PART NO. TODFY50-EN-00

HITACHI

Reliable solutions

Technical Manual
Operational Principle

ZX 250LC-7 250LCN-7
Hydraulic Excavator

Service Manual consists of the following separate Part No.

Technical Manual (Operational Principle)	: Vol. No.TODFY50-EN
Technical Manual (Troubleshooting)	: Vol. No.TTDFY50-EN
Workshop Manual	: Vol. No.WDFY50-EN
Engine Manual	: Vol. No.ETDFY50-EN, EWDFY50-EN

ZX250LC-7 • 250LCN-7 HYDRAULIC EXCAVATOR TECHNICAL MANUAL OPERATIONAL PRINCIPLE

TODFY50-EN-00

Hitachi Construction Machinery Co., Ltd.
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SECTION AND GROUP CONTENTS

TECHNICAL MANUAL

(O p e r a t i o n a l P r i n c i p l e)

SECTION1 GENERAL

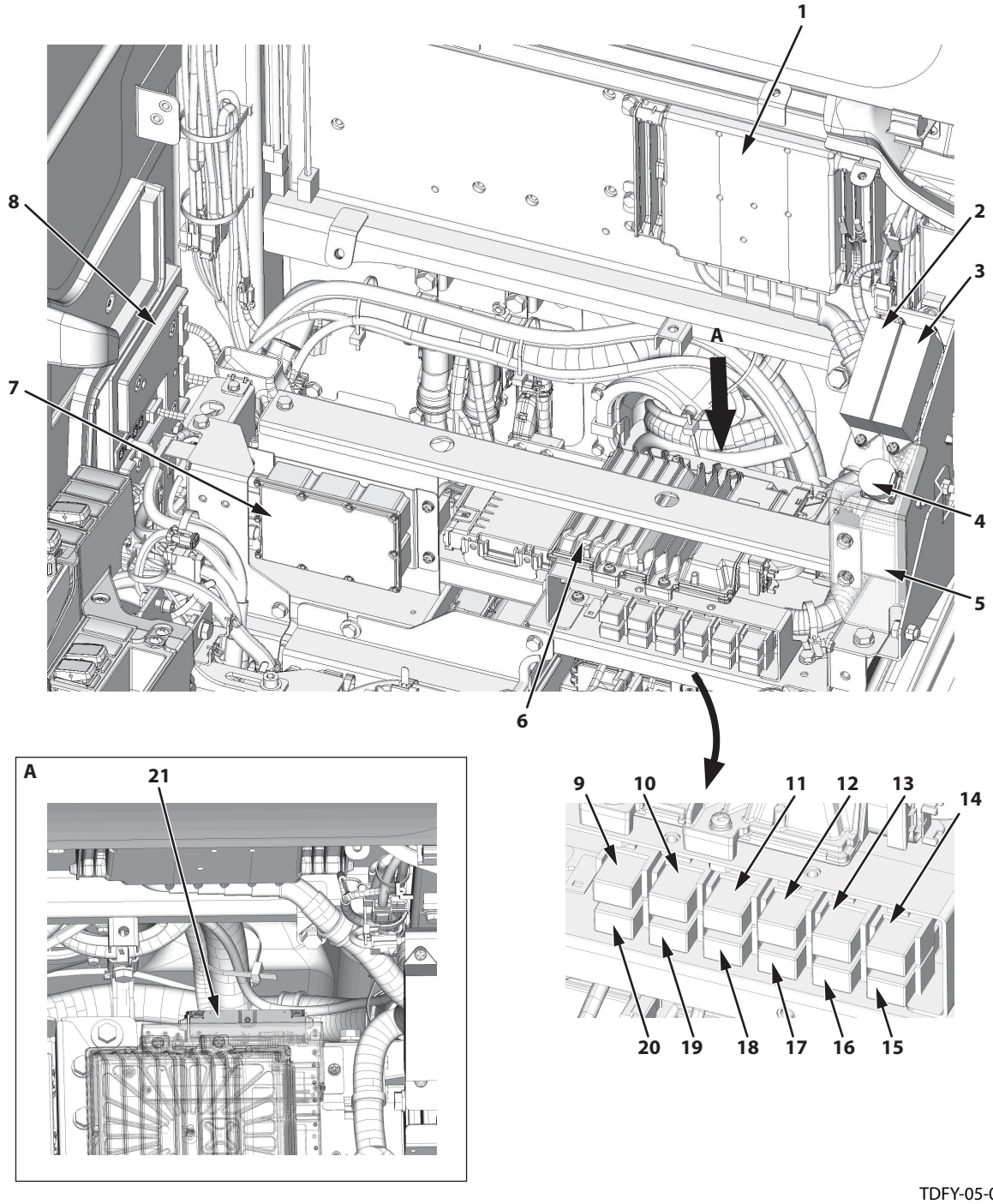
SECTION2 SYSTEM

SECTION3 COMPONENT OPERATION

1

GENERAL

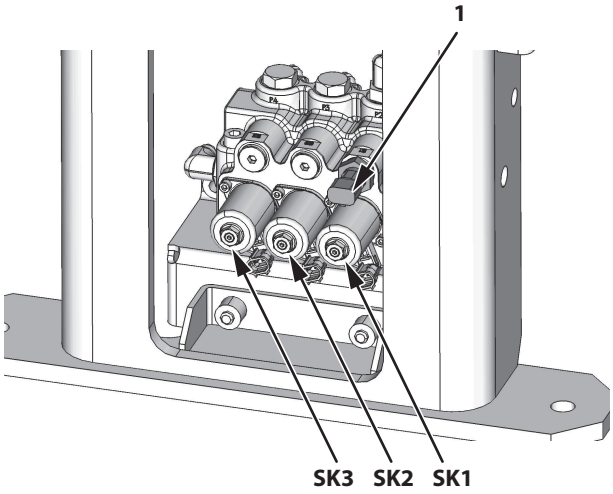
Electrical System (Rear Tray)



TDFY-05-04-004-1 ja

1- MC (Main Controller)
2- Fuse Box 1
3- Fuse Box 2
4- MPDr. Connector (Download Connector Using Combinedly)
5- DC-DC Converter
6- PLCU (Option)
7- GSM (Communication Controller)
8- Monitor Controller
9- Pilot Shut-Off Relay (R12)
10- Horn Relay (R10)
11- Work Light Relay 2 (R8)
12- Wiper Relay (R6)
13- Starter Cut Relay (R4)
14- ECM Main Relay (R2)
15- Load Dump Relay (R1)
16- Security Horn Relay (R3)
17- Key Switch ON Cut Relay (R5)
18- Work Light Relay 1 (R7)
19- Washer Relay (R9)
20- ACC Cut Relay (R11)
21- Aerial Angle Controller

3-Spool Solenoid Valve Unit



TDFY-05-01-019-2 ja

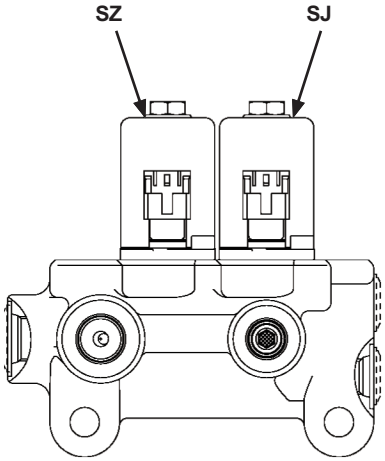
SK1- 3-Spool Solenoid Valve Unit (SK1)

SK2- 3-Spool Solenoid Valve Unit (SK2)

SK3- 3-Spool Solenoid Valve Unit (SK3)

1- Arm 1 Roll-In Pilot Pressure Sensor

2-Spool Solenoid Valve Unit (For Aftertreatment Device Regeneration Control)



TDAA-03-07-002-2 ja

SZ- 2-Spool Solenoid Valve Unit (SZ)

SJ- 2-Spool Solenoid Valve Unit (SJ)

Cylinder (2-Piece Boom)		Boom	Arm	Bucket	Positioning
	Rod Outer Diameter	90 mm	100 mm	90 mm	100 mm
	Tube Inner Diameter	125 mm	140 mm	130 mm	150 mm
	Stroke	1390 mm	1610 mm	1075 mm	1327 mm
	Fully Retracted Length	1990 mm	2177 mm	1632 mm	1910 mm
	Plating Thickness	30 μm	30 μm	30 μm	30 μm

Hose Rupture Valve	Relief Set Pressure	$40.5^{+1.0}_{0}$ MPa at 0.5±0.1 L/min

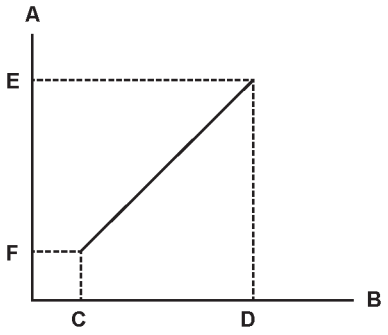
Specifications of Electrical Component

Battery Relay	Voltage/Current	24 V/100 A
Starter Relay	Voltage	24 V
Glow Plug Relay	Voltage	24 V
Hydraulic Oil Temperature Sensor	Operating Temperature	-30 to 120 °C
Air Cleaner Restriction Switch	Operating Pressure	6.2±0.6 kPa
Horn	Voltage/Current	24 V/$2.5^{+0.5}_{-1}$ A
	Sound Pressure	113±5 dB (A) at 2 m
Illumination	Work Light	LED 12 to 24V, 20W
	Cab Light	LED 24 V/0.03 A
Air Conditioner	Refrigerant	HFC134 a
	Cooling Ability	4.5 kW or more
	Cool Air Volume	550 m^3/h or more
	Heating Ability	5.4 kW or more
	Warm Air Volume	340 m^3/h or more
	Temperature Adjusting System	Electronic Type
	Refrigerant Quantity	850±50 g
	Compressor Oil Quantity	160 cm^3

Engine Control Dial Control

Purpose:

The engine control dial control controls the engine speed according to the rotation angle of engine control dial (32).



TDC1-02-02-048-1 ja

A- Engine Speed
B- Engine Control Dial Position
C- Slow Idle Speed Position
D- Fast Idle Speed Position
E- Fast Idle Speed
F- Slow Idle Speed

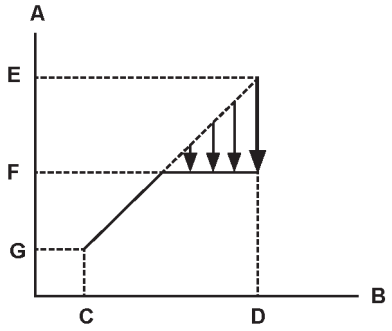
Operation:

1. Switch box controller (39) receives the signals of the rotation angle (the required engine speed) of engine control dial (32) and sends the signals to MC (10) by using CAN communication (14). MC (10) sends the signal equivalent to the target engine speed according to the received signals to ECM (15) by using CAN communication (14).
2. ECM (15) controls the engine speed according to CAN communication (14).

Auto-Idle Control

Purpose:

The auto-idle control reduces the engine speed when all control levers are in neutral. Therefore, the fuel consumption and noise level can be reduced.



TDC1-02-02-052-1 ja

A- Engine Speed
B- Engine Control Dial Position
C- Slow Idle Speed Position
D- Fast Idle Speed Position
E- Fast Idle Speed
F- Auto-Idle Speed
G- Slow Idle Speed

Operation:

1. When all following conditions exist, the auto-idle control is activated.
   - Coolant temperature: 10 °C or more
   - Auto-idle switch (30): ON position
   - Control lever: All control levers are held in the neutral position [travel pilot pressure sensor (6) and front pilot pressure sensor (7): OFF] beyond 3.5 seconds
2. When the auto-idle control is activated, MC (10) sends the signal equivalent to the auto-idle speed to ECM (15) by using CAN communication (14).
3. ECM (15) changes the engine speed into the auto-idle speed.
4. When any one of the following condition exists, the auto-idle control is deactivated.
   - Control lever: Any control lever is operated [travel pilot pressure sensor (6) and front pilot pressure sensor (7): ON]
   - When power mode switch (31) is operated
   - When engine control dial (32) is operated
   - Coolant temperature: 5 °C or less
5. MC (10) returns the signal sending to ECM (15) into the signal equivalent to the target engine speed set by engine control dial (32) immediately.

NOTE

The auto-idle speed can be adjusted by MPDr. (11). (AI Speed)

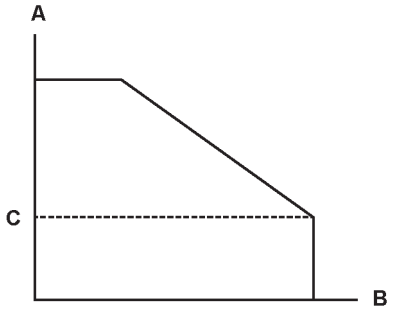
NOTE

The auto-idle control is disabled during aftertreatment device auto regeneration. When aftertreatment device auto regeneration is performed at the auto-idle control, the auto-idle control is kept until the auto-idle control is deactivated.

Engine Speed Slow Down Control

Purpose:

The engine speed slow down control gradually reduces the engine speed to the slow idle speed when the auto shut-down control is performed. Therefore, the loads of the engine and hydraulic actuator can be reduced.



TDC1-02-02-057-1 ja

A- Engine Speed
B- Time
C- Slow Idle Speed

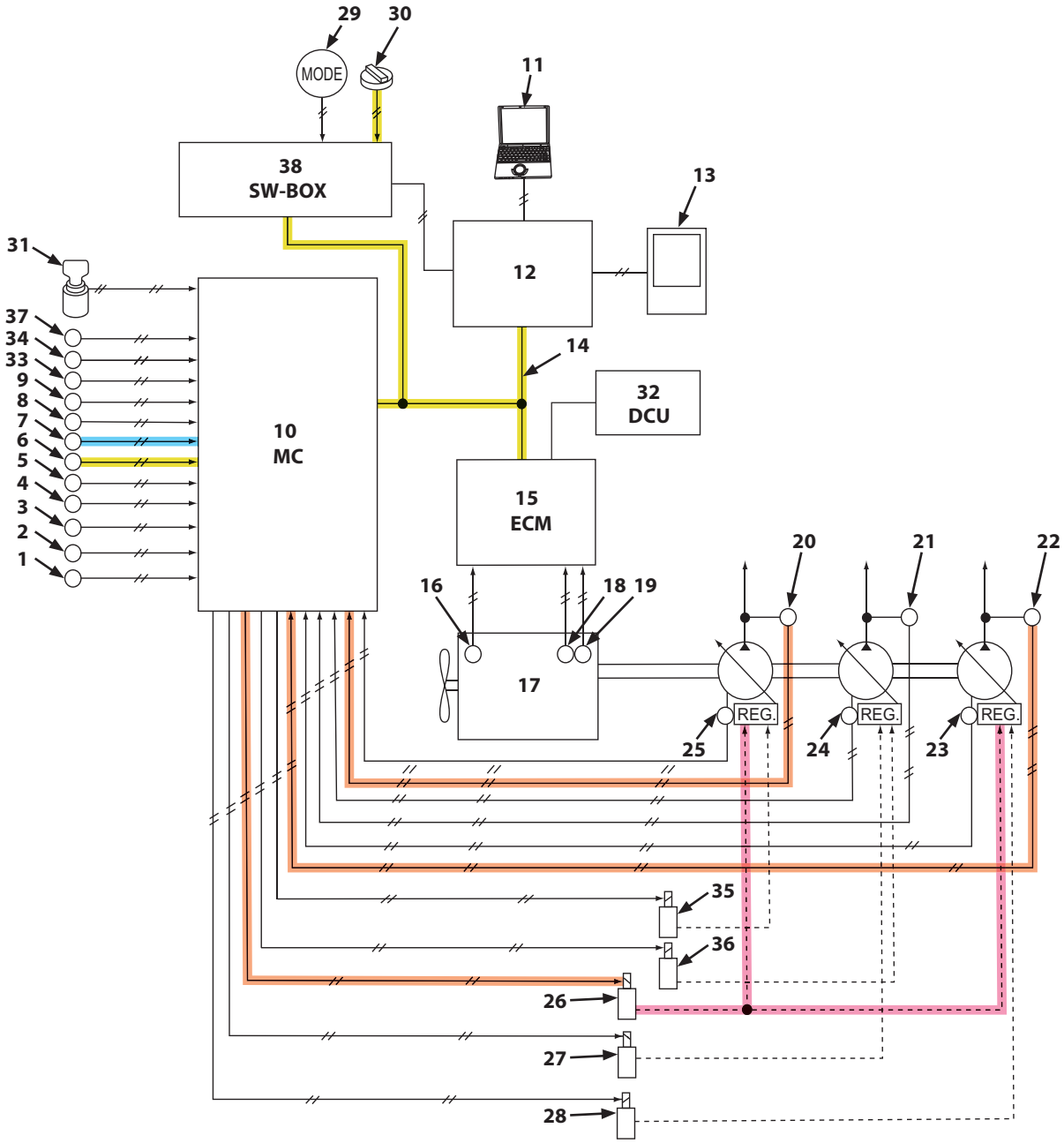
Operation:

1. MC (10) saves the engine speed at the moment when the auto shut-down control is performed.
2. MC (10) sends the signal that the engine speed gradually reduces from the saved engine speed to ECM (15) by using CAN communication (14).
3. ECM (15) changes the engine speed to the slow idle speed according to CAN communication (14).
4. Then, the auto shut-down control stops the engine. (Refer to "Auto Shut-Down Control"T2-2-100.)

Pump Control

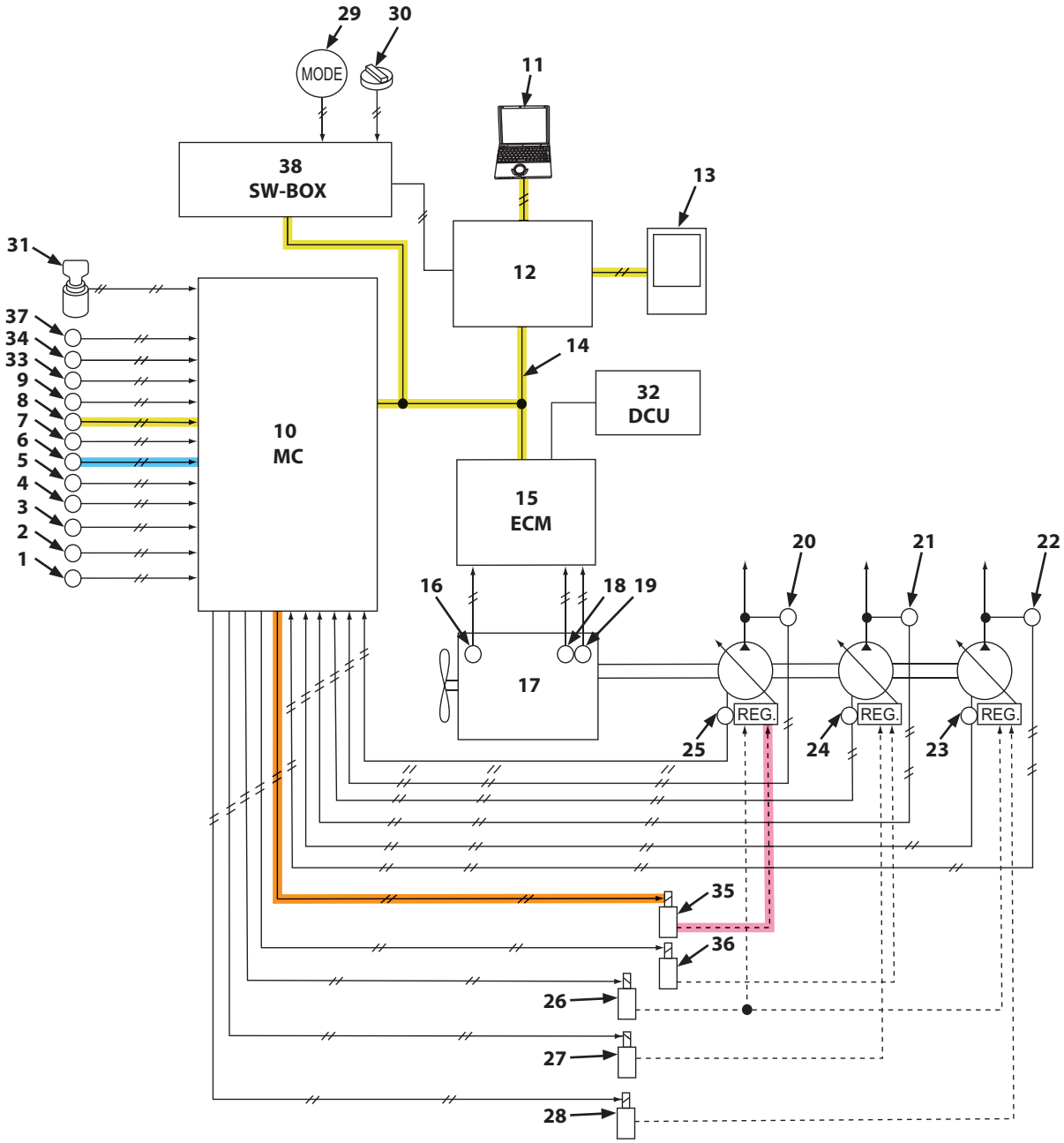
The pump control consists of the followings.

- Speed Sensing Control
- Swing Relief Cut Control
- Pump Torque Decrease Control (Radiator Coolant Temperature)
- Pump Torque Decrease Control (Hydraulic Oil Temperature)
- Travel Torque-Up Control
- Pump Torque Restriction Control (During Engine Output Restriction)
- Pump 1 Flow Rate Control
- Pump 2 Flow Rate Control
- Pump 3 Flow Rate Control
- Pump 1 Flow Rate Limit Control (Option)
- Pump 2 Flow Rate Limit Control (Option)
- Pump 3 Flow Rate Limit Control (Option)



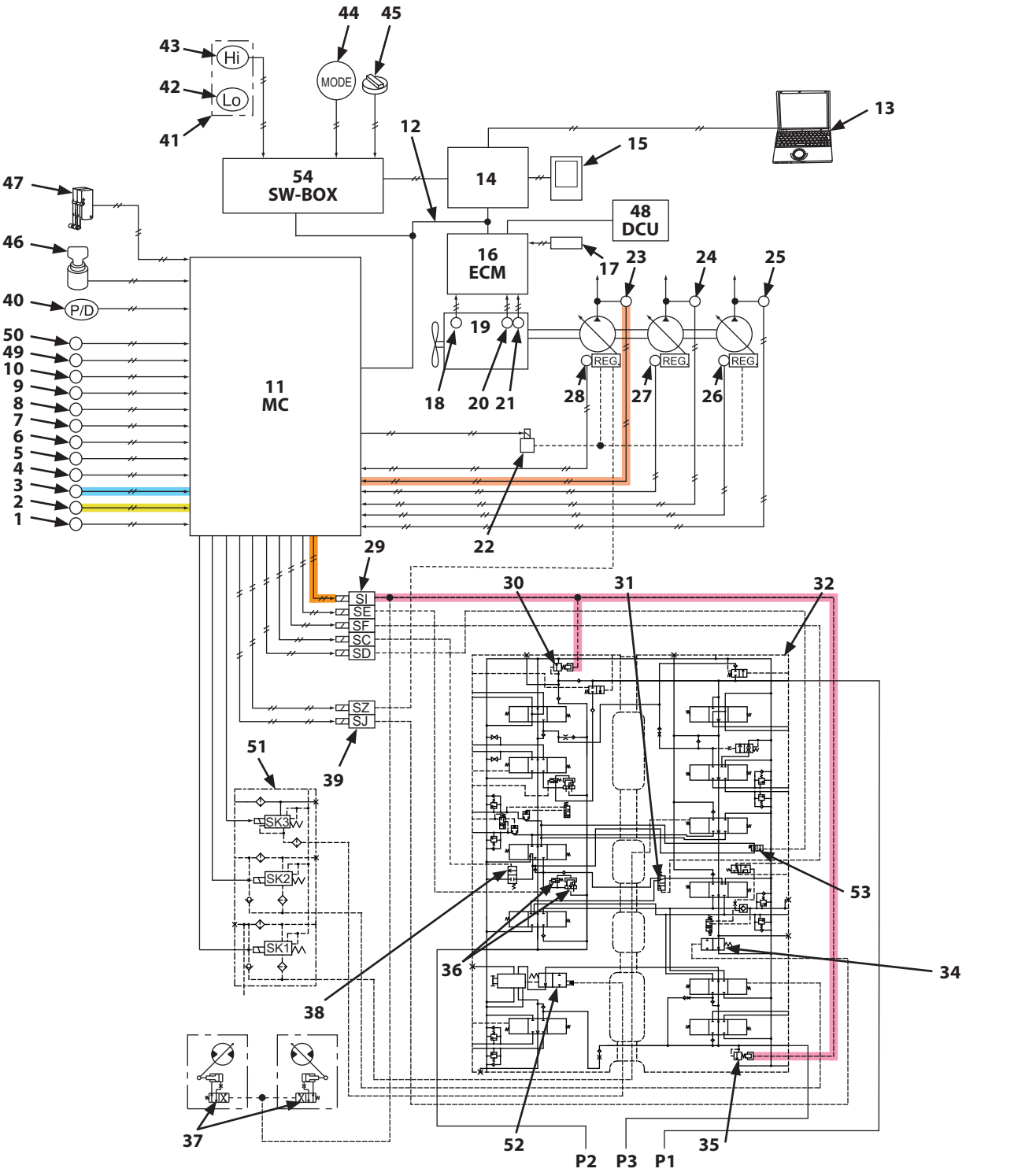
TDFY-02-02-022-1 ja

1- Hydraulic Oil Temperature Sensor
2- Boom Raise Pilot Pressure Sensor
3- Arm 1 Roll-In Pilot Pressure Sensor
4- Bucket Roll-In Pilot Pressure Sensor
5- Swing Pilot Pressure Sensor
6- Travel Pilot Pressure Sensor
7- Front Pilot Pressure Sensor
8- Auxiliary 1 Pilot Pressure Sensor (Option)
9- Auxiliary 2 Pilot Pressure Sensor (Option)
10- MC
11- MPDr.
12- Monitor Controller
13- Monitor
14- CAN
15- ECM
16- Coolant Temperature Sensor
17- Engine
18- Cam Angle Sensor
19- Crank Speed Sensor
20- Pump 1 Delivery Pressure Sensor
21- Pump 3 Delivery Pressure Sensor
22- Pump 2 Delivery Pressure Sensor
23- Pump 2 Control Pressure Sensor
24- Pump 3 Control Pressure Sensor
25- Pump 1 Control Pressure Sensor
26- Pump 1 and 2 Torque Control Solenoid Valve
27- Pump 3 Torque Control Solenoid Valve
28- Maximum Pump 2 Flow Rate Limit Control Solenoid Valve
29- Power Mode Switch
30- Engine Control Dial
31- Key Switch
32- DCU
33- Arm Roll-Out Pilot Pressure Sensor
34- Bucket Roll-Out Pilot Pressure Sensor
35- Maximum Pump 1 Flow Rate Limit Control Solenoid Valve
36- Maximum Pump 3 Flow Rate Limit Control Solenoid Valve
37- Arm 2 Roll-In Pilot Pressure Sensor
38- Switch Box Controller

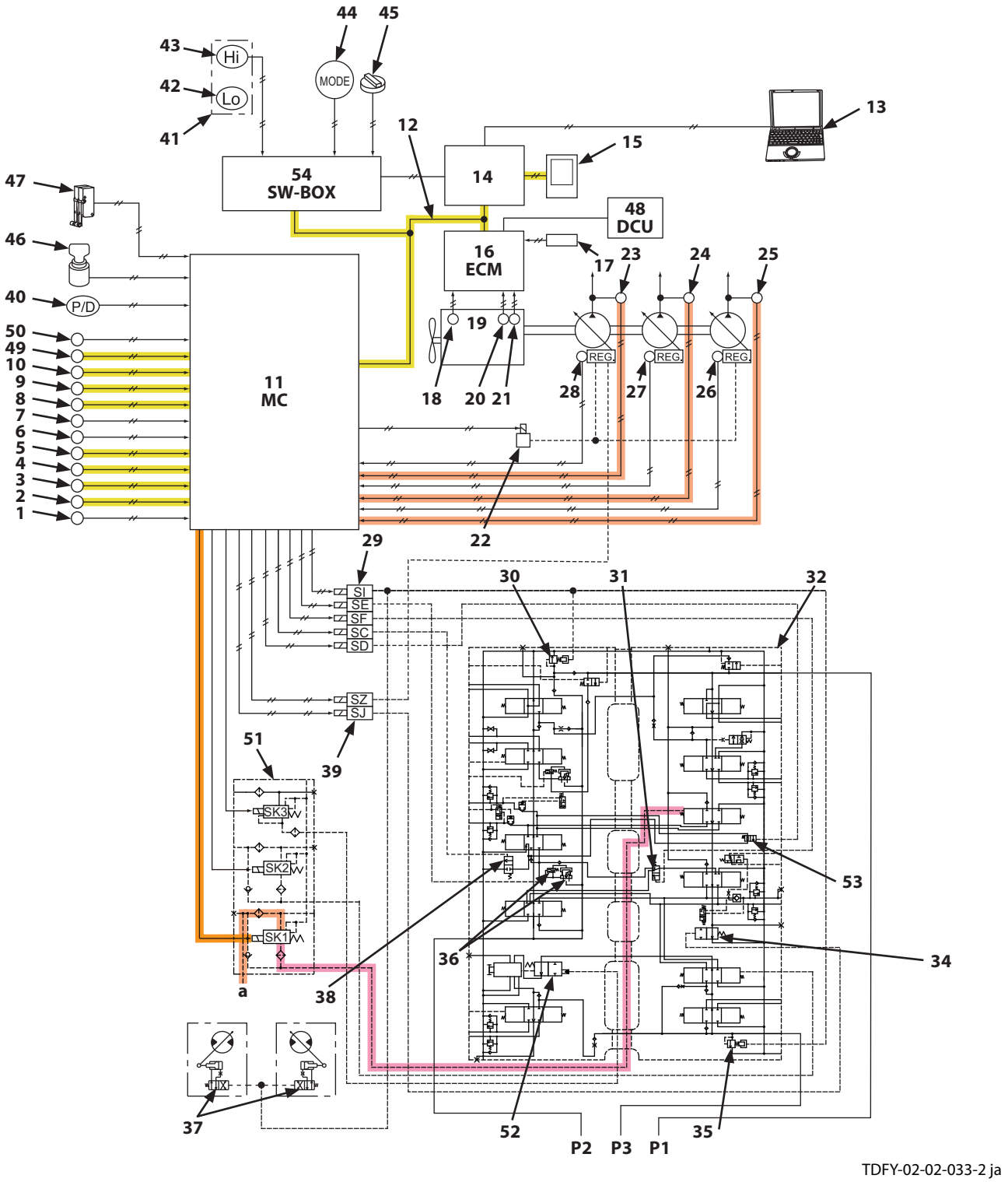


TDFY-02-02-023-1 ja

1- Hydraulic Oil Temperature Sensor
2- Boom Raise Pilot Pressure Sensor
3- Arm 1 Roll-In Pilot Pressure Sensor
4- Bucket Roll-In Pilot Pressure Sensor
5- Swing Pilot Pressure Sensor
6- Travel Pilot Pressure Sensor
7- Front Pilot Pressure Sensor
8- Auxiliary 1 Pilot Pressure Sensor (Option)
9- Auxiliary 2 Pilot Pressure Sensor (Option)
10- MC
11- MPDr.
12- Monitor Controller
13- Monitor
14- CAN
15- ECM
16- Coolant Temperature Sensor
17- Engine
18- Cam Angle Sensor
19- Crank Speed Sensor
20- Pump 1 Delivery Pressure Sensor
21- Pump 3 Delivery Pressure Sensor
22- Pump 2 Delivery Pressure Sensor
23- Pump 2 Control Pressure Sensor
24- Pump 3 Control Pressure Sensor
25- Pump 1 Control Pressure Sensor
26- Pump 1 and 2 Torque Control Solenoid Valve
27- Pump 3 Torque Control Solenoid Valve
28- Maximum Pump 2 Flow Rate Limit Control Solenoid Valve
29- Power Mode Switch
30- Engine Control Dial
31- Key Switch
32- DCU
33- Arm Roll-Out Pilot Pressure Sensor
34- Bucket Roll-Out Pilot Pressure Sensor
35- Maximum Pump 1 Flow Rate Limit Control Solenoid Valve
36- Maximum Pump 3 Flow Rate Limit Control Solenoid Valve
37- Arm 2 Roll-In Pilot Pressure Sensor
38- Switch Box Controller



TDFY-02-02-028-1 ja



TDFY-02-02-033-2 ja

a- Arm Roll-In Pilot Pressure

Valve Control (Option)

The valve control (option) consists of the followings.

- Attachment Flow Rate Control
- Auxiliary Flow Combiner Control
- Breaker 1 (HSB Breaker) Control
- Auxiliary Overload Relief Valve Pressure Control

NOTE

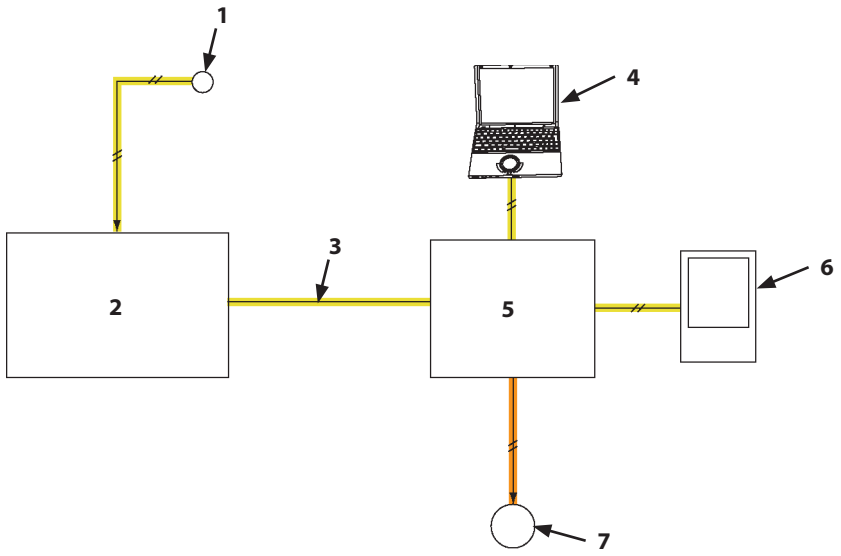
This control is for only the machine with the option parts equipped.

1- Hydraulic Oil Temperature Sensor
2- Boom Raise Pilot Pressure Sensor
3- Arm 1 Roll-In Pilot Pressure Sensor
4- Bucket Roll-In Pilot Pressure Sensor
5- Swing Pilot Pressure Sensor
6- Travel Pilot Pressure Sensor
7- Front Pilot Pressure Sensor
8- Auxiliary 1 Pilot Pressure Sensor (Option)
9- Arm Roll-Out Pilot Pressure Sensor
10- MC
11- CAN
12- MPDr.
13- Monitor Controller
14- Monitor
15- ECM
16- Engine
17- Pump 1 Delivery Pressure Sensor
18- Pump 3 Delivery Pressure Sensor
19- Pump 2 Delivery Pressure Sensor
20- Pump 2 Control Pressure Sensor
21- Pump 3 Control Pressure Sensor
22- Pump 1 Control Pressure Sensor
23- Auxiliary Control Solenoid Valve Unit
24- Auxiliary Flow Combiner Control Solenoid Valve
25- Auxiliary Flow Rate Control Solenoid Valve
26- Auxiliary Flow Combiner Valve
27- Control Valve
28- Pump 1 Bypass Shut-Out Valve
29- Auxiliary Flow Rate Control Valve
30- Auxiliary 1 Overload Relief Valve
31- Travel Pilot Pressure
32- Attachment
33- Accumulator Control Valve
34- Accumulator (High Pressure)
35- Accumulator (Low Pressure)
36- Breaker Relief Solenoid Valve
37- Selector Valve
38- Pilot Pump
39- Selector Valve Control Solenoid Valve
40- Bucket Roll-Out Pilot Pressure Sensor
41- Arm 2 Roll-In Pilot Pressure Sensor

Pump/Valve Coordination Control

The pump/valve coordination control consists of the following:

- Pump 3 Minimum Displacement Angle Hold Control during Digging Operation



TDAA-02-02-010-1 ja

1- Auxiliary 1 Pilot Pressure Sensor (Option)
2- MC
3- CAN
4- MPDr.
5- Monitor Controller
6- Monitor
7- Buzzer

Travel Alarm Control (Option)

Purpose:

The travel alarm control sounds buzzer (5) when performing the travel operation.

Operation:

1. MC (2) receives the signal from travel pilot pressure sensor (1) when the travel operation is performed.
2. As long as MC (2) receives this signal, MC (2) sends the signal to travel alarm device (3) and sounds buzzer (5).

NOTE

After traveling continuously for over 13 seconds, buzzer (5) can be deactivated by travel alarm deactivation switch (4).

Fuel Injection Rate Control

Purpose:

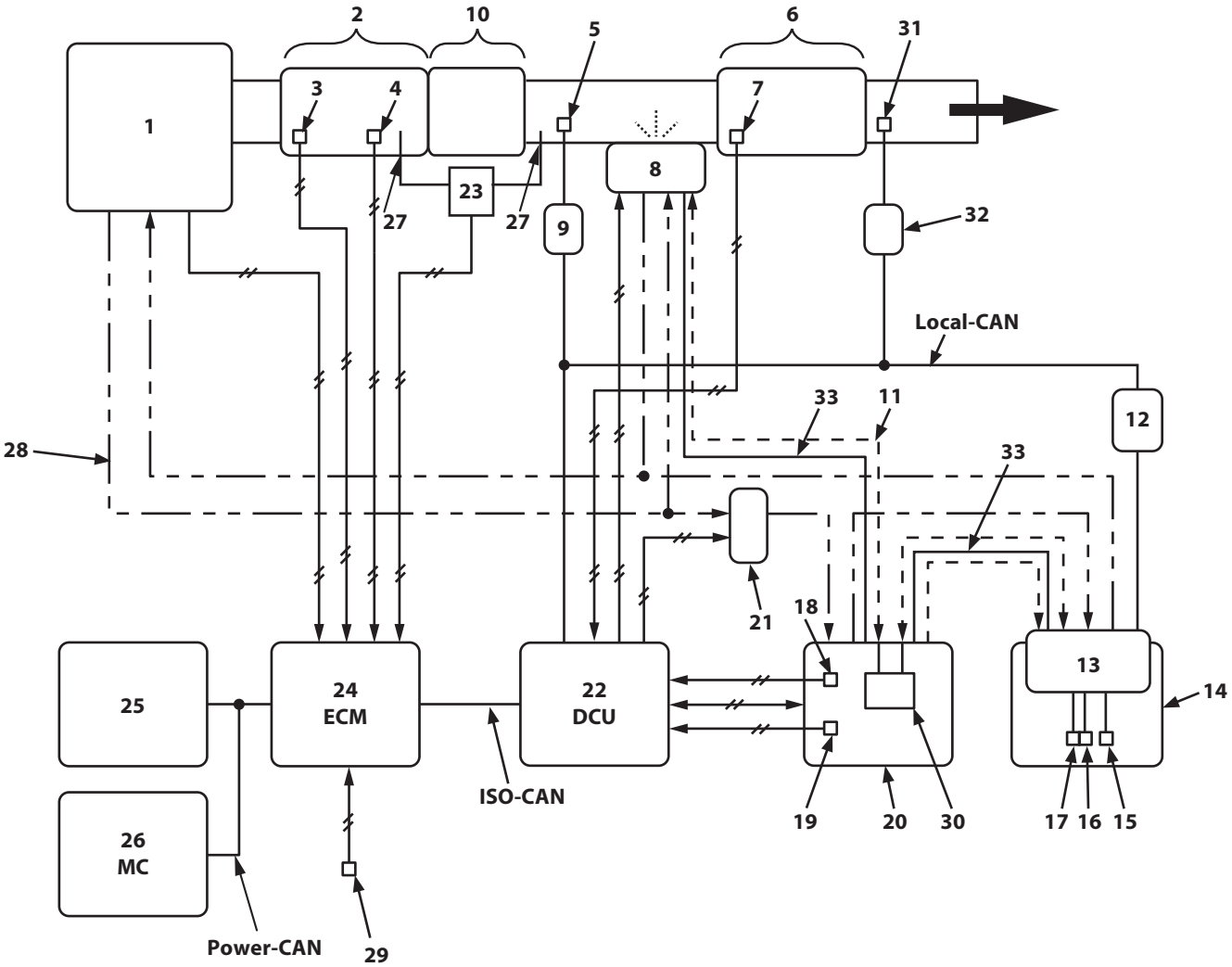
The fuel injection rate control controls the fuel injection timing and fuel injection amount, and sets proper combustion in the engine cylinder.

Operation:

1. The injector injects small amount of fuel (pilot injection) first and ignites.
2. After igniting, the injector makes second fuel injection (main injection).
3. ECM turns two-way valve (2) in the injector ON/OFF. Consequently, ECM controls the proper fuel injection timing and fuel injection amount.

Operation of Fuel Injection:

1. Fuel pressure is always applied to nozzle (6) in the injector.
2. When turning ON electromagnetic coil (9) in two-way valve (2), high-pressure fuel in control chamber (5) returns to the fuel tank through orifice A (4).
3. As the pressure in control chamber (5) decreases, hydraulic piston (10) is raised and nozzle (6) is opened so that the injection starts.
4. When turning OFF electromagnetic coil (9) in two-way valve (2), valve (8) is closed and the circuit to the fuel tank is closed. High-pressure fuel from the common rail flows to control chamber (5) through orifice B (12).
5. As high-pressure fuel flows to control chamber (5), the pressure difference occurs to the upper and lower parts of hydraulic piston (10). Hydraulic piston (10) is lowered by this pressure difference.As nozzle (6) is closed, the injection stops.



TDFY-02-03-008-1 ja

1- Engine
2- DOC (Diesel Oxidation Catalyst)
3- DOC Inlet Exhaust Temperature Sensor
4- DOC Outlet Exhaust Temperature Sensor
5- Upstream NOx Sensor
6- SCR Catalyst
7- SCR Exhaust Temperature Sensor
8- Dosing Module
9- Upstream NOx Sensor Controller
10- Filter (CSF)
11- DEF Piping
12- DEF Sensor Unit Controller
13- DEF Sensor Unit
14- DEF Tank
15- DEF Tank Level Sensor
16- DEF Tank Temperature Sensor
17- DEF Quality Sensor
18- DEF Pressure Sensor
19- DEF Supply Module Temperature Sensor
20- DEF Supply Module
21- Coolant Control Valve
22- DCU
23- Differential Pressure Sensor
24- ECM
25- Monitor Controller
26- MC
27- Differential Pressure Detection Port
28- Coolant Piping
29- MAF/Intake-Air Temperature Sensor
30- Reverting Valve
31- Downstream NOx Sensor
32- Downstream NOx Sensor Controller
33- Heating Wire

DEF Injection Control

Purpose:

The DEF injection control controls the proper injection amount of DEF.

Operation:

1. Upstream NOx sensor (5) detects the concentration of NOx in exhaust gas.
2. Upstream NOx sensor controller (9) sends the signals from upstream NOx sensor (5) to DCU (22) by using Local-CAN.
3. MAF/intake-air temperature sensor (29) detects intake-air flow rate from the air cleaner.
4. ECM (24) sends the signal from MAF/intake-air temperature sensor (29) to DCU (22) by using ISO-CAN.
5. DCU (22) controls dosing module (8) and sets a proper DEF injection amount according to the signal.

Engine Output Restriction Control Level	Step 1	Step 2	Step 3
Malfunction of the Urea SCR System (First Time)	- (Restriction starts.)	3 hours after starting the step 1	3.5 hours after starting the step 2
Malfunction of the Urea SCR System (Second Time) (Within 40 Hours)		- (Restriction starts.)	0.5 hours after starting the step 2
Malfunction of the EGR System (First Time)	- (Restriction starts.)	36 hours after starting the step 1	100 hours after starting the step 2
Malfunction of the EGR System (Second Time) (Within 40 Hours)		- (Restriction starts.)	5 hours after starting the step 2
Engine Torque	No restriction	Restriction	Restriction
Engine Speed	No restriction	No restriction	Slow Idle
Buzzer	Sounds once	Sounds once/One second	Sounds continuously
Monitor Screen	 TDFY-02-03-018 ja	 TDFY-02-03-019 ja	 TDFY-02-03-020 ja

Outline of Aftertreatment Device

Aftertreatment device (16) consists of the diesel oxidation catalyst (DOC) block, filter (CSF) (14), and the SCR catalyst block.
SCR catalyst 1 (11), SCR catalyst 2 (12), and the diesel oxidation catalyst (DOC) 2 (13) convert NOx in exhaust gas into nitrogen and water by a chemical reaction of NOx and DEF. Thus NOx is reduced from exhaust gas.
Filter (14) removes fine particles (PM) in exhaust gas. Diesel oxidation catalyst (DOC) 1 (15) oxidizes unburnt fuel and raises exhaust temperature. Filter (14) traps PM, then burns and removes the PM using high temperature exhaust gas that was heated by diesel oxidation catalyst. Catalyst is applied onto filter (14). This promotes PM burning.
DOC inlet exhaust temperature sensor (8) detects the exhaust temperature at upper stream of diesel oxidation catalyst (DOC) 1 (15).
DOC outlet exhaust temperature sensor (7) detects the exhaust temperature at down stream of diesel oxidation catalyst (DOC) 1 (15).
The differential pressure sensor (1) measures the differential pressure before and after filter (14) in order to detect the amount of trapped PM.
Upstream NOx sensor (6) detects the concentration of NOx upstream of SCR catalyst 1 (11).
Downstream NOx sensor (3) detects the concentration of NOx downstream of SCR catalyst 2 (12).
Dosing module (5) injects DEF into aftertreatment device (16).
SCR exhaust temperature sensor (9) detects the exhaust temperature at the upper stream of SCR catalyst 1 (11).

Pump Control Circuit (Refer to COMPONENT OPERATION/Pump Device.)

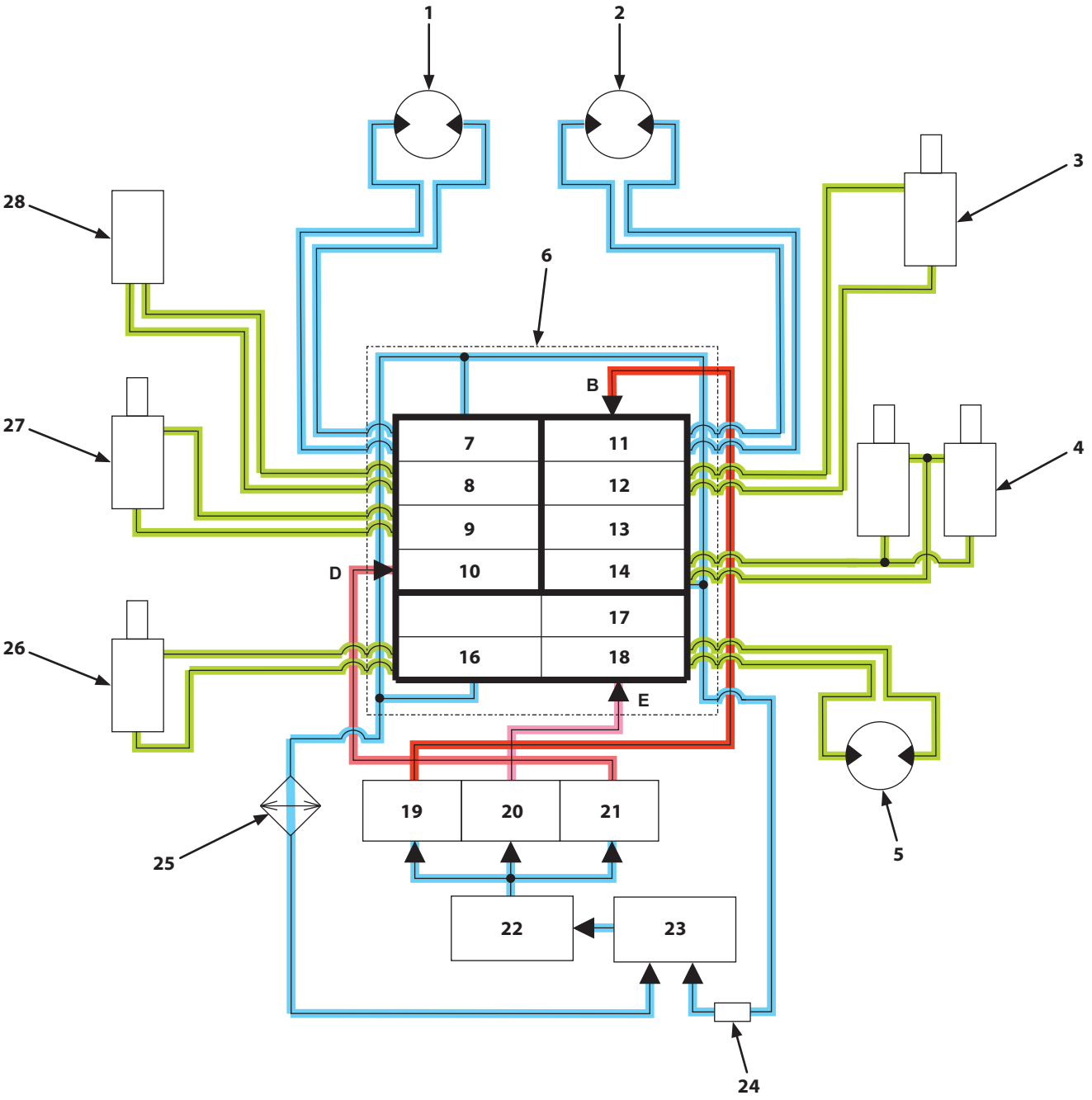
- Pump Delivery Flow Rate Control by Pump Control Pressure Pi (23)
  1. The pilot pressure from the pilot valve is selected by shuttle valve (10) in signal control valve (11). Then, pump 1 flow rate control valve (16), pump 2 flow rate control valve (14), and pump 3 flow rate control valve (13) in signal control valve (11) are shifted.
  2. Pilot pressure oil from pilot pump (26) flows to the regulators in pump 1 (20), pump 2 (22), and pump 3 (21) as pump control pressure Pi (23) through maximum pump flow rate limit control solenoid valves (27, 24, 28).
  3. The regulators increase or decrease the pump delivery flow rate according to pump control pressure Pi (23).

  NOTE

  The boom lower pilot pressure is routed to pump 1 flow rate control valve (16) through control valve (17) with the track raised off the ground. The auxiliary 1 pilot pressure is routed to pump 1 flow rate control valve (16) through auxiliary flow combiner control solenoid valve (12) (option).

- Pump Control by Torque Control Solenoid Valve
  1. The pilot pressure from pilot pump (26) is controlled by torque control solenoid valves (18, 25) and becomes torque control pressure Ppc (19).
  2. Torque control pressure Ppc (19) flows to the regulators in pump 1 (20), pump 2 (22), and pump 3 (21).
  3. The regulators increase or decrease the pump delivery flow rate according to torque control pressure Ppc (19).

Supplied to	Pilot Pressure is Supplied to
Pump 1 Flow Rate Control Valve (16)	Boom Raise (6), Boom Lower (5), Arm (4), Bucket (7), Travel (Right) (2), Auxiliary 1 (8)
Pump 2 Flow Rate Control Valve (14)	Boom Raise (6), Arm(4), Travel (Left) (1), Auxiliary 1(8)
Pump 3 Flow Rate Control Valve (13)	Boom Raise (6), Swing(3) Positioning/Auxiliary 2 (9)



TDAA-02-04-008-2 ja

B- Pump 1 Side

D- Pump 2 Side

E- Pump 3 Side

1- Travel Motor (Left)
2- Travel Motor (Right)
3- Bucket Cylinder
4- Boom Cylinder
5- Swing Motor
6- Control Valve
7- Travel (Left) Spool
8- Auxiliary 1 Spool
9- Arm 1 Spool
10- Boom 2 Spool
11- Travel (Right) Spool
12- Bucket Spool
13- Arm 2 Spool
14- Boom 1 Spool
16- Positioning/Auxiliary 2 Spool
17- Boom 3 Spool
18- Swing Spool
19- Pump 1
20- Pump 3
21- Pump 2
22- Suction Filter
23- Hydraulic Oil Tank
24- Bypass Check Valve
25- Oil Cooler
26- Positioning Cylinder
27- Arm Cylinder
28- Attachments

Digging Regenerative Circuit

Purpose:

The digging regenerative circuit increases the arm roll-in speed when performing the digging operation.

- Arm Roll-In, Boom Raise
  1. When performing the combined operation of arm roll-in and boom raise, the pilot pressure shifts arm 1 spool (17), arm 2 (4), boom 1 spool (7), boom 2 spool (13), and boom 3 spool (8).
  2. Pressure oil from pump 1 (11) flows to arm cylinder (18) through neutral circuit (2), parallel circuit (3), and arm 2 spool (4), and rolls in the arm. At the same time, pressure oil from pump 1 (11) flows through parallel circuit (3), flows to boom cylinder (6) through boom 1 spool (7), and raises the boom at the same time.
  3. Pressure oil from pump 2 (9) flows through parallel circuit (14) and boom 2 spool (13), is combined with pressure oil from pump 1 (11), flows to boom cylinders (6), and raises the boom. At the same time, pressure oil from pump 2 (9) flows through arm 1 spool (17), is combined with pressure oil from pump 1 (11), flows to arm cylinder (18), and rolls in the arm.
  4. Pressure oil from pump 3 (10) flows through boom 3 spool (8), is combined with pressure oil from pump 1 (11) and pump 2 (9), flows to boom cylinder (6), and raises the boom.
  5. At this time, when the pump delivery pressure becomes high, MC activates 5-spool solenoid valve unit (SF). (Refer to SYSTEM/Control System.)
  6. Pressure oil from the pilot pump flows through 5-spool solenoid valve unit (SF) and shifts digging regenerative valve (1).
  7. Returning oil from the boom cylinder (6) rod side flows to arm 1 spool (17) through boom 1 spool (7) and digging regenerative valve (1).
  8. Pressure oil from pump 1 (11) and pump 2 (9), and returning oil from the boom cylinder (6) rod side are combined, and flows to arm cylinder (18) so that the arm roll-in speed increases.

Arm Roll-In Meter-Out Open Control Circuit

Purpose:

The arm roll-in meter-out open control circuit shifts the arm roll-in meter-out open control spool (12) during arm roll-in operation. Therefore, the arm roll-in meter-out open control circuit increases the arm roll-in meter-out opening during arm roll-in operation.

NOTE

As an example, the combined operation of arm roll-in and bucket roll-in is explained here.

1. When performing combined operation of arm roll-in and bucket roll-in, the pilot pressure shifts 1 arm 1 spool (14), arm 2 spool (7), and bucket spool (5).
2. Pressure oil from pump 1 (11) flows to bucket cylinder (8) through neutral circuit (4), parallel circuit (3), and bucket spool (5), and rolls in the bucket. At the same time, pressure oil from pump 1 (11) flows to arm cylinder (15) through parallel circuit (3), and arm 2 spool (7), and rolls in the arm.
3. Pressure oil from pump 2 (9) flows through arm 1 spool (17), is combined with pressure oil from pump 1 (11), flows to arm cylinder (15), and rolls in the arm.
4. When pump 2 delivery pressure is high, MC activates the 5-spool solenoid valve unit (SD). (Refer to SYSTEM/Control System.)
5. Pressure oil from the pilot pump flows through 5-spool solenoid valve unit (SD) and shifts arm roll-in meter-out open control spool (12).
6. Therefore, the arm roll-in meter-out opening increases.

1- Travel (Left)
2- Travel (Right)
3- Auxiliary 1
4- Auxiliary Control Solenoid Valve Unit
5- Auxiliary Flow Combiner Control Solenoid Valve
6- Auxiliary Flow Rate Control Solenoid Valve
7- Auxiliary Flow Combiner Valve
8- Pump 1 Bypass Shut-Out Valve
9- Auxiliary Flow Rate Control Valve
10- Pilot Pump
11- Selector Valve Control Solenoid Valve
12- Selector Valve
13- Accumulator Control Valve

Auxiliary Flow Combiner Circuit

When pulverizer or crusher is selected on the work mode or 2 Pumps Combined Flow is set ON by MPDr., MC activates the auxiliary flow combiner control solenoid valve. Therefore, the auxiliary flow combiner valve is shifted. (Refer to SYSTEM/ Control System.)

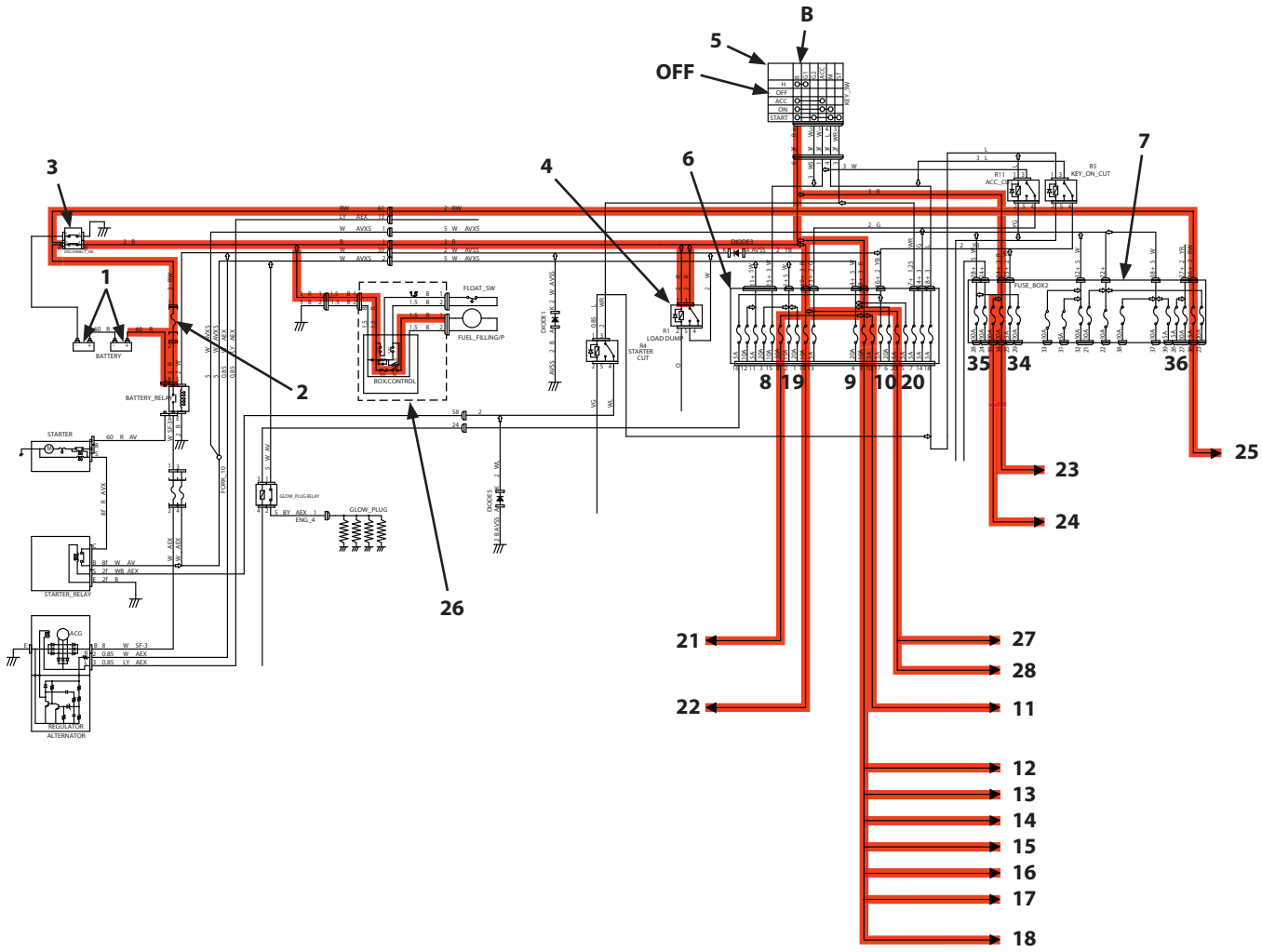
When Performing Single Operation of Auxiliary Flow Combiner Circuit

The auxiliary flow combiner valve combines pressure oil from both pump 1 (8) and pump 2 (7) when performing attachment (9) single operation. Therefore, the attachment (9) operating speed increases.

1. Attachment pilot pressure (2) shifts auxiliary flow combiner valve (1) and pump 1 bypass shut-out valve (6) through auxiliary flow combiner control solenoid valve (3) when performing single operation of attachment (9).
2. When pump 1 bypass shut-out valve (6) is shifted, neutral circuit (5) of pump 1 (8) is blocked.
3. Pressure oil from pump 1 (8) flows to auxiliary 1 spool (10) through auxiliary flow combiner valve (1).
4. Consequently, pressure oil in both pump 1 (8) and pump 2 (7) are combined and operating speed of attachment (9) increases.

NOTE

Attachment pilot pressure (2) shifts the pump 1 flow rate control valve in signal control valve through auxiliary flow combiner control solenoid valve (3) when operating attachment (9). Therefore, the displacement angle of pump 1 (8) increases and the pump delivery flow rate increases. (Refer to COMPONENT OPERATION/ Pump Device, Signal Control Valve.)

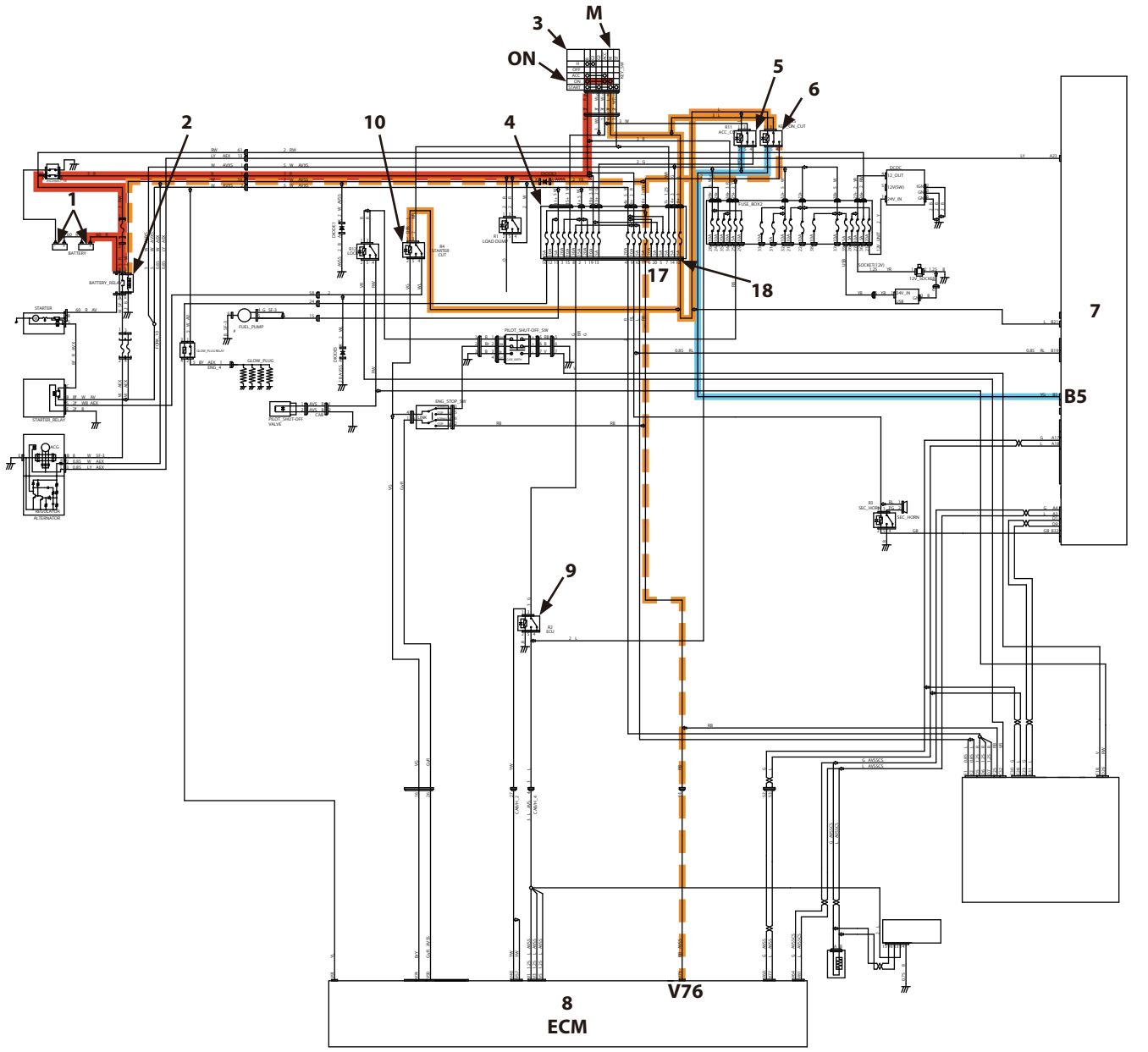


TDFY-02-05-001-1 ja

1- Battery
2- Fusible Link
4- Load Dump Relay
5- Key Switch
6- Fuse Box 1
7- Fuse Box 2
11- MC (Power)
12- Monitor Controller (Backup Power)
13- Switch Panel
14- Cab Light
15- Radio (Backup Power)
16- Security Horn (Power)
17- Security Horn Relay (Power)
18- GSM (Power)
21- ECM Main Relay (Power)
22- Horn Relay (Power)
23- DCU (Power)
24- SCR Control Relay
25- GSM
26- Fuel Filling Device
27- Option
28- Battery Disconnect Switch Indicator

CAN Circuit

CAN (Controller Area Network) is ISO Standards of the serial communication protocol.
This machine has seven networks (CAN bus (4)) that consist of Power-CAN (1), Body-CAN (5), ISO-CAN (18), Local-CAN (20), IF-CAN (26), PL-CAN (22), and OPT-CAN (27).
Power-CAN (1) and ISO-CAN (18) are used for the engine control. Body- CAN (5) is used for the accessories. Local-CAN (20) is used for the urea SCR system. IF-CAN (26) is used for communication. PL-CAN (22) is used for the AFL. OPT-CAN (27) is used for the oil monitoring sensor.
CAN bus (4) consists of two harnesses, CAN-H (High) (2) and CAN-L (Low) (3).
Each controller judges the CAN bus (4) level due to the potential difference between CAN-H (High) (2) and CAN-L (Low) (3).
Each controller arranges the CAN bus (4) level and sends the signal and data to other controllers.
Termination resistors (120 Ω) (17) are installed to both ends of CAN bus (4).

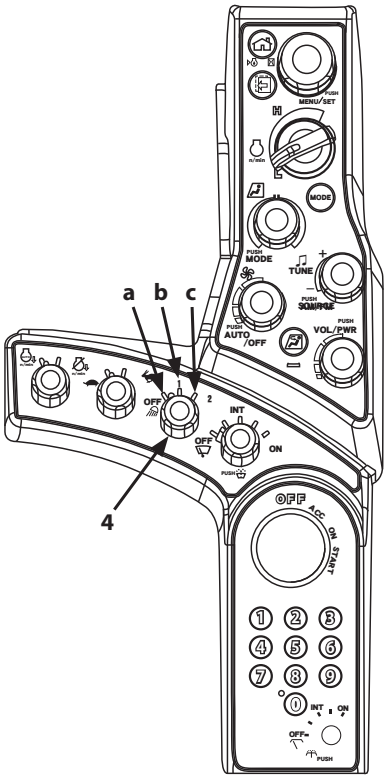


TDFY-02-05-007-1 ja

1-	Battery	4-	Fuse Box 1	7-	Monitor Controller	10-	Starter Cut Relay
2-	Battery Relay	5-	ACC Cut Relay	8-	ECM		
3-	Key Switch	6-	Key Switch ON Cut Relay	9-	ECM Main Relay		

Engine Stop Circuit

1. When key switch (1) is set from the ON position to OFF position, current from the terminal M in key switch (1) stops flowing to terminal #V76 of ECM (4).
2. ECM (4) stops the fuel injection of the injector and stops the engine.
3. When the engine stops, ECM (4) turns OFF ECM main relay (3). Then, ECM (4) is turned OFF.



TDFY-02-05-018-1 ja

a- OFF Position

b- 1 position

c- 2 position

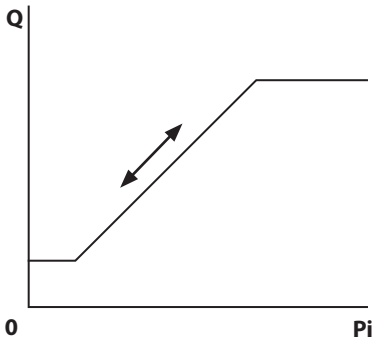
4- Work Light Switch

3

COMPONENT OPERATION

Control by Pump Control Pressure

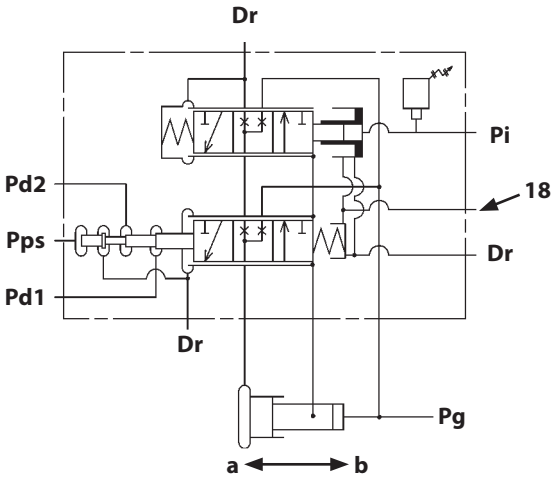
When a control lever is operated, the pump flow rate control valve in the signal control valve regulates pump control pressure Pi in response to the control lever stroke. The regulators increase or decrease the pump delivery flow rate according to pump control pressure Pi.
When the control lever is operated, pump control pressure Pi increases and the regulator increases the pump delivery flow rate. When the control lever is returned to neutral, pump control pressure Pi decreases and the regulator decreases the pump delivery flow rate.



MDC1-00-165 ja

Q- Flow Rate

Pi- Pump Control Pressure



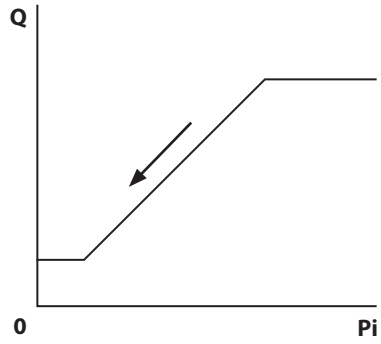
TDAA-03-01-003-1 ja

Pd1- Pump 1 Delivery Pressure
Pd2- Pump 2 Delivery Pressure
Dr- Returning to Hydraulic Oil Tank
Pi- Pump Control Pressure
Pps- Torque Control Pressure
Pg- Primary Pilot Pressure (From Pilot Pump)
a- Displacement Angle Increase
b- Displacement Angle Decrease

18- Air Bleeding

Control by Own and Partner Pump Delivery Pressure (Regulators for Pump 1 and Pump 2)

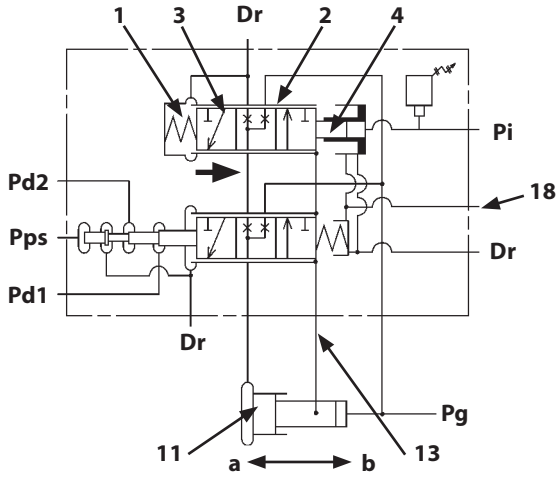
The regulators for pump 1 and pump 2 receive own pump delivery pressure Pd1 (or Pd2) and parter pump delivery pressure Pd2 (or Pd1) as control signal pressure. If the two-pump average pressures increase over the set P-Q line, the regulator reduces both pump delivery flow rates and the total pump output is returned to the set P-Q line. Therefore, the engine is protected from being overloaded.
Since the P-Q line is set using the average pressure of two main pump pressures, delivery rates of both pumps are approximately equal to each other.



MDC1-00-172 ja

Q- Flow Rate

Pi- Pump Control Pressure



TDAA-03-01-003-3 ja

Pd1- Pump 1 Delivery Pressure

Pd2- Pump 2 Delivery Pressure

Dr- Returning to Hydraulic Oil Tank

Pi- Pump Control Pressure

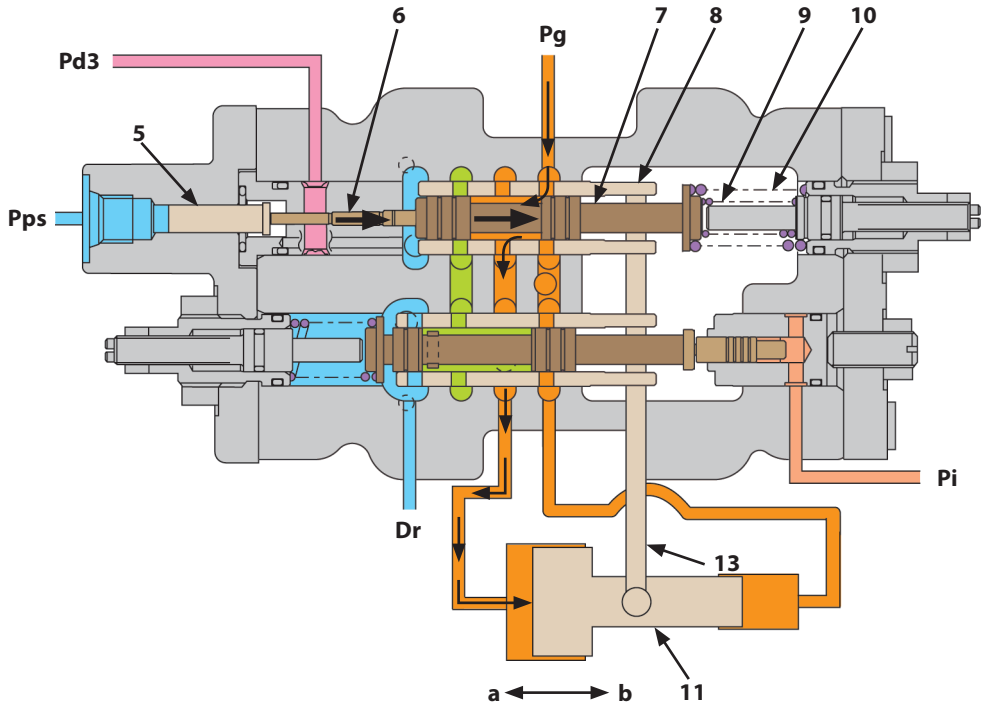
Pps- Torque Control Pressure

Pg- Primary Pilot Pressure (From Pilot Pump)

a- Displacement Angle Increase

b- Displacement Angle Decrease

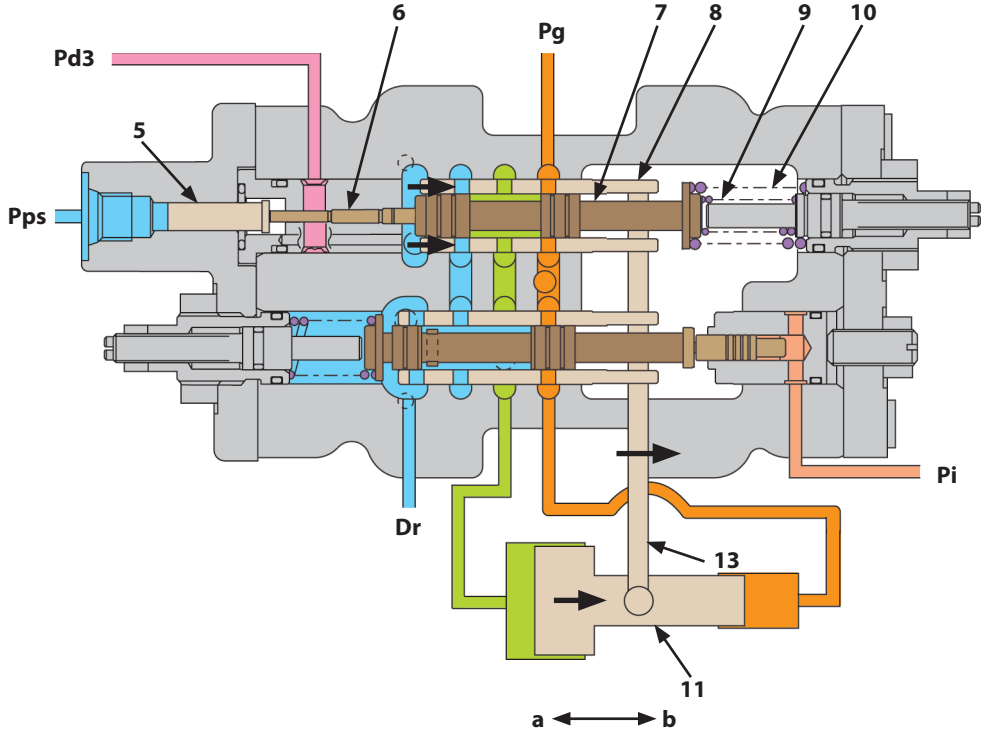
1- Spring
2- Sleeve A
3- Spool A
4- Piston
11- Servo Piston
13- Link
18- Air Bleeding



TDAA-03-01-004-1 ja

Pd3- Pump 3 Delivery Pressure
Dr- Returning to Hydraulic Oil Tank
Pi- Pump Control Pressure
Pps- Torque Control Pressure
Pg- Primary Pilot Pressure (From Pilot Pump)
a- Displacement Angle Increase
b- Displacement Angle Decrease

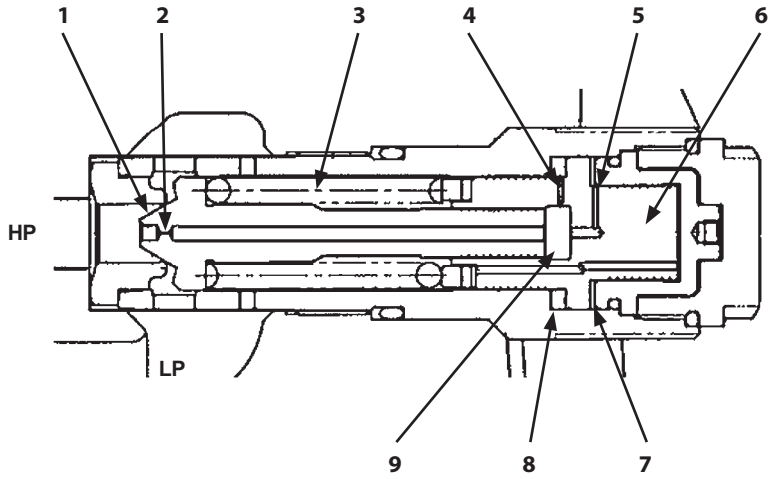
5- Load Piston 1
6- Load Piston 2
7- Spool B
8- Sleeve B
9- Inner Spring
10- Outer Spring
11- Servo Piston
13- Link



TDAA-03-01-005-1 ja

Pd3- Pump 3 Delivery Pressure
Pg- Primary Pilot Pressure (From Pilot Pump)

7- Pressure Receiving Area (Diaphragm)
8- Ground
9- Output Signal
10- Power Source (5 V)



T178-03-02-005-1 ja

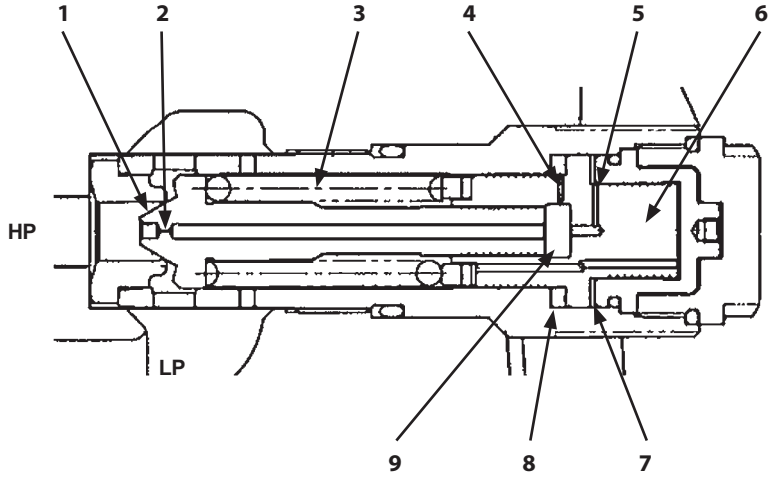
HP- Port HP (Swing Circuit)

LP- Port LP (Returning Circuit)

1- Poppet
2- Orifice
3- Spring
4- Passage A
5- Passage B
6- Piston
7- Oil Chamber B
8- Oil Chamber A
9- Oil Chamber C

High-Pressure Relief Operation (Overload Prevention) of Swing Relief Valve

1. After piston (6) reaches the stroke end, the circuit pressure becomes the normal relief set pressure.
2. When pressure at port HP increases further and is beyond the spring (3) set pressure, poppet (1) is opened and pressure oil flows to port LP.
3. When pressure at port HP is decreased to the specified level, poppet (1) is closed by the spring (3) force.



T178-03-02-005-1 ja

HP- Port HP (Swing Circuit)

LP- Port LP (Returning Circuit)

1- Poppet
2- Orifice
3- Spring
4- Passage A
5- Passage B
6- Piston
7- Oil Chamber B
8- Oil Chamber A
9- Oil Chamber C

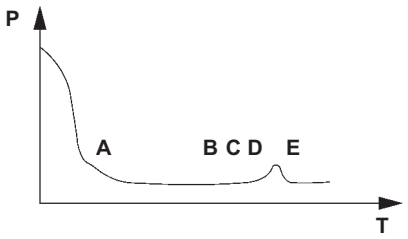
Outline of Swing Dampener Valve

Swing dampener valve (2) is built in valve unit (1).

3. Poppet (1) is also pushed to the left by the spring (7) force at the same time.
4. As the pressure difference is caused due to orifice (6) at this time, pressure in chamber M (11) increases.
5. Poppet (1) moves to the left more slowly.
6. Consequently, a clearance between poppet (1) and plunger (3) appears.Pressure oil from port BM flows to port AM through the clearance between poppet (1) and plunger (3).
7. As combination valve A (12) allows pressure oil in port BM (high pressure) to flow to port AM (low pressure), pressure increase at the high-pressure side is controlled and aftershock pressure is reduced. This state continues until aftershock pressure at port AM appears (output curve:D).

NOTE

Combination valve B (13) on the output curve between B and C is kept operated as the output curve between A and B. (Refer to "Output Curve of Swing Dampener Valve: Between A and B (When Relieving)"T3-2-10) This state continues until pressure at port BM decreases (output curve: C).

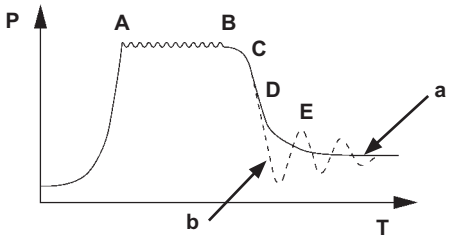


Pressure at Port AM

T1V1-03-02-001-1 ja

P- Pressure

T- Time



Pressure at Port BM

T1V1-03-02-002-1 ja

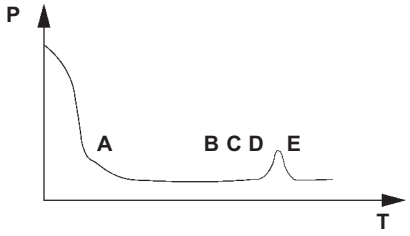
P- Pressure

T- Time

a- With Combination Valve

b- Without Combination Valve

Combination valve A (12) and combination valve B (13) repeat these procedures on the output curve between B and E, and prevent aftershock of machine. When pressures at ports AM and BM decrease completely, the combination valve stops operating.

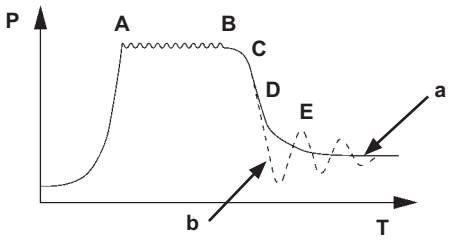


Pressure at Port AM

TDC1-03-02-001-1 ja

P- Pressure

T- Time



Pressure at Port BM

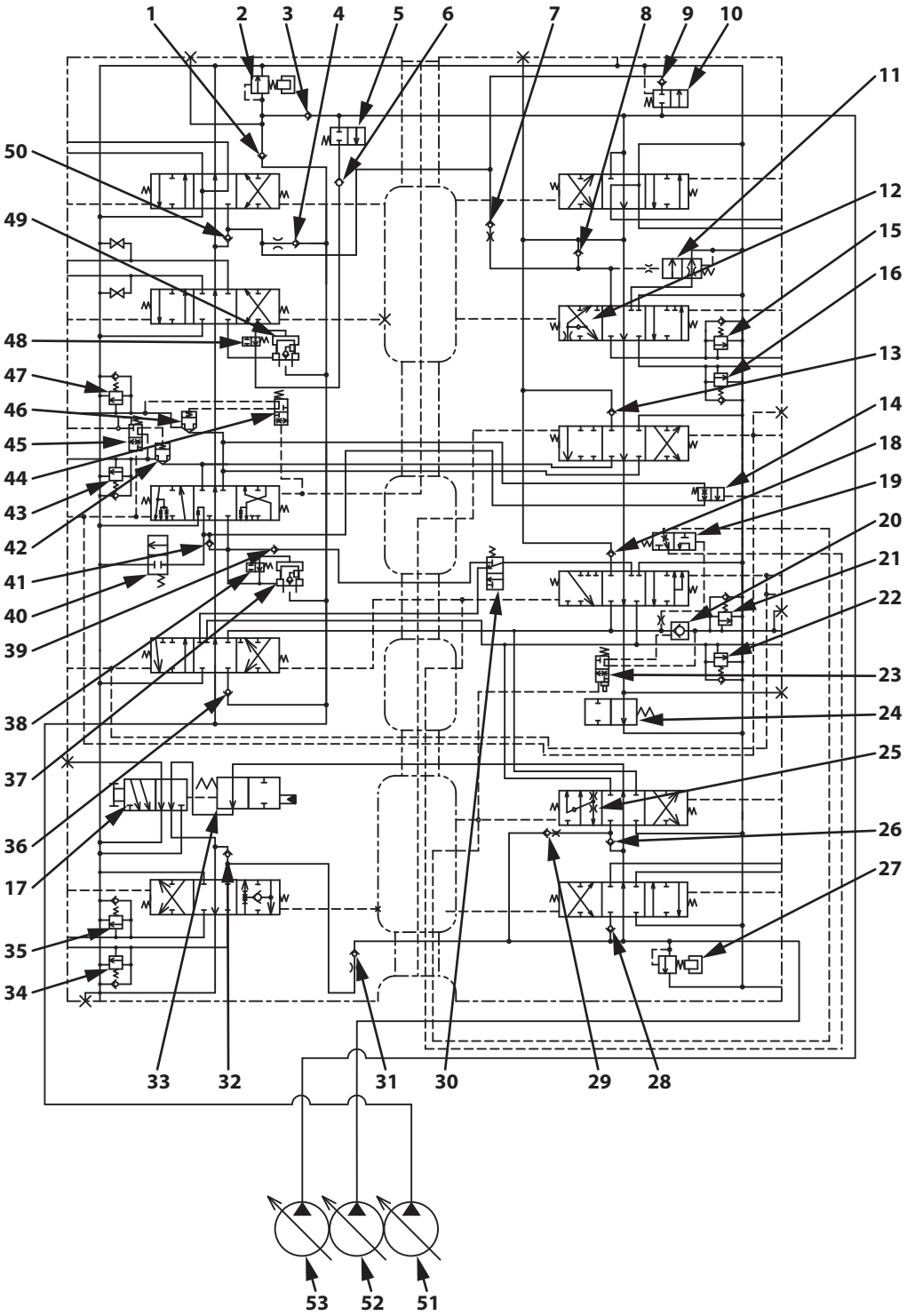
T1V1-03-02-002-1 ja

P- Pressure

T- Time

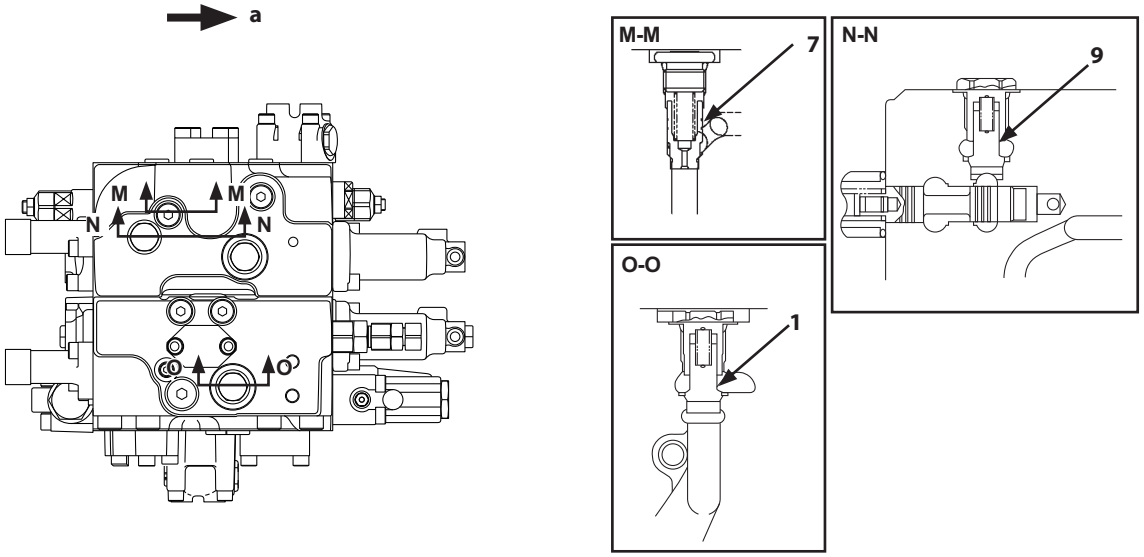
a- With Combination Valve

b- Without Combination Valve



TDFY-03-03-002-1 ja

1- Check Valve (Main Relief Circuit)
2- Main Relief Valve (P1, P2)
3- Check Valve (Main Relief Circuit)
4- Load Check Valve (Travel (Left) Parallel Circuit)
5- Auxiliary Flow Combiner Valve
6- Check Valve (Auxiliary Flow Combiner Circuit)
7- Load Check Valve (Orifice) (Bucket)
8- Check Valve (Bucket Tandem Circuit)
9- Check Valve (Flow Combiner Circuit)
10- Flow Combiner Valve
11- Bucket Regeneration Cut Valve
12- Bucket Regenerative Valve
13- Check Valve (Arm 2 Parallel Circuit)
14- Arm Roll-In Meter-Out Open Control Spool
15- Overload Relief Valve (Bucket: Rod Side)
16- Overload Relief Valve (Bucket: Bottom Side)
17- Auxiliary 2 Hydraulic Pressure Source Selector Spool
18- Load Check Valve (Boom 1 Parallel Circuit)
19- Boom Lower Meter-In Cut Valve
20- Boom Anti-Drift Valve (Check Valve)
21- Overload Relief Valve (Boom: Bottom Side)
22- Overload Relief Valve (Boom: Rod Side)
23- Boom Anti-Drift Valve (Selector Valve)
24- Pump 1 Bypass Shut-Out Valve
25- Boom Regenerative Valve
26- Load Check Valve (Boom 3 Tandem Circuit)
27- Main Relief Valve (P3)
28- Load Check Valve (Swing Tandem Circuit)
29- Load Check Valve (Boom 3 Parallel Circuit)
30- Digging Regenerative Valve
31- Load Check Valve (Auxiliary 2 Parallel Circuit)
32- Load Check Valve (Auxiliary 2 Tandem Circuit)
33- Pump 3 Bypass Shut-Out Valve
34- Overload Relief Valve (Positioning/Auxiliary 2)
35- Overload Relief Valve (Positioning/Auxiliary 2)
36- Load Check Valve (Boom 2 Parallel Circuit)
37- Arm 1 Flow Rate Control Valve (Poppet Valve)
38- Arm 1 Flow Rate Control Valve (Selector Valve)
39- Load Check Valve (Digging Regenerative Circuit)
40- Arm Regenerative Valve
41- Load Check Valve (Arm Regenerative Circuit)
42- Arm Bottom Anti-Drift Valve (Check Valve)
43- Overload Relief Valve (Arm: Bottom Side)
44- Arm Rod Anti-Drift Valve (Selector Valve)
45- Arm Bottom Anti-Drift Valve (Selector Valve)
46- Arm Rod Anti-Drift Valve (Check Valve)
47- Overload Relief Valve (Arm: Rod Side)
48- Auxiliary Flow Rate Control Valve (Selector Valve)
49- Auxiliary Flow Rate Control Valve (Poppet Valve)
50- Load Check Valve (Travel (Left) Tandem Circuit)
51- Pump 2
52- Pump 3
53- Pump 1



TDFY-03-03-009-1 ja

a- Machine Upper Side

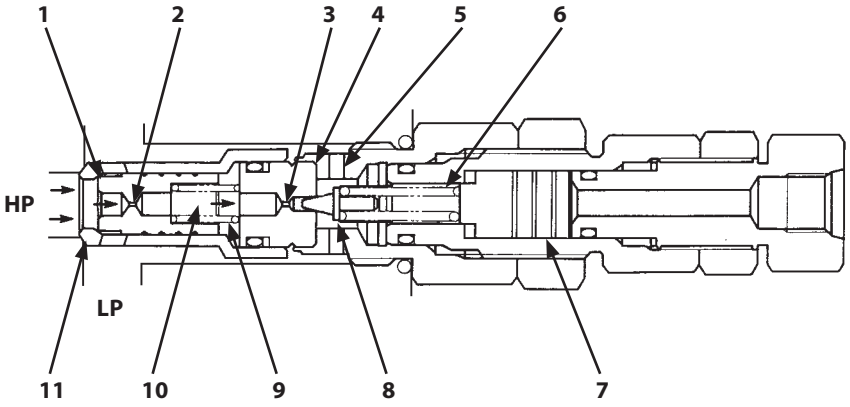
1- Check Valve (Main Relief Circuit)
7- Load Check Valve (Orifice) (Bucket)
9- Check Valve (Flow Combiner Circuit)

Outline of Main Relief Valve

The main relief valve prevents the pressure in the main circuit from exceeding the set pressure when the actuator such as the motor or the cylinder is operated.
Therefore, oil leak from hose and pipe joints and breakage of the actuator are prevented.

Relief Operation of Main Relief Valve

1. Pressure in port HP (main circuit) is routed to pilot poppet (8) through orifice A (2) in main poppet (1) and orifice B (3) in seat (4).
2. When pressure in port HP reaches the set pressure of spring B (6), pilot poppet (8) is opened. Pressure oil from passage A (5) flows along the external circumference of sleeve (11) and flows to port LP (hydraulic oil tank).
3. At this time, a pressure difference is caused between port HP and the spring chamber (10) due to orifice A (2).
4. When the force generated by this pressure difference reaches the set pressure of spring A (9), main poppet (1) is opened and pressure oil from port HP flows to port LP.
5. Consequently, the main circuit pressure decreases.
6. When the main circuit pressure decreases to the specified level, main poppet (1) is closed by the force of spring A (9). Pilot poppet (8) is also closed by the force of spring B (6).



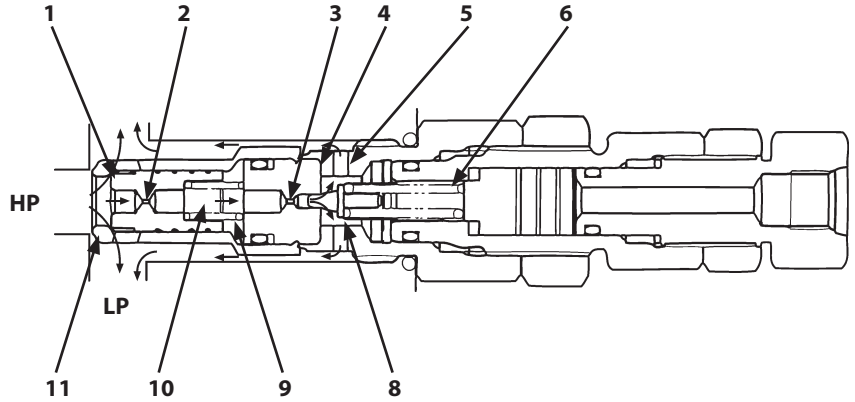
When Performing Normal Operation

TDAB-03-03-020-1 ja

HP- Main Circuit

LP- Hydraulic Oil Tank

1- Main Poppet
2- Orifice A
3- Orifice B
4- Seat
5- Passage A
6- Spring B
7- Piston
8- Pilot Poppet
9- Spring A
10- Spring Chamber
11- Sleeve



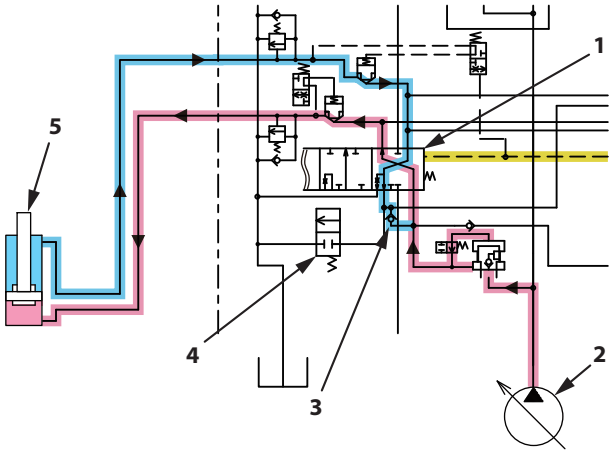
When Performing Relief Operation

TDAB-03-03-021-1 ja

HP- Main Circuit

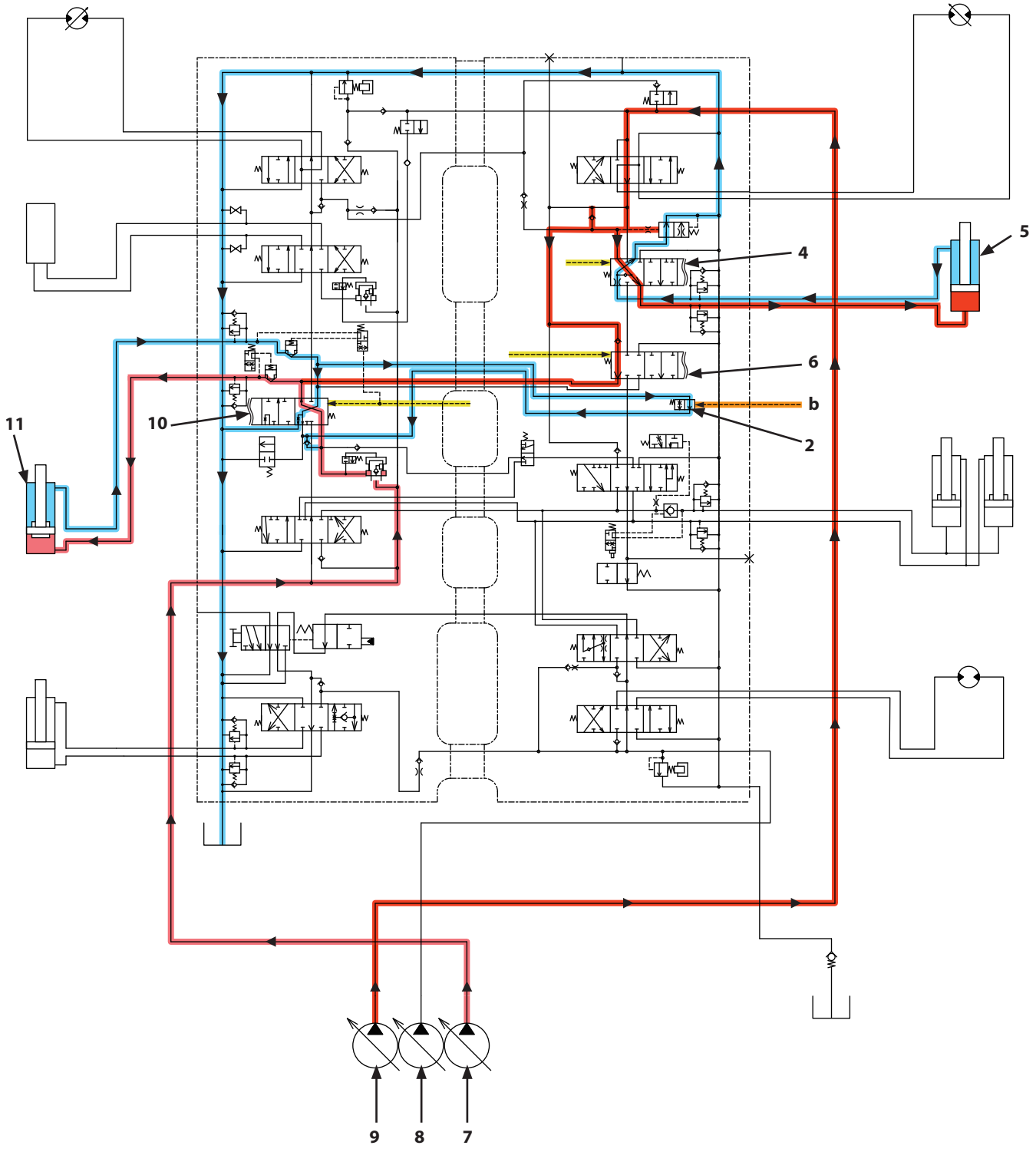
LP- Hydraulic Oil Tank

3. Only the circuit through notch (7) of arm 1 spool (1) is the circuit which flows from chamber A (6) to the hydraulic oil tank, and pressure in chamber A (6) increases.
4. As pressure in chamber A (6) increases, pressure in the rod side is higher than the arm cylinder (5) bottom side.
5. Pressure oil from pump 2 (2) and pressure in chamber A (6) act on to check valve (3). When these pressure become larger than the spring (8) force, check valve (3) is opened.
6. Consequently, returning oil from the arm cylinder (5) rod side is combined with pressure oil from pump 2 (2). The combined pressure oil is delivered to the arm cylinder (5) bottom side.
7. Therefore, regenerative operation is done.When performing arm roll-in operation, arm hesitation is prevented, and the arm roll-in speed increases.



TDFY-03-03-014-1 ja

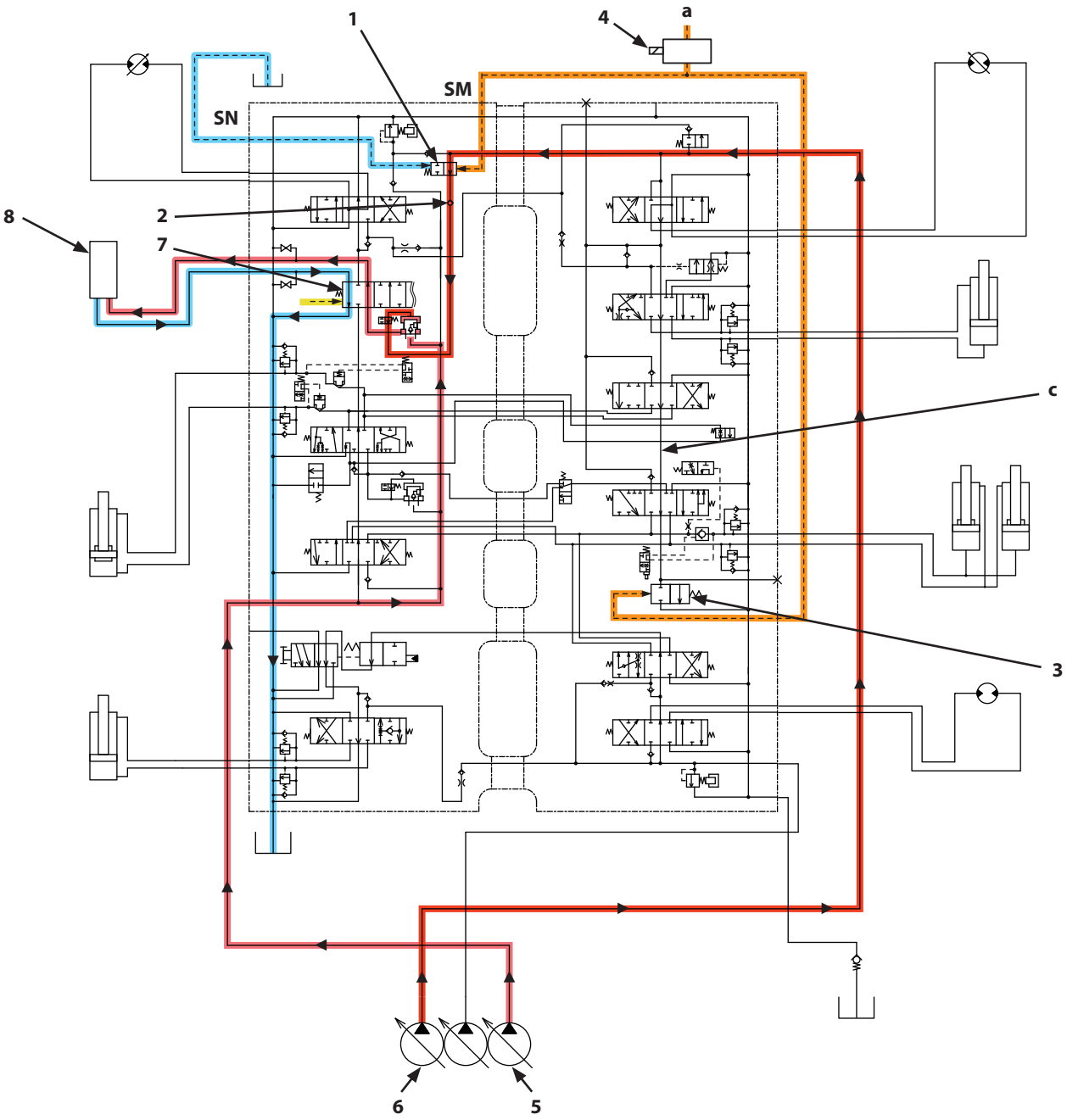
1- Arm 1 Spool
2- Pump 2
3- Check Valve
4- Spool (Arm Regenerative Valve)
5- Arm Cylinder



TDFY-02-04-024-2 ja

b- Pilot Pressure from 5-Spool Solenoid Valve Unit (SD)

2- Spool (Arm Roll-In Meter-Out Open Control Spool)
4- Bucket Spool
5- Bucket Cylinder
6- Arm 2 Spool
7- Pump 2
8- Pump 3
9- Pump 1
10- Arm 1 Spool
11- Arm Cylinder



TDFY-03-03-024-1 ja

a- Attachment Pilot Pressure

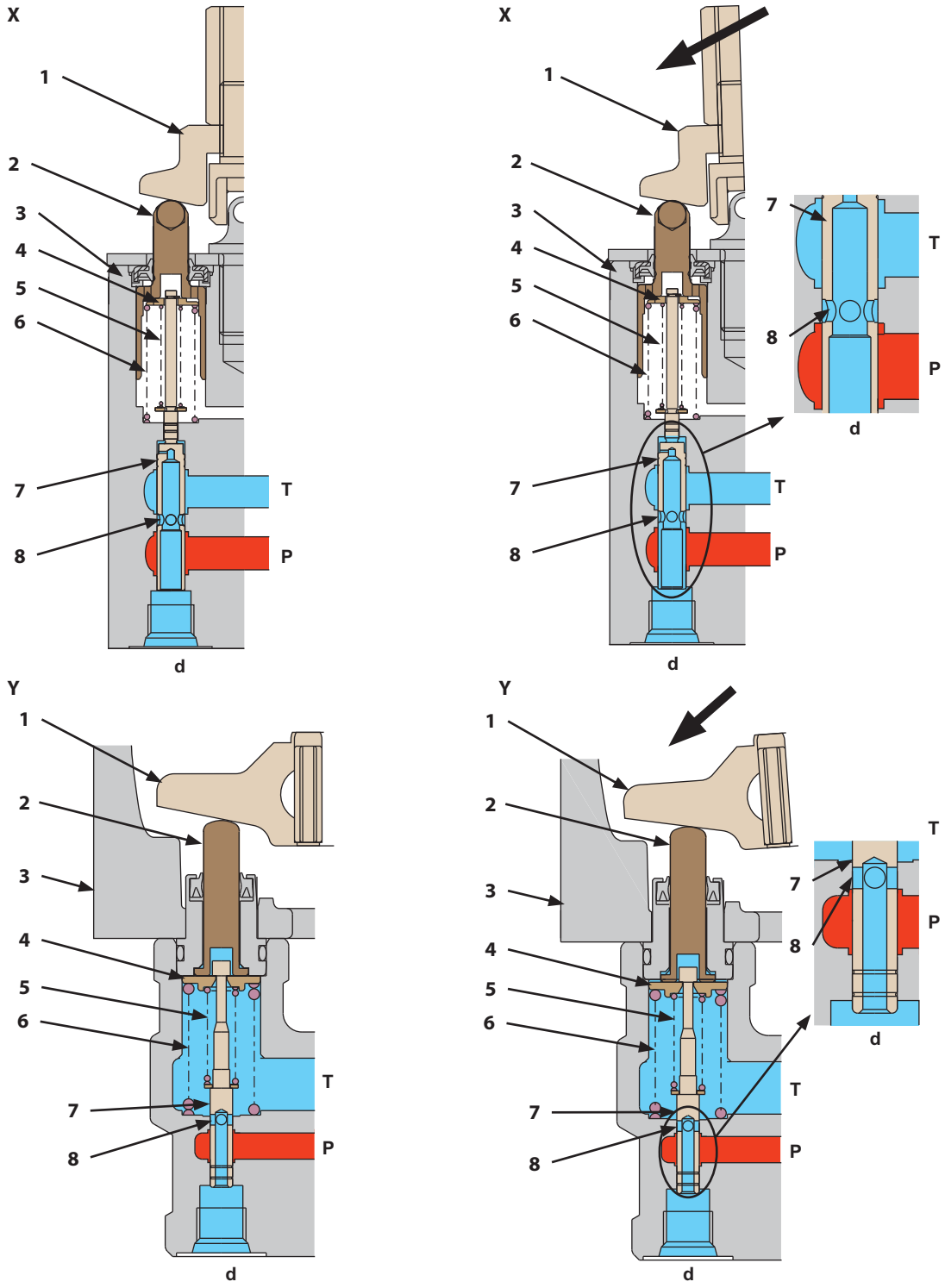
c- Pressure Oil from Pump 1 (6)

1- Spool (Auxiliary Flow Combiner Valve)
2- Check Valve
3- Spool (Pump 1 Bypass Shut-Out Valve)
4- Auxiliary Flow Combiner Control Solenoid Valve
5- Pump 2
6- Pump 1
7- Auxiliary 1 Spool
8- Attachment

Operation of Auxiliary Flow Combiner Valve and Pump 1 Bypass Shut-Out Valve (During Combined Operation)

When performing combined operation of attachment (8) and travel, the auxiliary flow combiner valve is not shifted. Therefore, the machine travel operating speed can be kept at the same speed during normal combined operation.

1. When attachment (8) is operated, attachment pilot pressure acts on port SM in the auxiliary flow combiner valve.
2. When travel is operated at the same time, pilot pressure from the signal control valve acts on port SN.



TDFY-03-04-003-1 ja

X- Front Attachment/Swing Pilot Valve

Y- Travel Pilot Valve

P- Port P

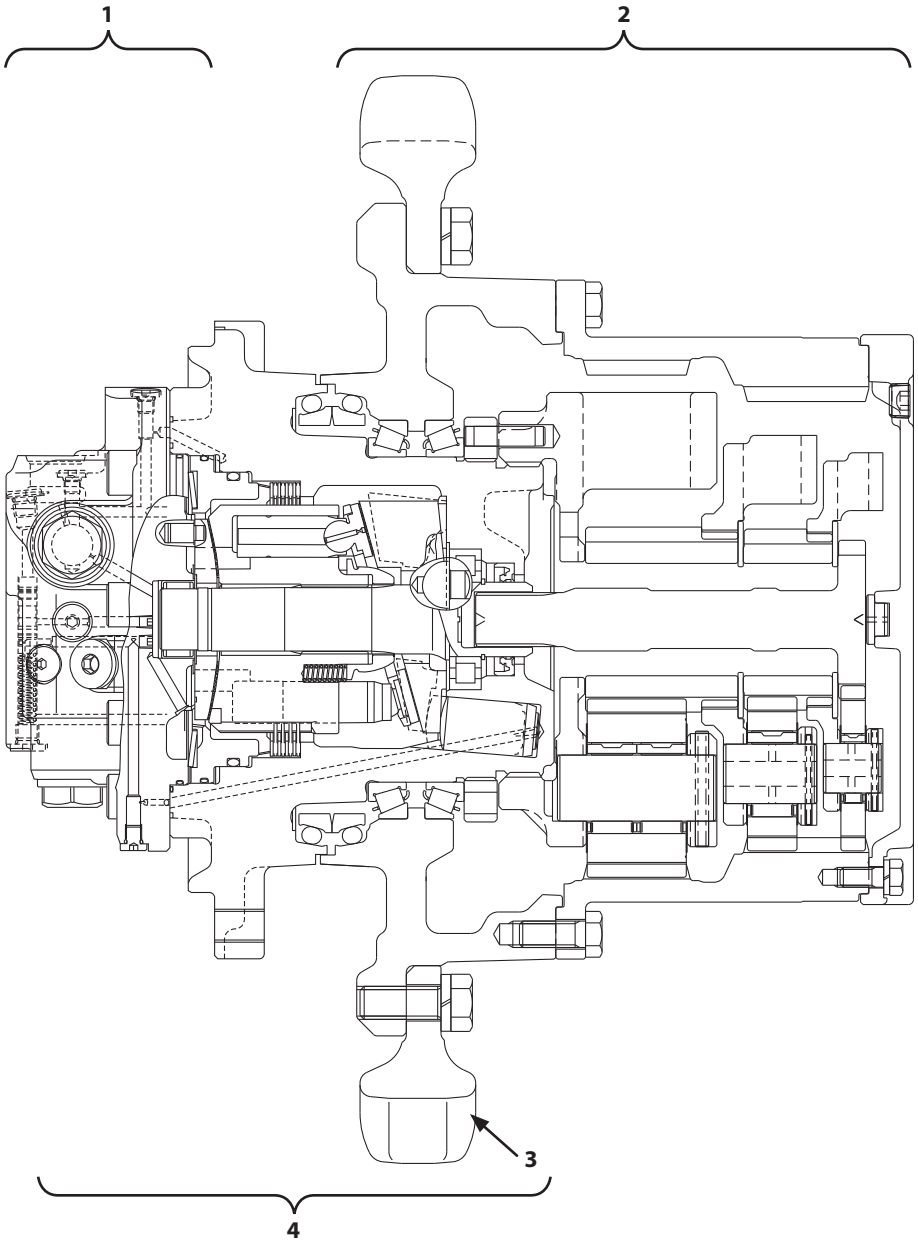
T- Port T

d- Output Port

1- Cam
2- Pusher
3- Casing
4- Spring Guide
5- Balance Spring
6- Return Spring
7- Spool
8- Hole

Outline of Travel Device

The travel device consists of travel motor (4), travel reduction gear (2), and travel brake valve (1).
Travel motor (4) is a swash plate type variable displacement axial plunger motor and equipped with a parking brake (a wet-type spring set hydraulic released multi-disc brake). Travel motor (4) is driven by pressure oil from the pump and transmits the rotation power to travel reduction gear (2).
Travel reduction gear (2) is a three-stage planetary reduction gear, converts the travel motor (4) rotation power to a slow-large torque, and rotates sprocket (3) and the track link.
Travel brake valve (1) protects the travel circuit from being overloaded and prevents the occurrence of cavitation.



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1- Travel Brake Valve 2- Travel Reduction Gear 3- Sprocket 4- Travel Motor

Outline of Travel Reduction Gear

The travel reduction gear is a three-stage planetary reduction gear.

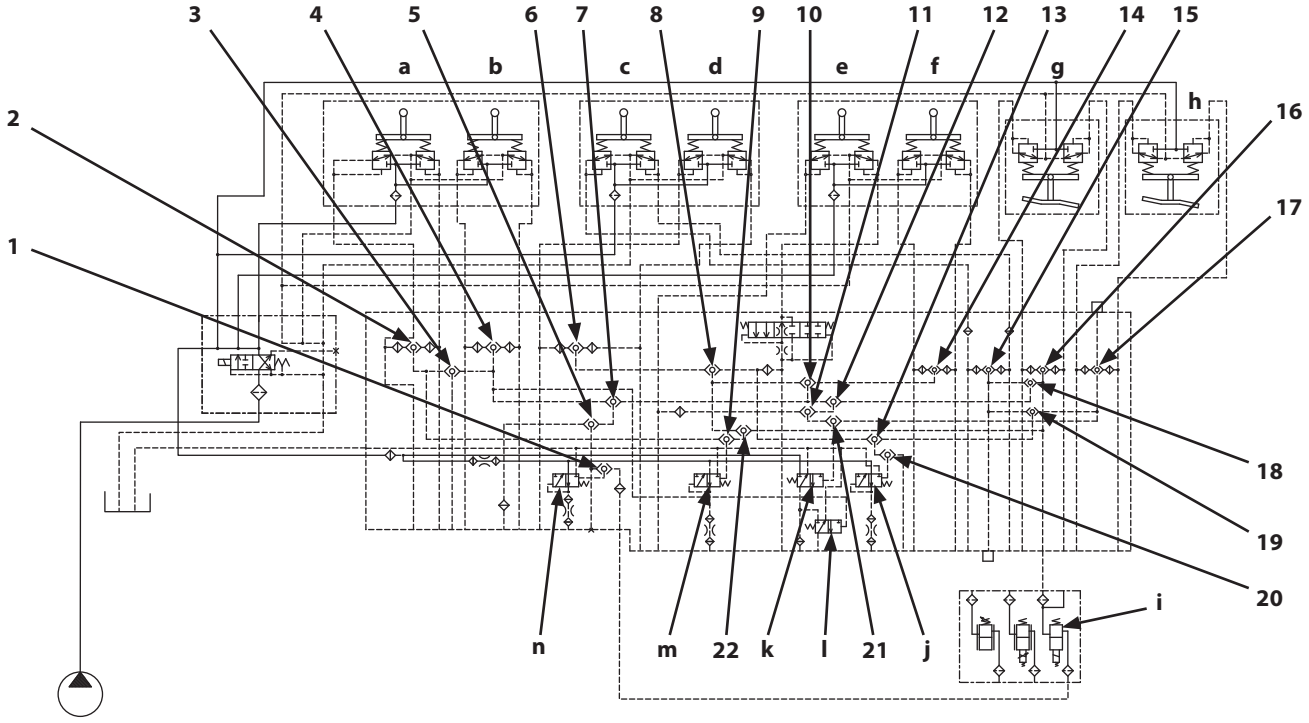
Outline of Travel Relief Valve

When the travel motor circuit pressure increases beyond the set pressure, the travel relief valve is opened and high pressure oil is relieved to the low-pressure side. Therefore, the travel motor is protected from being overloaded.
In addition, the overload relief valve relieves the shock loads developed due to inertia force when stopping the travel motor.
When the travel motor draws pressure oil like a pump, check valve is unseated (make-up operation) and prevents the cavitation.

Operation of Travel Relief Valve (During Relief)

1. Pressure oil in the travel circuit acts on poppet (5) through motor port AM (9) (or motor port BM (3)).
2. Pressure oil flows to the spring (7) chamber through orifice (4) in poppet (5).
3. Pressure oil flowing to the spring (7) chamber acts on piston (6) through orifice (8) and moves piston (6) upward.
4. As long as piston (6) keeps moving, a pressure difference is developed between the front and rear of poppet (5). When this pressure difference is increased beyond the spring (7) force, poppet (5) is opened and the pressure oil flows to motor port BM (3) or motor port AM (9) on the low-pressure side. (Shockless Function)
5. When piston (6) reaches the stroke end, the pressure difference between the front and rear of poppet (5) disappears and poppet (5) is closed.
6. Under this condition, the pressure in the travel motor circuit increases to the set pressure.
7. When the pressure in the travel motor circuit increases beyond the spring (7) force, poppet (5) is opened and pressure oil at the relief set pressure flows to motor port BM (3) or motor port AM (9) on the low-pressure side.
8. As described above, relief operation in two-stages prevents the travel motor from being overloaded and reduces shocks developed in the circuit when stopping the travel motor.

*2 As for only the machine with attachment (pulverizers 1 to 5 and crushers 1 to 5) equipped, the pump 1 flow rate control valve is operated by pressure from the auxiliary 1 pilot valve.



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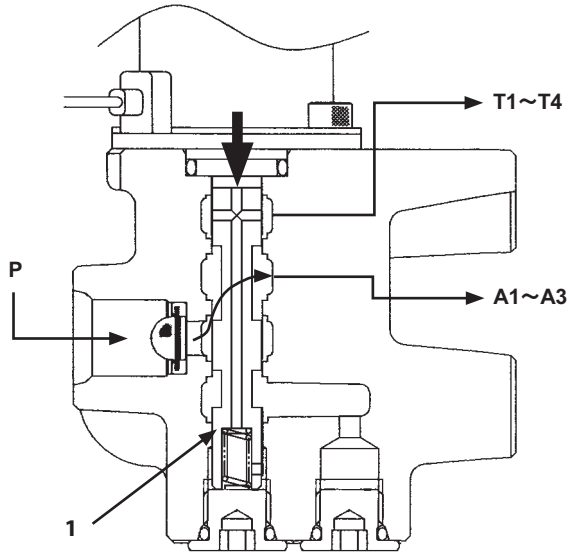
a- Travel (Left)
b- Travel (Right)
c- Swing
d- Arm
e- Boom
f- Bucket
g- Auxiliary 1
h- Positioning/Auxiliary 2
i- Auxiliary Flow Combiner Control Solenoid Valve
j- Pump 3 Flow Rate Control Valve
k- Swing Parking Brake Release Spool
l- Flow Combiner Valve Control Spool
m- Pump 2 Flow Rate Control Valve
n- Pump 1 Flow Rate Control Valve

1- Boom, Arm, Bucket, Travel (Right), Auxiliary 1
2- Travel (Left)
3- Travel (Left), Travel (Right)
4- Travel (Right)
5- Boom, Arm, Bucket, Travel (Right)
6- Arm
7- Boom Raise, Arm, Bucket, Travel (Right)
8- Boom Raise, Arm
9- Boom Raise, Arm, Travel (Left), Auxiliary 1
10- Boom Raise, Arm, Bucket
11- Boom, Arm, Bucket, Swing, Auxiliary 1
12- Boom Raise, Arm, Bucket, Swing, Auxiliary 1
13- Boom Raise, Swing, Positioning/Auxiliary 2
14- Bucket
15- Swing
16- Auxiliary 1
17- Positioning/Auxiliary 2
18- Swing, Auxiliary 1
19- Swing, Positioning/Auxiliary 2
20- Boom Raise, Swing, Positioning/Auxiliary 2
21- Boom, Arm, Bucket, Swing, Auxiliary 1, Positioning/Auxiliary 2
22- Boom Raise, Arm, Auxiliary 1



Pilot Shut-Off Lever: UNLOCK Position

TDEN-03-06-007-1 ja

P- Pressure Oil from Pilot Pump

A1- Pilot Pressure to Travel, Auxiliary 1 Pilot Valve

A2- Pilot Pressure to Boom, Bucket, Positioning/Auxiliary 2 Pilot Valve

A3- Pilot Pressure to Arm, Swing Pilot Valve

T1- Returning Oil from Travel, Auxiliary 1 Pilot Valve

T2- Returning Oil from Boom, Bucket, Positioning/Auxiliary 2 Pilot Valve

T3- Returning Oil from Arm, Swing Pilot Valve

T4- Returning Oil to Hydraulic Oil Tank

1- Spool

Outline of Solenoid Valve

The following solenoid valves are provided in this machine in order to control the functions.

Solenoid Valve	Control
5-Spool Solenoid Valve Unit	The 5-spool solenoid valve unit is for the valve control.
3-Spool Solenoid Valve Unit	The 3-spool solenoid valve unit is for the pump and valve control.
2-Spool Solenoid Valve Unit	The 2-spool solenoid valve unit is for the aftertreatment device regeneration control.
Auxiliary Flow Rate Control Solenoid Valve Unit (Option)	The auxiliary flow rate control solenoid valve unit is for the auxiliary flow rate control,

Outline of 5-Spool Solenoid Valve Unit

The 5-spool solenoid valve unit controls the control valve and the valve in travel motor according to the signal from MC (main controller). (Refer to SYSTEM/Control System.)
The 5-spool solenoid valve unit consists of proportional solenoid valves (SC, SF, SE, SD, and SI).

SC: This valve controls the arm regenerative valve in control valve.

SF: This valve controls the digging regenerative valve in control valve.

SE: This valve controls the arm 1 flow rate control valve (selector valve) in control valve.

SD: This valve controls the arm roll-in meter-out open control spool in control valve.

SI: This valve increases pressure of the main relief valve in control valve and controls the travel motor displacement angle control valve.