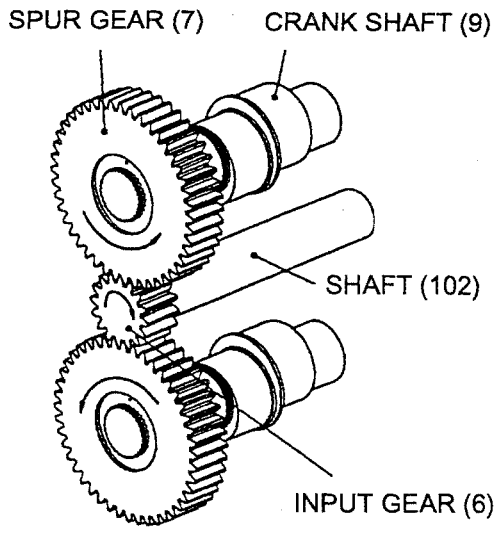
6.3 EXPLANATION OF FUNCTION

6.3.1 Reduction Unit

(1) Function

This reduction unit is equipped with spur gears (Hereinafter referred as 1st reduction gear section) and differential gears (Hereinafter referred as 2nd reduction gear section), reduces the high rotation speed from the hydraulic motor, coverts it to low speed large torque and rotates hub (1) (Casing.)



(2) Explanation of function

1) 1st reduction gear section

The rotation of hydraulic motor shaft is transmitted to input gear (6) which is linked with shaft (102) in spline.

Then, the rotation speed of two spur gears (7) which are engaged with input gear is reduced.

Also, the reduction rate of 1st reduction gear section is as follows.

$$i_1 = -\frac{ZS}{Zi}$$

i_1= Reduction rate of 1st reduction gear section

Zi=Number of teeth of input gear

Zs=Number of teeth of spur gear

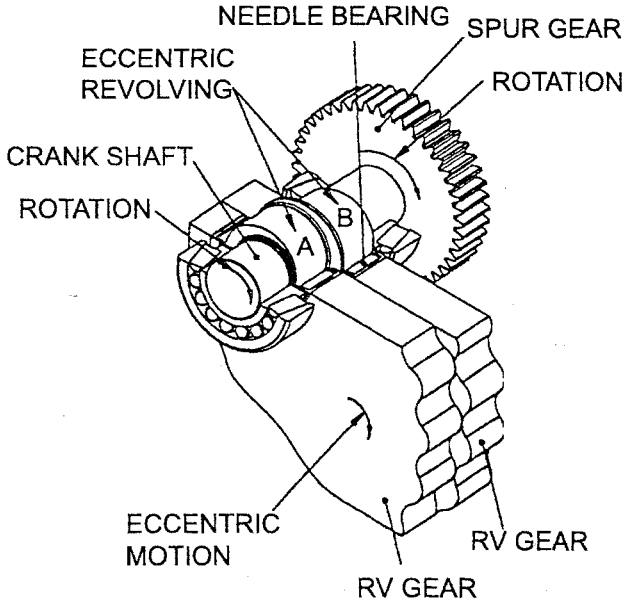
2) 2nd reduction gear section

a) Two spur gears are engaged with crankshaft respectively to transmit the power from the 1st reduction gear section to 2nd reduction gear section.

The eccentric bodies of crankshaft A and B revolve eccentrically (revolution) while rotating on its axis by rotating crankshaft.

Also, these eccentric bodies A and B and RV gears (4) transmit only the eccentric revolution.

And RV gears A and B revolve in the same direction and number of revolutions as spur gear and crankshaft.



b) Tooth surface ZR of RV gear is always engaged with ZP pins (17) rotating and changing the mesh part in order, by eccentrically revolving RV gear. By eccentrically revolving RV gear one turn, the pin revolves in the same direction of eccentrical revolution in the portion of difference between number of teeth ZR and number of pins ZP [(ZP - ZR) / ZP].
This revolution of pin is transmitted to hub, producing output rotation of reduction unit.
At this point, the speed ratio of 2nd reduction gear section is as follows.

$$1_2 = \frac{(ZP - ZR)}{ZP}$$

i_2 = Speed ratio of 2nd reduction gear section
ZR = Number of RV gear
ZP = Number of pins

Then, the output revolution is as follows, when the hydraulic motor shaft rotates one time.

$i = i_1 \times i_2$
i_1 = Speed ratio of 1st reduction gear section
I_2 = Speed ratio of 2nd reduction gear section

$$1_2 = - \frac{ZS}{Zi} \times \frac{(ZP - ZR)}{ZP}$$

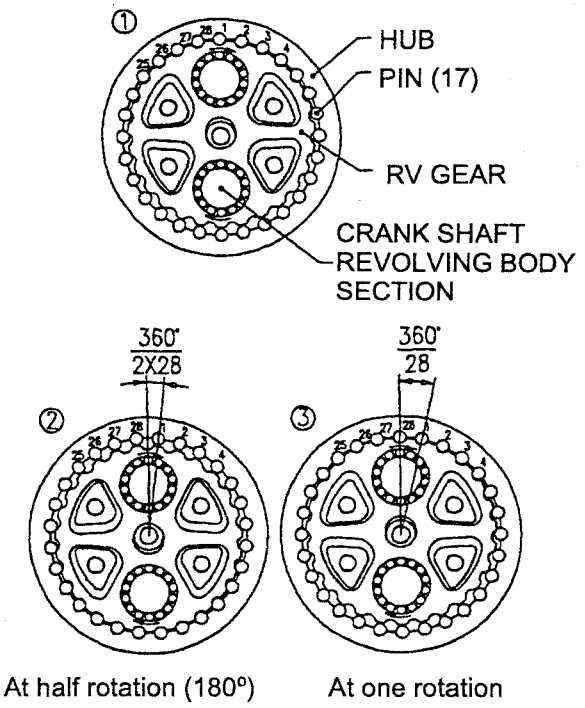


Fig. 6-7

6.3.2 Hydraulic Motor Section (**Brake valve, parking brake, high and low speed change mechanism**)

(1) Function

1) Hydraulic motor
Hydraulic motor is referred to as a swash plate type axial piston motor which converts the pressure oil power fed by pump into rotary motion.

2) Brake valve

a) Travel motor controls the force of rotational inertia of the body to brake and stop the rotation smoothly.

b) Check valve function to prevent hydraulic motor from cavitation.

c) Open the port to release the parking brake force at travel motor operation, and close the port at a standstill.

3) Parking brake

The parking brake is used to the prevent machine from running away or slipping while parking on a slope using the friction plate type brake mechanism, and is installed on the hydraulic motor.

4) High / Low 2-speed shifting mechanism

By means of changing the tilt angle of the swash plate to change the stroke volume of piston with help of the function on the shifting valve and control piston, the speed is shifted to high speed with low torque or low speed with high torque.

(2) Operation

1) Hydraulic motor

Hydraulic oil fed by pump enters rear flange (201) of travel motor, and is led from timing plate (109) to cylinder block (104) through brake valve mechanism. This pressure oil is led to only the one side of Y_1 - Y_2 tied between top dead point and bottom dead point of piston (105) stroke. And the pressure led to one side of cylinder block pushes 3 or 4 pistons (105), generating the power (F_1 kgf = P kgf / cm^2 × A cm^2). This power enters on swash plate (103), but swash plate (103) is fixed having an angle (α) against axis of drive shaft (102), and divided into component of force (F_2, F_3). And the radial component of force (F_3) generated various torque ($T = F_3 \times ri$) against line Y_1 - Y_2. The total torque [$T = \Sigma (F_3 \times ri)$] is connected to turning effort, and rotates cylinder block (104) through piston (105).

This cylinder block (104) is connected with drive shaft (102) with spline, and rotates drive shaft (102) to transmit torque.

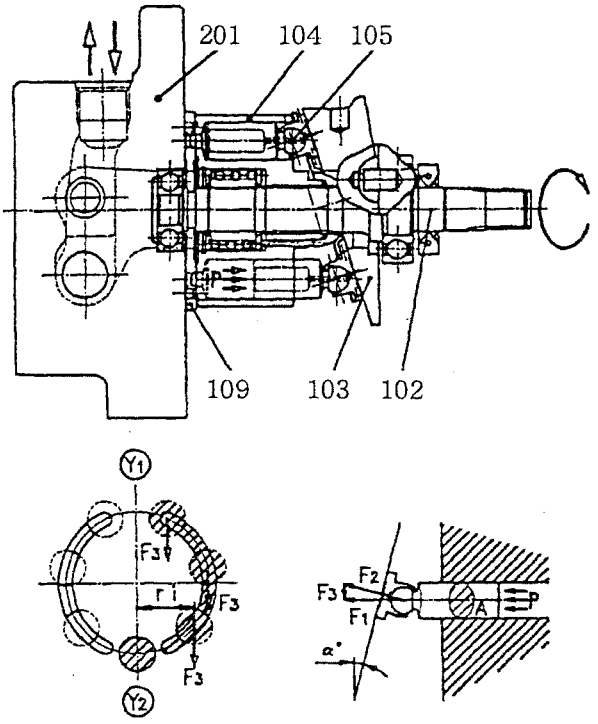


Fig. 6-8

2) Brake valve

a) Operation (Brake released)

The pressure oil is led to through port (A), opens valve (227), and led to port (C) on the section side of hydraulic motor to rotate hydraulic motor. At the same time, the pressure oil enters chamber (b) through passage (a) from the small hole of spool (223), and exerts on the end of spool to generate the force.

Then the force of spring (228) slides the spool placed on the neutral position leftward.

The sliding of spool forms the space (passage) between spool and rear flange with spool groove. This passage is connected to port (D) and port (B) of the return circuit of the hydraulic motor, and the return oil returns to tank side, enabling hydraulic motor to rotate.

Then, the sliding of spool (223) leads pressure oil to port (P). The pressure oil led to port (P) moves piston (112) of parking brake, and releases parking braking force. (For details, refer to item "Parking brake".)

If pressurized oil is supplied from port (B) the movements of spool (223) and valve (227) are reversed so that the hydraulic motor is rotated reversely.

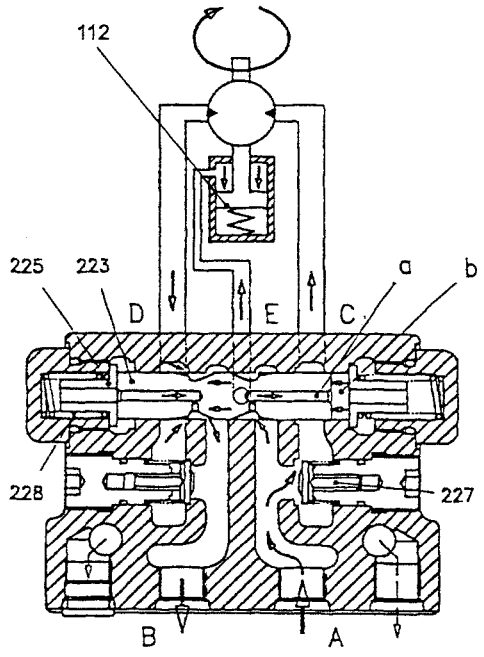


Fig. 6-9

b) Self-traveling

While machine is being operated, as the travel speed is increased due to steep slope, the oil flow rate of the hydraulic motor is higher than the supply flow rate of the hydraulic oil pump. The rotation of the hydraulic motor in this case is called a self-traveling (Overrun).

While self-traveling, the oil pressure is lowered similar to the stopping condition. Then brake valve is moved similar to the stopping condition, throttles passage in the return side of hydraulic motor, and generate back pressure.

In addition, the force of inertia decreases the revolution of hydraulic motor to revolution having a balance with the supply flow rate of pump.

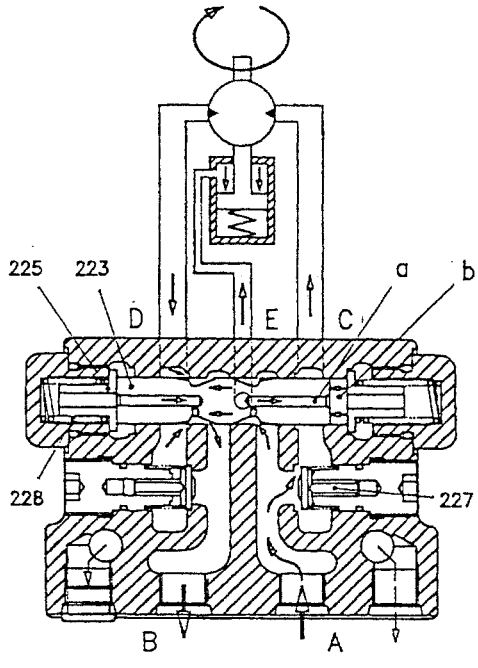


Fig. 6-10

c) Stop / Stall (braking action)

If pressurized oil supply through the port (A) is suspended while travelling, the hydraulic force to push up the spool is lost, and the spool (223) which is slided to left side, tries to return to the neutral position through the stopper (225) due to the spring (228) force. At that time, through the oil in the chamber (b) tries to flow out to the port (A) side through the passage (a) in the spool, its flow is restricted and some back pressure is generated by the throttle effect in the passage (a) controlling the return speed of the spool. At the same time, the hydraulic motor tries to rotate with its enertia force even though the pressurized oil is suspended, and the return oil from the hydraulic motor tries to return to the port (B) side from the port (D) through the passages on spool groove and rear flange.

When the spool entirely return to the neutral position, the passage on the hydraulic motor of the oil return side is completely closed by the spool, and the hydraulic motor ceases its rotation. While machine working, the brake valve smoothly stops rotation of the hydraulic motor which tries to rotate with its enertia force, by means of throttling the return side passage of the hydraulic motor, generating back pressure due to shape of the spool groove and controlling the return speed of the spool.

On the other hand, when braking is operated, the hydraulic motor tries to rotate with its enertia force and to intake oil with its pumping function. However, because the intake side is closed its passage with the spool, the oil supply is suspended. This causes cavitation in the hydraulic motor. To prevent the cavitation, the valve (227) is operated by very slight negative pressure to open the passages of port (A) side and intake port (C) of the hydraulic motor.

And when pressurized oil is supplied through the port (B), each motion of the above mentioned parts becomes symmetrical right and left to stop the hydraulic motor.

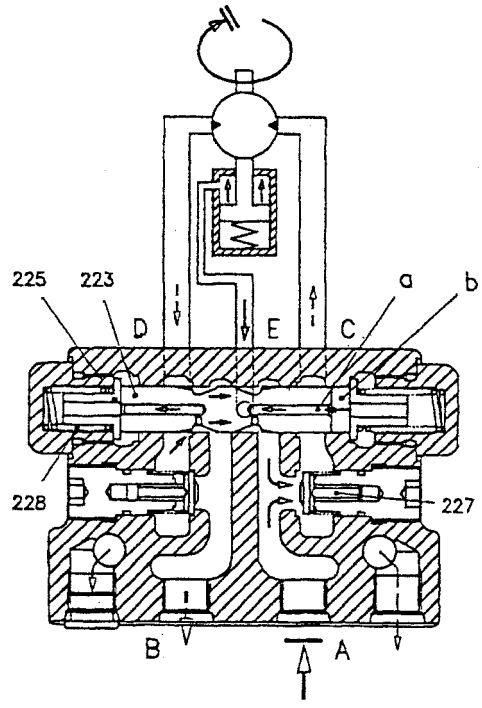


Fig. 6-11

3) Parking brake

a) Traveling

The pressure oil led trough brake valve actuates on spool (223) of brake valve on the hydraulic motor section, opens passage to parking brake, and is led to cylinder chamber (a) compressed of spindle (2) and piston (112) on the reduction gear section.

If the pressure of oil which is 9.1 kgf / cm^2 (130 psi) or higher it exceeds the force of spring moving piston (112) toward rear flange (201) side.

This movement of piston (112) reduces the push power to separator plate (116), (169) and friction plate (115), and makes the movement of friction plate (115) which is installed to cylinder block (104) on hydraulic motor section free releasing the brake power to cylinder block (104).

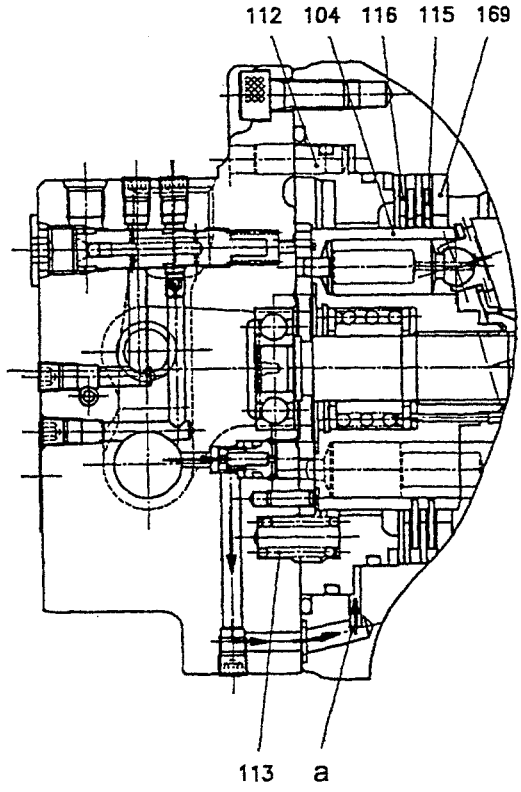


Fig. 6-12

b) Stopping

If pressure oil from brake valve is cut, and the pressure in cylinder chamber (a) lowers 9.1 kgf / cm^2 (130 psi) or less, the piston (112) goes to rightward by the force of spring (113).

Also, the force of the spring pushes mating plate (116), (169) and friction plate (115), which is in a free state because piston (112) is pushed, against spindle (2) on the reduction gear section. The frictional force produced by the push power stops the rotation of cylinder block (104), and transmits braking torque 6.6 kgf•m (48 lbf•ft) to hydraulic motor shaft. And since oil is controlled through the proper oil passage, it results in smooth operation.

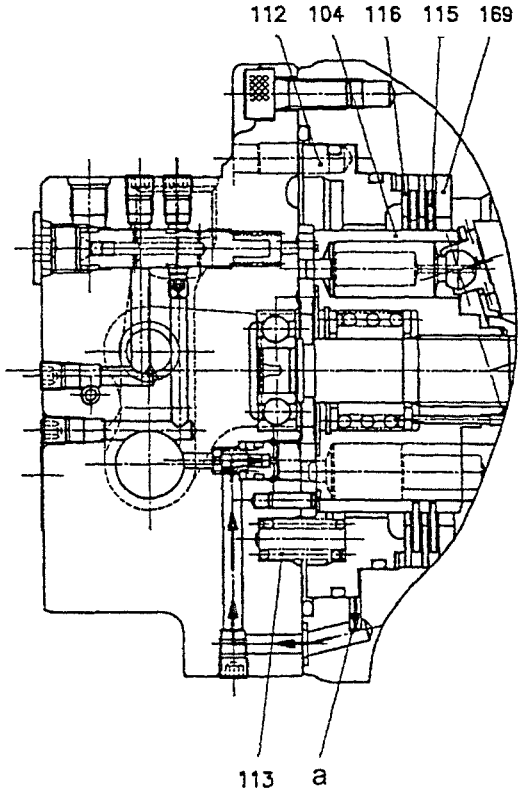


Fig. 6-13

4) High / Low 2-speed shifting mechanism

a) Low speed

When the pilot pressure is not supplied through the port (D), the valve (263) is pushed up to the upper position due to the spring (266) force and pressurized oil through the port (A) or (B), the pressurized oil is cut off at port (C), and oil in the chamber (P) is released into the drain (motor case) through the valve (263). Accordingly, the tilt angle of the swash plate (103) becomes the maximum $\theta 1$ resulting the maximum stroke volume and low speed rotation of the hydraulic motor.

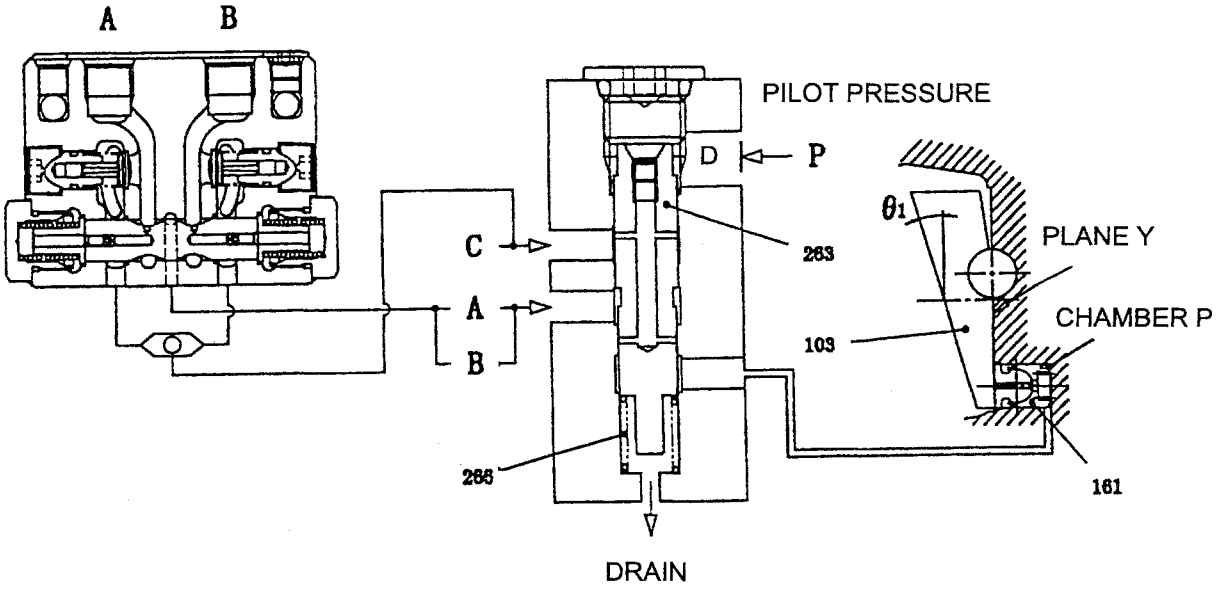


Fig. 6-14

b) High speed

When 30 kgf / cm² (430 psi) of the pilot pressure is supplied through the port (D), it defeats the spring (263) force and pressurized oil through the port (A) or (B) to push down the valve (263) to lower position, the pressurized oil at the port (C) is led to the chamber (P) through the valve (263), and the piston (161) pushes the swash plate (103) up to the plane X and maintain it at its position. At that time, the tilt angle of the swash plate becomes the minimum $\theta 2$ resulting the minimum stroke volume and high speed rotation of the hydraulic motor.

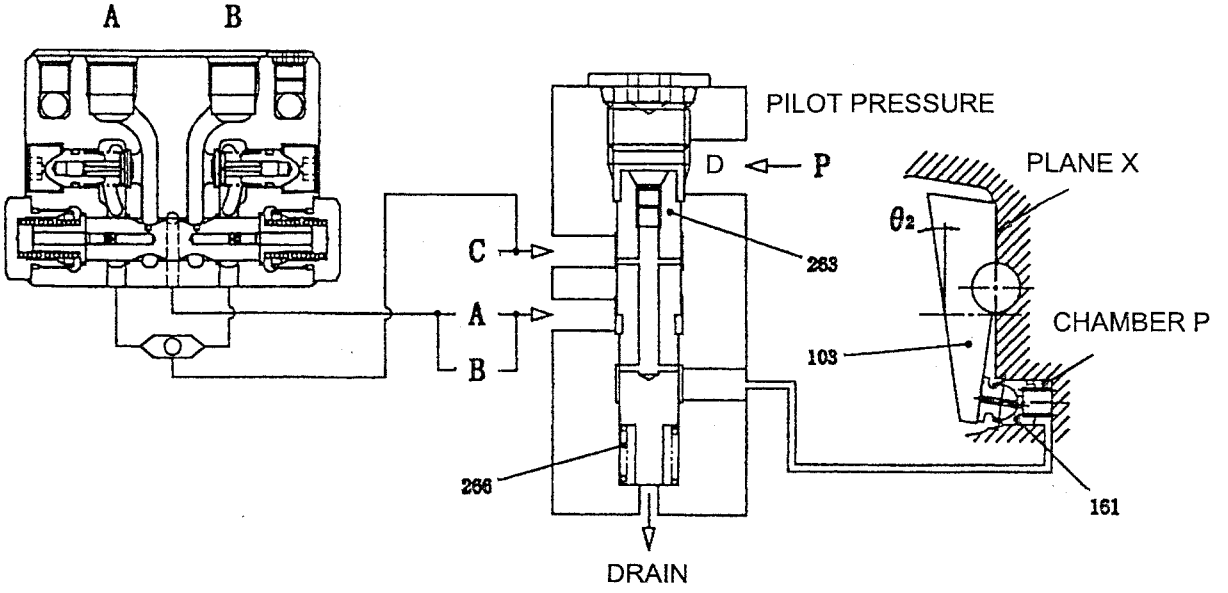


Fig. 6-15

c) Automatic shifting to low speed during high speed operation

If the load is increased while high speed operation, the oil pressure at the port (A) or (B) is also increased. And when the oil pressure reaches to 185 kgf / cm^2 (2630 psi), it excesses the pilot pressure of 30 kgf / cm^2 (430 psi), and the valve (263) is pushed up to upper position, and oil in the chamber (P) is released into the drain (motor case) through the valve (263). At that time, the swash plate (103) gets touch with the plane Y of spindle, and the tilt angle of swash plate become the maximum $\theta 1$ and is maintained at its position resulting low speed rotation.

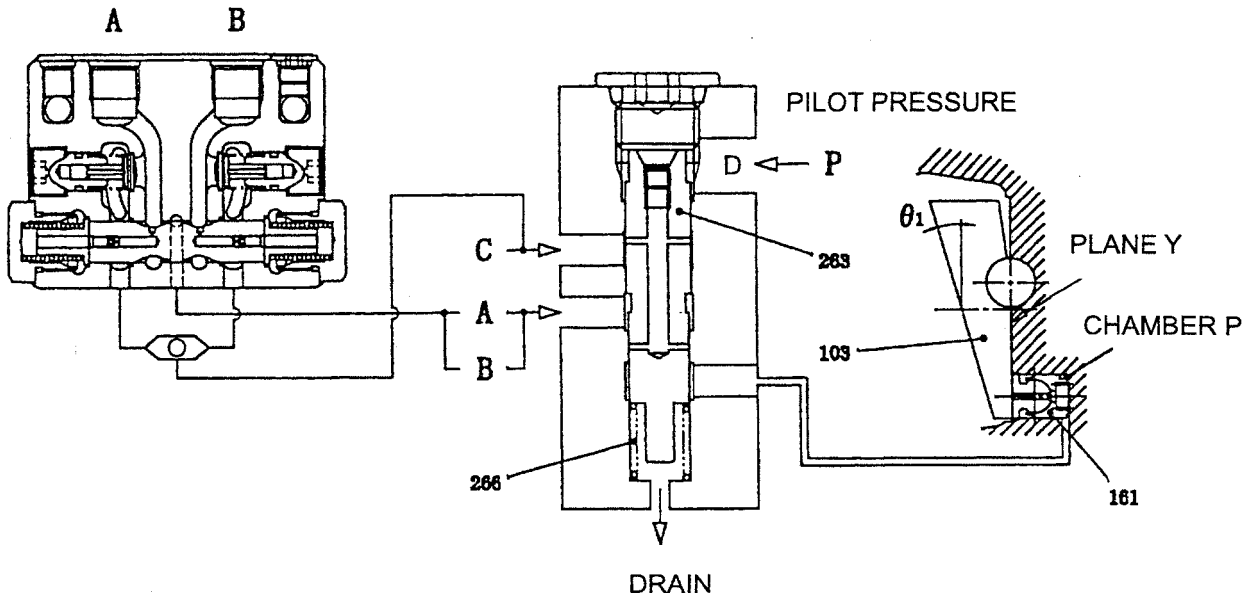


Fig. 6-16

7.SWIVEL JOINT

7.1 GENERAL VIEW

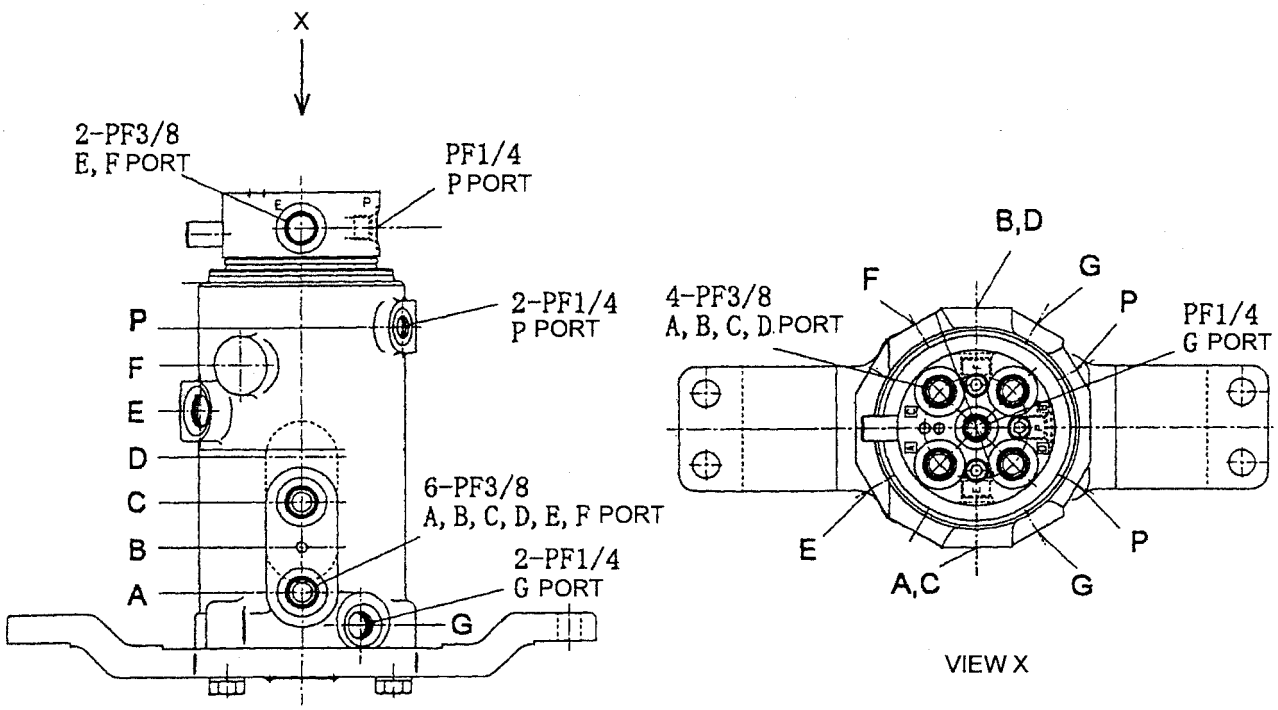


Fig.7-1 General view

7.2 SPECIFICATIONS

Table7-1

Model (Type)	YV-7200			
Port No.	A, B, C, D	E, F	P	G
Max. working pressure kgf/cm² (psi)	250 (3560)	←	210 (2990)	5 (71)
Pressure test kgf/cm² (psi)	375 (5330)	←	315 (4480)	10 (142)
Flow liter/min (gal/min)	60 (15.9)	30 (7.9)	5 (1.3)	←
Revolution rpm	Less than 15			
Weight kg (lb)	Approx 22 (48)			

7.3 CONSTRUCTION

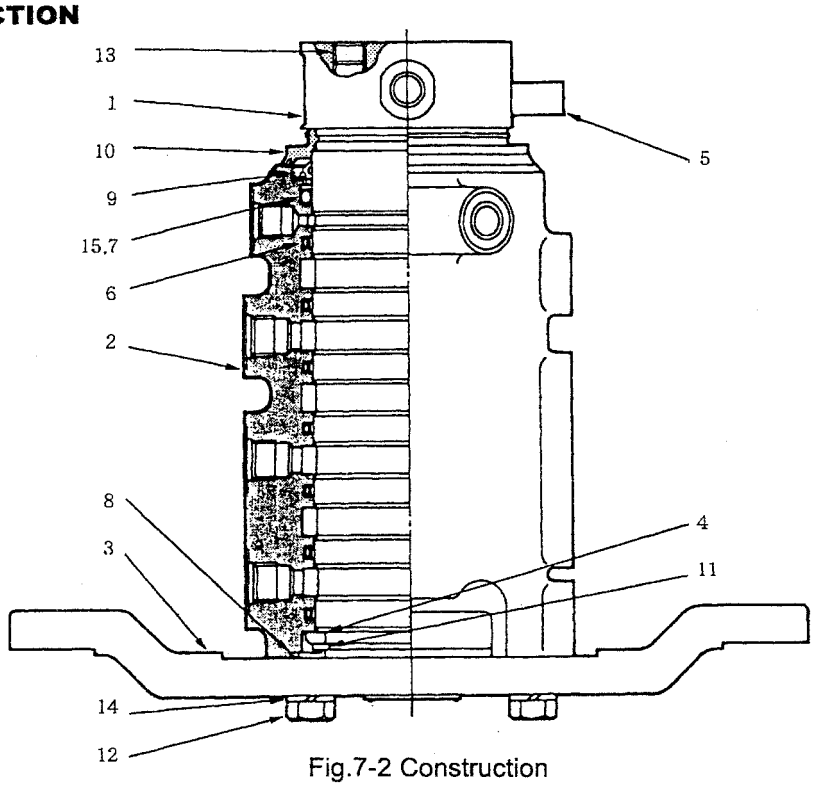


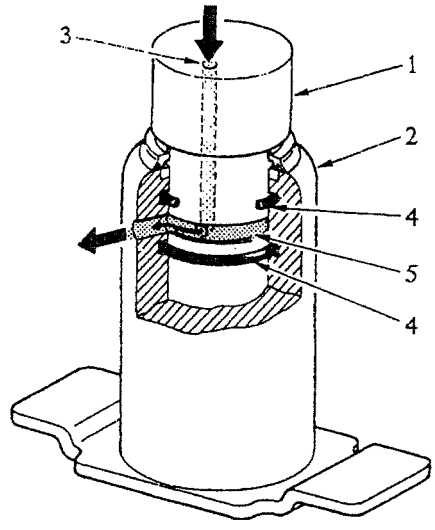
Fig.7-2 Construction

Table 7-2 Swivel joint Parts

No.	NAME	QTY	No.	NAME	QTY
1	SHAFT	1	9	DUST SEAL	1
2	BODY	1	10	DUST SEAL	1
3	FLANGE	1	11	SNAP RING	1
4	THRUST RING	1	12	BOLT	2
5	PIN	1	13	PLUG	1
6	SLIPPER SEAL	7	14	SPRING WASHER	4
7	O-RING	1	15	BACK-UP RING	4
8	O-RING	1			

7.4 FUNCTION

The swivel joint is installed at the slewing center of machine, and is to maintain the connection of hydraulic oil circuits regardless to the slewing angle on the upper frame. On the body (2) and shaft (1) which are able to independently rotate with each other, the necessary number of ports (3) are provided corresponding to the number of circuits. The necessary number of grooves is machined on both of the body (2) at its inner periphery and the shaft (1) at its outer periphery, and these grooves are sealed at upper and lower portions with the seal (4) The hydraulic oil flowing into the shaft from the port (3) is able to keep its flowing along through the hydraulic circuit (5) which is provided between the body (2) and shaft (1), and the circuits maintained without any hindrance due to the independent rotation of the body (2) and shaft (1).



8. CYLINDER

8.1 SPECIFICATIONS

(1) General View

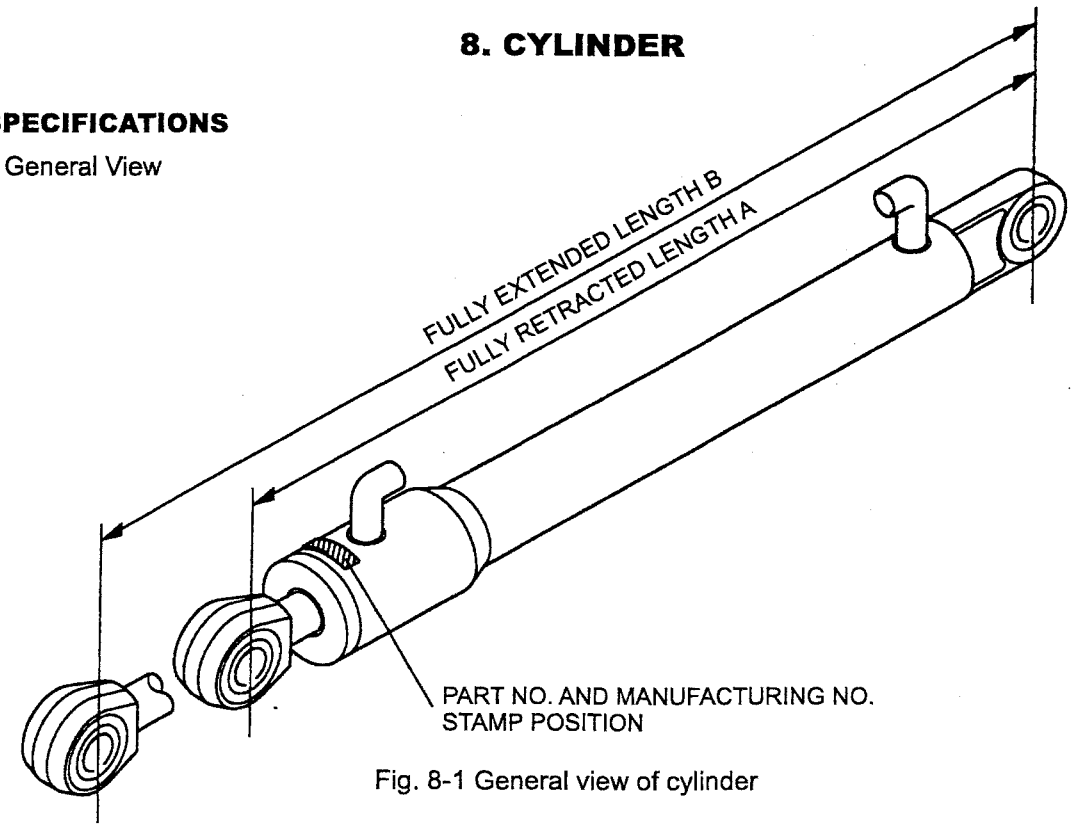


Fig. 8-1 General view of cylinder

(2) Specifications

■ SK30SR-2 Table 8-1 Unit : mm (ft•in)

Cylinder		Cylinder Bore / Rod Dia.	Stroke	Center distance of mounting pins Full extend B / Full retract A	Cushion	Dry weight kg (lb)
Boom	Canopy [NEW ZEALAND]	ø80 / ø45 (3.15" / 1.77")	518 (1'8.4")	1380 / 862 (4'6.3" / 2'9.9")	Rod side	33 (73)
	Cab	[ø80 / ø45 (3.15" / 1.77")]	[538 (1'9.2")]	[1400 / 862 (4'7.1" / 2'9.9")]		[34 (75)]
Arm		ø75 / ø45 (2.95" / 1.77")	541 (1'9.3")	1398 / 857 (4'7.0" / 2'9.7")	None	30 (66)
Bucket		ø65 / ø35 (2.56" / 1.38")	487 (1'7.2")	1240 / 753 (4'0.8" / 2'5.6")	None	20 (44)
Swing		ø80 / ø45 (3.15" / 1.77")	488 (1'7.2")	1331 / 843 (4'4.4" / 2'9.2")	Both sides	37 (82)
Dozer		ø80 / ø45 (3.15" / 1.77")	173 (6.8")	701 / 528 (2'3.6" / 1'8.8")	None	21 (46)

Note) • The dimensions in [ ] are only applicable for the machines with canopy specification which are delivered for aoceanian district.

■ SK35SR-2 Table 8-2 Unit : mm (ft•in)

Cylinder		Cylinder Bore / Rod Dia.	Stroke	Center distance of mounting pins Full extend B / Full retract A	Cushion	Dry weight kg (lb)
Boom	Canopy [NEW ZEALAND]	ø85 / ø50 (3.35" / 1.97")	531 (1'8.9")	1417 / 886 (4'7.8" / 2'10.9")	Rod side	37 (82)
	Cab	[ø85 / ø50 (3.35" / 1.97")]	[556 (1'9.9")]	[1442 / 886 (4'8.8" / 2'10.9")]		[37 (82)]
Arm		ø80 / ø45 (3.15" / 1.77")	560 (1'10.0")	1432 / 872 (2'8.4" / 2'10.3")	None	34 (75)
Bucket		ø65 / ø35 (2.56" / 1.38")	487 (1'7.2")	1240 / 753 (4'0.8" / 2'5.6")	None	20 (44)
Swing		ø80 / ø45 (3.15" / 1.77")	488 (1'7.2")	1331 / 843 (4'4.4" / 2'9.2")	Both sides	37 (82)
Dozer		ø90 / ø45 (3.54" / 1.77")	150 (5.9")	690 / 540 (2'3.2" / 1'9.3")	None	23 (51)

Note) • The dimensions in [ ] are only applicable for the machines with canopy specification which are delivered for aoceanian district.

8.2 CONSTRUCTION AND FUNCTION

8.2.1 Construction

(1) Boom cylinder

■ SK30SR-2 • SK35SR-2

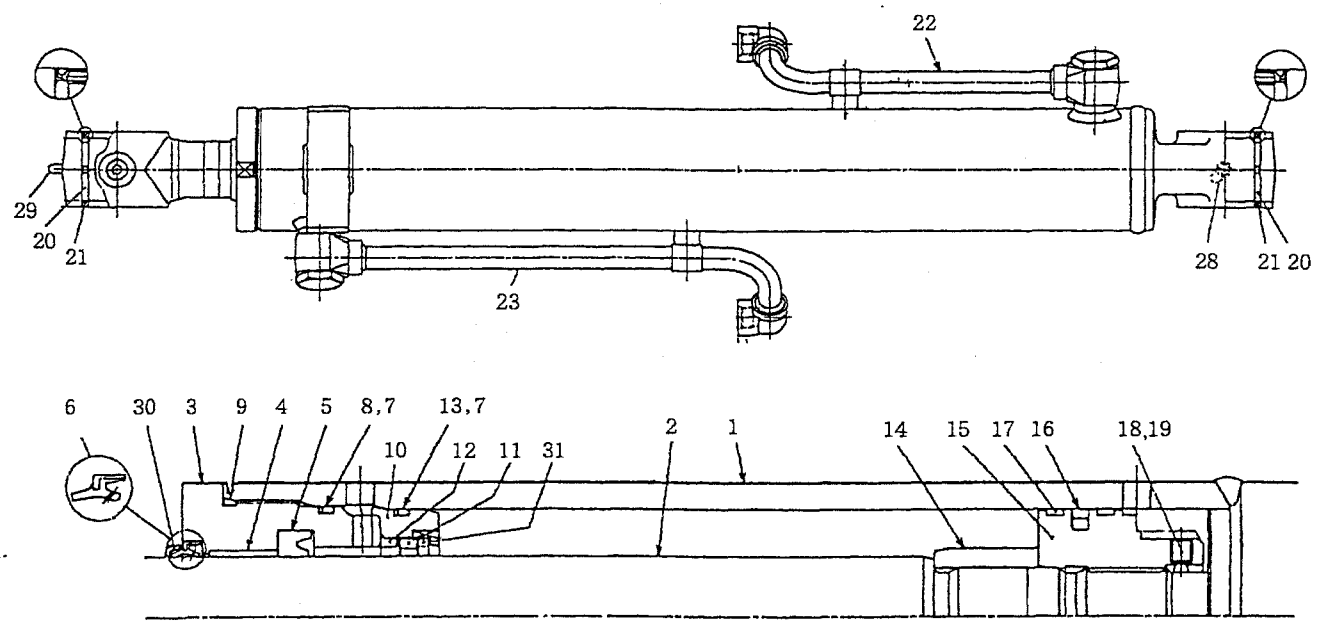


Fig. 8-2 Construction of boom cylinder

No.	NAME	Q'TY	No.	NAME	Q'TY	No.	NAME	Q'TY
1	CYLINDER TUBE ASSY	1	10	HOLDER	1	19	STEEL BALL	1
2	PISTON ROD ASSY	1	11	CUSHION SEAL	1	20	PIN BUSHING	2
3	CYLINDER HEAD	1	12	COLLAR	1	21	WIPER RING	4
4	BUSHING	1	13	BACK-UP RING	1	22	PIPE ASSY	1
5	U-RING	1	14	CUSHION BEARING	1	23	PIPE ASSY	1
6	WIPER RING	1	15	PISTON	1	28	GREASE NIPPLE	1
7	O-RING	2	16	SEAL RING ASSY	1	29	GREASE NIPPLE	1
8	BUCK-UP RING	1	17	SLIDE RING	2	30	CAP	1
9	O-RING	2	18	SETSCREW	1	31	SPACER	1

(2) Arm cylinder

■ SK30SR-2 • SK35SR-2

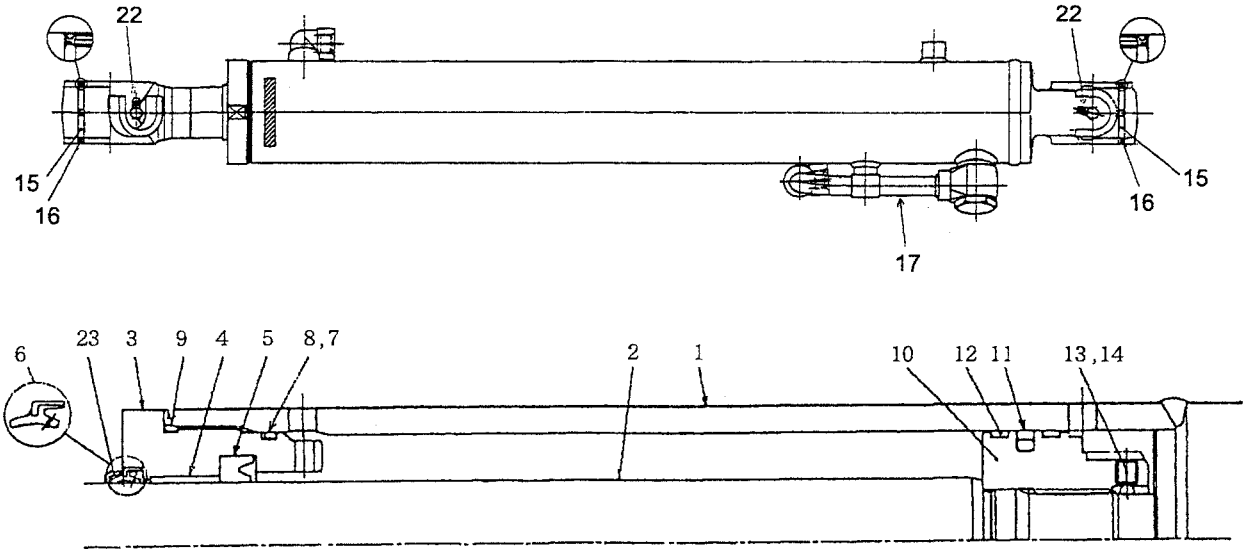


Fig. 8-3 Construction of Arm cylinder

No.	NAME	Q'TY	No.	NAME	Q'TY	No.	NAME	Q'TY
1	CYLINDER TUBE ASSY	1	8	BUCK-UP RING	1	15	PIN BUSHING	2
2	PISTON ROD ASSY	1	9	O-RING	1	16	WIPER RING	4
3	CYLINDER HEAD	1	10	PISTON	1	18	PIPE ASSY	1
4	BUSHING	1	11	SEAL RING ASSY	1	22	GREASE NIPPLE	2
5	U-RING	1	12	SLIDE RING	2	23	CAP	1
6	WIPER RING	1	13	SETSCREW	1			
7	O-RING	1	14	STEEL BALL	1			

(3) Bucket cylinder

■ SK30SR-2 • SK35SR-2

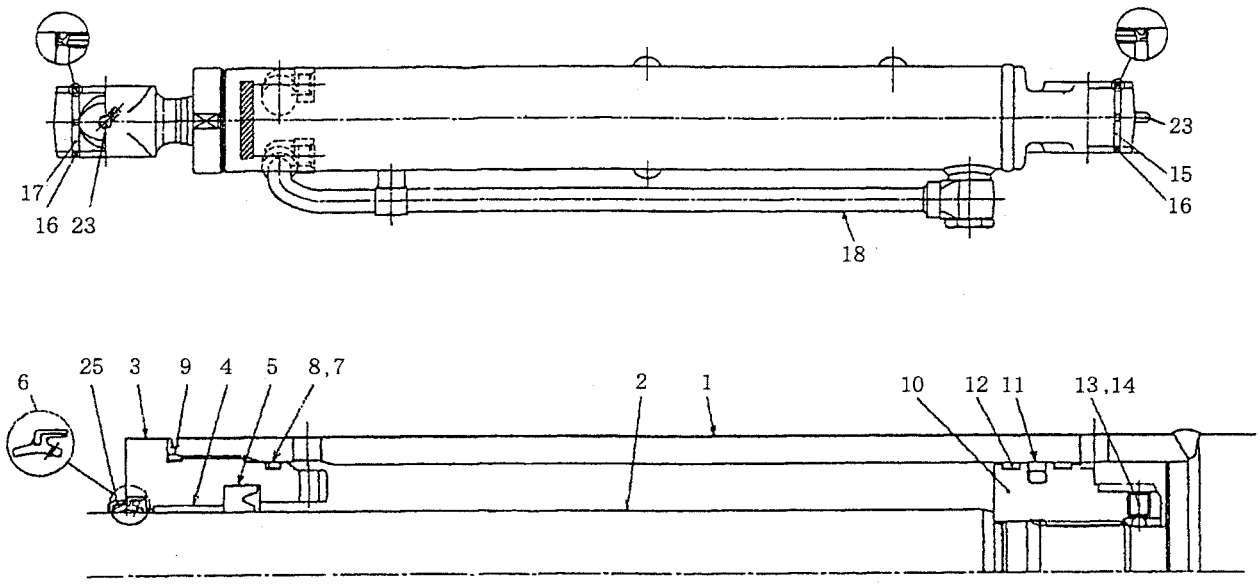


Fig. 8-4 Construction of bucket cylinder

No.	NAME	Q'TY	No.	NAME	Q'TY	No.	NAME	Q'TY
1	CYLINDER TUBE ASSY	1	8	BUCK-UP RING	1	15	PIN BUSHING	1
2	PISTON ROD ASSY	1	9	O-RING	1	16	WIPER RING	4
3	CYLINDER HEAD	1	10	PISTON	1	17	PIN BUSHING	1
4	BUSHING	1	11	SEAL RING ASSY	1	18	PIPE ASSY	1
5	U-RING	1	12	SLIDE RING	2	23	GREASE NIPPLE	2
6	WIPER RING	1	13	SETSCREW	1	25	CAP	1
7	O-RING	1	14	STEEL BALL	1			