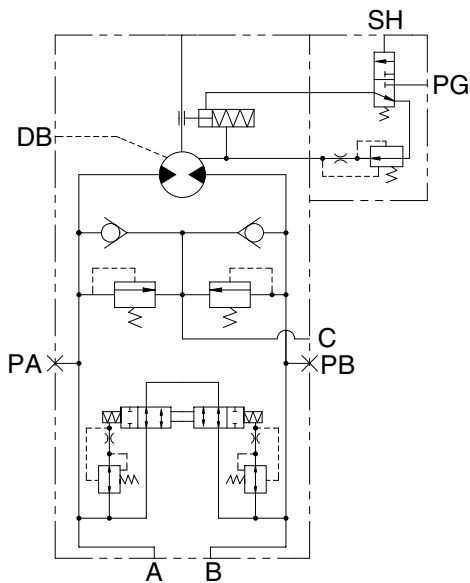
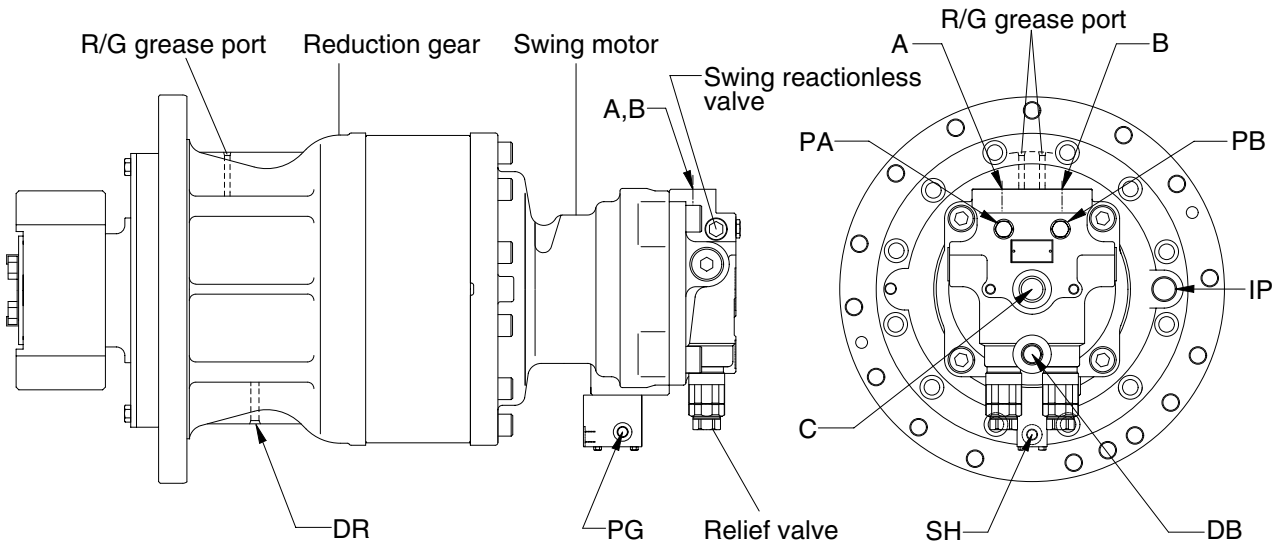


GROUP 3 SWING DEVICE

1. STRUCTURE

Swing device consists swing motor, swing reduction gear.

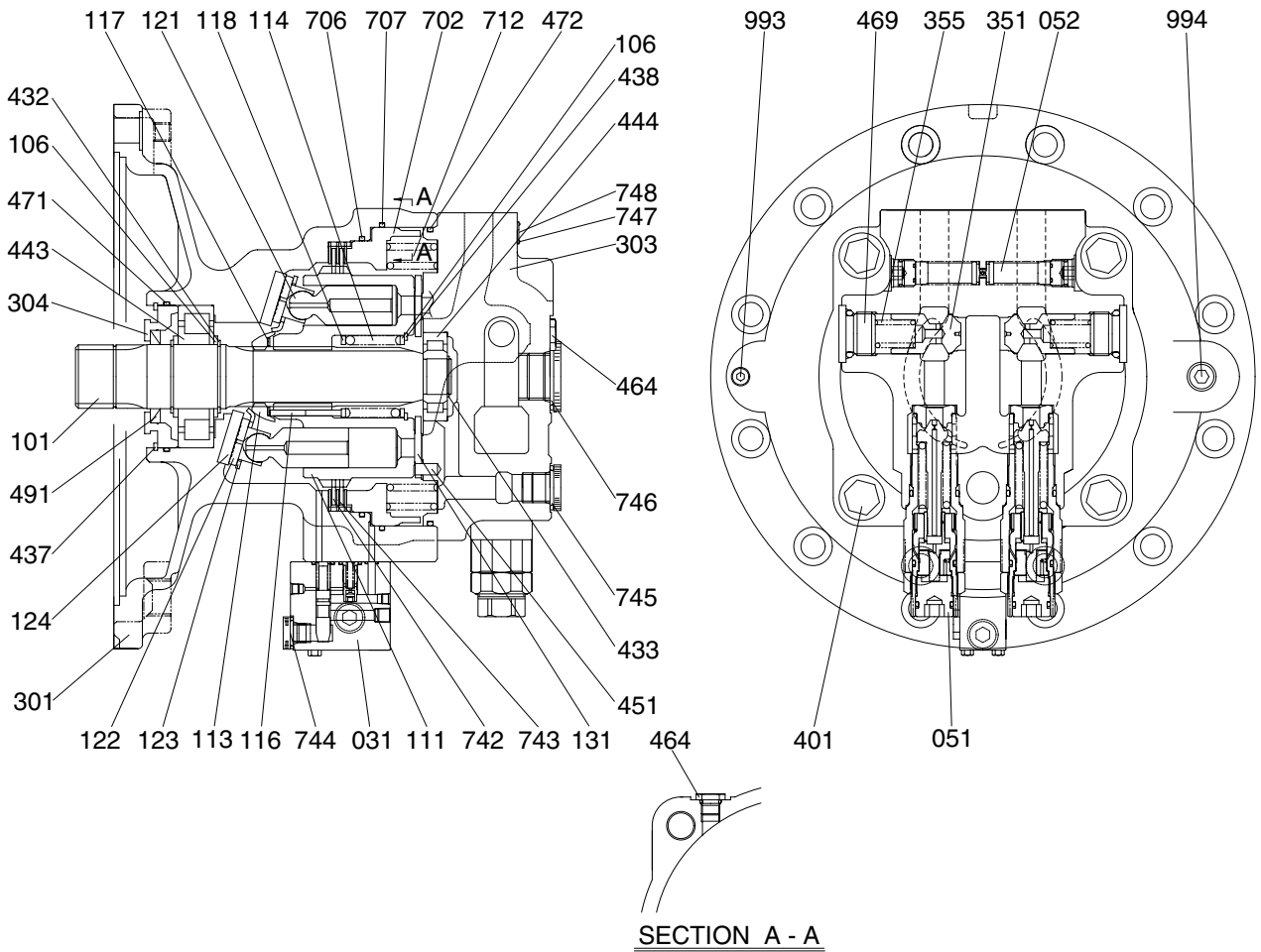
Swing motor include mechanical parking valve, relief valve, make up valve and time delay valve.



Port	Port name	Port size
A, B	Main port	∅ 20
DB	Drain port	PF 1/2-19
C	Make up port	PF 1-24
PA, PB	Gauge port	PF 1/4-12
PG	Brake release port	PF 1/4-12
SH	Brake pilot port	PF 1/4-12
IP	Gear oil inlet port	PT 3/4-19
DR	Gear oil drain port	PT 1/2

29092SM01

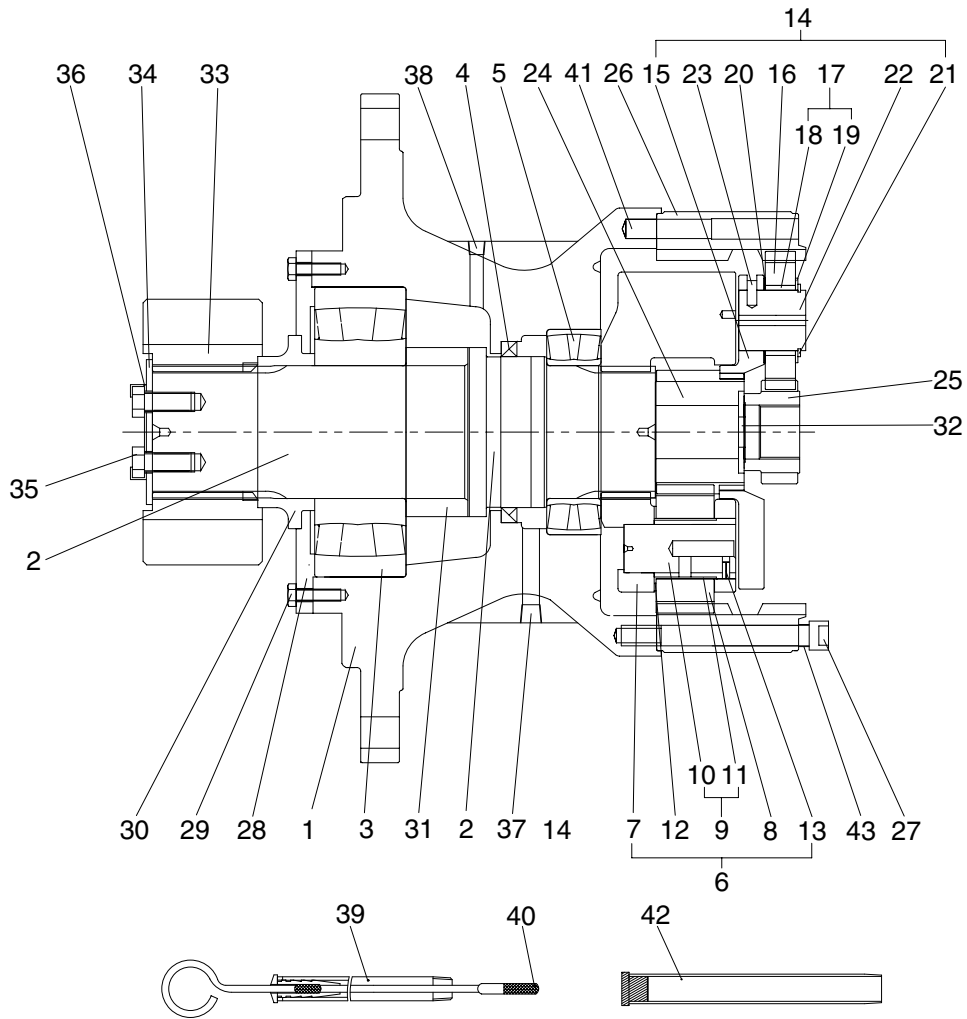
1) SWING MOTOR



29092SM02A

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

2) REDUCTION GEAR



1	Casing	16	Planet gear 1	31	Spacer ring
2	Drive shaft	17	Pin assy 1	32	Thrust plate 3
3	Roller bearing	18	Pin 1	33	Pinion gear
4	Oil seal	19	Bushing 1	34	Lock plate
5	Roller bearing	20	Side plate 1	35	Hexagon bolt
6	Carrier assy 2	21	Side plate 2	36	Lock washer
7	Carrier 2	22	Stop ring	37	Plug
8	Planet gear 2	23	Spring pin	38	Plug
9	Pin assy 2	24	Sun gear 2	39	Gage pipe
10	Pin 2	25	Sun gear 1	40	Gage bar
11	Bushing 2	26	Ring gear	41	Knock pin
12	Thrust washer	27	Socket bolt	42	Air breather assy
13	Spring pin	28	Cover plate	43	Bushing 2
14	Carrier assy 1	29	Hexagon bolt		
15	Carrier 1	30	Spacer		

29092SM03

2. FUNCTION

1) ROTARY PART

When high pressurized oil enters a cylinder through port (a), which is the inlet of valve plate (131), hydraulic pressure acting on the piston causes axial force F. The pressure force F works via the piston (121) upon the retainer (123) which acts upon the shoe plate (124) via an hydrostatic bearing. Force F1 perpendicular to shoe 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)

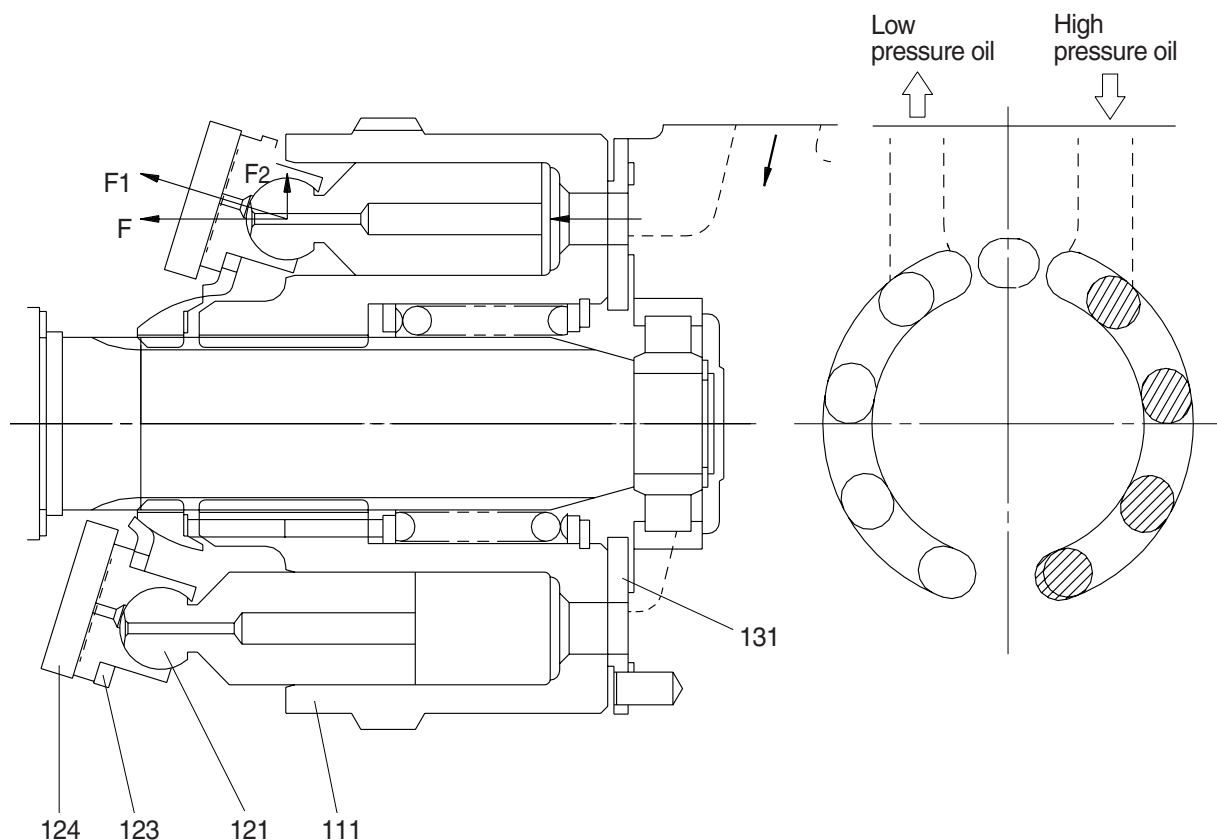
T : Output torque (kgf · cm)

Z : Piston number (9EA)

A : Piston area (cm²)

θ : Tilting angle of swash plate (degree)

S : Piston stroke (cm)



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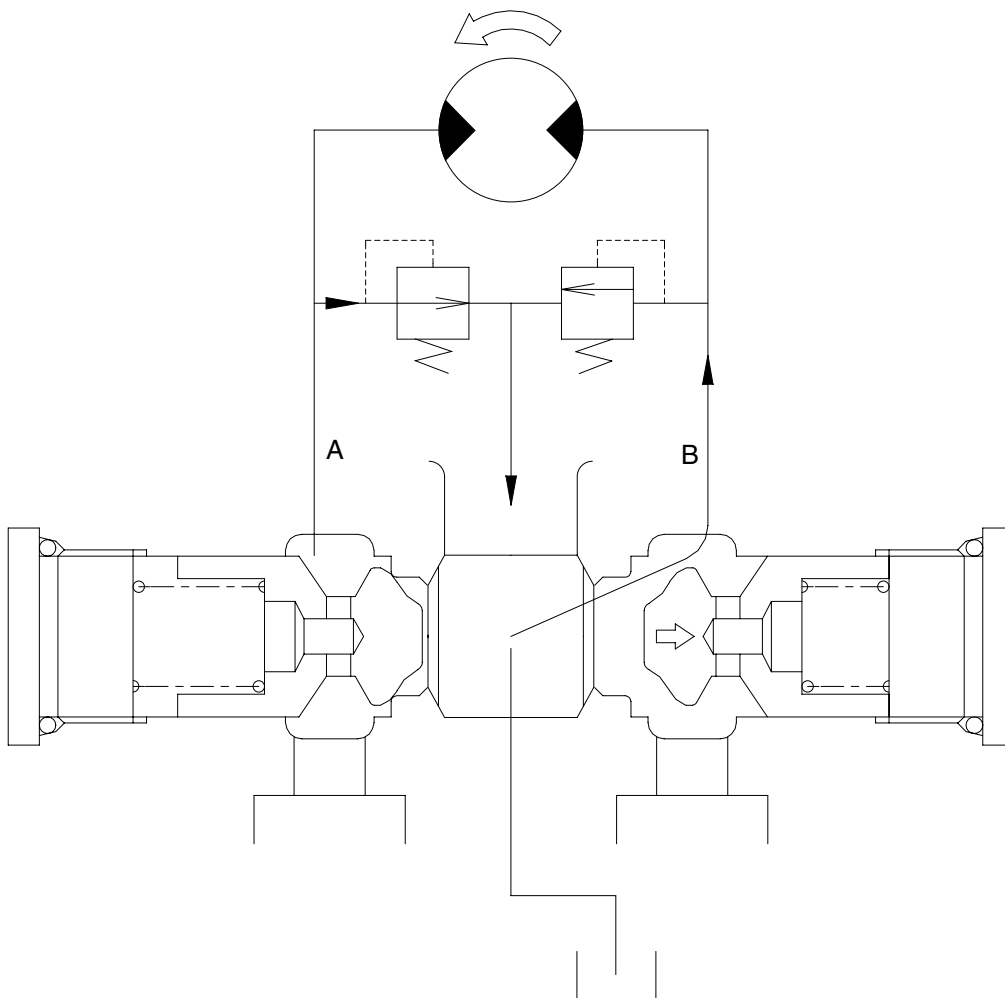
2) MAKE UP VALVE

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.

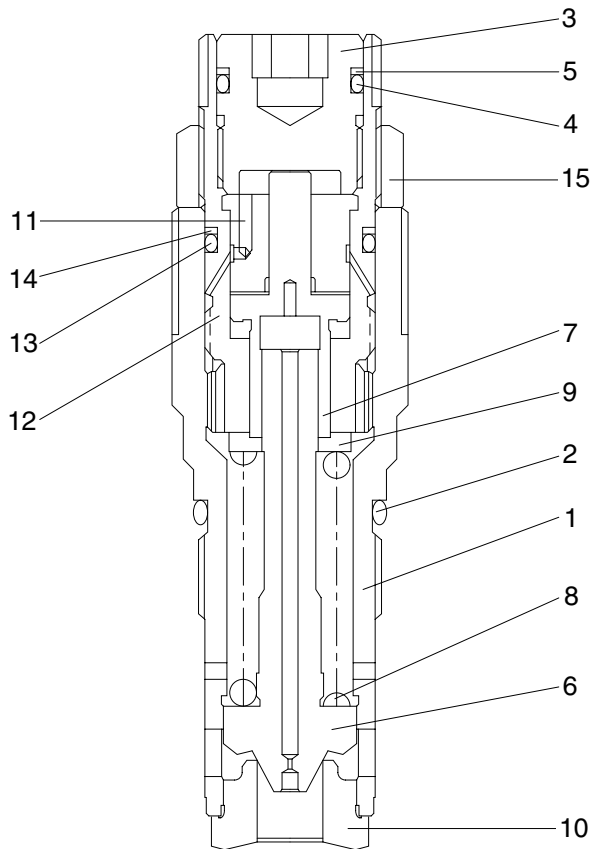
Pressurized oil into the port B, the motor rotate counterclockwise.

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.



29072SM09

3) RELIEF VALVE



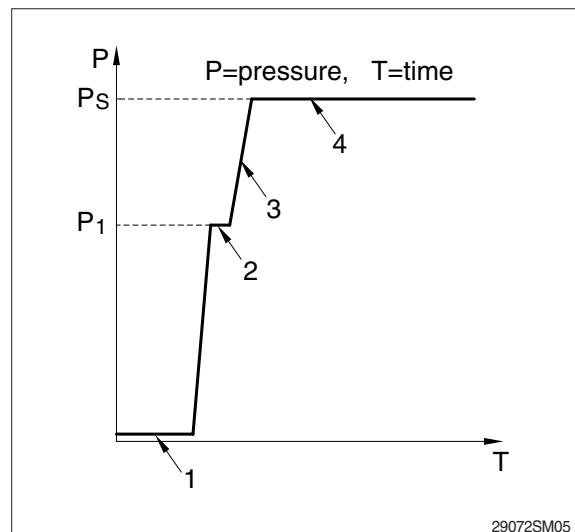
- 1 Body
- 2 O-ring
- 3 Plug
- 4 O-ring
- 5 Back up ring
- 6 Plunger
- 7 Piston
- 8 Spring
- 9 Seat spring
- 10 Seat
- 11 Sleeve
- 12 Adjust plug
- 13 O-ring
- 14 Back up ring
- 15 Nut

(1) Construction of relief valve

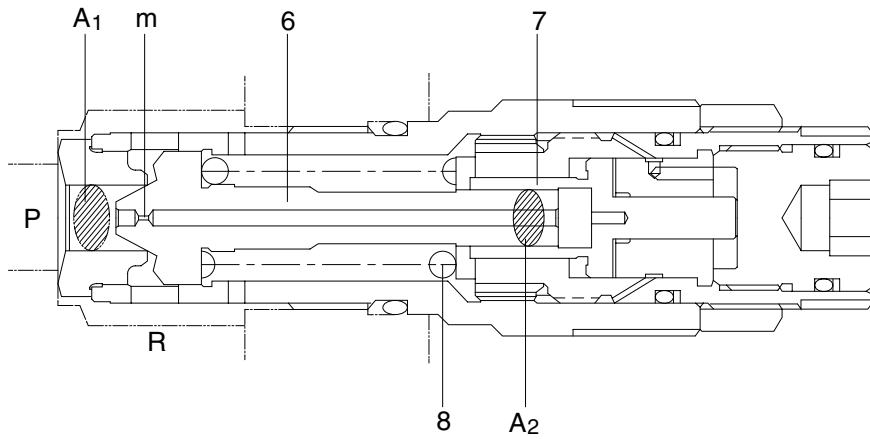
The valve casing contains two cartridge type relief valves that stop the regular and reverse rotations of the hydraulic motor. The relief valves relieve high pressure at start or at stop of swing motion and can control the relief pressure in two steps, high and low, in order to insure smooth operation.

(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.

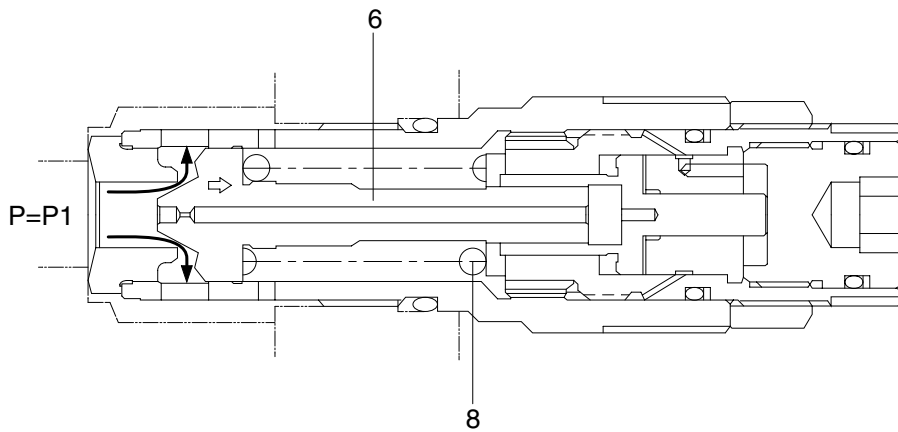


29072SM04

② When hydraulic oil pressure ($P \times A_1$) reaches the preset force (F_{SP}) of spring (8), the plunger (6) moves to the right as shown.

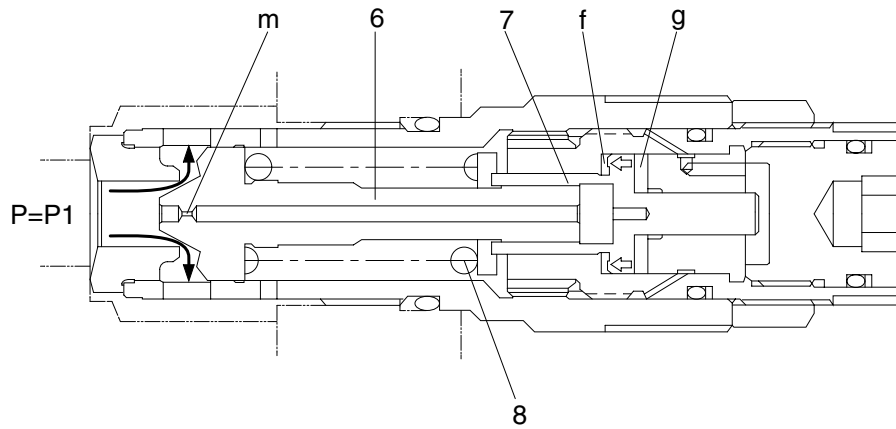
$$P_1 \times A_1 = F_{sp} + P_1 \times A_2$$

$$P_1 = \frac{F_{sp}}{A_1 - A_2}$$



29072SM06

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

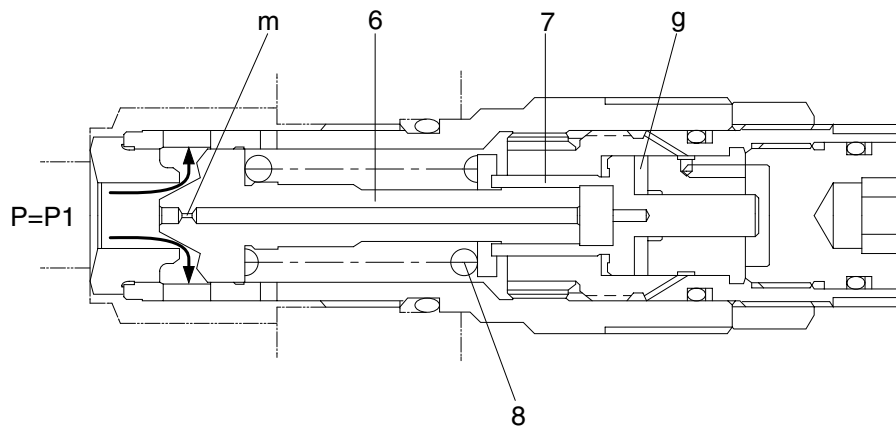


29072SM07

- 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 (P_s).

$$P_s \times A_1 = F_{sp} + P_s \times A_3$$

$$P_s = \frac{F_{sp}}{A_1 - A_3}$$



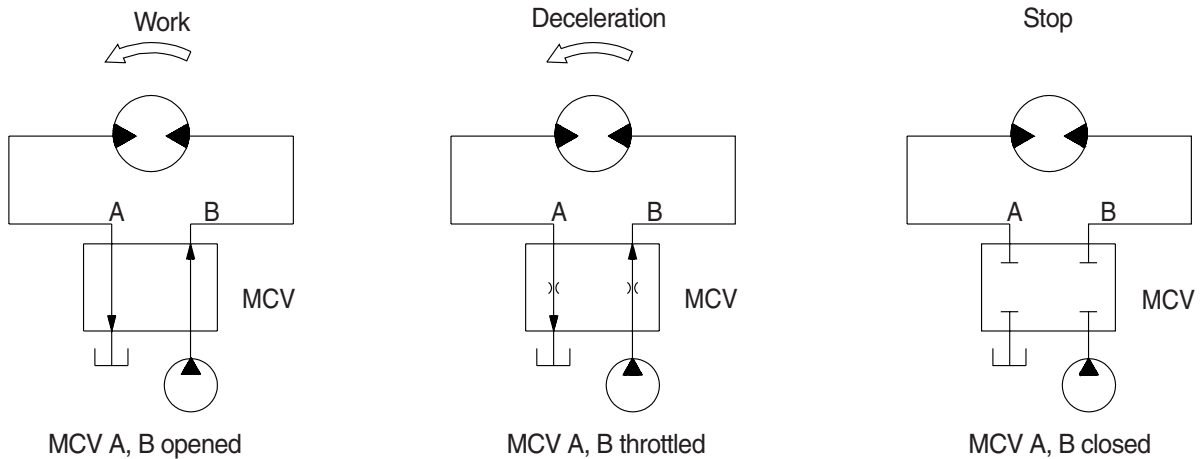
29072SM08

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.



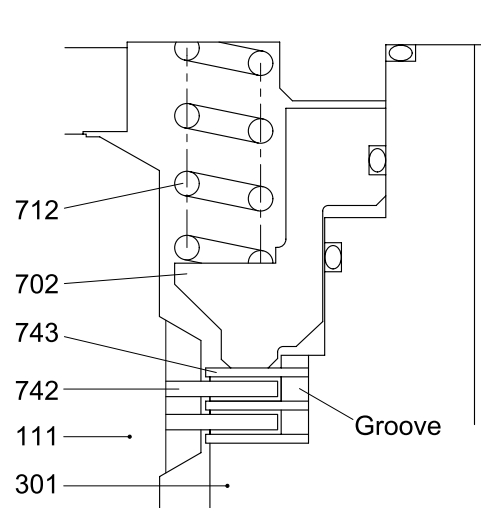
(2) Mechanical swing parking brake system

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 housing is pressed down by brake spring (712) 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.



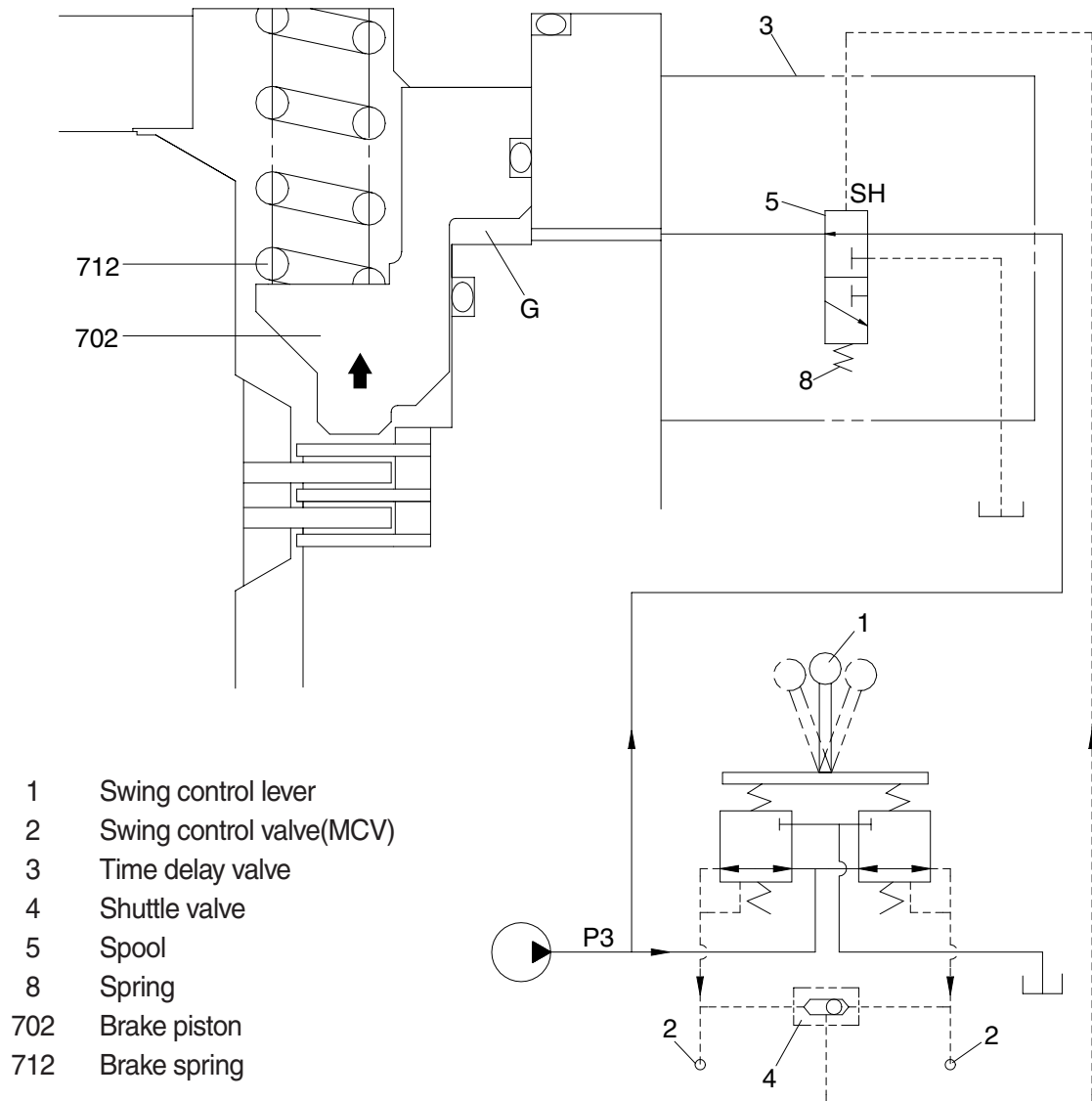
29092SM04

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

② Operating principle

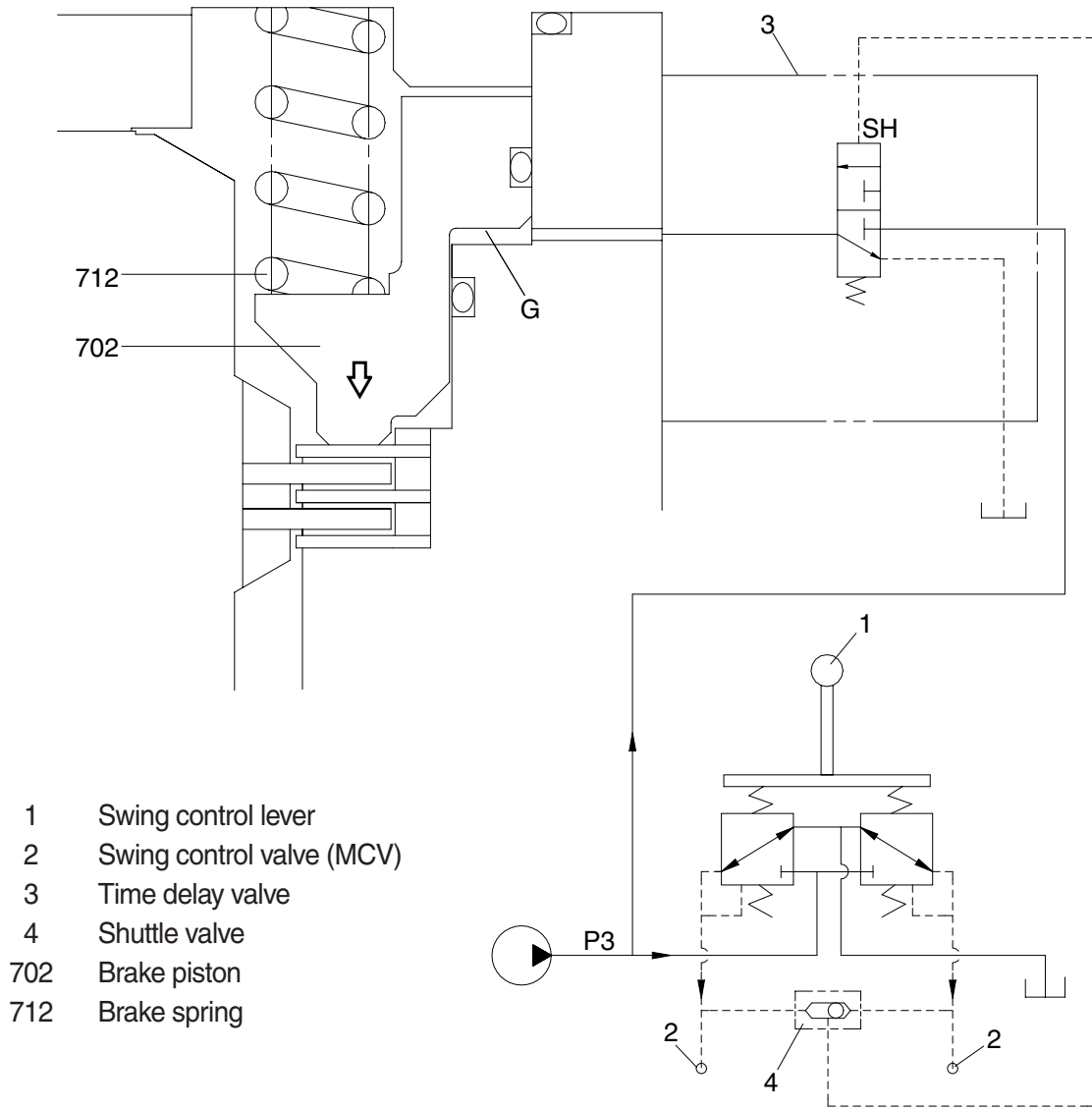
a. When the swing control lever (1) is set to the swing position, the pilot oil goes to the swing control valve (2) and to SH of the time delay valve (3) via the shuttle valve (4), this pressure move spool(5) to the leftward against the force of the spring(8), so pilot pump charged oil (P3) goes to the chamber G.

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.



29092SM05

- b. When the swing control lever (1) is set the neutral position, the time delay valve (3) shifts the neutral position and the pilot oil blocked chamber G.
- Then, the piston (702) is moved lower by spring (712) 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
- 702 Brake piston
- 712 Brake spring

29092SM06