

SECTION 2 STRUCTURE AND FUNCTION

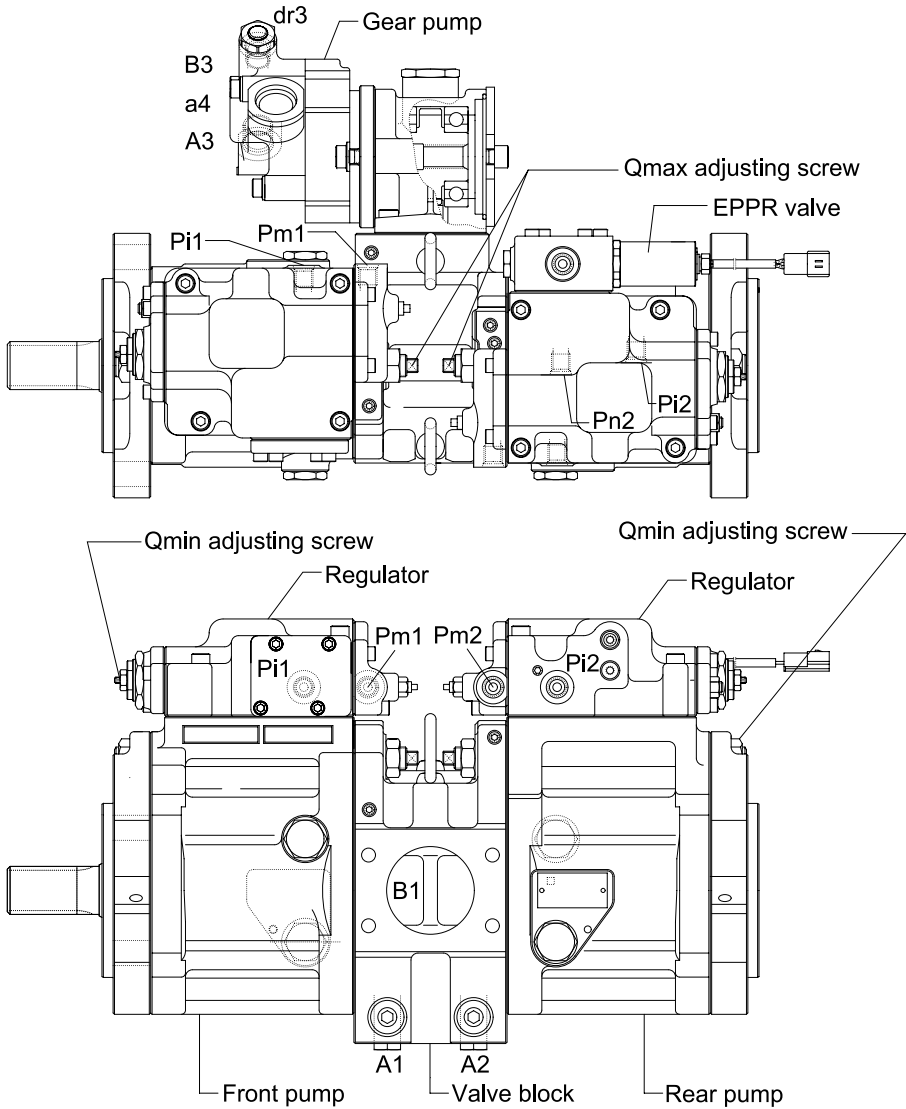
Group 1 Pump Device	2-1
Group 2 Main Control Valve	2-21
Group 3 Swing Device	2-43
Group 4 Travel Device	2-55
Group 5 RCV Lever	2-61
Group 6 Accelerator Pedal	2-68
Group 7 Brake Pedal	2-69
Group 8 Transmission	2-71
Group 9 Transmission Control Valve	2-78
Group 10 Steering Valve	2-80

SECTION 2 STRUCTURE AND FUNCTION

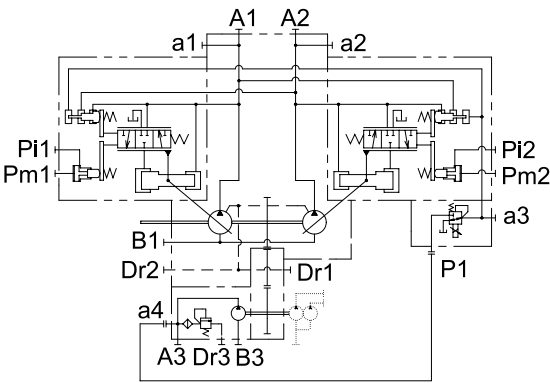
GROUP 1 PUMP DEVICE

1. STRUCTURE

The pump device consists of main pump, regulator and gear pump.



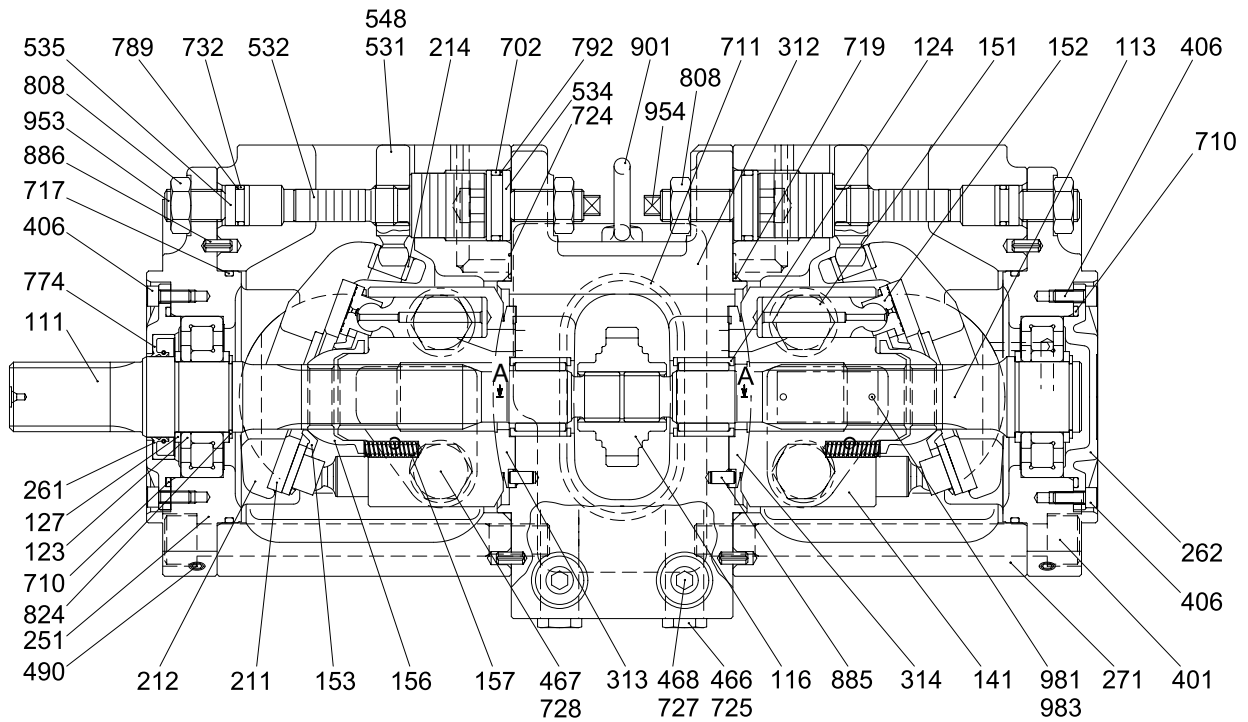
14W72SF01N



Port	Port name	Port size
A1,2	Delivery port	SAE6000psi 3/4"
B1	Suction port	SAE2500psi 2 1/2"
Dr1	Drain port	PF 3/4 - 20
Dr2	Drain port	PF 1/2 - 19
Dr3	Drain port	PF 3/8 - 15
Pi1 i2	Pilot port	PF 1/4 - 15
Pm1,Pm2	Qmax cut port	PF 1/4 - 15
P1	EPPR valve primary port	PF 1/4 - 15
a1,2,3	Gauge port	PF 1/4 - 15
a4	Gauge port	PF 1/4 - 14
A3	Gear pump delivery port	PF 1/2 - 19
B3	Gear pump suction port	PF 3/4 - 20.5

1) MAIN PUMP(1/2)

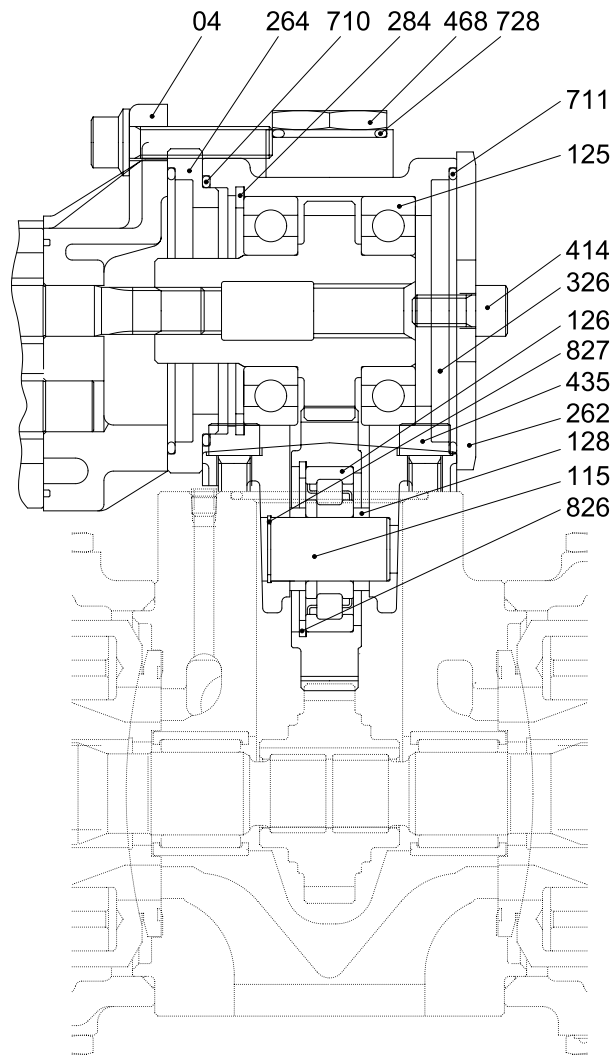
The main pump consists of two piston pumps(front & rear) and valve block.



14W72SF02

111 Drive shaft(F)	271 Pump casing	724 O-ring
113 Drive shaft(R)	313 Valve plate(R)	725 O-ring
116 Gear	314 Valve plate(L)	727 O-ring
123 Roller bearing	401 Hexagon socket bolt	728 O-ring
124 Needle bearing	406 Hexagon socket bolt	732 O-ring
127 Bearing spacer	466 VP Plug	774 Oil seal
141 Cylinder block	467 VP Plug	789 Back up ring
151 Piston	468 VP Plug	792 Back up ring
152 Shoe	490 Plug	808 Hex-ring nut
153 Push-plate	531 Tilting pin	824 Snap ring
156 Bushing	532 Servo piston	885 Pin
157 Cylinder spring	534 Stopper(L)	886 Spring pin
211 Shoe plate	535 Stopper(S)	901 Eye bolt
212 Swash plate	548 Pin	953 Set screw
214 Bushing	702 O-ring	954 Set screw
251 Support	710 O-ring	981 Plate
261 Seal cover(F)	717 O-ring	983 Pin
262 Seal cover(R)	719 O-ring	

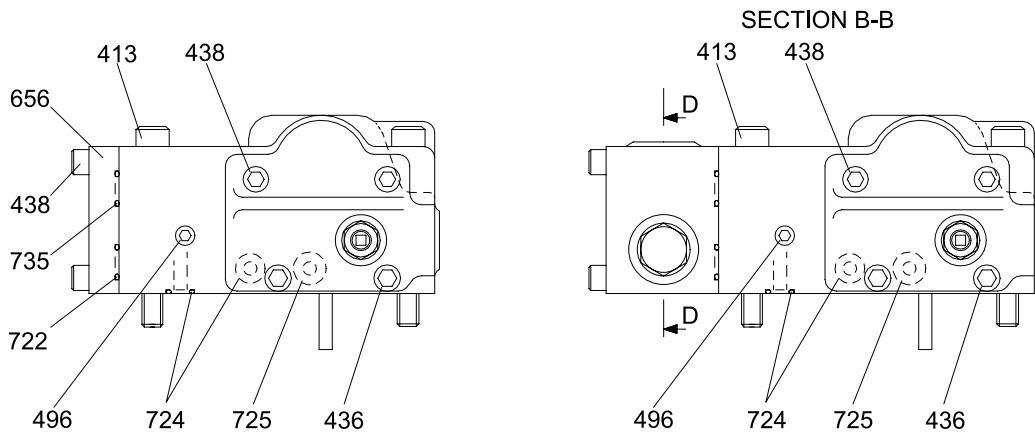
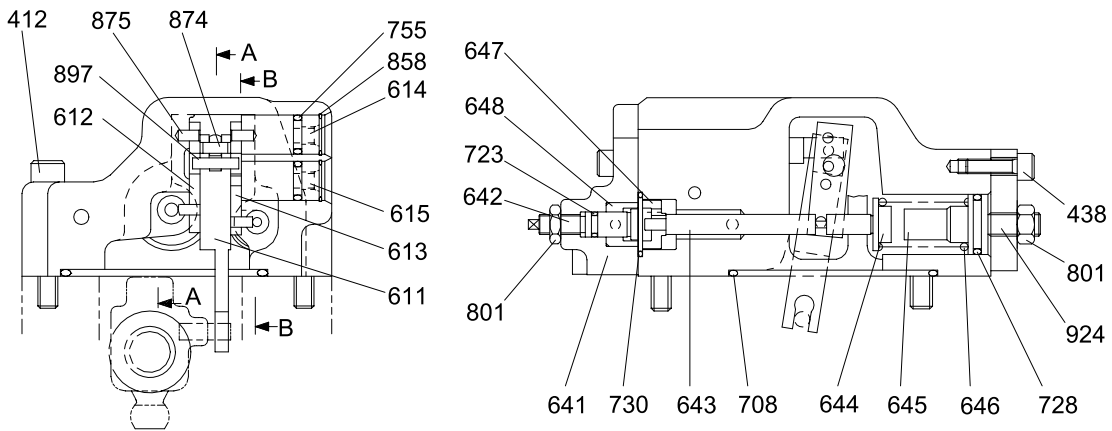
MAIN PUMP(2/2)



140W72SF03

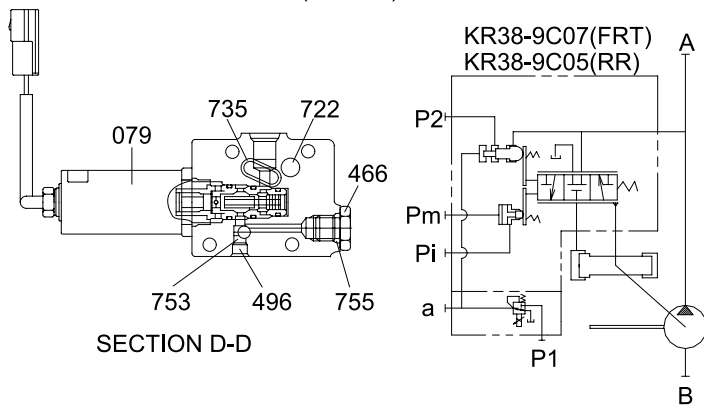
04	Gear pump	262	Cover	710	O-ring
115	Shaft	284	Plate	711	O-ring
117	Gear No.2	326	Case	728	O-ring
118	Gear No.3	414	Screw	825	Retainer ring
125	Ball bearing	435	Hexagon socket bolt	826	Retainer ring
126	Roller bearing	468	Plug	827	Retainer ring
128	Bearing spacer				

2) REGULATOR(1/2)



VIEW C(FRONT)

VIEW C(REAR)



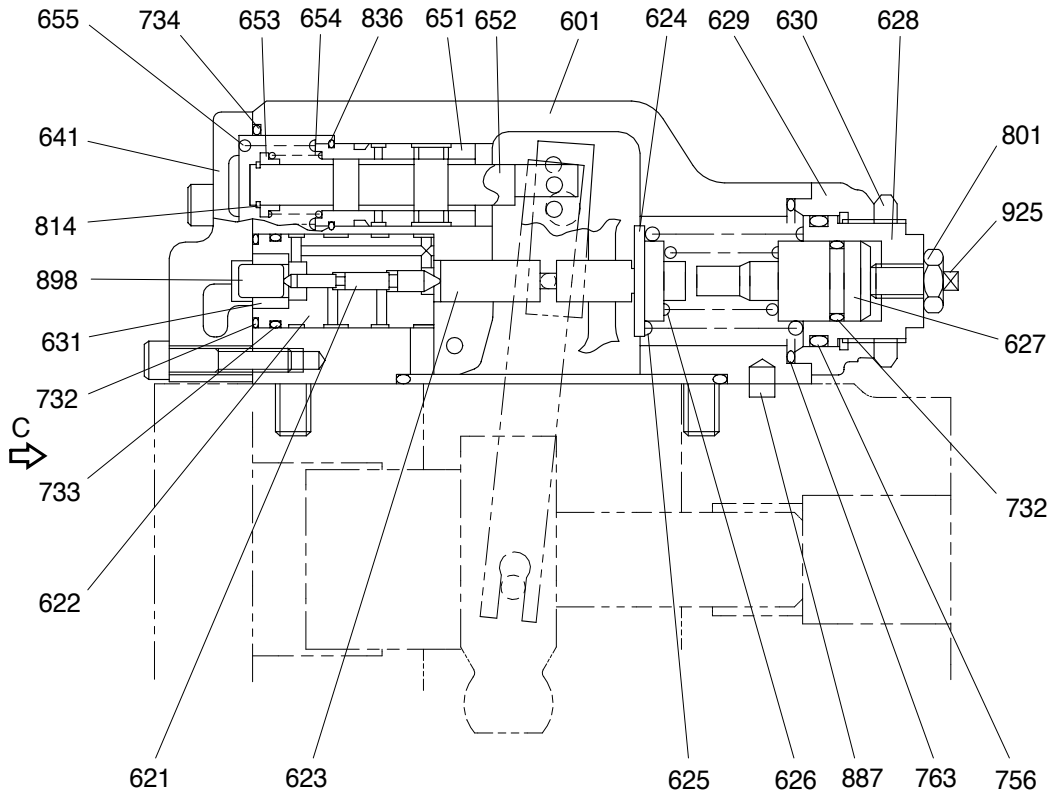
SECTION D-D

KR38-9C07(FRT)
KR38-9C05(RR)

140W72SF04

Port	Port name	port size
A	Delivery port	3/4"
B	Suction port	2 1/2"
Pn	Pilot port	PF 1/4-15
Pm	Qmax cut port	PF 1/4-15

REGULATOR(2/2)

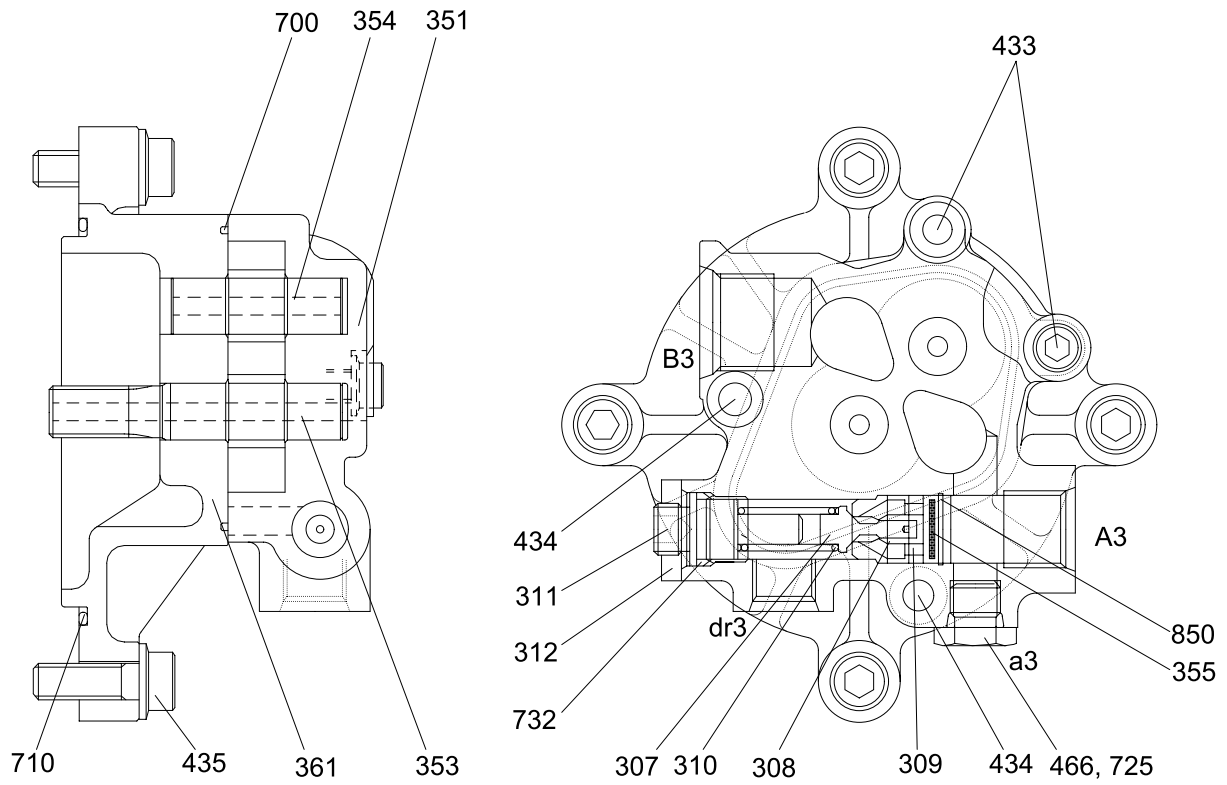


SECTION A-A

29072RE02

412 Hexagon socket screw	631 Sleeve, pf	730 O-ring
413 Hexagon socket screw	641 Pilot cover	732 O-ring
436 Hexagon socket screw	642 Pilot cover(QMC)	733 O-ring
438 Hexagon socket screw	643 Pilot piston	734 O-ring
496 Plug	644 Spring seat(Q)	735 O-ring
601 Casing	645 Adjust stem(Q)	755 O-ring
611 Feed back lever	646 Pilot spring	756 O-ring
612 Lever(1)	647 Stopper	763 O-ring
613 Lever(2)	648 Piston(QMC)	801 Nut
614 Fulcrum plug	651 Sleeve	814 Snap ring
615 Adjust plug	652 Spool	836 Snap ring
621 Compensator piston	653 Spring seat	858 Snap ring
622 Piston case	654 Return spring	874 Pin
623 Compensator rod	655 Set spring	875 Pin
624 Spring seat(C)	656 Block cover	887 Pin
625 Outer spring	708 O-ring	897 Pin
626 Inner spring	722 O-ring	898 Pin
627 Adjust stem(C)	723 O-ring	924 Set screw
628 Adjust screw(C)	724 O-ring	925 Adjust screw(QI)
629 Cover(C)	725 O-ring	
630 Lock nut	728 O-ring	

3) GEAR PUMP



140W72SF05

- 307 Poppet
- 308 Seat
- 309 Spring seat
- 310 Spring
- 311 Screw
- 312 Nut
- 351 Gear case

- 353 Drive gear
- 354 Driven gear
- 355 Filter
- 361 Front case
- 433 Flange socket
- 434 Flange socket
- 435 Flange socket

- 466 Plug
- 700 Ring
- 710 O-ring
- 725 O-ring
- 732 O-ring
- 850 Snap ring

2. FUNCTION

1) MAIN PUMP

The pumps may be classified roughly into the rotary group performing a rotary motion and working as the major part of the whole pump function: the swash plate group that varies the delivery rates: and the valve cover group that changes over oil suction and discharge.

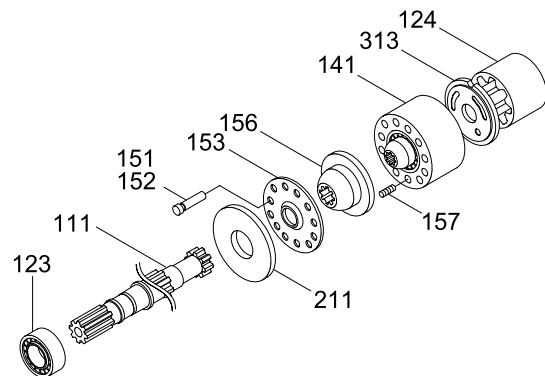
(1) Rotary group

The rotary group consists of drive shaft (F)(111), cylinder block(141), piston shoes(151,152), set plate(153), spherical bush(156) and cylinder spring(157).

The drive shaft is supported by bearing (123,124) at its both ends.

The shoe is caulked to the piston to form a spherical coupling. It has a pocket to relieve thrust force generated by loading pressure and the take hydraulic balance so that it slides lightly over the shoe plate(211). The sub group composed by a piston and a shoe is pressed against the shoe plate by the action of the cylinder spring via a retainer and a spherical bush.

Similarly, the cylinder block is pressed against valve plate(313) by the action of the cylinder spring.



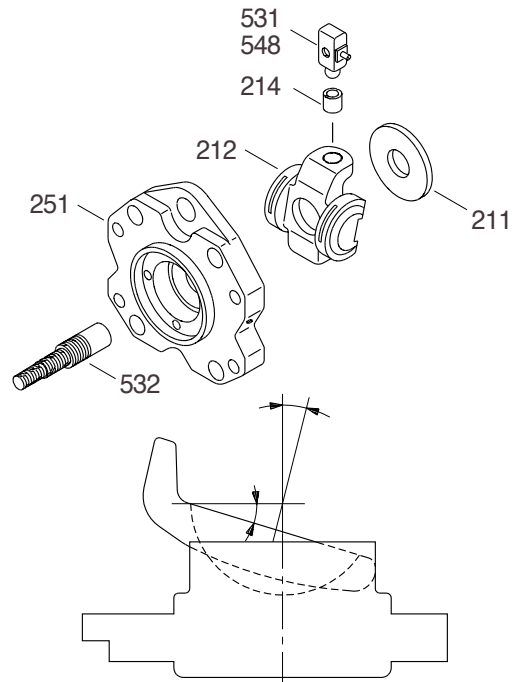
14072SF04

(2) Swash plate group

The swash plate group consists of swash plate(212), shoe plate(211), swash plate support(251), tilting bush(214), tilting pin(531) and servo piston(532).

The swash plate is a cylindrical part formed on the opposite side of the sliding surface of the shoe and is supported by the swash support.

If the servo piston moves to the right and left as hydraulic force controlled by the regulator is admitted to hydraulic chamber located on both sides of the servo piston, the swash plate slides over the swash plate support via the spherical part of the tilting pin to change the tilting angle ()



2-7 (140-7)

(3) Valve block group

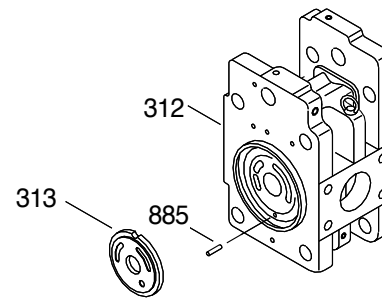
The valve block group consists of valve block(312), valve plate(313) and valve plate pin(885).

The valve plate having two melon-shaped ports is fixed to the valve block and feeds and collects oil to and from the cylinder block.

The oil changed over by the valve plate is connected to an external pipeline by way of the valve block.

Now, if the drive shaft is driven by a prime mover(electric motor, engine, etc), it rotates the cylinder block via a spline linkage at the same time. If the swash plate is tilted as in Fig(previous page) the pistons arranged in the cylinder block make a reciprocating motion with respect to the cylinder block, while they revolve with the cylinder block.

If you pay attention to a single piston, it performs a motion away from the valve plate(oil sucking process) within 180 degrees, and makes a motion towards the valve plate(or oil discharging process) in the rest of 180 degrees. When the swash plate has a tilting angle of zero, the piston makes no stroke and discharges no oil.



2-8 (140-7)

2) REGULATOR

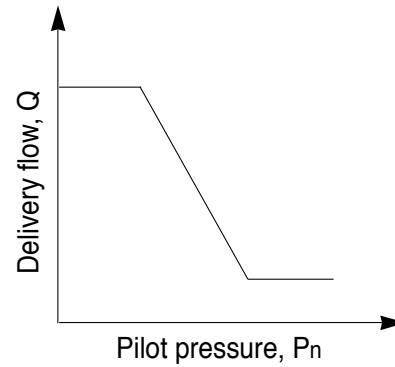
Regulator consists of the negative flow control, total horse power control and power shift control function.

(1) Negative flow control

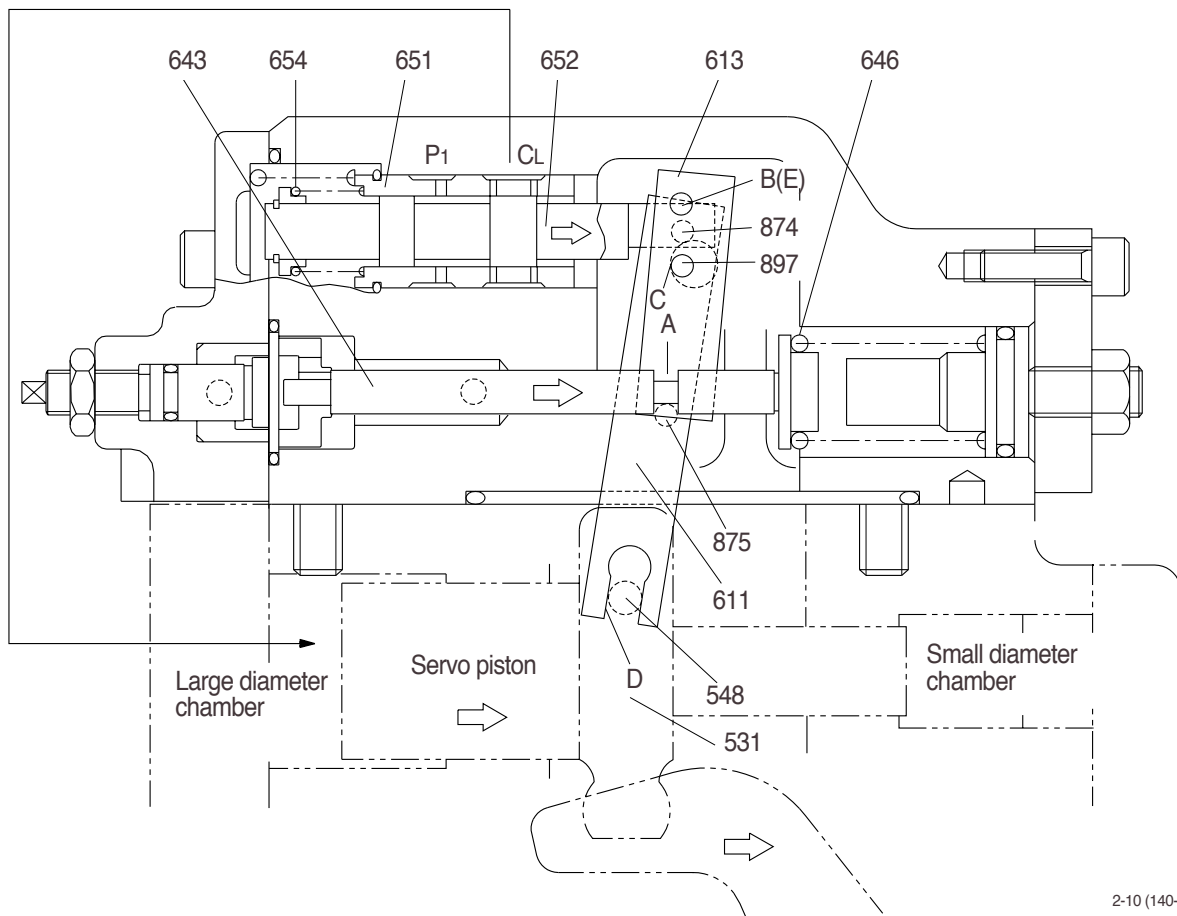
By changing the pilot pressure P_n , the pump tilting angle (delivery flow) is regulated arbitrarily, as shown in the figure.

This regulator is of the negative flow control in which the delivery flow Q decreases as the pilot pressure P_n rises.

With this mechanism, when the pilot pressure corresponding to the flow required for the work is commanded, the pump discharges the required flow only, and so it does not consume the power uselessly.



Flow reducing function



2-10 (140-7)

As the pilot pressure P_n rises, the pilot piston(643) moves to the right to a position where the force of the pilot spring(646) balances with the hydraulic force.

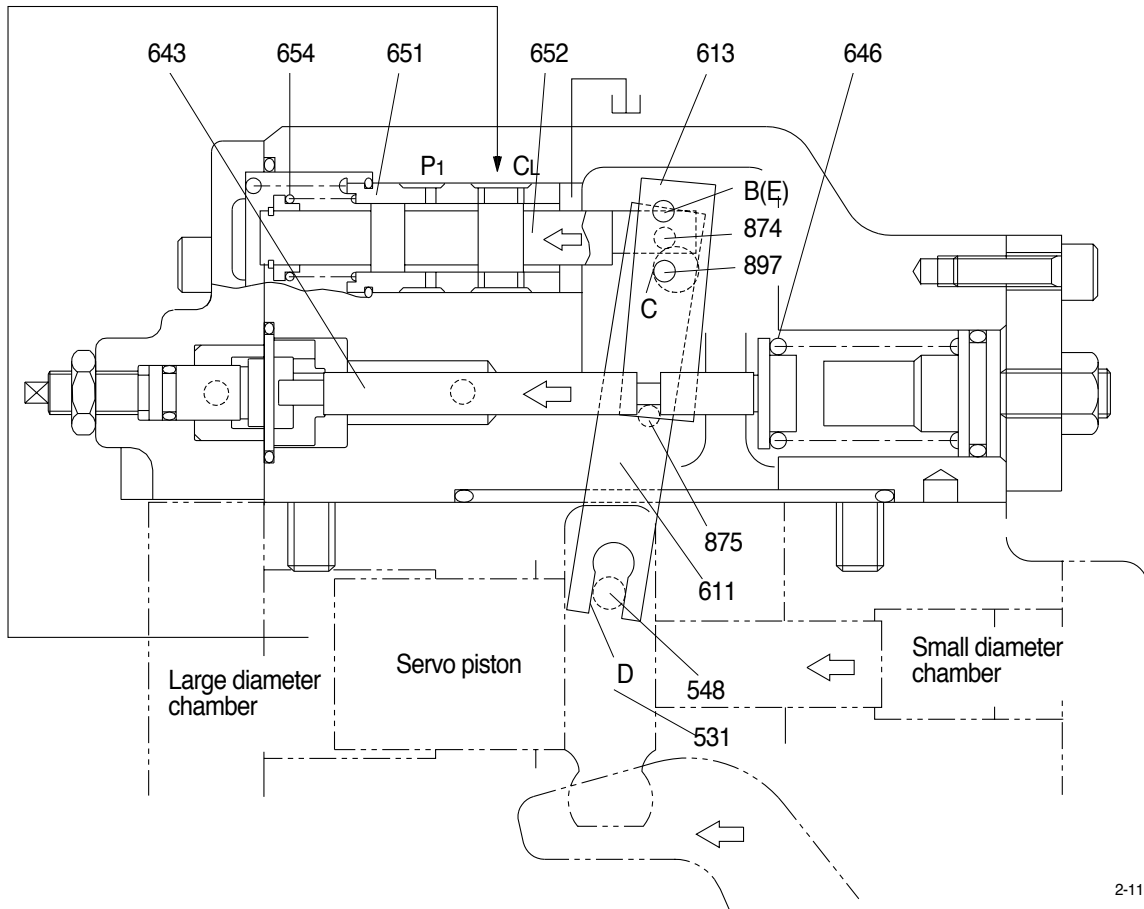
The groove(A) in the pilot piston is fitted with the pin(875) that is fixed to lever 2(613). Therefore, when the pilot piston moves, lever 2 rotates around the fulcrum of point B [fixed by the fulcrum plug(614) and pin(875)]. Since the large hole section(C) of lever 2 contains a protruding pin(897) fixed to the feedback lever(611), the pin(897) moves to the right as lever 2 rotates. Since the opposing-flat section(D) of the feedback lever is fitted with the pin(548) fixed by the tilting pin(531) that swings the swash plate, the feedback lever rotates around the fulcrum of point D, as the pin(897) moves.

Since the feedback lever is connected with the spool(652) via the pin(874), the spool moves to the right.

The movement of the spool causes the delivery pressure P_1 to connect to port CL through the spool and to be admitted to the large diameter section of the servo piston. The delivery pressure P_1 that is constantly admitted to the small diameter section of the servo piston moves the servo piston to the right due to the area difference, resulting in decrease of the tilting angle. When the servo piston moves to the right, point D also moves to the right. The spool is fitted with the return spring(654) and is tensioned to the left at all times, and so the pin(897) is pressed against the large hole section(C) of lever 2.

Therefore, as point D moves, the feedback lever rotates around the fulcrum of point C, and the spool is shifted to the left. This causes the opening between the sleeve(651) and spool(652) to close slowly, and the servo piston comes to a complete stop when it closes completely.

Flow increasing function



2-11 (140-7)

As the pilot pressure P_n decreases, the pilot piston(643) moves to the left by the action of the pilot spring(646) and causes lever 2(613) to rotate around the fulcrum of point B. Since the pin(897) is pressed against the large hole section(C) of lever 2 by the action of the return spring(654) via the spool(652), pin(874), and feedback lever(611), the feedback lever rotates around the fulcrum of point D as lever 2 rotates, and shifts the spool to the left. Port CL opens a way to the tank port as the spool moves. This deprives the large diameter section of the servo piston of pressure, and shifts the servo piston to the left by the discharge pressure P_1 in the small diameter section, resulting in an increase in the flow rate.

As the servo piston moves, point D also moves to the left, the feedback lever rotates around the fulcrum of point C, and the spool moves to the right till the opening between the spool and sleeve is closed.

Adjustment of flow control characteristic

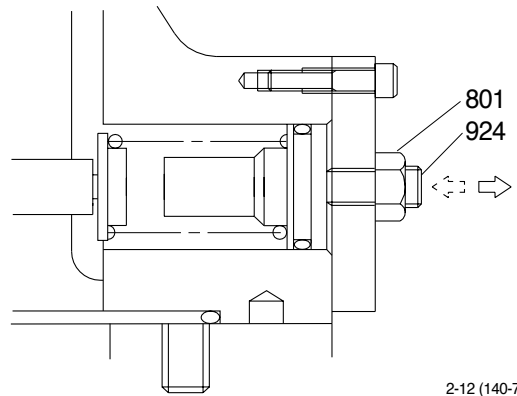
The flow control characteristic can be adjusted with the adjusting screw.

Adjust it by loosening the hexagon nut(801) and by tightening(or loosening) the hexagonal socket head screw(924).

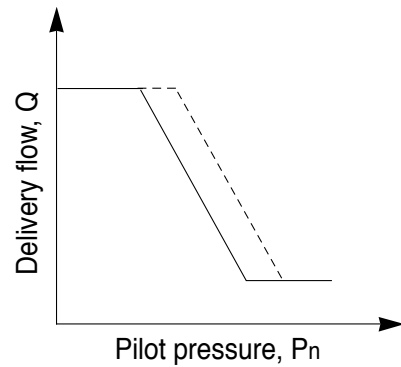
Tightening the screw shifts the control chart to the right as shown in the figure.

Adjusting values are shown in table.

Speed	Adjustment of flow control characteristic		
	Tightening amount of adjusting screw(924)	Flow control starting pressure change amount	Flow change amount
(min ⁻¹)	(Turn)	(kgf/cm ²)	(/min)
2100	+1/4	+1.5	+7.9



2-12 (140-7)



(2) Total horsepower control

The regulator decreases the pump tilting angle (delivery flow) automatically to limit the input torque within a certain value with a rise in the delivery pressure P_1 of the self pump and the delivery pressure P_2 of the companion pump.

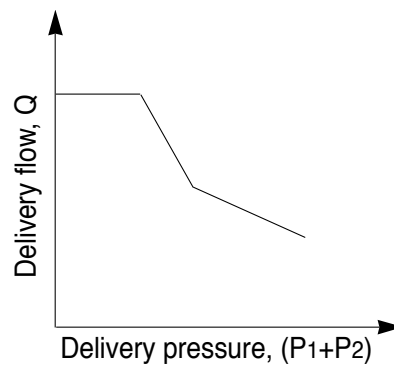
(The input horsepower is constant when the speed is constant.)

Since the regulator is of the simultaneous total horsepower type that operates by the sum of load pressures of the two pumps in the tandem double-pump system, the prime mover is automatically prevented from being overloaded, irrespective of the load condition of the two pumps, when horsepower control is under way.

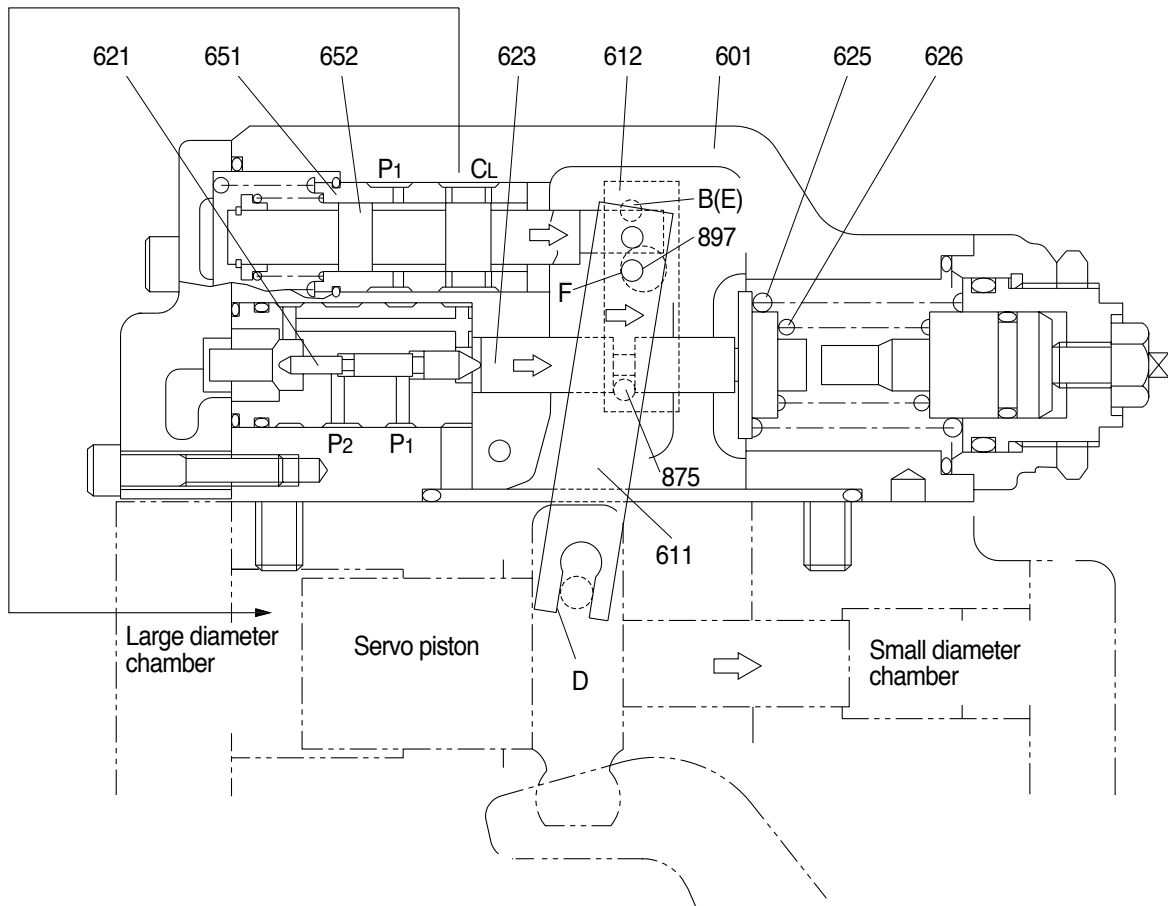
Since this regulator is of the simultaneous total horsepower type, it controls the tilting angles (displacement volumes) of the two pumps to the same value as represented by the following equation :

$$\begin{aligned} T_{in} &= P_1 \times q/2 + P_2 \times q/2 \\ &= (P_1 + P_2) \times q/2 \end{aligned}$$

The horsepower control function is the same as the flow control function and is summarized in the following. (For detailed behaviors of respective parts, refer to the section of flow control).



Overload preventive function



2-14 (140-7)

When the self pump delivery pressure P1 or the companion pump delivery pressure P2 rises, it acts on the stepped part of the compensating piston(621). It presses the compensating rod(623) to the right till the force of the outer spring(625) and inner spring(626) balances with the hydraulic force. The movement of the compensating rod is transmitted to lever 1(612) via pin(875). Lever 1 rotates around the pin(875) (E) fixed to the casing(601). Since the large hole section(F) of lever 1 contains a protruding pin(897) fixed to the feedback lever(611), the feedback lever rotates around the fulcrum of point D as lever 1 rotates, and then the spool(652) is shifted to the right. As the spool moves, the delivery pressure P1 is admitted to the large diameter section of the servo piston via port CL, causes the servo piston move to the right, reduces the pump delivery, flow rate, and prevents the prime mover from being overloaded. The movement of the servo piston is transmitted to the feedback lever via point D. Then the feedback lever rotates around the fulcrum of point F and the spool is shifted to the left. The spool moves till the opening between the spool(652) and sleeve(651) is closed.

Low tilting angle(Low flow) command preferential function

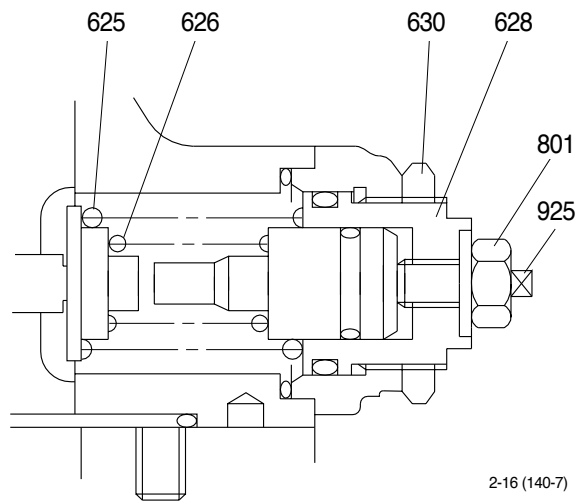
As mentioned above, flow control and horsepower control tilting angle commands are transmitted to the feedback lever and spool via the large-hole sections(C & F) of levers 1 and 2. However, since sections C and F have the pins(Ø4) protruding from the large hole(Ø8), only the lever lessening the tilting angle contacts the pin(897) ; the hole(Ø8) in the lever of a larger tilting angle command is freed without contacting the pin(897). Such a mechanical selection method permits preference of the lower tilting angle command of the flow control and horsepower control.

Adjustment of input horsepower

Since the regulator is of total cumulative horsepower type, adjust the adjusting screws of both the front and rear pumps, when changing the horsepower set values. The pressure change values by adjustment are based on two pumps pressurized at the same time, and the values will be doubled when only one pump is loaded.

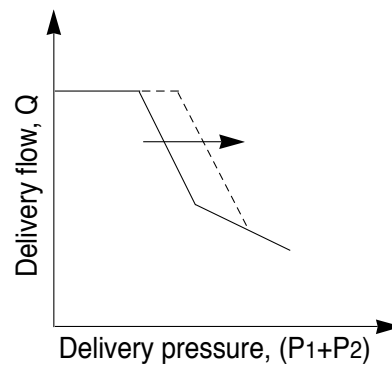
a. Adjustment of outer spring

Adjust it by loosening the hexagon nut(630) and by tightening(or loosening) the adjusting screw C(628). Tightening the screw shifts the control chart to the right and increases the input horsepower as shown in the figure. Since turning the adjusting screw C by N turns changes the setting of the inner spring(626), return the adjusting screw QI(925) by $N \times A$ turns at first.($A=1.9$)



Adjusting values are shown in table

Speed	Adjustment of outer spring		
	Tightening amount of adjusting screw(C) (924)	Compensating control starting pressure change amount	Input torque change amount
(min ⁻¹)	(Turn)	(kgf/cm ²)	(kgf · m)
2100	+1/4	+19.2	+3.04



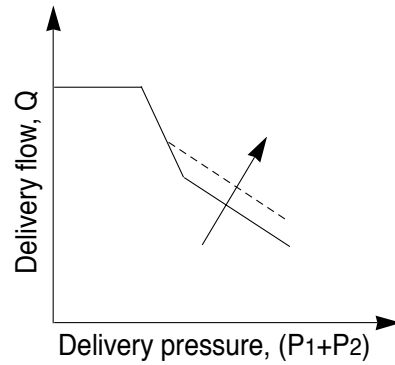
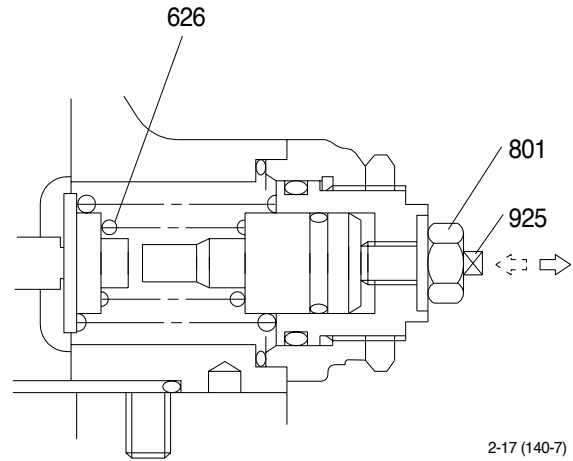
b. Adjustment of inner spring

Adjust it by loosening the hexagon nut (801) and by tightening(or loosening) the adjusting screw QI(925).

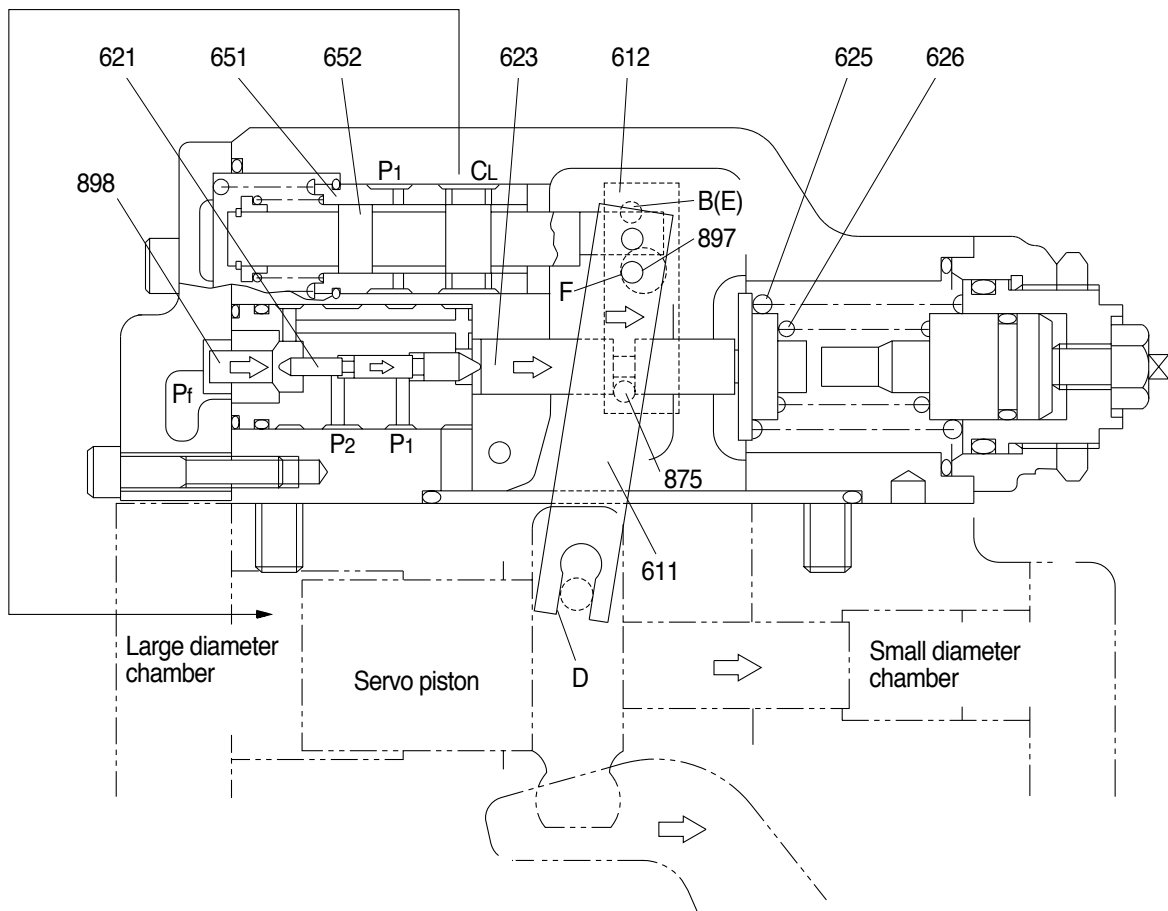
Tightening the screw increases the flow and then the input horsepower as shown in the figure.

Adjusting valves are shown in table

Speed	Adjustment of inner spring		
	Tightening amount of adjusting screw(QI) (925)	Flow change amount	Input torque change amount
(min ⁻¹)	(Turn)	(/min)	(kgf · m)
2100	+1/4	+5.6	+2.56



(3) Power shift control



2-18 (140-7)

The set horsepower valve is shifted by varying the command current level of the proportional pressure reducing valve attached to the pump.

Only one proportional pressure reducing valve is provided.

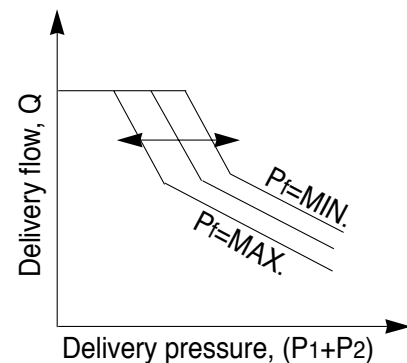
However, the secondary pressure P_f (power shift pressure) is admitted to the horsepower control section of each pump regulator through the pump's internal path to shift it to the same set horsepower level.

This function permits arbitrary setting of the pump output power, thereby providing the optimum power level according to the operating condition.

The power shift pressure P_f controls the set horsepower of the pump to a desired level, as shown in the figure.

As the power shift pressure P_f rises, the compensating rod (623) moves to the right via the pin (898) and compensating piston (621).

This decreases the pump tilting angle and then the set horsepower in the same way as explained in the overload preventive function of the horsepower control. On the contrary, the set horsepower rises as the power shift pressure P_f falls.

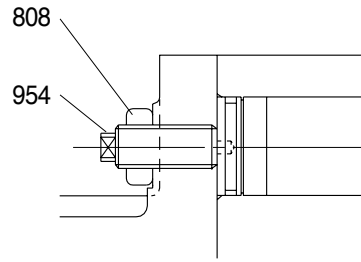


(4) Adjustment of maximum and minimum flows

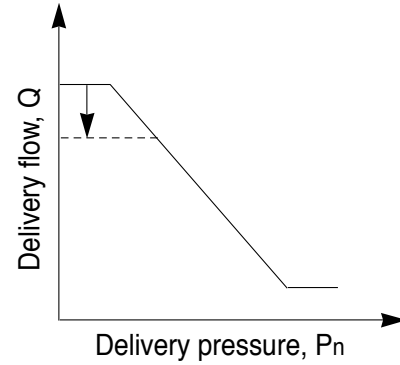
Adjust it by loosening the hexagon nut(808) and by tightening(or loosening) the set screw(954).

The maximum flow only is adjusted without changing other control characteristics.

Speed	Adjustment of min flow	
	Tightening amount of adjusting screw (954)	Flow change amount
(min ⁻¹)	(Turn)	(/min)
2100	+1/4	-3.4



2-19(1) 140-7

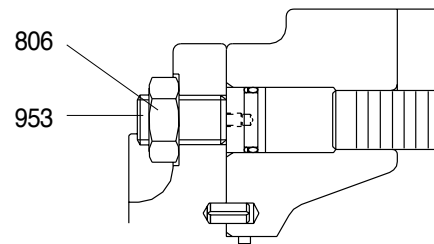


Adjustment of minimum flow

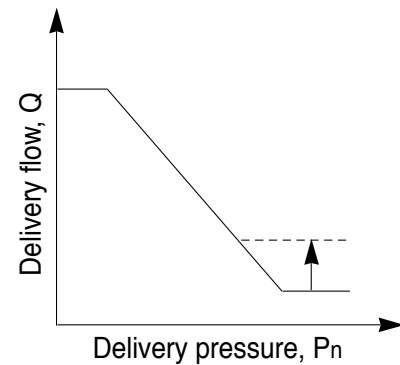
Adjust it by loosening the hexagon nut(808) and by tightening(or loosening) the hexagonal socket head set screw (953). Similarly to the adjustment of the maximum flow, other characteristics are not changed.

However, remember that, if tightened too much, the required horsepower during the maximum delivery pressure(or during relieving) may increase.

Speed	Adjustment of min flow	
	Tightening amount of adjusting screw (953)	Flow change amount
(min ⁻¹)	(Turn)	(/min)
2100	+1/4	+3.4

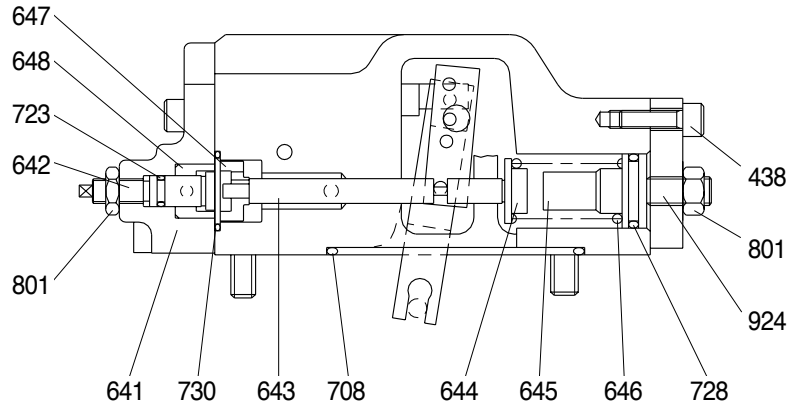


2-19(2) 140-7



(5) Qmax cut control

The regulator regulates the maximum delivery flow by inputting the pilot pressure P_m . Since this is a 2-position control method, the maximum delivery flow may be switched in two steps by turning on/off the pilot pressure P_m . (The maximum control flow cannot be controlled in intermediate level.)



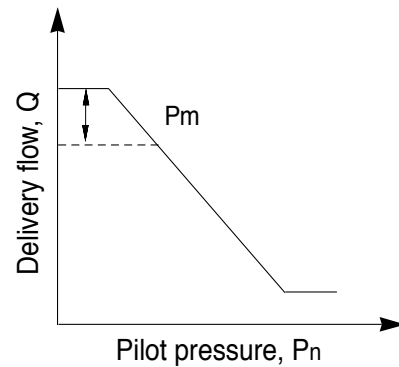
2-4 (140-7)

Functional explanation

As shown in the figure, the pilot pressure P_m switches the maximum flow in two steps.

When the pilot pressure P_m is given, it is admitted to the lefthand side of the piston QMC(648). The piston QMC moves the stopper(647) and pilot piston(643) to the right, overcoming the force of the pilot spring(646), thereby reducing the delivery flow of the pump.

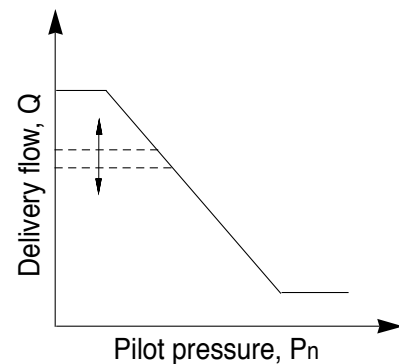
Since the adjusting screw QMC(642) is provided with a flange, the piston QMC stops upon contact with the flange, and the position of the pilot piston at this time determines the maximum flow of the pump.



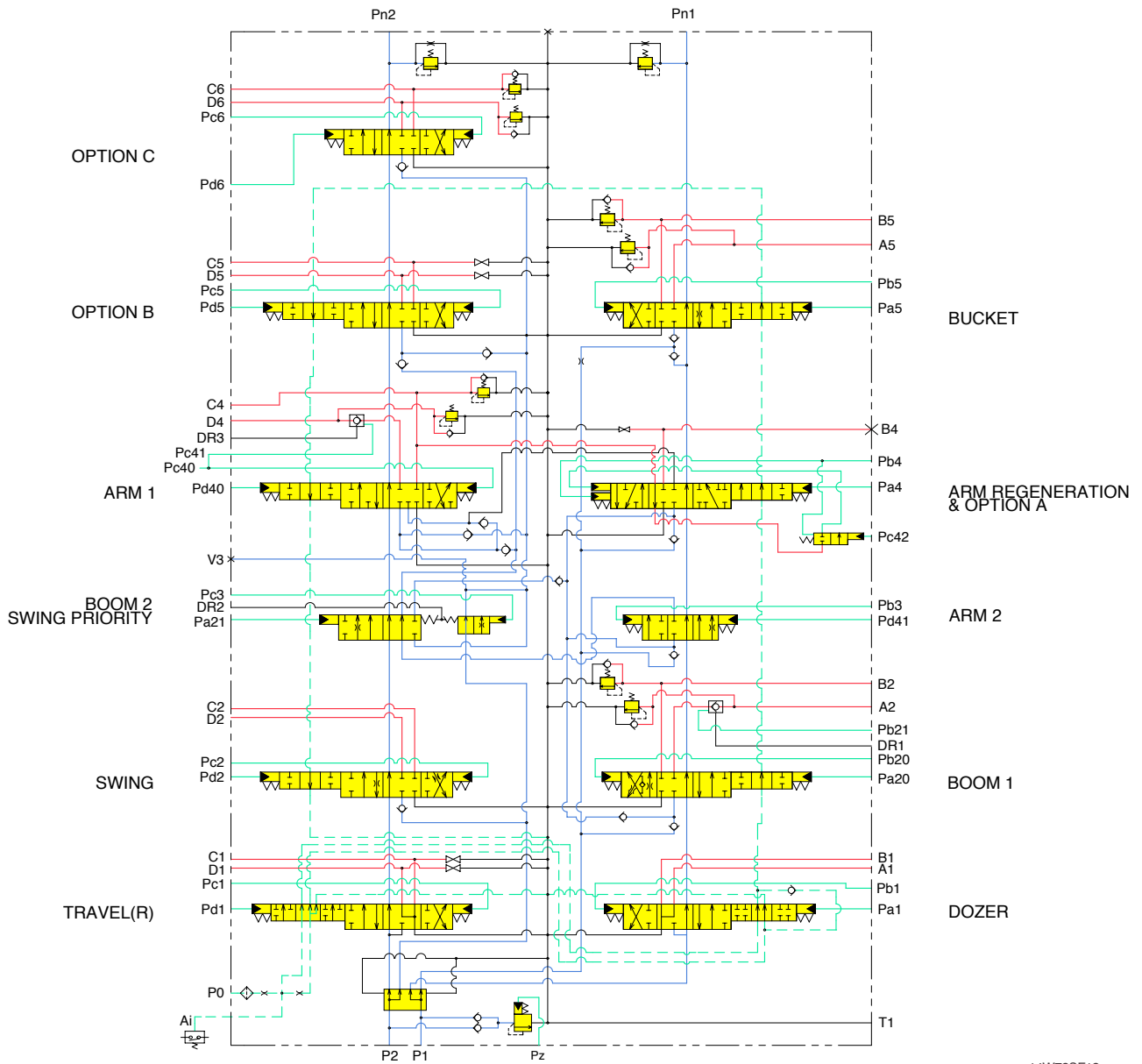
Adjustment of Qmax cut flow

Adjust it by loosening the hexagon nut(801) and by tightening(or loosening) the adjusting screw QMC(642).

Tightening the screw decreases the Q_{max} cut flow as shown in the figure.



2. HYDRAULIC CIRCUIT

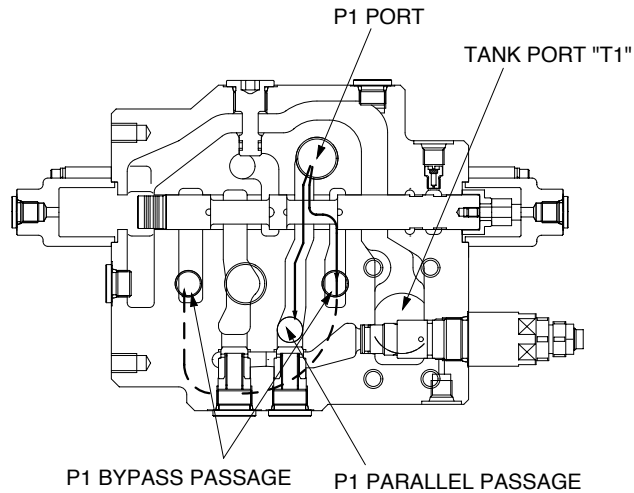


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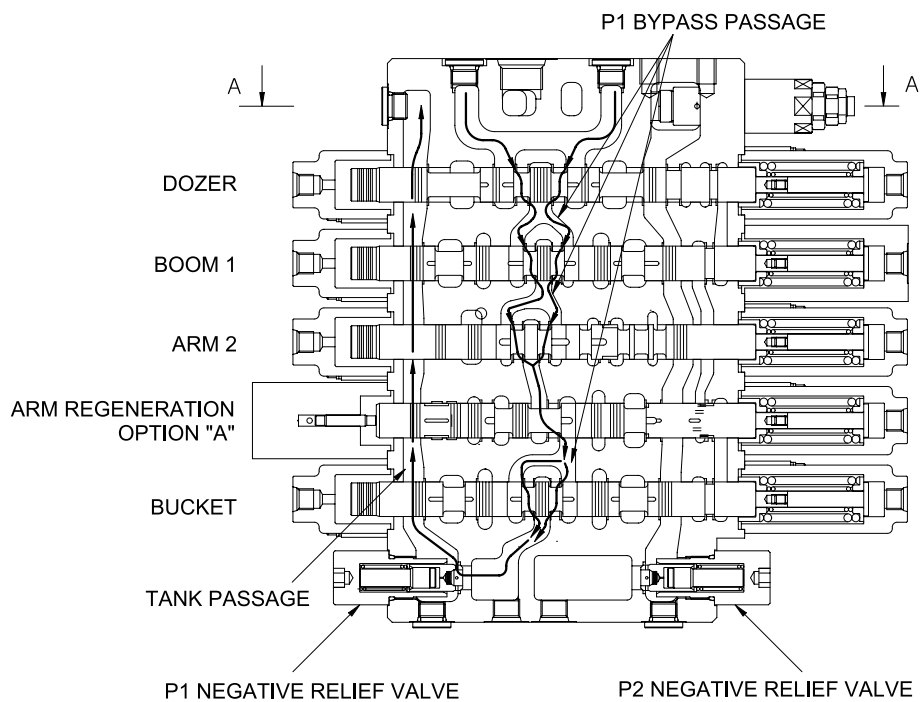
3. FUNCTION

1) CONTROL IN NEUTRAL FUNCTION

(1) P1 SIDE



14W72SF13

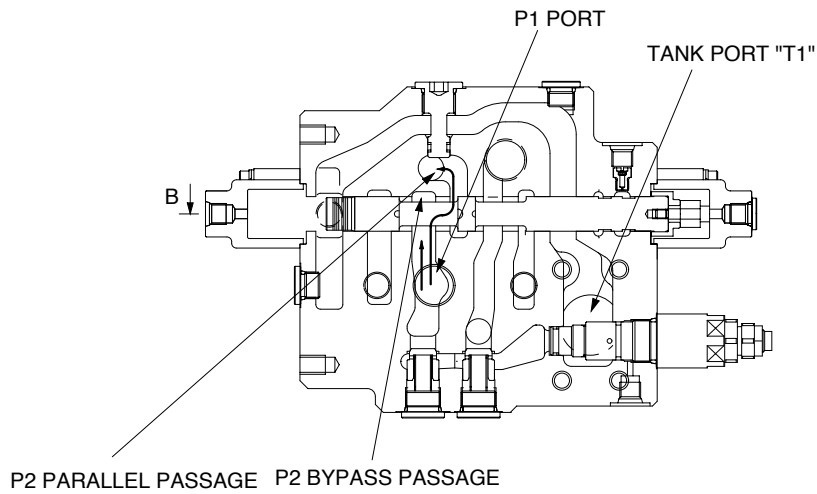


14W72SF15

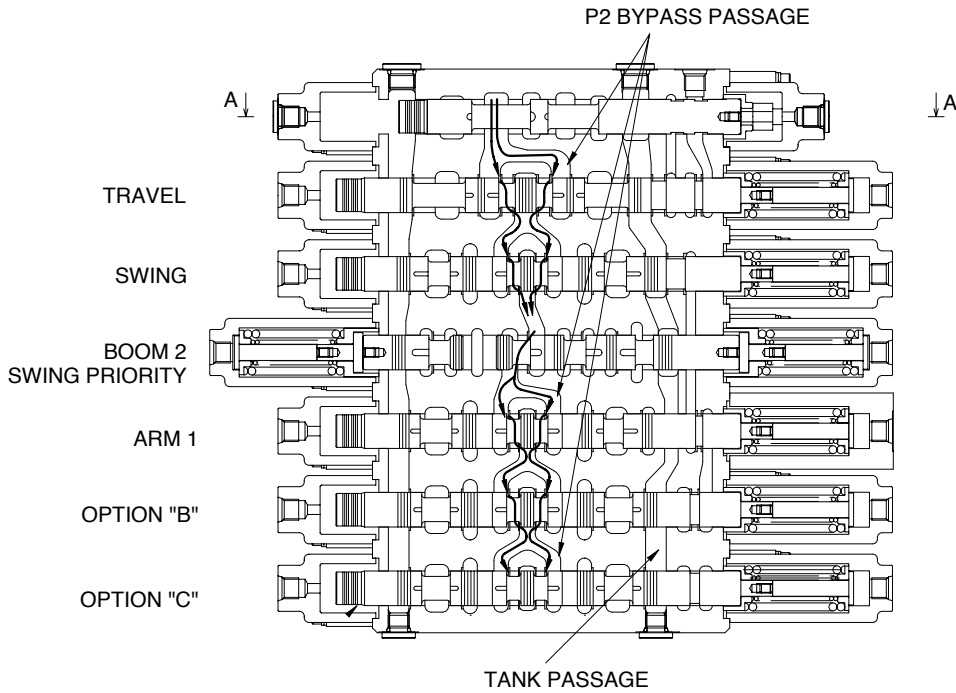
The hydraulic fluid from pump P1 flows into the main control valve through the inlet port "P1", into the P1 bypass passage and P1 parallel passage.

The hydraulic fluid from the pump P1 is directed to the tank through the bypass passage of spools : travel left, boom1, arm2, arm regeneration & option A and bucket, the negative relief valve, tank passage, and the tank port "T1"

(2) P2 SIDE



14W72SF14



14W72SF16

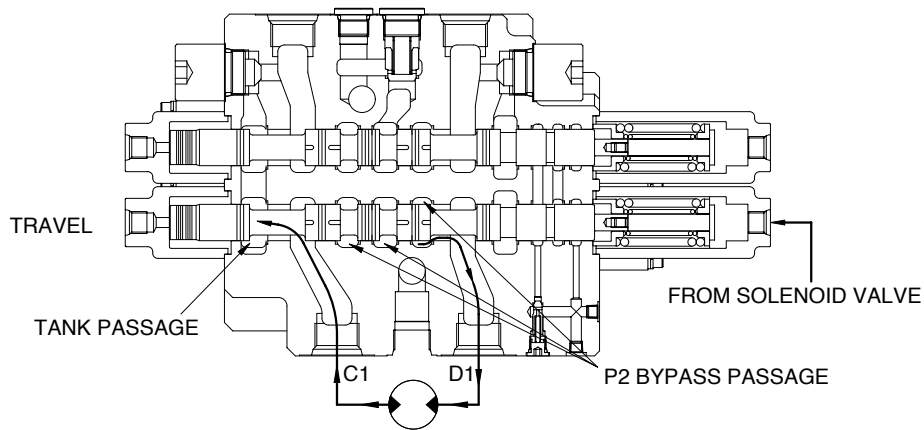
The hydraulic fluid from pump P2 flows into the main control valve through the inlet port "P2", into the P2 bypass passage and P2 parallel passage.

The hydraulic fluid from the pump P2 is directed to the tank through the bypass passage of spools : travel right, swing, boom2 & swing priority, arm1, option "B" and option "C", and the negative relief valve with the tank passage.

2) EACH SPOOL OPERATION

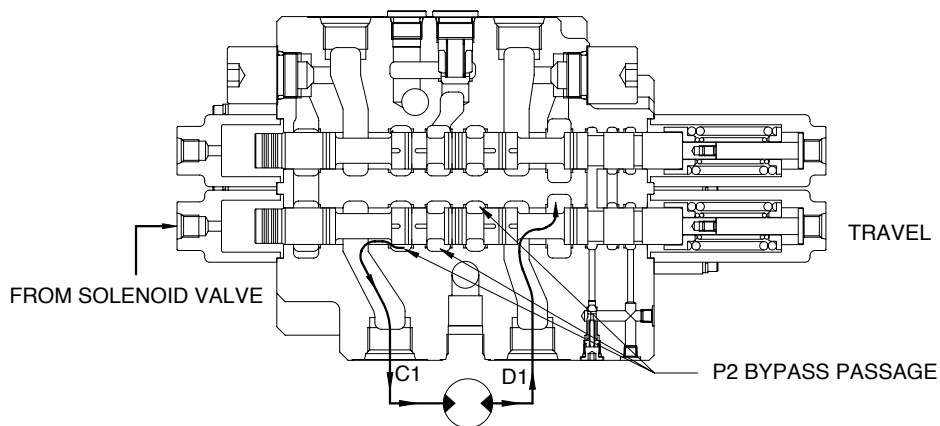
(1) TRAVEL OPERATION

Travel forward operation



14W72SF17

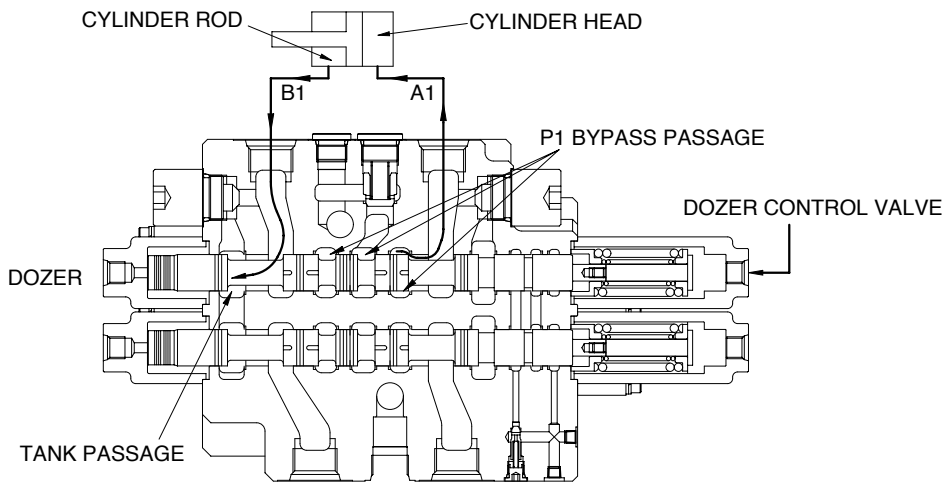
Travel backward operation



14W72SF18

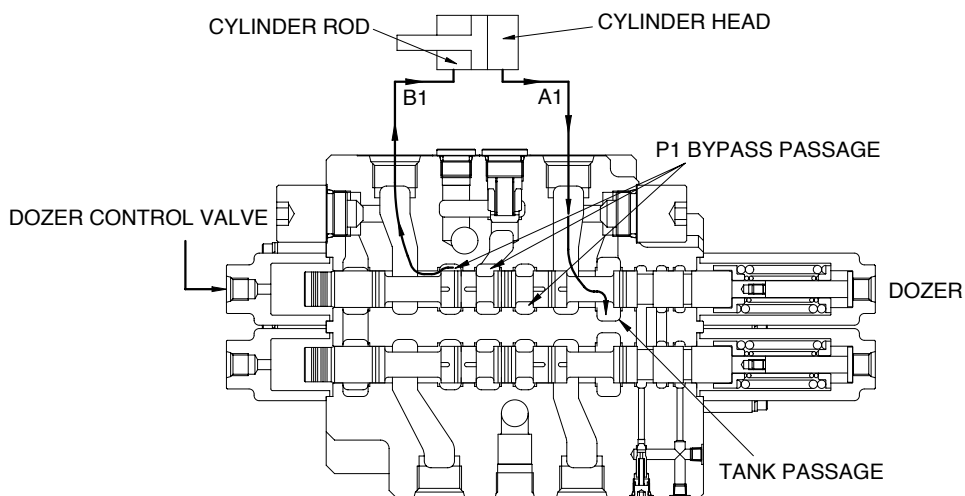
During the travel operation, the hydraulic fluid of the pump P2 is supplied to the travel motor. The pilot pressure from the solenoid valve is supplied to the spring side of pilot port. And it shifts travel spool in the left direction against springs. Hydraulic fluid from the pump P2 flow into the travel spool through the bypass passage. Then they are directed to the travel motor through port D1. As a result, the travel motor turn and hydraulic fluid returns to the tank passage through the travel spool. In case of the opposite operation, the operation is similar.

(2) DOZER OPERATION
Dozer down operation



14W72SF17A

Dozer up operation



14W72SF18A

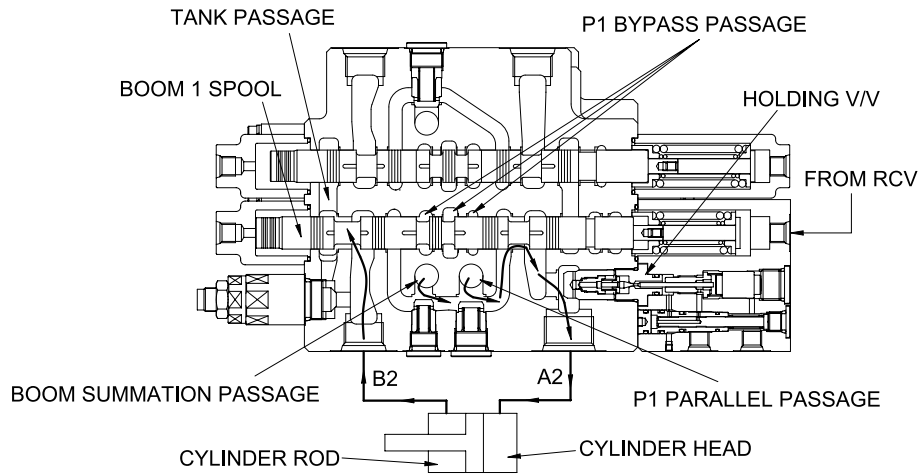
During dozer down operation, the pilot pressure from the dozer control valve is supplied into the port Pa1 and shift the dozer spool in the left direction.

The hydraulic fluid from the pump P1 enters the bypass passage and is directed to the head side of the dozer cylinder through port A1.

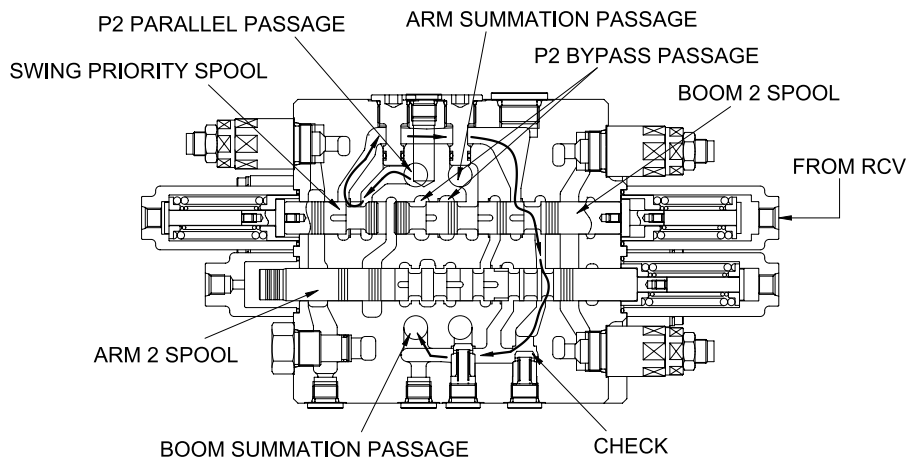
The return flow from the rod side of the dozer cylinder returns to the dozer spool through B1 port. Thereafter it is directed to the hydraulic tank through tank passage.

In case of the dozer up operation, operation is similar.

(3) BOOM OPERATION
Boom up operation



14072SF24



14072SF25

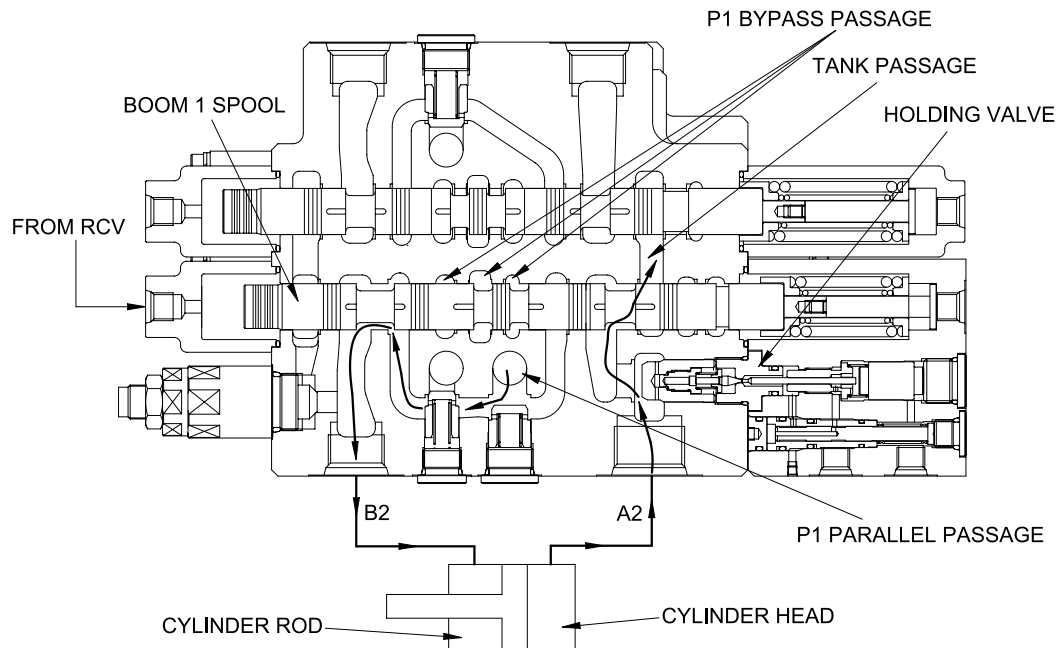
During boom up operation, the pilot pressure from RCV is supplied into the port Pa20 and shift the boom1 spool in the left direction. The hydraulic oil fluid from pump P1 is entered P1 parallel passage and then passes through the load check valve and boom holding valve then flows into the port A2. Following this it flows into the head side of the boom cylinder.

(In this case, the boom holding valve is free flow condition)

At the same time the pilot pressure through the port Pa21 shifts the boom2 spool. The hydraulic oil fluid from pump P2 entered boom summation passage via the P2 parallel passage, the swing priority spool, the boom2 spool, arm1 spool and the check. The flows combine in passage and are directed to port A2 and head side of boom cylinder.

The flow from rod side of the boom cylinder return to the boom1 spool through the port B2. There after it is directed to the hydraulic oil tank through the tank passage.

Boom down operation



14072SF26

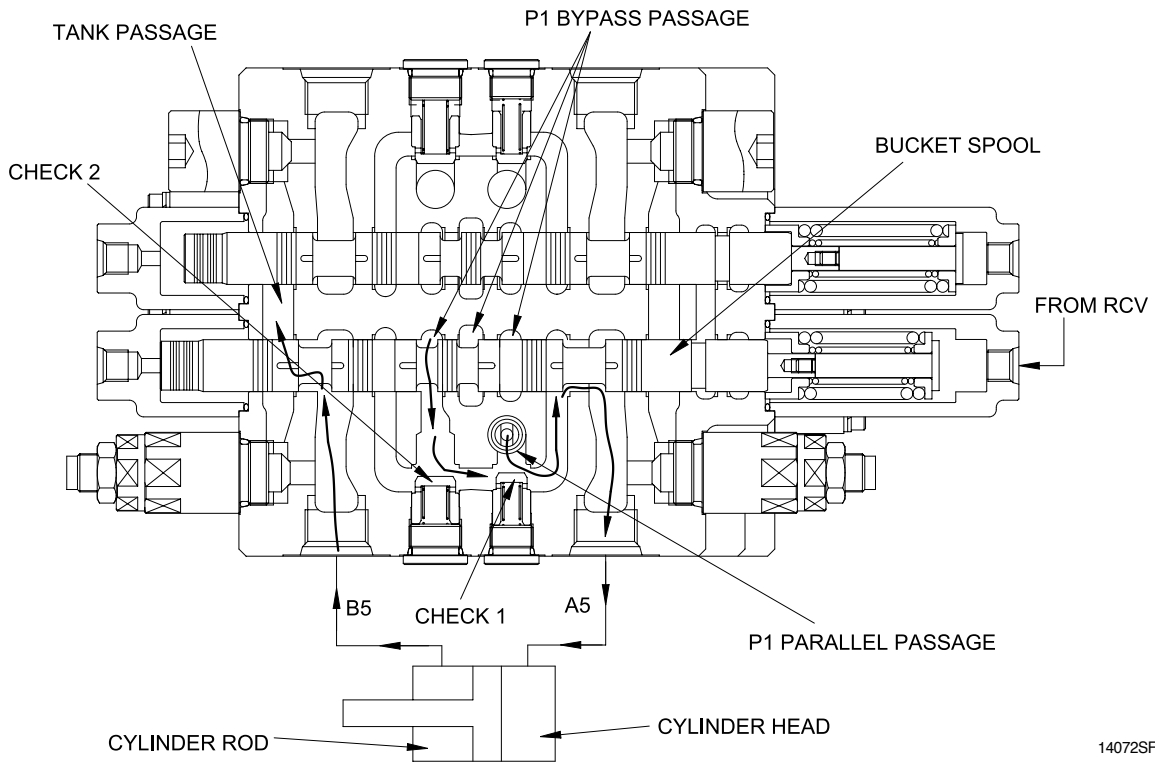
During the boom lowering operation, the pilot pressure from RCV is supplied to the port Pb20 and shift the boom1 spool in the right direction.

The hydraulic fluid from the pump P1 enters the parallel passage and is directed to the port B2 through the load check valve. Following this, it flows into the rod side of the boom cylinder.

The return flow from the head side of the boom cylinder returns to the boom1 spool through the port A2 and boom holding valve. Thereafter it is directed to the hydraulic oil tank through tank passage.

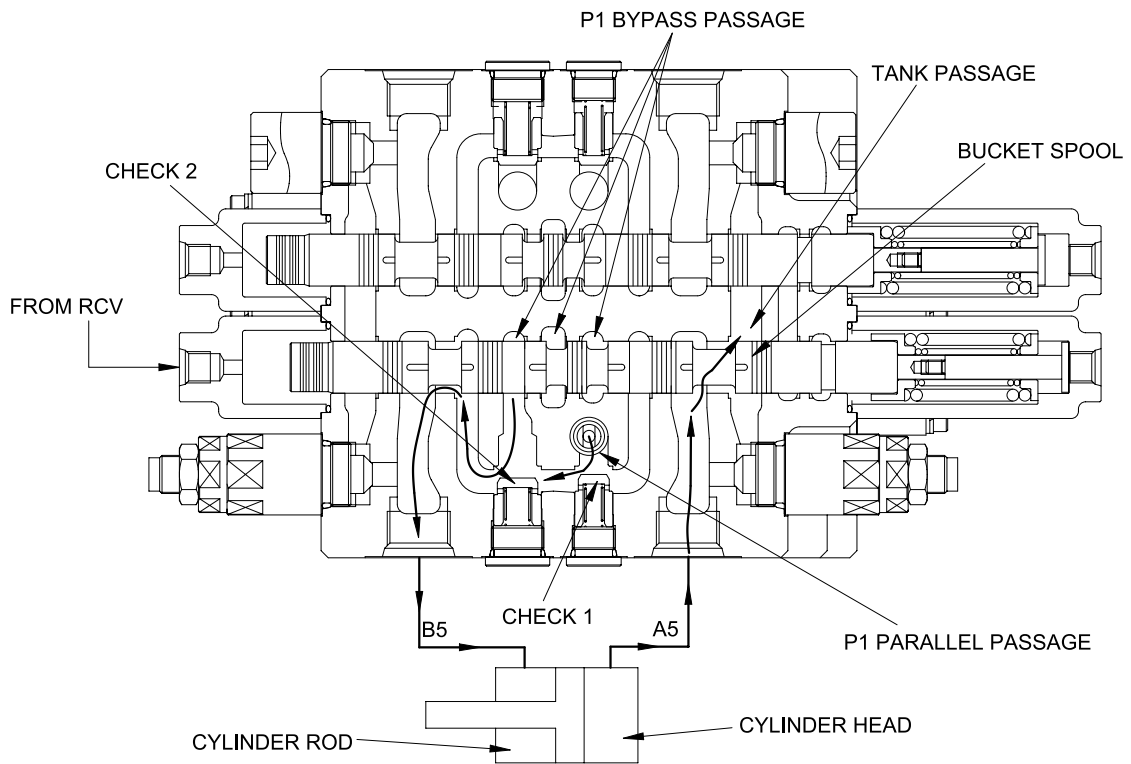
For details of the boom holding valve, see page 2-36.

(4) BUCKET OPERATION
Bucket roll in operation



14072SF34

Bucket roll out operation



14072SF35

Bucket roll in operation

During the bucket roll in operation, the pilot pressure from RCV is supplied to port Pa5 and shift the bucket spool in the left direction.

The hydraulic fluid from pump P1 entered P1 parallel passage and is directed to the port A5 through the check1.

At the same time, the hydraulic fluid from P1 bypass passage is directed to the port A5 through the check2.

Following this it flows into the head side of the bucket cylinder.

The return flow from the rod side of the bucket cylinder returns to the bucket spool through the port B5. Thereafter it is directed to the hydraulic oil tank through the tank passage.

Bucket roll out operation

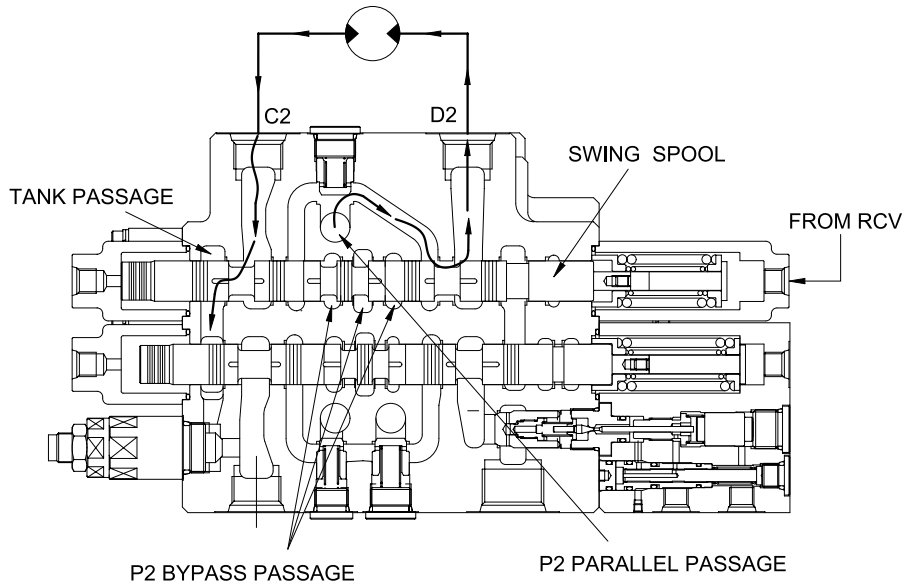
In case of the bucket roll out operation, the operation is similar

Bucket operation with arm or boom operation

When combined operation, mostly same as above but the fluid from bypass passage is empty.

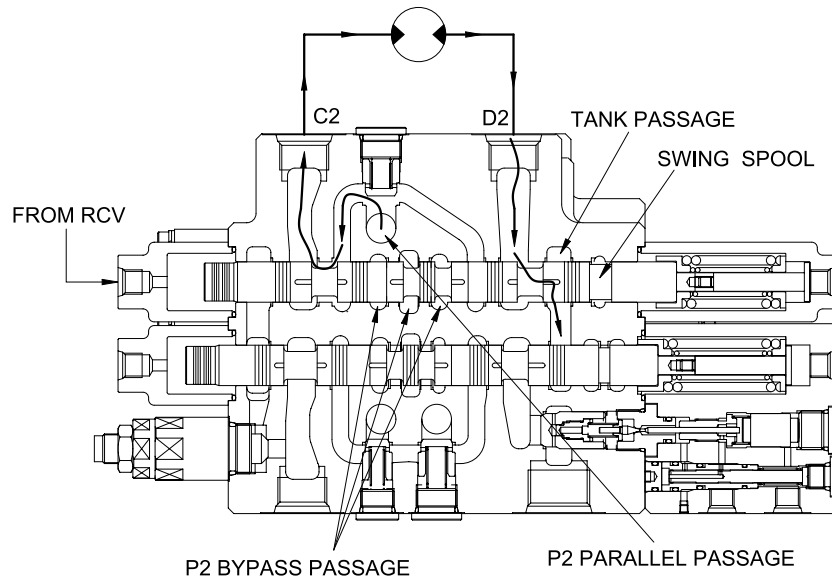
So only the fluid from parallel passage is supplied to the bucket cylinder. Also, parallel passage is installed the orifice for supplying the fluid from pump to the boom or the arm operation prior to the bucket operation.

(5) SWING OPERATION
Swing left operation



14072SF32

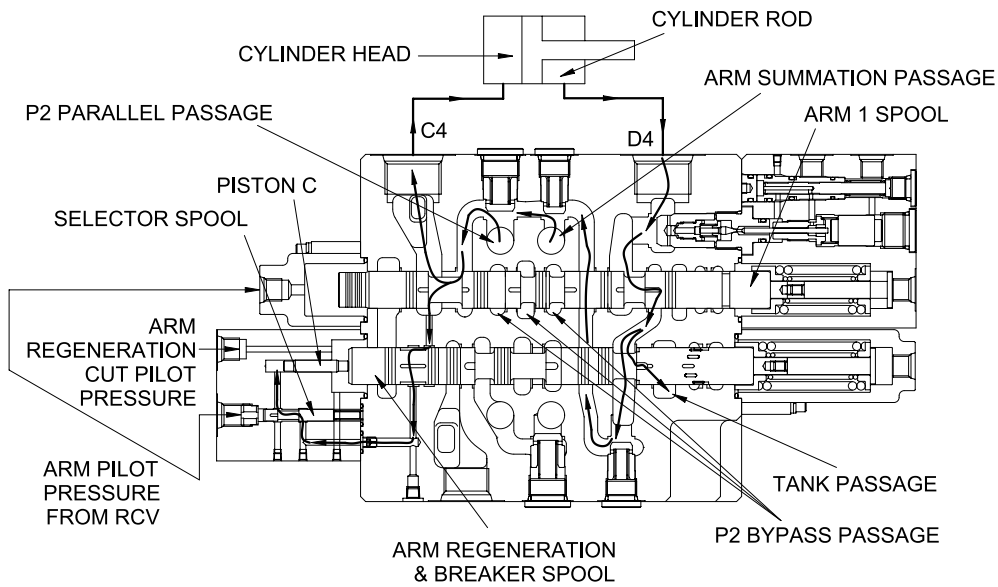
Swing right operation



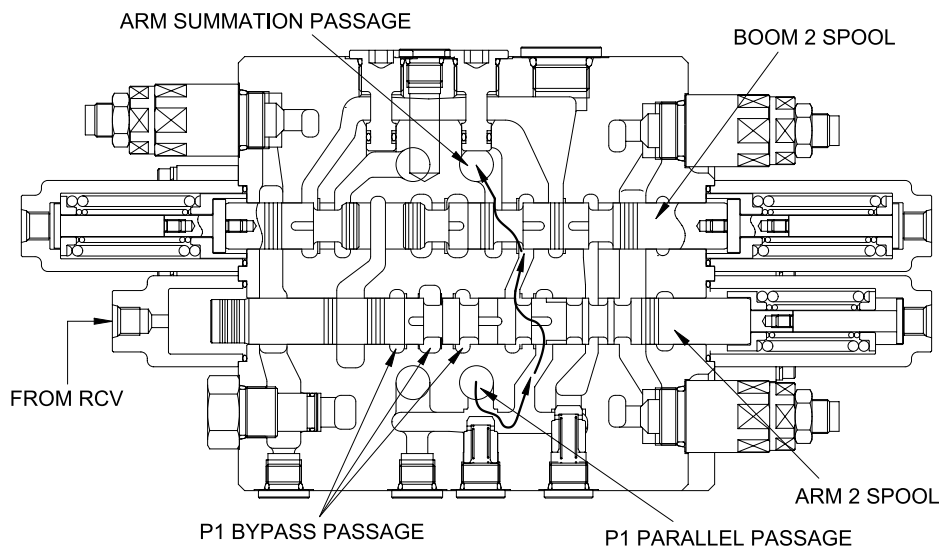
14072SF33

The pilot pressure from the RCV is supplied to the Pd2 and shift the swing spool in left direction. The hydraulic fluid from pump P2 flows into swing spool through the parallel passage. Then it is directed to swing motor through the port D2. As the result, swing motor turns and flow from the swing motor returns to the hydraulic oil tank through the port C2, swing spool and the tank passage . In case of swing right operation, the operation is similar.

(6) ARM OPERATION
Arm roll in operation



14072SF21



14072SF20

• Arm roll in operation :

During arm roll in operation the pilot pressure from the RCV is supplied to the port Pc40 and Pb3 and shifts arm1 spool and arm2 spool in the right direction.

The hydraulic oil from the pump P2 flows into the arm cylinder head side through P2 parallel passage, the load check valve and the port C4.

At same time, the hydraulic fluid from the pump P1 flows into the arm summation passage through parallel passage, the check valve, the arm2 spool and the boom2 spool. Then it entered the arm cylinder head side with hydraulic fluid from arm1 spool.

• **Arm regeneration :**

The return flow from the arm cylinder rod side is pressurized by self weight of arm and so, returns to port D4. The pressurized oil returning to port D4 enters the arm regeneration & breaker spool through the arm holding valve and the arm1 spool. It is supplied the arm cylinder head through internal passage. This is called the arm regeneration function.

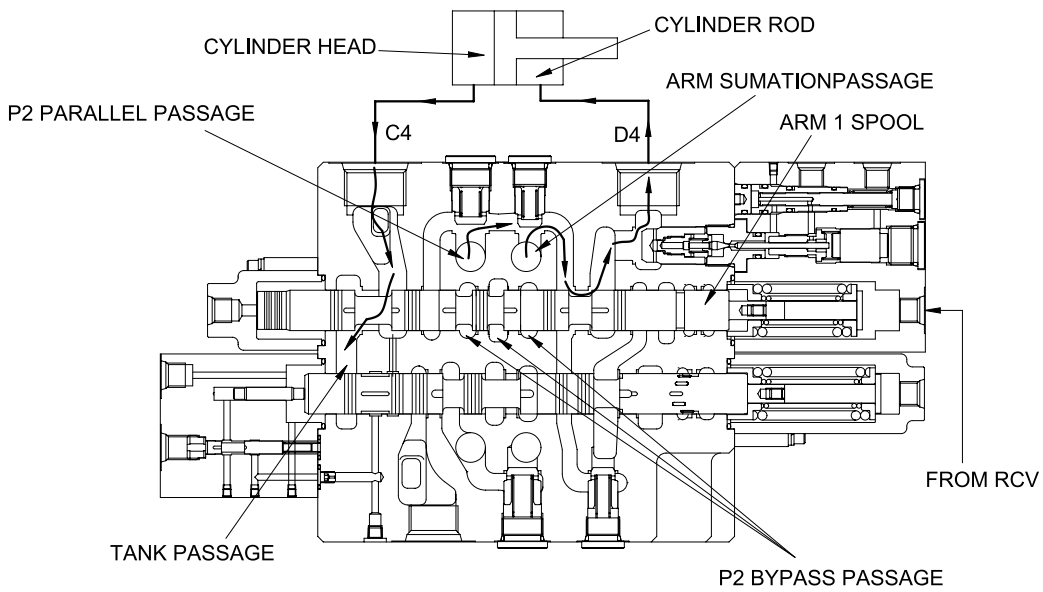
The amount of regeneration fluid are changed by movement of the arm regeneration & breaker spool.

A few fluid after P2 parallel passage is push piston "C" through the notch of arm regeneration spool and selector spool. At this time, the selector spool is opened by pilot pressure from RCV.

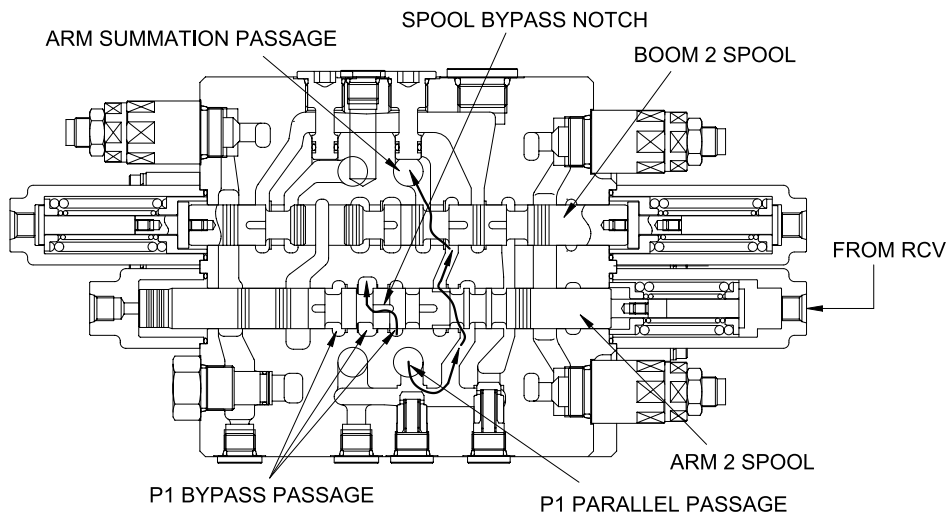
Then, the arm regeneration spool shift to right side and flow to tank pass increases and regeneration flow decreases. Therefore, pressure of arm cylinder head increases, then, arm regeneration flow decreases.

Furthermore, the arm regeneration cut pressure is supplied to port and arm regeneration spool is move into the right direction fully. The flow from the arm cylinder rod is returned to the hydraulic oil tank and regeneration function is not activated.

Arm roll out operation



14072SF23



14072SF22

During arm roll out operation the pilot pressure from RCV is supplied to the port Pd40 and the Pd41 and shifts arm1 spool and arm2 spool in the right direction.

The hydraulic fluid from pump P2 flows into arm1 spool through the parallel passage. Then it enters into the arm cylinder rod side through the load check valve, bridge passage, arm holding valve and the port D4.

Some of the hydraulic fluid from pump P2 bypassed through bypass notch.

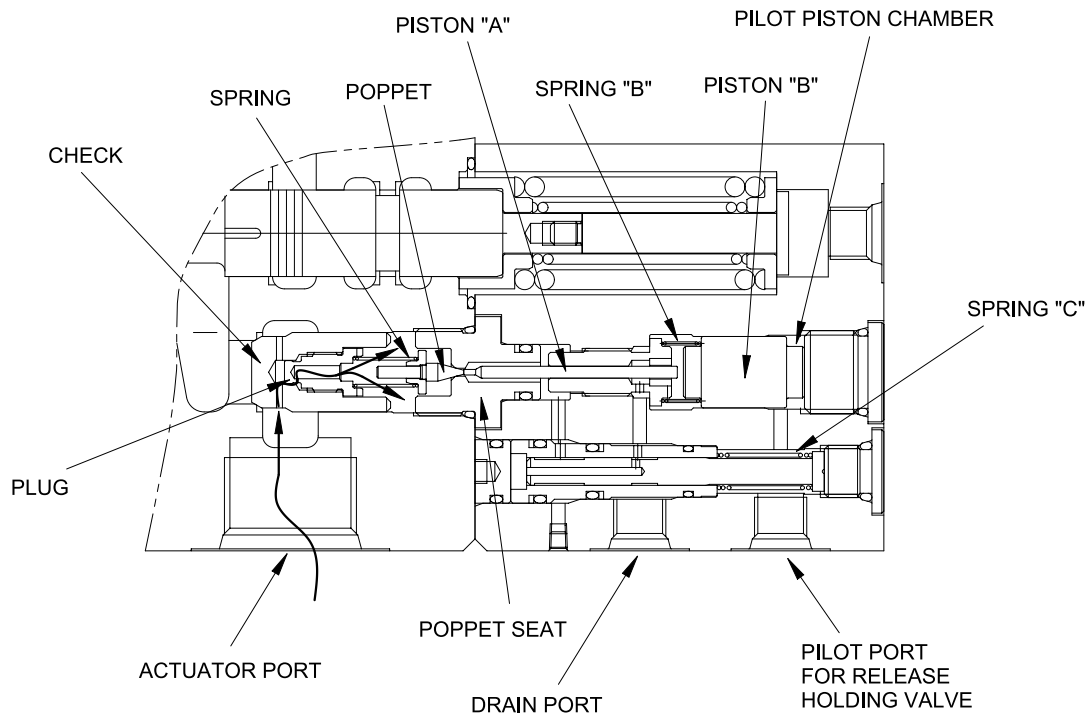
The rest of hydraulic fluid from pump P2 flows into the arm summation passage through P1 parallel passage the check valve arm2 spool and boom2 spool.

Then it enters into the arm cylinder rod side with the fluid from the arm1 spool.

The return flow from the arm cylinder head side returns to the hydraulic tank through the port C4 the arm1 spool and tank passage.

(7) HOLDING VALVE OPERATION

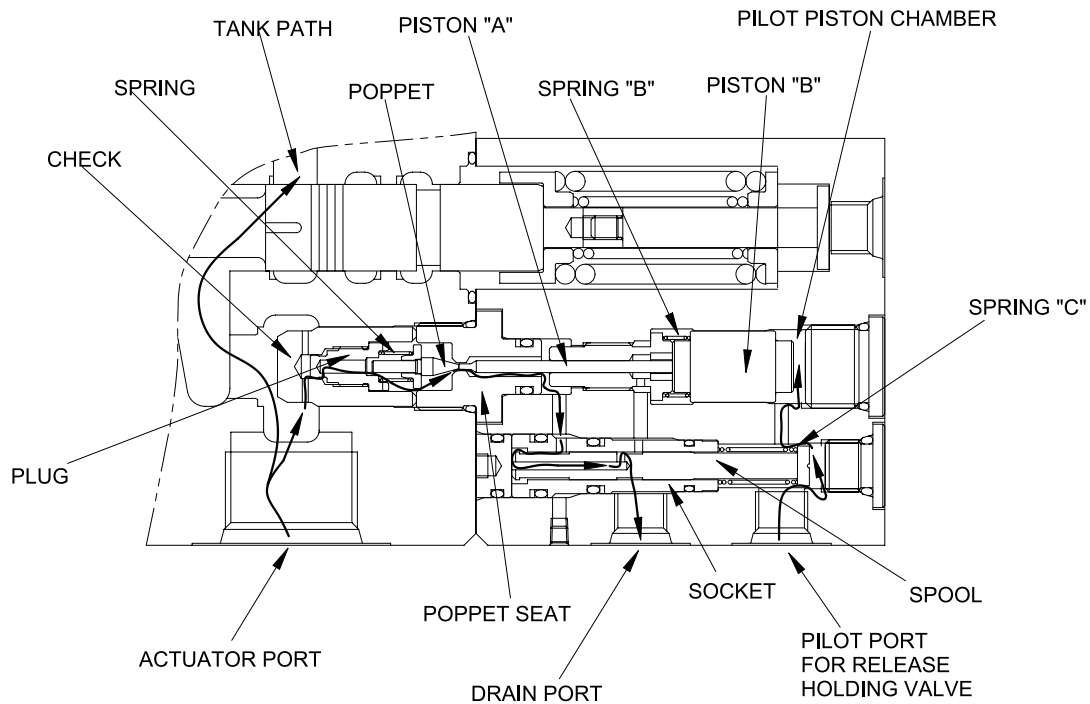
Holding operation



14072SF30

At neutral condition, the pilot piston chamber is connected to drain port through the pilot port. And the piston "B" is supported with spring "B" and the pressured fluid from actuator entered to inside of the holding valve through the periphery hole of check, crevice of the check and the plug and the periphery hole of plug. Then, this pressured oil pushed the poppet to the poppet seat and the check to the seat of body. So the hydraulic fluid from actuator is not escaped and the actuator is not moved.

Release holding operation



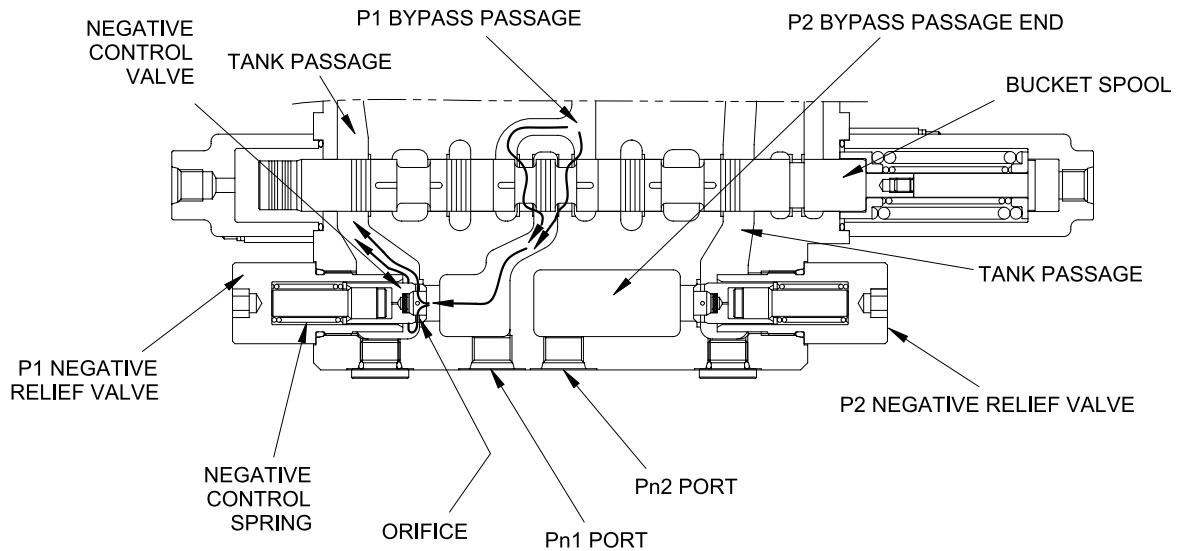
14072SF31

The pilot pressure is supplied to the pilot port for release holding valve and shifts the piston "B" in the left direction against the spring "B", and shifts the poppet in the left direction through piston "B" and piston "A" against spring "B" and shifts the spool in the left side.

At same time, the return fluid from actuator returns to the drain port through the periphery hole of check, crevice of the check and the plug, the periphery hole of the plug, in side of holding valve, crevice of the poppet and the poppet seat, the periphery hole of the poppet seat, crevice of the socket and spool and inside of spool.

When the poppet is opened, pressure of inside of holding valve is decreased and the return fluid from actuator returns to the tank passage through the notch of spool.

(8) NEGATIVE CONTROL



14072SF28

When no function is being actuated on P1 side, the hydraulic fluid from the pump P1, flows into the tank passage through the bypass passage and orifice. The restriction caused by this orifice thereby pressurizes. This pressure is transferred as the negative control signal pressure Pn1 to the pump P1 regulator.

It controls the pump regulator so as to minimize the discharge of the pump P1.

The bypass passage is shut off when the shifting of one or more spools and the flow through bypass passage became zero. The pressure of negative control signal become zero and the discharge of the pump P1 become maximum.

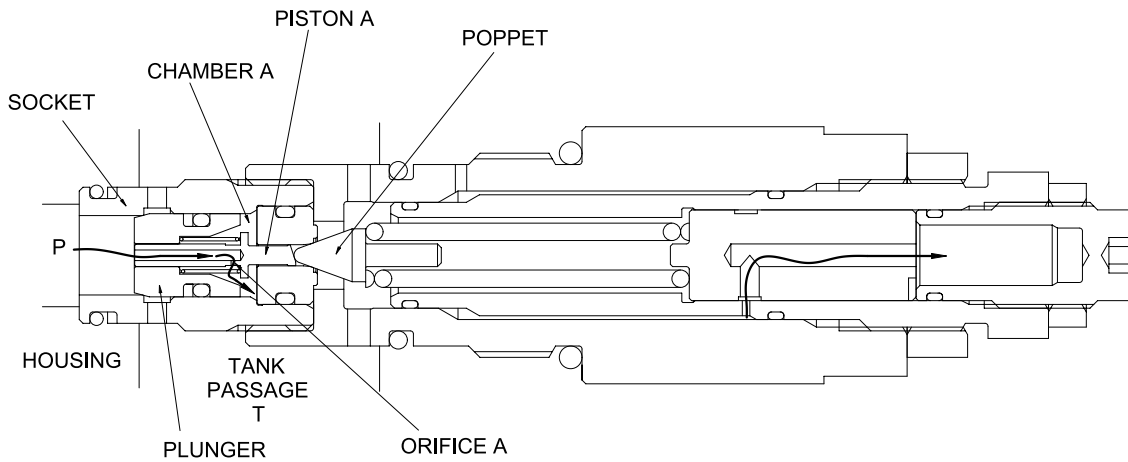
The negative control pressure reaches to the set level, the hydraulic fluid in the passage pushes open negative control valve and escapes into the return passage.

For the pump P2 the same negative control principle.

(9) OPERATION OF MAIN RELIEF VALVE

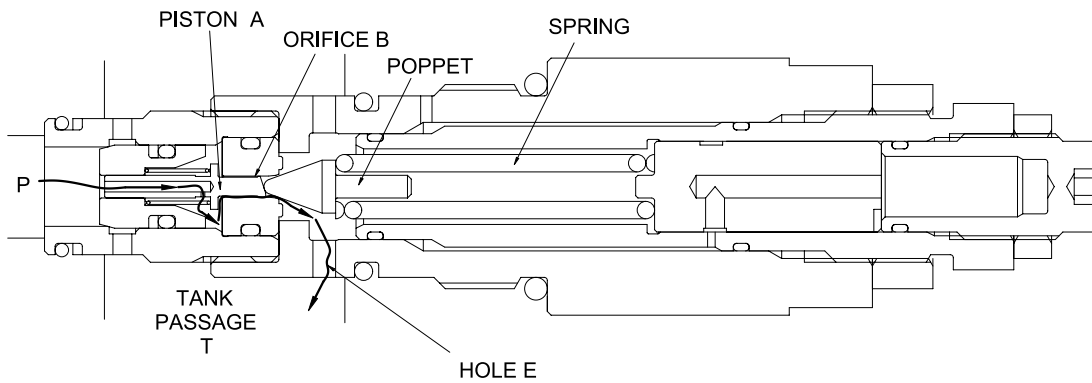
The main relief valve is fitted to the straight travel valve block and functions as follows :

The pressurized oil passes through the orifice (A) of the plunger is filled up in chamber A of the inside space, and seats the plunger against the housing securely.



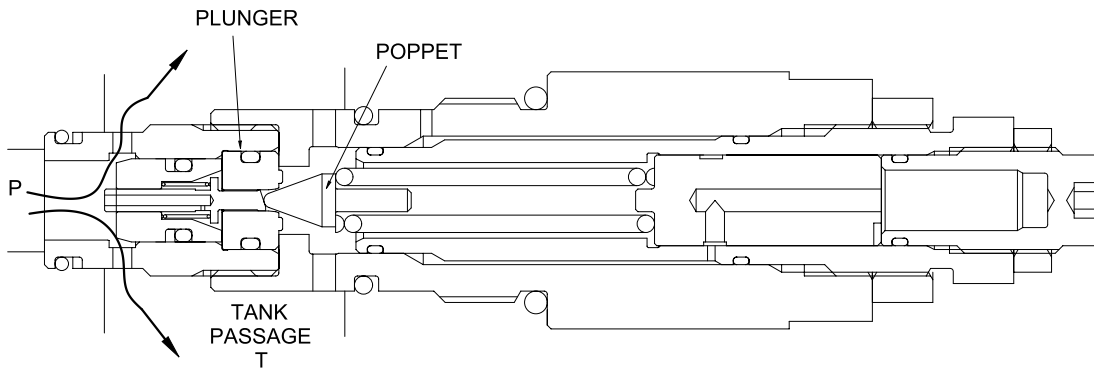
14072SF36

When the pressure at (P) becomes equal to the set pressure of the spring the hydraulic oil passes through the piston (A) pushes open the poppet and flows to tank passage (T) through the hole (E).



14072SF37

Opening the poppet causes the pressure in chamber A to fall and the plunger to open. As the result the pressurized oil at port P runs into tank passage (T)

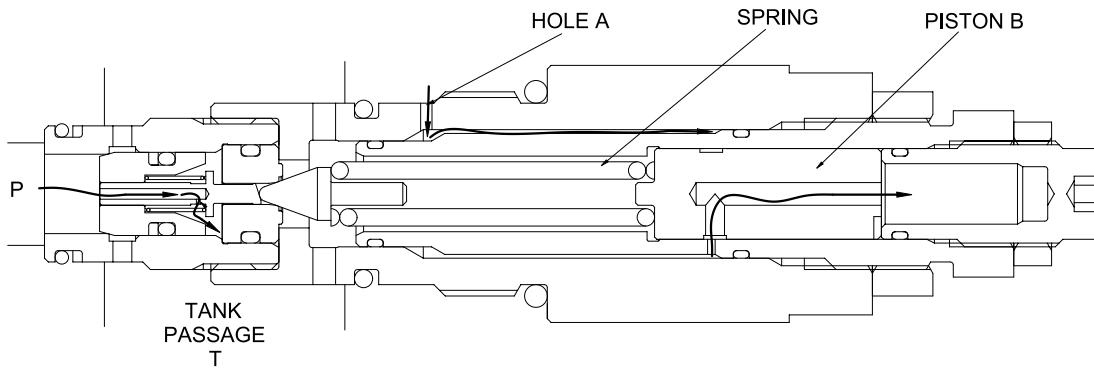


14072SF38

High pressure setting pilot signal(Pu) : ON

When the power boost switch is ON, the pilot pressure enters through hole A.

It pushes the piston(B) in the left direction to increase the force of the spring and change the relief set pressure to the high pressure.

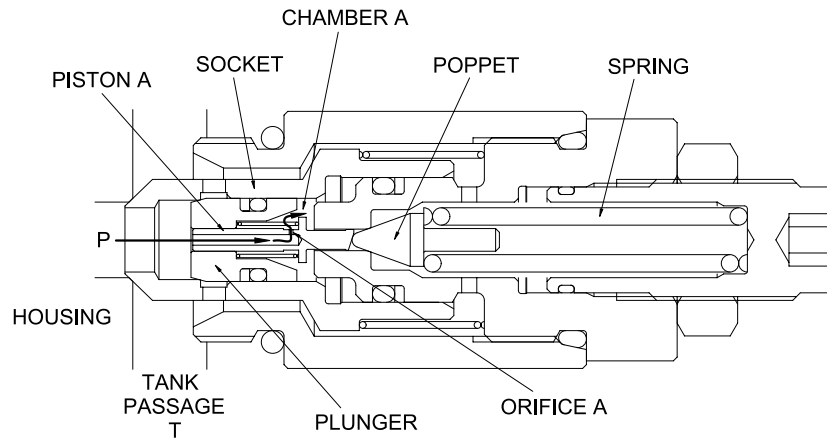


14072SF36

(10) OPERATION OF PORT RELIEF VALVE

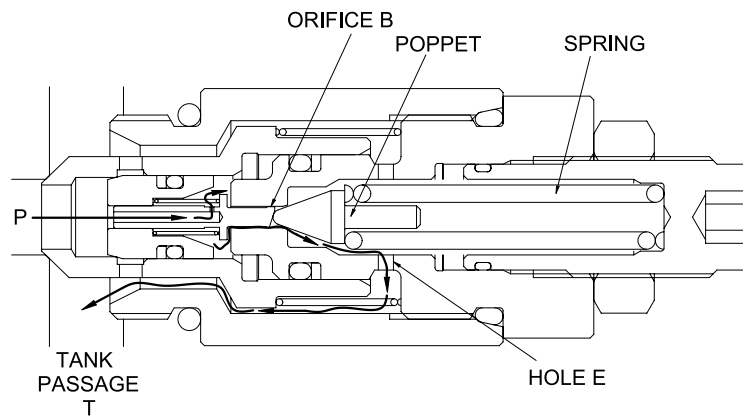
Function as relief valve

The pressurized oil passes through the piston A and orifice is filled up in chamber A of the inside space and seat the plunger against the socket and the socket against the housing securely.



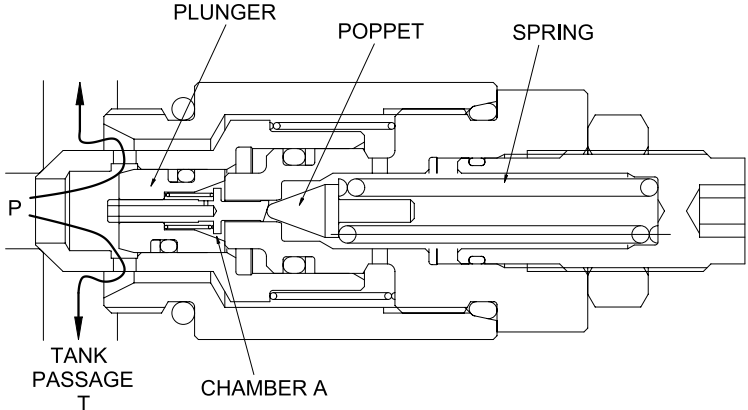
14072SF39

When the pressure at port P becomes equal to the set pressure of the spring, the pressurized oil pushes open the poppet flows to tank passage (T) through hole E.



14072SF40

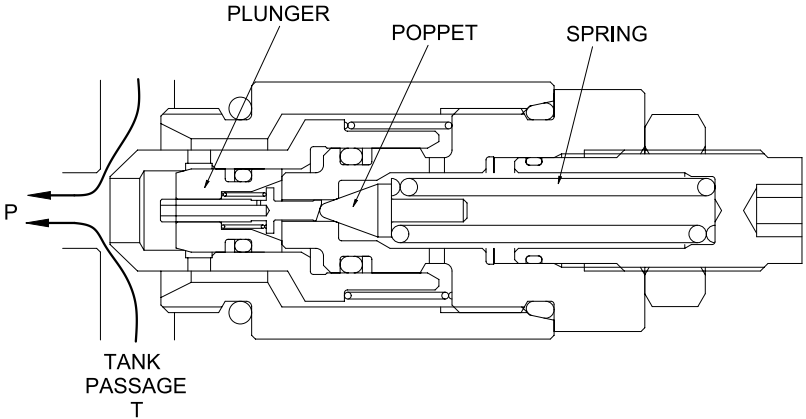
Opening of the poppet causes the pressure in chamber A to fall and the plunger to open. As the result the pressurized oil at port P runs into tank passage (T).



14072SF41

Make-up function

When negative pressure exists at port P, the oil is supplied through tank passage (T). When the pressure at tank passage (T) becomes higher than that at port P, the socket moves in the right direction. Then, sufficient oil passes around the socket from tank passage (T) to port P and fills up the space.



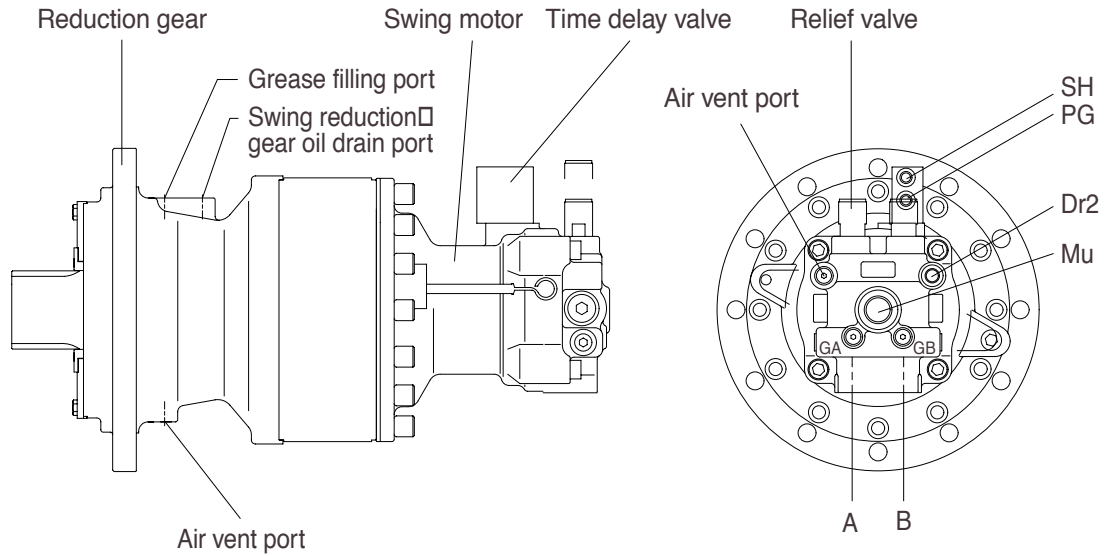
14072SF42

GROUP 3 SWING DEVICE

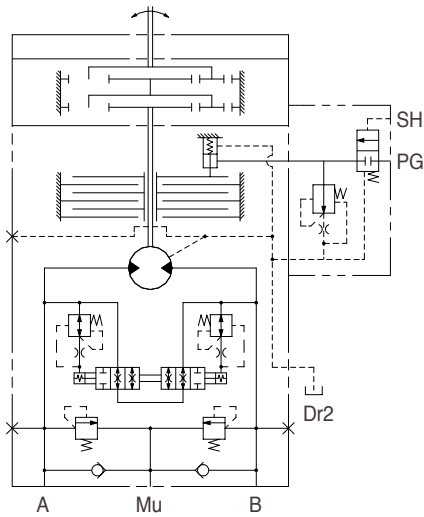
1. STRUCTURE

Swing device consists swing motor, swing reduction gear.

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

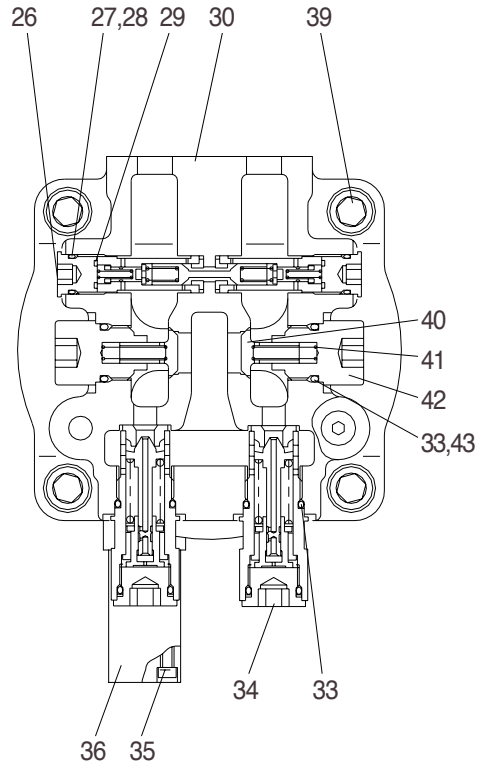
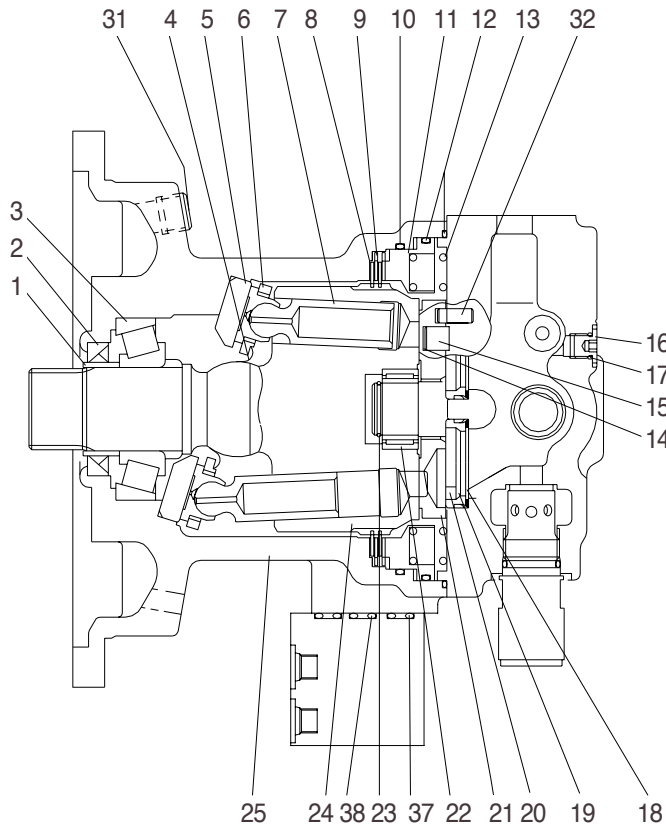


21072SF03



Port	Port name	Port size
A	Main port	PF 3/4
B	Main port	PF 3/4
Dr2	Drain port	PF 3/8
Mu	Make up port	PF 1
SH	Brake release port	PF 1/4
PG	Stand by port	PF 1/4
GA, GB	Gage port	PF 1/4

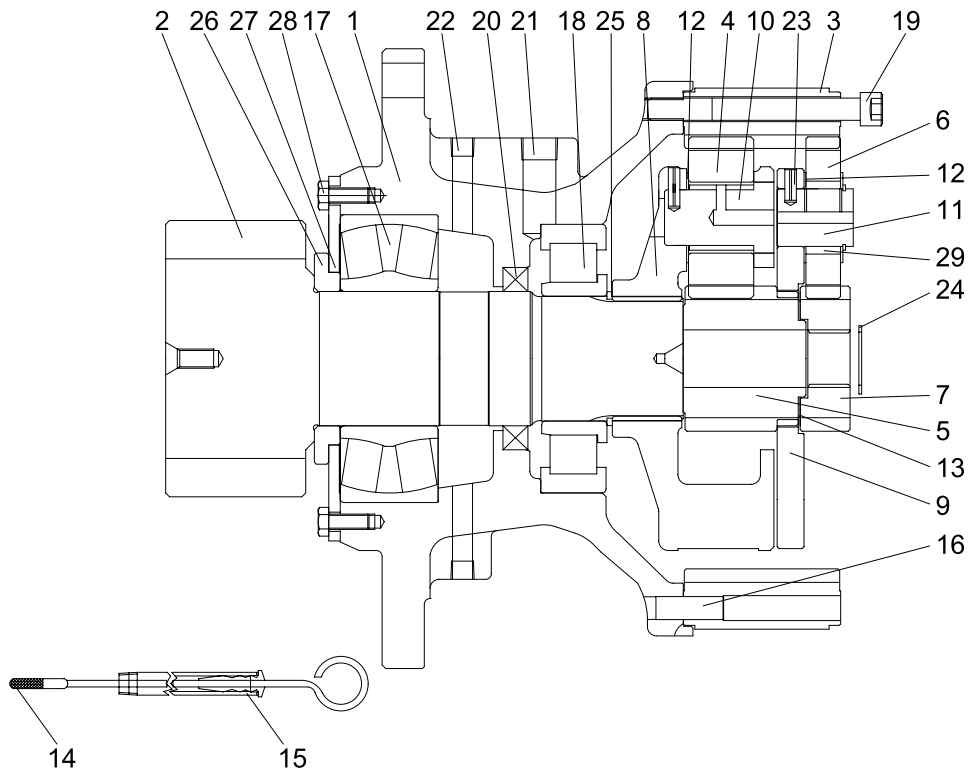
1) SWING MOTOR



14072SF50

- | | | |
|--------------------------|----------------------|---------------------|
| 1 Inner ring | 15 Piston | 29 O-ring |
| 2 Oil seal | 16 Cap | 30 Cover |
| 3 Tapered roller bearing | 17 O-ring | 31 Plug |
| 4 Backing spring | 18 Scrowave | 32 Parallel pin |
| 5 Cam plate | 19 Teflon ring | 33 O-ring |
| 6 Return plate | 20 Bush | 34 Relief valve |
| 7 Piston assembly | 21 Balance plate | 35 Bolt |
| 8 Lining plate | 22 Needle bearing | 36 Time delay valve |
| 9 Plate | 23 Snap ring | 37 O-ring |
| 10 O-ring | 24 Cylinder assembly | 38 O-ring |
| 11 Piston | 25 Housing | 39 Bolt |
| 12 O-ring | 26 Bypass valve assy | 40 Check |
| 13 Spring | 27 Back-up ring | 41 Spring |
| 14 Teflon ring | 28 O-ring | 42 Cap |
| | | 43 Back-up ring |

2) REDUCTION GEAR



14072SF51

1	Casing	10	Pin No.2 assembly	20	Oil seal
2	Drive shaft	11	Pin No.1	21	Plug(B)
3	Ring gear	12	Thrust washer(B)	22	Plug(A)
4	Planet gear No.2	13	Thrust washer(A)	23	Spring pin
5	Sun gear No.2	14	Gage bar	24	Stop ring
6	Planet gear No.1	15	Gage pipe	25	Stop ring
7	Sun gear No.1	16	Knock pin	26	Spacer
8	Carrier No.2	17	Sph roller bearing	27	Cover plate
9	Carrier No.1	18	Cyl roller bearing	28	Bolt
		19	Bolt	29	Needle cage

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 9 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.

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

Where p : Effective difference of pressure(kgf/cm²)

q : Displacement(cc/rev)

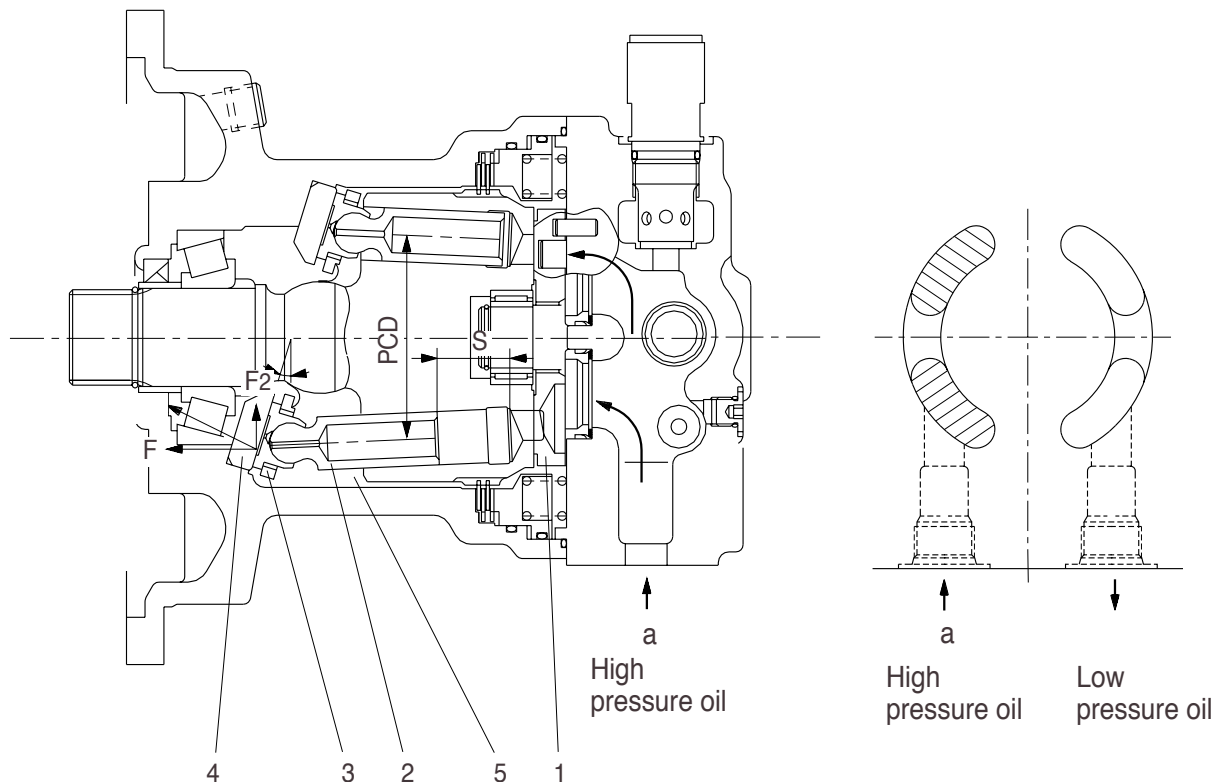
T : Output torque(kgf · cm)

Z : Piston number(9EA)

A : Piston area(cm²)

α : Tilting angle of swash plate(degree)

S : Piston stroke(cm)



2-46 (140-7)

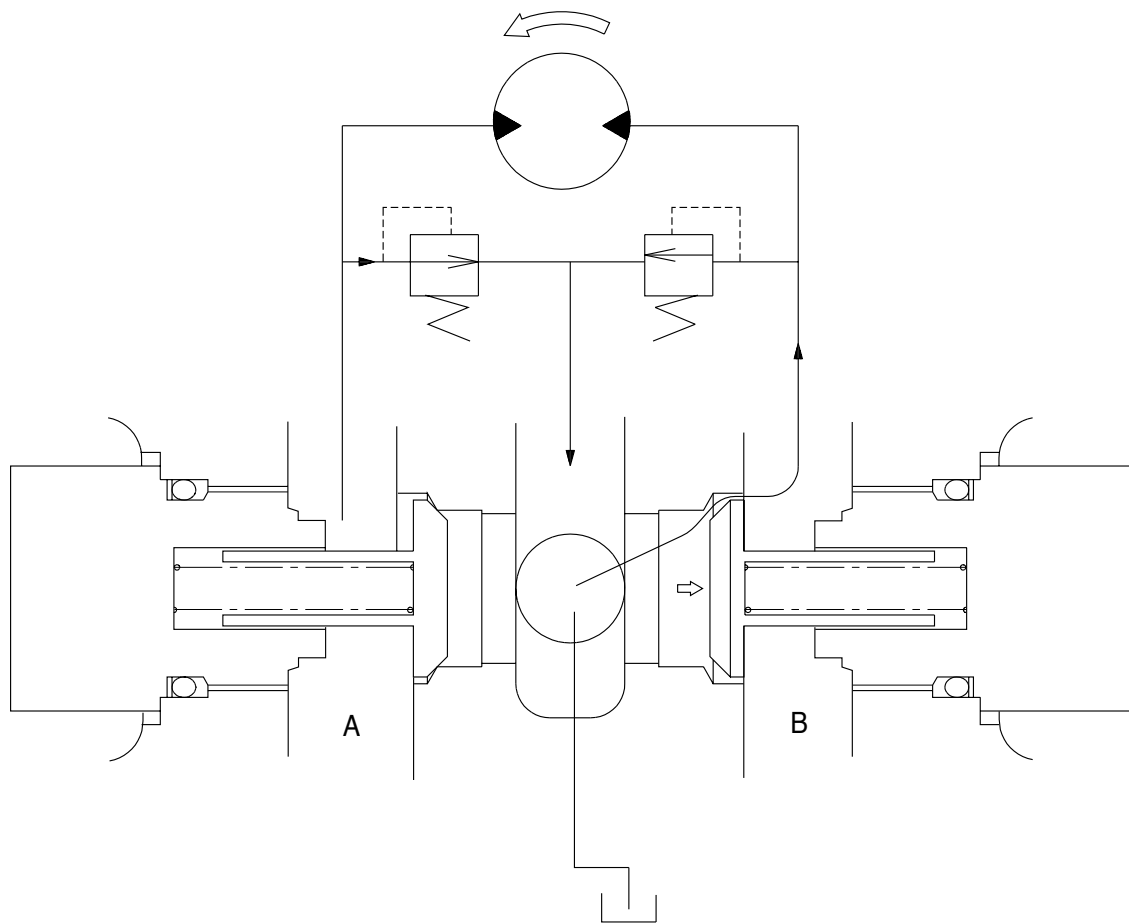
2) MAKE UP VALVE

In the system using this type of motor, there is no counter balance functioning valve and there happens the case of revolution exceeding hydraulic supply of motor. To prevent the cavitation caused by insufficient oil flow there is a make up valve to fill up the oil insufficiency.

A make up valve is provided immediately before the port leading to the hydraulic oil tank to secure feed pressure required when the hydraulic motor makes a pumping action. The boost pressure acts on the hydraulic motor's feed port via the make up valve.

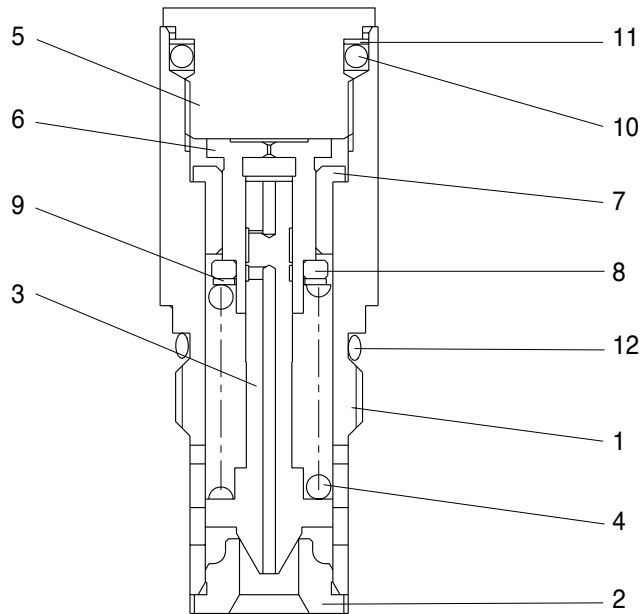
Pressurized oil into the port B, the motor rotate counterclockwise.

If the plunger of MCV moves neutral position, the oil in the motor is drain via left relief valve, the drain oil run into motor via right make up valve, which prevent the cavitation of motor.



2-47 (140-7)

3) RELIEF VALVE



- 1 Body
- 2 Seat
- 3 Plunger
- 4 Spring
- 5 Adjusting screw
- 6 Piston
- 7 Bushing
- 8 Spring seat
- 9 Shim
- 10 O-ring
- 11 Back up ring
- 12 O-ring

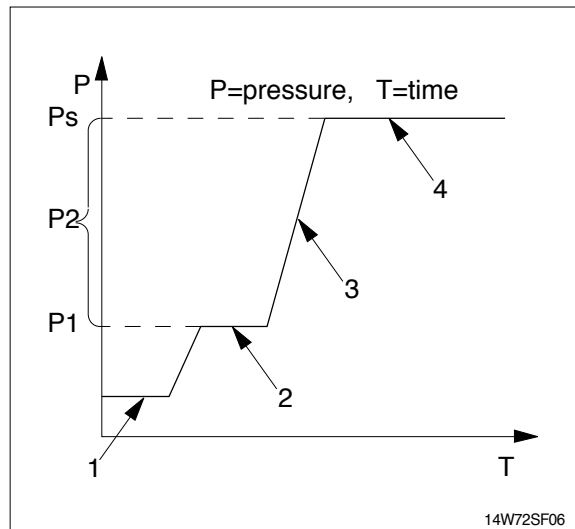
2-48(1) 140-7

(1) Construction of relief valve

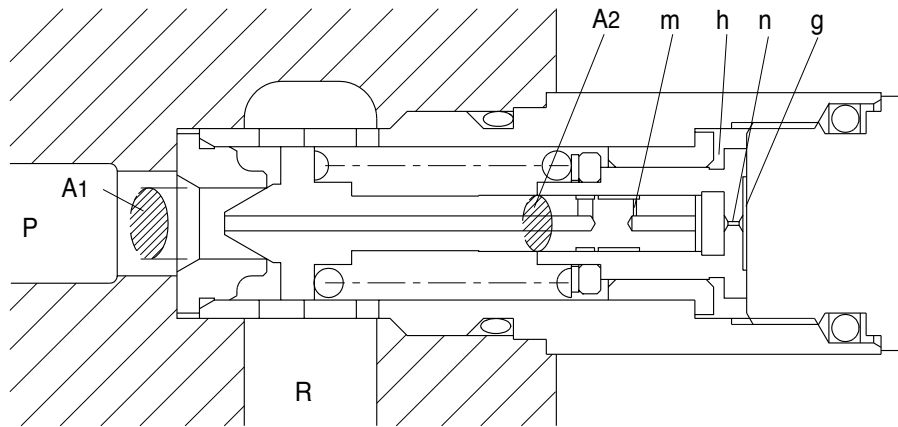
The valve casing contains two cartridge type relief valves that stop the regular and reverse rotations of the hydraulic motor. The relief valves relieve high pressure at start or at stop of swing motion and can control the relief pressure in two steps, high and low, in order to insure smooth operation.

(2) Function of relief valve

Figure illustrates how the pressure acting on the relief valve is related to its rising process. Here is given the function, referring to the figure following page.



Ports (P,R) at tank pressure.

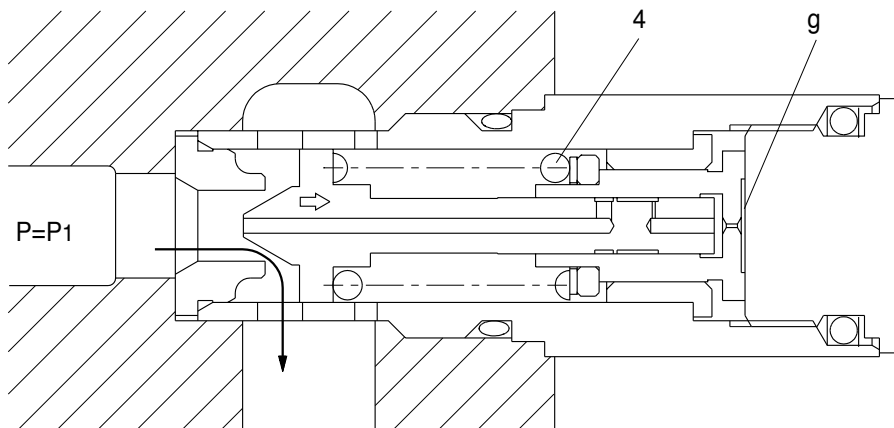


2-49 (140-7)

When hydraulic oil pressure($P \times A_1$) reaches the preset force(F_{SP}) of spring(4), the plunger(3) moves to the right as shown.

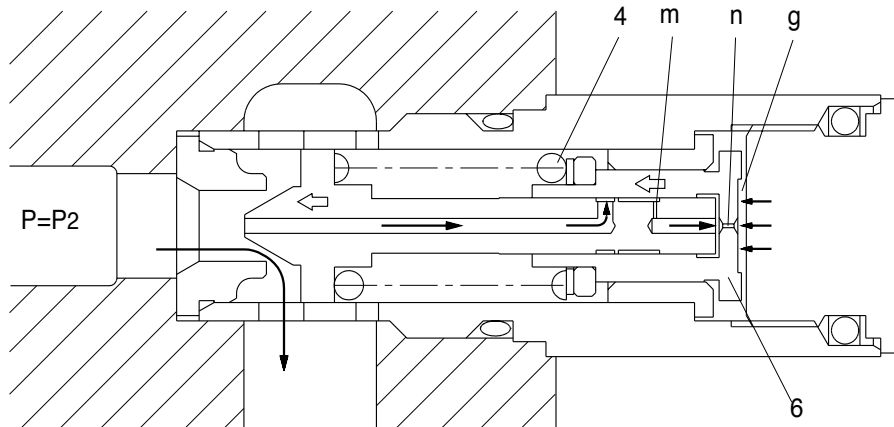
$$P_1 \times A_1 = F_{SP} + P_g \times A_2$$

$$P_1 = \frac{F_{SP} + P_g \times A_2}{A_1}$$



2-49 (140-7)

The oil flow chamber g via orifice m and n. When the pressure of chamber g reaches the preset force(FSP) of spring(4), the piston(6) moves left and stop the piston(6) hits the bottom of bushing(7).

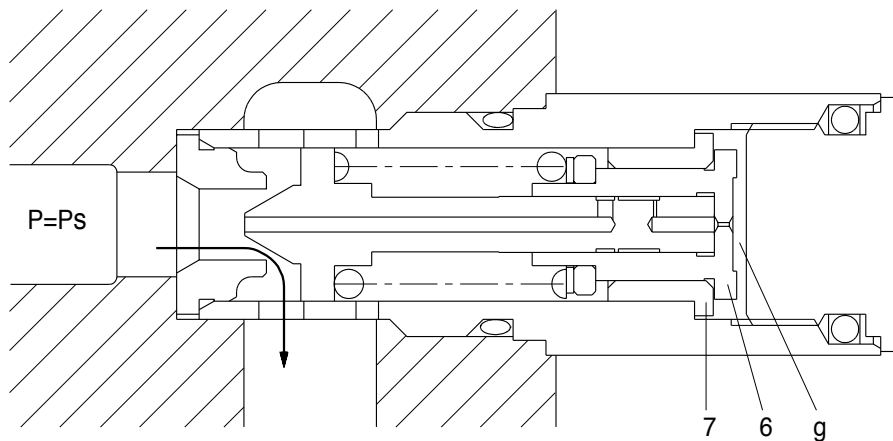


2-49 (140-7)

When piston(6) hits the bottom of bushing(7), it stops moving to the left any further. As the result, the pressure in chamber(g) equals(Ps).

$$P_s \times A_1 = F_{sp} + P_s \times A_2$$

$$P_s = \frac{F_{sp}}{A_1 - A_2}$$



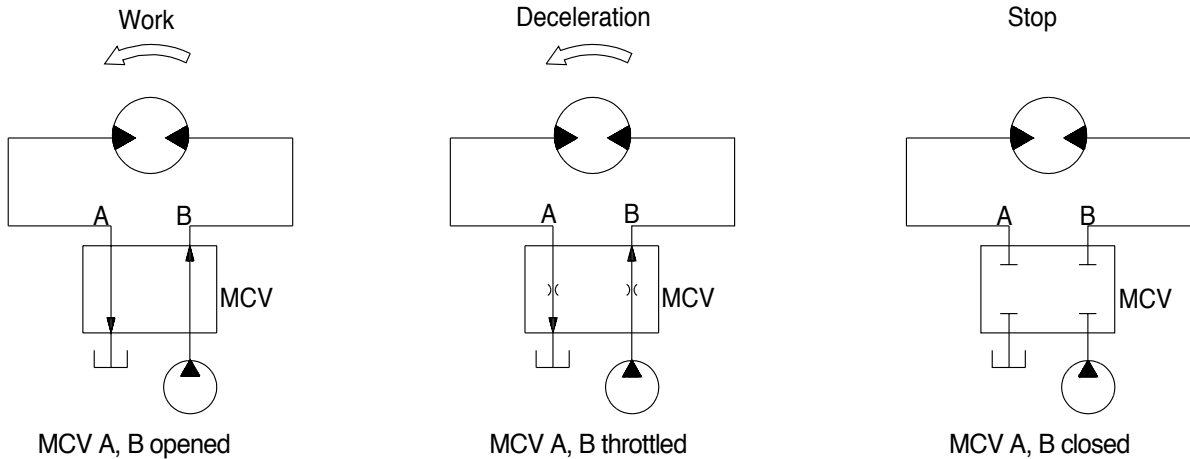
2-49 (140-7)

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.



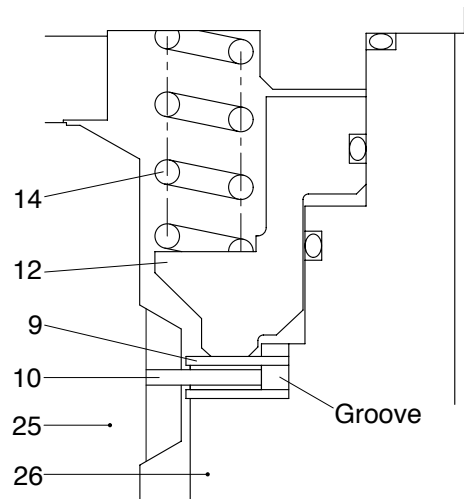
(2) Mechanical swing parking brake system

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.

Brake assembly

Circumferential rotation of separate plate(9) is constrained by the groove located at housing(26). When housing is pressed down by brake spring(16) through lining plate(10), separate plate(9) and brake piston(12), friction force occurs there.

Cylinder(25) is constrained by this friction force and brake acts, while brake releases when hydraulic force exceeds spring force.



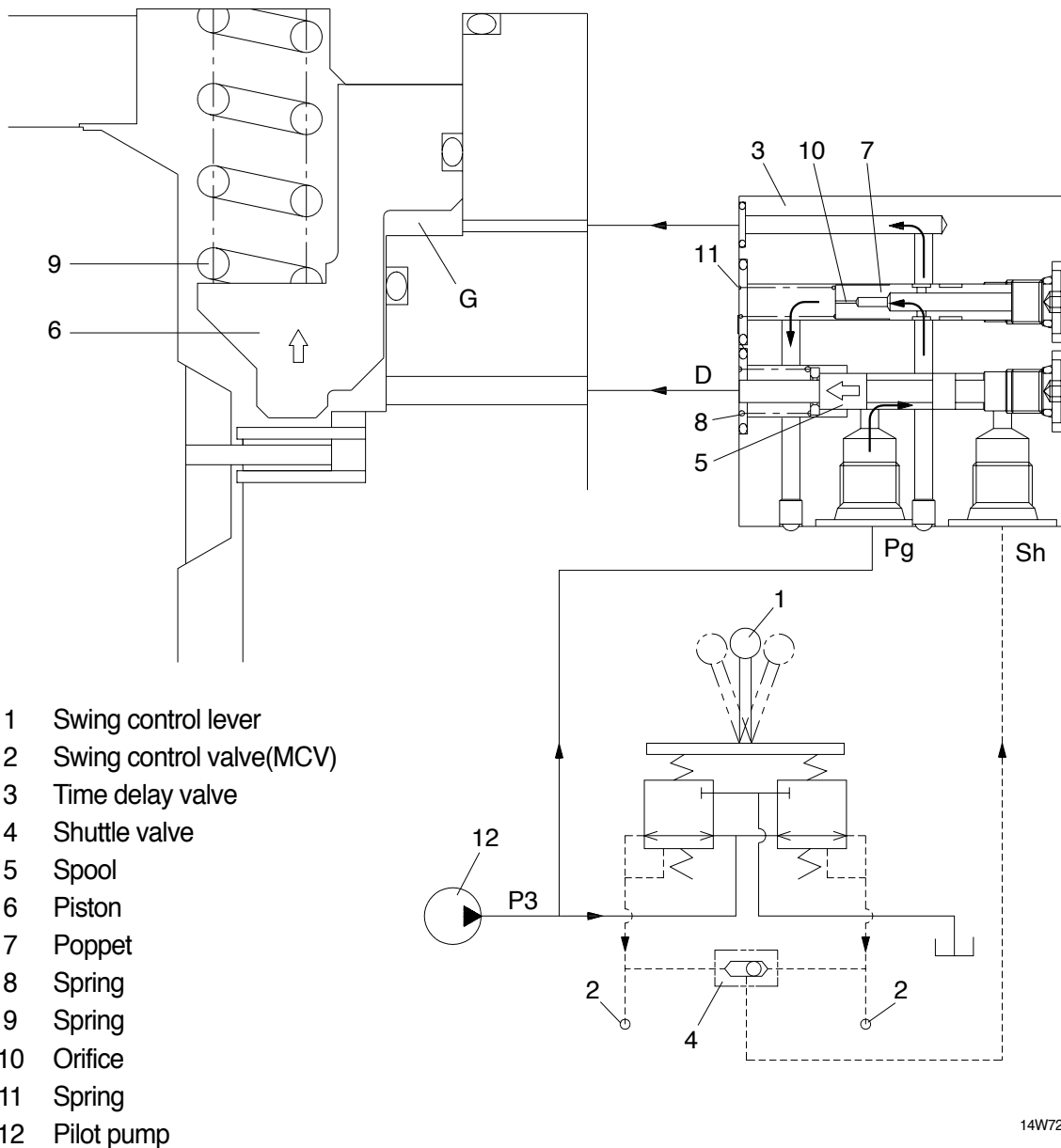
45070SM05

9	Separate plate	14	Spring
10	Lining plate	25	Cylinder
12	Brake piston	26	Housing

Operating principle

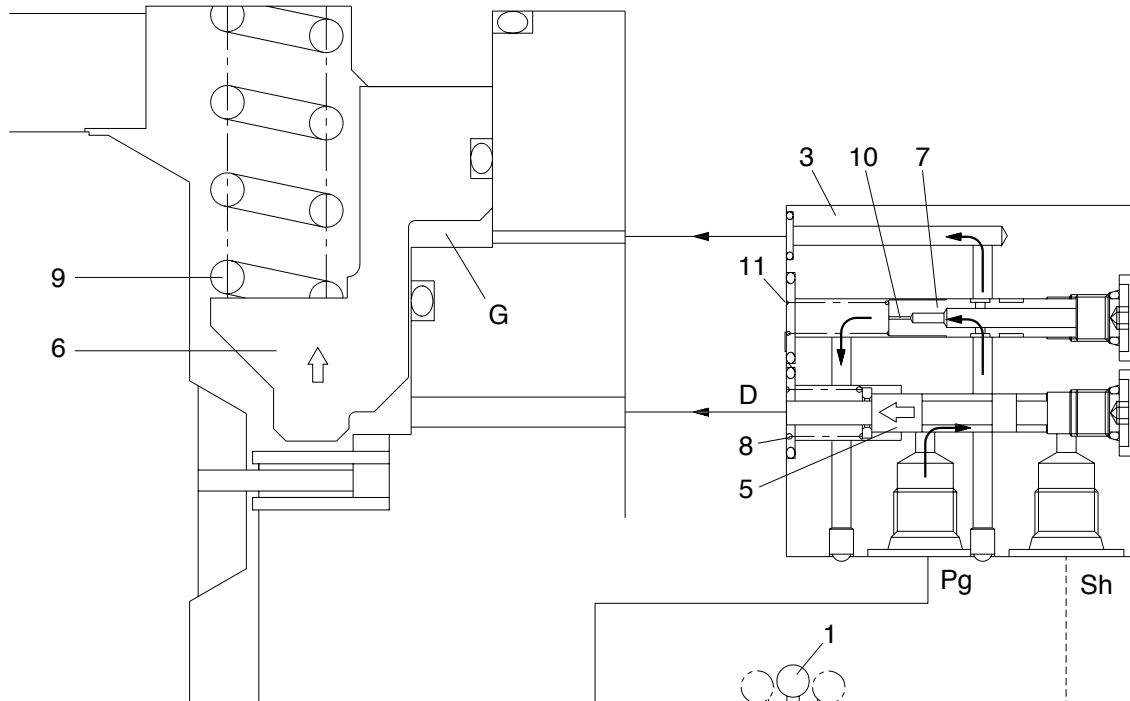
- a. When the swing control lever(1) is set to the swing position, the pilot oil go to the swing control valve(2) and to Sh of the time delay valve(3) via the shuttle valve(4), this pressure move spool(5) to the leftward against the force of the spring(8), so pilot pump charged oil(P3) goes to the chamber G.

This pressure is applied to move the piston(6) to the upward against the force of the spring(9). Thus, it releases the brake force.

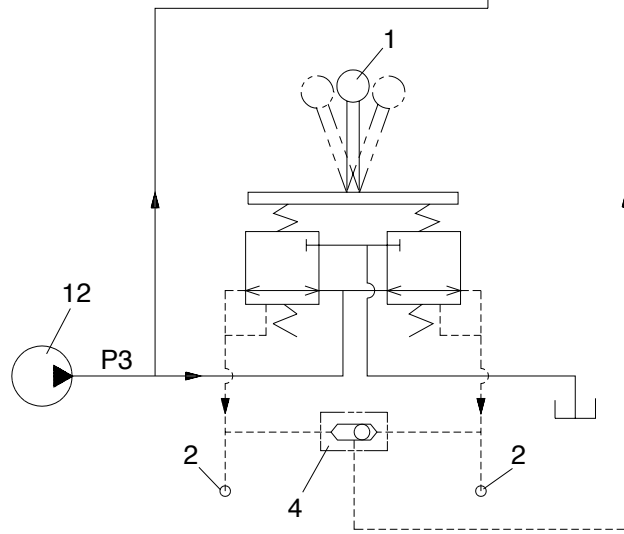


14W72SF07

b. Meantime, the oil pressure of port D balance with the preset force of spring(11), the pressure of chamber G keeps constant pressure.

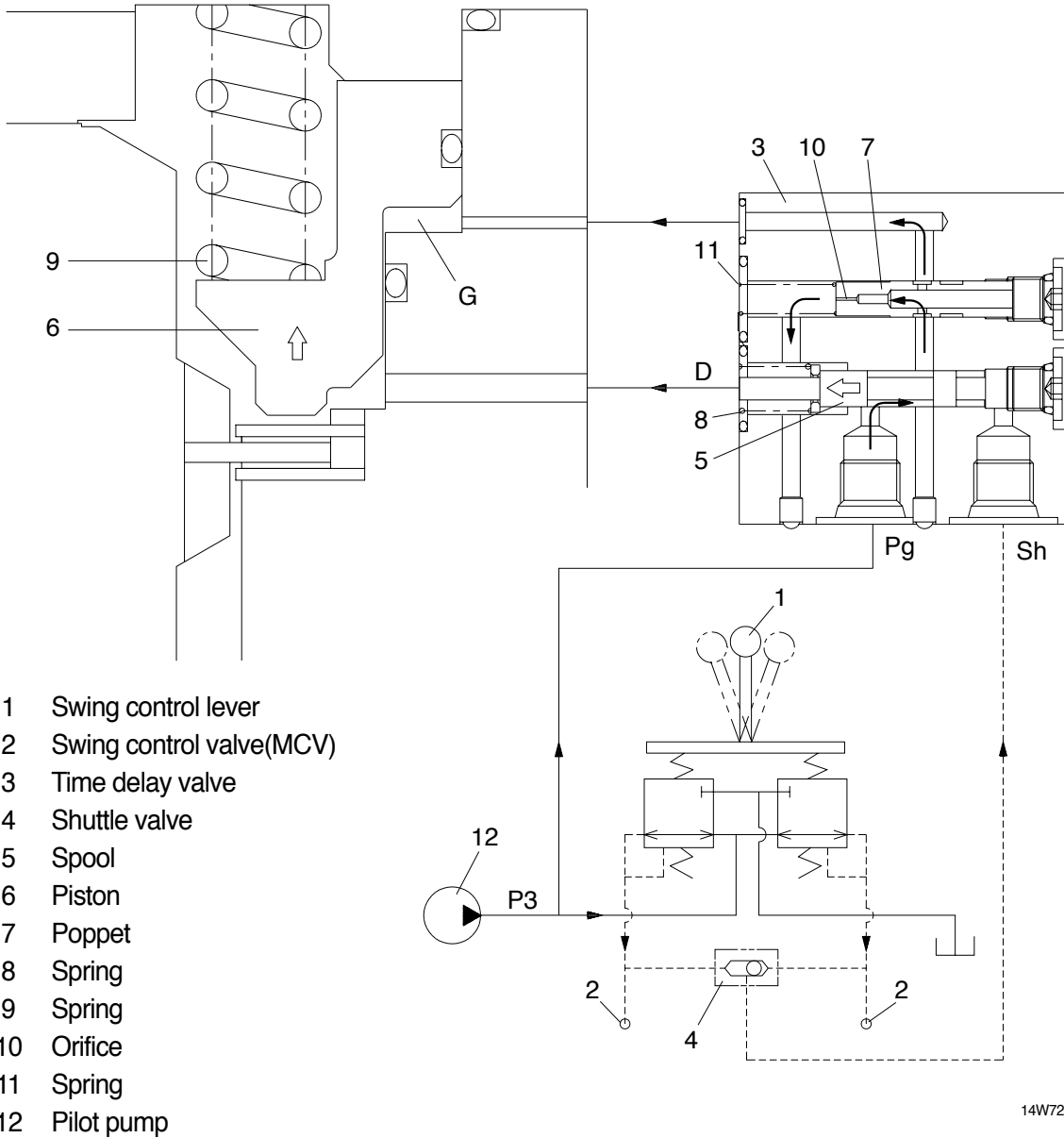


- 1 Swing control lever
- 2 Swing control valve(MCV)
- 3 Time delay valve
- 4 Shuttle valve
- 5 Spool
- 6 Piston
- 7 Poppet
- 8 Spring
- 9 Spring
- 10 Orifice
- 11 Spring
- 12 Pilot pump



14W72SF07

- c. When the swing control(1) lever is set the neutral position, the spool(5) returns right in the time delay valve(3).
 Then, the piston(6) is moved lower by spring force and the return oil from the chamber G flows back to D-port through orifice(10) of the poppet(7).
 At this time, the poppet(7) works to make a time lag for 5 seconds.

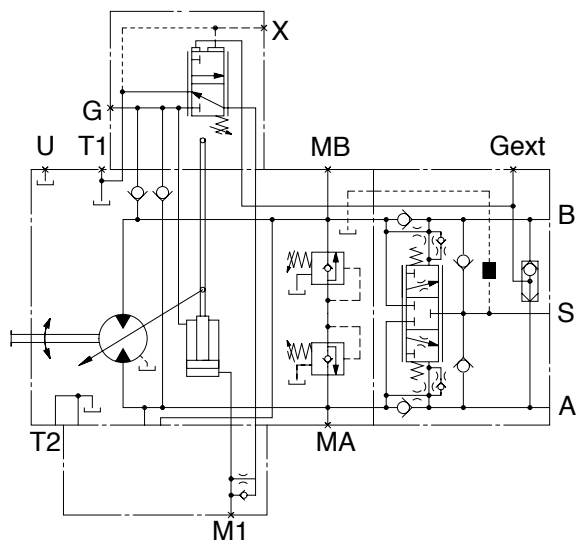
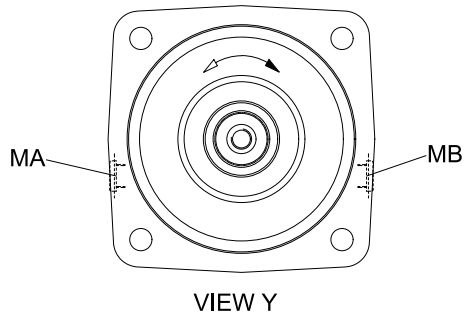
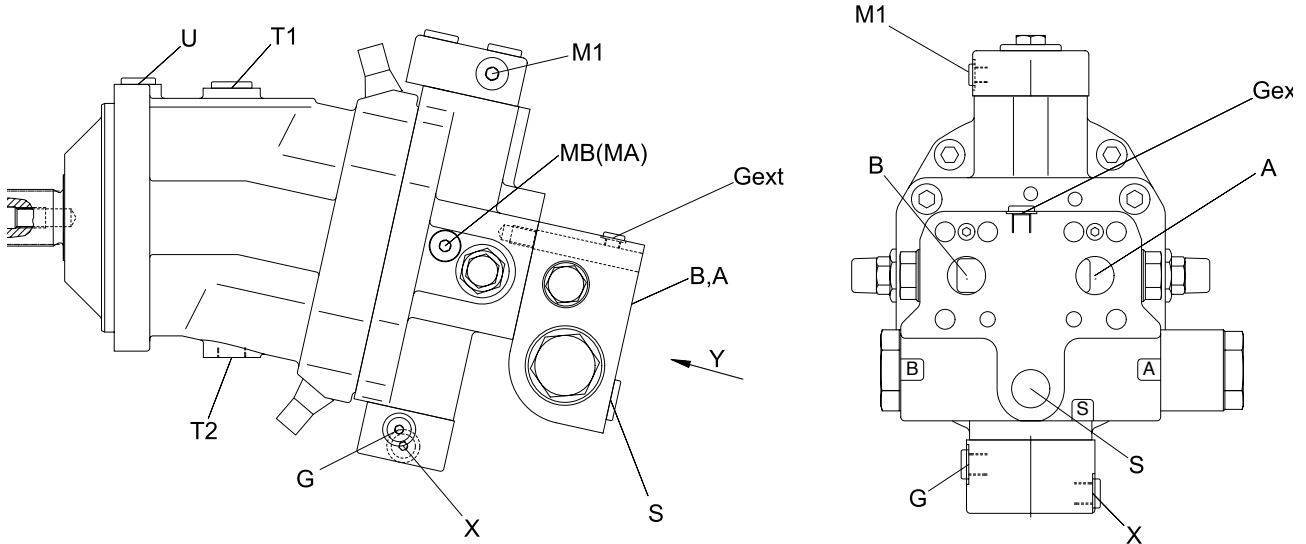


14W72SF07

GROUP 4 TRAVEL MOTOR

1. CONSTRUCTION

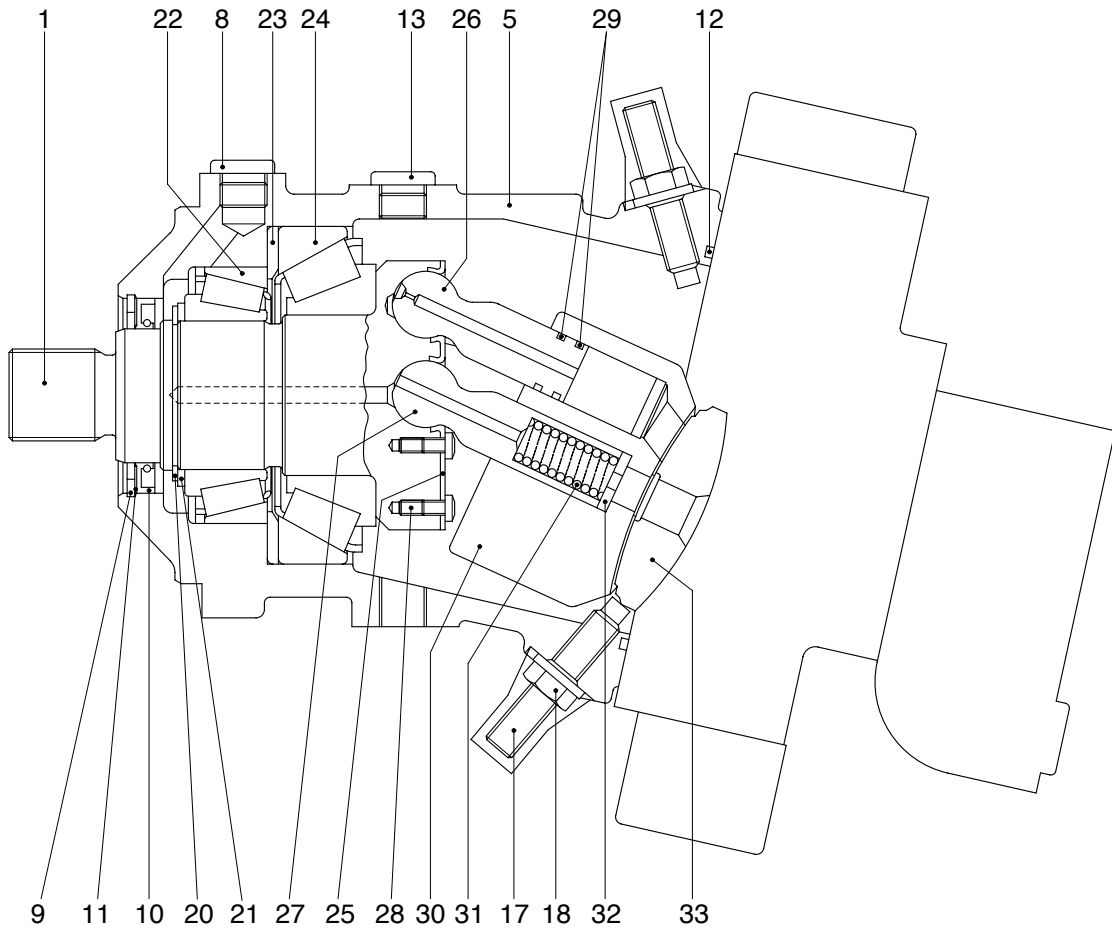
Travel motor consists motor unit, regulator and counter balance valve.



Port	Port name	Port size
A, B	Main port	SAE 6000psi 1
G	Gauge port	M14 x 1.5
M1	Gauge port	M14 x 1.5
X	Pilot pressure port	M14 x 1.5
T2	Drain port	M18 x 1.5
U	Flushing port	M18 x 1.5
S	Make up port	M27 x 2.0
Ma, Mb	Gauge port	M14 x 1.5
Gext	Brake release port	M12 x 1.5

14W72TM01

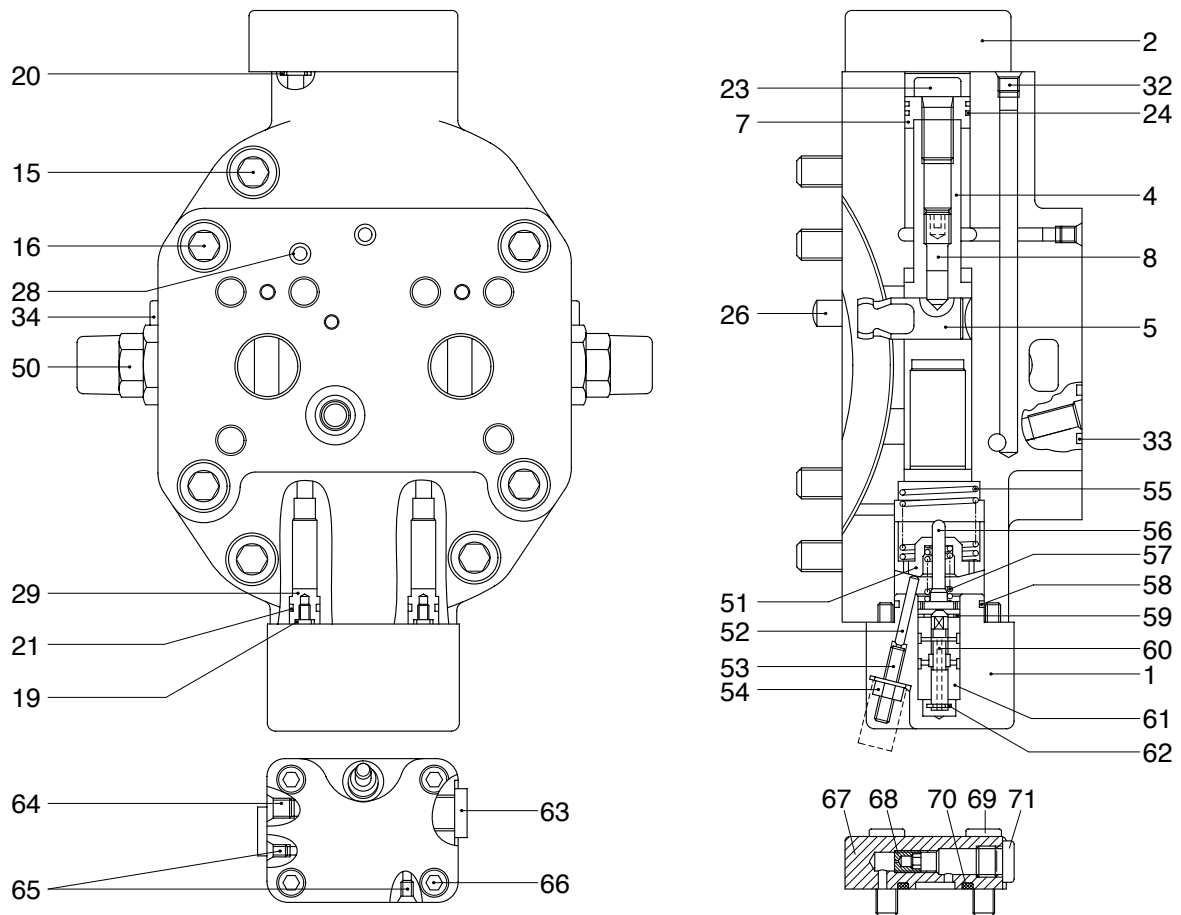
1) MOTOR UNIT



200W34TM02

- | | | | | | |
|----|-----------------|----|----------------------|----|--------------------|
| 1 | Drive shaft | 17 | Threaded pin | 26 | Piston |
| 5 | Housing | 18 | Seal lock nut | 27 | Center pin |
| 8 | Locking screw | 20 | Retaining ring | 28 | Pan head screw |
| 9 | Retaining ring | 21 | Back up plate | 29 | Steel sealing ring |
| 10 | Shaft seal ring | 22 | Taper roller bearing | 30 | Cylinder block |
| 11 | Back up plate | 23 | Shim | 31 | Pressure spring |
| 12 | O-ring | 24 | Taper roller bearing | 32 | Adjustment shim |
| 13 | Locking screw | 25 | Retaining plate | 33 | Control lens |

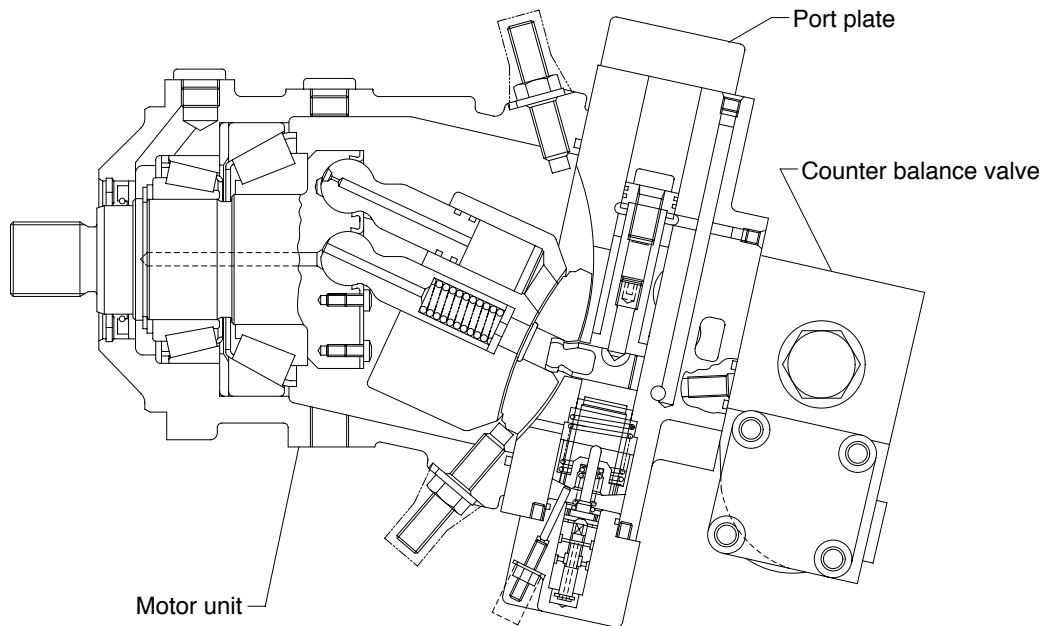
2) REGULATOR



- | | | | | | |
|----|----------------------|----|----------------------|----|----------------------|
| 1 | Control housing | 28 | Double break off pin | 59 | Retaining ring |
| 2 | Cover | 29 | Plug | 60 | Control piston |
| 4 | Positioning piston | 32 | Double break off pin | 61 | Control bushing |
| 5 | Positioning trunnion | 33 | O-ring | 62 | Retaining disc |
| 7 | Piston | 34 | Locking screw | 63 | Locking screw |
| 8 | Threaded pin | 50 | Relief valve | 64 | Double break off pin |
| 15 | Socket head screw | 51 | Adjusting bushing | 65 | Double break off pin |
| 16 | Socket head screw | 52 | Cylinder pin | 66 | Socket head screw |
| 19 | O-ring | 53 | Threaded pin | 67 | Cover |
| 20 | O-ring | 54 | Seal lock nut | 68 | Throttle screw |
| 21 | O-ring | 55 | Pressure spring | 69 | Socket head screw |
| 23 | Socket head screw | 56 | Spring collar | 70 | O-ring |
| 24 | Square ring | 57 | Pressure spring | 71 | Locking screw |
| 26 | Cylinder pin | 58 | O-ring | | |

14W72TM03

2. FUNCTION



14W72TM05

1) VARIABLE DISPLACEMENT MOTOR(With integrated counterbalance valve)

The variable displacement motor has a rotary group in bent axis design.

The torque is generated directly at the drive shaft.

The cylinder barrel is driven by a tapered piston arrangement.

The change of displacement is generated by the control lens via positioning piston. The control lens slides on a circular shaped surface.

In case of constant pump flow volume and high pressure

- The output speed is increased at smaller swivel angle, the torque is reduced

- The torque rises at swivel angle increase, the output speed is decreased

The max swivel angle is 25°, the min swivel angle is 0°.

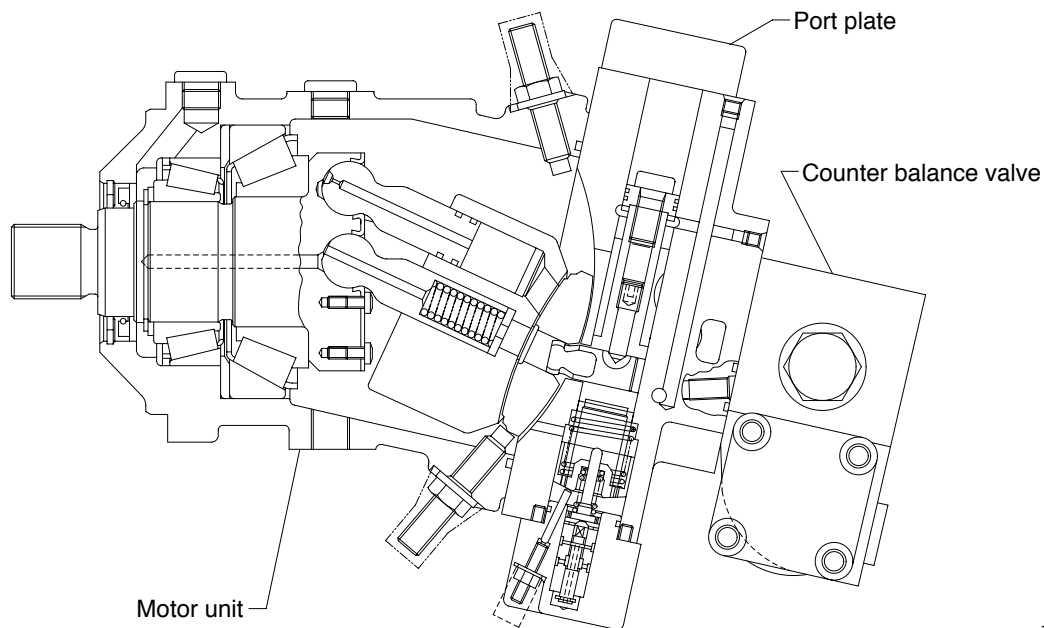
The variable displacement motor with integrated counterbalance valve is designed to be operated in open loop.

Min and max displacement are limited by a stop screw. Stepless adjustment to various higher values is possible.

Reduction to smaller displacement may result in overspeeding the motor.

2) PORT PLATE

With high pressure dependent control HA1, mounted counterbalance valve, integrated secondary pressure relief valves, plugged gauge and boosting ports, service ports to the rear.



14W72TM05

3) HIGH PRESSURE DEPENDENT CONTROL

The displacement is dependent on operating pressure - automatically adjusted. Upon reaching the operating pressure set at the control valve - internally measured at A or B - the motor swivels from V_{gmin} to V_{gmax} until output torque = load torque. For values lower than the adjusted one the motor keeps min swivel angle. The necessary positioning energy is taken from the respective high pressure side via shuttle valve.

Swivelling results in a change of the displacement.

Swivel time is controlled by an orifice installed in the cover of the large positioning piston side.

4) COUNTERBALANCE VALVE

Mounted at the rear of the port plate.

In case of downhill traveling or deceleration of the machine a counterbalance valve avoids overspeeding and cavitation of hydraulic motor.

5) FUNCTION AS TO CIRCUIT DIAGRAM

Check valves in the inlet line A and B for by passing of the counterbalance valve.

At traveling forward the return oil flow is controlled by a counterbalance spool. At drop in inlet pressure the counterbalance spool throttles the return oil flow. The motor is locked. The oil behind the spool is led to the low pressure side via an additional check valve. Same function for traveling forward and backward.

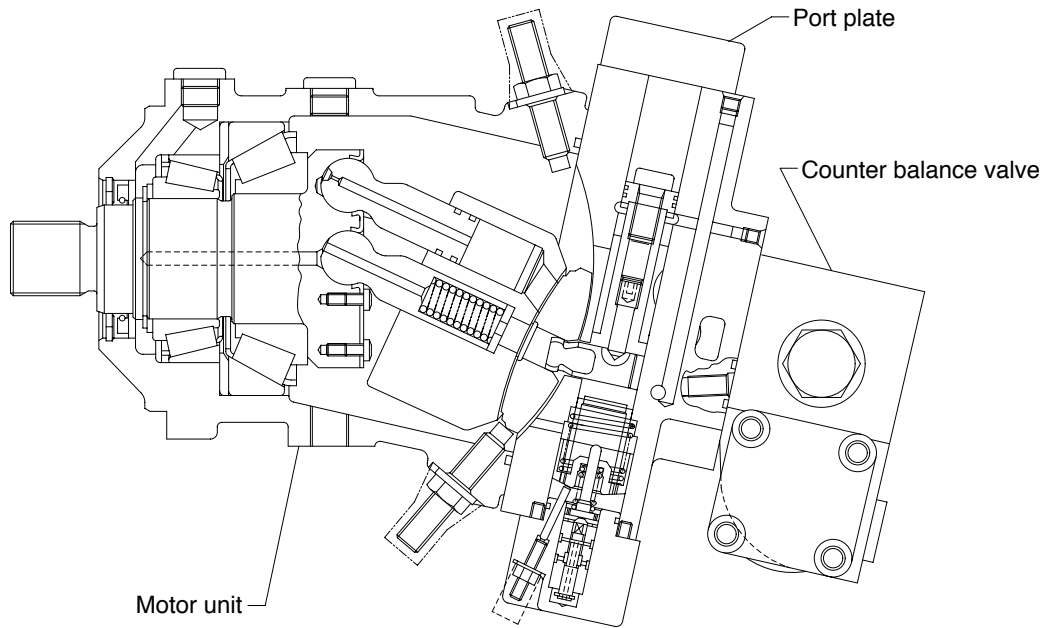
Braking means for the motor that

- At reduced or zero inlet flow the counterbalance spool reaches a modulating position or a neutral position caused by spring force
- The high pressure oil (At outlet side of the motor) is returned to the low pressure side (At inlet side) of the motor via crossover relief valves.

As the control pressure for regulation of the HA control via the integrated shuttle valve is no longer available, the motor with HA control and counterbalance valve will swivel to its minimum displacement during deceleration.

In addition, an external boost flow/pressure can be applied at port S for preventing cavitation.

Counterbalance valves do not replace the service and parking brake.



14W72TM05

6) INSTALLATION

The housing must be filled entirely with oil and shall also not run empty at rotary group standstill.

7) FILTRATION

According to purity class 9 as to NAS 1638, 6 as to SAE, ASTM, AIA and 18/15 as to ISO/DIS 4406.

8) PRESSURE

Ports A or B : Normal 400bar, peak pressure 450bar

Port A + B : Pressure summation below 700bar

Max permissible intermittent case pressure : 6bar

9) DIRECTION OF ROTATION/ DIRECTION OF FLOW

With view on the drive shaft - clockwise/ A to B; Counter-clockwise/ B to A

10) LEAKAGE OIL TEMPERATURE

In the bearing area max permitted -25,C to +80,C; Short time operation -40,C to +115,C

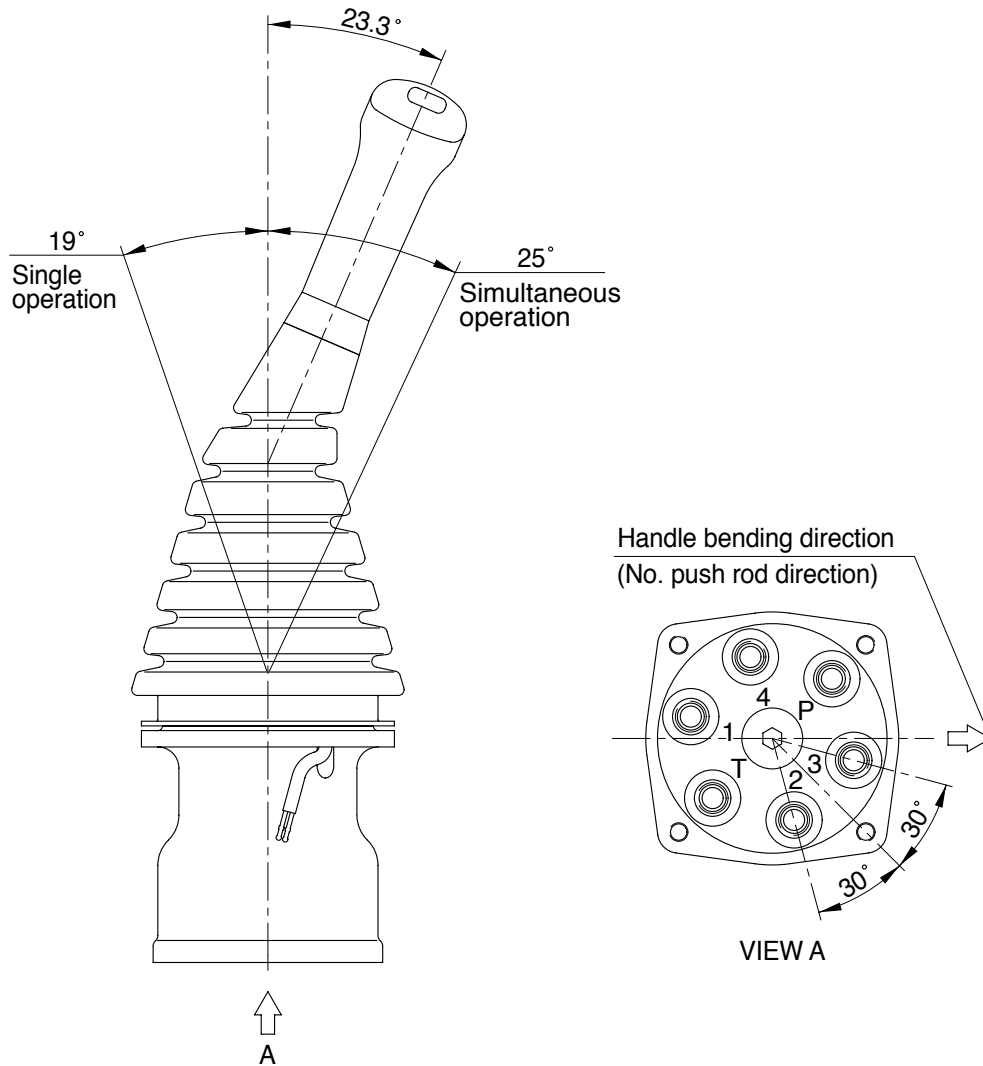
11) COMMISSIONING

Fill the housing entirely with oil through highest located T port. Also connect the leakage oil pipe at this port. After commissioning check sealing and make visual control of the complete installation.

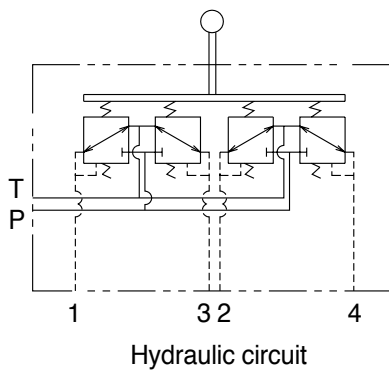
GROUP 5 RCV LEVER

1. STRUCTURE

The casing has the oil inlet port P(Primary pressure) and the oil outlet port T(Tank). In addition the secondary pressure is taken out through ports 1,2,3 and 4 provided at the bottom face.



25032RL01



Port	LH	RH	Port size
P	Pilot oil inlet port	Pilot oil inlet port	PF 1/4
T	Pilot oil return port	Pilot oil return port	
1	Left swing port	Bucket out port	
2	Arm in port	Boom down port	
3	Right swing port	Bucket in port	
4	Arm out port	Boom up port	

CROSS SECTION

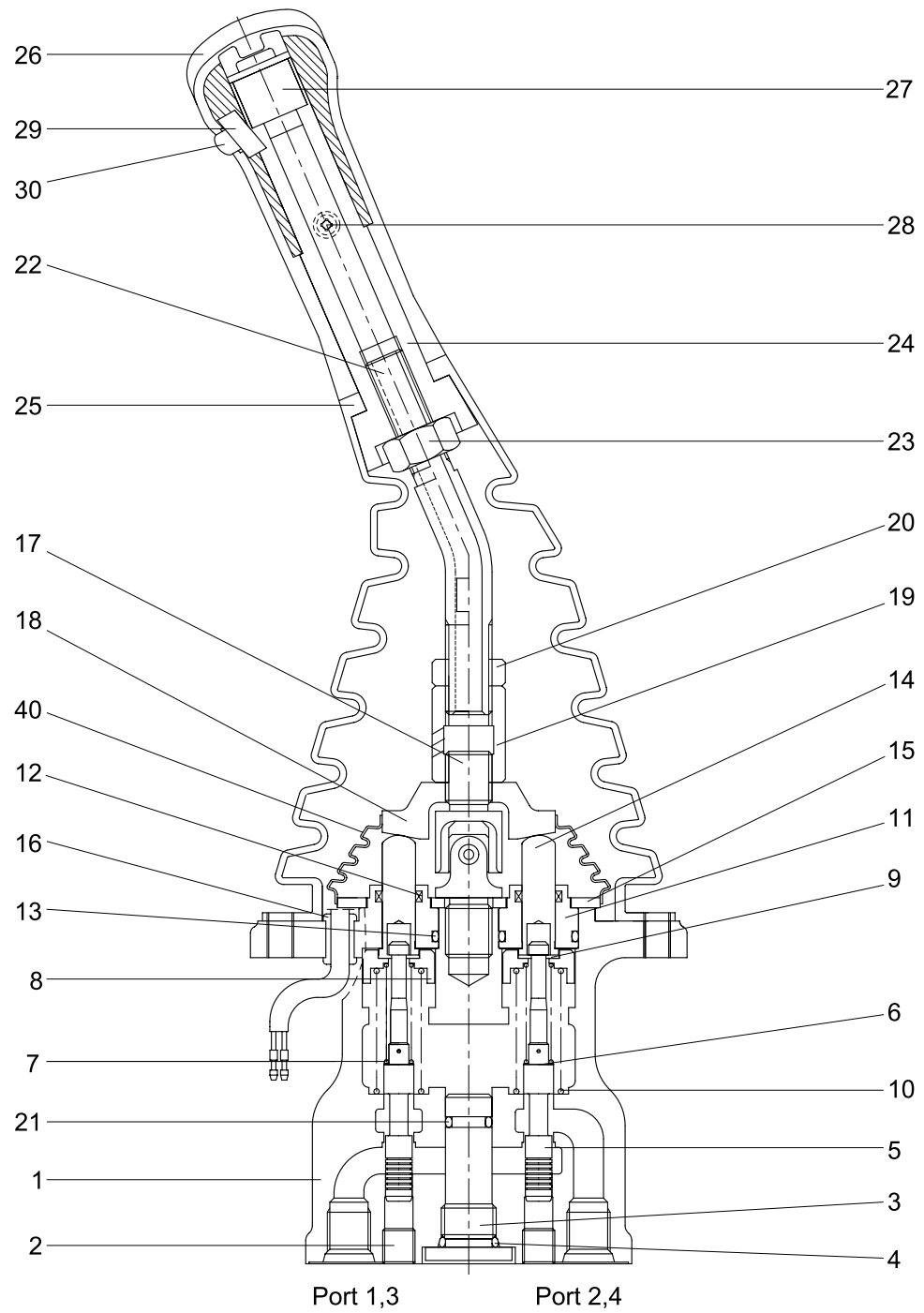
The construction of the pilot valve is shown in the attached cross section drawing. The casing has vertical holes in which reducing valves are assembled.

The pressure reducing section is composed of the spool(5), spring(7) for setting secondary pressure, return spring(10), stopper(9), spring seat(8) and shim(6). The spring for setting the secondary pressure has been generally so preset that the secondary pressure is 5 to 20.5kgf/cm²(Depending on the type). The spool is pushed against the push rod(14) by the return spring.

When the push rod is pushed down by tilting the handle, the spring seat comes down simultaneously and changes setting of the secondary pressure spring.

1	Case	11	Plug	21	O-ring
2	Plug	12	Rod seal	22	Handle connector
3	Plug	13	O-ring	23	Nut
4	O-ring	14	Push rod	24	Insert
5	Spool	15	Plate	25	Boot
6	Shim	16	Bushing	26	Handle
7	Spring	17	Joint assembly	27	Switch assembly
8	Spring seat	18	Swash plate	28	Screw
9	Stopper	19	Adjusting nut	29	Switch assembly
10	Spring	20	Lock nut	30	Switch cover
				40	Boot

CROSS SECTION



14072SF80

2. FUNCTIONS

1) FUNDAMENTAL FUNCTIONS

The pilot valve is a valve that controls the spool stroke, direction, etc of a main control valve. This function is carried out by providing the spring at one end of the main control valve spool and applying the output pressure(Secondary pressure) of the pilot valve to the other end.

For this function to be carried out satisfactorily, the pilot valve is composed of the following elements.

- (1) Inlet port(P) where oil is supplied from hydraulic pump.
- (2) Output ports(1,2,3 & 4) to apply pressure supplied from inlet port to ends of control valve spools.
- (3) Tank port(T) necessary to control the above output pressure.
- (4) Spool to connect output port to inlet port or tank port.
- (5) Mechanical means to control output pressure, including springs that work on the above spools.

2) FUNCTIONS OF MAJOR SECTIONS

The functions of the spool(5) are to receive the supply oil pressure from the hydraulic pump at its port P, and to change over oil paths to determine whether the pressure oil of port P is led to output ports 1,2,3 & 4 or the output port pressure oil to tank port T.

The spring(7) works on this spool to determine the output pressure.

The change the deflection of this spring, the push rod(14) is inserted and can slide in the plug(11).

For the purpose of changing the displacement of the push rod through the switch plate(19) and adjusting nut(20) are provided the handle(27) that can be tilted in any direction around the fulcrum of the universal joint(18) center.

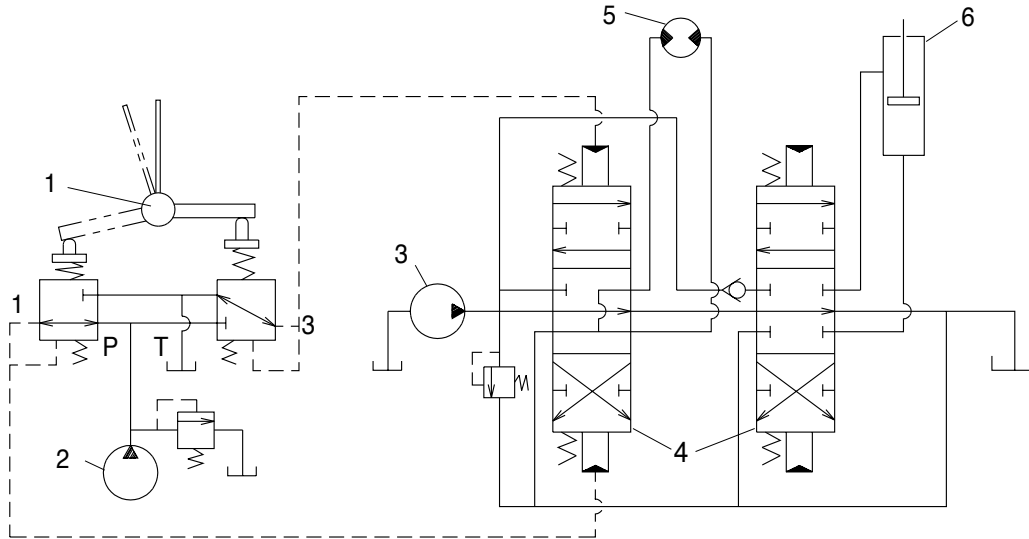
The spring(10) works on the case(1) and spring seat(8) and tries to return the push rod(14) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

This also has the effect of a reaction spring to give appropriate control feeling to the operator.

3) OPERATION

The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below and the attached operation explanation drawing.

The diagram shown below is the typical application example of the pilot valve.



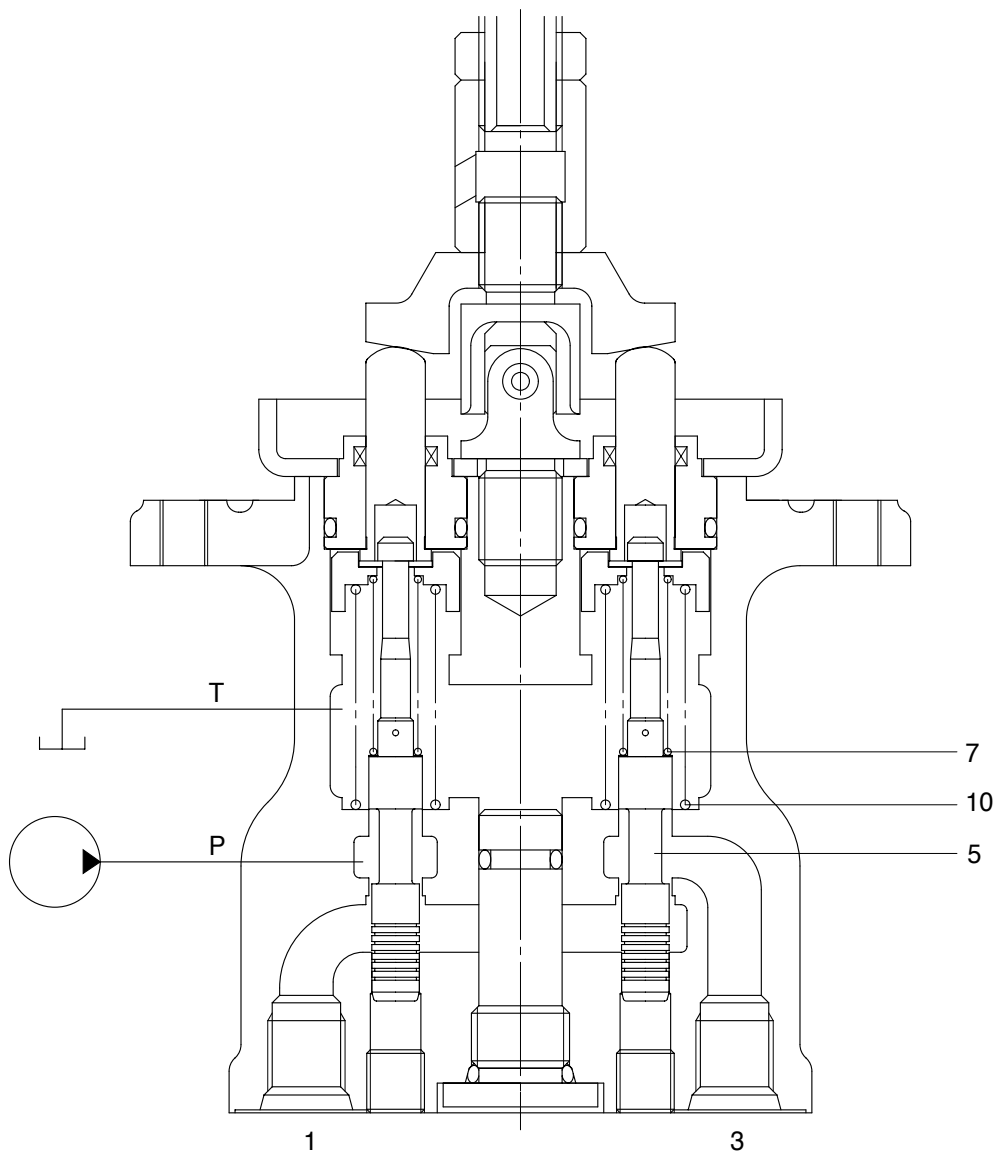
2-70 (210-7)

- 1 Pilot valve
- 2 Pilot pump

- 3 Main pump
- 4 Main control valve

- 5 Hydraulic motor
- 6 Hydraulic cylinder

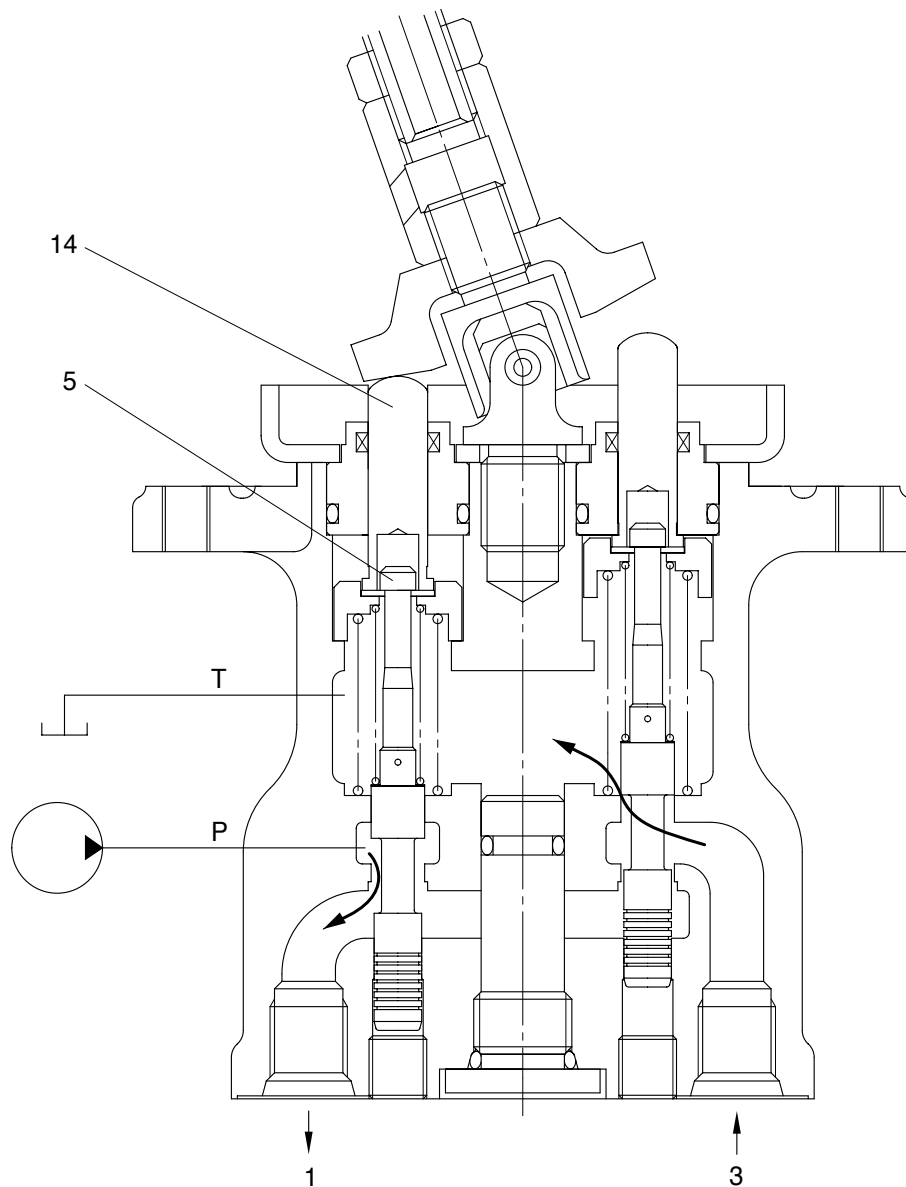
(1) Case where handle is in neutral position



25032RL03

The force of the spring(7) that determines the output pressure of the pilot valve is not applied to the spool(5). Therefore, the spool is pushed up by the spring(10) to the position of port(1, 3) in the operation explanation drawing. Then, since the output port is connected to tank port T only, the output port pressure becomes equal to tank pressure.

(2) Case where handle is tilted



25032RL04

When the push rod(14) is stroked, the spool(5) moves downwards.

Then port P is connected with port(1) and the oil supplied from the pilot pump flows through port(1) to generate the pressure.

When the pressure at port(1) increases to the value corresponding to the spring force set by tilting the handle, the hydraulic pressure force balances with the spring force. If the pressure at port(1) increases higher than the set pressure, port P is disconnected from port(1) and port T is connected with port(1). If it decreases lower than the set pressure, port P is connected with port(1) and port T is disconnected from port 1.

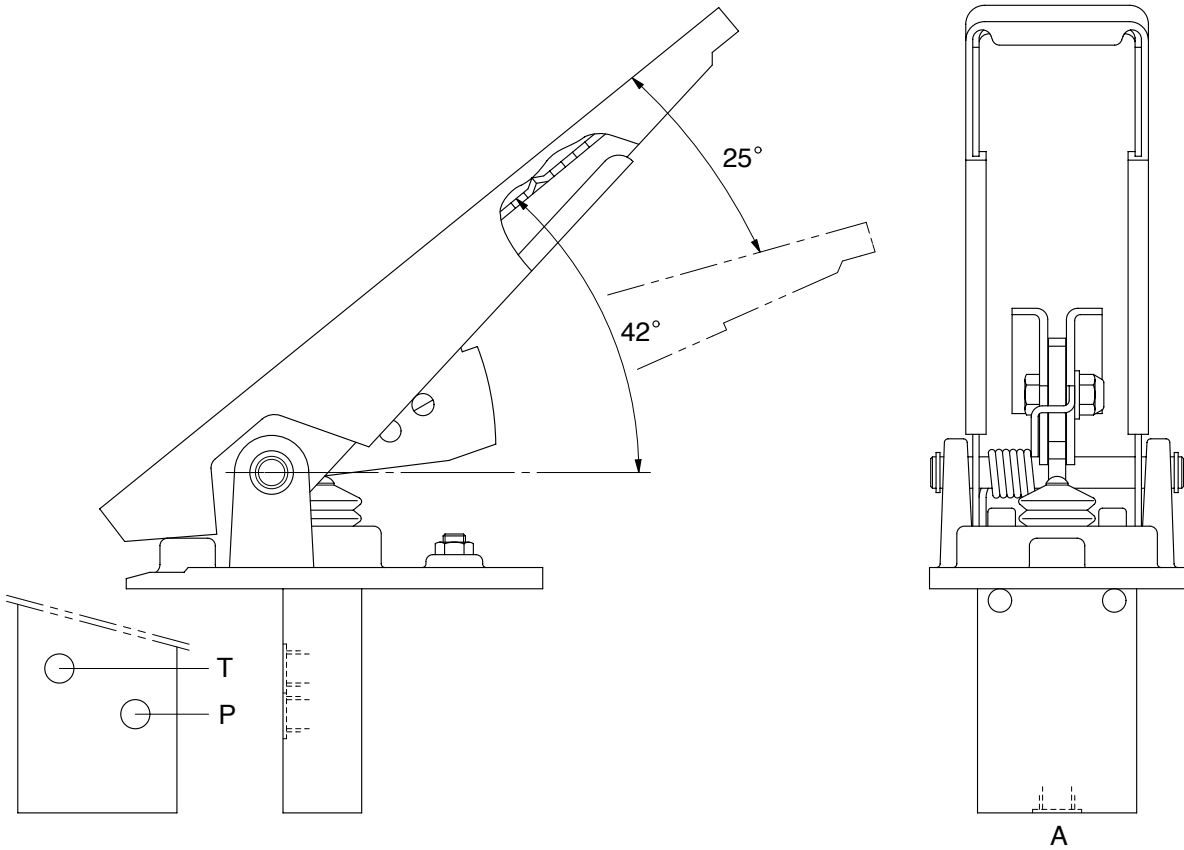
In this manner the secondary pressure is kept at the constant value.

Besides, in some type, when the handle is tilted more than a certain angle, the upper end of the spool contacts with the inside bottom of the push rod and the output pressure is left to be connected with port P.

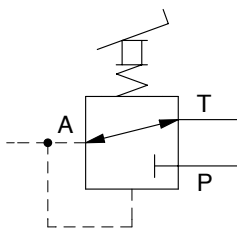
GROUP 6 ACCELERATOR PEDAL

1. STRUCTURE

The casing has the oil inlet port A(Primary pressure), and the oil return port T(Tank). In addition the secondary pressure is taken out through port P.



17032RP01



Hydraulic circuit

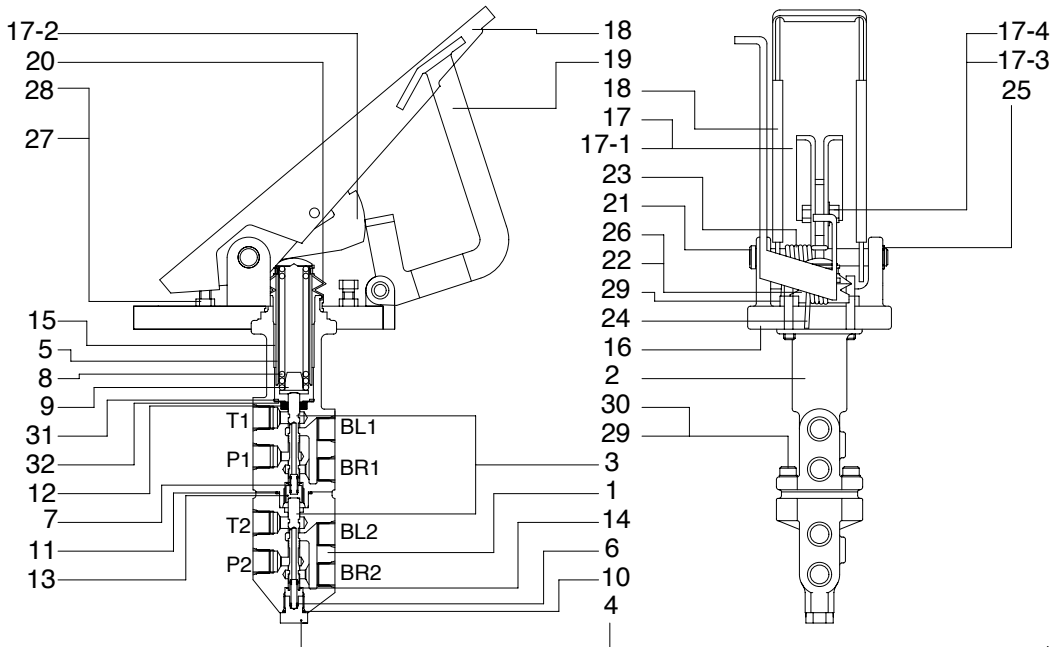
Port	Port name	Port size
A	Pilot oil inlet port	G 1/4
T	Pilot oil return port	
P	Pilot oil output port	

17032RP01(2)

GROUP 7 BRAKE PEDAL(VALVE)

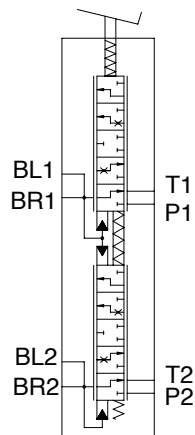
1. STRUCTURE

The casing(Spacer) has the oil inlet port A(Primary pressure), and the oil outlet port T(Tank). In addition the secondary pressure is taken out through ports 1, 2, 3 and 4 provided at the bottom face.



14W72BV01

- | | | |
|-------------------|------------------|---------------------|
| 1 Lower body | 13 S/P Guide | 21 Lock pin 1 |
| 2 Upper body | 14 Stop ring-C | 22 Lock pin 2 |
| 3 Spool | 15 DU bush | 23 Torsion spring 1 |
| 4 Plug | 16 Pedal plate | 24 Torsion spring 2 |
| 5 Holder | 17 Pedal assy | 25 Stop ring-C |
| 6 Lower spring | 17-1 Pedal | 26 E-ring |
| 7 Upper spring | 17-2 Lock plate | 27 Hex bolt |
| 8 Main spring | 17-3 Bolt | 28 Hex nut |
| 9 Spring retainer | 17-4 Plat washer | 29 Socket head bolt |
| 10 O-ring | 18 Pedal rubber | 30 Spring washer |
| 11 O-ring | 19 Latch | 31 Plat washer |
| 12 Oil seal | 20 Rubber cover | 32 Stop ring-C |



14W72BV02

Port	Port name	Port size
P1	Port	PF 3/8
P2	Port	PF 3/8
BR1	Brake cylinder port	PF 3/8
BR2	Brake cylinder port	PF 3/8
BL1	Plugging	PF 3/8
BL2	Plugging	PF 3/8
T1	Drain port	PF 3/8
T2	Drain port	PF 3/8

2. FUNCTION

1) PURPOSE

The purpose of the brake valve is to sensitively increase and decrease the braking pressure when the brake pedal is actuated.

2) READY POSITION

When the braking system is ready for operation, its accumulator pressure acts directly on port P1/P2 of the brake valve. A connection is established between ports BR1/BR2 and port T1/T2 so that the wheel brake ports BR1/BR2 are pressureless via the returns ports T1/T2.

3) PARTIAL BRAKING

When the brake valve is actuated, an amount of hydraulic pressure is output as a ratio of the foot force applied.

The spring assembly(8) beneath pedal plate(16) is designed in such a way that the braking pressure changes depending on the angle. In the lower braking pressure range, the machine can be slowed sensitively.

When the braking process is commenced, the upper spool(3) is mechanically actuated via spring assembly(8), and the lower spool(3) is actuated hydraulically by spool(3). As spools(3) move downward, they will first close returns T1/T2 via the control edges, thus establishing a connection between accumulator port P1/P2 and ports BR1/BR2 for the wheel brake cylinders. The foot force applied now determines the output braking pressure. The control spools(3) are held in the control position by the force applied(Spring assembly) above the spools and the hydraulic pressure below the spool(Balance of forces).

After output of the braking pressure, spools(3) are in a partial braking position, causing ports P1/P2 and T1/T2 to close and holding the pressure in ports BR1/BR2.

4) FULL BRAKING POSITION

When pedal(17) is fully actuated, an end position of the brakes is reached and a connection established between accumulator ports P1/P2 and brake cylinder ports BR1/BR2. Returns T1/T2 are closed at this point.

When the braking process ended, a connection is once again established between brake cylinder ports BR1/BR2 and return ports T1/T2, closing accumulator ports P1/P2.

The arrangement of spools in the valve ensures that even if one braking circuit fails the other remains fully operational. This is achieved by means of the mechanical actuation of both spools and requires slightly more pedal travel.

5) LIMITING THE BRAKING PRESSURE

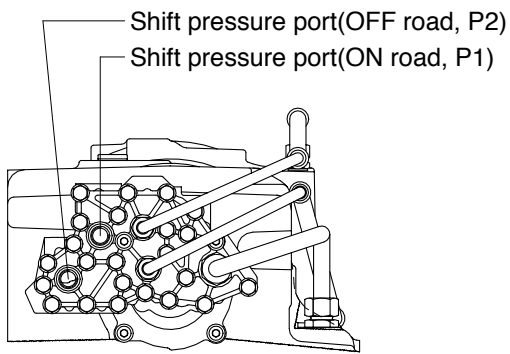
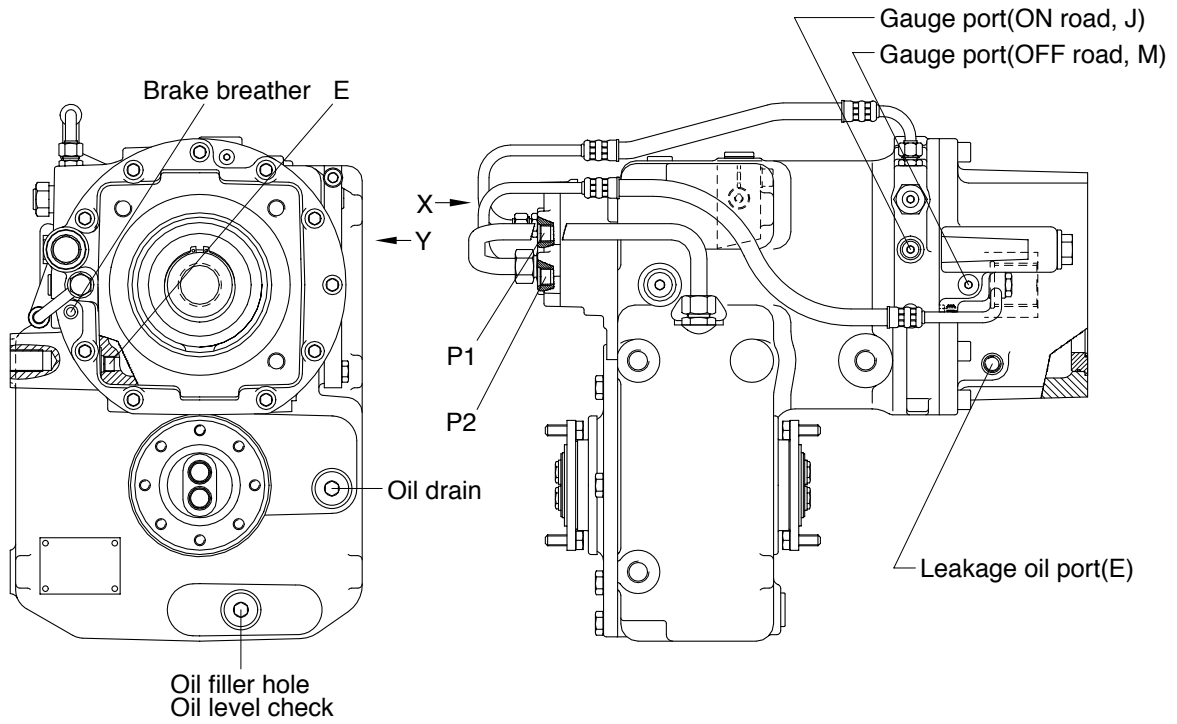
Pedal restriction screw(29) on pedal plate(16) below pedal(17) is used to limit the braking pressure.

6) FAILURE OF A CIRCUIT

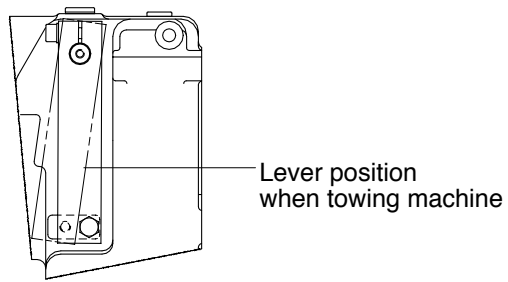
In the event of the lower circuit failing, the upper circuit will remain operational. Spring assembly (8) will mechanically actuate spool(3). In the event of the upper circuit failing, the lower circuit will remain operational since the lower spool(3) is mechanically actuated by spring assembly(8) and spool(3).

GROUP 8 TRANSMISSION

1. STRUCTURE



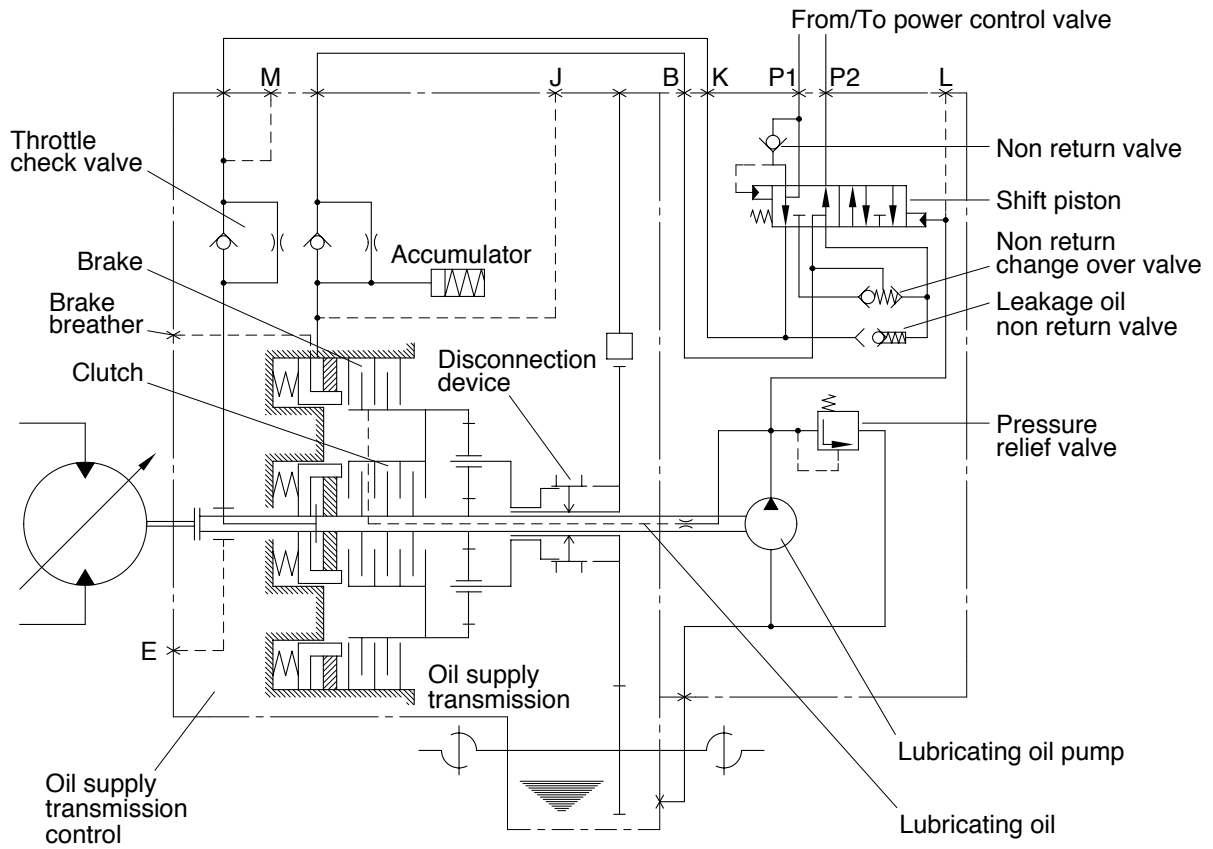
VIEW X



VIEW Y

17032TM01

2. TRANSMISSION DIAGRAM

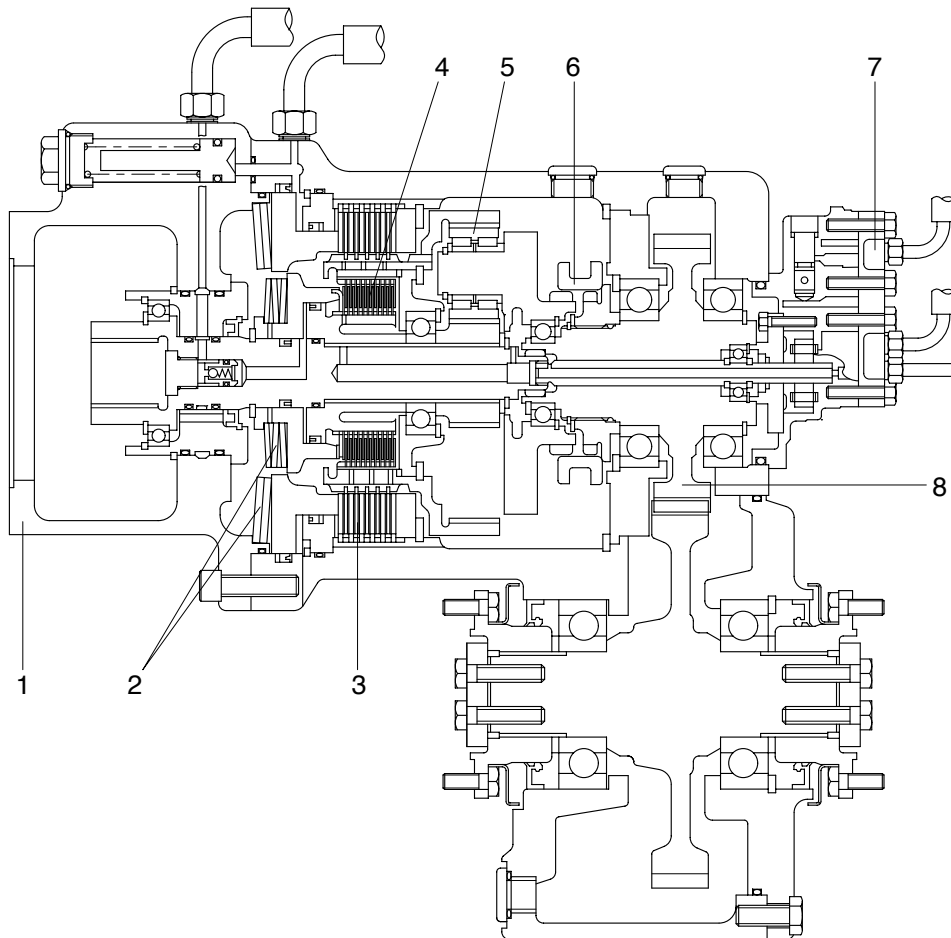


17032TM02

Port	Name	Size	Port	Name	Size
P1	Shift pressure, ON road	M16 × 1.5	M	Gauge port, OFF road	M14 × 1.5
P2	Shift pressure, OFF road	M16 × 1.5	L	Gauge port, Shift interlock	M12 × 1.5
J	Gauge port, ON road	M14 × 1.5	E	Leakage oil	M14 × 1.5

3. OPERATION OF TRANSMISSION

1) DESCRIPTION



17032TM03

- | | | | | | |
|---|--------------|---|--------------------|---|--------------------|
| 1 | Travel motor | 4 | Disc clutch | 7 | Shift interlock |
| 2 | Spring cup | 5 | Planetary gear set | 8 | Helical gear drive |
| 3 | Disc brake | 6 | Disconnect device | | |

Coaxially-mounted variable displacement travel motor(1) with specific displacement $105\text{cm}^3/\text{rev}$.

The 2-speed powershift transmission comprises a planetary gear set(5), a 2-shaft helical gear drive(8) with output flanges to front and rear axle.

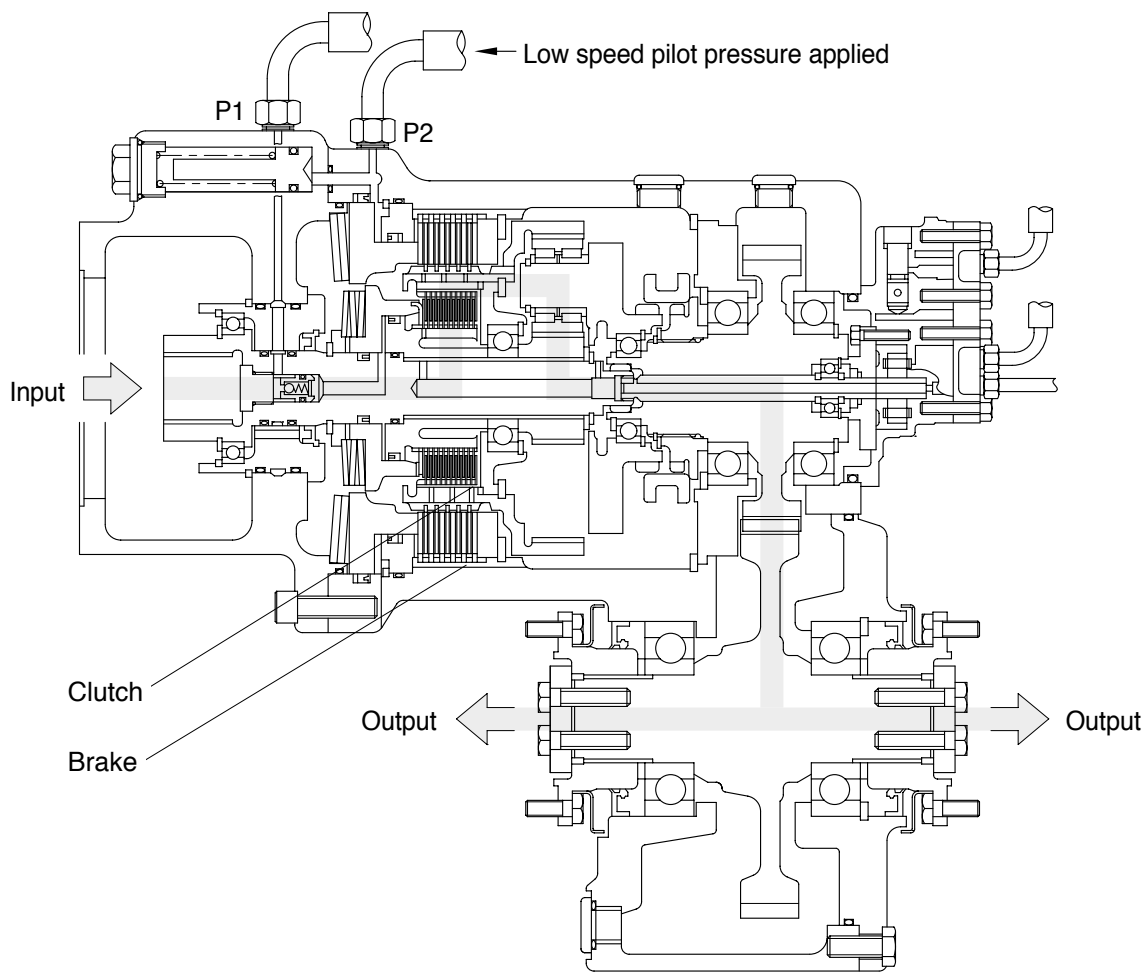
The powershift mechanism for the planet drive comprises a rotating multi-disc clutch(4) underneath a multi-disc brake(3) rigidly connected to the housing. Both are closed by spring pressure(2) and released hydraulically.

Between the planet drive and the helical drive, a disconnect device(6) is provided(Shifting when machine standstill). It is actuated by means of a lever mounted on the transmission housing, with firm locking in IN/OUT positions. This disconnect device interrupts the power drive train between the powershift section and the output and thus allows the machine to be towed up to its maximum speed and without special restrictions on distance. When the disconnect device disconnected, the parking brake does not function.

The disconnect device should only be used in emergency in order to remove the machine from a danger zone should power fail or should transmission control pressure not be available.

The shift interlock(7) prevents downshifts at high machine speeds and thus prevents over-rotation of the travel motor. If the off-road gear is selected while the on-road gear is engaged and input speed is above approx. 800rpm, The off-road gear shift is inhibited and only performed if input speed is below this limit. With higher viscosity oil(Cold starting), the downshift is performed at a lower input speed. Upshifts are always possible. The speed-dependent interlock is effective in both directions. It does not prevent the possibility of over-rotation when the machine is coasting. For this, a drive brake valve should be fitted to the travel motor.

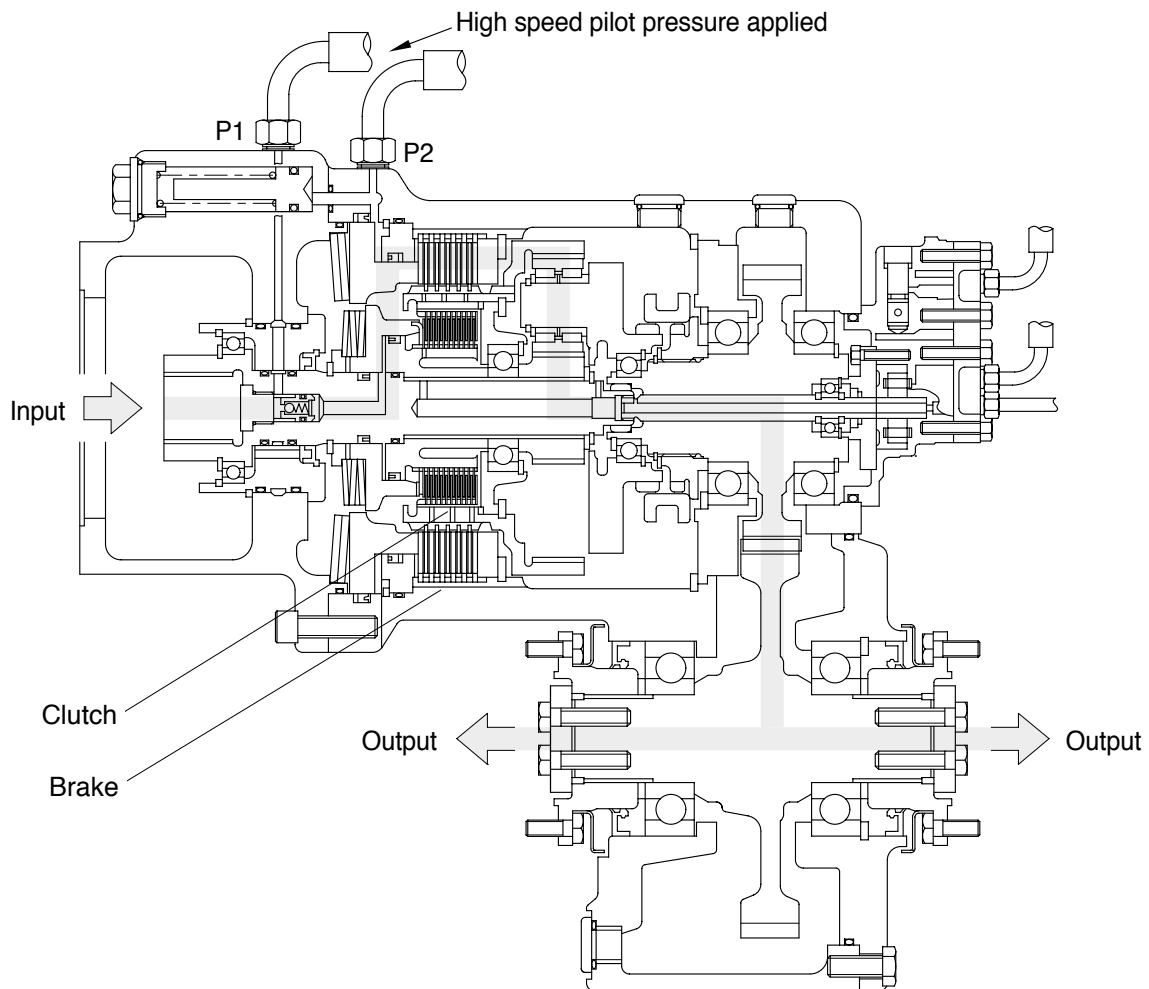
2) LOW SPEED(OFF ROAD, forward & reverse)



17032TM04

In OFF-road operation, the planet drive ring gear is supported on the closed brake fixed to the housing. In this gear, there is no pressure in the brake piston space so spring force acts on the multi-disc pack. Therefore, the clutch is opened.

3) HIGH SPEED(ON ROAD, forward & reverse)



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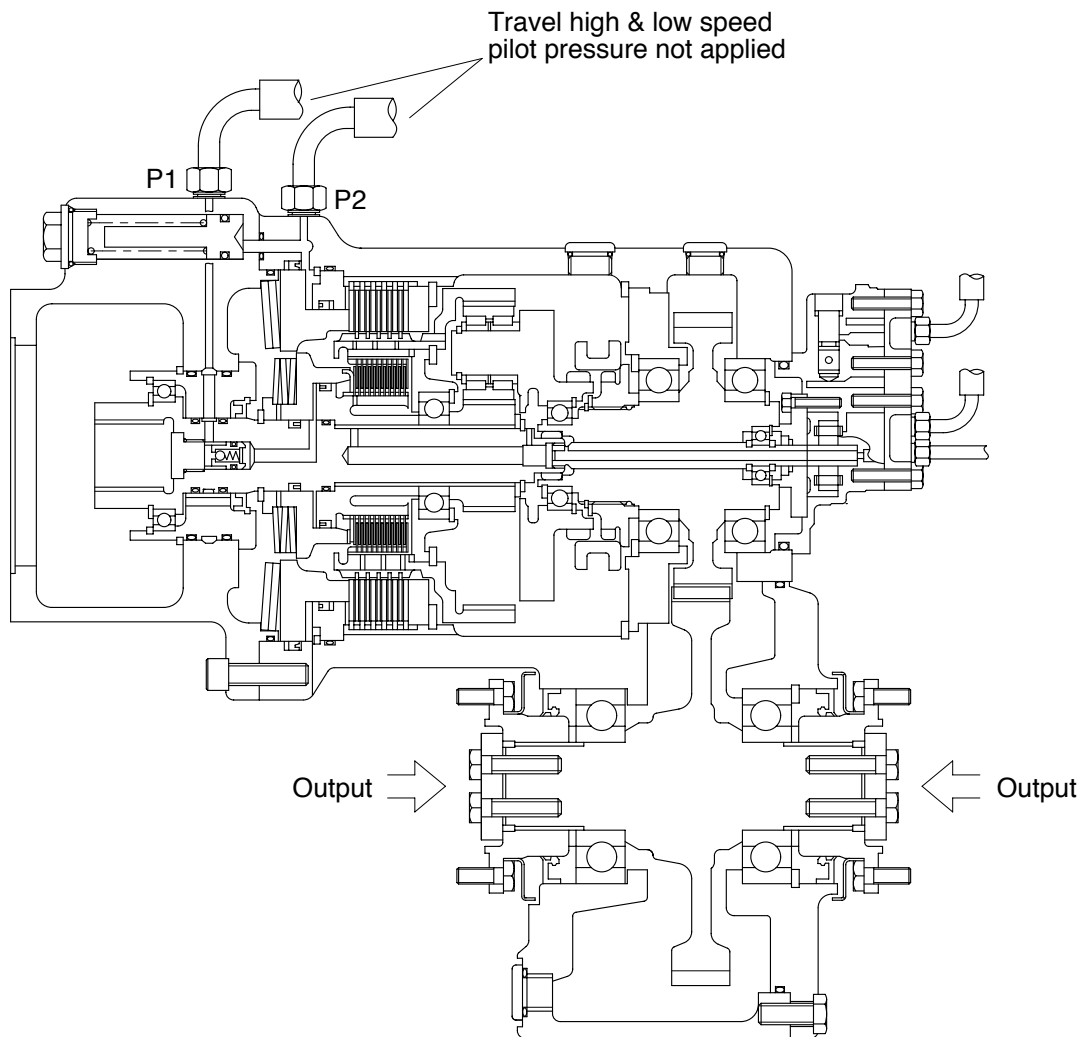
In ON-road operation, the clutch is held closed under spring pressure and the brake is hydraulically opened.

When a gear shift occurs-for example from ON-road to OFF-road gear- the oil from the brake piston space is fed back to the tank through a restrictor(Throttle non-return valve) due to the spring pressure acting on the brake piston. At the same time the clutch is filled with oil and opened. Required oil flow is necessary for the transmission control to ensure the clutch is open before the brake begins to transmit torque.

A spring accumulator is also integrated in the transmission. This modulates the pressure sequence at the brake during a downshift in order to achieve good shift quality.

The gear shift equipment also has the function of a parking brake. When the brake is operated-for example with ON-road gear engaged-the clutch is closed and is statically loaded.

4) BRAKES



17032TM06

When the travel high/low speed pilot pressure is not applied in the piston space, the piston compress against the multi disc pack due to the spring force. Thus the parking brake is engaged.

4. TECHNICAL DATA

1) GENERAL DATA

- (1) Max input power : 110kW
- (2) Max input torque : 78.5kg · m
- (3) Max input speed : 4500rpm
- (4) Hydraulic motor : 160cm³/rev
- (5) Transmission ratio
Gear step : 3.85
 - OFF-road gear : 5.35
 - ON-road gear : 1.39
- (6) Shift interlock
Downshift possible at operating temperature with input speed 800rpm.(Downshift point lower when oil temperature cold)
- (7) Disconnection device
For towing away machine auxiliary release device for parking brake
- (8) Brake
Parking brake. Necessary brake deceleration by controlled locking of planetary drive. Braking torque depends on opening pressure set at brake valve(13bar).
- (9) Output flange
Bolts for propshaft connection : M10 × 1.0(Class 10.9)
- (10) Transmission weight : 125kg

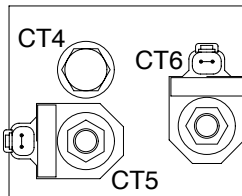
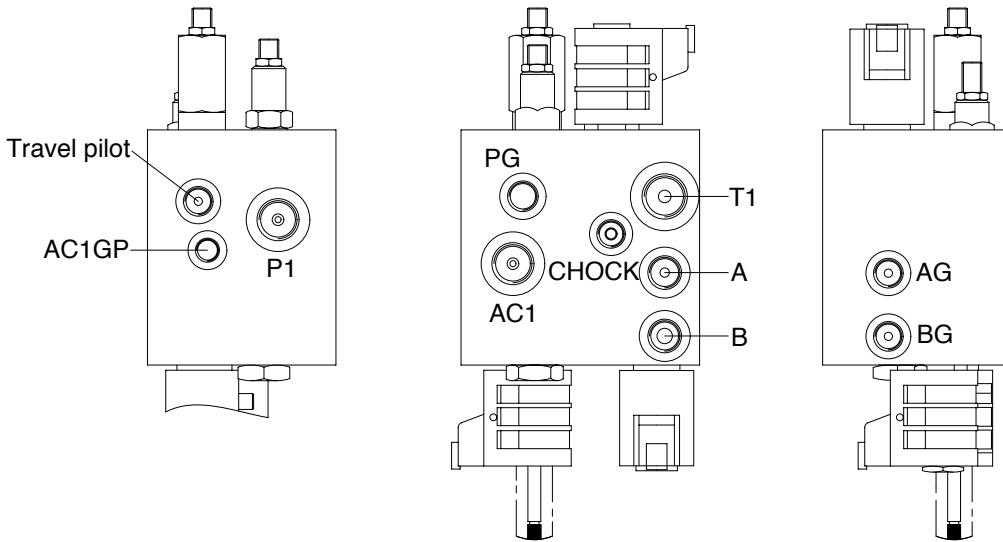
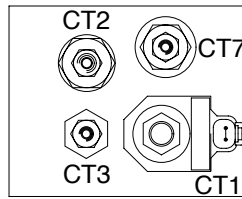
2) TRANSMISSION CONTROL

Following data are valid for oil temperature 30°C to 40°C in hydraulic tank, measured at connections at powershift transmission(See Structure and Diagram).

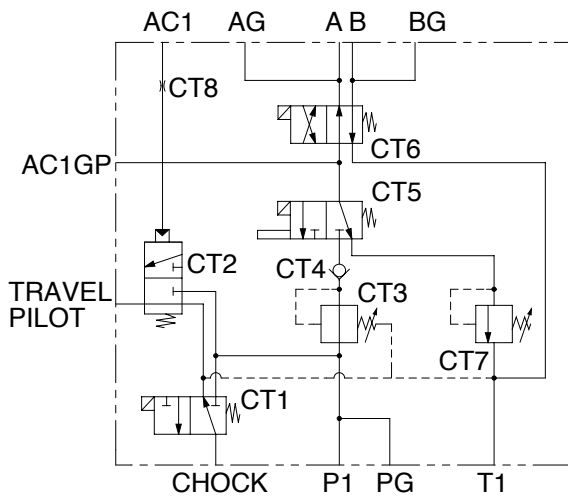
- (1) Control pressure
At connection P1 and P2 at Low/High engine speed : 33+1kg/cm²
Definition of lubricants : API GL-5, SAE 10W-30, 15W-40
- (2) Oil flow
Min oil flow at 24+1kg/cm² counter pressure(Low engine speed) : 5.5 /min
Max oil flow : 25 /min
- (3) Residual pressure
Max residual pressure in control line to tank connection P1 respectively P2 : 1.0kg/cm²
- (4) Leakage oil transmission control
Pressure in input housing connection(E) max : 1.0kg/cm²
Max oil flow(OFF road actuated) : 1 /min

GROUP 9 TRANSMISSION CONTROL VALVE

1. STRUCTURE



20W72TCV02

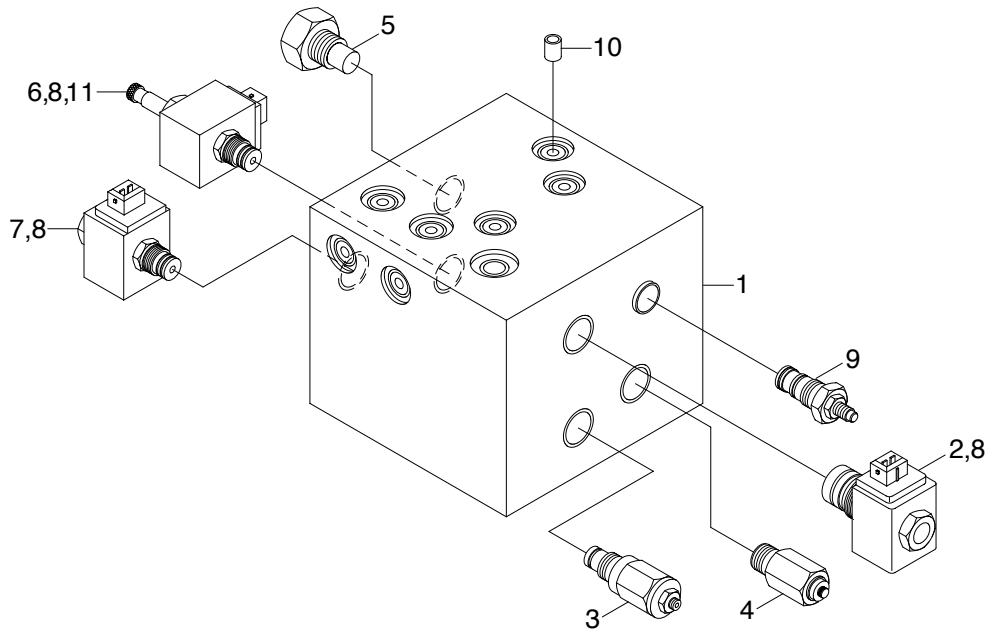


Hydraulic circuit

Port name	Port size
P1, T1, AC1	PF 1/2
Travel pilot, A, B	PF 3/8
AG, BG, PG, CHOCK	PF 1/4

20W72TCV03

2. COMPONENT



20W72TCV01

- | | | | |
|---|----------------|----|----------------|
| 1 | Body | 7 | Solenoid valve |
| 2 | Solenoid valve | 8 | Coil |
| 3 | POD valve | 9 | Relief valve |
| 4 | Reducing valve | 10 | Orifice |
| 5 | Check valve | 11 | Lock nut |
| 6 | Solenoid valve | | |