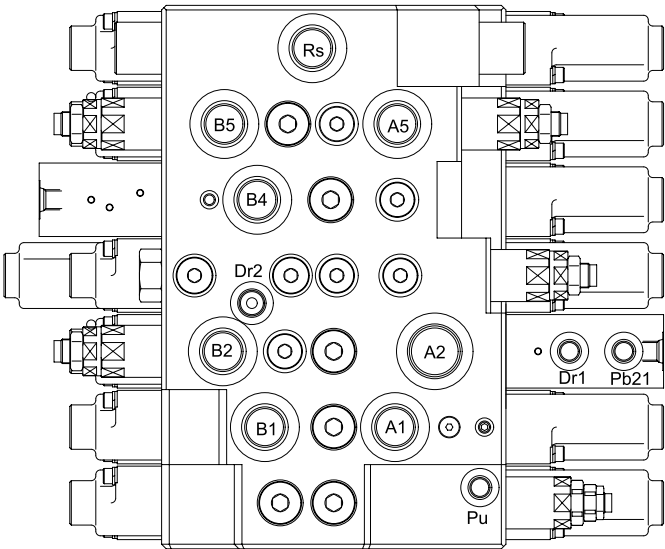
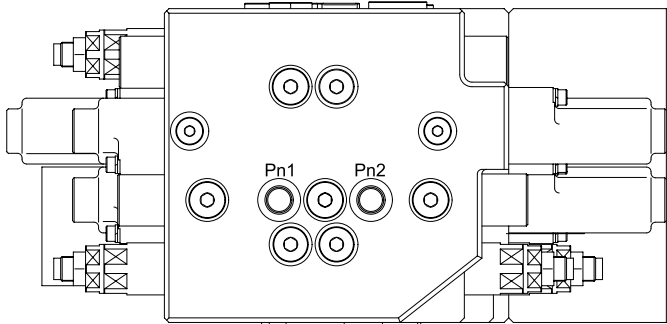
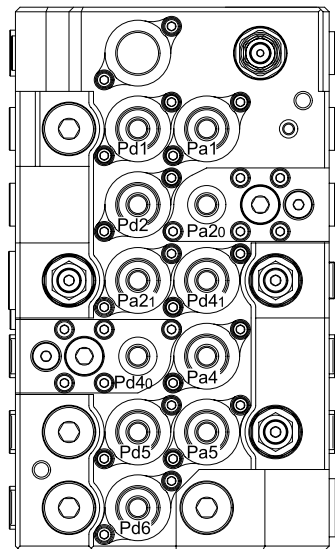
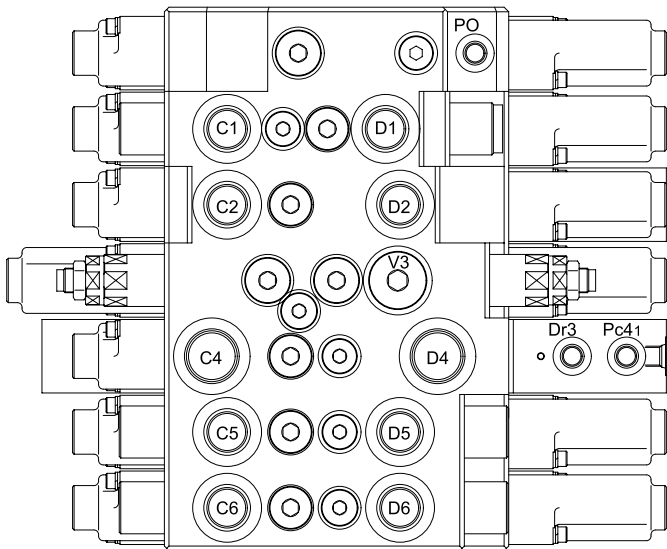
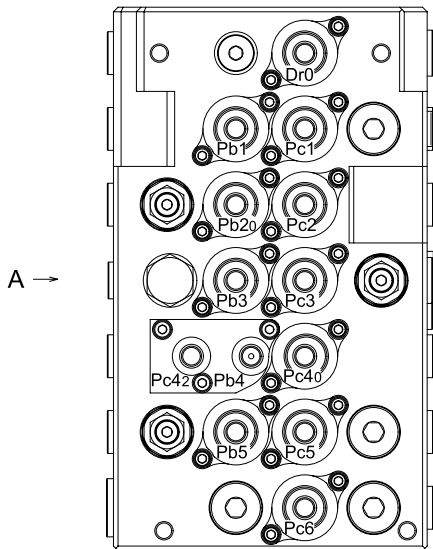
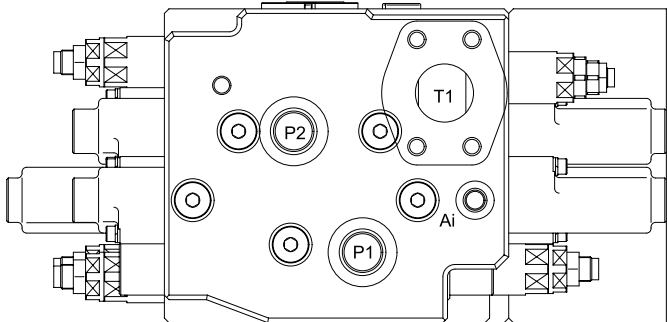


# GROUP 2 MAIN CONTROL VALVE

## 1. STRUCTURE

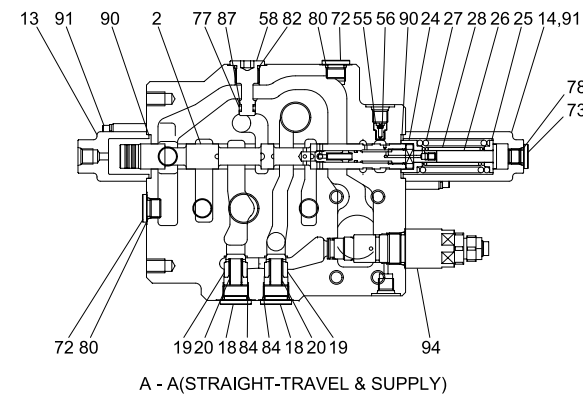
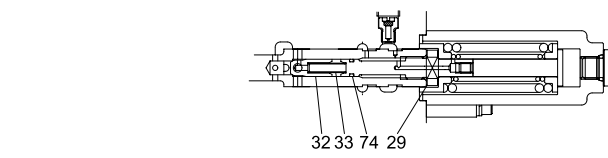


VIEW A

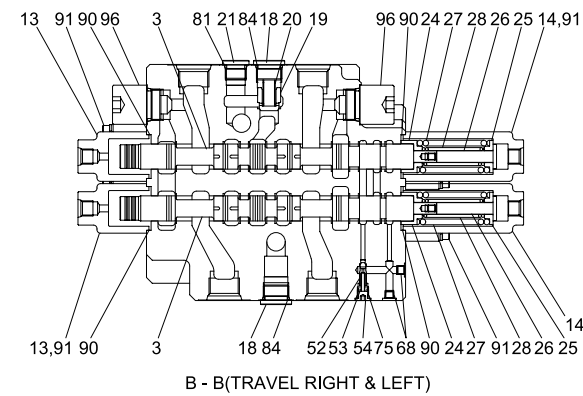


| Mark | Port name                                  | Port size               | Tightening torque                      |
|------|--------------------------------------------|-------------------------|----------------------------------------|
| Rs   | Make up for swing motor                    | G1/4                    | 3.5~3.9kgf · m<br>(25.3~28.2lbf · ft)  |
| Pa1  | Travel left pilot port(FW)                 |                         |                                        |
| Pb1  | Travel left pilot port(BW)                 |                         |                                        |
| Pc1  | Travel right pilot port(BW)                |                         |                                        |
| Pd1  | Travel right pilot port(FW)                |                         |                                        |
| Pa20 | Boom up pilot port                         |                         |                                        |
| Pa21 | Boom up confluence pilot port              |                         |                                        |
| Pb20 | Boom down pilot port                       |                         |                                        |
| Pb21 | Lock valve pilot port(Boom)                |                         |                                        |
| Pc2  | Swing pilot port(RH)                       |                         |                                        |
| Pd2  | Swing pilot port(LH)                       |                         |                                        |
| Pb3  | Arm in confluence pilot port               |                         |                                        |
| Pc3  | Swing priority pilot port                  |                         |                                        |
| Pa4  | Option A pilot port(Breaker)               |                         |                                        |
| Pb4  | Arm in regeneration cut port               |                         |                                        |
| Pc40 | Arm in pilot port                          |                         |                                        |
| Pc41 | Lock valve pilot port(Arm)                 |                         |                                        |
| Pc42 | Arm in regen-cut signal selector port      |                         |                                        |
| Pd40 | Arm out pilot port                         |                         |                                        |
| Pd41 | Arm out confluence pilot port              |                         |                                        |
| Pa5  | Bucket in pilot port                       |                         |                                        |
| Pb5  | Bucket out pilot port                      |                         |                                        |
| Pc5  | Option B pilot port                        |                         |                                        |
| Pd5  | Option B pilot port                        |                         |                                        |
| Pc6  | Option C pilot port                        |                         |                                        |
| Pd6  | Option C pilot port                        |                         |                                        |
| PO   | Pilot pressure port                        |                         |                                        |
| Pu   | Main relief pressure up                    |                         |                                        |
| Ai   | Auto idle signal port                      |                         |                                        |
| Dr0  | Drain port(Travel straight)                | G3/4                    | 15~18kgf · m<br>(109~130lbf · ft)      |
| Dr1  | Drain port(Boom holding valve)             |                         |                                        |
| Dr2  | Drain port(Boom2 & swing priority)         |                         |                                        |
| Dr3  | Drain port(Arm holding valve)              |                         |                                        |
| Pn1  | Negative control signal port(P1 port side) |                         |                                        |
| Pn2  | Negative control signal port(P2 port side) |                         |                                        |
| A1   | Travel motor left side port(FW)            |                         |                                        |
| B1   | Travel motor left side port(BW)            |                         |                                        |
| C1   | Travel motor right side port(BW)           |                         |                                        |
| D1   | Travel motor right side port(FW)           |                         |                                        |
| B2   | Boom rod side port                         |                         |                                        |
| C2   | Swing motor port(LH)                       |                         |                                        |
| D2   | Swing motor port(RH)                       |                         |                                        |
| B4   | Option A port(Breaker)                     | G1                      | 20~25kgf · m<br>(115~180lbf · ft)      |
| A5   | Bucket head side port                      |                         |                                        |
| B5   | Bucket rod side port                       |                         |                                        |
| C5   | Option B port                              |                         |                                        |
| D5   | Option B port                              | SAE3000, 1 1/2<br>(M12) | 8.5~11.5kgf · m<br>(61.5~83.1lbf · ft) |
| C6   | Option C port                              |                         |                                        |
| D6   | Option C port                              |                         |                                        |
| P1   | Pump port(P1 side)                         |                         |                                        |
| P2   | Pump port(P2 side)                         | SAE3000, 1 1/2<br>(M12) | 8.5~11.5kgf · m<br>(61.5~83.1lbf · ft) |
| A2   | Boom head side port                        |                         |                                        |
| C4   | Arm head side port                         |                         |                                        |
| D4   | Arm rod side port                          |                         |                                        |
| T1   | Return port                                | SAE3000, 1 1/2<br>(M12) | 8.5~11.5kgf · m<br>(61.5~83.1lbf · ft) |

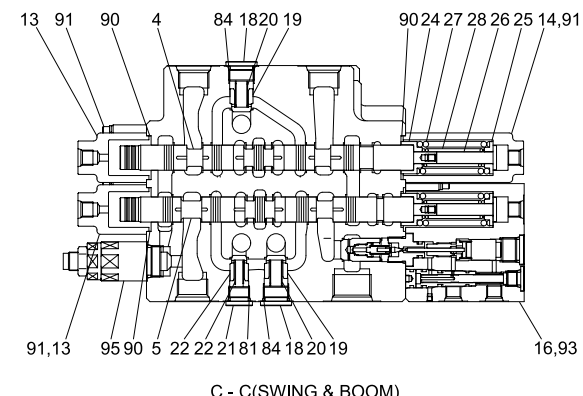
14072SF10



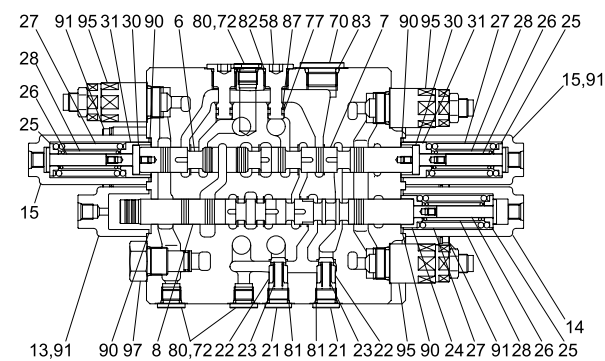
A - A(STRAIGHT-TRAVEL & SUPPLY)



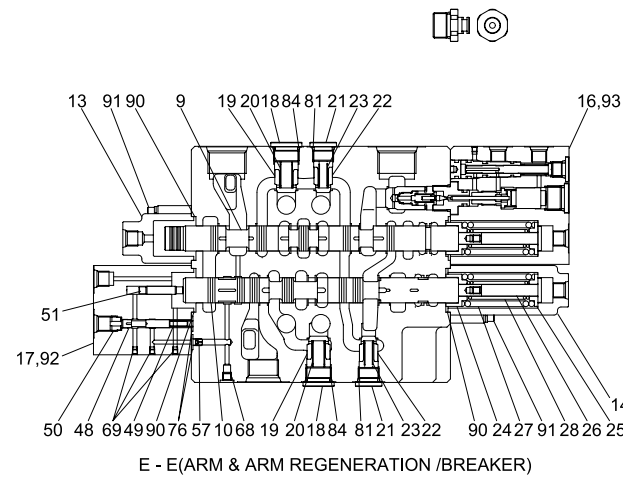
B - B(TRAVEL RIGHT & LEFT)



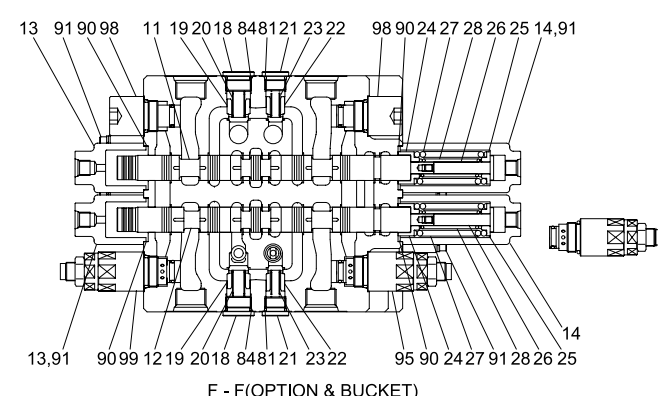
C - C(SWING & BOOM)



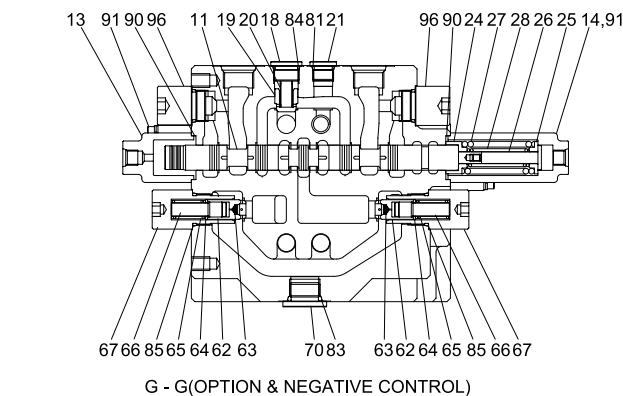
D - D(SWING PRIORITY & BOOM2 & ARM)



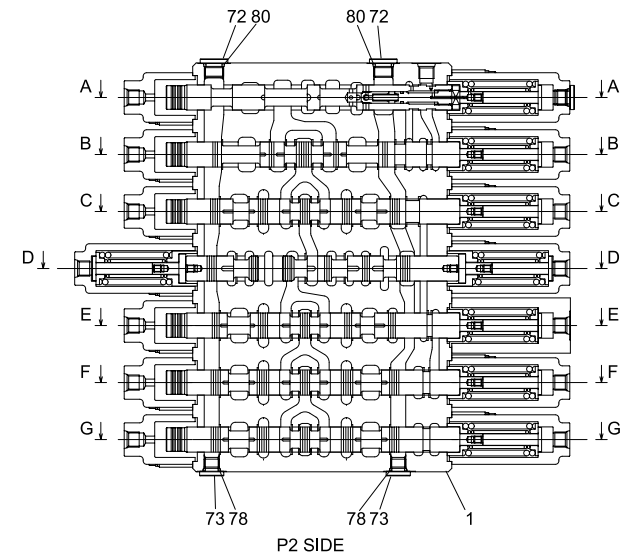
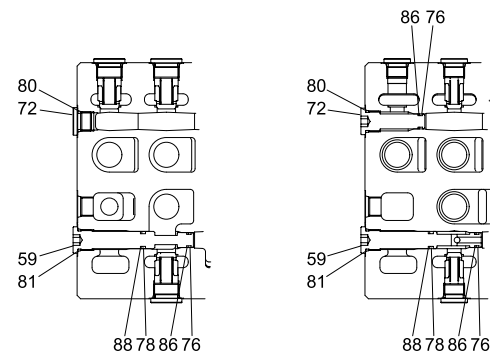
E - E(ARM & ARM REGENERATION /BREAKER)



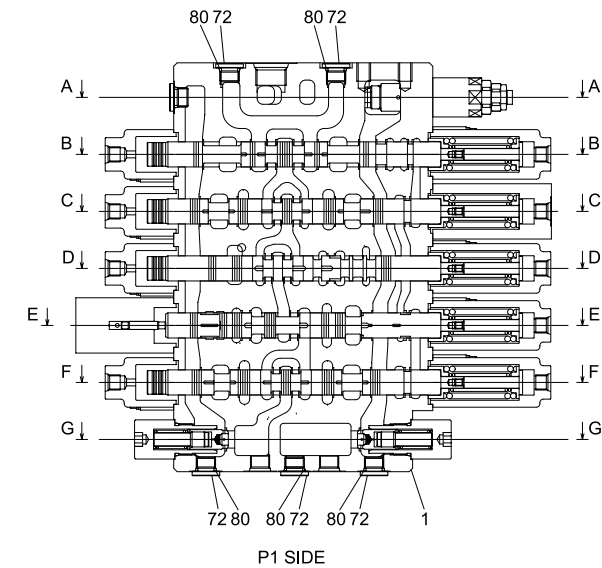
F - F(OPTION & BUCKET)



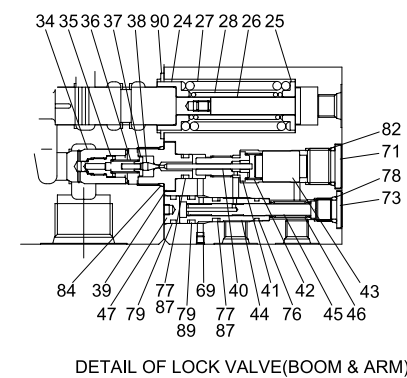
G - G(OPTION & NEGATIVE CONTROL)



P2 SIDE



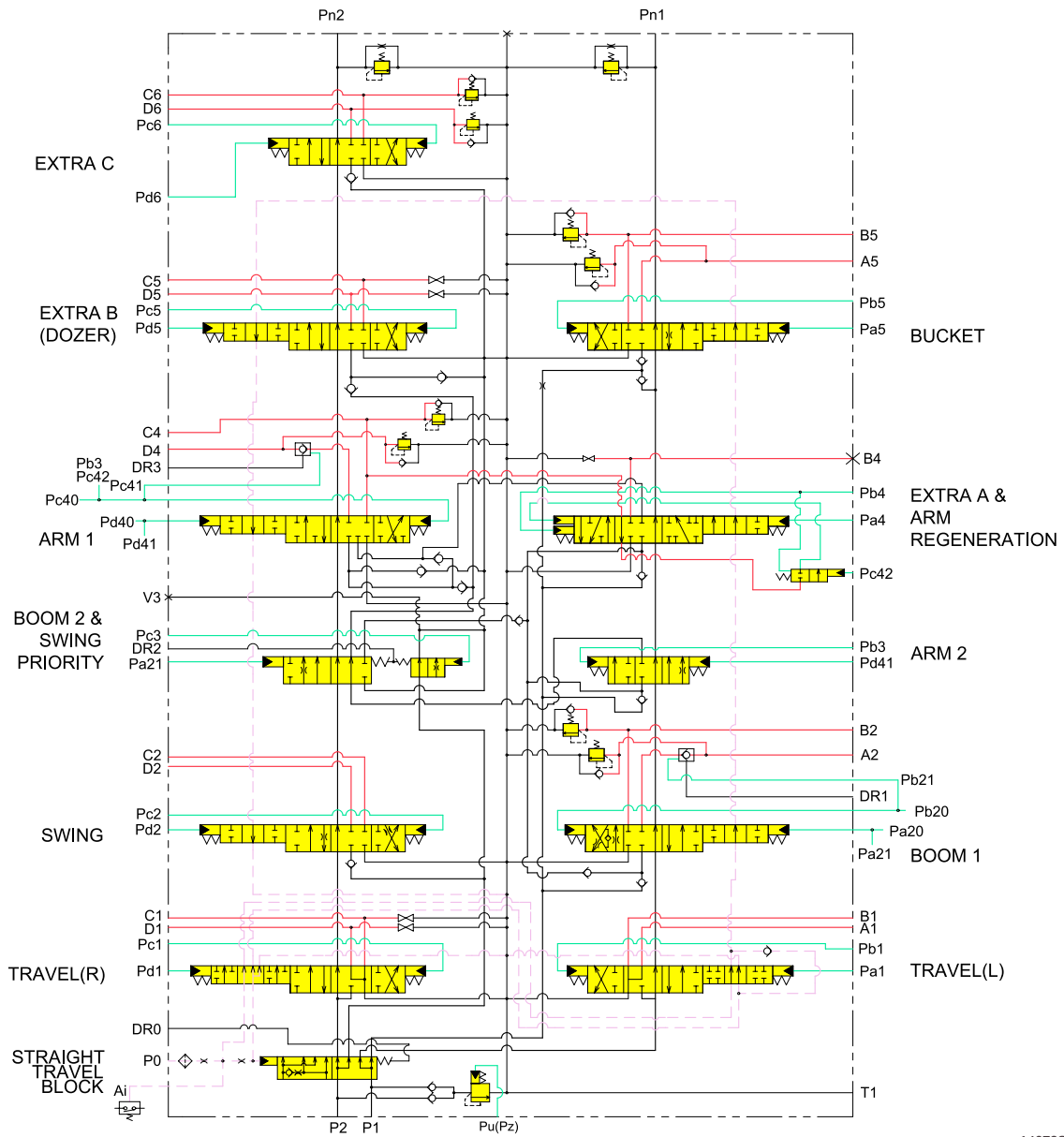
P1 SIDE



DETAIL OF LOCK VALVE(BOOM & ARM)

- |                                     |                            |
|-------------------------------------|----------------------------|
| 1 Body                              | 50 Stopper-regeneration    |
| 2 Spool-straight travel             | 51 Piston-cut off          |
| 3 Spool-travel                      | 52 Poppet-signal           |
| 4 Spool-swing                       | 53 Spring-signal           |
| 5 Spool-boom                        | 54 Plug                    |
| 6 Spool-swing priority              | 55 Orifice-signal          |
| 7 Spool-boom2                       | 56 Coin type filter        |
| 8 Spool-arm2                        | 57 Orifice-plug            |
| 9 Spool-arm                         | 58 Plug                    |
| 10 Spool-arm regeneration & breaker | 59 Plug                    |
| 11 Spool-option                     | 60 Plug                    |
| 12 Spool-bucket                     | 61 Plug-orifice            |
| 13 Cover-pilot A                    | 62 Poppet-negative control |
| 14 Cover-pilot B1                   | 63 Coin type filter        |
| 15 Cover-Pilot B2                   | 64 Spring seat             |
| 16 Block-holding                    | 65 Spring-negative control |
| 17 Block-regeneration               | 66 Piston-negative control |
| 18 Plug                             | 67 Socket-negative control |
| 19 Poppet1-check valve              | 68 Plug                    |
| 20 Spring-check valve               | 69 Plug                    |
| 21 Plug                             | 70 Plug                    |
| 22 Poppet2-check valve              | 71 Plug                    |
| 23 Spring-check valve               | 72 Plug                    |
| 24 Spring seat1                     | 73 Plug                    |
| 25 Spring seat3                     | 74 O-ring                  |
| 26 Spacer bolt                      | 75 O-ring                  |
| 27 Spring-return(L)                 | 76 O-ring                  |
| 28 Spring-return(S)                 | 77 O-ring                  |
| 29 Stopper1-TS                      | 78 O-ring                  |
| 30 Stopper2-priority                | 79 O-ring                  |
| 31 Spring seat2                     | 80 O-ring                  |
| 32 Poppet-TS check valve            | 81 O-ring                  |
| 33 Spring-TS check valve            | 82 O-ring                  |
| 34 Poppet-lock valve                | 83 O-ring                  |
| 35 Restrictor-lock valve            | 84 O-ring                  |
| 36 Spring-lock valve pilot          | 85 O-ring                  |
| 37 Guide poppet                     | 86 Back-up ring            |
| 38 Poppet-pilot                     | 87 Back-up ring            |
| 39 Seat-poppet                      | 88 Back-up ring            |
| 40 Piston1                          | 89 Back-up ring            |
| 41 Guide-piston                     | 90 O-ring                  |
| 42 Spring1-lock valve               | 91 Bolt with washer        |
| 43 Piston2                          | 92 Socket head bolt        |
| 44 Socket-lock valve                | 93 Socket head bolt        |
| 45 Spool-lock valve                 | 94 Main relief valve       |
| 46 Spring2-lock valve               | 95 Over load relief valve  |
| 47 Stopper-lock valve               | 96 Plug-relief valve       |
| 48 Spool-regen selector             | 97 Plug-relief valve       |
| 49 Spring-regeneration              | 98 Plug-relief valve       |
|                                     | 99 Over load relief valve  |

## 2. HYDRAULIC CIRCUIT

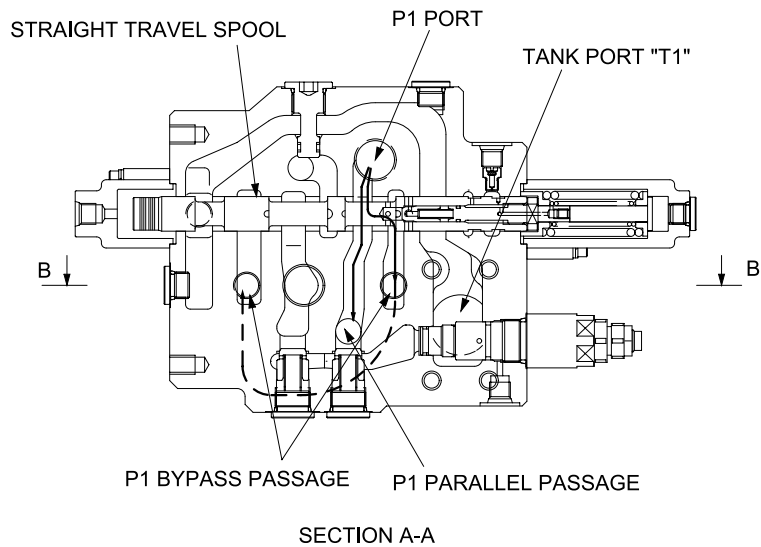


14072SF05

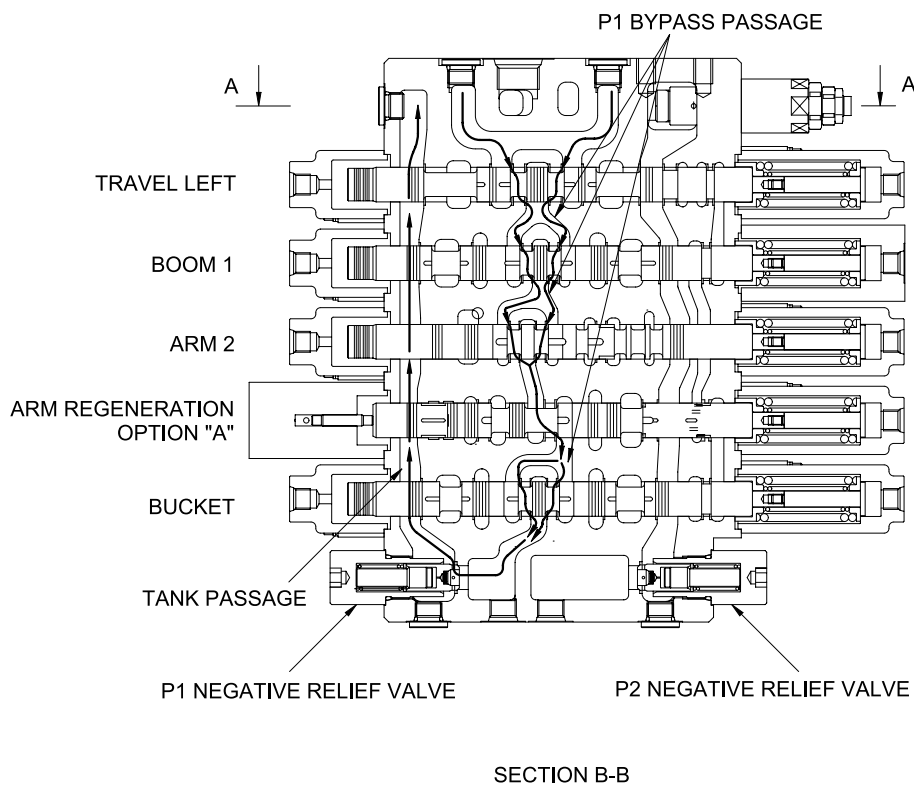
### 3. FUNCTION

#### 1) CONTROL IN NEUTRAL FUNCTION

##### (1) P1 SIDE



14072SF13

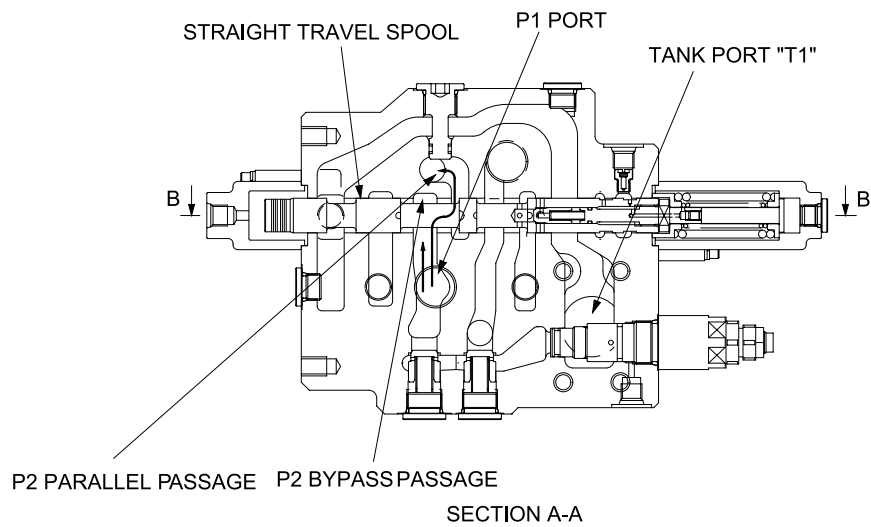


14072SF15

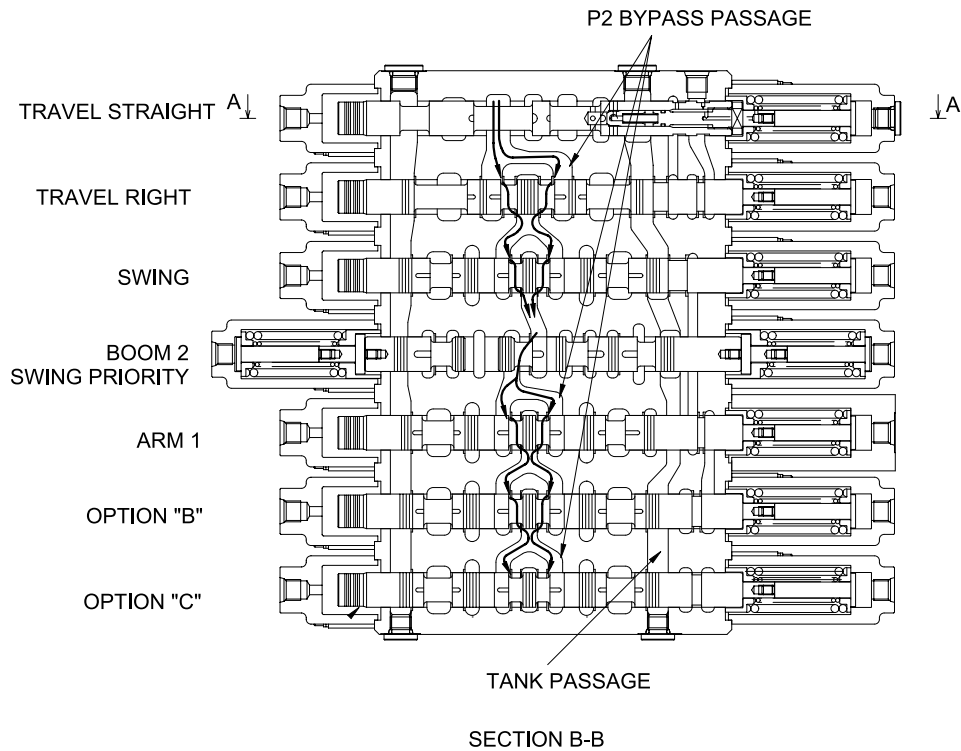
The hydraulic fluid from pump P1 flows into the main control valve through the inlet port "P1", pass the travel straight spool, into the P1 bypass passage and P1parallel passage.

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



14072SF14



14072SF16

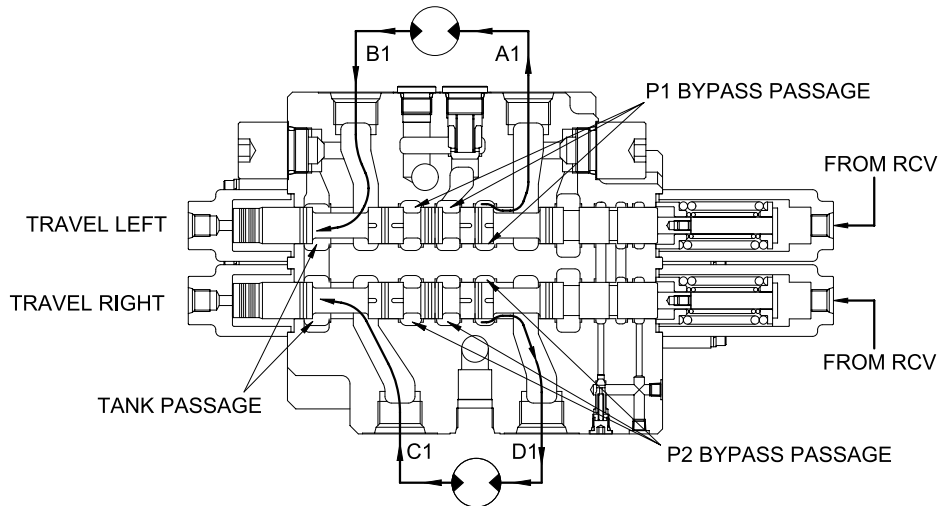
The hydraulic fluid from pump P2 flows into the main control valve through the inlet port "P2", pass the straight travel spool, into the P2 bypass passage and P2 parallel passage.

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

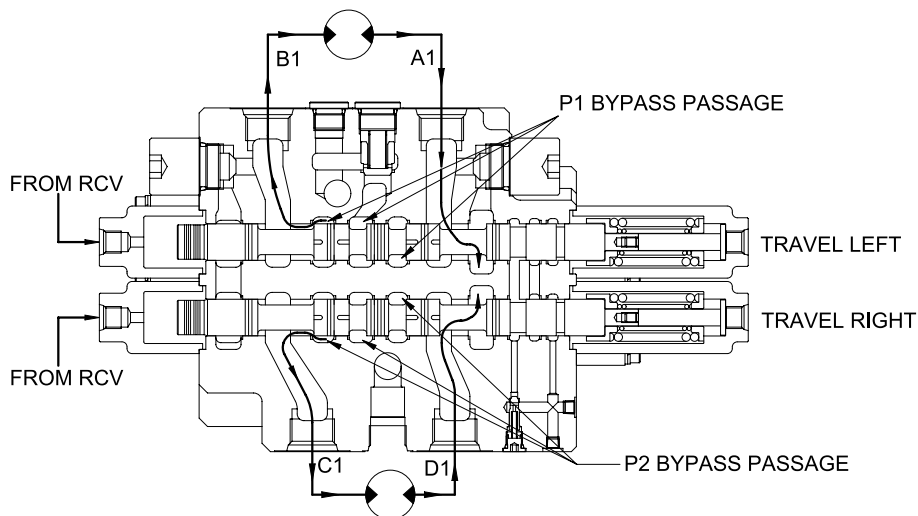
### (1) TRAVEL OPERATION

#### ① Travel forward operation



14072SF17

#### ② Travel backward operation



14072SF18

During the travel operation, the hydraulic fluid of the pump P1 is supplied to the travel motor and the hydraulic fluid of the pump P2 is supplied to the other travel motor.

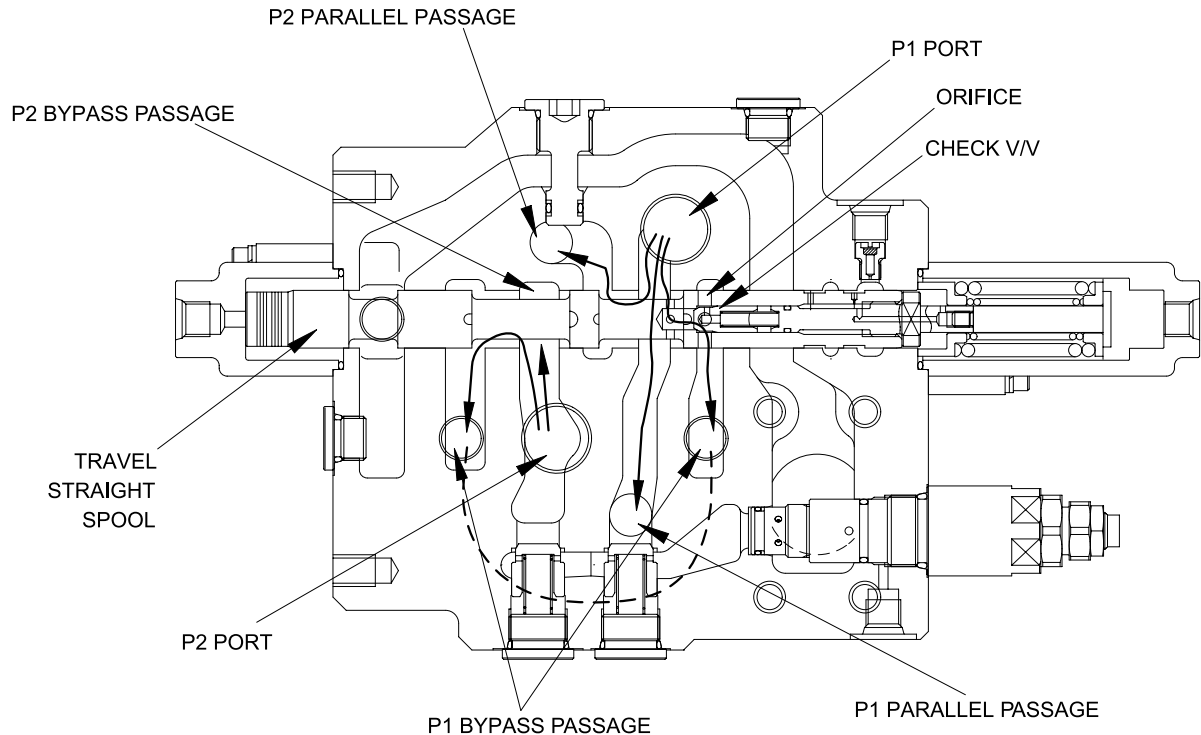
The pilot pressure from the pilot control valve is supplied to the spring side of pilot port (pa1, pd1).

And it shifts travel right and left spools in the left direction against springs. Hydraulic fluid from the pump P1 flow into the travel left spool through the bypass passage and hydraulic fluid from the pump P2 flow into the travel right spool through the bypass passage.

Then they are directed to the each travel motor through port A1 and D1. As a result, the travel motors turn and hydraulic fluid returns to the tank passage through the travel spools.

In case of the opposite operation, the operation is similar.

## (2) TRAVEL STRAIGHT FUNCTION



14072SF19

This function keeps straight travel in case of simultaneous operation of other actuators(boom, arm, bucket, swing) during a straight travel.

### ① During travel only :

The hydraulic fluid of the pump P1 is supplied to the travel motor and the pump P2 is supplied to the other motor.

Thus, the machine keep travel straight.

### ② The other actuator operation during straight travel operation :

When the other actuator spool(s) is selected under straight travel operation, the straight travel spool is moved.

The hydraulic fluid from pump P1 is supplied actuator through P1 and P2 parallel pass and travel motors through orifice at side of straight travel spool.

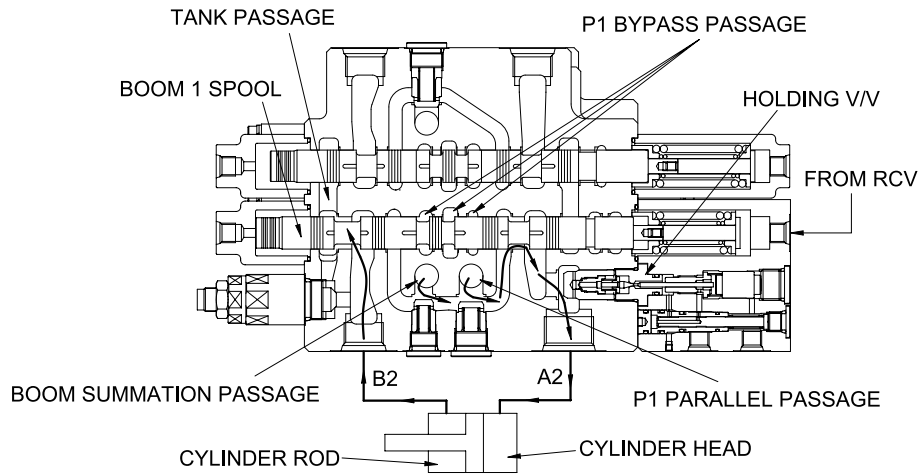
The hydraulic oil fluid from pump P2 is supplied to travel motors(left/right).

Therefore, the other actuator operation with straight travel operation, hydraulic oil fluid from pump P1 is mainly supplied to actuator, and the hydraulic oil fluid form pump P2 is mainly supplied to travel motors(left/right).

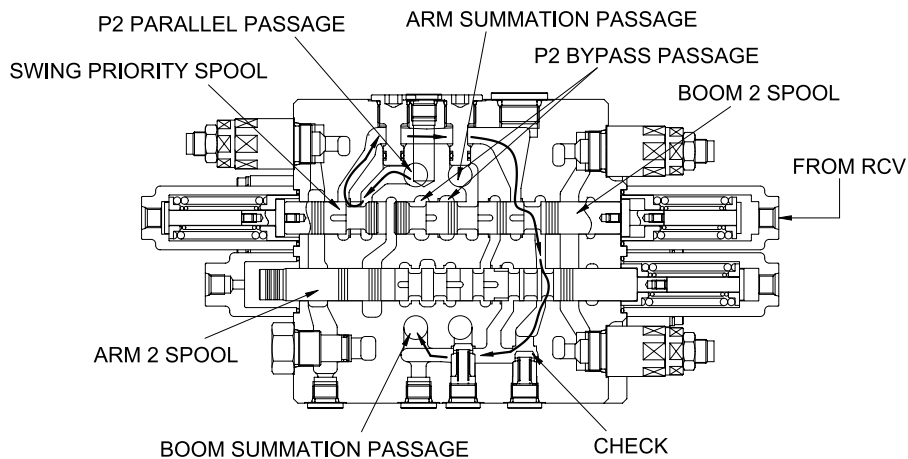
Then the machine keeps straight travel.

### (3) BOOM OPERATION

#### ① 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.

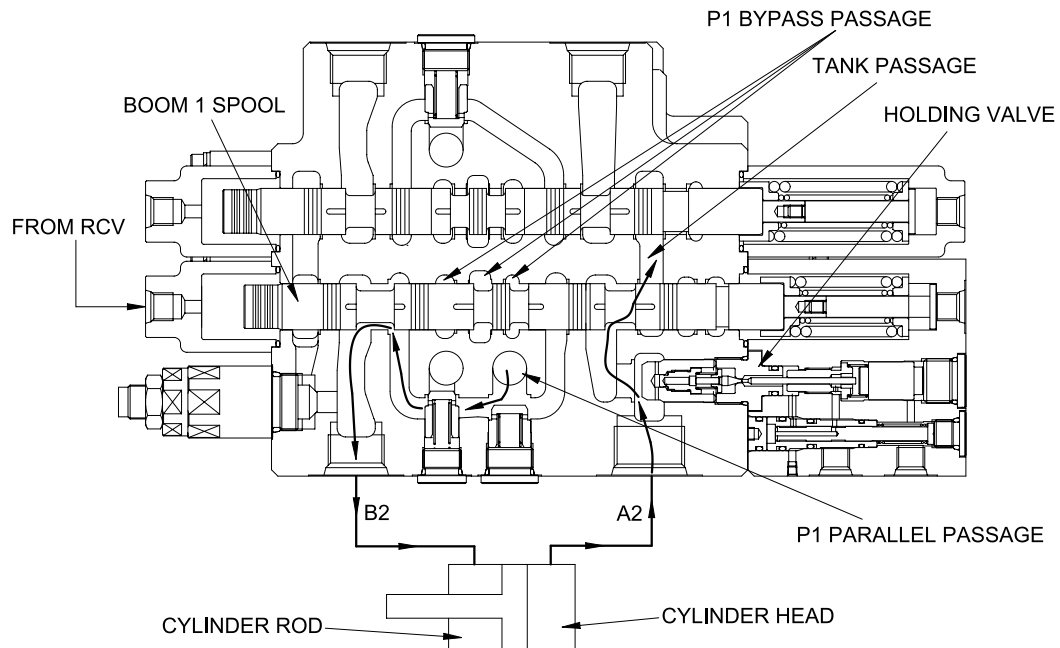
(In this case, the boom holding valve is free flow condition)

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.



## ② 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.

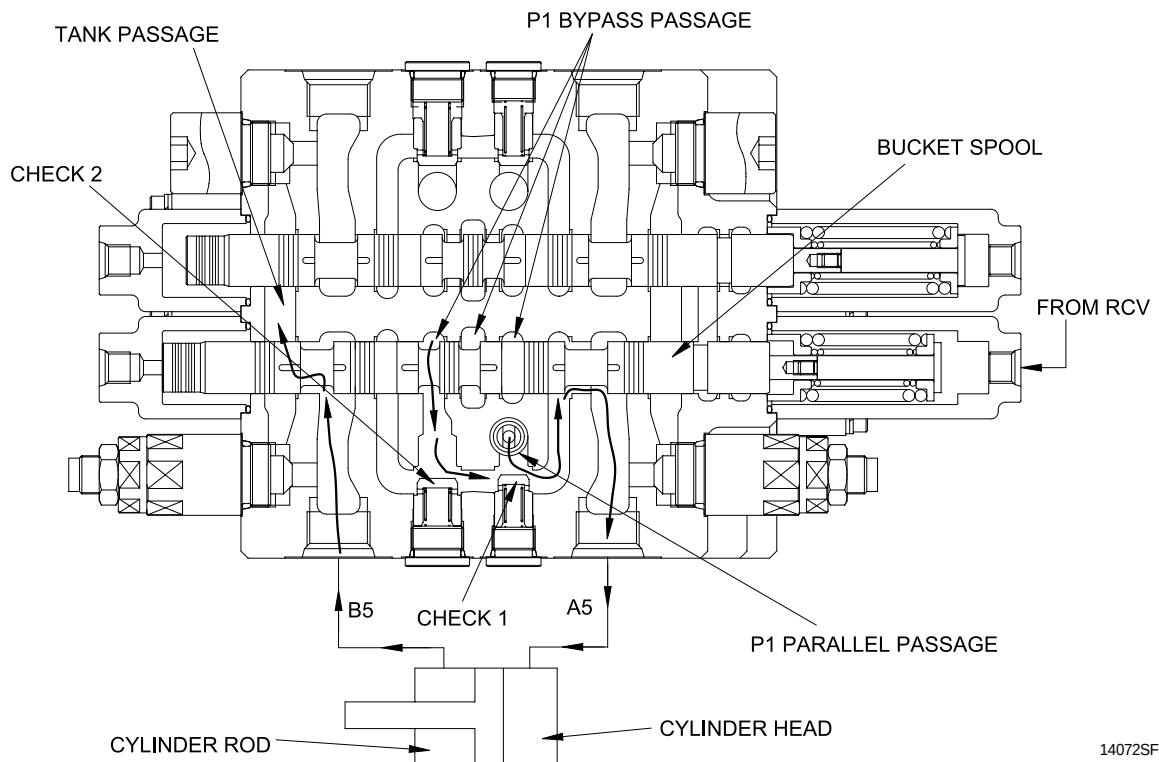
The hydraulic fluid from the pump P1 enters the parallel passage and is directed to the port B2 through the load check valve. Following this, it flows into the rod side of the boom cylinder.

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.

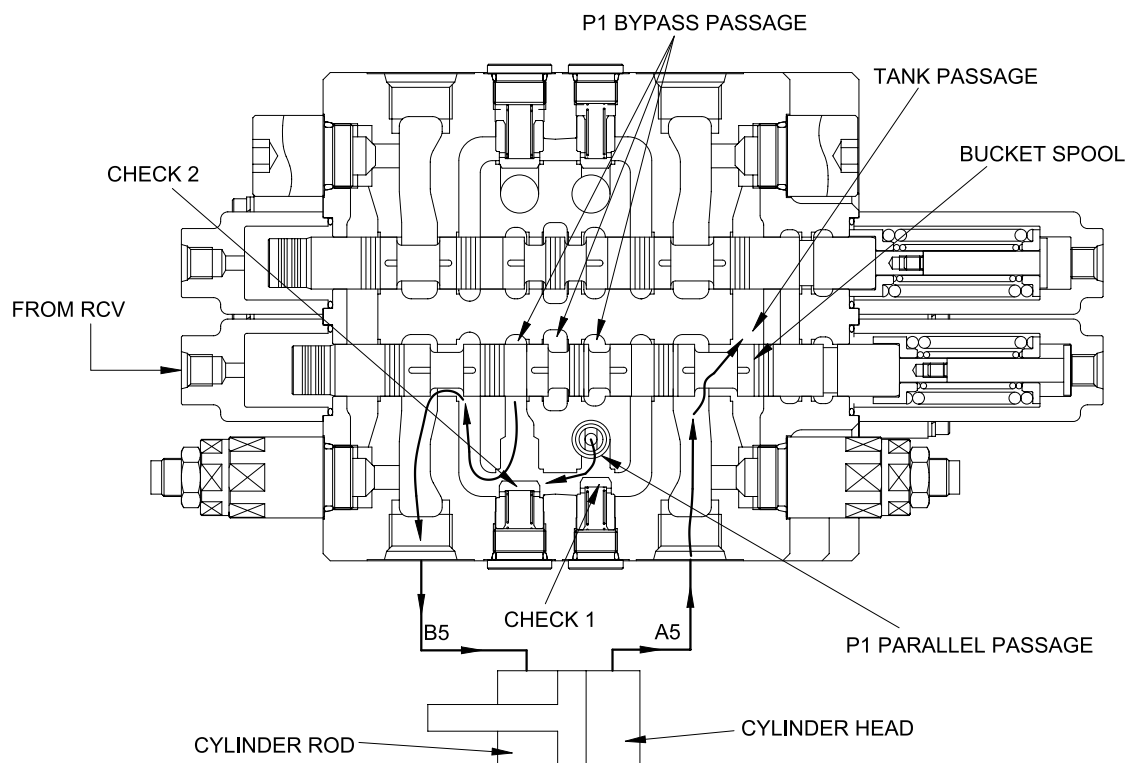
For details of the boom holding valve, see page 2-36.

#### (4) BUCKET OPERATION

##### ① Bucket roll in operation



##### ② Bucket roll out operation



**① 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.

**② Bucket roll out operation**

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

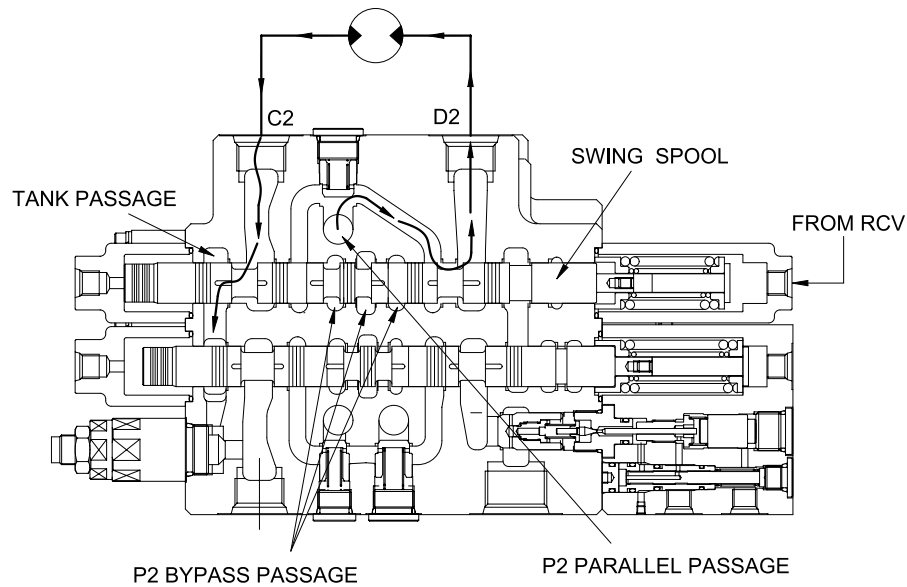
**③ Bucket operation with arm or boom operation**

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.

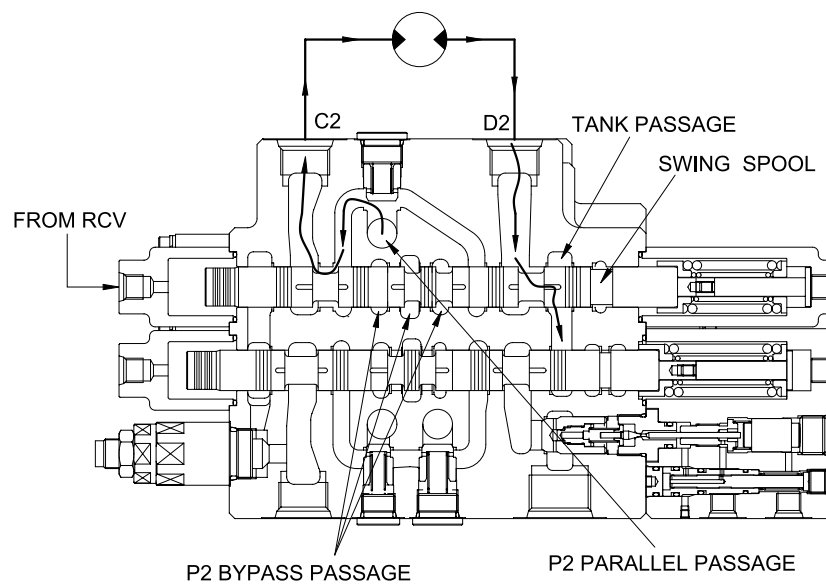
## (5) SWING OPERATION

### ① Swing left operation



14072SF32

### ② Swing right operation

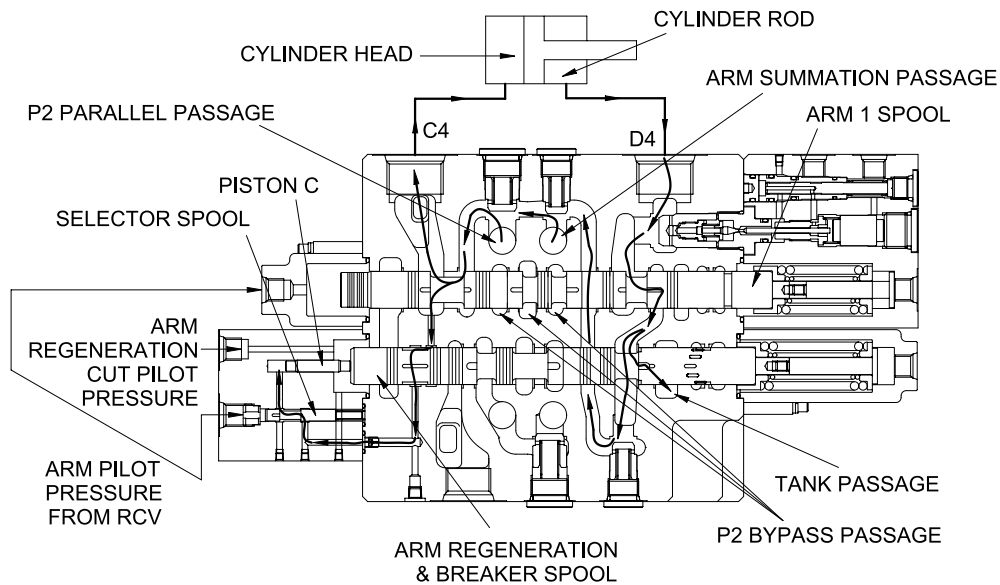


14072SF33

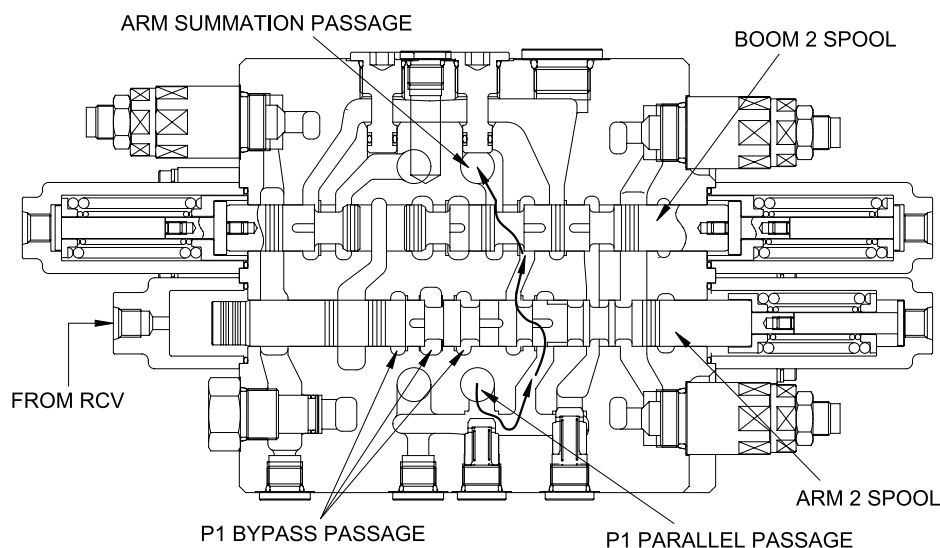
The pilot pressure from the RCV is supplied to the Pd2 and shift the swing spool in left direction. The hydraulic fluid from pump P2 flows into swing spool through the parallel passage. Then it is directed to swing motor through the port D2. As the result, swing motor turns and flow from the swing motor 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

### ① 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.

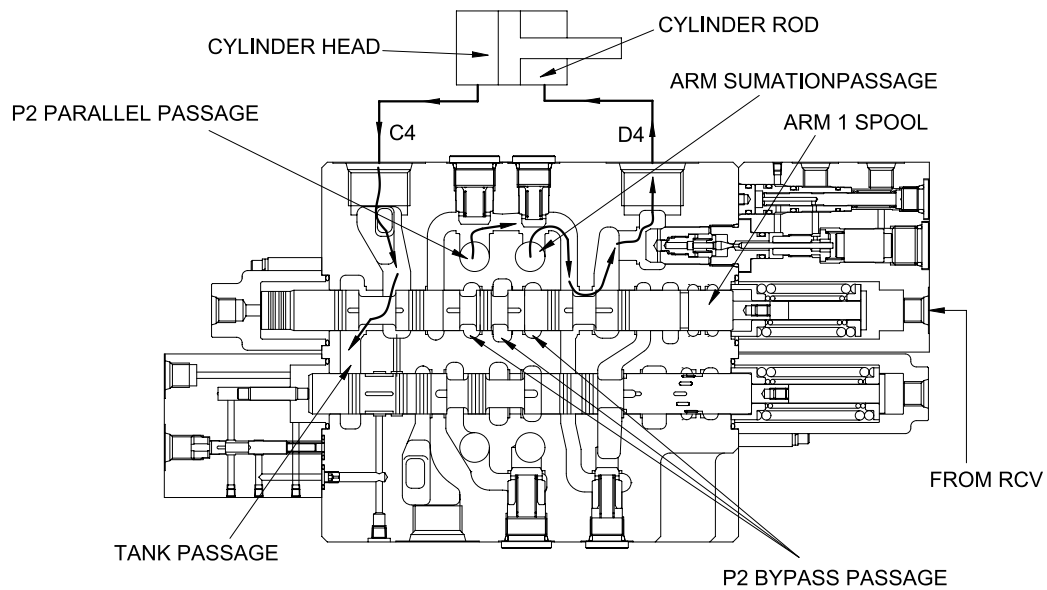
The amount of regeneration fluid are changed by movement of the arm regeneration & breaker spool.

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.

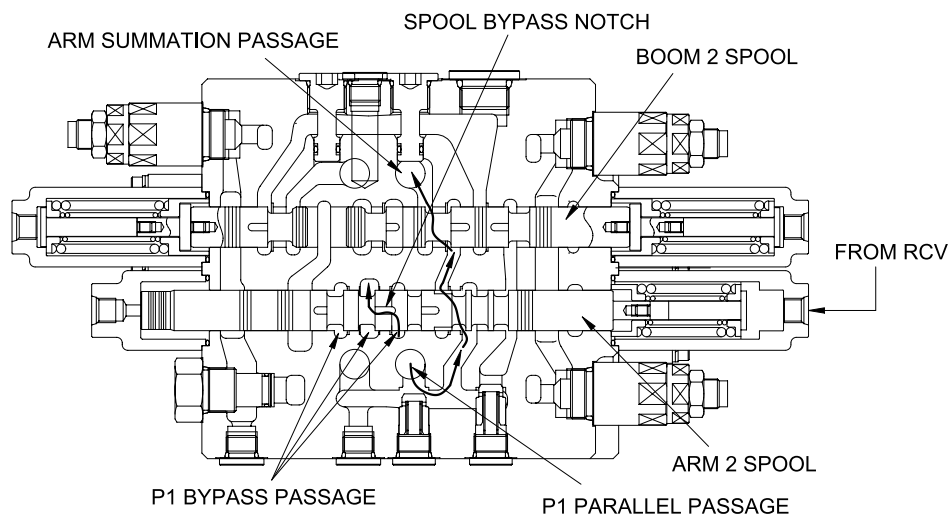
Then, the arm regeneration spool shift to right side and flow to tank pass increases and regeneration flow decreases. Therefore, pressure of arm cylinder head increases, then, arm regeneration flow decreases.

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.

## ② 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.

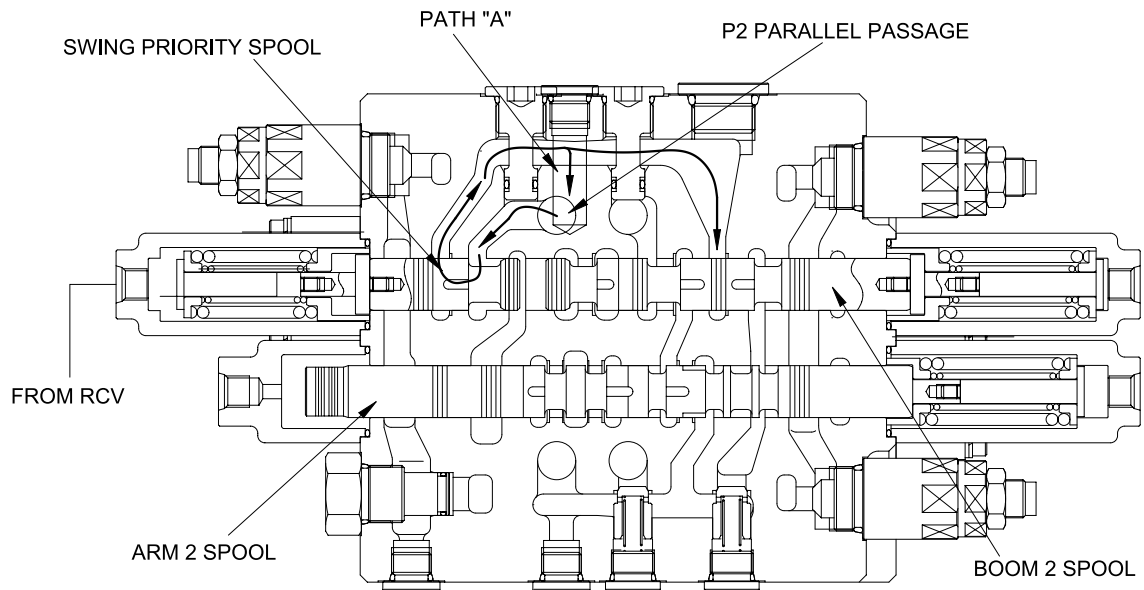
Some of the hydraulic fluid from pump P2 bypassed through bypass notch.

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) SWING PRIORITY FUNCTION



14072SF27

During swing priority operation, the pilot pressure is supplied to the port Pc3 and shift swing priority spool in the right direction.

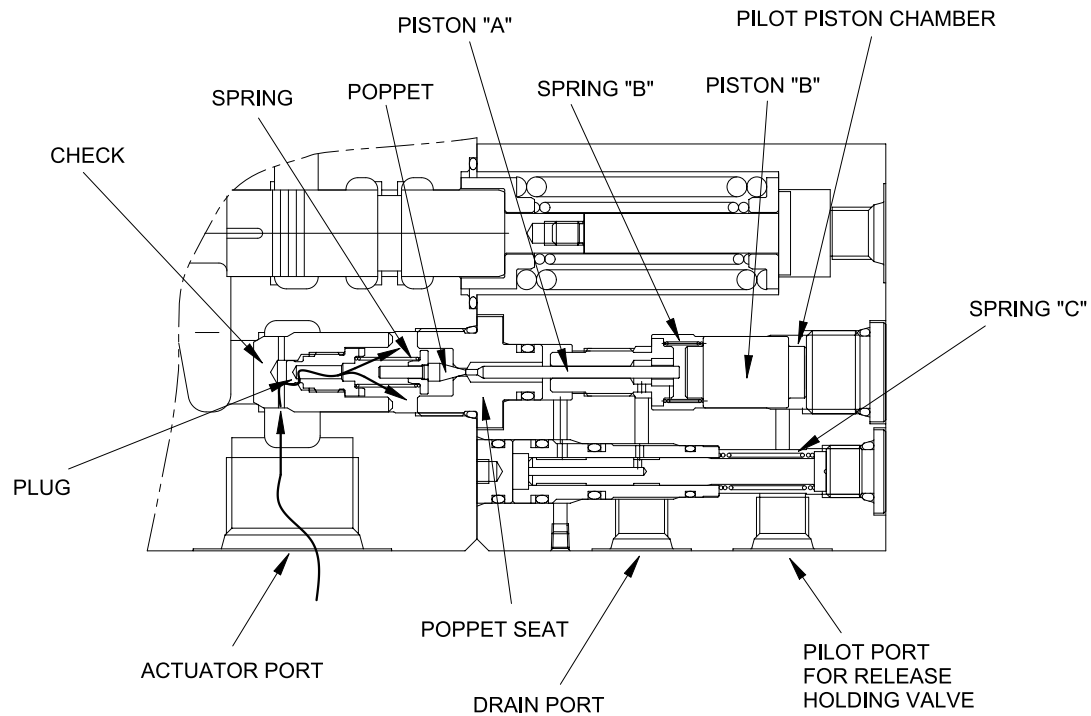
The hydraulic fluid from P2 parallel passage flows into the parallel passage of arm1 side through swing priority spool and the passage "A" and also flows into the boom2 spool.

Due to shifting of the swing priority spool, the fluid from pump P2 flows to swing side more then next spools to make the swing operation most preferential.



## (8) HOLDING VALVE OPERATION

### ① Holding operation



14072SF30

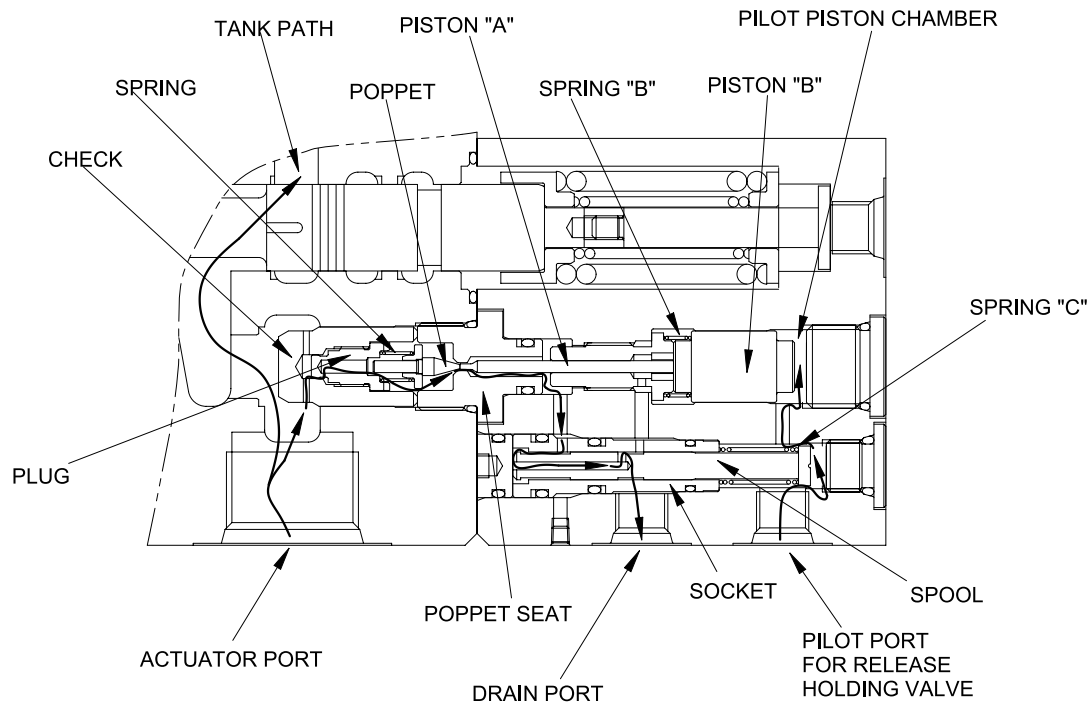
At neutral condition, the pilot piston chamber is connected to drain port through the pilot port.

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.

## ② Release holding operation



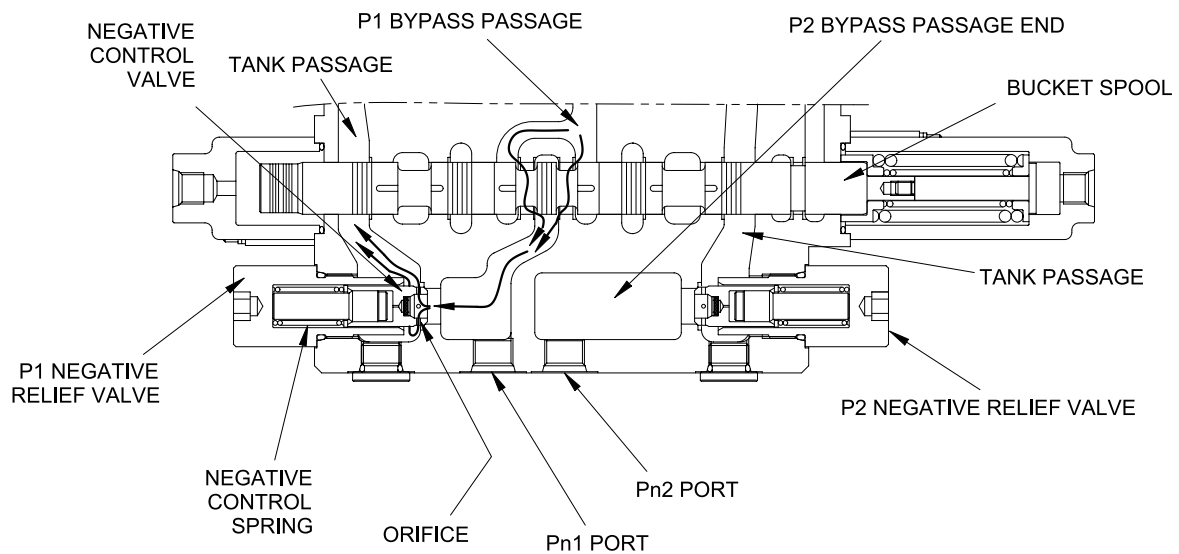
14072SF31

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.

## (9) 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.

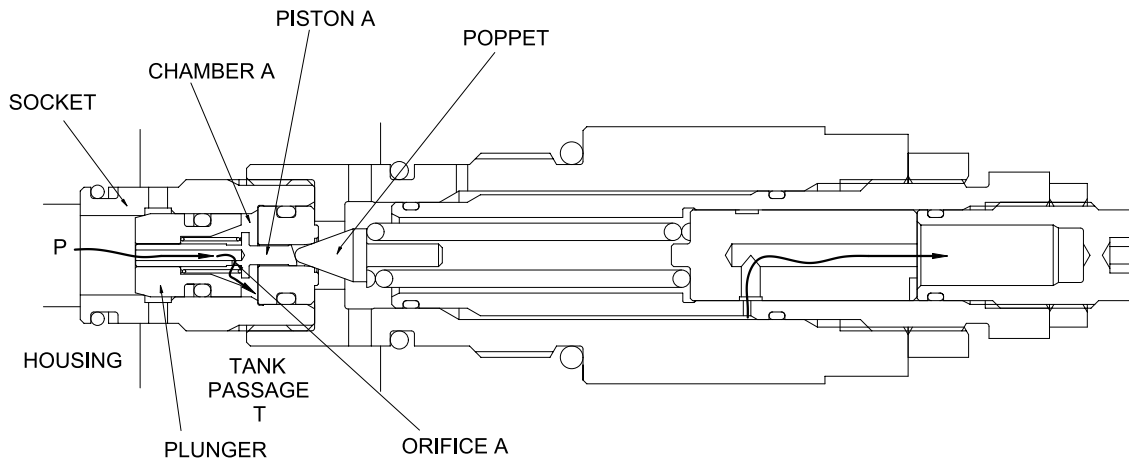
The negative control pressure reaches to the set level, the hydraulic fluid in the passage pushes open negative control valve and escapes into the return passage.

For the pump P2 the same negative control principle.

## (10) OPERATION OF MAIN RELIEF VALVE

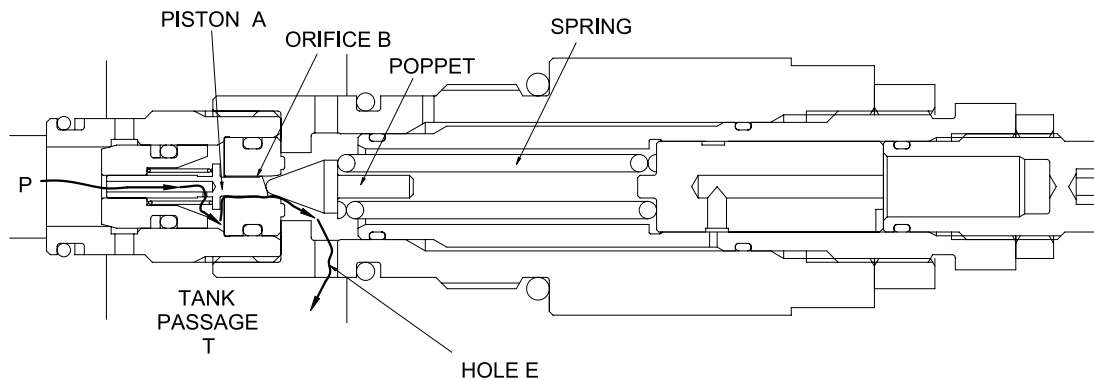
The main relief valve is fitted to the straight travel valve block and functions as follows :

- ① 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.



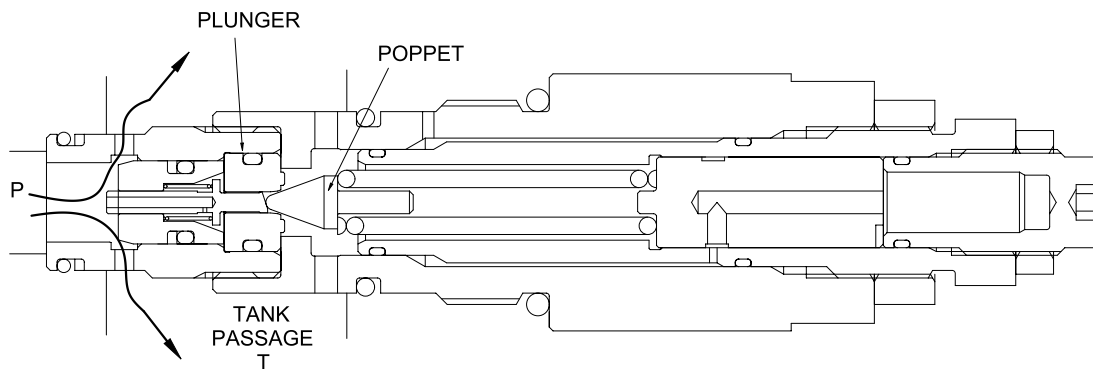
14072SF36

- ② 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

- ③ 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)

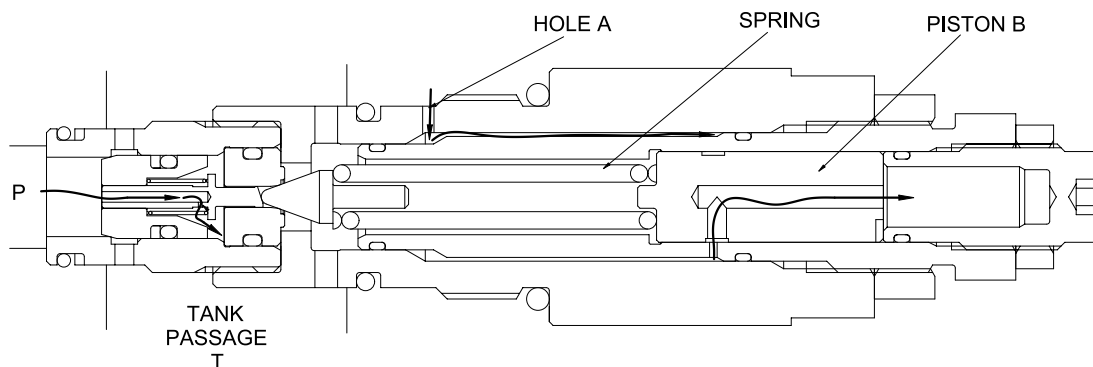


14072SF38

- ④ 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.

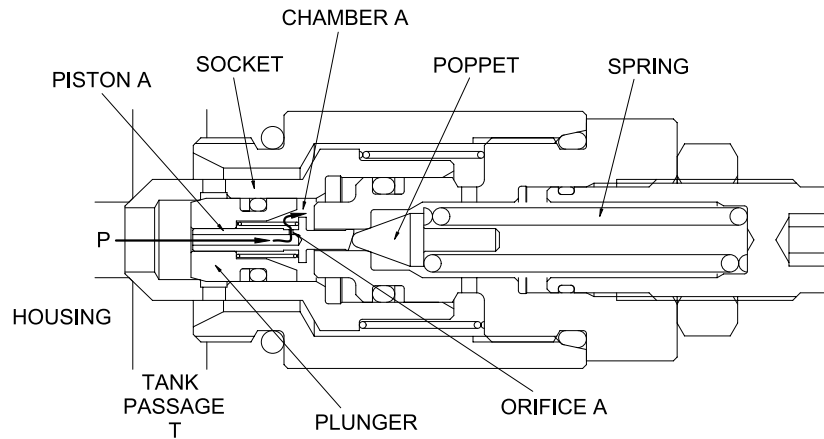


14072SF36

## (11) OPERATION OF PORT RELIEF VALVE

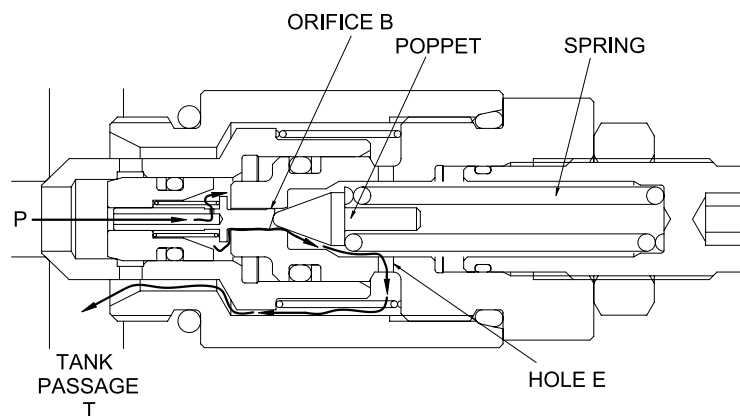
### ① Function as relief valve

- Ⓐ 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 the housing securely.



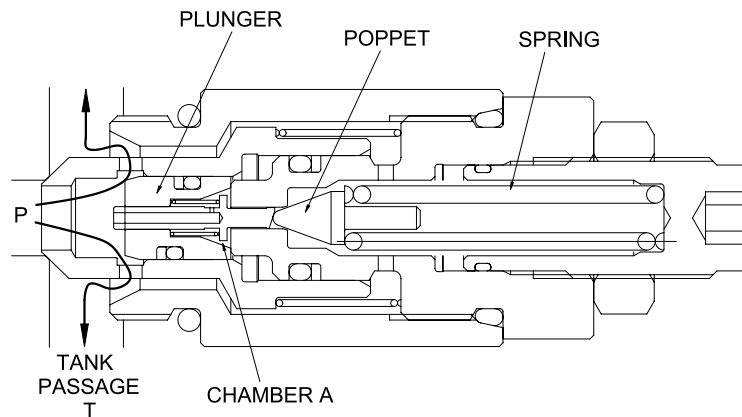
14072SF39

- Ⓑ 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

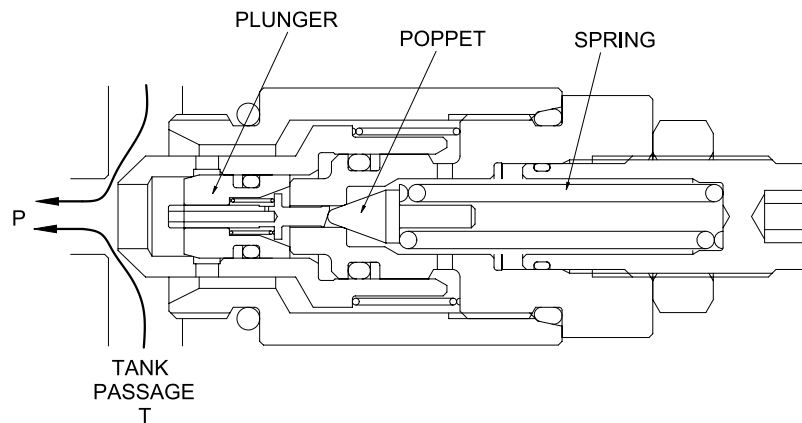
- ③ Opening of the poppet causes the pressure in chamber A to fall and the plunger to open. As the result the pressurized oil at port P runs into tank passage (T).



14072SF41

## ② 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