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Product Concept

Features

Compared with competitors' models, this hydraulic excavator is more operator-oriented and environmentally friendlier in basic excavator functions, thus featuring strong and distinguished selling points.

Improved Basic Hydraulic Excavator Functions

Cycle time:	Top-class cycle time
Low fuel consumption:	Top-class low fuel consumption
Low noise level:	Quiet cab inside
Operability:	High operability, no operator ever feels tired

Operator Friendly Design

Comfortable cab with enough working space:	Spacious cab / comfortable space created with comfortable equipment
Safety while in operation:	Seat belt / gate lock / emergency exit – standard equipment
Safety precautions for surroundings:	Travel alarms (RV) / engine room fire walls / anti-theft mechanism – standard equipment (RV)
Simple operation:	Auto Pressure Boosting / Auto Mode – standard equipment (RV)

Environment Friendly

Reduction in emission:	Adoption of engines being compliant with the Emissions Control* Extended greasing intervals (ball-race) Extended hydraulic oil exchange interval (New Nephron & new hydraulic oil)
Energy saving:	Top-class low fuel consumption.

* Administrative period and methods for the Second Emission Control in Japan are undecided. However, since the regulation values in Japan are those currently proposed by the Japanese Ministry of Construction, it is not expected that they will become stricter in Japan.

NEO POWER PAX (RV) – Selling Points

Selling Points on Basic Functions of Hydraulic Excavator	Cycle time	• Top–class cycle time (S–Mode speed is equivalent to other companies' H–mode speed)
	Low fuel consumption	• Top–class low fuel consumption (Compared with the existing models, 10% improved)
	Low noise level	• Quiet Cab inside/Quiet ambient noise (Complying to the stricter second European regulations)
	Operability	• High operability, no operator ever feels tired (Smooth combined operability)
Selling Points on Operator Friendly Designs	Comfortable Cab with enough working space	• Spacious Cab/comfortable space created with comfortable equipment (Automatic air–conditioning/ISO cab)
	Safety while in operation	• Seat–belt/gate lock • Emergency exit – standard equipment
	Safety precautions for surroundings	• Travel alarms/engine room fire walls • Anti–theft mechanism
	Simple operation	• Auto digging force boosting mode standard equipment (SH200 / 220–3) • Simplified switches • 2–speed automatic reduction gear mechanism – standard equipment
Selling Points Based on Friendliness to Environment	Reduction in emission	• Adoption of engines that will be compliant with the Second Emissions Control* in Japan • Extended greasing intervals (Ball–race) • Extended hydraulic oil exchange intervals (New Nephron & long–life hydraulic oil)
	Energy saving	• Top–class low fuel consumption • Compliant with the Energy Saving Tax Reduction Scheme

<< NEO POWER PAX (RV) Machine Concept >>

Compared with competitors' models, this hydraulic excavator is more operator–oriented and environmentally friendlier with basic shoveling functions, thus featuring strong and distinguished selling points!

* Administrative period and methods for the Second Emission Control in Japan are undecided. However, since the regulation values in Japan are proposed by the Japanese Ministry of Construction, it is not expected that they will become stricter in Japan.

NEO POWER PAX (GT) – Selling Points

Selling Points on Basic Functions of Hydraulic Excavator	Cycle time	• Top–class cycle time (N–Mode speed is equivalent to other companys' H–mode speed) • (N–Mode becomes Normal mode by switching N/E)
	Low fuel consumption	• Top–class low fuel consumption (Compared with the existing model, 10% improved)
	Low noise level	• Quiet cab inside/ambient noise (Complying to the stricter second European regulations)
	Operability	• High operability, no operator ever feels tired (Smooth combined operability)
Selling Points on Operator Friendly Designs	Comfortable Cab with enough working space	• Spacious cab/comfortable space created with comfortable equipment (Automatic air–conditioning/ISO cab)
	Safety while in operation	• Seat–belt/gate lock • Emergency exit–standard equipment
	Safety precautions for surroundings	• Engine room's fire walls–standard equipment • Travel alarms–optional equipment
	Simple operation	• 2–speed automatic reduction gear change mechanism–standard equipment • Easy–to–use switches
Selling Points Based on Friendliness to Environment	Reduction in emission	• Adoption of engines that will be compliant with the Second Emissions Control* • Extended greasing intervals (Ball–race) • Extended hydraulic oil exchange intervals (New Nephron & long–life hydraulic oil)
	Energy saving	• Top–class low fuel consumption • Compliant with the Energy Saving Tax Reduction Scheme

<< NEO POWER PAX (GT) Machine Concept >>

An operator and environment friendly hydraulic excavator machine with full basic shoveling functions!

Neo Power – Product Performances

EVERY ONE CAN EASILY ACHIEVE HIGHER
PERFORMANCE

ADVENT OF THE NEW CONTROL SYSTEM, "NEO":

NEW STYLE ECOLOGY OPERATING SYSTEM

- | | |
|---|----------------|
| [1] Superior Operability & Speed, no operator ever feels tired. | |
| [2] New operation mode | (New function) |
| [3] Auto Mode | (New function) |
| [4] Auto digging force boosting mode (SH200 / 220-3) | (New function) |
| [5] Adoption of electronically controlled engine | (New function) |

Neo Power – Environmental Performances

NEW PROPOSAL TO PEOPLE AND ENVIRONMENTS

IT'S NEW PAX'S ENVIRONMENTAL PERFORMANCE, "TES":

TOTAL ECOLOGY SYSTEM

- | | |
|---|----------------|
| [1] Equipped with new engines that will meet the Second Emissions control regulations* in Japan | |
| [2] Attachment EMS | |
| [3] Ball-races, extended greasing intervals | (New function) |
| [4] Extended exchange interval by adoption of new hydraulic oil | (New function) |
| [5] Highly reputed Nephron system | |
| [6] Low noise/low fuel consumption | |
| [7] Comfortable cab space | (New function) |

* Administrative period and methods for the Second Emission Control in Japan are undecided. However, since the regulation values in Japan are proposed by the Japanese Ministry of Construction, it is not expected that they will become stricter.

Machine Body Specification

	SH200-3	SH220-3
1. Main characteristics:		
Model name	SH200-3 Hydraulic Excavator	SH220-3 Hydraulic Excavator
Operating weight	19,100 kg	22,700 kg
Engine output	103 kw / 1,950 min ⁻¹	121 kw / 2,150 min ⁻¹
Bucket capacity	Heaped 0.80 m ³ Leveled 0.57 m ³	Heaped 1.00 m ³ Leveled 0.73 m ³
2. Performances		
Standard loading	10.3 kN	13.1 kN
Swing speed	11.9 min ⁻¹	10.4 min ⁻¹
Travel speed	I Speed 3.3 km/h II Speed 5.5 km/h	I Speed 3.4 km/h II Speed 5.5 km/h
Maximum traction force	183 kN	191 kN
Grade ability	70 % (35 °)	70 % (35 °)
Ground pressure	43 kPa (600 mm Grouser shoe) 38 kPa (700 mm Grouser shoe)	50 kPa (600 mm Grouser shoe) 43 kPa (700 mm Grouser shoe)
3. Complete machine dimensions		
	Standard arm (3.0 m arm)	Standard arm (3.1 m arm)
Length	9,390 mm	9,880 mm
Width	2,800 mm	2,990 mm
Height	2,910 mm	3,080 mm
4. Machine body dimensions		
Machine body length	4,810 mm	5,030 mm
Machine body width	2,800 mm	2,990 mm
Upper swing body width cab width	2,750 mm	2,750 mm
Machine body height	1,000 mm	1,000 mm
Rear end swing	2,880 mm	2,950 mm
Tail end radius	2750 mm	2,910 mm
Rear end distance of swing body	2,720 mm	2,900 mm
Lower face height of swing body end	1,040 mm	1,100 mm
Center distance between tumblers of tumbler	3,370 mm	3,460 mm
Overall crawler length	4,170 mm	4,260 mm
Maximum crawler width	2,800 mm	2,990 mm
Center distance of crawler	2,200 mm	2,390 mm
Width of track shoe	600 mm (Optional: 700 mm)	600 mm (Optional: 700 mm)
Minimum ground height	460 mm (to the bottom face of lower frame)	460 mm (to the bottom face of lower frame)

	SH200-3	SH220-3
5. Engine		
Name	ISUZU BB-6BG1T	ISUZU BB-6BG1T
Type	4-cycle water cooled,overhead valve,straigh,t,direct injection (electronic controlled type) engine with exhaust turbo-charger	4-cycle water cooled,overhead valve,straigh,t,direct injection (electronic controlled type) engine with exhaust turbo-charger
No. of cylinders-bore × stroke	6-105 mm×125 mm	6-105 mm×125 mm
Cylinder displacement	6,494 mL	6,494 mL
Maximum torque	532 N·m / 1,600 min ⁻¹	562 N·m / 1,800 min ⁻¹
Fuel consumption rate	243 g/kW·h or less	250 g/kW·h or less
Starter	24 V 4.5 kW	24 V 4.5 kW
Charging and generating system	24 V 40 A AC system	24 V 40 A AC system
Battery	2 12 V 120 Ah	2 12 V 120 Ah
6. Hydraulic device		
Hydraulic pump driving type	Engine direct-coupled (no transmission)	Engine direct-coupled (no tansmission)
Hydraulic pump Model	Double variable displacement type piston pump 1 Gear pump 1	Double variable displacement type piston pump 1 Gear pump 1
Discharge volume	Piston pump 2×201 L / min Gear pump 20 L / min	Piston pump 2 × 212 L / min Gear pump 22 L / min
Pump control method	Simultaneous total output horsepower control	Simultaneous total output horsepower control
Set pressure of main relief valve	34.3 MPa (Boosting 37.3 MPa)	34.3 MPa (Boosting 37.3 MPa)
Set pressure of over-load relief valve	39.2 MPa	39.2 MPa
7. Control valve		
Model	Quadruple-spool Integrated type 1 Quintuple-spool	Quadruple-spool Integrated type 1 Quintuple-spool
Operation method	Hydraulic pilot type:For travel, swing and operating machine	Hydraulic pilot type:For travel, swing and operating machine
8. Cooling system		
Fan type	Suction type	Suction type
Radiator	Pressure type	Pressure type
Oil cooler		
Cooling method	Air-cooling	Air-cooling
Radiation space	13.2 m ²	15.1 m ²

SH200-3/SH220-3		
9. Control devices		
Operator's seat		
Location	Left side	
Structure	Forward-backward, Up-down adjusting type, with reclining mechanism, with seat suspension	
Cab	Steel made enclosure type, reinforced glass (all sides)	
Levers and pedals		
For travel use	Levers and pedals (Hydraulic pilot type)	2
For control use	Levers (Hydraulic pilot type)	2
Instruments and switches		
Work mode change over	4 modes (Heavy digging, standard, finishing and Auto)	
2 travel speed change over	I Speed / II Speed – Panel switch type	
One-touch idle	Knob switch type	
Monitor device		
Machine status display (Full-dot liquid crystal)		
Travel speed selection status	I Speed / II Speed	
Work mode selection status	H/S/L/A	
Auto idle selection status	ON/OFF	
Instruments (Full-dot liquid crystal, except for hour meter)		
Fuel gauge	Bar graph indicator	
Engine water temperature meter	Bar graph indicator	
Hydraulic oil temperature meter	Bar graph indicator	
Hour meter	Digital type	
Machine Status and Warning Alarms (Full-dot liquid crystal and warning sound)		
Over heat*	Battery charging*	Electric system fault*
Fuel refill*	Engine oil pressure*	Cooling water refill*
Engine pre-heating	Automatic warming-up	Digging force boosting
Idling	Maintenance period	
*With warning sound alarm		

	SH200-3	SH220-3
Lighting	Tank front side: 24 V 70 W 1	Tank front side: 24 V 70 W
Work lamp	On the boom: 24 V 70 W 1	On the boom: 24 V 70 W 1
Room lamp	24 V 10 W 1	24 V 10 W 1
Horn	Electric horn 2	Electric horn 2
Miscellaneous	Rise-up wiper with intermittent function 1	Rise-up wiper with intermittent function 1
	Wind washer 1	Wind washer 1
	Air conditioner 1	Air conditioner 1
	Rear view mirror (right side) 1	Rear view mirror (right side) 1
	DC converter (optional) 1	DC converter (optional) 1
10. Swing equipment		
Swing circle	Swing bearing type (with internal gears)	Swing bearing type (with internal gears)
Swing hydraulic motor	Constant displacement piston motor 1	Constant displacement piston motor 1
Reduction gears	Planetary gears 2 speed reduction type	Planetary gears 2 speed reduction type
Swing parking brake	Mechanical lock (operation lever linkage type)	Mechanical lock (operation lever linkage type)
Swing lock	Mechanical lock (swing lock switch linkage type)	Mechanical lock (swing lock switch linkage type)
11. Travel Lower Mechanism		
Travel hydraulic motor	Variable displacement piston motor 2	Variable displacement piston motor 2
Reduction gears	Planetary gears 3 speed reduction type	Planetary gears 3 speed reduction type
Travel brake	Hydraulic lock	Hydraulic lock
Parking brake	Mechanical lock (travel lever linkage type)	Mechanical lock (travel lever linkage type)
Crawler shoes		
Model	Assembly type triple Grouser shoes	Assembly type triple Grouser shoes
Number of shoes (one side)	46	47
Shoe width	600 mm (optional: 700 mm)	600 mm (optional: 700 mm)
Grouser height	26 mm	26 mm
Link pitch	190 mm	190 mm
Roller		
Number of upper rollers(one side)	2	2
Number of lower rollers(one side)	7	8
Track belt tension adjuster	Grease cylinder type (with cushion spring)	Grease cylinder type (with cushion spring)

	SH200-3	SH220-3
12. Attachment device		
Model	Back hoe attachment	Back hoe attachment
Capacity / dimensions/ working dimensions	Standard Arm (3.0 m arm)	Standard Arm (3.1 m arm)
Bucket capacity	Heaped 0.80 m ³ (Struck 0.57 m ³)	Heaped 1.00 m ³ (Struck 0.73 m ³)
Bucket width	1,030 mm	1,180 mm
Width of bucket with side cutter	1,130 mm	1,260 mm
Mass of bucket with side cutter	610 kg	780 kg
Boom length	5,700 mm	5,850 mm
Arm length	3,000 mm	3,090 mm
Bucket wrist radius	1,450 mm	1,600 mm
Bucket wrist angle	77 °	176 °
Maximum digging radius	9,960 mm	10,420 mm
Maximum level digging radius	9,790 mm	10,260 mm
Maximum digging depth	6,710 mm	6,970 mm
Maximum vertical digging depth	6,080 mm	6,210 mm
Maximum digging height	9,650 mm	9,810 mm
Maximum dump height	6,840 mm	6,760 mm
Front minimum swing radius	3,620 mm	3,870 mm
Overall height when swinging at front minimum radius	7,640 mm	7,730 mm

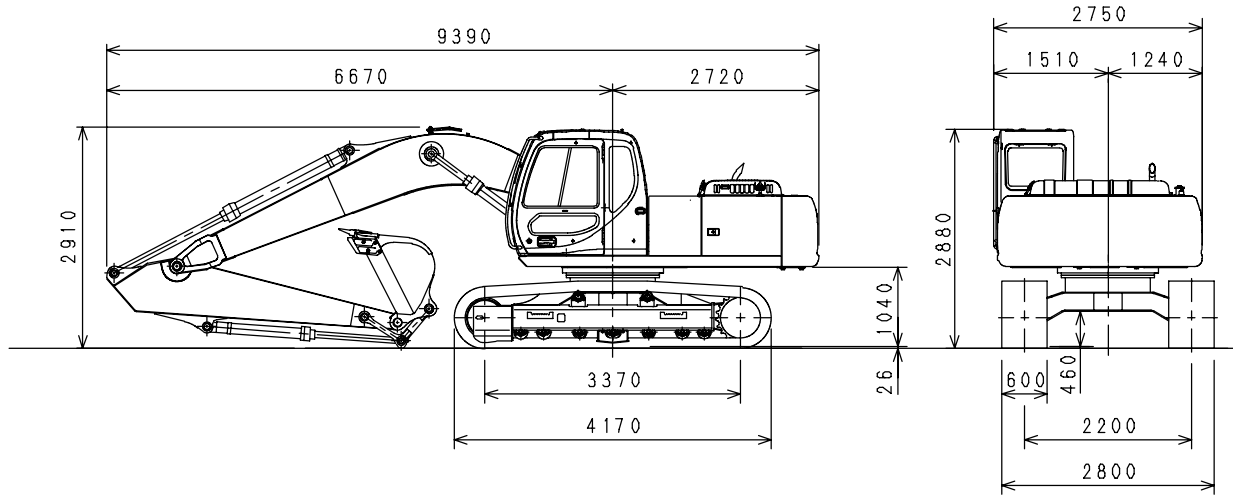
	SH200-3	SH220-3
13. Hydraulic Cylinder	inner rod quantity × diameter – diameter – stroke of tube Boom cylinder 2 × ϕ 120 mm × ϕ 85 mm × 1,255 mm Arm cylinder 1 × ϕ 135 mm × ϕ 95 mm × 1,474 mm Bucket cylinder 1 × ϕ 115 mm × ϕ 80 mm × 1,012 mm	inner rod quantity × diameter – diameter – stroke of tube 2 × ϕ 125 mm × ϕ 90 mm × 1,284 mm 1 × ϕ 145 mm × ϕ 105 mm × 1,627 mm 1 × ϕ 130 mm × ϕ 90 mm × 1,073 mm
14. Digging force (new JIS)		
Bucket digging force (Standard / Boosting)	130 kN / 141 kN	160 kN / 173 kN
Arm digging force (Standard / Boosting)	95.3 kN / 104 kN	115 kN / 125 kN
15. Capacity of water and oil		
Cooling water	27 L	27 L
Fuel	340 L	340 L
Engine lubricating oil	24 L	24 L
Travel reduction gear lubricating oil	4.7 L	4.7 L
Swing reduction gear lubricating oil	4.8 L	4.8 L
Hydraulic oil	206 L	225 L
Hydraulic oil tank capacity	120 L	120 L

COMPLETE MACHINE DIMENSIONS

SH200-3 (3.0 m arm)

Note 1 : Values may be changed without notice due to design changes or other reasons.

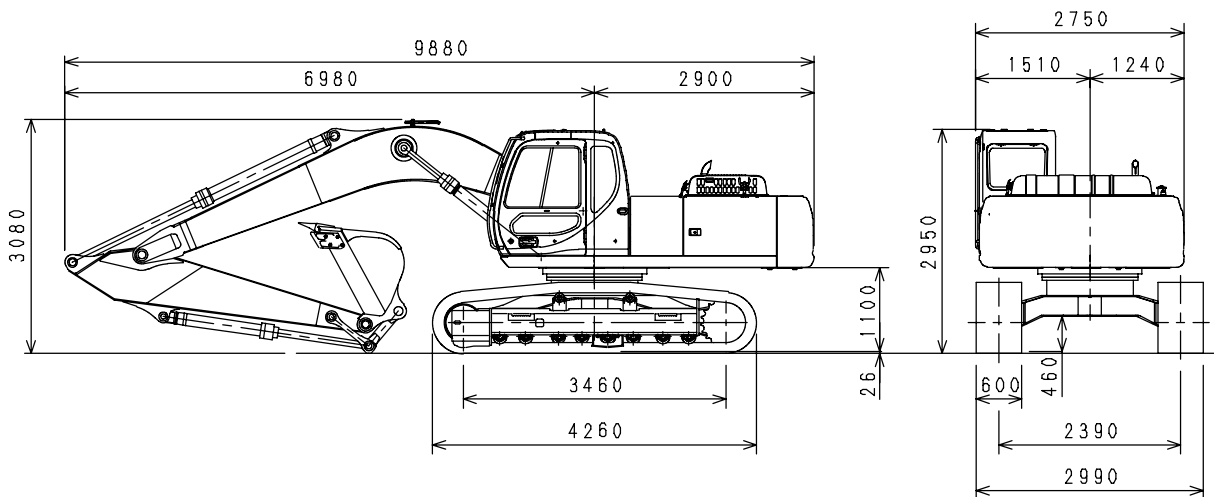
Note 2 : The values in the diagram include the lug height of shoe (26 mm).



SH220-3 (3.1 m arm)

Note 1 : Values may be changed without notice due to design changes or other reasons.

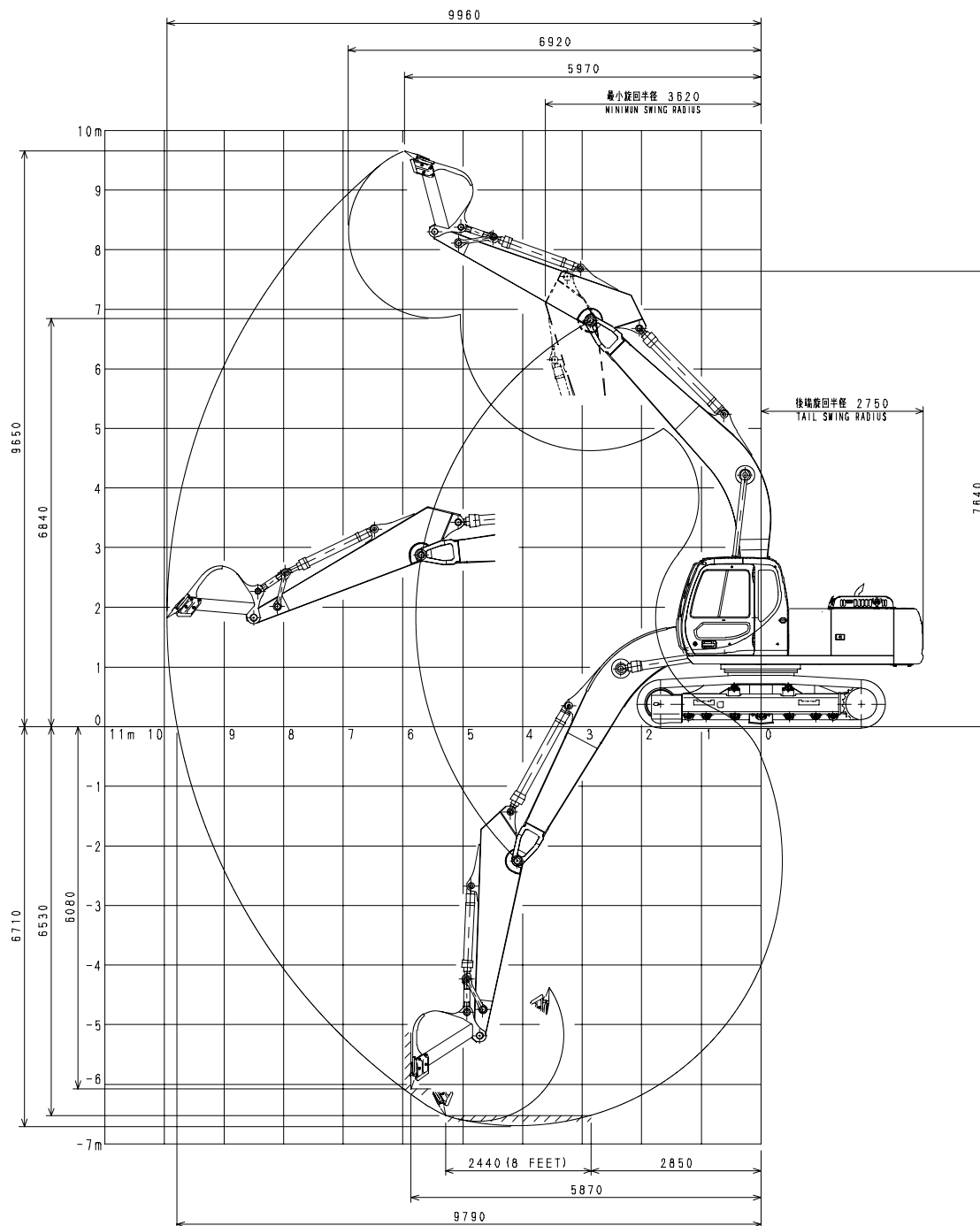
Note 2 : The values in the diagram include the lug height of shoe (26 mm).



SH200-3 (3.0 m arm)

Note 1 : Values may be changed without notice due to design changes or other reasons.

Note 2 : The values in the diagram exclude the lug height of shoe (26 mm).



SH220- 3 (3.1 m arm)

Note 1 : Values may be changed without notice due to design changes or other reasons.

Note 2 : The values in the diagram exclude the lug height of shoe (26 mm)

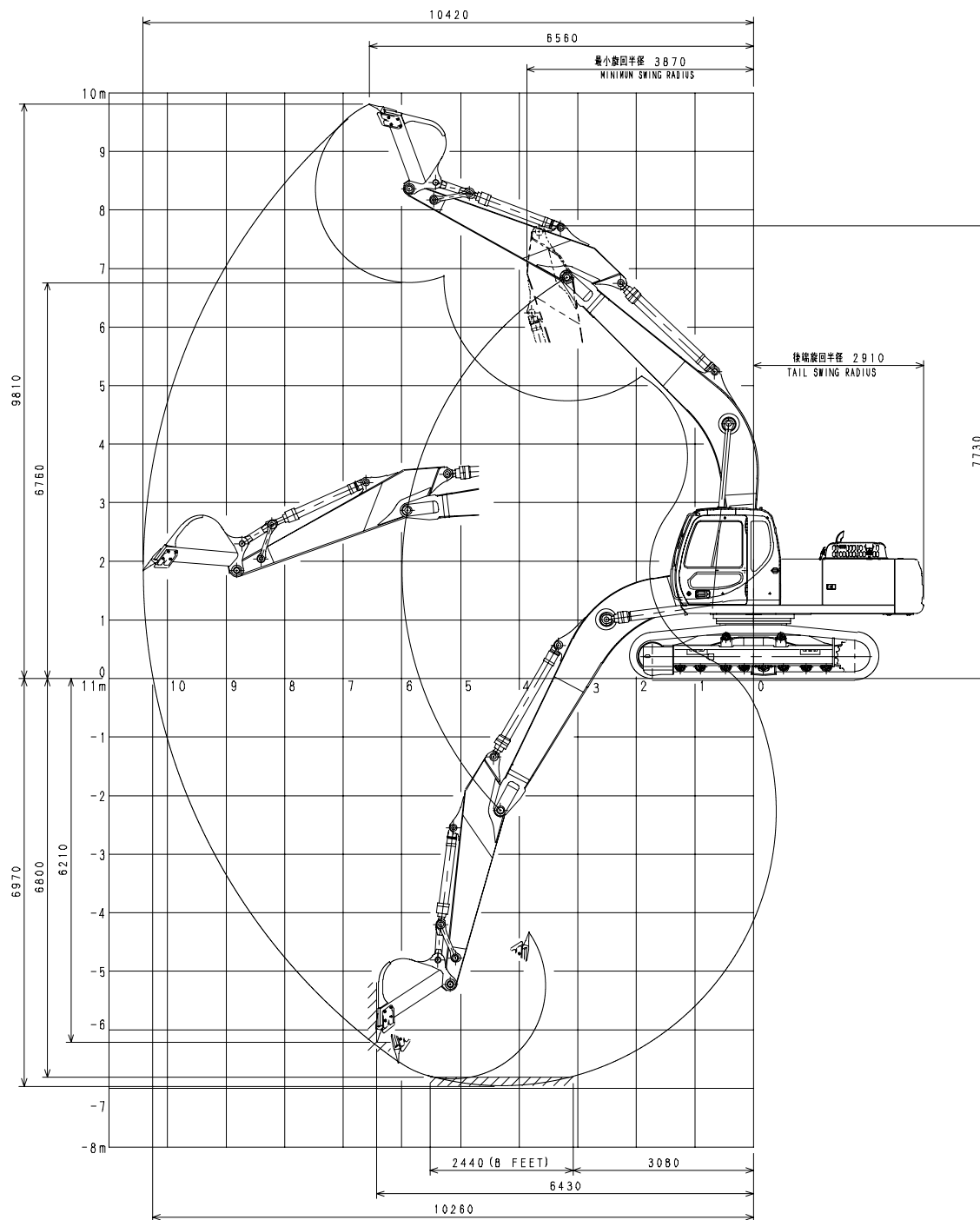


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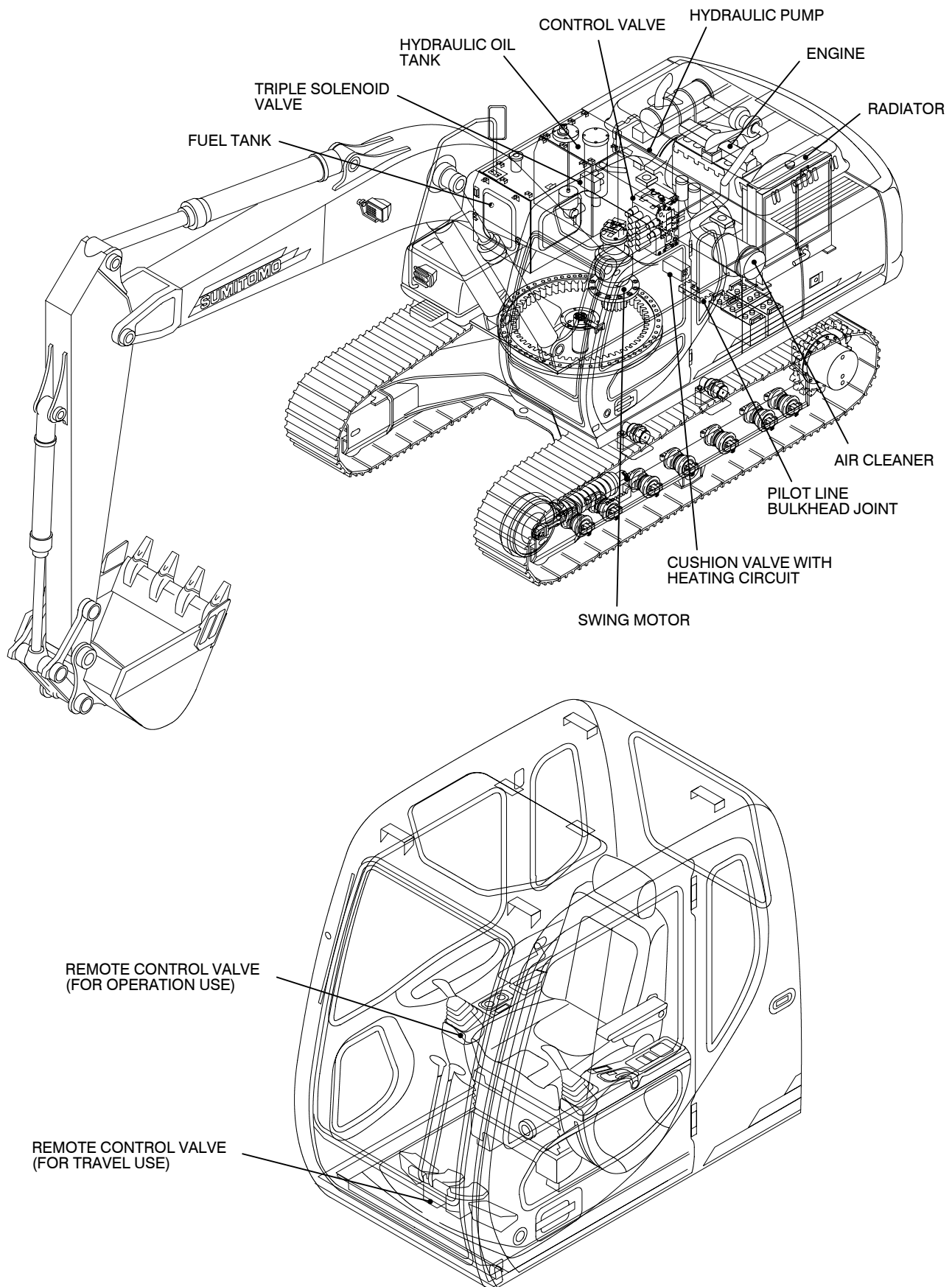
FULL VIEW OF MAIN COMPONENTS

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PILOT HOSE CONNECTION DIAGRAM

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Main Component Layout



HYDRAULIC COMPONENT LIST

	SH200-3	SH220-3
Engine	ISUZU BB-6BG1T 4-cycle with turbo-charger Electronic controlled type Rated output 103.0 kw (140 ps) at 1,950 min⁻¹ Maximum torque 532 N·m (54.2 kg·m) at 1,600 min⁻¹ Fuel consumption rate 243 g/kw·h or less (179.0 g/Ps·h) Dry weight 484 kg	ISUZU BB-6BG1T 4-cycle with turbo-charger Electronic controlled type Rated output 121.4 kw (165 ps) at 2,150 min⁻¹ Maximum torque 562 N·m (57.3 kg·m) at 1,800 min⁻¹ Fuel consumption rate 250 g/kw·h or less (184.0 g/Ps·h) Dry weight 484 kg
Hydraulic pump	KAWASAKI Heavy Industries • Tandem variable displacement piston pump - Discharge 201 L/min × 2 - Working pressure 37.3 Mpa (380 kgf/cm²) For boosting • Fixed displacement gear pump - Discharge 22 L/min - Working pressure 3.9 MPa (40 kgf/cm²) • Dry weight 139 kg	KAWASAKI Heavy Industries • Tandem variable displacement piston pump - Discharge 212 L/min × 2 - Working pressure 37.3 Mpa (380 kgf/cm²) For boosting • Fixed displacement gear pump - Discharge 22 L/min - Working pressure 3.9 MPa (40 kgf/cm²) • Dry weight 139 kg
Control Valve	KAYABA INDUSTRIES • Control method: Hydraulic pilot method • Relief set pressure: - Standard 34.3 Mpa (350 kgf/cm²) at 126 L/min - Boosting 37.3 Mpa (380 kgf/cm²) at 108 L/min • Overload relief pressure: 39.2 Mpa (400 kgf/cm²) at 20 L/min • Function: - Straight travel, Boom up/arm in tandem type, Internal confluence, Boom/arm with load holding valve, Boom lowering pressure feedback, Arm in forced pressure feedback Swing priority	KAYABA INDUSTRIES • Control method: Hydraulic pilot method • Relief set pressure: - Standard 34.3 Mpa (350 kgf/cm²) at 156 L/min - Boosting 37.3 Mpa (380 kgf/cm²) at 136 L/min • Overload relief pressure: 39.2 Mpa (400 kgf/cm²) at 20 L/min • Function: - Straight travel, Boom up/arm in tandem type, Internal confluence, Boom/arm with load holding valve, Boom lowering pressure feedback, Arm in forced pressure feedback Swing priority

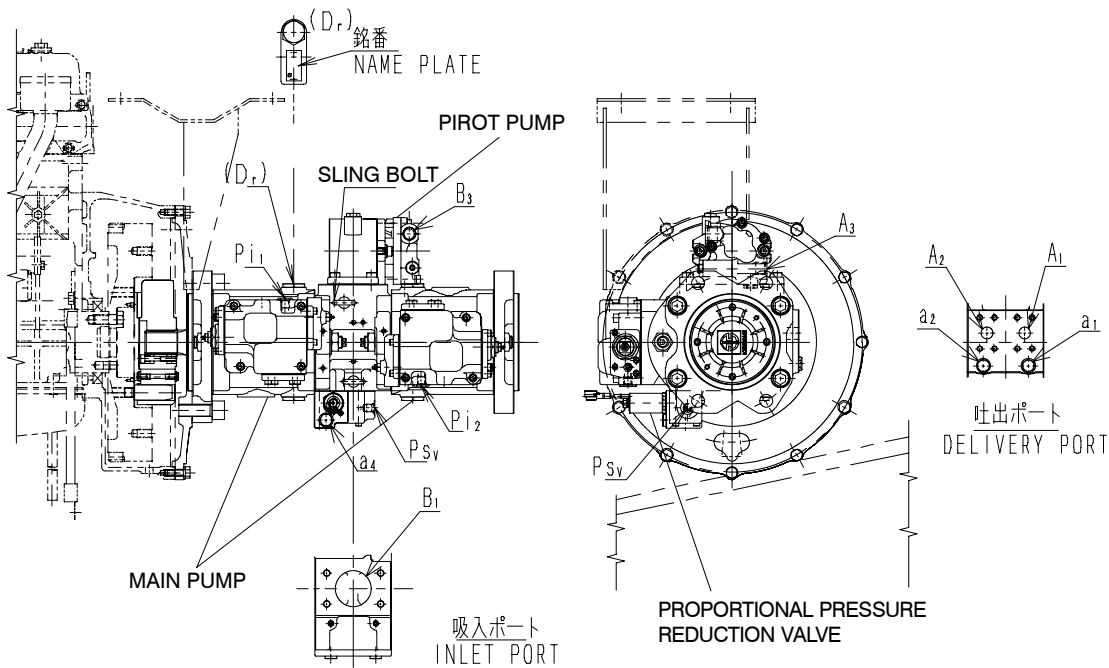
	SH200-3	SH220-3
Swing unit	TOSHIBA Machine Power unit Fixed displacement piston motor Suction volume 151 cc/rev. Relief set pressure 27.9 Mpa (285 kgf/cm ²) at 155 L/min Swing parking brake Mechanical lock Reduction gears (with anti-reverse rotation valve) Dry weight 217 kg	KAWASAKI Heavy Industries Power unit Fixed displacement piston motor Suction volume 145.9 cc/rev. Relief set pressure 28.9 Mpa (295 kgf/cm ²) at 182 L/min Swing parking brake Mechanical lock Reduction gears (with anti-reverse rotation valve) Dry weight 322 kg
Travel unit	KAYABA INDUSTRIES Motor type Variable displacement piston motor (Automatic 2 speed change-over) Suction volume 162.2/95.0 cc/rev. Relief set pressure 35.3 Mpa (360 kgf/cm ²) at 40 L/min Travel parking brake Mechanical lock Dry weight 250 kg	KAYABA INDUSTRIES Motor type Variable displacement piston motor (Automatic 2 speed change-over) Suction volume 168.9/100.3 cc/rev. Relief set pressure 35.3 Mpa (360 kgf/cm ²) at 40 L/min Travel parking brake Mechanical lock Dry weight 250 kg
Boom cylinder	KAYABA INDUSTRIES Cylinder I.D. φ 120 Rod diameter φ 85 Stroke 1,255 Dry weight 169 kg	KAYABA INDUSTRIES Cylinder I.D. φ 125 Rod diameter φ 90 Stroke 1,284 Dry weight 193 kg
Arm cylinder	KAYABA INDUSTRIES Cylinder I.D. φ 135 Rod diameter φ 95 Stroke 1,474 Dry weight 257 kg	KAYABA INDUSTRIES Cylinder I.D. φ 145 Rod diameter φ 105 Stroke 1,627 Dry weight 327 kg
Bucket cylinder	KAYABA INDUSTRIES Cylinder I.D. φ 115 Rod diameter φ 80 Stroke 1,012 Dry weight 151 kg	KAYABA INDUSTRIES Cylinder I.D. φ 130 Rod diameter φ 90 Stroke 1,073 Dry weight 194 kg

FULL VIEW OF MAIN COMPONENTS

Hydraulic Pump

	Port name	Port size
A _{1,2}	Delivery port	SAE6000psi 3/4"
B ₁	Suction port	SAE2500psi 2 1/2"
Dr	Drain port	G 3/4-20
Psv	Survo assist port	G 1/4-15
Pi _{1,2}	Negative control port	G 1/4-15
a _{1,2,3,4}	Gauge port	G 1/4-15
A ₃	Gea pump delivery port	G 1/2-19
B ₃	Gear pump suction port	G 3/4-20

Summary

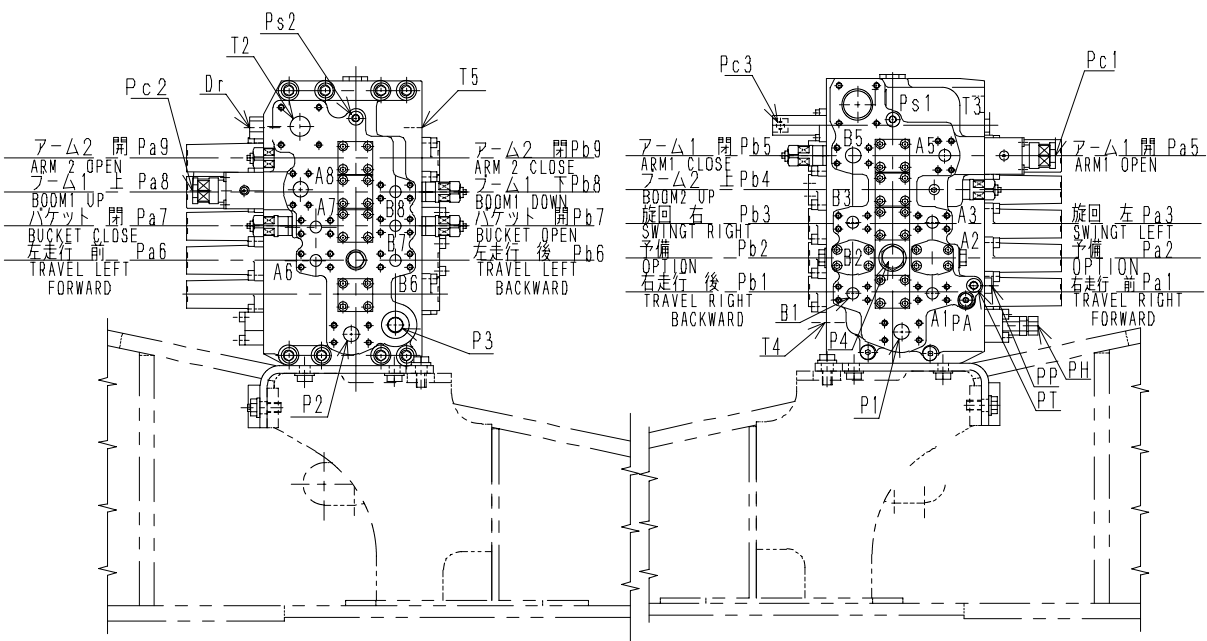


FULL VIEW OF MAIN COMPONENTS

Control Valve

Description of Control Valve Port

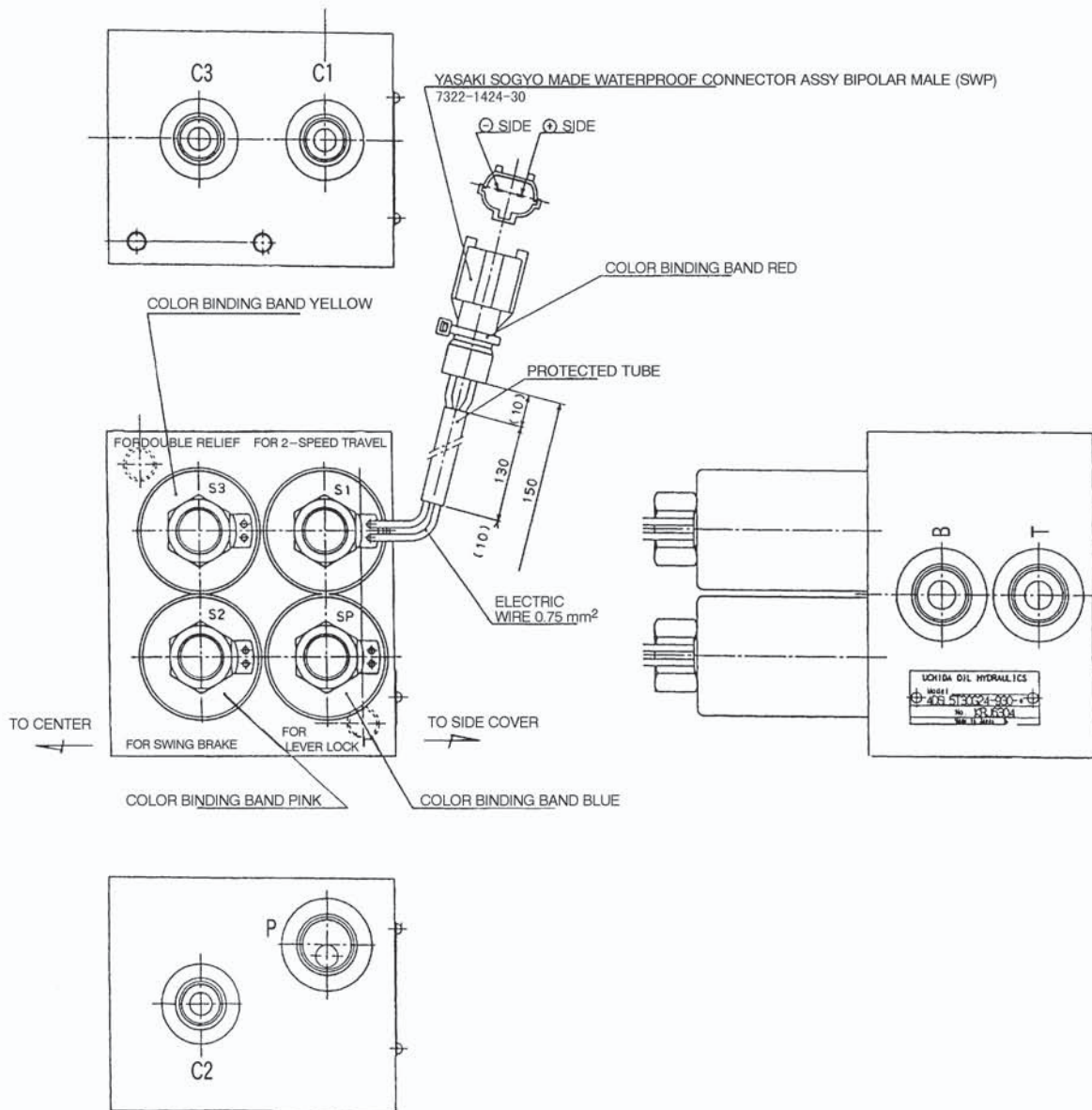
LINE NAME	MAIN PORT	LINE NAME	MAIN PORT
BUCKET OPEN LINE	B7	OPTION ONFLUENCE LINE	P3,P4
BUCKET CLOSE LINE	A7	RETURN LINE	T1,T2
BOOM DOWN LINE	B8	NEGATIVE CONTROL	Ps1,Ps2
BOOM UP LINE	A8	TRUCTION PRESSURE MEASUREMENT	PT
TRAVEL LEFT FORWARD LINE	A6	RAISED PRESSURE	PH
TRAVEL LEFT BACKWARD LINE	B6	ATTCHMENTS PRESSURE MEASUREMENT	PP,PA
ARM OUT LINE	A5	DRAIN	Dr
ARM IN LINE	B5	LOAD HOLDING AT ARM	Pc1
SWING RIGHT LINE	B3	LOAD HOLDING AT BOOM	Pc2
SWING LEFT LINE	A3	BY PASS FILTER	T4
OPTION LINE	A2	HEAT LINE	T5
OPTION LINE	B2	SWING MOTOR MAKE UP	T3
TRAVEL RIGHT FORWARD LINE	A1	SWING PRIORITY	Pc3
TRAVEL RIGHT BACKWARD LINE	B1	SWING PRIORITY RELEASE	Pbu
PRESSURE LINE	P1,P2		



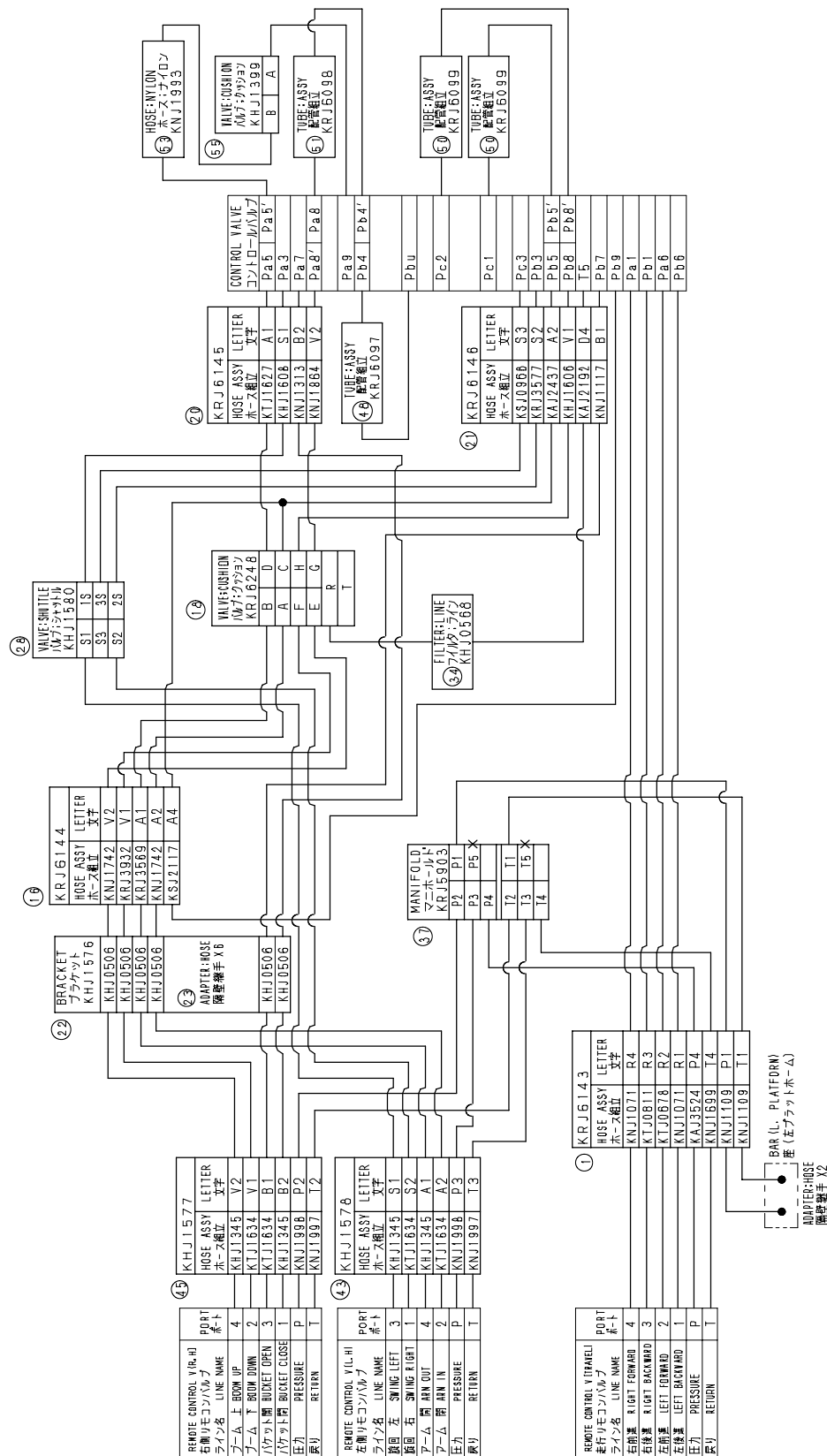
Summary

FULL VIEW OF MAIN COMPONENTS

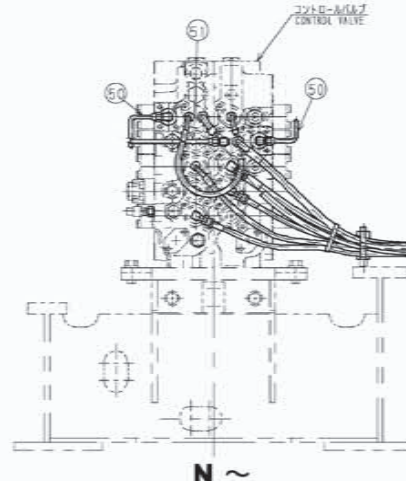
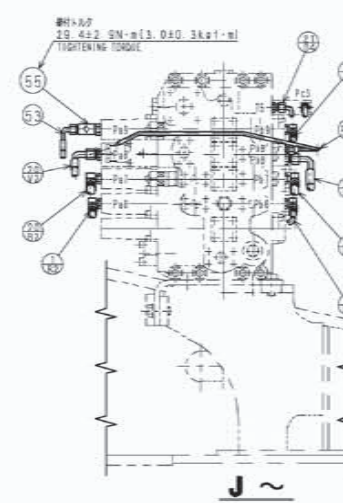
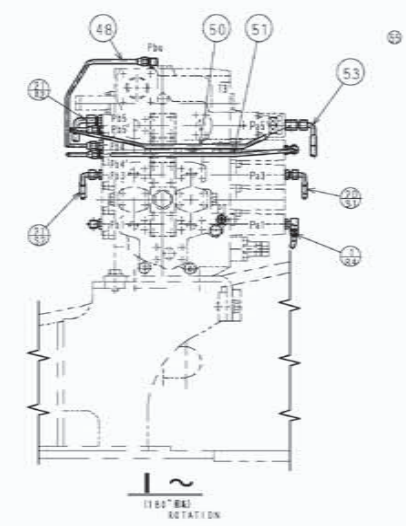
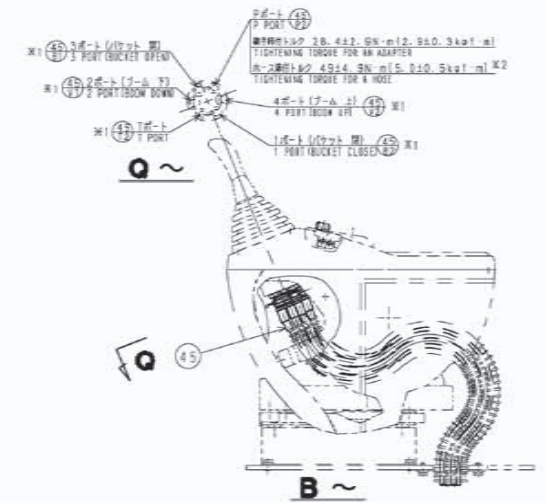
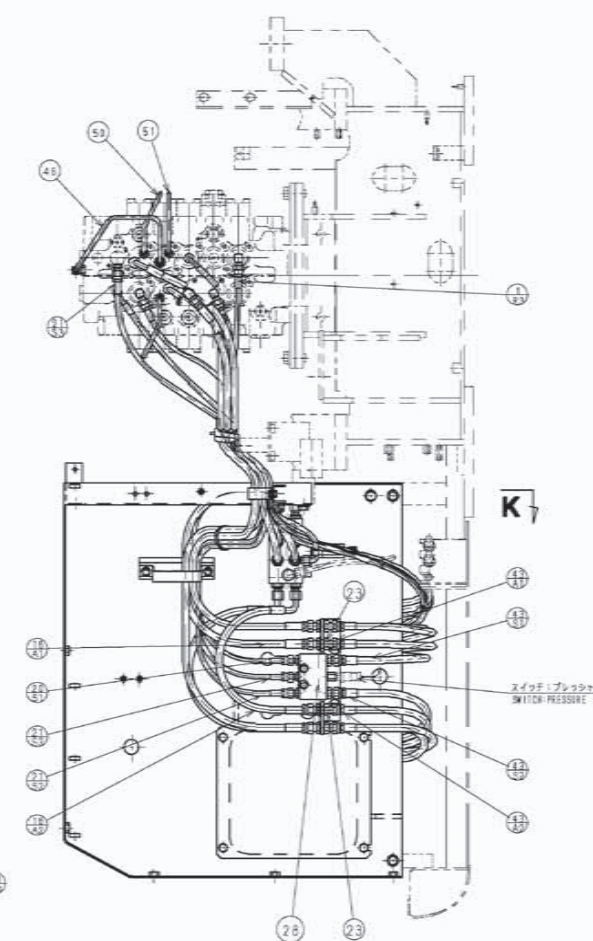
Quadruple Solenoid Valves



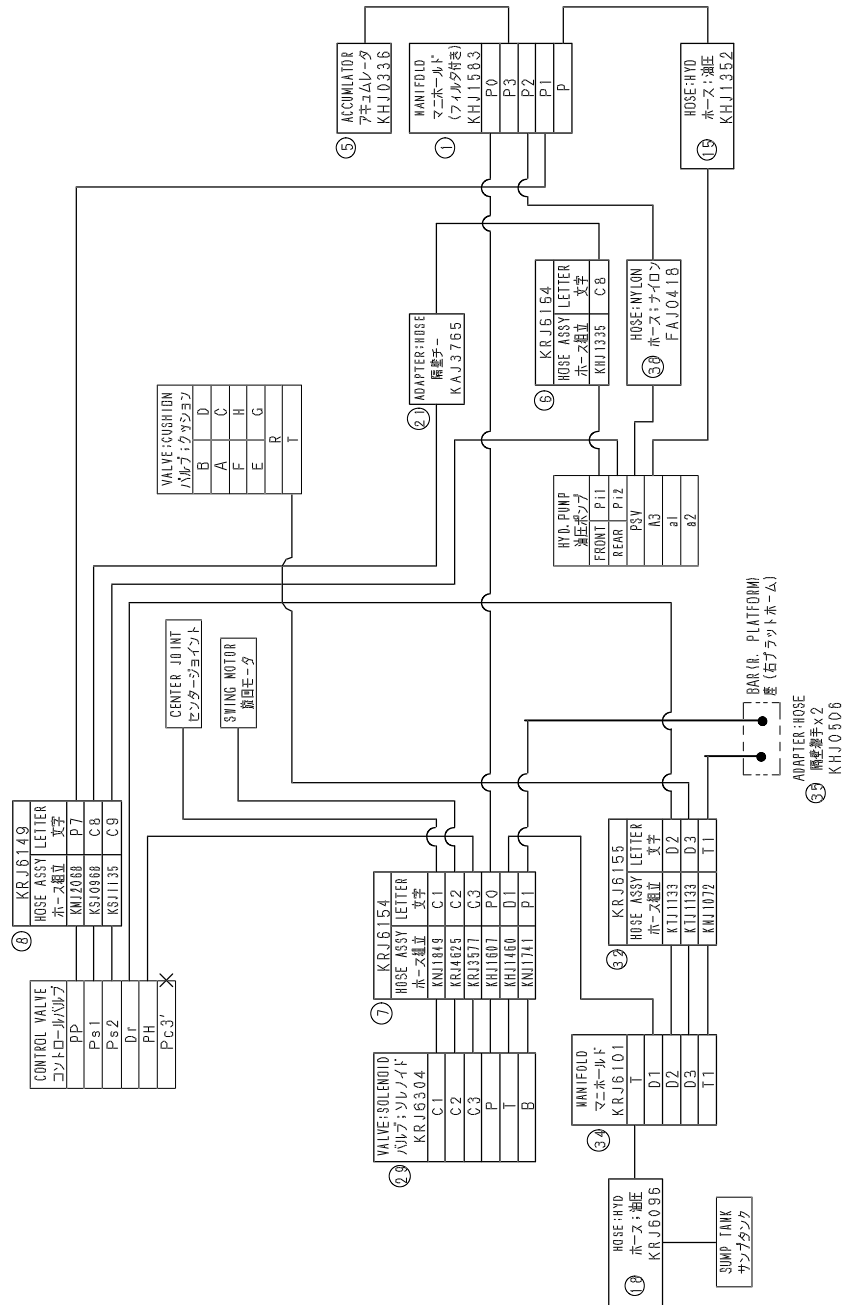
Summary



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Summary

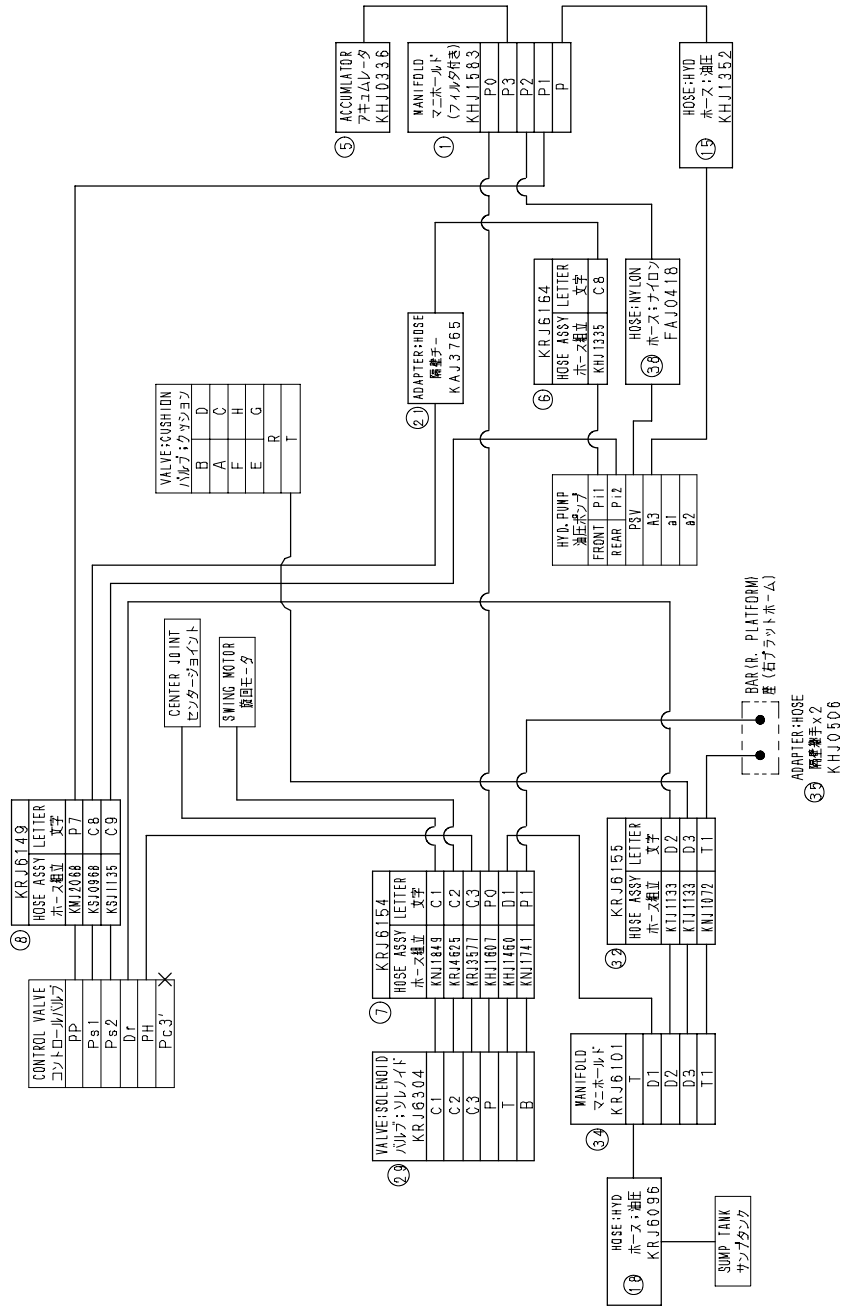


ホース：接続表

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PILOT HOSE CONNECTION DIAGRAM

Pilot P & T Line (SH220-3)



ホース接続表
HOSE CONNECTION TABLE

Summary

Summary



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DESCRIPTION OF OPERATION

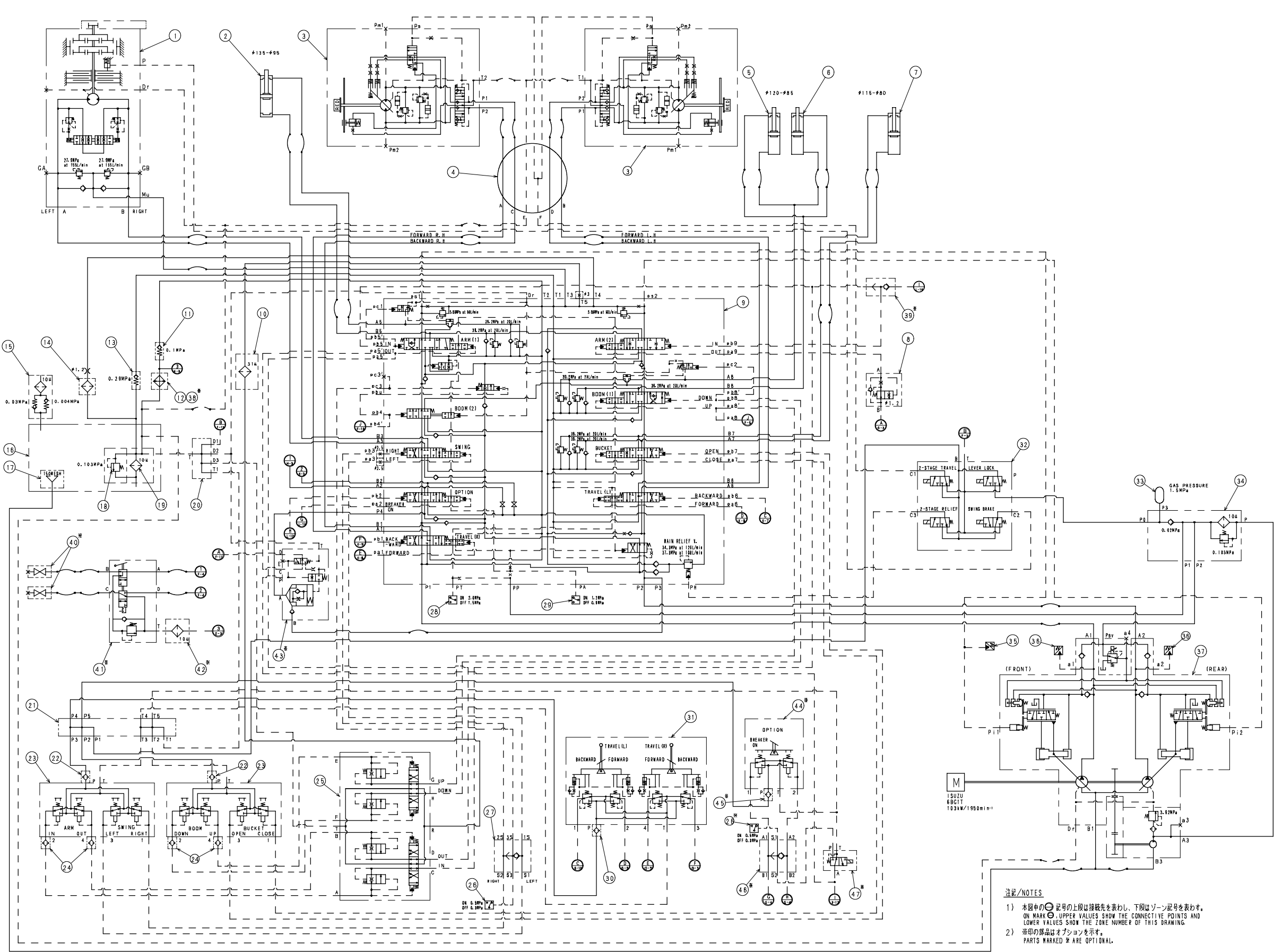
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ATTACHMENTS

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CIRCUIT DIAGRAMS

Hydraulic Circuit Diagram (SH200– 3)



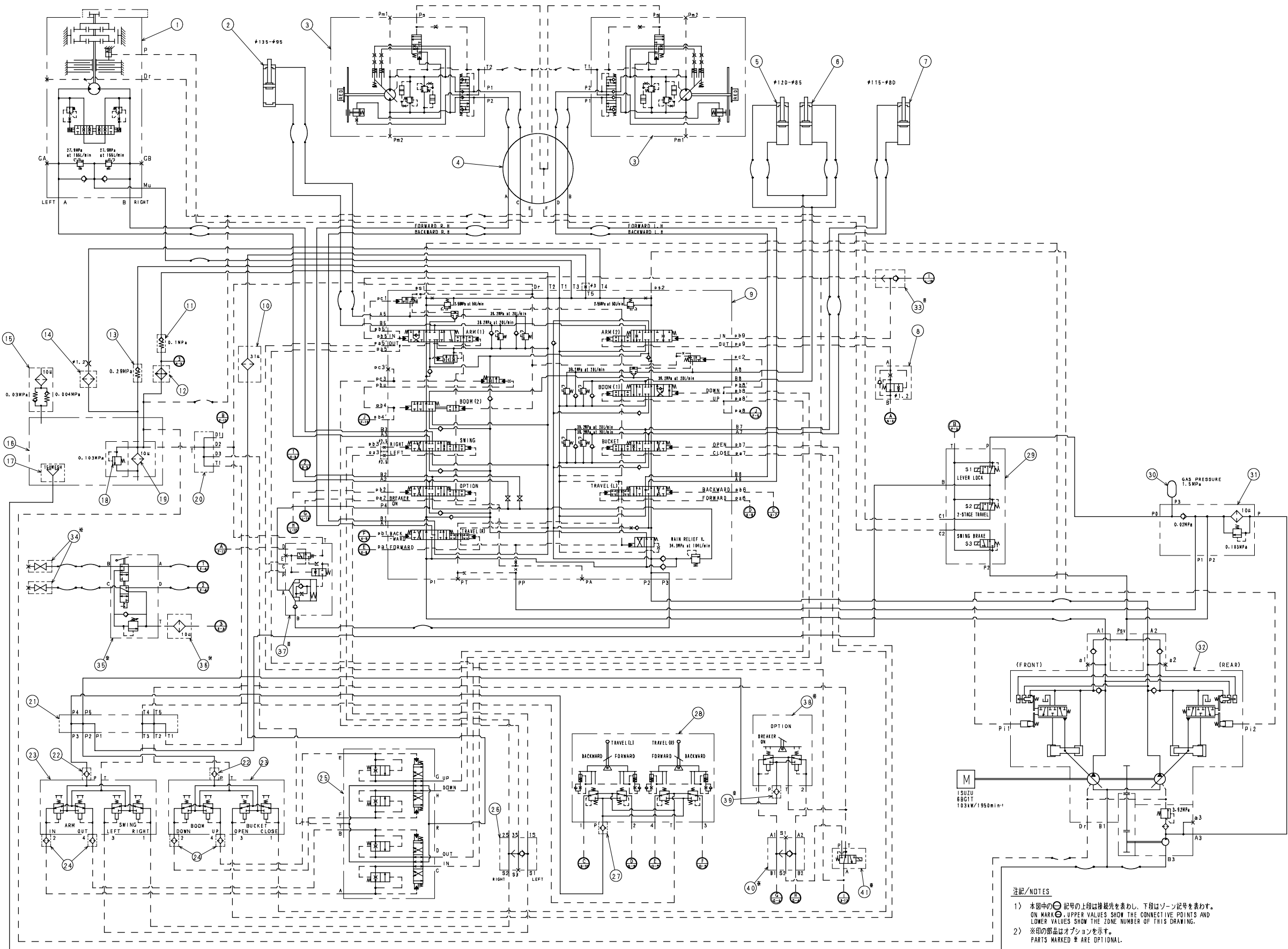
NO	PARTS NAME	NOTE	QTY
1	RED. BEAR:SWING ASSY		1
2	CYL. 7ARM		1
3	RED. BEAR:SWING ASSY		1
4	RED. BEAR:SWING ASSY		1
5	CYL. 800W(L)		1
6	CYL. 800W(R)		1
7	CYL. 800W(L)		1
8	CYL. 800W(R)		1
9	VALVE:CONTROL		1
10	VALVE:CHECK		1
11	VALVE:CHECK		1
12	VALVE:CHECK		1
13	VALVE:CHECK		1
14	VALVE:CHECK		1
15	VALVE:CHECK		1
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36	VALVE:CHECK		1
37	VALVE:CHECK		1
38	VALVE:CHECK		1
39	VALVE:CHECK		1
40	VALVE:CHECK		1
41	VALVE:CHECK		1
42	VALVE:CHECK		1
43	VALVE:CHECK		1
44	VALVE:CHECK		1
45	VALVE:CHECK		1
46	VALVE:CHECK		1
47	VALVE:CHECK		1

Hydraulic

注記/NOTES
1) 本図中の記号の上部は接続先を表わし、下部はソーン記号を表わす。
ON MARK ⊕, UPPER VALUES SHOW THE CONNECTIVE POINTS AND
LOWER VALUES SHOW THE ZONE NUMBER OF THIS DRAWING.
2) ※印の部品はオプションを示す。
PARTS MARKED * ARE OPTIONAL.

CIRCUIT DIAGRAMS

Hydraulic Circuit Diagram (SH200GT – 3)



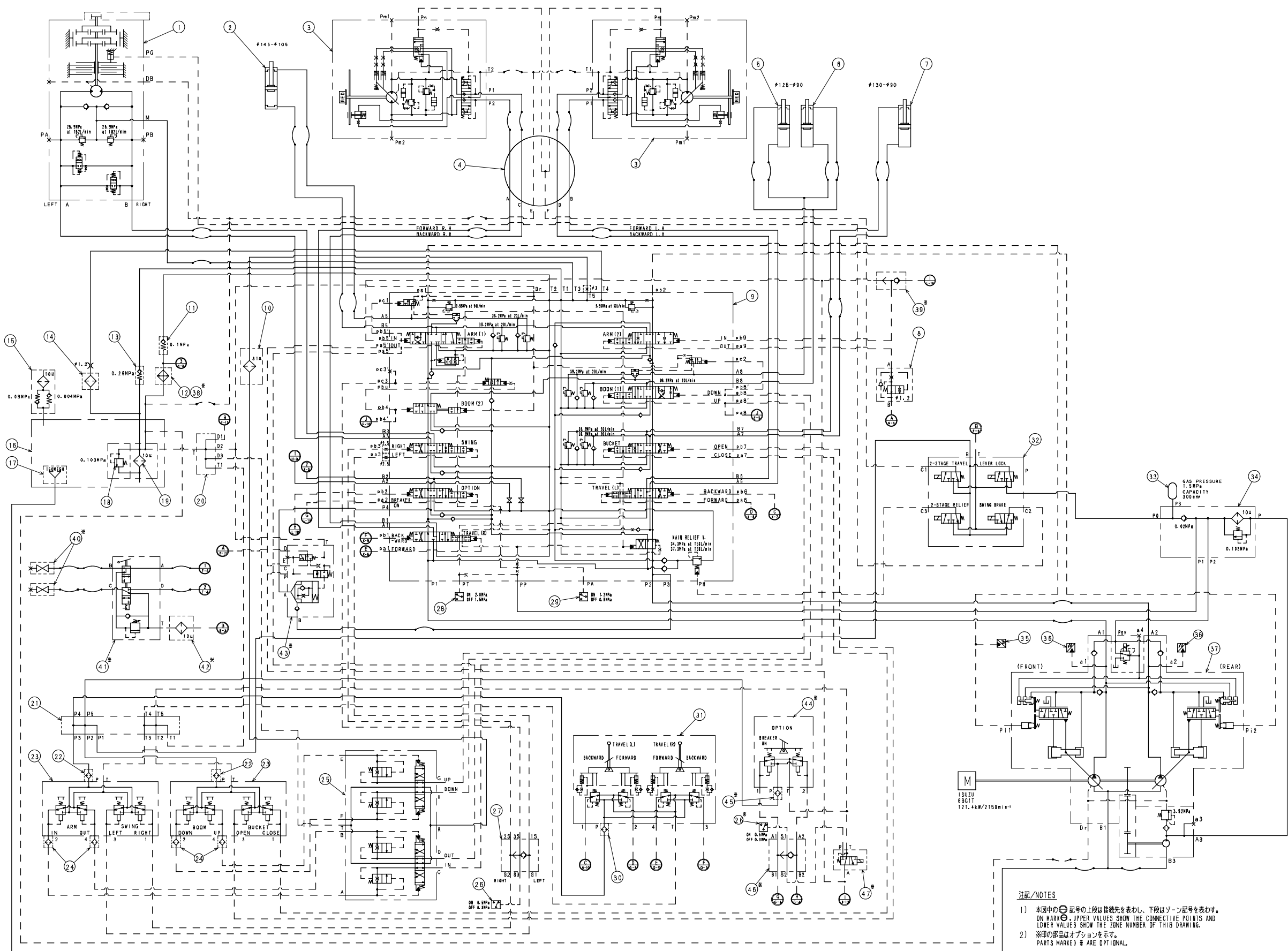
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2	ARM		1
3	ADAPTER: HOSE		1
4	JOINT: CTR		1
5	CYL: BOOM (L)		1
6	CYL: BOOM (R)		1
7	CYL: BUCKET		1
8	VALVE: POSITION		1
9	VALVE: CONTROL		1
10	FILTER: LINE		1
11	VALVE: CHECK		1
12	RADIATOR		1
13	VALVE: CHECK		1
14	FILTER: SPL		1
15	BREATHER: AIR		1
16	TANK: SWIVEL DELIVERY SPEC.		1
17	STRAINER		1
18	VALVE: RELIEF		1
19	FILTER: RETURN		1
20	MANIFOLD		1
21	MANIFOLD		1
22	ADAPTER: HOSE		2
23	VALVE: REMOTE CONT		2
24	ADAPTER: HOSE		4
25	VALVE: SPL		1
26	VALVE: SHUTTLE		1
27	WIPER		1
28	VALVE: REMOTE CONT		1
29	VALVE: SOLENOID		1
30	ACCUMULATOR		1
31	MANIFOLD		1
32	PUMP: HYD		1
33	VALVE: SHUTTLE		1
34	VALVE: STOP		2
35	VALVE: POSITION		1
36	FILTER: LINE		1
37	VALVE: HOLDING		1
38	VALVE: REMOTE CONT		1
39	ADAPTER: HOSE		1
40	VALVE: SHUTTLE		1
41	VALVE: SOLENOID		1

注記/NOTES
1) 本図中の⊕記号の上段は接続先を表わし、下段はゾーン記号を表わす。
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LOWER VALUES SHOW THE ZONE NUMBER OF THIS DRAWING.
2) ※印の部品はオプションを示す。
PARTS MARKED * ARE OPTIONAL.

Hydraulic

CIRCUIT DIAGRAMS

Hydraulic Circuit Diagram (SH220- 3)



NO	PARTS NAME	NOTE	QTY
1	RED. GEAR SWING ASSY		1
2	CYL. ARM		1
3	MOTOR TRACTION UNIT		2
4	JOINT:CTR		1
5	CYL. BOOM (L)		1
6	CYL. BOOM (R)		1
7	CYL. BUCKET		1
8	VALVE: CUSHION		1
9	VALVE: CONTROL		1
10	FILTER: LINE		1
11	VALVE: CHECK		1
12	RADIATOR		1
13	VALVE: CHECK		1
14	FILTER: SPL		1
15	ORFEE: AIR		1
16	TANK: SUPPLY DELIVERY SPEC.		1
17	STRAINER		1
18	VALVE: RELIEF		1
19	FILTER: RETURN		1
20	MANIFOLD		1
21	MANIFOLD		1
22	ADAPTER: HOSE		2
23	VALVE: REMOTE CONT		2
24	ADAPTER: HOSE		4
25	VALVE: SP		1
26	SWITCH: PRESS.	STD 1	2
27	VALVE: SHUTTLE		1
28	SWITCH: PRESS.		1
29	SWITCH: PRESS.		1
30	NIPPLE		1
31	VALVE: REMOTE CONT		1
32	VALVE: SOLENOID		1
33	ACCUMULATOR		1
34	MANIFOLD		1
35	SENSOR: PRESS.		1
36	SENSOR: PRESS.		2
37	PUMP: HYD		1
38	RADIATOR		1
39	VALVE: SHUTTLE		1
40	VALVE: SDP		2
41	VALVE: DIRECTION		1
42	FILTER: LINE		1
43	VALVE: HOLDING		1
44	VALVE: REMOTE CONT		1
45	ADAPTER: HOSE		1
46	VALVE: SHUTTLE		1
47	VALVE: SOLENOID		1

注記/NOTES

1) 本図中の⊕記号の上段は接続先を表わし、下段はソーン記号を表わす。
ON MARK ⊕. UPPER VALUES SHOW THE CONNECTIVE POINTS AND
LOWER VALUES SHOW THE ZONE NUMBER OF THIS DRAWING.

2) ※印の部品はオプションを示す。
PARTS MARKED ※ ARE OPTIONAL.

Hydraulic

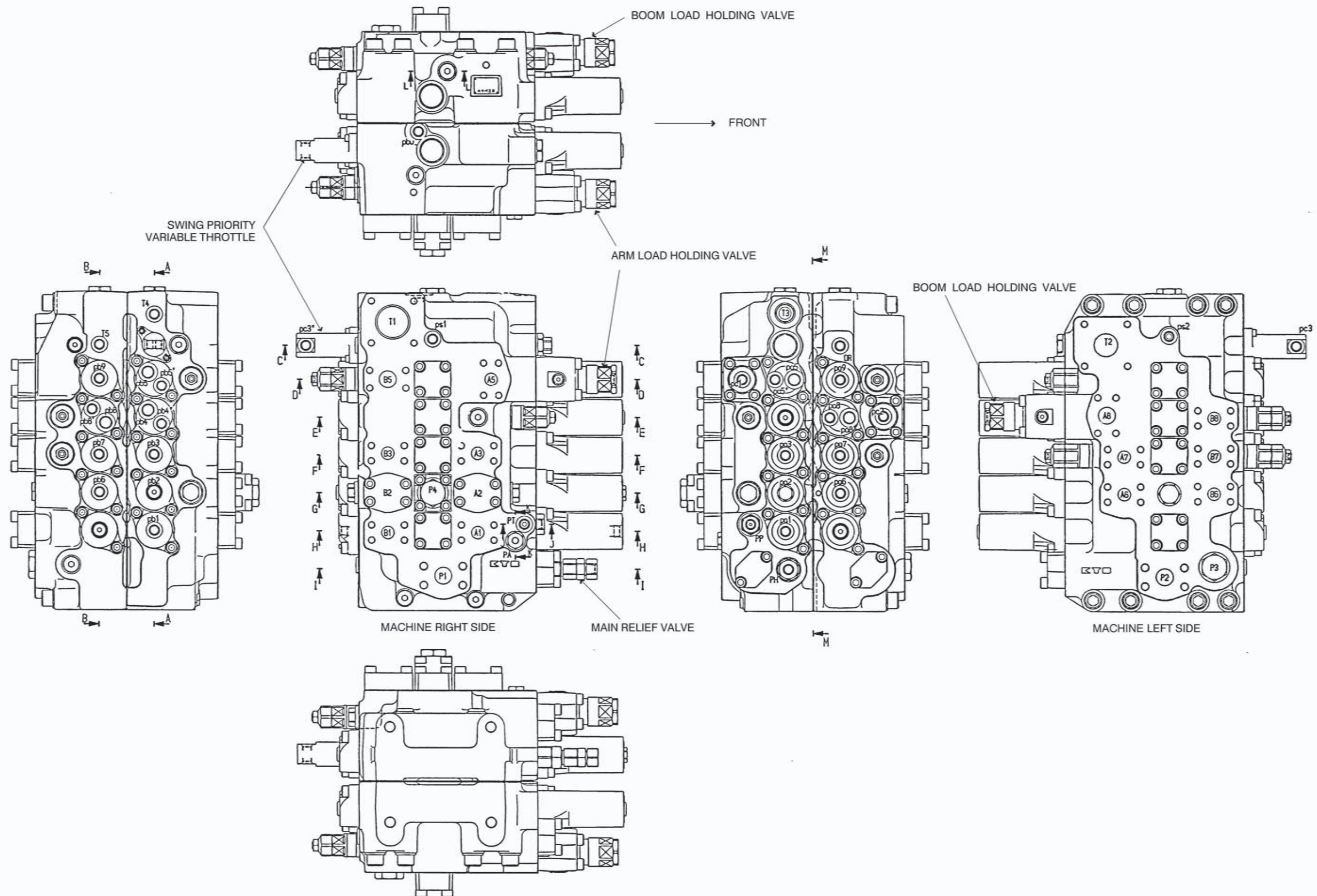
DESCRIPTION OF FUNCTIONS

Function List

Operation	Description of Function	Description of Operation
Travel		
High speed	High speeds can be achieved by setting the two-step slant angel of the travel motor to the smaller one. By utilizing load pressure on the travel motor, the speed is automatically changed to lower one. When changing to higher speeds by one-foot jacking up, keep pushing the travel change over switch. When you release your hand, the speed returns to the 1st speed. The 1st speed is designed to be applied when the travel pressure becomes 40 kgf/cm ² or less, in order to prevent hatching during steering at 2nd speed.	Page 8
Low speed	Low speeds can be achieved by setting the two-speed slant angel of the travel motor to the larger one.	Page 10
Straight travel	If you operate attachments or swing the machine while traveling, it keeps straight travel without zigzagging.	Page 12
Swing		
Parking	1. When the swing lever is in neutral, the swing parking is activated and the swing motion is kept holding with 100 % breaking force. 2. When the swing lever is operated, the mechanical brake is released and the normal swing operation is enabled. In addition, when the swing lever is in neutral and the attachment such as boom, arm or bucket is moved, loading pressure to them releases the swing parking. 3. The swing parking will be activated in 5 seconds after the swing lever is put in neutral or the attachment movement is stopped. 4. When the swing lock switch is turned ON, the swing parking brake becomes activated.	Page 14
Priority variable throttle	1. Swing side pushing force can be obtained by the swing priority throttle valve incorporated in the control valve. 2. While level excavation is performed, the swing priority variable throttle valve is activated in order to provide enough flow at the arm.	Page 16
Backward movement for swing motion stoppage	This function reduces the frequency of Backward movement for swing motion stoppage occurred when swing brake is applied. Reverse swing rotation protection valve is mounted on the swing motor.	
Attachments		
Boom up 2 speeds	Internal flow combination by changing over of the boom (2) spool makes its speed faster.	Page 18
Boom down load holding valve	Boom down movement can be made by releasing the load holding valve incorporated in the control valve.	Page 20
Boom down pressure feedback	Through the pressure feedback in the boom spool, speed-up and prevention of the negative pressure can be achieved.	Page 22
Prevention of machine extra movement at boom down motion starting prevention	High pressure is controlled with bleed off circuit and the machine extra movement at boom down motion starting can be reduced.	
Arm out 2 speed	Internal flow confluence by changing over of the arm (2) spool makes its speed faster.	Page 24
Arm in load holding valve	Arm in movement can be realized by releasing the load holding valve incorporated in the control valve.	Page 26
Arm in forced pressure feedback	The forced pressure feedback release valve in the control valve makes the speeds during the complex movements faster.	Page 28
Cushion valve	Shocks are moderated by the cushion valve with heat circuit. The valves are mounted on the pilot lines of the boom and the arm. There is no soft/hard switch.	
Option circuit	Optional sections are furnished in the main control valve as a standard equipment, and intended to be used for the special attachments such as breaker, crusher, etc.	Page 30
Other		
Auto boosting	The engine load ratio and circuit pressure can increase the pressure of the main relief from 350 kgf/cm ² to 380 kgf/cm ² .	
Negative control	This is designed to reduce power consumption by minimizing the flow of the discharge from the hydraulic pump when operating with no load.	

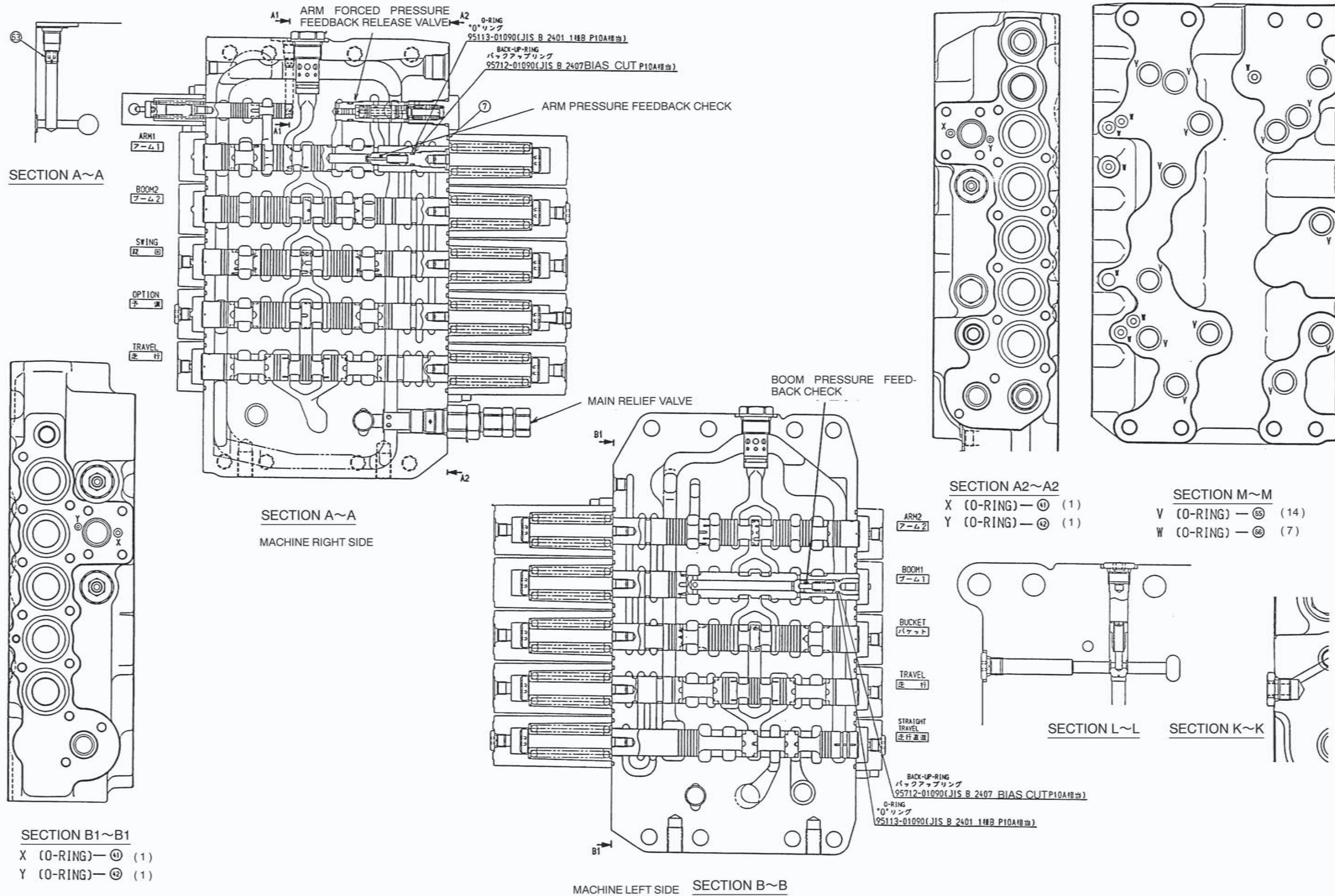
CONTROL VALVE

Structural Drawing of Control Valve



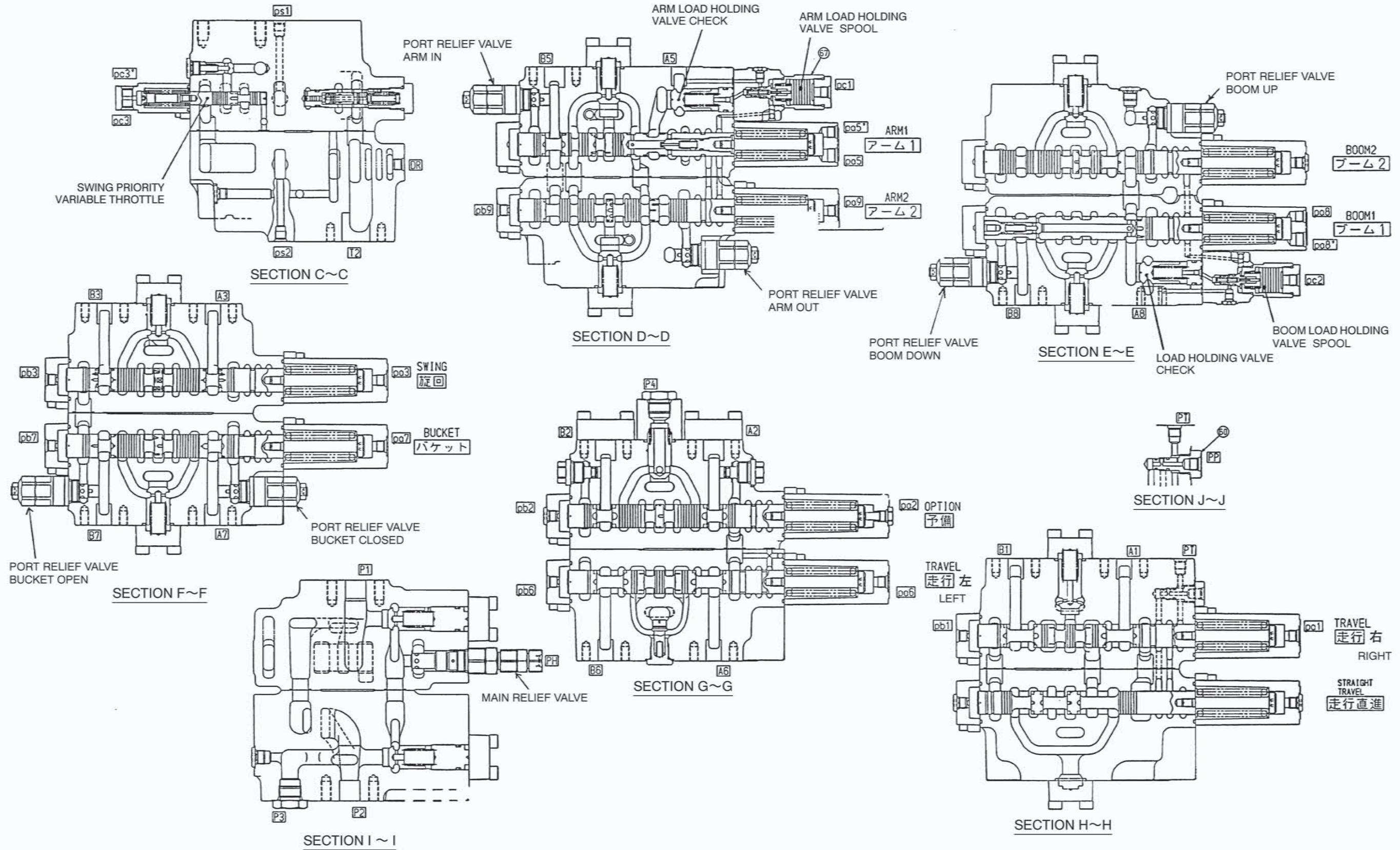
CONTROL VALVE

Structural Drawing of Control Valve



CONTROL VALVE

Structural Drawing of Control Valve



DESCRIPTION OF OPERATION

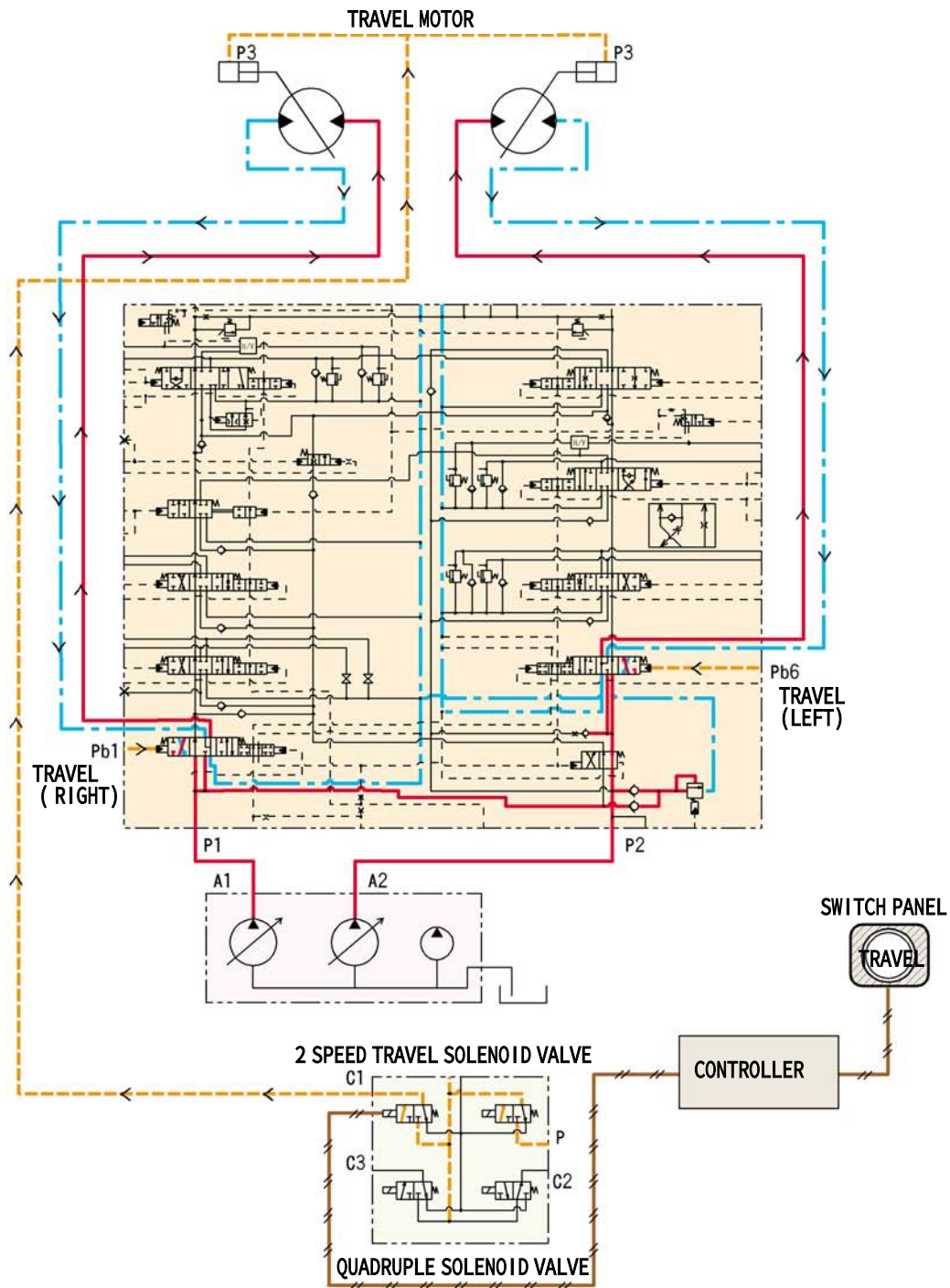
High Speed Travel Circuit

With High Speed Travel, high speeds can be achieved by setting the slant angle of the travel motor to the smaller one. The travel motor has a circuit, which changes the speed to the lower one by utilizing the load pressure added on the travel motor, only when traveling is made at high speed.

Discharged oil from A1 enters the P1 port of control valve entry while discharged oil from A2 enters the P2 port of control valve entry. Each flow goes into the travel motor through the changing over of the left and right travel spools. By these flows, the machine travels forward and backward. Electronic signals are sent to the solenoid valve from the travel change-over switch. And the controller sends electronic signals to the travel 2-speed solenoid valves in the quadruple solenoid valves and the solenoid valves are changed over. Original pilot pressure (3.9 MPa) from the C1 port of the quadruple solenoid valves is connected through the central joint to P3 ports of the left and right travel motors. The original pressure (3.9 MPa) entered the P3 ports of the left and right travel motors positions the slant angle of the travel motor to smaller inclination side, and make the speed faster.

DESCRIPTION OF OPERATION

High Speed Travel Circuit



Hydraulic

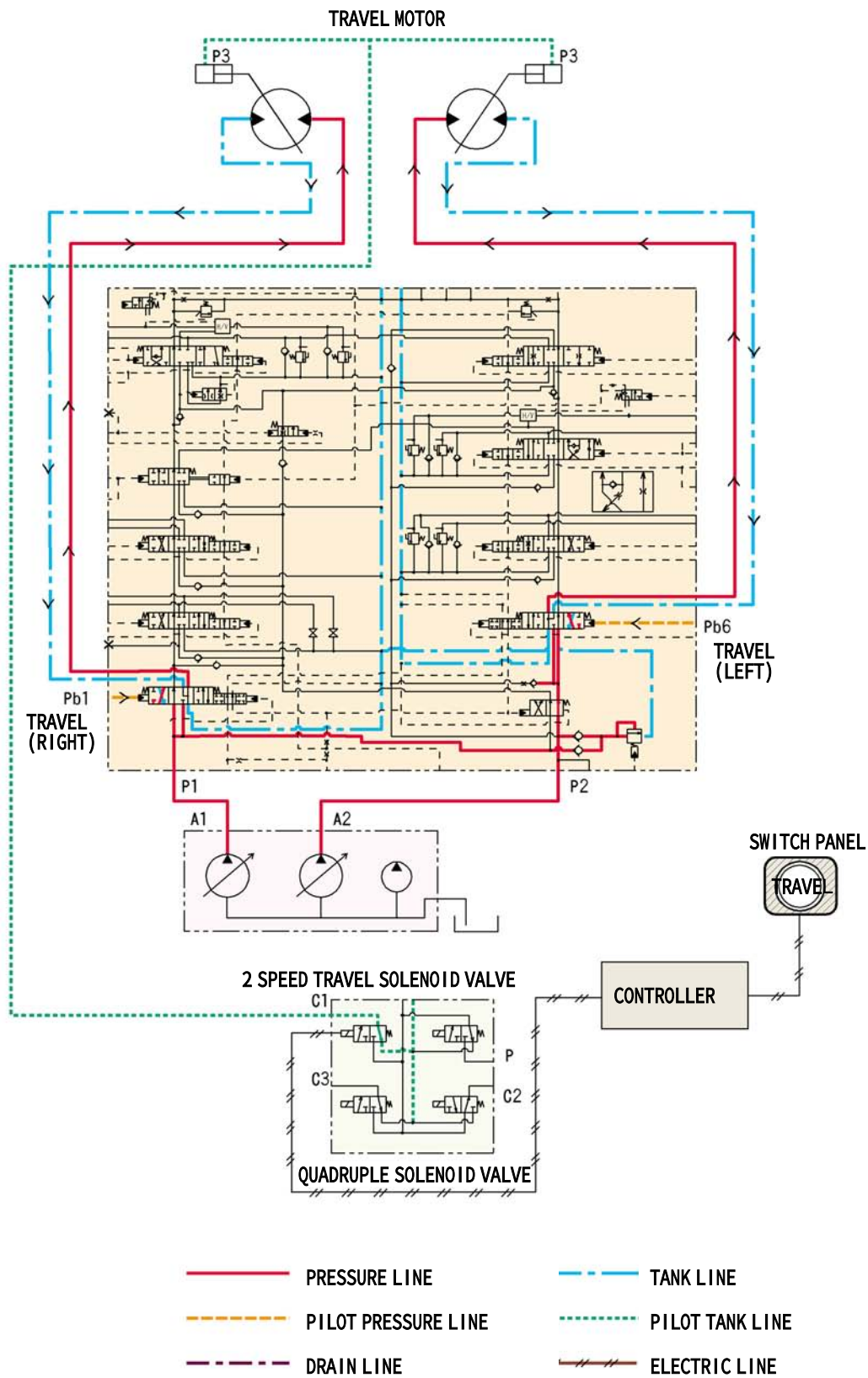
DESCRIPTION OF OPERATION

Low Speed Travel Circuit

This is a normal travel pattern. Even when the traveling position is in high speed, if the key switch is turned OFF and turned ON again, the speed setting will always return to this traveling pattern. Discharged oil from A1 enters into the P1 port of control valve entry while discharged oil from A2 enters into the P2 port of control valve entry. Each flow goes into the travel motor through the changing over of the left and right travel spools. By these flows, the machine travels forward and backward. The 2 speed travel solenoid valve becomes OFF, and the hydraulic oil in P3 port of the travel motor is connected to the tank line.

DESCRIPTION OF OPERATION

Low Speed Travel Circuit



Hydraulic

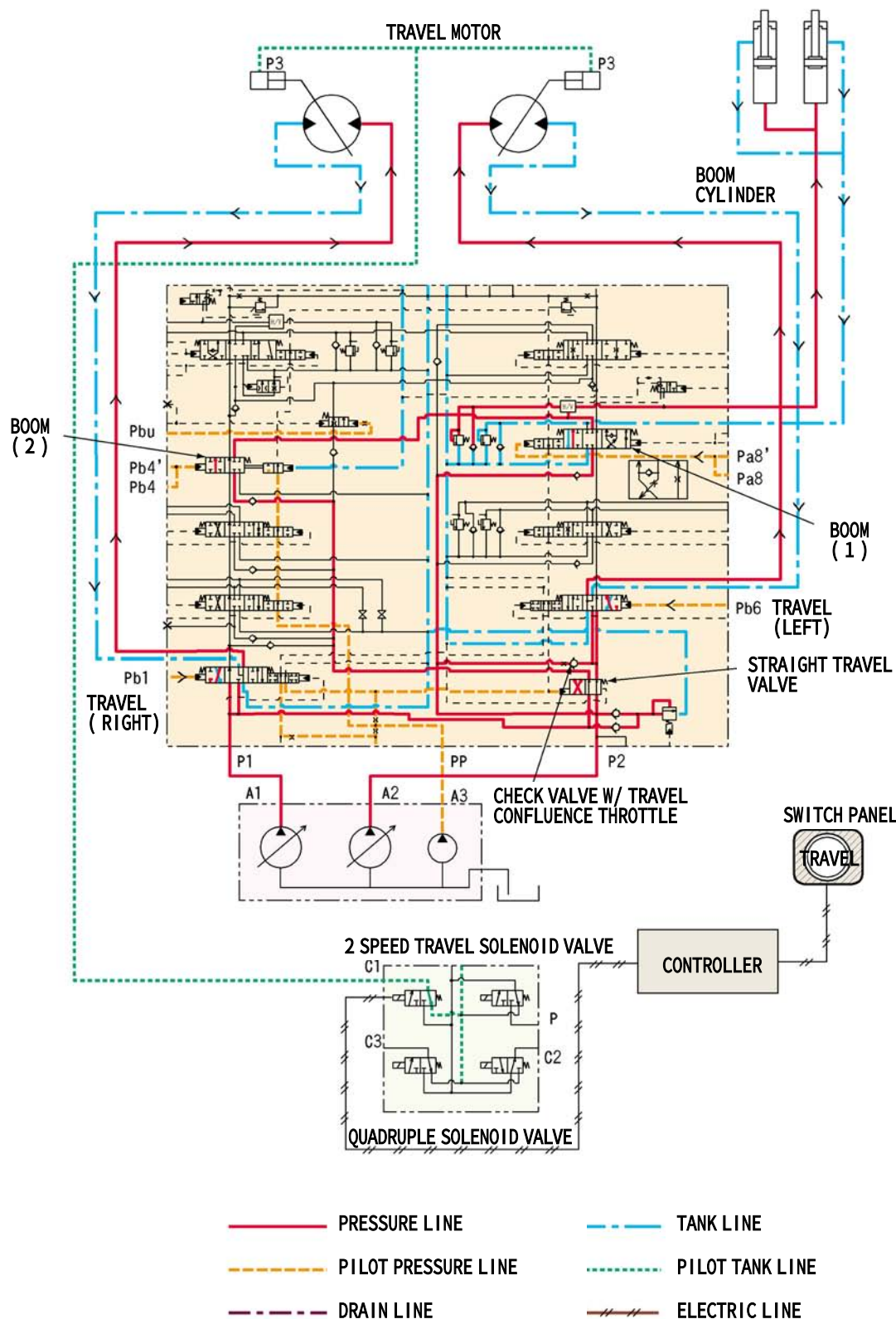
Straight Travel Circuit

This section describes the case where travel and boom – up operations are conducted at the same time. The hydraulic oil of the pilot pump entered the pilot pump from PP, which is connected to the tank via travel spool, is shut off by changing over of the travel spool.

In addition, diverted passage of the PR, which had been connected to the tank through all the spools of upper mechanism (boom, arm, bucket and swing), is shut off due to the change – over of the spool on the boom. Accordingly, the hydraulic oil from the pilot pump entered the PR has no place to go and stacks, and goes up to the original pressure (3.9 MPa). This original pressure acts on the pilot chamber of the straight travel valve and the straight travel valve changes over. Due to the changing over of the straight travel valve, it becomes possible for P1 to drive the travel mechanism and for P2 to drive the upper mechanisms. Travel lines are in the same pressure in the right and left travels as the right and left motors are driven by one pump, which makes the straight travel possible. Additionally, surplus hydraulic pressured oil from P2 is supplied to the travel side through the check with travel flow confluence throttle, and keeps the speed reduction to the minimum.

It is the same as above when the travel and other upper actuators than the boom are operated at the same time.

Straight Travel Circuit



DESCRIPTION OF OPERATION

Swing Parking Circuit

When the engine is started and the swing lever is in neutral, the swing brake solenoid valve is turned ON (24 V input) and the swing parking brake is activated.

When the swing pressure switch is turned ON by operating the lever, output to the swing brake solenoid valve from the controller is turned OFF and the swing parking brake is released. Thus swing operation is enabled. When the swing lever is in neutral and attachments such as arm, etc. are moved, swing lateral force is produced. In order to prevent the dragging of the brake, this parking brake is designed to be released.

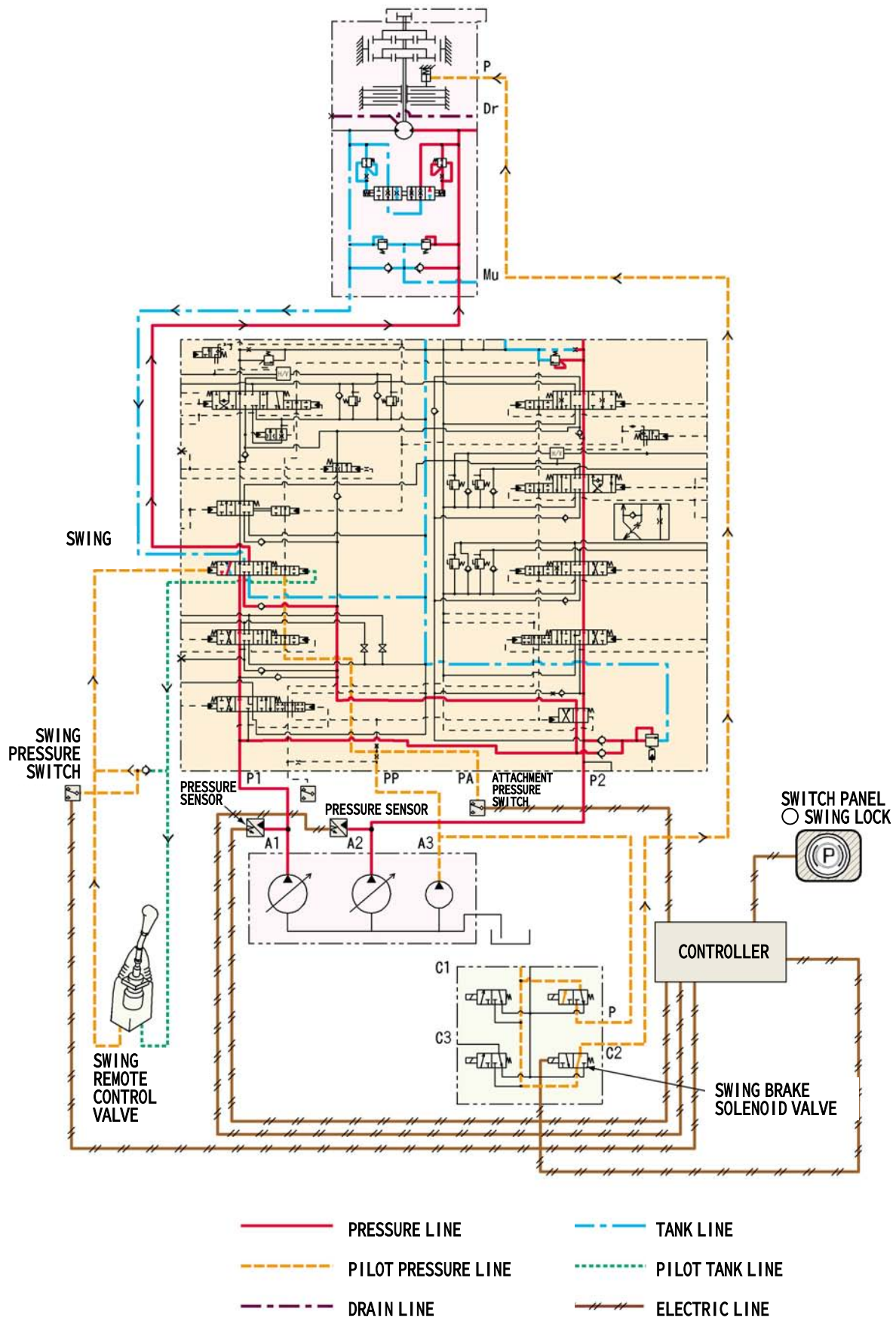
Signals from the pressure sensor A1 or A2 enters the controller and at the time when either one reaches 14.7 MPa, the output to swing brake solenoid valve from the controller is turned OFF and the swing parking brake is released.

In 5 seconds after the swing pressure switch or attachment pressure switch is turned OFF or the delivery pressure from A1 or A2 is below 14.7 MPa, the solenoid valve is turned ON and the swing parking brake is activated.

If the swing lock switch is turned ON, even when the swing pressure switch or attachment pressure switch is turned ON, the swing lock switch has the priority and the parking brake remains unreleased. When the swing lock switch is turned ON and the swing lever is in operation, the swing spool in the main control valve is changed over.

Key switch	Swing pressure switch	A1 or A2 (MPa) pressure on pressure sensor	Swing brake solenoid valve	Swing motor mechanical brake
OFF	OFF	0	OFF	ON
ON	OFF	0	ON	ON
ON	ON	0 or swing operation pressure	OFF	OFF
ON	OFF	14.7 MPa or more	OFF	OFF

Swing Parking Circuit



Hydraulic

DESCRIPTION OF OPERATION

Swing Priority Variable Throttle Circuit

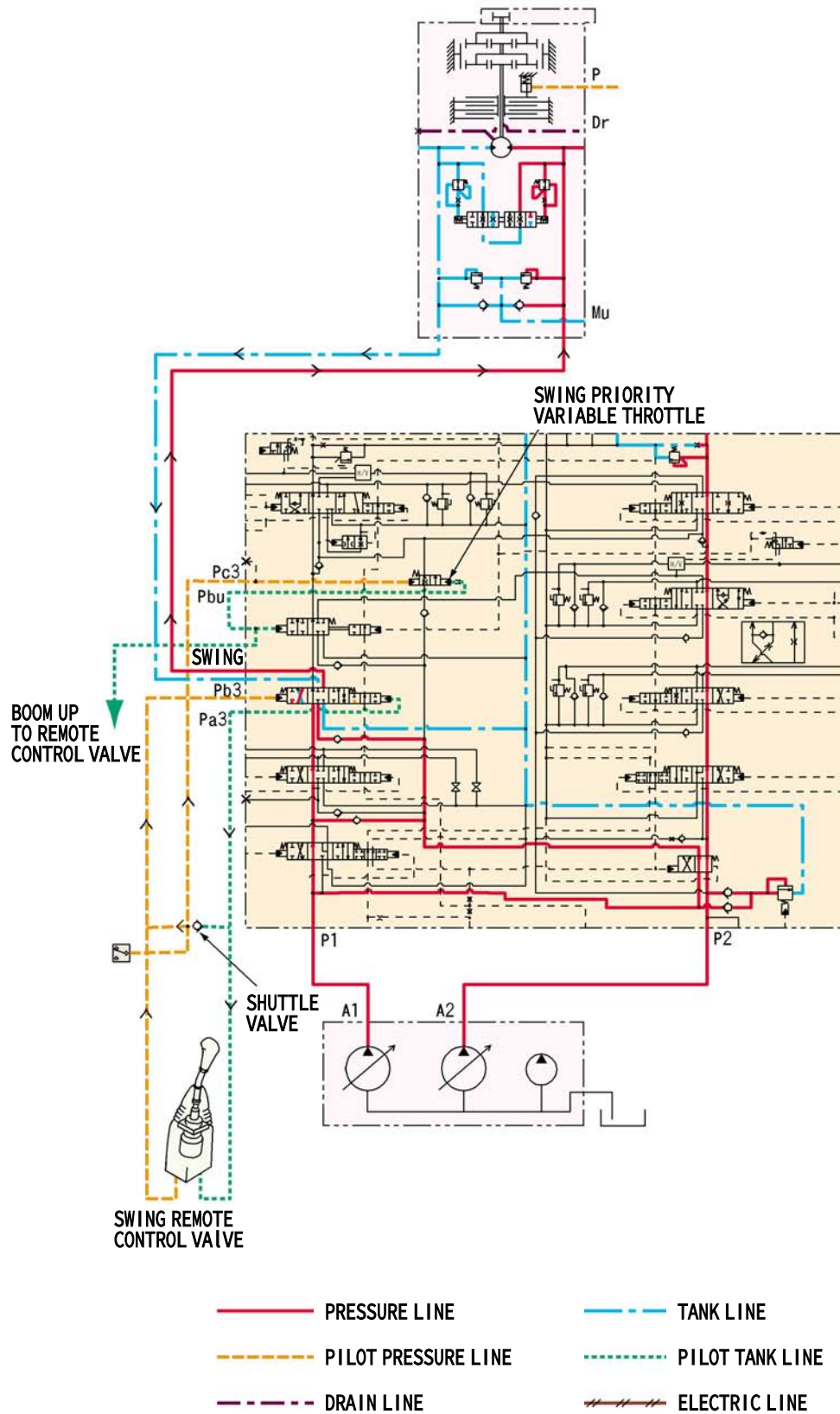
Swing pilot pressure is supplied to Pc3 port via shuttle valve and acts on the swing priority variable throttle. This throttles the parallel circuit resulting in raising the swing hydraulic line pressure and keeping the swing force for the press–digging operation when the arm and swing operations are conducted simultaneously.

Additionally, when level digging operation is made, boom up pilot pressure is supplied to Pbu port and the supply of hydraulic oil to the arm (1) is secured through moving the swing variable throttle to the left to open the parallel circuit and the smooth level digging operation can be achieved even if the center bypass is shut off by the boom (2) spool.

When the swing and arm in or boom up is operated at the same time, the swing priority variable throttle remains throttled, and the pressure for the swing motion is designed to be secured.

DESCRIPTION OF OPERATION

Swing Priority Variable Throttle Circuit



Hydraulic

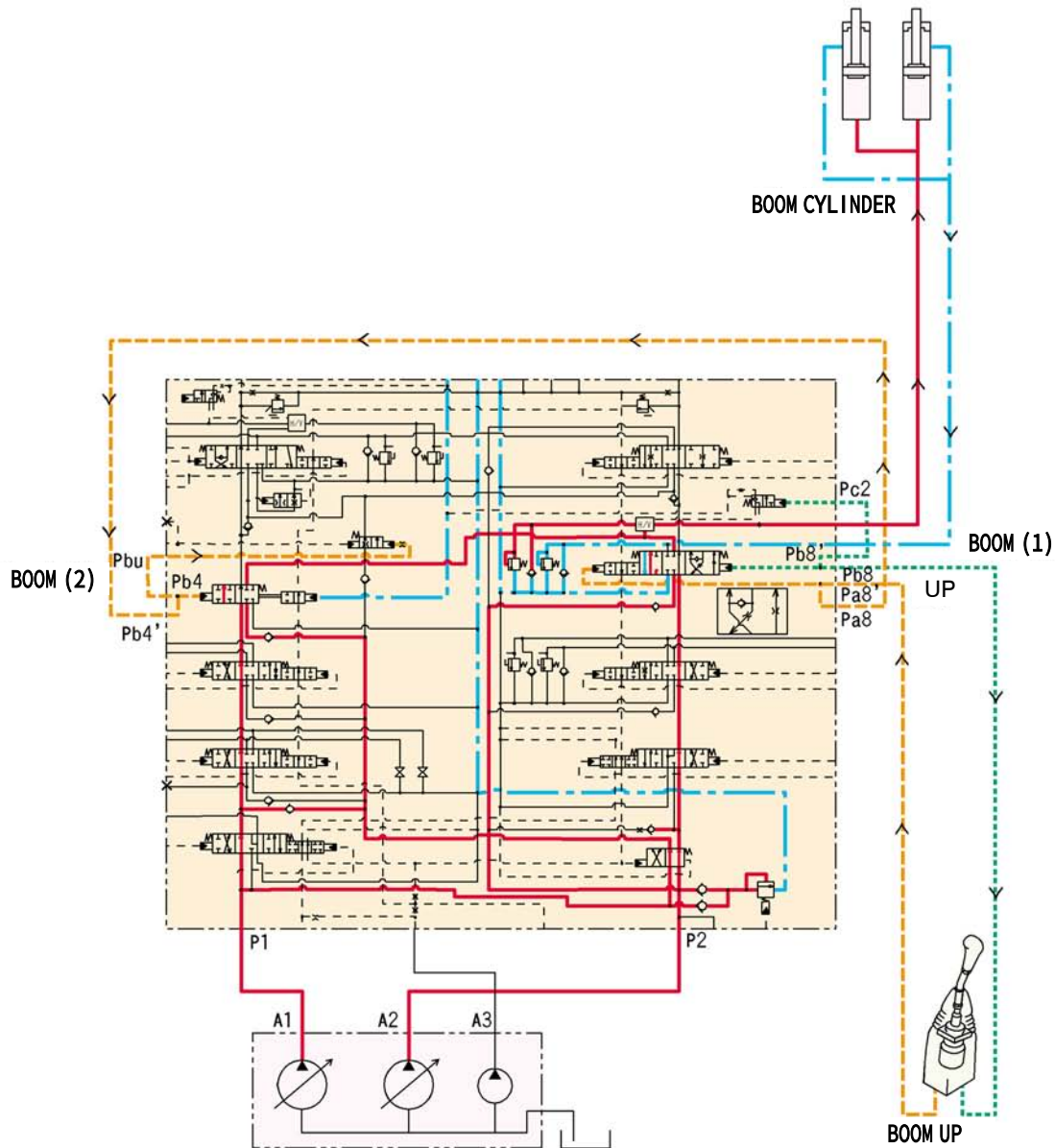
DESCRIPTION OF OPERATION

Boom up 2 Speed Circuit

The discharged oil from P1 is supplied to the boom (2) spool through the parallel oil passage via the right travel spool or the straight travel valve and merges at the downstream of the boom (1) spool. (Reduction of pressure loss)

The discharged oil from P2 merges with the discharged oil from the boom (2) via the boom (1) spool through the parallel oil passage and flows into the bottom side of the boom cylinder via the holding valve.

Boom up 2 Speed Circuit



Hydraulic

- | | |
|---|--|
| — PRESSURE LINE | --- TANK LINE |
| --- PILOT PRESSURE LINE | --- PILOT TANK LINE |
| --- DRAIN LINE | --- ELECTRIC LINE |

DESCRIPTION OF OPERATION

Boom Down Load Holding Valve Circuit

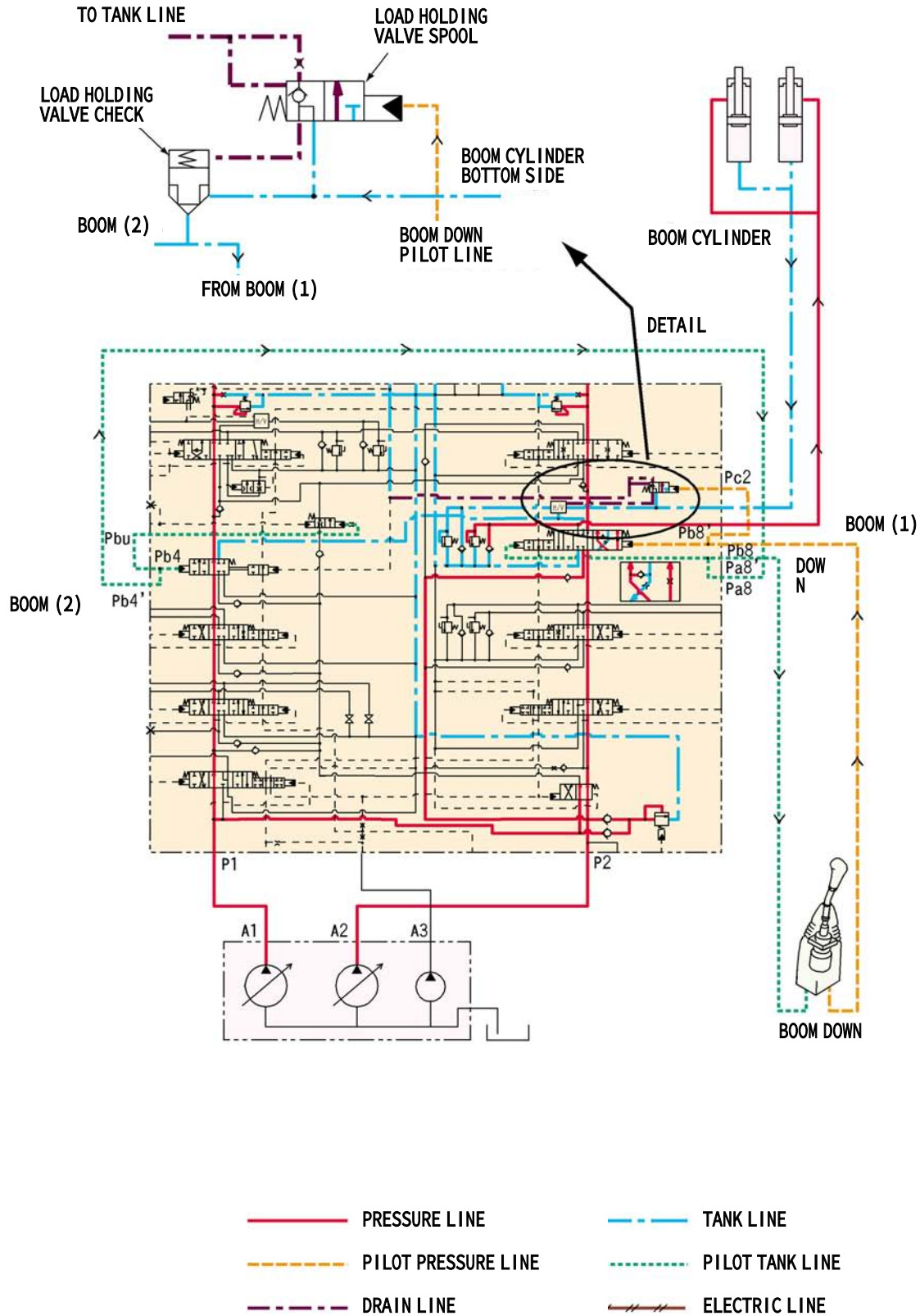
The pilot pressure of boom down goes into Pb8 port of control valve and the spool of main control valve moves to the left side.

At the same time, pilot pressure enters from Pb8' port to Pc2 port, the load holding valve spool moves to the left side. The oil in the spring chamber of the load holding valve check passes through the load holding valve spool to the tank. The pressure in the spring chamber decreases and the load holding valve check is released.

The hydraulic oil at the bottom side of the boom cylinder is returned to the tank line, the rod of the boom cylinder is retracted and the boom is lowered.

DESCRIPTION OF OPERATION

Boom Down Load Holding Valve Circuit



Hydraulic

DESCRIPTION OF OPERATION

Boom Down Pressure feedback Circuit

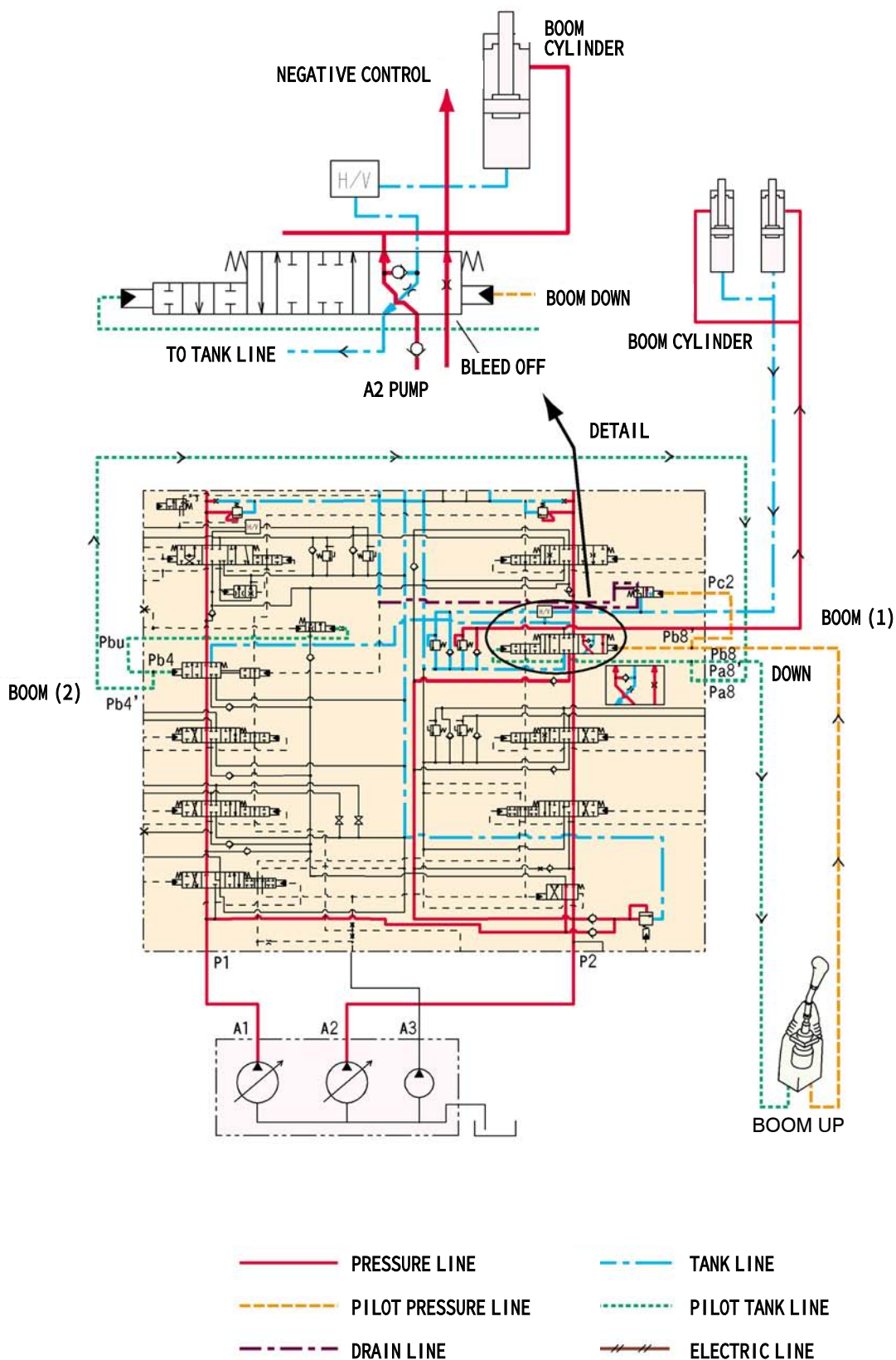
When boom down is operated, pilot pressure is supplied to Pb8 and boom spool moves to the left. At the same time, the pilot pressure from Pb8' opens the boom load holding valve and some of the discharged oil from the bottom side of boom cylinder is retruned to the rod side via the check in the spool. (The lower the load pressure at the cylinder rod side is, the more the returning amount is.) Even though the spool makes a full stroke, due to the bleed-off oil passage of the central bypass, the negative control pressure is generated and the pump does not deliver the full flow amount. The pressure shortage is compensated by this oil return. Therefore, the engine power can be utilized efficiently.

Machine Extra movement Prevention Circuit for Starting Boom down motion

Due to the bleeding oil passage of the center bypass, a high pressure occurrence is restricted and the machine extra movement is reduced even when boom down is operated very quickly, since hydraulic oil is bled.

Boom Down Pressure feedback Circuit

Machine Extra movement Prevention Circuit for Starting Boom down motion



DESCRIPTION OF OPERATION

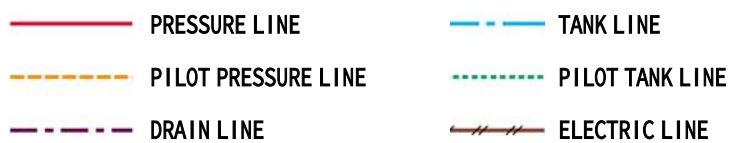
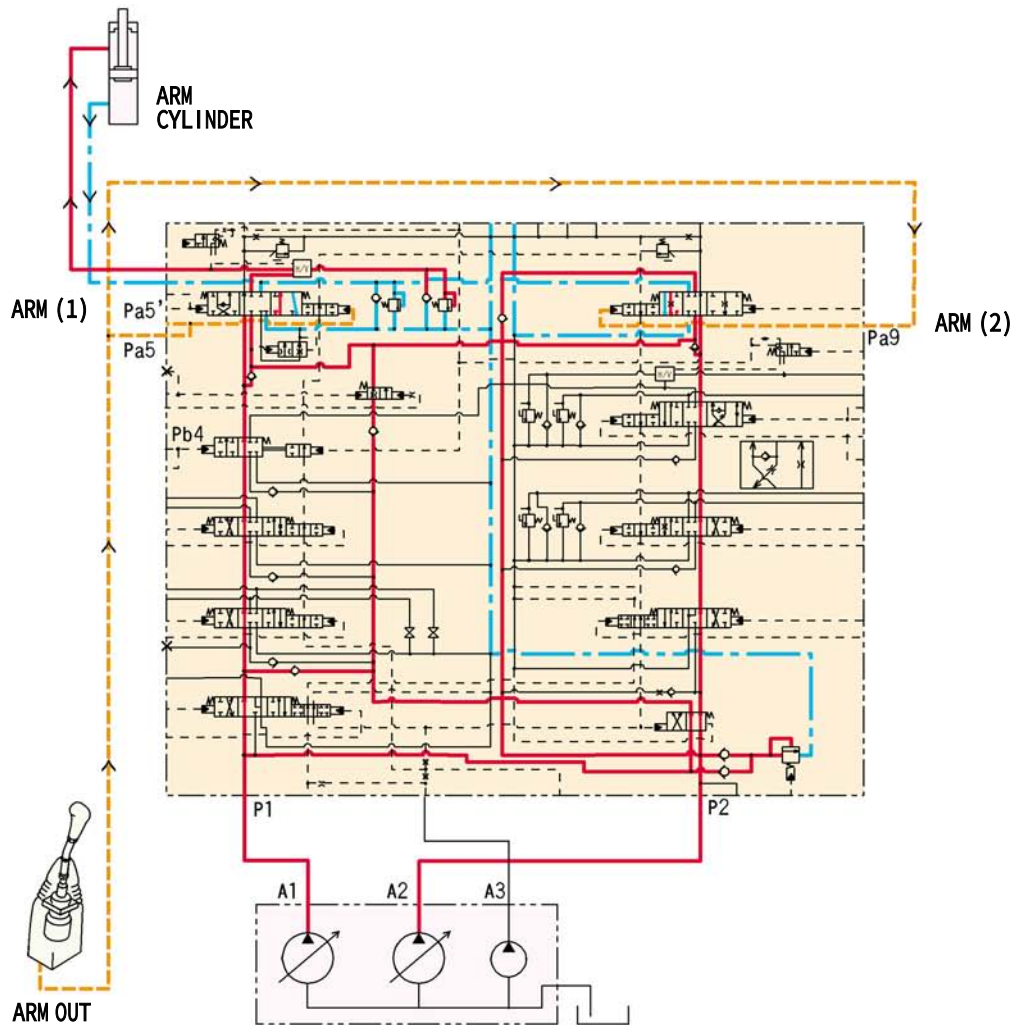
Arm Out 2 Speed Circuit

The discharged oil from A1 is supplied to the arm (1) spool via parallel oil passage through center bypass oil passage or straight travel spool.

The discharged oil from A2 is supplied to the arm (2) spool through the center bypass oil passage or parallel oil passage, and merges at the upstream of the arm (1) spool, then, flows into the rod side of the arm cylinder via the holding valve. The returned oil from the bottom side returns to the tank oil passage via the arm (1) and (2) spools.

DESCRIPTION OF OPERATION

Arm Out 2 Speed Circuit



Hydraulic

DESCRIPTION OF OPERATION

Arm In Load Holding Valve Circuit

The pilot pressure of the arm in enters Pb5 of the control valve and the spool of arm (1) moves to the right. At the same time, the pilot pressure also enters Pb9 and the spool of the arm (2) moves to the left.

Also, pilot pressure detached from Pb5 enters Pc1 and the load holding valve spool moves to the right. The oil in the spring chamber of the load holding valve check passes through the load holding valve spool to the tank line. The pressure in the spring chamber decreases and the load holding valve check is released. The hydraulic oil at the rod of the arm cylinder is returned to the tank line, the cylinder extends and the arm is retracted.



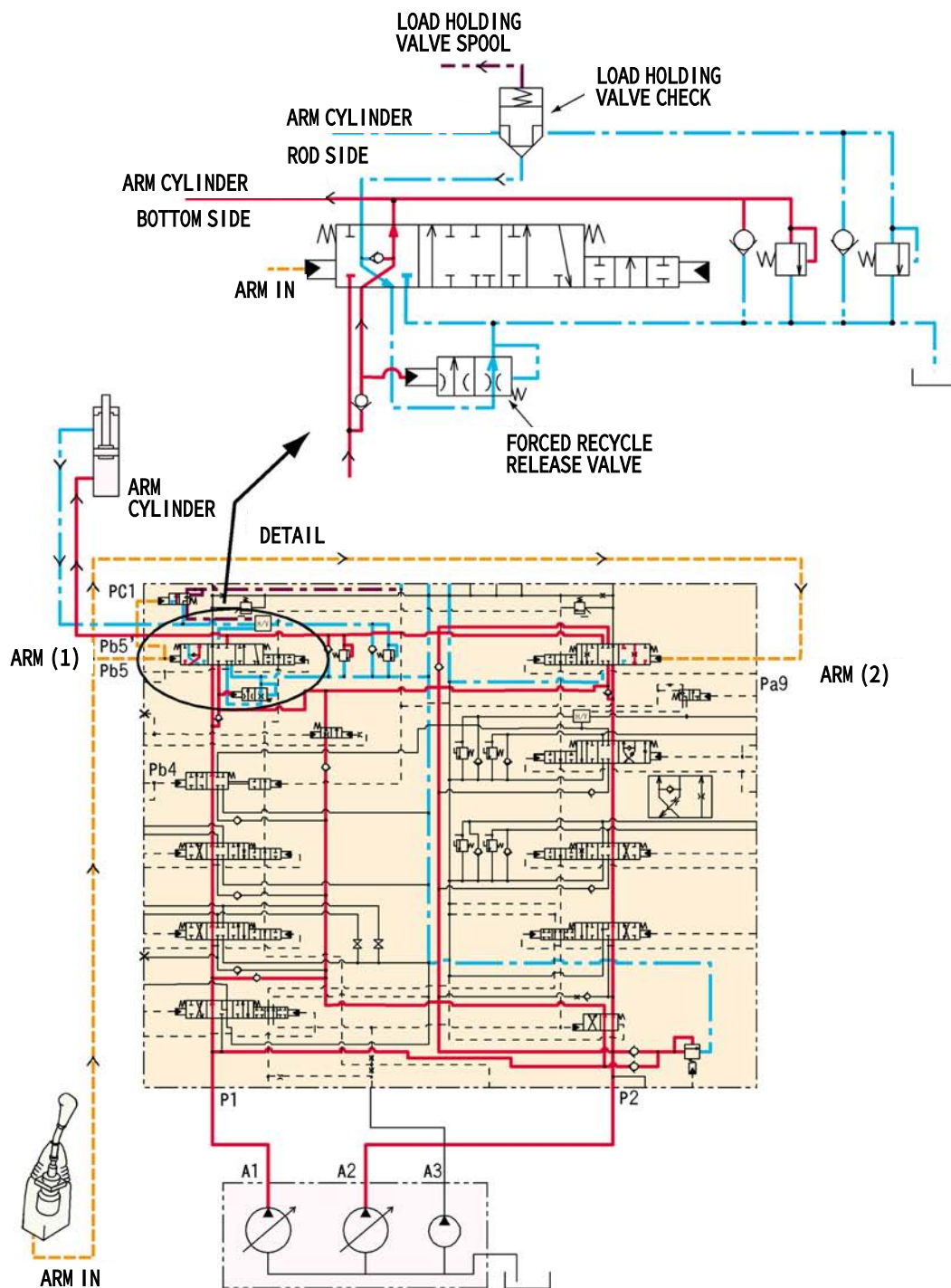
DESCRIPTION OF OPERATION

Arm In Forced Pressure feedback Circuit

This circuit throttles the return passage of the rod side at the forced pressure feedback release valve and forces the returned oil to be fed back to the bottom side via the check in the arm (1) spool. This secures the speed of the arm for level digging operation, etc.

When the load pressure is high at the bottom side, the forced pressure feedback release valve is changed over to the right and the opening of the return at the rod side becomes larger and no pressure feedback occurs.

Arm In Forced Pressure feedback Circuit



Hydraulic

DESCRIPTION OF OPERATION

Circuit for Breaker & Crusher (2 Speed Confluence Crusher Circuit)

When pushing the switch in the cab to crusher side, the solenoid valve is turned ON.

When the option pedal is moved, pilot pressure oil from the remote control valve passes through the solenoid valve via the shuttle valve and enters P port of the holding valve and Pb6 port of the arm (2) spool.

The arm (2) spool moves to the left and shuts off the center bypass. The pilot pressure entered P port of the holding valve first acts on the holding valve release spool; spring chamber of the holding valve check returns to the tank; and the pressure in the spring chamber decreases.

As a result of these, the check of the holding valve opens. As a result, hydraulic pressure oil at P3 port of the control valve enters upstream P4 port of control valve option spool via the holding valve check and merges the hydraulic oil from P1.

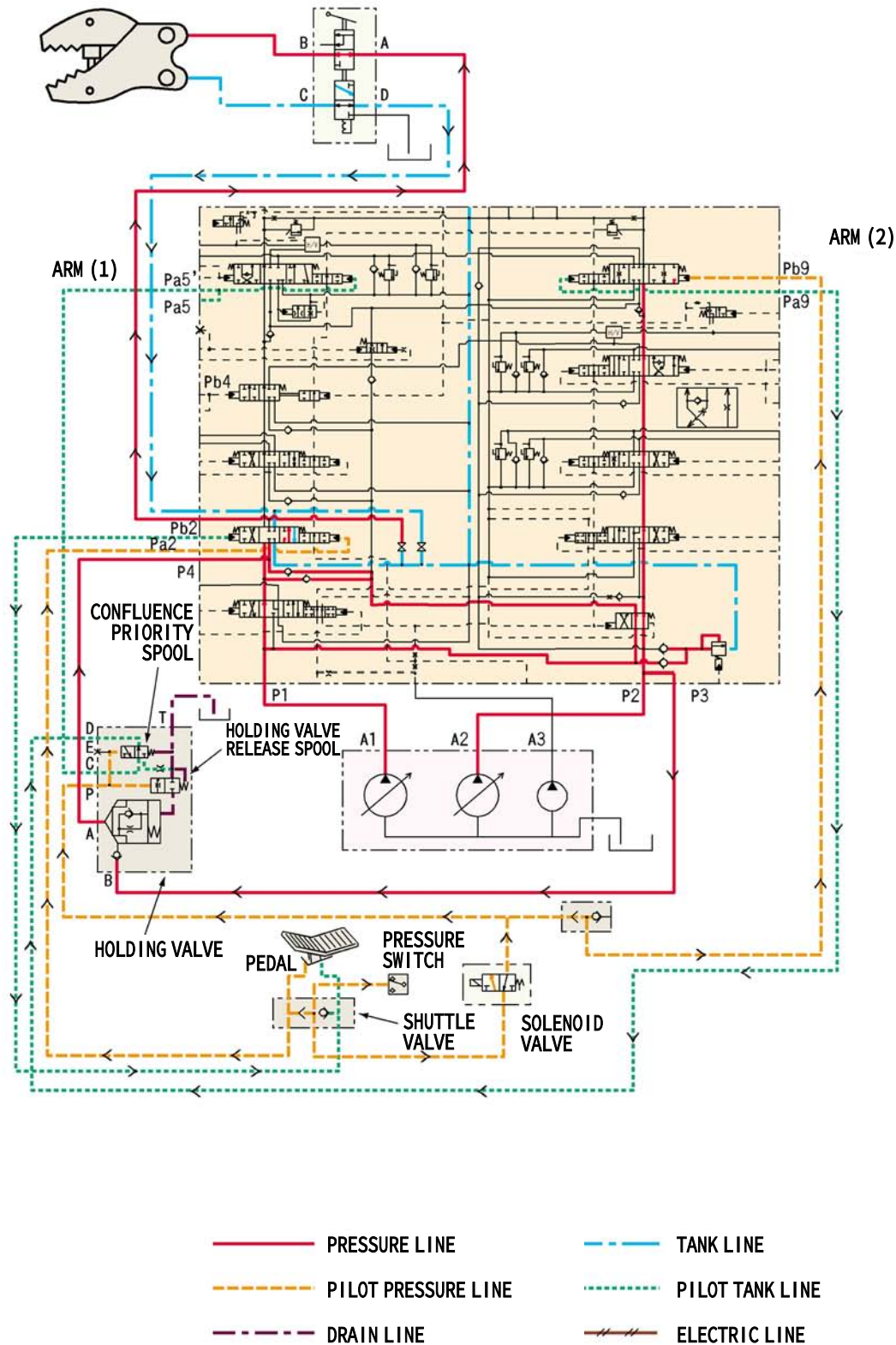
Also, pilot pressure oil entered P port of the holding valve acts on the confluence priority spool and the spool is changed over to the right side. Pilot pressure oil from port Pa9 of the control valve arm (2) out returns to the tank via this confluence priority spool. Therefore, the 2 speed oil confluence is prioritized when using the crusher and the arm out operation does not become 2 speed.

DESCRIPTION OF OPERATION

Circuit for Breaker & Crusher (2 Speed Confluence Crusher Circuit)

Crusher Changing Over

Change the direction valve to C.



Hydraulic

DESCRIPTION OF OPERATION

Circuit for Breaker & Crusher (Breaker Circuit)

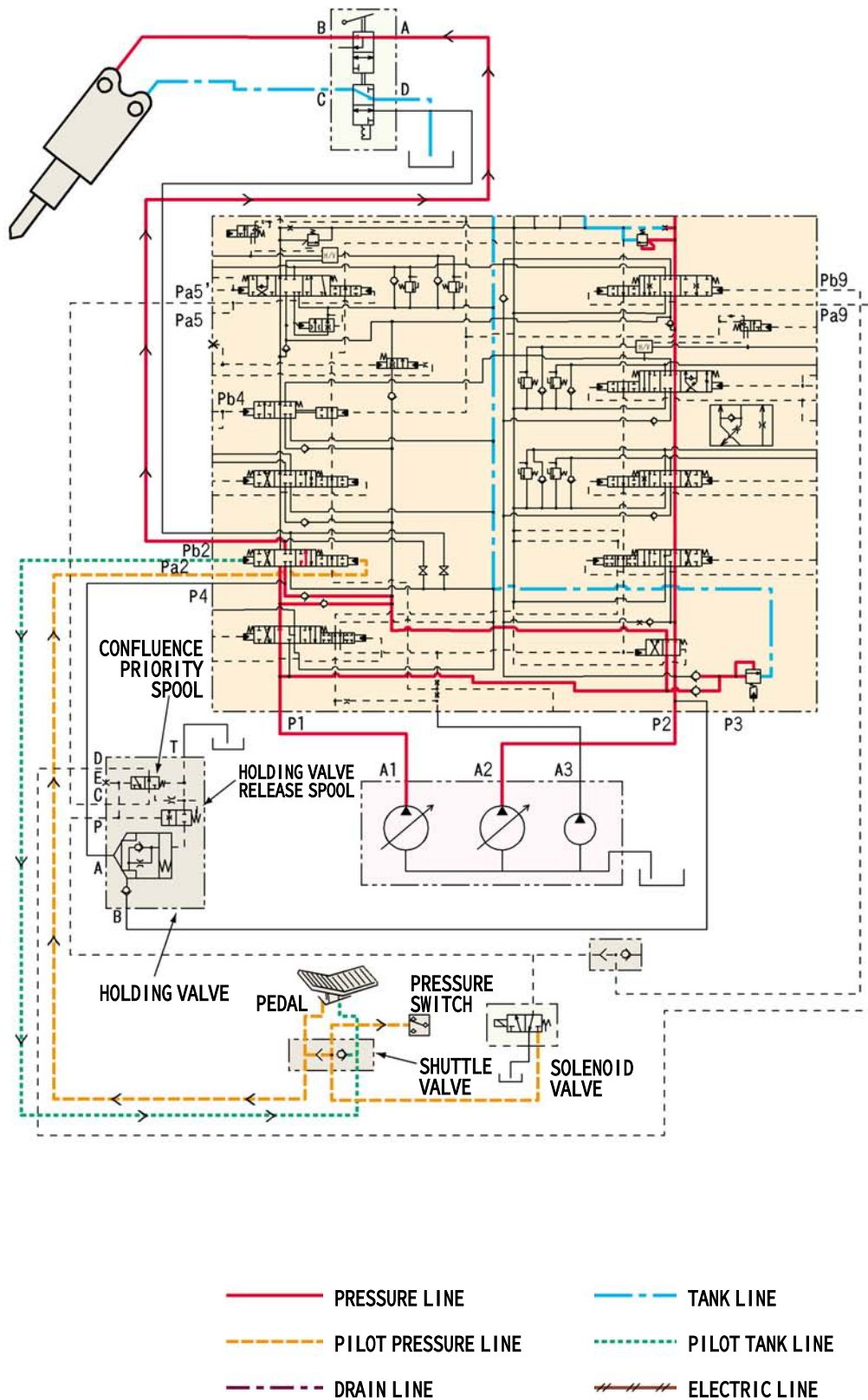
When the switch in the cab is turned towards the breaker side and the pedal is stepped forward, pilot pressure is detected by the pressure switch, then the engine falls to the preset revolution by the controller.

The pilot pressure oil entered at Pa2 of the control valve, changes over the option spool while the discharged oil from A1 is supplied to the breaker through the direction valve.

Circuit for Breaker & Crusher (Breaker Circuit)

Breaker Changing Over

Change the direction valve to B.



Hydraulic

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ELECTRIC COMPONENTS LAYOUT DRAWING

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ELECTRIC CIRCUIT DIAGRAM

4

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INITIAL SETTINGS FOR CONTROLLER

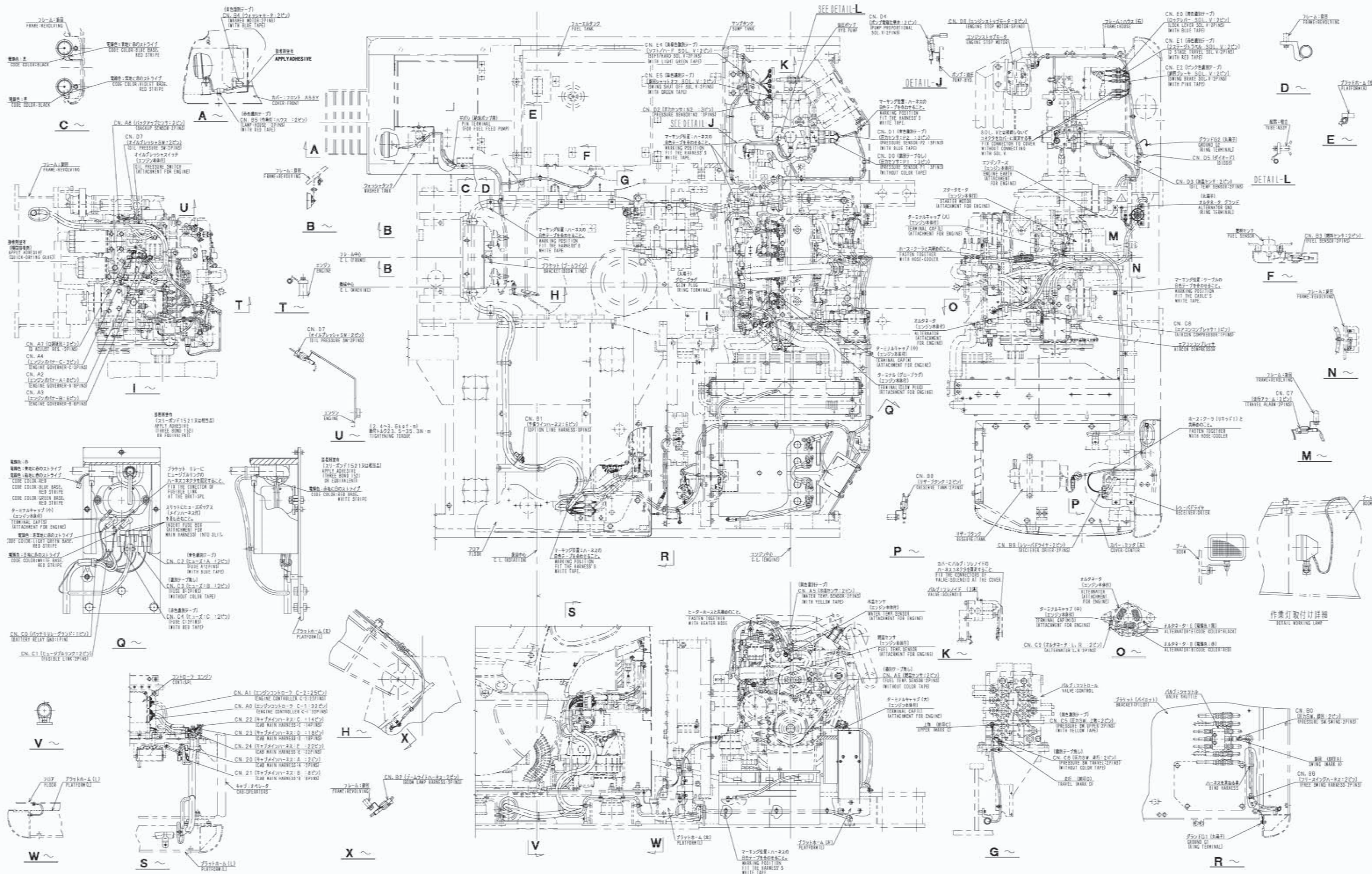
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ATTACHMENTS

Electrical Circuit Diagrams	Back cover pocket
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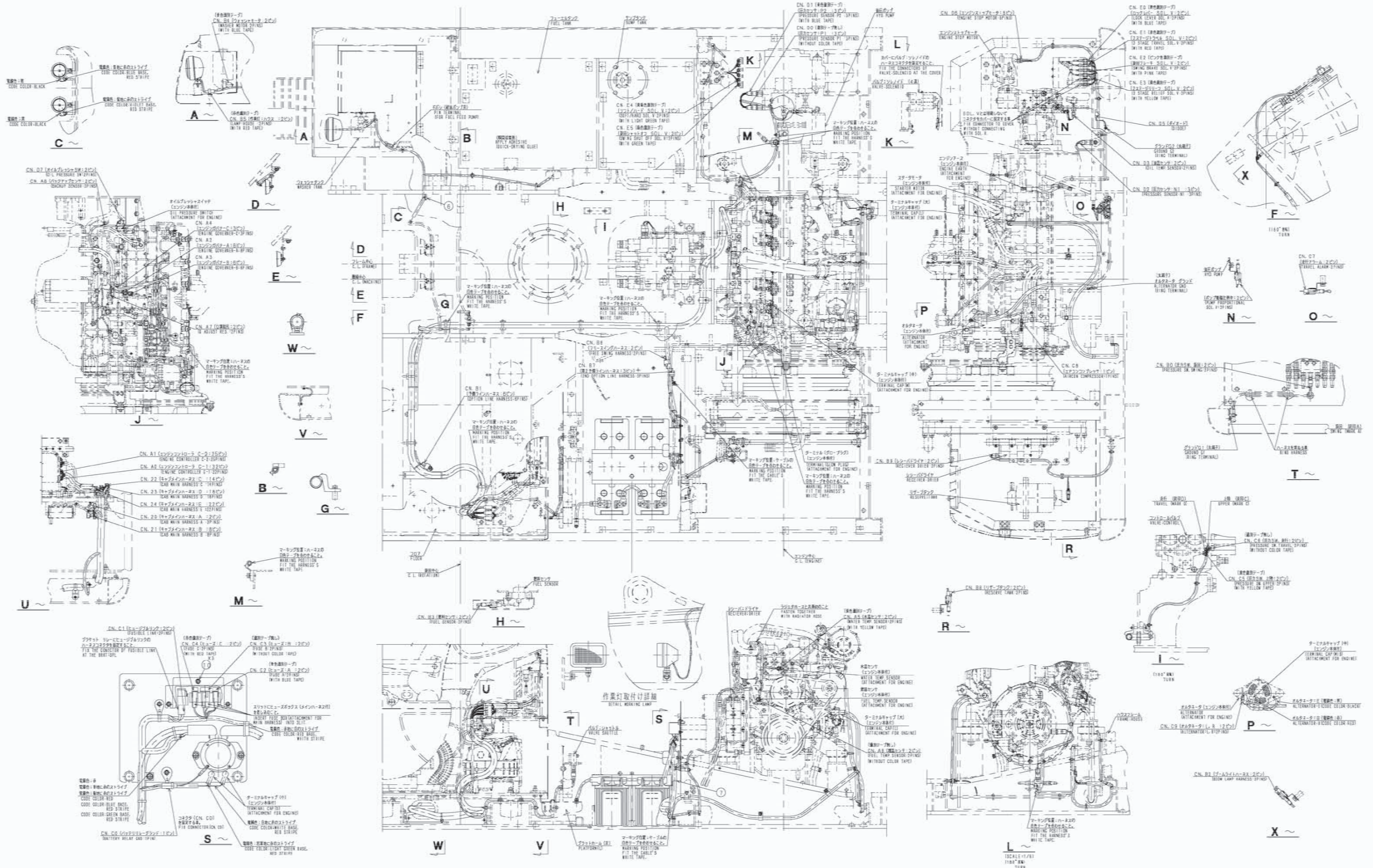
ELECTRIC COMPONENTS LAYOUT DRAWING

Overall View SH120-3



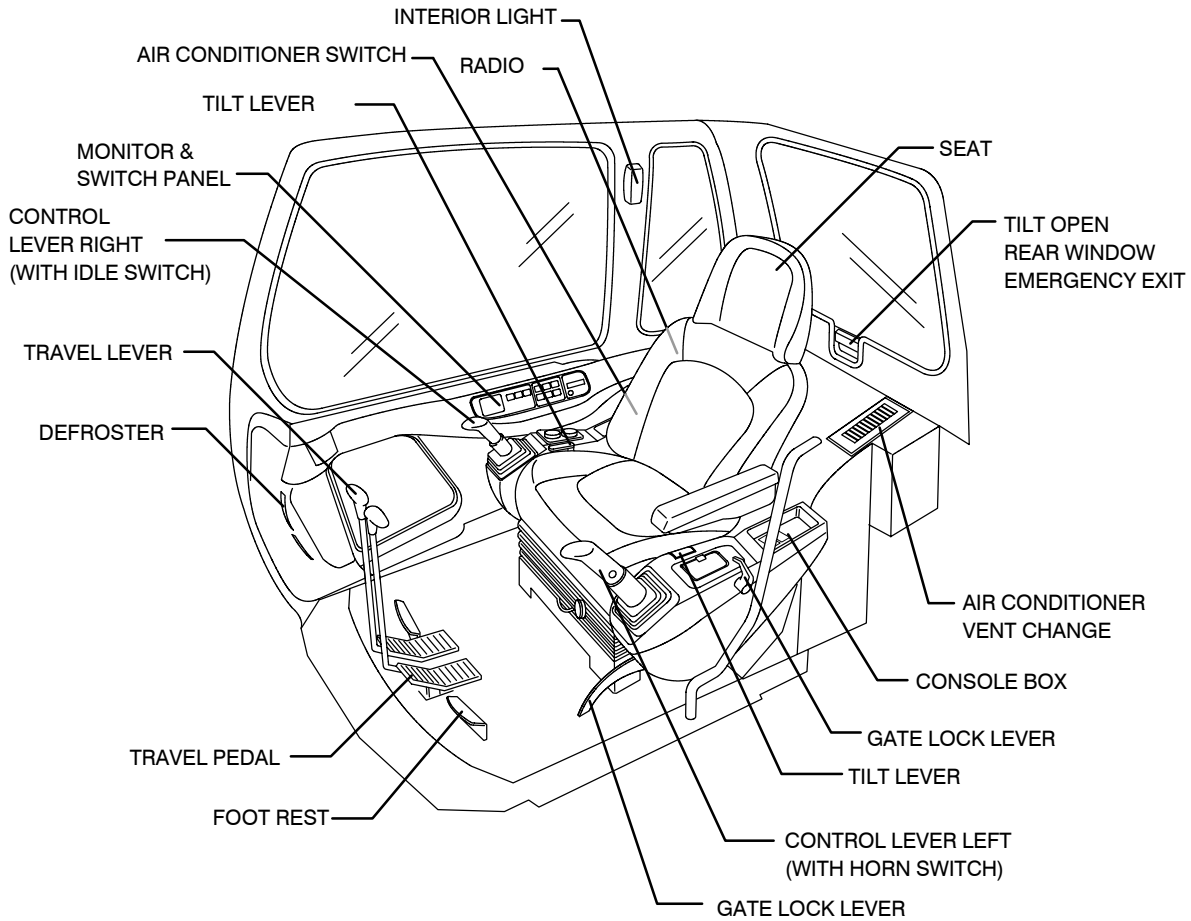
ELECTRIC COMPONENTS LAYOUT DRAWING

Overall View SH200-3/SH220-3



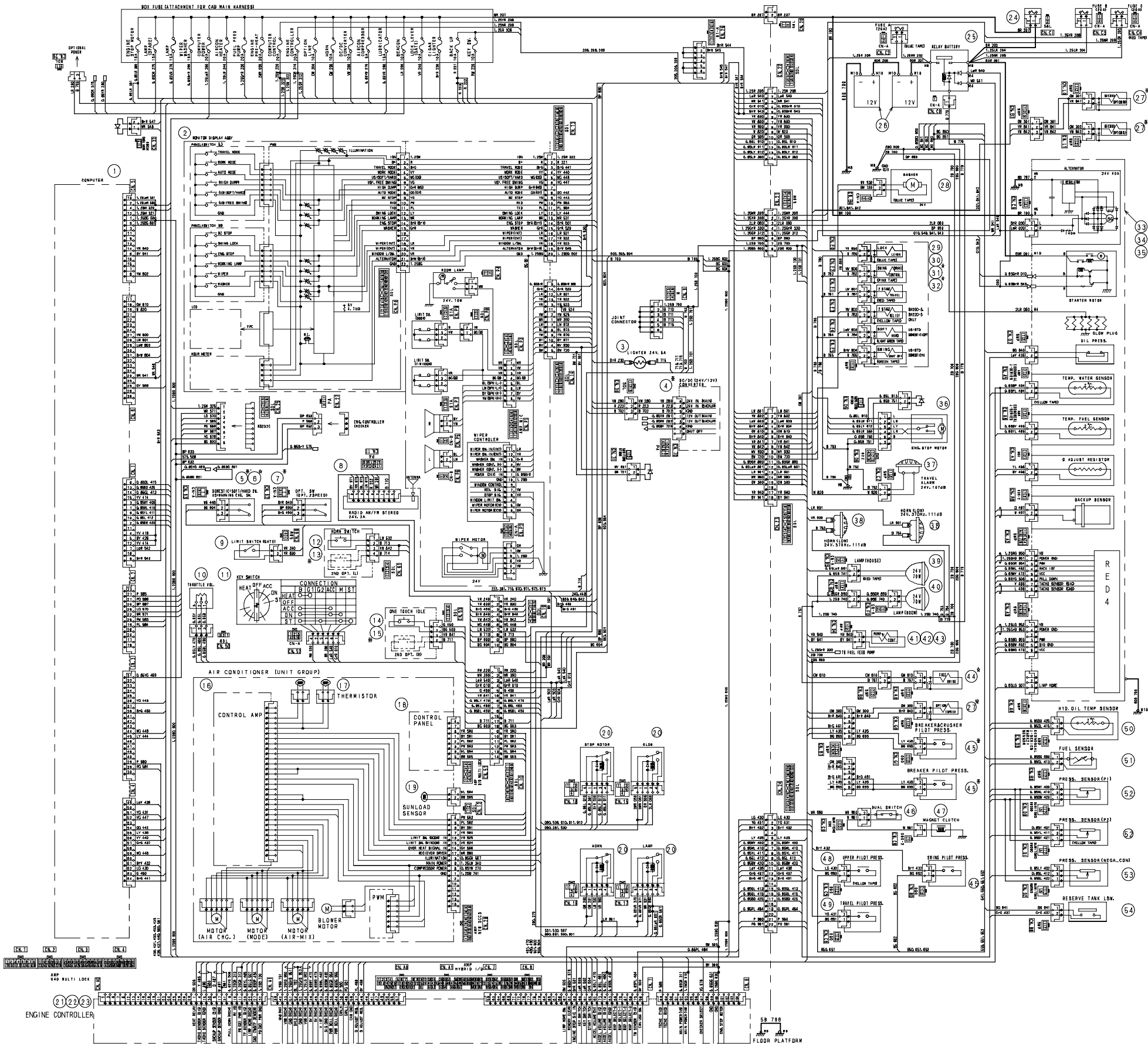
ELECTRIC COMPONENTS LAYOUT DRAWING

Operator' Cab



Electric

ELECTRIC CIRCUIT DIAGRAM



NO	NAME	NOTE	QTY
1	CONT:SP1		1
2	NONTO		1
3	LIGHTER:CIGAR		1
4	CONVERTER:DC-DC		1
5	SWTCH:SP1		1
6	SWTCH:SP1		1
7	RADIO		1
8	SWTCH:LIMIT		1
9	SWTCH:LIMIT		1
10	SWTCH:STARTER		1
11	SWTCH:STARTER		1
12	SWTCH:STARTER		1
13	SWTCH:STARTER		1
14	SWTCH:STARTER		1
15	SWTCH:STARTER		1
16	SWTCH:STARTER		1
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35	SWTCH:STARTER		1
36	SWTCH:STARTER		1
37	SWTCH:STARTER		1
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49	SWTCH:STARTER		1
50	SWTCH:STARTER		1
51	SWTCH:STARTER		1
52	SWTCH:STARTER		1
53	SWTCH:STARTER		1
54	SWTCH:STARTER		1

SYMBOL	NAME	SYMBOL	NAME
B	BLACK	R	RED
W	WHITE	Y	YELLOW
Br	BROWN	Lo	LOW
P	PUMP	SO	SOL
V	VOL	L	LOW
G	GREEN	Gr	GR
O	OR		

- 1) 本図は、SH120-3、SH200-3、SH220-3に適用する。
2) 本図は、オプション部品を示す。
3) 本図は、オプション部品(国内・海外輸出)を示す。
4) 本図は、オプション部品(国内・海外輸出)を示す。
5) 本図は、オプション部品(国内・海外輸出)を示す。
6) 本図は、オプション部品(国内・海外輸出)を示す。

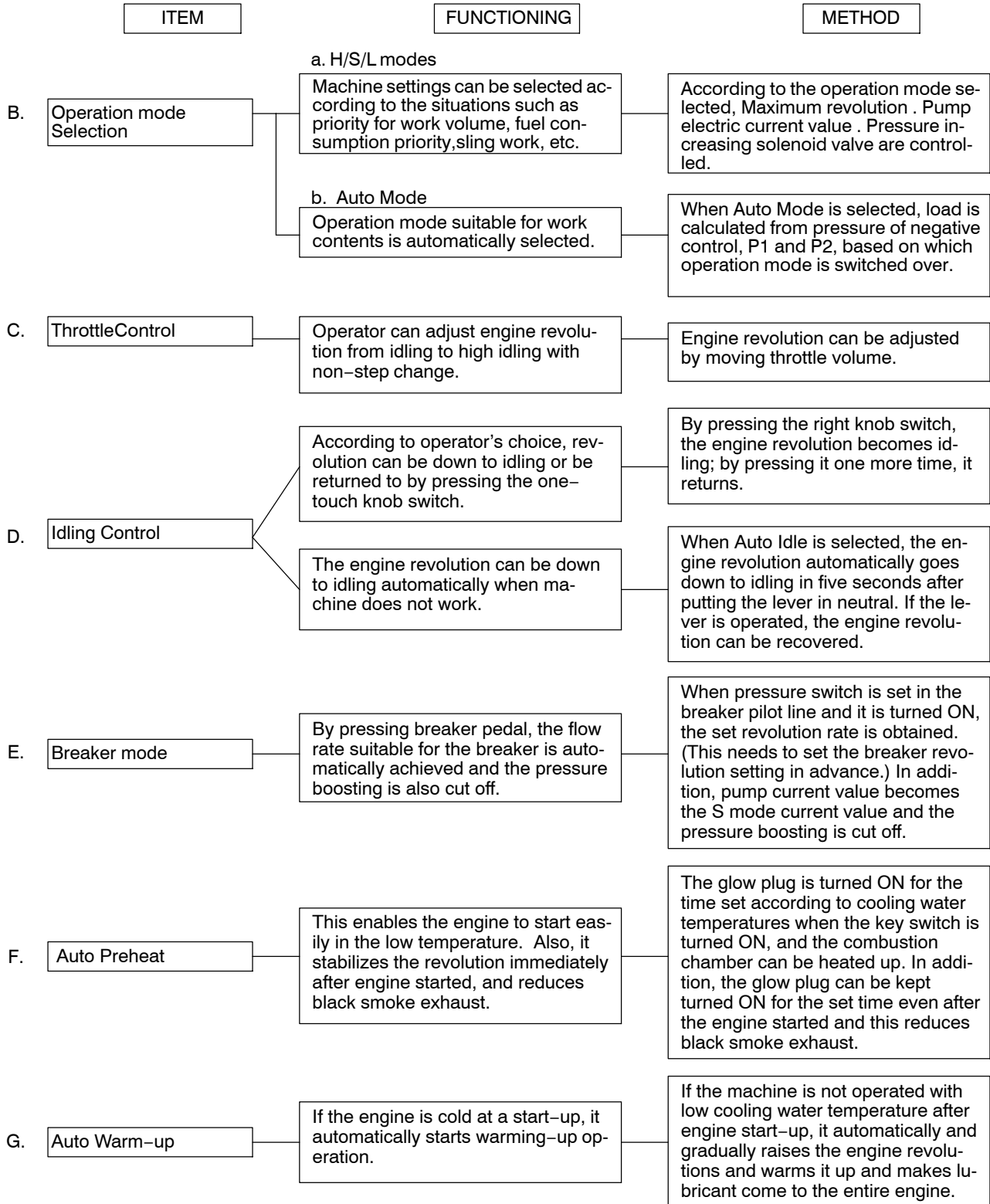
DESCRIPTION OF FUNCTIONS

1. List of Each Function

2. Function System Chart

A. Engine Control

(1) Description of Basic Function for Engine Control (Electronic Governor Control)



DESCRIPTION OF FUNCTIONS

	ITEM	FUNCTIONING	METHOD
H.	Idling Up	This prevents over-cooling or battery discharge when the coolant temperature or battery voltage is low.	When the cooling water is low or the electric power voltage supplied to the engine control is low, idling revolution can be increased by maximum 200 rpm on the usual operating revolution.
I.	Engine Emergency Stop	When the engine can not stop with the engine key switch OFF for some reason, this stops the engine.	By pressing the emergency stop switch, this manages the engine stop control and simultaneously cuts off the fuel supply by activating the stop motor.
J.	Limp-home Control	This prevents the machine from shutting down when the rack sensor in the engine governor is in trouble.	During Limp-home control, engine is temporally run by increasing or decreasing fuel injection amount only with the engine revolution sensor.
K.	Lever Lock	This prevents the machine from running even if a control lever is moved when the operator gets in and out from the cab or when you do not want to run the machine.	When operating the gate lever on the console, ON / OFF of the lever lock solenoid is switched over. When it is OFF, pilot pressure is cut off and the machine does not run.
L.	Auto Boosting Control *Pressure boosting not provided in SH120.	Boosting Control This automatically increases relief pressure about 10 % when more digging force is required.	The need for pressure boosting is judged from input data of engine load rate and pump discharge pressure and the pressure is boosted for 8 seconds if needed.
		Boosting cut Control At the time of operation where the equipment cannot stand pressure for boosting, this cuts off boosting pressure to protect the machine.	When traveling pressure switch and OPTION line pressure switch is ON, this forcible cuts off boosting.
M.	Swing Lock	This prevents from swinging when the swing lever is operated mistakenly.	When the swing lock switch is turned ON, the swing brake solenoid is turned ON and the mechanical brake which is incorporated in the swing break is activated.

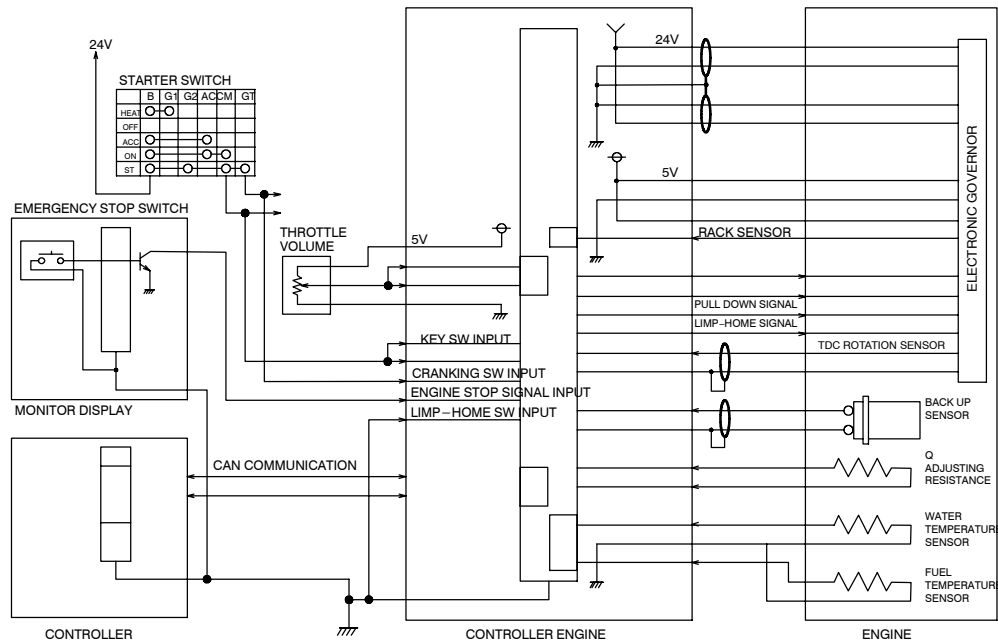
DESCRIPTION OF FUNCTIONS

	ITEM	FUNCTIONING	METHOD
N.	Swing Brake Control	When the swing lock is OFF, the swing mechanical brake is automatically turned ON/OFF according to operation conditions and protects the mechanism by preventing from overloading the swing motor and reduction gears.	ON/OFF of the swing mechanical brake being judged from the data of the pressure switches for swing, upper, travel and pump discharge pressure P1 and P2, the swing brake solenoid valve is controlled.
O.	Travel 2 Speed Change Over	The travel speed can be changed over in two stages according to work site conditions and work contents.	When High Speed (2 Speed) travel mode is selected with the travel mode switch in the monitor, the solenoid valve is turn ON and pressure goes into the PS port of the travel motor. As a result of this, slant angle of the motor is changed over to high-speed side.
P.	Travel Alarm	This alerts people in the surrounding area when the machine travels.	When travel pressure switch is turned ON, the buzzer is turned ON.
Q.	Power Supply Cut Delay	This turns OFF power supply when the engine is stopped and stabilized.	After the key switch is turned OFF, this creates delay time before battery relay is turned off.
R.	Power Transistor Protection Circuit	When any short circuit happens in power transistor connected to the controller, this protects the controller.	Over-current detection is furnished in the controller and when connected destination portion is short-circuited, power transistor stops its output.
S.	Monitor Display	a. Normal Display This displays current status of the machine for an operator.	The hydraulic oil temperature, coolant temperature, fuel level are displayed in bar graph on the full-dot LCD in the monitor. Current operation and travel modes and ON/OFF status of auto idling are also displayed.
		b. Message Display - Alarm display - Function display - Maintenance interval display	This displays various information in characters over the bar graph display in LCD.

DESCRIPTION OF FUNCTIONS

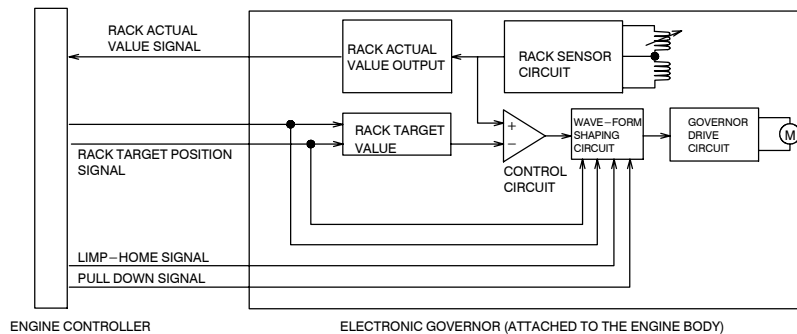
A. Engine Control

(1) Description of Basic Engine Control Operation (Electronic Governor Control) Starter Switch



(1) Fuel injection volume control

1. The engine controller computes target revolutions based on operation mode data sent via CAN communication from the controller, input signals (voltage) from the throttle volume, signals from the water temperature sensor (voltage) and signals of voltage supplying to the engine controller.
2. The engine controller computes based on the calculated difference between the target revolutions and actual revolutions (obtained by TDC revolution sensor and backup sensor), and obtains the fuel flow.
3. The engine controller converts the fuel flow to the target rack position, and corrects the target rack position according to the Q adjusting resistance. (The rack is located inside the governor, and fuel injection amount oil consumption is adjusted by its movement.)
4. The engine controller performs conversion on the computed target rack position and outputs it to the electronic governor.
5. The electronic governor computes based on the signals of target rack position sent out from the engine controller and the signals (actual rack position) of the rack sensor installed in the governor. The computed results is output, with which the rack position (i.e. control on the fuel injection amount) is controlled by moving the DC motor.

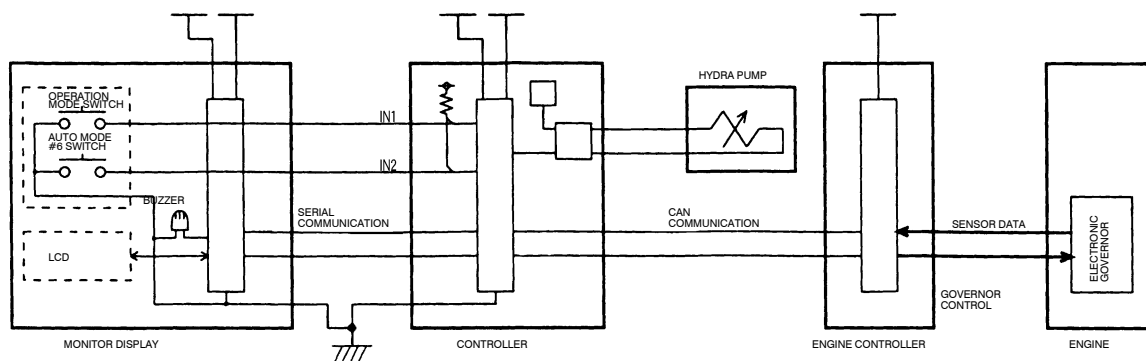


DESCRIPTION OF FUNCTIONS

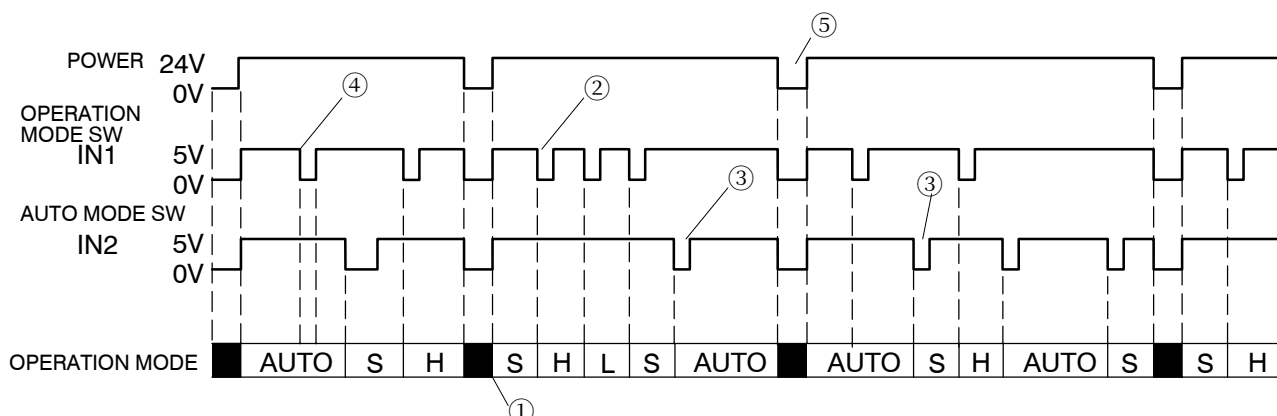
- (2) Engine control at start-up
 - 1. Positioning the starter switch to cranking position, starter motor turns ON and cranking signal is input to the engine controller simultaneously (ON=iGN).
 - 2. The engine controller determines the fuel injection level by start-up fuel control. The fuel flow rate is determined by water temperature data and the engine's actual number of revolution data.
 - 3. Once cranking signal turns OFF, the engine controller shifts from the start-up fuel control to the normal injection rate control.
- (3) Engine control at the stopping time
 - 1. Receiving the engine stopping signal (when key switch is OFF or emergency stop switch is ON), the engine controller transmits the signal of no injection rack position to the governor and switches ON (= GND) the pull down signal simultaneously.
 - 2. The pull down signal is input directly to governor and the rack is moved to the non injection position once pull down signal becomes ON.
 - 3. Normally the engine stop is initiated by pull down signal. However, even if the line of pull down signal is broken, rack is positioned to the no injection location by no injection signal.
- (4) Governor servo error and limp-home.
 - 1. The signal from rack sensor located inside the governor is input to the engine controller simultaneously as it is input directly to governor.
 - 2. Engine controller compares the positions of the target rack position which sends the output to the governor and the rack actual position sent from the rack sensor and determine if the rack is located on the right target position.
 - 3. If the engine controller determines that the rack is not located on the right target position, it regards as governor servo error and stops the engine.
 - 4. If limp-home SW is ON (= GND) during governor servo error, the engine runs in limp-home mode. (When limp-home SW = OFF, the engine cannot be started.)
Because this model is designed to have limp-home SW always connected to GND (ON), the engine starts automatically in limp-home mode when restarting the engine (without turning the key SW to OFF) after the engine stops.)
 - 5. The rack target position is not be controlled by the rack actual position in limp-home mode, it is controlled only by the number of engine revolutions obtained from the engine revolution sensor.

B. Operation Selection

(1) Configuration of circuit



(2) Time Chart



(3) Switch of mode

- ① After turning OFF the key switch in HSL mode, when turning ON the key again, mode becomes S mode. (Previous data is reset.)
- ② Every time when operation mode SW is pushed down, operation mode changes to S → H → L → S → H.
- ③ If auto mode SW is pushed down once, mode becomes auto mode regardless of the current mode. If auto mode SW is pushed again, the current auto mode becomes canceled, and the mode becomes to S mode regardless of the previous operation mode.
- ④ While auto mode is active, mode change is invalid although operation mode SW is pressed and mode does not change.
- ⑤ After turning OFF the key switch in auto mode, even if the key switch is turned ON again, mode stays in auto mode. (Previous data is kept remained.)

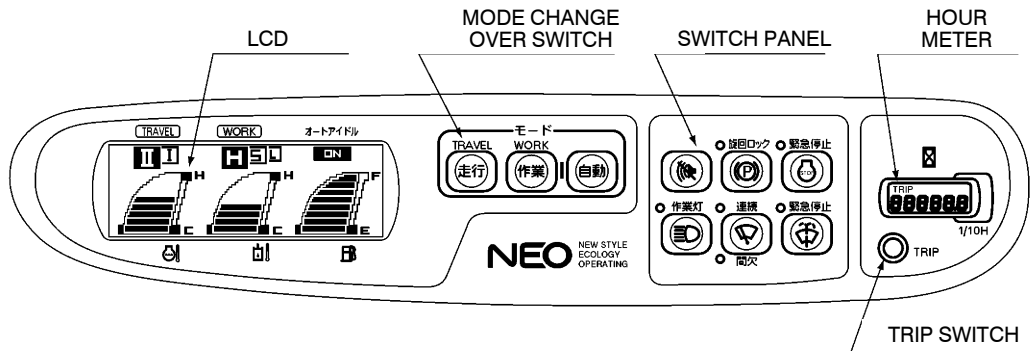
(4) Operation

1. Pushed down the mode switch on the monitor display, signal is input to the controller, and controller changes mode according to the input signal.
2. Controller transmits the current mode to the monitor via serial communication. According to the transmitted data, LCD display changes.
3. Controller transmits the current mode to engine controller via CAN communication, and engine controller controls the engine governor based on the transmitted data. Engine controller also transmits the current mode and transmitted data regarding the engine actual number of revolutions to the controller via CAN communication.
4. Controller computes the electric current of the pump based on the current mode and transmitted data regarding the engine actual number of revolutions, and number of target revolutions.
5. Monitor display switches to LCD display screen which is sent from the controller via serial communication.

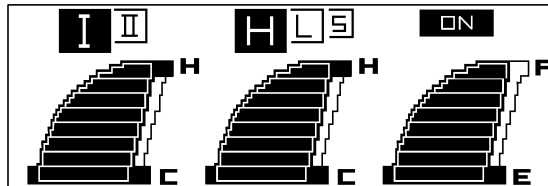
DESCRIPTION OF FUNCTIONS

(5) Operation switch/LCD display

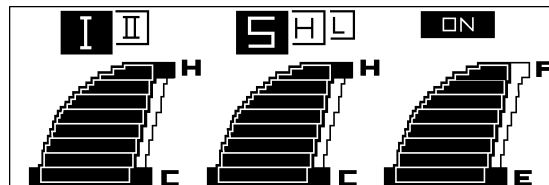
MONITOR DISPLAY



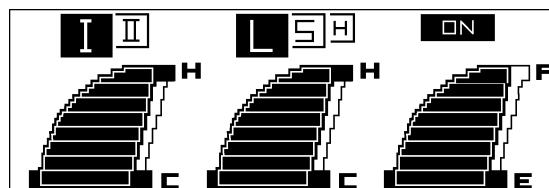
LCD DISPLAY WHEN IN H MODE



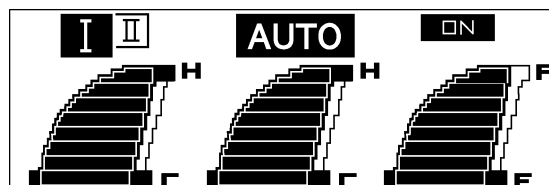
LCD DISPLAY WHEN IN S MODE



LCD DISPLAY WHEN IN L MODE



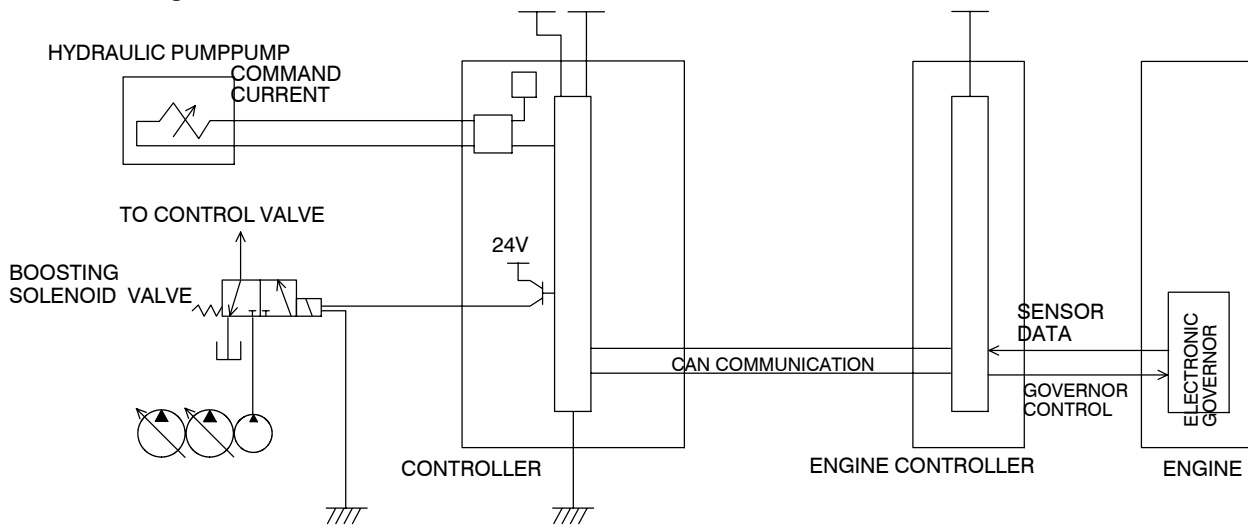
LCD DISPLAY WHEN IN AUTO MODE



DESCRIPTION OF FUNCTIONS

a. H/S/L mode control

(1) Configuration of circuit



(2) Summary

H Mode	No. of engine revolutions	= MAX (rpm)
	Pump control current	= Variable current (Imax – Imin)
	Boosting method	= Auto boosting control
S Mode	No. of engine revolutions	= MAX–200 (rpm)
	Pump control current	= Fixed current (90% torque)
	Boosting method	= Auto boosting control
L Mode	No. of engine revolutions	= MAX–300 (rpm)
	Pump control current value	= Fixed current (70% torque)
	Boosting method	= Constant boosting

(3) Set values for each mode

Mode	Item		Unit	SH120-3	SH200-3	SH220-3
H Mode	No. of engine revolutions(MAX)		rpm	2150±10	2000±10	2200±10
	Current	(I MAX)	mA	600	407	424
		(I MIN)	mA	450	292	307
S Mode	No. of engine revolutions(MAX)		rpm	1950±10	1800±10	2000±10
	Current		mA	450	292	307
L Mode	No. of engine revolutions(MAX)		rpm	1850±10	1700±10	1900±10
	Current		mA	<100	<50	<50
Idling	No. of engine revolutions (MAX)		rpm	1000±10	900±10	900±10
No. of engine revolutions when maximum torque			rpm	1600	1600	1800

(4) Addendum

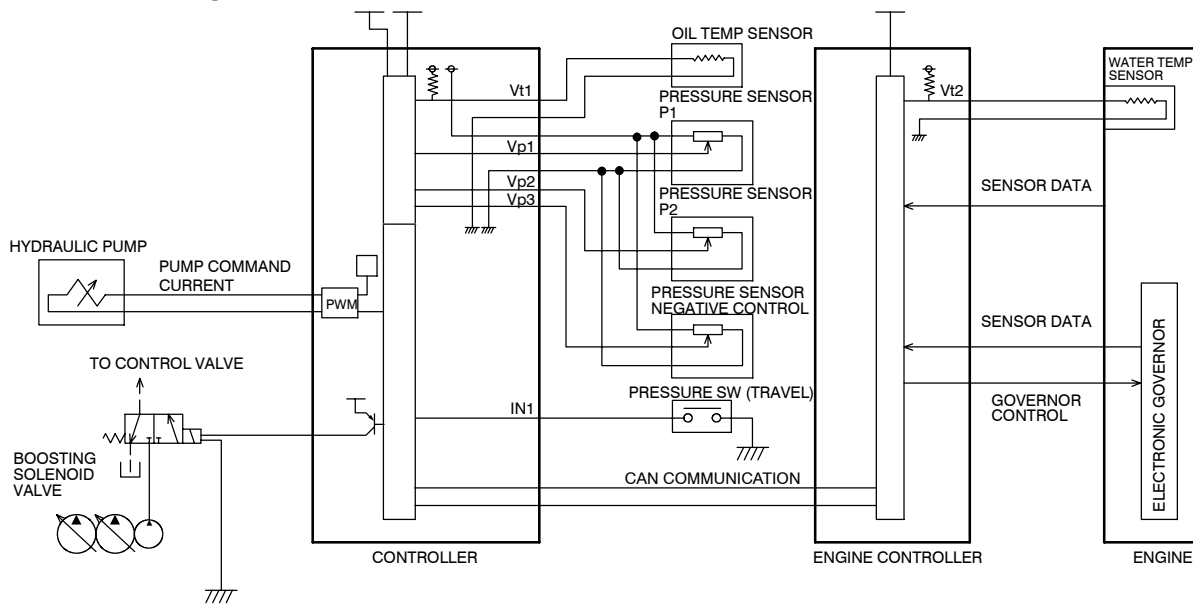
The set values in the previous section are the ones for the normal condition, and the followings are exceptions. (Details are explained in each section.)

1. When the number of engine target revolutions is lower than the number of revolutions at maximum torque, the pump current value becomes L mode current value even in the H / S mode.
2. Even in the L mode, when only travel operation is executed, S mode current value is adopted. (To prevent exclusive travel operation.)
3. The pump current value becomes L mode current value in the L mode, however, if the additional line (the breaker, crusher, etc.) is used, it becomes S mode current value.
4. If the engine coolant temperature is low, or power voltage supplied to the engine controller is low, the number of idling revolutions is increased to prevent over cooling or battery discharging.
5. Even in the case of 2. or 3. above, when having the situation of 1. (the number of engine revolutions is lower than the number of revolutions at maximum torque), it becomes L mode current valve.

DESCRIPTION OF FUNCTIONS

b. Auto mode control

(1) Configuration of circuit



(2) Summary

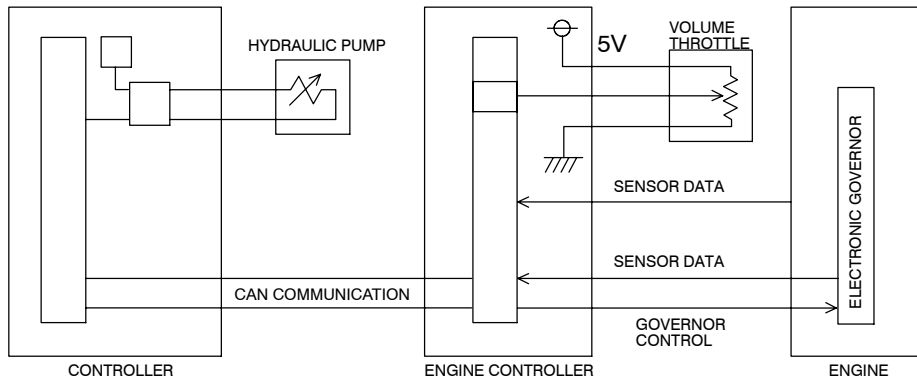
1. When auto mode is selected, 2 modes, S_A and L_A shown in the following table, are switched over, depending on the operation condition.
2. When selecting auto mode, it starts with L_A mode at the start, and it switches to S_A mode later depend on the operation condition. Furthermore it switches from S_A mode to L_A mode automatically.
3. Even though auto mode is chosen, if water temperature is lower than 50°C or oil temperature is lower than 25°C , auto mode control is not functioned, and L_A mode at start-up is fixed.
However, once water temperature becomes 50°C or higher and oil temperature becomes 25°C or higher, auto mode control starts, and auto mode control continues to function even though water temperature and oil temperature become lower.
4. During auto mode controlling, if travel pressure switch becomes ON, switch over of the operation mode is not executed as far as the auto mode is on. (If travel pressure switch becomes ON during S_A mode, S_A mode remains, and if travel pressure switch becomes ON during L_A mode, L_A mode remains.

Mode	Item	Unit	SH120-3	SH200-3	SH220-3
S_A Mode	No. of engine revolutions (MAX)	rpm	1950 ± 10	1800 ± 10	2000 ± 10
	Current	mA	$490 (=S+40)$	$332 (=S+40)$	$347 (=S+40)$
	Boosting method	—		Auto boosting	←
L_A Mode	No. of engine revolutions (MAX)	rpm	1850 ± 10	1700 ± 10	1900 ± 10
	Current	mA	$450 (=S)$	$292 (=S)$	$307 (=S)$
	Boosting method	—		Auto boosting	←

DESCRIPTION OF FUNCTIONS

C. Throttle Control

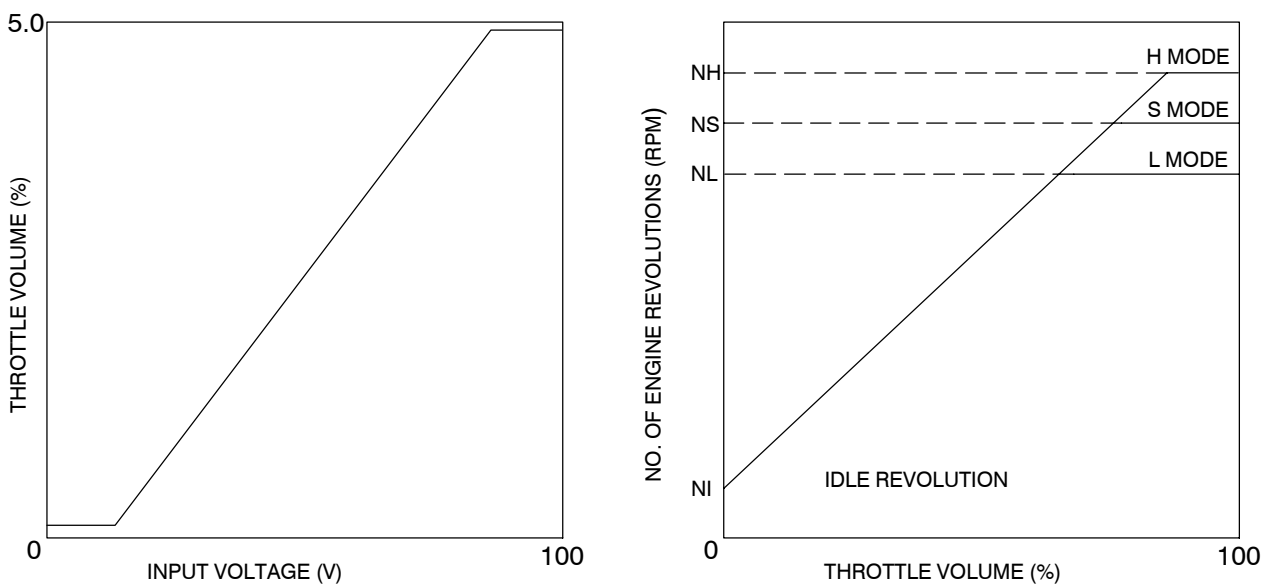
(1) Configuration of circuit



(2) Operation

1. Controller transmits the currently selected operation mode to controller via CAN communication.
2. Engine controller computes the target number of revolutions based on engine output selected according to the operation mode transmitted and the analog signal (voltage) of throttle volume input to engine controller.
3. Engine controller computes the target rack position using computed target number of revolutions and data of each sensor (actual number of engine revolutions, rack actual position, Q adjusting resistance), and it sends out the signal to electronic governor.
4. Electronic governor computes based on the target rack position and rack actual position (read value of rack sensor in governor) and move rack by running DC motor to adjust fuel injection amount.
5. Repeating the above mentioned process, engine controller controls the electronic governor to make actual number of revolutions = target number of revolutions as a final result.
6. If the number of engine revolutions is set to lower than the number of revolutions at the maximum torque by throttle volume, the pump current value becomes L mode current value even when the operation mode is either S mode / H mode.

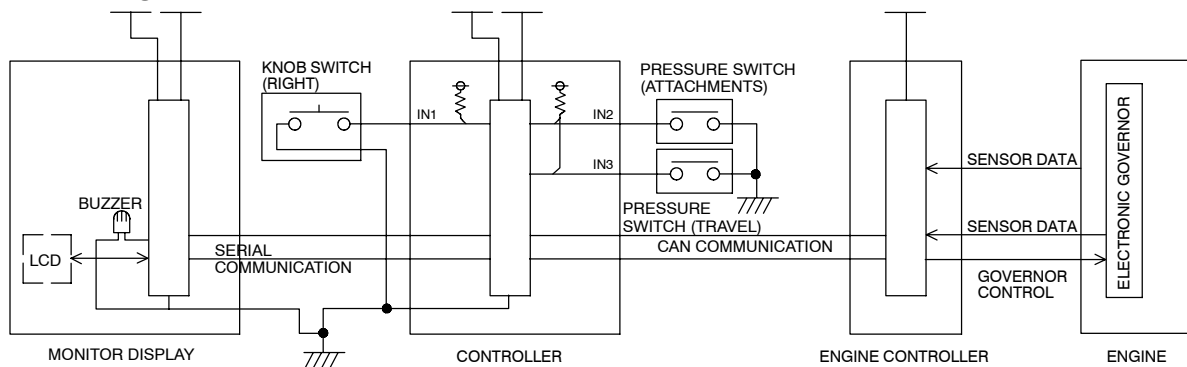
Relation between throttle volume and number of engine revolutions



DESCRIPTION OF FUNCTIONS

D. Idling Control (Auto / One touch)

(1) Configuration of circuit



(2) Change over between auto / one touch

- ① Change over between auto idle and one touch idle is performed by keeping to push down the knob SW (IN1) for 3 sec.
Once the mode has changed, ON / OFF display on the auto idle section on the LCD monitor, and buzzer alarms for 3 sec.
- ② When selecting auto idle / one touch idle, follow the previous settings even though turning the key SW from OFF to ON. (previous data is retained.)
- ③ ON/OFF status for auto idle is displayed in LCD. ON display = auto idle, OFF display = one touch idle.
- ④ If lever is not operated for 5 seconds with auto idle turned ON (both attachment pressure SW and travel pressure SW are OFF), the number of engine revolutions automatically goes back to idling state.
(The initial setting is 5 seconds. It can be changed between 1 and 30 seconds by settings in back screen.)
- ⑤ When auto idle is ON, if the lever is operated during idling (either attachment pressure SW or travel pressure SW is ON), the number of engine revolutions automatically goes back to the original one.
- ⑥ Even when auto idle is ON, by pressing the knob SW (one touch SW), idling/recovery operation is possible.
- ⑦ When auto idle is OFF (in one touch idle), idling / recovery is operated only by using knob SW (one touch idle SW) regardless of lever operation.
- ⑧ During idling, "IDLING" is displayed in LCD on the monitor.

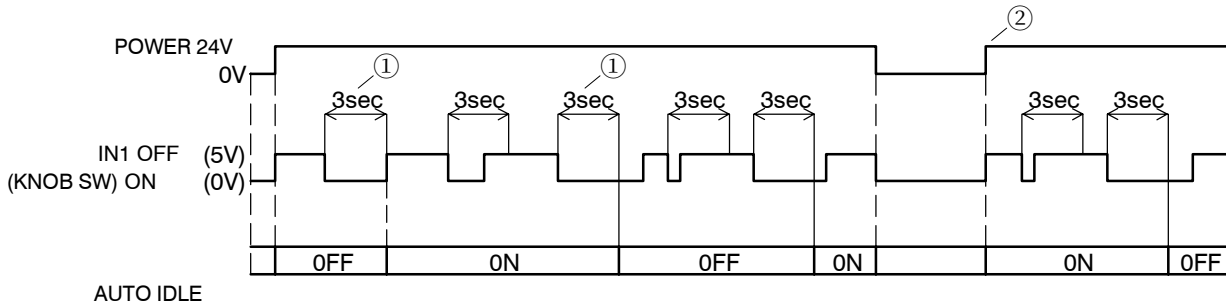
DESCRIPTION OF FUNCTIONS

(3) Operation

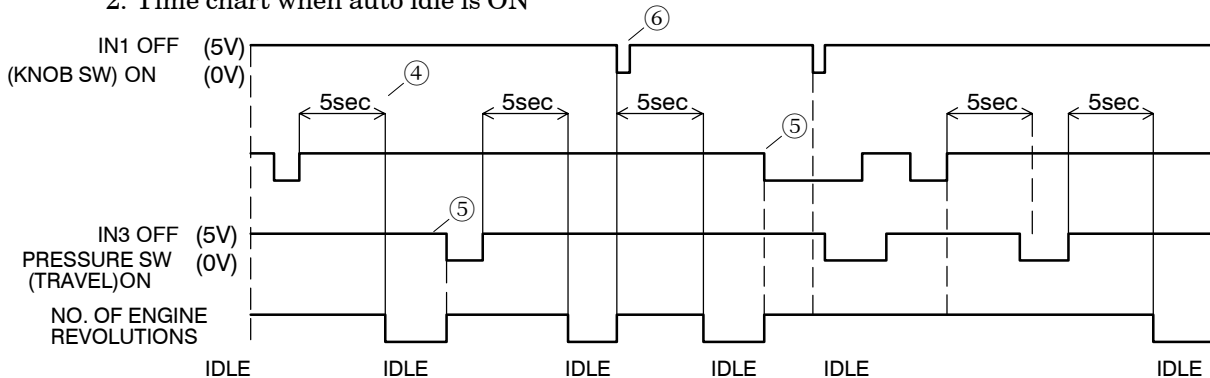
1. When setting idling revolutions based on conditions described in [2], the controller transmits idling signal to the engine controller via CAN communication.
Also, "IDLING" signal is transmitted via serial communication to the monitor display.
2. The engine controller selects idling mode and controls the number of engine revolutions to the idling state according to the transmitted idling signal.
3. The monitor display displays "IDLING" in the LCD according to the sent signal.
4. When recovering from idling based on the condition described in [1], the controller transmits the original mode signal to the engine controller via CAN communication.
Also, "IDLING" signal which has been transmitted to the monitor via serial communication is stopped.
5. The engine controller changes the idling to the original mode to control the number of engine revolutions according to the sent mode signal.
6. The monitor stops display of "IDLING" signal in LCD according to the stopped transmission of idling display.

(4) Time Chart

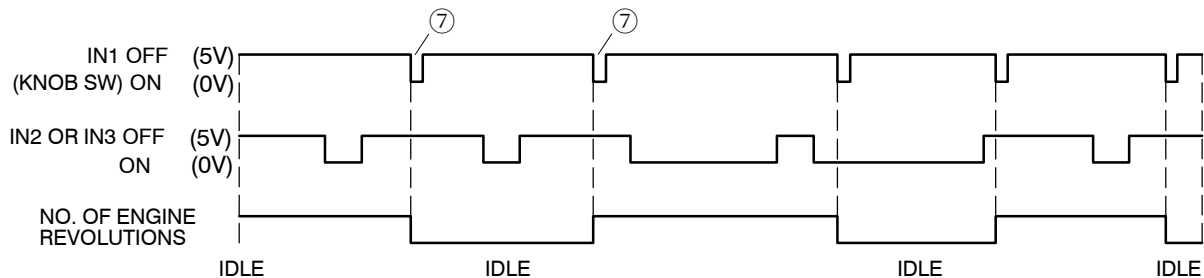
1. Time chart for auto idle ON/OFF selection



2. Time chart when auto idle is ON



3. Time chart when auto idle is OFF



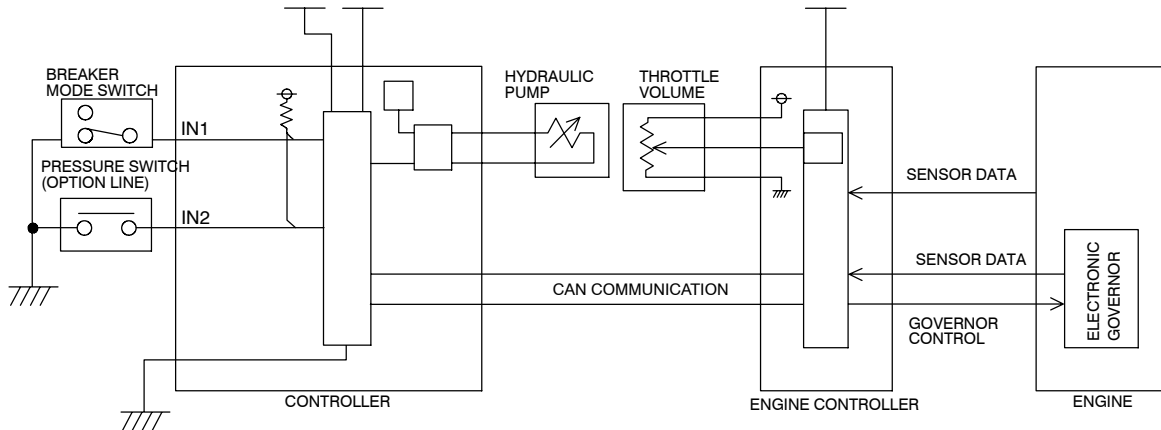
DESCRIPTION OF FUNCTIONS

E. Breaker Mode

(1) Summary

Compared to the Model 2 which controls the number of breaker revolutions when the pressure SW of the breaker is ON, the Model 3 controls the number of breaker revolutions when the input of the breaker SW becomes ON and also the additional line pressure SW becomes ON.

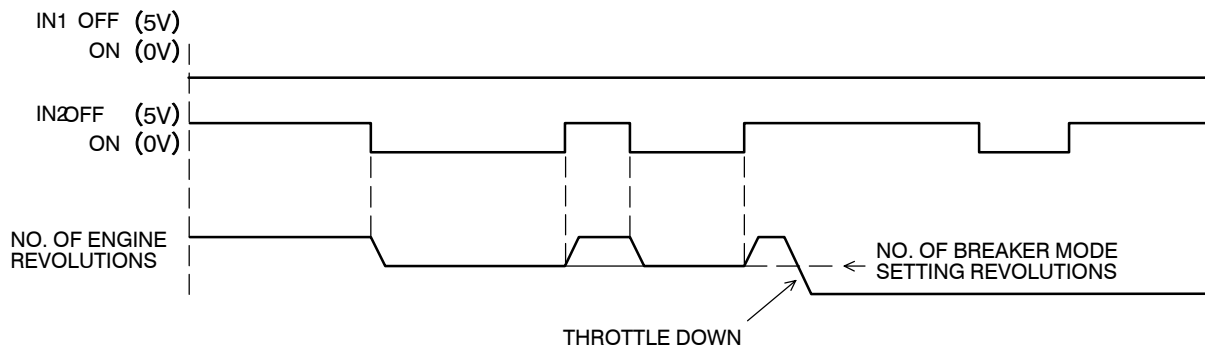
(2) Configuration of circuit



(3) Operation

1. If the breaker mode switch on the controller is ON, the controller controls as the breaker mode. (When input is OFF, the controller controls as the crusher mode.)
2. When it is in the breaker mode and the option line pressure SW becomes ON, the controller transmits the breaker mode to the engine controller via CAN communication.
3. Engine controller receives the breaker mode transmitted, and controls the number of engine revolutions to the number of breaker setting revolutions. (For the details of the number of breaker revolutions, refer to the service and support function section.)
4. If the additional lines pressure switch becomes ON when the number of engine revolutions is less than the number of breaker setting revolutions, the number of engine revolutions does not change.
(Engine controller controls to lower the number of engine revolutions, however, it does not control to increase it in the breaker mode.)
5. When the additional line pressure switch is ON, the pump current value becomes S mode current value regardless of the operation mode at that time.

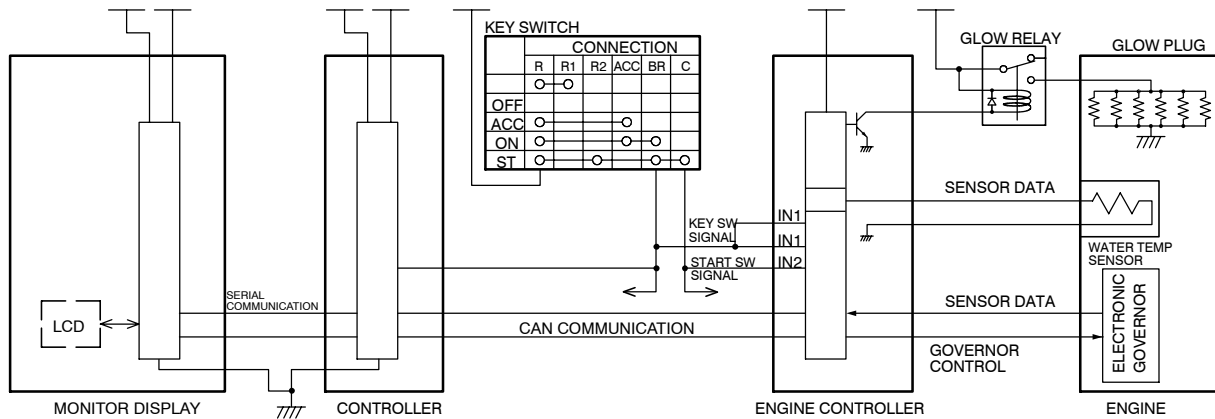
(4) Time Chart



DESCRIPTION OF FUNCTIONS

F. Auto Pre-heat

(1) Configuration of circuit

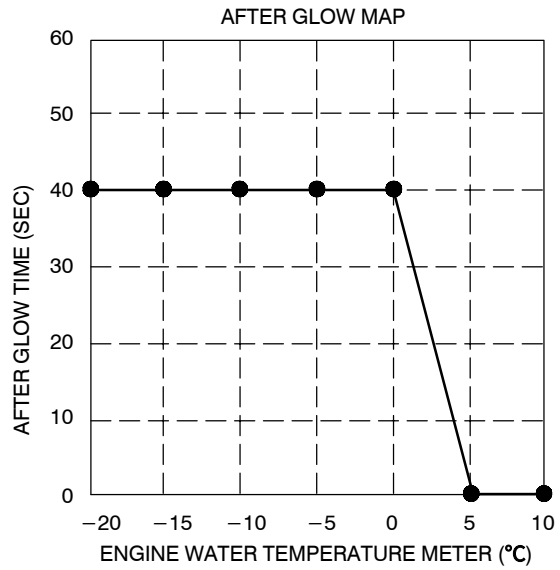
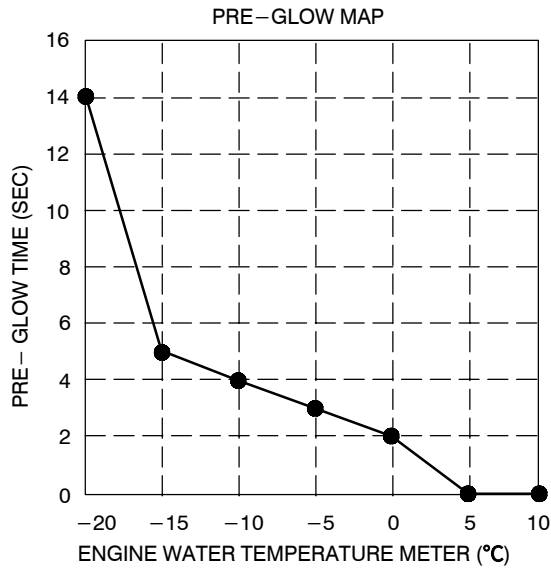


(2) Operation

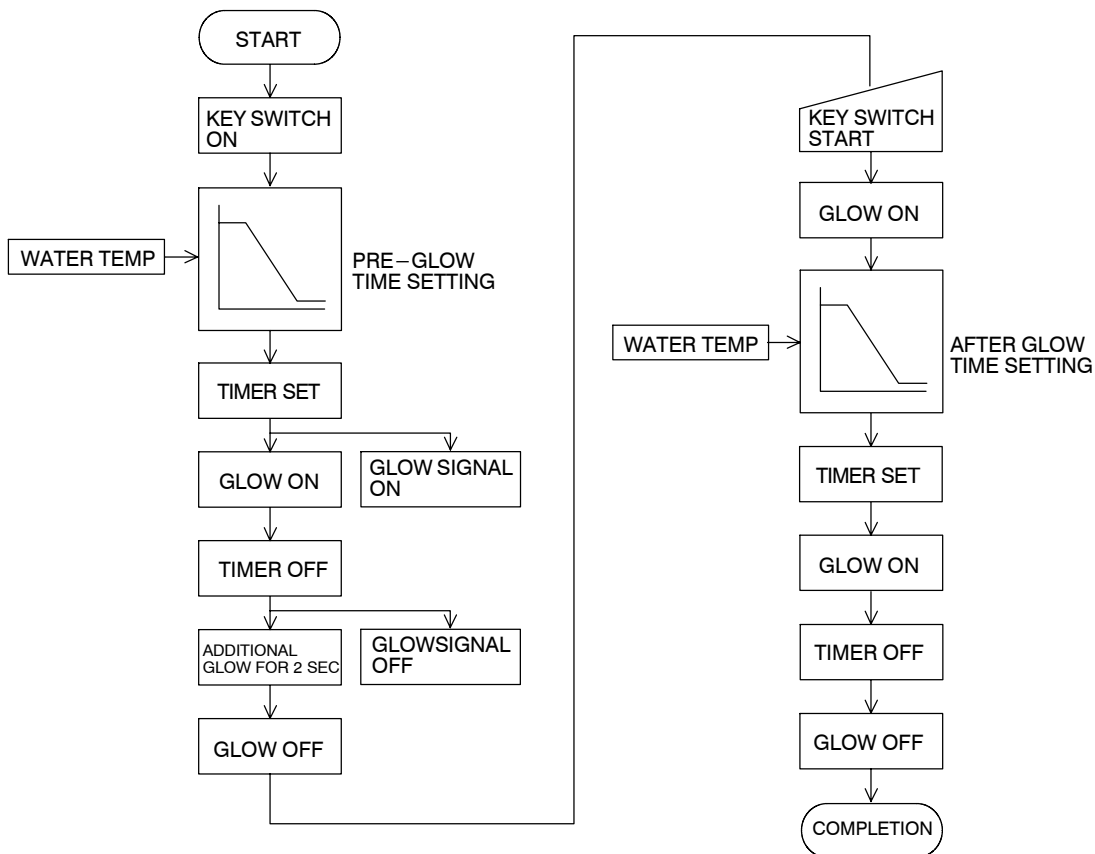
1. When the key switch becomes ON (IN1 = ON), the engine controller computes the pre-glow time (T_p) from the map described in the next page based on the engine coolant temperature.
2. The engine controller turns ON the glow relay output during the computed pre-glow time; T_p , and it transmits the warming up signal to the controller via CAN communication.
3. After pre-glow time has completed, engine controller completes transmitting the warming up signal to the controller. However, sending the output to the glow relay continues to remain ON for 2 more seconds.
4. When the key switch turns to START (IN2 = ON), the engine controller turns ON the glow relay output once more. However, it does not transmit the warming up signal to the controller.
5. The engine controller computes the after glow time (T_a) from the map described on the following map based on the engine coolant temperature.
6. After the key switch returns to START → ON (IN1 = ON, IN2 = OFF), the engine controller turns ON the glow relay output during the after glow time; T_A . (However, the controller does not transmit the warming up signal.)
7. The controller transmits the "Engine warming-up" display on the LCD display monitor while the "warming-up" signal from the engine controller via CAN communication is ON.
8. Because the control system mentioned above starts immediately once key switch turns ON, a message, "Engine warming-up", does not display on the monitor unless pre-glow time becomes longer than 3 seconds (water temperature is lower than -5°C). (In order to display the initial screen: PAX logo for 3 seconds after key switch is turned ON)

DESCRIPTION OF FUNCTIONS

(3) Pre-glow time; T_p , After glow time; T_a map



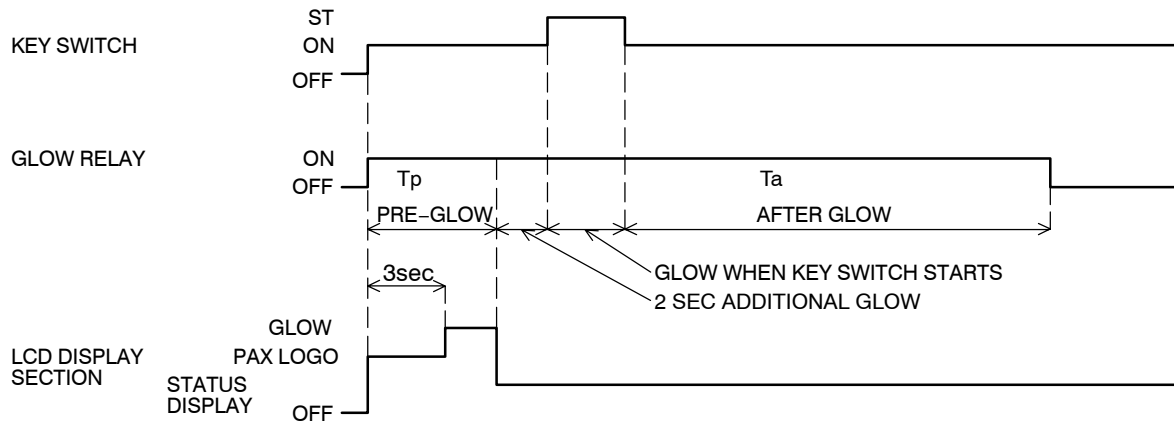
(4) Flow Chart



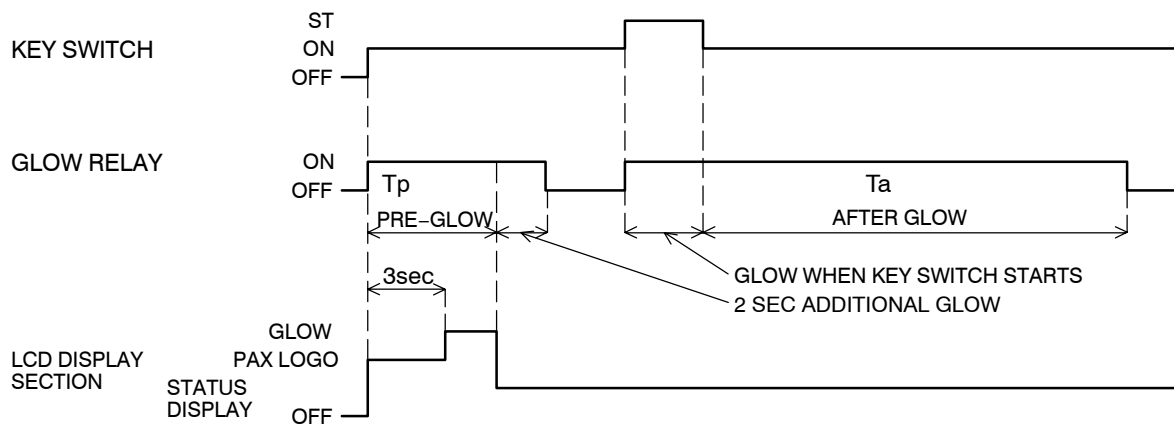
DESCRIPTION OF FUNCTIONS

(5) Time Chart

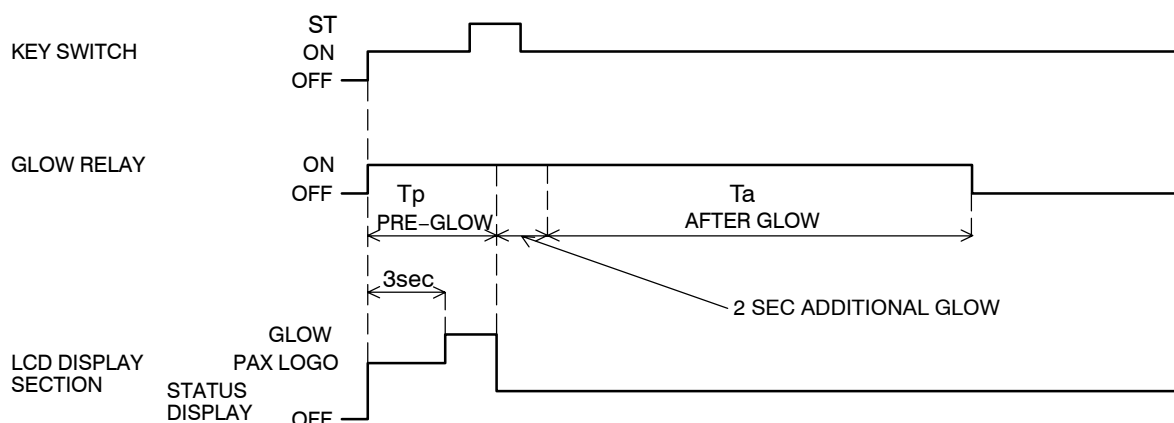
1. If cranking is made within 2 sec. after completion the "Engine warming-up" display (Normal)



2. When cranking 2 sec. after completion of "Engine warming-up" display



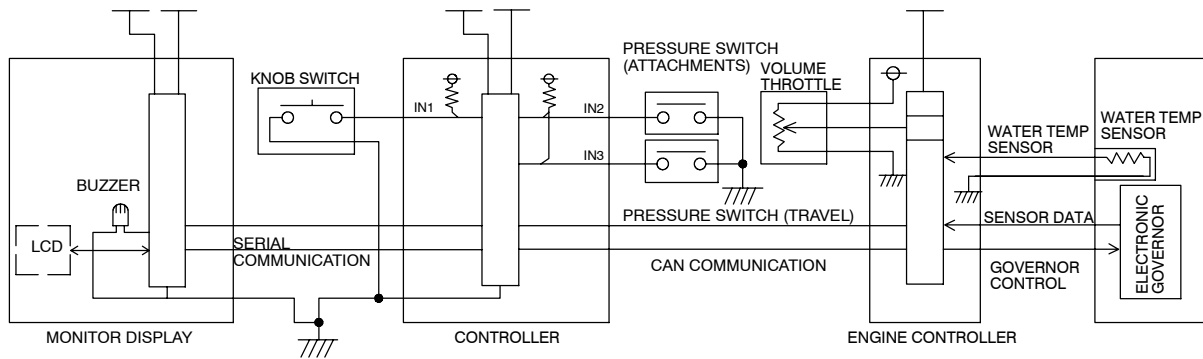
3. When cranking during "Engine warming-up" display



DESCRIPTION OF FUNCTIONS

G. Auto Warm-up

(1) Configuration of circuit

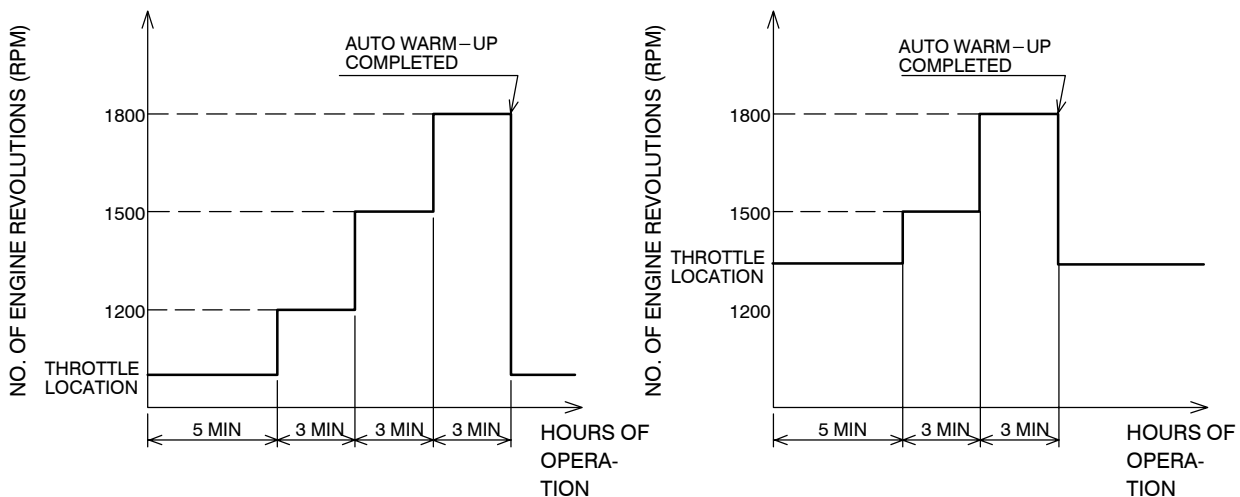


(2) Operation

1. The water temp sensor signal attached in the engine is input to the engine controller, and transformed to temperature. Then engine controller transmits water temperature data to controller via CAN communication.
2. After engine starts, if engine coolant temperature is 50°C or lower, the controller transmits auto warm-up signal to the engine controller via CAN communication.
3. The engine controller administers auto warm-up control according to the transmission from the controller.
4. Controller releases auto warm-up control determined by the following conditions. The engine controller completes auto warm-up control once auto warm-up control request is released.
 - When either one of attachments pressure SW / travel pressure SW / knob SW (One touch idle SW) becomes ON.
 - When the position of throttle volume is changed.
 - When 3 minutes has passed with a number of engine revolutions higher than 1800 rpm.
5. Once auto warm-up control is released, the controller does not start auto warm-up control again unless key SW is turned from OFF to ON.
6. While controller is conducting auto warm-up control, "Auto warm-up" message is displayed.

(3) Details of auto warm-up control

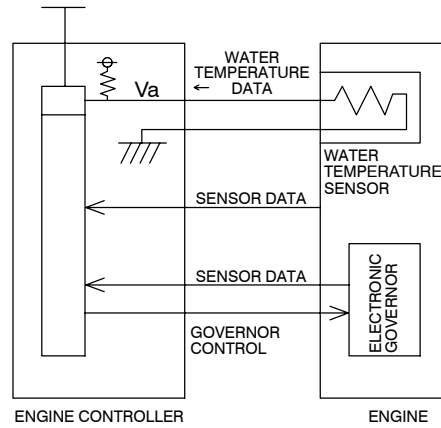
Details of auto warm-up control are the same as the Model 2 and the details are described as follows.



H. Idle Map

The purpose of this function is to prevent the battery discharging / the water temperature lowering in case of the long idling status by increasing the number of idling revolutions automatically when the power voltage supplied to the engine controller becomes lower or when the engine coolant temperature is low.

(1) Configuration of circuit



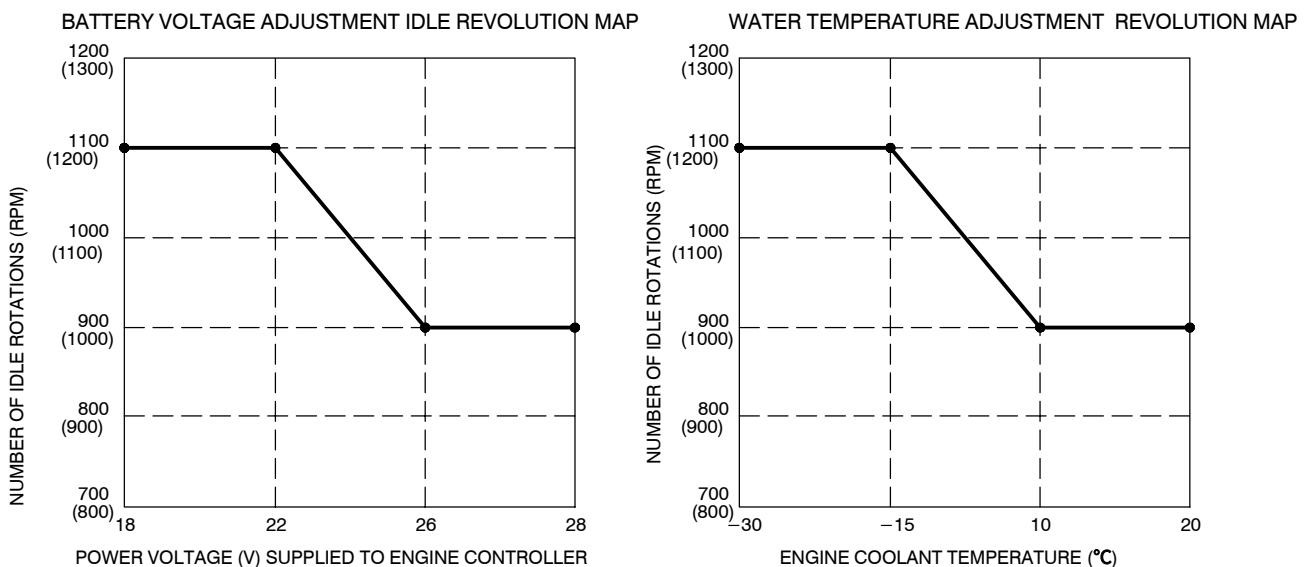
(2) Operation

Battery voltage adjustment idle revolution control is determined by a map illustrated below, based on the voltage of power supplied to the engine controller.

Water temperature adjustment idle revolution control is determined by a map illustrated below, based on water temperature obtained by converting the voltage (Va) at the water temperature sensor input portion.

The larger number of revolution between battery voltage adjustment idle revolution output and water temperature adjustment idle revolution output, becomes the number of revolution in idling.

(3) Characteristics of voltage adjustment idle revolution and water temperature adjustment idle revolution

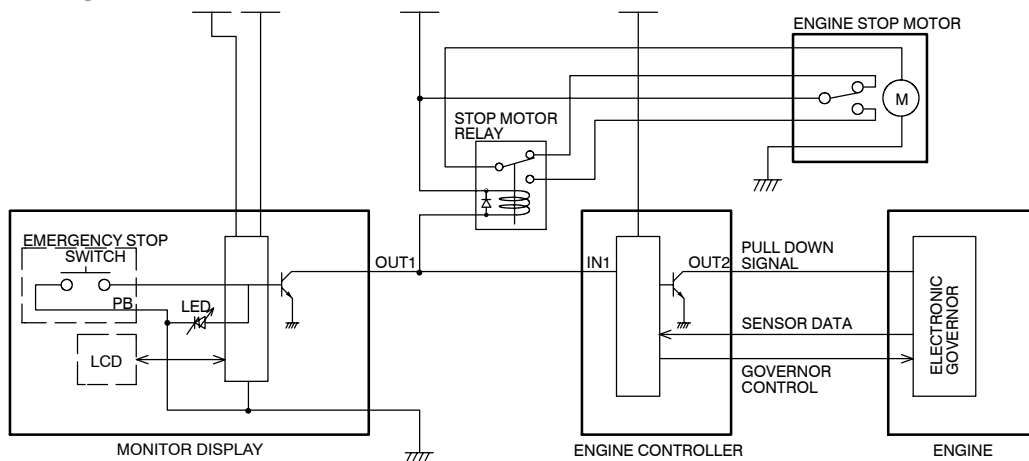


The numbers in () indicate the values for SH120-3.

DESCRIPTION OF FUNCTIONS

I. Engine Emergency Stop

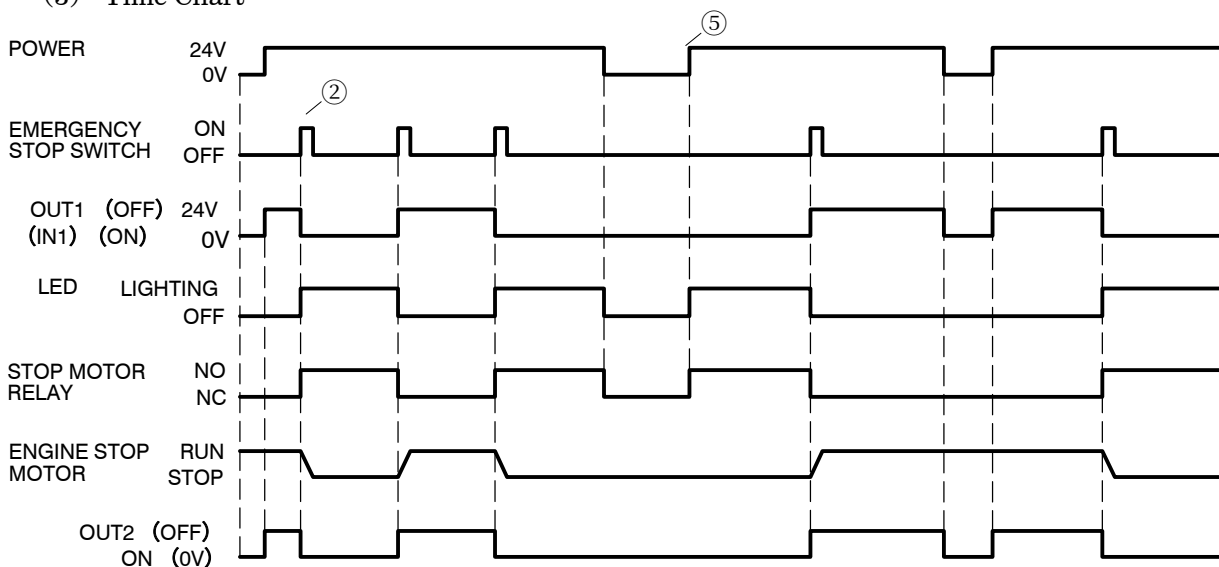
(1) Configuration of circuit



(2) Operation

1. If emergency stop SW on the monitor display is pressed down, the output becomes transistor output ($OUT1 = 0\text{ V}$) of the monitor, and LED on the SW section flashes.
2. By the $OUT1$ falling to 0 V , the stop motor relay is excited, and the engine stop motor runs rotates to the stop location.
3. In addition, engine stop signal input ($IN1$) on the engine controller falls down to 0 V . Consequently, the engine controller accepts it as emergency stop status and turns to the output ($OUT2 = 0\text{ V}$) of the pull down signal.
4. engine governor starts to control the engine to stop by receiving the pull down signal. (Rack position = 0 mm)
5. The status of emergency stop is retained even though turning ON the key from OFF. (The previous data are kept retained.)

(3) Time Chart



DESCRIPTION OF FUNCTIONS

J. Limp–home Control

(1) Summary of governor servo error control

In the electronic governor engine controls the number of engine revolutions by controlling the rack position in the governor.

- The engine controller sends out the rack target position as a PWM signal to the governor. The governor computes based on this target value and the rack actual values obtained from the governor built–in rack sensor circuit. Based on the computed results, DC motor is operated to control rack position. In addition, the rack actual value obtained from the rack sensor is also input to the engine controller.
- The engine controller checks if the governor is functioning properly by comparing the rack target position sent to the governor and the rack actual value.
- If the situation, which the differences between the actual rack position and the target rack position are 2 mm or more, continues longer than the duration specified in the below, the engine controller considers it as a governor servo error.
- If the governor servo error is detected, the engine controller stops the engine to prevent uncontrolled rotation on the engine.
- The engine controller transmits the trouble codes to the controller via CAN communication when a governor servo error occurs. When the controller receives the trouble code, it transmits the code via serial communication to the monitor to indicate the warning "electrical system problem" on the monitor's LCD screen.

Governor servo error determination time

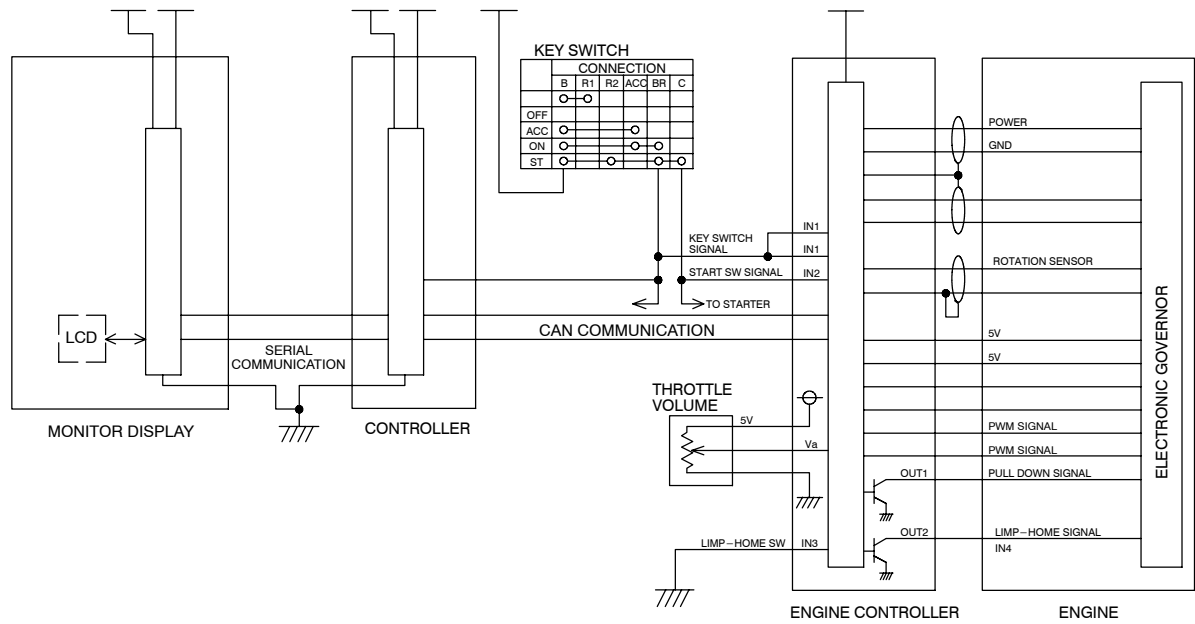
Starter switch ON (In cranking)	Starter switch OFF (During operation)
When number of engine revolutions $\geq$ 500 rpm 1sec	When number of engine revolutions $\geq$ 1000 rpm 1sec
When number of engine revolutions < 500 rpm 10sec	When number of engine revolutions < 1000 rpm 10sec

(2) Limp–home control

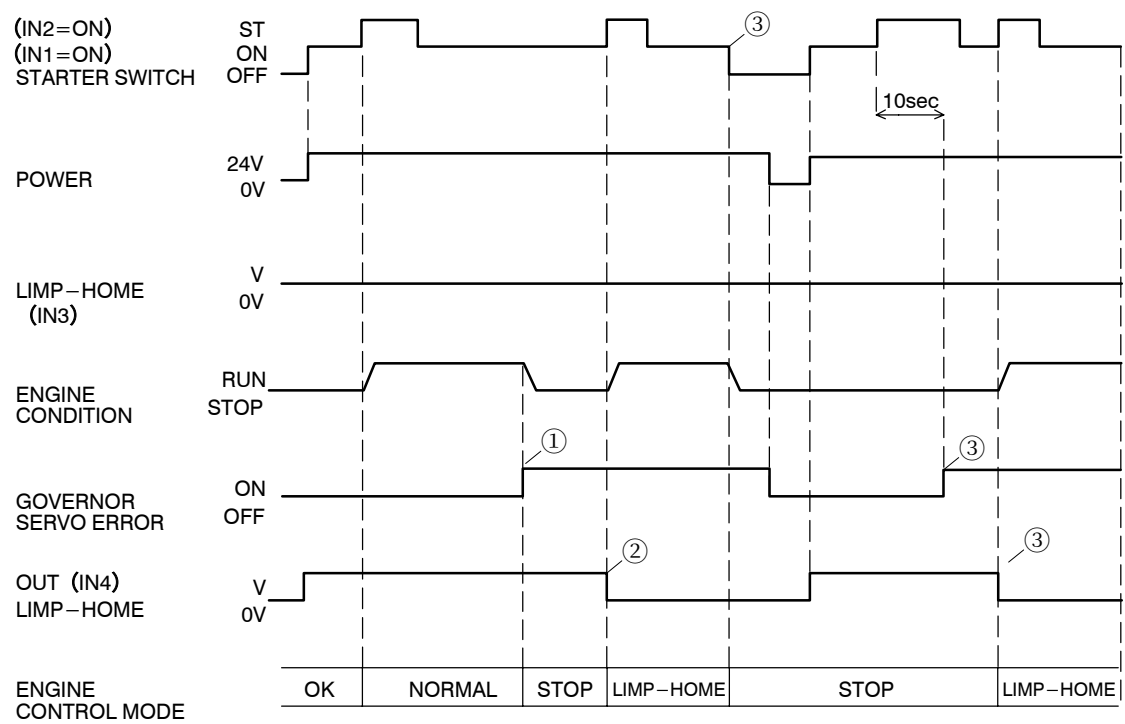
1. Summary of limp–home control

- ① The engine controller stops the engine by injecting no fuel when governor servo error is detected during engine running or cranking.
- ② After stopping the engine due to the governor servo error, if the engine is started again with limp–home switch ON (IN3 = ON = GND), the engine starts with limp–home mode.
(Since on the actual machine the limp–home switch is always ON, it becomes limp–home mode after the engine stops due to the governor servo error.)
- ③ When cranking once more after engine has been stopped during the operation, it starts with limp–home mode. When the starter switch has turned OFF, it starts with limp–home mode by cranking to make the governor servo error occur again, stopping cranking, and cranking again.
- ④ When controlling limp–home, it controls rack position with as much as the engine revolution amount obtained from engine revolution sensor. Thus normal engine performance cannot be obtained, but emergency engine control is only taken place.

2. Configuration of Circuit



3. Time Chart

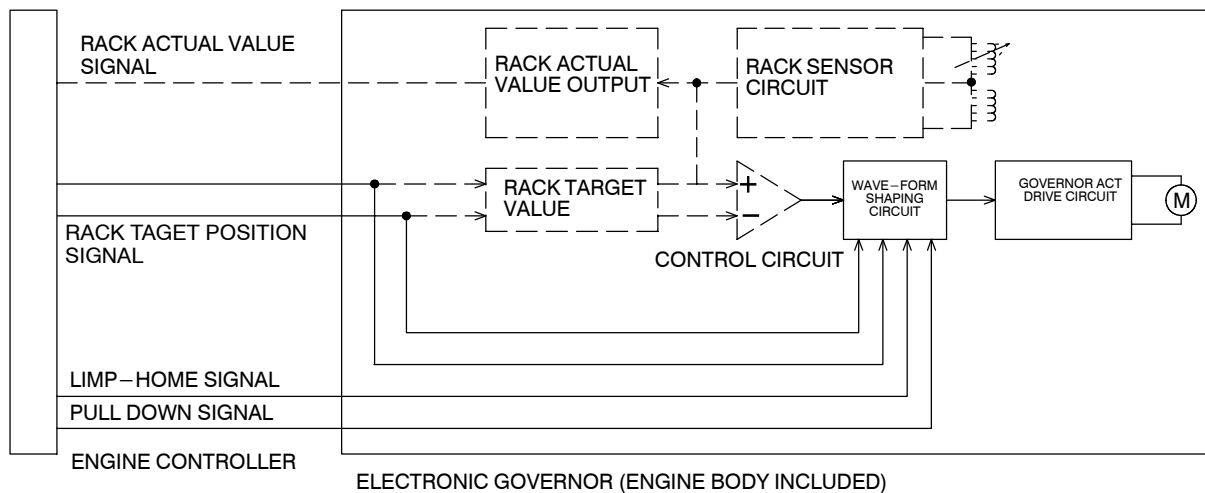


DESCRIPTION OF FUNCTIONS

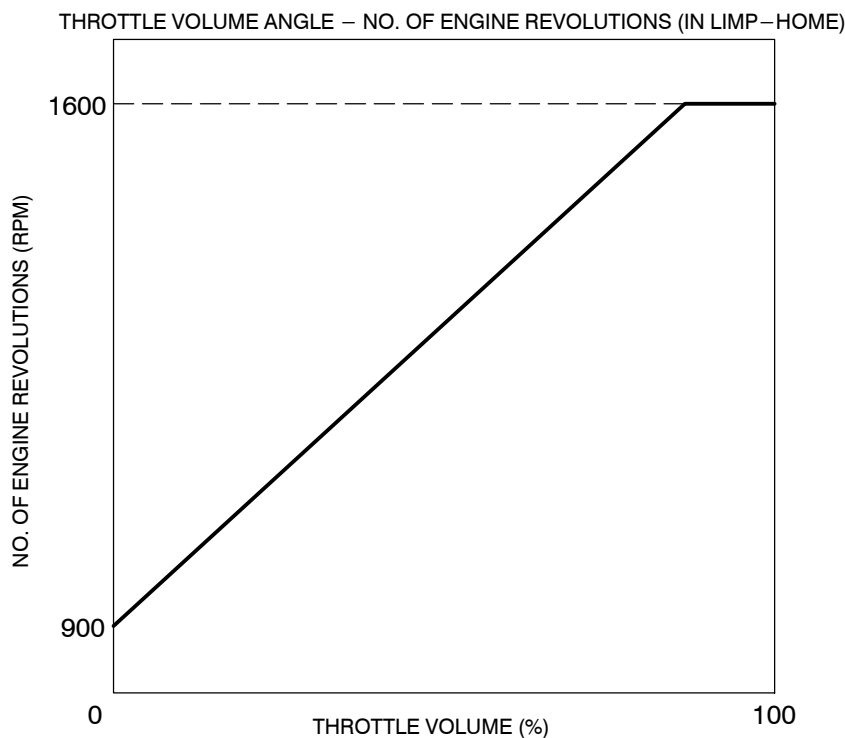
4. Engine control when limp-home is taken place

- Engine controller determines the target revolutions by transforming the voltage of throttle volume which is input.
- The engine controller controls the rack of governor by the differences between the engine's actual number of revolution obtained by a signal from revolution sensor built in governor (or back-up sensor installed in the flywheel housing) and the target number of the revolution.
- When it is in limp-home mode, the number of engine revolutions is controlled only by throttle volume. (The setting of maximum number of revolutions, etc. by the operation mode are not affected.)

The control by throttle volume is also different from the ones in the normal condition, and the control is described as follows.



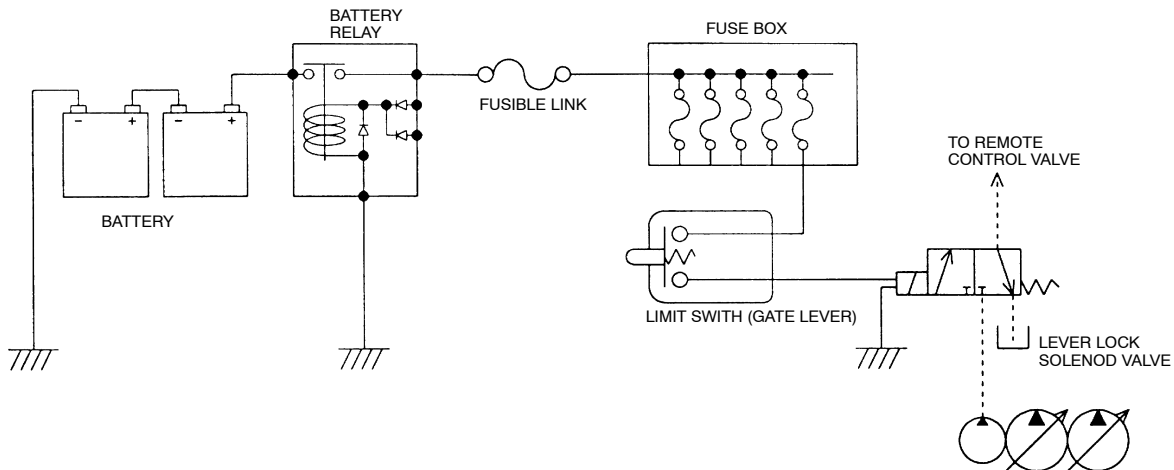
Electric



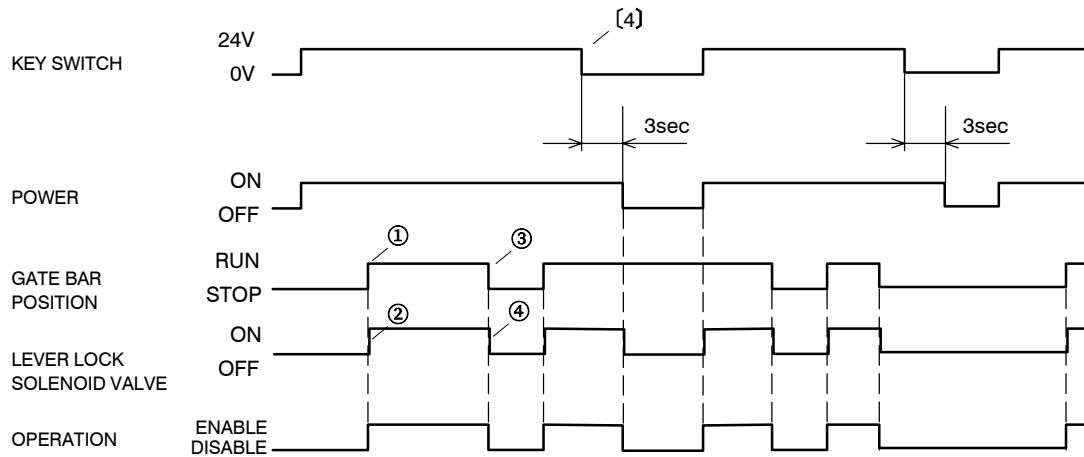
DESCRIPTION OF FUNCTIONS

K. Lever Lock

(1) Circuit Configuration



(2) Time Chart



(3) Operation

- ① When machine's power is ON, by positioning the gate lever attached on the console (left side) in the cab to the side of operating position (in the state when the gate bar is projected out), the limit switch is turned ON (closed), the lever lock solenoid valve becomes ON.
- ② When the lever lock solenoid valve is turned ON, pressure is supplied to pilot line and the machine is ready to operate.
- ③ When the gate lever is moved to the mount/dismount position (in the state when the gate bar is housed), the limit switch is turned OFF (opened), the lever lock solenoid valve becomes OFF.
- ④ When the lever lock solenoid valve is turned OFF, pressure is not supplied to the pilot line, and machine is disable to operate.

DESCRIPTION OF FUNCTIONS

L. Auto Boosting Control

Only SH200-3 and SH220-3 are equipped with the "Auto Boosting Function". SH120-3 does not have this function.

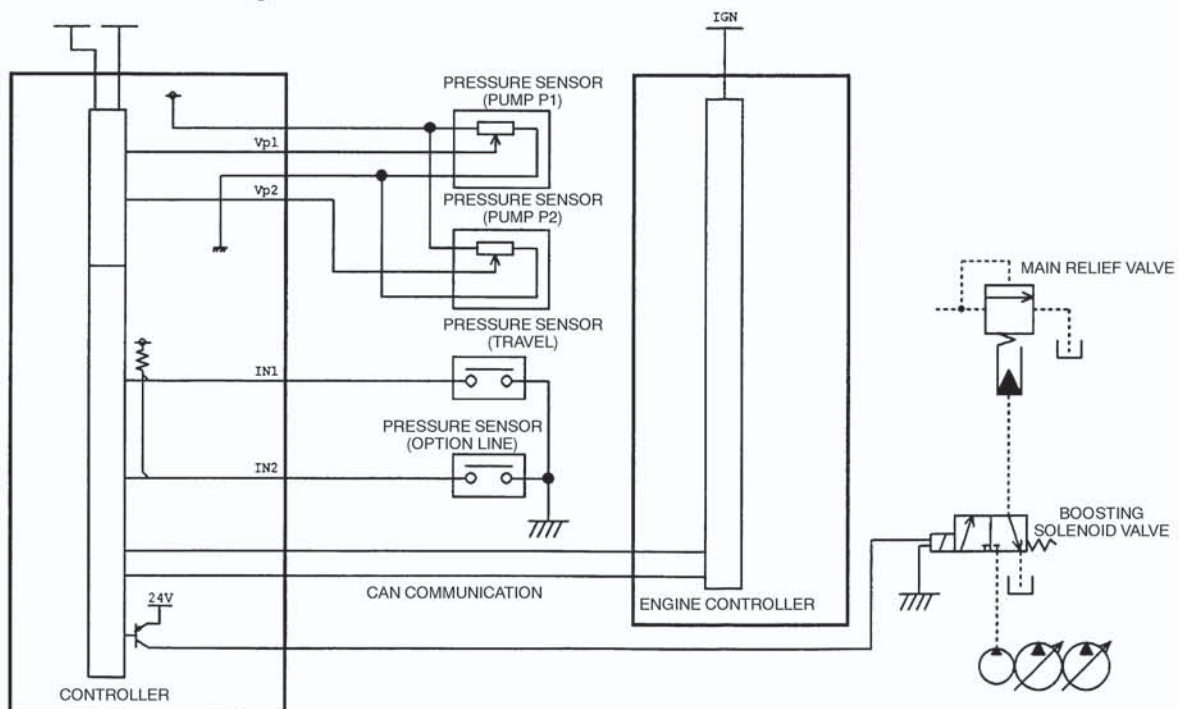
(1) Pressure increase control in each operation mode

	SH200-3 SH220-3	SH120-3
H Mode (Set pressure)	Auto Boosting (*1) (34.3/37.3 MPa)	No Boosting
S Mode (Set pressure)	Auto Boosting (*1)	No Boosting
L Mode (Set pressure)	Constant Boosting (*1)	No Boosting

*1. However, when travel pressure switch or auxiliary line pressure switch is turned ON, the boosting is cut off.

(2) Auto Boosting Control

1. Circuit Configuration



2. Auto Boosting Control Summary

When the operating mode is in H or S, the controller computes the work load based the engine load ratio transmitted from the engine controller via CAN communication and the data of main pressures P1/P2 obtained from pressure sensor attached on the main pump, and turns ON the boosting solenoid valve upon demand and increases the main pressure.

However, its boosting time is limited up to 8 seconds and boosting is not allowed to last for a long time.

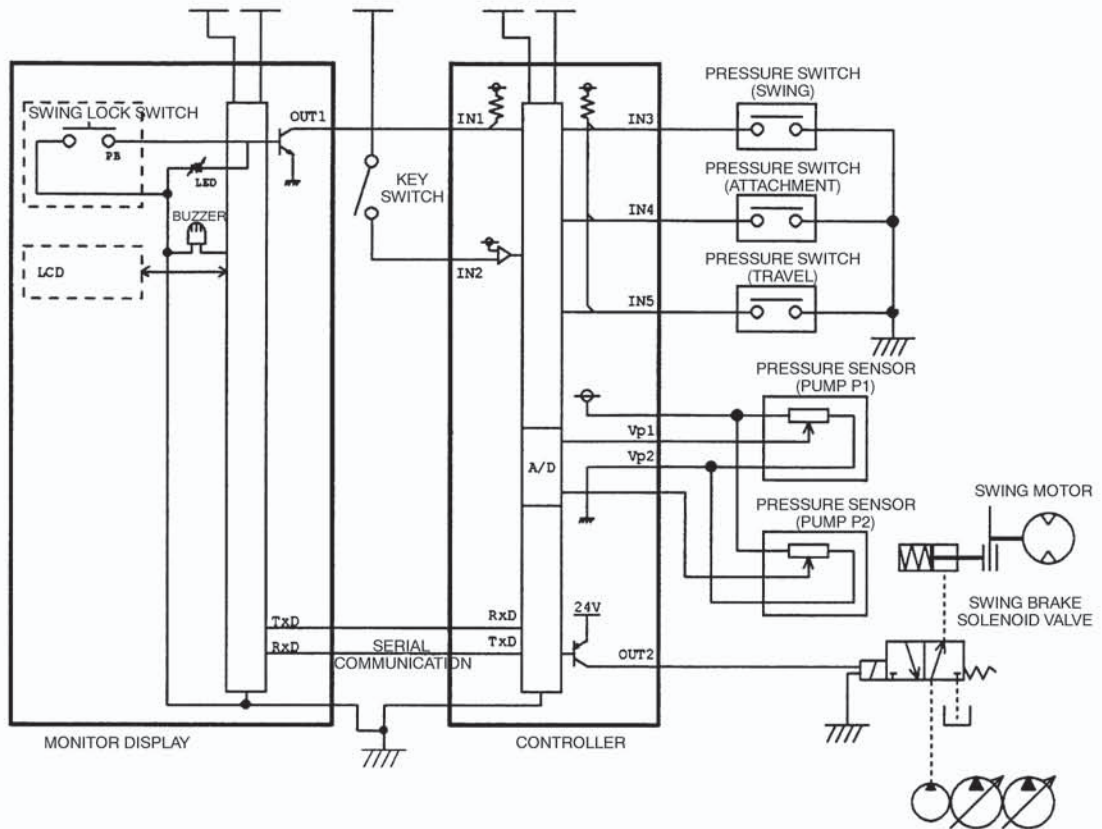
Also, in order protect the actuators which can not be used with the boosted pressure condition, such as travel motor, crusher, etc., the output to the boosting solenoid valve becomes OFF and the pressure boosting is released immediately when the travel pressure switch SW or the option line pressure SW are turned ON.

DESCRIPTION OF FUNCTIONS

M. Swing Lock

N. Swing Brake Control

(1) Circuit Configuration



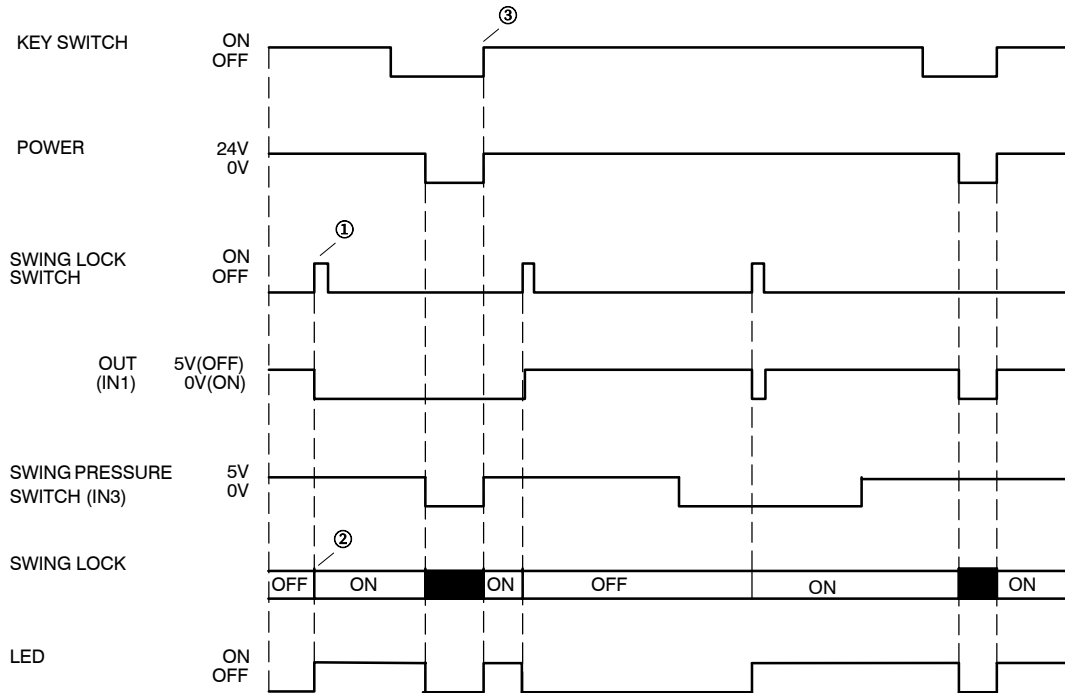
(2) Swing Lock Operation

1. Summary

- ① When pushing the swing lock switch located on the monitor display, red LED on its side lights on its side and the swing becomes locked.
- ② Subsequently, pushing the swing lock SW once again, LED is turned off, and the swing lock is released.
- ③ While the swing is locked, the transistor output on the controller is turned ON, and the mechanical brake installed in the swing motor is turned ON.
- ④ ON/Off status of the swing lock is held in the previous status even if the key SW is turned OFF and then ON.

DESCRIPTION OF FUNCTIONS

2. Time Chart



(3) Auto Swing Brake Control

1. Summary

Auto swing brake control is performed when the swing lock is OFF.

In this case, while digging as well as while operating the swing, the swing mechanical braking is released automatically. When stopping the operation, the swing mechanical brake is automatically turned ON by this control.

Specific ON/OFF conditions of the swing mechanical brake are as follows.

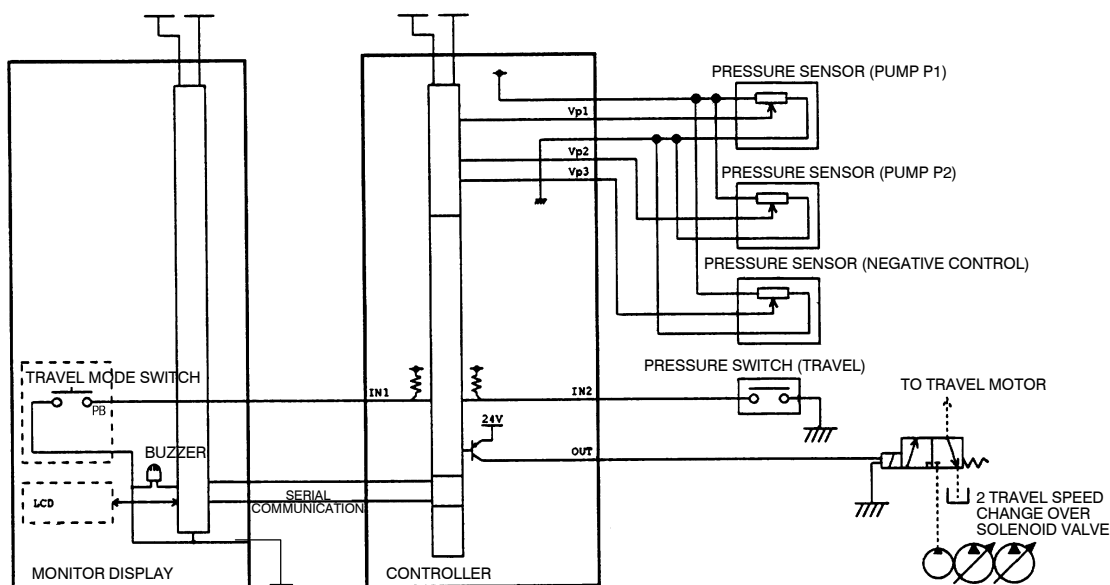
- Swing brake is turned OFF when the following circumstances coincides with during the swing brake is ON.
 - a. Pressure switch (Swing) = ON
 - b. $P1 > 15 \text{ MPa}$ or $P2 > 15 \text{ MPa}$
- Swing brake is turned ON when following circumstances coincides with during swing brake is OFF.
 - a. When status of pressure switch (attachment) = OFF continues for 5 seconds.
 - b. Key switch = OFF
- When the pump delivery pressure ($P1$ or $P2$) becomes greater than 15 MPa while traveling operation is conducted alone, the mechanical swing brake is once turned OFF but turns ON again in 5 seconds.

O. 2 Travel Speed Change Over

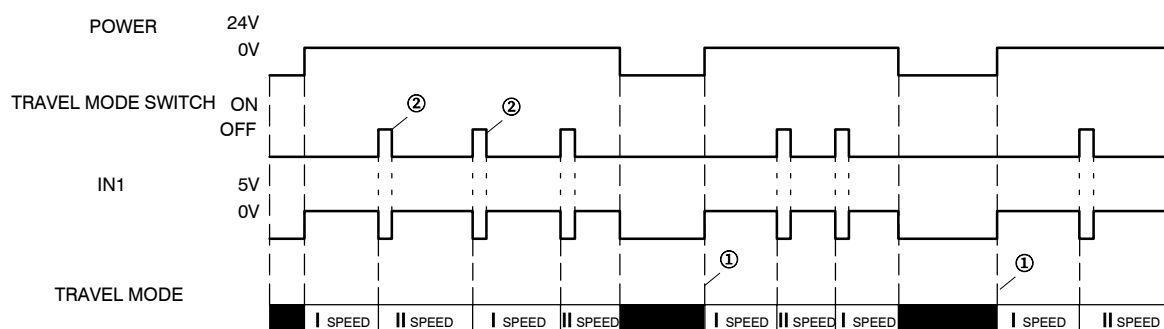
Low speed travel function has been discontinued.

		Type 3
II	High speed	Slanted to high speed side for travel motor (Speed automatic switch – over)
I	Low speed	Slanted to low speed side for travel motor

(1) Circuit Configuration



(2) Time Chart



(3) Travel mode change over

- ① When the key switch is ON, travel motor becomes Speed I regardless of the travel mode when the key switch turned OFF. (Resetting the previous data)
- ② Signals are input to the controller when the travel mode switch is pushed down, (IN : 0 V)
The controller switches the travel modes in the manner of Speed I → Speed II, Speed II → Speed I.
- ③ Controller transmits the changes on display monitor to the monitor display.
- ④ Monitor display changes the display according to the signals that have been sent.

DESCRIPTION OF FUNCTIONS

(4) Operation

1. When travel speed I is selected.

- Controller output (OUT) and 2 travel speed change over solenoid valves are always OFF, and the slant angle of the travel motor is set to low speed side.

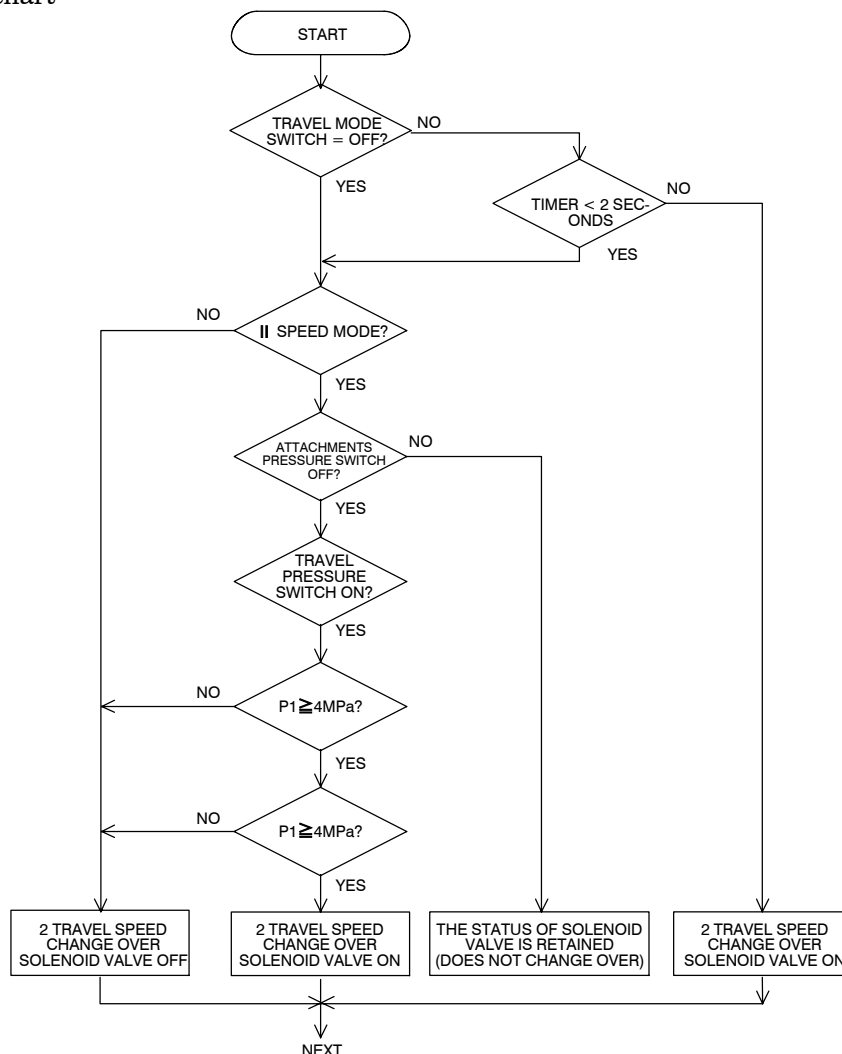
2. When travel speed II is selected

- ① Turn OFF the controller output when either pressure P1 or P2 (or both) becomes 4 Mpa or less (to avoid hunting when travel steering.) That is, when $P1 \geq 4$ MPa or more and $P2 \geq 4$ MPa and more, the control output is turned ON (travel 2 speed switching solenoid valve is ON), the slant angle of the travel motor switches to high speed side.
- ② During the upper pressure switch is ON, the controller output does not switch over to ON/OFF (the slant angle of the travel motor is not switched over while upper operates.)
- ③ Even though the output of controller is ON, when drive pressure of travel motor is high, travel motor changes the slant angle to low speed slant by the function of the motor itself (auto 2 speed function).

3. Travel Forced Speed II Function (Mud cleaning capability when being jacked up)

- Keep pressing the travel change over switch for more than 2 seconds (INI = 0 V). Then, while pressing the switch, the controller output is turned ON regardless of the delivery pressure P1 or P2, and the slant angle of the travel motor is changed over to high speed side. When the switch is turned OFF, it returns to the normal control (controls mentioned above 1. or 2.)

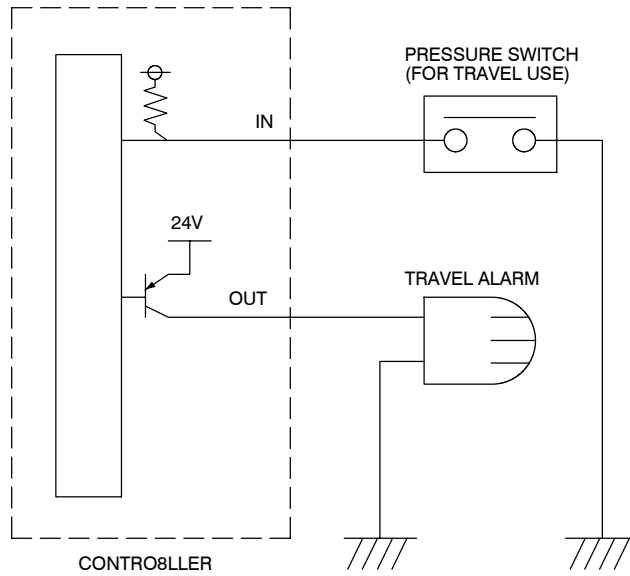
Flow chart



DESCRIPTION OF FUNCTIONS

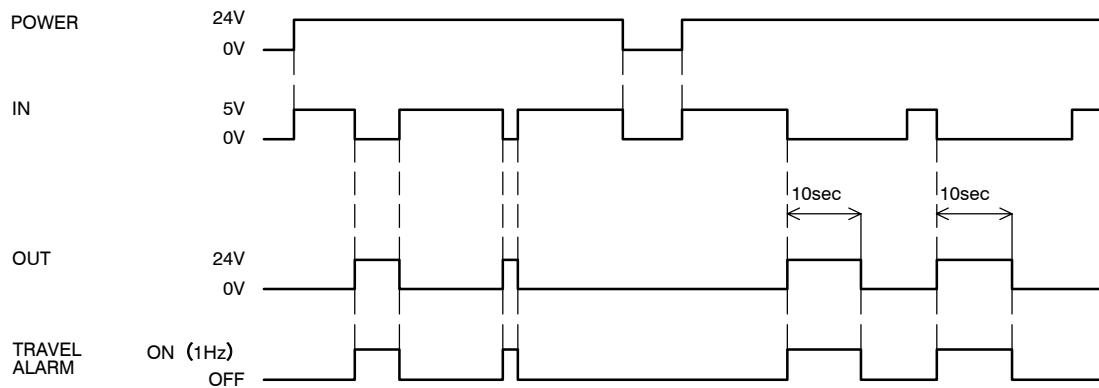
P. Travel Alarm

(1) Circuit Configuration



(2) Time Chart

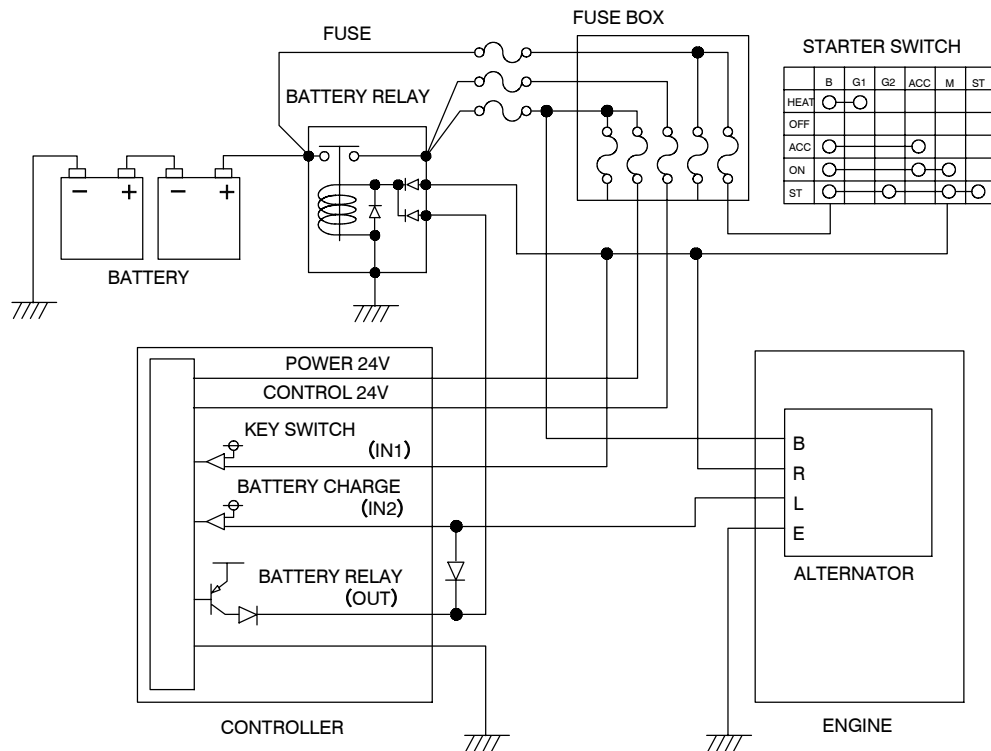
Pressure switch (travel) turns ON by operating the travel lever, and simultaneously the travel alarm signals for 10 seconds and it stops automatically.



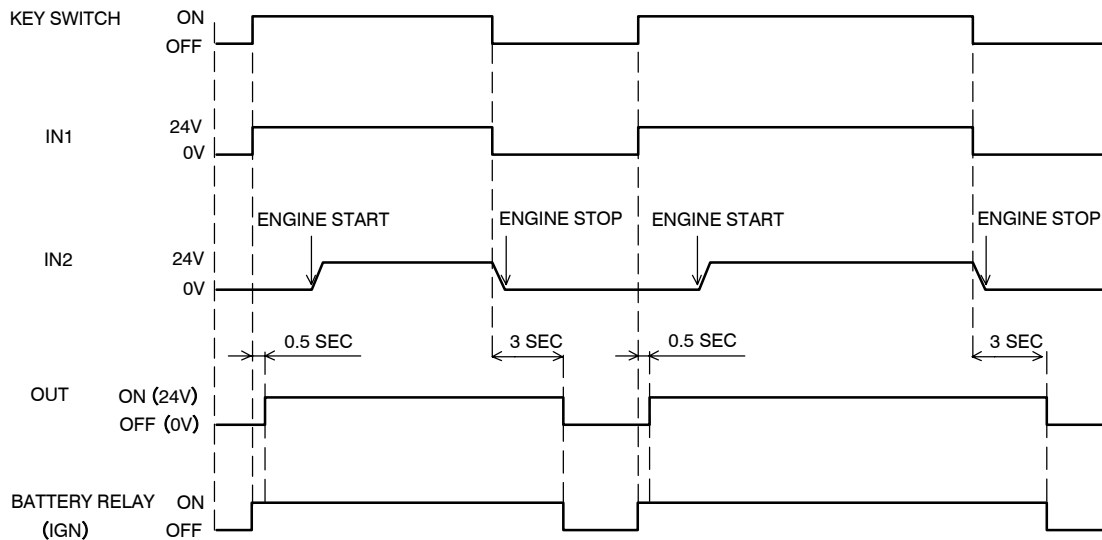
DESCRIPTION OF FUNCTIONS

Q. Power Cut Delay

(1) Circuit Configuration



(2) Time Chart



DESCRIPTION OF FUNCTIONS

R. Power Transistor Protection

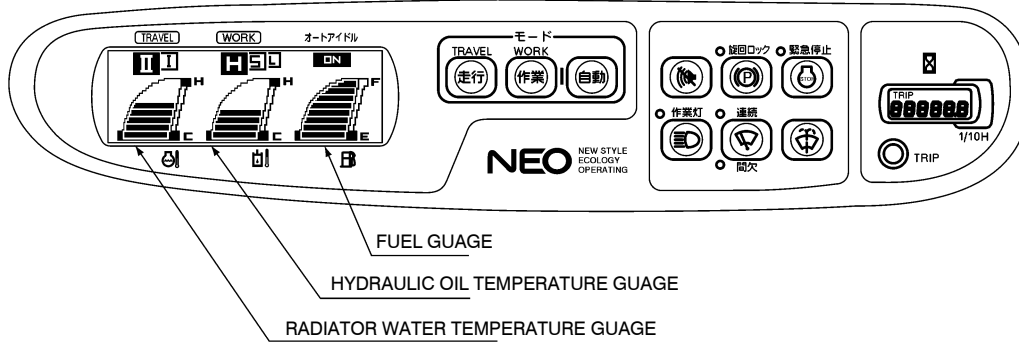
CONTROLLER	8	BOOSTING SOLENOID VALVE (SH200/220-3 ONLY)
	CONNECTOR NO. 17	SPARE 1
	18	SPARE 2
	19	TRAVEL ALARM
	20	BATTERY RELAY
	22	SPARE 3
	23	SPARE 4
	24	SPARE 5
	27	SWING BRAKE SOLENOID VALVE
	28	2 TRAVEL SPEED CHANGE OVER SOLENOID VALVE

Electric

When solenoid valves or relays are short circuited, the output from the power transistor is stopped to protect the controller. When this occurs, the display indicates a message "Electrical System Fault". By carrying out Service and Support check, the faulty areas are indicated.

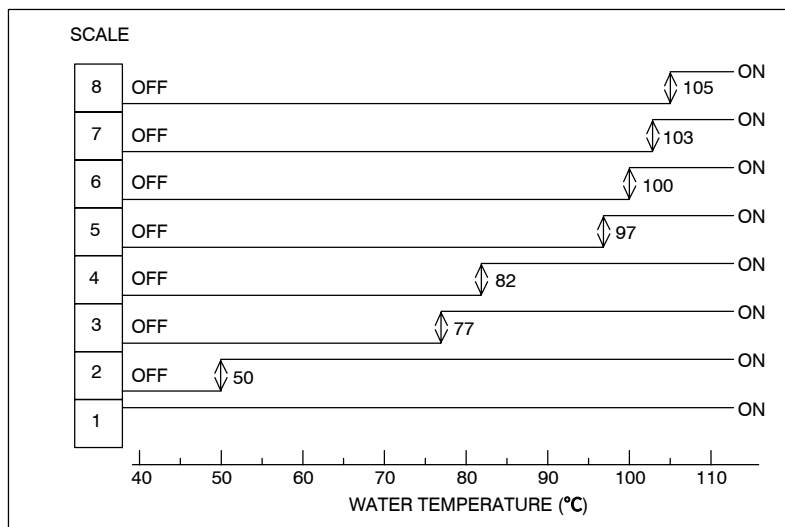
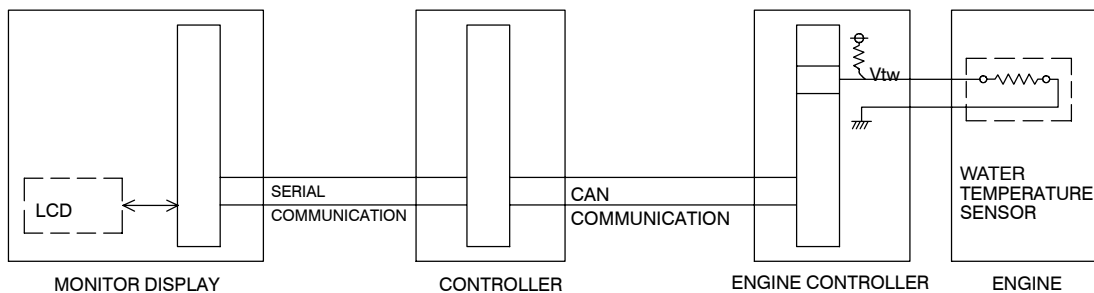
Check the wiring and devices based on the display of the faulty area.

S. Monitor Display



(1) Radiator water temperature

1. Circuit Configuration



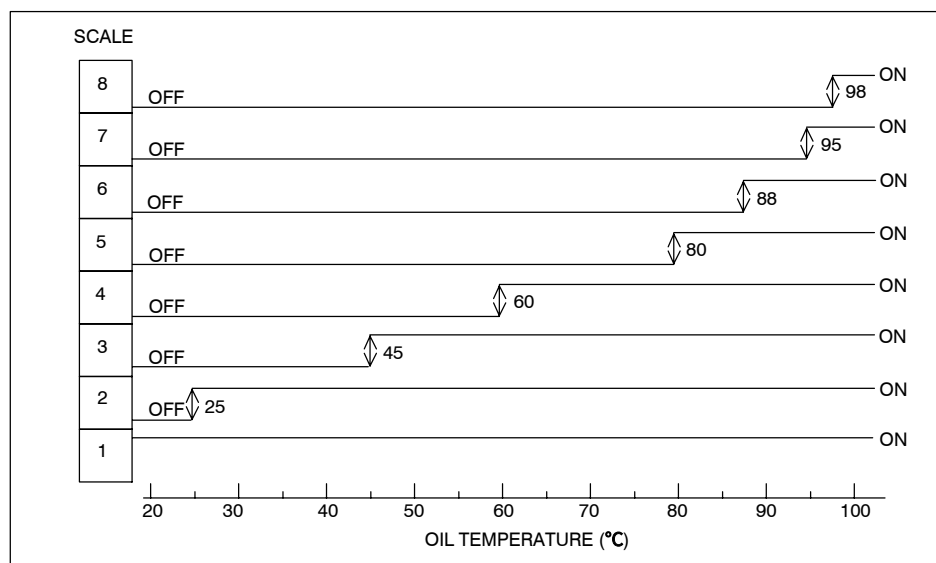
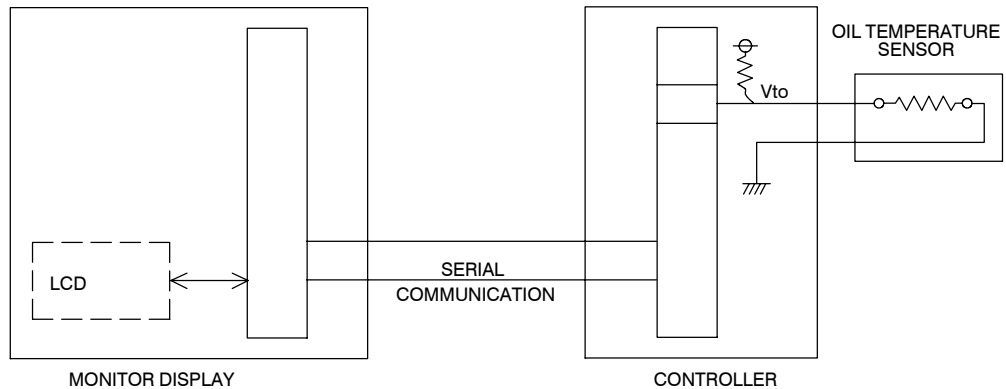
2. Operation

- 1) Signals, V_{tw} from the water temperature sensor attached on the engine are input to the engine controller as an analog signal (voltage).
- 2) The engine controller converts the input signals to temperature value, and transmits the water temperature data to the controller via CAN communication.
- 3) The controller determines the bar graph display against the received signals, and transmits the bar graph display to the monitor display via serial communication.
- 4) The monitor display shows the bar graph according to the display transmitted.
- 5) When the 8th lamp is lit, it indicates "Over heat." (The engine does not stop.)

DESCRIPTION OF FUNCTIONS

(2) Hydraulic oil temperature

1. Circuit Configuration



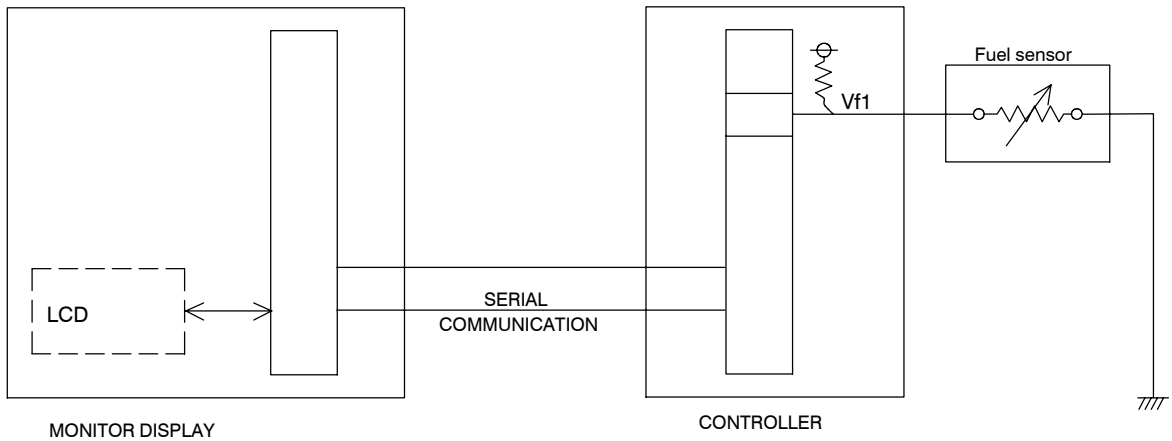
2. Operation

- 1) Signals, Vto from the oil temperature sensor attached to the suction piping, are input to the controller as an analog signal (Voltage).
- 2) Controller convert the input signals to temperature value, determines the bar graph display according to the above graph, and transmits the bar graph display on the monitor display via serial communication.
- 3) Monitor display shows the bar graph according to the transmitted display.
- 4) When the 8th lamp is lit, it indicates "Over heat".

DESCRIPTION OF FUNCTIONS

(3) Fuel remaining

1. Circuit Configuration



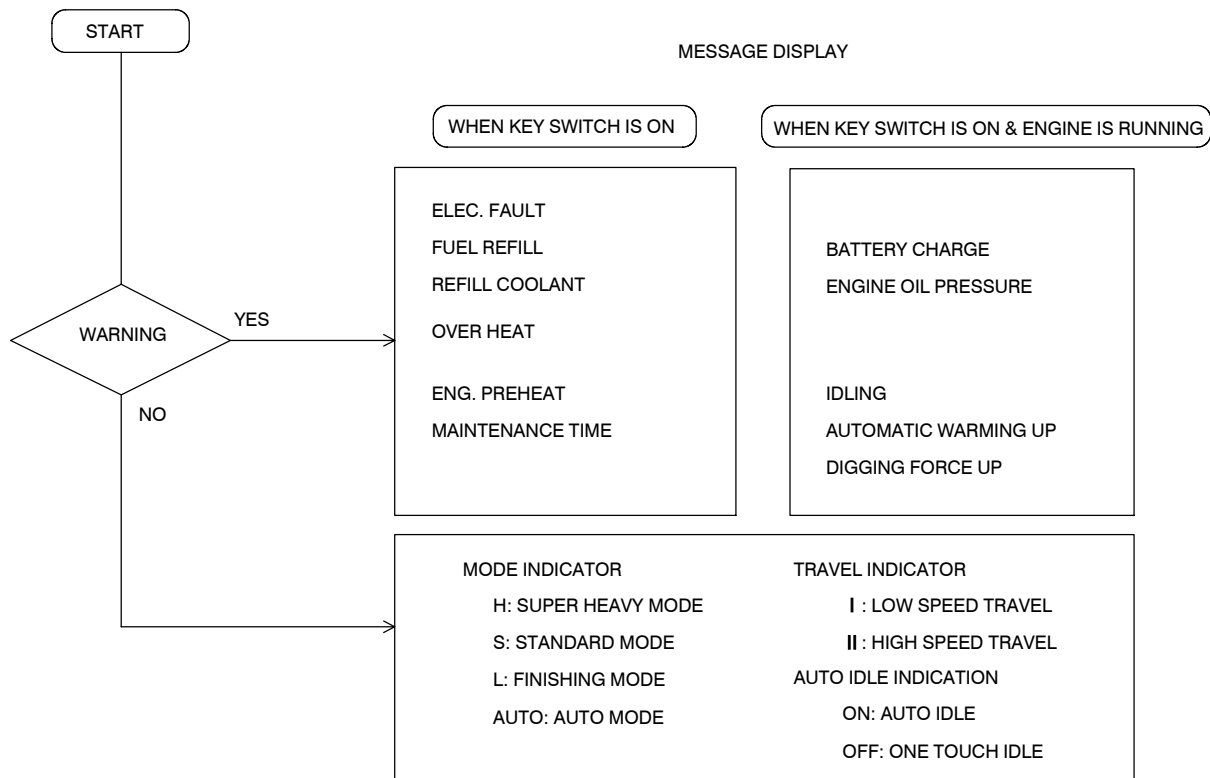
Fuel remaining (L)			Fuel sensor Resistance (Ω)	Input voltage Vfl (V)	Bar graph
SH120-3	SH200-3	SH220-3			
191.1~	261.6~	261.6~	10.0~18.1	0.455~0.766	8
159.8~	232.8~	232.8~	18.1~23.9	0.766~0.964	7
128.5~	190.0~	190.0~	23.9~29.6	0.964~1.142	6
97.1~	147.1~	147.1~	29.6~36.5	1.142~1.337	5
65.7~	104.2~	104.2~	36.5~46.3	1.337~1.582	4
34.4~	51.2~	51.2~	46.3~60.8	1.582~1.891	3
15.6~	25.6~	25.6~	60.8~74.7	1.891~2.138	2
~15.6	~25.6	~25.6	74.7~80.0	2.138~2.222	1 (Fuel refill)

2. Operation

- ① Signals, Vfl from the fuel sensor attached to the fuel tank, are input to the controller as an analog signal (Voltage).
- ② Controller determines the input signals according to the above-mentioned graph and transmits the bar graph display on the monitor display via serial communication.
- ③ Monitor display shows the bar graph according to the transmitted display.

DESCRIPTION OF FUNCTIONS

Warning Display (message display)

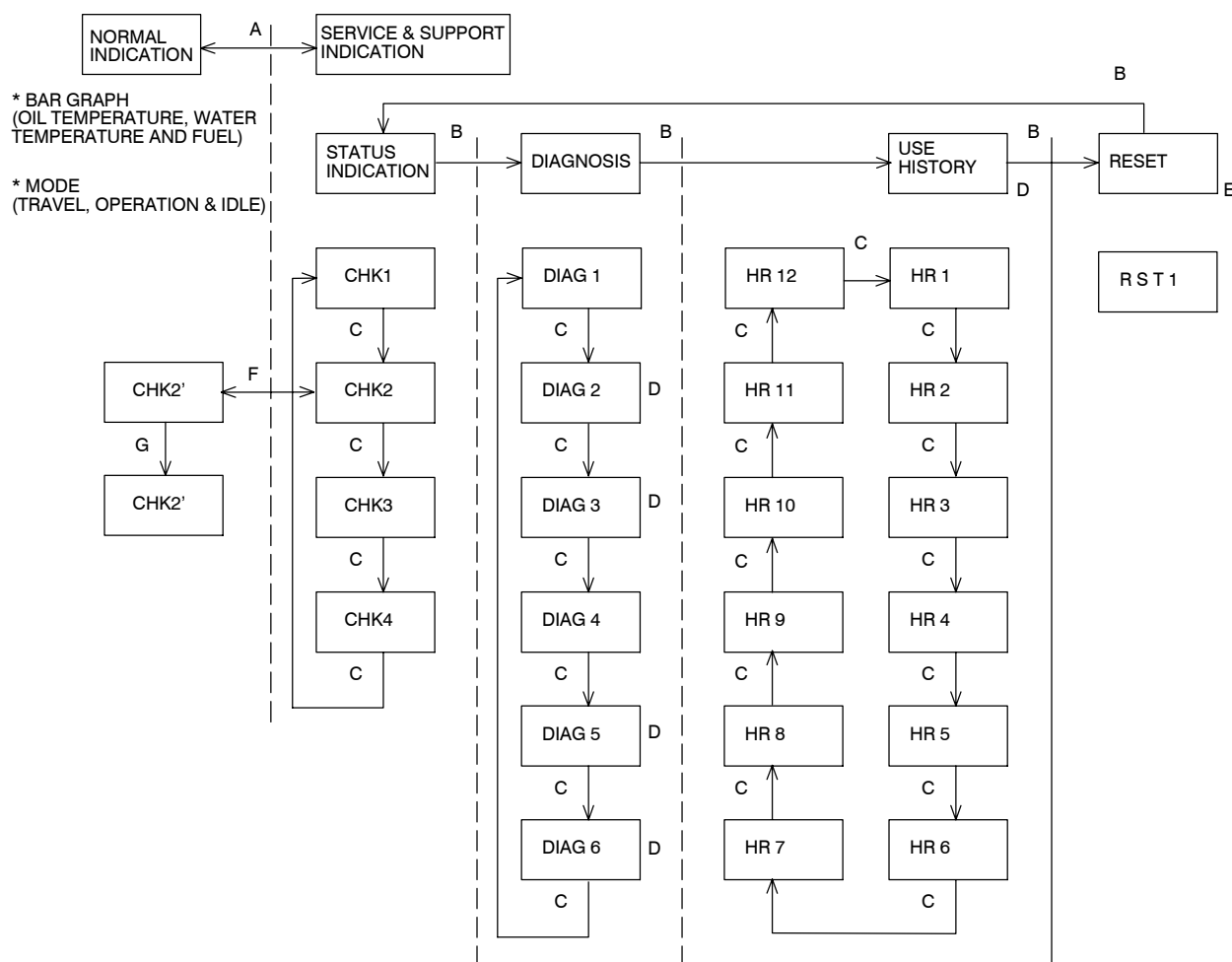


Buzzer	Message Display	Meaning and Measures to be Taken
	ENG. PREHEAT	Engine preheat (glow) is indicated.
	AUTO WARM UP	It is shown during engine automatic warming up. The automatic warming up is released by moving the throttle volume or operation levers.
	IDLING	It is shown while the engine is running at low idling.
	DIGGING FORCE UP	It is shown during automatic digging force up.
	MAINTENANCE TIME	At the time of every 500–hour service intervals, it is shown for 1 minute. (It is displayed 5 times.) Following the periodic maintenance list, conduct inspections and maintenance.
Sounds	FUEL REFILL	Indicates the fuel level is very low. Refill fuel.
Sounds	REFILL COOLANT	Indicates the coolant water level is low. Refill coolant.
Sounds	ENGINE OIL PRESSURE	Indicates the engine oil pressure is abnormally low. Stop the engine, check engine oil level and refill oil.
Sounds	OVER HEAT	Indicates the engine coolant temperature or hydraulic oil temperature abnormally rises. Run the engine at low idling to reduce water or oil temperatures. Check the radiator and oil cooler.
Sounds	BATTERY CHARGE	Indicates faults in battery charging system. Check the electrical circuits.
Sounds	ELEC. FAULT	Indicates electric faults (short circuit or disconnection) in the electrical system. Check the electrical circuits.

Summary

1. Machine Status Indication
Indicates the current operating status.
2. Diagnosis Indication
Indicates codes of current errors, codes of previous errors, and the time of the occurrence.
3. Use history Indication
Indicates each time for various operations of the machine.
4. Reset Indication
Indicates the current function settings, and the settings can be changed according to the user's requirement.

Operation



Switch Operation

- A. Changes over when travel & operation mode switch is ON for 3 seconds or more.
- B. Changes over when auto mode switch is ON.
- C. Changes over when buzzer stop switch is ON.
- D. Data will be cleared when operation mode switch is ON for 10 second or more.
(Buzzer sounds when clearing.)
- E. Selects the reset function when buzzer stop switch is ON, resets when travel mode switch is ON, and resets data when operation mode switch is ON for 10 seconds or more.
(Buzzer sounds when data is reset.)
- F. Checks output during the protection circuit is operating when travel mode switch is ON.
- G. Indicates the short-circuit auto detection results when travel mode switch is ON for 10 seconds or more. (Buzzer sounds.)

1. Status Indication (CHK 1)

CHK 1	MODE II.H	ENG 2000 rpm
	P1 030.0 Mpa	I 0300 mA
	P2 030.0 Mpa	WT 0080 °C
	N 03.00 Mpa	OT 0055 °C

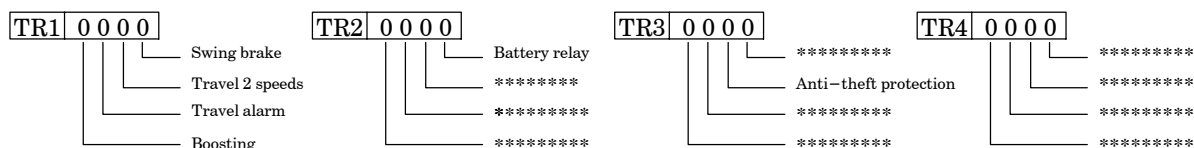
MODE : Travel Mode, Operation Mode
P1 : Main pump (P1) pressure
P2 : Main pump (P2) pressure
N : Negative control (N1) pressure
ENG : No. of engine revolutions
I : Pump control current values
WT : Radiator water temperature
OT : Hydraulic oil temperature

2. Status Indication (CHK 2)

CHK 2	MODE II.H	TR1 0000
	R 0080 %	TR2 0000
	FT 0040 °C	TR3 0000
	TV 0100 %	TR4 0000

R : Engine load ratio $((Q-Q_n) / (Q_f-Q_n))$
FT : Fuel temperature
TV : Throttle volume opening
TR1 : Controller transistor output
TR2 : Controller transistor output
TR3 : Controller transistor output
TR4 : Controller transistor output

Controller transistor output (0=OFF, 1=ON)

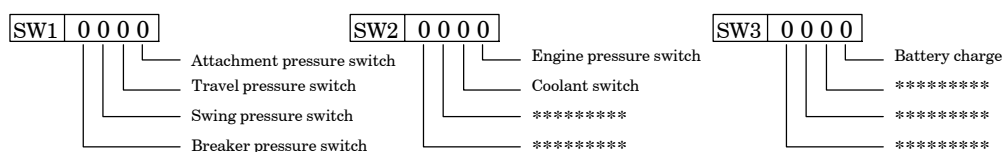


3. Status Indication (CHK 3)

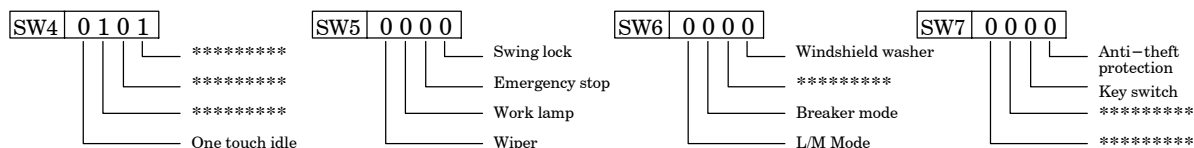
CHK 3	MODE II.H	SW4 0000
	SW1 0000	SW5 0000
	SW2 0000	SW6 0000
	SW3 0000	SW7 0000

SW1 : Controller switch input (Sensor switch)
SW2 : Controller switch input (Sensor switch)
SW3 : Controller switch input (Sensor switch)
SW4 : Controller switch input (Operation switch)
SW5 : Controller switch input (Operation switch)
SW6 : Controller switch input (Operation switch)
SW7 : Controller switch input (Operation switch)

Controller switch input; Sensor switch (0=OFF, 1=ON)



Controller switch input; Operation switch (0=OFF, 1=ON)



4. Status Indication (CHK 4)

CHK 4	MODE I.H	1	0 0 0 0
	FS 0 0 8 0 Ω	2	0 0 0 0
	AC 0 0 0 5	3	0 0 0 0
	TR5 0 0 1 0	4	0 0 0 0

FS : Fuel sensor resistance
AC : Temperature information for air conditioning
TR5 : NPN transistor output
1 : Target no. of revolutions (rpm)
2 : *****
3 : *****
4 : *****

AC 0 0 0 5

1 : WT < 30°C
2 : 30°C ≤ WT < 45°C
3 : 45°C ≤ WT < 65°C
4 : 65°C ≤ WT < 75°C

TR5 0 0 0 0

5. Status Indication (CHK 2')

CHK 2	MODE II.H	TR1	0 1 0 1
	R 0 0 8 0 %	TR2	0 0 0 1
	FT 0 0 4 0 °C	TR3	0 0 0 0
	TV 0 1 0 0 %	TR4	0 0 0 0

R : Engine load ratio $((Q-Q_n) / (Q_f-Q_n))$
FT : Fuel temperature
TV : Throttle volume opening
TR1 : Transistor output status when overcurrent is detected
TR2 : Transistor output status when overcurrent is detected
TR3 : Transistor output status when overcurrent is detected
TR4 : Transistor output status when overcurrent is detected

- 1) Indicates output status when over-current was detected in the past, while turning ON the travel mode switch on the "CHK 2" display.
- 2) Data is cleared by resetting the error code on the diagnosis display.
- 3) The example shown above indicates that output of travel alarm, swing brake and battery relay were outputting when over-current was detected.

6. Status Indication (CHK 2'')

CHK 2	MODE II.H	TR1	0 0 1 0
	R 0 0 8 0 %	TR2	0 0 0 0
	FT 0 0 4 0 °C	TR3	0 0 0 0
	TV 0 1 0 0 %	TR4	0 0 0 0

R : Engine load ratio $((Q-Q_n) / (Q_f-Q_n))$
FT : Fuel temperature
TV : Throttle volume opening
TR1 : Short circuit auto detect results
TR2 : Short circuit auto detect results
TR3 : Short circuit auto detect results
TR4 : Short circuit auto detect results

- 1) When the key switch is turned ON by turning ON the one touch idle switch, the short circuit auto detection starts to operate. (Do not start the engine.)
- 2) After changing over to the "CHK 2" display, turn ON the travel mode switch for 10 seconds to indicate auto detection results.
- 3) The example above indicates that the 2 travel speed line is short-circuited.
- 4) When turning OFF the key switch, the data is cleared.

7. Diagnosis (DIAG1), current error status of the engine system (Error codes) Error code

DIAG 1	MODE II.H	E	0	0	0	0
	E	0	0	1	5	
	E	0	0	0	0	
	E	0	0	0	0	

E : Engine system error codes

Example) Water sensor fault

Error code

- E 0032 : Rack sensor
- E 0031 : Governor internal circuit, linear servo motor
- E 0041 : TDC sensor
- E 0042 : Backup sensor
- E 0015 : Water temperature sensor
- E 0016 : Fuel temperature sensor
- E 0025 : Q adjusting resistance
- E 0000 : No fault

8. Diagnosis (DIAG2), Previous error status of the engine system (Error codes)

DIAG 2	MODE II.H	E	0	0	0	0
	E	0	0	3	2	
	E	0	0	1	6	
	E	0	0	0	0	

E : Engine system error codes

Rack sensor fault, fuel temperature sensor fault

9. Diagnosis (DIAG3), Previous error status of the engine system (Error codes)

(Error occurrence time; controller hour meter value)

DIAG 3	MODE II.H	E	0	0	0	0
	E	1	2	0	0	
	E	1	0	0	0	
	E	0	0	0	0	

E : Engine system error codes

Example) Rack sensor fault: Error occurs in 1200 HR
 Fuel temperature sensor fault: Error occurs in 1000 HR

- 1) When the operation mode switch 9. is turned on for 10 seconds or more, the previous error codes and the occurrence time data are cleared.
- 2) Time indicated in the 9. is the time when error code occurred first time after data was cleared.(Time is not recorded after the second occurrence.)
- 3) When data is cleared, the data of 6. and 7. are written on EEPROM. (No display is shown on the monitor. Make it possible to retrieve the data on PC.)

10. Diagnosis (DIAG4), Current error status of the Machine body (Error codes)

DIAG 4	MODE II.H	M 0 0 0 0
	M 0 0 2 0	M 0 0 0 0
	M 0 0 0 0	M 0 0 0 0
	M 0 0 0 0	M 0 0 0 0

M : Machine main system error codes

Example) Oil temperature sensor fault

Error codes

M 0010 : Transistor output short-circuit
M 0020 : Oil temperature sensor
M 0030 : Fuel sensor
M 0040 : Pressure sensor (P1)
M 0050 : Pressure sensor (P2)
M 0060 : Pressure sensor (N2)
M 0070 : Key switch

M 0080 : Pressure switch
(attachments or travel)
M 0090 : CAN communication error
M 00A0 : Controller reset
M 00B0 : Engine controller miss-match
M 00C0 : *****
M 00D0 : *****
M 00E0 : *****

M 0000 : No fault

11. Diagnosis (DIAG5), Previous error status of the Machine body (Error codes)

DIAG 5	MODE II.H	M 0 0 0 0
	M 0 0 2 0	M 0 0 0 0
	M 0 0 3 0	M 0 0 0 0
	M 0 0 0 0	M 0 0 0 0

M : Machine main system error codes

Example) Oil temperature sensor fault, fuel sensor fault

12. Diagnosis (DIAG6), Previous error status of the Machine body (Error codes)

DIAG 6	MODE II.H	M 0 0 0 0
	M 1 2 0 0	M 0 0 0 0
	M 1 0 0 0	M 0 0 0 0
	M 0 0 0 0	M 0 0 0 0

M : Machine main system error codes

Example) Oil temperature sensor fault: Error occurs in
1200 HR

Fuel sensor fault: Error occurs in 1000 HR

- 1) When the operation mode switch is turned on for 10 seconds or more, the previous problem codes and the occurrence time data will be cleared.
- 2) Time indicated in 12. is the time when problem code occurs first time after data was cleaned.(Time is not recorded after the second occurrence.)
- 3) When data is cleared, the data of 11. and 12. are written on EEPROM. (No display is shown on the monitor. Make it possible to retrieve the data on PC.)

13. Use history (HR 1)

HR 1	MODE II.H	T 0000	HR
	ENG 0000	S 0000	HR
	WRK 0000	PU 0000	HR
	U 0000	BRK 0000	HR

ENG : Hour meter (Alternator generating time)
 WRK : Machine operating time (attachments ON or travel ON)
 U : Attachments operating time
 T : Travel operating time
 S : Swing operating time
 PU : Boosting time
 BRK : Breaker spent time

14. Use history (HR 2)

HR 2	MODE II.H	A 0000	HR
	H 0000	WT 0000	°C
	S 0000	OT 0000	°C
	L 0000	FT 0000	°C

H : H mode spent time
 S : S mode spent time
 U : L mode spent time
 A : A mode spent time
 WT : Maximum water temperature
 OT : Maximum oil temperature
 FT : Maximum fuel temperature

15. Use history (HR 3)

HR 3	MODE II.H	4 0000	
	1 0000	5 0000	
	2 0000	6 0000	
	3 0000	7 0000	

1 : Controller power ON time
 2 : I Mode spent time
 3 : II Mode spent time
 4 : Travel time without operation
 5 : *****
 6 : *****
 7 : *****

16. Use history (HR 4)

HR 4	MODE II.H	4 0000	
	1 0000	5 0000	
	2 0000	6 0000	
	3 0000	7 0000	

P1 pressure distribution

1 : P1: Time for 10 MPa or less
 2 : P1: Time between 10 MPa – 15 MPa
 3 : P1: Time between 15 MPa – 20 MPa
 4 : P1: Time between 20 MPa – 25 MPa
 5 : P1: Time between 25 MPa – 30 MPa
 6 : P1: Time between 30 MPa – 35 MPa
 7 : P1: Time for 35 MPa or more

17. Use history (HR 5)

HR 5	MODE II.H	4 0000	
	1 0000	5 0000	
	2 0000	6 0000	
	3 0000	7 0000	

P2 pressure distribution

1 : P2: Time for 10 MPa or less
 2 : P2: Time between 10 MPa – 15 MPa
 3 : P2: Time between 15 MPa – 20 MPa
 4 : P2: Time between 20 MPa – 25 MPa
 5 : P2: Time between 25 MPa – 30 MPa
 6 : P2: Time between 30 MPa – 35 MPa
 7 : P2: Time for 35 MPa or more

18. Use history (HR 6)

HR 6	MODE II.H	4	0	0	0	0
	1	0	0	0	0	0
	2	0	0	0	0	0
	3	0	0	0	0	0
		5	0	0	0	0
		6	0	0	0	0
		7	0	0	0	0

No. of engine revolutions distribution

- 1 : N: Time for 1200 rpm or less
- 2 : N: Time between 1200 rpm – 1400 rpm
- 3 : N: Time between 1400 rpm – 1600 rpm
- 4 : N: Time between 1600 rpm – 1800 rpm
- 5 : N: Time between 1800 rpm – 2000 rpm
- 6 : N: Time between 2000 rpm – 2200 rpm
- 7 : N: Time between 2200 rpm or more

19. Use history (HR 7)

HR 7	MODE II.H	4	0	0	0	0
	1	0	0	0	0	0
	2	0	0	0	0	0
	3	0	0	0	0	0
		5	0	0	0	0
		6	0	0	0	0
		7	0	0	0	0

Water temperature distribution

- 1 : TW: Time for 77°C or less
(Bar graph 1, 2 scales)
- 2 : TW: Time between 77°C – 82°C
(Bar graph 3 scales)
- 3 : TW: Time between 82°C – 97°C
(Bar graph 4 scales)
- 4 : TW: Time between 97°C – 100°C
(Bar graph 5 scales)
- 5 : TW: Time between 100°C – 103°C
(Bar graph 6 scales)
- 6 : TW: Time between 103°C – 105°C
(Bar graph 7 scales)
- 7 : TW: Time for 105°C or more
(Bar graph 8 scales)

20. Use history (HR 8)

HR 8	MODE II.H	4	0	0	0	0
	1	0	0	0	0	0
	2	0	0	0	0	0
	3	0	0	0	0	0
		5	0	0	0	0
		6	0	0	0	0
		7	0	0	0	0

Oil temperature distribution

- 1 : TO: Time for 45°C or less
(Bar graph 1, 2 scales)
- 2 : TO: Time between 45°C – 60°C
(Bar graph 3 scales)
- 3 : TO: Time between 60°C – 80°C
(Bar graph 4 scales)
- 4 : TO: Time between 80°C – 88°C
(Bar graph 5 scales)
- 5 : TO: Time between 88°C – 95°C
(Bar graph 6 scales)
- 6 : TO: Time between 95°C – 98°C
(Bar graph 7 scales)
- 7 : TO: Time for 98°C or more
(Bar graph 8 scales)

21. Use history (HR 9)

HR 9	MODE II.H	4	0	0	0	0
	1	0	0	0	0	0
	2	0	0	0	0	0
	3	0	0	0	0	0
		5	0	0	0	0
		6	0	0	0	0
		7	0	0	0	0

Fuel temperature distribution

- 1 : TF: Time for 30°C or less
- 2 : TF: Time between 30°C – 40°C
- 3 : TF: Time between 40°C – 50°C
- 4 : TF: Time between 50°C – 60°C
- 5 : TF: Time between 60°C – 70°C
- 6 : TF: Time between 70°C – 80°C
- 7 : TF: Time for 80°C or more

22. Use history (HR 10)

HR 10	MODE II.H	4	0	0	0	0
	1	0	0	0	0	0
	2	0	0	0	0	0
	3	0	0	0	0	0
		5	0	0	0	0
		6	0	0	0	0
		7	0	0	0	0

Load ratio distribution

$$R = (Q - Q_n) / (Q_f - Q_n)$$

- 1 : R: Time for 30% or less
- 2 : R: Time between 30% – 40%
- 3 : R: Time between 40% – 50%
- 4 : R: Time between 50% – 60%
- 5 : R: Time between 60% – 70%
- 6 : R: Time between 70% – 80%
- 7 : R: Time for 80% or more

23. Use history (HR 11)

HR 11	MODE II.H	4	0000	
	1	0000	5	0000
	2	0000	6	0000
	3	0000	7	0000

Load ratio distribution when H Mode high idle

$$R = (Q - Q_n) / (Q_f - Q_n)$$

- 1 : R: Time for 30% or less
- 2 : R: Time between 30% – 40%
- 3 : R: Time between 40% – 50%
- 4 : R: Time between 50% – 60%
- 5 : R: Time between 60% – 70%
- 6 : R: Time between 70% – 80%
- 7 : R: Time for 80% or more

24. Use history (HR 12)

HR 12	MODE II.H		4	0000
	1	0000	5	0000
	2	0000	6	0000
	3	0000	7	0000

Load ratio distribution when S Mode high idle

$$R = (Q - Q_n) / (Q_f - Q_n)$$

- 1 : R: Time for 30% or less
- 2 : R: Time between 30% – 40%
- 3 : R: Time between 40% – 50%
- 4 : R: Time between 50% – 60%
- 5 : R: Time between 60% – 70%
- 6 : R: Time between 70% – 80%
- 7 : R: Time for 80% or more

When the operation mode switch in one of displays from [11] to [24] is turned ON for 10 seconds or more, all use history data will be cleared.

25. Reset (RST 1)

RST 1	MODE II.H	PA 0 0 0 0
	BRK 0 0 0 0 rpm	AU 0 0 0 0
	L/M 0 0 0 0 rpm	HLD 0 0 0 0
	AI 0 0 0 0 Sec	OUT 0 0 0 0

MODE : Travel Mode, Operation Mode

BRK : No. of engine revolutions setting for breaker

L/M : No. of engine revolutions setting for L/M

AI : Auto idle time setting (1 – 30 seconds)

PA : Pump output adjustment (0 = off, 1 = on)

AU : Auto boosting (0 = exist, 1 = none)

HLD : Previous data retain setting

OUT : PC communication setting

(0 = wait for transfer, 1 = transfer processing)

HLD	0 0 0 0
-----	---------

Auto mode (0 = Previous data retained, 1 = Previous data reset)

Operation mode (0 = Previous data reset, 1 = Previous data retained)

Travel mode (0 = Previous data reset, 1 = Previous data retained)

Maintenance time display

(0 = Display function, 1 = No display function)

Reset example 1: No. of engine revolutions setting for breaker.

- 1) Select breaker's no. of engine revolutions setting with the buzzer stop switch. (The selected item is changed from negative display to positive display.)

RST 1	MODE II.H	PA 0 0 0 0
	BRK 1 8 0 0 rpm	AU 0 0 0 0
	L/M 0 0 0 0 rpm	HLD 0 0 0 0
	AI 0 0 0 0 Sec	OUT 0 0 0 0

- 2) Then, set the breaker's no. of engine revolutions to 1800 rpm. Start the engine, and adjust the no. of engine revolutions with throttle volume while observing the monitor. Upon completing the adjustment, leave the operation mode switch ON for 10 seconds. When data storing is finished, the buzzer sounds.
- 3) Turn OFF the key switch. (Turn OFF the key switch OFF with the no. of engine revolution setting left as it is.)

Reset example 2: Change Auto idle time

- 1) Select Auto idle time setting with the buzzer stop switch. (The selected item is changed from negative display to positive display.)

RST 1	MODE II.H	PA 0 0 0 0
	BRK 1 8 0 0 rpm	AU 0 0 0 0
	L/M 0 0 0 0 rpm	HLD 0 0 0 0
	AI 0 0 0 0 Sec	OUT 0 0 0 0

- 2) Then, set the Auto idle time to 10 seconds. Keep turning the travel mode switch ON until the number increases up to 10. Every time the switch is turned ON, the number increases with the increment of 1. Values from 1 to 30 can be set. Upon completing the setting, leave the operation mode switch ON for 10 seconds. When data storing is finished, the buzzer sounds.
- 3) Turn OFF the key switch.

MEASURING METHODS FOR ELECTRICAL DEVICES

Measuring Equipment

1. Hydraulic pump solenoid proportional valve
2. Stop motor
3. Solenoid valve (SH200/220–3: quadruple, SH120–3: triple)
4. Backup sensor
5. Water/oil temperature sensors
6. Pressure sensor
7. Fuel sensor

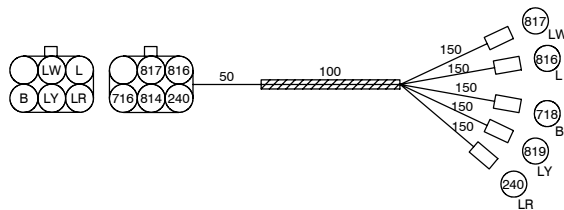
Jigs & Tools for Measurement

1. Tester
2. Service connector kit assembly

Parts number:

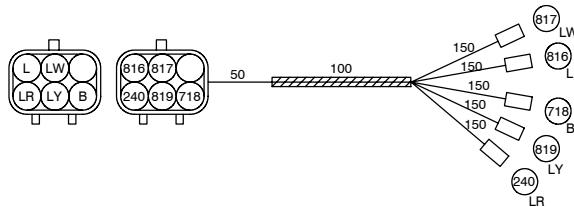
- 1) For stop motor use (6P)

Parts number: WDB0055–3



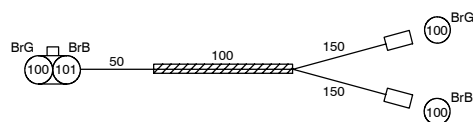
- 2) For stop motor's harness side use (6P)

Parts number: WDB0055–4



- 3) For solenoid valve use (2P)

Parts number: WDB0055–5



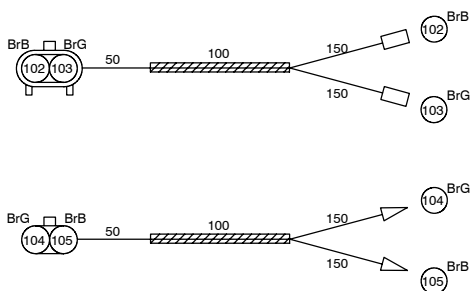
- Solenoid valve (quadruple)
- Fuel sensor

MEASURING METHODS FOR ELECTRICAL DEVICES

4) 5) For hydraulic pump's solenoid proportional valve use (2P)
WDB0055-6

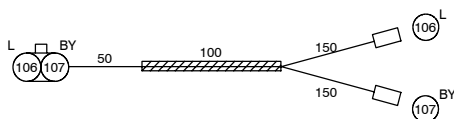
Parts number:

WDB0055-7



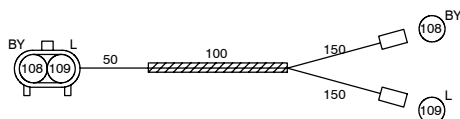
6) For pressure switch use (2P)

Parts number: WDB0055-8



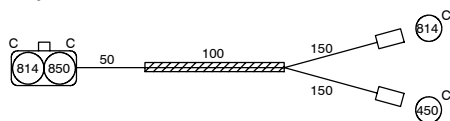
7) For pressure switch's harness side use (2P)

Parts number: WDB0055-9



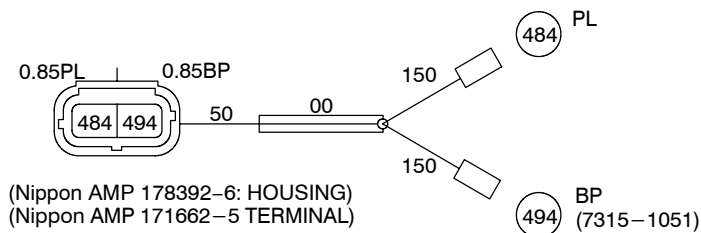
8) For receiver dryer use (2P)

Parts number: WDB0055-10



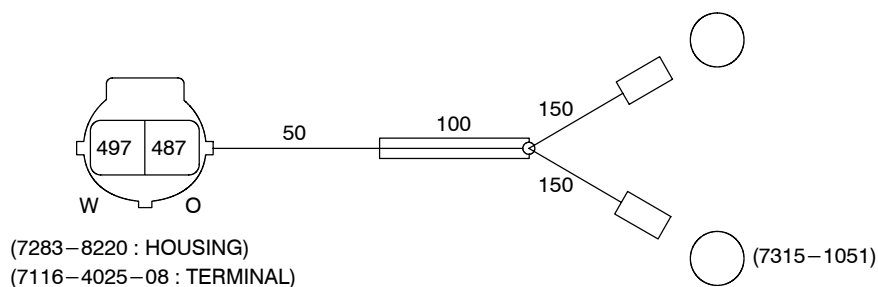
MEASURING METHODS FOR ELECTRICAL DEVICES

9) For oil temperature, water temperature sensor use (2P) Parts number:



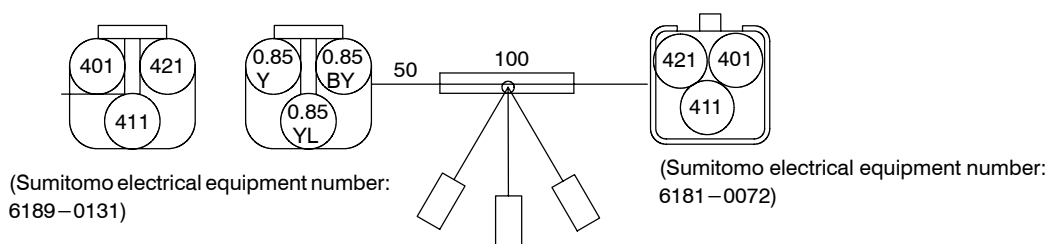
10) For backup sensor use (2P)

Parts number:



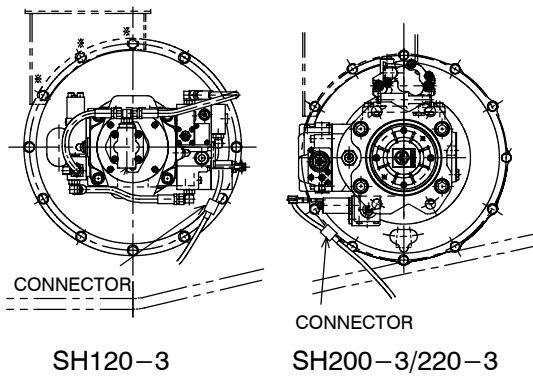
11) For pressure sensor use (2P)

Parts number:

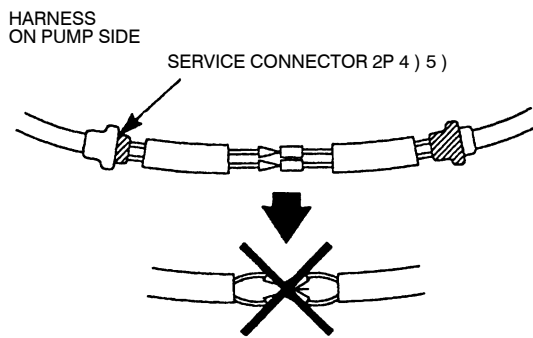


MEASURING METHODS FOR ELECTRICAL DEVICES

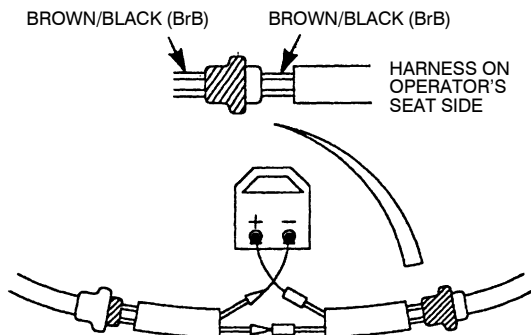
A. Hydraulic Pump Solenoid Proportional Valve



- Disconnect the connector on the solenoid proportional valve attached on the hydra pump.



- Connect a service connector for 2P between the disconnected connectors.
- Be careful not to insert the nail terminal to the opposite plug terminal when connecting the connectors.



- For the tester connection, confirm that the color of harnesses from the operator's seat side are brown/black (same colors as the ones for service connector side) and connect the red terminal of the tester to the operator's seat side and black terminal of the tester to the hydraulic pump side.
- After completing the connection, start the engine and check the current in each mode at the maximum speed.

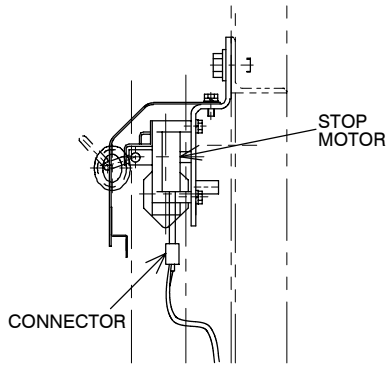
Current value in each mode

(mA)

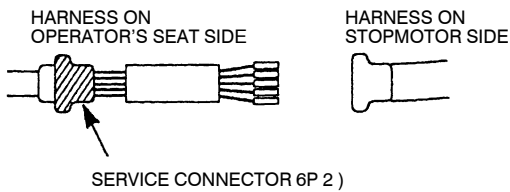
Machine Type \ Mode	H		S	L	Auto	
	MAX	MIN			S	L
SH120-3	600	450	450	100 or less	490	450
SH200-3	407	292	292	50 or less	332	292
SH220-3	424	307	307	50 or less	347	307

MEASURING METHODS FOR ELECTRICAL DEVICES

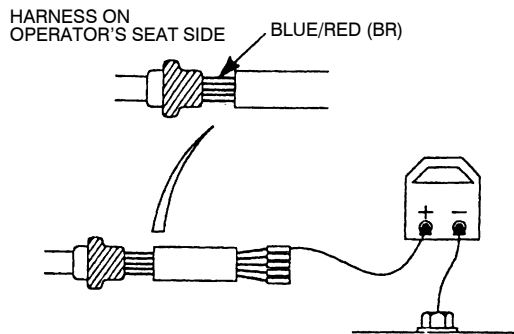
B. Stop Motor



- Disconnect the connector attached on the stop motor.



- Connect a service connector for 6P between the disconnected connectors. (Only for the operator's seat side)

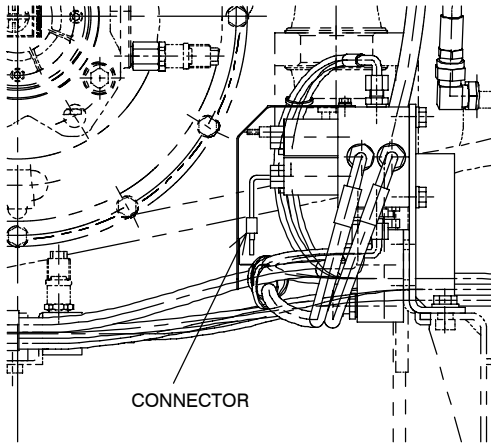


- Confirm that the color of harnesses from the operator's seat side are blue / red (same colors as the ones for service connector side), and connect the red terminal of the tester to a harness on the operator's seat side and black terminal of the testere to ground.
- After completing the connection, turn ON the key switch to check the voltage.

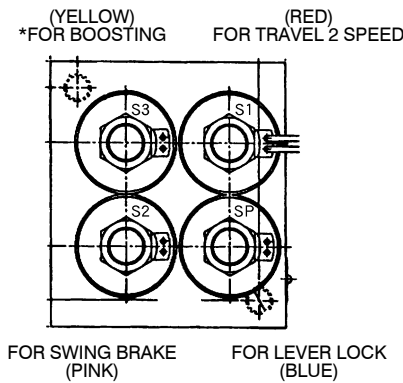
Voltage 24V

MEASURING METHODS FOR ELECTRICAL DEVICES

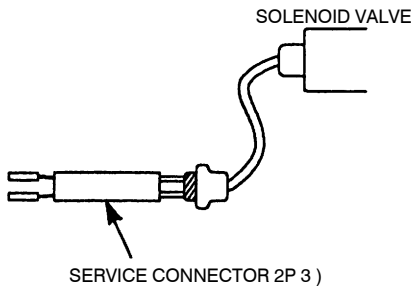
C. Solenoid Valve (Quadruple)



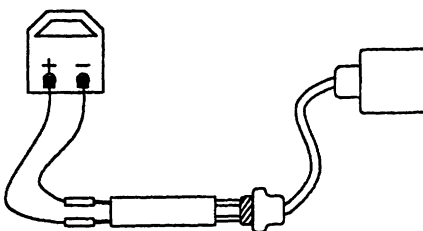
- Disconnect one connector attached on the solenoid valve.
(The following example explains steps for lever lock solenoid.)



- Four solenoid valves are attached. The left picture illustrates the purposes of each valve location. (Front view)
Solenoid for boosting marked with * is equipped on SH200/220-3.
A color band is attached on the connecting area.
When measuring, pay attention to the color. Each color indicates a different function.



- Connect a service connector for 2P between the disconnected connectors. (Only for the solenoid valve side.)



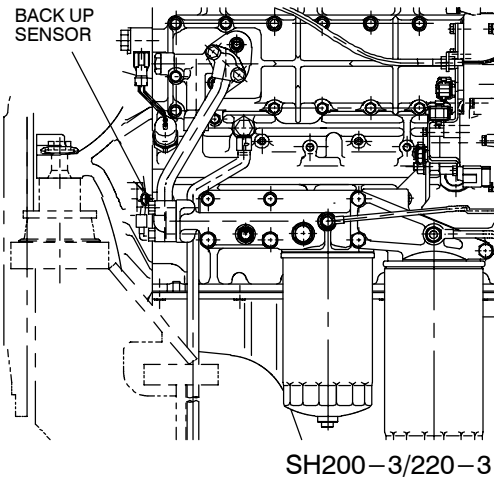
- Connect red/black terminals of the tester to the plug terminals of a service connector.
- After completing the connection, check the resistance.

Resistance 45 Ω (at 20°C)

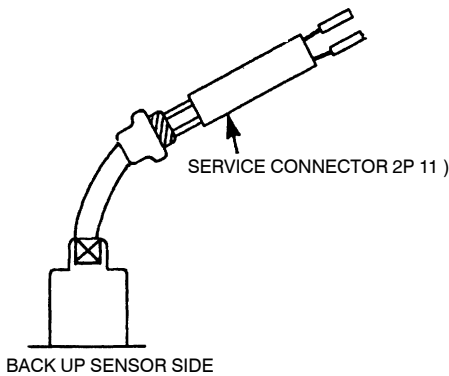
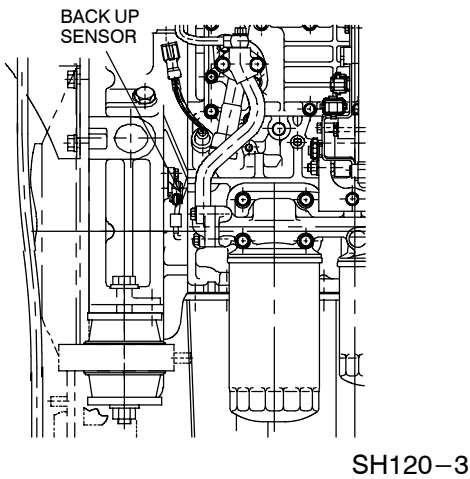
*Resistance value varies with the temperature.

MEASURING METHODS FOR ELECTRICAL DEVICES

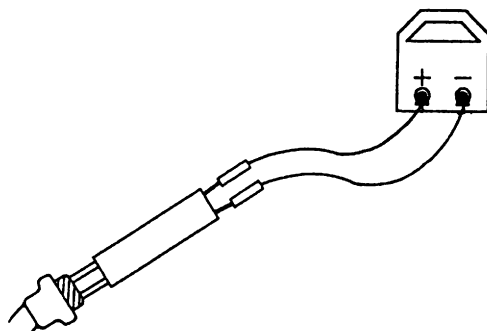
D. Back up Sensor



- Disconnect the connector attached on the back up sensor.



- Connect a service connector for 2P between the disconnected connectors. (Only for the rotation sensor side.)



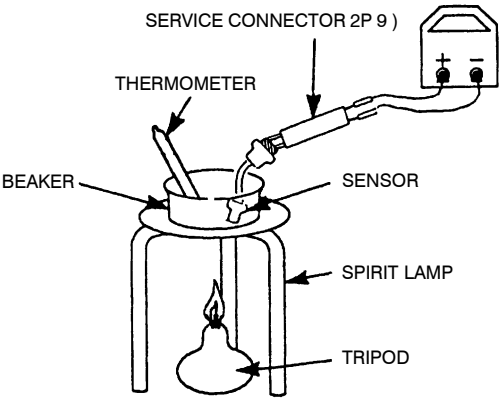
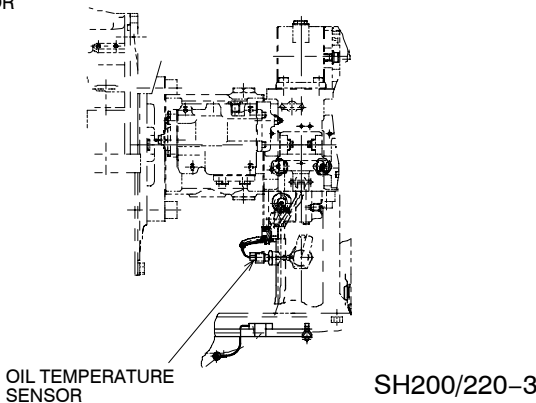
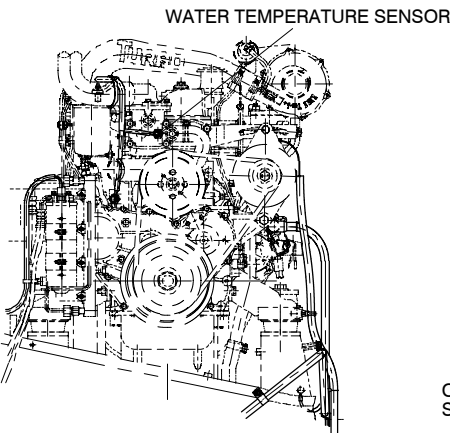
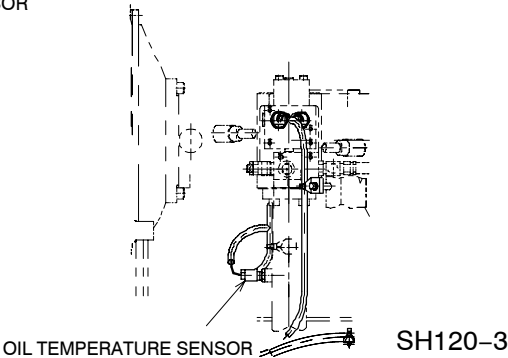
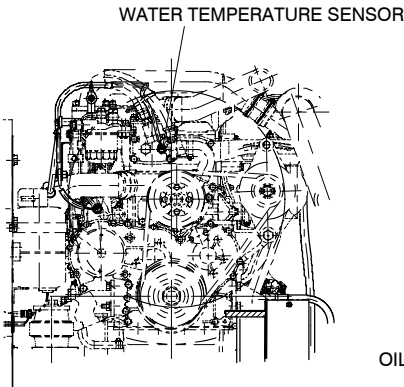
- Connect red/black terminals of the tester to the plug terminals of a service connector.
- After completing the connection, check the resistance. Resistance 0.7 kΩ (at 25°C).

*Resistance value varies with the temperature.

MEASURING METHODS FOR ELECTRICAL DEVICES

E. Water / Oil Temperature Sensor

- Disconnect the water temperature sensor or the oil temperature sensor.



- Connect the disconnected service connector for 2P.
- Connect red/black terminals of the tester to the plug terminals of a service connector.
- After completing the connection, increase the temperature gradually to check the resistance value.

Each temperature and resistance

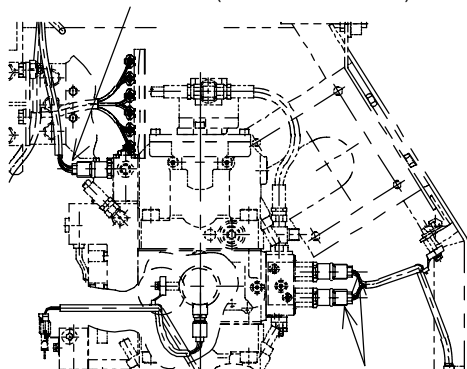
Unit : kΩ

Water Temperature (Oil Temperature)	Water Temperature Sensor	Oil Temperature Sensor
20°C	6.08	2.45
30°C	4.24	1.66
40°C	3.02	1.15
50°C	2.18	0.81
60°C	1.61	0.58
70°C	1.20	0.43
80°C	0.91	0.32

MEASURING METHODS FOR ELECTRICAL DEVICES

F. Pressure Sensor

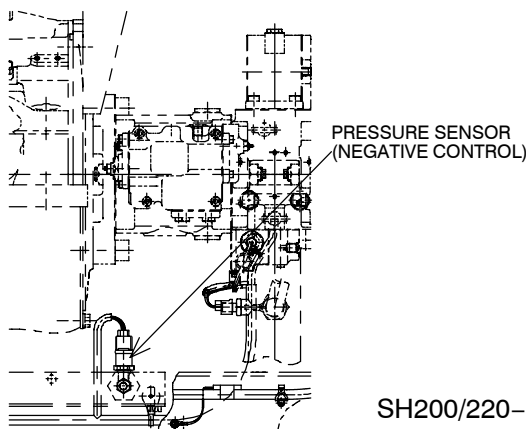
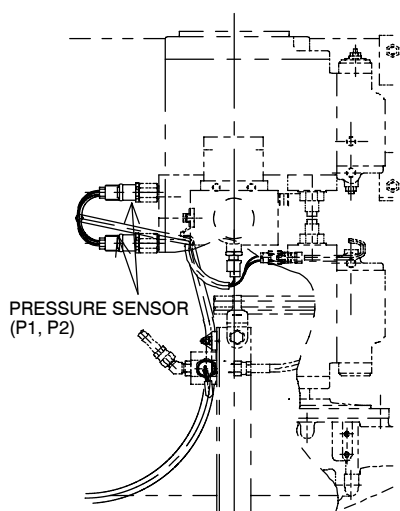
PRESSURE SENSOR (NEGATIVE CONTROL)



Disconnect the connector of the pressure sensor attached on the hydraulic pump.

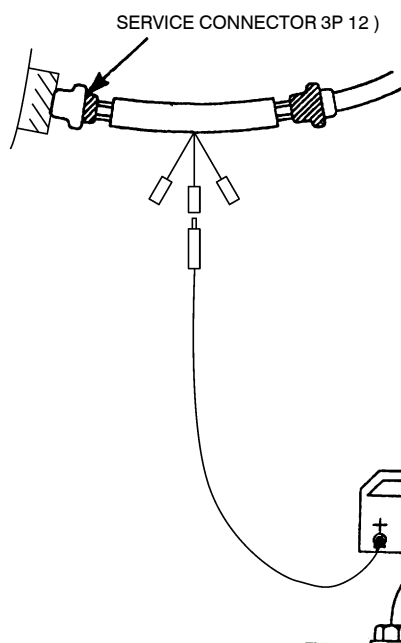
SH120-3

PRESSURE SENSOR (P1, P2)



SH200/220-3

PUMP PRESSURE SENSOR SIDE



- Connect a service connector for 3P between the disconnected connectors.
- Connect red terminal of the tester to the YL plug terminal (yellow/blue) of a service connector. Ground the black terminal of the tester.
- After completing the connection, turn ON the key switch to check the voltage.

MEASURING METHODS FOR ELECTRICAL DEVICES

Pressure sensor voltage

Pressure and Voltage

1. Pressure Sensor for P1 and P2

Conversion formula for pressure

$$1\text{MPa}=1.019\times 10\text{kgf/cm}^2$$

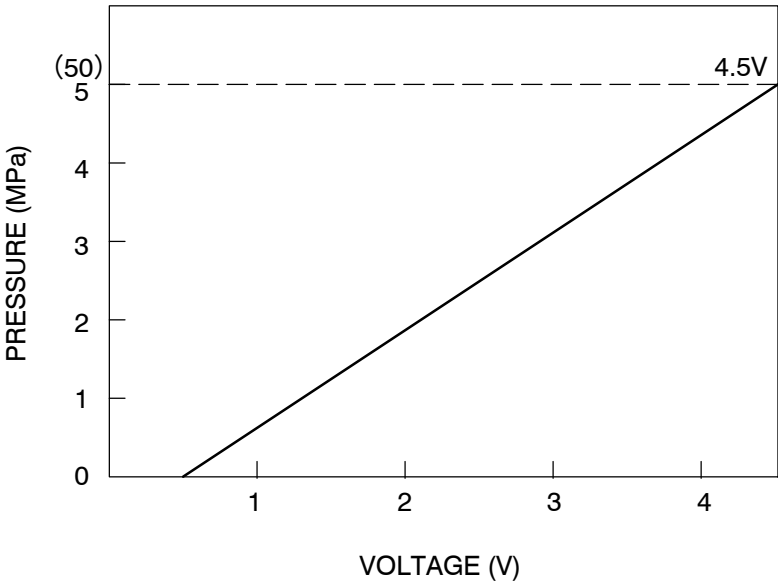
$$\text{Example) } 30\text{MPa} = 30 \times 1.019 \times 10 \\ = 305.7\text{kgf/cm}^2$$

$$2\text{MPa} = 2 \times 1.019 \times 10 \\ = 20.28\text{kgf/cm}^2$$

PRESSURE MPa	VOLTAGE (V)
50	4.5
43.7	4
37.5	3
25.0	2
17.5	1
0	0.5

2. Pressure sensor for negative control

PRESSURE MPa	VOLTAGE (V)
5.0	4.5
4.37	4
3.75	3
2.5	2
1.25	1
0	0.5



INITIAL SETTINGS FOR CONTROLLER

Selection of machine models

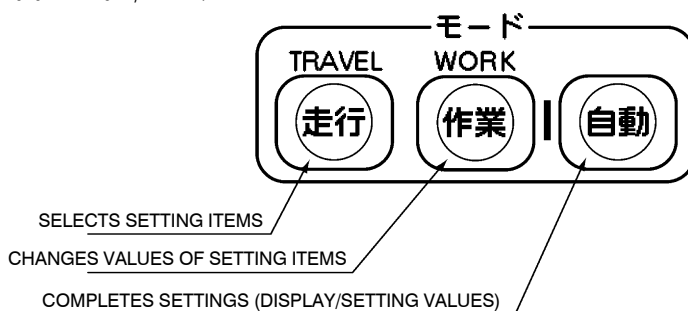
When machine is started up for the first time or when being started up for the first time after resetting the model settings (described later for the details), the machine model, destined country, language need to be set.

(1) Procedure for selecting controller machine model

- a. After resetting the controller, turn ON the key SW to show the model selection display on the LCD monitor like as followings.

MACHINE : SH ?		
TERRITORY : ? LANGUAGE : ?		
P / N	CONT.	KHR2667
	MONITOR	KHR0000
	E. CONT	KRH0000

- b. Using the Travel mode SW / Operation mode SW / Auto mode SW, select MACHINE / TERRITORY / LANGUAGE



- Every time when pressing Operation mode SW, setting item switch as MACHINE → TERRITORY → LANGUAGE → MACHINE. (The current setting item is highlighted with white/black colors reversed.)
- Every time when selecting the Travel mode SW, the setting values for each item are switched.
 When the setting item is MACHINE, SH120-3 → SH200-3 → SH220-3 → SH120-3 ...
 When the setting item is TERRITORY, 0 → 1 → 2 → 0 → 1 → 2 ...
 When the setting item is LANGUAGE* 0 → 1 → 2 → .. → 13 → 14 → 0 → 1..(0: Japanese)
- After completing the three settings, push the Auto mode SW to save the memory of the settings, and the settings become final. The monitor goes back to the normal display. (Bar graph is displayed after indicating PAX = for domestic model for 3 sec.)

INITIAL SETTINGS FOR CONTROLLER

(2) Error display function for the controller machine model selection setting

When the initial model setting is performed, the LCD monitor displays a controller model number which should be installed in the machine.

For example, if you push the Auto mode SW with the wrong part number of engine controller to save the setting, buzzer sounds continuously and ERROR is displayed.

If this happens, turn OFF the key SW. because all the inputs will be rejected without doing it. Verify the part numbers of the engine controller installed, and turn ON the key SW again to make the machine model setting again.

MACHINE : SH120-3		
TERRITORY : 0 LANGUAGE : 0		
P/N	CONT. MONITOR E. CONT	KHR2667 KHR0000 KRH0000
ERROR		

← ERROR IS DISPLAYED BECAUSE PART NUMBERS OF THE ENGINE CONTROLLER FOR SH200-3 ARE SHOWN DESPITE THE MACHINE MODE IS SET AS SH120-3.

(3) Currently available setting values

MACHINE	: SH120-3
	: SH200-3
	: SH220-3
TERRITORY	: 0 Domestic / General export
	: 1 LBX
	: 2 CASE
LANGUAGE	: 0 Japanese
	: 1 English
	: 2 Thai
	: 3 Chinese
	: 4 German
	: 5 French
	: 6 Italian
	: 7 Spanish
	: 8 Portuguese
	: 9 Dutch
	: 10 Danish
	: 11 Norwegian
	: 12 Swedish
	: 13 Finnish
	: 14 Symbol only

(4) Confirmation and reset of controller setting values

Once machine model setting is completed, next time when the machine is started up, the monitor shows a normal screen and the machine model setting display will not be shown.

On the normal screen, if you keep pushing the Auto mode SW for 10 sec., you can check the current setting status.

(However, the current settings cannot be changed in this stage.)

During the current setting status being displayed, if you keep push the Auto mode SW for 10 sec. once again, the current settings are all reset, and you can make the machine model setting again.

(During the current setting status being displayed, if you push the Auto mode SW for a short time [less than 10 sec.], the screen goes back to the normal display.)

- (1) The followings explain how to troubleshoot when message does not go away even though an appropriate procedure was performed according to the check point on the message.

Message Display	Symptom of problem	Problem No.
FUEL REFILL	Message remains even after refilling fuel.	1
REFILL COOLANT	Message remains even after refilling coolant.	2
LOW OIL PRESSURE	Message remains even after refilling the engine oil correctly.	3
OVER HEAT	Message remains even the hydraulic oil temperature is 84°C or less, and engine coolant temperature is 92°C or less.	4
BATTERY CHARGE	Message does not go away.	5
ELECTRICAL SYSTEM PROBLEM	Message does not go away.	6

- (2) The followings explain how to troubleshoot when the machine does not function normally without message being displayed on the screen.

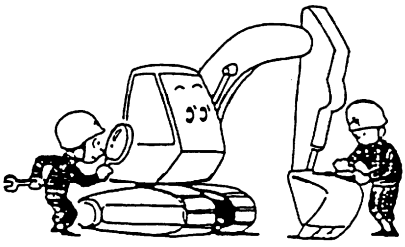
1. Engine control related

SYMPTOM OF PROBLEMS		PROBLEM NO.
ENGINE DOES NOT START ELECTRICAL SYSTEM PROBLEM IS INDICATED ON THE MONITOR. YES NO		REFER TO PROBLEM NO. 6 REFER TO PROBLEM NO. 7

Inspections Prior to Troubleshooting

Item	Criterion	Procedure
CHECK ITEMS FOR OPERATION		
LUBRICANTS / COOLANT		
1. Check the fuel level	—	Refill with oil
2. Check the contaminant in the fuel	—	Clean and drain
3. Check the oil level	—	Refill
4. Check the oil strainer	—	Clean and drain
5. Check lubrication on each reduction gear	—	Add oil
6. Check the engine oil level (Oil level in pan)	—	Add oil
7. Check the coolant level	—	Add coolant
8. Check for clogging on the dust indicator	—	Clean or replace
ELECTRICAL DEVICES		
9. Check if the wires on the battery terminals are loosened or corroded.	—	Tightening or replacement
10. Check if the wiring on the alternator terminals are loosened or corroded.	—	Tightening or replacement
11. Check if the wiring on the starter terminals are loosened or corroded.	—	Tightening or replacement
OTHER CHECK ITEMS		
HYDRA / MACHINE		
12. Check for abnormal noise and odor	—	Repair
13. Check for oil leaking	—	Repair
14. Perform air bleeding	—	Air bleeding
ELECTRICAL SYSTEM / DEVICES		
15. Check battery voltage (after engine stops.)	23~36V	Replace
16. Check the battery liquid level	—	Refill or replace
17. Check for color change, burning, and sheath peeling on the wires	—	Replace
18. Check for disconnection of wire clamps, hanging wires	—	Repair
19. Check for water drop on the wiring. (Watch out for leaking water drop onto the connectors and terminals.)	—	Disconnect and dry out the connectors in case of water leak on connectors.
20. Check fuse for breaking or corrosion	—	Replace
21. Check alternator voltage (with running engine 1/2 throttle or more). (In case of battery charge shortage, voltage becomes about 25 V soon after engine running.)	27.5~29.5V	Replace
22. Check the sound from battery relay (When turning ON / OFF starter SW.)	—	Replace

Procedure of Troubleshooting

	① When a user contacts for repairs or troubles, the following information are essential to ask. - User name - Machine model, Serial No. - Working site, etc.
Faulty monitor display? ① Message related ② Bar graph related Faulty smooth operation? ① Engine related ② About smooth operation	② Understand the trouble summary during the communication with the user. - Situations of problems - Specific description of working condition when problem occurred - Working environment - Repair history, maintenance description.
 	③ Prepare required tools. Crimp pliers (for plug terminal, for round shape terminal) Nipper Plug terminal (For connection)* * AJ wires containing pins for connectors
 	④ Go straight to the working site, check the problem reproduction and self-test display. - Operate each working function to examine the problems. - Check the self-test display.
	⑤ After reviewing the results of inspections prior to troubleshooting, identify the problems and conduct temporary repairs. - Check items for starting operation - Other check items

How to Use the Flow Chart

(1) Problem No. and problem symptoms

Above each flow chart, problem No. and problem symptoms are described.

Problem No.	Problem symptom
1	Message remains even after refilling fuel
2	Message remains even after adding coolant

(2) About check items prior to operation

Check the "Inspections Prior to Troubleshooting List" before trying to find the cause.

(3) Procedure

- After checking or measuring items described in a box, according to the results, choose YES or NO and go to the next box.
- The branch description for YES or NO is directly related to the cause of the problem as a result of checking or measuring, refer to the cause description and perform the troubleshooting procedures shown in the right.
- Inspection / measurement / judgment criteria are described in a box. Select YES should be chosen if the criteria or questions are met to the situation; Select NO if the they are not met.
- Under a box, necessary preparation work, operation methods, judgment criteria are described. These must be read carefully before starting inspection and measurement and follow the procedures starting step (1) since negligent preparation work or wrong operation methods may cause damage to the machine.

(4) Wire color

Refer to the table below for the wire colors of the measuring points for trouble shooting.
(Refer to the following pages for the connector No.)

Wire color chart

Symbol	B	W	Br	P	V	G	O
Color	Black	White	Brown	Pink	Purple	Green	Orange
Symbol	R	Y	Lg	Sb	L	Gr	
Color	Red	Yellow	Light green	Sky blue	Blue	Gray	

ab indicates the color b stripe on the color a foundation wire.

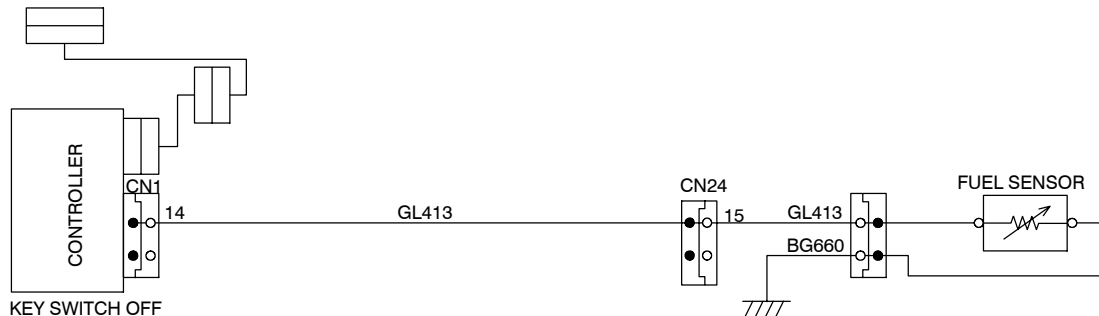
Example) BR: Red stripe on black foundation.

(5) Always turn OFF the key switch before connecting or disconnecting the connectors.

Fuel Refill

Problem symptom (Problem No.1)

- Message remains even after refilling fuel.



TROUBLESHOOTING		CAUSE	PROCEDURE
KEY SWITCH ON Measure the resistance of the sensor by service support CHK4. (Refer to the table below for the resistance.) YES → Defective controller. → Replace controller. NO → KEY SWITCH OFF Disconnect the coupler from the sensor to measure the resistance of the coupler on the sensor side. (Refer to the table below for the resistance.) NO → Defective fuel sensor. → Replace or check sensor. YES → Disconnect the connector of CN24 to measure the resistance between female GL and GND (Ground). (Refer to the table below for the resistance.) NO → Bad connection of fuel sensor. → Clean connector terminal YES → Disconnect the connector of CN1 to measure the resistance between female GL and GND (Ground). (Refer to the table below for the resistance.) NO → Bad connection of CN24 → Clean CN24 connector terminal YES → Defective controller or connection failure of CN1. → Replace the controller or clean CN11 connector terminal			

Note: All bar graph lights are off when circuit disconnection occurs.

Resistance between GL and BG

Monitor	1 Refill the fuel	2	3	4	5	6	7	8
Resistance (OHM)	80~75	75~61	61~47	47~37	37~30	30~24	24~19	19~10

Refill Cooling water

Problem symptom (Problem No.2)

- Message remains even after refilling coolant.

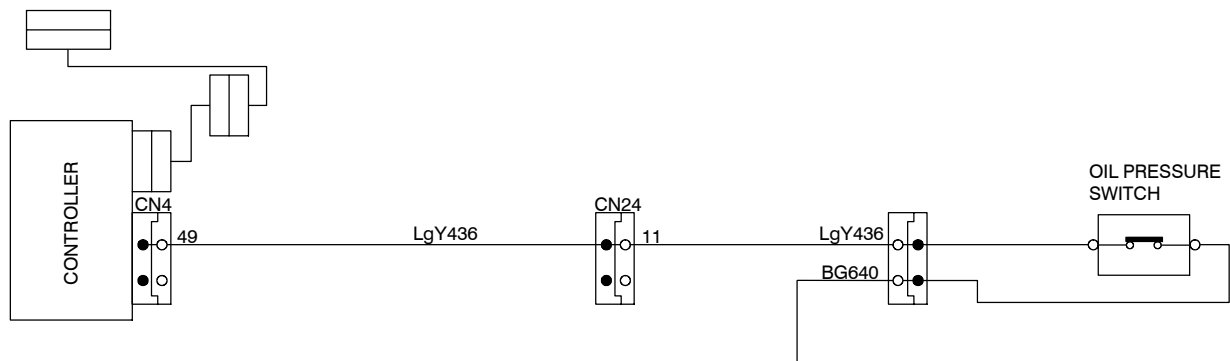


TRUBLESHOOTING	CAUSE	PROCEDURE
KEY SWITCH ON Disconnect the connector on the reserve tank level switch to see if message goes away. YES → Defective reserve tank level switch. → Replace reserve tank. NO → Disconnect the CN24 connector to see if message goes away. YES → Short circuit of the wire GrG between the reserve tank level switch and CN24. → Repair wire GrG. NO → Disconnect the CN4 connector to see if message goes away. YES → Short circuit of the wire GrG between the CN24 and CN4. → Repair wire GrG. NO → Defective controller → Replace controller		

Low Engine Oil Pressure

Problem symptom (Problem No.3)

- Message remains even after refilling engine oil correctly.



TRUBLESHOOTING	CAUSE	PROCEDURE
Check the followings in 12 sec. After engine started. <pre> graph TD Start[Check the followings in 12 sec. After engine started.] --> Step1[Disconnect the oil pressure switch connector to see if message goes away.] Step1 -- YES --> Cause1[Defective oil pressure switch] Step1 -- NO --> Step2[Disconnect the CN24 connector to see if message goes away.] Step2 -- YES --> Cause2[Short circuit of the wire LgY between the oil pressure switch and CN24] Step2 -- NO --> Step3[Disconnect the CN4 connector to see if message goes away.] Step3 -- YES --> Cause3[Short circuit of the wire LgY between the CN24 and CN4] Step3 -- NO --> Cause4[Defective controller] </pre>		
	Defective oil pressure switch	Replacement
	Short circuit of the wire LgY between the oil pressure switch and CN24	Repair wire LgY.
	Short circuit of the wire LgY between the CN24 and CN4	Repair wire LgY.
	Defective controller	Replace controller

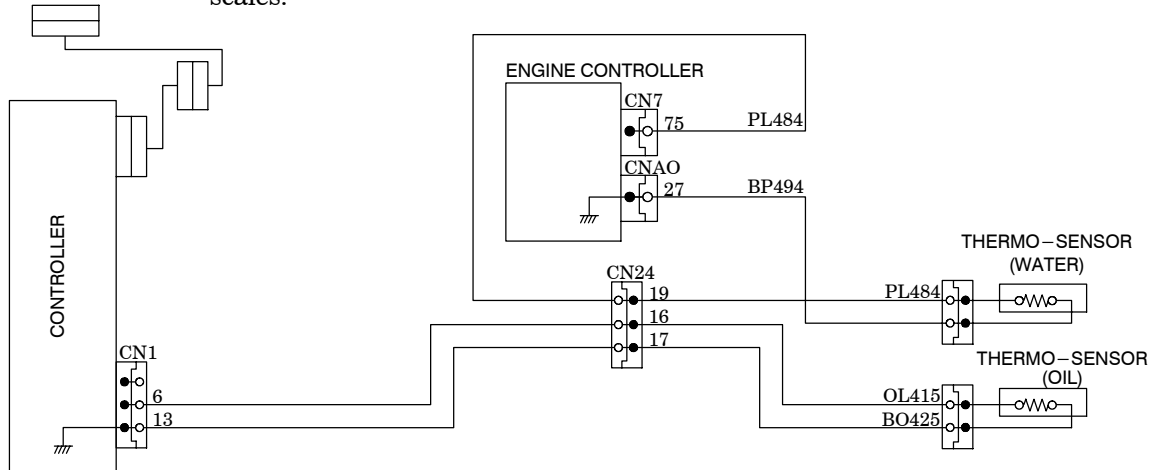
Over Heat

Problem symptom (Problem No.4)

- Message remains even the hydraulic oil temperature is 98°C or less, and engine coolant temperature is 105°C or less.

Precautions

1. Check if the bar graph of water temperature or oil temperature shows eight scales.



TROUBLESHOOTING	CAUSE	PROCEDURE
1) Water temp bar graph lights the eight scales. KEY SWITCH ON Temperature of thermo-sensor (water) is abnormal by service support CHK1 (Compare between actual temp and indicated temp.). • Show water temperature on CHK1 WT. • Measure the actual temperature. YES → Verify the problem code E0015 for water temperature sensor by service trouble shooting (DIAG1). YES → Disconnect the connector from the thermo-sensor (water) to measure the resistance of the connector on the sensor side. NO → Defective thermo-sensor (water). YES → Disconnect the connectors of CN24 and CNA0 to measure the resistance between female PL and BP. (Refer to the table below for the resistance.) NO → Bad connection of the connector on the thermo-sensor (water). YES → Disconnect the connectors of CN7 and CNA0 to measure the resistance between female PL and BP. (Refer to the table below for the resistance.) NO → Bad connection of CN24. YES → Defective controller or bad connection of CN7 and CNA0. Note: All bar graph lights are off when circuit disconnection occurs.	Defective thermo-sensor (water). Bad connection of the connector on the thermo-sensor (water). Bad connection of CN24. Defective controller or bad connection of CN7 and CNA0.	Replace sensor Clean the connector terminal on the sensor. Clean the CN24 connector terminal. Replace controller or clean CN7, CNA0 connector terminal.

TRoubleshooting	CAUSE	PROCEDURE
2) Oil temp bar graph lights the eight scales. Abnormal temperature of thermo-sensor (oil) by service support CHK1 (Compare between actual temp and indicated temp.). YES • Show water temperature on CHK1 OT. • Measure the actual temperature. Verify the problem code M0020 for oil temperature sensor by service trouble shooting (DIAG4). YES Disconnect the connector from the thermo-sensor (oil) to measure the resistance of the connector on the sensor side. (Refer to the table attached for the resistance.) NO Defective thermo-sensor (oil). Replace sensor. YES Disconnect the connector of CN24 to measure the resistance between male terminal OL and BO. (Refer to the table attached for the resistance.) NO Bad connection of the connector on the thermo-sensor (oil). Clean connector terminal on the sensor. YES Disconnect the connector of CN1 to measure the resistance between female OL and BO. (Refer to the table attached for the resistance.) NO Bad connection of CN24. Clean CN24 connector terminal. YES Defective controller or bad connection of CN1. Replace controller or clean CN1 connector terminal. Note: All bar graph lights are off when circuit disconnection occurs.		

Resistance value of the sensor

Note: Resistance value varies with the temperature.

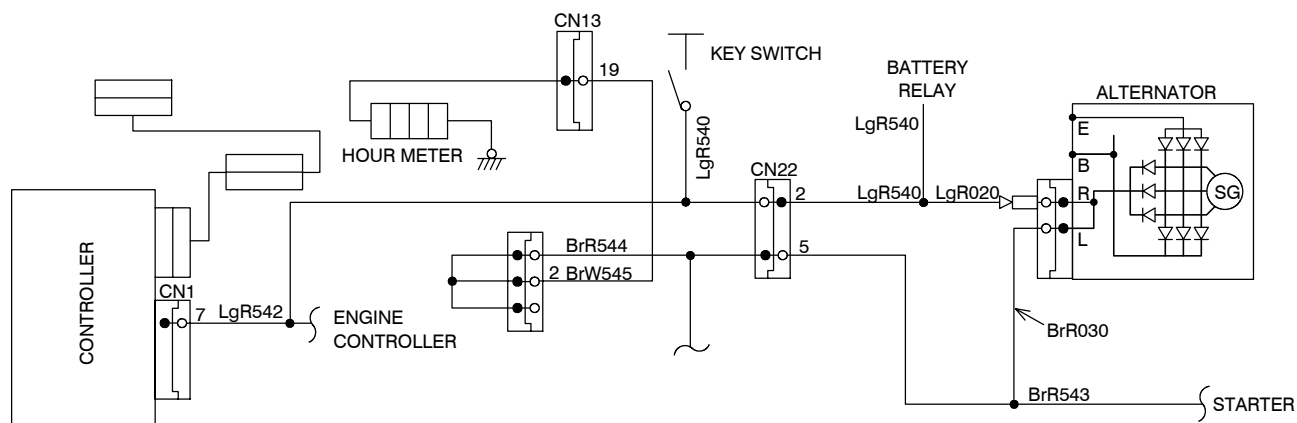
Unit : k Ω

Water temperature (Oil temperature)	Water temperature sensor	Oil temperature sensor
20°C	6.08	2.45
30°C	4.24	1.66
40°C	3.02	1.45
50°C	2.18	0.81
60°C	1.61	0.51
70°C	1.19	0.43
80°C	0.91	0.32

Alternator

Problem symptom (Problem No.5)

- Message does not go away.

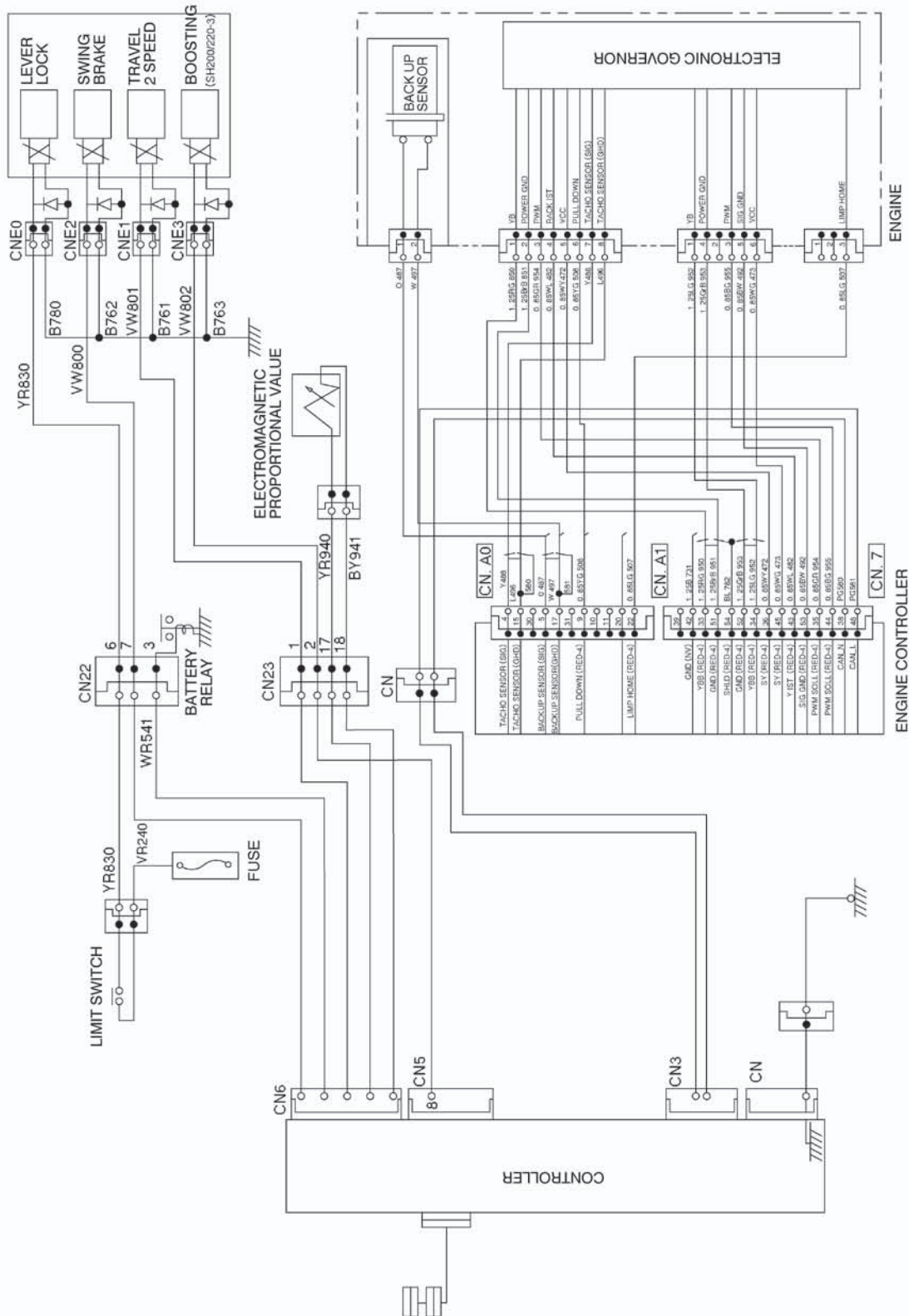


TRUBLESHOOTING	CAUSE	PROCEDURE
Hour meter does not function. YES Disconnect the connector on alternator R terminal to measure the voltage between alternator side and Ground. More than 10 V. YES Disconnect the CN22 connector to measure the voltage between male side terminal LgR and Ground. More than 10 V. YES	NO Short circuit of LgR wire between CN1 and CN22. Bad connection on CN1 or defective controller. Defective alternator. Open circuit of wire LgR between CN22 and alternator or bad connection of the alternator connector terminal.	Re-wire or repair of LgR. Clean CN1 connector terminal or replace controller. Replace alternator. Repair wire LgR between CN22 and alternator or clean the connector.

Electrical Problems

Problem symptom (Problem No.6)

- Message does not go away



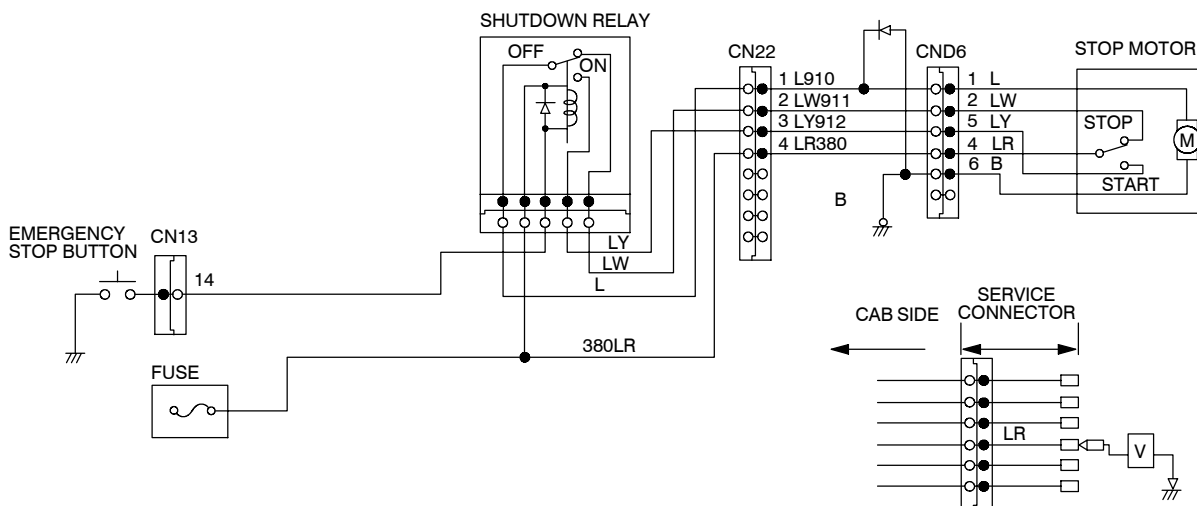
TROUBLESHOOTING	CAUSE	PROCEDURE
Check the trouble condition by service support troubleshooting. Key Switch On Trouble area is found in DIAG1. → NO → To DIAG4 YES E0031 display → YES → NO E0032 display → YES → NO E0041 display → YES → Trouble area is found in DIAG4. YES M00B0 → YES → NO M0010 → Check transistor output for short circuit YES To CHK2" Auto detect finds short circuit. YES Message goes away by disconnecting solenoid valve connector. → YES → NO Message goes away by disconnecting CN22 connector. → YES → NO Message goes away by disconnecting CN23 connector. → YES → NO Message goes away by disconnecting CN6 connector. → YES → NO Message goes away by disconnecting CN5 connector. → YES → NO	Circuit faulty inside governor. Rack sensor signal problem inside governor. TDC sensor signal problem. Same as above. Wrong engine controller. Defective solenoid valve. Short circuit of the wire between CN22 and solenoid valve. Short circuit of the wire between CN23 and solenoid valve. Short circuit of the wire between CN23 and CN6. Short circuit of the wire between CN22 and CN5. Defective controller.	Check electronic governor. Same as above. Same as above. Replace engine controller. Replace solenoid valve. Repair wiring. Repair wiring. Repair wiring. Repair wiring. Replace controller.

Problem symptom (Problem No.7)

- Engine does not start even though message, "Electrical system problem", is not displayed.

Precautions

- Check there is no abnormality in the engine and fuel system.
- Fuses are not broken.
- Starter motor runs and engine cranks.



TROUBLESHOOTING	CAUSE	PROCEDURE
Key Switch ON Fuel cut lever is located on the stop side. NO YES Disconnect the stop motor connector (CND6) to measure voltage between – Ground and + LR which is connecting the service connector (for P) to female side (cab side). 20–30 V NO YES Disconnect the connector on stop motor to check continuity between L and LW which attach service connector on female side. Key switch ON: continuity Key switch OFF: infinity YES NO Measure voltage between (+) connector L on shut down relay and (–) ground. Emergency stop button ON: 0 V Emergency stop button OFF: 20–30 V NO YES Also you can check the defectiveness of relay by replacing the relay using the relay assy.	Engine system problem. Open circuit on wire LR between stop motor connector and CN or wire LR between fuse and CN. Defective stop motor. Defective shut down relay. Open circuit between shut down relay and wire L.	Check engine system. Repair wire LR. Replace stop motor. Replace shut down relay. Replace shut down relay or repair wire L.

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APPENDIX

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PRESSURE MEASUREMENT/ADJUSTMENT

1. Pressure Measurement

A. Basic Condition

Model Condition	SH200-3	SH220-3
Operation mode	S Mode	
Oil temperature	45~55°C	
No load engine revolutions	1800±10	2000±10

B. Set Values

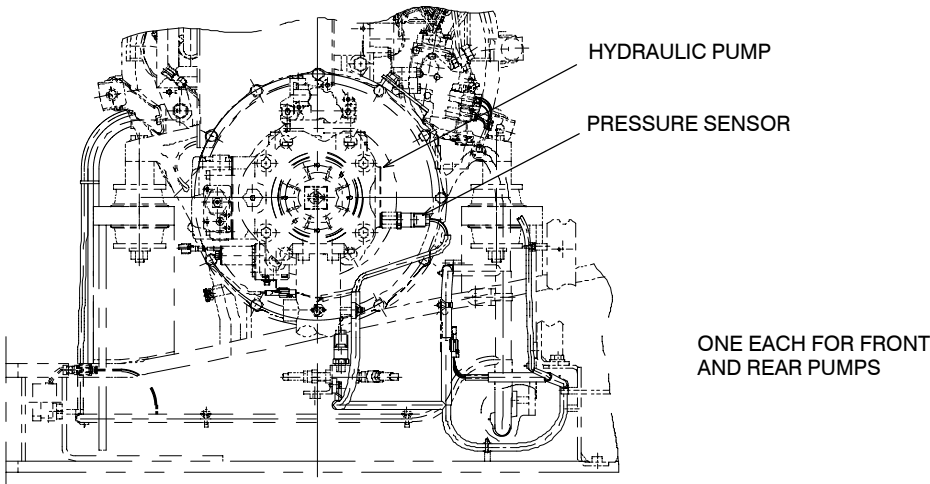
The values below are measured values on an actual machine and not standard values.

		Relief valve Unit set pressure	Values measured on actual machine	Measuring methods
Main relief pressure	Standard	34.3 Mpa at 126L/min (350 kgf/cm ²)	34.3±0.3 Mpa (350±3 kgf/cm ²)	Arm relief
	Increased pressure	37.3 Mpa at 108L/min (380 kgf/cm ²)	37.3±0.3 Mpa (380±3 kgf/cm ²)	Arm relief
Boom port relief	Up	39.2 Mpa at 20L/min (400 kgf/cm ²)	39.5±0.5 Mpa (403±5 kgf/cm ²)	Fasten the main relief up to 180° + Boom Up/Down relief
	Down	39.2 Mpa at 20L/min (400 kgf/cm ²)	↑	↑ + Boom down relief
Arm In/Out port relief		39.2 Mpa at 20L/min (400 kgf/cm ²)	↑	↑ + Arm relief
Bucket Open/Close port relief		39.2 Mpa at 20L/min (400 kgf/cm ²)	↑	↑ + Bucket relief
Swing relief	SH200-3	27.9 Mpa at 155L/min (285 kgf/cm ²)	29.1±0.4 Mpa (297±4 kgf/cm ²)	Swing relief
	SH220-3	28.9 Mpa at 182L/min (295 kgf/cm ²)	30.1±0.4 Mpa (309±4 kgf/cm ²)	↑
Pilot relief		3.9 Mpa (40 kgf/cm ²)	3.9±0.1 Mpa (40±1 kgf/cm ²)	Lever neutral

PRESSURE MEASUREMENT/ADJUSTMENT

C. Pressure Measuring Port

A pressure sensor is mounted on Model 3 pump and the left side of the circuit can be displayed on the monitor. (Except for pilot pressure)

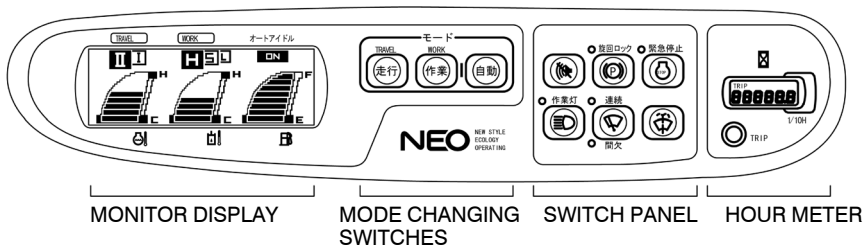


Pressure on each relief valve (except for pilot pressure) can be confirmed on the monitor display.

(1) Pressure displaying method on the monitor display

To display on the monitor display, use the mode changing switch on the monitor display.

Monitor & switch panel



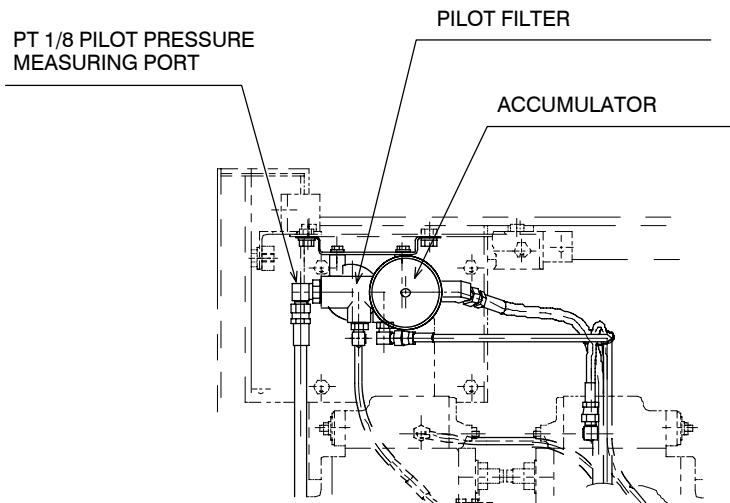
How to operate

Operating button	Monitor display
TRAVEL WORK 走行 作業 Travel and Work Mode Press the switch for 3 seconds or longer.	CHK 1 MODE II.H ENG 2000 rpm P1 030.0 Mpa I 0300 mA P2 030.0 Mpa WT 0080 ℃ N 03.00 Mpa OT 0055 ℃ P1 and P2 are pump pressures, and P1 indicates the front pump and P2 the rear pump. Units are MPa (mega pascal).

PRESSURE MEASUREMENT/ADJUSTMENT

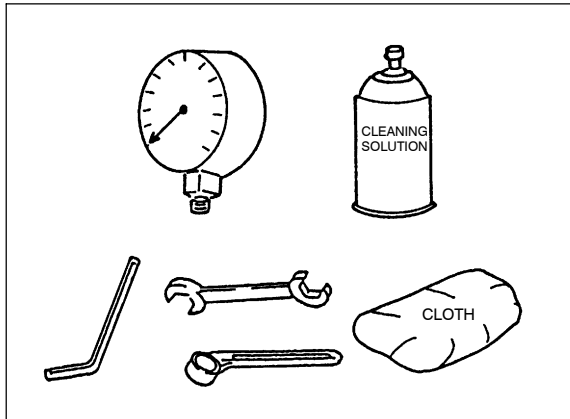
(2) Pilot line

When the right side cover is opened, there are an accumulator and pilot filter mounted in front of the counterweight. Remove the PT 1/8 blank plug, which is an L shaped joint attached to the manifold, and measure pressure.



PRESSURE MEASUREMENT/ADJUSTMENT

D. Preparation for Pressure Measurement



1. Required Items for Preparation

- a. Pressure gauge For 9.8 MPa (100 kgf/cm²) use
- b. Tools Ring spanner 17 mm
Hexagon wrench 6 mm
- c. Others Cloth, cleaning solution

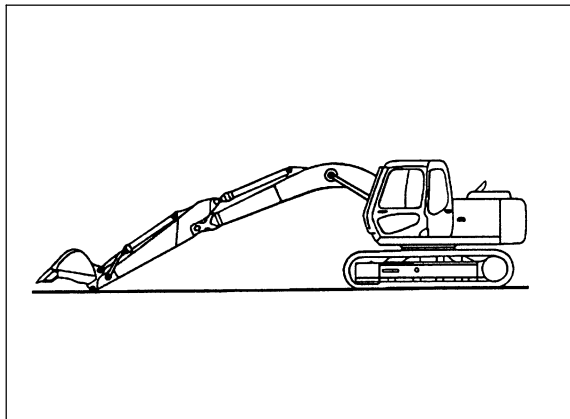
2. Monitor Check

- In the Service Check, make sure the engine maximum revolutions with no load and the input electric current value of the pump in S mode.

CHK 1	MODE II.H	ENG	2 0 0 0	rpm		
	P1	0 3 0 . 0	Mpa	I	0 3 0 0	mA
	P2	0 3 0 . 0	Mpa	WT	0 0 8 0	℃
	N	0 3 . 0 0	Mpa	OT	0 0 5 5	℃

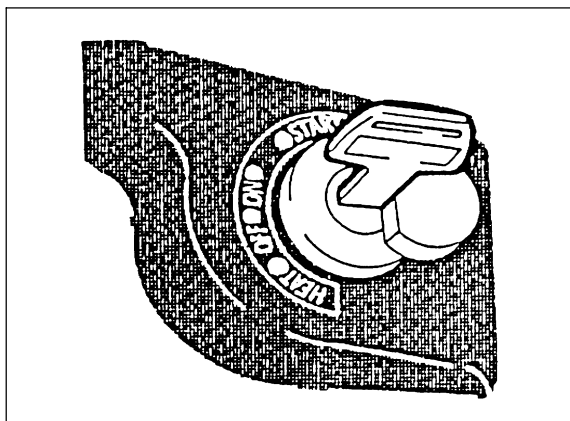
ENG: ENGINE REVOLUTIONS
I: CURRENT.

	Engine Max. Rev.	S Mode current value
SH200-3	1800 ± 10min ⁻¹	292mA
SH220-3	2000 ± 10min ⁻¹	307mA



3. Machine Positioning

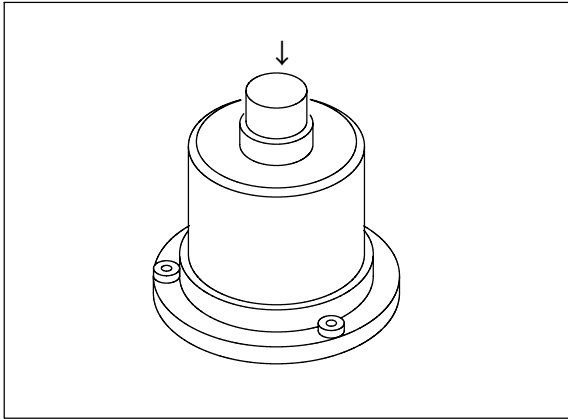
- Position the machine on a firm, level ground, lower the boom until the arm end touches the ground, with the bucket cylinder out until stroke end, and arm cylinder out until stroke end.



4. Pressure Relief in Circuit

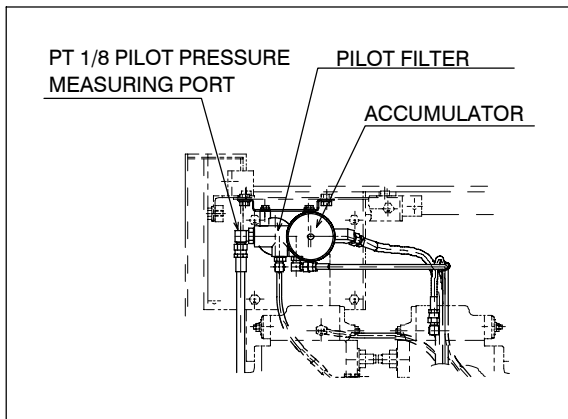
- Turn the engine OFF and confirm the engine has stopped. Turn the key ON again.
Note: Do not start the engine.
- Operate each lever more than 10 times and make sure that the attachments do not move. Then, turn the key OFF.

PRESSURE MEASUREMENT/ADJUSTMENT



5. Pressure Relief in Hydraulic Oil Tank

- Press the air breather button located on the hydraulic oil tank to release the pressure in the tank.



6. Installing Pressure Gauge

- Install a pressure gauge to the pilot pressure measuring port.

Pressure gauge For 9.8 MPa (100 kgf/cm²) use

Port size PT 1/8

7. Checking Oil Temperature

- Following the Service Check, make sure hydraulic oil temperature is as follows.

Oil temperature	45~55°C
-----------------	---------

- If the oil temperature is low, follow the instructions for warming up in the Operator's Manual to increase the oil temperature is as follows.

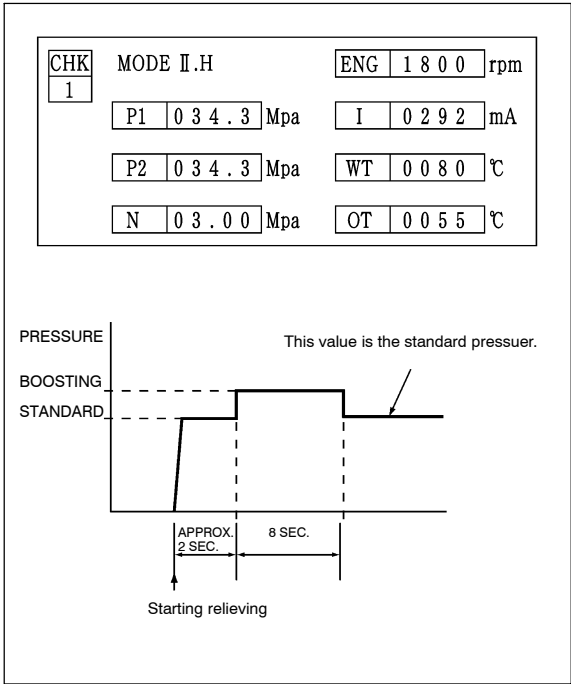
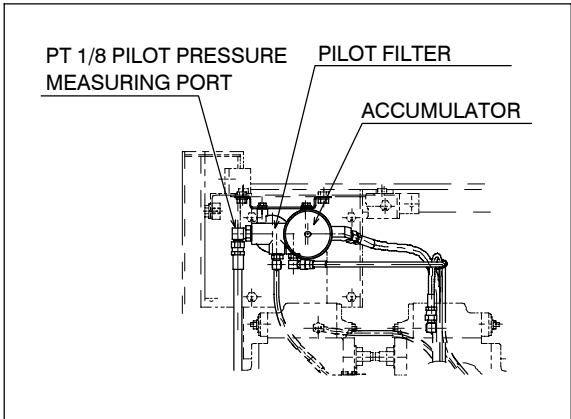
Now, the preparation has been completed.

CHK	MODE II.H	ENG	2000	rpm	
1					
P1	030.0	Mpa	I	0300	mA
P2	030.0	Mpa	WT	0080	°C
N	03.00	Mpa	OT	0055	°C

OT INDICATES HYDRAULIC OIL TEMPERATURE

PRESSURE MEASUREMENT/ADJUSTMENT

E. Pressure Measurement



The pressure on the swing monitor is displayed in the P1 section on the monitor display.

- Pilot Relief Pressure**
 Lever operation Neutral
 Using pressure gauge For 9.8 MPa
 (100 kgf/cm²)
 Set pressure 3.9 ± 0.1 MPa
 (40 ± 1 kgf/cm²)

- Main Relief Pressure**
 Lever operation Arm in relief
 The value is displayed on the monitor display.
 Refer to [3] -1) in the previous Section.
 Make sure P1 and P2 on the monitor display.

- Standard set pressure 34.3 ± 0.3 Mpa
 (350 ± 3 kgf/cm²)

After relieving arm in, the boosting is displayed for 8 seconds and then the pressure goes down to the standard one. Read the value.

- Boosting set pressure 37.3 ± 0.3 Mpa
 (380 ± 3 kgf/cm²)

About 2 seconds after relief valve starts working, the boosting set pressure is displayed for 8 seconds. Read the value.

- Swing Port Relief Pressure**
 Lever operation Swing relief
 The value is displayed on the monitor display.
 Set pressure
 SH200-3 29.1 ± 0.4 Mpa
 (297 ± 4kgf/cm²)
 SH220-3 30.1 ± 0.4 Mpa
 (307 ± 4 kgf/cm²)

When measuring pressure while swinging, the measurement must be carried out after activating the mechanical brake by pushing the swing lock switch to lock the swing.

Note: Press the lock switch and decrease the engine revolutions to about 1,000 rpm when operating the swing lever first. After making sure that the swing does not move, increase the engine revolutions up to the maximum.

PRESSURE MEASUREMENT/ADJUSTMENT

	Boom Up	Boom Down	Arm Out	Arm In	Bucket Open	Bucket Closed
Measured pressure	39.5±0.5Mpa (403±5kgf/cm ²)					
Display section on monitor	P2	P2	P1	P1	P2	P2

4. Other Port Relief Pressure

Lever operation Put the attachments to be measured in a relief condition.

The value is displayed on the monitor display.

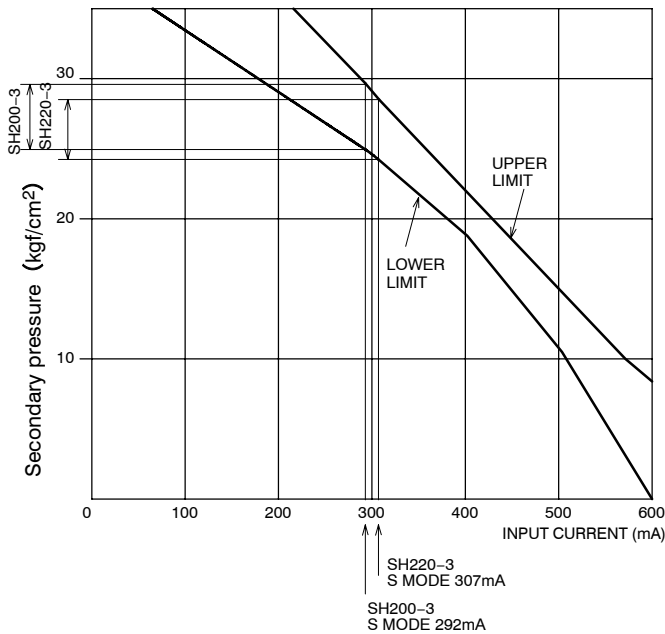
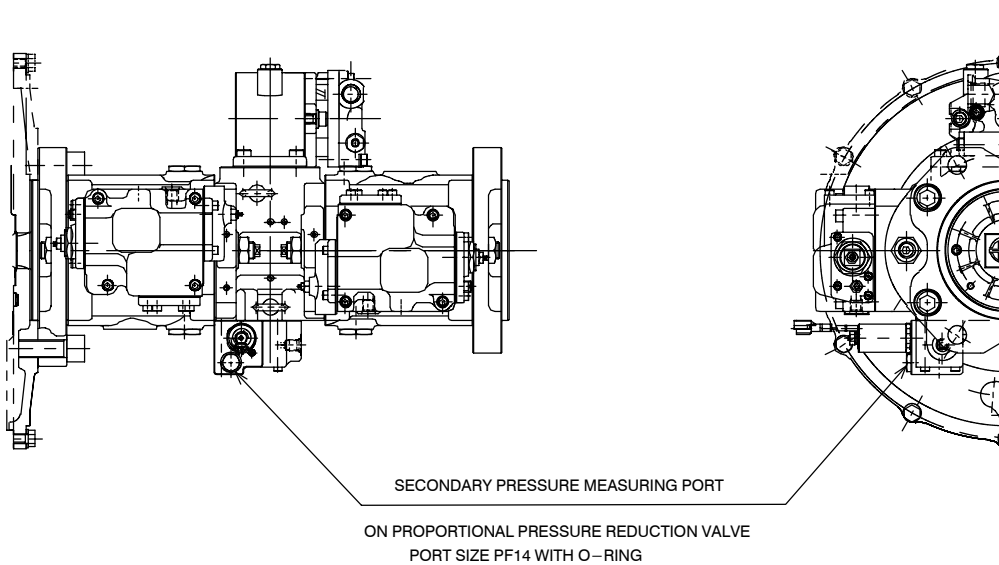
Temporary adjustments are necessary because the port relief pressure of the attachment is higher than the one for the main relief.

Refer to the Pressure Adjustment for adjustment instructions.

PRESSURE MEASUREMENT/ADJUSTMENT

F. Other Pressure Measurement

Secondary pressure on the solenoid proportional pressure reduction valve of the hydraulic pump



Mode		SH200-3	SH220-3
H Mode	Current value (mA)	MAX 407	MAX 424
	Secondary pressure (kgf/cm ²)	18~21	16.5~20
S Mode	Current value (mA)	292	307
	Secondary pressure (kgf/cm ²)	25~29.5	24~28.5

Measuring conditions

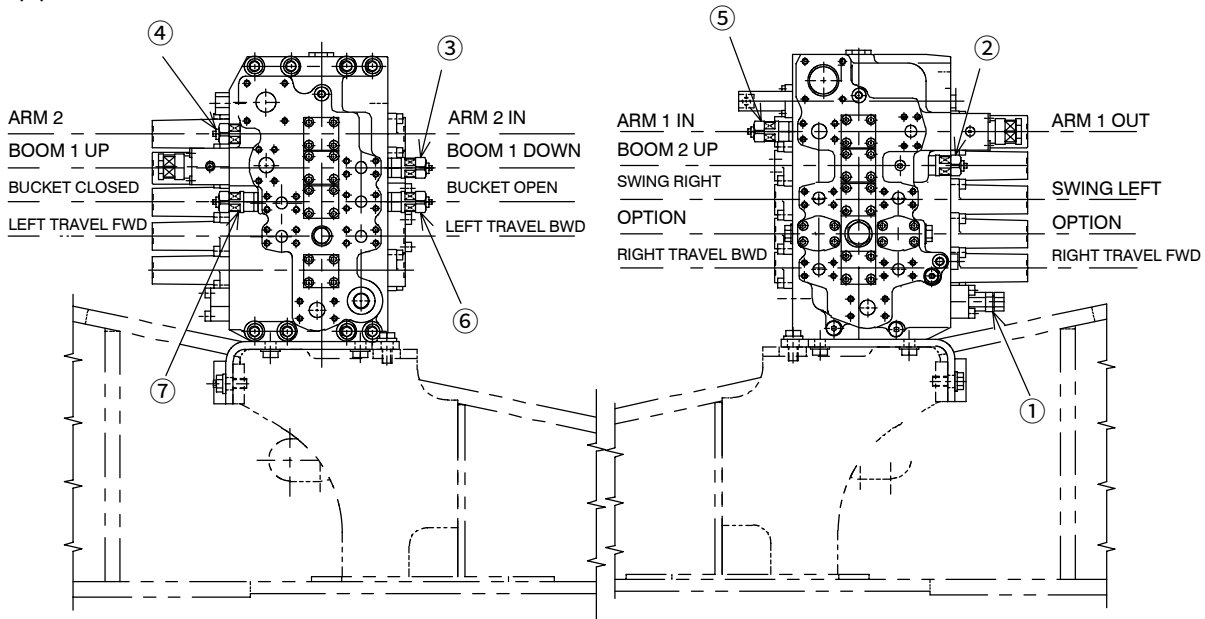
Engine maximum revolution with no load

PRESSURE MEASUREMENT/ADJUSTMENT

2. Pressure Adjustment

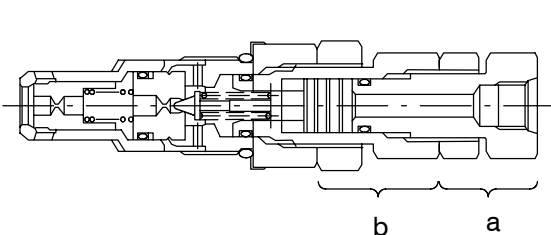
A. Pressure Adjusting Points

(1) Control valve

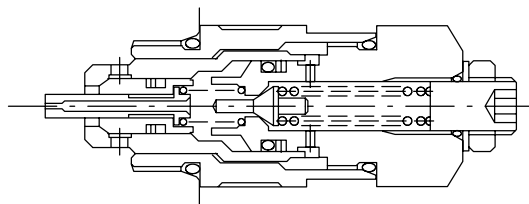


			Measuring port	Tools used		Set pressure	Adjusting screw per turn
				Lock nut	Adjusting screw		
①	a	Main standard	Monitor P1	27	27	34.3±0.3Mpa (350±3kgf/cm²)	21.3Mpa (217kgf/cm²)
	b	Main boosting	Monitor P1	27	32	37.3±0.3Mpa (380±3kgf/cm²)	28.4Mpa (290kgf/cm²)
②		Boom UP	Monitor P2	17	Hexagon wrench 6 mm	39.5±0.5Mpa (403±5kgf/cm²)	21.2Mpa (216kgf/cm²)
③		Boom DOWN					
④		Arm OUT	Monitor P1				
⑤		Arm IN					
⑥		Bucket OPEN	Monitor P2				
⑦		Bucket CLOSE					

Maintenance



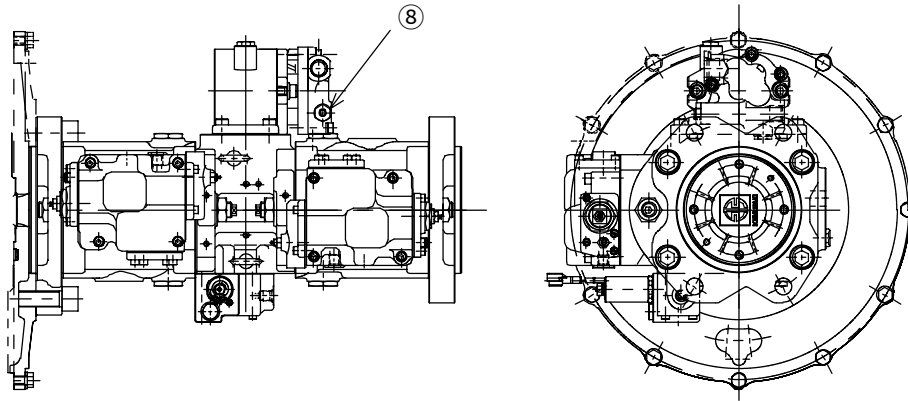
(1) MAIN RELIEF



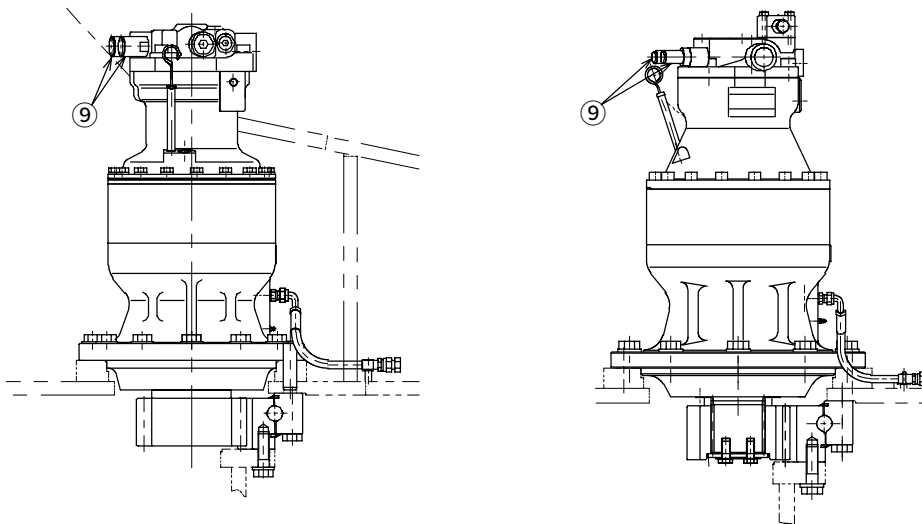
(2) – (7) PORT RELIEF

PRESSURE MEASUREMENT/ADJUSTMENT

(2) Hydraulic pump



(3) Swing motor.



SH200-3

SH220-3

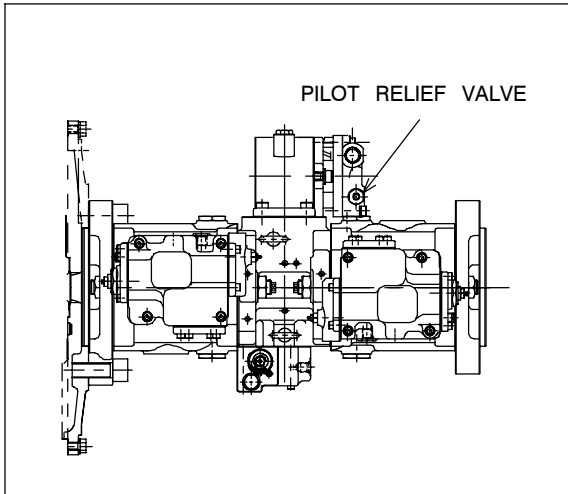
Maintenance

	Name		Measuring port	Tools used		Set pressure	Adjusting screw per turn
				Lock nut	Adjusting screw		
⑧	Pilot		P3	24	Hexagon wrench 6	$3.9 \pm 0.1 \text{ Mpa}$ ($40 \pm 1 \text{ kgf/cm}^2$)	2Mpa (20.8 kgf/cm^2)
⑨	Swing motor	SH200-3	Monitor P1	Hexagon wrench 14	Shim	$29.1 \pm 0.4 \text{ Mpa}$ ($297 \pm 4 \text{ kgf/cm}^2$)	0.5Mpa (5 kgf/cm^2)
		SH220-3	Monitor P1	32	24	$30.1 \pm 0.4 \text{ Mpa}$ ($307 \pm 4 \text{ kgf/cm}^2$)	11.6Mpa (118 kgf/cm^2)

PRESSURE MEASUREMENT/ADJUSTMENT

B. Pressure Adjusting Instructions

(1) Pilot pressure



No. of engine revolutions	S Mode maximum revolutions
Lever operation	Neutral
Oil temperature	45~55°C
Tools	Spanner 24mm、Hexagon wrench 6mm
Measuring port	Joint close to accumulator
Used pressure gauge	For 9.8Mpa (100kgf/cm ²) use
Set pressure	3.9±0.1Mpa (40±1kgf/cm ²)

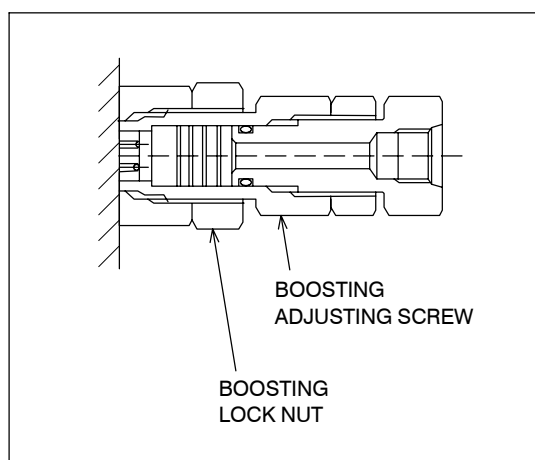
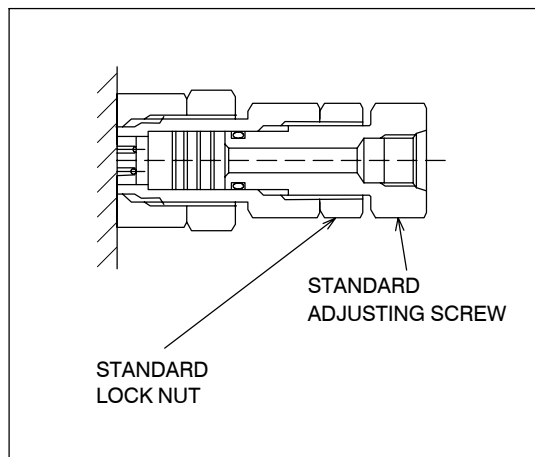
Pressure Adjusting Instructions

- Loosen the lock nut on the pilot relief.
- Adjust to the set pressure while fastening the adjusting screw.
- Fix the adjusting screw with wrench and fasten the lock nut.
- After locking, make sure the pressure once again.

PRESSURE MEASUREMENT/ADJUSTMENT

(2) Main relief pressure

No. of engine revolutions		S Mode maximum revolutions
Lever operation		Arm IN relief
Oil temperature		45~55°C
Tools		Spanner 27 (2), 32 (1)
Measuring port		Monitor P1
Set pressure	Standard	34.3 ± 0.3 Mpa (350 ± 3 kgf/cm ²)
	Boosting	37.3 ± 0.3 Mpa (380 ± 3 kgf/cm ²)



Pressure adjusting Instructions

Before adjusting, start checking main relief valve. Remove boosting pressure signal pilot hose and plug the hose side.

For Boosting

- Loosen standard lock nut 27, tighten adjusting screw 27. Fix it with spanner 27 so that the boosting adjusting screw does not turn.
- After tightening the adjusting screw until it is no longer turn, tighten the lock nut.
- Start the engine and run it at the maximum revolution.
- Put the arm lever into IN to bring it in relief condition and hold it.
- Loosen the boosting pressure lock nut 32 and adjust it at a set pressure with adjusting screw 27.
 - If it is lower than the set pressure, tighten it.
 - If it is higher than the set pressure, make it lower than set pressure once and adjust at the tightening side.
- After adjusting pressure, fix the adjusting screw with spanner 27 and fasten the lock nut.
- After locking it, check the pressure at the boosting side. If a desired value has not been achieved, repeat the steps e. and f.

For Standard

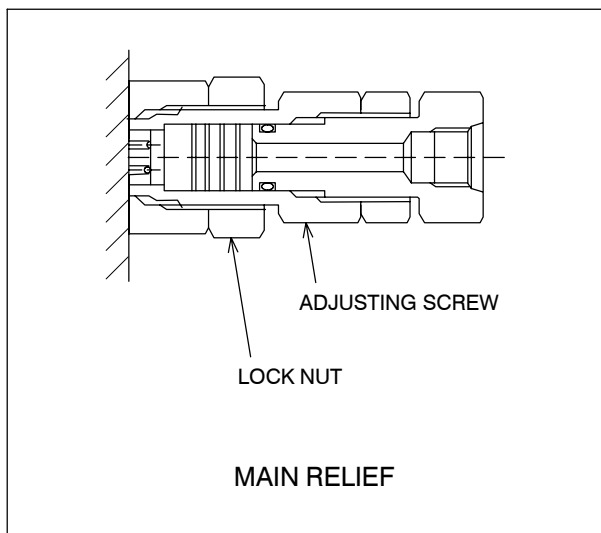
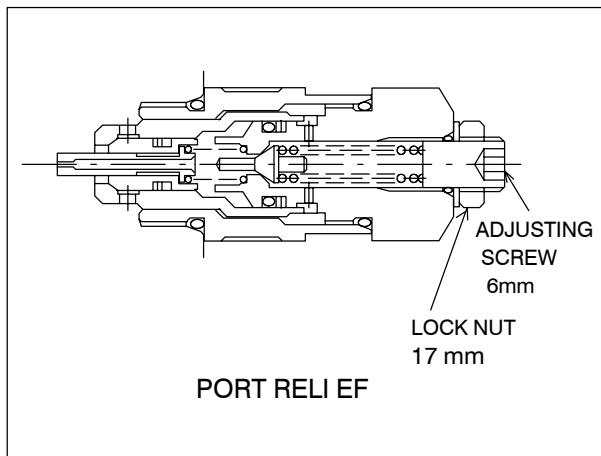
- Loosen the standard lock nut.
- Loosen the adjusting screw to lower the pressure below the set pressure and adjust it at the tightening side.
- After adjusting a pressure, while fixing the adjusting screw with spanner, fasten the lock nut.
- After locking it, check the pressure. If a desired value has not been achieved, repeat the steps h., i. and j.
- Stop the engine.

Re-checking

- Start the engine, press the right lever boosting switch with the engine maximum revolution, and verify no oil leakage presents at the adjusting area.
- Set the arm in relief condition at the arm IN side, check standard pressure. And then press the boosting pressure switch and check the boosted pressure.
- If a desired pressure has not been achieved, repeat the steps starting a..

PRESSURE MEASUREMENT/ADJUSTMENT

(3) Port relief pressure



Engine revolutions	S Mode maximum revolutions
Oil temperature	45~55°C
Tools used	Hexagon wrench 6, Spanner 17, 27, 32
Set pressure	39.5±0.5Mpa (403±5kgf/cm ²)

- It is necessary to set temporarily the main relief pressure higher than the port pressure because the port relief pressure is set higher than the main relief pressure.

Main relief pressure temporary setting

- Loosen the lock nut for boosting, and fasten the boosting pressure adjusting screw 180 ° and tighten the lock nut.
- After adjusting port relief pressure, loosen boosting lock nut and boosting adjusting screw 180 ° or greater to lower a pressure below the standard set pressure. And then make adjustment at the tightening side.

Note: Standard adjusting screw can not be used for adjustment.

Note: Boosting adjusting screw is used for adjustment. However the pressure to be set is adjusted at the standard pressure side.

Pressure adjustment

The port relief pressure for the boom, arm, bucket is adjusted referring to the previous section, (1) Control valve in the A. Pressure Adjusting Points.

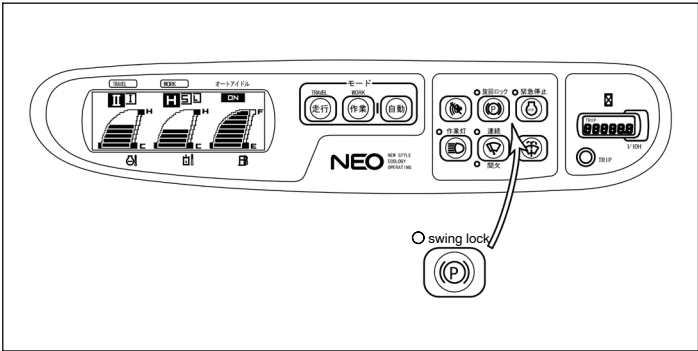
After the adjustment is completed, the main relief pressure should be set at a normal value.

For set pressure of each port, refer to set pressures in the previous section.

PRESSURE MEASUREMENT/ADJUSTMENT

(4) Swing motor relief pressure (SH200-3)

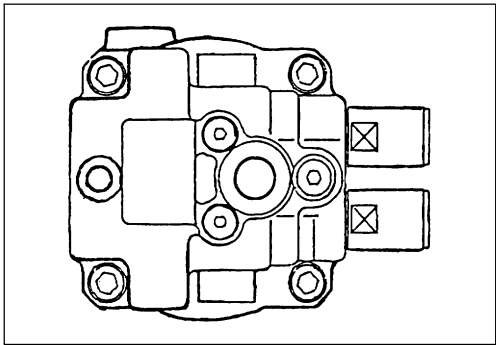
Swing Locking Instructions



Press the swing lock switch located on the right switch panel in the cab to confirm that the lamp next to the switch is turned on.

When the swing lever is first put in place, the engine revolutions should be reduced to about 1,000 rpm.

After making sure that the swing does not move, increase the engine revolutions up to the maximum.



Pressure Adjusting Instructions

- Check the current set pressure.
- Decide the number of adjusting shims required according to the difference between the set pressure and current pressure.

Number of shims	$\frac{\text{Set pressure} - \text{Current pressure}}{5}$
-----------------	---

- Remove the port relief assembly for swing motor from the motor body.
- When the removal is carried on both sides at the same time, mark the parts in order to avoid mixing them up while reassembling.
- Fix the port relief assembly on a vice and remove the cap, then, take out the piston, liner, spacer, puppet, shim, and spring.
- Remove the puppet and spring, and insert (or pull out) shims between the spring and spacer. The number of shims is calculated in the above step b.
- After adjusting shims, reassemble the puppet, spring, spacer, shim, piston, liner into the sleeve.

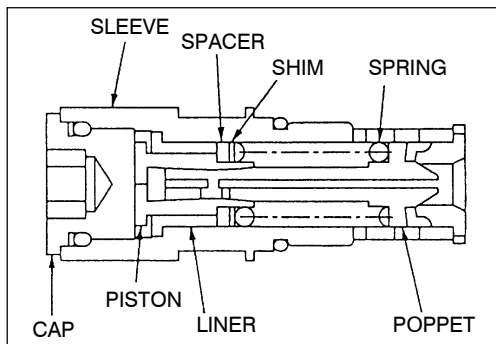
- Fix the sleeve on the vice and attach the cap on it.

Cap tightening torque	156.9 N•m (16 kgf•m)
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- Install the port relief assembly to the swing motor body and check the pressure.

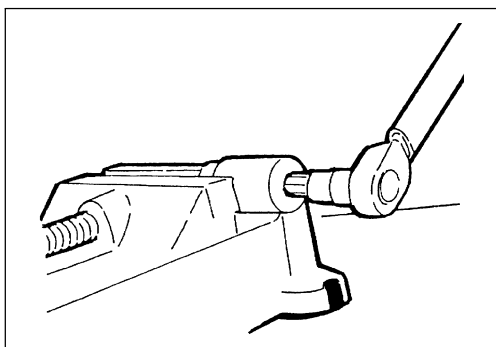
Relief assembly tightening torque	78.5 N•m (8 kgf•m)
Set pressure	29.1 ± 0.4 MPa (297 ± 4 kgf/cm ²)

PRESSURE MEASUREMENT/ADJUSTMENT



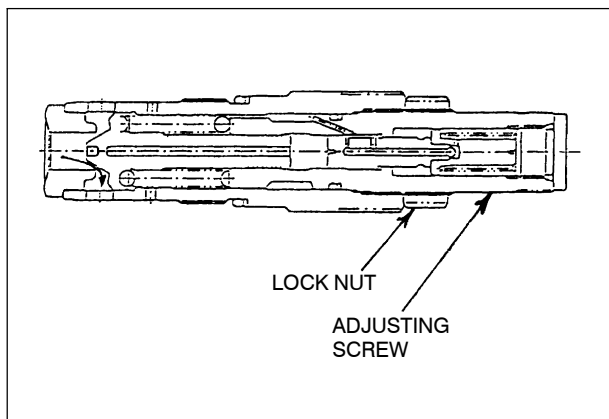
j. If the pressure is out of the set pressure range, repeat the procedure from a).

If the pressure is within the set pressure range, the pressure adjustment is completed.



(5) Swing motor relief pressure (SH220-3)

Swing lock procedures are the same as the ones for SH200-3.



No. of engine revolutions	S Mode maximum revolutions
Oil temperature	45~55°C
Tools	Spanner 24、32
Set pressure	30.1±0.4Mpa (307±4kgf/cm ²)

- a. Check the current set pressure.
- b. If the set pressure is different from the current pressure, adjust the adjusting screw.

Main Parts Common Features & Compatibility List

- Common features ○: Common parts △: Partially different ×: Different
- Compatibility ← ○ →: Compatible in both directions — ○ →, — × →, ← ○ —, ← × —: Compatible in one direction ← × →: Not compatible in both directions

SH200-3&SH200-2

Parts Name	Common Features	Compatibility			Notes:
		SH200-3		SH200-2	
Travel motor Assembly	×	KRA1426	← × →	KRA1274	
Shoe alone	×		← × →		
Reduction gear alone	×		← × →		
Shoe /link Assembly	△	KRA1383	← ○ →	KRA1255	with/without seal
Shoe alone	○	KRA1005	← ○ →	KRA1055	Model 3 (= with seal)
Link assembly	△	KRA1385	← ○ →	KRA1254	Model 2 (= without seal)
Lower roller (outer flange)	○	KRA1189	← ○ →	KRA1189	
Lower roller (inner flange)	×	—	← × →	KRA1190	Model 3 no inner flange (all outer flanges)
Upper roller	○	KRA1302	← ○ →	KRA1302	
Take-up roller	△	KRA1432	← ○ →	KRA1198	Model 3: Rolling rim Model 2: Rolling forging
Drive sprocket	○	KRA1397	← ○ →	KRA1397	
Central joint	△	KRA1486	← × →	KRA1111	Different screw on the P • T port Model 3: G screw Model 2: Rc screw
Counterweight	×	KRB1376	← × →	KRB1056	
Turntable bearing	×	KRB1347	← × →	KRB1090	
Swing motor Assembly	×	KRC0157	← × →	KRC0121	
Shoe alone	×	KRC0159	← × →		
Reduction gear alone	×	KRC0158	← × →		
Engine	×	KRH1334	← × →	KRH1012	
Engine controller	×	KRH1335	← × →	—	
Radiator/oil cooler					
Standard	×	KRH1327	← × →	KRH1014	
Swing out	×	KRH1328	← × →	KRH0814	
Air cleaner Assembly	△	KRH1221	← ○ →	KRH1017	Material: Model 2 = metal,
(single) Element	○	KRH0652	← ○ →	KRH0652	Model 3 = resin

Main Parts Common Features & Compatibility List

- Common features ○: Common parts △: Partially different ×: Different
- Compatibility ← ○ →: Compatible in both directions — ○ →, — × →, ← ○ —, ← × —: Compatible in one direction ← × →: Not compatible in both directions

SH200-3&SH200-2

Parts Name	Common Features	Compatibility			Notes:
		SH200-3		SH200-2	
Muffler	×	KRH1227	← × →	KRH1027	
Fuel tank	×	KRH1351	← × →	KRH0916	
Hydraulic pump	×	KRJ6199	← × →	KRJ4573	
Control valve	×	KRJ5753	← × →	KRJ4668	
Remote control valve (operation)	×	KRJ5804	← × →	KRJ3428	
Remote control valve (travel)	×	KRJ5803	← × →	KRJ4575	
Hydraulic oil tank	×	KRJ6209	← × →	KRJ4904	
Operator's cab	×	KHN2353	← × →	KHN2167	
Operator's seat	×	KHN2225	← × →	KHN1366	
Console box	×	KHN2327	← × →	KHN1869 KHN1870	Model 3: left/right one assembly Model 2: left/right separate (69: right, 70: left)
Controller	×	KHR2667	← × →	KHR1794	
Monitor display	×	KHR2697	← × →	KHR2123	
Air conditioner Assembly	×		← × →		Only connector is different.
Air conditioner unit	×	KHR2756	← × →	KHR2018	
Compressor	△	KHR2465	← × →	KHR2273	
Condenser	×	KHR2592	← × →	KHR1607	
Receiver dryer	○	KHR2594	← ○ →	KHR2594	
Boom	×	KRV2359	← × →	KRV1556	
Arm	×	KRV2362	← × →	KRV1557	
Bucket	×	KRV2383	← ○ →	KRV1381	
Boom cylinder (Right)	×	KRV2490	← × →	KRV1815	
(Left)	×	KRV2491	← × →	KRV1816	
Arm cylinder	×	KRV2492	← × →	KRV1817	
Bucket cylinder	×	KRV2493	← × →	KRV1818	

Main Parts Common Features & Compatibility List

- Common features ○: Common parts △: Partially different ×: Different
- Compatibility ← ○ →: Compatible in both directions — ○ —, — × —, ← ○ —, ← × —: Compatible in one direction ← × →: Not compatible in both directions

SH200-3&SH200GT-3

Parts Name	Common Features	Compatibility			Notes:
		SH200-3		SH200 GT-3	
Travel motor Assembly	○	KRA1426	←○→	KRA1426	
Shoe alone	○		←○→		
Reduction gear alone	○		←○→		
Shoe /link Assembly	○	KRA1383	←○→	KRA1383	with seal
Shoe alone	○	KRA1005	←○→	KRA1005	
Link assembly	○	KRA1385	←○→	KRA1385	
Lower roller (outer flange)	○	KRA1189	←○→	KRA1189	
Upper roller	○	KRA1302	←○→	KRA1302	
Take-up roller	○	KRA1432	←○→	KRA1432	
Drive sprocket	○	KRA1397	←○→	KRA1397	
Central joint	○	KRA1486	←○→	KRA1486	
Counterweight	○	KRB1376	←○→	KRB1376	
Turntable bearing	○	KRB1347	←○→	KRB1347	
Swing motor Assembly	○	KRC0157	←○→	KRC0157	
Shoe alone	○	KRC0159	←○→	KRC0159	
Reduction gear alone	○	KRC0158	←○→	KRC0158	
Engine	○	KRH1334	←○→	KRH1334	
Engine controller	○	KRH1335	←○→	KRH1335	
Radiator/oil cooler					
Standard	○	KRH1327	←○→	KRH1327	No swing out setting
Swing out	×	KRH1328	— × —		
Air cleaner Assembly	○	KRH1221	←○→	KRH1221	
Element (Outer)	○	KRH0652	←○→	KRH0652	
Element (Inner)	○	KRH1320	←○→	KRH1320	
Muffler	○	KRH1227	←○→	KRH1227	

Main Parts Common Features & Compatibility List

- Common features ○: Common parts △: Partially different ×: Different
- Compatibility ← ○ →: Compatible in both directions — ○ →, — × →, ← ○ —, ← × —: Compatible in one direction ← × →: Not compatible in both directions

SH200-3&SH200GT-3

Parts Name	Common Features	Compatibility			Notes:
		SH200-3		SH200 GT-3	
Fuel tank	○	KRH1351	←○→	KRH1351	
Hydraulic pump	×	KRJ6199	←×→	KRJ6255	Control methods are different
Control valve	×	KRJ5753	←×→	KRJ6256	Settings are different
Remote control valve (operation)	○	KRJ5804	←○→	KRJ5804	
Remote control valve (travel)	○	KRJ5803	←○→	KRJ5803	
Hydraulic oil tank	○	KRJ6209	←○→	KRJ6209	
Operator's cab	△	KHN2353	←×→	KHN2551	Only harness for monitor is different
Operator's seat	○	KHN2225	←○→	KHN2225	
Console box	○	KHN2327	←○→	KHN2327	
Controller	×	KHR2667	←×→	—	
Monitor display	×	KHR2697	←×→	KHR2956	
Air conditioner Assembly	○		←○→		
Air conditioner unit	○	KHR2756	←○→	KHR2756	
Compressor	○	KHR2465	←○→	KHR2465	
Condenser	○	KHR2592	←○→	KHR2592	
Receiver dryer	○	KHR2594	←○→	KHR2594	
Boom	○	KRV2359	←○→	KRV2359	
Arm	○	KRV2362	←○→	KRV2362	
Bucket	○	KRV2383	←○→	KRV2383	
Boom cylinder (Right)	○	KRV2490	←○→	KRV2490	
(Left)	○	KRV2491	←○→	KRV2491	
Arm cylinder	○	KRV2492	←○→	KRV2492	
Bucket cylinder	○	KRV2493	←○→	KRV2493	

Main Parts Common Features & Compatibility List

- Common features ○: Common parts △: Partially different ×: Different
- Compatibility ← ○ →: Compatible in both directions – ○ →, – × →, ← ○ –, ← × –: Compatible in one direction ← × →: Not compatible in both directions

SH220–3&SH220–2

Parts Name	Common Features	Compatibility			Notes:
		SH220–3		SH220–2	
Travel motor Assembly	×	KBA1024	← × →	KBA0926	
Shoe alone	×		← × →		
Reduction gear alone	×		← × →		
Shoe /link Assembly	△	KBA1033	← ○ →	KBA0916	with/without seal
Shoe alone	○	KBA0839	← ○ →	KBA0839	Model 3 (= with seal)
Link assembly	△	KBA1037	← ○ →	KBA0915	Model 2 (= without seal)
Lower roller (outer flange)	×	KBA1008	← × →	KBA1047	Only color and shaft are different
Lower roller (inner flange)	×	–	← × →	KBA1050	Model 3 no inner flange (all outer flanges)
Upper roller	○	KRA1302	← ○ →	KRA1302	
Take–up roller	○	KBA1030	← ○ →	KBA1030	
Drive sprocket	△	KRA1397	– × → ← ○ –	KRA1109	Materials are different. Model 3: S38BC model 2: S45C
Central joint	△	KRA1486	← × →	KRA1111	Different screw on the P.T port Model 3: G screw Model 2: Rc screw
Counterweight	×	KBB0722	← × →	KBB0551	
Turntable bearing	×	KBB0691	← × →	KBB0413	
Swing motor Assembly	×	KBC0109	← × →	KBC0087	
Shoe alone	×	KBC0108	← × →		
Reduction gear alone	×	KBC0110	← × →		
Engine	×	KBH0845	← × →	KBH0727	
Engine controller	×	KBH0846	← × →	–	
Radiator/oil cooler					
Standard	×	KBH0840	← × →	KBH0742	
Swing out	×	KBH0841	← × →	KBH0501	

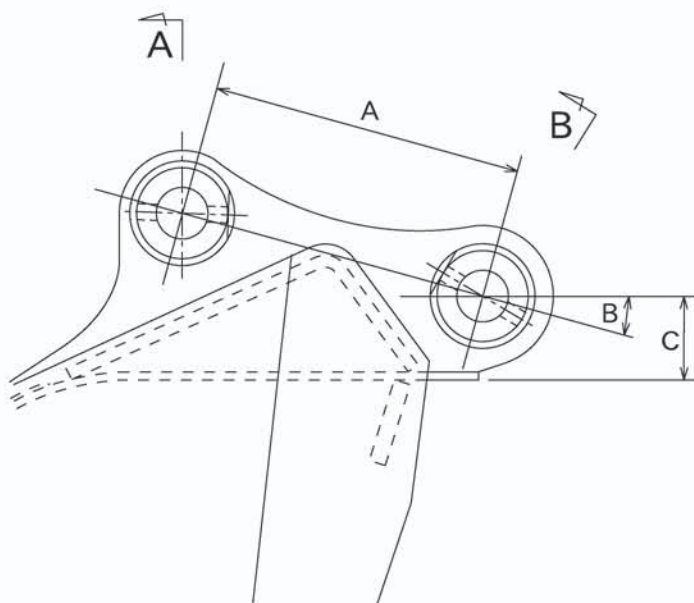
Main Parts Common Features & Compatibility List

- Common features ○: Common parts △: Partially different ×: Different
- Compatibility ← ○ →: Compatible in both directions — ○ —, — × —, ← ○ —, ← × —: Compatible in one direction ← × →: Not compatible in both directions

SH220-3&SH220-2

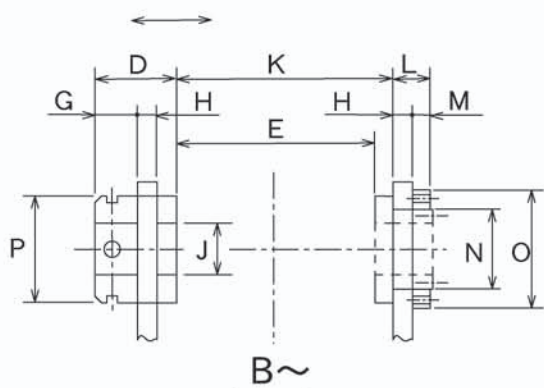
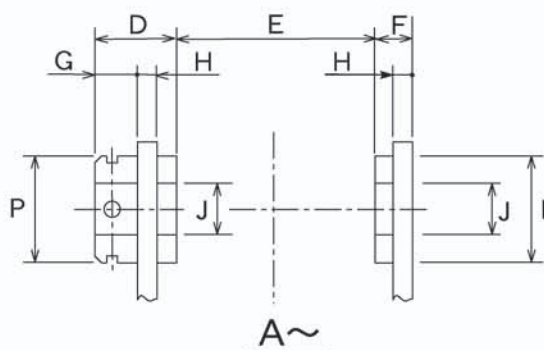
Parts Name		Common Features	Compatibility			Notes:
			SH220-3		SH220-2	
Air cleaner (single)	Assembly	△	KRH1221	←○→	KRH1017	Material: Model 2 = metal, Mode3 = resin
	Element	○	KRH0652	←○→	KRH0652	
Muffler		×	KBH0848	←×→	KBH0730	
Fuel tank		×	KRH1351	←×→	KRH0916	
Hydraulic pump		×	KBJ2789	←×→	KBJ2579	
Control valve		×	KBJ2747	←×→	KBJ2771	
Remote control valve (operation)		×	KRJ5804	←×→	KRJ3428	
Remote control valve (travel)		×	KRJ5803	←×→	KRJ4575	
Hydraulic oil tank		×	KRJ6209	←×→	KRJ4904	
Operator's cab		×	KHN2353	←×→	KHN2167	
Operator's seat		×	KHN2225	←×→	KHN1366	
Console box		×	KHN2327	←×→	KHN1869 KHN1870	Model 3: left/right one assembly Model 2: left/right separate (69: right, 70: left)
Controller		×	KHR2667	←×→	KHR1794	
Monitor display		×	KHR2697	←×→	KHR2123	
Air conditioner	Assembly	×		←×→		
	Air conditioner unit	×	KHR2756	←×→	KHR2018	
	Compressor	△	KHR2465	←×→	KHR2273	
	Condenser	×	KHR2592	←×→	KHR1607	
	Receiver dryer	○	KHR2594	←○→	KHR2594	
Boom		×	KBV1331	←×→	KBV0970	
Arm		×	KBV1334	←×→	KBV0971	
Bucket		×	KBV1355	←○→	KBV0756	
Boom cylinder	(Right)	×	KBV1400	←×→	KBV1141	
	(Left)	×	KBV1401	←×→	KBV1142	
Arm cylinder		×	KBV1343	←×→	KBV1143	
Bucket cylinder		×	KBV1402	←×→	KBV1144	

Bucket Related Dimensions

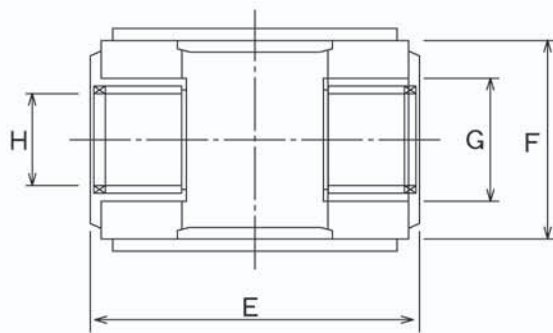
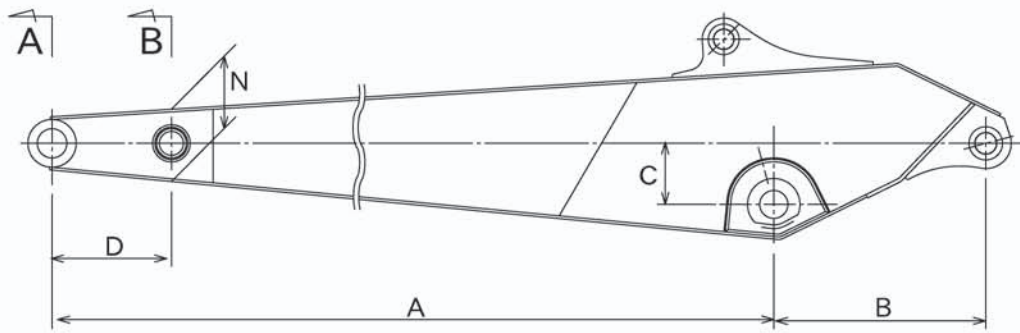


(mm)

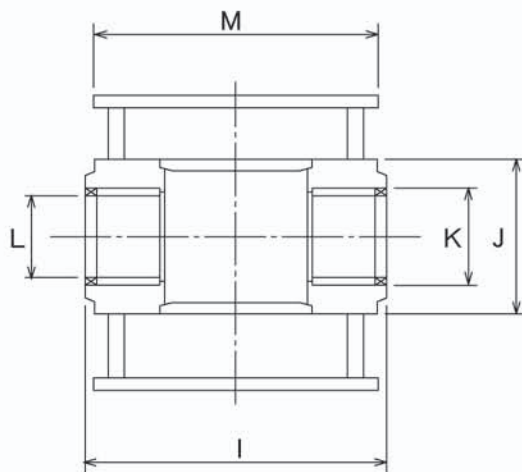
Section	SH200-3	SH220-3
A	451	468
B	3.9	6.3
C	102	117
D	99	102
E	307	326
F	54	57
G	45	45
H	22	25
I	150	170
J	80	90
K	323	342
L	54	63
M	16	22
N	120	130
O	180	190
P	120	130



Arm Related Dimensions



A~



B~

(mm)

Section	SH200-3	SH220-3
A	2,990	3,077
B	801	872
C	260	280
D	445	460
E	306	325
F	φ 180	φ 190
G	φ 110	φ 120
H	φ 80	φ 90
I	296	316
J	φ 140	φ 150
K	φ 90	φ 95
L	φ 75	φ 80
M	280	300
N	Approx. 280	Approx. 298

Extended Ball – race Greasing Intervals

Greasing Intervals

Model 2	250hours
Model 3	500hours

Improved points

[1] Seal improvement

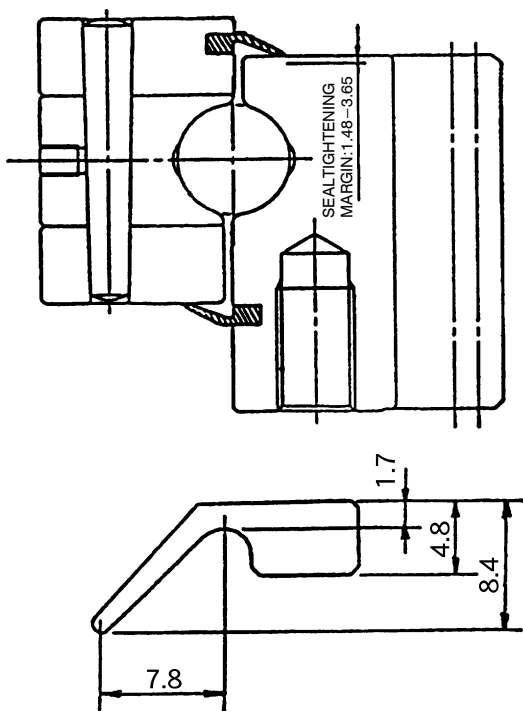
Material: Improvements in permanent set in fatigue, hardening speed and hardening tendency at low temperatures

Shape: Enhanced repulsion

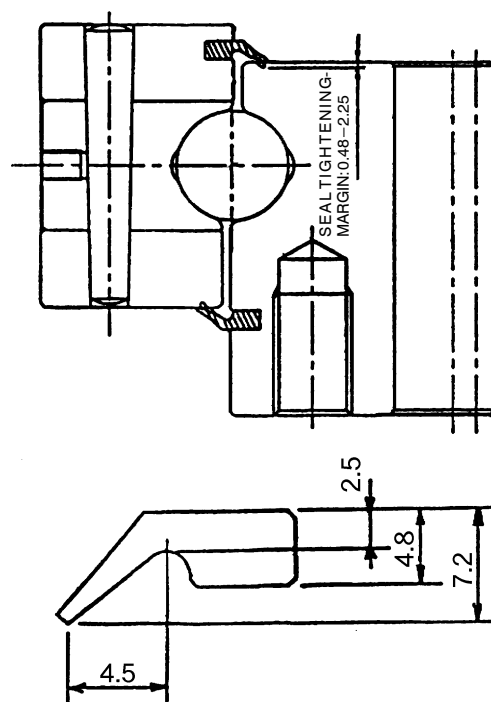
[2] Initial grease filling rate (Model 2) ----- Approx. 20%

Void volume filling rate (Model 3) ----- Approx. 60%

SH200 – 2



SH200 – 3



Long–life hydraulic oil (IDEMITSU Daphne Super Hydro 46SX)

Features

Currently used oils

Zinc (referred as Zn–DTP afterwards) is used in the currently used abrasive resistant hydraulic oil (Zn type hydraulic oil) as an wear prevention agent (extreme pressure additive agent) and anti–oxidation agent.

However, it is prone to thermally decompose considerably rapidly and generate sludge since hydraulic devices become smaller and use higher pressure in recent years. As a result, it becomes impossible to use these devices for a long period because there is a risk of failure occurrence such as filter blockage, sludge substance accumulation at the bottom of the tank, misoperation of control valves, quicker wear in devices, etc.

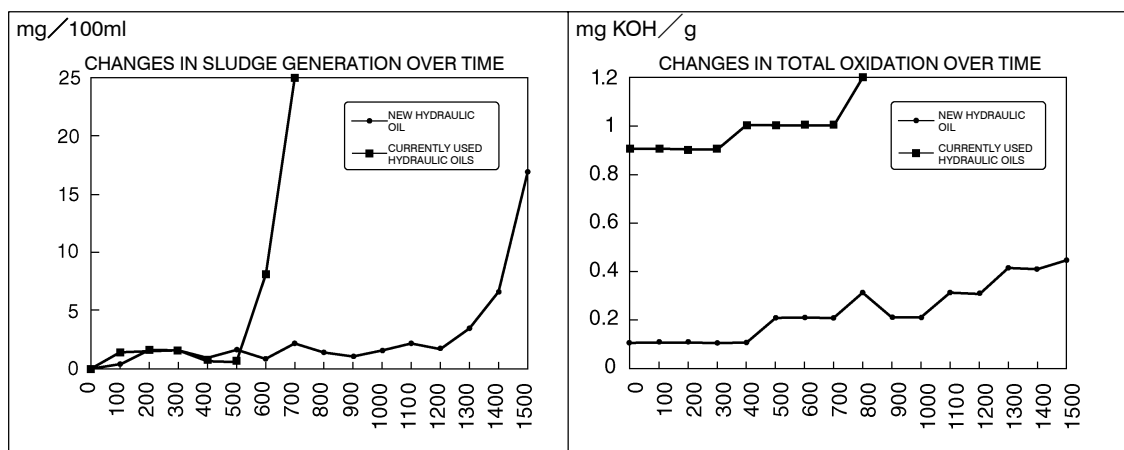
About new hydraulic oil

By using additives, as a wear prevention agent which generates less thermal–decomposed sludge, and as an anti–oxidation agent which controls partial oxidation deterioration at high temperatures, twice of heat resistance and oxidation stability has been realized. In addition, by maintaining other performances such as lubricating and defoaming characteristics at the same or higher level as the ones of the currently used oils, the life has been extended.

Adoption of non–zinc type additives
which have superior heat resistance

1. Reduced sludge generation
 2. Low copper corrosion
- As a result, the exchange period can be extended.

Table 1. The Results of High Pressure Circulation Deterioration Test
(Source: IDEMITSU's Test Results)



The life of hydraulic oil is usually determined by the changes in three factors below:

1. Changes in kinematic viscosity over time (Not so much difference is found between new hydraulic oil and currently used ones.)
2. Changes in total oxidation over time (Considerable improvement has been made. See Table 1)
3. Changes in sludge generation over time (Considerable improvement has been made. See Table 1)

To evaluate the heat resistance and oxidation stability of hydraulic oil, high pressure circulation tests are generally used. Judging from the results above, it can be concluded that the new hydraulic oil has twice life period compared with currently used ones.

Note1: If new oil is mixed with 10% or more of currently used oils (MOBILE DTE25B), its properties will change to the ones of currently used oils.

Note2: At the beginning of the line start at the factory on September 20th, new hydraulic oil has been filled in all machines for domestic delivery.

55U2-1920-	65U2-1593-	75X2-1166-	60H2-1817-
60G2-1355-	100C2-1683-	120A2-2418-	135X2-1140-
160A2-1111-	200A2-2690-	200C2-2012-	200L2-1223-
215N2-1108-	215X2-1108-	301L2-1154	

220A2 & 300A2 are for the next production

APPENDIX

Units Conversion Table

Gravitational units	— (×) → ← (÷) —	SI unit
Kgf	9.807	N
lbf	4.448	N
Kgf·cm	0.0981	N·m
lbf·ft	1.356	N·m
lbf·in	0.113	N·m
Kgf/cm ²	0.0981	MPa
atm	0.1013	MPa
lbf/in ²	0.0069	MPa
mmHg	133.3	Pa
in Hg	3386	Pa
Kgf·m/s	0.00981	KW
lbf·ft/s	0.00136	KW
PS	0.7355	KW
HP	0.746	KW
Kgf·m	9.807	J
Kcal	4186	J
Kgf·s/cm ²	98067	Pa·s
cP	0.001	Pa·s
P	0.1	Pa·s
cSt	1×10^{-6}	m ² /s
St	0.0001	m ² /s