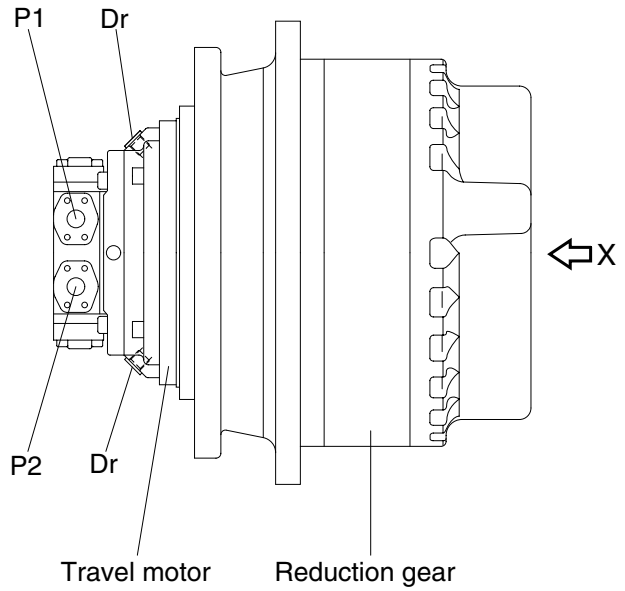
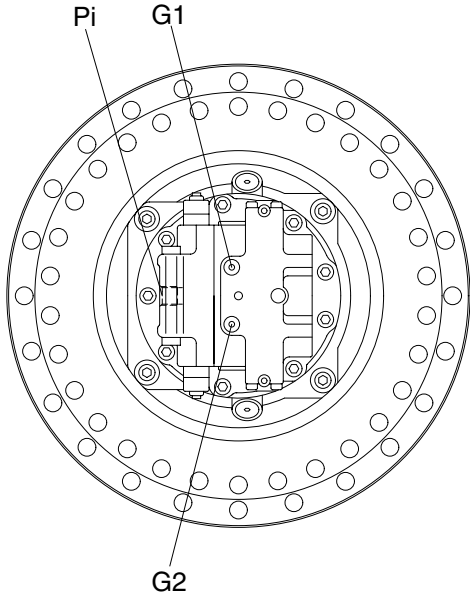


# GROUP 4 TRAVEL DEVICE

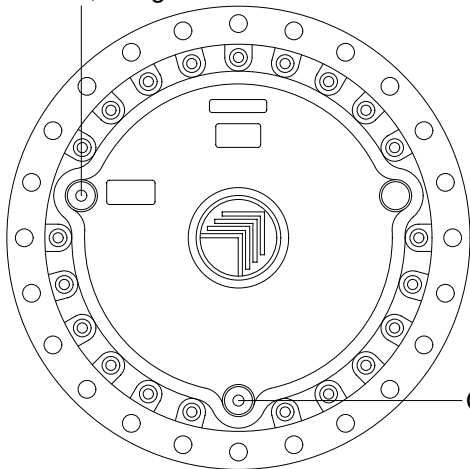
## 1. CONSTRUCTION

Travel device consists travel motor and gear box.

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

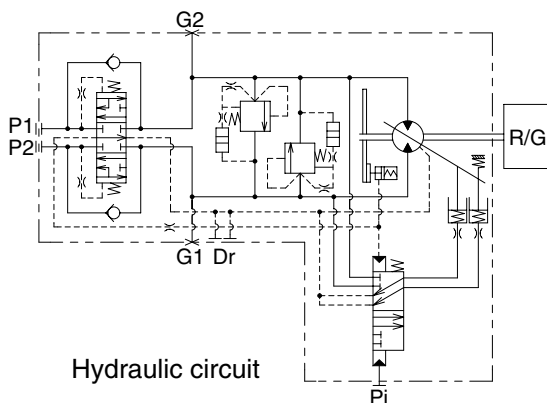


Oil level, filling



VIEW X

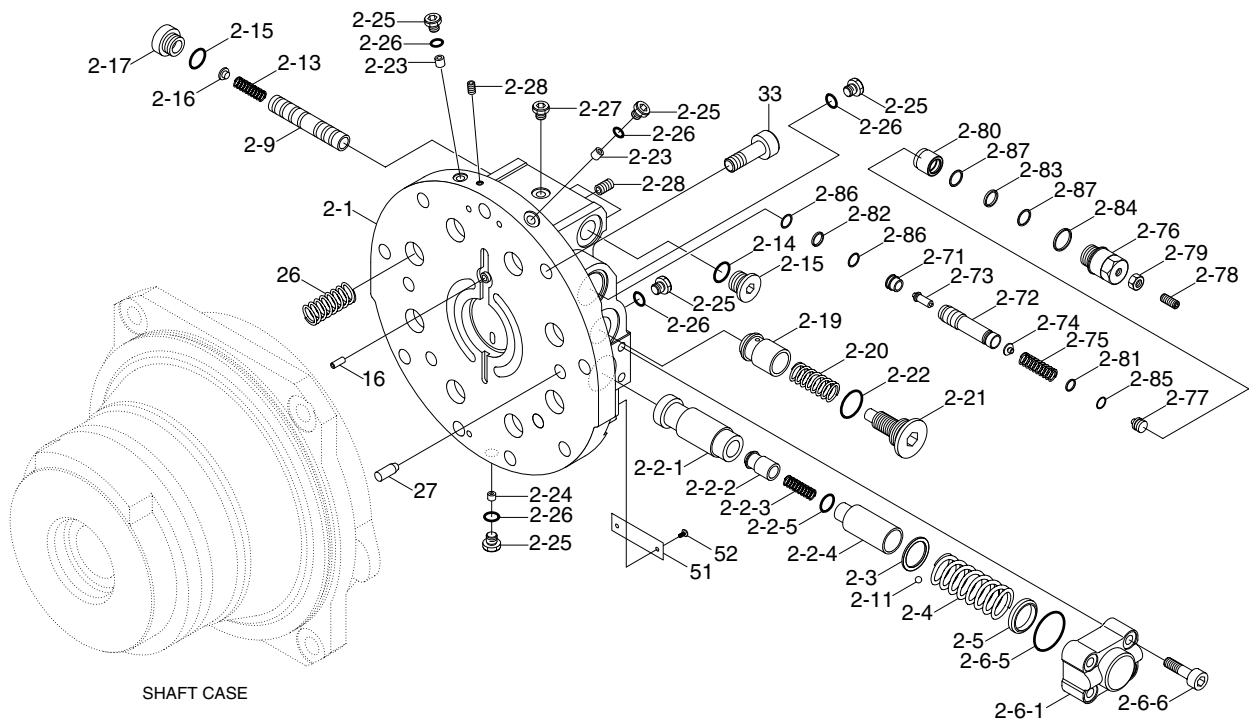
8007A2TM01



Hydraulic circuit

Port	Port name	Port size
P1	Main port	SAE 1"
P2	Main port	SAE 1"
G1, G2	Gauge port	PF 1/4
Dr	Drain port	PF 3/4
Pi	2 speed control port	PF 1/4

# 1) TRAVEL MOTOR(1/2)

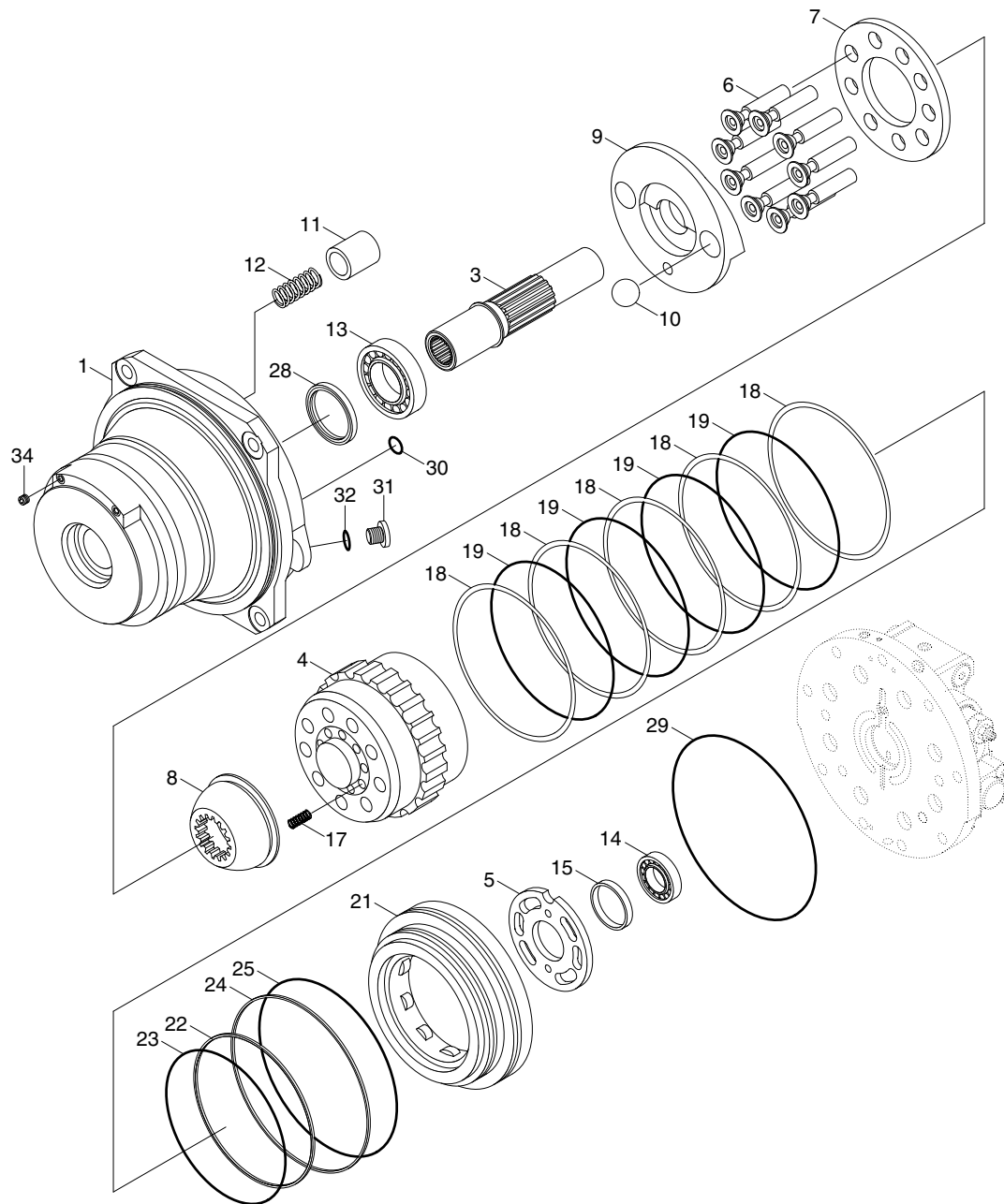


8007A2TM02

- |                       |                    |                    |
|-----------------------|--------------------|--------------------|
| 2-1 Base plate        | 2-7-5 Spring       | 2-15 O-ring        |
| 2-2 Spool assy        | 2-7-6 Plug         | 2-16 Spring guide  |
| 2-2-1 Spool           | 2-7-7 Spring guide | 2-17 Plug          |
| 2-2-2 Check valve     | 2-7-8 Set screw    | 2-19 Check valve   |
| 2-2-3 Spring          | 2-7-9 Nut          | 2-20 Spring        |
| 2-2-4 Plug            | 2-80 Free piston   | 2-21 Plug          |
| 2-2-5 O-ring          | 2-81 O-ring        | 2-22 O-ring        |
| 2-3 Spring seat       | 2-82 O-ring        | 2-23 Orifice       |
| 2-4 Spring            | 2-83 O-ring        | 2-24 Orifice       |
| 2-5 Spring seat       | 2-84 O-ring        | 2-25 Plug          |
| 2-6 Cap assy          | 2-85 Back up ring  | 2-26 O-ring        |
| 2-6-1 Cap             | 2-86 Back up ring  | 2-27 Shipping plug |
| 2-6-5 O-ring          | 2-87 Back up ring  | 2-28 Plug          |
| 2-6-6 Bolt            | 2-9 Valve assy     | 16 Pin             |
| 2-7 Relief valve assy | 2-9-1 Spool        | 26 Spring          |
| 2-7-1 Poppet seat     | 2-9-2 Spool-C      | 27 Pin             |
| 2-7-2 Relief housing  | 2-11 Orifice       | 33 Socket bolt     |
| 2-7-3 Poppet          | 2-13 Spring        | 51 Name plate      |
| 2-7-4 Spring seat     | 2-14 Plug          | 52 Drive screw     |

## TRAVEL MOTOR(2/2)

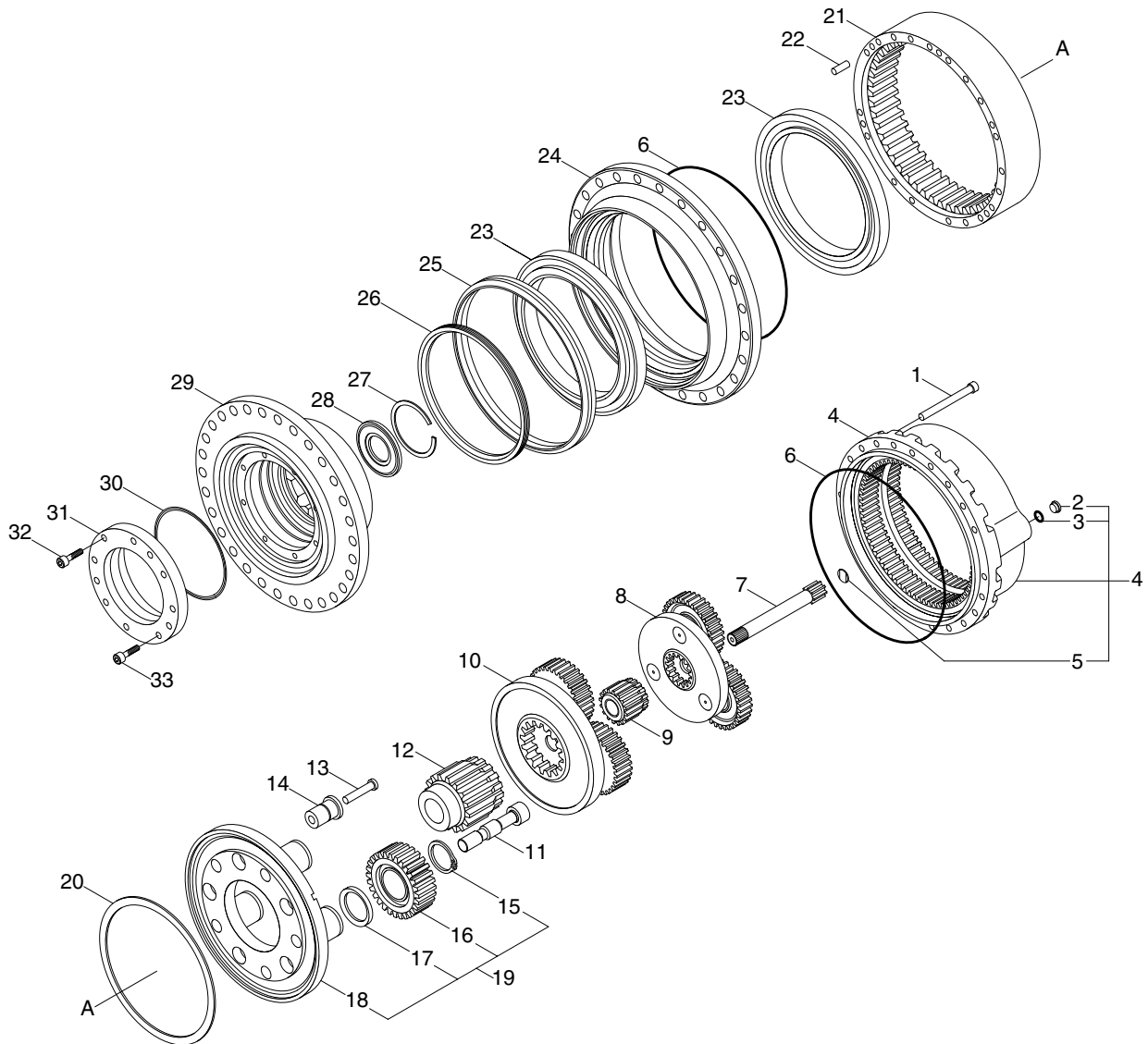
### • Control part



8007A2TM03

1	Case	12	Spring	24	O-ring
3	Shaft	13	Roller bearing	25	Back up ring
4	Cylinder block	14	Roller bearing	28	Oil seal
5	Valve plate	15	Collar	29	O-ring
6	Piston assy	17	Spring	30	O-ring
7	Retainer plate	18	Friction plate	31	Plug
8	Plate holder	19	Disc plate	32	O-ring
9	Swash plate	21	Brake piston	34	Plug
10	Steel ball	22	O-ring		
11	Piston assy	23	Back up ring		

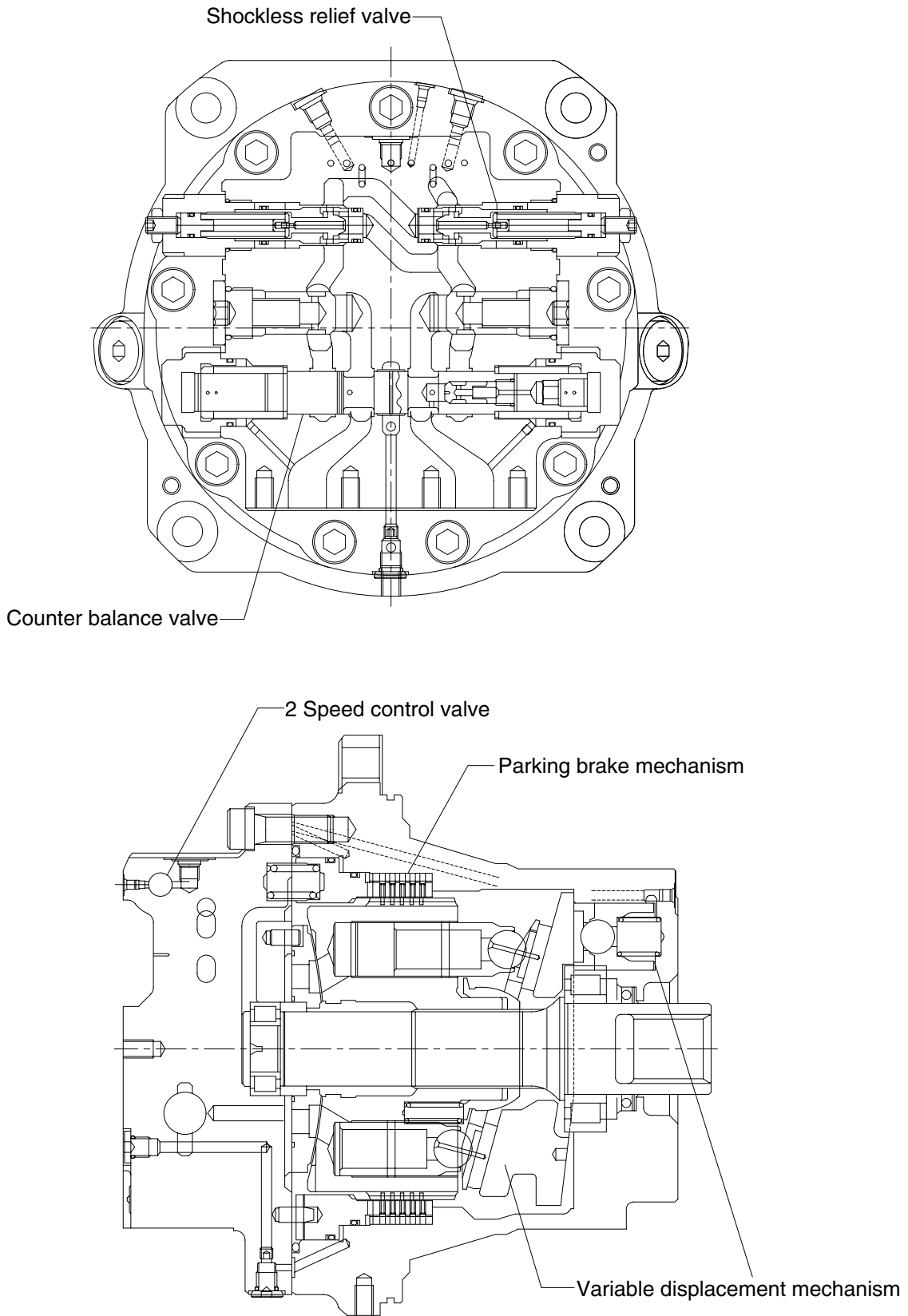
## 2) REDUCTION GEAR



8007A2TM04

1	Screw	12	Sun gear	23	Bearing
2	Oil breather plug	13	Screw	24	Gear box housing
3	Washer	14	Pin	25	Life time seal
4	Cover assy	15	Circlip	26	Spacer
5	Pad	16	Planetary assy	27	Circlip
6	O-ring	17	Spacer	28	Discs retainer
7	Sun gear	18	Planetary carrier	29	Hub
8	Gear assy(1st)	19	Gear assy(3rd)	30	O-ring
9	Sun gear	20	Spacer	31	Motor adaptor
10	Gear assy(2nd)	21	Toothed ring	32	Screw
11	Screw	22	Pin	33	Screw

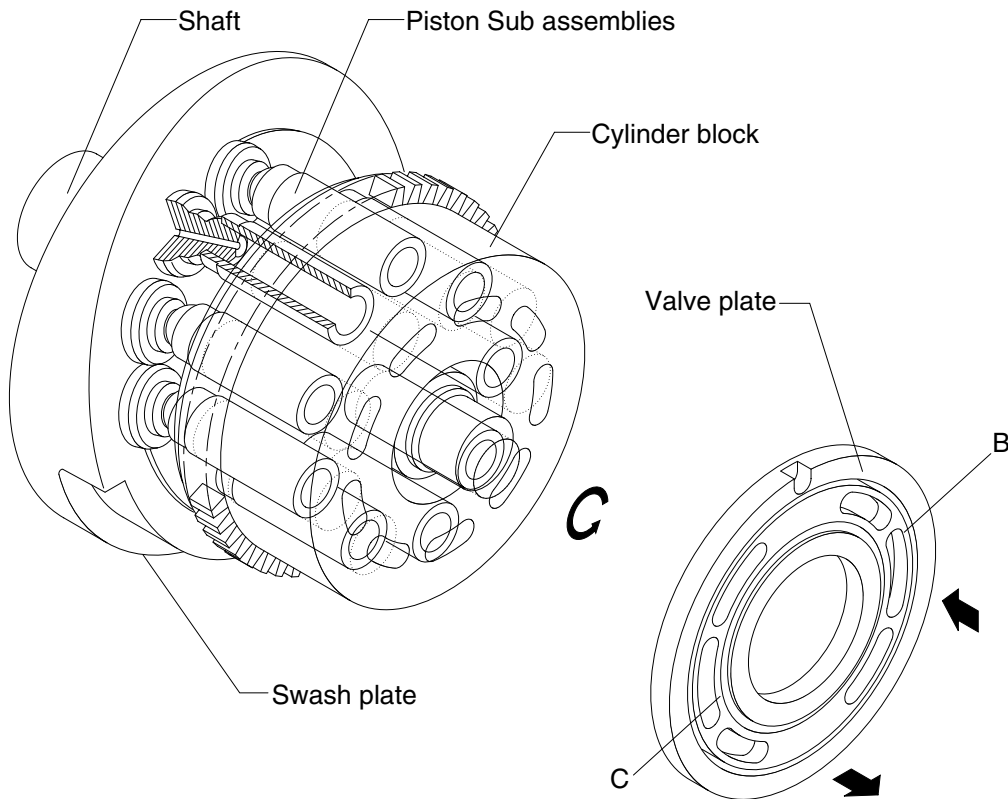
### 3) BASIC STRUCTURE



8007A2TM05

## 2. FUNCTION

### 1) HYDRAULIC MOTOR

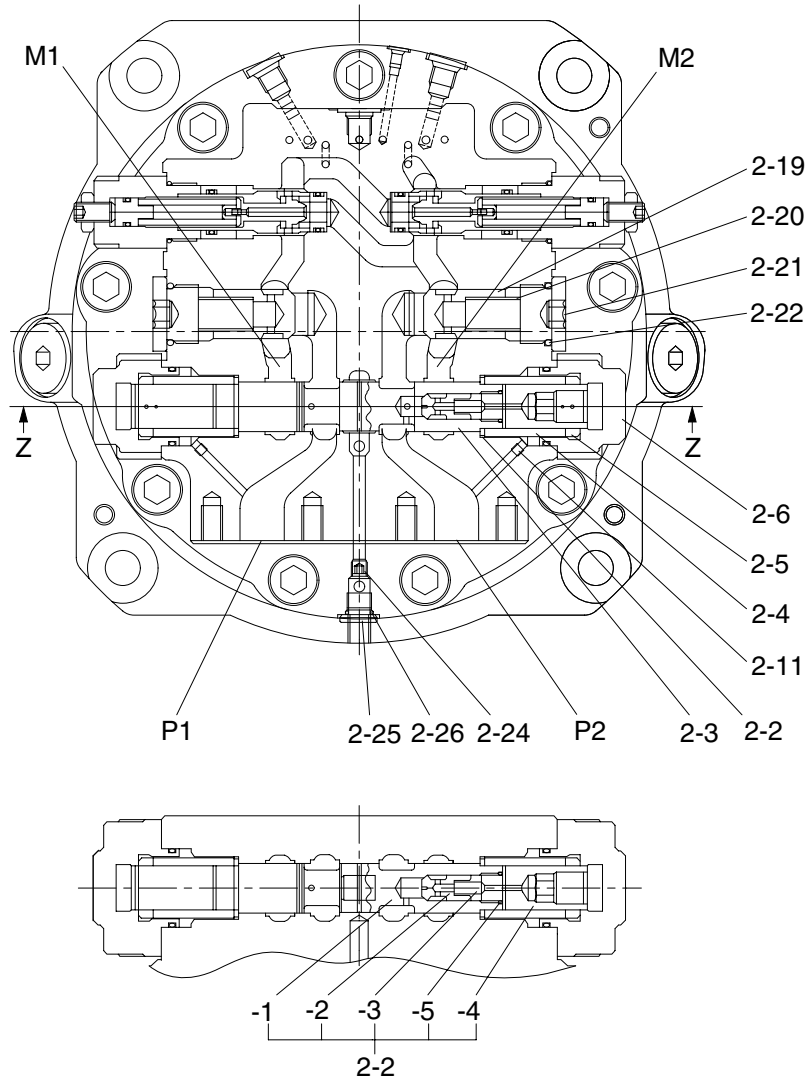


8007A2TM06

Nine piston sub assemblies are assembled in cylinder block. The end face of cylinder block is in contact with valve plate having two half moon shaped ports, B and C (high and low pressure ports).

When supplying pressure fluid (pressure  $P$ ) to B port, swash plate is pushed by the force of piston sub assemblies having  $F = P \cdot A$  ( $A$ : Piston pressure area). Piston sub assemblies receive the reaction force against it, and produce the reaction force ( $F_t$ ) in rotating direction. The total force of high-pressure side piston sub assemblies in rotating direction produces a rotating force in the cylinder block, and the torque is transmitted to shaft through the spline resulting in the rotation of the shaft.

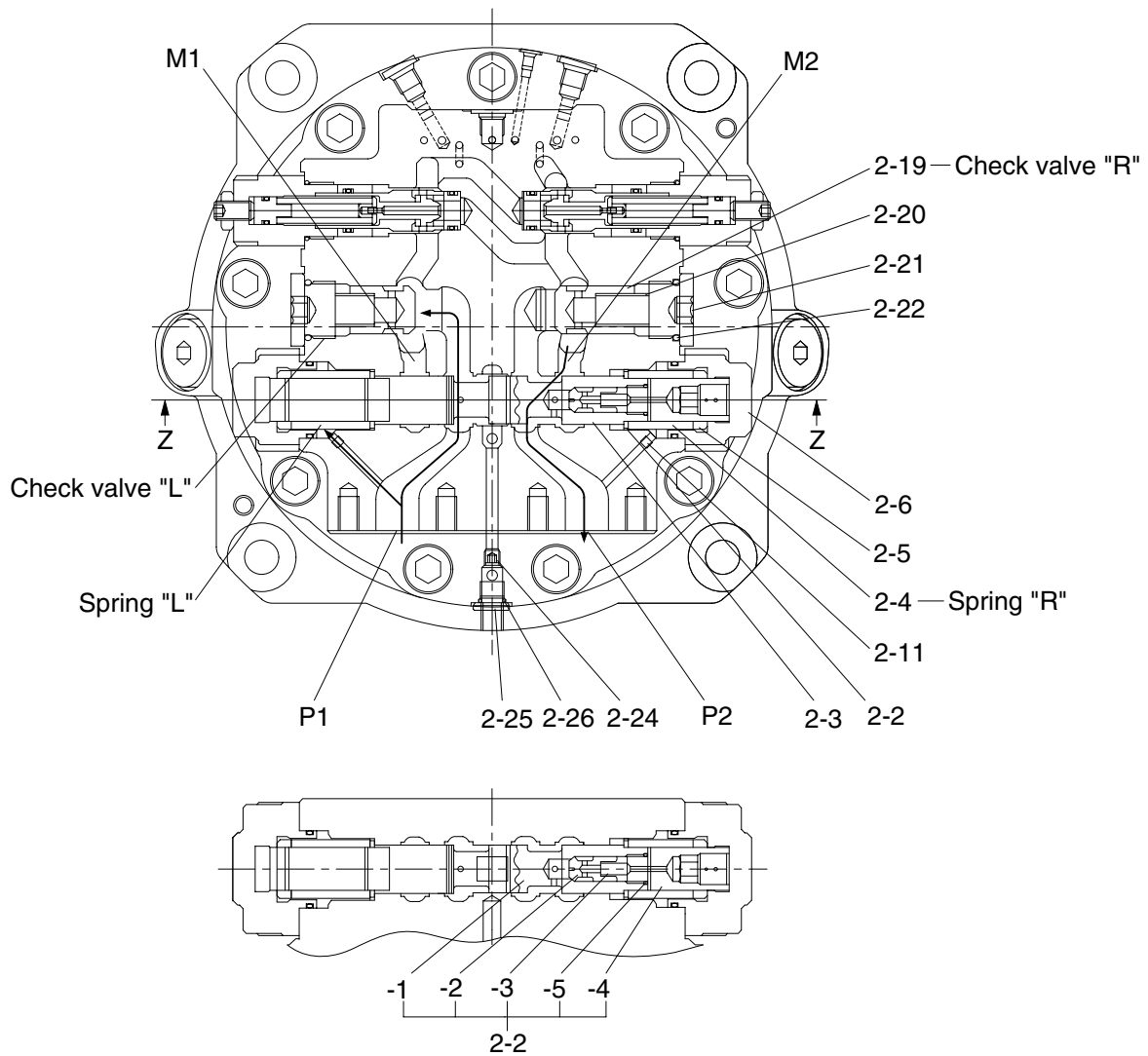
## 2) COUNTER BALANCE VALVE



8007A2TM07

The counter balance valve is provided to stop the axial piston motor and to prevent overrun. When the control valve is set to the neutral position, there is no pressure in the ports P1 and P2, and ports M1 and M2 are blocked by spool (2-2-1) and check valve (2-19), consequently the motor does not start rotating.

## (1) COUNTER BALANCE VALVE WORK



8007A2TM08

When the fluid is supplied from pump to counter balance valve port P1 through control valve, the fluid flows into piston motor through check valve "L" (2-19), and rotate the piston motor.

On the other hand, the return fluid from the piston motor flows into the counter balance valve through port M2, but the fluid is interrupted by check valve "R" (2-19), and consequently the pump delivery pressure will increase.

The high-pressure oil at port P1 passes through orifices "L" (2-11) pushes the end of face of spool assy (2-2) and pushes the plunger rightward against spring "R" (2-4) on the opposite side with the force proportional to the pressure.

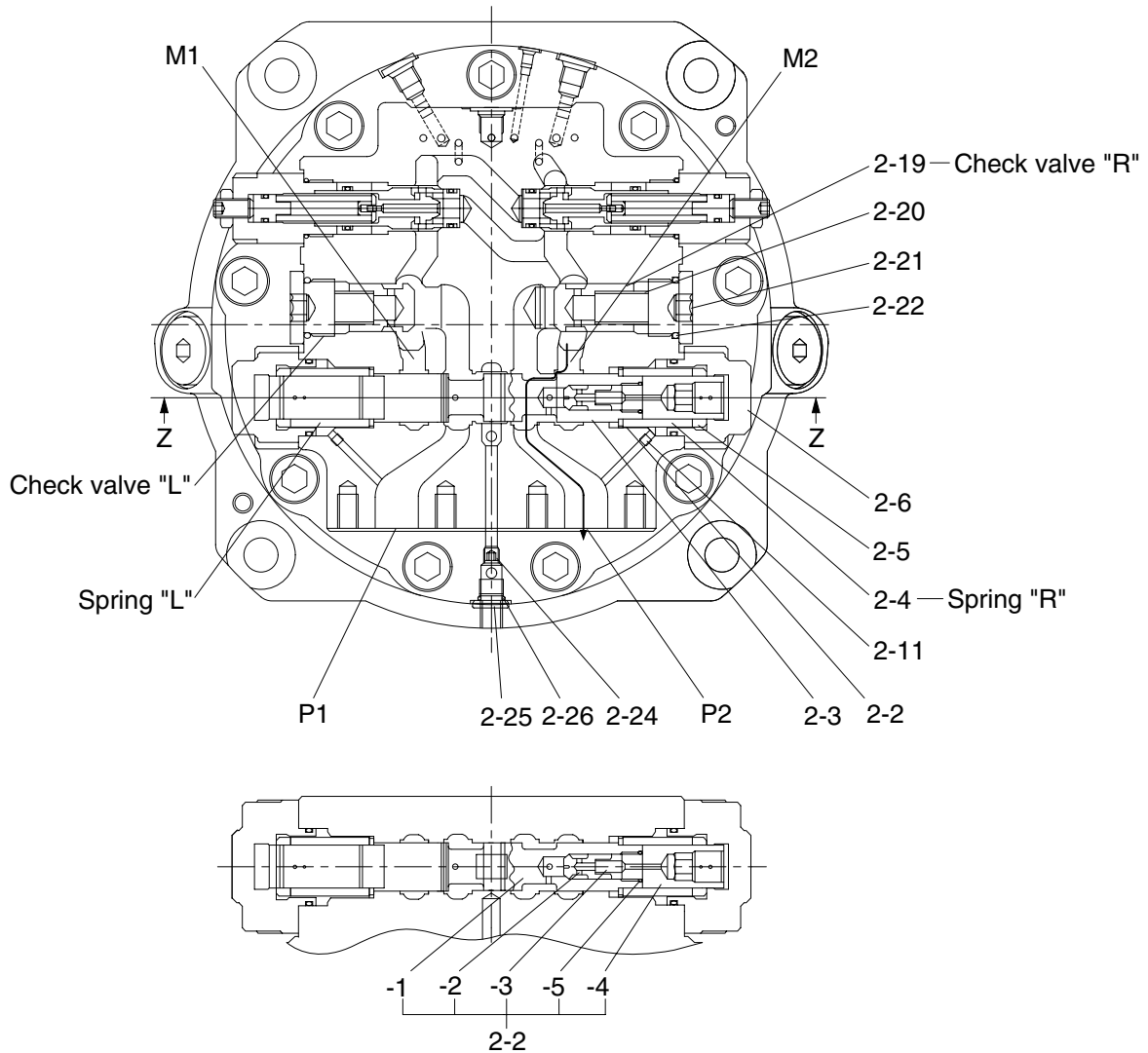
When the hydraulic pressure rises to a certain pressure, spool assy (2-2) starts moving rightward, and the fluid in port M2 passes through the notch machined outer circular of spool assy (2-2) and flows into the port P2, producing a back pressure on the port M2, finally returning into the tank through a control valve.

And when the pump delivery pressure rises, the throttling aperture of the notch in spool assy (2-2) becomes larger, and consequently the backpressure of the port M2 becomes lower.

This way, the throttling aperture of the notch in spool assy (2-2) automatically adjusts the area of a return side passage in order to rotate the piston motor with the appropriate speed for Port P1 side flow rate (inlet flow).



## (2) BRAKE WORK



8007A2TM09

Then, when the control valve returns to the neutral position, the pressurized oil from the pump is shut off and the pressures of the ports P1 and P2 become equal. Spool assy (2-2) tries to be returned to neutral position by force of spring "R" (2-4).

When spool assy (2-2) moves, the throttle opening of plunger becomes small.

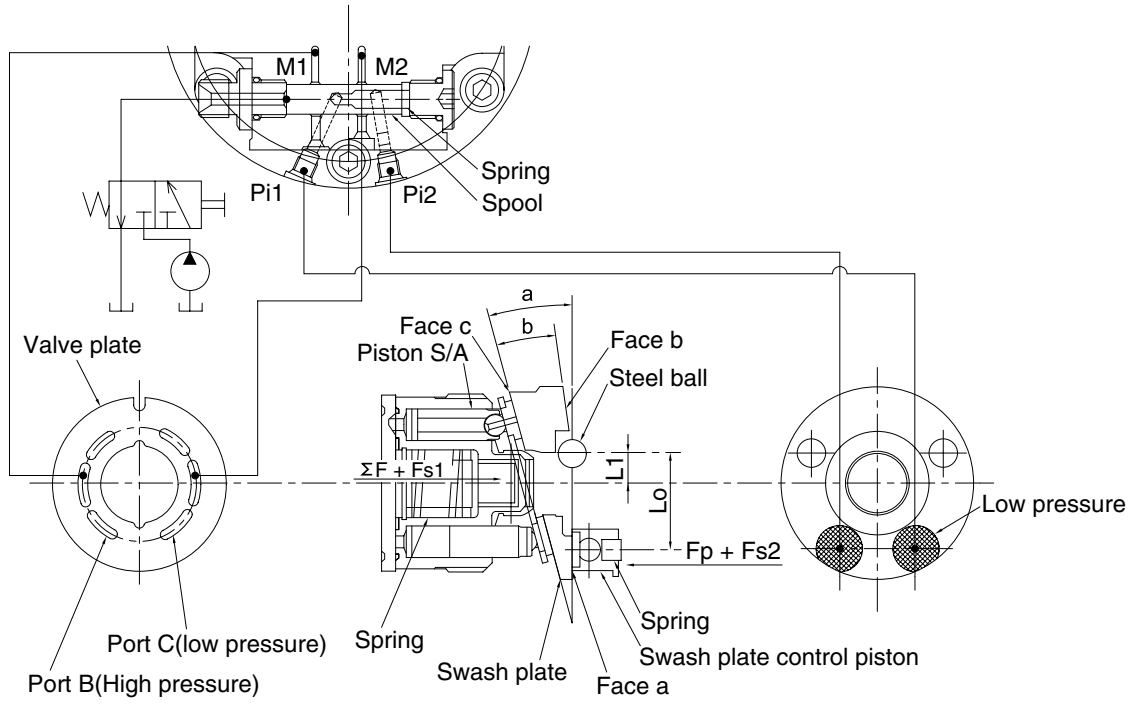
Piston motor tries to rotate with inertia energy (pumping action of motor) and the pressure rises on port M2.

With the movement of spool assy (2-2), the oil of spring "L" room flows out through orifices "L" (2-11) and controls the speed of spool assy (2-2).

By this movement, the shock pressure due to the inertia energy on the port M2 is absorbed, simultaneously preventing the cavitation on the port M1.

### 3) TWO SPEED CHANGE MECHANISM

#### (1) When running at 1st speed(low speed)



8007A2TM10

Swash plate has three faces, from "a" to "c", as shown in the figure, and installed in the flange holder with two steel balls in the condition where it can be tilted.

When the control valve is set to the 1st speed position, spool is placed in the position shown in upper figure by the force of spring, and the passage of swash plate control piston passes across the Pi1 and Pi2 port positions and led to the tank port. Therefore, the force pushing up the swash plate does not act on swash plate control piston.

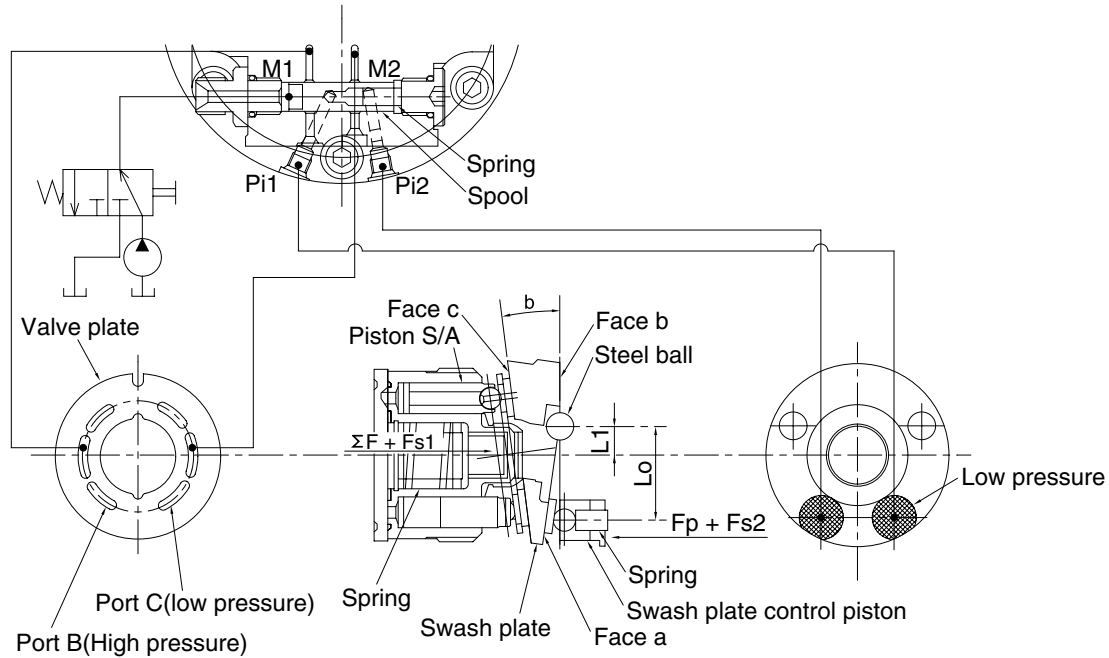
$$F_p = (A_p \times P) = 0$$

$F_p$  : Swash plate control piston thrust

$A_p$  : Swash plate control piston pressure receiving area

$P$  : Pressure

(2) When running at 2nd speed(high speed)



8007A2TM11

When control valve is set to the 2nd speed position, the pressure oil delivered by the pump is led to spool, and spool is switched to the position shown in the figure.

And the pressurized oil flows into each ports Pi1 and Pi2 through ports M1 and M2 and the motor driving pressure (P1: high pressure and P2: low pressure) is led to each swash plate control piston. Therefore the force pushing up the swash plate acts on swash plate control piston.

$$F_{p1} = A_p \times P_1 \quad F_{p2} = A_p \times P_2$$

When steel ball is placed on the tilting center, the balance of moment acting on swash plate is in the condition of  $(\Sigma F + F_{s1}) \times L_1 < (F_p + F_{s2}) \times L_o$  depending on the total  $\Sigma F$  of driving force of piston S/A.

The face "b" of swash plate stabilizes and the swash plate angle becomes " $\beta$ " angle, consequently the motor speed is the 2nd speed (high speed).

While the engine is stopped, spool is returned to the 1st speed position by the force of spring since pressurized oil does not flow. When steel ball is placed on the tilting center, the balance of moment acting on swash plate is in the condition of  $F_s \times L_1 > F_p \times L_o$ , the face "a" of swash plate stabilizes and the swash plate angle becomes " $\alpha$ " angle, consequently the motor speed at starting is always the 1st speed.

#### 4) AUTO TWO SPEED CHANGE MECHANISM

Auto two-speed control mechanism consists of two spools and spring. This valve automatically changes motor displacement in portion to motor pressure. This valve works while the pilot port "Ps" is pressurized.

##### (1) Motor pressure is low.

The motor displacement is small (high speed displacement) as shown figure.

When the two-speed spool is on the right position. Motor pressure Pm1 and Pm2 are connected to each side of chamber of two speed piston. So swash plate is moved to high-speed position by two-speed piston and motor displacement is kept on high-speed position.

Pilot pressure is applied on the area "Ap" when Ps port is pressurized. Then the pressure of Ps pushes the spool to the right direction on figure. At the same time,

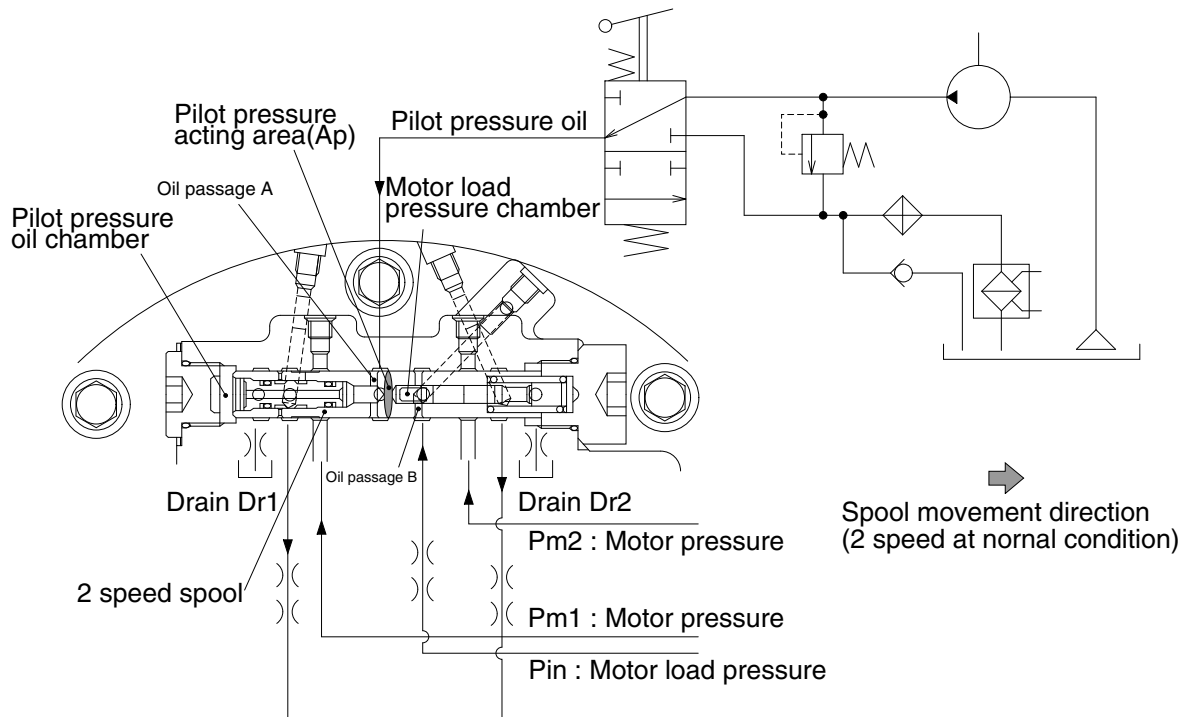
Motor inlet pressure is applied on the area "Am". So, the spool is also applied to the left direction by Am pressure. According to above, if the motor pressure is lower and keeps the following condition, the spool stays on the right position.

$$Ps \times Ap > Am \times Pin + Kx$$

Kx : Spring force

AP : Swash plate control piston pressure receiving area

Ps : Pilot pressure



8007A2TM12

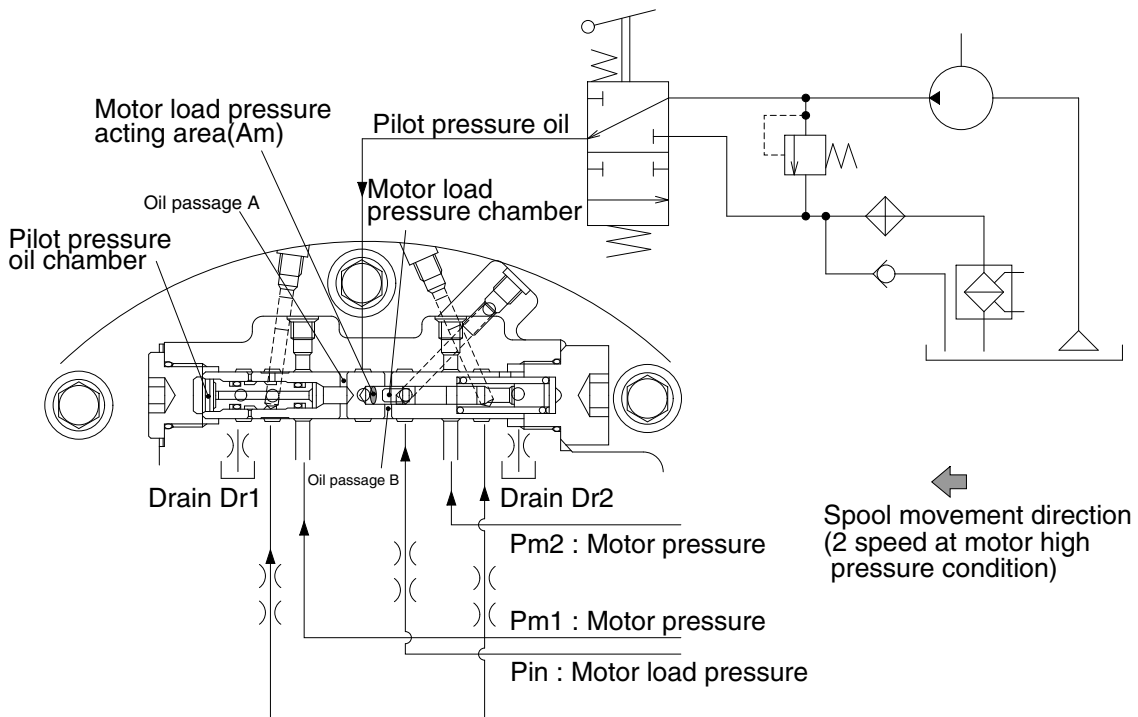
**(2) Motor pressure is low.**

The motor displacement is large (low speed displacement) as shown figure.

The two-speed spool is on the left position if  $P_{in}$  pressure is high. Then,  $P_{m1}$  and  $P_{m2}$  are shuttled by the spool.

If the motor pressure is higher and keeps the following condition, the spool stays on the left position.

$$P_s \times A_p < A_m \times P_{in} + K_x$$



8007A2TM13

## 5) RELIEF VALVE

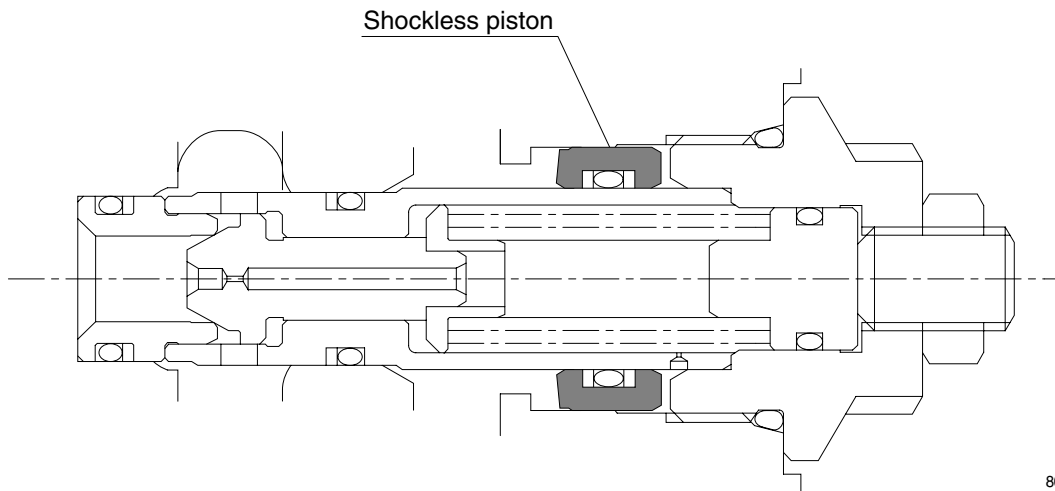
The relief valves determine the drive force and the brake force for hydraulic excavator travel and are installed in the main port M1 and M2 lines.

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

### (1) The 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.



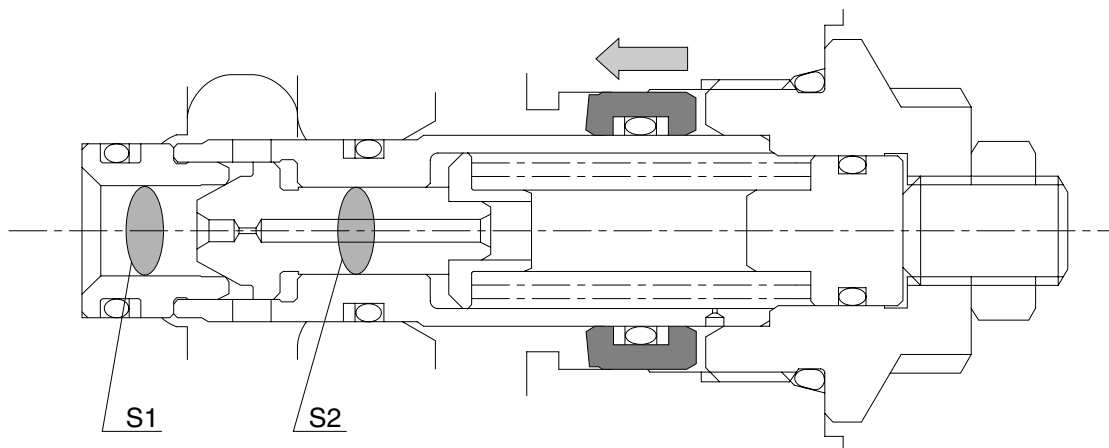
8007A2TM16

### (2) The relief valve operates in two stages as follows.

#### 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.

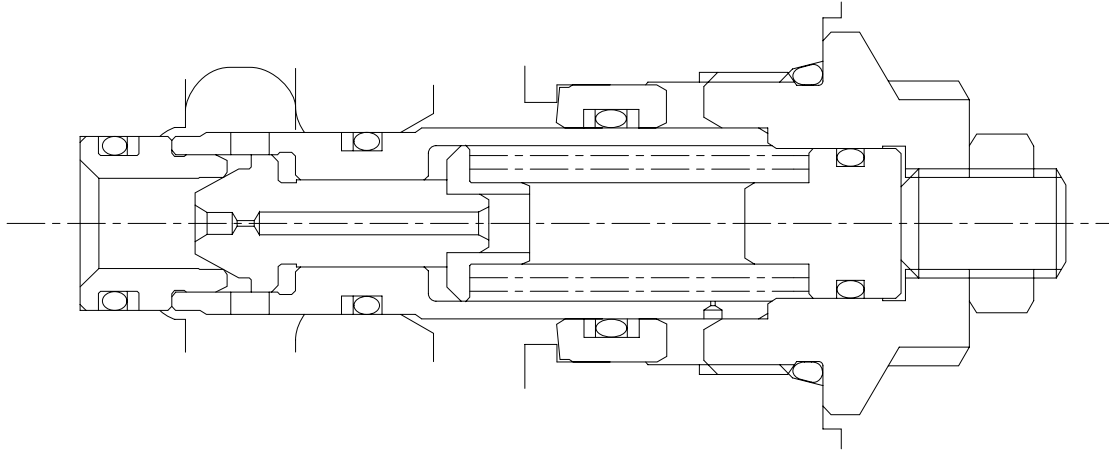


8007A2TM15

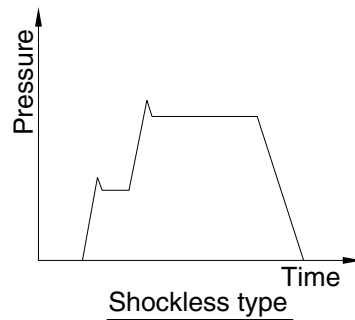
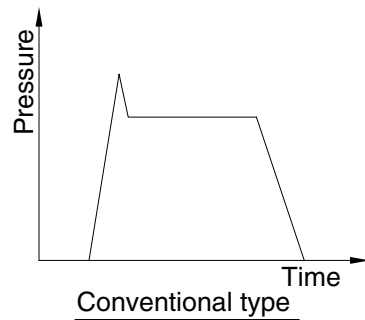
② **Second stage**

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.

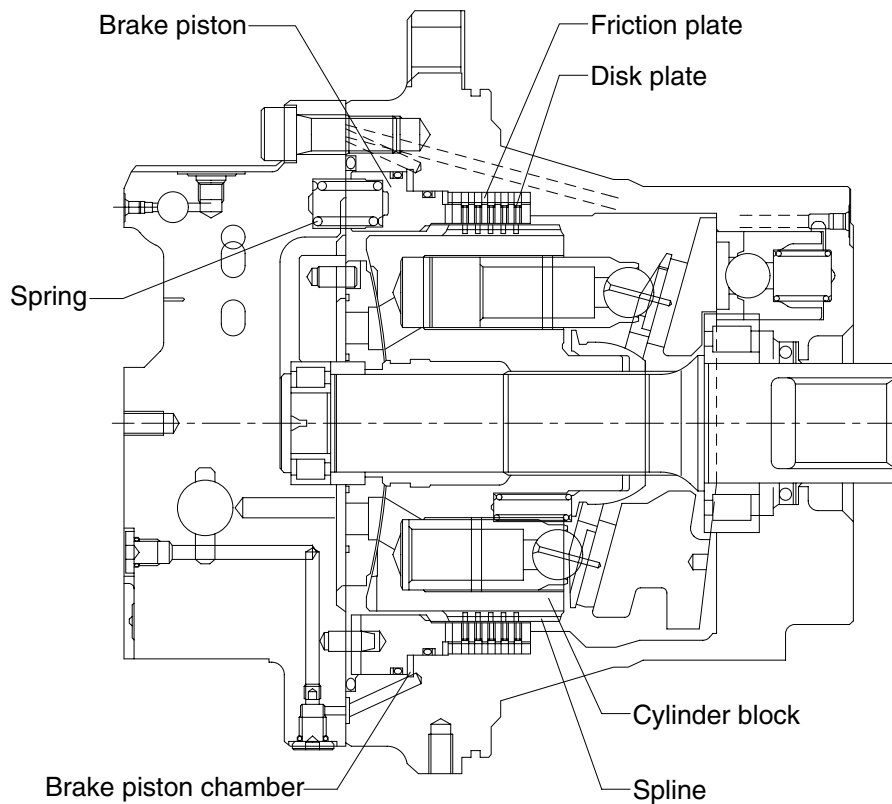


8007A2TM14



8007A2TM17

## 6) PARKING BRAKE



8007A2TM18A

The parking brake is a kind of negative brake which consist of disk, brake piston, friction plate and spring.

The cylinder block and disk are combined with a spline, and friction material is bonded on both sides of disk.

The disk generates frictional force between the case, the friction plate and the brake piston by the force of spring and restricts the rotating force of the motor, achieving the best performance of the parking brake.

When the pressurized oil flows into the motor, the plunger moves and the parking brake release port is opened.

After the oil flows into brake piston chamber, the thrust "F" is generated, corresponding to the pressure receiving surface of brake piston and the thrust "F" becomes larger than the force of spring "f", consequently the brake piston moves toward right.

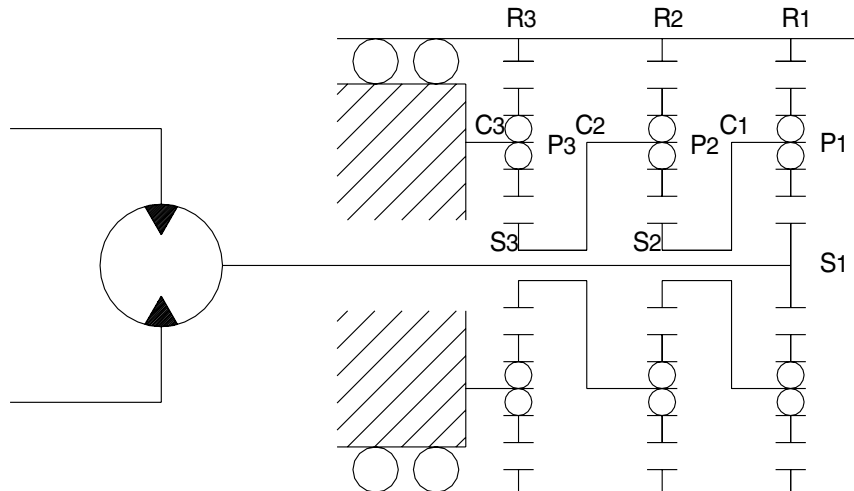
Then, the disk rotates freely between the flange holder and brake piston, and parking brake is released.

When the motor is stopped, the plunger returns to the neutral position and the parking brake release port is closed. Consequently the pressurized oil in brake piston chamber flows into motor case, the parking brake acts by the force of spring.



## 7) REDUCTION GEAR

The reduction gear is composed of a three-stage planetary gear mechanism shown in the following figure. Since the sun gear is designed to have a floating mechanism, errors of the gears and carrier pin hole pitches will not affect the gears' lives heavily.



R290TM08(1)

The input rotation of the hydraulic motor is transmitted to No. 1 sun gear (S1) and this drives No. 1 planetary gears (P1). This No. 1 planetary gears (P1) drive No.1 ring gear (R1) with the same force as the meshing tangential force with No. 1 sun gear (S1), and also No. 1 carrier (C1) with the same force as the meshing reaction force. In other words, No. 1 planetary gears (P1) revolve rotating. This rotation of No. 1 carrier (C1) becomes the output of the 1st stage, and is transmitted directly to No. 2 sun gear (S2).

(No. 1 carrier is spline-coupled with No. 2 sun gear.) Similarly the revolution of No. 2 planetary gear (P2) are transmitted via No.2 carrier (C2) to No. 3 sun gear (S3). Since No. 3 carrier (C3) supporting No. 3 planetary gears (P3) are fixed, No. 3 planetary gears (P3) do not revolve, but rotates to drive No. 3 ring gears (R3).

Therefore, the rotating case is driven by the overall driving torque of numbers.

1,2 and 3 ring gears. This reduction ratio is expressed as shown below:

$$i = \frac{(Z_{S1} + Z_{R1}) (Z_{S2} + Z_{R2}) (Z_{S3} + Z_{R3})}{Z_{S1} \cdot Z_{S2} \cdot Z_{S3}} - 1$$

Where Z : Number of teeth of each gear

The direction of rotation is reverse to that of the input shaft.