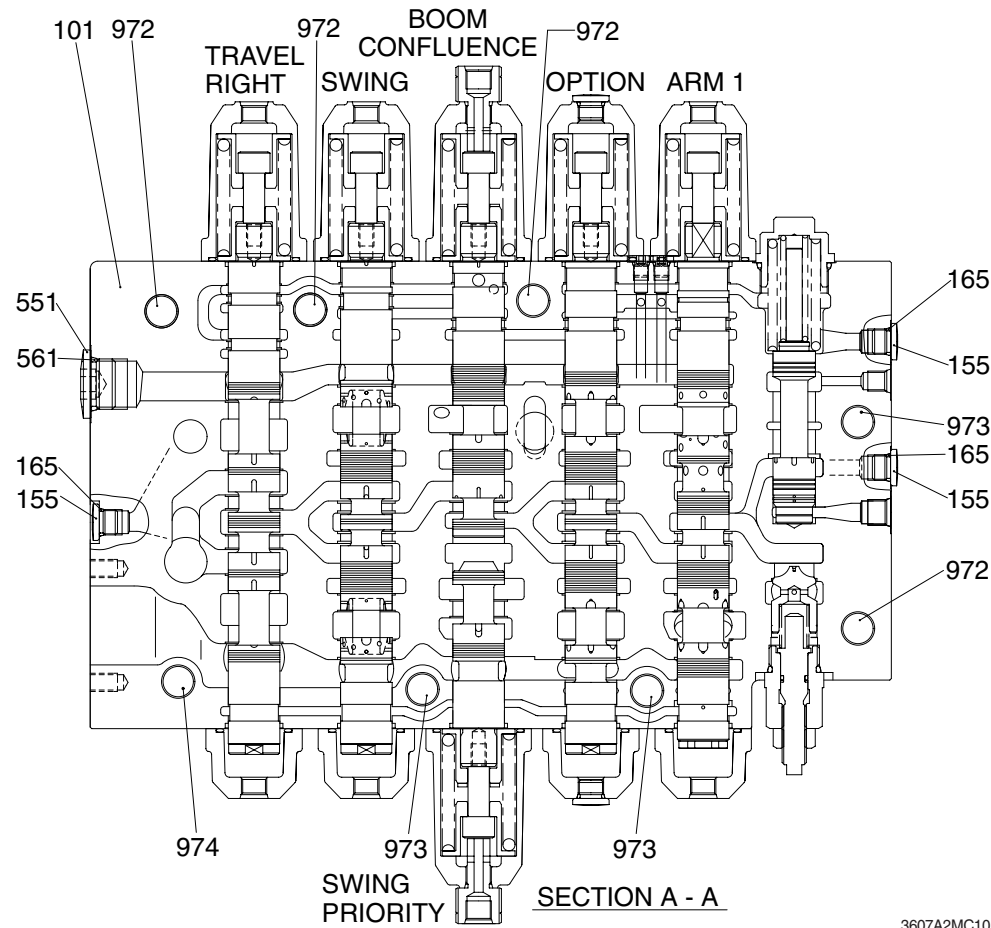
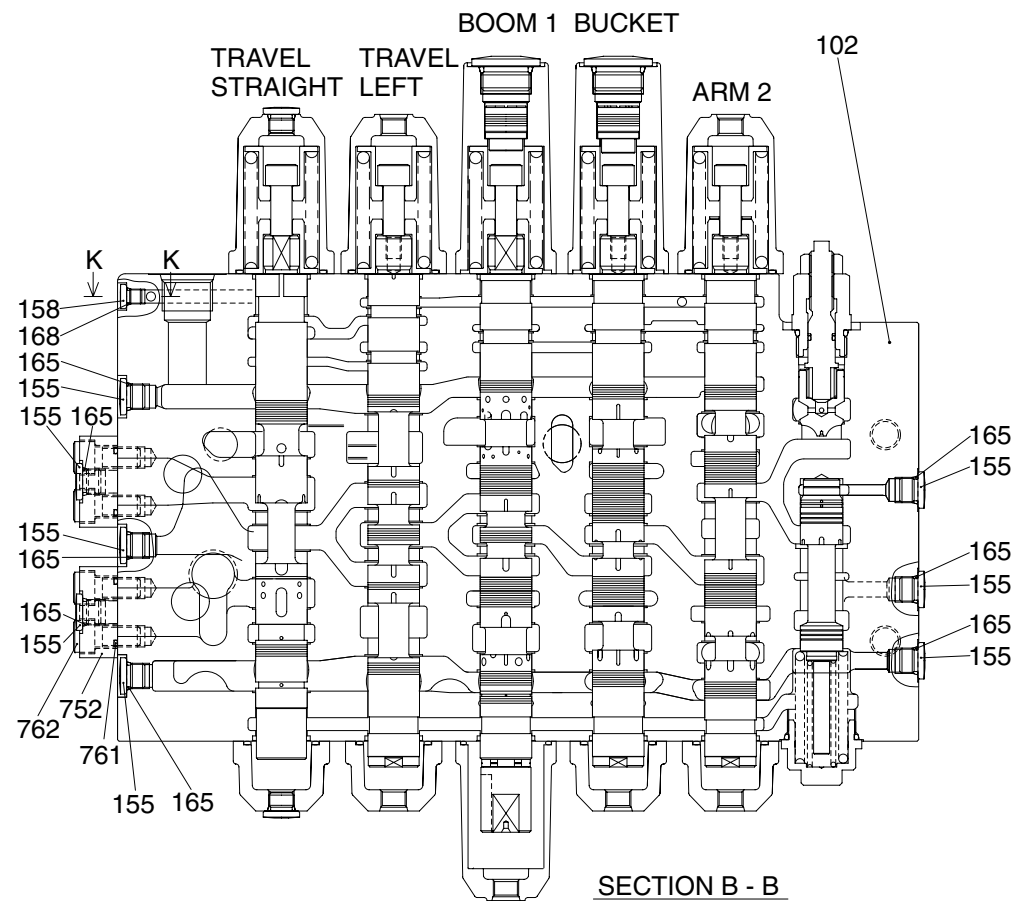
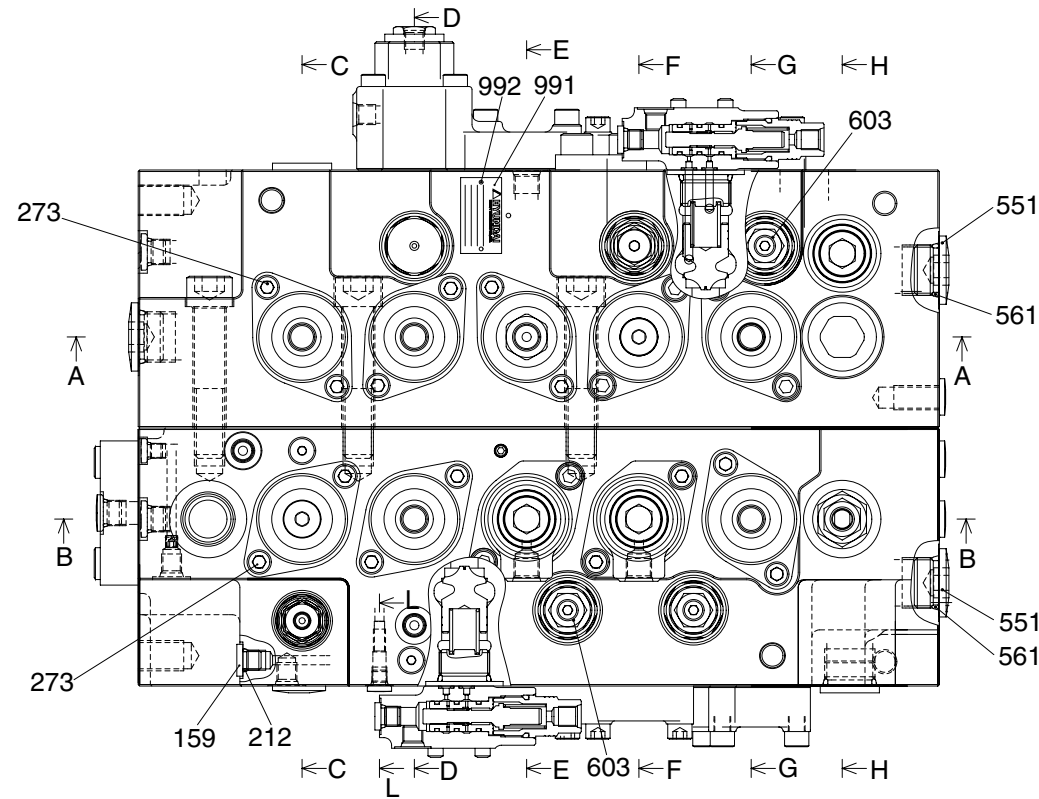
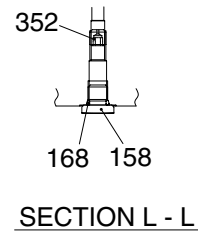
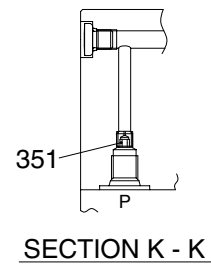


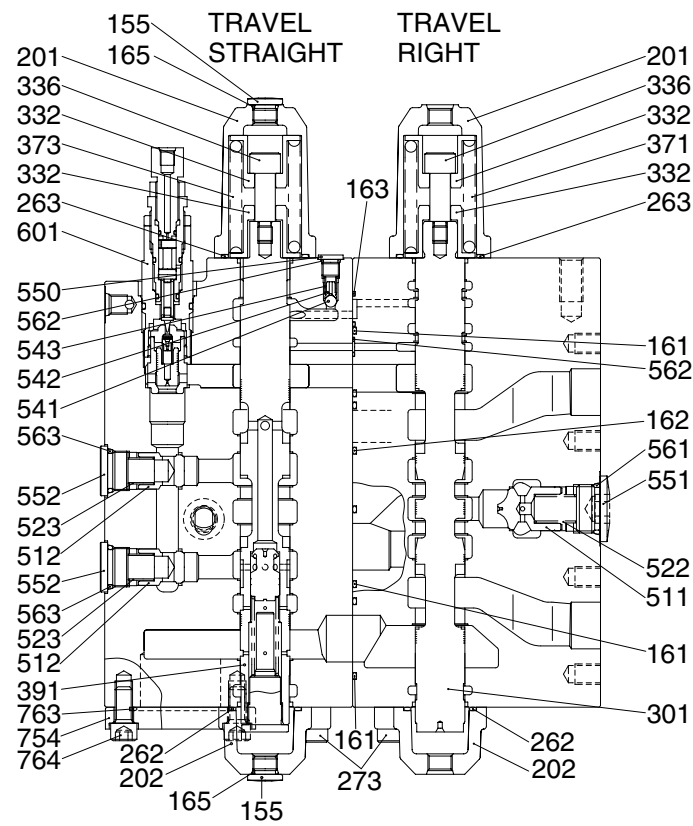
STRUCTURE (3/4)



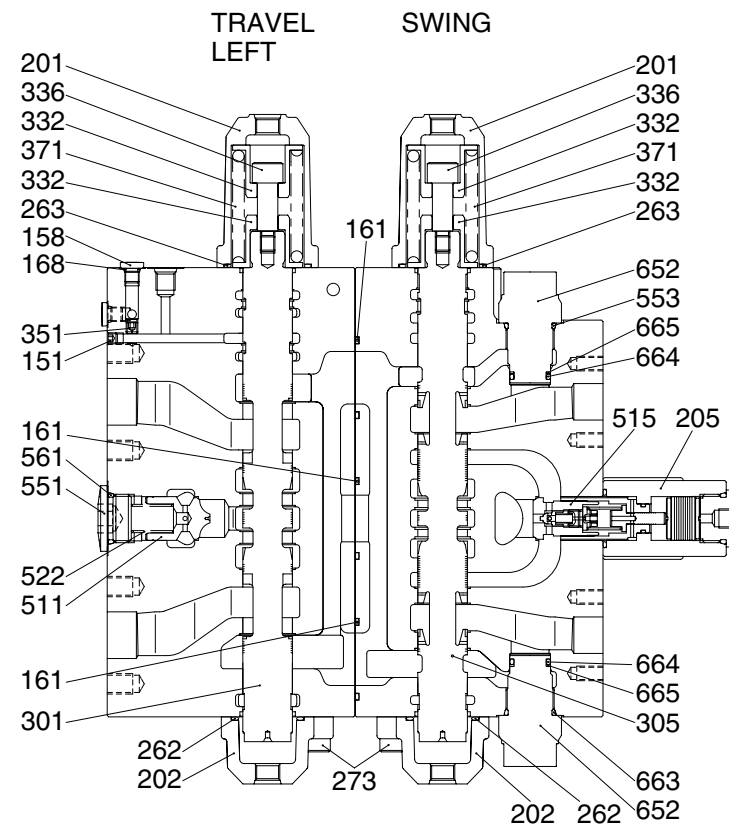
101	Casing-A	373	Spring
102	Casing-B	391	Travel straight spool assy
151	Plug	392	Bypass cut spool
155	Plug	393	Boom confluence spool
158	Plug	394	Arm confluence spool
159	Plug	395	Swing priority spool
161	O-ring	511	Poppet
162	O-ring	512	Poppet
163	O-ring	513	Poppet
165	O-ring	514	Poppet
168	O-ring	515	Boom priority valve assy
201	Cover	522	Spring
202	Cover	523	Spring
203	Cover	524	Spring
204	Cover	525	Spring
205	Cover assy	541	Steel ball
206	Cover	542	Spring seat
208	Cover	543	Spring
211	Plug	550	Plug
212	O-ring	551	Plug
251	Plug	552	Plug
252	Lock valve assy	553	Plug
262	O-ring	554	Plug
263	O-ring	557	Plug assy
264	O-ring	558	Plug
265	O-ring	561	O-ring
267	O-ring	562	O-ring
273	Bolt	563	O-ring
274	Bolt	601	Main relief valve
275	Bolt	603	Port relief valve
301	Travel spool	604	Port relief valve
302	Arm 1 spool assy	605	Port relief valve
303	Boom 1 spool; assy	611	Negative control relief valve
304	Bucket spool	652	Plug
305	Swing spool	663	O-ring
308	Option spool	664	O-ring
313	Plug	665	Backup ring
326	Spring	751	Flange
327	Spring	752	Flange
332	Spring seat	754	Flange
335	Shim	761	O-ring
336	Bolt	762	Bolt
337	Rod	763	O-ring
351	Orifice	764	Bolt
352	Orifice	972	Bolt
355	Piston	973	Bolt
356	Piston	974	Bolt
371	Spring	991	Name plate
372	Spring	992	Pin

3607A2MC10

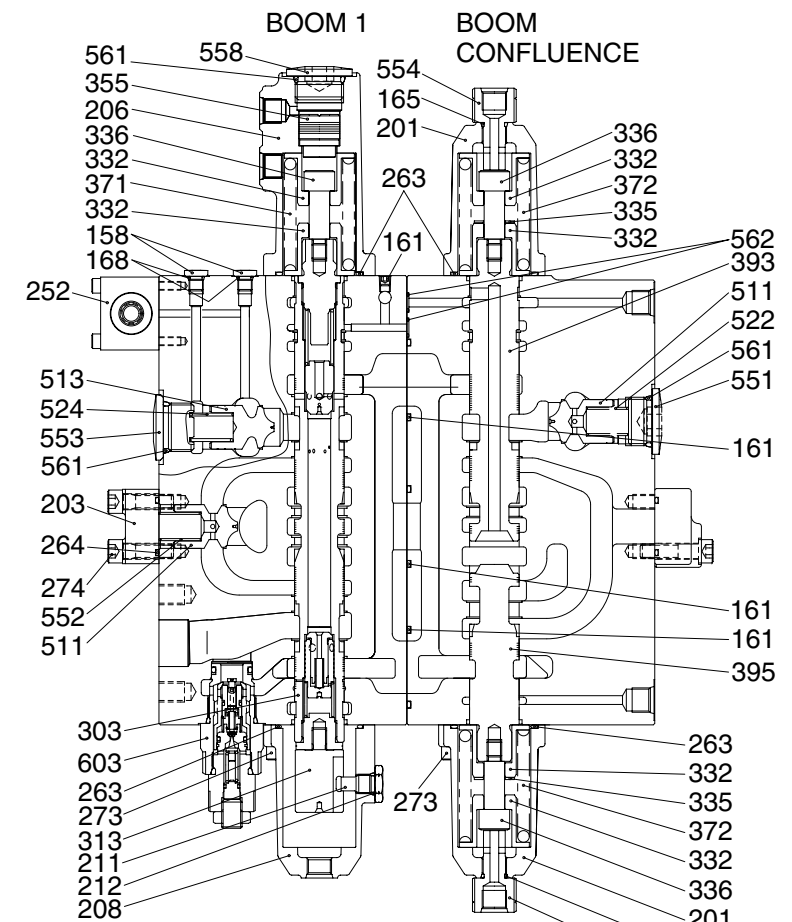
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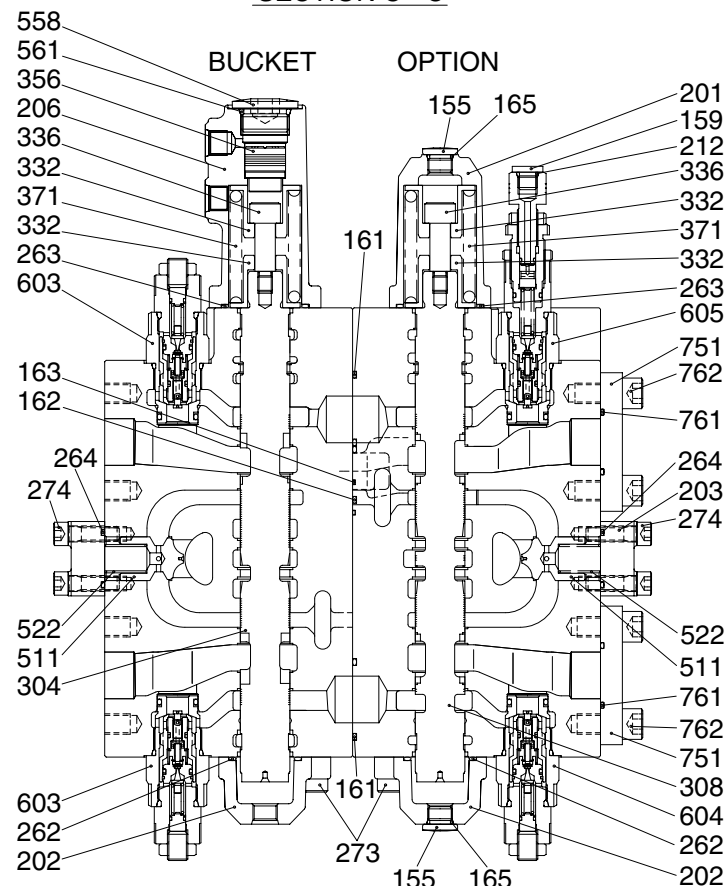
SECTION C - C



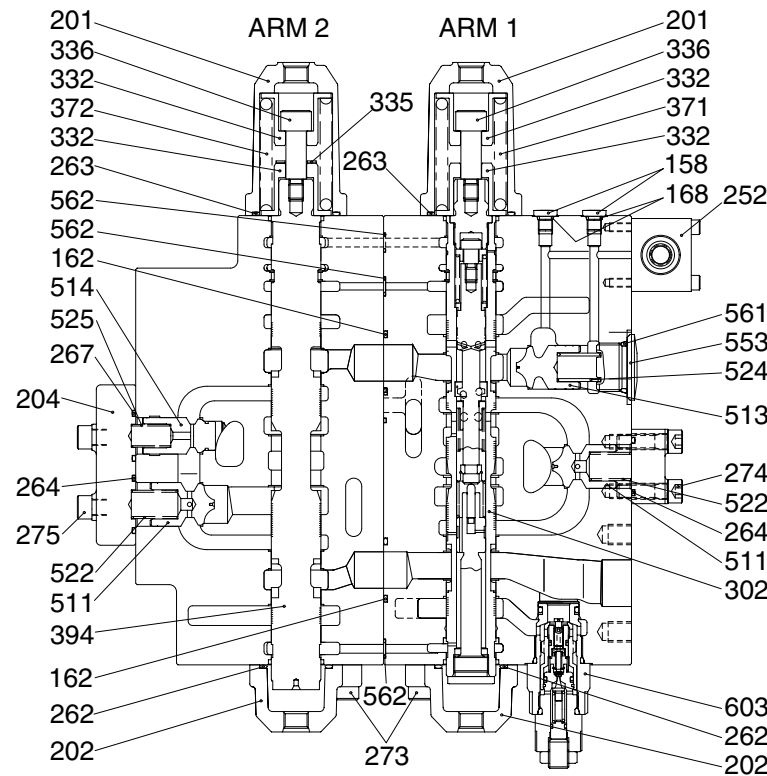
SECTION D - D



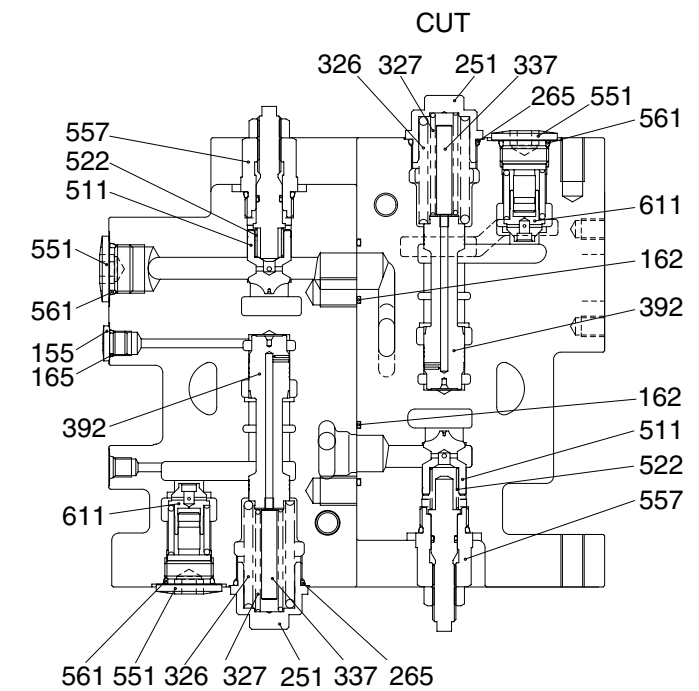
SECTION E - E



SECTION F - F



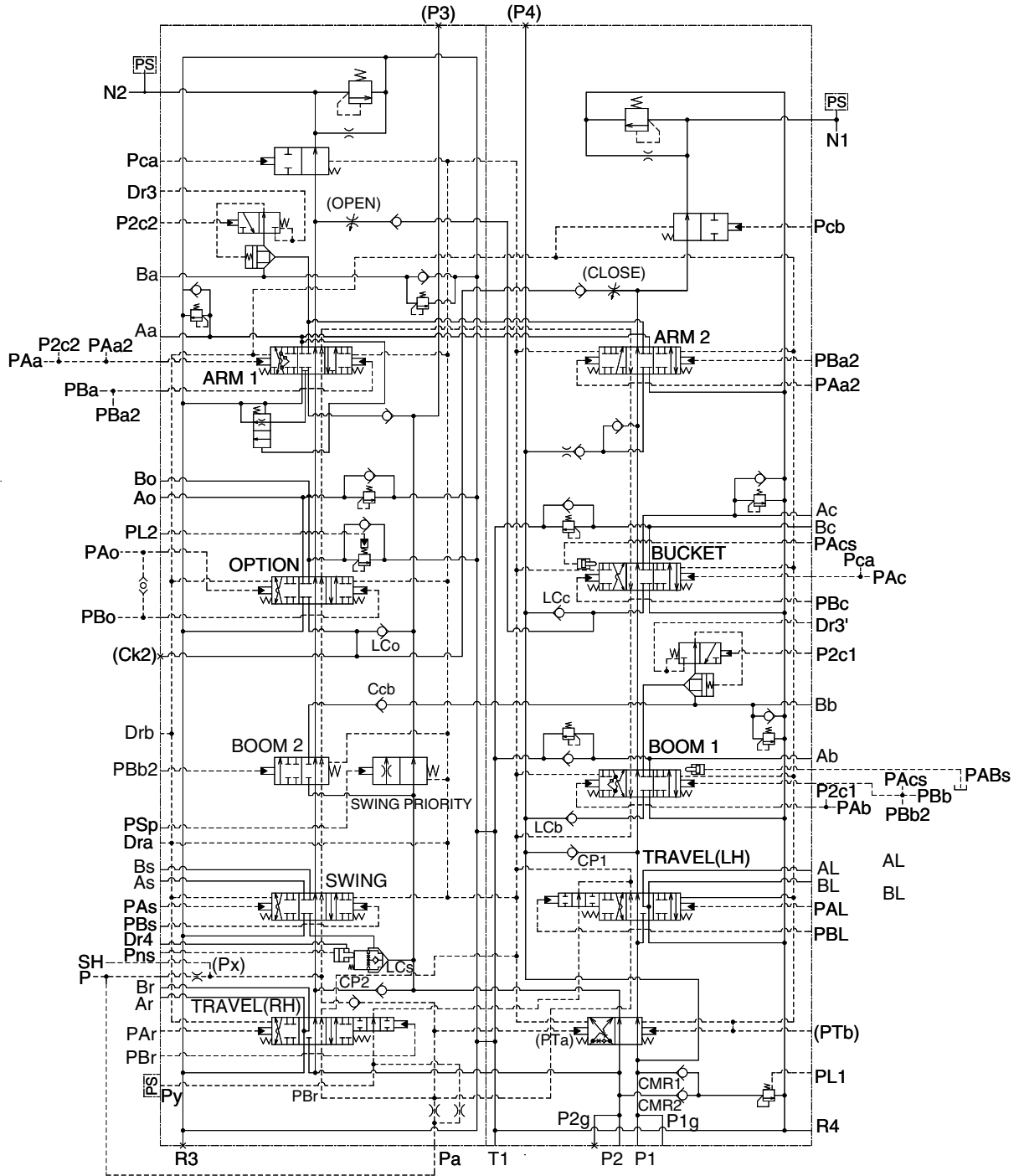
SECTION G - G



SECTION H - H

2. FUNCTION

1) HYDRAULIC CIRCUIT



3607A2MC13

2) OPERATION

(1) Neutral positions of spools

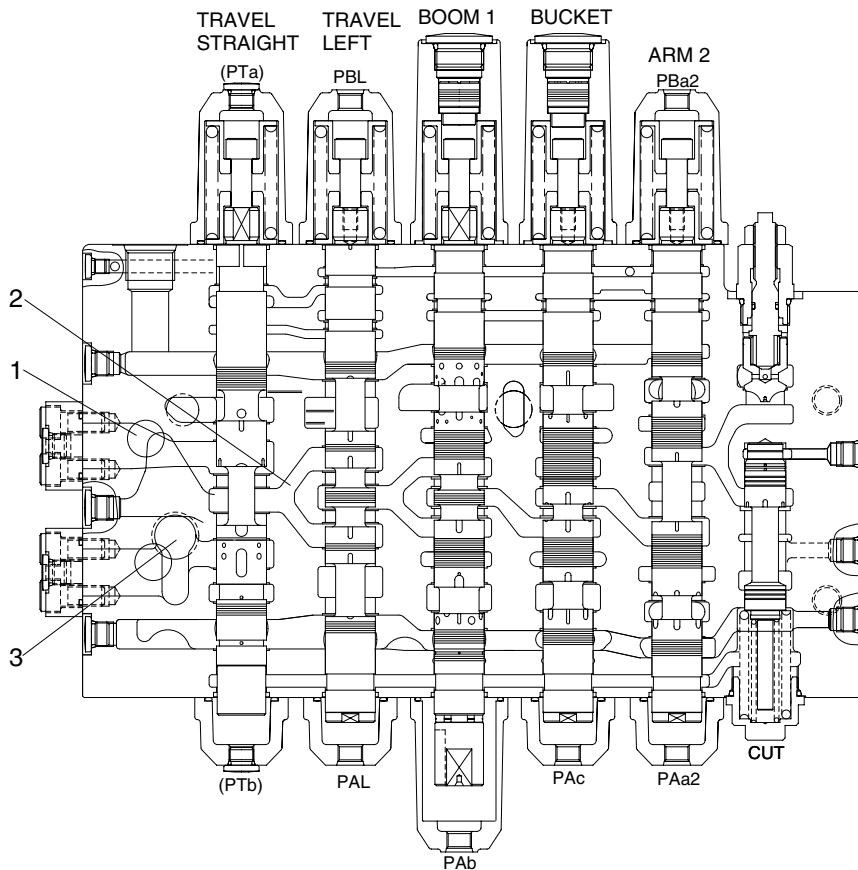
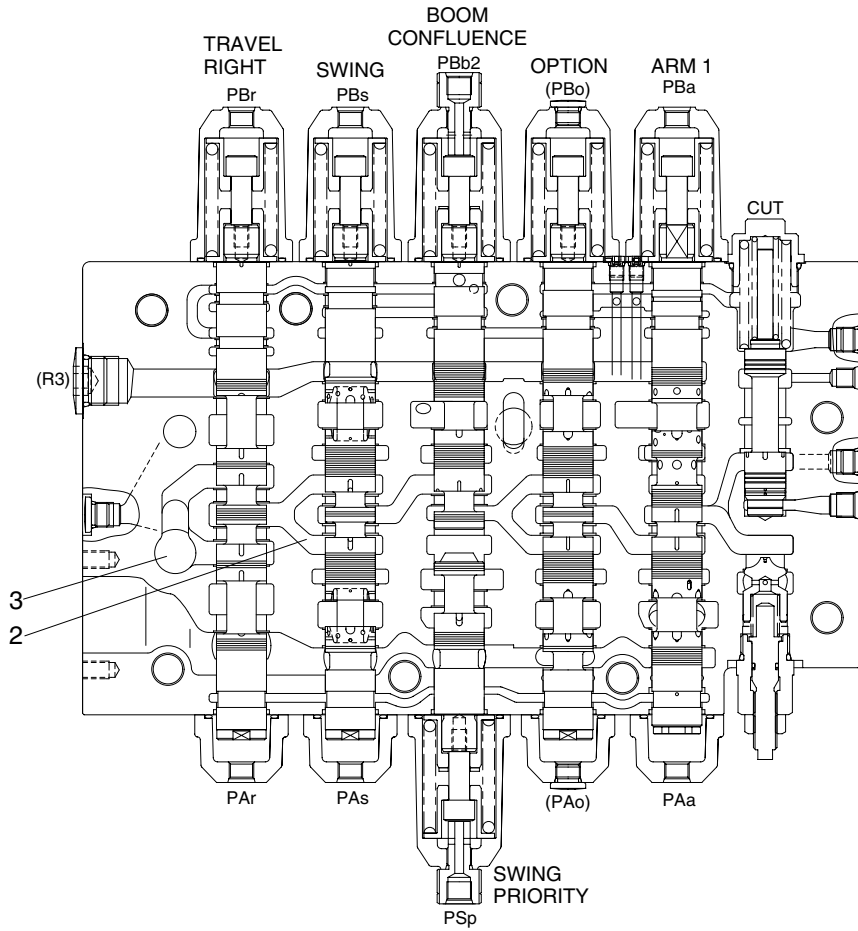
When all spools are in the neutral positions, the pressurized oil discharged from the hydraulic pump (A1) passes through Port P1, the main path (1), the bypass circuit (2) passing the spools for boom1, bucket and arm 2, and boom 1 side negative control orifice, and returns to the hydraulic oil tank through the tank port (T1).

The pressure upstream the boom 1 side negative control orifice (the negative control signal pressure) is led from port N1 to the regulator on the hydraulic pump (A1) side, and controls the pump discharge flow rate to its minimum value.

The oil discharged from the hydraulic pump (A2) passes through port P2, the main path (3), the bypass circuit (2) passing the spools for swing, boom confluence (boom 2), option and arm 1, and the arm 1 side negative control orifice, and returns to the hydraulic oil tank through the tank port (T1).

The pressure upstream the arm 1 side negative control orifice (the negative control signal pressure) is led from port N2 to the regulator on the hydraulic pump (A2) side, and controls the pump discharge flow rate to its minimum value.

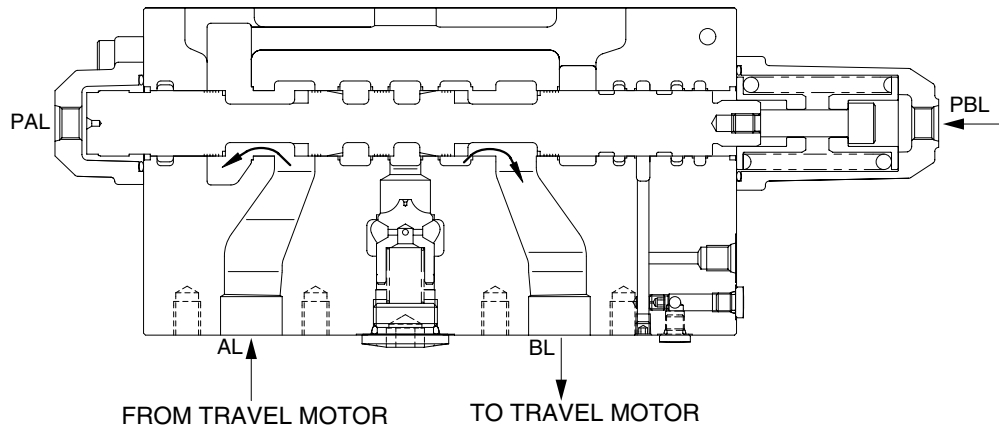
When any of nine main spools is changed over, the bypass circuit (2) is cut off and the hydraulic oil at port N1 or N2 in the negative control circuit is shut off.



3607A2MC14

(2) Travel operation

When pilot port PBL of the travel left spool is pressurized, the bypass circuit (2) in the arm 2 side is shut off and pressurized oil from port P2 passes through port BL and flows to the travel motor. On the other hand, the return oil from the travel motor passes through port AL and returns to the hydraulic oil tank through the tank port (T1).



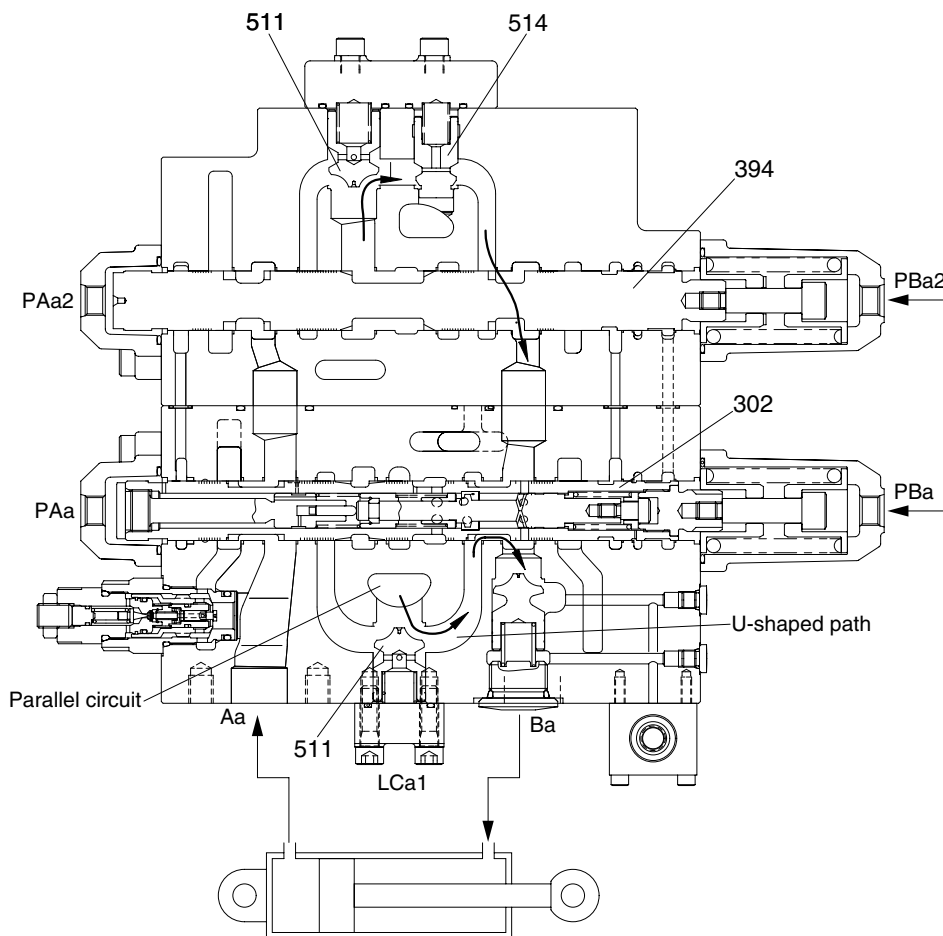
3607A2MC15

(3) Arm

① Arm out operation

During the arm out operation the pilot pressure enters through ports PBa and PBa2. When the pressure enters through port PBa, the spool transfers in the left direction in figure. The hydraulic oil entering through port P2 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 arm 1 spool. Therefore, the hydraulic oil from the parallel circuit pushes open the check valve (511) and flows through the U-shaped path to the arm1 spool (302). Then, it flows around the periphery of the arm 1 spool (302) to port Ba, and is supplied to the arm cylinder rod side (R).

On the other hand, the oil entering through port P1 passes in the main path (1), and flows into the bypass circuit (2), and the bypass circuit is shut off due to transfer of the arm 2 spool (394). Oil from the parallel circuit pushes open the check valve (514) and oil from the bypass circuit pushes open the check valve (511) and flows through the U-shaped path to the arm 2 spool (394). Then, it flows around the periphery of arm 2 spool in the inside path and joins into port Ba. Besides, the return oil from the arm cylinder head side (H) passes through port Aa, flows into tank line in arm 1 side and in arm 2 side and returns to the hydraulic oil tank through the tank port (T1).



3607A2MC16

② Arm in operation

During the arm in operation, the pilot pressure enters through ports PAa and PAa2. When the pressure enters through port PAa, the spool transfers in the right direction in figure MC17A. The hydraulic oil entering through port P2 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 arm 1 spool. Therefore, the hydraulic oil from the parallel circuit pushes open the check valve (511) and flows through the U-shaped path to the arm 1 spool (302). Then, it flows around the periphery of the arm1 spool to port Aa, and is supplied to the arm cylinder head side (H).

Besides, the oil entering through port P1 passes in the main path (1), and flows into the bypass circuit (2), and the bypass circuit is shut off due to transfer of the arm 2 spool (394). Oil from the parallel circuit pushes open the check valve (514) and oil from the bypass circuit pushes open the check valve (511) and flows through the U-shaped path to the arm 2 spool (394). Then, it flows around the periphery of arm 2 spool in the inside path and joins into port Aa.

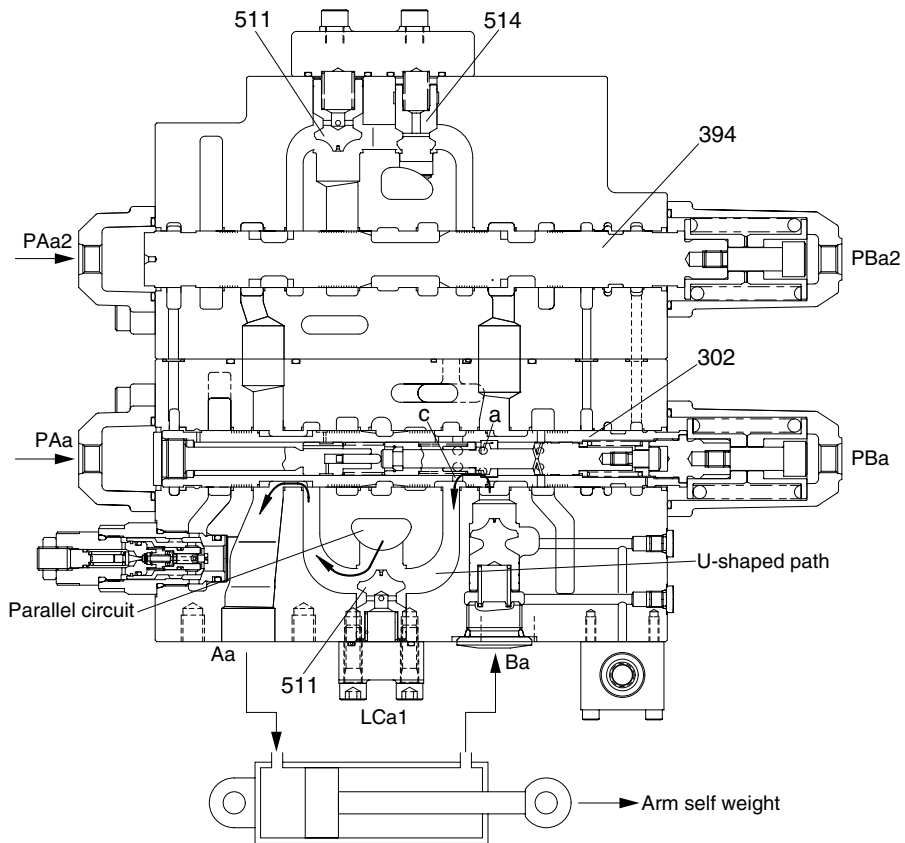
On the other hand, the return oil from the arm cylinder rod side (R) is pressurized by self-weight of the arms and so on, and returns to port Ba. The pressurized oil returning to Port Ba enters into the spool through the outside hole (a) of the arm1 spool (302). During a light load only, it pushes open the sleeve check valve and part of oil flows the U-shaped path reversely from the spool hole (c), and joins into port Aa. The rest of oil returns to the hydraulic oil tank through the tank port (T1).

This is called the arm regeneration function.

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 backpressure. This shuts off the arm regeneration function, and the return oil from the arm cylinder rod side (R) enters from port Ba through the periphery hole (a) of the arm1 spool into the spool, flows out through the periphery hole (b) of the spool, and returns through the tank port (T1) to the hydraulic oil tank.

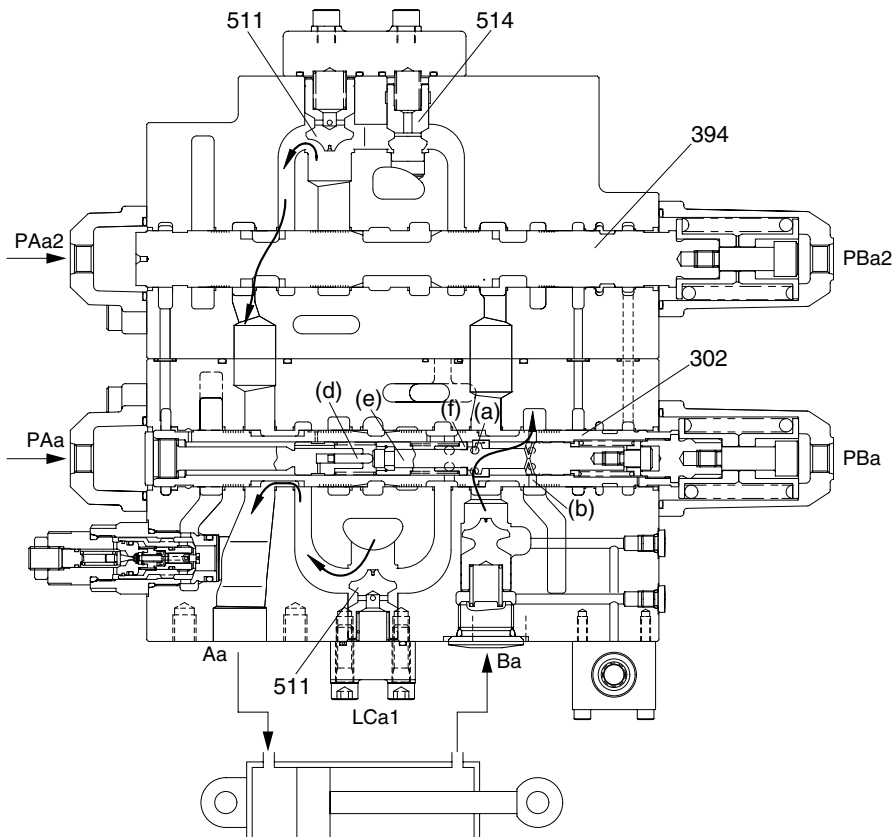
On the other hand, the pressurized oil entering through port P1 joins into port Aa through the inside path similarly to the case of the arm stretching operation.

- During light load only



3607A2MC17A

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



3607A2MC17B

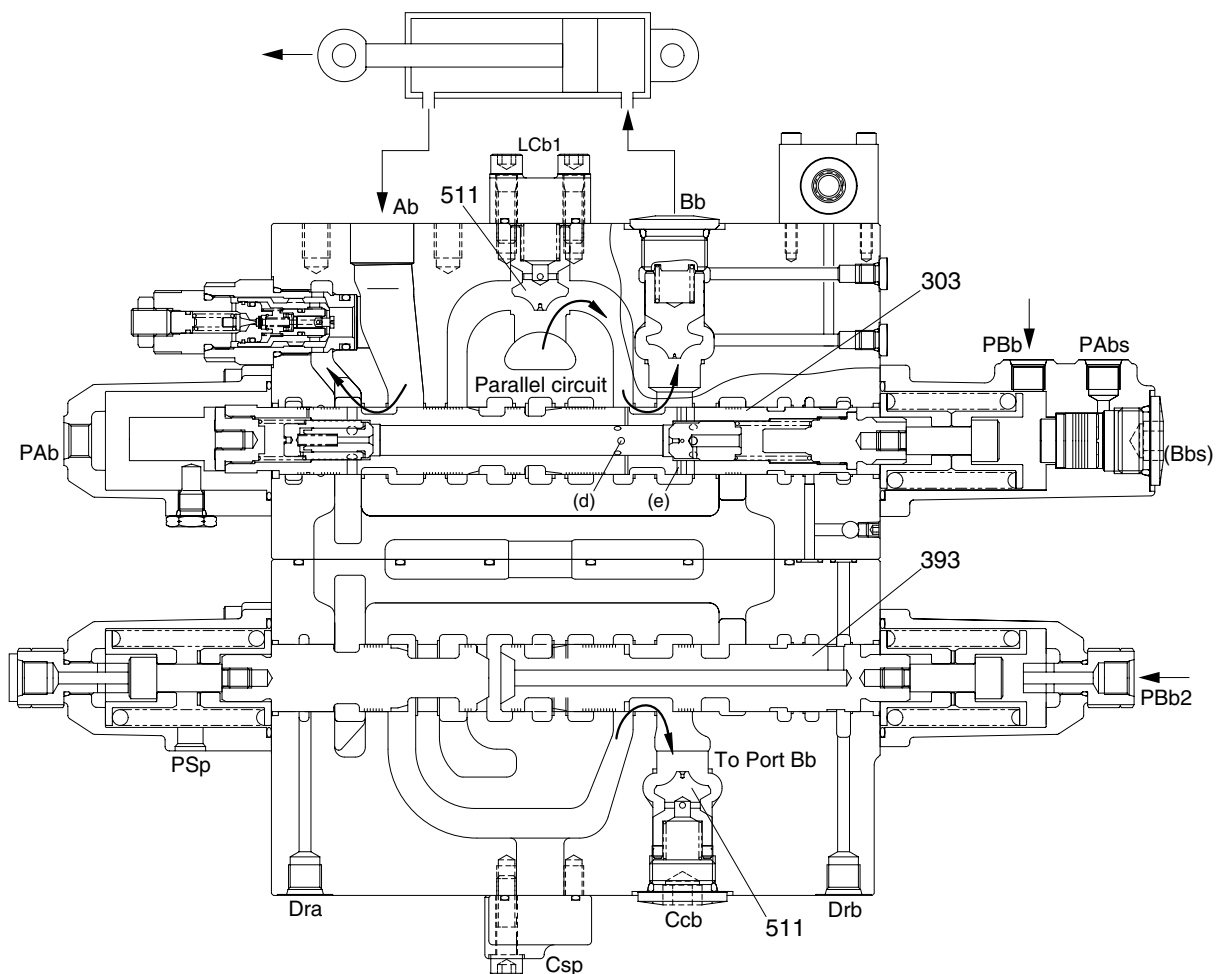
(4) Boom

① Boom up operation

During the boom up operation, the pilot pressure enters through port PBb and moves the boom 1 spool in the left direction in figure. The pressurized oil entering through port P1 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 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 boom1 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 Bb through the periphery hole (e). When the stroke of the boom 1 spool is large, the oil flows out to port Bb through the periphery of the spool.

At the same time, the pilot pressure enters also through Port PBb2 to transfer the boom 2 spool (393) in the left direction in figure. Though the pressurized oil enters into port P2, the bypass is shut off due to transfer of the boom 2 spool. Therefore, the oil flows in the parallel circuit and flows through the U-shaped path to the boom 2 spool. Then, the oil passes through the periphery of the boom 2 spool, pushes open the check valve (511), joins into port Bb in the inside path, and is supplied to the boom cylinder head side (H). (Boom confluent flow)

On the other hand, the return oil from the boom cylinder rod side (R) enters through port Ab and returns to the hydraulic oil tank through the tank port (T1).



3607A2MC18

② Boom down operation

During the boom down operation, the pilot pressure enters through port PAb and transfers the boom1 spool in the right direction in figure. The pressurized oil entering through port P1 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 boom 1 spool. Therefore, the pressurized oil flows into the parallel circuit, pushes open the check valve (511), and flows through the U-shaped path to the boom 1 spool (303). Then, it flows around the periphery of the boom 1 spool to port Ab and is supplied to the boom cylinder rod side (R).

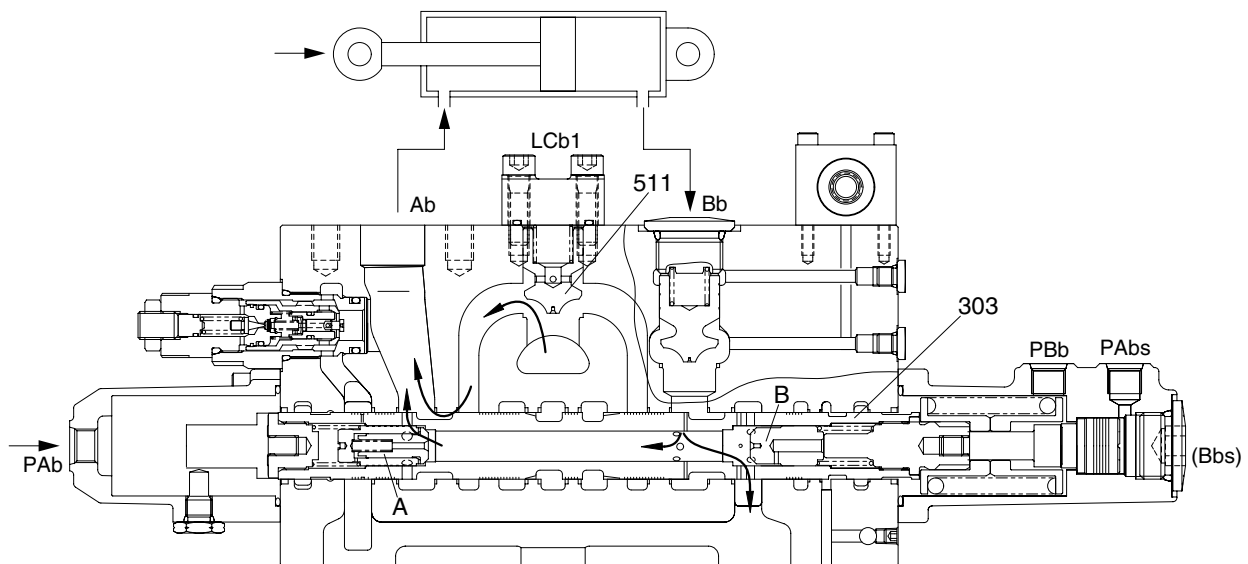
On the other hand, the return oil from the boom cylinder head side (H) passes to the notch of the boom 1 spool.

Since this return oil has a sufficient pressure caused by the weight of the boom, it passes through the path inside the spool, pushes the poppet A in the spool in the left direction shown in the figure, flows around the outside of the spool. Then, it is supplied again to the boom cylinder rod side (R) as hydraulic oil to lower the boom. (Boom regeneration)

Besides, a part of the return oil from the boom cylinder flows from the check valve B (boost check) into the tank.

The boost check boosts the hydraulic oil flowing to the tank to secure the sufficient regeneration flow rate.

During the boom down and arm stretching operation, the pilot pressure enters through port PAb and the boom 1 spool transfers in the half stroke not full stroke.



3607A2MC19

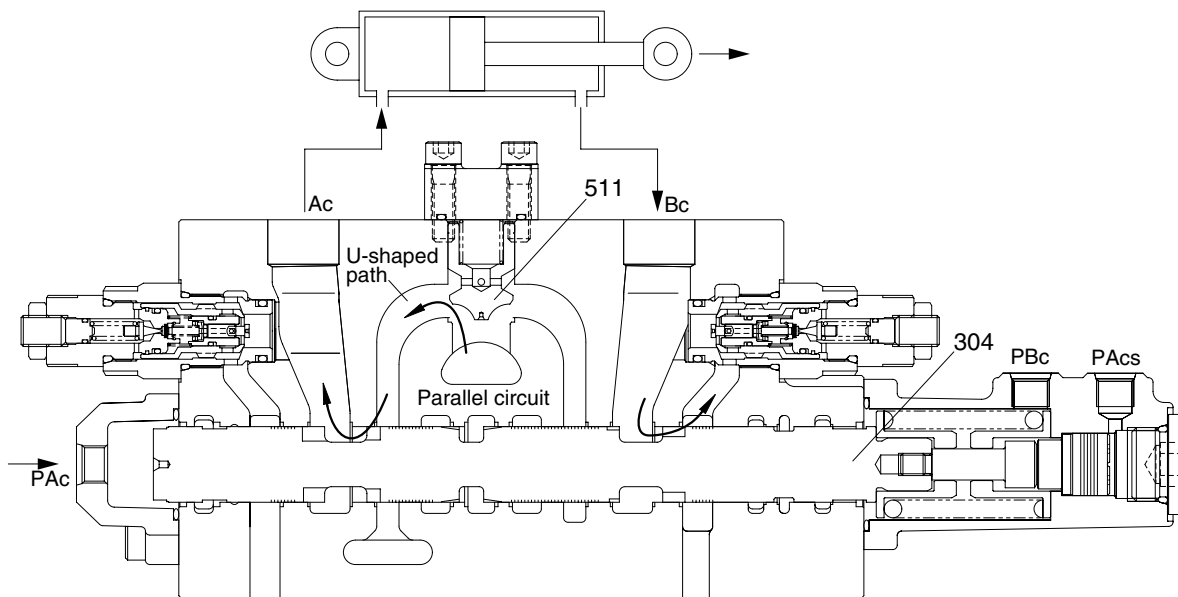
(5) Bucket

① Bucket in operation

During the bucket in operation, the pilot pressure enters through port PAc and transfers the bucket spool in the right direction in figure. The pressurized oil entering through port P1 passes through the main path (1) 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 (511), and flows through the U-shaped path to the bucket spool (304). Then, it flows through the periphery of the spool to port Ac and is supplied to the bucket cylinder head side (H).

On the other hand, the return oil from the bucket cylinder rod side (R) enters through port Bc, passes around the periphery of the spool, and returns to the hydraulic oil tank through the tank port (T1).

During the boom up and bucket in operation, the pilot pressure enters through Port PAc and the bucket spool transfers in the half stroke not full stroke. Therefore, the most of pressurized oil entering through Port P1 flows to the boom 1 spool (304) than the bucket spool (304) to make the boom up operation most preferential.

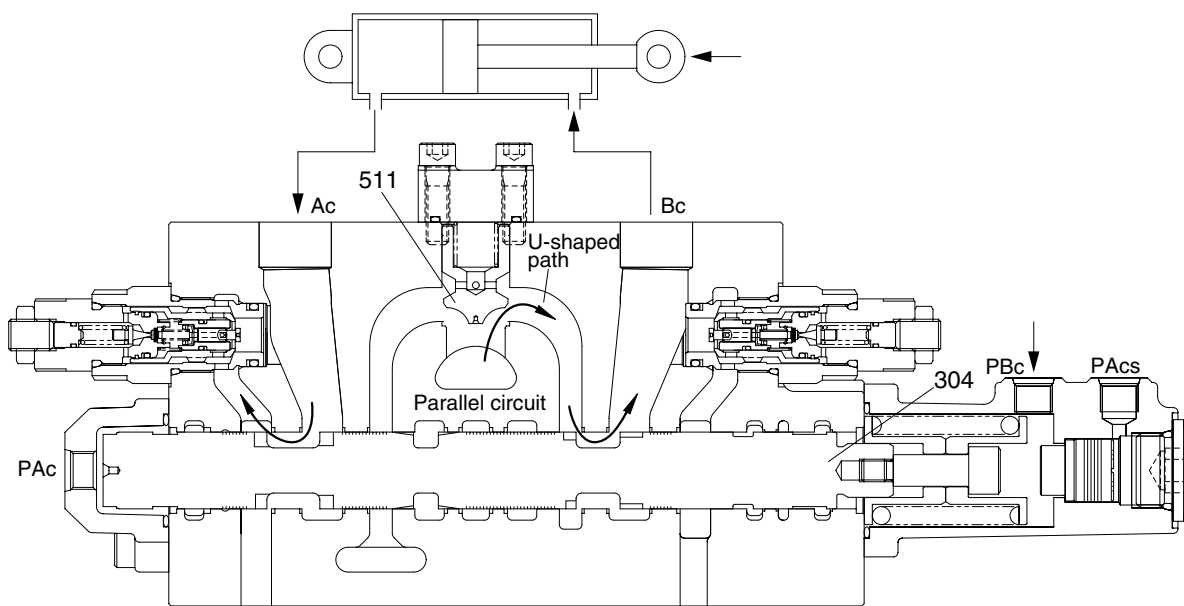


3607A2MC20

② Bucket out operation

During the bucket out operation, the pilot pressure enters through port PBc and transfers the bucket spool in the left direction in figure. The pressurized oil entering through port P1 passes through the main path (1) 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 (511), and flows through the U-shaped path to the bucket spool (304). Then, it flows through the periphery of the spool to port Bc 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 Ac, passes around the periphery of the spool, and returns to the hydraulic oil tank through the tank port (T1).



3607A2MC21

(6) Swing

① Independent swing operation

During the swing operation, the pilot pressure enters through port PAs (or PBs) and transfers the swing spool. The pressurized oil entering through Port P2 flows to Port As (or Bs) and is supplied to the swing motor. The return oil from the swing motor enters Port Bs (or As) and returns to the hydraulic oil tank through the tank port (T1).

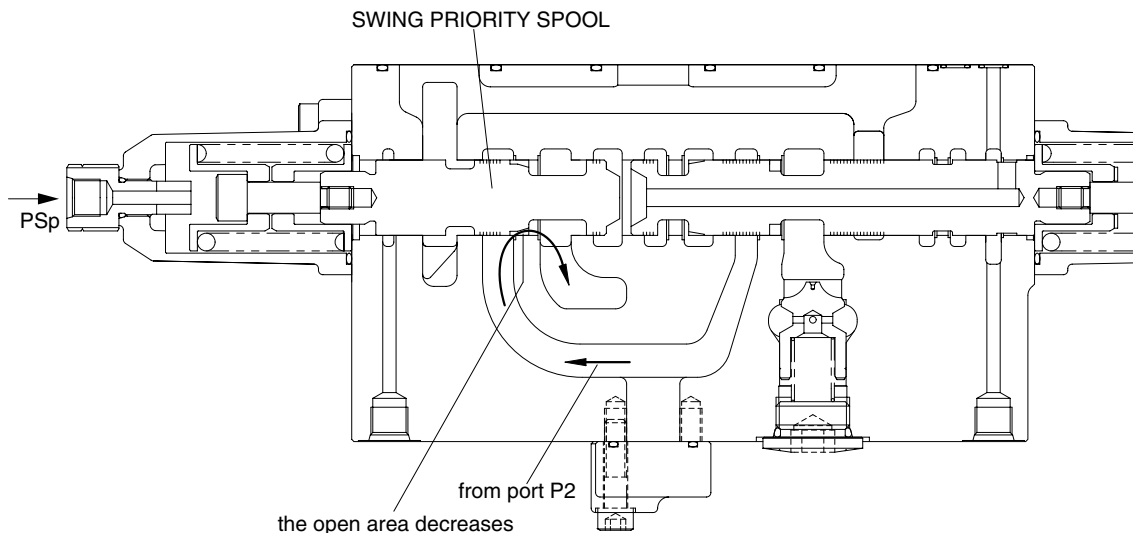
② Swing operation preference function

[Pilot Circuit]

The pilot pressure enters through Port PSp to transfer the swing priority spool (395).

[Main Circuit]

Due to transfer of the swing priority spool, the open area of the swing priority spool decreases, and the most of the pressurized oil entering through port P2 flows to the swing side to make the swing operation most preferential.



3607A2MC22

(7) Travel straight operation

Simultaneous operating of both travel spools and other spool.

A case where both travel spools and swing spool are changed over will be considered.

(The pilot ports PAL, PAr and PAs are pressurized.)

[Pilot Circuit]

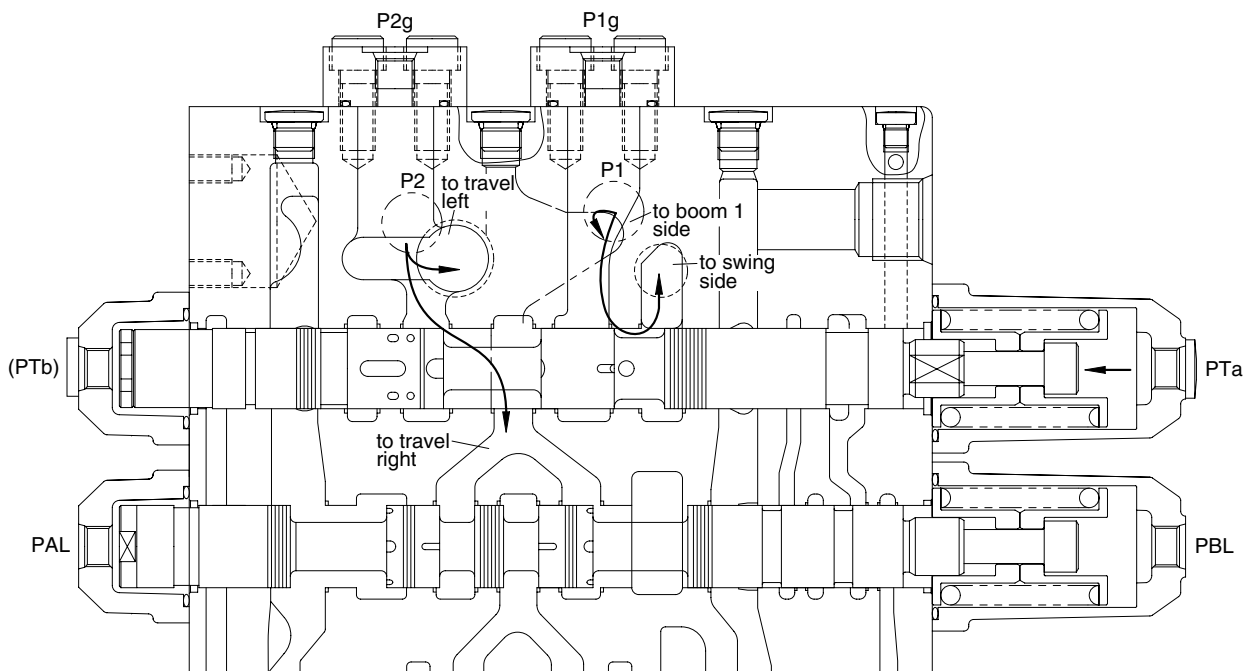
Since the side bypass sections of both travel spools close and the side bypass section of the downstream-side swing closes, the pilot pressure from the port Pa enters through the port PTa to transfer the travel straight spool.

[Main Circuit]

After changeover of the travel straight spool, the port P2 and both travel spools are connected preferentially and the port P1 and the parallel paths of swing, boom 2, option and arm 1 / boom 1, bucket and arm 2 are connected preferentially. Therefore, the pressurized oil entering through port P2 passes through mainly ports AL and Ar, and flows to both travel motors separately.

On the other hand, the pressurized oil entering through port P1 flows to port As and is supplied to the swing motor.

When the pressure of port P2 is lower than the pressure of port P1, part of oil entering through port P1 flows into port P2 side. Therefore, it prevents the rapid slowdown of travel.



3607A2MC23

(8) Function of lock valve

The lock valve is fitted between the arm cylinder rod side (R) and the arm1 spool (302). It decreases the leakage by the pressure of the cylinder.

Another lock valve is similarly fitted between the boom cylinder head side (H) and the boom1 spool (303). It decreases the leakage by the pressure of the cylinder.

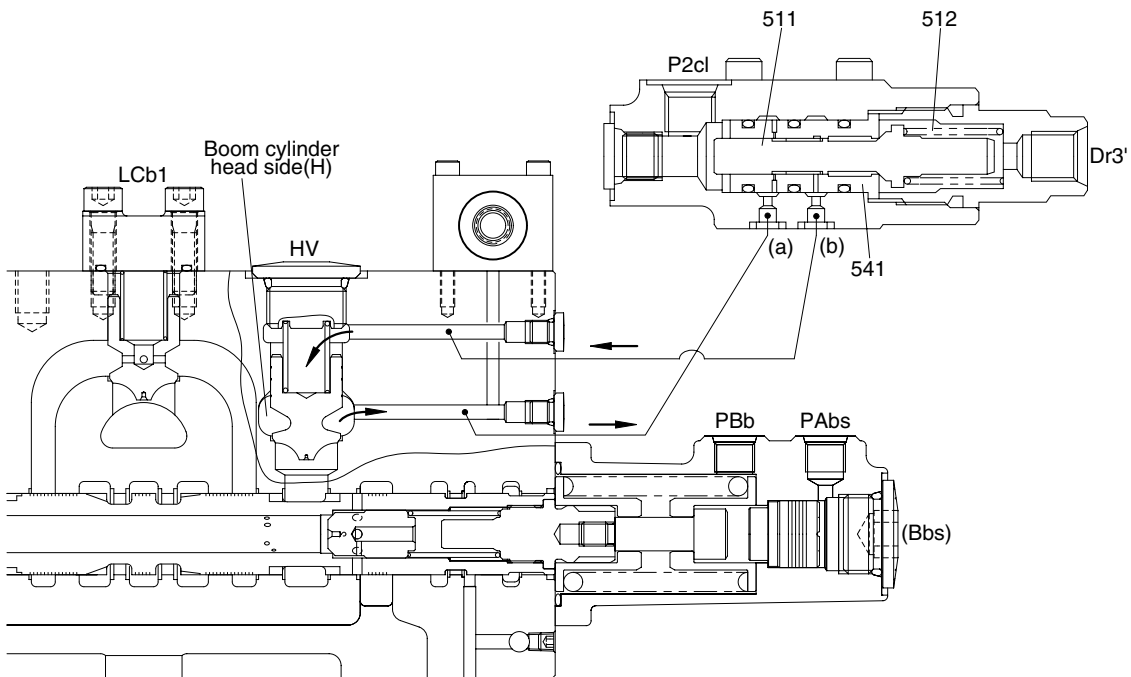
① Neutral positions of spools

The following is the case of the boom 1 spool.

(The case of the arm 1 spool is in the same way.)

During the boom 1 spool is in neutral position, the lock valve is kept in the position shown in figure. The spool (511) in lock valve is pushed to the seat of the bush (541) by the force of the spring (512).

In this position, pressurized oil from the boom cylinder head side (H) enters through hole (a), the periphery of the spool and hole (b), and it pushes the poppet to the casing seat, and the leakage is decreased.

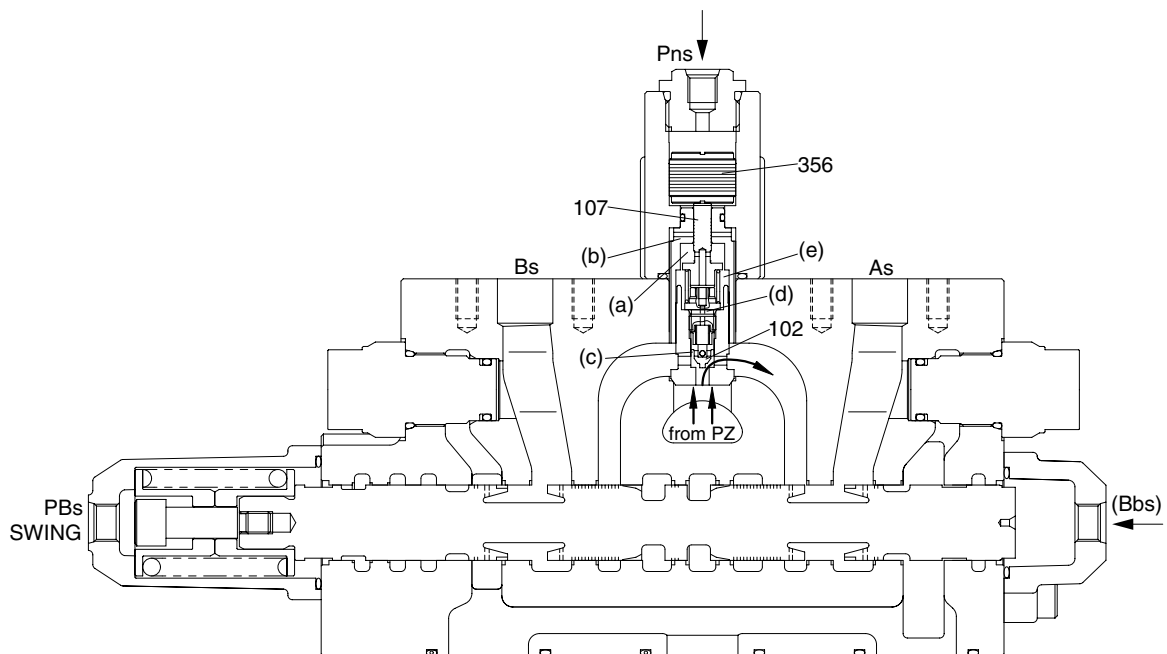


3607A2MC24

(9) Function of boom priority valve

During both the swing operation and the boom hoisting operation, the pilot pressure enters through ports PAs(or PBs), PBb and Pns. The pressure Pns transfers the piston (356) and the spool (107) to the down direction, and the path from (a) to (b) is closed. Hereby, the pressurized oil pushes open the poppet (102), passes in the path (c) and (d), enters into the chamber (e), and the poppet (101) is pushed to the casing seat. Therefore, the most of pressurized oil entering through port P2 flows to the boom priority spool (393) than the swing spool (305) to make the boom hoisting operation most preferential.

On the other hand, in the independent swing operation, the pilot pressure does not enter through ports Pns, and the path from (a) to (b) is not closed, and oil of chamber (e) flows to the path (a) and (b). The pressurized oil entering through port P2 pushes open the poppet (101) and flows to the swing spool (305).

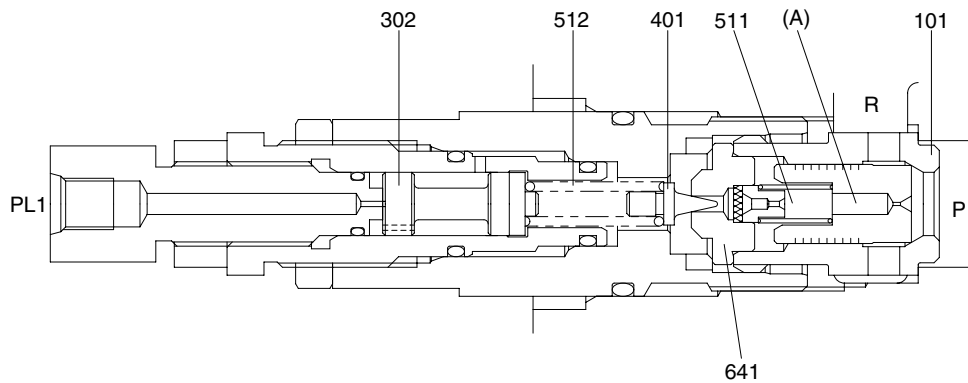


3607A2MC26

(10) Function of main relief valve

The main relief valve is fitted in the casing B and functions as follows :

- ① The hydraulic oil is filled up in the inside space chamber (A) from the path (P) through a hole of the body (101) and a restriction of the plunger (511), and seats the plunger (511) against body (101) securely.
- ② When the pressure in the path (P) becomes equal to the set load of the spring (512), the poppet (401) opens to make the hydraulic oil flow through a hole of the seat (2) (641), around the poppet (401) and into the low pressure path (R).
- ③ Opening of the poppet (401) causes the pressure in the chamber (A) to fall and the plunger (511) to open. As the result the pressurized oil in the path (P) runs into the low pressure path (R) directly.
- ④ When the pressurized oil higher than pressure 2.2MPa enters through the port PL1, it pushes the piston (302) to change the relief set pressure of the spring (512) to the high pressure.



3607A2MC27

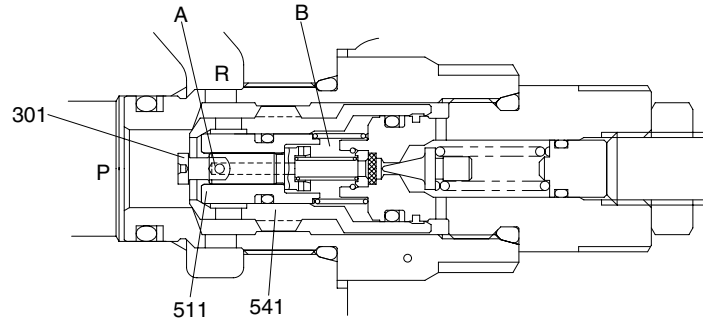
(11) Function of port relief valve

The port relief valve is fitted between the cylinder port and low-pressure path.

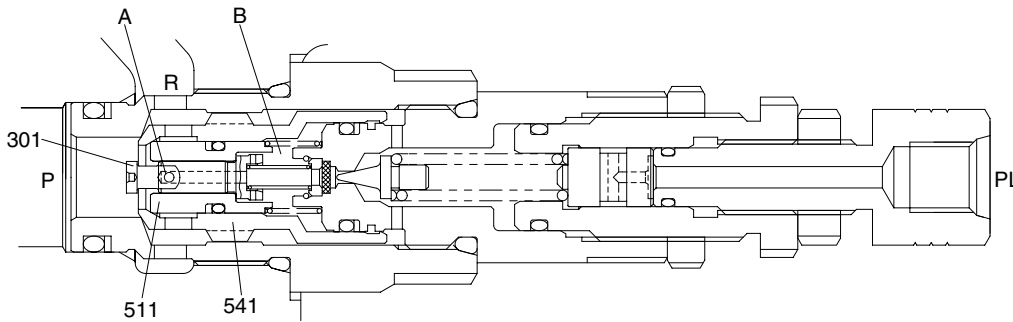
In addition to the relief valve, this serves also as an anti-cavitation check valve, and functions as follows:

(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.

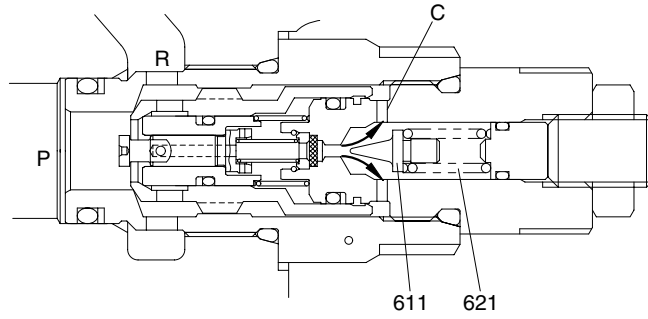


3607A2MC28

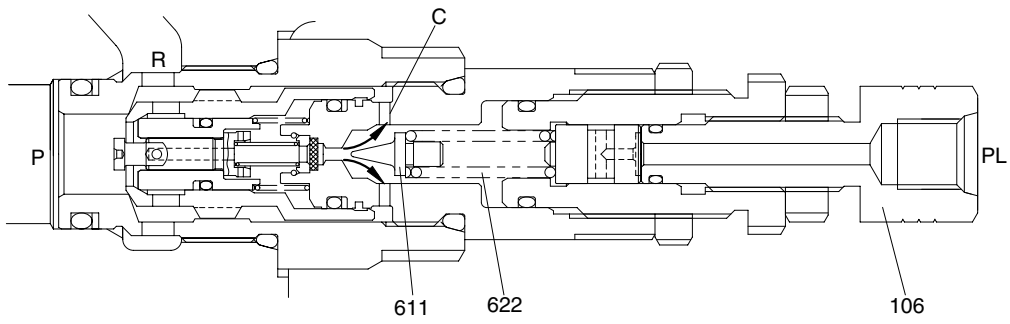


3607A2MC29

- ② When the pressure in the path (P) becomes equal to the set pressure of the spring (621 or 622), the pressurized oil pushes open the poppet (611), flows around it, and flows to the low pressure path (R) through Hole C.

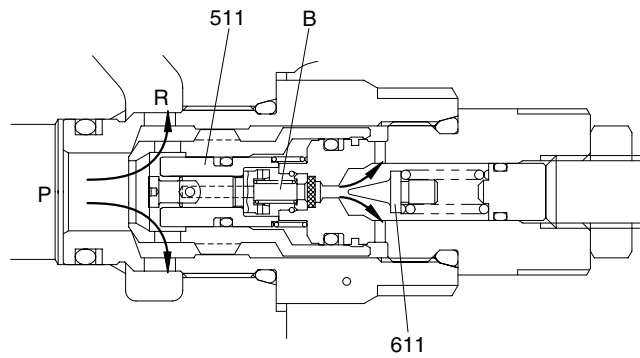


3607A2MC30

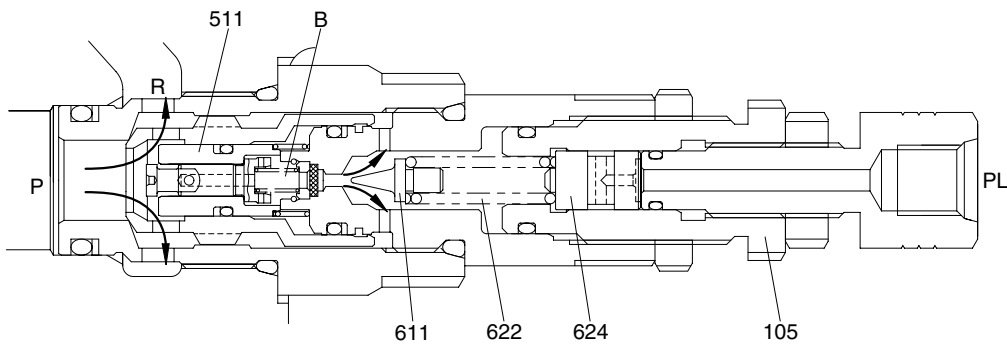


3607A2MC31

- 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 in the path (P) runs into the low pressure path (R) directly.



3607A2MC32



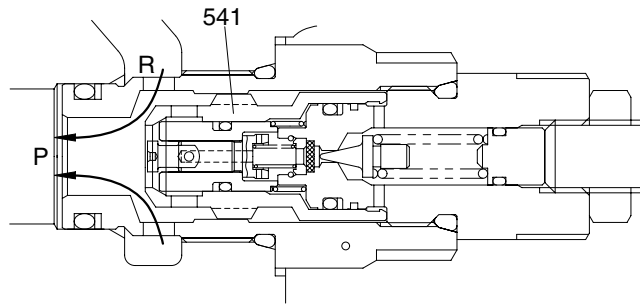
3607A2MC33

- ④ When the pressurized oil higher than pressure 1.5MPa enters through the port PL, it pushes the piston (614) to change the relief set pressure of the spring (622) to the high pressure.

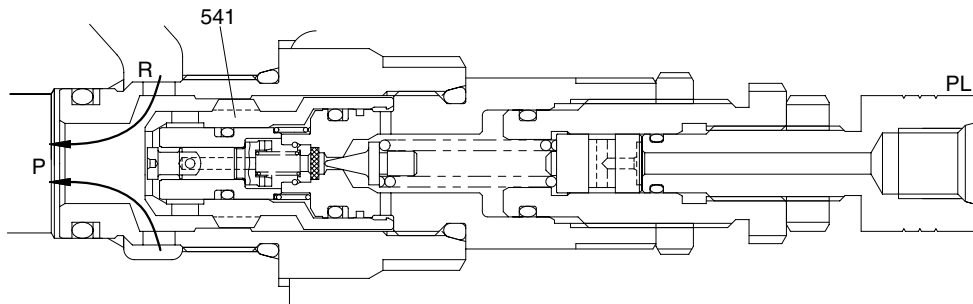
(2) Function as anti-cavitation check valve

When any negative pressure exists in the path (p), the oil is supplied through the path (R). When the pressure at (R) becomes higher than that in the path (P), the seat (541) moves in the right direction.

Then, sufficient oil passes around the seat (541) from the path (R) to the path (P) and prevents cavitation.



3607A2MC34

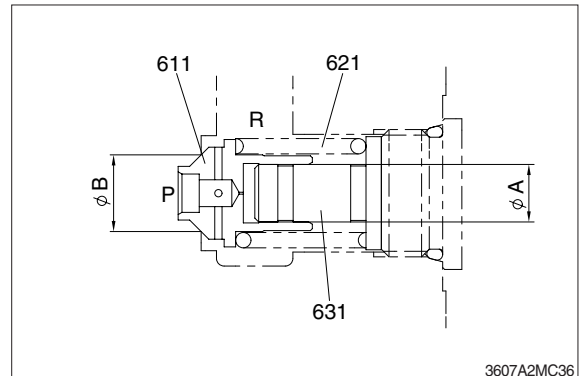


3607A2MC35

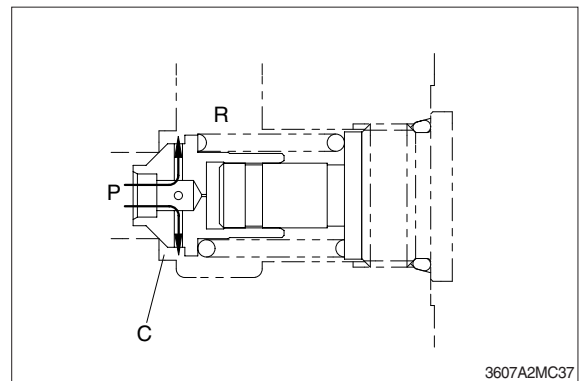
(12) Function of negative control relief valve

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

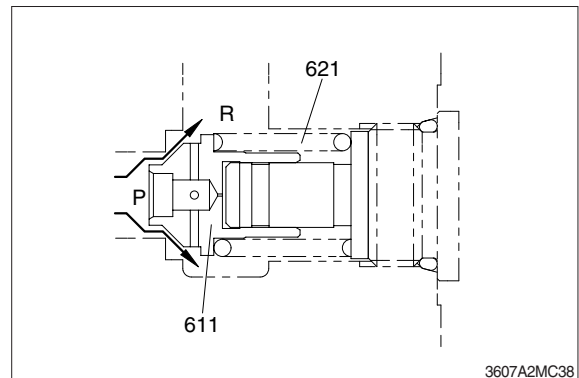
- ① When the pressure in the path (P) falls below the set level of the spring (621), the poppet (611) is in the condition shown in the figure. The pressure acting area of the poppet (611) is reduced to $(\phi B - \phi A)$, as the area ϕB is cancelled by the area ϕA of the damping rod (631).



- ② In this condition, the pressurized oil in the path (P) runs out to the path (R) through the orifice (c).



- ③ When the pressure in the path (P) goes over the set pressure of the spring (621), the poppet (611) opens. Then, the pressurized oil in the path (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 the path (P) to the low-pressure path (R) is as shown in the diagram.

