SECTION 2 STRUCTURE AND FUNCTION

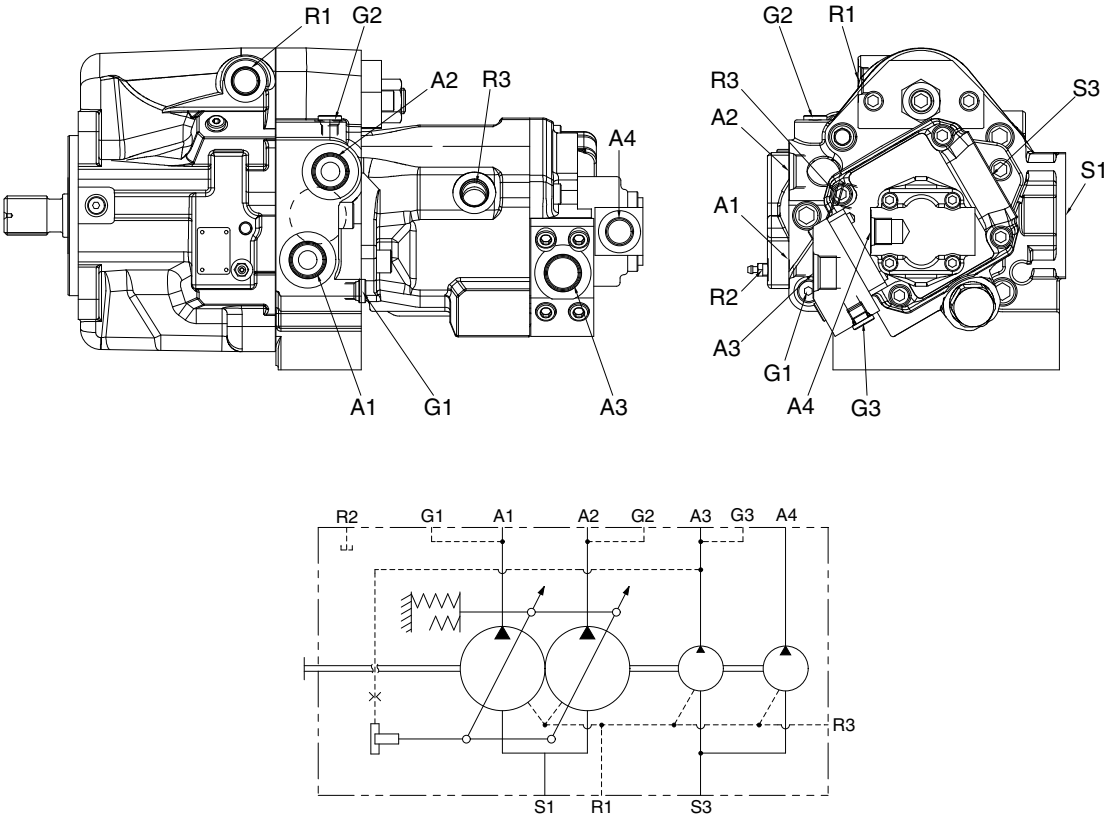
GROUP 1 HYDRAULIC PUMP

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.



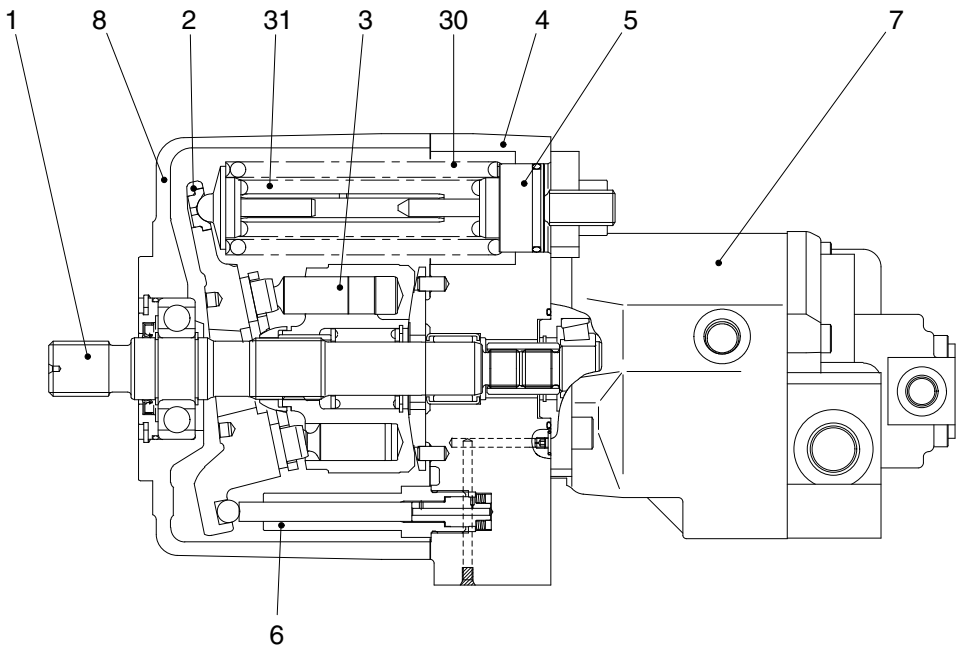
Hydraulic circuit

80CR92MP01

Description of the ports

Port	Name	Bore
S1	Suction port	SAE 2 (standard)
S3	Suction port	SAE 1 1/4 (standard)
A1, A2	Discharge port	PF 3/4
A3	Discharge port	PF 3/4
A4	Discharge port	PF 1/2
R1	Drain port	PF 1/2
R2	Air bleeder port	M10 × 1.0 (with bleeder valve)
R3	Drain port	PF 1/2
G1, G2, G3	Gauge port	PF 1/4 with quick coupler

2. PRINCIPAL COMPONENTS AND FUNCTIONS



80CR92MP02

1	Drive shaft	6	Control piston
2	Hanger	7	Piston pump
3	Rotary group	8	Housing
4	Cover	30	Spring
5	Spring seat	31	Spring

SPECIFICATIONS

- Capacity : 2 × 36+28+8.9 cc/rev
- Rated oil flow : 2 × 68.4+53+16.9 ℓ /min
- Maximum pressure : 2 × 280+230+35 kgf/cm^2

1) PISTON PUMP

This is a variable displacement double-piston pump for discharge with two equal displacements from one cylinder block. Because this is one rotary group, 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 oil pressure caused by the discharge pressure acts on the hanger and 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 third pump and pilot pump can be connected to the same shaft via a coupling.

2) PRINCIPLE OF OPERATION

(1) Function of pump

Displacement q (cm^3)

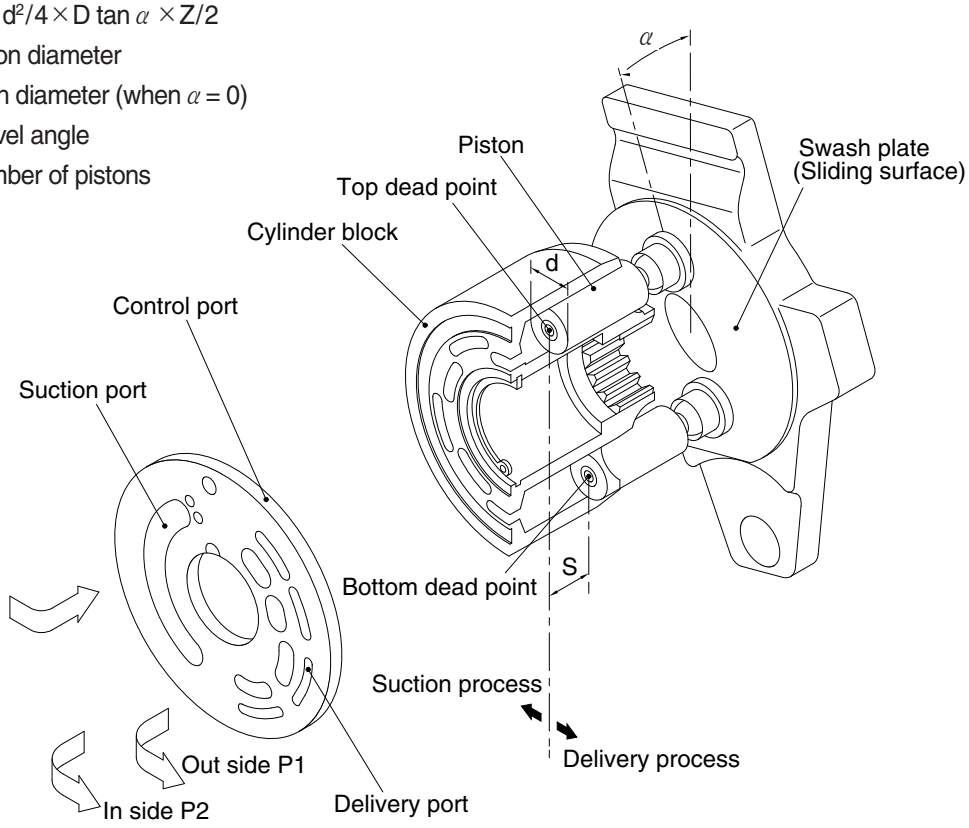
$q = \pi \times d^2/4 \times D \tan\alpha \times Z/2$

d : Piston diameter

D : Pitch diameter (when $\alpha = 0$)

α : Swivel angle

Z : Number of pistons



80CR92MP03

The cylinder block is connected via spline and can rotate together with the drive shaft.

The piston assembled into the cylinder block performs reciprocal operation while following the swash plate on the hanger.

The piston moves in a direction to increase the displacement during a stroke from the top to the bottom dead points. The oil flows from the suction port via a cover into the cylinder block (suction process).

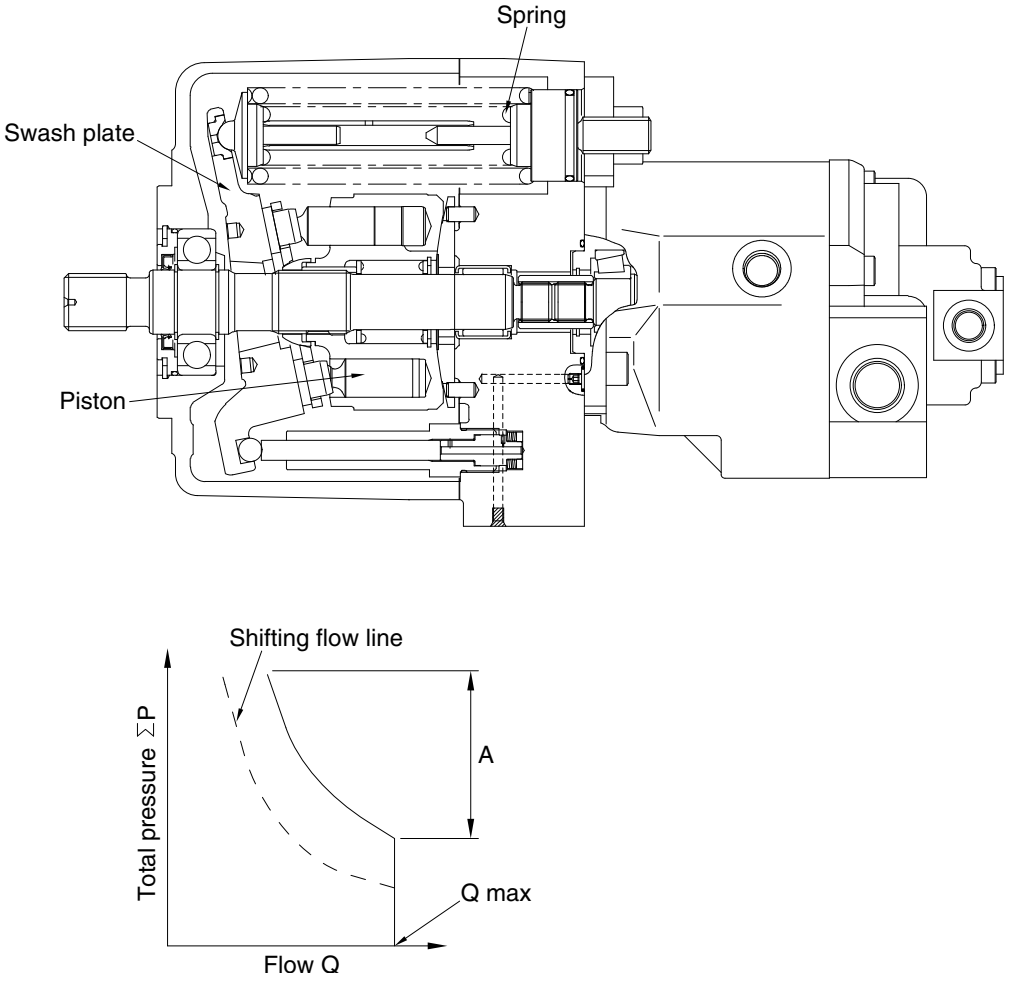
During a stroke from the bottom to the top dead points, the piston moves in a direction to decrease the displacement. The oil is discharged to the discharge port (discharge process).

Charging the tilting of the hanger can be change the displacement.

The oil sucked through the port in the cylinder block is discharged from the discharge port on the inside of the control plate.

The oil sucked through the port on the outside of the cylinder block is discharged from the discharge port on the outside of the port plate.

2) CONTROL FUNCTIONS



80CR92MP04

The delivery pressure P1 and P2 are directed to the piston which slides on the swash plate, and acts on the swash plate.

The spring is provided to act against the delivery pressure.

When the oil pressure via piston acting on the swash plate is less than the installation load of the spring, the swash plate is fixed to the maximum tilting position.

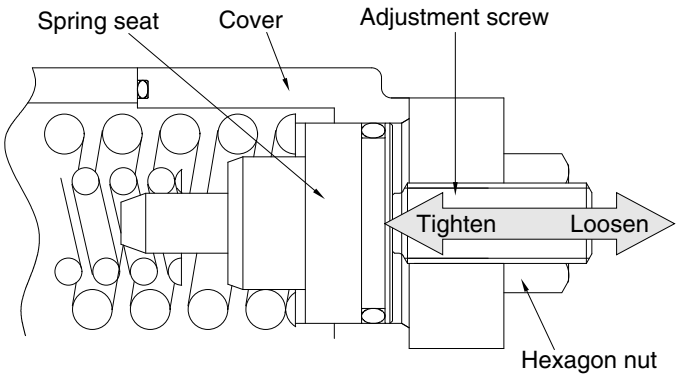
When the oil pressure via piston acting on the swash plate exceeds the installation load of the spring, the swash plate is tilted and kept tilted at a position where the oil pressure is balanced with the spring force (region A in above figure).

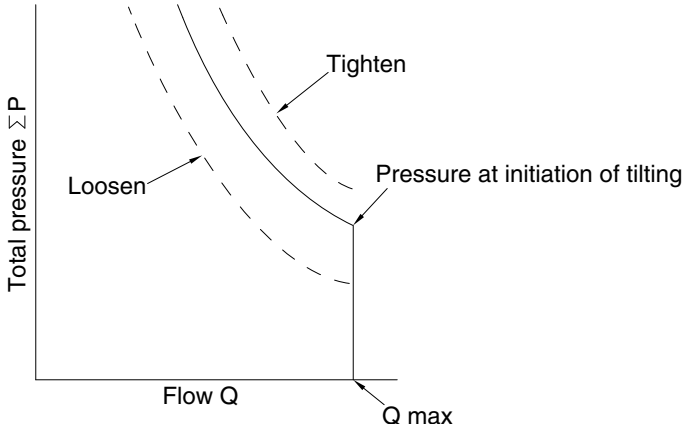
When the P3 oil pressure acts on the shift piston, the control shifting line is shifted.

3) ADJUSTMENT PROCEDURE OF SETTING TORQUE

(1) Loosen the hexagonal nut.

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

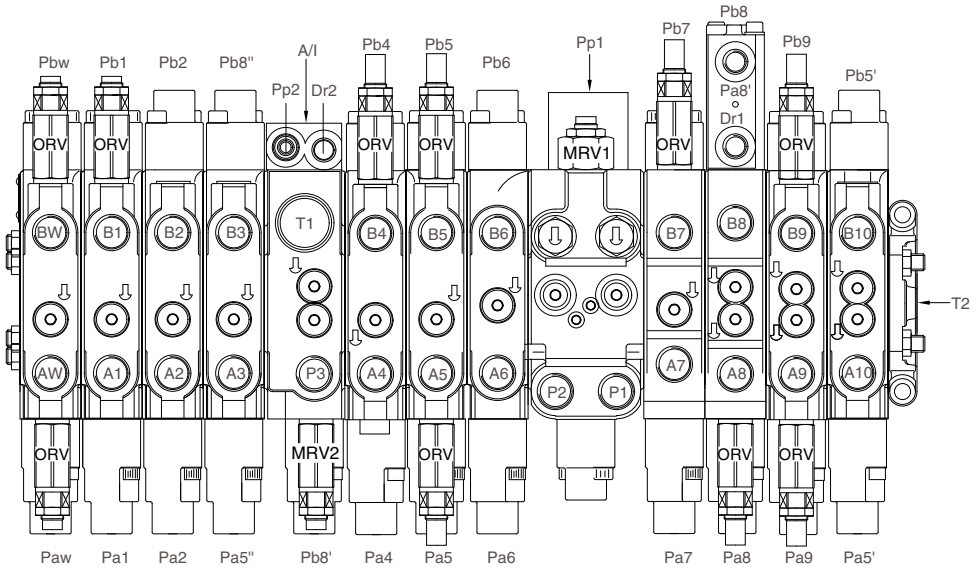




80CR92MP05

GROUP 2 MAIN CONTROL VALVE

1. OUTLINE

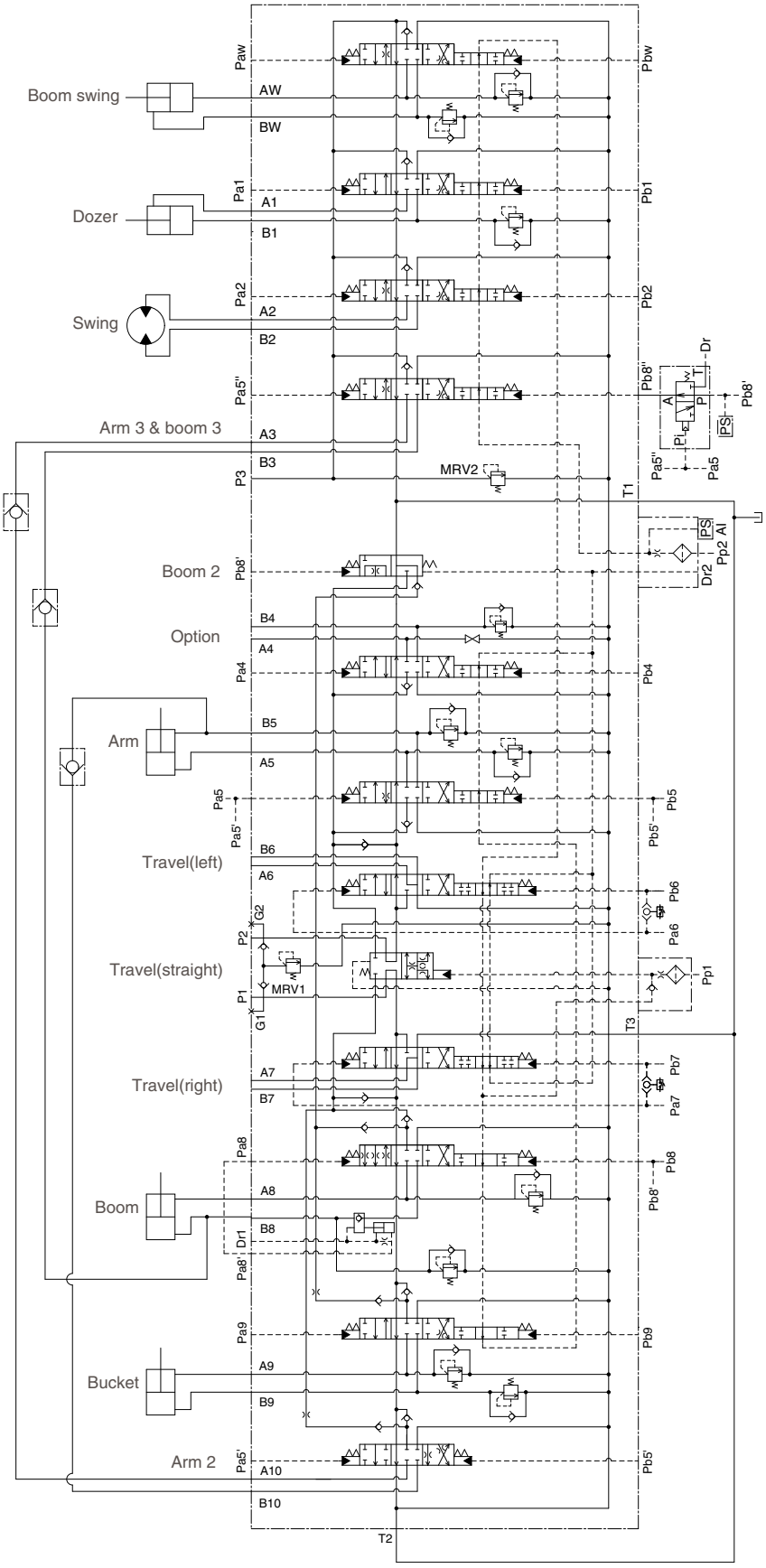


80CR9A2MC01

Mark	Port name	Port size	Tightening torque
P1	P 1 inlet port	PF 1/2	6.0~7.0 kgf · m
P2	P 2 inlet port		
P3	P 3 inlet & boom 2 port		
T1	P 3 & boom 2 tank port	PF1	10~12 kgf · m
T2	End cover tank port	PF 1/2	6.0~7.0 kgf · m
T3	Travel tank port		
A1	Dozer port		
B1			
A2	Swing port		
B2			
A3	Arm 3 & boom 3 port		
B3			
A4	Option port		
B4			
A5	Arm port		
B5			
A6	Travel port (left)		
B6			
A7	Travel port (right)		
B7			
A8	Boom port		
B8			
A9	Bucket port		
B9			
A10	Arm 2 port		
B10			
AW	Boom swing port		
BW			

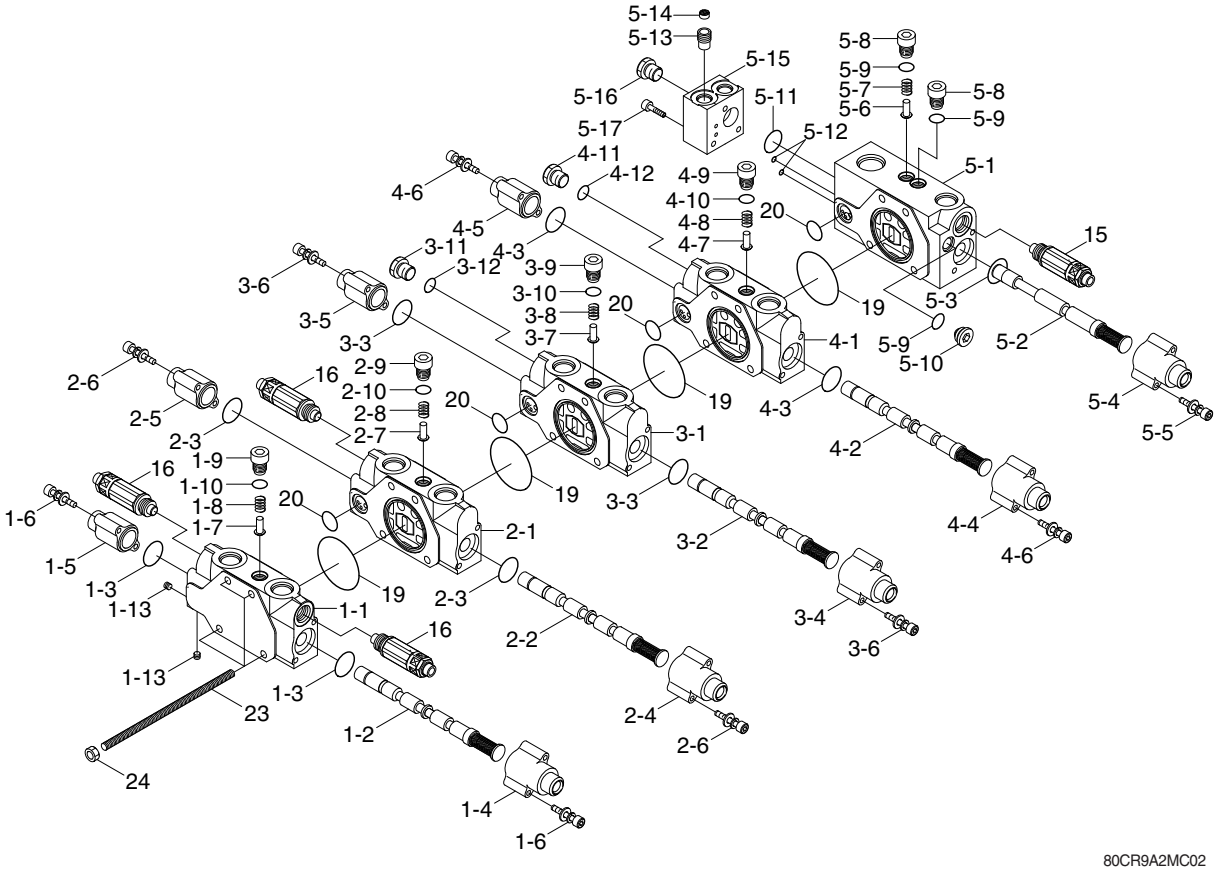
Mark	Port name	Port size	Tightening torque
Pa1	Dozer pilot port	PF 1/4	2.5~3.0 kgf · m
Pb1			
Pa2	Swing pilot port		
Pb2			
Pa3	Arm 3 & boom 3 pilot port		
Pb3			
Pb8'	P 3 inlet & boom 2 pilot port		
Pa4	Option pilot port		
Pb4			
Pa5	Arm pilot port		
Pb5			
Pa6	Travel pilot port (left)		
Pb6			
Pa7	Travel pilot port (right)		
Pb7			
Pa8	Boom pilot port		
Pb8			
Pa9	Bucket pilot port		
Pb9			
Pa5'	Arm 2 pilot port		
Pb5'			
Paw	Boom swing pilot port		
Pbw			
Pp1	P1, P2 & straight travel pilot port		
Pp2	P3 & boom 2 pilot port		
Dr2	P3 & boom 2 drain port		
A/I	Auto idle pilot port		
Pa8'	Boom lock valve release pilot port		
Dr1	Boom lock valve drain port		

2. HYDRAULIC CIRCUIT



80CR9A2MC06

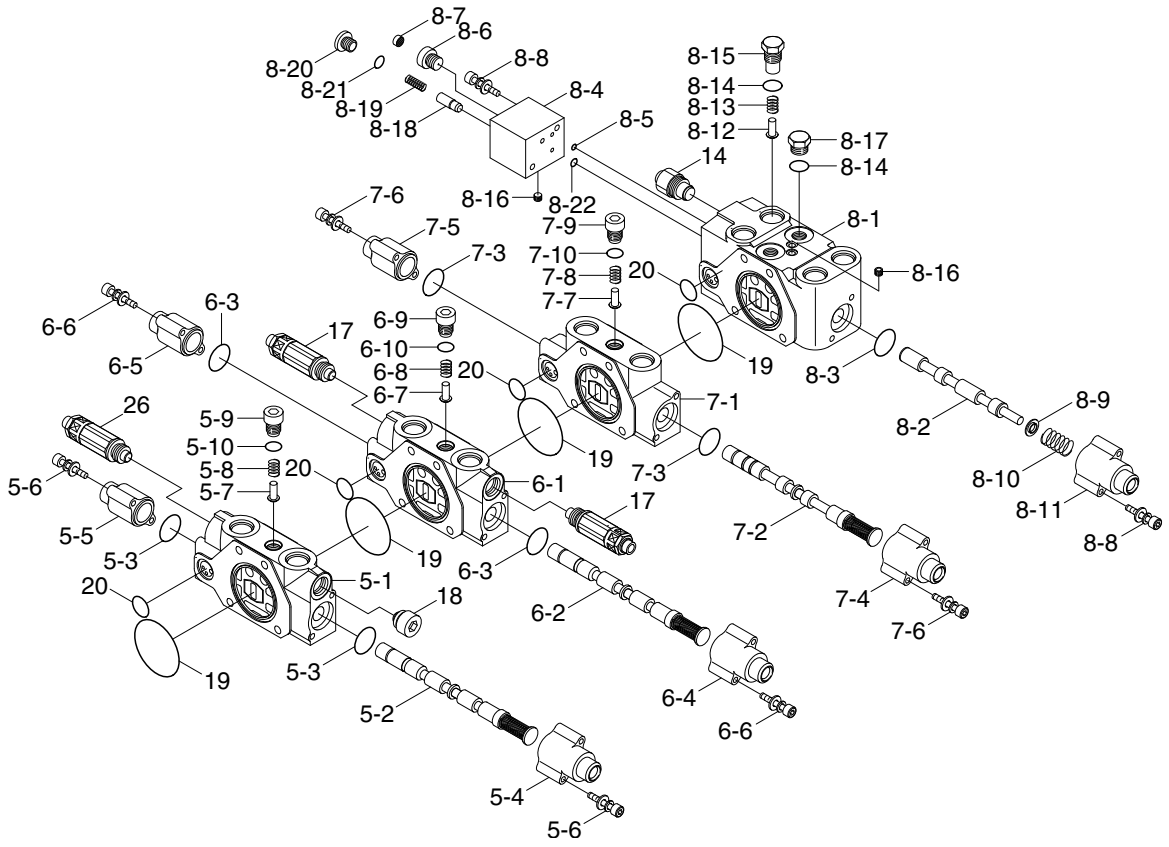
3. STRUCTURE (1/4)



80CR9A2MC02

1	Boom swing block	3-2	Swing spool assy	5	Boom 2 block
1-1	Work body	3-3	O-ring	5-1	Work body
1-2	Boom swing spool assy	3-4	Pilot cover	5-2	Boom 2 spool assy
1-3	O-ring	3-5	Pilot cover	5-3	O-ring
1-4	Pilot cover	3-6	Socket bolt	5-4	Pilot cover
1-5	Pilot cover	3-7	Poppet	5-5	Socket bolt
1-6	Socket bolt	3-8	Spring	5-6	Check valve poppet
1-7	Poppet	3-9	Check valve plug	5-7	Spring
1-8	Spring	3-10	O-ring	5-8	Check valve plug
1-9	Check valve plug	3-11	Plug	5-9	O-ring
1-10	O-ring	3-12	O-ring	5-10	Plug
1-13	Plug	4	Arm 3 & boom 3 block	5-11	O-ring
2	Dozer block	4-1	Work body	5-12	O-ring
2-1	Work body	4-2	Arm 3 & boom 3 spool	5-13	Orifice
2-2	Dozer spool assy	4-3	O-ring	5-14	Coin type filter
2-3	O-ring	4-4	Pilot cover	5-15	Pilot body
2-4	Pilot cover	4-5	Pilot cover	5-16	Plug
2-5	Pilot cover	4-6	Socket bolt	5-17	Socket bolt
2-6	Socket bolt	4-7	Poppet	15	Relief valve
2-7	Poppet	4-8	Spring	16	Relief valve
2-8	Spring	4-9	Check valve plug	19	O-ring
2-9	Check valve plug	4-10	O-ring	20	O-ring
2-10	O-ring	4-11	Plug	23	Tie bolt
3	Swing block	4-12	O-ring	24	Hexagon nut
3-1	Work body				

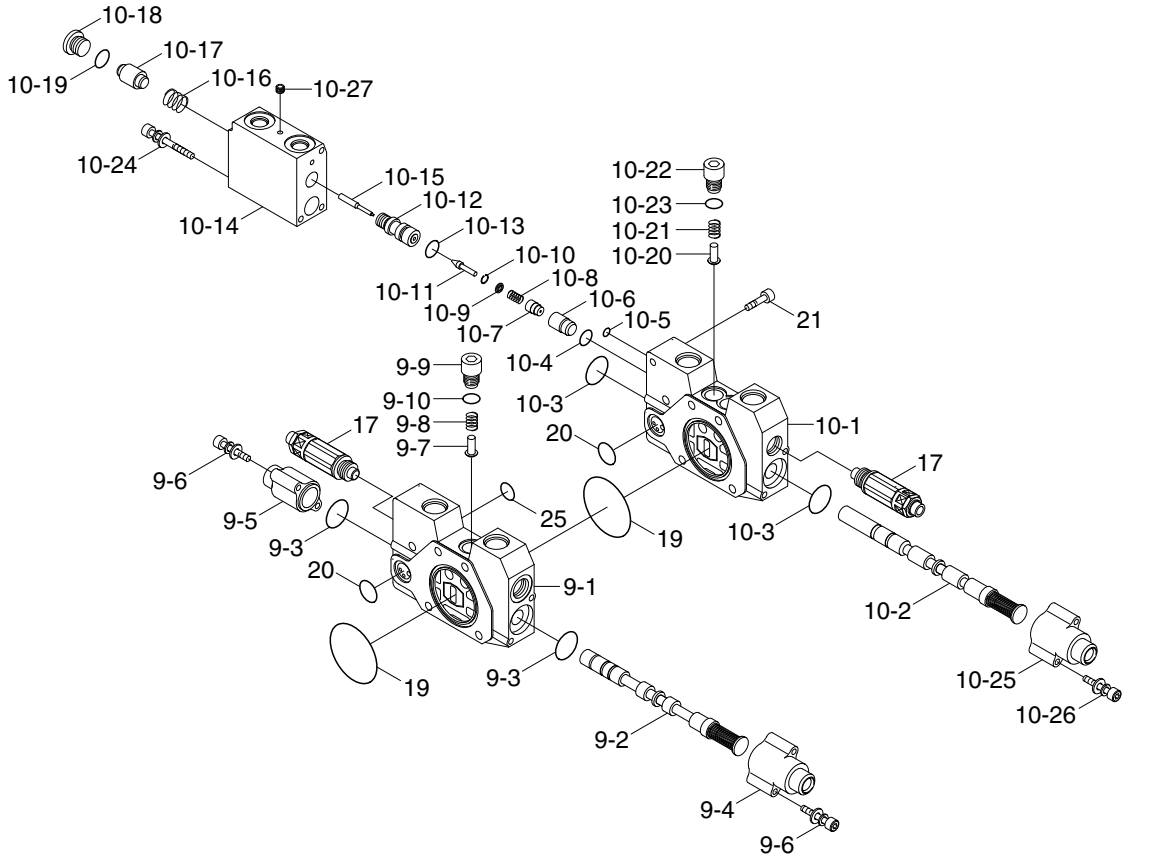
STRUCTURE (2/4)



80CR92MC03

5	Service block	6-10	O-ring	8-9	Spring seat
5-1	Work body	7	Left travel block	8-10	Spring
5-2	Service spool assy	7-1	Work body	8-11	Pilot cover
5-3	O-ring	7-2	Travel spool assy	8-12	Check valve poppet
5-4	Pilot cover	7-3	O-ring	8-13	Check valve spring
5-5	Pilot cover	7-4	Pilot cover	8-14	O-ring
5-6	Socket bolt	7-5	Pilot cover	8-15	Check valve plug
5-7	Poppet	7-6	Socket bolt	8-16	Plug
5-8	Spring	7-7	Check valve poppet	8-17	Plug
5-9	Check valve plug	7-8	Spring	8-18	Check valve
5-10	O-ring	7-9	Check valve plug	8-19	Check valve spring
6	Arm block	7-10	O-ring	8-20	Plug
6-1	Work body	8	Straight travel block	8-21	O-ring
6-2	Arm spool assy	8-1	Work body	8-22	O-ring
6-3	O-ring	8-2	Travel spool assy	14	Main relief valve
6-4	Pilot cover	8-3	O-ring	17	Relief valve
6-5	Pilot cover	8-4	Pilot body	18	Plug
6-6	Socket bolt	8-5	O-ring	19	O-ring
6-7	Poppet	8-6	Orifice	20	O-ring
6-8	Spring	8-7	Coin type filter	26	Relief valve
6-9	Check valve plug	8-8	Socket bolt		

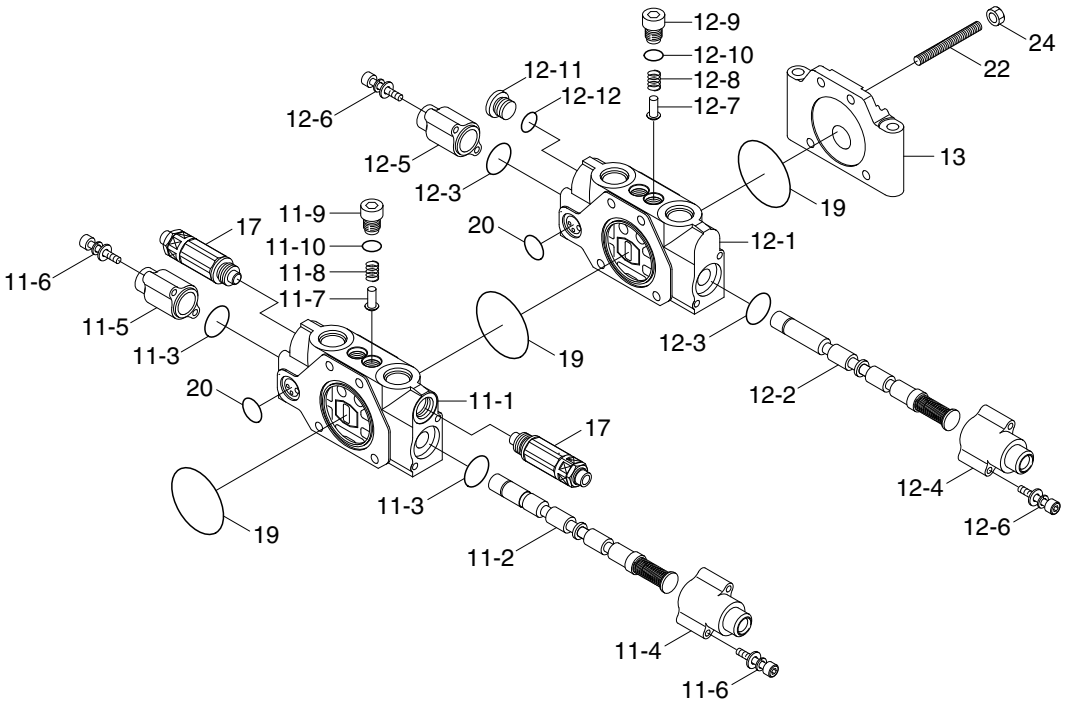
STRUCTURE (3/4)



80CR92MC04

9	Right travel block	10-4	O-ring	10-19	O-ring
9-1	Work body	10-5	O-ring	10-20	Poppet
9-2	Travel spool assy	10-6	Lock valve	10-21	Spring
9-3	O-ring	10-7	Lock restrictor	10-22	Check valve plug
9-4	Pilot cover	10-8	Holder spring	10-23	O-ring
9-5	Pilot cover	10-9	Holder spring	10-24	Socket bolt
9-6	Socket bolt	10-10	Retaining ring	10-25	Pilot cover
9-7	Check valve plug	10-11	Poppet	10-26	Socket bolt
9-8	Spring	10-12	Piston guide	10-27	Plug
9-9	Check valve plug	10-13	O-ring	17	Relief valve
9-10	O-ring	10-14	Pilot cover	19	O-ring
10	Boom block	10-15	Piston	20	O-ring
10-1	Work body	10-16	Lock valve spring	21	Socket bolt
10-2	Boom spool assy	10-17	Piston	25	O-ring
10-3	O-ring	10-18	Plug		

STRUCTURE (4/4)



80CR92MC05

11	Bucket block	11-10	O-ring	12-9	Check valve plug
11-1	Work body	12	Arm 2 block	12-10	O-ring
11-2	Bucket spool assy	12-1	Work body	12-11	Plug
11-3	O-ring	12-2	Arm 2 spool assy	12-12	O-ring
11-4	Pilot cover	12-3	O-ring	13	End cover
11-5	Pilot cover	12-4	Pilot cover	17	Reliefvalve
11-6	Socket bolt	12-5	Pilot cover	19	O-ring
11-7	Poppet	12-6	Socket bolt	20	O-ring
11-8	Spring	12-7	Poppet	22	Tie bolt
11-9	Check valve plug	12-8	Spring	24	Hexagon nut

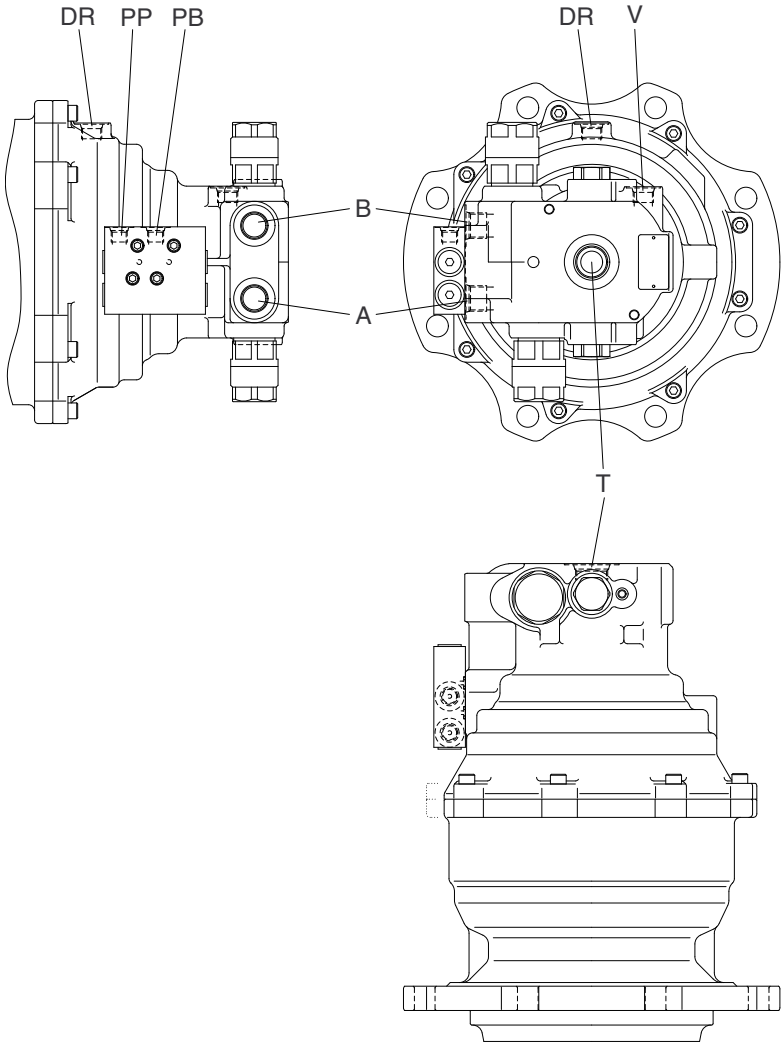
GROUP 3 SWING DEVICE

1. STRUCTURE

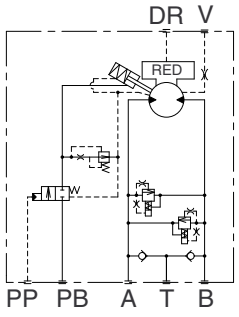
Swing device consists swing motor and swing reduction gear.

1) SWING MOTOR

Swing motor include mechanical parking valve, relief valve, make up valve and time delay valve.



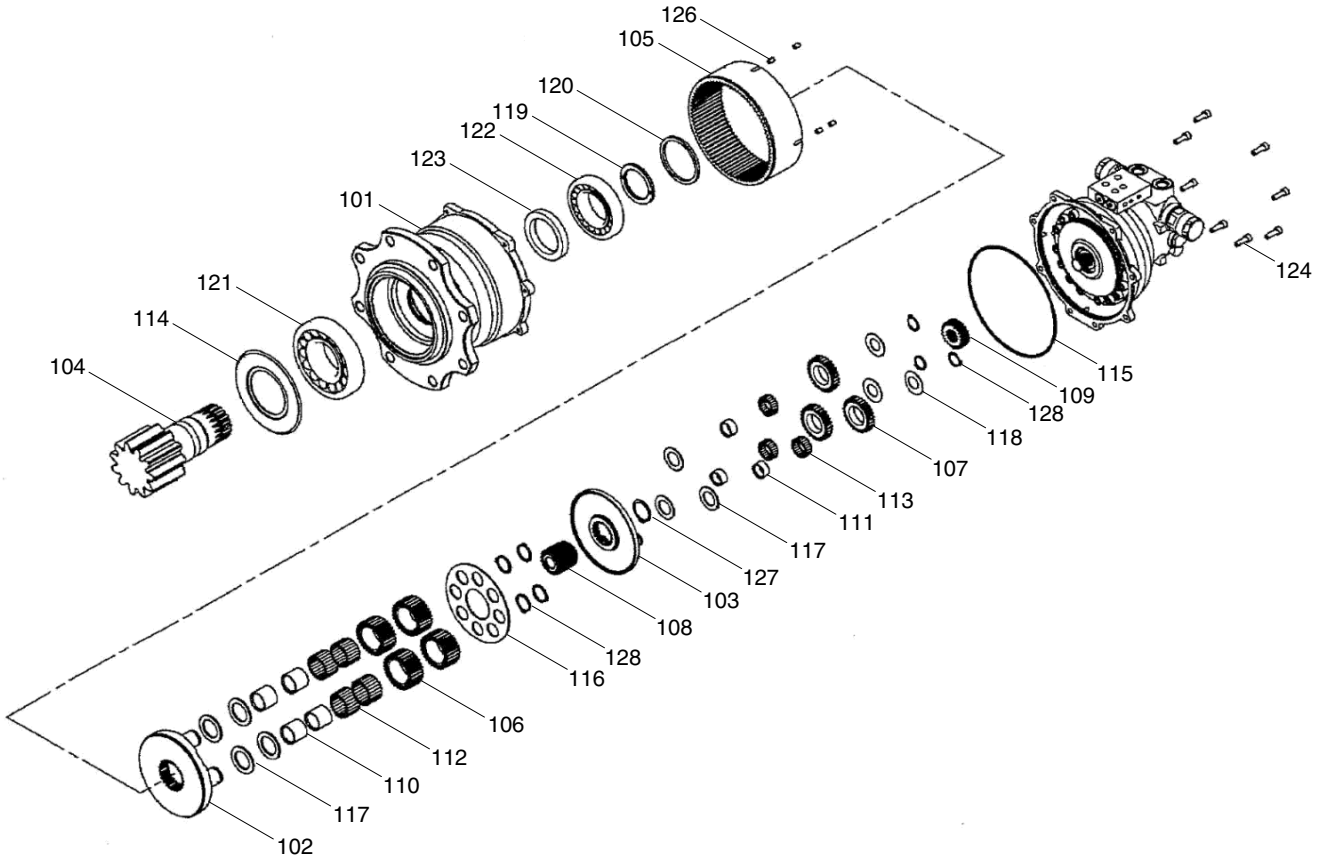
Port	Port name	Port size
A	Main port	PF 1/2
B	Main port	PF 1/2
DR	Drain port	PF 3/8
T	Make up port	PF 3/4
PB	Brake release stand by port	PF 1/4
PP	Brake release pilot port	PF 1/4
V	Air vent port	PF 3/8



HYDRAULIC CIRCUIT

80CR9A2SM01

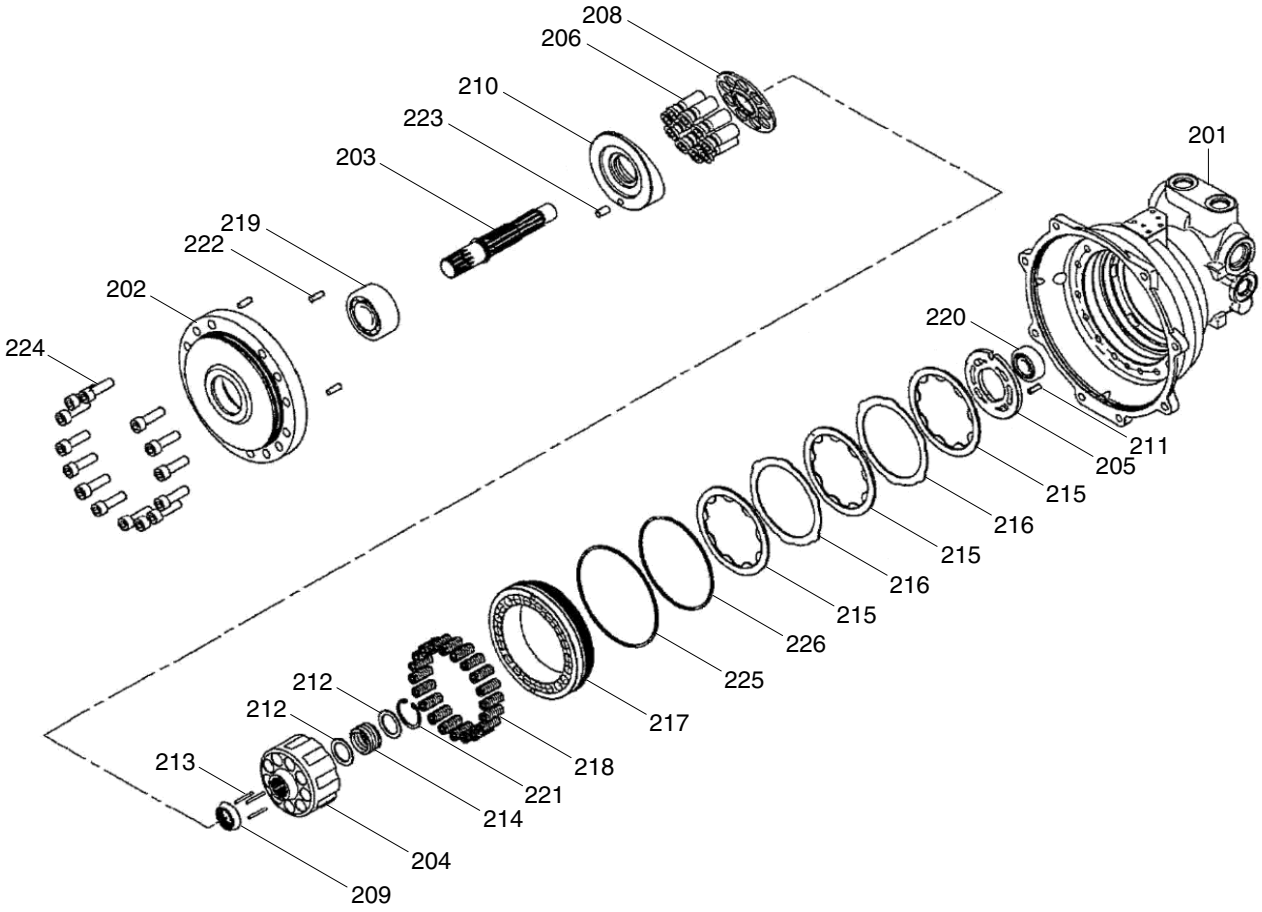
2) COMPONENTS (1/3)



80CR9A2SM15

101	Body	110	Ring 1	119	Preload collar
102	Carrier 1	111	Ring 2	120	Ring
103	Carrier 2	112	Needle	121	Bearing
104	Pinion shaft	113	Needle	122	Bearing
105	Internal gear	114	Ring seal	123	Oil seal
106	Gear B1	115	O-ring	124	Screw
107	Gear B2	116	Thrust plate	126	Bushing pin
108	Gear S1	117	Thrust washer 1	127	Snap ring
109	Gear S2	118	Thrust washer 2	128	Snap ring

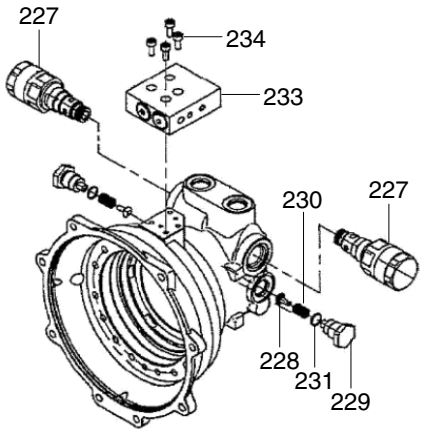
COMPONENTS (2/3)



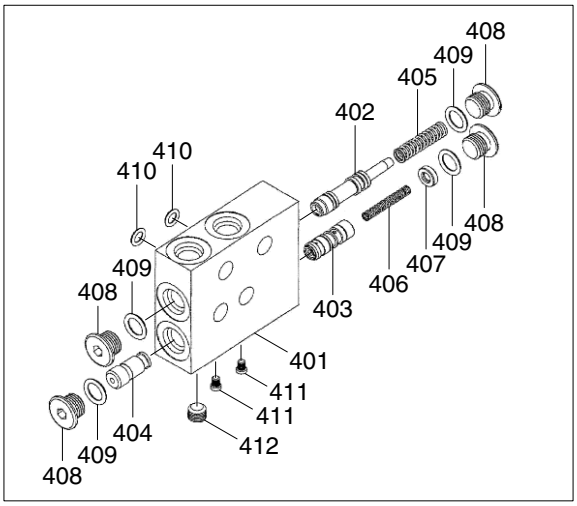
80CR9A2SM16

201	Body H	211	Spring pin	220	Bearing
202	Plate S	212	Retainer	221	Snap ring
203	Shaft	213	Pin	222	Pin
204	Cylinder barrel	214	Spring C	223	Pin
205	Valve plate	215	Disk plate	224	Screw
206	Piston assy	216	Steel plate	225	O-ring
208	Shoe holder	217	Brake piston	226	O-ring
209	Barrel holder	218	Spring B		
210	Swash plate	219	Bearing		

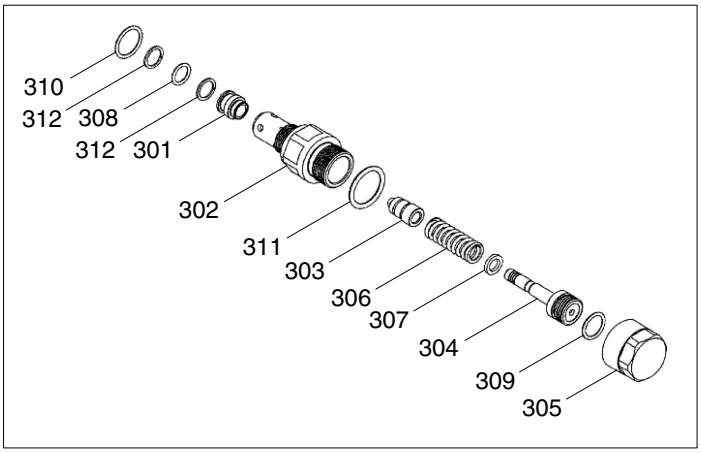
COMPONENTS (3/3)



DETAIL ITEM 233



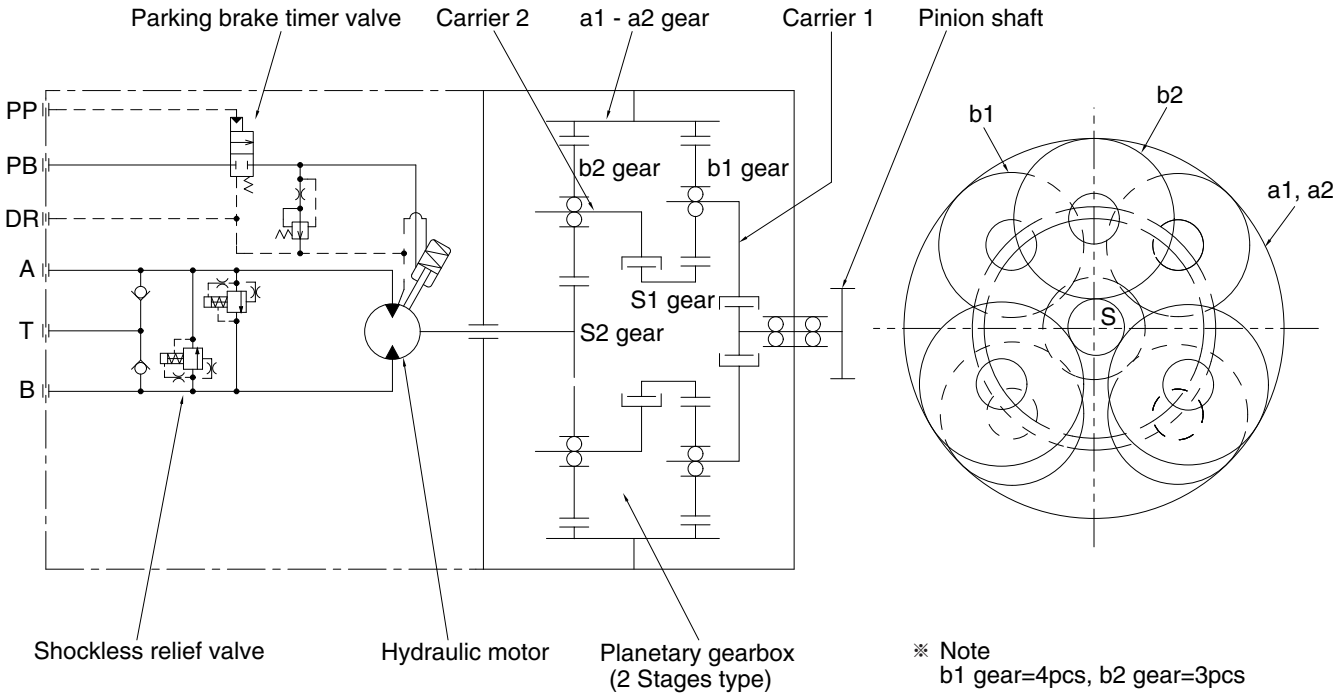
DETAIL ITEM 227



80CR9A2SM16-1

227	Relief valve	305	Cap	404	Stopper
228	Check valve	306	Spring	405	Spring
229	Plug	307	Spacer	406	Spring
230	Spring	308	O-ring	407	Spring holder
231	O-ring	309	O-ring	408	Plug
233	P/brake timer valve	310	O-ring	409	O-ring
234	Screw	311	O-ring	410	O-ring
301	Seat	312	Back-up ring	411	Metal plug
302	Retainer	401	Body	412	Plug
303	Poppet	402	Spool		
304	Piston	403	Piston		

2. OPERATION PRINCIPLE



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 two stages. The high output speed of the hydraulic motor is reduced to low speed with high torque and obtaining the pinion shaft rotation.

(2) Operation

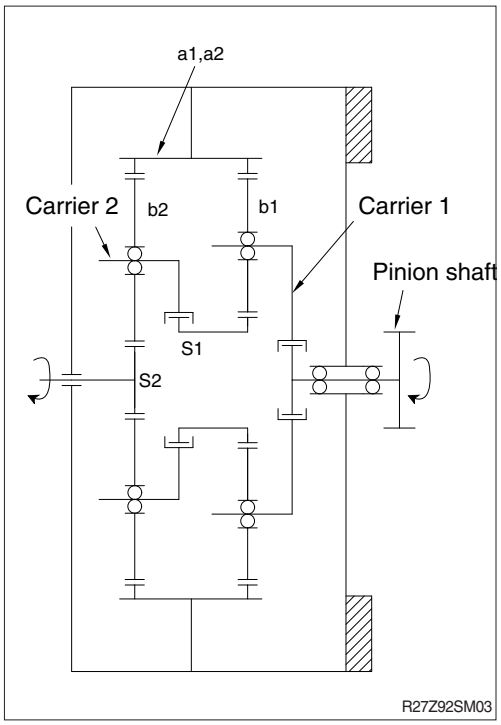
The s2 gear is attached to the hydraulic motor shaft, and the s2 output speed is reduced between the gears (s2, b2, a2).

This reduced output speed is transmitted to the s1 gear and the speed is reduced again between the gears (s1, b1, a1), and it is transmitted to the pinion shaft, and drives the machine.

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

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

※ Z ** : Number of gear teeth.



2) HYDRAULIC MOTOR SECTION

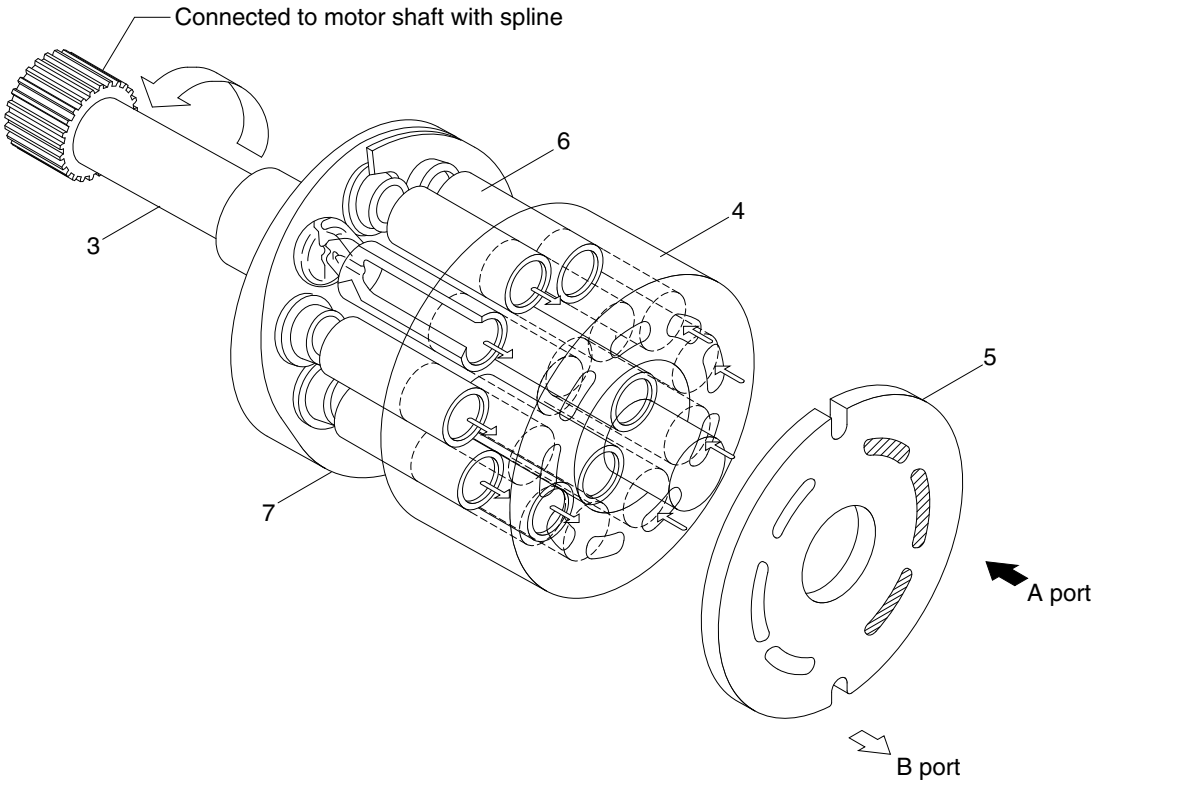
(1) Function

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.



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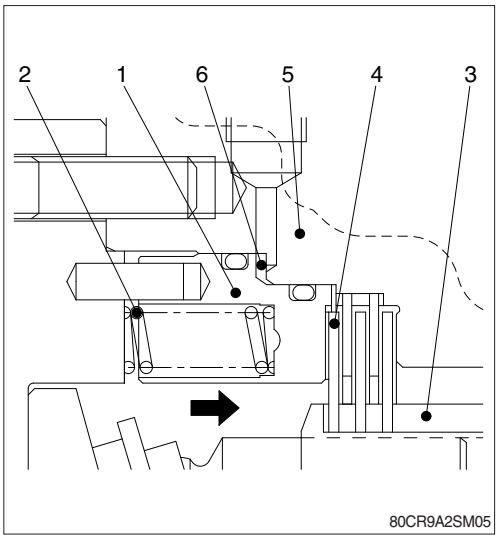
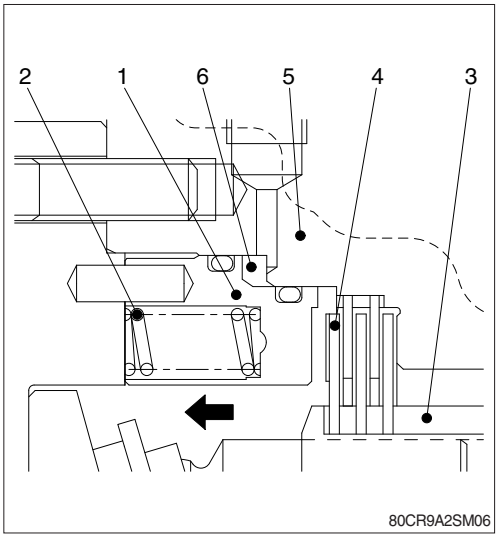
(3) Parking brake

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



① At the brake releasing pressure OFF

When brake releasing pressure is not supplied, the brake piston (1) is pressed in the direction (shown as arrow) by the spring (2). Then the disk plate (4) which is fixed to the cylinder barrel (3) is held between the body H (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.



② At the brake releasing pressure ON

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

Then the brake piston (1) is moved to the direction (shown as arrow) 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.

3) HYDRAULIC VALVE SECTION

(1) Shockless relief valve

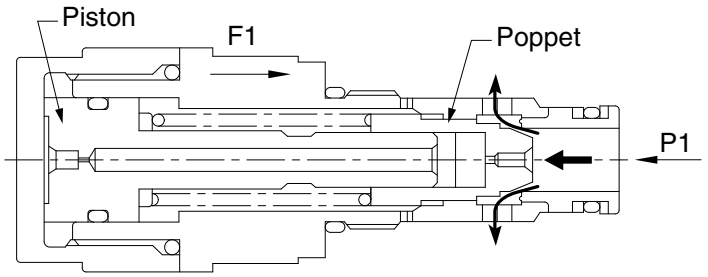
The shockless relief valve consists of the direct relief valve (poppet) and the piston for changing the spring force with two stages.

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

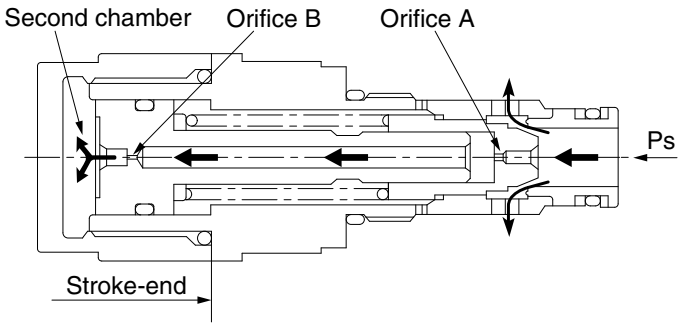
When the P1 pressure is going up, the poppet opens due to the pressure of the spring force F1.



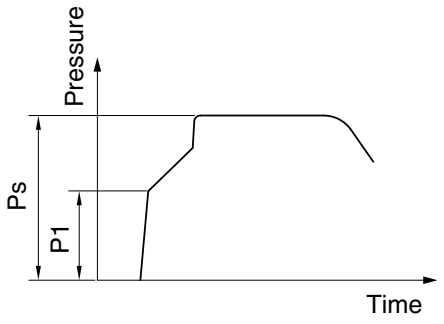
80CR9A2SM07

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.



80CR9A2SM08



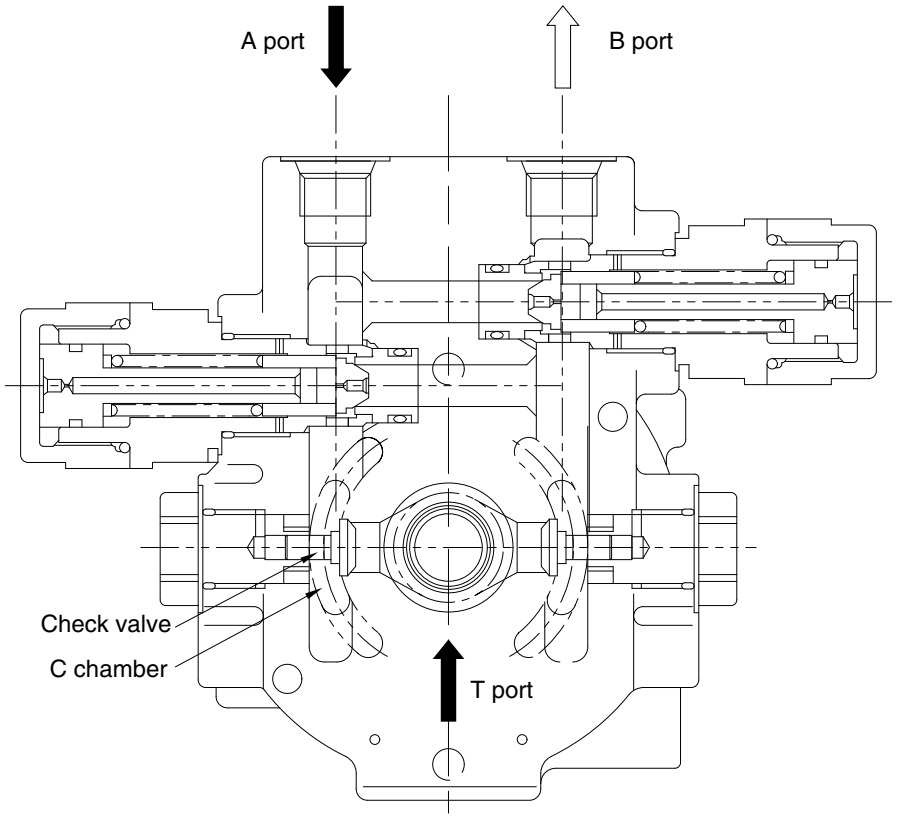
80CR9A2SM09

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.



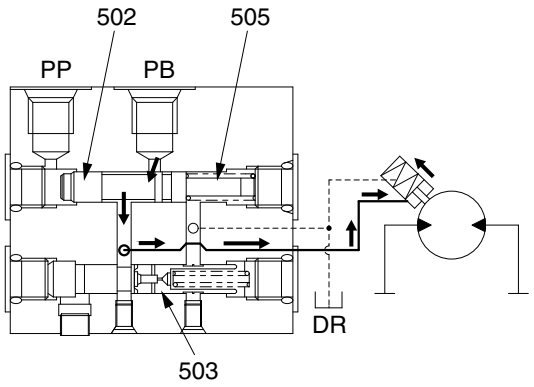
80CR9A2SM10

(3) P/B timer valve

P/B timer valve delays the parking brake activating for a period of time until the swing motor stops to prevent the hydraulic motor being damaged.

① When the parking brake is released

Brake pilot pressure is supplied to the PP port. The spool (502) is moved to the position against the force of the spring (505). Then, the oil is led to the parking brake section through the path (shown as arrow in figure), and it releases the parking brake.



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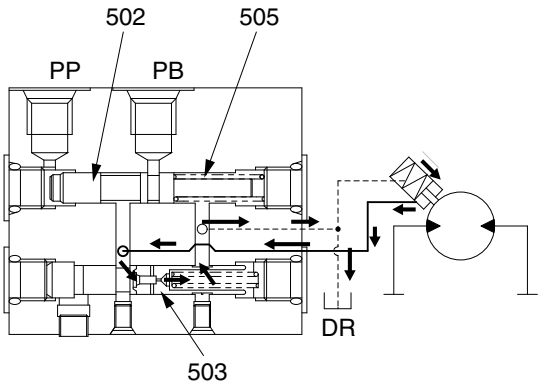
② When the parking brake is activated

Brake pilot pressure in PP port is shut off. The spool (502) is returned to the position by the force of the spring (505), and the brake releasing pressure to the parking brake section is shut off by spool (502). Then the oil in the parking brake section is pushed back to DR port through the path (shown as arrow in figure) by the force of the springs in the parking brake section, but it is choked by the orifice in the piston (503), and is gradually dumped to DR port. As a result, brake activation is delayed.



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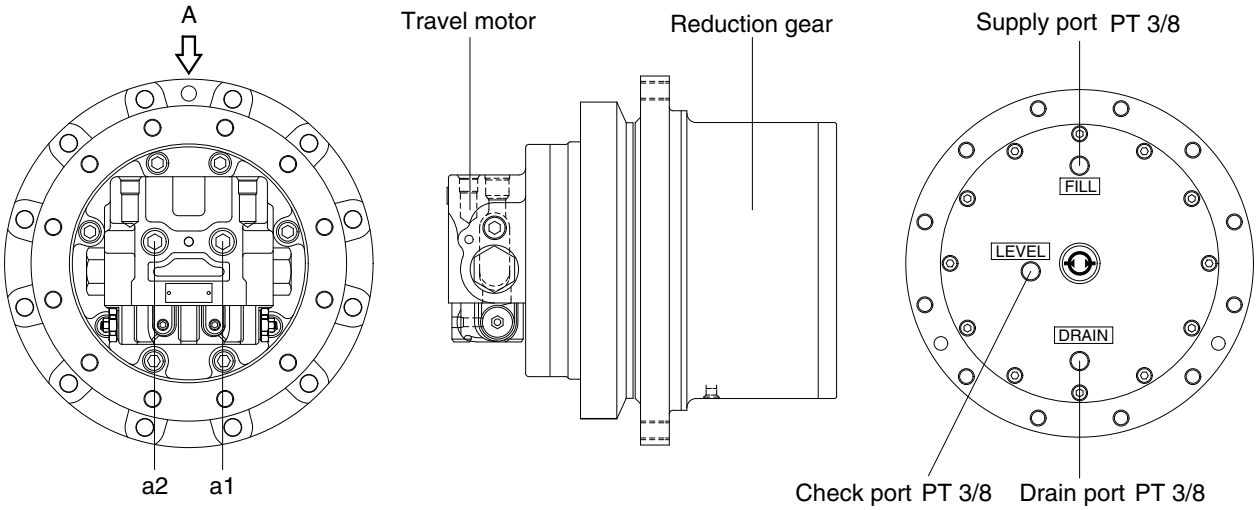
GROUP 4 TRAVEL DEVICE

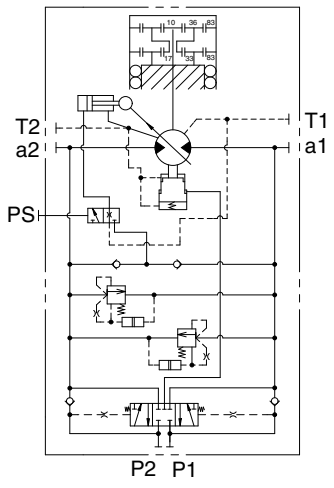
1. CONSTRUCTION

Travel device consists travel motor and gear box.

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



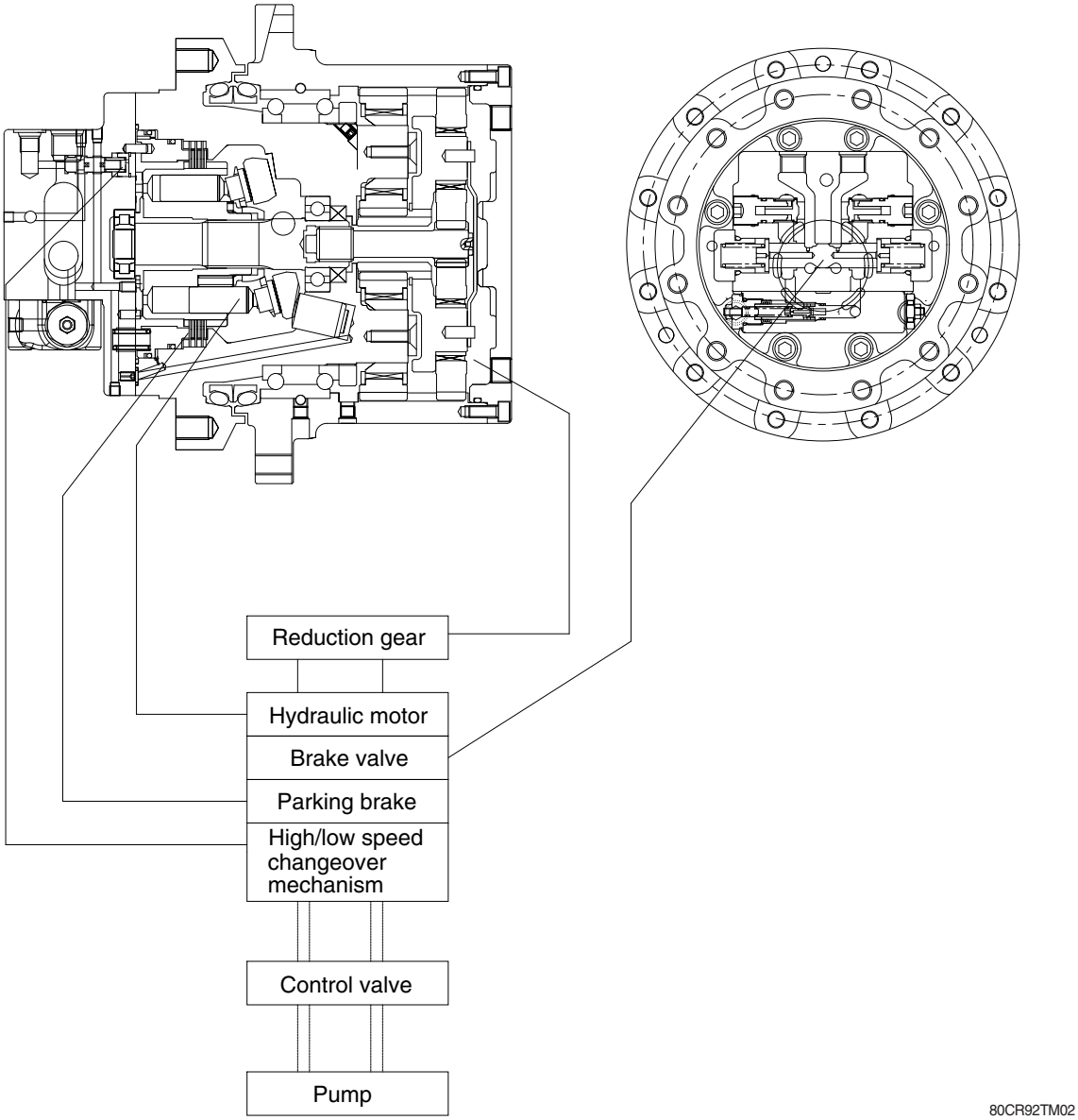
80CR92TM01



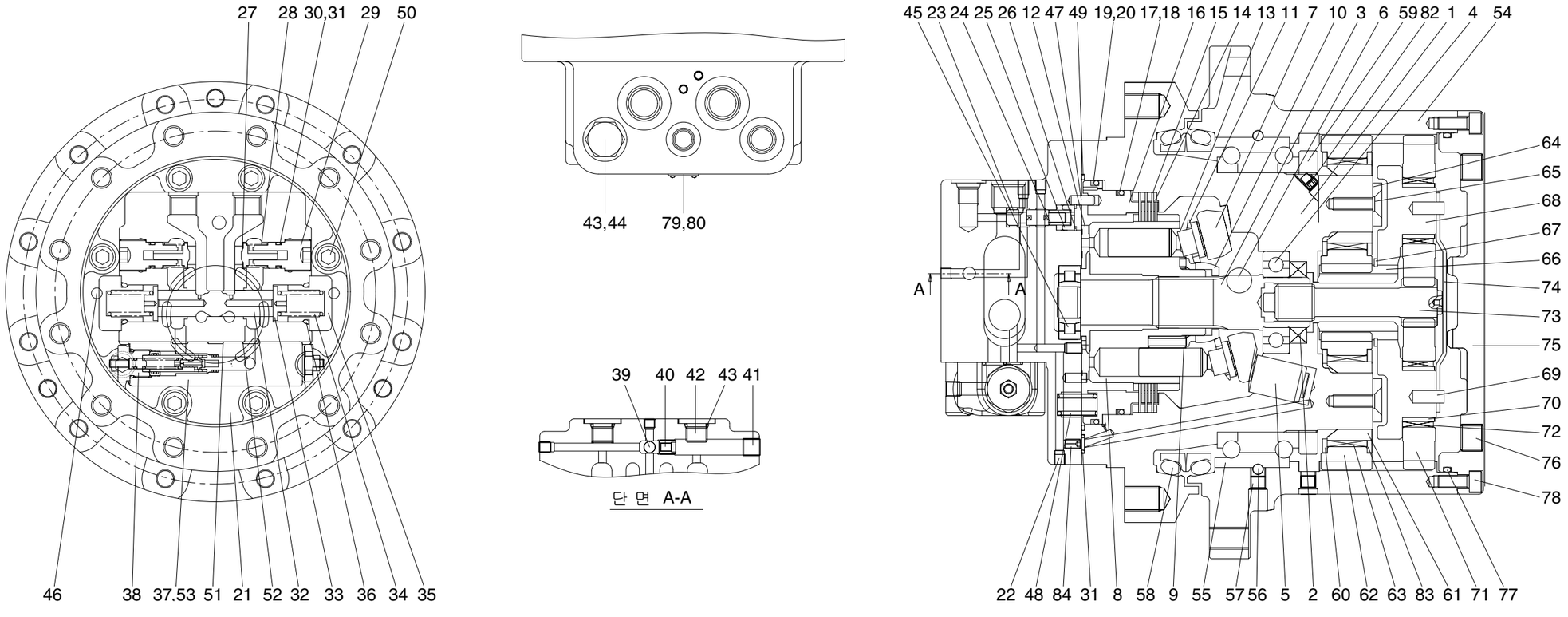
Hydraulic circuit

Port	Port name	Port size
P1	Main port	PF 1/2
P2	Main port	PF 1/2
a1,a2	Gauge port	PT 1/4
T1,T2	Drain port	PF 3/8
Ps	2 speed control port	PF 1/4

1) BASIC STRUCTURE



2) STRUCTURE



80CR92TM03

1	Shaft casing	15	Parking plate	29	Plug	43	O-ring	58	Floating seal	72	Needle bearing
2	Oil seal	16	Parking piston	30	O-ring	44	Plug	59	Nut	73	Drive gear
3	Shaft	17	O-ring	31	Back up ring	45	Ball bearing	60	Washer	74	Thrust plate
4	Bearing	18	Back up ring	32	Main spool	46	Parallel pin	61	Collar	75	Ring gear cover
5	Swash piston	19	O-ring	33	Spring seat	47	Parallel pin	62	Planetary gear	76	Plug
6	Swash steel ball	20	Back up ring	34	Spring	48	Spring	63	Needle bearing	77	O-ring
7	Swash plate	21	Rear cover	35	Plug	50	Wrench bolt	64	Plate	78	Wrench bolt
8	Cylinder block	22	Plug	36	O-ring	51	O-ring	65	Bolt	79	Name plate
9	Spring	23	Spool	37	Relief valve assy	52	O-ring	66	Sun gear	80	Rivet
10	Ball guide	24	Spring	38	Relief valve assy	53	Wrench bolt	67	Snap ring	82	Set screw
11	Set plate	25	Stopper	39	Steel ball	54	Ring gear	68	Carrier	83	Washer
12	Valve plate	26	Snap ring	40	Check seat	55	Angular bearing	69	Spring pin	84	Plug
13	Piston	27	Check	41	Plug	56	Steel ball	70	Collar		
14	Friction plate	28	Spring	42	Plug	57	Plug	71	Planetary gear		

2. PRINCIPLE OF DRIVING

1) GENERATING THE TURNING FORCE

The high hydraulic supplied from a hydraulic pump flows into a cylinder (8) through valve casing of motor (21), and valve plate (12).

The high hydraulic is built as flowing on one side of Y-Y line connected by the upper and lower sides of piston (13).

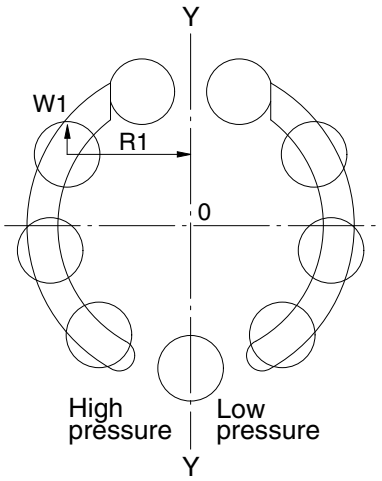
The high hydraulic can generate the force, F1 = P × A (P : Supplied pressure, A : water pressure area), like following pictures, working on a piston.

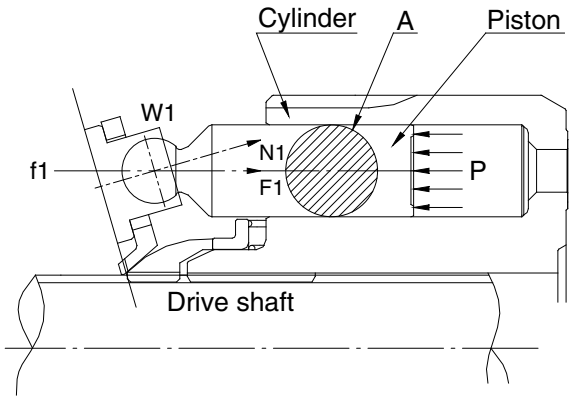
This force, F1, is divided as N1 thrust partial pressure and W1 radial partial pressure, in case of the swash plate (7) of a tilt angle, α .

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

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

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





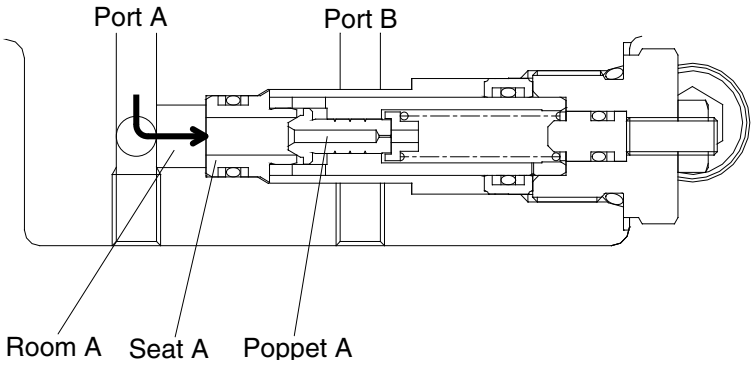
5592TM03

2) WORKING OF RELIEF VALVE

Relief valve carries on two functions of followings.

(1) It standardizes a pressure in case of driving a hydraulic motor ; bypasses and extra oil in a motor inlet related to acceleration of an inertia to an outlet.

(2) In case of an inertia stopped, it forces an equipment stopped, according to generating the pressure of a brake on the projected side.
Room A is always connected with port A of a motor. If the pressure of port is increased, press poppet B. And if it is higher than the setting pressure of a spring, the oil of an hydraulic flows from room A to port B, because poppet A is detached from the contact surface of seat A.



80CR92TM05

3) WORKING OF BRAKE

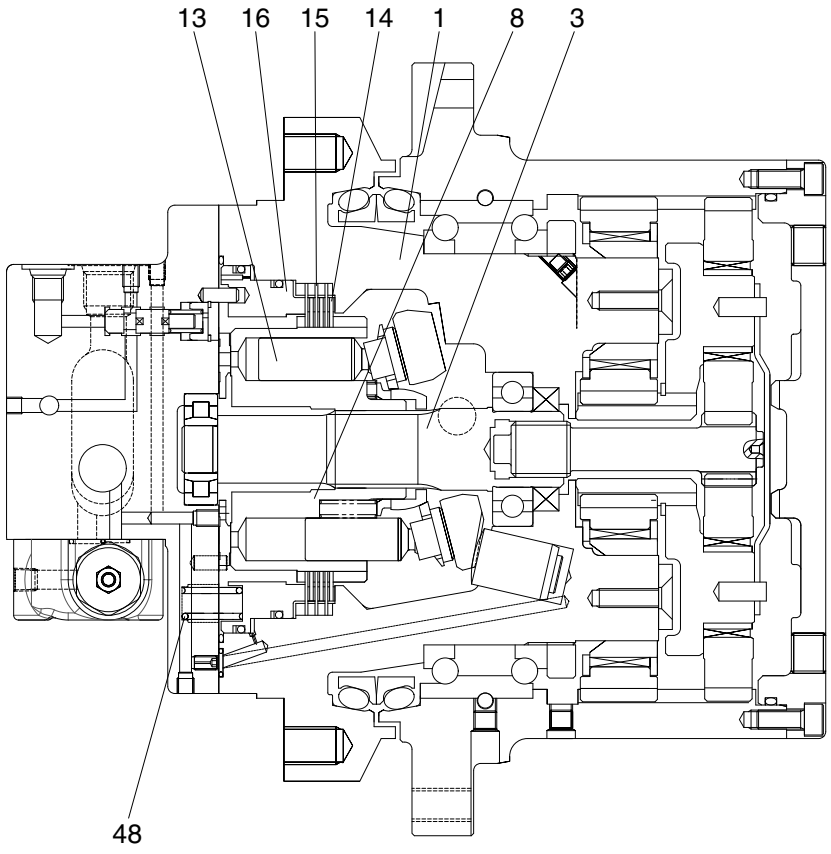
Brake operates the pressure supplied through spool (simultaneous peripheral operation online) installed in valve casing (21) to the part of parking piston (16) and releases a brake.

When the pressure does not work, the brake always runs.

The force of a brake is generated by the frictional force among a plate (15), brake piston (16) and a cylinder block (8) that is connected through spline which are fixed by shaft casing (1) with friction plate (14).

When a pressure does not work on the part of piston, brake spring presses brake piston; oil in a brake room flows into the drain of a motor through an orifice; in that time, brake piston compresses a frictional plate (14) and a detached plate in the middle of shaft casing and brake piston according to the force springs (48); finally, it makes a frictional force.

This frictional force helps the brake fixing a turning axis (3) connected by a cylinder and spline operated.



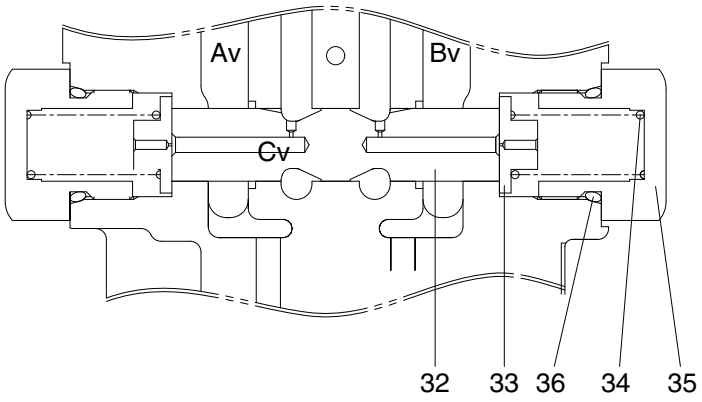
80CR92TM06

4) COUNTERBALANCE VALVE

Av port is connected into a hydraulic pump and Bv port is into a tank. Hydraulic pump supplying oil is come into Av → Cv room. In accordance with spring force (34) that is working on the spool's side it moves to the spool (32) on the right side which is medium position and that time motor is turning.

When the spool (32) is come back to the medium position that time hydraulic motor is stopped.

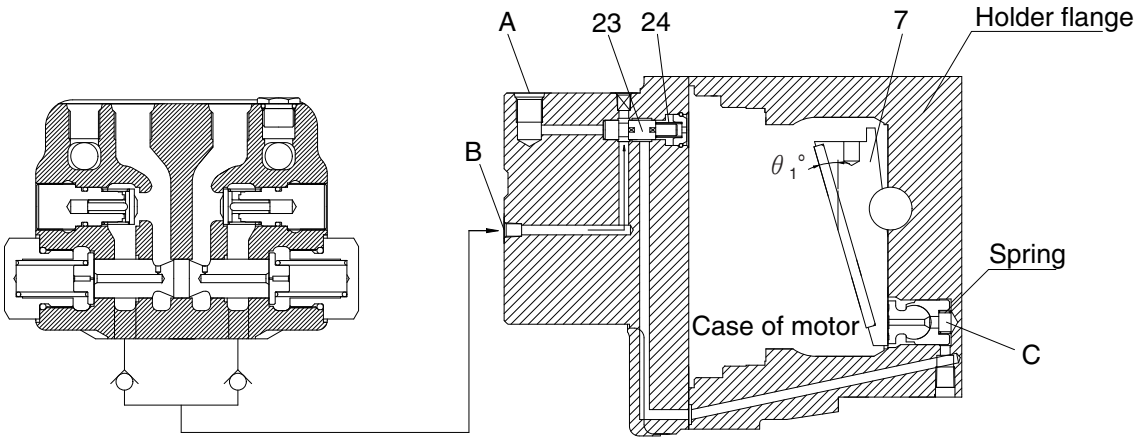
In accordance with spool's returning speed and shape control the working oil that is returning from hydraulic motor smoothly stopping the motor.



80CR92TM07

4) HIGH/LOW SPEED CHANGEOVER MECHANISM

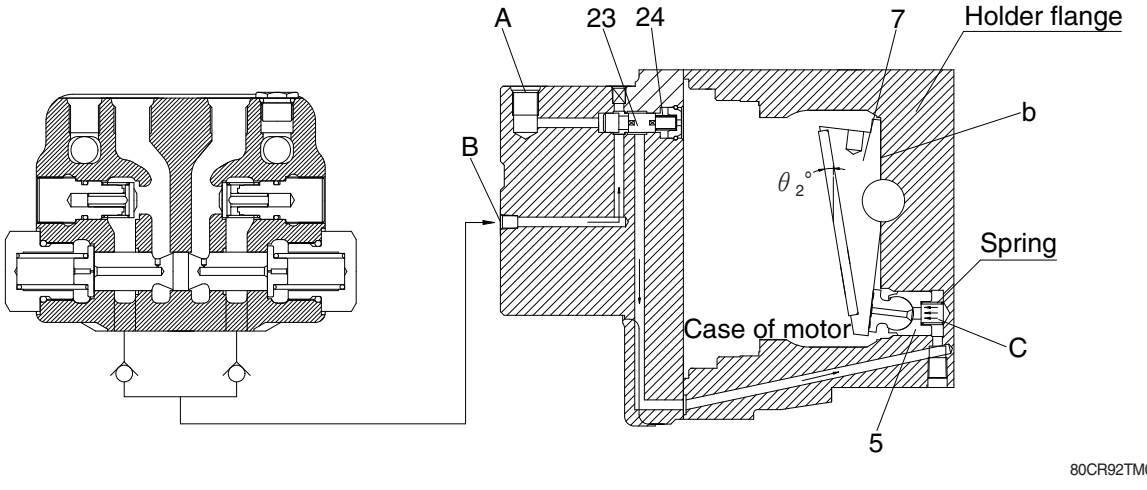
(1) At low speed-at pilot pressure of less than 10 kgf/cm² (0.98 Mpa)



When no pilot pressure is supplied from port (A) at a pressure of 10 kgf/cm² (0.98 Mpa) or less, spool (23) is pressed toward the left by the force of spring (24), the pressurized oil supply port B is shut off, and oil in chamber (C) is released into the motor case via spool (23).

Consequently, swash plate (7) is tilted at a maximum angle (θ_1°) and the piston displacement of hydraulic motor becomes maximum, thus leading to low-speed rotation.

(2) At high speed-at pilot pressure of 10 kgf/cm² (0.98 Mpa) or more



When a pilot pressure is supplied from port (A) at a pressure of 10 kgf/cm² (0.98 Mpa) or more, the pressure overcomes the force of spring (24) and spool (23) is pressed toward the right. The pressurized oil at supply port (B) is then introduced into chamber (C) via spool (23).

Piston (5) pushes up swash plate (7) until it touches side (b) of the holder flange.

At this time, swash plate (7) is tilted at a minimum angle (θ_2°) and the piston displacement of hydraulic motor becomes maximum, thus leading to high-speed rotation.

2. REDUCTION GEAR

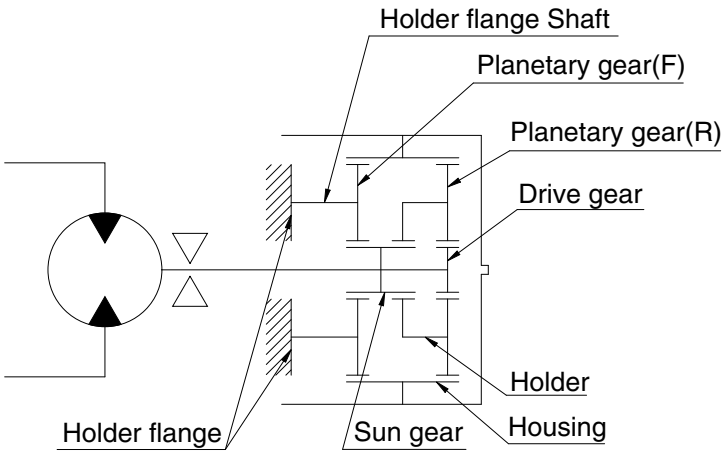
1) FUNCTION

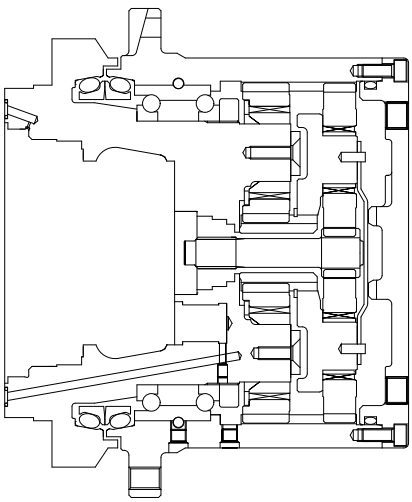
The reduction gear unit consists of a combination of simple planetaly gear mechanism.

This mechanism reduce the high speed rotation from the hydraulic motor and convert it into low speed, high torque to rotate the hub (or case), which in turn rotates the sprocket.

2) OPERATING PRINCIPLE

Shaft → Drive gear → Planetary Gear R → Housing
→ Holder → Sun gear → Planetary Gear F →Rotation of Housing





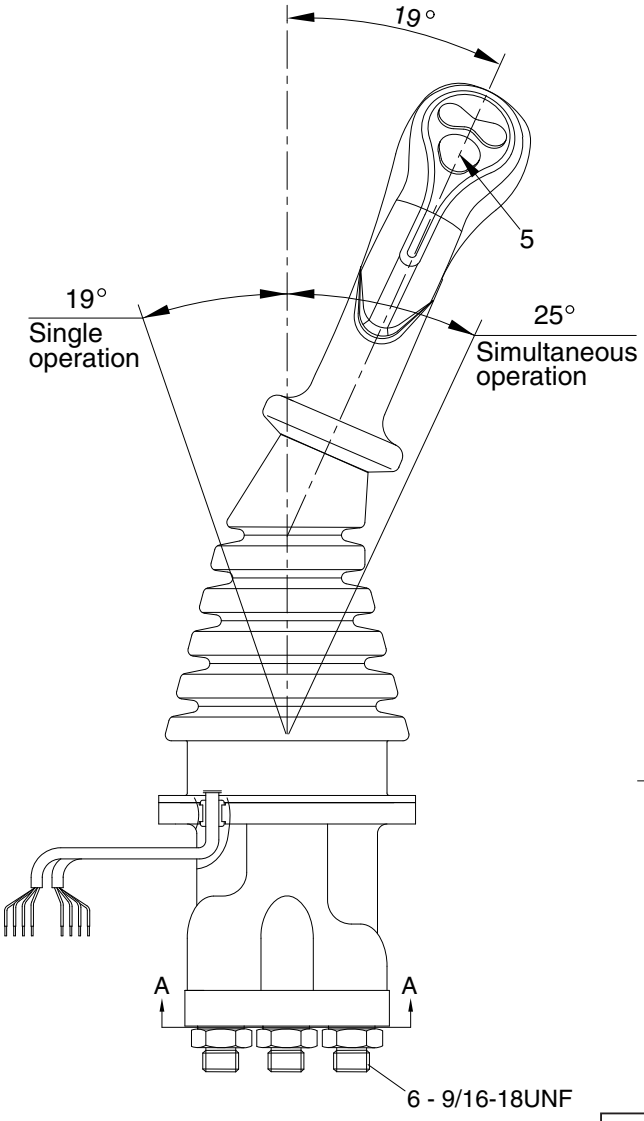
5592TM07

Reduction ratio = (Housing Teeth/Drive Gear Teeth + 1)
× (Housing Teeth/Sun Gear Teeth + 1) - 1.

GROUP 5 RCV LEVER

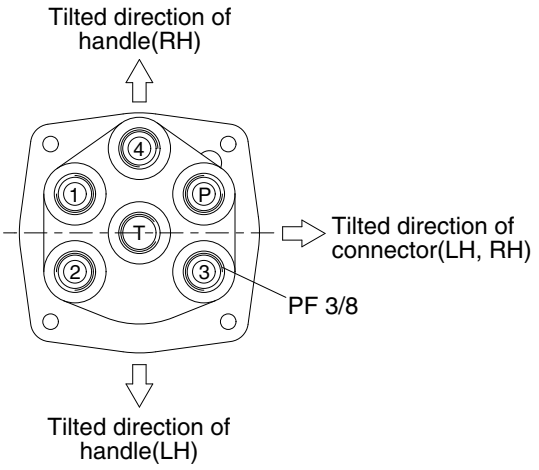
1. STRUCTURE

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.



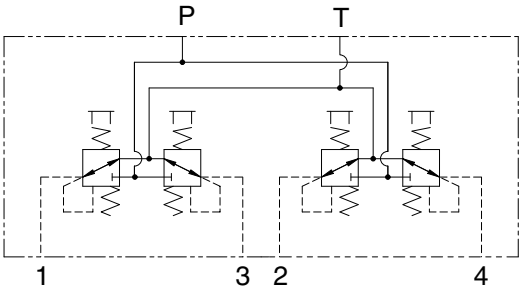
Switches

No.	LH	RH
5	Horn	Breaker



VIEW A

559A2RL01



Hydraulic circuit

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 in port	Boom down port	
3	Right swing port	Bucket in port	
4	Arm out port	Boom up port	

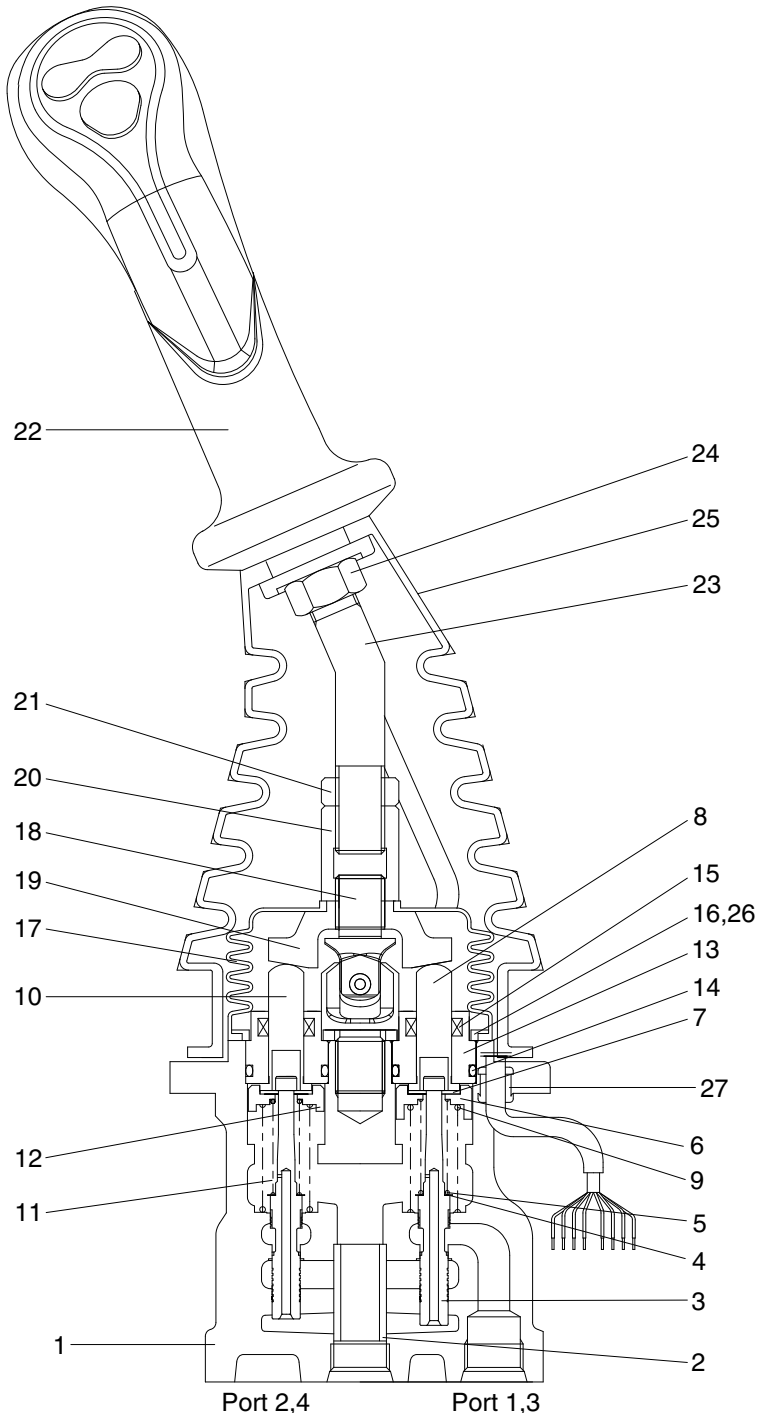
CROSS SECTION

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 (3), spring (5) for setting secondary pressure, spring (9), stopper (7), spring seat (6, 12) and shim (4). 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 (8, 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.

CROSS SECTION



60W9S2RL02

1	Case	8	Push rod	15	Rod seal	22	Handle assembly
2	Bushing	9	Spring	16	Plate	23	Handle bar
3	Spool	10	Push rod	17	Boot	24	Nut
4	Shim	11	Spring	18	Joint assembly	25	Boot
5	Spring	12	Spring seat	19	Swash plate	26	Spring pin
6	Spring seat	13	Plug	20	Adjusting nut	27	Bushing
7	Stopper	14	O-ring	21	Lock nut		

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

The functions of the spool (3) 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 (5) works on this spool to determine the output pressure.

The change the deflection of this spring, the push rod (8,10) is inserted and can slide in the plug (13).

For the purpose of changing the displacement of the push rod through the swash plate (19) and adjusting nut (20) are provided the handle (22) that can be tilted in any direction around the fulcrum of the universal joint (18) center.

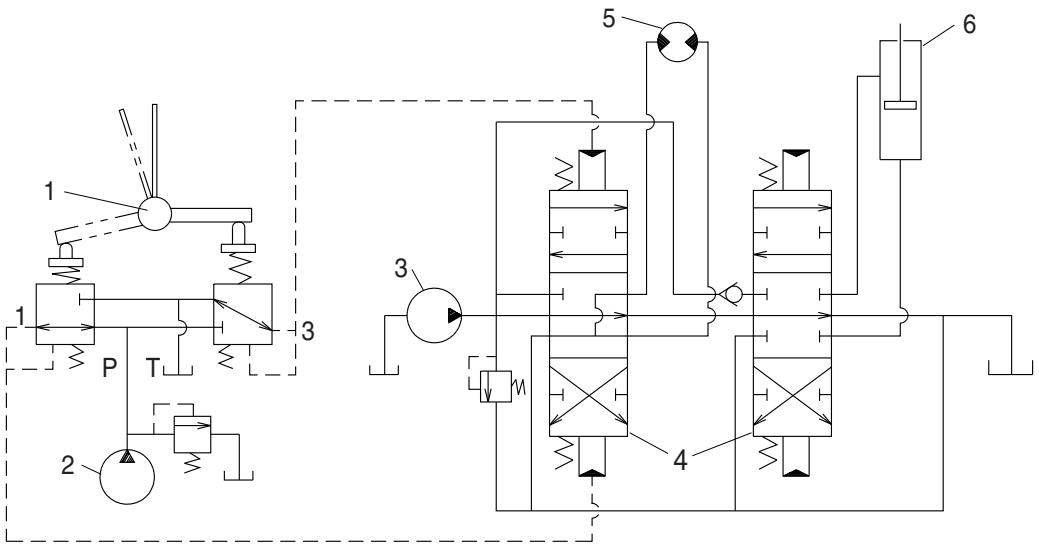
The spring (9) works on the case (1) and spring seat (6, 12) and tries to return the push rod (8,10) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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 and the attached operation explanation drawing.

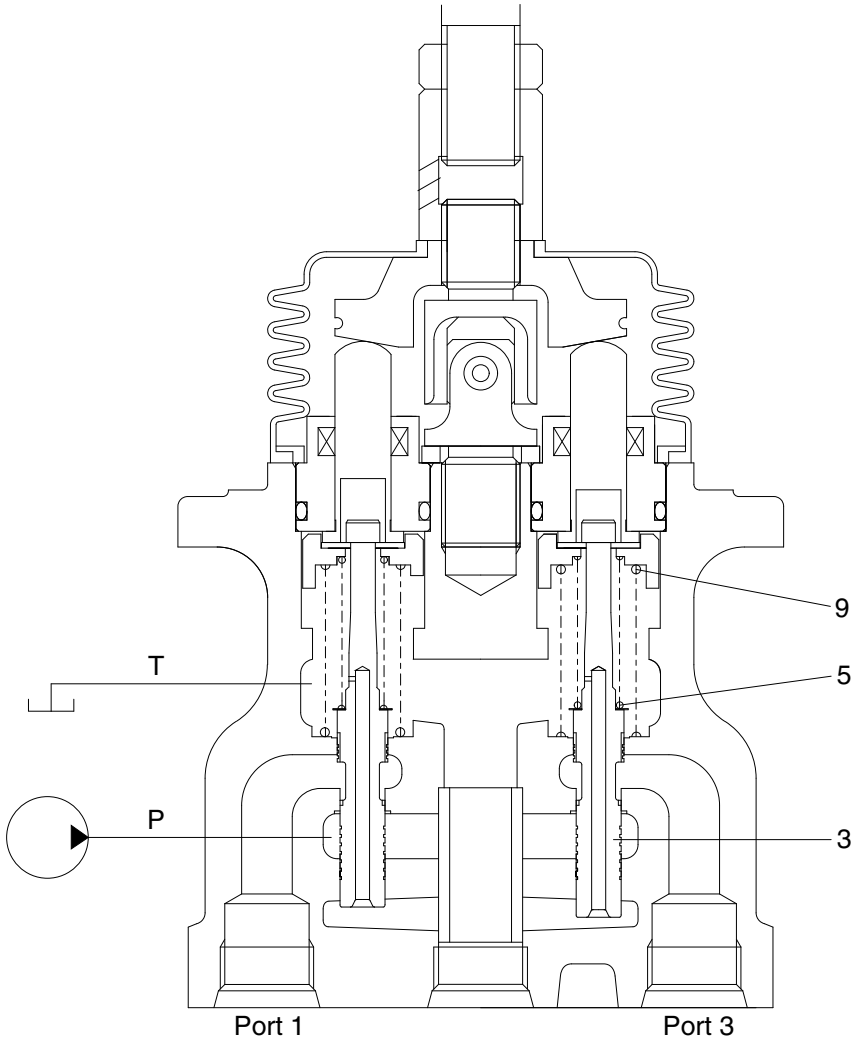
The diagram shown below is the typical application example of the pilot valve.



2-70

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

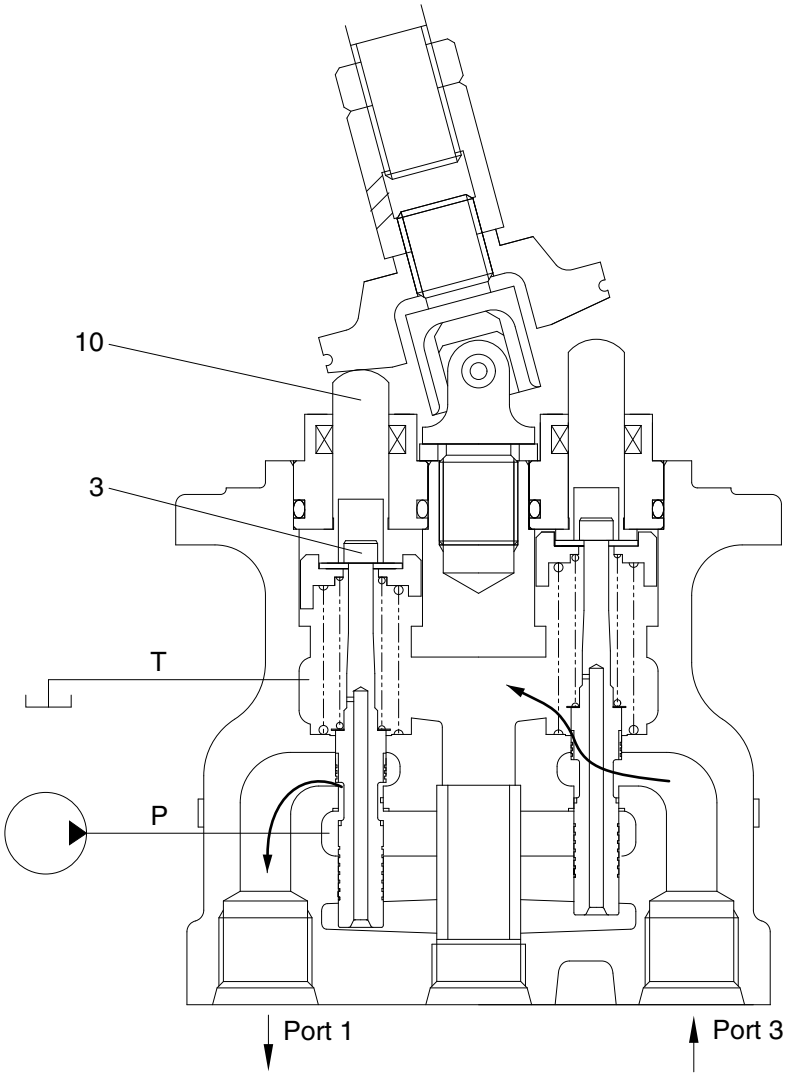
(1) Case where handle is in neutral position



60W9S2RL03

The force of the spring (5) that determines the output pressure of the pilot valve is not applied to the spool (3). Therefore, the spool is pushed up by the spring (9) 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



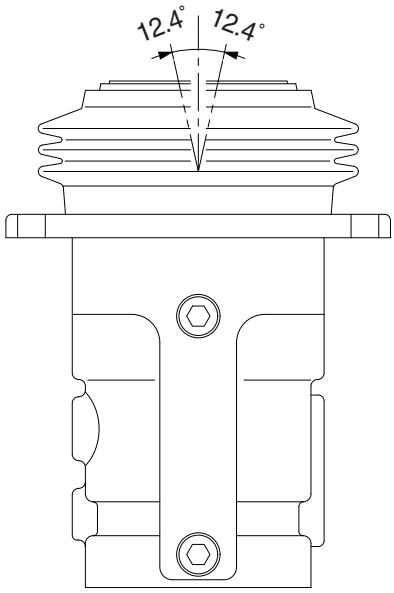
60W9S2RL04

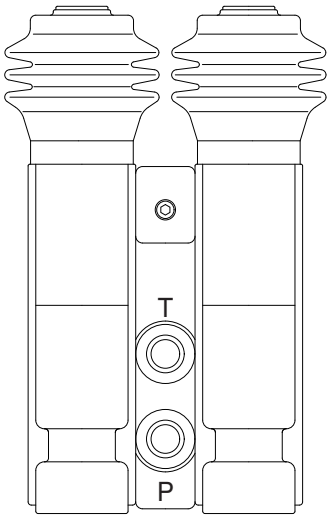
When the push rod (10) is stroked, the spool (3) moves downwards.
Then port P is connected with port 1 and the oil supplied from the pilot pump flows through port 1 to generate the pressure.
When the pressure at port 1 increases to the value corresponding to the spring force set by tilting the handle, 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.
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.

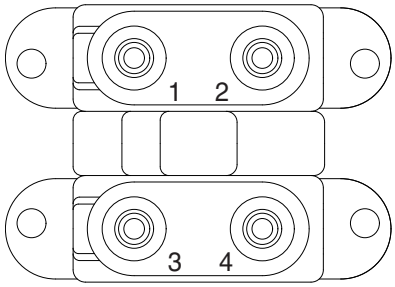
GROUP 6 RCV PEDAL

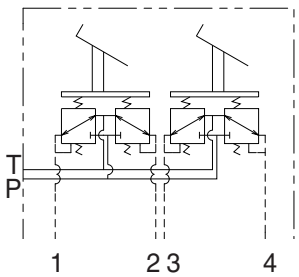
1. STRUCTURE

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

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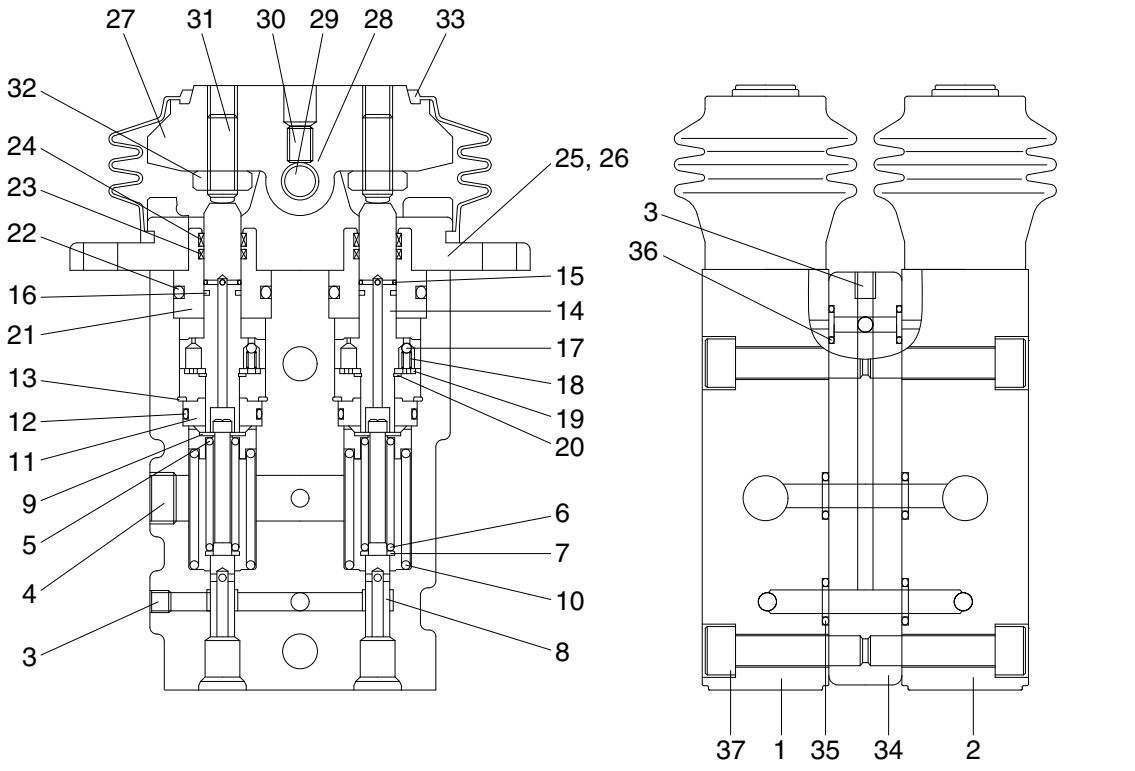
CROSS SECTION

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 (8), spring (6) for setting secondary pressure, return spring (10), stopper (9), and spring seat (7). 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 (14) 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.



14072SF70

1	Body (1)	14	Push rod	27	Cam
2	Body (2)	15	Spring pin	28	Bushing
3	Plug	16	Seal	29	Cam shaft
4	Plug	17	Steel ball	30	Set screw
5	Spring seat	18	Spring	31	Set screw
6	Spring	19	Plate	32	Nut
7	Spring seat	20	Snap ring	33	Bellows
8	Spool	21	Plug	34	Space
9	Stopper	22	O-ring	35	O-ring
10	Spring	23	Rod seal	36	O-ring
11	Rod guide	24	Dust seal	37	Bolt
12	O-ring	25	Cover		
13	Snap ring	26	Bolt		

2. FUNCTIONS

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 (8) 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 (6) works on this spool to determine the output pressure.

The change the deflection of this spring, the push rod (14) is inserted and can slide in the plug (21). For the purpose of changing th displacement of the push rod through the cam (27) and adjusting nut (32) are provided the pedal that can be tilted in any direction around the fulcrum of the cam (27) center.

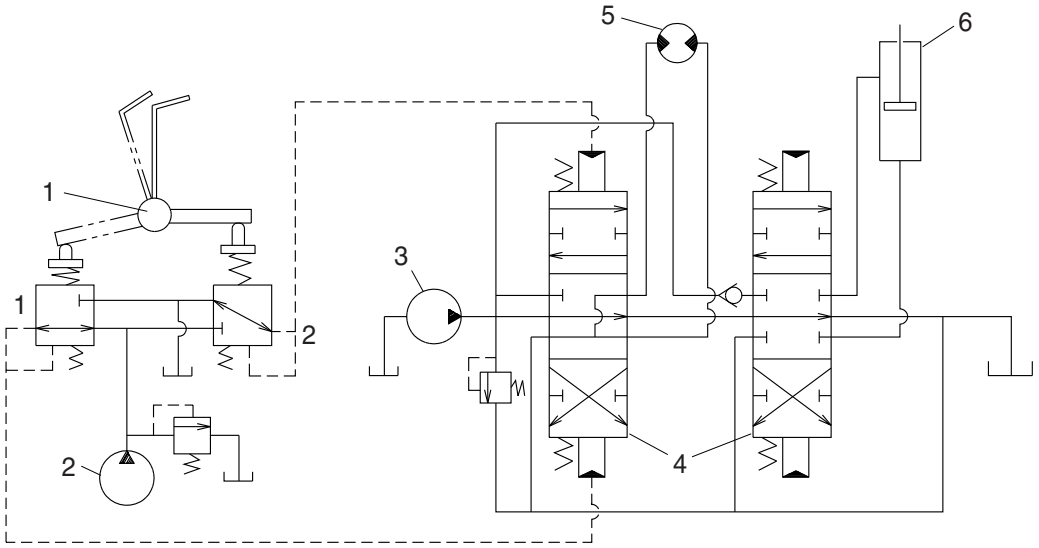
The spring (10) works on the casing (1) and spring seat (7) and tries to return the push rod (14) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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.



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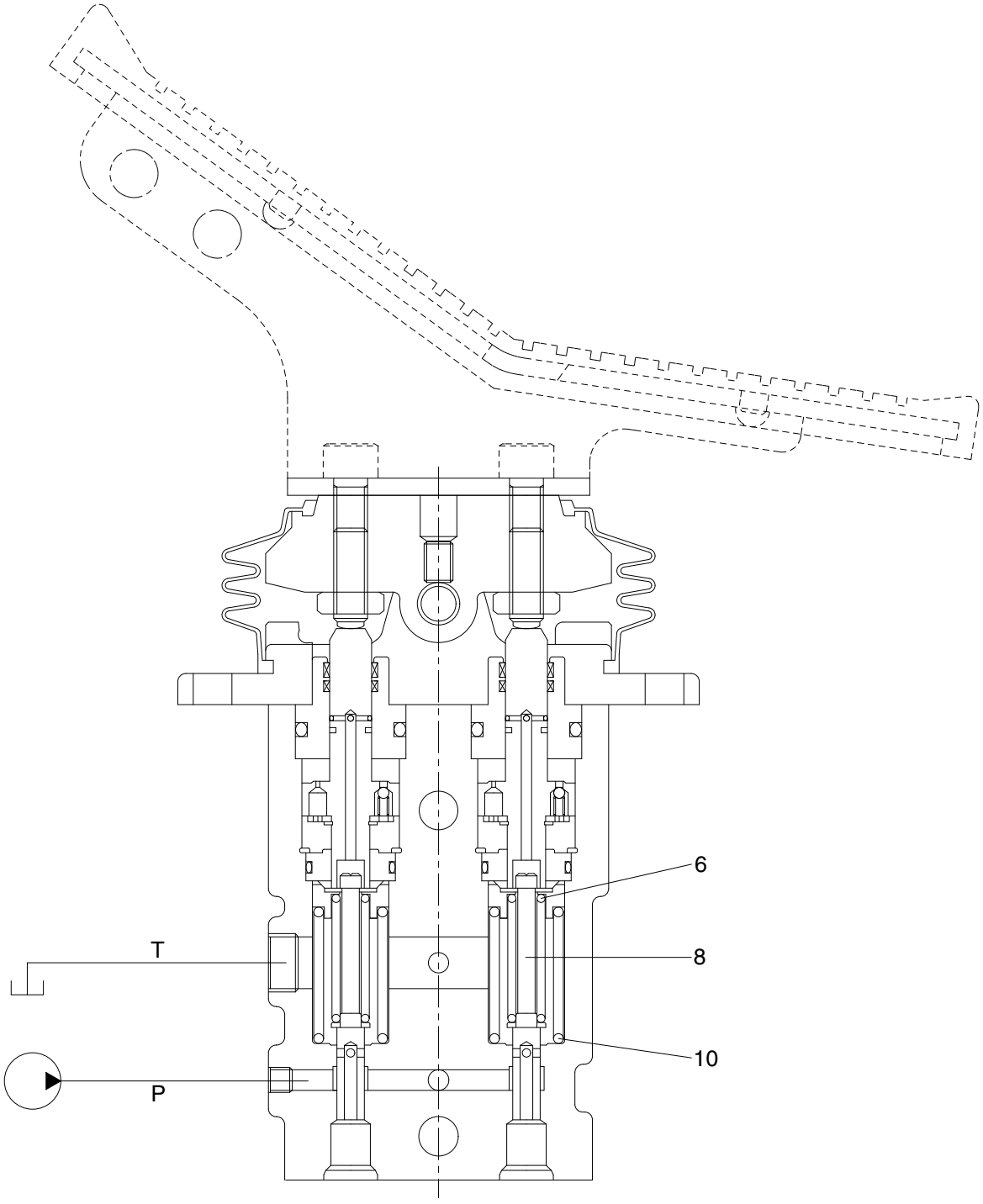
1	Pilot valve	3	Main pump	5	Hydraulic motor
2	Pilot pump	4	Main control valve	6	Hydraulic cylinder

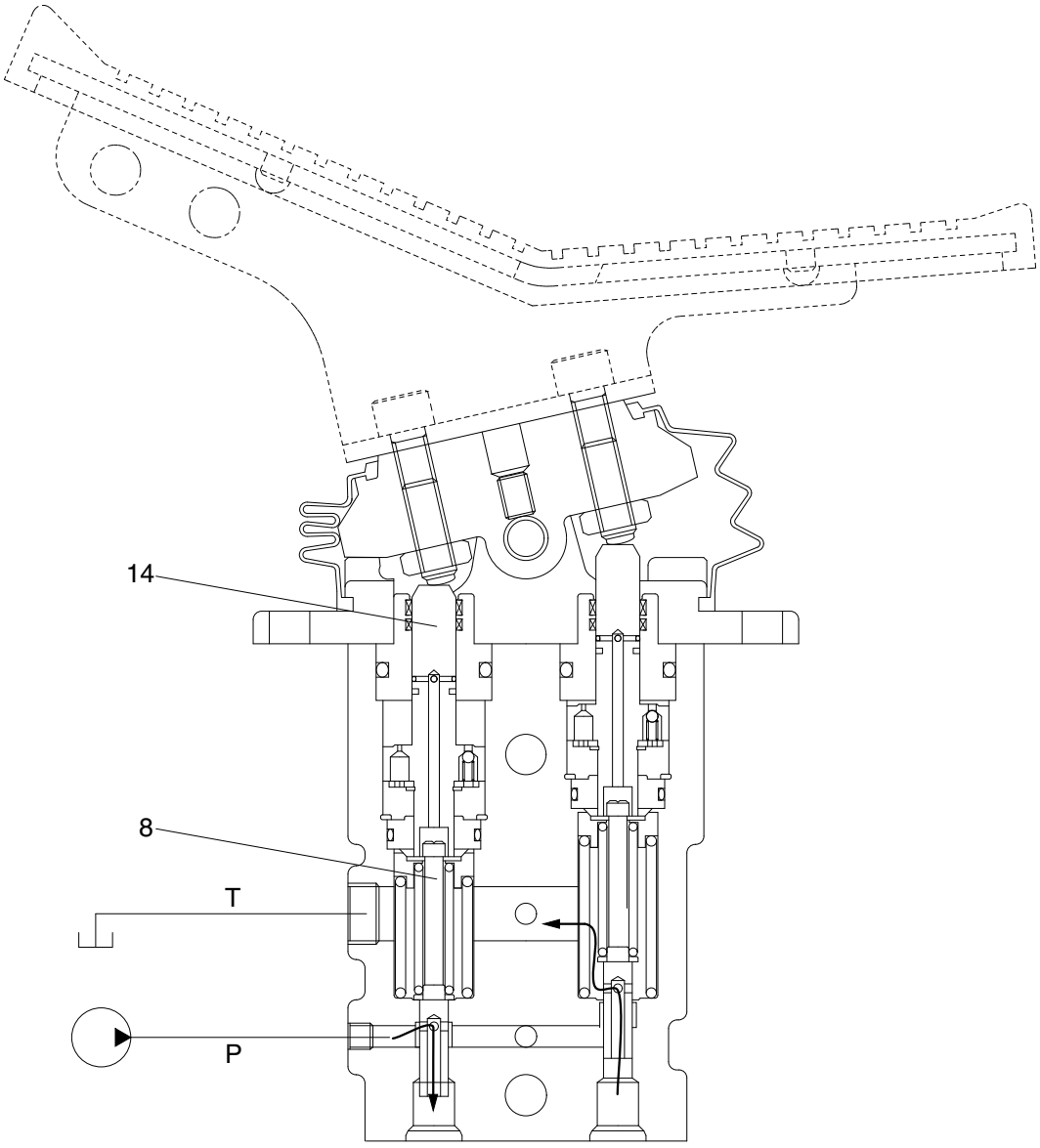
(1) Case where handle is in neutral position



14072SF74

The force of the spring (6) that determines the output pressure of the pilot valve is not applied to the spool (8). Therefore, the spool is pushed up by the spring (10) 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 handle is tilted



14072SF75

When the push rod (14) is stroked, the spool (8) 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.
Besides, in some type, when the handle is tilted more than a certain angle, the upper end of the spool contacts with inside bottom of the push rod and the output pressure is left to be connected with port P.