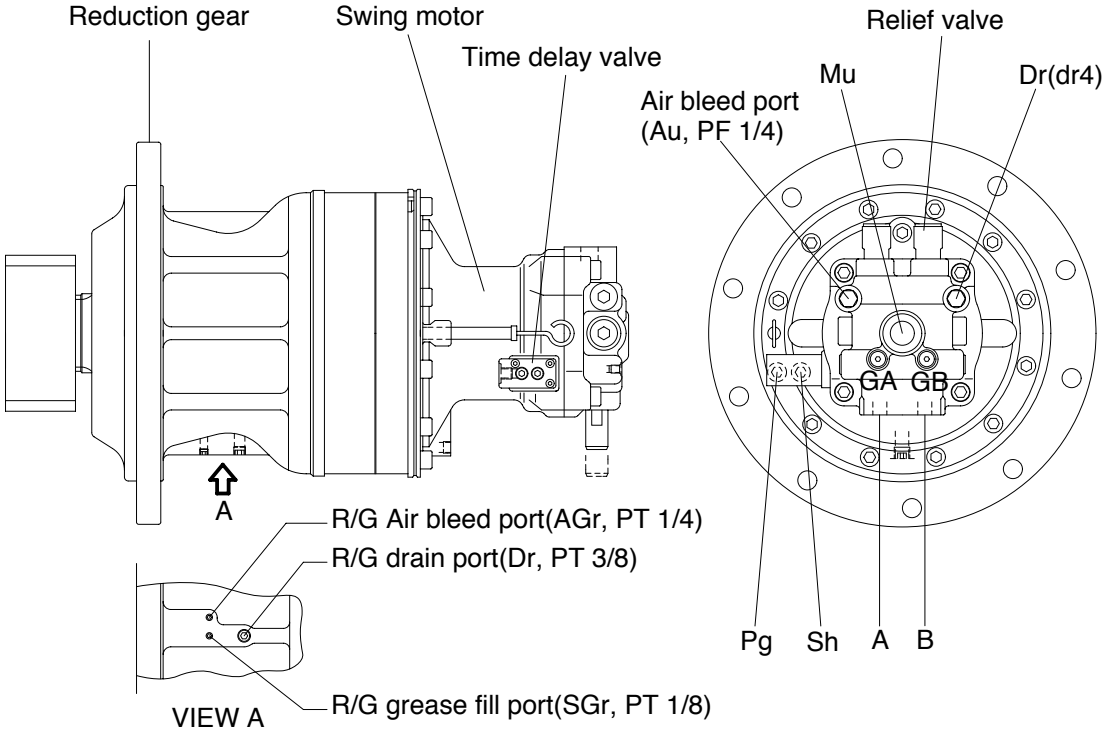
GROUP 3 SWING DEVICE

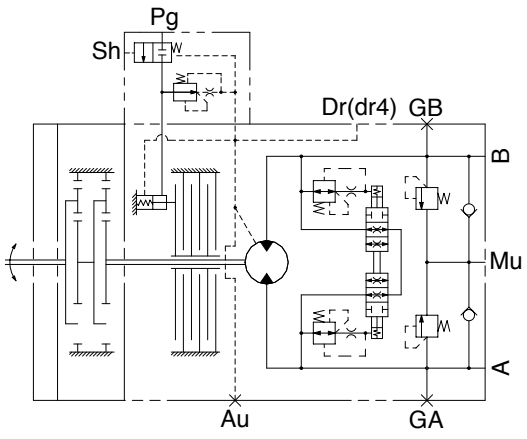
1. STRUCTURE

Swing device consists swing motor, swing reduction gear.

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



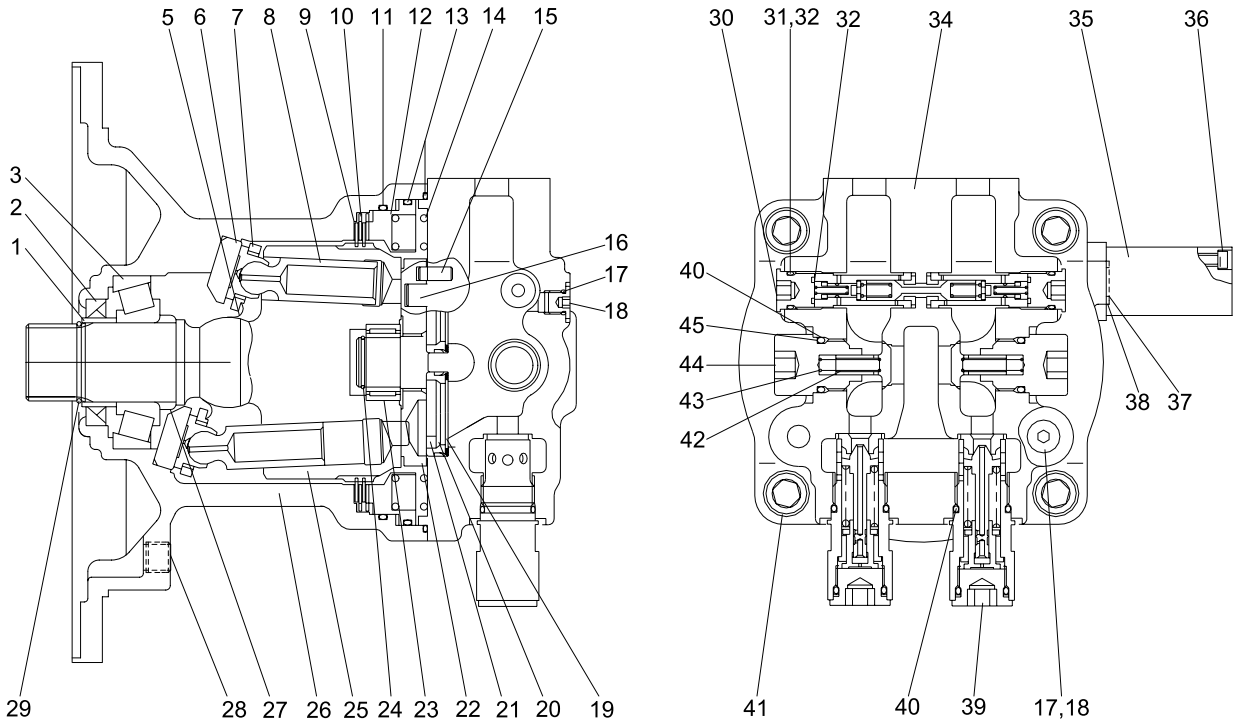
25072SM01



25072SM02

Port	Port name	Port size
A, B	Main port	Ø19
Dr2	Drain port	PF 3/8
Mu	Make up port	PF 1
GA, GB	Gauge port	PF 1/4
Pg	Brake release port	PF 1/4
Sh	Brake pilot port	PF 1/4

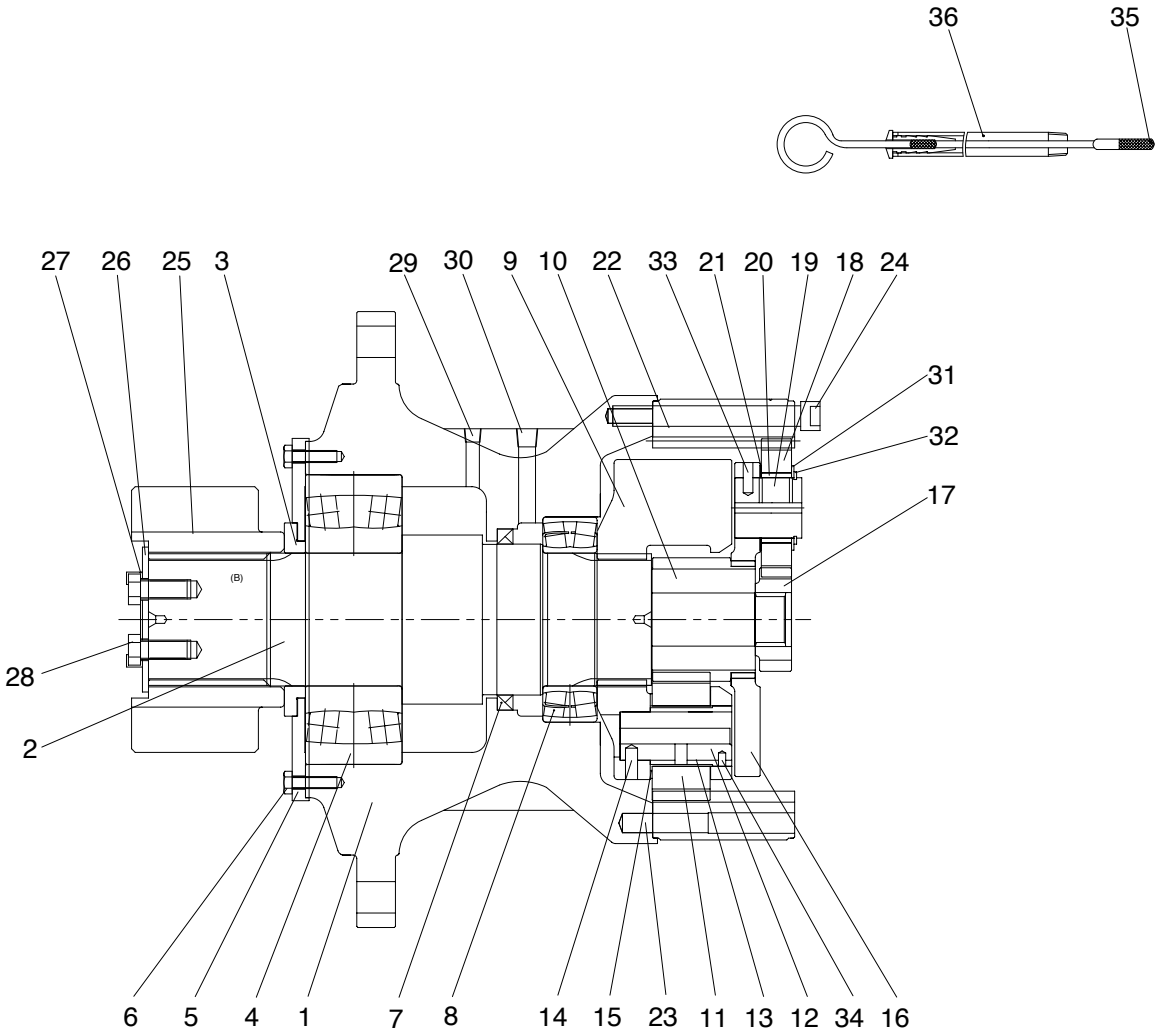
1) SWING MOTOR



25072SM03

1	Iner ring	17	O-ring	32	O-ring
2	Oil seal	18	Cap	33	O-ring
3	Taper roller bearing	19	Scrowave	34	Cover
5	Backing spring	20	Teflon ring	35	Time delay valve
6	Cam plate	21	Bushing	36	Hexagon socket bolt
7	Return plate	22	Balance plate	37	O-ring
8	Piston assembly	23	Needle bearing	38	O-ring
9	Lining plate	24	Snap ring	39	Reliet valve assy
10	Plate	25	Cylinder	40	O-ring
11	O-ring	26	Housing	41	Hexagon socket bolt
12	Piston	27	Collar	42	Check
13	O-ring	28	Plug	43	Spring
14	Spring	29	Snap ring	44	Cap
15	Parallel pin	30	Bypass valve assembly	45	Back up ring
16	Piston	31	Back up ring		

2) REDUCTION GEAR



25072SM04

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

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.

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

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

q : Displacement(cc/rev)

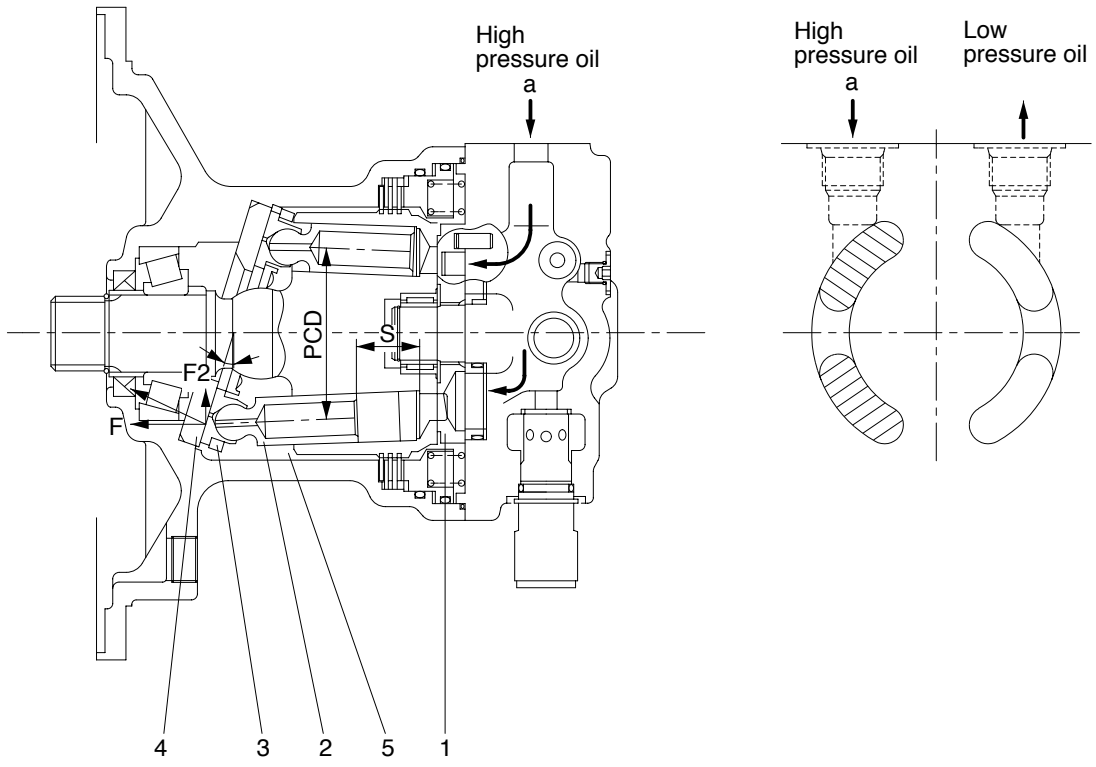
T : Output torque(kgf · cm)

Z : Piston number(9EA)

A : Piston area(cm^2)

θ: Tilting angle of swash plate(degree)

S : Piston stroke(cm)



25072SM05

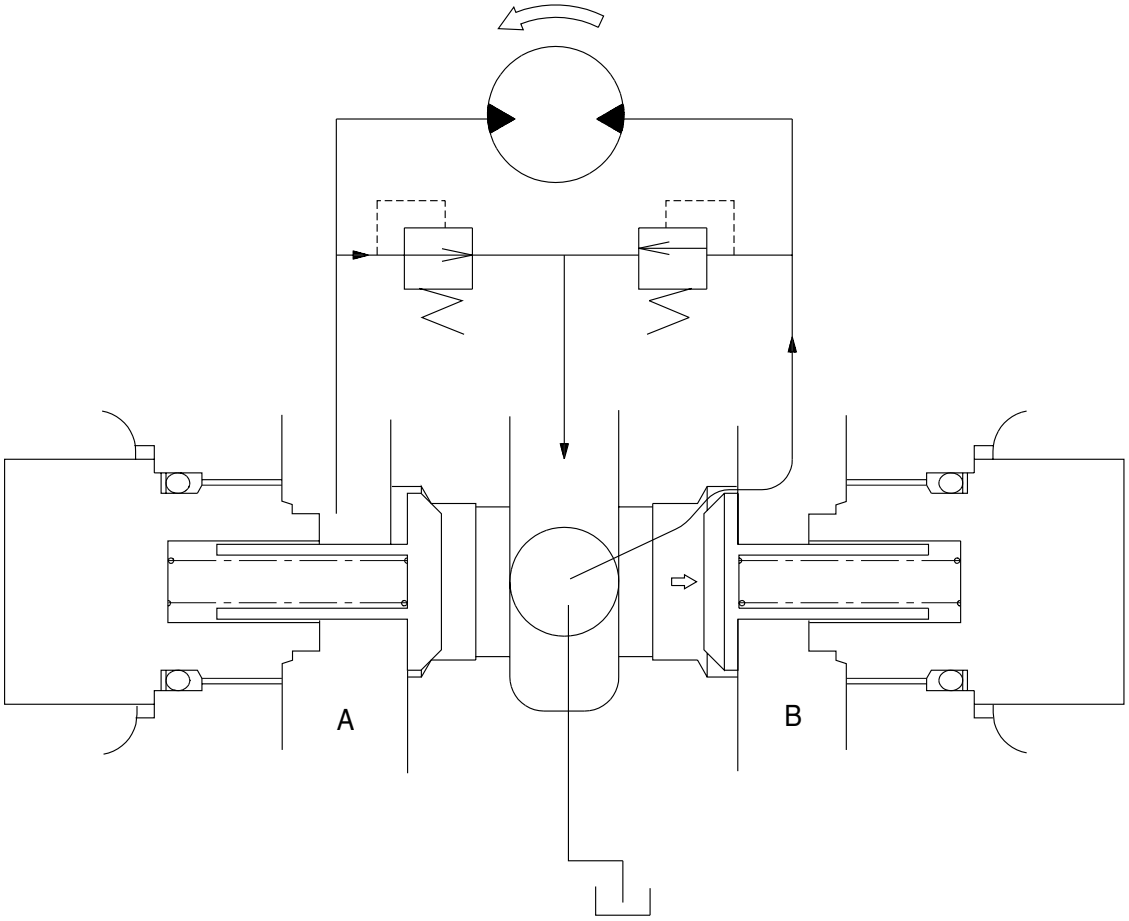
2) MAKE UP VALVE

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.

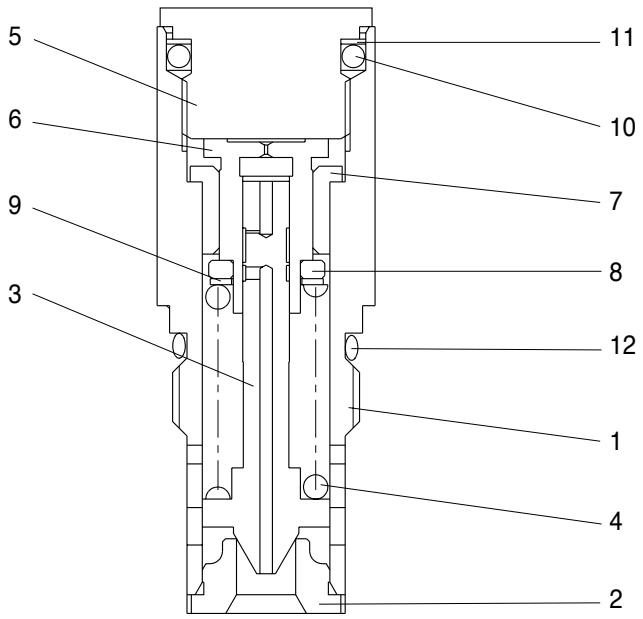
Pressurized oil into the port B, the motor rotate counterclockwise.

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.



210LC-7(2-47)

3) RELIEF VALVE



(210LC-7) 2-48(1)

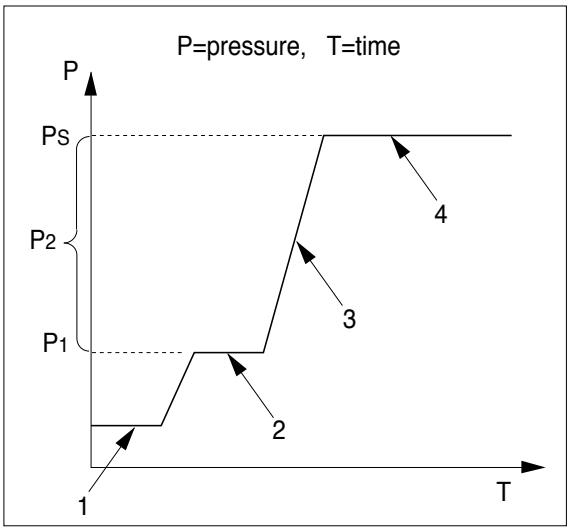
1	Body
2	Seat
3	Plunger
4	Spring
5	Adjusting screw
6	Piston
7	Bushing
8	Spring seat
9	Shim
10	O-ring
11	Back up ring
12	O-ring

(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.

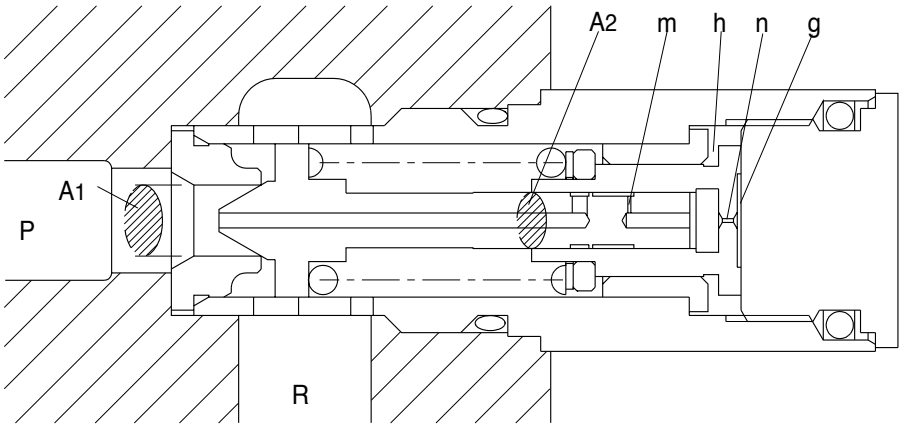
(2) Function of relief valve

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.



(360LC-7) 2-51(1)

① Ports (P,R) at tank pressure.

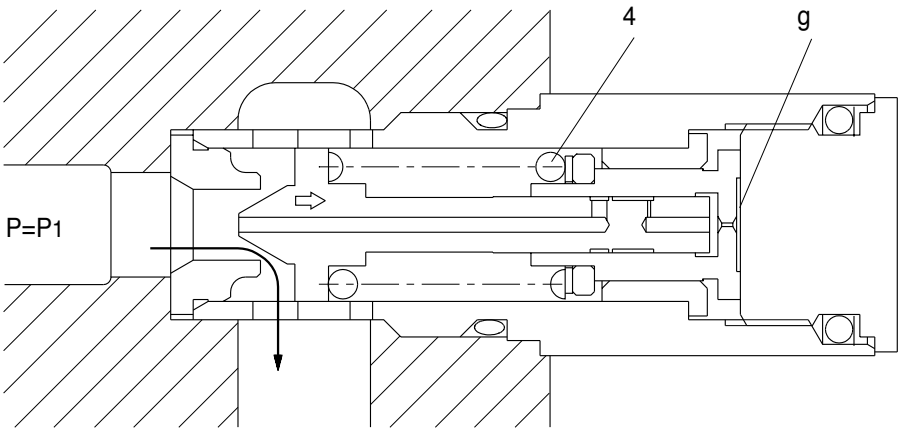


210LC-7(2-49)

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.

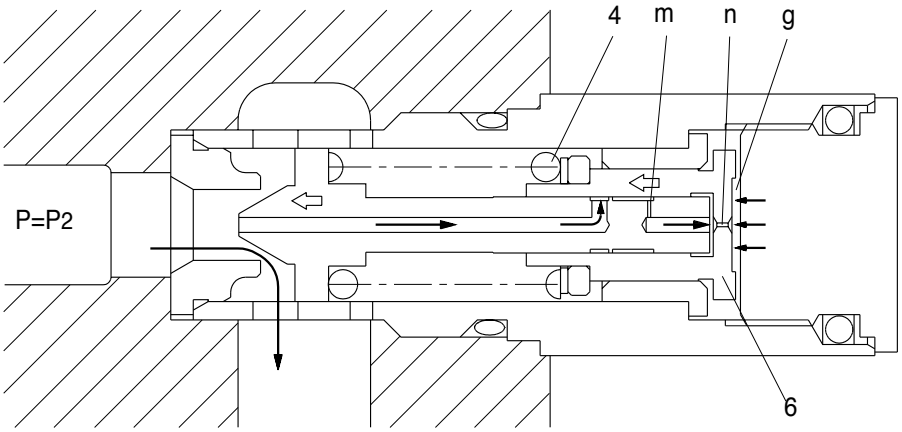
$P_1 \times A_1 = Fsp + Pg \times A_2$

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



210LC-7(2-49)

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).

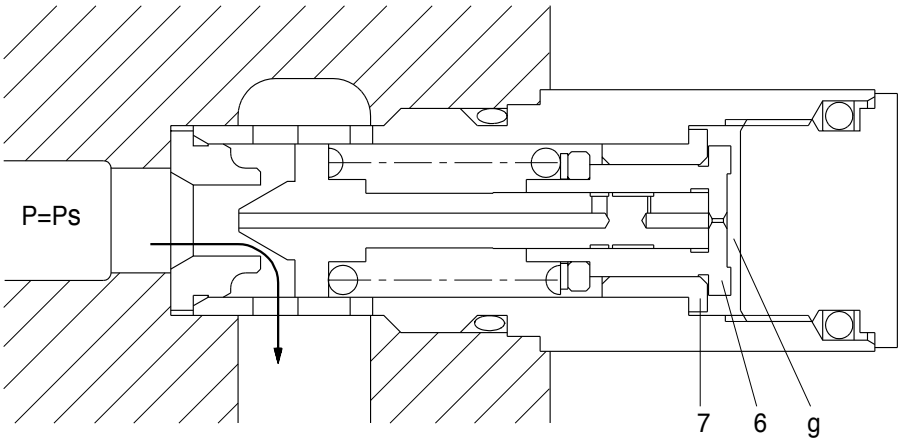


(210LC-7) 4-29

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).

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

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



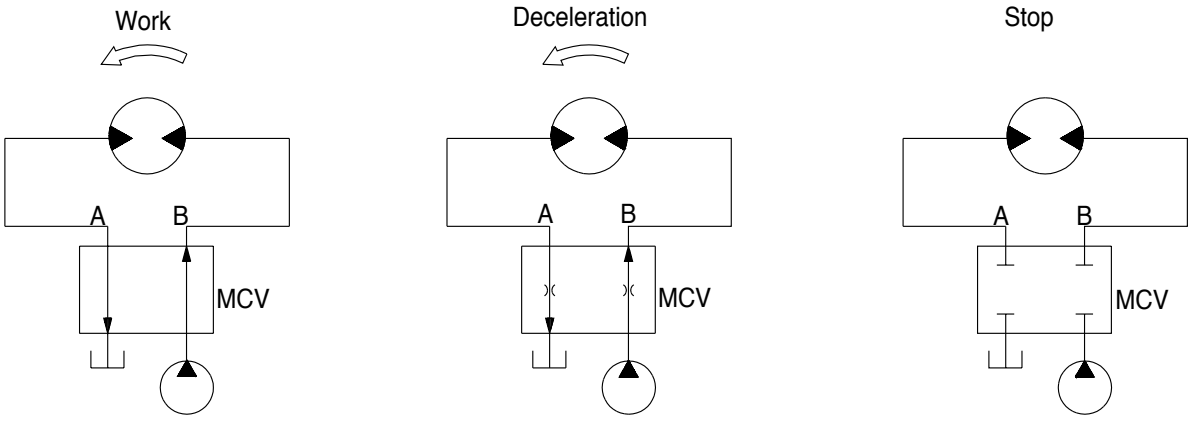
(210LC-7) 4-49

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

(210LC-7) 2-48(1)

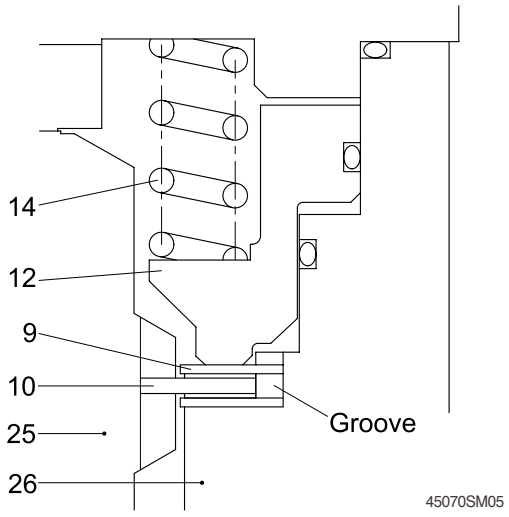
(2) Mechanical swing parking brake system

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.



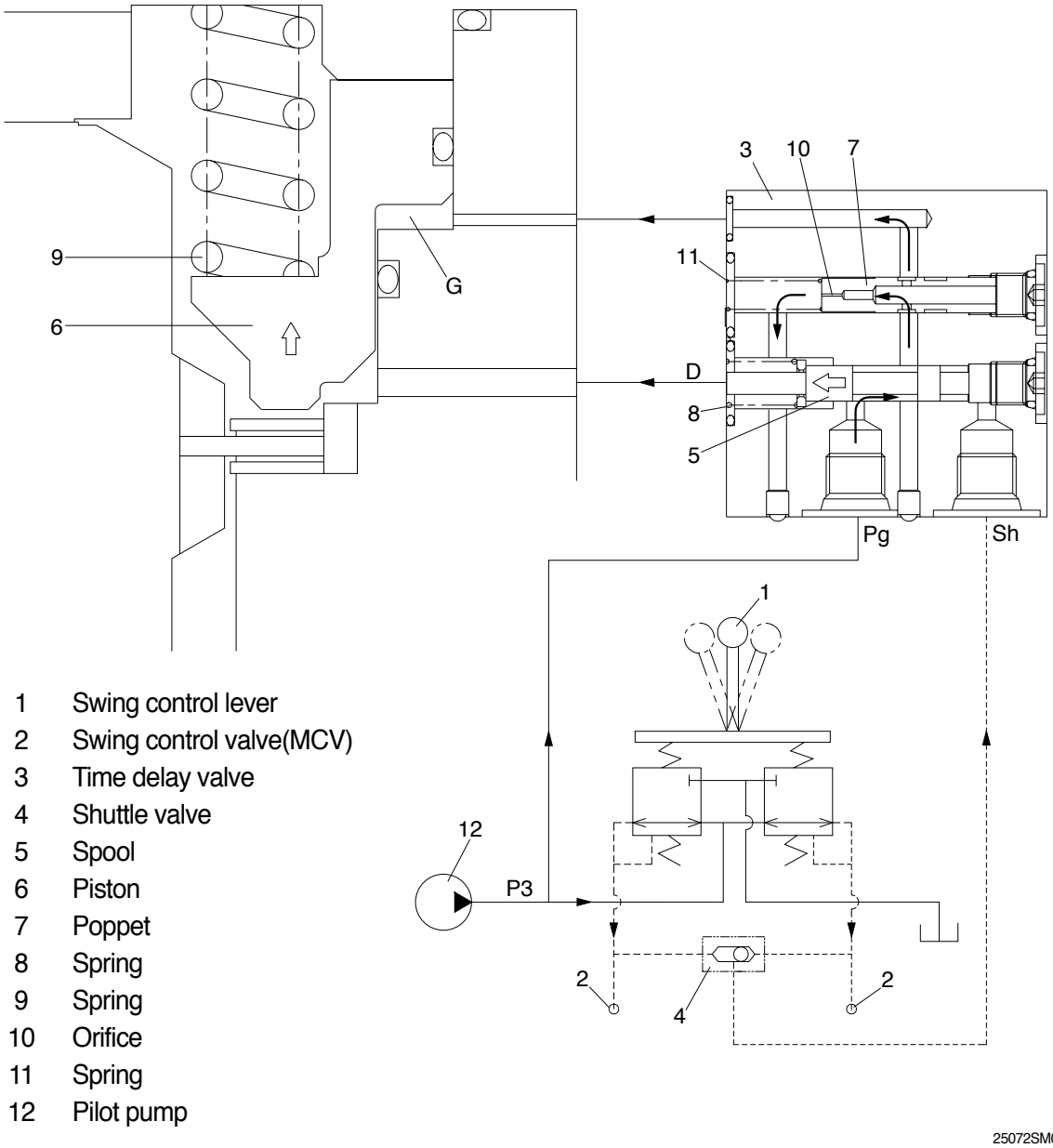
45070SM05

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.

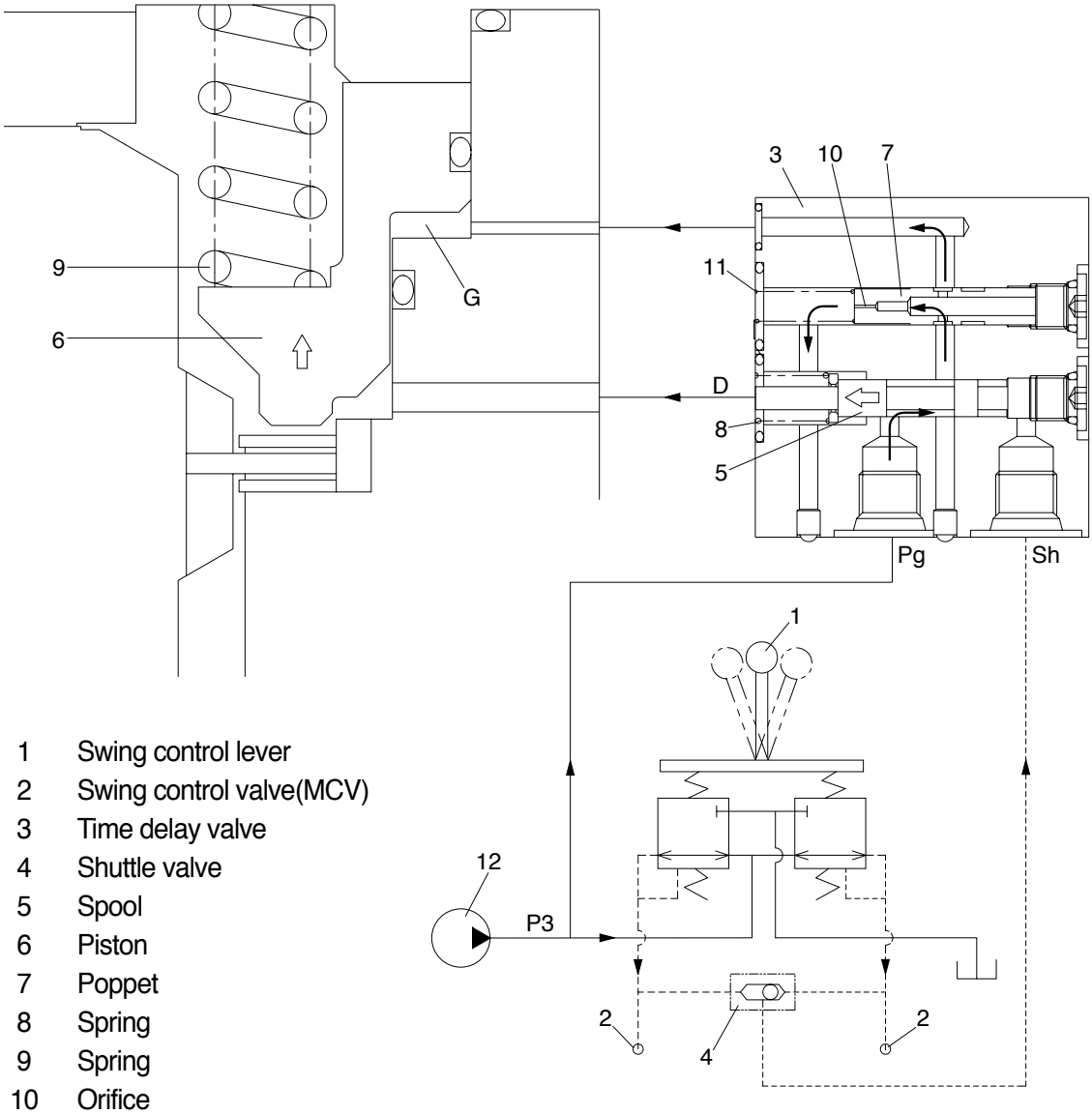
This pressure is applied to move the piston(6) to the upward against the force of the spring(9). Thus, it releases the brake force.



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

25072SM06

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



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

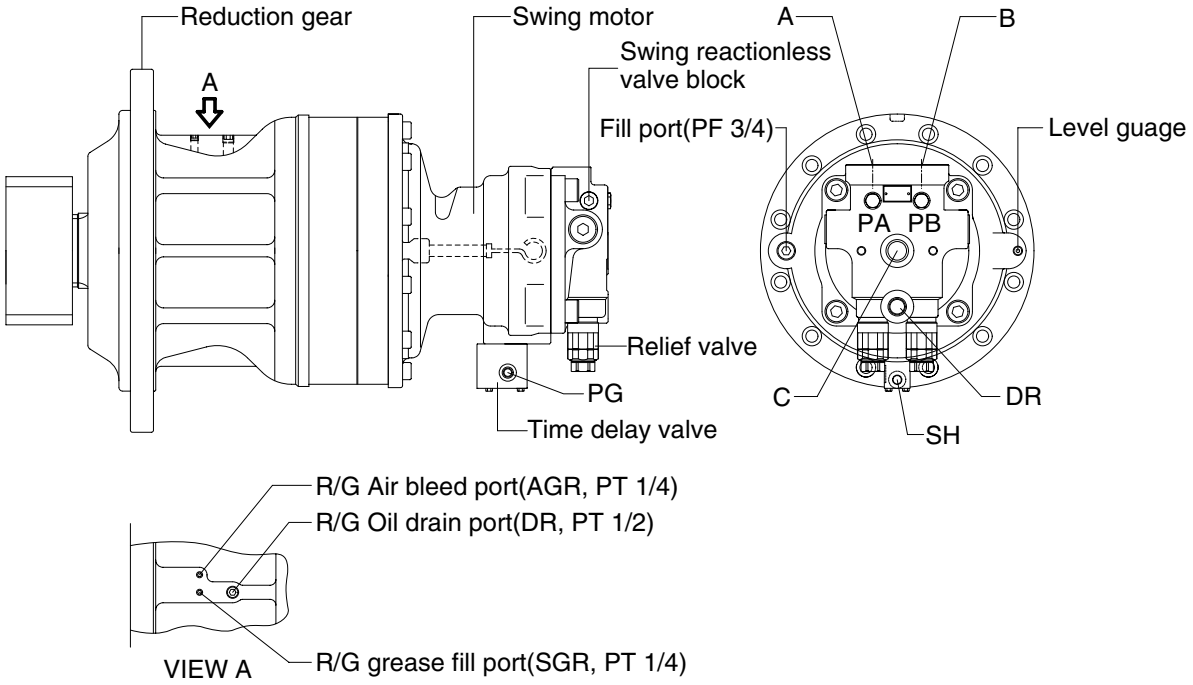
25072SM06

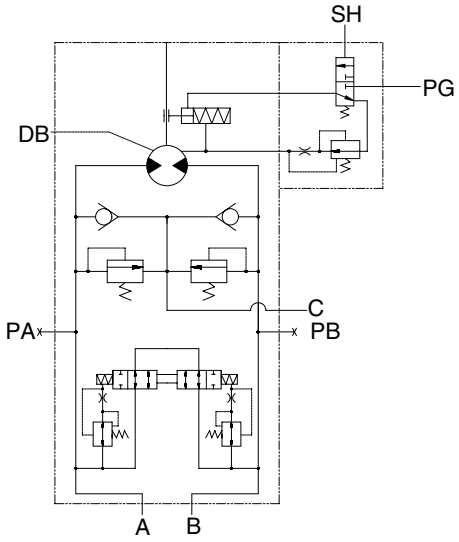
GROUP 3 SWING DEVICE(Option)

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.

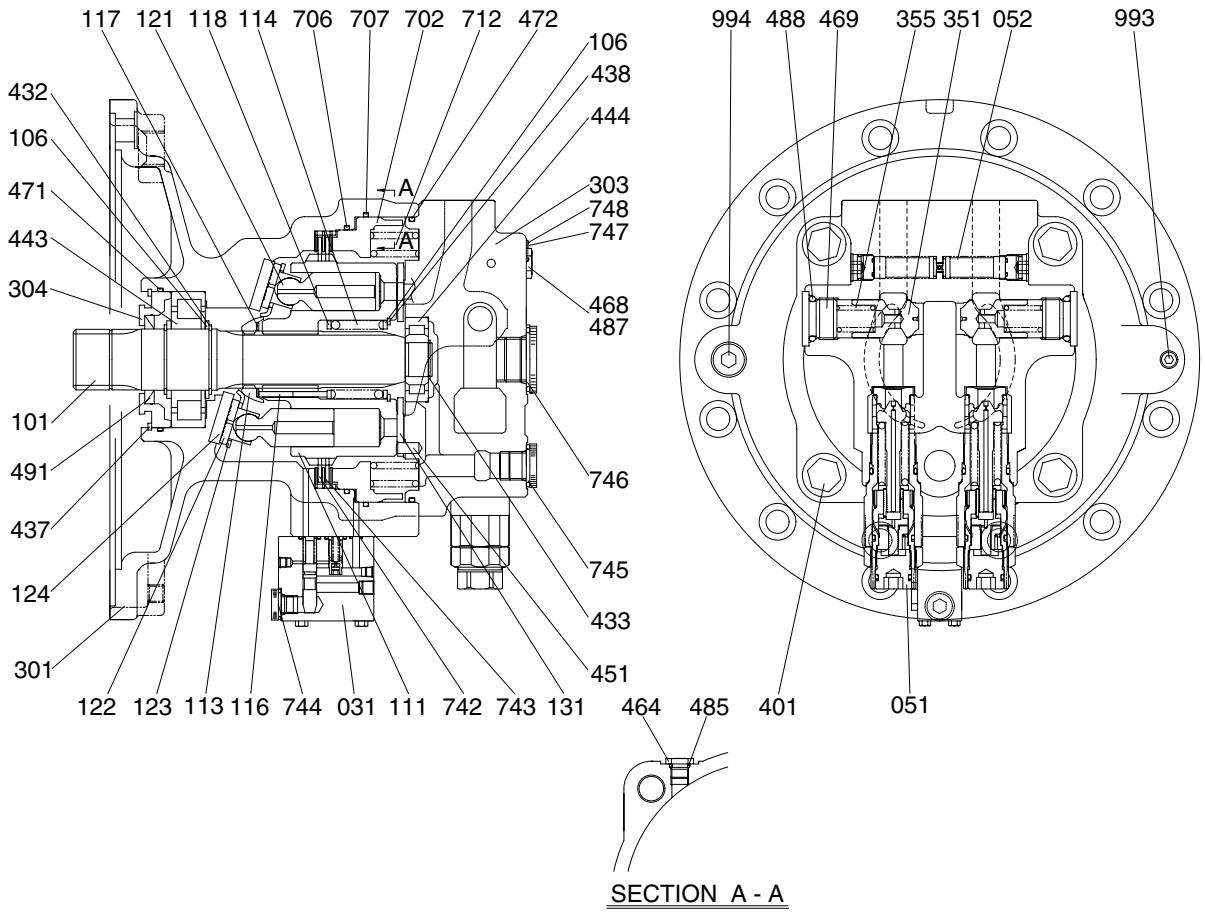




Port	Port name	Port size
A, B	Main port	ø 20
DR	Drain port	PF1/2
C	Make up port	PF 1
PA, PB	Gauge port	PF1/4
PG	Brake release port	PF1/4
SH	Brake pilot port	PF1/4

2507A2SM01

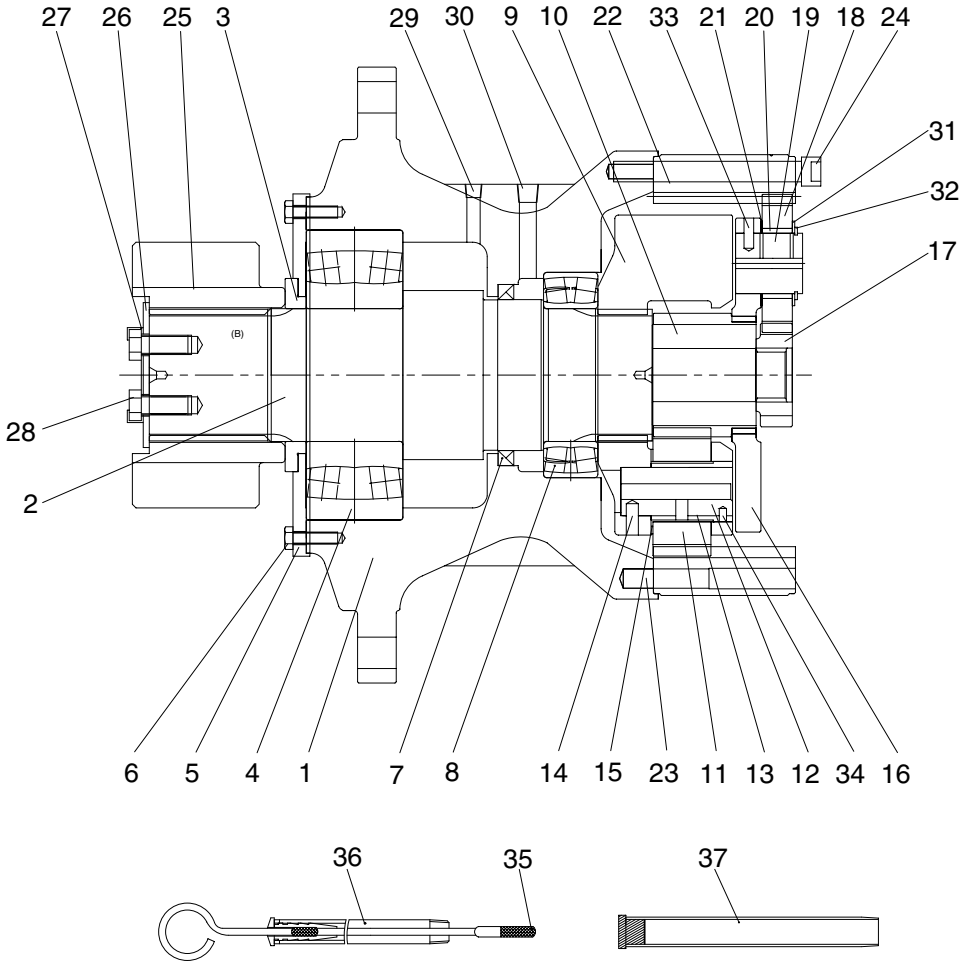
1) SWING MOTOR



2507A2SM02

031	Time delay valve	303	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	Piston
111	Cylinder	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



2507A2SM03

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	Gage bar
10	Sun gear 2	23	Knock pin	36	Gage 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

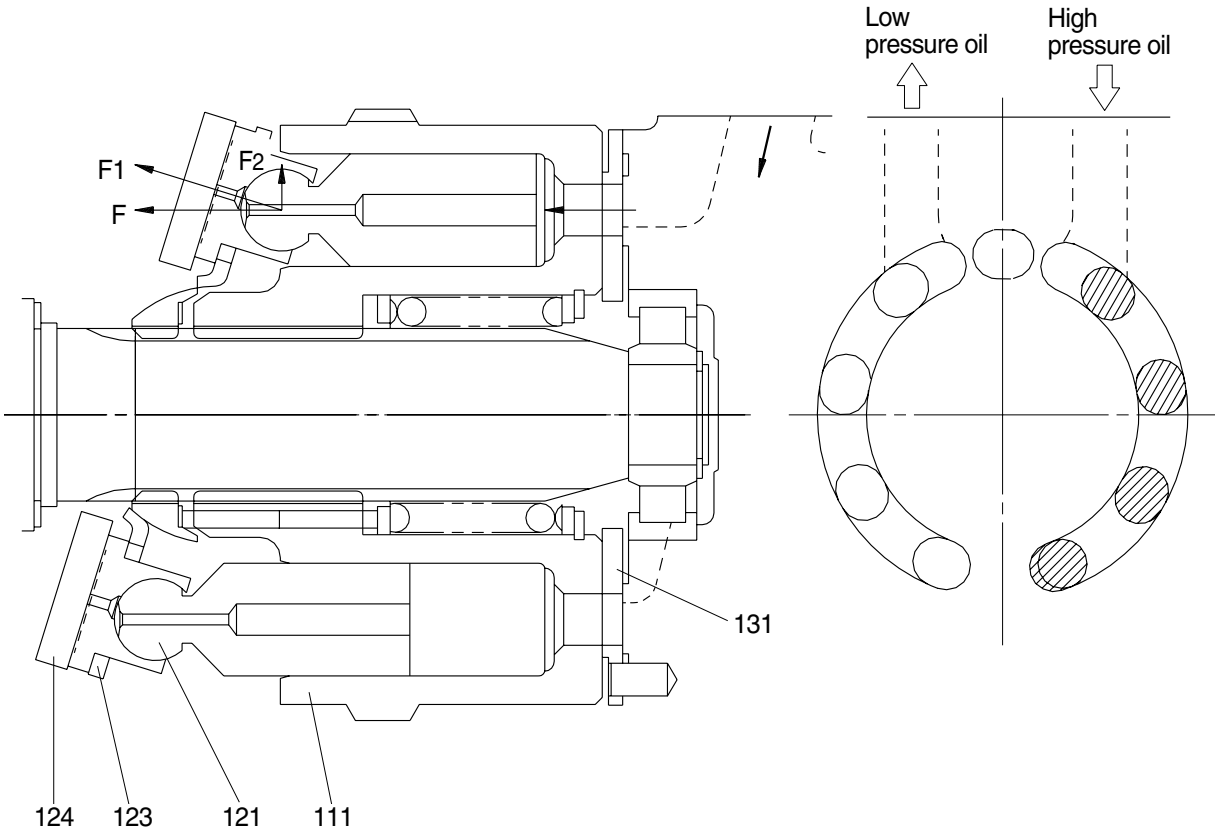
1) ROTARY PART

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)



R290SM05(2)

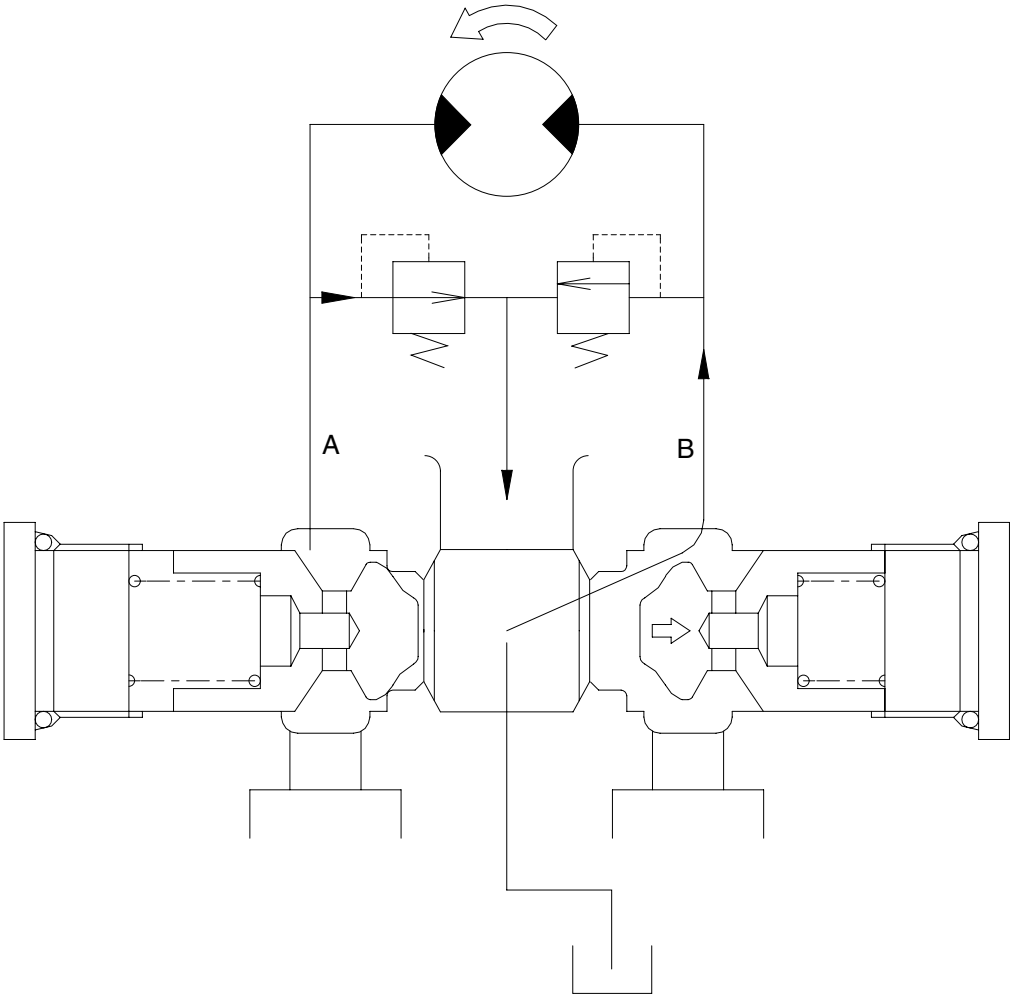
2) MAKE UP VALVE

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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