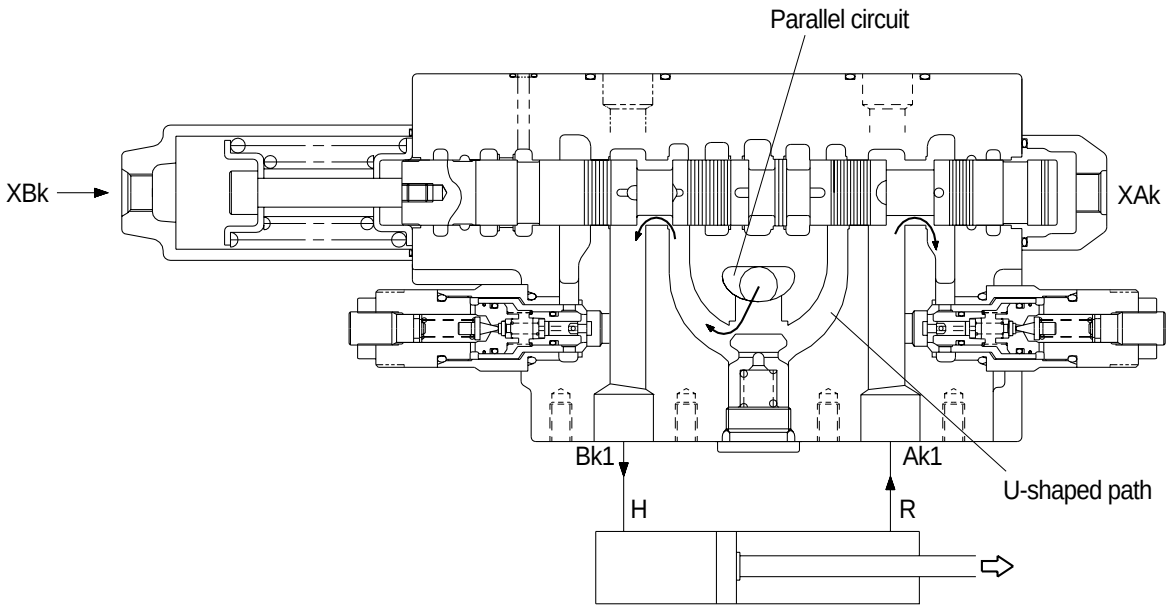
① **Pilot circuit**

Since the bucket spool(304) transfers and shuts off the side bypass path, the pressure at port P_X increases.

② **Main circuit**

During the bucket in operation, the pilot pressure enters through ports XB_k and transfers the bucket spool in the right direction as shown in the figure. The pressurized oil entering through port P_2 passes through the main path(3) and flows through the bypass circuit(2), but the bypass circuit is shut off due to transfer of the bucket spool. Therefore, the pressurized oil flows into the parallel circuit, pushes open the check valve, and flows through the U-shaped path to the bucket spool(304). Then, it flows through the periphery of the spool to port B_{k1} and is supplied to the bucket cylinder head side(H).

On the other hand the return oil from the bucket cylinder rod(R) enters through port A_{k1}, passes around the periphery of the spool, and returns to the hydraulic oil tank through the tank port(R_2).



(2) Bucket out

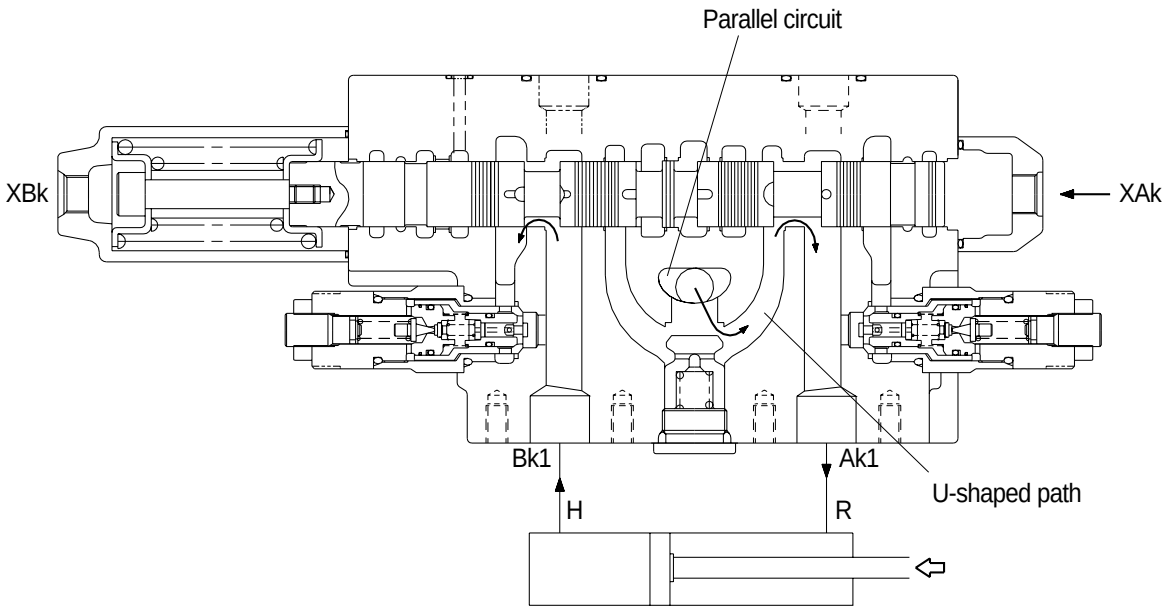
① **Pilot circuit**

Since the bucket spool(304) transfers and shuts off the side bypass path, the pressure at port P_X increases.

② **Main circuit**

During the bucket out operation, the pilot pressure enters through ports XA_k and transfers the bucket spool in the left direction as shown in the figure. The pressurized oil entering through port P_2 passes through the main path(3) and flows through the bypass circuit(2), but the bypass circuit is shut off due to transfer of the bucket spool. Therefore, the pressurized oil flows into the parallel circuit, pushes open the check valve, and flows through the U-shaped path to the bucket spool(304). Then, it flows through the periphery of the spool to port A_{k1} and is supplied to the bucket cylinder rod side(R).

On the other hand the return oil from the bucket cylinder head side(H) enters through port B_{k1}, passes around the periphery of the spool, and returns to the hydraulic oil tank through the tank port(R_2).



6) OPERATION OF SWING

(1) Swing single operation

① **Pilot circuit**

Since the swing spool(305) transfers and shuts off the side bypass path, the pressure at port P_X increases.

② **Main circuit**

During the swing operation, the pilot pressure enters through ports XA_S(or XB_S) and transfers the swing spool. The pressurized oil entering through port P_1 flows to port A_S(or B_S) and is supplied to the swing motor. The return oil from the swing motor enters through port B_S(or A_S) and returns to the hydraulic oil tank through the tank port(R_2).

(2) Swing priority function

① **Pilot circuit**

The pilot pressure enters through port P_{SP} to transfer the swing priority spool(395).

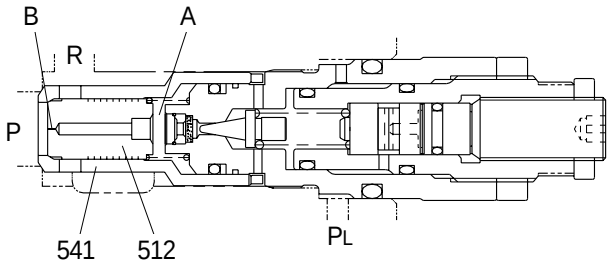
② **Main circuit**

Due to transfer of the swing priority spool the pressurized oil entering through port P_1 all flows to the swing side to make the swing operation most preferential.

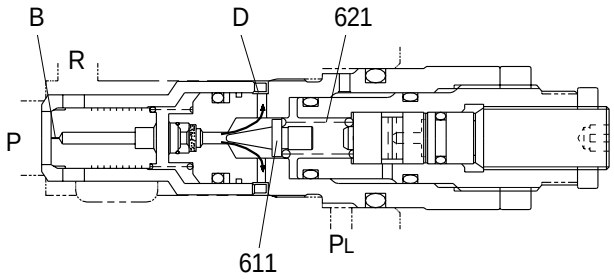
7) OPERATION OF MAIN RELIEF VALVE

The main relief valve is fitted to the straight travel valve block and functions as follows :

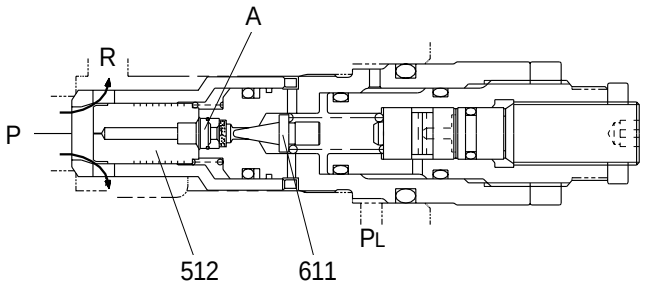
(1) The pressurized oil passes through the orifice(B) of the plunger(512), is filled up in chamber A of the inside space, and seats the plunger(512) against the body(541) securely.



(2) When the pressure at (P) becomes equal to the set pressure of the spring(621), the hydraulic oil passes through the restriction(B), pushes open the poppet(611), and flows to (R) through the hole (D).



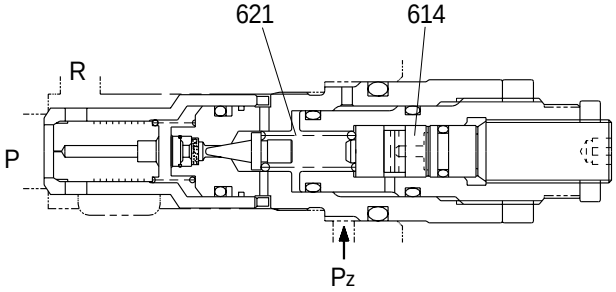
(3) Opening of the poppet(611) causes the pressure in chamber A to fall and the plunger(512) to open. As the result the pressurized oil at port P runs into(R) directly.



(4) High pressure setting pilot signal(Pz) : ON

When the power boost switch is pushed ON, the pilot pressure enters through port Pz.

It pushes the piston(614) in the left direction to increase the force of the spring(621) and change the relief set pressure to the high pressure.

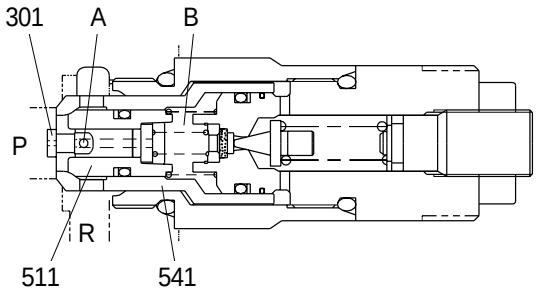


8) OPERATION OF PORT RELIEF VALVE

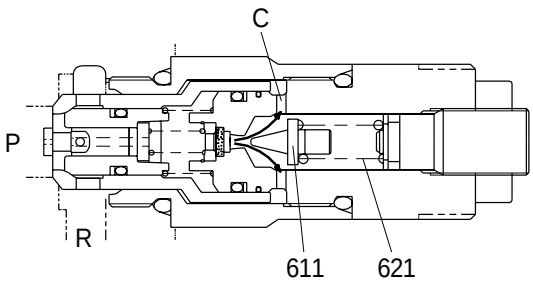
The port relief valve is fitted between the cylinder port and low pressure path. In addition to the relief valve this serves also as an anti-cavitation check valve, and functions as follows :

(1) Function as relief valve

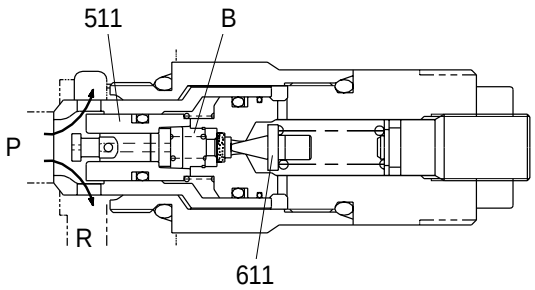
① The pressurized oil passes through hole A of the piston(301), is filled up in chamber B of the inside space, and seat the plunger(511) against the seat(541) securely.



② When the pressure at port P becomes equal to the set pressure of the spring(621), the pressurized oil pushes open the poppet(611), flows around it, and flows to (R) through hole C.

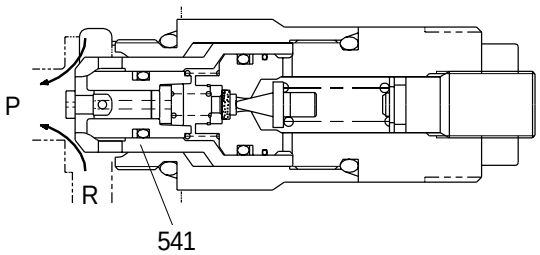


③ Opening of the poppet(611) causes the pressure in chamber B to fall and the plunger(511) to open. As the result the pressurized oil at port P runs into (R) directly.



(2) Function as anti-cavitation check valve

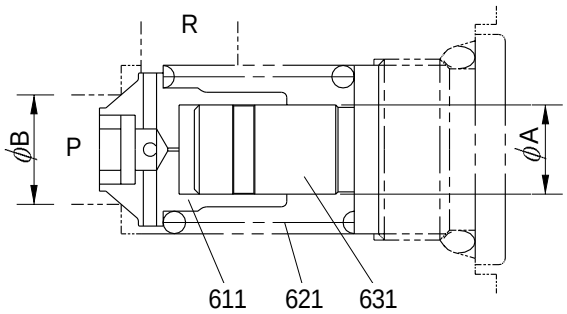
When any lower pressure exists at port P, the oil is supplied through (R). When the pressure at (R) becomes higher than that at port P, the seat(541) moves in the right direction. Then, sufficient oil passes around the seat(541) from (R) to port P and fills up the space.



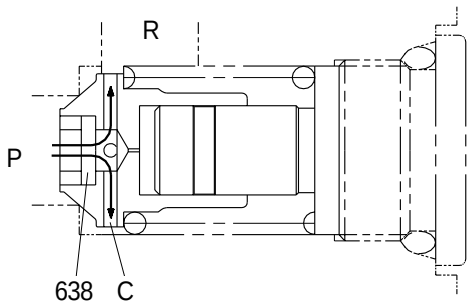
9) OPERATION OF NEGATIVE CONTROL RELIEF VALVE

The negative control valve is fitted between the downstream of the center bypass path and low pressure path, and functions as follows :

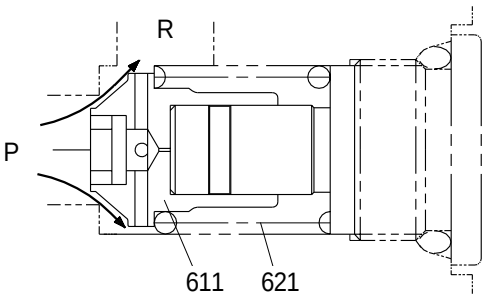
(1) When the pressure at port P falls below the set level of the spring(621), the poppet(611) is in the condition shown in the figure. The pressure acting area of the poppet(611) is reduced to(ϕB - ϕA), as the area ϕB is cancelled by the area ϕA of the damping rod(631).



(2) In this condition the pressurized oil at port P runs out to port R through the orifice(C). Since the orifice(C) is provided downstream of the filter(638), there is no chance of clogging.



(3) When the pressure at port P goes over the set pressure of the spring(621), the poppet(611) opens. Then, the pressurized oil at port P passes around the outside of the poppet(611) and flows to the low pressure path(R).



The relation between the flow rate Q and pressure P of the hydraulic oil that flows from port P to the low pressure path(R) is as shown in th diagram.