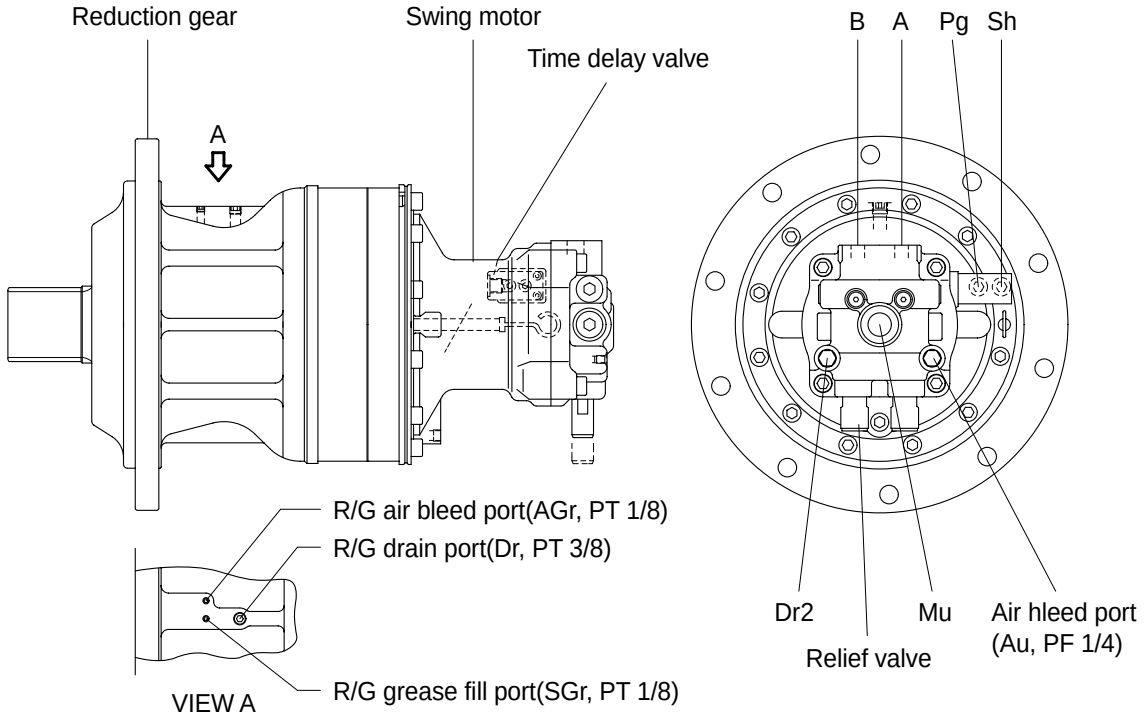
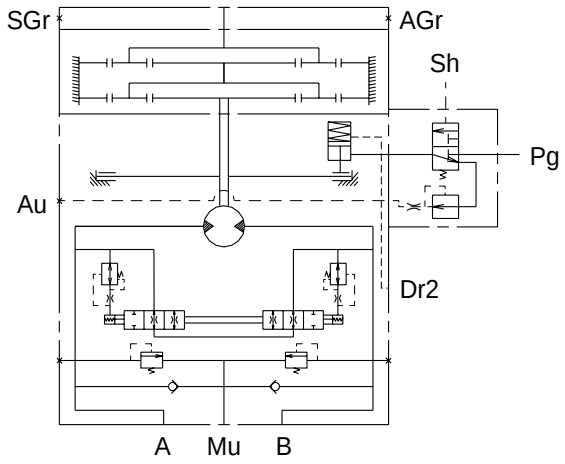
GROUP 3 SWING DEVICE

1. STRUCTURE

Swing device consists swing motor, swing reduction gear.

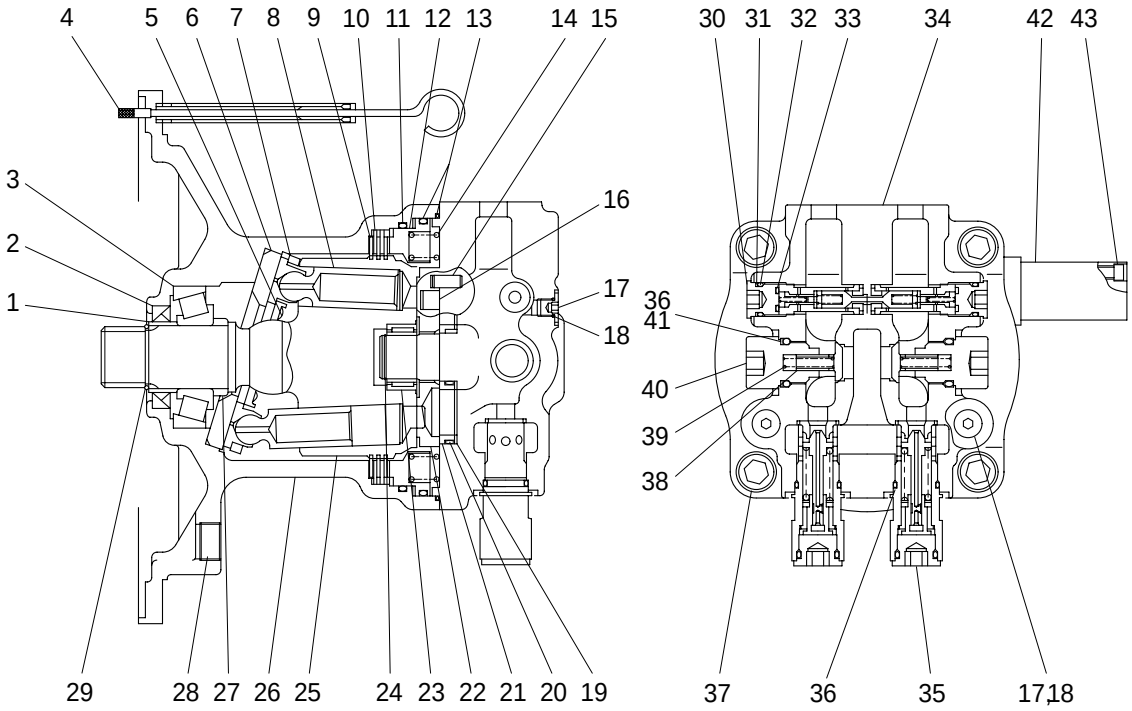
Swing motor include mechanical parking valve, relief valve, make up valve and time delay valve.





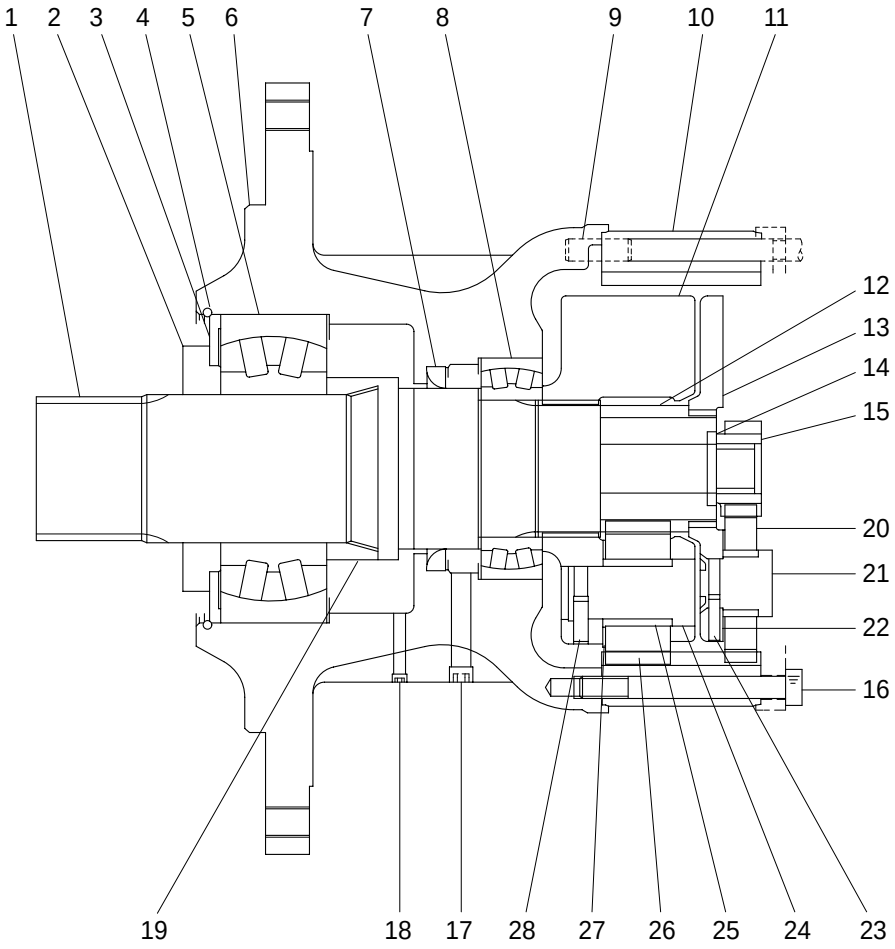
Port	Port name	Port size
A	Main port	PF 3/4
B	Main port	PF 3/4
Dr2	Drain port	PF 3/8
Mu	Make up port	PF 1
Sh	Brake release port	PF 1/4
Pg	Stand by port	PF 1/4

1) SWING MOTOR



1	Inner ring	16	Piston	31	Back up ring
2	Oil seal	17	Cap	32	O-ring
3	Taper roller bearing	18	O-ring	33	O-ring
4	Level gauge assembly	19	Coned disc spring	34	Cover
5	Backing spring	20	Teflon ring	35	Relief assembly
6	Cam plate	21	Bushing	36	O-ring
7	Return plate	22	Balance plate	37	Hexagon socket bolt
8	Piston assembly	23	Needle bearing	38	Check
9	Lining plate	24	Snap ring	39	Spring
10	Plate	25	Cylinder	40	Cap
11	O-ring	26	Housing	41	Back up ring
12	Piston	27	Collar	42	Time delay valve
13	O-ring	28	Plug	43	Hexagon socket bolt
14	Spring	29	Snap ring		
15	Parallel pin	30	Bypass valve assembly		

2) REDUCTION GEAR



1	Pinion shaft	11	Holder 2	20	Planetary gear 2
2	Collar	12	Planetary gear 4	21	Shaft 1
3	Plate	13	Holder 1	22	Thrust plate 1
4	Snap ring	14	Thrust plate 1	23	Spring pin
5	Roller bearing	15	Sun gear	24	Shaft 2
6	Gear casing	16	Lock bolt	25	Bushing
7	Oil seal	17	Plug	26	Planetary gear 5
8	Roller bearing	18	Plug	27	Thrust plate 2
9	Pin	19	Collar	28	Spring pin
10	Ring gear				

2. FUNCTION

1) ROTARY PART

When high pressurized oil enters a cylinder through port(a), which is the inlet of balance plate(1), hydraulic pressure acting on the piston causes axial force F. The pressure force F works via the piston(2) upon the return plate(3) which acts upon the swash plate(4) via an hydrostatic bearing. Force F1 perpendicular to swash plate(4) and force F2 perpendicular to cylinder center.

Being transferred to the cylinder block(5) through piston, force F2 causes rotational moment at surroundings of cylinder.

Since cylinder block has 9 equidistantly arrayed pistons, rotational torque is transmitted to cylinder shaft in order by several pistons connected to the inlet port of high pressurized oil. When the direction of oil flow is reversed, rotational direction of cylinder is also reversed. Output torque is given by the equation.

$T = \frac{p \times q}{2\pi}$, $q = Z \cdot A \cdot PCD \cdot \tan\theta$, $F_1 = \frac{F}{\cos\theta}$, $F_2 = F\tan\theta$, $S = PCD \times \tan\theta$

Where p : Pressure effective difference(kgf/cm^2)

q : Displacement(cc/rev)

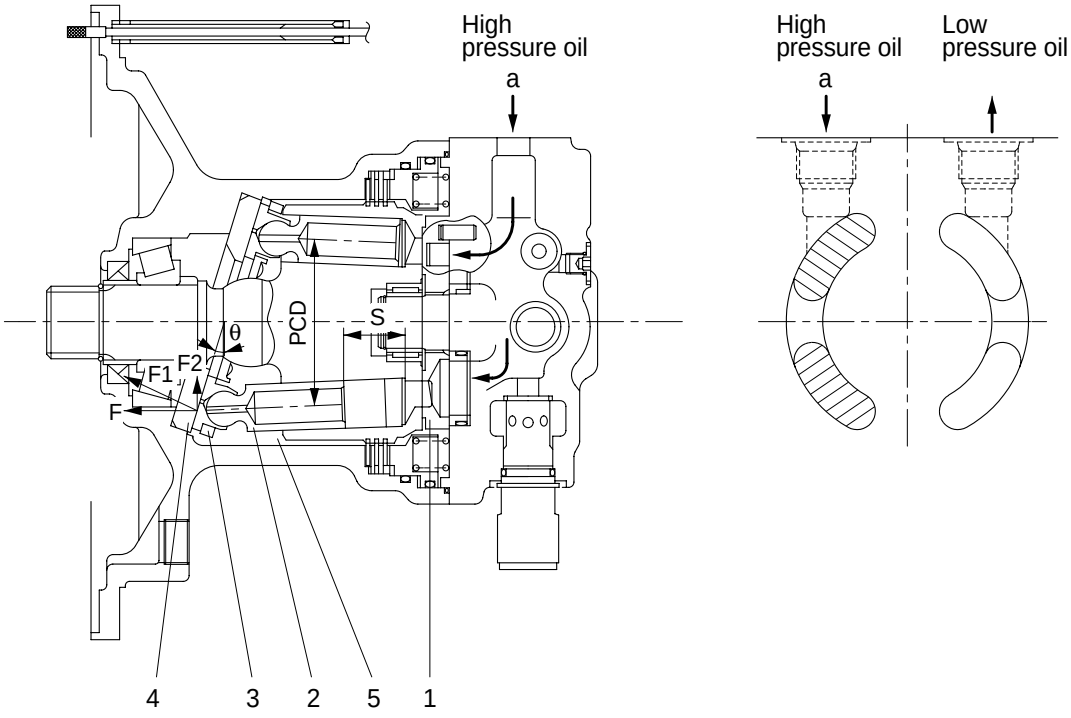
T : Output torque(kgf · cm)

Z : Piston number(9EA)

A : Piston area(cm^2)

θ : Tilting angle of swash plate(degree)

S : Piston stroke(cm)



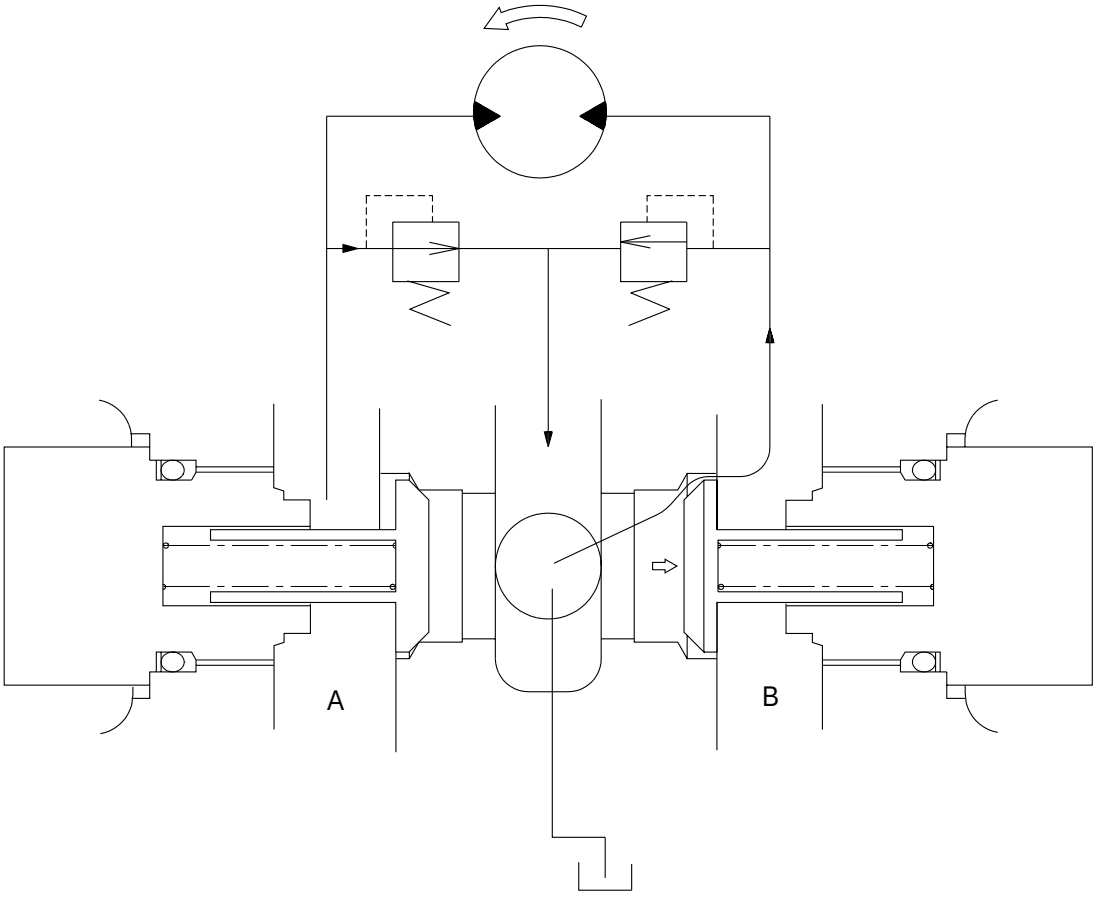
2) MAKE UP VALVE

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

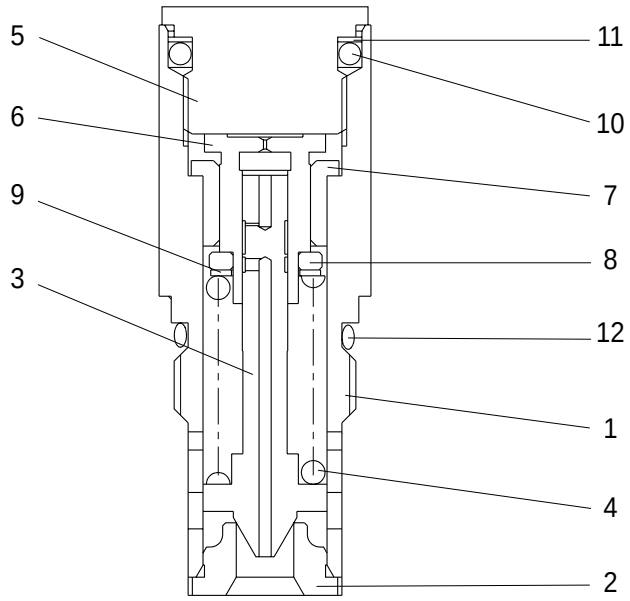
A make up valve is provided immediately before the port leading to the hydraulic oil tank to secure feed pressure required when the hydraulic motor makes a pumping action. The boost pressure acts on the hydraulic motor's feed port via the make up valve.

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

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



3) RELIEF VALVE



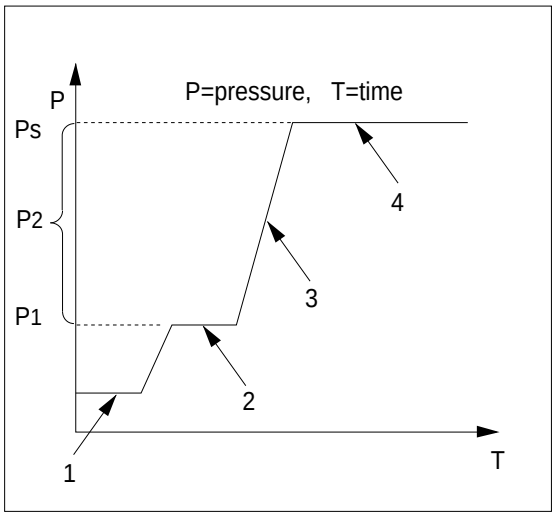
1	Body
2	Seat
3	Plunger
4	Spring
5	Adjusting screw
6	Piston
7	Bushing
8	Spring seat
9	Shim
10	O-ring
11	Back up ring
12	O-ring

(1) Construction of relief valve

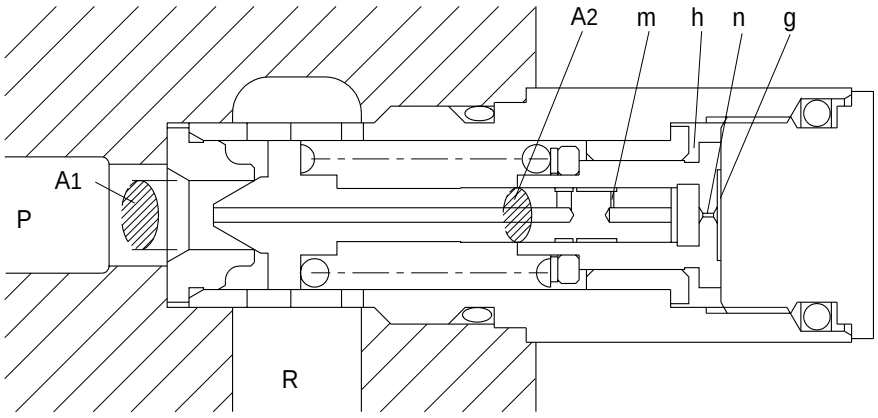
The valve casing contains two cartridge type relief valves that stop the regular and reverse rotations of the hydraulic motor. The relief valves relieve high pressure at start or at stop of swing motion and can control the relief pressure in two steps, high and low, in order to insure smooth operation.

(2) Function of relief valve

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



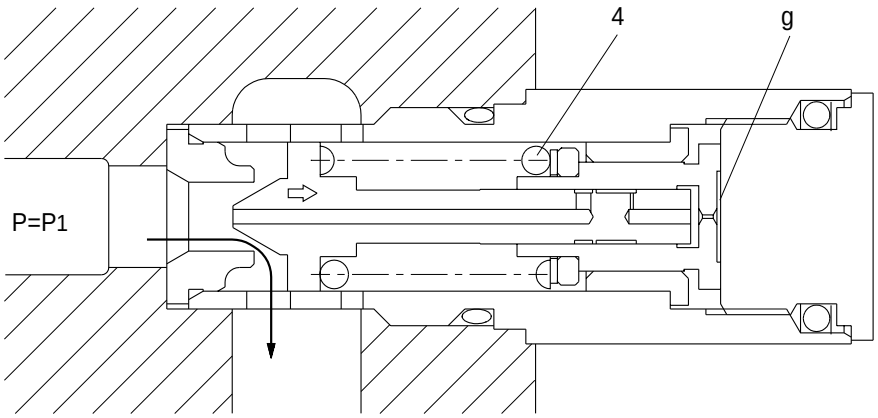
① Ports(P,R) at tank pressure.



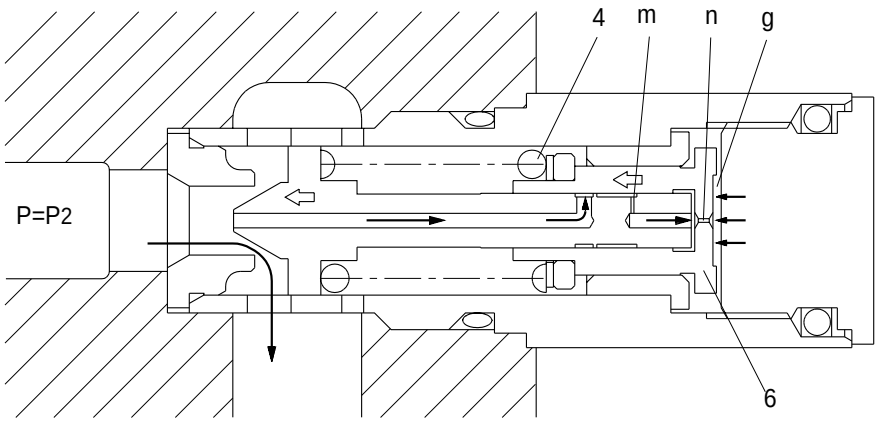
② When hydraulic oil pressure($P \times A_1$) reaches the preset force(F_{SP}) of spring(4), the plunger(3) moves to the right as shown.

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

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



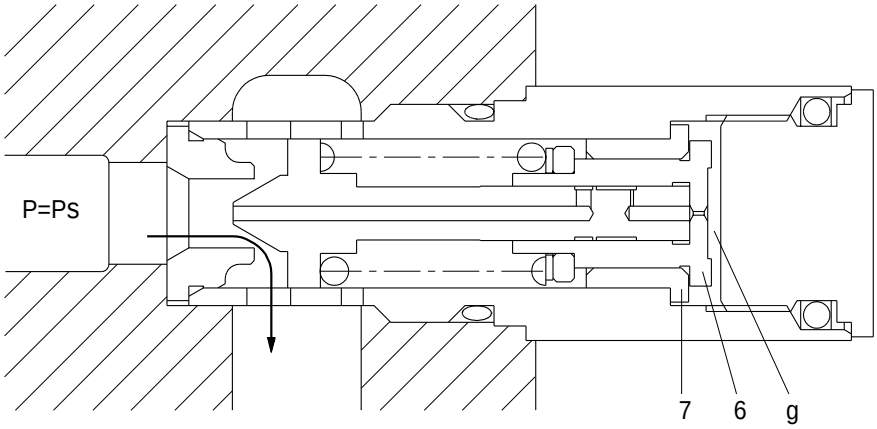
③ The oil flow chamber g via orifice m and n. When the pressure of chamber g reaches the preset force(F_{SP}) of spring(4), the piston(6) moves left and stop the piston(6) hits the bottom of bushing(7).



④ When piston(6) hits the bottom of bushing(7), it stops moving to the left any further. As the result, the pressure in chamber(g) equals(Ps).

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

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

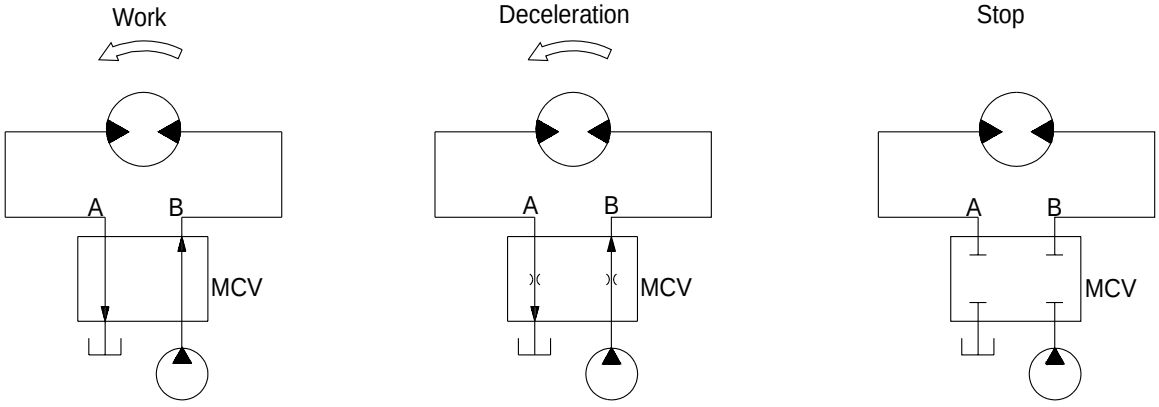


4) BRAKE SYSTEM

(1) Control valve swing brake system

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

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



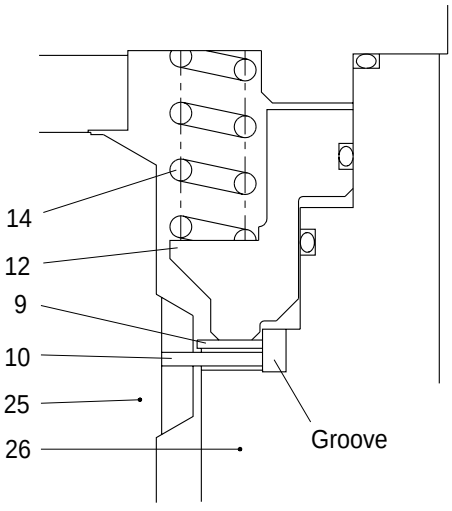
(2) Mechanical swing parking brake system

The mechanical swing parking brake system is installed to prevent the upper structure from swinging downhill because of its own weight when the excavator is parked on a slope since it completely eliminates the hydraulic drift of swing motion while the excavator is on a slop, work can be done more easily and safely.

① Brake assembly

Circumferential rotation of separate plate(9) is constrained by the groove located at housing(26). When housing is pressed down by brake spring(16) through lining plate(10), separate plate(9) and brake piston(12), friction force occurs there.

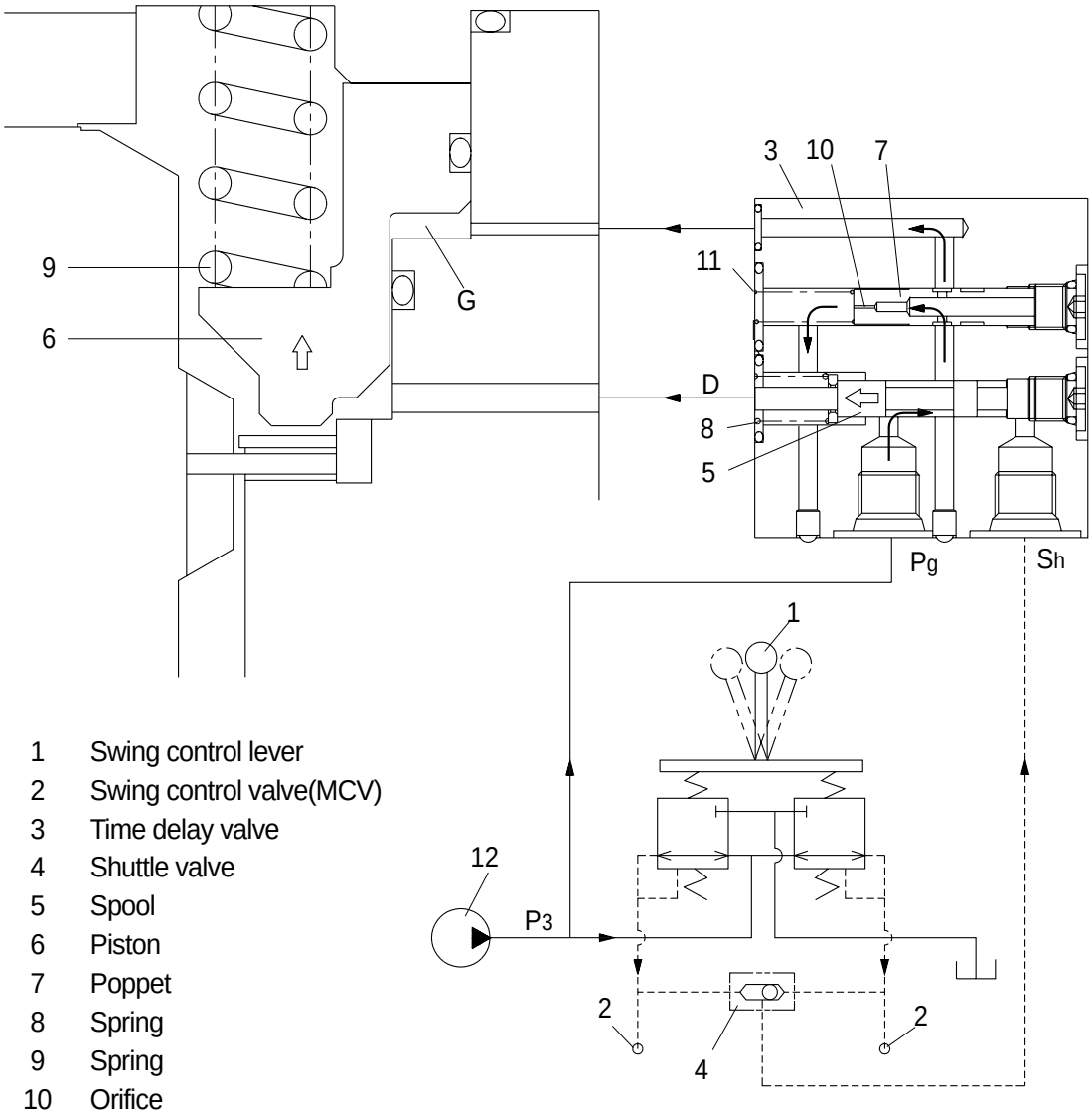
Cylinder(25) is constrained by this friction force and brake acts, while brake releases when hydraulic force exceeds spring force.



9	Separate plate	14	Spring
10	Lining plate	25	Cylinder
12	Brake piston	26	Housing

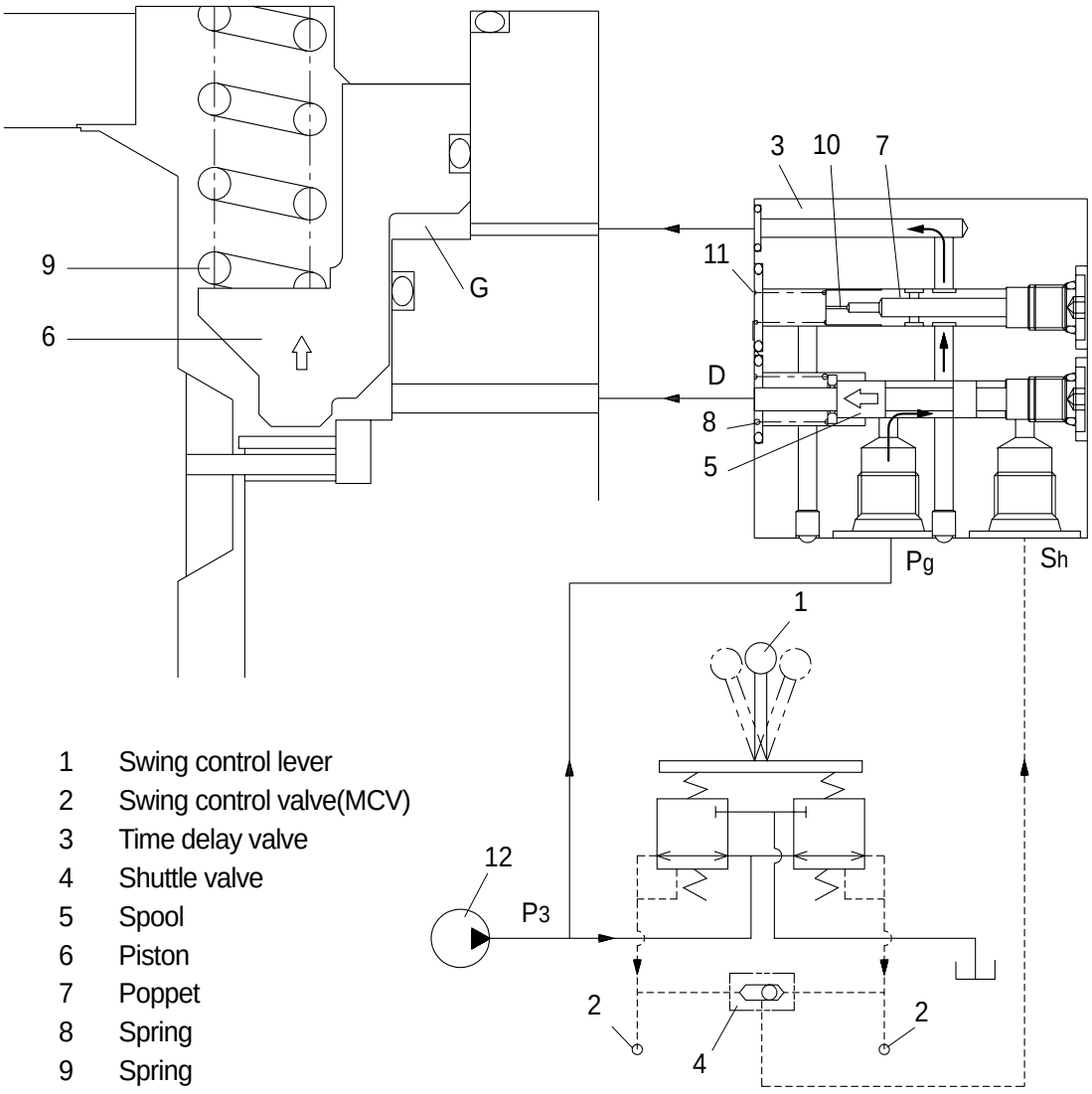
② Operating principle

a. When the swing control lever(1) is set to the swing position, the pilot oil go to the swing control valve(2) and to S_h of the time delay valve(3) via the shuttle valve(4), this pressure move spool(5) to the leftward against the force of the spring(8), so pilot pump charged oil(P_3) goes to the chamber G.
This pressure is applied to move the piston(6) to the upward against the force of the spring(9). Thus, it releases the brake force.



1 Swing control lever
2 Swing control valve(MCV)
3 Time delay valve
4 Shuttle valve
5 Spool
6 Piston
7 Poppet
8 Spring
9 Spring
10 Orifice
11 Spring
12 Pilot pump

b. Meantime, the oil pressure of port D balance with the preset force of spring(11), the pressure of chamber G keeps constant pressure.



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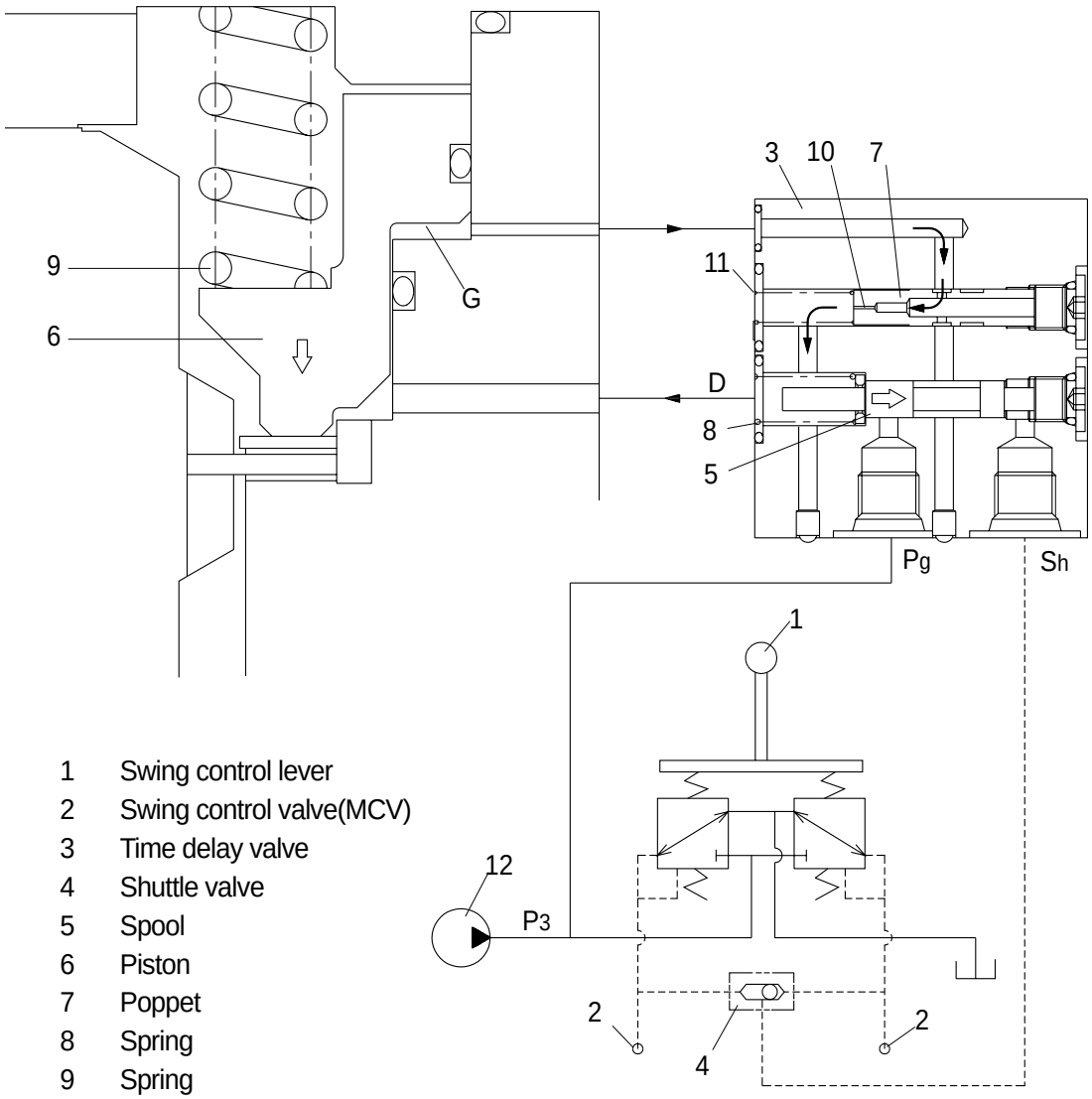
c. When the swing control(1) lever is set the neutral position, the spool(5) returns right in the time delay valve(3).
Then, the piston(6) is moved lower by spring force and the return oil from the chamber G flows back to D-port through orifice(10) of the poppet(7).
At this time, the poppet(7) works to make a time lag for 5 seconds.



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