SECTION 2 STRUCTURE AND FUNCTION

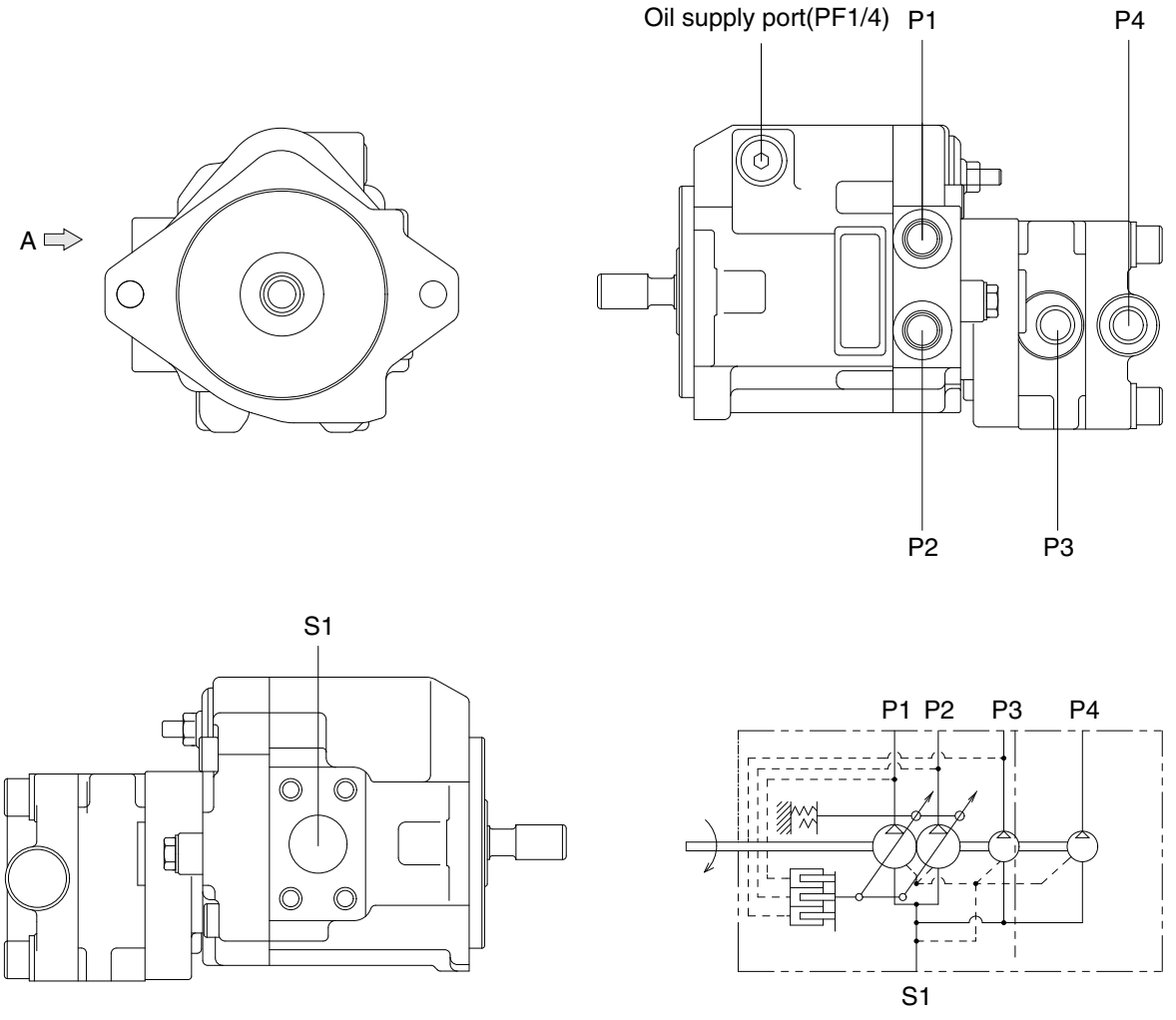
GROUP 1 HYDRAULIC PUMP

1. GENERAL

This is a variable displacement double-piston pump for discharge with equal displacements from one cylinder block. This pump is so compact as to appear a single pump though this is actually a double pump.

Because this pump has one swash plate, the tilting angle is the same for two pumps. Tilting of the pump changes in response to the total pressure of P1 + P2. Namely, the output is controlled to the constant value so that the relationship between the discharge pressure and flow rate Q becomes constant, (P1 + P2) * Q =Constant.

The third pump and pilot pump can be connected to the same shaft via a coupling.



VIEW A

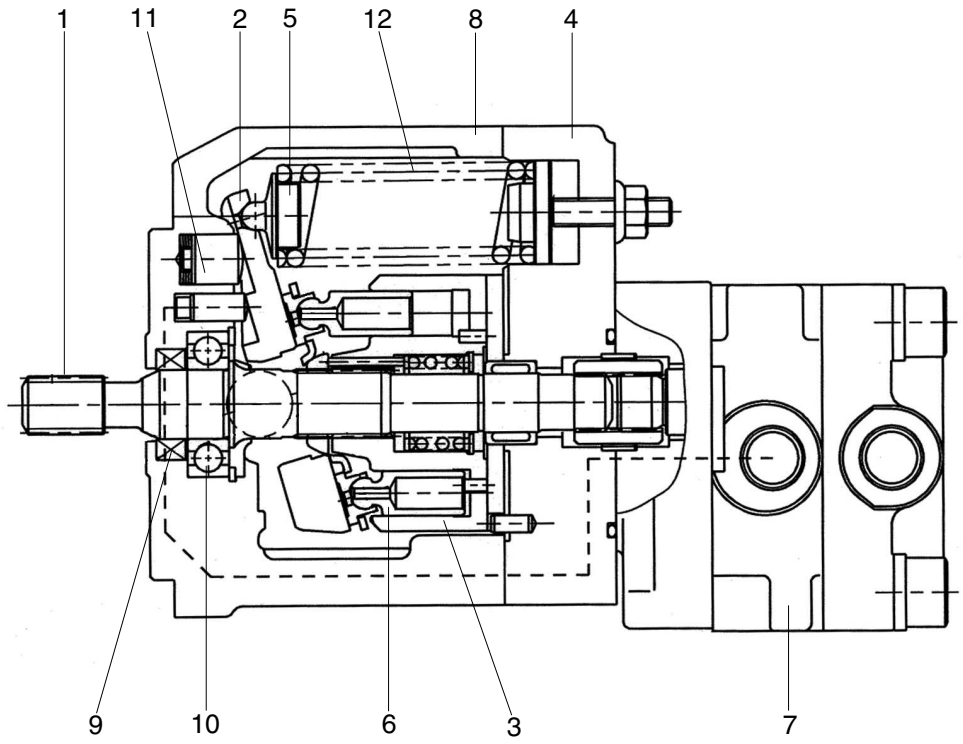
Hydraulic circurit

17Z9A2MP01

Description of the ports

Port	Port name	Port size
S1	Suction port	SAE 1
A1, A2, A3, A4	Discharge port	PF 3/8

2. MAJOR COMPONENTS AND FUNCTIONS



17Z9A2MP02

1	Drive shaft assembly	7	Gear pump
2	Swash plate assembly	8	Body
3	Cylinder barrel	9	Oil seal
4	Port plate assembly	10	Bearing
5	Spring holder assembly	11	Stopper pin assembly
6	Piston	12	Spring

This is a variable displacement double-piston pump for discharge with two equal displacements from one cylinder block. Because this is one cylinder barrel, there is only one suction port.

The oil is divided into two equal flows by the control plate in the cover and directed to two discharge ports provided in the cover.

The discharge pressure directed to the piston tilts the hanger by overcoming the spring force.

Since the piston stroke changes according to the tilting angle of the hanger, the flow can be changed.

The simultaneous tilting angle constant-output control method is employed.

The pilot pump can be connected to the same shaft via a coupling.

1) PRINCIPLE OF OPERATION

(1) Function of pump

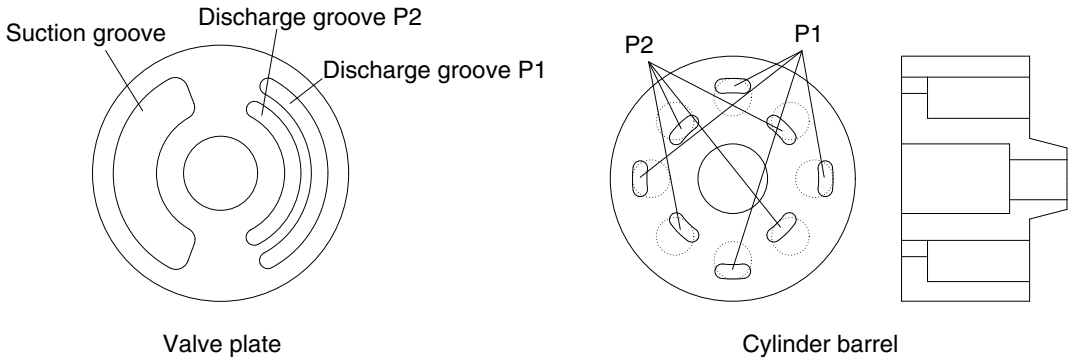


Figure 1 Working principle of PVD pump

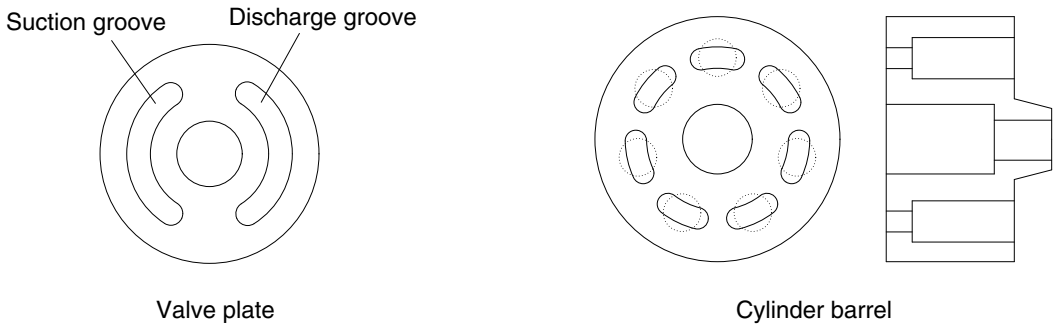


Figure 2 Working principle of Conventional type

R17Z9A2MP05

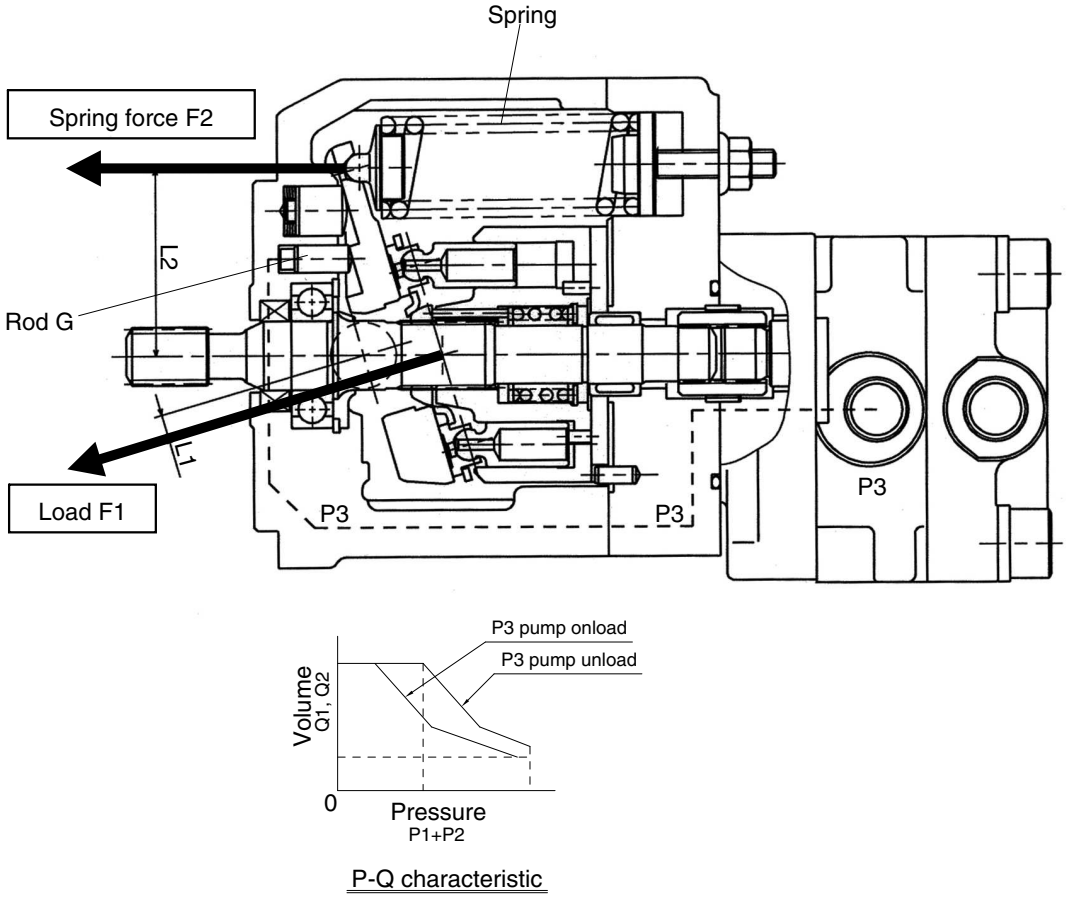
This pump adopts a new method using even numbered pistons to make functions of two same volume pumps available in one casing of a swash plate type variable volume piston pump.

Conventional valve plate has one suction groove and one discharge groove respectively as shown in figure 2. But this method adopts one common suction groove and two discharge grooves on the outer side (P1) and the inner side (P2) as shown in figure 1, the piston room in the cylinder barrel opens to either the outer side (P1) or the inner side (P2) discharge groove of the valve plate alternately, and the discharges are performed independently on the inner side and the outer side.

Since this model has even numbered pistons, same No of pistons open to the outer side and the inner side of the valve plate. All pistons are of same swash plate, so the discharges from the outer side (P1) and the inner side (P2) are equal.

Also, since only one swash plate is used, the discharges from P1 and P2 ports changes equally when the swash plate angle of rake changes in variable controls. So, there is no difference between the two discharges.

2) CONTROL FUNCTIONS



P-Q characteristic

17Z9A2MP04

(1) Constant horse power variable structure

The pump output flow rate is variable depending on an angle of the swash plate which is controlled according to the pump output pressure. This control enables the pump consumption horse power to be sustained at the maximum. The tilt point of the swash plate is the balls located behind the swash plate. The load F1 from the pistons is in the direction shown in the illustration and generates a clockwise moment against the swash plate. Against this force the spring (force F2) is located in the opposite direction to keep the horse power constant and set at the appointed load. As the pressure increases, the above clockwise moment increases, and when it overcomes the counter-clockwise moment created by the spring force, the spring is sagged and the swash plate angle gets smaller. Then the output flow rate is reduced to keep the horse power constant.
This prevents engine stall and the engine horse power can be utilized at the maximum.

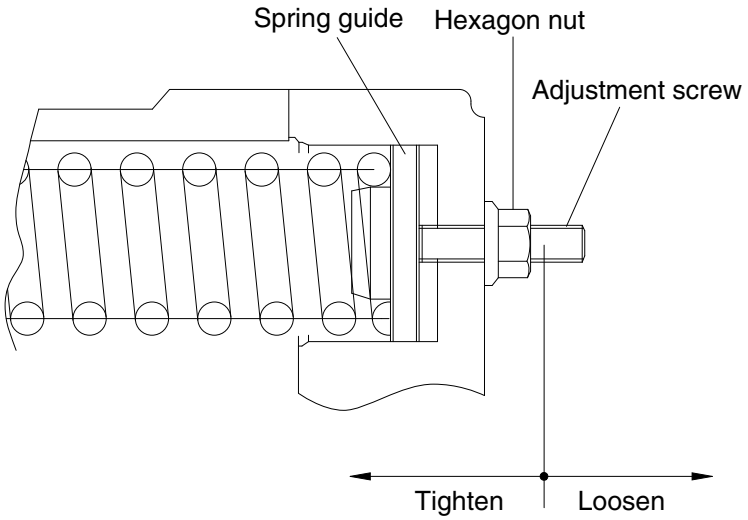
(2) Power shift mode (Reduced horse power control by P3 pressure)

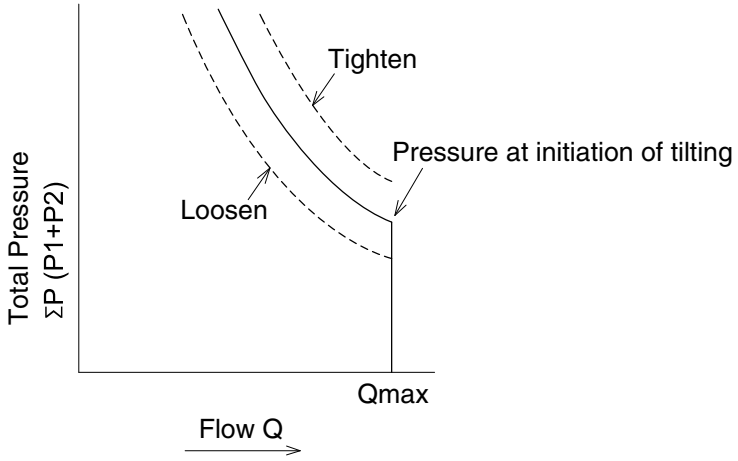
This control keeps the maximum value of the pump consumption horse power including the third pump (gear pump) constant. When the P3 (gear pump) pressure acts on the rod G, a clockwise moment proportion to the pressure acts on the swash plate and the P-Q characteristic shifts so that the total pump consumption horse power including the gear pump horse power is kept constant.

3) CONTROL / ADJUSTMENT PROCEDURE

(1) Loosen the hexagonal nut.

(2) Tighten or loosen the adjusting screw to set the power shifting line.

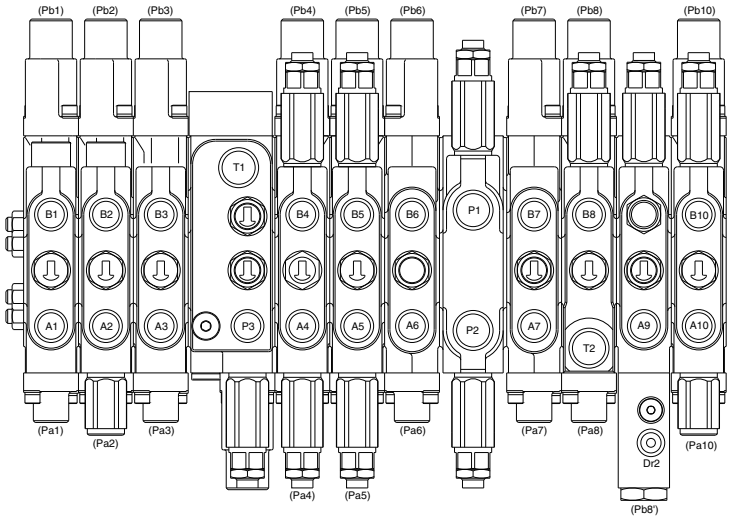


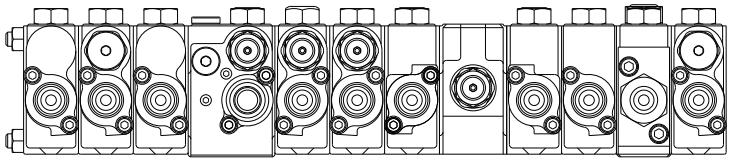


17Z9A2MP07

GROUP 2 MAIN CONTROL VALVE

1. OUTLINE



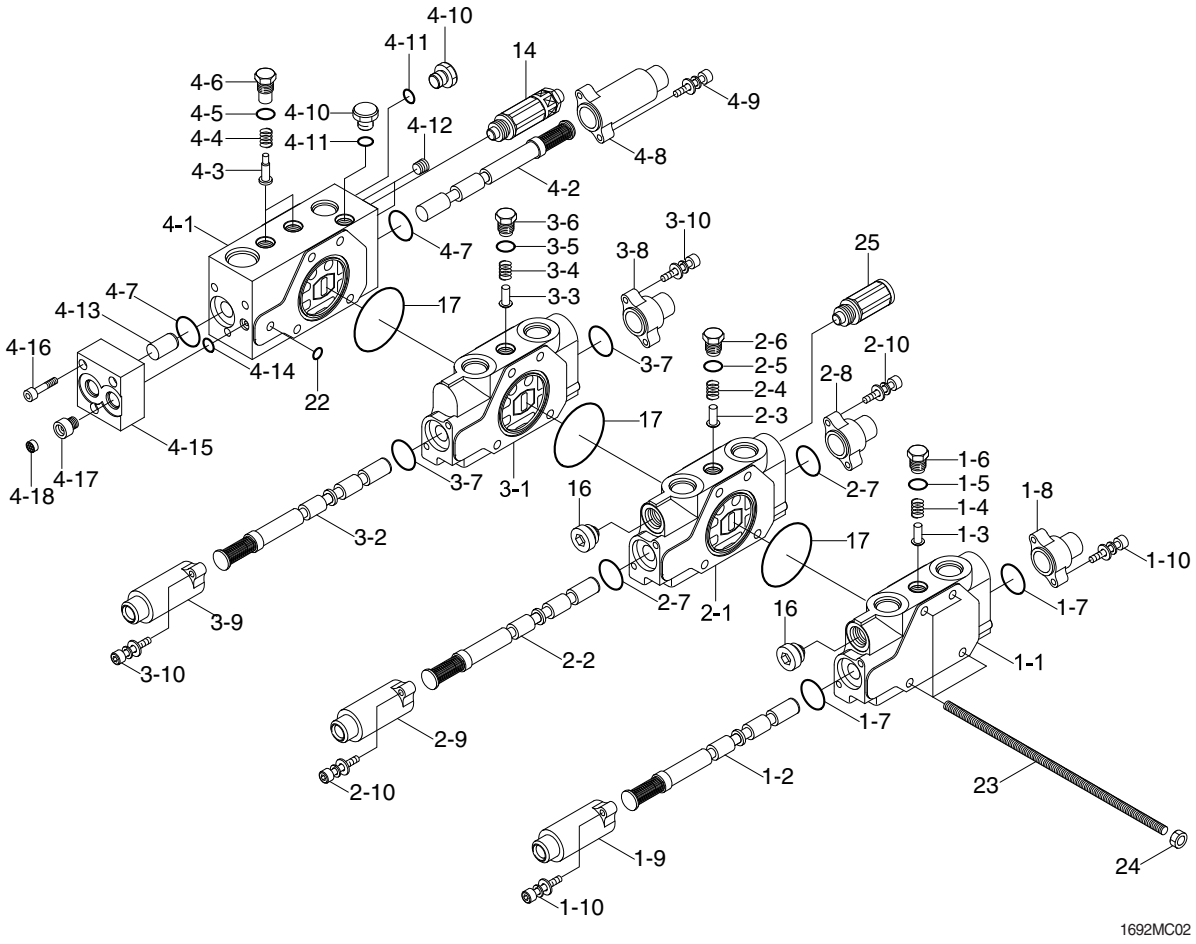


1692MC01

Mark	Port name	Port size	Tightening torque
P1	P1 (A1) pump port	PF 1/2	6~7 kgf · m
P2	P2 (A2) pump port		
T1	Tank return port		
T2	Tank return port		
P3	P3 (A3) pump port	PF 3/8	4.0~5.0 kgf · m
A1	Dozer		
B1	Dozer		
A2	Boom swing (RH) port		
B2	Boom swing (LH) port		
A3	Swing (LH) port		
B3	Swing (RH) port		
A4	Option port		
B4	Option port		
A5	Arm out port		
B5	Arm in port		
A6	Travel [LH/RR] port		
B6	Travel [LH/FW] port		
A7	Travel [RH/RR] port		
B7	Travel [RH/FW] port		
A9	Boom up port		
B8	Boom down port		

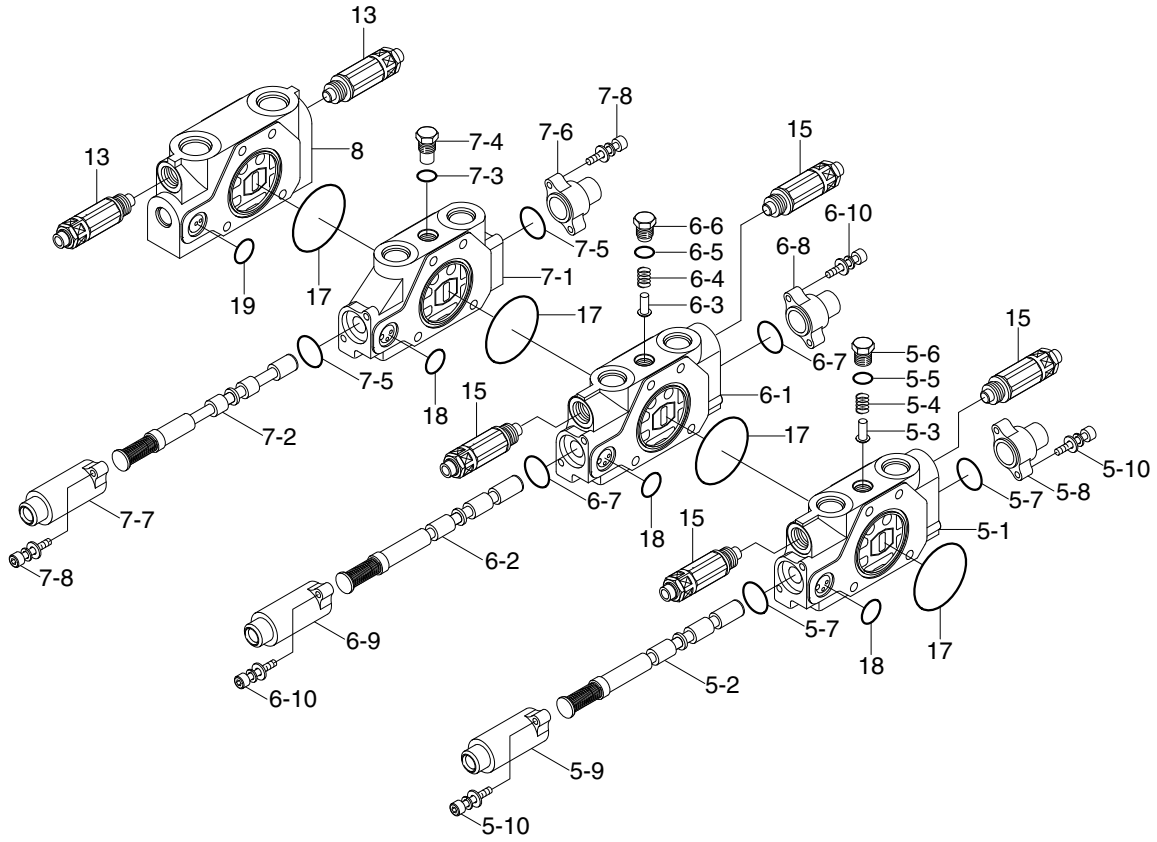
Mark	Port name	Port size	Tightening torque
A10	Bucket out port	PF 3/8	4.0~5.0 kgf · m
B10	Bucket in port		
Pa1	Dozer down pilot port	PF 1/4	2.5~3.0 kgf · m
Pb1	Dozer up pilot port		
Pa2	Boom swing (RH) pilot port		
Pb2	Boom swing (LH) pilot port		
Pa3	Swing (RH) pilot port		
Pb3	Swing (LH) pilot port		
Pa5	Arm out pilot port		
Pb5	Arm in pilot port		
Pa6	Travel [LH/RR] pilot port		
Pb6	Travel [LH/FW] pilot port		
Pa7	Travel [RH/RR] pilot port		
Pb7	Travel [RH/FW] pilot port		
Pa8	Boom up pilot port		
Pb8	Boom down pilot port		
Pa10	Bucket out pilot port		
Pb10	Bucket in pilot port		
Pp1	Travel signal input port		
Pb8	Boom lock valve release port		
Dr1	Travel drain port		
Dr2	Bool lock valve drain port		

2. STRUCTURE (1/3)



1	Dozer work block	2-9	Cover-pilot	4-7	O-ring
1-1	Body-work	2-10	Bolt-soc head w/washer	4-8	Cover-pilot
1-2	Spool assy	3	Swing work block	4-9	Bolt-soc head w/washer
1-3	Poppet	3-1	Body-work	4-10	Plug
1-4	Spring	3-2	Spool assy	4-11	O-ring
1-5	O-ring	3-3	Poppet	4-12	Plug
1-6	Plug	3-4	Spring	4-13	Piston
1-7	O-ring	3-5	O-ring	4-14	O-ring
1-8	Cover-pilot	3-6	Plug	4-15	Body-pilot
1-9	Cover-pilot	3-7	O-ring	4-16	Bolt-soc head w/washer
1-10	Bolt-soc head w/washer	3-8	Cover-pilot	4-17	Orifice
2	Boom swing work block	3-9	Cover-pilot	4-18	Filter-coin type
2-1	Body-work	3-10	Bolt-soc head w/washer	14	Relief valve
2-2	Spool assy	4	Connecting block	16	Plug
2-3	Poppet	4-1	Body-work	17	O-ring
2-4	Spring	4-2	Spool assy	22	O-ring
2-5	O-ring	4-3	Poppet	23	Bolt-tie
2-6	Plug	4-4	Spring	24	Nut-hex
2-7	O-ring	4-5	O-ring	25	Anticavitation valve
2-8	Cover-pilot	4-6	Plug		

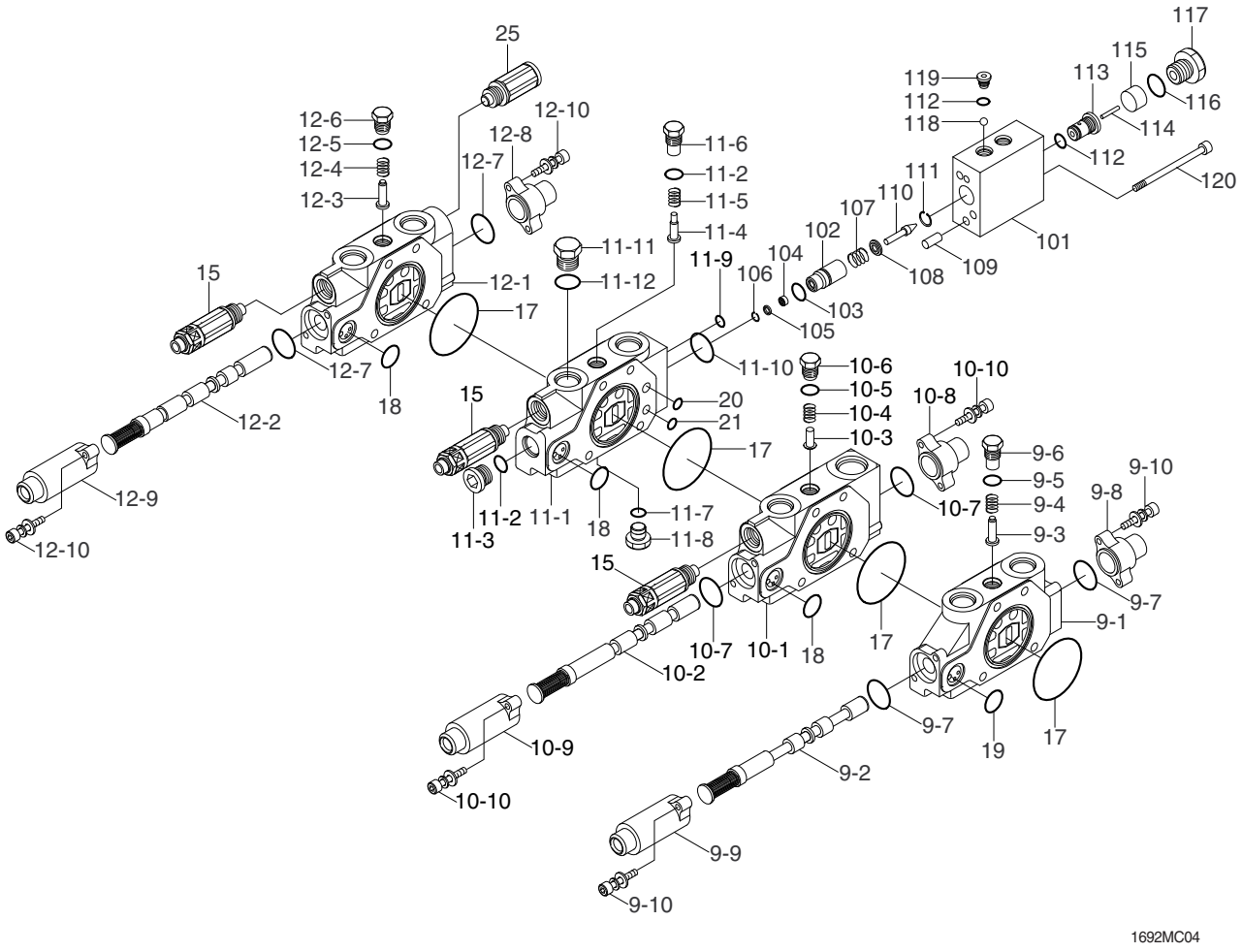
STRUCTURE (2/3)



1692MC03

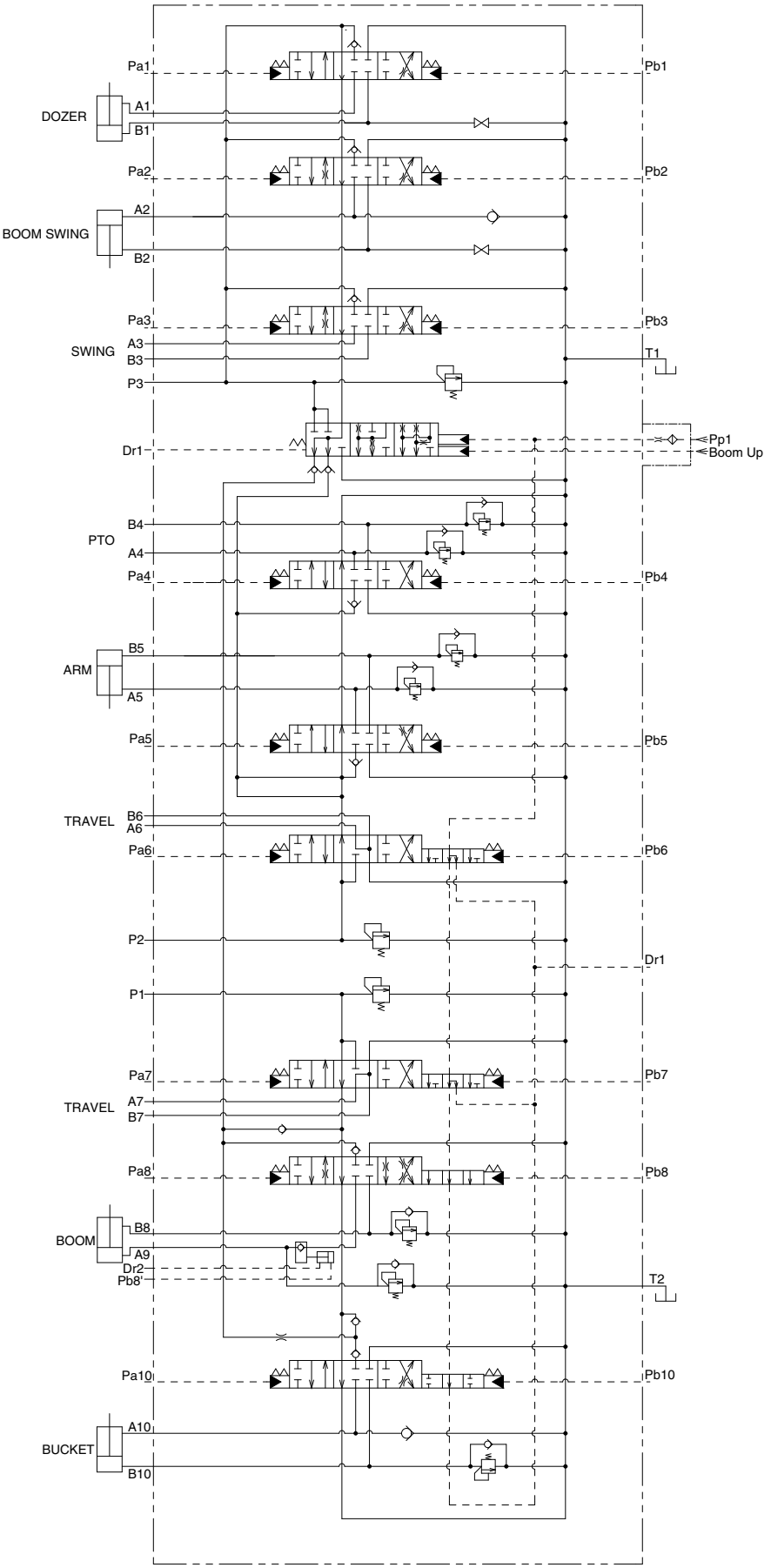
5	PTO work block	6-2	Spool assy	7-4	Plug
5-1	Body-work	6-3	Poppet	7-5	O-ring
5-2	Spool assy	6-4	Spring	7-6	Cover-pilot
5-3	Poppet	6-5	O-ring	7-7	Cover-pilot
5-4	Spring	6-6	Plug	7-8	Bolt-soc head w/washer
5-5	O-ring	6-7	O-ring	8	Inlet work block
5-6	Plug	6-8	Cover-pilot	13	Relief valve
5-7	O-ring	6-9	Cover-pilot	15	Overload relief valve
5-8	Cover-pilot	6-10	Bolt-soc head w/washer	17	O-ring
5-9	Cover-pilot	7	Travel work block	18	O-ring
5-10	Bolt-soc head w/washer	7-1	Body work	19	O-ring
6	Arm work block	7-2	Spool assy		
6-1	Body-work	7-3	O-ring		

STRUCTURE (3/3)



9	Travel work block	10-8	Cover-pilot	12-3	Poppet	105	Spacer
9-1	Body-work	10-9	Cover-pilot	12-4	Spring	106	Ring-retaining
9-2	Spool assy	10-10	Bolt-soc head w/washer	12-5	O-ring	107	Spring A-lock valve
9-3	Poppet	11	Boom lock valve	12-6	Plug	108	Spring seat
9-4	Spring	11-1	Body-work	12-7	O-ring	109	Pin
9-5	O-ring	11-2	O-ring	12-8	Cover-pilot	110	Poppet
9-6	Plug	11-3	Plug	12-9	Cover-pilot	111	Ring-retaining
9-7	O-ring	11-4	Poppet	12-10	Bolt-soc head w/washer	112	O-ring
9-8	Cover-pilot	11-5	Spring	15	Overload relief valve	113	Guide-piston
9-9	Cover-pilot	11-6	Plug	17	O-ring	114	Piston A1
9-10	Bolt-soc head w/washer	11-7	O-ring	18	O-ring	115	Piston B
10	Boom work block	11-8	Plug	19	O-ring	116	O-ring
10-1	Body-work	11-9	O-ring	20	O-ring	117	Connector
10-2	Spool assy	11-10	O-ring	21	O-ring	118	Ball-steel
10-3	Poppet	11-11	Plug	25	Anticavitation valve	119	Plug
10-4	Spring	11-12	O-ring	101	Cover-lock valve	120	Bolt-hex. socket head
10-5	O-ring	12	Bucket work block	102	Lock valve		
10-6	Plug	12-1	Body-work	103	Seal		
10-7	O-ring	12-2	Spool assy	104	Filter		

3. HYDRAULIC CIRCUIT



1692MC05

4. FUNCTION

1) IN NEUTRAL (When all spools are in neutral position)

P1 : The oil discharged from the hydraulic pump flows into control valve P1 port, and then flows through P1 and P2 supply body the P1 side travel spool. The oil flows through the bypass passage in the direction of travel → boom → bucket spool, and then flows from the bypass passage to the tank passage in the bucket section.

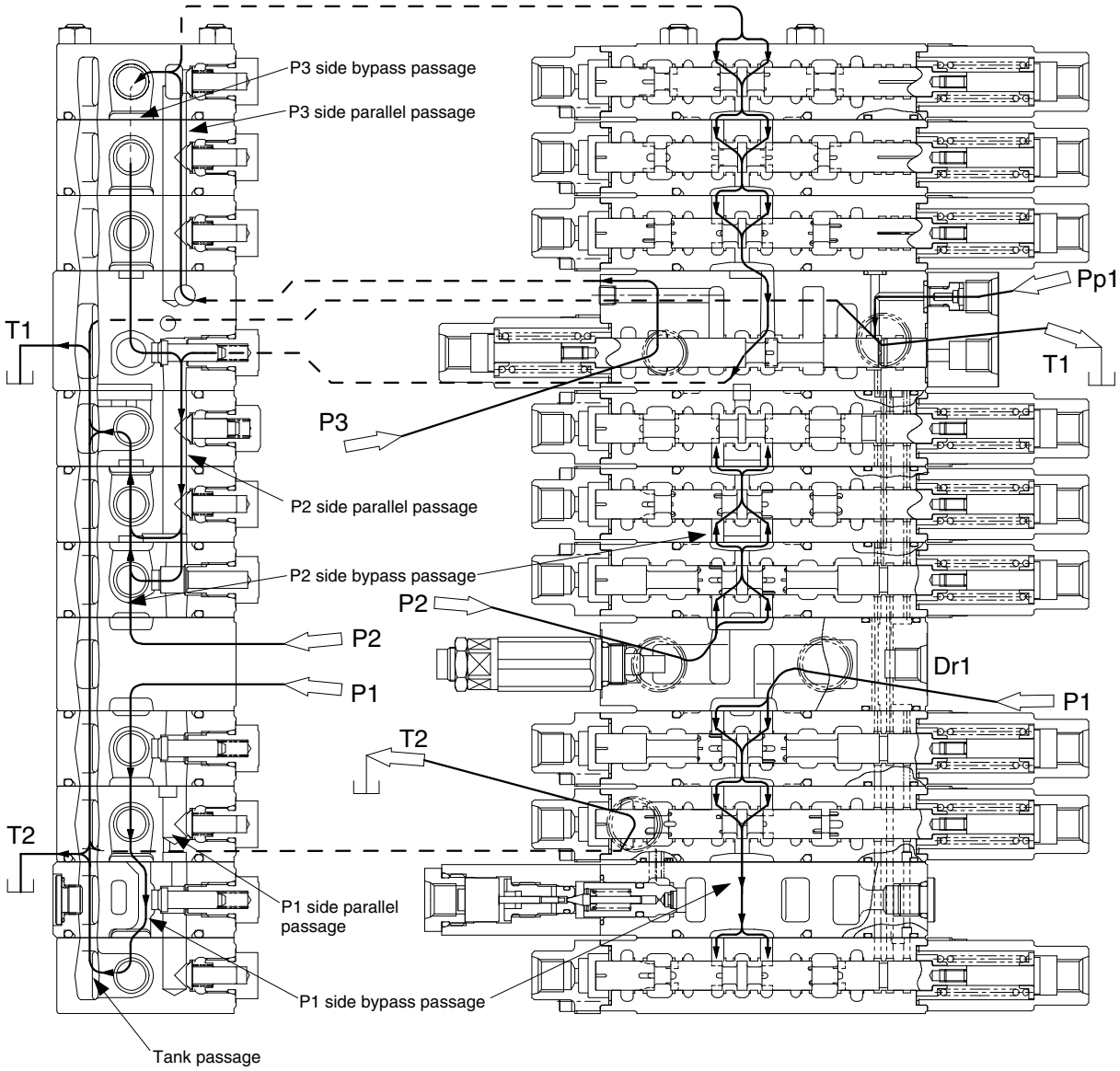
P2 : The oil discharged for the hydraulic pump flows into the control valve from P2 port, and then flows through P1 and P2 supply body to the P2 side travel spool. The oil flows through the bypass passage in the direction of travel → arm → PTO spool, and the flows from the bypass passage to the tank passage in the PTO section.

P3 : The oil discharged from the hydraulic pump flows into the control valve from P3 port, and then flows through the parallel passage of dozer, boom swing, and swing. The oil that has followed into the parallel passage flows through the bypass passage in the direction of dozer → Boom swing → swing spool, the connecting spool land, the P2 side parallel passage, the bypass passage from arm to PTO spool, the bypass passage in the PTO section, and then to the tank passage.

※ **Since each line (P1, P2, P3) is supplied with oil from the pump, the section is operatable; therefore, do not operate the control valve except the working time.**

- P1 line : Travel, boom, bucket
- P2 line : Travel, arm, PTO
- P3 line : Dozer, boom swing, arm, PTO, boom (up only)

P_P1 : When P_P1 port is applied with pilot pressure, the oil flows into the travel independent passage via an orifice.
With the spool in neutral, the oil flows into Dr1 port provided in the P1 and P2 supply body.



Hydraulic oil flow in neutral

R35Z72MCV11

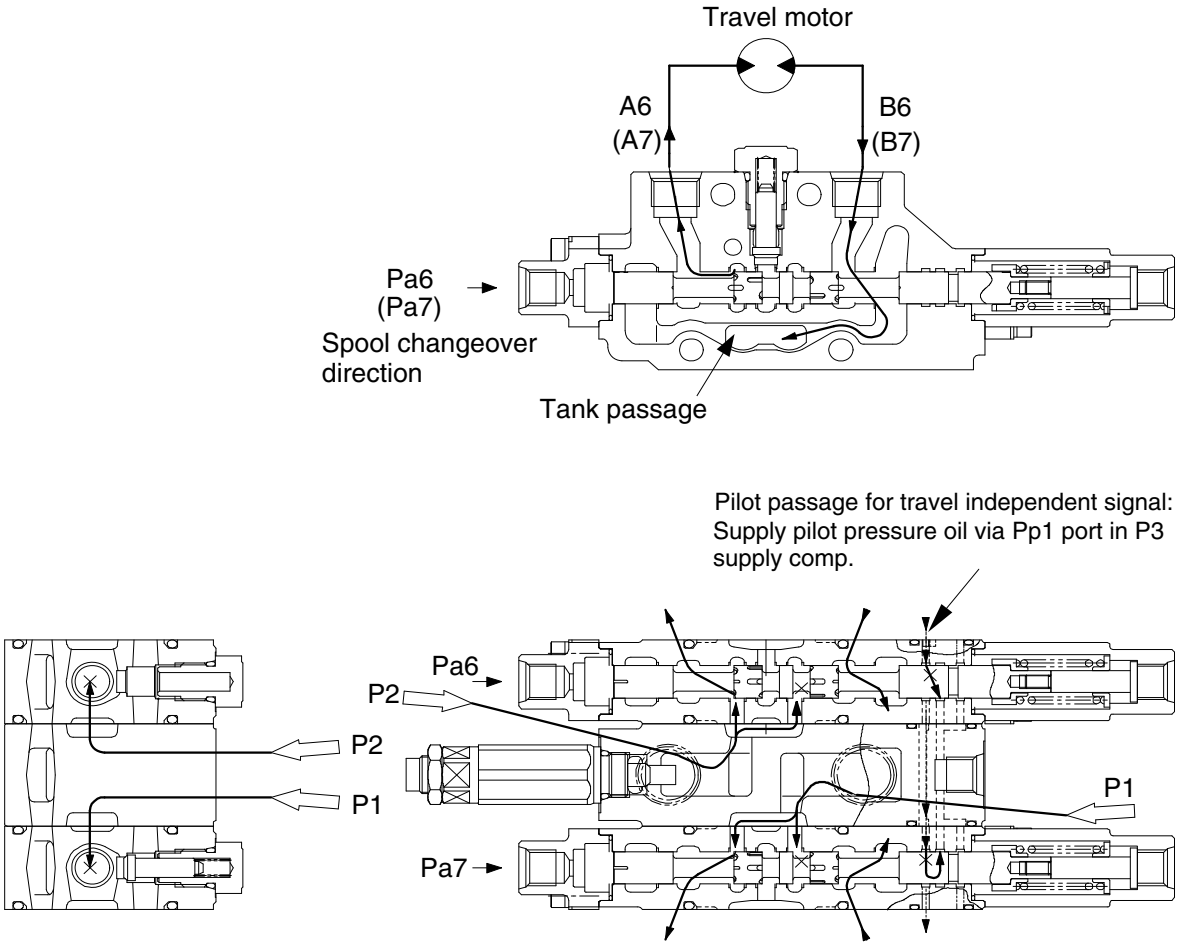
2) TRAVEL OPERATION

For the travel operation, both Pa pressurization and Pb pressurization are the same on operation so that only Pa pressurization is explained as follows.

When left (right) travel reverse is operated, the secondary pressure from the remote control valve is applied to Pa6 [Pa7] port to change over the travel spool. The oil flowed from P2 [P1] port flows through the supply body into the P2 [P1] side bypass passage. The oil flowed into the P2 [P1] side bypass passage flows through A6 [A7] port that has been opened by the spool changeover to the travel motor. On the other hand, the oil returned from the travel motor flows into the control valve from B6 [B7] port and then to the tank passage has been opened after the spool changeover.

The oil flowed from P_P1 port flows through the orifice passage provided in the P3 supply section into the travel independent signal passage.

Although the travel independent passage (see page 2-14) in the travel section that has been opened during neutral is blocked after the both travel spools changeover, the travel independent signal passage is connected to the drain port via the bucket section Accordingly, when the bucket section has not changed over, the connecting spool in the P3 supply section does not change over because the pressure in the travel independent signal passage is equal to the drain pressure.



Operation during travel(Forward)

R35Z72MCV12

3) BOOM OPERATION

Boom up operation

When the boom up operation is carried out, the secondary pressure from the remote control valve is applied to Pa8 port to change over the boom spool. Since Pa8 port is connected to boom up port through the piping, the pressure oil supplied to boom up port changes over the connecting spool through the connecting piston in the P3 supply section

Also, since the P1 side bypass passage is shut off at the boom section after the boom spool changeover, the oil flowed from P1 port flows through the check valve provided above the bypass passage in the travel section into the P1 side parallel passage.

On the other side, after the connecting spool changeover the oil flowed into P3 port.

① Flows through the internal passage in connecting spool and the check valve in the P3 supply section into the P1 side parallel passage.

② The oil flows through the P3 side parallel passage and P3 side bypass passage and then:

a. Flows through the check valve in the P3 supply section into the P1 side parallel passage.

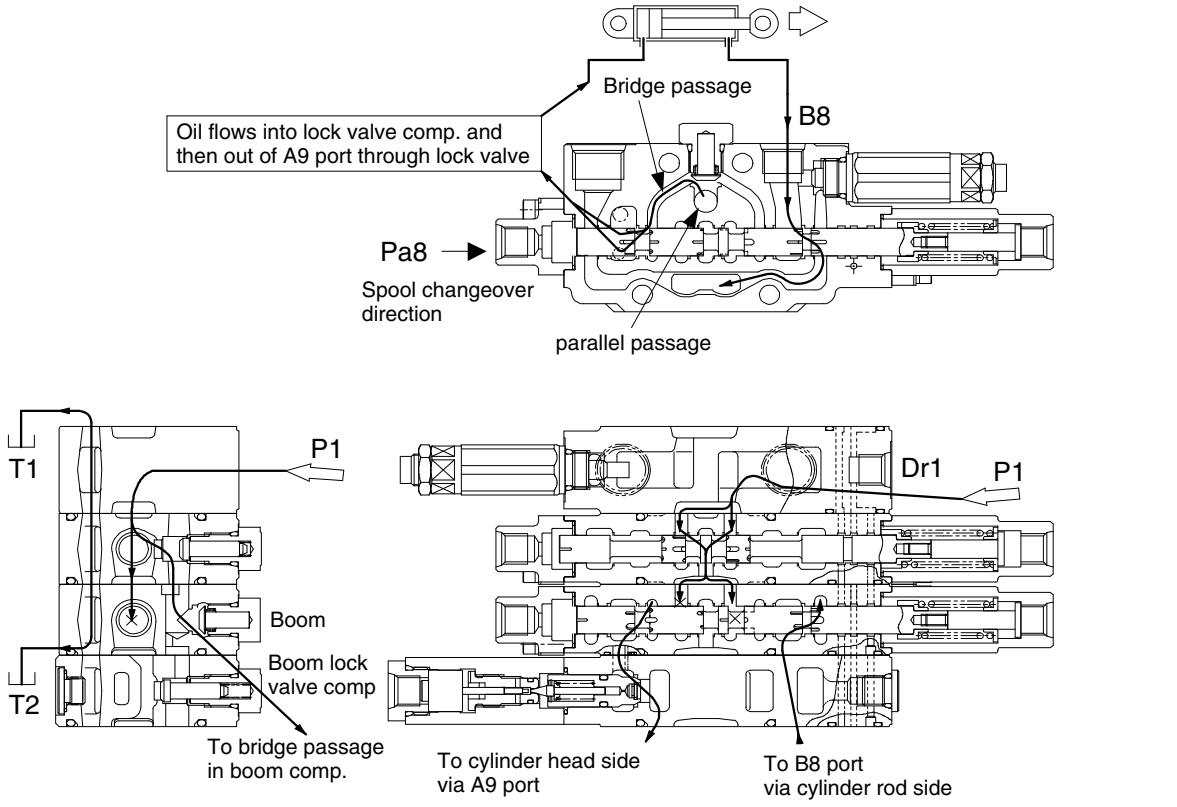
b. Some oil flows through the orifice passage provided in the connecting spool and the check valve in the P3 supply section into the P2 side parallel passage.

The oil flowed into the P1 side parallel passage is connected with the oil from P1 pump.
The oil flowed into the P2 side parallel passage flows through the bypass passages in the arm section and PTO section to the tank passage.

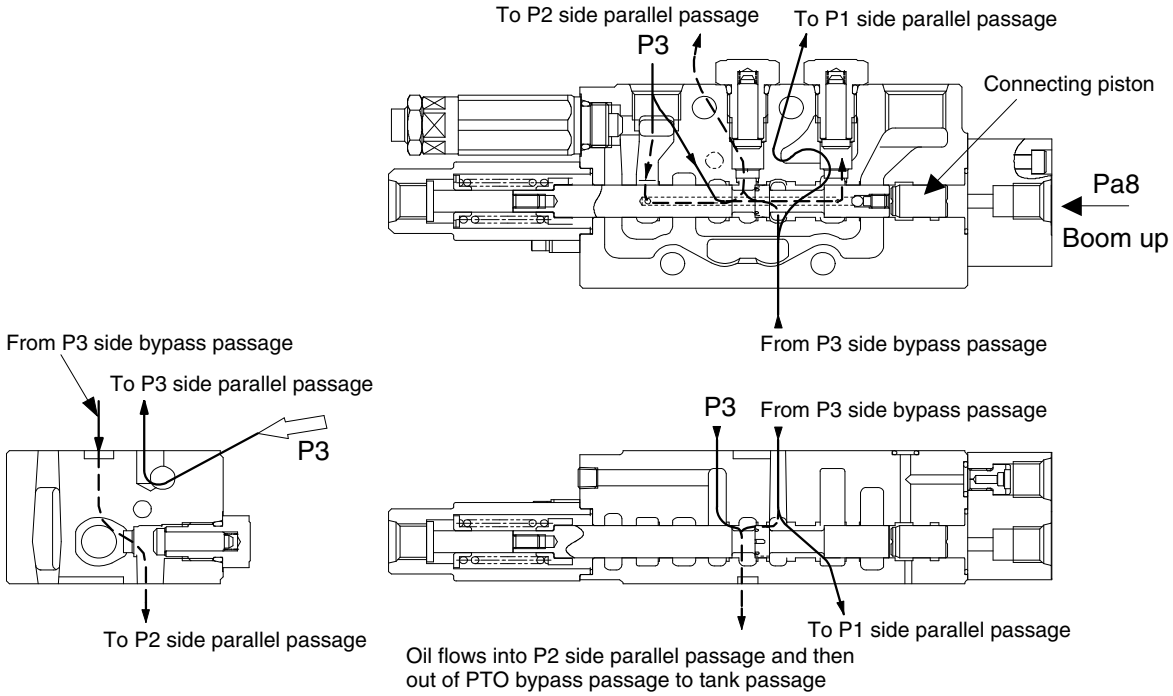
Since the passage connected to the boom lock valve and the bridge passage are opened after the boom spool changeover, the oil flowed into the P1 side parallel passage flows through the load check valve in the boom section and the bridge passage into the boom lock valve section
The oil flowed into the boom lock valve section opens the lock valve (free flow condition), flows into A9 port, and the to the head side of the boom cylinder.

On the other hand, the oil returned from the rod side of the boom cylinder flows into B8 port to the tank passage that has opened with the spool's notch after the spool changeover. Then, the boom cylinder extends to raise the boom.

P1 side circuit



P3 side (Connecting side) circuit

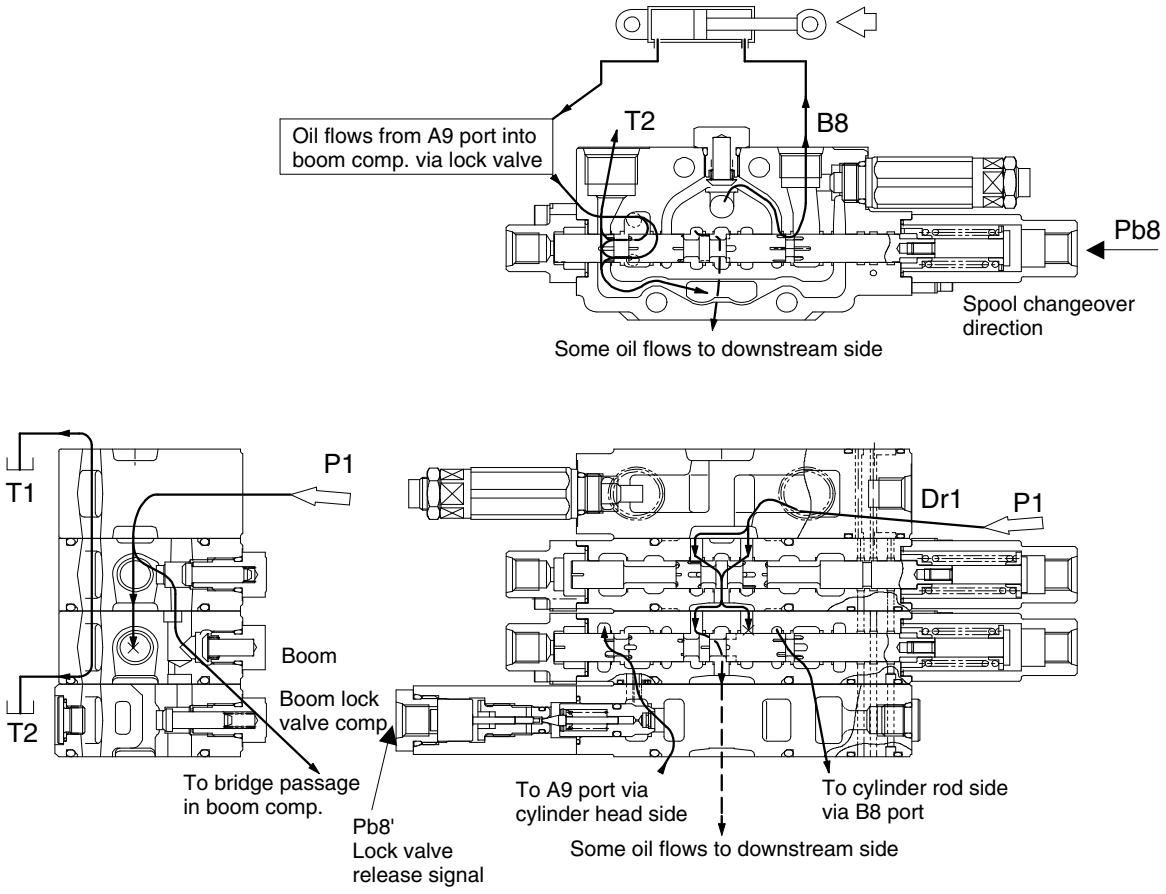


Boom up operation

R35Z72MCV13

Boom down operation

When the boom down operation is carried out, the secondary pressure from the remote control valve is applied to Pb8 port to change over the boom spool.
Since Pb8 port is connected to Pb8' port through the piping, the pressure is also applied to pb8' port (Boom lock valve release port) to release the boom lock valve.
(For the explanation of boom lock valve operation, see pages 2-19, 20)
Since the bypass passage is shut off at the boom section after the spool changeover (some oil flows through the orifice passage provided in the boom spool's bypass passage to the downstream side of the bypass passage), the oil flowed from P1 port flows through the check valve provided above the bypass passage in the travel section into the P1 side parallel passage.
Also, since a passage between B8 port and bridge passage is opened with the spool's notch after the spool changeover, the oil flowed into the P1 side parallel passage flows through the load check valve in the boom section into B8 port via the bridge passage and then into the rod side of the boom cylinder.
On the other side, the oil returned from the head side of the boom cylinder flows into A9 port to the tank passage that has been opened with the spool's notch after the spool changeover through the boom lock valve that has been released by Pb8' port pressure. Then, the boom cylinder retracts to lower the boom.



Boom down operation

R35Z72MCV14

4) Operation of boom lock valve

(1) Holding

In the boom spool neutral condition,

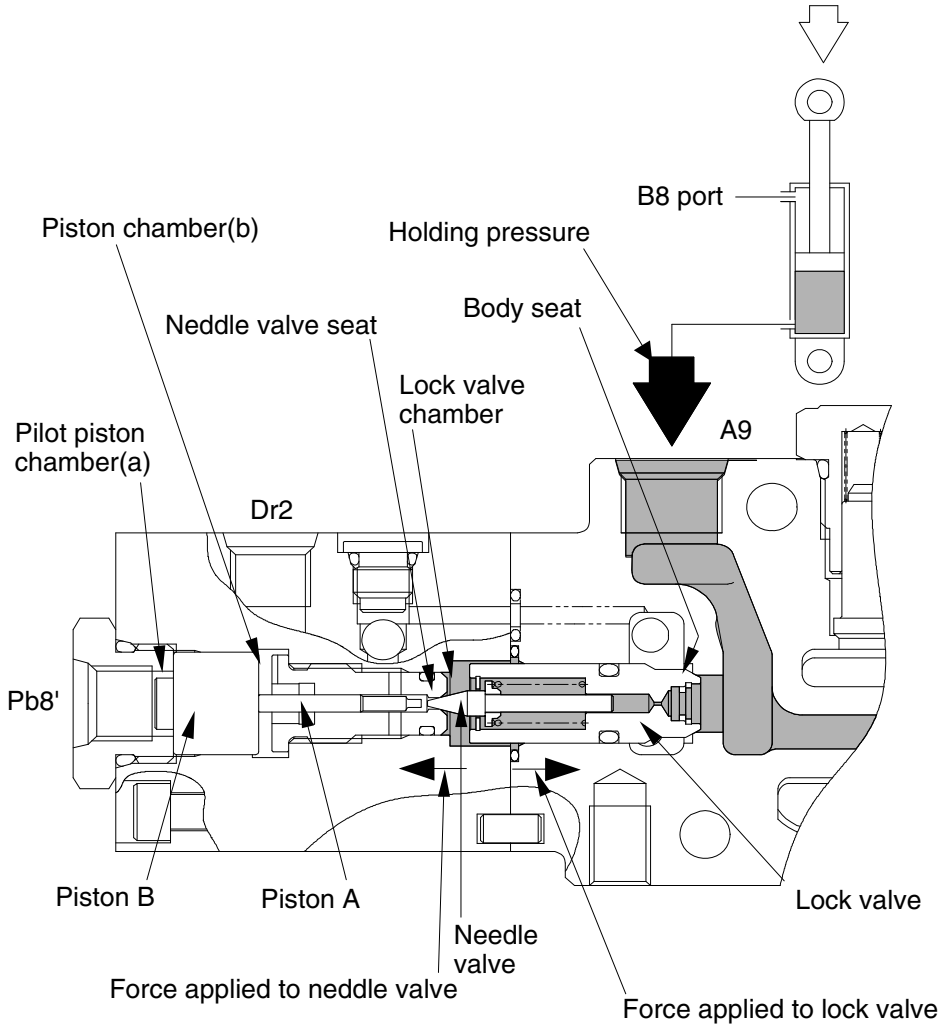
- The pilot piston chamber (a) is connected to the drain passage through the pilot port (Pb8') for releasing the boom lock valve.
- The piston chamber (b) is also connected to the drain passage through the drain port (Dr2).

Therefore, the piston (B) maintains the condition shown in the figure.

The boom cylinder holding pressure (shown in half-tone dot meshing) is applied to the lock valve chamber as shown in the figure to :

- Press the needle valve against the needle valve seat.
- Press the lock valve against the body seat.

Then, oil leakage from the boom cylinder head side is prevented to stop the movement of the boom cylinder due to leakage.



Operation of boom lock valve (holding)

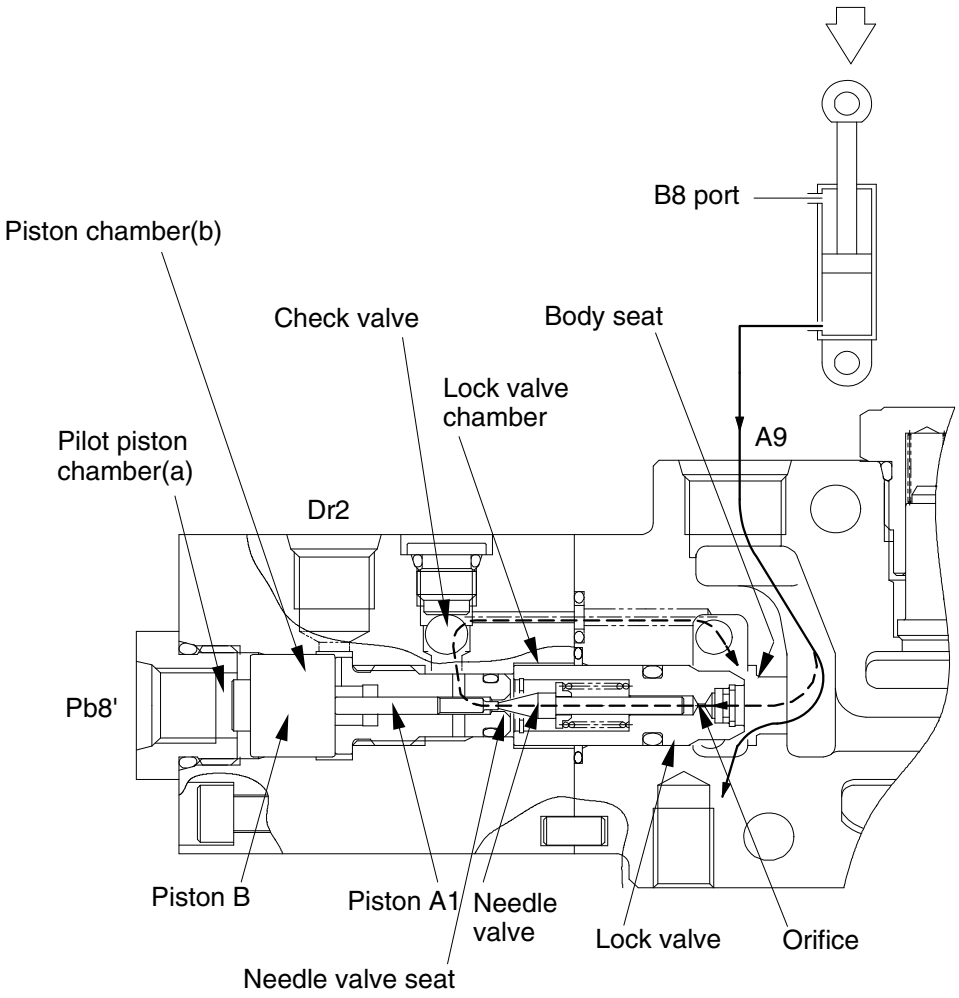
R35Z72MCV15

(2) Release

When the pilot pressure is applied to the pilot port (Pb8') for boom lock valve release, the piston (B) moves rightward to open the needle valve through the piston (A1).

Then, the oil returned from the boom cylinder flows through the passage in the direction of lock valve's orifice → lock valve chamber → needle valve seat → check valve into the lock valve's downstream side chamber (boom section).

When the lock valve's downstream chamber is connected to the tank passage after the boom spool changeover and the needle valve is released, the pressure in the lock valve chamber decreases to open the lock valve by the oil returned from the boom cylinder. The returned oil flows into the tank passage with the boom spool's notch to operate the cylinder.



Operation of boom lock valve (release)

R35Z72MCV16

5) BUCKET OPERATION

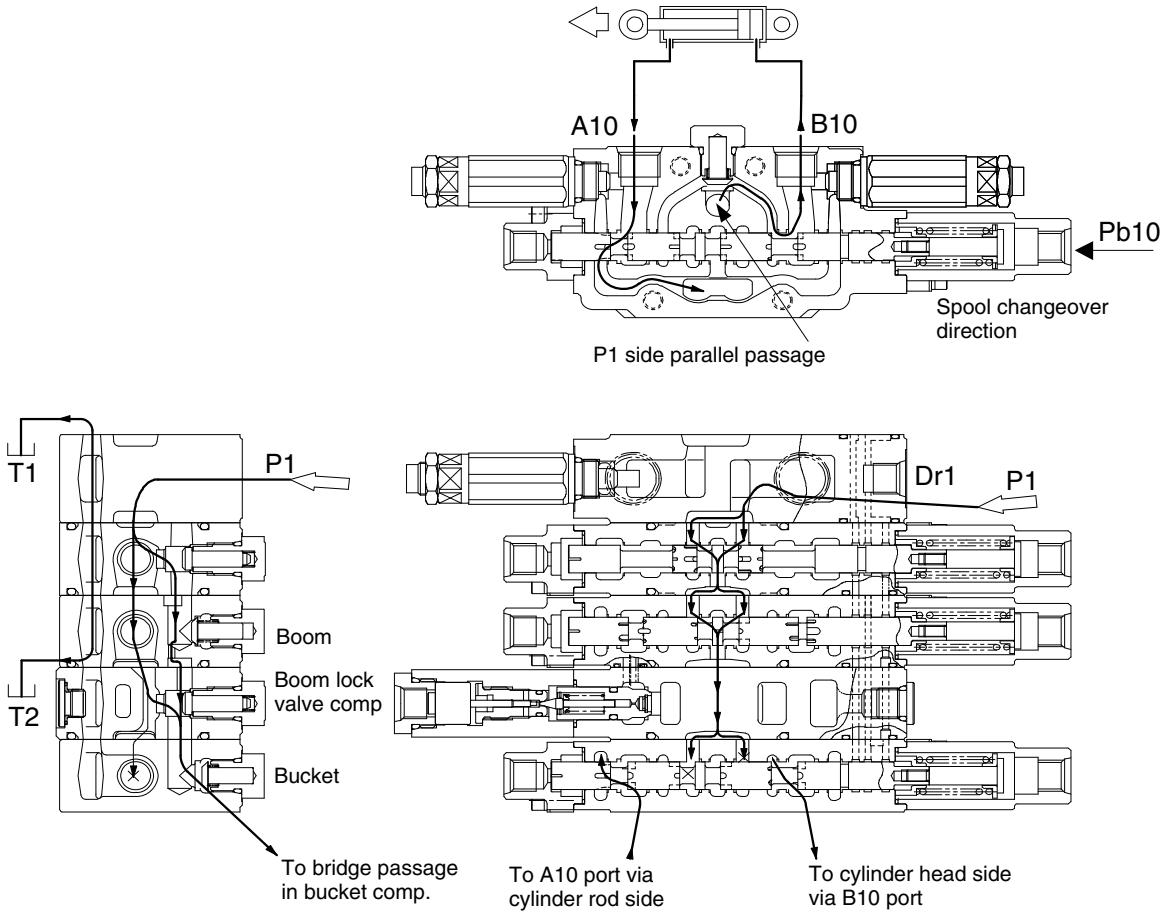
Bucket in operation

When the bucket in operation is carried out, the secondary pressure from the remote control valve flows into Pb10 port to change over the bucket spool.

Since the P1 side bypass passage is shut off at the bucket section after the bucket spool changeover, the oil flowed from P1 port flows through the check valve provided above the bypass passage in the travel section into the P1 side parallel passage.

Also, since a passage between B10 port and the bridge passage is opened after the spool changeover, the oil flowed into the P1 side parallel passage flows through the load check valve in the bucket section into B10 port via the bridge passage and then the head side of the bucket cylinder.

On the other hand, the oil returned from the rod side of the bucket cylinder flows into A10 port to the tank passage that has opened with the spool's notch after the spool changeover. Then, the bucket cylinder extends to make the bucket in.



Bucket in operation

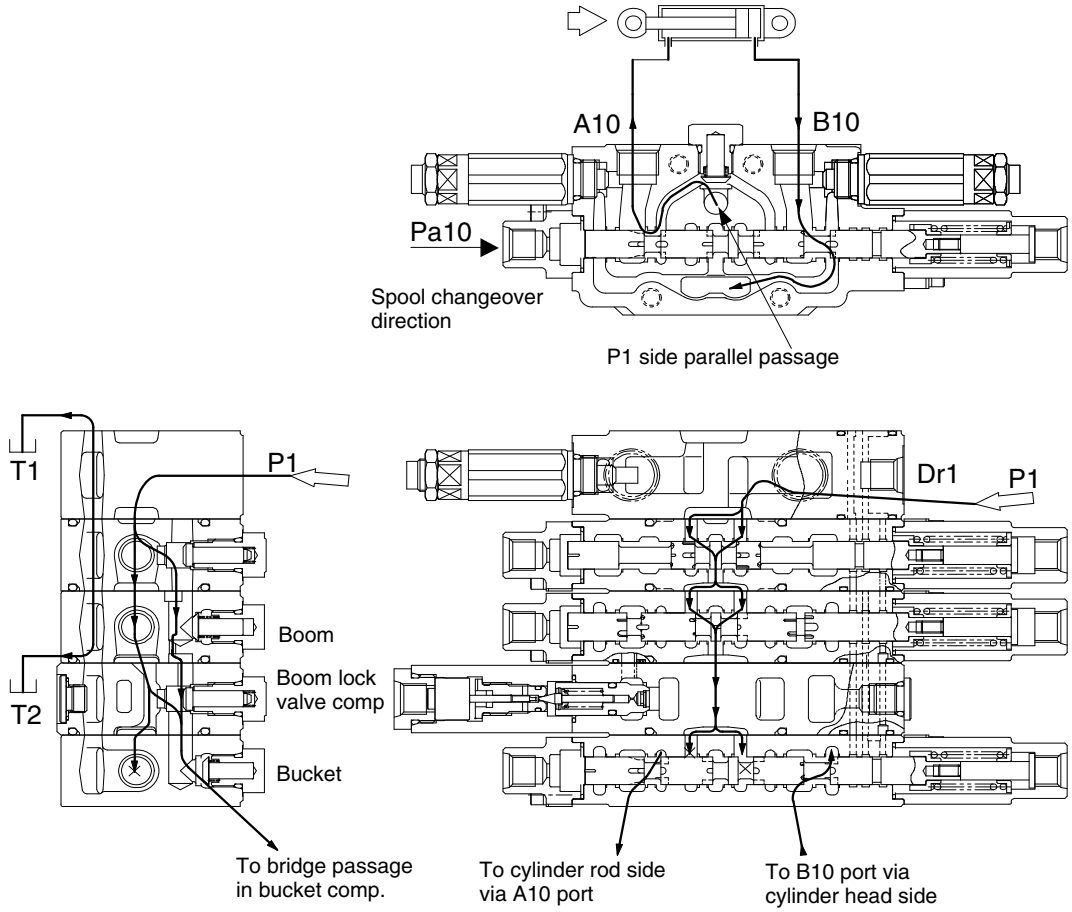
R35Z72MCV17

Bucket out operation

When the bucket out operation is carried out, the secondary pressure from the remote control valve flows into Pa10 port to change over the bucket spool.

Since the P1 side bypass passage is shut off at the bucket section after the bucket spool changeover, the oil flowed from P1 port flows through the check valve provided above the bypass passage in the travel section into the P1 side parallel passage.

Also, since a passage between A10 port and the bridge passage is opened after the spool changeover, the oil flowed into the P1 side parallel passage flows through the load check valve in the bucket section into A10 port via the bridge passage and then the rod side of the bucket cylinder. On the other hand, the oil returned from the head side of the bucket cylinder flows into B10 port to the tank passage that has opened after the spool changeover.



Bucket out operation

R35Z72MCV18

6) ARM OPERATION

Arm in operation

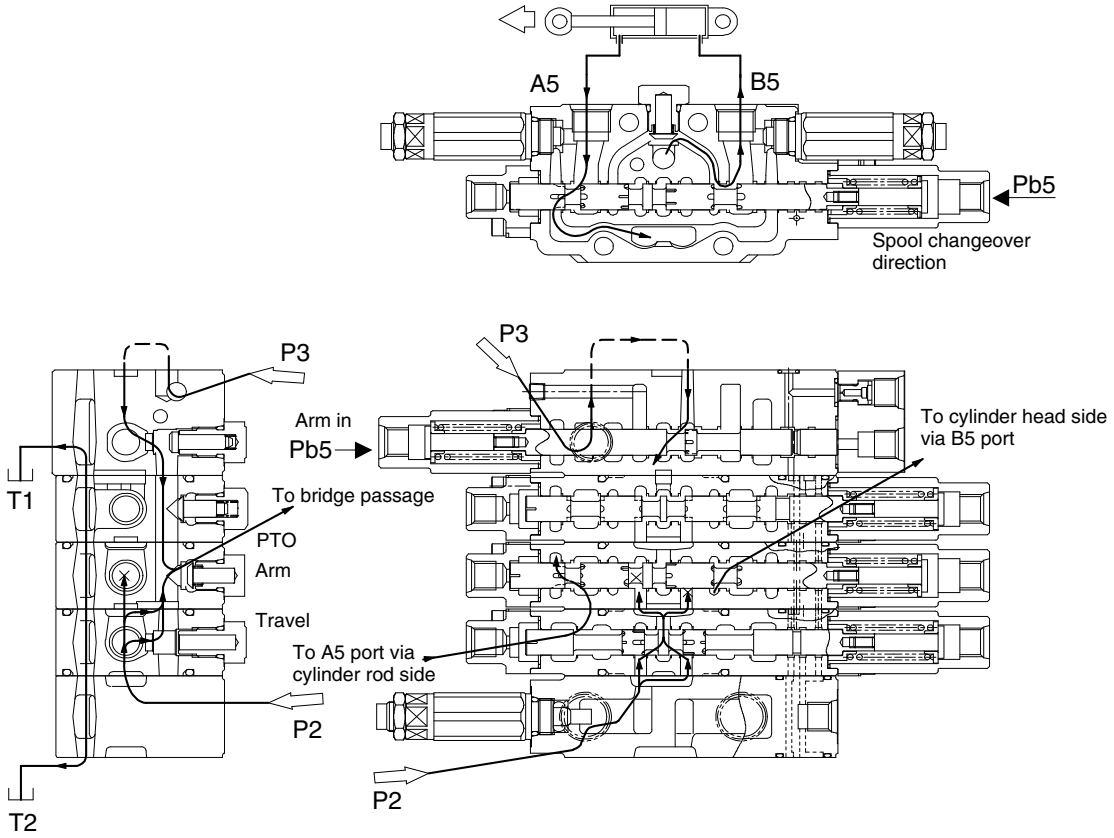
When the arm in operation is carried out, the secondary pressure from the remote control valve is applied to Pb5 port to change over the arm spool. The secondary pressure is also applied to the pilot chamber (arm in port) on the connecting section spring chamber side that has been connected through the piping. Therefore, when the operation is carried out together with the boom up operation at the same time, the connecting spool is hard to change over against the pilot pressure for arm in operation.

Since the P2 port bypass passage is shut off at the arm section after the arm spool change over, the oil flowed from P2 port flows through the travel section and a passage between travel section and arm section into the P2 side parallel passage.

Also, since the oil flowed from P3 port flows through the direction of dozer → boom swing → swing section and then into the P2 side parallel passage via the check valve in the P3 supply section, the connecting flow of P2 pump and P3 pump is supplied to the P2 side parallel passage. [Although the P3 side bypass passage is also connected to the P1 side parallel passage through the check valve in the P3 section, there is no oil flow into the P1 side as long as the P1 side sections (boom , bucket) are not operated.]

Since a passage between B5 port and the bridge passage is opened after the spool changeover, the oil flowed into the P2 side parallel passage flows through the load check valve in the arm section into B5 port via the bridge passage and then into the head side of the arm cylinder.

On the other hand, the oil returned from the rod side of the arm cylinder flows into A5 port to the tank passage that has opened with the spool's notch after the spool changeover. Then, the arm cylinder extends to make the arm in.



Arm in operation R35Z72MCV19

Arm out operation

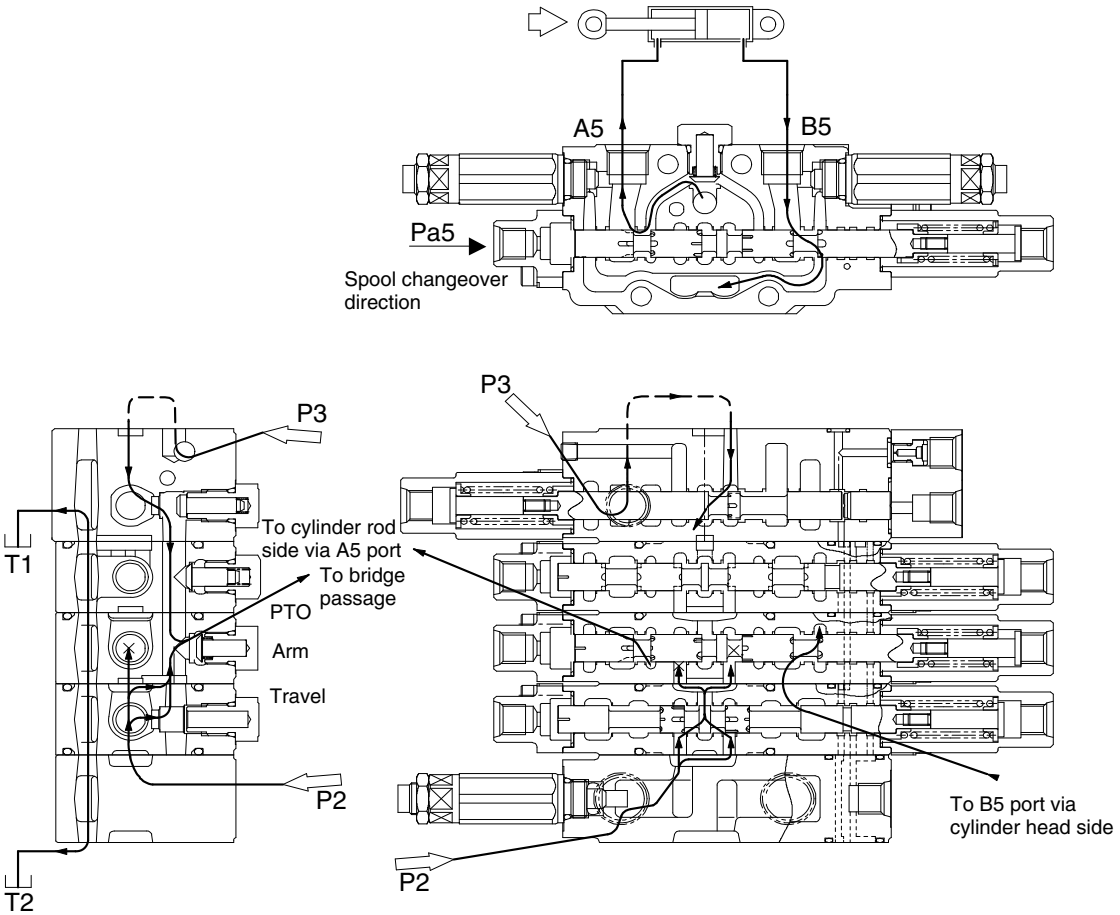
When the arm out operation is carried out, the secondary pressure from the remote control valve is applied to Pa5 port to change over the arm spool.

Since the P2 side bypass passage is shut off at the arm section after the arm spool changeover, the oil flowed from P2 port flows through the travel section and a passage between travel section and arm section into the P2 side parallel passage.

Also, since the oil flowed from P3 port flows through the direction of dozer → boom swing → swing section and then into the P2 side parallel passage via the check valve in the P3 supply section, the connecting flow of P2 pump and P3 pump is supplied to the P2 side parallel passage. [Although the P3 side bypass passage is also connected to the P1 side parallel passage through the check valve in the P3 section, there is no oil flow into the P1 side as long as the P1 side sections (boom , bucket) are not operated.]

Since a passage between A5 port and the bridge passage is opened after the spool changeover, the oil flowed into the P2 side parallel passage flows through the load check valve in the arm section into A5 port via the bridge passage and then into the rod side of the arm cylinder.

On the other hand, the oil returned from the head side of the arm cylinder flows into B5 port to the tank passage that has opened after the spool changeover. Then, the arm cylinder retracts to make the arm out.



Arm out operation

R35Z72MCV20

7) PTO OPERATION

For the PTO operation, both Pa pressurization and Pb pressurization are the same on operation so that only Pa pressurization is explained as follows.

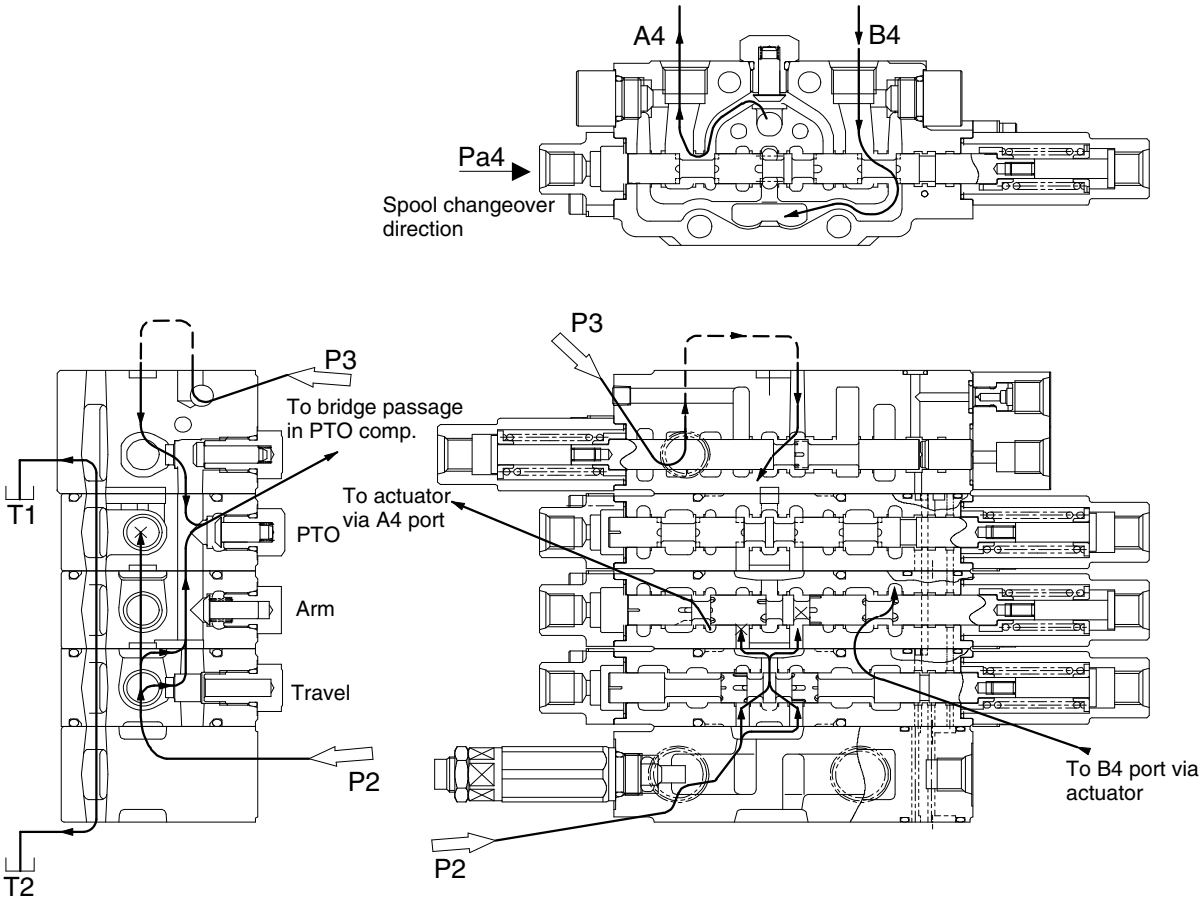
When the PTO operation (Pa4 pressurization) is carried out, the secondary pressure from the remote control valve is applied to Pa4 port to change over the PTO spool. Since the P2 side bypass passage is shut off at the PTO section after the PTO spool changeover, the oil flowed from P2 port flows through the travel section and a passage between travel section and arm section into the P2 side parallel passage.

Also, since the oil flowed from P3 port flows through the direction of dozer → boom swing → swing section and then into the P2 side parallel passage via the check valve in the P3 supply section, the connecting flow of P2 pump and P3 pump is supplied to the P2 parallel passage.

[Although the P3 side bypass passage is also connected to the P1 side parallel passage through the check valve in the P3 section, there is no oil flow into the P1 side as long as the P1 side sections (boom , bucket) are not operated.]

Since a passage between A4 port and the bridge passage is opened after the spool changeover, the oil flowed into the P2 side parallel passage flows through the load check valve in the PTO section into A4 port via the bridge passage and then into the actuator for PTO.

On the other hand, the oil returned from actuator for PTO flows into B4 port to the tank passage that has opened after the spool changeover.



PTO operation

R35Z72MCV21

8) DOZER OPERATION

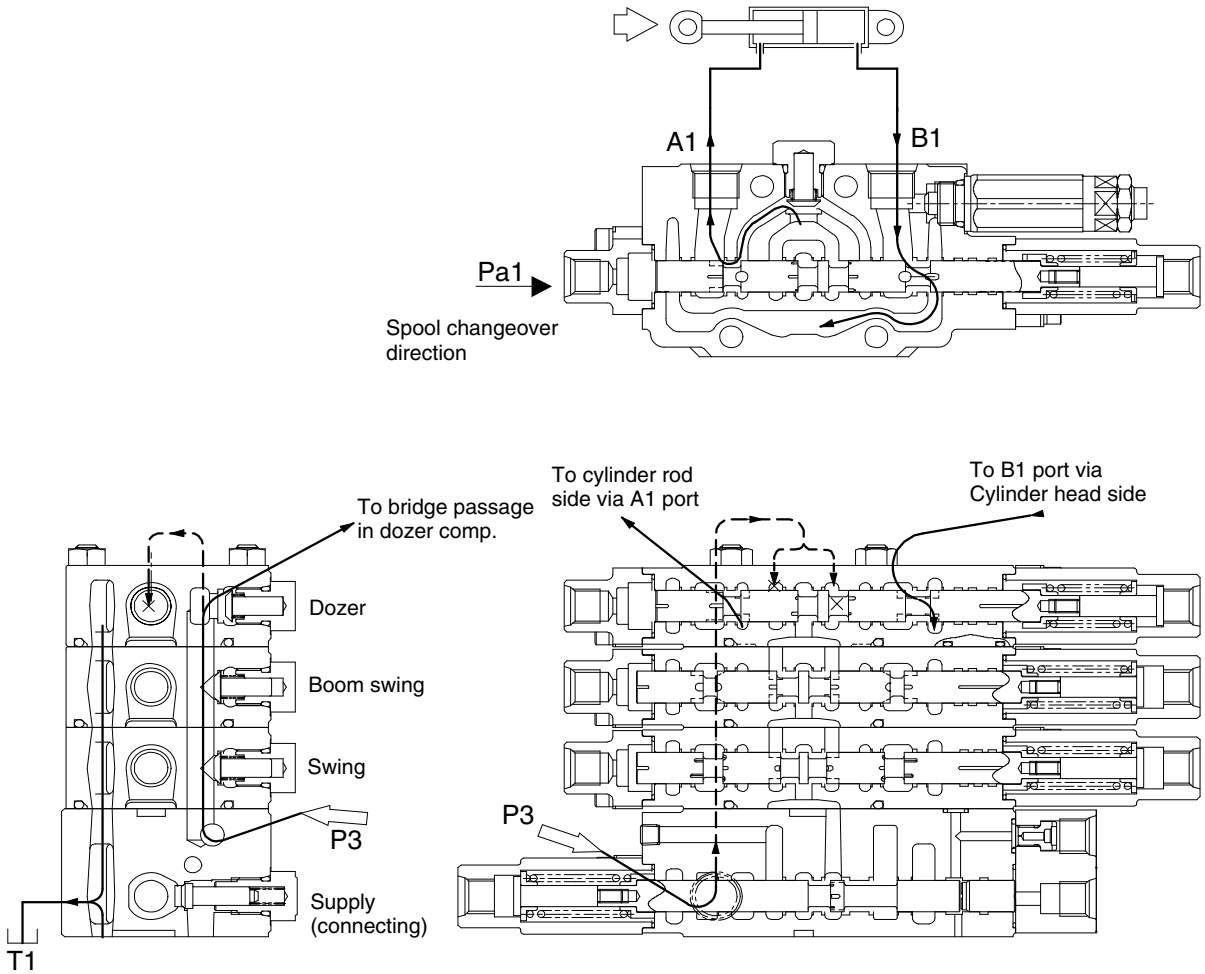
Dozer up operation

When the dozer up operation is carried out, the secondary pressure from the remote control valve is applied to Pa1 port to change over the dozer spool.

Since the P3 side bypass passage is shut off at the dozer section after the dozer spool changeover, the oil flowed from P3 port through the P3 side parallel passage flows into A1 port through the load check valve in the dozer section and the bridge passage since A1 port and the bridge passage have been opened after the spool changeover and then into the rod side of the dozer cylinder.

On the other hand, the oil returned from the head side of the dozer cylinder flows into B1 port to the tank passage that has opened after the spool changeover.

Then, the dozer cylinder retracts to raise the dozer.



Dozer up operation

R35Z72MCV22

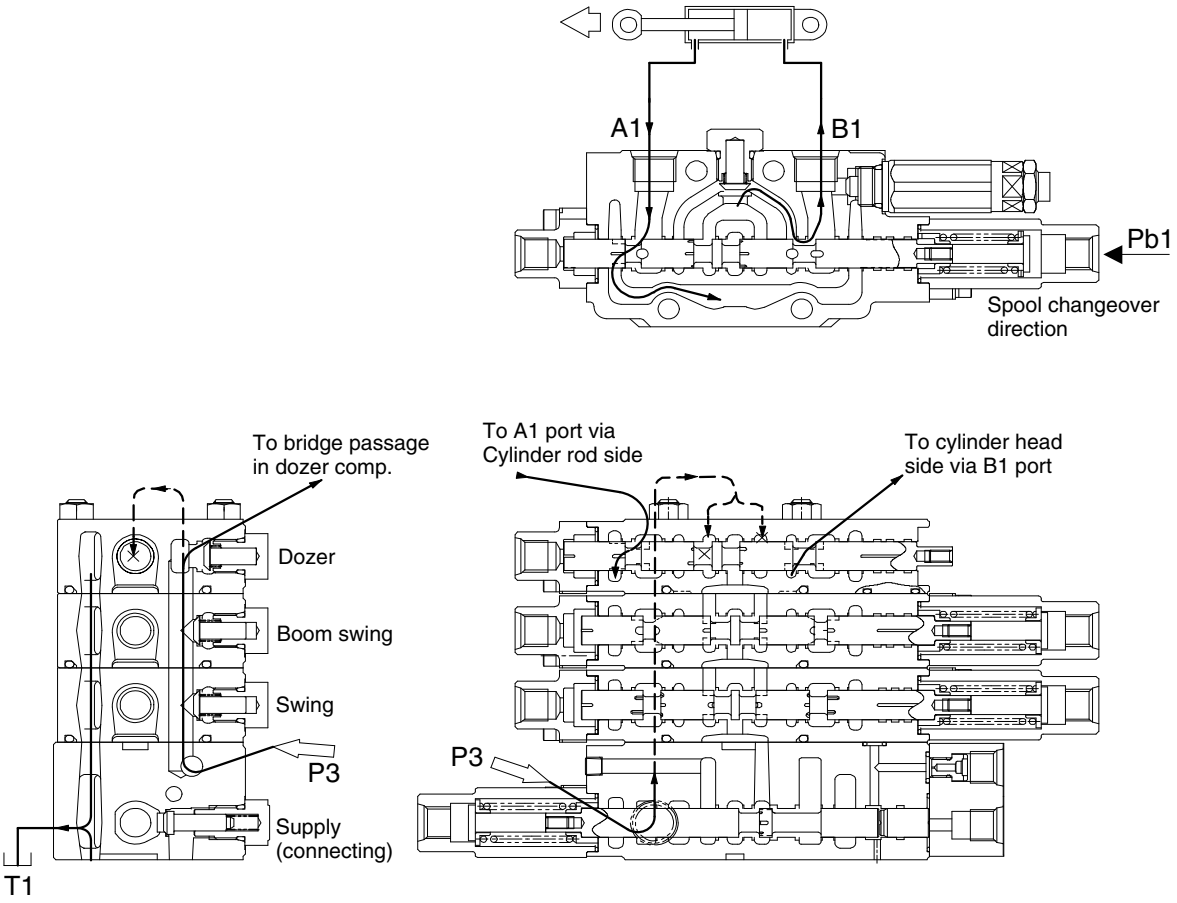
Dozer down operation

When the dozer down operation is carried out, the secondary pressure from the remote control valve is applied to Pb1 port to change over the dozer spool.

Since the P3 side bypass passage is shut off at the dozer section after the dozer spool changeover, the oil flowed from P3 port through the P3 side parallel passage flows into B1 port through the load check valve in the dozer section and the bridge passage since B1 port and the bridge passage have been opened after the spool changeover and then into the head side of the dozer cylinder.

On the other hand, the oil returned from the rod side of the dozer cylinder flows into A1 port to the tank passage that has opened with the spool's notch after the spool changeover.

Then, the dozer cylinder extends to lower the dozer.



Dozer down operation

R35Z72MCV23

9) BOOM SWING OPERATION

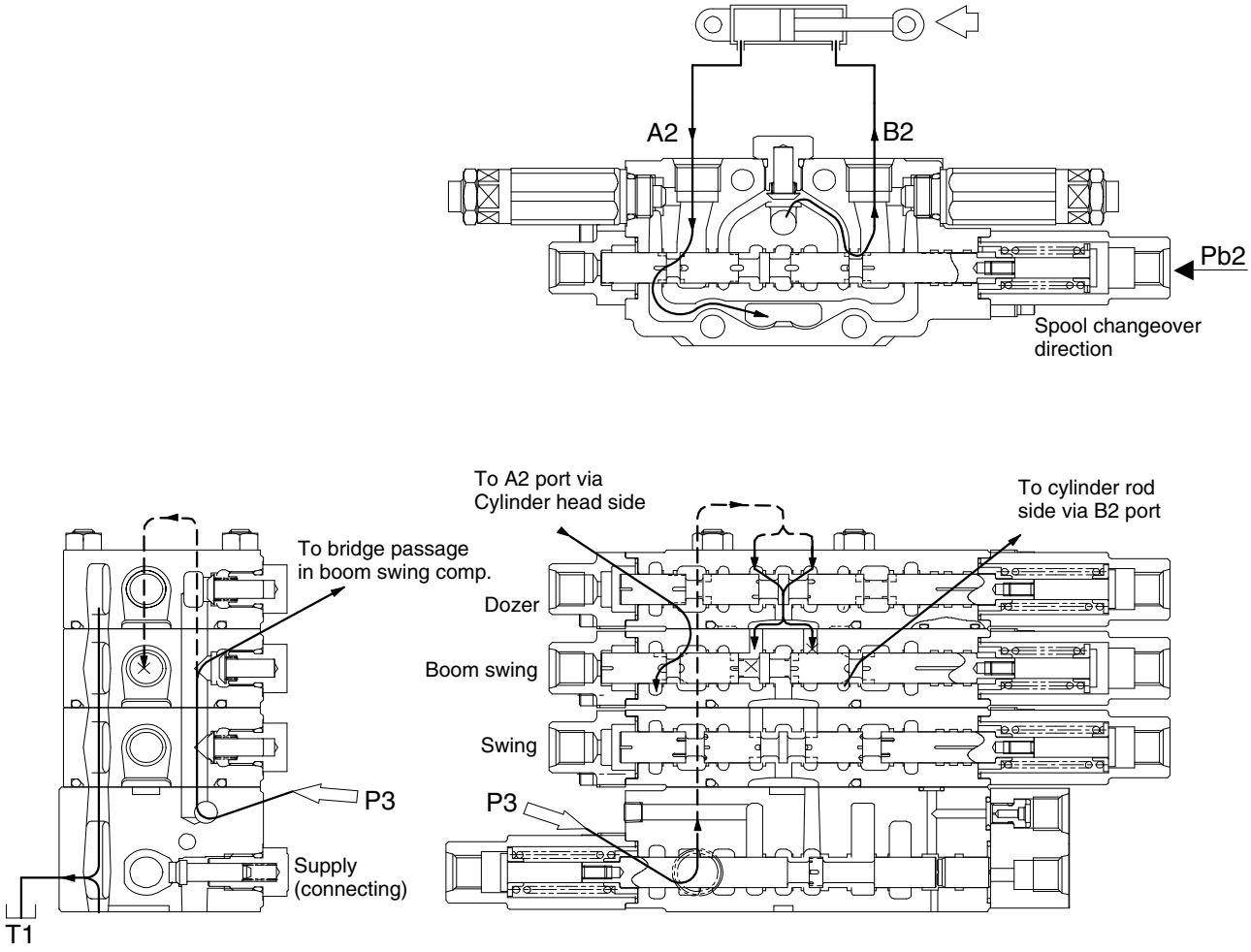
Boom left swing operation

When the boom left swing operation is carried out, the secondary pressure from the remote control valve is applied to Pb2 port to change over the boom swing spool.

Since the P3 side bypass passage is shut off at the boom swing section after the boom swing spool changeover, the oil flowed from P3 port through the P3 side parallel passage flows into B2 port through the load check valve in the boom swing section and the bridge passage since B2 port and the bridge passage have been opened after the spool changeover and then into the rod side of the boom swing cylinder.

On the other hand, the oil returned from the head side of the boom swing cylinder flows into A2 port to the tank passage that has opened with the spool's notch after the spool changeover.

Then, the boom swing cylinder retracts to swing the attachment left.



Boom left swing operation

R35Z72MCV24

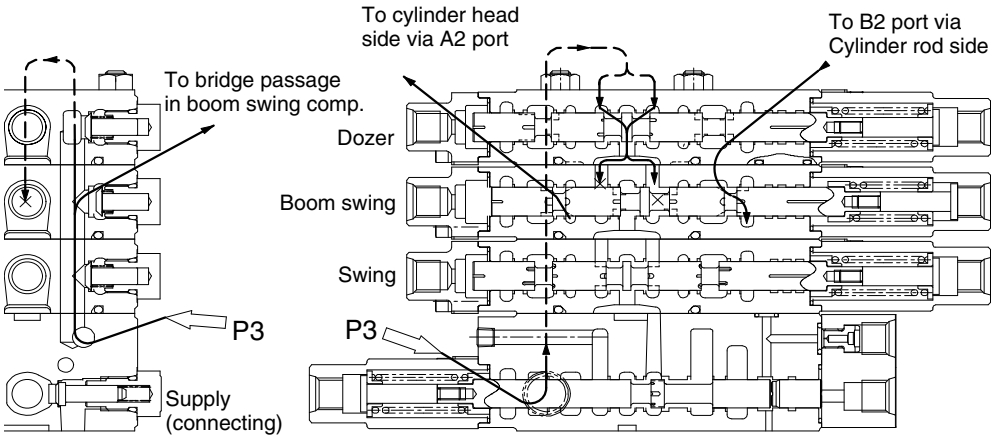
Boom right swing operation

When the boom right swing operation is carried out, the secondary pressure from the remote control valve is applied to Pa2 port to change over the boom swing spool.

Since the P3 side bypass passage is shut off at the boom swing section after the boom swing spool changeover, the oil flowed from P3 port through the P3 side parallel passage flows into A2 port through the load check valve in the boom swing section and the bridge passage since A2 port and the bridge passage have been opened after the spool changeover and then into the head side of the boom swing cylinder.

On the other hand, the oil returned from the rod side of the boom swing cylinder flows into B2 port to the tank passage that has opened with the spool's notch after the spool changeover.

Then, the boom swing cylinder extends to swing the attachment right.



Boom right swing operation

R35Z72MCV25

10) SWING OPERATION

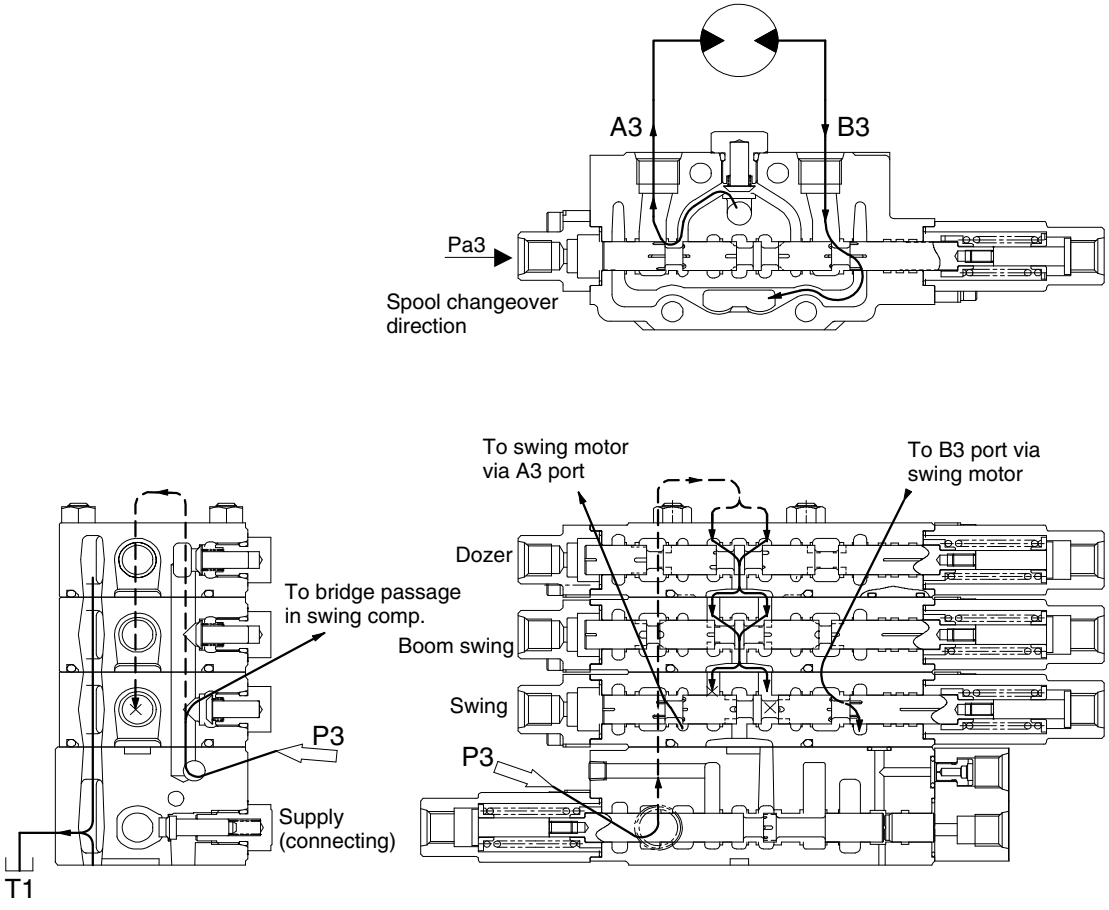
For the swing operation, both Pa pressurization and Pb pressurization are the same on operation so that only Pa pressurization is explained as follows.

When the right swing operation is carried out, the secondary pressure from the remote control valve is applied to Pa3 port to change over the swing spool.

Since the P3 side bypass passage is shut off at the swing section after the swing spool changeover, the oil flowed from P3 port through the P3 side parallel passage flows into A3 port through the load check valve in the swing section and the bridge passage since A3 port and the bridge passage have been opened after the spool changeover and then into the swing motor.

On the other hand, the oil returned from the swing motor flows into B3 port to the tank passage that has opened with the spool's notch after the spool changeover.

Then, the upper swing body swings right.



Right swing operation

R35Z72MCV26

11) COMBINED CONTROL OPERATION ①

Boom up + Arm in + bucket

When the above combined control is carried out, the secondary pressure from the remote control valve is applied to each spool to change over them. Since the secondary pressure for arm in operation is also applied to the pilot chamber on the connecting section spring chamber side according to the piping, the connecting spool operates against the secondary pressure developed from boom up operation and arm in operation.
(Boom up operation secondary pressure - Arm in operation secondary pressure =
connecting spool changeover pressure)

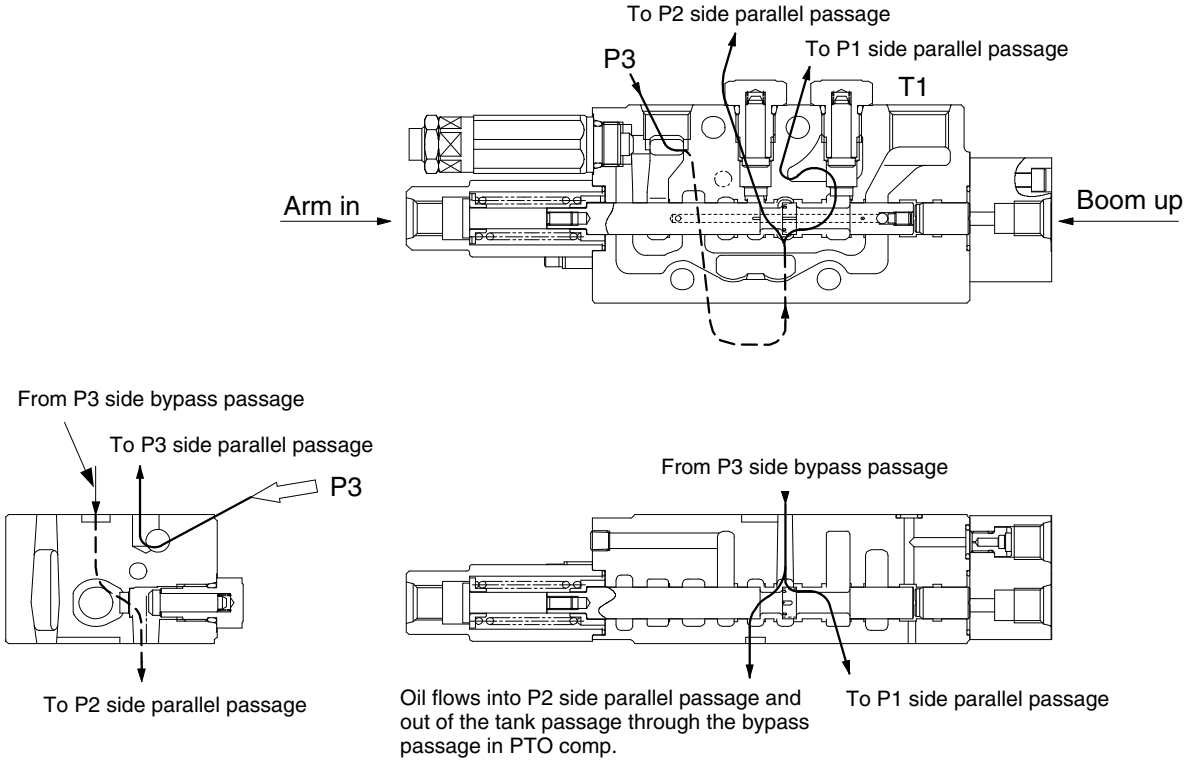
When all the above combined operations are carried out in full lever operation (full changeover), the oil supplied from P1 pump is supplied to the boom and bucket and the oil from P2 pump to the arm. Since the connecting spool changeover pressure becomes "0" as mentioned above, the connecting spool cannot change over and the oil from P3 pump flows to the P1 and P2 side parallel passages through the connecting section. Accordingly, much oil flows to the arm side normally because of its low working load.

In this condition, since gradually restricting the arm in operation (returning the lever) causes the secondary pressure for arm in operation to decrease, the connecting spool changeover pressure to increase, the connecting spool to start changing over, and the passage to the arm side to be narrowed, the oil supplied from P3 pump flows abundantly into the P1 side (Boom, bucket).

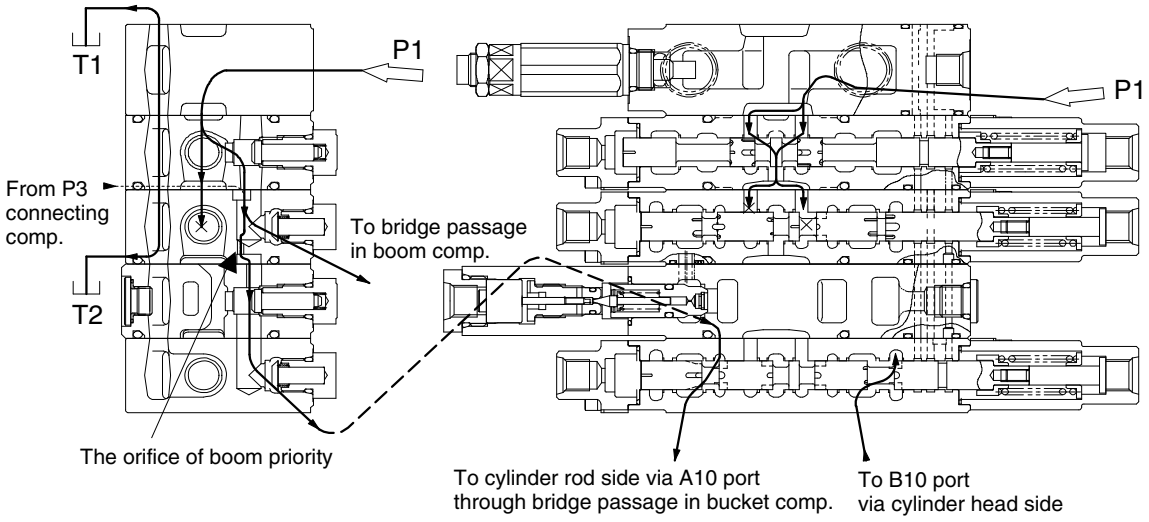
As mentioned above, the oil supplied from P3 pump flows suitably into each attachment according to the control input during the above combined control, resulting in a well-balanced and efficient working speed.

Besides, since the oil flow to the bucket whose working load is less than the boom is restricted with an orifice (the orifice of boom priority) provided before the bucket section in the P1 side parallel passage, much oil flows into the boom section. As a result, the working speed balance between both attachments is maintained during the combined operation of boom and bucket.

P3 side (connecting side) circuit



P1 side circuit (the orifice of boom priority)



Oil flow during combined operation

R35Z72MCV27

12) COMBINED CONTROL OPERATION ②

Both travels + bucket

When the both travels operation is carried out together with the bucket operation at the same time, the oil flowed from Pp1 port flows through the orifice passage and into the travel independent signal passage; both travels and the bucket spool changeover make a passage to the drain port shut off.

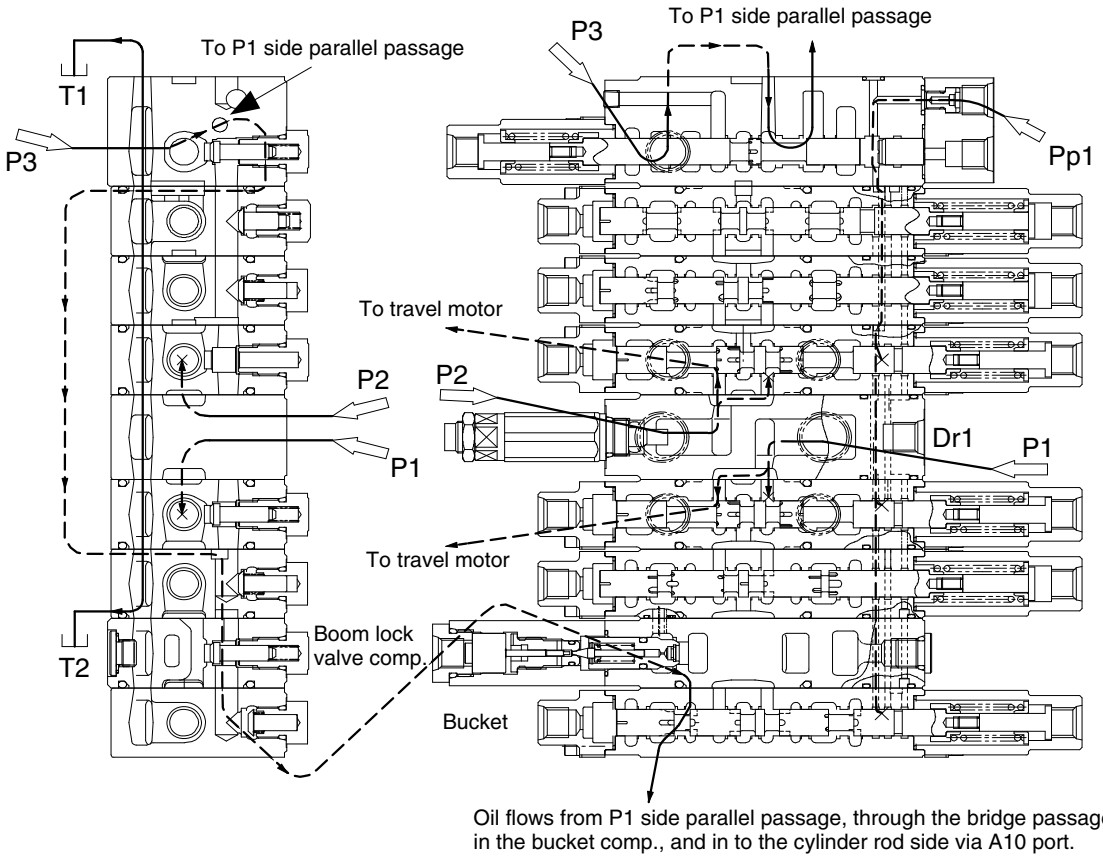
Then, the travel independent passage becomes the same pressure as Pp1 port pressure (pilot primary pressure).

When the travel independent passage becomes Pp1 pressure, the Pp1 pressure is applied to the connecting spool to change over the connecting spool.

Since the bypass passage from P3 to P2 side, which is a passage to the tank, in restricted, the oil from P3 side flows into the P1 side parallel passage that is connected through a check valve.

With his circuit arrangement, the bucket section is supplied with pressure oil from P3 during both travels operation, the simultaneous operation becomes possible.

Besides, since each of P1 and P2 is used independently during both travels and only P3 is used for bucket operation, stable travel is possible to continue even if there is change in the bucket load.



Travel independence operation

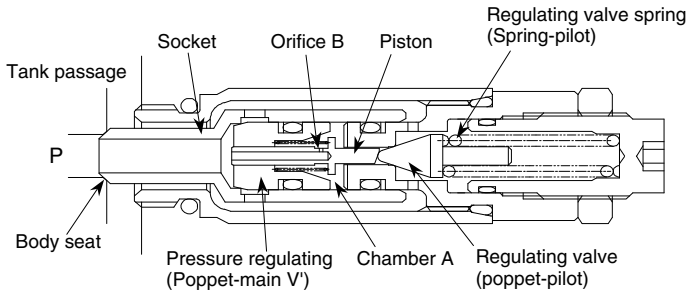
R35Z72MCV28

13) MAIN AND PORT RELIEF VALVE OPERATION

Main relief valve operation

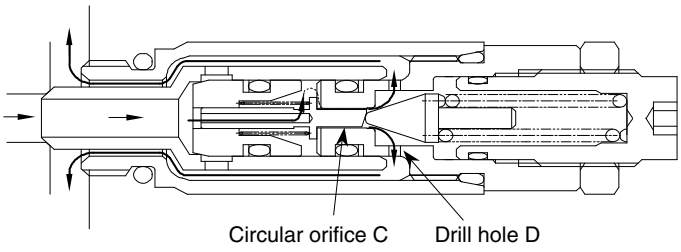
Main relief valves (MRV) are different in the uses for P1/P2 and P3; however, their structures and operation are the same.

① Pressure oil flows through the inside of the piston built in the pressure regulating valve (poppet-main V') and the orifice B and then into the internal chamber A until it is filled up. The filled up pressure causes both of the pressure regulating valve and the socket and body seat to be seated securely.



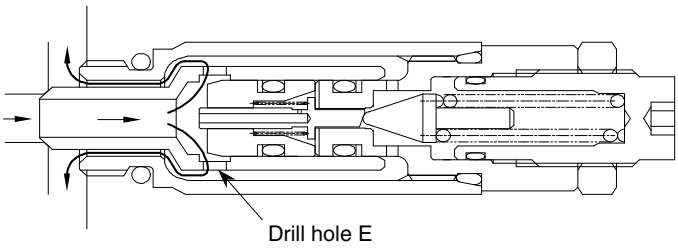
MRV operation (1) R35Z72MCV29

② When the oil pressure at port P increases up to the setting pressure of regulating valve spring, the pressure oil is applied to the regulating valve via the piston to open the regulating valve. Then, the pressure oil flows through a passage in the direction of piston inside → orifice B → chamber A → circular orifice C → Drill hole D and the external of socket and then into the tank passage.



MRV operation (2) R35Z72MCV30

③ Since the pressure inside the chamber A decreases when the regulating valve is opened, which causes the pressure regulating valve to open to let the pressure oil port P flows into the tank passage through drill hole E.

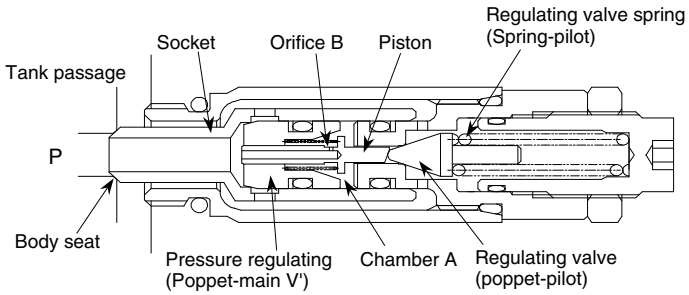


MRV operation (3) R35Z72MCV31

④ Also, since the regulating valve is pressed to the seat by regulating valve spring when the pressure at port P decreases below the setting pressure of regulating valve spring, the pressure inside chamber A becomes the same as the pressure at port P to cause the pressure regulating valve to be pressed to the seat, resulting in the original condition (①).

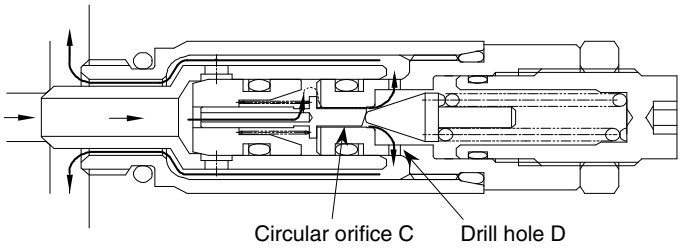
Overload relief valve (ORV) operation ①

① Pressure oil flows through the inside of the piston built in the pressure regulating valve (poppet-main V') and the orifice B and then into the internal chamber A until it is filled up. The filled up pressure causes both of the pressure regulating valve and socket and body seat to be seated securely.



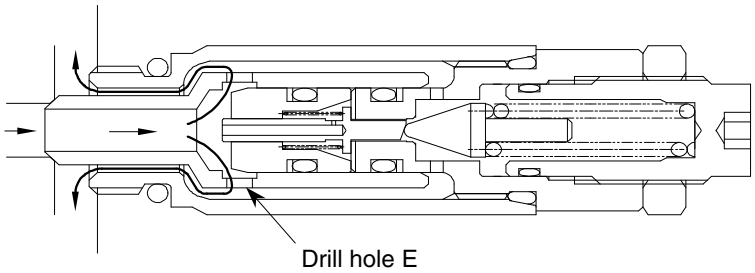
ORV operation (1) R35Z72MCV32

② When the oil pressure at port P increases up to the setting pressure of regulating valve spring, the pressure oil is applied to the regulating valve via the piston to open the regulating valve. Then, the pressure oil flows through a passage in the direction of piston inside → orifice B → chamber A → circular orifice C → Drill hole D and the external of socket and then into the tank passage.



ORV operation (2) R35Z72MCV33

③ Since the pressure inside the chamber A decreases when the regulating valve is opened, which causes the pressure regulating valve to open to let the pressure oil port P flows into the tank passage through drill hole E.

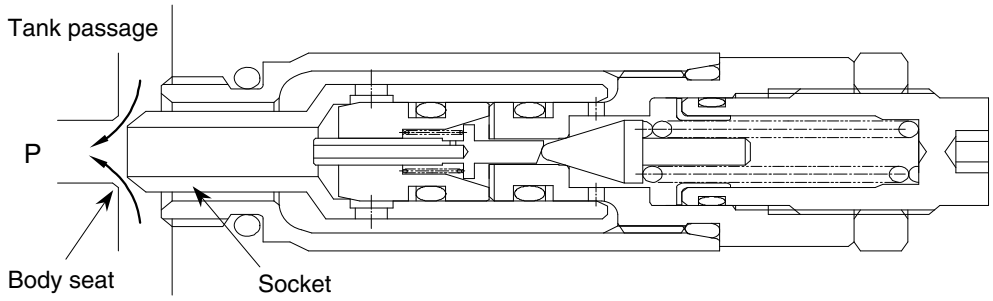


ORV operation (3) R35Z72MCV34

④ Also, since the regulating valve is pressed to the seat by regulating valve spring when the pressure at port P decreases below the setting pressure of regulating valve spring, the pressure inside chamber A becomes the same as the pressure at port P to cause the pressure regulating valve to be pressed to the seat, resulting in the original condition (①).

Overload relief valve (ORV) operation ② 【Operation during suction】

If there is negative pressure at port P (or the tank passage pressure is higher than P pressure), the socket is applied with press and open force. Then, the opening between body seat and socket increases to cause the oil to flow into port P from the tank passage, filling up the space.



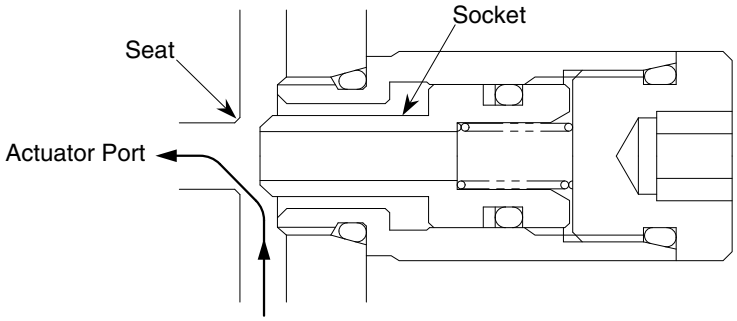
ORV operation (during suction)

R35Z72MCV35

Anti cavitation valve (ACV) operation

If there is negative pressure at actuator port, the tank pressure makes the socket pressed and opened.

Since the passage the seat and the socket is opened by the socket transfer, the oil discharged from the tank flows into the actuator port through this passage.



ACV operation

1692MC06

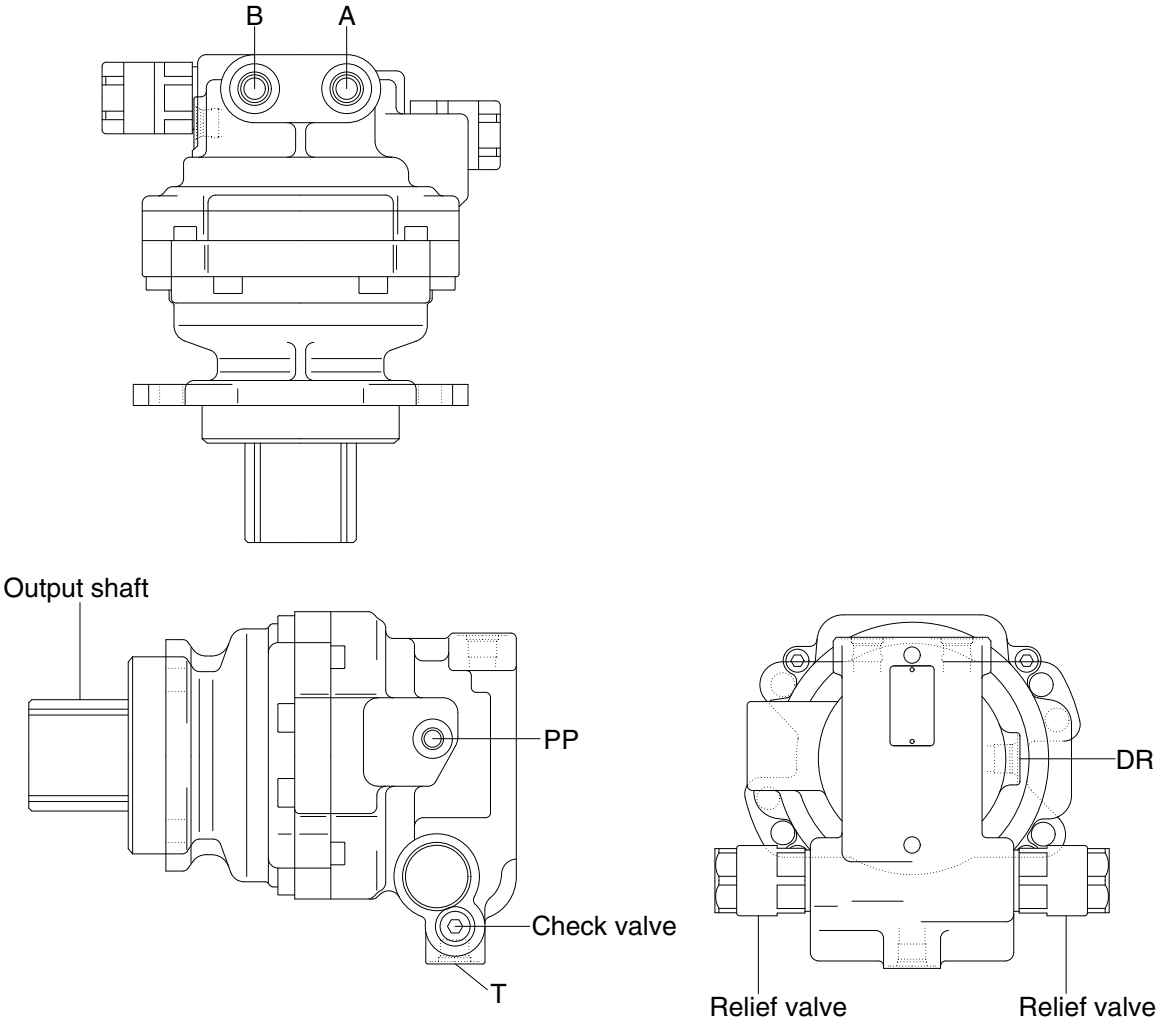
GROUP 3 SWING DEVICE

1. STRUCTURE

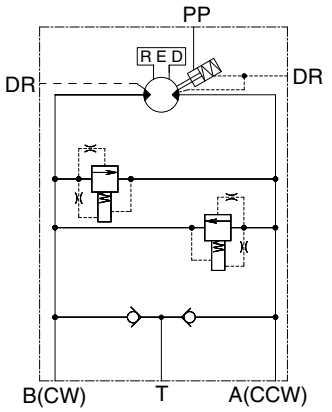
Swing device consists swing motor and swing reduction gear.

1) SWING MOTOR

Swing motor include mechanical relief valve, make up valve and check valve.



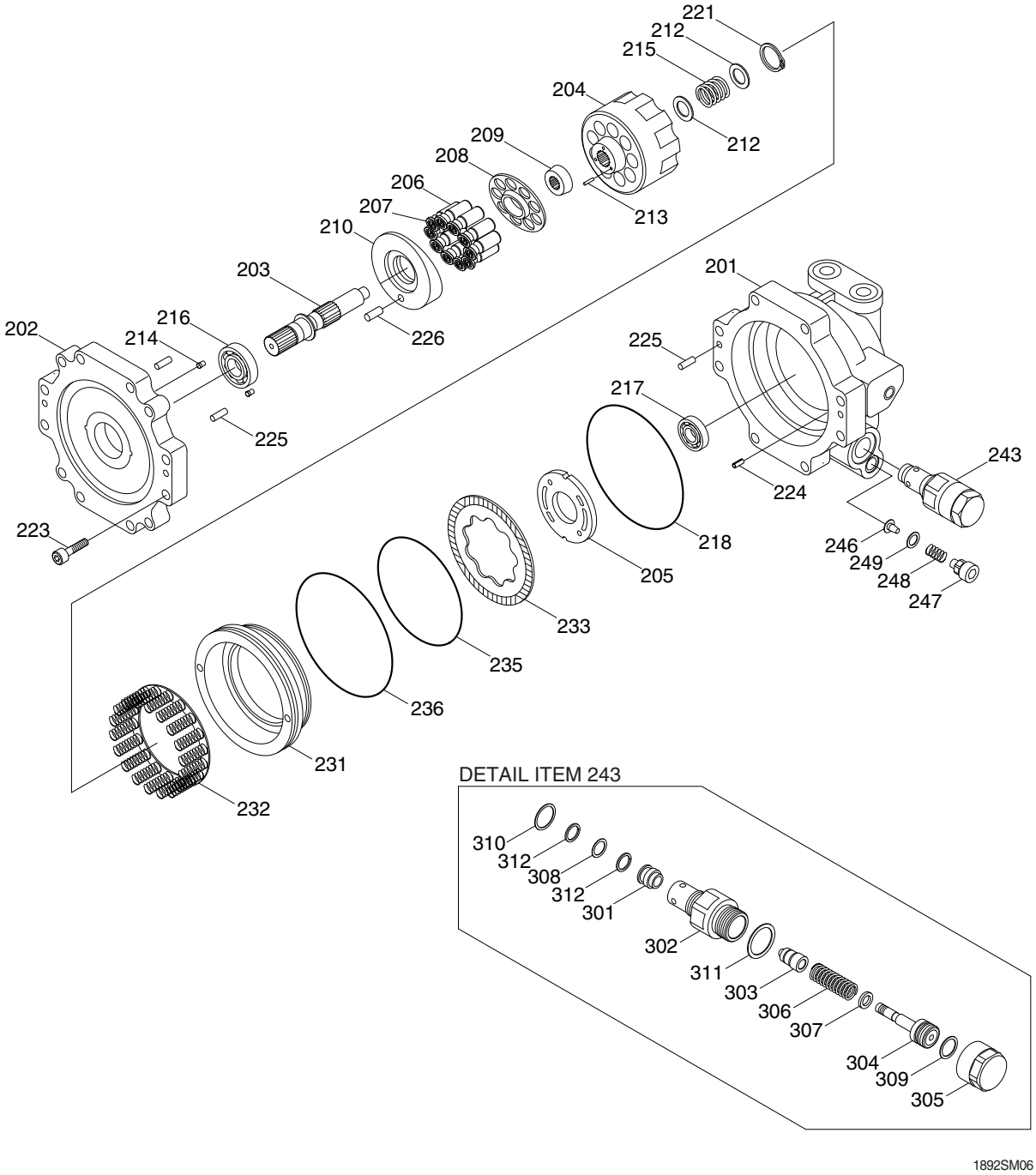
1892SM01



Hydraulic Circuit

Port	Port name	Port size
A	Main port	PF 3/8
B	Main port	PF 3/8
DR	Drain port	PF 3/8
PP	Parking brake port	PF 1/4
T	Make up port	PF 3/8

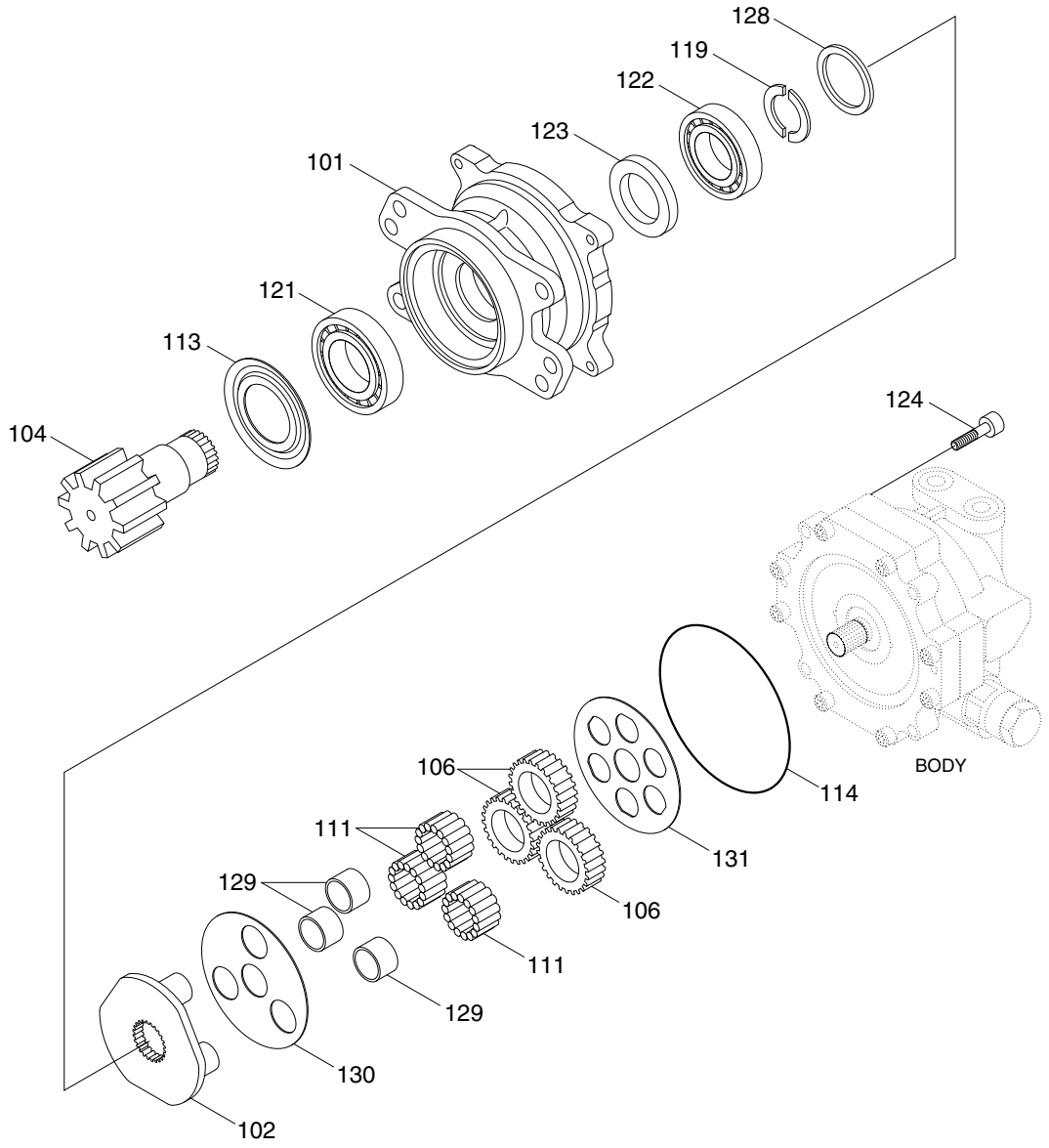
2) COMPONENTS (1/2)



1892SM06

201	Body	213	Pin	231	Brake piston	302	Retainer
202	Plate	214	Filter	232	Spring assy	303	Poppet
203	Shaft	215	Spring C	233	Disk plate	304	Piston
204	Cylinder barrel	216	Bearing	235	O-ring	305	Cap
205	Valve plate	217	Bearing	236	O-ring	306	Spring
206	Piston	218	O-ring	243	Relief valve	307	Spacer
207	Shoe	221	Snap ring	246	Check valve	308	O-ring
208	Shoe holder	223	Screw	247	Plug	309	O-ring
209	Barrel holder	224	Spring pin	248	Spring	310	O-ring
210	Swash plate	225	Pin	249	O-ring	311	O-ring
212	Retainer	226	Pin	301	Seat	312	Back up-ring

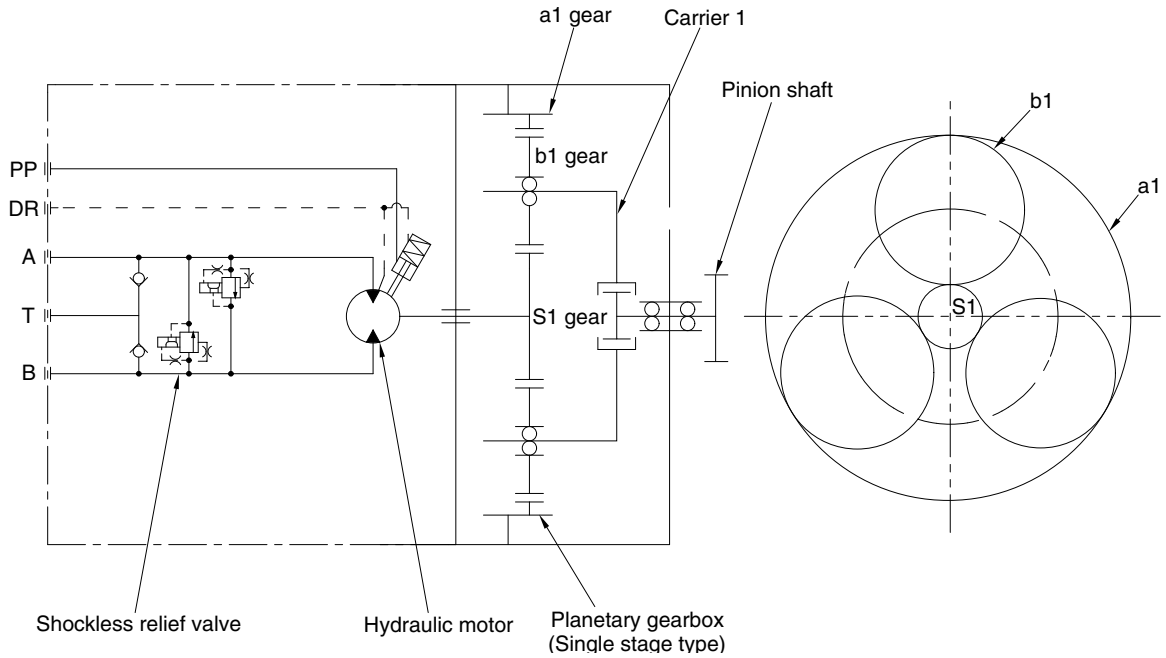
COMPONENTS (2/2)



1892SM08

101	Body	114	O-ring	128	Ring
102	Carrier 1	119	Preload collar	129	Ring 1
104	Pinion shaft	121	Bearing	130	Thrust plate 1
106	Gear B1	122	Bearing	131	Thrust plate 2
111	Needle	123	Oil seal		
113	Seal ring	124	Screw		

2. OPERATION PRINCIPLE



1892SM02

3. OPERATION

The swing motor consists of a planetary gear speed reducer, a hydraulic motor and the hydraulic valves.

1) REDUCTION GEAR SECTION

(1) Function

The speed reducer of swing motor is a simple planetary gear type with single stage. The high output speed of the hydraulic motor is reduced to low speed with high torque and obtaining the pinion shaft rotation.

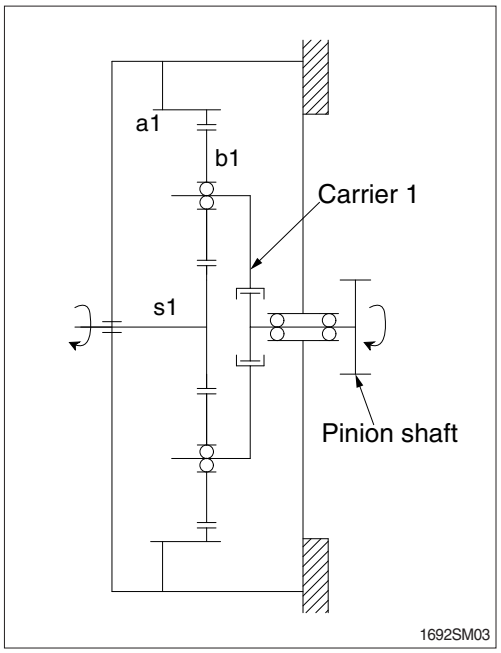
(2) Operation

The s1 gear is attached to the hydraulic motor shaft, and the s1 output speed is reduced between the gears (s1, b1, a1).
This reduced output speed is transmitted to the pinion shaft, and drives the machine.

The gear ratio of single stages simple planetary speed reducer is calculated using the following formula.

$$R = \frac{Zs1}{Zs1+Za1}$$

※ Z ** : Number of gear teeth.



2) HYDRAULIC MOTOR SECTION

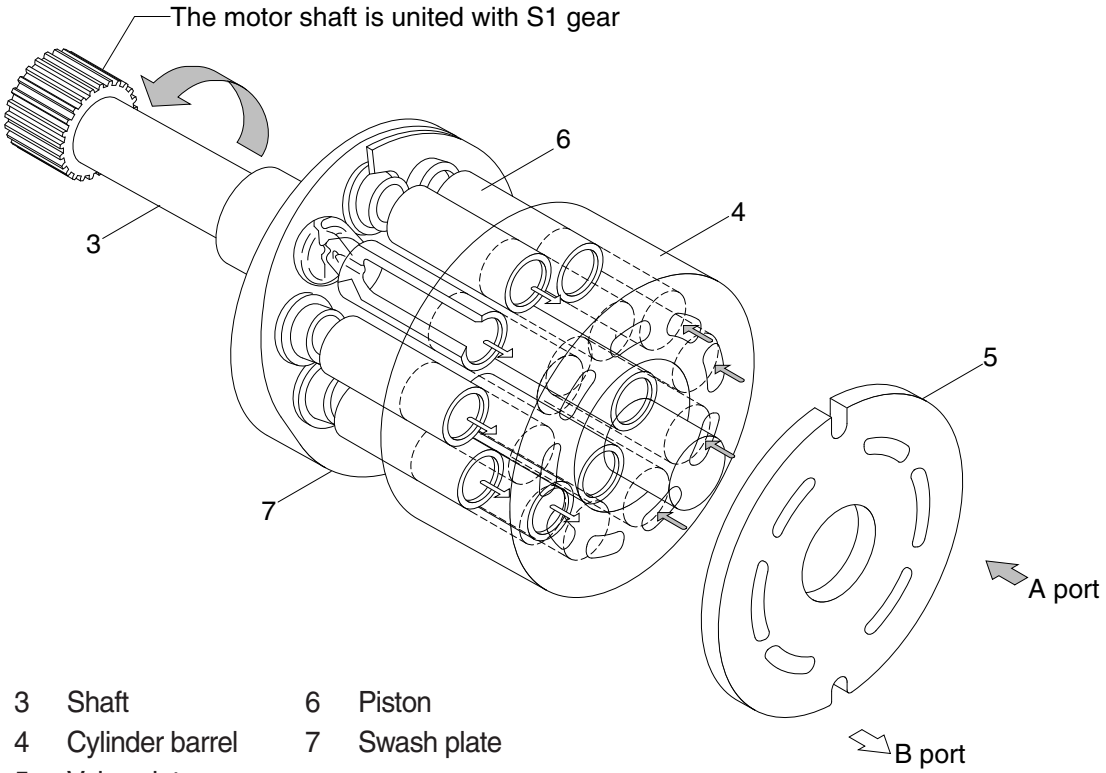
(1) Function

This hydraulic motor is an axial piston type, and changes the hydraulic energy supplied from the pump to the rotary motion.

(2) Structure

Through a hydraulic valve, the pressurized oil is supplied to the valve plate (5). When the pressurized oil is supplied to the A port, this pressurized oil pushes the piston (6) in the cylinder barrel (4). This pushing force is changed to the rotational power by the swash plate (7) and transmitted to the shaft (3) which is connected to the cylinder barrel (4) with the spline. The return flow from the cylinder port is going out through the B port of the valve plate (5).

To reverse rotation, pressurized oil is supplied to the B port and returning oil exits through the A port.



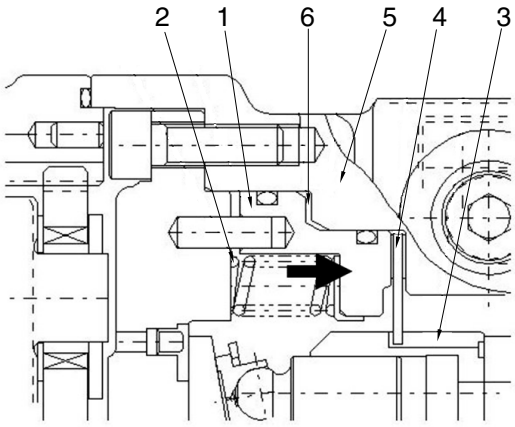
3	Shaft	6	Piston
4	Cylinder barrel	7	Swash plate
5	Valve plate		

1692SM04

(3) Parking brake

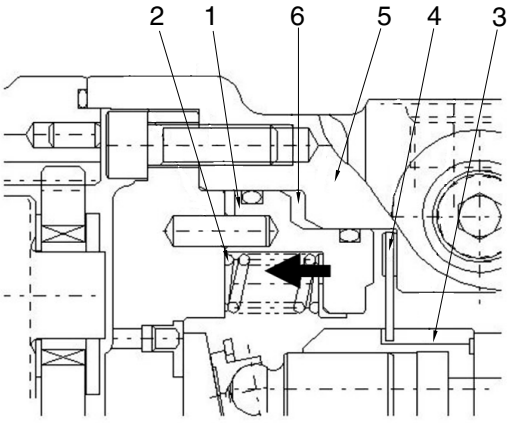
The parking brake fixes the output shaft of hydraulic motor mechanically while the swing motor is stopped.

When brake releasing pressure is not supplied, the brake piston (1) is pressed in the direction (shown as arrow in figure A) by the spring (2). Then the disk plate (4) which is fixed to the cylinder barrel (3) is held between the body (5) and the brake piston (1). As a result, with the friction of these parts, the cylinder barrel (3) and the hydraulic motor are unable to rotate.(figure A)



At the brake erleasing pressure OFF

Figure A



At the brake erleasing pressure ON

Figure B

1892SM07

When brake releasing pressure is supplied, the oil is lead to chamber (6) shown in figure B.

Then the brake piston (1) is moved to the direction (shown as arrow in figure B) against the force of spring (2). As a result, the disk plate (4) is released from the friction, and the cylinder barrel (3) can be rotated.(figure B)

3) HYDRAULIC VALVE SECTION

(1) Shockless relief valve

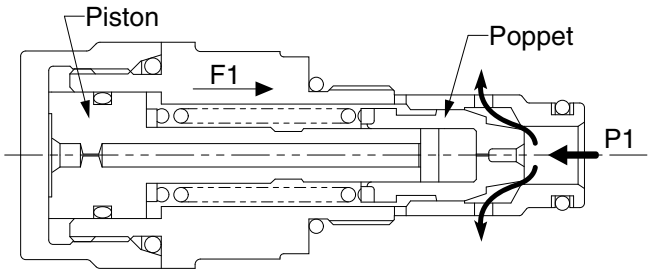
The shockless relief valve consists of the direct relief valve (poppet) and the piston for changing the spring force with two stages.

When the hydraulic motor is stopped, even after closing IN and OUT port of the hydraulic motor, the motor tries to run with inertia. Motor works as like a pump, and the pressure (brake pressure) is made on the OUT port side. The shockless relief valve releases this brake pressure with two stages of operation. This makes the shock smooth, and prevents the motor being damaged.

It also makes the start of the motor smooth.

① First stage

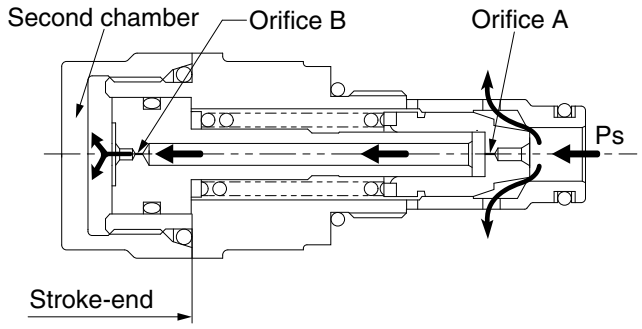
When the P1 pressure is going up, the poppet opens due to the pressure of the spring force F1.



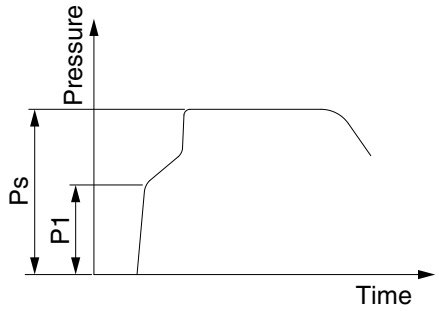
1692SM09

② Second stage

When P1 pressure enters the second chamber through the orifice A and B, the piston moves to its stroke-end. With this action, the spring is compressed, the spring force becomes stronger, and the P1 pressure is increased to the setting pressure Ps.



1692SM10



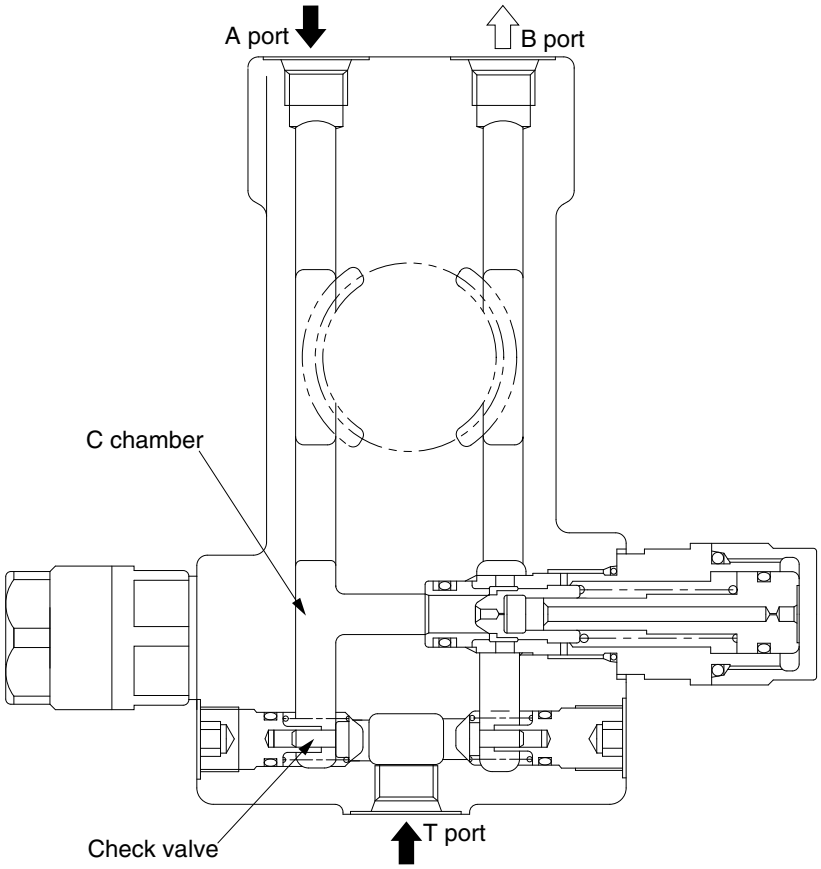
1692SM11

With the above two stages of operation, the motor starts and stops smoothly.

(2) Check valve

When the swing motor is decelerated by operating the control valve, it continues to be moved by the inertia of the machine. Then, it works as pump, and the pressure of C chamber tends to become negative. However, when B port pressure is below cracking pressure of the relief valve, all flow in A port goes out from B port through the motor.

Therefore, if C chamber can get flow only from the control valve, the flow will not be enough to prevent the negative pressure; as a result, cavitation could occur. The check valve works to supply the flow from T port to C chamber; and prevents cavitation.



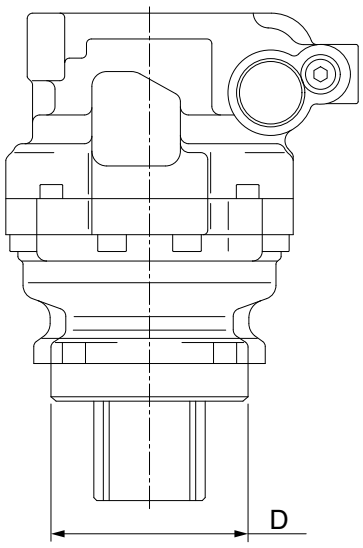
1692SM05

4. HANDLING

1) MOUNTING

(1) Pilot dimension D

D = $\varnothing 110h8\ ^{0}_{-0.054}$



1692SM08

(2) When installing the motor to the machine, do not force the sections and/or strike them with a heavy object as damage may result. The best method is to use the mounting bolts as a guide and slowly slide it into place.

(3) Use the specified bolts (equivalent grade 10.9 or higher) for mounting the motor, and tighten using the following torque.

Bolt size	Torque
M12	10±1 kgf · m (72.3±7.2 lbf · ft)

2) PIPING

(1) Pay attention to the rotation direction and piping.

Rotation direction (from view of output shaft)

Direction	IN Port	OUT port
Clockwise	B port	A port
Counter clockwise	A port	B port

(2) When assembling the motor to the machine, fill hydraulic oil into the motor body through the drain port for lubrication before connecting the drain port.

(3) The permissible drain pressure is limited by the oil seal. Pay attention to the drain piping so that the drain pressure does not exceed the limit. The permissible drain pressure is 2.0 kgf/cm^2 (28.4 psi).

(4) Fine filtration prolongs the hydraulic system life and ensures high reliability. Install a 10 μm filter, or better in the circuit.

3) GEAR LUBRICATION OIL

The gearbox is lubricated with drain oil from the hydraulic motor. When shipped, the gearbox is empty. Fill hydraulic oil through the drain port before use.

Replacement of the hydraulic oil in the gearbox is not required.

4) GENERAL PRECAUTION

(1) Always pay attention to oil leaks and loose bolts, detect and correct these problems as soon as possible to prevent damage to the motor or machine. Making a check sheet is recommended.

(2) Pay attention to the temperature of the reduction gear body. The permissible maximum temperature is 100˚C.

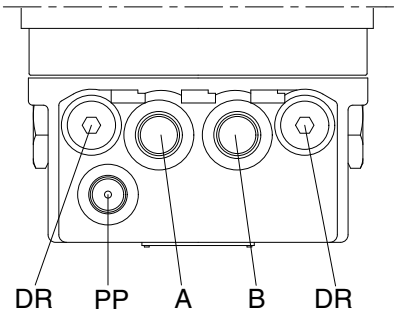
GROUP 4 TRAVEL DEVICE

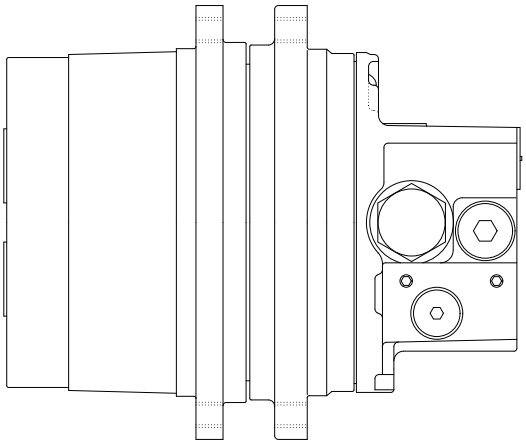
1. CONSTRUCTION

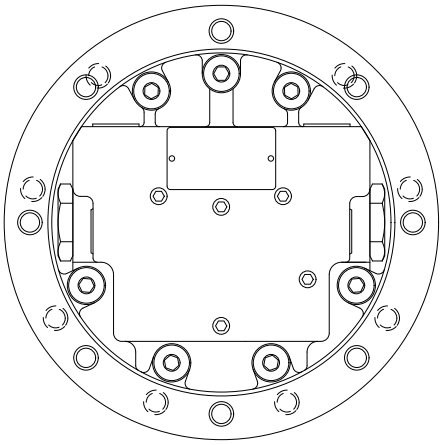
Travel device consists travel motor and gear box.

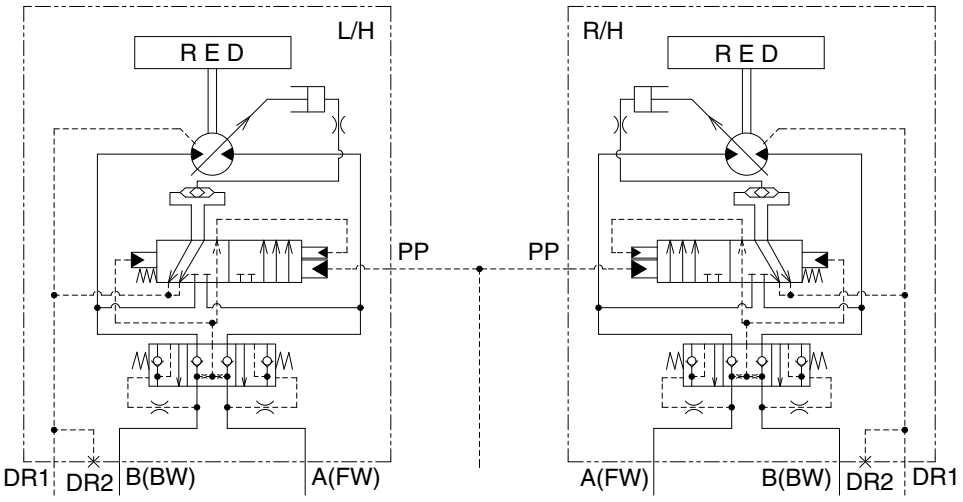
Travel motor includes counterbalance valve, parking brake and high/low speed changeover mechanism.

Port	Port name	Port size
A	Main port	PF 3/8
B	Main port	PF 3/8
DR1, DR2	Drain port	PF 1/4
PP	2 speed control port	PF 1/4





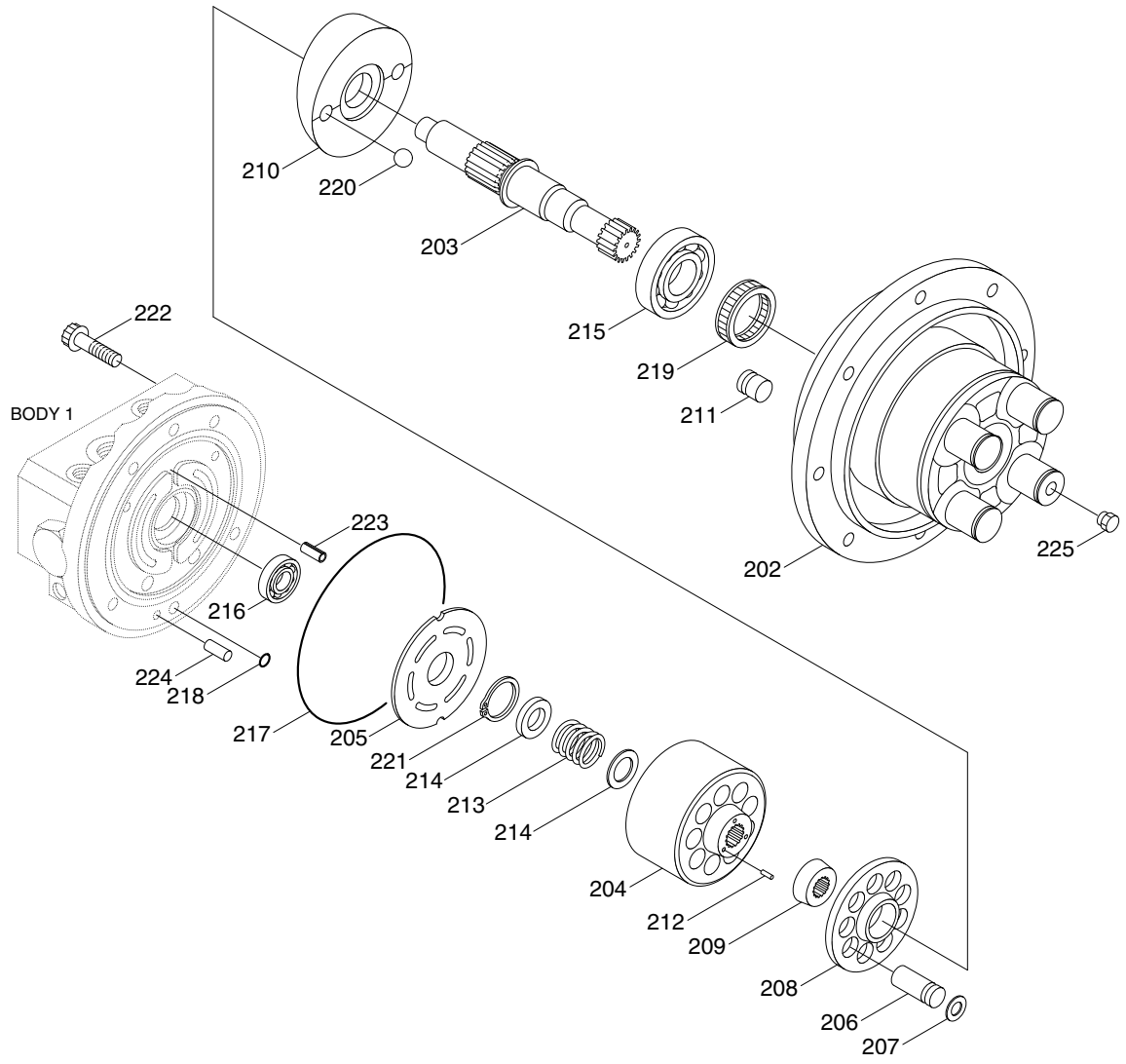




HYDRAULIC CIRCUIT

17Z9A2TM01

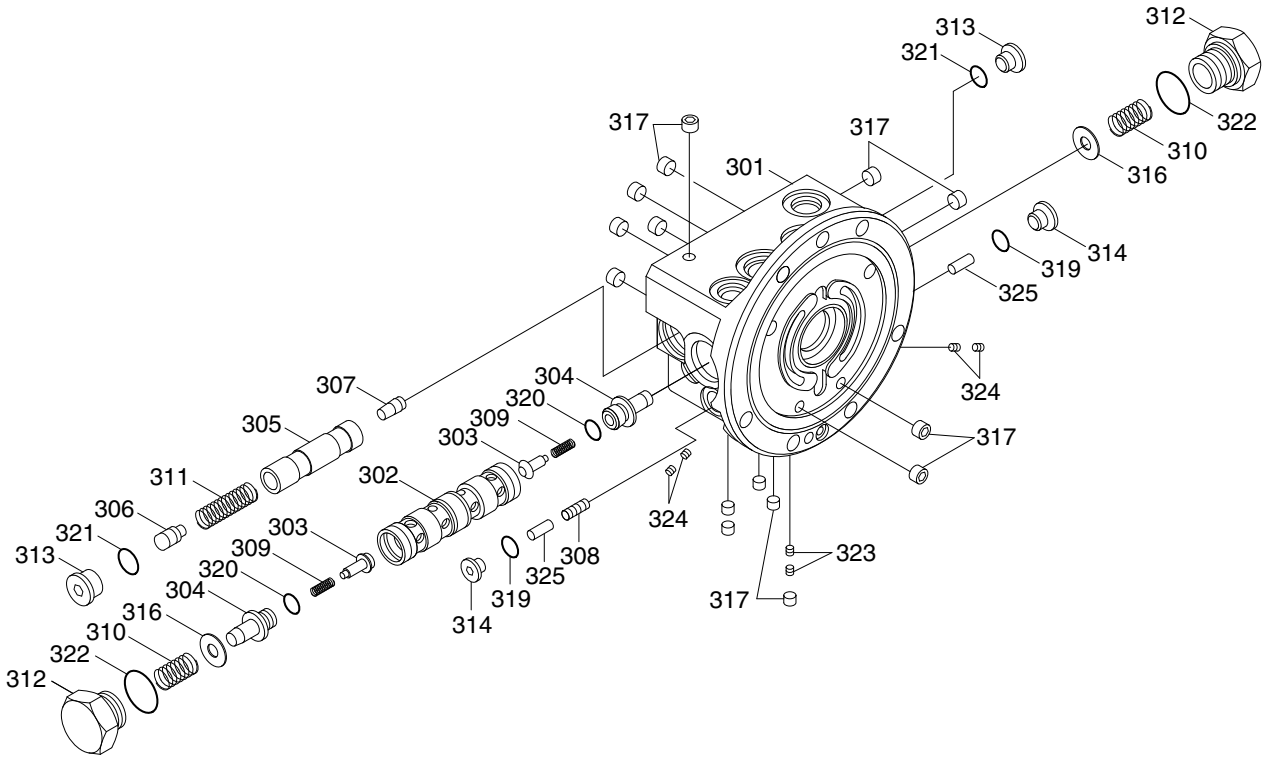
2) STRUCTURE (1/3)



1692TM02

202	Body 2	210	Swash plate	218	O-ring
203	Shaft	211	Control piston	219	Oil seal
204	Cylinder barrel	212	Pin	220	Ball
205	Valve plate	213	Spring C	221	Snap ring
206	Piston	214	Retainer	222	Screw
207	Shoe	215	Bearing	223	Spring pin
208	Shoe holder	216	Bearing	224	Pin
209	Barrel holder	217	O-ring	225	Plug

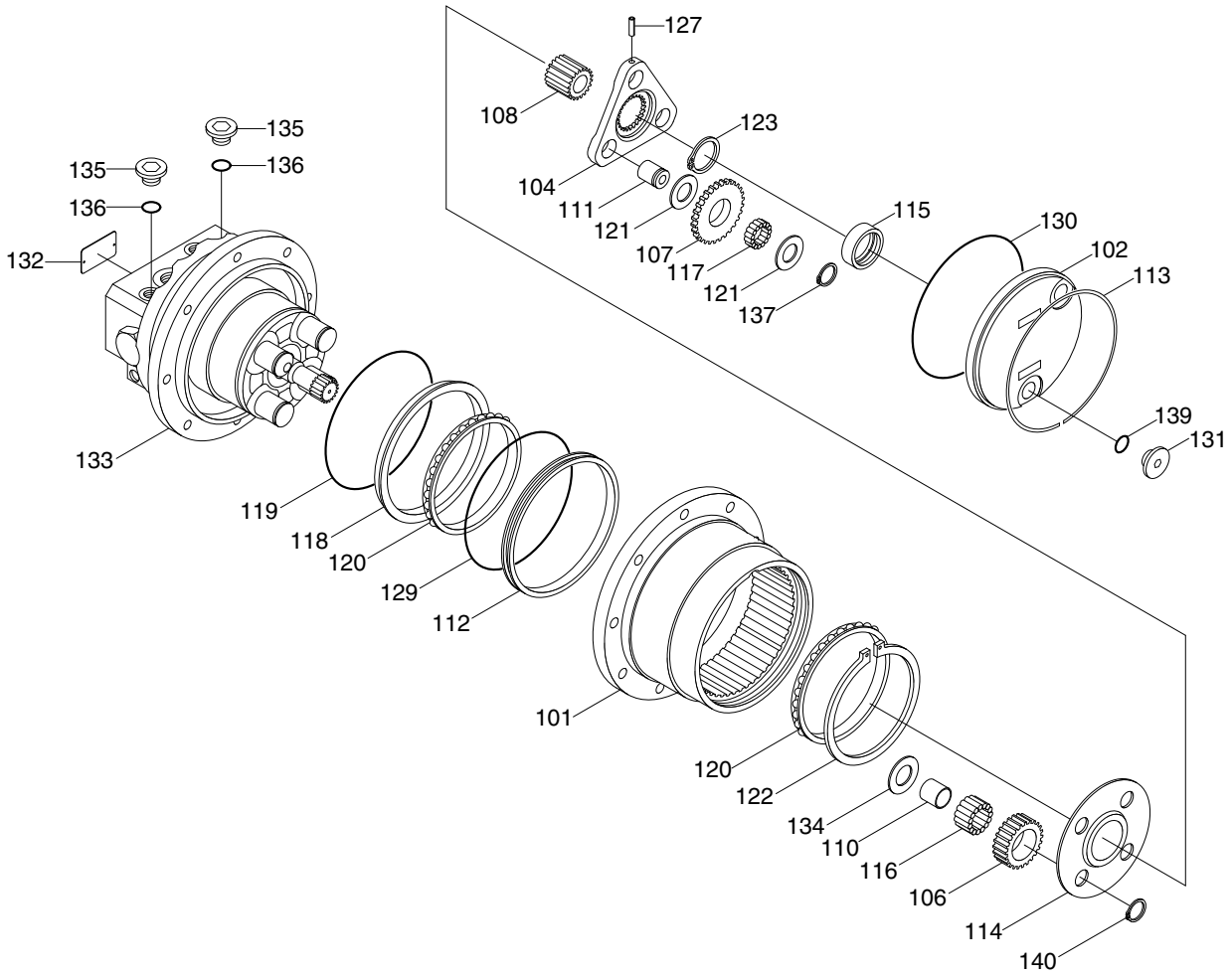
STRUCTURE (2/3)



17Z9A2TM03

301	Body 1	309	Spring V1	319	O-ring
302	Spool	310	Spring V2	320	O-ring
303	Check valve	311	Spring V3	321	O-ring
304	Spring guide	312	Plug	322	O-ring
305	Spool	313	Plug	323	Choke
306	Spool B	314	Ring	324	Choke
307	Spool C	316	Plug	325	Pin
308	Shuttle spool	317	Plug		

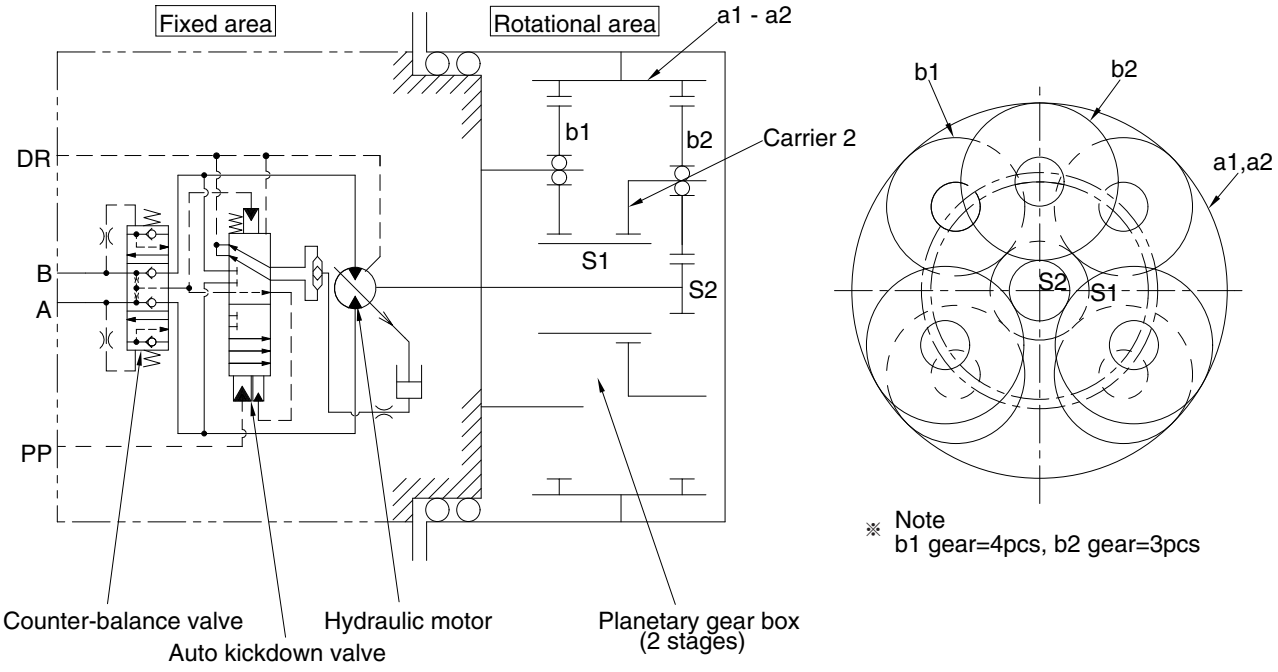
STRUCTURE (3/3)



1692TM04

101	Body	113	Snap ring	121	Thrust washer	134	Thrust washer
102	Cover	114	Thrust plate	122	Snap ring	135	Plug
104	Carrier 2	115	Slide ring	123	Snap ring	136	O-ring
106	Gear B1	116	Needle	127	Spring pin	137	Snap ring
107	Gear B2	117	Needle	129	O-ring	139	O-ring
108	Gear S1	118	Floating seat	130	O-ring	140	Snap ring
110	Ring		(Incl 119)	131	Plug		
111	Pin B2	119	O-ring	132	Name plate		
112	Seal ring	120	Bearing	133	Hydraulic motor		

2. DRAWING OF OPERATIONAL PRINCIPLE



17Z9A2TM05

3. OPERATION

Travel motor consists of a hydraulic motor "Fixed parts" and a planetary gear speed reducer "Rotating parts".

1) REDUCTION GEAR SECTION

(1) Function

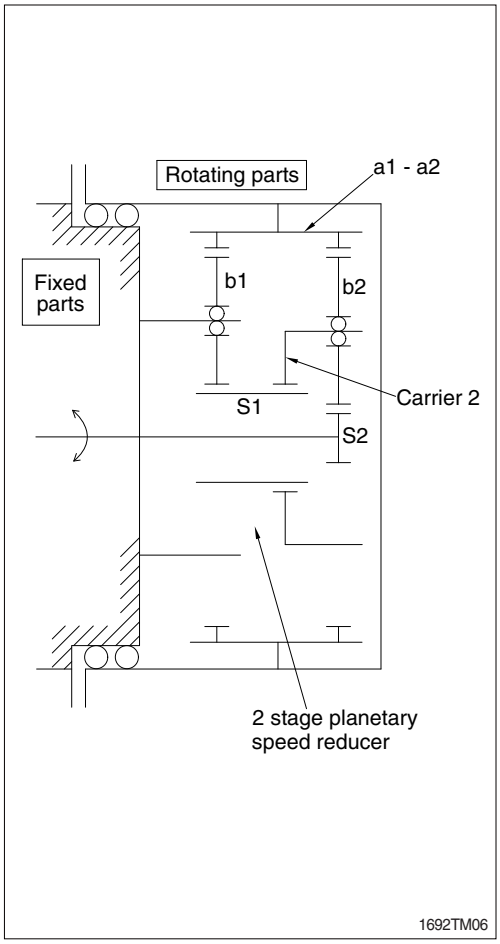
The speed reducer of travel motor is a simple planetary gear type with two stages. The high output speed of the hydraulic motor is reduced to low speed with high torque.

(2) Operation

The S2 gear is attached to the hydraulic motor shaft and the S2 output speed is reduced between the gears (s2, b2, a2) as a first stage speed reducer.

The reduced output speed of this first stage is reduced again between the gears (s1, b1, a1) which are connected to the carrier 2 with the spline.

This reduced output speed of the second stage is transmitted to the body case "rotating parts" through the inner gears (a1, a2) and drives the machine.



The gear ratio of 2 stage simple planetary speed reducer is calculated using the following formula.

$$R = \frac{Zs1}{Zs1+Za1} \times \frac{Zs2}{Zs2+Za2}$$

※ Z_{**} : Number of teeth

With the travel motor, the body case rotating, so the gear ratio is ;

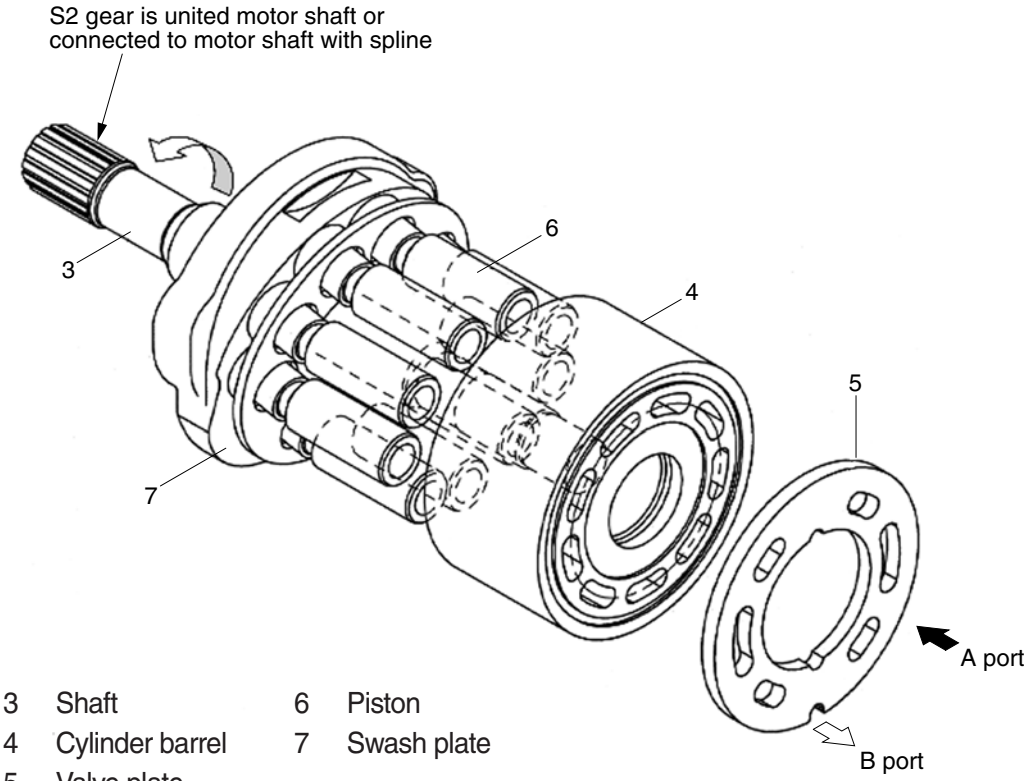
$$R' = \frac{1}{1-1/R}$$

2) HYDRAULIC MOTOR SECTION

(1) Function

This hydraulic motor is an axial piston type, and changes the hydraulic energy supplied from the pump to the rotary motion.

(2) Structure



3	Shaft	6	Piston
4	Cylinder barrel	7	Swash plate
5	Valve plate		

17Z9A2TM06

Through a hydraulic valve, the pressurized oil is supplied to the valve plate (5).
When the pressurized oil is supplied to the A port, this pressurized oil pushes the piston (6) in the clylinder barrel (4). This pushing force is changed to the rotational power by the swash plate (7) and transmitted to the shaft (3) which is connected to the cylinder barrel (4) with the spline. The return flow from the cylinder port is going out through the B port of the valve plate (5). To reverse rotation, pressurized oil is supplied to the B port and returning oil exits through the A port.

(3) 2 speed motor operation

The swash plate, which has surface Ⅰ and Ⅱ in the opposite side to the shoe sliding surface, is supported by the 2 balls which are fixed to the body 2.

Since the balls are located in the eccentric position, in the low speed range, the surface Ⅰ is faced to the body 2 by the oil pressure in the piston and the spring force in the cylinder barrel. The swash plate angle is α (max capacity).

When the pressurized oil is supplied to the (PP) port, the two-speed spool moves to the high position.

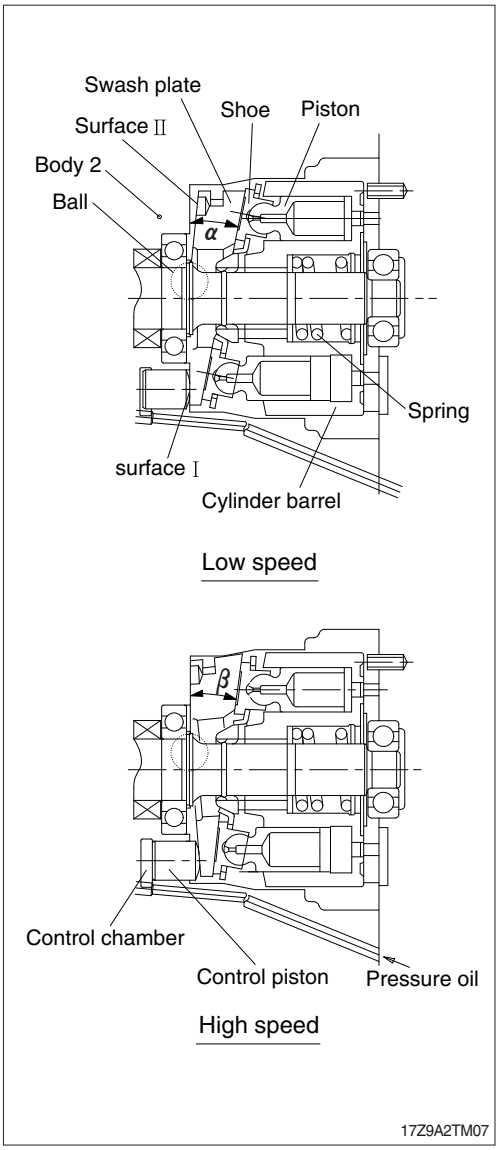
And the pressurized oil of inlet is led to the control chamber through the two-speed spool.

The control piston moves forward until the surface Ⅱ of the swash plate is in contact with the body 2, and the swash plate angle becomes β .

The capacity of the hydraulic motor is made small.

The pressurized oil of the (PP) port is shut off (or the engine is stopped), the two-speed spool moves to the low position.

And the control chamber is led to the tank port through the two-speed spool and the swash plate position comes to the low speed by the spring force.

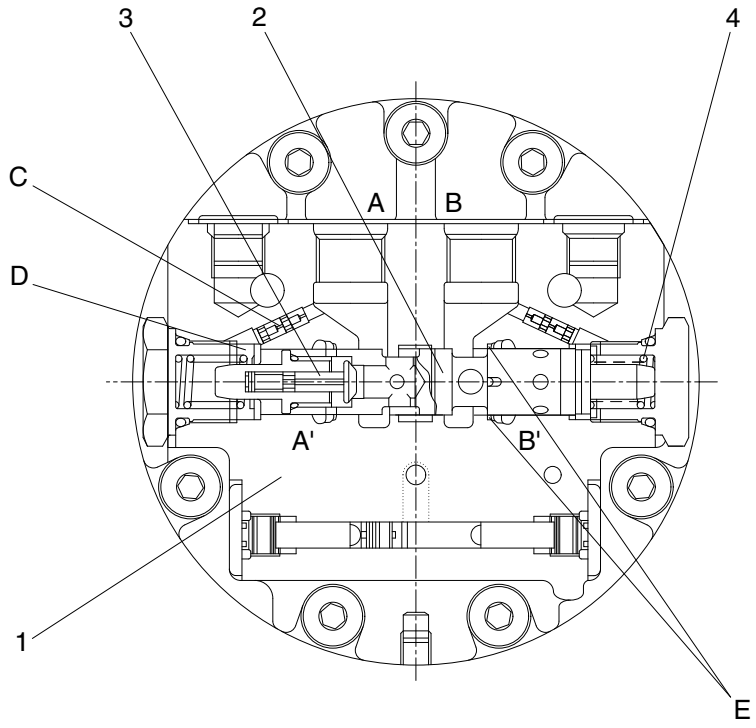


3) HYDRAULIC VALVE SECTION

(1) Counter-balance valve

When the pressurized oil is supplied from the A port, the pressurized oil opens the check valve (3) and flows into the hydraulic motor inlet A' port. At the same time, the pressurized oil goes through the orifice C into the chamber D, pushes the spring (4) and moves the spool (2) to right. Then the returned oil from the hydraulic motor flows into the B port, goes through area E and drives the hydraulic motor. When the pressurized oil is supplied from the B port, the hydraulic motor rotates in reverse.

Even the pressurized oil of the A port is shut off, the hydraulic motor tries to rotate by inertia force. When the pressurized oil from the A port is shut off, the spool (2) tries to return to left by the spring (4) force. At this time, the oil in the chamber D tries to go out to the A port through the orifice C, but due to the throttle effect of orifice C, the spool (2) speed is reduced. With the orifice and notches on the spool, the returned oil is controlled gradually and the hydraulic motor stops smoothly.



17Z9A2TM08

(2) Auto kick down valve

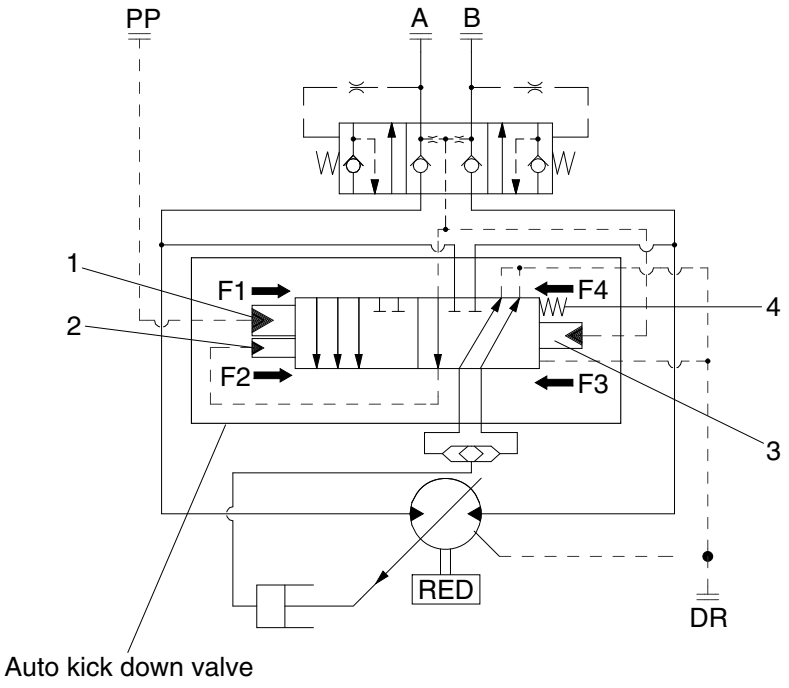
When the travel speed control switch for Hi speed mode is turned on, the pilot pressure for Hi speed mode comes from PP port to the hydraulic pilot (1), then the force F1 occurs. The auto kick down valve moves to the right direction because the F1 is larger than F4, which is by spring (4). Then the speed of track motor is changed to the Hi speed mode.

On the other hand, the operating pressure comes from A or B port to the hydraulic pilot (2) and (3), then the force F2 and F3 occur. The F3 is larger than F2 because the area of (3) is wider than the area of (2). Therefore, if the operating pressure increases, the difference between F2 and F3 also increases.

When the operating pressure is larger than the setting pressure of Hi speed to Lo speed, the right direction resultant of F1 and F2 is smaller than the left direction resultant of F3 and F4.

Therefore the auto kick down valve moves to the left direction, then the speed of track motor is changed to the Lo speed mode. When the operating pressure is smaller than the setting pressure of Lo speed to Hi speed, the right direction resultant of F1 and F2 is larger than the left direction resultant of F3 and F4.

Therefore the auto kick down valve moves to the right direction, then the speed of track motor is changed to the Hi speed mode.

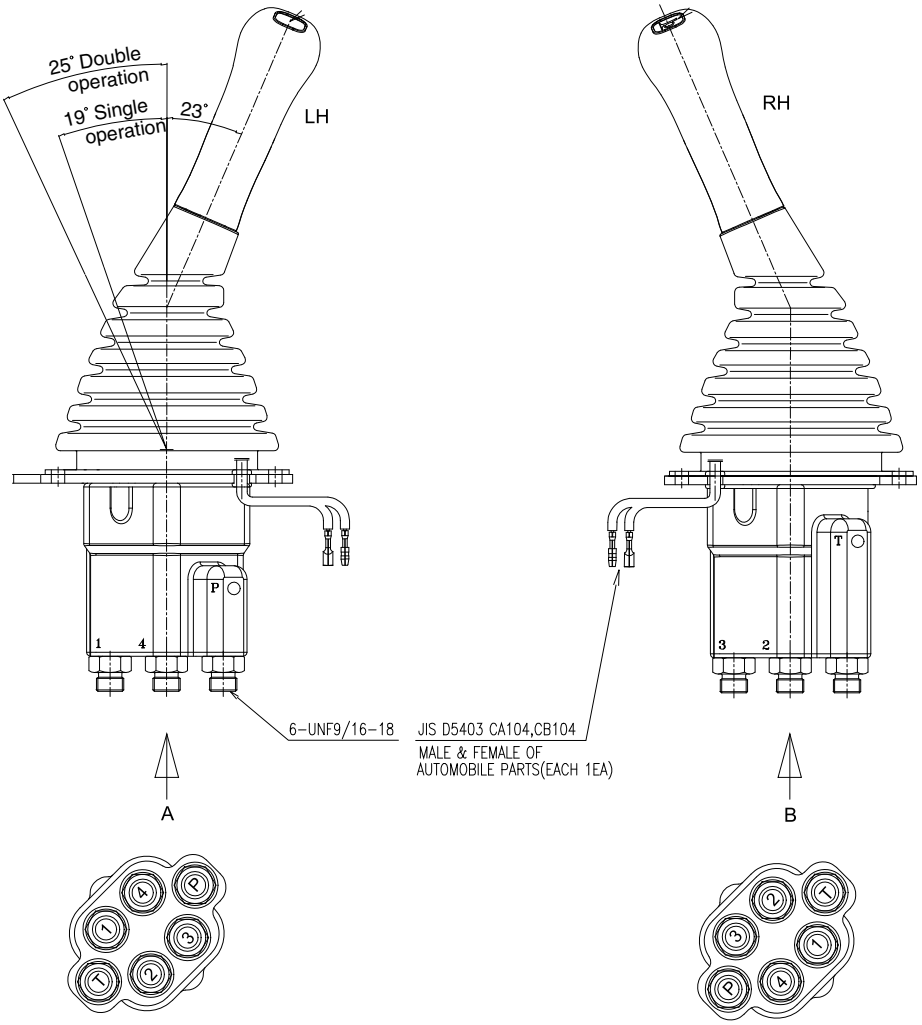


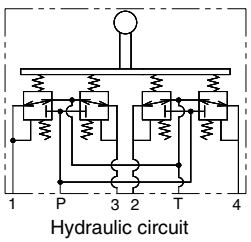
17Z9A2TM10

■ TYPE 1 (STANDARD)

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.





Hydraulic circuit

18AK2RL01

Port	LH	RH	Port size
P	Pilot oil inlet port	Pilot oil inlet port	PF 1/4
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	

CROSS SECTION

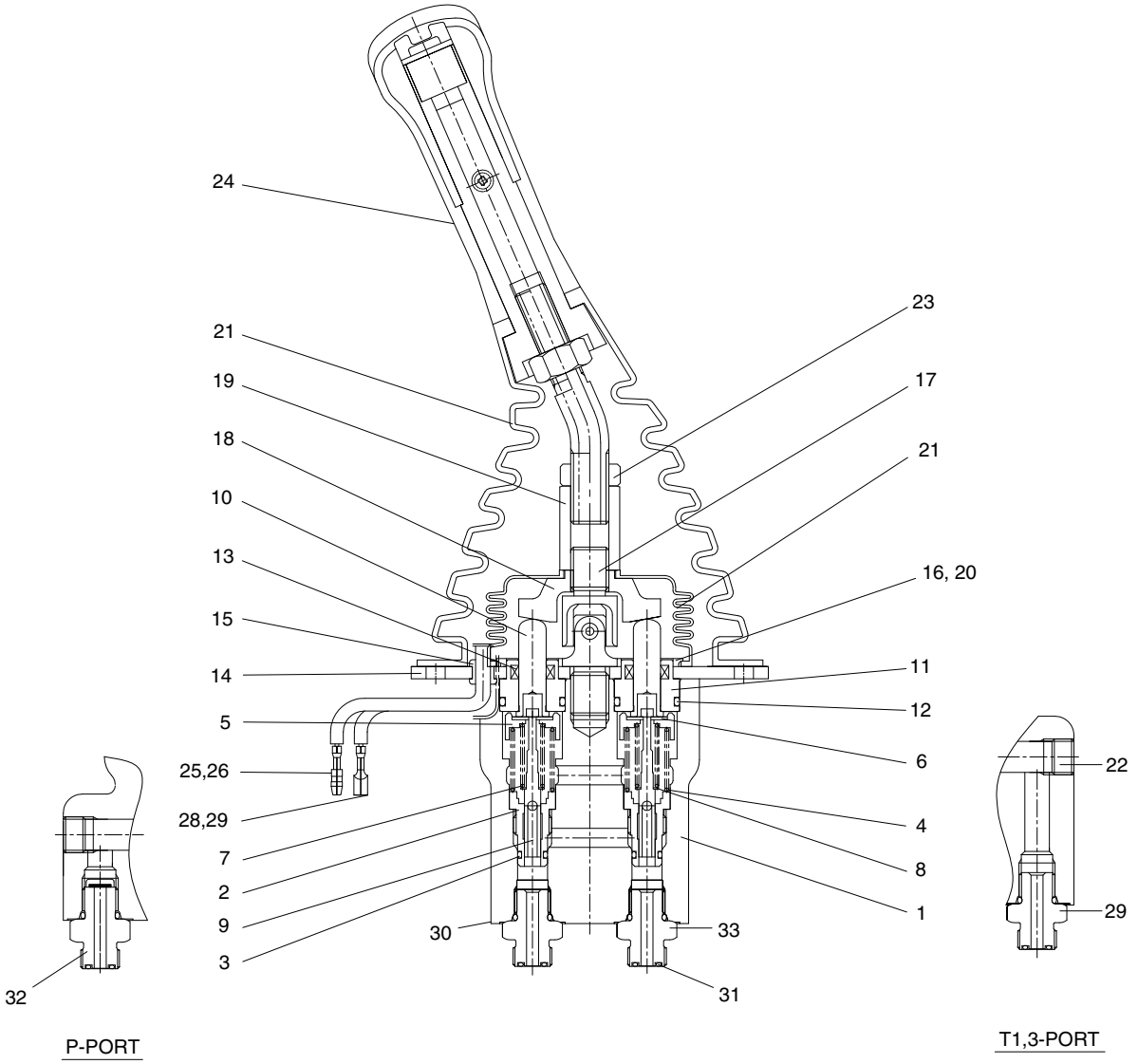
The construction of the pilot valve is shown in the attached cross section drawing. The casing has vertical holes in which reducing valves are assembled.

The pressure reducing section is composed of the spool (9), spring (7) for setting secondary pressure, return spring (4), stopper (6), spring seat (5) and shim (8). 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 (10) 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.

1	Body	12	O-ring	23	Nut
2	Plug	13	Rod-seal	24	Handle ass'y
3	O-ring	14	Plate (A)	25	Tube
4	Spring	15	Bushing	26	Terminal
5	Spring seat	16	Machine screw	27	Tube
6	Stopper	17	Joint ass'y	28	Terminal
7	Spring	18	Swash plate	29	Connector
8	Shim	19	Hex nut	30	O-ring
9	Spool	20	Plate (B)	31	O-ring
10	Push rod	21	Inner boots	32	Connector
11	Plug	22	Plug		

CROSS SECTION

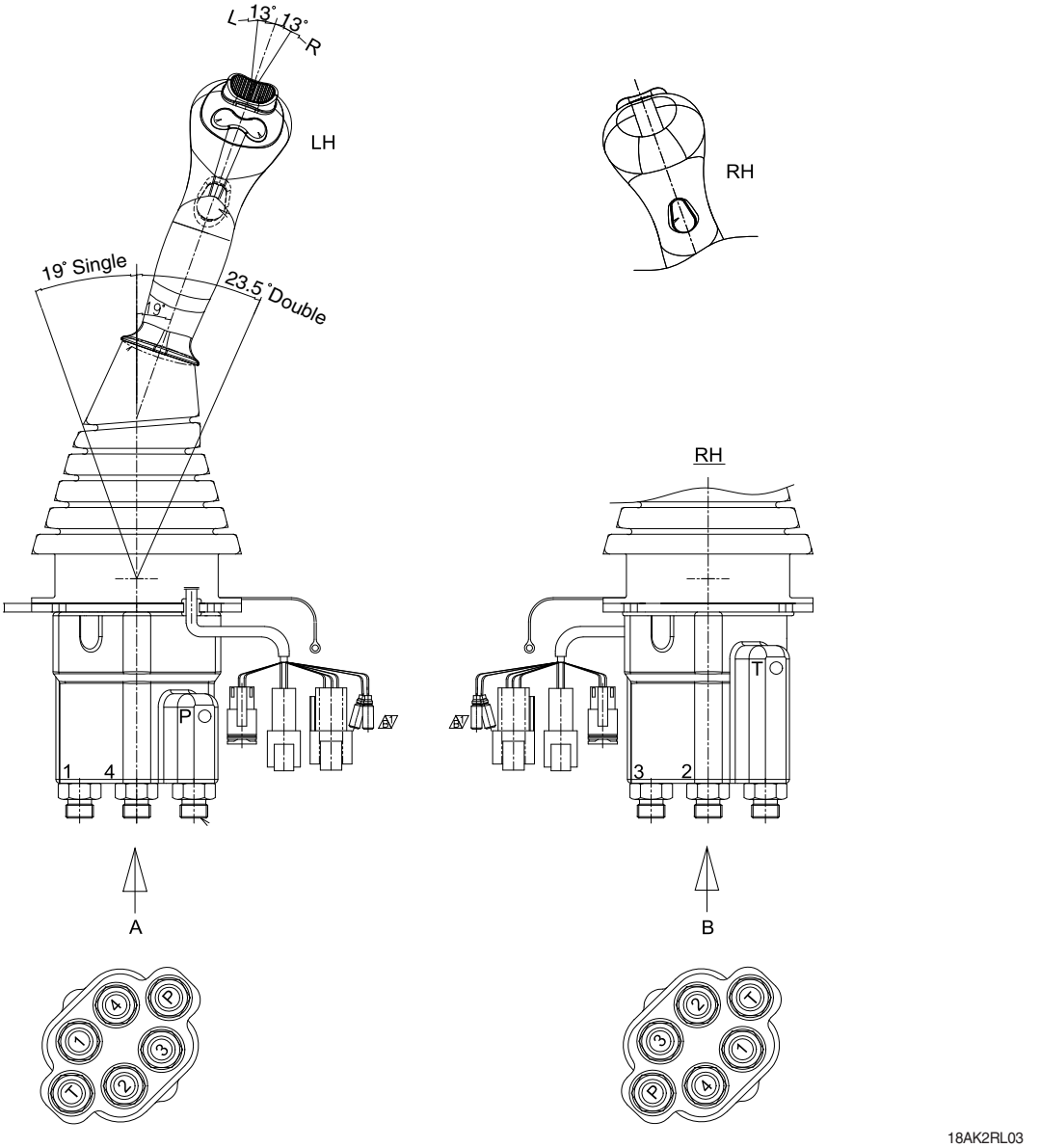


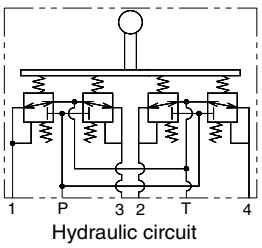
18AK2RL02

■ TYPE 2 (PROPORTIONAL, OPTION)

2. 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.





Hydraulic circuit

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

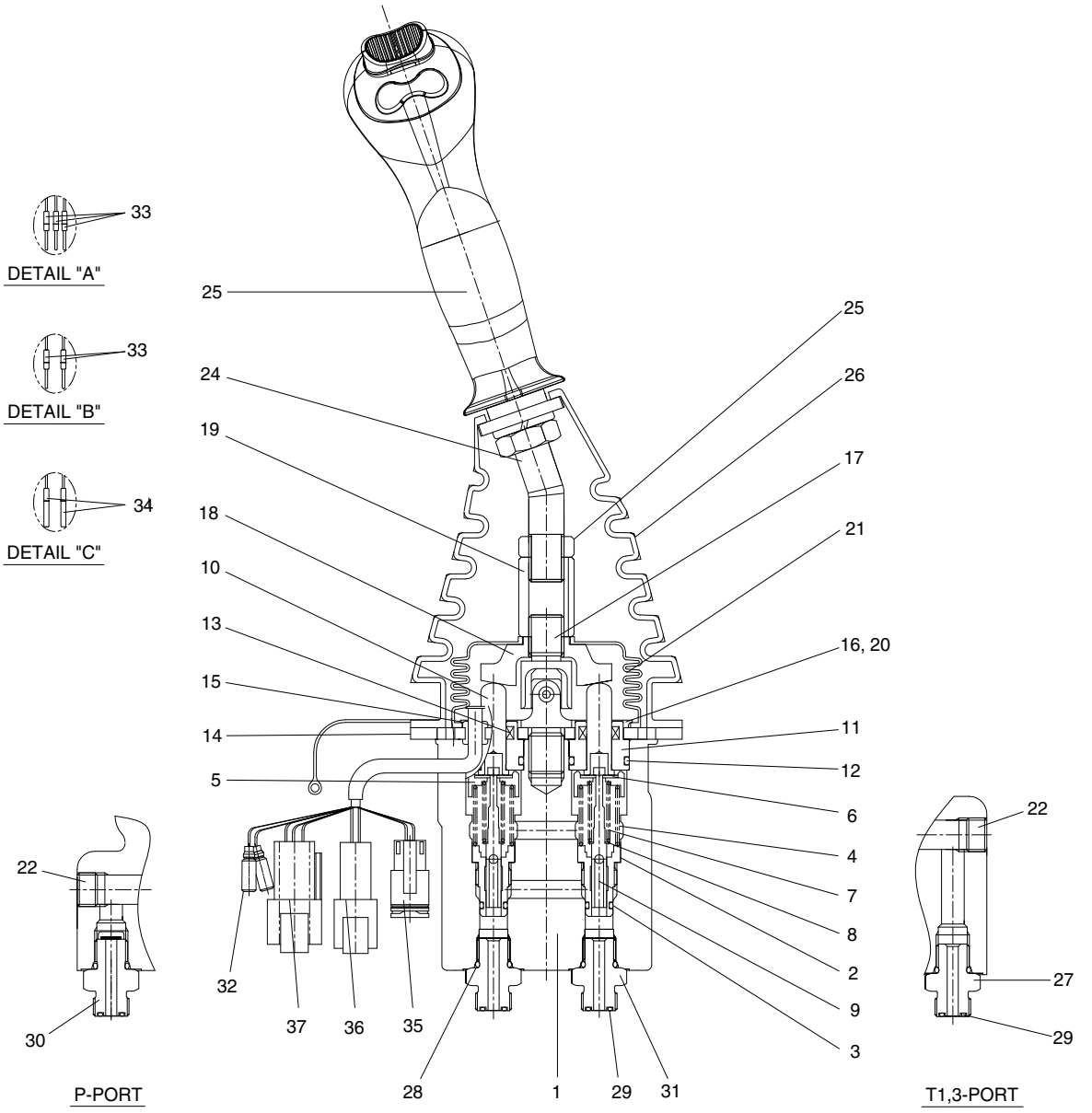
CROSS SECTION

The structure of the remote control valve is as shown in the assembly. There is a vertical axial hole in the casing and the reduction valves are inserted into this.

The secondary pressure setting spring is set such that the secondary pressure is calculated as 5.1~10.2 kgf/cm^2. Spool (9) is pushed onto the push rod (10) by return spring (4).
Tilting the control handle pushes down push rod (10), the spring seat (5) also moves down and the setting of the secondary pressure setting spring is changed.
Port P, oil inlet (primary pressure) and port T outlet (tank) are in the casing.

1	Body	12	O-ring	23	Handle ass'y
2	Plug	13	Rod-seal	24	Handle bar
3	O-ring	14	Plate (A)	25	Nut
4	Spring	15	Bushing	26	Boots
5	Spring seat	16	Machine screw	27	Connector
6	Stopper	17	Joint ass'y	28	O-ring
7	Spring	18	Swash plate	29	O-ring
8	Shim	19	Hex nut	30	Last guard filter
9	Spool	20	Plate (B)	31	O-ring
10	Push rod	21	Inner boots	32	Connector
11	Plug	22	Plug		

CROSS SECTION

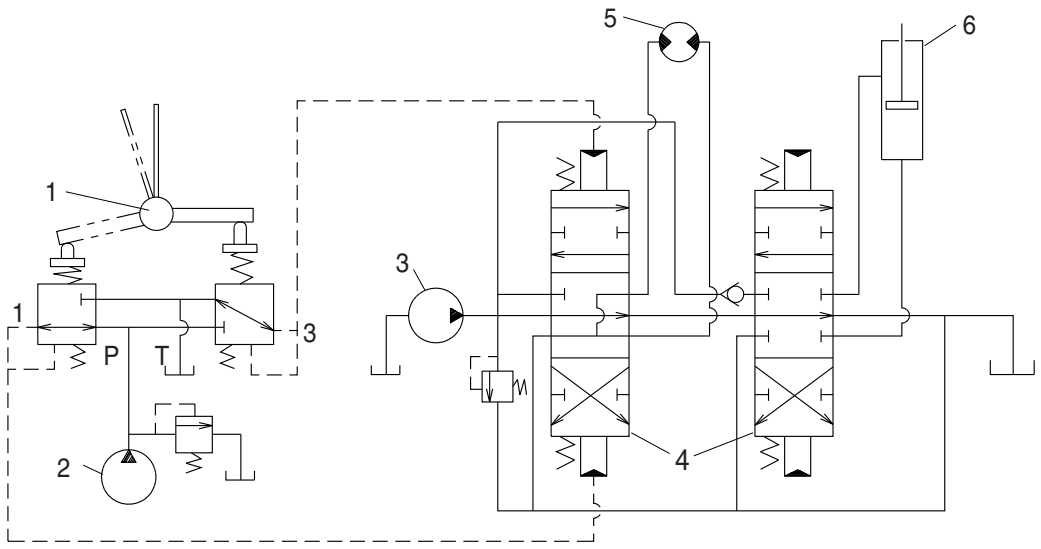


18AK2RL04

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.

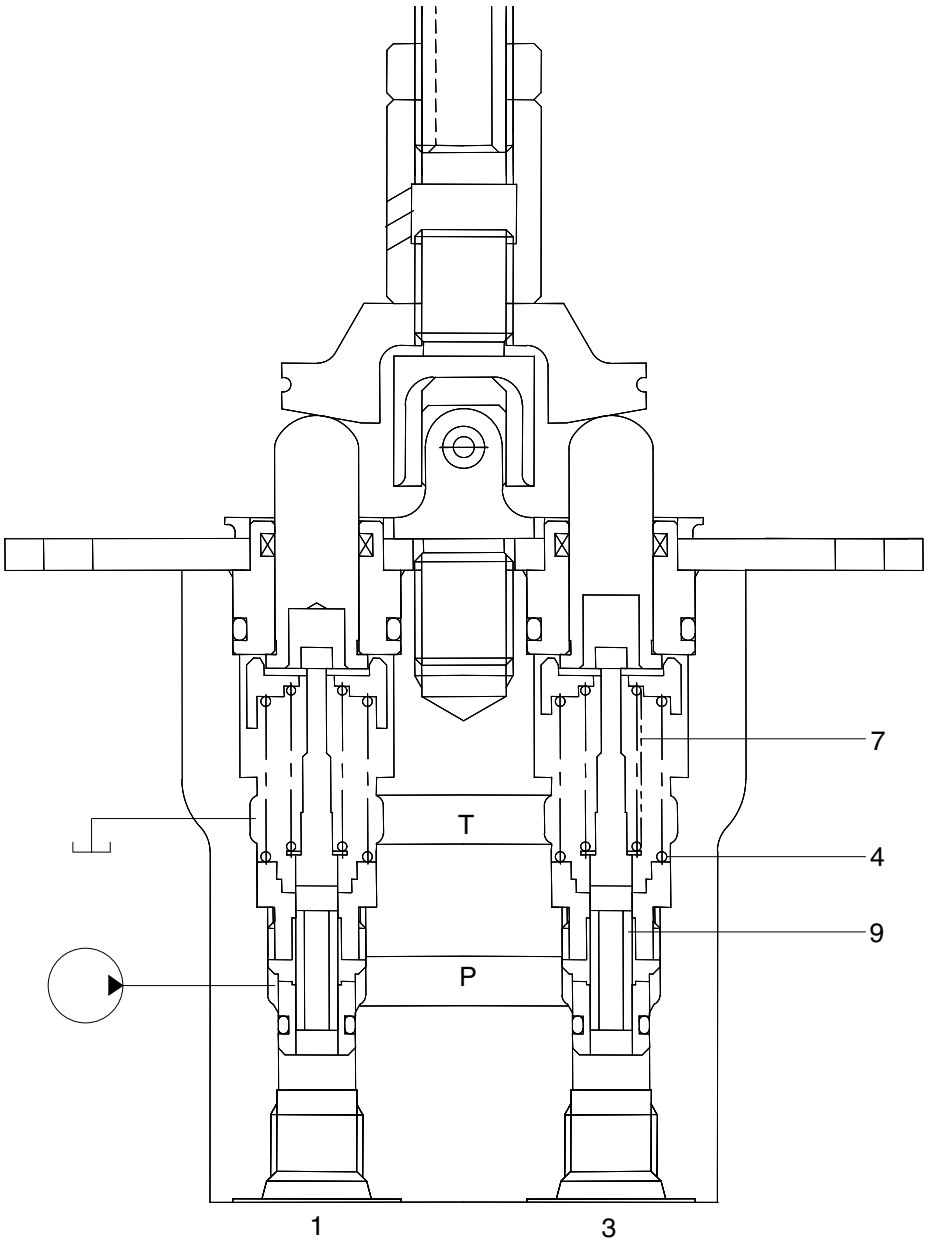
The diagram shown below is the typical application example of the pilot valve.



2-70 (140-7TIER)

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

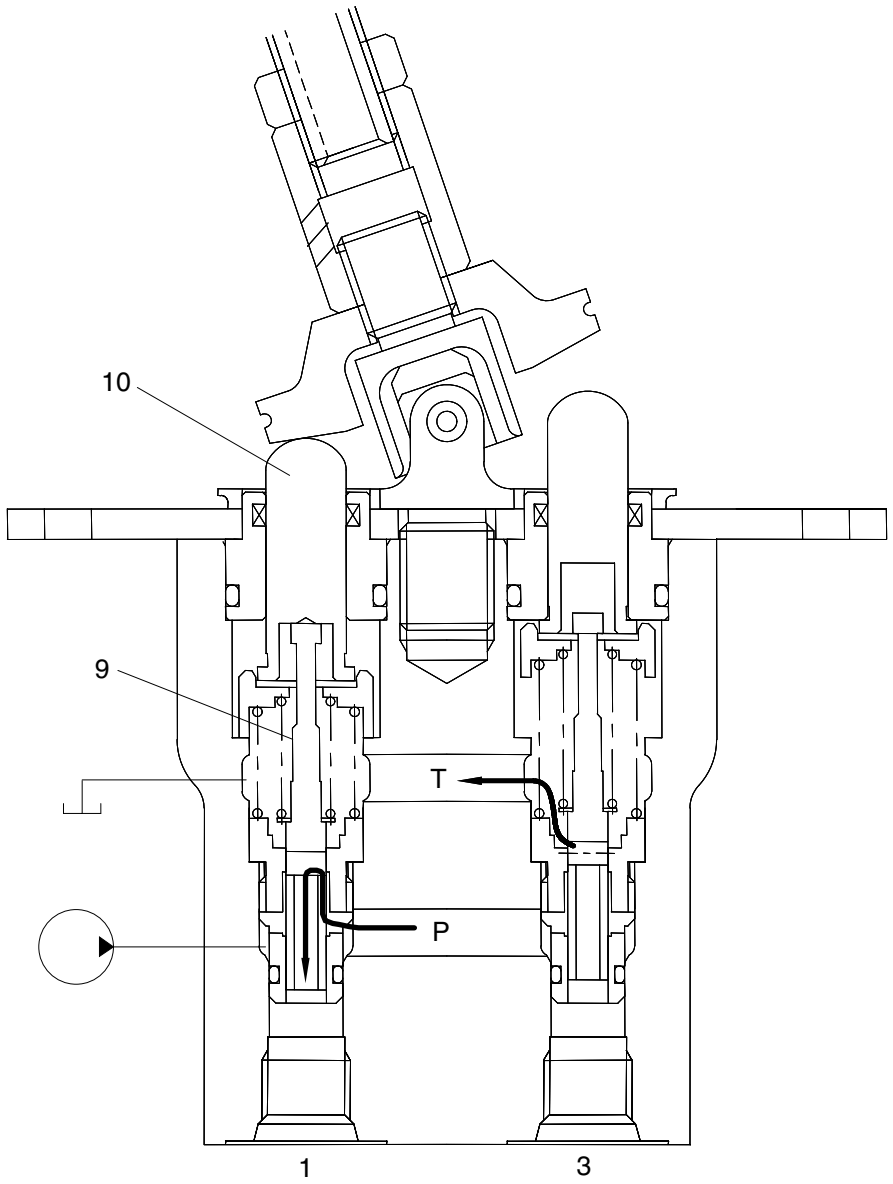
(1) Case where handle is in neutral position



R30Z9AK2RL03

The force of the spring (7) that determines the output pressure of the pilot valve is not applied to the spool (9). Therefore, the spool is pushed up by the spring (4) 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



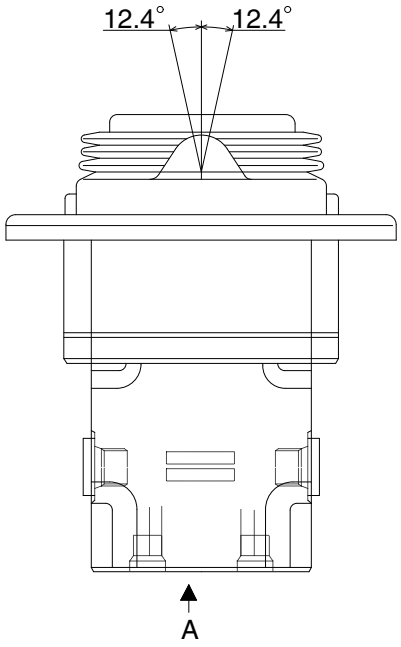
R30Z9AK2RL04

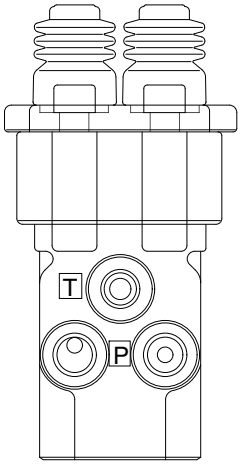
When the push rod (10) is stroked, the spool (9) moves downwards.
Then port P is connected with port (1) and the oil supplied from the pilot pump flows through port (1) to generate the pressure.
When the pressure at port (1) increases to the value corresponding to the spring force set by tilting the 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.

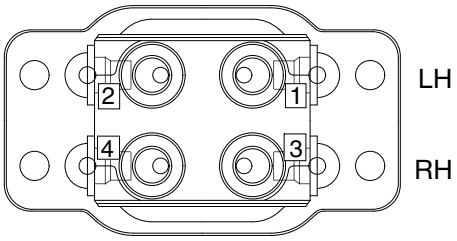
GROUP 6 RCV PEDAL

1. STRUCTURE

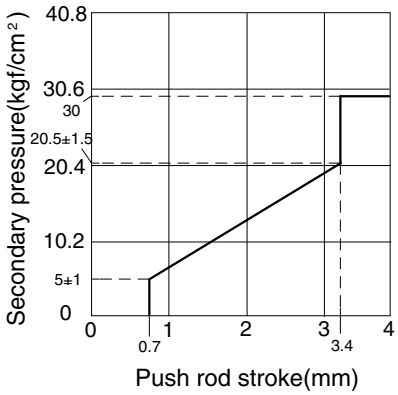
The casing has the oil inlet port P (primary pressure), and the oil outlet port T (tank). In addition the secondary pressure is taken out through ports 1, 2, 3 and 4 provided at the bottom face.



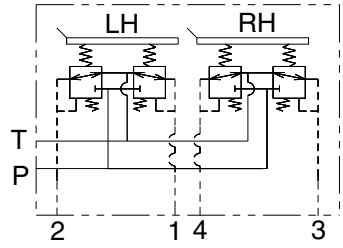




VIEW "A"



R35Z72RCP01



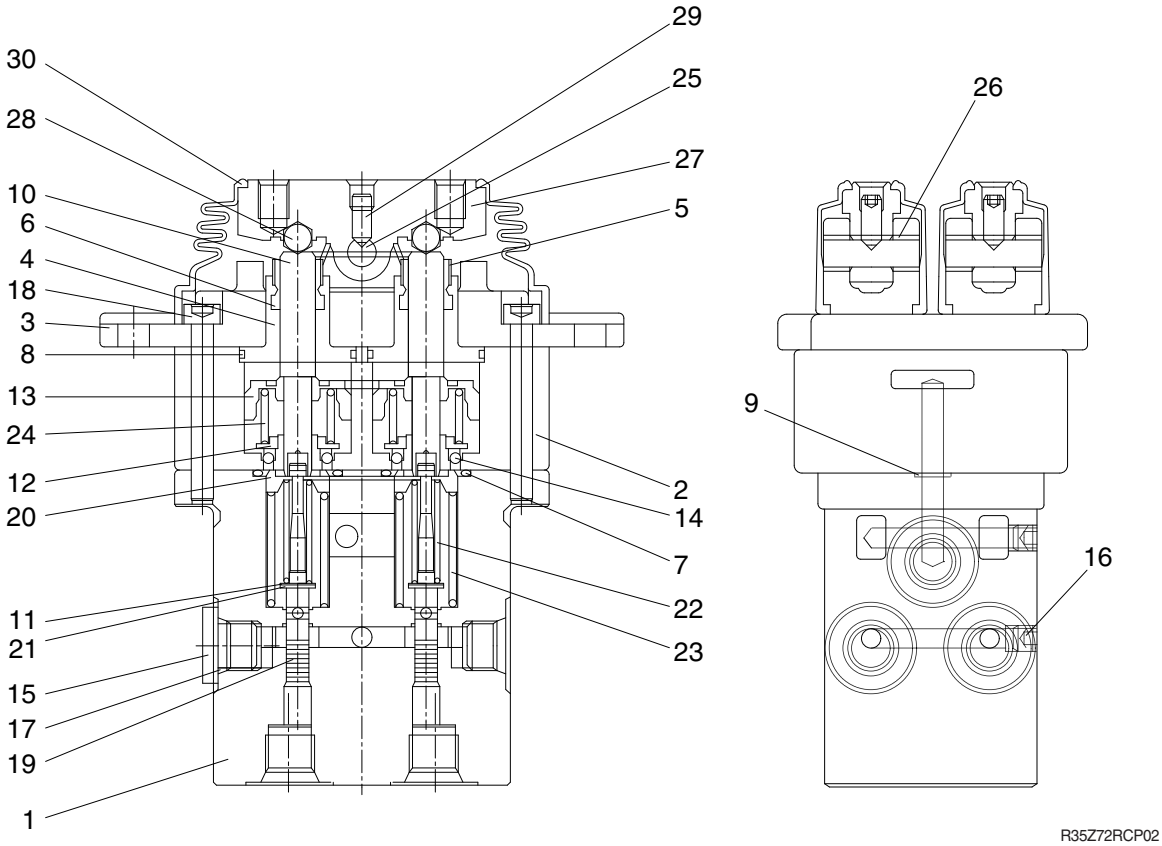
Port	Port name	Port size
P	Pilot oil inlet port	PF 1/4
T	Pilot oil return port	
1	Travel (LH, Backward)	
2	Travel (LH, Forward)	
3	Travel (RH, Backward)	
4	Travel (RH, Forward)	

CROSS SECTION

The construction of the RCV pedal is shown in the below drawing. The casing has vertical holes in which reducing valves are assembled.

The pressure reducing section is composed of the spool (19), spring (22) for setting secondary pressure, return spring (23), spring seat (20) and washer (21). The spring for setting the secondary pressure has been generally so preset that the secondary pressure is 5 to 19 kgf/cm^2 (depending on the type). The spool is pushed against the push rod (10) by the return spring.

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



R35Z72RCP02

1	Casing (1)	11	Shim	21	Washer
2	Casing (2)	12	Spring seat	22	Spring
3	Cover	13	Piston	23	Spring
4	Plug	14	Steel ball	24	Spring
5	Grease cap	15	Plug	25	Cam shaft
6	Packing	16	Plug	26	Bushing
7	O-ring	17	O-ring	27	Cam
8	O-ring	18	Hex soc head screw	28	Steel ball
9	O-ring	19	Spool	29	Set screw
10	Push rod	20	Spring seat	30	Bellows

2. FUNCTION

1) FUNDAMENTAL FUNCTIONS

The pilot valve is a valve 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 port (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 tank port.

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

2) FUNCTIONS OF MAJOR SECTIONS

The functions of the spool (19) 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 spool to determine the output pressure.

The spring (22) works on this spool to determine the output pressure.

The change the deflection of this spring, the push rod (10) is inserted and can slide in the plug (4).

For the purpose of changing th displacement of the push rod through the cam (27) and steel ball (28) are provided the pedal that can be tilted in any direction around the fulcrum of the cam (27) center.

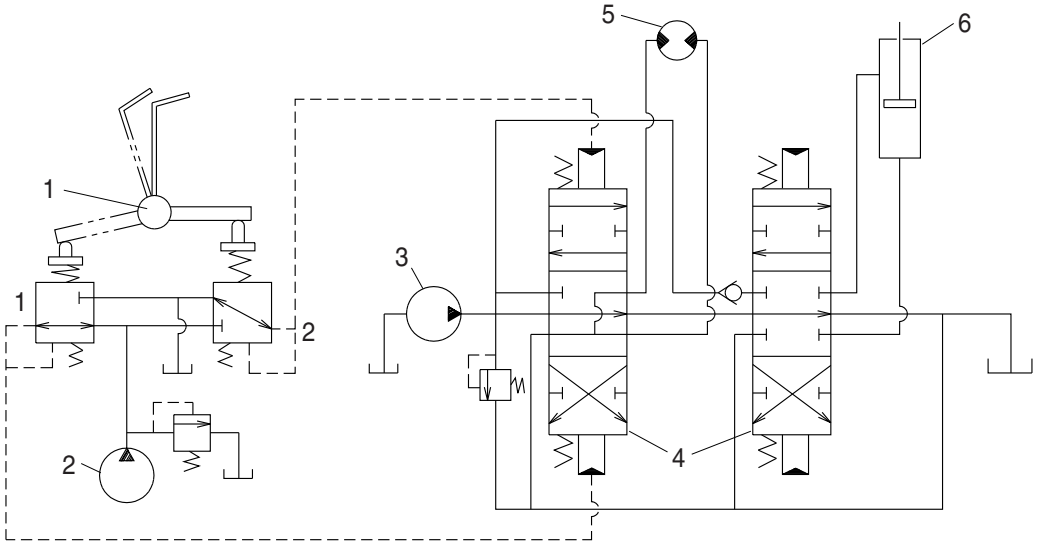
The spring (23) works on the casing (1) and washer (21) and tries to return the push rod (10) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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 ant the attached operation explanation drawing.

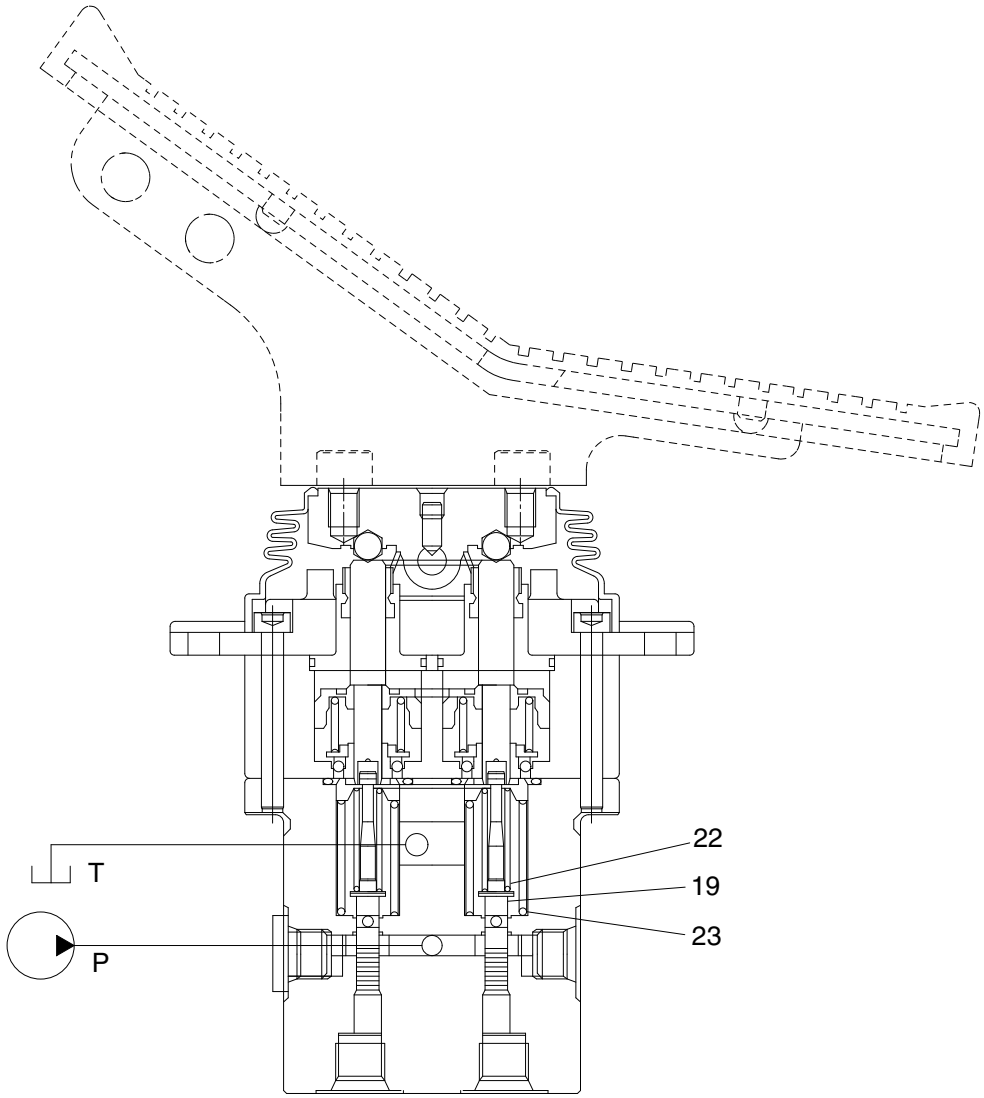
The diagram shown below is the typical application example of the pilot valve.



140LC-7 기타2-76

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

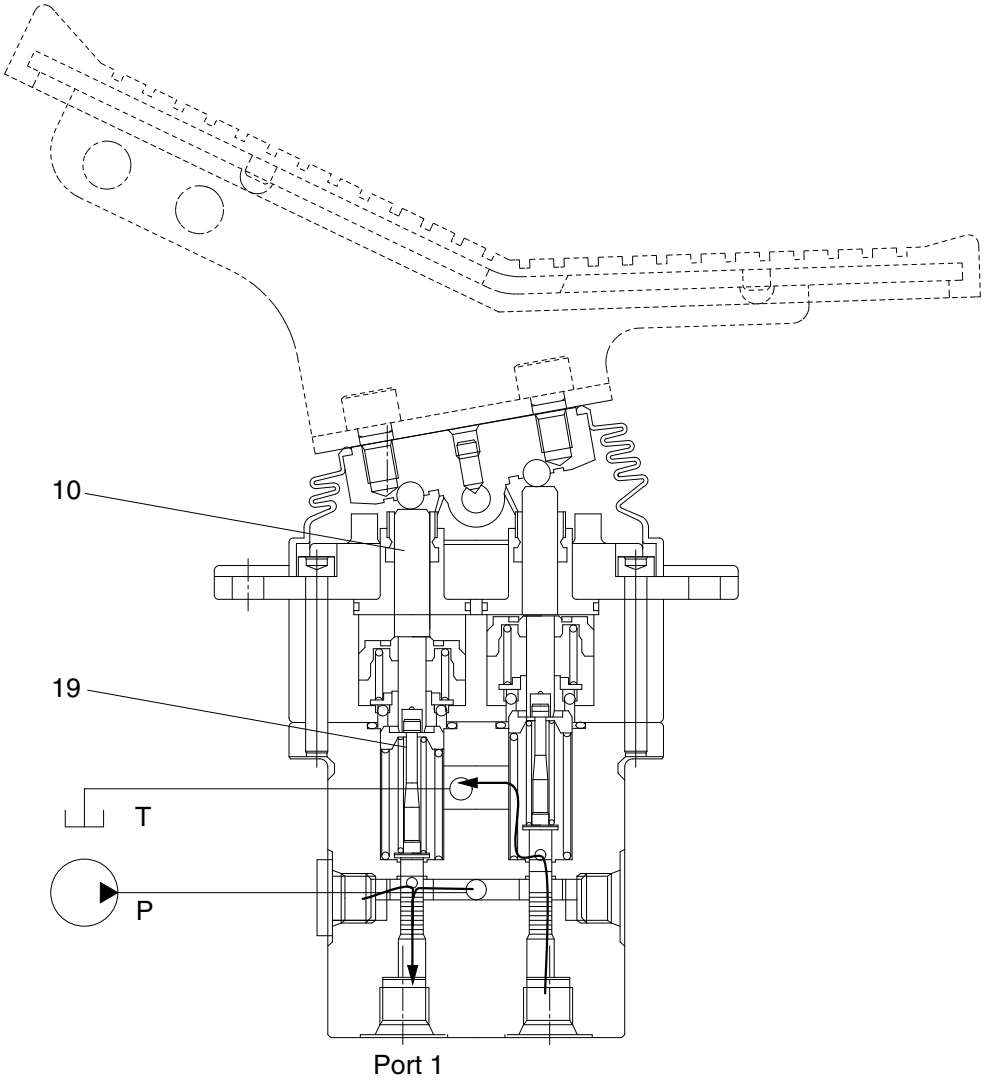
(1) Case where pedal is in neutral position



R35Z72RCP04

The force of the spring (22) that determines the output pressure of the pilot valve is not applied to the spool (19). Therefore, the spool is pushed up by the spring (23) to the position of port 2 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 pedal is tilted



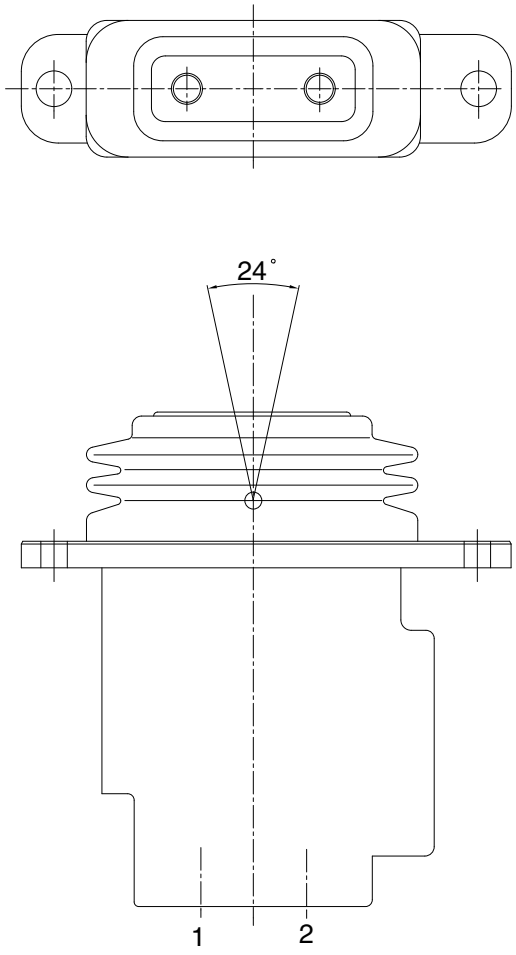
R35Z72RCP05

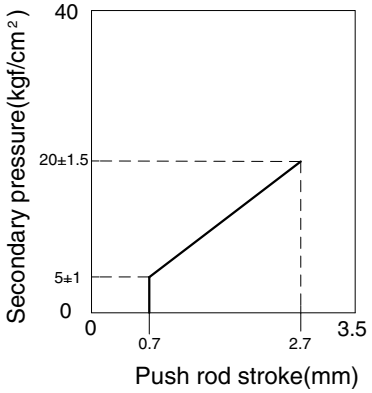
When the push rod (10) is stroked, the spool (19) moves downwards.
Then port P is connected with port 1, and the oil supplied from the pilot pump flows through port 1 to generate the pressure.
When the pressure at port 1 increases to the value corresponding to the spring force set by tilting the handle, 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.

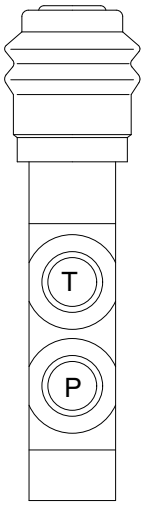
3. BOOM SWING PEDAL

1) STRUCTURE

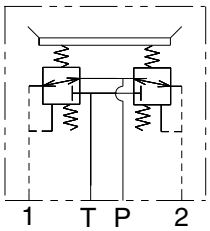
The casing has the oil inlet P (primary pressure) and the oil return port (tank).
In addition the secondary pressure is taken out through port 1 and port 2 provided at the housing bottom face.







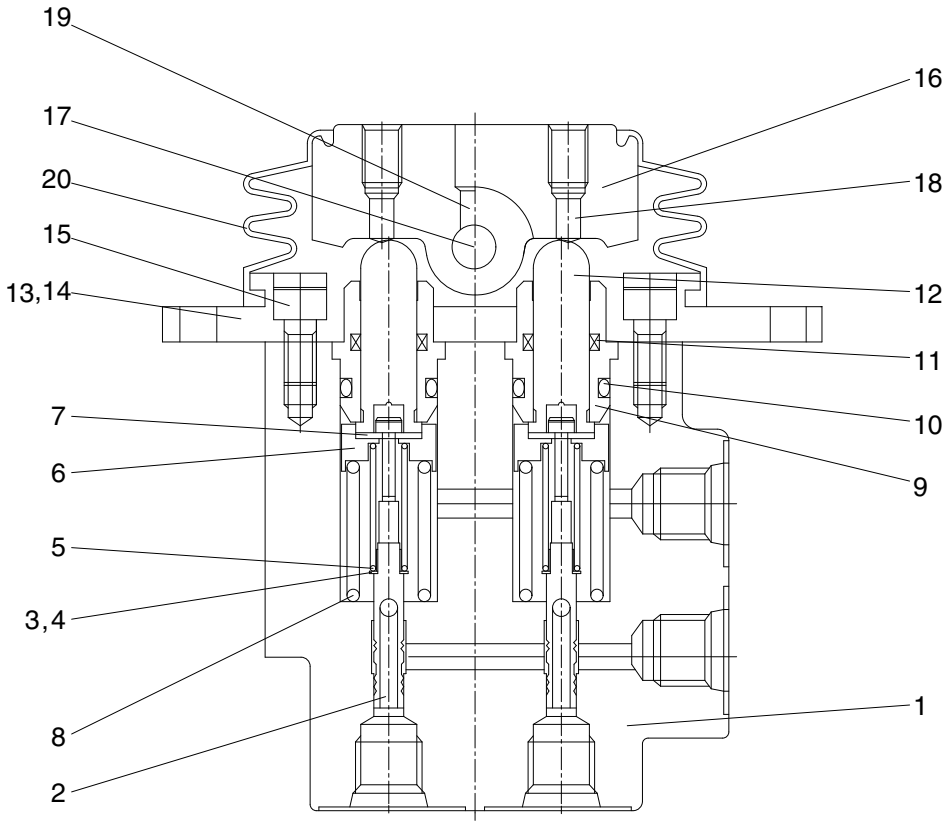
R35Z72RSP01



Hydraulic circuit

Port	Port name	Port size
P	Pilot oil inlet port	PF 1/4
T	Pilot oil return port	
1	Boom swing (LH)	
2	Boom swing (RH)	

2) COMPONENT



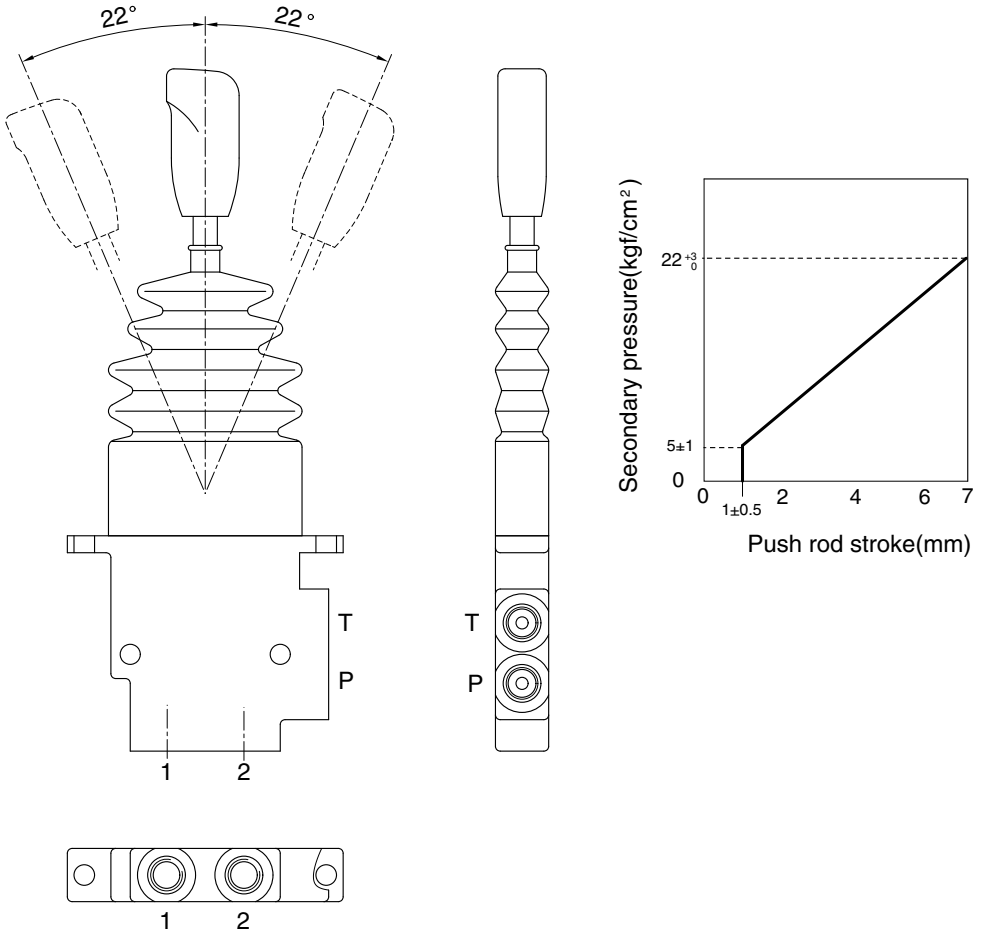
R35Z72RSP02

1	Body	8	Stopper	15	DU bush
2	Plug	9	Spring	16	Wrench bolt
3	O-ring	10	Plug	17	Cam
4	Spool	11	O-ring	18	Pin
5	Spring seat	12	Rod seal	19	Adjust screw
6	Spring	13	Push rod	20	Socket bolt
7	Spring seat	14	Cover	21	Bellows

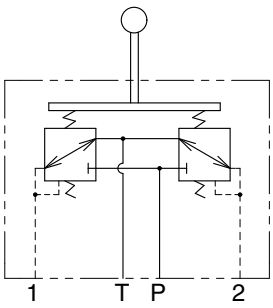
4. DOZER LEVER

1) STRUCTURE

The casing has the oil inlet P (primary pressure) and the oil return port (tank).
In addition the secondary pressure is taken out through port 1 and port 2 provided at the housing bottom face.



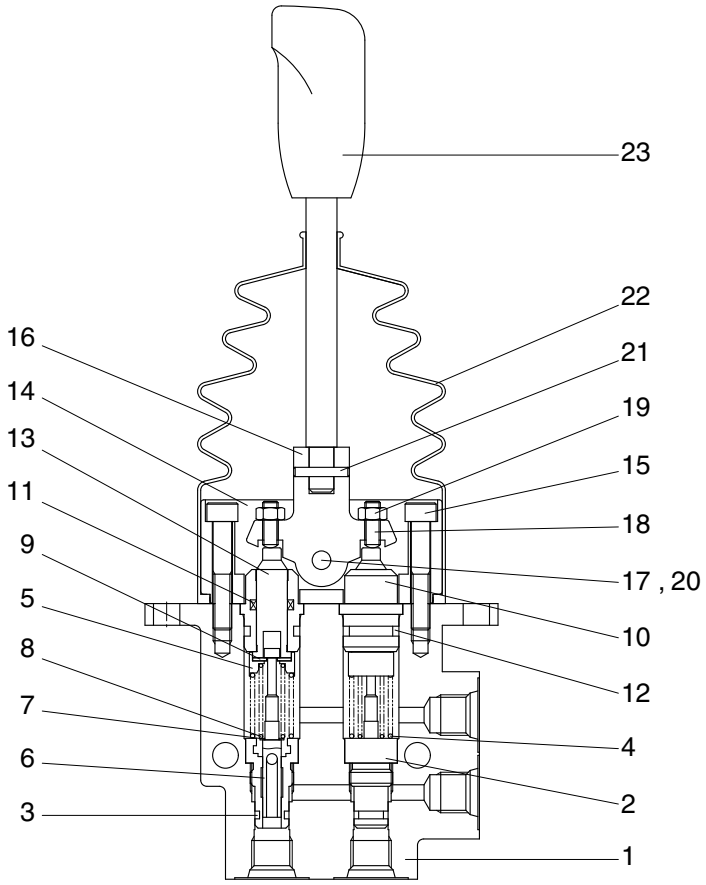
R35Z72DL01



Hydraulic circuit

Port	Port	Port size
P	Pilot oil inlet port	PF 1/4
T	Pilot oil return port	PF 1/4
1	Dozer blade up port	PF 1/4
2	Dozer blade down port	PF 1/4

2) COMPONENT



R35Z72DL02

1	Body	9	Stopper	17	Pin
2	Plug	10	Plug	18	Socket bolt
3	O-ring	11	Rod seal	19	Nut
4	Spring	12	O-ring	20	Snap ring
5	Spring seat	13	Push rod	21	Spring pin
6	Spool	14	Cover	22	Bellows
7	Spring seat	15	Wrench bolt	23	Lever
8	Spring	16	Guide		