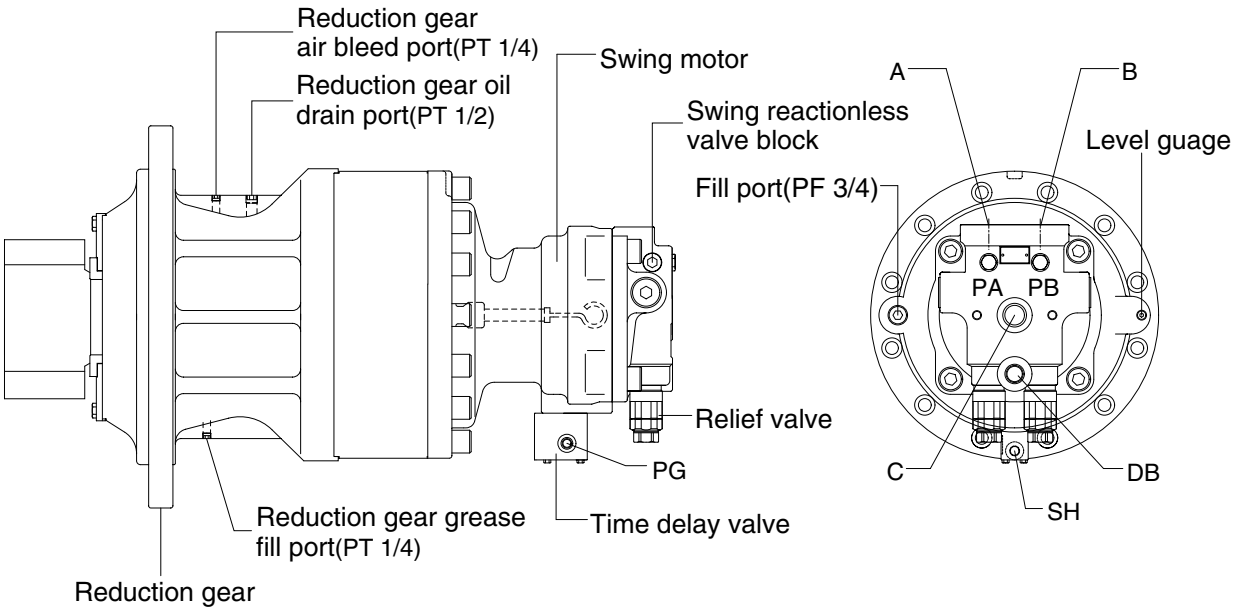
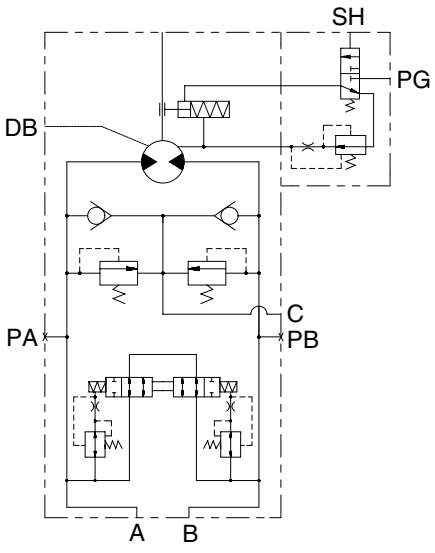
GROUP 3 SWING DEVICE

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.





Hydraulic circuit

Port	Port name	Port size
A	Main port	ø 20
B	Main port	ø 20
DB	Drain port	PF 1/2
C	Make up port	PF 1
PG	Brake release port	PF 1/4
SH	Stand by port	PF 1/4
PA, PB	Gauge port	PF 1/4

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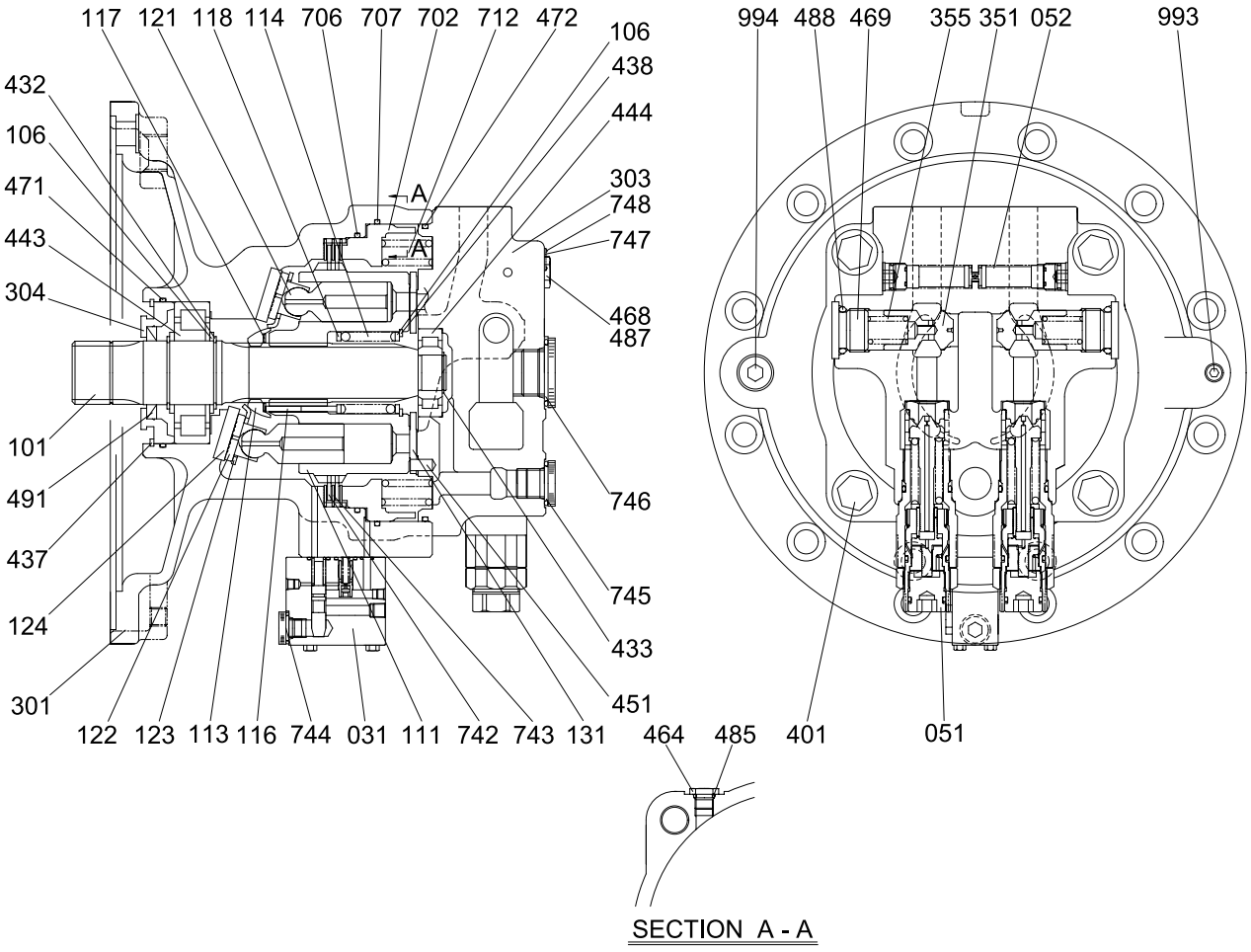
1) SWING MOTOR



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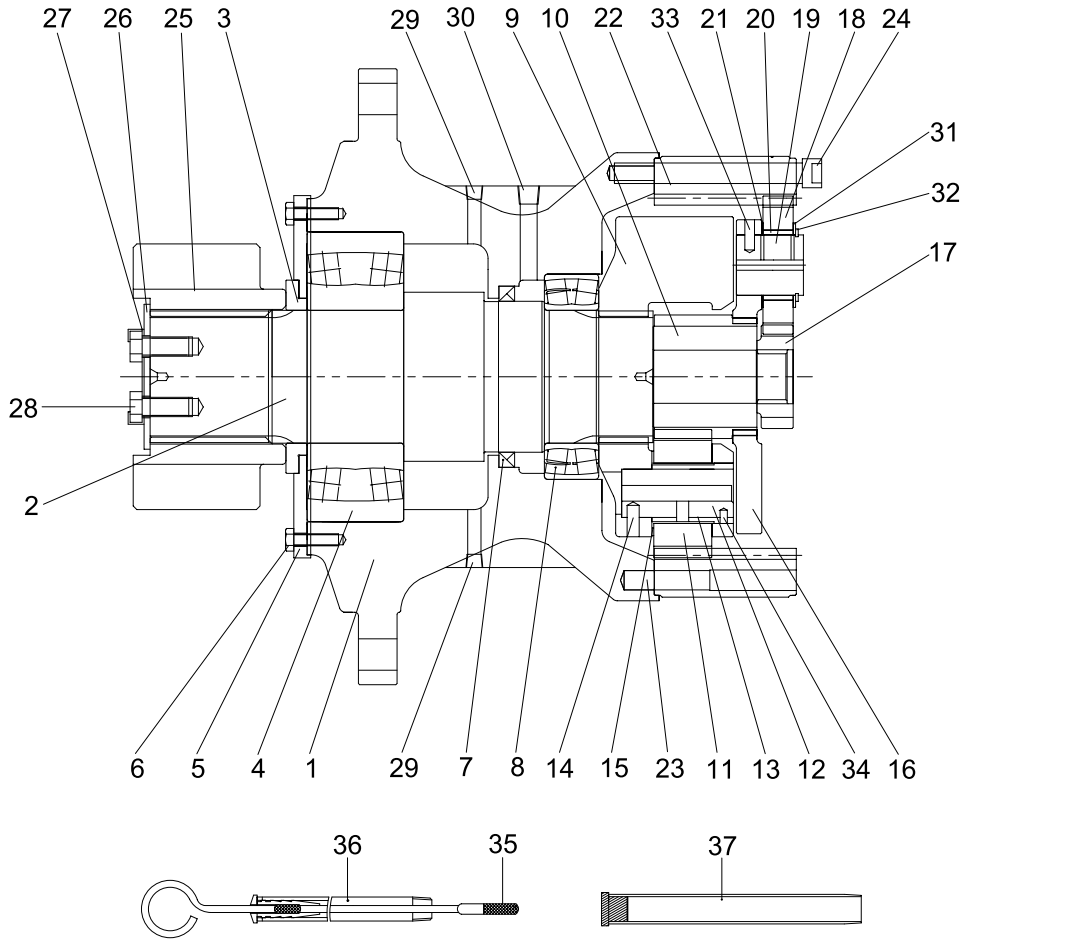
031	Time delay valve	303	Valve casing	485	O-ring
051	Relief valve	304	Front cover	487	O-ring
052	Shockless valve assy	351	Plunger	488	O-ring
101	Drive shaft	355	Spring	491	Oil seal
106	Spacer	401	Socket bolt	702	Brake piston
111	Cylinder block	432	Snap ring	706	O-ring
113	Spherical bush	433	Snap ring	707	O-ring
114	Spring	437	Snap ring	712	Brake spring
116	Push rod	438	Snap ring	742	Friction plate
117	Spacer	443	Roller bearing	743	Separate plate
118	Spacer	444	Roller bearing	744	Dust plug
121	Piston	451	Spring pin	745	Dust plug
122	Shoe	464	Plug	746	Dust plug
123	Retainer	468	Plug	747	Name plate
124	Shoe plate	469	Plug	748	Rivet screw
131	Valve plate	471	O-ring	993	Level gauge
301	Casing	472	O-ring	994	Plug

2) REDUCTION GEAR



1	Casing	14	Spring pin	27	Lock washer
2	Drive shaft	15	Thrust washer	28	Hexagon bolt
3	Spacer	16	Carrier 1	29	Plug
4	Roller bearing	17	Sun gear 1	30	Plug
5	Cover plate	18	Planet gear 1	31	Side plate 2
6	Hexagon bolt	19	Pin 1	32	Stop ring
7	Oil seal	20	Needle cage	33	Spring pin
8	Roller bearing	21	Side plate 1	34	Spring pin
9	Carrier 2	22	Ring gear	35	Gauge bar
10	Sun gear 2	23	Knock pin	36	Gauge pipe
11	Planet gear 2	24	Socket bolt	37	Air breather assy
12	Pin 2	25	Pinion gear		
13	Bushing 2	26	Lock plate		

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.

$$T = \frac{p \times q}{2\pi}, \quad q = Z \cdot A \cdot PCD \cdot \tan\theta, \quad F1 = \frac{F}{\cos\theta}, \quad F_2 = F\tan\theta, \quad S = PCD \times \tan\theta$$

Where p : Effective difference of pressure(kgf/cm^2)

q : Displacement(cc/rev)

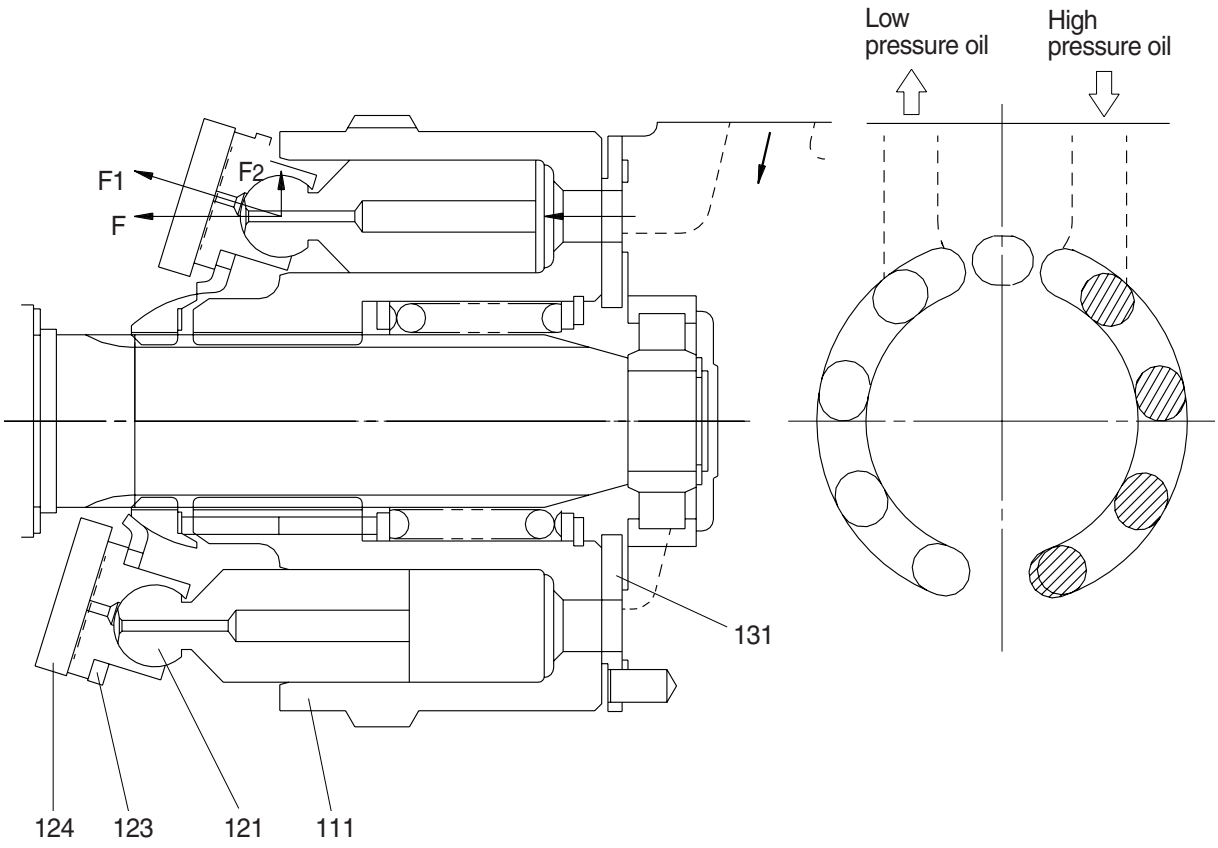
T : Output torque(kgf · cm)

Z : Piston number(9EA)

A : Piston area(cm^2)

θ : Tilting angle of swash plate(degree)

S : Piston stroke(cm)



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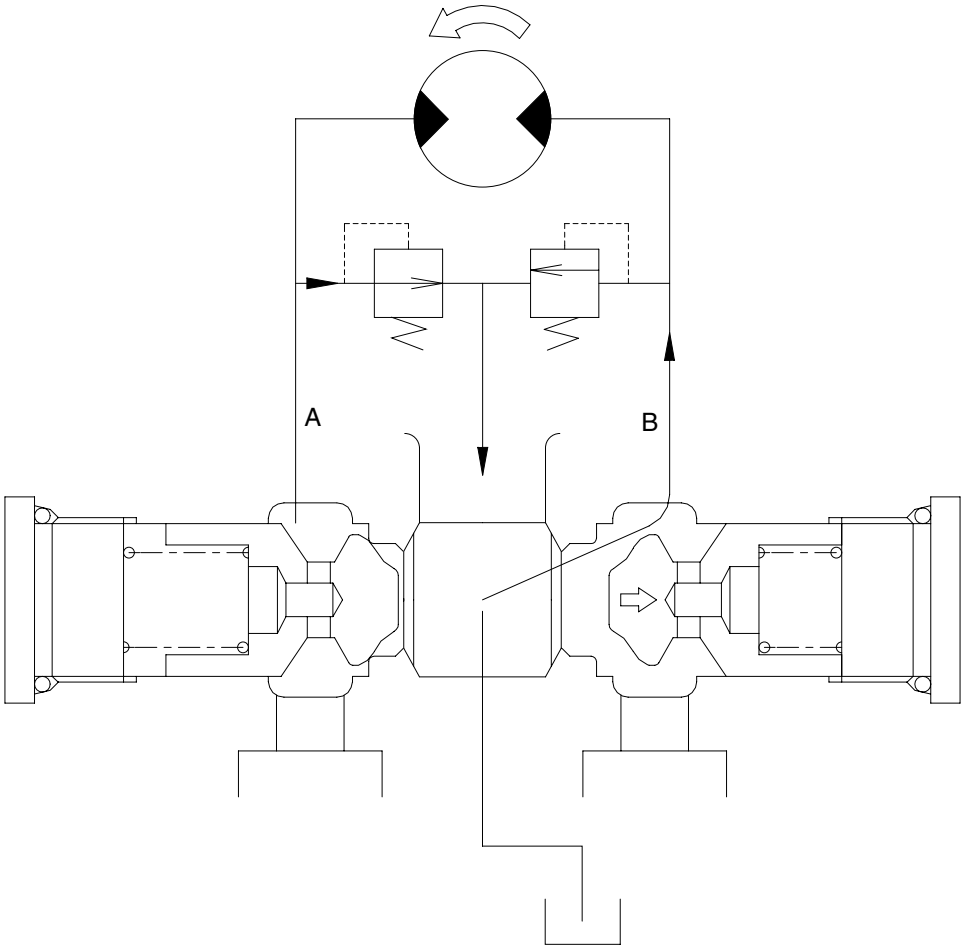
2) MAKE UP VALVE

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.



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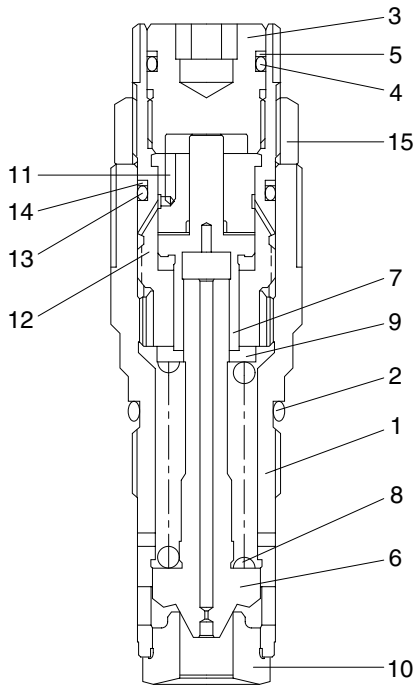
3) RELIEF VALVE



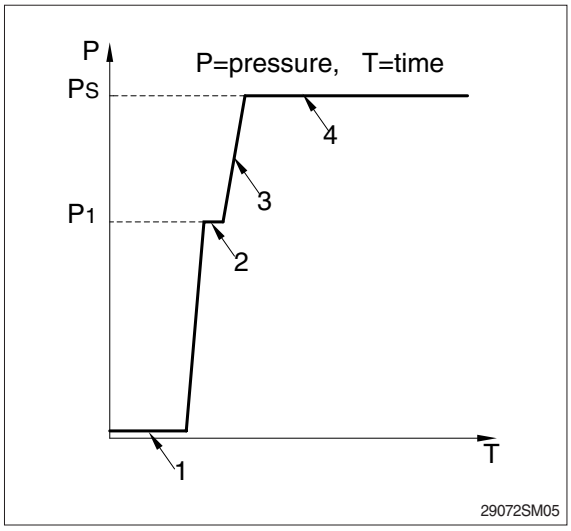
1	Body
2	O-ring
3	Plug
4	O-ring
5	Back up ring
6	Plunger
7	Piston
8	Spring
9	Seat spring
10	Seat
11	Sleeve
12	Adjust plug
13	O-ring
14	Back up ring
15	Nut

(1) Construction of relief valve

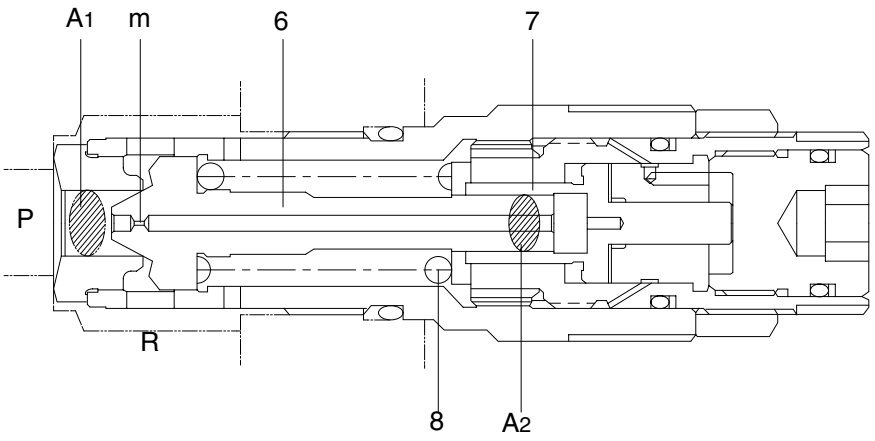
The valve casing contains two cartridge type relief valves that stop the regular and reverse rotations of the hydraulic motor. The relief valves relieve high pressure at start or at stop of swing motion and can control the relief pressure in two steps, high and low, in order to insure smooth operation.

(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.



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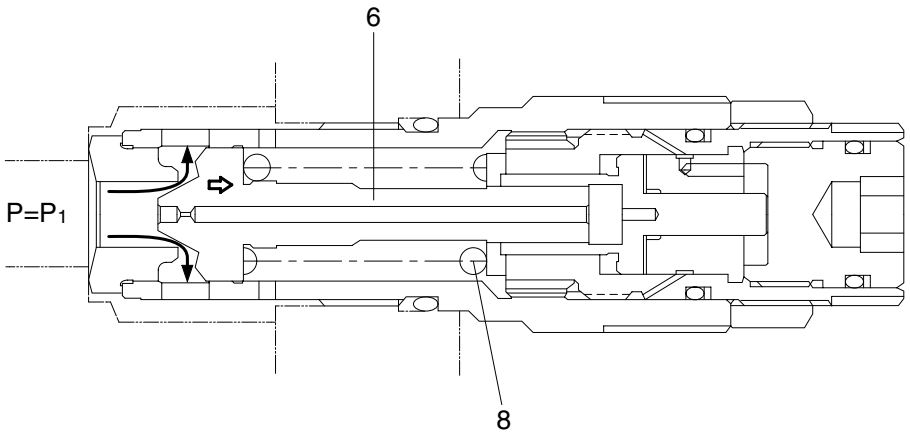
② When hydraulic oil pressure(P×A1) reaches the preset force(FSP) of spring(8), the plunger (6) moves to the right as shown.

$$P1 \times A1 = Fsp + P1 \times A2$$

$$P_1 = \frac{Fsp}{A_1 - A_2}$$



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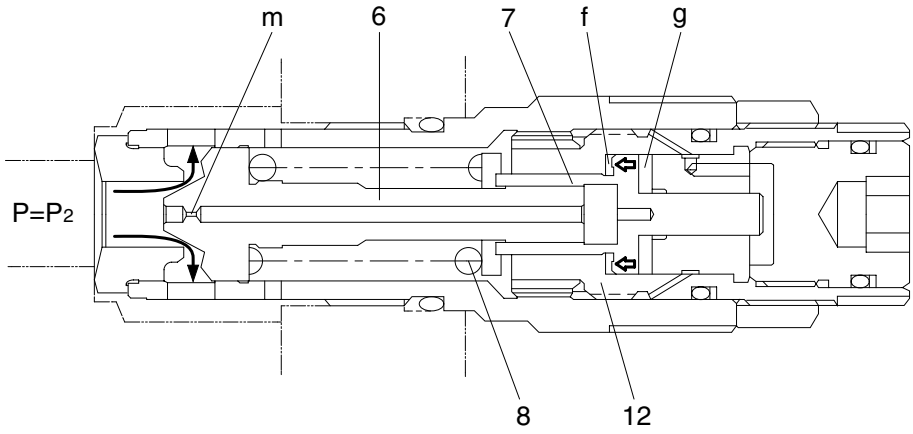
③ When the pressure of chamber g reaches the preset force(Fsp) of spring(8), the piston(7) moves right and stop the piston(7) hits the end of body.



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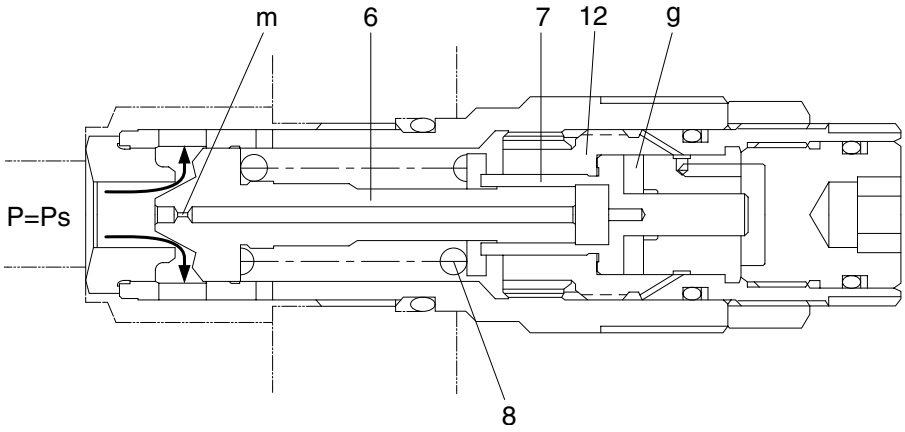
④ When piston(7) hits the end of body, it stops moving to the right any further. As the result, the pressure in chamber(g) equals(Ps).

$Ps \times A1 = Fsp + Ps \times A3$

$$Ps = \frac{Fsp}{A_1 - A_3}$$



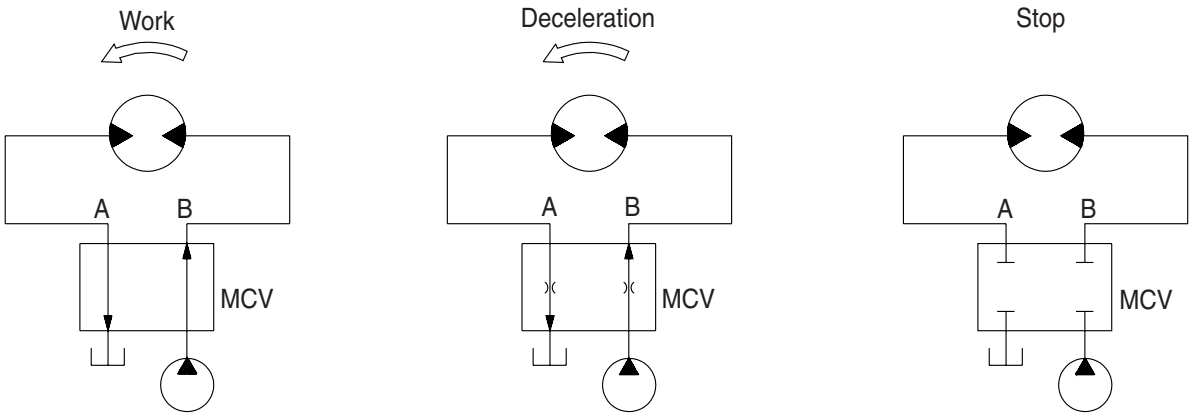
29072SM08

4) BRAKE SYSTEM

(1) Control valve swing brake system

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

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



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

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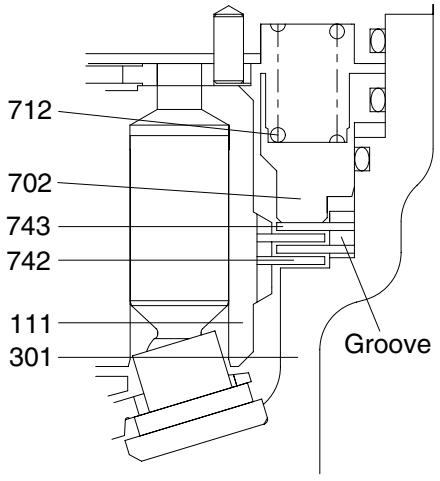
(2) Mechanical swing parking brake system

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(743) is constrained by the groove located at casing(301). When housing is pressed down by brake spring(712) through lining 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.



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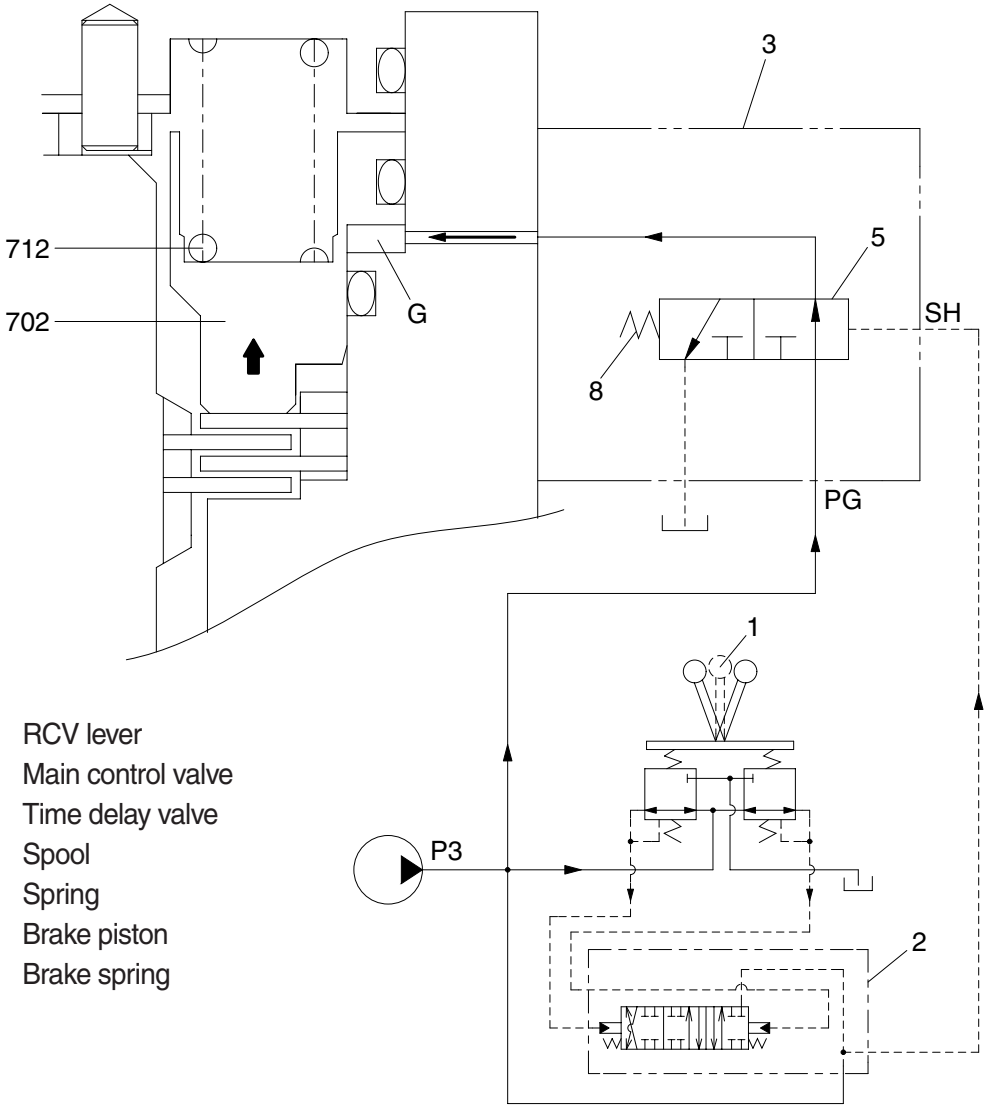
111	Cylinder	712	Brake spring
301	Casing	742	Lining plate
702	Brake piston	743	Separate plate

② **Operating principle**

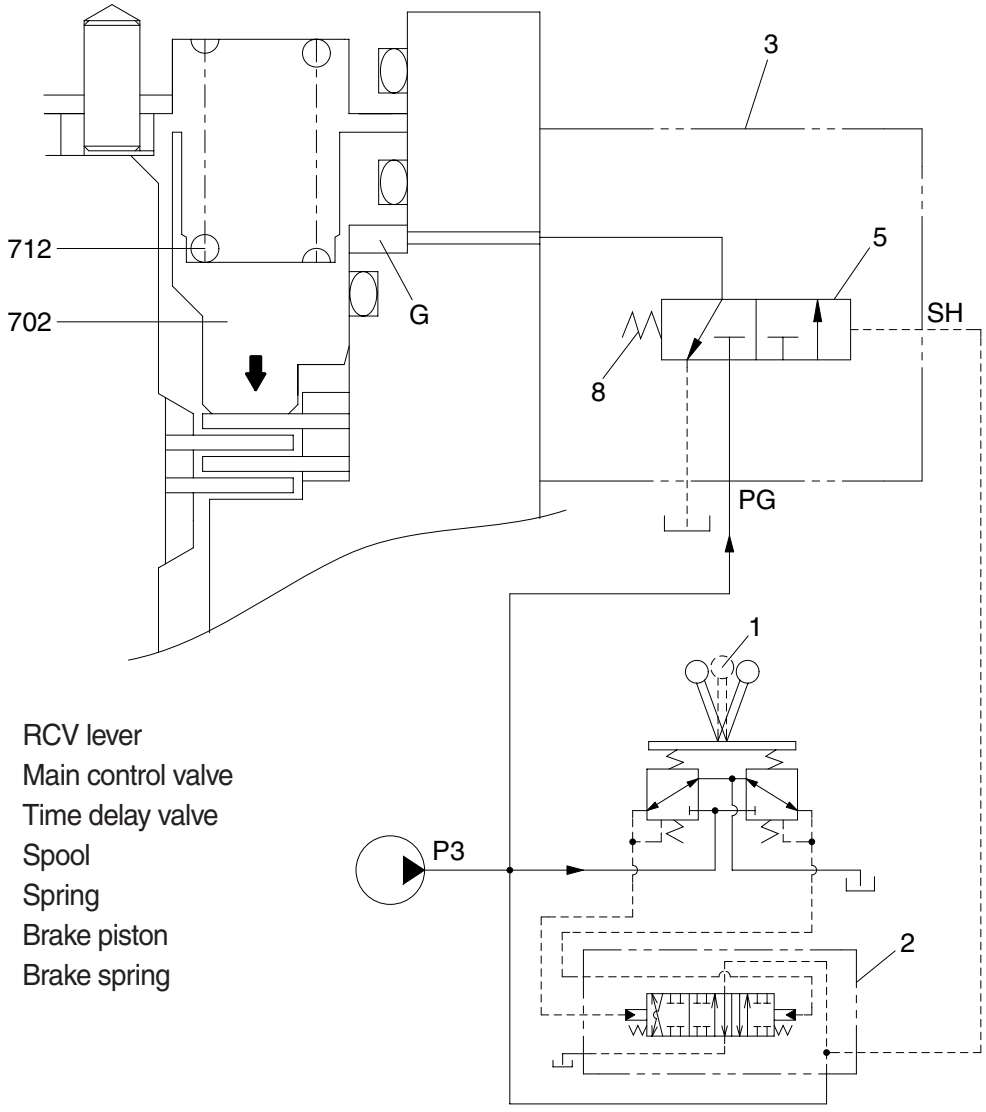
a. When one of the RCV lever (1) is set to the operation position, the each spool is shifted to left or right and the pilot oil flow is blocked. Then the pilot oil go to SH of the time delay valve (3). This pressure moves spool (5) to the leftward against the force of the spring(8), so pilot pump charged oil (P3) goes to the chamber G through port PG.
This pressure is applied to move the piston (702) to the upward against the force of the spring (712). Thus, it releases the brake force.



1	RCV lever
2	Main control valve
3	Time delay valve
5	Spool
8	Spring
702	Brake piston
712	Brake spring

25092SM16

b. When all of the RCV lever (1) are set the neutral position, the spool (5) returns to right.
Then, the piston (702) is moved lower by spring force and the return oil from the chamber G flows back to tank port.
At this time, the brake works.



1 RCV lever
2 Main control valve
3 Time delay valve
5 Spool
8 Spring
702 Brake piston
712 Brake spring

25092SM17