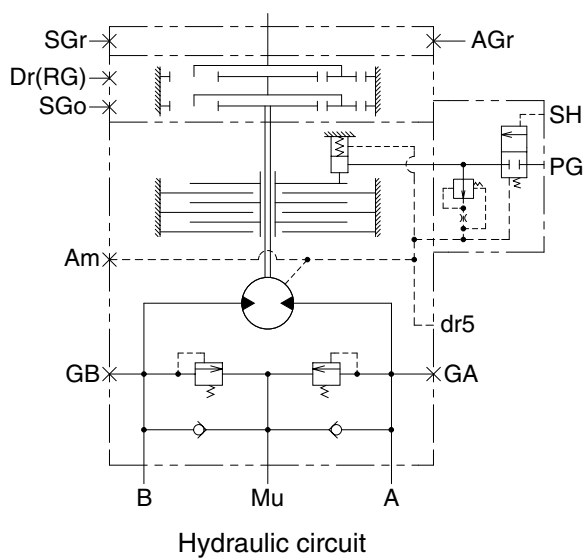
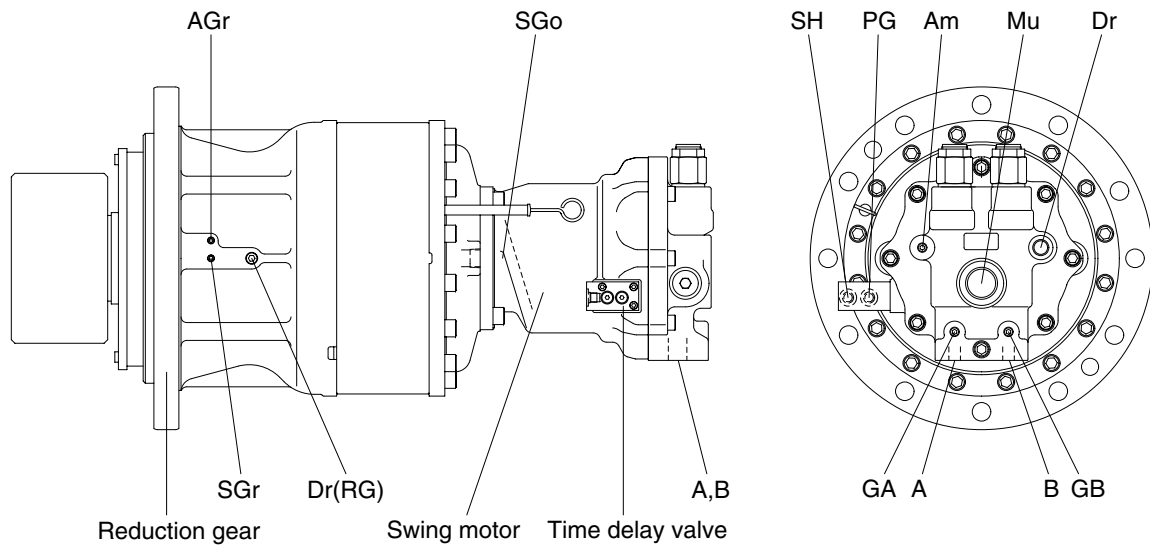


## GROUP 3 SWING DEVICE

### 1. STRUCTURE

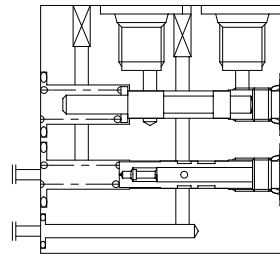
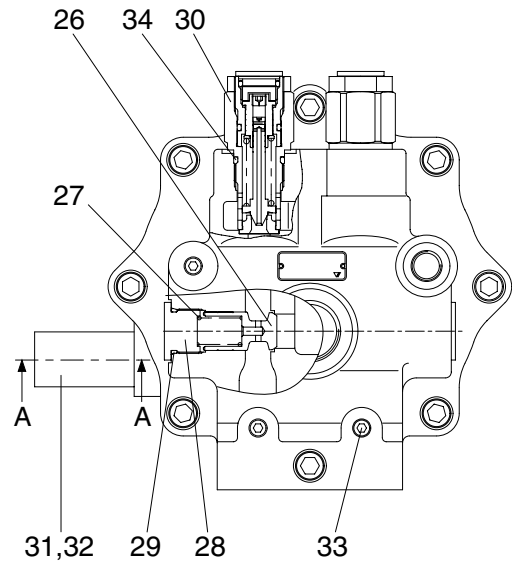
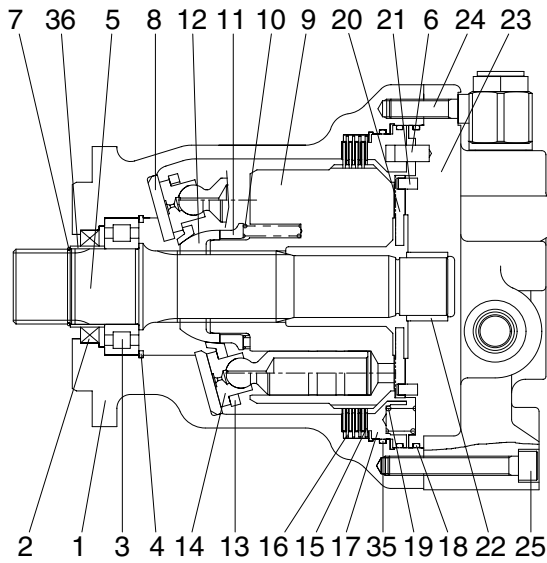
Swing device consists swing motor, swing reduction gear.

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



| Port    | Port name             | Port size |
|---------|-----------------------|-----------|
| A       | Main port             | SAE 1"    |
| B       | Main port             | SAE 1"    |
| Dr      | Drain port            | PF 1/2    |
| Mu      | Make up port          | PF 1 1/4  |
| SH      | Brake release port    | PF 1/4    |
| PG      | Stand by port         | PF 1/4    |
| GA, GB  | Gauge port            | PF 1/4    |
| Am      | Motor air bleed port  | PF 1/4    |
| AGr     | R/G air bleed port    | PT 1/8    |
| SGr     | Grease filling port   | PT 1/8    |
| Dr(R/G) | Gear oil drain port   | PT 3/8    |
| SGo     | Gear oil filling port | PT 3/4    |

## 1) SWING MOTOR

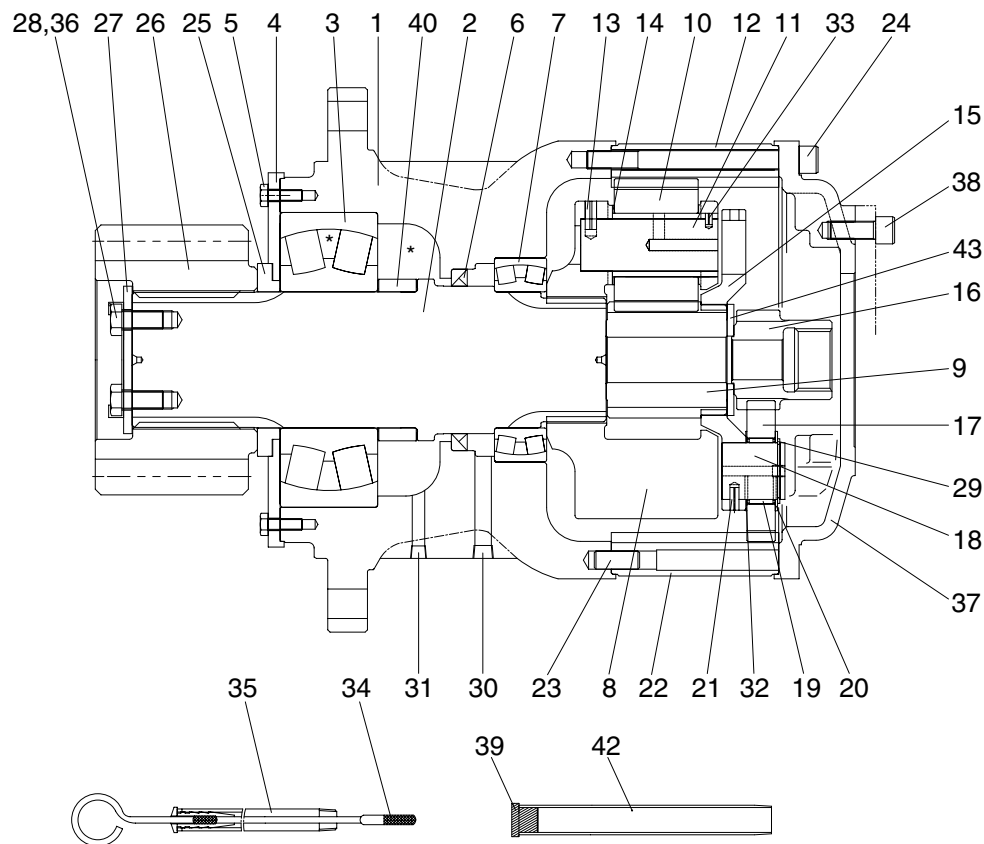


SECTION A-A

3607A2SM02

|    |                 |    |                |    |                   |
|----|-----------------|----|----------------|----|-------------------|
| 1  | Body            | 13 | Set plate      | 25 | Wrench bolt       |
| 2  | Oil seal        | 14 | Piston assy    | 26 | Poppet            |
| 3  | Roller bearing  | 15 | Friction plate | 27 | Spring            |
| 4  | Snap ring       | 16 | Plate          | 28 | Plug              |
| 5  | Shaft           | 17 | Brake piston   | 29 | O-ring            |
| 6  | Pin             | 18 | O-ring         | 30 | Relief valve assy |
| 7  | Stop ring       | 19 | Spring         | 31 | Time delay valve  |
| 8  | Shoe plate      | 20 | Valve plate    | 32 | Wrench bolt       |
| 9  | Cylinder block  | 21 | Pin            | 33 | Plug              |
| 10 | Spring          | 22 | Needle bearing | 34 | O-ring            |
| 11 | Ball guide seat | 23 | Rear cover     | 35 | O-ring            |
| 12 | Ball guide      | 24 | Wrench bolt    | 36 | Bushing           |

## 2) REDUCTION GEAR



37007A2SM01

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

## 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.

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

Where p : Effective difference of pressure(kgf/cm<sup>2</sup>)

q : Displacement(cc/rev)

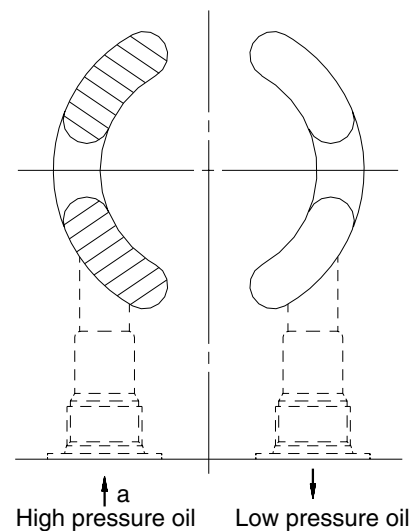
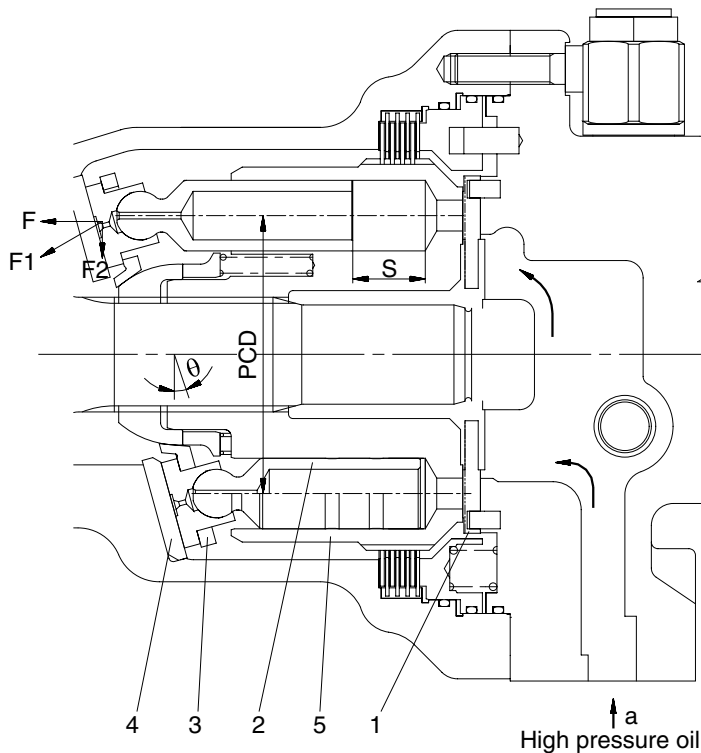
T : Output torque(kgf · cm)

Z : Piston number

A : Piston area(cm<sup>2</sup>)

θ : Tilting angle of swash plate(degree)

S : Piston stroke(cm)



37072SM01

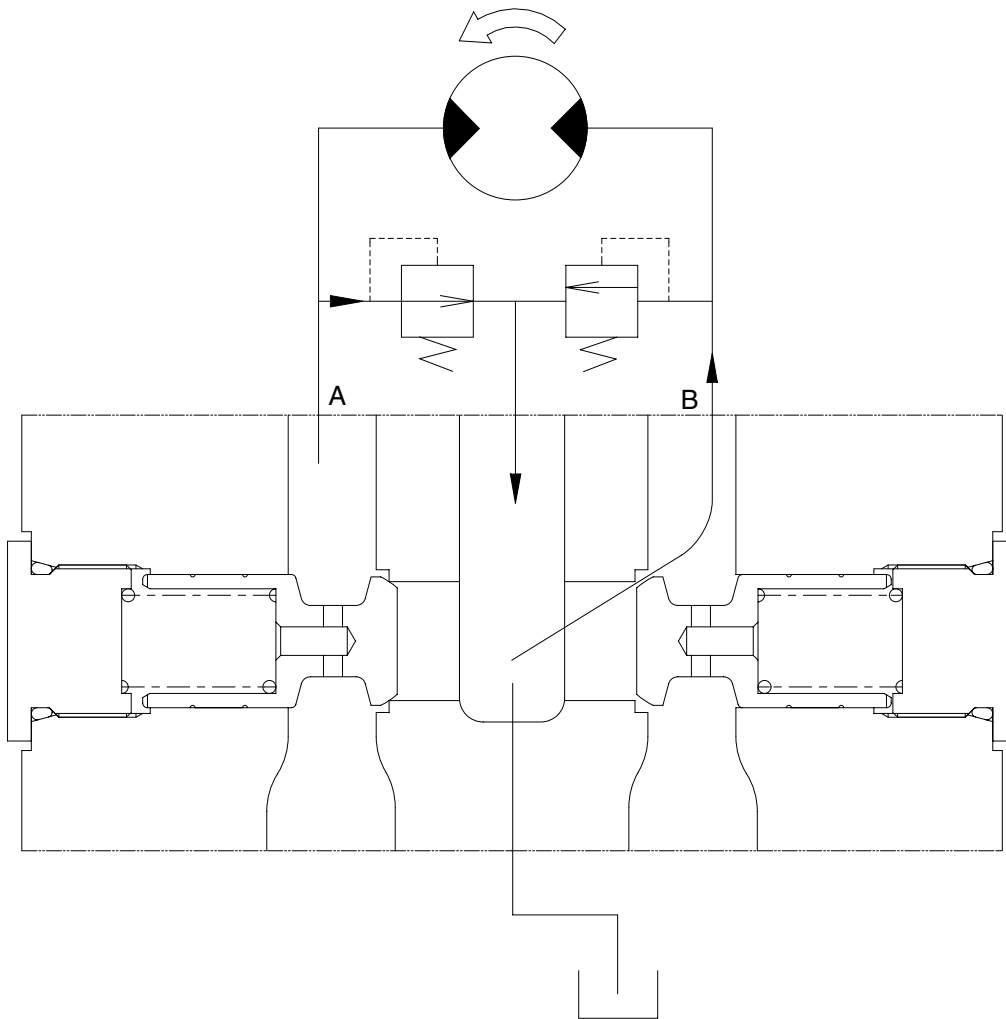
## 2) MAKE UP VALVE

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.

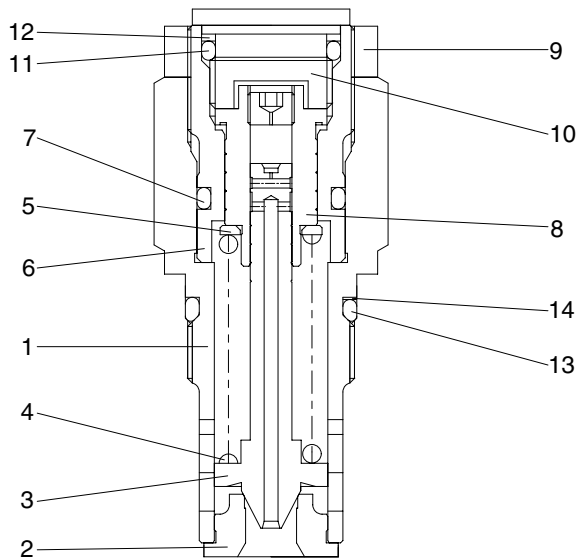
Pressurized oil into the port B, the motor rotate counterclockwise.

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.



37007A2SM10

### 3) RELIEF VALVE



- 1 Body
- 2 Poppet seat
- 3 Poppet
- 4 Spring
- 5 Spring seat
- 6 Stopper
- 7 O-ring
- 8 Shockless valve
- 9 Nut
- 10 Plug
- 11 O-ring
- 12 Backup ring
- 13 O-ring
- 14 Backup ring

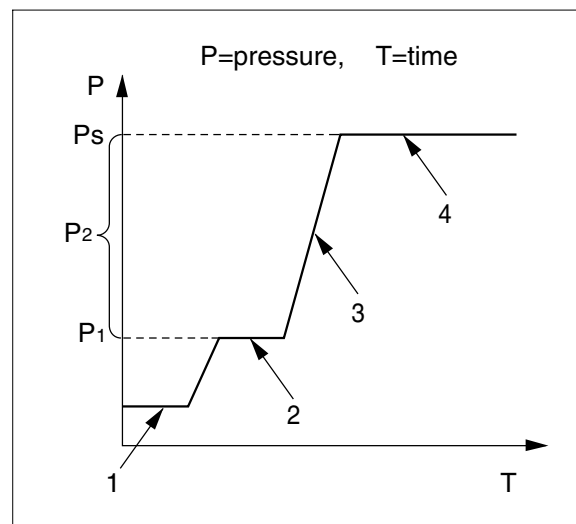
37007A2SM03

#### (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.

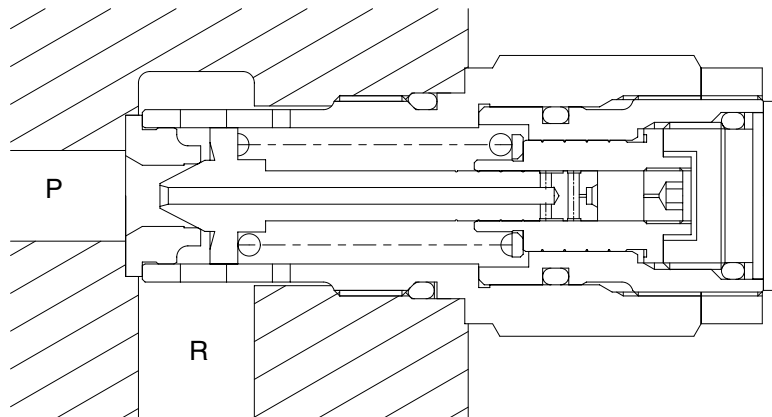
#### (2) Function of relief valve

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.



2-51(2) [360-7]

- ① Ports (P, R) at tank pressure.

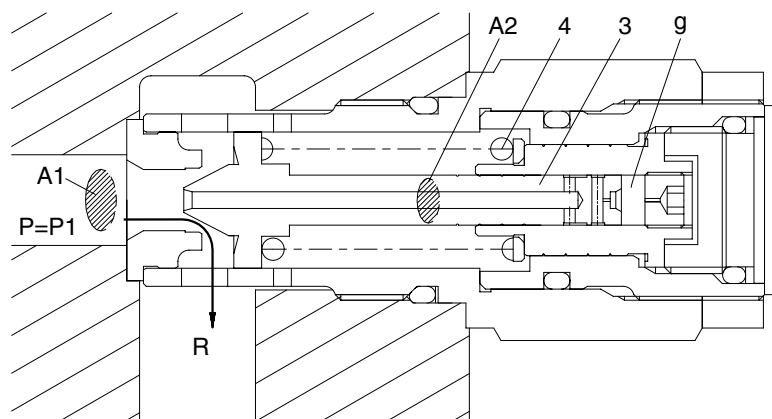


37007A2SM04

- 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.

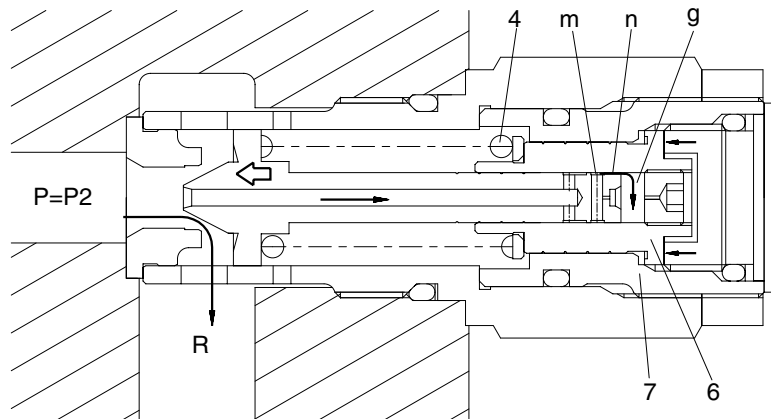
$$P_1 \times A_1 = F_{sp} + P_1 \times A_2$$

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



37007A2SM05

- ③ The oil flow chamber g via orifice m and n. When the pressure 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 body(7).

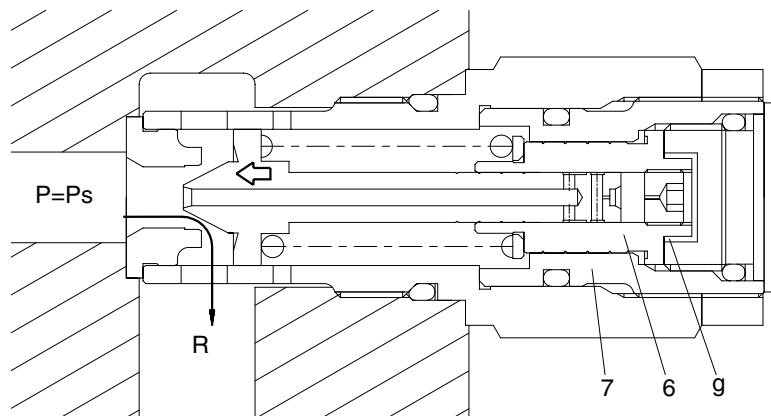


37007A2SM06

- ④ When piston(6) hits the end of sleeve(7), it stops moving to the left any further. As the result, the pressure in chamber(g) equals ( $P_s$ ).

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

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



37007A2SM07

#### 4) PARKING BRAKE

##### (1) PARKING BRAKE ON

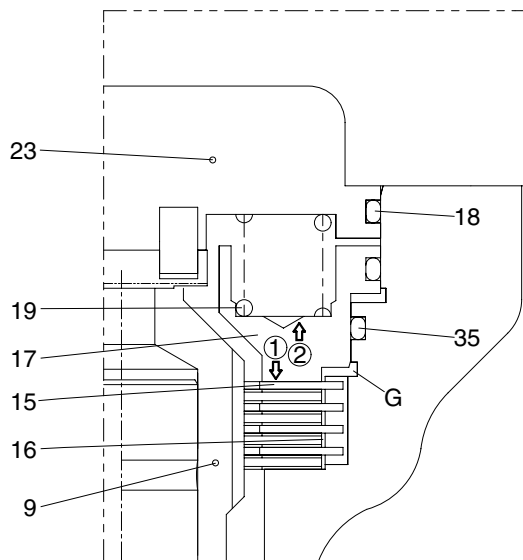
When the swing motor stops the parking brake is normally kept being fixed by mechanical force. When the brake release pressure is blocked, brake piston(17) is pushed by spring(19) force according to the arrow direction ①.

Consequently, pressure plate(16) which is fixed to cylinder block(9) and separate plate(15) which is assembled to casing(23) are pressed. And then swing motor stops.

##### (2) PARKING BRAKE OFF

When the brake releases pressure-supply, the oil flows into room(G). Oil pressure is pressing the spring(19) force, and then brake piston(17) is pushed according to the arrow direction ②.

The pressure of pressure plate(16) and separate plate(15) is released. Following this procedure the cylinder block(9) is rotating.



- 9 Cylinder block
- 15 Separate plate
- 16 Pressure plate
- 17 Brake piston
- 18 O-ring
- 19 Spring
- 23 Casing
- 35 O-ring

8007A2SM08

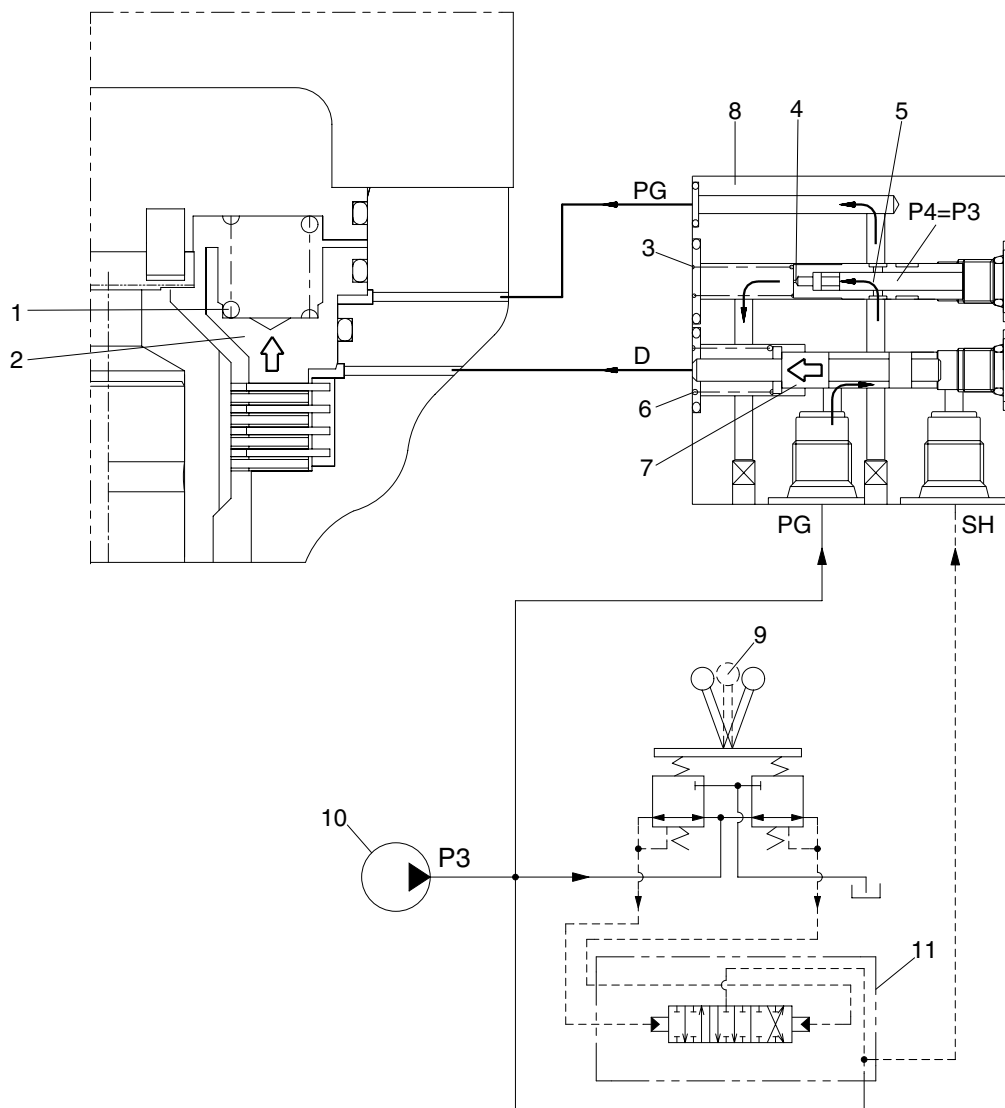
## 5) TIME DELAY VALVE

When the swing motor stops, time delay valve delays the parking brake function for a while.

For the parking brake works all of a sudden it may break the swing motor parts. When the swing control lever(9) sets up to the swing position, the pilot oil goes to the swing control valve and to SH of the time delay valve(8) through the MCV(11).

The oil pressure moves to the piston(2) to the upward against the force of the spring(1).

Thus the brake force is released.



37007A2SM09

- 1 Spring
- 2 Piston
- 3 Spring
- 4 Orifice
- 5 Poppet
- 6 Spring

- 7 Spool
- 8 Time delay valve
- 9 Swing control lever
- 10 Pilot pump
- 11 Main control valve