

SERVICE MANUAL

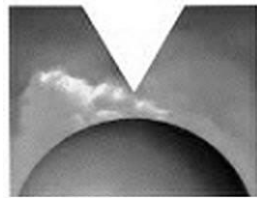
MINI-CRAWLER CRANE

MC-174CRM

Serial No. G0121 and up

The parts numbers and lists written in this service manual are the references for the services such as disassembling and assembling. Be sure to ALWAYS refer to the latest parts catalog (the latest information) before ordering any part, since the parts and the model numbers are subject to change during the endless improvements and changes of our Machine.

M A E D A



M A E D A

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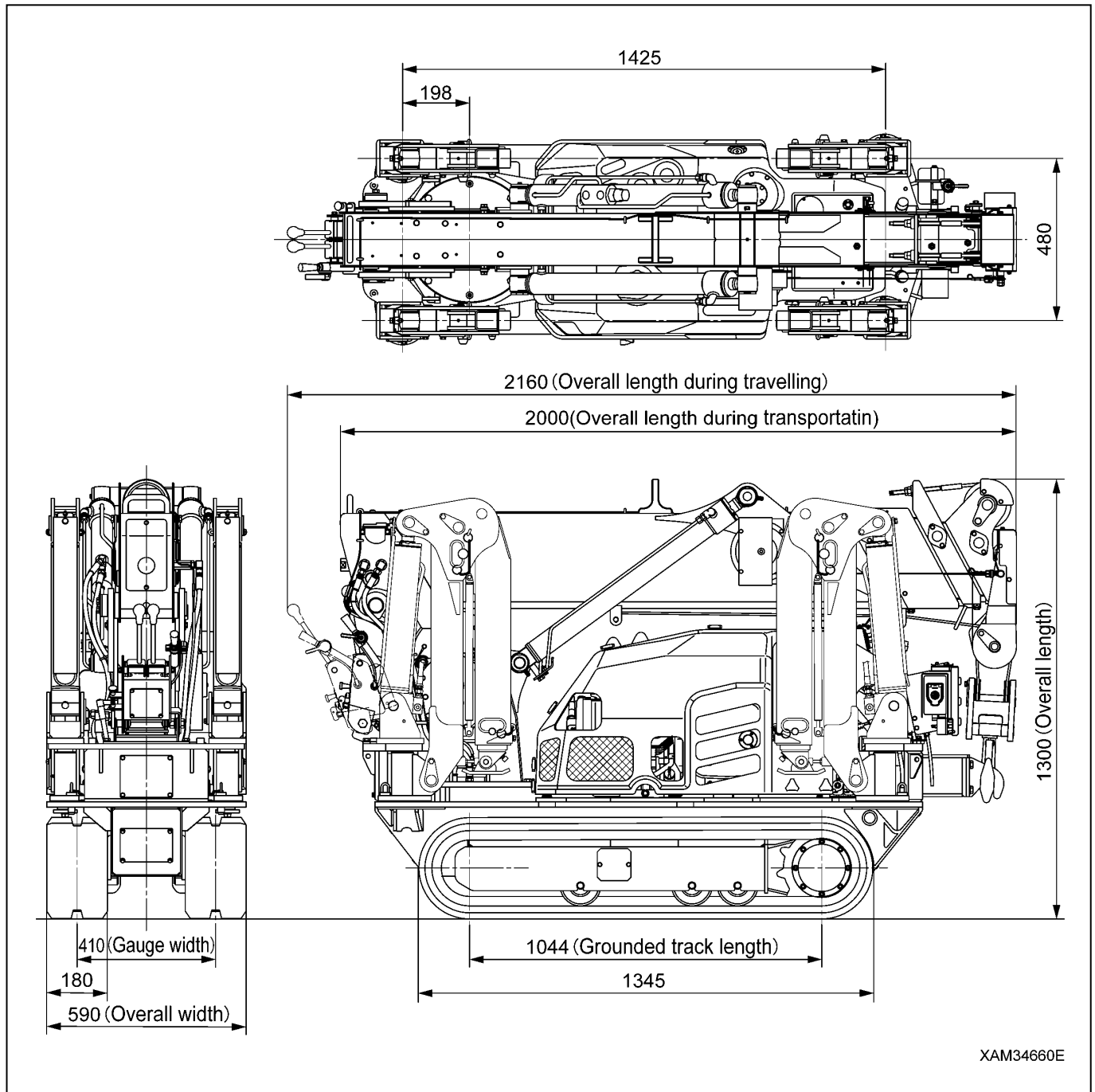
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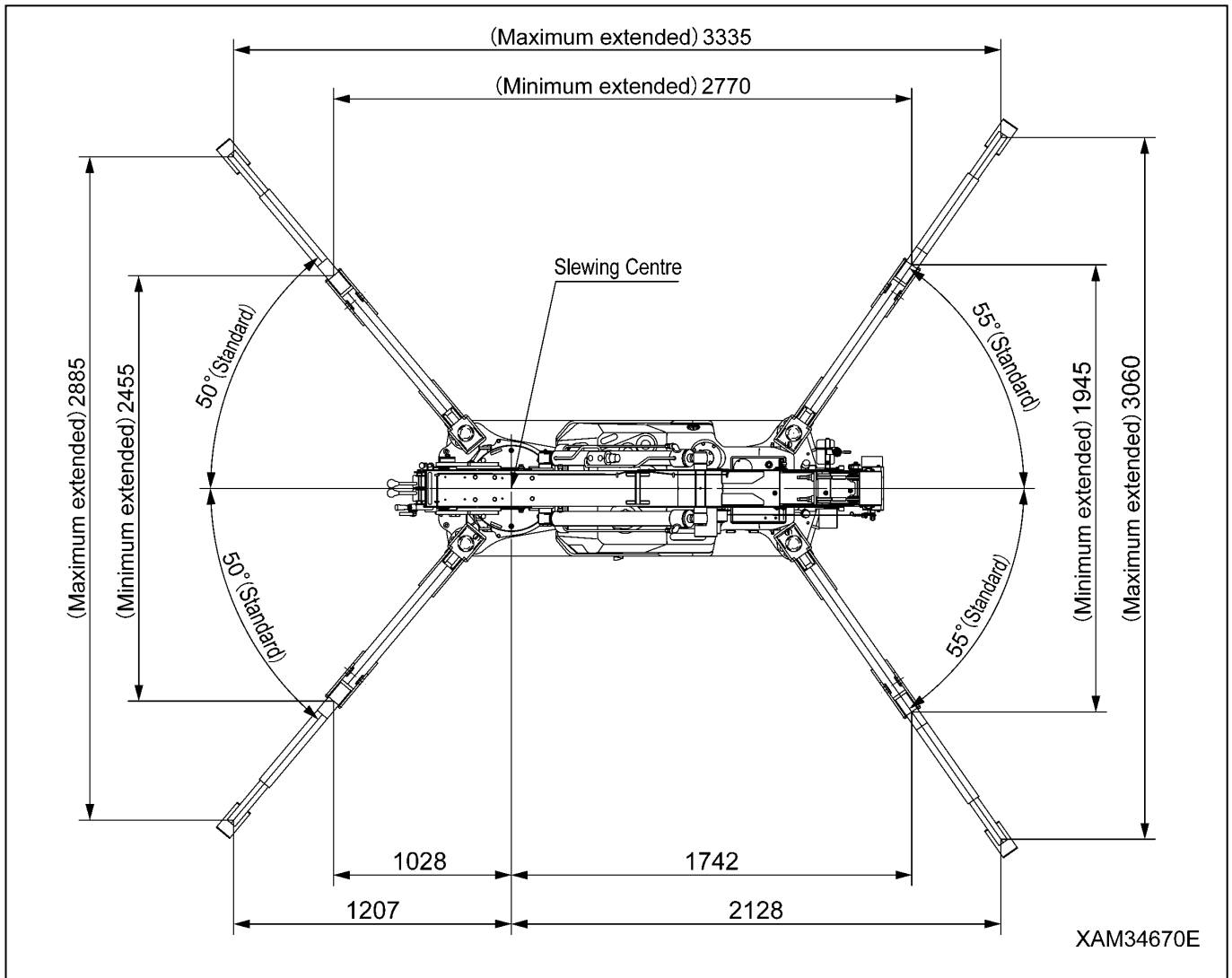
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1. SPECIFICATION DIMENSIONAL DRAWING



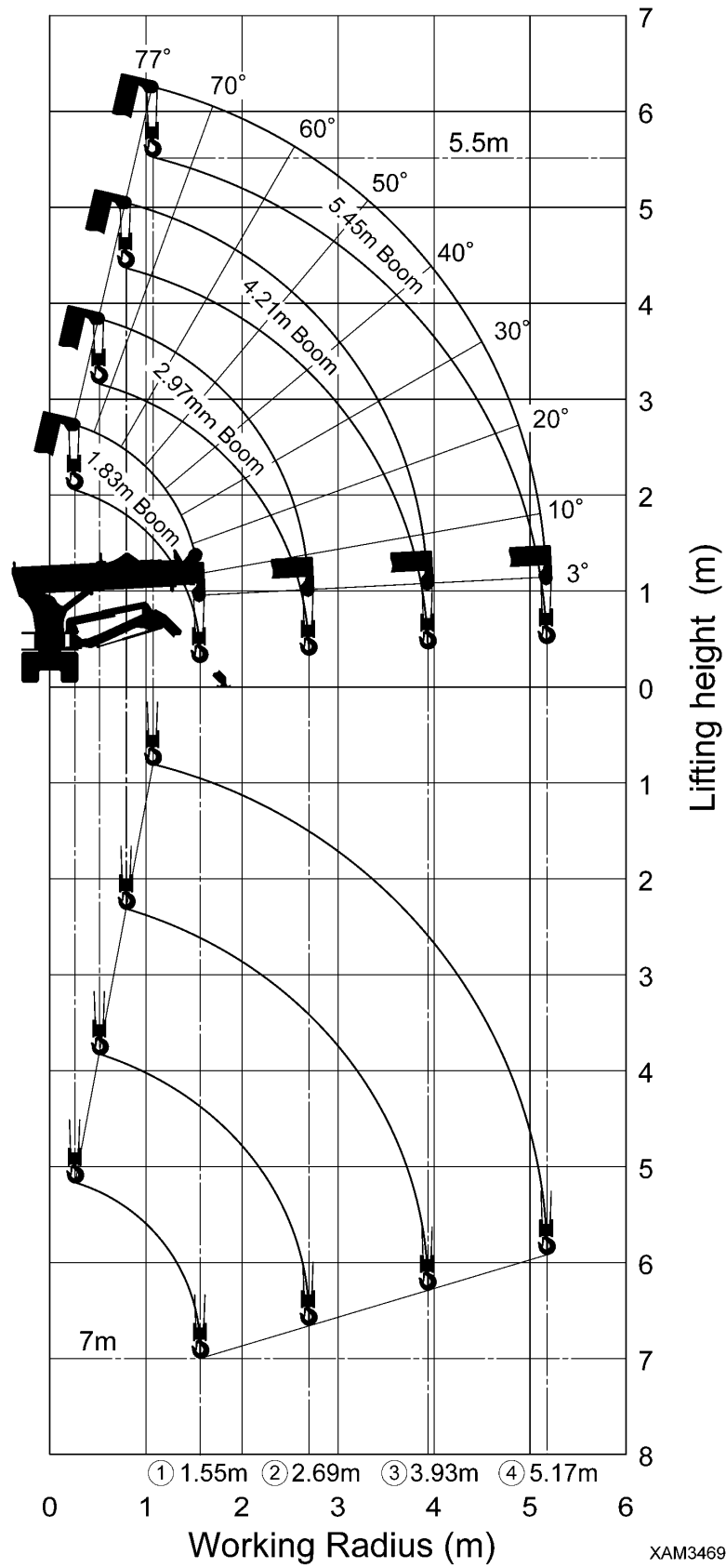
2. DIMENSIONAL DRAWING OF OUTRIGGER WIDTH



3. PRINCIPLE SPECIFICATION LIST

System / Item			MC-174CRM
Mass and dimensions	Machine mass		1290kg
	Overall length × width × height		2000mm x 590mm x 1300mm
	Distance between idler and sprocket		1044mm
	Track gauge		410mm
	Track width		180mm
Capacity	Maximum total rated load × working radius		1.72t x 1.0m
	Maximum working radius		5.17m
	Maximum lifting height		5.5m
Winch system	Method		Hydraulic piston motor drive, reduction spur gear, mechanical brake
	Winding speed		10.9m/min (3 layers, 4 falls)
	Hoisting rope		IWRC 6 x Fi (29) 0/0 ϕ 6 x 35m
Boom telescoping system	Method		Sequentially telescoping hydraulic cylinder (2 pieces) + Wire rope expansion device (1 piece) (With a hydraulic automatic locking device)
	Boom type		Pentagonal section, hydraulic automatic extension, 4-stage boom (Stage 3/4: Simultaneous telescoping)
	Boom length		1.83m – 2.97m – 4.21m – 5.45m
	Boom telescoping stroke/ time		3.62m/15sec
Boom derricking system	Method		Direct push-type hydraulic double-acting cylinder (2 pieces), (With a hydraulic automatic locking device)
	Derrick angle/ time		3 to 77 deg./12sec
Slewing system	Method		Swing bearing, trochoid motor drive, Reduction gear: Worm + Reduction spur gear, Brake: Worm-selflock
	Slewing angle/ speed		360 deg. (continuous)/ 2rpm
Outrigger system	Method		1st stage with flexible stay damper, 2nd stage manual pull-out, hydraulic cylinder direct acting
	Overall width of extended outriggers		(Front) 3060mm x (Right/left) 3335mm x (Rear) 2885mm
Travelling system	Method		Hydraulic two-speed motor drive, Variable speed, Built-in brake
	Travel speed	High speed	Forward/backward: 0 – 3.3km/h
		Low speed	Forward/backward: 0 – 2.0km/h
	Gradeability		20 deg.
Hydraulic system	Hydraulic pump		Double-throw variable piston pump (8.6cc/rev × 2)
	Rated pressure		20.6MPa (210kgf/cm ²)
	Hydraulic oil tank capacity		20 litres
Engine	Model		Mitsubishi GM401LE
	Type		1-cylinder, Air cooled, 4-cycle gasoline engine
	Displacement		0.391 litres (391cc)
	Rated output (continuous)		6.6kW/1800min ⁻¹ (9.0PS/1800rpm)
	Fuel tank capacity		Lead-free gasoline/6 litres
Battery	Model		30A19R (DC12V x 1 piece)
Safety device	Over hoist detector/automatic stop device, hydraulic safety valve, hydraulic automatic locking device, slinging rope detachment protector, alarm buzzer, level, crane inclination alarm (travel mode : more than 15 degree, crane & outrigger mode : more than 3 degree), moment limiter (working envelope limited), working status lamp, over un-winding detector		

4. WORKING RADIUS AND LIFTING HEIGHT



5. TOTAL RATED LOAD CHART

★The Total rated load Chart is based on actual working radius with the bending of boom attributable to load reflected and is shown with the mass of hook block (20kg) included.

[1] TOTAL RATED LOAD CHART FOR 4 FALLS

Outrigger Extended to Maximum							
1.83m BOOM		2.97m BOOM		4.21m BOOM		5.45m BOOM	
Working radius (m)	Total rated load (kg)	Working radius (m)	Total rated load (kg)	Working radius (m)	Total rated load (kg)	Working radius (m)	Total rated load (kg)
1.0 or less	1720	1.0 or less	1720	1.3 or less	1320	1.7 or less	770
1.3	1320	1.3	1320	1.5	1120	2.0	700
1.55	1090	1.5	1120	2.0	820	2.5	660
--	--	2.0	820	2.5	670	2.8	580
--	--	2.5	670	3.0	530	3.0	530
--	--	2.69	580	3.5	420	3.5	410
--	--	--	--	3.93	370	4.0	330
--	--	--	--	--	--	4.5	270
--	--	--	--	--	--	5.17	220

Outrigger Extended to Other than Maximum							
1.83m BOOM		2.97m BOOM		4.21m BOOM		5.45m BOOM	
Working radius (m)	Total rated load (kg)	Working radius (m)	Total rated load (kg)	Working radius (m)	Total rated load (kg)	Working radius (m)	Total rated load (kg)
1.0 or less	1220	1.0 or less	1220	1.3 or less	940	1.7 or less	720
1.3	940	1.3	940	1.5	810	2.0	600
1.55	790	1.5	810	2.0	600	2.5	390
--	--	2.0	600	2.5	390	2.8	330
--	--	2.5	390	3.0	300	3.0	300
--	--	2.69	310	3.5	220	3.5	220
--	--	--	--	3.93	180	4.0	180
--	--	--	--	--	--	4.5	140
--	--	--	--	--	--	5.17	100

Hook block : 20 kg

[2] TOTAL RATED LOAD CHART FOR 2 FALLS

Outrigger Extended to Maximum							
1.83m BOOM		2.97m BOOM		4.21m BOOM		5.45m BOOM	
Working radius (m)	Total rated load (kg)	Working radius (m)	Total rated load (kg)	Working radius (m)	Total rated load (kg)	Working radius (m)	Total rated load (kg)
1.0 or less	860	1.0 or less	860	1.3 or less	860	1.7 or less	770
1.3	860	1.3	860	1.5	860	2.0	700
1.55	860	1.5	860	2.0	820	2.5	660
--	--	2.0	820	2.5	670	2.8	580
--	--	2.5	670	3.0	530	3.0	530
--	--	2.69	580	3.5	420	3.5	410
--	--	--	--	3.93	370	4.0	330
--	--	--	--	--	--	4.5	270
--	--	--	--	--	--	5.17	220

Outrigger Extended to Other than Maximum							
1.83m BOOM		2.97m BOOM		4.21m BOOM		5.45m BOOM	
Working radius (m)	Total rated load (kg)	Working radius (m)	Total rated load (kg)	Working radius (m)	Total rated load (kg)	Working radius (m)	Total rated load (kg)
1.0 or less	860	1.0 or less	860	1.3 or less	860	1.7 or less	720
1.3	860	1.3	860	1.5	810	2.0	600
1.55	790	1.5	810	2.0	600	2.5	390
--	--	2.0	600	2.5	390	2.8	330
--	--	2.5	390	3.0	300	3.0	300
--	--	2.69	310	3.5	220	3.5	220
--	--	--	--	3.93	180	4.0	180
--	--	--	--	--	--	4.5	140
--	--	--	--	--	--	5.17	100

Hook block : 20 kg

[3] TOTAL RATED LOAD CHART FOR SINGLE FALL

Outrigger Extended to Maximum							
1.83m BOOM		2.97m BOOM		4.21m BOOM		5.45m BOOM	
Working radius (m)	Total rated load (kg)	Working radius (m)	Total rated load (kg)	Working radius (m)	Total rated load (kg)	Working radius (m)	Total rated load (kg)
1.0 or less	430	1.0 or less	430	1.3 or less	430	1.7 or less	430
1.3	430	1.3	430	1.5	430	2.0	430
1.55	430	1.5	430	2.0	430	2.5	430
--	--	2.0	430	2.5	430	2.8	430
--	--	2.5	430	3.0	430	3.0	430
--	--	2.69	430	3.5	420	3.5	410
--	--	--	--	3.93	370	4.0	330
--	--	--	--	--	--	4.5	270
--	--	--	--	--	--	5.17	220

Outrigger Extended to Other than Maximum							
1.83m BOOM		2.97m BOOM		4.21m BOOM		5.45m BOOM	
Working radius (m)	Total rated load (kg)	Working radius (m)	Total rated load (kg)	Working radius (m)	Total rated load (kg)	Working radius (m)	Total rated load (kg)
1.0 or less	430	1.0 or less	430	1.3 or less	430	1.7 or less	430
1.3	430	1.3	430	1.5	430	2.0	430
1.55	430	1.5	430	2.0	430	2.5	390
--	--	2.0	430	2.5	390	2.8	330
--	--	2.5	390	3.0	300	3.0	300
--	--	2.69	310	3.5	220	3.5	220
--	--	--	--	3.93	180	4.0	180
--	--	--	--	--	--	4.5	140
--	--	--	--	--	--	5.17	100

Hook block : 10 kg

6. STANDARD PRESSURE AND OPERATING TIME CHART

6.1 OUTRIGGER

(When Oil Temperature 30 - 50 °C)

		When Full Accelerating	
		Operating Pressure (MPa) (At Travelling control valve)	Operating time (sec)
Front Outrigger Slide (1), (4) (1-piece)	Extend	17.4±1	8.4±2
	Retract	19.6±1	9.4±2
Rear Outrigger Slide (2), (3) (1-piece)	Extend	17.5±1	8.3±2
	Retract	19.4±1	9.2±2

6.2 CRANE OPERATION

(When Oil Temperature 30 - 50 °C)

		When Full Accelerating	
		Operating Pressure (MPa) (At Travelling control valve)	Operating time (sec)
Boom Derricking (0 – 80 deg.)	Raise	4.5±1	8.4±1
	Lower	16.3±1	13.2±1
Hoisting (2m, 2-boom)	Raise	3.3±1	5.3±1
	Lower	5.2±1	5.4±1
Boom Telescoping (No.1 boom to No.4 boom)	Extend	3.7±1	15.3±1
	Retract	17.6±1	21.7±2
Slewing (360 deg.)	Clockwise	11±1	30.2±3

6.3 TRAVELLING OPERATION

(When Oil Temperature 30 - 50 °C)

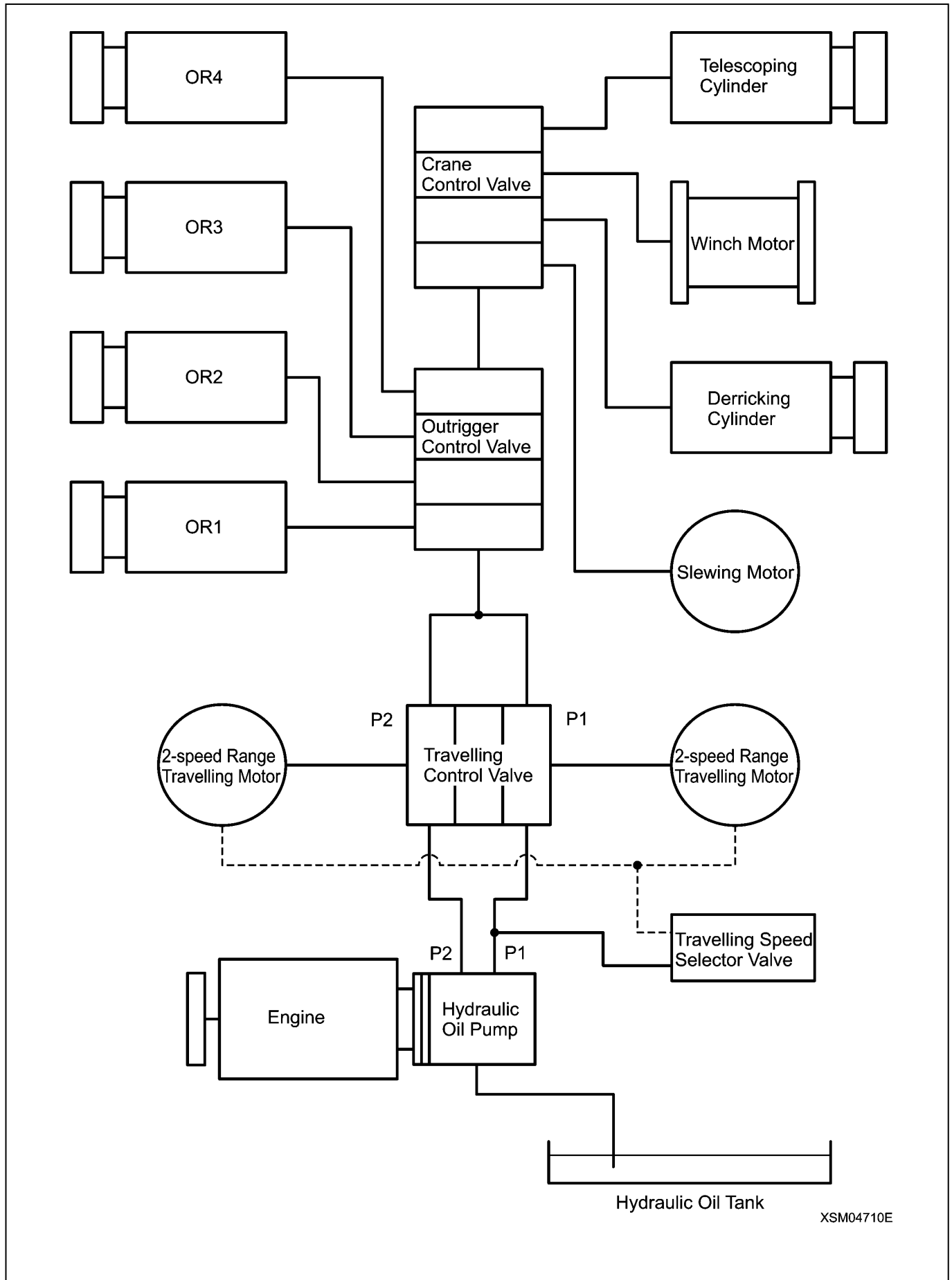
		When Full Accelerating	
		Operating Pressure (MPa) (At Travelling control valve)	Operating time (sec)
Straight Travelling (20 m)	Forward 1st speed	5.2±1	36.7
	Forward 2nd speed	8.5±1	20.9

6.4 MICRO SPEED

(When Oil Temperature 30 - 50 °C)

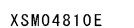
Micro Speed	1	2	3
Setting value	10	18	60
Winding speed (m/min)	0.094	0.168	6.59

7. POWER TRAIN DRAWING



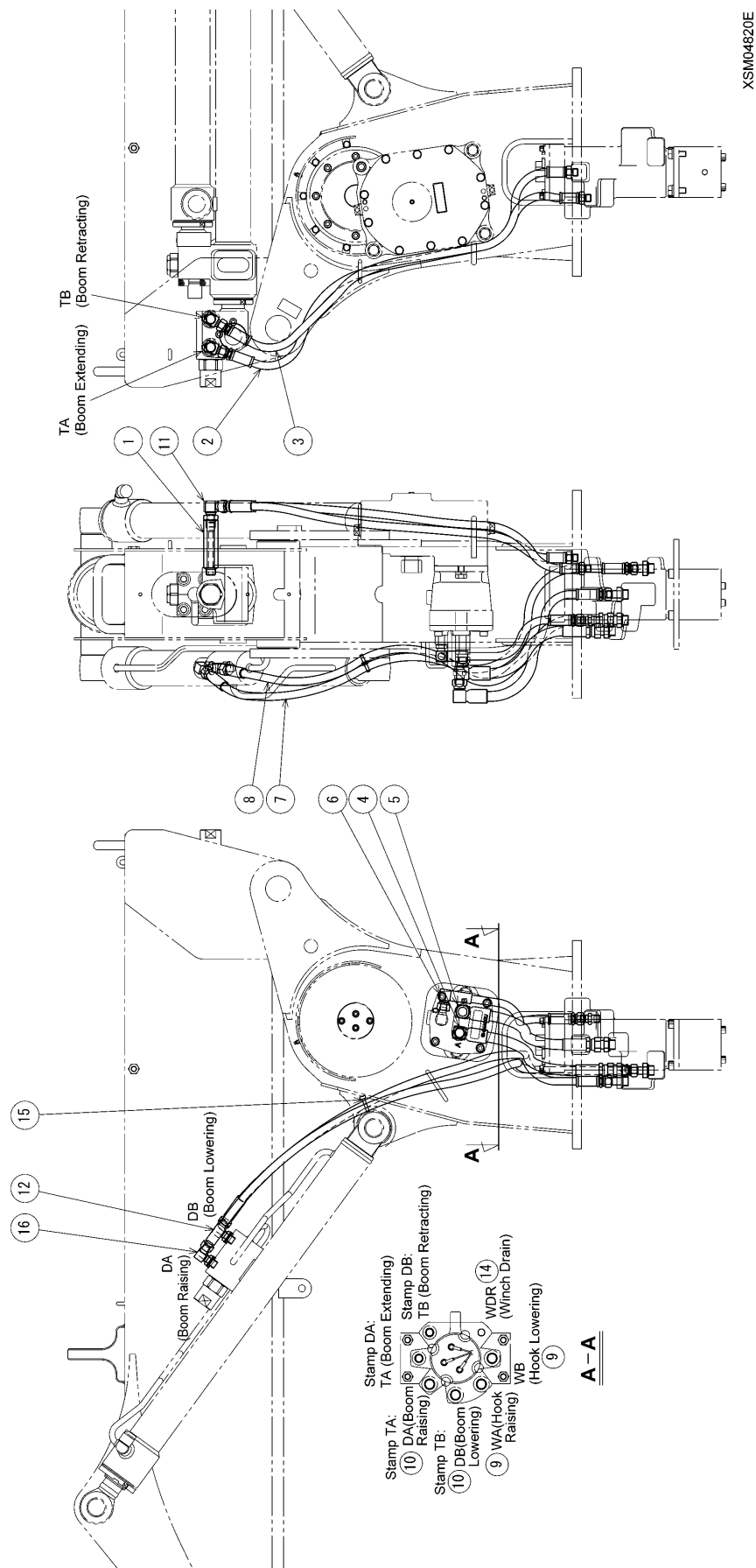
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2. HYDRAULIC OIL PIPING

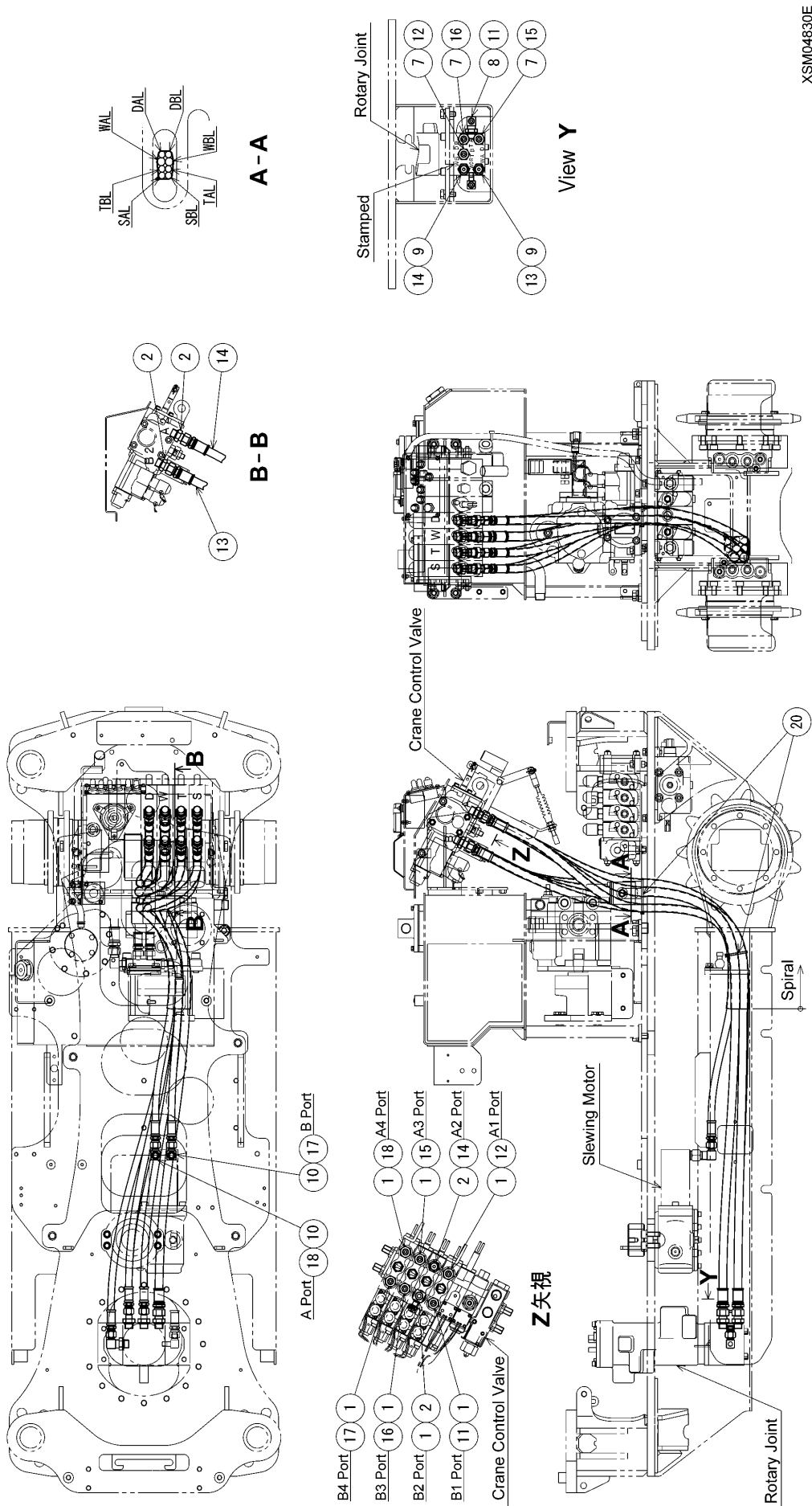
2.1 CRANE ROTATE PORTION



Rotary Joint Connection Table										
Port	Connector		Hose/Piping			Connector		Port	Connecting to Equipment	Function
	No.	Parts No.	No.	Mark	Parts No.	No.	Parts No.			
TB	10	22611-11035	8	DB	22779-83088	12	22611-11130	B	Derricking Cylinder	Boom lowering
TA	10	22611-11035	7	DA	22779-83099	12	22611-11130	A		Boom raising
WB	9	22611-11050	5	WB	22788-95026		(22611-11050)	B	Winch Motor	Hook lowering
							(349-4413000)			
WA	9	22611-11050	4	WA	22778-95033		(22611-10150)	A		Hook raising
							(4382-23000-1)			
DA			2	TA	22779-63082	11	22611-11135	A	Telescoping cylinder	Boom extending
						1	349-4412500			
DB			3	TB	22779-63082	11	22611-11135	B		Boom retracting
						1	349-4412500			
WDr	14	22611-10130	6	WDr	22779-93030		(22611-14230)	D	Winch Motor	Drain

NO.	DESCRIPTION	Q'TY	NOTICE
1	Long Connector (3/8)	2	Parts No.: 349-4412500
2	Hydraulic Oil Hose (TA) (Boom extending)	1	NN173-04-820L, 6007=10051 (Bind spiral tube)
3	Hydraulic Oil Hose (TB) (Boom retracting)	1	NN173-04-820L, 6007=10051 (Bind spiral tube)
4	Hydraulic Oil Hose (WA) (Hook raising)	1	NV210-9-330L, 0590=1005
5	Hydraulic Oil Hose (WB) (Hook lowering)	1	NV210-9-260L, 0590=1005
6	Drain Hose (W)	1	NN173-04-300L, 0590=1005
7	Hydraulic Oil Hose (DA) (Boom raising)	1	NN173-04-990L, 1005=1005
8	Hydraulic Oil Hose (DB) (Boom lowering)	1	NN173-04-880L, 1005=1005
9	Connector (with O-ring)	2	1067-06
10	Connector (with O-ring)	2	1071-06-04
11	Elbow (90 deg. With Seat)	2	1071-06-04
12	Elbow (90 deg. With Seat)	2	1071-04
13	Skipped No.		
14	Connector	1	1009-04
15	Tie Band	2	CV-150B
16	Elbow (90 deg. With Seat)	1	1071-04, Orifice: φ1.5

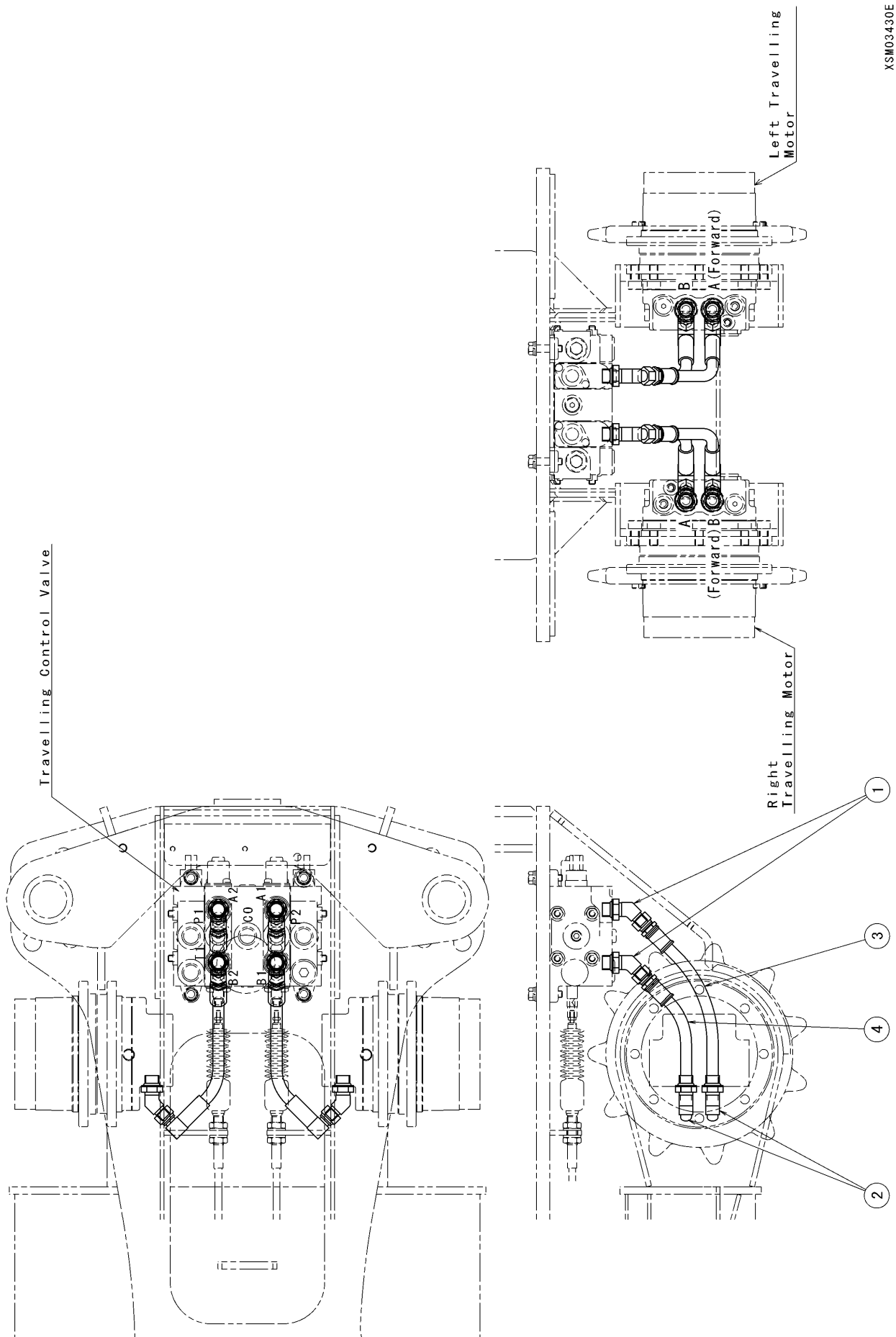
2.2 CRANE FIXED PORTION



Crane Control Valve Connection Table											
Port	Connector		Hose/Piping			Connector		Port	Connecting to Equipment	Function	
	No.	Parts No.	No.	Mark	Parts No.	No.	Parts No.				
A1	1	22611-11035	12	DBL	22781-83145	7	22611-11035	TB	Rotary Joint	Boom lowering	
B1	1	22611-11035	11	DAL	22781-83150	8	22611-11035	TA		Boom raising	
A2	2	22611-11050	14	WBL	22782-85145	9	22611-11050	WB		Hook lowering	
B2	3	349-441300	13	WAL	22782-85142	9	22611-11050	WA			Hook raising
	4	S101J2062000									
		5	22611-10410	19	G	22771-31040	6	329-4288700	-	Load Meter	-
A3	1	22611-11035	15	TAL	22781-83145	7	22611-11035	DA	Rotary Joint	Boom extending	
B3	1	22611-11035	16	TBL	22781-83145	7	22611-11035	DB		Boom retracting	
A4	1	22611-11035	18	SBL	22781-83110	10	22611-10435	A	Slewing Motor	Counter clockwise	
B4	1	22611-11035	17	SAL	22781-83108	10	22611-10435	B		Clockwise	

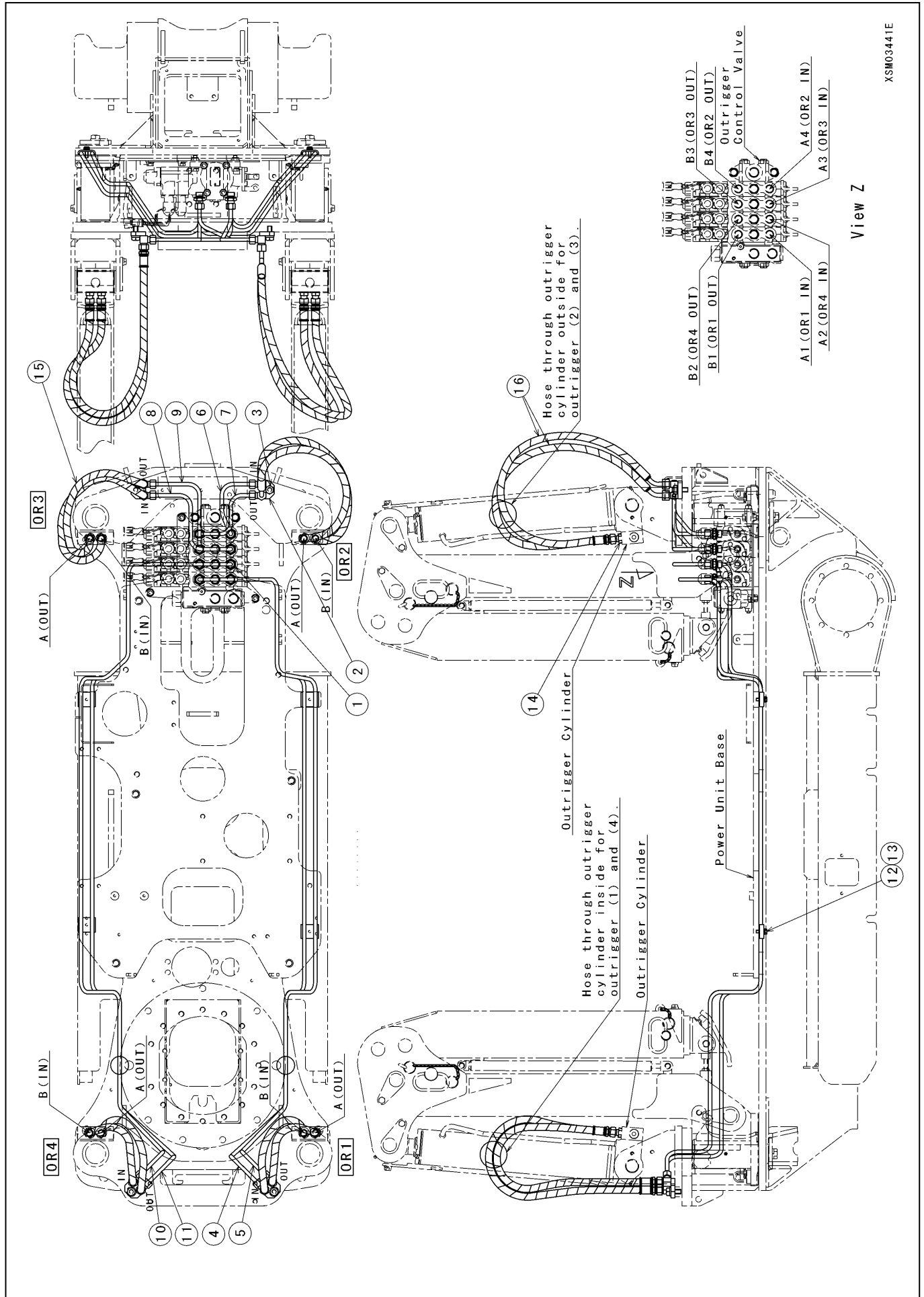
NO.	DESCRIPTION	Q'TY	NOTICE
1	Connector	6	1067-06-04
2	Connector	1	1067-06
3	Connector (3/8)	1	Parts No.: 349-4413000
4	Tee	1	Parts No.: S101J2062000
5	Elbow	1	1034-02
6	Socket	1	Parts No.: 329-4288700
7	Connector	3	1067-06-04
8	Elbow (With Seat)	1	1071-06-04
9	Connector	2	1067-06
10	Elbow	2	1034-06-04
11	Hydraulic Oil Hose (DA, Boom raising)	1	KF04-1500L-C=C
12	Hydraulic Oil Hose (DB, Boom lowering)	1	KF04-1450L-C=C
13	Hydraulic Oil Hose (WA, Hook raising)	1	KG06-1420L-C=C
14	Hydraulic Oil Hose (WB, Hook lowering)	1	KG06-1450L-C=C
15	Hydraulic Oil Hose (TA, Boom extending)	1	KF04-1450L-C=C
16	Hydraulic Oil Hose (TB, Boom retracting)	1	KF04-1450L-C=C
17	Hydraulic Oil Hose (SA, Clockwise)	1	KF04-1080L-C=C
18	Hydraulic Oil Hose (SB, Counter clockwise)	1	KF04-1110L-C=C
19	Hydraulic Oil Hose (G)	1	N173-02-400L-1001=1005
20	Tie Band	2	CV-150B

2.3 TRAVELLING LINE



NO.	DESCRIPTION	Q'TY	NOTICE
1	Elbow (45 deg.)	2	1072-06-04
2	Elbow (45 deg.)	2	1072-06-04
3	Travelling Hose (A)	2	NV210-6-300L 1005=0590
4	Travel ling Hose (B)	2	NV210-6-230L 1005=0590

2.4 OUTRIGGER LINE



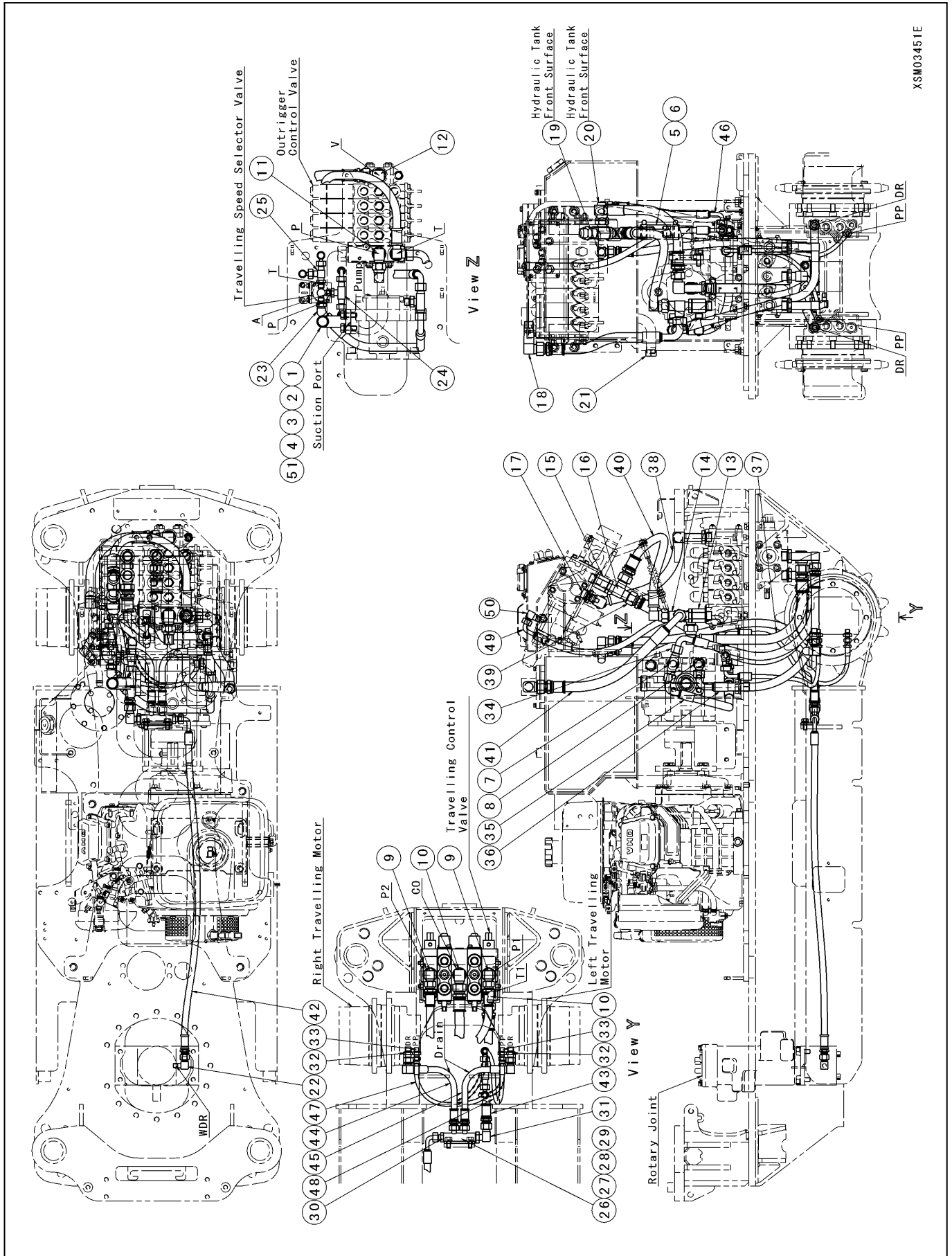
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Outrigger Control Valve Connection Table						
Port	Connector		Hose/Piping		Connector	
	No.	Parts No.	No.	Parts No.	No.	Parts No.
A1	1	22511-07350	4	101-3290900	2	350-4390100
B1			5	101-3291000		
A2			10	101-3291100		
B2			11	101-3291200		
A3			8	101-4556600		
B3			9	101-4556700		
A4			6	101-4556400		
B4			7	101-4556500		

Outrigger Cylinder Connection Table								
Port	Hose/Piping			Connector		Port	Connecting to Equipment	Function
	No.	Mark	Parts No.	No.	Parts No.			
A1	OR	15	22779-83070	14	22611-11030	B	Outrigger (1) Cylinder	In
B1						A		Out
A2						B	Outrigger (2) Cylinder	In
B2						A		Out
A3						B	Outrigger (3) Cylinder	In
B3						A		Out
A4						B	Outrigger (4) Cylinder	In
B4						A		Out

NO.	DESCRIPTION	QTY	NOTICE
1	Connector	8	LLM-UR-8X3/8 With O-ring
2	Terminal	4	Parts No.: 350-4390100
3	Sems Bolt	4	M10X1.5X25L
4	Outrigger pipe (RRA)	1	Parts No.: 101-3290900
5	Outrigger pipe (RRB)	1	Parts No.: 101-3291000
6	Outrigger pipe (FRA)	1	Parts No.: 101-4556400
7	Outrigger pipe (FRB)	1	Parts No.: 101-4556500
8	Outrigger pipe (FLA)	1	Parts No.: 101-4556600
9	Outrigger pipe (FLB)	1	Parts No.: 101-4556700
10	Outrigger pipe (RLA)	1	Parts No.: 101-3291100
11	Outrigger pipe (RLB)	1	Parts No.: 101-3291200
12	Gall	4	Parts No.: 4672912
13	Sems Bolt	4	M6X1.0X20L
14	Connector	8	1067-04
15	Outrigger Hydraulic Oil Hose	6	NN173-04-700L 1005= 1005 (Bind spiral tube)
16	Outrigger (2) Hydraulic Oil Hose	2	NN173-04-700L 1005= ML45 (Bind spiral tube)

2.5 PUMP, TANK, DRAIN AND PILOT LINE



XSM03451E

Pump Line Connection Table										
Equipment	Port	Connector		Hose			Connector		Port	Connecting to Equipment
		No.	Parts No.	No.	Mark	Parts No.	No.	Parts No.		
Pump	S1	1	101-3289200	5	-	22812-25009	-	-	Suction (Under)	Hydraulic Tank
	P1	7	22611-12850	34	P1	22750-A5055	9	22611-12356	P1	Travelling Control Valve
	P2	8	22611-11150	36	P2	22750-A5052	9	22611-12356	P2	
Outrigger Control Valve	P	11	22611-11160	37	CO1	22750-F6040	10	22611-11160	CO	Crane Control Valve
	V	12	22611-12360	38	CO2	22750-F6033	17	22611-11160	P	

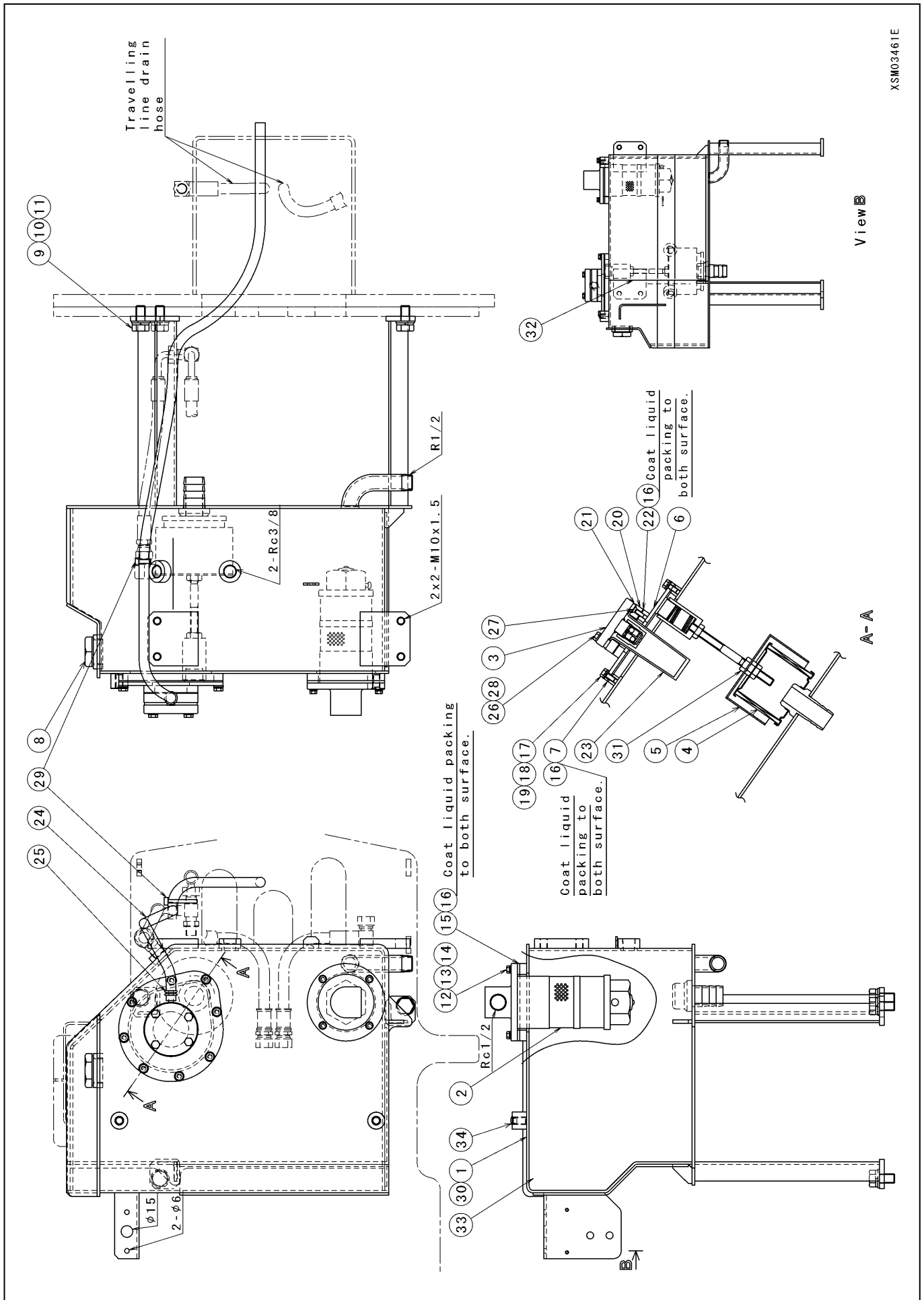
Tank Line Connection Table										
Equipment	Port	Connector		Hose			Connector		Port	Connecting to Equipment
		No.	Parts No.	No.	Mark	Parts No.	No.	Parts No.		
Crane Control Valve	T	15	S101J2061000	39	T1	22740-86065	10	22611-11160	T1	Travelling Control Valve
		16	22611-12060	40	T2	22740-F6041	13	S101J2061000	T	Outrigger Control Valve
Hydraulic Tank	Return (U/R)	18	22611-10560	41	T3	22713-A6040	14	22611-12060		

Drain Line Connection Table										
Equipment	Port	Connector		Hose			Connector		Port	Connecting to Equipment
		No.	Parts No.	No.	Mark	Parts No.	No.	Parts No.		
Hydraulic Tank	F/L	20	22611-10435	46	DR2	22713-A3028	25	22611-12030	T	Hi/Lo Speed Selector valve
Crane Control Valve	Dr	50	22611-11430	49	ADR	22713-B3050				
Hydraulic Tank	F/R	19	22611-10450	43	DR1	22740-85063	31	22611-11153	Left	Return Manifold Block (S101J2063000)
Left Travelling Motor	Dr	32	22611-11030	45	DRL	22777-F3023	-	-	F/L	
Right Travelling Motor	Dr	32	22611-11030	44	DRR	22777-F3028	-	-	F/R	
Rotary Joint	WDr	22	22611-10431	42	WDR	22713-A3081	30	22611-11030	Right	

Pilot Line Connection Table										
Equipment	Port	Connector		Hose			Connector		Port	Connecting to Equipment
		No.	Parts No.	No.	Mark	Parts No.	No.	Parts No.		
Travelling Speed Selector valve	P	23	22611-11253	35	PP	22750-A5036	7	22611-12850	P1	Pump
	A	24	22611-12830	48	PPL	22771-J1039	33	22611-11010	PP	Left Travelling Motor
				47	PPR	22771-J1045	33	22611-11010	PP	Right Travelling Motor

NO.	DESCRIPTION	QTY	NOTICE
1	Suction Elbow	1	Parts No.: 101-3289200
2	Bolt	4	M10X1. 5X30L (Plating)
3	Plane Washer	4	M10 (Plateing)
4	Spring Washer	4	M10 (Plateing)
5	Suction Hose	1	φ25X28 90L
6	Band	2	1X-40 (φ40 - φ30)
7	Tee (With Seat)	1	9071-06
8	Elbow (90 deg. With Seat)	1	1071-06
9	Long Elbow (90 deg. With Seat)	2	1071-08-06-78A
10	Elbow (90 deg. With Seat)	2	1071-08
11	Elbow (90 deg. With Seat)	1	1071-08
12	Long Elbow (90 deg. With Seat)	1	1071-08-78A
13	Bushing	1	Parts No.: S101J2061000
14	Tee (With Seat)	1	9070-08
15	Bushing	1	Parts No.: S101J2061000
16	Tee (With Seat)	1	9070-08
17	Elbow (90 deg. With Seat)	1	1071-08
18	Long Elbow (90 deg.)	1	9034-08
19	Elbow	1	1034-06
20	Elbow	1	1034-06-04
21	Hex. Head Cap	1	NC-1004-PT1/2
22	Elbow	1	1034-02-04
23	Elbow (45 deg. With Seat)	1	1072-04-06
24	Tee (With Seat)	1	9071-04
25	Tee (With Seat)	1	9070-04
26	Manifold Block	1	Parts No.: S101J2063000
27	Bolt	2	M8X1. 25X20L (Plateing)
28	Plane Washer	2	M8 (Plateing)
29	Spring Washer	2	M8 (Plateing)
30	Connector	1	1067-04
31	Elbow (90 deg. With Seat)	1	1071-04-06
32	Connector	2	1067-04
33	Connector	2	1067-02
34	Hydraulic Oil Hose (P1)	1	NWP210-9-550L 1005= ML90
35	Hydraulic Oil Hose (PP)	1	NWP210-9-360L 1005= ML90
36	Hydraulic Oil Hose (P2)	1	NWP210-9-520L 1005= ML90
37	Hydraulic Oil Hose (CO1)	1	NWP210-12-400L 1005= 0590
38	Hydraulic Oil Hose (CO2)	1	NWP210-12-330L 1005= 0590
39	Hydraulic Oil Hose (T1)	1	NWP35-12-650L 1005= 1005
40	Hydraulic Oil Hose (T2)	1	NWP35-12-410L 1005= 0590
41	Hydraulic Oil Hose (T3)	1	PA0308-400L C=CR9 (BS)
42	Hydraulic Oil Hose (WDR)	1	PA0304-810L C=CR9 (BS)
43	Hydraulic Oil Hose (DR1)	1	NWP35-9-630L 1005= 1005
44	Hydraulic Oil Hose (DRR)	1	NWP35-6-250L 1005= 0590
45	Hydraulic Oil Hose (DRL)	1	NWP35-6-250L 1005= 0590
46	Hydraulic Oil Hose (DR2)	1	PA0304-280L C=CR9 (BS)
47	Hydraulic Oil Hose (PPR)	1	N173-02-450L 1005-02= ML90-04-02
48	Hydraulic Oil Hose (PPL)	1	N173-02-390L 1005-02= ML90-04-02
49	Hydraulic Oil Hose (ADR)	1	PA0304-500L CR9= CR9 (BS)
50	Elbow	1	1034-04
51	O-ring	1	P39-1B

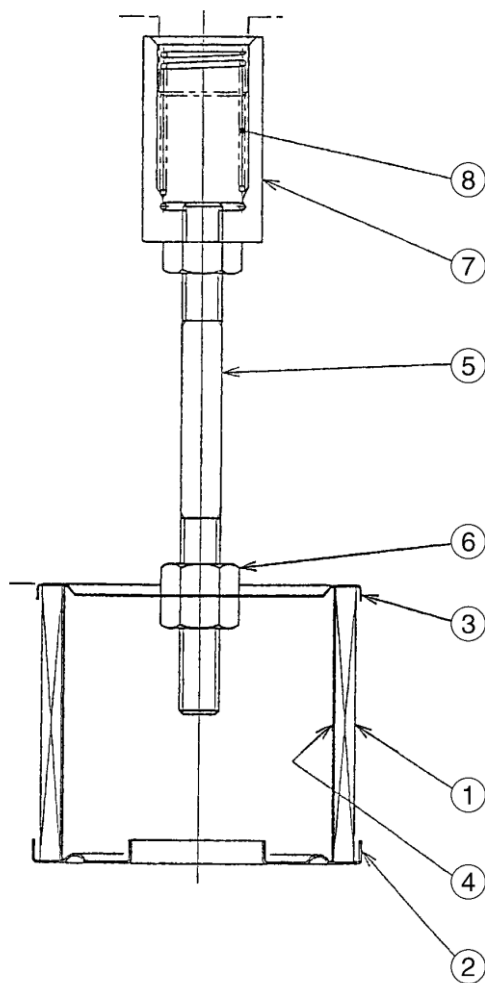
3. HYDRAULIC OIL TANK



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NO.	DESCRIPTION	Q'TY	NOTICE
1	Hydraulic Oil Tank	1	Parts No.: 101-1143700
2	Return Filter	1	Parts No.: 329-3112700
3	Air Breather Assembly	1	Parts No.: 353-4453000
4	Suction Filter	1	Parts No.: 359S72100000
5	Suction Cover-	1	Parts No.: 359-4470700
6	Flange	1	Parts No.: 359-3225800
7	Packing	1	Parts No.: 359-4470800
8	Level Gauge	1	Parts No.: 329-4290000
9	Bolt	3	M12X1.75X25L (Plateing)
10	Spring Washer	3	M12 (Plateing)
11	Plane Washer	3	M12 (Plateing)
12	Bolt	4	M5X0.8X20L (Plateing)
13	Spring Washer	4	M5 (Plateing)
14	Plane Washer	4	M5 (Plateing)
15	Packing	1	Parts No.: 329-4286900
16	Liquid Packing	-	Three Bond #12078
17	Bolt	8	M6X1.0X16L (Plateing)
18	Spring Washer	8	M6 (Plateing)
19	Plane Washer	8	M6 (Plateing)
20	Plate	1	Parts No.: 353-4451100
21	Packing (1)	1	Parts No.: 353-4450800
22	Packing (2)	1	Parts No.: 353-4450900
23	Nylon Strainer	1	Parts No.: 353S69300000
24	Hose	1	φ6.6xφ12.7 0.75L
25	Wire Band	1	Size 13 13-11
26	Bolt	4	M6X1.0X20L (Plateing)
27	Screw	3	M5X0.8X16L (Plateing)
28	Seal Washer	4	SW6X10
29	Tie Band	2	CV-250B
30	Hydraulic Oil	20L	ISO VG32
31	Nut	1	M10X1.5 (Plateing)
32	Insulator	1	Parts No.: 101-4570500
33	Insulator	1	Parts No.: 101-4570600
34	Hole Plug	2	CP-30HP-2

3.1 SUCTION FILTER

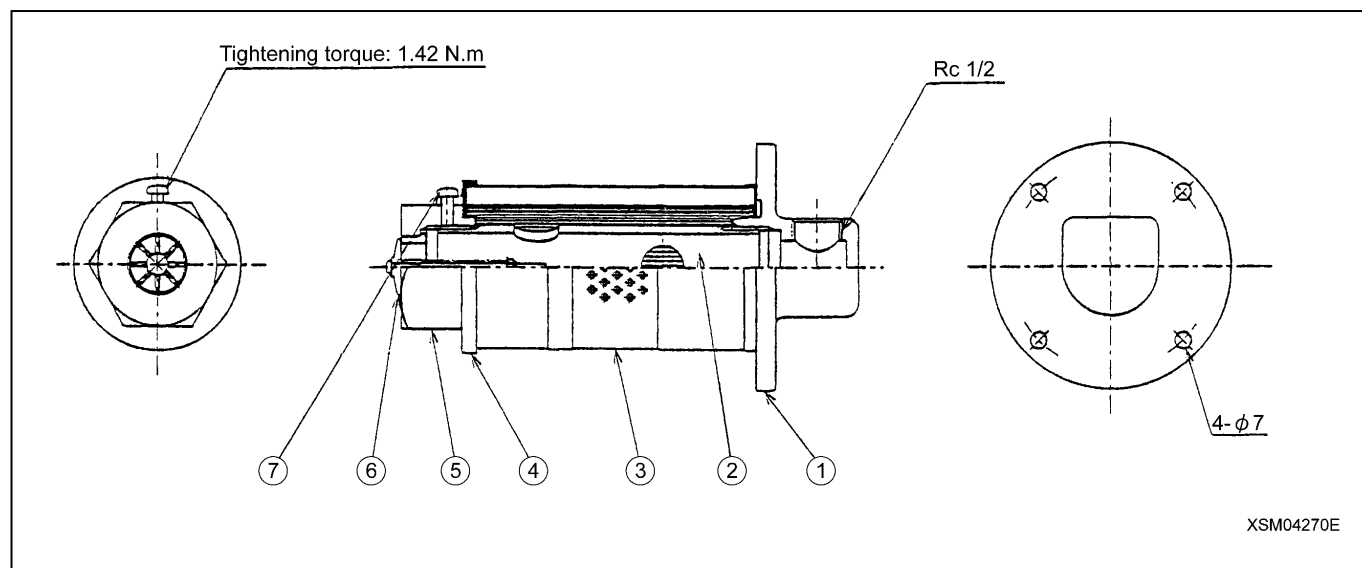


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NO.	DESCRIPTION	Q'TY	NOTICE
1	Filter	1	150 mesh
2	End Plate (A)	1	
3	End Plate (B)	1	
4	Inner Tube	1	
5	Rod	1	L= 30mm
6	Nut	1	
7	Holder	1	
8	Spring	1	

Specifications	
Model	SFR-08
Filtration Precision	150 mesh
Flow Capacity	90L/min

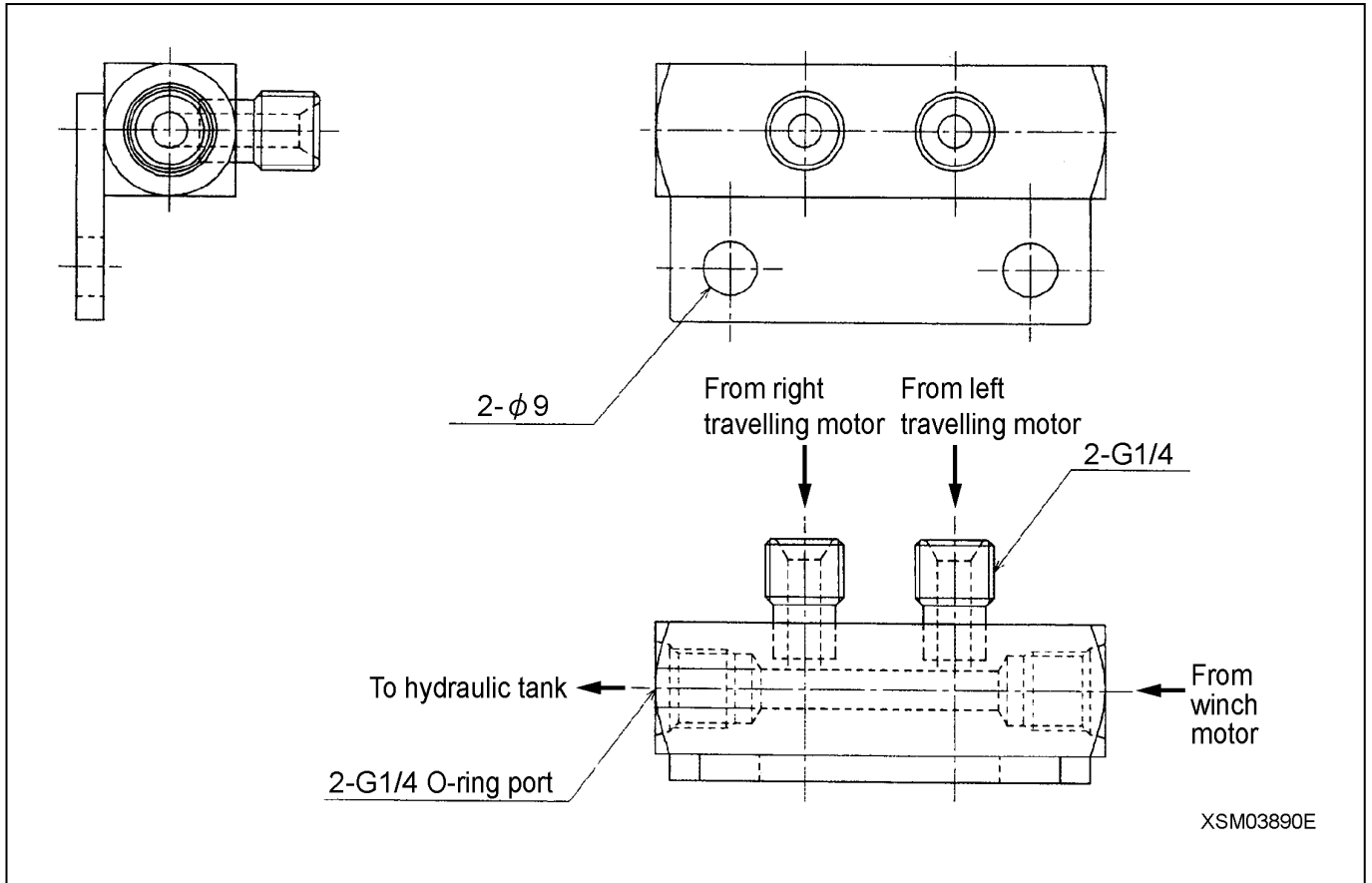
3.2 RETURN FILTER



NO.	DESCRIPTION	Q'TY	NOTICE
1	Cover	1	
2	Inner Tube	1	
3	Element	1	30μ
4	Plate	1	0.8t
5	Valve Holder	1	
6	Valve Assembly	1	
7	Stopper Screw	1	M5X12

Specifications	
Used Oil	ISO VG32, 46
Flow Capacity	25L/min (Max.40L/min)
Oil Temperature	-20°C to 120°C
Filtration Precision	30μ
Filtration Area	1400cm ²
Bypass Valve Setting Pressure	0.1MPa

4. RETURN MANIFOLD BLOCK



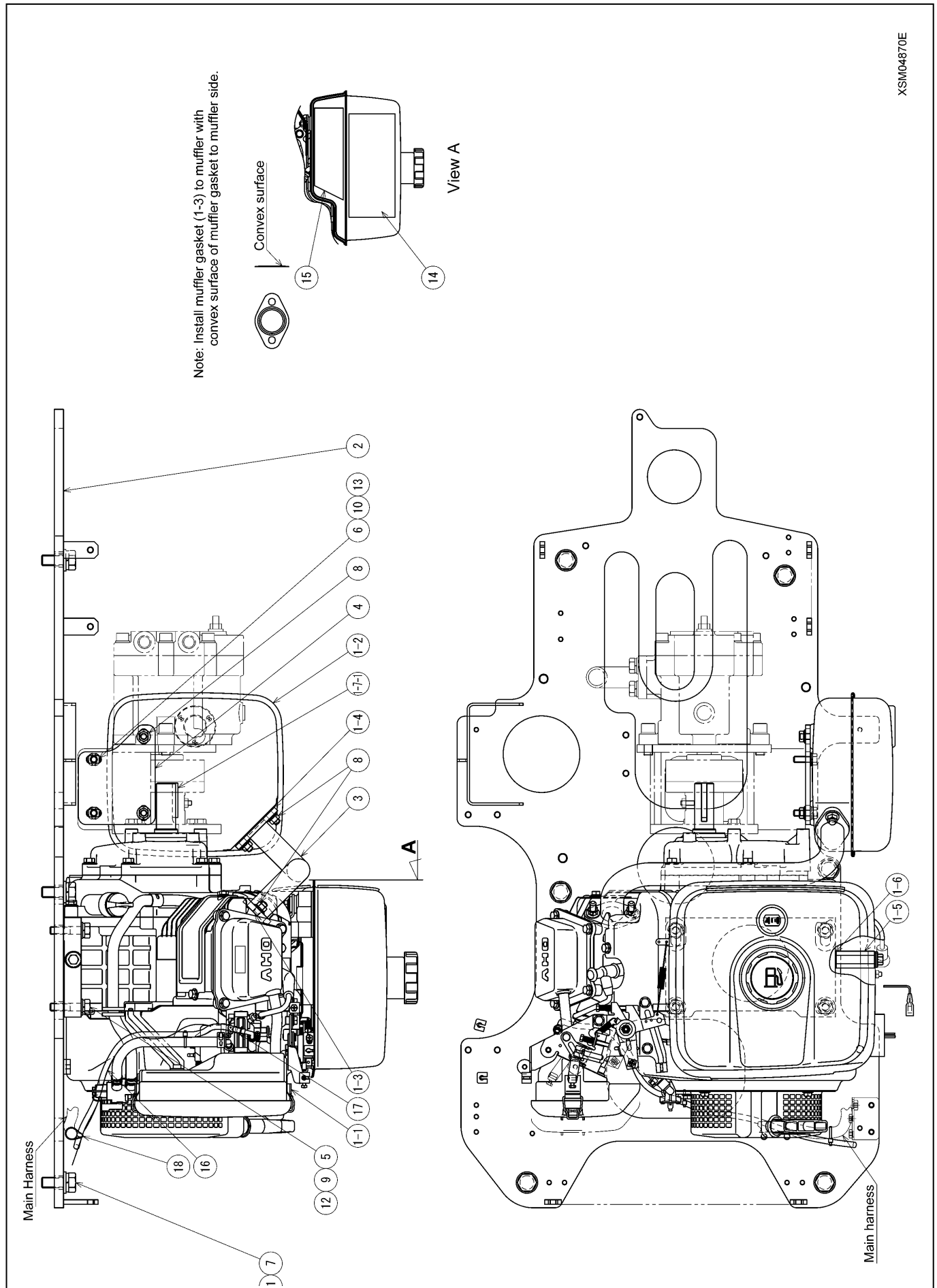
5. ENGINE ASSEMBLY

★Details of the engine of structures and inspections see separate engine manual “WORKSHOP MANUAL, MITSUBISHI MEIKI ENGINE, TYPE GM SERIES”.

5.1 ENGINE SPECIFICATIONS

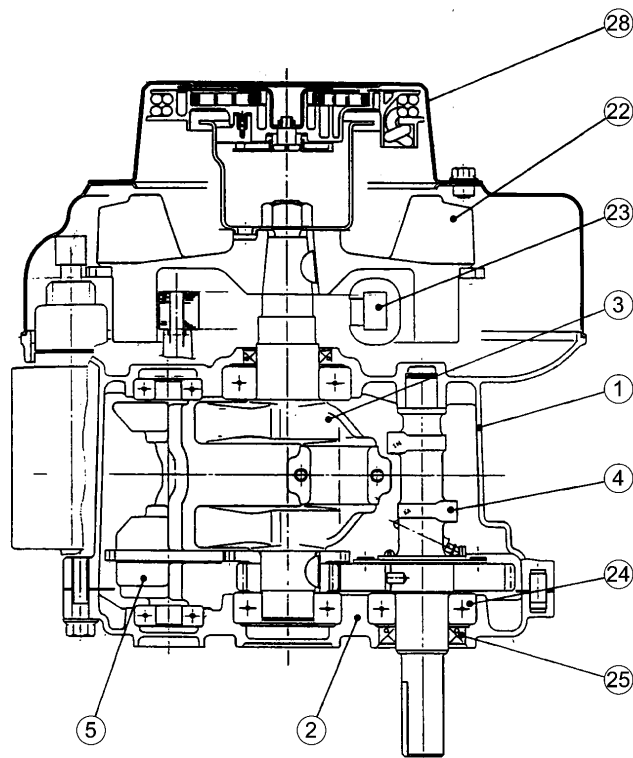
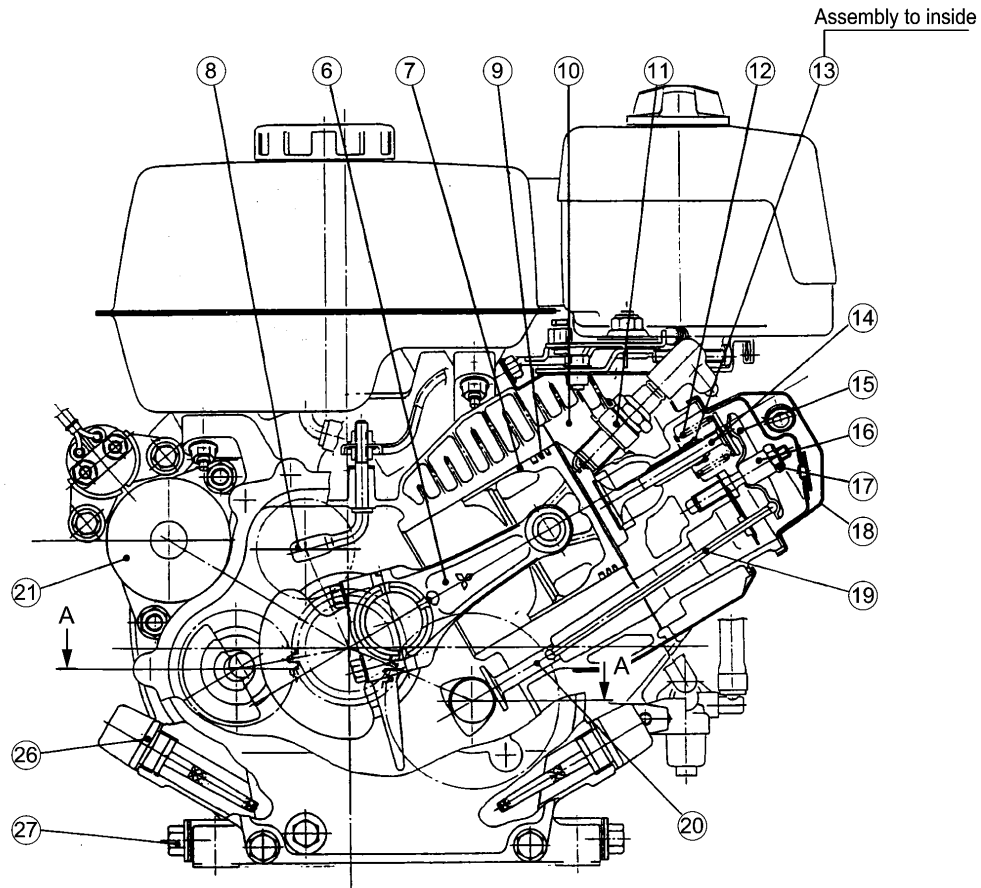
Engine Model	Mitsubishi GM401LE
Type	1-cylinder, Air cooled, 4-cycle gasoline engine
No. of Cylinder - Bore x Stroke	1 – ϕ 89mm x 63mm
Displacement	0.391 litres (391cc)
Continuous Rated Output	6.6kW/1800min ⁻¹ (9.0PS/1800rpm)
Max. Output	8.1kW/4000rpm (11.0PS/4000rpm)
Max. Torque	23.5N•m/2800rpm (2.4kgf•m/2800rpm)
Direction of Rotation	Counterclockwise Viewed from Output shaft end
Type of Fuel	Lead-free gasoline
Fuel Tank Capacity	6 litres
Grade of Lubricating Oil	API Service Category SD or better SAE30 (At Cold Weather: SAE20)
Engine Oil Pan Capacity	1.2 litres
Carburetor	Float Type Butterfly Valve, Side Draft
Ignition System	Contactless Magnet Ignition
Spark Plug	CHANPION RC12YC
Starting System	Recoil Starter or Starter Motor
Governing System	Centrifugal Weight Type All Speed
Lubricating System	Oil Pump Splash type
Reducing System	1/2 External Reduction Gear type
Air-cleaning System	Semi-dry Polyurethane or Oil Bath type
Ignition Ability	6V - 15W
Battery Charge Ability	12V - 4A
Engine Weight (Dry)	35.0kg
Dimensions (L x W x H)	462.5mm x 463mm x 466mm

5.2 ENGINE EXTERIOR VIEW



NO.	DESCRIPTION	QTY	NOTICE
1	Engine Assembly	1	Parts No. S101A2426000
1A	Engine (GM401LE-993)	1	(MITSUBISHI)
1B	Muffler (Silent type)	1	
1C	Muffler Gasket (t=0.2mm)	1	
1D	Muffler Gasket (t=1.4mm)	1	
1E	Nipple (L=50mm)	1	
1F	Gasket (For nipple)	1	
1G	PTO Parts	1	
1H	Parallel Key	1	
1J	Tool Set (Not shown)	1	
2	Power Unit Base	1	
3	Exhaust Pipe	1	
4	Muffler Bracket	1	
5	Bolt	4	M10X 1.75 X 45L (Plating)
6	Bolt	2	M8X 1.25 X 25L (Plating)
7	Bolt	6	M14X 2.0 X 35L (Plating)
8	Flange Nut	6	M8X 1.25 (Plating)
9	Plane Washer	4	M10 (Plating)
10	Plane Washer	2	M8 (Plating)
11	Plane Washer	6	M14 (Plating)
12	Spring Washer	4	M10 (Plating)
13	Spring Washer	2	M8 (Plating)
14	Insulator (3)	1	
15	Insulator (4)	1	
16	Tube	1	4 X 7 - 600L
17	Clip Band	1	
18	Tie Band	1	For $\phi 6 - 5$
18	Tie Band	3	CV-100B (100L)

5.3 EACH SECTION NAME



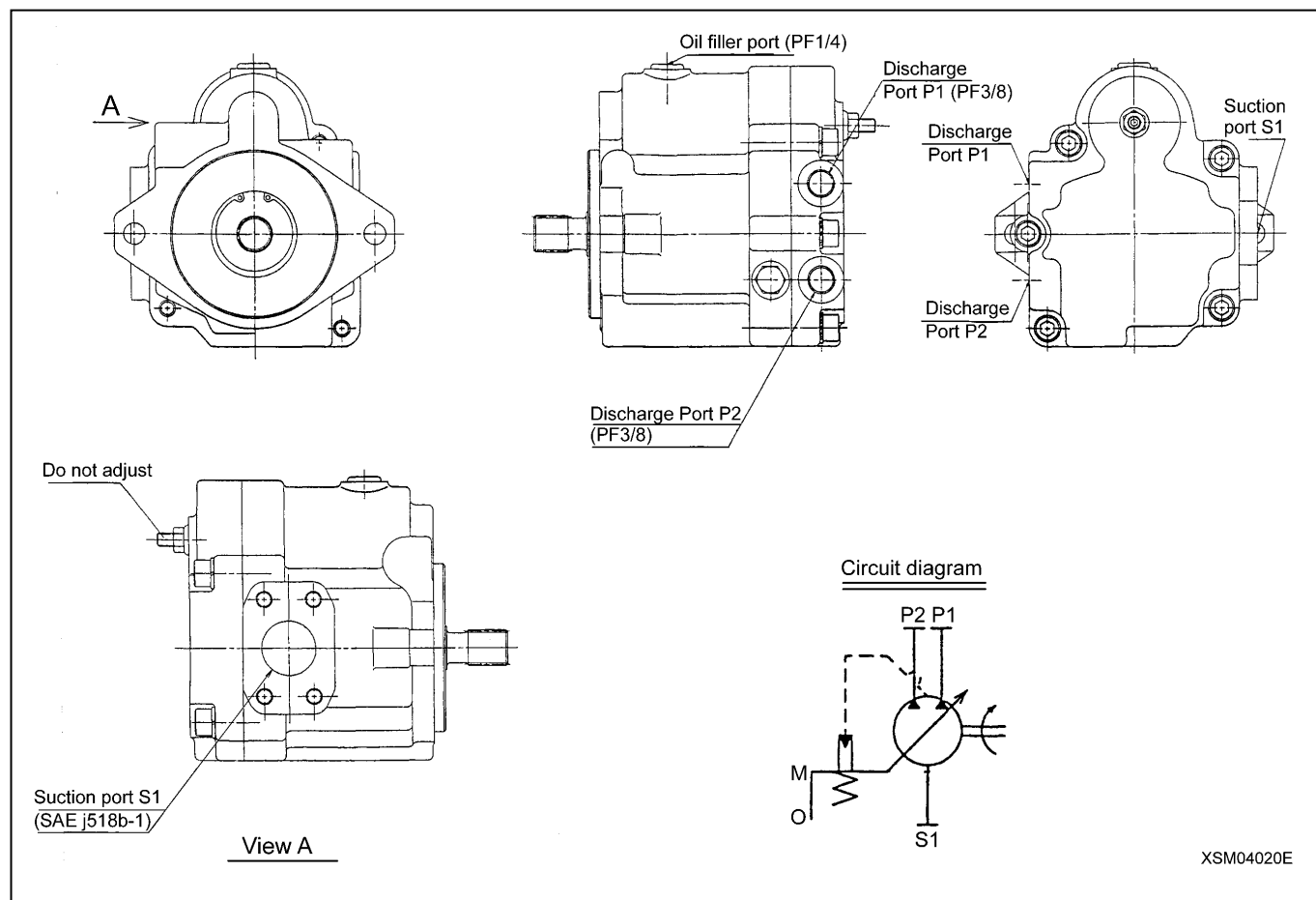
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NO.	DESCRIPTION	NO.	DESCRIPTION	NO.	DESCRIPTION
1	Cylinder Block	11	Spark Plug	21	Starter
2	Crankcase Cover	12	Valve Spring	22	Flywheel
3	Crankshaft	13	Valve Stem Seal	23	Charging Coil
4	Camshaft	14	Intake & Exhaust valve	24	Bearing
5	Blancer Shaft	15	Rocker Arm	25	Oil Seal
6	Connecting Rod	16	Pivot Nut	26	Oil Gauge
7	Piston	17	Lock Nut	27	Drain Plug
8	Governor Shaft	18	Cylinder Head Cover	28	Recoil Starter
9	Piston Ring	19	Push Rod		
10	Cylinder Head	20	Tappet		

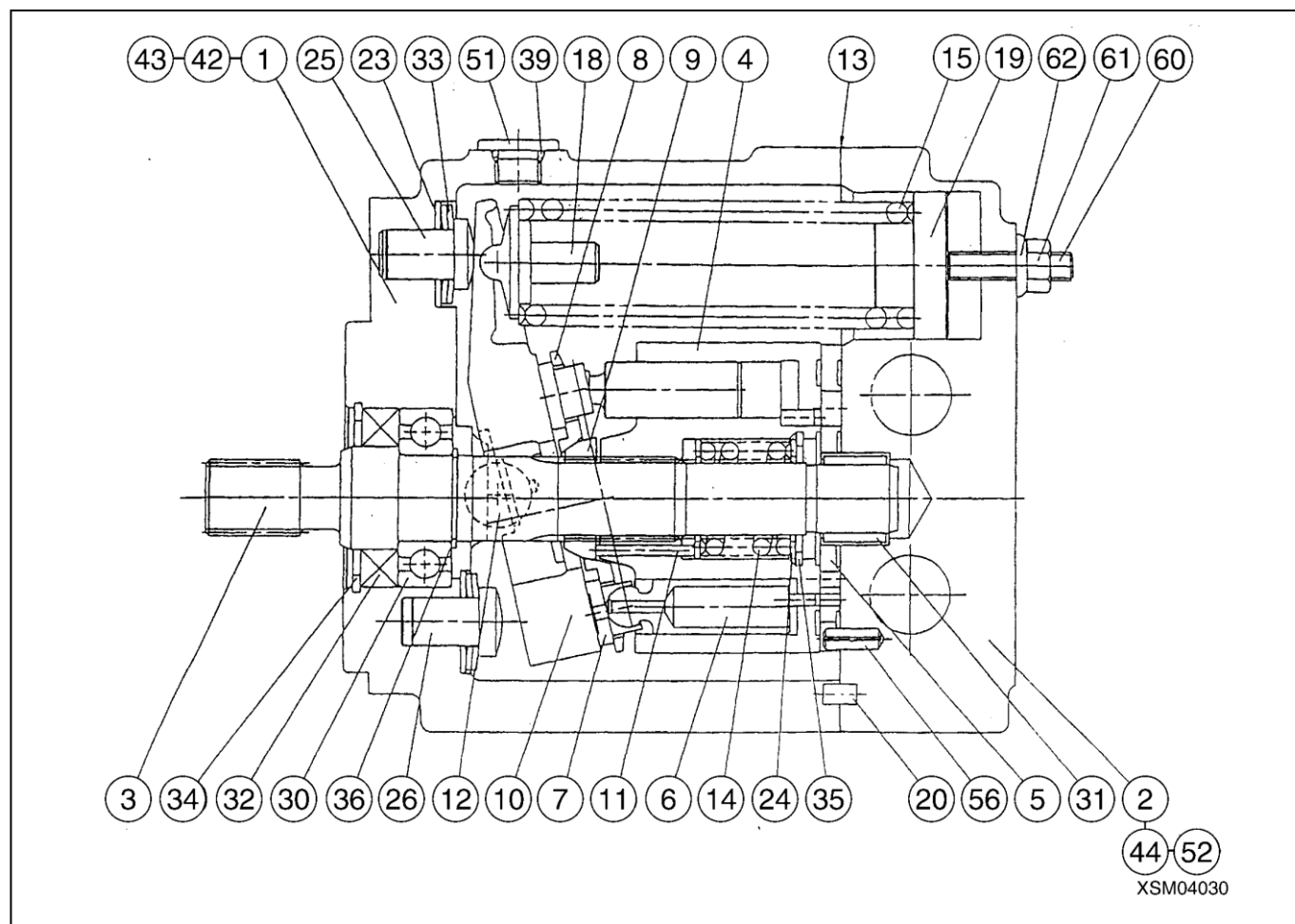
6. HYDRAULIC OIL PUMP

6.1 EXTERIOR VIEW AND SPECIFICATIONS



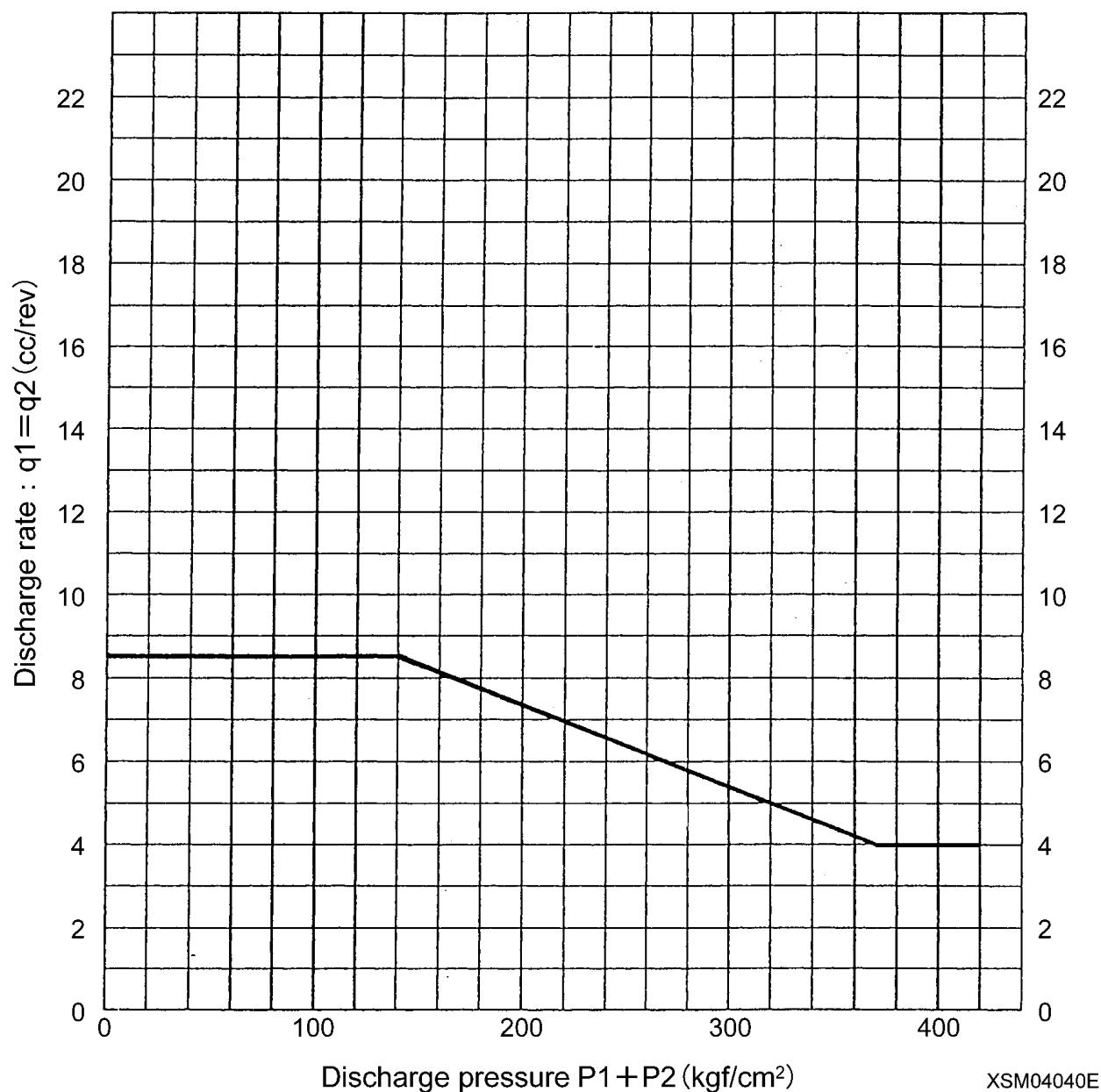
Specifications		
Pump Capacity		P1+P2: 8.6 + 8.6 cc/rev
Max. Oil Pressure		P1: 20.59 MPa P2: 20.59 MPa
Revolution	Rated	1800 min ⁻¹
	Max.	2000 min ⁻¹
Suction Pressure		-0.02 to +0.04 MPa
Recommended Oil		ISO VG 32, 46
Operating Oil Temperature		60°C
Operating Oil Temperature Range		-20 to 100°C
Drive System		Direct drive from Engine: 6.5 kW/1800 rpm Input Torque: 33.93 N•m
Control Character		Constantly Horsepower control

6.2 INNER PARTS



NO.	DESCRIPTION	Q'ty	NO.	DESCRIPTION	Q'ty	NO.	DESCRIPTION	Q'ty
1	Body (S)	1	22	Skipped No.		43	O-ring	1
2	Body (S)	1	23	Washer	1	44	Hex. Head Bolt	5
3	shaft	1	24	Retainer	2	45	Skipped No.	
4	Cylinder Barrel	1	25	Stopper Pin (A)	1	46	Skipped No.	
5	Valve Plate	1	26	Stopper Pin (B)	1	47	Skipped No.	
6	Piston	10	27	Skipped No.		48	Skipped No.	
7	Shoe	10	28	Skipped No.		49	Skipped No.	
8	Shoe Holder	1	29	Skipped No.		50	Skipped No.	
9	Barrel Holder	1	30	Ball Bearing	1	51	Plug	1
10	Swash Plate	1	31	Needle Bearing	1	52	Spring Washer	5
11	Needle	3	32	Oil Seal	1	53	Skipped No.	
12	Oscillation Pin	2	33	Spring	4	54	Skipped No.	
13	Packing	1	34	Snap Ring	1	55	Skipped No.	
14	Spring (C)	1	35	Snap Ring	1	56	Spring Pin	1
15	Spring (T1)	1	36	Snap Ring	1	57	Skipped No.	
16	Skipped No.		37	Skipped No.		58	Skipped No.	
17	Skipped No.		38	Skipped No.		59	Skipped No.	
18	Spring Holder	1	39	O-ring	1	60	Hex. Head Set screw	1
19	Spring Guide	1	40	O-ring	2	61	Hex. Nut	1
20	Pin	1	41	Skipped No.		62	Seal Washer	1
21	Skipped No.		42	Hex. Plug	1			

6.3 P – Q CHART



Testing Condition		Remarks	
Recommended Oil	ISO VG 32, 46	Input Torque	33.34 N•m
Oil Temperature	50±5 °C		
Revolution	1800 min ⁻¹	Pump Horsepower Consumption	7.28 PS
Revolution Direction	Clockwise	Pump Absorption Torque	28.44 N•m

6.4 BASICS OF FUNCTIONALITY

1. Outline

This lightweight hydraulic pump can discharge two equal amounts of flow despite its compact size which requires only one conventional variable pump space.

It provides with constant horsepower control characteristics which reduces discharge against increase of pump load to maintain constant load of the engine and to efficiently utilize its power.

In the event that discharge pressures, P1 and P2, become higher, resultant force from pistons to the Swash Plate increase. When such resultant force exceeds spring tension, the plate turn around Oscillation Pin which results decreasing discharge.

2. Structure and Function

Variable discharges Swash Plate Pumps have multiple pistons which enables discharging two equal amounts of flow in one pump casing.

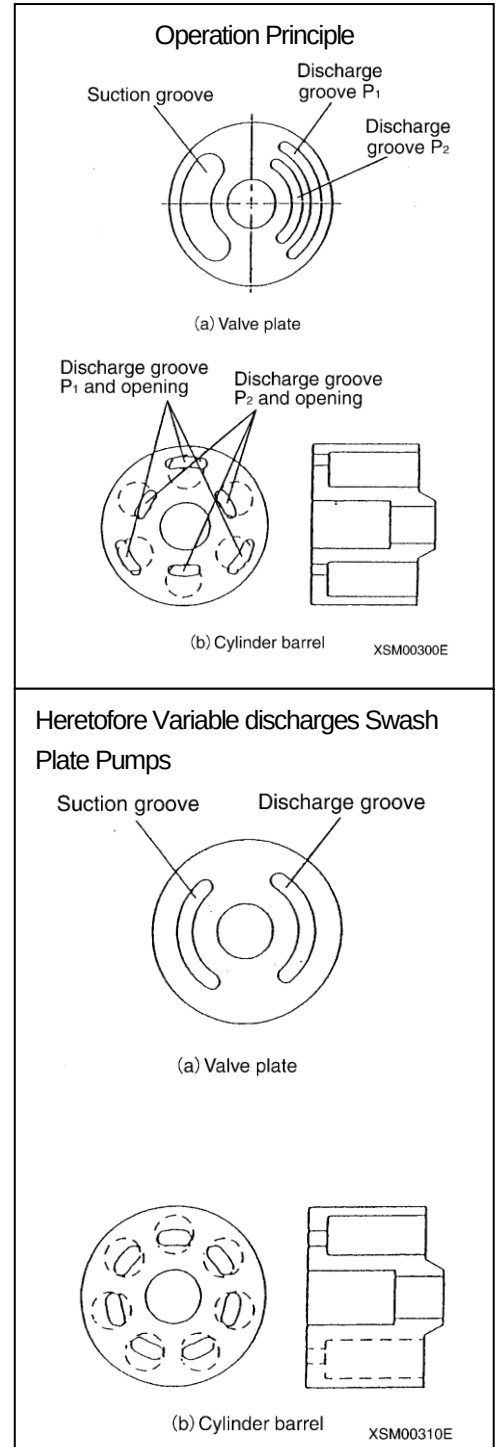
Conventional valve plates, as shown in right-below figure, have only one intake and discharge slot respectively. By contrast, the valve plate of this pump has two, outer (1) and inner (2), slots for discharge respectively.

Piston chambers in cylinder barrel will alternately have apertures with either of outer (1) and inner (2) discharge slots.

Intake of inner and outer are at the same time, however, discharge of inner and outer are independent.

Due to multiple pistons, this pump provides same numbers of pistons which have apertures with outer or inner slots. Further, all the pistons have the same diameter and positioned in the same pitch circle, as well as they slide on the same Swash Plate face. Consequently, amounts of discharges from inner and outer slots of the valve plate are the same.

When the Swash Plate changes its angle by variable control mechanism, discharge amounts from outer and inner varies correspondently since they slide on the same one swash plate. No difference of discharge between outer and inner shall result.



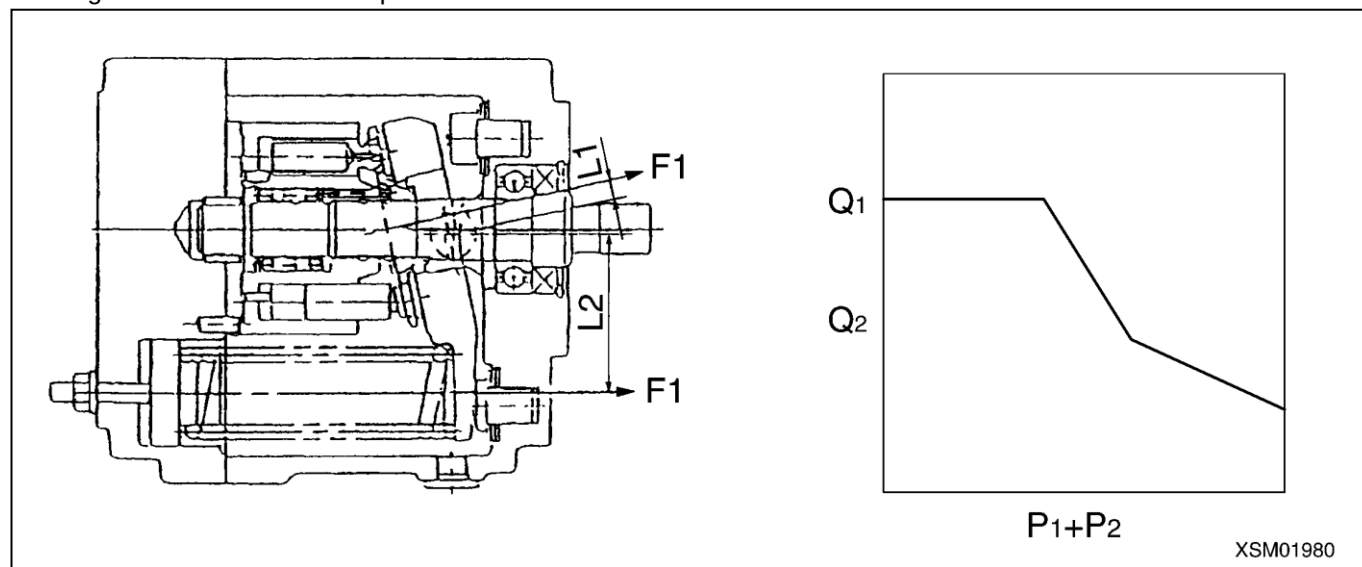
3. Constant Horsepower Variable Mechanism

The pump capacity varies with the swash plate angle, and the swash plate angle allows performing constant horsepower control with the simple direct-acting variable mechanism.

The center of rotation of the swash plate is at the ball on the rear side of the pump.

Load F_1 from the piston side is located in the direction shown in the figure and generates a right-turn moment to the swash plate. On the other hand, a spring for setting constant horsepower is fitted in the opposite direction and is set to a fixed load.

As the pressure increases, the above moment increases and bends the spring and reduces the swash plate angle, so that the discharge decreases and the horsepower is maintained constant.

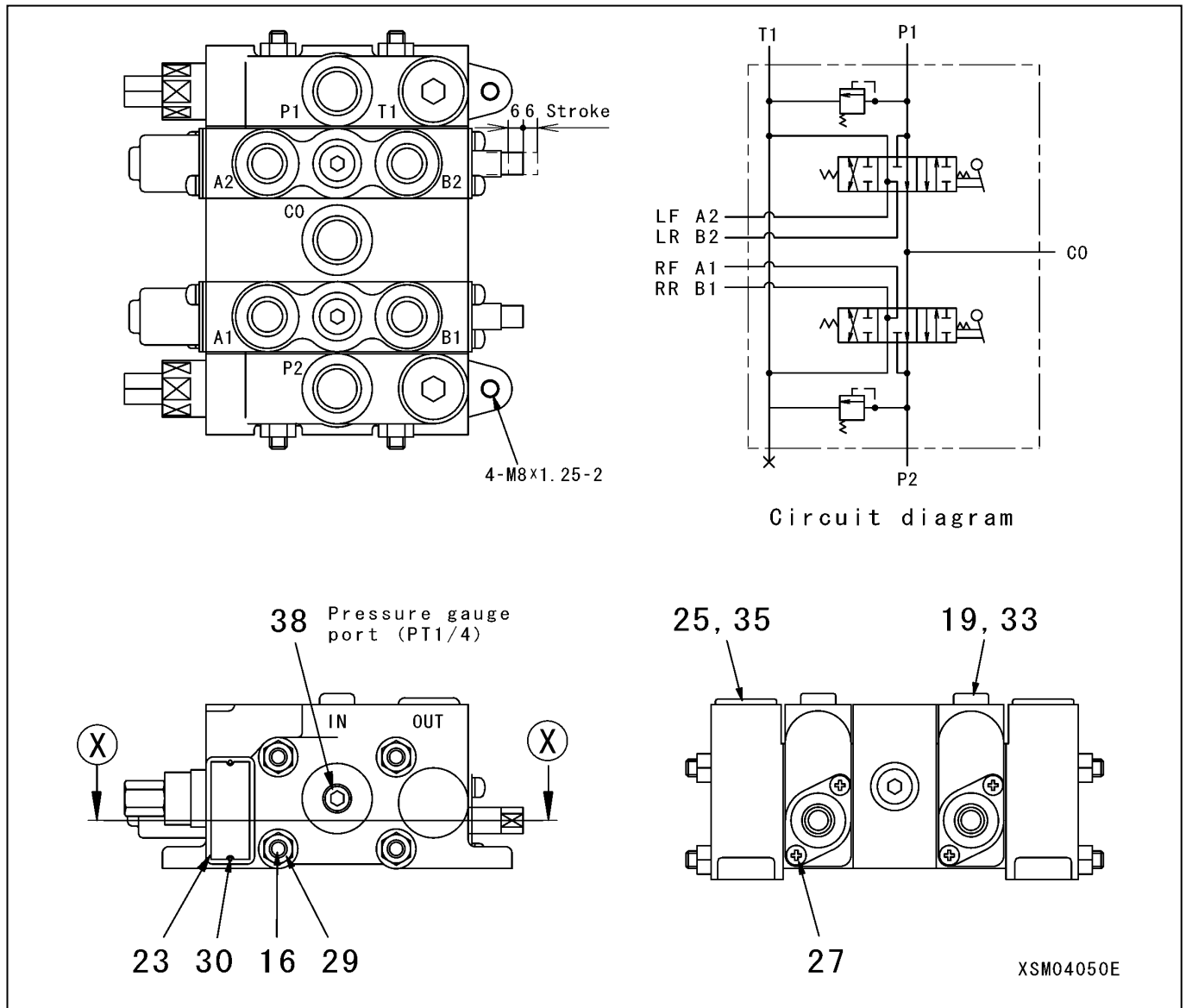


6.5 TROUBLE SHOOTING

Disorders	Cause	Counter-action
Engine, Over load	• Engine revolution rate is higher than the prescription. • Pressure is higher than the prescription. • Pump components, seizure or damage.	• Adjust to prescribed rate. • Adjust to prescribed rate. • Repair or replace
Hydraulic oil discharge amount is extremely low, Discharge pressure shows no build up.	• Engine revolution rate is lower. • Damage to coupling for pump mount. • Pump components, seizure or damage.	• Adjust engine revolution rate • Repair or replace coupling. • Repair or replace pump.
Abnormal noise or vibration (Cavitation)	• Air or water mixture to hydraulic oil • Clogged or choked suction pipe • Damage to staking fit of piston shoe • Loose fit of pump mount • Damage to coupling for pump mount.	• Re-tighten hydraulic circuit components, especially, suction pipe. • Exchange water mixed oil. • Repair or replace suction pipe. • Replace Piston Assembly • Replace mounting components • Repair or replace coupling.
Oil leakage	• Defect of O-ring, seat and/or packing • Loose or mis-tightened cap ring. • Oil leaks from oil seal edge.	• Replace O-ring, seat and/or packing • Re-tighten to prescribed torque. • Repair or replace oil seal and/or shaft.

7. TRAVELLING CONTROL VALVE

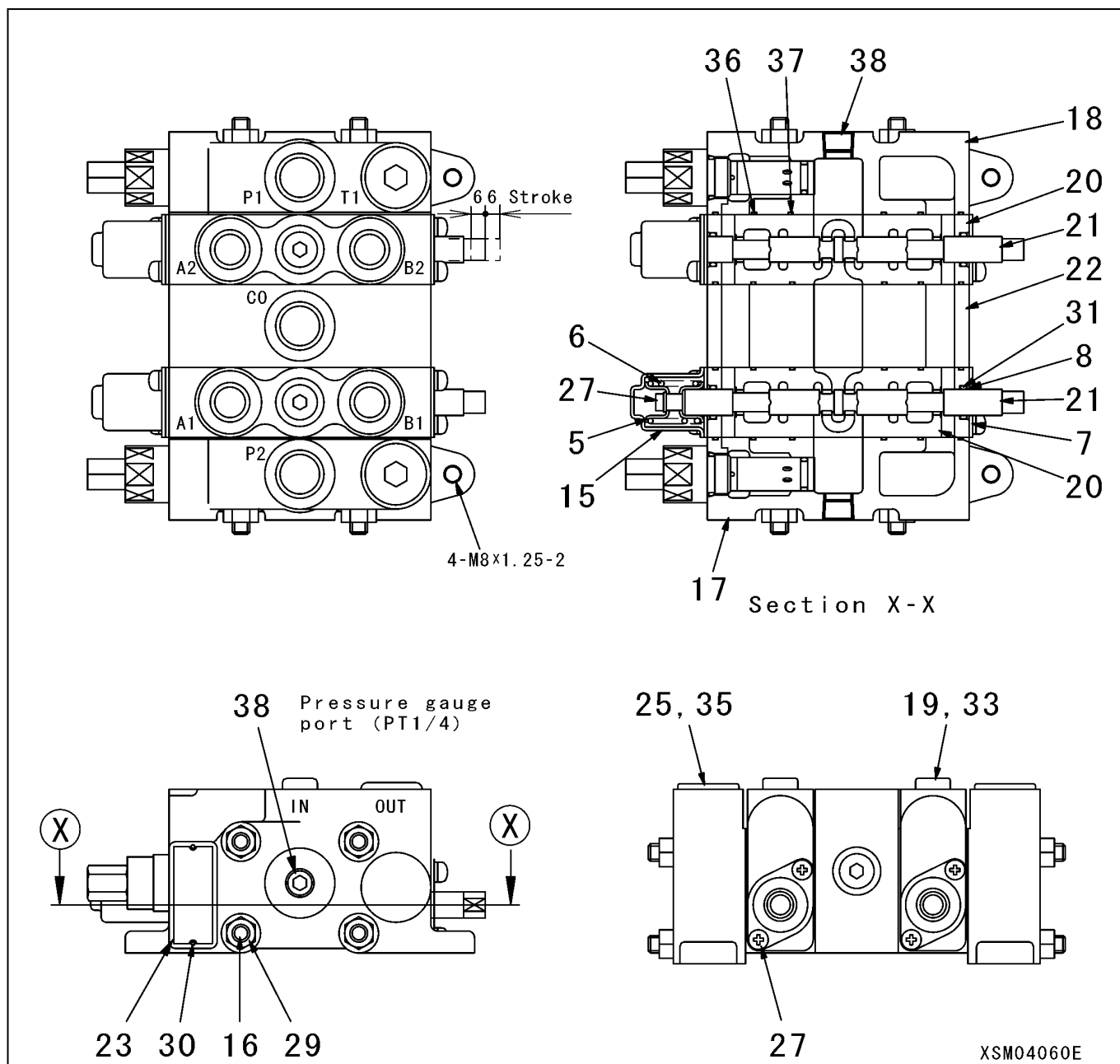
7.1 EXTERIOR VIEW AND SPECIFICATIONS



Each Ports Connection			Each Ports Connection		
P1	Pump P2 Port	PF1/2	A1	Right Travelling Motor B Port (Forward)	PF3/8
P2	Pump P1 Port	PF1/2	B1	Right Travelling Motor A Port (Reverse)	PF3/8
T1	Return	PF1/2	A2	Left Travelling Motor A Port (Forward)	PF3/8
CO	Crane Control Valve P Port	PF1/2	B2	Left Travelling Motor B Port (Reverse)	PF3/8

Specifications			
Max. Flow Capacity	P1, P2: 15 Litres/min CO: 30 Litres/min	Leakage from inside (At 9.8 MPa, 50 - 55 °C)	Each Spools: Less than 200 mL/min
Main Relief Valve (P1 and P2)	20.6±0.5 MPa (At 15 Litres/min)	Spool Operating Force	When Neutral: Approx. 88.2 N When Full Stroke: Approx. 11736N
Hydraulic Oil	ISO VG 32, 46	Allowable back pressure to T-port (Normal back pressure)	1.47 MPa (Less than 0.49 MPa)
Operation Temperature Range	-20 to +90 °C		

7.2 INNER PARTS



NO.	DESCRIPTION	QTY	NO.	DESCRIPTION	QTY	NO.	DESCRIPTION	QTY
1	Compression Spring	2	14	Wire	2	27	Screw (M5 X 12)	8
2	Needle Valve	2	15	Spring Cover	2	28	Set Screw (M10 X 14)	2
3	Cap Nut	2	16	Tie Rod	4	29	Nut (M8)	8
4	Gasket	2	17	Inlet Housing	1	30	Rivet	2
5	Spring Holder	4	18	Inlet Housing	1	31	O-Ring (1A-P12)	4
6	Compression Spring	2	19	Plug	2	32	O-Ring (1B-P9)	2
7	Seal Holder	4	20	Plunger Housing	2	33	O-Ring (1B-P10)	2
8	Back-up Ring	4	21	Open Spool	2	34	O-Ring (1B-P12)	2
9	Sleeve	2	22	Body	1	35	O-Ring (1B-P18)	3
10	Poppet	2	23	Name Plate	1	36	O-Ring (1B-AS568-017)	8
11	Compression Spring	2	24	Skipped No.		37	O-Ring (1B-AS568-030)	4
12	Housing	2	25	Flange Plug (PF1/8)	1	38	Hex. Head Socket Plug (PT1/4)	2
13	Valve Seat	2	26	Flange Bolt (M5 X 12)	2			

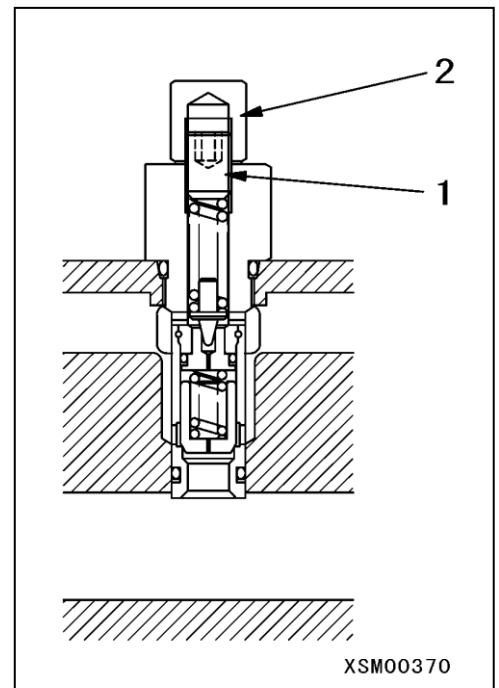
7.3 INSPECTION AND ADJUSTMENT

[1] PARTS INSPECTION

Assembly	Criteria	Counter-action
• Housing • Block Body	• Scratch, rust and/or corrosion in spool sliding area. • Scratch, rust and/or corrosion in seal pocket of spool insertion. • Scratch, rust and/or corrosion in port seal area next to O-ring. • Scratch, rust and/or corrosion in seal area of relief valves and such. • Other defects which potentially damage normal function of parts.	• Replace • Replace • Replace • Replace • Replace
• Spool	• Claw scratch in outer sliding area. • Scratch in sliding area caused by seals in both ends. • Spool function is not smooth.	• Replace • Replace • Repair or replace
• Load Check Valve	• Incorrect sealing due to damaged valve/spring. • Verification of smooth actuation when it is inserted into block body and tested.	• Repair or replace • Normal
• Spring area	• Spring holder and cover, serious damage such as rust, corrosion, deform and/or breakage.	• Replace
• Seal of Spool area	• Oil leakage to exterior • Seal and Holder, rust, corrosion and/or deform.	• Repair or replace • Repair or replace
• Main relief valve • Port relief valve • Anti-cavitation valve	• External rust and damage. • Damage at valve seat working face. • Damage at poppet working face. • Spring disorder • Sealing parts, such as O-ring, back-up ring.	• Replace • Replace • Replace • Replace • Total replacement, as a rule

[2] ADJUSTMENT OF MAIN RELIEF VALVE

1. Set Pressure gauge to gauge port.
2. Operate the pump with rated revolution.
3. Actuate control valve spool for full stroke, then read pressure gauge.
4. Loosen lock-nut (2) of main relief valve.
5. Turn Set-screw (1) to regulate pressure in accordance with gauge read.
 - Clockwise: Higher pressure set value
 - Counterclockwise: Lower pressure set value
6. Tighten Lock nut (2) after completion of pressure set value adjustment where setscrew (2) should be correctly secured to prevent deviating.
7. Start pump operation again with rated rotation to secure that pressure is stable.



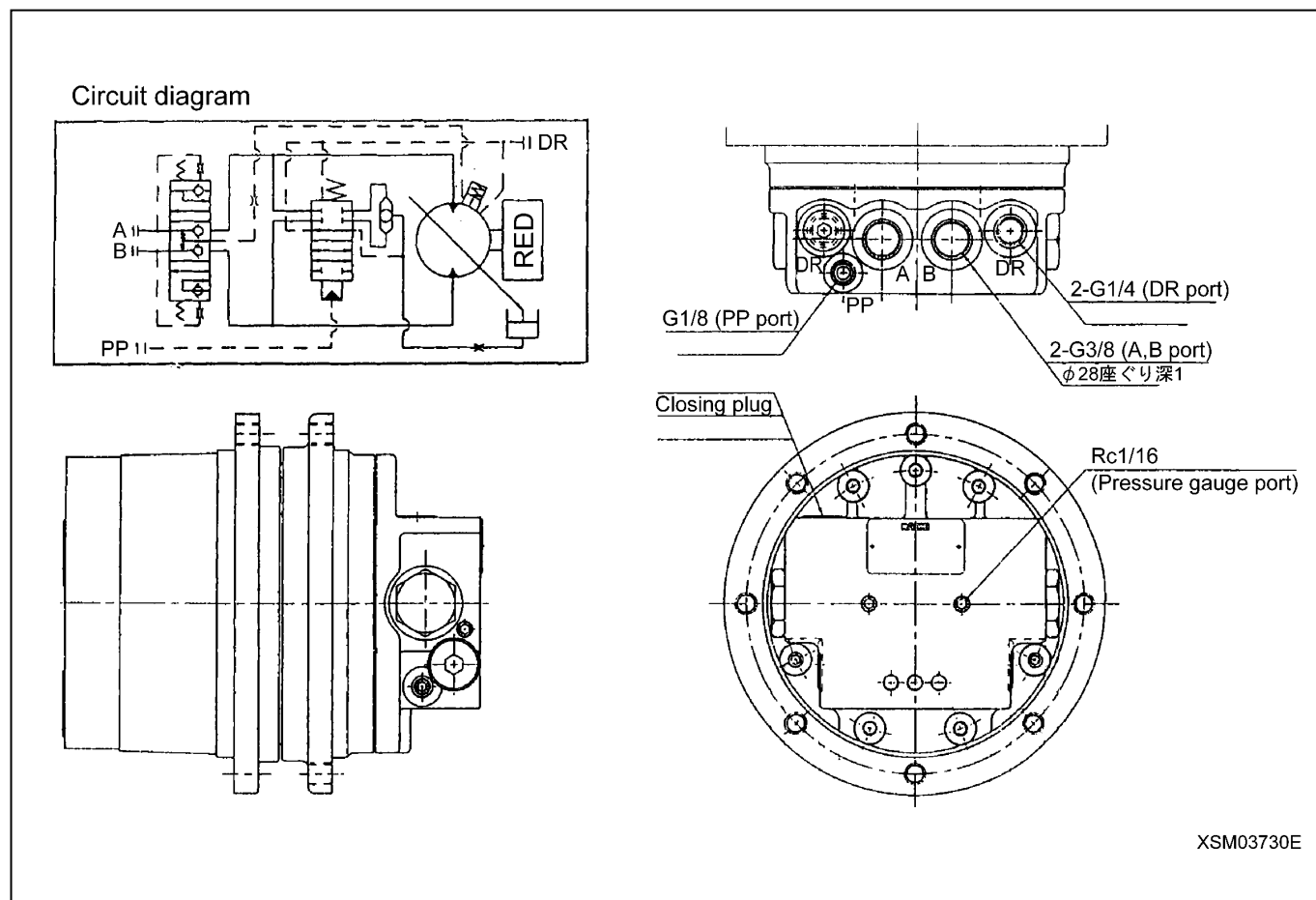
7.4 TROUBLE SHOOTING

Each Item shown in the table below indicates only individual problem, however, troubles may be caused by multiple problems, in many cases. It is advisable to check one by one for efficient trouble shooting.

Disorders	Cause	Counter-action
Oil leakage from spool seal area	- Sealing parts may have scratch or wear due to long term operation. - Sliding area of spool with seal has damages such as dent or scratch caused by exterior parts. - Warp of cover containing sealing parts. - Sliding area of spool with seal is contaminated with paint. - Pressure of tank circuit is too high and excesses capacity of sealing parts.	- Replace to new parts - Repair or replace spool. - Repair to normal form and check extent of seal lip wear. - Solvent clean or abrasive clean; Spool surface or seal lip should not be damaged. - Remove the factor of flow resistance cause.
Spool sliding is not smooth	- Inclusion of foreign matters into spool sliding area. - Oil film between spool and body run out due to high temperature. - Lubrication error due to deterioration of hydraulic oil. - Spool wear due to long term operation or offset stress. - Spool deforming by stress. - Valve deformation due to deformation of fitting face. - Too tight screwing at valve assembling. - Excess oil in spool function area and opposite spring cover.	- Overhaul and then repair or replace parts. - Take a measure to cool oil, or when relieve valve works to frequently, check the cause to ease its operation. - Overhaul of total circuit may be required, as well as exchanging hydraulic oil. - Measure spool diameter and verify for replacing. - Measure roundness of spool and repair or replace as required. - Loosen bolts and check the cause of deformation. - Re-set bolts to correct torque, - Overhaul and repair, or replace seal.
Failure to travel (Oil pressure is correct)	- Spool is not stroking proper distance (6 mm). - Excess load to travelling mechanism. - Clogging of circuit, or bending or crimping of piping.	- Check and repair travel link lever mechanism. - Check interfering matters and clean. - Check and repair piping and clean.
Failure to hold spool in neutral position	- Excess leakage from spool due to incorrect clearance between spool and body. - Spool is not returned to neutral position. - Inclusion of foreign matters to seat area of port relief valve or anti-cavitation valve, or damage to seat.	- Replace spool or valve block assembly - Check and repair manual travel lever link mechanism. - Check hydraulic operation pilot pressure. - Overhaul and then repair or replace.
Failure to travel (Oil pressure is not correct)	- Inclusion of foreign matters to seat area of Relief valve, or damage to seat. - Relief valve adjuster, loose bolt. - Inclusion of foreign matters to seat area of Port relief valve or anti-cavitation valve, or damage to seat. - Spool is not stroking proper distance (6 mm) - Oil feed from pump is not sufficient.	- Overhaul and clean, and repair or replace damaged parts. - Re-tighten adjuster bolt. - Overhaul and clean, and repair or replace damaged parts. - Check and repair manual travel link lever mechanism. - Check hydraulic operation pilot pressure. - Check and repair pump.

8. TRAVELLING MOTOR

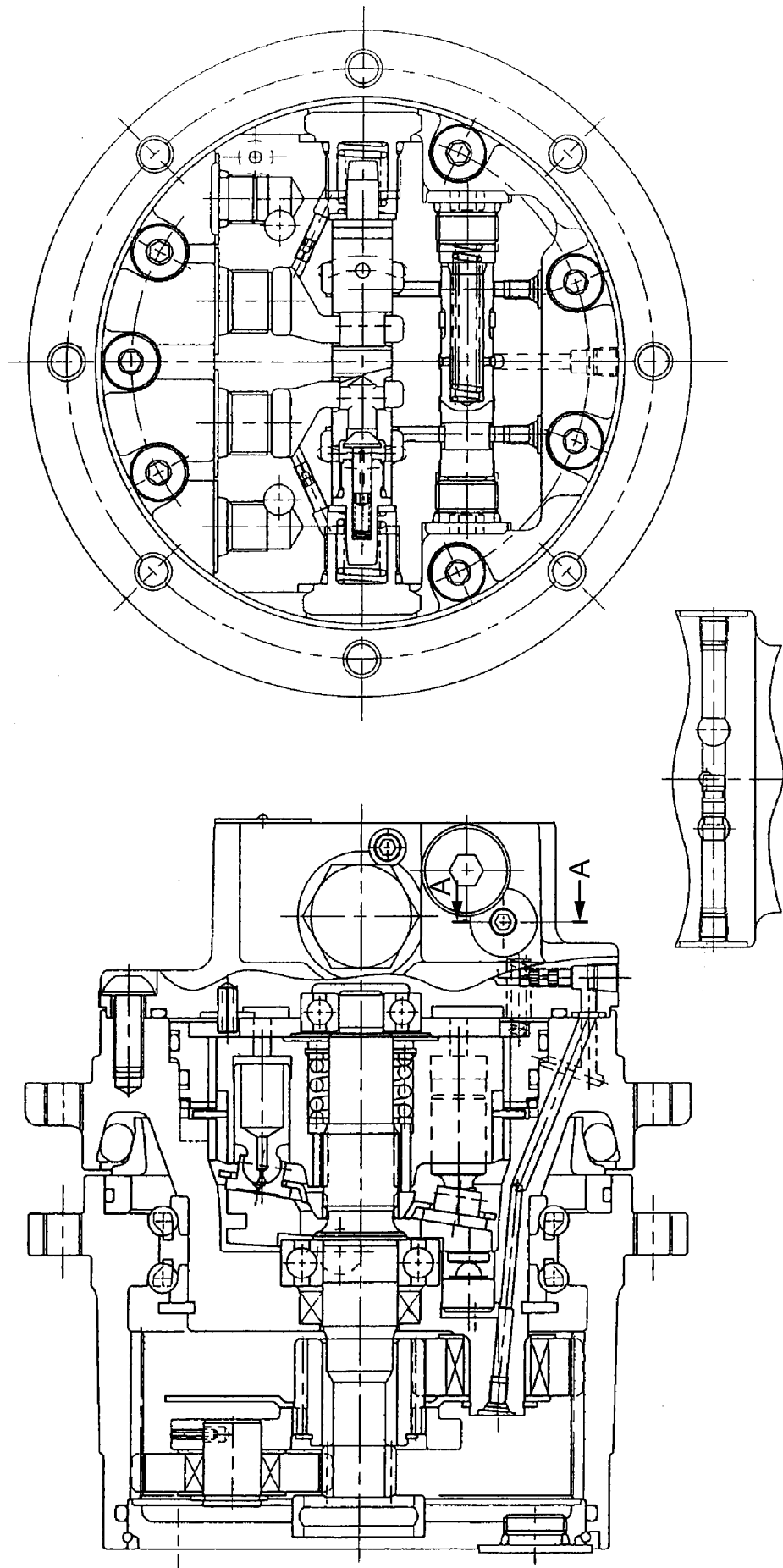
8.1 EXTERIOR VIEW AND SPECIFICATIONS



Right Travelling Motor		Left Travelling Motor	
A Port	Reverse	B Port	Reverse
B Port	Forward	A Port	Forward

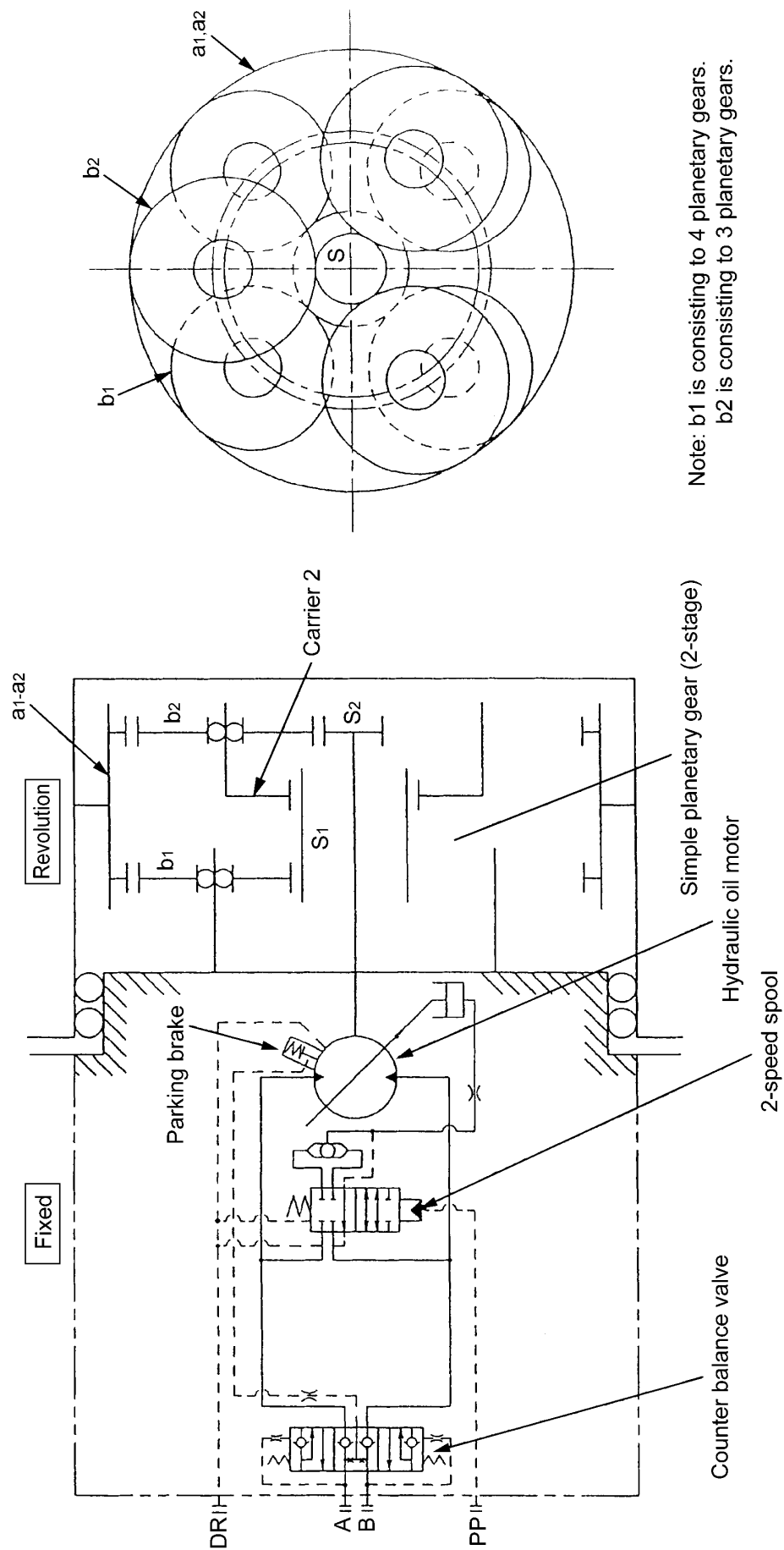
Specifications			
Specifications of Reduction Gear			
Max. Output Torque	978.5 N•m (99.8 kgf•m)	Capacity	351.1/173.7 cm ³ /rev
Max. Output Revolution	41.9/83.8 min ⁻¹	Recommended Oil	ISO VG32, 46
Reduction Ratio	1/36.96	Operating Oil Temperature	-60 to 100°C
Specifications of Hydraulic Motor			
Capacity	9.5/4.7 cm ³ /rev	Filtering	10 μm
Max. Common Use Pressure	20.6 MPa (210 kgf/cm ²)	Recommended Gear Oil	ISO VG320
Max. Output Revolution	1547/3096 min ⁻¹	Gear Oil Amount	0.33 Litres
Max. Flow Capacity	15.0 Litres/min	Mass	17 kg
Speed Range Changing Pressure		1.5 MPa (15 kgf/cm ²)	
Parking Brake	Static Frictional Torque	Allowable Back Pressure	Operating pressure
	Release Pressure		Serge Pressure
	33.3 N•m (3.4 kgf•m)		0.3 MPa (3 kgf/cm ²)
	2.0 MPa (20 kgf/cm ²)		1.0 MPa (10 kgf/cm ²)

8.2 INNER PARTS



XSM03740E

8.3 BASICS OF FUNCTIONALITY



Note: $b1$ is consisting to 4 planetary gears.
 $b2$ is consisting to 3 planetary gears.

Fig.2

XSM03750E

8.4 FUNCTION

PHV-series Travelling motor consists of the fixed body mainly composed of a hydraulic motor and a hydraulic valve and the rotating body mainly composed of a simple planetary reduction gear.

8.4.1 REDUCTION GEAR

[1] FUNCTION

Travelling motor reduction gear is composed of 2 stages of simple planets, reduces the speed of high-speed rotary motion from the hydraulic motor, converts it into low-speed large torque and rotates the case.

[2] OPERATION

As shown in the right figure, the gear S_2 is connected to the hydraulic motor output shaft with spline, and rotation of the gear S_2 is reduced a stage among the gears (S_2 , b_2 and a_2). The one-stage reduced rotation is reduced two stages among the gears (S_1 , b_1 and a_1) connected to Carrier 2 with spline, and this rotation is transmitted to the rotating body through the internal gears a_1 and a_2 and become the travel driving force.

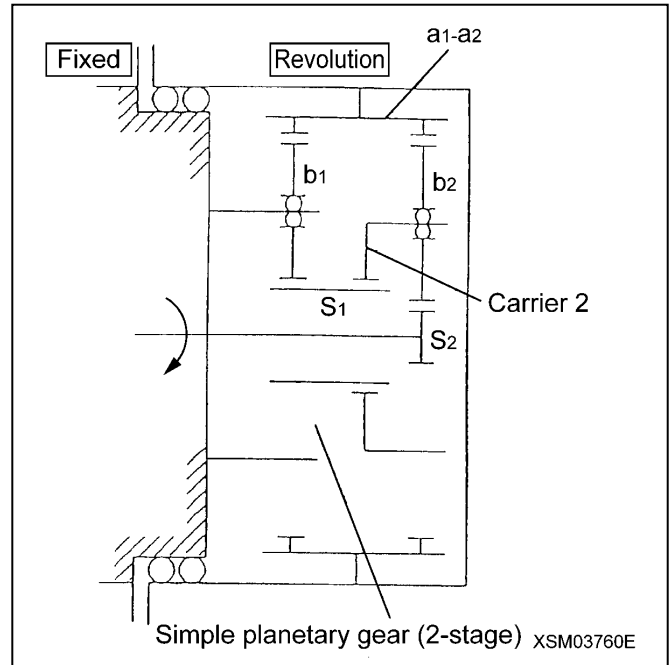
The reduction ratio of the 2-stage simple planet is generally expressed as follows:

$$R = \frac{Z_{s1}}{Z_{s1} + Z_{a1}} \times \frac{Z_{s2}}{Z_{s2} + Z_{a2}}$$

where,

$Z_{s1, 2}$: Number of teeth of the gears s_1 and s_2

$Z_{a1, 2}$: Number of teeth of the gears a_1 and a_2



Since the body rotates, the reduction ratio of ... Series travelling motor is expressed as follows:

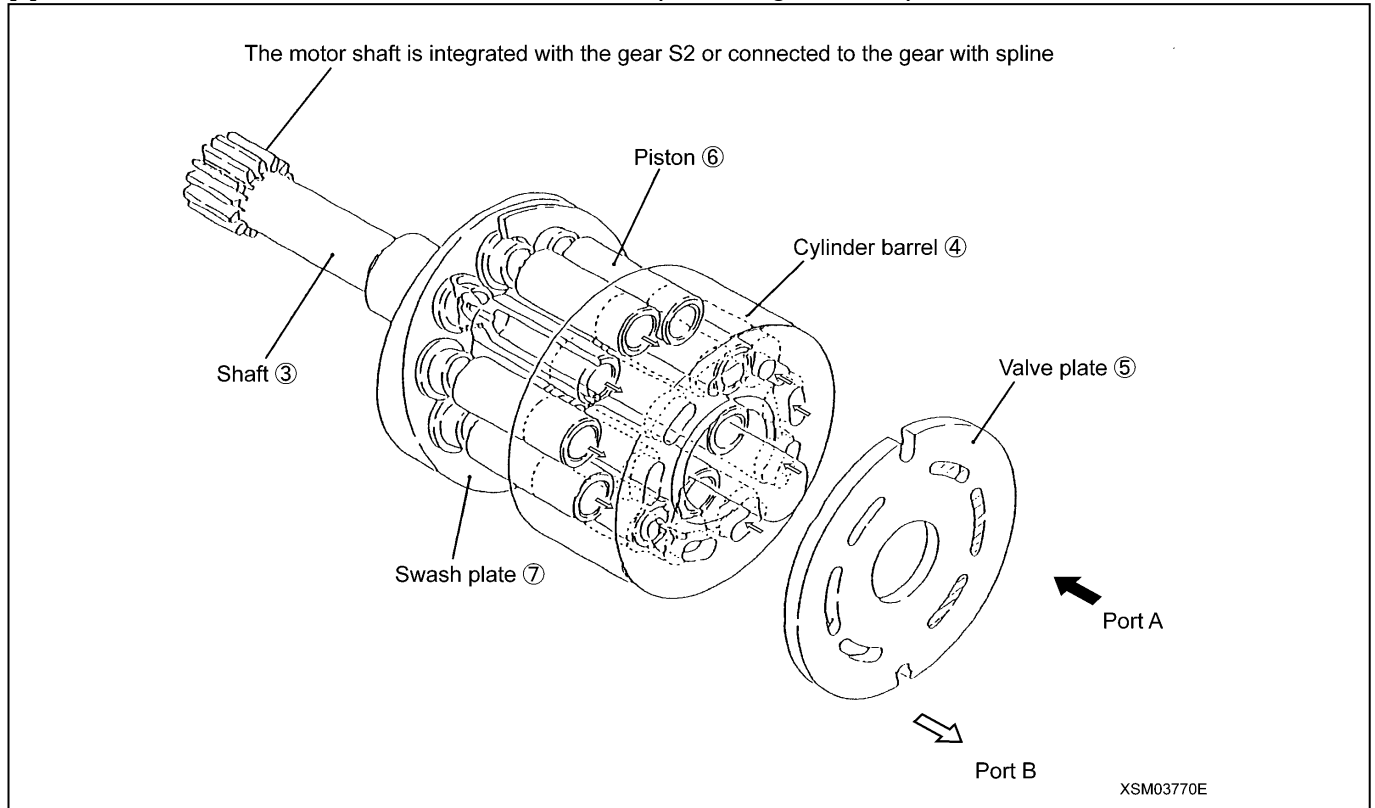
$$R' = \frac{1}{1 - 1/R}$$

8.4.2 HYDRAULIC MOTOR

[1] FUNCTION

The hydraulic motor is of an axial piston motor type (rotating cylinder swash plate type) and converts hydraulic energy from the pump into rotary motion.

[2] STRUCTURE AND BASICS OF FUNCTIONALITY (See the figure below.)



The pressurized oil flow in from the hydraulic valve is supplied to the valve plate (5). The pressurized oil, if supplied to Port A, flows in the cylinder port in the cylinder barrel (4) and pushes the piston (6). This press force is converted into torque through the swash plate (7) and the torque is taken out to the shaft (3) connected to the cylinder barrel with spline. The return oil in the cylinder port flows out through Port B of the valve plate (5). In case of reverse rotation, the pressurized oil flows in Port B, and the return oil flows out of Port A.

[3] BASICS OF FUNCTIONALITY OF 2-SPEED MOTOR

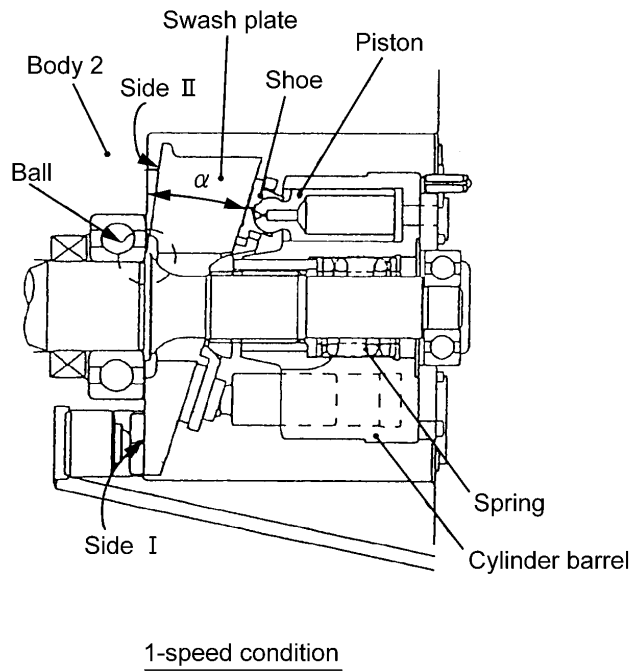


Fig.5

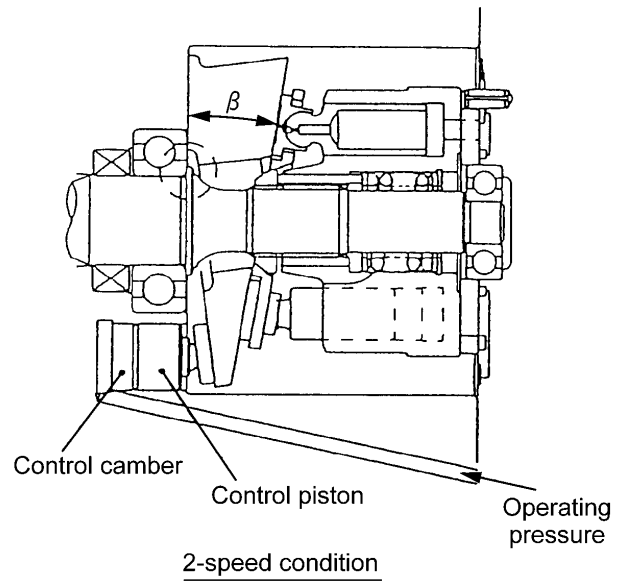
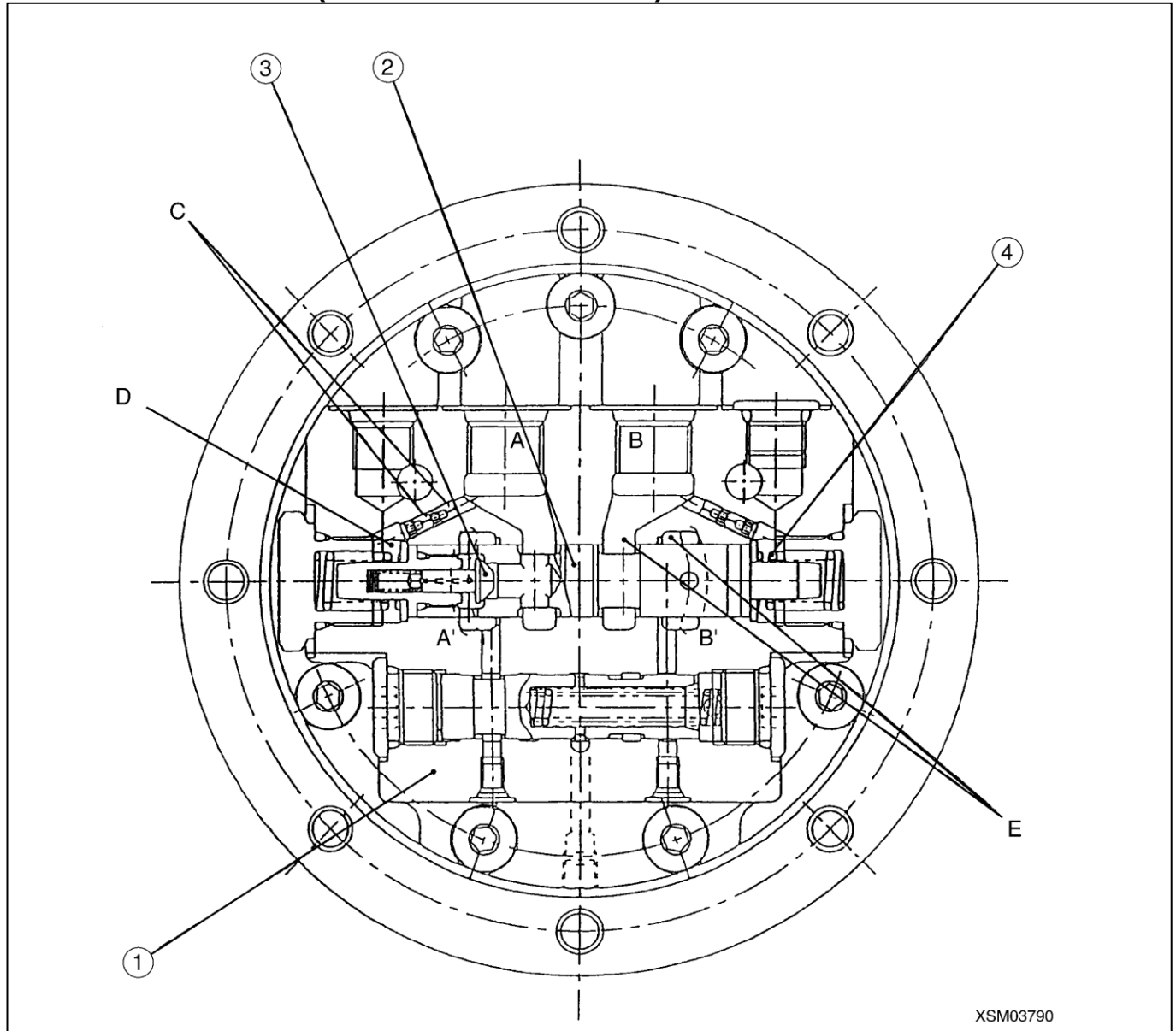


Fig.6

XSM03780E

Swash plate has two sides "I" and "II" on the opposite from the side shoe frictions, and is supported by two balls fixed on body. The balls are fixed eccentrically to the axis line, so when the speed set to low, side "I" is pushed on to body 2 by hydraulic power on piston and spring power in cylinder barrel, making swash plate angle α , capacity maximum. When dual-speed lever is shifted to high, hydraulic pressure is led to control room through high-speed spool, and control piston moves until swash plate side II touches body 2, and fix the swash plate at the angle β . Capacity of the motor at this time is minimum. When engine is stopped, the control room is connected to drain port through the high-speed spool, so the swash plate returns to low-speed condition by the spring power. Therefore it is always in low-speed condition at the time of starting.

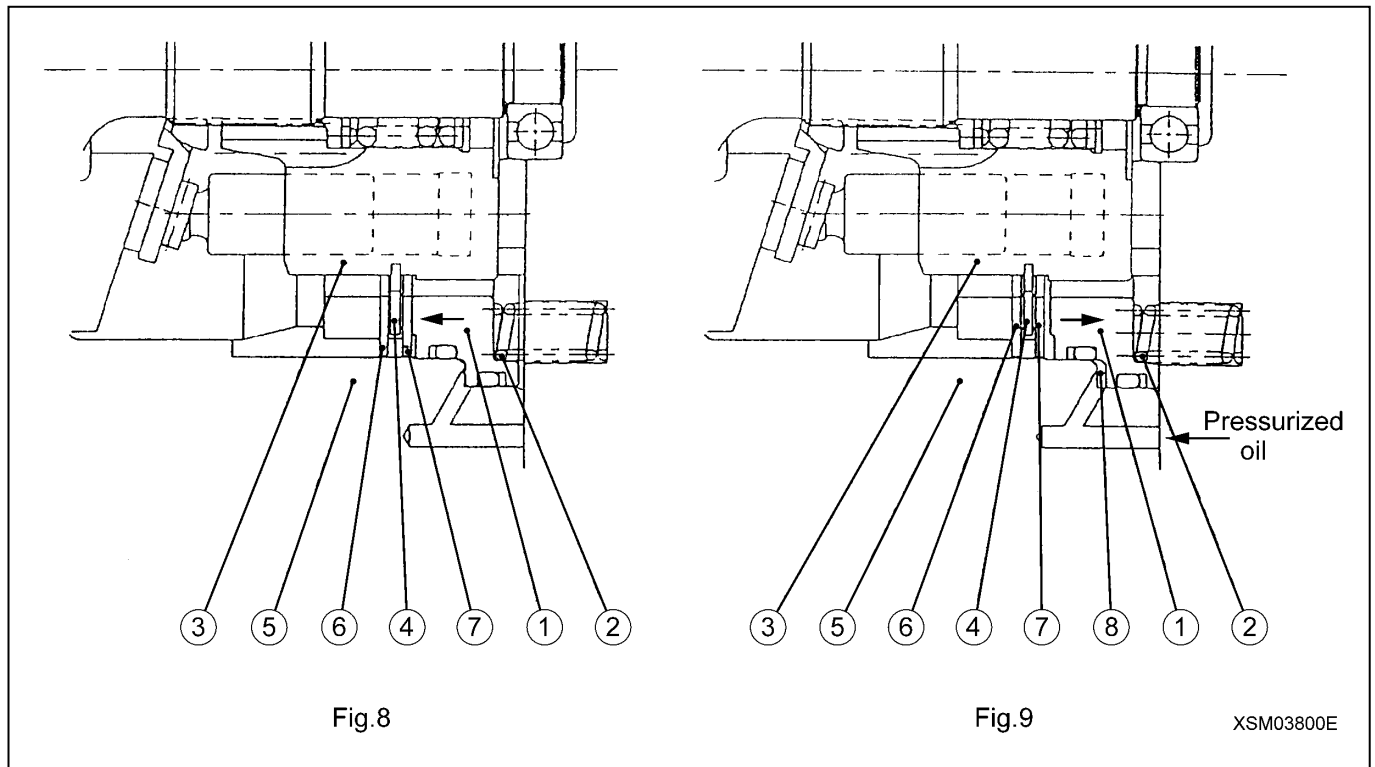
8.4.3 HYDRAULIC VALVE (CONTER BALANCE VALVE)



The pressurized oil, when supplied from Port A, pushes to open the check valve (3) and flows in the inlet side port A' of the hydraulic motor. The pressurized oil flows through the choke hole C, enters the chamber D, overcomes the spring (4) and slides the spool (2) to the right. Then, the return oil of the hydraulic motor flows in from Port B, returns to Port B through the opening E between the body (1) and the spool (2) and rotates the hydraulic motor. When the pressurized oil is supplied from Port B, the above parts operate in reverse and the hydraulic motor rotates in reverse.

When the pressurized oil from Port A is interrupted from the pressurized state, the spool (2) moved to the right tries to return to the left side due to the spring (4) force. At the time, the oil in the chamber D tries to flow out to Port A through the choke hole C, but the spool (2) controls the speed returning to the left side by the throttling effect of the choke hole C. Even if the pressurized oil in Port A is interrupted, the hydraulic motor tries to rotate by inertia force. At the time, the spool (2) limits the return oil gradually to stop the hydraulic motor smoothly depending in the switching speed and the notch shape.

8.4.4 PARKING BRAKE



Parking brake works to fix hydraulic motor inlet axis mechanically, when travelling motor is at halt.

[1] PARKING BRAKE AT WORK

When pressurized oil is not supplied to A or B port, brake piston (1) is pushed to the direction of the arrow shown in Fig. 8 by spring (2).

When this happens, disk plate (4), fixed to cylinder barrel (3) in semilunar groove, get caught between steel plate (6) and (7), fixed similarly to body 2 (5).

As a result, friction force between the disk plate (4) and the steel plate (6) & (7) disables the cylinder barrel (3) to rotate, and fixes the hydraulic motor inlet axis. (See Fig. 8)

[2] PARKING BRAKE RELEASED

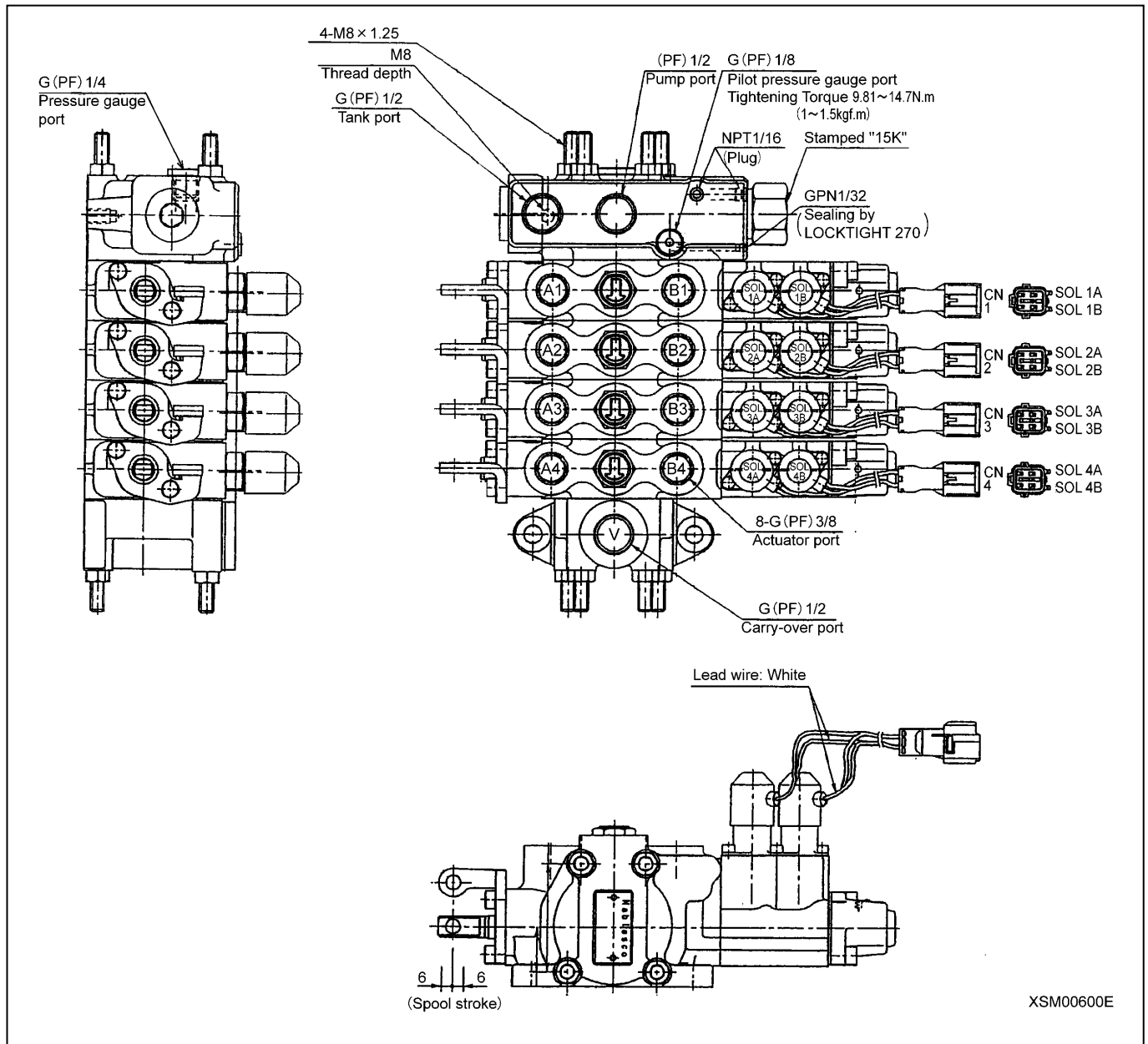
When pressurized oil is supplied to A or B port, the pressurized oil is led to room (8) shown in Fig. 9.

The force of this pressurized oil wins force of spring (2), and moves brake piston (1) to direction of the arrow shown in Fig. 9.

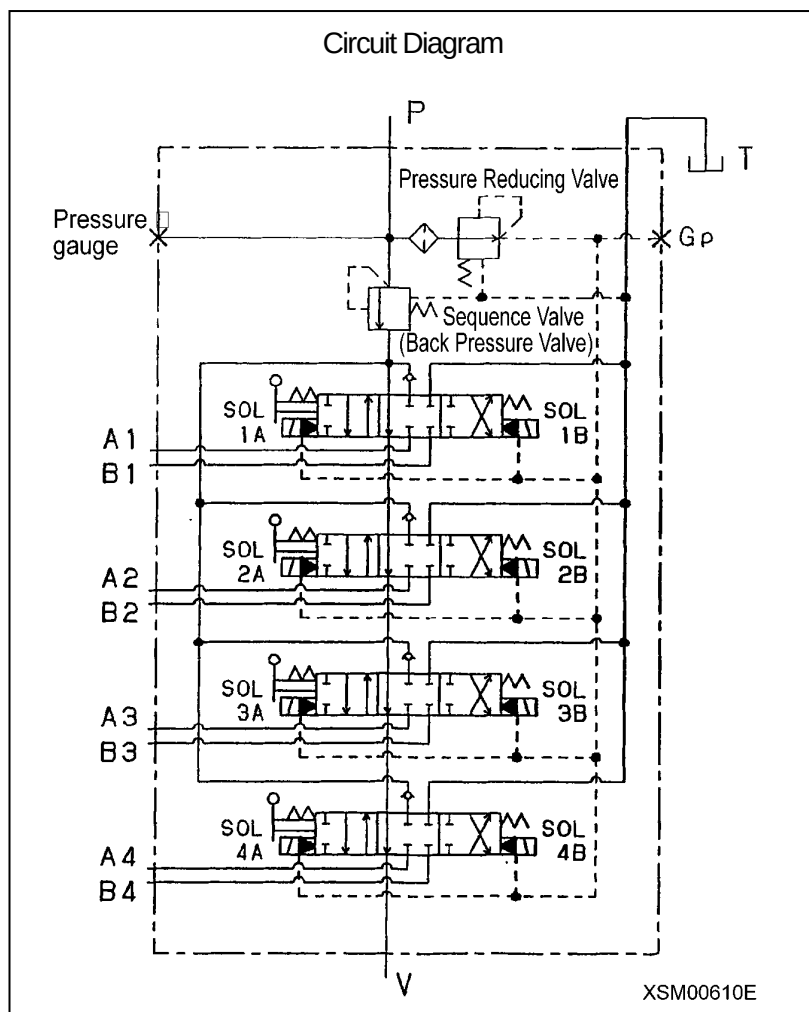
As a result, the disk plate (4) and the steel plate (6) & (7) are released and lose friction force, enabling the cylinder barrel (3) to rotate. (See Fig. 9).

9. OUTRIGGER CONTROL VALVE

9.1 EXTERIOR VIEW AND SPECIFICATIONS

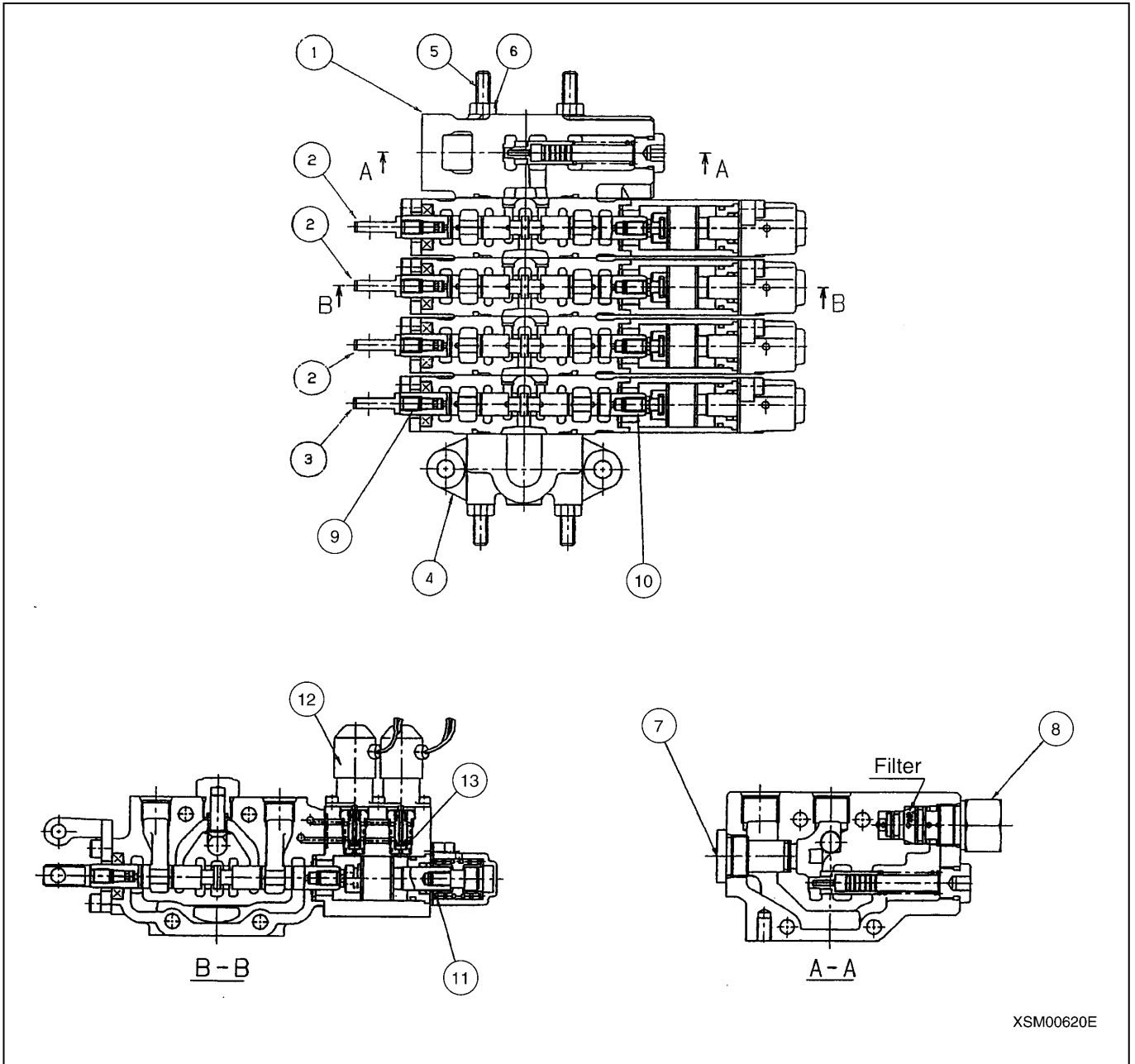


Each Ports Connection		Port Size	Each Ports Connection		Port Size
P	Confluence Selector Solenoid Valve A Port	PF1/2	A3	Outrigger 1 Solenoid Valve P1 Port (Out)	PF3/8
T	Return	PF1/2	B3	Outrigger 1 Solenoid Valve P2 Port (In)	PF3/8
A1	Outrigger 3 Solenoid Valve P1 Port (Out)	PF3/8	A4	Outrigger 2 Solenoid Valve P1 Port (Out)	PF3/8
B1	Outrigger 3 Solenoid Valve P2 Port (In)	PF3/8	B4	Outrigger 2 Solenoid Valve P2 Port (In)	PF3/8
A2	Outrigger 4 Solenoid Valve P1 Port (Out)	PF3/8	V	Return	PF1/2
B2	Outrigger 4 Solenoid Valve P2 Port (In)	PF3/8	Gp	Drain	PF1/8



Valve Rated Specifications	
Common Use Pressure	20.6 MPa (210 kgf/cm ²)
Rated Flow Capacity	50 Litre/min
Relief Setting Pressure	2.94 to 24.5 MPa (30 to 250 kgf/cm ²)
Sequence Valve Setting Pressure	1.27 to 1.67 MPa (13 to 17 kgf/cm ²)
Pressure Reducing Valve Setting Pressure	1.18 to 1.57 MPa (12 to 16 kgf/cm ²)
T Port Allowable Back Pressure	0.98 MPa (10 kgf/cm ²)

9.2 INNER PARTS

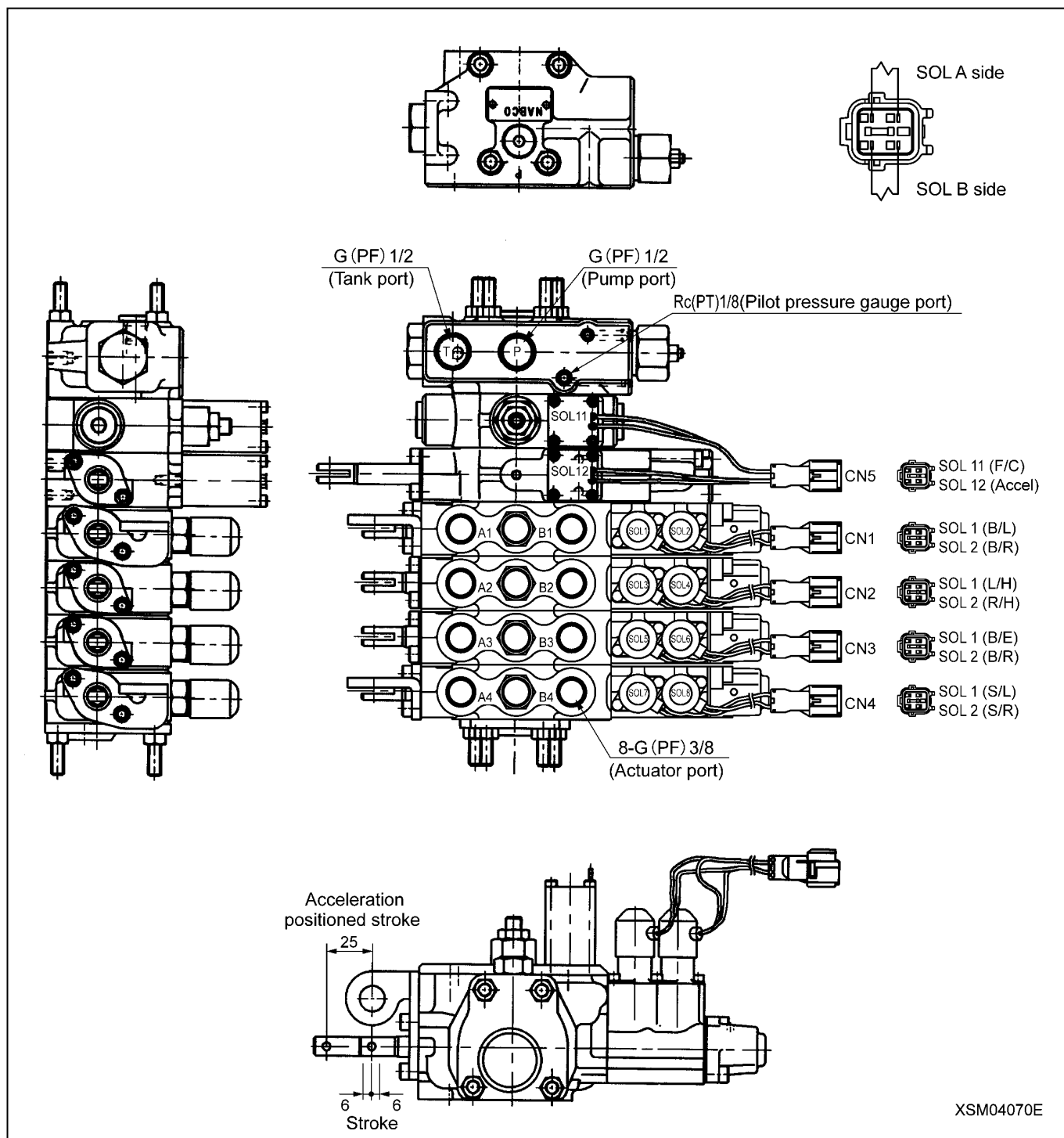


Tightening Torque Table		
Section	Thread Size	Tightening Torque (N•m)
Assembly Bolt	M8	19.6±0.98
Spool End, Connecting End	M8	18.6±0.98 Coat the LOCKTIGHT #242
Solenoid Assembly Bolt	M4	2.45 to 3.43
Socket Head Bolt	M6	9.81 to 10.8
Accelerator Valve, Plug	PF1/4	24.5 to 29.4
	PF3/8	39.2 to 49.0
	M18	39.2 to 49.0
	M24	58.8 to 68.6
Socket Head Plug	GPM1/32	1.47 to 1.96 Coat the LOCKTIGHT #242
	NPT1/16	9.81 to 11.8

NO.	DESCRIPTION	Q'TY
1	Inlet Section	1
2	Block (Outtrigger 1, 3, 4)	1
	Spool (Outtrigger 1, 3, 4)	1
3	Block (Outtrigger 2)	1
	Spool (Outtrigger 2)	1
4	Outlet Section	1
5	Tie Bolt (M8)	4
6	Nut (M8)	8
7	Relief Valve Assembly	1
8	Sequence Valve Assembly	1
9	Spool End	4
10	Connecting End	4
11	Return Spring	4
12	Solenoid Valve Assembly (12VDC)	8
13	Pilot Valve Spring	8

10. CRANE CONTROL VALVE

10.1 EXTERIOR VIEW



Each Ports Connection			Port Size	Each Ports Connection			Port Size
P	Travelling Control Valve (CO1)		PF1/2	T	Return		PF1/2
A1	Derricking Cylinder Head (Boom Lowering)		PF3/8	A3	Telescoping cylinder Bottom (Boom Extending)		PF3/8
B1	Derricking Cylinder Bottom (Boom Raising)		PF3/8	B3	Telescoping cylinder Head (Boom Retracting)		PF3/8
A2	Winch Motor Port B (Hook Lowering)		PF3/8	A4	Slewing Motor Port B (Counterclockwise)		PF3/8
B2	Winch Motor Port A (Hook Raising)		PF3/8	B4	Slewing Motor Port A (Clockwise)		PF3/8

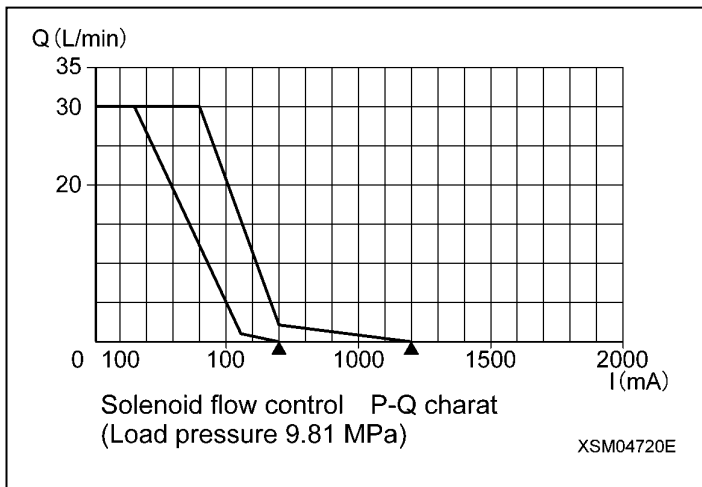
10.2 OUTLINE

Valve Rated Specifications	
Max. Operating Pressure	20.6 MPa (210 kgf/cm ²)
Rated Flow Capacity	50 Litre/min
Sequence Valve Setting Pressure	1.27 to 1.67 MPa (13 to 17 kgf/cm ²)
Reducing Pressure Valve Setting Pressure	1.42 to 1.47 MPa (14.5 to 15.0 kgf/cm ²)
Operating Oil Temperature Range	-20 to 80 °C
Recommended Hydraulic Oil Viscosity Range	8 to 400 cSt

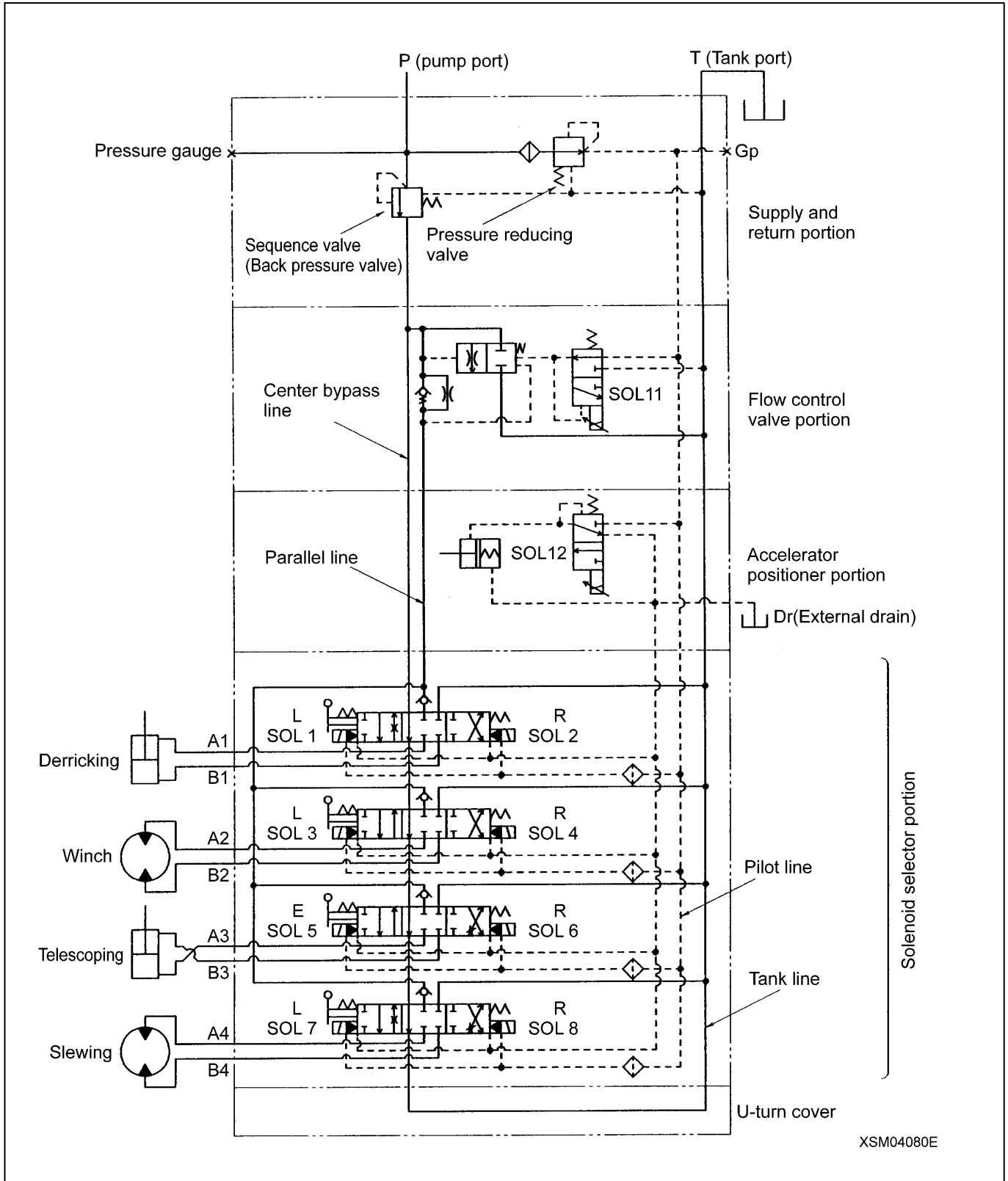
Solenoid Rated Specifications		
Rated voltage		12 VDC
Voltage fluctuation range		+20 to -10%V
Current and power consumption (at 20°C)	Sol No.1 to 8	0.91 A, Approx.11 W (For actuator drive control)
	Sol No.11 and 12	Max. 1.7 A, Approx. 20.4 W (For controlling flow control valve and accelerator positioner)
Excitation rating		Continuous. (Continuous excitation heats the solenoid to high temperature. Do not touch it carelessly, but you will get your fingers burned.)

This valve is an electromagnetic control valve with the functions to change magnetic direction for operating and stopping the load actuator with solenoid and to maintain the operating speed of the actuator constant with the pressure-compensated flow control valve at the time of single operation.

P – Q CHART OF SOLENOID FLOW CONTROL (Load Pressure 9.81 MPa)



10.3 HYDRAULIC CIRCUIT DIAGRAM



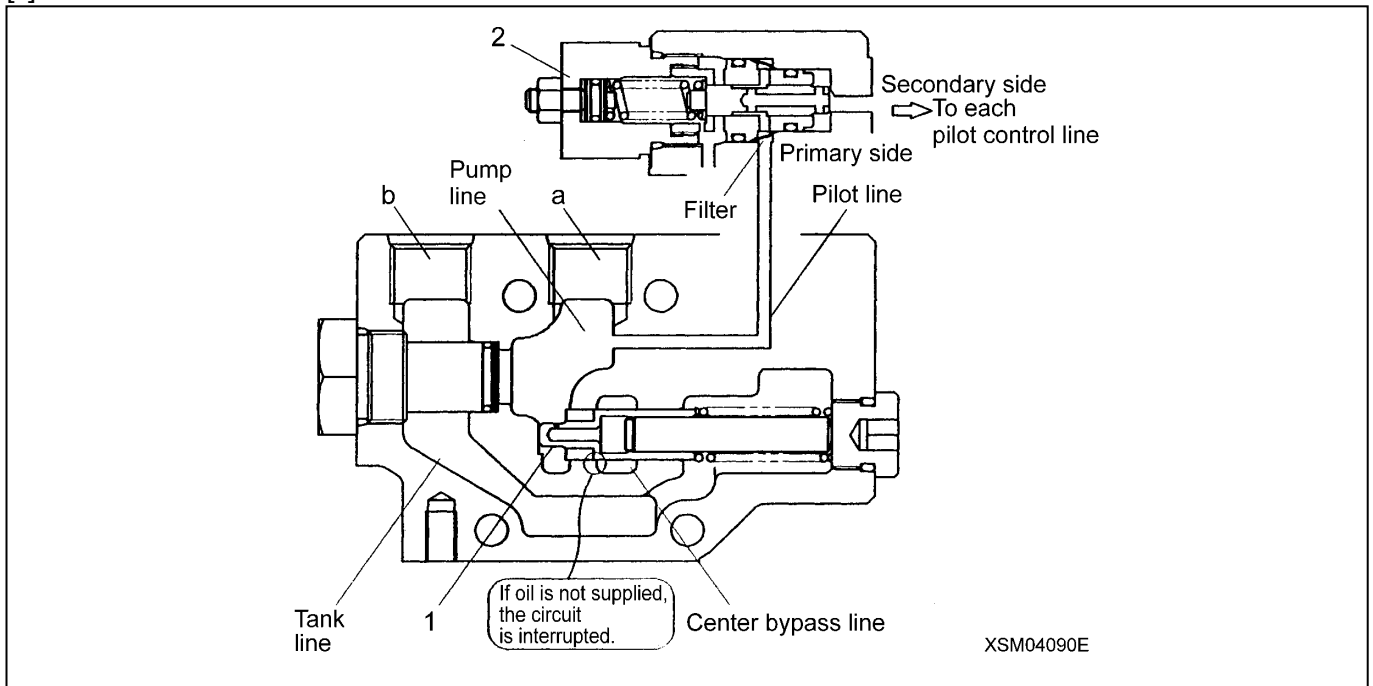
[Circuit Configuration]

Since the solenoid selector valve (Derrick, winch, Telescopic and slewing) is composed of parallel circuits, more than one solenoid selector valve can be operated at the same time. In case of simultaneous operation, the actuator with the lowest load pressure starts operating first.

This valve has the center bypass line through which supplied oil from the pump is released without load when the selector valve is set to neutral.

10.4 FUNCTION OF EACH SECTION

[1] COMPOSITION AND FUNCTION OF SUPPLY SECTION



1. Sequence Valve
2. Pressure Reducing Valve

★The figure is simplified to show the circuit configuration.

The supply section is composed of the supply port (a) to which pressurized oil is supplied from the pump, the oil line through which the pressurized oil flows to the controller (selector), the outlet port (b) through which return oil from the actuator flows to the tank, the sequence valve (1) and the pressure reducing valve (2).

The sequence valve (1) is intended to secure the minimum working pressure of the pilot at the time of solenoid selecting without load, and the pressure reducing valve (2) keeps the pilot pressure at the specified value.

When oil is not supplied, both the sequence valve (1) and the pressure reducing valve (2) do not operate, and the line from the pump to the center bypass is closed but the line to the primary side from the pump to the pressure reducing valve (2) is open.

The oil, when supplied from the pump, pushes to open the sequence valve (1), flows to the center bypass line and does not operate the downstream selector valve. In that case, the pump pressure at the supply port (a) becomes the one of the sequence valve (1). (Cracking pressure: 13 to 17 kgf/cm²). At the same time, the pressure reducing valve (2) starts holding the pilot pressure as the set pressure of the valve. (Pressure reducing valve set pressure: 14.0 to 14.5 kgf/cm²)

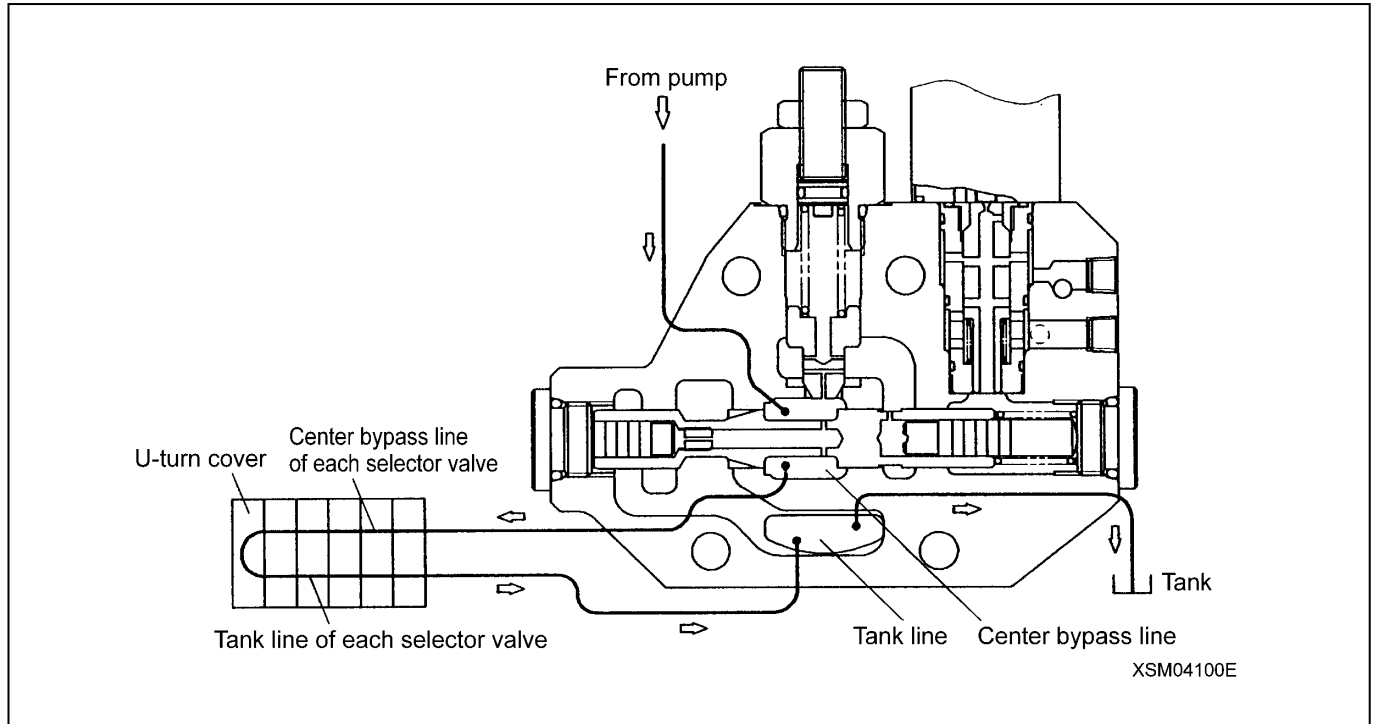
When the oil from the pump operates the downstream selector valve, the pump pressure becomes the load pressure, and when the load pressure reaches the set pressure of the external relief valve, the circuit pressure is held as the relief valve set pressure.

⚠ WARNING

- This selector valve is not fitted with a relief valve. So, the circuit maximum pressure depends on the relief valve fitted to other than the selector valve.
- Set the relief valve set pressure to lower than the valve rated pressure. If the set pressure is set to over the rated pressure, the relief valve will be degraded, get out of order or be broken.

[2] FUNCTION OF FLOW CONTROL VALVE

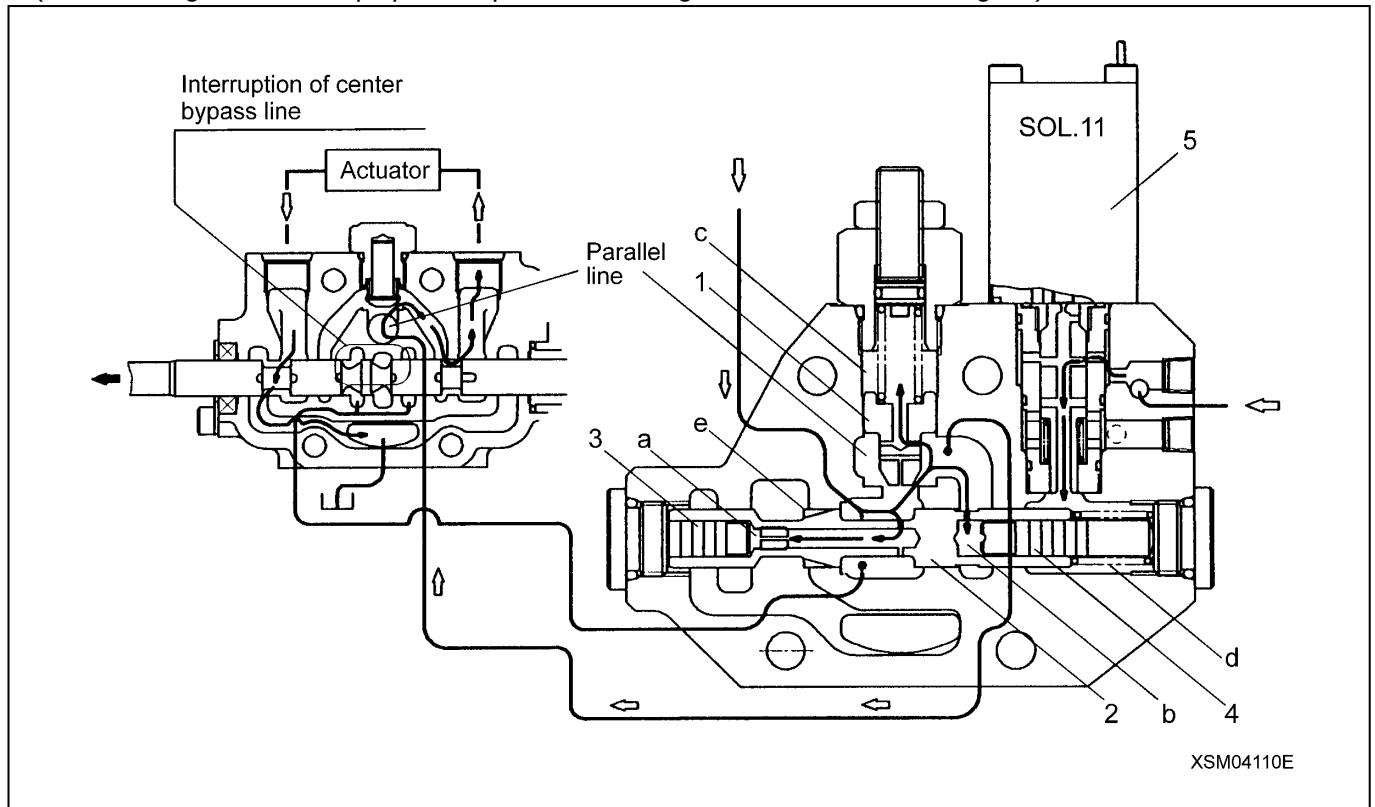
1. When each selector valve is at the neutral position



Pressurized oil from the pump flows through the center bypass lines of the control valve and of each selector valve and the tank line and returns to the tank from the outlet port of the supply section.

2. When selector valves are operated

(When the negative solenoid proportional pressure reducing valve solenoid is not energized)



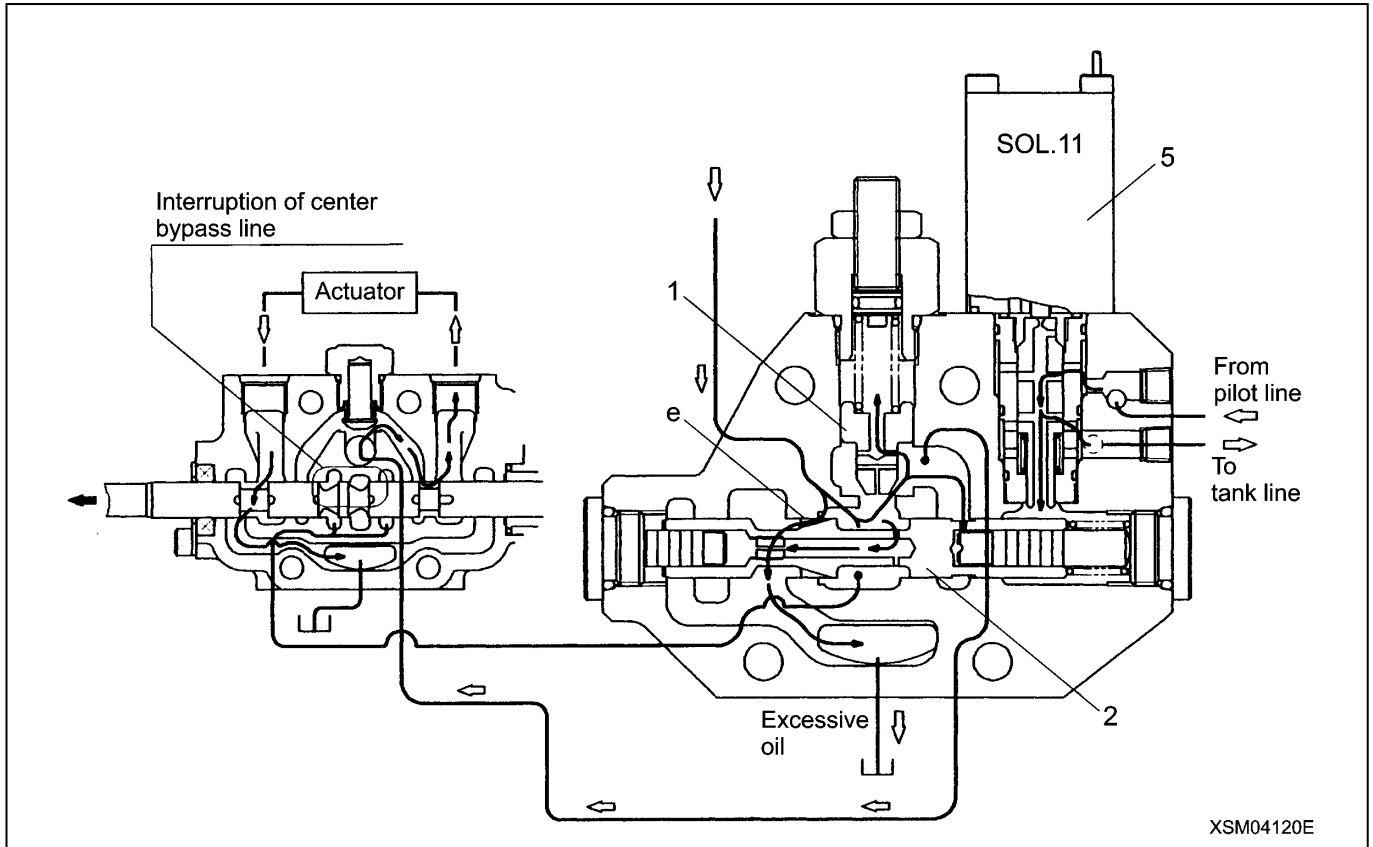
1. Detection Valve
2. Flow Control Spool
3. Primary Side Piston A

4. Secondary Side Piston B
5. Negative Solenoid Proportional Pressure Reducing Valve

When any selector valve is changed over, the center bypass line is closed, and pressurized oil pushes up the detection valve (1) and flows in the parallel line. At the time, the pump pressure affects the primary side chamber (a) of the flow control spool (2) while the load pressure (the detection valve downstream pressure) affects the secondary side chamber (b) and the detection valve spring chamber (c). Since the primary side piston (3) and the secondary side piston (4) are of the same diameter, the differential pressure between the front and the rear of the detection valve (1) affects the flow control spool (2) in the right direction. On the other hand, the secondary pressure of the negative solenoid proportional pressure reducing valve (5) affects the control valve spring chamber (d) and also affects the flow control spool (2) in the left direction together with the spring force. Since the secondary pressure comes to the maximum when the negative solenoid proportional pressure reducing valve solenoid (SOL11) is not energized, the rightward force, which affects the flow control spool (2), exceeds the leftward force, and the flow control spool (2) comes to the left end. Therefore, the control notch (e) portion remains closed, and the all pressurized oil from the pump flows to the selector valves through the parallel line.

3. When the selector valves are operated

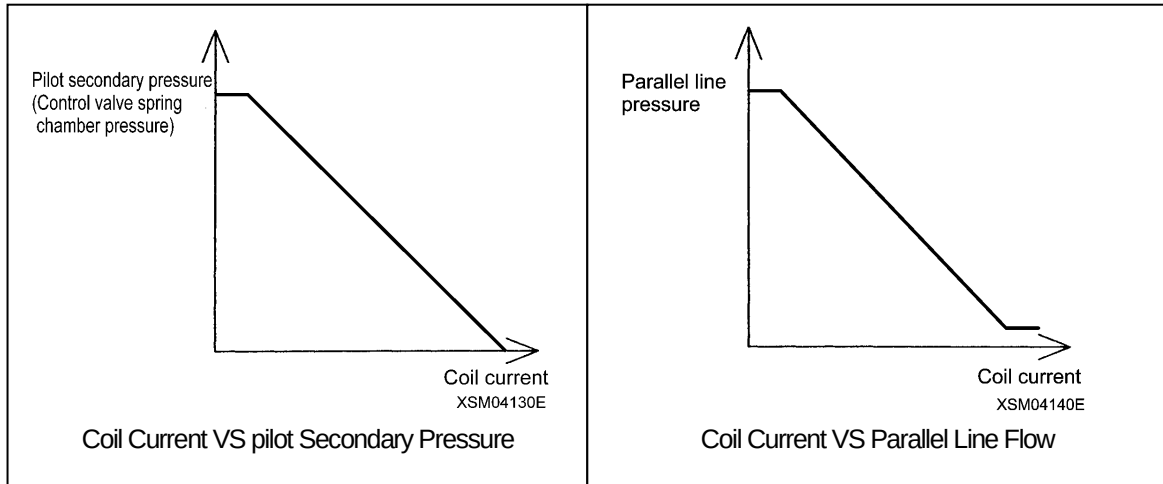
(When the negative solenoid proportional pressure reducing valve solenoid is energized)



1. Detection Valve

2. Flow Control Spool

5. Negative Solenoid Proportional Pressure Reducing Valve



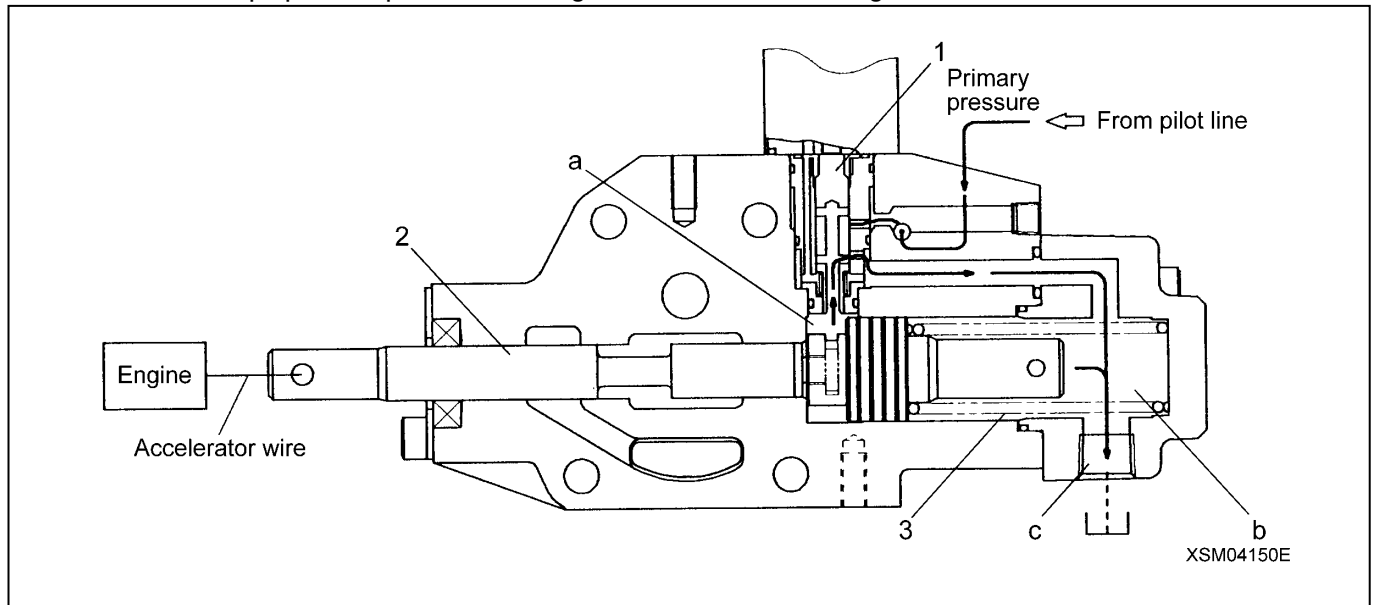
When a current is applied to the negative solenoid proportional pressure reducing valve (5) solenoid (SOL11), the secondary pressure changes (drops) according to the current value and the leftward force, which affects the flow control spool (2), also reduces. As a result, the flow control spool moves to the right and opens the control notch (e) portion to release excessive oil to the tank. Since the oil flow from the detection valve (1) to the parallel line decreases by that, the differential pressure between the front and the rear of the detection valve (1) reduces and the rightward force, which affects the flow control spool (2), reduces as well. Then, the flow control spool (2) moves to the position where the rightward force balances with the leftward force.

These motions occur continuously, and the oil flow is controlled according to the applied current value. When the load pressure changes in the state, the flow control spool (2) changes the opening of the control notch (e) portion so as to keep the differential pressure between the front and the rear of the detection valve (1) constant. Also, the spool makes the oil flow to the actuator constant irrespective of load pressure.

[3] FUNCTION OF ACCELERATOR POSITIONER

When a current is applied to the solenoid (SOL12), the final controlling element moves the spool (2) by the input current, changes the engine speed with the connected accelerator wire and controls the discharge flow from the pump.

1. When the solenoid proportional pressure reducing valve solenoid is not energized



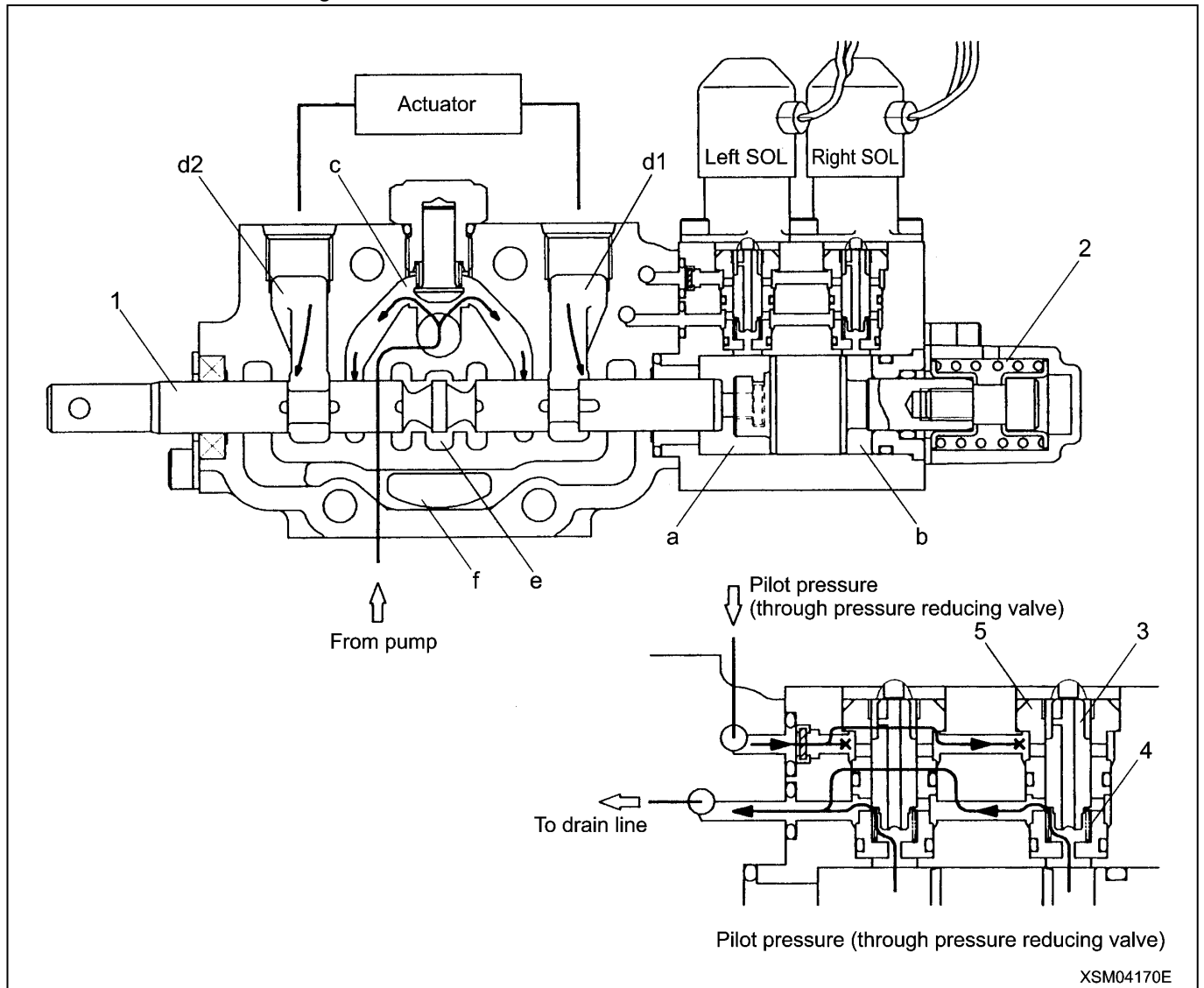
- 1. Pressure Reducing valve Spool
- 2. Spool
- 5. Return Spring

For the pilot pressure (primary pressure) from the pilot line, the pressure reducing valve spool (1) closes the line to the secondary side pilot chamber (a). On the other hand, the pilot chamber (a) is connected to the spring chamber (b) through the internal line of the pressure reducing valve spool (1) and also to the drain port (c).

So, the pressures in the pilot chamber (a) and in the spring chamber (b) becomes equal (the drain pressure), and the return spring (3) pushes the spool (2) to the left.

[4] FUNCTION OF SOLENOID SELECTOR VALVE (Derricking, Winch, Telescoping and Slewing)

1. When the solenoid is not energized



XSM04170E

- | | |
|------------------|-----------------------|
| 1. Spool | 4. Pilot Valve Spring |
| 2. Return Spring | 5. Socket |
| 3. Pilot Valve | |

The return spring (2) retains the spool (1) at the neutral position.

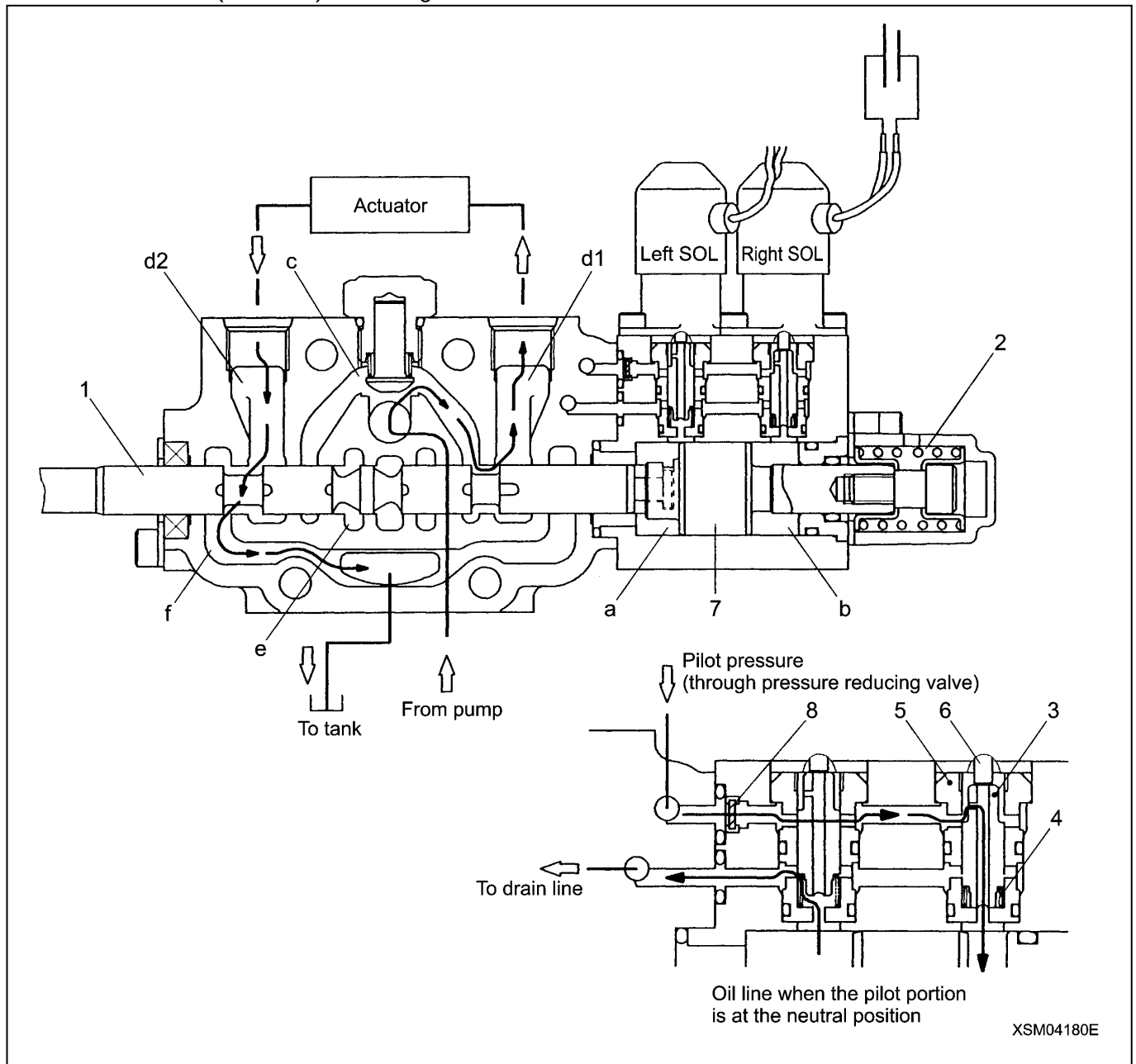
The pilot valve spring (4) has pushed up the pilot valve (3) to the solenoid side. In the state, the pilot line is interrupted with the pilot valve (3), but the pilot chambers (a) and (b) are connected to the drain line with the socket (5).

So, the pressures in the pilot chambers (a) and (b) become equal (the drain pressure), and no pressure occurs that moves the spool (1).

Since the spool is of the all-port block type, the lines between the parallel line (c) and the actuator lines (d1) and (d2) and the lines between the actuator lines (d1) and (d2) and the tank line (f) are closed when the spool is at the neutral position. Therefore, all lines to the actuator are interrupted, and the actuator is at a halt.

On the other hand, when other selector valves are at the neutral position, oil from the pump returns to the tank through the center bypass line (e) of each selector valve, the U-turn cover and the tank line (f).

2. When the solenoids (SOL1 to 8) were energized



- | | | |
|------------------|-----------------------|-----------------|
| 1. Spool | 4. Pilot Valve Spring | 7. Pilot Piston |
| 2. Return Spring | 5. Socket | 8. Filter |
| 3. Pilot Valve | 6. Push Pin | |

The following explanation is based on the state that the right solenoid was energized.

The push pin (6) pushes down the right pilot valve (3), and the pilot chamber (b) is connected to the pilot line through the filter (8) and the pilot pressure is supplied to the chamber. At the time, the left pilot chamber (a) remains connected to the drain line. Therefore, the differential pressure between the pilot pressure and the drain pressure affects the pilot piston (7) and moves the spool (1) to the left.

As the spool moves, the center bypass line (e) is closed, but the pump line (c) is connected to the actuator line (d1) and the left actuator line (d2) is connected to the tank line (f). Then, the actuator starts moving.

When the left solenoid is energized, the line configuration becomes contrary to the above, and the spool (1) moves to the right but the actuator moves in the reverse direction.

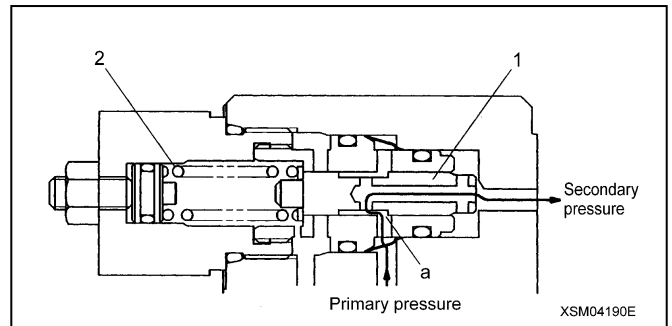
When the solenoid is demagnetized, the return spring (2) returns the spool (1) to the neutral position (the state in 4-1), and the actuator return to the neutral position and stops there.

[5] FUNCTION OF PRESSURE REDUCING VALVE

1. When the secondary pressure is below the set value

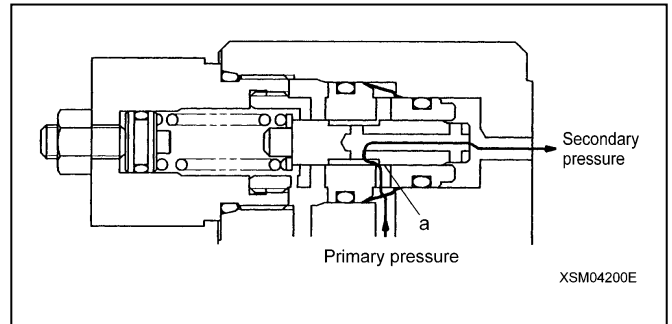
Since the pressure reducing valve spool (1) pressed with the pressure reducing valve spring (2), the pressurized oil of the primary pressure flows to the secondary side of the pressure reducing valve spool (1) line (a).

1. Pressure Reducing Valve Spool
2. Pressure Reducing Valve Spring



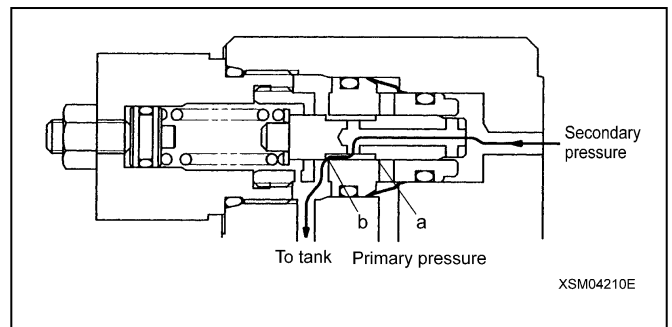
2. When the primary pressure is higher than the set pressure of the secondary pressure

The pressure reducing valve spool (1) moves until the secondary pressure balance with the pressure reducing valve spring (2) and throttles the line (a) of the pressure reducing valve spool (1) to retain the secondary pressure at the set value.



3. When the secondary pressure is higher than the set value

The pressure reducing valve spool (1) moves until the secondary pressure balanced with the pressure reducing valve spring, closes the line (a) of the pressure reducing valve spool (1) and opens the line (b) at the same time to connect it to the tank and reduces the secondary pressure to the set pressure.

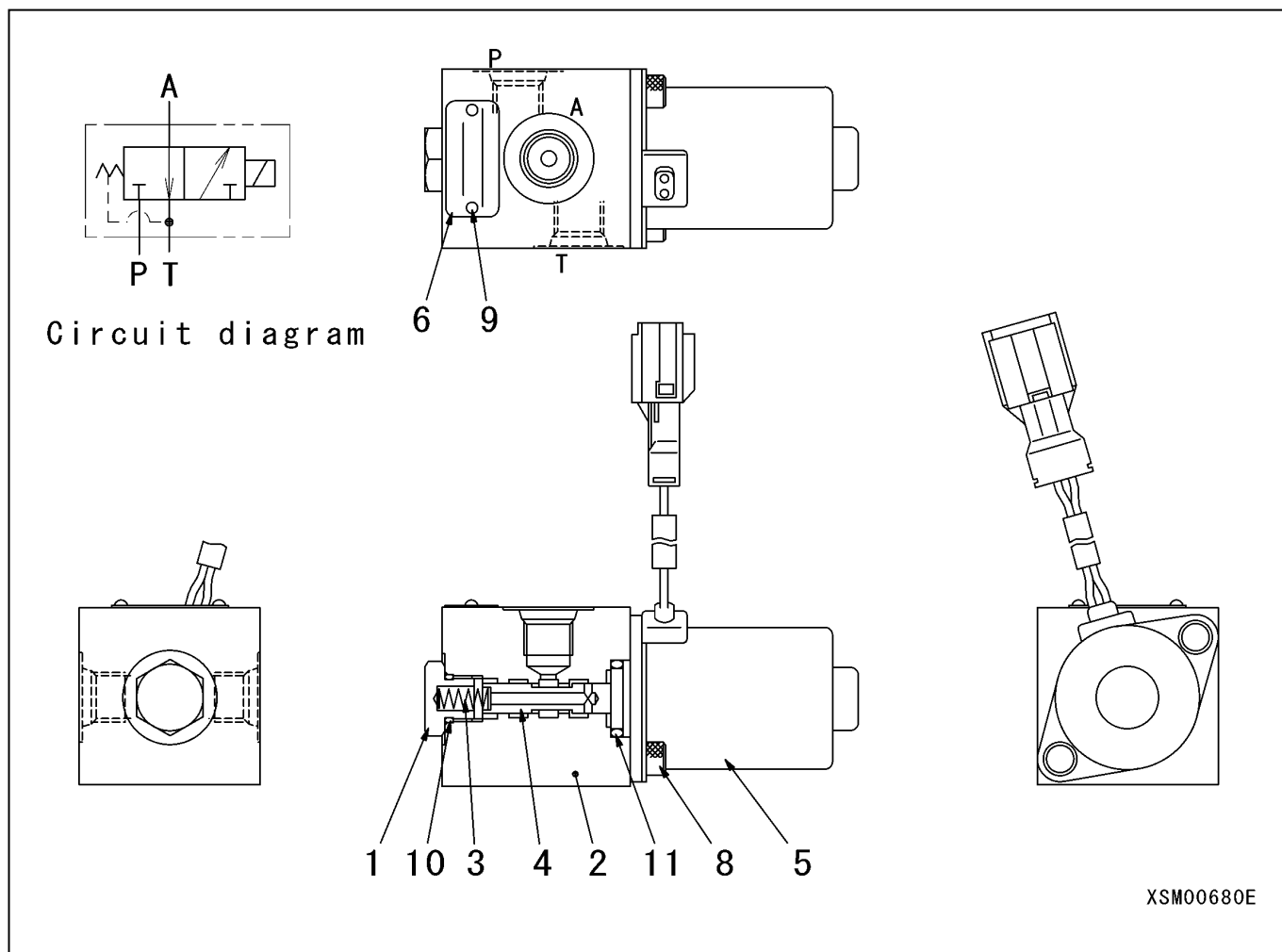


10.5 TROUBLE SHOOTING

Disorders	Cause	Counter-action
The pressure does not reach the specified pressure.	- The mounting bolts does not tighten with the specified tightening torque. - Being unloaded without full stroke.	- Check the torque value - See "The solenoid selector valve does not change over even though energized."
The solenoid selector valve does not change over even though energized.	- The energized voltage is too low, or disconnect wiring. - Foreign matters being caught to the pilot valve. - Foreign matters being caught to the spool - Drop below set pressure of the pressure reducing valve. - Drop below set pressure of the sequence valve.	- Inspect and repair the electric system If the coil is broken, it replace. - Overhaul and then repair or replace - Overhaul and then repair or replace - Overhaul and then repair or replace - Overhaul and then repair or replace
The solenoid selector valve does not return to the neutral position even though energized.	- Foreign matters being caught to the pilot valve. - Foreign matters being caught to the spool.	- Overhaul and then repair or replace - Overhaul and then repair or replace
The solenoid selector valve changes over though not energized.	Foreign matters being caught to the pilot valve.or deformed seat..	Overhaul and then repair or replace
Oil leakage from spool seal section.	- Damage of seal parts, or wear of seal lip - Dent or scratch on seal sliding section of spool. - Improper setting of seal parts and slip-on cover. - Adhesion of paint on seal sliding section of spool.	- Replace - Repair or replace the spool - Check irregular wear of seal lip and correct it - Remove the paint by thinner
The spool does not slide smoothly.	- Foreign matters being caught to the spool. - Breakage of oil film between spool and body. due to abnormal rise of oil temperature. - Wear of spool. - Lubrication failure due to oil deterioration. - Bent spool. - Distortion of the whole valve due to defective mounting face. - Defective external final controlling element. - Oil remaining on cover opposite to spool.	- Overhaul and then repair or replace - Lower the oil temperature or replace the spool - Replace - Change the oil (overhaul the circuit) - Check straightness of the spool, repair or replace the spool - Loosen the mounting bolts and check the mounting face - Check and correct the link, lever, etc. - When the spool is moved, oil comes out of the air vent hole on the cover due to oil leakage from the spool sea. Make sure that this phenomenon occurs, then replace the spool.
Flow cannot be controlled smoothly.	- Foreign matters being caught to the spool and piston. - Clogging of restriction with foreign matters to the spool hoke hole. - Drop of set value due to foreign matters being caught. to the pressure reducing valve. - Defective operation due to foreign matters being caught to the negative proportional pressure reducing valve. - Clogging of restriction due to foreign matter sto the detection valve.	- Overhaul and then repair or replace - Overhaul and then repair or replace - Overhaul and then repair or replace - Overhaul and then repair or replace - Overhaul and then repair or replace
The accelerator cannot be controlled smoothly.	- Foreign matters being caught to the spool and piston. - Defective operation due to foreign matters being caught to the negative proportional pressure reducing valve. - Drop of set value due to foreign matters being caught. to the pressure reducing valve. - Defective external final controlling element	- Overhaul and then repair or replace - Overhaul and then repair or replace - Overhaul and then repair or replace - Check and correct the link, lever, etc.

11. TRAVELLING SPEED SELECTOR VALVE

11.1 EXTERIOR VIEW AND SPECIFICATIONS



Each Ports Connection		Port Size
P	Travelling Control Valve Pressure Gauge Port	PF1/4
A	Left and Right Travelling Motor PP Port	PF1/4
T	Drain	PF1/4

NO.	DESCRIPTION	Q'TY	NO.	DESCRIPTION	Q'TY	NO.	DESCRIPTION	Q'TY
1	Plug	1	5	Solenoid	1	9	Rivet	2
2	Body	1	6	Name Plate	1	10	O-ring (1A-P10)	1
3	Compression Spring	1	7	Skipped No.		11	O-ring (1B-P16)	1
4	Spool	1	8	Socket Head Bolt (M5X10)	2			

Specifications		
Common Use Pressure		3.9 MPa (40 kgf/cm ²)
Common Use Flow Capacity		7 Litre/min (Through P to A Flow Capacity)
Operating Temperature Range		-20 to +90 °C
Allowable Back Pressure	Static Pressure	1.96 MPa (20 kgf/cm ²)
	Actual Pressure	0.98 MPa (10 kgf/cm ²)

11.2 INSPECTION AND ADJUSTMENT

[1] PARTS INSPECTION

Assembly	Criteria	Counter-action
• Coil Assembly	• Damage to solenoids, including short-circuit and wire breakage. • Short-circuit and wire breakage.	• Replace • Replace
• Housing	• Scratch, rust and/or corrosion in spool sliding area. • Scratch, rust and/or corrosion in port seal area next to O-ring. • Other defects which potentially damage normal function of parts.	• Replace • Replace • Replace
• Spool	• Scratch in external sliding area which could be felt when picked with nails.	• Normal
• Plunger	• Actuation is not smooth.	• Repair or replace
• Spring	• Serious damage such as rust, corrosion, deform or breakage.	• Replace
• O-Ring	---	• Replace

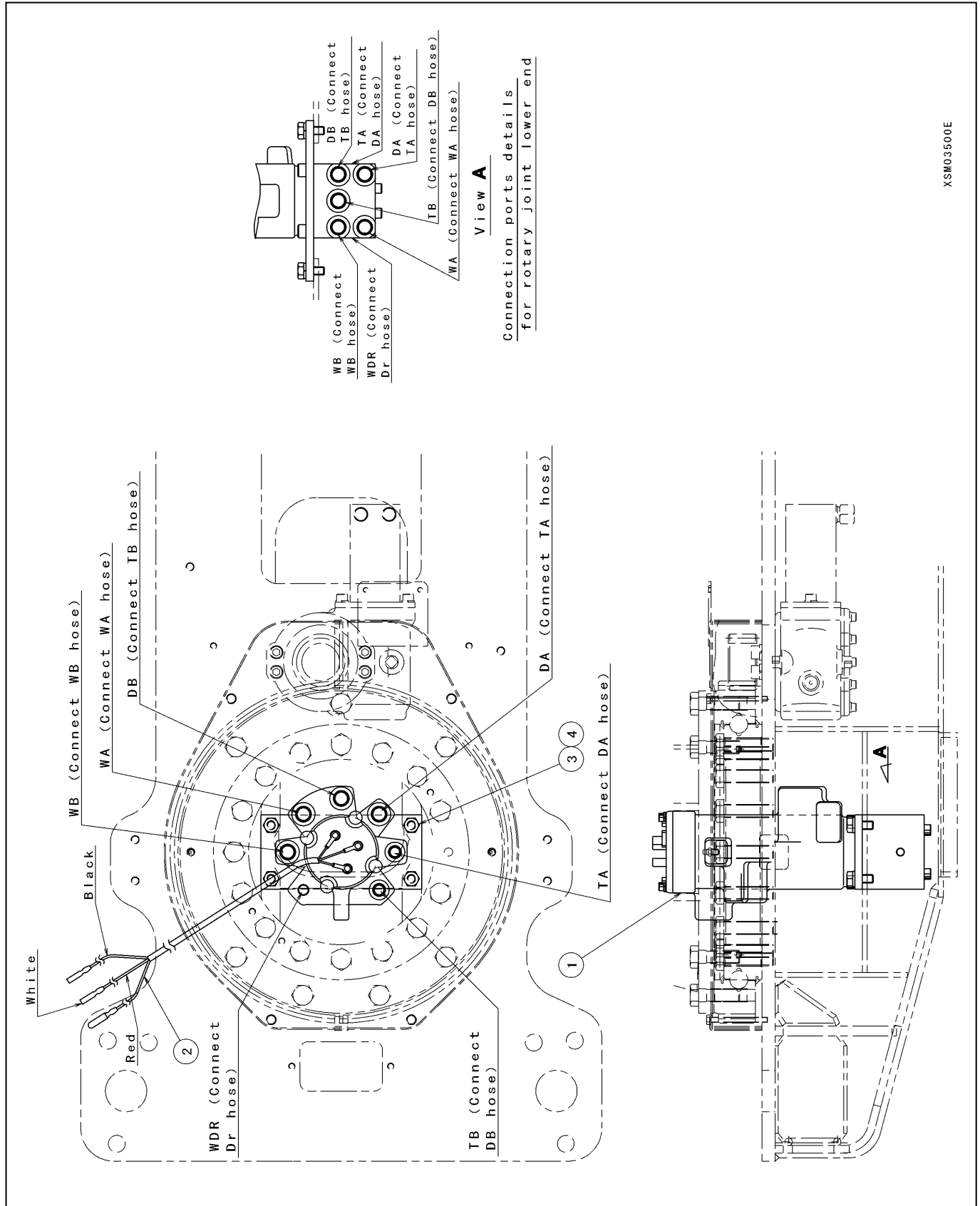
11.3 TROUBLE SHOOTING

Each Item shown in the table below indicates only individual problem; however, troubles may be caused by multiple problems, in many cases. It is advisable to check one by one for efficient trouble shooting.

Disorders	Cause	Counter-action
Solenoid valves, not actuating correctly	• Short-circuit and/or wire breakage. • Short-circuit and/or wire breakage coil assembly • Inclusion of foreign matters to spool. • Scratch at external sliding area of spool. • Inclusion of foreign matters to plunger. • Scratch at external sliding area of plunger.	• Replace • Replace • Overhaul and then repair or replace • Overhaul and then repair or replace • Overhaul and then repair or replace • Overhaul and then repair or replace
Oil leakage from solenoid valves, cover and relief valves	• Damage to O-rings	• Replace
Insufficient Pressure Level	• Inclusion of foreign matters to Relief Valve.	• Clean and replace

12. ROTARY JOINT

12.1 EXTERIOR VIEW AND SPECIFICATIONS

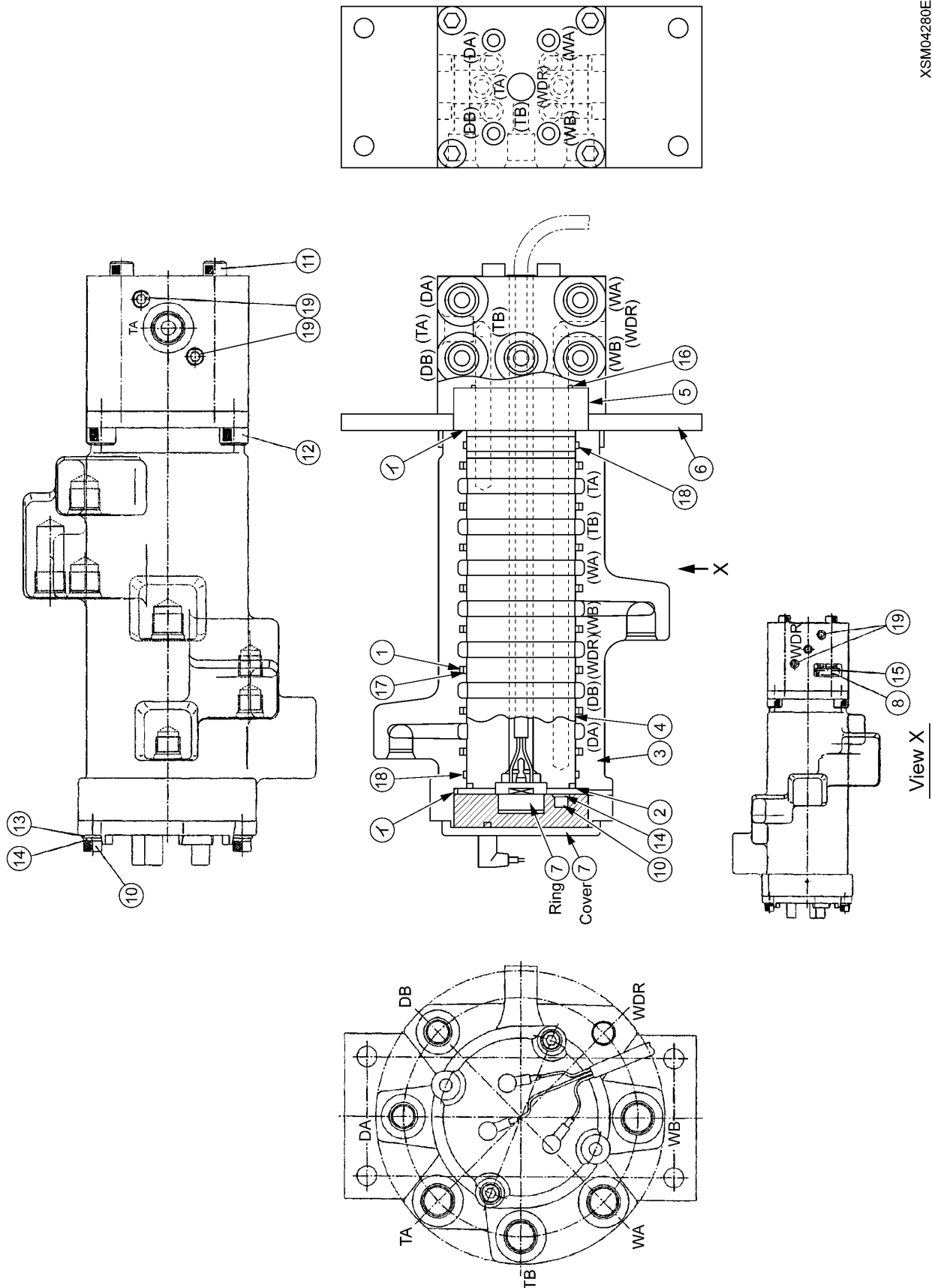


NO.	DESCRIPTION	QTY	NOTICE
1	Rotary Joint	1	
2	Slip Ring Assembly	1	
3	Bolt	4	M10X1.5X25L (Plating) 109T
4	Spring Washer	4	M10 (Plating)

Rotary Joint Connection Table					
Stamp	Upper Side Connecting Hose	Thread Size	Stamp	Lower Side Connecting Hose	Thread Size
WA	WA Hose (Winch Motor Port A) (Hook Raising)	PF3/8	WA	WA Hose (Crane Control Valve Port B2)	PF3/8
WB	WB Hose (Winch Motor Port B) (Hook Lowering)	PF3/8	WB	WB Hose (Crane Control Valve Port A2)	PF3/8
TA	TA Hose (Telescoping cylinder Bottom Port) (Boom Extending)	PF3/8	TA	TA Hose (Crane Control Valve Port B1)	PF3/8
TB	TB Hose (Telescoping cylinder Head Port) (Boom Retracting)	PF3/8	TB	TB Hose (Crane Control Valve Port A1)	PF3/8
DA	DA Hose (Derricking Cylinder Bottom Port) (Boom Raising)	PF3/8	DA	DB Hose (Crane Control Valve Port A3)	PF3/8
DB	DB Hose (Derricking Cylinder Head Port) (Boom Lowering)	PF3/8	DB	DA Hose (Crane Control Valve Port B3)	PF3/8
WDR	Dr Hose (Drain)	PT1/4	WDR	Dr Hose (Drain)	PT1/8

Specifications	
Max. Rated Flow Capacity	50 L/min
Max. Common Use Pressure	TA, TB, WA, WB, DA, DB: 20.6 MPa (210 kgf/cm ²)
	WDR: 2.9 MPa (30 kgf/cm ²)
Withstand Pressure	TA, TB, WA, WB, DA, DB: 30.9 MPa (315 kgf/cm ²)
	WDR: 3.5MPa (36 kgf/cm ²)
Operating Temperature Range	-20 to +90 °C
Inside Leakage Capacity	TA, TB, WA, WB, DA, DB: Less than 1 cc/ min [At 20.6 MPa (210 kgf/cm ²)]
	WDR: Less than 1 cc/min [At 2.9 MPa (30 kgf/cm ²)]
Rotation Torque	When Starting: Less than 98.1 N•m (10 kgf•m) [Supply 20.6 MPa (210 kgf/cm ²) From Port DA and TA]
Hydraulic Oil	ISO VG32, VG46

12.2 INNER PARTS

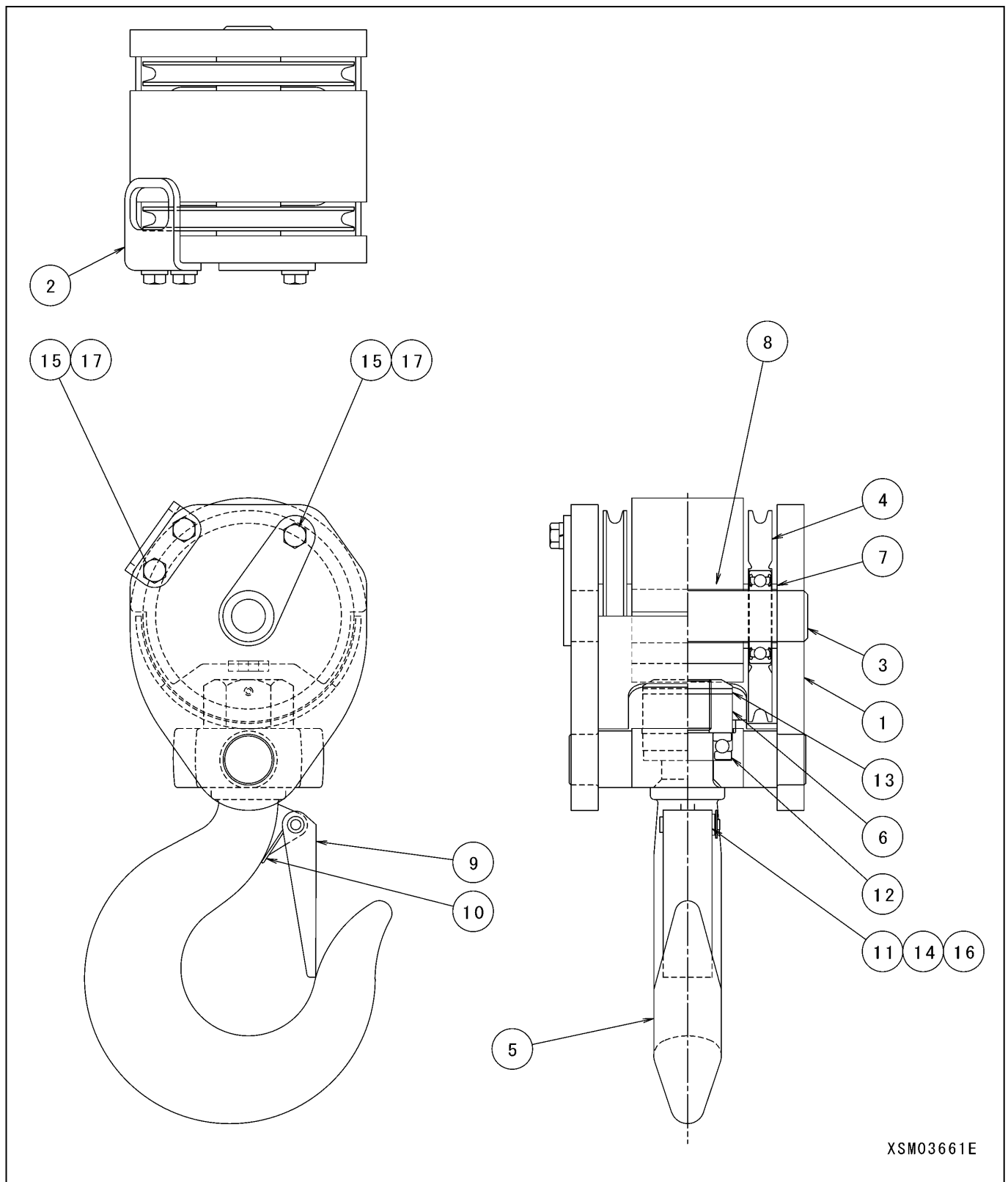


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NO.	DESCRIPTION	Q'TY	NO.	DESCRIPTION	Q'TY	NO.	DESCRIPTION	Q'TY
1	Slipper Seal	8	8	Name Plate	1	15	Rivet	2
2	Plate	1	9	Skipped No.		16	O-Ring (1B-P10)	7
3	Hub	1	10	Hex. Socket Head Bolt (M6X16)	4	17	O-Ring (1B-G65)	8
4	Shaft	1	11	Hex. Socket Head Bolt (M8X70)	4	18	O-Ring (AS568-229)	2
5	Body	1	12	Hex. Socket Head Bolt (M10X18)	4	19	Hex. Socket Head Bolt (PT1/8)	4
6	Flange	1	13	Plane Washer (M6)	2			
7	Slip Ring	1	14	Spring Washer (M6)	4			

13. HOOK BLOCK



NO.	DESCRIPTION	Q'TY	NOTICE
1	Block Plate	1	
2	Bracket	1	
3	Sheave Pin	1	
4	Sheave	2	
5	Hook	1	
6	Hook Nut	1	
7	Sheave Collar	2	3L
8	Weight	1	
9	Wire Rope Latch	1	
10	Wire Rope Latch Spring	1	
11	Pin	1	
12	Thrust Bearing	1	#51206
13	Thrust Bearing	1	5 X 45L
14	Cotter Pin	1	2X12L (Plating)
15	Bolt	3	M8X15L (Plating) 10.9t
16	Plane Washer	1	M6 (Plating)
17	Spring Washer	3	M8 (Plating)

13.1 HOOK BLOCK INSPECTION

The hook block is one of the important maintenance parts. Check by the following procedure and be sure to always use under safe condition.

Repair or replace immediately whenever any defect is found as result of the inspection.

Replacement requires a modification inspection prior.

1. The sheave grooves should be smooth and slick so that the wire ropes will not be damaged.

If any sharp edge exists, repair using a grinder or similar tool.

2. Check whether the sheave rotates without resistance.

If the resistance is large, the wire ropes will slip around the sheave and may suffer damage.

Check each of the sheave bearings, and replace the ones that are disturbing smooth rotation.

3. Check the sheave mounting bolt and make sure that the mounting is secure and that no damage exists.

Retighten if loose. Replace if damaged.

4. Check the hook nut and make sure that the mounting is secure and that no damage exists.

Retighten if loose. Replace if the hook nut is worn or damaged.

5. Check that the wire rope latch works properly.

If the work is not proper, replace or repair.

6. Check for cracks and other flaws of the hook by "magnetic flaw detection" at least once a year.

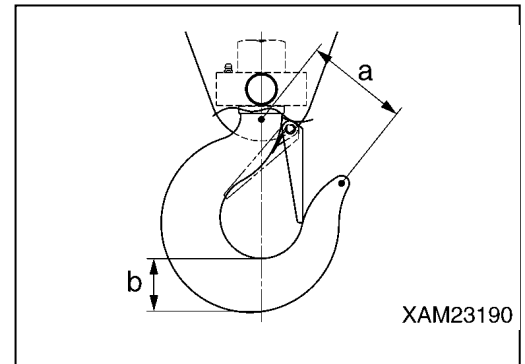
Replace immediately whenever a crack is found.

7. Two "punch marks" are punched on the hook. Measure the dimension between the punch marks of the hook.

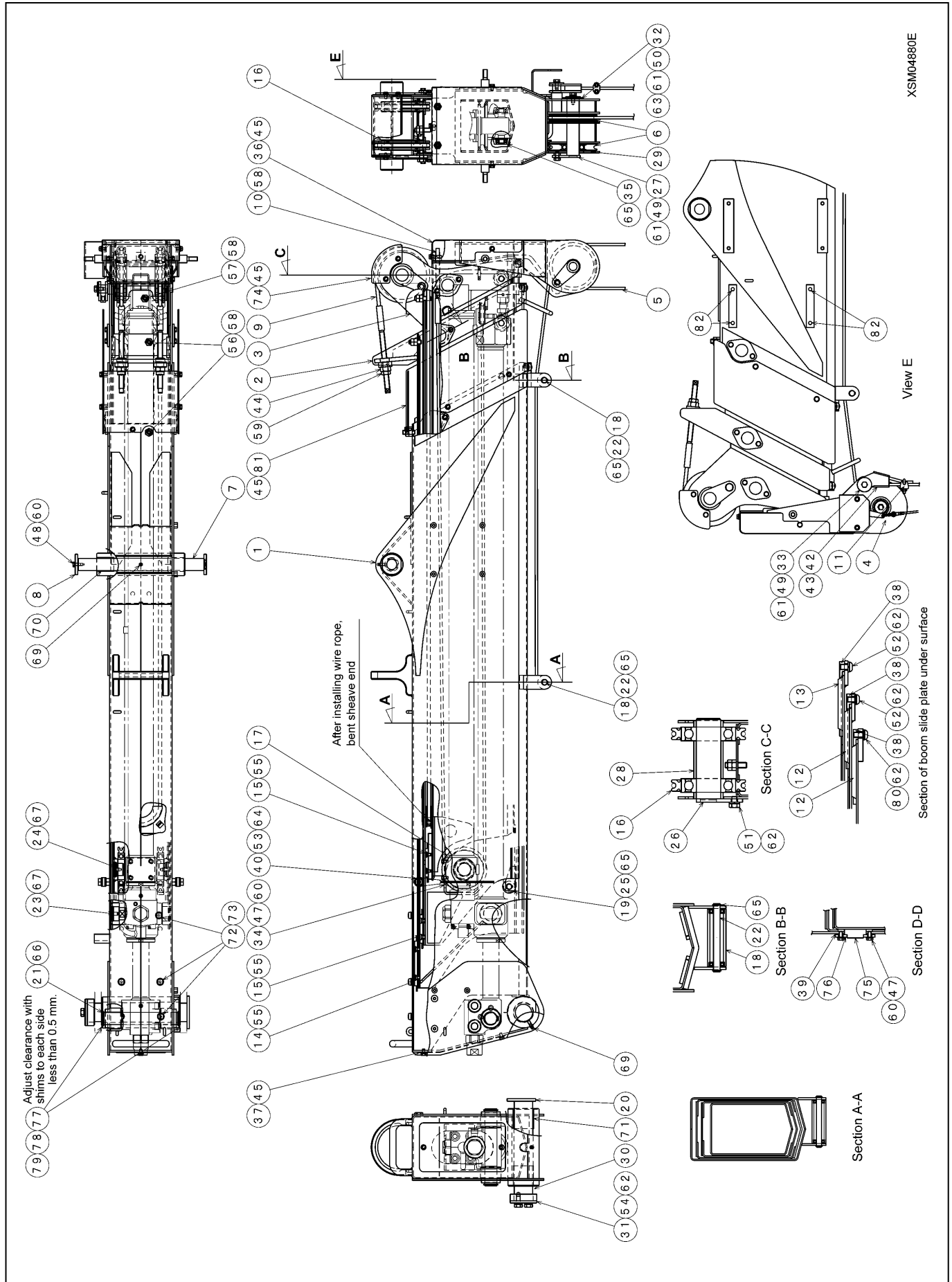
If the measurement result indicated this dimension increased 2% or more from the original dimension (dimension **a**), replace the hook.

In addition, measure the dimension of the rope hanging part of the hook to decide the local abrasion of the hook.

If the measurement result indicated this dimension decreased 3% or more from the original dimension (dimension **b**), replace the hook.



14. BOOM SYSTEM



NO.	DESCRIPTION	QTY	NOTICE
1	No.1 Boom	1	
2	No.2 Boom	1	
3	No.3 Boom	1	
4	No.4 Boom	1	
5	Wire Rope	1	
6	Sheave	2	
7	Derricking Cylinder Pin	1	
8	End Plate	1	
9	Wire Rope (For Boom Extending)	1	
10	Wire Rope (For Boom Retracting)	1	
11	Wire Clip Assembly	1	
12	Slide Plate (Boom Bottom)	4	
13	Slide Plate (BD3 Bottom)	2	
14	Slide Plate (BD2 Upper)	2	
15	Slide Plate (BD3 Upper)	4	
16	Sheave (For Boom Extending)	2	
17	Sheave (For Boom Retracting)	2	
18	Idler Assembly	2	
19	Telescopic Guide Roller	1	
20	Foot Pin	1	
21	Telescoping Cylinder Head Pin	1	
22	Idler Shaft	2	
23	Telescoping Cylinder Trunnion Pin	2	
24	No.3 Trunnion Pin	2	
25	Telescopic Guide Roller Pin	1	
26	Sheave Pin (For Boom Extending)	1	
27	Point Pin	1	
28	Sheave Collar (For Boom Extending)	1	
29	Collar	4	3L
30	Spacer	1	
31	End Plate	1	
32	End Plate	1	
33	End Plate	1	
34	Wire Guard	1	
35	TD Guide Roller Assembly	4	
36	Boom Head Cover	1	
37	Boom Tail Cover	1	
38	Side Stopper Plate	6	
39	Side Stopper Plate Shim	36	
40	Arrow	2	
41	Skipped No.		
42	Wedge Socket	1	
43	Wedge	1	
44	Spherical Nut	2	
45	Bolt	9	M6X1.0X10L (Plating) 10.9T With Washer
46	Skipped No.		
47	Bolt	16	M6X1.0X12L (Plating) 4.6T
48	Bolt	2	M6X1.0X15L (Plating) 10.9T
49	Bolt	2	M8X1.25X15L (Plating) 12.9T
50	Bolt	1	M8X1.25X15L (Plating) 8.8T

NO.	DESCRIPTION	QTY	NOTICE
51	Bolt	1	M10X1.5X14L (Plating) 10.9T
52	Button Bolt (With Hex. Hole)	8	M10X1.5X16L (Plating) 8.8T
53	Bolt	2	M10X1.5X20L (Plating) 8.8T
54	Bolt	2	M10X1.5X20L (Plating) 10.9T
55	Flat Head Bolt (With Hex. Hole)	12	M6X1.0X10L
56	Socket Head Screw	2	M10X1.5X30L
57	Socket Head Screw	1	M10X1.5X40L
58	Nut	7	M10X1.5 (Plating)
59	Nut	2	M12X1.75 (Plating)
60	Spring Washer	18	M6 (Plating)
61	Spring Washer	3	M8 (Plating)
62	Spring Washer	15	M10 (Plating)
63	Plane Washer	1	M8 (Plating)
64	Plane Washer	4	M10 (Plating)
65	Snap Ring	10	For Shaft C-12
66	Snap Ring	2	For Shaft C-30
67	Snap Ring	4	For Hole C-35
68	Skipped No.		
69	Grease Nipple	2	A-M6F
70	DU Bushing	2	M83040DU
71	DU Bushing	2	M84550DU
72	Screw	6	M5X0.8X7L
73	Plate Nut (Square)	6	M5 (plating)
74	Sheave Cover	1	
75	Side Plate	6	
76	Side Stopper Plate	6	
77	Shim (0.5t)	2	
78	Shim (1.0t)	2	
79	Shim (1.6t)	2	
80	Button Bolt (With Hex. Hole)	4	M10X1.5X20L (Plating) 10.9T
81	Boom Cover	1	
82	Hole Plug	4	

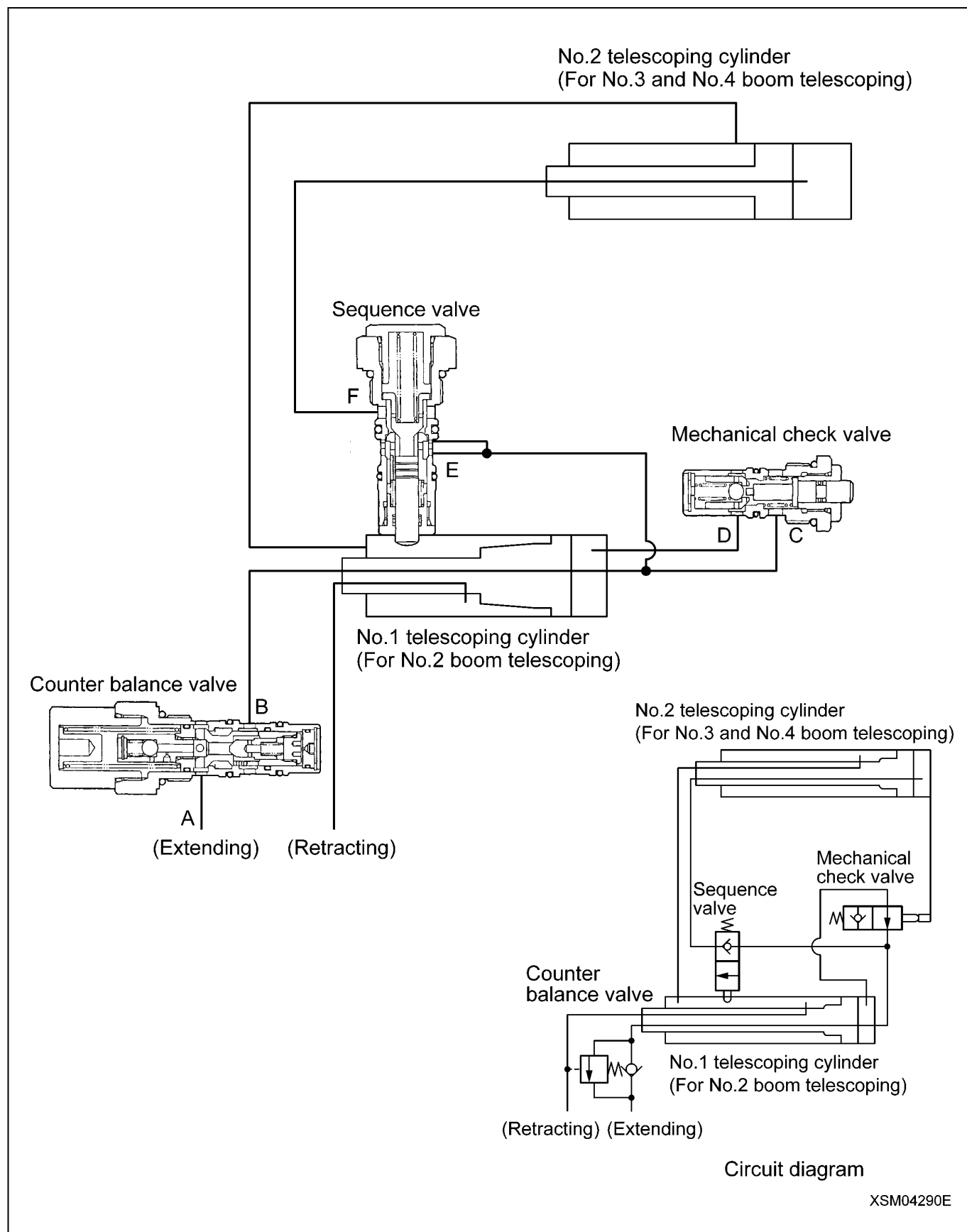
NO.	DESCRIPTION	QTY	NOTICE
1	Cylinder (No.1 Cylinder)	1	
2	Piston Rod (No.1 Cylinder)	1	
3	Cylinder Head (No.1 Cylinder)	1	
4	Bushing (No.1 Cylinder)	1	LFB-4020
5	Stopper (No.1 Cylinder)	1	
6	Rod Packing (No.1 Cylinder)	1	
7	Dust Seal (No.1 Cylinder)	1	
8	O-RING (No.1 Cylinder)	1	1B-P50A
9	Piston (No.1 Cylinder)	1	
10	Sleeve (No.1 Cylinder)	1	
11	Piston Packing (No.1 Cylinder)	2	
12	O-RING (No.1 Cylinder)	1	1B-P24
13	Back-up Ring (No.1 Cylinder)	2	T3-P24
14	O-RING (No.1 Cylinder)	2	1B-P16
15	Back-up Ring (No.1 Cylinder)	2	T2-P16
16	Bushing (No.1 Cylinder)	1	LFB-1610
17	Dog (No.1 Cylinder)	1	
18	Set Screw (No.1 Cylinder)	1	M6X6L Tightening Torque: 9.8 N•m
19	Pipe (No.1 Cylinder)	1	
20	Stopper (No.1 Cylinder)	1	
21	Plug (No.1 Cylinder)	1	Tightening Torque: 68.6 to 78.5 N•m
22	O-RING (No.1 Cylinder)	1	1B-P20
23	Sheave Assembly (No.1 Cylinder)	1	
24	Socket Head Bolt (No.1 Cylinder)	4	M10X18L Tightening Torque: 53.9 N•m (Coat the LOCKTIGHT #262)
25	Slide Plate (No.1 Cylinder)	1	
26	Screw (No.1 Cylinder)	2	M6X6L Tightening Torque: 9.8 N•m (Coat the LOCKTIGHT #262)
27	Plug (For shipping) (No.1 Cylinder)	5	R1/8 Tightening Torque: 9.8 N•m
28	Plug (For shipping) (No.1 Cylinder)	3	R1/4 Tightening Torque: 919.6 N•m
29	Cylinder (No.2 Cylinder)	1	
30	Piston Rod (No.2 Cylinder)	1	
31	Cylinder Head (No.2 Cylinder)	1	
32	Bushing (No.2 Cylinder)	1	LFB-4020
33	Stopper (No.2 Cylinder)	1	
34	Rod Packing (No.2 Cylinder)	1	
35	Dust Seal (No.2 Cylinder)	1	
36	O-RING (No.2 Cylinder)	1	1B-P50A
37	Piston (No.2 Cylinder)	1	Tightening Torque: 470.7 N•m締
38	Sleeve (No.2 Cylinder)	1	
39	Piston Packing (No.2 Cylinder)	2	
40	O-RING (No.2 Cylinder)	1	1B-P16
41	Back-up Ring (No.1 Cylinder)	2	T2-P16
42	Cushion Ring (No.2 Cylinder)	1	
43	Snap Ring (No.2 Cylinder)	1	
44	Cushion Bearing (No.2 Cylinder)	1	Tightening Torque: 215.8 N•m
45	O-RING (No.2 Cylinder)	1	1B-P16
46	Set Screw (No.2 Cylinder)	1	Tightening Torque: 68.6 to 78.5 N•m
47	Slide Plate (No.2 Cylinder)	1	
48	Screw (No.2 Cylinder)	2	M6X14L Tightening Torque: 9.8 N•m (Coat the LOCKTIGHT #262)
49	Bolt (No.2 Cylinder)	1	M16X50L
50	Nut (No.2 Cylinder)	1	M16 Tightening Torque: 117.6 N•m (Coat the LOCKTIGHT #262)

NO.	DESCRIPTION	QTY	NOTICE
51	Set Screw (No.2 Cylinder)	1	M6X6L Tightening Torque: 9.8 N•m (Coat the LOCKTIGHT #262)
52	O-RING (No.1 Cylinder)	2	1B-P12
53	Socket Head Bolt	4	M12X75L Tightening Torque: 107.9 N•m
54	Counter Balance Valve	1	Part No.: 300S09200000 Tightening Torque: 88.2 to 98.1 N•m
55	Sequence Valve	1	Part No.: 300S09000000 Tightening Torque: 98.1 to 117.6 N•m
56	Mechanical Check Valve	1	Part No.: 300S09100000 Tightening Torque: 68.6 to 78.5 N•m

No.1 Telescoping Cylinder Specifications		
Cylinder Bore x Rod O.D. - Stroke		55 mm X 40mm – 1262 mm
Normal Load	When extending	48.9 kN (At 20.6 MPa) [4.9 ton (At 210 kgf/cm ²)]
	When retracting	23.1 kN (At 20.6 MPa) [2.3 ton (At 210 kgf/cm ²)]
Test Pressure	When extending	30.9 MPa (315 kgf/cm ²)
	When retracting	30.9 MPa (315 kgf/cm ²)
No.2 Telescoping Cylinder Specifications		
Cylinder Bore x Rod O.D. - Stroke		φ 55×φ 40-1240
Normal Load	When extending	48.9 kN (At 20.6 MPa) [4.9 ton (At 210 kgf/cm ²)]
	When retracting	23.1 kN (At 20.6 MPa) [2.3 ton (At 210 kgf/cm ²)]
Test Pressure	When extending	30.9 MPa (315 kgf/cm ²)
	When retracting	30.9 MPa (315 kgf/cm ²)

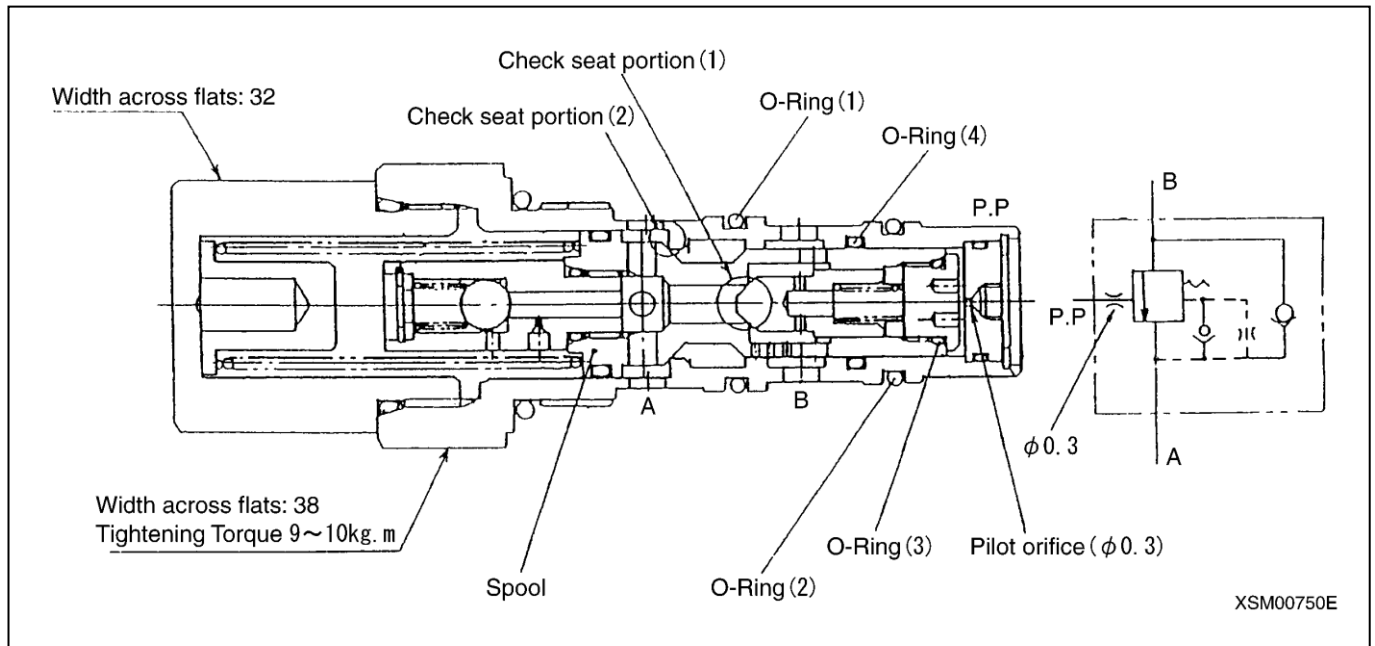
Natural retracting range of cylinder (leaking quantity of inner oil) (Notice: Change in temperature makes heat expansion of oil and it will probably cause retracting range of cylinder. Keep the regular temperature.)				
Section		Max. leaking quantity of inner oil (cc/min)	Square measure of bore (cm ²)	Shrinking range of cylinder (cm/day)
No.1 Telescoping cylinder		0.14	23.8	8.5
No.2 Telescoping cylinder		0.14	23.8	8.5
Counter Balance Valve	No.1 Cylinder	0.05	23.8	1.0
	No.2 Cylinder		23.8	1.0
			Total	19.0

15.2 TELESCOPING CYLINDER HYDRAULIC CIRCUIT SYSTEM



15.3 COUNTER BALANCE VALVE

(FOR TELESCOPING AND DERRICKING CYLINDER)



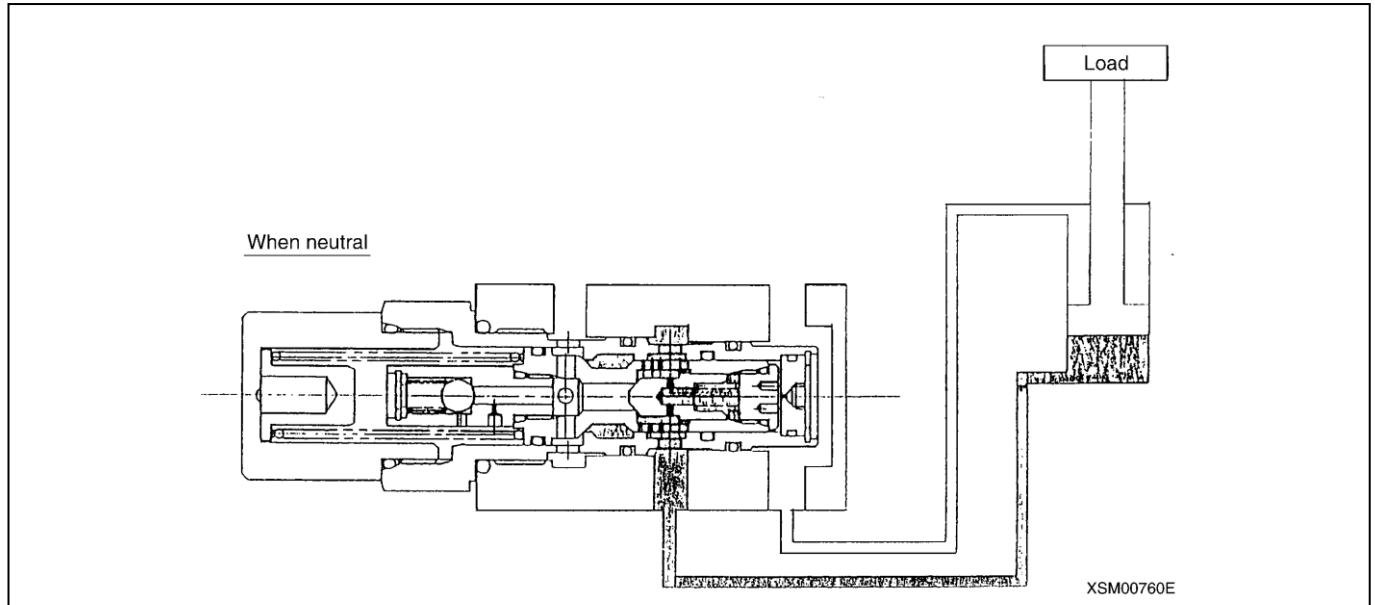
Specifications	
Max. Common Use Pressure	20.6 MPa (210 kgf/cm ²)
Resiting Pressure	30.9 MPa (315 kgf/cm ²)
Max. Flow Capacity	50 L/min
Rated Flow Capacity	40 L/min
Allowable Leakage Capacity	Less than 0.05 L/min (Apply 20.6 MPa [210 kgf/cm ²] From Port B)
Pilot Pressure	1.18 ^{+0.3} MPa (12 ⁺³ kgf/cm ²) At Valve Opened
Spool Choke Area	2.6 O.D. (At Spool Stroked)
Check Valve Cracking Pressure	0.098 MPa (1 kgf/cm ²)
Operating Temperature Range	-10 to +80 °C

15.3.1 TROUBLE SHOOTING

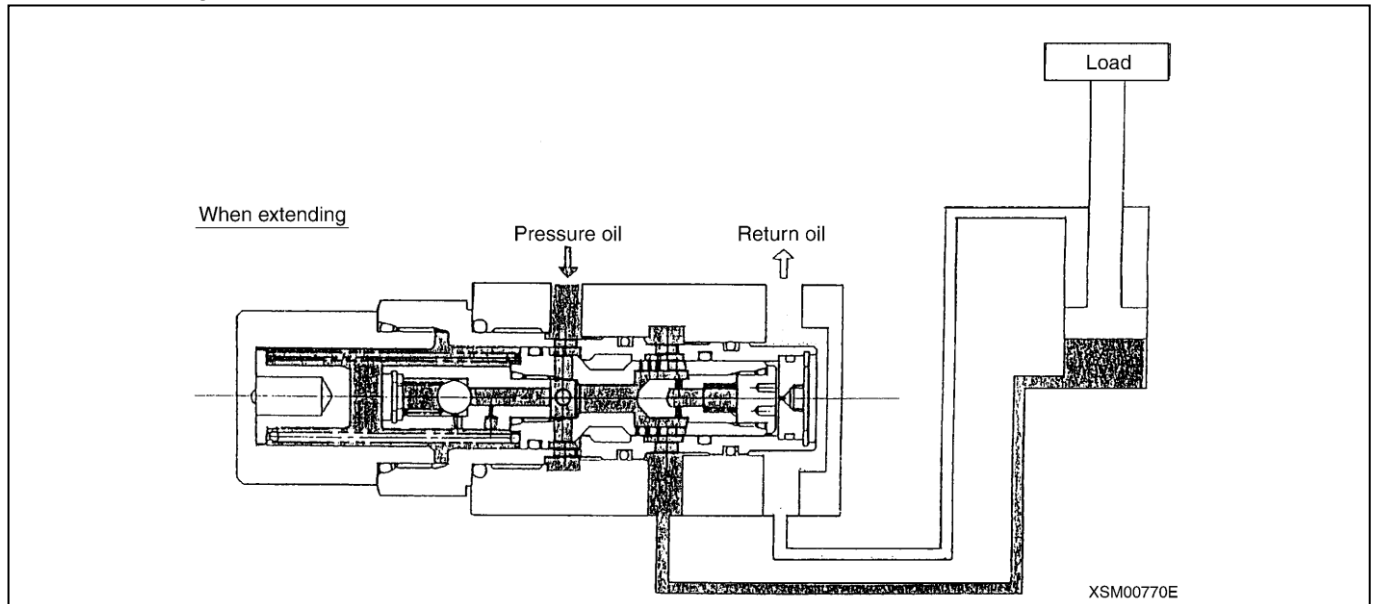
Disorders	Cause	Counter-action
Telescoping/Derricking Cylinders retract while hoisting operation. (Boom lowered)	- Failure of check seat area (1) and (2), or inclusion of foreign matters. - Damage to O-ring (1), (2), (3) or (4). - Pilot Hole (0.3) clogging which causes spool does not return, and then check seat (2) stays open.	- Clear of foreign matters - Replace O-rings - Clear pilot hole clogging.
Telescoping/Derricking Cylinders do not retract (Boom is not lowered), or retract too quickly.	Pilot hole (0.3) clogging	Clear pilot hole clogging.

15.3.2 FUNCTION

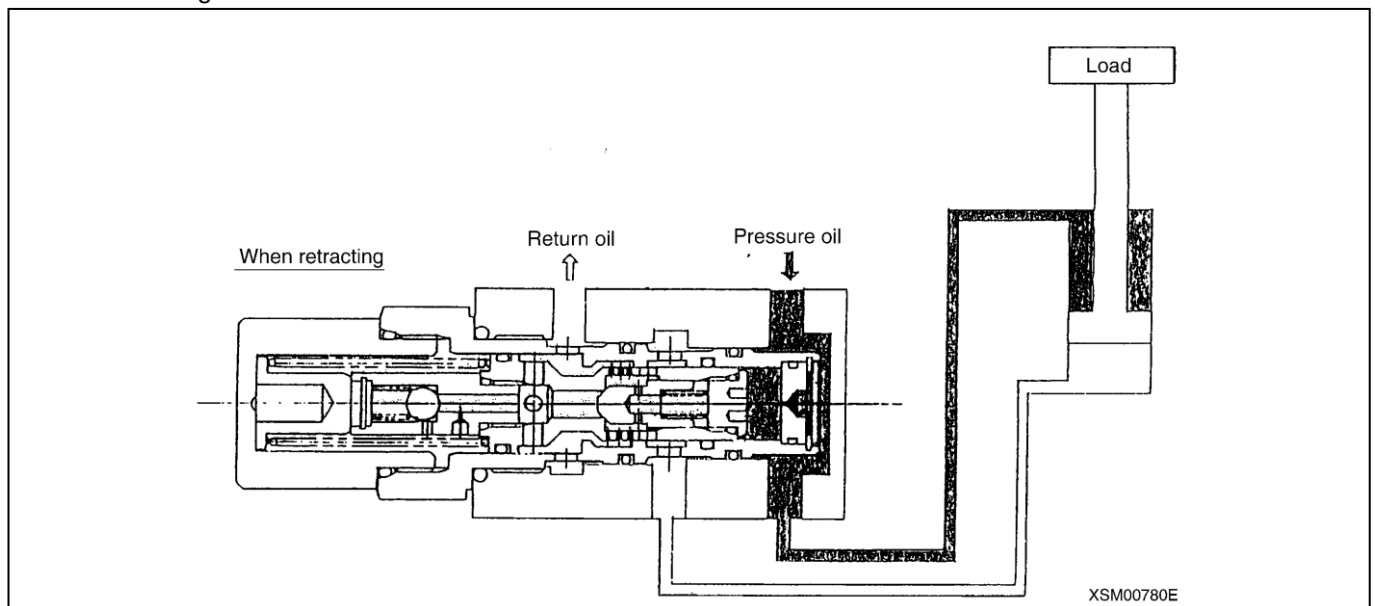
1. When Neutral



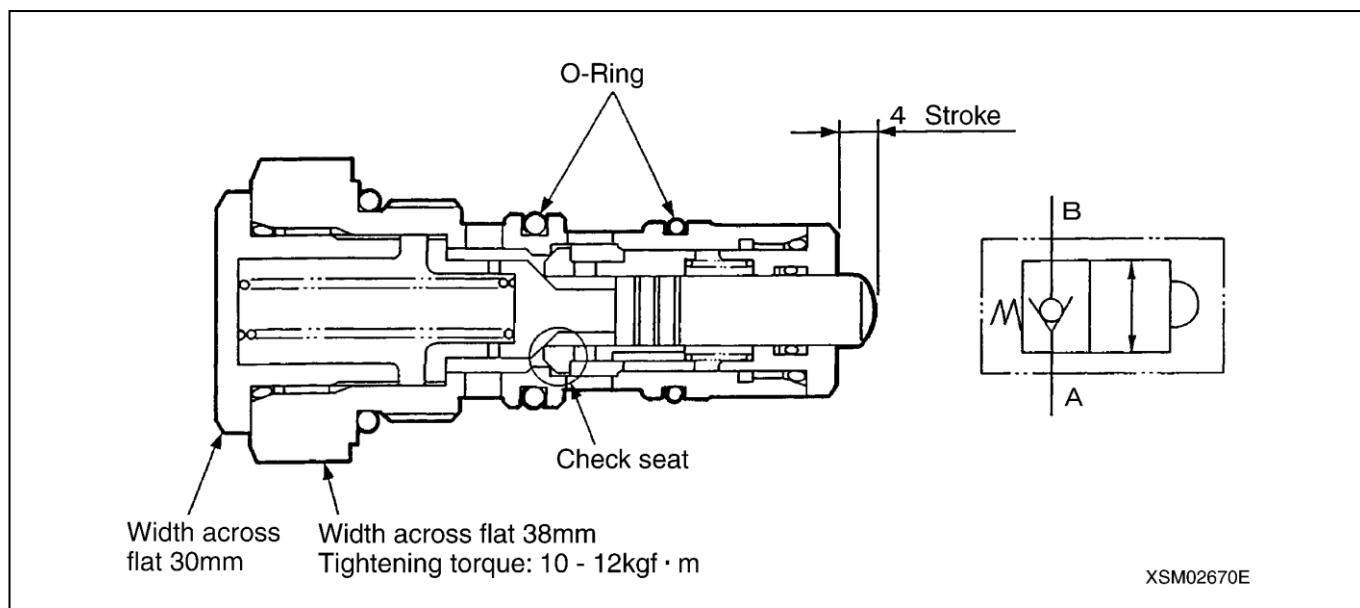
2. When Extending



3. When Retracting



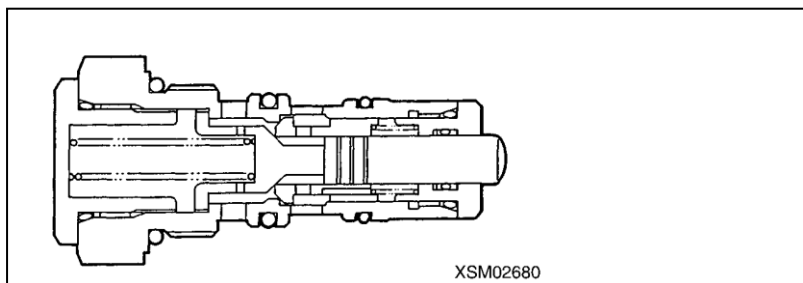
15.4 SEQUENCE VALVE (FOR TELESCOPING CYLINDER)



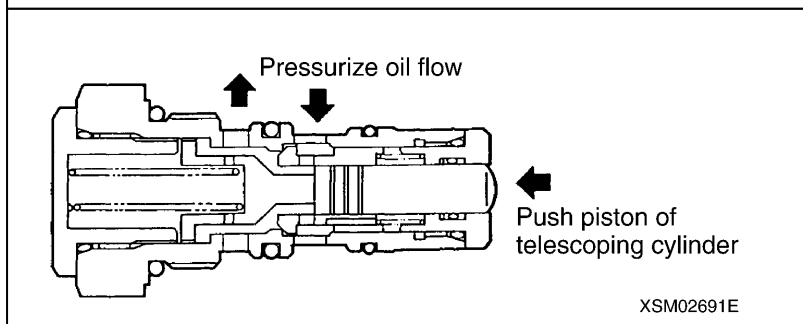
Specifications	
Rated Flow Capacity	40 L/min
Allowable Leakage Capacity	Less than 0.05 cc/min [Apply 20.6 MPa (210 kgf/cm ²) From Port B]
Pilot Pressure	1.18 ^{+0.3} MPa (12 ⁺³ kgf/cm ²) At Valve Opened
Check Valve Cracking Pressure	2.45 MPa (25 kgf/cm ²)
Operating Force	0.65 x Pressure + 20 kg

15.4.1 FUNCTION

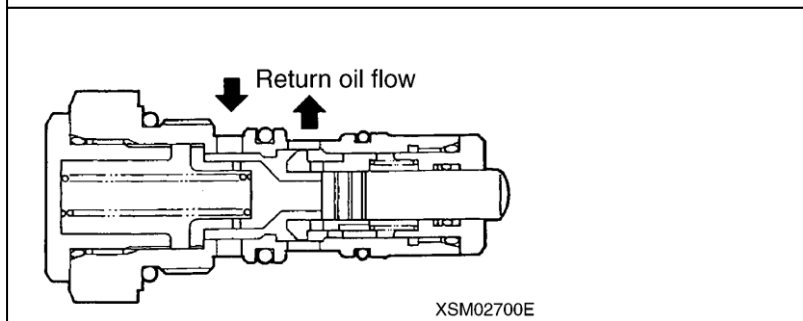
1. When Neutral



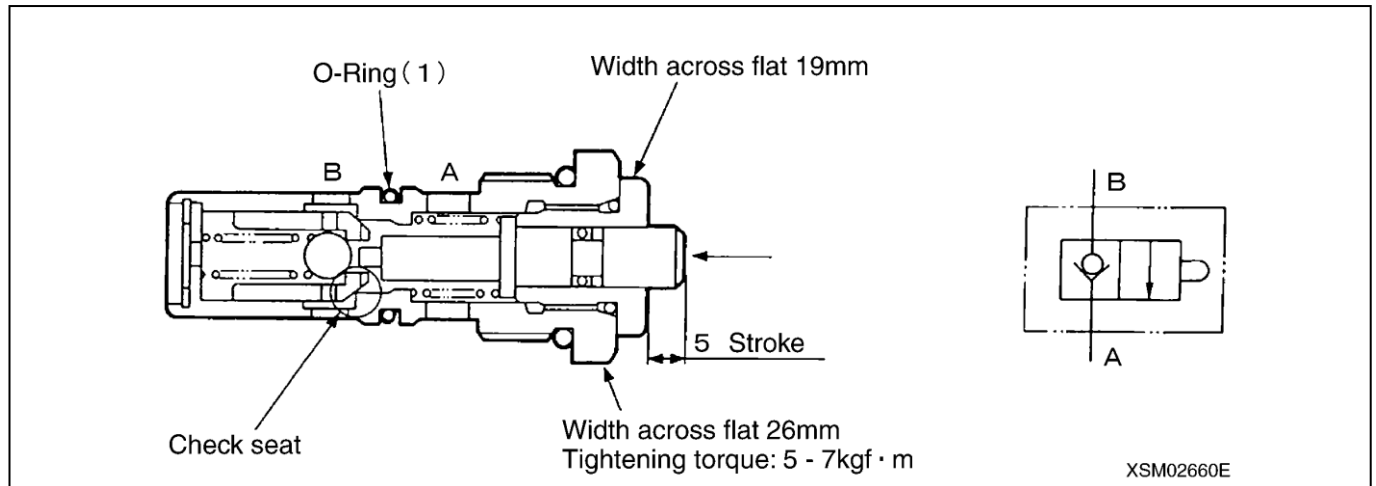
2. When Sequence Valve Operation



3. When Check Valve Operation

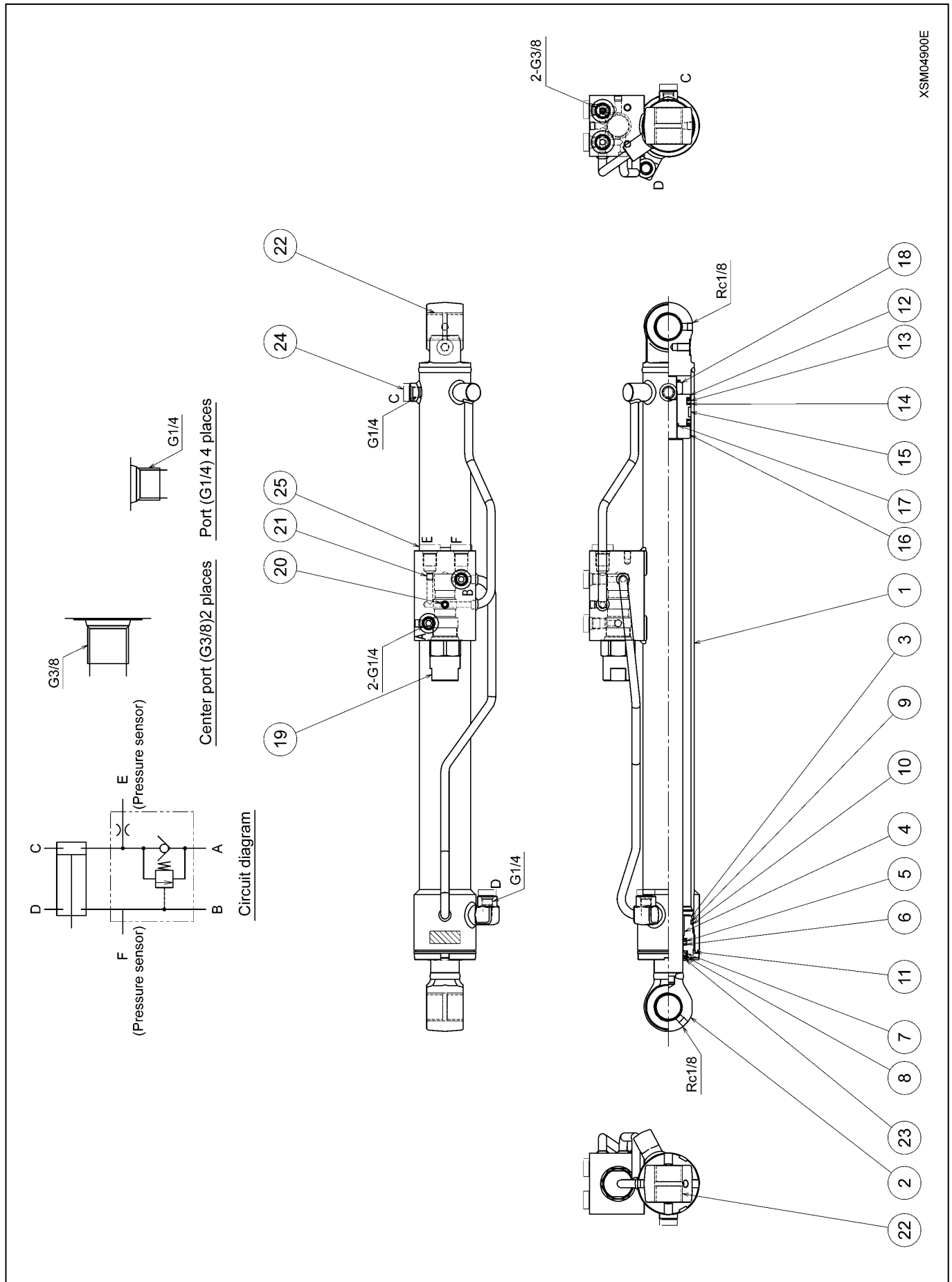


15.5 MECHANICAL CHECK VALVE (FOR TELESCOPING CYLINDER)



Specifications	
Rated Flow Capacity	50 L/min
Pilot Pressure	$1.18^{+0.3}$ MPa (12^{+3} kgf/cm ²) At Valve Opened
Pressure Loss (B to A)	Less than 9.8 MPa (100 kgf/cm ²)
Check Valve Cracking Pressure	0.098 MPa (1 kgf/cm ²)

15.6 LEFT SIDE DERRICKING CYLINDER

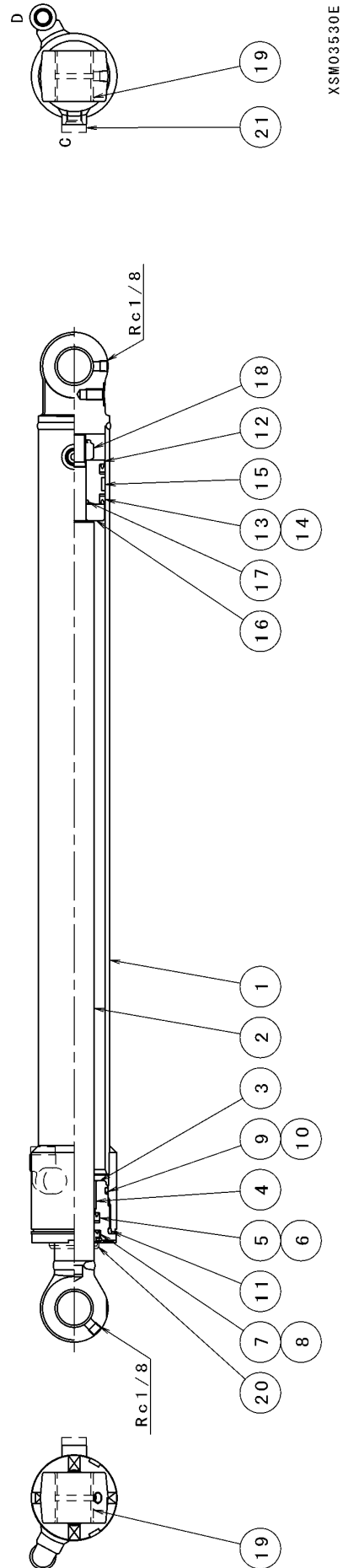
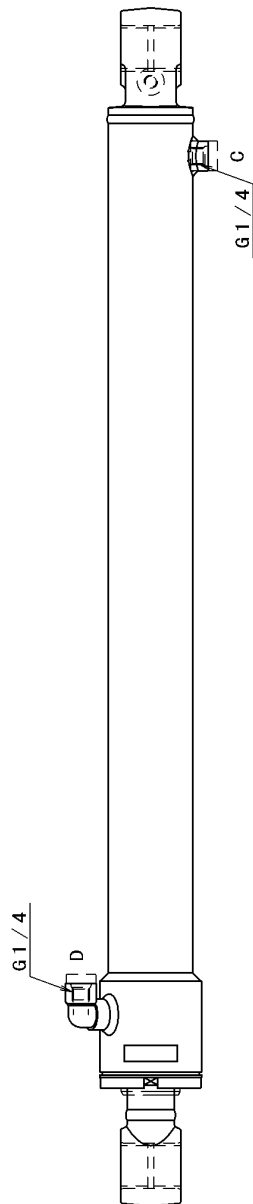
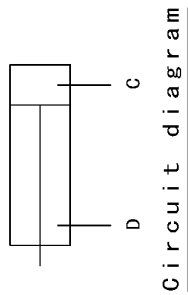
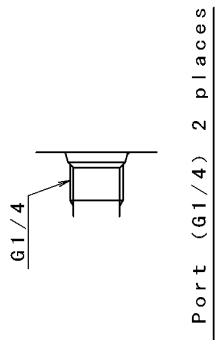


NO.	DESCRIPTION	QTY	NOTICE
1	Cylinder	1	
2	Piston Rod	1	
3	Cylinder Head	1	
4	Bushing	1	LFB-3525
5	Rod Packing	1	GNV-35
6	Back-up Ring	1	35,45,1.5
7	Dust Seal	1	SCB-35
8	Snap Ring	1	AR48
9	O-RING	1	1B-G55
10	Back-up Ring	1	T3-G55
11	O-RING	1	1B-G60
12	Piston	1	
13	Piston Ring	2	GPY-55
14	Back-up Ring	2	45,55,1.5
15	Wear Ring	1	55,49,12
16	U-ring Holder	1	
17	O-RING	1	1B-P21
18	U-nut	1	M20X1.5
19	Counter Balance Valve	1	Parts No.: 300S09200000
20	Bushing	2	
21	Orifice	1	
22	Bushing	4	K5B3020
23	Cap	1	
24	Plug (For shipping)	4	R1/4
25	Plug (For shipping)	2	R3/8

Specifications		
Cylinder Bore x Rod O.D. - Stroke		55 mm X 35 mm – 585mm
Normal Load	When extending	48.9 kN (At 20.6 MPa) [4.9 ton (At 210 kgf/cm ²)]
	When retracting	29.1 kN (At 20.6 MPa) [2.9 ton (At 210 kgf/cm ²)]
Test Pressure	When extending	30.9 MPa (315 kgf/cm ²)
	When retracting	30.9 MPa (315 kgf/cm ²)

Natural retracting range of cylinder (leaking quantity of inner oil) (Notice: Change in temperature makes heat expansion of oil and it will probably cause retracting range of cylinder. Keep the regular temperature.)			
Section	Max. leaking quantity of inner oil (cc/min)	Square measure of bore (cm ²)	Shrinking range of cylinder (cm/day)
Derricking Cylinder	0.40	50.3	11.5
Counter Balance Valve	0.05		1.4
		Total	12.9

15.7 RIGHT SIDE DERRICKING CYLINDER



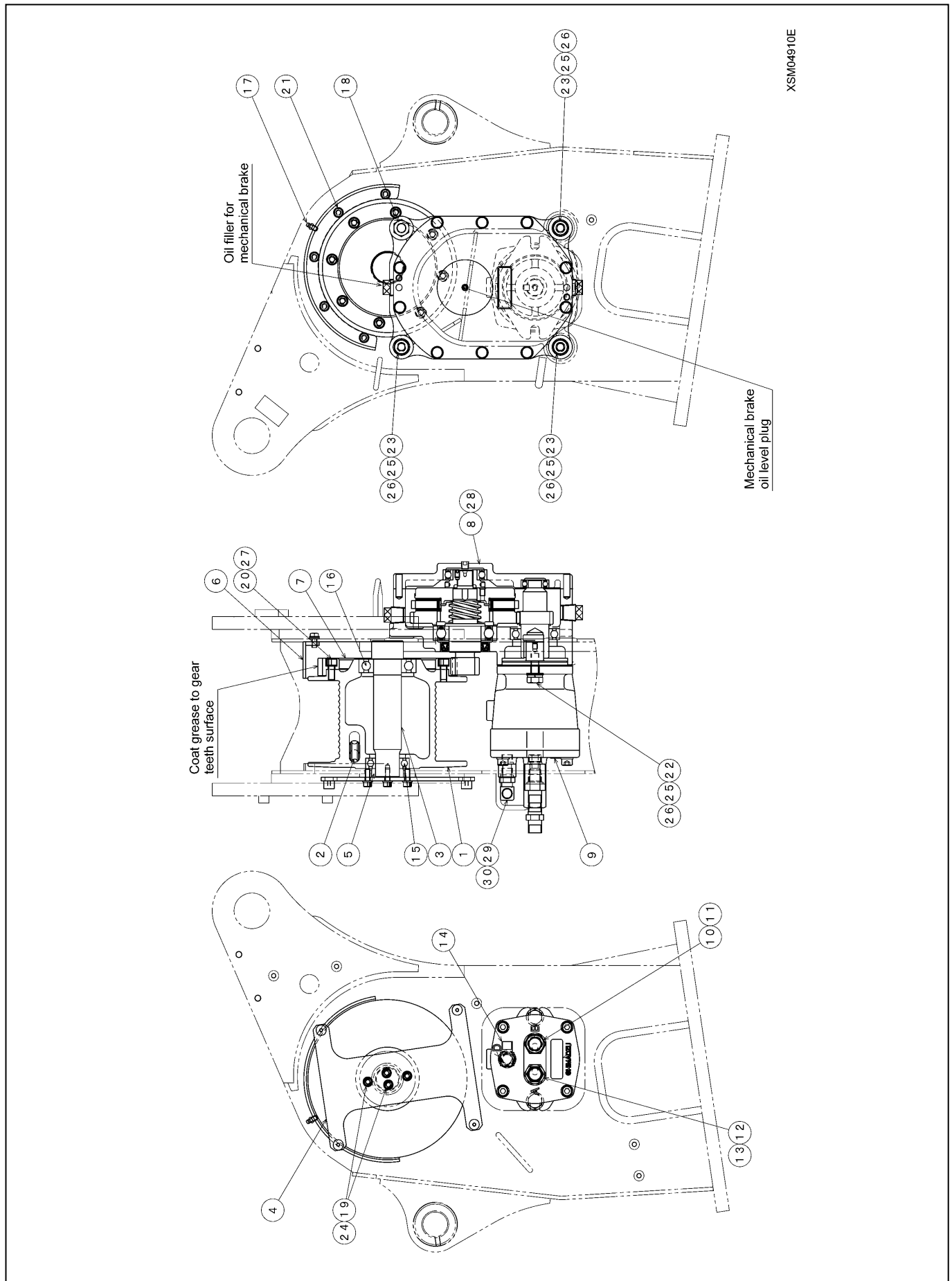
NO.	DESCRIPTION	QTY	NOTICE
1	Cylinder	1	
2	Piston Rod	1	
3	Cylinder Head	1	
4	Bushing	1	LFB-3525
5	Rod Packing	1	GNV-35
6	Back-up Ring	1	35,45,1.5
7	Dust Seal	1	SCB-35
8	Snap Ring	1	AR48
9	O-RING	1	1B-G55
10	Back-up Ring	1	T3-G55
11	O-RING	1	1B-G60
12	Piston	1	
13	Piston Ring	2	GPY-55
14	Back-up Ring	2	45,55,1.5
15	Wear Ring	1	55,49,12
16	U-ring Holder	1	
17	O-RING	1	1B-P21
18	U-nut	1	M20X1.5
19	Bushing	4	K5B3020
20	Cap	1	
21	Plug (For shipping)	2	R1/4

Specifications		
Cylinder Bore x Rod O.D. - Stroke		55 mm X 35 mm – 585mm
Normal Load	When extending	48.9 kN (At 20.6 MPa) [4.9 ton (At 210 kgf/cm ²)]
	When retracting	29.1 kN (At 20.6 MPa) [2.9 ton (At 210 kgf/cm ²)]
Test Pressure	When extending	30.9 MPa (315 kgf/cm ²)
	When retracting	30.9 MPa (315 kgf/cm ²)

Natural retracting range of cylinder (leaking quantity of inner oil) (Notice: Change in temperature makes heat expansion of oil and it will probably cause retracting range of cylinder. Keep the regular temperature.)			
Section	Max. leaking quantity of inner oil (cc/min)	Square measure of bore (cm ²)	Shrinking range of cylinder (cm/day)
Derricking Cylinder	0.40	50.3	11.5
Counter Balance Valve	0.05		1.4
		Total	12.9

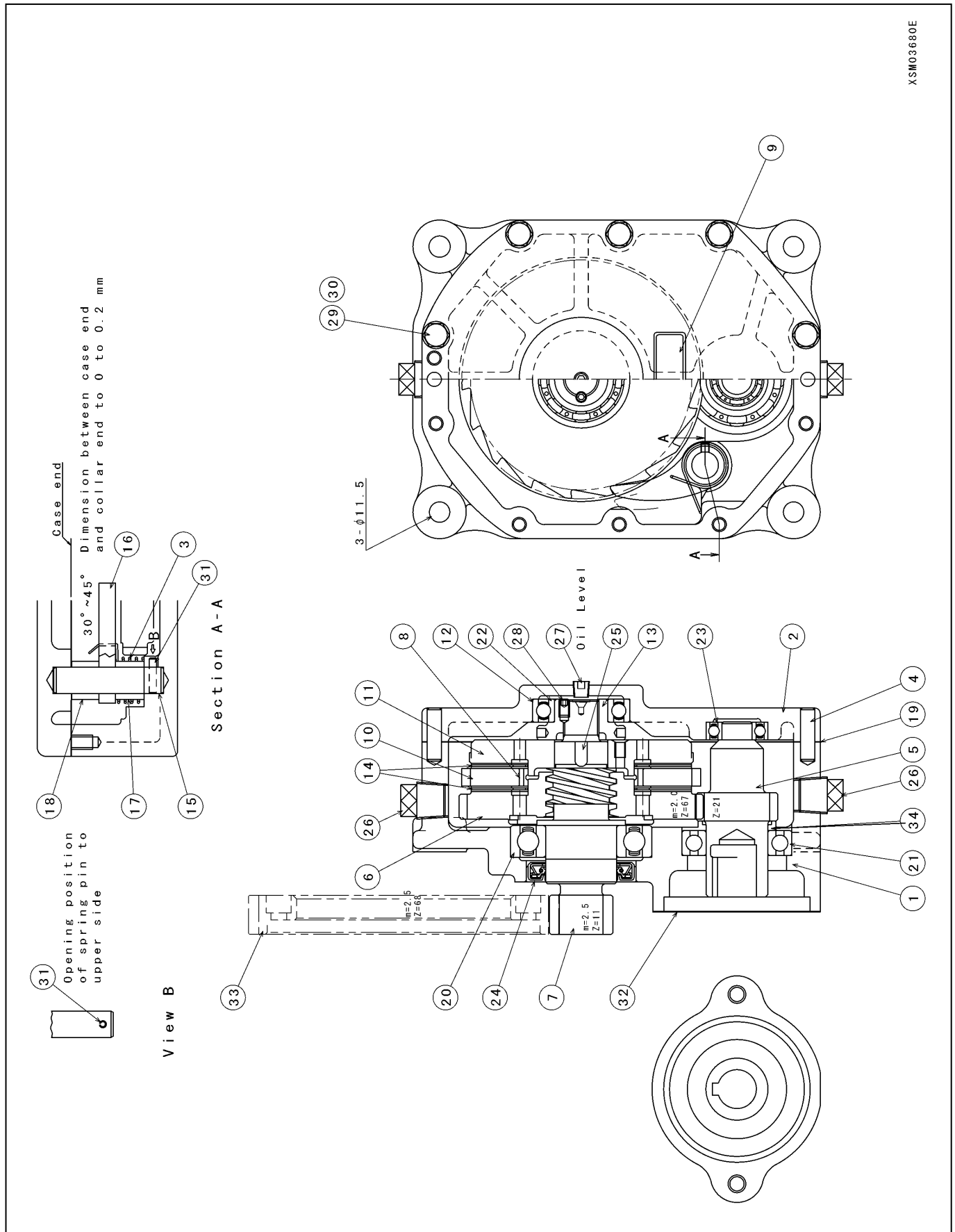
16. WINCH SYSTEM

16.1 EXTERIOR VIEW OF WINCH UNIT



NO.	DESCRIPTION	QTY	NOTICE
1	Drum (With Groove)	1	
2	Wedge	1	
3	Drum Shaft	1	
4	Fixed Plate	1	
5	Staffing	1	
6	Winch Gear Cover	1	
7	Gear (BY20)	1	
8	Mechanical Brake	1	
9	Hydraulic Motor	1	
10	Connector	1	PT3/8 Tightening Torque: 49 to 78 N•m
11	Connector	1	
12	Adapter (With Check)	1	Tightening Torque: 49 to 78 N•m
13	Connector	1	
14	Elbow	1	
15	Bearing	1	#6006ZZ
16	Bearing	1	#6207ZZ
17	Grease Nipple	1	A-M6F
18	Reamer Bolt	1	M12X39L Tightening Torque: 42.6 to 56.4 N•m
19	Socket Head Bolt	4	M6X1.0X16L
20	Socket Head Bolt	8	M8X1.25X18L Tightening Torque: 26.8 to 36.2 N•m
21	Socket Head Bolt	5	M6X1.0X14L (With Plane Washer and Spring Washer) (plating)
22	Bolt	2	M10X1.5X30L (Plating) 10.9T Tightening Torque: 45 to 61 N•m
23	Bolt	3	M10X1.5X35L (Plating) 10.9T Tightening Torque: 45 to 61 N•m
24	Spring Washer	4	M6 (Plating)
25	Spring Washer	5	M10 (Plating)
26	Plane Washer	5	M10 (Plating)
27	Spring Washer	8	M8 (Plating)
28	Lubricating Oil		0.8 Litres NIPPON OIL LIMITED: BONNOC M320
29	Connector	1	
30	Elbow	1	

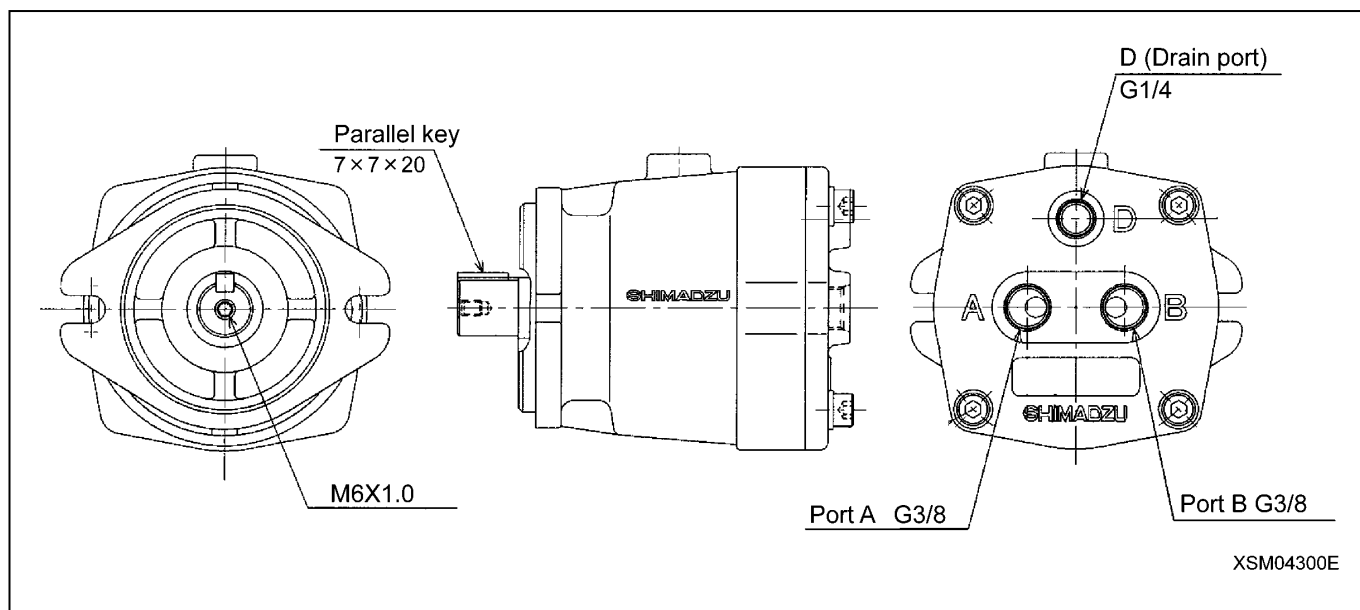
16.2 MECHANICAL BRAKE INNER PARTS AND SPECIFICATIONS



NO.	DESCRIPTION	QTY	NOTICE
1	Case	1	
2	Cover	1	
3	Spring	1	
4	Parallel Pin	1	8x30
5	Gear (1)	1	
6	Gear (2)	1	
7	Gear Shaft	1	
8	Bushing	1	
9	Name Plate	1	
10	Latchet Wheel	1	
11	Brake Disc	1	
12	Shim	AR	
13	Disc Retainer	1	
14	Disc Assembly	2	
15	Shaft	1	
16	Latch	1	
17	Collar	1	
18	Collar	1	
19	Packing	1	
20	Roller Bearing	1	#6208
21	Roller Bearing	1	#6007
22	Roller Bearing	1	#6006
23	Roller Bearing	1	#6003
24	Oil Seal	1	TCN406211
25	Key	2	7X7X14
26	Plug	2	PT1/2
27	Socket Head Plug	1	PT1/8
28	Socket Head Screw	1	M6X1.0X10
29	Bolt	10	M8X1.25X30
30	Spring Washer	10	M8
31	Spring Pin	1	4X20AW
32	Packing	1	
33	Gear (4)	1	
34	Spacer	1	

Specifications	
Max. Hoisting Load	7.7 kN (785 kgf) (At Gear Shaft output)
Use Motor	SHM1.5-15-9413
Lubricating Oil	0.8 litres (NIPPON OIL LIMITED: BONNOC M320)
Reduction Ratio	11/68X21/67=1/19.72
Leakage Test	Not Leakage at apply air pressure 0.15 MPa (1.5kgf/cm ²)
Mass	10.5 kg

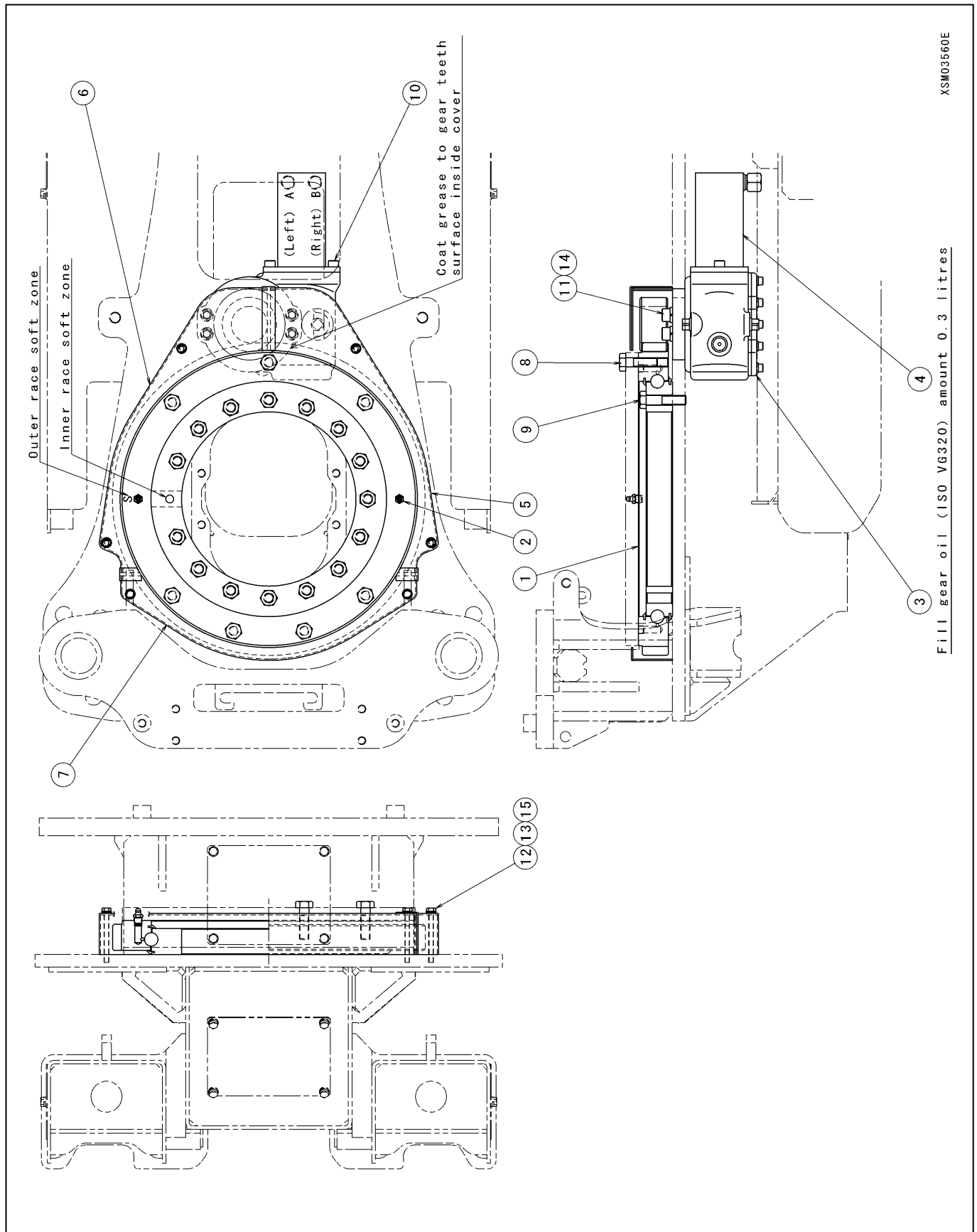
16.3 EXTERIOR VIEW AND SPECIFICATIONS OF WINCH MOTOR



Specifications		
Capacity per Stroke		14.5 cm ³ /rev
Rated Pressure		20.6 MPa (210 kgf/cm ²)
Sage Pressure		24.5 MPa (250 kgf/cm ²)
Max. Output Revolution		3000 min ⁻¹
Drain Circuit Pressure	Common	Less than 0.1 MPa (1 kgf/cm ²)
	Peak	Less than 0.3 MPa (3 kgf/cm ²)
Using Oil	Viscosity	9 to 430 mm ² /s
	Temperature Range	-20 - +80 °C

17. SLEWING SYSTEM

17.1 EXTERIOR VIEW



NO.	DESCRIPTION	Q'TY	NOTICE
1	Slewing Bearing	1	
2	Grease Nipple	2	A-PT1/8
3	Slewing Gear Box Assembly	1	
4	Hydraulic Oil Motor	1	
5	Slewing Gear Cover (A)	1	
6	Slewing Gear Cover (B)	1	
7	Slewing Gear Cover (C)	1	
8	Bolt	7	M12X1.75X40L Tightening Torque: 92.6 to 125.5 N•m (Coat the LOCKTIGHT #262)
9	Bolt	15	M12X1.75X50L Tightening Torque: 92.6 to 125.5 N•m (Coat the LOCKTIGHT #262)
10	Socket Head Bolt	2	M8X1.25X14L
11	Socket Head Bolt	4	M10X1.5X30L Tightening Torque: 53.3 to 72.1 N•m (Coat the LOCKTIGHT #262)
12	Bolt	6	M6X1.0X65L
13	Spring Washer	6	M6 (Plating)
14	Spring Washer	4	M10 (Plating)
15	Plane Washer	6	M6 (Plating)
	Lubricating Oil	0.3	NIPPON OIL EUROPE LIMITED: BONNOC M320 After assembling reduction gear and hydraulic oil motor, refill the lubricating oil into the oil filler to specification amount.

17.1.1 SLEWING BEARING WOBBLE LIMIT TOLERANCE

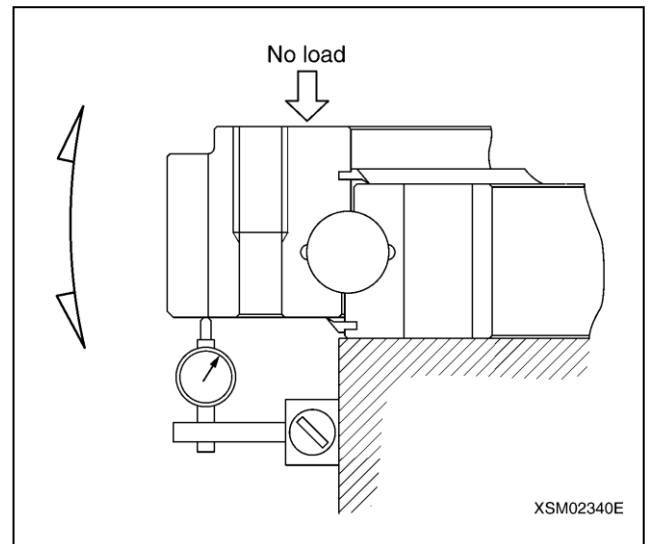
In case the clearance is excessive, when the bearing receives the momentum load, the osculating ellipse that is generated at the contact between the orbit and the steel ball approaches the matching between the inner and outer rings, and in some may cases may leave the orbit and cause a depression or other defect to occur at the end of the orbit.

For your reference, the values based on the contact angle that may cause such phenomenon are shown later.

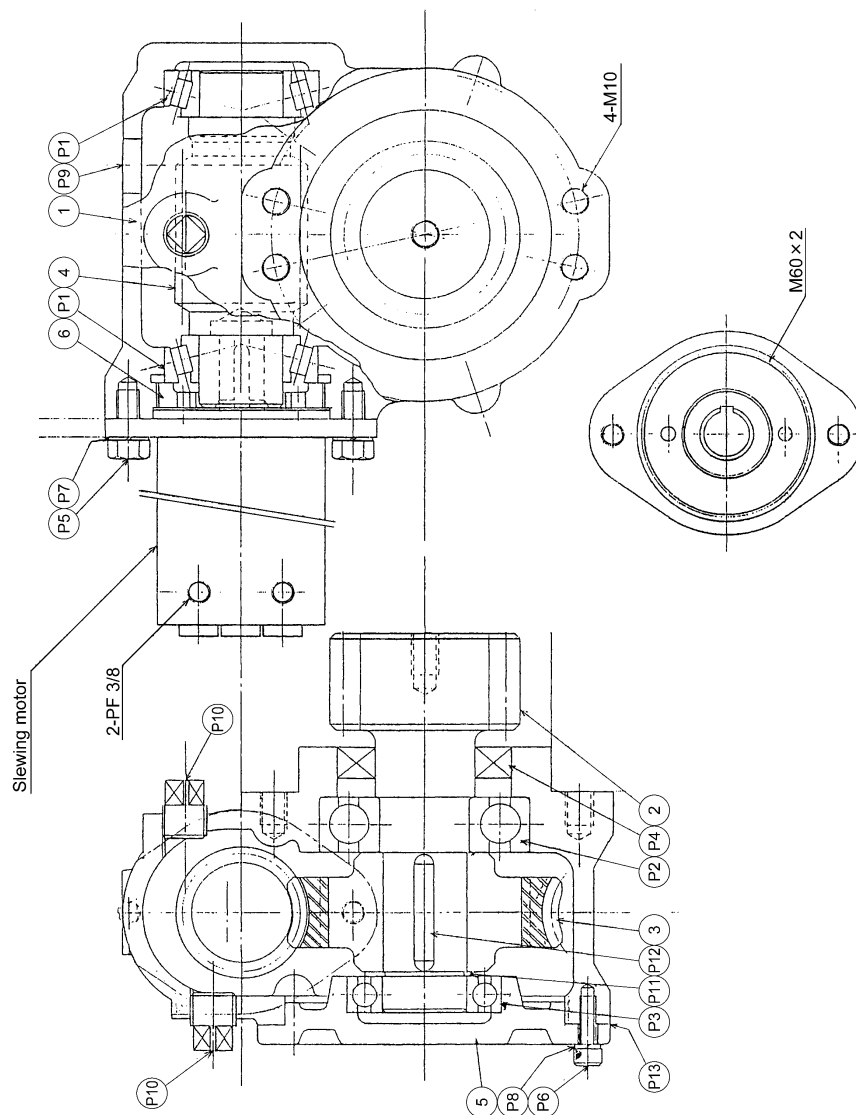
Use this for the reference of the wobble tolerance.

1. Fix the inner ring to a rigid object.
2. Set the dial gauge as shown in the figure.
3. Fluctuate the outer ring. When doing so, use human force only and do not apply any greater force (to prevent elastic deformation of the orbit or steel ball).

Wobble tolerance: No more than "2.62 mm" by gauge reading



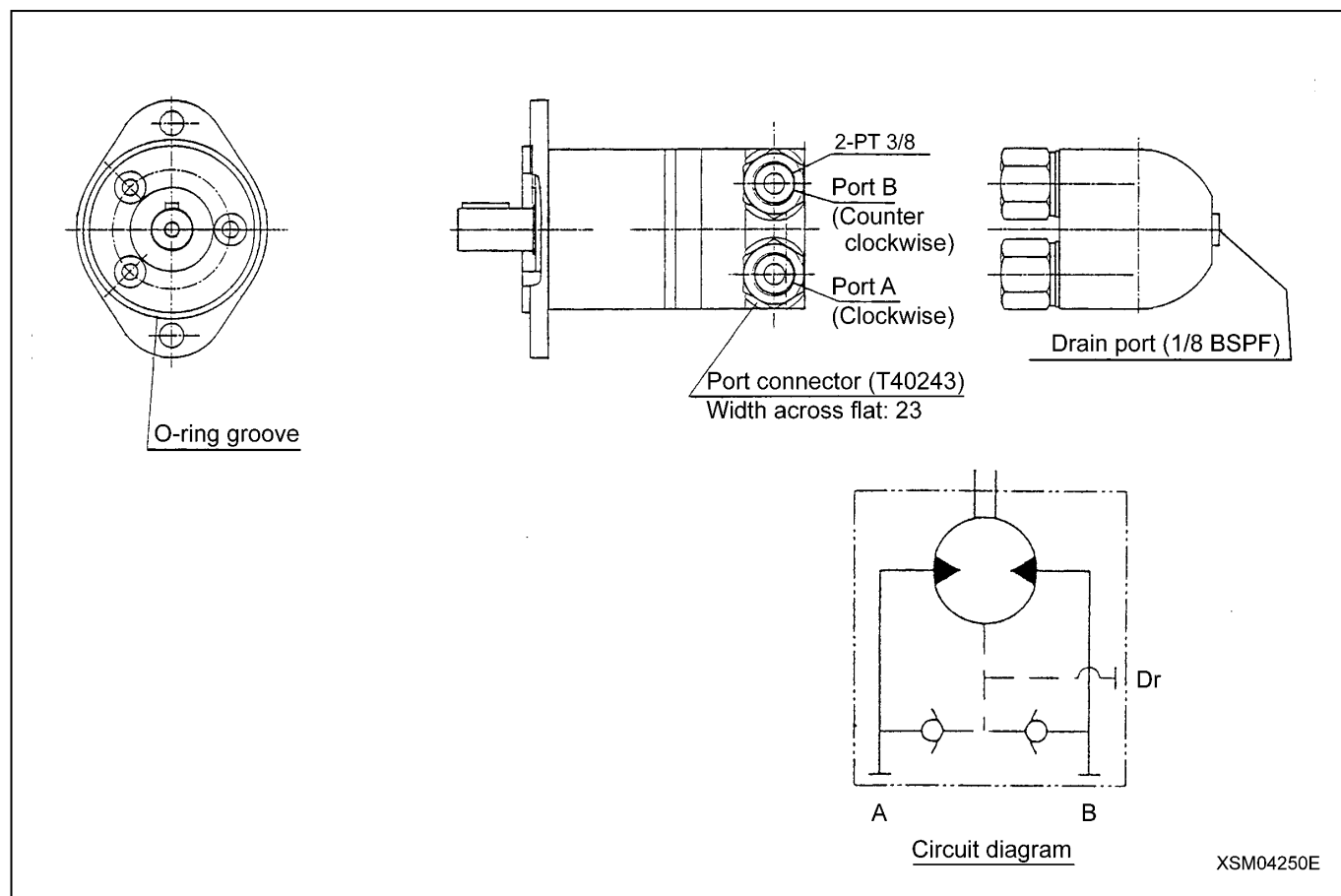
17.2 SLEWING REDUCTION GEAR



XSM04240E

NO.	DESCRIPTION	QTY	NOTICE
1	Gear Box	1	
2	Pinion Shaft	1	
3	Worm wheel	1	
4	Worm Shaft	1	
5	Cover	1	
6	Bearing Retainer	1	
P1	Taper Roller Bearing	2	#32006
P2	Roller Bearing	1	#63132
P3	Roller Bearing	1	#6006
P4	Oil Seal	1	LSRD 406211
P5	Bolt	2	M8X16
P6	Socket Head Bolt	5	M6X16
P7	Spring Washer	2	M8
P8	Spring Washer	5	M6
P9	Oil Gauge	1	D.M. 20 mm
P10	Plug	2	PT3/8
P11	Snap Ring	1	For Shaft C-30
P12	Parallel Key	1	
P13	Packing	1	

17.3 SLEWING MOTOR EXTERIOR VIEW AND SPECIFICATIONS

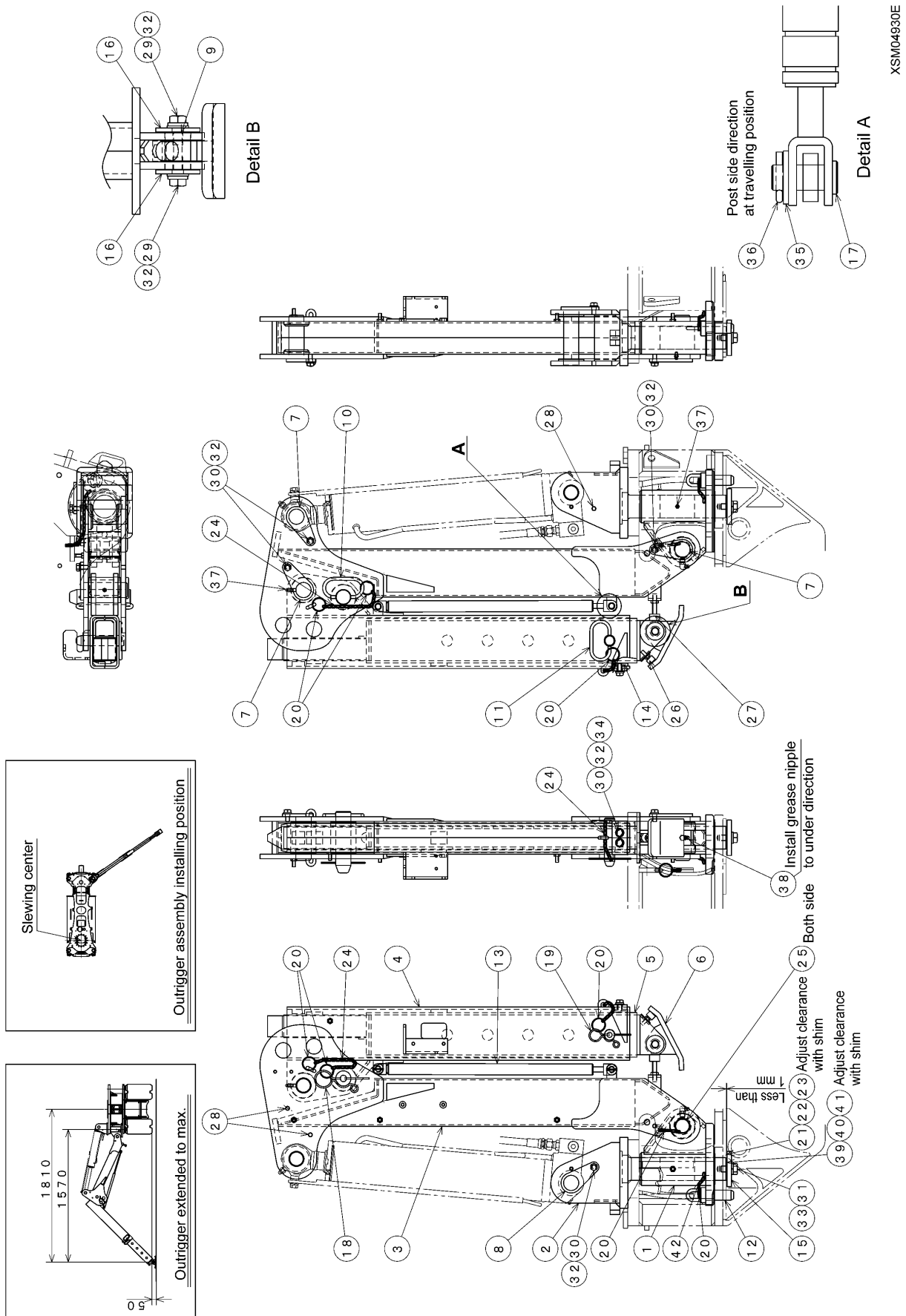


Slewing Motor	
Port A	Clockwise
Port B	Counterclockwise

Specifications	
Model	J-32EBE-B
Capacity per Stroke	31.6 cc/rev
Rated revolution	661 min ⁻¹
Rated Torque	39 N•m (4.0 kgf•m)
Max. Torque	49 N•m (5.0 kgf•m)
Rated Pressure	9.3 MPa (95 kgf/cm ²)
Max. Pressure	11.8 MPa (120 kgf/cm ²)

NO.	DESCRIPTION	QTY	NOTICE
1	Rotary	1	
2	Rotary Shaft	1	
3	Outrigger Base	1	
4	Outrigger Top	1	
5	Inner Box	1	
6	Rigger Adapter	1	
7	Outrigger Base and Top Connecting Pin	3	
8	Outrigger Cylinder Bottom Pin	1	
9	Rigger Adapter Connecting Pin	1	
10	Position Pin	1	
11	Position Pin	1	
12	Position Pin	1	
13	Stay Dumper	1	
14	Inner BoxStopper	1	
15	End Plate	1	
16	End Plate	2	
17	Dumper Pin	2	
18	Snap Pin (1)	1	
19	Snap Pin (2)	1	
20	Ring	8	
21	Shim (1.6t)	AR	
22	Shim (1.0t)	AR	
23	Shim (0.5t)	AR	
24	Chain	4	SM16L 130L
25	Bushing	2	MB3020DU
26	Stopper Bolt	1	UNAH No.6 L=20 mm
27	Stopper Bolt	1	UNAH No.6 L=40 mm
28	Hole Plug	4	CP-30-HP-1
29	Bolt	2	M8X1.25X16L (Plating) 8.8T
30	Bolt	6	M8X1.25X18L (Plating) 8.8T
31	Bolt	1	M12X1.75X25L (Plating) 10.9T
32	Spring Washer	8	M8 (Plating)
33	Spring Washer	1	M12 (Plating)
34	Plane Washer	2	M8 (Plating)
35	Plane Washer	2	M12 (Plating)
36	Cotter Pin	2	2.5X20L
37	Grease Nipple	2	A-M6F
38	Grease Nipple	1	B-PT1/8
39	Shim Plate	AR	
40	Shim (30X0.5t)	AR	
41	Shim (30X1.6t)	AR	
42	Chain	1	

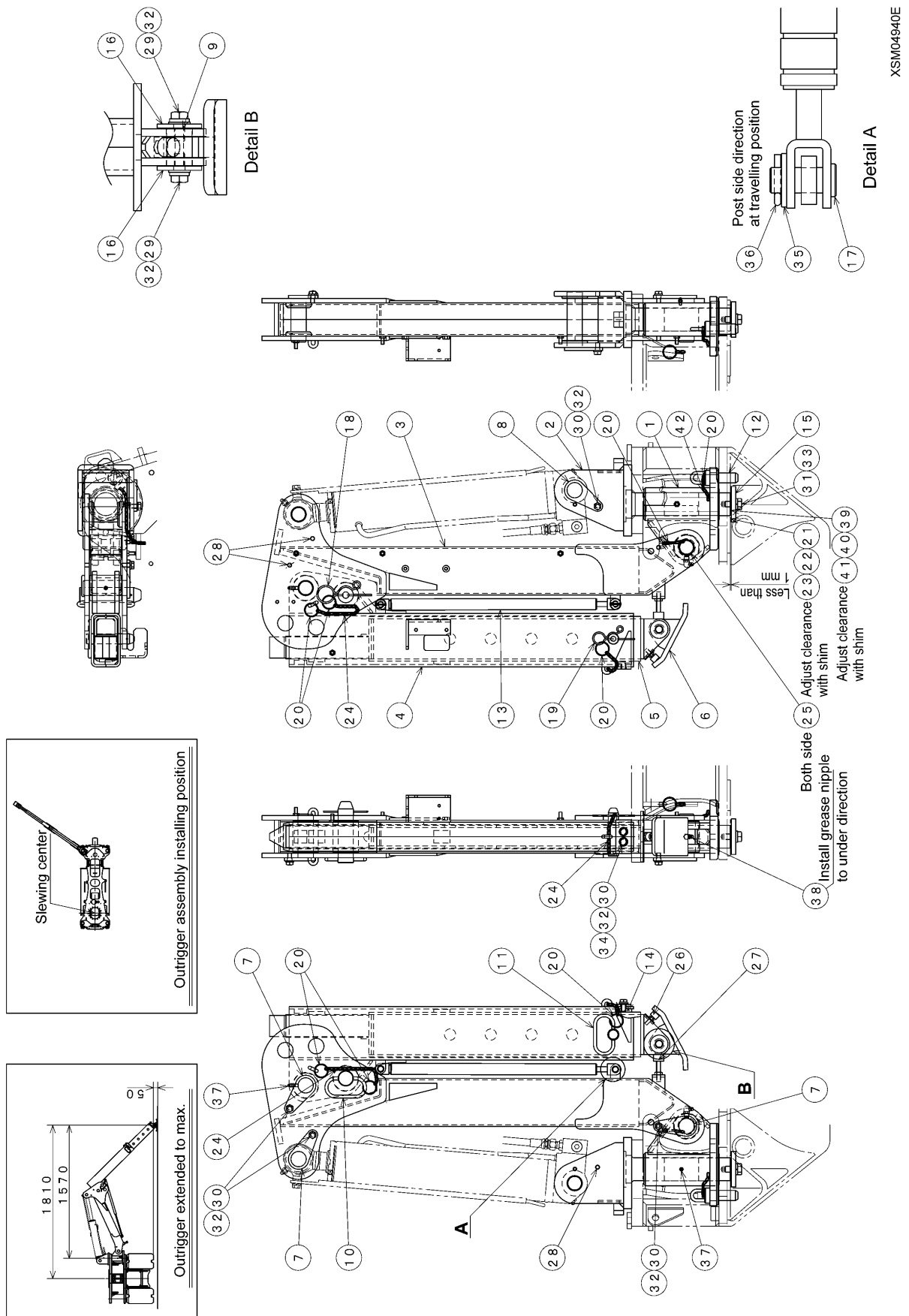
18.2 EXTERIOR VIEW OF No.2 OUTRIGGER



XSM04930E

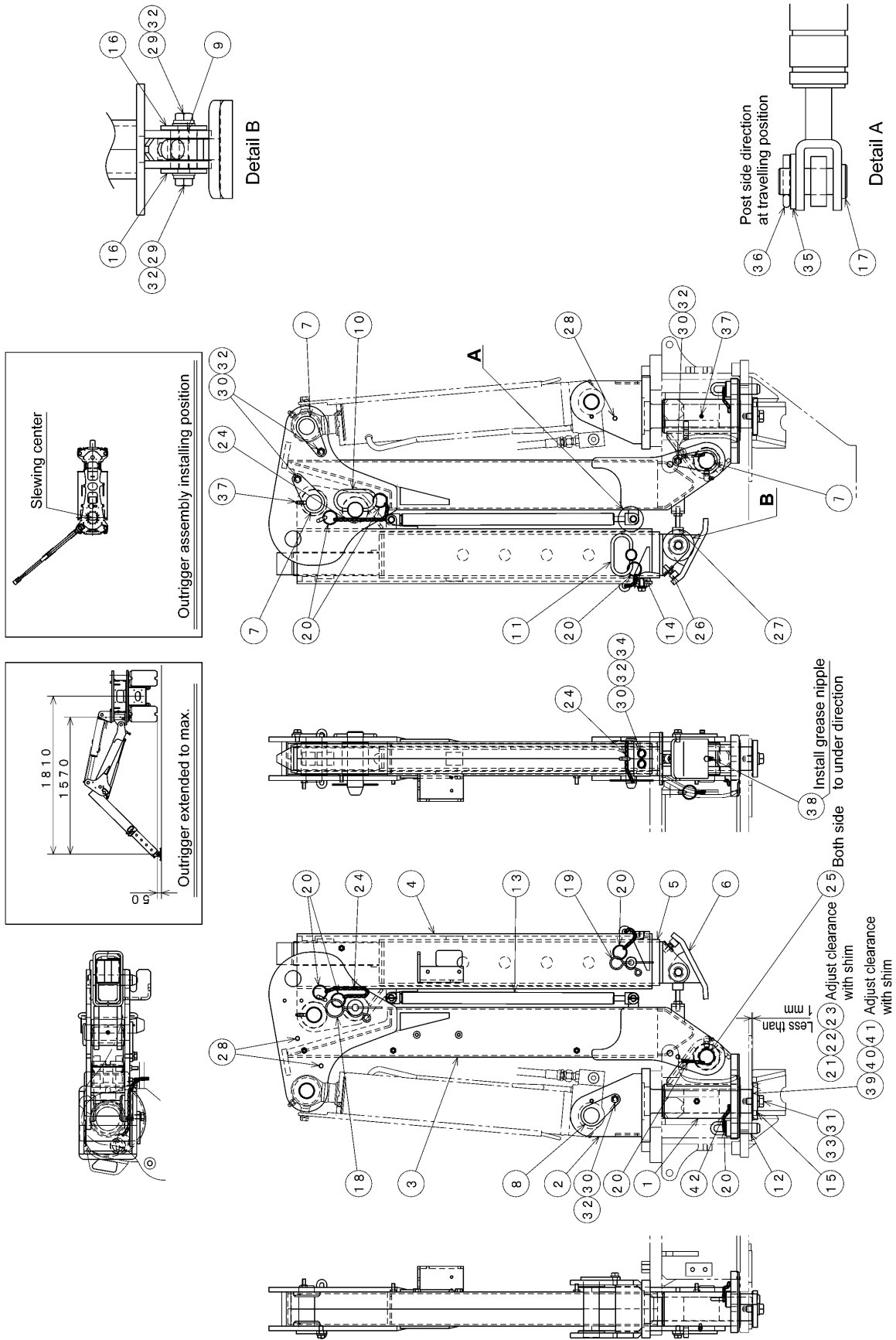
NO.	DESCRIPTION	QTY	NOTICE
1	Rotary	1	
2	Rotary Shaft	1	
3	Outrigger Base	1	
4	Outrigger Top	1	
5	Inner Box	1	
6	Rigger Adapter	1	
7	Outrigger Base and Top Connecting Pin	3	
8	Outrigger Cylinder Bottom Pin	1	
9	Rigger Adapter Connecting Pin	1	
10	Position Pin	1	
11	Position Pin	1	
12	Position Pin	1	
13	Stay Dumper	1	
14	Inner BoxStopper	1	
15	End Plate	1	
16	End Plate	2	
17	Dumper Pin	2	
18	Snap Pin (1)	1	
19	Snap Pin (2)	1	
20	Ring	8	
21	Shim (1.6t)	AR	
22	Shim (1.0t)	AR	
23	Shim (0.5t)	AR	
24	Chain	4	SM16L 130L
25	Bushing	2	MB3020DU
26	Stopper Bolt	1	UNAH No.6 L=20 mm
27	Stopper Bolt	1	UNAH No.6 L=40 mm
28	Hole Plug	4	CP-30-HP-1
29	Bolt	2	M8X1.25X16L (Plating) 8.8T
30	Bolt	6	M8X1.25X18L (Plating) 8.8T
31	Bolt	1	M12X1.75X25L (Plating) 10.9T
32	Spring Washer	8	M8 (Plating)
33	Spring Washer	1	M12 (Plating)
34	Plane Washer	2	M8 (Plating)
35	Plane Washer	2	M12 (Plating)
36	Cotter Pin	2	2.5X20L
37	Grease Nipple	2	A-M6F
38	Grease Nipple	1	B-PT1/8
39	Shim Plate	AR	
40	Shim (30X0.5t)	AR	
41	Shim (30X1.6t)	AR	
42	Chain	1	

18.3 EXTERIOR VIEW OF No.3 OUTRIGGER



NO.	DESCRIPTION	QTY	NOTICE
1	Rotary	1	
2	Rotary Shaft	1	
3	Outrigger Base	1	
4	Outrigger Top	1	
5	Inner Box	1	
6	Rigger Adapter	1	
7	Outrigger Base and Top Connecting Pin	3	
8	Outrigger Cylinder Bottom Pin	1	
9	Rigger Adapter Connecting Pin	1	
10	Position Pin	1	
11	Position Pin	1	
12	Position Pin	1	
13	Stay Dumper	1	
14	Inner BoxStopper	1	
15	End Plate	1	
16	End Plate	2	
17	Dumper Pin	2	
18	Snap Pin (1)	1	
19	Snap Pin (2)	1	
20	Ring	8	
21	Shim (1.6t)	AR	
22	Shim (1.0t)	AR	
23	Shim (0.5t)	AR	
24	Chain	4	SM16L 130L
25	Bushing	2	MB3020DU
26	Stopper Bolt	1	UNAH No.6 L=20 mm
27	Stopper Bolt	1	UNAH No.6 L=40 mm
28	Hole Plug	4	CP-30-HP-1
29	Bolt	2	M8X1.25X16L (Plating) 8.8T
30	Bolt	6	M8X1.25X18L (Plating) 8.8T
31	Bolt	1	M12X1.75X25L (Plating) 10.9T
32	Spring Washer	8	M8 (Plating)
33	Spring Washer	1	M12 (Plating)
34	Plane Washer	2	M8 (Plating)
35	Plane Washer	2	M12 (Plating)
36	Cotter Pin	2	2.5X20L
37	Grease Nipple	2	A-M6F
38	Grease Nipple	1	B-PT1/8
39	Shim Plate	AR	
40	Shim (30X0.5t)	AR	
41	Shim (30X1.6t)	AR	
42	Chain	1	

18.4 EXTERIOR VIEW OF No.4 OUTRIGGER

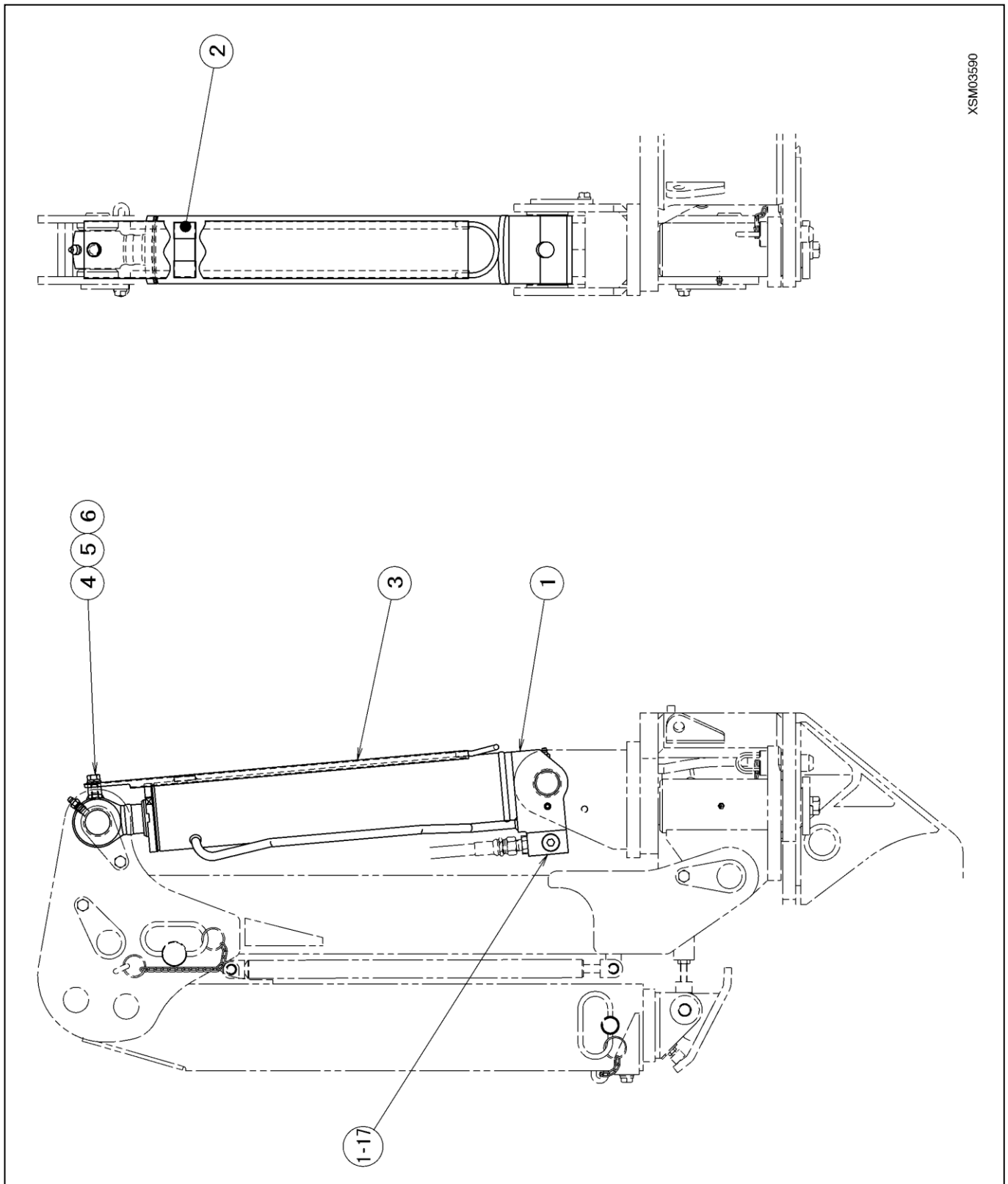


XSM04950E

NO.	DESCRIPTION	QTY	NOTICE
1	Rotary	1	
2	Rotary Shaft	1	
3	Outrigger Base	1	
4	Outrigger Top	1	
5	Inner Box	1	
6	Rigger Adapter	1	
7	Outrigger Base and Top Connecting Pin	3	
8	Outrigger Cylinder Bottom Pin	1	
9	Rigger Adapter Connecting Pin	1	
10	Position Pin	1	
11	Position Pin	1	
12	Position Pin	1	
13	Stay Dumper	1	
14	Inner BoxStopper	1	
15	End Plate	1	
16	End Plate	2	
17	Dumper Pin	2	
18	Snap Pin (1)	1	
19	Snap Pin (2)	1	
20	Ring	8	
21	Shim (1.6t)	AR	
22	Shim (1.0t)	AR	
23	Shim (0.5t)	AR	
24	Chain	4	SM16L 130L
25	Bushing	2	MB3020DU
26	Stopper Bolt	1	UNAH No.6 L=20 mm
27	Stopper Bolt	1	UNAH No.6 L=40 mm
28	Hole Plug	4	CP-30-HP-1
29	Bolt	2	M8X1.25X16L (Plating) 8.8T
30	Bolt	6	M8X1.25X18L (Plating) 8.8T
31	Bolt	1	M12X1.75X25L (Plating) 10.9T
32	Spring Washer	8	M8 (Plating)
33	Spring Washer	1	M12 (Plating)
34	Plane Washer	2	M8 (Plating)
35	Plane Washer	2	M12 (Plating)
36	Cotter Pin	2	2.5X20L
37	Grease Nipple	2	A-M6F
38	Grease Nipple	1	B-PT1/8
39	Shim Plate	AR	
40	Shim (30X0.5t)	AR	
41	Shim (30X1.6t)	AR	
42	Chain	1	

19. OUTRIGGER CYLINDER

19.1 EXTERIOR VIEW AND SPECIFICATIONS

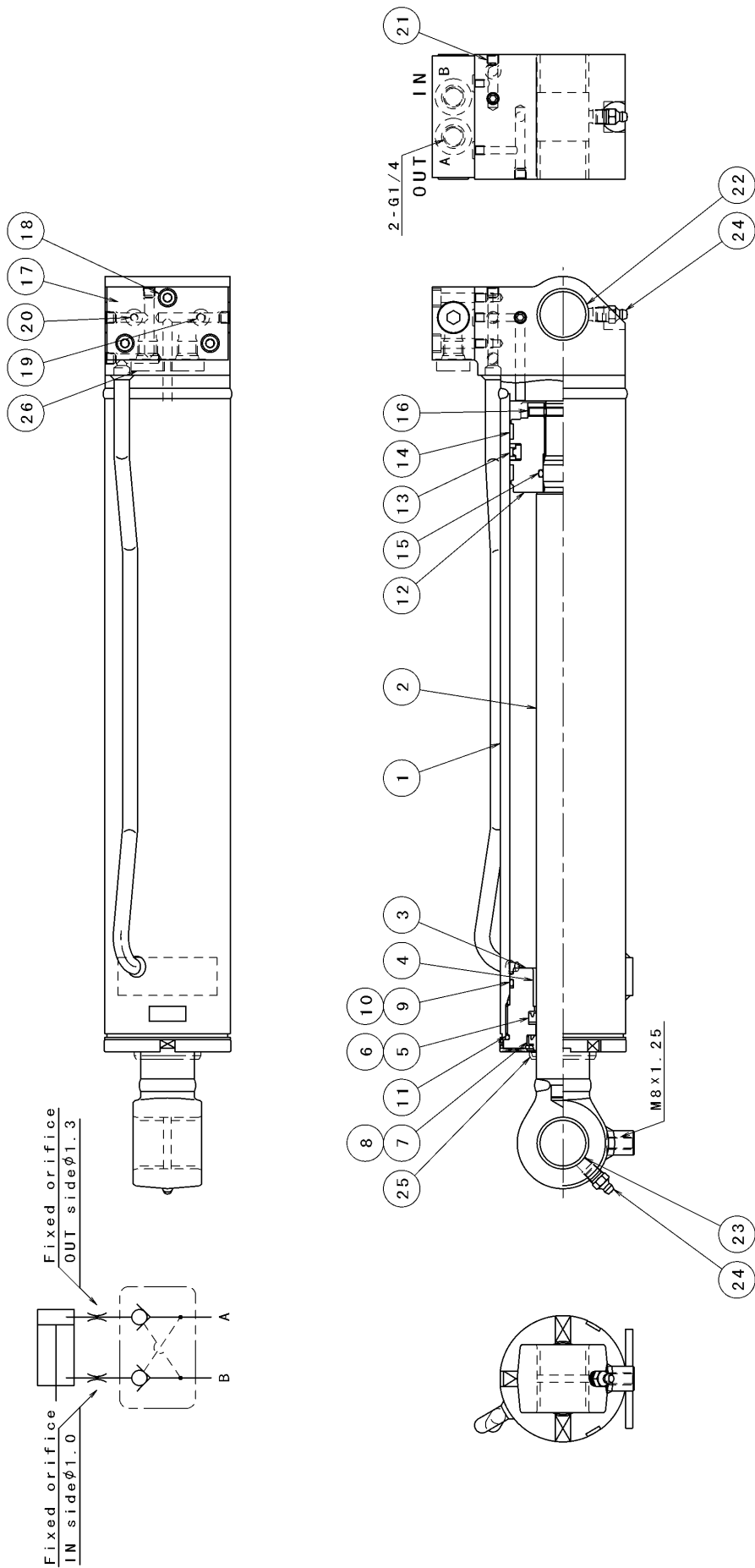


NO.	DESCRIPTION	QTY	NOTICE
1	Outtrigger Cylinder	1	
1-17	Double Pilot Check Valve	1	
2	Rod Guide Cover	2	Tightening Torque: 294 N•m
3	Outtrigger Cover	1	
4	Bolt	1	M8X1.25X16L (Plating)
5	Spring Washer	1	M8 (Plating)
6	Plane Washer	1	M8 (Plating)

Specifications			
Cylinder Bore x Rod O.D. - Stroke		70 mm X 35 mm - 313 mm	
Pressure	When extending	79.2 kN (At 20.6 MPa) [8.0 ton (At 210 kgf/cm ²)]	
	When retracting	59.4 kN (At 20.6 MPa) [6.0 ton (At 210 kgf/cm ²)]	
Test Pressure	When extending	30.9 MPa (315 kgf / kgf/cm ²)	
	When retracting	30.9 MPa (315 kgf / kgf/cm ²)	

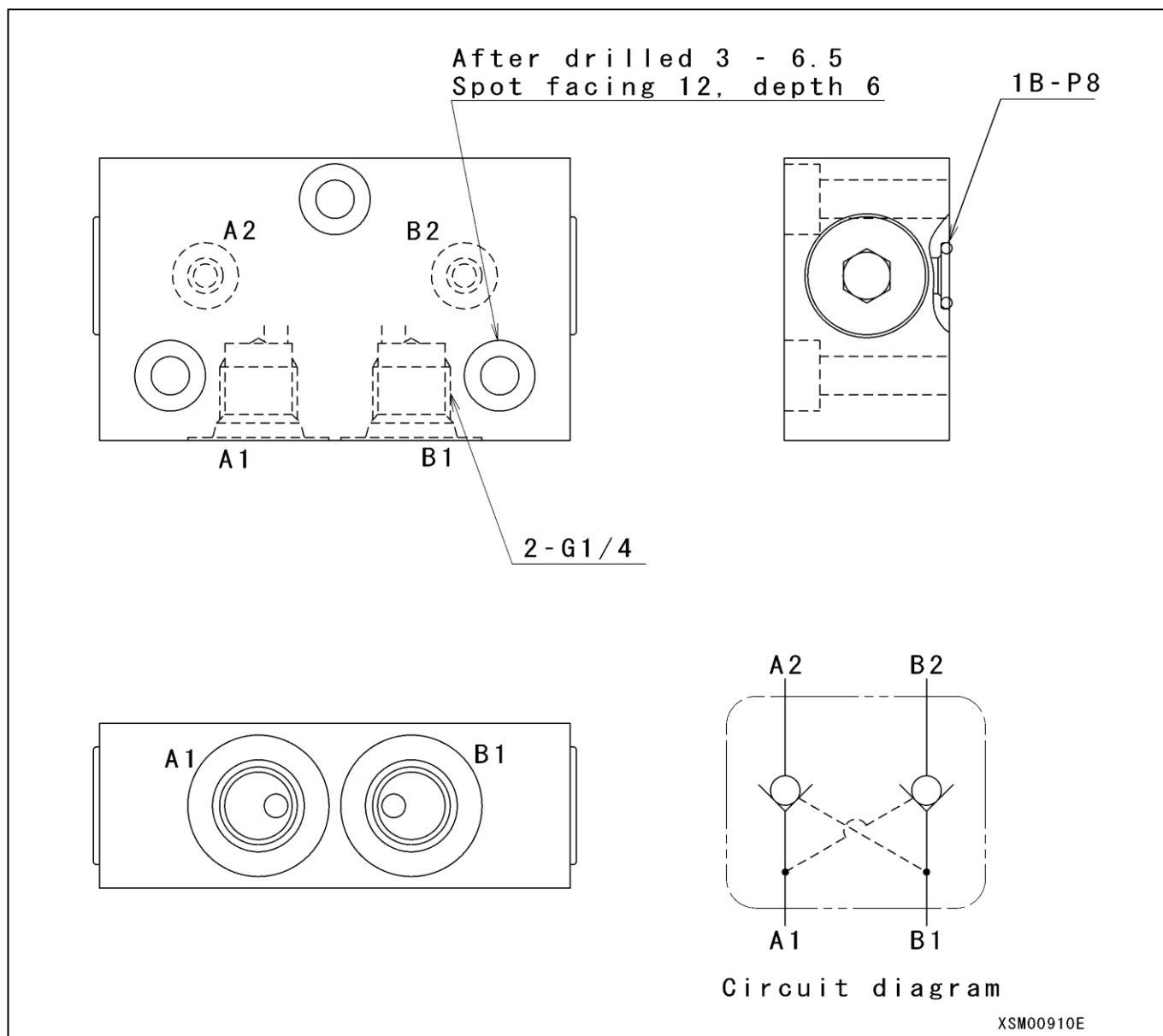
Natural retracting range of cylinder (leaking quantity of inner oil) (Notice: Change in temperature makes heat expansion of oil and it will probably cause retracting range of cylinder. Keep the regular temperature.)			
Section	Max. leaking quantity of inner oil (cc / min)	Square measure of bore (cm ²)	Shrinking range of cylinder (cm / day)
Outtrigger Cylinder	0.40	38.4	15.0
Double Pilot Check Valve	0.05		1.9
		Total	16.9

19.2 INNER PARTS



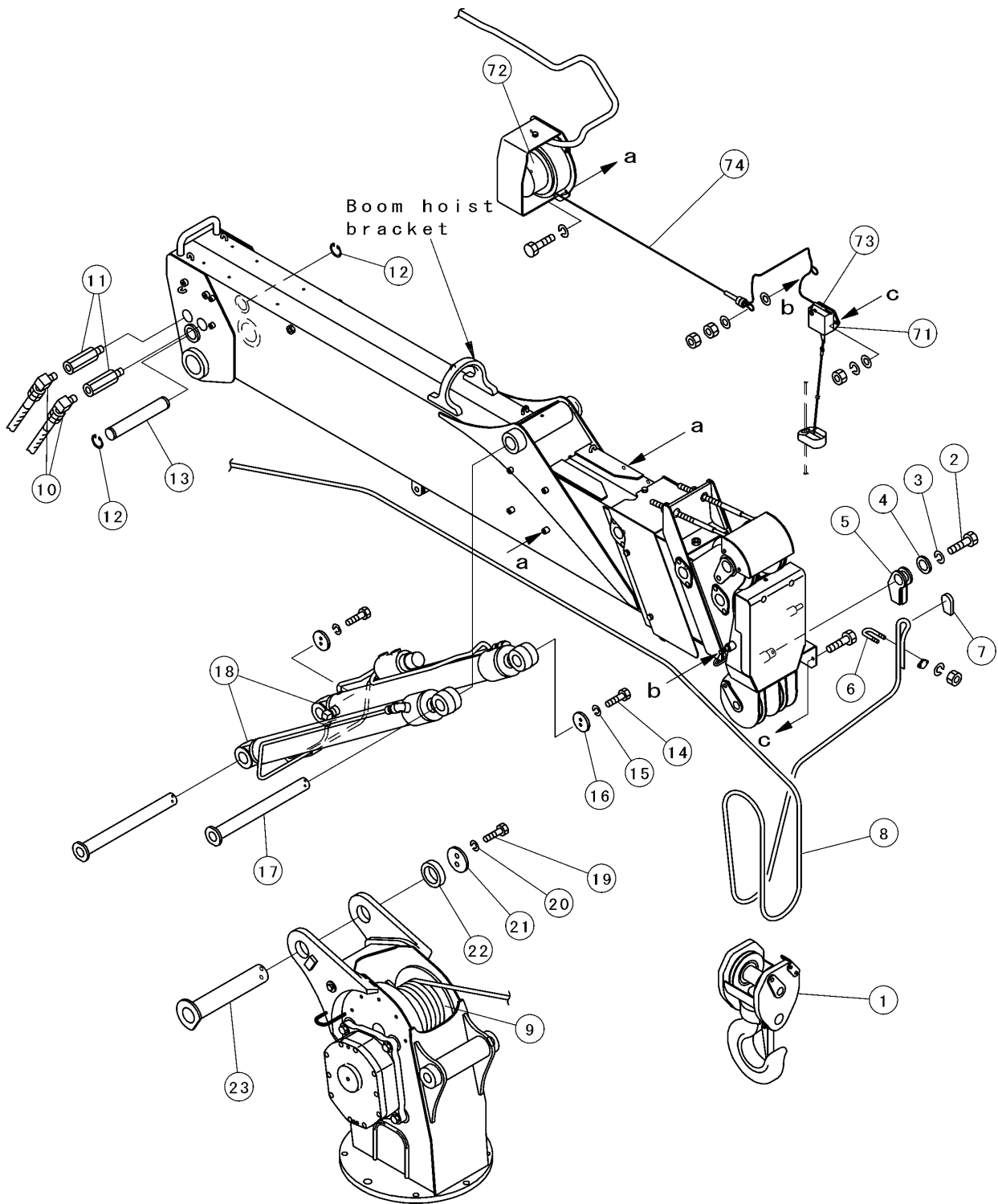
NO.	DESCRIPTION	Q'TY	NOTICE
1	Cylinder Tube Assembly	1	
2	Piston Rod Assembly	1	
3	Cylinder Head	1	Tightening Torque: 294 N•m
4	Bushing	1	LFB-3525
5	Rod Packing	1	GNV-35
6	Back-up Ring	1	35,45,1.5
7	Dust Seal	1	SCB-35
8	Snap Ring	1	AR48
9	O-RING	1	1B-G65
10	Back-up Ring	1	T3-G65
11	O-RING	1	1B-G70
12	Piston	1	Tightening Torque: 392.3 N•m
13	Piston Ring	1	SPGW 70
14	Wear Ring	2	70,65,10
15	O-RING	1	1B-P26
16	Set Screw	1	M6X12L Tightening Torque: 9.8 N•m
17	Double Pilot Check Valve	1	Parts No.: 103S92800000
18	Socket Head Bolt	3	M6X12L Tightening Torque: 9.8 N•m
19	Orifice	1	M5 Hole D.M.= 1.3 Tightening Torque: 2.5 N•m
20	Orifice	1	M5 Hole D.M.= 1.0 Tightening Torque: 2.5 N•m
21	Plug (For shipping)	4	R1/16 Tightening Torque: 7.8 N•m
22	Bushing	2	K5B3025
23	Bushing	2	K5B3020
24	Grease Nipple	2	A-PT1/8
25	Cap	1	

19.3 DOUBLE PILOT CHECK VALVE



Specifications	
Rated Pressure	20.6 MPa (210 kgf/cm ²)
Resisting Pressure	41.2 MPa (420 kgf/cm ²)
Max. Flow Capacity	10 L/min
Allowable Leakage Level	Less than 0.05 L/min (Apply 17.2 MPa [175 kgf/cm ²] From Port A2 and B2)
Check Valve Cracking Pressure	0.49 MPa (5 kgf/cm ²)
Pilot Area Ratio	6.2 : 1
Oil Temperature Range for Test	50±5 °C
Operating Temperature Range	-10 - +80 °C

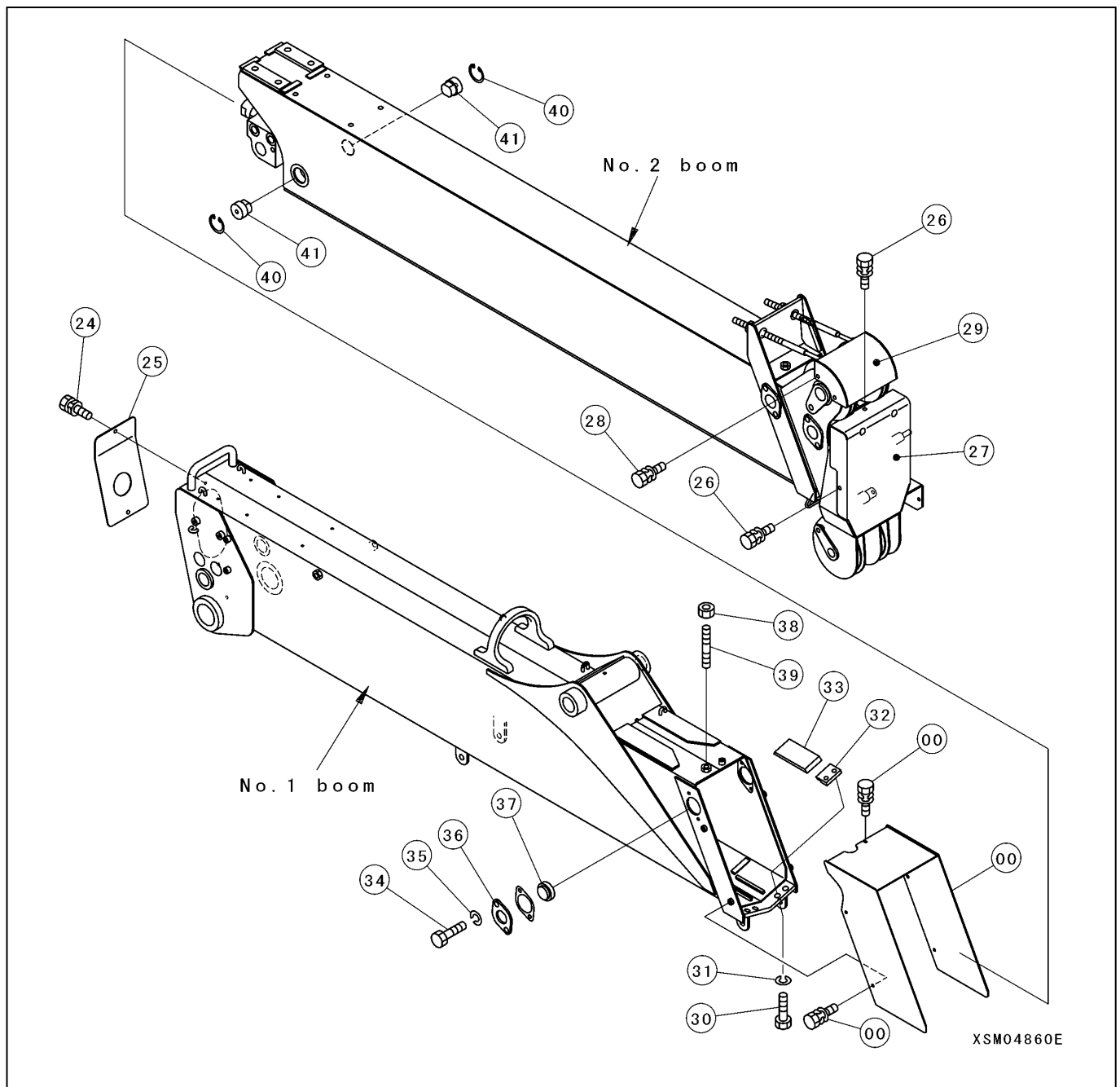
20. ASSEMBLY AND DISASSEMBLY OF BOOM



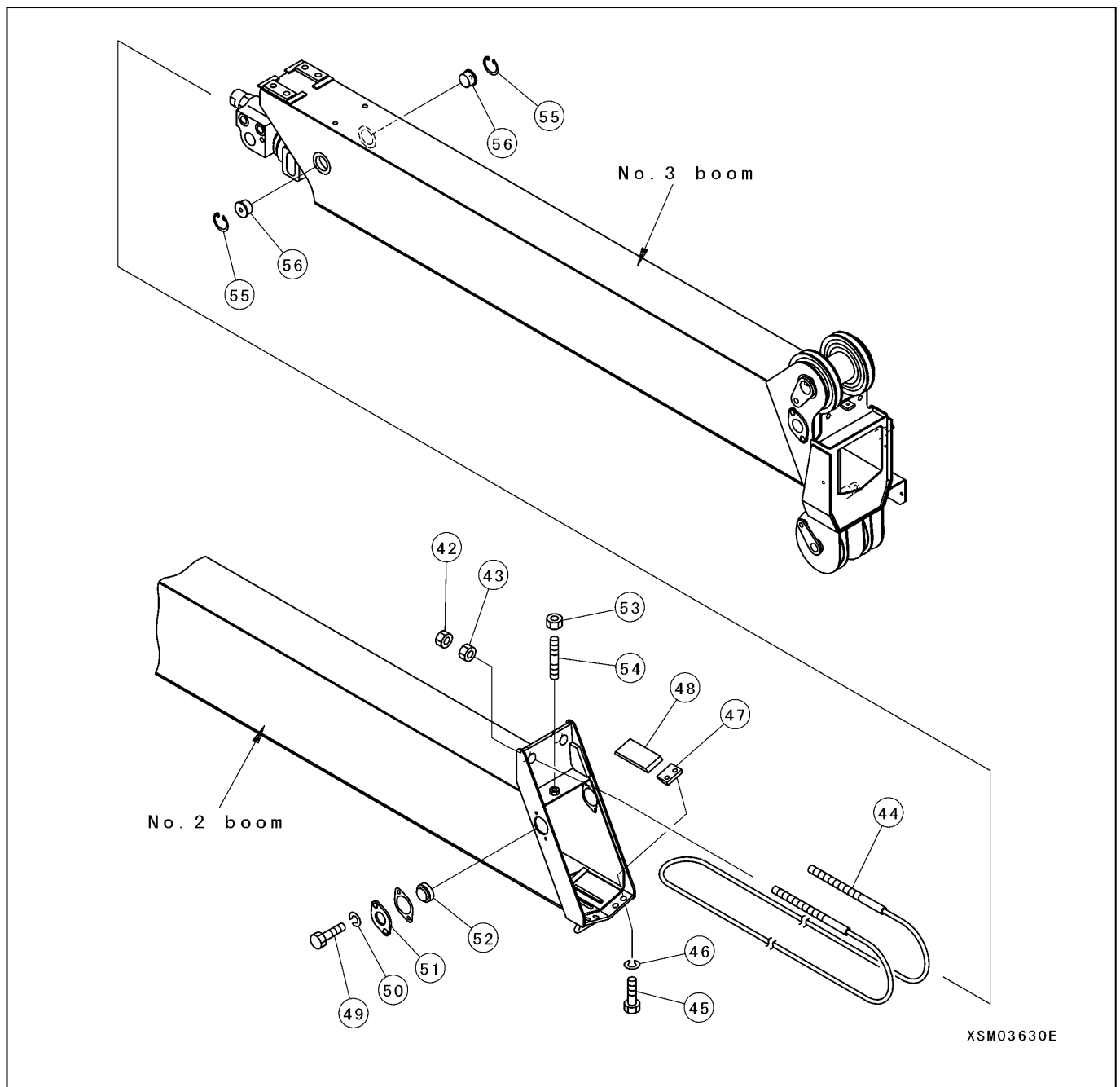
XSM04850E

[Procedure for Overhaul]

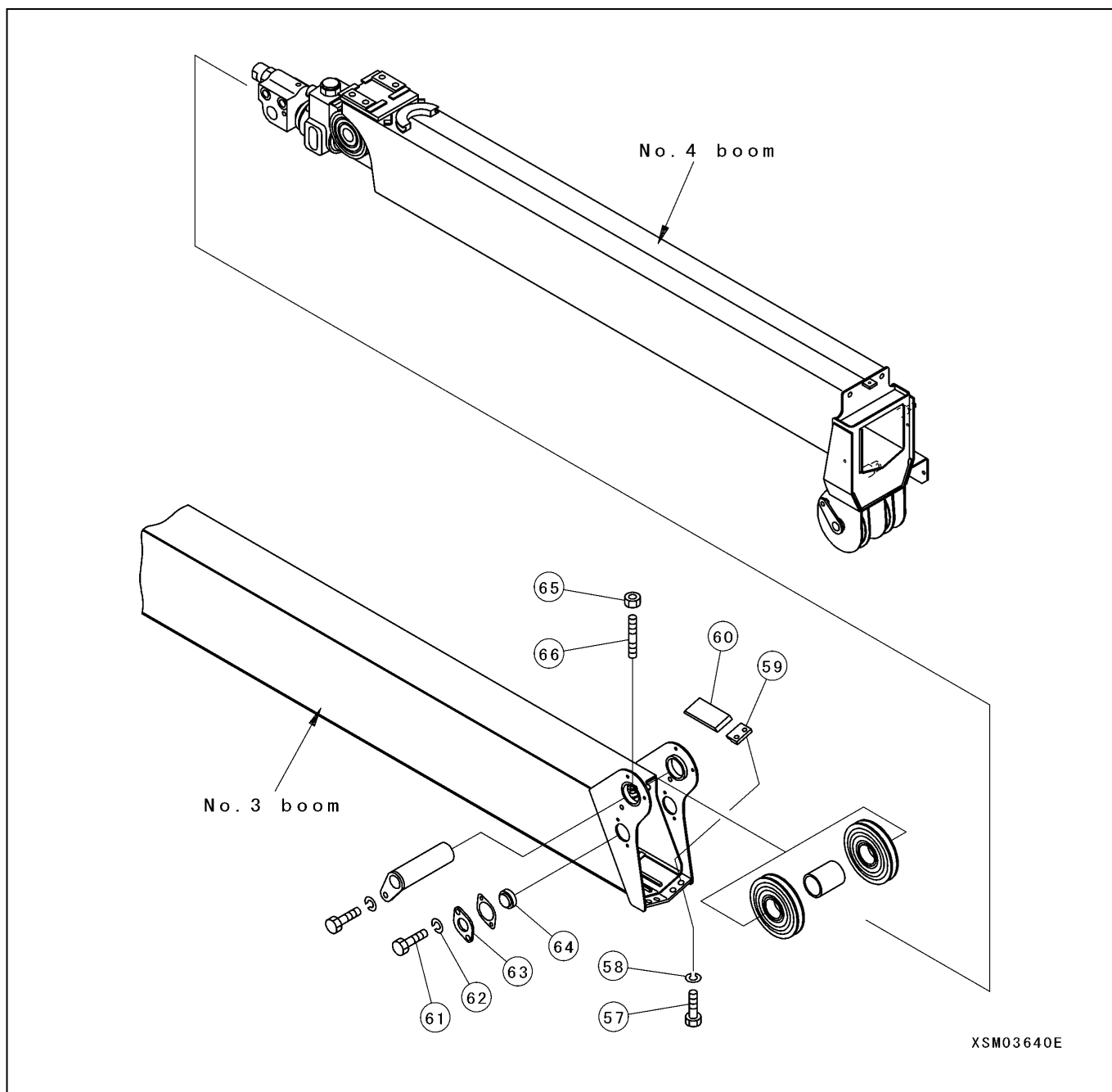
1. Start engine and lower hook block (1) to the ground. Winch wire rope should be properly slack.
Take care not to cause random wound caused by over unwinding.
2. Stop engine. Unscrew bolt (2) (M8 X 15L), remove spring washer (3) and end plate (4), and take off wedge socket (5).
3. Take off wire clip assembly (6), and then remove wedge (7) to pull out wire rope (8) from hook block (1) and No.4 boom.
4. Start engine to wind wire rope (8) to the winch drum of winch assembly (9).
Take care not to cause random wound.
5. Take off connector between over-hoisting detector (71) and cord reel (72), remove tie band and corrugate tube from cord (73), and wind the cord (73) to the cord reel (72). Take care not to let end of the cord into cord reel (72).
6. Take off 2 telescoping cylinder hoses, and remove 2 each of elbow (10) and long connector (11).
7. Remove two snap rings (12), and extract telescoping cylinder head pin (13).
You may hammer the pin through a steel pipe or such between the pin and hammer to extract it.
8. Hoist boom using a sling to hoist bracket on upper face of boom assembly, to prevent collapse when derricking cylinders and foot pin are withdrawn.
9. Unscrew bolt (14) (M6 X 15L) and remove spring washer (15) and end plate (16), then extract derricking cylinder head pin (17).
You may hammer the pin through a steel pipe or such between the pin and hammer to extract it.
10. Unscrew 2 bolts (19) (M10 X 20L) and remove spring washer (20) and end plate (21), then extract foot pin (23).
You may hammer the pin through a steel pipe or such between the pin and hammer to extract it.



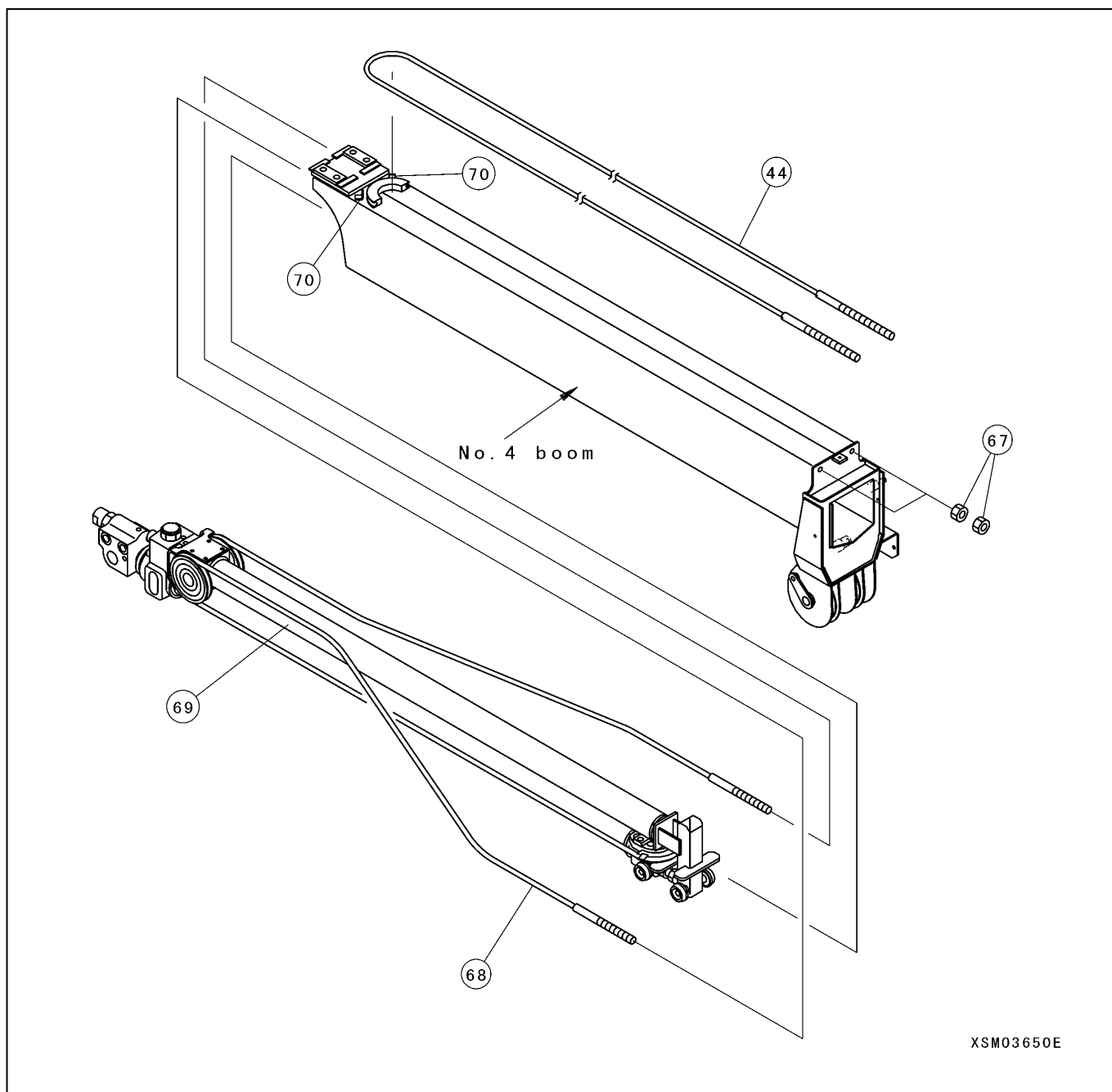
11. Unscrew 2 bolts (24) (M6 X 12L), and take off boom tail cover (25).
12. Unscrew 3 bolts (26) (M6 X 12L), and take off boom head cover (27).
13. Unscrew 4 bolts (28) (M6 X 12L), and take off sheave cover (29).
14. Unscrew 5 bolts (82) (M6 X 12L), and take off boom cover (81).
15. Unscrew 4 bolts (30) (M10 X 20L), and remove 4 spring washers (31), then take off stopper 2 plates (32).
16. Unscrew 4 bolts (34) (M6 X 12L), and remove 4 spring washers (35) on both left and right side, then remove 2 side plate stopper plates (36) and side slide plates (37) respectively, on both left and right side.
17. loosen hexagonal nut (38) (M10) and remove hexagonal hole screw (39) (M10 X 30L), then pull out No.2, 3 and 4 booms and telescoping cylinder assembled together out from No.1 boom.
18. Remove 2 slide plates (33) from bottom side of No.1 boom.
19. Detach 2 snap rings (40) and pull out 2 telescoping cylinder trunnion pins (41) on both left and right side, where an M8 bolt (approximately 30L) may be used. Screw the bolt to M8 tapped hole of the trunnion pin (41) and pinch the bolt by a plier to pull out.



20. Remove 2 lock nuts (42) (M12), then remove 2 spherical surface nuts (43) (M10) from the tips of boom extension wire (44), and pull out the extension wire (44) from No.2 boom.
21. Unscrew 4 bolts (45) (M10 X 16L), and remove 4 spring washers (46), then take off 2 stopper plates (47).
22. Unscrew 4 bolts (49) (M6 X 12L), and remove 4 spring washers (50) on both left and right side, then remove 2 side plate stopper plates (51) and side slide plates (52) respectively, on both left and right side.
23. loosen hexagonal nut (53) (M10) and remove hexagonal hole screw (54) (M10 X 30L), then pull out No.3 and 4 booms and telescoping cylinder assembled together out of No.2 boom.
24. Remove 2 slide plates (48) from bottom side of No.2 boom.
25. Detach 2 snap rings (55) and pull out 2 No.3 trunnion pins (56) on both left and right side, where an M8 bolt (approximately 30L) may be used. Screw the bolt to M8 tapped hole of the trunnion pin (56) and pinch the bolt by a plier to pull out.



26. Unscrew 4 bolts (57) (M10 X 16L), and remove 4 spring washers (58), then take off 2 stopper plates (59).
27. Unscrew 4 hexagonal bolts (61) (M6 X 12L), and remove 4 spring washers (62) on both left and right side, then remove 2 side plate stopper plates (63) and side slide plates (64) respectively, on both left and right side.
28. Loosen hexagonal nut (65) (M10), and remove hexagonal hole screw (66) (M10 X 30L), then pull out No.4 boom and telescoping cylinder assembled together out of No.3 boom.
29. Remove 2 slide plates (60) from bottom side of No.3 boom.



30. Remove 4 hexagonal nuts (67) (M10) from wire tips, and remove boom retraction wire (68) from No.4 boom.
31. Pull out telescoping cylinder (69) and boom retraction wire (68) assembled together out of No.4 boom.
32. Remove boom retraction wire (44) from No.4 boom. Flatten 2 bended plates (70) on No.4 boom when removing this retraction wire (44).

The boom disassembly ends here.

[Assembly procedure]

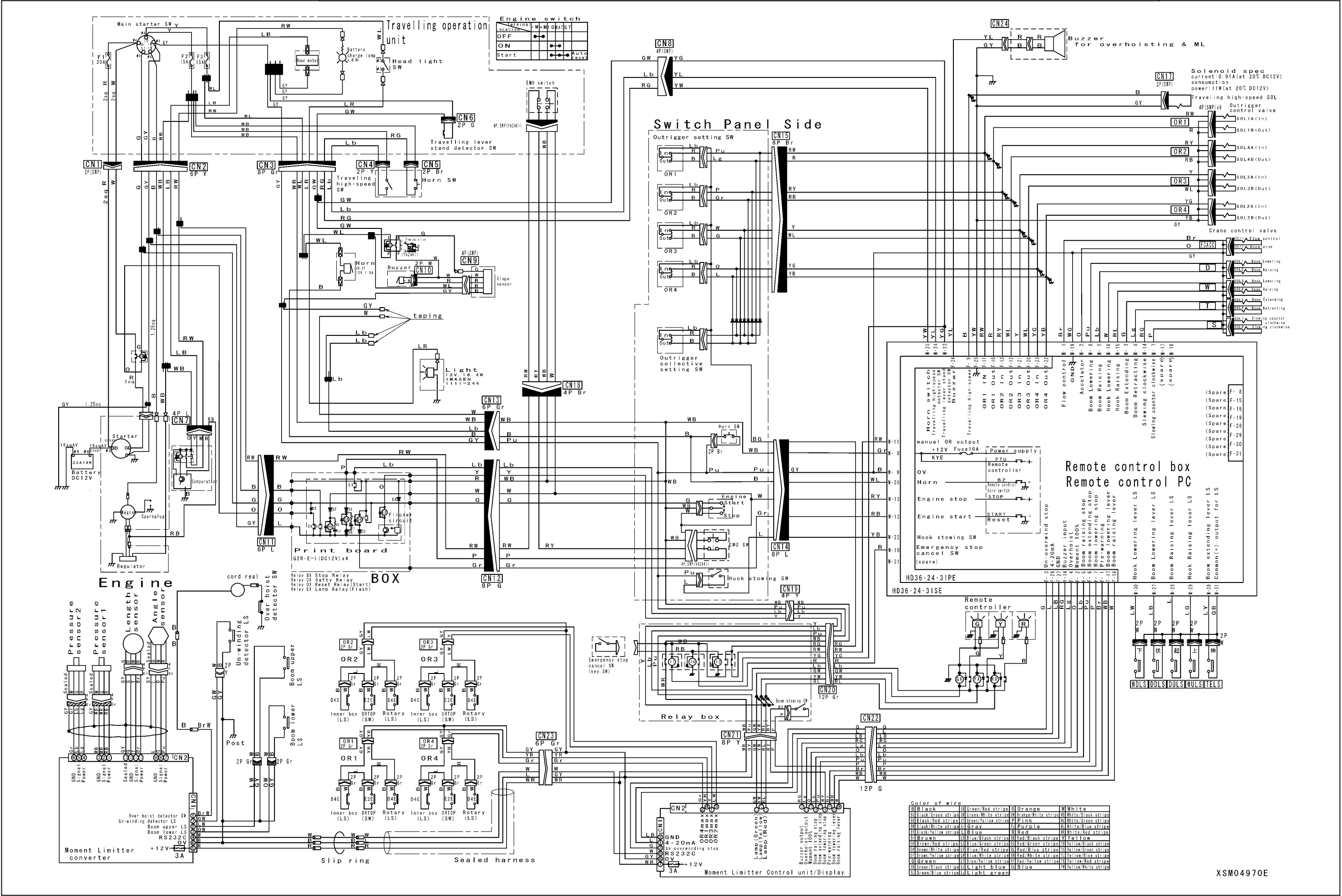
Assemble by following disassembly procedure in reverse.

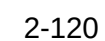
Caution: Make sure that neither of the boom extension wire, boom retraction wire or cord reel cross with each other and suffer damage during the assembly.

Also surely bend 2 plates (70) on the No.4 boom to prevent extension wire (44) to come out, after fitting the boom extension wire (44).

21. ELECTRIC CIRCUIT DIAGRAM

Note: A version of this electrical circuit diagram enlarged to A2 size is prepared as an appendix. Refer to the separate A2 size circuit diagram for details.





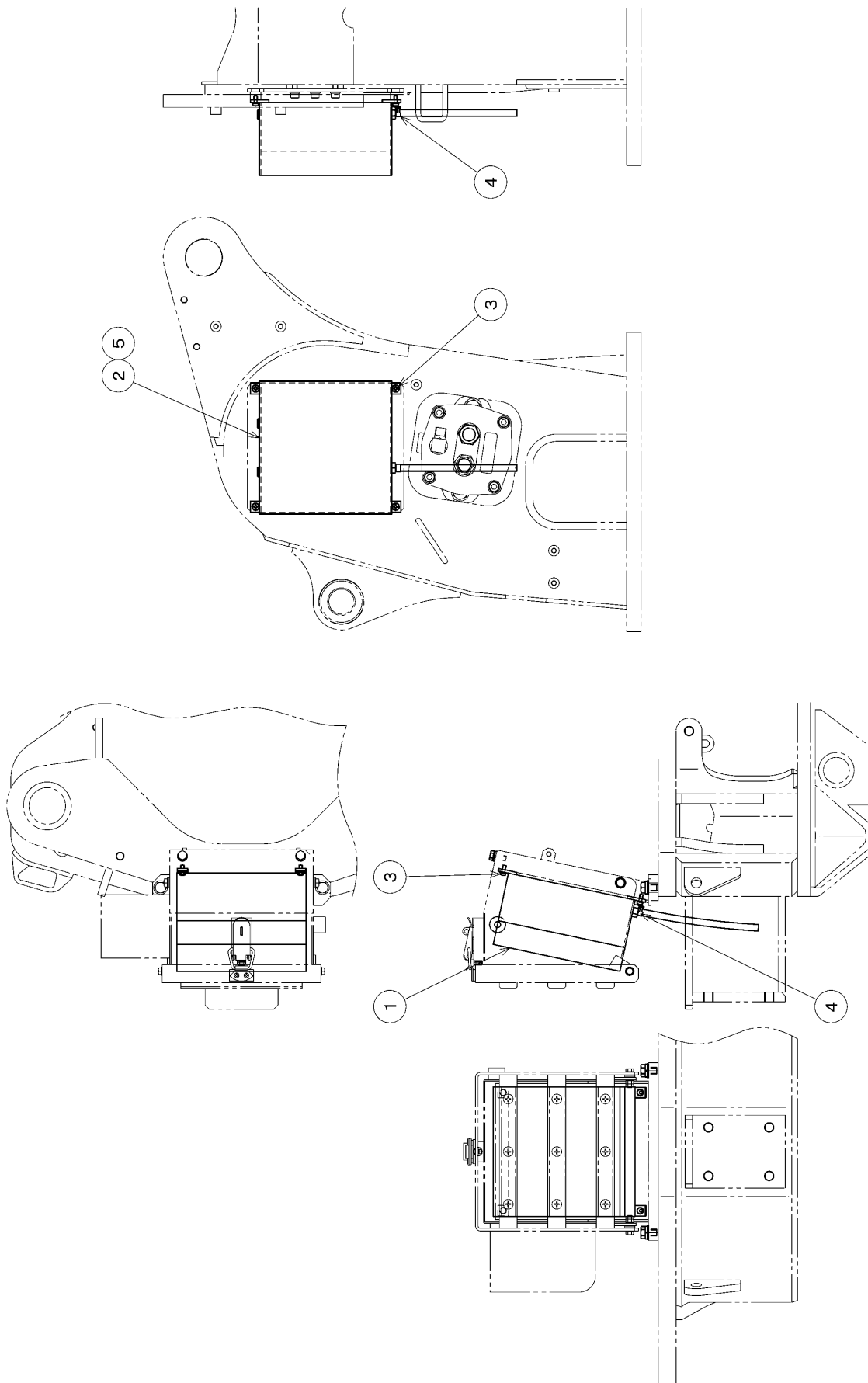
NO.	DESCRIPTION	QTY	NOTICE	NO.	DESCRIPTION	QTY	NOTICE
1	Connector Bracket (LF)	1		28	Translation Cable Assembly	1	(For remote Control)
2	Bolt	2	M8X1.25X20L (Plating) 4.8T	29	Translation Cable Assembly	1	(For remote Control)
3	Spring Washer	2	M8 (Plating)	30	Engine Ground Cable	1	L=170
4	Plane Washer	2	M8 (Plating)	31	Battery Cable (+)	1	L=800
5	Connector Bracket (RF)	1		32	Battery Cable (-)	1	L=330
6	Bolt	2	M8X1.25X20L (Plating) 4.8T	33	Tie Band	30	CV-150B
7	Spring Washer	2	M8 (Plating)	34	Bolt	1	M1.0X1.5X20L (Plating) 4.8T
8	Plane Washer	2	M8 (Plating)	35	Spring Washer	1	M1.0 (Plating)
9	Connector Cover	1		36	Rubber Cover (R)	1	
10	Bolt (With Washer)	4	M5X0.8X10L (Plating)	39	Cushion	1	
11	Connector Bracket (R)	1		41	Connector Bracket	3	
12	Bolt	2	M6X1.0X14L (Plating) 4.8T	42	Bolt	6	M6X1.0X14L (Plating) 4.8T
13	Spring Washer	2	M6 (Plating)	43	Spring Washer	6	M6 (Plating)
14	Plane Washer	2	M6 (Plating)	44	Plane Washer	6	M6 (Plating)
15	Connector Bracket (L)	1		45	Clamp	3	
16	Bolt	2	M6X1.0X14L (Plating) 4.8T	46	Clamp	14	
17	Spring Washer	2	M6 (Plating)	50	Cord Reel Extension Cable	1	
18	Plane Washer	2	M6 (Plating)	51	Stop Ring Translation Cable (OR1, OR4)	1	
19	Engine Starting Detection Unit Assembly	1		52	EMO Switch Extension Cord	1	
20	Bolt (With Washer)	2	M5X0.8X10L (Plating)	53	Censor, Power Control Cord Assembly	1	
21	Main & Engine Harness Assembly	1		54	Power Cord Assembly	1	
22	Bolt	1	M6X1.0X12L (Plating) 4.8T	55	Input and Output Cord Assembly	1	
23	Spring Washer	1	M6 (Plating)	59	Key Switch and Buzzer Box Assembly	1	
24	Plane Washer	1	M6 (Plating)	63	Fixed Clamp	14	
25	Bolt	1	M6X1.0X14L (Plating) 4.8T	64	Bolt (With Washer)	2	M6X1.0X10L (Plating) 4.8T
26	Spring Washer	1	M6 (Plating)	68	Screw	2	M4X0.7X6L (Plating)
27	Plane Washer	1	M6 (Plating)				

MOMENT LIMITER

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1. MOMENT LIMITER PARTS

1.1 DISPLAY UNIT AND CONVERTER

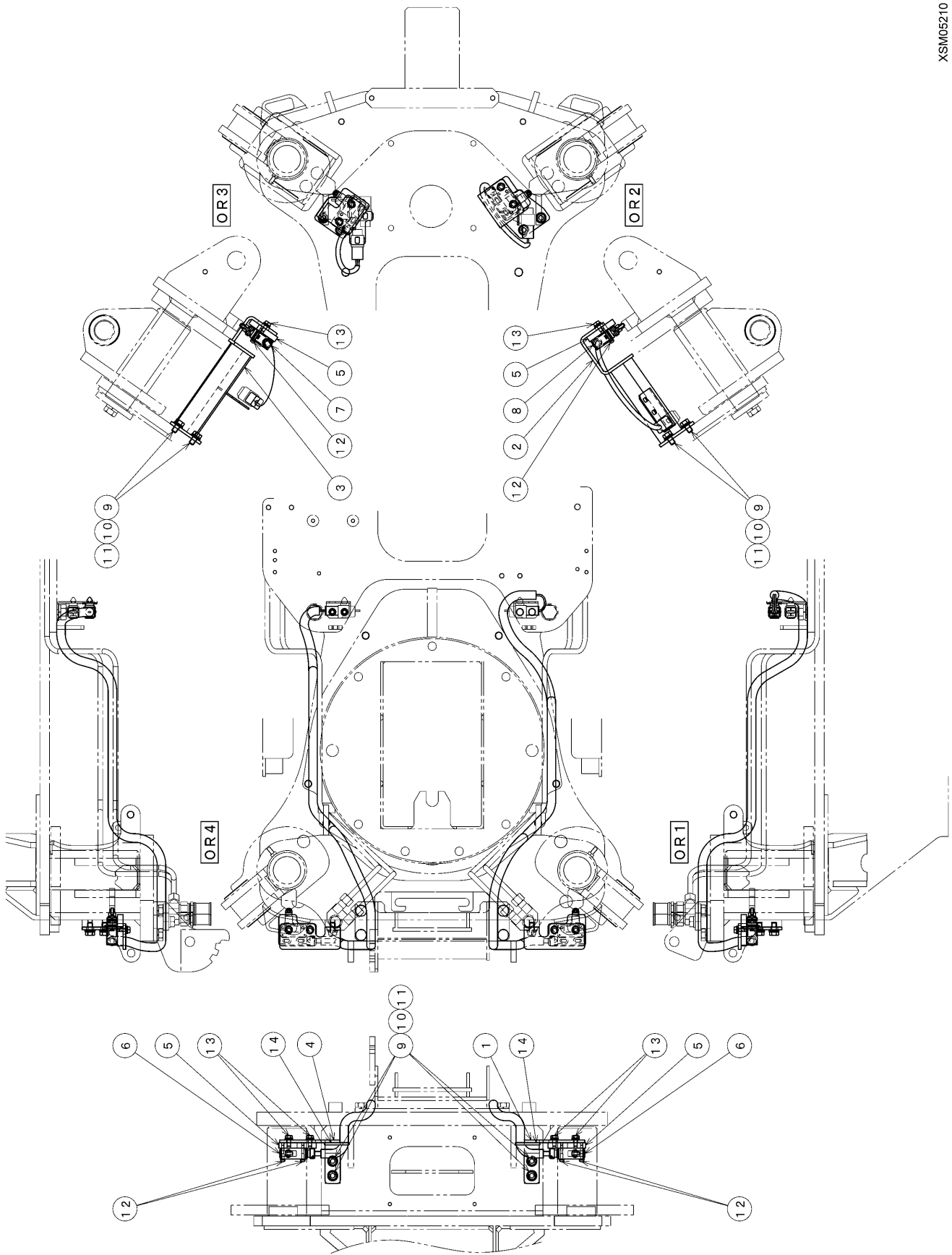


XSM05200

NO.	DESCRIPTION	Q'TY	NOTICE
1	Moment Limiter Display	1	
2	Moment Limiter Converter	1	
3	Screw (With Washer)	8	M4X0.7X10L (Plating)
4	Clamp	2	RS-8000
5	Moment Limiter Converter Cover	1	

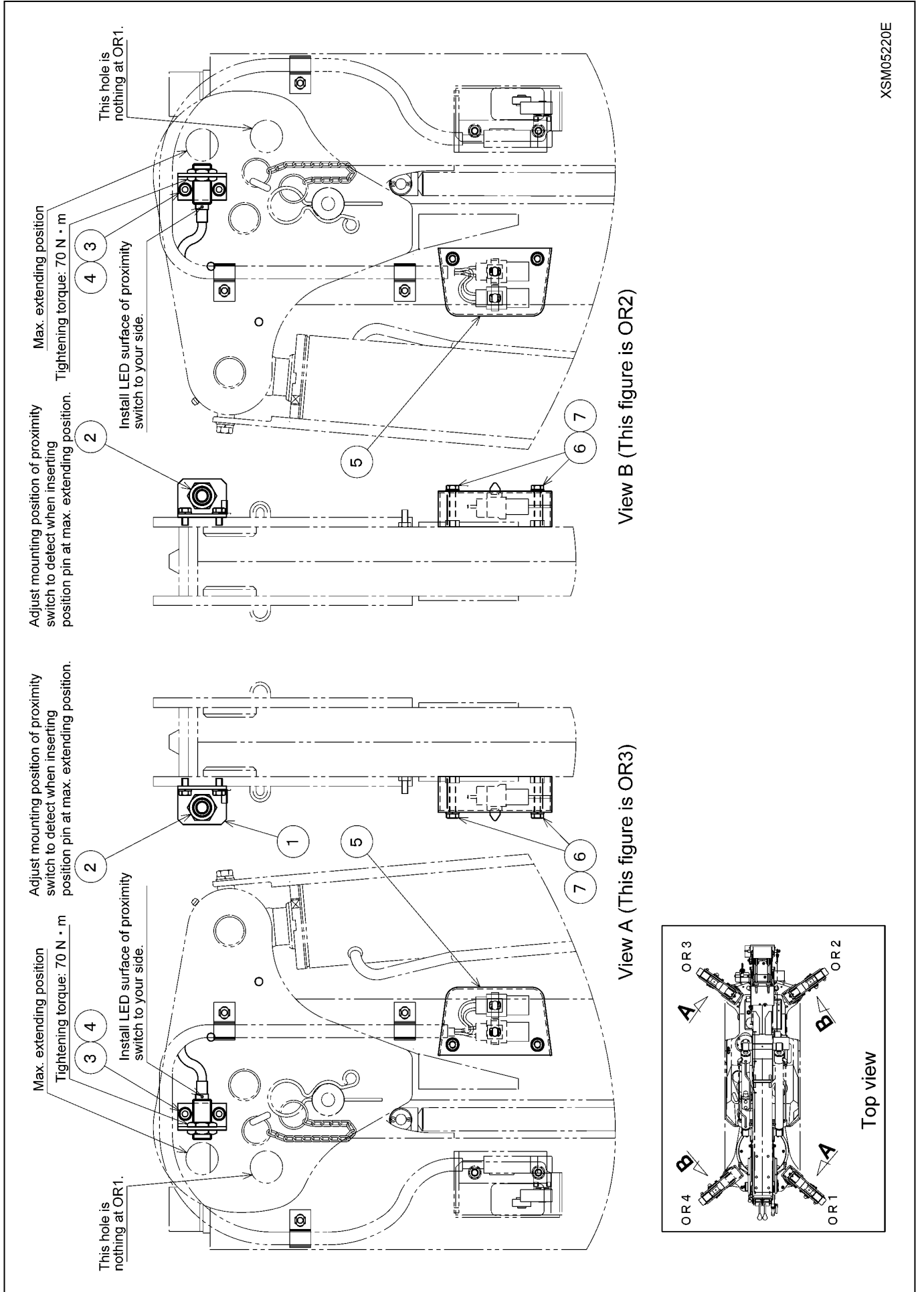
1.2 OUTRIGGER POSITION DETECTOR

XSM05210



NO.	DESCRIPTION	Q'TY	NOTICE
1	Limit Switch Bracket 1	1	
2	Limit Switch Bracket 2	1	
3	Limit Switch Bracket 3	1	
4	Limit Switch Bracket 4	1	
5	Limit Switch Mounting Plate	1	
6	Limit Switch 1	2	
7	Limit Switch 2	1	
8	Limit Switch 3	1	
9	Bolt	8	M8X1.25X16L (Plating)
10	Spring Washer	8	M8 (Plating)
11	Plane Washer	8	M8 (Plating)
12	Screw (With Washer)	8	M4X12L (Plating)
13	Bolt (With Washer)	8	M6X1.0X12L (Plating)
14	Tie Band	2	CV-150B (L=150)

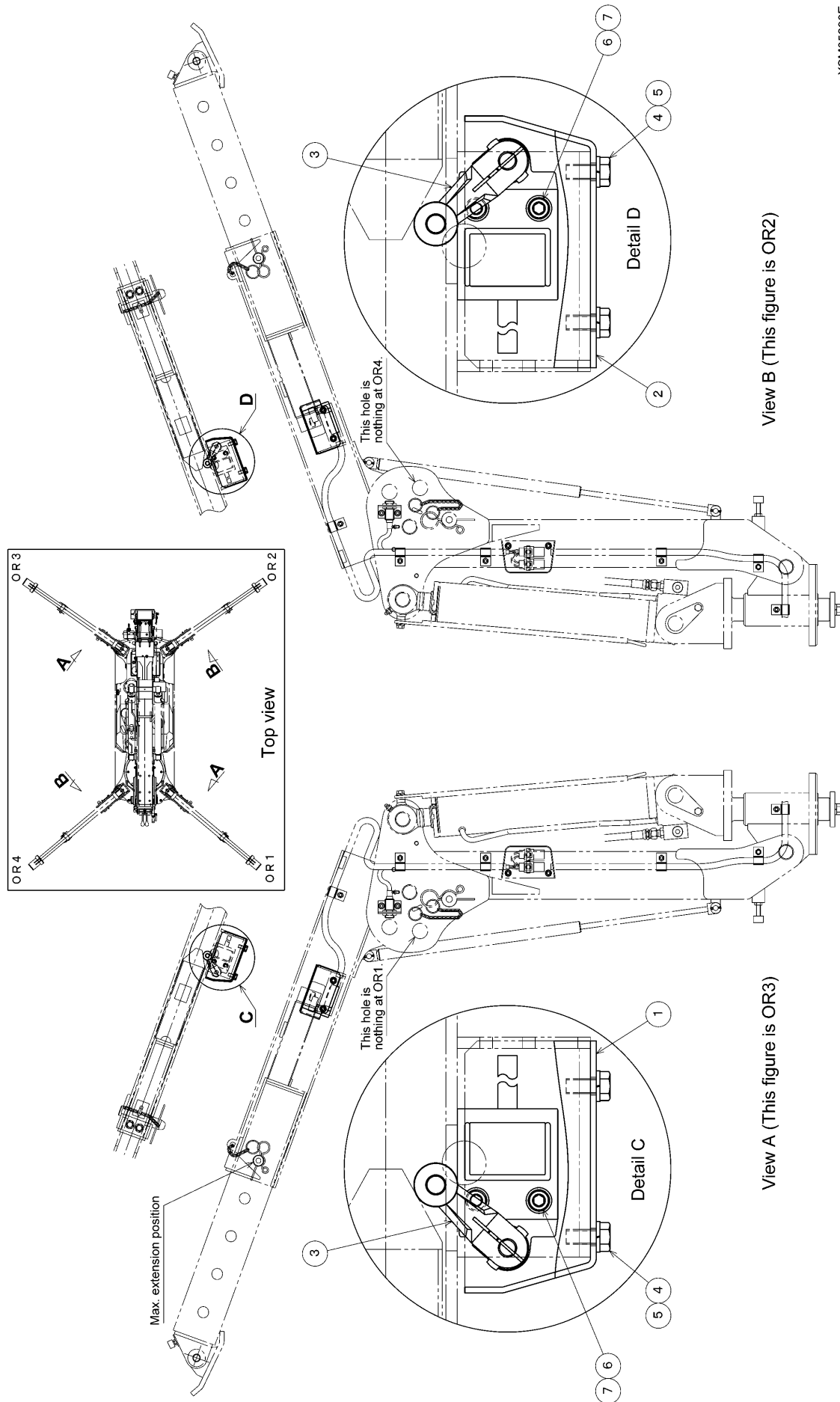
1.3 OUTRIGGER OPENING DETECTOR



XSM05220E

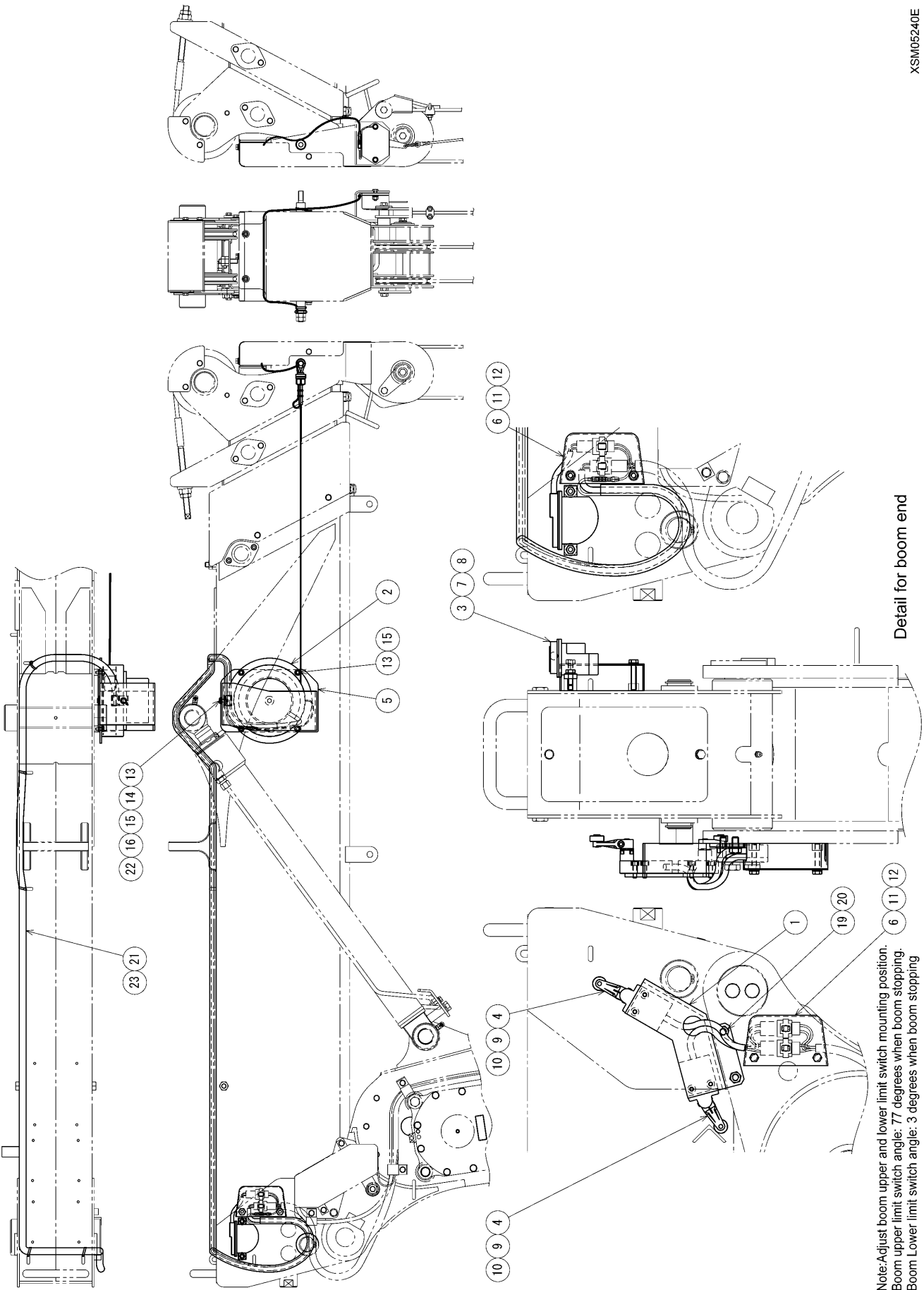
NO.	DESCRIPTION	Q'TY	NOTICE
1	Switch Bracket	4	
2	Proximity Switch	4	
3	Bolt	8	M6X1.0X12L (Plating)
4	Spring Washer	8	M6 (Plating)
5	Connector Cover	4	M6X6L (Plating)
6	Bolt	8	M6X1.0X35L (Plating)
7	Spring Washer	8	M6 (Plating)

1.4 OUTRIGGER EXTENDING DETECTOR



NO.	DESCRIPTION	Q'TY	NOTICE
1	Cover (A)	2	
2	Cover (B)	2	
3	Limit Switch	4	
4	Bolt	8	M6X1.0X12L (Plating)
5	Spring Washer	8	M6 (Plating)
6	Bolt	8	M5X0.8X16L (Plating)
7	Spring Washer	8	M5 (Plating)

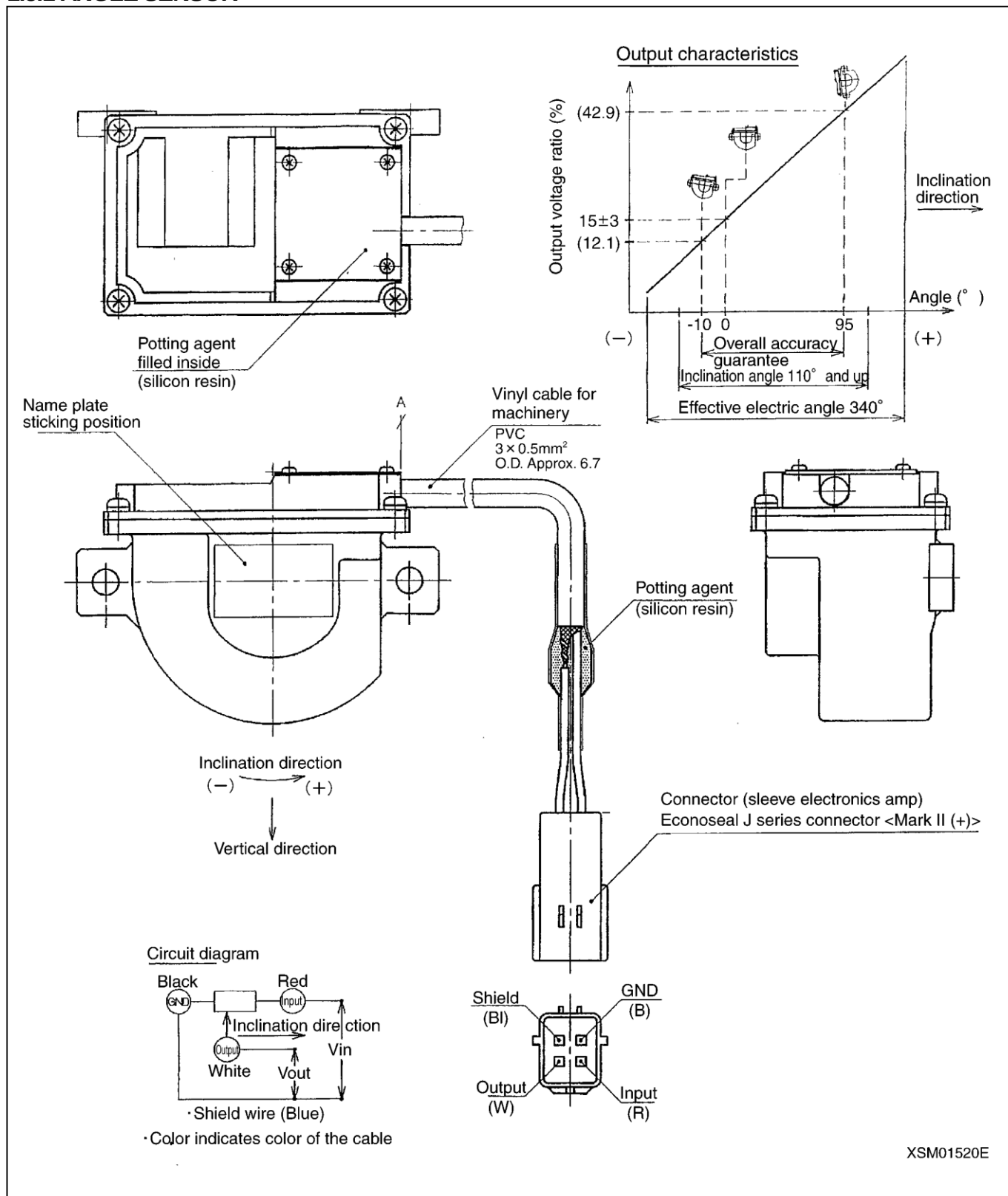
1.5 BOOM STATE DETECTOR



XSM05240E

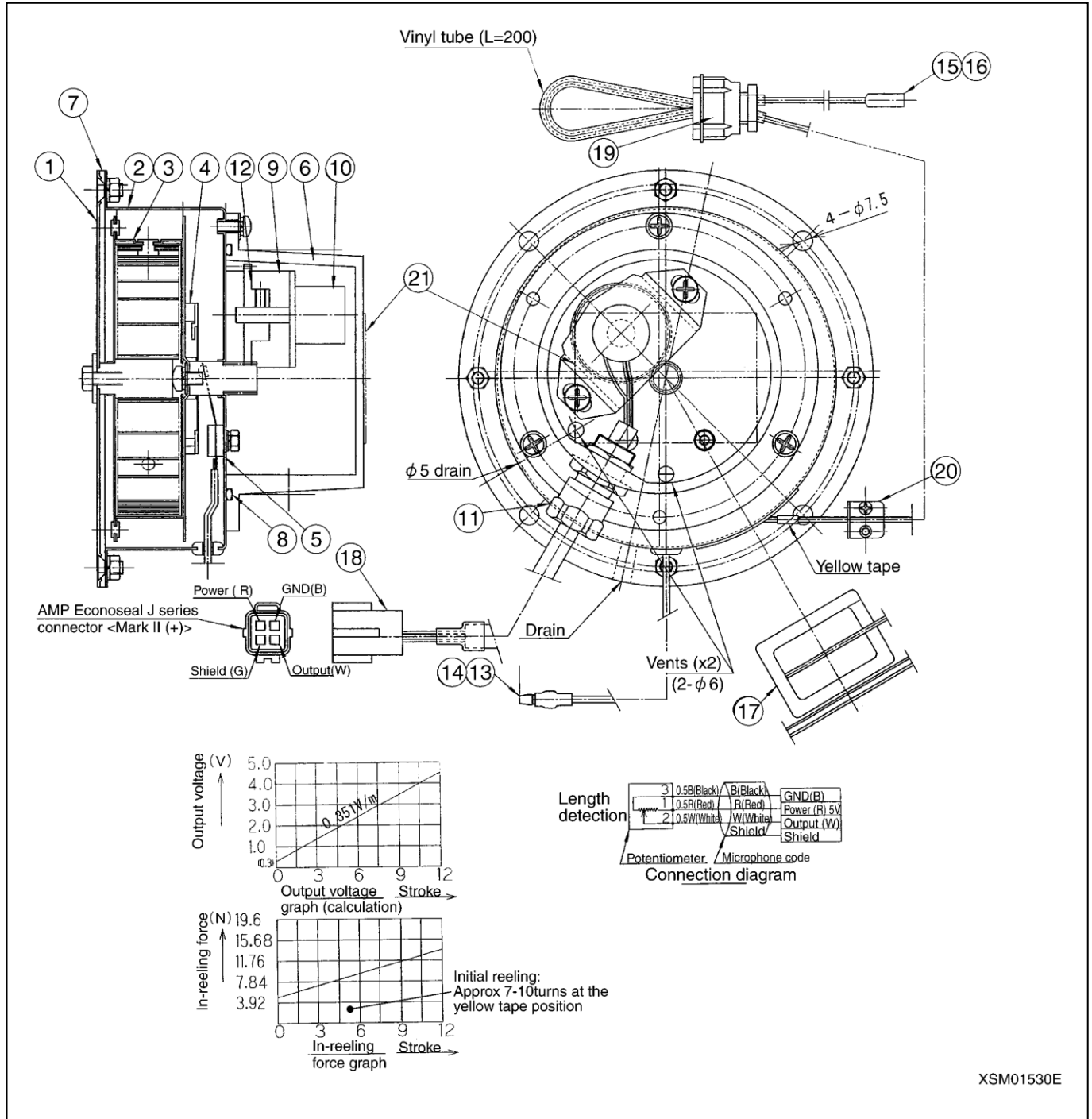
NO.	DESCRIPTION	Q'TY	NOTICE
1	Seat Plate	1	
2	Length Sensor	1	
3	Angle Sensor	1	
4	Limit Switch	2	
5	Length Sensor Bracket	1	
6	Connector Cover (A)	2	
7	Bolt	2	M6X1.0X16L (Plating)
8	Spring Washer	2	M6 (Plating)
9	Socket Head Bolt	4	M5X0.8X16L
10	Spring Washer	4	M5 (Plating)
11	Bolt	4	M6X1.0X35L (Plating)
12	Spring Washer	4	M6 (Plating)
13	Bolt	5	M6X1.0X14L (Plating)
14	Nut	1	M6X1.0 (Plating)
15	Spring Washer	5	M6 (Plating)
16	Plane Washer	1	M6 (Plating)
17	Skipped No.		
18	Skipped No.		
19	Bolt	2	M8X1.25X15L (Plating)
20	Spring Washer	2	M8 (Plating)
21	Tie Band	11	
22	Clamp	1	
23	Corrugate Tube	1	

1.5.1 ANGLE SENSOR



Specifications	
Inclination Angle	110°, min. (98°, min. to plus range and 12°, min. to minus range, based on 0° of the chart above.)
Total Accuracy	±1% under vibrating conditions (Including linearity and hysteresis).
Response	Approx. 1 second at Inclination angle 90° (Adequate under operation temperature conditions)
Potentiometer (CP-2 or equivalent)	
Significant Electrical Angle	340° +2°/-3°
Total Resistance	1 k-ohm ± 20%
Index Point	Output to calibrate to 15±3% at the condition of above chart (0°)
Insulation Resistance	200 M-ohm, minimum, DC 500 V
Withstand Voltage	AC500V, 1 minute
Rated Current	0.5W/50°C
Resistance to Environment	
Operation Temperature Range	-30 to 80°C
Stand-by Temperature Range	-40 to 80°C
Vibration Resistance	50m/S ² 33Hz Each 2 hours to 3 axes
Resistance to Impact	200m/S ² Each 3 impacts for 6 directions
Protection Classification	IP64
Damper Oil, used	Silicon Oil 500mm ² /s (Toshiba Silicon TSF451-500)

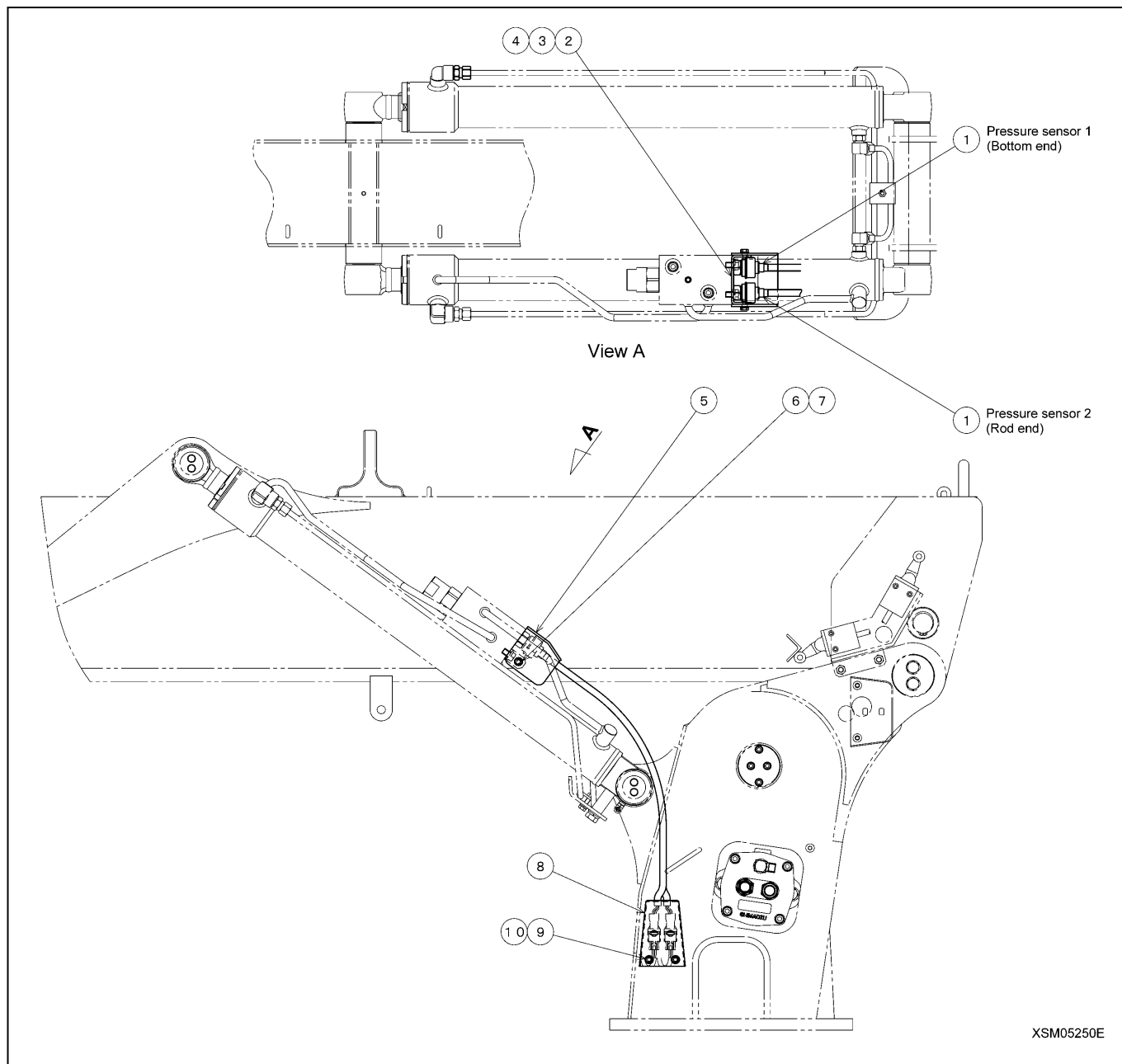
1.5.2 LENGTH SENSOR



XSM01530E

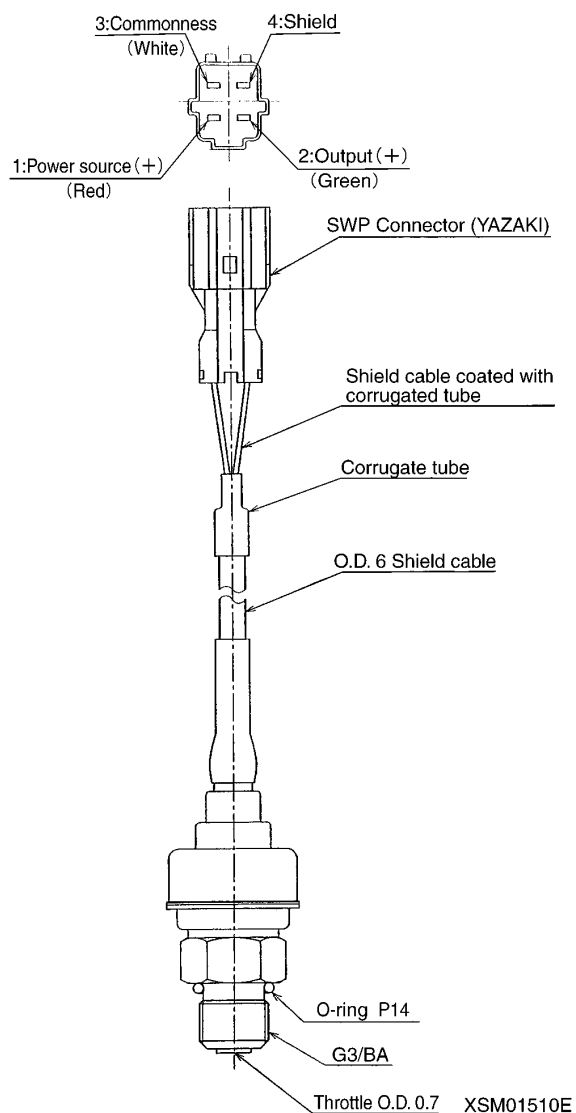
No.	Description	Q'ty	Remarks
1	Base Plate	1	
2	Case	1	
3	Drum Assembly	1	
4	Contact Cylinder Assembly	1	
5	Contact Assembly	1	
6	Potentiometer Case	1	
7	Packing	1	
8	O-ring	1	
9	Bracket	1	
10	Potentiometer	1	
11	NIPOSEAL, Seal Connector	1	
12	Gear	1	
13	Fasten Terminal (male)	1	
14	Sleeve	1	
15	Fasten Terminal (female)	1	
16	Sleeve	1	
17	Cable Guide	1	
18	Microphone Code Assembly	1	
19	Super lock	1	
20	Cable Stopper	2	
21	Caution Label	1	

1.6 LOAD DETECTOR



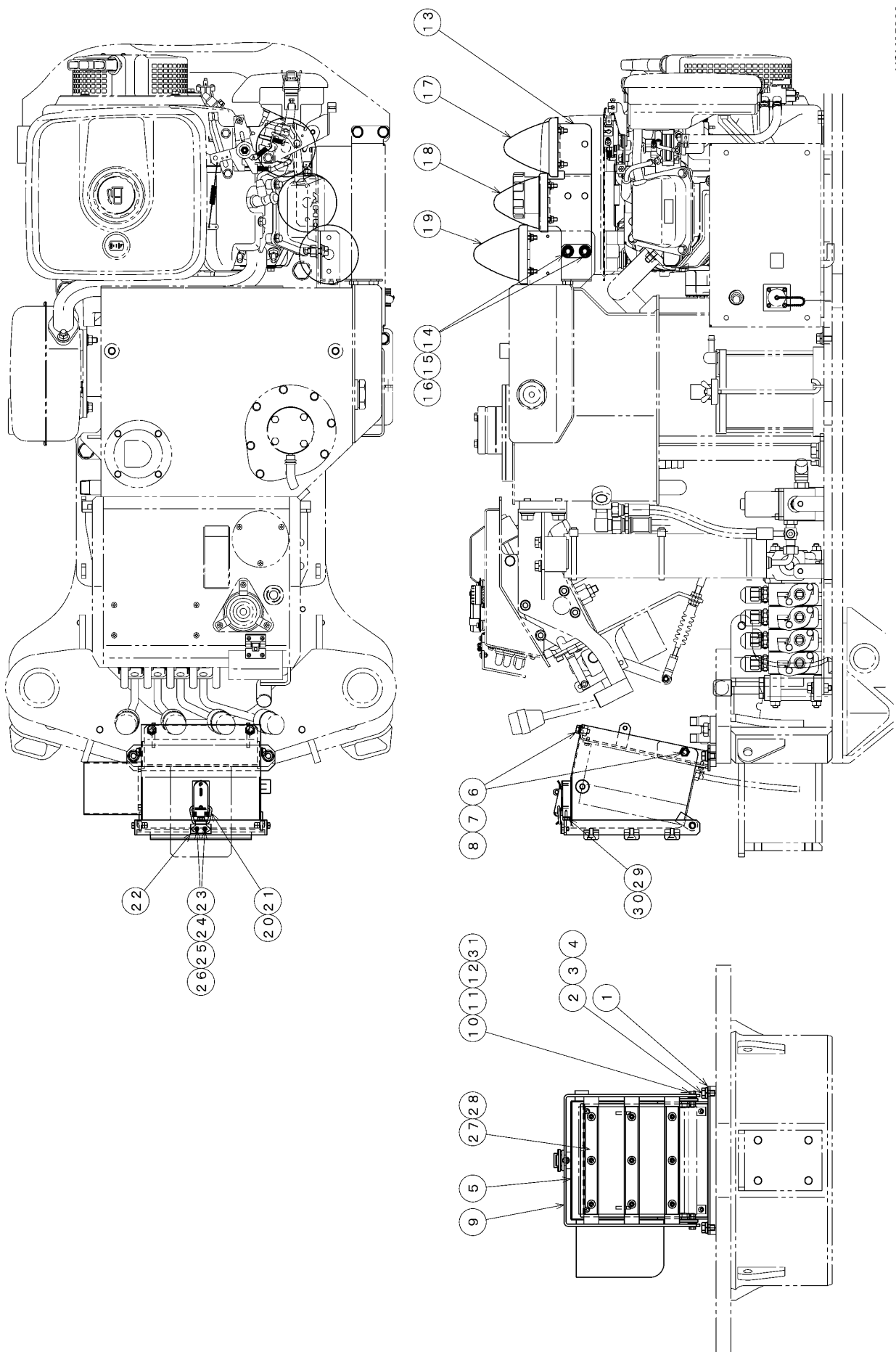
NO.	DESCRIPTION	QTY	NOTICE
1	Pressure Sensor	2	
2	Cover Bracket	1	
3	Bolt	2	M8X1.25X14L (Plating)
4	Spring Washer	2	M8 (Plating)
5	Pressure Sensor Cover	1	
6	Bolt	2	M6X1.0X12L (Plating)
7	Spring Washer	2	M6 (Plating)
8	Connector Cover (B)	1	
9	Bolt	2	M6X1.0X35L (Plating)
10	Spring Washer	2	M6 (Plating)

1. 6.1 PRESSURE SENSORS



Specifications/Capacity	
Working range	0 to 35 MPa
Permissible pressure	52.5 MPa
Power Supply Voltage	12V DC $\pm 10\%$
Power Form	1 to 5 DC 3 wires
Load Resistance	10 K-ohm, min.
Accuracy	$\pm 1.0\%$ F.S. (Including linearity, hysteresis and repeatability at $23 \pm 2^\circ\text{C}$)
Temperature Coefficient, origin	$\pm 0.1\%$ F.S./ $^\circ\text{C}$
Temperature Coefficient, span	$\pm 0.1\%$ F.S./ $^\circ\text{C}$
Temperature Compensation Range	-20 to $+70^\circ\text{C}$
Operation Temperature Range	-20 to $+70^\circ\text{C}$
Stand-by Temperature Range	-20 to $+80^\circ\text{C}$
Vibration Resistance	66.6miri/S^2 (33.3Hz) X direction 4Hr Y direction 2Hr Z direction 2 Hr
Resistance to Impact	297miri/S^2 (11ms or less) X, Y and Z, 3 impacts each.
Protection Classification	IP54 (Except Cables)
Insulation Resistance	100 M-ohm, min. (50V DC)
Power Consumption	10 mA DC, max.

1.7 MOMENT LIMITER ACCESSORY



XSM05260

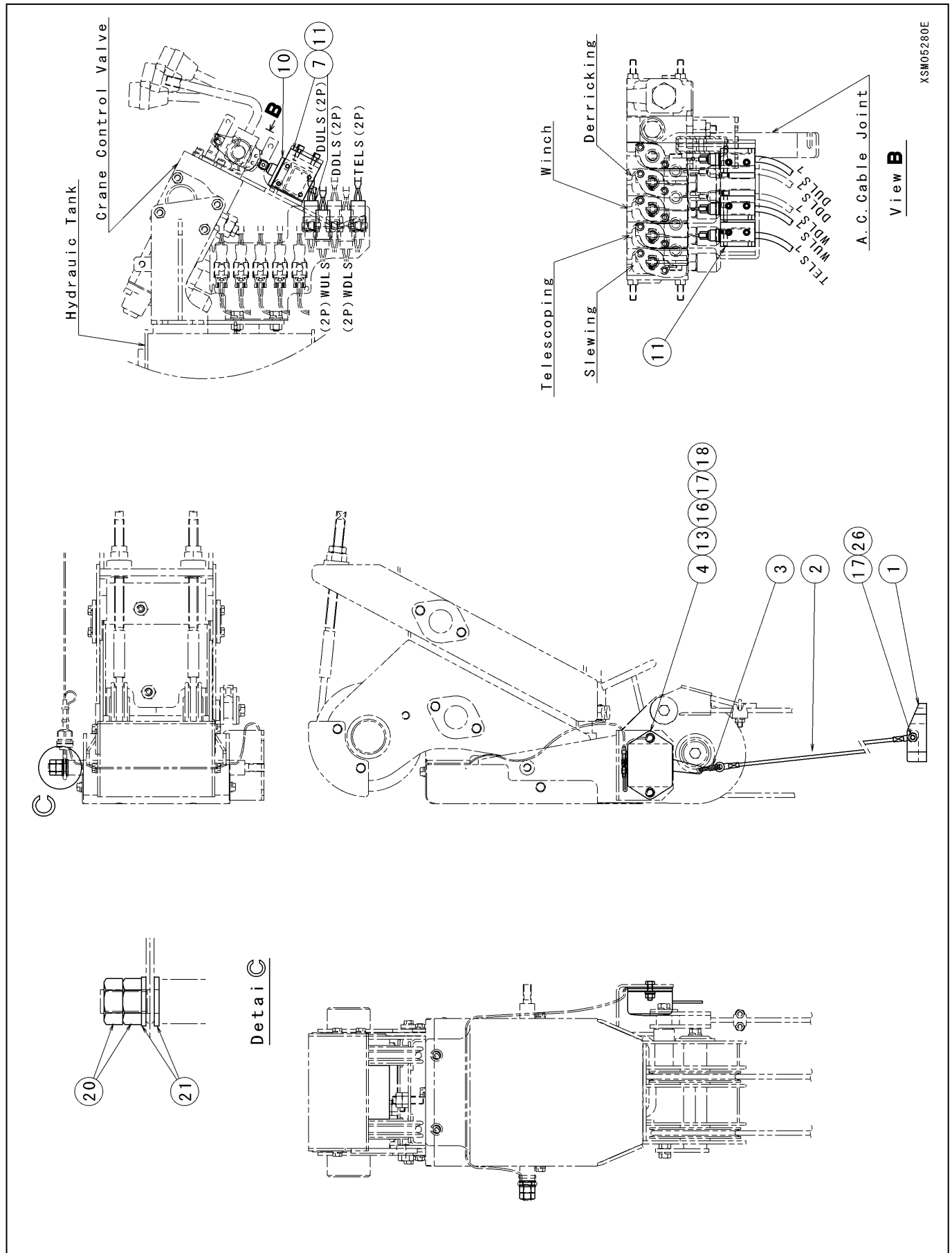
NO.	DESCRIPTION	Q'TY	NOTICE
1	Moment Limiter Display Bracket	1	
2	Bolt	2	M8X1.25X14L (Plating)
3	Spring Washer	2	M8 (Plating)
4	Plane Washer	2	M8 (Plating)
5	Moment Limiter Display Cover	1	
6	Bolt	4	M6X1.0X16L (Plating)
7	Spring Washer	4	M6 (Plating)
8	Plane Washer	4	M6 (Plating)
9	Moment Limiter Display Cover	1	
10	Bolt	2	M5X0.8X20L (Plating)
11	Spring Washer	4	M5 (Plating)
12	Plane Washer	4	M5 (Plating)
13	Working Status Lamp Bracket	1	
14	Bolt	2	M8X1.25X25L (Plating)
15	Spring Washer	2	M8 (Plating)
16	Plane Washer	2	M8 (Plating)
17	Working Status Lamp (Green)	1	
18	Working Status Lamp (Yellow)	1	
19	Working Status Lamp (Red)	1	
20	Buckle	1	
21	Screw	2	M3X0.5X12L (Plating)
22	Spacer	1	
23	Screw	2	M3X0.5X12L (Plating)
24	Spring Washer	2	M3 (Plating)
25	Plane Washer	2	M3 (Plating)
26	Nut	2	M3X0.5 (Plating)
27	Plate	3	
28	Screw	9	M6X1.0X14L (Plating)
29	Rubber Mount	1	
30	Screw	1	M3X0.5X8L (Plating)
31	Washer	2	

3-20



NO.	DESCRIPTION	QTY	NOTICE
1	Roller Arm	1	
2	Axle	1	
3	Drive Arm	1	
4	Base	1	
5	Limit Switch Cover	1	
6	Roller	1	
7	Roller Shaft	1	
8	Bearing Spacer	2	
9	Spacer (1)	1	
10	Spacer (2)	1	
11	Bushing	2	
12	Limit Switch	1	
13	Expanding Spring	1	
14	Ball Bearing	2	#6001ZZ
15	Bushing	2	
16	Parallel Key	1	5X5X16L
17	Bolt	3	M8X1.25X25L (Plating)
18	Bolt (With Washer)	3	M6X1.0X12L (Plating)
19	Socket Head Bolt	2	M5X0.8X20L (Plating)
20	Nylon Nut	1	M12X1.75 (Plating)
21	Nut	1	M8X1.25 (Plating)
22	Spring Washer	2	M8 (Plating)
23	Plane Washer	1	M14 (Plating)
24	Plane Washer	1	M12 (Plating)
25	Plane Washer	2	M8 (Plating)
26	Snap Ring	1	For shaft (C-15)
27	Snap Ring	2	For hole (C-12)

1.9 OVER HOISTING STOP SYSTEM

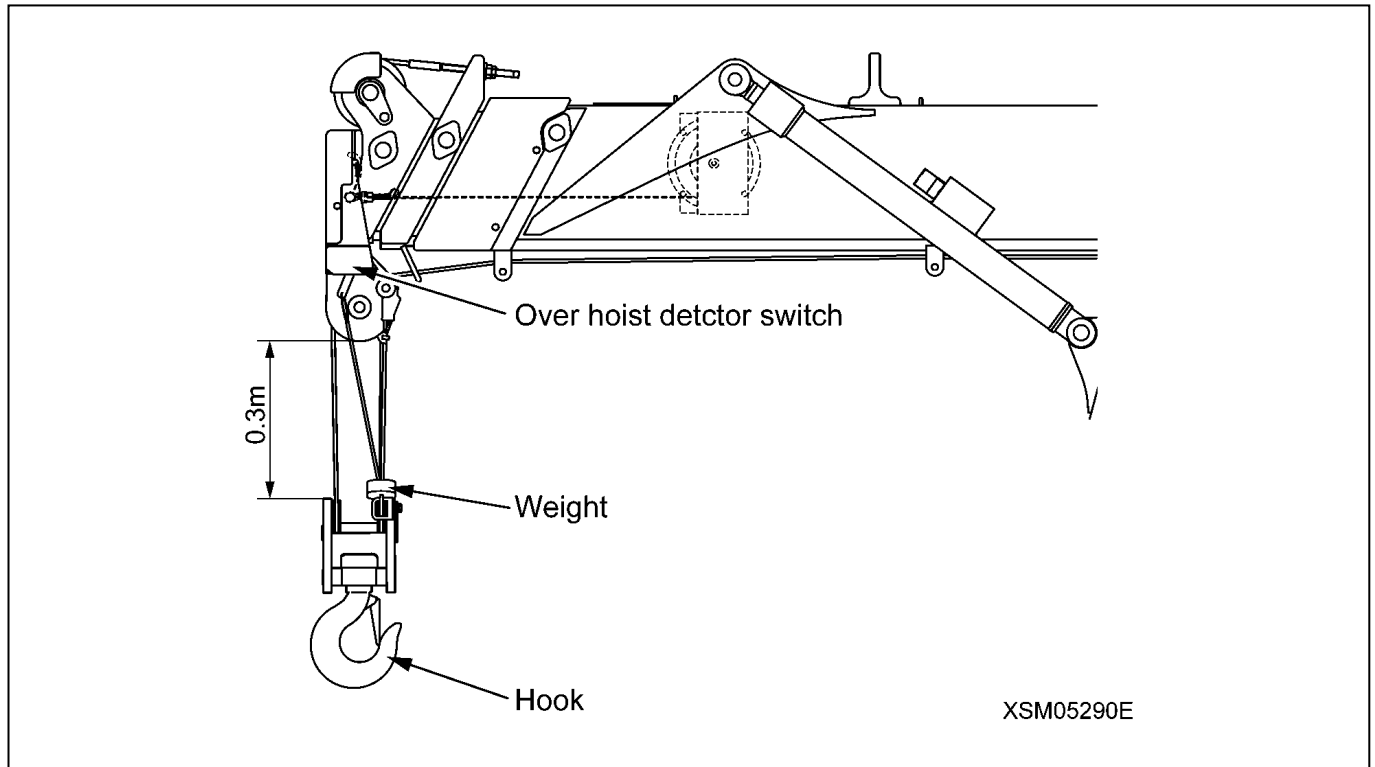


NO.	DESCRIPTION	Q'TY	NOTICE
1	Protect Weight	1	
2	Protective Rope	1	
3	Ring	1	
4	Over Hoist Detector Switch	1	
5	No. skipped		
6	No. skipped		
7	Limit Switch Bracket	3	
8	No. skipped		
9	No. skipped		
10	Limit Switch Assembly	3	
11	Socket Head Bolt	8	M5X0.8X16L (Plating)
12	No. skipped		
13	Bolt	2	M6X1.0X20L (Plating)
14	No. skipped		
15	No. skipped		
16	Nut	2	M6X1.0 (Plating)
17	Spring Washer	3	M6 (Plating)
18	Plane Washer	2	M6 (Plating)
19	No. skipped		
20	Nut	1	M10X1.5 (Plating)
21	Plane Washer	1	M10 (Plating)
22	No. skipped		
23	No. skipped		
24	No. skipped		
25	Tie Band	15	
26	Bolt	1	M6X1.0X55L (Plating)

1.9.1 OPERATION PRINCIPLE

When the hook is raised too much, the weight hoisted through the wire rope is pushed up by the hook, and activates the over hoist detector switch.

The contact of the over hoist detector switch opens, and the signal thereof enters the moment limiter computer, and causes the hook raising and boom extending operations to stop. At the same time, the lamp at the moment limiter display flashes, and in this condition, a short intermittent sound alarm is sounded whenever any hook raising or boom extending operation is attempted.

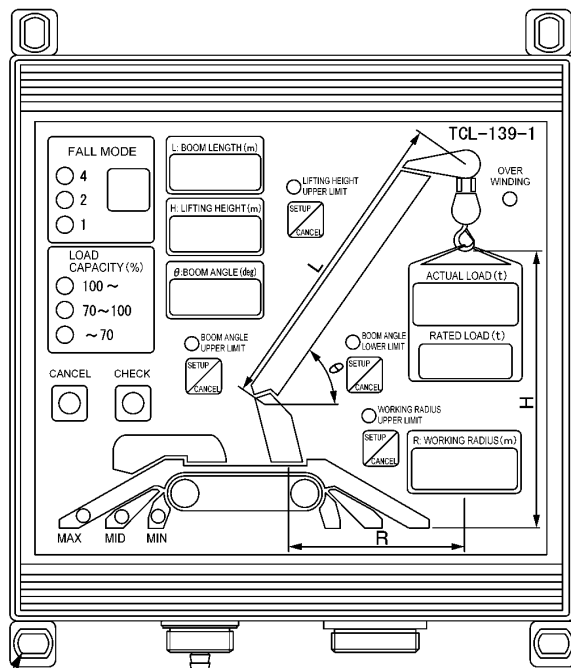


2. MOMENT LIMITER OVERVIEW AND FEATURES

Items		MC-174C
Type of Moment Limiter		Automatic Cut Out
Crane Rated Load		0 to 1.72 ton [Pressure Range: 0 to 20.6 MPa (0 to 210kg/cm ²)]
Power Supply		DC 12V (DC 10V – 15V)
Max. Power Dissipation	Display Panel	0.8 A (at DC 12V)
	Converter	0.2A (at DC 12V)
Calibration		Electrical Calibration

3. EXTERNAL VIEW OF MOMENT LIMITER

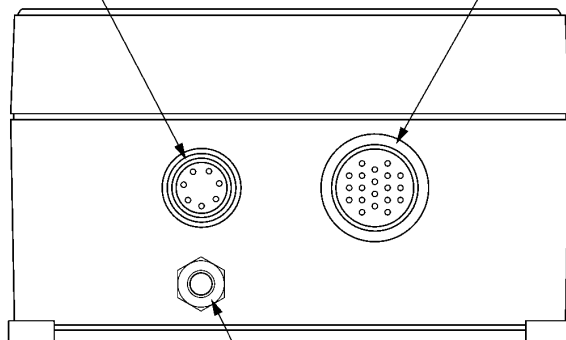
3.1 DISPLAY UNIT



4 Point-Long hole
(5) × (7.9)

Receptacle
RM15WTR-8P:Hirose

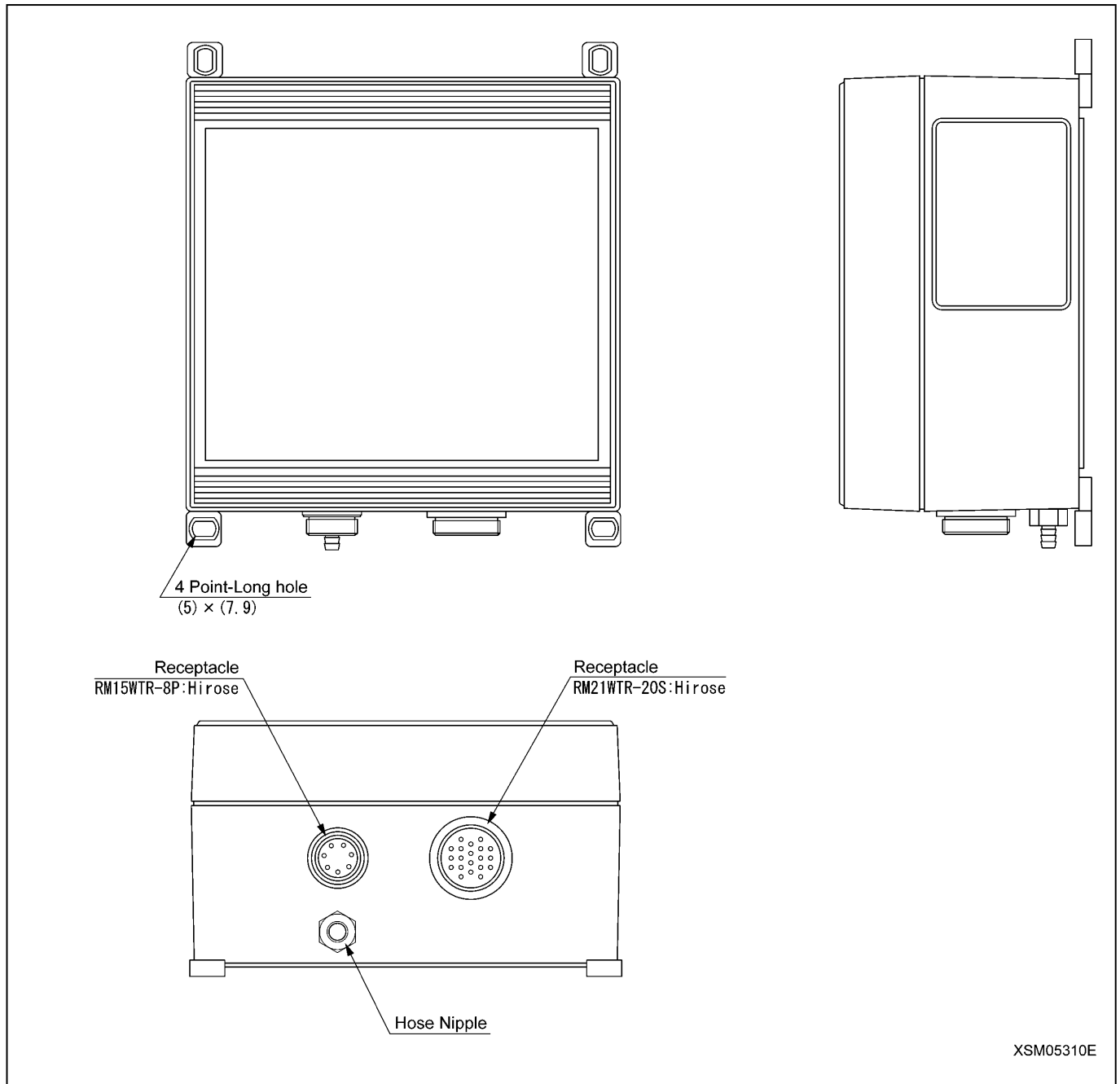
Receptacle
RM21WTR-20S:Hirose



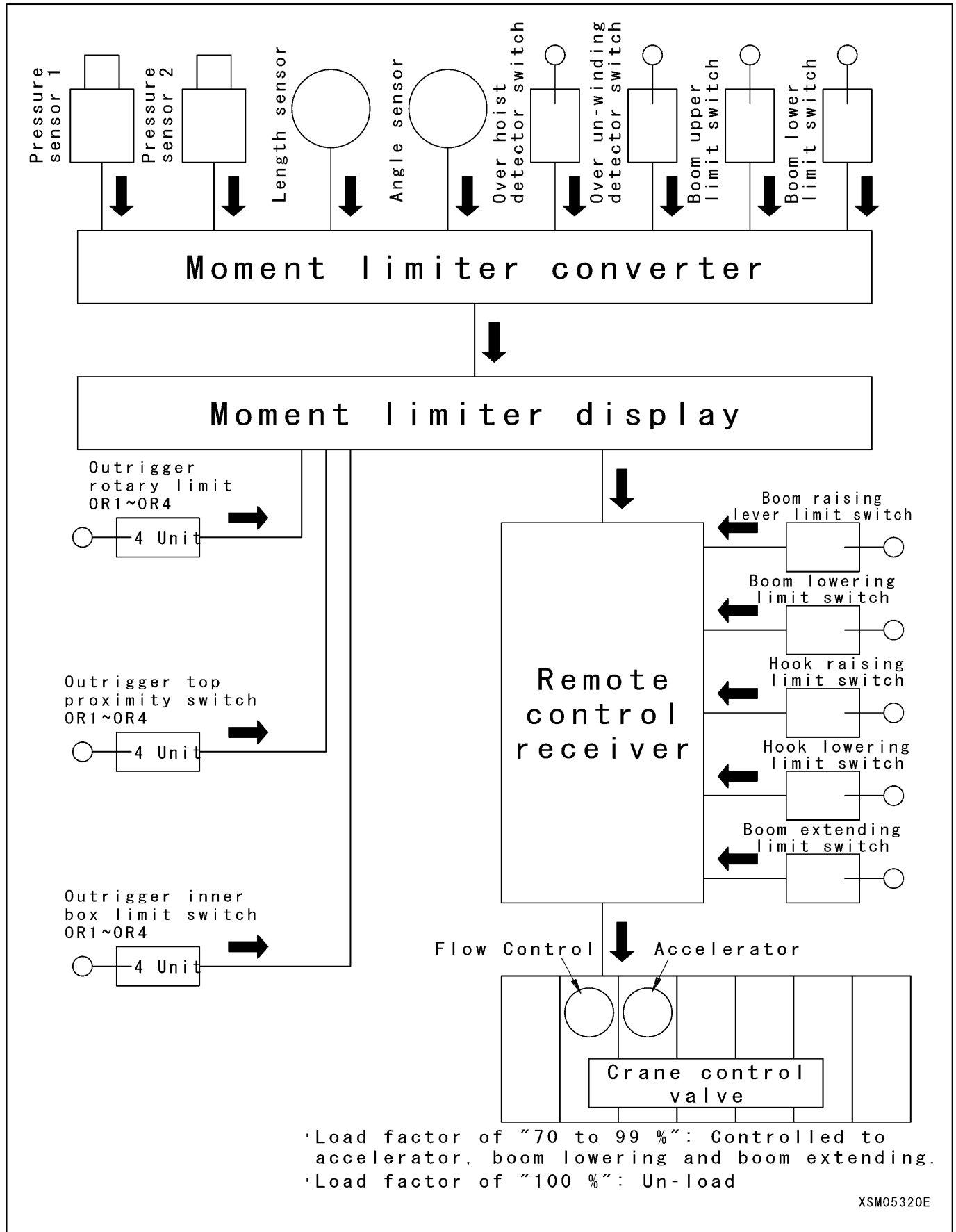
Hose Nipple

XSM05300E

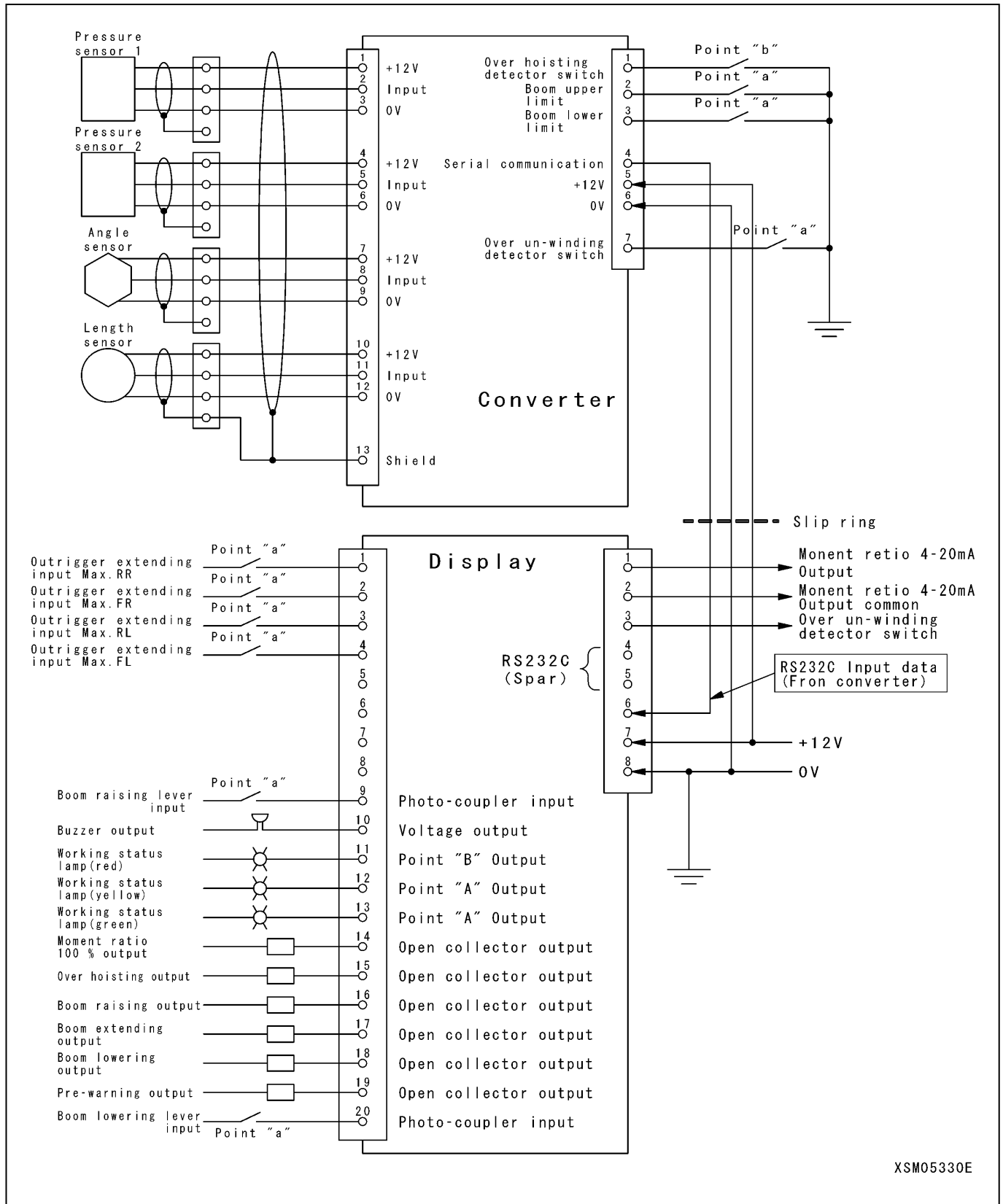
3.2 CONVERTER



4. SYSTEM DIAGRAM



5. CONNECTOR DIAGRAM



6. CONNECTOR PIN ASSIGNMENT

The Converter has two connectors and the Display Unit has two connectors.

Pin assignment of each connector are as listed below:

6.1 CONVERTER CONNECTORS

[1] POWER CONTROL CONNECTOR

Model: RM15WTR-8P (HIROSE in Japan)

[Corresponding Plug (Harness side): RM15WTP-8S-0 (HIROSE in Japan)]

Pin No.	Signal
1	Over Hoist Detector input (1b contact)
2	Boom Angle Upper Limit input (1a contact)
3	Boom Angle Lower Limit input (1a contact)
4	Serial Communication output
5	+12V
6	0V
7	Over Un-winding Limit Switch input (Optional)
8	Not used

[2] SENSOR CONNECTOR

Model: RM21WTR-15S (HIROSE in Japan)

[Corresponding Plug (Harness side): RM21WTP-15P0 (HIROSE in Japan)]

Pin No.	Signal	Pin No.	Signal
1	Pressure Sensor 1 +12V	9	Angle Sensor GND
2	Pressure Sensor 1 input	10	Length Sensor +12V
3	Pressure Sensor 1 GND	11	Length Sensor input
4	Pressure Sensor 2 +12V	12	Length Sensor GND
5	Pressure Sensor 2 input	13	Shield
6	Pressure Sensor 2 GND	14	Not used
7	Angle Sensor +12V	15	Not used
8	Angle Sensor input		

6.2 DISPLAY UNIT CONNECTORS

[1] POWER CONTROL CONNECTOR

[Corresponding Plug (Harness side): RM15WTP-8S-0 (HIROSE in Japan)]

Pin No.	Signal
1	Moment ratio 4 – 20 mA output (+)
2	Moment ratio 4 – 20 mA output (-)
3	Over Un-winding output (Optional)
4	Not used
5	Not used
6	Serial Communication output
7	+12V
8	0V

Model: HD34-24-31SN (for Japan/Germany)

[Corresponding Plug (Harness side): HD36-24-31PE-059 for Japan/Germany]

Pin No.	Signal	Pin No.	Signal
1	Outrigger 1 Extending input Max.	11	Working Status Lamp (Red) output
2	Outrigger 2 Extending input Max.	12	Working Status Lamp (Yellow) output
3	Outrigger 3 Extending input Max.	13	Working Status Lamp (Green) output
4	Outrigger 4 Extending input Max.	14	Moment Ration 100 % output
5	Not used	15	Over Hoisting output
6	Not used	16	Boom Raising output
7	Not used	17	Boom Extending output
8	Not used	18	Boom Lowering output
9	Boom Raising Lever input	19	Pre-warning output
10	Buzzer output	20	Boom Lowering Lever Input

7. INPUT/OUTPUT

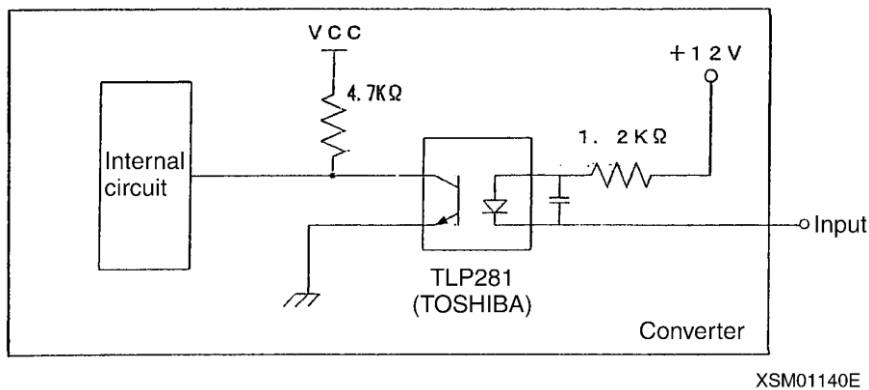
7.1 CONVERTER

Direction	Description	Q'ty	Specifications
Input	Pressure Sensor 1	1	Analog input [1 to 2.35V / 0 to 20.6 MPa (0 to 210 kgf/cm ²)]
	Pressure Sensor 2	1	Analog input [1 to 2.35V / 0 to 20.6 MPa (0 to 210 kgf/cm ²)]
	Angle Sensor	1	Analog input (1.8 to 4.619V / 0 to 80°)
	Length Sensor	1	Analog input (0.72 to 3.77V / 1.83 to 5.45 m)
	Boom Angle Upper Limit	1	Photo Coupler input (See Note 1)
	Boom Angle Lower Limit	1	Photo Coupler input (See Note 1)
	Over Hoisting Detector	1	Photo Coupler input (See Note 1)
	Over Un-winding Detector	1	Photo Coupler input (See Note 1)
Output	RS232C output	1	Data from each Sensors and Switches

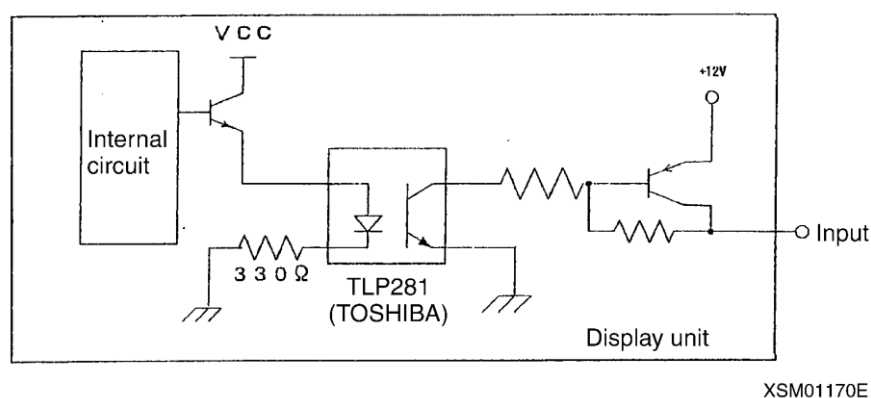
7.2 DISPLAY UNIT

Direction	Description	Q'ty	Specifications
Input	RS232C	1	Input Data from Converter
	Outrigger Extending Detector input (Max. X 4, Mid. X 4)	4	Photo Coupler input (See Note 1)
Output	Boom Raising Lever input	1	Photo Coupler input (See Note 1)
	Buzzer output	1	Voltage output Transistor Spec. (DC12V 50mA Max.) (See Note 2)
	Working Status Lamp (Red) output	1	B Contact output Relay output (Contact Capacity +12V 0.5A Max.) (See Note 3)
	Working Status Lamp (Yellow) output	1	A Contact output Relay output (Contact Capacity +12V 0.5A Max.) (See Note 3)
	Working Status Lamp (Green) output	1	A Contact output Relay output (Contact Capacity +12V 0.5A Max.) (See Note 3)
	Moment 100% output	1	Open Collector output Transistor Spec. (DC12V 50mA Max.) (See Note 4)
	Over Hoisting output	1	Open Collector output Transistor Spec. (DC12V 50mA MAX) (See Note 4)
	Moment Ratio	1	Analog output (4 to 20mA)
	Boom Raising output	1	Open Collector output Transistor Spec. (DC12V 50mA MAX) (See Note 4)
	Boom Extending output	1	Open Collector output Transistor Spec. (DC12V 50mA MAX) (See Note 4)
	Boom Lowering output	1	Open Collector output Transistor Spec. (DC12V 50mA MAX) (See Note 4)
	Pre-warning output	1	Open Collector output Transistor Spec. (DC12V 50mA MAX) (See Note 4)
	Boom Lowering Lever input	1	Photo Coupler input (See Note 1)
	Over Un-winding output	1	Open Collector output Transistor Spec. (DC12V 50mA MAX) (See Note 4)

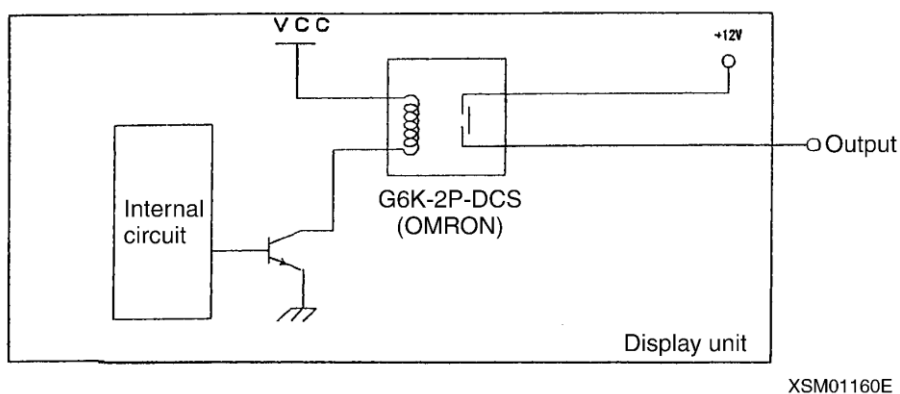
Note 1: Photo Coupler input



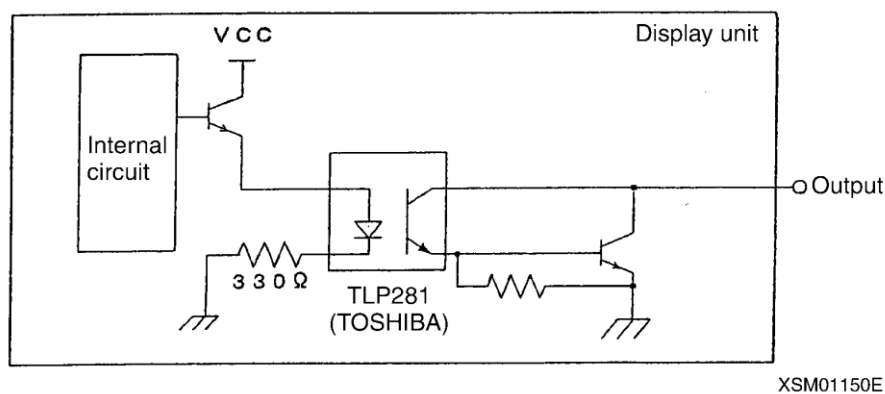
Note 2: Voltage output



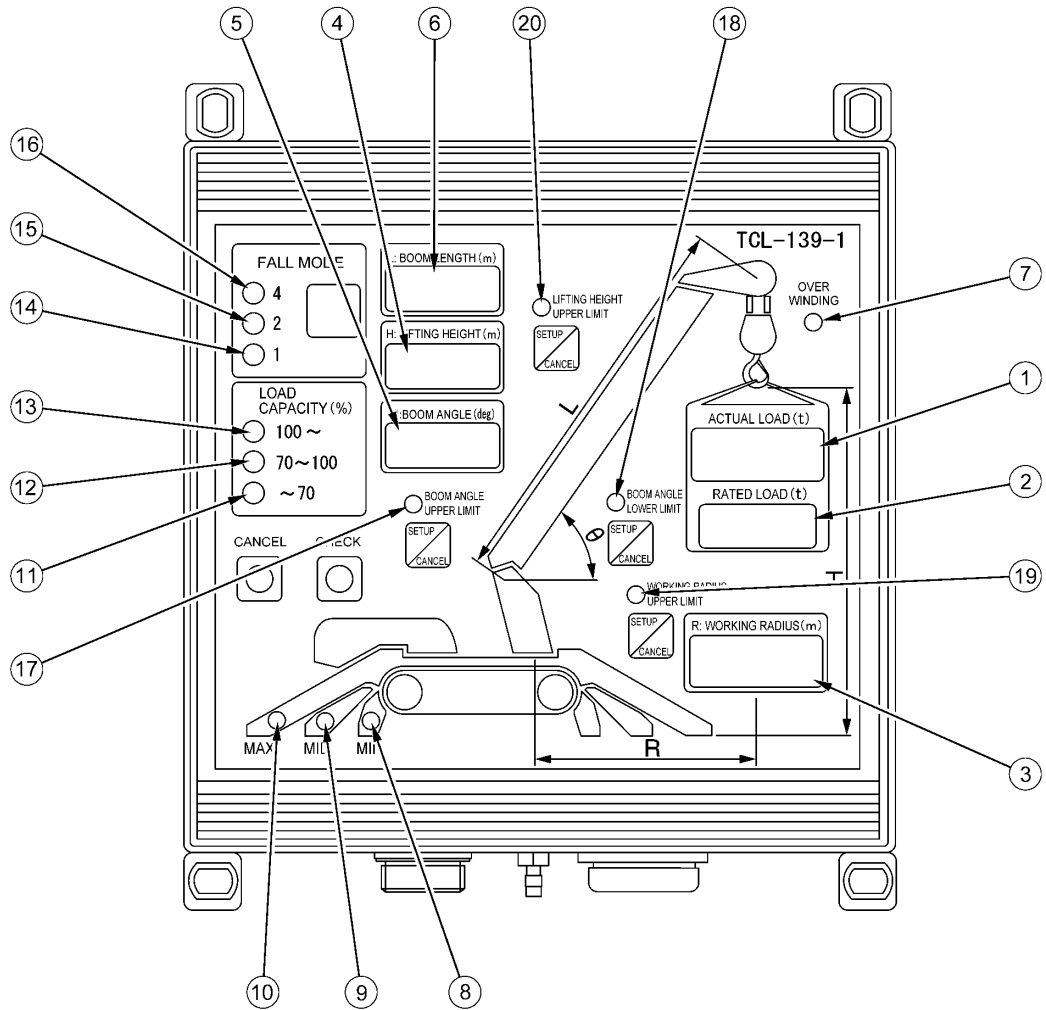
Note 3: Relay output



Note 4: Open Collector output



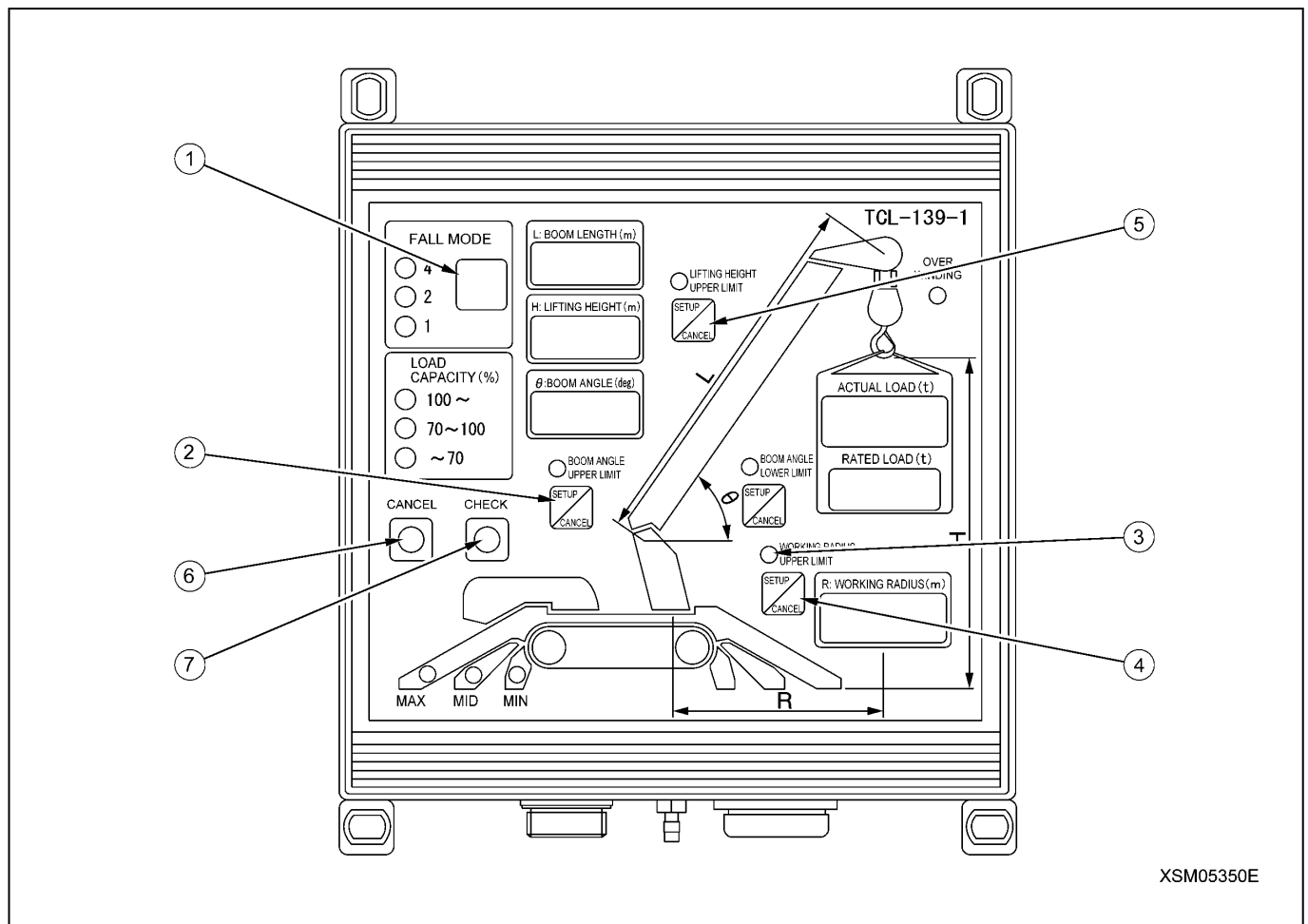
8. DISPLAYS



XSM05340E

No.	Item	Type	Remarks
1	Actual Load	7 Segments	Permanent Indication (Letter height 10mm)
2	Total rated load	7 Segments	Permanent Indication (Letter height 8mm)
3	Working Radius	7 Segments	Permanent Indication (Letter height 10mm)
4	Lifting Height	7 Segments	Permanent Indication (Letter height 8mm)
5	Boom Angle	7 Segments	Permanent Indication (Letter height 8mm)
6	Boom Length	7 Segments	Permanent Indication (Letter height 8mm)
7	Over Hoist	LED (Red)	LED flashes when Over Hoist Detector input/output is ON (Open).
8	Outriggers Extension, Min.	LED (orange)	LED lights when one or more Detectors input/output for Outriggers Extension Max. or Mid. are OFF.
9	Outriggers Extension, Mid. ★MC-174C is not used.	LED (orange)	LED lights when all of four Detectors input/output for Outriggers Extension MID are ON and one or more Detectors input/output for Outriggers Extension Max. are OFF.
10	Outriggers Extension, Max.	LED (orange)	LED lights when all of four Detectors input/output for Outriggers Extension Max. are ON.
11	Load Capacity less than 70%	LED (orange)	LED lights when Load Capacity is less than 70%.
12	Load Capacity 70 to less than 100%	LED (orange)	LED lights when Load Capacity is 70% or more and less than 100%.
13	Load Capacity 100% or more	LED (orange)	LED lights when Load Capacity is less than 100% or more.
14	Wire Fall: 1 Wire	LED (orange)	Push the Wire Falls Selector Switch and hold for two seconds or more shall turn the "Wire Fall" LED Indicator. Another push and hold shall switch to the next configuration. The Wire Fall configuration indicated by LED shall be assigned to the Boom Moment computation.
15	Wire Fall: 2 Wires	LED (orange)	
16	Wire Fall: 4 Wires	LED (orange)	
17	Boom Angle Upper Limit	LED (Red)	LED lights when Boom Angle Upper Limit value is set and it flashes when the Boom angle reaches the upper limit.
18	Boom Angle Lower Limit	LED (Red)	LED lights when Boom Angle Lower Limit value is set and it flashes when the Boom angle reaches the lower limit.
19	Working Radius Upper Limit	LED (Red)	LED lights when Max. Working Radius value is set and it flashes when the Radius reaches the limit.
20	Lifting Height Upper Limit	LED (Red)	LED lights when Lifting Height Upper Limit value is set and it flashes when the height reaches the limit.

9. SWITCHES



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No.	Function	Remarks
1	Wire Falls Selector Switch	Push the Wire Falls Selector Switch to switch for another Wire Fall configuration. Push the Switch and hold for two seconds or more shall activate configuration change function. One push for more seconds shall not proceed continuously. Another push and hold shall switch to the further configuration. Sequence of switching is 4 - 2 - 1 - 4 - ... of Wire Falls.
2	Set and Cancel Switch for Boom Angle Upper Limit	Push the "Boom Angle Upper Limit" Switch to set or cancel the Boom Angle Upper Limit. Push the Switch and hold for two seconds or more shall set the current angle as the upper limit. Push the Switch and hold for five seconds or more shall cancel the current value. One push for more seconds shall not proceed continuous set/cancel switching. (It is required, to once cancel the Switch.)
3	Set and Cancel Switch for Boom Angle Lower Limit	Push the "Boom Angle Lower Limit" Switch to set or cancel the boom angle lower limit. Push the Switch and hold for two seconds or more shall set the current angle as the lower limit. Push the Switch and hold for five seconds or more shall cancel the current value. One push for more seconds shall not proceed continuous set/cancel switching. (It is required, to once cancel the Switch.)

No.	Function	Remarks
4	Set and Cancel Switch for Working Radius Upper Limit	Push the "Working Radius Upper Limit" Switch to set or cancel the Working Radius Upper Limit. Push the Switch and hold for two seconds or more shall set the current radius as the upper limit. Push the Switch and hold for five seconds or more shall cancel the current value. One push for more seconds shall not proceed continuous set/cancel switching. (It is required, to once cancel the Switch.)
5	Set and Cancel Switch for Lifting Height Upper Limit	Push the "Boom Lifting Height Upper Limit" Switch to set or cancel the lifting height upper limit. Push the Switch and hold for two seconds or more shall set the current height as the upper limit. Push the Switch and hold for five seconds or more shall cancel the current value of height. One push for more seconds shall not proceed continuous set/cancel switching. (It is required, to once cancel the Switch.)
6	Cancel Switch	All the upper and lower limits shall be canceled when this "Cancel Switch" and "Check Switch" are push and held for five seconds or more, simultaneously.
7	Check Switch	Each one push of this Switch shall indicate values of specific setting. Each one push shall indicate: - Boom Angle Indicator shows Boom Angle Upper Limit (Boom Angle Upper Limit LED flashes). ⇒ Boom Angle Indicator shows Boom Angle Lower Limit (Boom Angle Lower Limit LED flashes). ⇒ Working Radius Indicator shows Working Radius Upper Limit (Working Radius Upper Limit LED flashes). ⇒ Lifting Height Indicator shows Lifting Height Upper Limit (Lifting Height Upper Limit LED flashes). ⇒ Restored to initial indicating of actual values. ⇒ Boom Angle Indicator shows Boom Angle Upper Limit (Boom Angle Upper Limit LED flashes). ...Iteration... Indicators other than assigned shall be out to blank. While this Check Switch mode, releasing the Switch for five seconds or more, or pushing any other Switches shall resume to initial indicating of actual values. The assigned Indicator may indicate blank in case no limit value is set to the functions.

10. DISPLAY UNIT; DETAIL OF EACH SEGMENT

[1] Outriggers Extending Detector input (4 sets)

1. Controls as below shall be active when all of four Outrigger Extending Detectors input for maximum is ON:
 - “Outriggers Extension Max.” LED shall light.
 - “Total rated load” for “Outriggers Extension Max.” configuration shall be in use.
2. Controls as below shall be active when one or more Detectors input for Outriggers Extension Max. are OFF.
 - “Outriggers Extension Min.” LED shall light.
 - “Total rated load” for “Outriggers Extension to other than Max.” configuration shall be in use.

[2] Over Hoist Detector input

Controls as below shall be active when Over Hoist Detector input is ON:

- “Over Winding” LED shall light.
- Over Hoist Detector output shall be ON

[3] Boom Angle Upper Limit Detector input

Controls as below shall be active when Boom Angle Upper Limit Detector input is ON:

- Boom Angle Upper Limit Detector output shall be OFF (Open).

[4] Boom Angle Lower Limit Detector input

Controls as below shall be active when Boom Angle Lower Limit Detector input is ON:

- Boom Angle Lower Limit Detector output shall be ON.

[5] Over Un-Winding Detector input

Controls as below shall be active when Over Un-Winding Detector input is ON:

- Over Un-Winding Detector output shall be ON.

[6] Fall Mode

Push the Switch and hold for two seconds or more shall switch to another Fall Mode configuration. One push for more seconds shall not proceed continuously.

Another push and hold shall switch to the next configuration. Sequence of switching is 1 - 2 - 4 - 1 - ... of Wire Falls.

1. When 4 wires Indicator (LED) is on, “Total rated load” for “4 wires” configuration shall be in use.
2. When 2 wires Indicator (LED) is on, “Total rated load” for “2 wires” configuration shall be in use.
3. When 1 wire Indicator (LED) is on, “Total rated load” for “1 wire” configuration shall be in use.

11. START-UP SEQUENCE

1. All LEDs shall light approximately for 2 seconds. Only Green of Green/Red combination LEDs shall light.
2. All the switches activation shall be checked.
3. Input from external devices shall be checked.
4. Status of output is as shown in the table below:

Signals	Output
Buzzer output	OFF
Working Status Lamp (Red) output	ON (Continuity)
Working Status Lamp (Yellow) output	OFF
Working Status Lamp (Green) output	OFF
Moment Ratio exceeds 100% output	ON
Over Hoisting output	OFF
Boom Raising output	OFF
Boom Extending output	OFF
Boom Lowering output	OFF
Pre-warning output	OFF
Moment Ratio 4 to 20mA	20mA
Over Un-winding output	OFF

12. MOMENT LIMITER FUNCTIONS

[1] When Load Capacity is less than 70%.

- LED lights up “Load Capacity less than 70%”.

[2] When Load Capacity is more than 70% and less than 100%.

- LED lights up “Load Capacity 70% or more and less than 100%”.

[3] When Load Capacity is 100% or more.

- LED lights up “Load Capacity 100% or more”.
- “Moment 100% output” shall be ON.

[4] Moment Ratio output (4 to 20mA)

- Moment Ratio 70%: 4mA to Moment Ratio 99%: 20mA; output linear current
- Output is fixed to 4mA when Moment Ratio is 70% or less.
- Output is fixed to 20mA when Moment Ratio is 99% or more.
- Output is fixed to 120mA when any errors occur.

[5] Working Status Lamp (Green, Yellow, Red) output and Buzzer output

- Load Capacity less than 90%: Continuity to “Working Status Lamp, Green” shall start.
- Load Capacity 90% or more and less than 100%: Continuity to “Working Status Lamp, Yellow” shall start and “Buzzer output” shall be ON with intermission.
- Load Capacity 100% or more : Continuity to “Working Status Lamp, Red” shall start and “Buzzer output” shall be ON with continuation.

13. DISPLAY OF SPECIFIC INDICATORS

[1] ACTUAL LOAD INDICATOR

Load shall be compensated by “Boom Raising Lever input” and “Boom Lowering Lever input” for computing actual load.

Actual Load shall be displayed in unit of “Ton” after so converted and rounded off to one decimal place. (XX.X)

Minus value is not available for display.

Only in the calibration mode, Actual Load shall be rounded off to tow decimal places and displayed. (X.XX)

[2] RATED LOAD INDICATOR

Actual Load shall be displayed in unit of “Ton” after so converted and rounded off to one decimal place. (XX.X)

Minus value is not available for display.

[3] WORKING RADIUS INDICATOR

Working Radius shall be displayed in unit of “Meter” after so converted and rounded off to one decimal place. (XX.X)

[4] LIFTING HEIGHT INDICATOR

Lifting Height shall be displayed in unit of “Meter” after so converted and rounded off to one decimal place. (XX.X)

[5] BOOM ANGLE INDICATOR

Value of angle θ shall be displayed after rounded off to one decimal place. (XX.X)

[6] BOOM LENGTH INDICATOR

Boom Length shall be displayed in unit of “Meter” after so converted and rounded off to one decimal place. (XX.X)

[7] OTHERS

1. The Working Status Lamp Red shall be B contact output and keep the continuity between the contacts when the unit stalls.
Therefore, the Working Status Lamp Red is lit at unit downtime.
During normal operations, while each relay maintains continuity, electricity to the to the Working Status Lamp Red is turned off due to the ON condition.
2. The input/output response speed in the Display Unit and Converter shall be as quick as possible.

14. OPERATION RANGE LIMITATION CONTROL

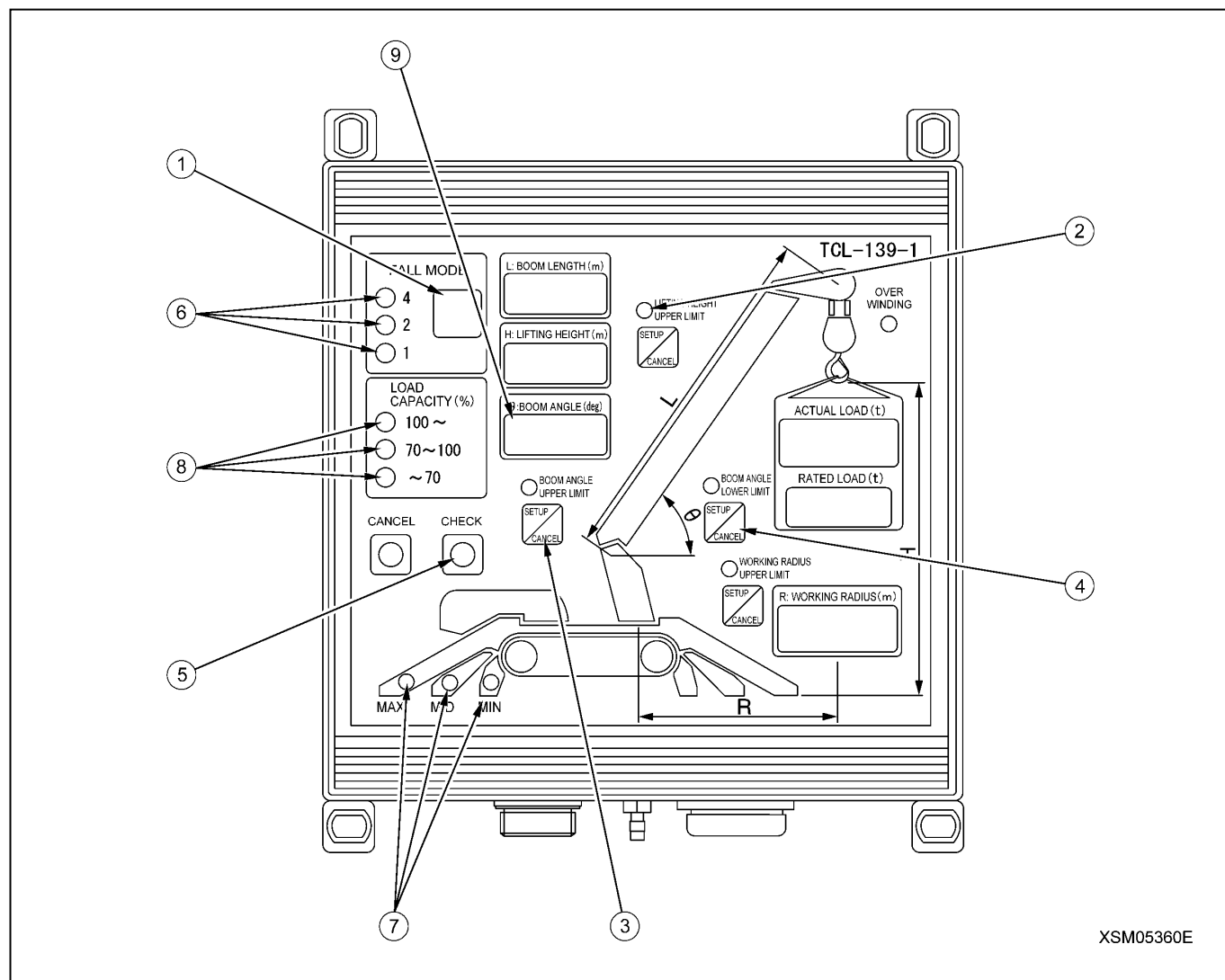
Parameter	Control
Boom Angle Upper Limit	At $[(\text{Boom Angle Upper Limit}) - 10^\circ] > (\text{Boom Angle})$, control as below shall be active (Safety range): • “Boom Angle Upper Limit LED” shall light.
	At $[(\text{Boom Angle Upper Limit}) - 7^\circ] > (\text{Boom Angle}) \geq [(\text{Boom Angle Upper Limit}) - 10^\circ]$, controls as below shall be active: • “Boom Angle Upper Limit LED” shall flash. • “Pre-warning” output shall be ON. • “Buzzer” output shall be ON with intermission.
	At $(\text{Boom Angle}) \geq [(\text{Boom Angle Upper Limit}) - 7^\circ]$, controls as below shall be active: • “Boom Angle Upper Limit LED” shall flash. • “Pre-warning” output shall be ON. • “Boom Angle Upper Limit” output shall be ON. • “Working Status Lamp, Yellow Light output” shall be ON. • “Buzzer” output shall be ON with continuation.
Boom Angle Lower Limit	At $[(\text{Boom Angle Lower Limit}) + 11^\circ] < (\text{Boom Angle})$, controls as below shall be active (Safety range): • “Boom Angle Lower Limit LED” shall light.
	At $[(\text{Boom Angle Lower Limit}) + 8^\circ] < (\text{Boom Angle}) \leq [(\text{Boom Angle Lower Limit}) + 11^\circ]$, controls as below shall be active: • “Boom Angle Lower Limit LED” shall flash. • “Pre-warning” output shall be ON. • “Buzzer” output shall be ON with intermission.
	At $(\text{Boom Angle}) \leq [(\text{Boom Angle Lower Limit}) + 4^\circ]$, controls as below shall be active: • “Boom Angle Lower Limit LED” shall flash • “Pre-warning” output shall be ON. • “Boom Angle Lower Limit” output shall be ON. • “Working Status Lamp, Yellow Light output” shall be ON. • “Buzzer” output shall be ON with continuation.
Working Radius Upper Limit	At $[(\text{Working Radius Upper Limit}) - 1.3\text{m}] > (\text{Working Radius})$, control as below shall be active (Safety range): • “Working Radius Upper Limit LED” shall light.
	At $[(\text{Working Radius Upper Limit}) - 0.45\text{m}] > (\text{Working Radius}) \geq [(\text{Working Radius Upper Limit}) - 1.3\text{m}]$, controls as below shall be active: • “Working Radius Upper Limit LED” shall flash. • “Pre-warning” output shall be ON. • “Buzzer” output shall be ON with intermission.
	At $(\text{Working Radius}) \geq [(\text{Working Radius Upper Limit}) - 0.45\text{m}]$, controls as below shall be active: • “Working Radius Upper Limit LED” shall flash. • “Pre-warning” output shall be ON. • “Boom Extending” output shall be ON. • “Boom Retracting” output shall be ON. • “Working Status Lamp, Yellow Light output” shall be ON. • “Buzzer” output shall be ON with continuation.
Lifting Height Upper Limit	At $[(\text{Lifting Height Upper Limit}) - 1.3\text{m}] > (\text{Lifting Height})$, control as below shall be active (Safety range): • “Lifting Height Upper Limit LED” shall light.
	At $[(\text{Lifting Height Upper Limit}) - 0.45\text{m}] > (\text{Lifting Height}) \geq [(\text{Lifting Height Upper Limit}) - 1.3\text{m}]$, controls as below shall be active: • “Lifting Height Upper Limit LED” shall flash. • “Pre-warning” output shall be ON. • “Buzzer” output shall be ON with intermission.
	At $(\text{Lifting Height}) \geq [(\text{Lifting Height Upper Limit}) - 0.45\text{m}]$, controls as below shall be active: • “Lifting Height Upper Limit LED” shall flash. • “Pre-warning” output shall be ON. • “Boom Extending” output shall be ON. • “Boom Retracting” output shall be ON. • “Working Status Lamp, Yellow Light output” shall be ON. • “Buzzer” output shall be ON with continuation.

Note:

- In the event that Limit Values are not writed (i.e. default mode or canceled mode), “Boom Angle Upper Limit LED”, “Boom Angle Lower Limit LED”, “Working Radius Upper Limit LED” and “Lifting Height Upper Limit LED” shall be out.
- Each limit value shall only be active when the specific functions resume within safety range. In the event that a specific function is already in alarm range when the limit value is writed, no immediate alarm shall work.
- Each writed value shall be stored in memory, even while the power is turned OFF.

15. CALIBRATION PROCEDURE

15.1 LIST OF ITEMS



[Switches]

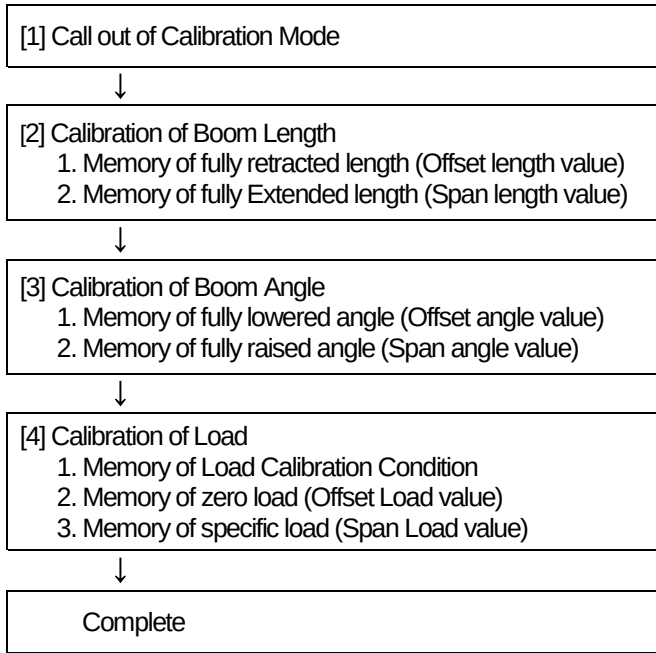
- (1) Fall Mode Selector Switch
- (2) Lifting Height Upper Limit Switch
- (3) Boom Angle Upper Limit Switch
- (4) Boom Angle Lower Limit Switch
- (5) Check Switch

[LED Indicators]

- (6) Wire Falls LED
- (7) Outriggers Extension LED
- (8) Load Capacity LED
- (9) Boom Angle Display

15.2 PROCEDURE

15.2.1 CALIBRATION WORK FLOW



Note:

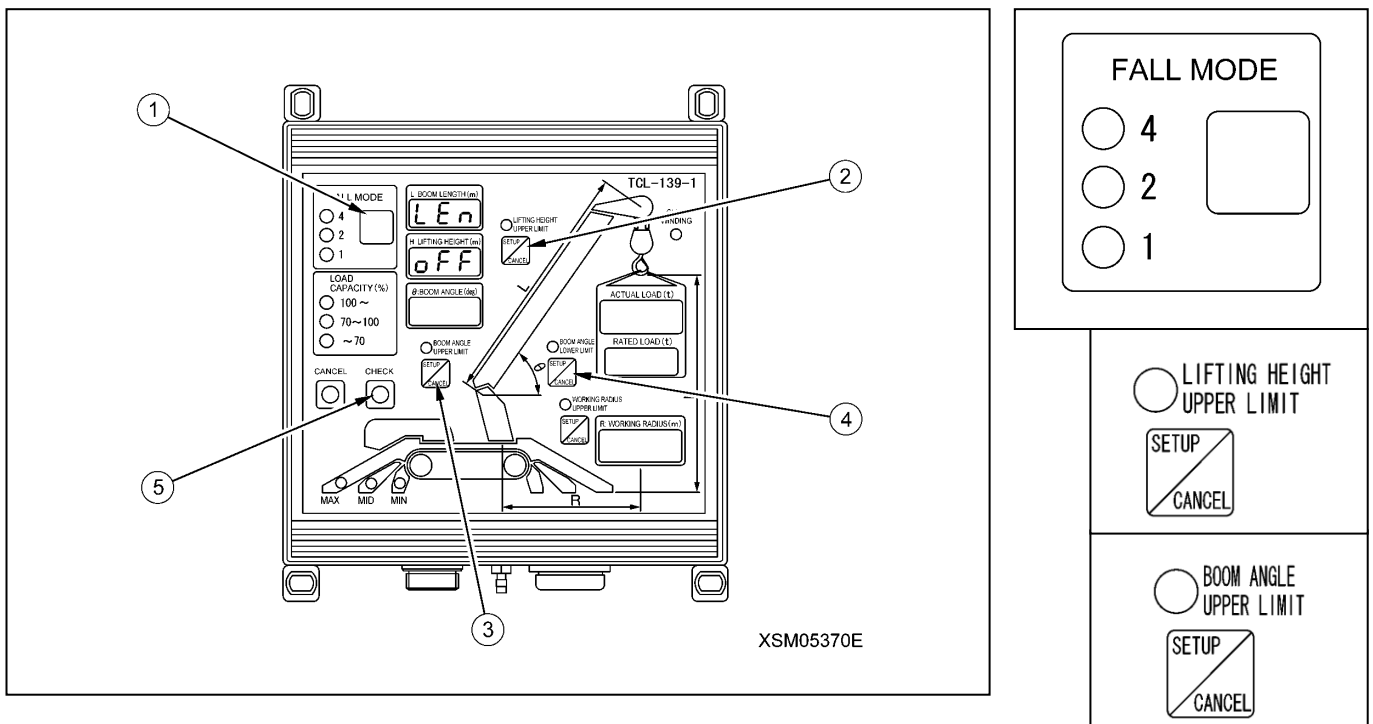
Calibration Mode shall turn output unconditionally ON, of “Outriggers Setting”, “Outriggers Stowing”, “Over Hoist” and “Working Status Red Lamp”. Other controls shall not output and limit values are canceled.

Outriggers must be fully Extended and any hazardous operations such as overload and/or haste must be absolutely avoided.

15.2.2 CALL OUT OF CALIBRATION MODE

Push three Switches for “Fall Mode Selector (1)”, “Lifting Height Upper Limit (2)”, “Boom Angle Upper Limit (3)” simultaneously and hold for three seconds in Crane Operation Mode.

Boom Length Indicator shall turn to display “LEn” and Lifting Height Indicator to “oFF” to notice that Calibration Mode is ready.



15.2.3 CALIBRATION OF BOOM LENGTH

Note: When this Boom length calibration is not required, skip the operations below by pushing “Lifting Height Upper Limit Switch (2)” twice. Refer to subsequent “15.2.4 Calibration of Boom Angle “ when Boom Length Indicator turns to “Ang” and Lifting Height Indicator to “oFF”.

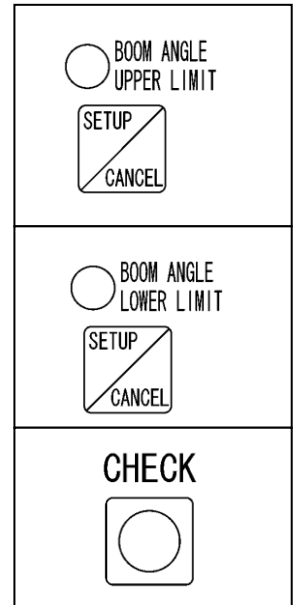
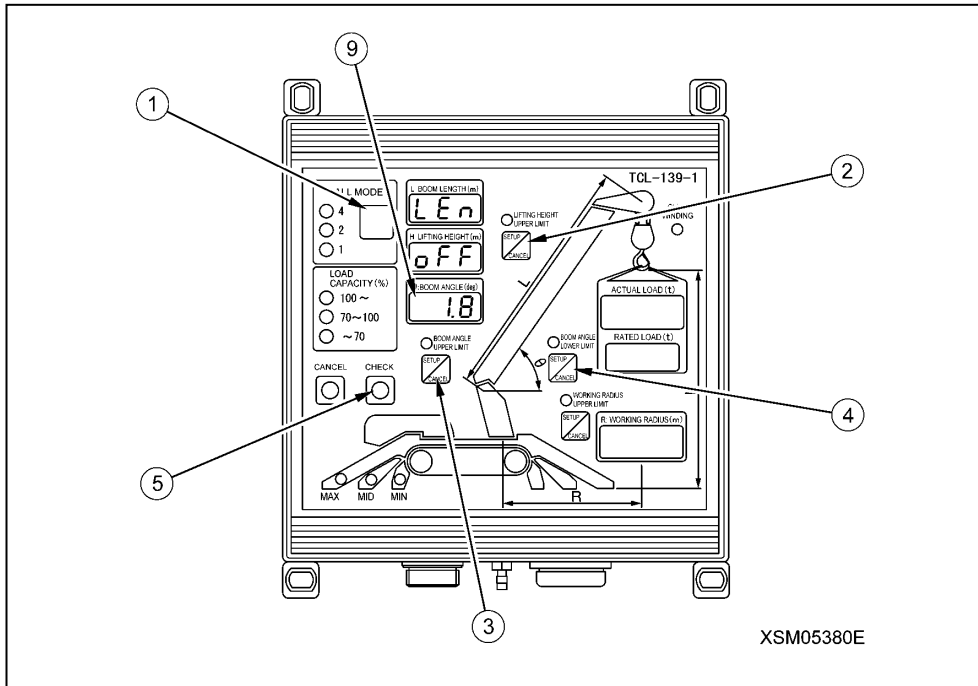
[1] Memory of fully retracted length (Offset length value)

1. Ensure that Boom Length Indicator and Lifting Height Indicator display “LEn” and “oFF” respectively.

Set the figures in the Boom Angle Indicator to the value of Boom length at fully retracted condition by pushing “Boom Angle Upper Limit Switch (3)” and/or “Boom Angle Lower Limit Switch (4)”.

A value of two decimal places may be acquired by pushing and holding “Check Switch (5)”.

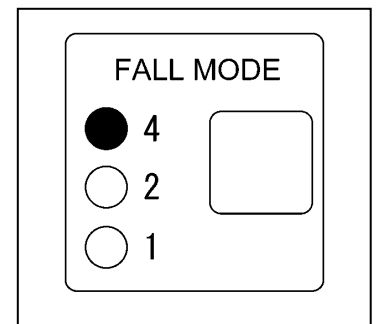
Note: Boom length at fully retracted condition: 1.83 (Nominal Boom length is 1.830m)



2. Operate crane and retract the boom to the shortest condition.

3. Push “Fall Mode Selector Switch” to write Boom length at fully retracted value.

“Wire Fall: 4 Indicator” shall light when the value is correctly input.



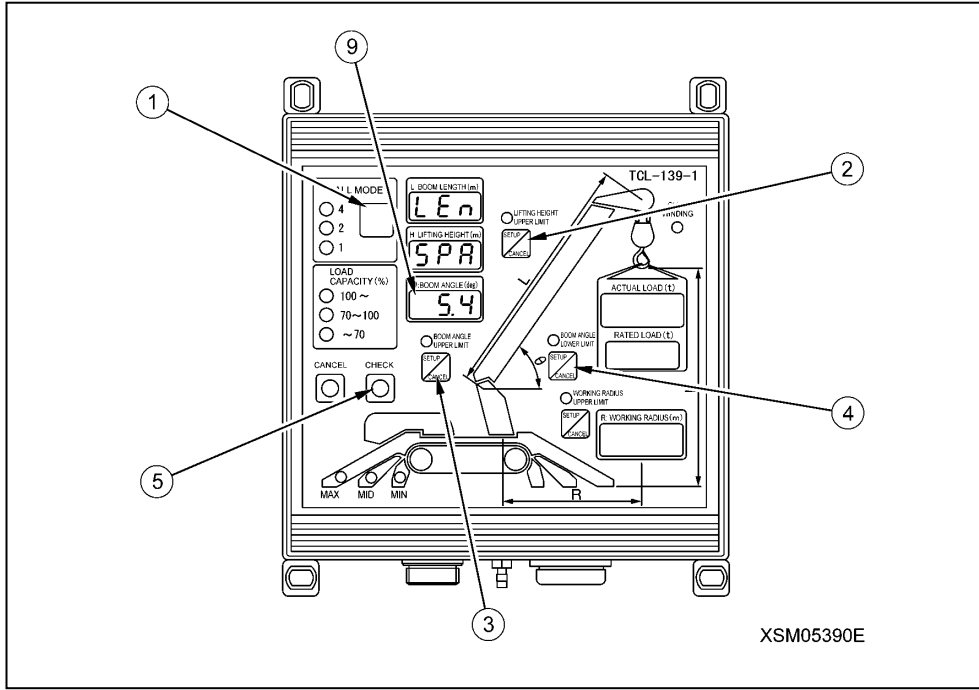
[2] Memory of fully Extended length (Span length value)

1. Push "Lifting Height Upper Limit Switch (2)" and ensure that Boom Length Indicator and Lifting Height Indicator display "LEn" and "SPA" respectively.

Set the figures in the Boom Angle Indicator to the value of Boom length at fully Extended condition by pushing "Boom Angle Upper Limit Switch (3)" and/or "Boom Angle Lower Limit Switch (4)".

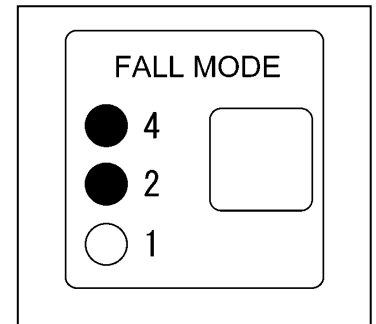
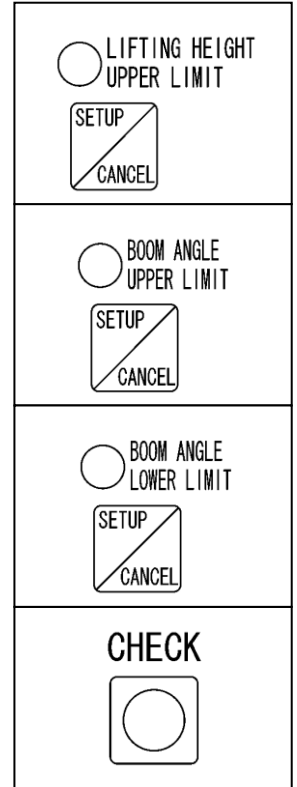
A value of two decimal places may be acquired by pushing and holding "Check Switch (5)".

Note: Boom length at fully extended condition: 5.45 (Nominal Boom length is 5.445m)



2. Operate crane and extend the boom to the longest condition.

3. Push "Fall Mode Selector Switch (1)" to write Boom length at fully extended value.
"Wire Fall: 2 Indicator" shall light when the value is correctly input.



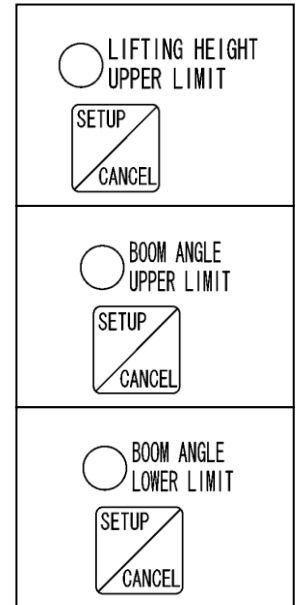
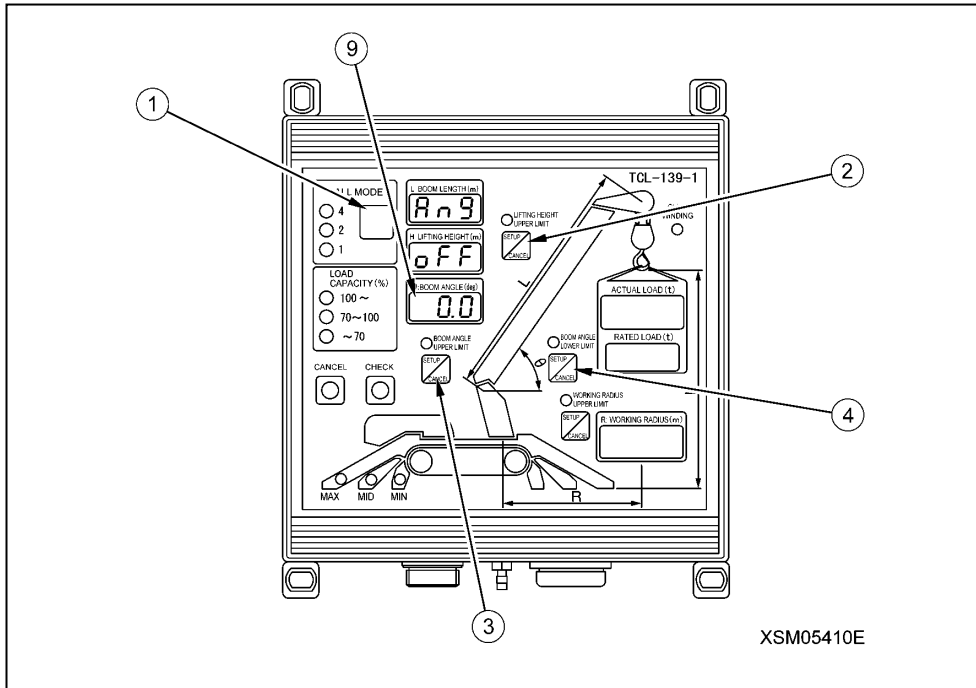
15.2.4 CALIBRATION OF BOOM ANGLE

Note: When this Boom angle calibration is not required, skip the operations below by pushing “Lifting Height Upper Limit Switch (2)” twice. Refer to subsequent “16.2.5 Calibration of Load” when Boom Length Indicator turns to “ton” and Lifting Height Indicator to “PAR”.

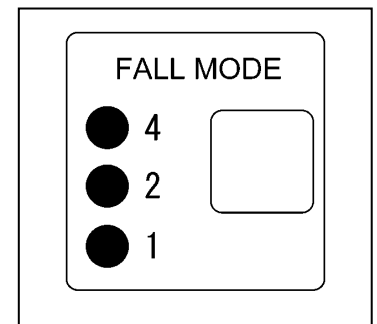
[1] Memory of fully lowered angle (Offset angle value)

1. Push “Lifting Height Upper Limit Switch (2)” and ensure that Boom Length Indicator and Lifting Height Indicator display “Ang” and “oFF” respectively.

Set the figures in the Boom Angle Indicator to “0” (for 0 degree when the Boom is fully lowered) by pushing “Boom Angle Upper Limit Switch (3)” and/or “Boom Angle Lower Limit Switch (4)”.



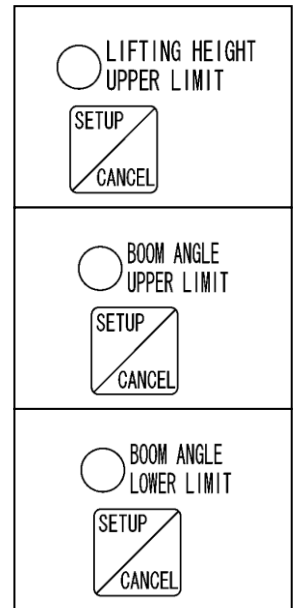
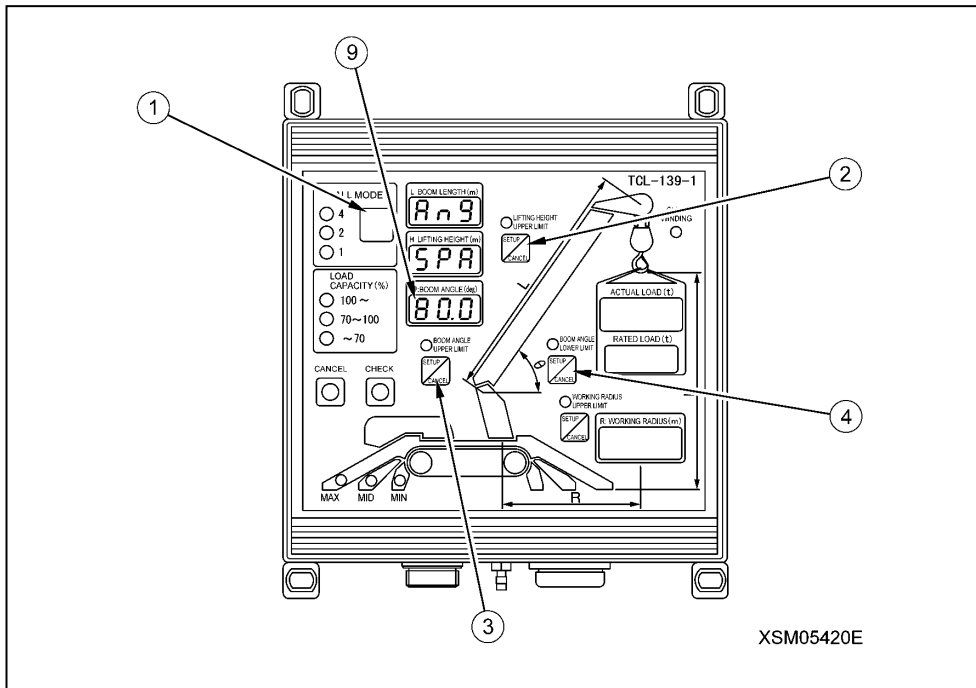
2. Operate crane and lower the boom to the lowest condition.
3. Push “Fall Mode Selector Switch (1)” to write Boom angle at fully lowered value. “Wire Fall: 1 Indicator” shall light when the value is correctly input.



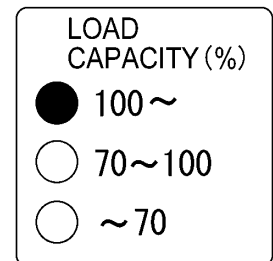
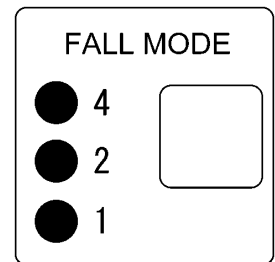
[2] Memory of fully raised angle (Span angle value)

1. Push "Lifting Height Upper Limit Switch (2)" and ensure that Boom Length Indicator and Lifting Height Indicator display "Ang" and "SPA" respectively.

Set the figures in the Boom Angle Indicator to "80" (for 80 degree when the Boom is fully raised) by pushing "Boom Angle Upper Limit Switch (3)" and/or "Boom Angle Lower Limit Switch (4)".



2. Operate crane and raise the boom to the highest condition.
3. Push "Fall Mode Selector Switch (1)" to write Boom angle at fully raised value.
"Load Capacity 100% or more Indicator" shall light when the value is correctly input.



15.2.5 CALIBRATION OF LOAD

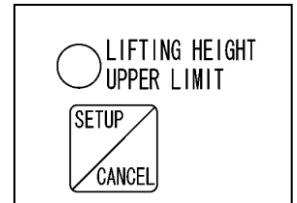
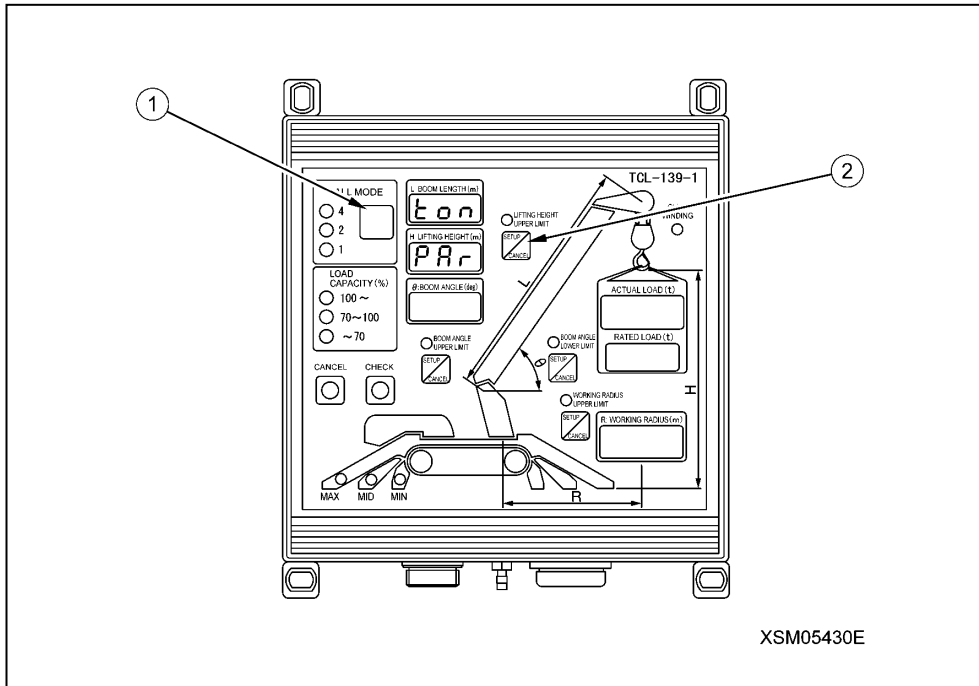
Note: When this Load calibration is not required, skip the operations below by pushing “Lifting Height Upper Limit Switch (2)” three times. Calibrating operation shall terminate and displays of all indicators resume to normal conditions.

[1] Memory of Load Calibration Parameters

1. Push “Lifting Height Upper Limit Switch (2)” and ensure that Boom Length Indicator and Lifting Height Indicator display “ton” and “Par” respectively.

Load calibration parameters shall be calibrated to the conditions as listed below:

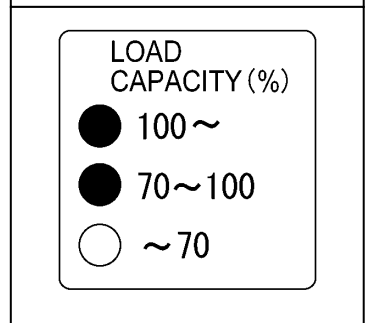
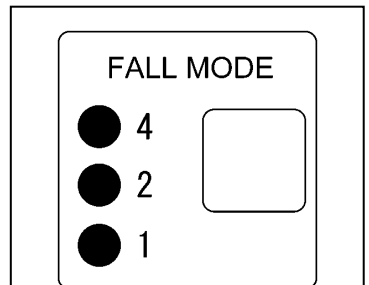
Boom length	2.9m (with 2 sections)
Working Radius	1.5m
Verification weight	1000kg



2. Operate crane and adjust boom length to 2.9m with 2 sections and working radius to 1.5m.

3. Push “Fall Mode Selector Switch (1)” to resister Load Calibration Condition.

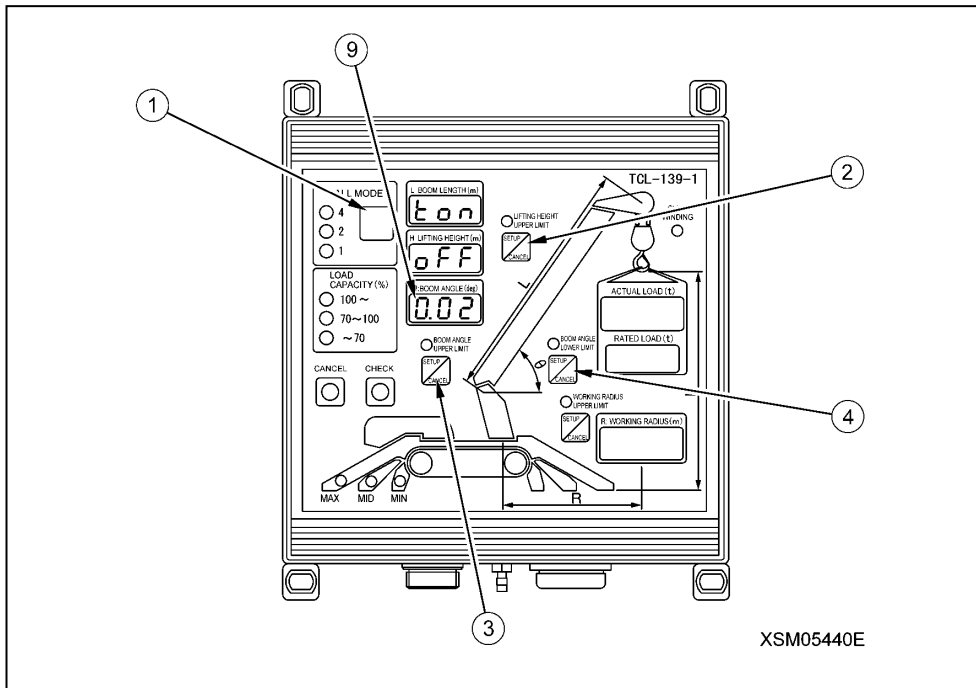
“Load Capacity 70 to 100% Indicator” shall light when the value is correctly input.



[2] Memory of zero load (Offset Load value)

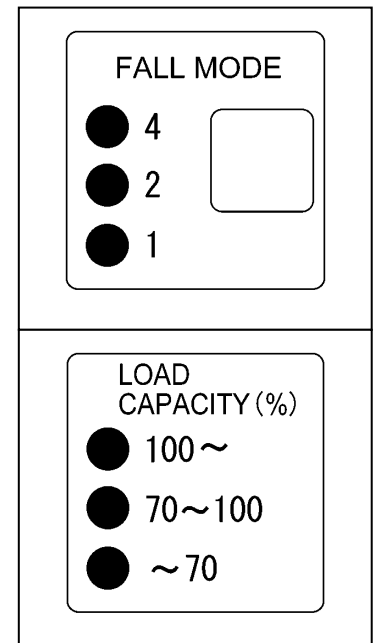
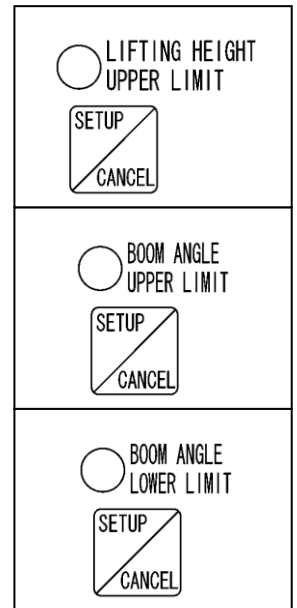
1. Push "Lifting Height Upper Limit Switch (2)" and ensure that Boom Length Indicator and Lifting Height Indicator display "ton" and "oFF" respectively.

Set the figures in the Boom Angle Indicator to "0.02" (for zero load lifting weight, 0.02 tons of Hook weight) by pushing "Boom Angle Upper Limit Switch (3)" and/or "Boom Angle Lower Limit Switch (4)".



2. Keep the boom configuration as settled by "[1] Memory of Load Calibration Parameters" above and push "Fall Mode Selector Switch (1)" to write zero load value.

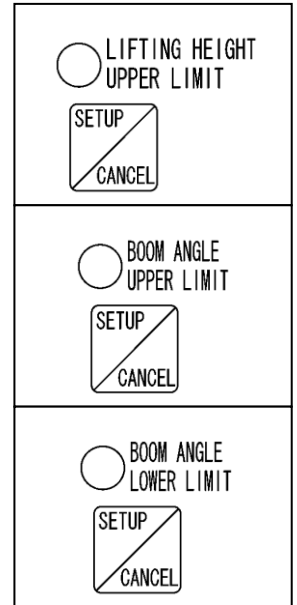
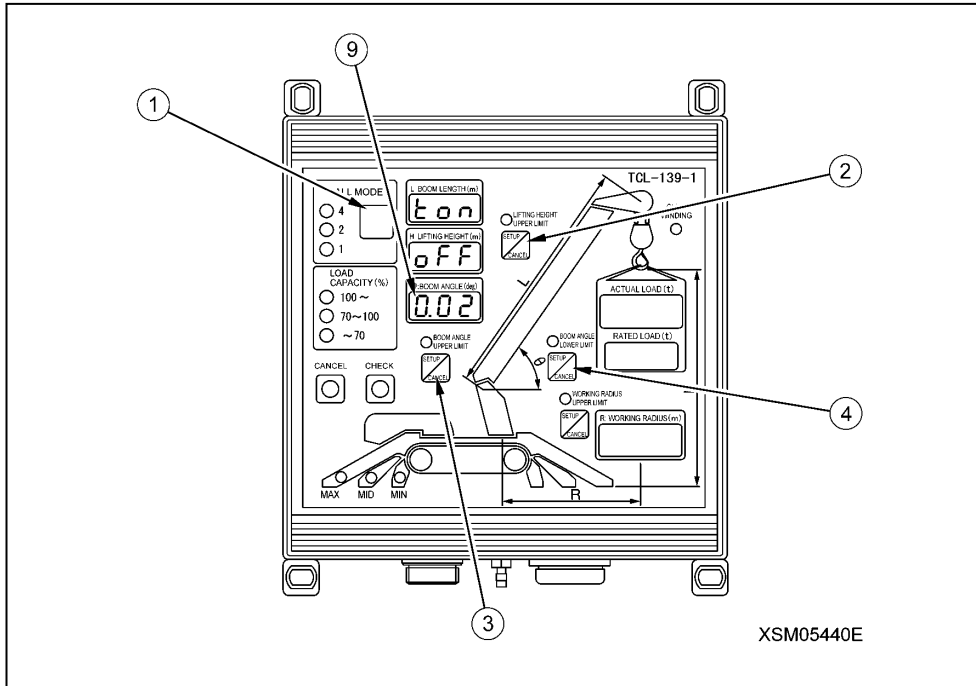
"Load Capacity less than 70% Indicator" shall light when the value is correctly input.



[3] Memory of specific load (Span Load value)

1. Push "Lifting Height Upper Limit Switch (2)" and ensure that Boom Length Indicator and Lifting Height Indicator display "ton" and "SPA" respectively.

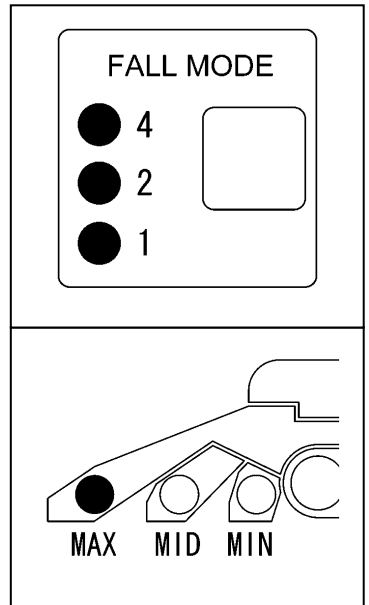
Set the figures in the Boom Angle Indicator to "1.02" (for test lifting load weight 1.00 plus 0.02 tons of Hook weight) by pushing "Boom Angle Upper Limit Switch (3)" and/or "Boom Angle Lower Limit Switch (4)".



2. Lift up a test weight of "1.00 ton" with the Working Radius 1.5m configuration as identical to above "[2] Memory of zero load" (also identical to previous "[1] Memory of Load Calibration Parameters").

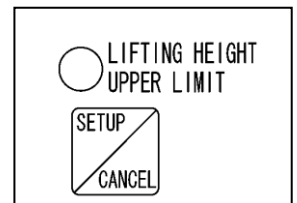
When swing of the weight stops after lifting up, push "Fall Mode Selector Switch (1)" to write specific load value.

"Outrigger Status MAX Indicator" shall light when the value is correctly input.



3. Push "Lifting Height Upper Limit Switch (2)".

Calibrating operation shall terminate and displays of all indicators resume to normal conditions.



15.3 DISPLAY DETAILS AT CALIBRATION MODE

Indicator Calibration Items	Boom Length (Calibration Items)	Lifting Height (Calibration Items)	Boom Angle (Calibration Items)
Offset Length	000	000	00.0
Span Length	000	000	00.0
Offset Angle	000	000	00.0
Span Angle	000	000	00.0
Length and Angle at Load Calibration	000	000	
Offset Load	000	000	00.0
Span Load	000	000	00.0

16. TEST MODE

Test Mode is provided with this Moment Limiter for the verification of operations and/or signals input/out of each of module.

Test Mode can be called out by a procedure as mentioned below. Once the Test Mode starts, power should be turned off for resuming Normal Mode.

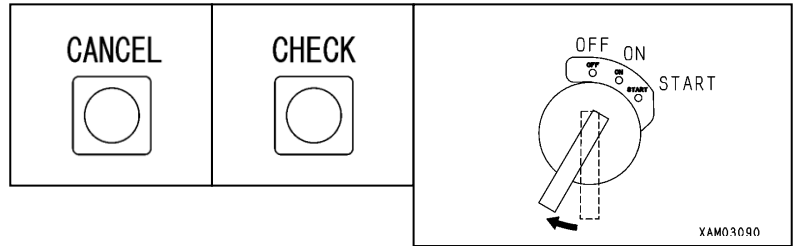
Note:

Calibration Mode shall turn unconditionally ON, output of “Outriggers Setting”, “Outriggers Stowing”, “Over Un-Winding”, “Over Hoist” and “Working Status Red Light”. Other controls shall not output and limit values are canceled.

Outriggers must be fully Extension and any hazardous operations such as overload and/or haste must be absolutely avoided.

16.1 CALL OUT OF TEST MODE

1. Turn Power ON (Key-switch ON) while pushing both “Cancel Switch” and “Check Switch” in Crane Mode.



2. Ensure display of “L01” at “Boom Length Indicator”.

3. Each push of “Cancel Switch” shall sequentially switch test items from “L01” to “L08”.

Test Items

Test Items	Description	
L01	ROM/RAM Test	
L02	LED Test	
L03	Switch Test	
L04	Input Signal Test of outrigger extension and boom derricking	
L05	Output Signal Test	
L06	4 to 20mA Test	
L07	Input Voltage Value Test from each sensor	
L08	Loop Back Test	

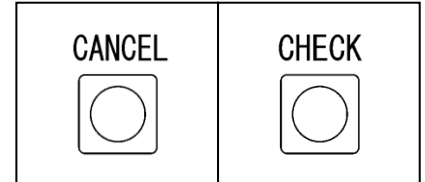
16.2 L01 (ROM/RAM Test)

Note: This test is not necessary.

16.3 L02 (LED TEST)

[1] Procedure:

1. Ensure that Boom Length Indicator displays "L02".
When any other Test Item is on, push "Cancel Switch" to switch to "L02".
2. When you push "Check Switch", each of LED tests shall start and proceed.
Another push of "Check Switch" shall turn off LEDs and "L02" shall be back to Boom Length Indicator.
3. Push "Cancel Switch" again to switch to subsequent Test Item.



[2] Result Indication

Display	Boom Length (Show Test Item)	Lifting Height	Boom Angle	Actual Load	Total rated load	Working Radius
Data	L02	888	888	888	888	888

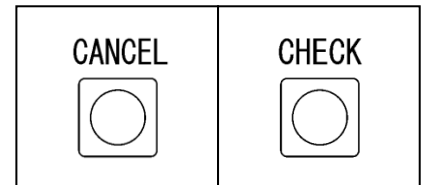
Note:

When you push "Check Switch", each LED Indicator shall light up.

16.4 L03 (Switch Test)

[1] Procedure

1. Ensure that Boom Length Indicator displays "L03".
When any other Test Item is on, push "Cancel Switch" to switch to "L03".
2. When you push "Check Switch", Switch tests shall start and proceed.
Each push of "Switches" on panel shall result an indication of a number per specific "Switch" at "Lifting Height Indicator".
3. Push "Check Switch" again to switch to subsequent Test Item.



[2] Result Indication

Display	Boom Length (Show Test Item)	Lifting Height (Show Test Result)	Boom Angle	Actual Load	Total rated load	Working Radius
Data	L03	1 (Per pushing each "Switch")				

[3] Reference of each Switch and indicated number

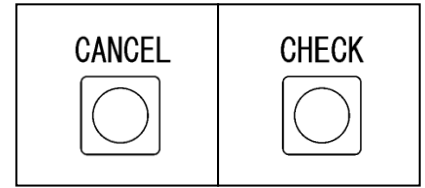
	Switches on Panel	Numbers at Lifting Height Indicator
1	Check Switch	1
2	Cancel Switch	2
3	Lifting Height Upper Limit	3
4	Working Radius Upper Limit	4
5	Boom Angle Upper Limit	5
6	Boom Angle Lower Limit	6

⇐Note: 2 pushes shall switch to a subsequent test.

16.5 L04 (Outrigger Extension Value/Boom Derricking Operation Input Signal Test)

[1] Procedure:

1. Ensure that Boom Length Indicator displays "L04".
When any other Test Item is on, push "Cancel Switch" to switch to "L04".
2. When you push "Check Switch", Tests shall start. Each function shall be verified by actual processes of "Switches".
3. Push "Check Switch" again to switch to subsequent Test Item.



[2] Result Indication

Display	Boom Length	Lifting Height	Boom Angle	Actual Load	Total rated load	Working Radius
	(Show Test Item)	(Show Test Result)				
Data	L04	Example: 20F				

Note:

In the Lifting Height Indicator, the detection signal of each outrigger extension and input signal of the Boom Derricking Lever will be displayed in 3 digits.

Digit	Three digits Numbers displayed at "Lifting Height Indicator"		
	100	10	1
Functions	Boom Derricking Lever	Outriggers Mid. Extension	Outriggers Max. Extension
Display	Boom Derricking Lever "1" for "Raising" Position "2" for "Lowering" Position Neutral Position has no result indication.	Displays "0" for no setting	Represents 4 detection signals in 4 numerical values (Refer to the table below) and displays the total in hexadecimal.

Contrast Table of Outrigger Number and Input Signal

Outrigger Number	Input Signal Number
(1)	1
(2)	2
(3)	4
(4)	8

Contrast Table of Decimal Number and Hexadecimal Number

Decimal Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Hexadecimal Number	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	G

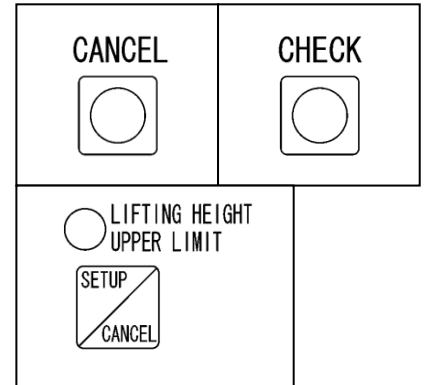
For example: When fully extending (3) and (4) outriggers only.

$$4 (3) + 8 (4) = 12 \text{ (decimal number)} \Rightarrow C \text{ (hexadecimal number)}$$

16.6 L05 (Output Signal Test)

[1] Procedure:

1. Ensure that Boom Length Indicator displays "L05".
When any other Test Item is on, push "Cancel Switch" to switch to "L05".
2. When you push "Check Switch", Tests shall start.
Additional push of "Check Switch" shall switch test subject; when specific test subject is displayed, push "Lifting Height Switch" to toggle "ON/OFF" of output signal.
Once "Lifting Height Switch" is pushed and "ON/OFF" position is fixed to preferable status, the status shall be held until L05 "Output Signal Test" is terminated. Each function shall be verified by actual processes of "Switches".
3. Push "Check Switch" again to switch to subsequent Test Item.



[2] Result Indication

Display	Boom Length	Lifting Height	Boom Angle	Actual Load	Total rated load	Working Radius
	(Show Test Item)	(Show Test Result)	(ON/OFF Status)			
Data	L05	1 (Per pushing each "Switch")	ON/OFF			

[3] Reference of each Output Signal and indicated number

	Output Signal	Indicated number
1	Boom Angle Upper Limit	1
2	Boom Extending Limit	2
3	Boom Angle Lower Limit	3
4	Over Un-Winding	4
5	Alarm buzzer	5
6	Working Status Lamp, "Red"	6
7	Working Status Lamp, "Yellow"	7
8	Working Status Lamp, "Green"	8
9	Moment 100%	9
10	Over Hoist	10
11	Pre-warning	11

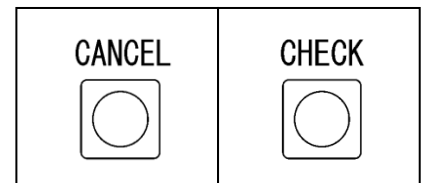
←Note: Default values us ON for Output Signal.

←Note: Default values us ON for Output Signal.

16.7 L06 (4 to 20mA Test)

[1] Procedure:

1. Ensure that Boom Length Indicator displays "L06".
When any other Test Item is on, push "Cancel Switch" to switch to "L06".
2. Push "Check Switch", start automatic test cycle.
3. Push "Check Switch" again to switch to subsequent Test Item.



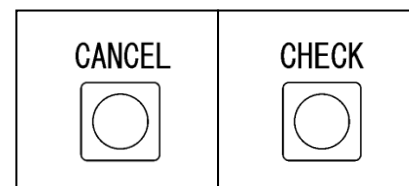
[2] Result Indication

Display	Boom Length	Lifting Height	Boom Angle	Actual Load	Total rated load	Working Radius
	(Show Test Item)	(Show Test Result)				
Data	L06	mA 4.0⇒8.0⇒12.0⇒16.0⇒20.0				

16.8 L07 (Test for Input Voltage Value from Each Sensor)

[1] Procedure:

1. Ensure that Boom Length Indicator displays "L07".
When any other Test Item is on, push "Cancel Switch" to switch to "L07".
2. When you push "Check Switch", Tests shall start. Each function shall be verified by actual processes of "Switches".
3. Push "Check Switch" again to switch to subsequent Test Item.



[2] Result Indication

Display	Boom Length	Lifting Height	Boom Angle	Actual Load	Total rated load	Working Radius
	(Show Test Item)	Pressure Sensor 1 (V)	Pressure Sensor 2 (V)	Angle Sensor (V)	Length Sensor (V)	
Data	L07	1 to 2.4	1 to 2.4	1.8 to 2.8	0.72 to 3.07	

16.9 L08 (Loop Back Test)

Note: This test is not necessary. (Displays "Err" in the "Lifting Height Indicator".)

Display	Boom Length	Lifting Height	Boom Angle	Actual Load	Total rated load	Working Radius
	(Show Test Item)	(Show Test Result)				
Data	L08	Err				

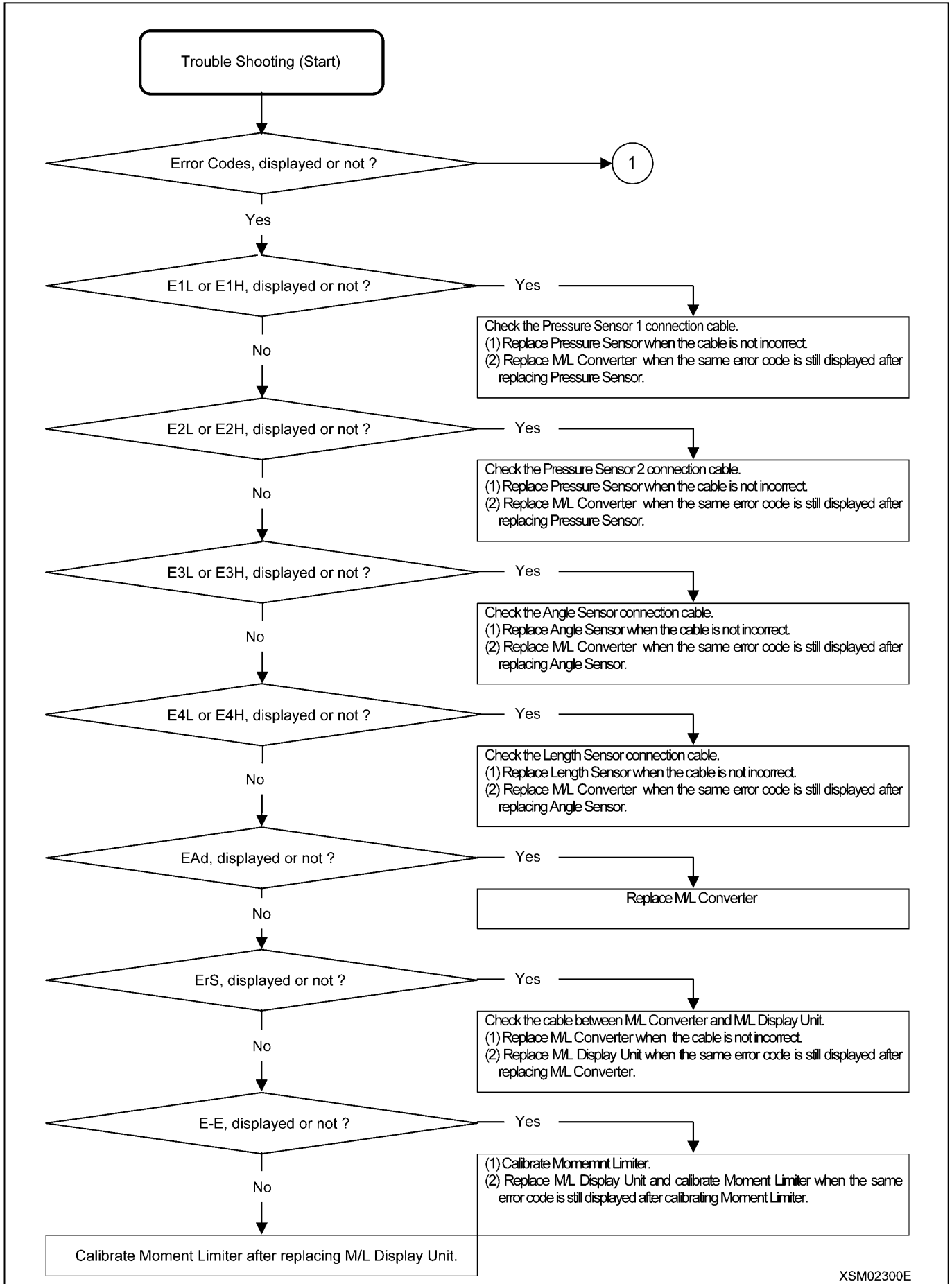
17. ERROR MESSAGES

Any detectable errors cause "Total rated load Indicator" to display error codes.

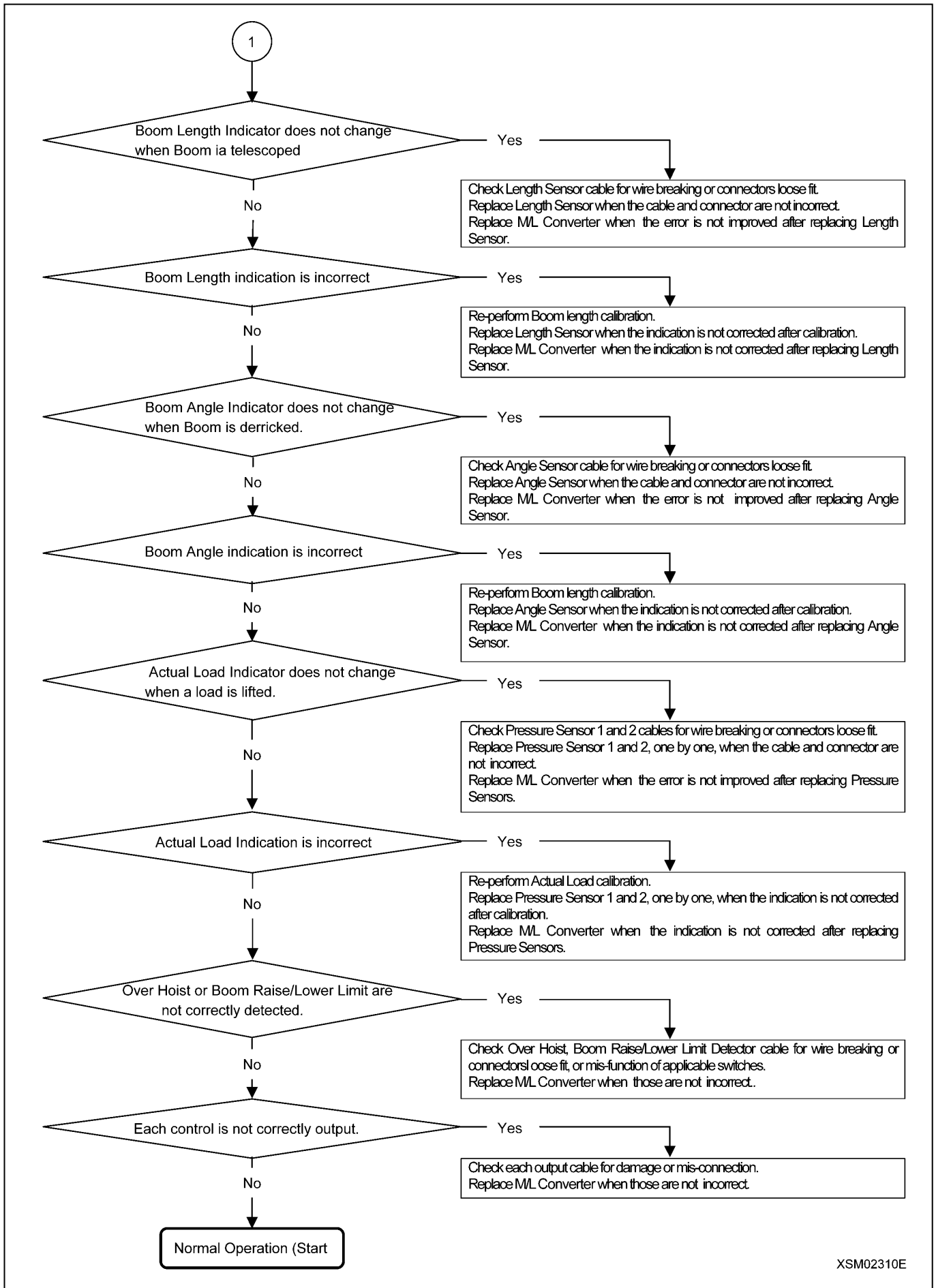
Error Code	Description	Counter Measure
	Pressure Sensor 1 input is under standard value	Check Pressure Sensor 1
	Pressure Sensor 1 input is over standard value	
	Pressure Sensor 2 input is under standard value	Check Pressure Sensor 2
	Pressure Sensor 2 input is over standard value	
	Angle Sensor input is under standard value	Check Angle Sensor
	Angle Sensor input is over standard value	
	Length Sensor input is under standard value	Check Length Sensor
	Length Sensor input is over standard value	
	AD Converter in Converter is not correctly working.	Turn off the main power once then turn on again. In the event that an error recurs, replace Converter.
	Communication error between Converter and Display Unit.	• Check the cable between Converter and Display Unit. In the event that the cable is not incorrect, replace Converter. • Check the fuse built-in the converter.
	Calibration memory error. The same error code is displayed in modes other than calibration.	Turn off the main power once then turn on again. In the event that an error recurs, replace Display Unit.
No displayed	---	Check the fuse built-in the display unit.

18. TROUBLE SHOOTING

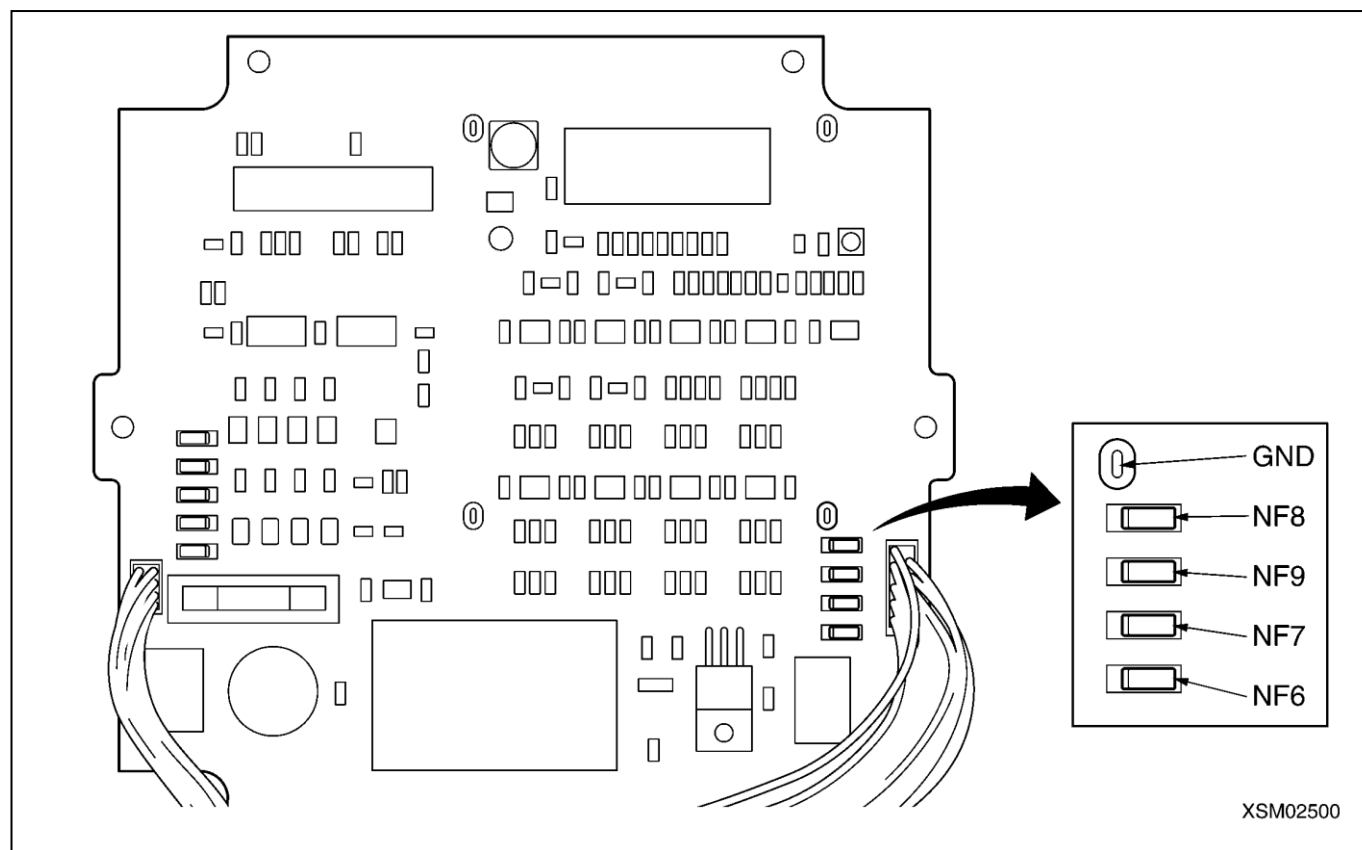
In the event of malfunction, check each device in accordance with the Flow-Chart below:



XSM02300E



19. POINTS FOR INPUT VOLTAGE MEASUREMENT OF EACH SENSOR



The drawing above is the motherboard for Converter.

From top to bottom

- NF8: Angle Sensor
- NF9: Length Sensor
- NF7: Pressure Sensor 2
- NF6: Pressure Sensor 1

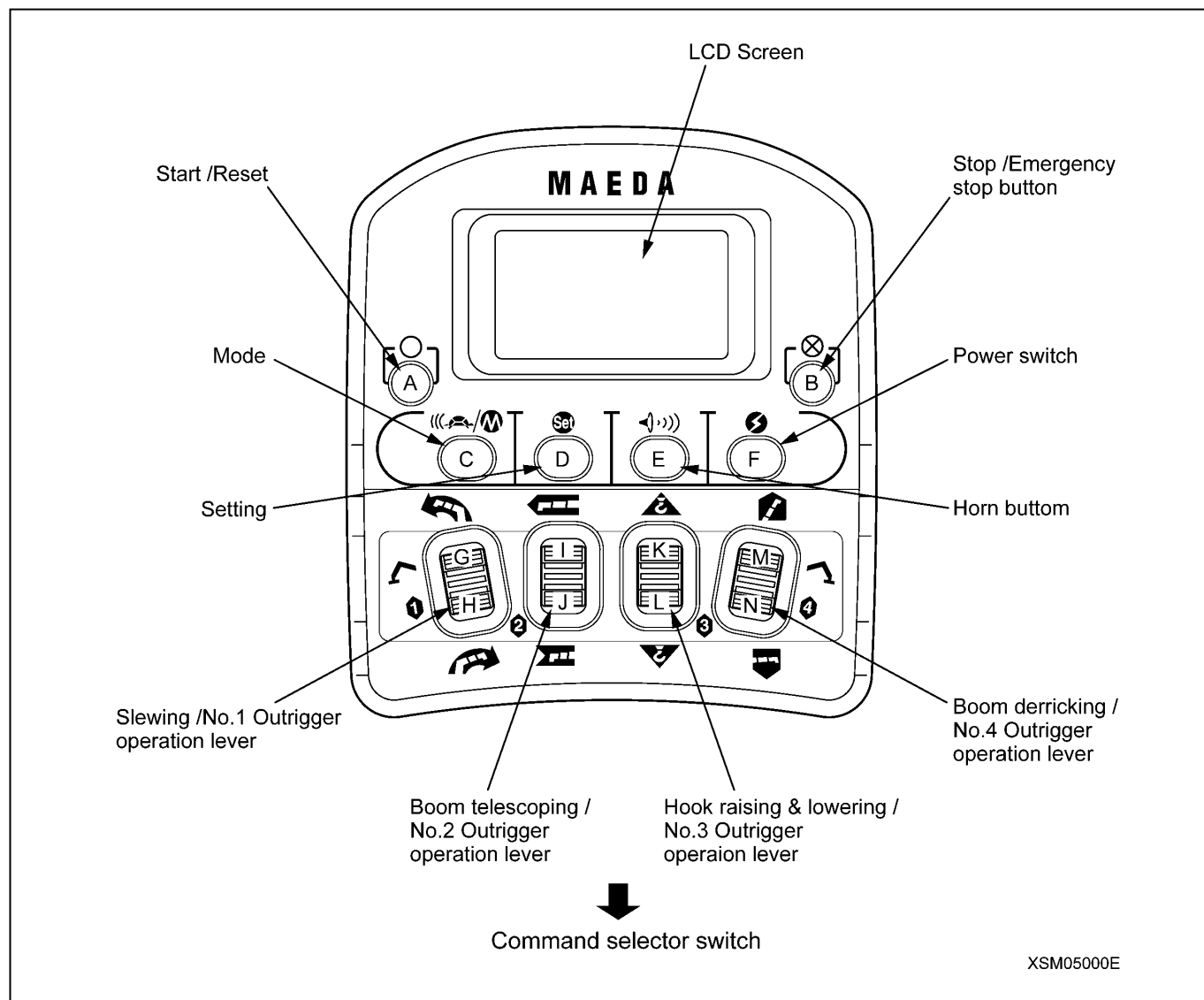
Measure voltage between each of above points and GND.

REMOTE CONTROL

1. INITIAL MODE SETTING PROCEDURE	4- 2
2. RECEIVER	4-16
3. TROUBLESHOOTING	4-23

1. INITIAL MODE SETTING PROCEDURE

1.1 BUTTON AND LEVER ARRANGEMENT ON CONTROL PANEL



★Alphabetical character on each button corresponds to the button name that appears in the following discussion.

1.2 ESTABLISHING INITIAL MODE:

Example: Changing the setting of OFF timer from 5M to 10M.

1. Use K and L levers a few times so that cursor ▲ or ▼ comes to the side of item you desire to set.

2. When the cursor ▲ (or ▼) comes to the side of “OFF timer”, push the D button.

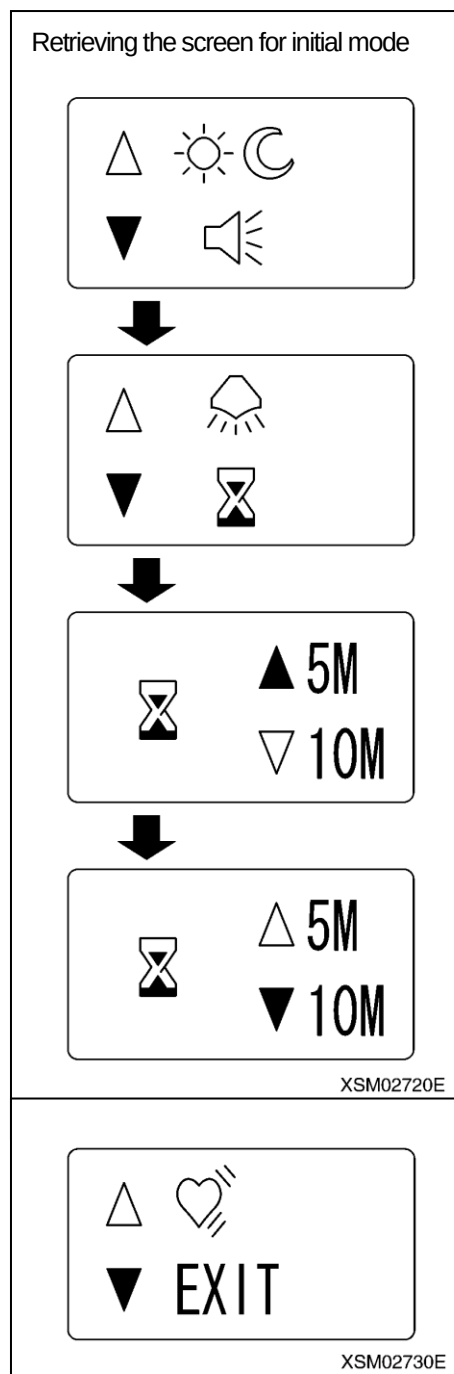
The screen will become that for setting the OFF timer.

3. Use K and L levers until cursor ▼ comes to the side of “10M”, before pushing the D button.

That change the OFF timer to show “10M”.

4. To exit from the initial mode for user, bring the cursor ▼ to the side of “EXIT”. And push the D button. The finishes the initial mode for user and the system goes into crane mode.

Note: Unless you finish in this manner, the established setting will not become valid.



1.3 INITIAL MODE FOR USER (A MODE)

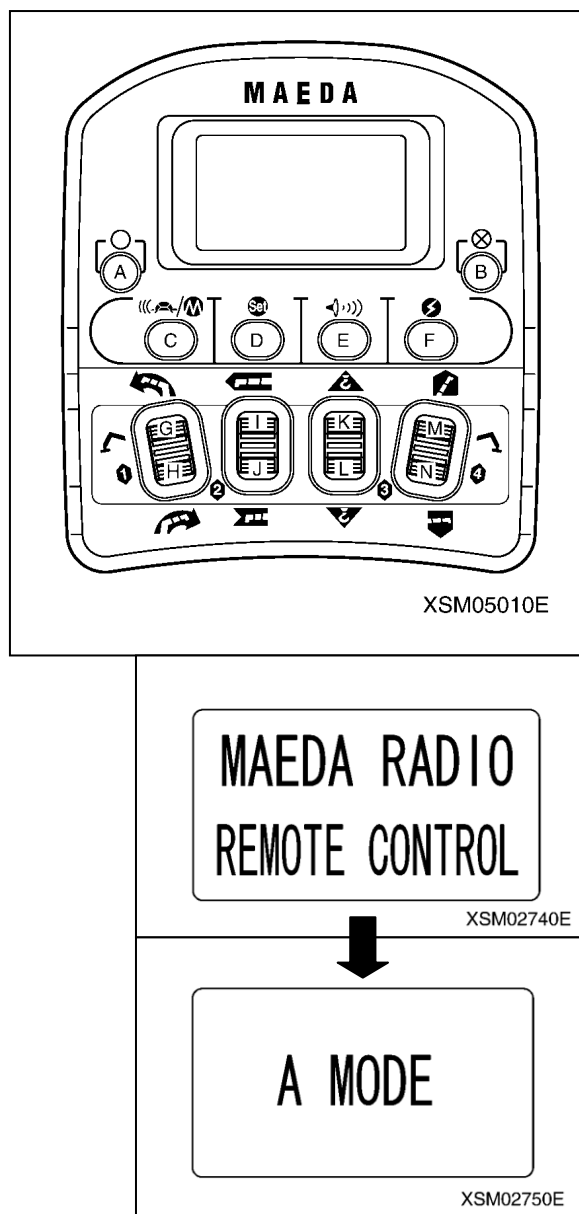
This system has an Initial Mode for User.

Items and contents for changing are as follows:

★The content of setting, once established, will be saved in memory, requiring no more setting for each work.

1. Retrieving the screen for initial mode for user:

With the system power remaining turned OFF, while holding C button pressed, continue to press F button until the screen of initial mode for user appears (For about 2 seconds).



After "MAEDA RADIO REMOTE CONTROL" having appeared.

Note:

- Be sure to turn OFF the main switch at receiver before starting to operate the initial mode.
- Before starting to change the setting, always make sure that "A MODE" has appeared on the LCD.

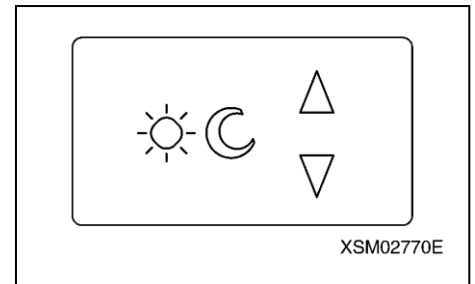
2. Items for establishing the initial mode for user:

(1) Contrast of LCD

For adjusting the contrast of LCD.

- To make the contrast stronger: Press K lever
- To make the contrast weaker: Press L lever

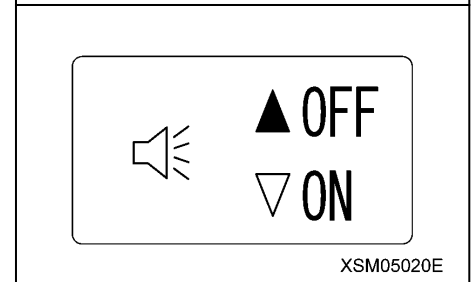
★At the time of factory shipment, the contrast is set to be optimum for in door use.



(2) Voice Volume

Not used.

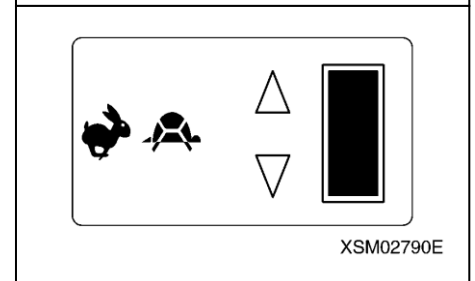
★At the time of factory shipment, this is set at OFF.



(3) Acceleration

For changing the amount of engine revolutions in accordance with the angle of accelerator lever. (Setting the maximum amount)

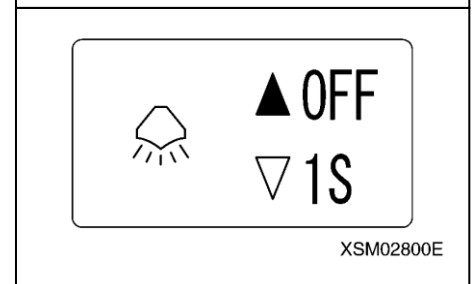
★At the time of factory shipment, this is set at 100%.



(4) Light

For selection of backlight OFF as well as how many seconds the backlight remains on after releasing each operation button and lever. There are 4 selections of OFF, 1, 3 and 5 seconds. If you are concerned about running down of battery, set this at OFF.

★At the time of factory shipment, this is set at 3 seconds.

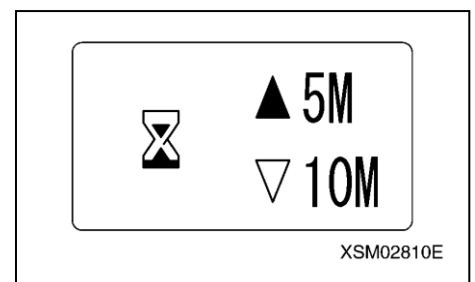


(5) OFF Timer

For setting the Auto Power Off time for transmitter power.

There are 3 selections of 5, 10 and 15 minutes.

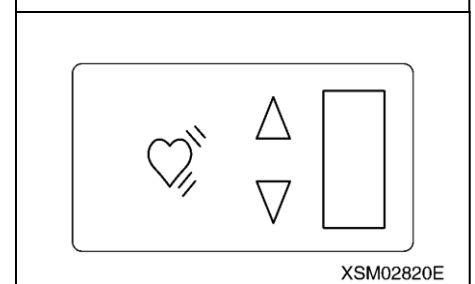
★At the time of factory shipment, this is set at 5 minutes.



(6) Idling Up

For setting the percentage of acceleration from established idling speed for crane operation.

★At the time of factory shipment, this is set at 0% up.

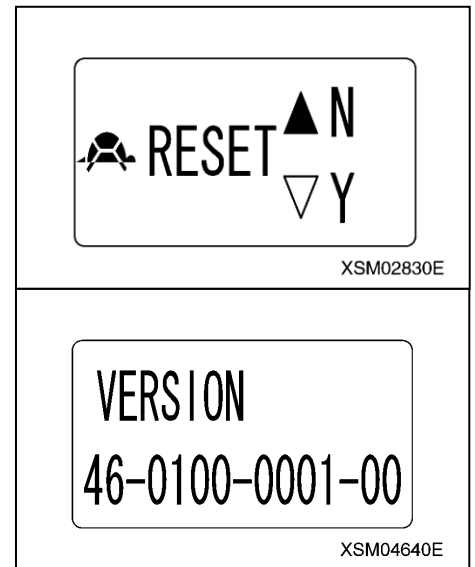


(7) Reset Micro Speed

For resetting user Micro Speed Mode rate to the initial value.

N: Not reset setting value of the item to default.

Y: Reset setting value of the item to default.



(8) Version

Version will be displayed.

1.4 INITIAL MODE FOR SERVICE (B MODE)

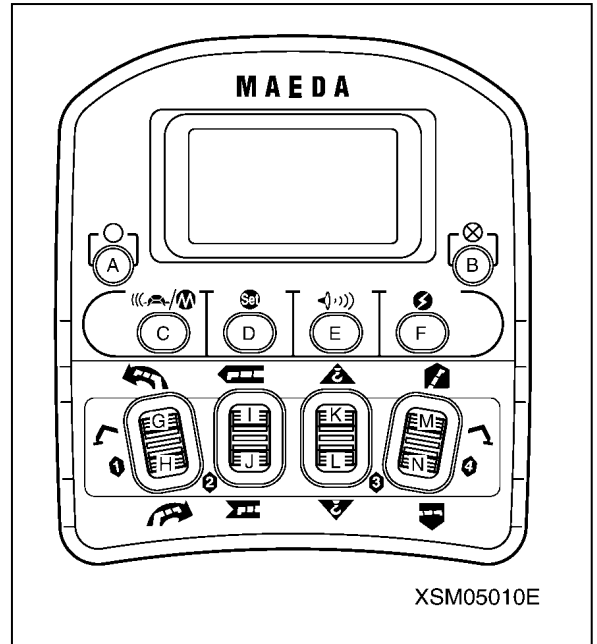
This system has an Initial Mode for Service for the user by service shop or Rental Company.

Items and contents for changing are as follows:

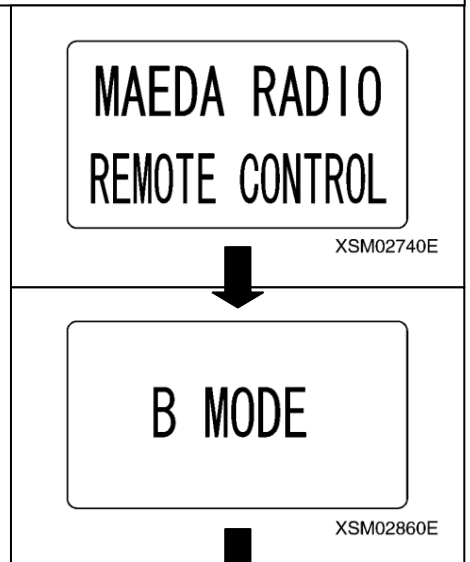
- ★The content of setting, once established, will be saved in memory, requiring no more setting for each work.

1. Calling the screen for initial mode for service:

With the system power remaining turned OFF, while holding H and N levers pressed, continue to press F button until the screen of initial mode for user appears (For about 2 seconds).



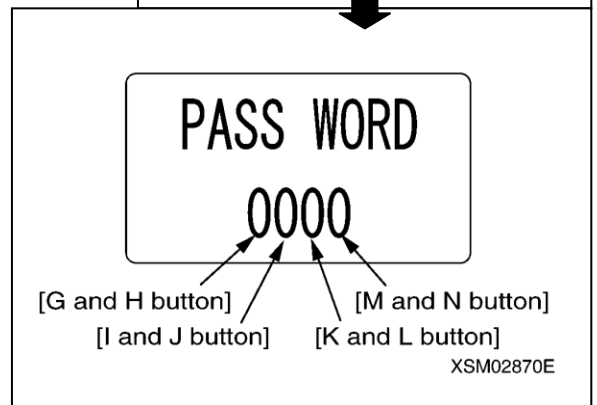
After “MAEDA RADIO REMOTE CONTROL” having showed up.



“B MODE” appears, before the prompt for password “PASS WORD 0000” comes up.

Each digit corresponds to levers as shown above.

Operate each levers to enter [2435], before pressing D button.



Note:

- Be sure to turn OFF the main switch at receiver before starting to operate the initial mode.
- Before starting to change the setting, always make sure that “B MODE” has appeared on the LCD.

2. Items for setting the initial mode for service:

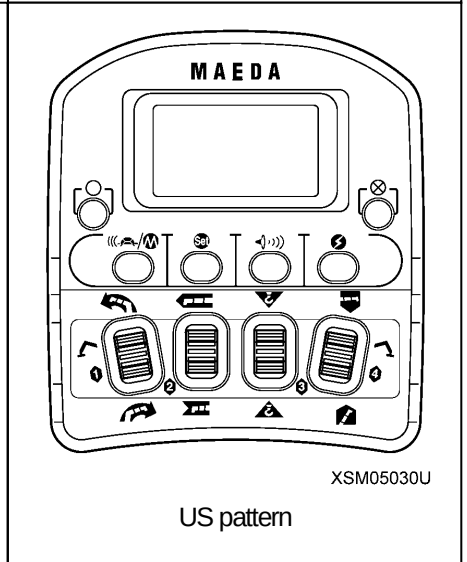
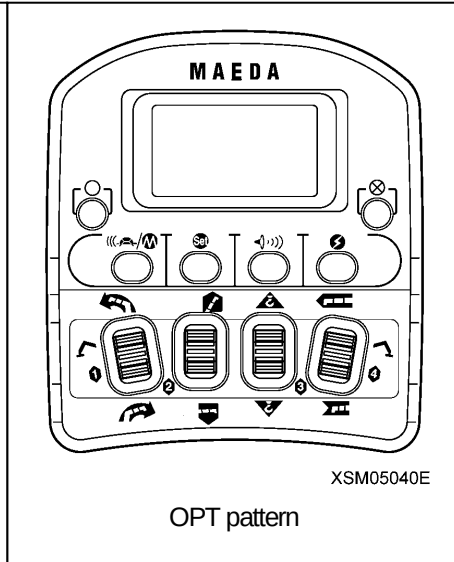
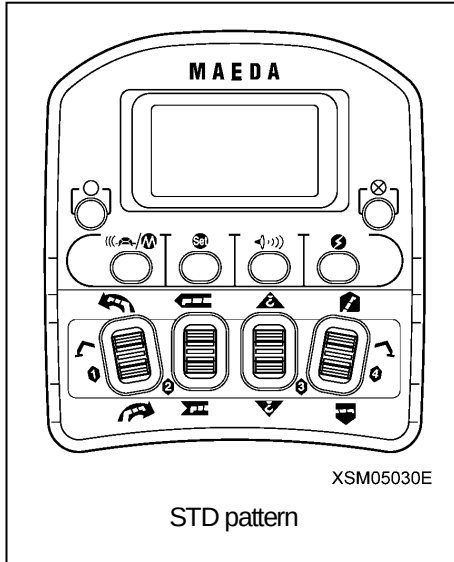
(1) Pattern

Allow you to change the operating pattern. There are 3 patterns of STD, OPT or US patterns.

★At the time of factory shipment, this is set as STD.



XSM02880E



(2) Slewing Speed

For changing the gain in slewing.

There are 3 selections of HI, MID and LOW.

• HI: Increase the gain.

• MID:

• LOW: Reduces the gain.



★At the time of factory shipment, this is set at HI.



XSM02910E

(3) Boom Raising and Lowering Speed

For changing the gain in boom raising and lowering.

There are 3 selections of HI, MID and LOW.

• HI: Increase the gain.

• MID:

• LOW: Reduces the gain.



★At the time of factory shipment, this is set at HI.



XSM02930E

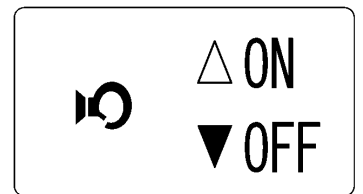
(4) Hook Stowing

For selection of availability of hook stowing function. Check the specifications of your crane.

If it has the function, set is as ON.

If not, set it as OFF.

★At the time of factory shipment, this is set at OFF.



XSM05050E

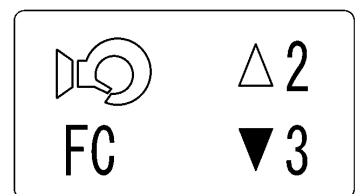
If a D (setting) Button is pushed, it will change to the screen of the right figure.

For adjusting the flow capacity (speed) of hook stowing.

There are 5 selections of 1, 2, 3, 4 and 5 are available.

• 1 ←→ 5

Slowly Quickly



XSM05060E

(5) Over Hoist Detector Switch

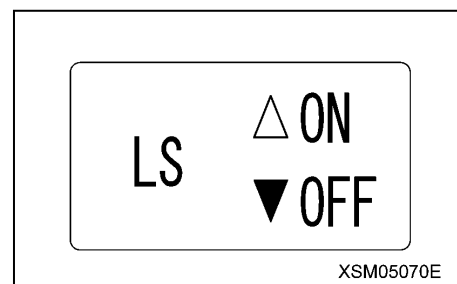
For selection of contacts A and B of over hoist detector switch.

For the contact A (NO), set it at ON.

For the contact B (NC), set it at OFF.

If your crane is not provided with hook stowing function, select this OFF.

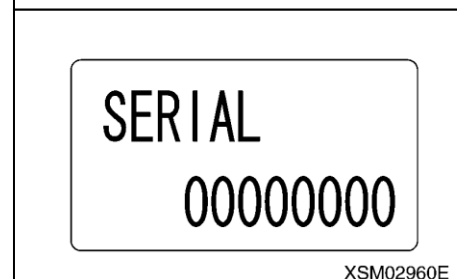
★At the time of factory shipment, this is set at OFF.



(6) Serial Number

Serial number will be displayed.

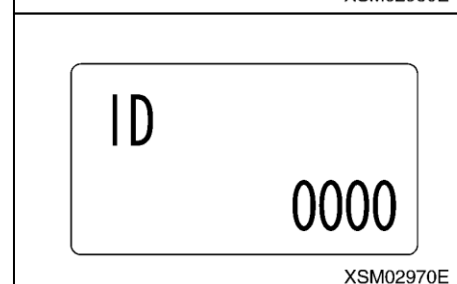
★At the time of factory shipment, serial number of your transmitter has been entered. Make sure that it coincides with the serial number label affixed to your transmitter. This is different from the label number affixed to receiver.



(7) ID Code

ID code will be displayed.

Not used.

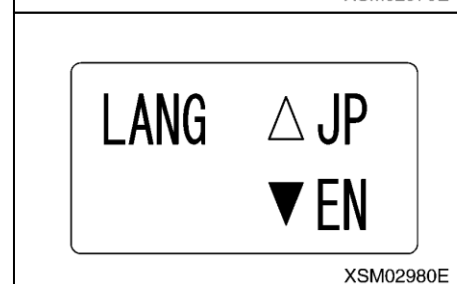


(8) Language

For selection of language for the transmitter in use.

- JP: Japanese
- EN: English

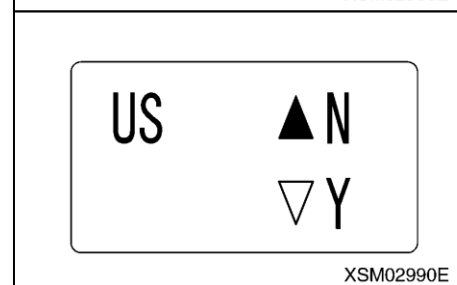
★At the time of factory shipment, this is set at EN.



(9) Unit

Not used.

★At the time of factory shipment, this is set at N.



1.5 INITIAL MODE FOR MAKER (C MODE)

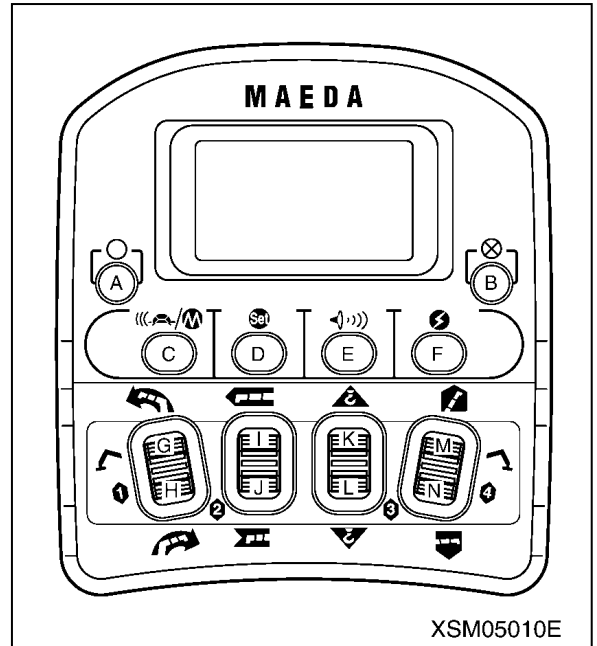
This system has an Initial Mode for Maker.

Items and contents for changing are as follows:

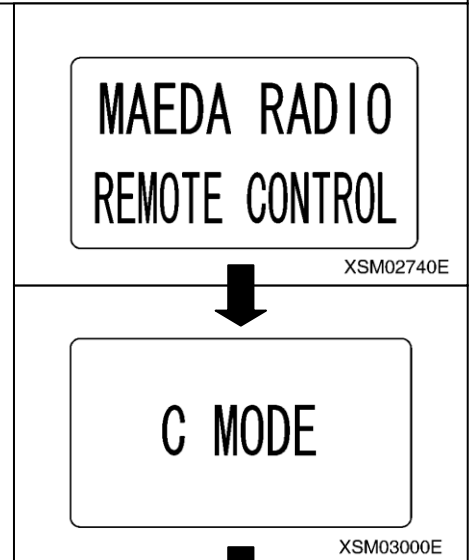
★The content of setting, once established, will be saved in memory, requiring no more setting for each work.

1. Retrieving the screen for initial mode for maker:

With the system power remaining turned OFF, while holding I and L levers pressed, continue to press F button until the screen of initial mode for maker appears (For about 2 seconds).



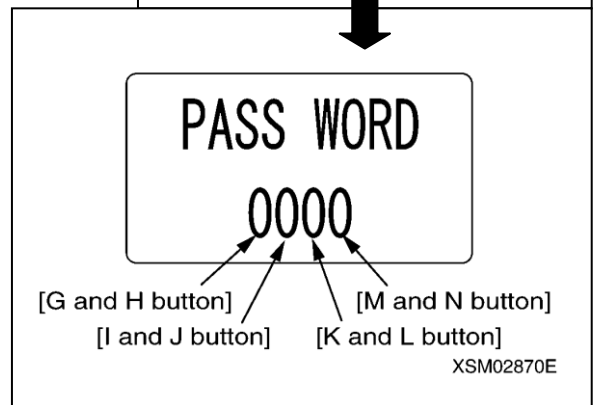
After “MAEDA RADIO REMOTE CONTROL” having showed up.



”C MODE (Initial Mode for Maker)” appears, before the prompt for password “PASS WORD 0000” comes up.

Each digit corresponds to levers as shown above.

Operate each levers to enter [2FC6], before pressing D button.



Note:

- Be sure to turn OFF the main switch at receiver before starting to operate the initial mode.
- Before starting to change the setting, always make sure that “C MODE (Initial Mode for Maker)” has appeared on the LCD.

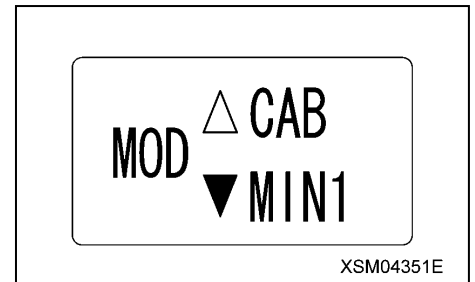
2. Items for setting the initial mode for maker:

(1) Model

For selection of model.

There are 3 selections of "CAB", "MIN", "MIN 1", "MIN 2" and "MIN 4".

★At the time of factory shipment, this is set at "MIN".

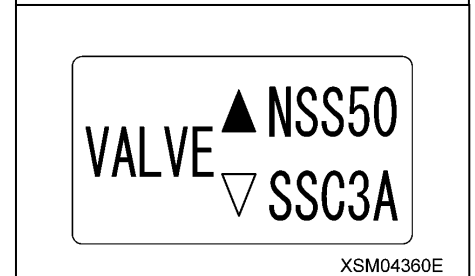


(2) Valve

For selection of valve.

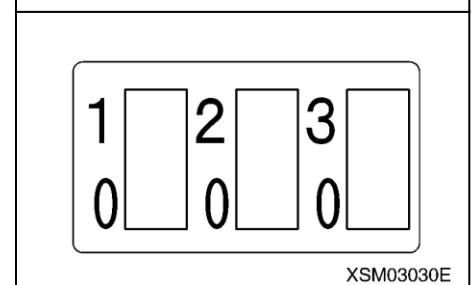
There are 3 selections of "NSS50", "SSC3A" and "NACHI".

★At the time of factory shipment, this is set at "NSS50".



If a use valve is chosen and a D (setting) Button is pushed, it will change to the screen of the right figure.

★At the time of factory shipment, the micro speed "1" is set at "10", the micro speed "2" is set at "18", and micro speed "3" is set at "60".

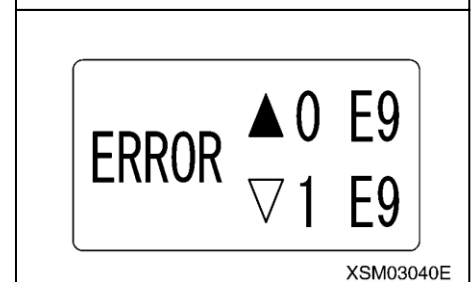


(3) Error

The error generated in the past can be called.

It has memorized by the past 8 times.

★At the time of shipment, although the error may be displayed, the time of manufacture, and since it is alike and is displayed with the operation check at the time of shipment etc.. If it is operating normally now, it does not have a problem.

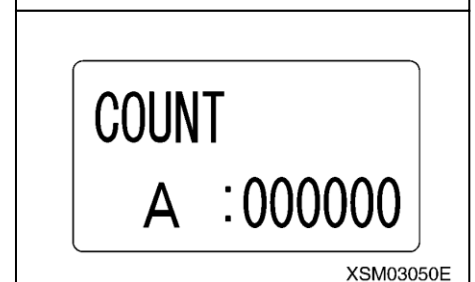


(4) Number of Times of Operation

The number of times of operation of each old operation button is known.

It counts only at the time of operation in crane mode etc., and the operation at the time of setting mode is not counted.

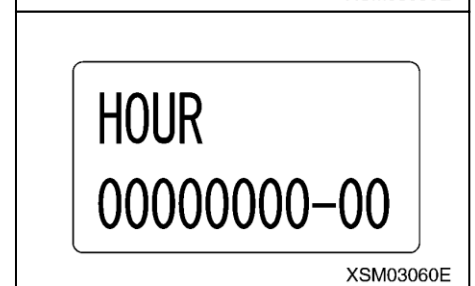
★Please understand that it counts with the operation check at the time of shipment etc. at the time of shipment although counted several times.



(5) Operation Time

Operating time will be displayed.

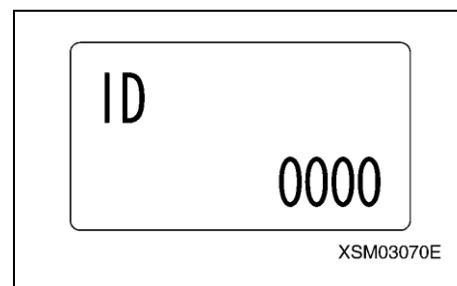
★At the time of shipment, although displayed for a number of hours, it is at the shipment time. Please understand that it counts with an operation check etc.



(6) ID Code

ID code will be displayed.

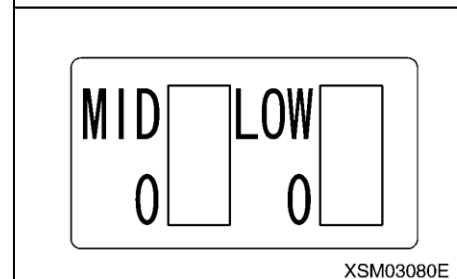
Not used.



(7) Gain

A setup of the gain value (Slewing, Boom raising and lowering) "MID" and "LOW" can be performed.

★At the time of factory shipment, the "MID" is set to "46", and the "LOW" is set to "33".

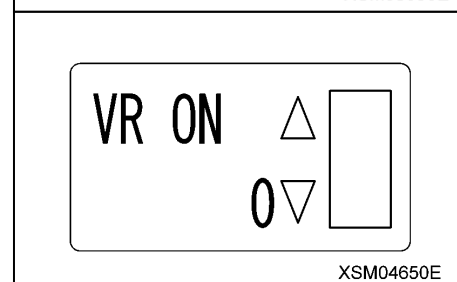


(8) Accelerator ON position

For setting of Accelerator ON position, in proportion to triggering ratio.

Select level with the selection levers, and press D button to set. The display then returns to "initial mode setting".

★At the time of factory shipment, this value is set to "0".

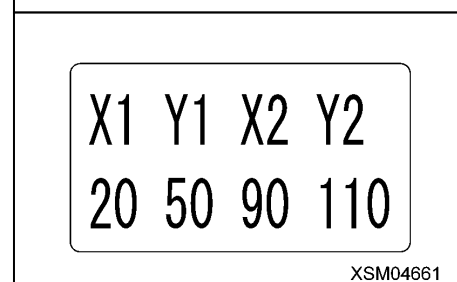


(9) Flow-control

For setting of two points of maximum flow rate point, in proportion to triggering ratio. Select level with the selection levers, and press D button to set. The display then returns to "initial mode setting".

★At the time of factory shipment, this value is set to "X1:20, Y1:50, X2:90, Y2:110".

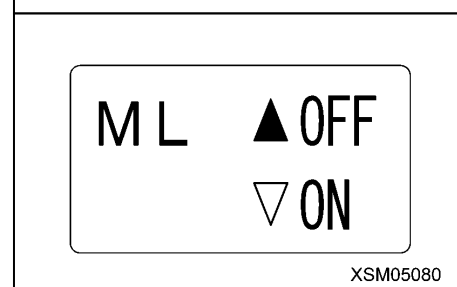
Do not change this value if unnecessary.



(10) ML

Not used.

★At the time of factory shipment, this is set at "OFF".



1.6 INITIAL MODE SETTING (For interactive remote controller)

★High-light in “Selective Modes and Values” are the initial values.

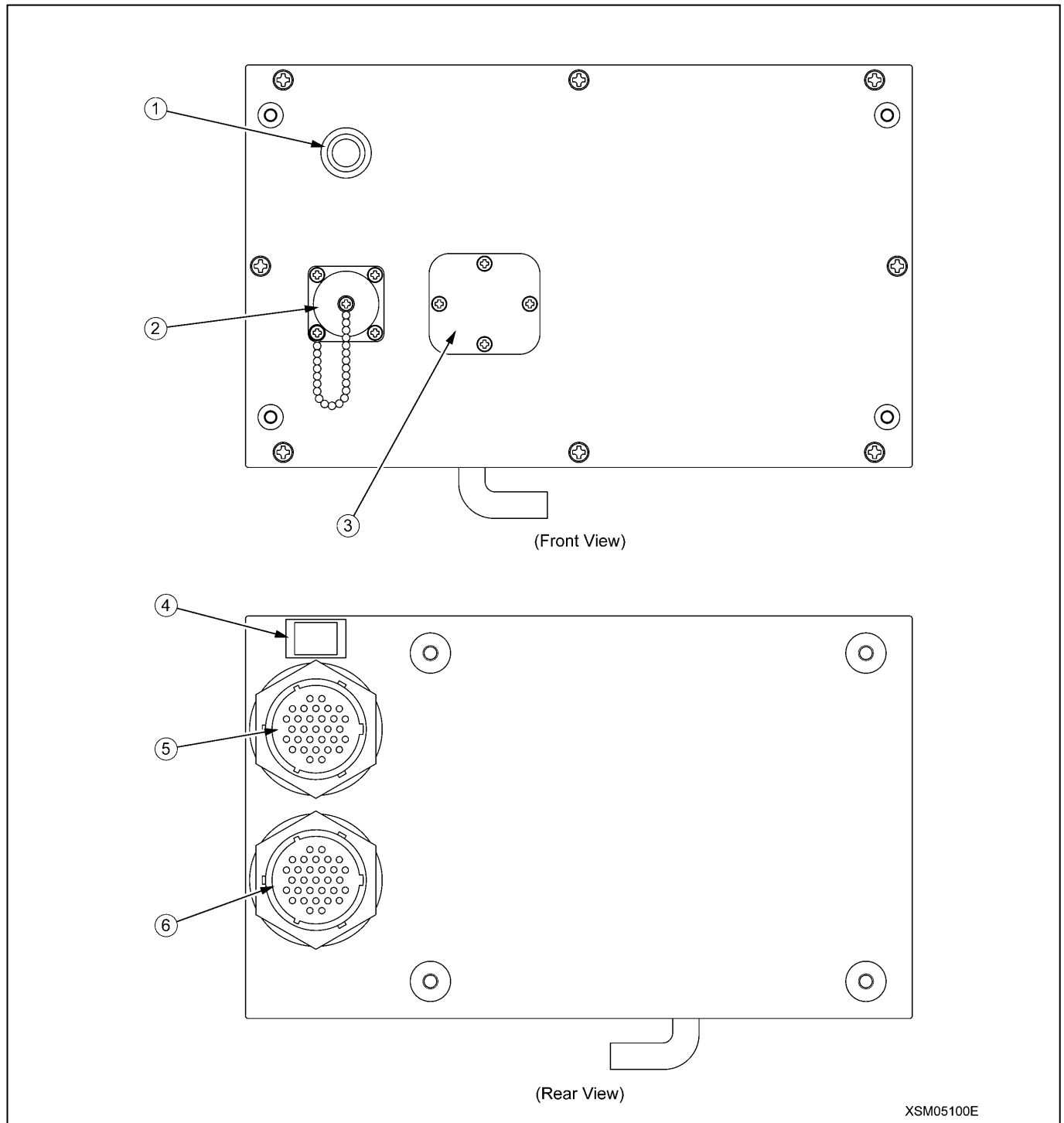
Mode	Setting Items		Selective Modes and Values		Remarks	
A MODE (For User)		LCD Contrast	Optimum		For indoors operation	
		Voice Volume	ON		Bar chart indicator	
		Accelerator	OFF			
		Accelerator	100%			
		Light	OFF			
			1S			
			3S			
		OFF Timer	5S			
		OFF Timer	5M			
		OFF Timer	10M			
		Idle Up	15M		Bar chart indicator	
		Reset Micro Speed	0%			
	Reset Micro Speed	N				
		Y				
	VERSION	Version	46-0106-0001-00			
B MODE (For Service)	PTN	Pattern	STD			
			OPT			
			US			
		Slewing Speed	HI			
			MID			
			LOW			
		Boom Raising and Lowering	HI			
			MID			
			LOW			
		Hook Stowing	ON	1		
				2		
			OFF	3		
				4		
				5		
	LS	Over Hoist Detector Switch	ON			
			OFF			
	SERIAL	Serial Number			Indication, only	
	ID	ID Code	0000		Indication, only	
	LANG	Language	JP			
			EN			
	US	Unit	N			
			Y			

★High-light in “Selective Modes and Values” are the initial values.

Mode	Setting Items		Selective Modes and Values	Remarks		
C MODE (For Maker)	MOD	Model	CAB			
			MIN			
			MIN1			
			MIN3			
			MIN4			
	VALVE	Valve	NSS50	Micro 1 : 10	Speed	
			SSC3A	Micro 2 : 18	Speed	
			NACHI	Micro 3 : 60	Speed	
	ERROR	Error		Indication, only		
	COUNT	Number of Times of Operation		Indication, only		
	HOUR	Operation Time		Indication, only		
	ID	ID Code	0000	Indication, only		
	GAIN	Gain	MID: 46 LOW: 33			
	VR ON	Accelerator ON Position	0			
	FLOW ADJ	Flow-control	X1: 20 Y1: 50 X2: 90 Y2: 110			
ML	Moment Limiter	OFF				
		ON				

2. RECEIVER

2.1 EXTERIOR VIEW



XSM05100E

- (1) Receiver main switch
- (2) Remote control connector
- (3) 7 segments LED
- (4) Label (Serial number)
- (5) M connector (31 P)
- (6) F connector (31 P)

2.1.1 CONNECTOR PIN ASSIGNMENT

Receiver has two connectors for Input/Output.

[1] M CONNECTOR

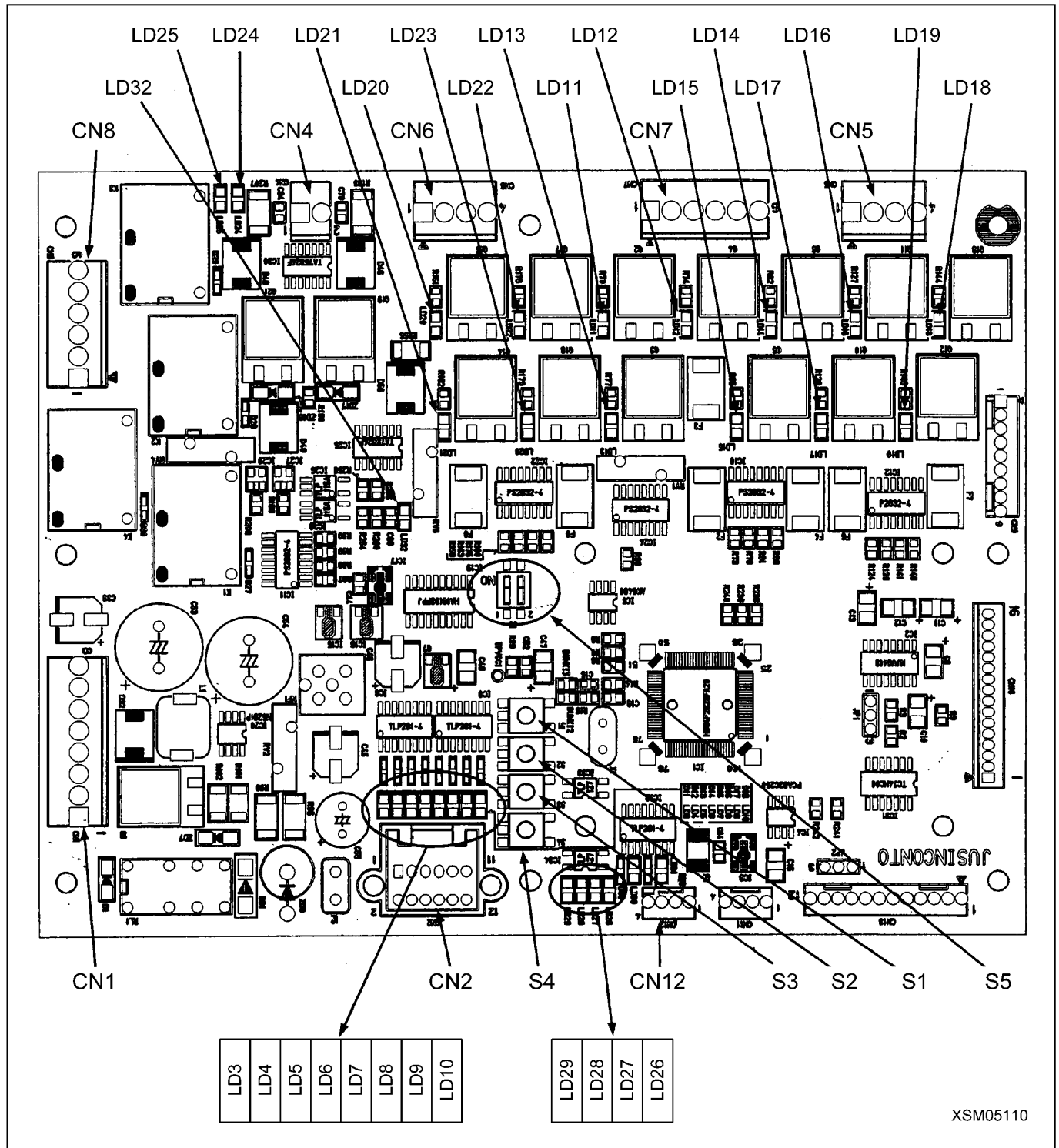
Pin	Description	Pin	Description
1	Flow Control Output	17	Not used
2	Accelerator Output	18	Not used
3	Boom Extending Output	19	GND
4	Boom Retracting Output	20	Horn Output
5	Boom Raising Output	21	Not used
6	Boom Lowering Output	22	Manual Hook Stowing Switch Input
7	Slewing Clockwise Output	23	Travelling Lever Stand Detector Limit Switch Input
8	+ Power Source (+12V)	24	Travelling 2-speed Input
9	- Power source (GND)	25	Horn Input
10	Emergency Stop Cancel Input	26	Boom Raising Lever Limit Switch Input
11	Manual Outrigger Operation Output	27	Boom Lowering Lever Limit Switch Input
12	Engine starting Output	28	Boom Extending Lever Limit Switch Input
13	Engine Stopping Output	29	Hook Raising Lever Limit Switch Input
14	Slewing Counterclockwise Output	30	Hook Lowering Lever Limit Switch Input
15	Hook Raising Output	31	For Common (+) Output for Limit Switch
16	Hook Lowering Output		

[2] F CONNECTOR

Pin	Description	Pin	Description
1	Pre-warning Input	17	Boom Lowering ML Output
2	Moment Ratio 100% Input	18	Not used
3	Over Un-winding Detector Input	19	Not used
4	Over Hoist detector Input	20	Outrigger 3 OUT Output
5	Boom Raising Stop Input	21	Outrigger 3 IN Output
6	Boom Extending Stop Input	22	Outrigger 4 OUT Output
7	Boom Lowering Stop Input	23	Outrigger 4 IN Output
8	Not used	24	Alarm Buzzer Output
9	Travelling 2-speed Output	25	GND
10	Outrigger 1 OUT Output	26	ML Ratio (4 to 20 mA) Input
11	Outrigger 1 IN Output	27	ML GND Input
12	Outrigger 2 OUT Output	28	Not used
13	Outrigger 2 IN Output	29	Not used
14	Buzzer Output	30	Not used
15	Not used	31	Not used
16	Boom Raising ML Output		

2.2 CONTROL PRINT CARD LOCATIONS

2.2.1 MAIN PRINT CARD



[1] PRINT CARD INPUT/OUTPUT

Connector No.	Pin No.	Description	Connector No.	Pin No.	Description
CN1	1	Power Source + Input (+12V)	CN5	1	Boom Extending
	2	Power Source + Input (+12V)		2	Boom Retracting
	3	Power Source - Input (GND)		3	Boom Raising
	4	Power Source - Input (GND)		4	Boom Lowering
	5	Power Source - Input (GND)	CN6	1	Slewing Clockwise
	6	Not used		2	Slewing Counterclockwise
	7	Output Common Input		3	Hook Raising
	8	Output Common Input		4	Hook Lowering
CN2	1	Not used	CN7	1	Travelling 2-speed Output
	2	Not used		2	Not used
	3	Manual Hook Stowing Switch		3	Not used
	4	Not used		4	Not used
	5	Not used		5	Not used
	6	Not used		6	Power Source - (For Valve GND)
	7	Travelling Lever Stand Detector Limit	CN8	1	Engine Starting
	8	Not used		2	Relay Common (For CN8-1)
	9	Not used		3	Engine Stopping
	10	Not used		4	Relay Common (For CN8-3)
	11	Not used		5	Horn
	12	Not used		6	Relay Common (For CN8-5)
CN4	1	Flow Control			
	2	Accelerator			

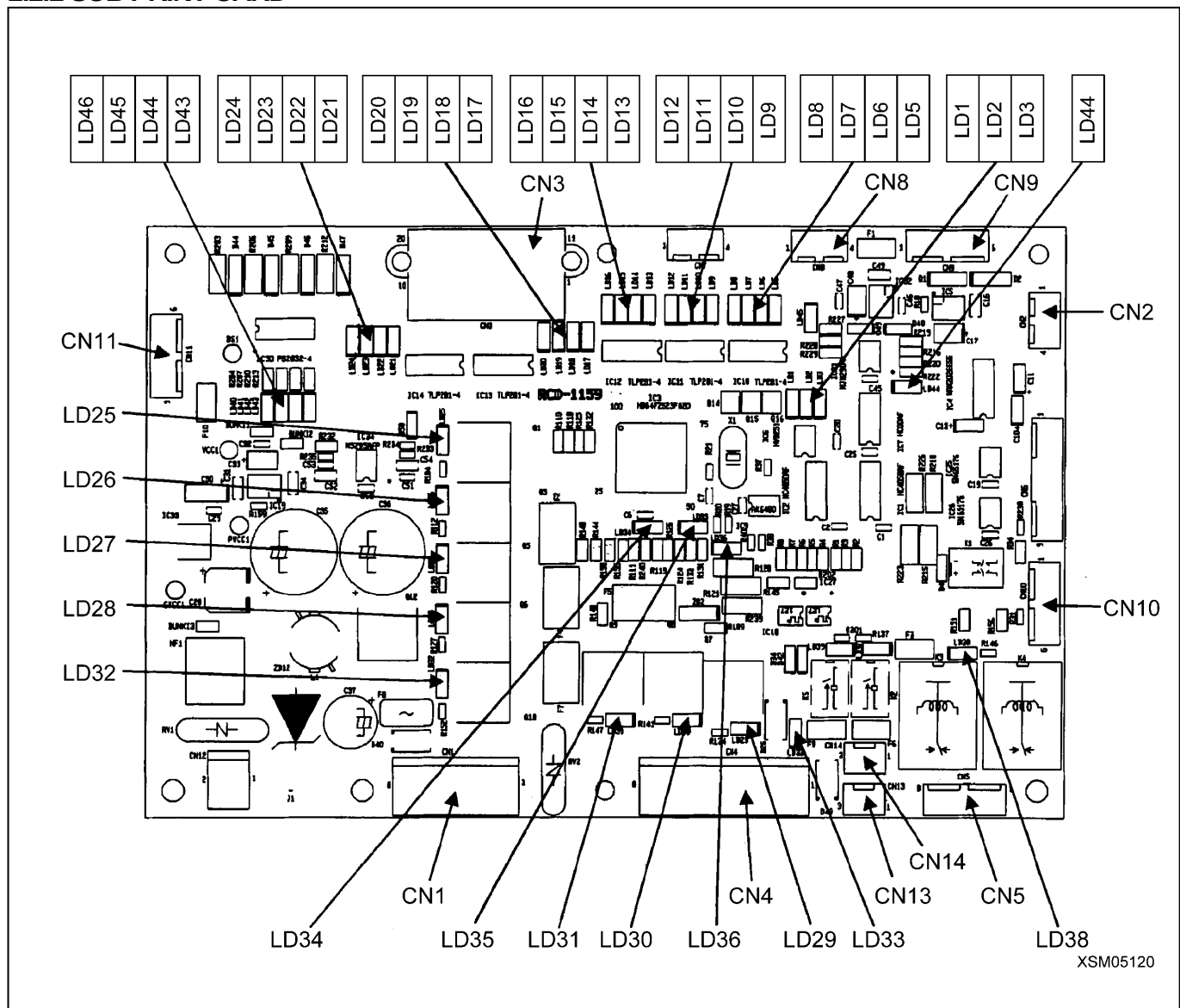
[2] COMMUNICATION BETWEEN PRINT CARDS

Connector No.	Pin No.	Description	Connector No.	Pin No.	Description
CN12	1	Communication Power Source -	CN13	1	Remote Control Transmitting/Receiving
	2	Communication Low		2	Remote Control ON
	3	Communication Hi		3	Remote Control Transmitting Data
	4	Communication Power Source +		4	Remote Control Receiving Data

[3] PRINT CARD LED DISPLAY

LED No.	Description	LED No.	Description
INPUT		LD16	Boom Retracting
LD3	Not used	LD17	Boom Extending
LD4	Not used	LD18	Boom Lowering
LD5	Manual Hook Stowing	LD19	Boom Raising
LD6	Not used	LD20	Slewing Counterclockwise
LD7	Not used	LD21	Slewing Clockwise
LD8	Not used	LD22	Hook Lowering
LD9	Travelling Lever Stand Detector Limit	LD23	Hook Raising
LD10	Not used	LD24	Accelerator
OUTPUT		LD25	Flow Control
LD11	Travelling 2-speed	CONTROL SUPERVISORY	
LD12	Not used	LD26	If communicate to receiver, lights up.
LD13	Not used	LD27	M/C operation display (when normal, lights up)
LD14	Not used	LD28	Current control output error display (when normal, lights up)
LD15	Not used	LD29	Communication error display (when normal, lights up)

2.2.2 SUB PRINT CARD



[1] PRINT CARD INPUT/OUTPUT

Connector No.	Pin No.	Description	Connector No.	Pin No.	Description
CN1	1	Power Source + (+12V)	CN3	6	Boom Extending Stop
	2	Power Source + (+12V)		7	Boom Lowering Stop
	3	Power Source - Input (GND)		8	Pre-warning
	4	Power Source - Input (GND)		9	Not used
	5	Power Source - (GND)		10	Not used
	6	Power Source - (GND)		11	Emergency Cancel
CN2	1	Main Switch		12	Boom Raising Limit
	2	GND		13	Boom Lowering Limit
	3	Not used		14	Boom Extending Limit
	4	GND		15	Hook Raising Limit
CN3	1	+5v		16	Buzzer
	2	Moment Ratio 100%		17	Travelling 2-speed Switch
	3	Over Un-winding		18	Hook Lowering Limit
	4	Over hoisting		19	Horn Switch
	5	Boom Raising Stop		20	GND

Connector No.	Pin No.	Description	Connector No.	Pin No.	Description
CN4	1	Outrigger 1 OUT Valve	CN11	1	Not used
	2	Outrigger 1 IN Valve		2	Not used
	3	Outrigger 2 OUT Valve		3	Not used
	4	Outrigger 2 IN Valve		4	Not used
	5	Outrigger 3 OUT Valve		5	Not used
	6	Outrigger 3 IN Valve		6	Not used
	7	Outrigger 4 OUT Valve	CN13	1	Moment Ratio +
	8	Outrigger 4 IN Valve		2	Moment Ratio -
CN5	1	Buzzer	CN14	1	Not used
	2	Not used		2	Not used
	3	Boom Raising			
	4	Boom Lowering			
	5	Not used			
	6	Not used			

[2] COMMUNICATION BETWEEN PRINT CARDS

Connector No.	Pin No.	Description	Connector No.	Pin No.	Description
CN8	1	Communication Power Source -	CN9	1	Remote Control Transmitting/Receiving
	2	Communication Low		2	Remote Control Transmitting Data
	3	Communication Hi		3	Remote Control Receiving Data
	4	Communication Power Source +		4	Remote Control ON

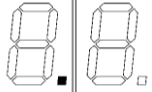
[3] PRINT CARD LED DISPLAY

LED No.	Description	LED No.	Description
INPUT		OUTPUT	
LD5	Main switch	LD25	Outrigger 1 OUT
LD6	Not used	LD26	Outrigger 1 IN
LD7	Moment ratio 100%	LD27	Outrigger 2 OUT
LD8	Over Un-winding	LD28	Outrigger 2 IN
LD9	Over Hoisting	LD29	Outrigger 3 OUT
LD10	Boom Raising Stop	LD30	Outrigger 3 IN
LD11	Boom Extending Stop	LD31	Outrigger 4 OUT
LD12	Boom Lowering Stop	LD32	Outrigger 4 IN
LD13	Pre-warning	LD33	Buzzer
LD14	Not used	LD34	Not used
LD15	Not used	LD35	Boom Raising
LD16	Emergency Cancel	LD36	Boom Lowering
LD17	Boom Raising Limit	LD38	Manual Outrigger
LD18	Boom Lowering Limit	LD40	Not used
LD19	Boom Extending Limit	LD41	Not used
LD20	Hook Raising Limit	LD42	Not used
LD21	Buzzer	LD43	Not used
LD22	Travelling 2-speed	CONTROL SUPERVISORY	
LD23	Hook Lowering Limit	LD1	Error display (when normal, lights up)
LD24	Horn	LD2	Error display (when normal, lights up)
LD44	Moment Ratio (4 to 20 mA Input)	LD3	Not used

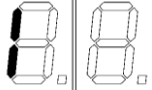
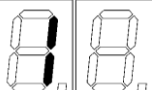
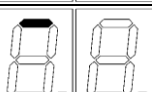
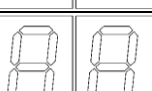
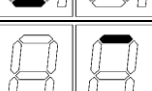
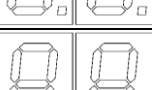
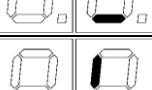
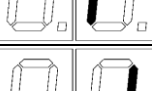
2.3 MONITOR DISPLAY MESSAGE

2.3.1 NORMAL OPERATION MESSAGE

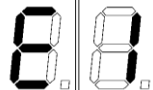
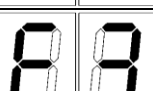
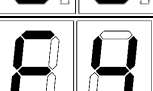
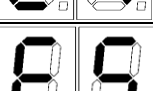
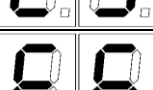
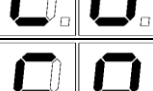
[1] Receive status

Display Code	Details
	Receiving (A dot blinks alternately)

[2] Function display

Display Code	Details
	Boom extending
	Boom retracting
	Winch hoisting
	Winch un-hoisting
	Boom raising
	Boom lowering
	Boom slewing counter-clockwise
	Boom slewing clockwise

2.3.2 ERROR MESSAGE

Error Code	Details
	Emergency stop
	Signal receiving error
	Breaking of wire within transmitter
	Volume position error during starting
	Volume position error at restarting
	EEPROM error
	Button and Lever position error at starting

3. TROUBLESHOOTING

While crane operates perfectly under manual control, it do not at all under remote control.

(When crane is displayed, in case of manual operation.)

Error display	Main cause	Remedy
Nothing displayed	Fuse inside receiver defective	Replace fuse (10A).
	Emergency stop being applied to transmitter.	Push reset button and cancel the emergency stop.
	Power source of transmitter is OFF.	Push power supply button of transmitter.
	Remote control cable defective.	Check, repair or replace the remote control cable.
	Transmitter defective.	Check, repair or replace the transmitter.
	At power ON, the transmitter accelerator control lever position inappropriate.	With the accelerator control lever returned, power ON the transmitter again and see.
	At power ON, the transmitter accelerator control lever position inappropriate and the transmitter control lever was no in Neutral.	With the accelerator control lever returned and see.
	Memory inside receiver content defective.	Power ON again and see.
	At power ON, the transmitter control buttons or levers were no in Neutral.	With the control buttons and levers in Neutral, power ON the transmitter again and see.

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