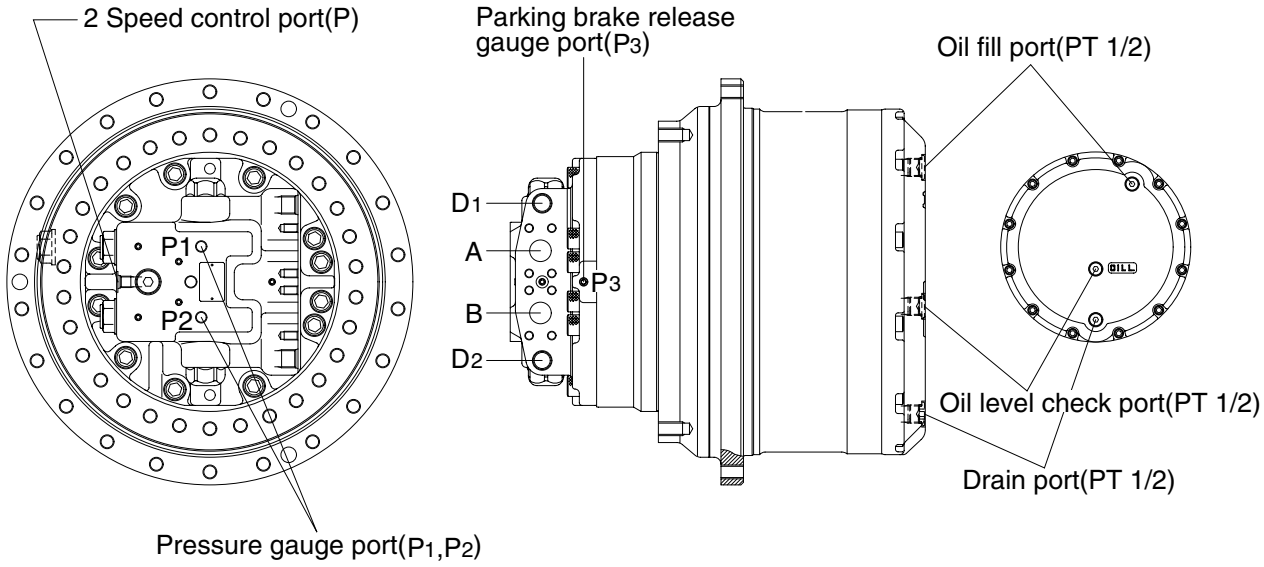
GROUP 4 TRAVEL DEVICE

1. CONSTRUCTION

Travel device consists travel motor and gear box.

Travel motor includes brake valve, parking brake and high/low speed changeover mechanism.



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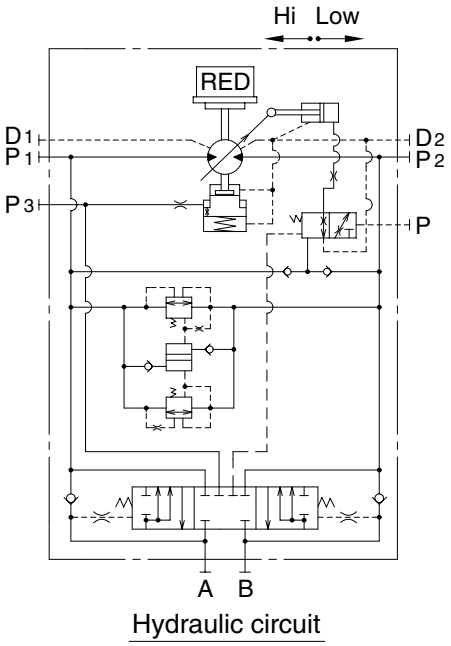
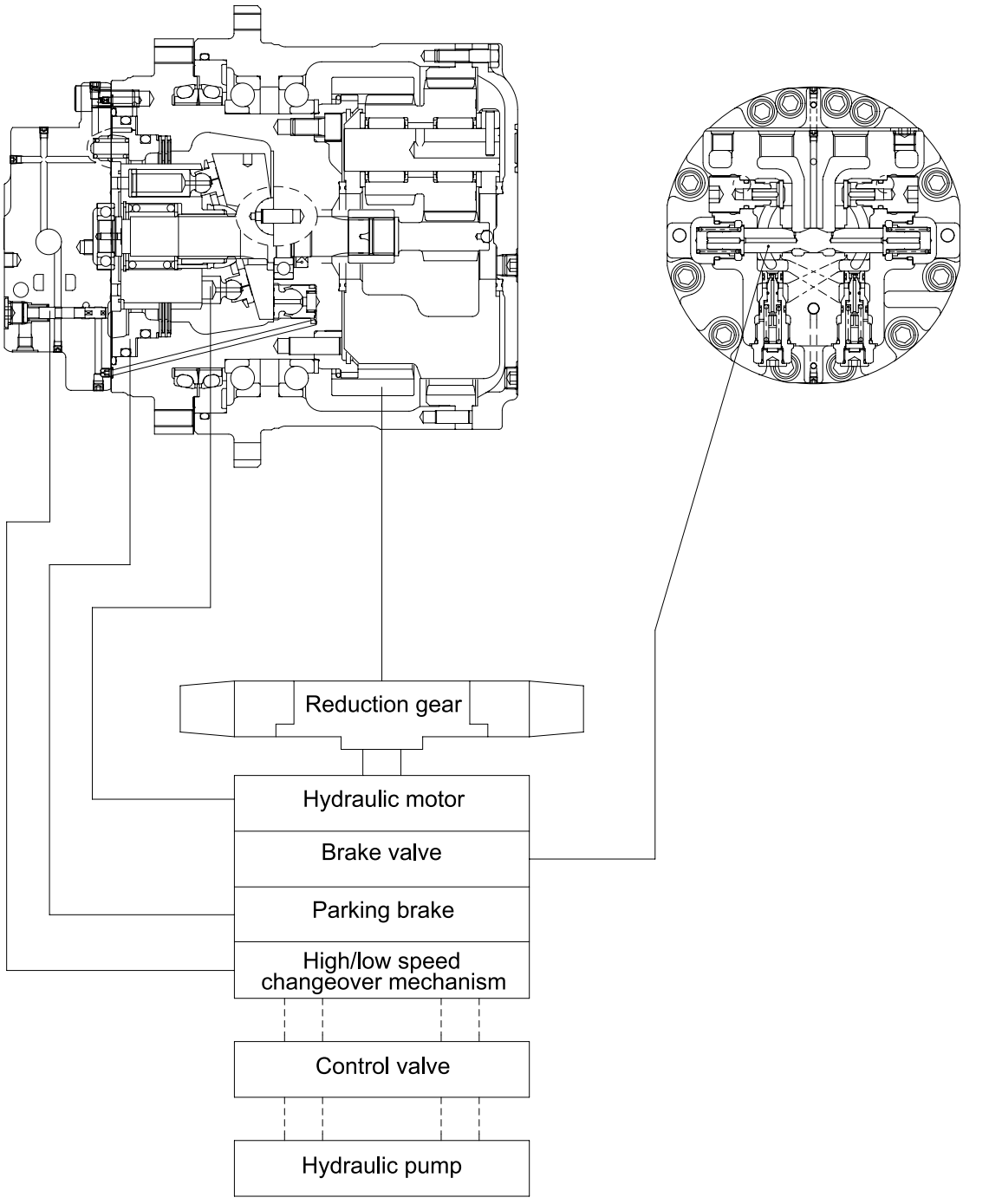


Hydraulic circuit

Port	Port name	Port size
A	Main port	SAE 5000psi 1"
B	Main port	SAE 5000psi 1"
P1, P2	Gauge port	PT 1/4
P3	Gauge port	PT 1/8
D1, D2	Drain port	PT 1/2
P	2 speed control port	PF 1/4

1) BASIC STRUCTURE



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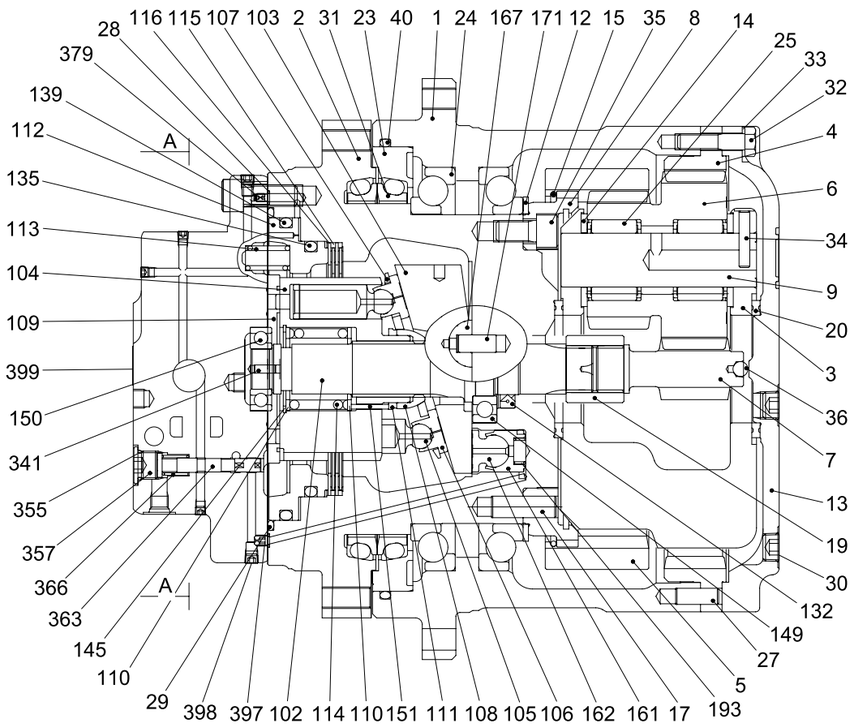
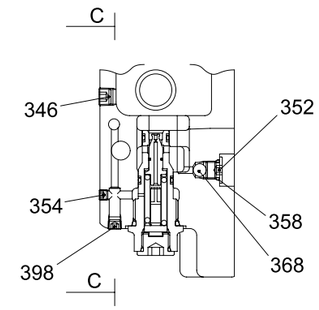
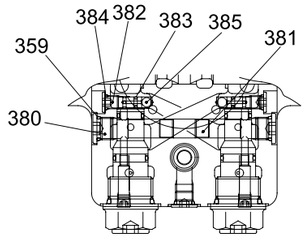
2) STRUCTURE

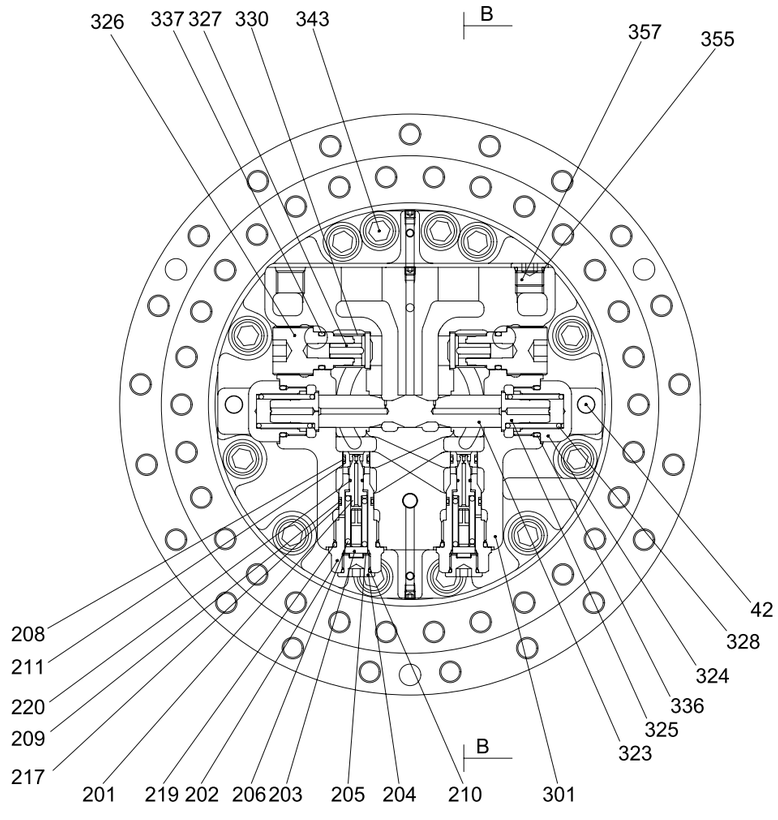




SECTION B - B



SECTION C - C



SECTION A - A

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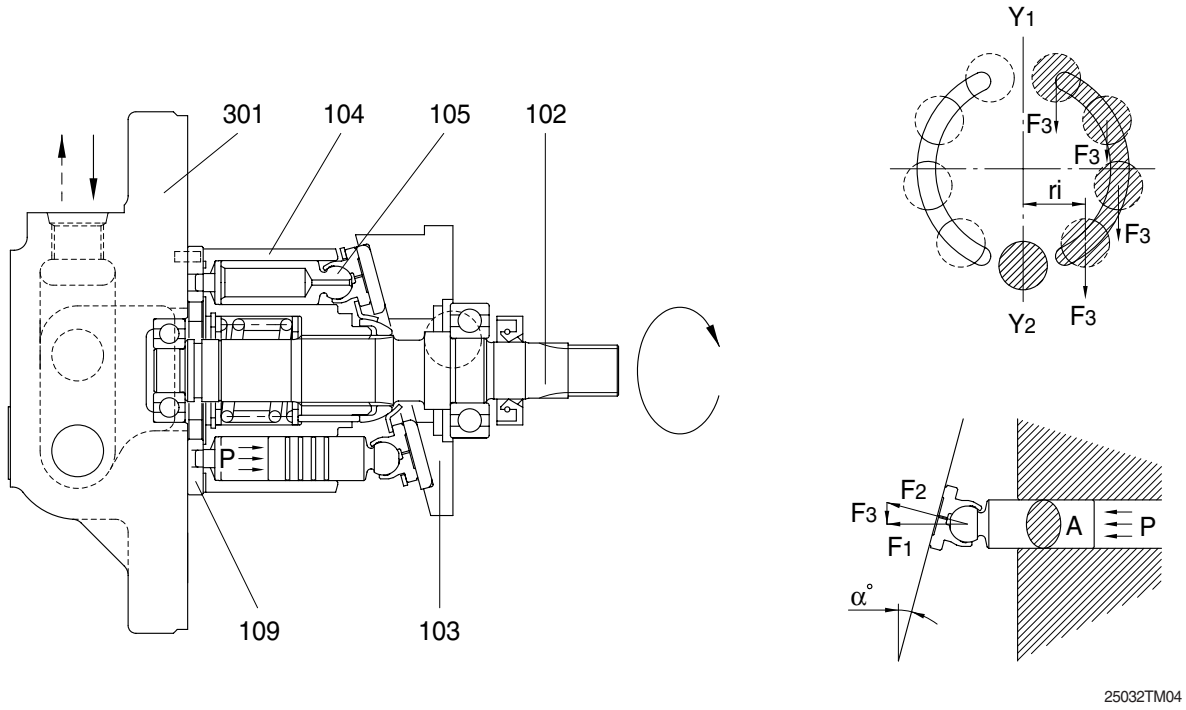
1	Hub	25	Needle bearing	106	Shoe	151	Roller	219	O-ring	355	O-ring
2	Spindle	27	Parallel pin	107	Retainer plate	161	Piston 2	220	Piston seal	357	RO plug
3	Carrier	28	O-ring	108	Thrust ball	162	Shoe 2	301	Rear flange	358	O-ring
4	Ring gear A	29	O-ring	109	Timing plate	167	Pivot	323	Spool	359	O-ring
5	Ring gear B	30	PT plug	110	Washer	171	Parallel pin	324	Plug	363	Spool 2
6	Cluster gear	31	Floating seal	111	Collar	193	Spring	325	Stopper	366	Spring
7	Sun gear	32	Socket bolt	112	Piston	201	Valve	326	Plug	368	Steel ball
8	Coupling gear	33	Spring washer	113	Spring	202	Sleeve	327	Valve	379	Filter
9	Cluster shaft	34	Parallel pin	114	Spring	203	Spring retainer	328	Spring	380	Plug
12	Distance piece	35	Socket bolt	115	Friction plate	204	Plug	330	Spring	381	Piston
13	Cover	36	Steel ball	116	Mating plate	205	Shim	336	O-ring	382	Plug
14	Thrust collar	40	O-ring	132	Oil seal	206	Spring	337	O-ring	383	O-ring
15	Ring	42	Parallel pin	135	O-ring	208	O-ring	341	Parallel pin	384	O-ring
17	Pin	102	Main shaft	139	O-ring	209	O-ring	343	Socket bolt	385	Steel ball
19	Coupling	103	Swash plate	145	Snap ring	210	O-ring	346	PT plug	397	Orifice
20	Thrust plate	104	Cylinder block	149	Ball bearing	211	Back-up ring	352	RO plug	398	PT plug
23	Seal ring	105	Piston	150	Ball bearing	217	Back-up ring	354	PT plug	399	Name plate
24	Ball bearing										

2. FUNCTION

1) HYDRAULIC MOTOR

(1) Rotary group



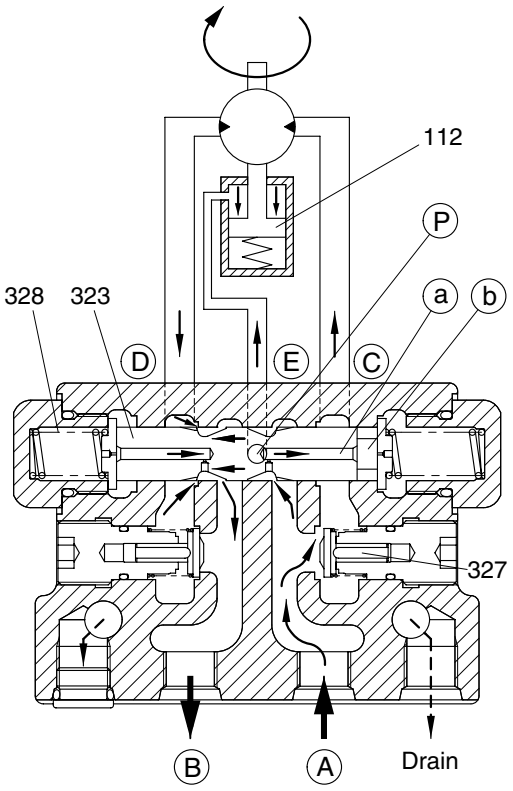
The pressurized oil delivered from the hydraulic pump flows to rear flange(301) of the motor, passes through the brake valve mechanism, and is introduced into cylinder block(104) via timing plate(109). This oil constructively introduced only to one side of Y1-Y2 connecting the upper and lower dead points of stroke of piston(105). The pressurized oil fed to one side in cylinder block(104) pushes each piston(105, four or five) and generates a force(F kg = P kg/cm^2 × A cm^2).
This force acts on swash plate(103), and is resolves into components (F2 and F3) because swash plate(103) is fixed at an angle(α°) with the axis of drive shaft(102). Redial component(F3) generates respective torques(T = F3 × ri) for Y1-Y2. This residual of torque(T = F3 × ri) rotates cylinder block(104) via piston(105). Cylinder block(104) is spline-coupled with drive shaft(102). So the drive shaft(102) rotates and the torque is transmitted.

(2) Brake valve

① **Brake released**(Starting / Running)

When the pressurized oil supplied from port , the oil opens valve(327) and flows into port at the suction side of hydraulic motor to rotate motor. At the same time, the pressurized oil passes through pipe line ⓐ from a small hole in spool(323) and flows into chamber ⓑ. The oil acts on the end face of spool(323) which is put in neutral position by the force of spring(328), thus causing spool(323) to side to the left. When spool(323) slides, port on the passage at the return side of hydraulic motor, which is closed by the spool groove during stoppage, connected with port at the tank side and the return oil from the hydraulic motor runs into the tank. In consequence, the hydraulic motor rotates. Moreover, sliding of spool(323) causes the pressurized oil to flow into ports .

The pressurized oil admitted into port activates piston(112) of the parking brake to release the parking brake force. (For details, refer to description of the parking brake.) When the pressurized oil is supplied from port , spool(323) move reversely and the hydraulic motor also rotates reversely.



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② **Brake applied**(Stopping / Stalling)

When the pressurized oil supplied from port is stopped during traveling, no hydraulic pressure is applied and spool(323) which has slid to the left will return on the right(Neutral) via stopper (325) by the force of spring(328).

At the same time, the hydraulic motor will rotate by the inertia even if the pressurized oil stopped, so the port D of the motor will become high pressure.

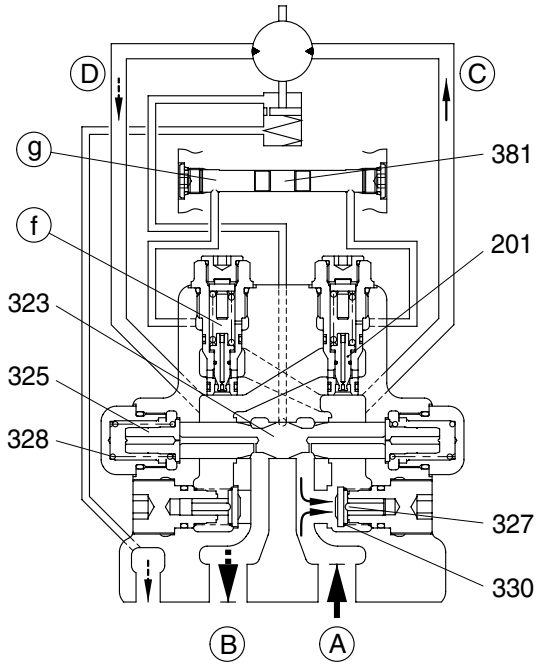
This pressurized oil goes from chamber ⓕ to chamber ⓖ through the left-hand valve(201).

When the oil enters chamber ⓖ, the piston(381) slids to the right so as not to rise the pressure, as shown in the figure. Meanwhile, the left-hand valve(201) is pushed open by the pressurized oil in port D.

Therefore, the pressurized oil in port D flows to port C at a relatively low pressure, controlling the pressure in port D and preventing cavitation in port C.

When the piston(381) reaches the stroke end, the pressure in chamber ⓖ and ⓕ increase and the left-hand valve(201) closes again, allowing the oil pressure in port D to increase further. Then, the right-hand valve(201) opens port C with pressure higher than that machine relief set pressure.

In this way, by controlling the pressure in port D in two steps, the hydraulic motor is smoothly braked and brought to a stop.



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③ Braking effect on downhill travel

If the machine traveling downhill with a relatively small supply of high pressure oil to its travel motors should start coasting, the same braking effect as the one described above would automatically occur.

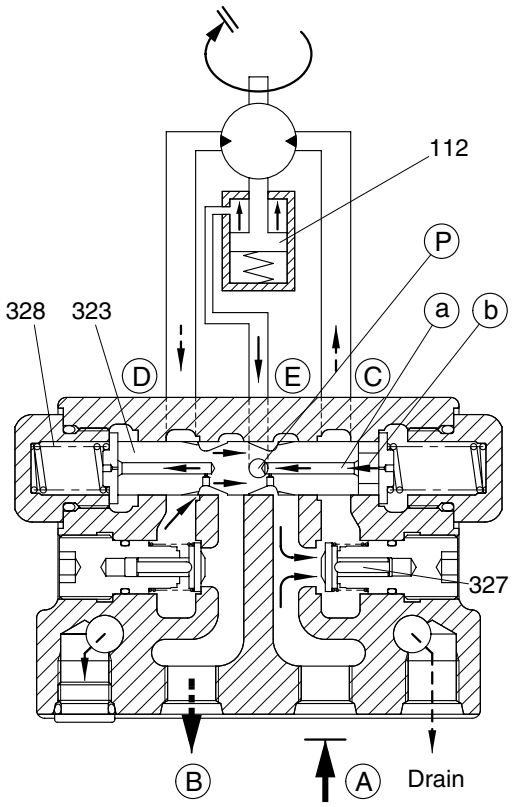
In the coasting condition, the motor is driven, instead of driving the track, from the ground and sucks high pressure oil in.

In other words, the motor tends to draw more high pressure oil than is being supplied.

Under this condition, port A goes negative to pull oil out of chamber ⓑ through oil way ⓐ, moving back the spool(323) rather rapidly.

The clearance on the left then becomes smaller to throttle the outgoing oil more than before, thereby obstructing the pumping action of the motor.

As in stopping the machine, pressure will build up in port D to make it harder to drive the motor from the ground: This is the braking action.



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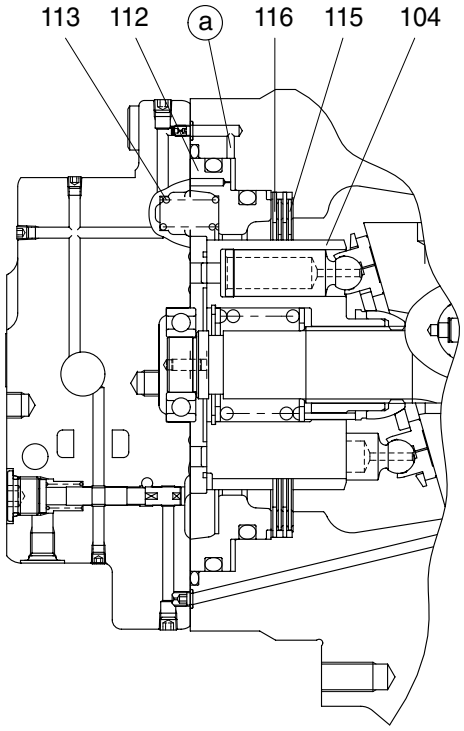
(3) Parking brake

① Running

When the pressurized oil is supplied from the brake valve, the spool of brake valve in the hydraulic motor assembly actuates to open the passage to the parking brake and the pressurized oil is introduced into cylinder chamber ⓐ which is composed of the spindle of reduction gear assembly and piston(112). When the hydraulic pressure reaches 6kgf/cm²(0.59Mpa) or more, it overcomes the force of spring (113) and shifts piston(112). With shift of piston(112), no pressing force is applied to mating plate(116) and friction plate (115) and the movement of friction plate (115) becomes free, whereby the brake force to the cylinder in the hydraulic motor assembly is released.



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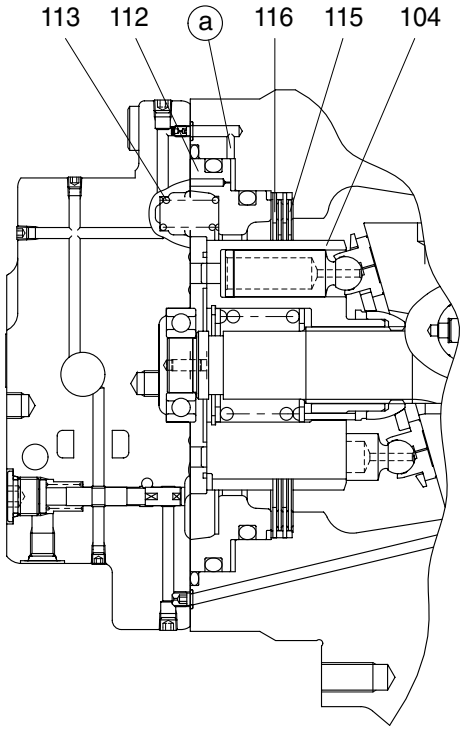
② Stopping

When the pressurized oil from the brake valve is shut off and the pressure in cylinder chamber ⓐ drops 6kgf/cm² (0.59Mpa) or less, piston(112) will return by the force of spring(113).

Piston(112) is pushed by this force of spring(113), and mating plate(116) and friction plate(115) in free condition are pressed against the spindle of reduction gear assembly.

The friction force produced by this pressing stops rotation of the cylinder block(104) and gives a braking torque 40.6kgf · m(398N · m) to the hydraulic motor shaft.

Note that oil control through a proper oil passage ensures smooth operation.



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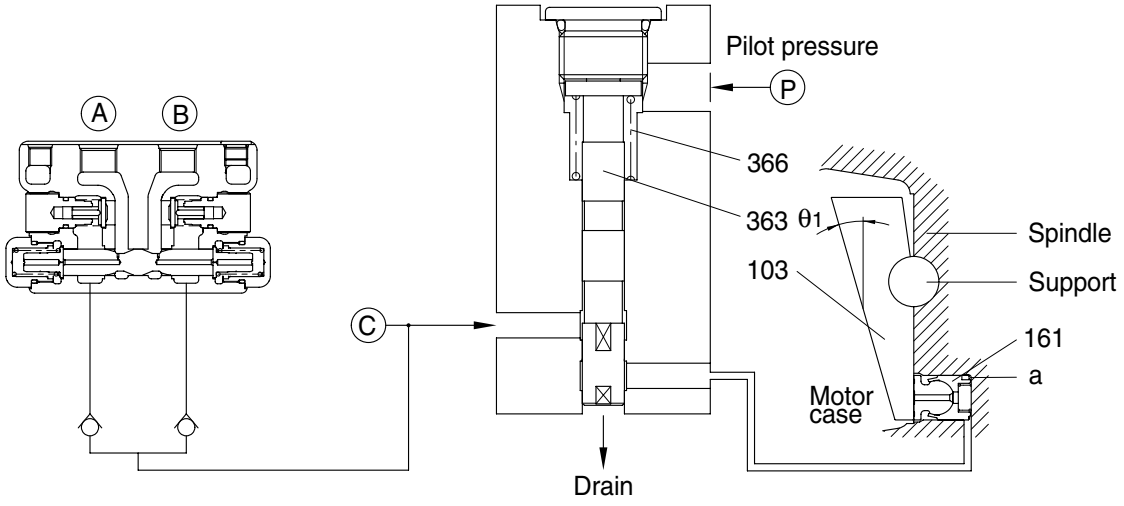
(4) High/low speed changeover mechanism

① **At low speed** - At pilot pressure of less than 20kgf/cm²(1.96Mpa)



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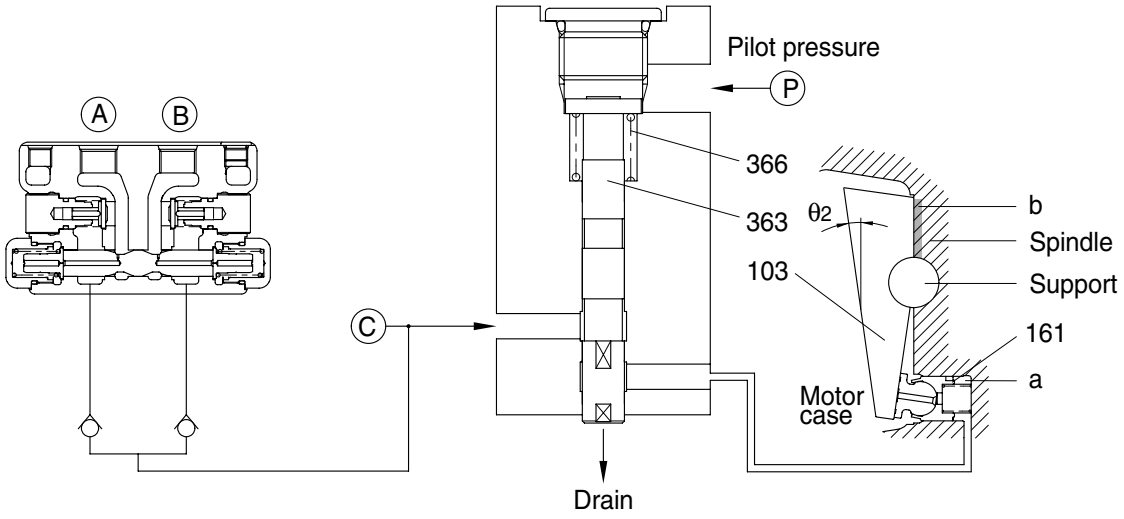
When the pilot pressure is shut off from port , valve(363) is pressed upward by the force of spring(366), the pressurized oil supply port is shut off, and oil in chamber ⓐ is released into the motor case through the valve(363). Consequently, swash plate(103) is tilted at a maximum angle(θ_1) and the piston displacement of hydraulic motor becomes maximum, thus leading to low-speed operation.

② **At high speed** - At pilot pressure of 20kgf/cm²(1.96Mpa) or more



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When a pilot pressure supplied from port (At a pressure of 20kgf/cm²(1.96Mpa) or more), the pressure overcomes the force of spring(366) and valve(363) is pressed downward. The pressurized oil supply port is then introduced into chamber ⓐ through the valve(363). Piston (161) pushes up swash plate(103) until it touches side ⓑ of the spindle. At this time, swash plate(103) is tilted at a minimum angle(θ_2) and the piston displacement of hydraulic motor becomes minimum, thus leading to high-speed operation.

2) REDUCTION GEAR

(1) Function

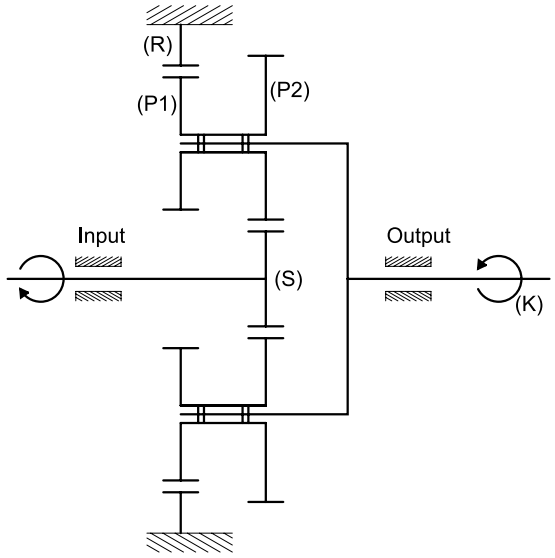
The reduction gear unit consists of a combination of simple planetary gear mechanism and differential gear mechanism. This mechanism reduce the high speed rotation from the hydraulic motor and convert it into low speed, high torque to rotate the hub(or case), which in turn rotates the sprocket.

(2) Operating principle

① Upon rotation of the sun gear (S) via the input shaft, the planetary gear (P) engages with the fixed ring gear (R) while rotating on its axis.
Rotation around the fixed ring gear (R) is transmitted to the carrier (K).

$$i1 = 1 + \frac{R \cdot P2}{S \cdot P1}$$

Planetary gear mechanism



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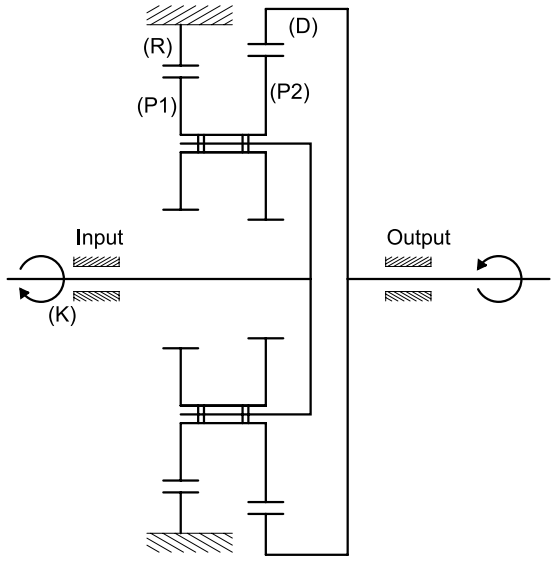
② With rotation of the carrier (K), the planetary gears (P1) and (P2) rotate around the fixed ring gear(R).
When a proper difference in number of teeth is given between (P1) and (R) and between (P1) and (P2), a difference in rotation is produced on the gear (D) because the gears (P1) and (P2) are on the same axis.

$$i2 = \frac{1}{1 - \frac{R \cdot P2}{D \cdot P1}}$$

Differential gear mechanism



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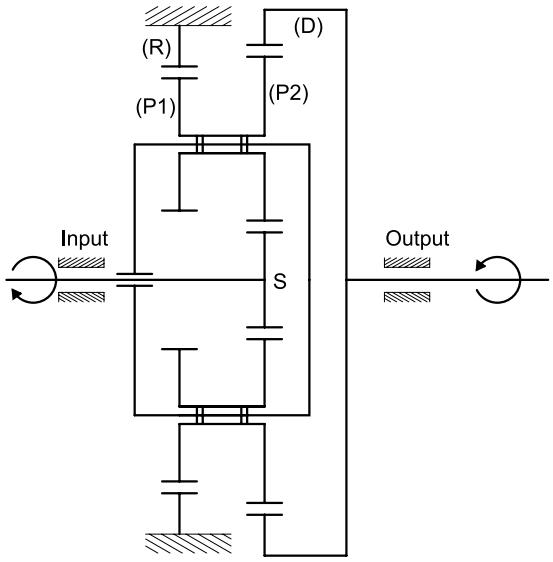
③ Upon rotation of the sun gear (S) via the input shaft, planetary motion is given among the gears (S), (P1) and (R) and rotation of the gear (P1) around another gear causes the carrier (K) to rotate.
This carrier rotation gives differential motion among the gears (R), (P1), (P2) and (D) to rotate the ring gear (D). The motor then rotates since the ring gear (D) is connected to the hub (case) of the motor.

$$i = i1 \times i2 = \frac{1 + \frac{R \cdot P2}{S \cdot P1}}{1 - \frac{R \cdot P2}{D \cdot P1}}$$

Combination of planetary gear mechanism and differential gear mechanism



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