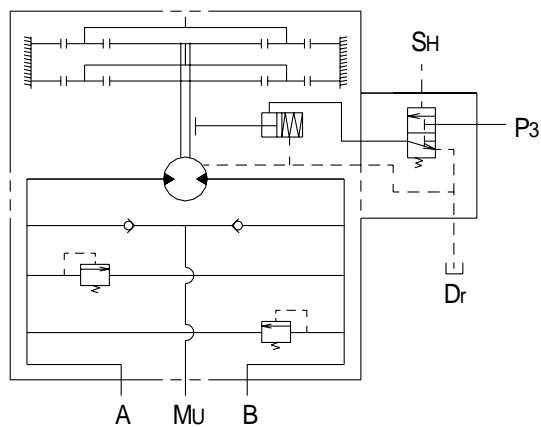
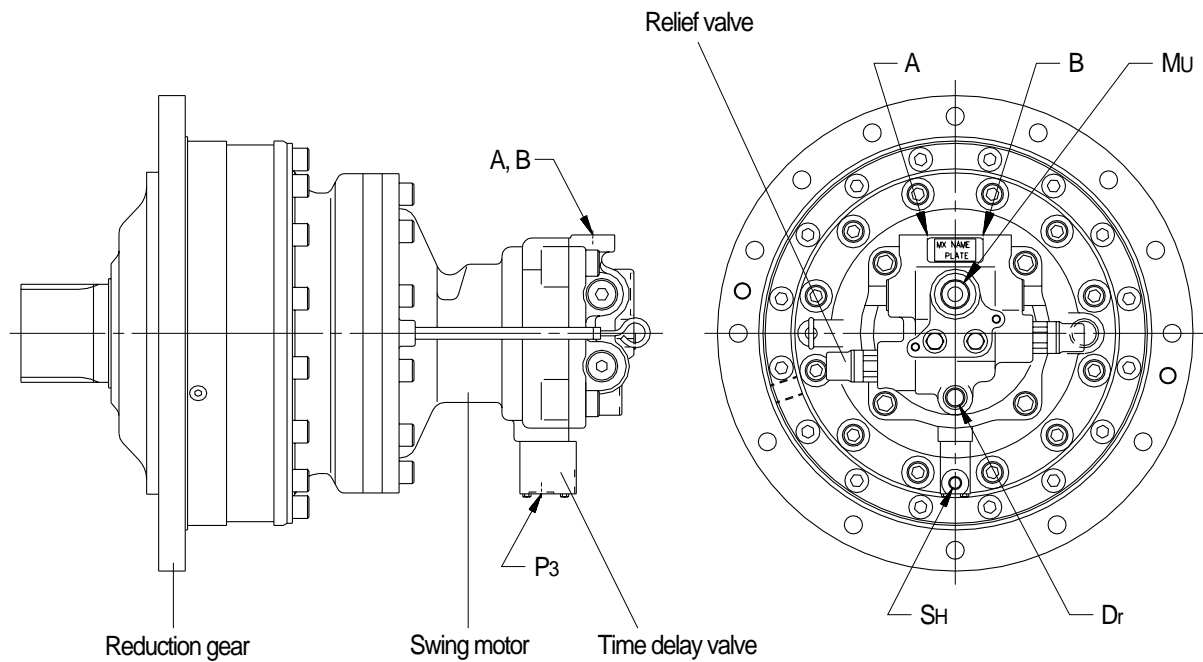


GROUP 3 SWING DEVICE

1. STRUCTURE

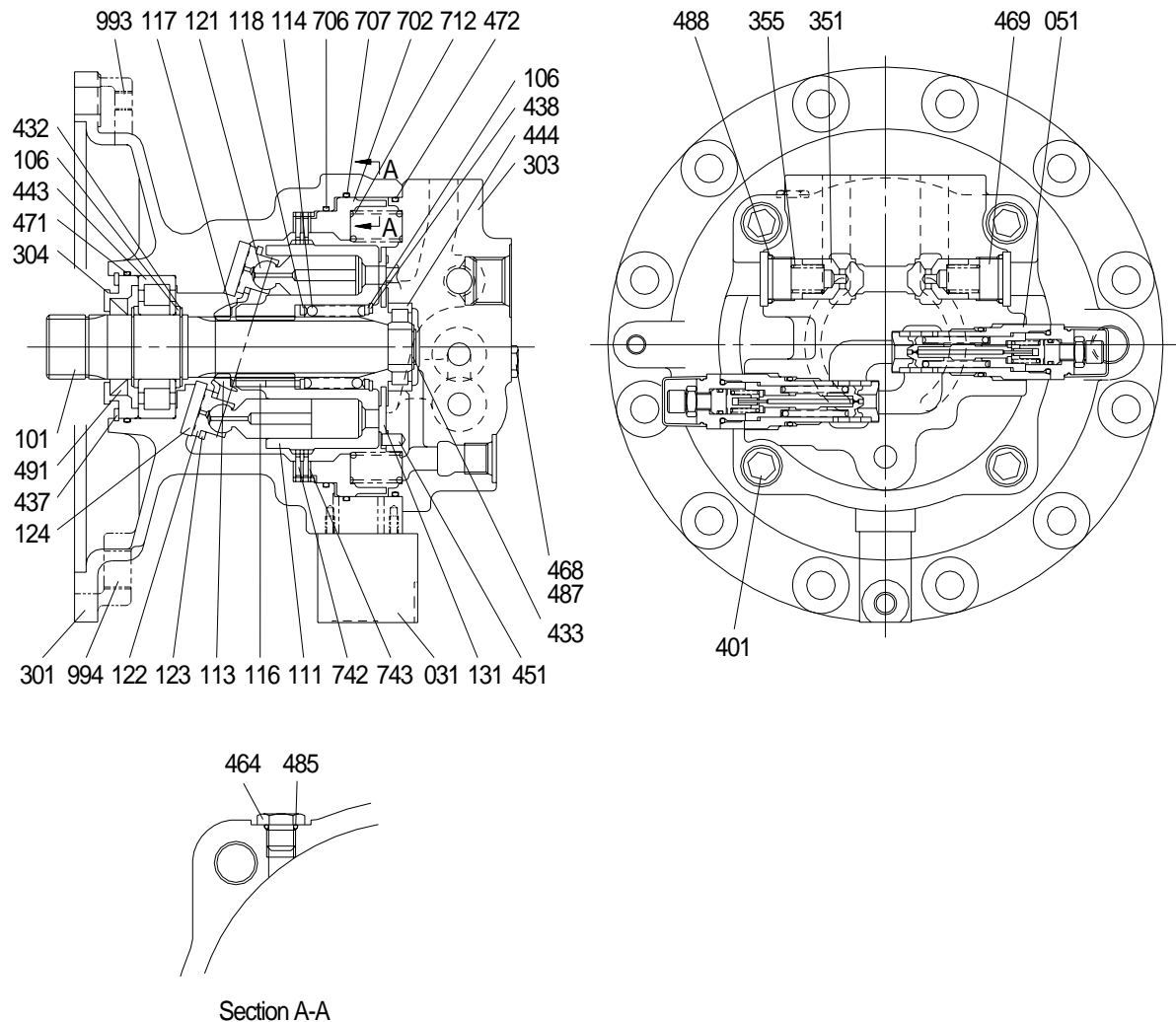
Swing device consists swing motor, swing reduction gear.

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



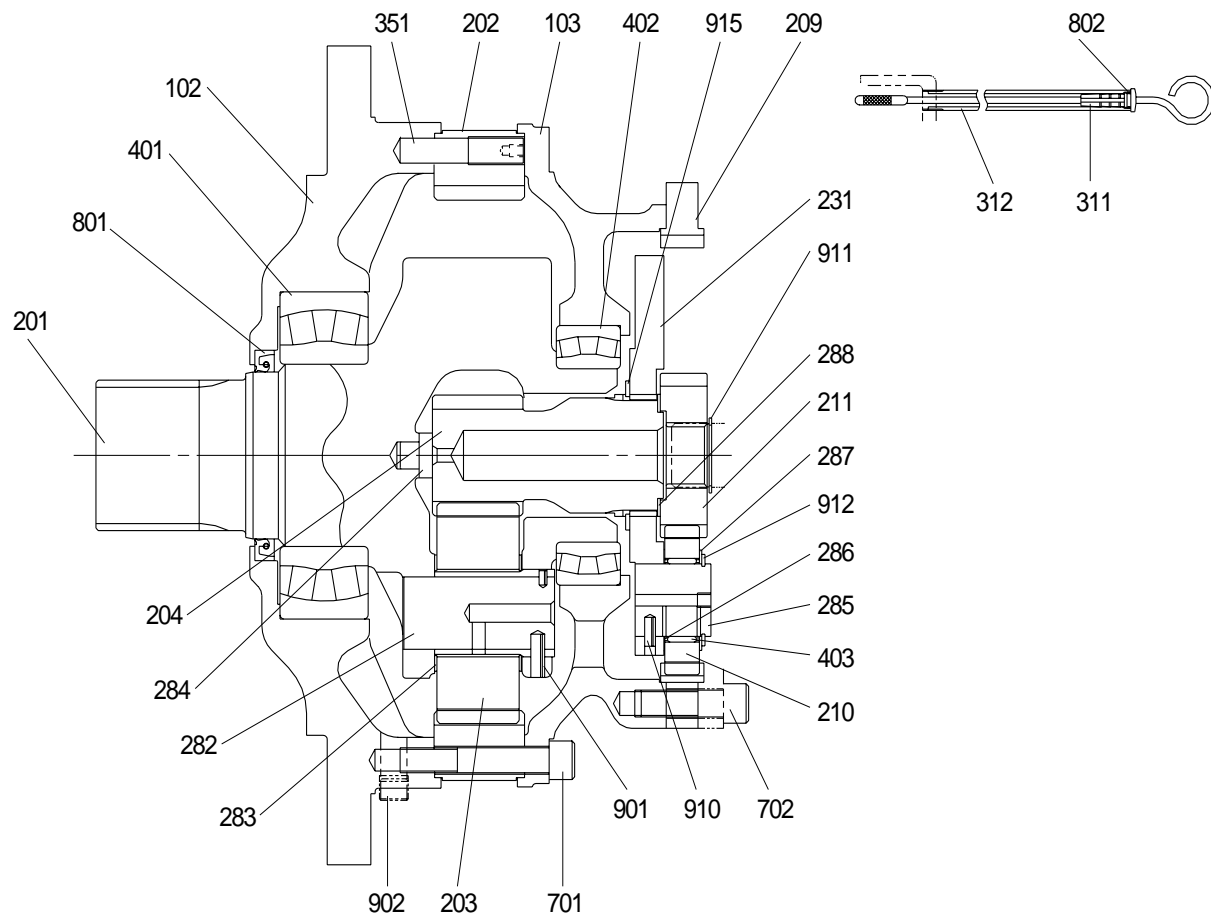
Port	Port name	Port size
A	Main port	SAE 3/4"
B	Main port	SAE 3/4"
Dr	Drain port	PF 1/2
MU	Make up port	PF 1
SH	Brake release port	PF 1/4
P3	Stand by port	PF 1/4

1) SWING MOTOR



101	Drive shaft	304	Front cover	485	O-ring
106	Spacer	351	Plunger	487	O-ring
111	Cylinder block	355	Spring	488	O-ring
113	Retainer	401	Hex socket screw	491	Oil seal
114	Cylinder spring	432	Snap ring	702	Brake piston
116	Push rod	433	Snap ring	706	O-ring
117	Spacer F	437	Snap ring	707	O-ring
118	Spacer R	438	Snap ring	712	Brake piston
121	Piston	443	Roller bearing	742	Friction plate
122	Shoe	444	Roller bearing	743	Separator plate
123	Return plate	451	Pin	993	Plug
124	Swash plate	468	VP plug	994	Plug
131	Balance plate	469	RO plug	051	Relief valve
301	Casing A	471	O-ring	031	Time delay valve
303	Valve casing A	472	O-ring		

2) REDUCTION GEAR



102	Front casing	283	Thrust washer	403	Needle gauge
103	Middle casing	284	Thrust button	701	Hex socket bolt
201	Shaft	285	Pin1	702	Hex socket bolt
202	Ring gear 2	286	Side plate	801	Oil seal
203	Planetary gear 2	287	Side plate	802	O - ring
204	Sun gear 2	288	Side plate	901	Spring pin
209	Ring gear 1	311	Level bar	902	plug
210	Planetary gear 1	312	Pipe	910	Spring pin
211	Sun gear 1	351	Lock pin	911	Stop ring
231	Carrier	401	Roller bearing	912	Stop ring
282	Pin	402	Roller bearing	915	Stop ring

2. FUNCTION

1) ROTARY PART

When high pressurized oil enters a cylinder through port(a), which is the inlet of balance plate(131), hydraulic pressure acting on the piston causes axial force F. The pressure force F works via the piston(121) upon the return plate(123) which acts upon the swash plate(124) via an hydrostatic bearing. Force F1 perpendicular to swash plate(124) and force F2 perpendicular to cylinder center. Being transferred to the cylinder block(111) 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.

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

Where p : Effective difference of pressure(kgf/cm²)

q : Displacement(cc/rev)

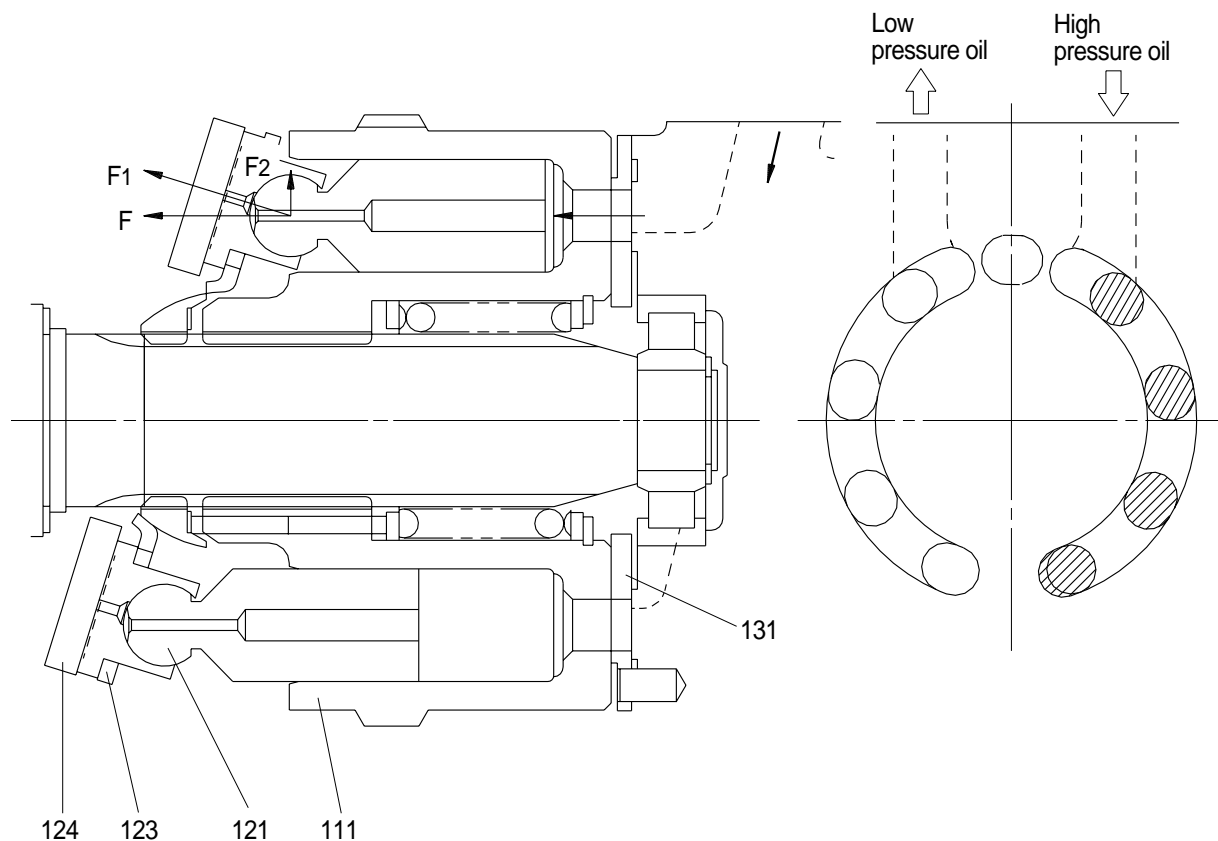
T : Output torque(kgf · cm)

Z : Piston number

A : Piston area(cm²)

θ : Tilting angle of swash plate(degree)

S : Piston stroke(cm)



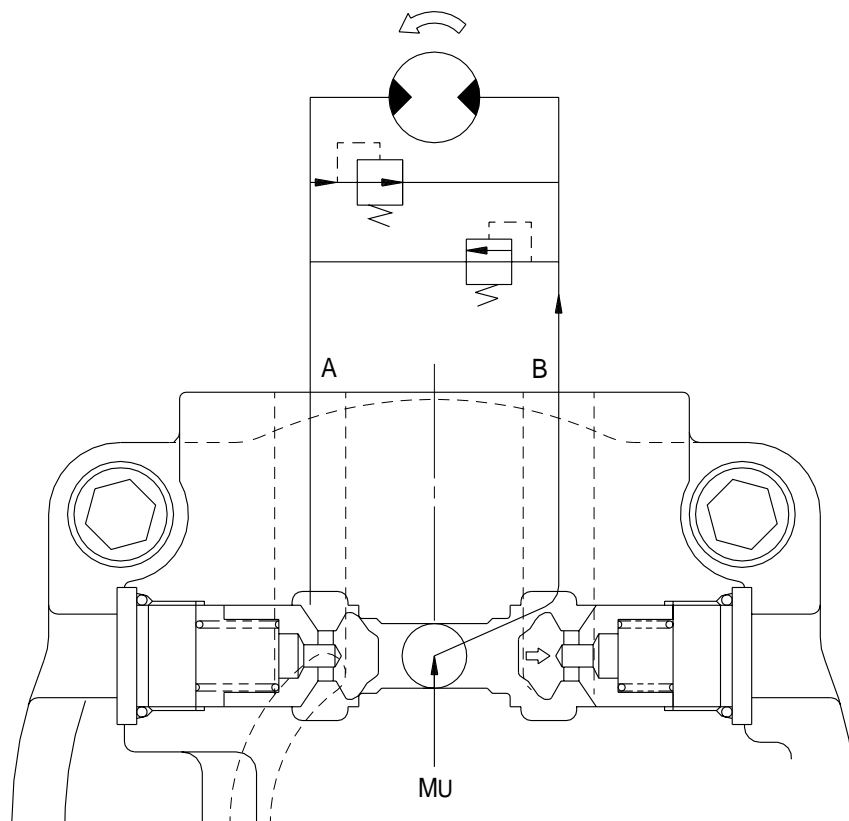
2) MAKE UP VALVE

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.

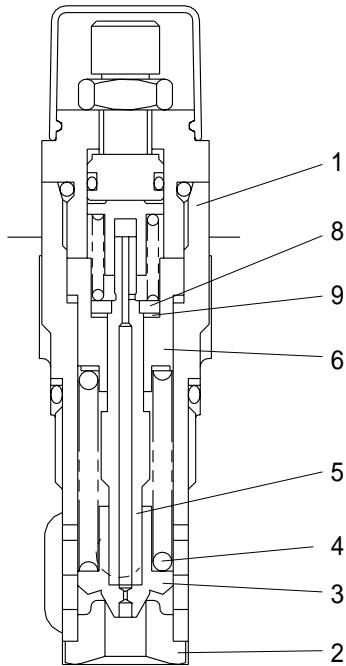
A make up valve is provided immediately before the port leading to the hydraulic oil tank to secure feed pressure required when the hydraulic motor makes a pumping action. The boost pressure acts on the hydraulic motor's feed port via the make up valve.

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

If the plunger of MCV moves neutral position, the drain oil from Mu port run into motor via right make up valve, which prevent the cavitation of motor.



3) RELIEF VALVE



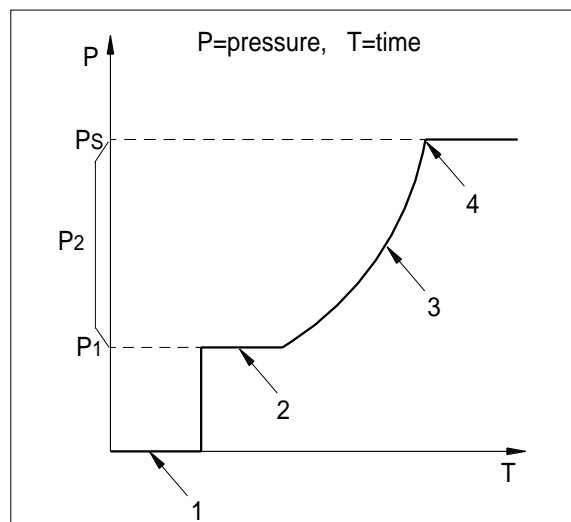
- 1 Body
- 2 Seat
- 3 Plunger
- 4 Spring
- 5 Rod
- 6 Piston
- 8 Spring seat
- 9 Shim

(1) Construction of relief valve

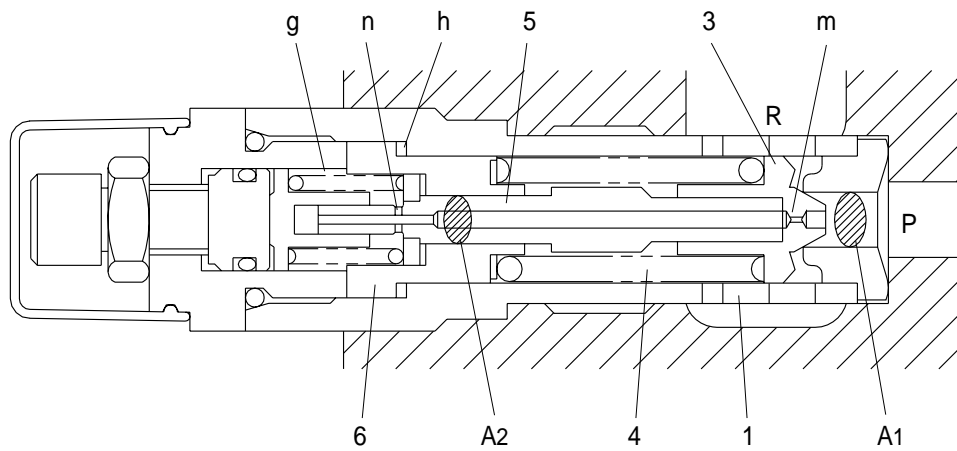
The valve casing contains two cartridge type relief valves that stop the regular and reverse rotations of the hydraulic motor. The relief valves relieve high pressure at start or at stop of swing motion and can control the relief pressure in two steps, high and low, in order to insure smooth operation.

(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.



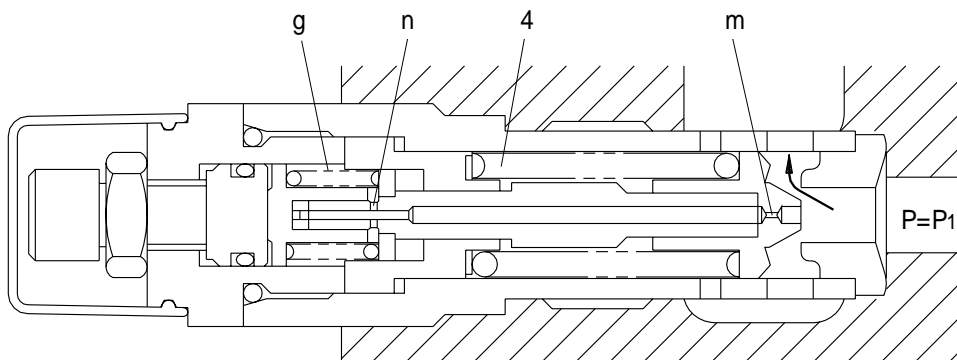
- ① Ports (P, R) at tank pressure.



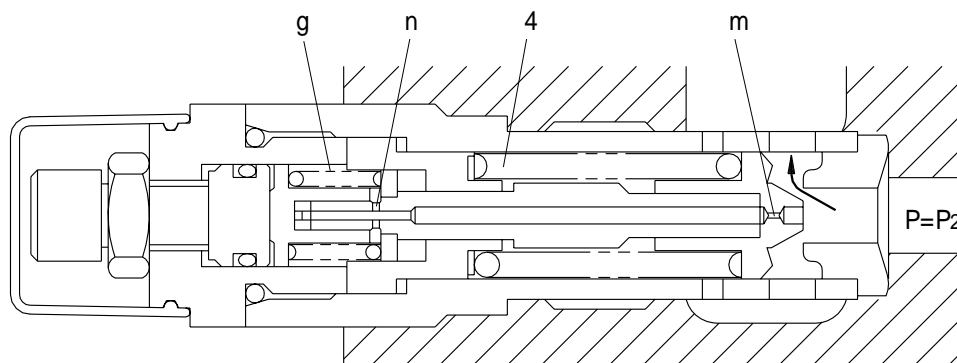
- ② When hydraulic oil pressure ($P \times A1$) reaches the preset force (F_{SP}) of spring (4), the plunger (3) moves to the left as shown. Also the oil flow chamber g via orifice m and n.

$$P_1 \times A1 = F_{SP} + P_g \times A2$$

$$P_1 = \frac{F_{SP} + P_g \times A2}{A1}$$



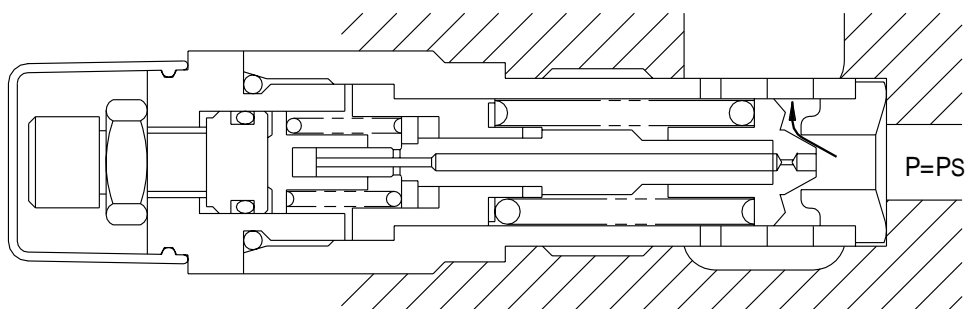
- ③ When the pressure of chamber g reaches the preset force(F_{SP}) of spring(4), the piston(6) moves right and stop the piston(6) hits the end of body(1).



- ④ When piston(6) hits the end of body(1), it stops moving to the right any further. As the result, the pressure in chamber g equals P_s .

$$P_s \times A_1 = F_{SP} + P_s \times A_2$$

$$P_s = \frac{F_{SP}}{A_1 - A_2}$$

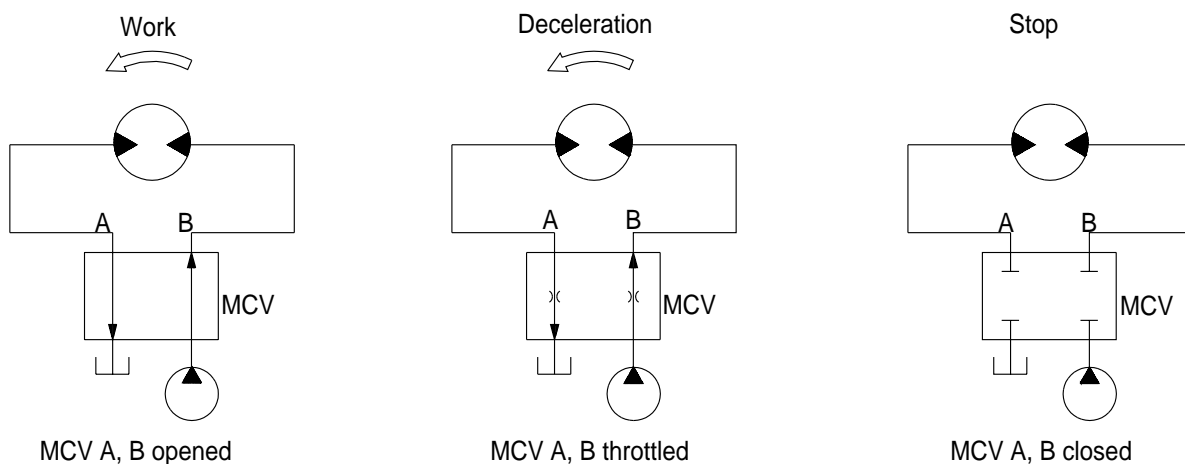


4) BRAKE SYSTEM

(1) Control valve swing brake system

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



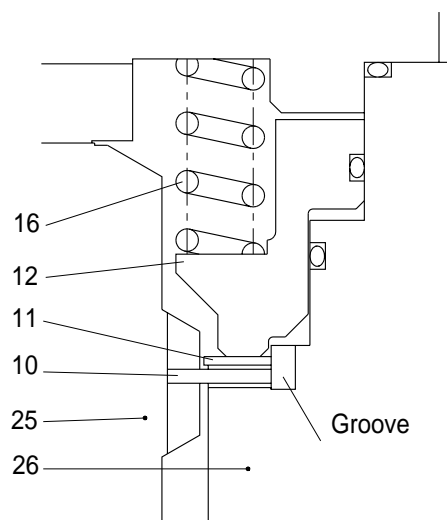
(2) Mechanical swing parking brake system

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 slope, work can be done more easily and safely.

① Brake assembly

Circumferential rotation of separate plate(743) is constrained by the groove located at casing (301). When casing is pressed down by brake spring(702) through friction plate(742), separate plate(743) and brake piston(702), friction force occurs there.

Cylinder(111) is constrained by this friction force and brake acts, while brake releases when hydraulic force exceeds spring force.

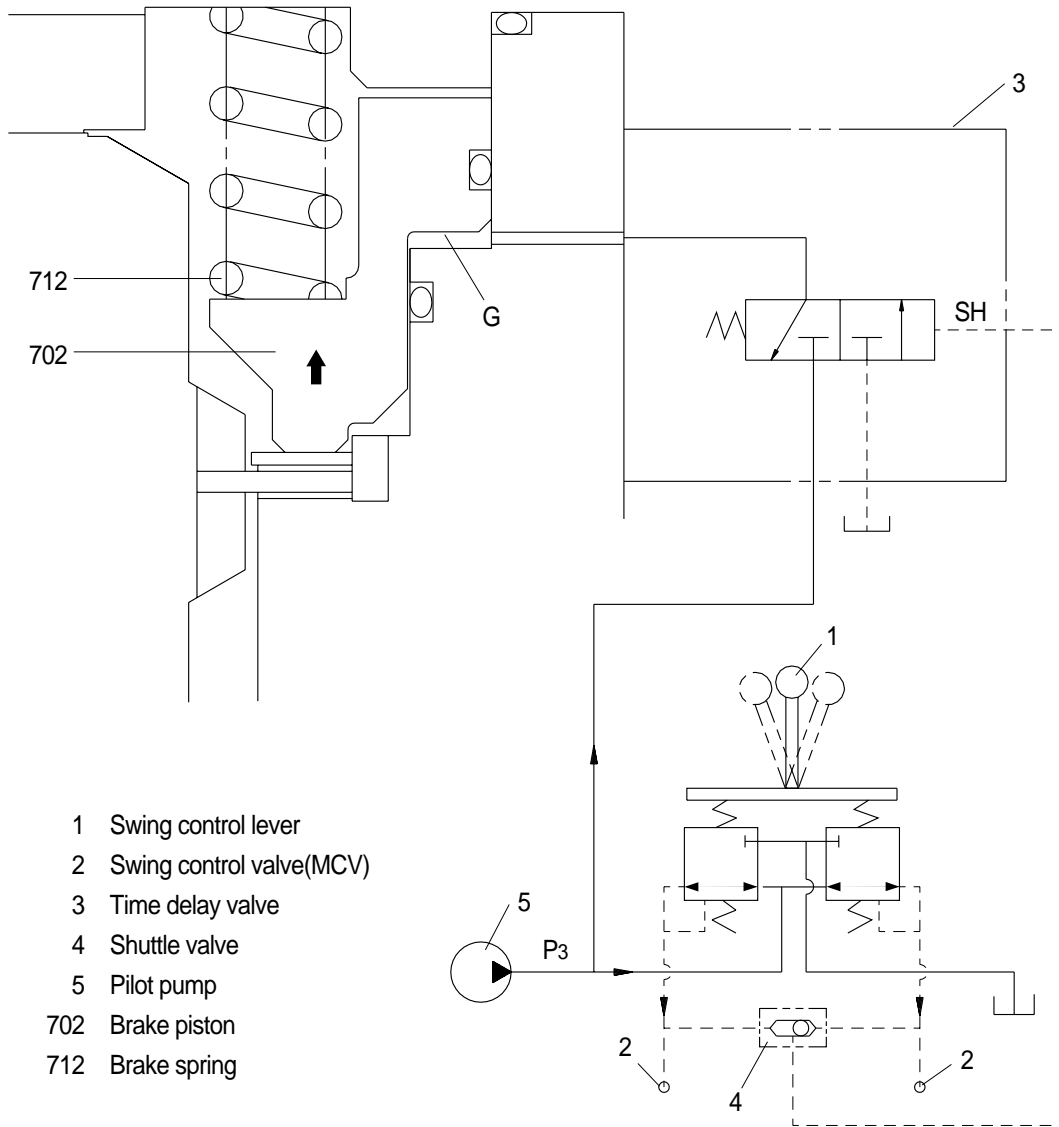


111	Cylinder	712	Brake spring
301	Casing	742	Disc
702	Brake piston	743	Separate plate

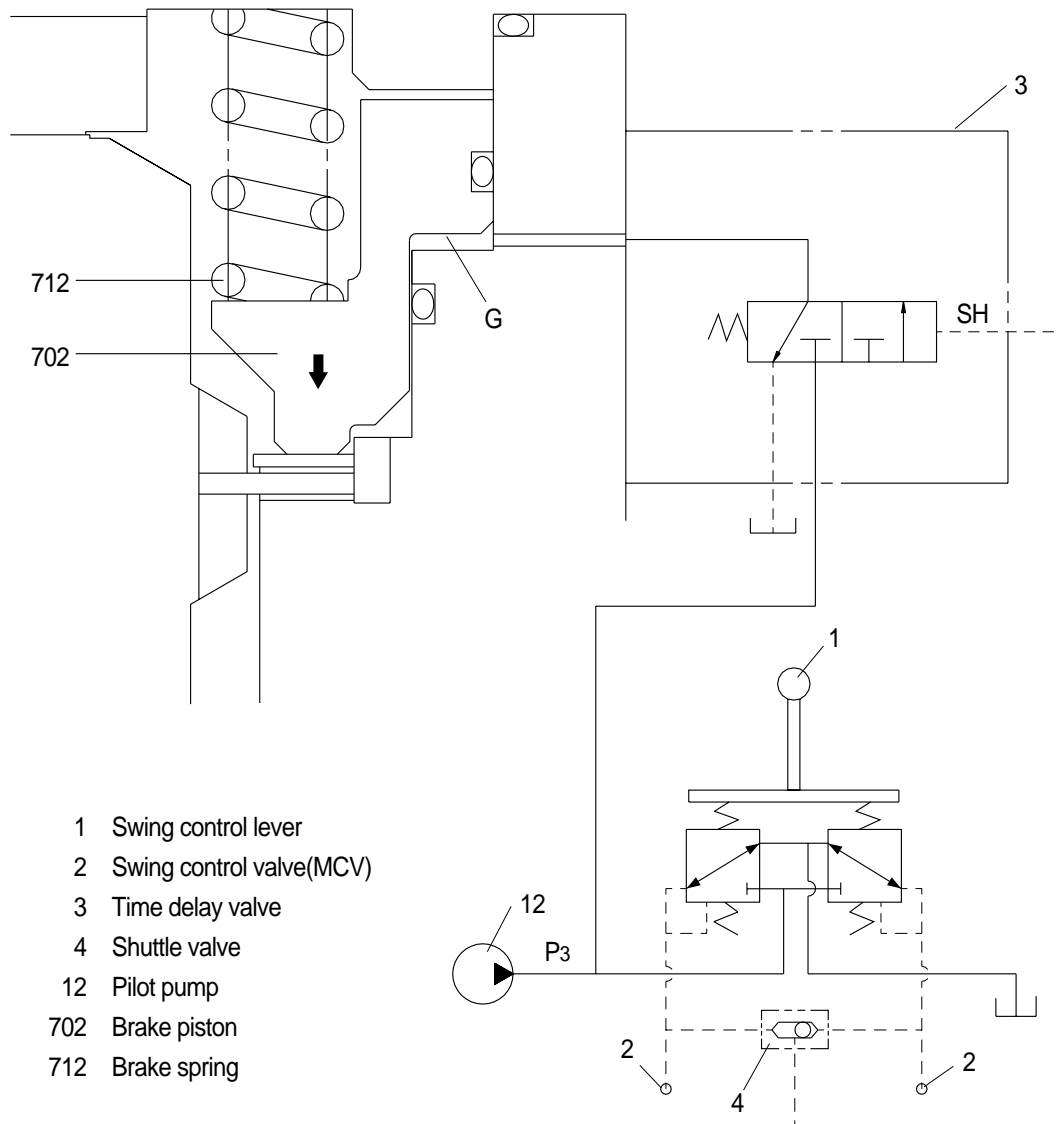
② Operating principle

- 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 SH of the time delay valve(3) via the shuttle valve(4), this pressure shift time delay valve so, pilot pump charged oil(P3) go to the chamber G.

This pressure is applied to move the piston(6) to the upward against the force of the spring(9) thus releasing the brake force.



- b. When the swing control(1) lever is set the neutral position, the time delay valve(3) shifts the neutral position and the pilot oil blocked chamber G. Then, the piston(6) is moved lower by spring force and the return oil from the chamber G is drain.



- 1 Swing control lever
- 2 Swing control valve(MCV)
- 3 Time delay valve
- 4 Shuttle valve