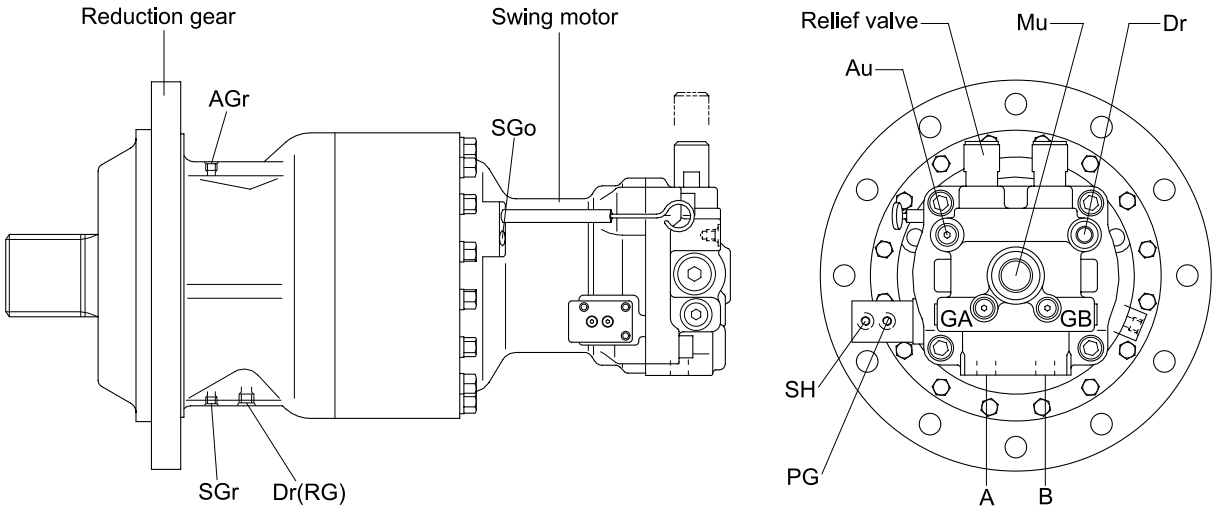
GROUP 3 SWING DEVICE(~#0408)

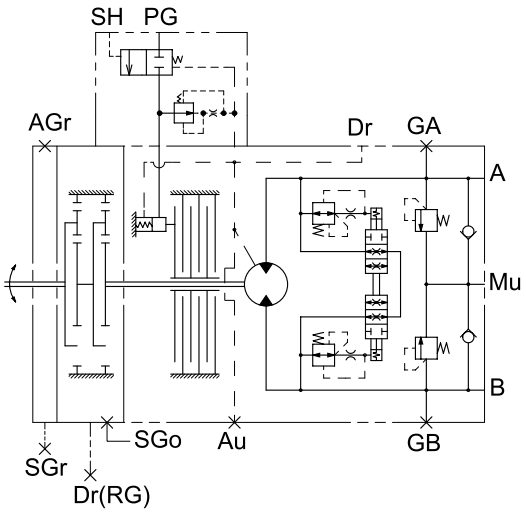
1. STRUCTURE

Swing device consists swing motor, swing reduction gear.

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



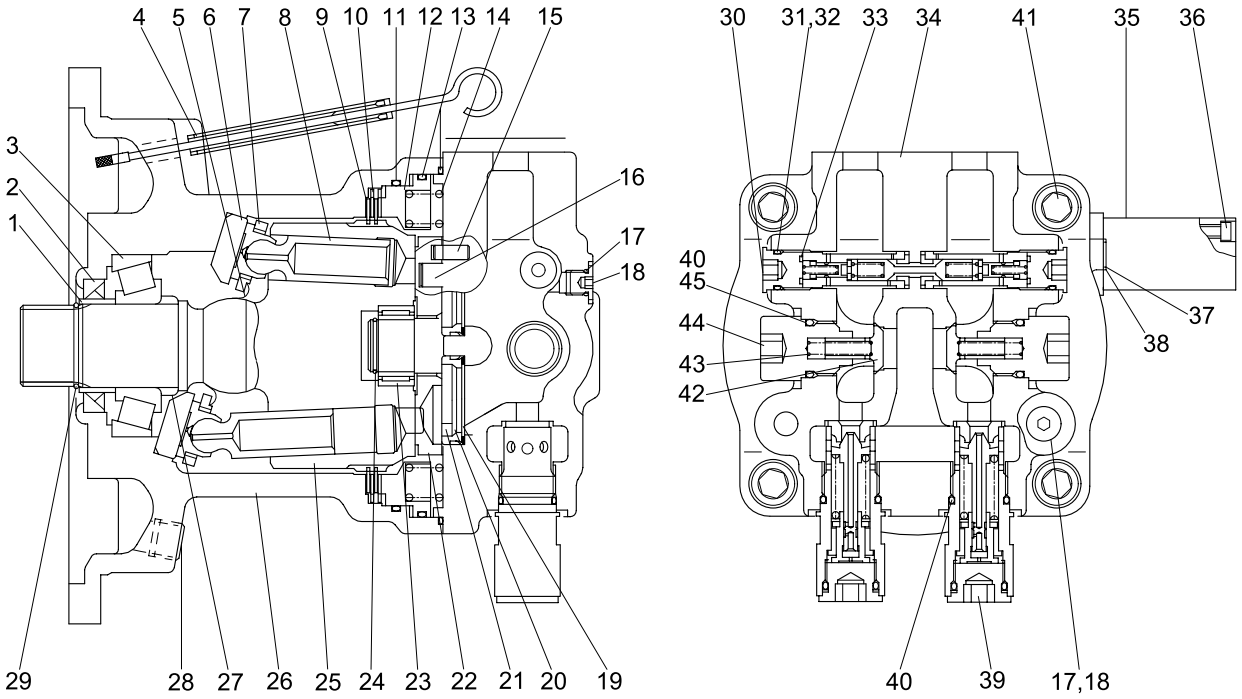
45070SM01



45070SM02

Port	Port name	Port size
A, B	Main port	PF 3/4
Dr	Drain port	PF 3/8
Mu	Make up port	PF 1
GA,GB	Gauge port	PF 1/4
Au	Air vent port	PF 1/4
SGo	Reduction gear oil fill port	PT 1/2
SGr	Reduction gear grease fill port	PT 1/8
AGr	Reduction gear air vent port	PT1/8
Dr(RG)	Reduction gear drain port	PT 3/8
PG	Brake release port	PF 1/4
SH	Brake pilot port	PF 1/4

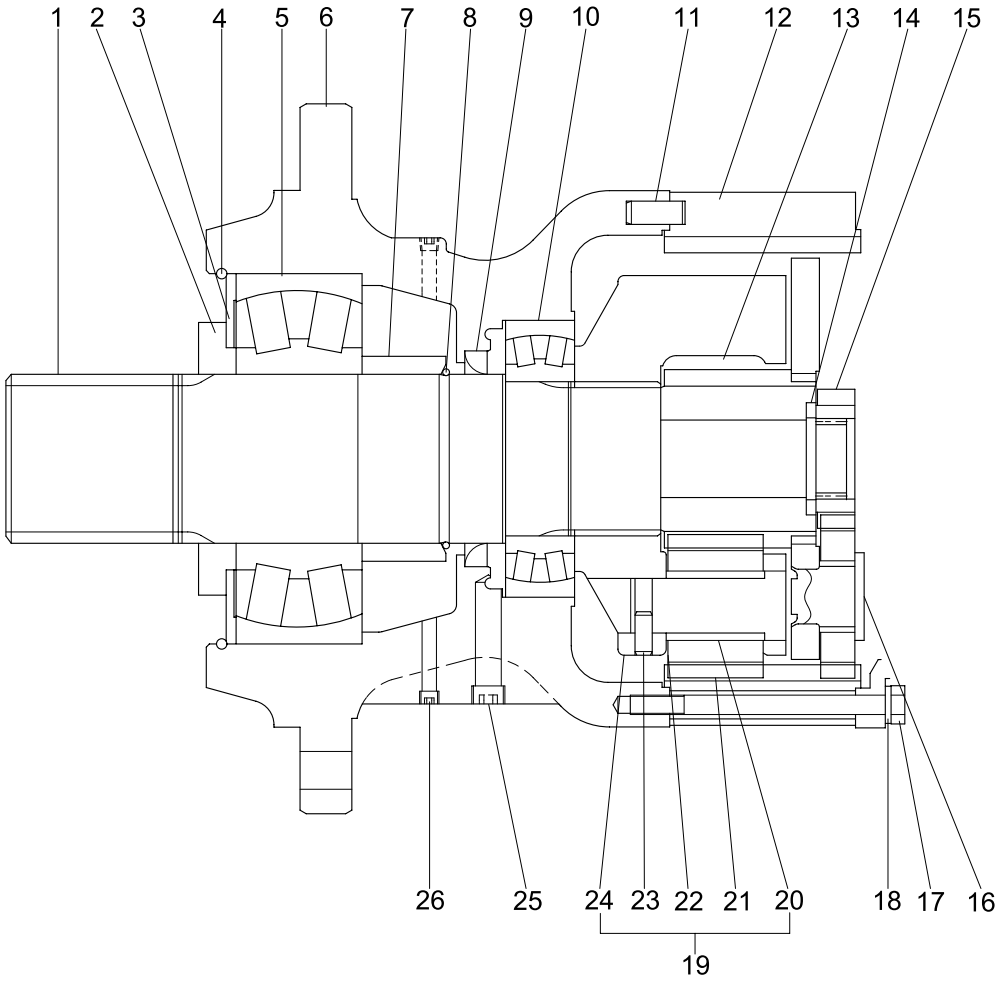
1) SWING MOTOR



45070SM06

1	Inner ring	16	Piston	31	Back up ring
2	Oil seal	17	O-ring	32	O-ring
3	Taper roller bearing	18	Cap	33	O-ring
4	Level gauge assy	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 assy	23	Needle bearing	38	O-ring
9	Lining plate	24	Snap ring	39	Relief valve
10	Plate	25	Cylinder assy	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 assy	45	Back up ring

2) REDUCTION GEAR



45070SR01

1	Pinion shaft	10	Roller bearing	19	Holder assy 2
2	Collar	11	Parallel pin	20	Shaft 2
3	Plate	12	Ring gear	21	Spur gear 5
4	Snap ring	13	Spur gear4	22	Thrust plate 2
5	Roller bearing	14	Thrust plate	23	Spring pin
6	Gear casing	15	Sun gear	24	Holder 2
7	Collar	16	Holder assy 1	25	Plug
8	Snap ring	17	Bolt	26	Plug
9	Oil seal	18	Lock washer		

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)

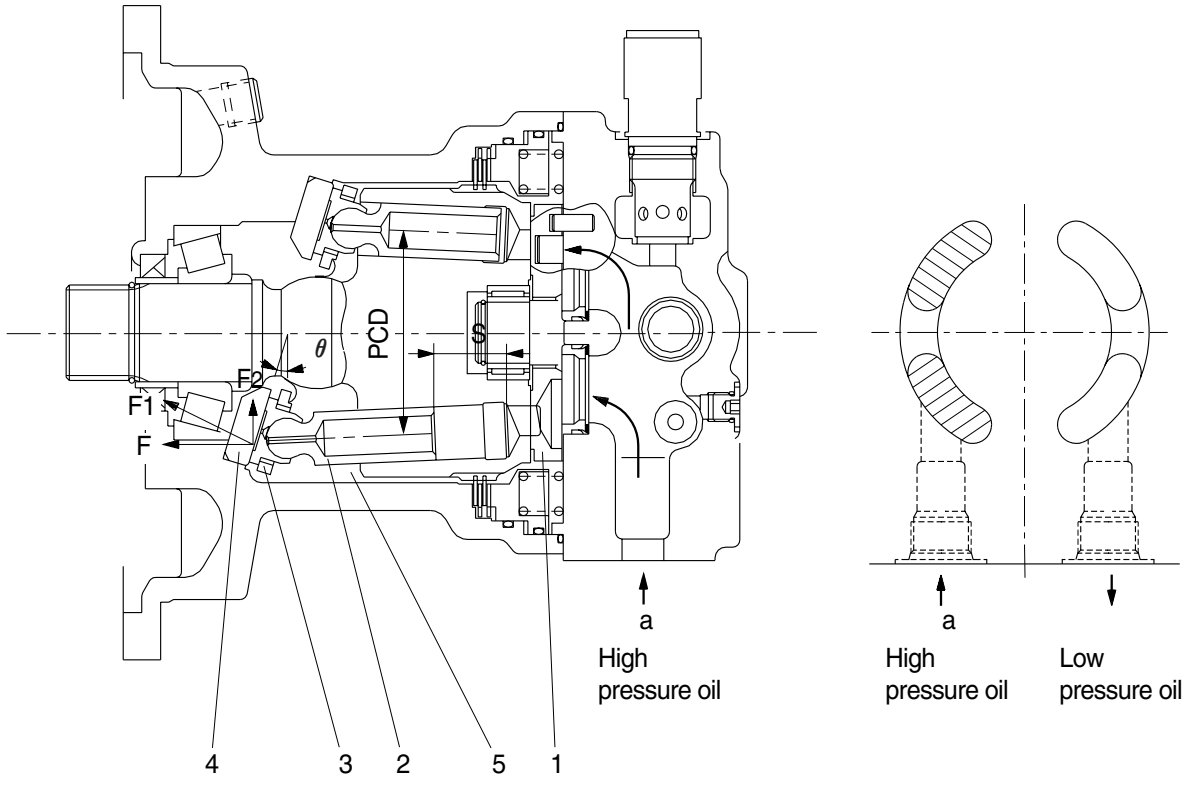
T : Output torque(kgf · cm)

Z : Piston number(9EA)

A : Piston area(cm^2)

θ : Tilting angle of swash plate(degree)

S : Piston stroke(cm)



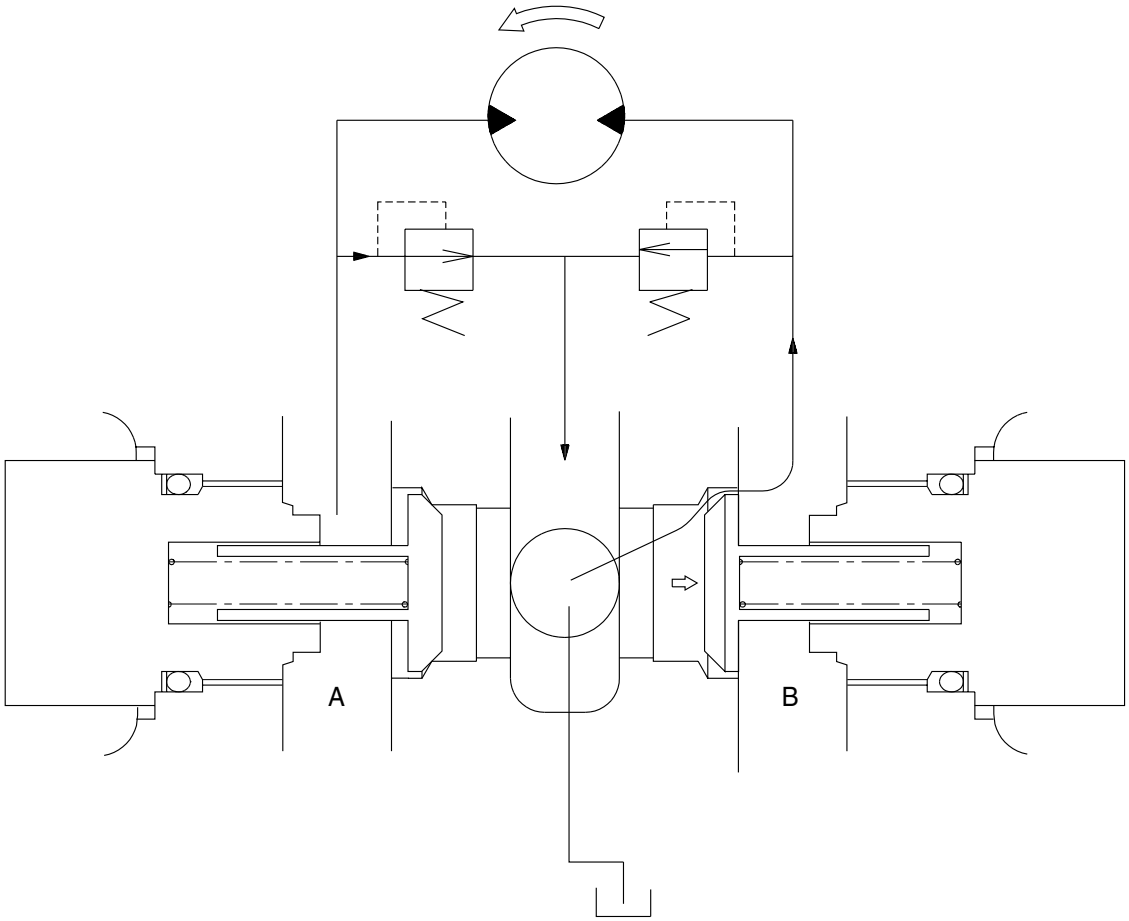
2) MAKE UP VALVE

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.

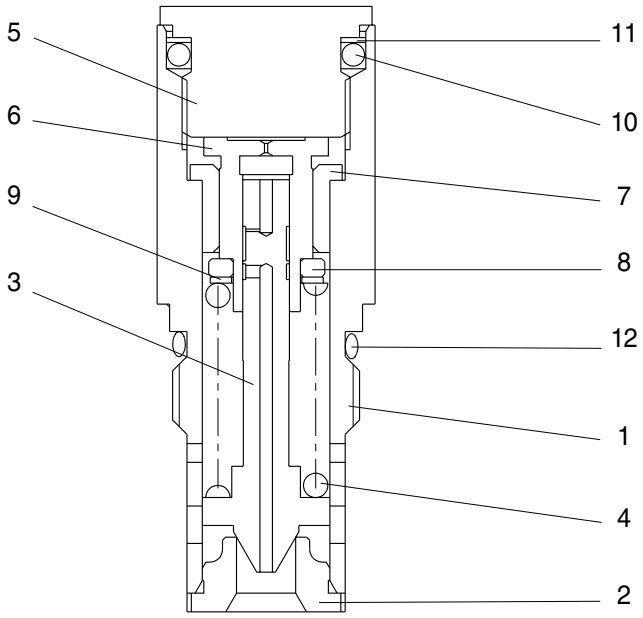
Pressurized oil into the port B, the motor rotate counterclockwise.

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.



R130SM03

3) RELIEF VALVE



R130SM05

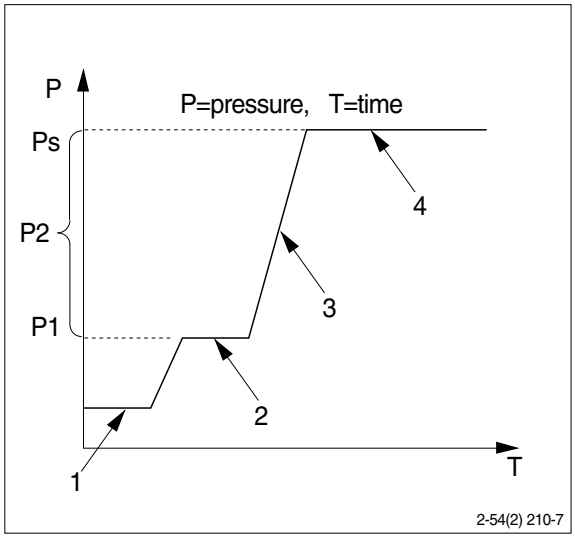
1 Body
2 Seat
3 Plunger
4 Spring
5 Adjusting screw
6 Piston
7 Bushing
8 Spring seat
9 Shim
10 O-ring
11 Back up ring
12 O-ring

(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.

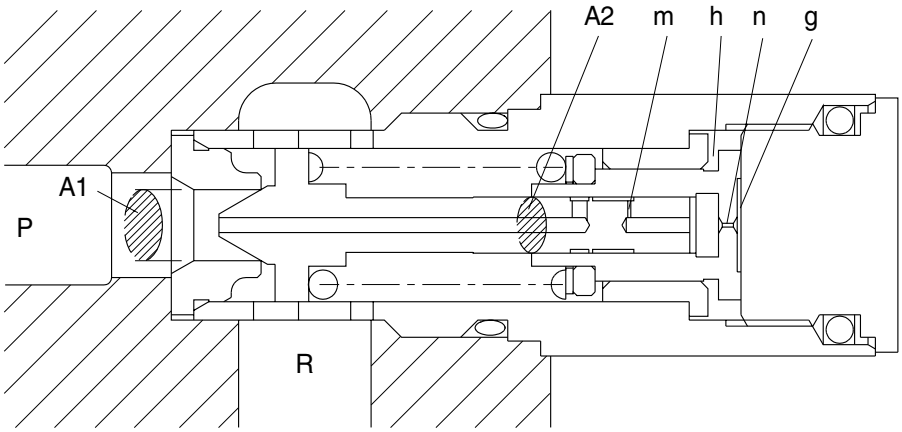
(2) Function of relief valve

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.



2-54(2) 210-7

① Ports (P,R) at tank pressure.

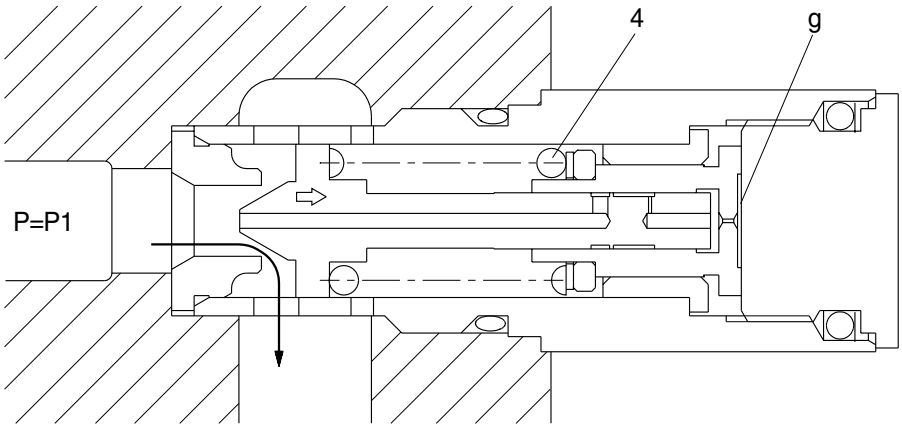


R130SM04

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.

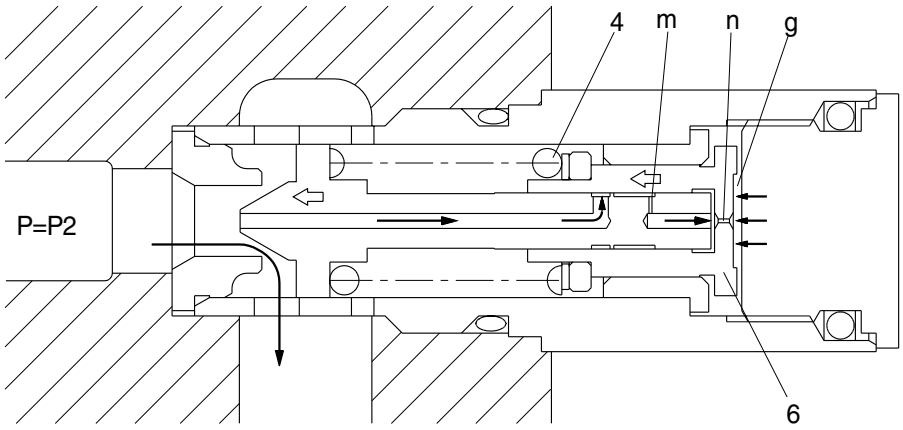
$P_1 \times A_1 = Fsp + Pg \times A_2$

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



R130SM04

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).

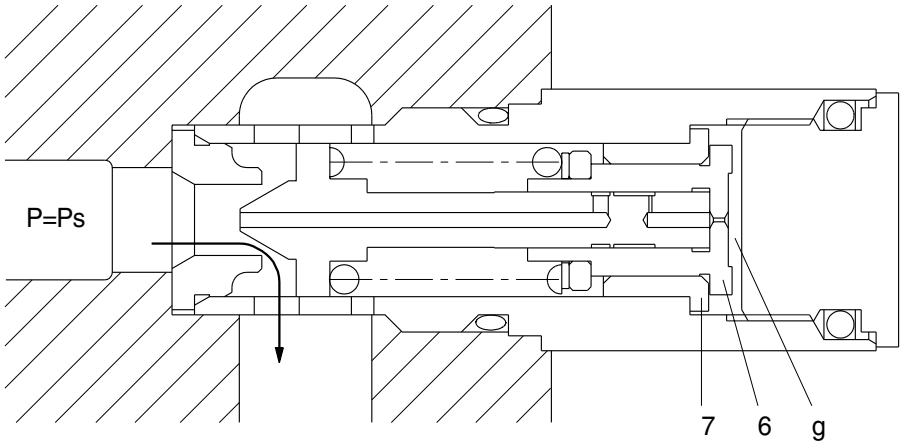


R130SM04

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).

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

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



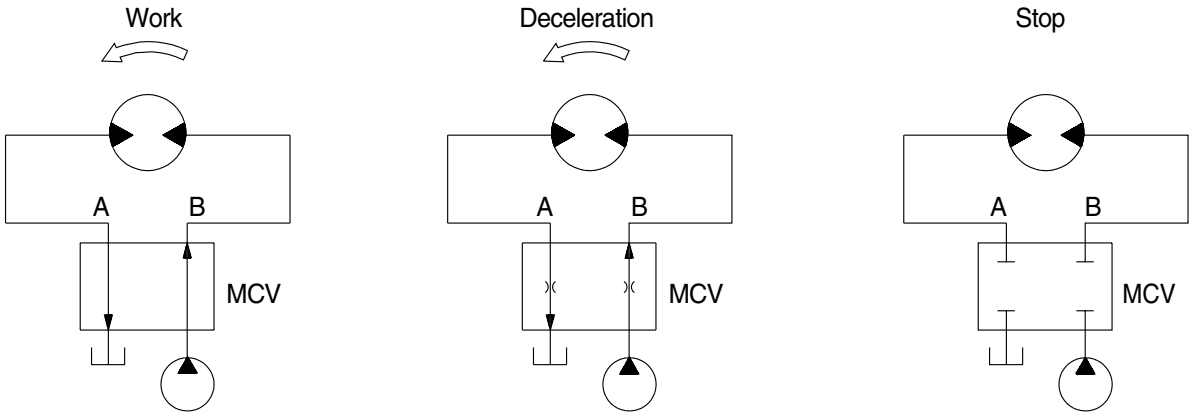
R130SM04

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

R130SM05

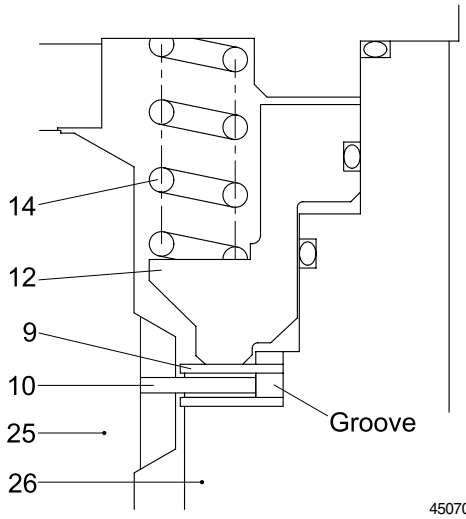
(2) Mechanical swing parking brake system

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(14) 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.

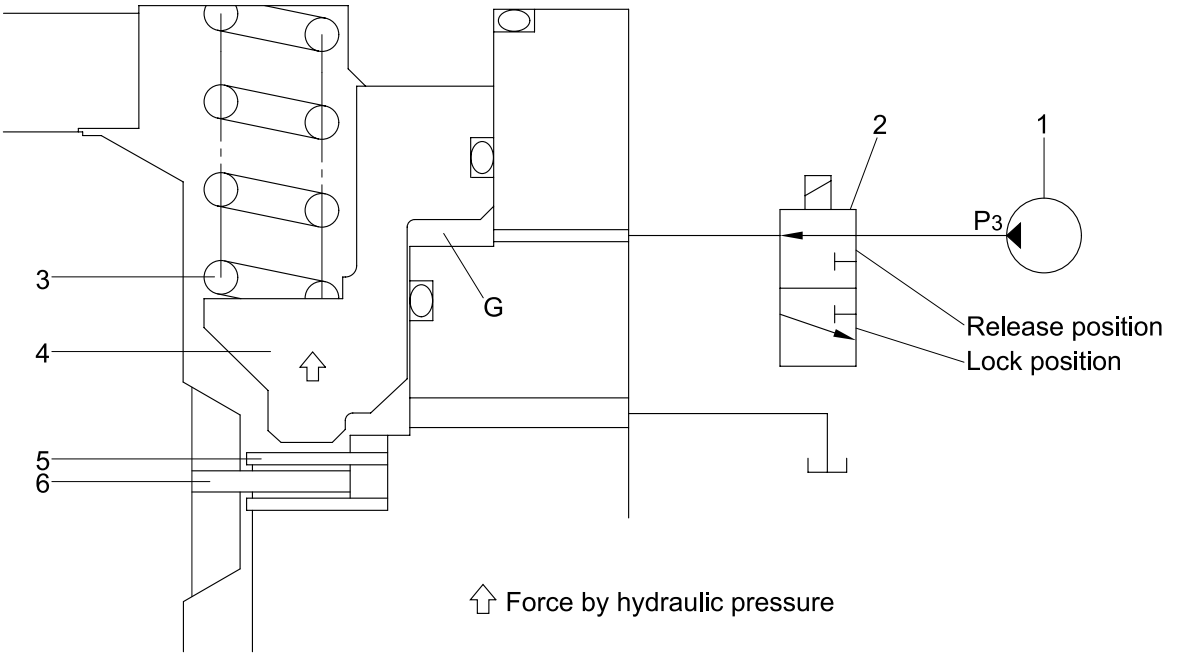


45070SM05

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

② Operating principle

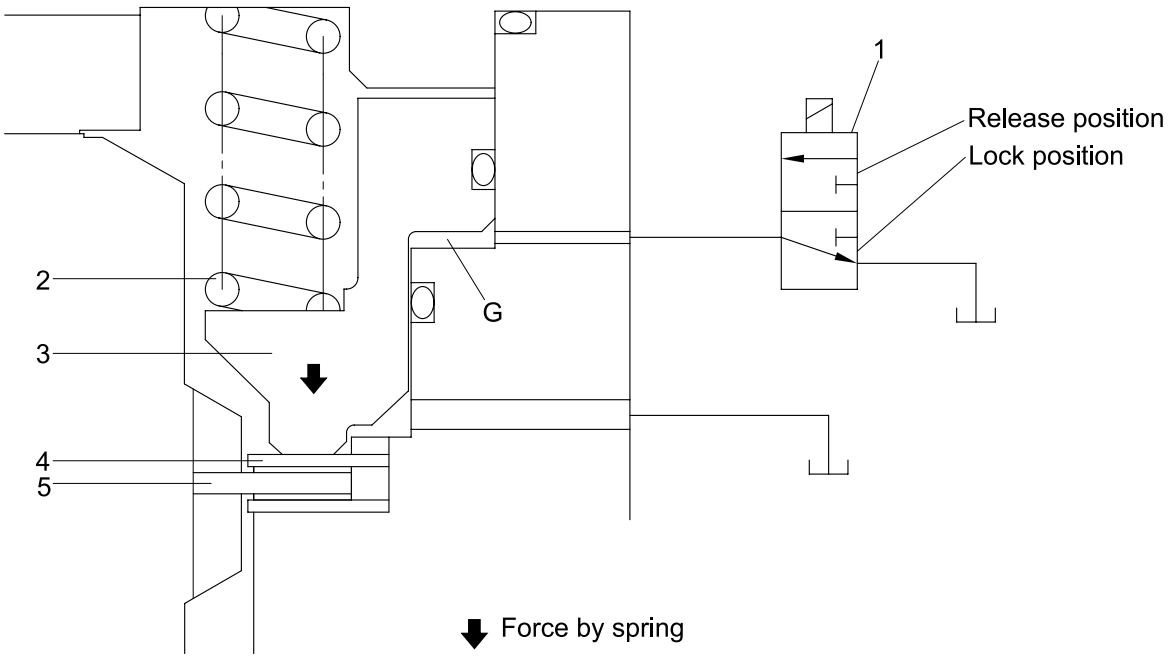
a. When the swing control lever is operated, the swing lock solenoid valve is excited, so the pilot pump discharged oil(P3) goes to the chamber G.
This pressure is applied to move the piston(6) to the upward against the force of the spring(9). Thus, it releases the brake force.



45070SM03

1 Pilot pump
2 Swing lock solenoid valve
3 Spring
4 Brake piston
5 Separate plate
6 Lining plate

b. When the swing control lever gets back to neutral position, the swing lock solenoid valve is deactivated, so the pilot pump discharged oil(P_3) is not applied to the chamber G.
Thus, the brake is actuated by spring force.



45070SM04

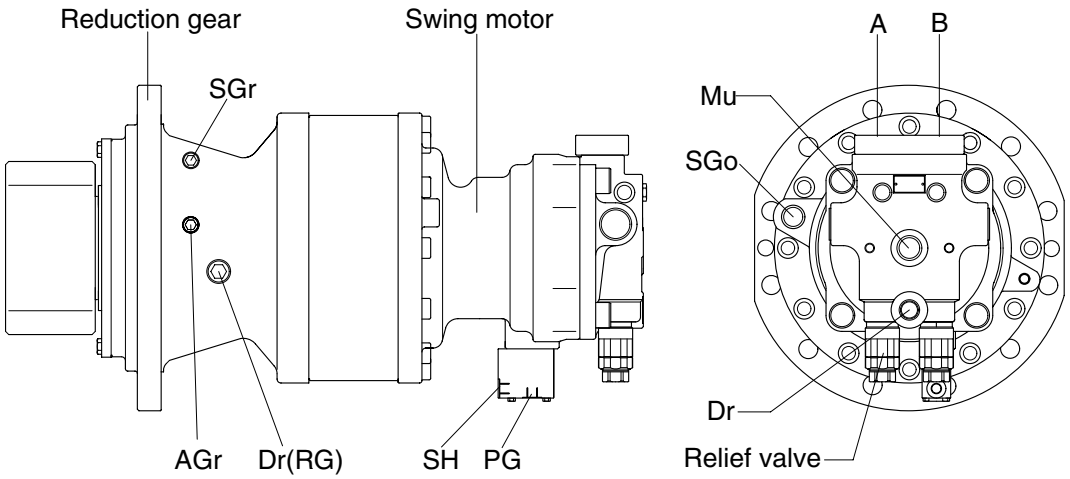
1 Swing lock solenoid valve
2 Spring
3 Brake piston
4 Separate plate
5 Lining plate

GROUP 3 SWING DEVICE(#0409~)

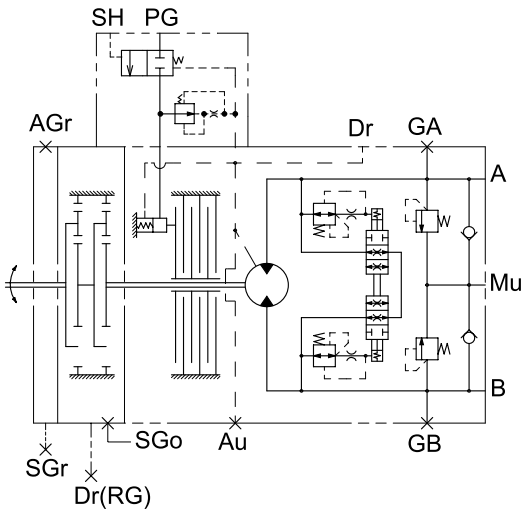
1. STRUCTURE

Swing device consists swing motor, swing reduction gear.

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

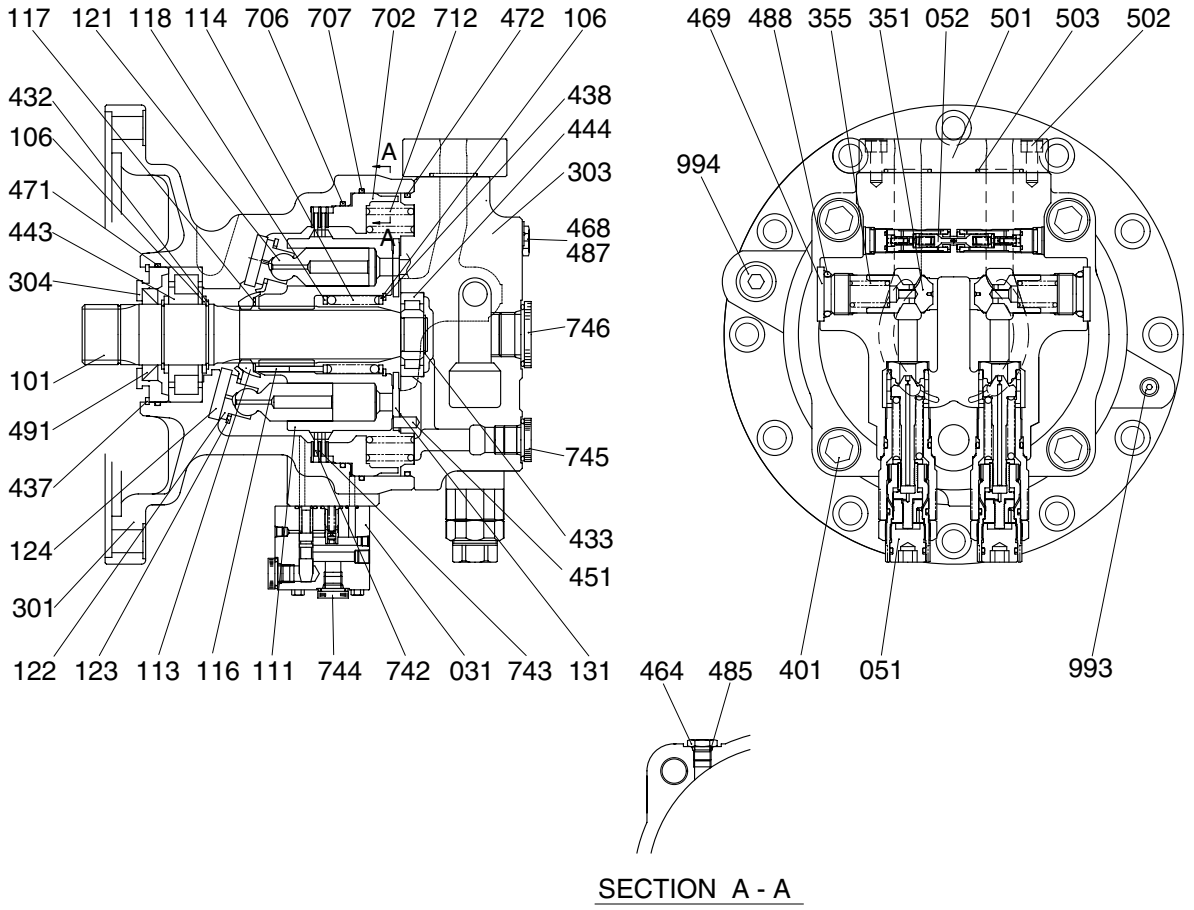


50072SM01



Port	Port name	Port size
A, B	Main port	PF 3/4
Dr	Drain port	PF 1/2
Mu	Make up port	PF 1
GA,GB	Gauge port	PF 1/4
Au	Air vent port	PF 1/4
SGo	Reduction gear oil fill port	PT 3/4
SGr	Reduction gear grease fill port	PT 1/4
AGr	Reduction gear air vent port	PT 1/4
Dr(RG)	Reduction gear drain port	PT 1/2
PG	Brake release port	PF 1/4
SH	Brake pilot port	PF 1/4

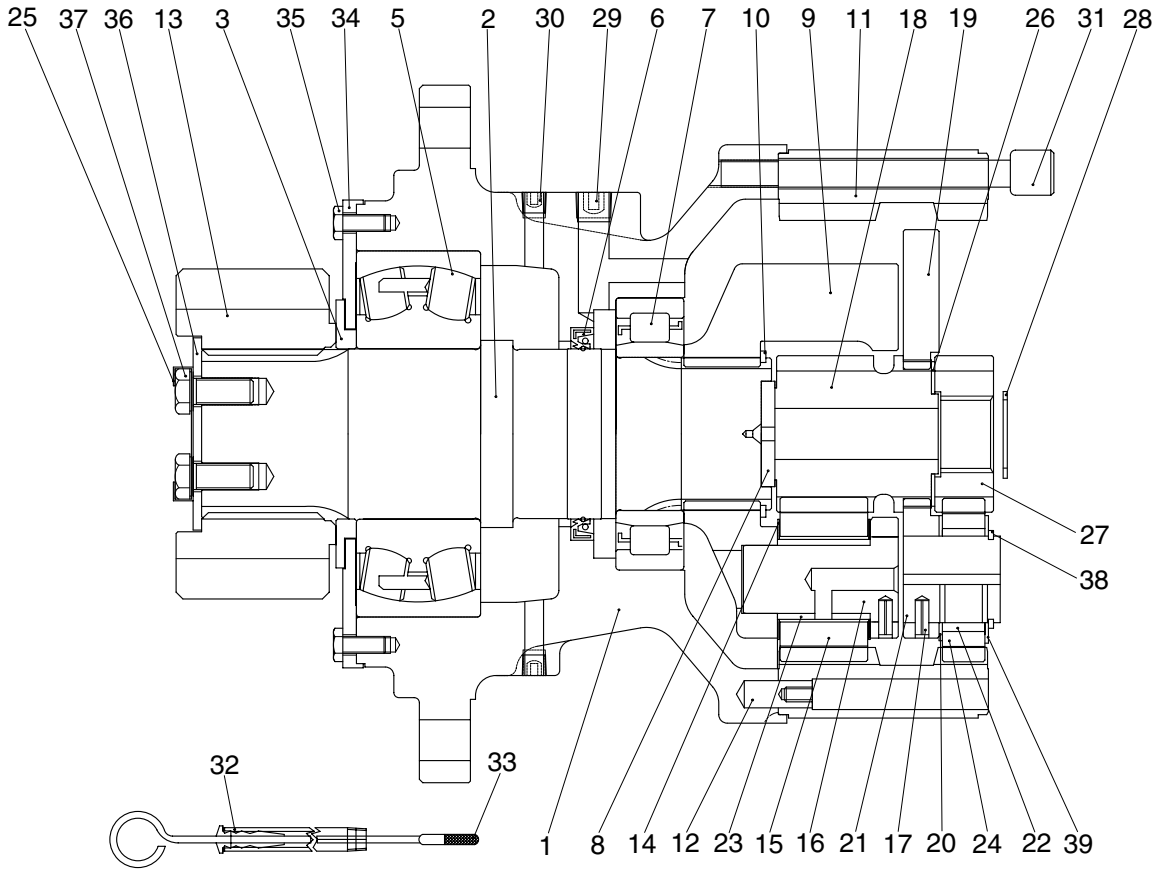
1) SWING MOTOR



50072SM02

031	Brake valve	303	Valve casing(K)	485	O-ring
051	Relief valve	304	Front cover	487	O-ring
052	Reactionless valve assy	351	Plunger(K)	488	O-ring
101	Drive shaft	355	Spring	491	Oil seal
106	Spacer	401	Socket bolt	501	Adapter
111	Cylinder block	432	Snap ring	502	Socket bolt
113	Spherical busing	433	Snap ring	503	O-ring
114	Cylinder spring	437	Snap ring	702	Brake piston
116	Push rod	438	Snap ring	706	O-ring
117	Spacer(F)	443	Roller bearing	707	O-ring
118	Spacer(R)	444	Roller bearing	712	Brake spring
121	Piston	451	Spring pin	742	Friction plate
122	Shoe plate	464	VP Plug	744	Dust plug
123	Retainer	468	VP Plug	745	Dust plug
124	Shoe	469	RO Plug	746	Dust plug
131	Valve plate	471	O-ring	993	PT Plug
301	Casing(F)	472	O-ring	994	PT Plug

2) REDUCTION GEAR



50072SM03

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

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)

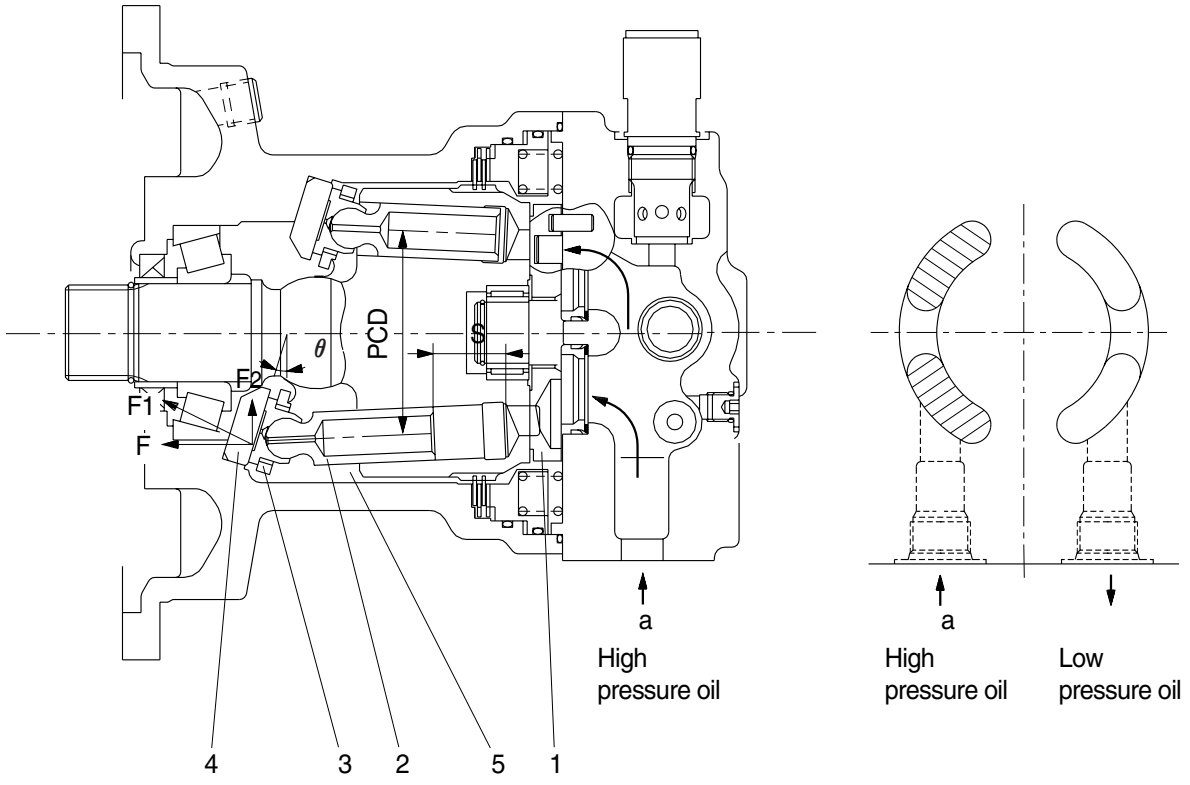
T : Output torque(kgf · cm)

Z : Piston number(9EA)

A : Piston area(cm^2)

θ : Tilting angle of swash plate(degree)

S : Piston stroke(cm)



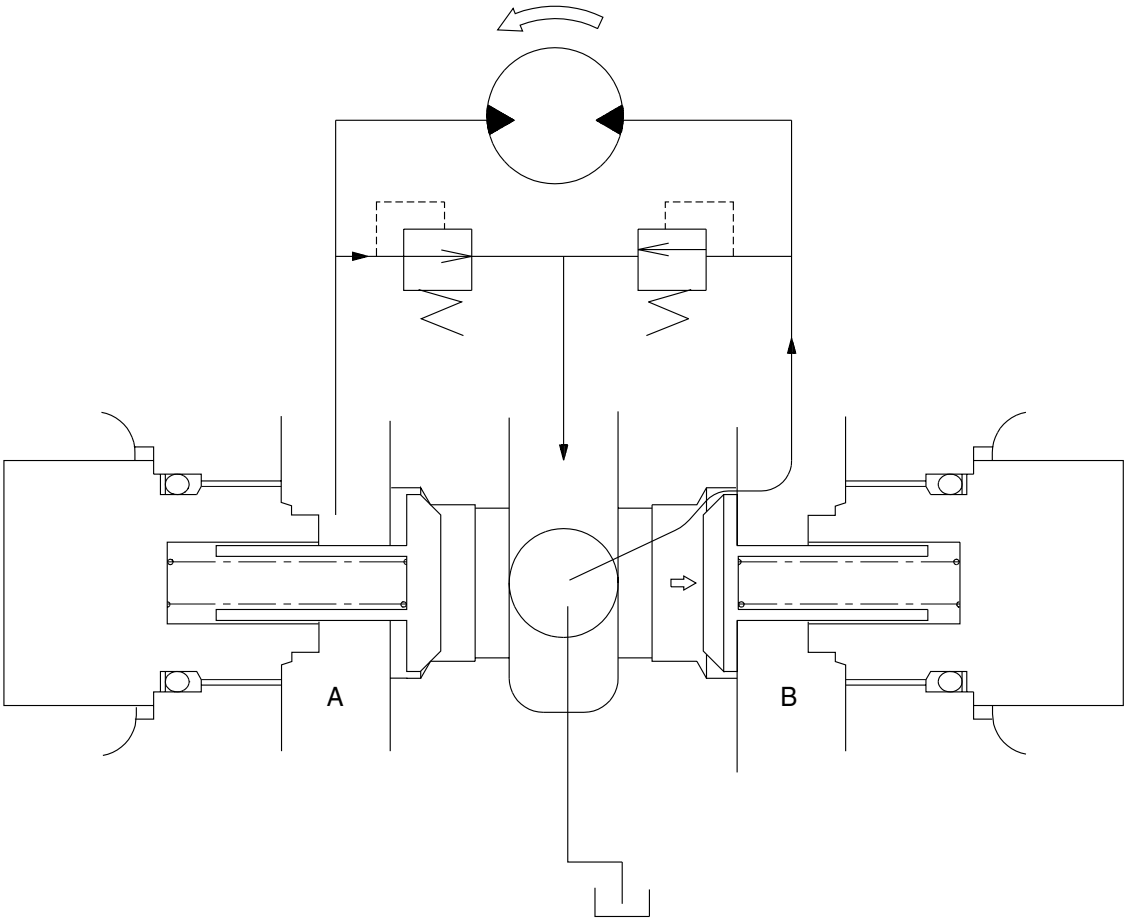
2) MAKE UP VALVE

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.

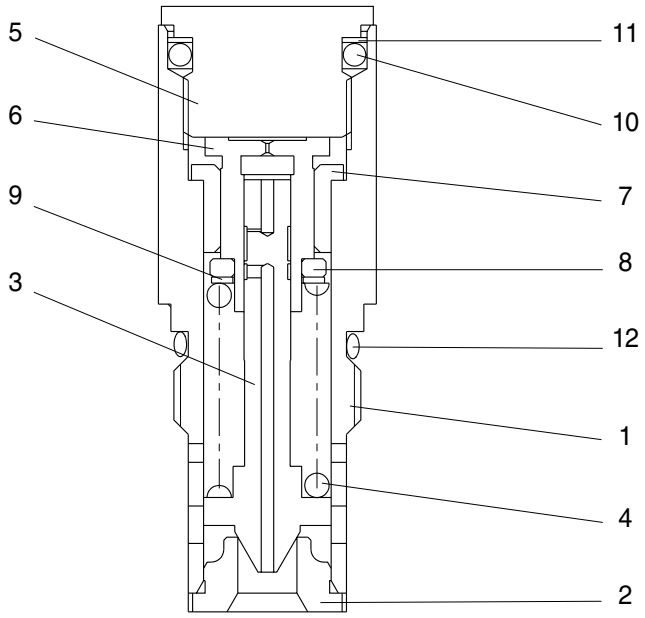
Pressurized oil into the port B, the motor rotate counterclockwise.

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.



R130SM03

3) RELIEF VALVE



R130SM05

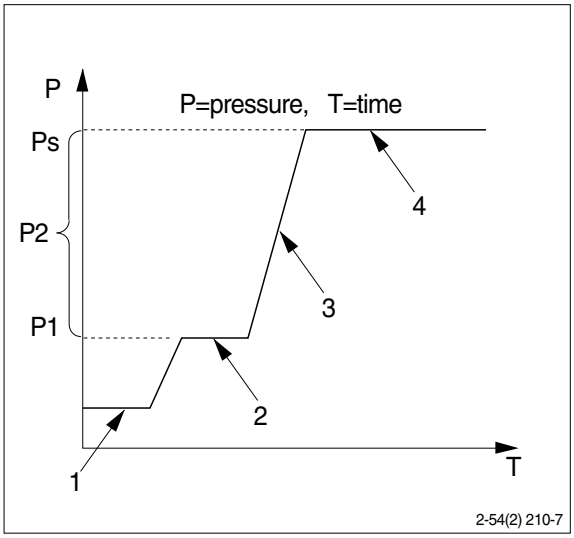
1 Body
2 Seat
3 Plunger
4 Spring
5 Adjusting screw
6 Piston
7 Bushing
8 Spring seat
9 Shim
10 O-ring
11 Back up ring
12 O-ring

(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.

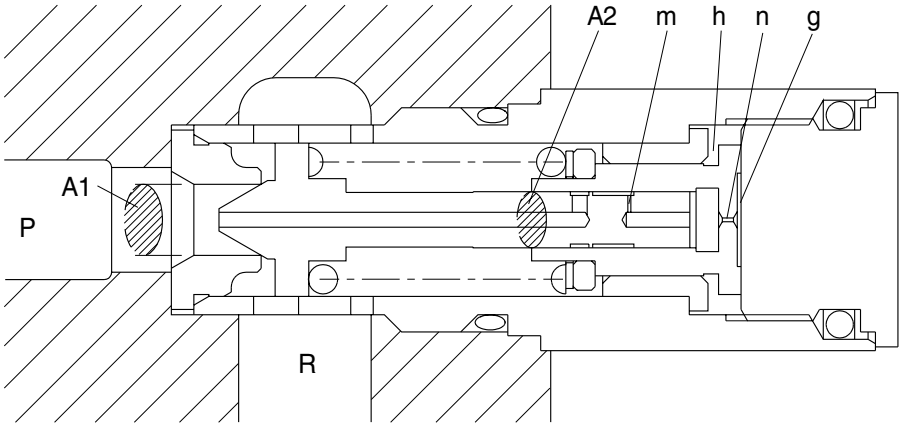
(2) Function of relief valve

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.



2-54(2) 210-7

① Ports (P,R) at tank pressure.

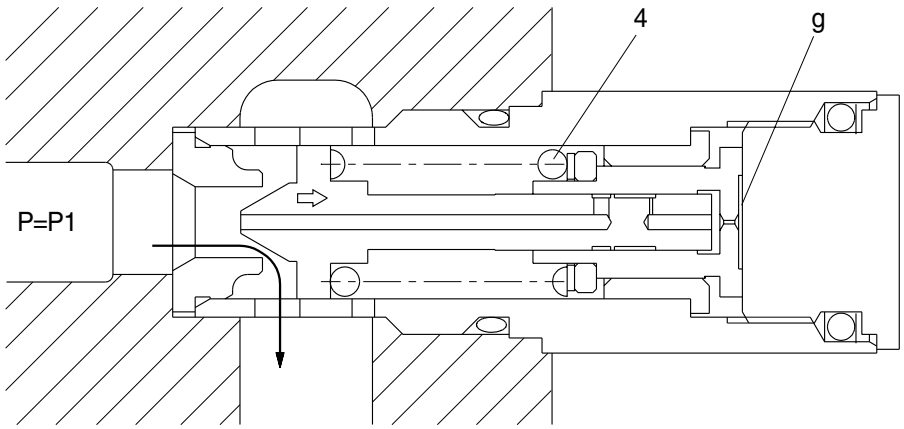


R130SM04

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.

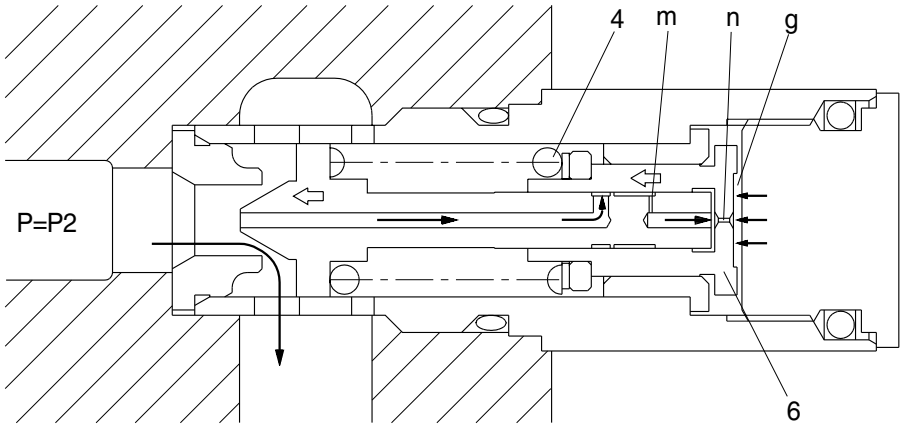
$P_1 \times A_1 = Fsp + Pg \times A_2$

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



R130SM04

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).

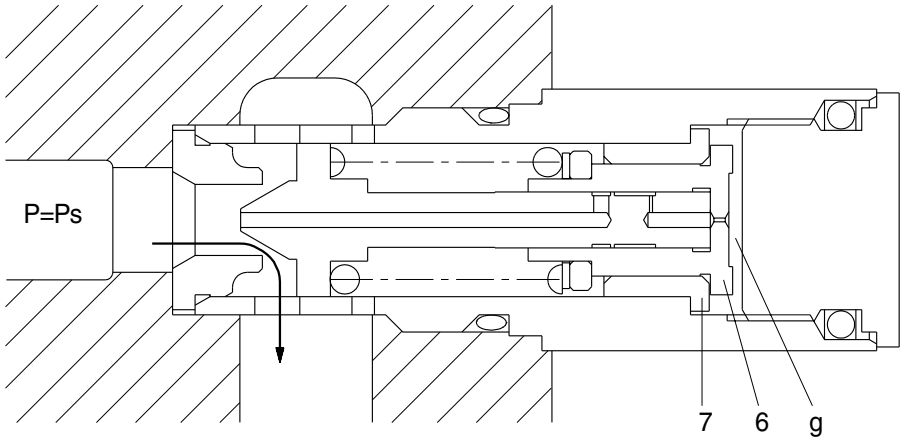


R130SM04

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).

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

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



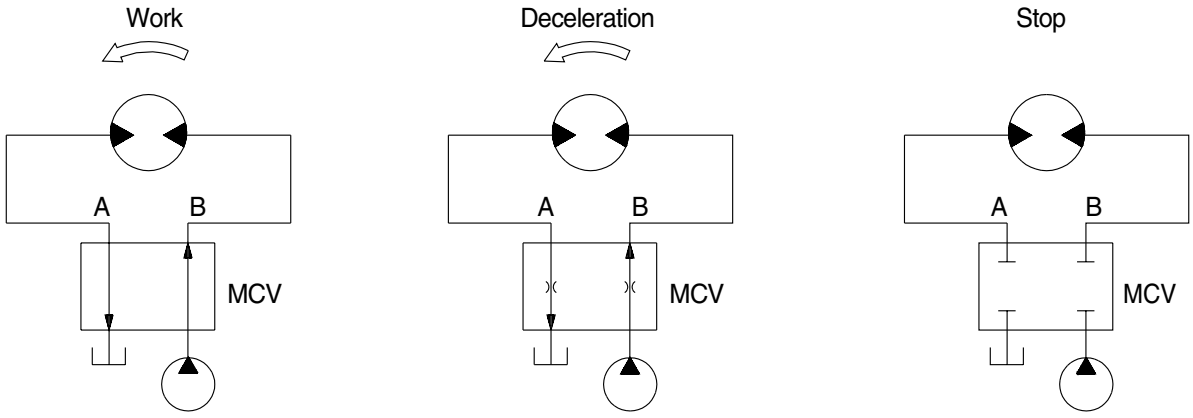
R130SM04

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

R130SM05

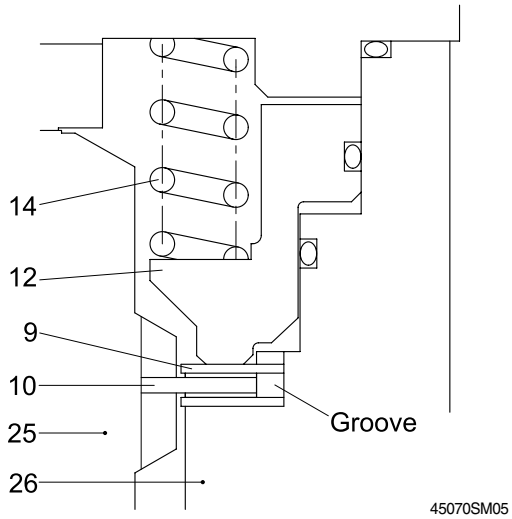
(2) Mechanical swing parking brake system

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(14) 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.

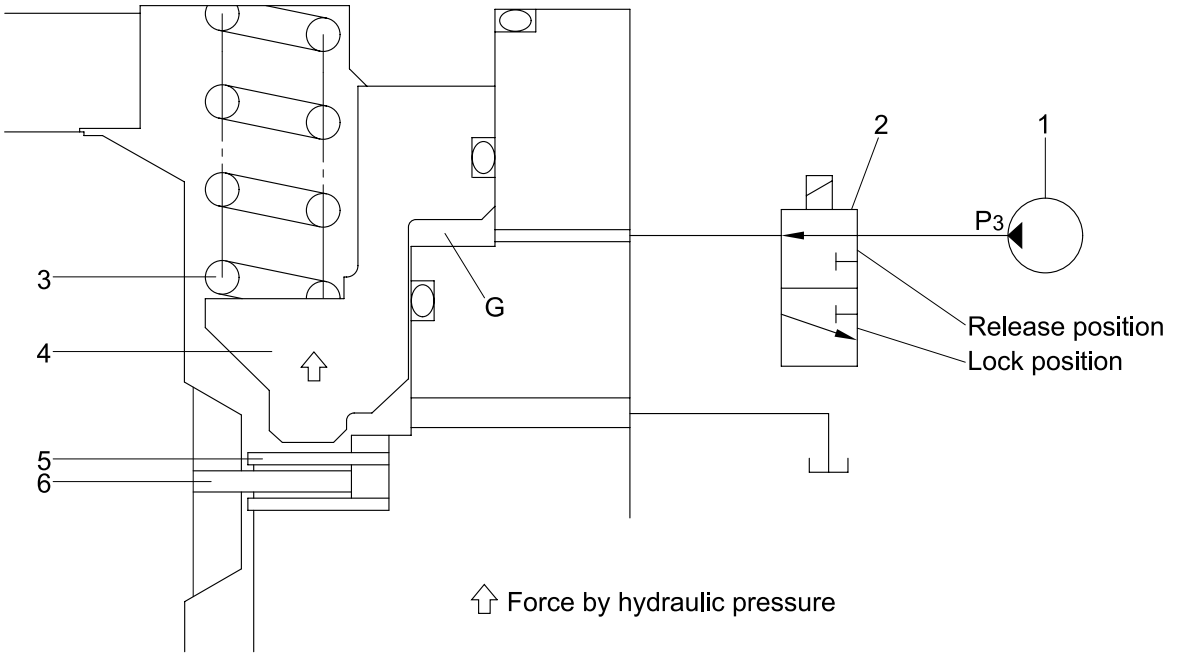


45070SM05

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

② Operating principle

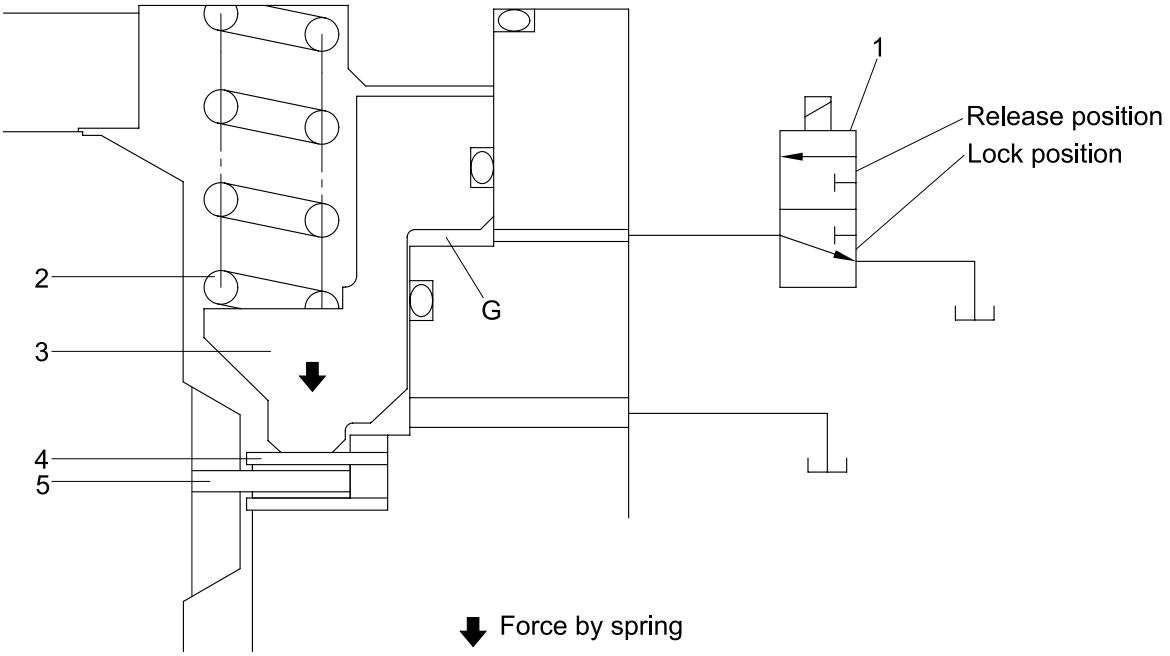
a. When the swing control lever is operated, the swing lock solenoid valve is excited, so the pilot pump discharged oil(P3) goes to the chamber G.
This pressure is applied to move the piston(6) to the upward against the force of the spring(9). Thus, it releases the brake force.



45070SM03

1 Pilot pump
2 Swing lock solenoid valve
3 Spring
4 Brake piston
5 Separate plate
6 Lining plate

b. When the swing control lever gets back to neutral position, the swing lock solenoid valve is deactivated, so the pilot pump discharged oil(P_3) is not applied to the chamber G.
Thus, the brake is actuated by spring force.



45070SM04

1 Swing lock solenoid valve
2 Spring
3 Brake piston
4 Separate plate
5 Lining plate