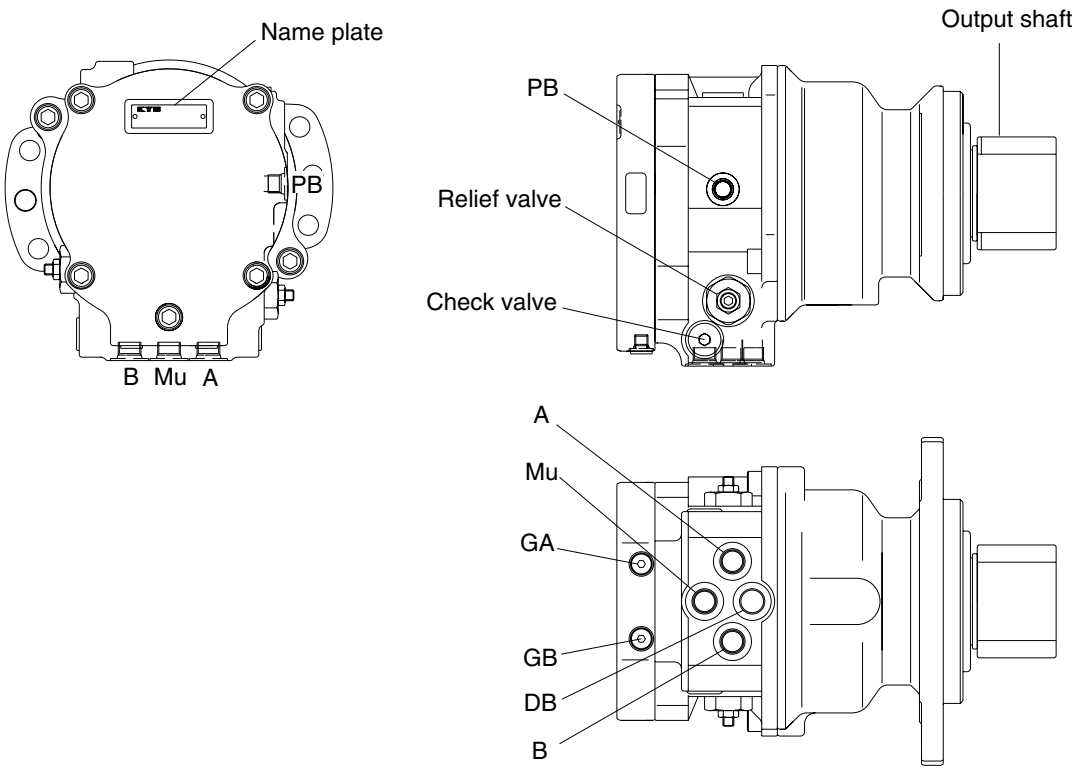
GROUP 3 SWING DEVICE

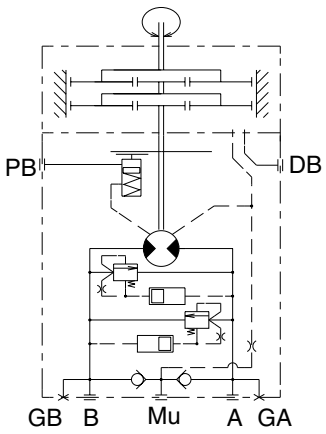
1. STRUCTURE

Swing device consists swing motor and swing reduction gear.

1) SWING MOTOR

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





HYDRAULIC CIRCUIT

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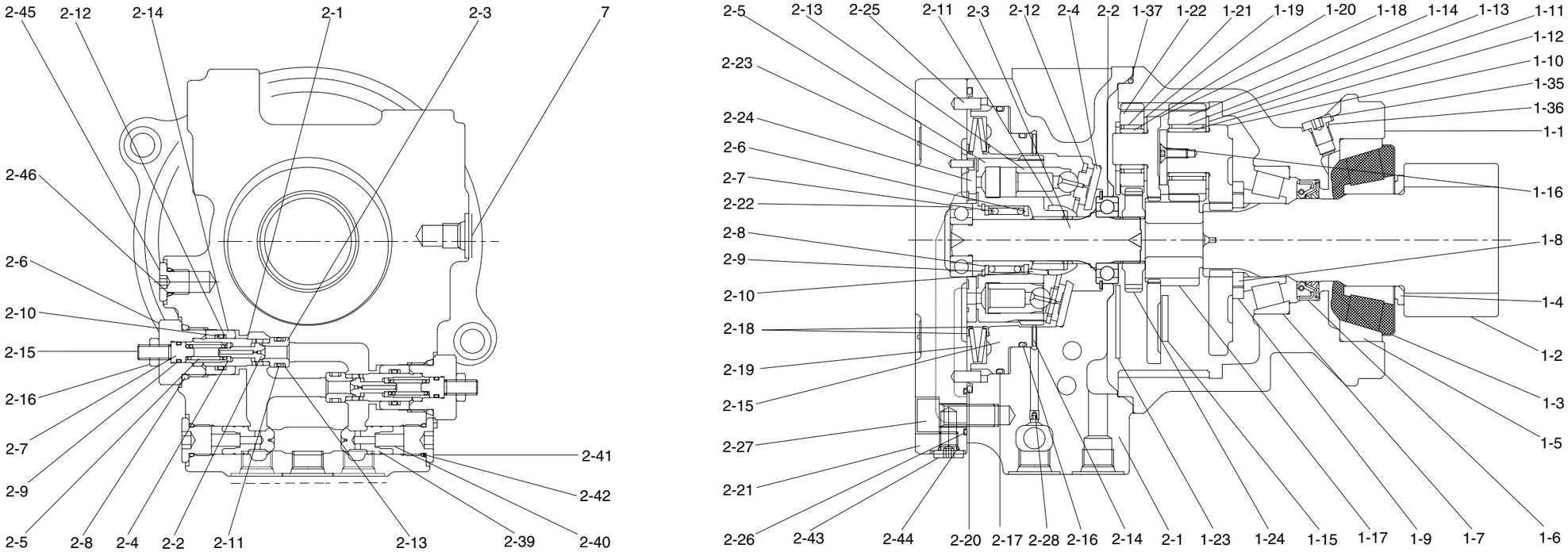
Port	Port name	Port size
A	Main port	PF 3/8
B	Main port	PF 3/8
DB	Drain port	PF 3/8
Mu	Make up port	PF 3/8
PB	Brake release port	PF 1/4
GA,GB	Gage port	PF 1/8

2) COMPONENTS



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1	Gear box	1-11	Thrust washer	1-22	Planetary gear	2-5	Cylinder block	2-16	O-ring	2-27	Socket head bolt
1-1	Housing	1-12	Inner race	1-23	Thrust plate	2-6	Collar	2-17	O-ring	2-28	Orifice
1-2	Pinion shaft	1-13	Needle bearing	1-24	Drive gear	2-7	Spring	2-18	Spring seat	2-38	Relief valve assy
1-3	Plate	1-14	Planetary gear B	1-35	Plug	2-8	Washer	2-19	Spring	2-39	Check valve
1-4	Collar	1-15	Thrust plate	1-36	O-ring	2-9	Ring-snap	2-20	O-ring	2-40	Spring
1-5	Tapper roller bearing	1-16	Screw	1-37	O-ring	2-10	Pin	2-21	Cover	2-41	Plug
1-6	Oil seal	1-17	Sun gear B	2	Axial motor piston	2-11	Retainer holder	2-22	Ball bearing	2-42	O-ring
1-7	Tapper roller bearing	1-18	Holder	2-1	Case	2-12	Retainer plate	2-23	Pin	2-43	Plug
1-8	Plate	1-19	Thrust washer	2-2	Ball bearing	2-13	Piston assy	2-24	Valve plate	2-44	O-ring
1-9	Collar	1-20	Inner race	2-3	Shaft	2-14	Disc	2-25	Pin	2-45	Plug
1-10	Holder	1-21	Needle bearing	2-4	Thrust plate	2-15	Brake piston	2-26	O-ring	2-46	O-ring

2. DESCRIPTION OF FUNCTION AND OPERATION

1) SWASH PLATE MOTOR

The cylinder block incorporates nine pistons. The end face of the cylinder block is in contact with the valve plate having two woodruff ports B and C (distributing valve to change over between high and low pressure).

Principle of generation torque

When high pressure oil (Pressure P) is introduced to the B port, the inclined surface is pushed by a force of "F = P × A, A : Piston sectional area" per piston and the piston receives a reaction force from the inclined surface. The piston that is restricted in the moving direction by the cylinder block due to the reaction force generates a rotating force. The total of rotating force by the reaction force of the high pressure side pistons works on the cylinder block. The generated rotating force is transmitted as a torque to the shaft via the spline to turn the shaft.

On the other hand, if the high pressure oil is introduced to the C port, the opposite rotation is caused.

The output torque and the revolution are calculated as follows :

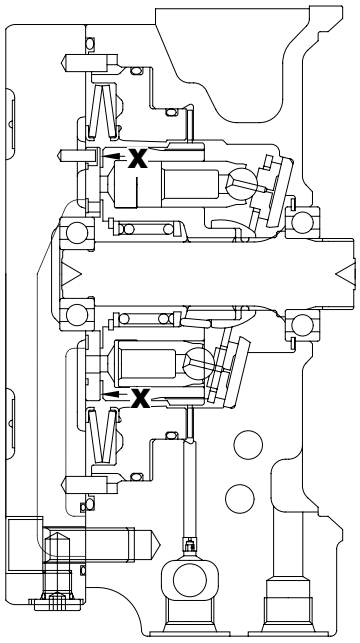
· Output torque (T)

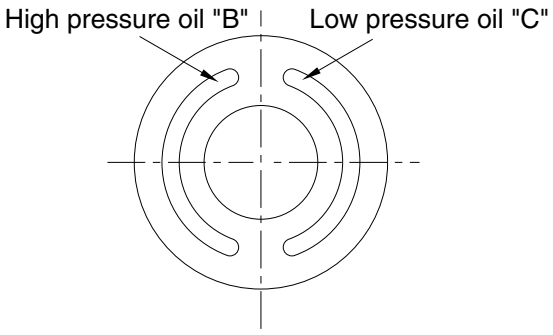
$$T = \frac{P \times D \times i \times \eta m \times \eta G}{2 \times \pi \times 100}$$

· Revolution (N)

$$N = \frac{Q \times 1000 \times \eta v}{D \times i}$$

D : Displacement (cm^3/rev)
P : Effective drive pressure (MPa)
Q : Inflow (L/min)
ηm : Mechanical efficiency (motor) ($\% \times 10^{-2}$)
ηv : Volumetric efficiency (motor) ($\% \times 10^{-2}$)
i : Speed ratio of reduction gear
ηG : Efficiency of reduction gear ($\% \times 10^{-2}$)





View X-X of valve plate(Outline)

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2) PARKING BRAKE

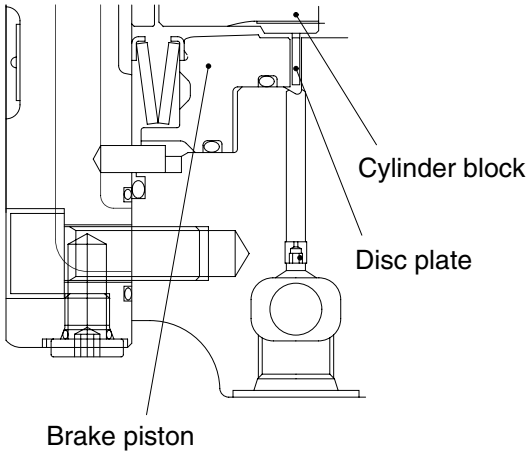
The parking brake is of wet type multi-plate construction of hydraulic release type and has a shaft lock mechanism that changes between ON and OFF of the brake by external signal pressures.

① Parking brake ON

When the hydraulic pressure for brake release is shut, the disc coupled to the periphery of the cylinder block via the spline is pushed by the spring force against the brake piston (pinned to the case so that it will not rotate) and the cylinder block and the case secured by the frictional force. Thus the shaft is locked.

② Parking brake OFF

When the brake release pressure is introduced to the brake cylinder chamber (C) via the "PB" port, the brake piston is operated by the release pressure in opposition to the spring force to eliminate the force of friction with the disc, thus allowing the shaft to rotate freely.



"PB" (Brake releasing pressure) OFF

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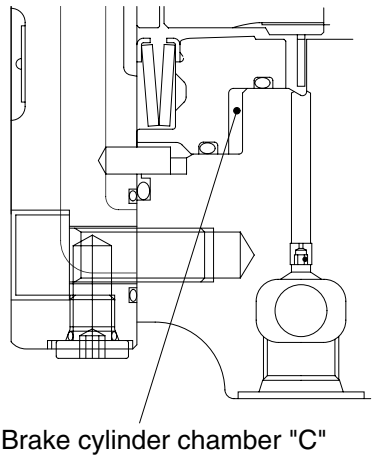

"PB" (Brake releasing pressure) ON

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3) RELIEF VALVE

The relief valves determine the drive force and the brake force for hydraulic shovel swing and are installed in the main port A and B lines. The circuit is configured to return the relief valve return oil to the counterpart main low pressure line.

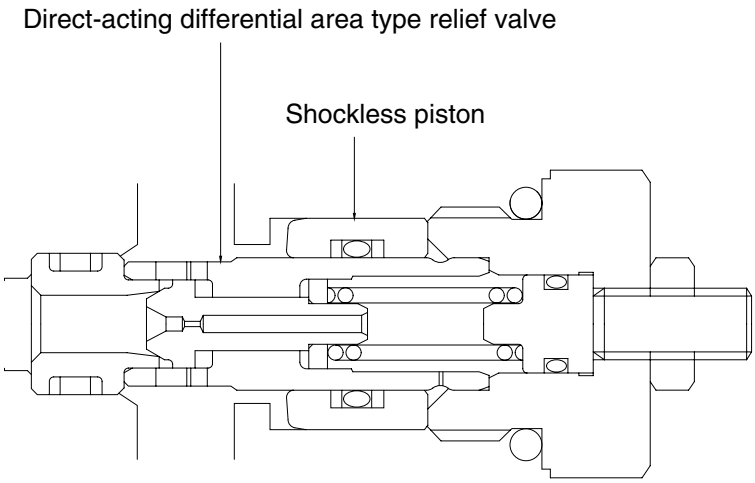
A shockless function is also incorporated to reduce shock produced at the start of both acceleration and deceleration.

(1) Construction of the relief valve

① A direct-acting differential area type relief valve

② A shockless piston

The installation of a shockless type relief valve helps reduce shock and stress produced in the strength members.



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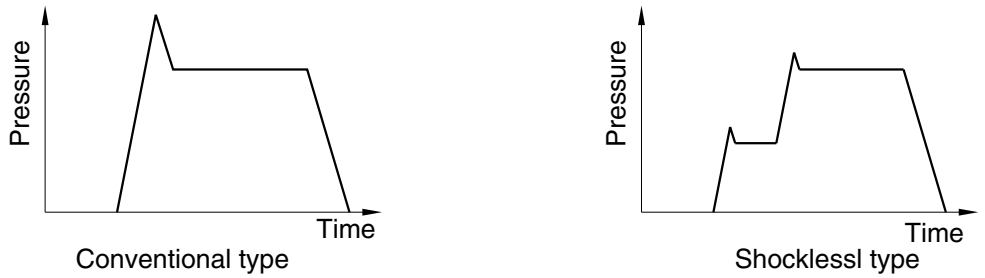

Comparison of pressure wave forms

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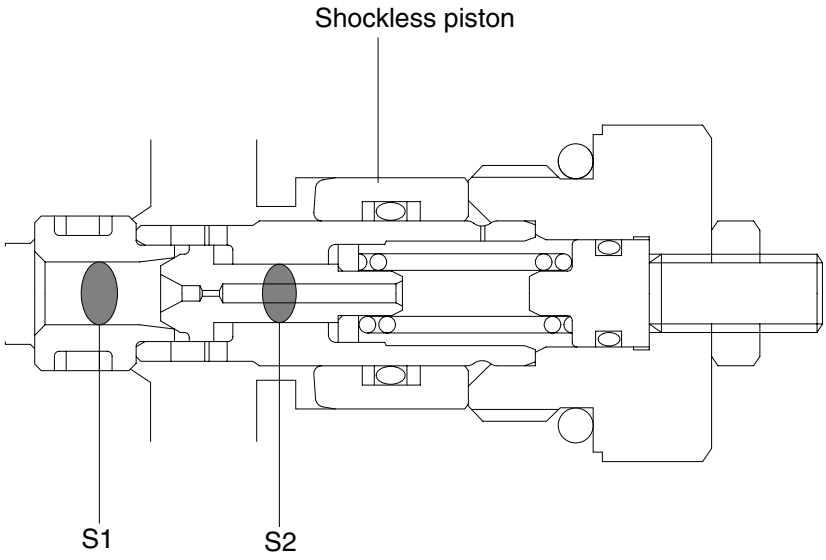
⑵ Relief valve operation

① First stage

At the start of operation, the shockless piston moves to maintain the spring chamber at a low pressure. Thus, the pressure receiving area of the poppet becomes the poppet seat area (S1), a considerably larger area than the pressure receiving area (S1-S2) at the specified relief setting. For this reason, the relief operating pressure is kept at a low pressure until the shockless piston completes its movement.

The low pressure holding time depends on the poppet orifice diameter, the free piston pressure receiving area and the free piston stroke.



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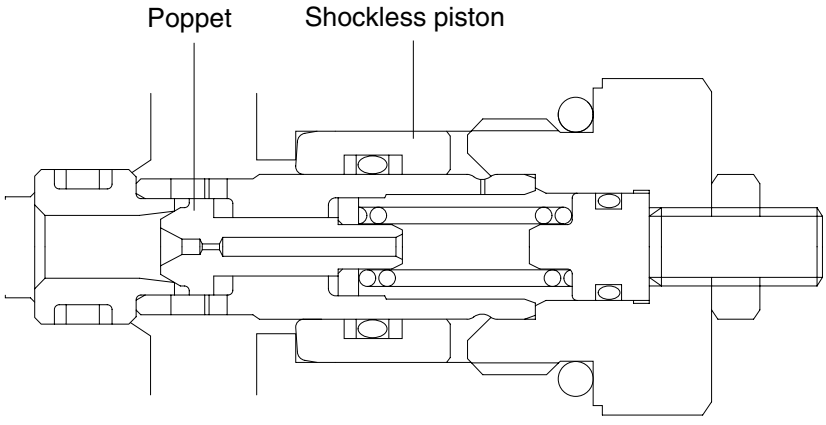
② Second stage

When the shockless piston completes its movement, the pressure inside the spring chamber increases to make the pressures before and after the poppet equal. Then the relief valve operates at the specified set pressure.



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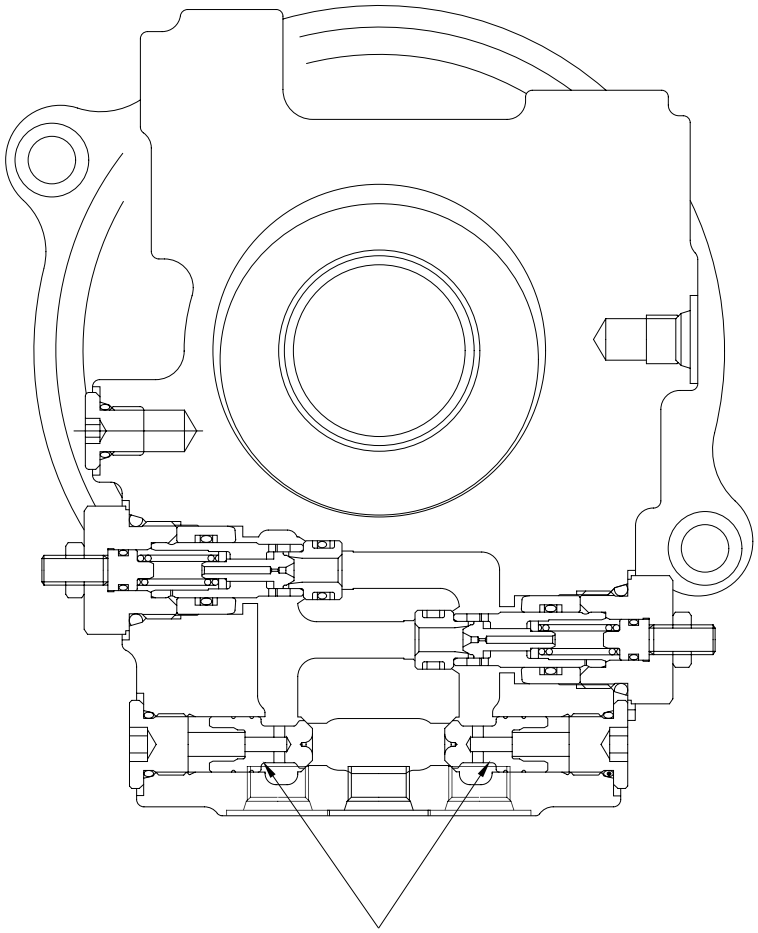
4) MAKE-UP VALVE

The make-up valve has the following two functions.

One is to prevent cavitation produced by overrun of the piston motor in order to prevent the overrun of the upper body. When the motor is turned by the inertia of the upper body to cause the pumping action, which then causes the motor revolution to rise above the revolution equivalent to the amount of oil supplied to the motor, the amount of oil equipvalent to the shortage is supplied to the motor main circuit via the make-up valve from outside to prevent occurrence of vacuum inside the circuit.

The other is a function to add the amount of motor drain and valve leak via the make-up valve to prevent vacuum inside the circuit to provide the braking capability in the normal circuit status when a closed circuit is formed between the control valve and the motor as when braking.



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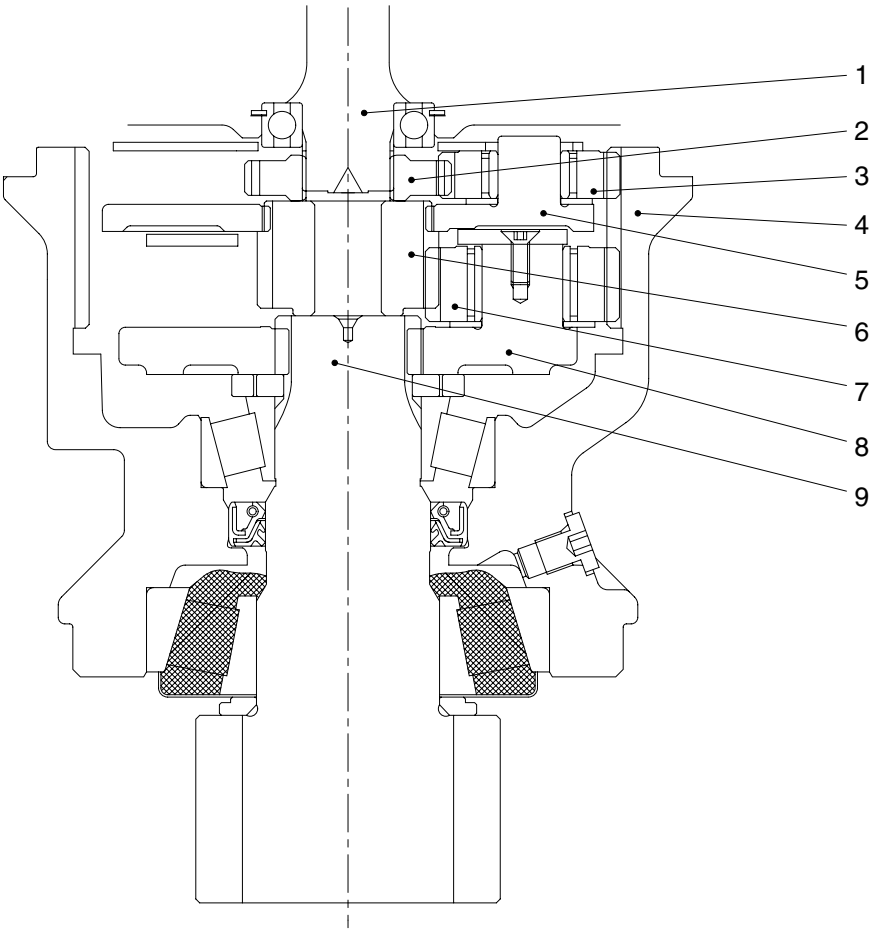
5) **REDUCTION GEAR** (Planetary two-stage)

Refer to the cross section.

The motor shaft (1) is coupled to the drive gear (2) via a spline. The drive force of the hydraulic motor is transmitted from the drive gear (2) to the engaged planetary gear (3). The planetary gear (3) is meshed with the ring gear of the reduction gear housing (4). Thus, while rotating, it revolves around the ring gear. The planetary gear (3) is held by the holder (5) via the bearing and the holder transmits the revolving motion of the planetary gear (3) to the sun gear (6) coupled via the spline. The sun gear (6) meshes with the planetary gear (7) and as with the first stage, transmits the rotary motion to the planetary gear (7). Since the planetary gear (7) is meshed with the ring gear of the housing (4), it revolves while rotating. Since the planetary gear (7) is held by the holder (8) via the bearing, the holder (8) transmits the revolving motion of the planetary gear (7) to the pinion shaft (9) coupled via the spline.



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