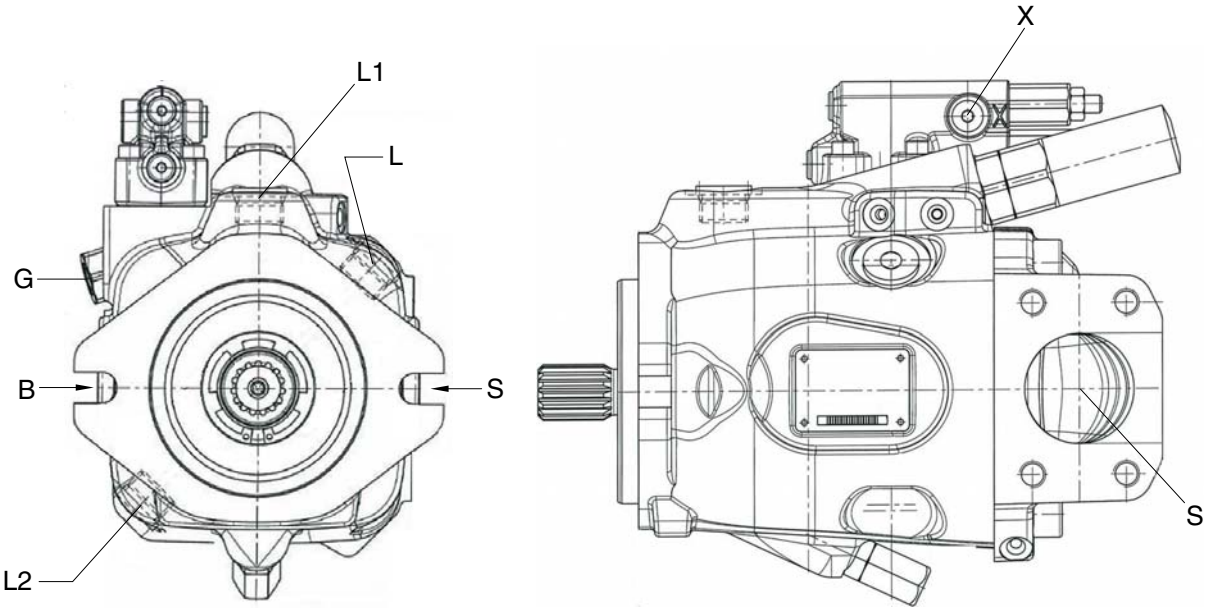
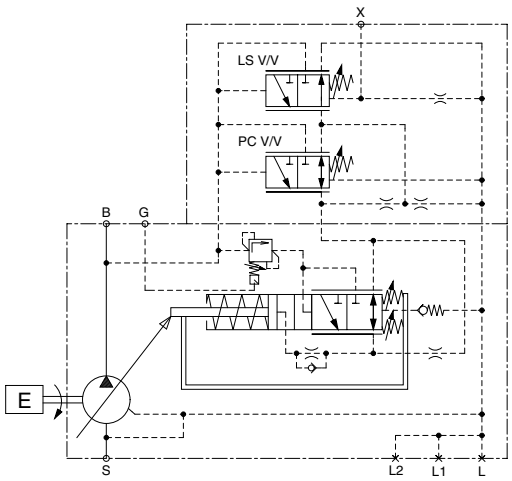
# SECTION 2 STRUCTURE AND FUNCTION

# GROUP 1 HYDRAULIC PUMP

## 1. GENERAL

This main pump is variable displacement piston type with load sensing system.




Hydraulic circuit

48AZ2MP01

Description of the ports

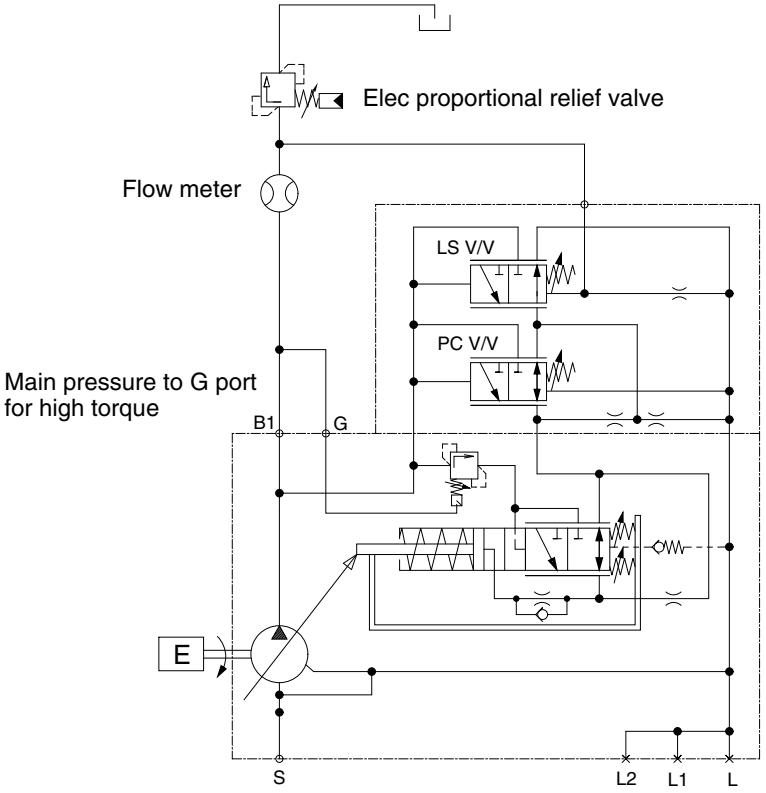
| Port | Name | Bore |
|---|---|---|
| S | Suction port | SAE 2" |
| B | Discharge port | SAE 1" |
| G | High pressure port for dual torque function | M10x1 |
| X | Pilot pressure port | PF7/16-20UNF |
| L, L1, L2 | Case drain port | PF7/8-14UNF |

## 2. START OF POWER CONTROL

Setting of starting point in P-Q curve shall be carried out as per following conditions and procedures.

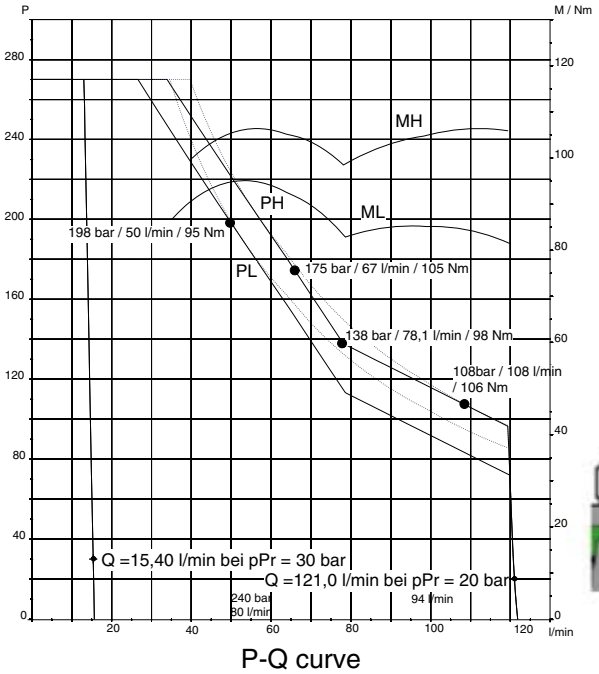
### 1) CONDITIONS

(1) Engine shall be running at 2000 rpm.
(2) Oil temperature shall be adjusted at 40 ℃.
(3) Pressure gauges and a flow meter shall be installed.

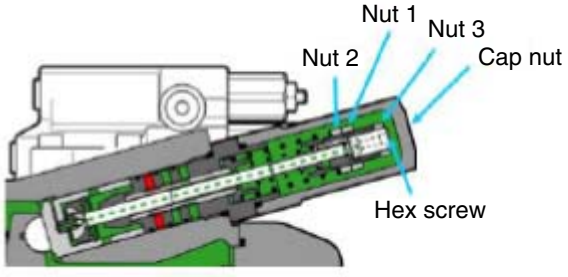



Schematic circuit

85A2MP10




P-Q curve




Pump schematic drawing

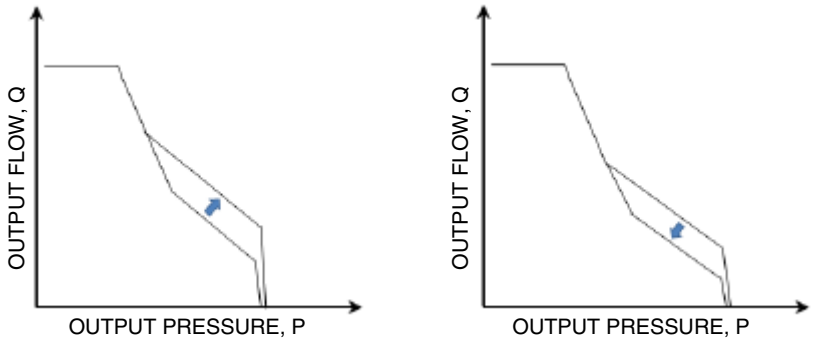
48AZ2MP11

### 2) PROCEDURES

(1) Loosen nut 1 fixing nut 2.
(2) Adjust outer spring by tightening or loosening nut 2.
① Increase pressure up to 170 bar.
② Turn Nut 2 clockwise to increase power until pumping flow reaches 123 ℓ/min (±4 ℓ/min).
(3) Secure the setting of nut 2 by tightening nut 1.

### 3) CHANGE OF P-Q CURVE

(1) If length of outer spring is decreased by tightening nut 2, the P-Q curve is moved to right in general like a graph left under as the spring tension is increased.
(2) If length of outer spring is increased by loosening nut 2, the P-Q curve is moved to left in general like a graph right under as the spring tension is decreased.




85A2MP12

## 3. END OF POWER CONTROL

Setting of ending point in P-Q curve shall be carried out following procedures and conditions.

### 1) CONDITIONS

(1) The conditions shall be set same as above.

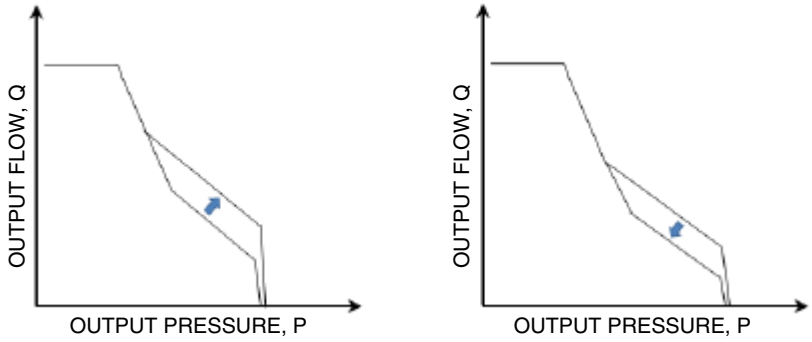
### 2) PROCEDURES

(1) Loosen the nut 3.
(2) Set end of control by turning Hexagonal screw.
① Increase pressure to 220 bar.
② Turn Screw clockwise to increase power until 92 ℓ /min (±4 ℓ /min) is reached.
(3) Secure the setting of nut 3.
(4) Tighten Cap nut.

### 3) CHANGE OF P-Q CURVE

(1) If length of Inner spring is deceased by tightening hexagonal screw, lower part of P-Q curve is moved to right like a graph left under as the tension force of spring is increased.

(2) If length of Inner spring is increased by loosening hexagonal screw, lower part of P-Q curve is moved to left like a graph left under as the tension force of spring is decreased.




85A2MP13

## 4. APPENDIXES

Required torque for bolt tightening

| Part | Name | Required torque | |
|---|---|---|---|
| | | kgf·m | lbf·ft |
| Nut 1 | 14 mm | 5.1 | 36.9 |
| Nut 2 | 14 mm | 5.1 | 36.9 |
| Nut 3 | 10 mm | 4.1 | 29.7 |
| Cap nut | 32 mm | 7.1 | 51.4 |
| Hexagon screw | 10 mm | - | - |

## 5. DUAL TORQUE MODE

Pump power needs to be decreased in case that engine power is not enough to cover air condition operating at maximum pump operating. This function lets the pump power decrease by operating of dual torque valve.

### (1) Normal operating condition (without air conditioner mode)

Solenoid valve (7) maintains the pushed position and allows oil to flow from passage (15) to passage (19). The pressure pushes dual torque valve (5) not to allow the pumping oil to flow toward control valve (6) inside. As a result, pressure in front of dual torque valve (5) does not effect on the angle of swash plate (25).

### (2) Excessive operating condition (by air conditioner mode)

If air conditioner operates with maximum pump operating, the increased power will overload engine. Therefore, pump power needs to be decreased to share power consumption with air conditioner without overload to engine.

Connection between passage (15) and passage (19) is blocked by deactivation of solenoid valve (7). Dual torque valve which was pushed by the pressure in passage (19) also returns to initial position by spring force. This return allows the pumping oil to flow toward control valve (6) inside. The angel of swash plate (25) is decreased by the pressure in control valve. As a result, pump flow is decreased and power consumption by pump also is decreased.

## 6. UPSTROKE

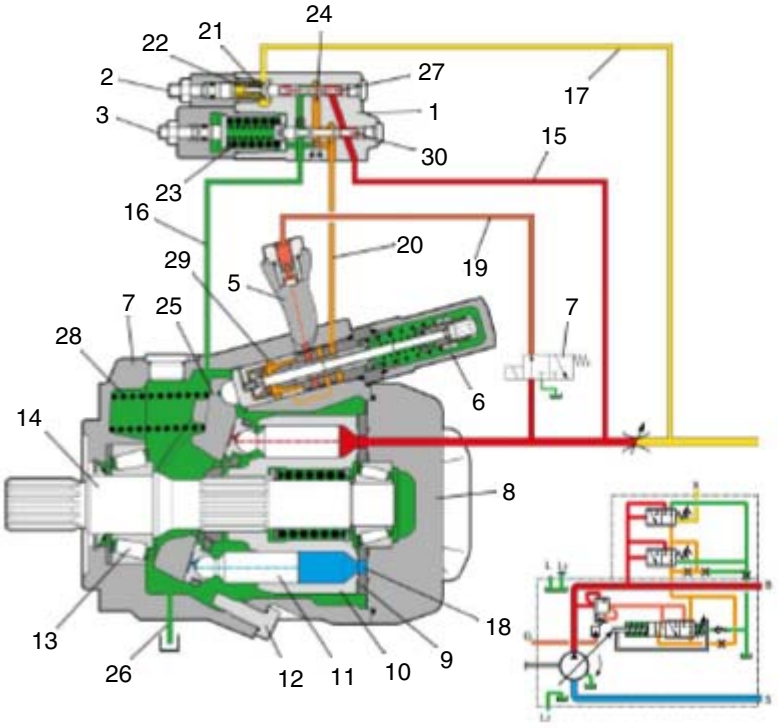
Upstroking of the pump occurs as a demand for flow from attachment.

The increased demand for flow causes a LS pressure in passage (17). The LS pressure in passage (17) combines with the force of spring (22) in cavity (21). The force of spring (22) causes pump pressure to be higher than pressure of passage (17).

If the combination of LS pressure and spring force is greater than the pump discharge pressure in passage (15), this difference pressure causes a spool (27) to move right. As the spool (27) moves right, the spool (27) blocks inflow of pumping oil to control piston (6) through passage (20). Swash plate (25) is controlled by pressure and flow as much as hydraulic system requests.

Pilot oil in passage (20) drains to passage (24). The oil then flows into housing through passage (16) into the housing and finally drains to tank. It also causes pumping flow to increase. As flow requirement is satisfied, pump output pressure increases. The pressure increases until the pressure in passage (24) moves flow compensator spool (27) up to be satisfied with system requirement for pressure and flow.

· Pump discharge pressure = force of spring (22) + LS pressure (17)




85A2MP14

1 Regulator
2 Flow adjustment screw
3 Pressure adjustment screw
4 Pump housing
5 Dual torque valve
6 Control valve
7 Solenoid valve
8 Port plate
9 Distributor plate
10 Cylinder block
11 Piston
12 Minimum flow limitation valve
13 Bearing
14 Drive shaft
15 Passage (high pressure)
16 Passage (leakage pressure)
17 Passage (pilot pressure)
18 Passage (suction pressure)
19 Passage (dual torque valve pilot pressure)
20 Passage (control piston pilot pressure)
21 Cavity
22 Spring
23 Spring
24 Passage
25 Swash plate
26 Casing drain
27 Flow compensator spool
28 Spring
29 Cross drilled hole
30 Pressure compensator spool

## 7. DESTROKE

The decreased flow demand causes LS pressure in passage (17). LS pressure in passage (17) combines with force of spring (22) in cavity (21).

This combination of LS pressure and spring force is less than the pump pressure in passage (15). It causes flow compensator spool (27) to move left.

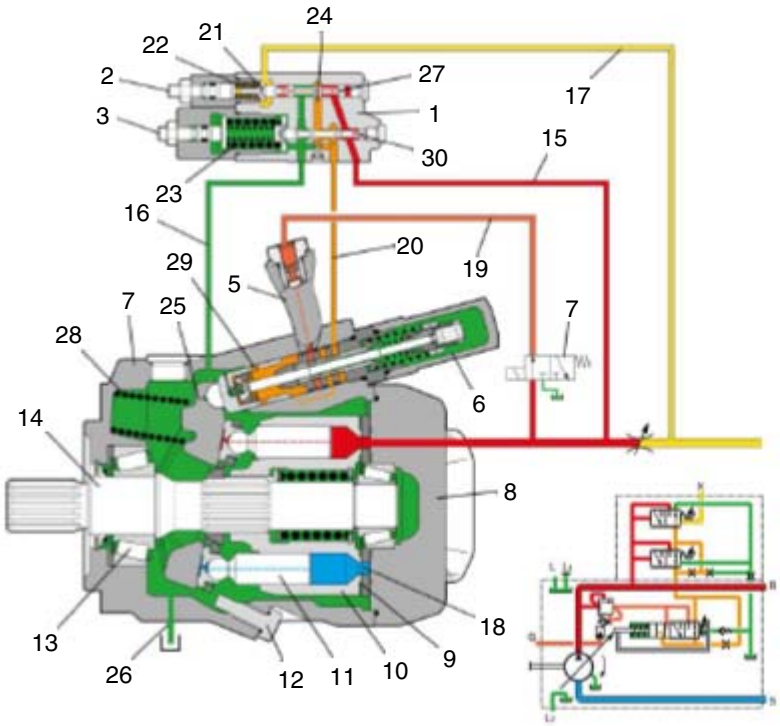
Pumping oil now flows through passage (15). The oil then flows past flow compensator spool (27), and then to control piston (6) through passage (20).

Combined force of pump pressure behind control piston (6) and counter spring (28) is bigger than force of springs inside control piston (6). Angle of swash plate (25) decreases.

This action results in decreasing of pump output and system pressure.

When the flow is decreased enough, flow compensator spool (27) moves right up to the balance position.

Swash plate (25) maintains the angle that is sufficient to provide the lower required pressure. If the operator does not operate RCV lever or pedal, the pump will return to low pressure stand-by.




85A2MP15

## 8. LOW PRESSURE STAND-BY

Low pressure standby constitutes the following condition: a running engine and inactive attachment. There is no flow demand or pressure demand on the pump. Therefore, there is no LS pressure in passage (17).

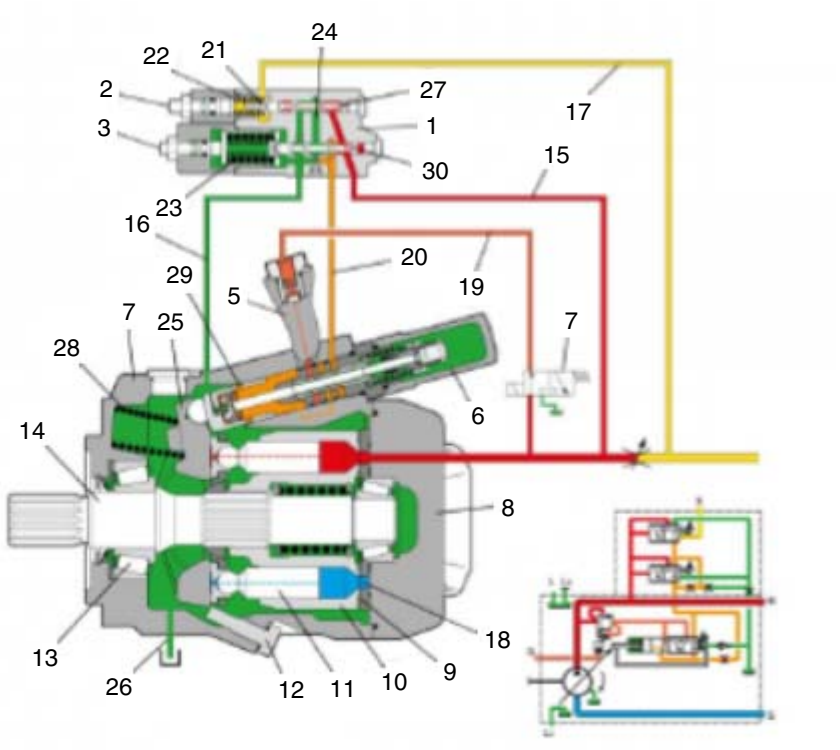
Before you start the engine, counter spring (28) holds swash plate (25) at the maximum angle. As the pump begins to operate, oil begins to flow and pressure increases in the system.

As the pressure increases, the pressure pushes flow compensator spool (27) against spring (22). It causes flow compensator spool (27) to move left. It opens passage (24) in order to allow pumping oil to flow to control piston (6) via passage (20).

The oil acts against control piston (6) in order to overcome the force of counter spring (28). The oil causes control piston (6) to move to the left. When control piston (6) moves to the left, the piston moves swash plate (25) toward the minimum angle. Control piston (6) continues to move to the left until cross-drilled hole (29) allows the oil to drain to pump housing. Cross-drilled hole (29) limits the maximum travel of control piston (6) toward the left.

The pump supplies a sufficient amount of flow that can compensate for the system leakage and the pump leakage. The leakage to the pump housing is flowed from the cross-drilled hole. The pump maintains low pressure stand-by. Low pressure stand-by should not exceed 15 bar.

**※ Low pressure standby will vary in the same pump as the system leakage or the pump leakage increases. The pump will slightly upstroke in order to compensate for the leakage increasing. Control piston (6) will cover much flow control than the flow through the cross-drilled hole.**



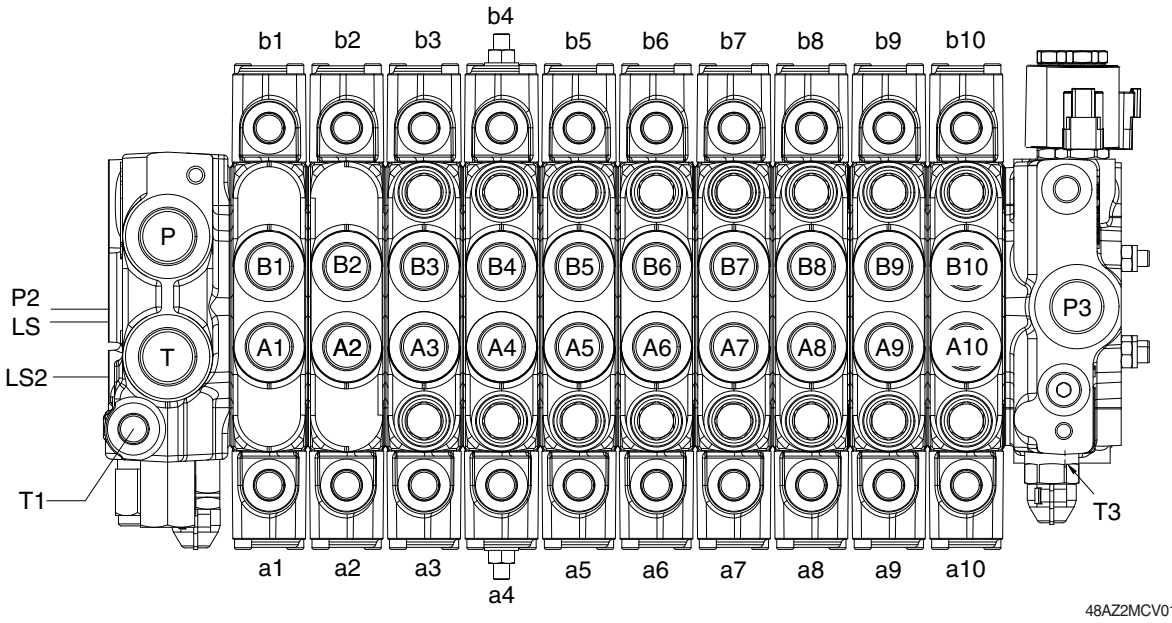

85A2MP16

## 9. CUT OFF FUNCTION

Once sudden pressure increasing in LS line occurs while attachments work, flow decreasing should be a necessary function to prevent a shock inside the pump. When high pressure in passage (15) flows to regulator (1), spools are likely to move by its force. However, shift of flow compensator spool (27) is restricted by LS pressure pushing spring (22) which is generated from attachments. Therefore, flow compensator spool (27) still blocks a connection from passage (27) to passage (24). The flow blocked by flow compensator spool (27) alternatively shifts pressure compensator spool (30) to right. Passage (15) connects to passage (20) by this shift. High pressure flows to control valve (6), then decreases an angle of swash plate (25). Pumping flow finally will decrease by shift of flow compensator spool (27) although flow compensator spool (27) does not shift.

# GROUP 2 MAIN CONTROL VALVE

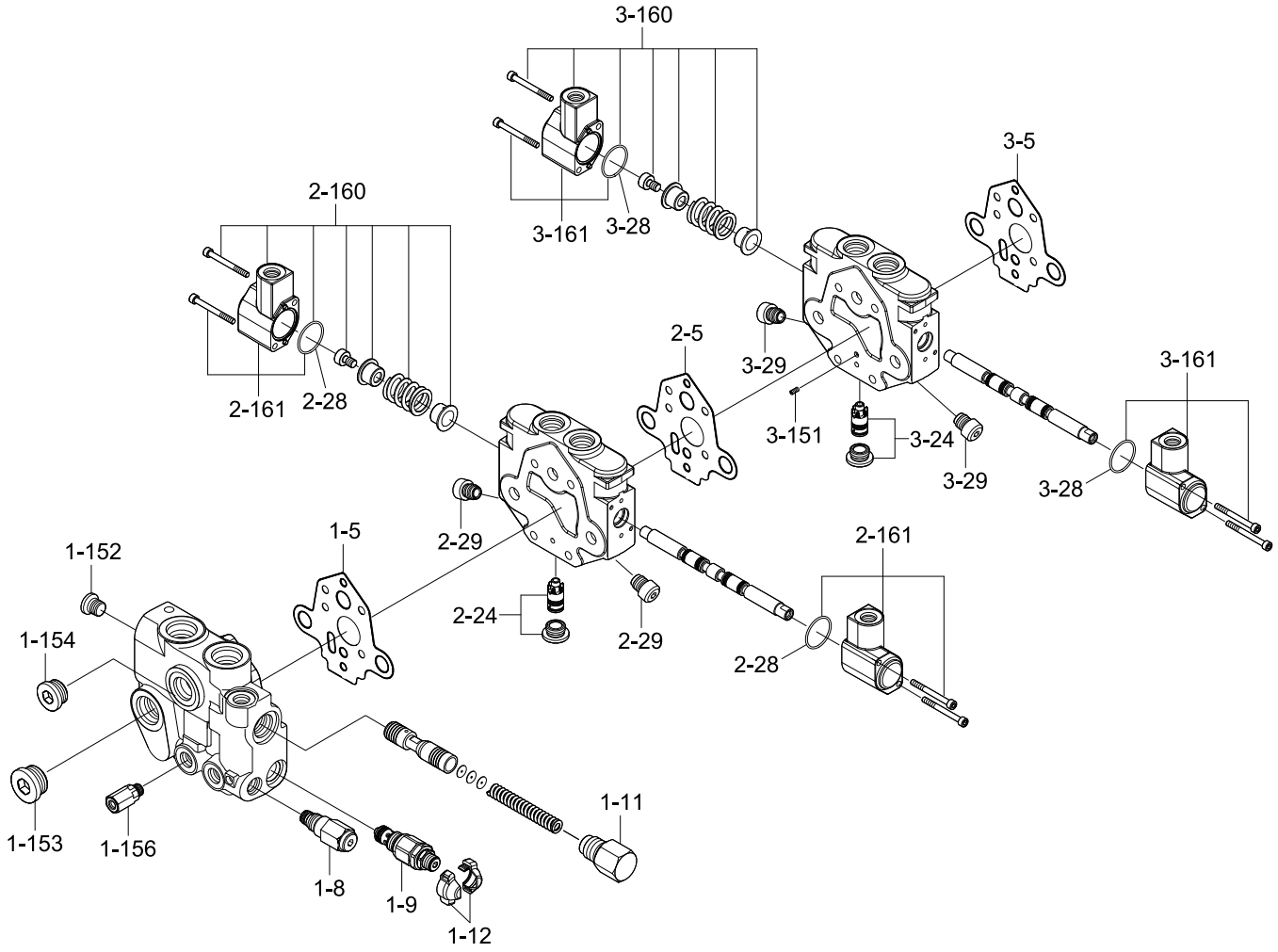
## 1. OUTLINE




| Mark | Port name |
|---|---|
| P | Pump port |
| P3 | Pump port |
| A4 | Swing port (LH) |
| B4 | Swing port (RH) |
| A7 | Dozer down port |
| B7 | Dozer up port |
| A8 | Boom swing port (LH) |
| B8 | Boom swing port (RH) |
| A10 | Rotating port-CCW |
| B10 | Rotating port-CW |
| A5 | Arm out port |
| B5 | Arm in port |
| A2 | Travel port [LH/FW] |
| B2 | Travel port [LH/RR] |
| A1 | Travel port [RH/FW] |
| B1 | Travel port [RH/RR] |
| A3 | Boom up port |
| B3 | Boom down port |
| A6 | Bucket in port |
| B6 | Bucket out port |
| A9 | Auxiliary 1 port (opt) |
| B9 | Auxiliary 1 port (opt) |
| T | Tank return port |

| Mark | Port name |
|---|---|
| T1, T3 | Tank return port |
| a4 | Swing pilot port (LH) |
| b4 | Swing pilot port (RH) |
| a7 | Dozer down pilot port |
| b7 | Dozer up pilot port |
| a8 | Boom swing pilot port (LH) |
| b8 | Boom swing pilot port (RH) |
| a10 | Rotating pilot port-CCW |
| b10 | Rotating pilot port-CW |
| a5 | Arm out pilot port |
| b5 | Arm in pilot port |
| a2 | Travel pilot port (LH/FW) |
| b2 | Travel pilot port (LH/RR) |
| a1 | Travel pilot port (RH/FW) |
| b1 | Travel pilot port (RH/RR) |
| a3 | Boom up pilot port |
| b3 | Boom down pilot port |
| a6 | Bucket in pilot port |
| b6 | Bucket out pilot port |
| a9 | Auxiliary 1 pilot port (opt) |
| b9 | Auxiliary 1 pilot port (opt) |
| LS | Load sensing port |
| LS2 | Load sensing port |

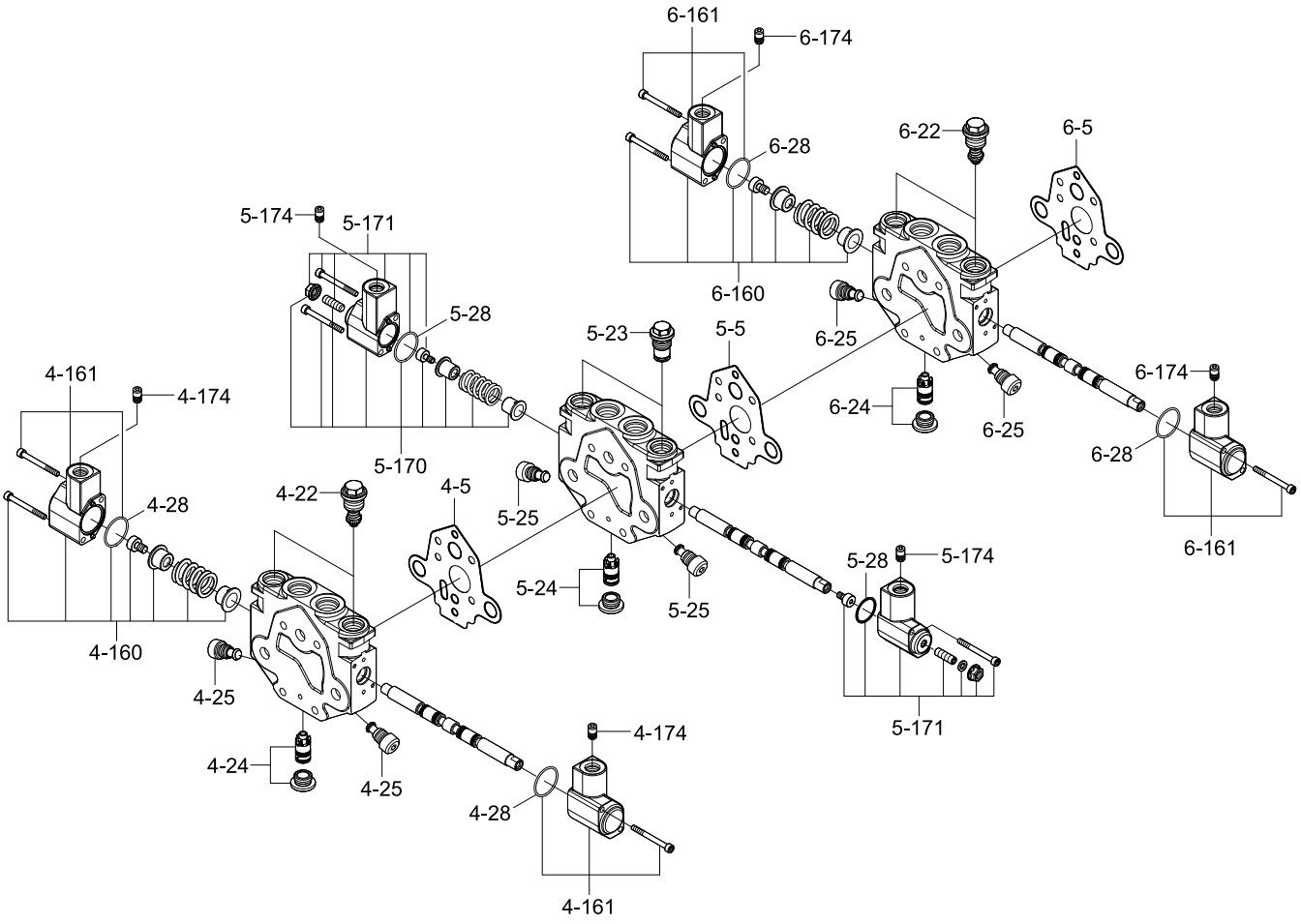
## 2. STRUCTURE (1/4)




48AZ2MCV02

| | | | | | |
|---|---|---|---|---|---|
| 1 | Inlet block assy | 1-154 | Sealing plug | 3 | Travel block assy |
| 1-5 | Plate seal | 1-156 | Shuttle valve | 3-5 | Plate seal |
| 1-8 | Flow regulator | 2 | Travel block assy | 3-24 | Compensator kit |
| 1-9 | Relief valve | 2-5 | Plate seal | 3-28 | Seal kit |
| 1-11 | Plug | 2-24 | Compensator kit | 3-29 | Orifice plug |
| 1-12 | Locking cover | 2-28 | Seal kit | 3-151 | Throttle screw |
| 1-12 | Locking cover | 2-29 | Orifice plug | 3-160 | W/spool cover kit |
| 1-152 | Sealing plug | 2-160 | W/spool cover kit | 3-161 | Cover kit |
| 1-153 | Sealing plug | 2-161 | Cover kit | | |

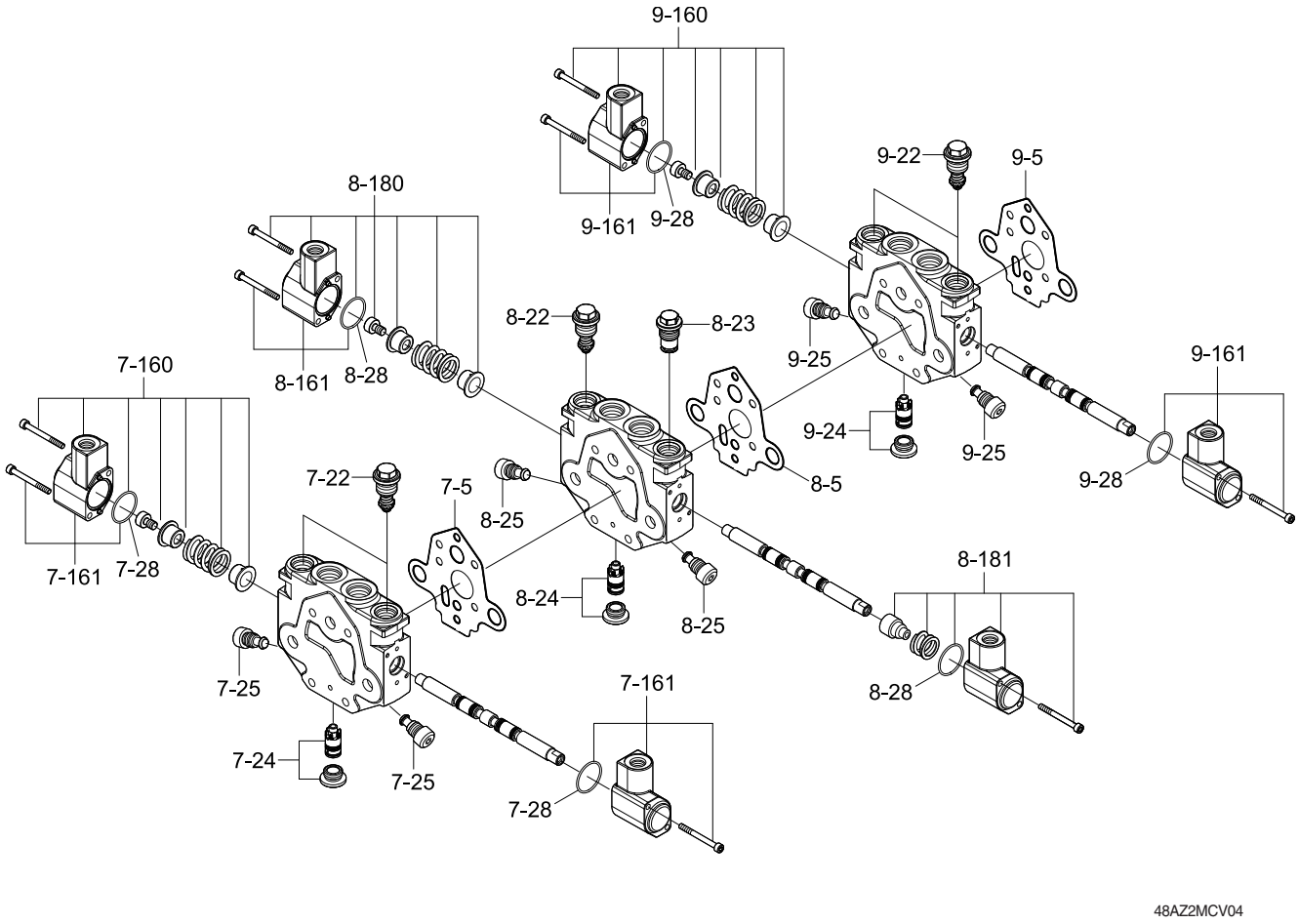
## STRUCTURE (2/4)




48AZ2MCV03

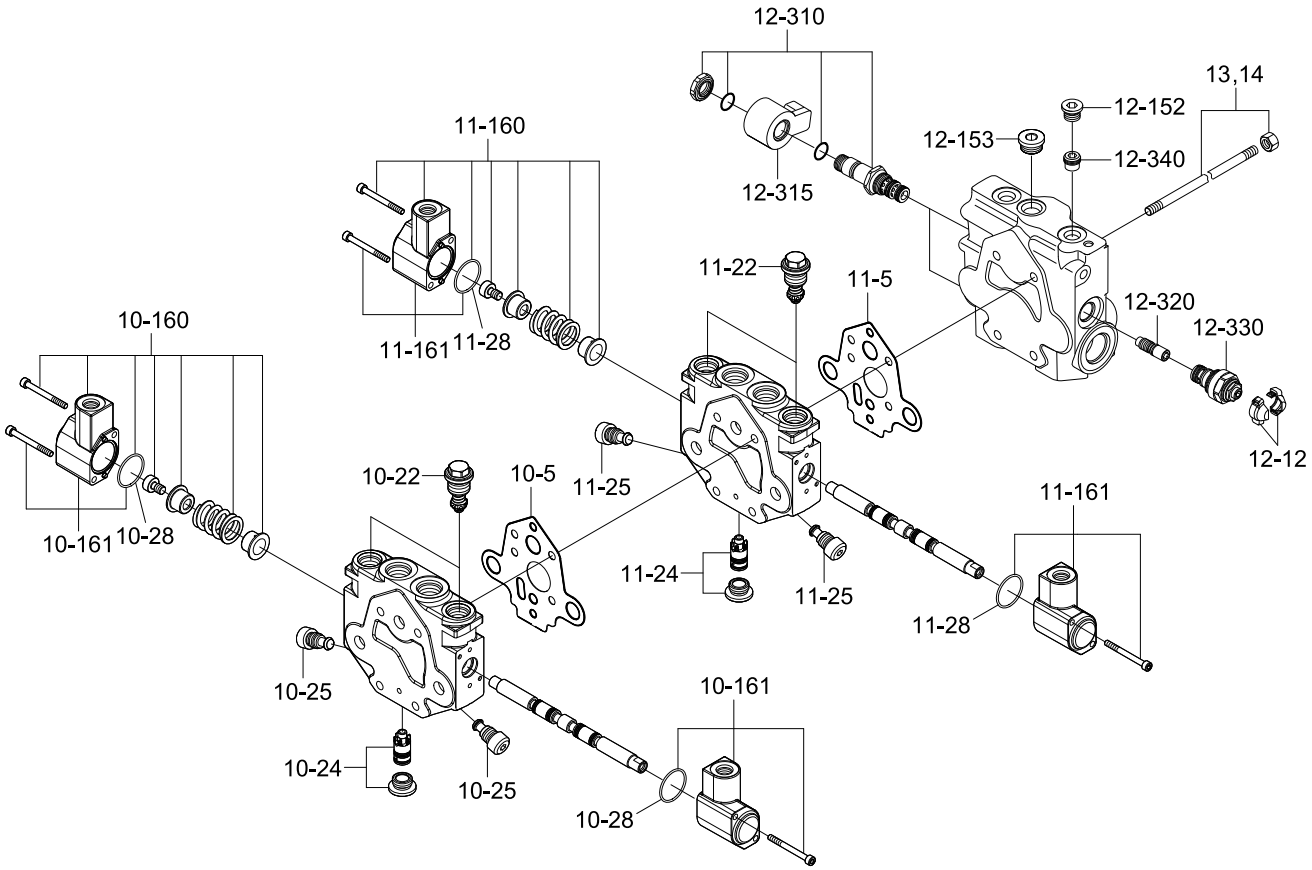
| | | | | | |
|---|---|---|---|---|---|
| 4 | Boom block assy | 5 | Swing block assy | 6 | Arm block assy |
| 4-5 | Plate seal | 5-5 | Plate seal | 6-5 | Plate seal |
| 4-22 | Relief valve | 5-23 | Plug | 6-22 | Relief valve |
| 4-24 | Compensator kit | 5-24 | Compensator kit | 6-24 | Compensator kit |
| 4-25 | Check valve | 5-25 | Check valve | 6-25 | Check valve |
| 4-28 | Seal kit | 5-28 | Seal kit | 6-28 | Seal kit |
| 4-160 | W/spool cover kit | 5-170 | W/spool cover kit | 6-160 | W/spool cover kit |
| 4-161 | Cover kit | 5-171 | Cover kit | 6-161 | Cover kit |
| 4-174 | Snubber | 5-174 | Snubber | 6-174 | Snubber |

## STRUCTURE (3/4)




| | | | | | |
|---|---|---|---|---|---|
| 7 | Bucket block assy | 8-5 | Plate seal | 9 | Boom swing block assy |
| 7-5 | Plate seal | 8-22 | Anticavitation valve | 9-5 | Plate seal |
| 7-22 | Relief valve | 8-23 | Plug | 9-22 | Relief valve |
| 7-24 | Compensator kit | 8-24 | Compensator kit | 9-24 | Compensator kit |
| 7-25 | Check valve | 8-25 | Check valve | 9-25 | Check valve |
| 7-28 | Seal kit | 8-28 | Seal kit | 9-28 | Seal kit |
| 7-160 | W/spool cover kit | 8-161 | Cover kit | 9-160 | W/spool cover kit |
| 7-161 | Cover kit | 8-180 | W/spool cover kit | 9-161 | Cover kit |
| 8 | Dozer block assy | 8-181 | W/spool cover kit | | |

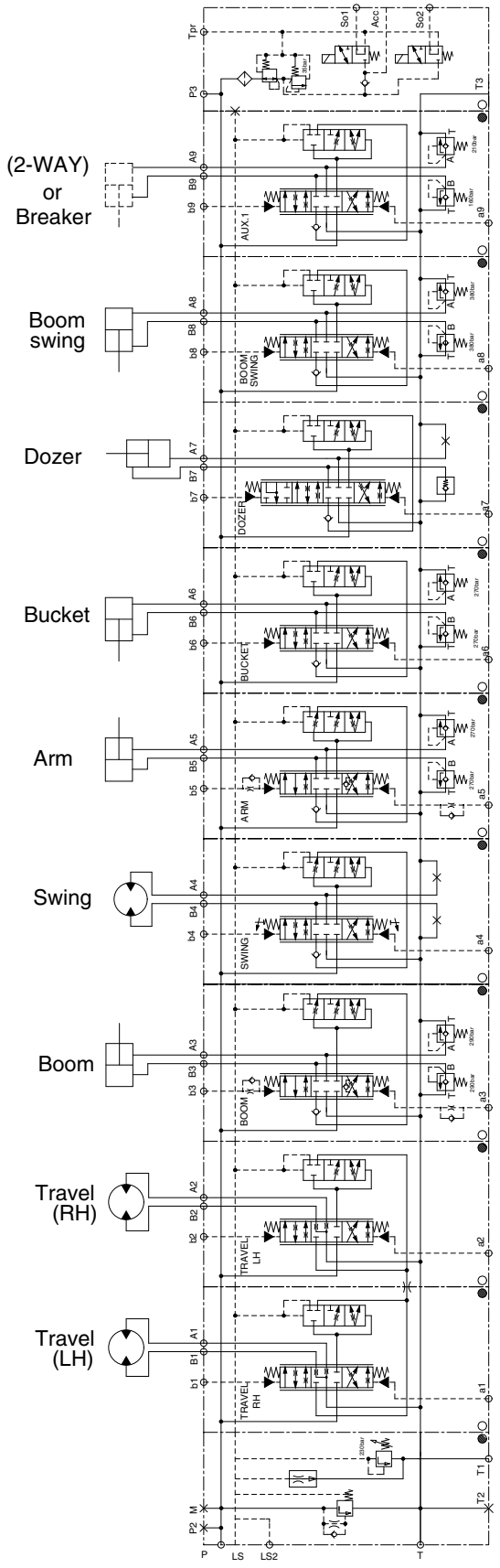
## STRUCTURE (4/4)




48AZ2MCV05

| | | | | | |
|---|---|---|---|---|---|
| 10 | Aux 1 block assy | 11-5 | Plate seal | 12-152 | Sealing plug |
| 10-5 | Plate seal | 11-22 | Relief valve | 12-153 | Sealing plug |
| 10-22 | Relief valve | 11-24 | Compensator kit | 12-310 | Valve kit |
| 10-24 | Compensator kit | 11-25 | Check valve | 12-315 | Solenoid |
| 10-25 | Check valve | 11-28 | Seal kit | 12-320 | Shuttle |
| 10-28 | Seal kit | 11-160 | W/spool cover kit | 12-330 | Pressure relief valve |
| 10-160 | W/spool cover kit | 11-161 | Cover kit | 12-340 | Filter |
| 10-161 | Cover kit | 12 | Outlet block assy | 13 | Tie rod |
| 11 | Aux 2 block assy | 12-12 | Locking cover | 14 | Tie rod |

## 3. HYDRAULIC CIRCUIT (boom swing, 2-way)

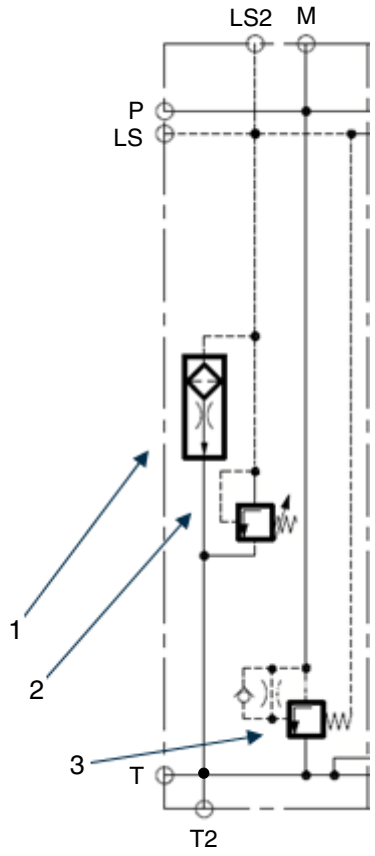



48AZ2MCV06

## 4. FUNCTION

### 1) INLET ELEMENT DESCRIPTION

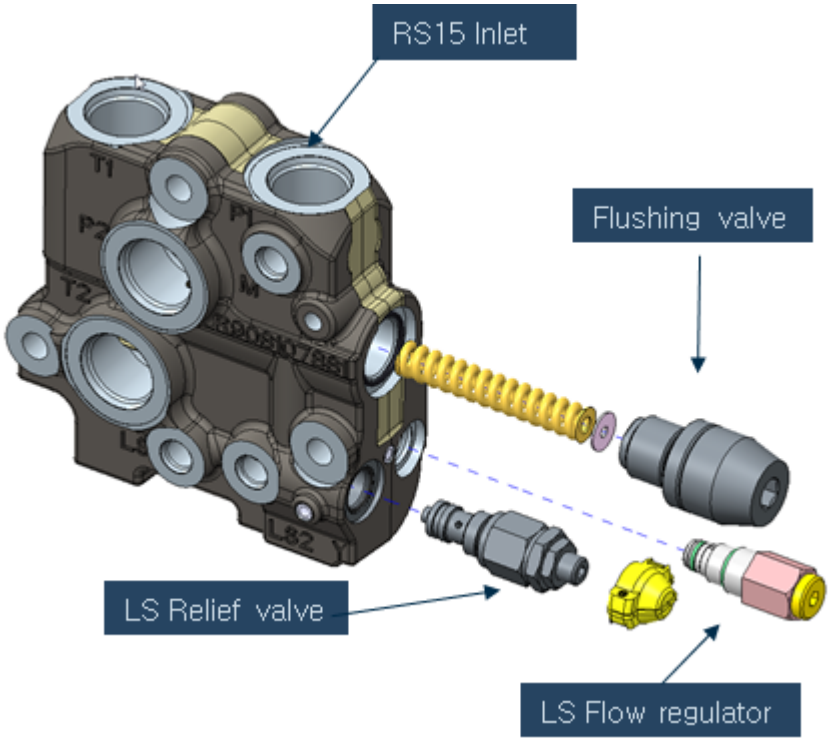
- The inlet plate has the line connections P, T, LS, T2 and M.
- The inlet element moreover comprises all components necessary for the system function: One flow control valve (1) for the controlled unloading of the LS line and one LS pressure relief valve (2) to limit the maximum system pressure.
- Protection of the system by means of LS pressure relief valve (2) combined with flushing valve (3).



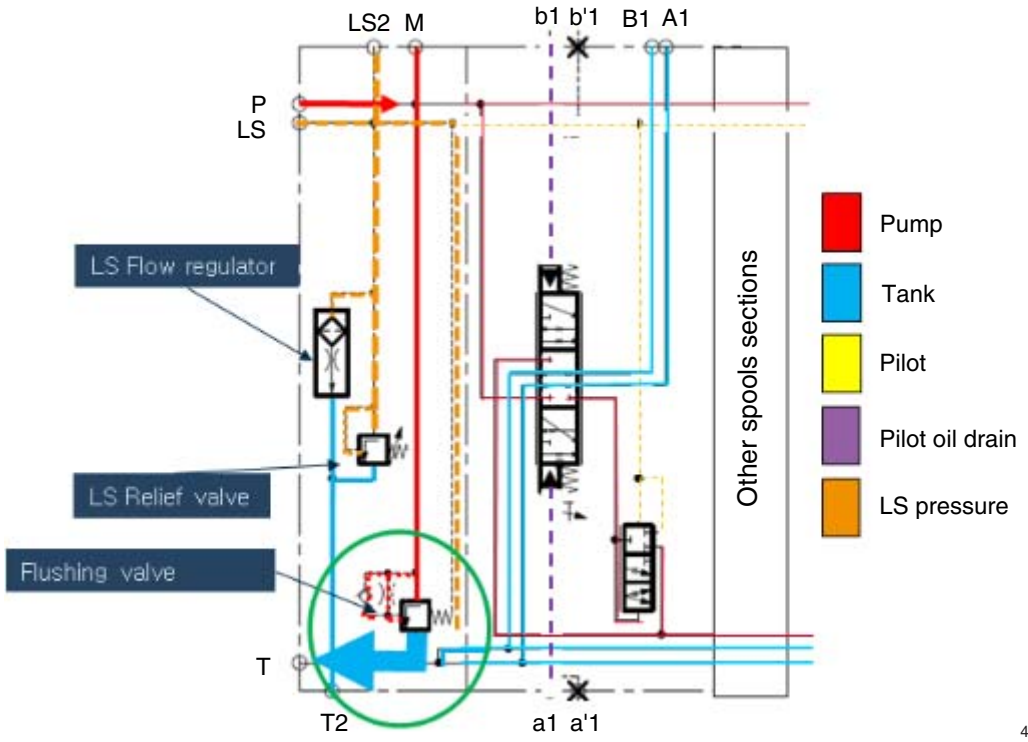

48AZ2MCV10

### (1) Inlet description - all spools at neutral position

First section-travel-represented at neutral




85A2MC11




48AZ2MCV12

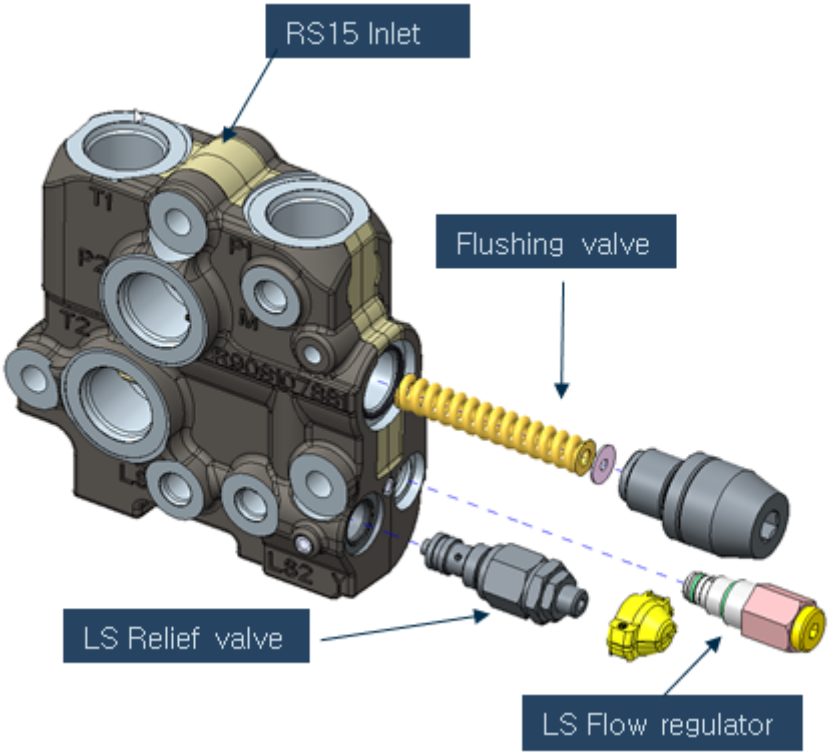
The Inlet element allows the exchange of the in the flow from the pump and the out flow to the tank.

When all sections are in neutral position, the pump is in stand-by and flow is reduced to the minimum pump flow (14 ℓ/min).

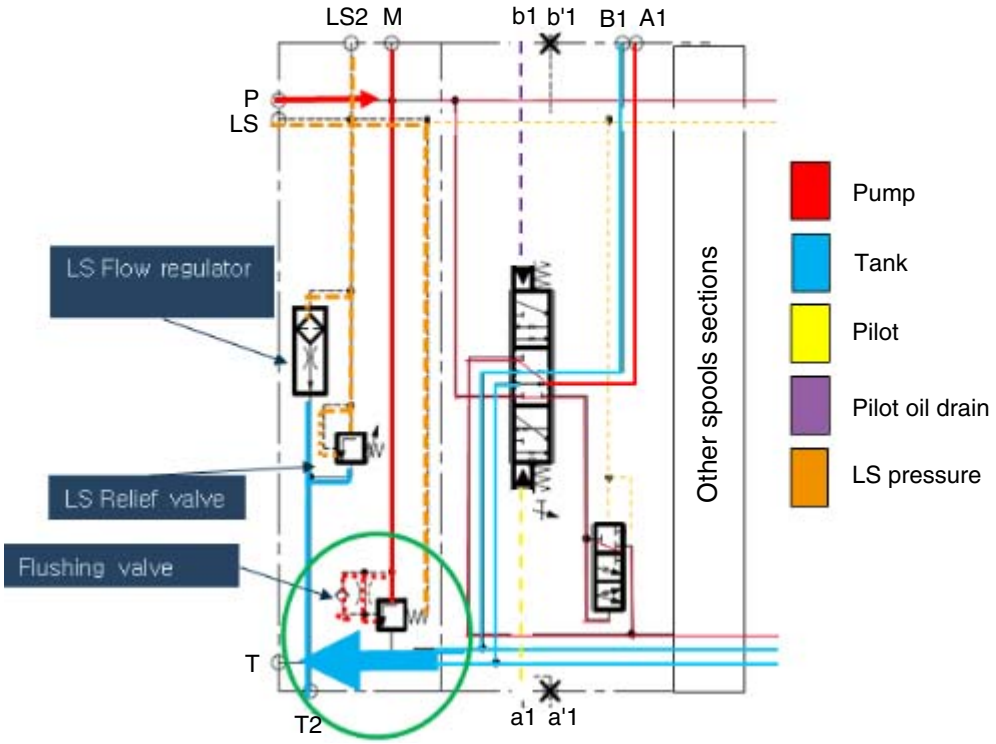
All the minimum pump flow pass through the flushing valve which is open, it means connected to the tank.

### (2) Inlet description - spool actuated

First section-travel-PABT spool position represented.




85A2MC13

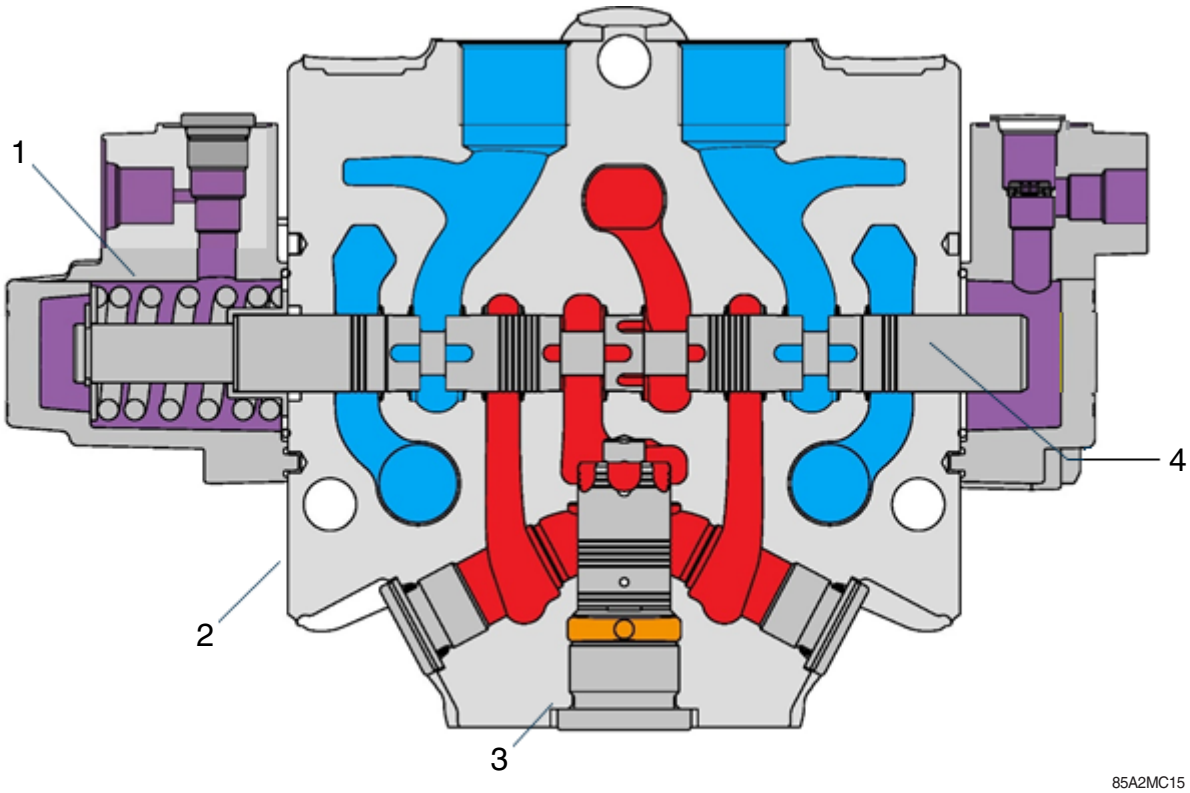



48AZ2MCV14

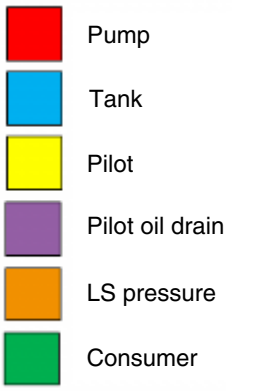
As soon as one or more spool moves, the flow stop to pass trough the flushing valve, which is closed, not anymore connected to the tank. The flow pass trough the spool to reach the movement, and then go to the tank by the T line after the spool.

## 2) TRAVEL SECTION DESCRIPTION - SECTION 1 AND 2

### (1) Component description



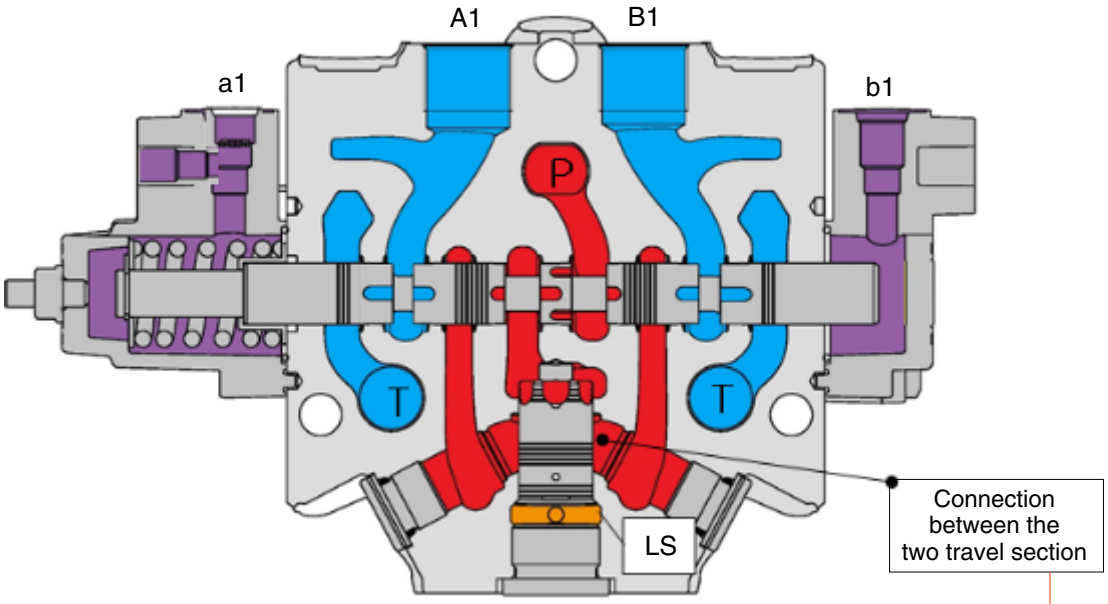

85A2MC15



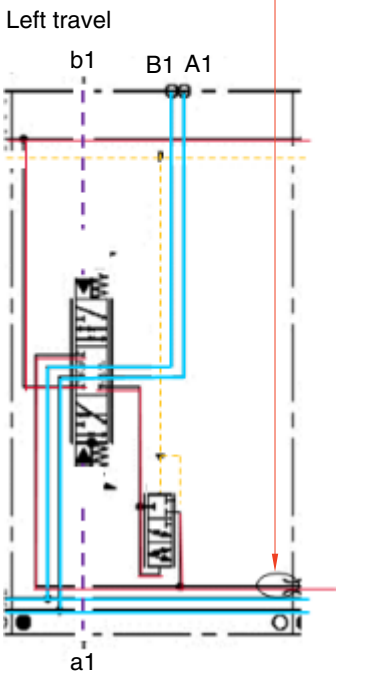

85A2MC16

1 Spring pack
2 Housing
3 Pressure compensator
4 Spool

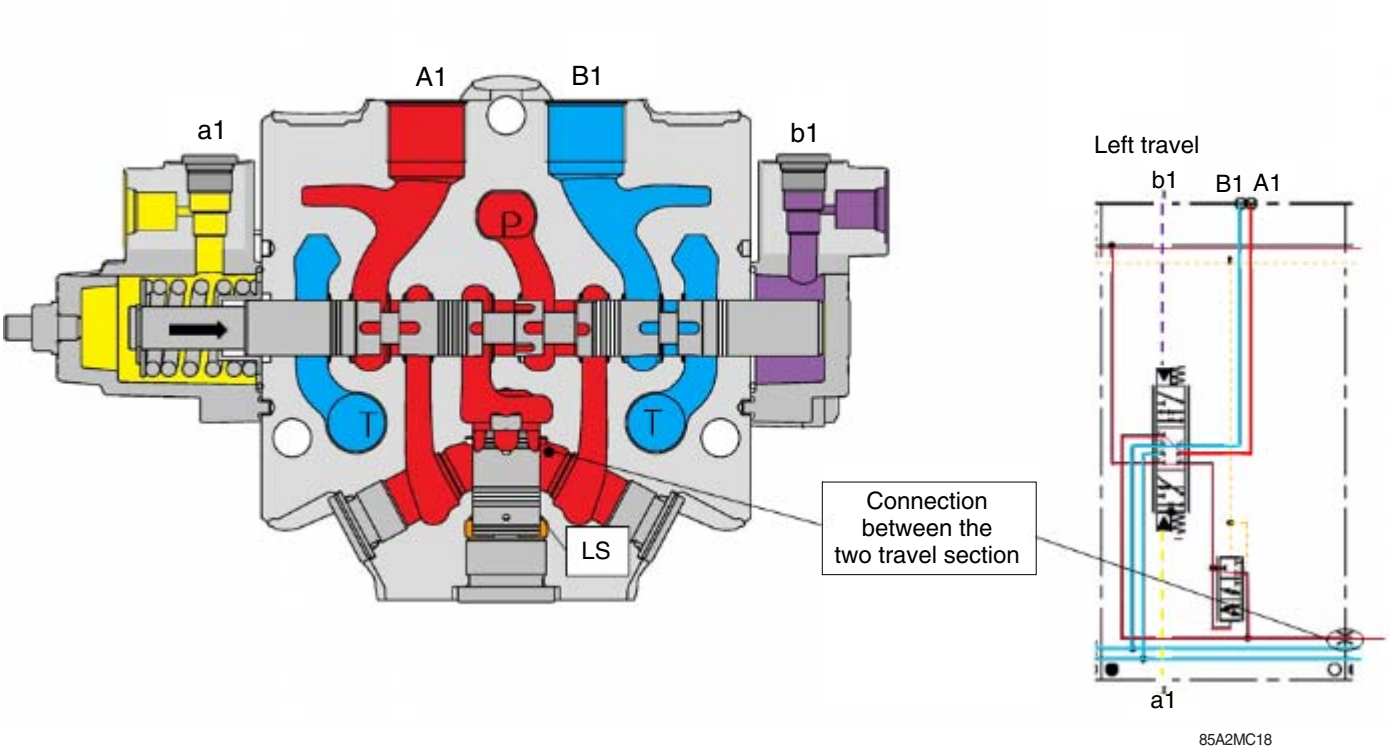
## (2) Neutral position




The spool is in neutral position, pump is in low pressure stand-by. The A and B ports are not connected to the pumps but to the tank. This is in order to ensure A and B to be drained to tank. The two translation branches, 1 and 2, are connected in order not to have differences in traction.

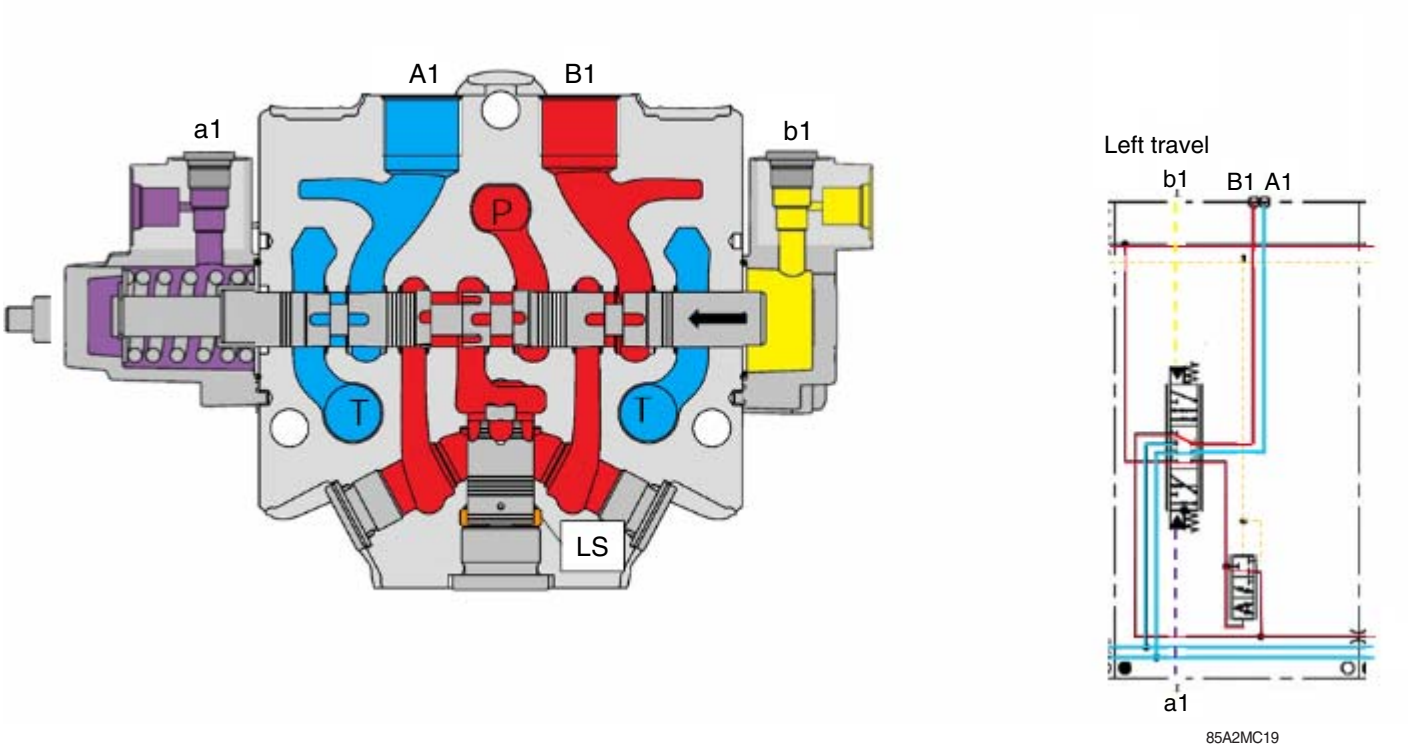


### (3) Travel forward position




When the pilot pressure is led to the port a1, the oil from the pump flows to the cylinder port A1 and oil from the cylinder flows into the tank through the cylinder port B1.

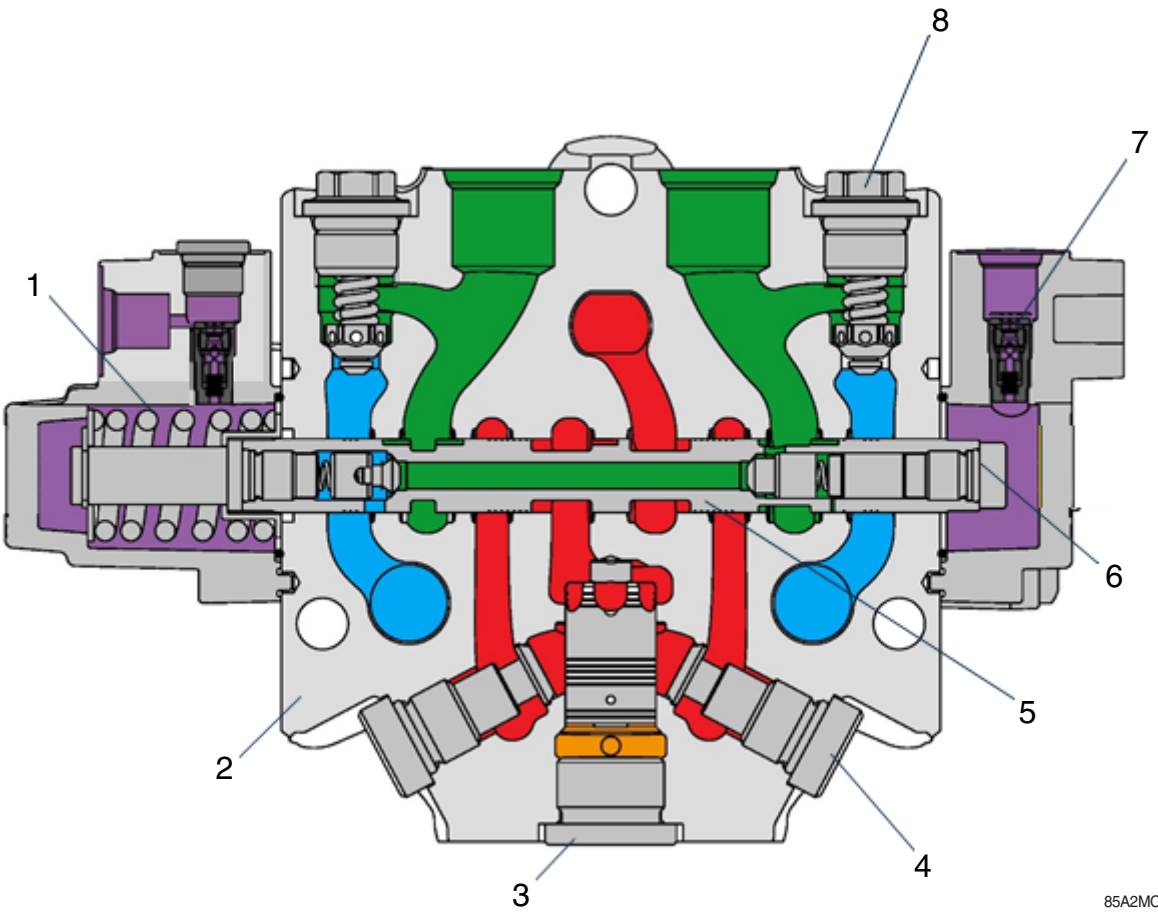
### (4) Travel reverse position




When the pilot pressure is led to the port b1, the oil from the pump flows to the cylinder port B1 and oil from the cylinder flows into the tank through the cylinder port A1.

### 3) BOOM AND ARM SECTION 3 AND 5 DESCRIPTION - WITH REGENERATION SPOOLS

#### (1) Component description



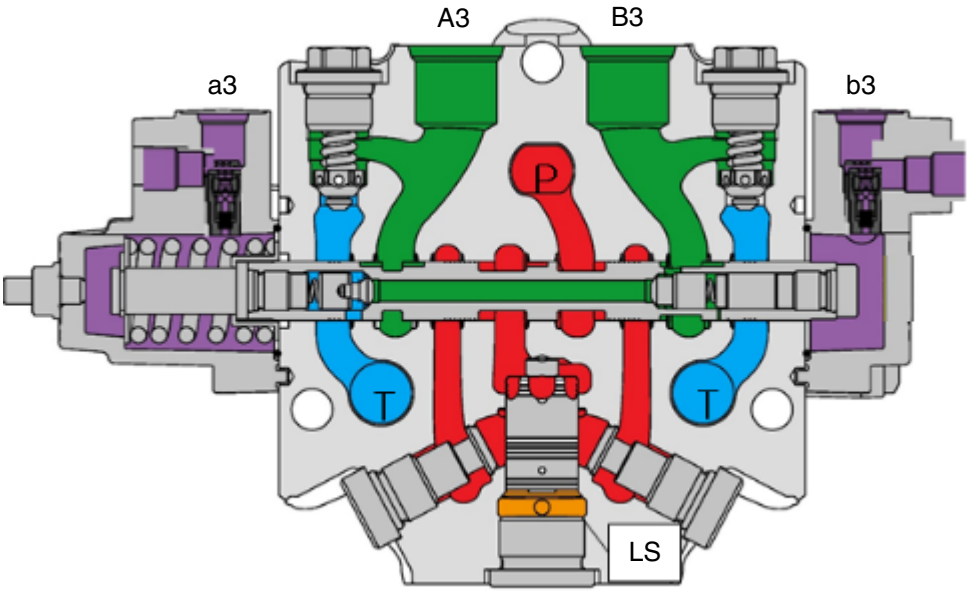

85A2MC20

- Pump
- Tank
- Pilot
- Pilot oil drain
- LS pressure
- Consumer
- Regeneration flow (position PABT on nest pages)

85A2MC21

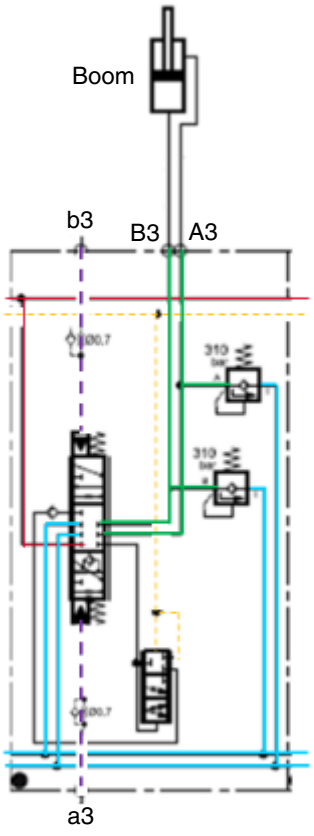
1 Spring pack
2 Housing
3 Pressure compensator
4 Check valves
5 Regeneration spool
6 Spool
7 Shuttle valve
8 Relief valves

## (2) Neutral position




85A2MC22

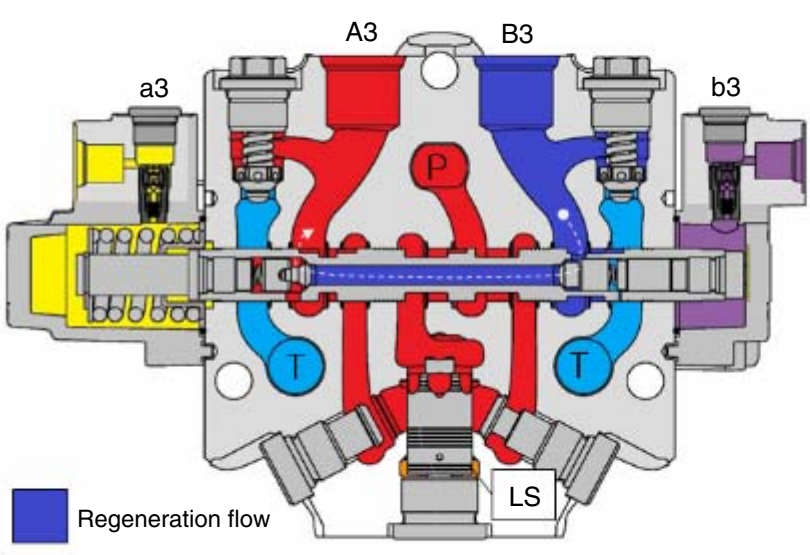
The spool is in neutral position, oil from the pump is blocked, pump is in low pressure stand-by. The A and B ports are not connected to the pump nor the tank.

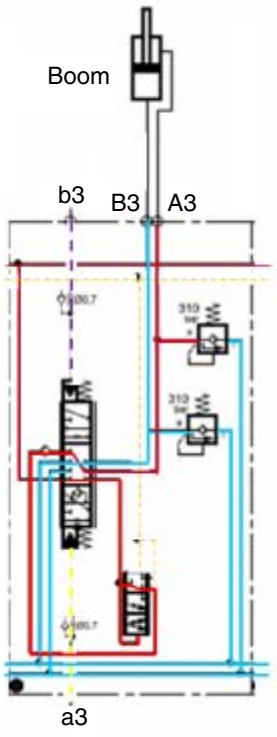



85A2MC23

### (3) Boom section description

#### ① Boom down position

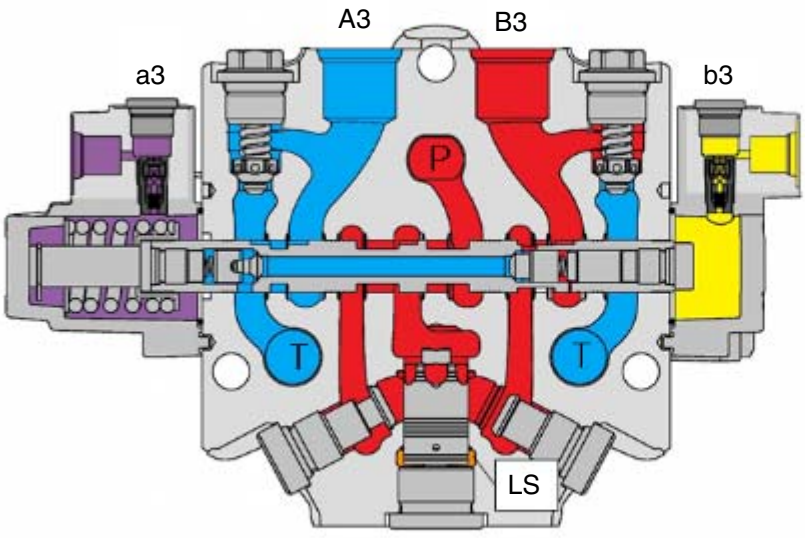


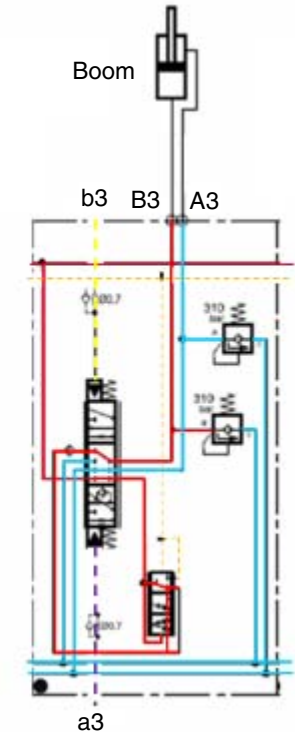




85A2MC24

When the pilot pressure is led to the port a4, the oil from the pump flows to the cylinder port A4 and oil from the cylinder flows partially into the tank and partially trough regeneration path B to A through the cylinder port B4 .

#### ② Boom up position



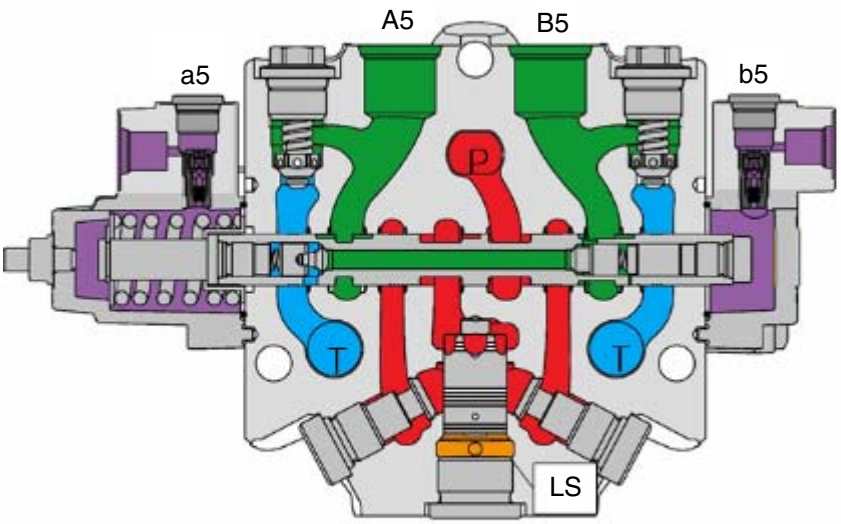



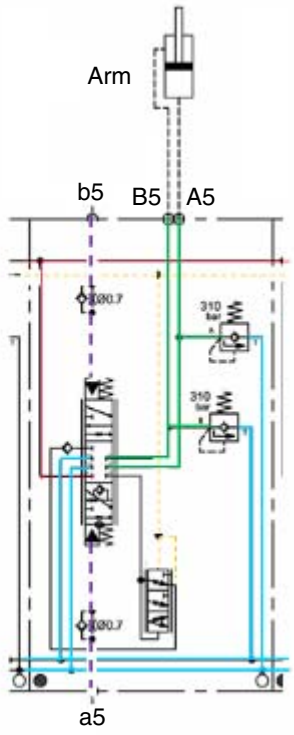

85A2MC25

When the pilot pressure is led to the port b4, the oil from the pump flows to the cylinder port B4 and oil from the cylinder flows into the tank through the cylinder port A4.

### (4) Arm section description

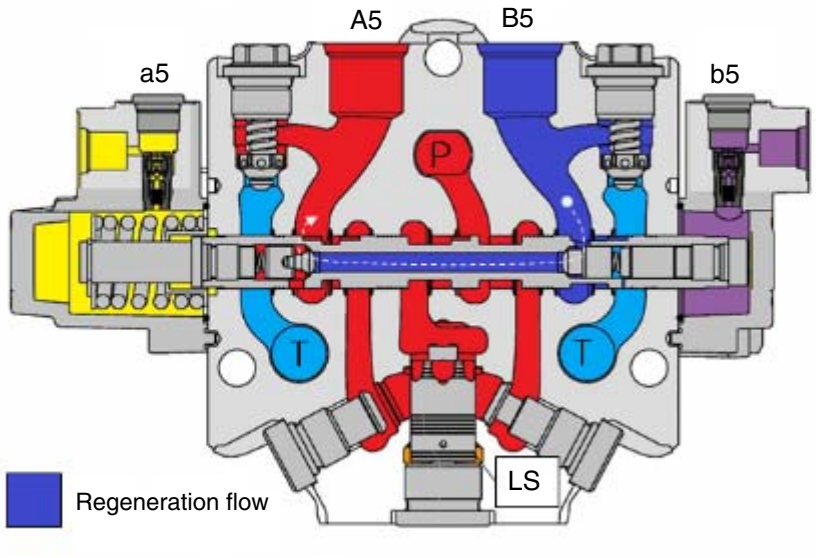
#### ① Neutral position

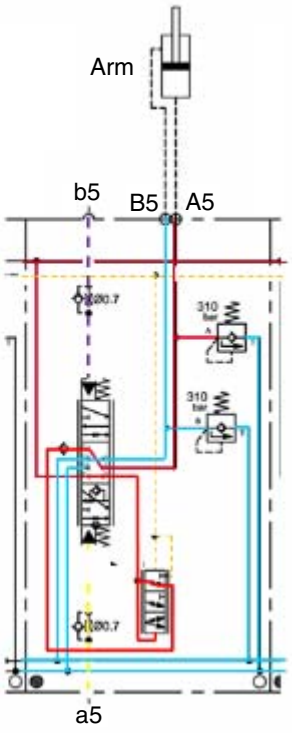



The spool is in neutral position, oil from the pump is blocked, pump is in low pressure stand-by. The A5 and B4 ports are not connected to the pump nor the tank.

### ② Arm roll in position

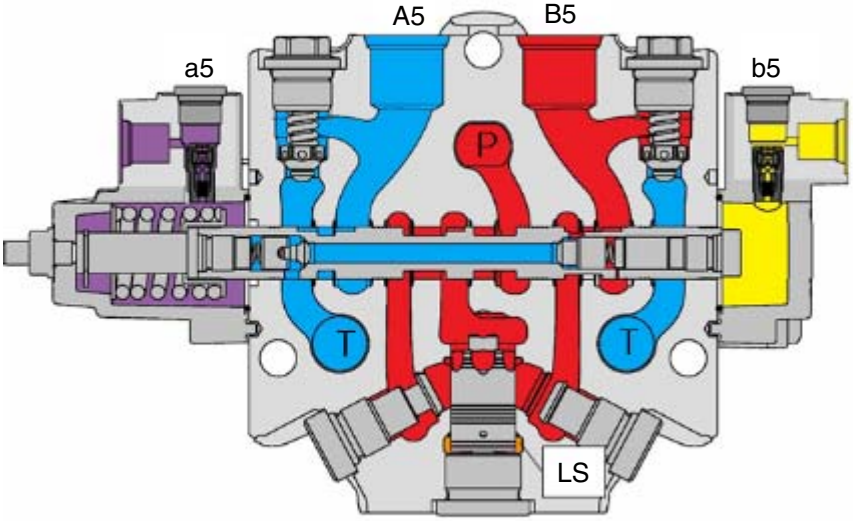


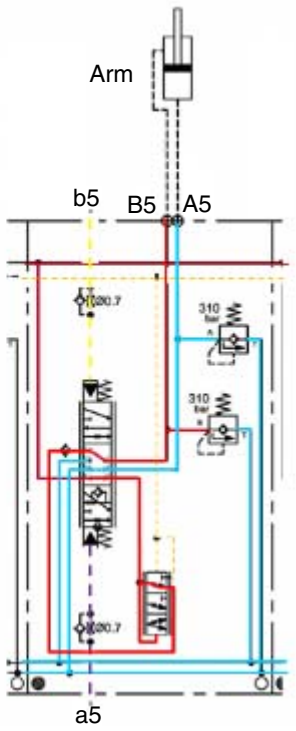




48AZ2MCV27

When the pilot pressure is led to the port a5, the oil from the pump flows to the cylinder port A5 and oil from the cylinder flows partially into the tank and partially trough regeneration path B to A through the cylinder port B5.

### ③ Arm roll out position



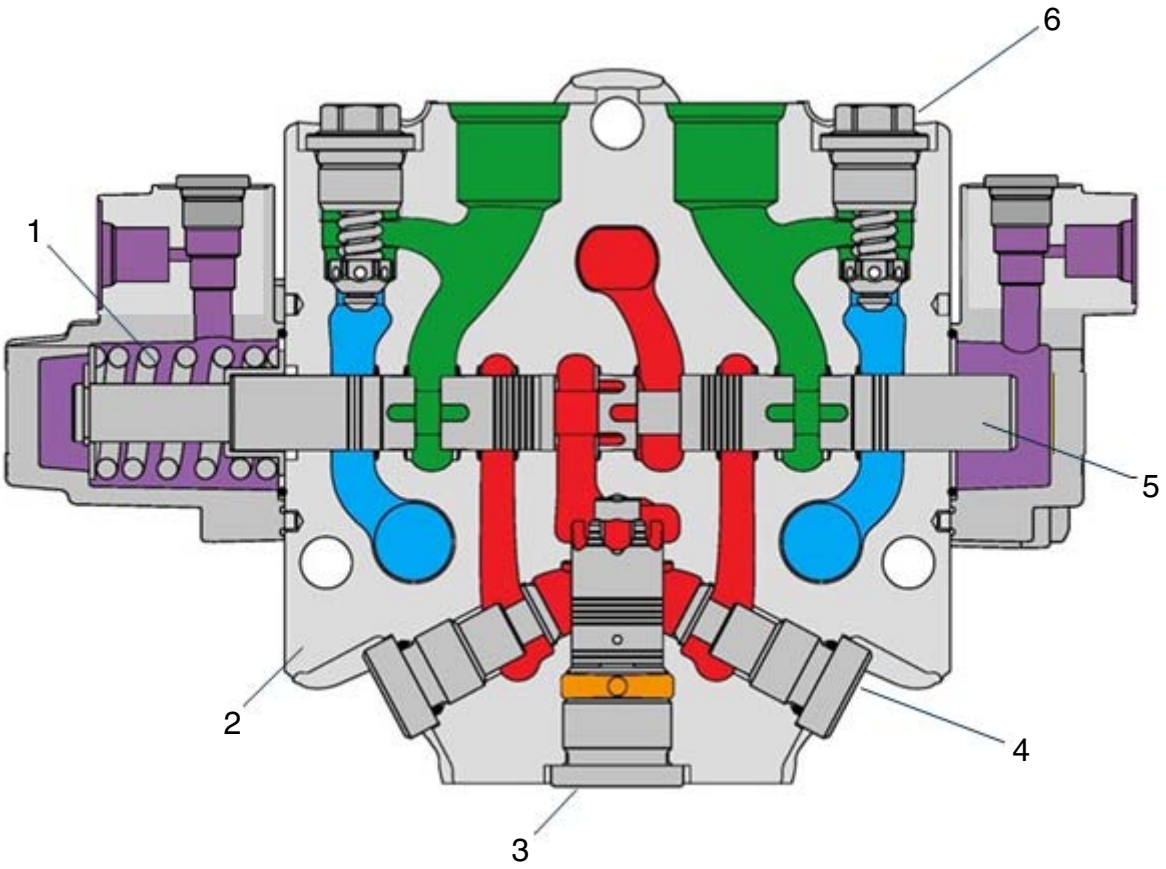




48AZ2MCV28

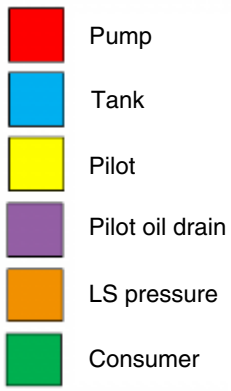
When the pilot pressure is led to the port b5, the oil from the pump flows to the cylinder port B5 and oil from the cylinder flows into the tank through the cylinder port A5.

## 4) BUCKET SECTION DESCRIPTION - SECTION 6

### (1) Component description



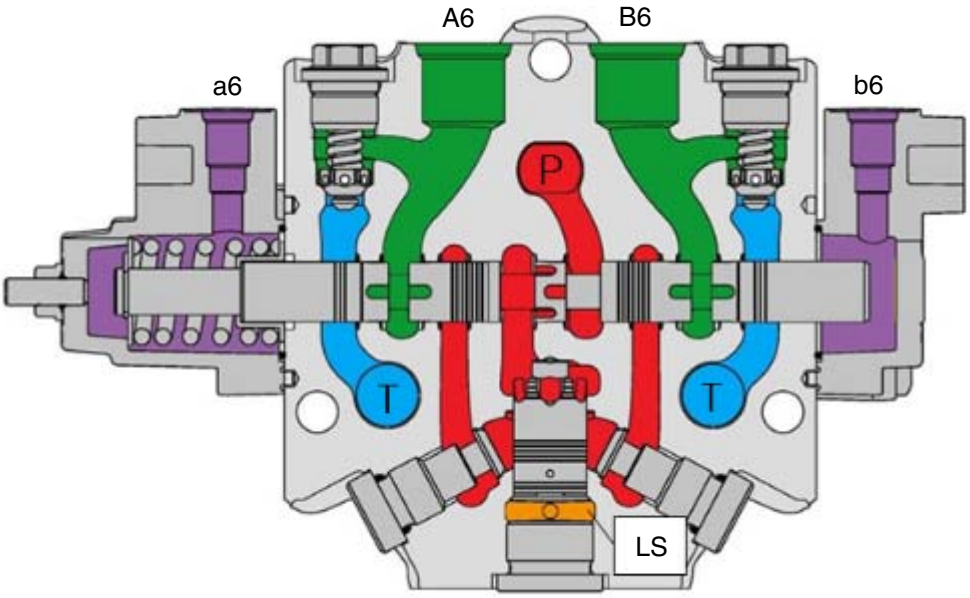

85A2MC29




85A2MC30

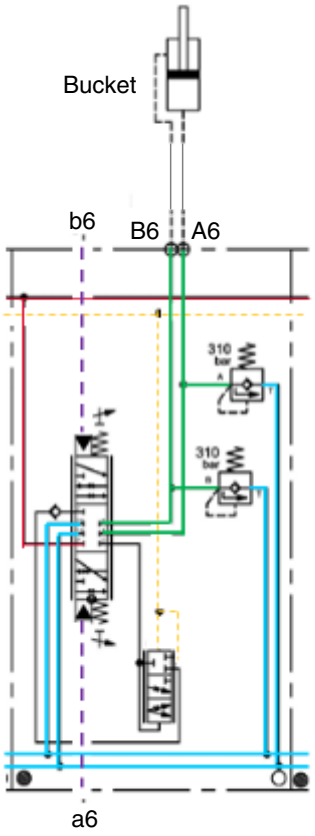
1 Spring pack
2 Housing
3 Pressure compensator
4 Check valves
5 Spool
7 Overload relief valves

## (2) Neutral position



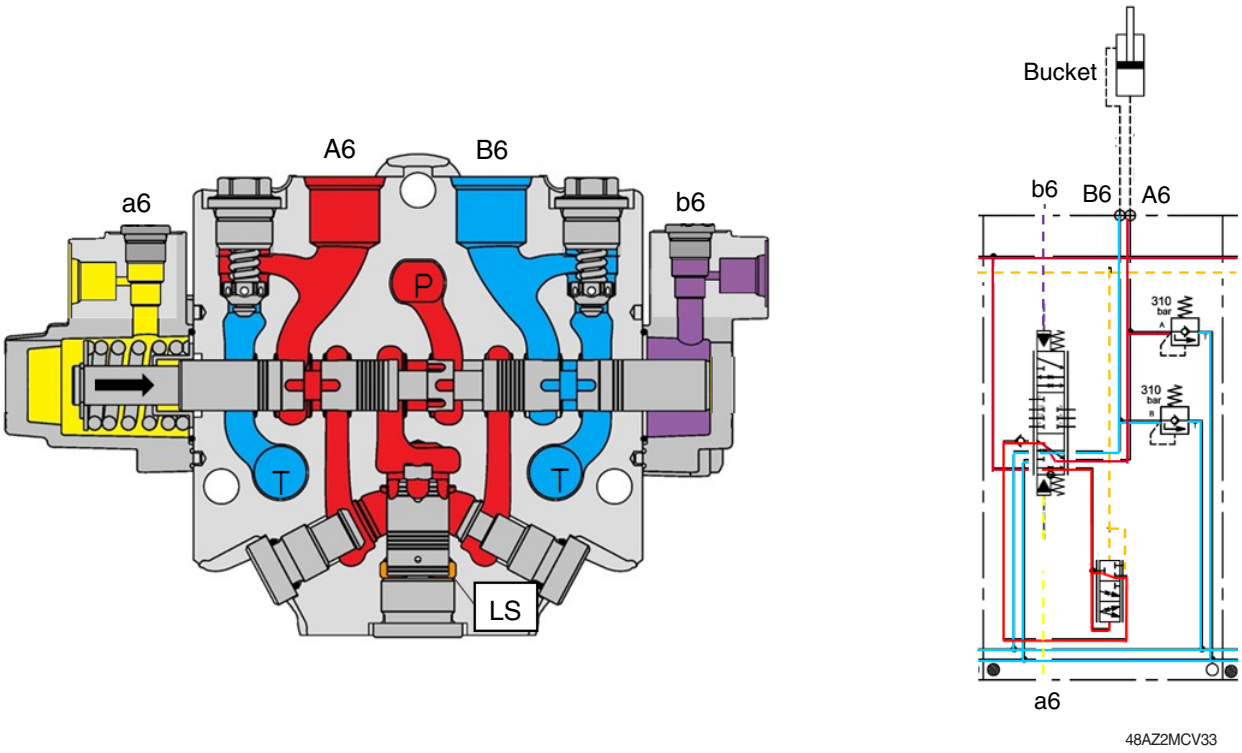

48AZ2MCV31

The spool is in neutral position, pump is in low pressure stand-by. The A6 and B6 ports are not connected to the pumps nor the tank.



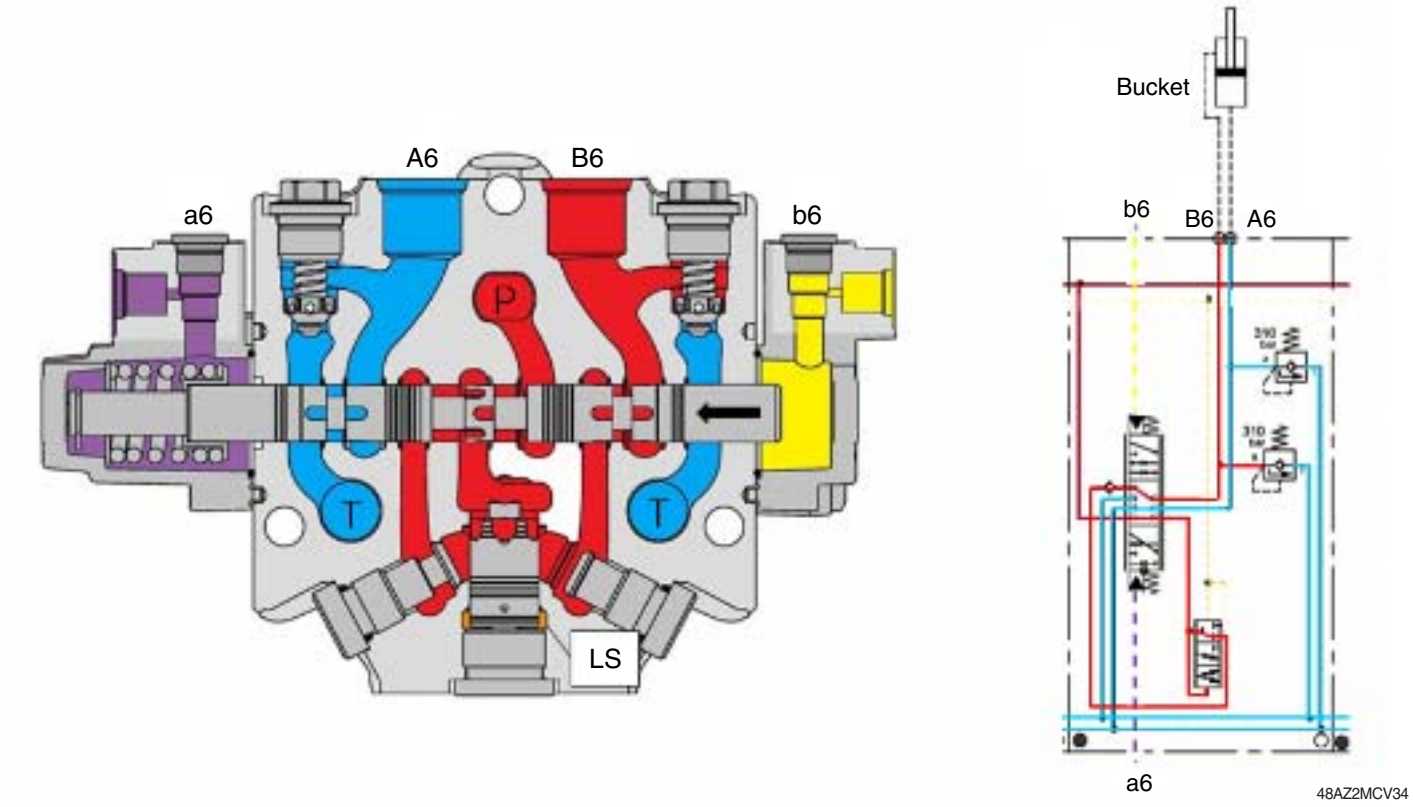

48AZ2MCV32

### (3) Bucket roll in position




When the pilot pressure is led to the port a6, the oil from the pump flows to the cylinder port A6 and oil from the cylinder flows into the tank through the cylinder port B6.

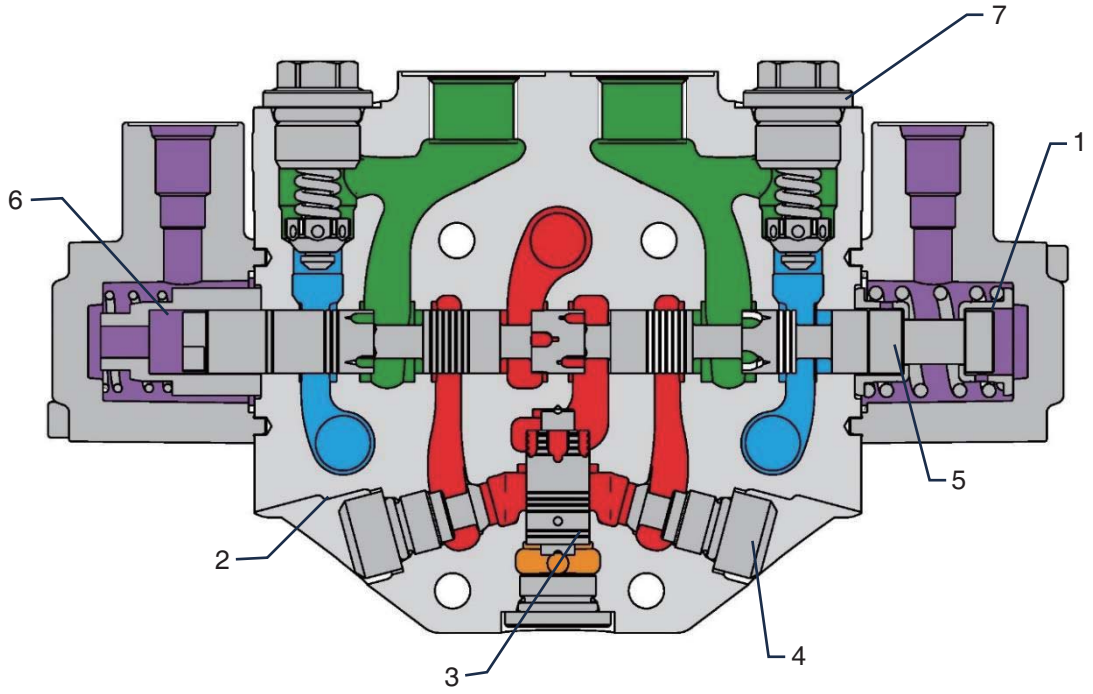
### (4) Bucket roll out position



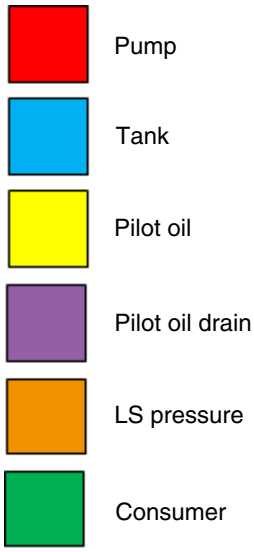

When the pilot pressure is led to the port b6, the oil from the pump flows to the cylinder port B6 and oil from the cylinder flows into the tank through the cylinder port A6.

## 5) DOZER SECTION DESCRIPTION - SECTION 7

### (1) Component description




85A2MC35

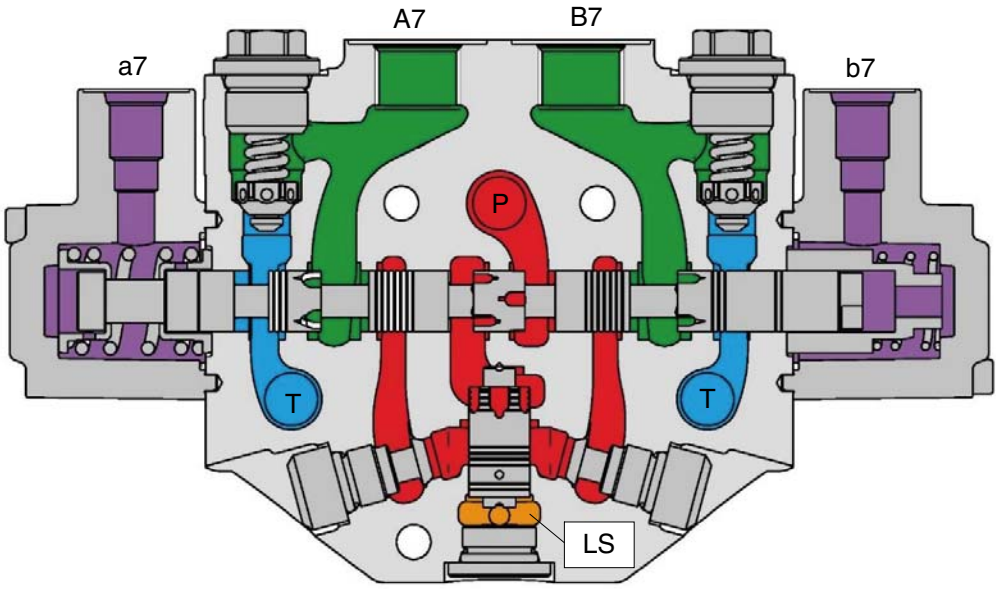



48AA2MC43

1 Spring pack
2 Housing
3 Pressure compensator
4 Check valves
5 Spool
6 Fourth position spring pack
7 Relief valves

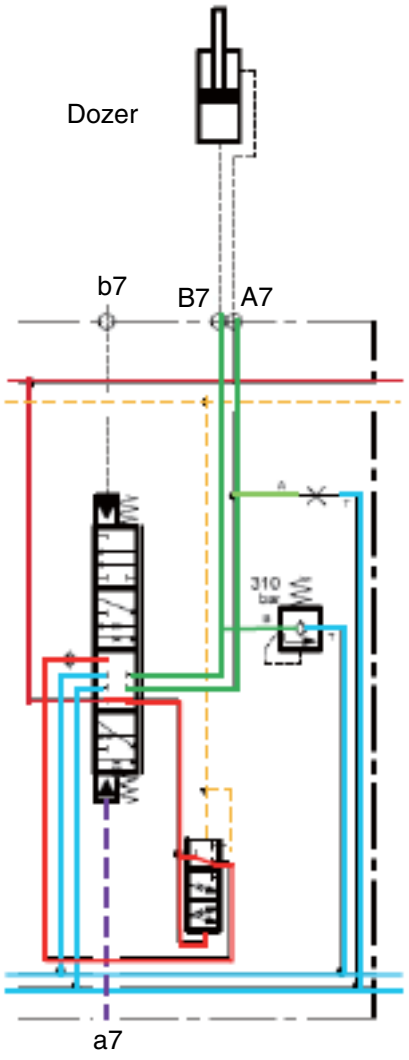
※ This particular slide has a four position spool: neutral, PABT, PBAT and floating position.

### (2) Neutral position



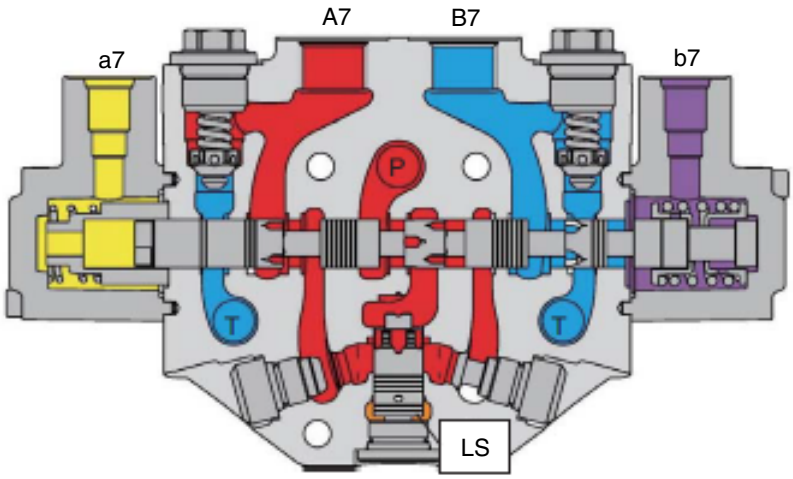

48AZ2MCV37

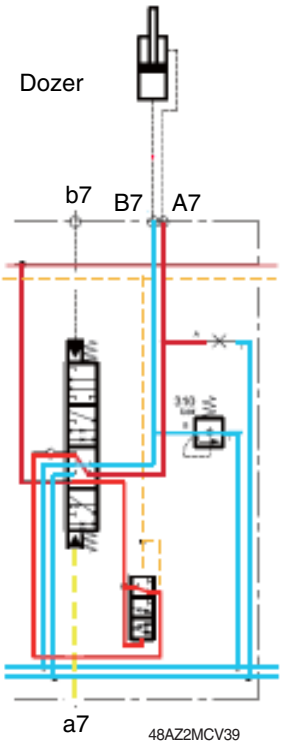
The spool is in neutral position, oil from the pump is not connected to the A7 or to the B7 ports. Pump is in low pressure stand-by.




48AZ2MCV38

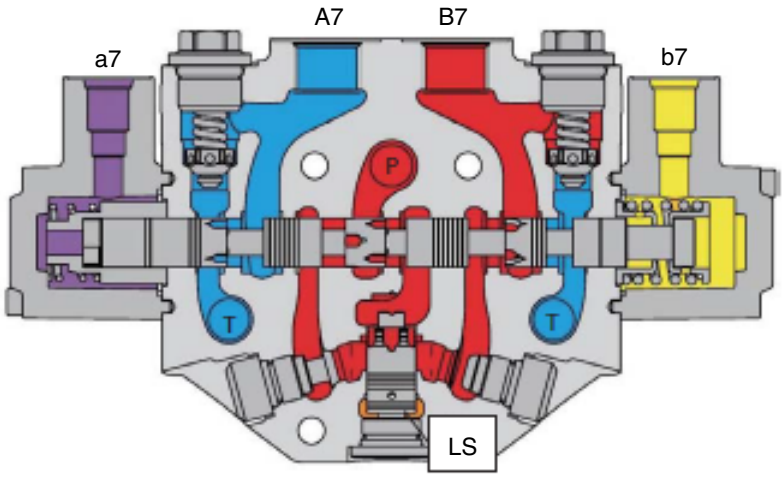
### (3) PABT position (dozer up)

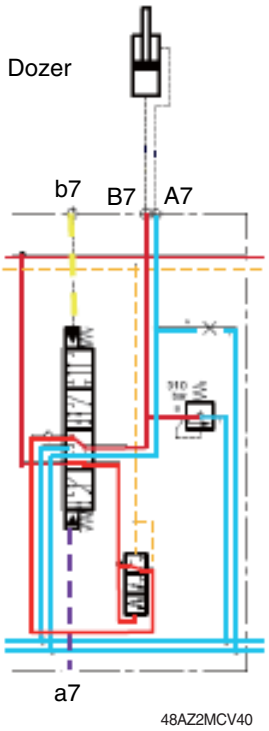



When the pilot pressure is led to the port a7, the oil from the pump flows to the cylinder port A7 and oil from the cylinder flows into the tank through the cylinder port B7.

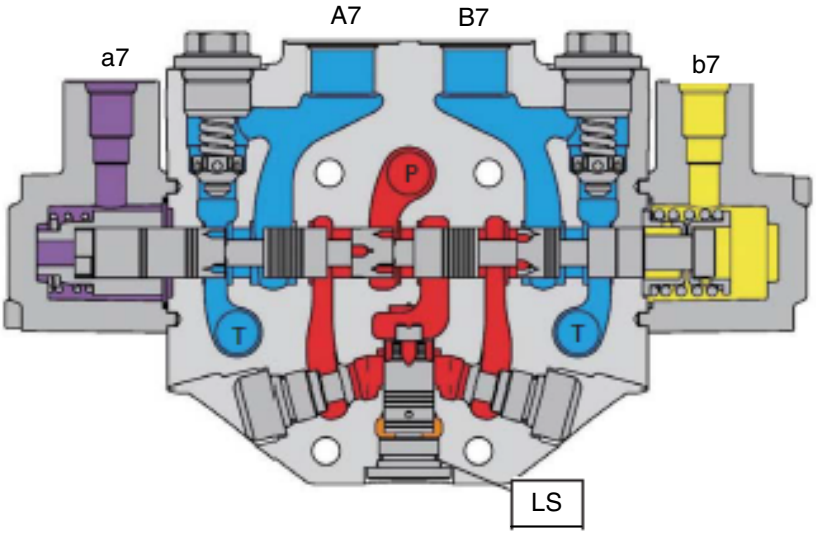
### (4) PBAT position (dozer down)

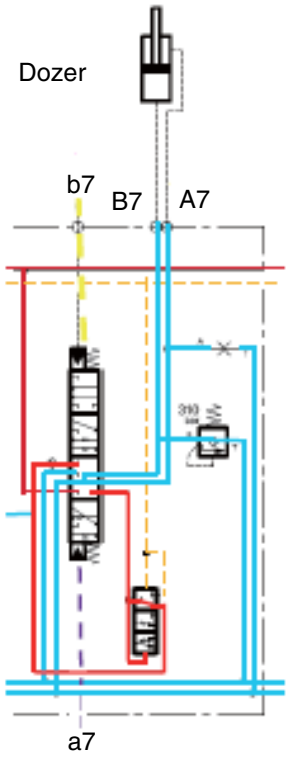



When the pilot pressure is led to the port b7, the oil from the pump flows to the cylinder port B7 and oil from the cylinder flows into the tank through the cylinder port A7.

### (5) Floating position

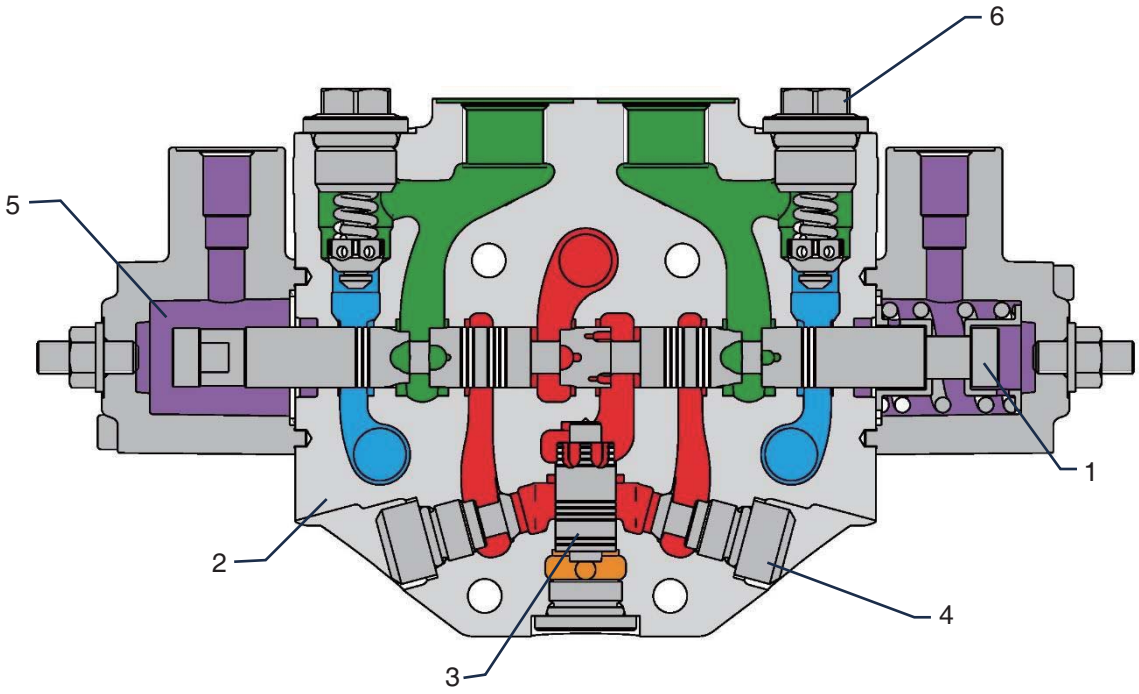



When the pilot pressure is led to the port b6 to maximal pressure, the spool is in the forth position, floating. The pump is in low pressure stand-by while A7 and B7 are connected to tank.

## 6) SLICES DESCRIPTION 8 : BOOM SWING

### (1) Component description




85A2MC42

Pump

Tank

Pilot oil

Pilot oil drain

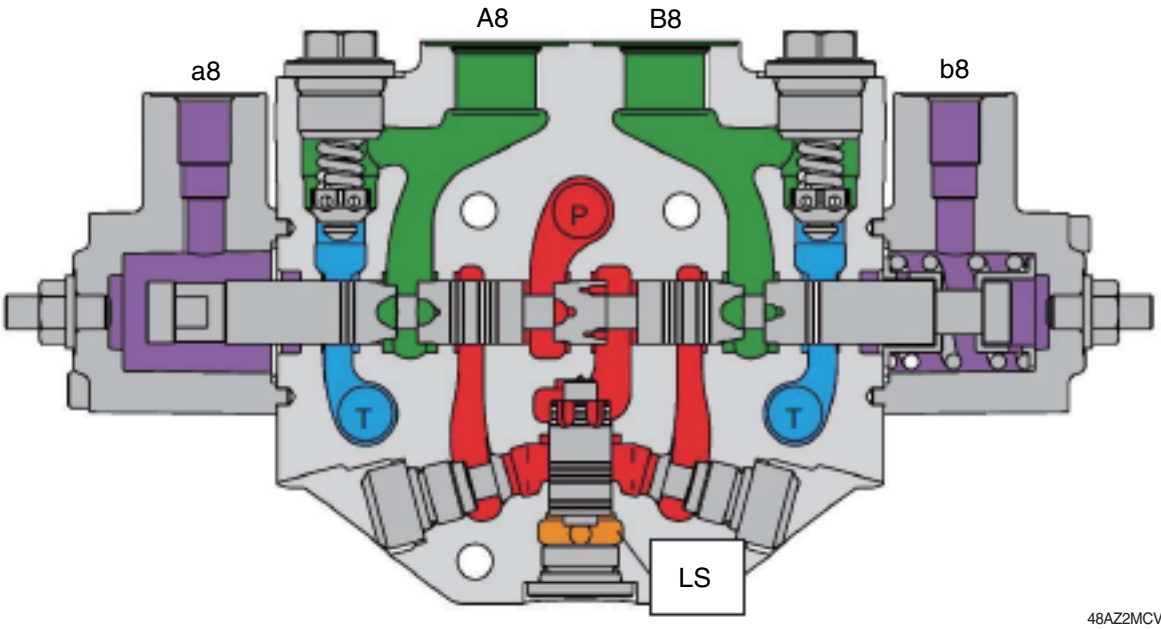
LS pressure

Consumer

48AA2MC43

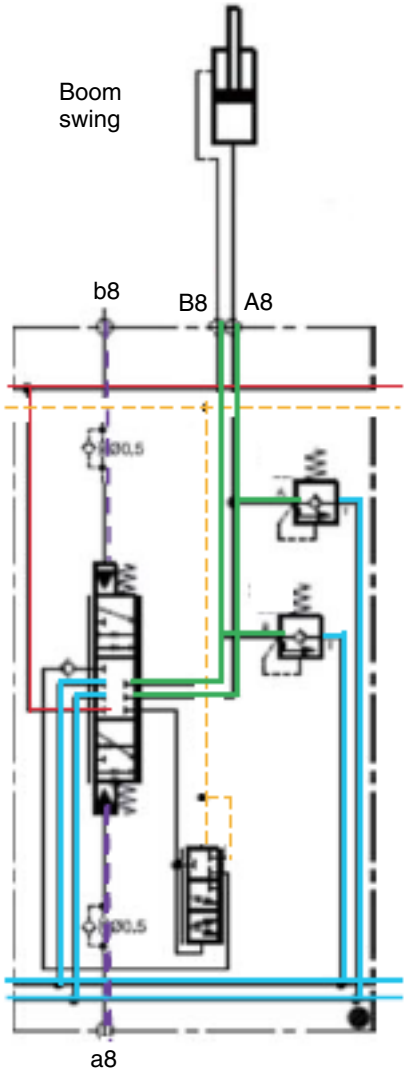
1 Spring pack
2 Housing
3 Pressure compensator
4 Check valves
5 Spool
6 Relief valves

### (2) Neutral position



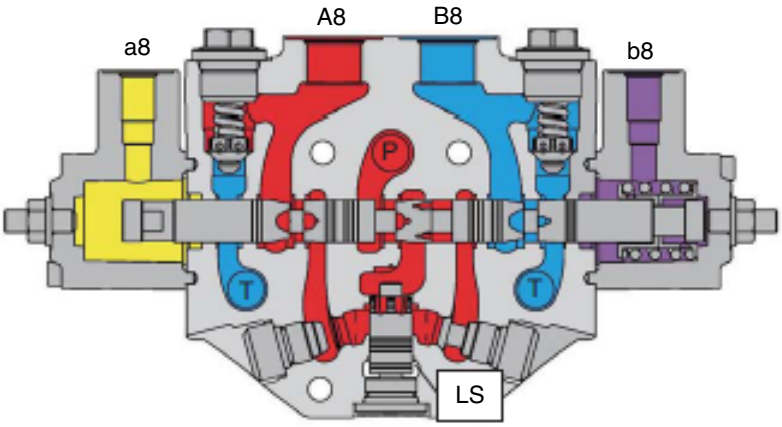

48AZ2MCV44

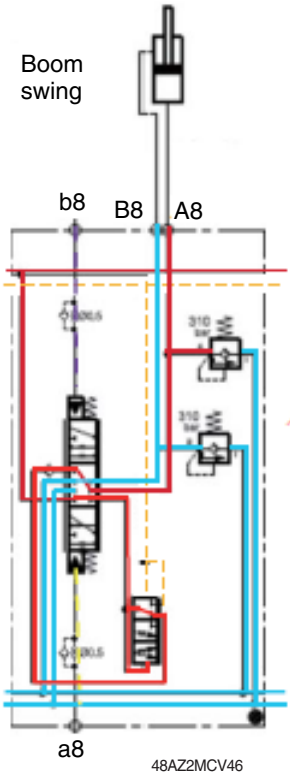
The spool is in neutral position, pump is in low pressure stand-by. The A8 and B8 ports are not connected to the pumps nor the tank.




48AZ2MCV45

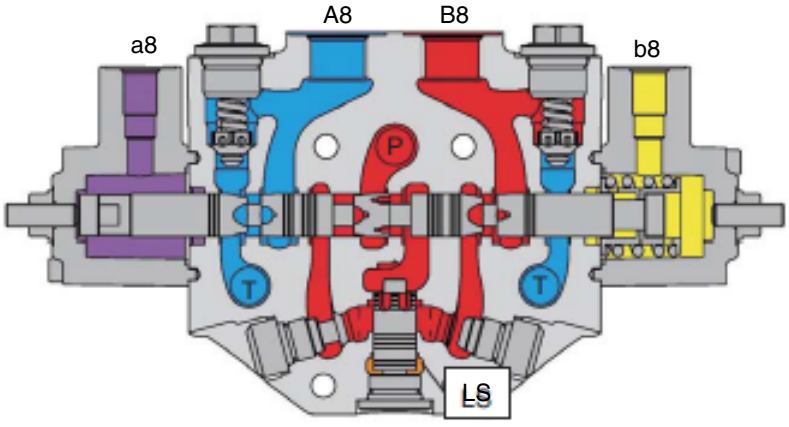
### (3) PABT position

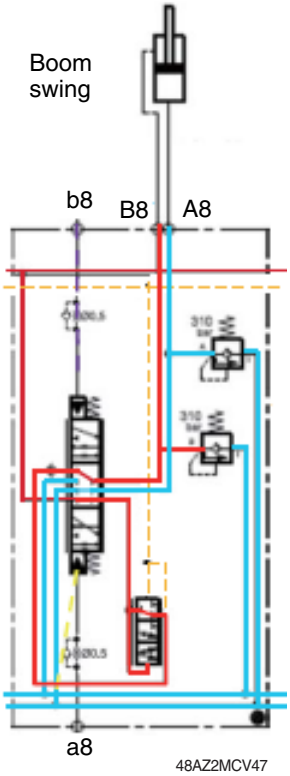



When the pilot pressure is led to the port a7, the oil from the pump flows to the cylinder port A7 and oil from the cylinder flows into the tank through the cylinder port B7.

### (4) PBAT position

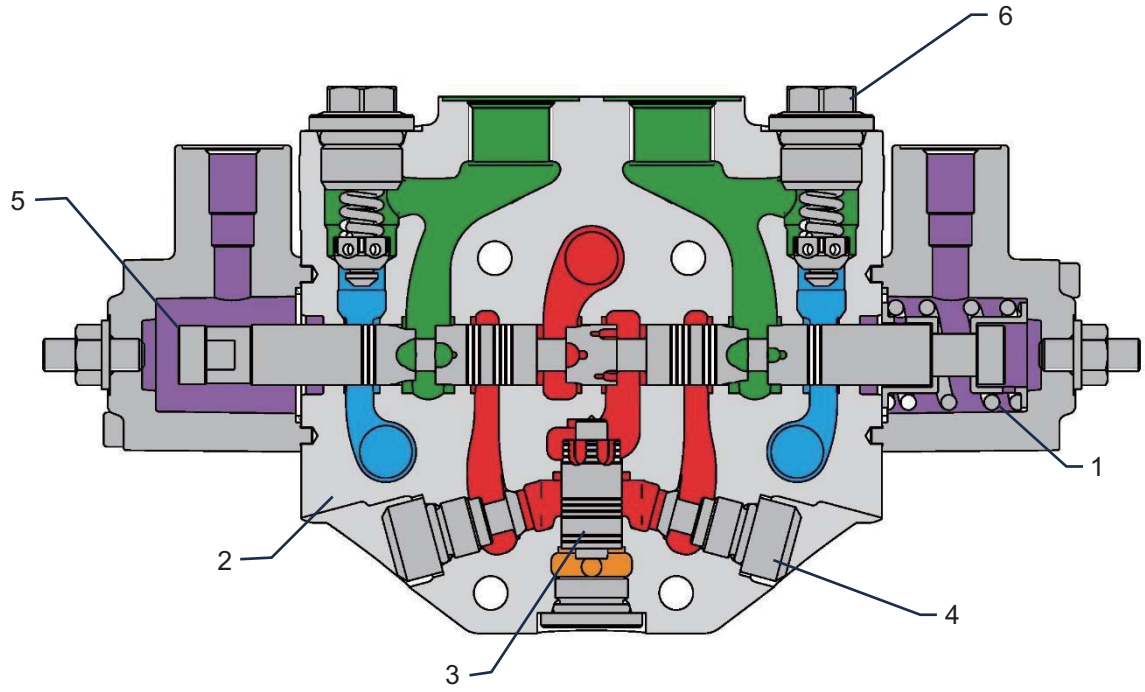



When the pilot pressure is led to the port b7, the oil from the pump flows to the cylinder port B7 and oil from the cylinder flows into the tank through the cylinder port A7.

## 7) SLICES DESCRIPTION 9 : AUX 1

### (1) Component description




85A2MC48

Pump

Tank

Pilot oil

Pilot oil drain

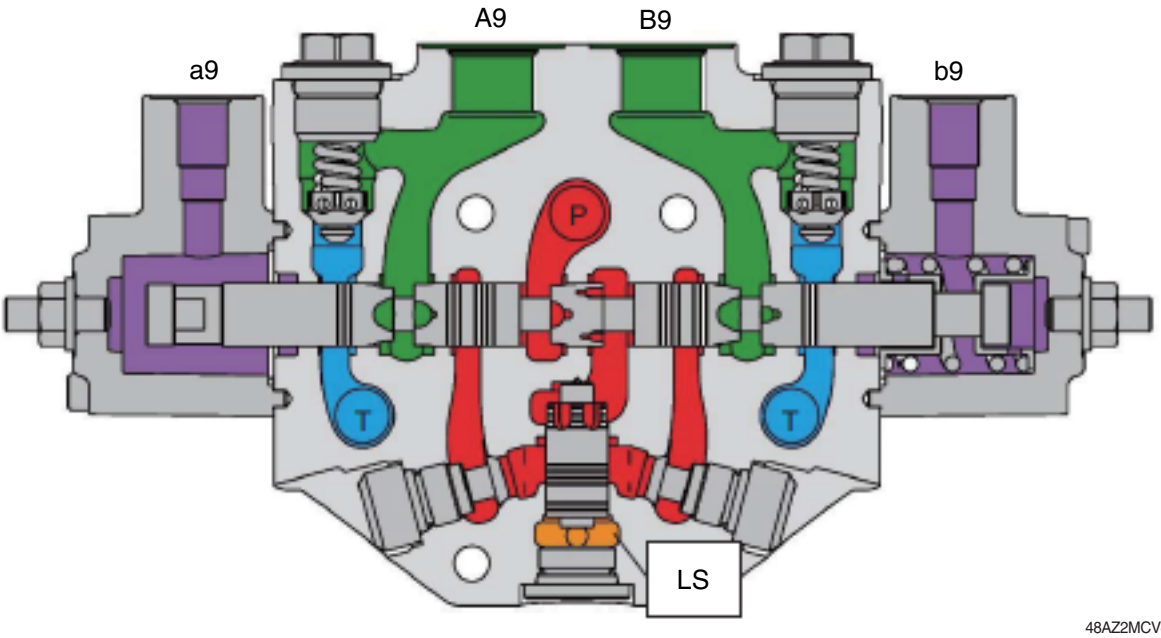
LS pressure

Consumer

1 Spring pack
2 Housing
3 Pressure compensator
4 Check valves
5 Spool
6 Relief valves

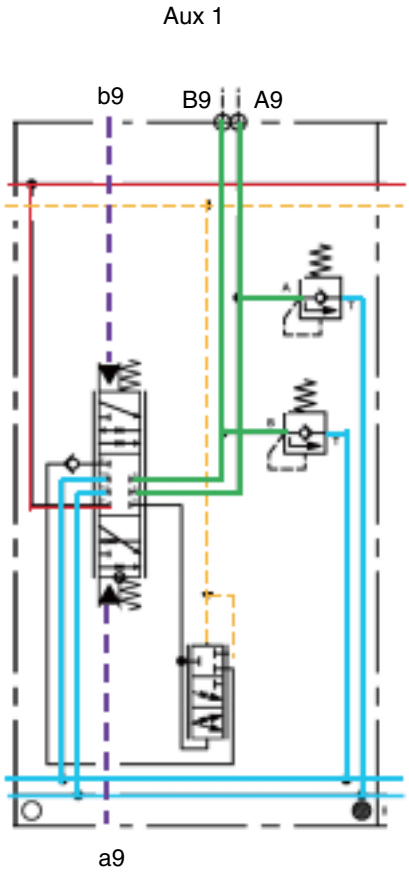
48AA2MC43

### (2) Neutral position



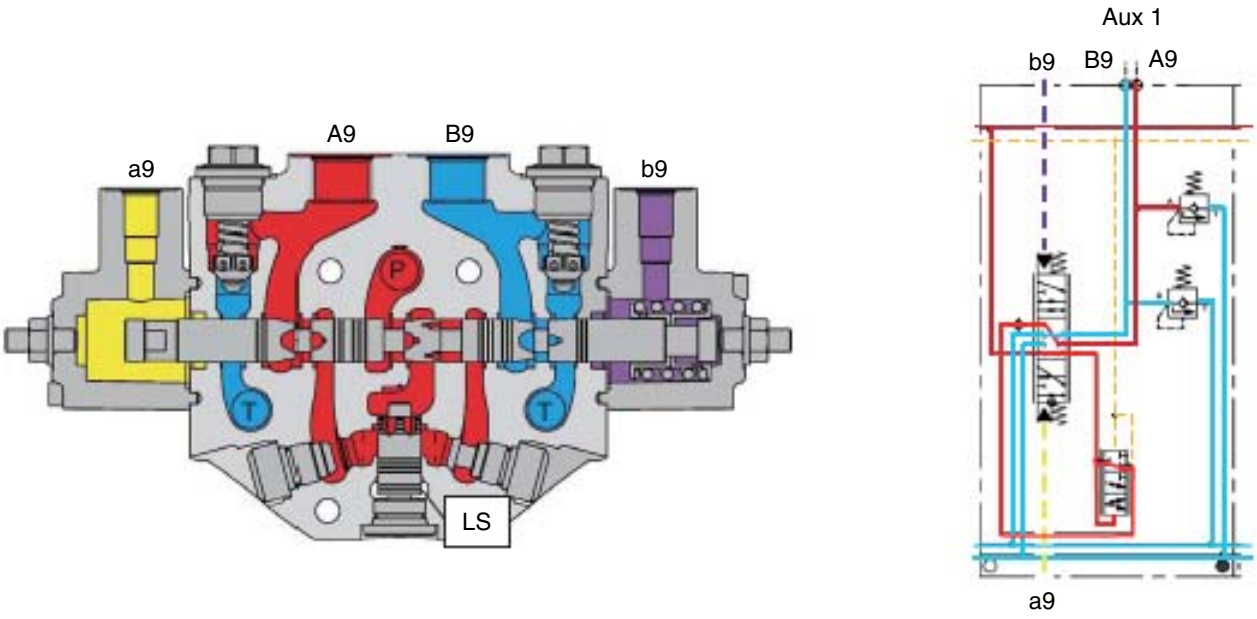

48AZ2MCV49

The spool is in neutral position, pump is in low pressure stand-by. The A9 and B9 ports are not connected to the pumps nor the tank.




48AZ2MCV50

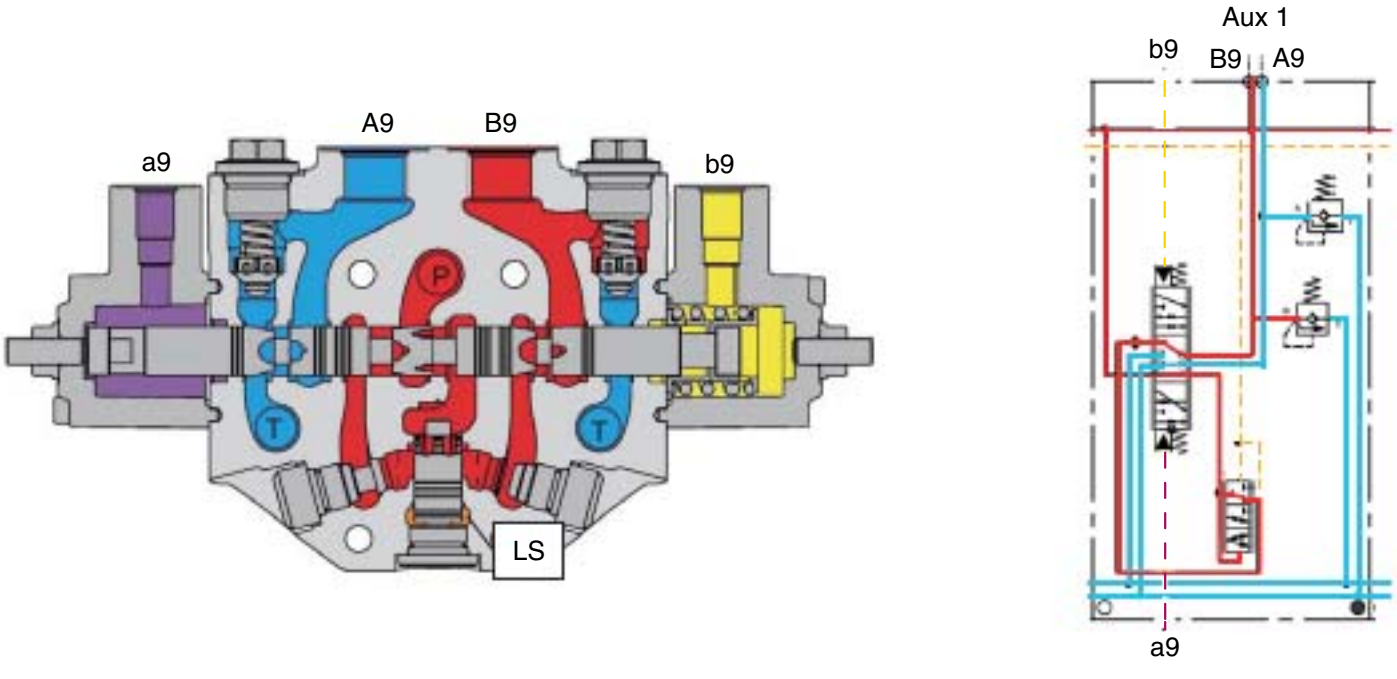
### (3) PABT position




48AZ2MCV51

When the pilot pressure is led to the port a9, the oil from the pump flows to the cylinder port A9 and oil from the cylinder flows into the tank through the cylinder port B9.

### (4) PBAT position

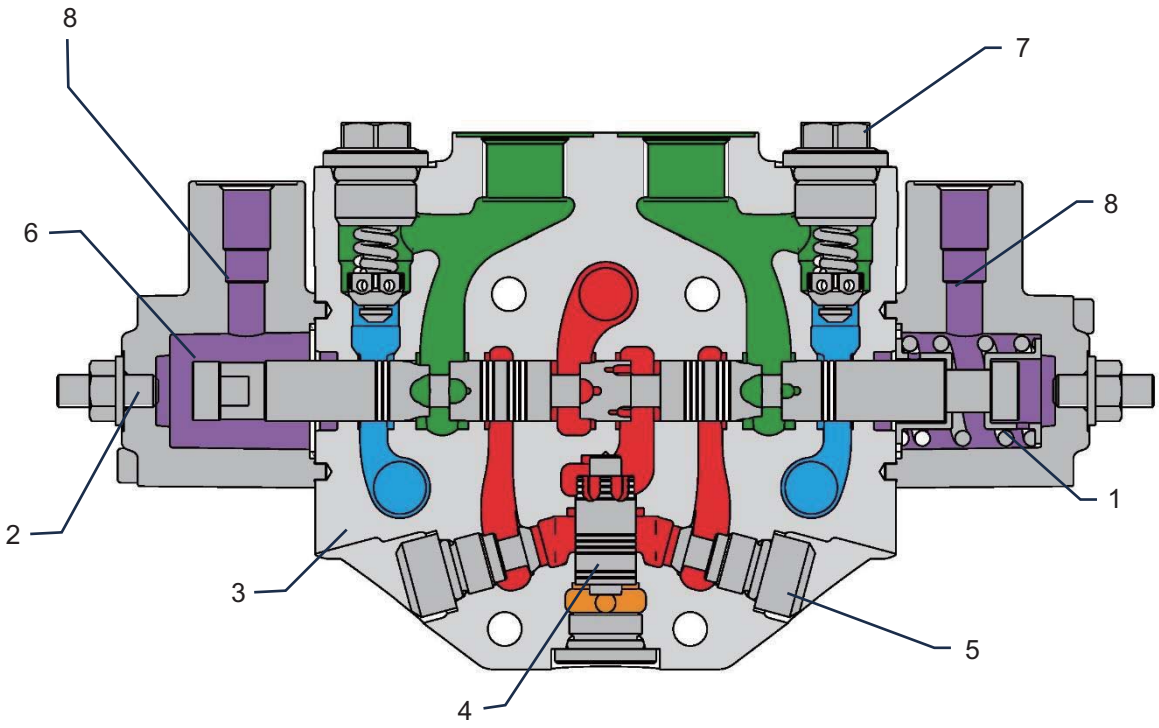



48AZ2MCV52

When the pilot pressure is led to the port b9, the oil from the pump flows to the cylinder port B9 and oil from the cylinder flows into the tank through the cylinder port A9.

## 8) SWING SLICE DESCRIPTION

### (1) Component description




85A2MC53

Pump

Tank

Pilot oil

Pilot oil drain

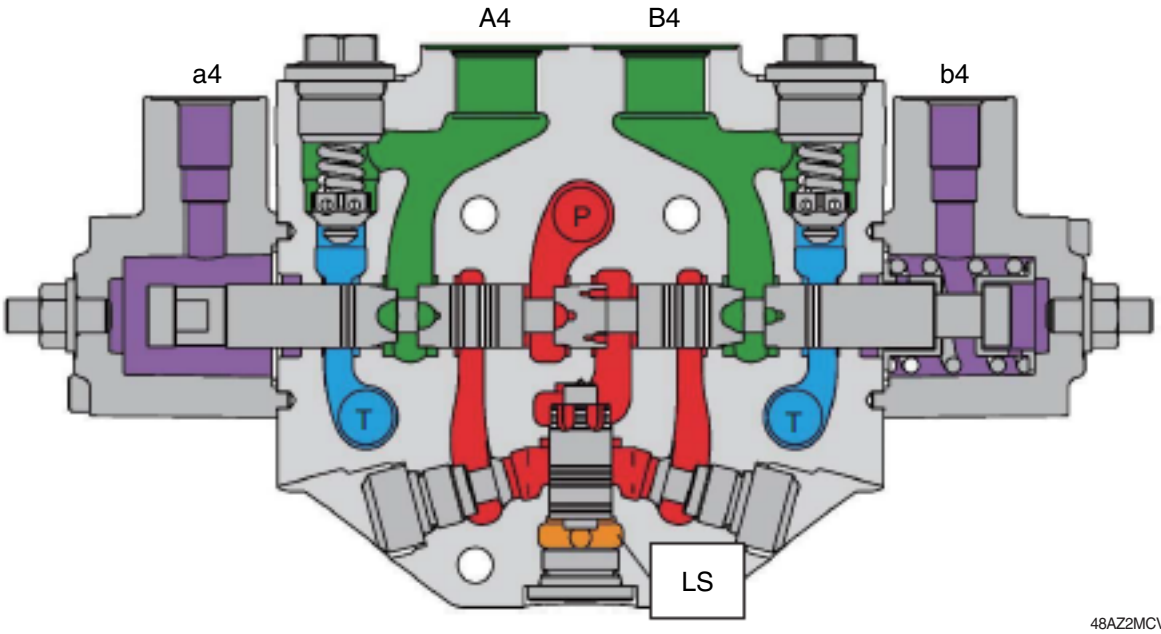
LS pressure

Consumer

1 Spring pack
2 Stroke limitation device
3 Housing
4 Pressure compensator
5 Check valves
6 Spool
7 Plug
8 Snubbers

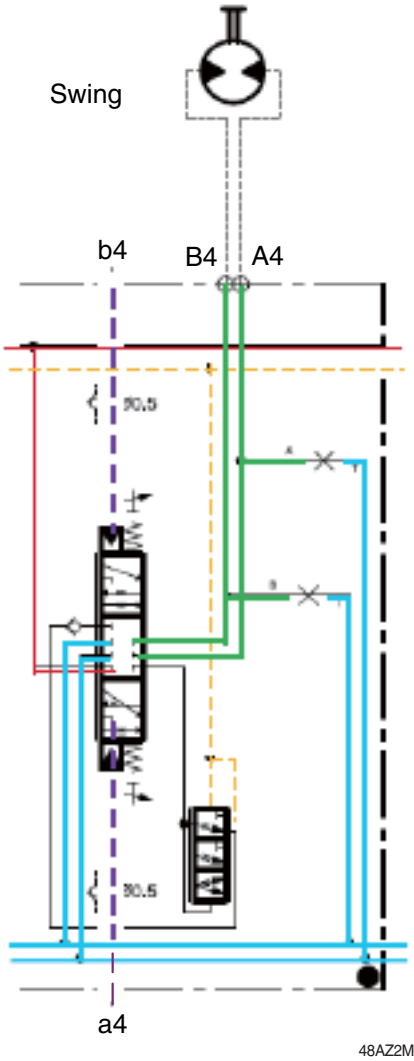
48AA2MC43

### (2) Neutral position



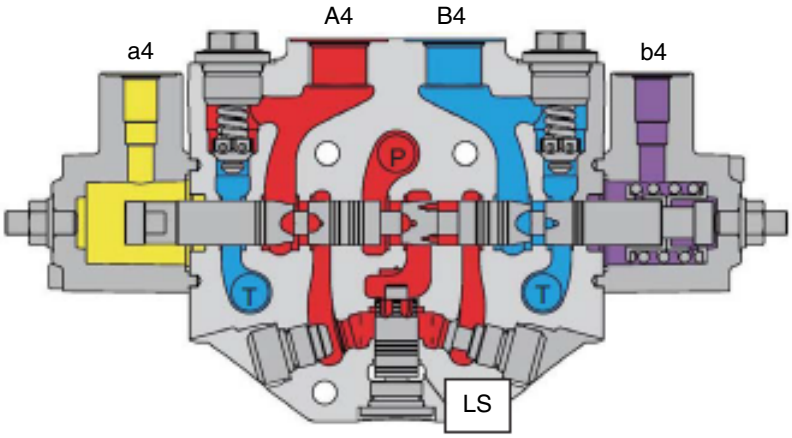

48AZ2MCV54

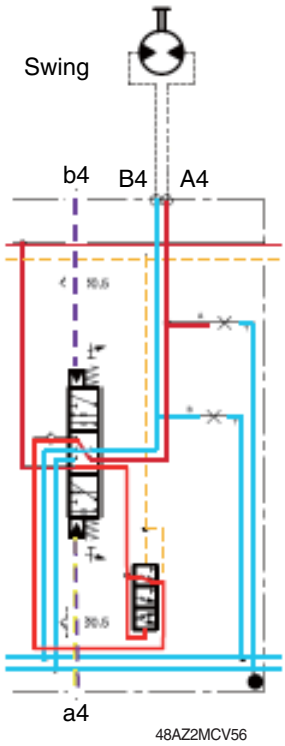
The spool is in neutral position, pump is in low pressure stand-by. The A4 and B4 ports are not connected to the pumps nor the tank. This slice is equipped with spool stroke limiters




48AZ2MCV55

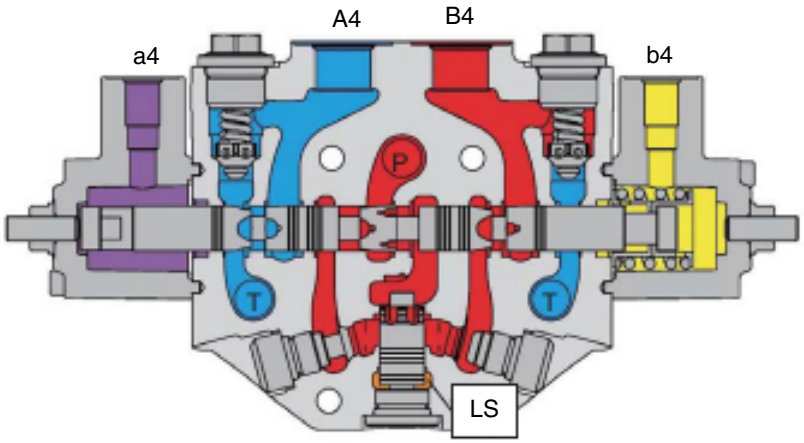
### (3) PABT position

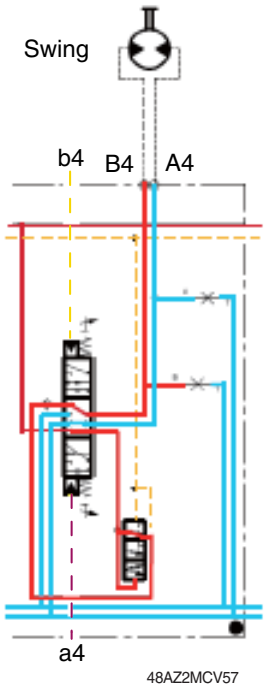



When the pilot pressure is led to the port a4, the oil from the pump flows to the motor port A4 and oil from the cylinder flows into the tank through the motor B4.

### (4) PBAT position




When the pilot pressure is led to the port b4, the oil from the pump flows to the motor port B4 and oil from the cylinder flows into the tank through the motor port A4.

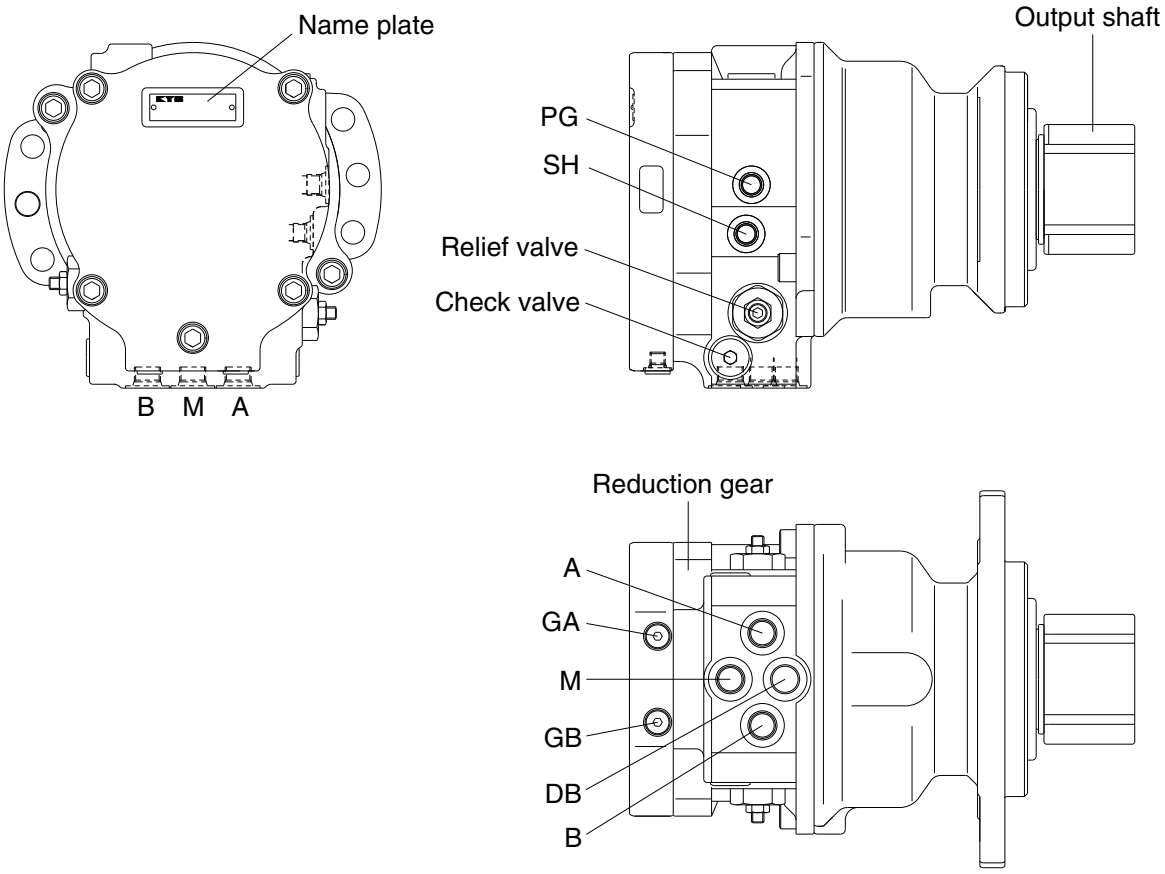
# GROUP 3 SWING DEVICE

## 1. STRUCTURE

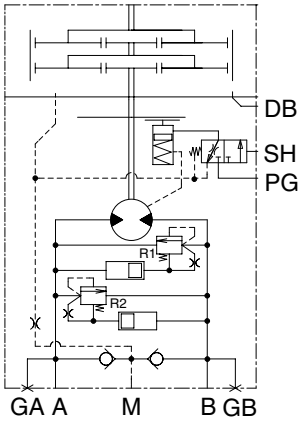
Swing device consists swing motor and swing reduction gear.

### 1) SWING MOTOR

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



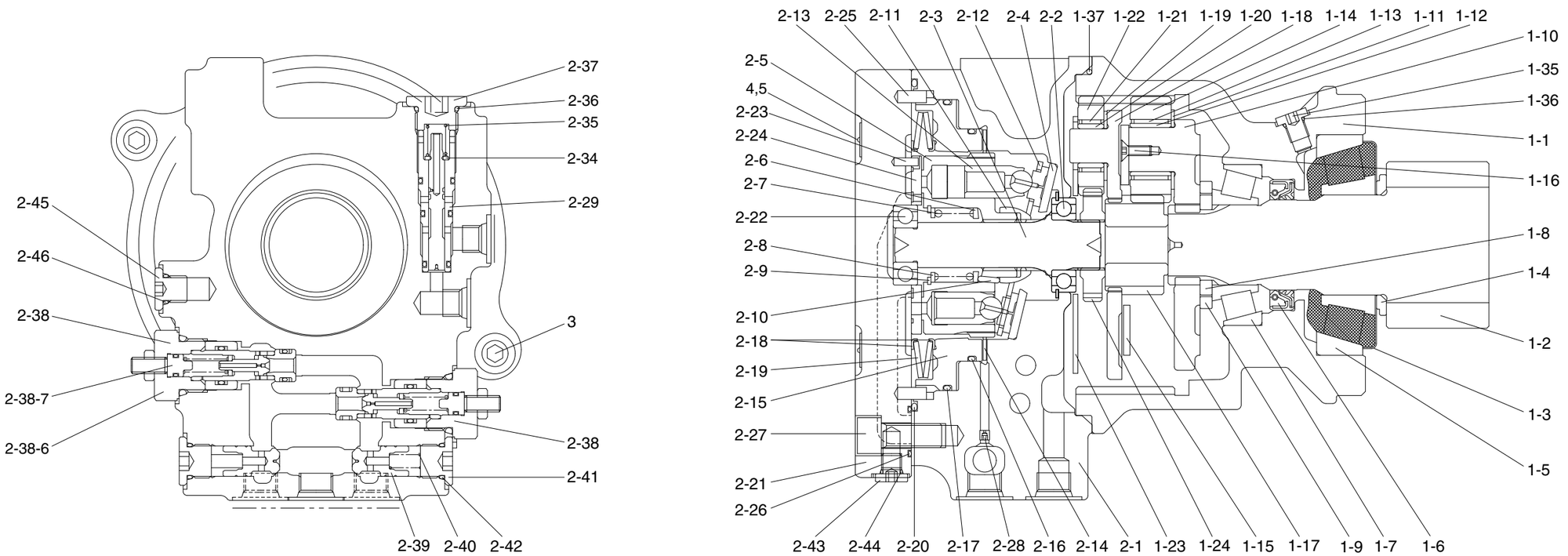

40A2SM01




Hydraulic circuit

| Port | Port name | Port size |
|---|---|---|
| A | Main port | PF 3/8 |
| B | Main port | PF 3/8 |
| DB | Drain port | PF 3/8 |
| M | Make up port | PF 3/8 |
| PG | Brake release stand by port | PF 1/4 |
| SH | Brake pilot port | PF 1/4 |
| GA,GB | Gage port | PF 1/8 |

## 2) COMPONENTS




40A2SM02

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | Gear box | 1-13 | Needle bearing | 1-36 | O-ring | 2-11 | Retainer holder |
| 1-1 | Housing | 1-14 | Planetary gear B | 1-37 | O-ring | 2-12 | Retainer plate |
| 1-2 | Pinion shaft | 1-15 | Thrust plate | 2 | Axial piston motor | 2-13 | Piston assy |
| 1-3 | Plate | 1-16 | Screw | 2-1 | Case | 2-14 | Disc |
| 1-4 | Collar | 1-17 | Sun gear B | 2-2 | Ball bearing | 2-15 | Brake piston |
| 1-5 | Tapper roller bearing | 1-18 | Holder | 2-3 | Shaft | 2-16 | O-ring |
| 1-6 | Oil seal | 1-19 | Thrust washer | 2-4 | Thrust plate | 2-17 | O-ring |
| 1-7 | Tapper roller bearing | 1-20 | Inner race | 2-5 | Cylinder block | 2-18 | Spring seat |
| 1-8 | Plate | 1-21 | Needle bearing | 2-6 | Collar | 2-19 | Spring |
| 1-9 | Collar | 1-22 | Planetary gear | 2-7 | Spring | 2-20 | O-ring |
| 1-10 | Holder | 1-23 | Thrust plate | 2-8 | Washer | 2-21 | Cover |
| 1-11 | Thrust washer | 1-24 | Drive gear | 2-9 | Ring-snap | 2-22 | Ball bearing |
| 1-12 | Inner race | 1-35 | Plug | 2-10 | Pin | 2-23 | Pin |

| | | | | | |
|---|---|---|---|---|---|
| 2-24 | Valve plate | 2-39 | Check valve | 3 | Socket head bolt |
| 2-25 | Pin | 2-40 | Spring | 4 | Name plate |
| 2-26 | O-ring | 2-41 | Plug | 5 | Screw |
| 2-27 | Socket head bolt | 2-42 | O-ring | | |
| 2-28 | Orifice | 2-43 | Plug | | |
| 2-29 | Valve assy | 2-44 | O-ring | | |
| 2-34 | Washer | 2-45 | Plug | | |
| 2-35 | Spring | 2-46 | O-ring | | |
| 2-36 | O-ring | | | | |
| 2-37 | Plug | | | | |
| 2-38 | Relief valve assy | | | | |
| 2-38-6 | Plug | | | | |
| 2-38-7 | Adjust kit | | | | |

## 2. DESCRIPTION OF FUNCTION AND OPERATION

### 1) SWASH PLATE MOTOR

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

#### Principle of generation torque

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

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

The output torque and the revolution are calculated as follows :

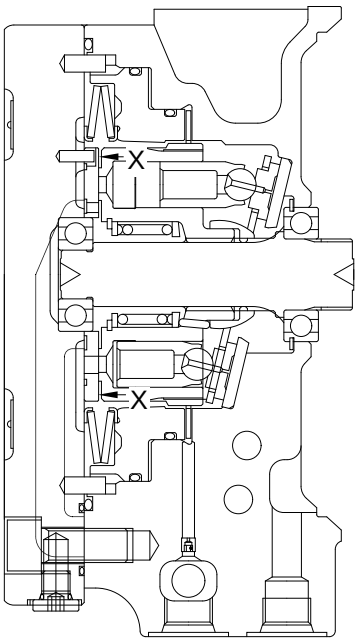
· Output torque (T)

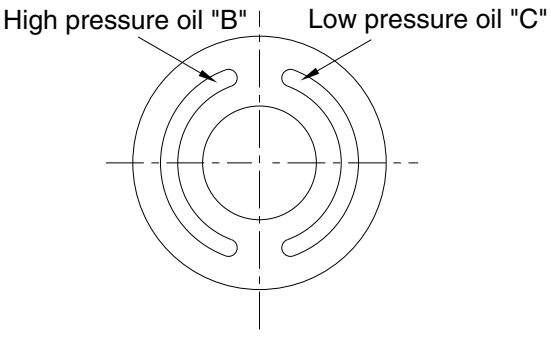
$$T = \frac{P \times D \times i \times \eta m \times \eta G}{2 \times \pi \times 100}$$

· Revolution (N)

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

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




View X-X of valve plate(Outline)

R35Z72SM02

## 2) PARKING BRAKE

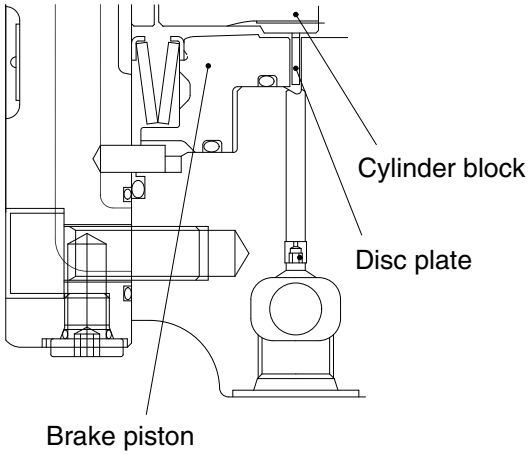
The parking brake is of wet type multi-plate construction of hydraulic release type and has a shaft lock mechanism that changes between ON and OFF of the brake by external signal pressures.

### ① Parking brake ON

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

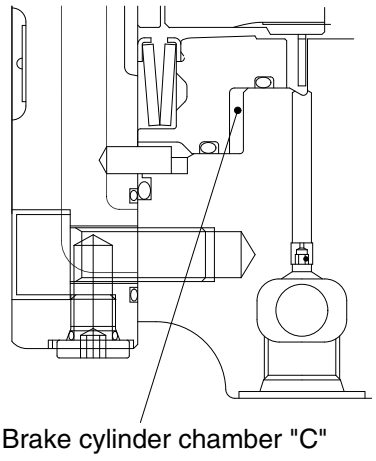
### ② Parking brake OFF

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




"PB" (Brake releasing pressure) OFF

R35Z72SM03




"PB" (Brake releasing pressure) ON

R35Z72SM04

### 3) RELIEF VALVE

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

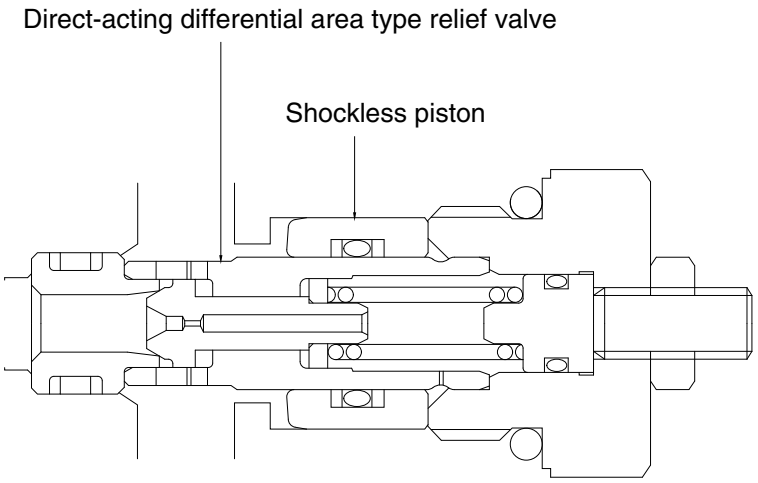
A shockless function is also incorporated to reduce shock produced at the start of both acceleration and deceleration.

#### (1) Construction of the relief valve

① A direct-acting differential area type relief valve

② A shockless piston

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

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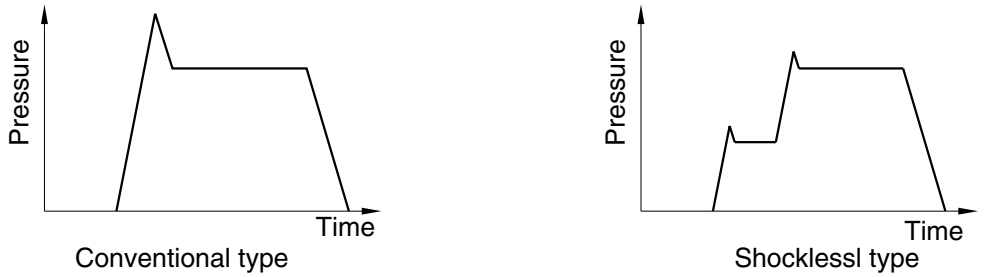



Comparison of pressure wave forms

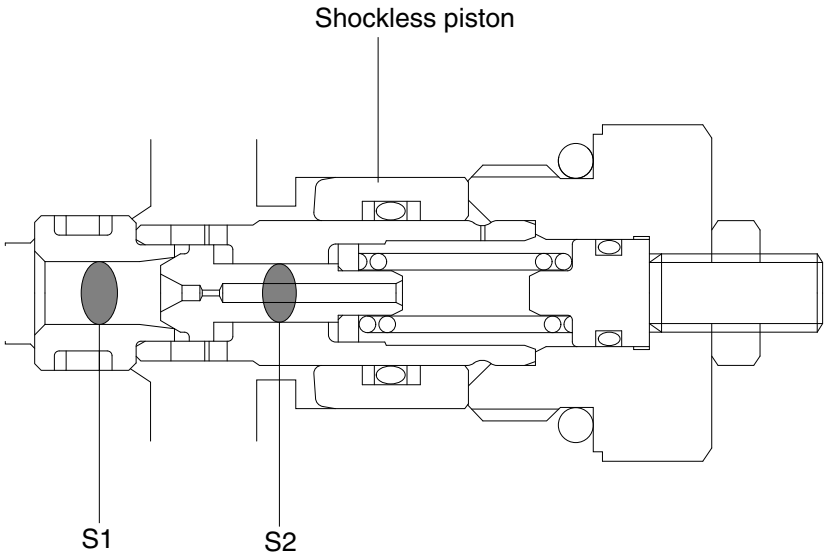
R35Z72SM08

### (2) Relief valve operation

#### First stage

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

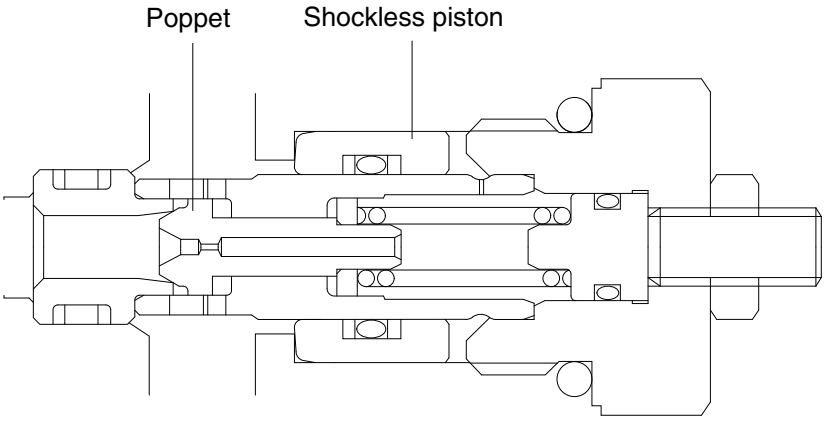
The low pressure holding time depends on the poppet orifice diameter, the free piston pressure receiving area and the free piston stroke.




R35Z72SM06

#### ② Second stage

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



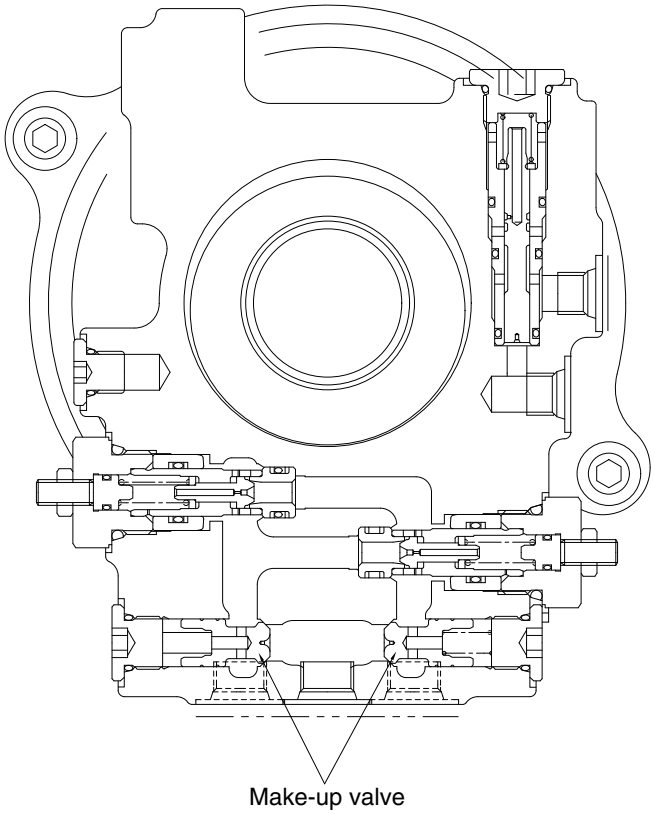

R35Z72SM07

### 4) MAKE-UP VALVE

The make-up valve has the following two functions.

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

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

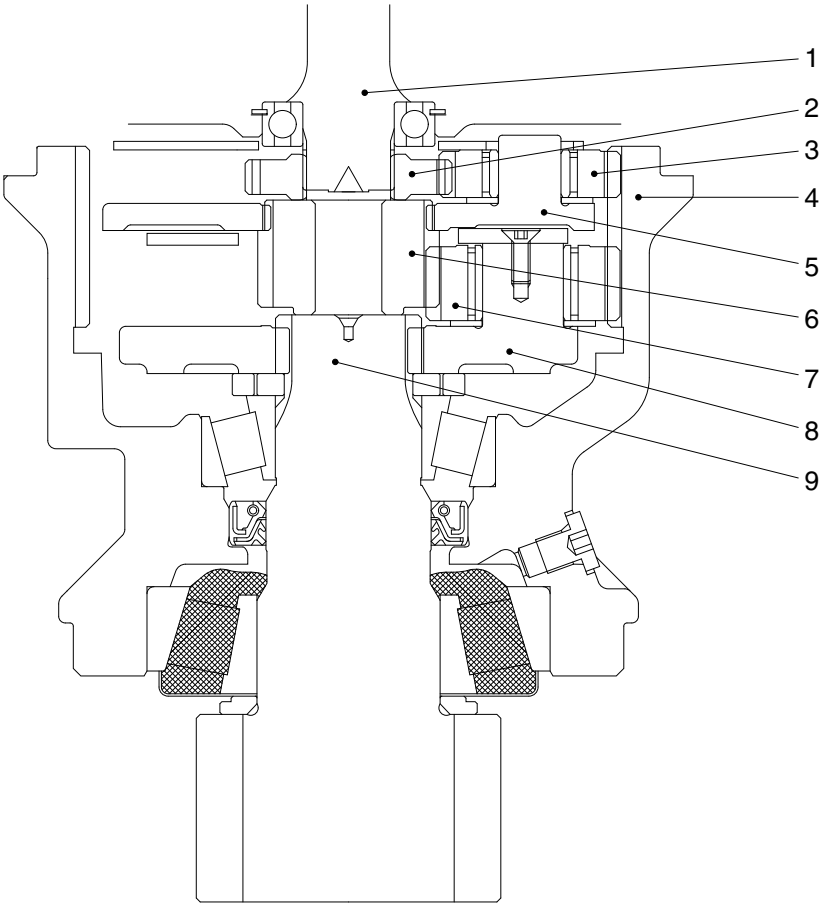



40A2SM09

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

Refer to the cross section.

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



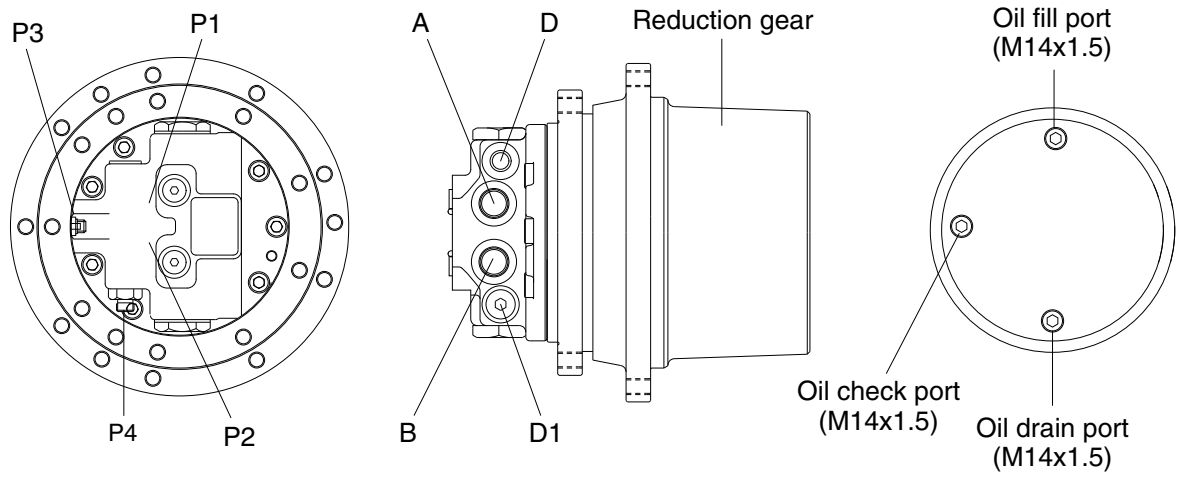

R35Z72SM10

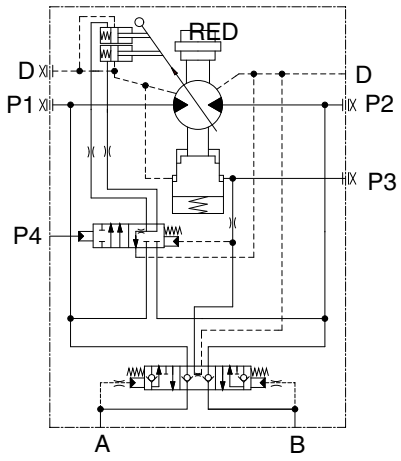
# GROUP 4 TRAVEL DEVICE

## 1. CONSTRUCTION

Travel device consists travel motor and reduction gear box.

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



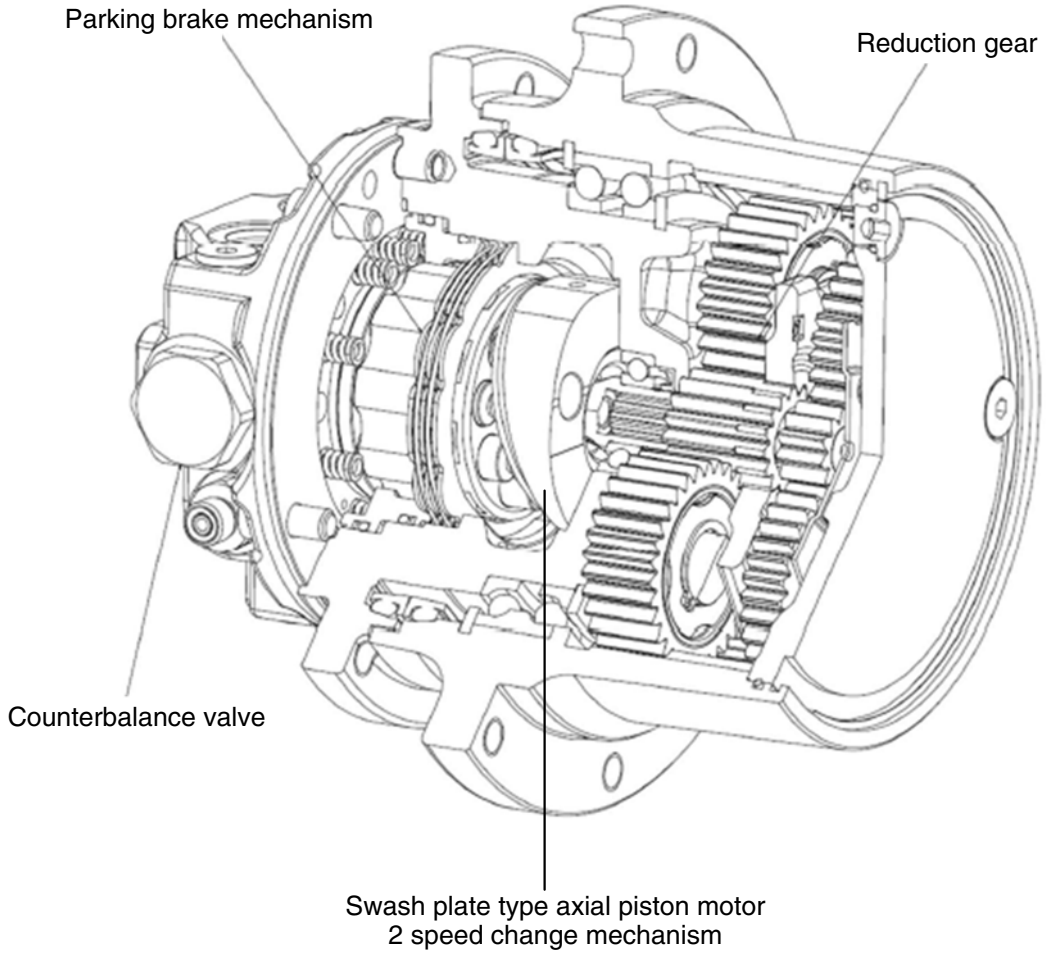




Hydraulic circuit

40A2TM01

| Port | Port name | Port size |
|---|---|---|
| A | Main port | PF 1/2 |
| B | Main port | PF 1/2 |
| P1, P2 | Gauge port | PF 1/4 |
| D, D1 | Drain port | PF 1/4 |
| P4 | 2 speed control port | 9/16-18 UNF |
| P3 | Brake release port | PF 1/8 |

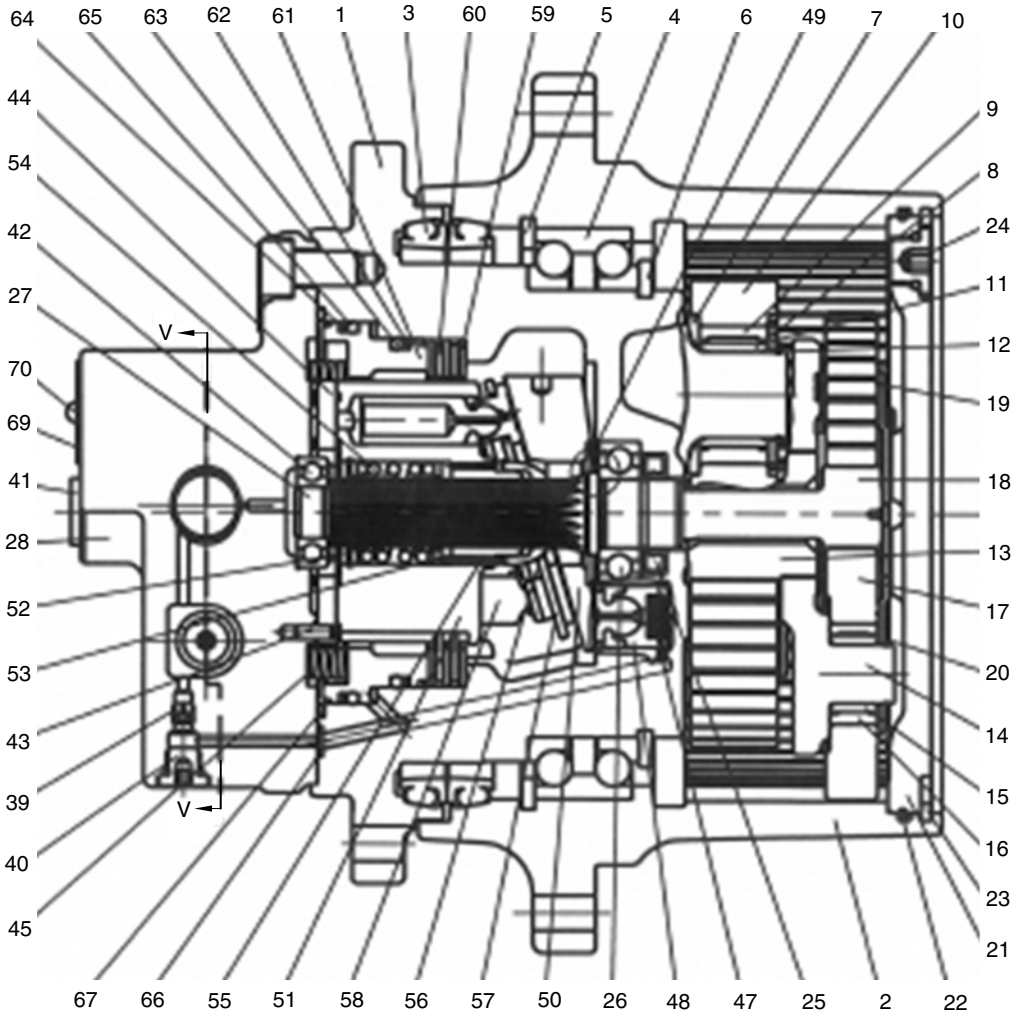
## 1) STRUCTURE (1/3)




35AZ2TM04

The travel motor is constituted with swash plate type axial piston motor, counterbalance valve, 2 speed change mechanism, parking brake, anti-cavitation valve and reduction gear unit.

## STRUCTURE (2/3)

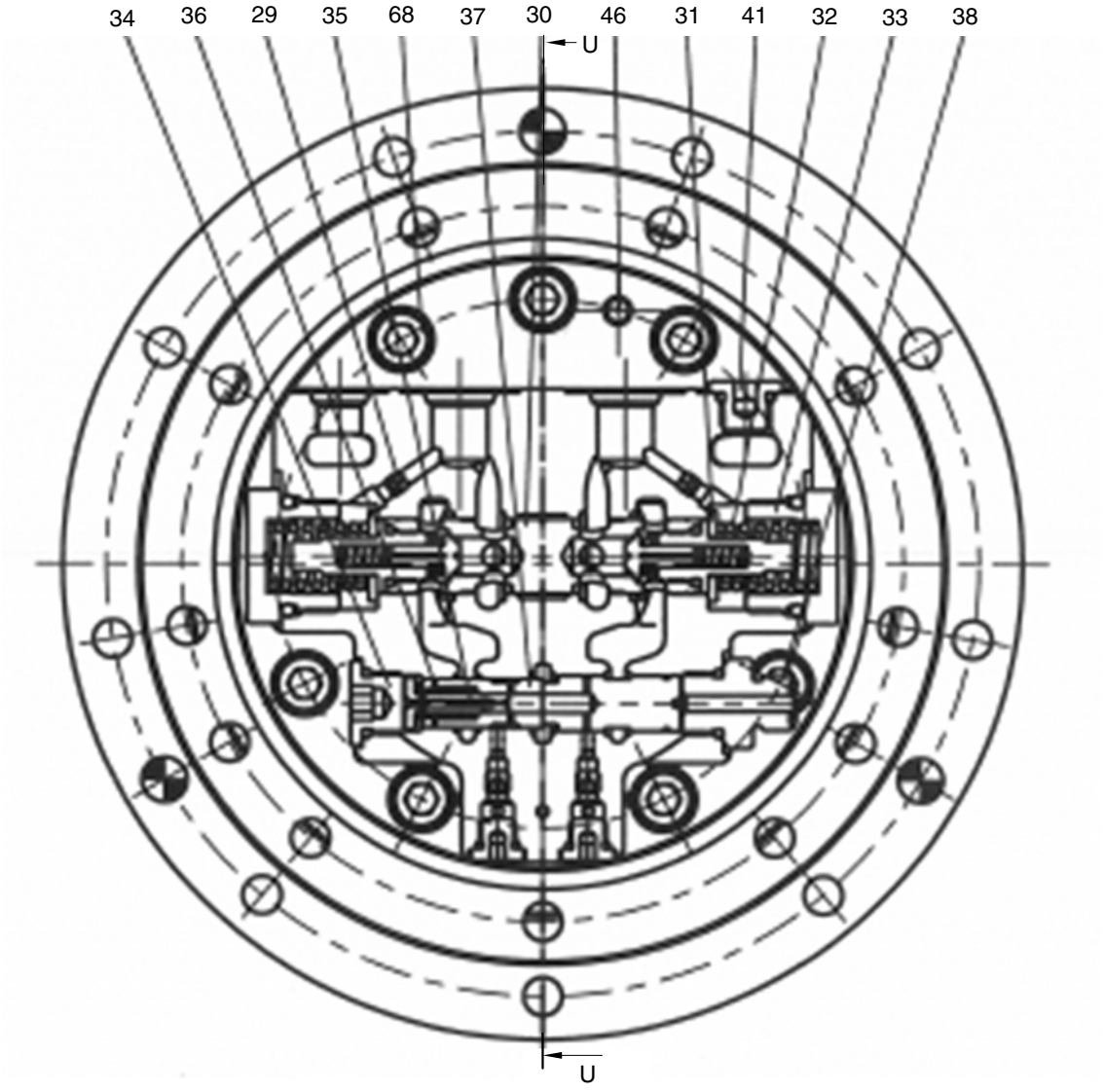



SECTION U-U

35AZ2TM02

| | | | | | |
|---|---|---|---|---|---|
| 1 | Spindle | 21 | Cover | 52 | Snap ring |
| 2 | Hub | 22 | O-Ring | 53 | Washer |
| 3 | Floating seal | 23 | Clip | 54 | Spring |
| 4 | Angular ball bearing | 24 | Plug | 55 | Roller |
| 5 | Snap ring | 25 | Oil seal | 56 | Thrust ball |
| 6 | Shim plate | 26 | Ball bearing | 57 | Retainer plate |
| 7 | Washer | 27 | Drive shaft | 58 | Piston assembly |
| 8 | Inner race | 28 | Valve casing | 59 | Separation plate |
| 9 | Needle bearing | 39 | Orifice | 60 | Friction plate |
| 10 | Planet gear No.2 | 40 | Plug assy | 61 | Parking piston |
| 11 | Thrust washer | 41 | Plug assy | 62 | Back up ring |
| 12 | Snap ring | 42 | Ball bearing | 63 | O-ring |
| 13 | Sun sear No.2 | 43 | Parallel pin | 64 | Back up ring |
| 14 | Carrier No.1 | 44 | Valve plate | 65 | O-ring |
| 15 | Inner race | 45 | Parking spring | 66 | O-ring |
| 16 | Needle bearing | 47 | Spring | 67 | O-ring |
| 17 | Planet gear No.1 | 48 | 2 speed piston assy | 69 | Name plate |
| 18 | Sun gear No.1 | 49 | Steel ball | 70 | Screw |
| 19 | Thrust plate No.1 | 50 | Swash plate | | |
| 20 | Snap ring | 51 | Cylinder block | | |

## STRUCTURE (3/3)



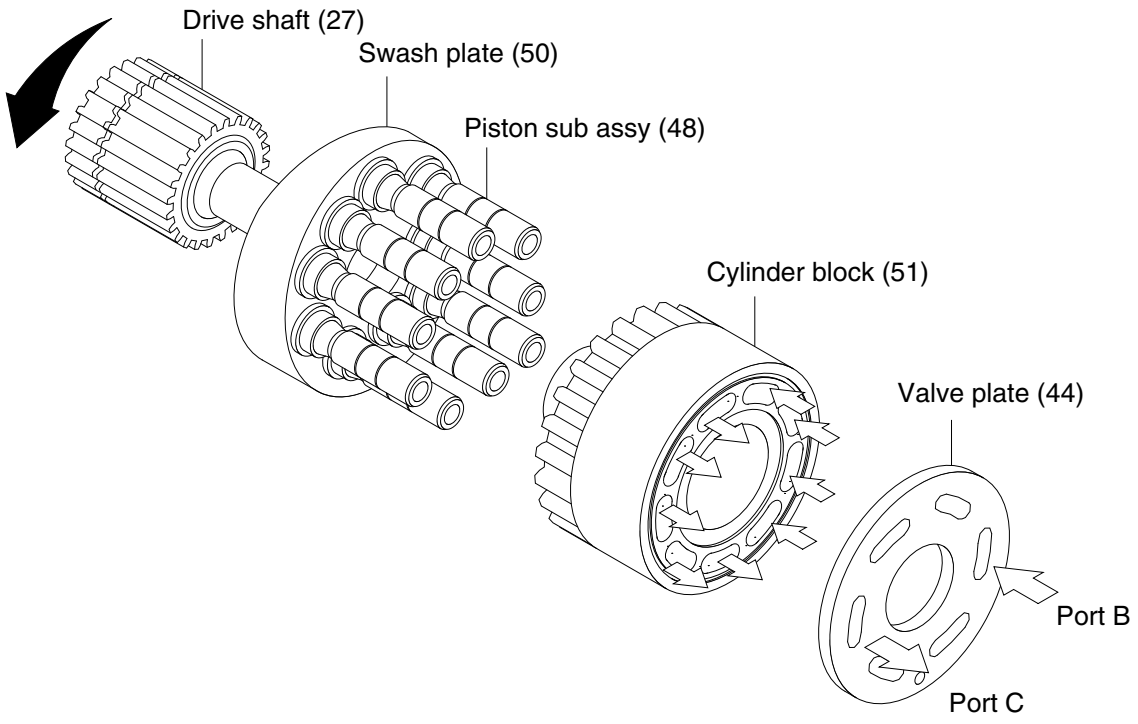

SECTION V-V

35AZ2TM03

29 Orifice
30 CB spool assy
31 Washer
32 Spring
33 Main plug assy
34 Plug assy
35 Speed shift guide spool
36 Spring
37 2-speed spool
38 Plug assy
41 Plug assy
46 Parallel pin
68 Socket bolt

## 2. FUNCTION

### 1) HYDRAULIC MOTOR




35AZ2TM05

Nine piston sub assemblies (48) are assembled in cylinder block (51). The end face of cylinder block (51) is in contact with valve plate (44) having two crescent shaped ports, B and C (high and low pressure ports).

When supplying pressure fluid (pressure P) to B port, a swash plate (50) is pushed by the force of piston sub assemblies having F = P · A (A : piston pressure area). Piston sub assemblies receive the reaction force against it, and produce the reaction force (Ft) in rotating direction. The total force of high pressure side piston sub assemblies in rotating direction produces a rotating force in the cylinder block, and the torque is transmitted to drive shaft (27) through the spline resulting in the rotation of the shaft.

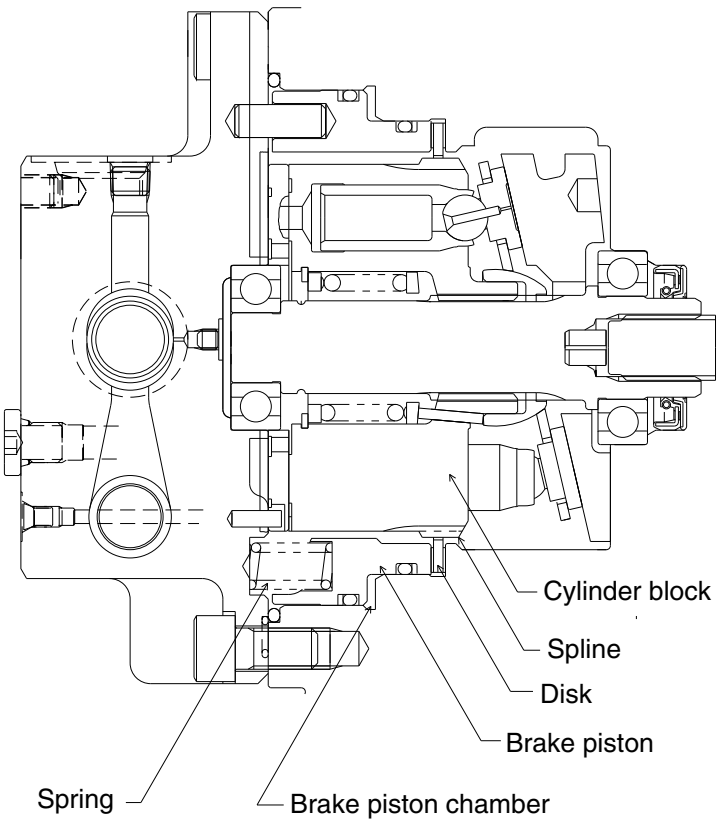
According to the above working principle, the output torque and rotating speed of the piston motor are determined by supply pressure (P) and flow rate (Q), and are calculated by the following equation.

$$T = \frac{P \times D \times \eta m}{2^* \pi}$$

$$N = \frac{Q \times 10^3 \times \eta v}{D}$$

T : Output torque [N · m]
N : Speed of rotation [rpm]
P : Working pressure [MPa]
Q : Flow rate [L/min]
D : Theoretical displacement [$cm^3$/rev]
$\eta$ m : Mechanical efficiency
$\eta$ v : Volumetric efficiency

## 2) PARKING BRAKE

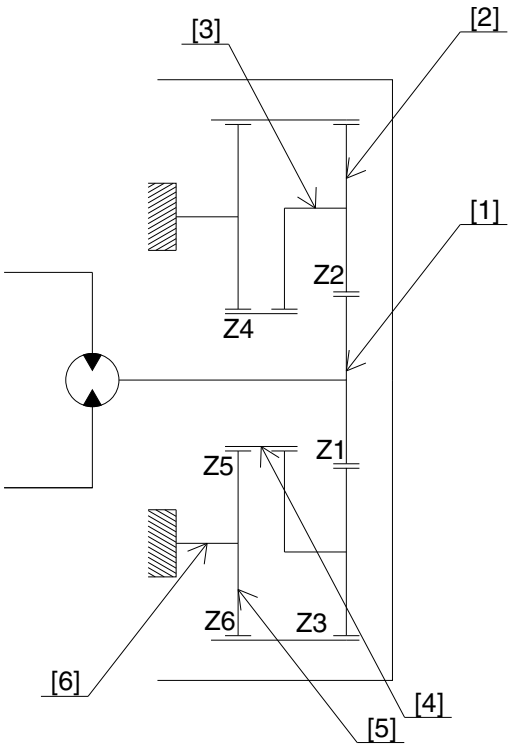



R35Z72TM18

The parking brake is a negative brake consisting of disk, brake piston and spring.
The cylinder block and the disk are combined with a spline, and friction material is bonded on both sides of disk. The disk generates frictional force between the flange holder and the brake piston by the force of spring and restricts the rotating force of the motor, achieving the best performance of the parking brake.
When the pressurized oil flows into the motor, the plunger moves and the parking brake release port is opened. After the oil flows into brake piston chamber, the thrust F is generated, corresponding to the pressure receiving area of brake piston and the thrust F becomes larger than the force of spring f, consequently the brake piston moves toward right.
Then, the disk rotates freely between the flange holder and brake piston, and parking brake is released.
When the motor is stopped, the plunger returns to the neutral position and the parking brake release port is closed. Consequently the pressurized oil in brake piston chamber flows into motor case, the parking brake acts by the force of spring.

### 3) REDUCTION UNIT

The reduction unit consists of double stage planetary gear mechanism.




R35Z72TM19

Drive gear[1] is engaged with the 1st planetary gear [2], 2nd stage sun gear [4] is engaged with the 2nd planetary gear [5]. The 2nd stage planetary carrier [6] is fixed machine body. Planetary gears [2], [5] are engaged with ring gear (housing).

The driving force form the piston motor is transmitted to drive gear [1], and the speed is reduced by each gear.

The reduced driving force is transmitted to ring gear through planetary gear [5] of planetary carrier [6] fixed on the machine body. (The driving force is also transferred from 1st stage planetary gear [2]). The direction of output rotation are reversed against that of input rotation.

The reduction gear ratio " i " is shown as follows.

※ Reduction gear ratio (i)

$$I = (i1 \times i2\text{-}1) = \left( \frac{Z1+Z3}{Z1} \times \frac{Z4+Z6}{Z4} \text{-}1 \right)$$

※ Output torque of reduction unit (T)

$T = TM \times i \times \eta M$

Z1 : Drive gear teeth number
Z2 : Ring gear teeth number
Z4 : Sun gear teeth number
Z6 : Ring gear teeth number

※ Reduction gear output rotating speed (N)

$$N = \frac{NM}{i}$$

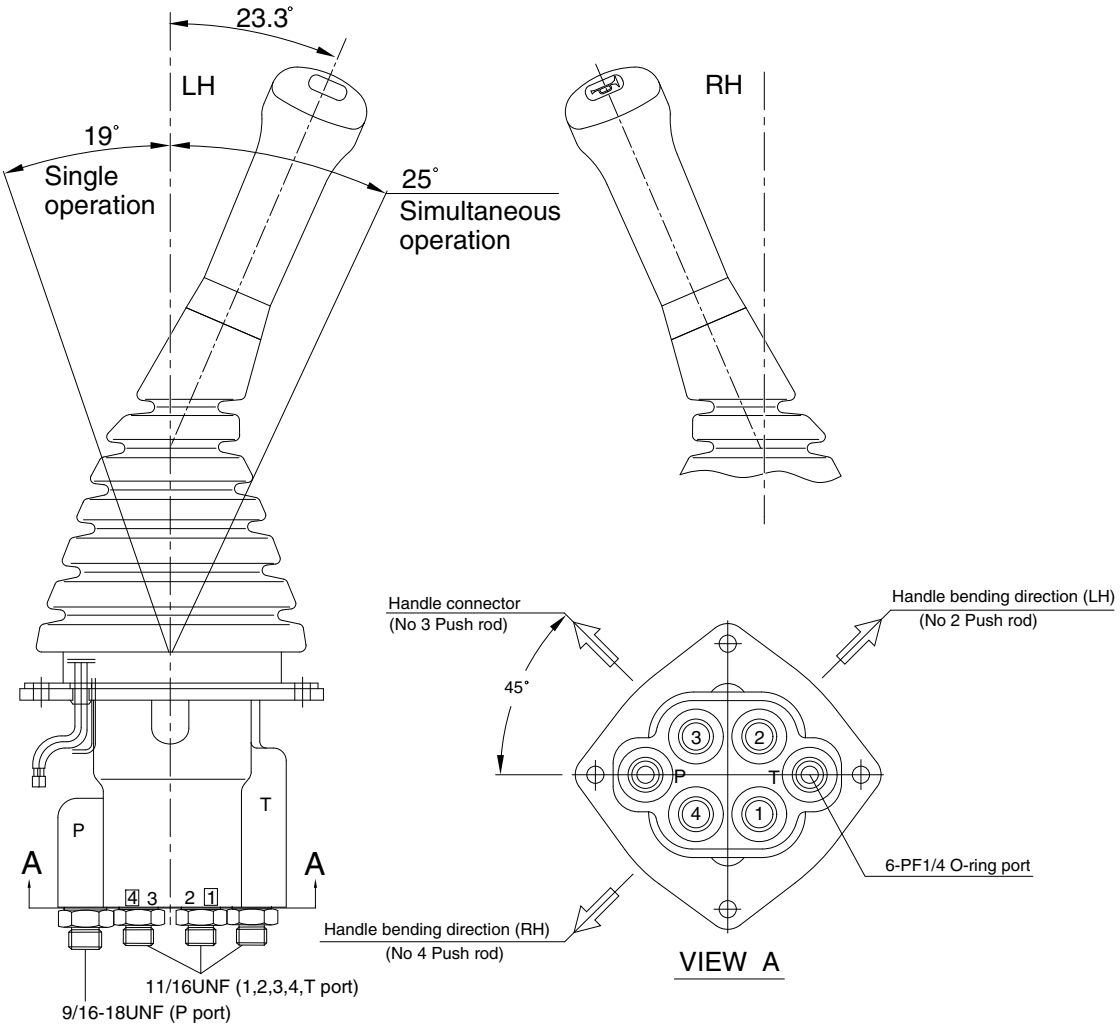
TM : Input torque (motor output torque)
i : Reduction gear ratio
$\eta$ M : Mechanical efficiency
NM : Input speed of rotation (output motor speed)

# GROUP 5 RCV LEVER

## ■ TYPE 1 (STD)

### 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.

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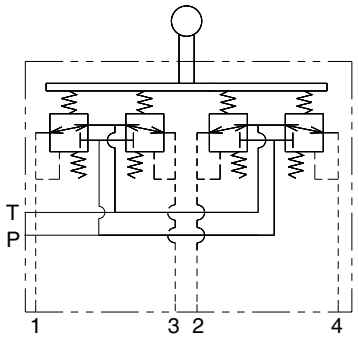



Hydraulic circuit

| 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 out port | Boom up port | |
| 3 | Right swing port | Bucket in port | |
| 4 | Arm in port | Boom down port | |

## CROSS SECTION

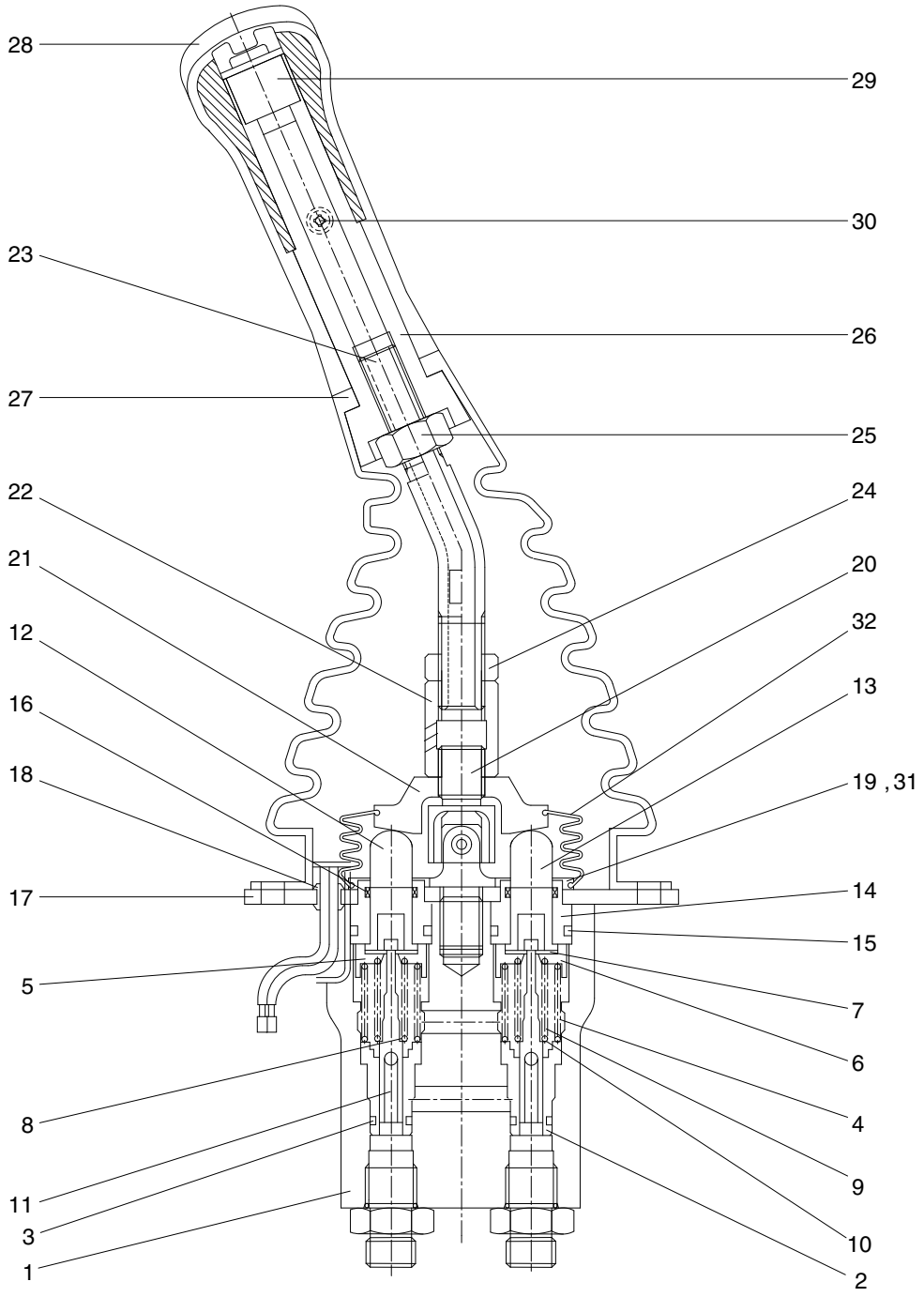
The construction of the pilot valve is shown in the attached cross section drawing. The casing has vertical holes in which reducing valves are assembled.

The pressure reducing section is composed of the spool (11), spring (8, 9) for setting secondary pressure, return spring (4), stopper (7), spring seat (5, 6) and spring seat (10). The spring for setting the secondary pressure has been generally so preset that the secondary pressure is 5 to 20.5 kgf/cm$^2$ (depending on the type). The spool is pushed against the push rod (12, 13) 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 | 12 | Push rod (1, 3) | 23 | Connector |
| 2 | Plug | 13 | Push rod (2, 4) | 24 | Nut |
| 3 | O-ring | 14 | Plug | 25 | Nut |
| 4 | Spring | 15 | O-ring | 26 | Insert |
| 5 | Spring seat (1, 3) | 16 | Rod seal | 27 | Boot |
| 6 | Spring seat (2, 4) | 17 | Plate (A) | 28 | Handle |
| 7 | Stopper | 18 | Bushing | 29 | Switch assembly |
| 8 | Spring (1, 3) | 19 | Machine screw | 30 | Screw |
| 9 | Spring (2, 4) | 20 | Joint assembly | 31 | Plate |
| 10 | Spring seat | 21 | Swash plate | 32 | Boot |
| 11 | Spool | 22 | Hex nut | | |

## CROSS SECTION




R25Z9A2RL02

## 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 (11) 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 (8, 9) works on this spool to determine the output pressure.

The change the deflection of this spring, the push rod (12, 13) is inserted and can slide in the plug (14).

For the purpose of changing the displacement of the push rod through the switch plate (21) and adjusting nut (22) are provided the handle (28) that can be tilted in any direction around the fulcrum of the universal joint (20) center.

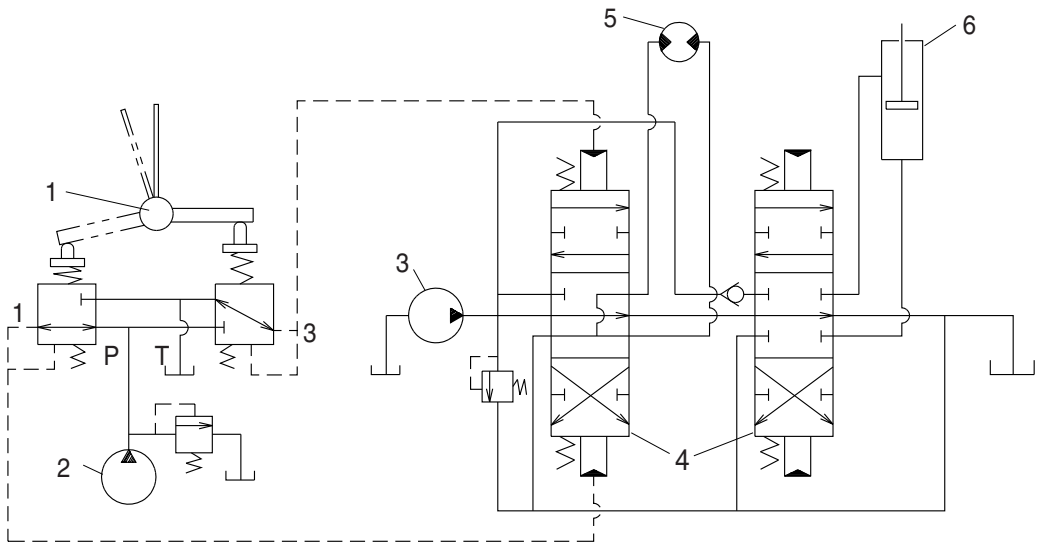
The spring (4) works on the case (1) and spring seat (5, 6) and tries to return the push rod (12, 13) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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.

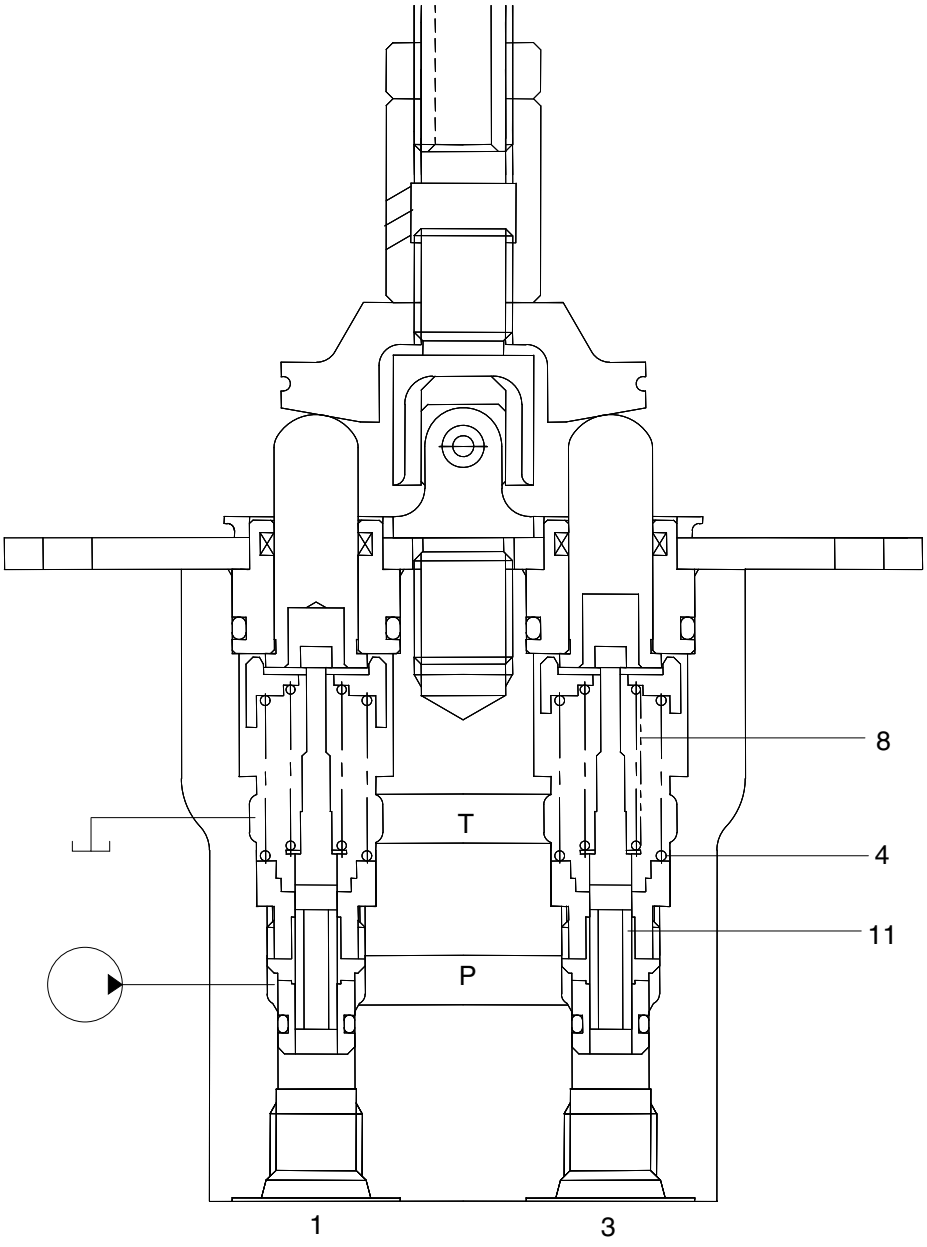
The diagram shown below is the typical application example of the pilot valve.




2-70 (140-7TIER)

| | | | | | |
|---|---|---|---|---|---|
| 1 | Pilot valve | 3 | Main pump | 5 | Hydraulic motor |
| 2 | Pilot pump | 4 | Main control valve | 6 | Hydraulic cylinder |

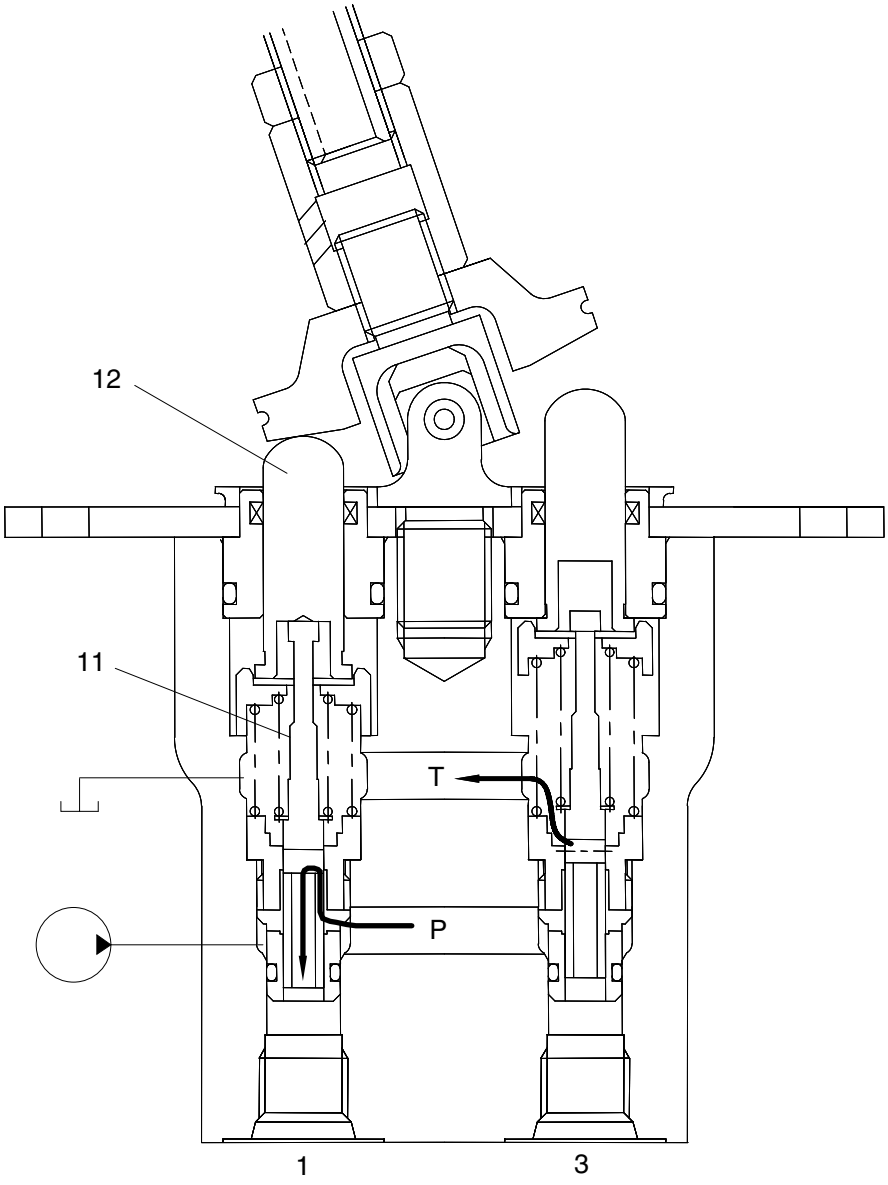
(1) Case where handle is in neutral position




R35Z72RL03

The force of the spring (8) that determines the output pressure of the pilot valve is not applied to the spool (11). Therefore, the spool is pushed up by the spring (4) 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

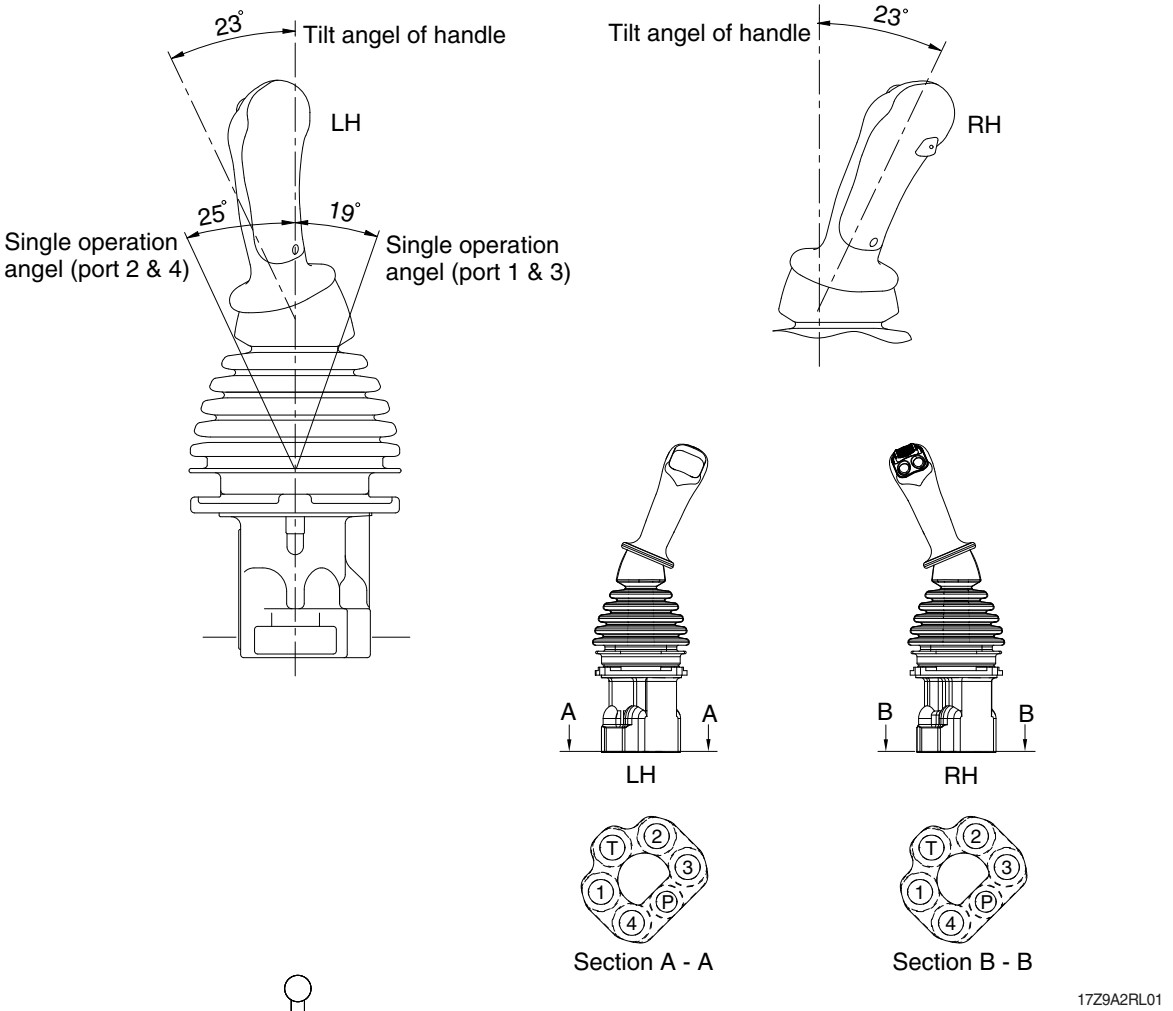


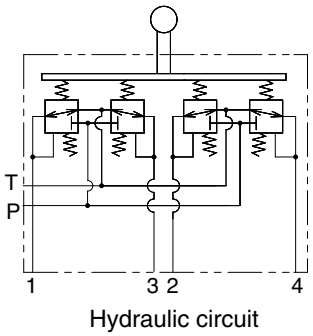

When the push rod (12) is stroked, the spool (11) moves downwards.
Then port P is connected with port (1) and the oil supplied from the pilot pump flows through port (1) to generate the pressure.
When the pressure at port (1) increases to the value corresponding to the spring force set by tilting the 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.

## ■ TYPE 2 (OPT)

### 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.

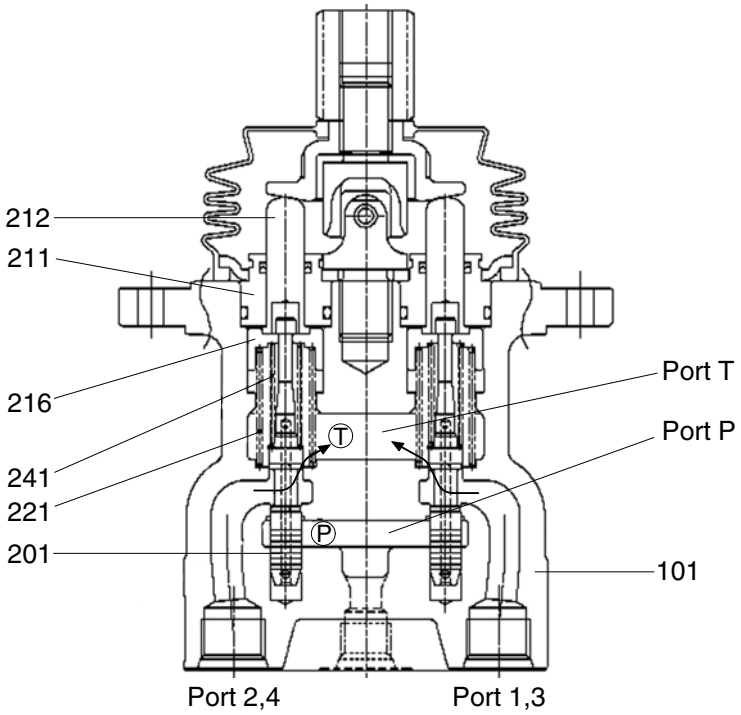



Hydraulic circuit

| Port | LH | RH (with proportional) | Port size |
|---|---|---|---|
| P | Pilot oil inlet port | Pilot oil inlet port | PF 1/4 |
| T | Pilot oil return port | Pilot oil return port | PF 3/8 |
| 1 | Left swing port | Bucket out port | |
| 2 | Arm out port | Boom down port | |
| 3 | Right swing port | Bucket in port | |
| 4 | Arm in port | Boom up port | |

## CROSS SECTION




17Z9A2RL02

101 Casing
201 Spool
211 Plug
212 Push rod
216 Spring seat
221 Return spring
241 Secondary pressure setting spring

The structure of the remote control valve is as shown in the assembly. There is a vertical axial hole in the casing and the reduction valves are inserted into this.

The secondary pressure setting spring (241) is set such that the secondary pressure is calculated as 5.1~10.2 kgf/cm$^2$. Spool (201) is pushed onto the push rod (212) by return spring (221).
Tilting the control handle pushes down push rod (212), the spring seat (216) also moves down and the setting of the secondary pressure setting spring (241) is changed.
Port P, oil inlet (primary pressure) and port T outlet (tank) are in the casing (101).

## 2. PERFORMANCE

### 1) BASIC PERFORMANCE

The remote control valve controls the stroke and direction of the control valve spools. This is achieved by the output pressure of the remote control valve acting on the tip of the control valve spool.

To achieve satisfactory performance, the remote control valve comprises the following elements :

(1) An inlet port (P) for oil fed from the hydraulic pump.

(2) Multiple output ports (1, 2, 3 and 4) to allow pressure from the inlet port to act on the spool tips of the control valve.

(3) A tank port (T) to control the output pressure.

(4) A spool to connect the output port to the inlet port or tank port.

(5) A mechanical assembly, which contains a spring which acts on the spool and controls the output pressure.

### 2) PERFORMANCE OF THE MAIN PARTS

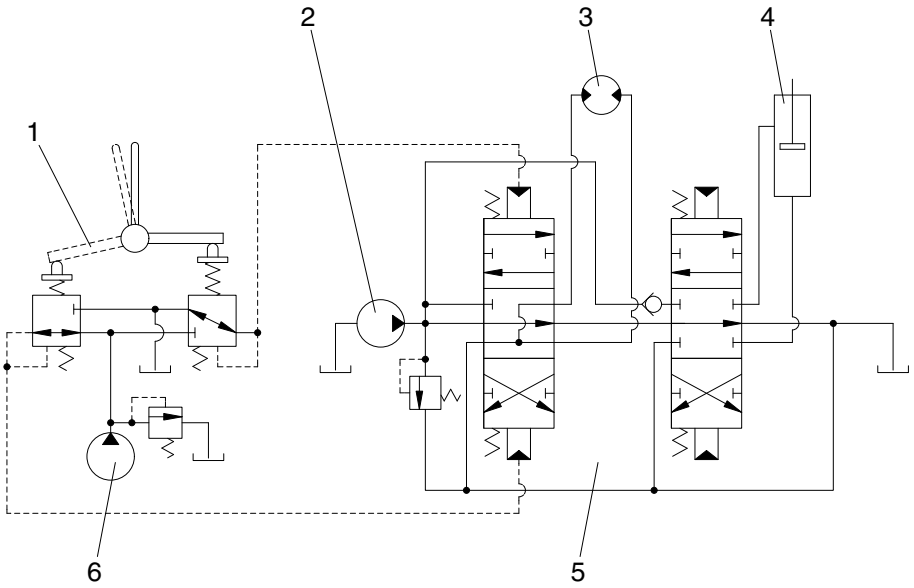
The spool (201) operates to take the supply oil pressure from the hydraulic pump. This switches the oil channel so that the port P oil pressure is directed to the output ports 1, 2, 3, 4 or to port T. The secondary pressure setting spring (241) determines the output pressure that acts on the spool (201).

The push-rod (212), which changes the strain of the secondary pressure setting spring (241), is inserted so that it can move smoothly into the plug (211).

The return spring (221) acts to return the push-rod (212) towards zero displacement without reference to the output pressure acting on the spring seat (216) and casing (101). This acts to ensure the return to neutral of the spool (201) and also acts as a resistance spring to provide the operator with an appropriate operating "feel".

### 3) OPERATION

The operation of the remote control valve is described in the hydraulic circuit plan and operation explanatory figures (see figures RL04, 05 and 06). The below figure shows a typical example of the use of the remote control valve.




17Z9A2RL03

| | | | | | |
|---|---|---|---|---|---|
| 1 | Remote control valve | 3 | Hydraulic motor | 5 | Control valve |
| 2 | Main pump | 4 | Hydraulic cylinder | 6 | Pilot pump |

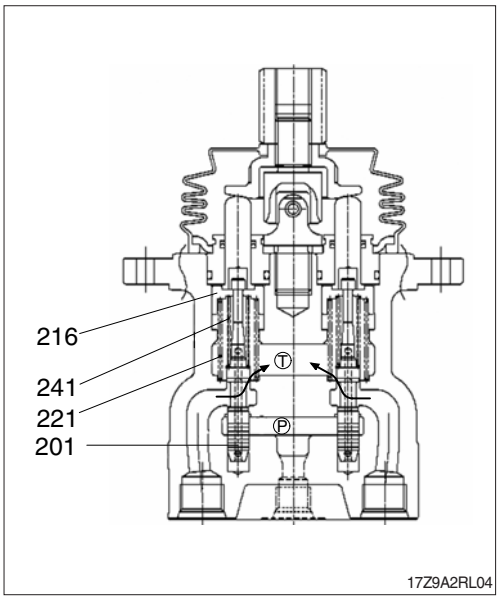
#### (1) Control handle neutral

The force of the secondary pressure setting spring (241) (which determines the output pressure of the pilot valve) does not act on the spool (201).

Spool (201) is pressed upward by the return spring (221) and spring seat (216) .

Output ports (2, 4) and port T are open.

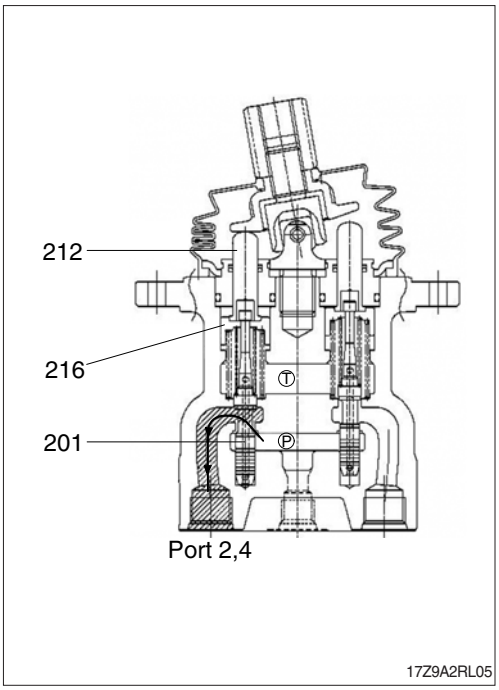
The output pressure is the same as the tank pressure.




17Z9A2RL04

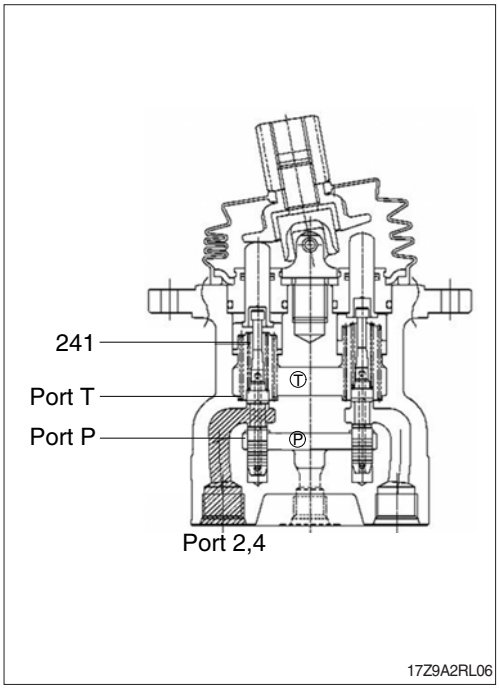
### (2) Control handle tilted

The push-rod moves, (spring seat (216)), spool (201) moves downward, port P and ports (2, 4) are open and the oil fed from the pilot pump flows to ports (2, 4) and generates pressure.




### (3) Control handle held

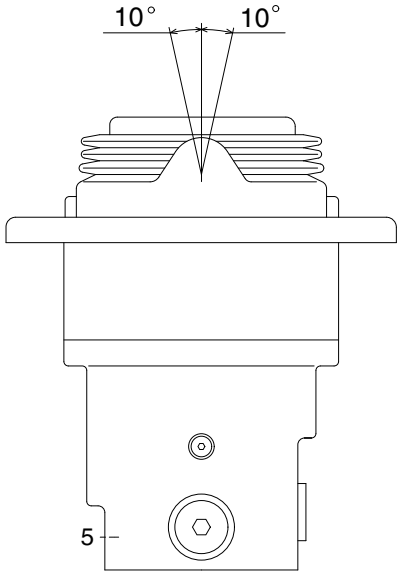
The pressure of ports (2, 4) rises to become equal to the spring (241) force; the oil pressure and spring pressures become balanced. If the pressure of ports (2, 4) exceeds the set pressure, ports (2, 4) and port P close, ports (2, 4) and port T open. If the pressure of ports (2, 4) falls below the set pressure, ports (2, 4) and port P open and ports (2, 4) and port T close. The secondary pressure is kept constant.

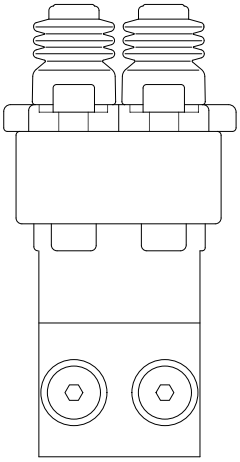


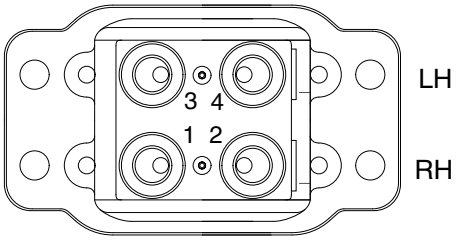
# GROUP 6 RCV PEDAL

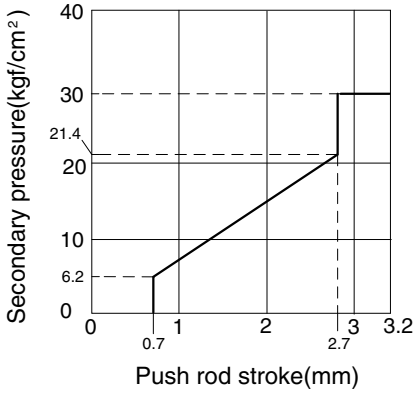
## 1. STRUCTURE

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.

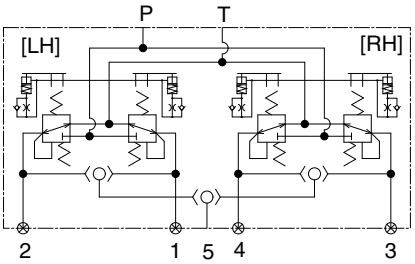





35AZ2RCP01



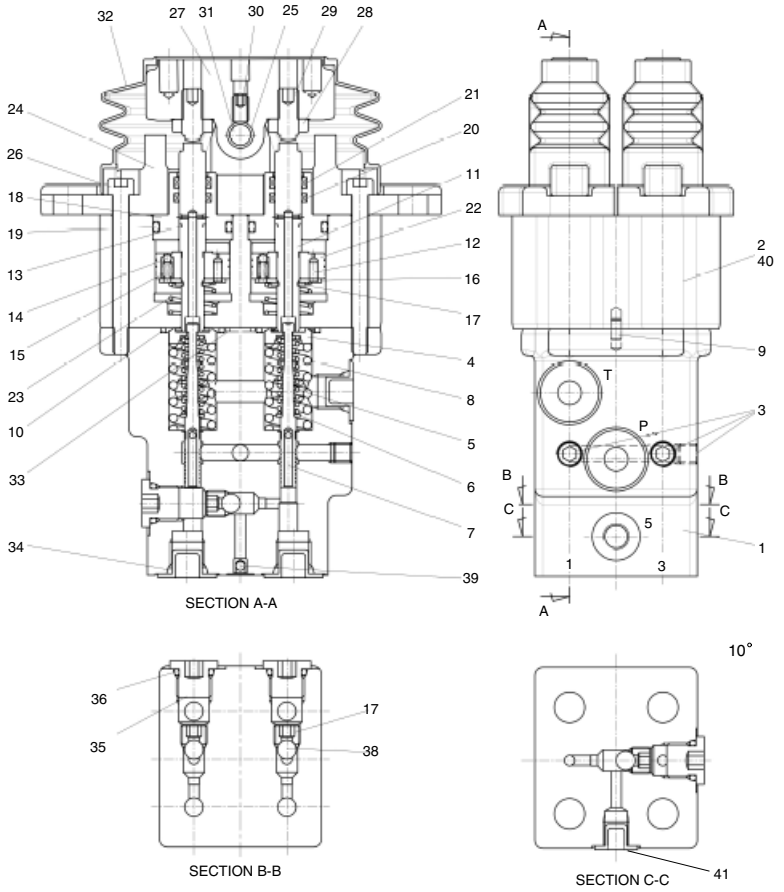

| Port | Port name | Port size |
|---|---|---|
| P | Pilot oil inlet port | PF 1/4 |
| T | Pilot oil return port | |
| 1 | Travel (LH, backward) | |
| 2 | Travel (LH, forward) | |
| 3 | Travel (RH, backward) | |
| 4 | Travel (RH, forward) | |
| 5 | Travel alarm | PT 1/8 |

## CROSS SECTION

The construction of the RCV pedal is shown in the below drawing. The casing has vertical holes in which reducing valves are assembled.

The pressure reducing section is composed of the spool (7), spring (5) for setting secondary pressure, return spring (8), spring seat (4) and washer (6). The spring for setting the secondary pressure has been generally so preset that the secondary pressure is 6.2 to 21.4 kgf/cm$^2$ (depending on the type). The spool is pushed against the push rod (11) by the return spring.

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




| | | | | | |
|---|---|---|---|---|---|
| 1 | Body 1 | 15 | Spring | 29 | Set screw |
| 2 | Body 2 | 16 | Plate | 30 | Set screw |
| 3 | Plug | 17 | Snap ring | 31 | Cam shaft |
| 4 | Spring seat | 18 | Plug | 32 | Bellows |
| 5 | Spring | 19 | O-ring | 33 | O-ring |
| 6 | Washer | 20 | Rod seal | 34 | Cap |
| 7 | Spool | 21 | Dust seal | 35 | Plug |
| 8 | Spring | 22 | Piston | 36 | O-ring |
| 9 | Spring pin | 23 | Spring | 37 | Check seat |
| 10 | O-ring | 24 | Cover | 38 | Steel ball |
| 11 | Push rod | 25 | Bushing | 39 | Expander |
| 12 | Spring pin | 26 | Wrench bolt | 40 | Name plate |
| 13 | Seal | 27 | Cam assy | 41 | Cap |
| 14 | Steel ball | 28 | Hex nut | | |

## 2. FUNCTION

### 1) FUNDAMENTAL FUNCTIONS

The pilot valve is a valve 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 port (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 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 (7) 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 spool to determine the output pressure.

The spring (5) works on this spool to determine the output pressure.

The change the deflection of this spring, the push rod (11) is inserted and can slide in the plug (18).

For the purpose of changing th displacement of the push rod through the cam (27) and steel ball (28) are provided the pedal that can be tilted in any direction around the fulcrum of the cam (27) center.

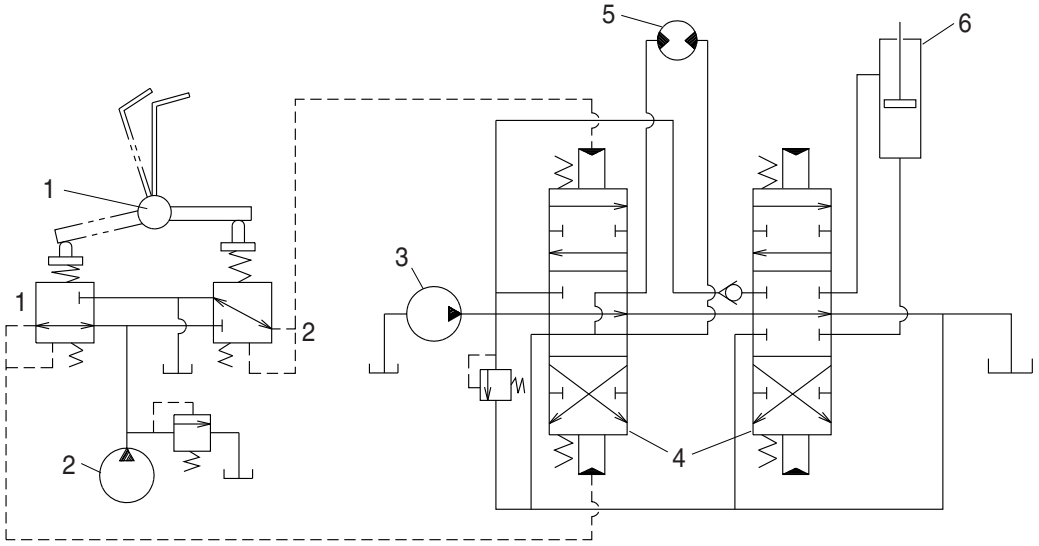
The spring (8) works on the casing (1) and washer (6) and tries to return the push rod (11) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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 ant the attached operation explanation drawing.

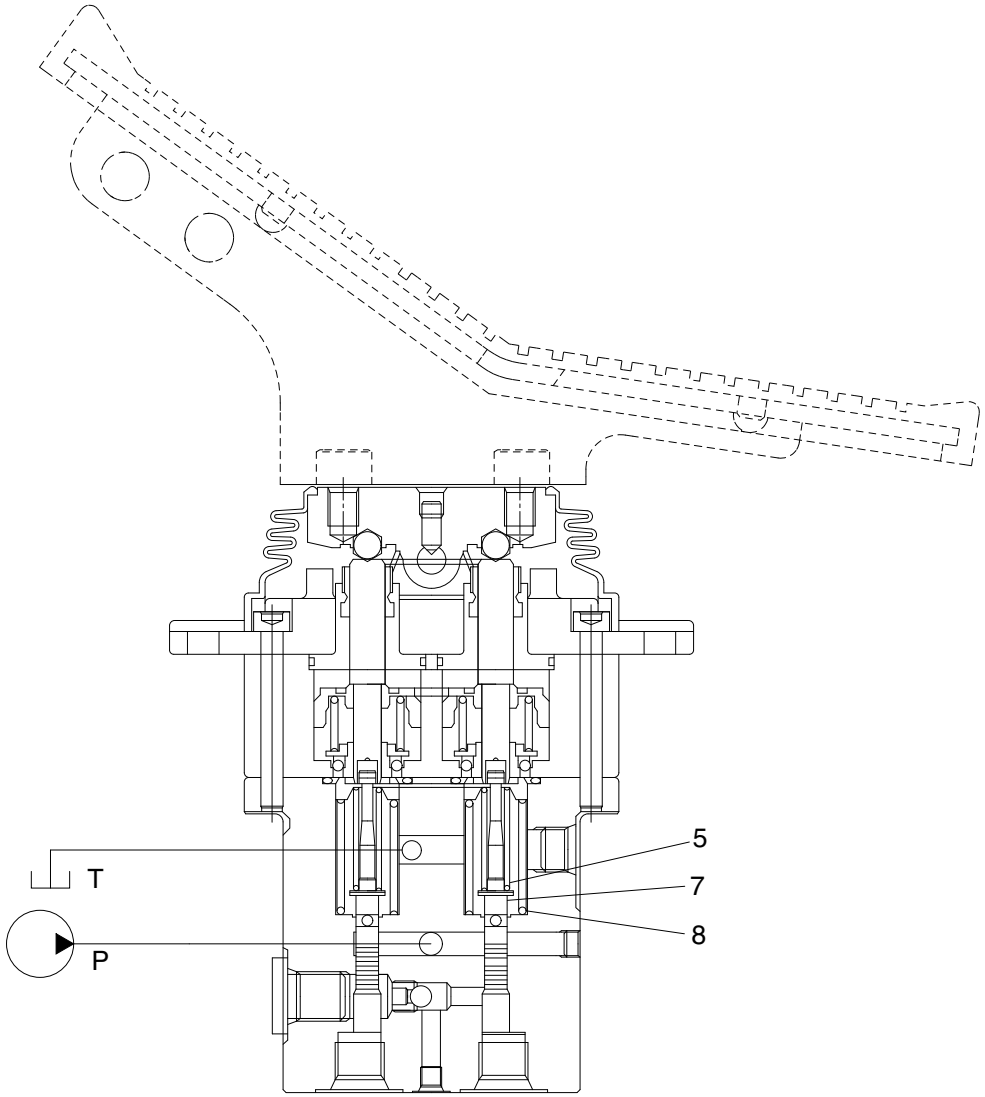
The diagram shown below is the typical application example of the pilot valve.




140LC-7 기타2-76

| | | | | | |
|---|---|---|---|---|---|
| 1 | Pilot valve | 3 | Main pump | 5 | Hydraulic motor |
| 2 | Pilot pump | 4 | Main control valve | 6 | Hydraulic cylinder |

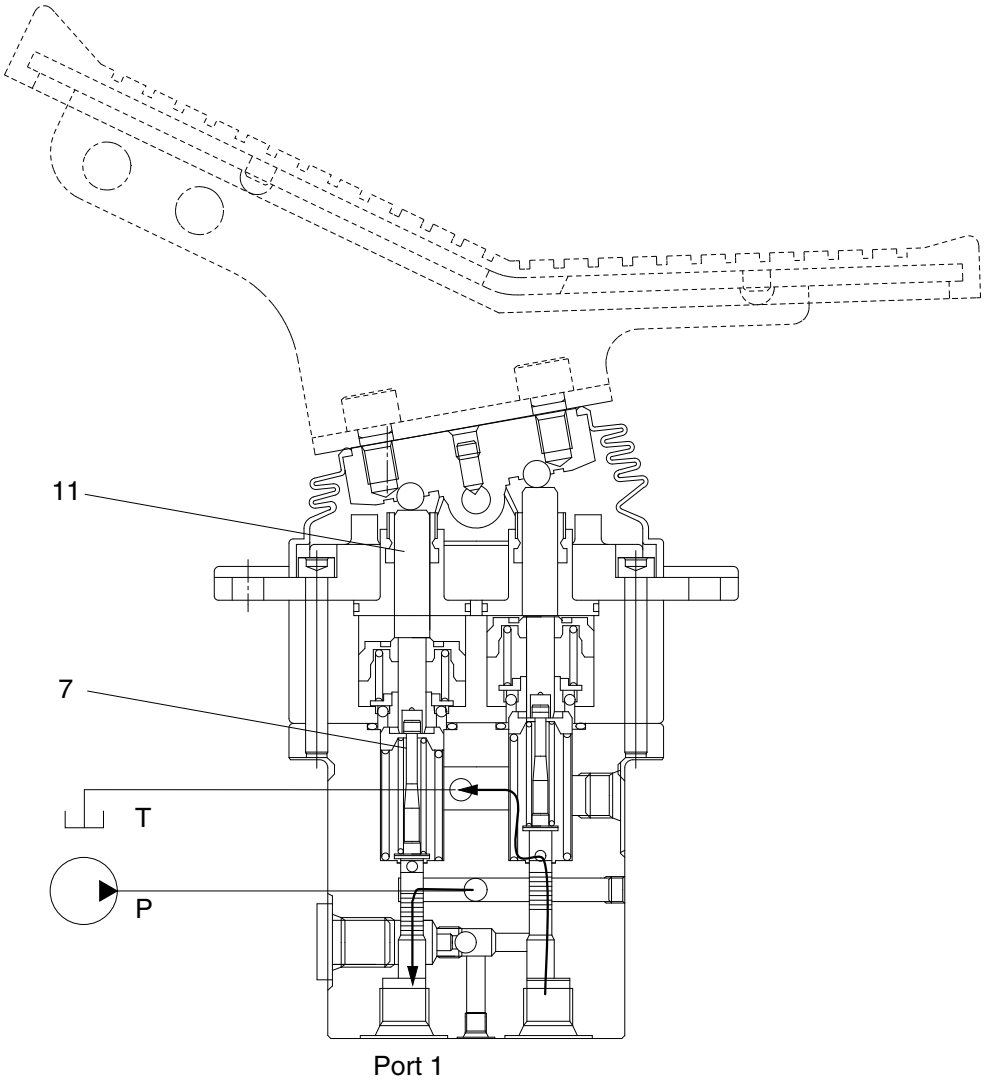
(1) Case where pedal is in neutral position




35AZ2RCP04

The force of the spring (5) that determines the output pressure of the pilot valve is not applied to the spool (7). Therefore, the spool is pushed up by the spring (8) to the position of port 2 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 pedal is tilted



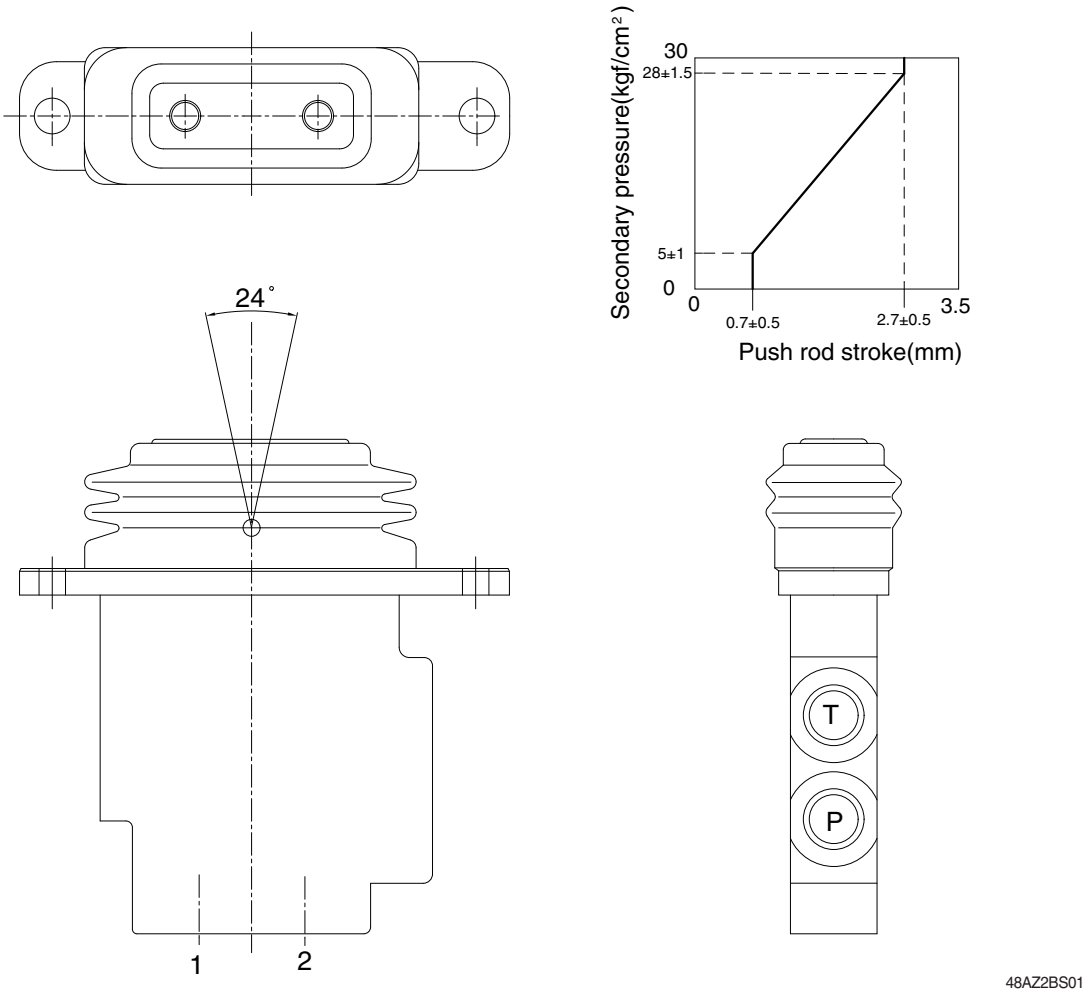

35AZ2RCP05

When the push rod (11) is stroked, the spool (7) 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.

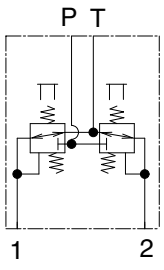
## 3. BOOM SWING PEDAL

### 1) STRUCTURE

The casing has the oil inlet P (primary pressure) and the oil return port (tank).
In addition the secondary pressure is taken out through port 1 and port 2 provided at the housing bottom face.



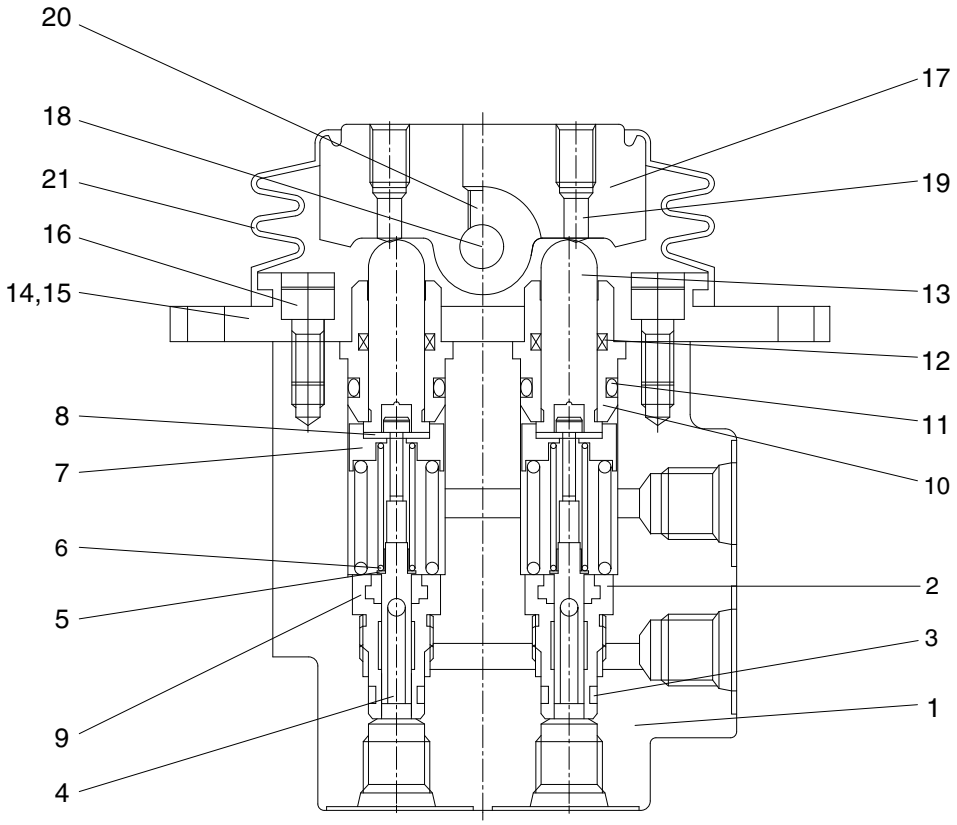

48AZ2BS01




Hydraulic circuit

| Port | Port name | Port size |
|---|---|---|
| P | Pilot oil inlet port | PF 1/4 |
| T | Pilot oil return port | |
| 1 | Boom swing (LH) | |
| 2 | Boom swing (RH) | |

## 2) COMPONENT



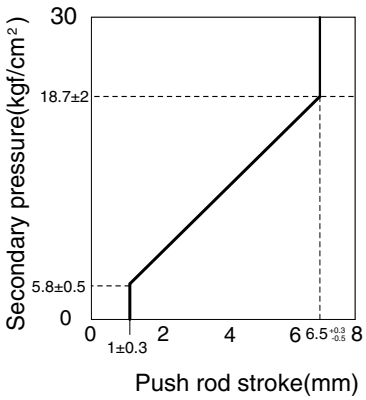

31MT-20050

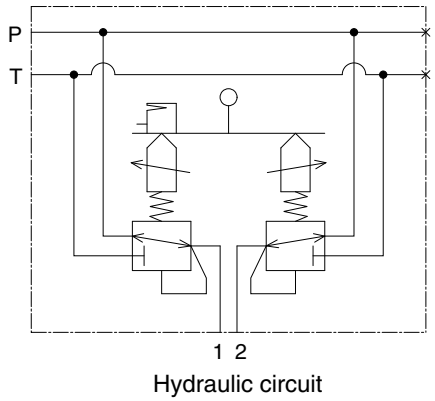
| | | | | | |
|---|---|---|---|---|---|
| 1 | Body | 8 | Stopper | 15 | DU bush |
| 2 | Plug | 9 | Spring | 16 | Wrench bolt |
| 3 | O-ring | 10 | Plug | 17 | Cam |
| 4 | Spool | 11 | O-ring | 18 | Pin |
| 5 | Spring seat | 12 | Rod seal | 19 | Adjust screw |
| 6 | Spring | 13 | Push rod | 20 | Socket bolt |
| 7 | Spring seat | 14 | Cover | 21 | Bellows |

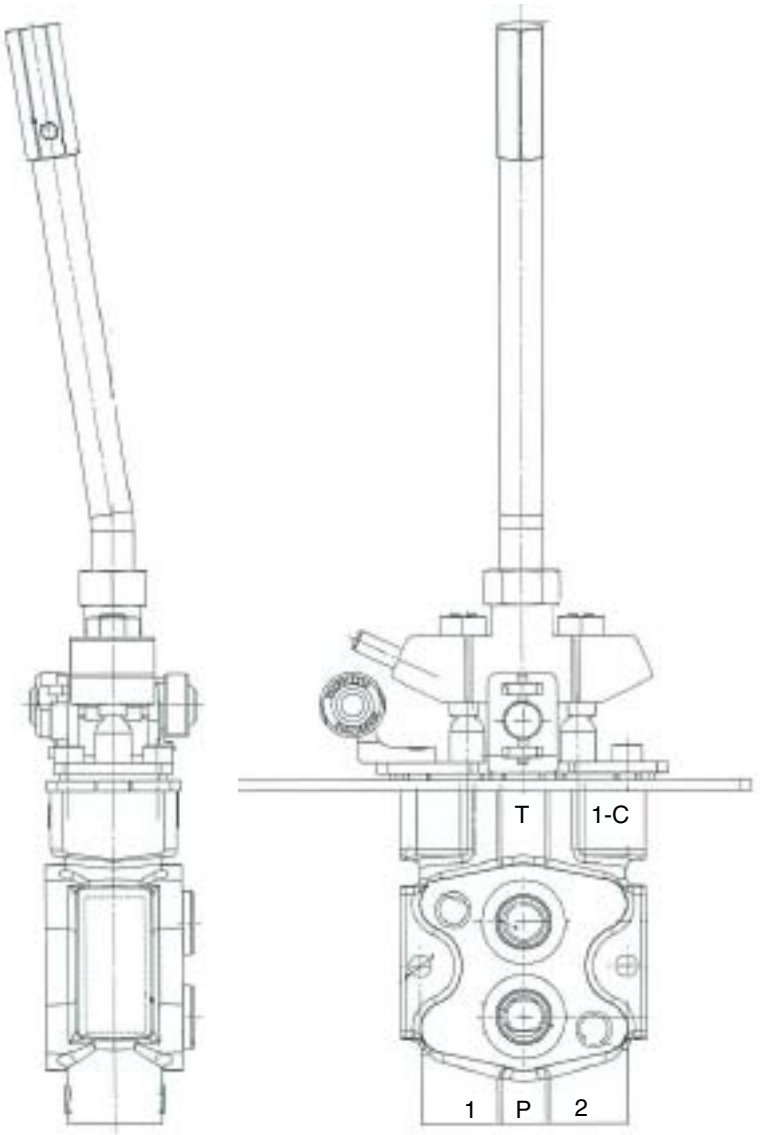
## 4. DOZER LEVER

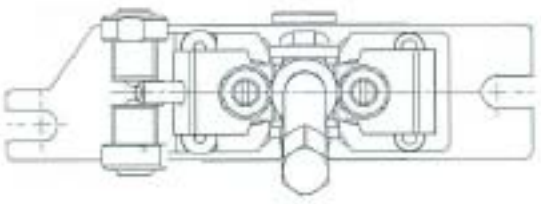
### 1) STRUCTURE

The casing has the oil inlet P (primary pressure) and the oil return port (tank).
In addition the secondary pressure is taken out through port 1 and port 2 provided at the housing bottom face.



| Port | Port | Port size |
|---|---|---|
| P | Pilot oil inlet port | PF 1/4 |
| T | Pilot oil return port | PF 1/4 |
| 1 | Dozer blade up port | PF 1/4 |
| 2 | Dozer blade down port | PF 1/4 |

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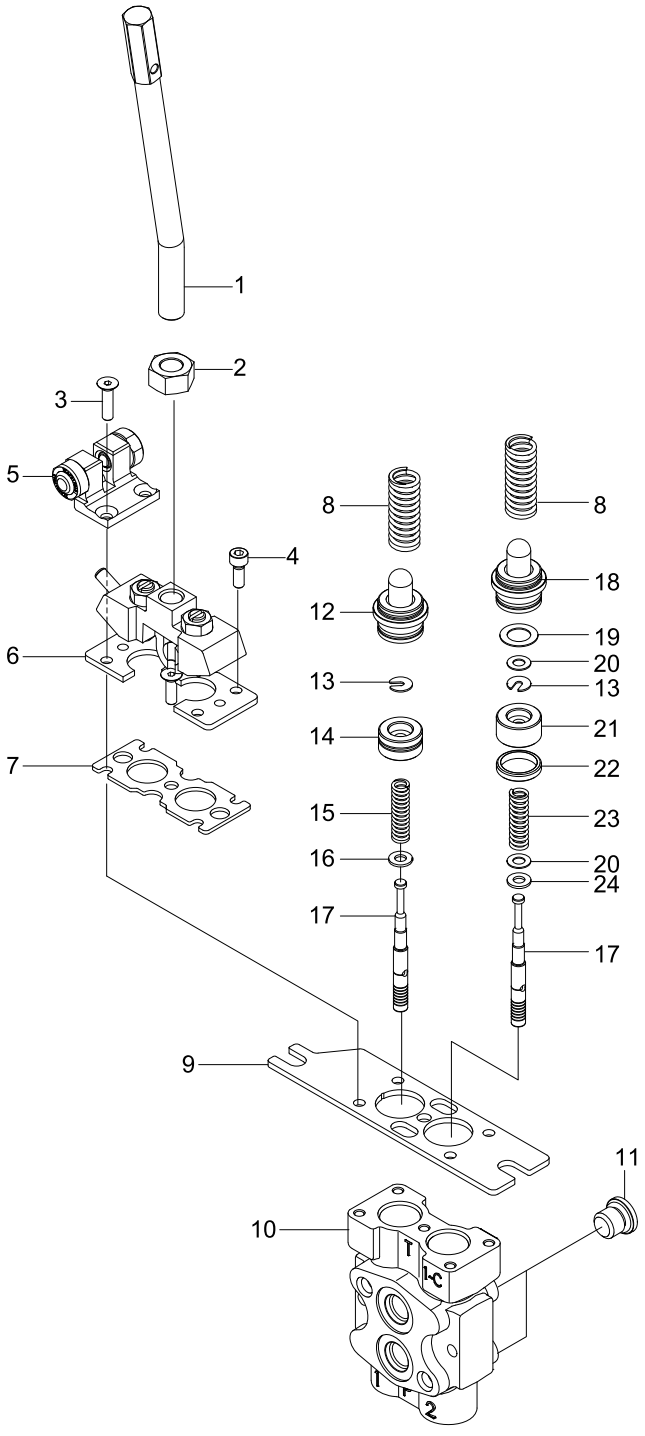
## 2) COMPONENT




35AZ2DL02

| | | | | | |
|---|---|---|---|---|---|
| 1 | RCV lever | 9 | Lower plate | 17 | Rod |
| 2 | Lever nut | 10 | Lower body | 18 | Plunger |
| 3 | Screw | 11 | Plug | 19 | Spacer |
| 4 | Screw | 12 | Plunger | 20 | Spacer |
| 5 | Bracket | 13 | Retainer | 21 | Bushing |
| 6 | Upper body | 14 | Bushing | 22 | Spacer |
| 7 | Upper plate | 15 | Spring | 23 | Spring |
| 8 | Spring | 16 | Seal washer | 24 | Gasket |