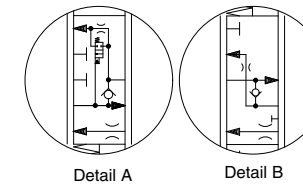
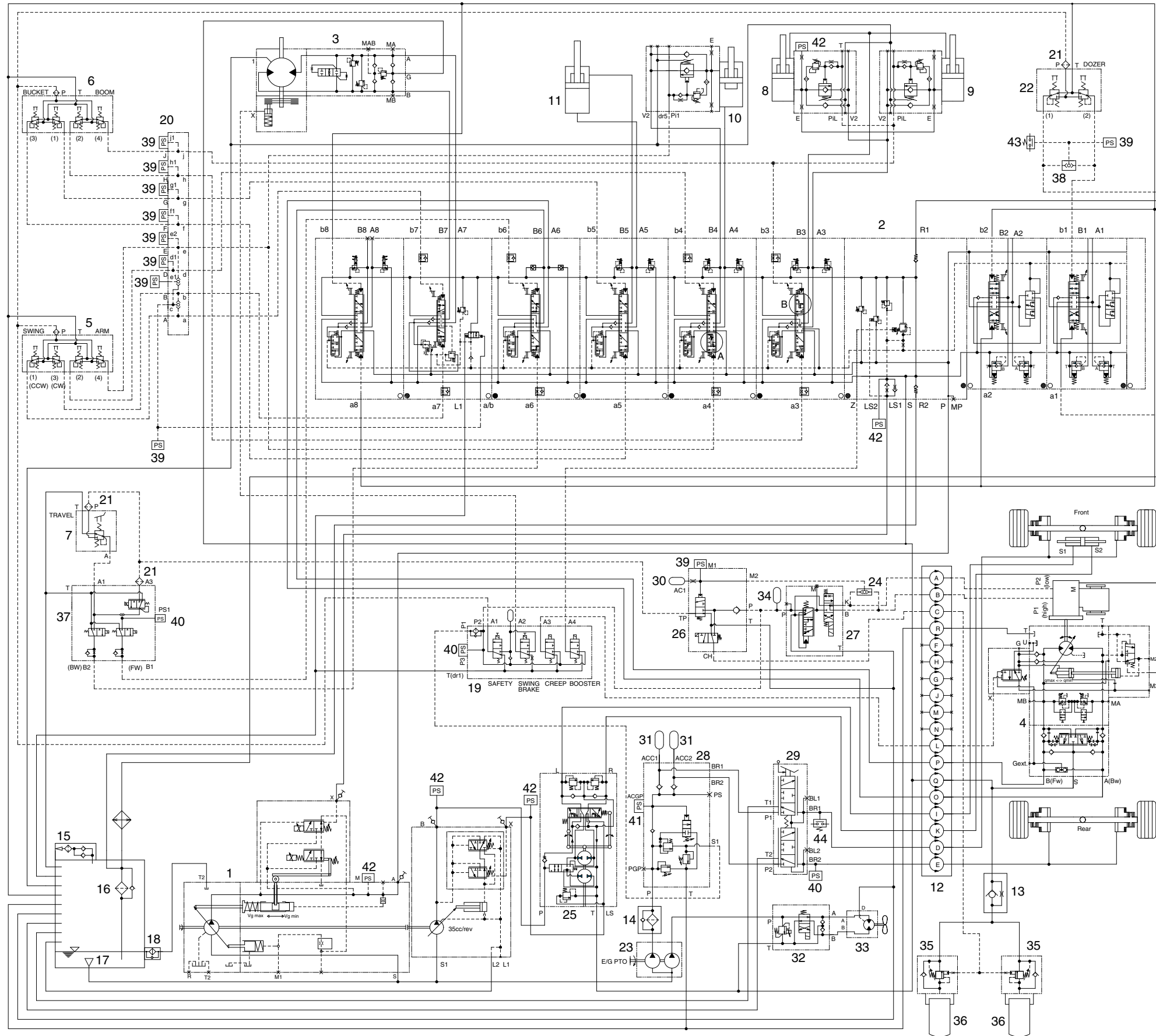


## SECTION 3 HYDRAULIC SYSTEM

Group 1 Hydraulic Circuit .....	3-1
Group 2 Main Circuit .....	3-4
Group 3 Pilot Circuit .....	3-7
Group 4 Single Operation .....	3-15
Group 5 Combined Operation .....	3-30

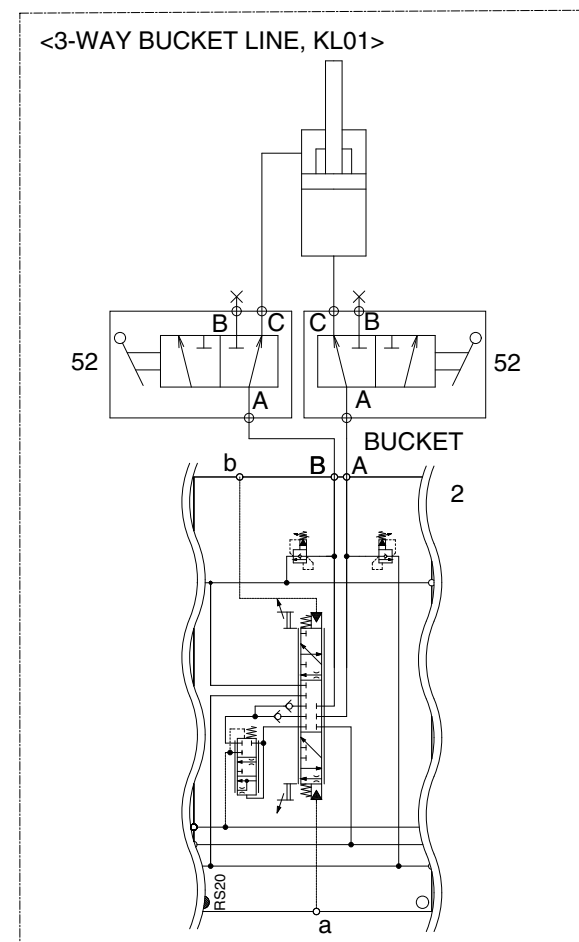
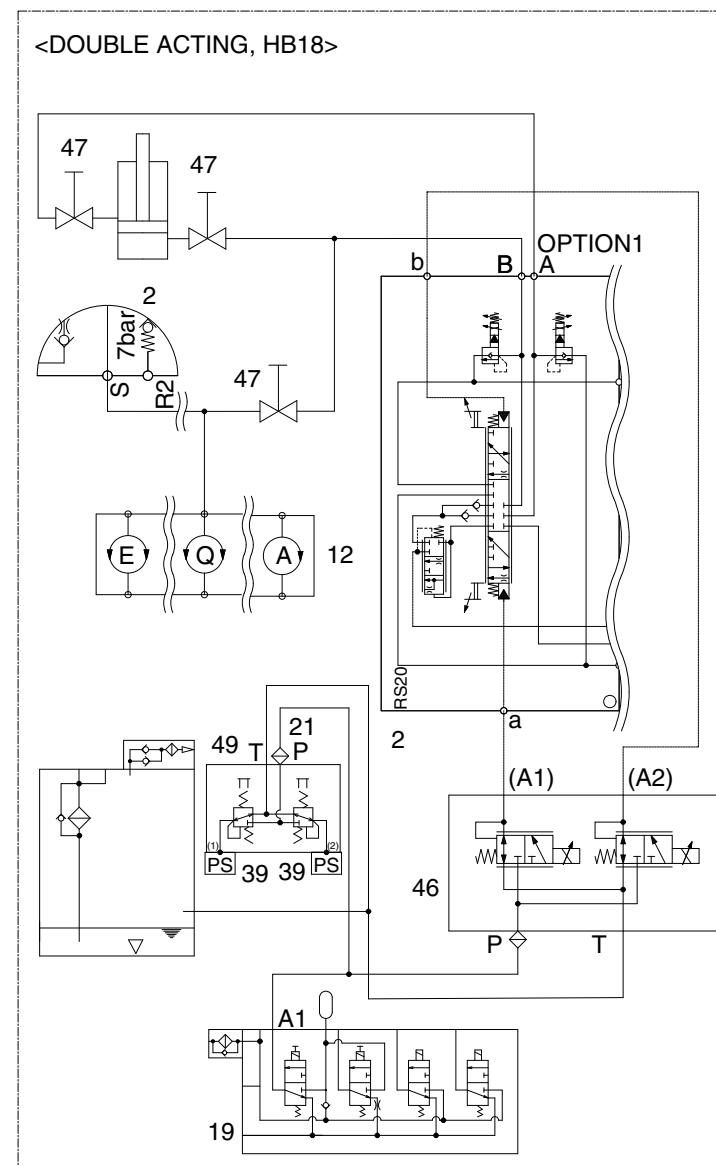
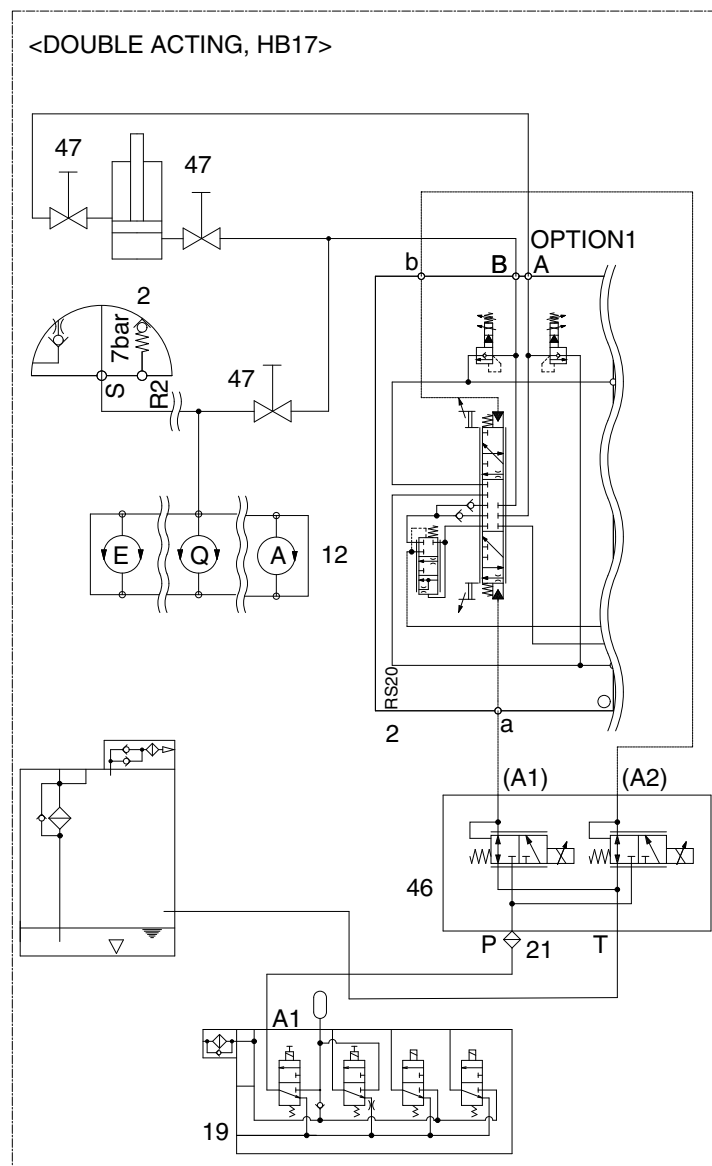
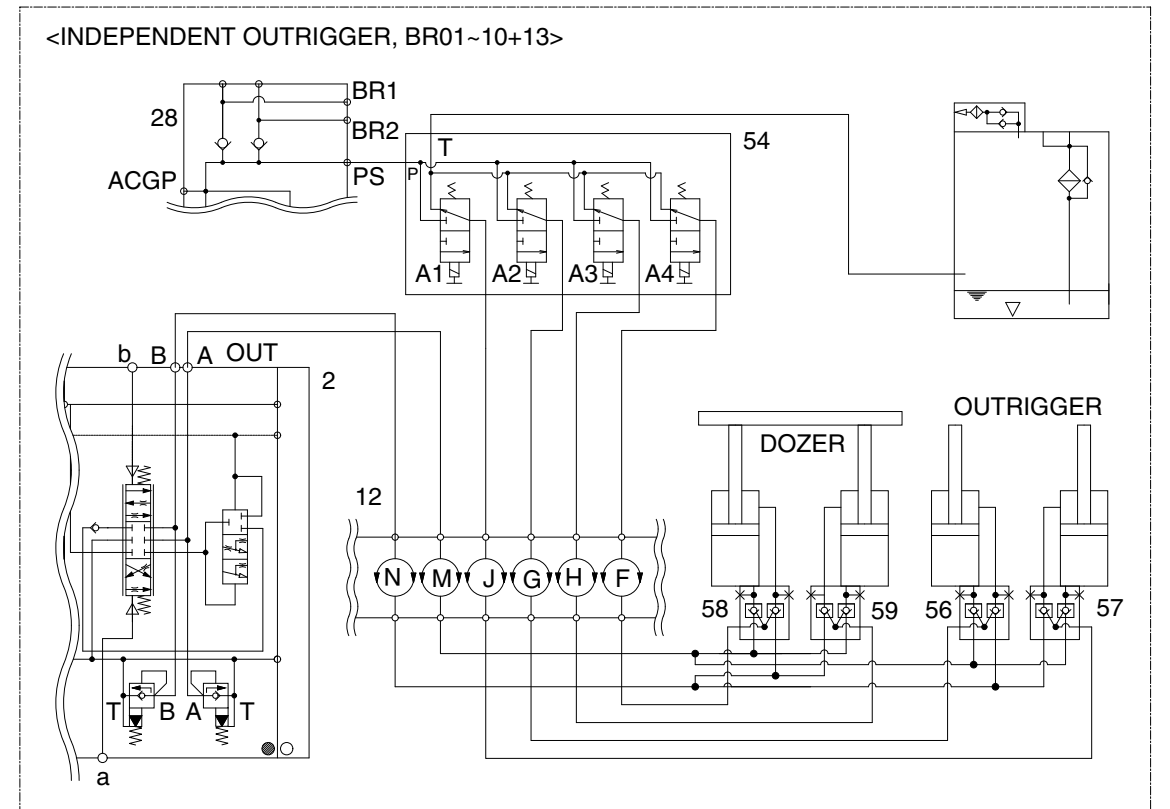
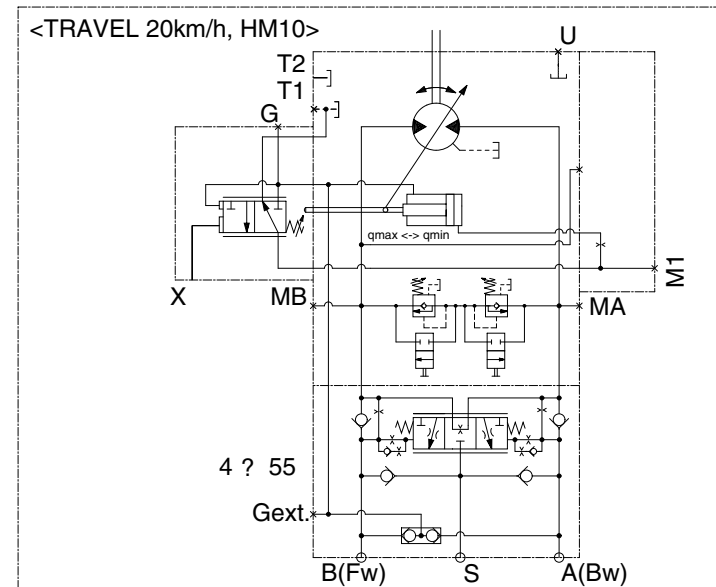
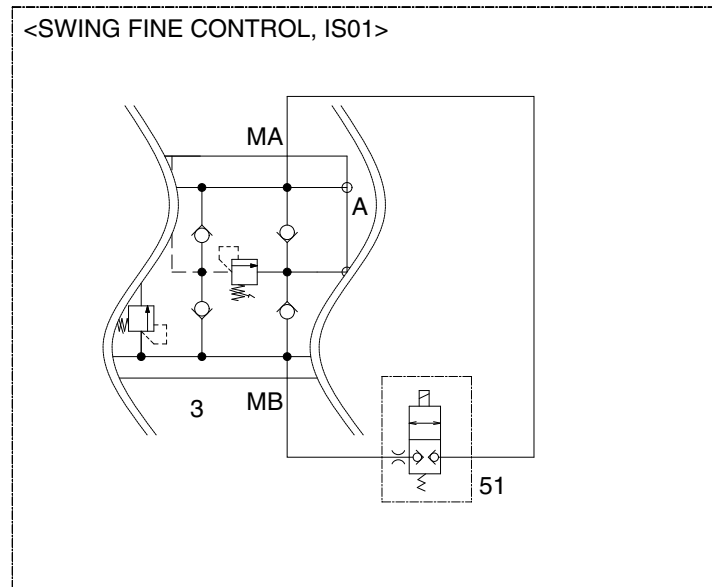
# GROUP 1 HYDRAULIC CIRCUIT

## 1. HYDRAULIC CIRCUIT (1/4)



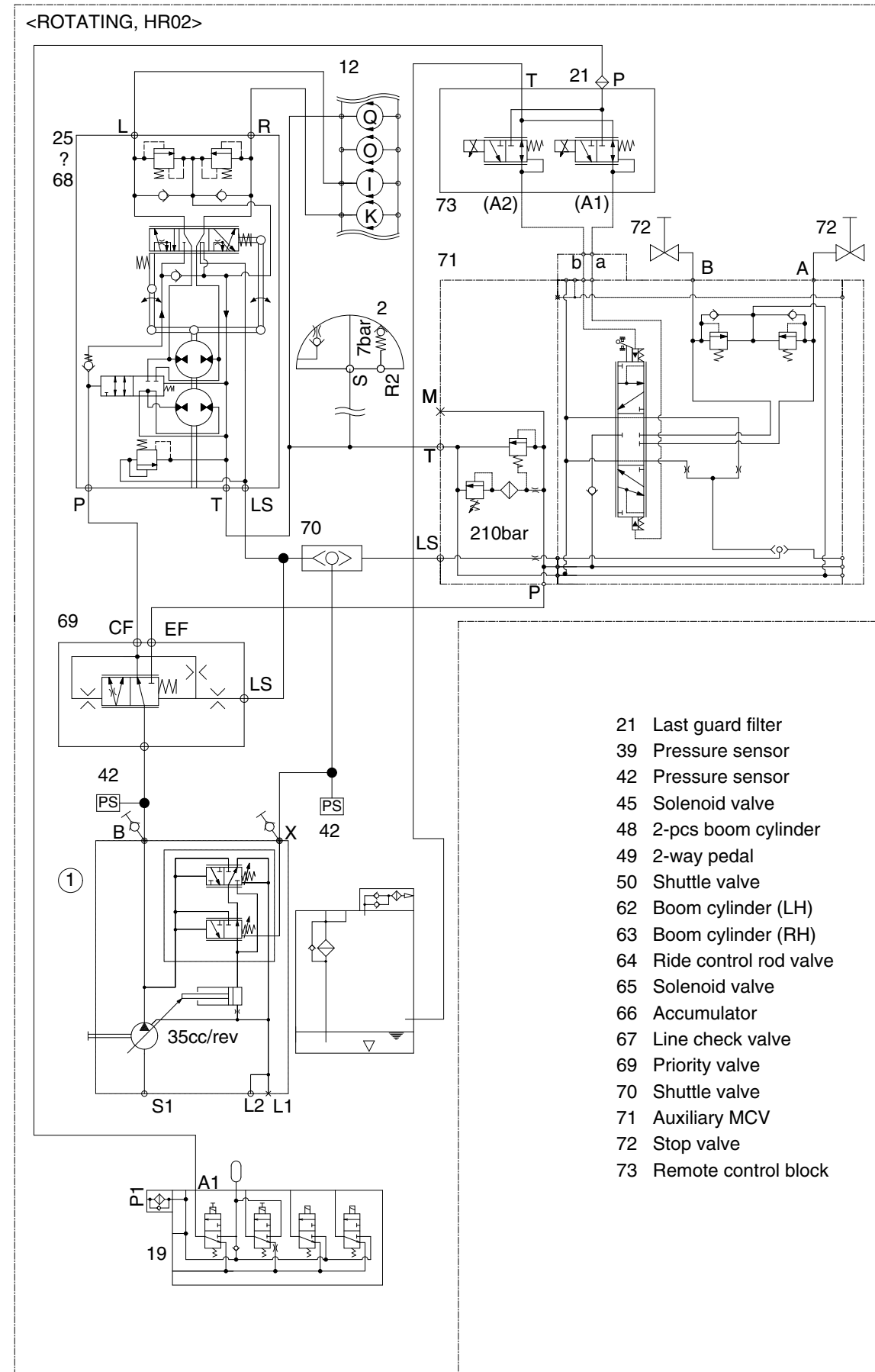
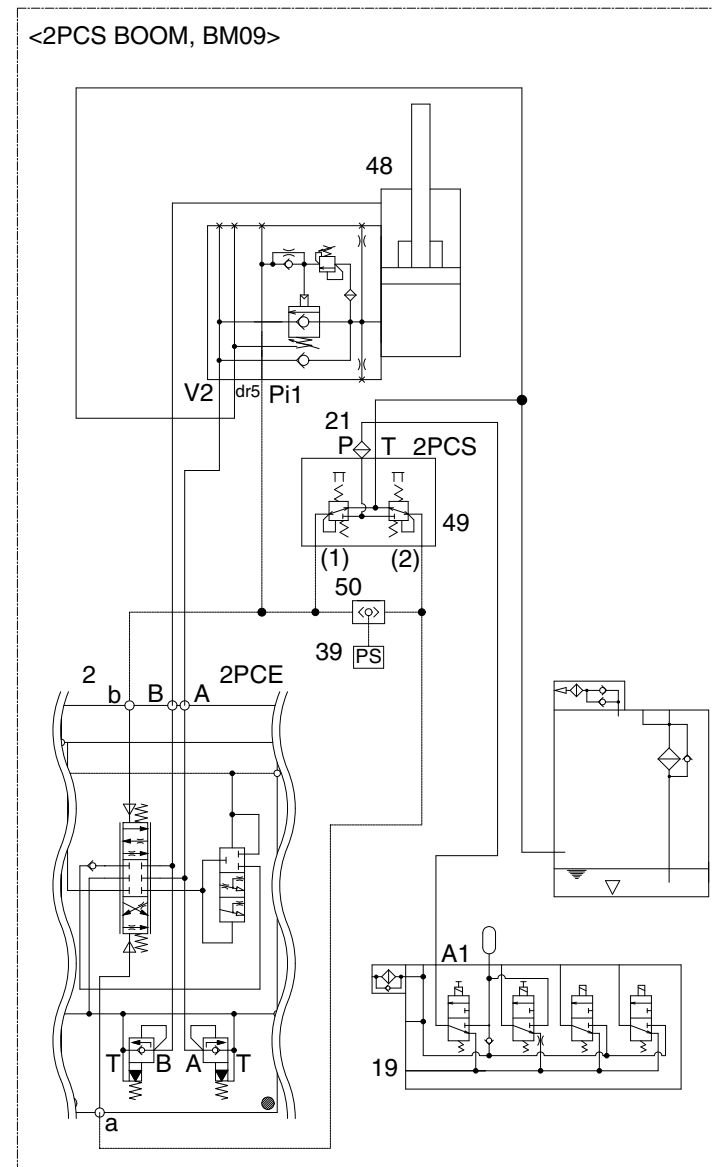
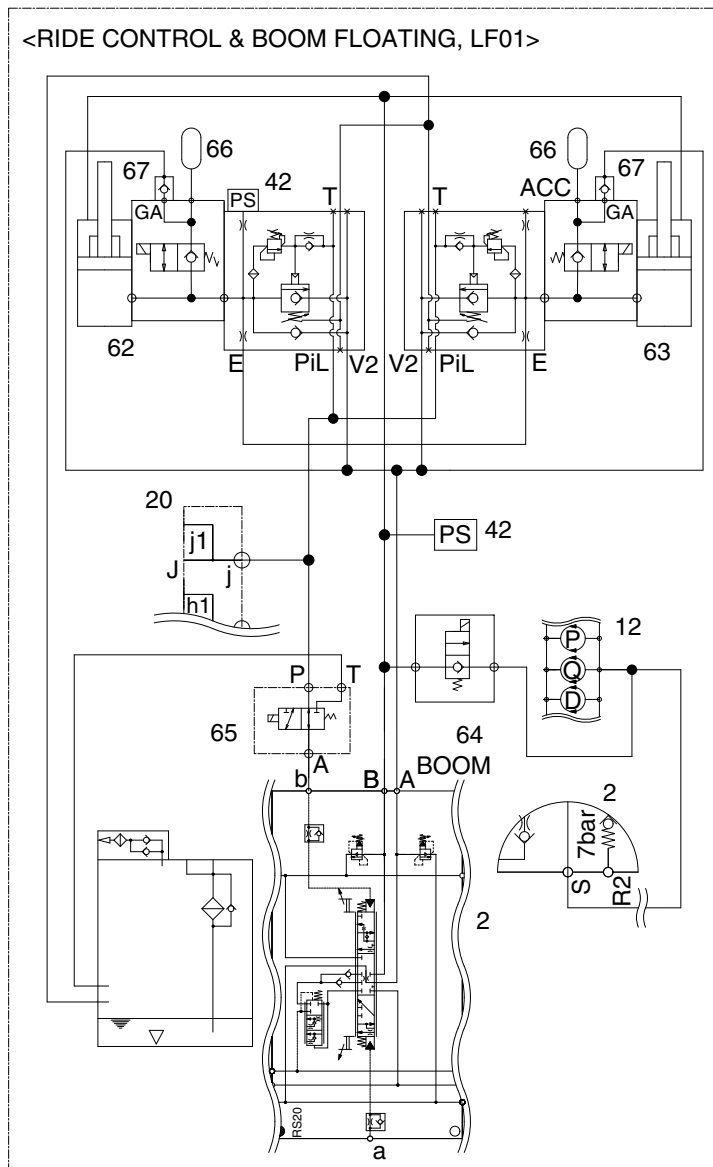
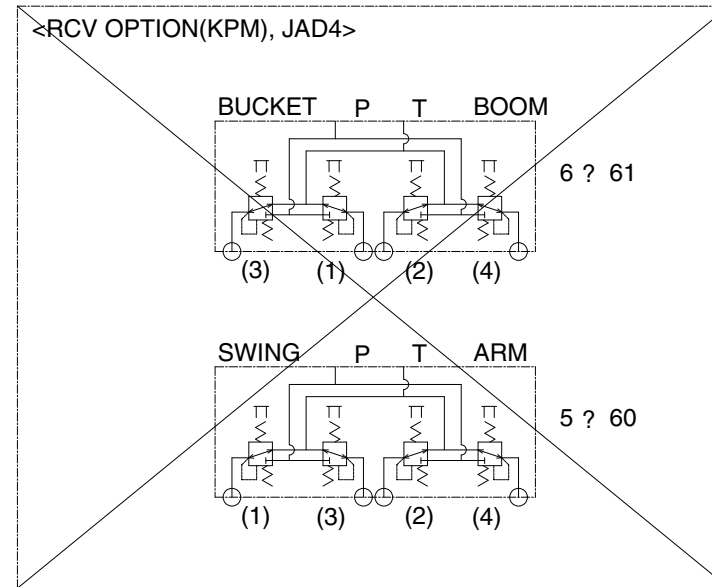
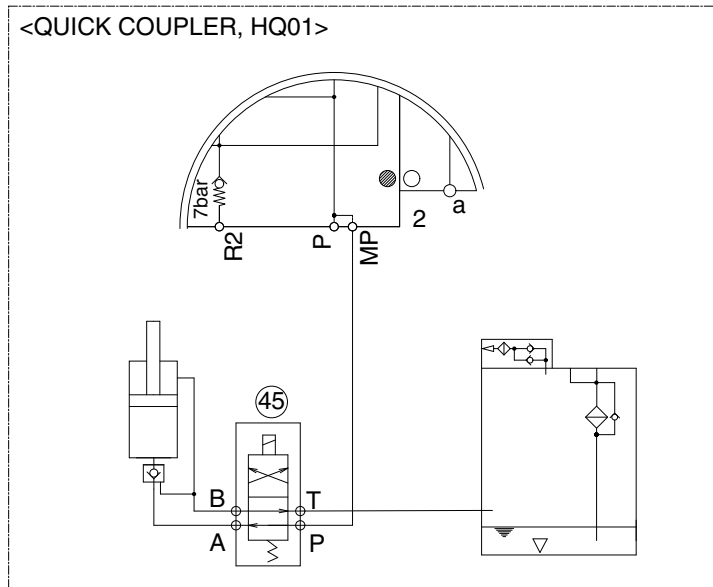
- 1 Main pump
- 2 Main control valve
- 3 Swing motor
- 4 Travel motor
- 5 RCV lever (LH)
- 6 RCV lever (RH)
- 7 RCV pedal
- 8 Boom cylinder (LH)
- 9 Boom cylinder (RH)
- 10 Arm cylinder
- 11 Bucket cylinder
- 12 Turning joint
- 13 Orifice and check valve
- 14 Last guard filter
- 15 Air breather
- 16 Return filter w/bypass valve
- 17 Strainer
- 18 Drain filter
- 19 4-cartridge valve
- 20 Terminal block
- 21 Last guard filter
- 22 RCV dozer lever
- 23 Gear pump
- 24 Shuttle valve
- 25 Steering unit
- 26 Travel control valve
- 27 Transmission control valve
- 28 Brake supply valve
- 29 Brake valve
- 30 Accumulator
- 31 Accumulator
- 32 Fan control valve
- 33 Fan motor-bi
- 34 Accumulator
- 35 Locking valve
- 36 Oscillating cylinder
- 37 3-cartridge valve
- 38 Shuttle valve
- 39 Pressure sensor
- 40 Pressure sensor
- 41 Pressure sensor
- 42 Pressure sensor
- 43 Pressure switch
- 44 Pressure switch

## 2. HYDRAULIC CIRCUIT (2/4)



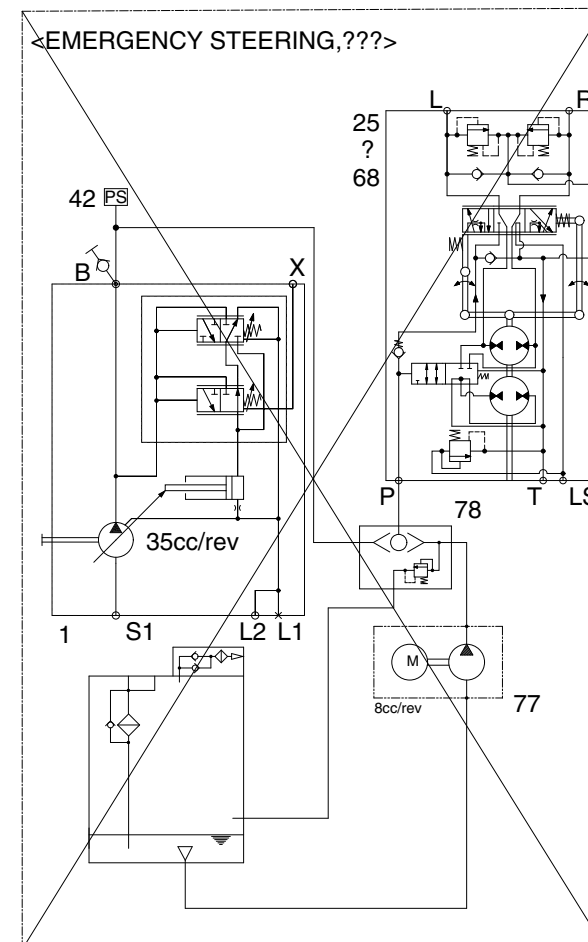
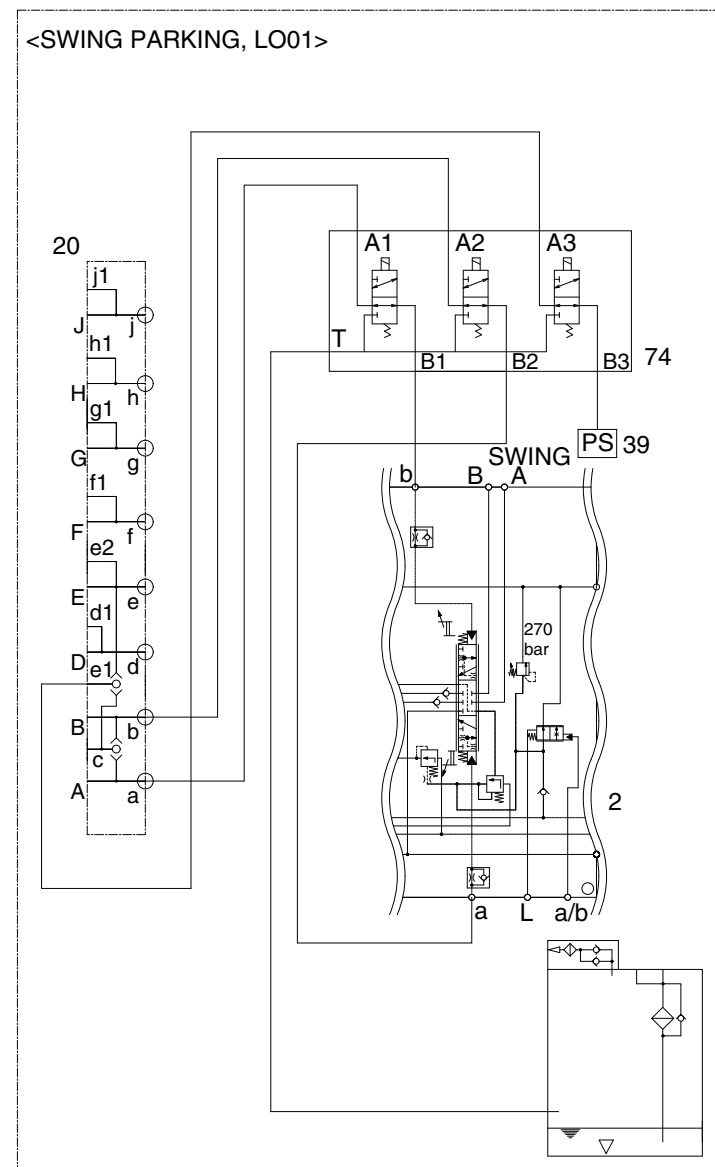
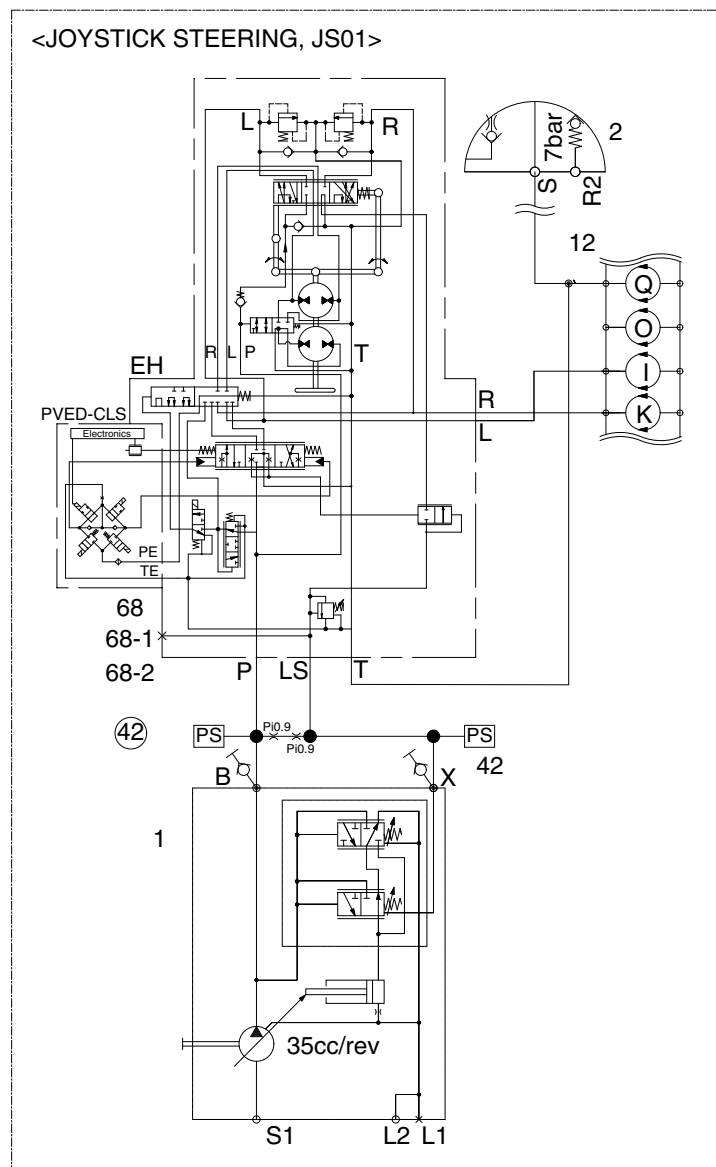
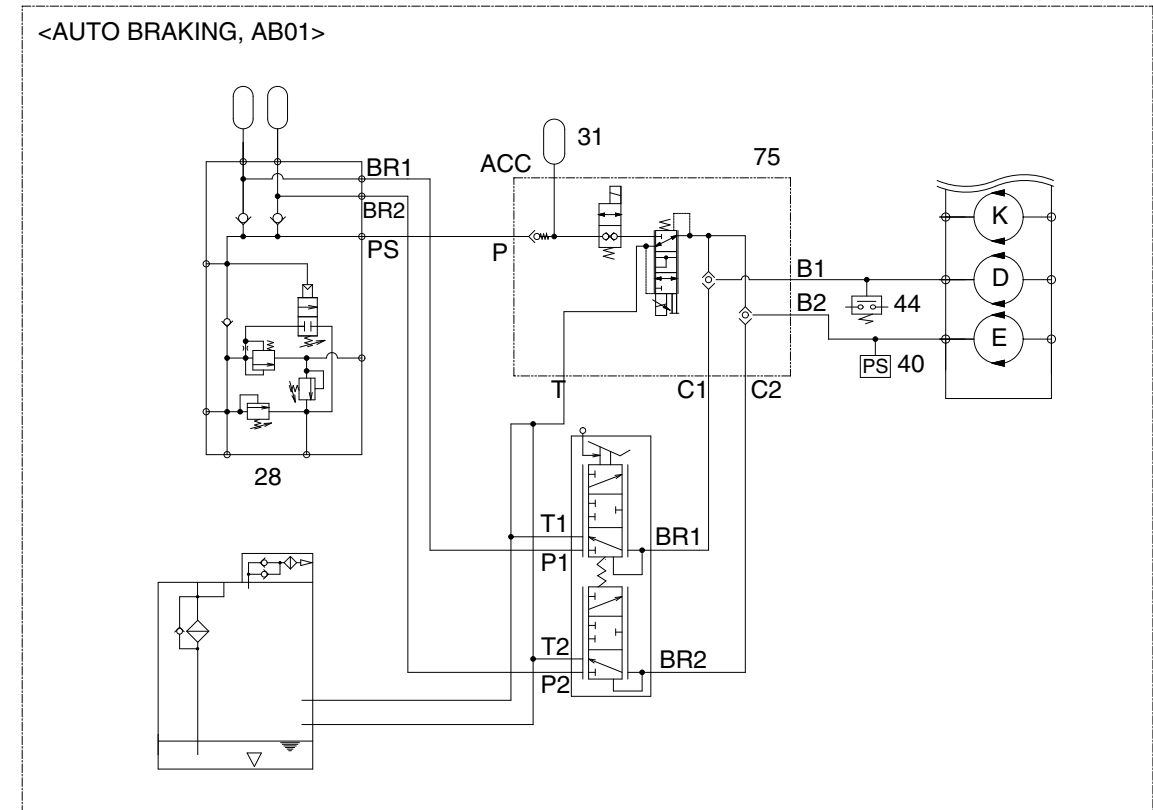
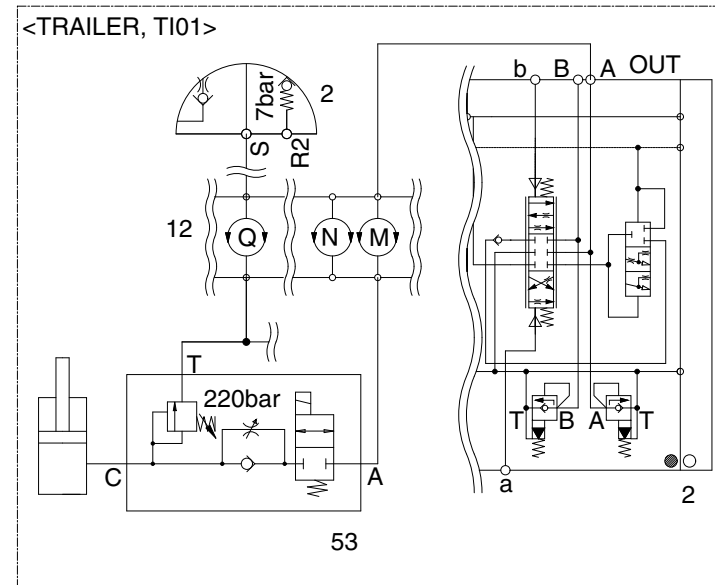
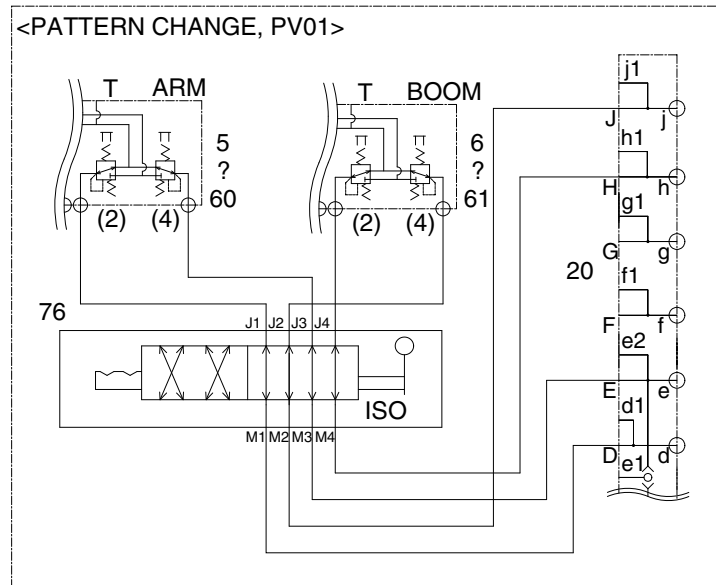
- 21 Last guard filter
- 39 Pressure sensor
- 46 Remote control block
- 47 Stop valve
- 49 2-way pedal
- 51 Solenoid valve
- 52 3-way valve
- 54 4-cartridge valve
- 55 Travel motor
- 56 D.P check valve (LH)
- 57 D.P check valve (RH)
- 58 D.P check valve (LH)
- 59 D.P check valve (RH)

### 3. HYDRAULIC CIRCUIT (3/4)



- 21 Last guard filter
- 39 Pressure sensor
- 42 Pressure sensor
- 45 Solenoid valve
- 48 2-pcs boom cylinder
- 49 2-way pedal
- 50 Shuttle valve
- 62 Boom cylinder (LH)
- 63 Boom cylinder (RH)
- 64 Ride control rod valve
- 65 Solenoid valve
- 66 Accumulator
- 67 Line check valve
- 69 Priority valve
- 70 Shuttle valve
- 71 Auxiliary MCV
- 72 Stop valve
- 73 Remote control block

#### 4. HYDRAULIC CIRCUIT (4/4)



- 31 Accumulator
- 53 Trailer valve
- 68 Steering unit
- 68-1 Adapter
- 68-2 Steering sensor
- 74 Solenoid valve
- 75 Auto brake valve
- 76 Pattern change valve

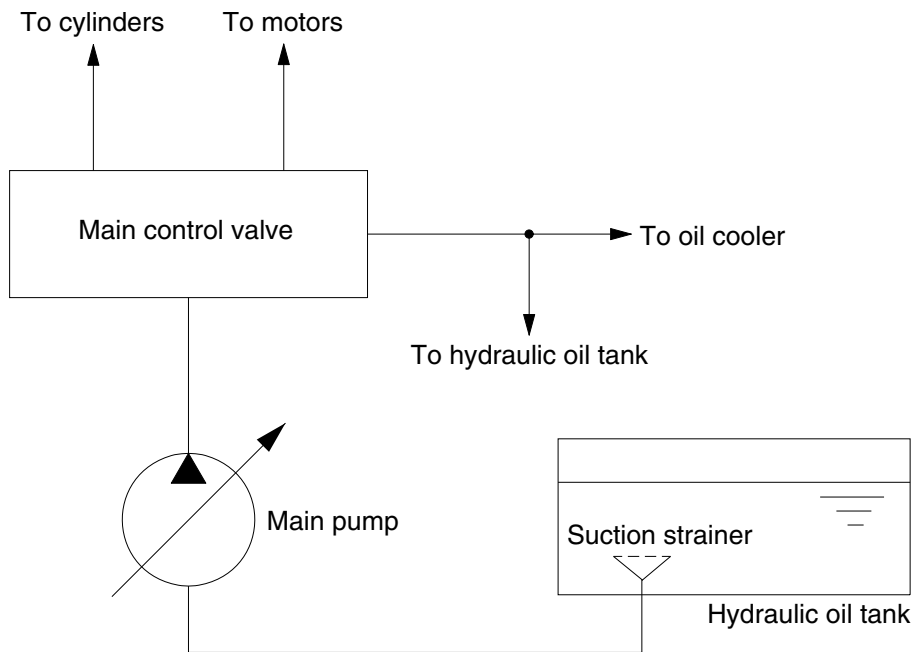
## GROUP 2 MAIN CIRCUIT

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 two travel motors.

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



140L3C101

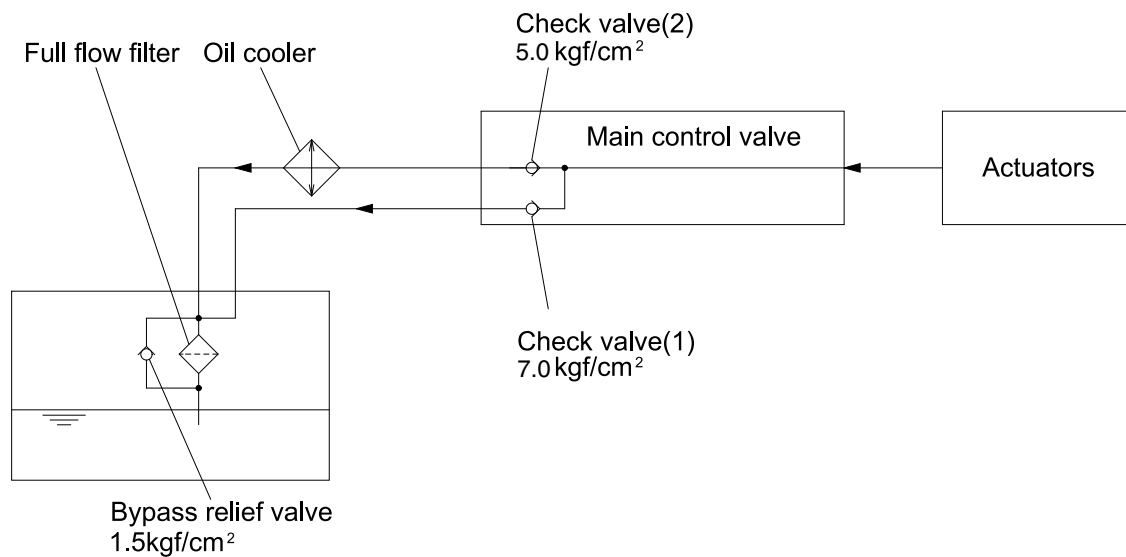
The pumps receive oil from the hydraulic tank through a suction strainer. The discharged oil from the pump flows into the control valve and goes out the tank ports.

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



140WA3CI01

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

The bypass check valves are provided in the return circuit.

The setting pressure of bypass check valves are  $5.1 \text{ kgf/cm}^2$  (71 psi) and  $7.1 \text{ kgf/cm}^2$  (100 psi). Usually, oil returns to the hydraulic tank from the left side of 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  $7.1 \text{ kgf/cm}^2$  (100 psi), the oil returns directly to the hydraulic tank, resulting in the oil temperature being raised quickly at an appropriate level.

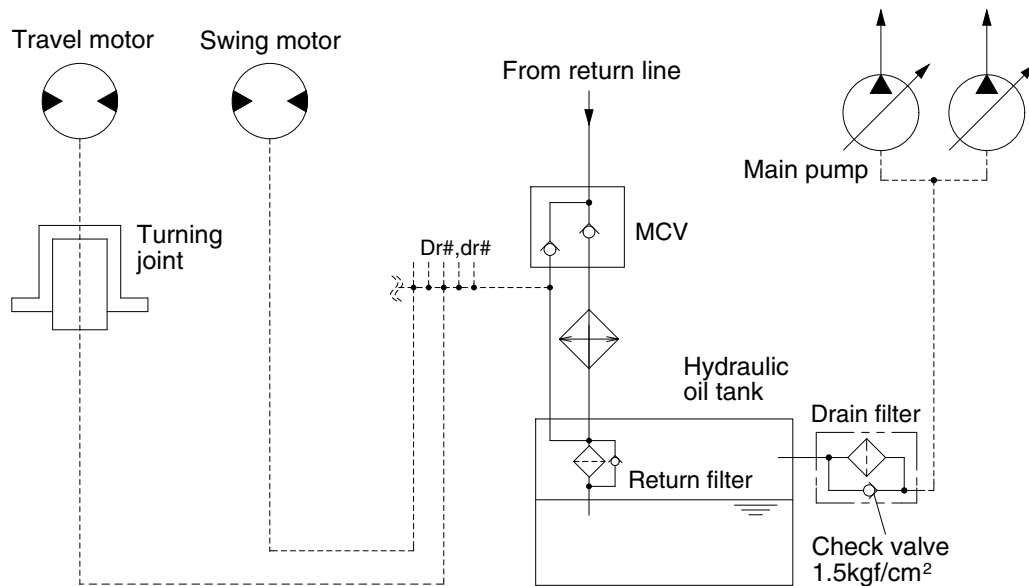
When the oil cooler is clogged, the oil returns directly to the hydraulic tank through bypass check valve (1).

The return filter and bypass relief 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 relief valve is provided in the full-flow filter.

When the filter element is clogged, the bypass relief valve opens at  $1.5 \text{ kgf/cm}^2$  (21 psi) differential pressure.

### 3. DRAIN CIRCUIT



140WA3CI02

Besides internal leaks from the motor, transmission, front and rear axle the oil for lubrication circulates. The main pump drain oil have to be fed to the hydraulic tank passing through drain filter. When the drain oil pressure exceed  $1.5 \text{ kgf/cm}^2$  ( $21 \text{ psi}$ ), the oil returns to the hydraulic tank directly.

#### 1) TRAVEL MOTOR DRAIN CIRCUIT

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 after being filtered by return filter.

#### 2) SWING MOTOR DRAIN CIRCUIT

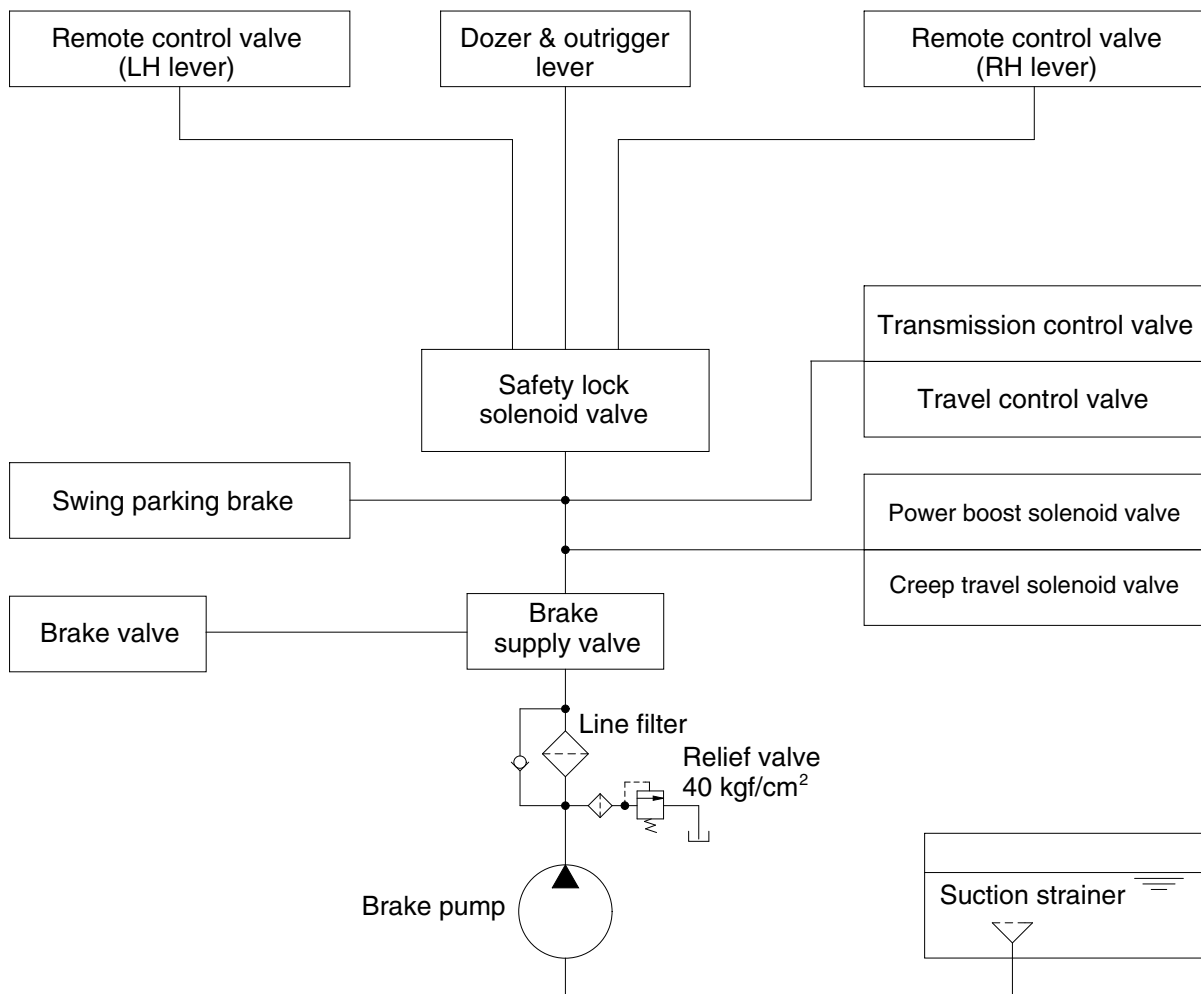
Oil leaking from the swing motor comes out and return to the hydraulic tank.

#### 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



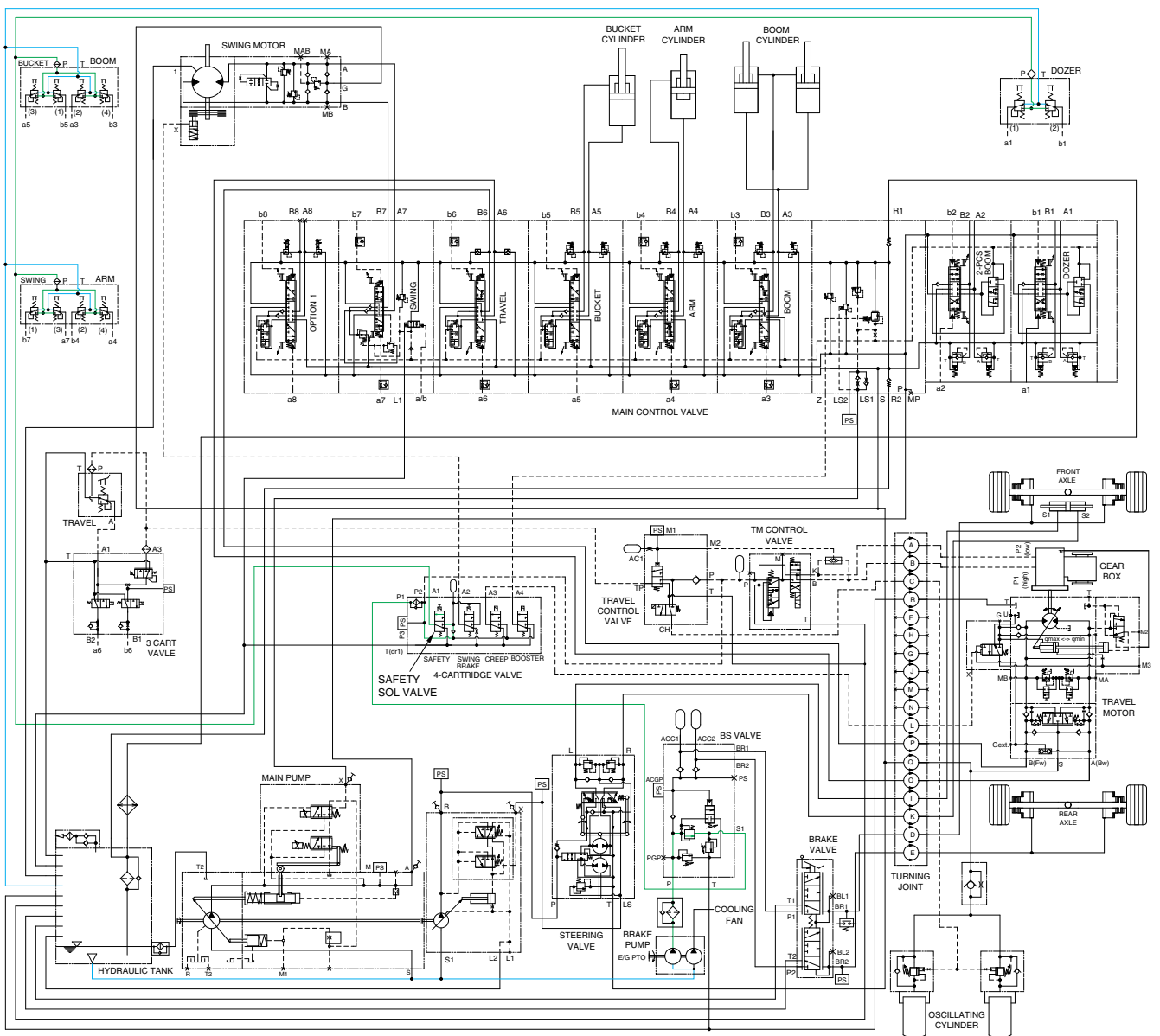
140WA3CI03

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

The brake pump receives the oil from the hydraulic tank through the suction strainer.

The discharged oil from the brake pump flows to the remote control valve via safety lock solenoid valve and the swing brake solenoid valve, creep travel solenoid valve, power boost solenoid valve, transmission control valve and travel control valve through the line filter and brake supply valve.

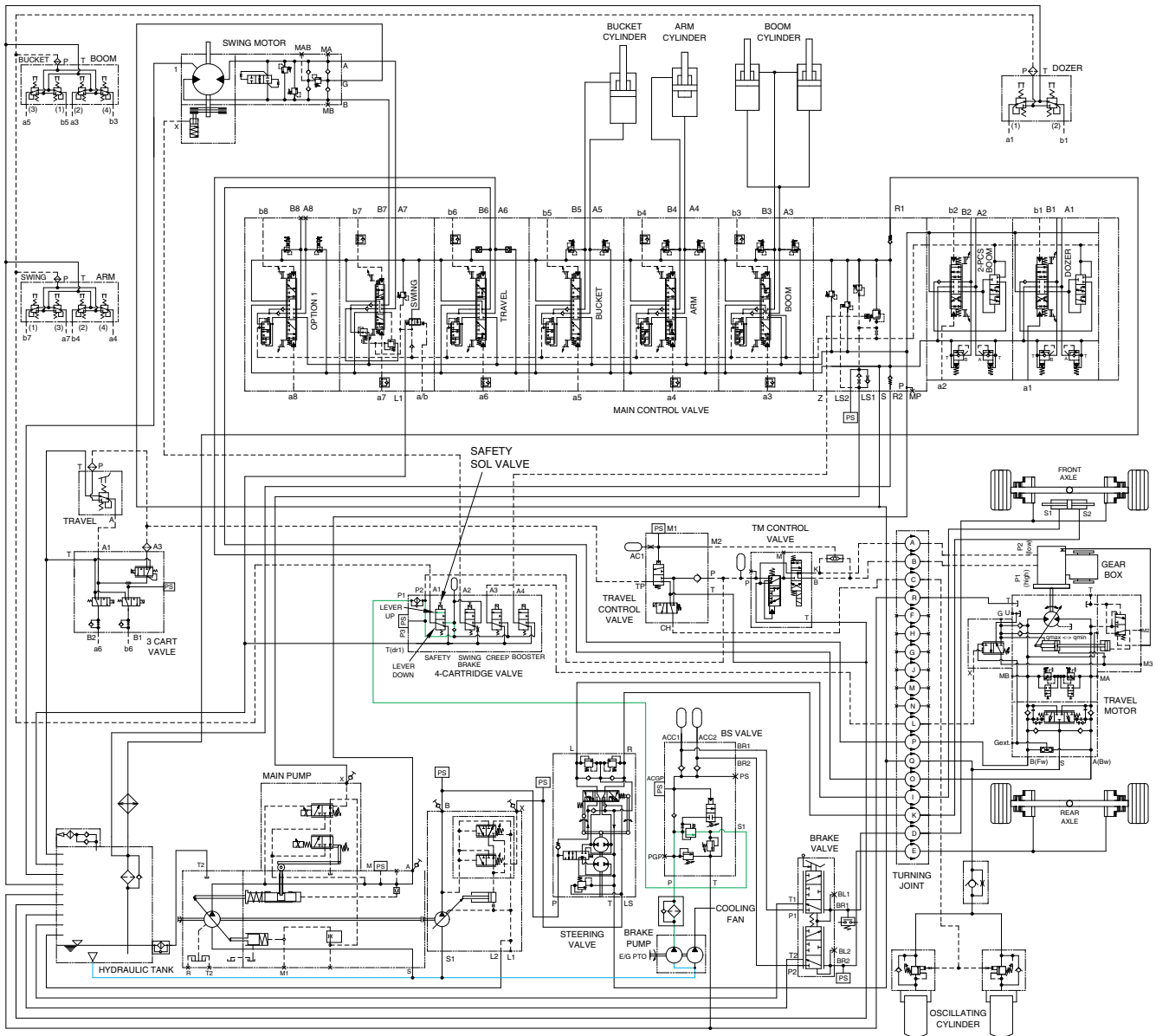
# 1. SUCTION, DELIVERY AND RETURN CIRCUIT



140WA3HC02

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

## 2. SAFETY SOLENOID VALVE (SAFETY LEVER)

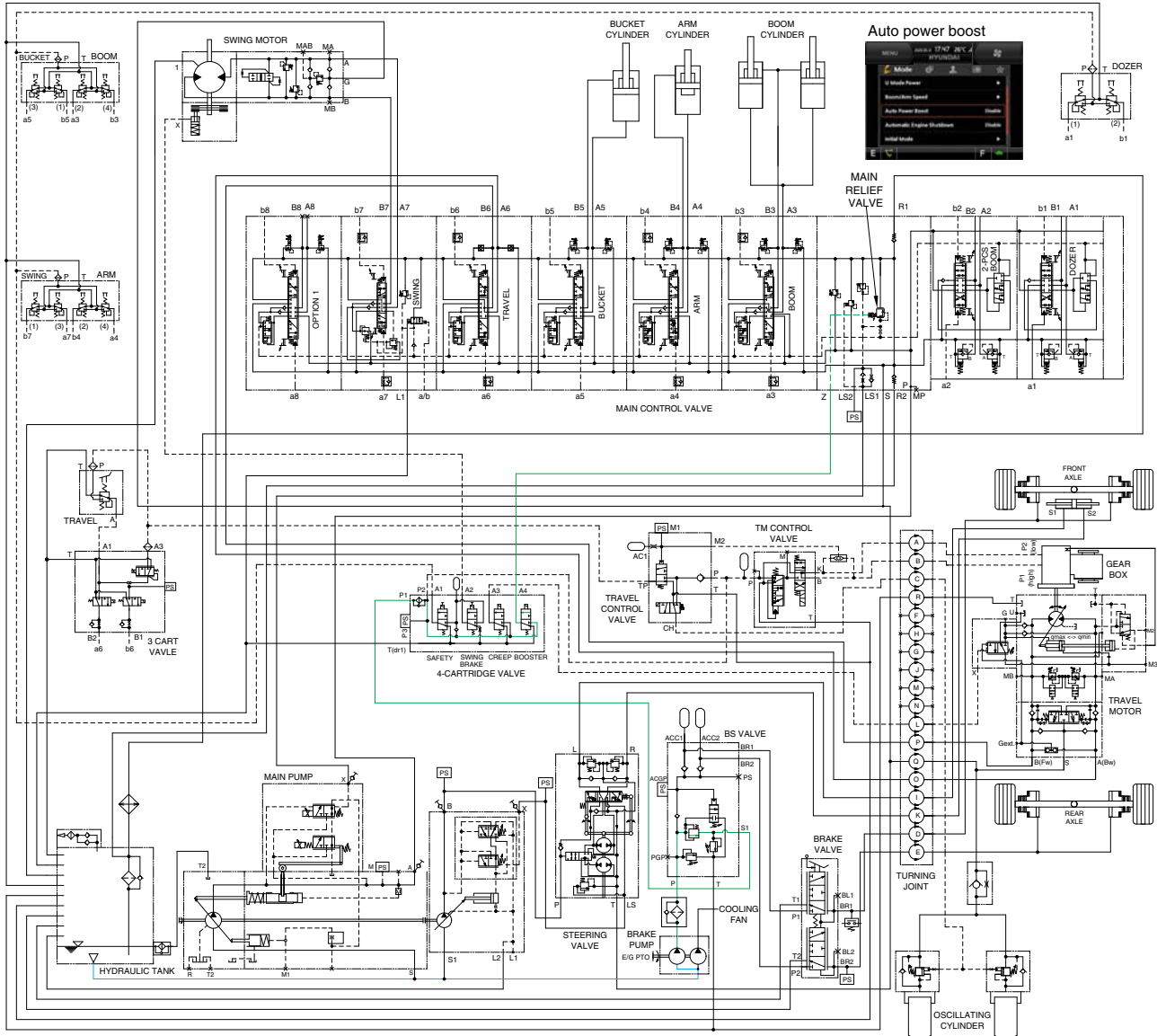


140WA3HC03

When the lever of the safety solenoid valve is moved upward, oil flows into the remote control valve through solenoid valve and line filter.

When the lever of the safety solenoid valve moved downward, oil does not flows into the remote control valve, because of blocked port.

### 3. MAIN RELIEF PRESSURE CHANGE SYSTEM

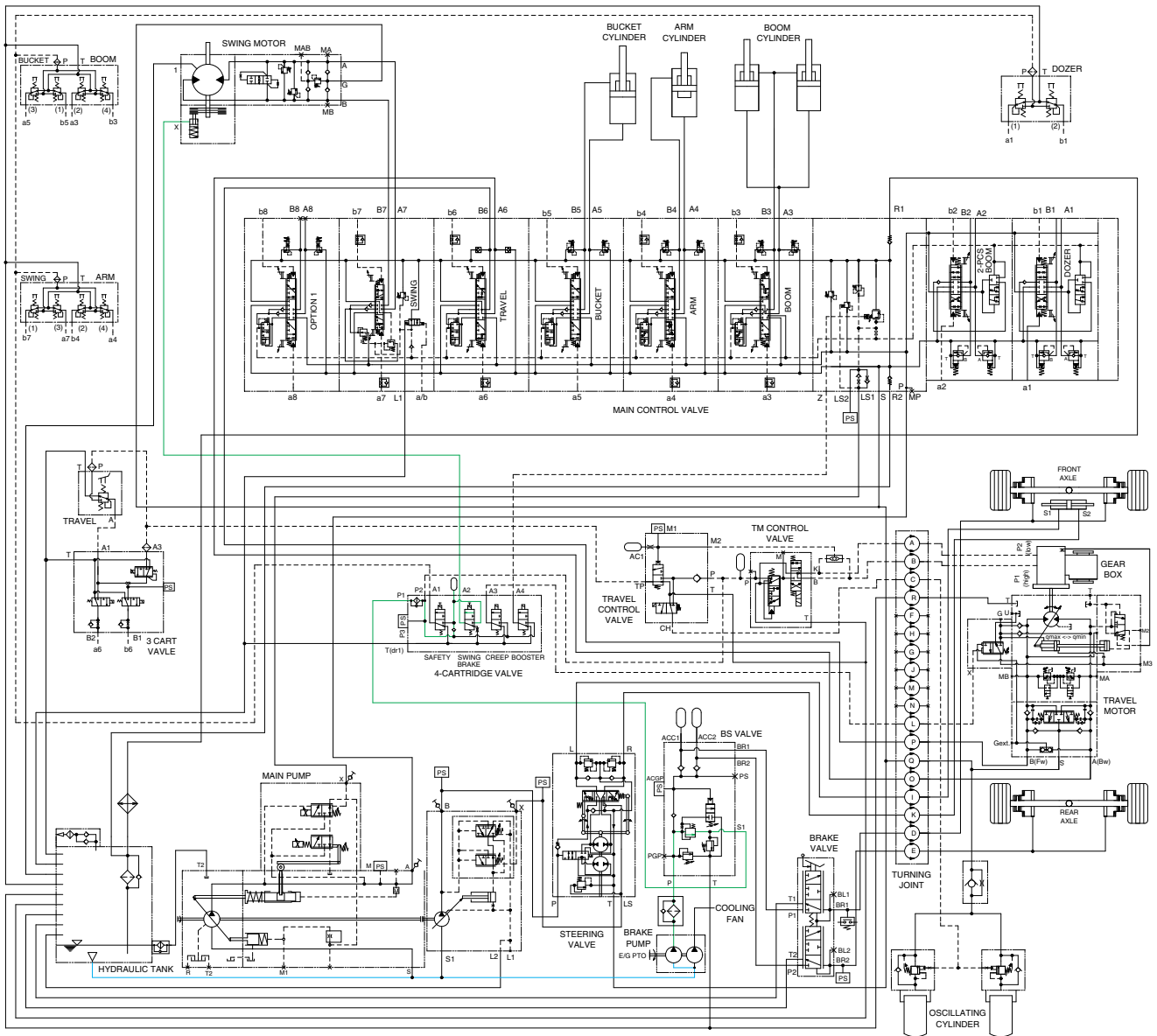


140WA3HC04

When the power boost switch on the left control lever is pushed ON, the power boost solenoid valve is actuated, the discharged oil from the brake pump flows into Z port of the main relief valve in main control valve ; then the setting pressure of the main relief valve is raises from 350 kgf/cm<sup>2</sup> to 380 kgf/cm<sup>2</sup> 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/cm<sup>2</sup> as working condition by the MCU. It is also operated max 8 seconds. Refer to page 5-83.

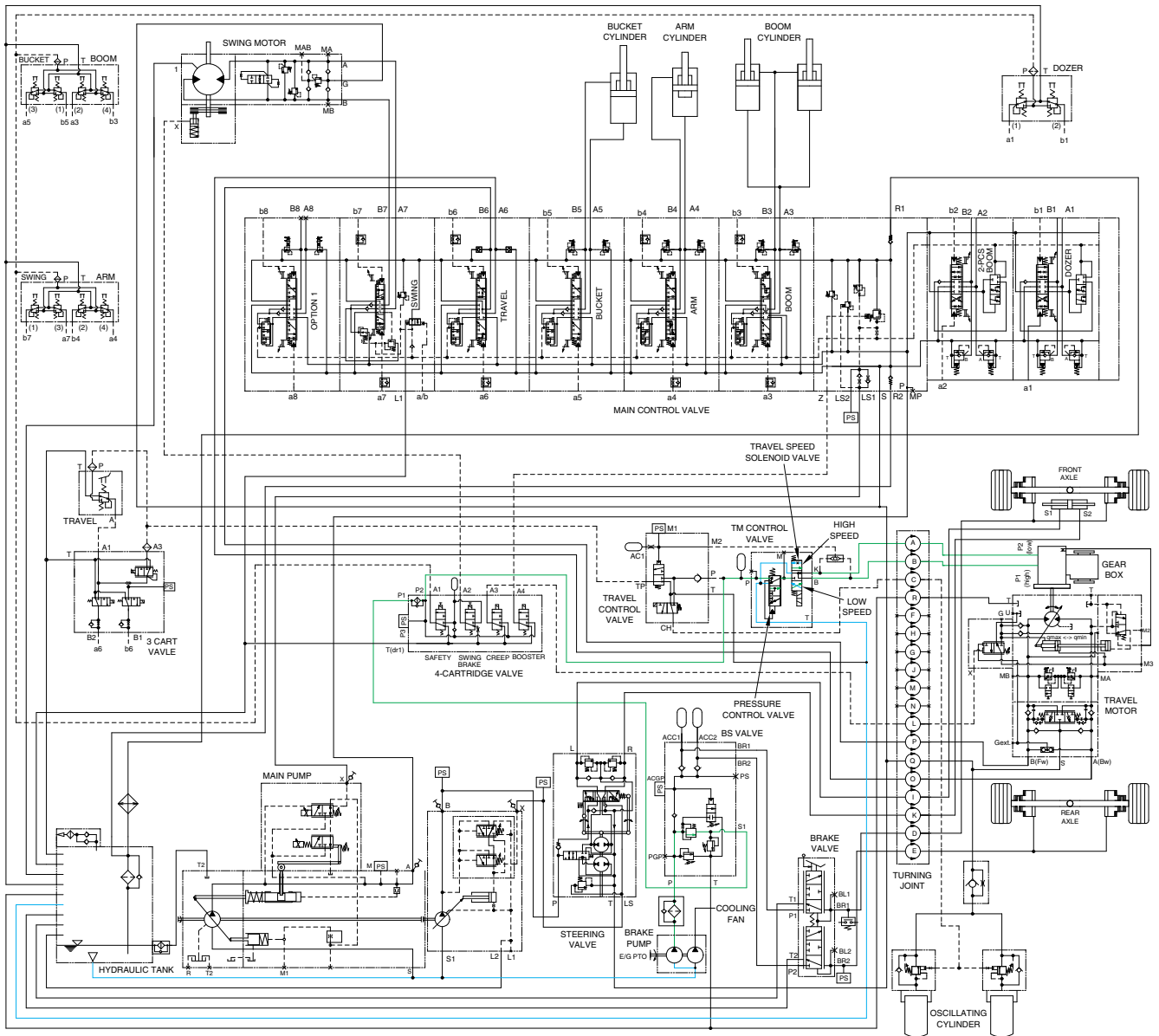
## 4. SWING PARKING BRAKE RELEASE



140WA3HC05

When the swing or arm in control lever is tilted, the swing brake solenoid valve is shifted to the downward by the MCU that senses the pilot pressure of the RCV control lever. The discharged oil from brake pump flows to swing motor through the swing brake solenoid valve. This pressure is applied to swing motor disc, thus the brake is released. When the swing and arm in control lever are set in the neutral position, the swing brake solenoid valve is shifted to the upward, oil in the swing motor disc cylinder is drained through the the swing brake solenoid valve, thus the brake is applied. For details, refer to page 2-60.

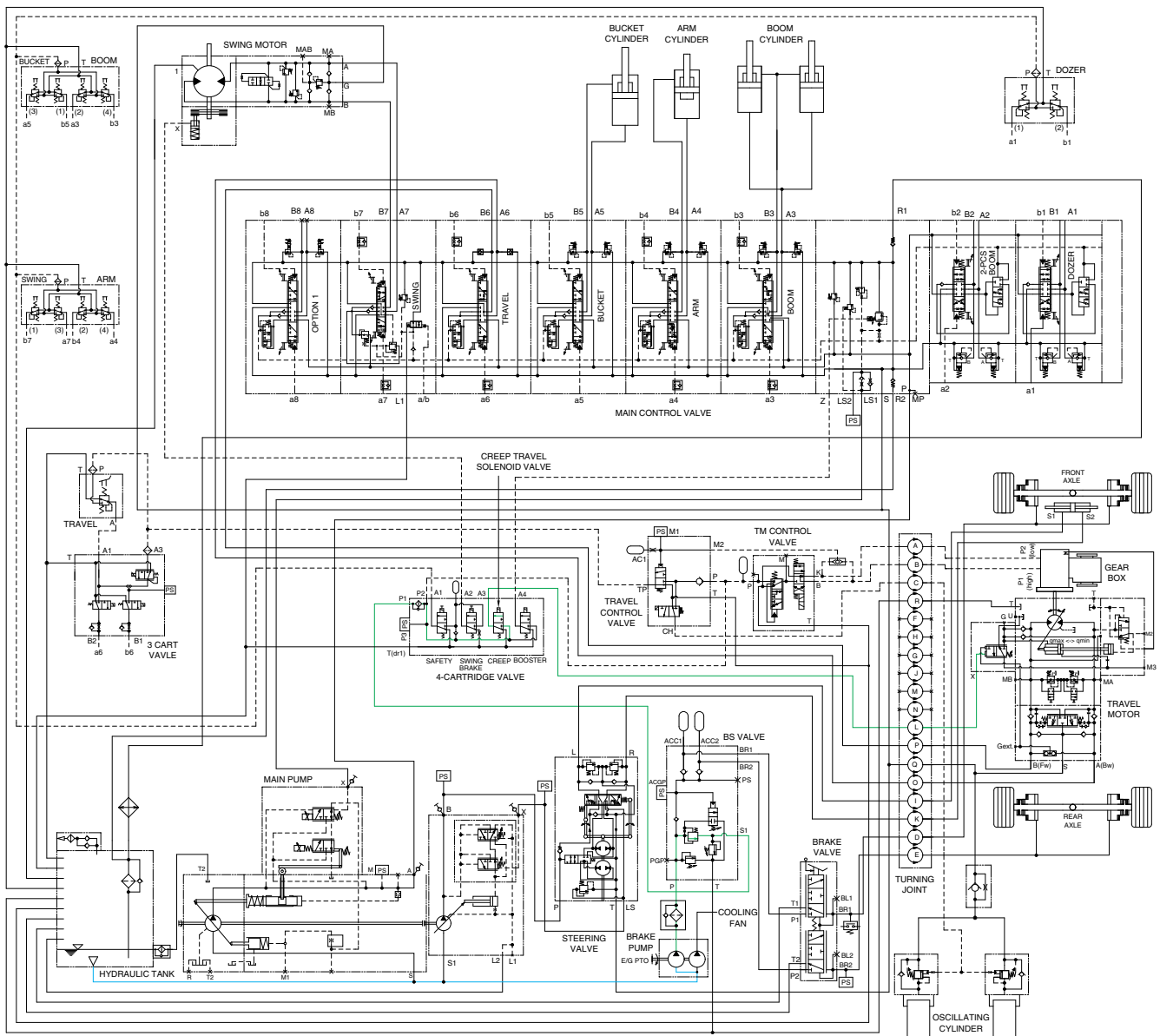
## 5. TRAVEL SPEED SELECTION SYSTEM



140WA3HC06

When LH multifunction switch was placed in high or low speed position, the pressure oil from brake 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



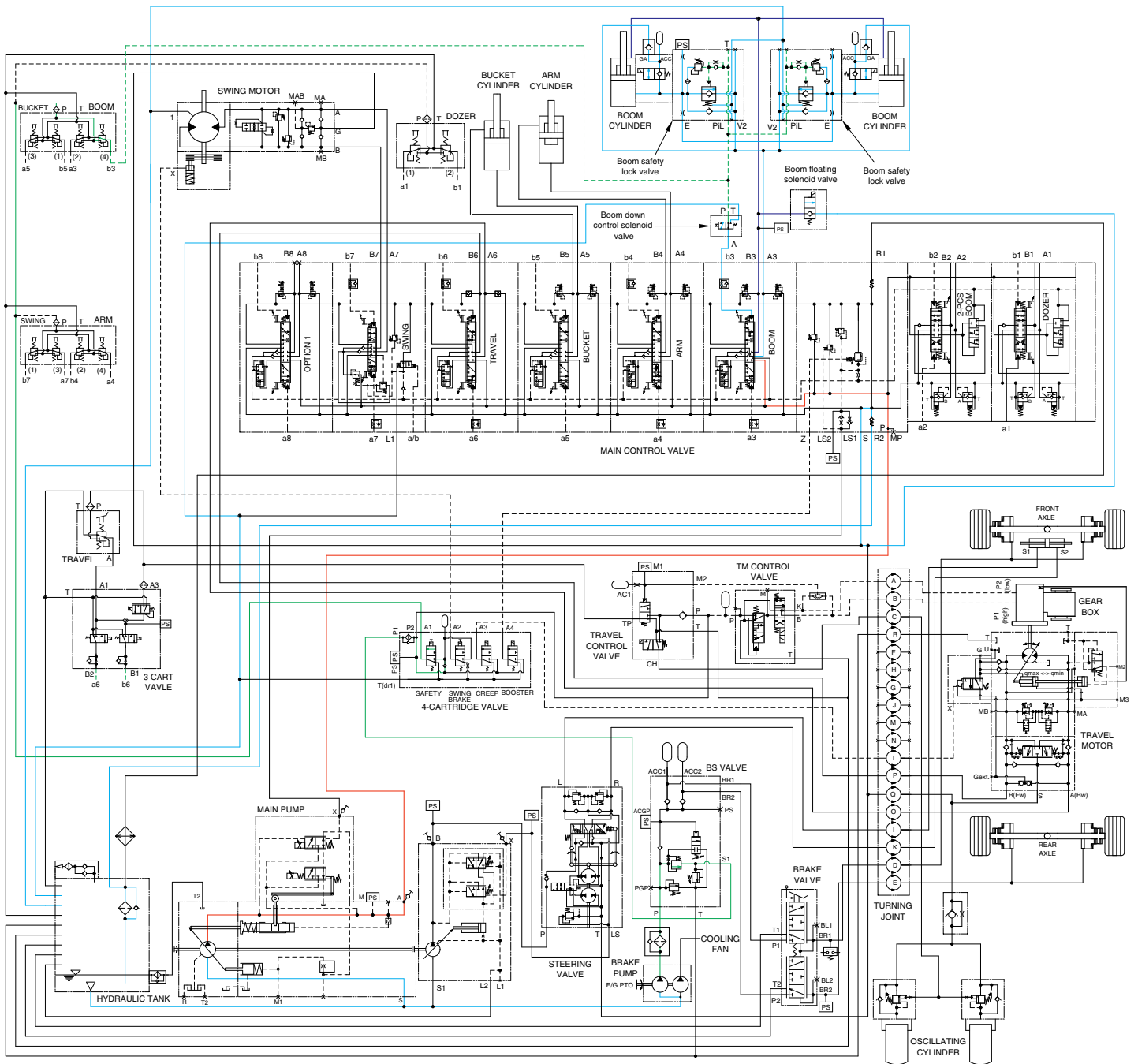
140WA3HC07

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

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

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

## 7. BOOM FLOATING SYSTEM



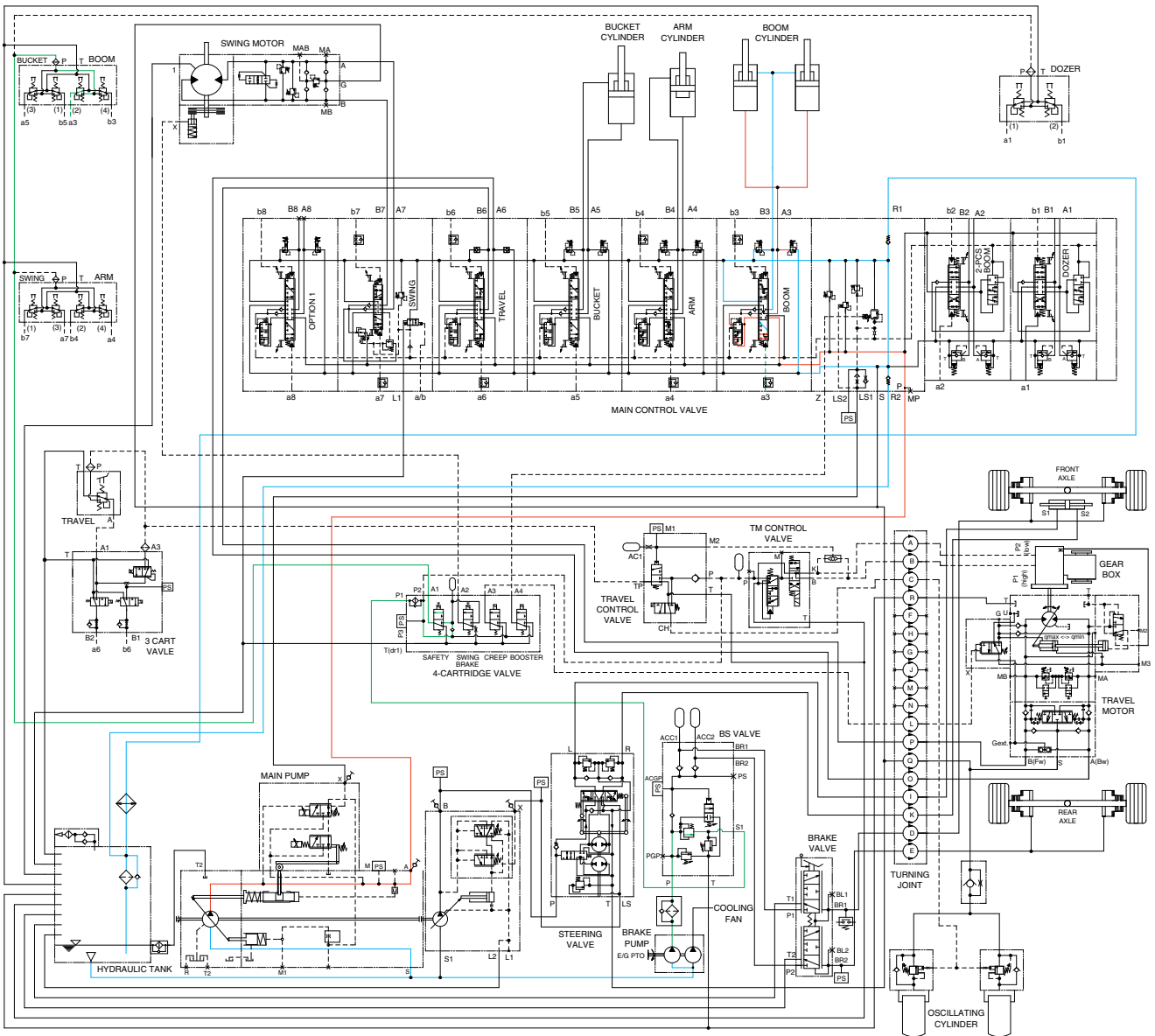
140WA3HC08

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



# GROUP 4 SINGLE OPERATION

## 1. BOOM UP OPERATION

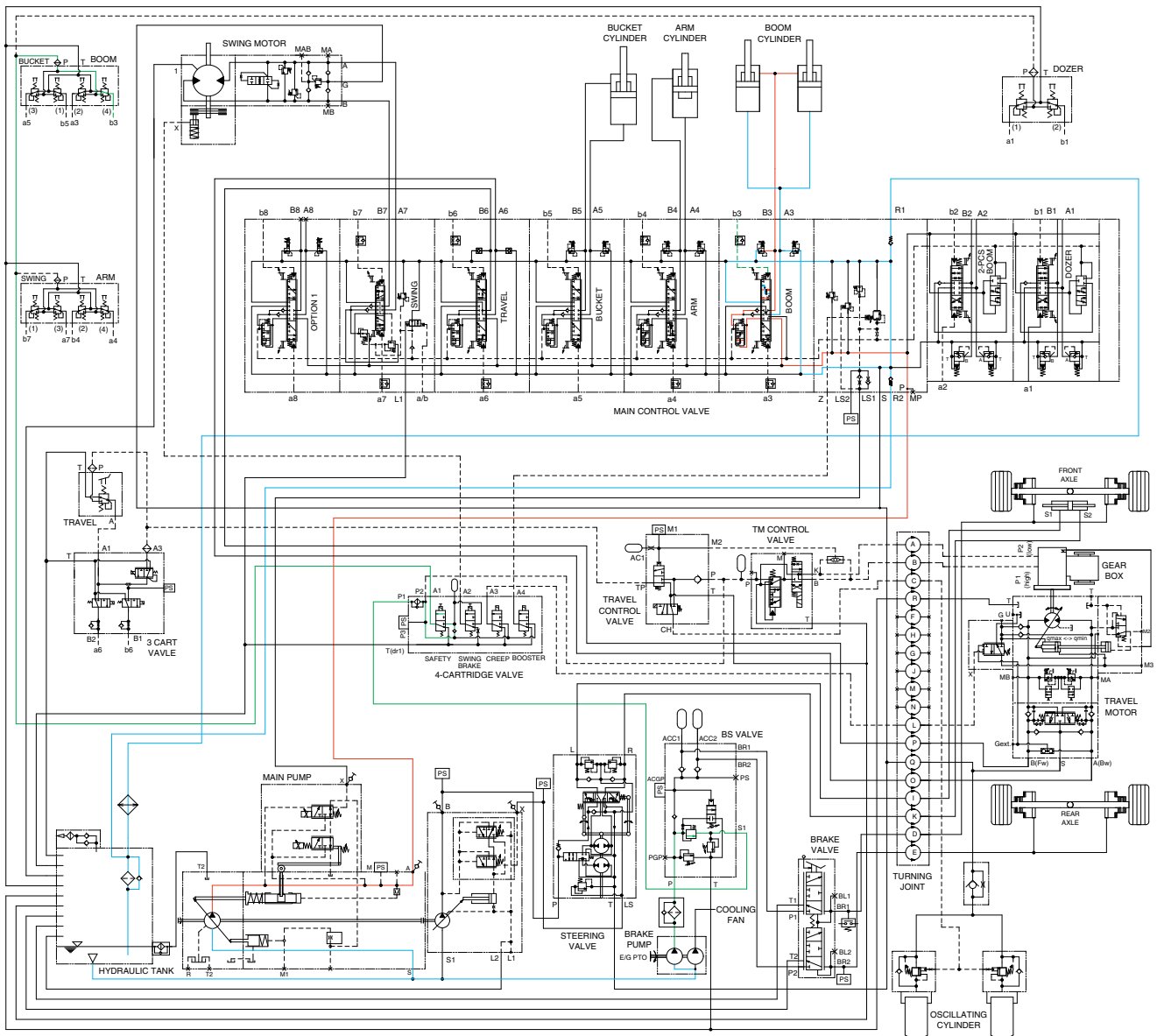


140WA3HC10

When the right control lever is pulled back, the boom spool in the main control valve is moved to the up position by the pilot oil pressure (a3) from the remote control valve.

The oil from the main 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 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 cylinder is closed by the boom holding valve. This prevents the hydraulic drift of boom cylinders.

## 2. BOOM DOWN OPERATION



140WA3HC11

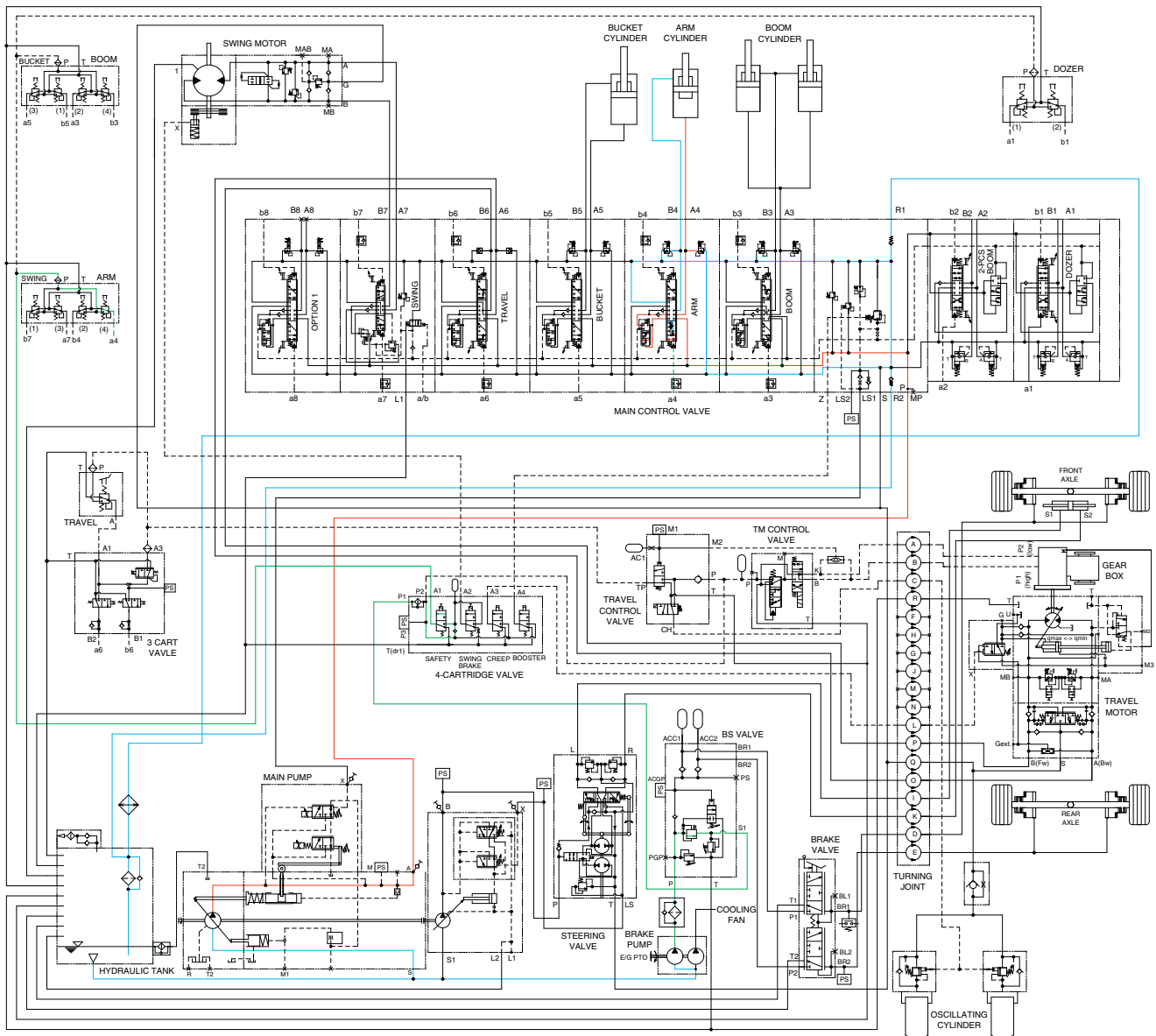
When the right control lever is pushed forward, the boom spool in the main control valve is moved to the down position by the pilot oil pressure (b3) from the remote control valve.

The oil from the main 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 spool in the main control valve.

When the down speed of boom is faster, the oil returned from the large chamber of boom cylinder combines with the oil from the main pump, and flows into the small chamber of the cylinder.

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

### 3. ARM IN OPERATION



140WA3HC12

When the left control lever is pulled back, the arm spool in the main control valve are moved to the arm in position by the pilot oil pressure (a4) from the remote control valve.

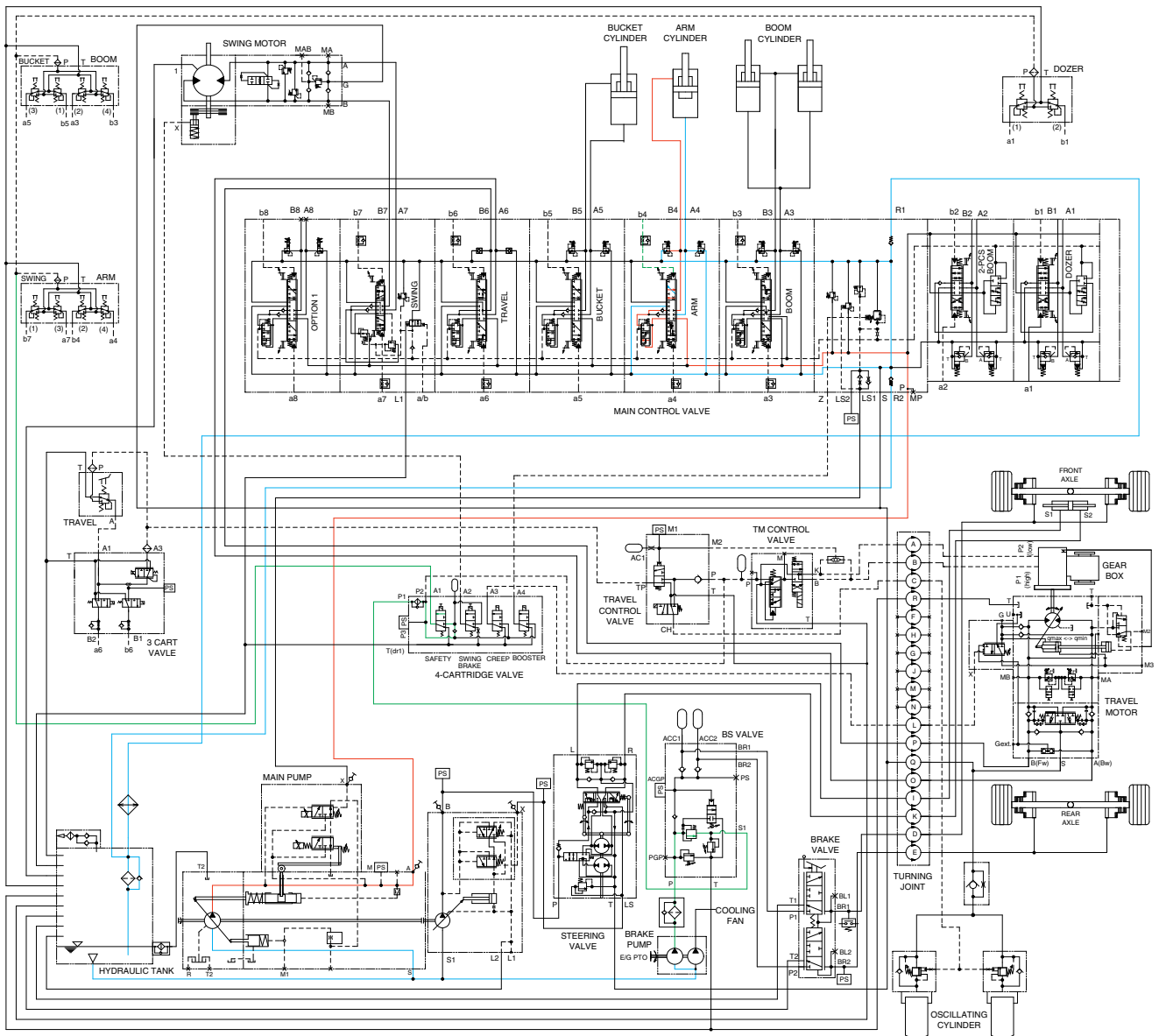
The oil from the main pump flows into the main control valve and then goes to the large chamber of arm cylinder.

At the same time, the oil from small chamber of arm cylinder returns to the hydraulic oil tank through the arm 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.

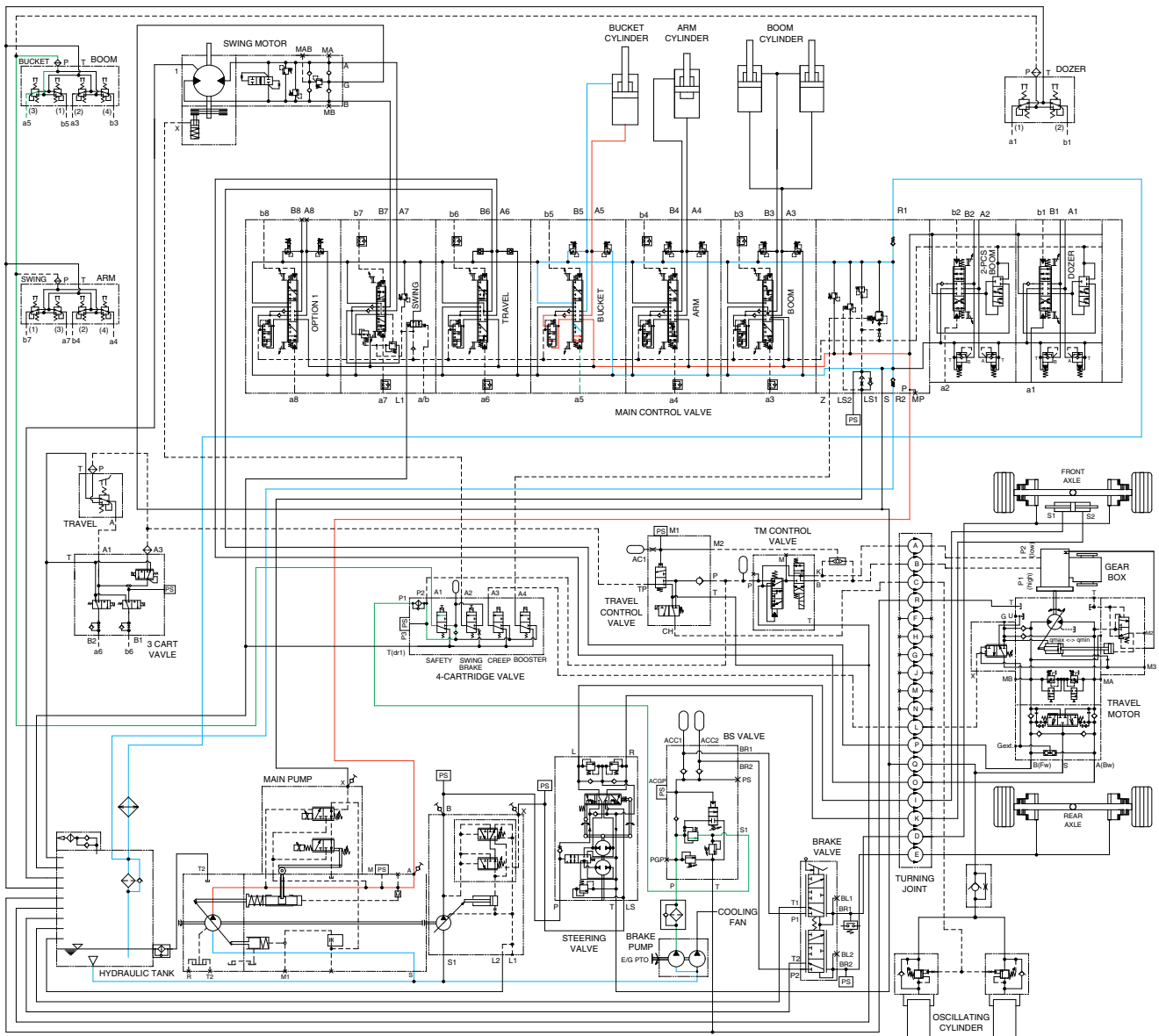
## 4. ARM OUT OPERATION



140WA3HC13

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 (b4) from the remote control valve. The oil from the main 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 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



140WA3HC14

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 (a5) from the remote control valve.

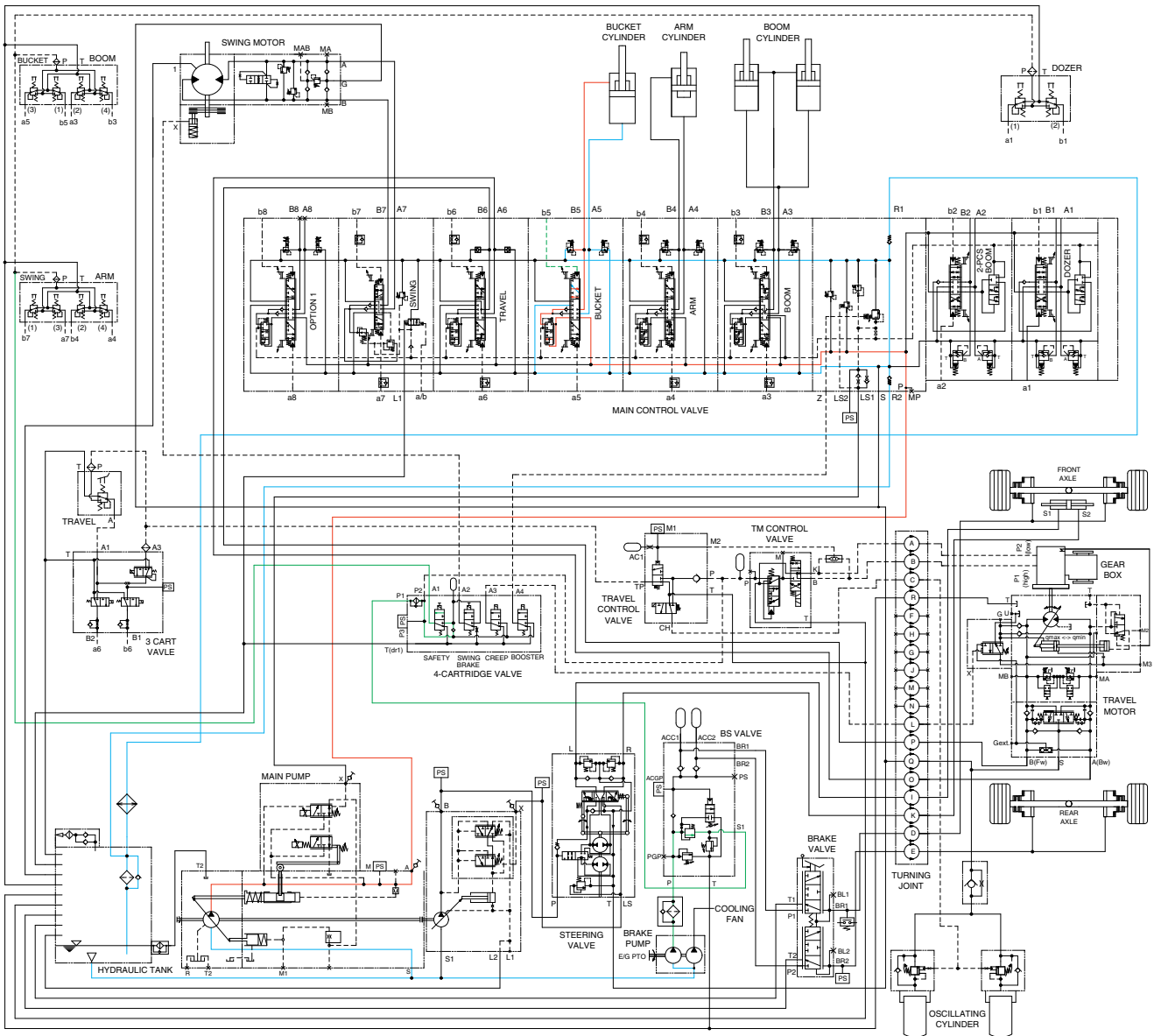
The oil from the main pump flows into the main control valve and then goes to the large chamber of bucket cylinder.

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



140WA3HC15

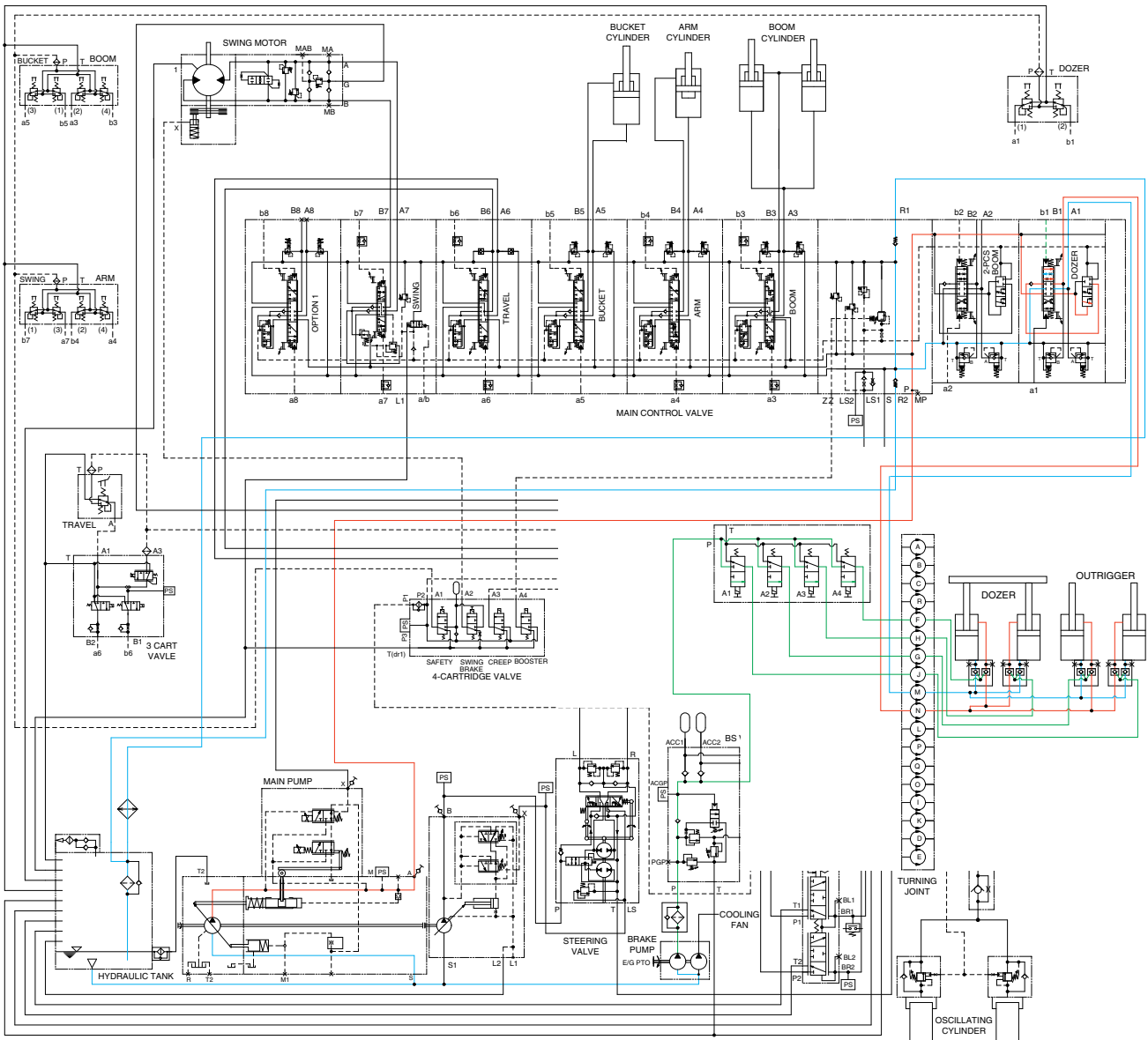
When the right control lever is pushed right, the bucket spool in the main control valve is moved to the bucket out position by the pilot oil pressure (b5) from the remote control valve.

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

## 7. DOZER/OUTRIGGER UP OPERATION



140WA3HC16

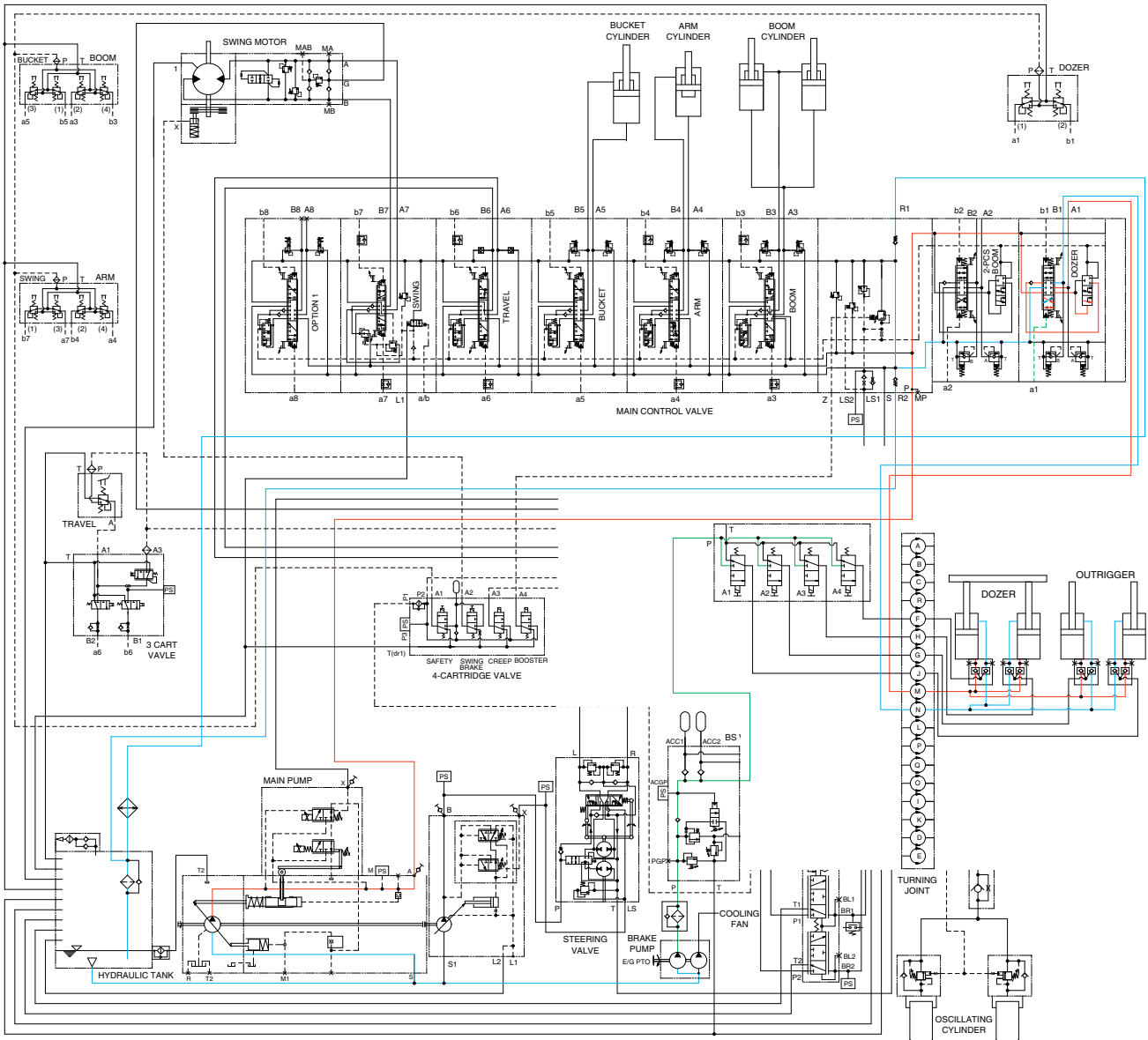
When the dozer control lever is pulled back, the dozer spool in the main control valve is moved to the dozer up position by the pilot oil pressure (b1) from the remote control valve.

The oil from the main 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.

## 8. DOZER/OUTRIGGER DOWN OPERATION



140WA3HC17

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 (a1) from the remote control valve.

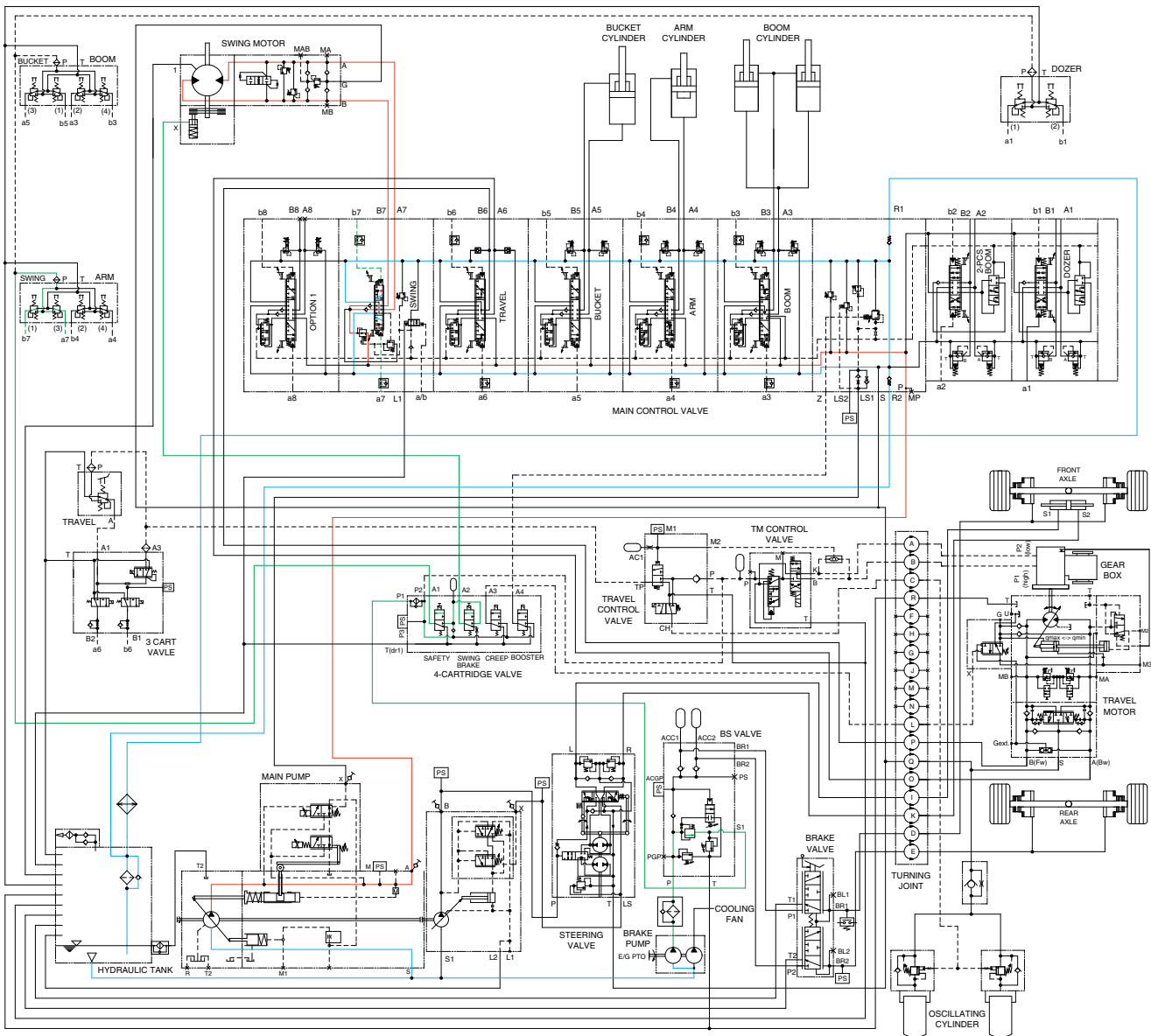
The oil from the main pump flows into the main control valve and then goes to the large chamber of rear actuator cylinders (dozer or outrigger).

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 steering main control valve. When this happens, the dozer (outrigger) goes down.



## 9. SWING OPERATION



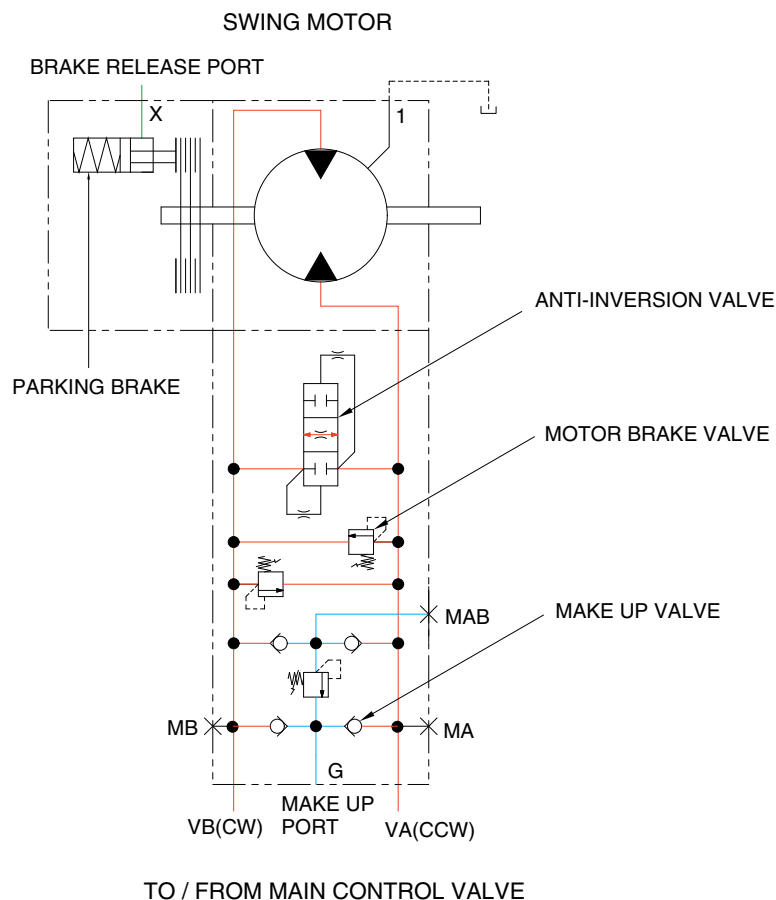
140WA3HC:18

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 (a7 or b7) from the remote control valve. The oil from the main 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



140WA3HC19

### 1) MOTOR BRAKE VALVE

Motor brake valve for the swing motor limits to cushion the starting and stopping pressure of swing operation and controls the swing motor operating pressure to 270 kgf/cm<sup>2</sup> (3840 psi).

### 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

When any of the swing or arm in control lever is tilted, the swing brake solenoid valve is energized by the MCU that senses the swing pilot oil pressure.

The discharged oil from brake pump flows to swing motor X port through the swing brake solenoid valve. This pressure is applied to swing parking brake piston, thus the brake is released.

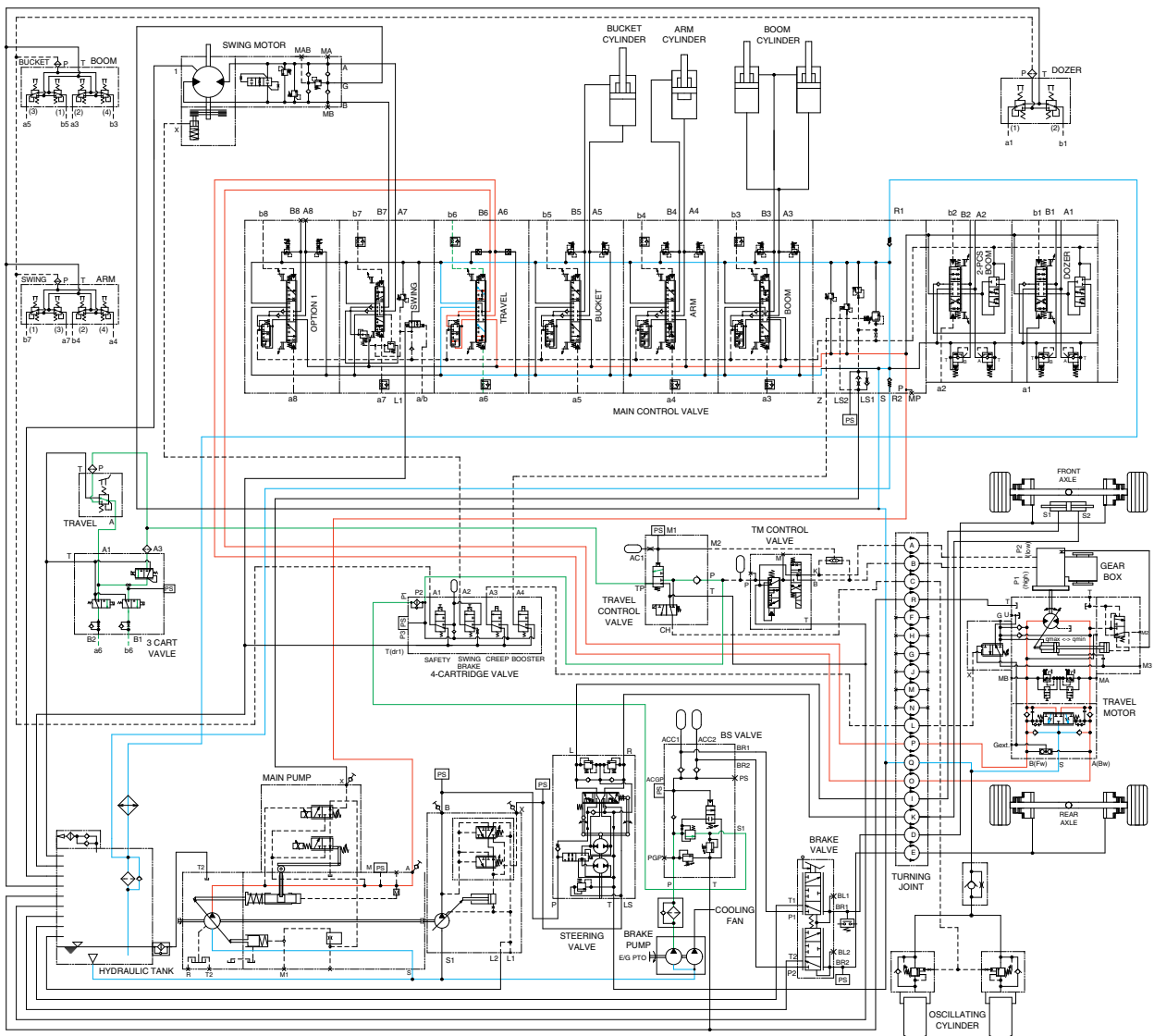
#### PARKING BRAKE "ON" OPERATION

When the swing and arm in control levers are set in the neutral position, the swing brake solenoid valve is de-energized, oil in the swing parking brake chamber is drained through the the swing brake solenoid valve, thus the brake is applied by spring force.

### 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



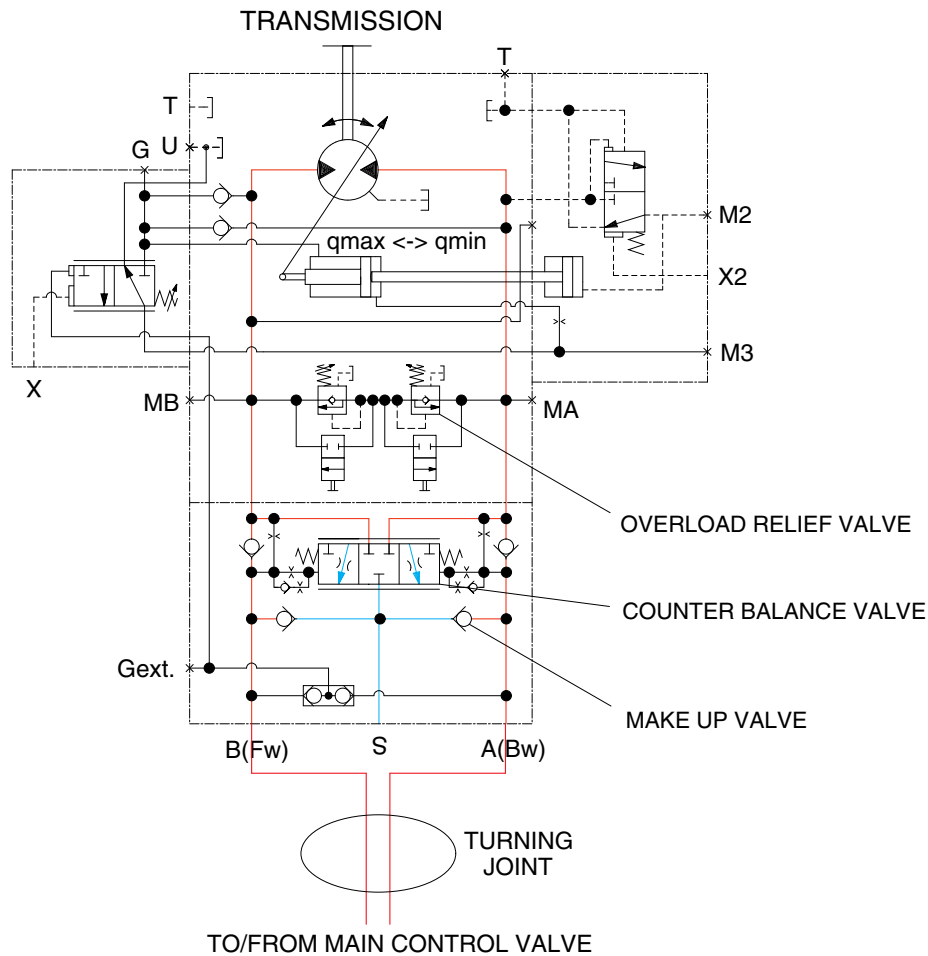
140WA3HC20

When the FNR switch of the RH RCV lever 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 (a6 or b6) from brake pump through the travel pilot solenoid valve of travel control valve. The oil from the main 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 booster motor itself.

## TRAVEL CIRCUIT OPERATION



140WA3HC21

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.

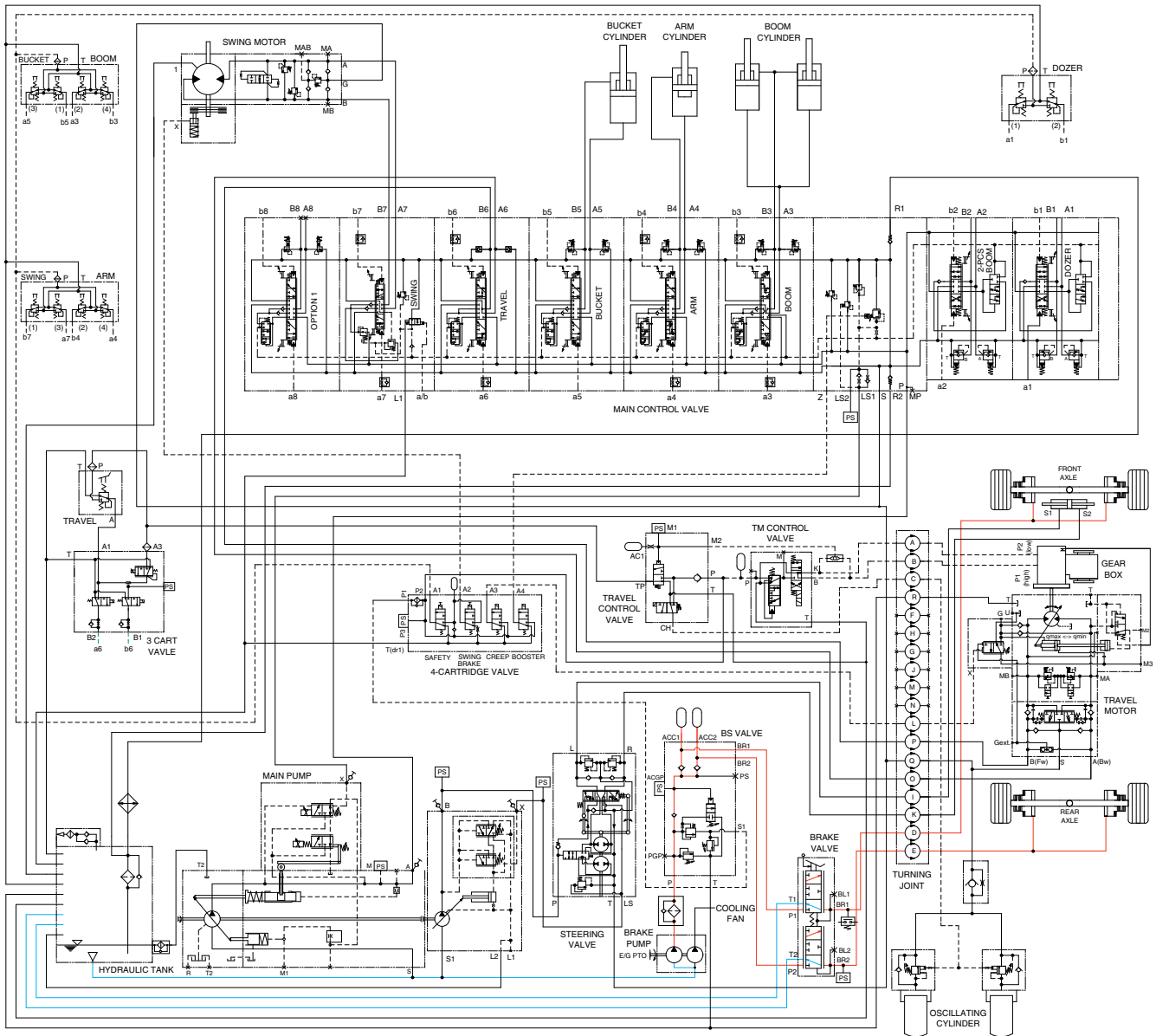
### 2) OVERLOAD RELIEF VALVE

Relief valve limits the circuit pressure below  $380 \text{ kgf/cm}^2$  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.

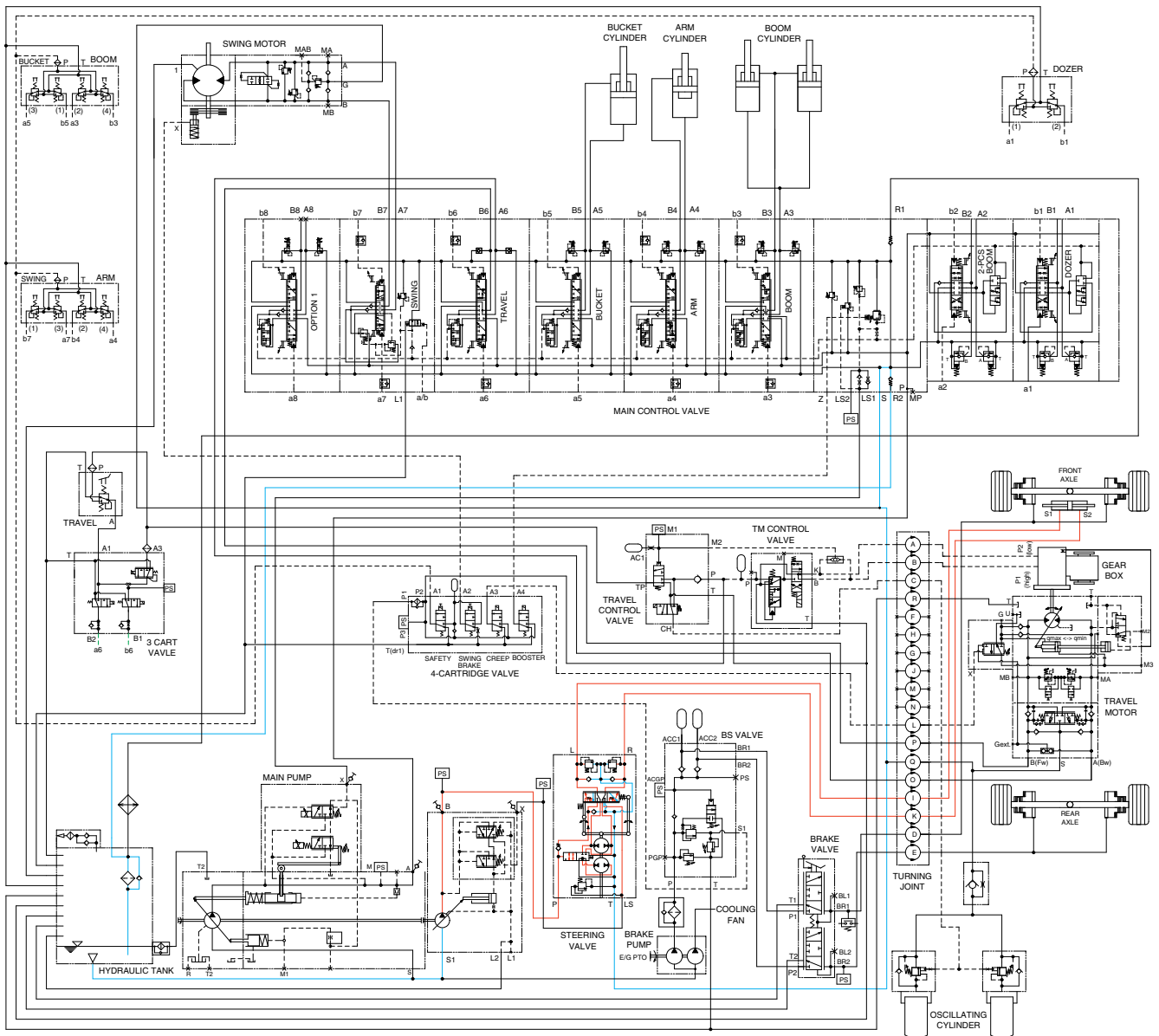
# 11. FRONT AND REAR AXLE BRAKE SYSTEM (SERVICE BRAKE)



140WA3HC22

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

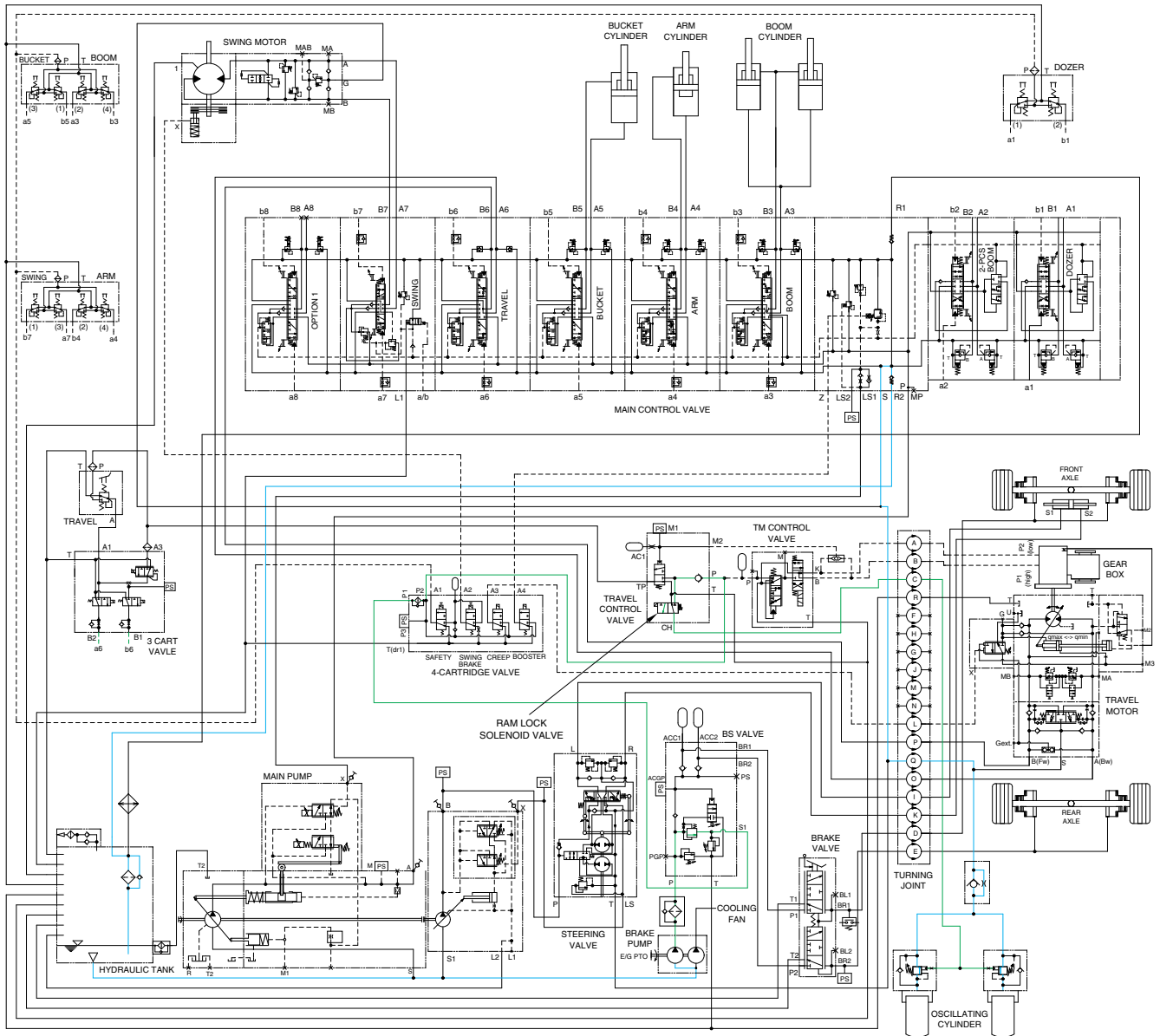
## 12. STEERING CIRCUIT OPERATION



140WA3HC23

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 steering pump flows into steering cylinder through spool and gerotor within the steering valve.  
 Then the steering direction is applied.

### 13. RAM LOCK CIRCUIT OPERATION

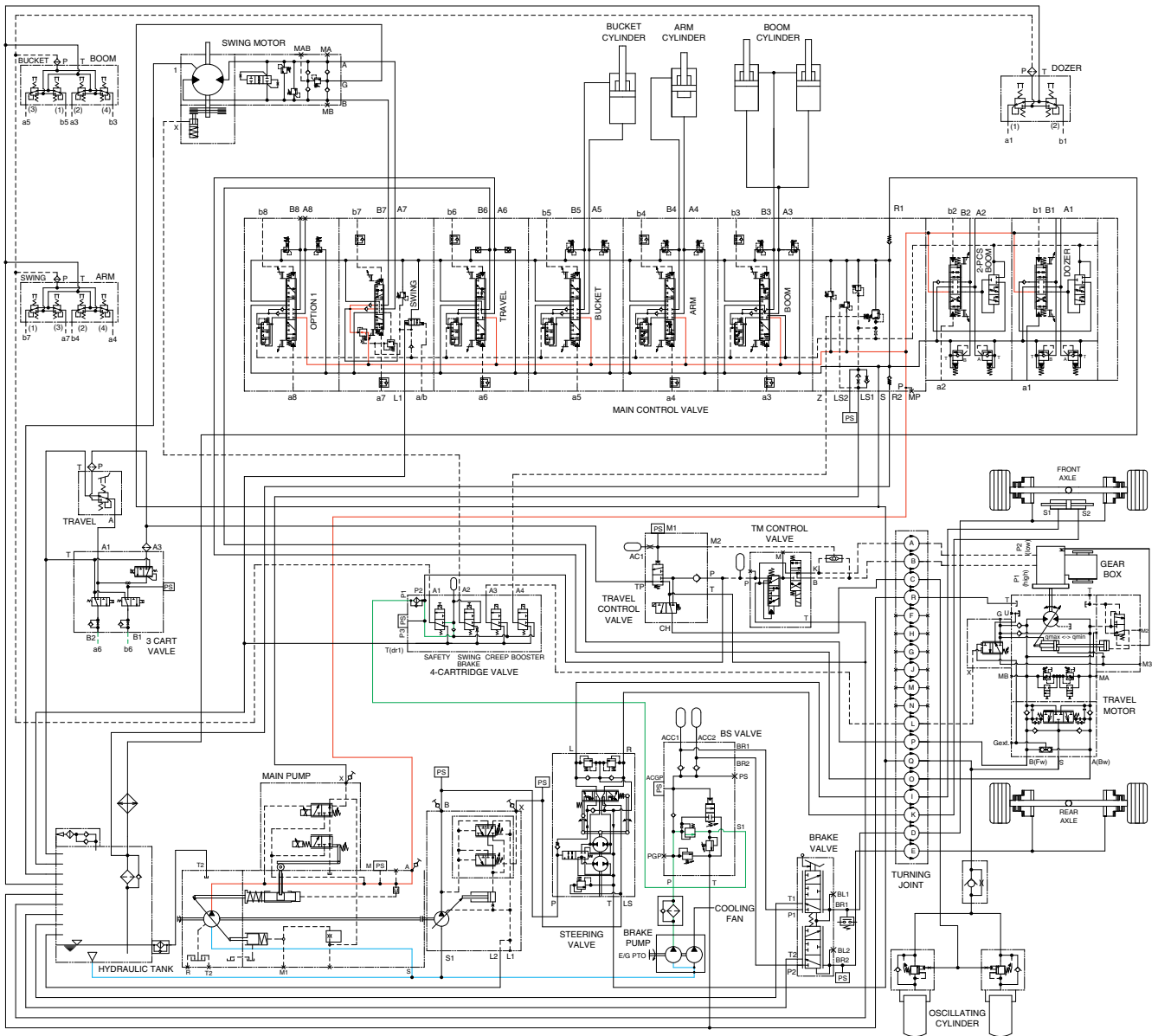


140WA3HC24

When the ram lock rotary 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 brake pump flows into oscillating cylinder through ram lock solenoid and locking pump valve. This pressure is applied to check valve and oscillating cylinder, thus the oscillating function is operated (Ram lock released).

# GROUP 5 COMBINED OPERATION

## 1. OUTLINE

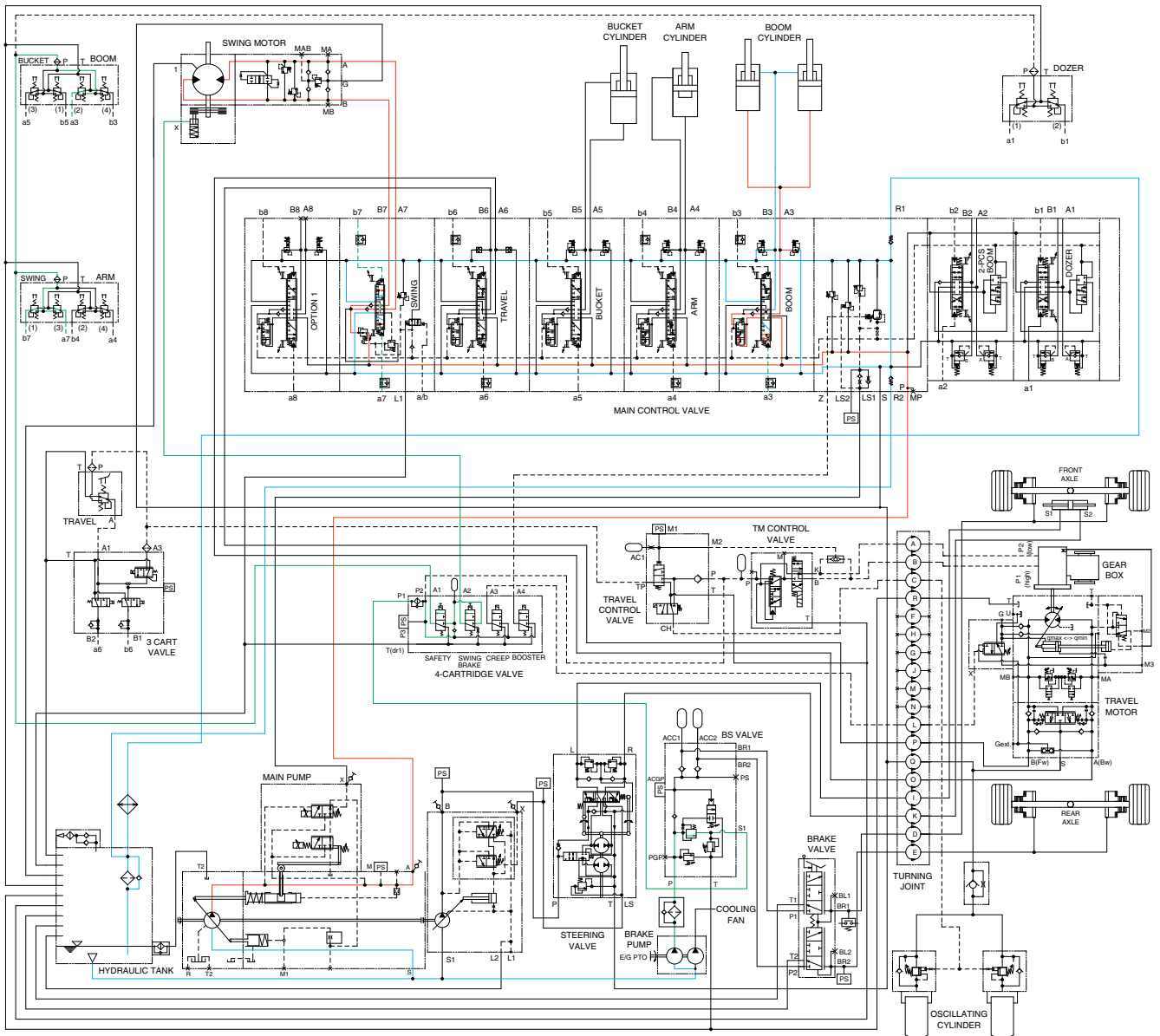


140WA3HC30

The oil from the main pump flows through the parallel 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



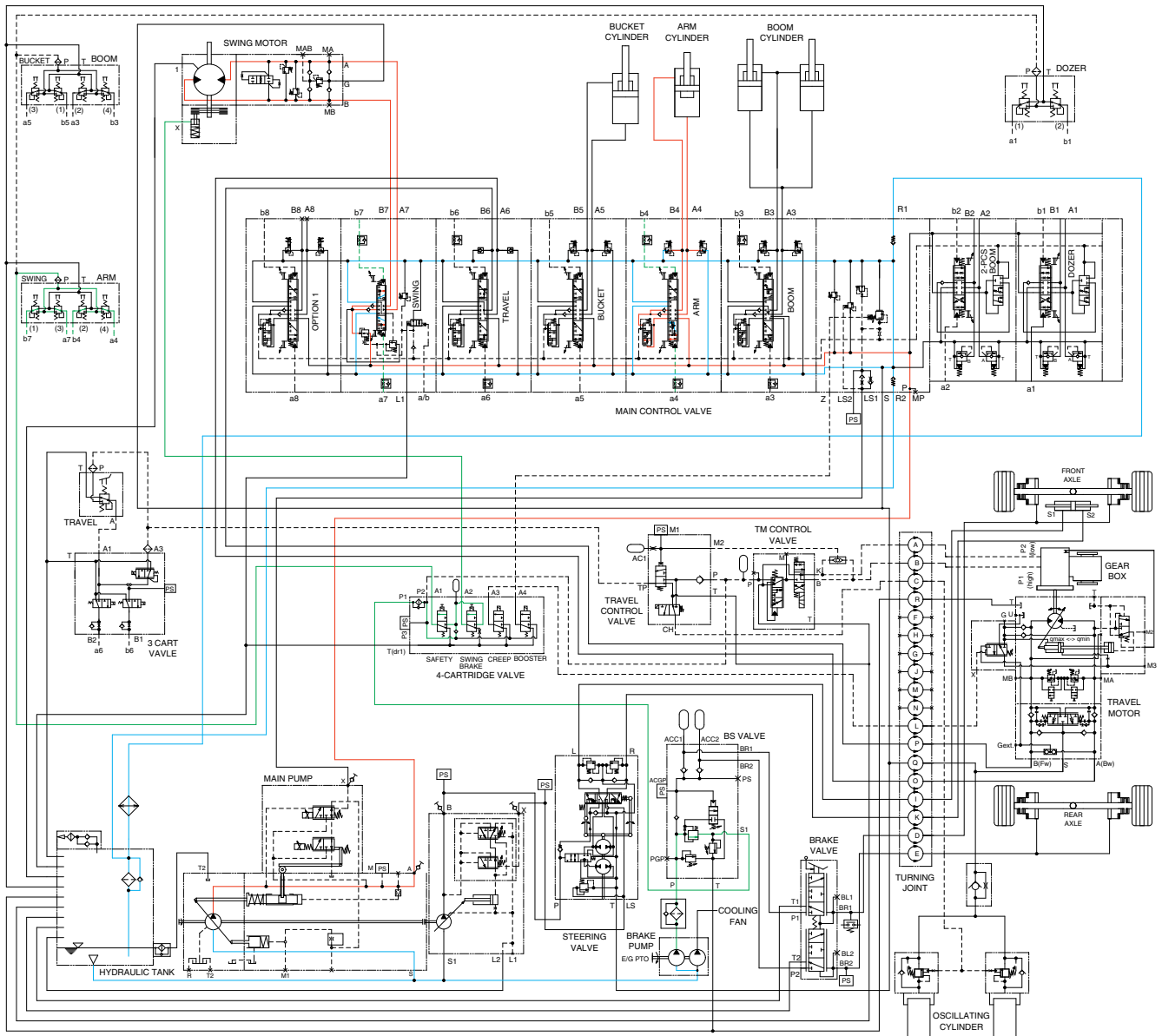
140WA3HC31

When the swing and boom up functions are operated, simultaneously the swing spool and boom spool in the main control valve are moved to the functional position by the pilot oil pressure (a7, b7, a3) from the remote control valve.

The oil from the main pump flows into the swing motor through swing spool and flows into the boom cylinders through the boom spool via the parallel passage.

The upper structure swings and the boom goes up.

### 3. COMBINED SWING AND ARM OPERATION



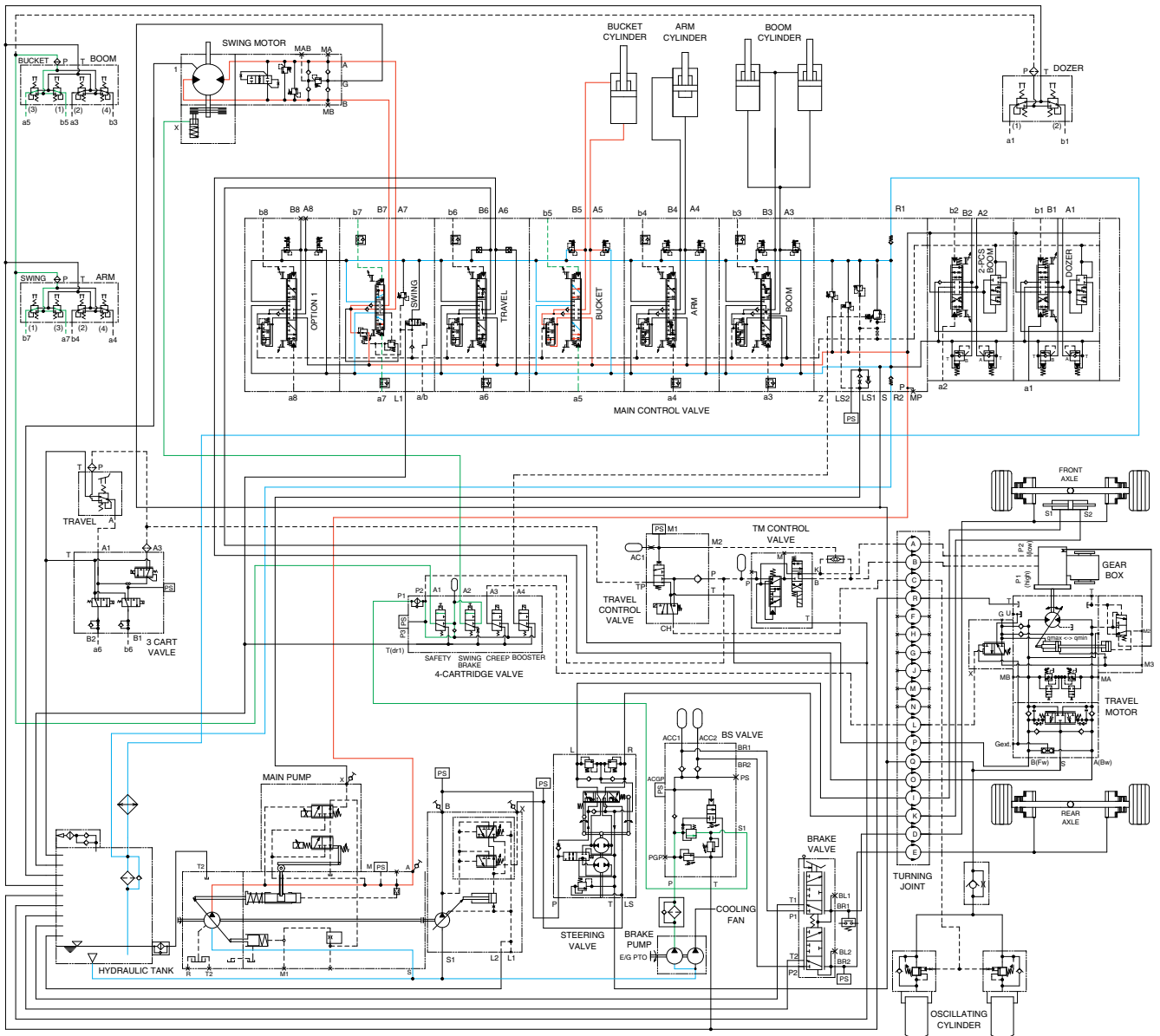
140WA3HC32

When the swing and arm functions are operated, simultaneously the swing spool and arm spool in the main control valve are moved to the functional position by the pilot oil pressure (a7, b7, a4, b4) from the remote control valve.

The oil from the main pump flows into the swing motor through swing spool and flows into the arm cylinder through the arm spool via the parallel passage.

The upper structure swings and the arm is operated.

## 4. COMBINED SWING AND BUCKET OPERATION



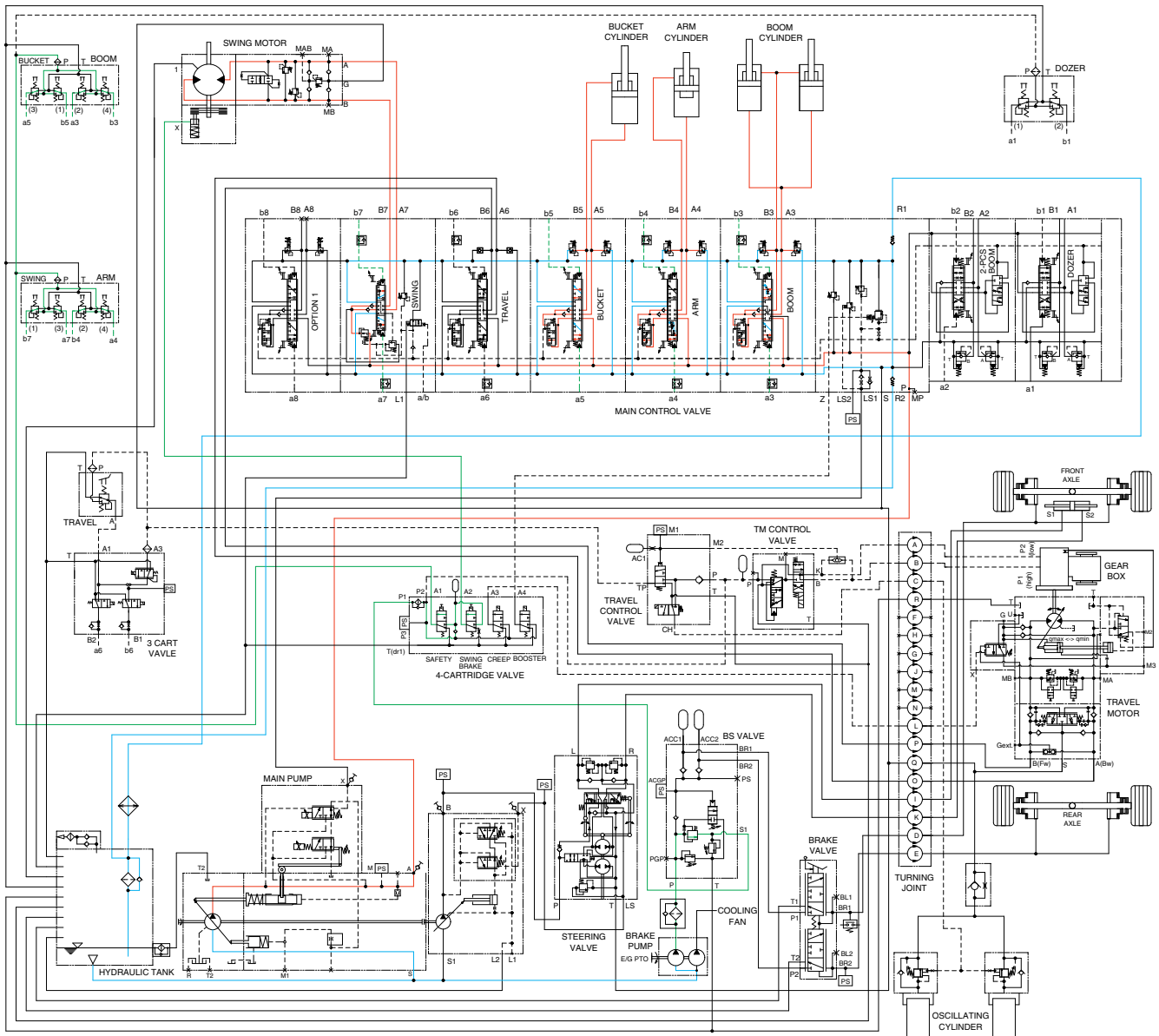
140WA3HC33

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 (a7, b7, a5, b5) from the remote control valve.

The oil from the main pump flows into the swing motor through the swing spool and flows into the bucket cylinder through the bucket spool via the parallel passage.

The upper structure swings and the bucket is operated.

## 5. COMBINED SWING, BOOM, ARM AND BUCKET OPERATION



140WA3HC34

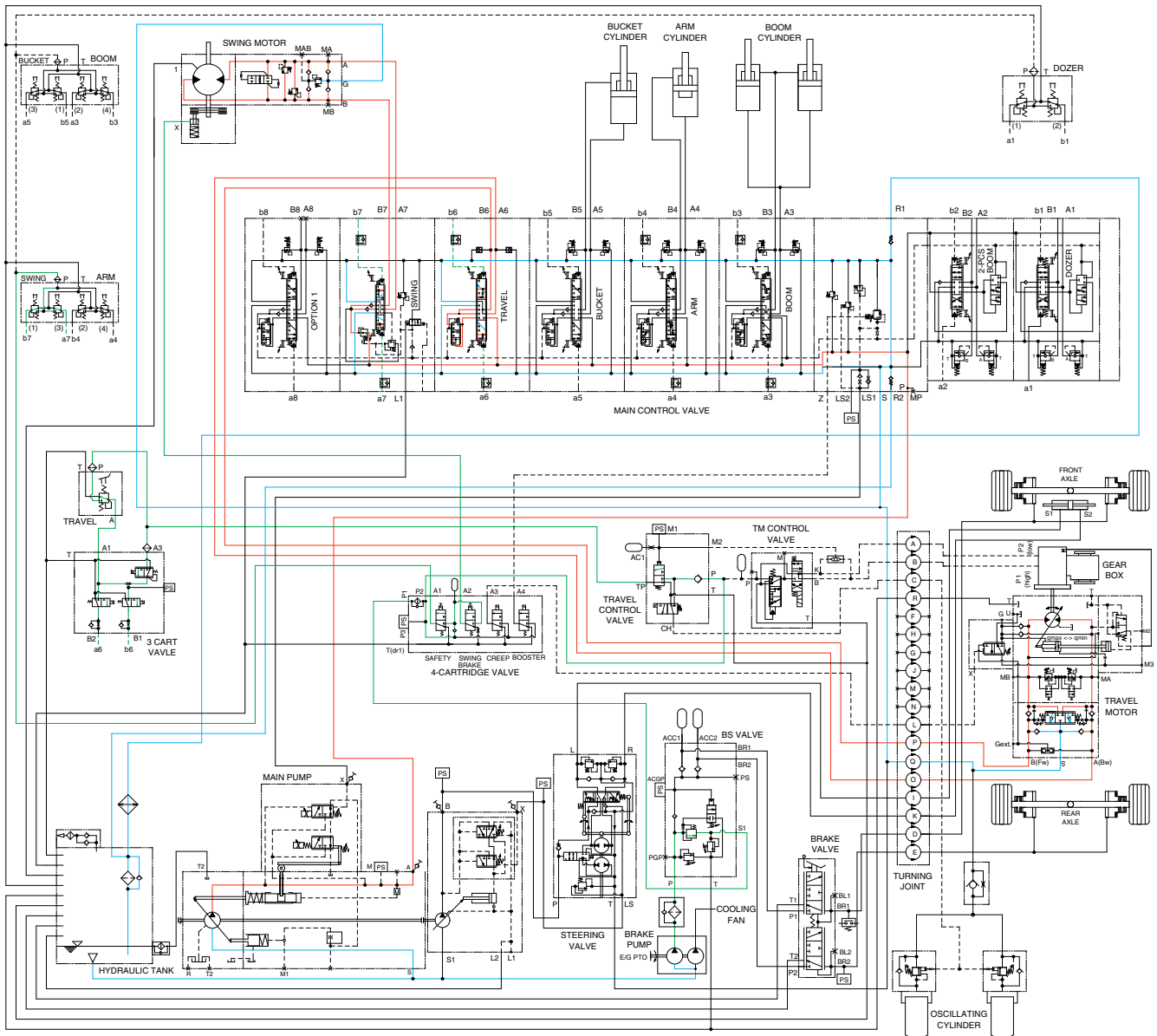
When the swing, boom, arm and bucket functions are operated, simultaneously each spool in the main control valve is moved to the functional position by the pilot oil pressure (a7, b7, a3, b3, a4, b4, a5, b5) from the remote control valve.

The oil from the main pump flows into the boom cylinder, arm cylinder and bucket cylinder through the boom spool, arm spool, bucket spool via the parallel passage.

Also, the oil flows into the swing motor through the swing spool via the parallel passage.

The superstructure swings and the boom, arm and bucket are operated.

## 6. COMBINED SWING AND TRAVEL OPERATION



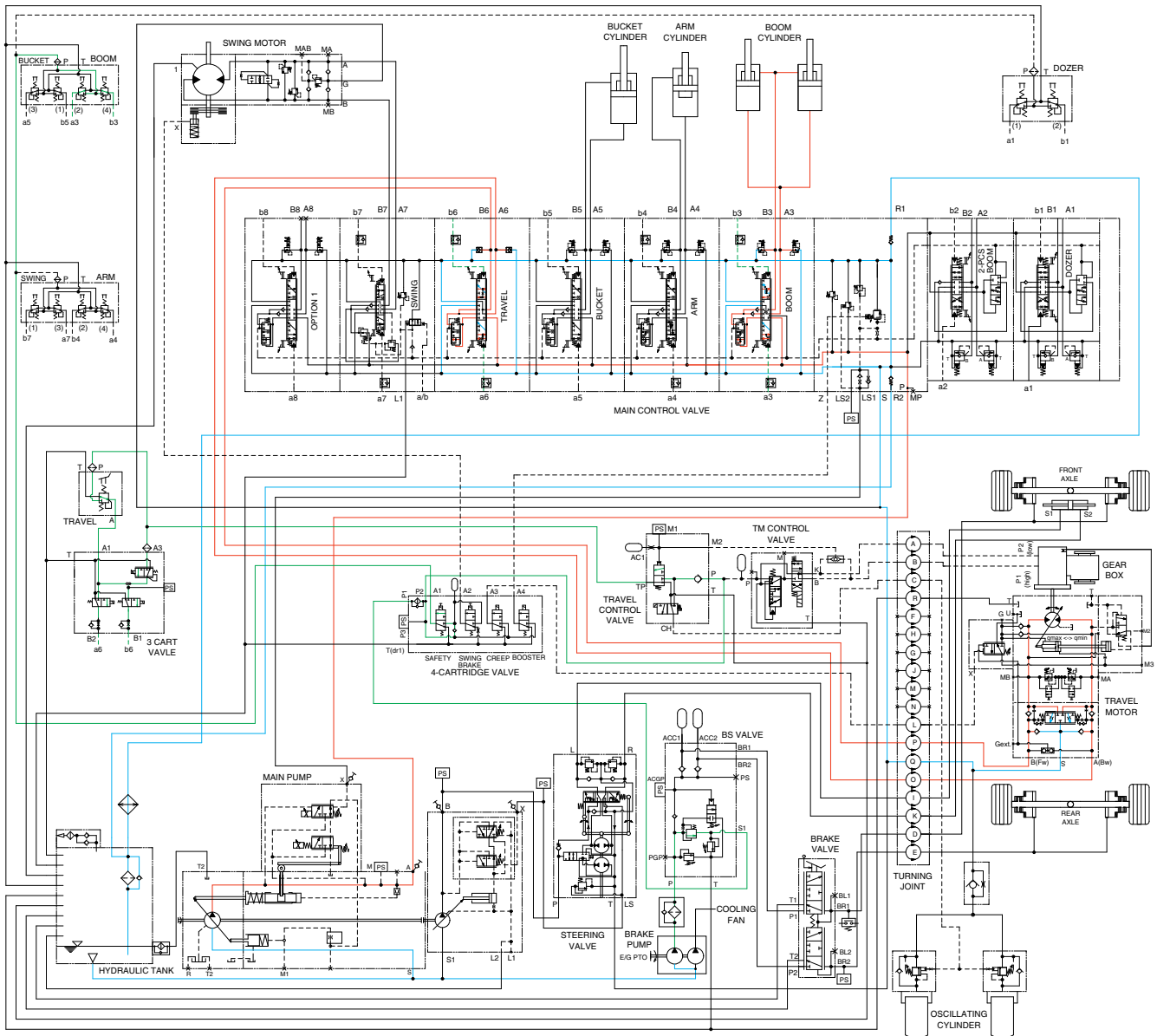
140WA3HC35

When the swing and travel functions are operated, simultaneously the swing spool and travel spool in the main control valve are moved to the functional position by the pilot oil pressure (a7, b7, a6, b6) from the remote control valve.

The oil from the main pump flows into the swing motor and travel motor through the swing spool and travel spool via the parallel passage.

The superstructure swings and the machine travels straight.

## 7. COMBINED BOOM AND TRAVEL OPERATION



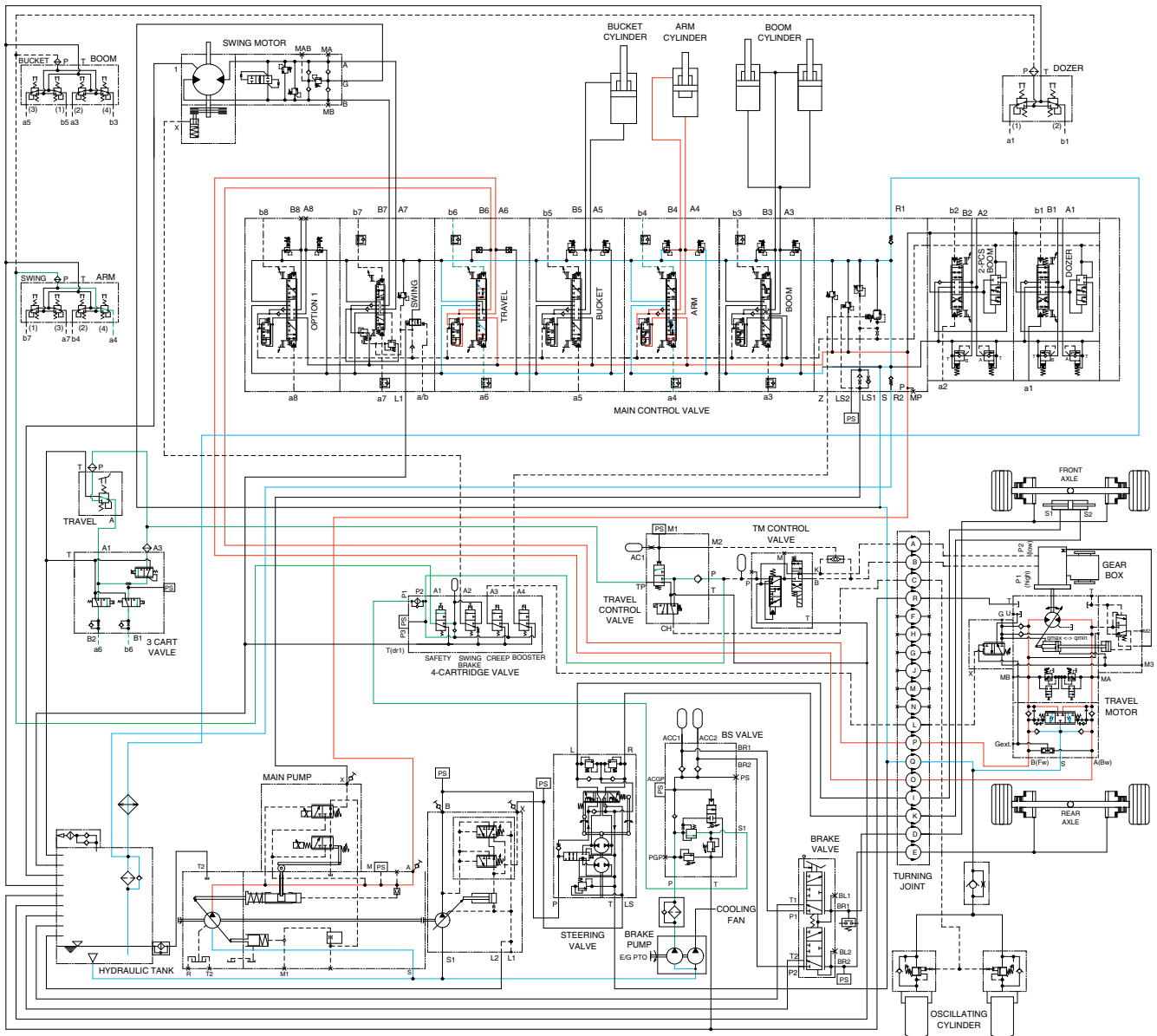
140WA3HC36

When the boom and travel functions are operated, simultaneously the boom spool and travel spool in the main control valve are moved to the functional position by the pilot oil pressure (a3, b3, a6, b6) from the remote control valve.

The oil from the main pump flows into the boom cylinder and the travel motor through, boom and travel spool via the parallel passage.

The boom is operated and the machine travels straight.

## 8. COMBINED ARM AND TRAVEL OPERATION



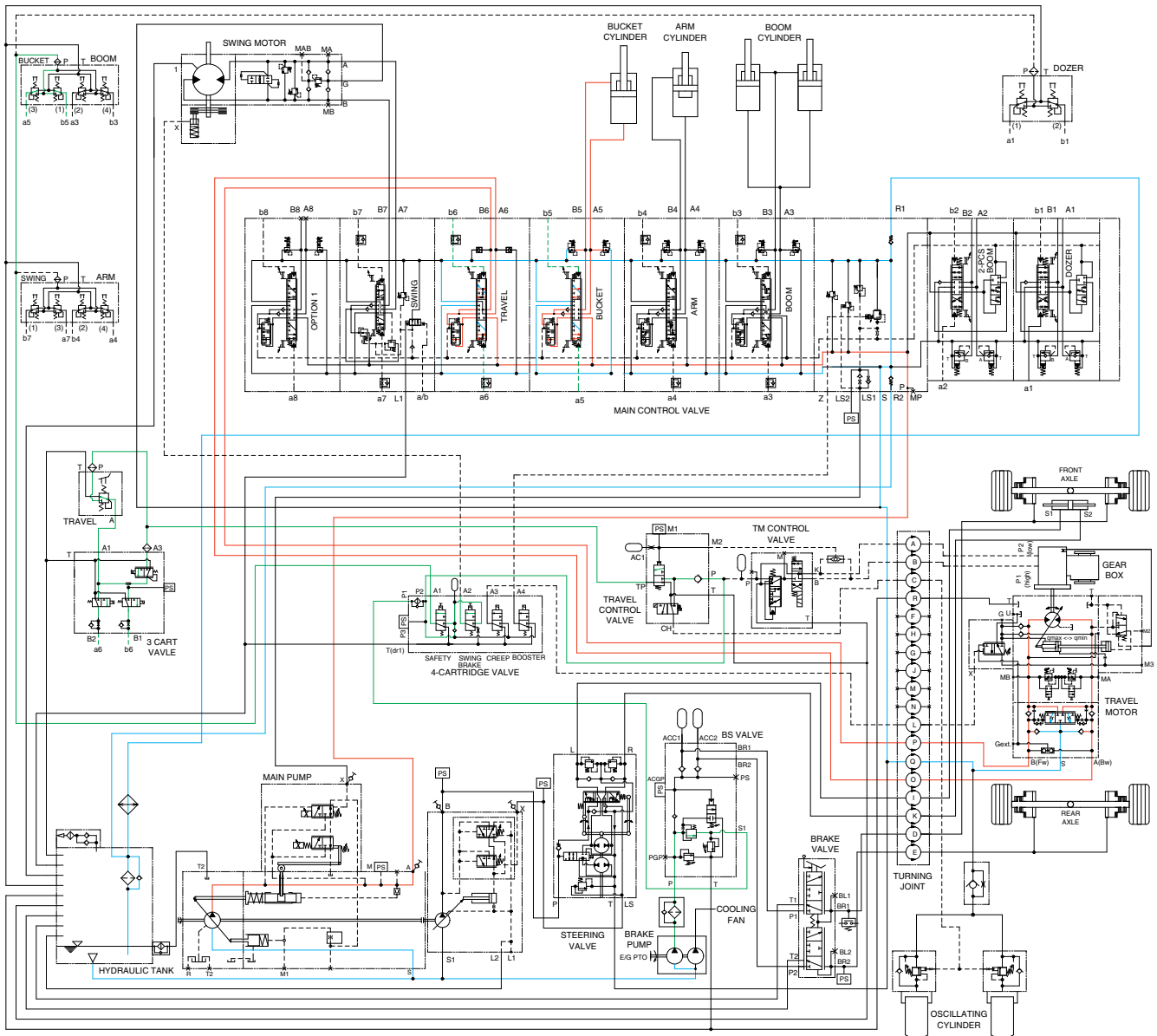
140WA3HC37

When the arm and travel functions are operated, simultaneously the arm spool and travel spool in the main control valve are moved to the functional position by the pilot oil pressure (a4, b4, a6, b6) from the remote control valve.

The oil from the main pump flows into the travel motor and the arm cylinder through travel spool and arm spool via the parallel passage.

The arm is operated and the machine travels straight.

## 9. COMBINED BUCKET AND TRAVEL OPERATION



140WA3HC38

When the bucket and travel functions are operated, simultaneously the bucket spool and travel spool in the main control valve are moved to the functional position by the pilot oil pressure (a5, b5, a6, b6) from the remote control valve.

The oil from the main pump flows into the travel motor and the bucket cylinder through the travel spool and the bucket spool via the parallel passage.

The bucket is operated and the machine travels straight.