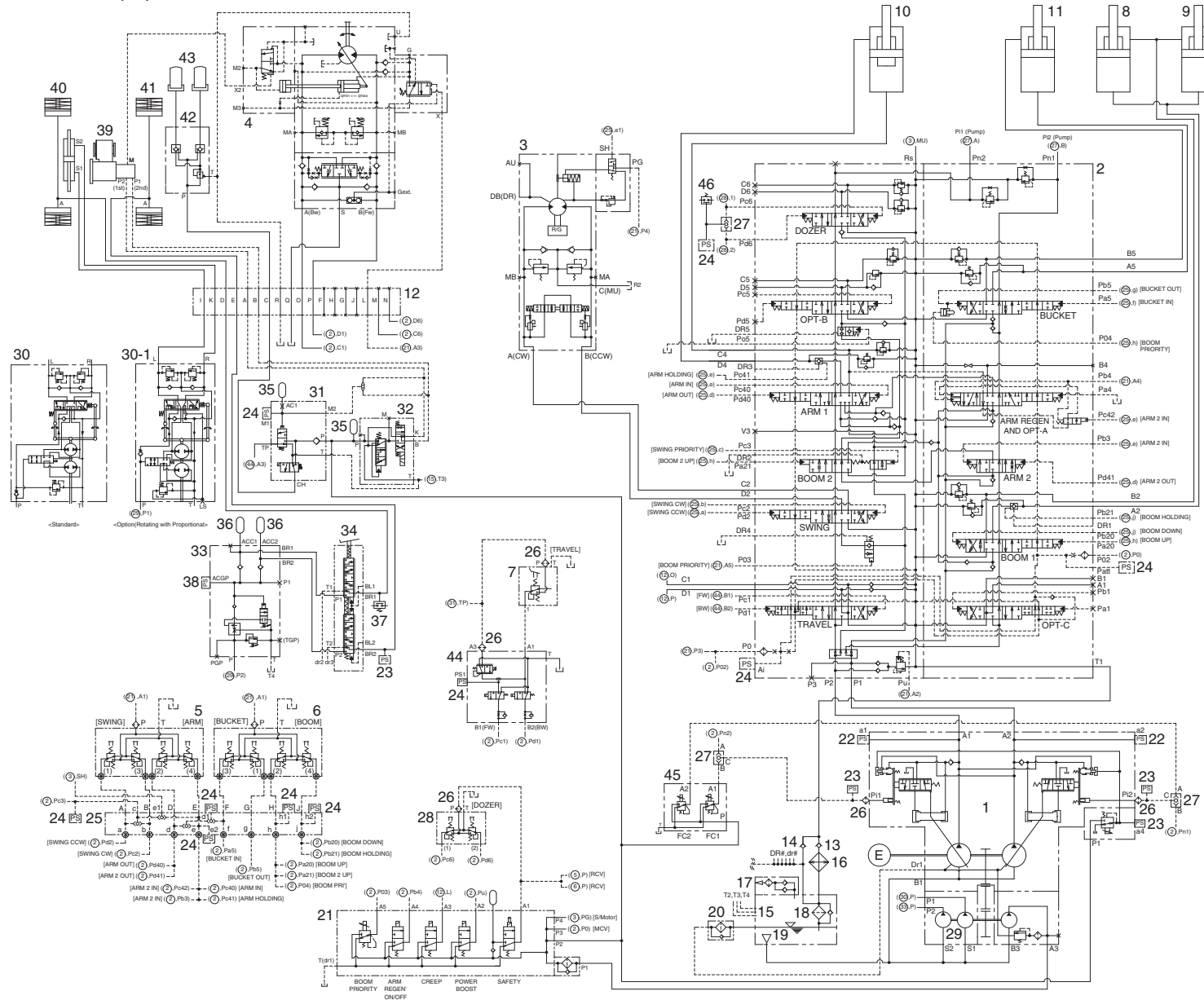


SECTION 3 HYDRAULIC SYSTEM

Group 1 Hydraulic Circuit	3-1
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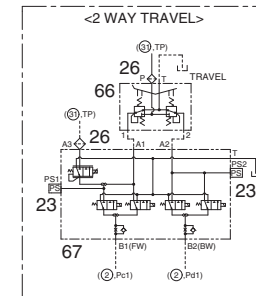
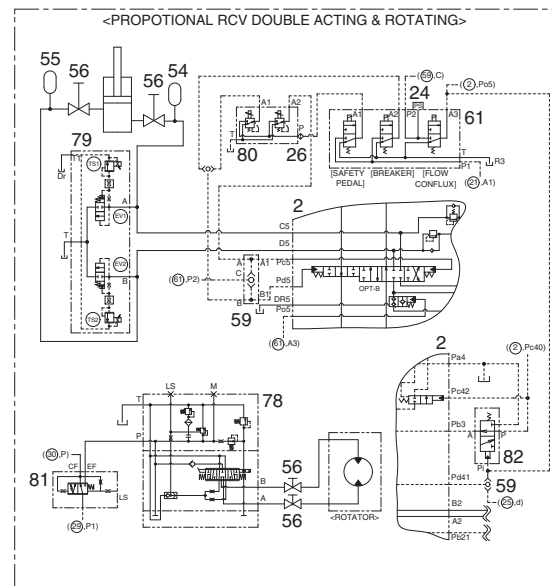
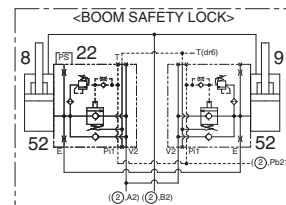
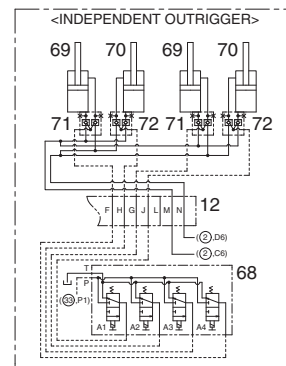
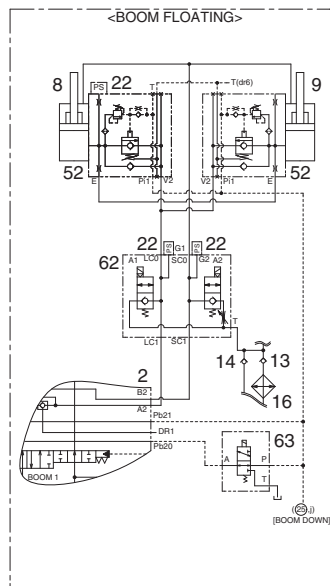
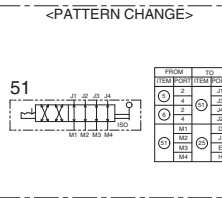
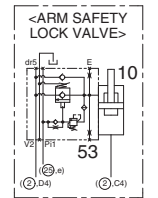
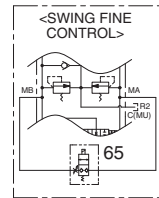
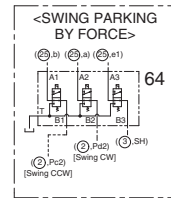
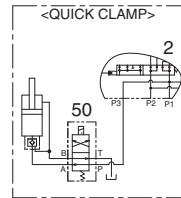
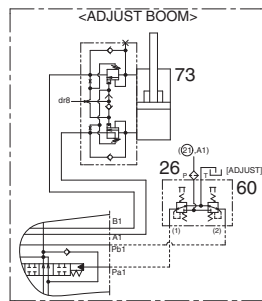
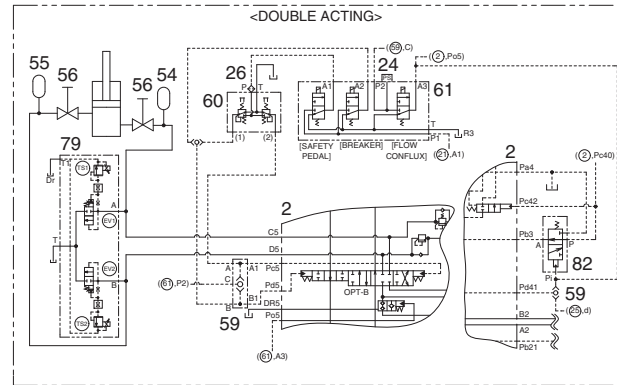
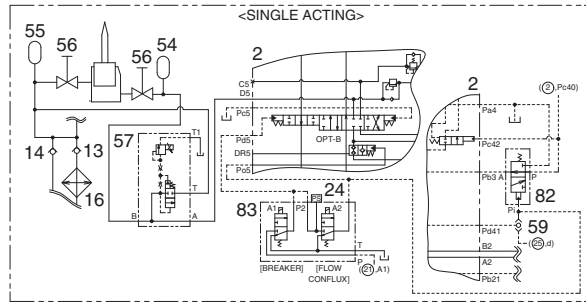
GROUP 1 HYDRAULIC CIRCUIT

1. HYDRAULIC CIRCUIT (1/2)



- 1 Main pump
- 2 Main control valve
- 3 Swing motor
- 4 Travel motor
- 5 RCV lever (LH)
- 6 RCV lever (RH)
- 7 Accelerator pedal (1 way)
- 8 Boom cylinder (LH)
- 9 Boom cylinder (RH)
- 10 Arm cylinder
- 11 Bucket cylinder
- 12 Turning joint
- 13 Check valve
- 14 Check valve
- 15 Hydraulic tank
- 16 Oil cooler
- 17 Air breather
- 18 Return filter
- 19 Suction strainer
- 20 Drain filter
- 21 5 cartridge valve
- 22 Pressure sensor
- 23 Pressure sensor
- 24 Pressure sensor
- 25 Terminal block
- 26 Last guard filter
- 27 Shuttle valve
- 28 RCV dozer (option)
- 29 Power train pump
- 30 Steering valve (Standard)
- 30-1 Steering valve (Option)
- 31 Travel control valve
- 32 Transmission control valve
- 33 Brake supply valve
- 34 Brake valve
- 35 Accumulator
- 36 Accumulator
- 37 Pressure switch
- 38 Pressure sensor
- 39 Transmission
- 40 Front axle
- 41 Rear axle
- 42 Locking valve
- 43 Oscillating cylinder
- 44 3 cartridge valve
- 45 2-EPPR cartridge valve
- 46 Pressure switch

2. HYDRAULIC CIRCUIT (2/2)



- 2 Main control valve
- 8 Boom cylinder (LH)
- 9 Boom cylinder (RH)
- 12 Turning joint
- 13 Check valve
- 13 Check valve
- 14 Check valve
- 16 Oil cooler
- 22 Pressure sensor (option)
- 24 Pressure sensor (option)
- 26 Last guard filter (option)
- 50 Solenoid valve (option)
- 51 Pattern change valve (option)
- 52 Boom safety lock valve (option)
- 53 Arm safety lock valve (option)
- 54 Accumulator (option)
- 55 Accumulator (option)
- 56 Stop valve (option)
- 57 Proportional relief valve (option)
- 59 Shuttle valve (option)
- 60 2 way pedal (option)
- 61 3 solenoid valve (option)
- 62 Float cartridge valve (option)
- 63 Solenoid valve (option)
- 64 Solenoid valve (option)
- 65 Solenoid valve (option)
- 66 Accelerator pedal (2 way, option)
- 67 5 cartridge valve (option)
- 68 4 cartridge valve (option)
- 69 Outrigger cylinder (LH, option)
- 70 Outrigger cylinder (RH, option)
- 71 Double pilot check valve (LH, option)
- 72 Double pilot check valve (RH, option)
- 73 Adjustable boom cylinder (option)
- 78 Proportional valve (option)
- 79 Proportional relief valve (option)
- 80 2 EPPR valve (option)
- 81 Priority valve (option)
- 82 Pilot selector valve (option)
- 83 2 solenoid valve (option)

160WF3HC01-2A

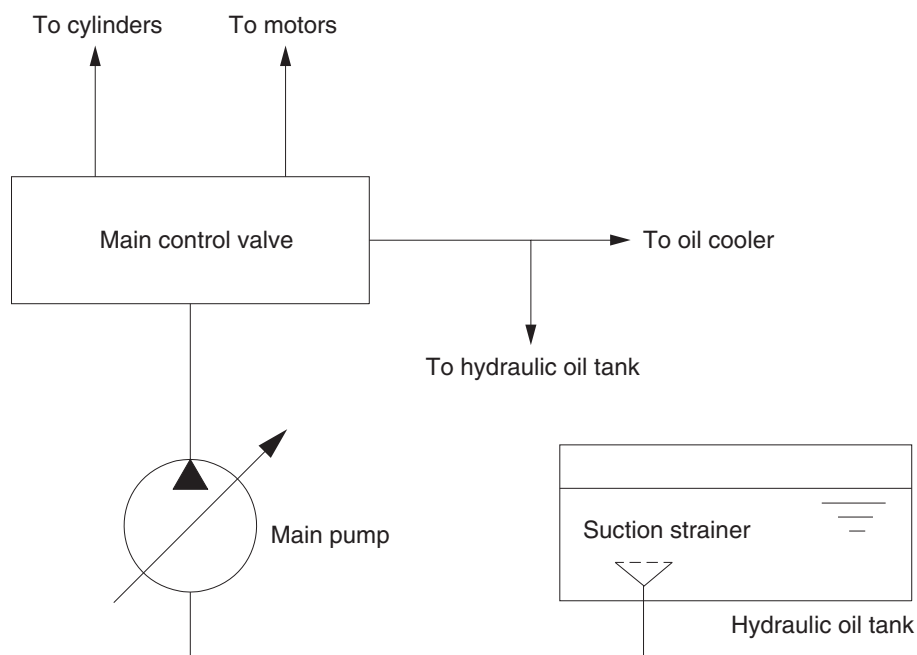
GROUP 2 MAIN CIRCUIT

The main hydraulic circuit consists of suction circuit, delivery circuit, return circuit and drain circuit.

The hydraulic system consists of one main pump, one control valve, one swing motor, four cylinders and one travel motor.

The swash plate type variable displacement axial piston pump is used as the main pump and it is driven by the engine at ratio 1.0 of engine speed.

1. SUCTION AND DELIVERY CIRCUIT



140WF3-2

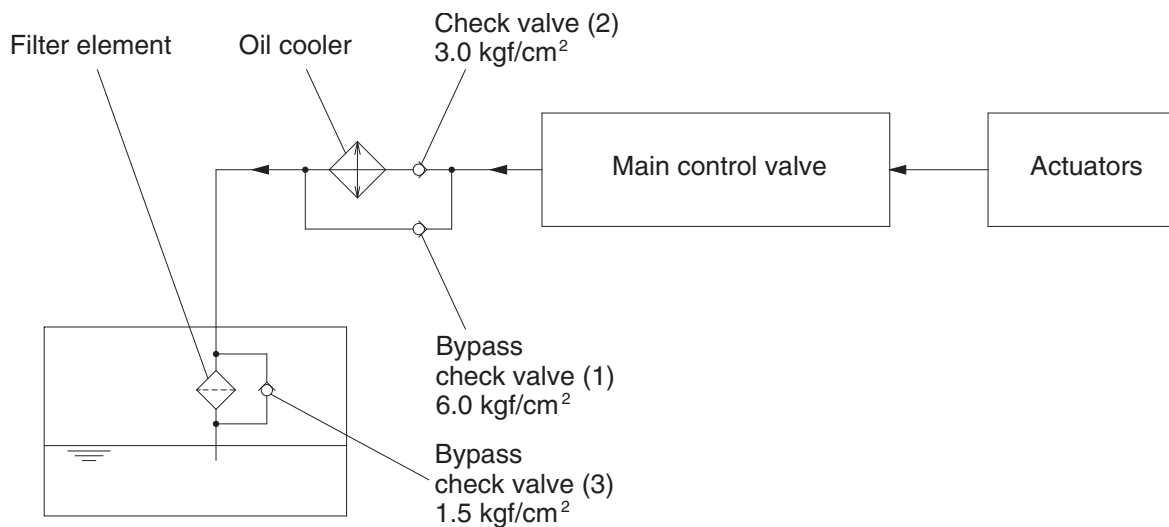
The pumps receive oil from the hydraulic tank through a suction strainer. The discharged oil from the pump flows into the control valve and goes out the tank ports.

The oil discharged from the main pump flows to the actuators through the control valve.

The control valve controls the hydraulic functions.

The return oil from the actuators flows to the hydraulic tank through the control valve and the oil cooler.

2. RETURN CIRCUIT



160WF3CI01

All oil from each actuator returns to the hydraulic tank through the control valve.

The bypass check valve (1) and check valve (2) are provided in the return circuit.

The setting pressure of check valves are 3.0 kgf/cm^2 (43 psi) and 6.0 kgf/cm^2 (85 psi). Usually, oil returns to the hydraulic tank from the control valve through oil cooler.

When oil temperature is low, viscosity becomes higher and flow resistance increases when passing through the oil cooler. When the oil pressure exceeds 6.0 kgf/cm^2 (85 psi), the oil returns directly to the hydraulic tank through the bypass check valve (1), resulting in the oil temperature being raised quickly at an appropriate level.

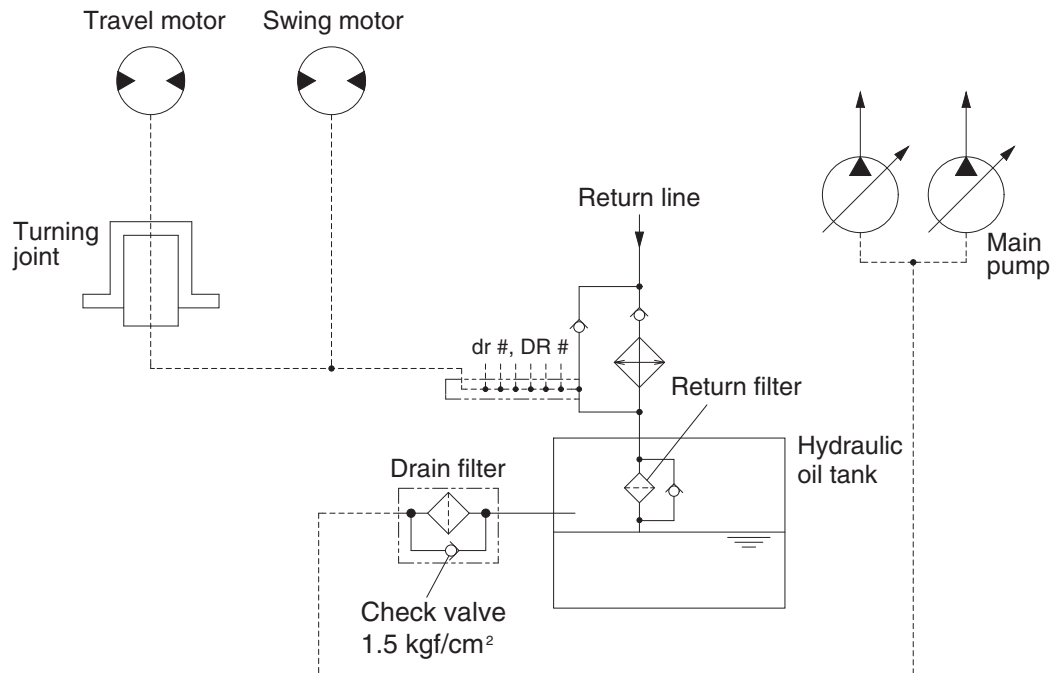
Also, when the oil cooler is clogged, the oil returns directly to the hydraulic tank through bypass check valve (1).

The return filter and bypass check valve are provided in the hydraulic tank.

The oil returned from right and left side of control valve is combined and filtered by the return filter. A bypass check valve is provided in the return filter.

When the filter element is clogged, the bypass check valve opens at 1.5 kgf/cm^2 (21 psi) differential pressure.

3. DRAIN CIRCUIT



160WF3CI02

The main pump drain oil have to be fed to the hydraulic tank passing through drain filter. When the drain oil pressure exceed 1.5 kgf/cm^2 (21 psi), the oil returns to the hydraulic tank directly.

TRAVEL MOTOR DRAIN CIRCUIT

1) Oil leaking from the travel motor comes out of the drain ports provided in the motor casing. This oil passes through turning joint and returns to the hydraulic tank through the return filter.

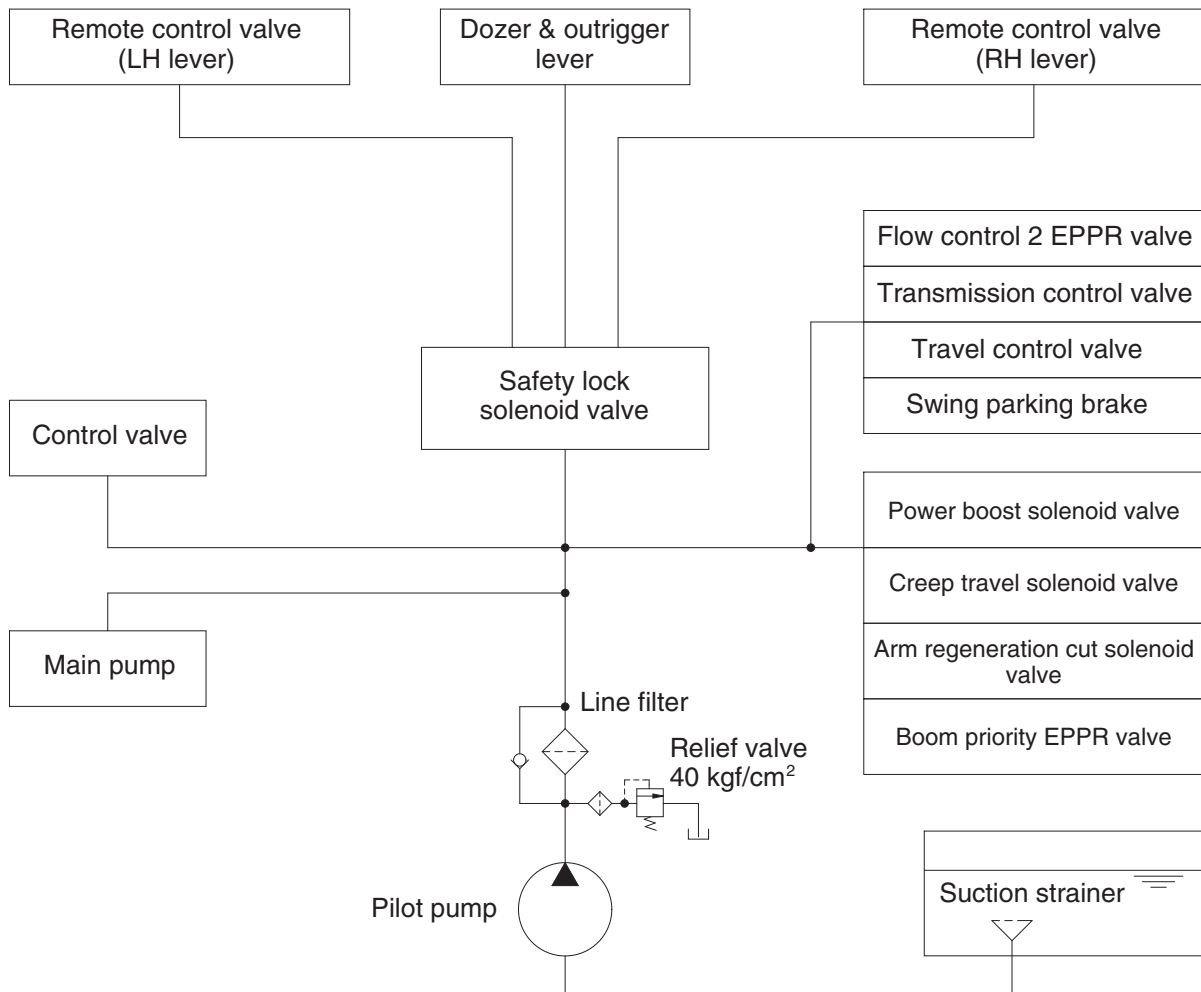
2) SWING MOTOR DRAIN CIRCUIT

Oil leaking from the swing motor comes out and return to the hydraulic tank passing through the return filter.

3) MAIN PUMP DRAIN CIRCUIT

Oil leaking from main pump come out and return to the hydraulic tank passing through drain filter.

GROUP 3 PILOT CIRCUIT



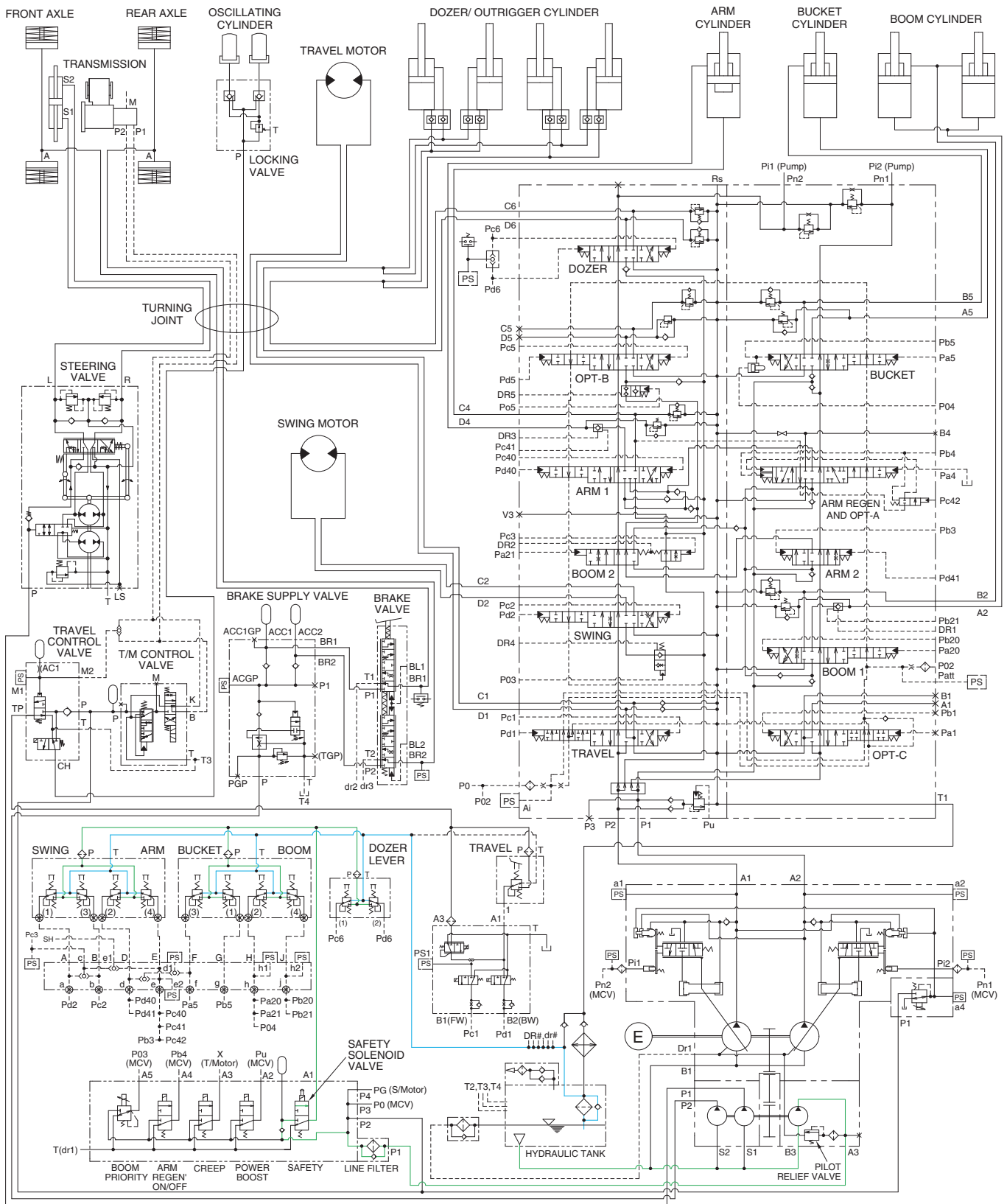
160WF3CI03

The pilot circuit consists of suction circuit, delivery circuit and return circuit.

The pilot pump is provided with relief valve, receives the oil from the hydraulic tank through the suction strainer.

The discharged oil from the pilot pump flows to the remote control valve (through the safety lock solenoid valve), EPPR valve, solenoid valve assemblies, swing parking brake, main control valve and safety lock solenoid valve through line filter.

1. SUCTION, DELIVERY AND RETURN CIRCUIT



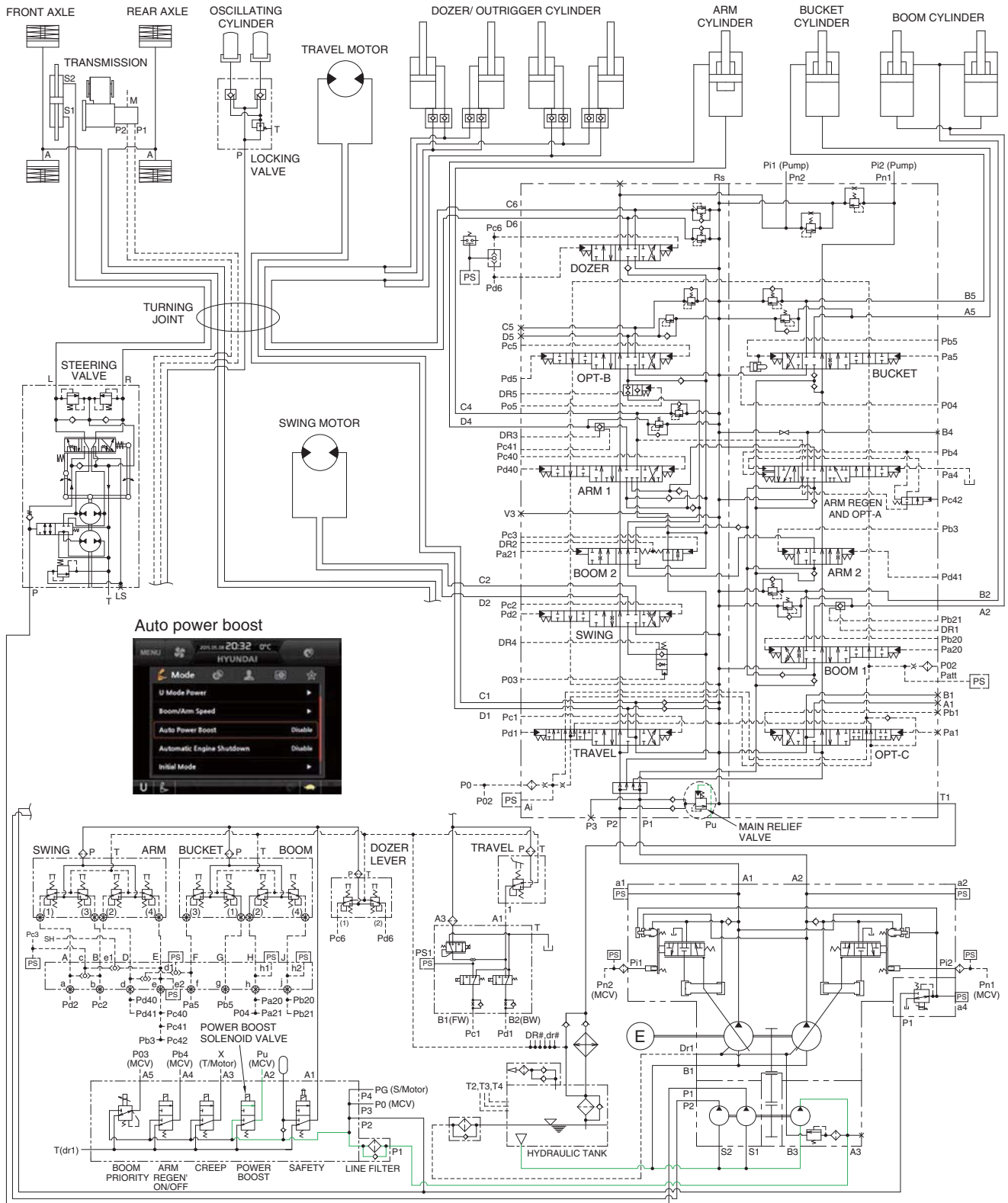
160WF3HC02

The pilot pump receives oil from the hydraulic tank. The discharged oil from the pilot pump flows to the safety solenoid valve through the line filter. The oil is filtered by the line filter. The pilot relief valve is provided in the pilot pump for limiting the pilot circuit pressure.

The oil filtered by line filter flows remote control valves through safety solenoid valve.

The return oil from remote control valves is returned to the hydraulic tank.

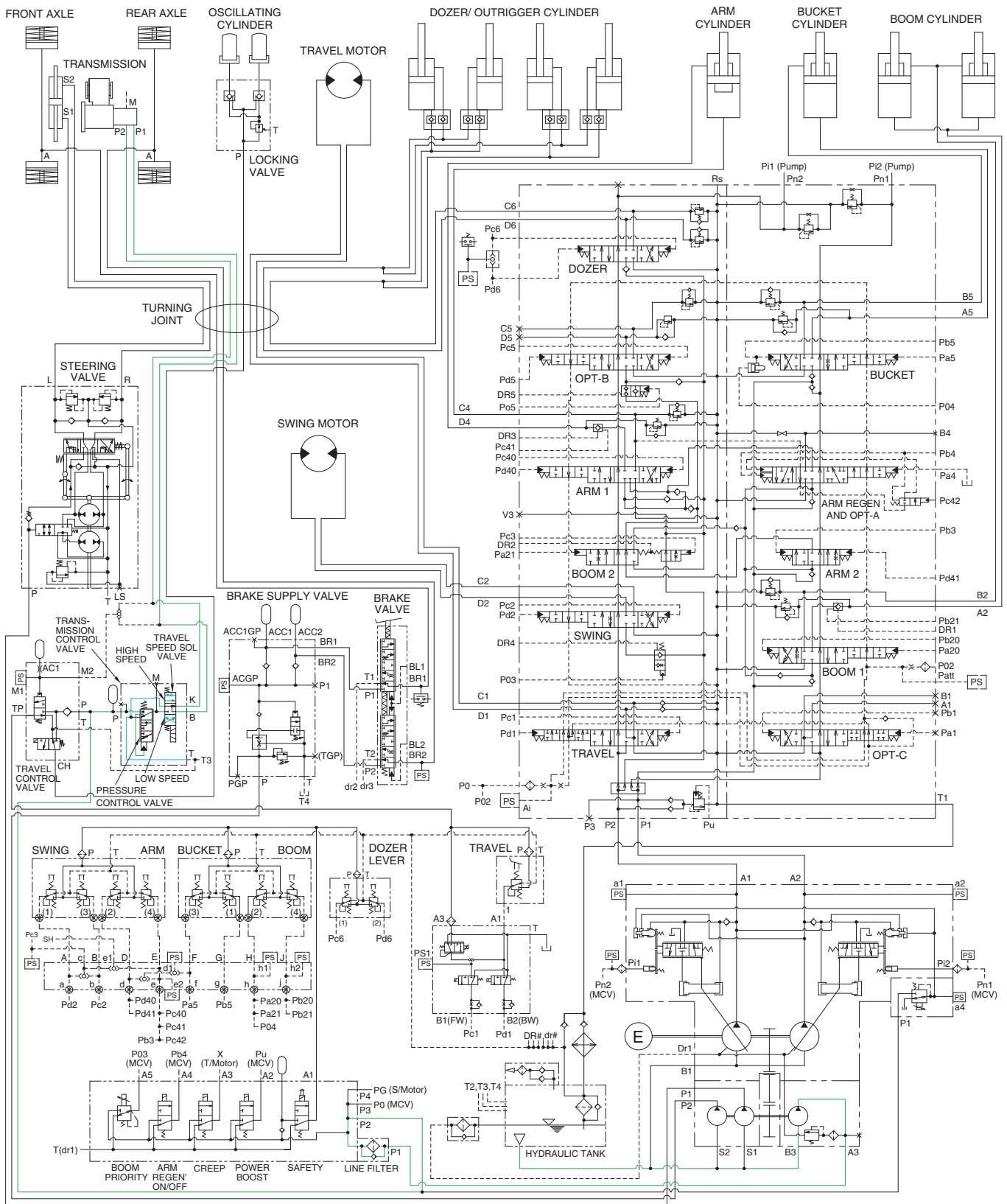
3. MAIN RELIEF PRESSURE CHANGE SYSTEM



When the power boost switch on the left remote control lever is pushed ON, the power boost solenoid valve is actuated, the discharged oil from the pilot pump flows into **Pu** port of the main relief valve in main control valve ; then the setting pressure of the main relief valve is raises from 350 kgf/cm² to 380 kgf/cm² for increasing the digging power. And even when press continuously, it is canceled after 8 seconds.

When the auto power boost function is selected to **Enable** on the cluster, the pressure of the main relief pressure is automatically increased to 380 kgf/cm² as working condition by the MCU. It is also operated max 8 seconds.

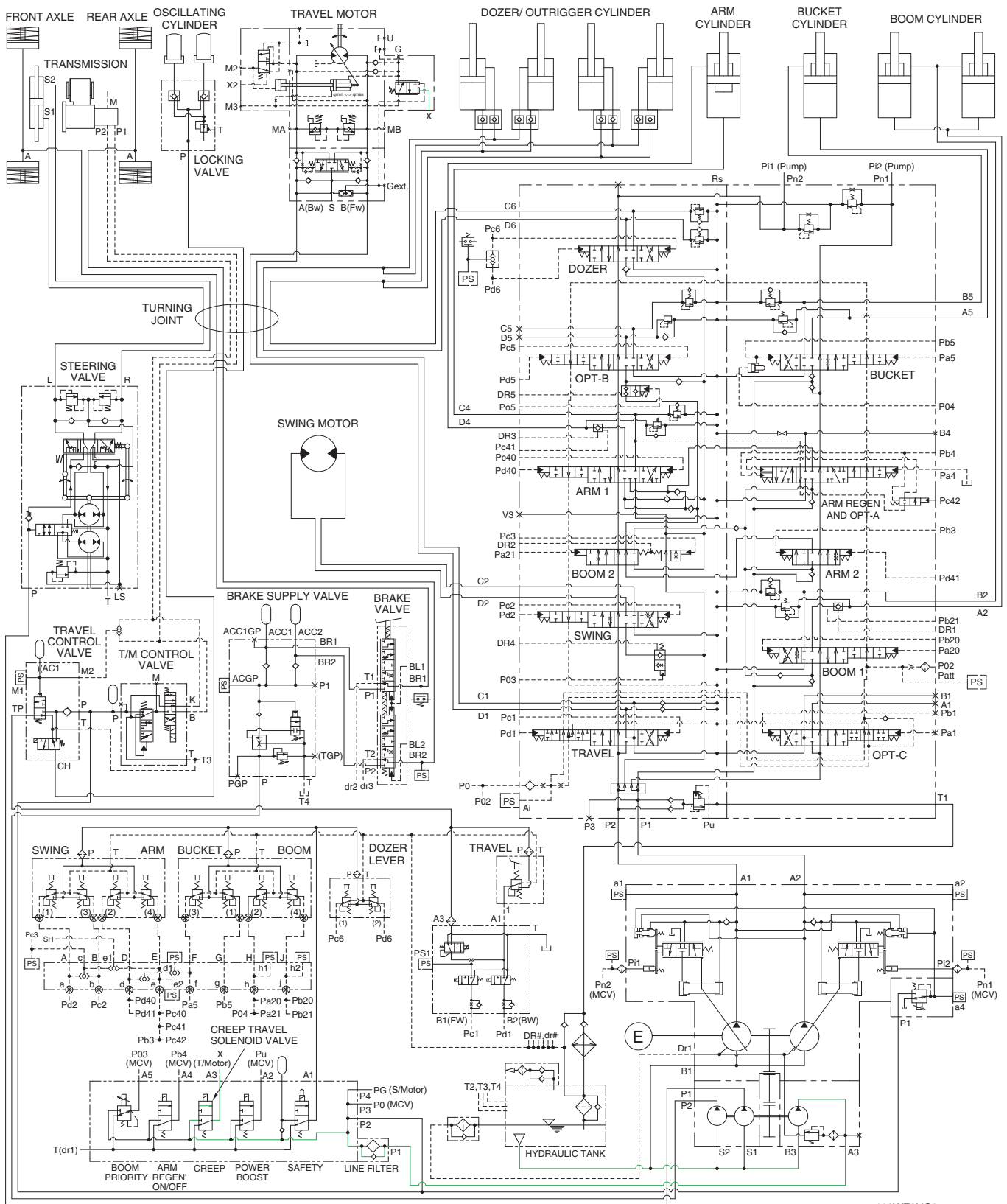
5. TRAVEL SPEED SELECTION SYSTEM



160WF3HC06

When RH multifunction switch was turned to high or low speed position, the pressure oil from pilot pump flows to travel speed solenoid valve through pressure control valve, thus the transmission is changed into high (P1) or low (P2) speed condition.

6. CREEP TRAVEL SYSTEM



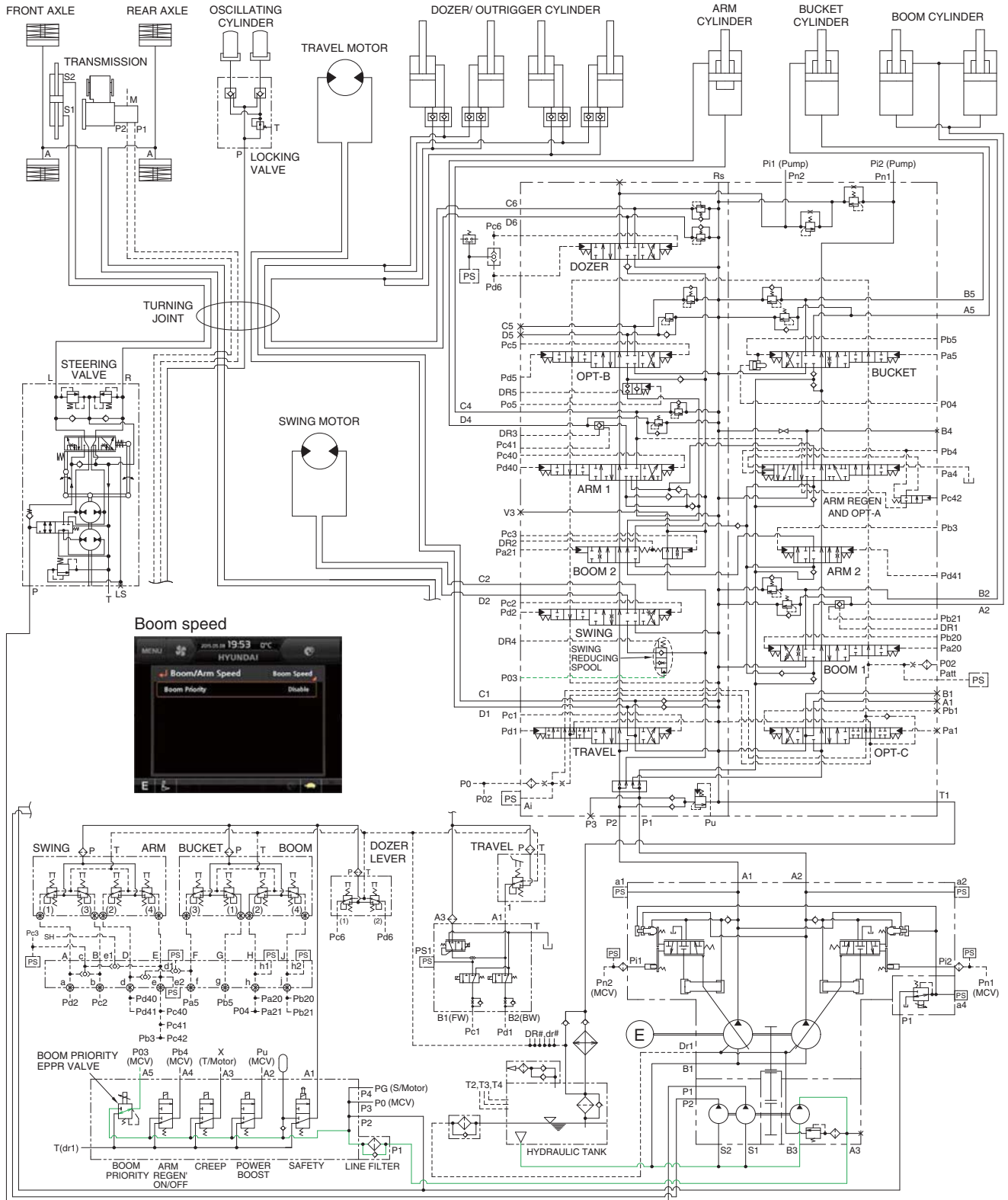
160WF3HC07

When the creep button on the dashboard of the steering column is pushed ON, the creep travel solenoid valve is actuated.

The discharged oil from the pilot pump flows into X port of travel motor through solenoid valve.

Then, the machine speed is very low travelling more than 1st speed.

8. BOOM PRIORITY SYSTEM



160WF3HC09

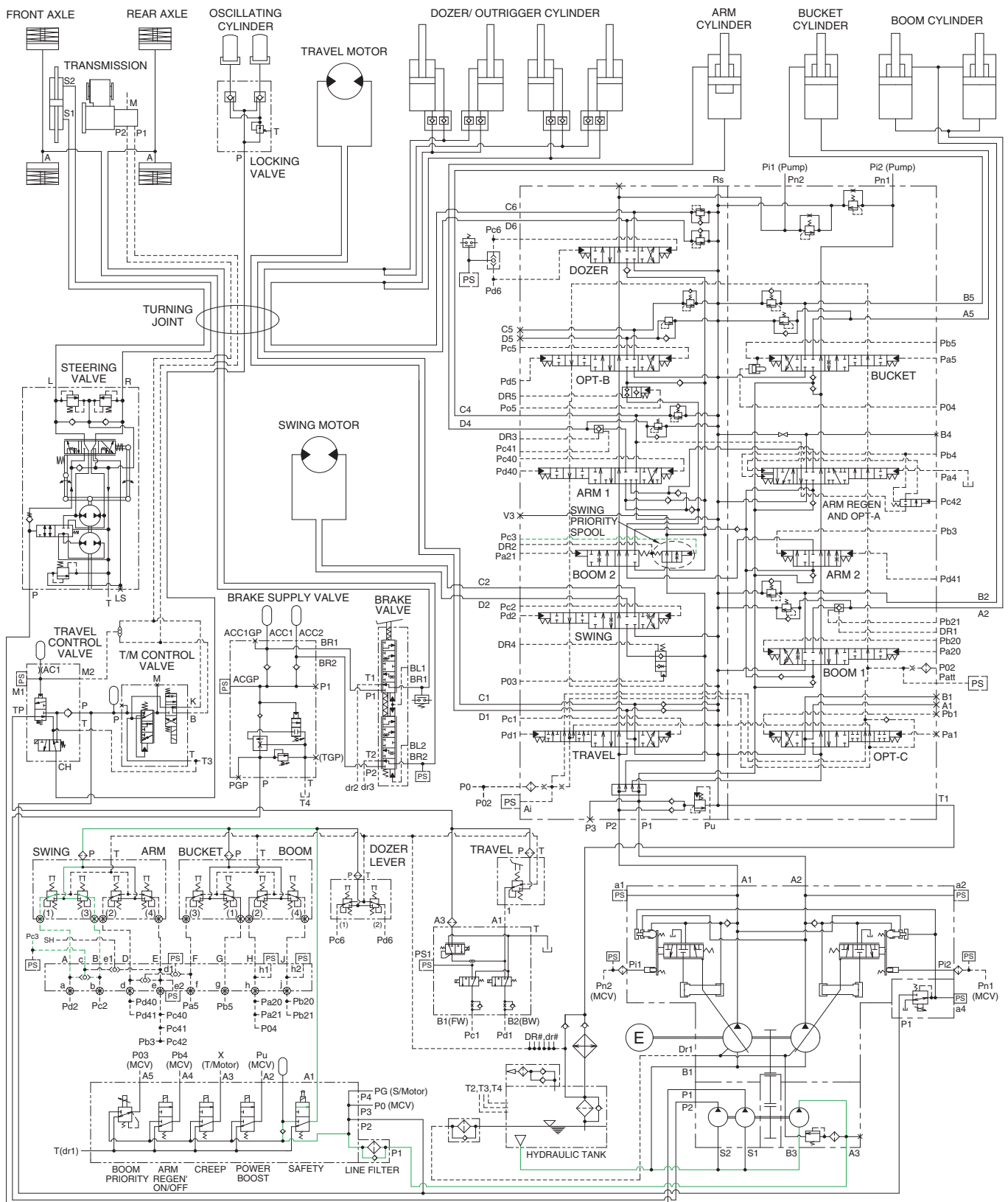
When carrying out the combined operation of swing and boom up, the boom up operating speed is lowered then normal operation. To increase working efficiency, swing speed reducing system is used.

When the boom priority function is selected to Enable on the cluster, the boom priority EPPR valve is activated. The pilot oil from pilot pump flow into **P03** port in main control valve through boom priority EPPR valve. **P03** oil pressure moves swing reducing spool to upper position and oil flow rate to the swing motor decreased as working conditions by the MCU.

Then, the boom up speed is increased. This is called the boom priority system.

The boom priority function can be selected on the cluster. Refer to page 3-22 of the operator's manual.

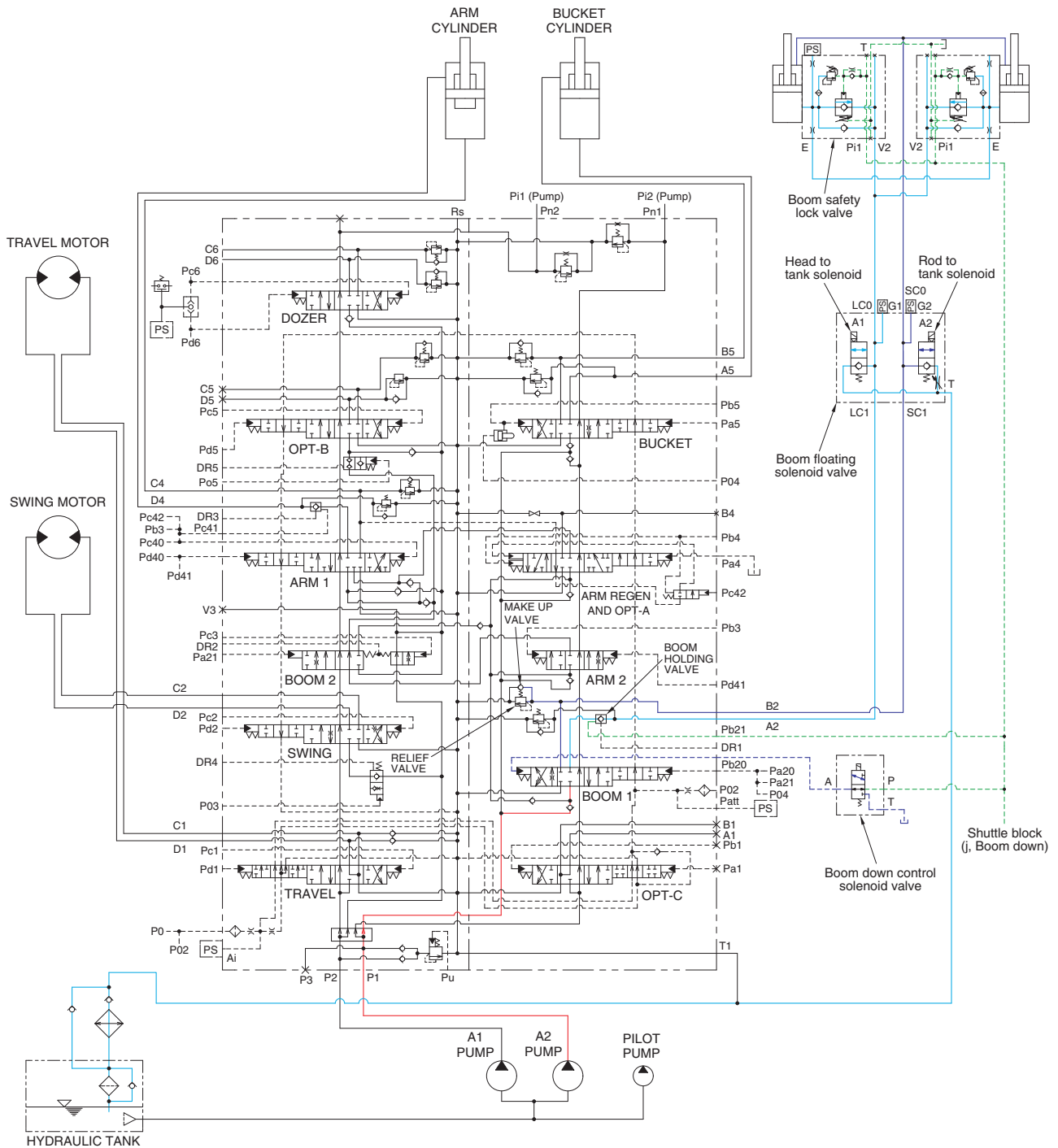
9. SWING PRIORITY SYSTEM



When carrying out the combined operation of swing and arm of the left control valve, the swing speed can be lowered than arm speed.

Pc3 pressure oil from the terminal block changes the swing priority spool to the left position and then the oil flow rate is decreased to the next section to make the swing operation most preferential. This is called the swing priority system. For details, refer to page 2-39.

10. BOOM FLOATING SYSTEM

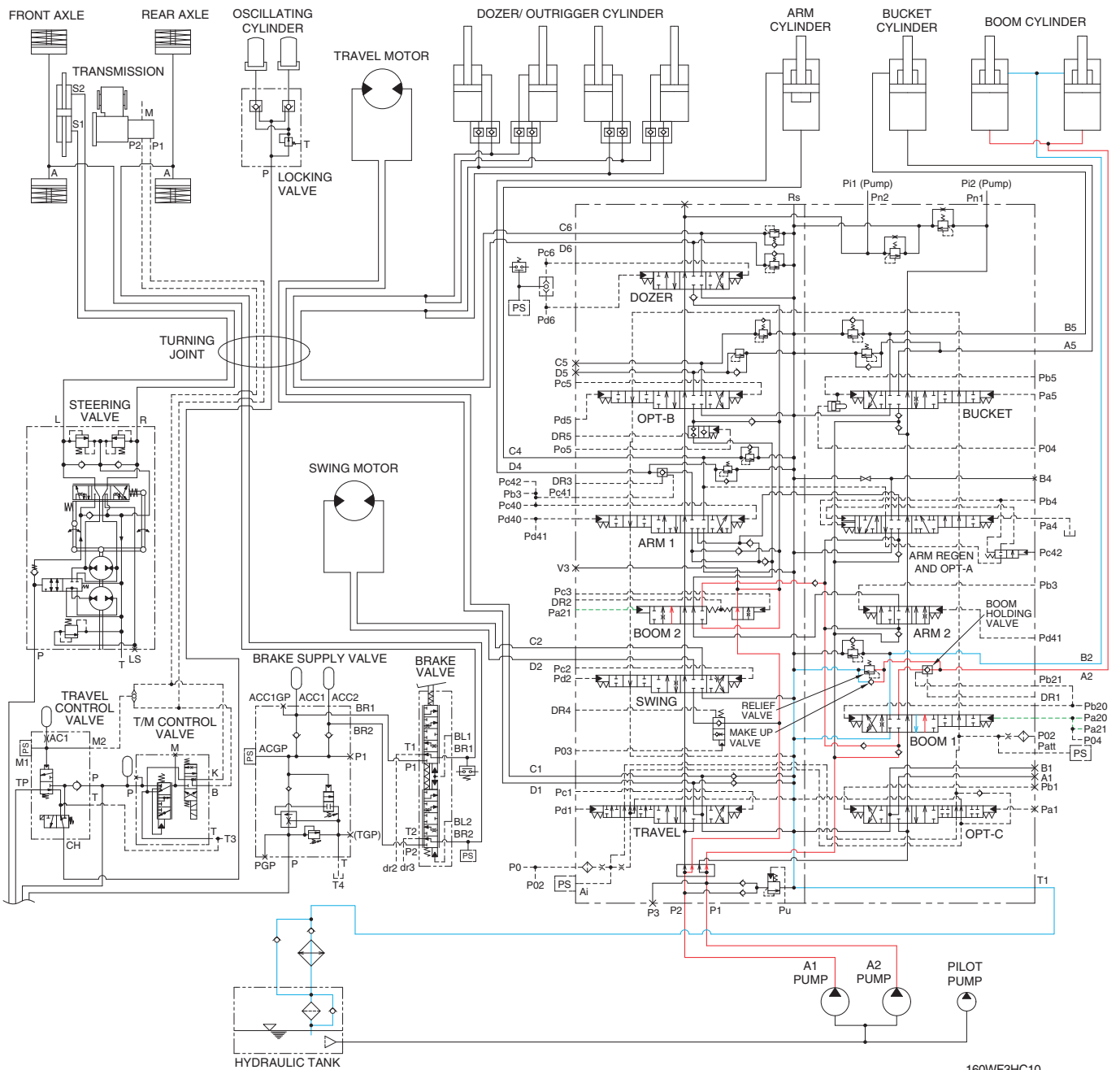


140WF3HC31

Smooth and convenient boom movement is accomplished by only arm control lever operation. The boom floating solenoid valves are equipped in the rod and head of boom cylinders that are controlled to act as floating mode. "Rod to tank solenoid" and "Head to tank solenoid" are activated by the boom floating switch on the switch panel in the cab. So the hydraulic oil of rod and head goes to tank, and floating is accomplished. In the mode, boom down control solenoid valve is activated so that boom down pilot pressure is cut. For more details, refer to page 5-13.

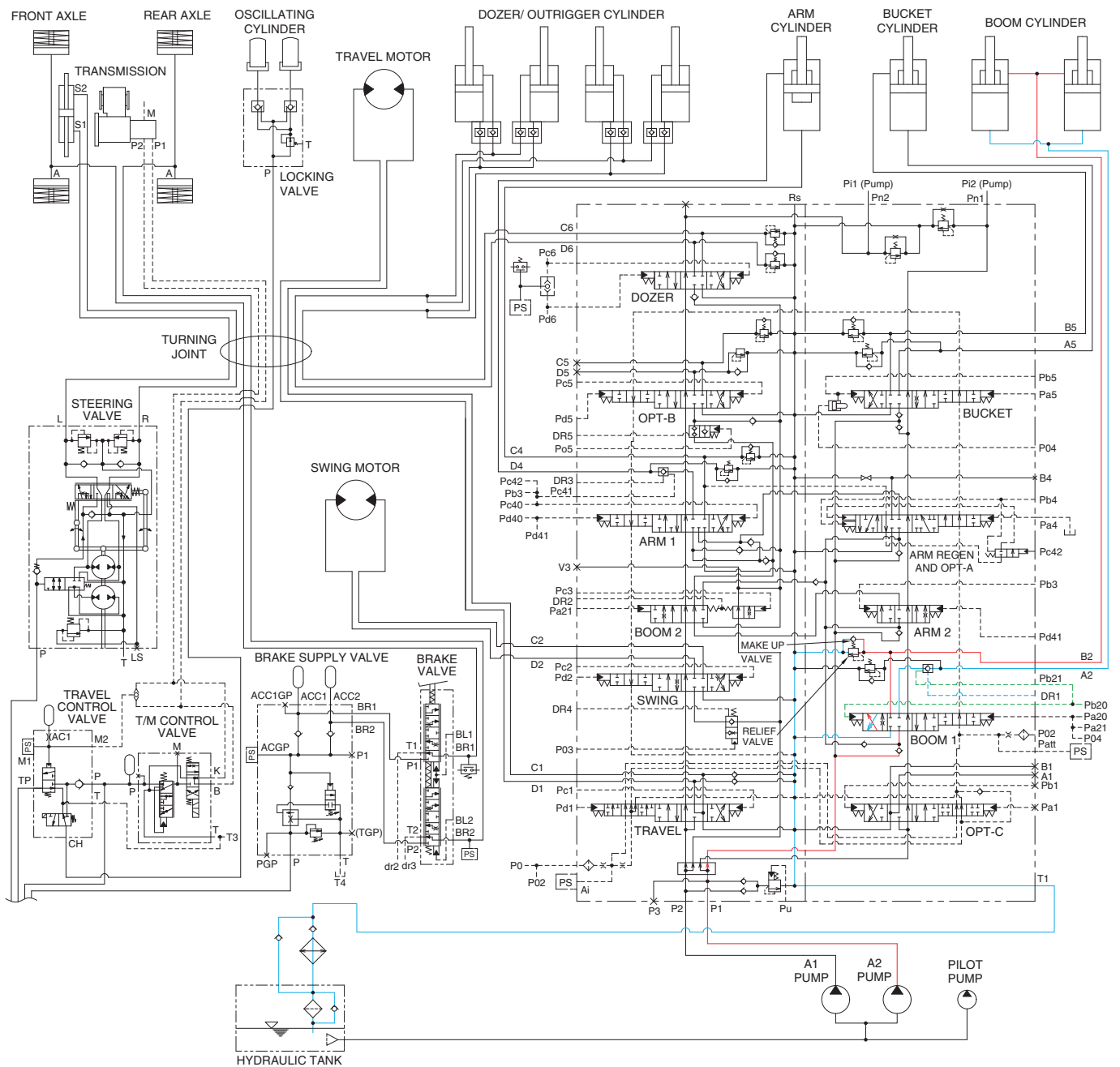
GROUP 4 SINGLE OPERATION

1. BOOM UP OPERATION



When the right control lever is pulled back, the boom spools in the main control valve are moved to the up position by the pilot oil pressure from the remote control valve. The oil from the A1 and A2 pump flows into the main control valve and then goes to the large chamber of boom cylinders. At the same time, the oil from the small chamber of boom cylinders returns to the hydraulic oil tank through the boom 1 spool in the main control valve. When this happens, the boom goes up. The excessive pressure in the boom cylinder head side is prevented by relief valve. When the boom is up and the control lever is returned to neutral position, the circuit for the holding pressure at the head side of the boom cylinders is closed by the boom holding valve. This prevents the hydraulic drift of boom cylinders.

2. BOOM DOWN OPERATION



160WF3HC11

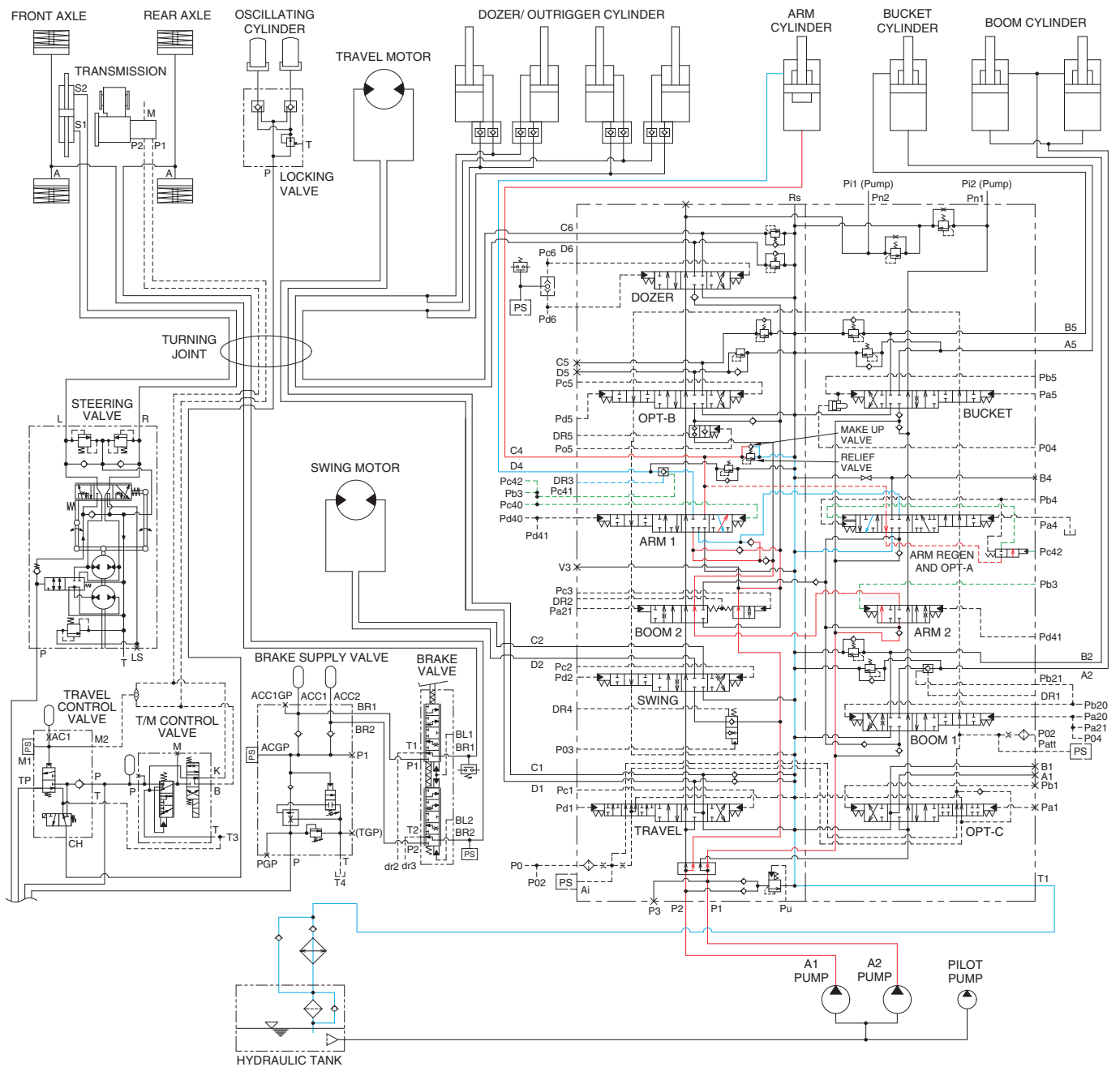
When the right control lever is pushed forward, the boom 1 spool in the main control valve is moved to the down position by the pilot oil pressure from the remote control valve.

The oil from the A2 pump flows into the main control valve and then goes to the small chamber of boom cylinders. At the same time, the oil from the large chamber of boom cylinders returns to the hydraulic tank through the boom 1 spool in the main control valve.

When the down speed of boom is faster, the oil returned from the large chamber of boom cylinders combines with the oil from the A2 pump through the make up valve, and flows into the small chamber of the cylinders.

This prevents cylinder cavitation by the negative pressure when the A2 pump flow can not match the boom down speed. And the excessive pressure in the boom cylinder rod side is prevented by the relief valve.

3. ARM IN OPERATION



160WF3HC12

When the left control lever is pulled back, the arm spools in the main control valve are moved to the arm in position by the pilot oil pressure from the remote control valve.

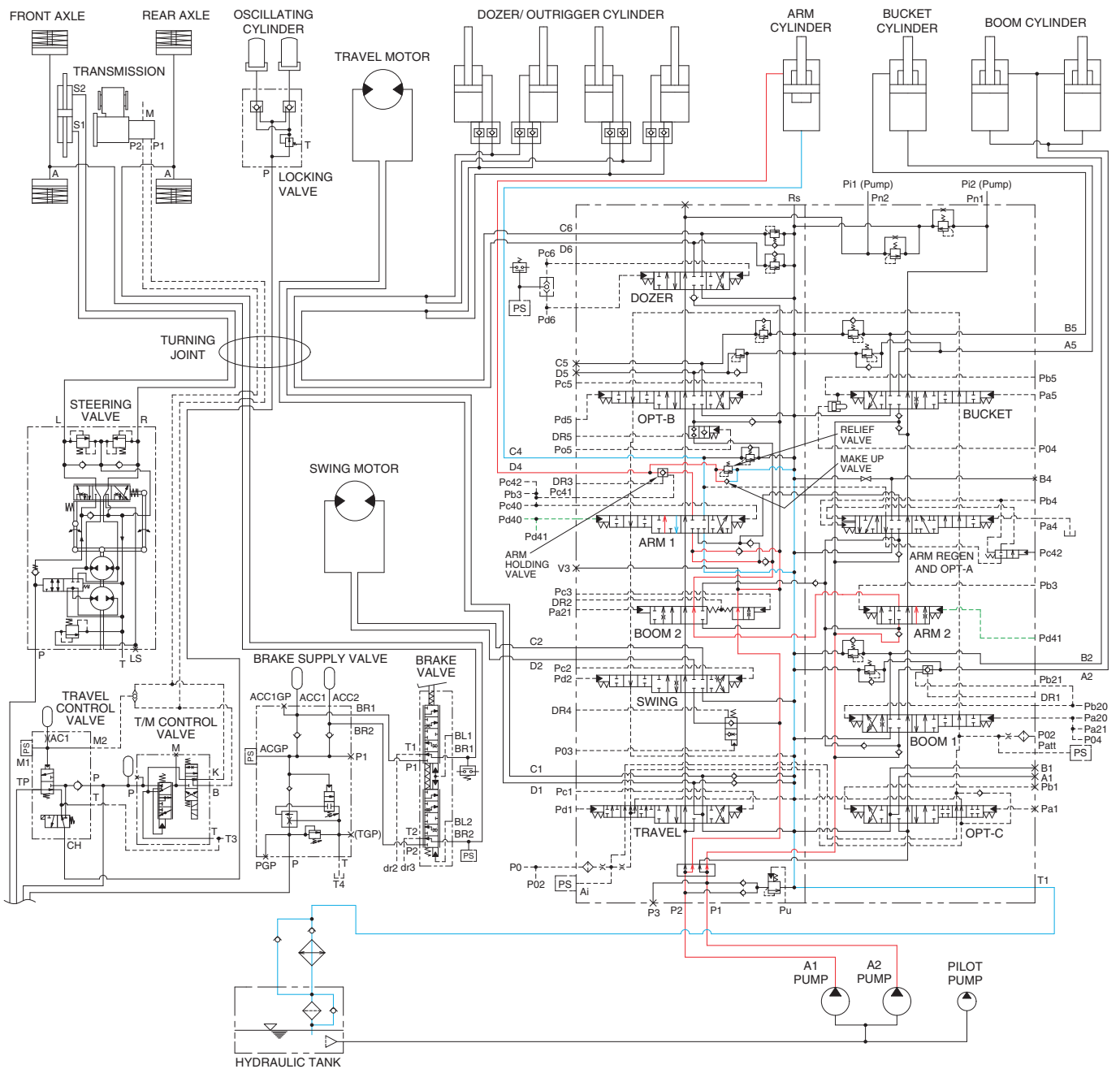
The oil from the A1 and A2 pump flows into the main control valve and then goes to the large chamber of arm cylinder.

At the same time, the oil from small chamber of arm cylinder returns to the hydraulic oil tank through the arm 1 spool and arm regeneration spool in the main control valve. When this happens, the arm rolls in.

The excessive pressure in the arm cylinder head side is prevented by relief valve.

The cavitation which will happen to the head side of the arm cylinder is also prevented by the make-up valve in the main control valve.

4. ARM OUT OPERATION

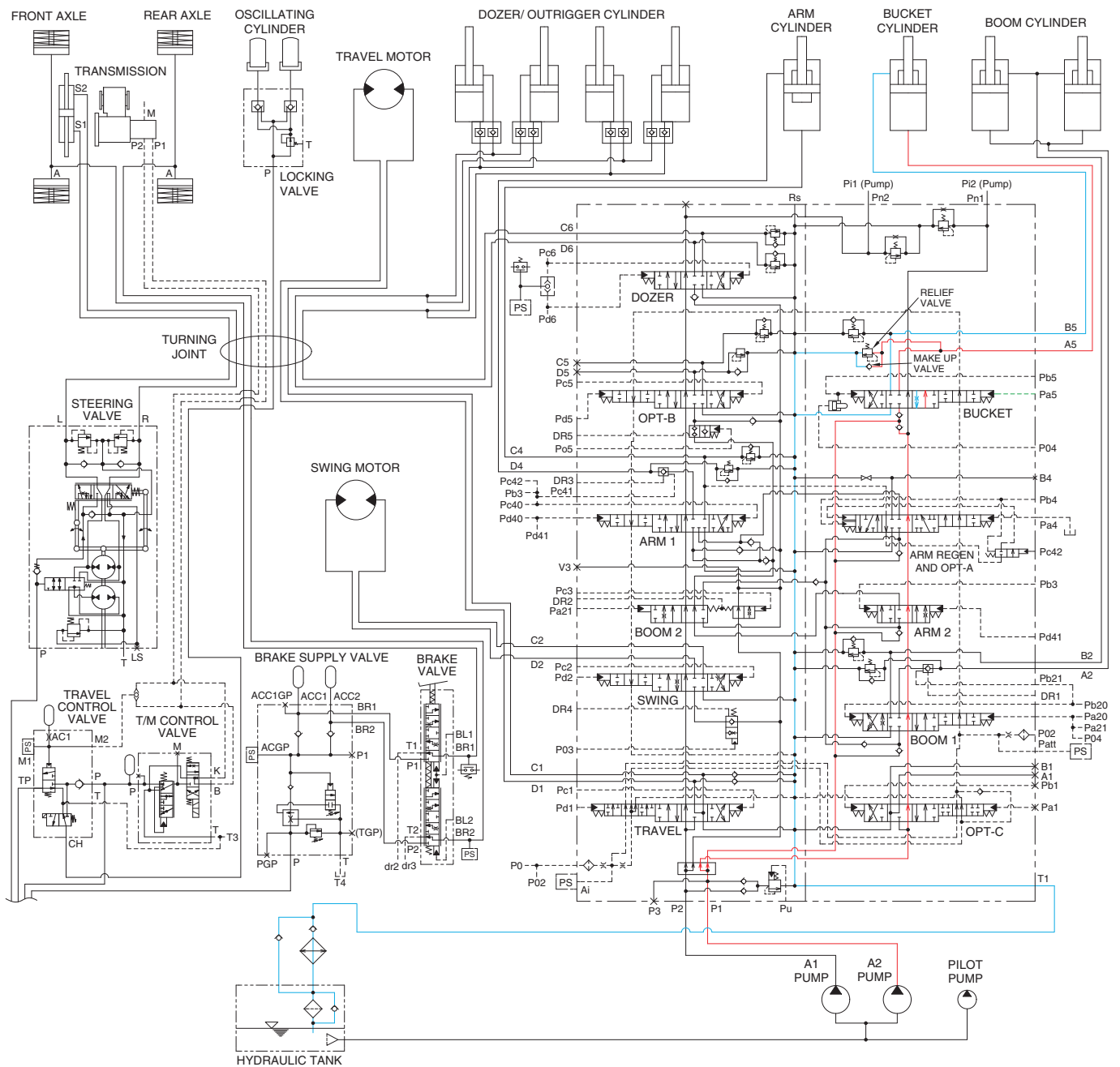


160WF3HC13

When the left control lever is pushed forward, the arm spools in the main control valve are moved to the arm out position by the pilot oil pressure from the remote control valve.

The oil from the A1 and A2 pump flows into the main control valve and then goes to the small chamber of arm cylinder. At the same time, the oil from the large chamber of arm cylinder returns to the hydraulic oil tank through the arm 1 spool in the main control valve. When this happens, the arm rolls out. The cavitation which will happen to the rod side of the arm cylinder is also prevented by the make-up valve in the main control valve. When the arm is roll out and the control lever is returned to neutral position, the circuit for the holding pressure at the rod side of the arm cylinder is closed by the arm holding valve. This prevent the hydraulic drift of arm cylinder.

5. BUCKET IN OPERATION



160WF3HC14

When the right control lever is pulled left, the bucket spool in the main control valve is moved to the roll in position by the pilot oil pressure from the remote control valve.

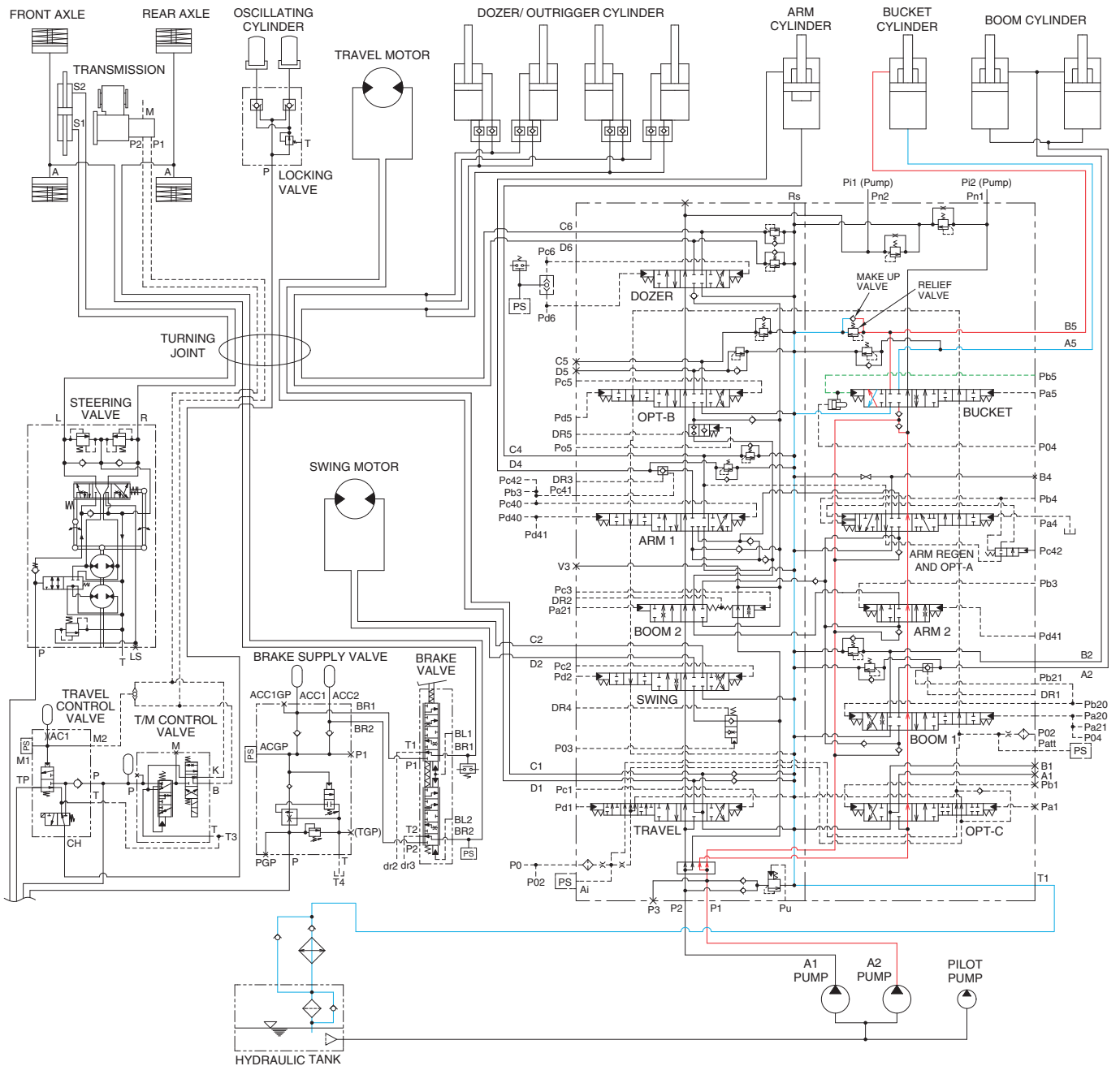
The oil from the A2 pump flows into the main control valve and then goes to the large chamber of bucket cylinder.

At the same time, the oil from the small chamber of bucket cylinder returns to the hydraulic oil tank through the bucket spool in the main control valve. When this happens, the bucket rolls in.

The excessive pressure in the bucket cylinder head side is prevented by relief valve.

The cavitation which will happen to the head side of the bucket cylinder is also prevented by the make-up valve in the main control valve.

6. BUCKET OUT OPERATION



160WF3HC15

When the right control lever is pushed right, the bucket spool in the main control valve is moved to the bucket out position by the pilot oil pressure from the remote control valve.

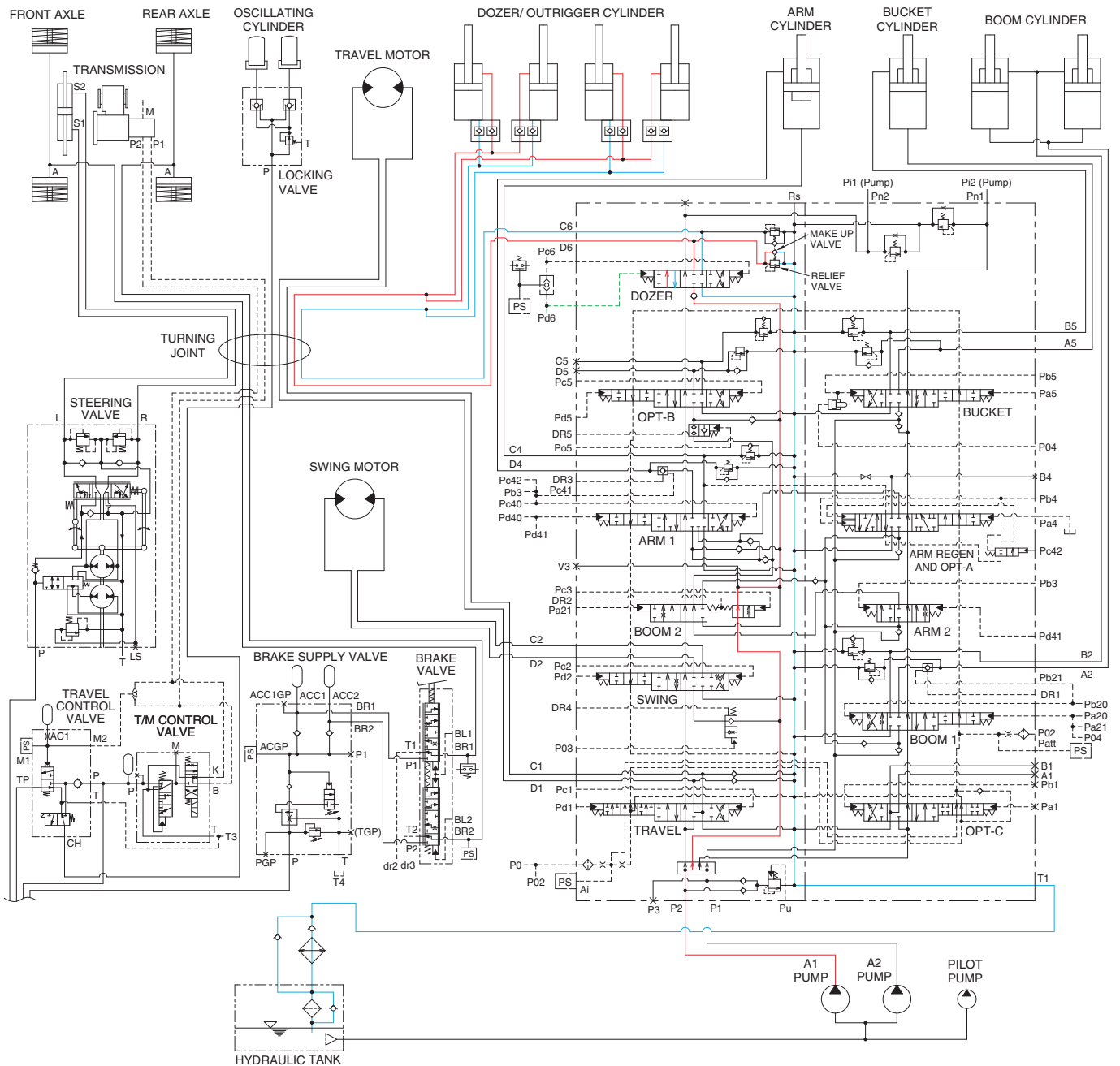
The oil from the A2 pump flows into the main control valve and then goes to the small chamber of bucket cylinder.

At the same time, the oil from the large chamber of bucket cylinder returns to the hydraulic oil tank through the bucket spool in the main control valve. When this happens, the bucket rolls out.

The excessive pressure in the bucket cylinder rod side is prevented by relief valve.

The cavitation which will happen to the rod side of the bucket cylinder is also prevented by the make-up valve in the main control valve.

7. DOZER/OUTRIGGER UP OPERATION



160WF3HC16

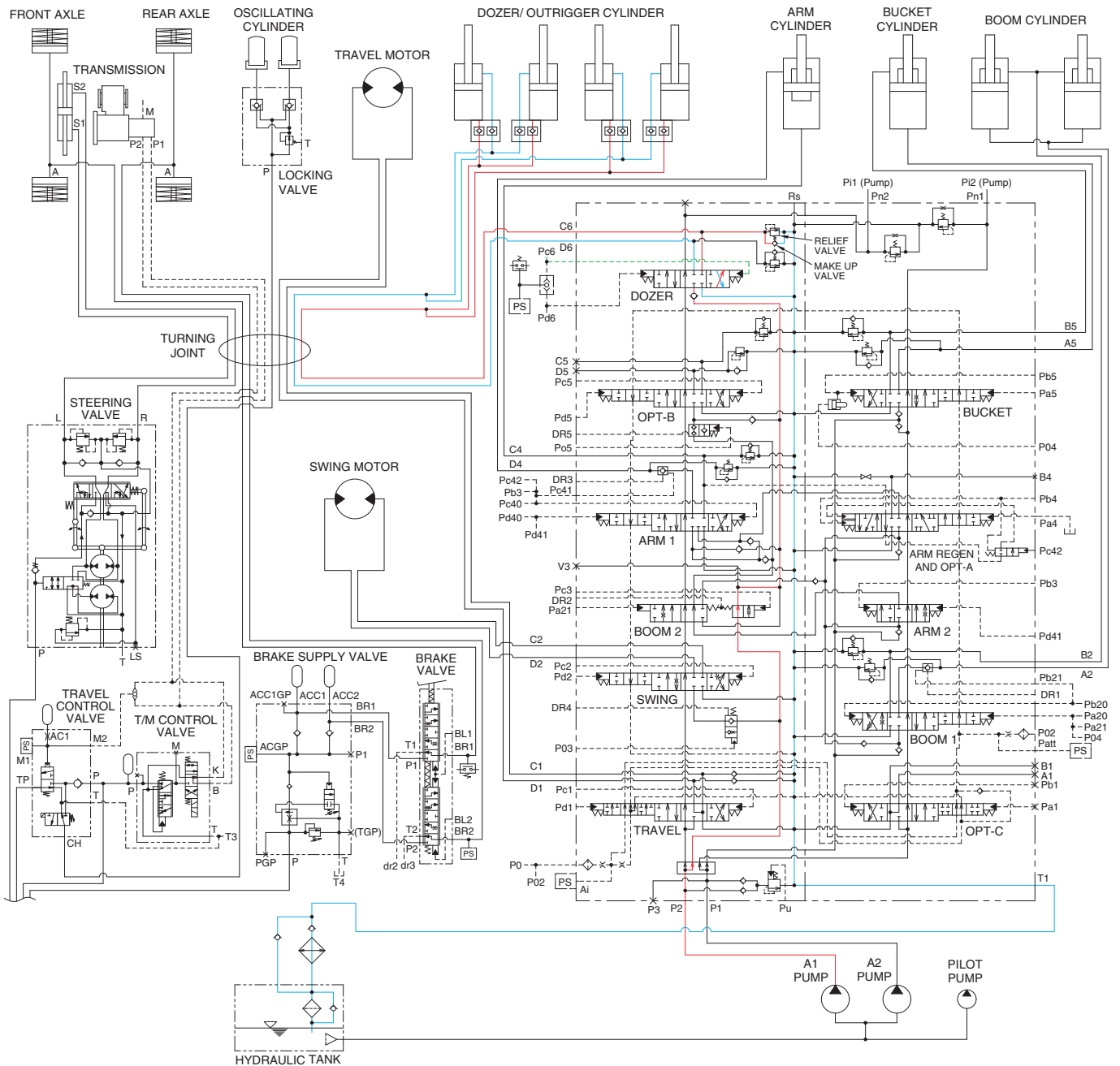
When the dozer control lever is pulled back, the dozer spool in the main control valve is moved to the dozer up position by the pilot oil pressure from the remote control valve.

The oil from the A1 pump flows into the main control valve and then goes to the small chamber of rear actuator cylinders (dozer or outrigger).

The other case, the oil flows into the small chamber of front actuator cylinders (dozer or outrigger). At the same time, the oil from the large chamber of dozer (outrigger) cylinders returns to the hydraulic oil tank through the dozer spool in the main control valve. When this happens, the dozer (outrigger) goes up.

Refer to the page 3-18 of the operator's manual for the switch selections of the front and rear of the dozer or outrigger.

8. DOZER/OUTRIGGER DOWN OPERATION



160WF3HC17

When the dozer control lever is pushed forward, the dozer spool in the main control valve is moved to the dozer down position by the pilot oil pressure from the remote control valve.

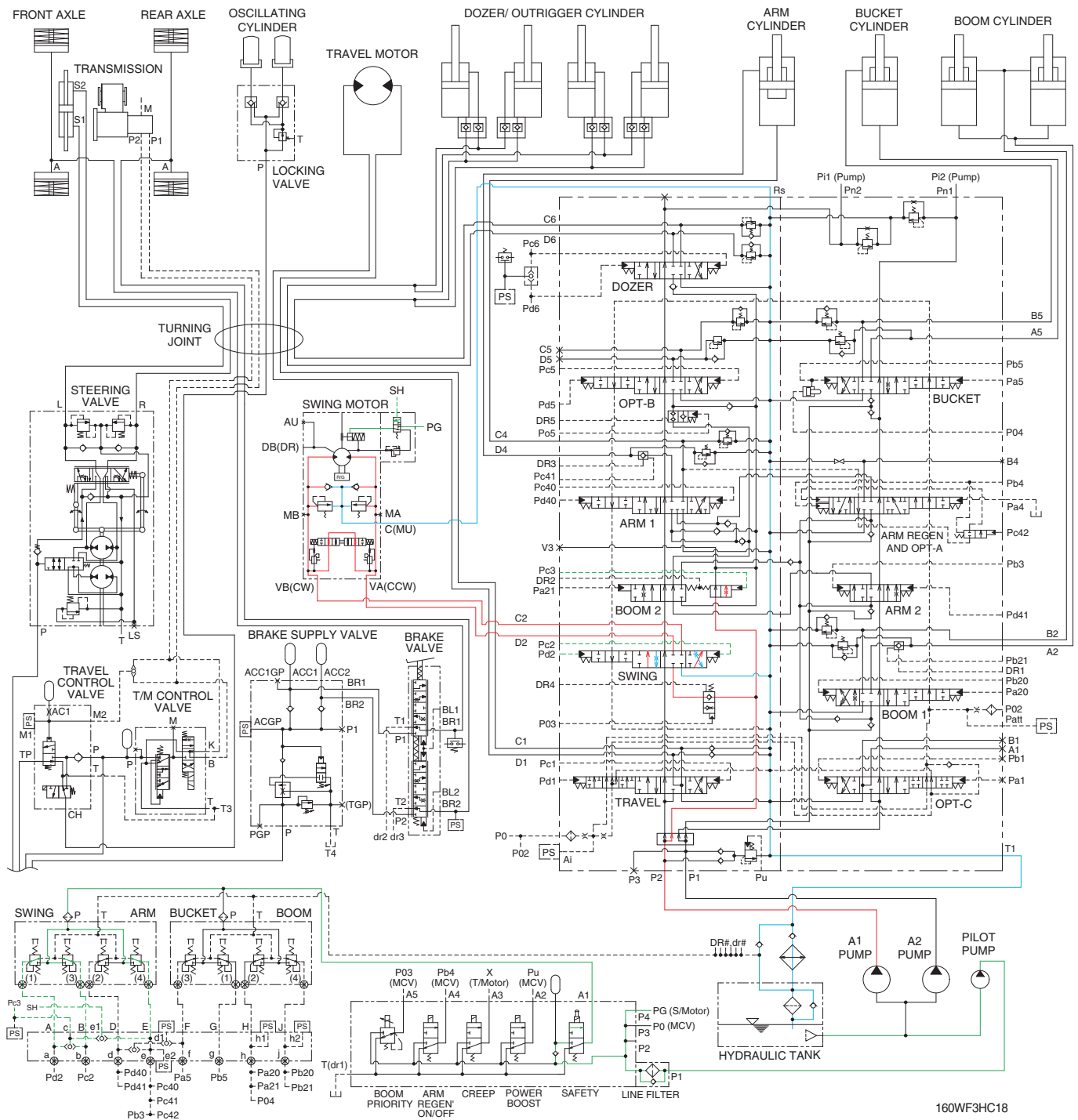
The oil from the A1 pump flows into the main control valve and then goes to the large chamber of rear actuator cylinders (dozer or outrigger).

The other case, the oil flows into the large chamber of front actuator cylinders (dozer or outrigger).

At the same time, the oil from the small chamber of dozer (outrigger) cylinders returns to the hydraulic oil tank through the dozer spool in the main control valve. When this happens, the dozer (outrigger) goes down.

Refer to the page 3-18 of the operator's manual for the switch selections of the front and rear of the dozer or outrigger.

9. SWING OPERATION



When the left control lever is pushed left or right, the swing spool in the main control valve is moved to the left or right swing position by the pilot oil pressure from the remote control valve.

Also the swing operation preference function is operated by the pilot pressure **Pc3** (refer to page 3-14).

The oil from the A1 pump flows into the main control valve and then goes to the swing motor.

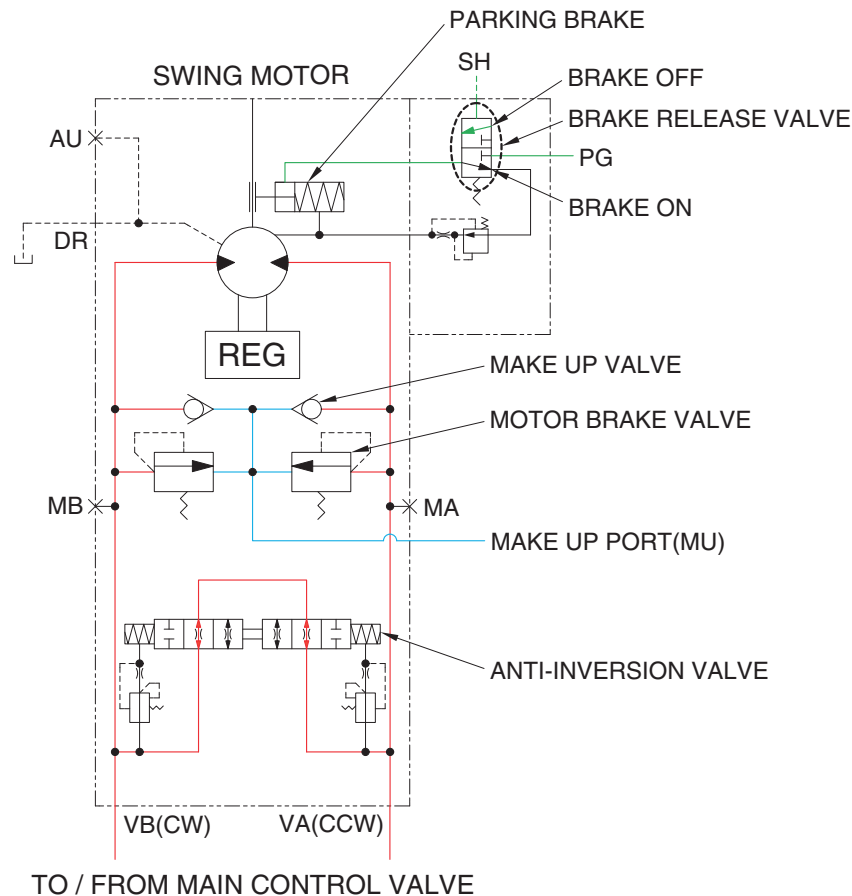
At the same time, the return oil from the swing motor returns to the hydraulic oil tank through the swing spool in the main control valve.

When this happens, the upper structure swings to the left or right.

The swing parking brake, make up valve and the motor brake valve are provided in the swing motor.

The cavitation which will happen to the swing motor is also prevented by the make up valve in the swing motor itself.

SWING CIRCUIT OPERATION



160WF3HC18A

1) MOTOR BRAKE VALVE

Motor brake valves for the swing motor limit to cushion the starting and stopping pressure of swing operation and control the swing motor operating pressure.

2) MAKE UP VALVE

The make up valves prevent cavitation by supplying return oil to the vacuum side of the motor.

3) PARKING BRAKE

This is function as a parking brake only when the swing control lever and arm in control lever are not operated.

PARKING BRAKE "OFF" OPERATION

The parking brake is released by the pilot pressure oil from the pilot pump.

When the swing control lever or arm in control lever placed in the operating position, the pilot oil flows into SH port through the terminal block. This pressure transferred to the brake release valve and the brake release valve is change over. Then the pilot oil pressure PG lifts the brake piston and release the parking brake.

PARKING BRAKE "ON" OPERATION

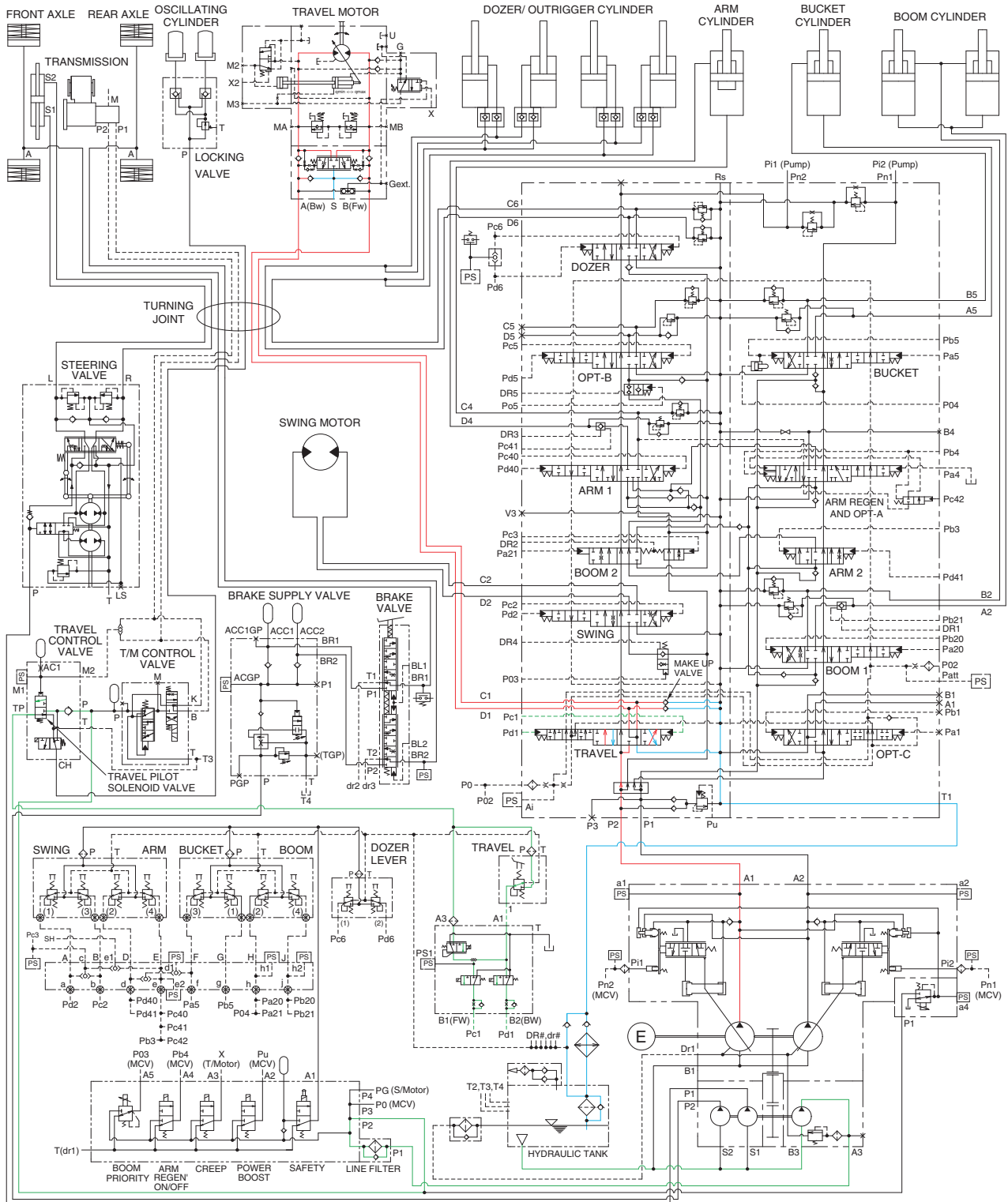
When the swing control lever and arm in control lever placed in the neutral position, the pressure of the pilot oil passage down.

Then the brake release valve returned to the neutral position and the oil is returned from the brake piston to the hydraulic oil tank. And the parking brake is set to 'ON'.

4) ANTI-INVERSION VALVE

This anti-inversion valve absorbs shocks produced as swing motion stops and reduced oscillation cause by swing motion.

10. TRAVEL FORWARD AND REVERSE OPERATION



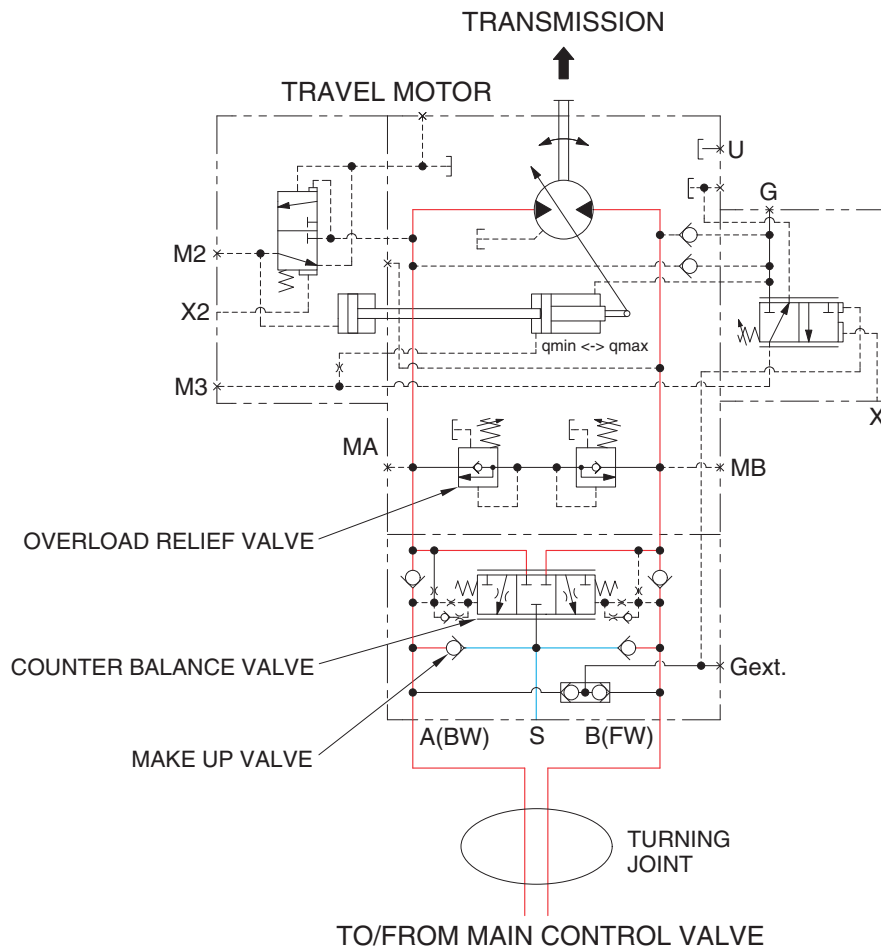
160WF3HC19

When the RH multifunction switch is placed in forward or reverse position, the travel spool in the main control valve is moved to the forward or reverse position by the pilot oil pressure from pilot pump through the travel pilot solenoid valve of travel control valve. The oil from the A1 pump flows into the main control valve and then goes to the travel motor. At the same time, the oil returned from the travel motor returns to the hydraulic oil tank through the turning joint and travel spool in the main control valve.

When this happens, the machine moves forward or reverse.

The cavitation which will happen to the travel motor is prevented by the make-up valves in the main control valve and make up valves in the travel motor itself.

TRAVEL CIRCUIT OPERATION



160WF3HC19A

Valves are provided on travel motor to offer the following functions.

1) COUNTER BALANCE VALVE

When stopping the motor on a slope descending, this valve prevents the motor from over running.

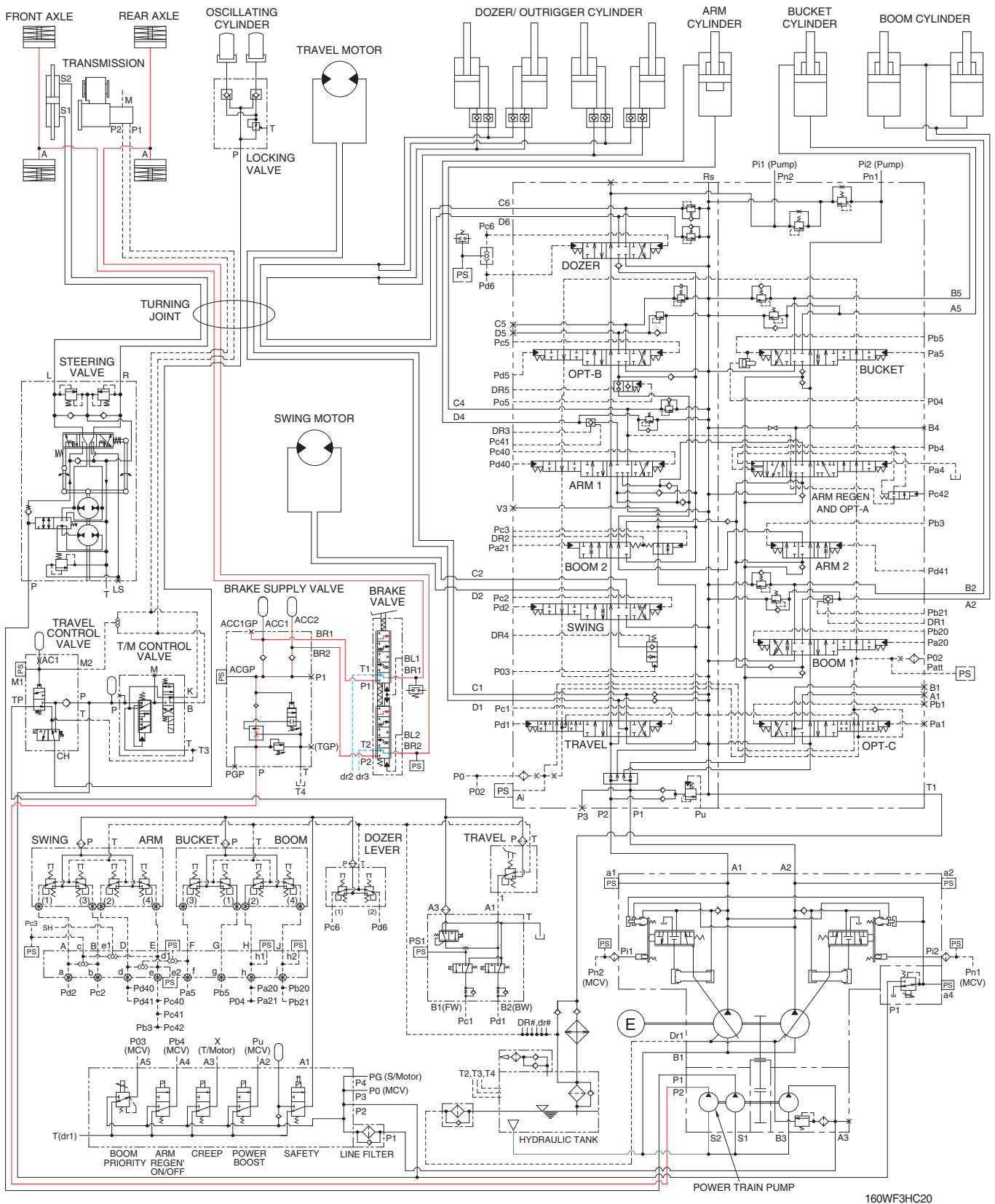
2) OVERLOAD RELIEF VALVE

Relief valve limits the circuit pressure below 380 kgf/cm^2 to prevent high pressure from being generated at the time of stopping the machine. When stopping the motor, this valve sucks the oil from lower pressure passage for preventing the negative pressure and the cavitation of the motor.

3) MAKE UP VALVE

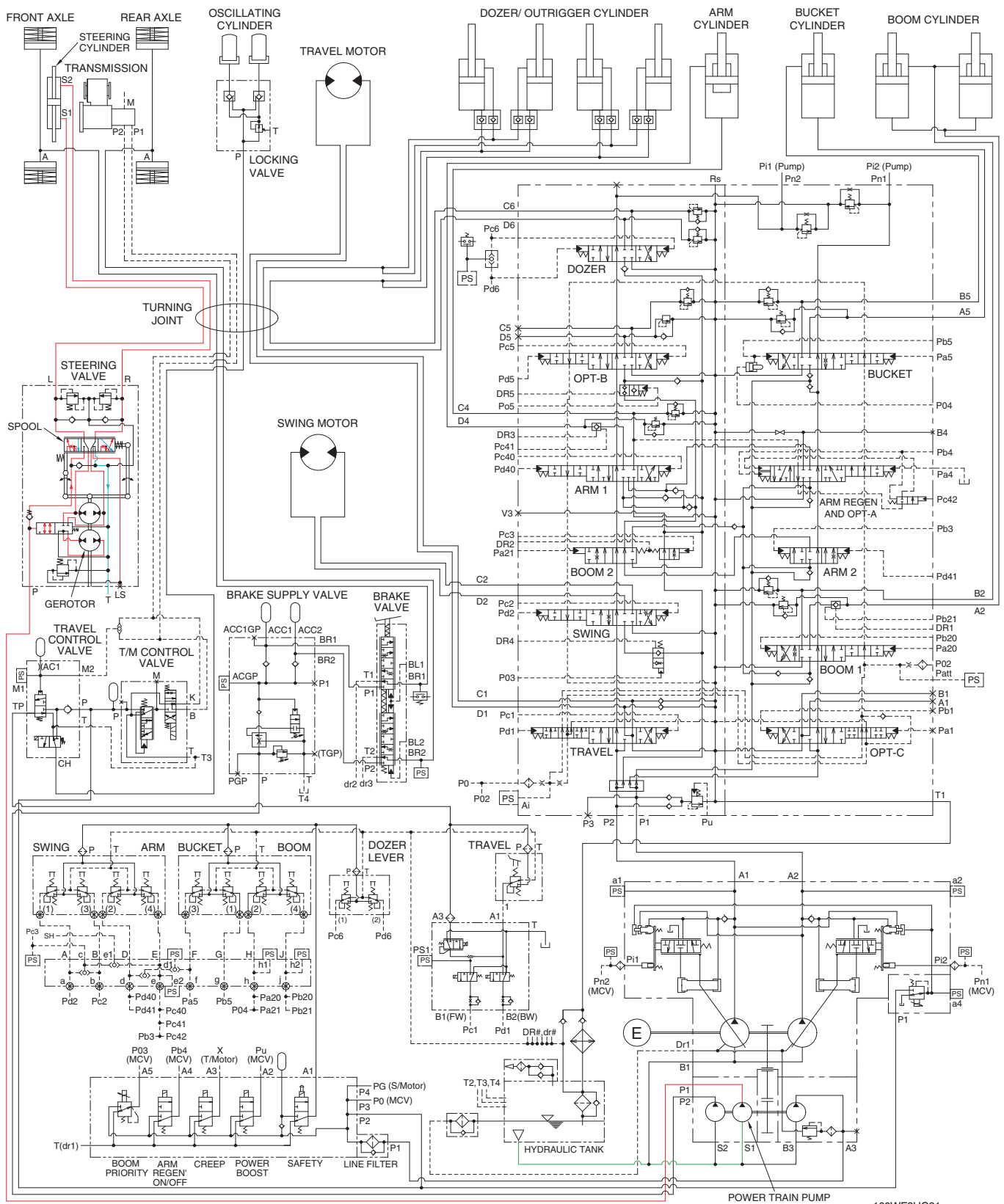
The make up valves prevent cavitation by supplying return oil to the vacuum side of the motor.

11. FRONT AND REAR AXLE BRAKE SYSTEM (SERVICE BRAKE)



When the brake pedal (valve) is pushed, the discharged oil from the power train pump (P2) flows into the front and rear axle brake piston through the solenoid valve of brake supply valve. This pressure is applied to axle brake disc, thus the service brake is applied.

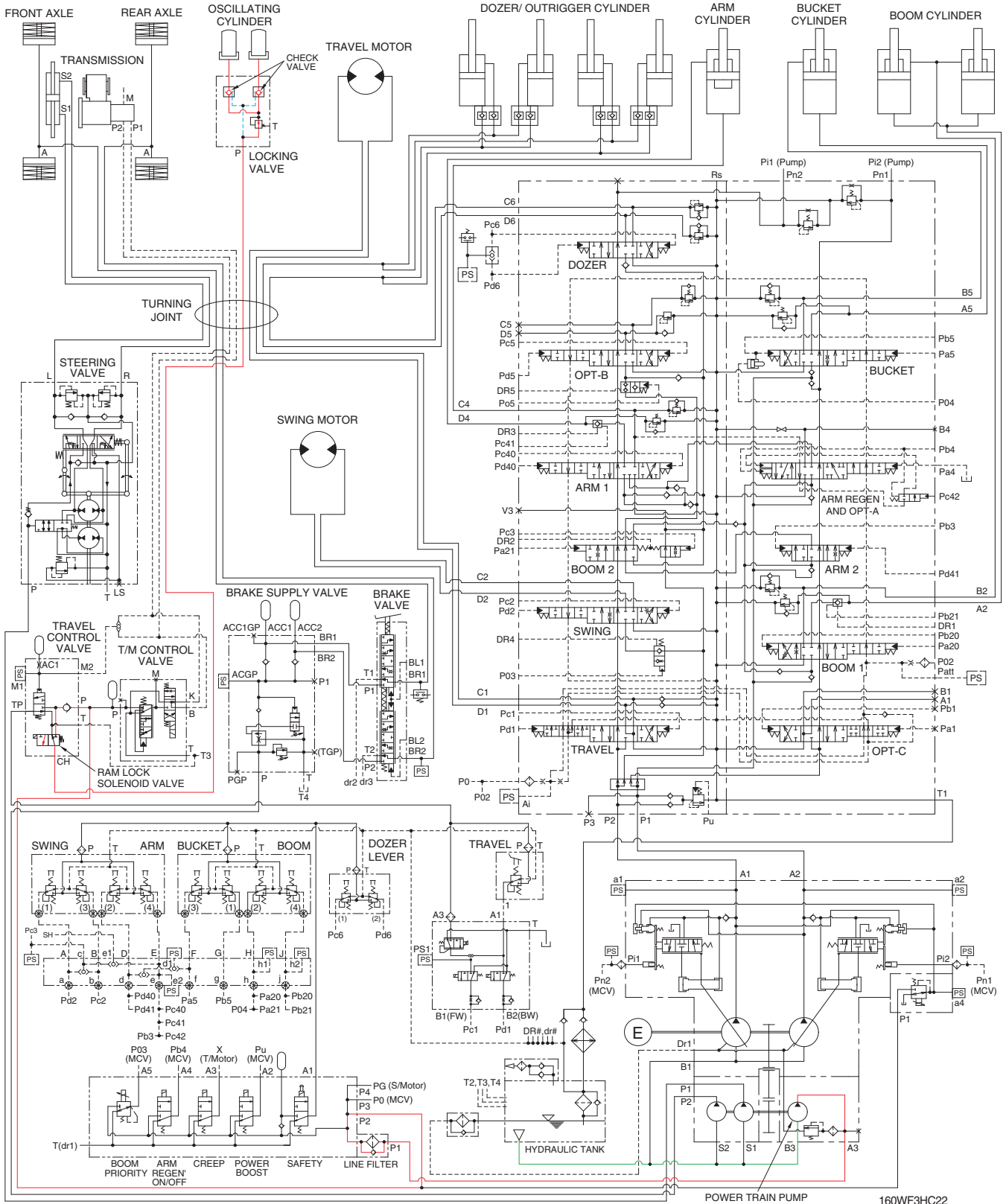
12. STEERING CIRCUIT OPERATION



160WF3HC21

When the steering wheel is turned to the left or right, the spool within the steering valve turns left or right hand direction : Because the spool is connected with steering column.
 At this time, the oil discharged from the power train pump (P1) flows into steering cylinder through spool and gerotor within the steering valve and the turning joint.
 Then the steering direction is applied.

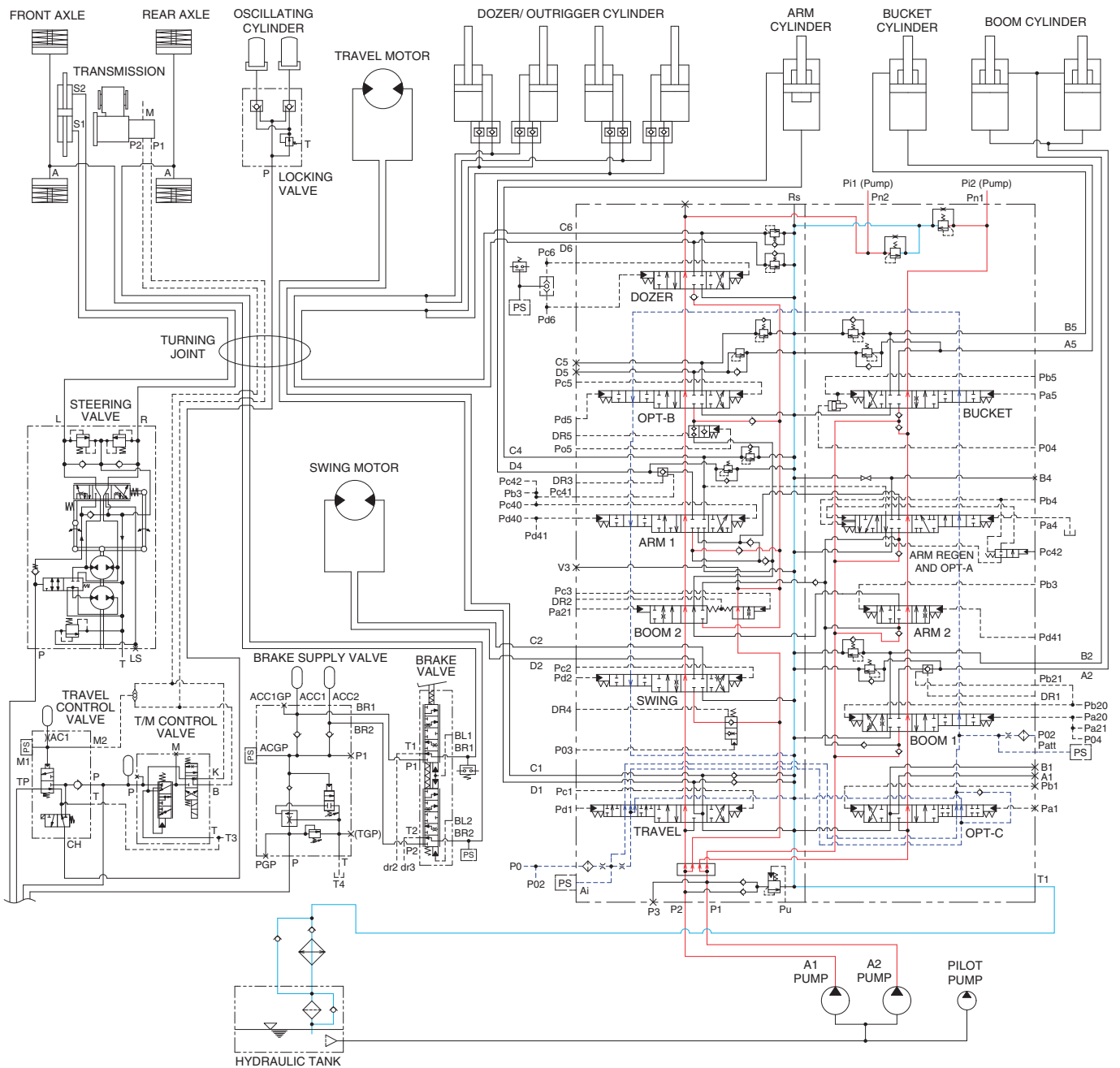
13. RAM LOCK CIRCUIT OPERATION



When the ram lock switch on the dashboard of the steering column is selected OFF position, the ram lock solenoid valve is changed over. Thus, the oil discharged from the pilot pump flows into oscillating cylinder through ram lock solenoid and locking valve. This pressure is applied to check valve and oscillating cylinder, thus the oscillating function is operated (Ram lock released). Refer to the page 3-47 for the ram lock function as the ram lock switch positions.

GROUP 5 COMBINED OPERATION

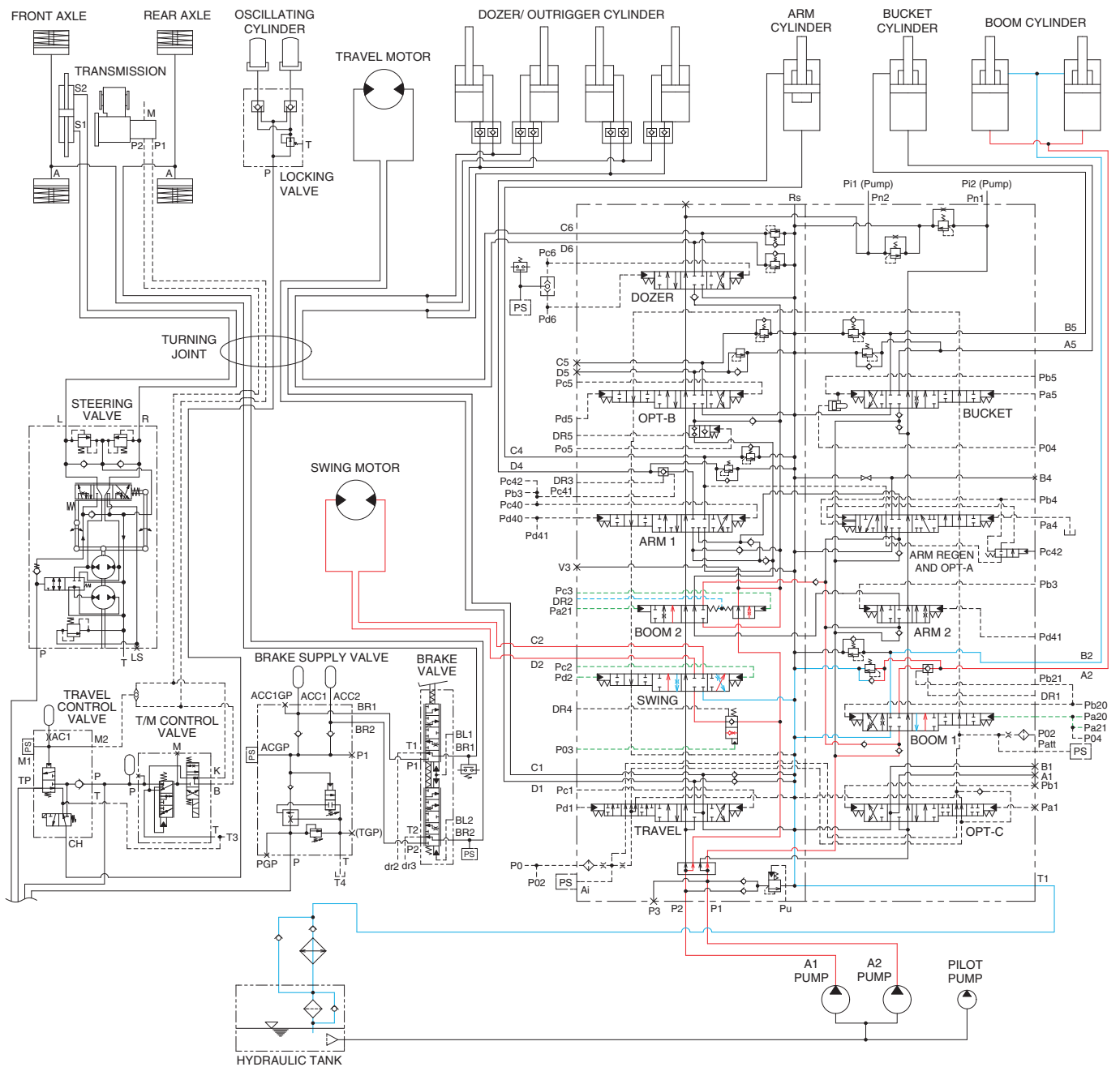
1. OUTLINE



160WF3HC23

The oil from the A1 and A2 pump flows through the neutral oil passage, bypass oil passage and confluence oil passage in the main control valve. Then the oil goes to each actuator and operates them. Check valves and orifices are located on these oil passage in the main control valve. These control the oil from the main pumps so as to correspond to the operation of each actuator and smooth the combined operation.

2. COMBINED SWING AND BOOM UP OPERATION



160WF3HC24

When the swing and boom up functions are operated simultaneously, the swing spool and boom spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

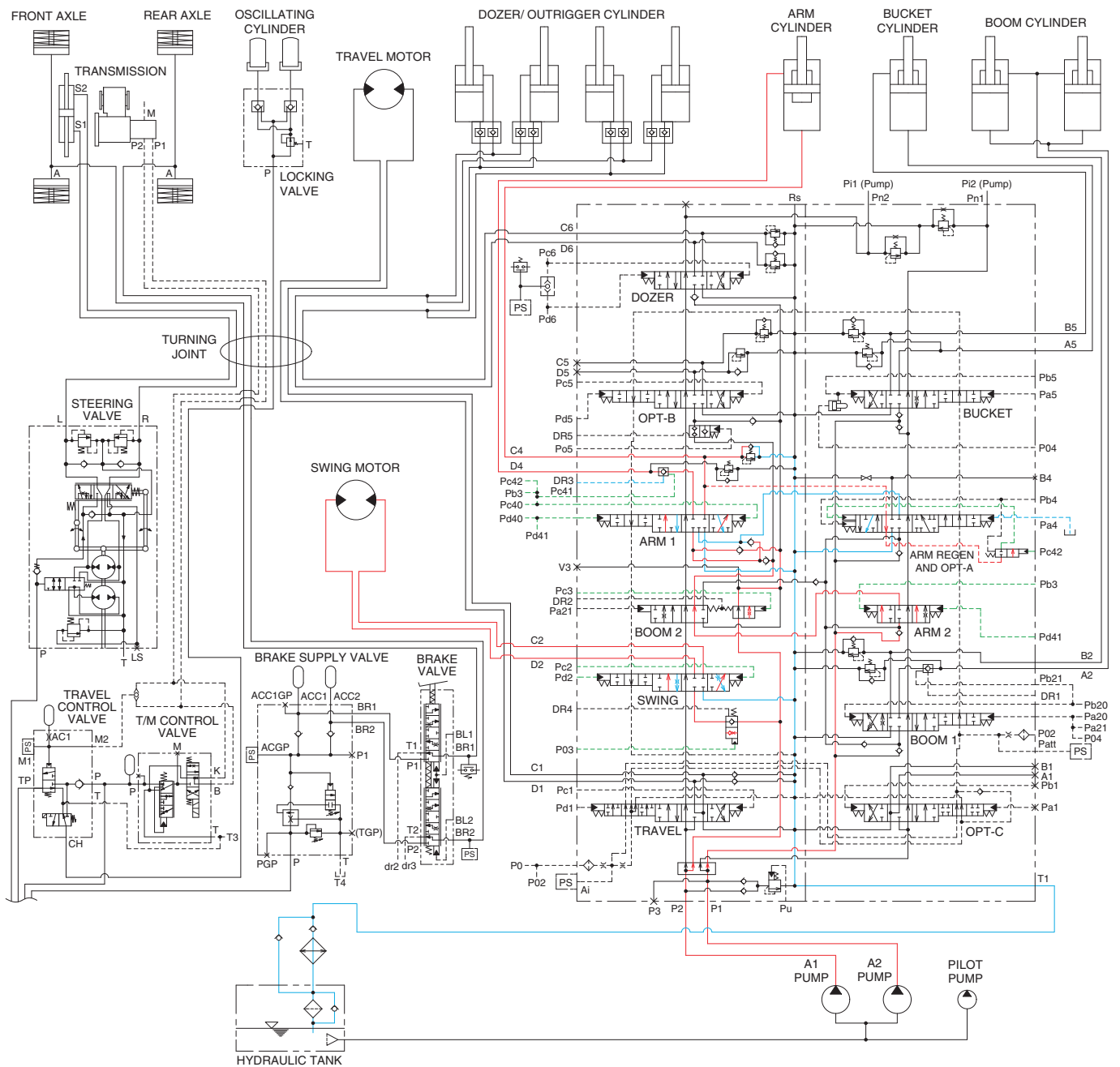
The oil from the A1 pump flows into the swing motor through swing spool and the boom cylinders through boom 2 spool and boom 1 spool.

The oil from the A2 pump flows into the boom cylinders through the boom 1 spool in the main control valve.

The super structure swings and the boom is up.

Refer to page 3-14 for the boom priority system.

3. COMBINED SWING AND ARM OPERATION



160WF3HC25

When the swing and arm functions are operated simultaneously, the swing spool and arm spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

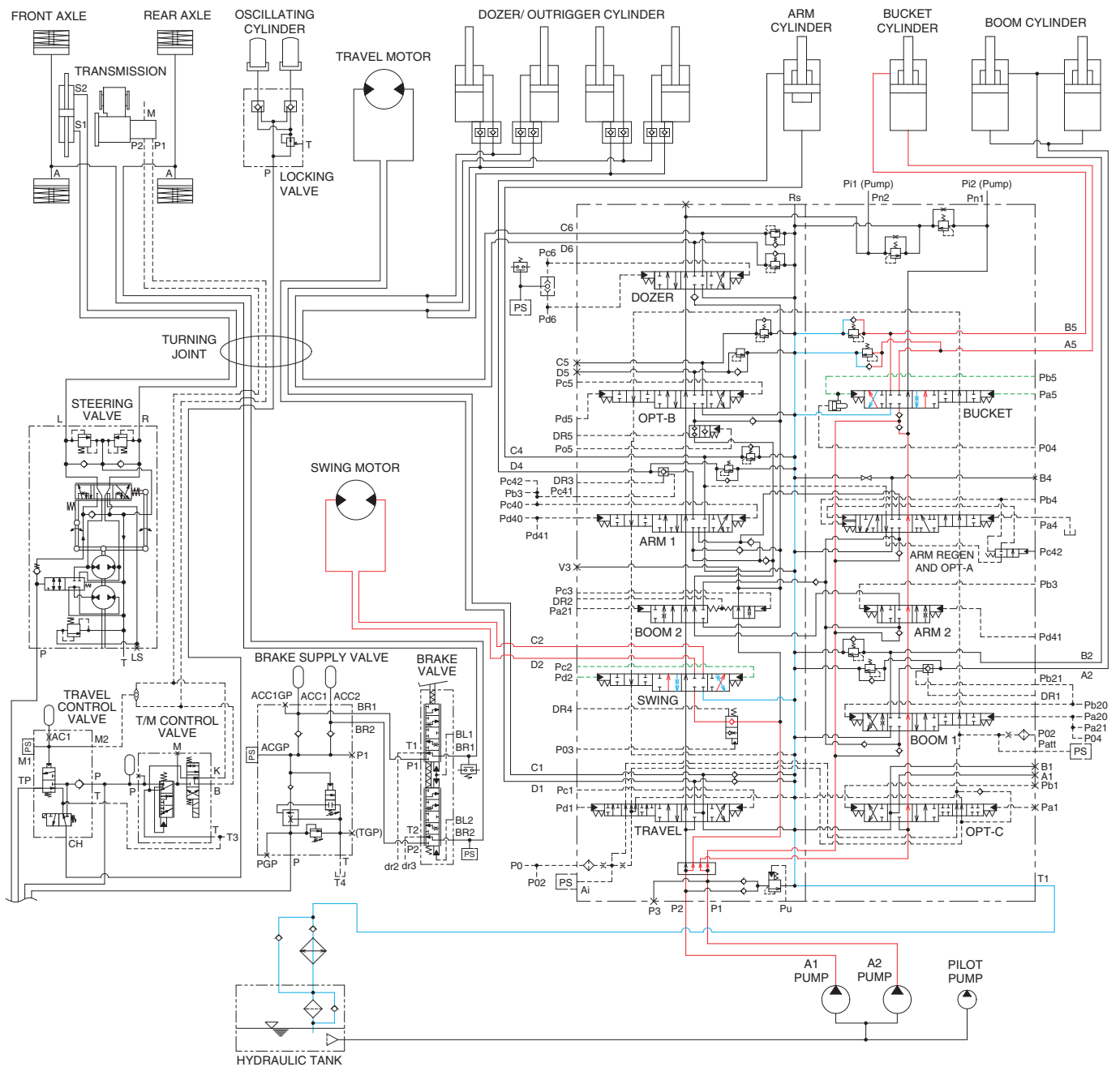
The oil from the A1 pump flows into the swing motor through swing spool and the arm cylinder through arm 1 spool.

The oil from the A2 pump flows into the arm cylinder through the arm 2 spool and arm 1 spool of the control valve.

The super structure swings and the arm is operated.

Refer to page 3-15 for the swing operation preference function.

4. COMBINED SWING AND BUCKET OPERATION



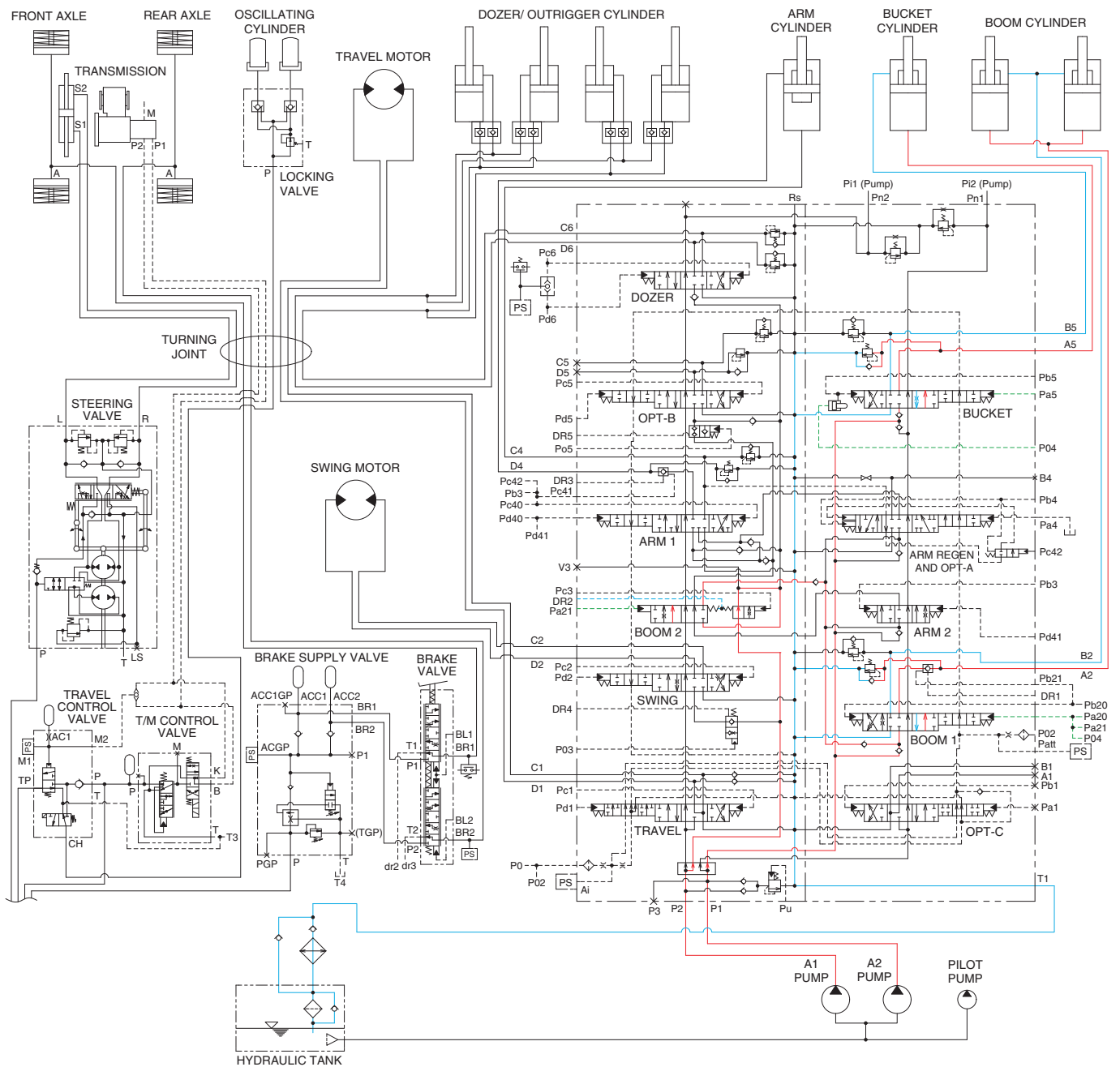
160WF3HC26

When the swing and bucket functions are operated simultaneously, the swing spool and bucket spool in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

The oil from the A1 pump flows into the swing motor through the swing spool in the left control valve. The oil from the A2 pump flows into the bucket cylinder through the bucket spool in the right control valve.

The super structure swings and the bucket is operated.

5. COMBINED BOOM UP AND BUCKET IN OPERATION



160WF3HC27

When the boom up and bucket in function are operated simultaneously, each spool in the main control valve is moved to the functional position by the pilot oil pressure from the remote control valve.

The oil from the A1 pump flows into the boom cylinders through the boom 2 spool and boom 1 spool in the main control valve. The oil from the A2 pump flows into the boom cylinders and bucket cylinder through the boom 1 spool, bucket spool and the parallel and confluence oil passage in the right control valve.

When the boom up and bucket in functions are operated simultaneously, the boom up operation preference function is operated by the pilot pressure **P04** and then the the bucket spool transfers in the half stroke not full stroke (refer to page 2-33). Therefore, the most of pressurized oil flows into boom 1 spool than the bucket spool to make the boom up operation more preferential.

The boom and bucket in are operated.