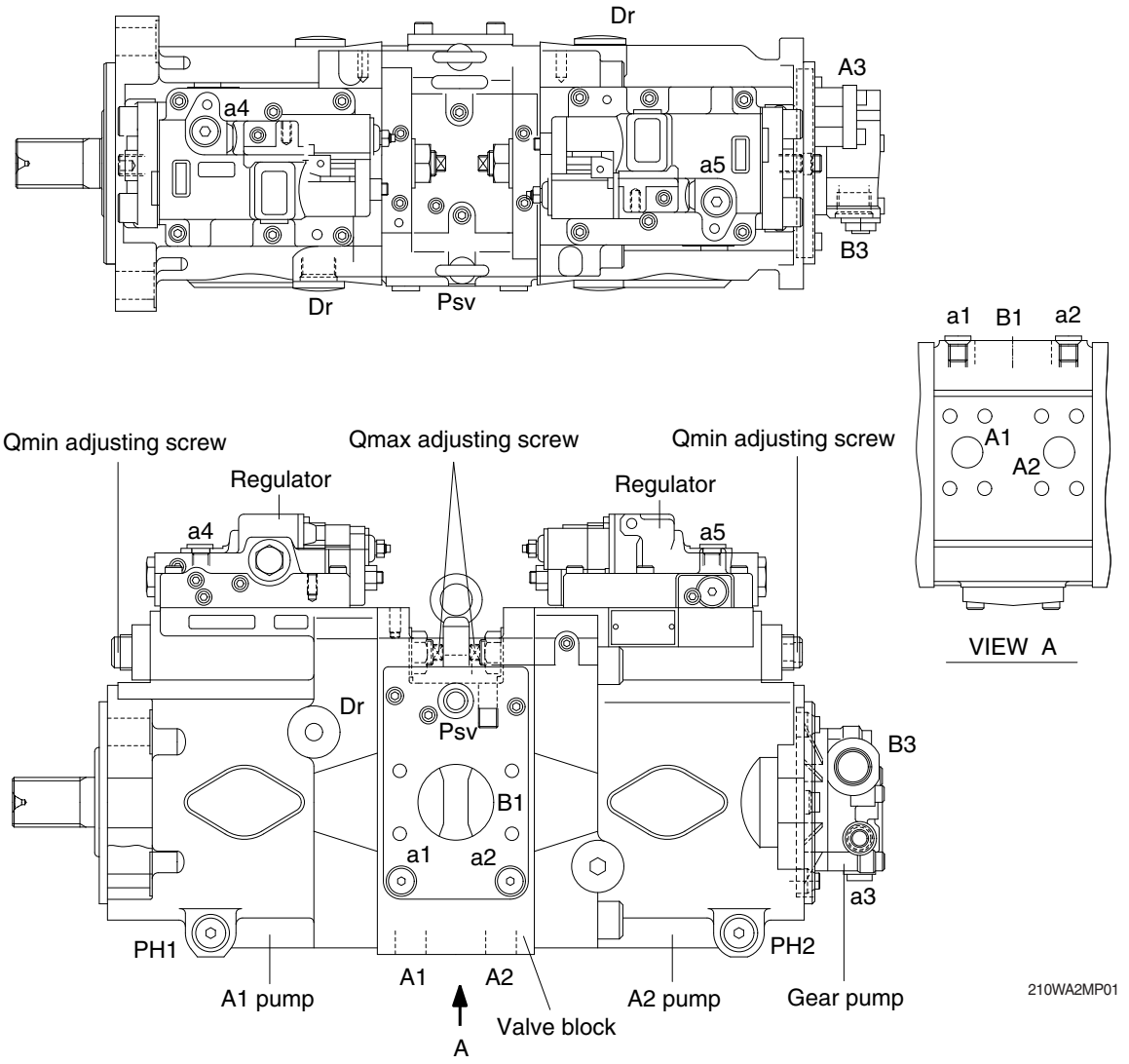
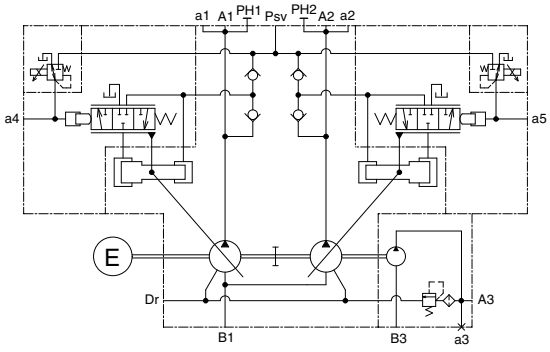
SECTION 2 STRUCTURE AND FUNCTION

GROUP 1 PUMP DEVICE

1. STRUCTURE

The pump device consists of main pump, regulator, gear pump and EPPR valve assy.

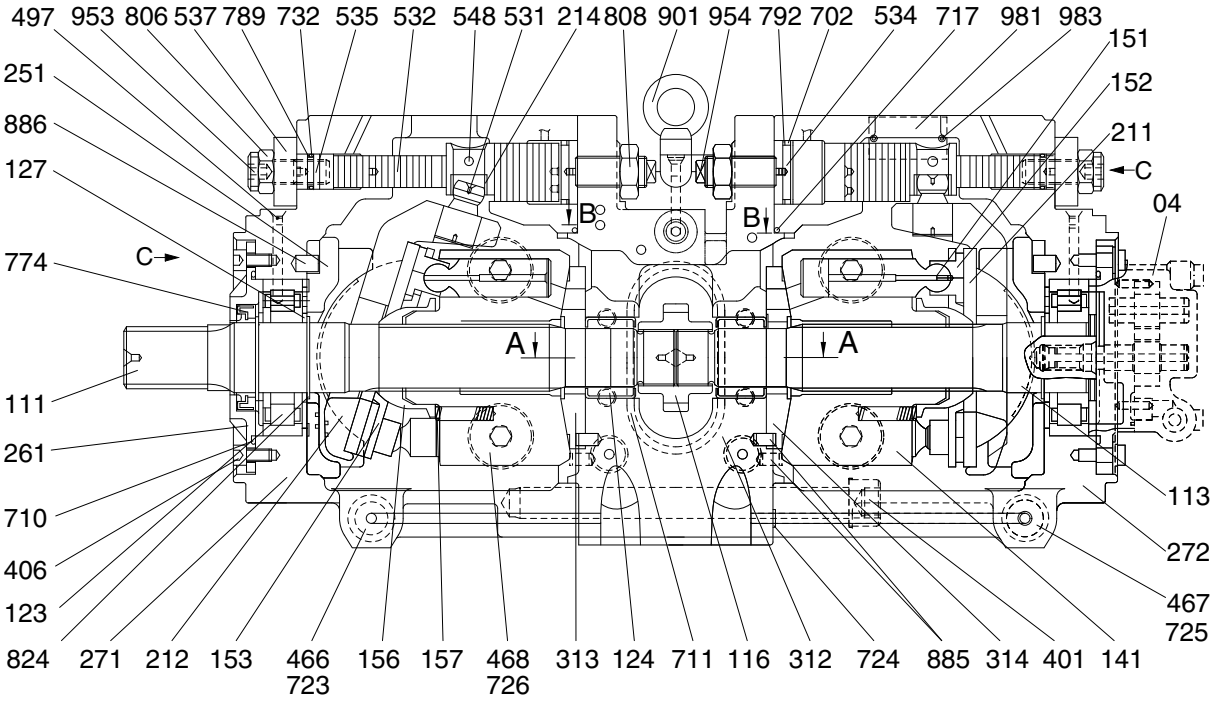




Port	Port name	Port size
A1,2	Delivery port	SAE 6000 psi 1"
B1	Suction port	SAE 2500 psi 2 1/2"
Dr	Drain port	PF 3/4-20
Psv	Servo assist port	PF 3/8-17
PH1,2	Pressure sensor port	PF 3/8-17
a1,2	Gauge port	PF 1/4-15
a3	Gauge port	PF 1/4-14
a4,5	Gauge port	PF 1/4-15
A3	Gear pump delivery port	PF 1/2-19
B3	Gear pump suction port	PF 3/4-20.5

1) MAIN PUMP (1/2)

The main pump consists of two piston pumps (front & rear) and valve block.

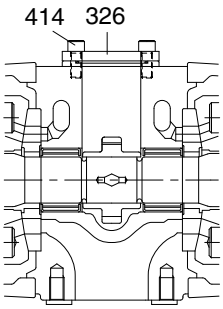


※ Section A-A, B-B, view C : see next page.

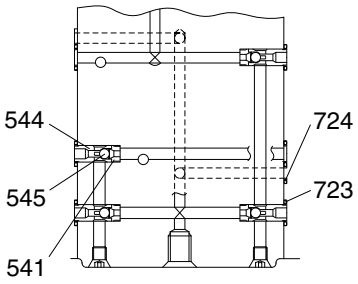
210WA2MP05

04	Gear pump	272	Pump casing (R)	723	O-ring
111	Drive shaft (F)	312	Valve block B	724	Square ring
113	Drive shaft (R)	313	Valve plate (R)	725	O-ring
116	1st gear	314	Valve plate (L)	726	O-ring
123	Roller bearing	401	Hexagon socket bolt	732	O-ring
124	Needle bearing	406	Hexagon socket bolt	774	Oil seal
127	Bearing spacer	466	Plug	789	Back up ring
141	Cylinder block	467	Plug	792	Back up ring
151	Piston	468	Plug	806	Hexagon head nut
152	Shoe	497	Plug	808	Hexagon head nut
153	Set plate	531	Tilting pin	824	Snap ring
156	Spherical bushing	532	Servo piston	885	Pin
157	Cylinder spring	534	Stopper (L)	886	Pin
211	Shoe plate	535	Stopper (S)	901	Eye bolt
212	Swash plate	537	Servo cover	953	Hexagon socket set screw
214	Tilting bushing	548	Feedback pin	954	Set screw
251	Support	702	O-ring	981	Name plate
261	Seal cover (F)	710	O-ring	983	Pin
271	Pump casing (F)	711	O-ring		
		717	O-ring		

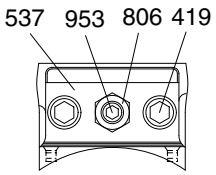
MAIN PUMP (2/2)



SECTION A-A



SECTION B-B

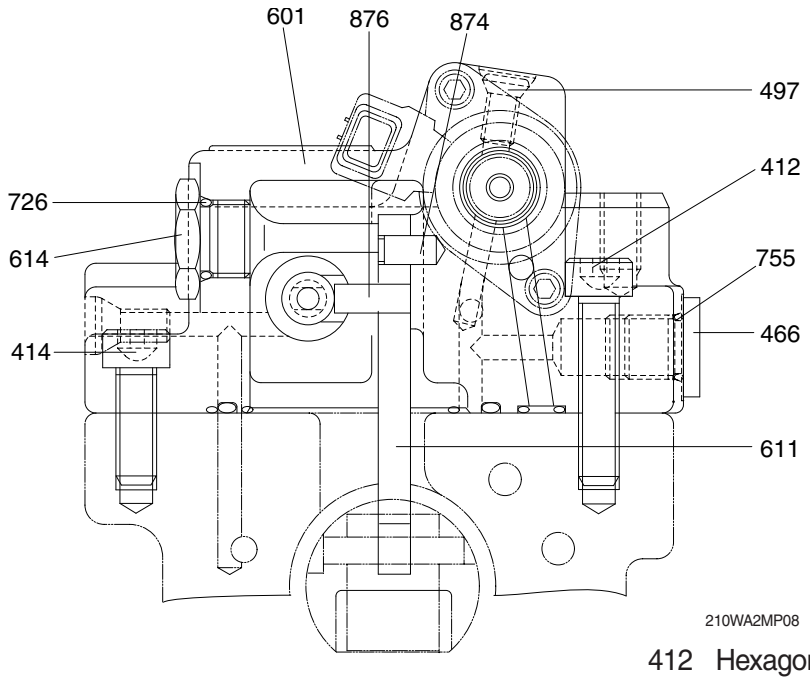


VIEW C

210WA2MP06

326	Cover	541	Seat	724	Square ring
414	Hexagon socket bolt	544	Stopper 1	806	Hexagon head nut
419	Hexagon socket bolt	545	Steel ball	953	Hexagon set screw
537	Servo cover	723	O-ring		

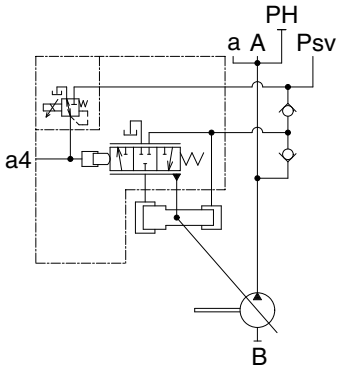
2) REGULATOR (1/2)



210WA2MP08

SECTION A-A

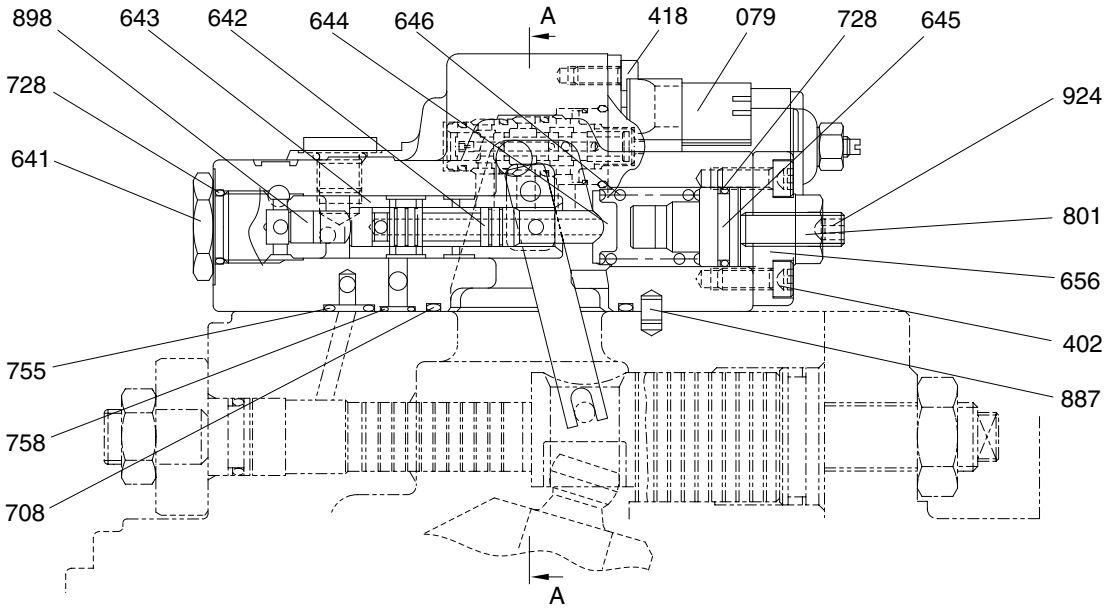
See next page



412 Hexagon socket screw
414 Hexagon socket screw
466 Plug
497 Plug
601 Regulator casing
611 Feed back lever
614 Adjust plug
726 O-ring
755 O-ring
874 Pivot pin
876 Pin

Port	Port name	Port size
A	Delivery port	SAE 6000 psi 1"
B	Suction port	SAE 2500 psi 2 1/2"
Psv	Servo assist port	PF 3/8-17
a, a4	Gauge port	PF 1/4-15
PH	Pressure sensor port	PF 3/8-17

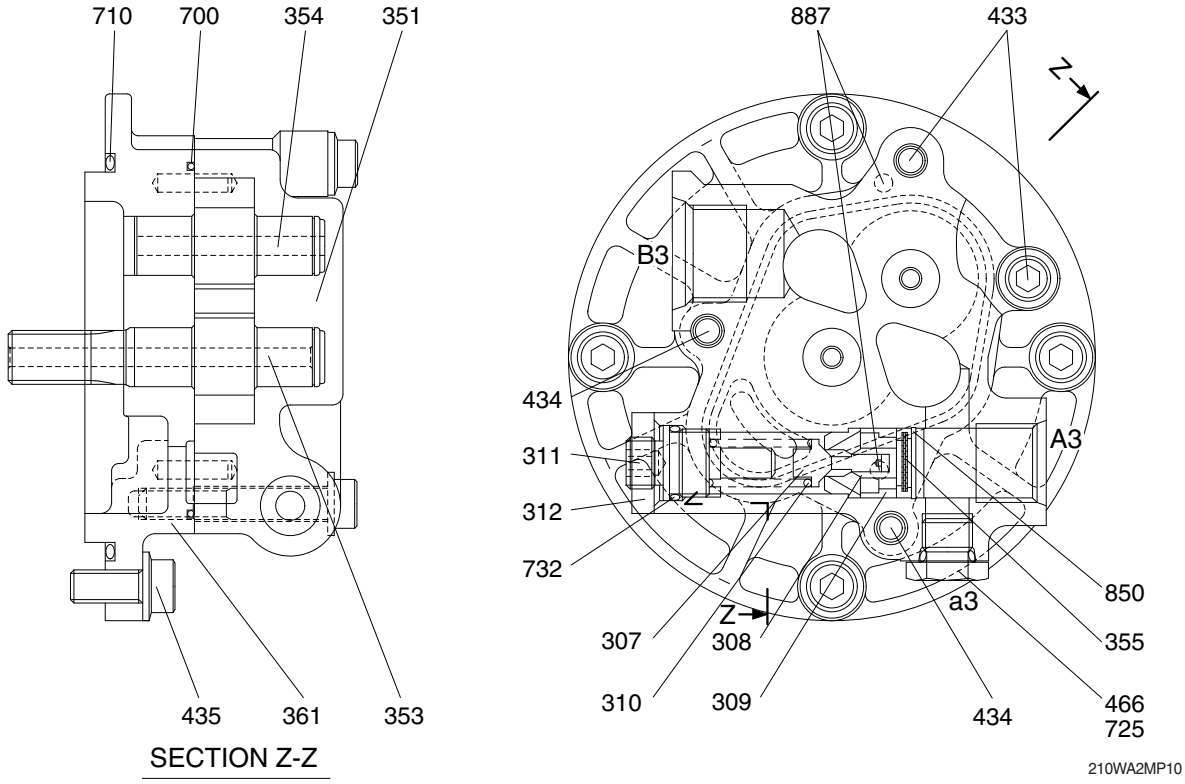
REGULATOR (2/2)



210WA2MP09

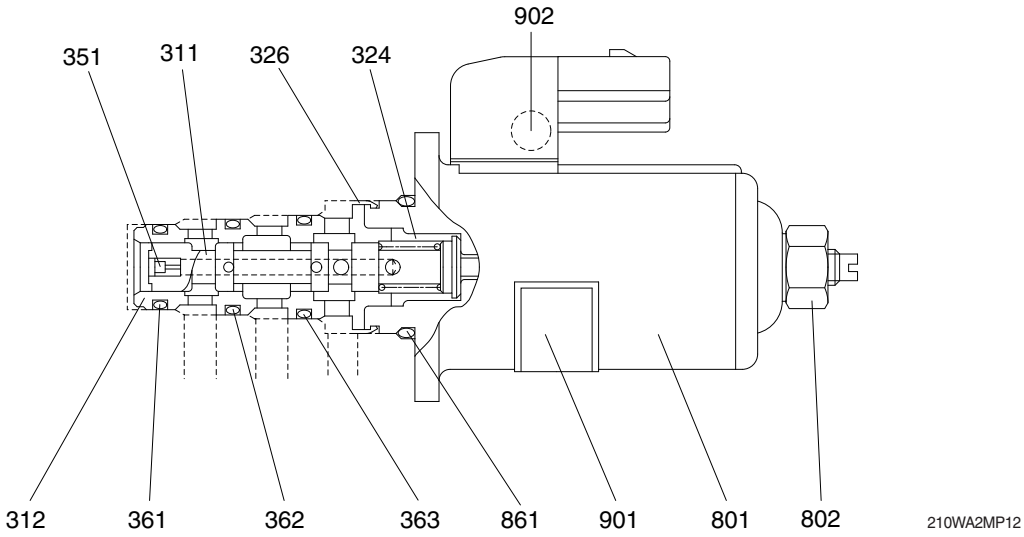
079	EPPR valve	644	Spring seat (Q)	755	O-ring
402	Hexagon socket screw	645	Adjust stem (Q)	758	Square ring
418	Hexagon socket screw	646	Pilot spring	801	Nut
641	Pilot plug	656	Cover	887	Pin
642	Pilot spool	708	O-ring	898	Piston piston
632	Pilot sleeve	728	O-ring	924	Hexagon socket set screw

3) GEAR PUMP



307	Poppet	353	Drive gear	466	Plug
308	Seat	354	Driven gear	700	Ring
309	Ring	355	Filter	710	O-ring
310	Spring	361	Front case	725	O-ring
311	Adjusting screw	433	Flange socket bolt	732	O-ring
312	Lock nut	434	Flange socket bolt	850	Snap ring
351	Gear case	435	Flange socket bolt	887	Pin

4) EPPR VALVE ASSY



311	Spool	361	O-ring	802	Seal nut
312	Sleeve	362	O-ring	861	O-ring
324	Spring	363	O-ring	901	Name plate
326	Retaining ring	801	Solenoid	902	Function name plate
351	Orifice				

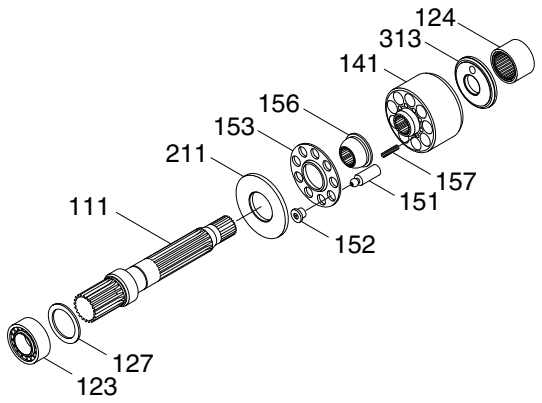
2. MAIN PUMP

The pumps may be classified roughly into the rotary group performing a rotary motion and working as the major part of the whole pump function: the swash plate group that varies the delivery flow: and the valve block group that changes over oil suction and discharge.

1) ROTARY GROUP

The rotary group consists of drive shaft (F) (111), bearing spacers (127), cylinder block (141), piston shoes (151, 152), set plates (153), spherical bushings (156) and cylinder springs (157). The drive shaft is supported by bearings (123, 124) at its both ends.

The shoe is caulked to the piston to form a spherical joint for lessening thrust force generated by load pressure and has grooves to slide on the shoe plate (211) smoothly and hydraulically balanced. The piston-shoe sub group is pushed onto the shoe plate by the cylinder springs through the set plate and spherical bushing for enabling smooth sliding on the shoe plate. Similarly, the cylinder block is pushed onto the valve plate (313, 314) by the cylinder springs (157).



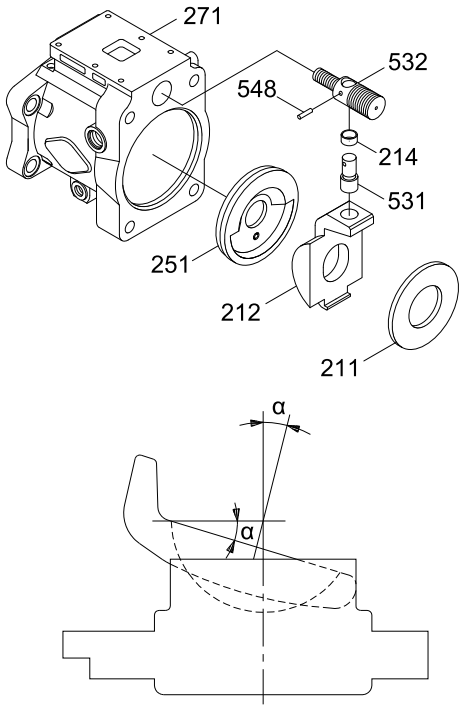
220S2MP13

2) SWASH PLATE GROUP

The swash plate group consists of pump casing (271), swash plate (212), shoe plate (211), swash plate support (251), tilting bushing (214), tilting pin (531) and servo piston (532).

The swash plate is supported by the swash plate support at the cylindrical portion formed on the opposite side of the shoe sliding face.

When the servo piston is moved to the left or right by introducing the hydraulic force controlled by the regulator into the hydraulic chamber provided on both ends of the servo piston, the swash plate slides over the swash plate support through the spherical portion of the tilting pin and can vary the tilting angle (α).



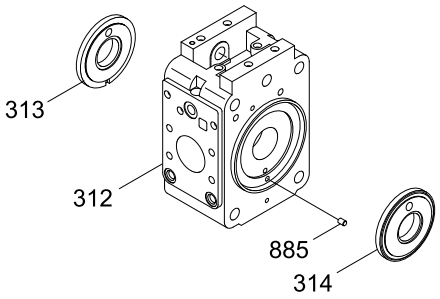
210WA2MP14

3) VALVE BLOCK GROUP

The valve block group consists of the valve block (312), valve plate (313, 314) and valve plate pin (885).

The valve plate having two arc ports is attached to the valve block and feeds and collects oil to and from the cylinder block.

The oil exchanged by the valve plate is connected to an external piping through the valve block.



210WA2MP15

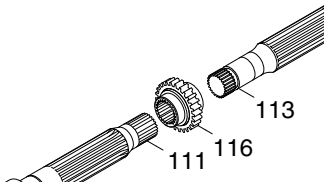
4) PTO GROUP

The PTO group is composed of the 1st gear (116), 2nd gear (111) and 3rd gear (113).

The 2nd gear (111) and 3rd gear (113) are supported by the bearings, respectively and attached to the valve block.

Now, suppose the drive shaft is rotated by the motor or engine, the cylinder block is also rotated through the spline conection. If the swash plate is tilted, the pistons arranged inside the cylinder reciprocate relatively to the cylinder, rotating with the cylinder block. Accordingly, if a piston is focused on, its motion is separating from the valve plate (oil suction process) for 180 degrees, and approaching the valve plate (oil delivery process) for the remaining 180 degrees. When the swash plate has a tilting angle of zero, the piston makes no stroke and discharges no oil.

In the meantime, the rotation of the drive shaft is picked up by the 1st gear (116), transmitted to the 3rd gear (113) through the 2nd gear (111), and drives the auxiliary pump connected to the 3rd gear (113).



220F2MP11

3. REGULATOR

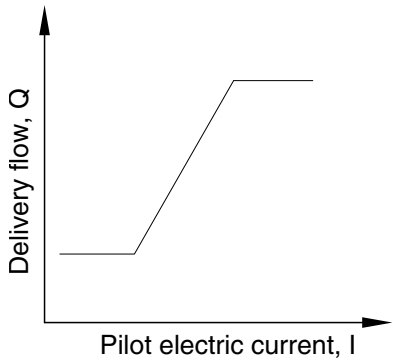
1) OUTLINE

The regulator for the K7V series axial piston pump has various models to satisfy various kinds of specifications required.

Electric flow control

By changing the pilot electric current I for proportional reducing valve, the pump tilting angle (delivery flow) is controlled arbitrarily, as shown in the figure.

This regulator has the positive flow control in which the delivery flow Q increases as the pilot electric current I increases. With this commanded, the pump discharges the required flow only, and so it does not consume the power uselessly.

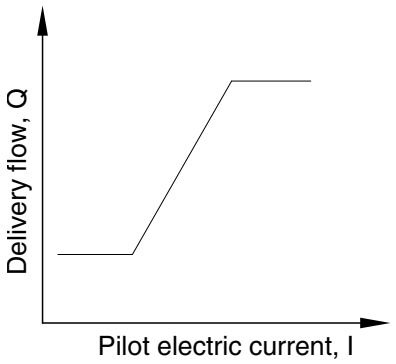


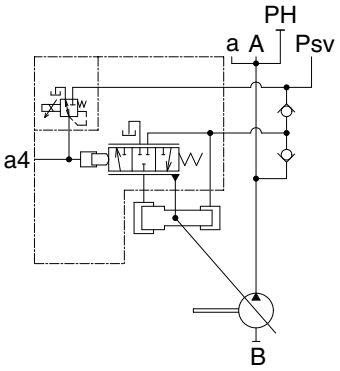
220F2MP16

2) FUNTION

(1) Flow control

By changing the pilot electric current I, the pump tilting angle (delivery flow) is regulated arbitrarily, as shown in the figure.





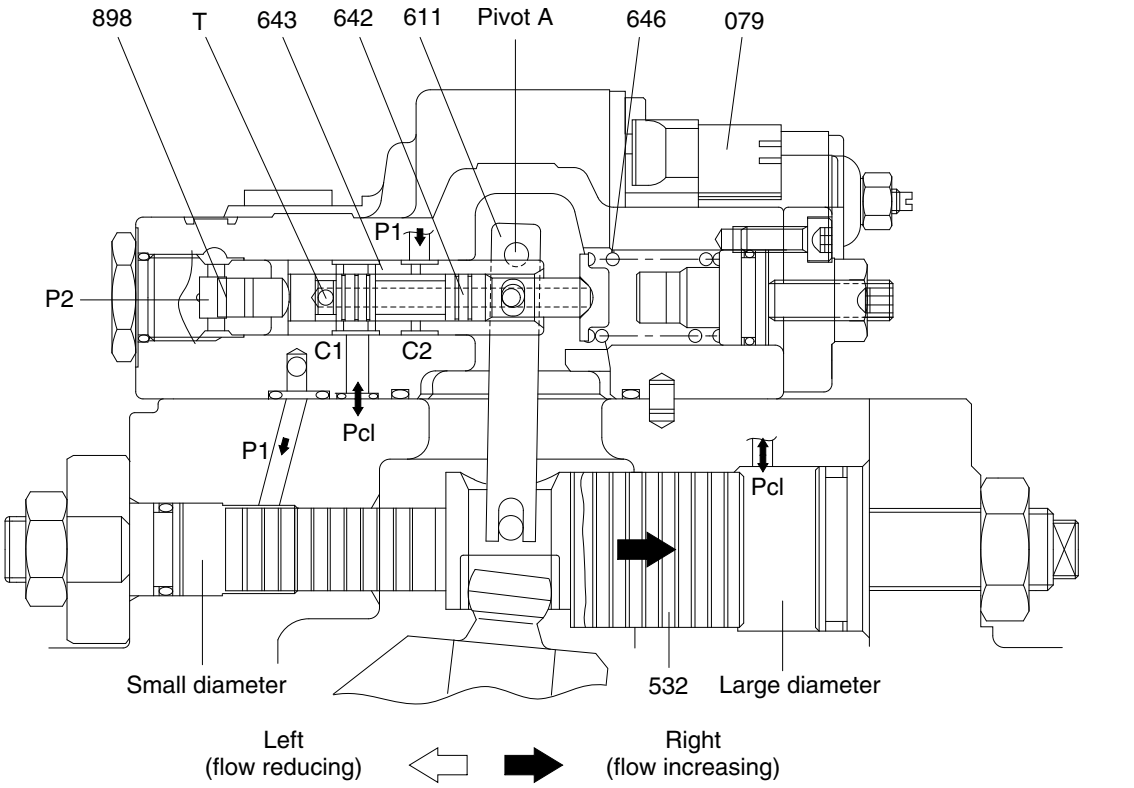
220F2MP17

① Flow increasing funtion

As the pilot electric current I increases, the secondary pressure of the proportional pressure reducing valve (079) increases too. Then the pilot spool (642) through the pilot piston (898) moves to the right to position where the force of the pilot spring (646) balances with the hydraulic force.

The movement of the pilot spool (642) causes the port C1 connects to the tank port (T). This deprives the pressure of the large-diameter section of the servo piston (532) and moves the servo piston (532) to the right by the discharge pressure P1 in the small-diameter section, resulting in the flow rate increase.

The feedback lever (611) links both the servo piston (532) and the pilot sleeve (643). When the servo piston (532) moves, the feedback lever (611) rotates around the pivot A, and the pilot sleeve (643) moves to the left. This causes the opening between the pilot sleeve (643) and the pilot spool (642) to close slowly, and the servo piston (532) comes to being stop completely when the port C1 closes completely.

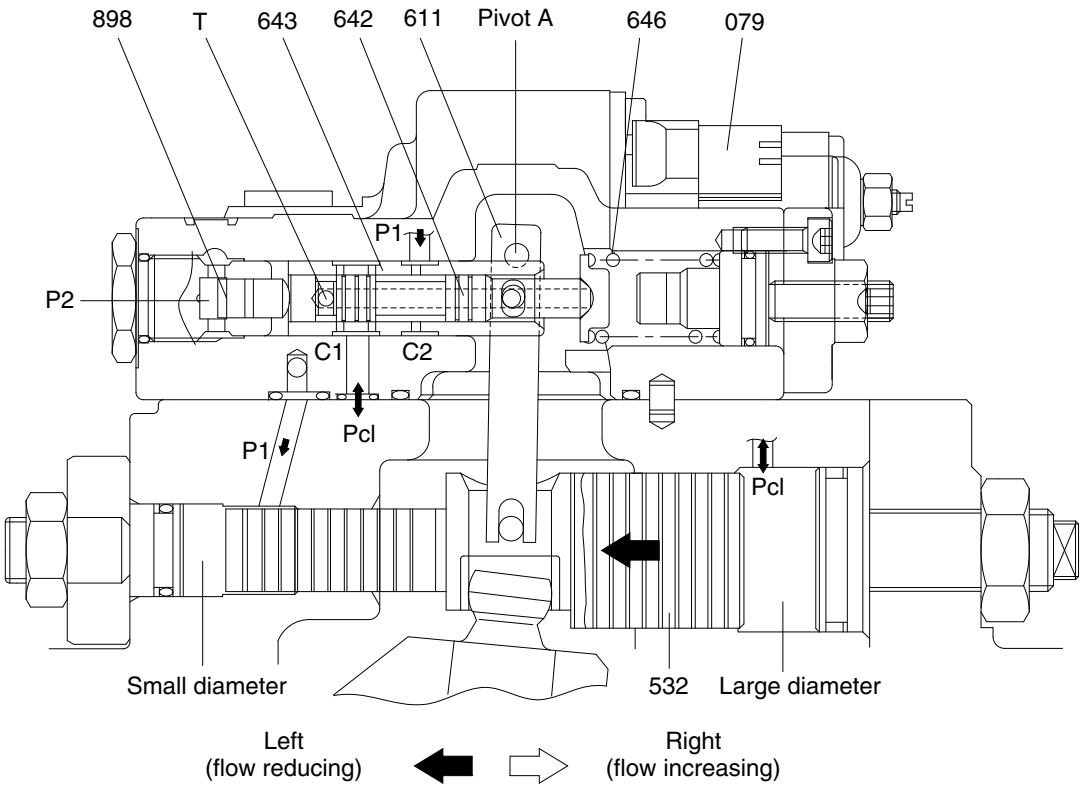


② **Flow reducing function**

As the pilot electric current I decreases, the secondary pressure of the proportional pressure reducing valve (079) decreases too, the pilot spool (642) moves to the left by action of the pilot spring (646).

The movement of the pilot spool (642) causes the delivery pressure P1 to connects to the port C2 through the pilot spool (642) and to be admitted to the large-diameter section of the servo piston (532). Although the delivery pressure P1 is constantly admitted to the small-diameter section of servo piston (532), the servo piston (532) moves to the left because of its difference of the area between large and small-diameter section. As a result, the tilting angle is decreased.

As the servo piston (532) moves, the feedback lever (611) rotates around the pivot A, and the pilot sleeve (643) moves to the right till the opening between the pilot spool (642) and pilot sleeve (643) being closed.



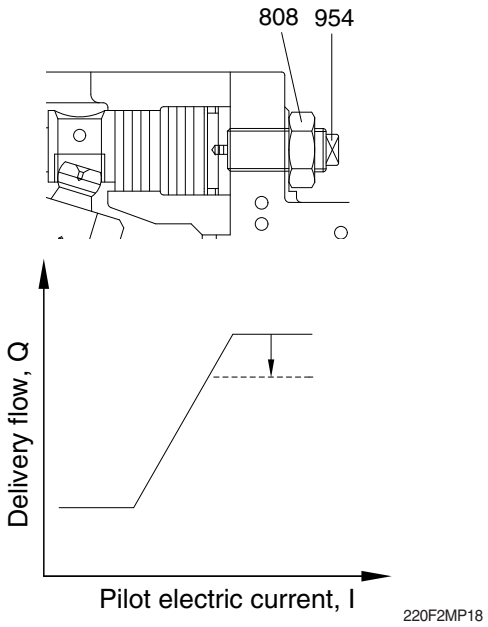
210WA2MP26

4. ADJUSTMENT OF MAXIMUM AND MINIMUM FLOWS

The maximum flow and minimum flow can be adjusted with the adjusting screws (954, 953) of the pump. The flow control characteristics can be adjusted with the hexagon socket set screw (924). The maximum flow and minimum flow can be adjusted with the adjusting screws of the pump.

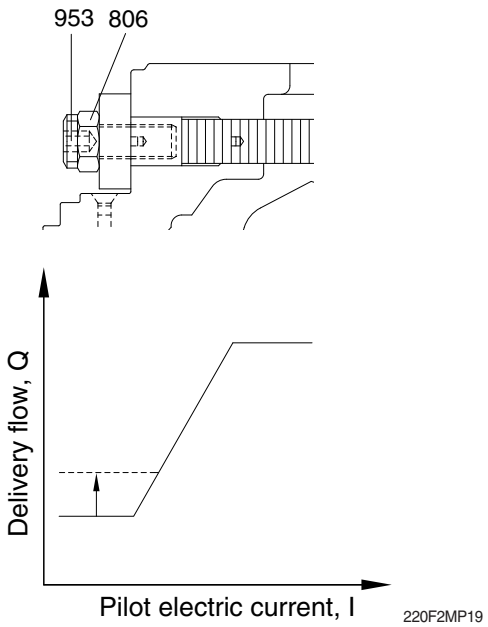
1) ADJUSTMENT OF MAXIMUM FLOW (MAIN PUMP SIDE)

Adjust it by loosening the hexagon nut (808) and by tightening (or loosening) the adjust screw (954). Only the maxinum flow is adjusted without changing other control characteristics.

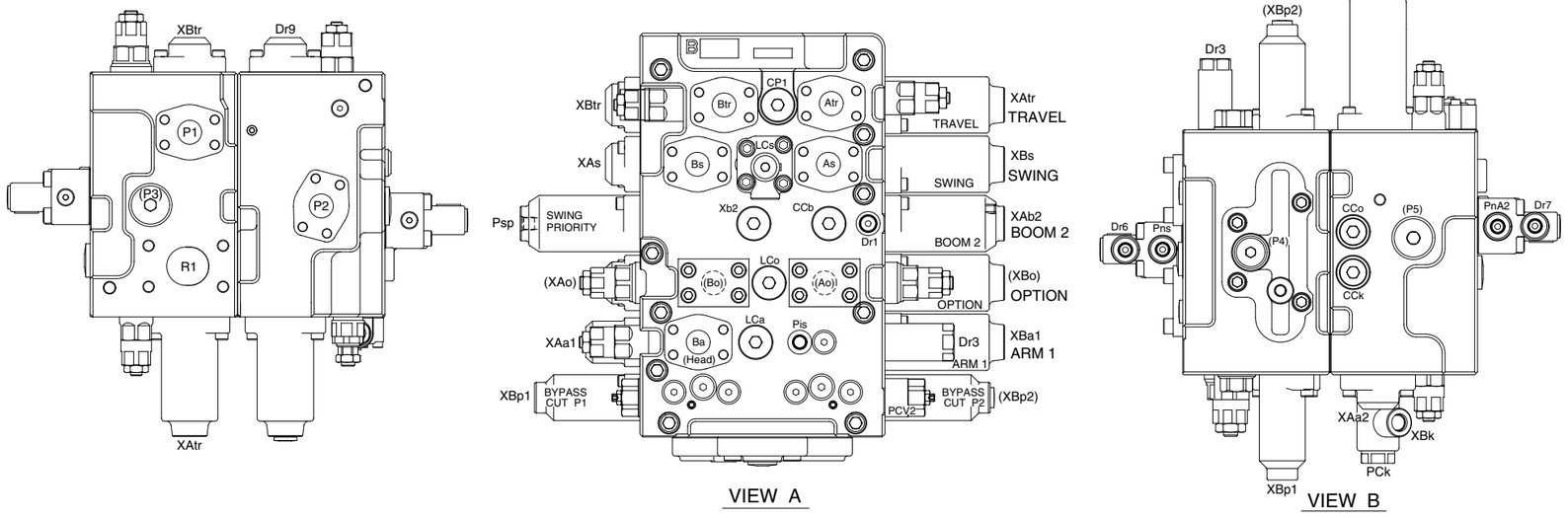


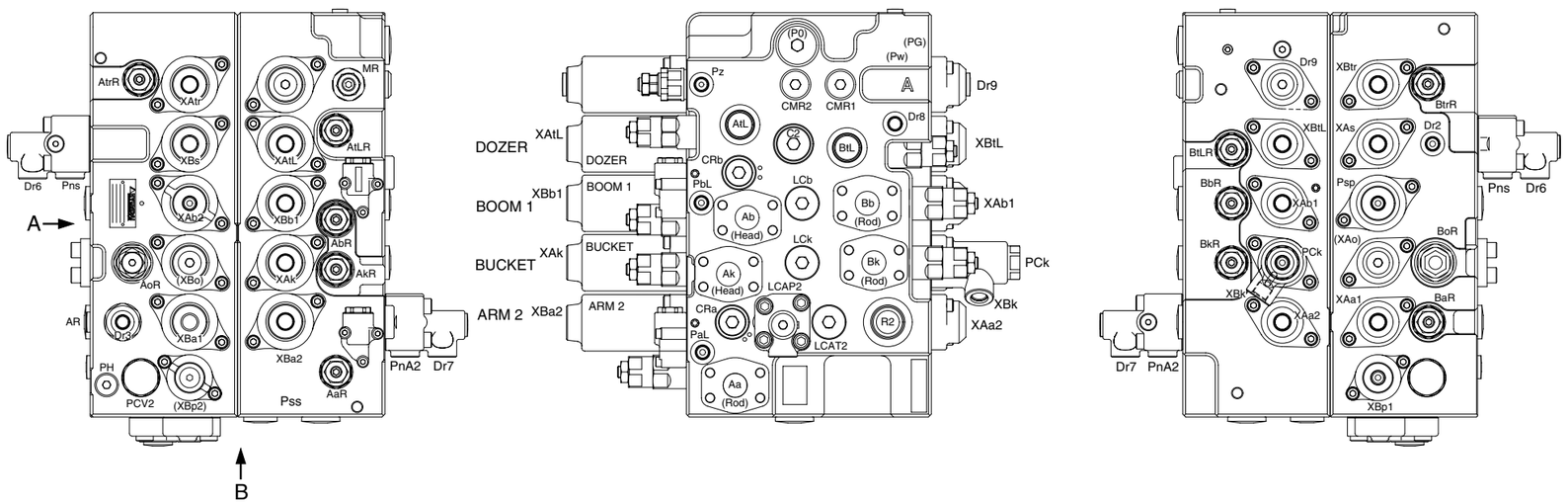
2) ADJUSTMENT OF MINIMUM FLOW (MAIN PUMP SIDE)

Adjust it by loosening the hexagon nut (806) and by tightening (or loosening) the hexagon socket head set screw (953). Similarly to the adjustment of the maximum flow, other characteristics are not changed. However, remember that, if tightened too much, the required horsepower at the maximum delivery pressure (or during relieving) may increase.



1. STRUCTURE

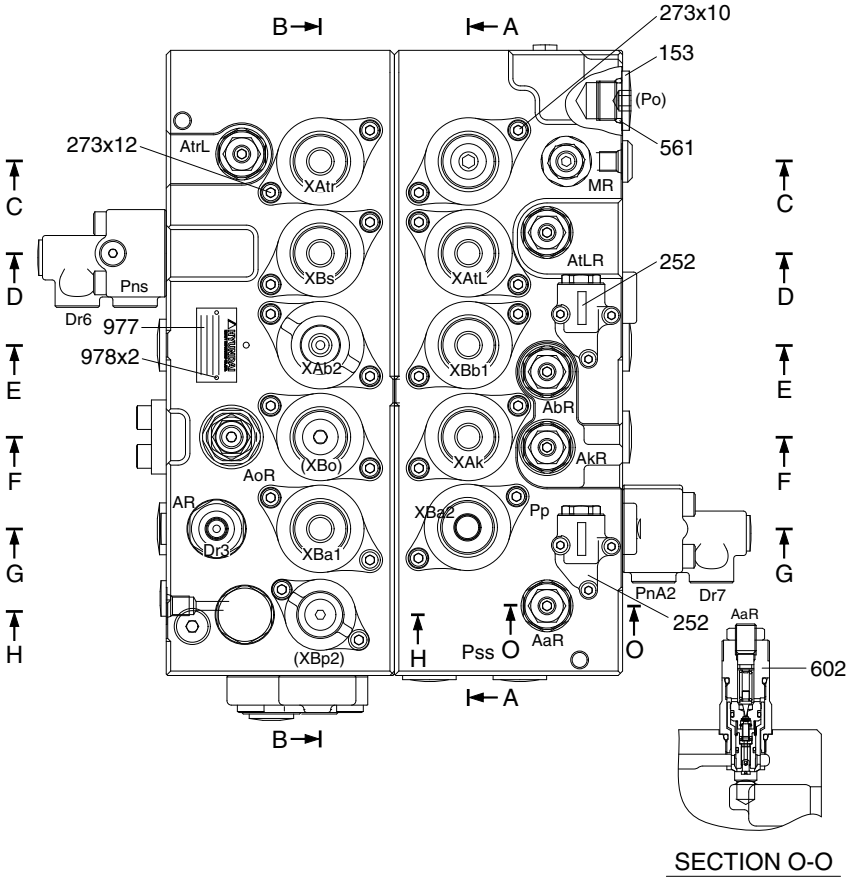




Mark	Port name	Port size	Tightening torque
R2	Make up port for swing	PF 1	20~25 kgf · m (115~180 lbf · ft)
XAtr XBtr (XAo) (XBo) XAk XBk XAb1 XBb1 XAa2 XBa2 XAtL XBtL XAs XBs XAa1 XBa1 Dr1 Dr9	Travel forward pilot port Travel reverse pilot port Optional pilot port Optional pilot port Bucket in pilot port Bucket out pilot port Boom up pilot port Boom down pilot port Arm out confluence pilot port Arm in confluence pilot port Dozer down pilot port Dozer up pilot port Swing right pilot port Swing left pilot port Arm out pilot port Arm in pilot port Drain port Drain port	PF 3/8	7~8 kgf · m (50.6~57.8 lbf · ft)
(Pw) Dr8 Pz (PG) Dr3 Dr6 Dr7 Pns PaL PbL XAb2 Psp XBp1 (XBp2) PCk Pis PnA2	Pressure port for auto idle signal Drain port Main relief set pressure up pilot pressure port Pilot pressure port Drain port Drain port Drain port Swing logic valve pilot port Lock valve pilot port (arm rod side) Lock valve pilot port (boom head side) Boom up confluence pilot port Swing priority pilot port Bypass cut spool pilot port (P1 side) Bypass cut spool pilot port (P2 side) Bucket in stroke limiter pilot port Arm regeneration cut pilot port Arm 2 logic valve pilot port	PF 1/4	3.5~3.9 kgf · m (25.3~28.2 lbf · ft)
Atr Btr (Ao) (Bo) Ak Bk Ab Bb As Bs Aa Ba P1 P2	Travel forward port Travel reverse port Optional port Optional port Bucket cylinder head side port Bucket cylinder rod side port Boom cylinder head side port Boom cylinder rod side port Swing motor right port Swing motor left port Arm cylinder rod side port Arm cylinder head side port Pump port (P1 side) Pump port (P2 side)	M10	5~6.6 kgf · m (36.1~47.7 lbf · ft)
R1	Return port	M12	8.5~11.2 kgf · m (61.5~81.1 lbf · ft)
AtL BtL (P0) (P3) (P5)	Dozer cylinder head side port Dozer cylinder rod side port Quick clamp solenoid valve supply port - -	PF 3/4	15.3~18.4 kgf · m (110.6~133 lbf · ft)
(P4)	-	PF 1/2	10~12.2 kgf · m (72.3~88.2 lbf · ft)

210WF2MC01

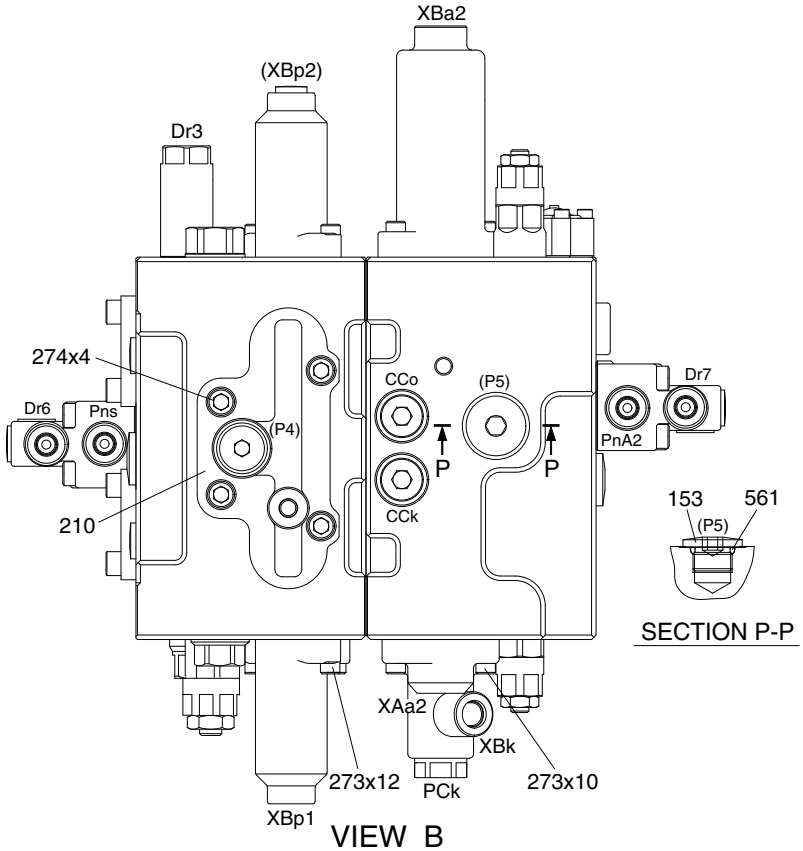
1) RELIEF VALVE SIDE VIEW



153 Plug
252 Lock valve selector sub assy
273 Socket screw
561 O-ring
602 Port relief valve assy
977 Name plate
978 Pin

210WA2MC02

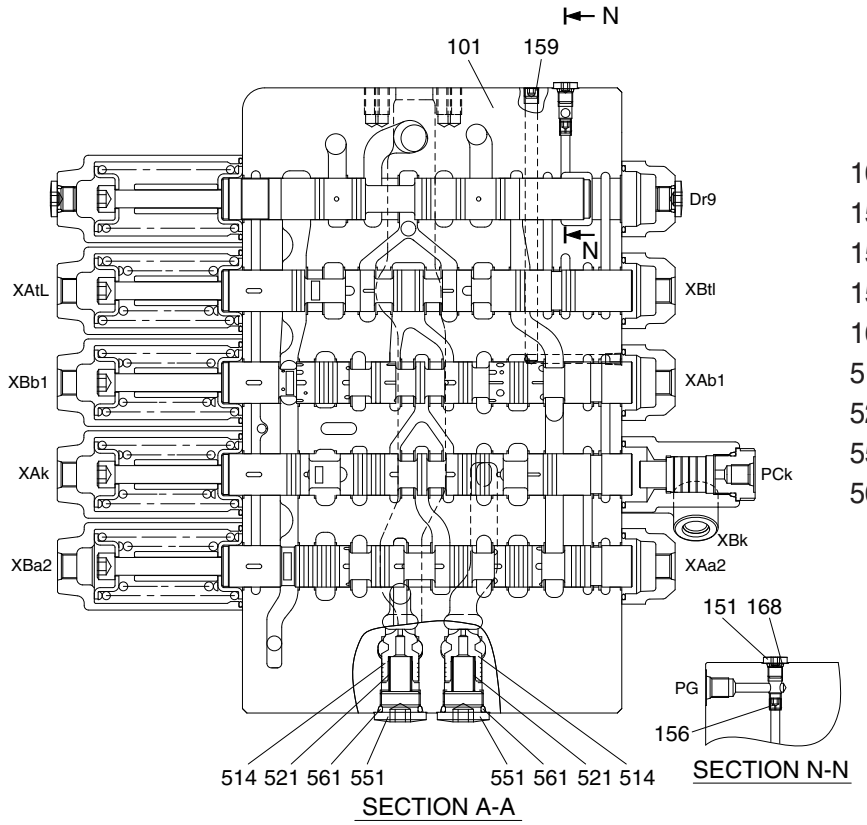
2) BYPAS CUT SPOOL SIDE VIEW



153 Plug
210 Plate
273 Socket screw
274 Socket screw
561 O-ring

210WA2MC03

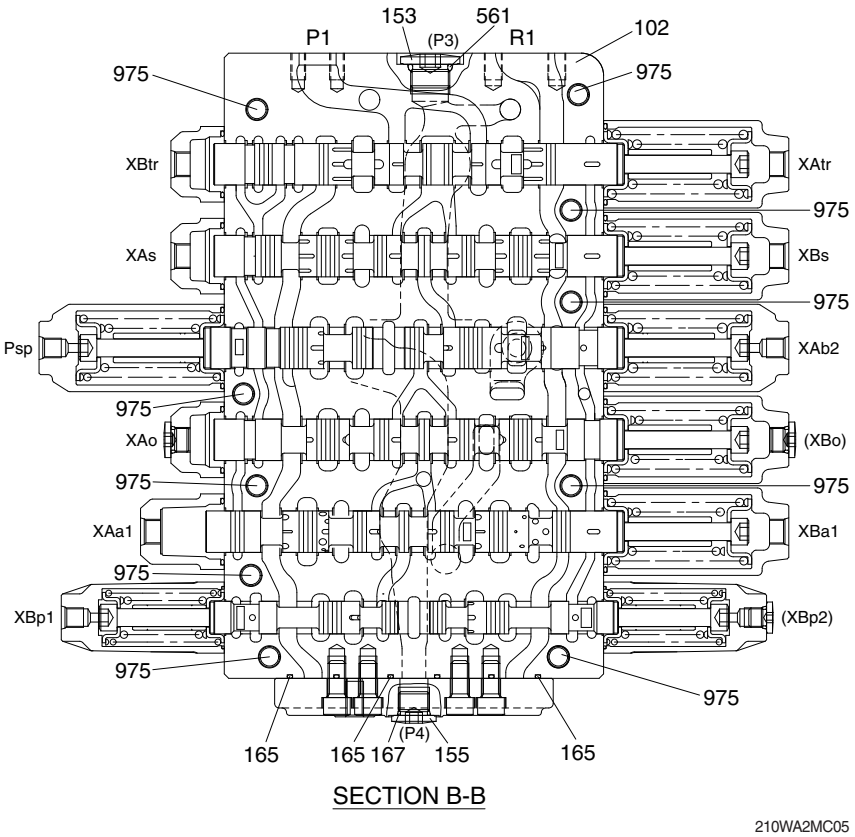
3) CASING A SPOOL SECTION



101 Casing A
151 Plug
156 Plug
159 Plug
168 O-ring
514 Poppet
521 Spring
551 Plug
561 O-ring

210WA2MC04

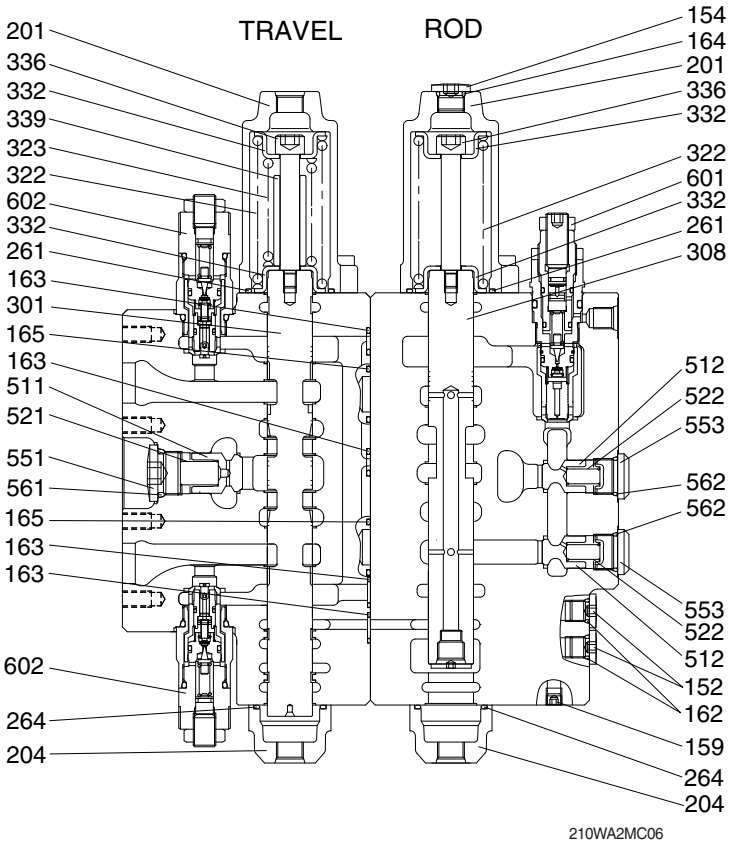
4) CASING B SPOOL SECTION



102 Casing B
153 Plug
155 Plug
165 O-ring
167 O-ring
561 O-ring
975 Socket screw

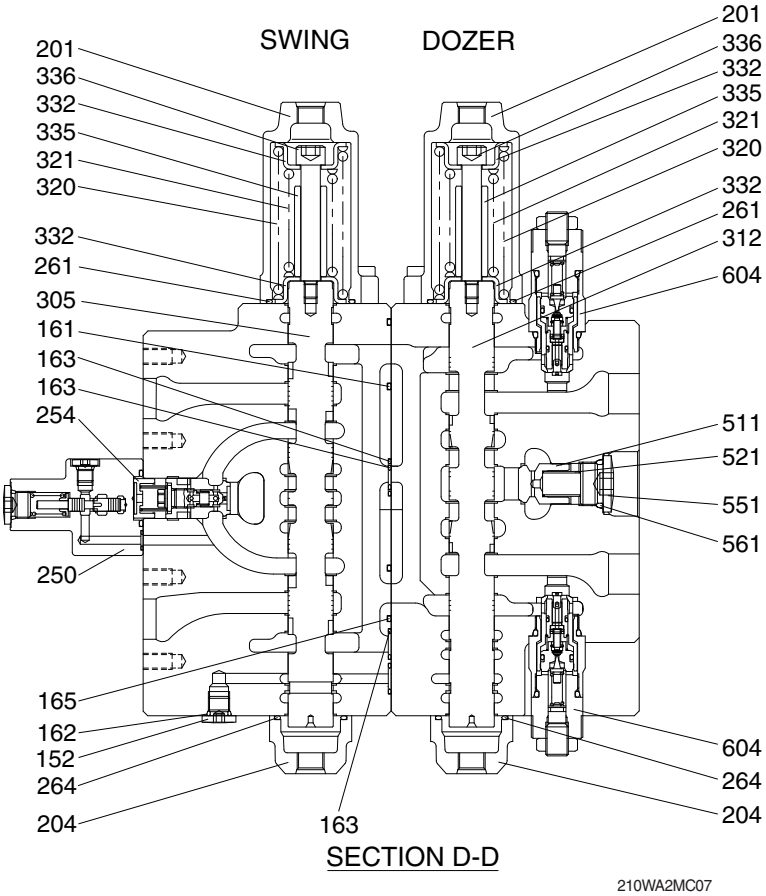
210WA2MC05

5) TRAVEL AND ROD SECTION



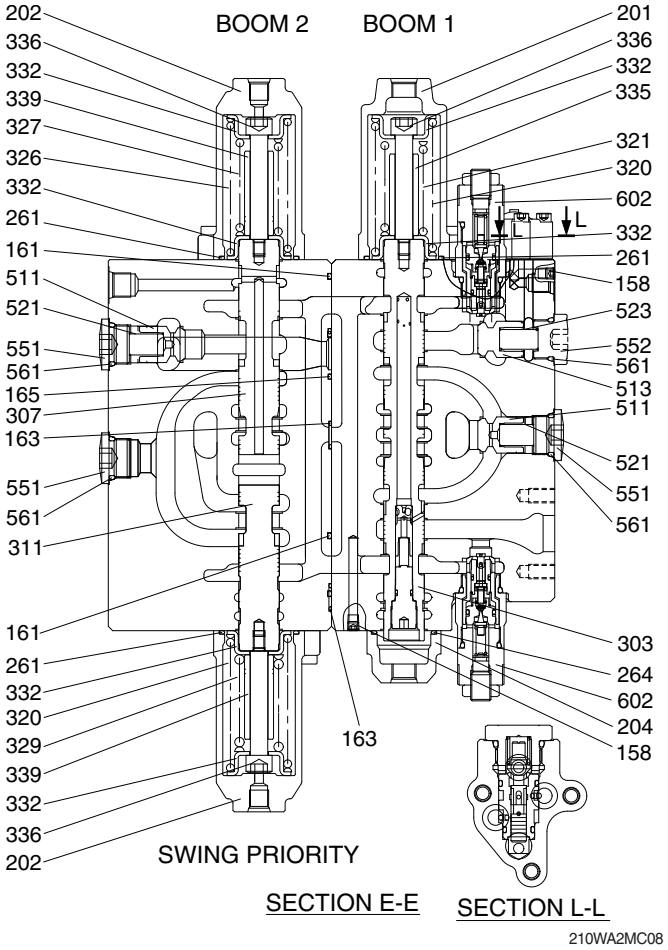
152 Plug
154 Plug
159 Plug
162 O-ring
163 O-ring
164 O-ring
165 O-ring
201 Spring cover
204 Spool cover
261 O-ring
264 Square ring
301 Travel spool
308 Rod spool assy
322 Spring
323 Spring
332 Spring seat
336 Spacer bolt
339 Stopper
511 Poppet
512 Poppet
521 Spring
522 Spring
551 Plug
553 Plug
561 O-ring
562 O-ring
601 Main relief valve assy
602 Port relief valve assy

6) SWING AND DOZER SECTION



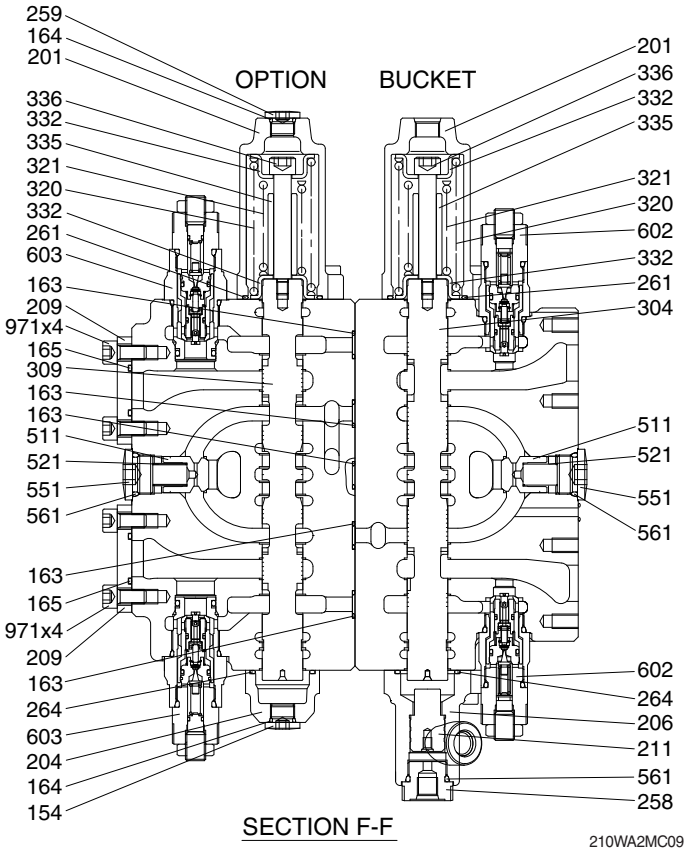
152 Plug
161 O-ring
162 O-ring
163 O-ring
165 O-ring
201 Spring cover
204 Spool cover
250 Logic control valve assy
254 Swing Logic poppet assy
261 O-ring
264 Square ring
305 Swing spool
312 Dozer spool
320 Spring
321 Spring
322 Spring
323 Spring
332 Spring seat
335 Stopper
336 Spacer bolt
511 Poppet
521 Spring
551 Plug
561 O-ring
604 Port relief valve assy

7) BOOM 1 AND BOOM 2 SECTION



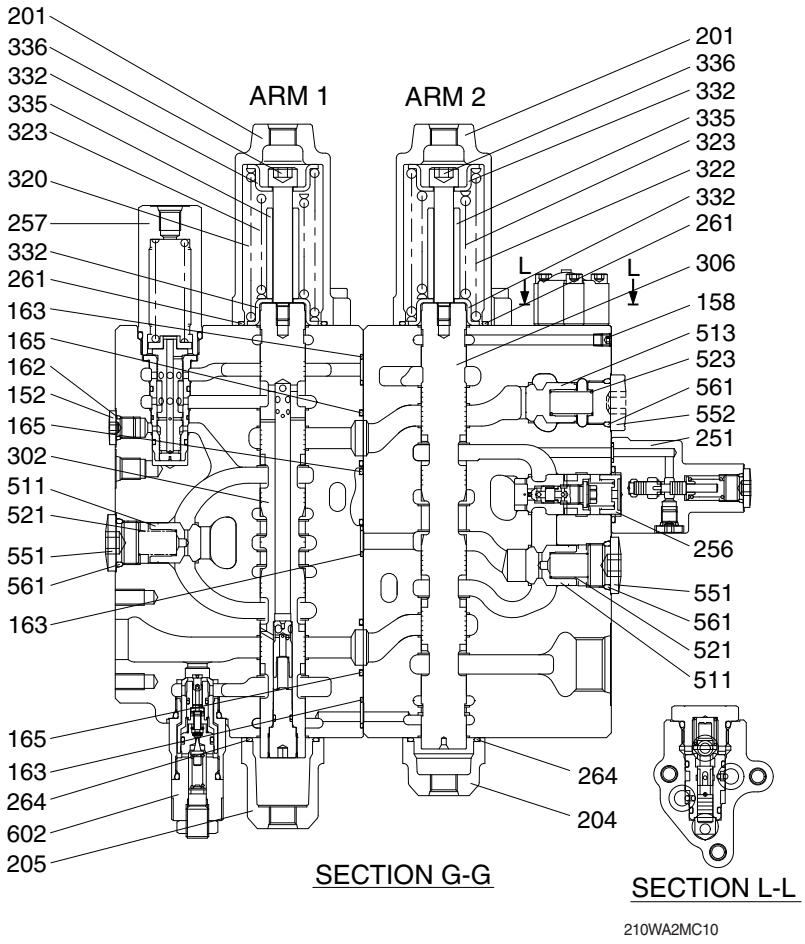
158 Plug
161 O-ring
163 O-ring
165 O-ring
201 Spring cover
202 Spring cover
204 Spool cover
261 O-ring
264 Square ring
303 Boom 1 spool sub assy
307 Boom 2 spool
311 Swing priority spool
320 Spring
321 Spring
326 Spring
327 Spring
329 Spring
332 Spring seat
335 Stopper
336 Spacer bolt
339 Stopper
511 Poppet
513 Poppet
521 Spring
523 Spring
551 Plug
552 Plug
561 O-ring
602 Port relief valve assy

8) BUCKET AND OPTION SECTION



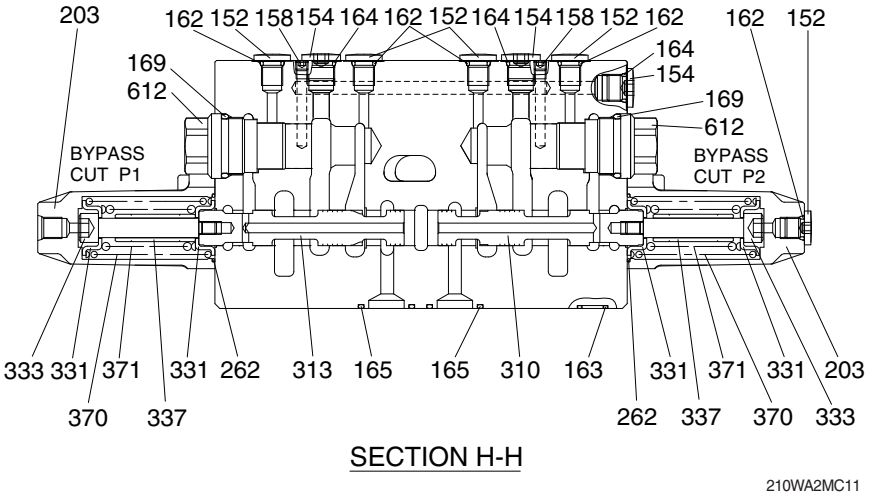
154 Plug
163 O-ring
164 O-ring
165 O-ring
201 Spring cover
204 Spool cover
206 Spool cover
209 Flange
211 Piston
258 Plug
259 Plug
261 O-ring
264 Square ring
304 Bucket spool
309 Option spool
320 Spring
321 Spring
332 Spring seat
335 Stopper
336 Spacer bolt
511 Poppet
521 Spring
551 Plug
561 O-ring
602 Port relief valve assy
603 Port relief valve assy
971 Socket screw

9) ARM 1 AND ARM 2 SECTION



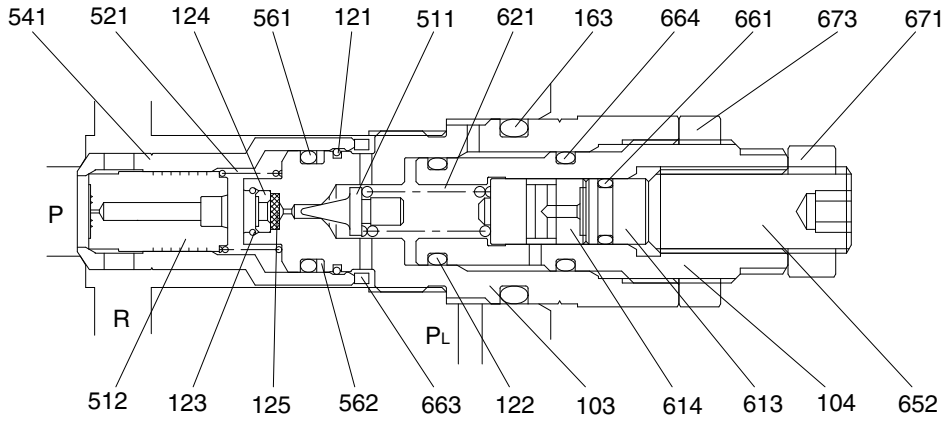
152 Plug
158 Plug
162 O-ring
163 O-ring
165 O-ring
201 Spring cover
204 Spool cover
205 Spool cover
251 Logic control valve assy
256 Arm 2 Logic poppet assy
257 Arm regeneration cut sub assy
261 O-ring
264 Square ring
302 Arm 1 spool sub assy
306 Arm 2 spool
320 Spring
322 Spring
323 Spring
332 Spring seat
335 Stopper
336 Spacer bolt
511 Poppet
513 Poppet
521 Spring
523 Spring
551 Plug
552 Plug
561 O-ring
602 Port relief valve assy

10) BYPASS CUT SECTION



152 Plug
154 Plug
158 Plug
162 O-ring
163 O-ring
164 O-ring
165 O-ring
169 O-ring
203 Spring cover
262 O-ring
310 Bypass cut spool
313 Bypass cut spool
331 Spring seat
333 Spring seat
337 Stopper
370 Spring
371 Spring
612 Plug

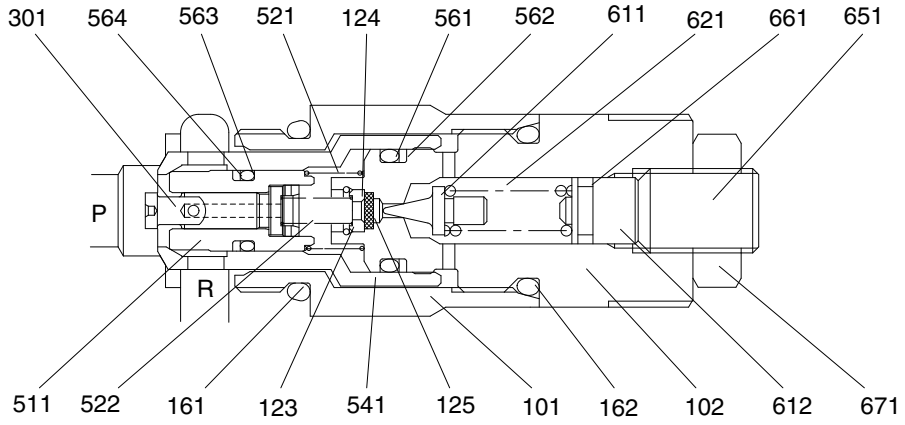
11) MAIN RELIEF VALVE (601)



220F2MC70

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

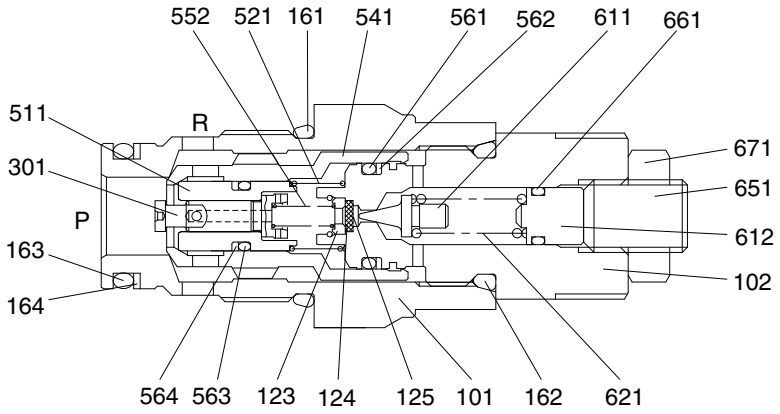
12) PORT RELIEF VALVE (602)



220F2MC71

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

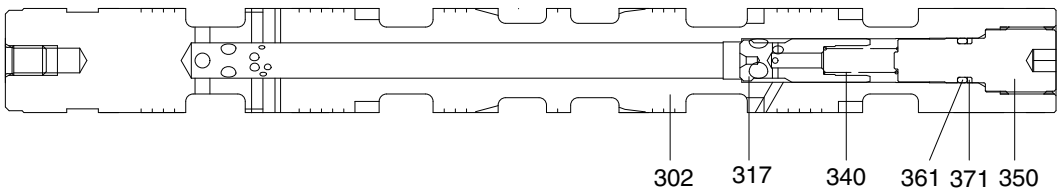
13) PORT RELIEF VALVE (603)



220F2MC72

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

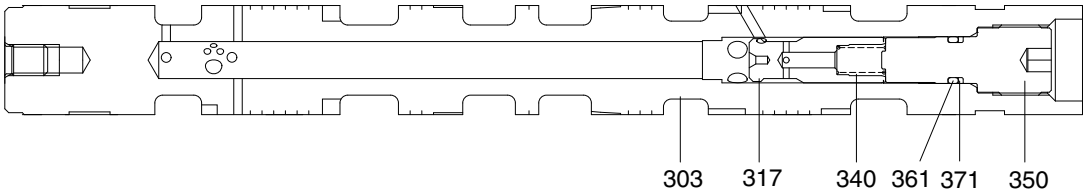
14) ARM 1 SPOOL ASSY (302)



210WA2MC12

302	Spool	340	Spring	361	O-ring
317	Plunger	350	Plug	371	Back-up ring

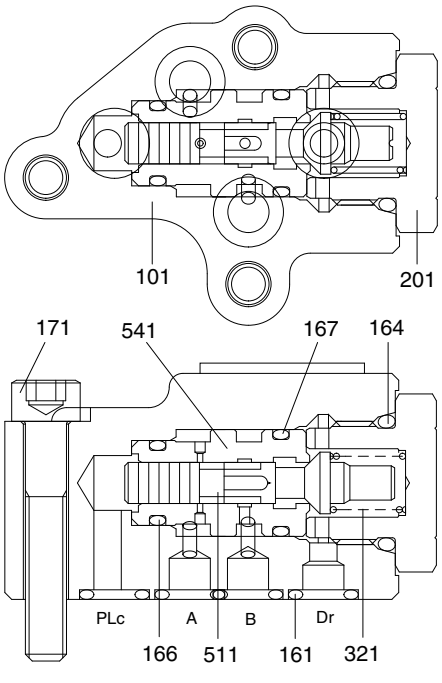
15) BOOM 1 SPOOL ASSY (303)



210WA2MC13

303	Spool	340	Spring	361	O-ring
317	Plunger	350	Plug	371	Back-up ring

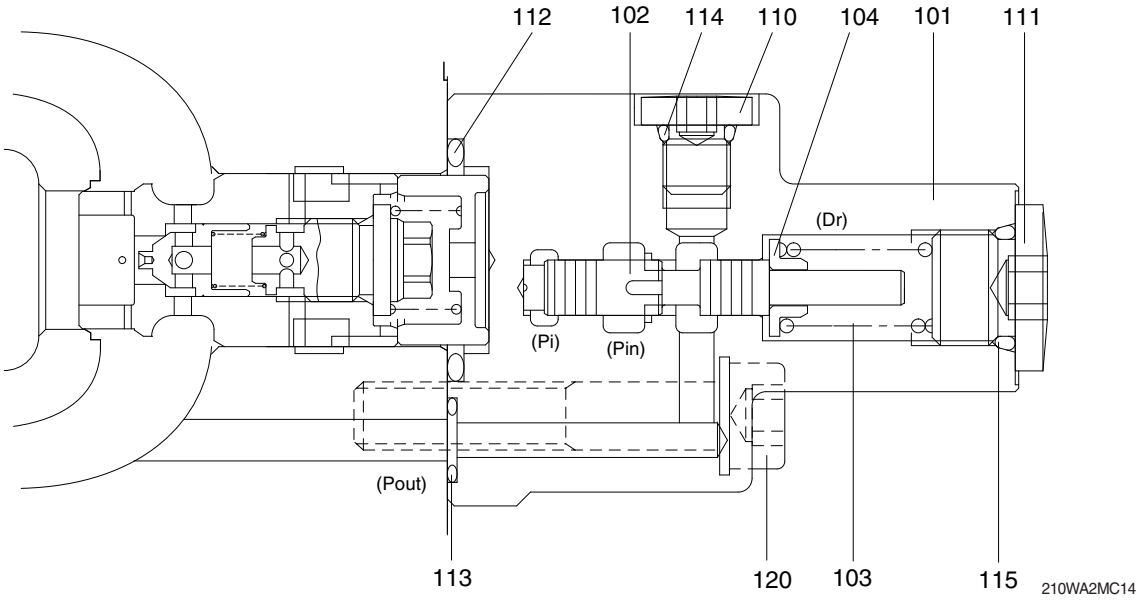
16) LOCK VALVE SELECTOR SUB ASSY (252)



220F2MC76

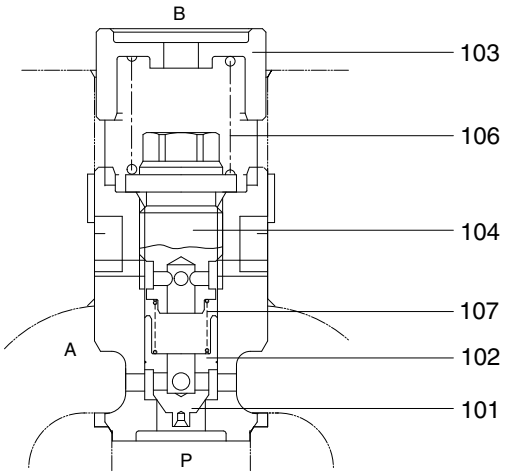
101 Casing
161 O-ring
164 O-ring
166 O-ring
167 O-ring
171 Hex socket head cap screw
201 Plug
321 Spring
511 Spool
541 Sleeve

17) LOGIC CONTROL VALVE ASSY (250, 251)



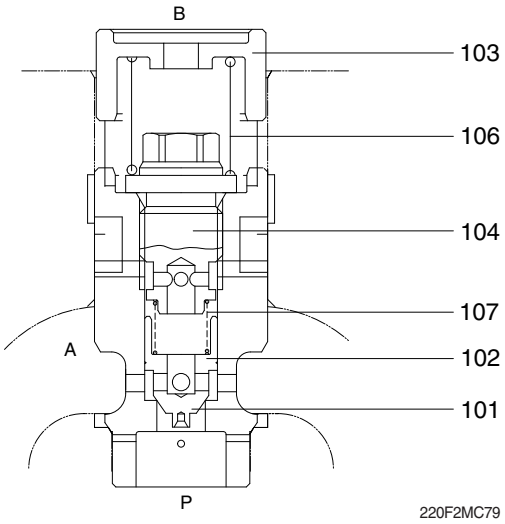
101	Casing	110	Plug	114	O-ring
102	Spool	111	Plug	115	O-ring
103	Spring	112	O-ring	120	Hex socket head cap screw
104	Spring seat	113	O-ring		

18) SWING LOGIC POPPET ASSY (254)



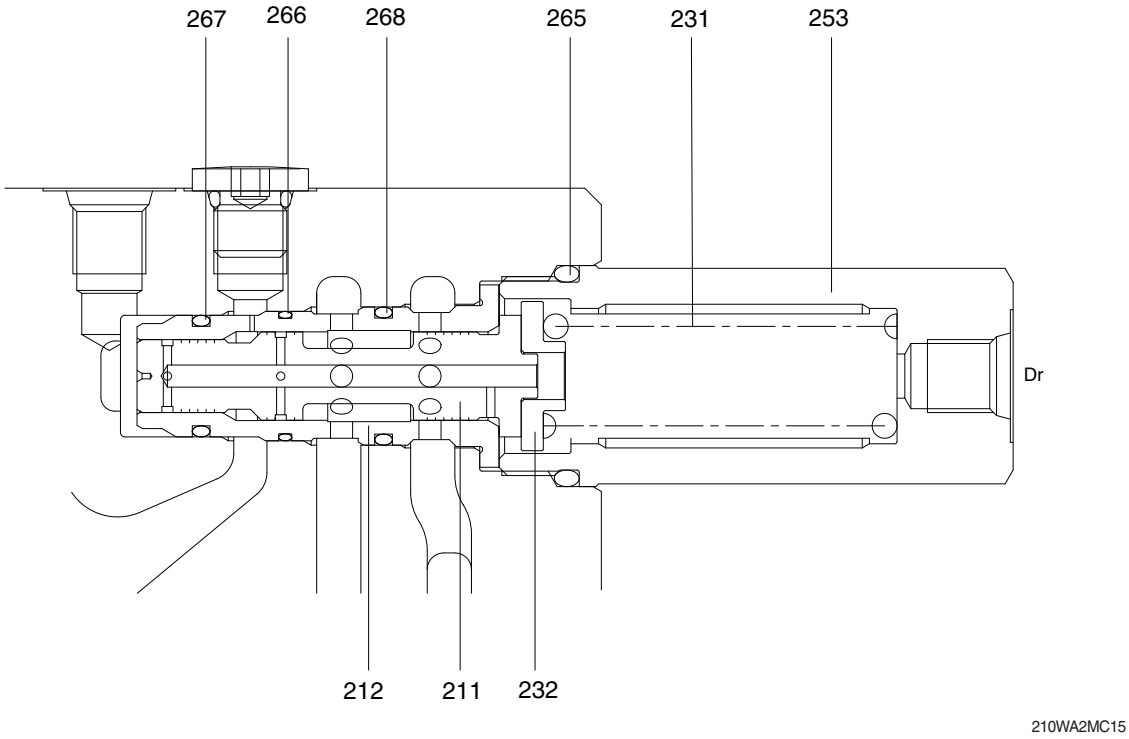
101	Logic poppet
102	Poppet
103	Spring seat
104	Plug
106	Spring
107	Spring

19) ARM 2 LOGIC POPPET ASSY (256)



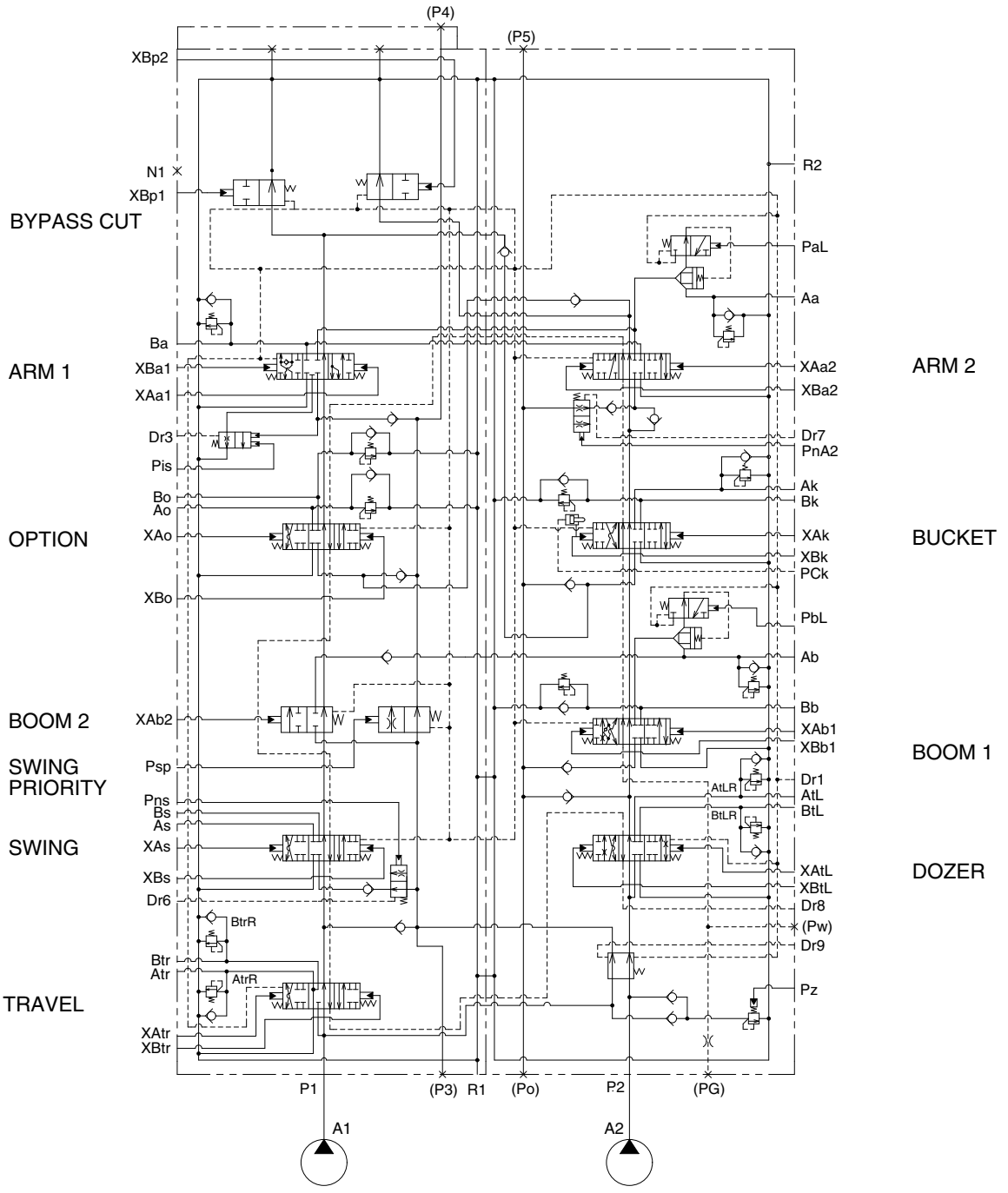
101 Logic poppet
102 Poppet
103 Spring seat
104 Plug
106 Spring
107 Spring

20) ARM REGENERATION CUT SUB ASSY (257)



211 Spool
212 Sleeve
231 Spring
232 Spring seat
253 Plug
265 O-ring
266 O-ring
267 O-ring
268 O-ring

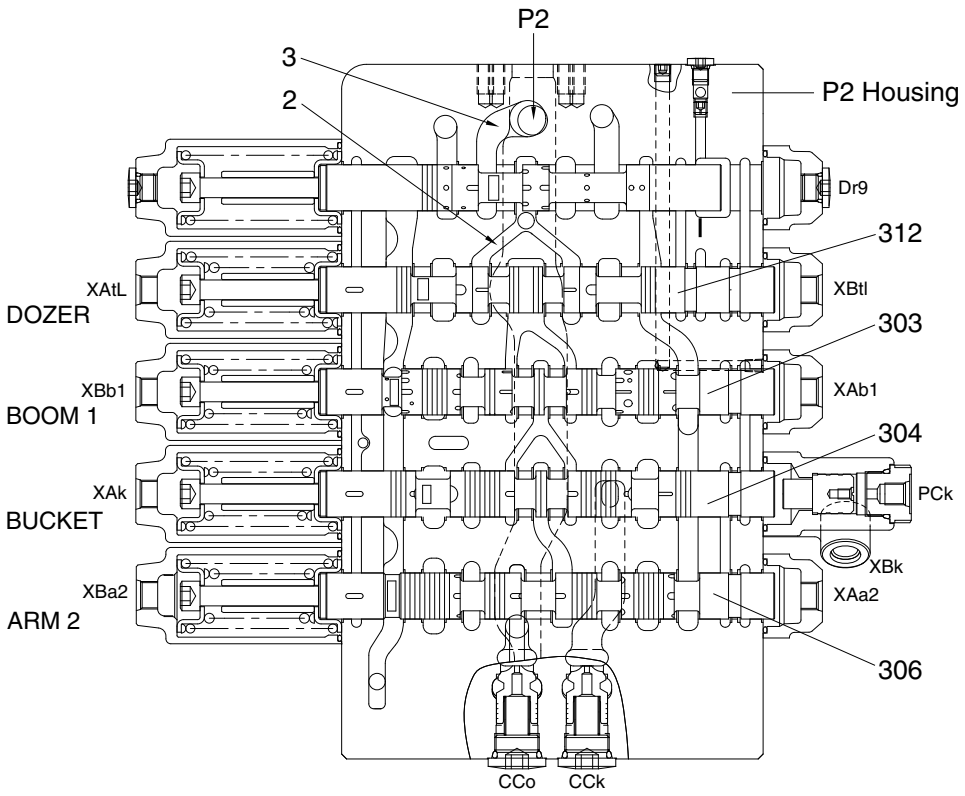
2. HYDRAULIC CIRCUIT



210WA2MC16

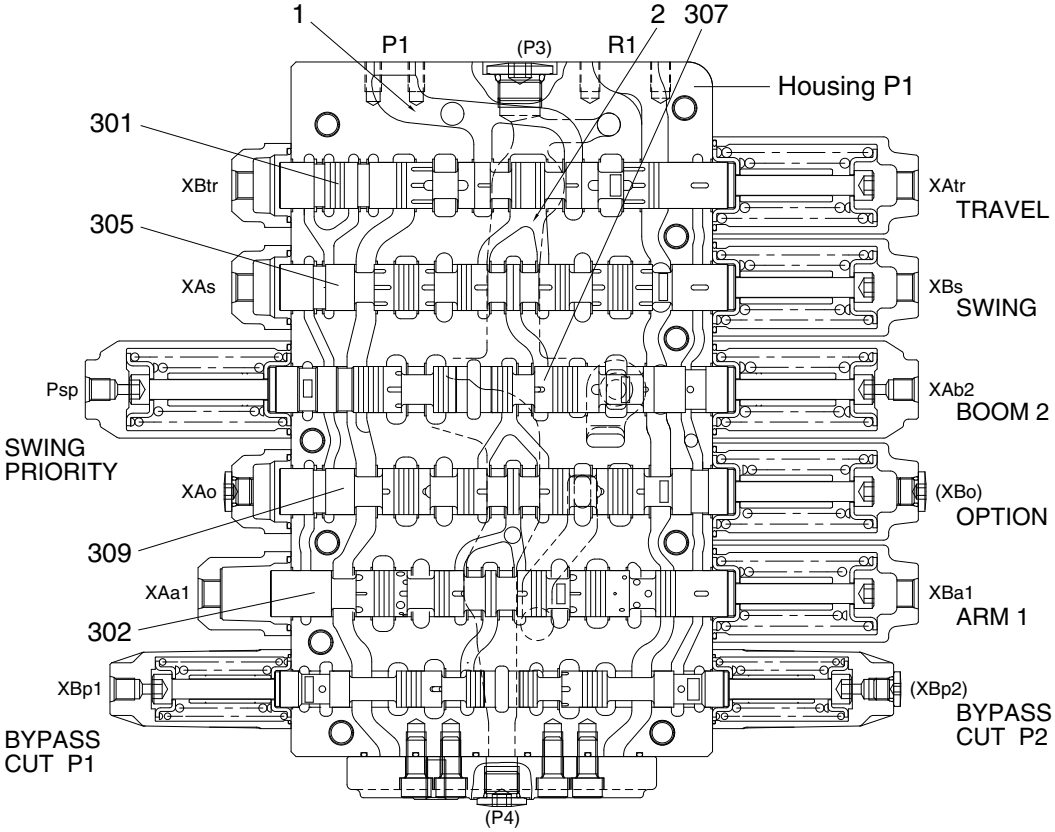
3. FUNCTION

1) CONTROL IN NEUTRAL POSITION



SPOOL SECTION (P2)

210WA2MC20



SPOOL SECTION(P1)

210WA2MC21

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 travel (301), swing (305), boom confluence (boom 2; 307), option (309) and arm 1 (302), and returns to the hydraulic oil tank through the tank port (R1).

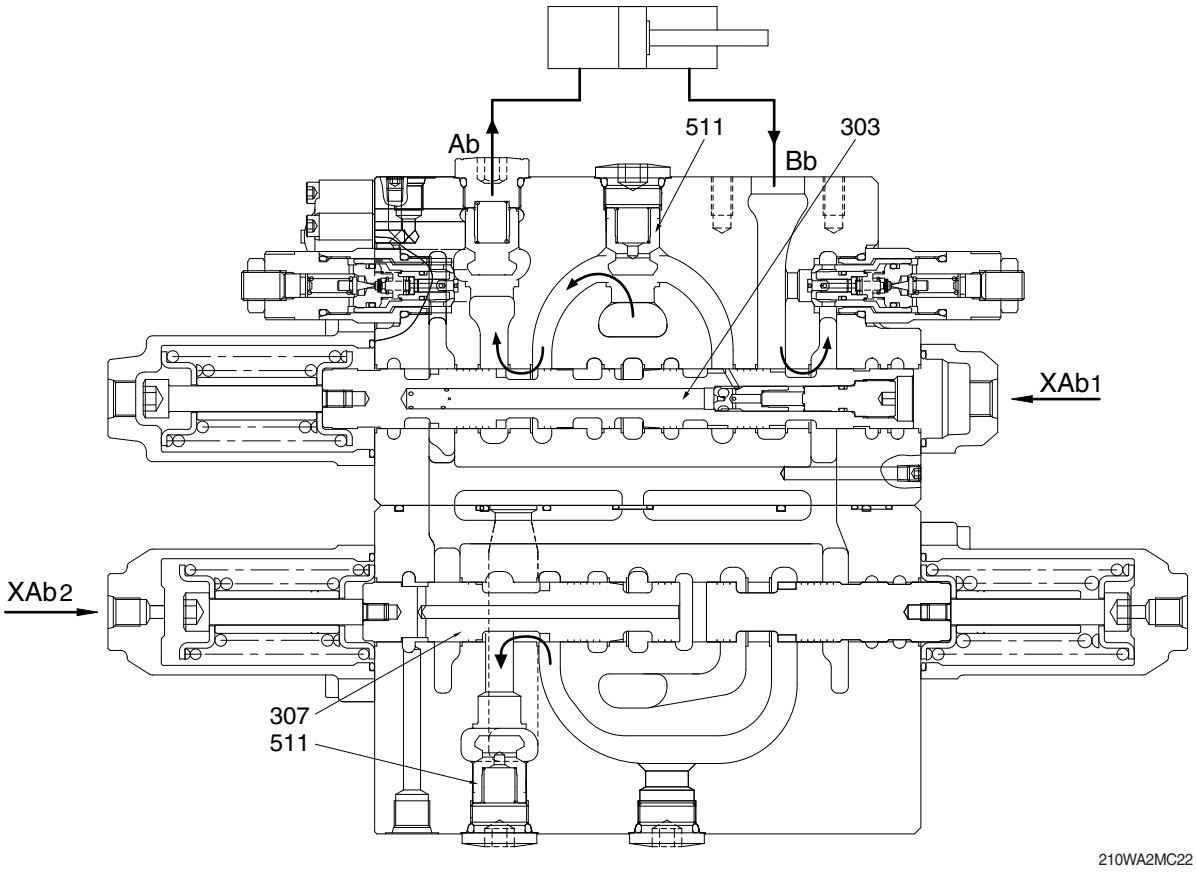
The oil discharged from the hydraulic pump (A2) passes through Port P2, the main path (3), the bypass circuit (2) passing the spools for dozer (312), boom 1 (303), bucket (304) and arm 2 (306), and returns to the hydraulic oil tank through the tank port (R1).

The discharge oil of the pump is reduced by controlling electrically the regulator with 2nd pressure of the RCV when all spools are in the neutral positions.

2) EACH SPOOL OPERATION

(1) Boom control

① Boom up operation

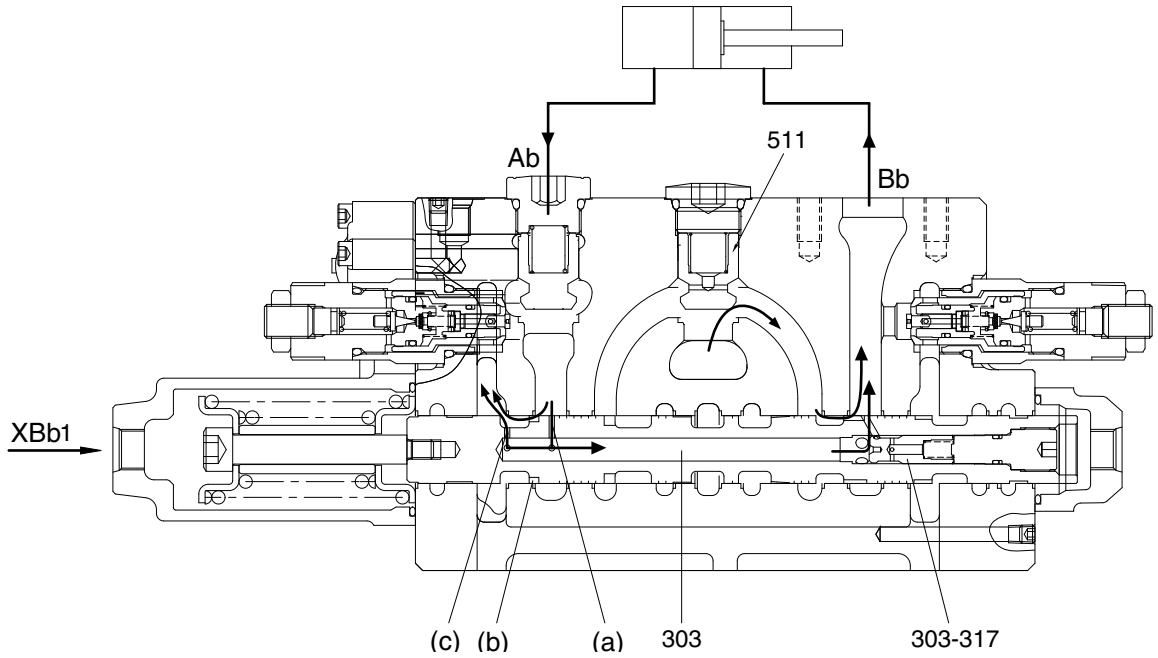


During the boom up operation, the pilot pressure enters through Port XAb1 and moves the boom 1 spool (303) in the left direction. The pressurized oil entering through Port P2 passes through the main path (3) and flows to the bypass circuit (2), but the bypass circuit (2) is shut off due to transfer of the boom 1 spool (303). 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 (303) to Port Ab, and is supplied to the boom cylinder head side.

At the same time, the pilot pressure enters also through Port XAb2 to transfer the boom 2 spool (307) in the right direction. Though the pressurized oil enters into Port P1, the bypass circuit (2) is shut off due to transfer of the boom 2 spool (307). Therefore, the hydraulic oil flows in the parallel circuit and flows through the U-shaped path to the boom 2 spool (307). Then, the hydraulic oil passes through the periphery of the boom 2 spool (307), pushes open the check valve (511), joins into Port Ab in the inside path, and is supplied to the boom cylinder head side. (Boom confluent flow)

On the other hand, the return oil from the boom cylinder rod side enters through Port Bb and returns to the hydraulic oil tank through the tank port (R1).

② **Boom down operation**



21092MC12

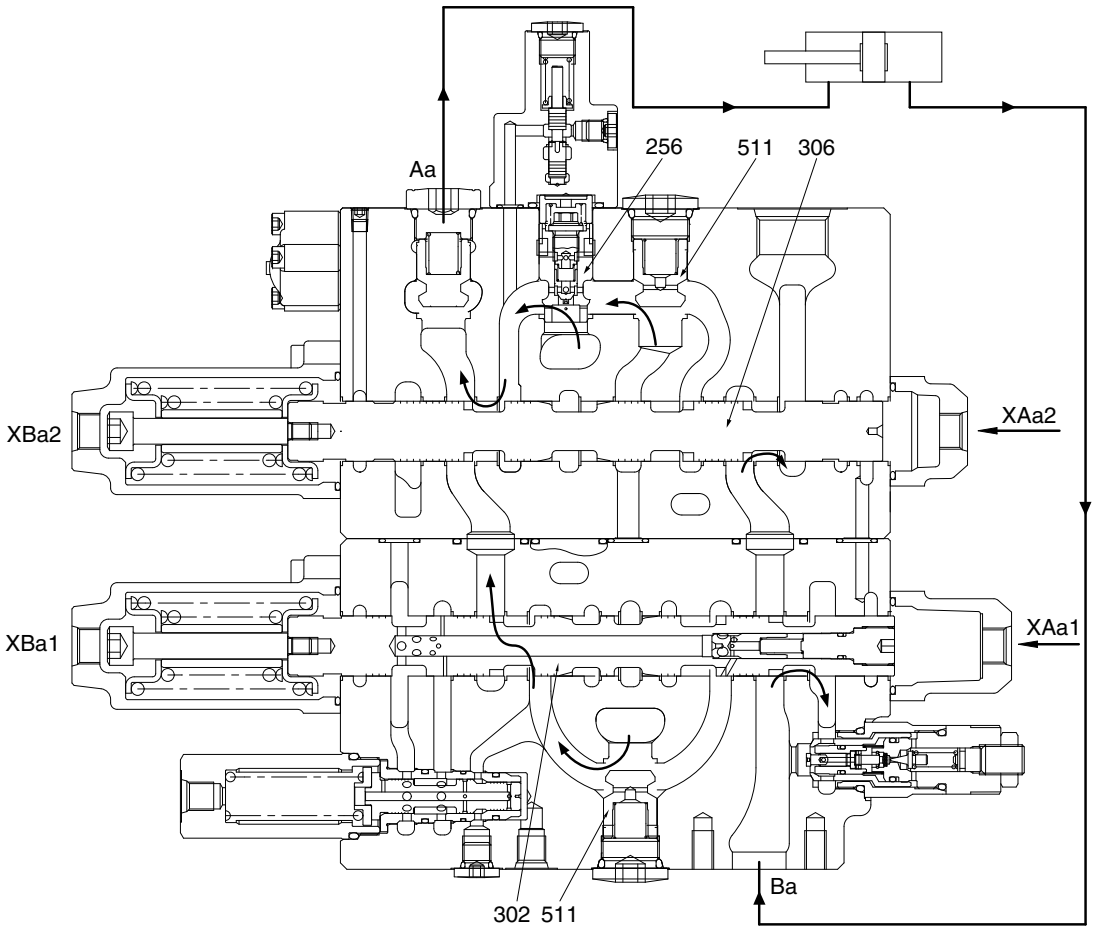
During the boom down operation, the pilot pressure enters through Port XBb1 and transfers the boom 1 spool (303) in the right direction. The pilot pressure enters also through port PbL and the release signal is sent to the lock valve. The pressurized oil entering through Port P2 passes through the main path (3) and flows to the bypass circuit (2), but the bypass circuit (2) is shut off due to transfer of the boom 1 spool (303). 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 (303) to Port Bb and is supplied to the boom cylinder rod side.

On the other hand, the return oil from the boom cylinder head side passes to the holes (a) and the notches (b) of the boom 1 spool (303).

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 (303-317) in the spool in the right direction, flows around the outside of the spool. Then, it is supplied again to the boom cylinder rod side as hydraulic oil to lower the boom. (Boom regeneration)
Besides, a part of the return oil from the boom cylinder flows from the hole (c) into the tank.

(2) Arm control

① Arm out operation



During the arm out operation, the pilot pressure enters through Ports XAa1 and XAa2. When the pressure enters through Port XAa1 and XAa2, the spools transfer in the left direction. The hydraulic 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 arm 1 spool (302).

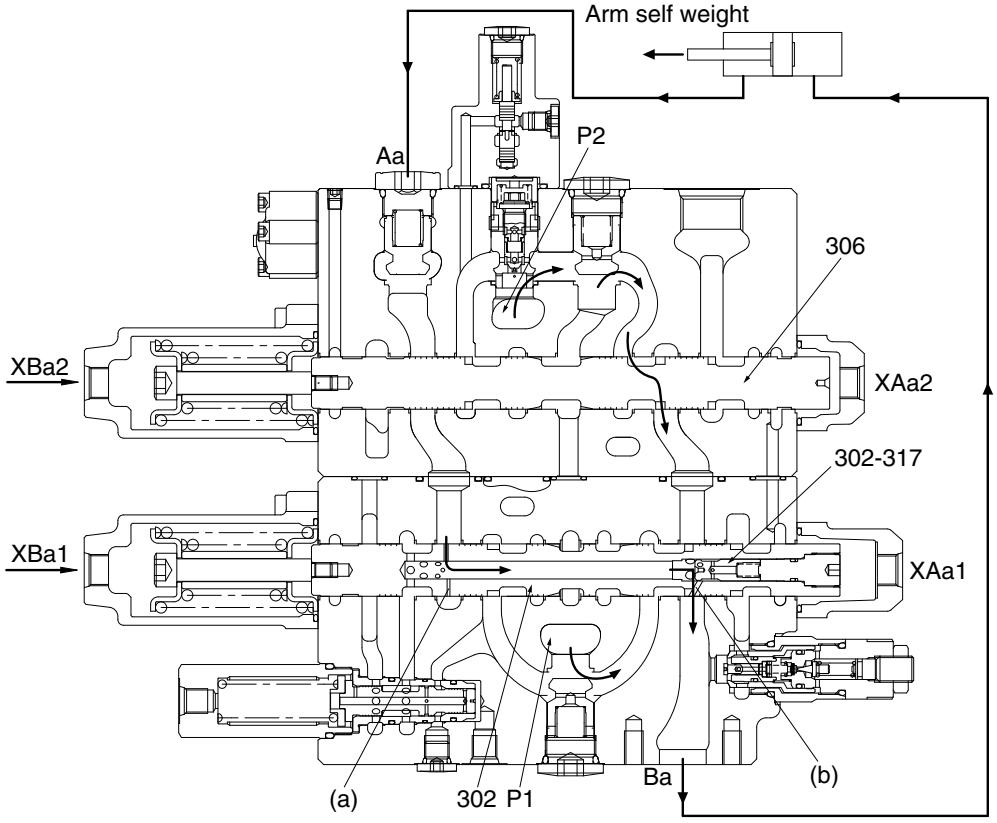
Therefore, the hydraulic oil from the parallel circuit pushes open the check valve (511) and flows through the U-shaped path to the arm 1 spool (302). Then, it flows around the periphery of the arm 1 spool (302) and the arm 2 spool (306) to Port Aa, and is supplied to the arm cylinder rod side.

On the other hand, the hydraulic oil entering through Port P2 passes in the main path (3), and flows into the bypass circuit (2), and the bypass circuit is shut off due to transfer of the arm 2 spool (306). The hydraulic oil from the parallel circuit pushes open the logic poppet (256) and the hydraulic oil from the bypass circuit (2) pushes open the check valve (511) and flows through the U-shaped path to the arm 2 spool (306). Then, it flows around the periphery of the arm 2 spool (306) in the inside path and joins into Port Aa.

Besides, the return oil from the arm cylinder head side passes through Port Ba, flows into tank line in arm 1 side and in arm 2 side, and returns to the hydraulic oil tank through the tank port (R1).

② Arm in operation

· During light load only



210WA2MC24

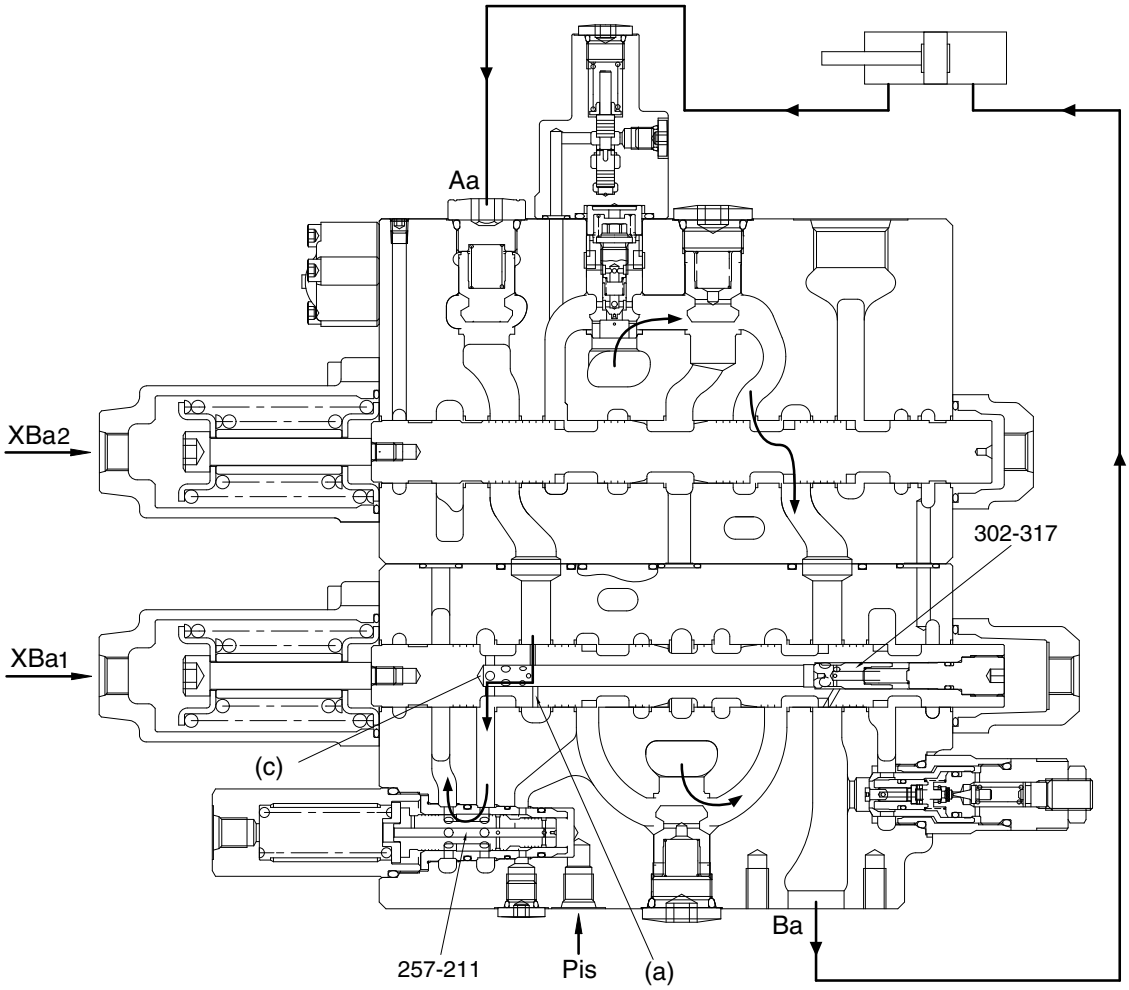
Main circuit

During the arm in operation, the pilot pressure enters through Ports XBa1 and XBa2. When the pressure enters through Port XBa1 and Port XBa2, the spools transfer in the right direction. The pilot pressure enters also through Port PbL and the release signal is sent to the lock valve. The hydraulic 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 arm 1 spool (302). 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 arm 1 spool (302) to Port Ba, and is supplied to the arm cylinder head side.

On the other hand, the hydraulic oil entering through Port P2 passes in the main path (3), and flows into the bypass circuit (2), and the bypass circuit is shut off due to transfer of the arm 2 spool (306). The hydraulic oil from the parallel circuit pushes open the logic poppet (256) and the hydraulic oil from the bypass circuit (2) pushes open the check valve (511) and flows through the U-shaped path to the arm 2 spool (306). Then, it flows around the periphery of the arm 2 spool (306) and the arm 1 spool (302) in the inside path and joins into Port Ba.

Besides, the return oil from the arm cylinder rod side is pressurized by self-weight of the arms and so on, and returns to Port Aa. The pressurized oil returning to Port Aa enters into the spool through the periphery hole (a) of the arm 1 spool (302). During a light load only, it pushes open the check valve (302-317) and joins into Port Ba from the spool hole (b). The rest of oil returns to the hydraulic oil tank through the tank port (R1). This is called the arm regeneration function.

· The pressure in the arm cylinder head side increases

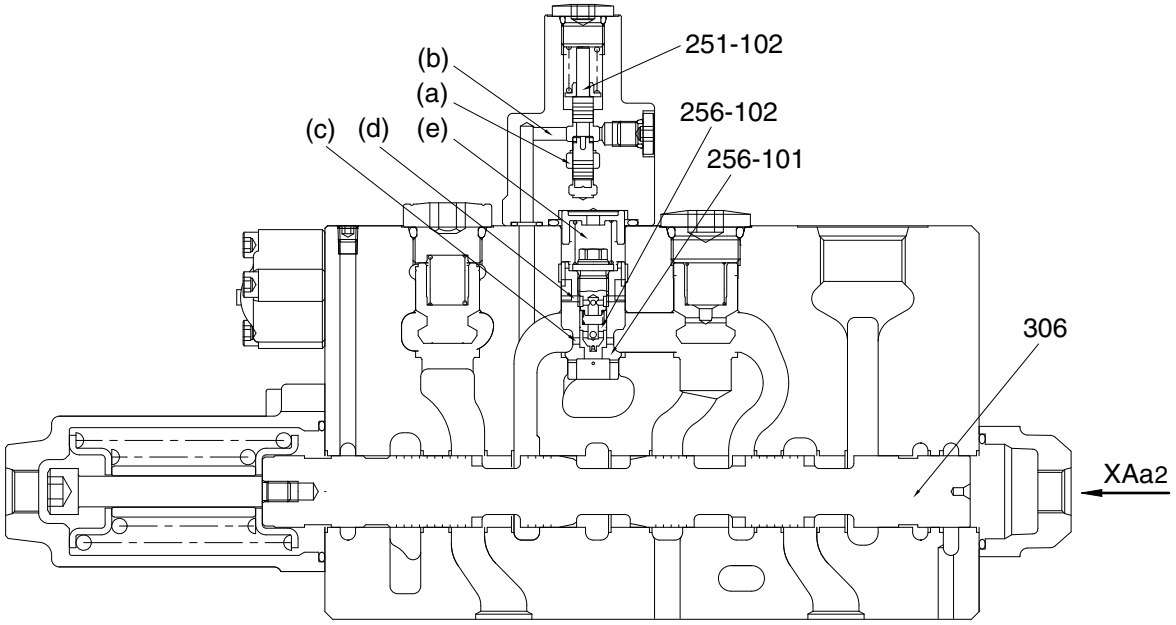


210WA2MC25

When the pressure in the arm cylinder head side and the U-shaped path increases, the arm regeneration cut spool (257-211) is transferred in the left direction, and at the same time the check valve (302-317) is closed by its back pressure. This shuts off the arm regeneration function, and the return oil from the arm cylinder rod side enters from Port Aa through the periphery hole (a) of the arm 1 spool (302) into the spool, flows to the arm regeneration cut valve (257) through the periphery hole (c) of the arm 1 spool (302), and returns through the tank port (R1) to the hydraulic oil tank.

When the Pilot Port Pis of the arm regeneration cut spool (257-211) is pressurized, a part of the return oil from the arm cylinder rod side flows to the arm regeneration cut valve (257) and returns through the tank port (R1) to the hydraulic oil tank. (Variable arm regeneration)

③ **Arm 2 logic control valve operation**



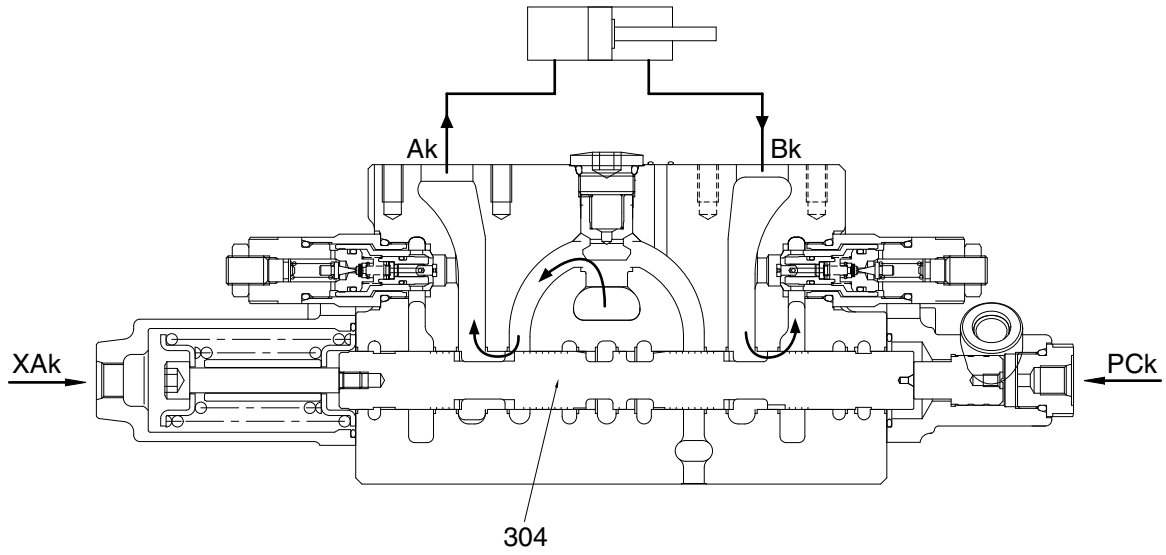
210WA2MC26

During both the arm in operation and the boom up operation, the pilot pressure enters through Ports XBa1, XBa2, XAb1, XAb2, PaL and PnA2. The pressure PnA2 transfers the spool (251-102) in the arm 2 logic control valve to the top direction, and the path from (a) to (b) is closed. Hereby, the pressurized oil pushes open the poppet (256-102), passes in the path (c) and (d), enters into the chamber (e), and the poppet (256-101) is pushed to the casing seat. Therefore, the most of pressurized oil entering through Port P2 flows to the boom 1 spool (303) than the arm 2 spool (306) to make the boom hoisting operation most preferential.

On the other hand, in the independent arm in operation, the pilot pressure does not enter through Ports PnA2, and the path from (a) to (b) is not closed, and the hydraulic oil of the chamber (e) flows to the path (a) and (b). The pressurized oil entering through Port P2 pushes open the poppet (256-101) and flows to the arm 2 spool (306).

(3) Bucket control

① Bucket in operation



During the bucket in operation, the pilot pressure enters through Port XAk and transfers the bucket spool (304) in the right direction. The pressurized oil entering through Port P2 passes through the main path (3) and flows through the bypass circuit (2), but the bypass circuit (2) is shut off due to transfer of the bucket spool (304). 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 Ak and is supplied to the bucket cylinder head side.

On the other hand, the return oil from the bucket cylinder rod side enters through Port Bk, passes around the periphery of the spool, and returns to the hydraulic oil tank through the tank port (R1).

During both the boom up operation and bucket in operation, the pilot pressure enters through Port PCk and the bucket spool transfers in the half stroke not full stroke. Therefore, the most of pressurized oil entering through Port P2 flows to the boom 1 spool (303) than the bucket spool (304) to make the boom up operation most preferential.

② Bucket in confluence

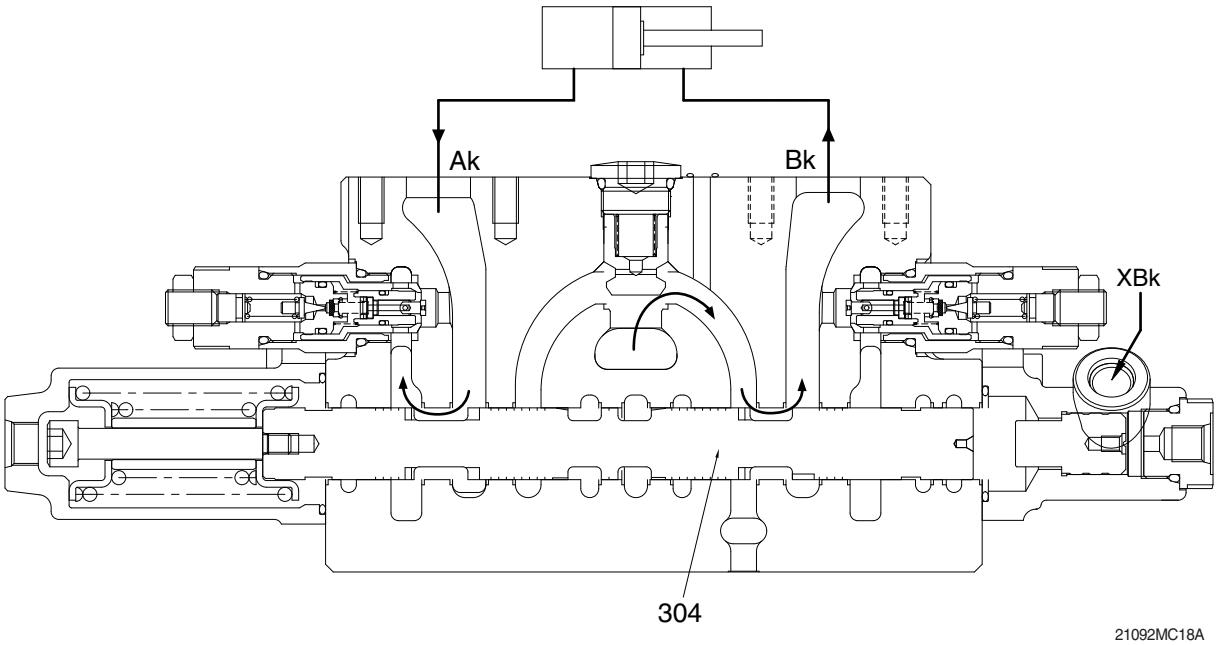
During the bucket out operation, the pilot pressure enters also through Port XBp1 and transfers the bypass-cut spool.

The pressurized oil entering through Port P1 passes through the main path (1) and flows through the bypass circuit (2), but the bypass circuit (2) is shut off due to transfer of the bypass-cut spool (313). Therefore, the pressurized oil pushes open the check valve (514), and flows through inside path and the U-shaped path to the bucket spool (304).

③ **Bucket out operation**

During the bucket out operation, the pilot pressure enters through Port XBk and transfers the bucket spool (304) in the left direction. The pressurized oil entering through Port P2 passes through the main path (3) and flows through the bypass circuit (2), but the bypass circuit (2) is shut off due to transfer of the bucket spool (304). 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 Bk and is supplied to the bucket cylinder rod side.

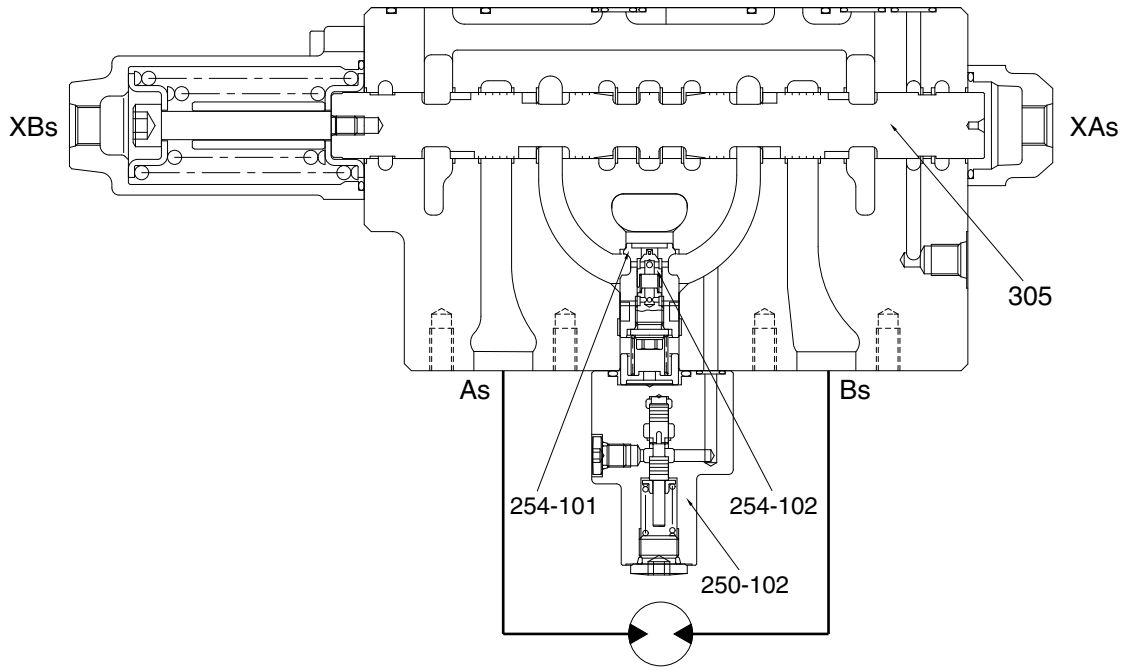
On the other hand, the return oil from the bucket cylinder head side enters through Port Ak, passes around the periphery of the spool, and returns to the hydraulic oil tank through the tank port (R1).



④ **Bucket in confluence**

During the bucket in operation, the pilot pressure enters also through Port XBp1 and transfers the bypass-cut spool (313). The pressurized oil entering through Port P1 passes through the main path (1) and flows through the bypass circuit (2), but the bypass circuit (2) is shut off due to transfer of the bypass-cut spool (313). Therefore, the pressurized oil pushes open the check valve (514), and flows through inside path and the U-shaped path to the bucket spool (304).

(4) Swing control



① **Swing operation**

During the swing operation, the pilot pressure enters through Port XAs (or XBs) and transfers the swing spool (305). The pressurized oil entering through Port P1 passes through the main path (1) and flows through the bypass circuit (2), but the bypass circuit (2) is shut off due to transfer of the swing spool (305). Therefore, the pressurized oil flows into the parallel circuit, pushes open the check valve (511), and flows through the U-shaped path to the swing spool (305). Then, it flows through the periphery of the spool to Port As (or Bs) and is supplied to the swing motor.

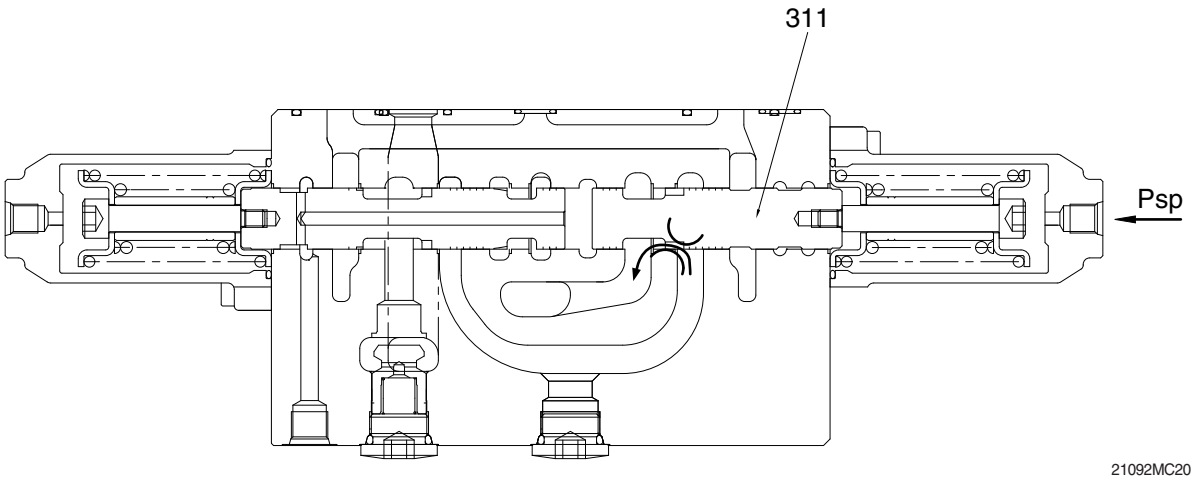
On the other hand, the return oil from the swing motor enters Port Bs (or As) and returns to the hydraulic oil tank through the tank port (R1).

② **Swing logic control valve operation**

During both the swing operation and the boom up operation, the pilot pressure enters through Ports XBs (or XAs), XAb1, XAb2 and Pns. The pressure Pns transfers the spool (250-102) in swing logic control valve. Hereby, the pressurized oil pushes open the poppet (254-102), and the poppet (254-101) is pushed to the casing seat. Therefore, the most of pressurized oil entering through Port P1 flows to the boom 2 spool (307) than the swing spool (305) to make the boom up operation most preferential.

On the other hand, in the independent swing operation, the pilot pressure does not enter through Ports Pns. The pressurized oil entering through Port P1 pushes open the poppet (254-101) and flows to the swing spool (305).

③ Swing operation preference function



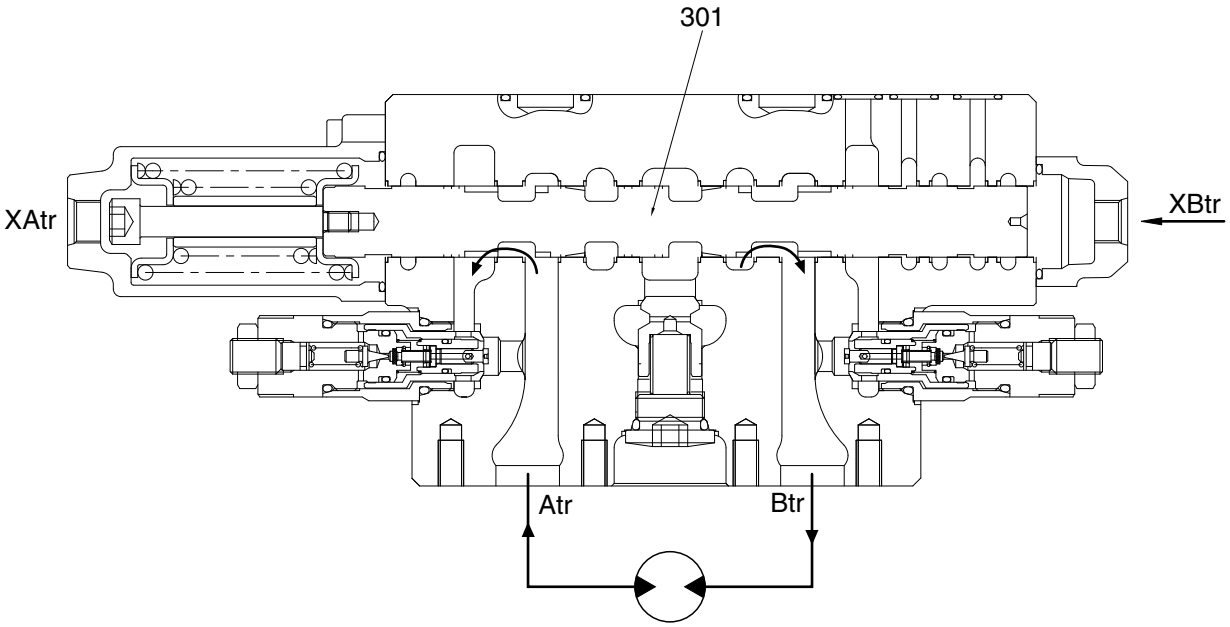
Pilot circuit

The pilot pressure enters through Port Psp to transfer the swing priority spool (311).

Main circuit

Due to transfer of the swing priority spool (311), the open area of the swing priority spool decreases, and the most of the pressurized oil entering through Port P1 flows to the swing side to make the swing operation most preferential.

(5) Travel control

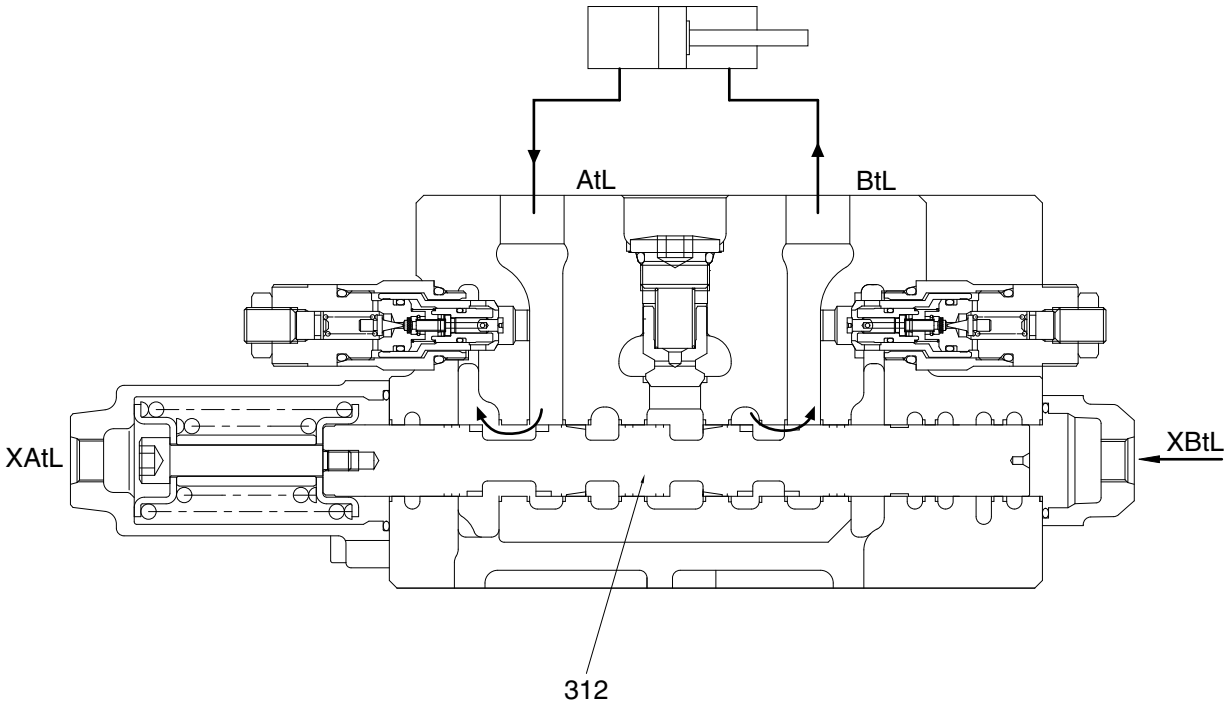


210WA2MC27

When Pilot Port XBtr of the travel spool (301) is pressurized, the bypass circuit (2) in the arm 1 side is shut off and the working fluid discharged from the hydraulic pump (A1) through Port Btr and flows to the travel motor.

On the other hand, the return oil from the travel motor passes flows from Port Atr to the travel spool (301) and returns to the hydraulic oil tank through the tank port (R1).
In the case of the opposite operation (when the pilot pressure is applied to Ports XAtr of the control valve), the operation is similar.

(6) Dozer operation



210WA2MC28

When Pilot Port XBtL of the dozer spool (312) is pressurized, the bypass circuit (2) in the boom 1 side is shut off and the working fluid discharged from the hydraulic pump (A2) through Port BtL and flows to the dozer cylinder rod side.

On the other hand, the return oil from the dozer cylinder rod side passes flows from Port AtL to the dozer spool (312) and returns to the hydraulic oil tank through the tank port (R1).
In the case of the opposite operation (when the pilot pressure is applied to Ports XAtL of the control valve), the operation is similar.

3) FUNCTION OF LOCK VALVE

The lock valve (252) is fitted between the arm cylinder rod side and the arm 2 spool (306). It decreases the leakage by the pressure of the cylinder.

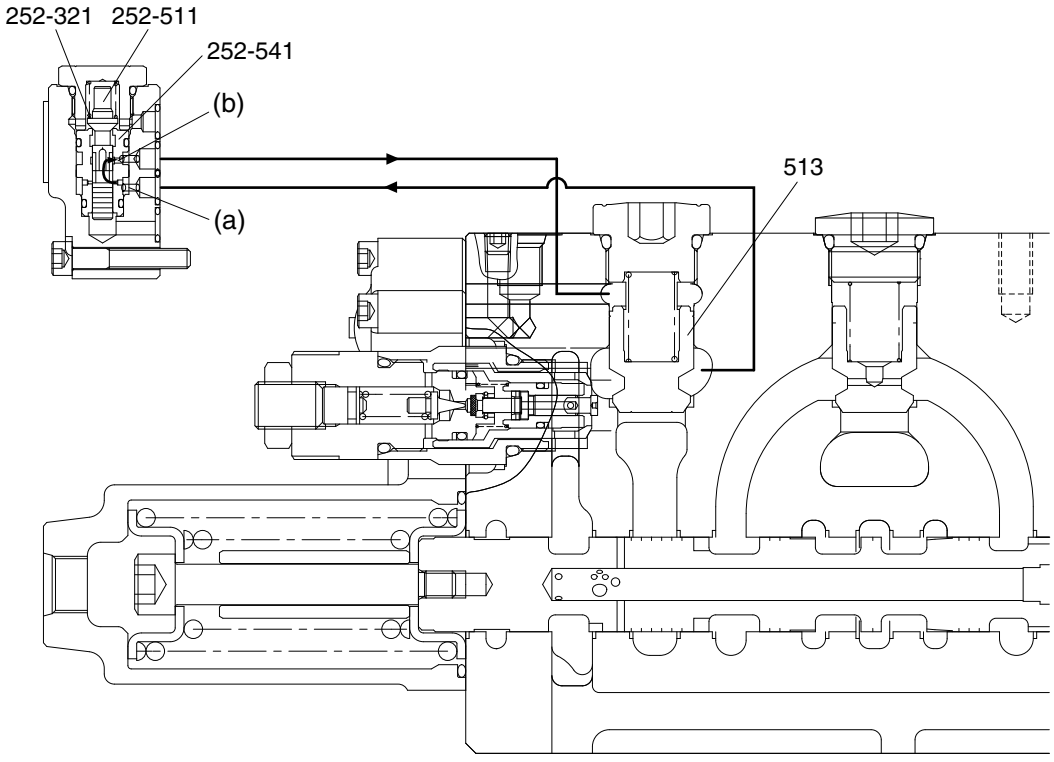
Another lock valve (252) is similarly fitted between the boom cylinder head side and the boom 1 spool (303). It decreases the leakage by the pressure of the cylinder.

(1) Neutral positions of spools

The following is the case of the boom 1 spool (303). (The case of the arm 2 spool (306) is in the same way.)

During the boom 1 spool (303) is in the neutral position, the lock valve (252) is kept in the position shown in figure. The spool (252-511) in the lock valve is pushed to the seat of the sleeve (252-541) by the force of the spring (252-321).

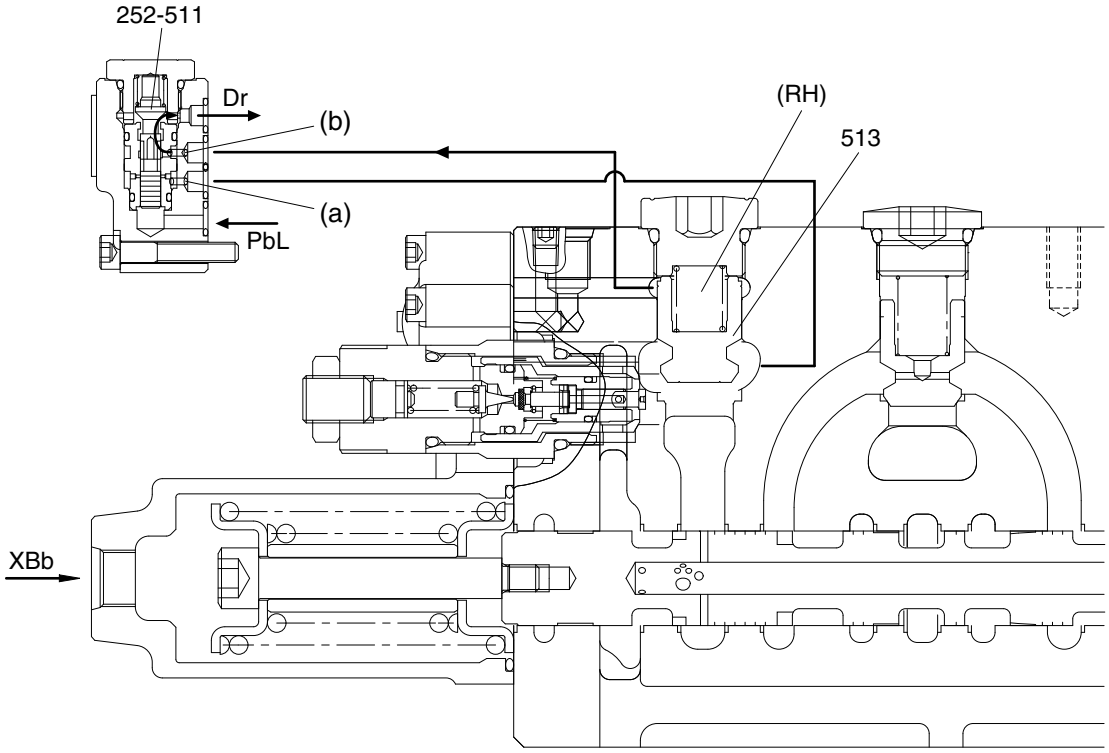
In this position, the pressurized oil from the boom cylinder head side enters through the hole (a), the periphery of the spool (252-511) in the lock valve and the hole (b), and it pushes the poppet (513) to the casing seat, and the leakage is decreased.



210WA2MC29

(2) Boom down operation

During the boom down operation, the pilot pressure enters through Port PbL and XBb1. The pilot pressure transfers the spool (252-511) in the lock valve assy in the top direction. By the transfer of the spool (252-511), firstly the hole (a) is blocked and the pressurized oil from the boom cylinder head side does not enter to the spring chamber (RH). Secondly, the oil in the spring chamber (RH) enters through the hole (b) and flows to drain circuit. Therefore, the poppet (513) is lifted by the pressure of the boom cylinder head side and the function of the lock valve (252) is released.



210WA2MC30

(3) Boom up operation

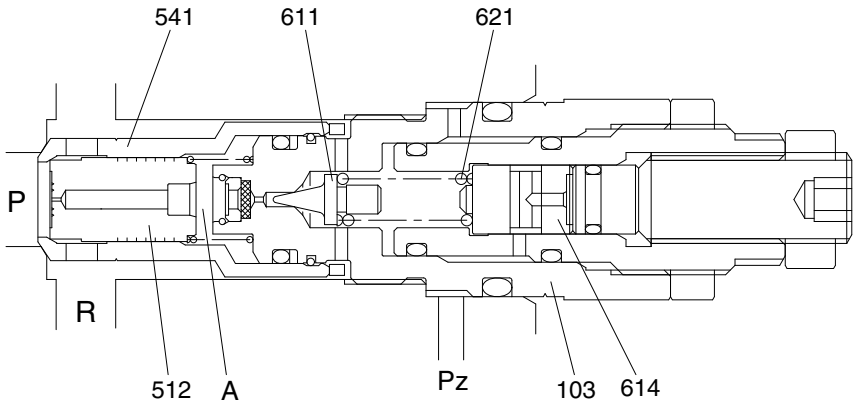
During the boom up operation, the pilot pressure enters through Port XAb1. The oil flowing from the boom 1 spool pushes open the poppet (513) and flows to Port Ab.

4) CIRCUIT PRESSURE PROTECTION

The control valve has two kinds of relief valve to limit the pressure in a circuit.

(1) Main relief valve

The main relief valve is fitted in the P2 housing and functions as follows.



21092MC25

① The hydraulic oil is filled up in the inside space chamber (A) from the path (P) through a hole of the seat (541) and a restriction of the plunger (512), and seats the plunger (512) against the seat (541) securely.

② When the pressure in the path (R) becomes equal to the set load of the spring (621), the poppet (611) opens to make the hydraulic oil flow through a hole of the plug (103), around the poppet (611) and into the low pressure path (R).

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

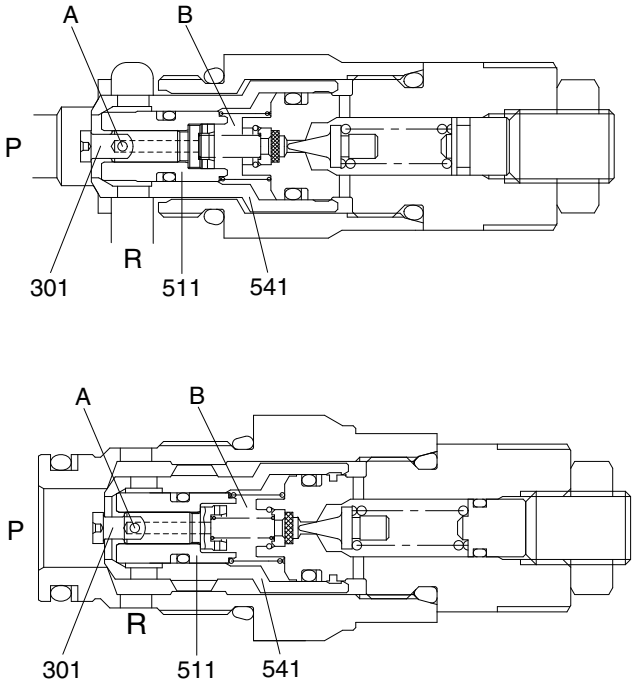
④ When the pressurized oil higher than pressure 30 kgf/cm^2 enters through the port Pz, it pushes the piston (614) to change the relief set pressure of the spring (621) to the high pressure.

(2) 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:

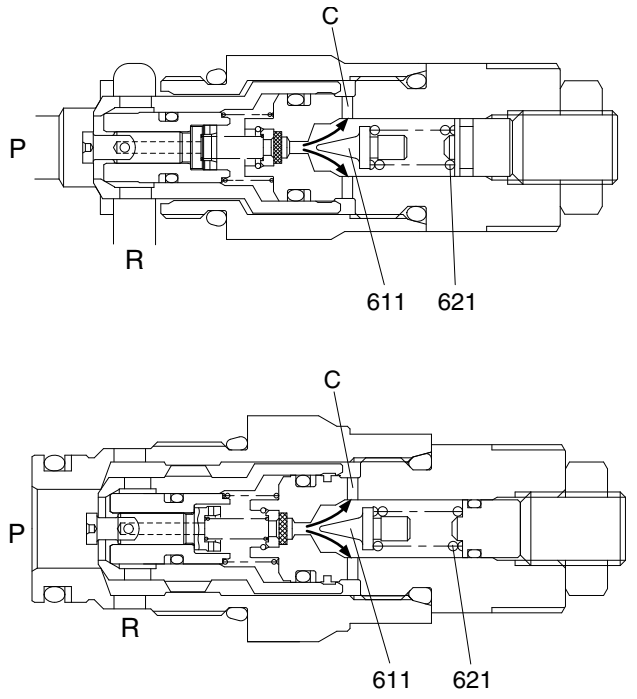
① Function as relief valve

a. 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.



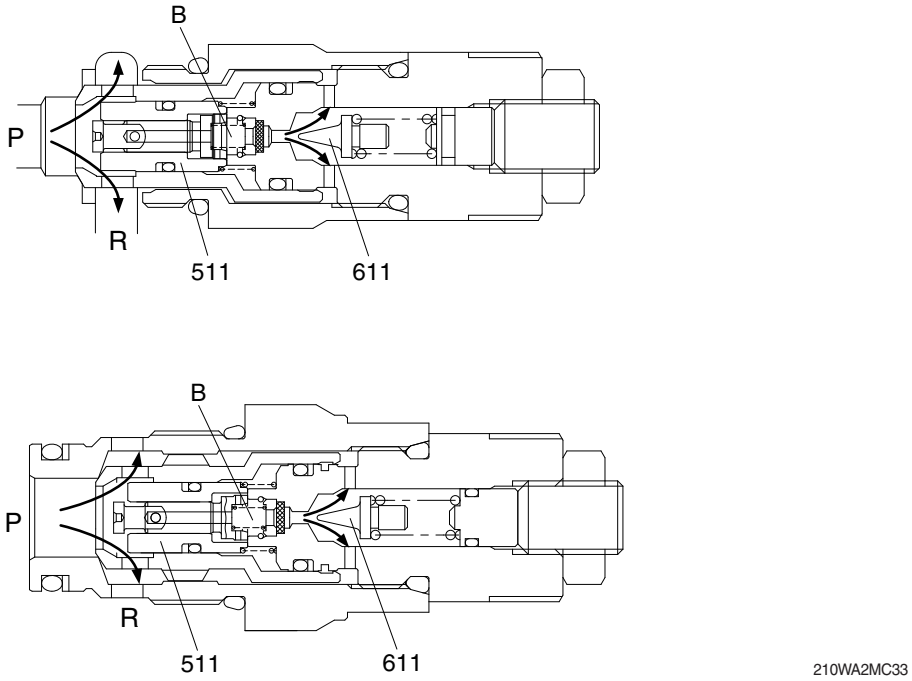
210WA2MC31

b. 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.



210WA2MC32

c. 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.

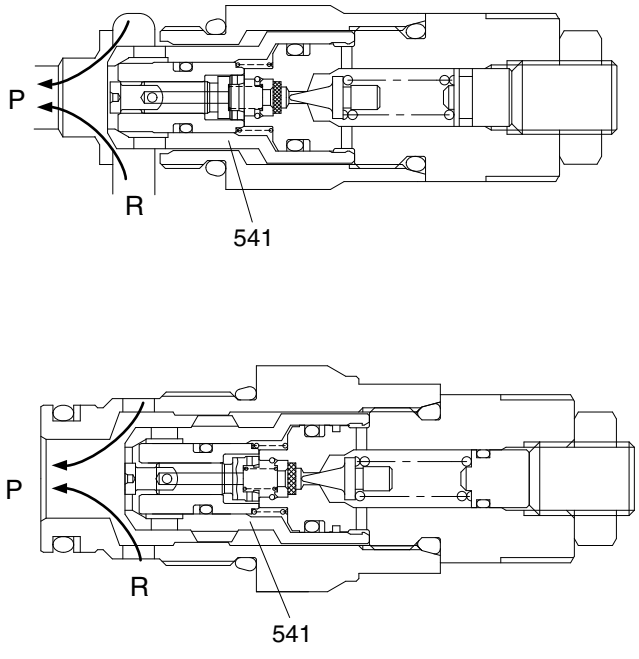


210WA2MC33

d. When the pressurized oil higher than pressure 25 kgf/cm^2 enters through the port PL, it pushes the piston (624) 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.



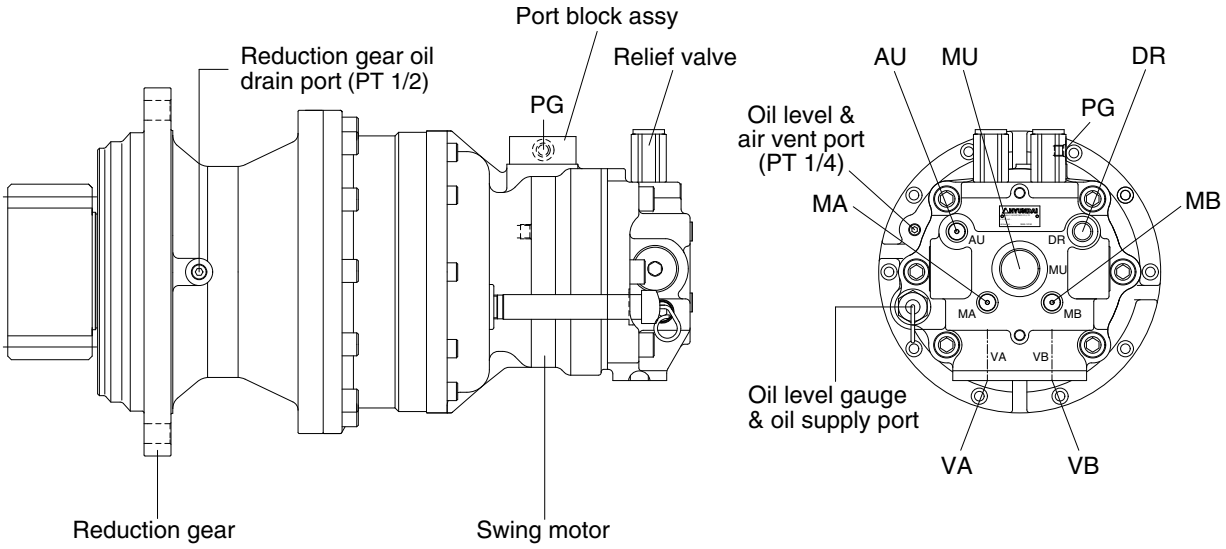
210WA2MC34

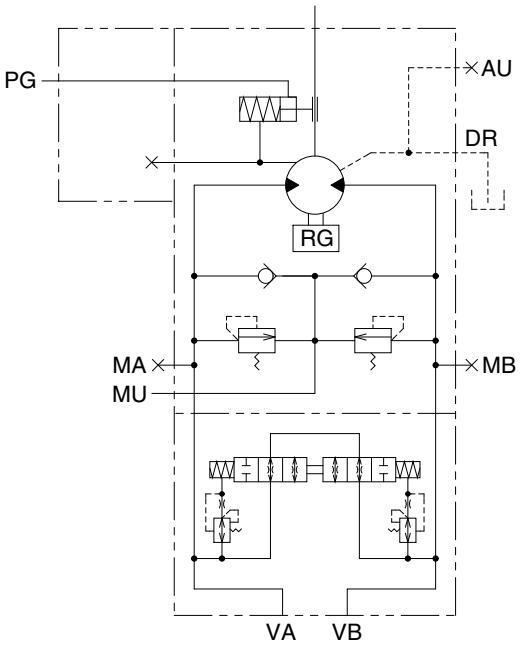
GROUP 3 SWING DEVICE

1. STRUCTURE

Swing device consists swing motor and swing reduction gear.

Swing motor include mechanical parking valve, relief valve, make up valve and port block assy.



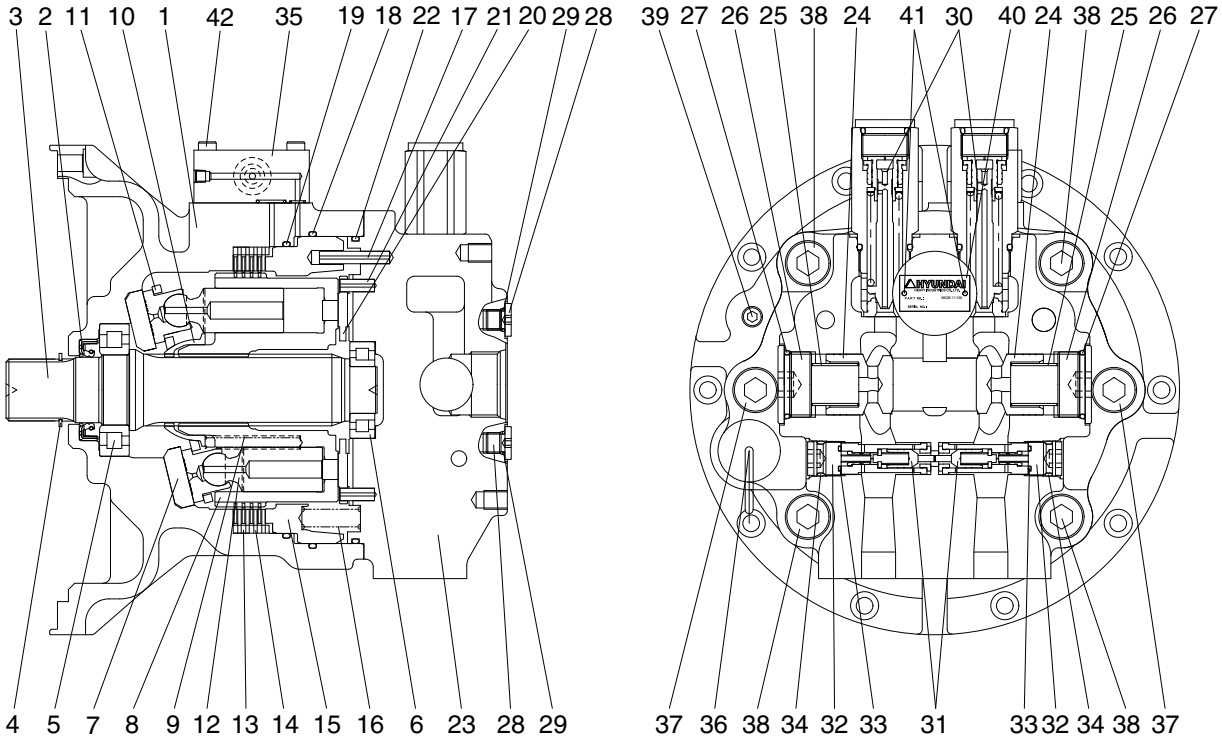


Hydraulic circuit

Port	Port name	Port size
VA	Main port	Ø20
VB	Main port	Ø20
DR	Drain port	PF 1/2
MU	Make up port	PF 1 1/4
PG	Stand by port	PF 1/4
MA, MB	Gauge port	PF 1/4
AU	Air vent port	PF 1/4

210WA2SM01

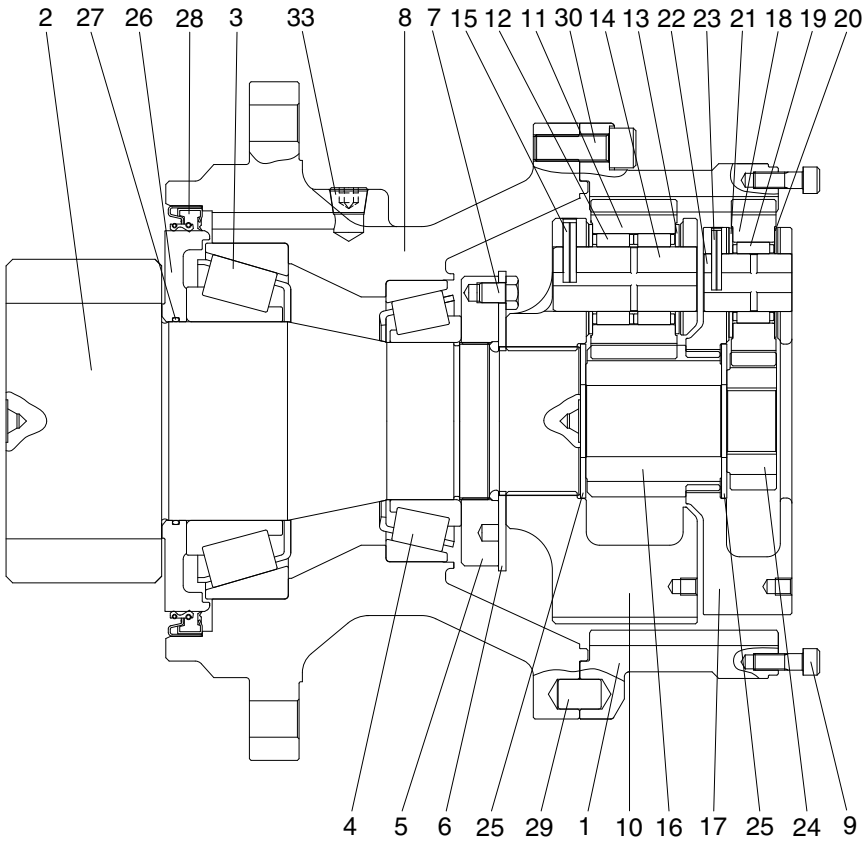
1) SWING MOTOR



210WA2SM02

1	Casing	15	Parking piston	29	O-ring
2	Oil seal	16	Brake spring	30	Relief valve assy
3	Shaft	17	Spring pin	31	Anti-rotating valve assy
4	Retainer ring	18	O-ring	32	Plug
5	Roller bearing	19	O-ring	33	O-ring
6	Roller bearing	20	Valve plate	34	O-ring
7	Swash plate	21	Spring pin	35	Port block assy
8	Rotary block	22	O-ring	36	Level gauge assy
9	Spring	23	Valve casing	37	Socket bolt
10	Ball guide	24	Check valve	38	Socket bolt
11	Retainer plate	25	Spring	39	Plug
12	Piston assy	26	Plug	40	Name plate
13	Friction plate	27	O-ring	41	Rivet
14	Separate plate	28	Plug	42	Socket bolt

2) REDUCTION GEAR



210WF2SM03

1	Ring gear	12	Needle bearing	23	Spring pin
2	Drive shaft	13	Thrust washer	24	Sun gear 1
3	Taper roller bearing	14	Carrier pin 2	25	Thrust plate
4	Taper roller bearing	15	Spring pin	26	Sleeve
5	Ring nut	16	Sun gear 2	27	O-ring
6	Lock plate	17	Carrier 1	28	Oil seal
7	Hexagon bolt	18	Planetary gear 1	29	Parallel pin
8	Casing	19	Needle bearing	30	Socket bolt
9	Socket bolt	20	Thrust washer	33	Plug
10	Carrier 2	21	Thrust washer		
11	Planetary gear 2	22	Carrier pin 1		

2. PRINCIPLE OF DRIVING

1) GENERATING THE TURNING FORCE

The high hydraulic supplied from a hydraulic pump flows into a rotary block (8) through valve casing of motor (23), and valve plate (20).

The high hydraulic is built as flowing on one side of Y-Y line connected by the upper and lower sides of piston (12).

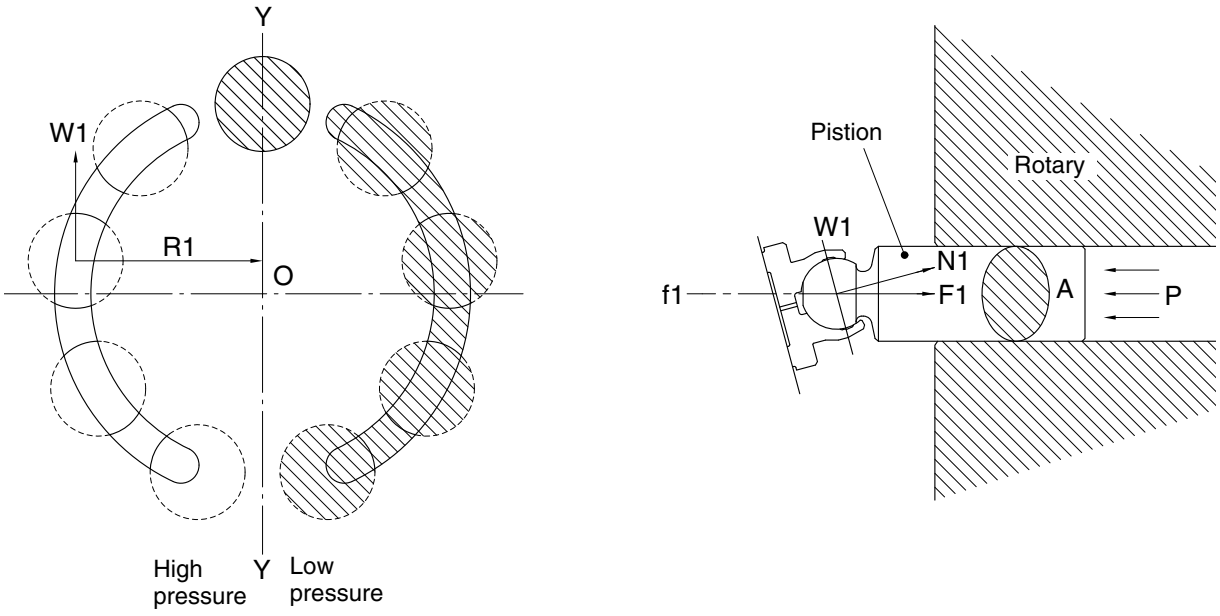
The high hydraulic can generate the force, F1=P×A (P : supplied pressure, A : water pressure area), like following pictures, working on a piston.

This force, F1, is divided as N1 thrust partial pressure and W1 radial partial pressure, in case of the plate of a tilt angle, α.

W1 generates torque, T=W1×R1, for Y-Y line connected by the upper and lower sides of the piston as following pictures.

The sum of torque (ΣW1×R1), generated from each piston (4~5 pieces) on the side of a high hydraulic, generates the turning force.

This torque transfers the turning force to a rotaty (8) through a piston; because a rotary is combined with a turning axis and spline, a turning axis rotates and a turning force is sent.



210WA8SM05

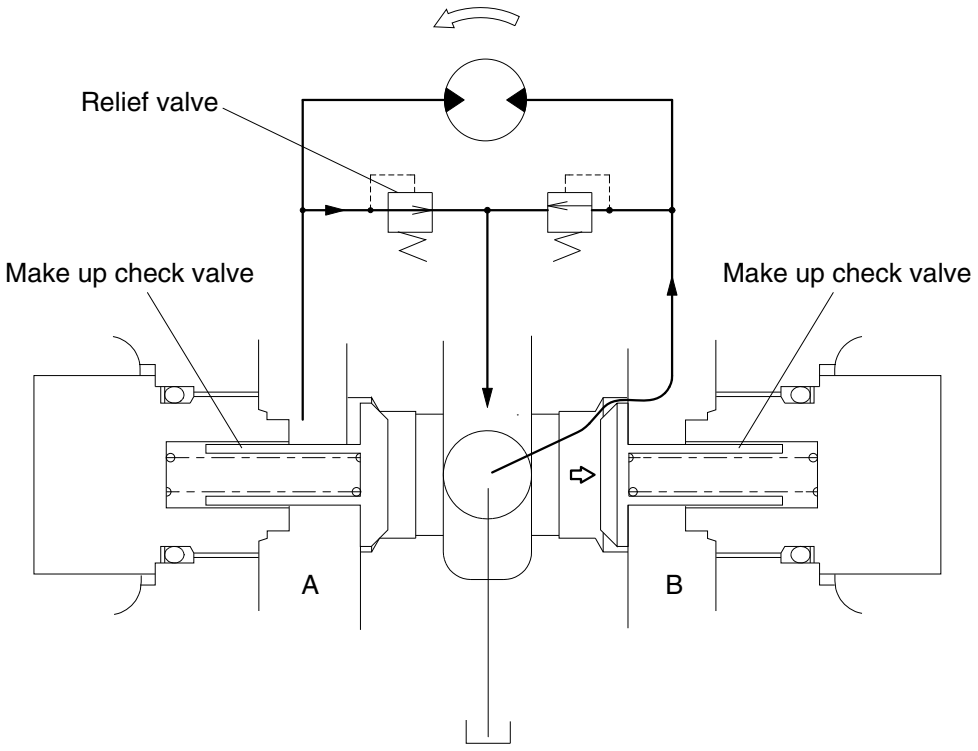
2) MAKE UP VALVE

In the system using this type of motor, there is no counter balance functioning valve and there happens the case of revolution exceeding hydraulic supply of motor. To prevent the cavitation caused by insufficient oil flow there is a make up valve to fill up the oil insufficiency.

A make up valve is provided immediately before the port leading to the hydraulic oil tank to secure feed pressure required when the hydraulic motor makes a pumping action. The boost pressure acts on the hydraulic motor's feed port via the make up valve.

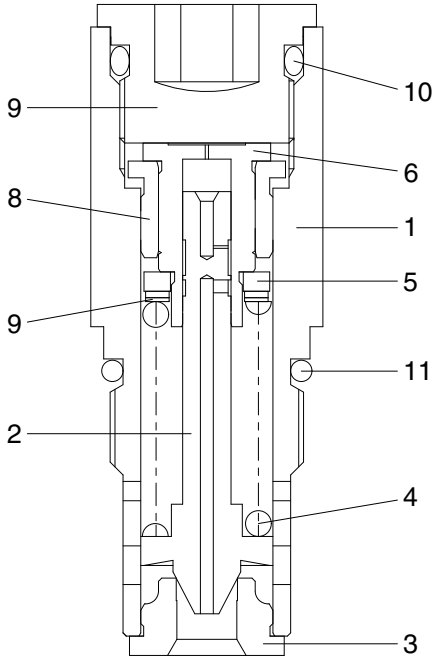
Pressurized oil into the port B, the motor rotate counterclockwise.

If the plunger of MCV moves neutral position, the oil in the motor is drain via left relief valve, the drain oil run into motor via right make up valve, which prevent the cavitation of motor.



21092SM04

3) RELIEF VALVE



2209A2SM25

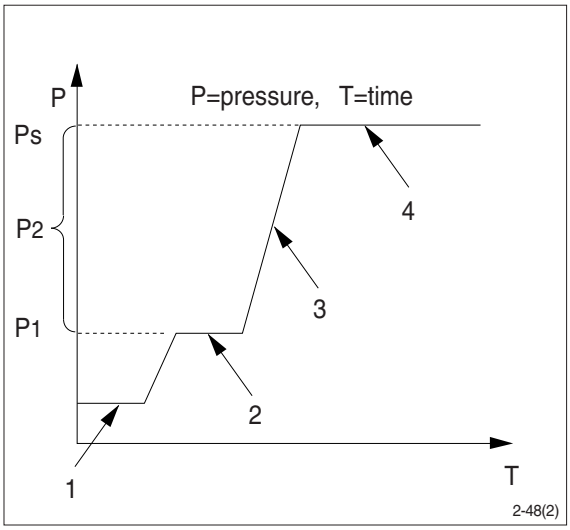
1	Sleeve
2	Poppet
3	Poppet seat
4	Spring
5	Spring seat
6	Shim
7	Piston
8	Stopper
9	Plug
10	O-ring
11	O-ring

(1) Construction of relief valve

The valve casing contains two cartridge type relief valves that stop the regular and reverse rotations of the hydraulic motor. The relief valves relieve high pressure at start or at stop of swing motion and can control the relief pressure in two steps, high and low, in order to insure smooth operation.

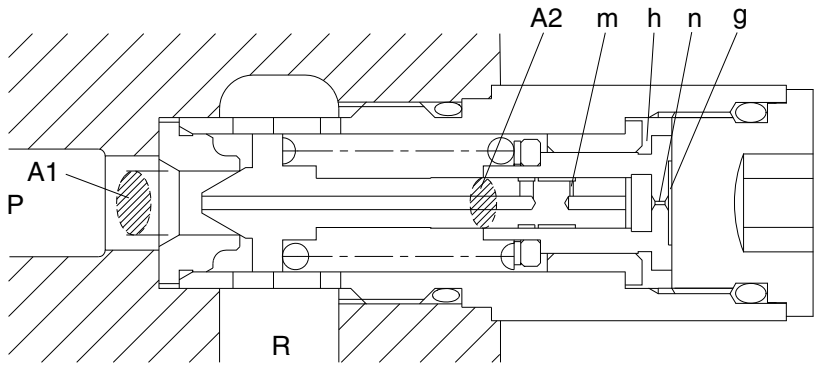
(2) Function of relief valve

Figure illustrates how the pressure acting on the relief valve is related to its rising process. Here is given the function, referring to the figure following page.



2-48(2)

① Ports (P,R) at tank pressure.

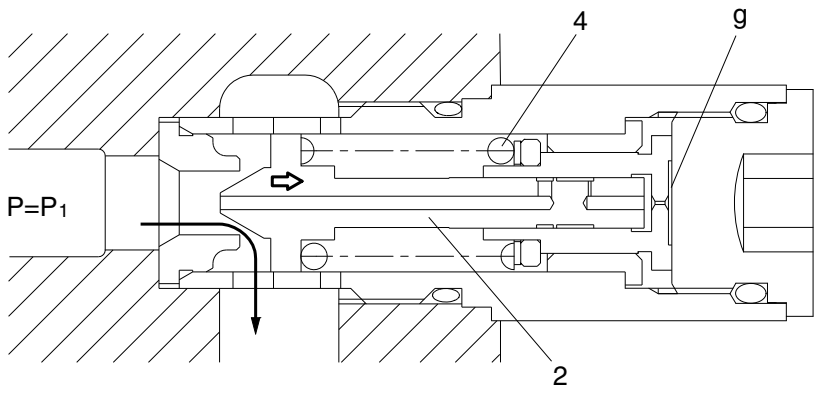


2209A2SM26

② When hydraulic oil pressure ($P \times A_1$) reaches the preset force (F_{SP}) of spring (4), the plunger (2) moves to the right as shown.

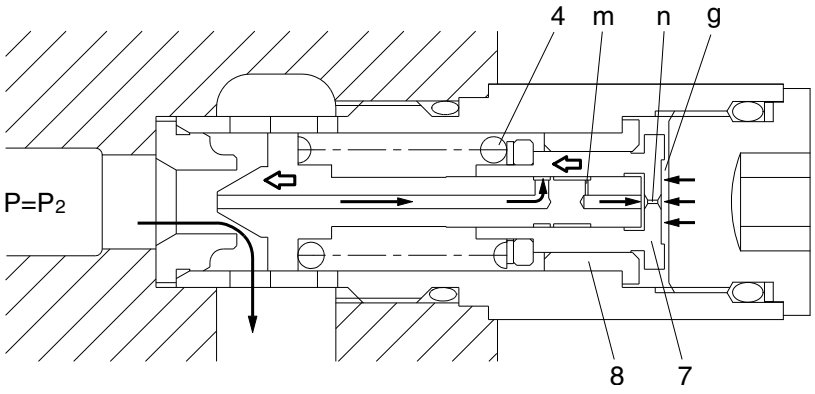
$P_1 \times A_1 = Fsp + Pg \times A_2$

$$P_1 = \frac{Fsp + Pg \times A_2}{A_1}$$



2209A2SM27

③ The oil flow chamber g via orifice m and n. When the pressure of chamber g reaches the preset force (FSP) of spring (4), the piston (7) moves left and stop the piston (7) hits the bottom of bushing (8).

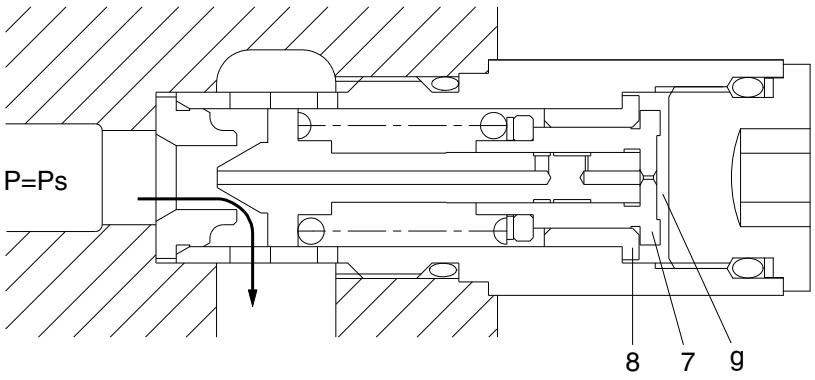


2209A2SM28

④ When piston (7) hits the bottom of bushing (8), it stops moving to the left any further. As the result, the pressure in chamber (g) equals (Ps).

$Ps \times A_1 = Fsp + Ps \times A_2$

$$Ps = \frac{Fsp}{A_1 - A_2}$$



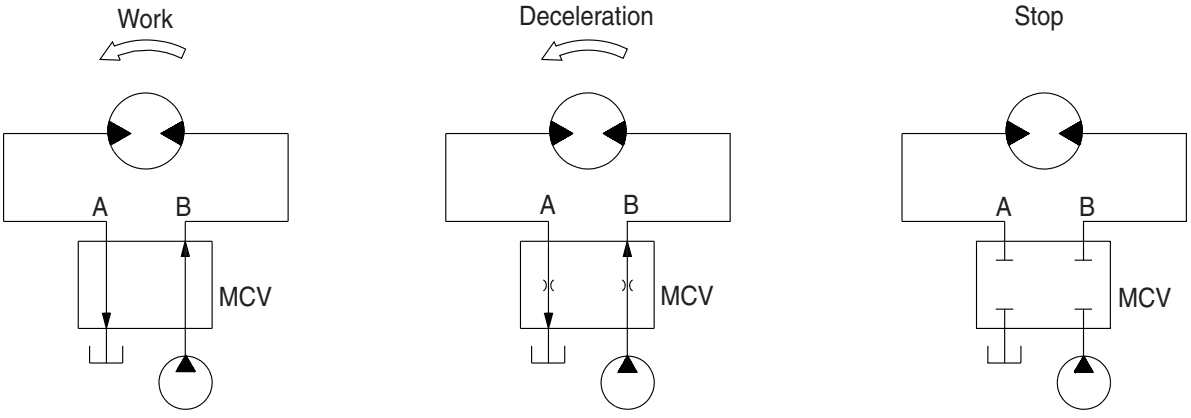
2209A2SM29

4) BRAKE SYSTEM

(1) Control valve swing brake system

This is the brake system to stop the swing motion of the excavator during operation.

In this system, the hydraulic circuit is throttled by the swing control valve, and the resistance created by this throttling works as a brake force to slow down the swing motion.



MCV A, B opened | MCV A, B throttled | MCV A, B closed

2-48(1)

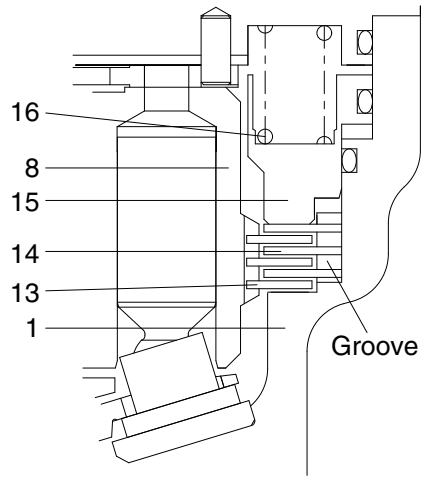
(2) Mechanical swing parking brake system

This is function as a parking brake only when any one of the swing, arm in and boom up function is not operated.

① Brake assembly

Circumferential rotation of separate plate (14) is constrained by the groove located at casing (1). When housing is pressed down by brake spring (16) through friction plate (13), separate plate (14) and parking piston (15), friction force occurs there.

Rotary block (8) is constrained by this friction force and brake acts, while brake releases when hydraulic force exceeds spring force.



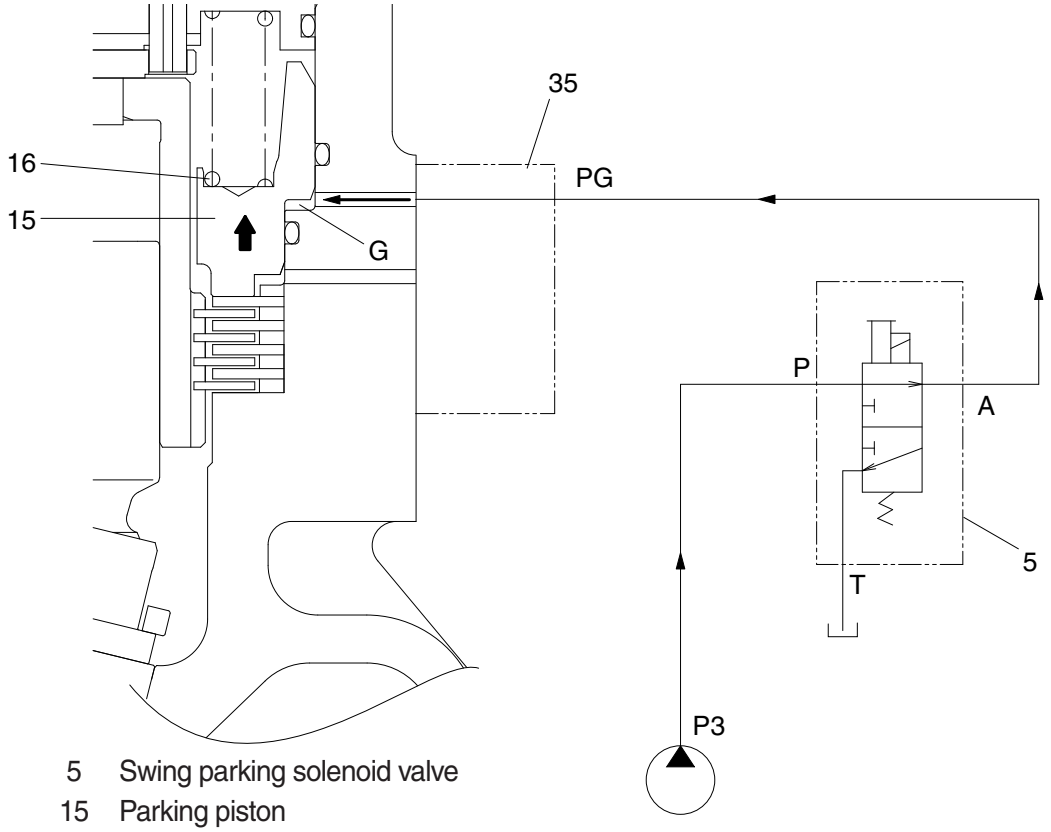
2209A2SM35

1	Casing	14	Separate plate
8	Rotary block	15	Parking piston
13	Friction plate	16	Brake spring

② Operating principle

a. When any of the swing, arm in, travel and boom up function is operated, the swing parking solenoid valve (5) is shifted to the swing position, so pilot pump charged oil (P3) goes to the chamber G through port PG.
This pressure is applied to move the brake piston (15) to the upward against the force of the brake spring (16). Thus, it releases the brake force.

b. Stop operation and a few second has been elapsed, the swing parking solenoid valve (5) is shifted to the swing parking position and swing brake works.



5 Swing parking solenoid valve
15 Parking piston
16 Brake spring
35 Port block assy

210WA2SM10

③ Electric control swing prarking system

a. A safety is ensured by recognizing the swing operation and canceling the swing parking only under specific conditions by releasing parking electronically.

b. After receiving the RCV pressure, the MCU applies the parking release signal.

c. Depending on each RCV operation, there is a time difference between re-entry into swing parking.

Mode	Fine swing switch	RCV operation	Parking delay time
Work mode	ON or OFF (No condition)	Swing	5 sec
		Arm in	1 sec
	ON	Boom up	2 sec
		Travel	3 sec
	OFF	Boom up / Travel	Not applied

④ **Manual override function**

When the swing parking solenoid valve or related electric system is malfunction, the swing parking brake is not released even if the swing lever is operated.

To release the swing parking brake, the manual override function is needed.

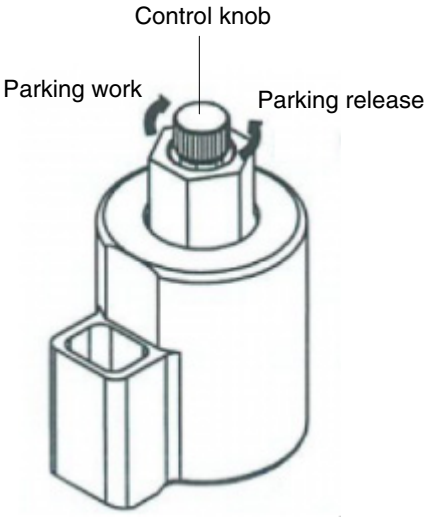
※ **Manual override solenoid valve**

a. Use hand only to turn the control knob (do not use a tool).

b. **Parking brake release**
Turn the control knob to counterclockwise fully (about 2.5 mm)

c. **Parking brake work**
Turn the control knob to clockwise fully.

※ **Be careful not damage the control knob by using a tool or tightening forcibly.**
It can cause malfunction of the solenoid valve.



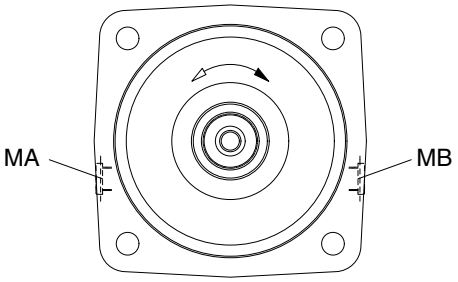
Swing parking solenoid valve

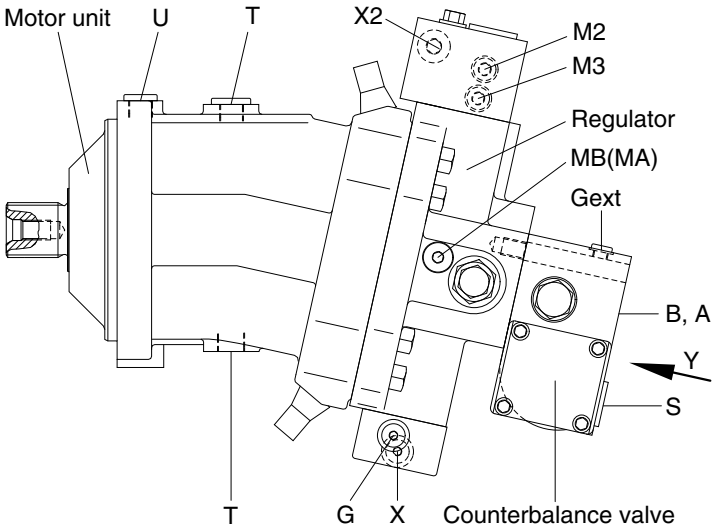
160A2SM11

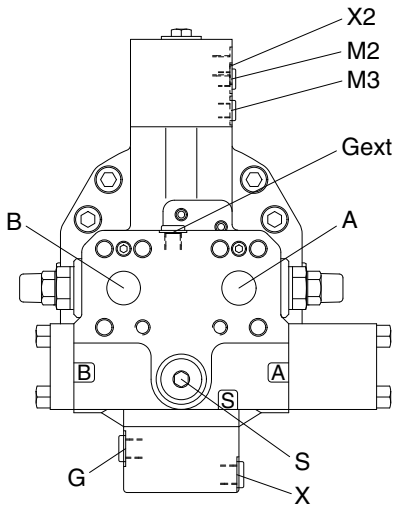
GROUP 4 TRAVEL MOTOR

1. CONSTRUCTION

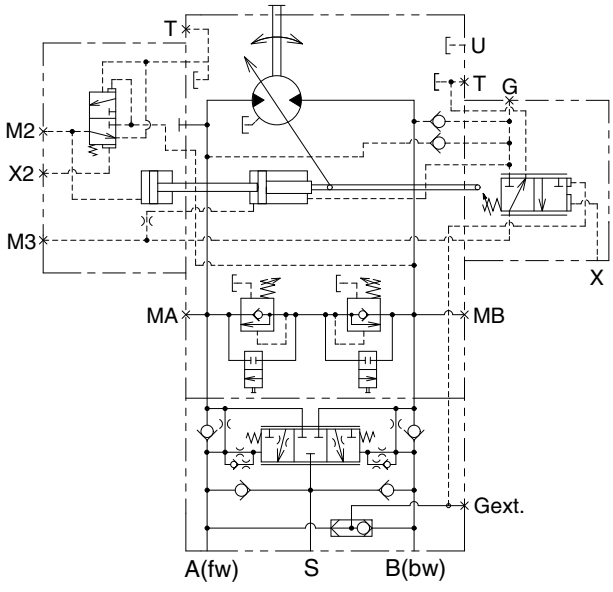
Travel motor consists motor unit, regulator and counterbalance valve.







VIEW Y



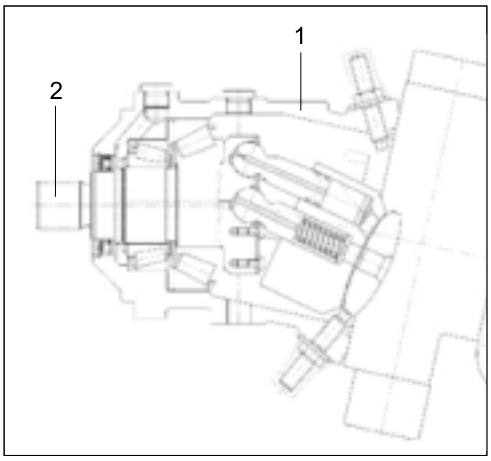
Hydraulic circuit

210WA2TR01

Port	Port name	Port size
A, B	Main port	SAE 1 1/4"
G	Plugged	M14×1.5 - 12
X	Pilot pressure port	M14×1.5 - 12
X2	Pilot pressure port	M14×1.5 - 12
T	Drain port	PF 3/4 - 18
U	Flushing port	PF 1/2 - 17
S	Make up port	M27×2.0 - 16
MA, MB	Gauge port	M18×1.5 - 12
M2, M3	Gauge port	M10×1.0 - 8
Gext	Brake release port	M12×1.5 - 12.5

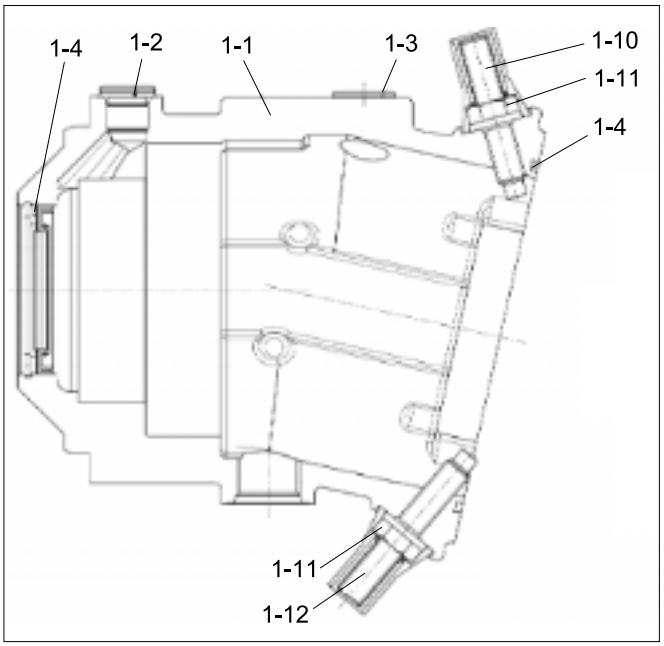
1) PARTS LIST (1/3)

MOTOR ASSY

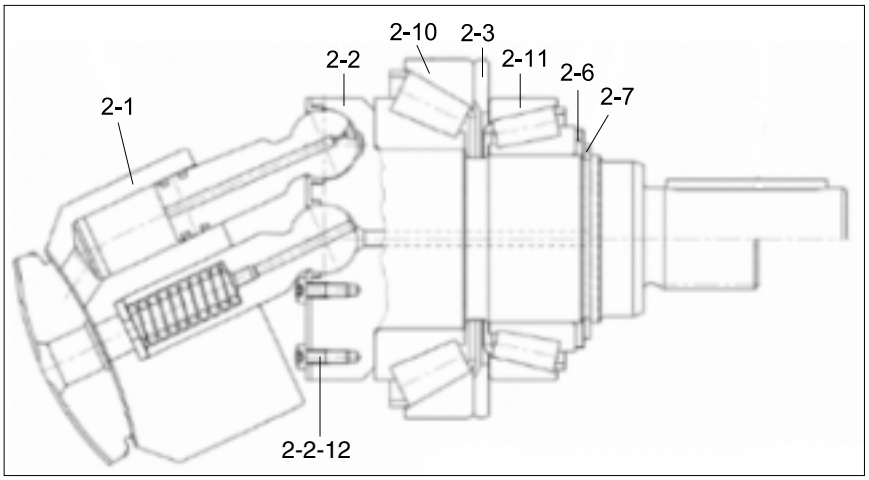


1 Motor housing assy
2 Rotary kit

ITEM 1



ITEM 2

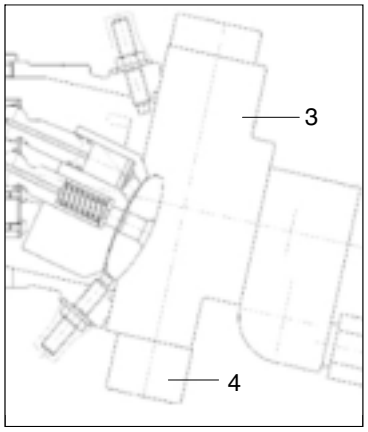


140WA2TR10

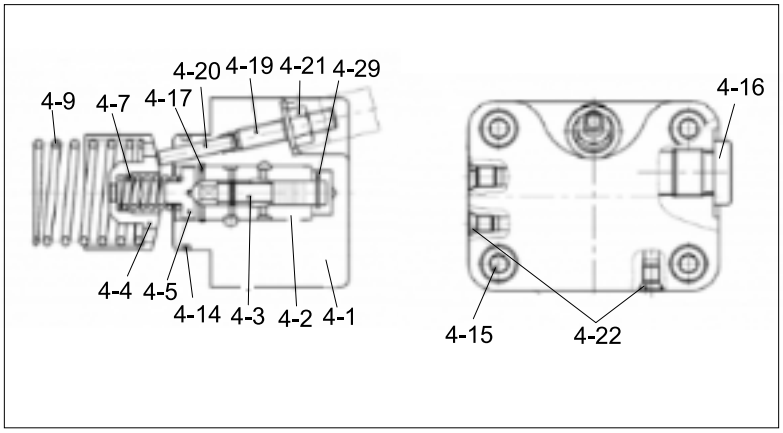
1-1	Housing	1-11	Sealing nut	2-3	Shim
1-2	Lock screw	1-12	Threaded pin	2-6	Backup plate
1-3	Lock screw	2-1	Hydraulic rotary section	2-7	Retainer ring
1-4	Motor seal kit	2-2	Drive shaft	2-10	Roller bearing
1-10	Threaded pin	2-2-12	Screw	2-11	Roller bearing

PARTS LIST (2/3)

MOTOR ASSY

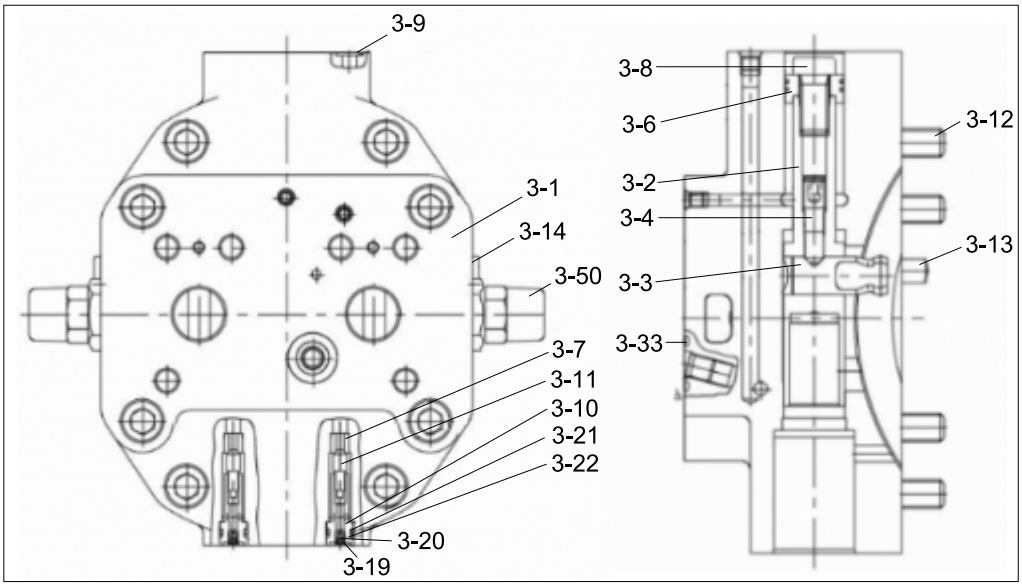


ITEM 4



3 Port plate assy
4 Control unit

ITEM 3

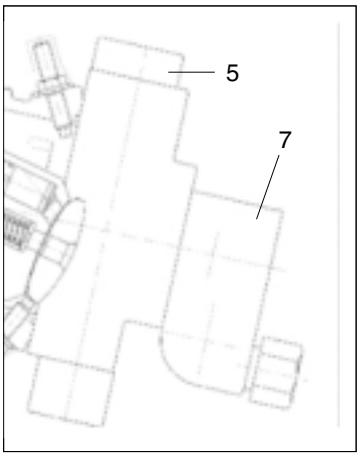


210WA2TR12

3-1	Port plate	3-14	Locking screw	4-7	Pressure spring
3-2	Positioning piston	3-19	O-ring	4-9	Pressure spring
3-3	Positioning trunnion	3-20	Throttle screw	4-14	O-ring
3-4	Threaded pin	3-21	O-ring	4-15	Socket screw
3-6	Piston ring	3-22	Back up ring	4-16	Locking screw
3-7	Bushing	3-33	O-ring	4-17	Retainer ring
3-8	Socket screw	3-50	Relief valve	4-19	Thread pin
3-9	O-ring	4-1	Control housing	4-20	Cylinder pin
3-10	Valve guide	4-2	Control bushing	4-21	Seal lock nut
3-11	Socket bolt	4-3	Control piston	4-22	Break pin
3-12	Socket screw	4-4	Adjust bushing	4-29	Retainer disc
3-13	Cylinder pin	4-5	Spring collar		

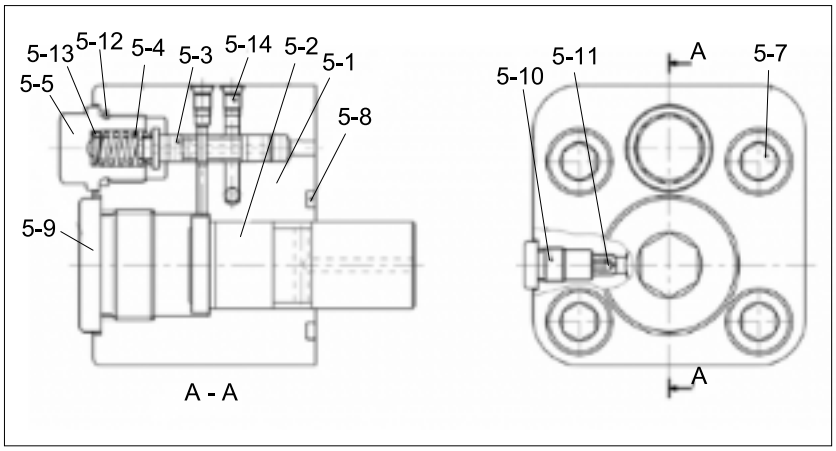
PARTS LIST (3/3)

MOTOR ASSY

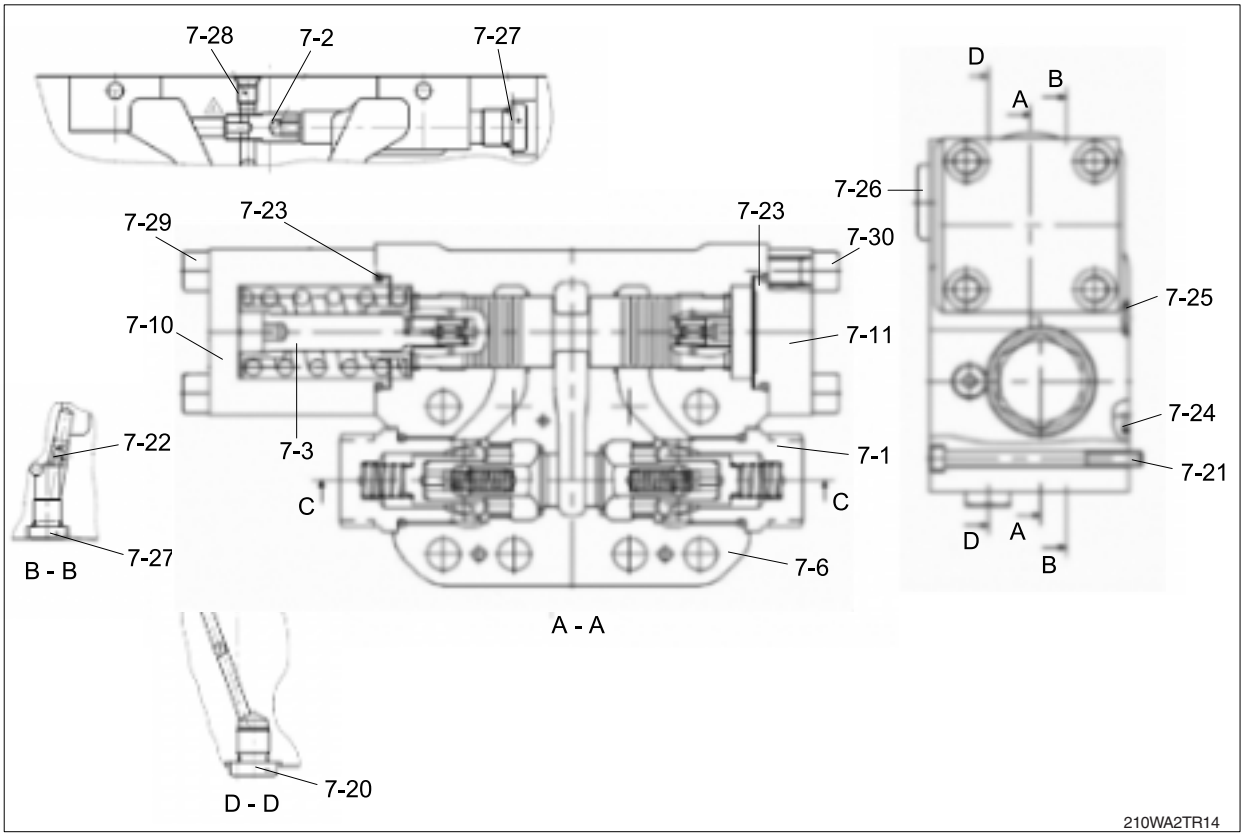


5 Hydraulic stroke limiter
7 Motion control valve assy

ITEM 5

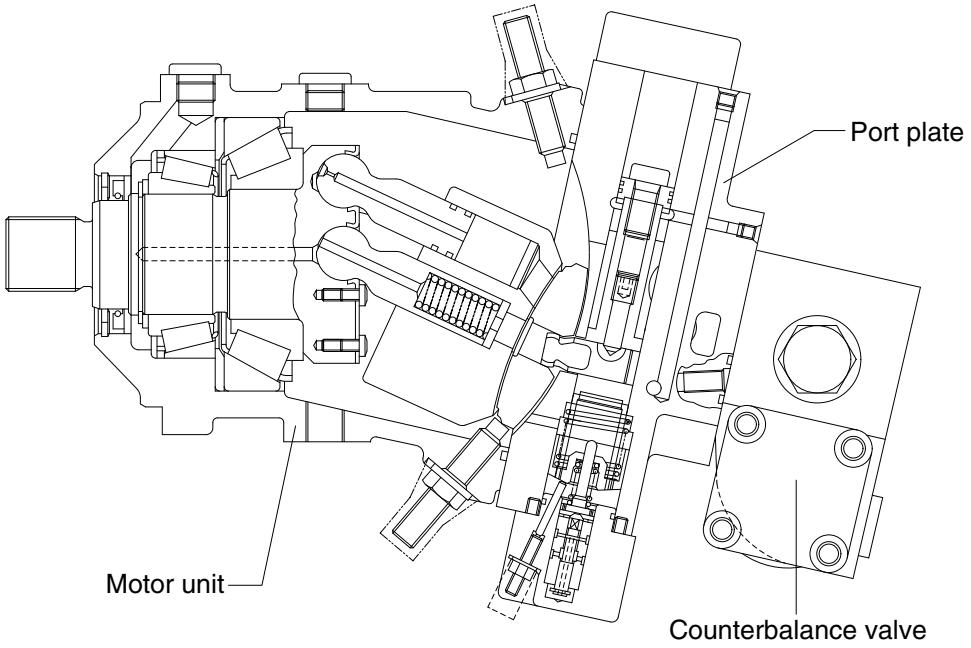


ITEM 7



5-1	Limiter housing	5-12	O-ring	7-21	Socket screw
5-2	Piston	5-13	Shim	7-22	Plug
5-3	Control piston	5-14	Break pin	7-23	O-ring
5-4	Pressure spring	7-1	Control valve assy	7-24	O-ring
5-5	Lock screw	7-2	Shuttle valve	7-25	O-ring
5-7	Cap screw	7-3	Brake piston assy	7-26	Locking serew
5-8	O-ring	7-6	Housing	7-27	Locking screw
5-9	Lock screw	7-10	Cover	7-28	Break pin
5-10	Lock screw	7-11	Cover	7-29	Socket serew
5-11	Orifice	7-20	Locking screw		

2. FUNCTION



160WA2TR05

1) **VARIABLE DISPLACEMENT MOTOR** (with integrated counterbalance valve)

The variable displacement motor has a rotary group in bent axis design.
The torque is generated directly at the drive shaft.
The cylinder barrel is driven by a tapered piston arrangement.
The change of displacement is generated by the control lens via positioning piston. The control lens slides on a circular shaped surface.

In case of constant pump flow volume and high pressure
- The output speed is increased at smaller swivel angle, the torque is reduced
- The torque rises at swivel angle increase, the output speed is decreased

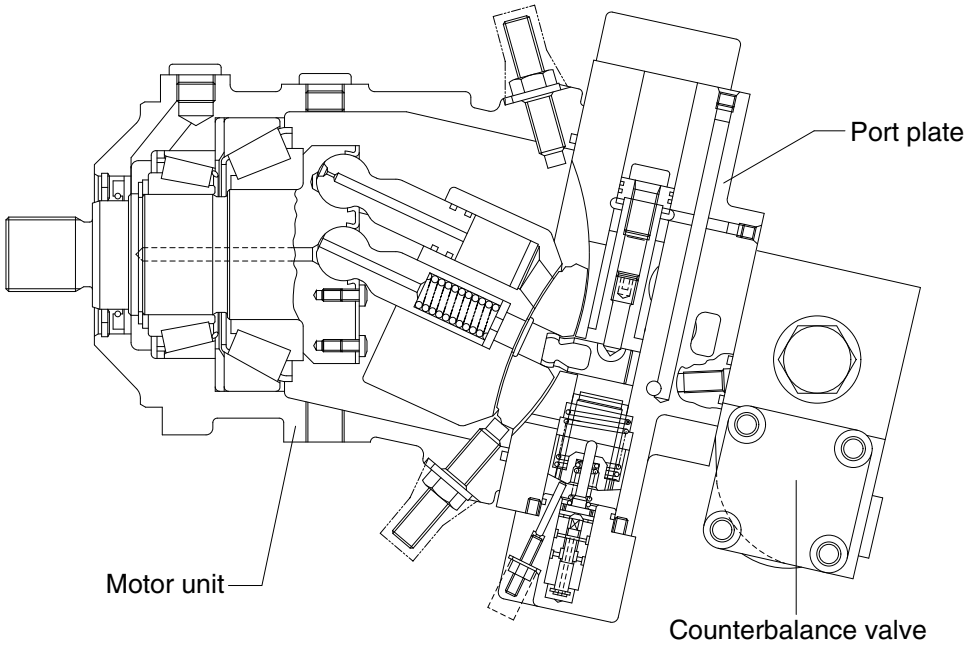
The max swivel angle is 25°, the min swivel angle is 0°.

The variable displacement motor with integrated counterbalance valve is designed to be operated in open loop.

※ Min and max displacement are limited by a stop screw. Stepless adjustment to various higher values is possible.
Reduction to smaller displacement may result in overspeeding the motor.

2) **PORT PLATE**

With high pressure dependent control HA1, mounted counterbalance valve, integrated secondary pressure relief valves, plugged gauge and boosting ports, service ports to the rear.



3) HIGH PRESSURE DEPENDENT CONTROL

The displacement is-dependent on operating pressure - automatically adjusted. Upon reaching the operating pressure set at the control valve - internally measured at A or B - the motor swivels from V_{gmin} to V_{gmax} until output torque = load torque. For values lower than the adjusted one the motor keeps min swivel angle. The necessary positioning energy is taken from the respective high pressure side via shuttle valve.

Swivelling results in a change of the displacement.
Swivel time is controlled by an orifice installed in the cover of the large positioning piston side.

4) COUNTERBALANCE VALVE

Mounted at the rear of the port plate.
Incase of downhill traveling or deceleration of the machine a counterbalance valve avoids overspeeding and cavitation of hydraulic motor.

5) FUNCTION AS TO CIRCUIT DIAGRAM

Check valves in the inlet line A and B for by passing of the counterbalance valve.
At traveling forward the return oil flow is controlled by a counterbalance spool. At drop in inlet pressure the counterbalance spool throttles the return oil flow. The motor is locked. The oil behind the spool is led to the low pressure side via an additional check valve. Same function for traveling forward and backward.

Braking means for the motor that
- At reduced or zero inlet flow the counterbalance spool reaches a modulating position or a neutral position caused by spring force
- The high pressure oil (at outlet side of the motor) is returned to the low pressure side (at inlet side) of the motor via crossover relief valves.

As the control pressure for regulation of the HA control via the integrated shuttle valve is no longer available, the motor with HA control and counterbalance valve will swivel to its minimum displacement during deceleration.
In addition, an external boost flow/pressure can be applied at port S for preventing cavitation.

※ Counterbalance valves do not replace the service and parking brake.

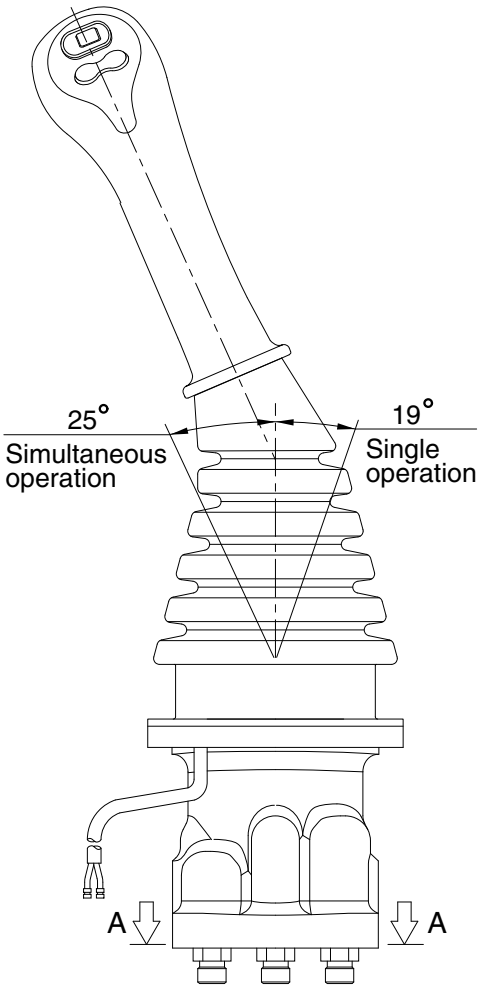
GROUP 5 RCV LEVER

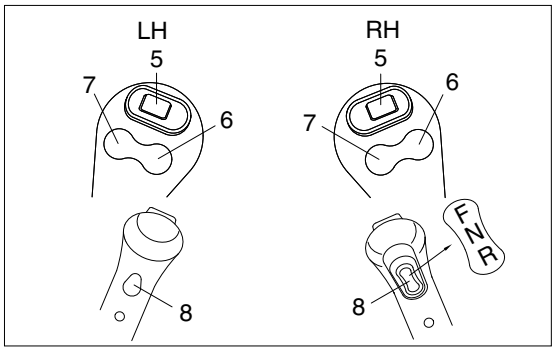
1. STRUCTURE

The casing has the oil inlet port P (primary pressure) and the oil outlet port T (tank). In addition the secondary pressure is taken out through ports 1, 2, 3 and 4 provided at the bottom face.

※ Refer to the parts manual for the types of the RCV lever.

1) TYPE M6

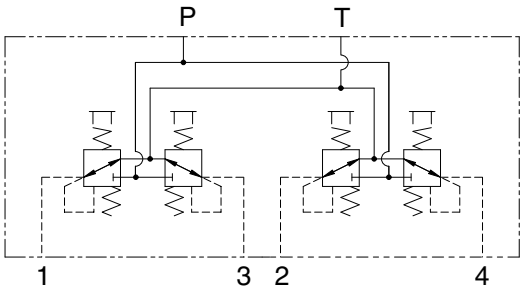




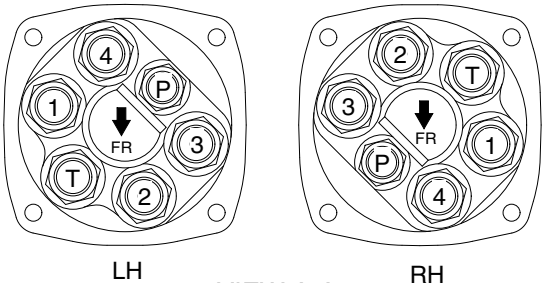
TYPE M6

Switches

Type	No.	LH	RH
M6	5	N.A	Breaker
	6	One touch decel	Quick coupler
	7	Ram lock	Horn
	8	Power max	FNR switch



Hydraulic circuit



LH RH

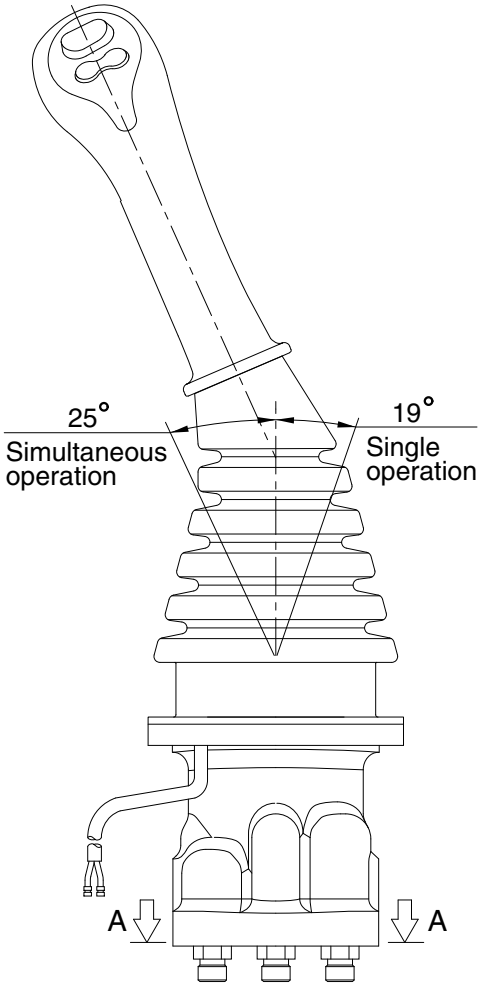
VIEW A-A

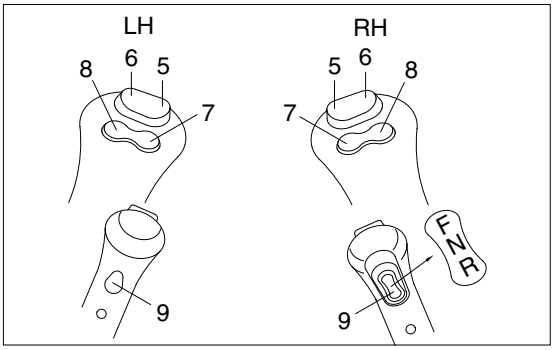
Pilot ports

Port	LH	RH	Port size
P	Pilot oil inlet port	Pilot oil inlet port	PF 3/8
T	Pilot oil return port	Pilot oil return port	
1	Left swing port	Bucket out port	
2	Arm out port	Boom up port	
3	Right swing port	Bucket in port	
4	Arm in port	Boom down port	

210WA2RL01

2) TYPE M26

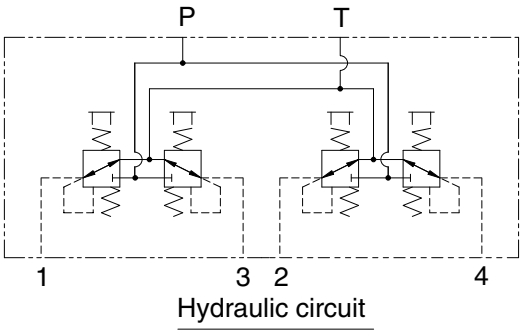




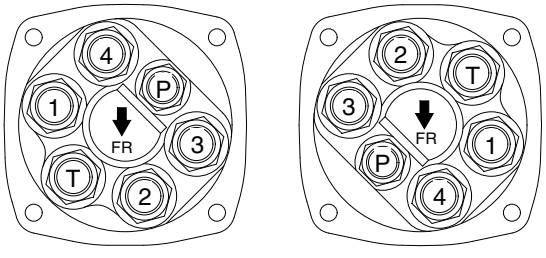
TYPE M26

Switches

Type	No.	LH	RH
M26	5	Rotating-CW	2-way clamp
	6	Rotating-CCW	2-way release
	7	One touch decel	Quick coupler
	8	Ram lock	Horn
	9	Power max	FNR switch



Hydraulic circuit



LH RH

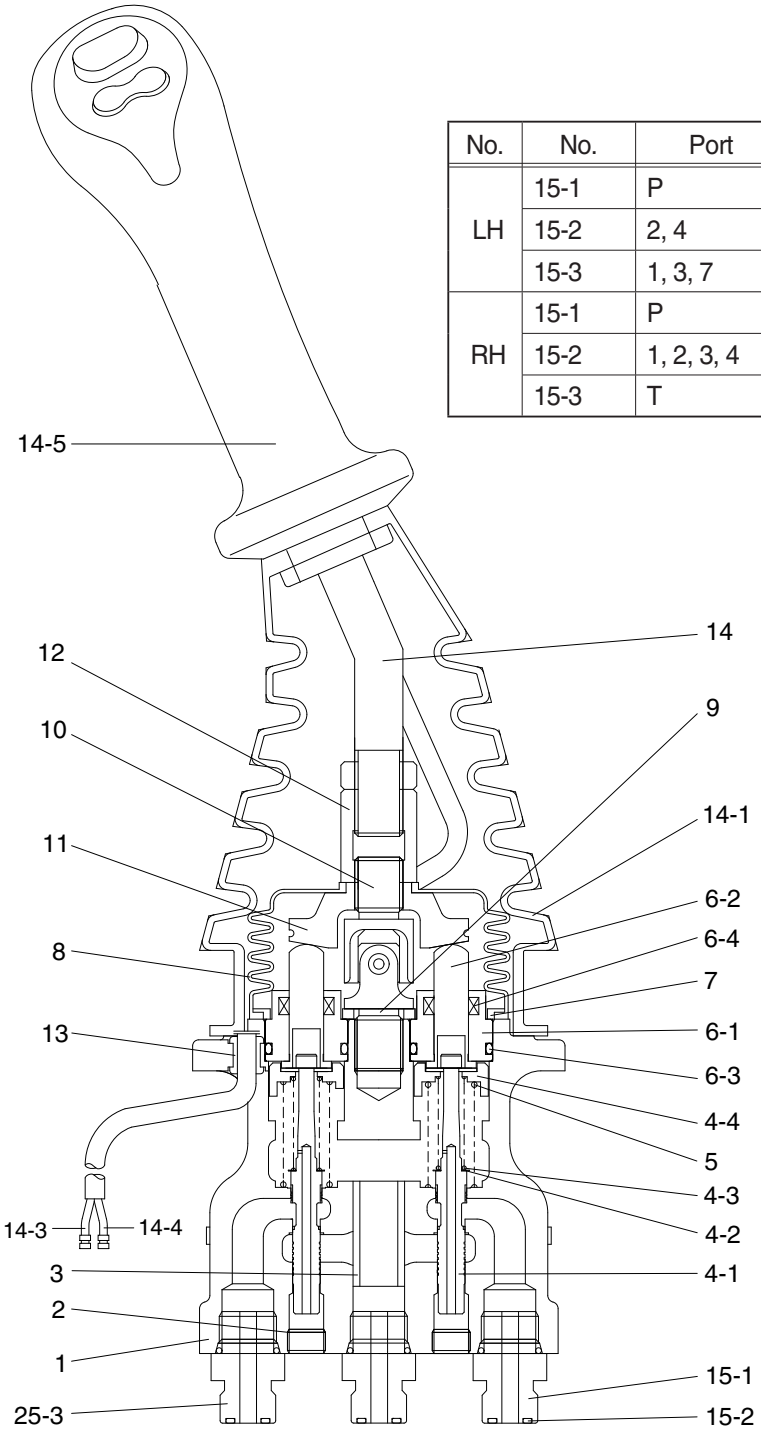
VIEW A-A

Pilot ports

Port	LH	RH	Port size
P	Pilot oil inlet port	Pilot oil inlet port	PF 3/8
T	Pilot oil return port	Pilot oil return port	
1	Left swing port	Bucket out port	
2	Arm out port	Boom up port	
3	Right swing port	Bucket in port	
4	Arm in port	Boom down port	

210WA2RL02

3) CROSS SECTION



No.	No.	Port
LH	15-1	P
	15-2	2, 4
	15-3	1, 3, 7
RH	15-1	P
	15-2	1, 2, 3, 4
	15-3	T

1	Case
2	Plug
3	Bushing
4-1	Spool
4-2	Shim
4-3	Spring
4-4	Spring seat
5	Spring
6-1	Plug
6-2	Push rod
6-3	O-ring
6-4	Rod seal
7	Spacer
8	Boot
9	Spacer
10	Joint Assy
11	Swash plate
12	Adjusting nut
13	Bushing
14-1	Boot
14-2	Spring pin
14-3	Housing
14-4	Housing
14-5	Handle
15-1	Filter
15-2	Connector
15-3	Connector

140WA2RL06

Item numbers are based on the type M6.

The construction of the pilot valve is shown in the attached cross section drawing. The casing has vertical holes in which reducing valves are assembled.

The pressure reducing section is composed of the spool (4-1), spring (4-3) for setting secondary pressure, return spring (5), spring seat (4-4) and shim (4-2). The spring for setting the secondary pressure has been generally so preset that the secondary pressure is 5 to 20.5 kgf/cm^2 (depending on the type). The spool is pushed against the push rod (6-2) by the return spring.

When the push rod is pushed down by tilting the handle, the spring seat comes down simultaneously and changes setting of the secondary pressure spring.

2. FUNCTIONS

1) FUNDAMENTAL FUNCTIONS

The pilot valve is a valve that controls the spool stroke, direction, etc of a main control valve. This function is carried out by providing the spring at one end of the main control valve spool and applying the output pressure (secondary pressure) of the pilot valve to the other end.

For this function to be carried out satisfactorily, the pilot valve is composed of the following elements.

(1) Inlet port (P) where oil is supplied from hydraulic pump.

(2) Output ports (1, 2, 3 & 4) to apply pressure supplied from inlet port to ends of control valve spools.

(3) Tank port (T) necessary to control the above output pressure.

(4) Spool to connect output port to inlet port or tank port.

(5) Mechanical means to control output pressure, including springs that work on the above spools.

2) FUNCTIONS OF MAJOR SECTIONS

Item numbers are based on the type M6.

The functions of the spool (4-1) are to receive the supply oil pressure from the hydraulic pump at its port P, and to change over oil paths to determine whether the pressure oil of port P is led to output ports 1, 2, 3 & 4 or the output port pressure oil to tank port T.

The spring (4-3) works on this spool to determine the output pressure.

The change the deflection of this spring, the push rod (6-2) is inserted and can slide in the plug (6-1).

For the purpose of changing the displacement of the push rod through the swash plate (11) and adjusting nut (12) are provided the handle (14-5) that can be tilted in any direction around the fulcrum of the universal joint (10) center.

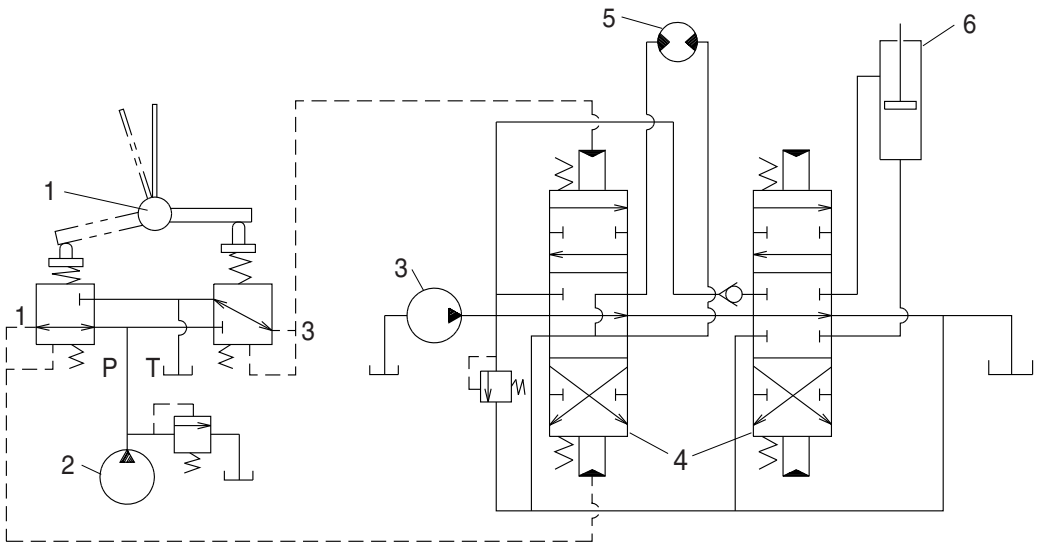
The spring (5) works on the case (1) and spring seat (4-4) and tries to return the push rod (6-2) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

This also has the effect of a reaction spring to give appropriate control feeling to the operator.

3) OPERATION

The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below and the attached operation explanation drawing.

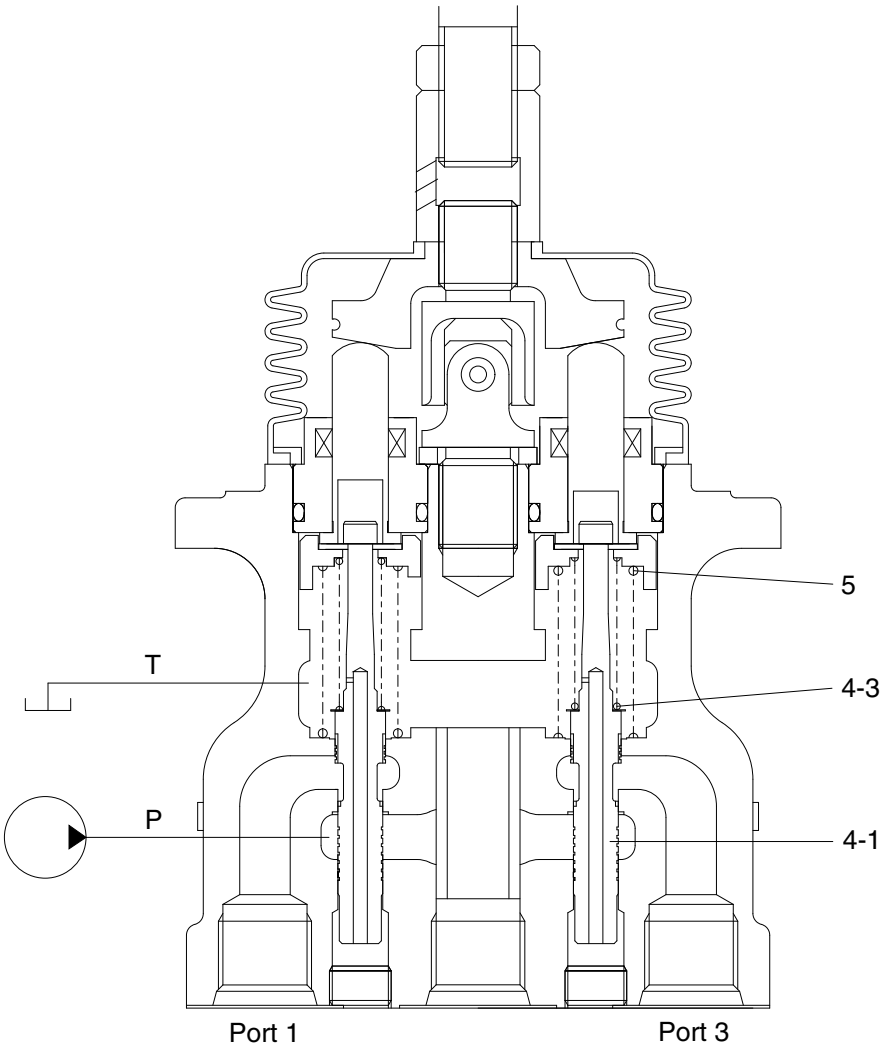
The diagram shown below is the typical application example of the pilot valve.



2-70

1	Pilot valve	3	Main pump	5	Hydraulic motor
2	Brake pump	4	Main control valve	6	Hydraulic cylinder

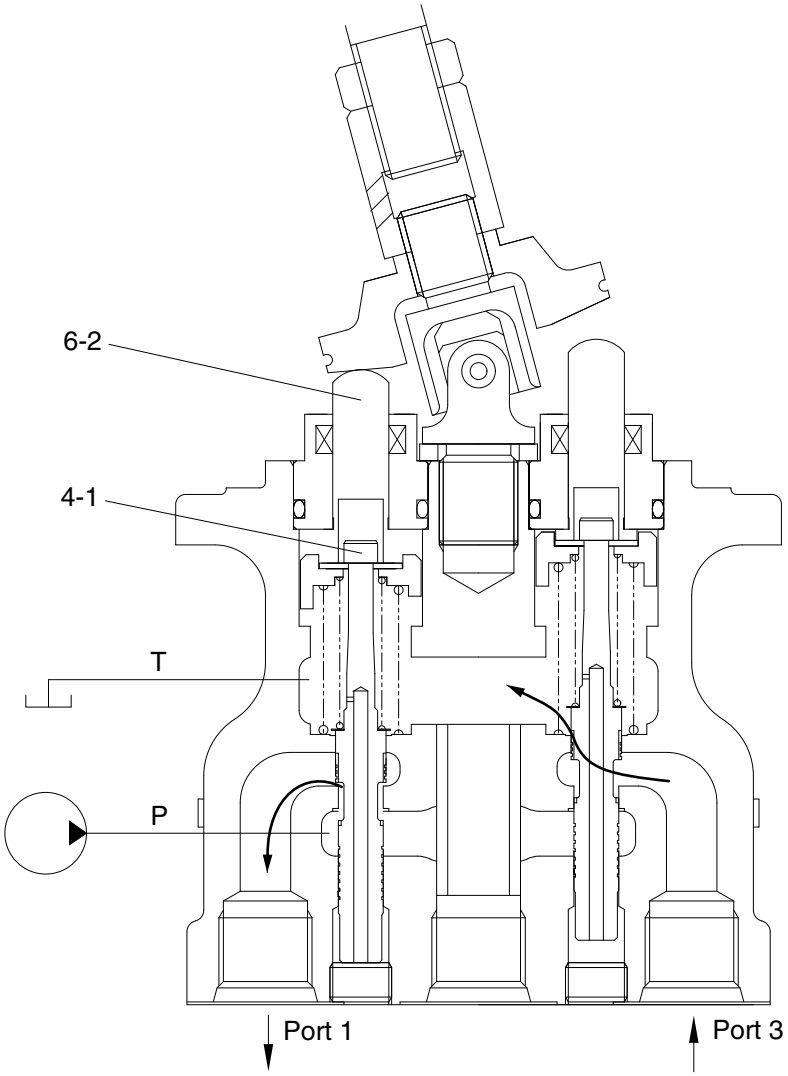
(1) Case where handle is in neutral position



140WAL2RL06

The force of the spring (4-3) that determines the output pressure of the pilot valve is not applied to the spool (4-1). Therefore, the spool is pushed up by the spring (5) to the position of port (1, 3) in the operation explanation drawing. Then, since the output port is connected to tank port T only, the output port pressure becomes equal to tank pressure.

(2) Case where handle is tilted



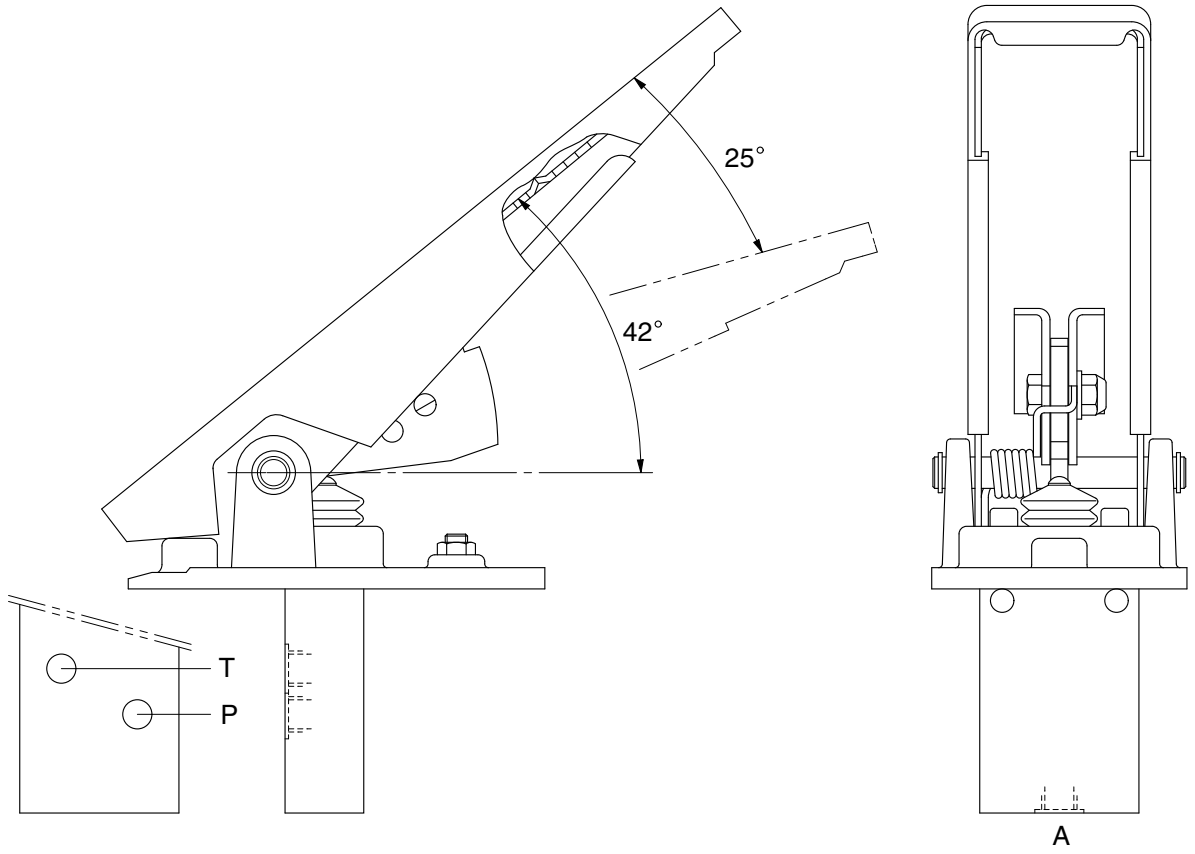
140WAL2RL07

When the push rod (6-2) is stroked, the spool (4-1) moves downwards.
Then port P is connected with port (1) and the oil supplied from the brake pump flows through port (1) to generate the pressure.
When the pressure at port (1) increases to the value corresponding to the spring force set by tilting the handle, the hydraulic pressure force balances with the spring force. If the pressure at port (1) increases higher than the set pressure, port P is disconnected from port (1) and port T is connected with port (1). If it decreases lower than the set pressure, port P is connected with port (1) and port T is disconnected from port 1.
In this manner the secondary pressure is kept at the constant value.
Besides, in some type, when the handle is tilted more than a certain angle, the upper end of the spool contacts with the inside bottom of the push rod and the output pressure is left to be connected with port P.

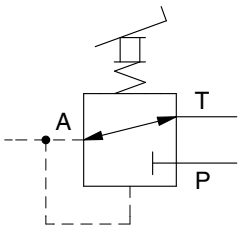
GROUP 6 ACCELERATOR PEDAL

1. STRUCTURE

The casing has the oil inlet port P (primary pressure), and the oil return port T (tank). In addition the secondary pressure is taken out through port A.



17032RP01



Hydraulic circuit

Port	Port name	Port size
P	Pilot oil inlet port	PF 1/4
T	Pilot oil return port	
A	Pilot oil output port	

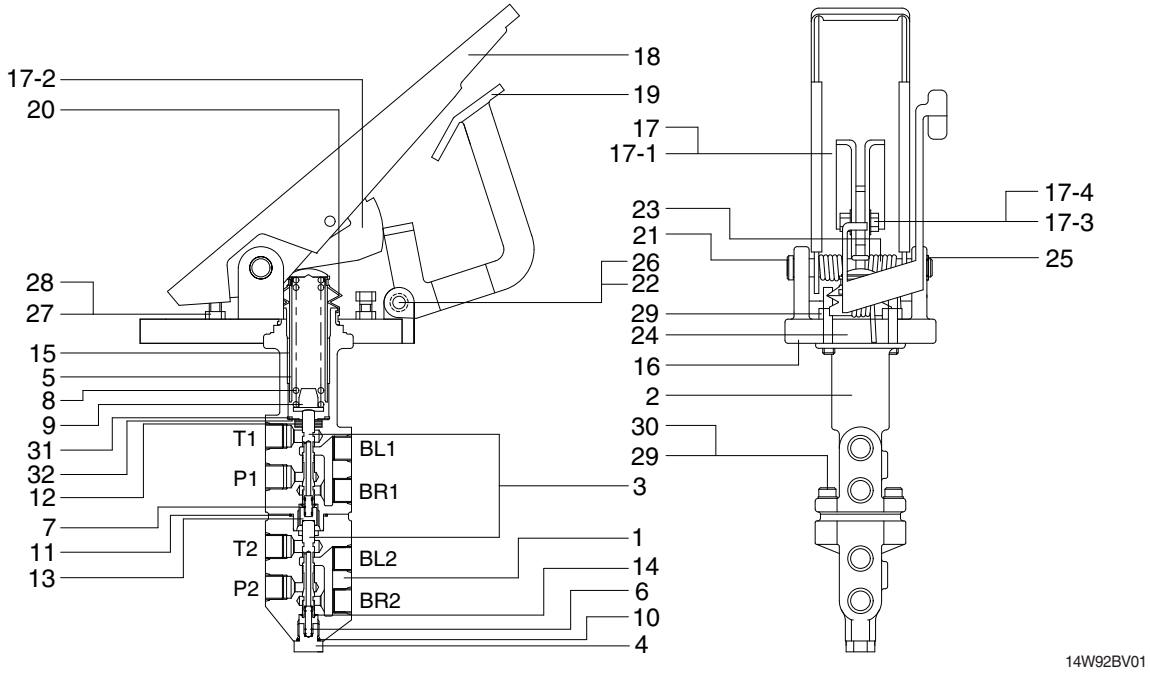
17032RP01(2)

GROUP 7 BRAKE DEVICE

■ BRAKE VALVE

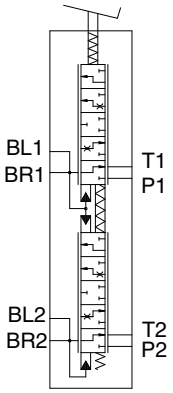
1. STRUCTURE

The body has the oil inlet port P1, P2 (primary pressure), and the oil outlet port T1, T2 (tank). In addition the secondary pressure is taken out through brake cylinder port BR1 (front axle) and BR2 (rear axle).



14W92BV01

1	Lower body	13	Spring guide	21	Lock pin 1
2	Upper body	14	Snap ring	22	Lock pin 2
3	Spool	15	DU bushing	23	Torsion spring 1
4	Plug	16	Pedal plate	24	Torsion spring 2
5	Holder	17	Pedal assy	25	Retainer ring
6	Lower spring	17-1	Pedal	26	E-ring
7	Upper spring	17-2	Lock plate	27	Hex bolt
8	Main spring	17-3	Hex bolt	28	Hex nut
9	Spring retainer	17-4	Plain washer	29	Socket head bolt
10	O-ring	18	Pedal cover	30	Spring washer
11	O-ring	19	Latch	31	Plate washer
12	Oil seal	20	Rubber cover	32	Retainer ring



14W72BV02

Port	Port name	Port size
P1	Port	PF 3/8
P2	Port	
BR1	Brake cylinder port	
BR2	Brake cylinder port	
BL1	Pluging	
BL2	Pluging	
T1	Drain port	
T2	Drain port	

2. FUNCTION

1) PURPOSE

The purpose of the brake valve is to sensitively increase and decrease the braking pressure when the brake pedal is actuated.

2) READY POSITION

When the braking system is ready for operation, its accumulator pressure acts directly on port P1/P2 of the brake valve. A connection is established between ports BR1/BR2 and port T1/T2 so that the wheel brakes ports BR1/BR2 are pressureless via the returns ports T1/T2.

3) PARTIAL BRAKING

When the brake valve is actuated, an amount of hydraulic pressure is output as a ratio of the foot force applied.

The main spring (8) beneath pedal plate (16) is designed in such a way that the braking pressure changes depending on the angle. In the lower braking pressure range, the machine can be slowed sensitively.

When the braking process is commenced, the upper spool (3) is mechanically actuated via main spring (8), and the lower spool (3) is actuated hydraulically by spool (3). As spools (3) move downward, they will first close returns T1/T2 via the control edges, thus establishing a connection between accumulator port P1/P2 and ports BR1/BR2 for the wheel brake cylinders. The foot force applied now determines the output braking pressure. The control spools (3) are held in the control position by the force applied (spring assembly) above the spools and the hydraulic pressure below the spool (balance of forces).

After output of the braking pressure, spools (3) are in a partial braking position, causing ports P1/P2 and T1/T2 to close and holding the pressure in ports BR1/BR2.

4) FULL BRAKING POSITION

When pedal (17-1) is fully actuated, an end position of the brakes is reached and a connection established between accumulator ports P1/P2 and brake cylinder ports BR1/BR2. Returns T1/T2 are closed at this point.

When the braking process ended, a connection is once again established between brake cylinder ports BR1/BR2 and return ports T1/T2, closing accumulator ports P1/P2.

The arrangement of spools in the valve ensures that even if one braking circuit fails the other remains fully operational. This is achieved by means of the mechanical actuation of both spools and requires slightly more pedal travel.

5) LIMITING THE BRAKING PRESSURE

Pedal restriction socket bolt (29) on pedal plate (16) below pedal assy (17) is used to limit the braking pressure.

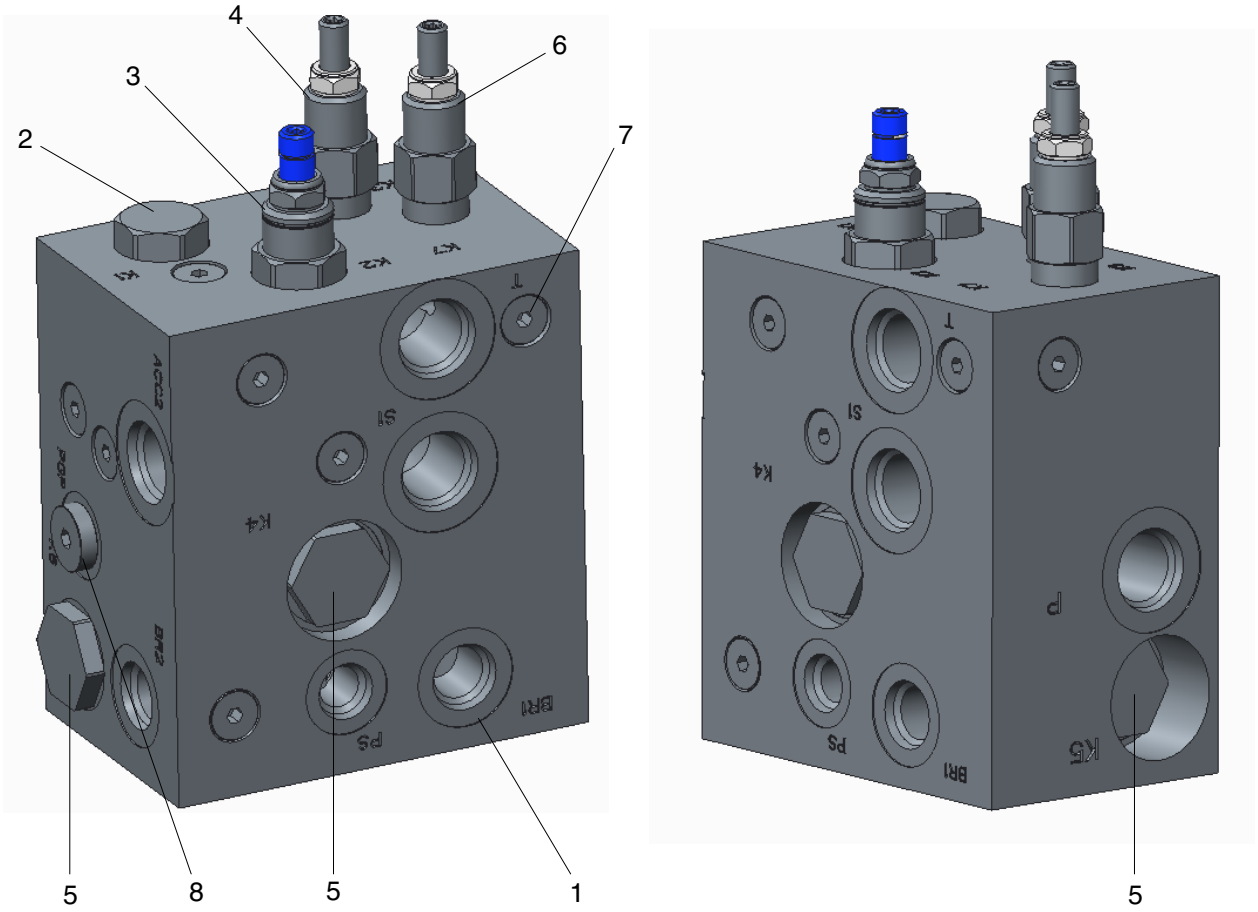
6) FAILURE OF A CIRCUIT

In the event of the lower circuit failing, the upper circuit will remain operational. Main spring (8) will mechanically actuate spool (3). In the event of the upper circuit failing, the lower circuit will remain operational since the lower spool (3) is mechanically actuated by main spring (8) and spool (3).

■ BRAKE SUPPLY VALVE

1. STRUCTURE

The brake supply valve consists of the following parts.



Item	Part name	Size	Qty	Remark
1	Manifold block	-	1	-
2	Logic valve	-	1	K1 port
3	Unloading valve	-	1	K2 port
4	Relief valve	-	1	K3 port
5	Check valve	-	3	K4, 5, 6 ports
6	Relief valve	-	1	K7 port
7	Plug	PF 1/8"	9	-
8	Plug	PF 1/4"	1	PGP port

2. FUNCTION

1) ASSEMBLY

This brake supply valve has the following functions.

(1) Brake pump overload prevention function - energy saving function

(2) Safety device function of brake braking system

(3) Brake braking pressure supply function

2) FUNCTION FOR EACH VALVE

Symbol	Valve name	Description	Remark
K1	Logic valve	This valve is operated by remote control according to the set pressure value of the unloading valve (K2).	
K2	Unloading valve	This valve switches the operation of the pump to a no-load state by bypassing the pressure and flow rate discharged from the pump to the tank when a load occurs in the braking system.	Set pressure - Cut-in set value 112±5 kgf/cm^2 - Cut-out set value 142±5 kgf/cm^2
K3	Relief valve	This valve functions to maintain the pressure of the flow flowing into the “S1” port at the set pressure.	Set pressure 8 l/min @ 32+2 kgf/cm^2
K4	Check valve	This valve prevents reverse flow against the pressure and flow rate formed in the braking system of the brake.	
K5, K6	Check valve	This valve prevents the loss of pressure and flow accumulated in the accumulators installed in the ACC1 and ACC2 ports. In other words, it prevents the back flow of pressure and flow accumulated in the accumulator.	
K7	Relief valve	This valve functions as a safety device to prevent breakage or damage to the system when overload or abnormal pressure occurs within the brake system.	Set pressure 30 l/min @ 173+2 kgf/cm^2

3) DETAIL FUNCTION AND USAGEE

(1) Brake pump overload prevention function - energy saving

① The pressure and flow discharged from the brake pump are supplied to the brake device through the brake supply valve.

② When the engine rotation (rpm) of the machine increases, the rotation of the brake pump increases, increasing the discharge pressure and flow rate.

③ This increased pressure and flow rate causes loss of pump power source and fluid energy. This valve prevents energy loss by reducing power source and fluid energy loss.

④ When the braking system pressure of the brake exceeds the set pressure value of the unloading valve (K2), the pilot spool of the unloading valve is activated and the flow formed in the drain line of the logic valve (K1) is bypassed to the “T” line.

⑤ Therefore, when the flow rate of the drain line of the logic valve is bypassed, the spool of the logic valve is pushed and the pressure and flow rate discharged from the brake pump are bypassed to the tank, thereby converting the pump's operating state to a no-load state.

⑥ Also, when the brake system pressure falls below the set pressure value of the unloading valve, the pilot spool of the unloading valve is closed.

⑦ As the pilot spool of the unloading valve closes, a flow rate is formed in the drain line of the logic valve, and the spool of the logic valve also closes. When the spool of this logic valve is closed, the pressure and flow discharged from the pump are supplied to the brake braking device.

⑧ The discharge pressure and flow rate of the pump are called cut-out when bypassed to the tank, and cut-in when supplied to the brake device.

⑨ When this valve is shipped, the unloading valve setting value is as follows.

Unit : kgf/cm^2

Flow rate	Reference value		Set value	
	Cut-in	Cut-off	Cut-in	Cut-off
30 l/min	112±5	142±5	112±5	142±5

(2) Safety device function of brake braking device

① If an overload occurs within the brake system due to an external force, an abnormal pressure rise may occur, which may cause damage or breakage to various brake systems.

② To prevent such machine problems, a relief valve (K7) is installed.

③ If the system pressure within the brake system exceeds the set pressure value of the relief valve, the relief valve operates to maintain the set pressure value of the relief valve.

④ In other words, the pressure above the set pressure value of the relief valve is returned to the tank to relieve the abnormal rise in pressure caused by overload within the system, thereby preventing damage and breakage of various devices within the system.

⑤ When this valve is shipped, the relief valve setting value is as follows.

Flow rate	Reference value	Set value	Remark
30 l/min	173±2 kgf/cm^2	173±2 kgf/cm^2	-

(3) Brake braking pressure supply function

① When the brake pedal is pressed, the pressure accumulated in the accumulator falls below the cut-in set pressure value of the unloading valve.
At this time, the pilot spool of the unloading valve is closed.

② As the pilot spool of the unloading valve closes, flow is formed in the drain line of the logic valve and the spool of the logic valve also closes.

③ When the spool of this logic valve is closed, the pressure and flow discharged from the pump are supplied to the accumulator and brake device.

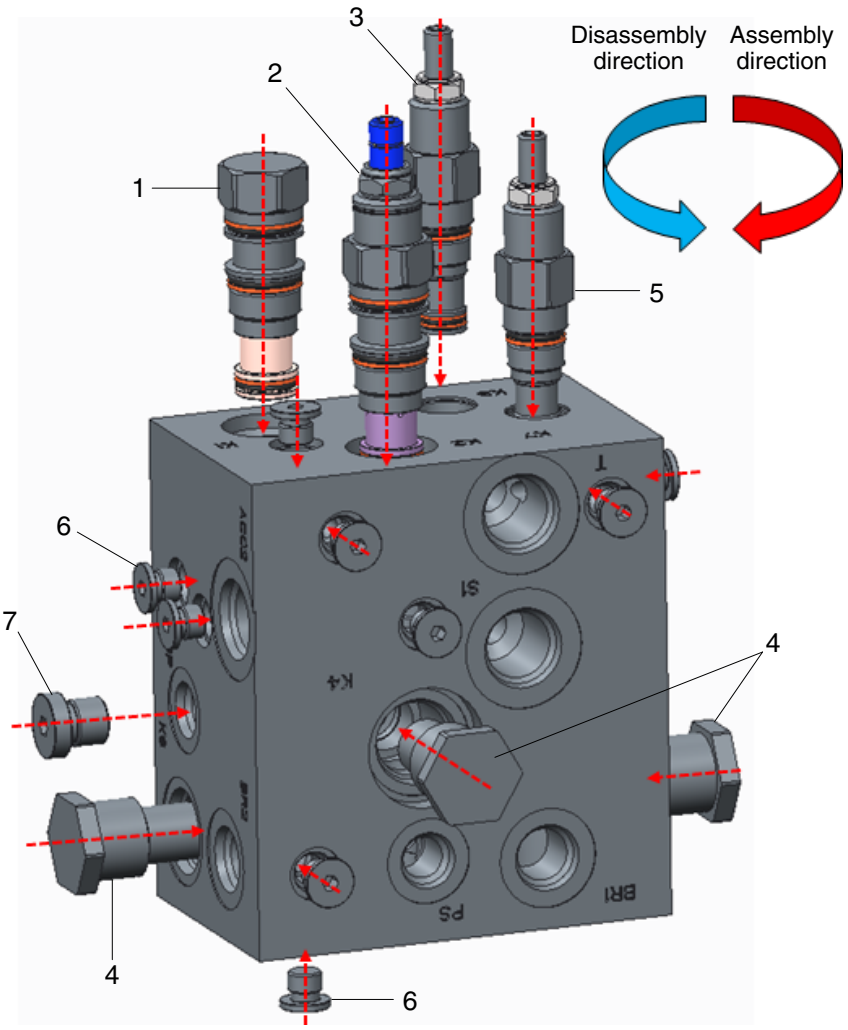
④ Also, when the brake pressure is formed and exceeds the cut-out pressure value of the unloading valve, the logic valve and unloading valve operate to bypass the pressure and flow rate discharged from the pump to the tank, thereby maintaining the no-load start of the pump and prevents rise the pressure within the brake system.

⑤ Check valves (K5, K6) separate each brake circuit (front, rear) so that they do not affect the opposite brake and maintain each brake function.

3. ASSEMBLY DRAWING AND WORK TOOLS

See below for assembly, disassembly, and work tools for the brake supply valve.

※ **The designated tools and tightening torque must be observed.**



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No.	Part name	Screw spec	Torque (kg · cm)	Assembly tool
1	Logic valve	M20×1.5	480	Torque wrench/7/8" hex socket
2	Unloading valve	M20×1.5	480	Torque wrench/7/8" hex socket
3	Relief valve	M16×1.5	350	Torque wrench/3/4" hex socket
4 (3ea)	Check valve	UNF7/8-14"	400	Torque wrench/1" hex socket
5	Relief valve	M16×1.5	350	Torque wrench/3/4" hex socket
6 (9ea)	Plug	PF 1/8	100	Torque wrench/4 mm wrench socket
7	Plug	PF 1/4	300	Torque wrench/6 mm wrench socket

4. PRECAUTION WHEN DISASSEMBLING AND ASSEMBLING

1) Before assembling and disassembling, clean the surrounding area thoroughly to ensure there are no contaminants.

2) When disassembling and assembling parts, be sure to use the assembly torque and tools specified on the previous page.

3) Refer to the picture on the previous page for assembly and disassembly directions.

4) When reassembling after disassembly and inspection, be careful to prevent contaminants from entering the valve.

5) When disassembling and assembling all parts, be sure to wash them and then reassemble them.

5. INSPECTION ITEMS AND DETAILS FOR EACH PART WHEN AN ERROR OCCURS

Problem	Inspection item	Inspection detail and method	Repair
Brake pressure is not supplied	1. Check whether foreign substances and contaminants have entered the logic valve.	1. Disassemble the logic valve and check whether contaminants such as foreign matter or sludge have entered between the spool and body.	Removing foreign substances, cleaning, and assembling
	2. Check whether foreign substances and contaminants enter the relief valve.	2. Disassemble the relief valve and check whether contaminants such as foreign matter or sludge have entered between the poppet and body.	Removing foreign substances, cleaning, and assembling
	3. Check the discharge amount and discharge pressure of the brake pump	3. Install a pressure gauge on the “PGP” port to check the pressure value discharged from the brake pump. - Check at engine low speed - Check with the unloading valve fully closed. - Reference set value; 173±2 kgf/cm^2	Repair or replacement
Brake warning lamp comes ON	1. Check the unloading valve cut-in pressure value	1. Check the cut-in pressure value of the unloading valve (K2) - Install a pressure gauge on the “PGP” port to measure the pressure value at cut-in. - Reference set value; 112±5 kgf/cm^2	Readjust pressure value
	2. Check pressure switch operation	2. If the pressure measurement value in item 1 above is normal but the brake warning lamp continues to come on, check the contact status of the pressure switch.	Repair or replacement
	3. Check the degree of contamination of the brake filter element.	3. Check the element screen in the brake filter for contamination by foreign substances.	Cleaning or replacement
	4. Check whether foreign substances and contaminants are entering the logic valve and relief valve.	4. Refer to paragraphs 1 and 2 of “Brake pressure is not supplied” above.	Removing foreign substances, cleaning, and assembling

Problem	Inspection item	Inspection detail and method	Repair
The cycle of cut-in and cut-out is fast	1. Check whether the O-ring and back-up ring installed on each check valve are damaged.	1. After disassembling each check valve (K4, K5, K6), check whether the O-ring and back-up ring are damaged.	Replace check valve
	2. Check foot brake valve leakage	2. Remove the hydraulic hose installed at the outlet port (BR1, BR2) of the foot brake valve and check the amount of oil leakage. - Check without pressing the brake pedal-Neutral state - Reference set value; Refer to foot brake valve leakage management standards	Replace foot brake valve

6. CHECK BRAKE PRESSURE IN CASE OF ABNORMALITY

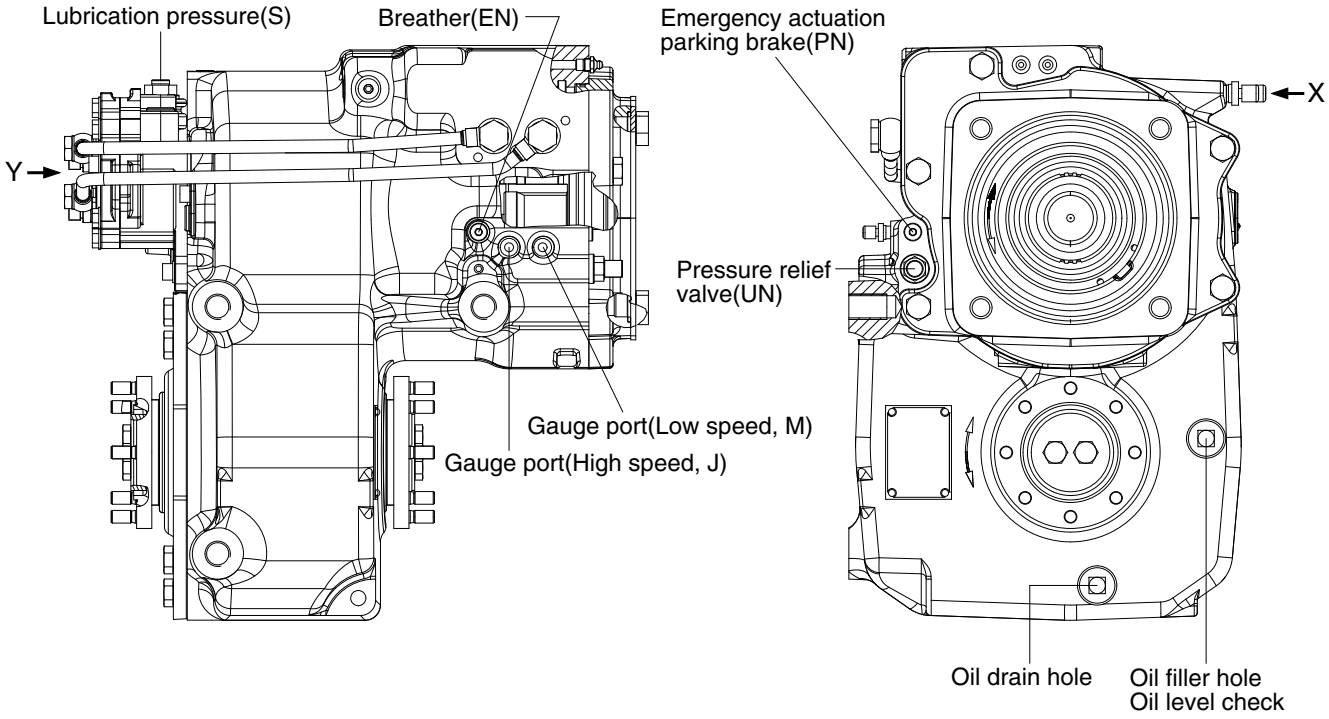
1) INSTALLATION OF PRESSURE GAUAGE

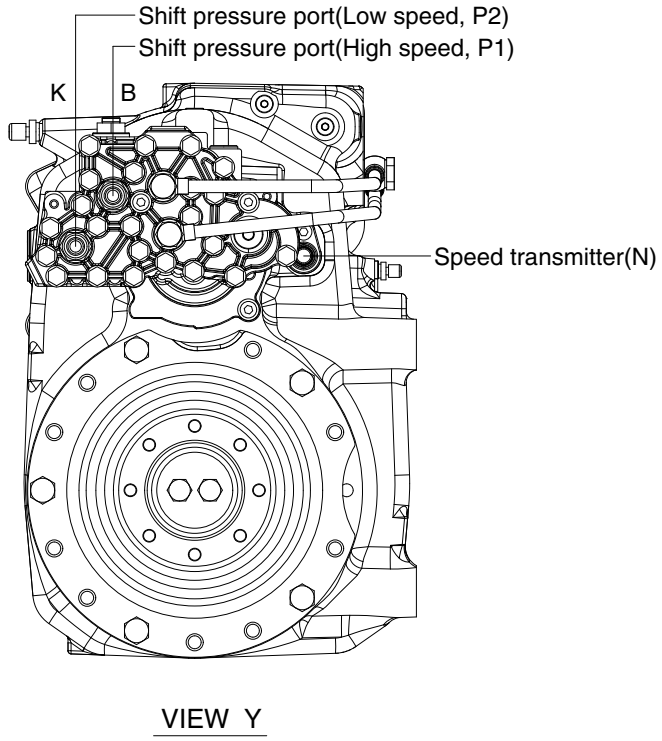
Pressure gauge installation port	Screw	Remark
PGP	PF1/4" O-ring boss	-

2) CHECK PRESSURE VALUE DURING INSPECTION

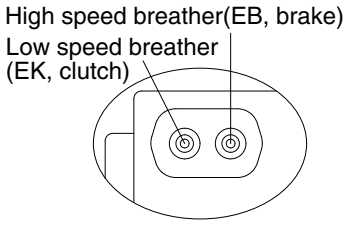
Pressure value confirmation port	Unloading valve operating status	
	Cut-in	Cut-off
PGP	112±5 kgf/cm^2	142±5 kgf/cm^2

1. STRUCTURE





VIEW Y



VIEW X

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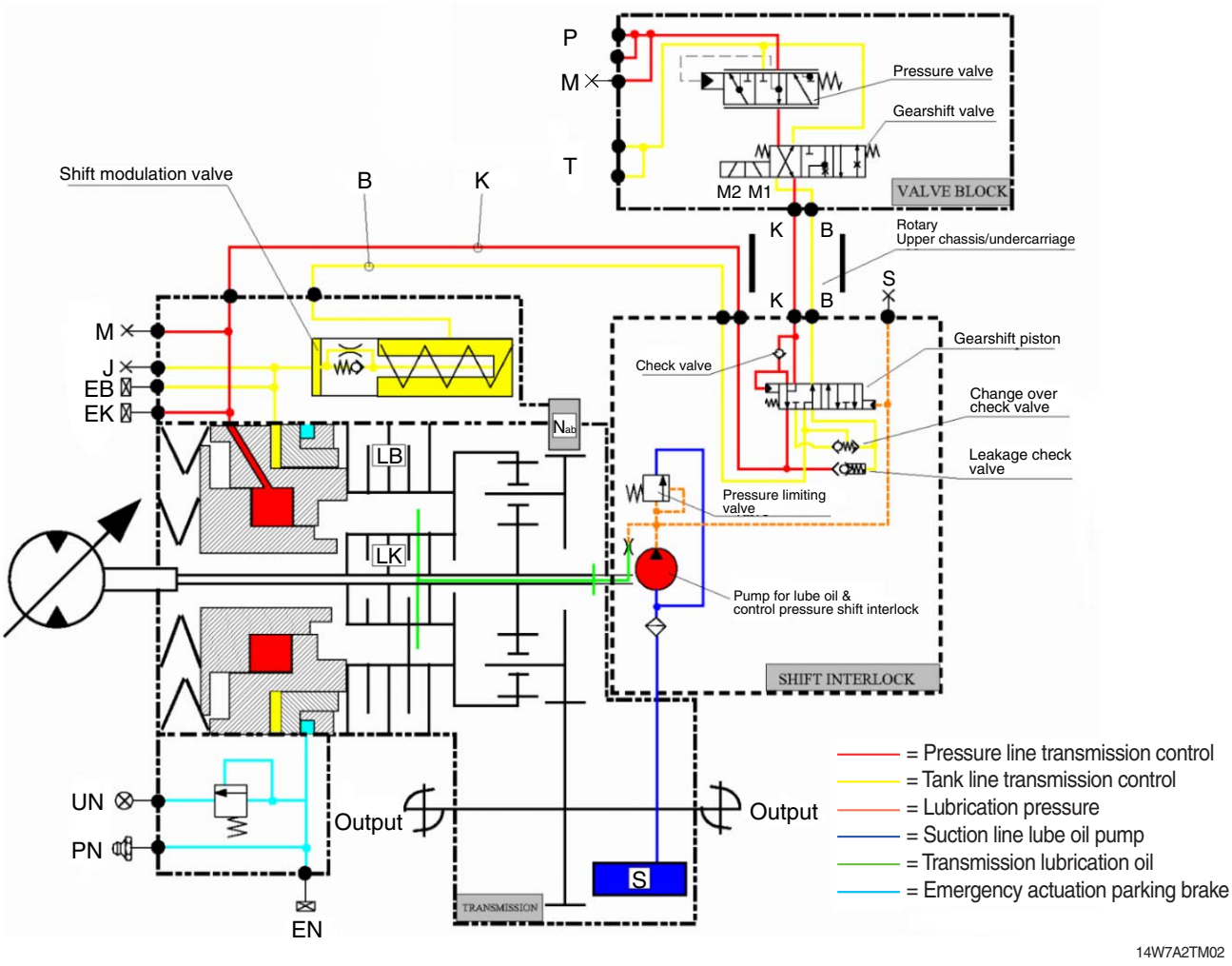
2. TRANSMISSION DIAGRAM



Measuring points-Transmission/Shift interlock :
J : High speed (brake)
M : Low speed (clutch)
S : Lubrication pressure

Connections-Transmission/Shift interlock :
B : Brake
K : Clutch
PN : Emergency actuation parking brake

Measuring points-Valve block :
M : System pressure transmission control

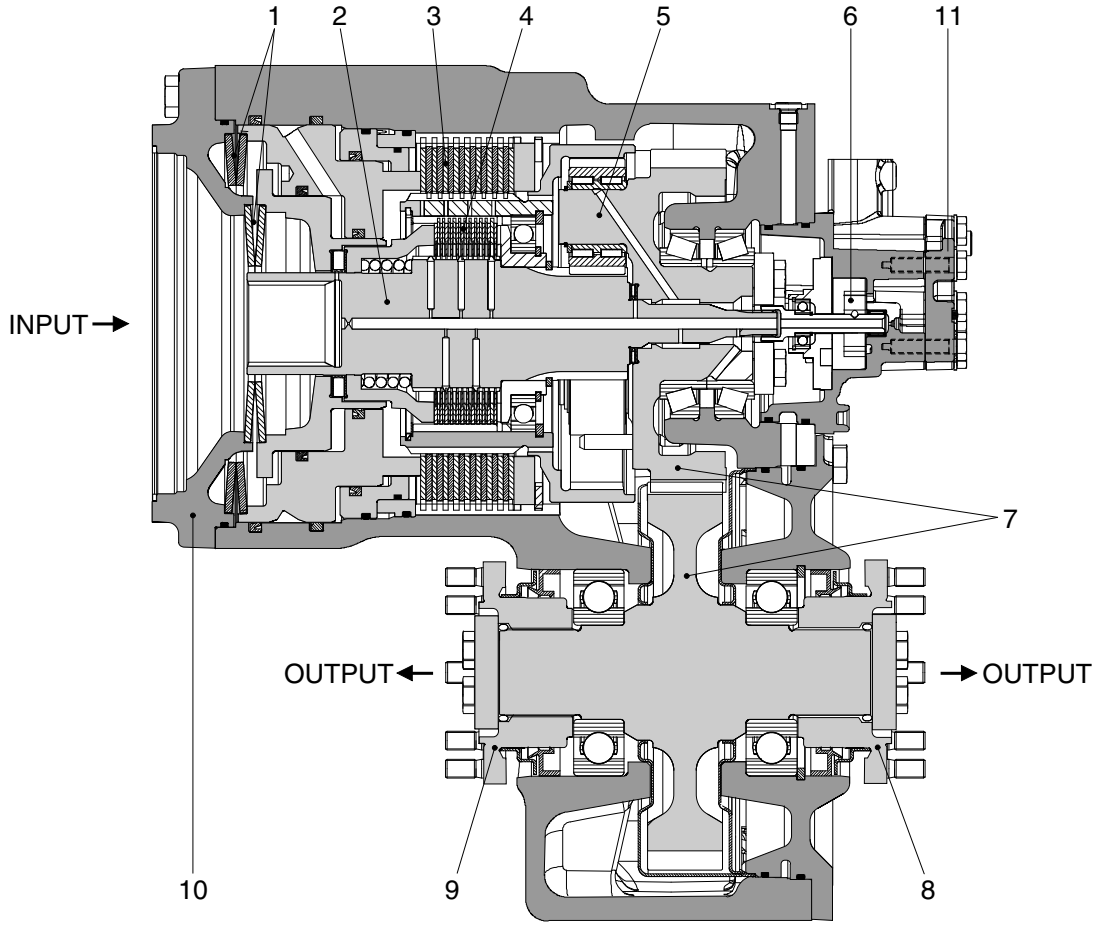
Connections-Valve block :
P : System pressure transmission control
T : Tank
B : Brake
K : Clutch

Solenoid valves-valve block :
M1 : Solenoid valve (low speed)
M2 : Solenoid valve (high speed)

Port	Name	Size	Port	Name	Size
P1 (B)	Shift pressure, High speed	M16×1.5	M	Gauge port, Low speed	M10×1.0
P2 (K)	Shift pressure, Low speed	M16×1.5	S	Lubrication pressure port	M10×1.0
J	Gauge port, High speed	M10×1.0	PN	Parking brake lubricant	Grease nipple

3. OPERATION OF TRANSMISSION

1) DESCRIPTION



1	Cup spring	5	Planetary drive	9	Output flange-Front axle
2	Input shaft	6	Lub oil pump	10	Travel motor attachment
3	Disk brake	7	Spur gear drive	11	Shift interlock
4	Disk clutch	8	Output flange-Rear axle		

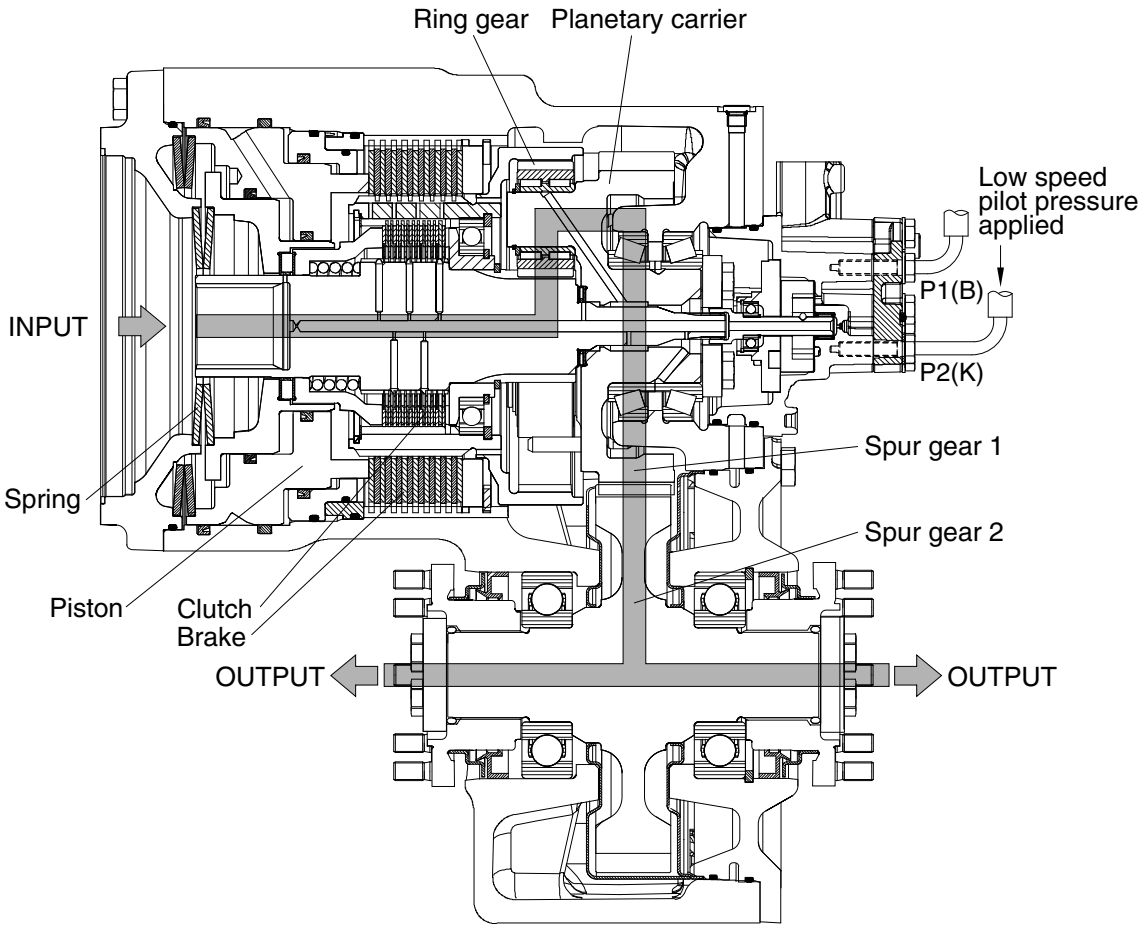
Coaxially-mounted variable displacement travel motor (10) with specific displacement 107 cm^3/rev.

The 2-speed powershift transmission comprises a planetary drive (5), a 2 shaft spur gear drive (7) with output flanges to front and rear axle.

The powershift mechanism for the planet drive comprises a rotating multi-disk clutch (4) underneath a multi-disk brake (3) rigidly connected to the housing. Both are closed by spring pressure (2) and released hydraulically.

The shift interlock (11) prevents downshifts at high machine speeds and thus prevents over-rotation of the travel motor. If the low speed gear is selected while the high speed gear is engaged and input speed is above approx. 1000 rpm, the low speed gear shift is inhibited and only performed if input speed is below this limit. With higher viscosity oil (cold starting), the downshift is performed at a lower input speed. Upshifts are always possible.The speed-dependent interlock is effective in both directions. It does not prevent the possibility of over-rotation when the machine is coasting. For this, a drive brake valve should be fitted to the travel motor.

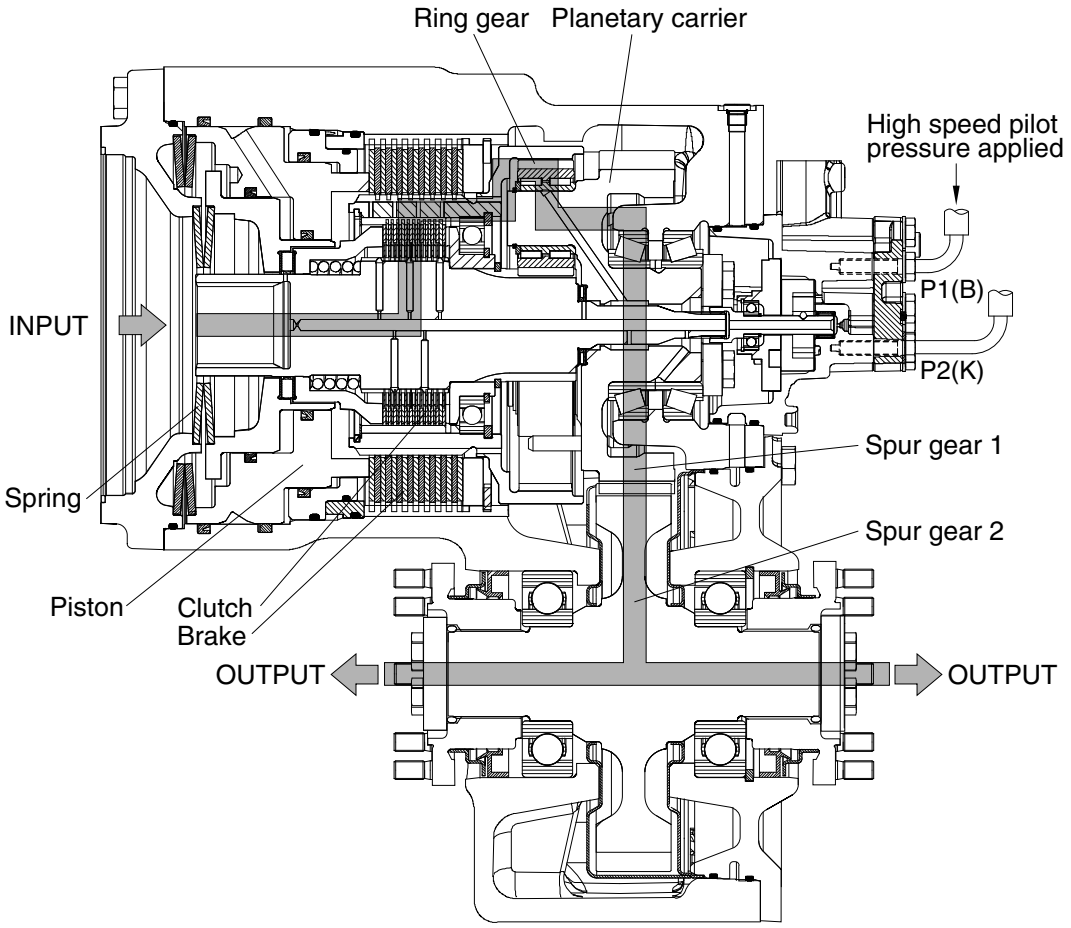
2) LOW SPEED (forward & reverse)



14W7A2TM04

In low speed operation, the internal gear of the planetary drive is backing upon the closed, case-rigid brake. In this speed the piston chamber of the brake is unpressurized, so that the elastic force and additionally the hydraulic pressure of the clutch piston is acting upon the disk pack.
At this time the clutch is open, i.e. the hydraulic released.

3) HIGH SPEED (forward & reverse)



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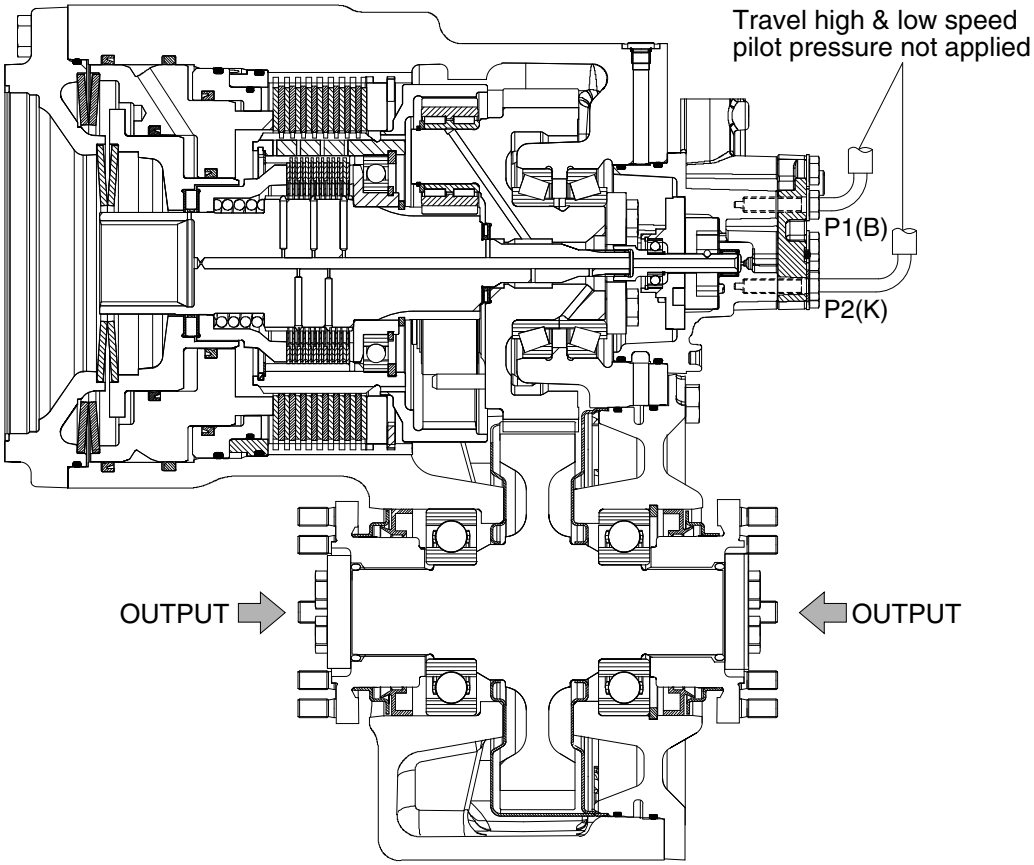
In high speed operation, the clutch is held closed under spring pressure and the brake is hydraulically opened.

When a gear shift occurs-for example from high speed to low speed gear- the oil from the brake piston space is fed back to the tank through a restrictor (change over check valve) due to the spring pressure acting on the brake piston. At the same time the clutch is filled with oil and opened. Required oil flow is necessary for the transmission control to ensure the clutch is open before the brake begins to transmit torque.

A shift modulation valve is also integrated in the transmission. This modulates the pressure sequence at the brake during a upshift in order to achieve good shift quality.

The gear shift equipment also has the function of a parking brake. When the brake is operated-for example with high speed gear engaged-the clutch is closed and is statically loaded.

4) BRAKES



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When the travel high/low speed pilot pressure is not applied in the piston space, the piston compress against the multi disk pack due to the spring force. Thus the parking brake is engaged.

4. TECHNICAL DATA

1) GENERAL DATA

(1) Max input power : 110 kW

(2) Max input torque : 78.5 kgf · m

(3) Max output speed : 3500 rpm

(4) Hydraulic motor : 140 cm^3/rev

(5) Transmission ratio
Gear step : 4.06
· Low speed gear : 4.87
· High speed gear : 1.20

(6) Shift interlock
Downshift possible at operating temperature with input speed 1000 rpm (downshift point lower when oil temperature cold).

(7) Disconnection device
For towing away machine auxiliary release device for parking brake.

(8) Brake
Parking brake. Necessary brake deceleration by controlled locking of planetary drive. Braking torque depends on opening pressure set at brake valve (13 bar).

(9) Output flange
Bolts for propshaft connection : M10 × 1.0 (class 10.9)

(10) Transmission weight : 135 kg (300 lb)

2) TRANSMISSION CONTROL

Following data are valid for oil temperature 30˚C to 40˚C in hydraulic tank, measured at connections at powershift transmission (see structure and diagram).

(1) Control pressure
① At connection P1 and P2 at Low/High engine speed : 33+1 kgf/cm^2
② Definition of lubricants : API GL-5, SAE 10W-30, 15W-40

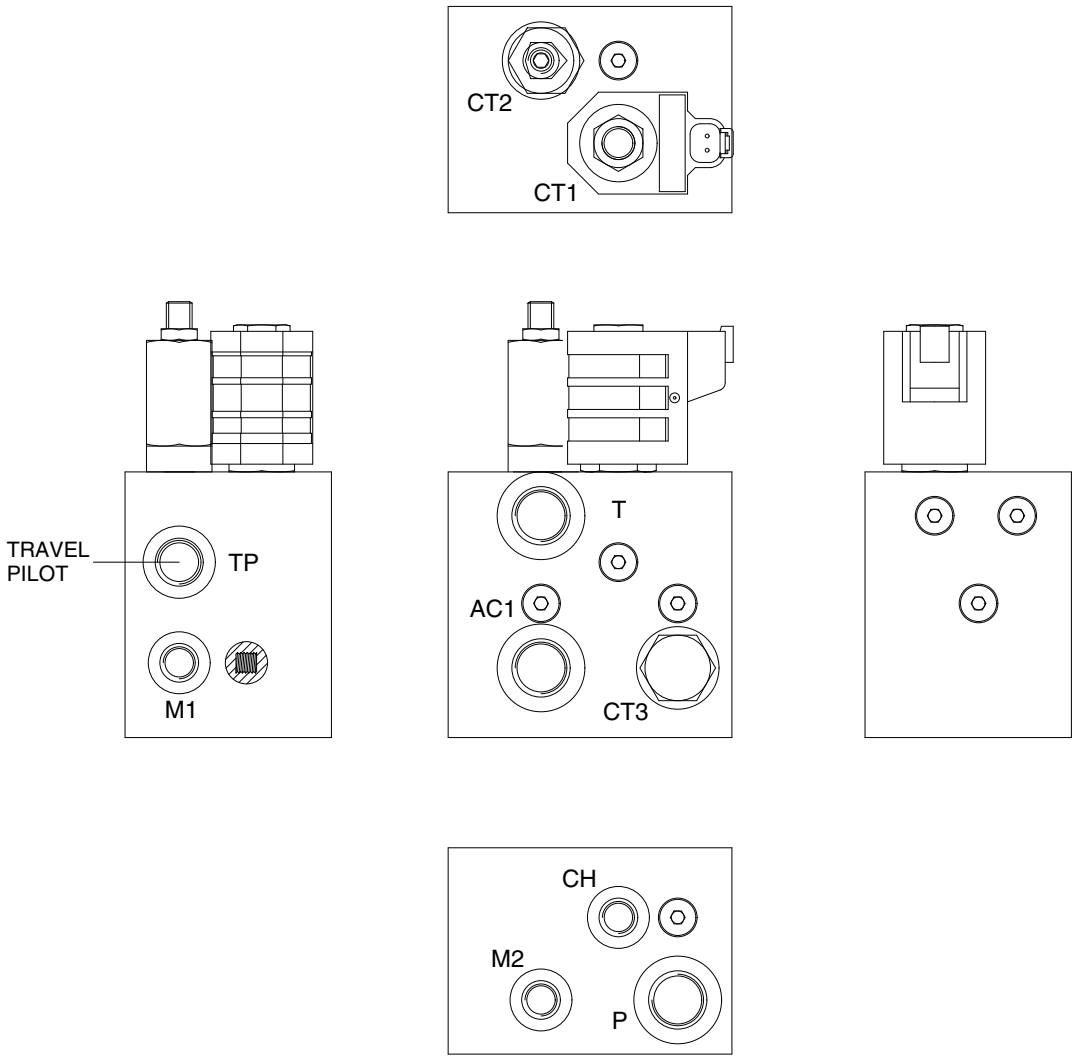
(2) Oil flow
① Min oil flow at 24+1 kgf/cm^2 counter pressure (low engine speed) : 5.5 ℓ/min
② Max oil flow : 25 ℓ/min

(3) Residual pressure
① Max residual pressure in control line to tank connection P1 and P2 : 1.0 kgf/cm^2

(4) Leakage oil transmission control
① Pressure in input housing connection (E) max : 1.0 kgf/cm^2
② Max oil flow (low speed actuated) : 1 ℓ/min

GROUP 9 TRAVEL CONTROL VALVE

1. STRUCTURE



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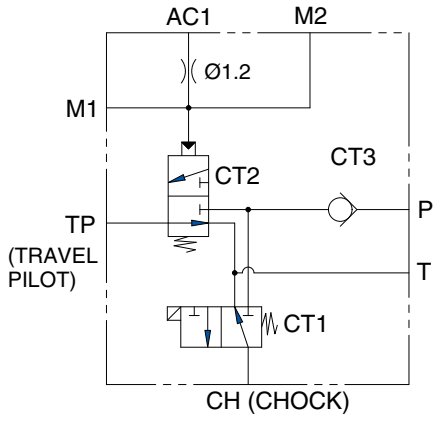
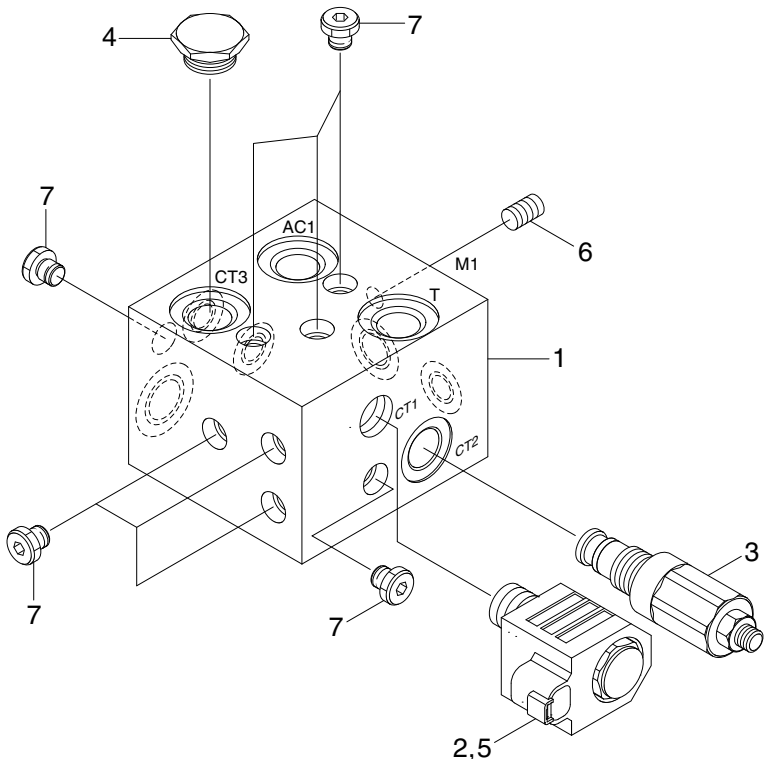


Hydraulic circuit

Port name	Port size
P, T, AC1	PF 1/2
TP	PF 3/8
M1, M2, CH	PF 1/4

2. COMPONENT



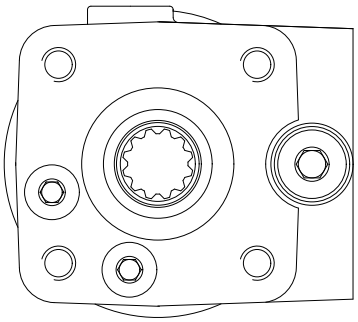
14W7A2TCV01

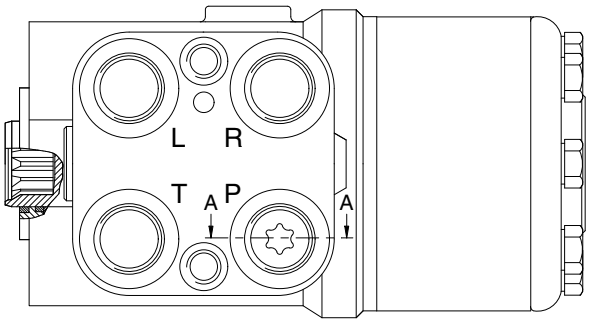
1	Body	5	Coil
2	Solenoid valve	6	Orifice
3	POD valve	7	Plug
4	Check valve		

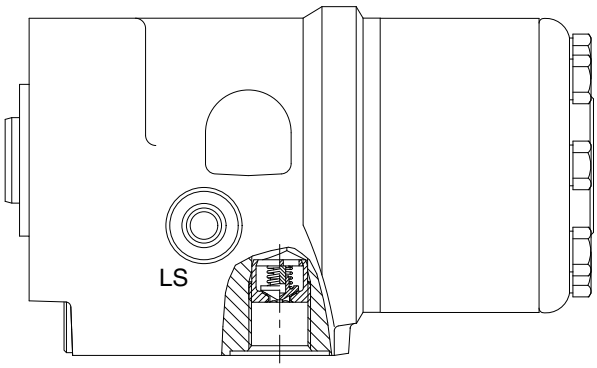
GROUP 10 STEERING VALVE

1. STRUCTURE

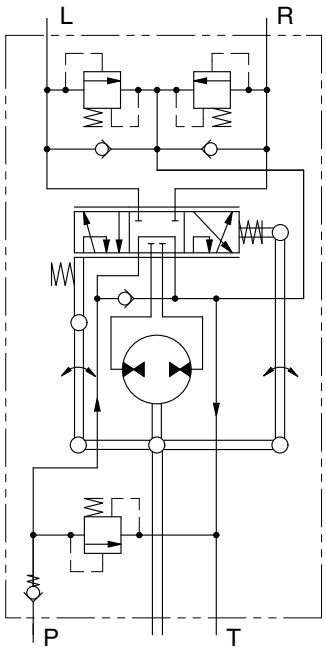
1) TYPE 1 (With PTO)







SECTION A-A

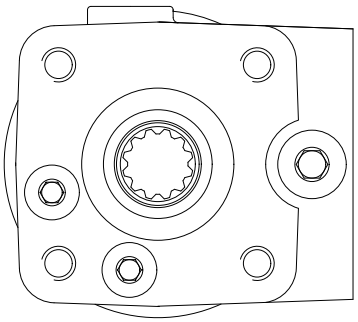


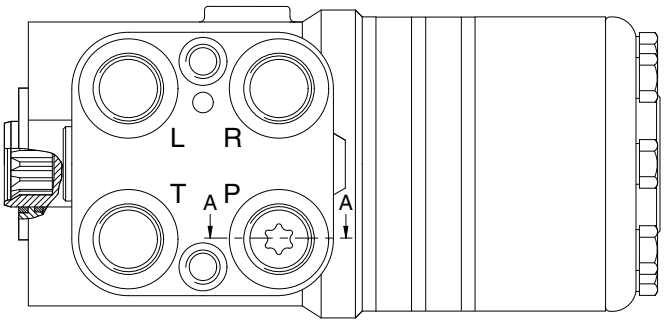
Hydraulic circuit

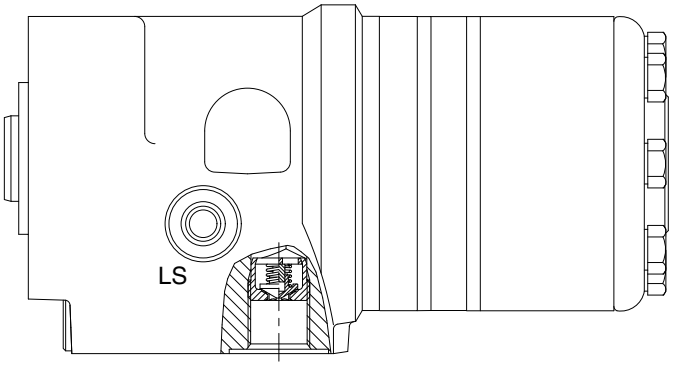
Port	Port name	Port size
L	Left port	3/4-16UNF
R	Right port	
T	Tank port	
P	Pump port	

81E4-0006-E

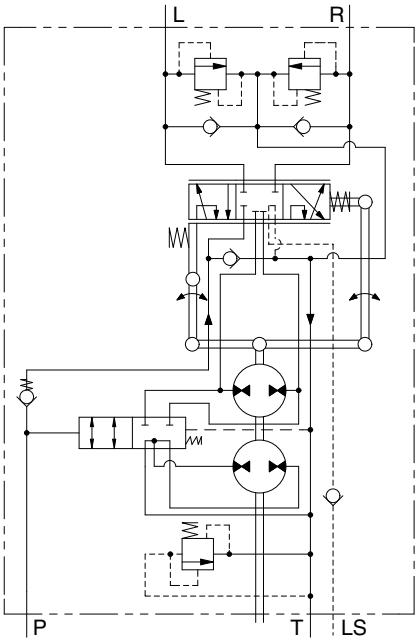
2) TYPE 2 (Without PTO)







SECTION A-A

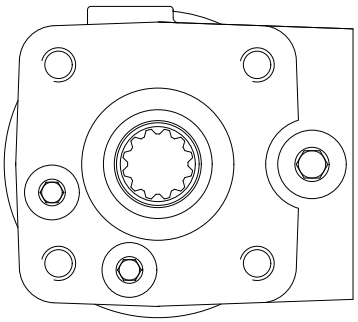


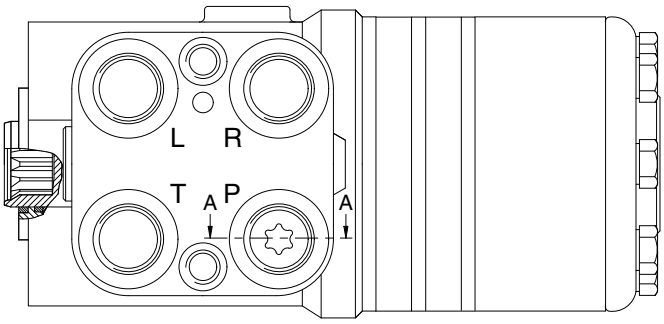
Hydraulic circuit (Standard)

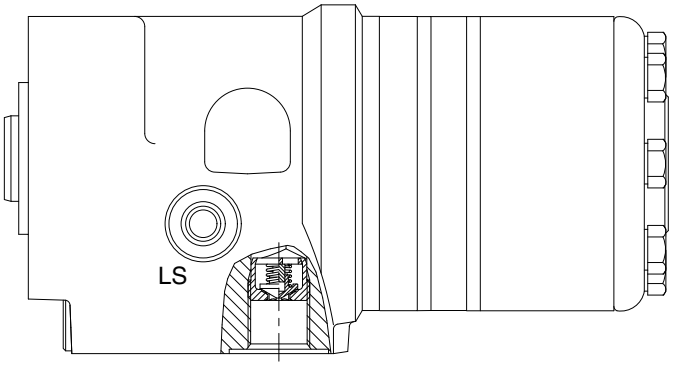
Port	Port name	Port size
L	Left port	3/4-16UNF
R	Right port	
T	Tank port	
P	Pump port	
LS	Load sensing port	7/16-20UNF

81Q6-00030-E

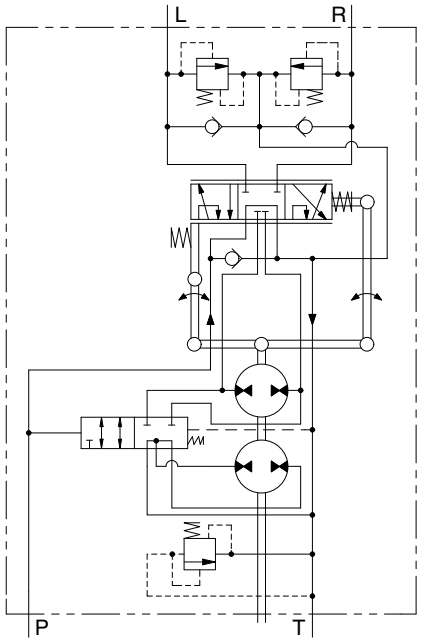
3) TYPE 3 (Emergency steering)







SECTION A-A

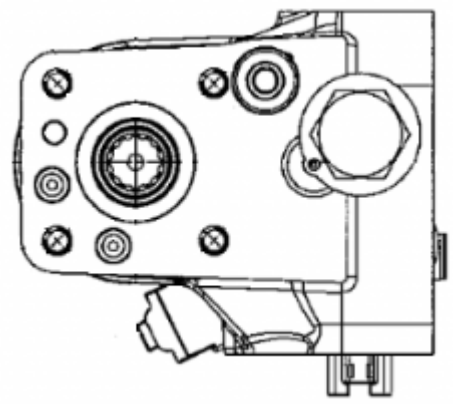


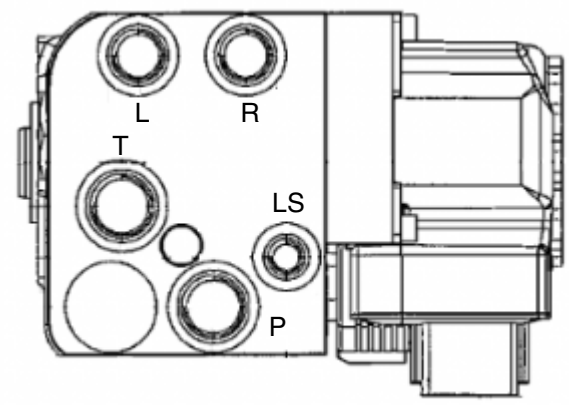
Hydraulic circuit

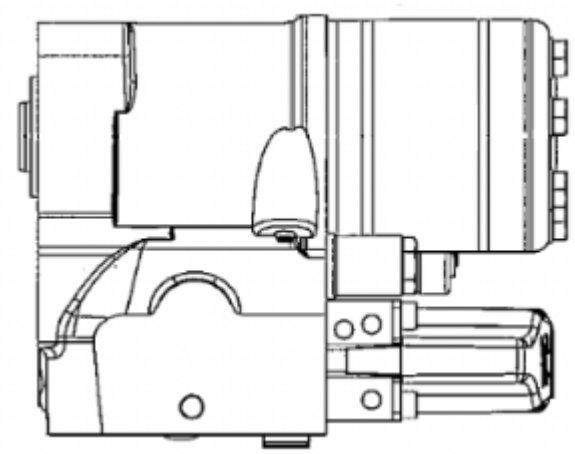
Port	Port name	Port size
L	Left port	3/4-16UNF
R	Right port	
T	Tank port	
P	Pump port	

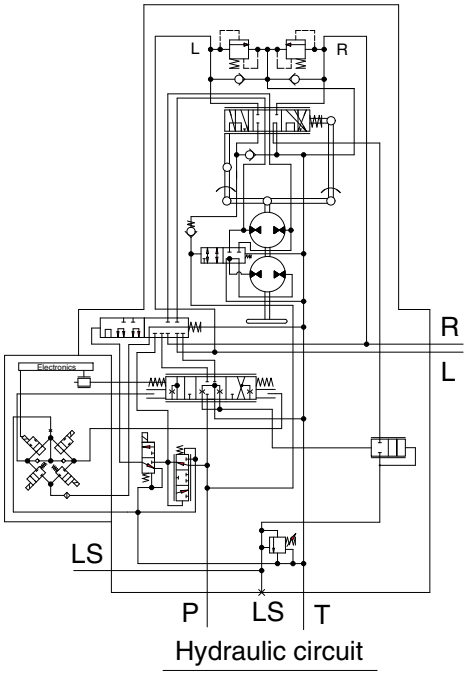
81Q6-00010-E

4) TYPE 4 (Joystick steering)









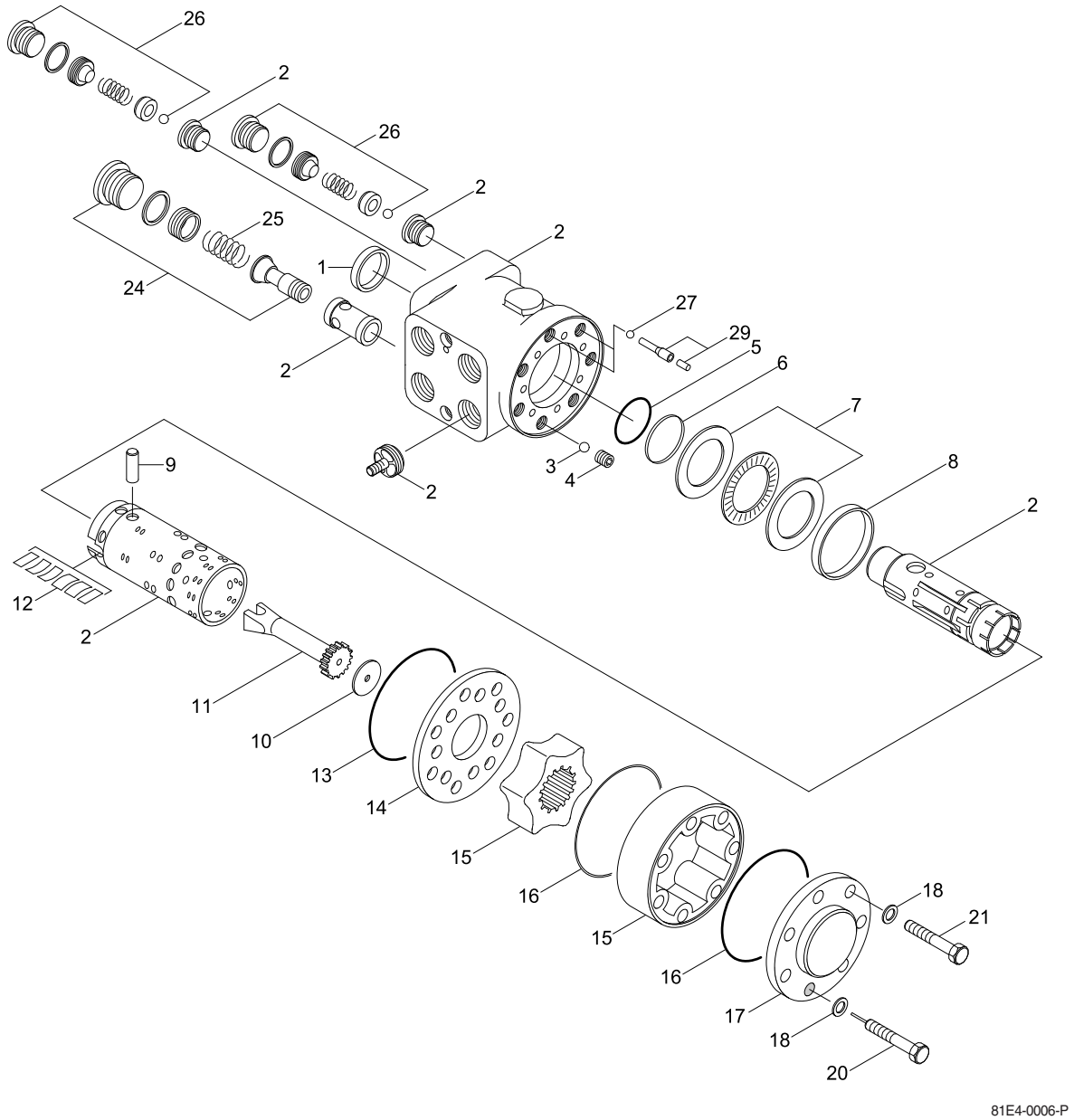
Hydraulic circuit

Port	Port name	Port size
L	Left port	M18x1.5
R	Right port	M18x1.5
T	Tank port	M22x1.5
P	Pump port	M22x1.5
LS	Load sensing port	M12x1.5

81K5-00040-E

2. COMPONENTS

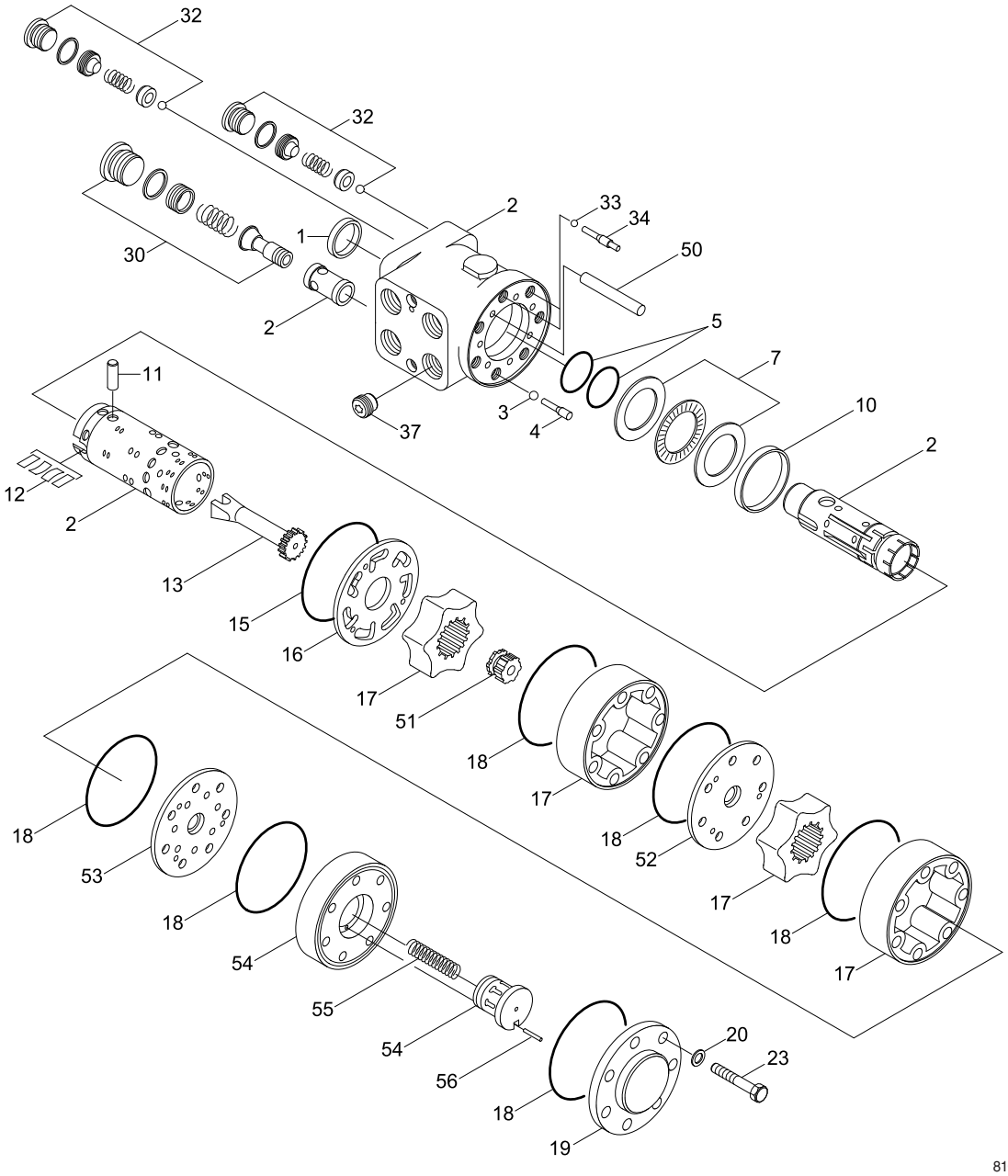
1) TYPE 1 (With PTO)



81E4-0006-P

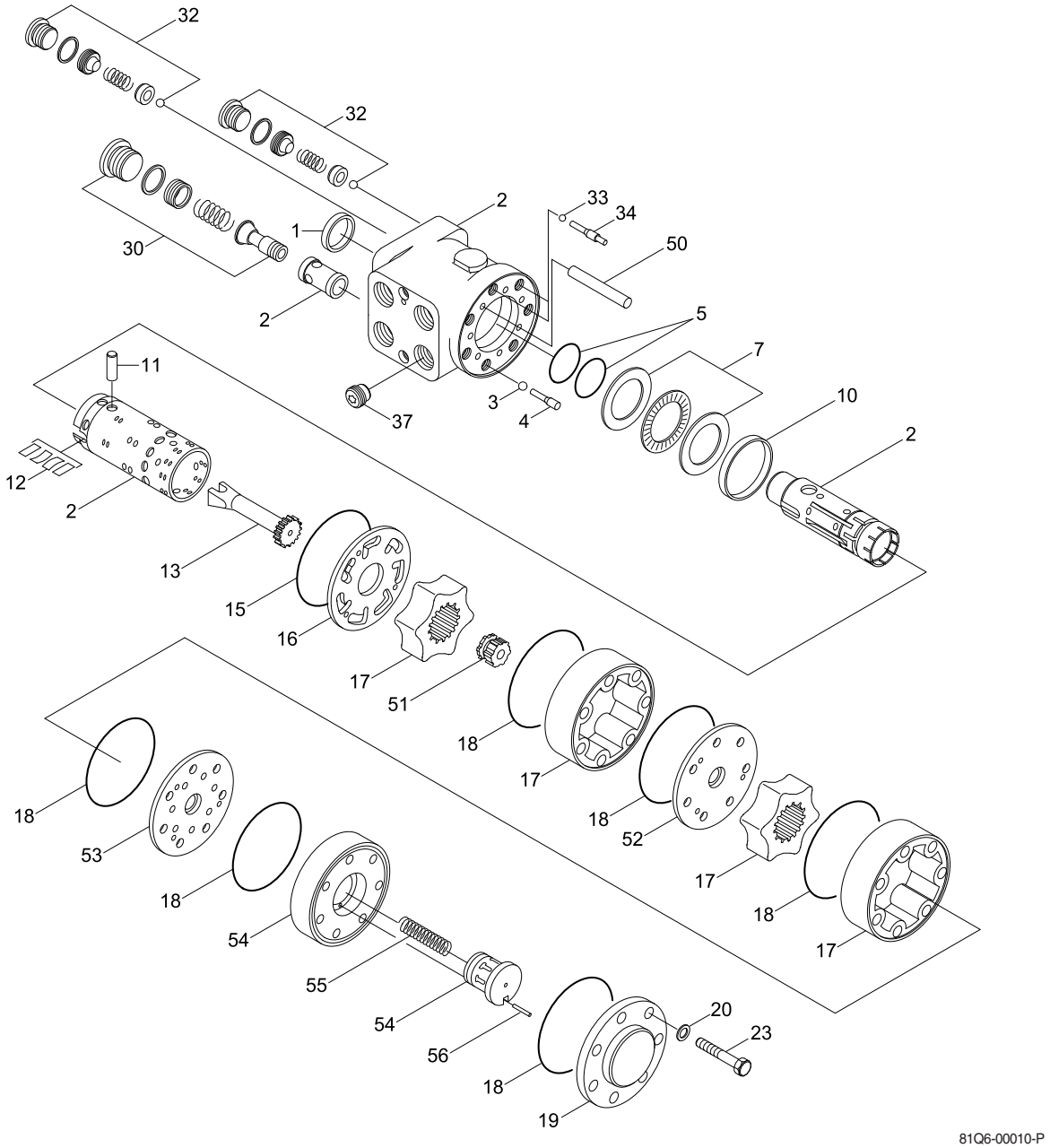
1	Dust seal	10	Spacer	20	Pin screw
2	Housing, spool, sleeve	11	Shaft	21	Screw
3	Ball	12	Spring set	24	Relief valve assy
4	Bushing	13	O-ring	25	Wire spring
5	O-ring	14	Distributor plate	26	Shock valve
6	King ring	15	Gear wheel set	27	Ball
7	Bearing assy	16	O-ring	29	Bushing
8	Ring	17	End cover		
9	Cross pin	18	Washer		

2) TYPE 2 (Without PTO)



1	Dust seal	13	Shaft	31	Relief valve assy
2	Housing, spool, sleeve	16	Distributor plate	32	Shock valve
3	Ball	17	Gear wheel set	33	Ball
4	Ball	18	O-ring	34	Bushing
5	O-ring	19	End cover	37	Check valve
7	Bearing assy	20	Washer	50	Mounting pin
10	Ring	23	Screw	51	Cardan shaft
11	Cross pin	24	name plate	54	Valve and housing
12	Spring set	30	Relief valve assy		

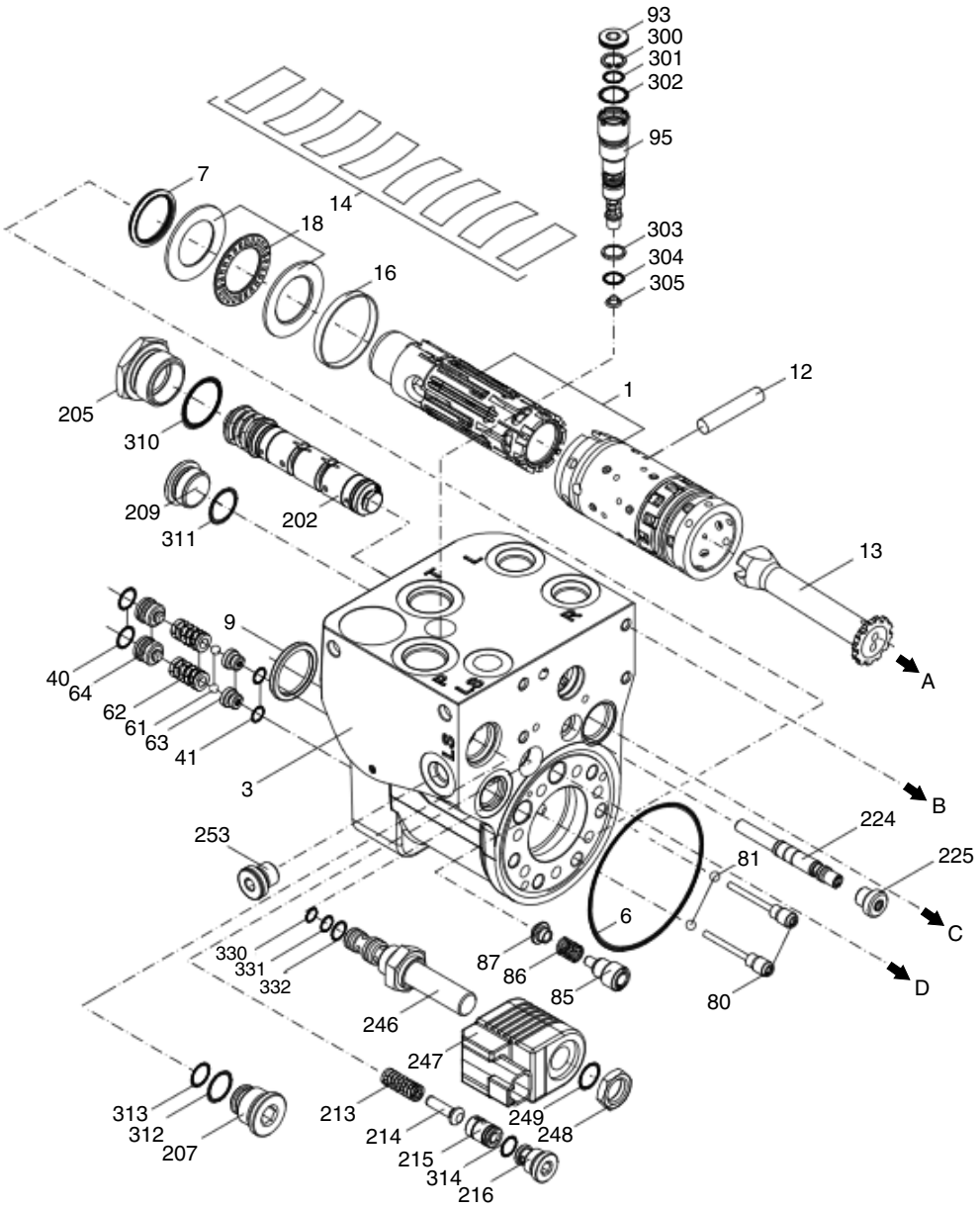
3) TYPE 3 (Emergency steering)



81Q6-00010-P

1	Dust seal	15	O-ring	34	Bushing
2	Housing, spool, sleeve	16	Distributor plate	50	Mounting pin
3	Ball	17	Gear wheel set	51	Cardan shaft
4	Bushing	18	O-ring	52	Distributor plate
5	O-ring	19	End cover	53	Distributor plate
7	Bearing assy	20	Washer	54	Valve & housing
10	Ring	23	Screw	55	Spring
11	Cross pin	30	Relief valve assy	56	Guide pin
12	Spring set	32	Shock valve	57	Check valve
13	Cardan shaft	33	Ball		

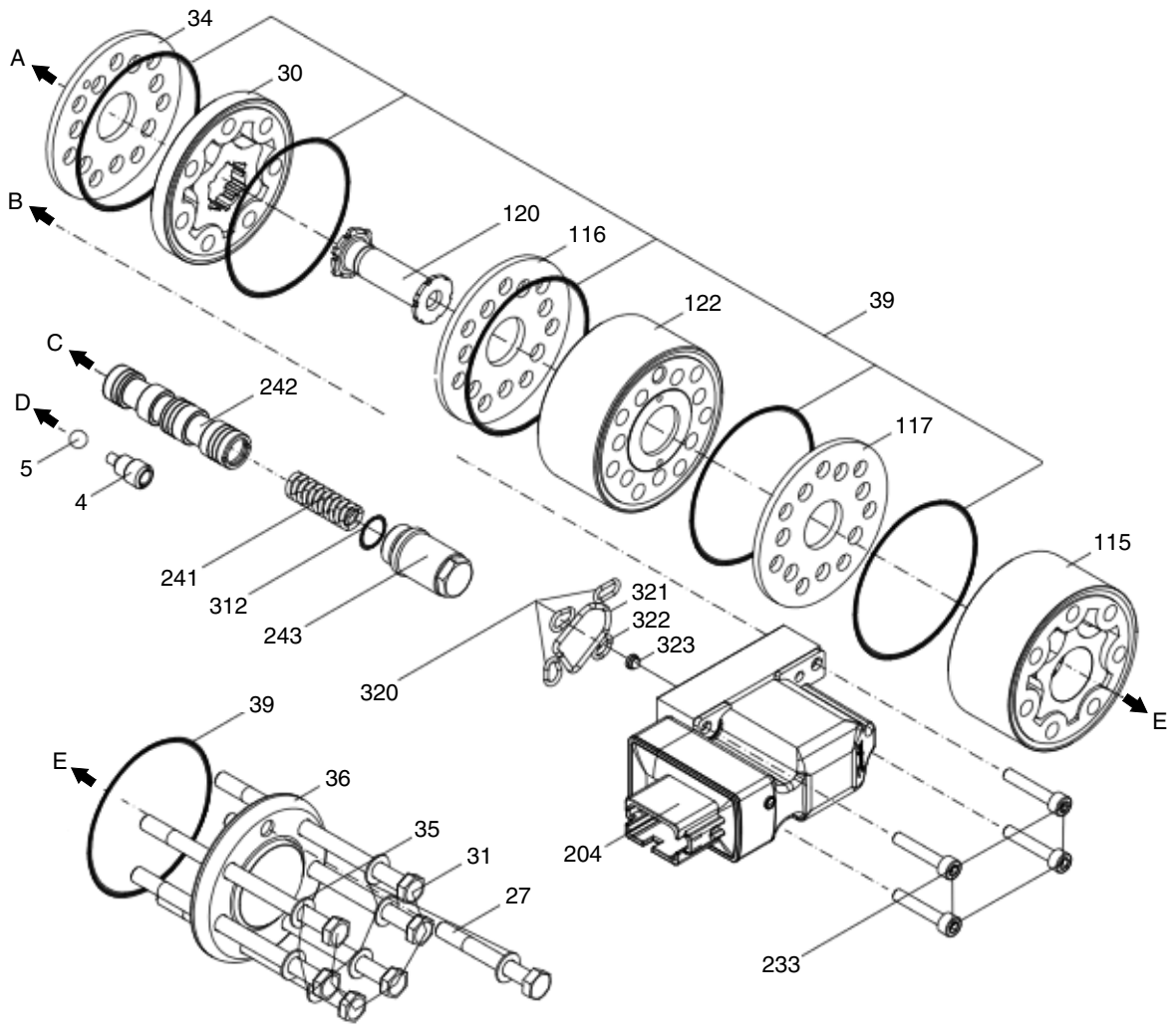
4) TYPE 4 (Joystick steering, 1/2)



81K5-00040-P1

1	Spool/sleeve set	81	Ball	247	Coil
3	Housing	85	Screw	248	Nut
6	O-ring	86	Spring	249	O-ring
7	Shaft seal	87	Valve cone	253	Plug
9	Dust seal ring	93	Plug	300	Lock ring
12	Cross pin	95	Port relief valve cartridge	301	O-ring
13	Shaft	202	Spool	302	O-ring
14	Spring set	205	Plug	303	Backup ring
16	Ring	207	Plug	305	Filter
18	Bearing	209	Plug	310	O-ring
40	O-ring	213	Spring	311	O-ring
41	O-ring	214	Cone pilot supply	312	O-ring
61	Ball	215	Spool pilot supply	313	O-ring
62	Spring	216	Plug	314	O-ring
63	Valve seat	224	Spool	330	O-ring
64	Adjust screw	225	Plug	331	O-ring
80	Pin	246	Spool	332	O-ring

TYPE 4 (Joystick steering, 2/2)



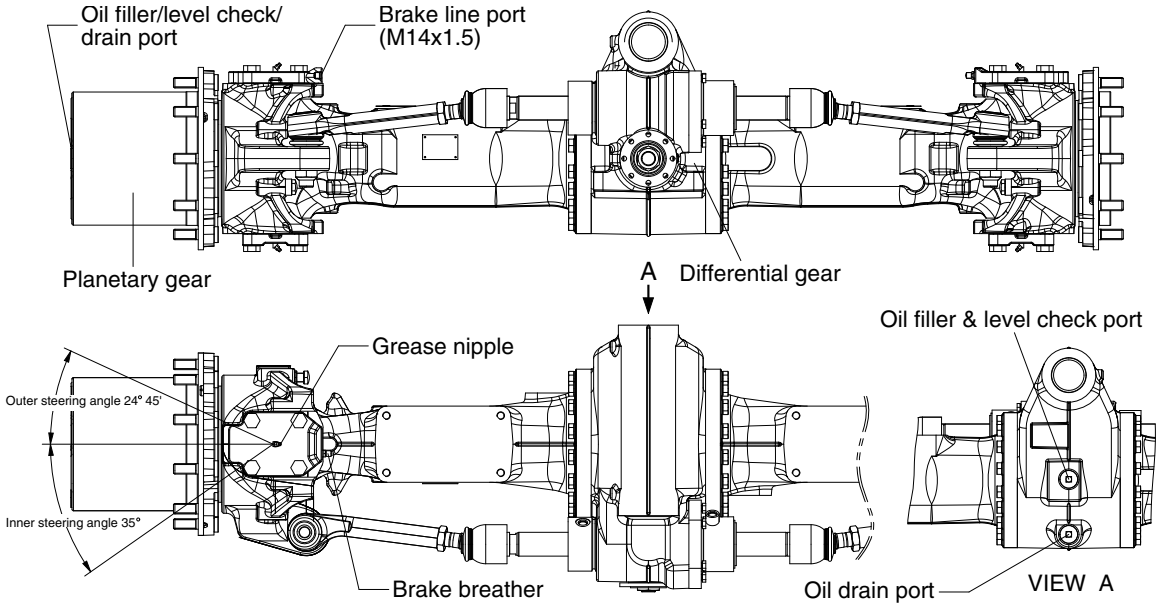
81K5-00040-P2

4	Screw	39	O-ring	241	Spring
5	Ball	115	Gear set	242	Spool
27	Short screw	116	Valve plate	243	Plug
30	Gear set	117	Valve plate	320	O-ring
31	Screw	120	Shaft	321	O-ring
34	Valve plate	122	Valve housing	322	O-ring
35	Washer	204	PVE	323	O-ring
36	End cover	233	Plug		

1. OPERATION

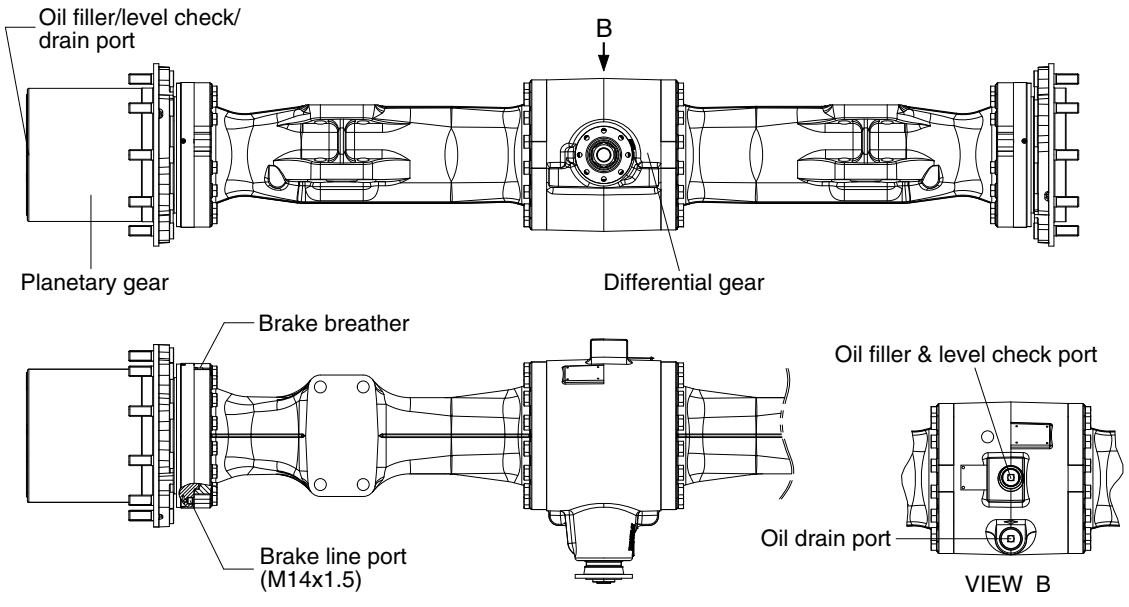
· The power from the engine passes through main pump, travel motor and transmission and drive shafts, and is then sent to the front and rear axles.
Inside the axles, the power passes from the bevel pinion to the bevel gear and is sent at right angles.
· At the same time, the speed is reduced and passes through the both differentials to the axle shafts. The power of the axle shafts is further reduced by planetary-gear-type final drives and is sent to the wheels.

1) FRONT AXLE



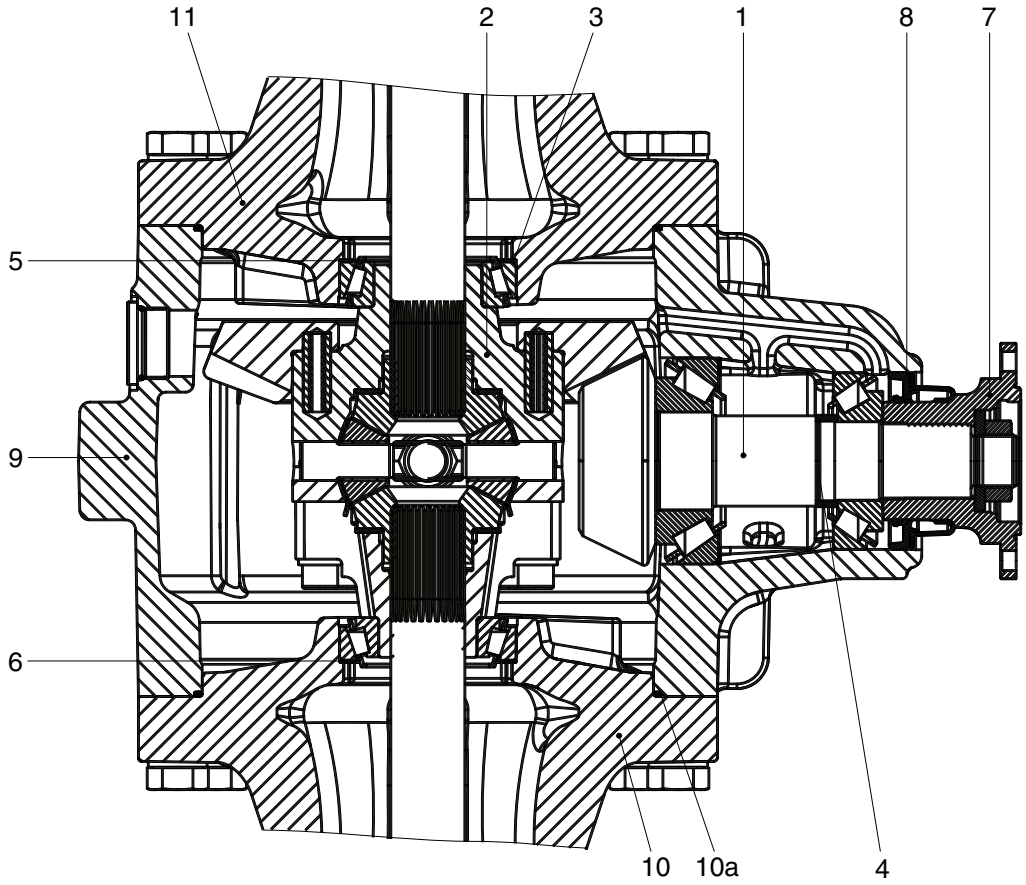
210WA2AX01

2) REAR AXLE



20W7A2AX01A

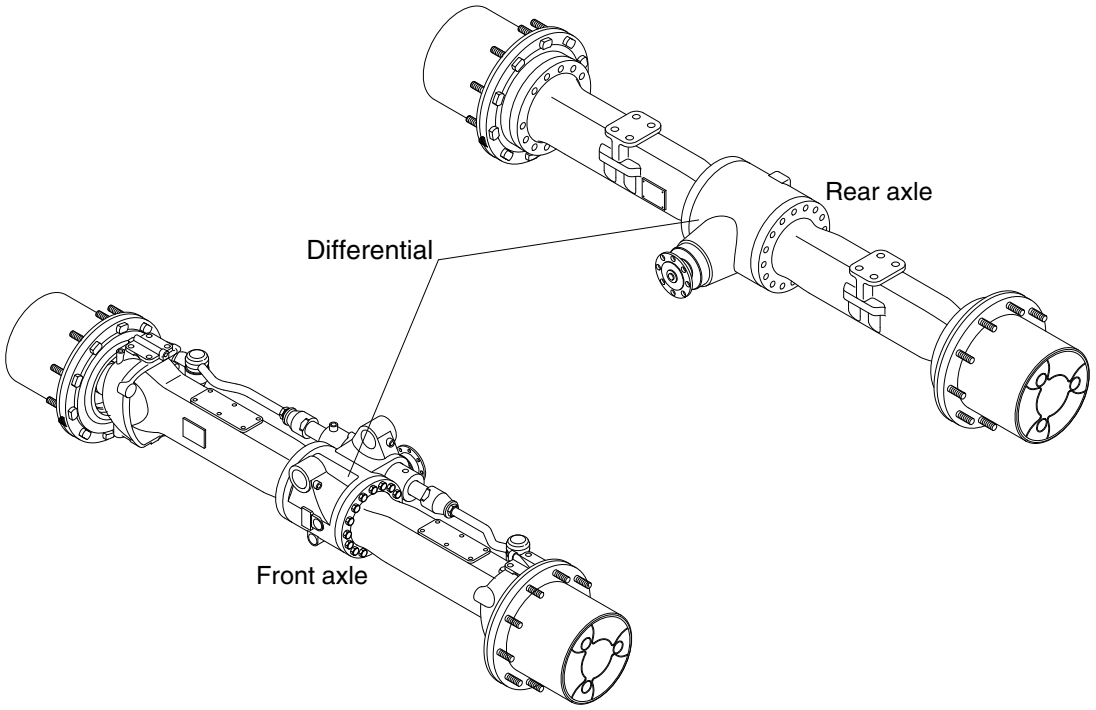
2. SECTION OF DIFFERENTIAL



17W7A2AX02

1 Drive pinion
2 Differential (with crown wheel)
3 Shim for contact pattern (bevel gear set)
4 Spacer ring (bearing rolling moment / pinion bearing)
5 Shim for backlash
6 Shim (bearing rolling moment / differential bearing)
7 Input flange
8 Seal ring
9 Axle drive housing
10 Axle housing
10a O-ring
11 Axle housing (crown wheel side)

3. DIFFERENTIAL



17W7A2AX03

The differential is installed on the front and rear axle to transfer the driving torque from the axle to the wheels. The differential transfers half of the output torque of the transmission via the universal drive shaft to the planetary gear of the wheel hubs and transfers the rpm and torque from the gear via the pinion and the ring.

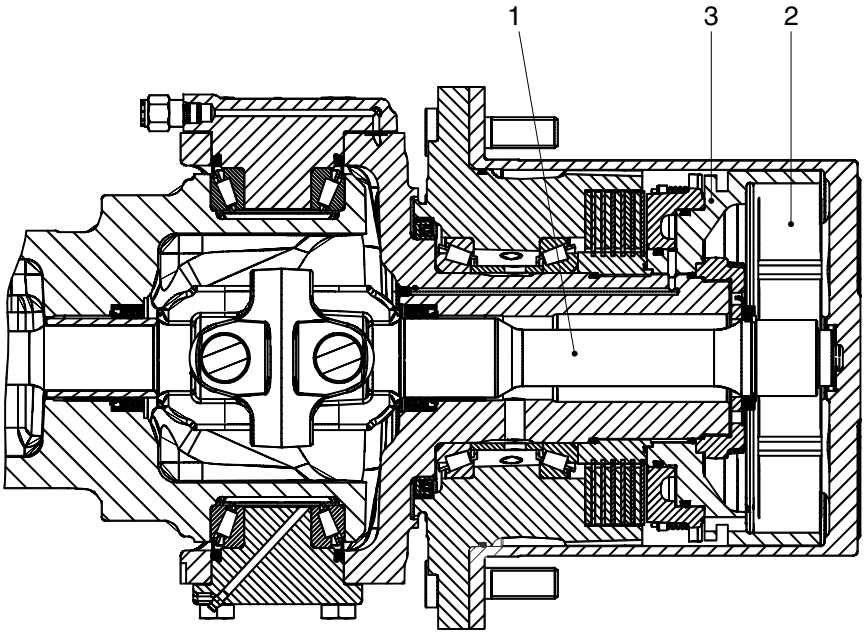
In addition, the differential also servers as an equalizer when going around curves. If the mechanical connection from the transmission to the universal drive shaft, differential, shaft, and planetary gears to the wheels would be rigid, every steering movement would strain the axle construction and would result in increased tire wear.

The equalizing function comes from the special construction of the differential. The power input from the input flange to the pinion shaft, ring and differential housing to the equalizing axle in the differential housing meshes the four equalizing tapered gears with the axle gears, which are located in the equalizing axles. This changes the relative direction of rotation between the shafts meshed with the side gears. This means that one shaft turns clockwise and the other counterclockwise, and one shaft turns faster than the other.

This balancing movement has the disadvantage that when traveling off road, traction is reduced on uneven ground, on loose ground or on snow or ice only wheel per axle is engaged. This disadvantage can be corrected in part by installing a self locking differential.

4. FINAL DRIVE

1) FRONT AXLE



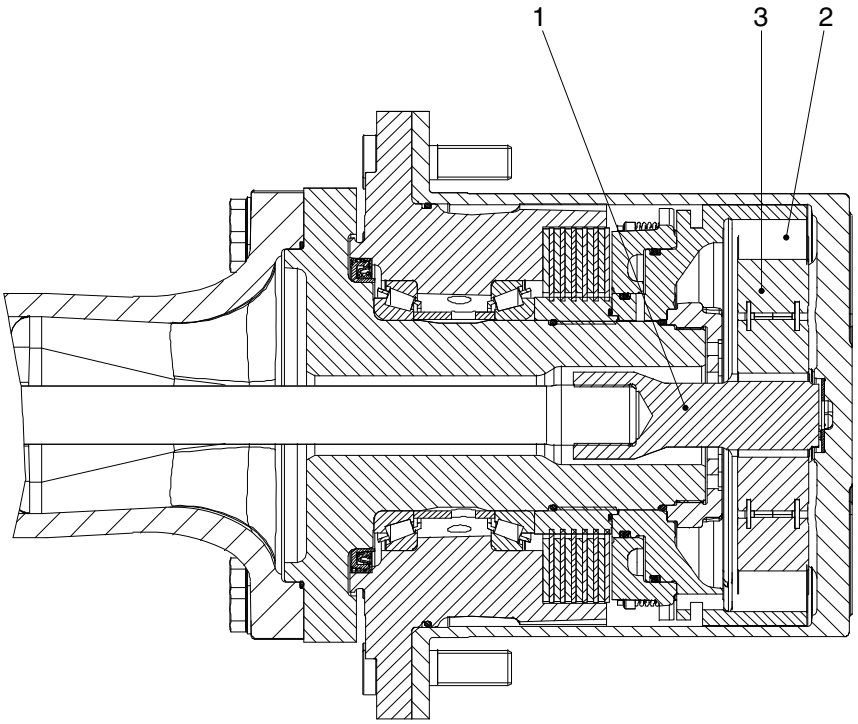
17W7A2AX04

1 Joint fork 2 Planetary gear 3 Ring gear

(1) To gain a large drive force, the final drive uses a planetary gear system to reduce the speed and send drive force to the tires.

(2) The power transmitted from the differential through joint fork (1) is transmitted to planetary gear (2). The planetary gear rotates around the inside of a fixed ring gear (3) and in this way transmits rotation at a reduced speed to the planetary carrier.
This power is then sent to the wheels which are installed to the planetary carriers.

2) REAR AXLE



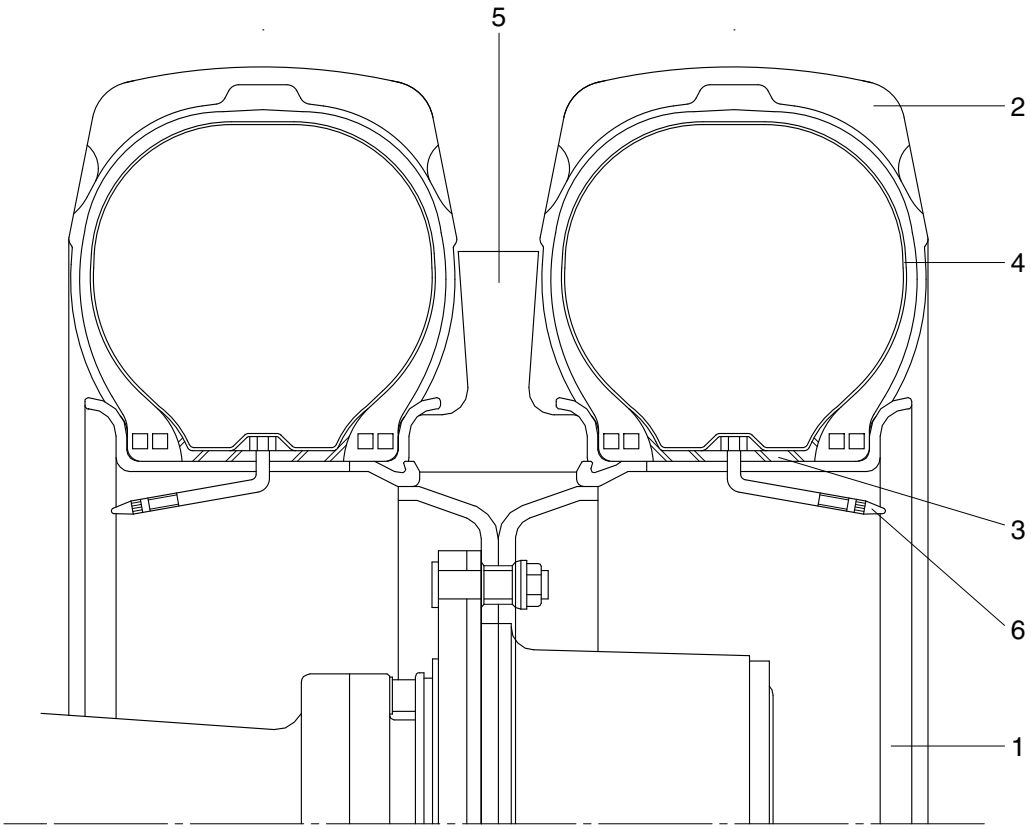
17W7A2AX05

1 Sun gear shaft 2 Planetary gear 3 Ring gear

(1) To gain a large drive force, the final drive uses a planetary gear system to reduce the speed and send drive force to the tires.

(2) The power transmitted from the differential through sun gear shaft (1) is transmitted to planetary gear (2). The planetary gear rotates around the inside of a fixed ring gear (3) and in this way transmits rotation at a reduced speed to the planetary carrier.
This power is then sent to the wheels which are installed to the planetary carriers.

5. TIRE AND WHEEL



17032TI01

1	Wheel rim	3	Flap	5	Stone resister ring
2	Tire	4	Tube	6	Valve assembly

1) The tire acts to absorb the shock from the ground surface to the machine, and at the same time they must rotate in contact with the ground to gain the power which drives the machine.

2) Various types of tires are available to suit the purpose. Therefore it is very important to select the correct tires for the type of work and bucket capacity.