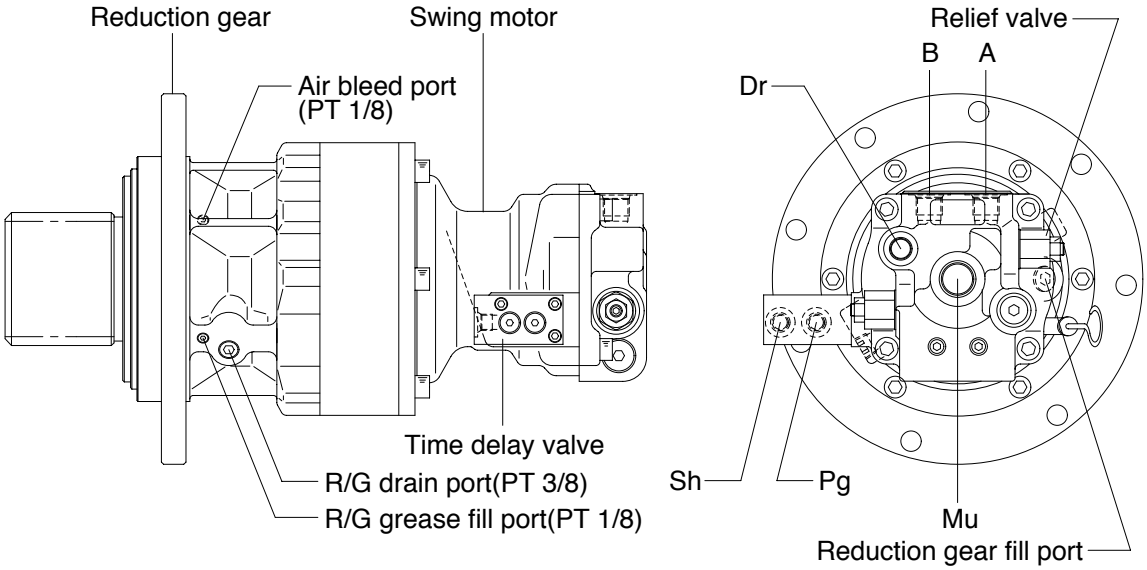
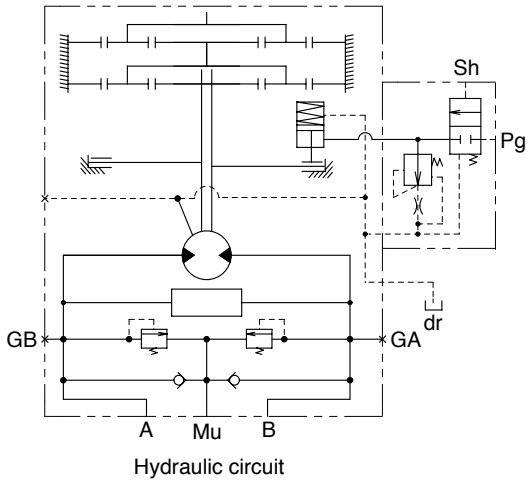
GROUP 3 SWING DEVICE

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.

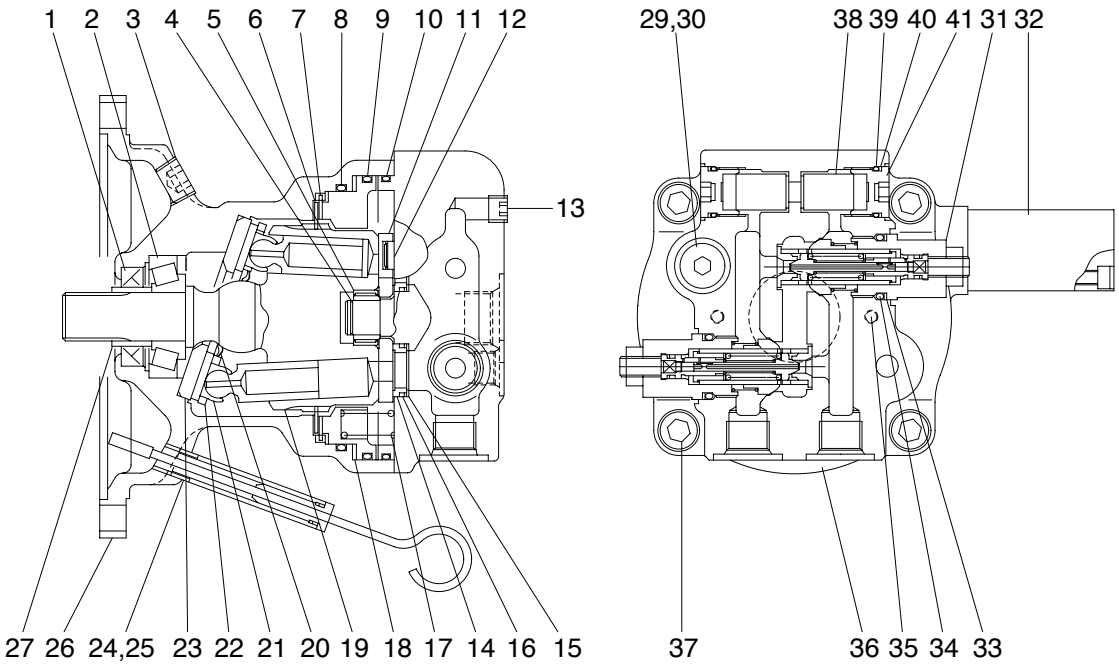




Hydraulic circuit

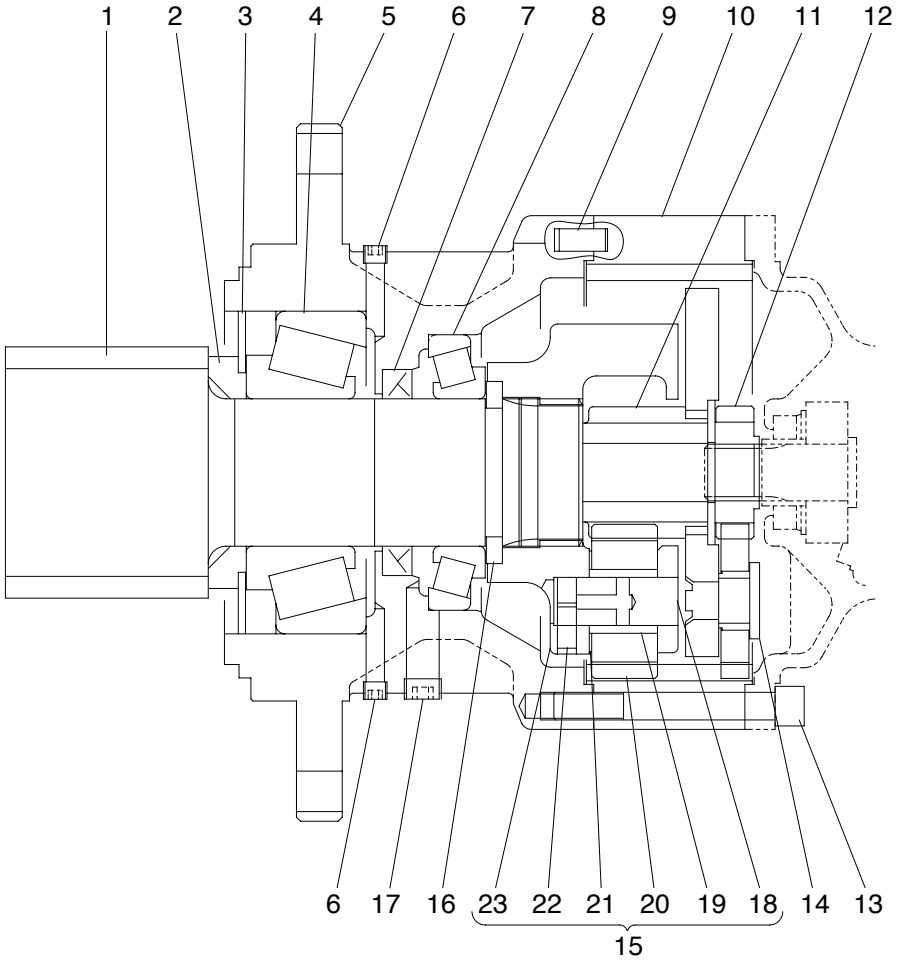
Port	Port name	Port size
A	Main port	PF 1/2
B	Main port	PF 1/2
Dr	Drain port	PF 3/8
Mu	Make up port	PF 3/4
Sh	Brake release port	PF 1/4
Pg	Stand by port	PF 1/4
GA, GB	Gauge port	PF 1/4

1) SWING MOTOR



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

2) REDUCTION GEAR



1	Pinion shaft	7	Oil seal	13	Holder assembly 1
2	Collar	8	Roller bearing	14	Hexagon socket bolt
3	Plate	9	Pin	15	Holder assembly 2
4	Roller bearing	10	Ring gear	16	Collar
5	Gear casing	11	Spur gear 4	17	Plug
6	Plug	12	Sun gear		

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 7 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.

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

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

q : Displacement(cc/rev)

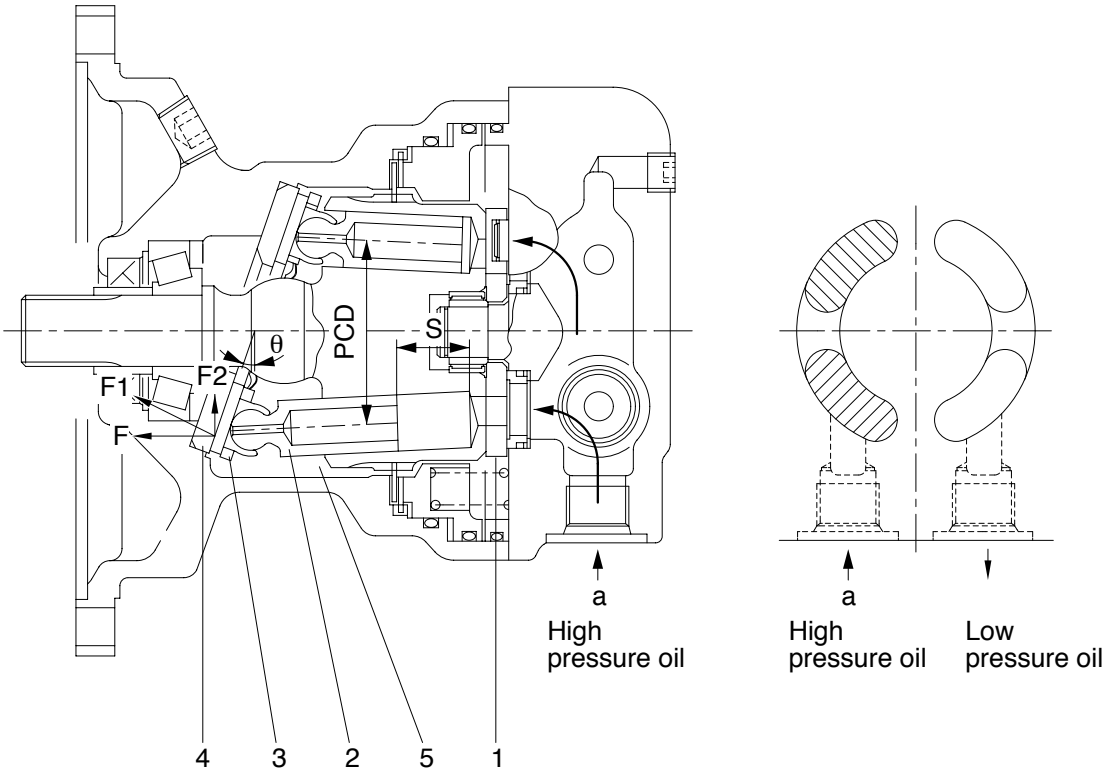
T : Output torque(kgf · cm)

Z : Piston number(7EA)

A : Piston area(cm^2)

θ: Tilting angle of swash plate(degree)

S : Piston stroke(cm)



2) MAKE UP VALVE

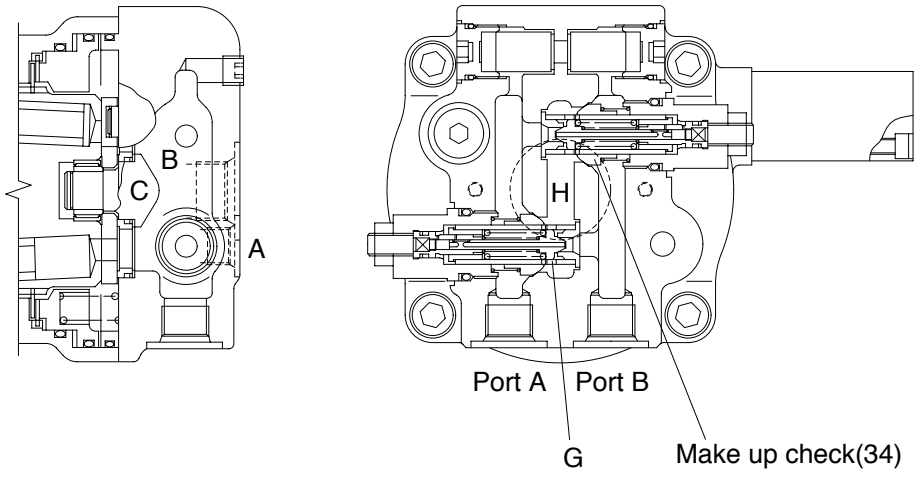
(1) During half brake action(When the cushion relief is not working)

When the superstructure has accelerated and then begins to decelerate due to the action of the control valve at half lever the volume of oil supply from the pump to port A reduces. If however the superstructure has been moving at a comparatively high speed the pumping action of the motor causes depressurization at area **C** and extra oil supply is required. If the pressure at port B is below the cushion relief action pressure the full volume of oil flowing to areas **C** from port A passes through port B and is discharged to the control valve. Therefore the volume of oil supplied from the control valve alone(The valve is at the half lever position so the flow of oil from the pump is restricted) is less than the absolutely required flow at area **C**. To prevent this problem the make up check(34) supplies supplementary oil flow to area **C** from the make up port.

(2) When the brake is acting(When the cushion relief has acted)

If in the above situation the control lever is moved suddenly back to the neutral position the oil flow from the pump to port A ceases completely but the superstructure continues to swing due to inertia. In this case the port B cushion relief acts and the oil drawn in by the relief passes through oil channels **G** and **H**, pushes open the make up check(34) on the port A side to pass to channels **B** and **C**.

However the volume supplied will be insufficient by exactly the amount of any leakage. To prevent this further oil supply from the makeup port opens the make up check(34) to flow into channels **B** and **C**, preventing cavitation.



3) RELIEF VALVE

(1) On starting

Oil supplied to port A due to manipulation of the control valve does not produce rated turning speed immediately due to the large inertia of the superstructure. Some of the oil supplied passes through the cross relief valve, which functions as a safety valve, and the through channels **I** and **H** to push open check(54) on the port B side and flow to port B.

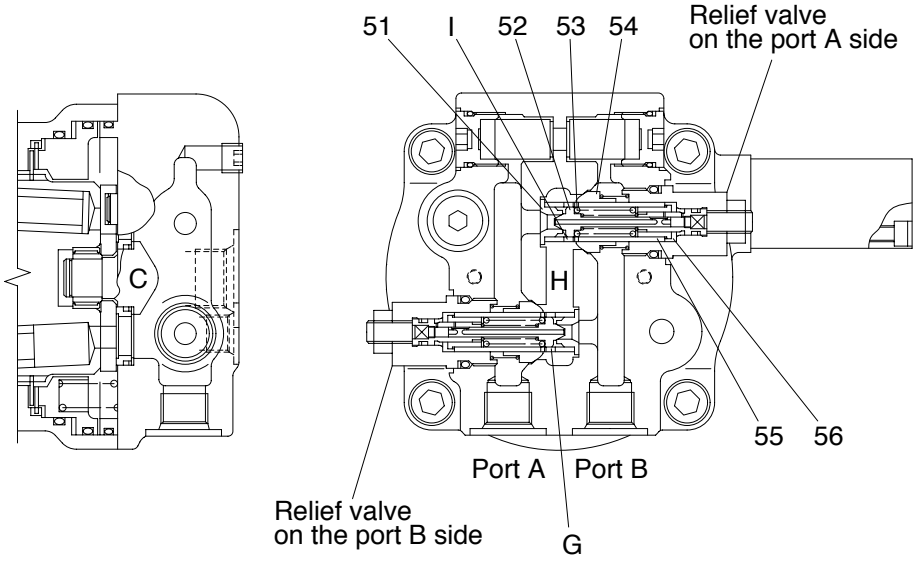
Oil at port A overcomes the force of a spring(53) and pushes open a poppet(52) to pass between the poppet(52) and the seat(51). It then flows through channel **I** to flow into channel **H**.

(2) Brake side(Cushion action)

When the control valve is returned to its neutral position the return oil channel for oil leaving the motor is blocked. Immediately after this control operation the motor continues to be turned by a large inertial force. As the motor turns its pumping action draws oil in from the port A and discharges it to port B direction but as the control valve return channel is blocked the pressure at port B rises.

The increased pressure at port B exceeds the spring force required to push open the poppet(52). This allows oil to pass from port B through channels **G** and **H** to push open the check valve(54) and flow into channels **C**. This process absorbs the inertia if the superstructure as it slows to a stop.

Furthermore during the above pressure rise process at port B oil passes through the orifice of the poppet(52) to enter the spring seat chamber and push the piston(56) until it touches the sleeve(55). During this period the poppet(52) has already been pushed open so the cushion relief action works initially with a rather low pressure and then a moment later(Approximately 0.1~0.2s) rises to the regulation pressure in a two step relief action which alleviates the instantaneous shock which occurs on braking.

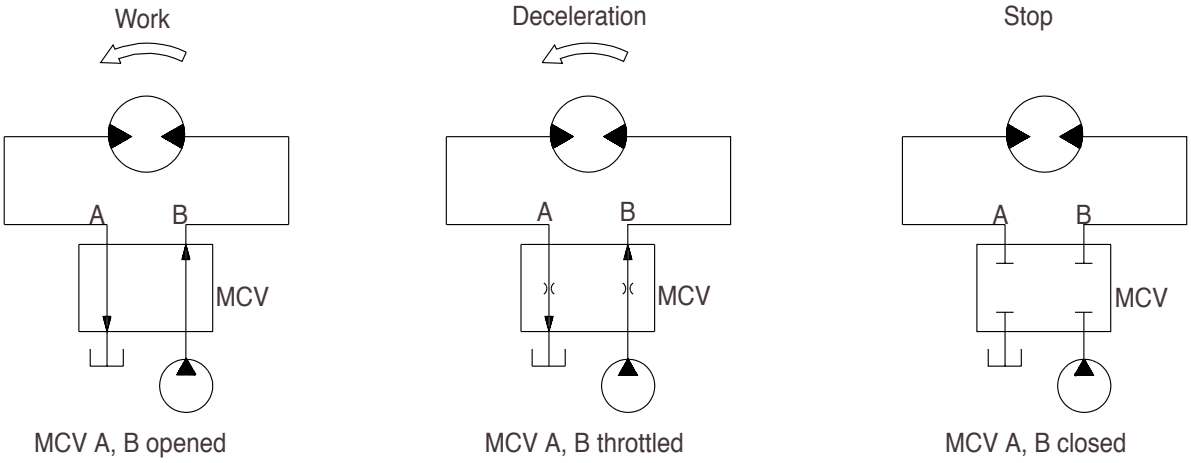


4) BRAKE SYSTEM

(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

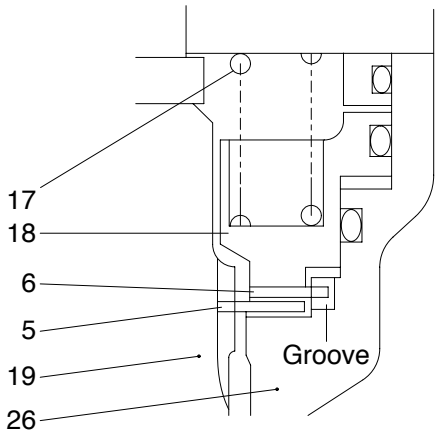
(2) Mechanical swing parking brake system

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(6) is constrained by the groove located at housing(26). When housing is pressed down by brake spring(17) through lining plate(5), separate plate(6) and brake piston(18), friction force occurs there.

Cylinder(19) is constrained by this friction force and brake acts, while brake releases when hydraulic force exceeds spring force.



5	Lining plate	18	Brake piston
6	Separate plate	19	Cylinder
17	Spring	26	Housing