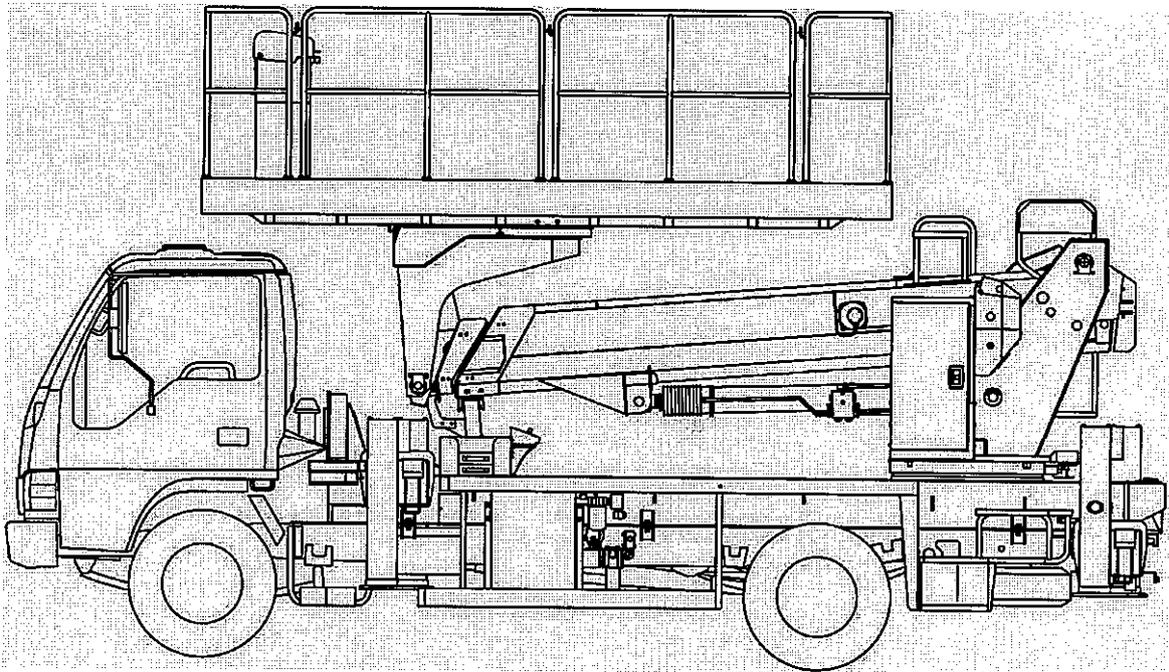


SERVICE MANUAL

TZ12A / ITZ40A



/// MICH
CORPORATION

1152, RYOKE, AGE0, SAITAMA, JAPAN.

Introduction

This manual describes correct adjustment and servicing procedures for truck mounted aerial platform TZ12A/ITZ40A in order to ensure the most effective use of superb performance and excellent features for your satisfaction.

Read this manual carefully and understand the descriptions correctly before making any repair or maintenance works.

Always be sure of the following items when conducting repair or maintenance works.

- **Use only the spare parts approved by the manufacturer, particularly for load-supporting and safety-related components.**
- **Do not make any modifications to the machine without obtaining the manufacturer's approval.**

The design check, the manufacturing check as well as the practical test should be conducted by the approved agent, if the modification which would affect the stability, strength or performance of the machine is made.

Please, note that the numerical values in this manual may be subject to change due to engineering improvement.

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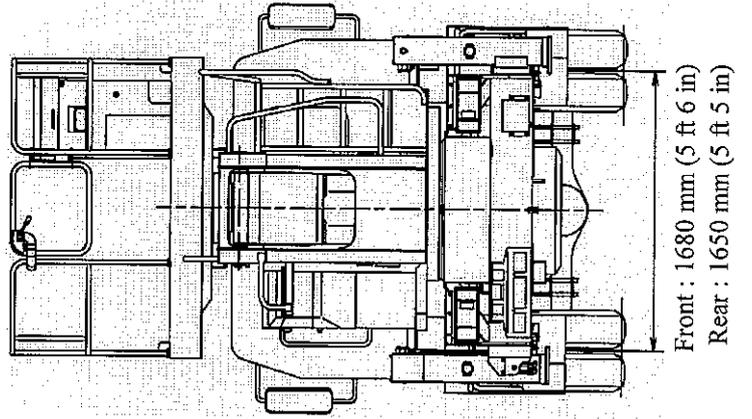
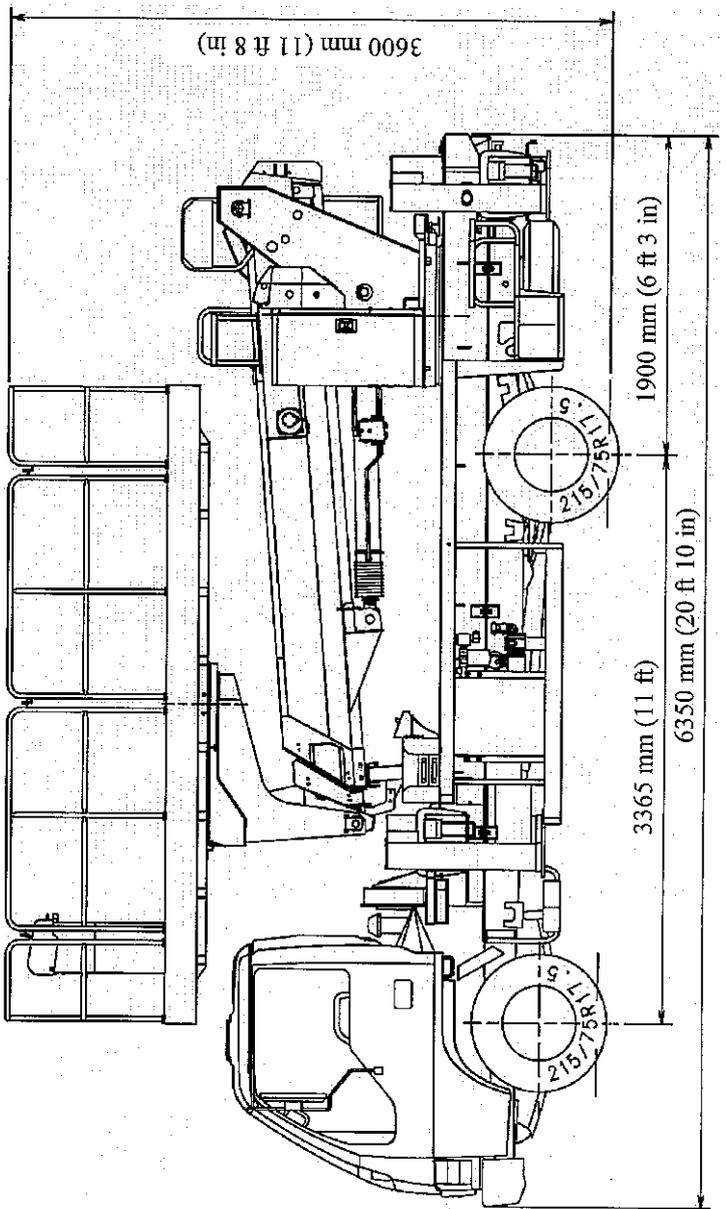
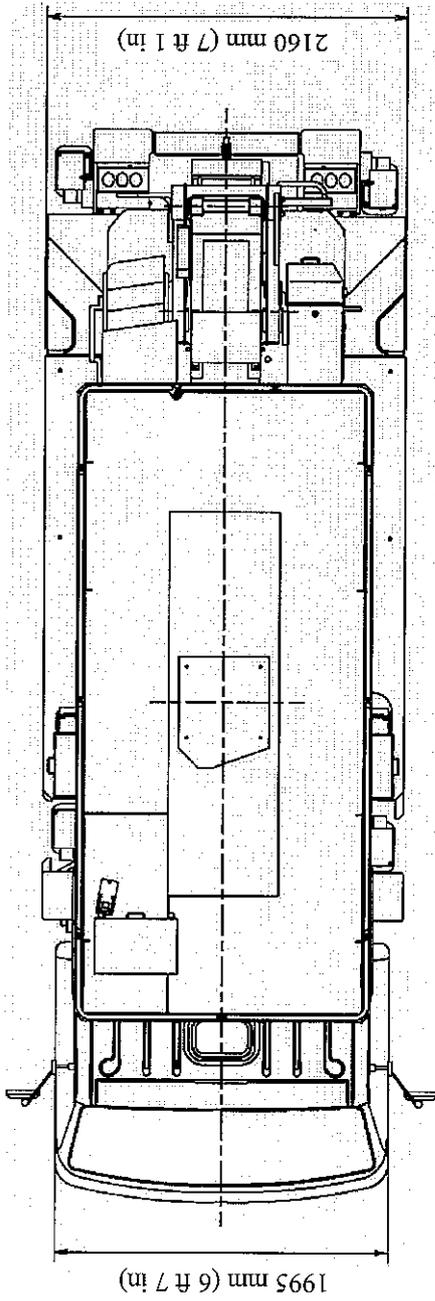
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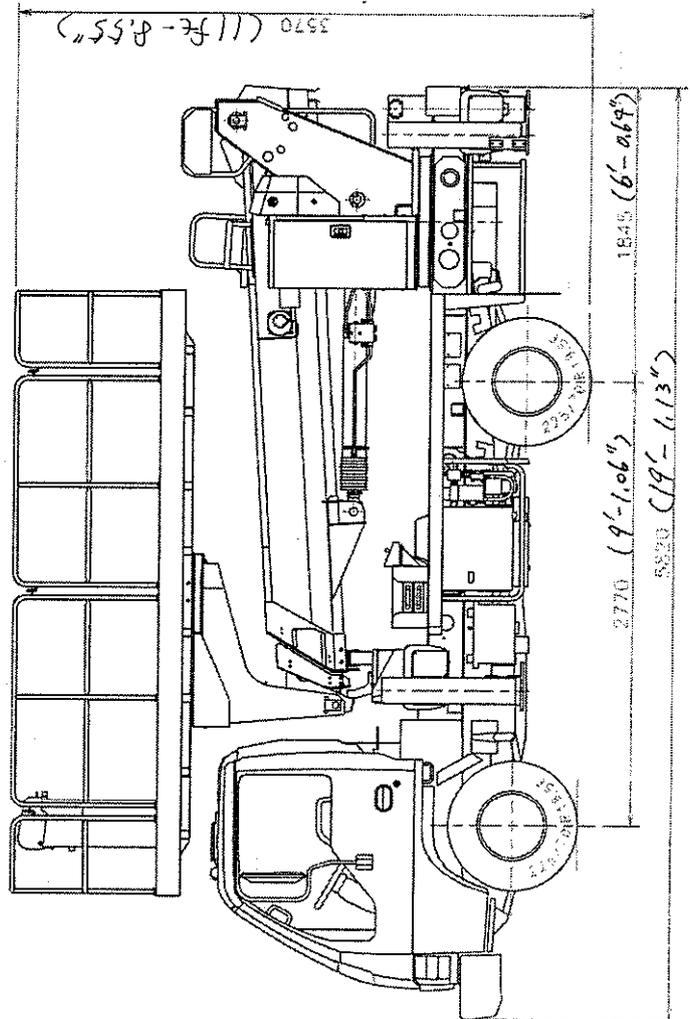
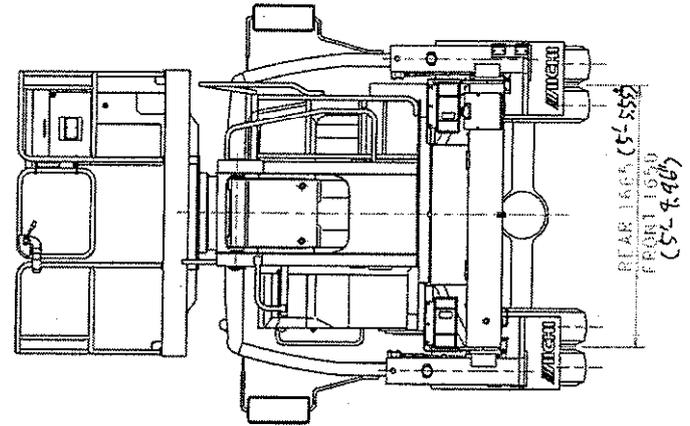
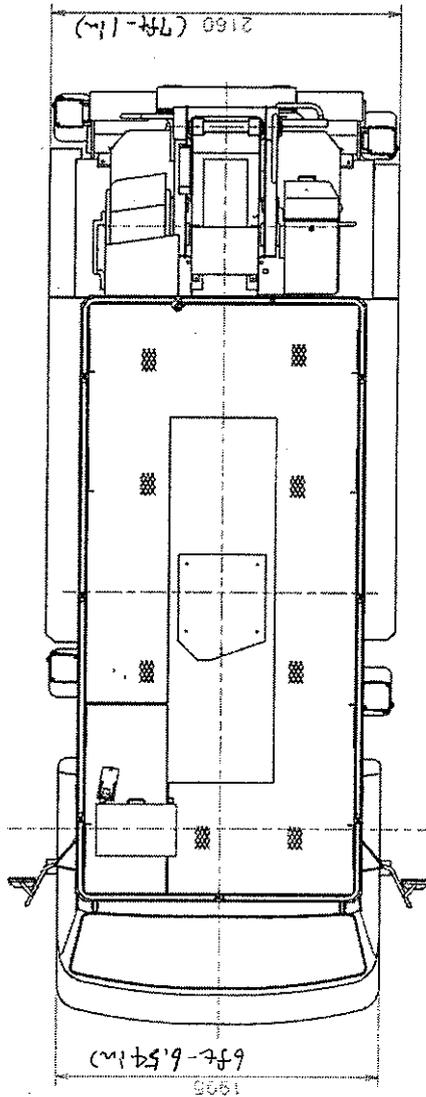
1. General information

Over all dimensions



Overall dimensions

Chassis applied: ISUZU NQR

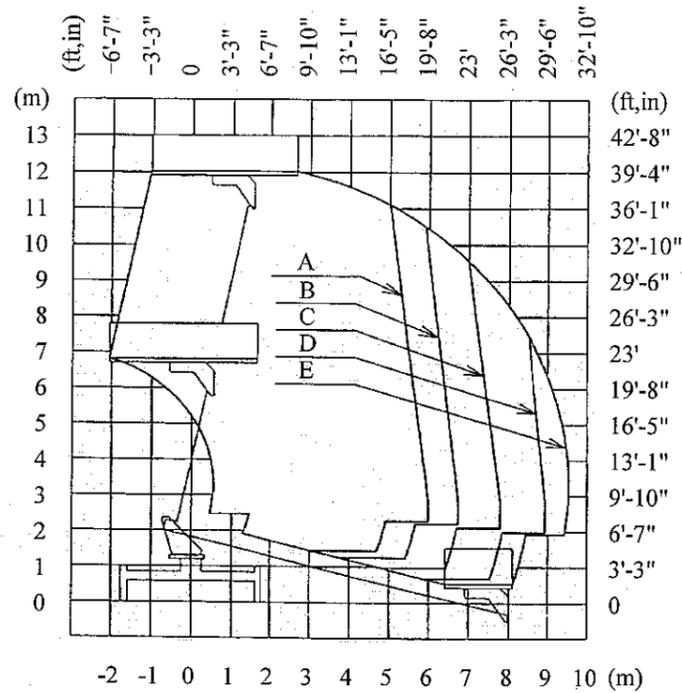


Specifications

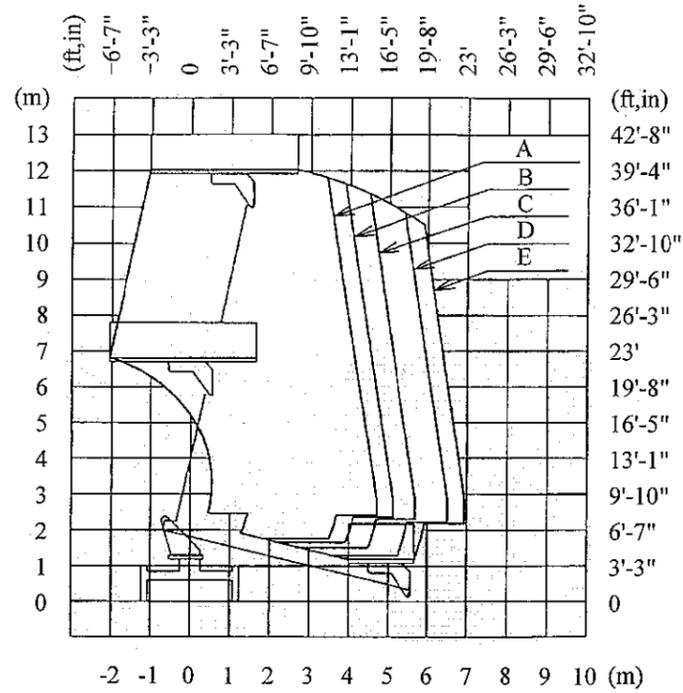
Model		TZ12A	ITZ40A	
Platform	Rated load	1,000 kg or 8 persons + Tools (360 kg)	2,200 LBS or 8 persons + Tools (780LBS)	
	Inner dimensions (L×W×H)	3,700×1,690×1,100 mm	12 ft 2 in × 5 ft 7 in × 3 ft 7 in	
	Rotation angle	360 deg. (Continuously)	←	
	Maximum floor height	12.1 m	39 ft 8 in	
	Maximum allowable side force	41 kg	90 LBS	
Boom	Length	3,685 ~ 8,995 mm	12 ft 1 in ~ 29 ft 6 in	
	Angle	-15 ~ 79 deg.	←	
	Rotation angle	360 deg. (Continuously)	←	
Maximum allowable tilt angle		0 degree.	←	
Maximum allowable wind speed		12.5 m/second	28 MPH	
Outrigger	Width	1,870 ~ 4,100 mm	6 ft 2 in ~ 13 ft 5 in	
	Jack stroke	495 mm	1 ft 7 in	
Speed	Elevation	Up	40 ± 10 seconds	←
		Down	45 ± 10 seconds	←
	Telescope	Out	30 ± 10 seconds	←
		In	30 ± 10 seconds	←
	Boom rotation	C.W	60 ± 10 seconds / 360 deg.	←
		C.C.W	60 ± 10 seconds / 360 deg.	←
	Platform rotation	C.W	60 ± 10 seconds / 360 deg.	←
		C.C.W	60 ± 10 seconds / 360 deg.	←
Hydraulic system	Oil reservoir	Capacity	100 liters	26.5 gallons
		hydraulic oil	Shell Tellus oil T22	←
	Hydraulic pump	Type	Gear pump	←
		Displacement	40 cc / rev	2.4 in ³ / rev
		Speed	350 ~ 1,000 rpm	←
	Specific maximum pressure		175 kg / cm ²	2,500 PSI

Working range chart

1. When the outrigger extension is MAX (4,100 mm / 13 ft 5 in)



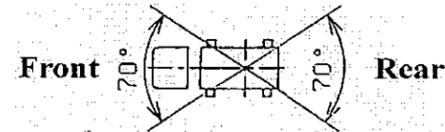
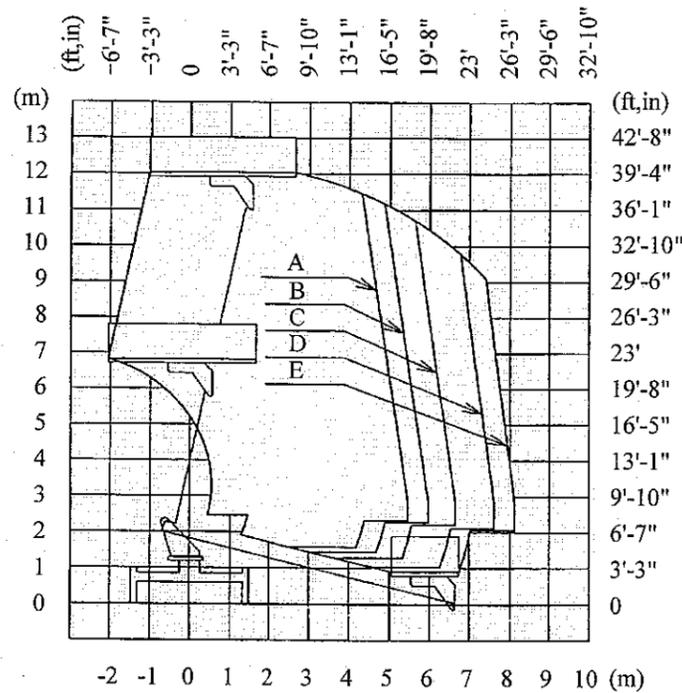
3. When the outrigger extension is MID1 (2,600 mm / 8 ft 6 in)



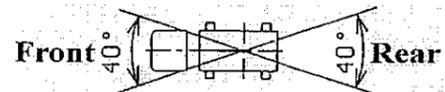
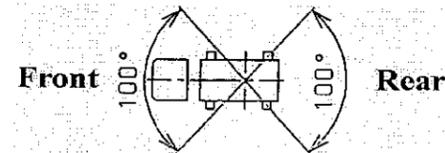
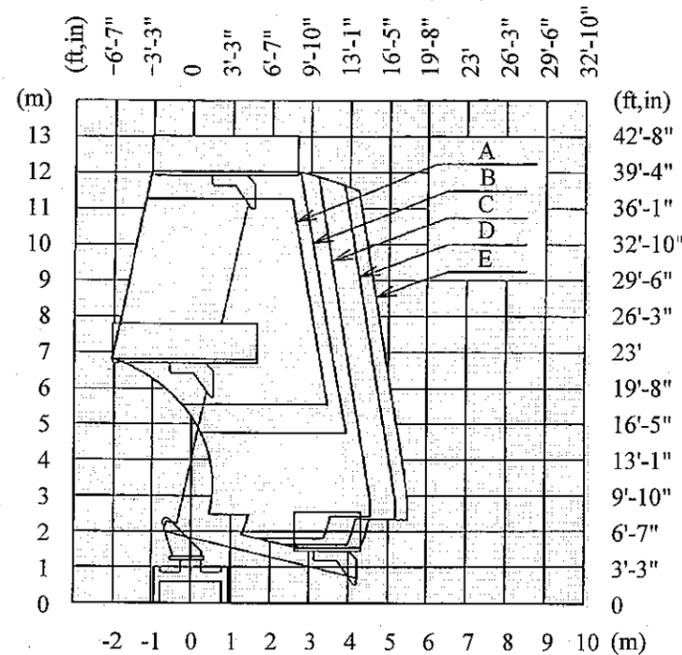
Working load

A	--- 1,000 kg	(2,200 lbs)
B	----- 750 kg	(1,650 lbs)
C	----- 500 kg	(1,100 lbs)
D	----- 250 kg	(550 lbs)
E	----- 150 kg	(330 lbs)

2. When the outrigger extension is MID2 (3,330 mm / 10 ft 11 in)



4. When the outrigger extension is MIN (1,870 mm / 6 ft 2 in)



NOTE :

1. The deflection of boom is not considered in the working range chart.
2. The working range is calculated, assuming that the machine is set up on firm and level ground.
3. The working range which is obtained with the outrigger extended to MAX is always obtained regardless of the outrigger extension, if the boom is rotated to the front or rear side of the vehicle shown in each figure below the charts.

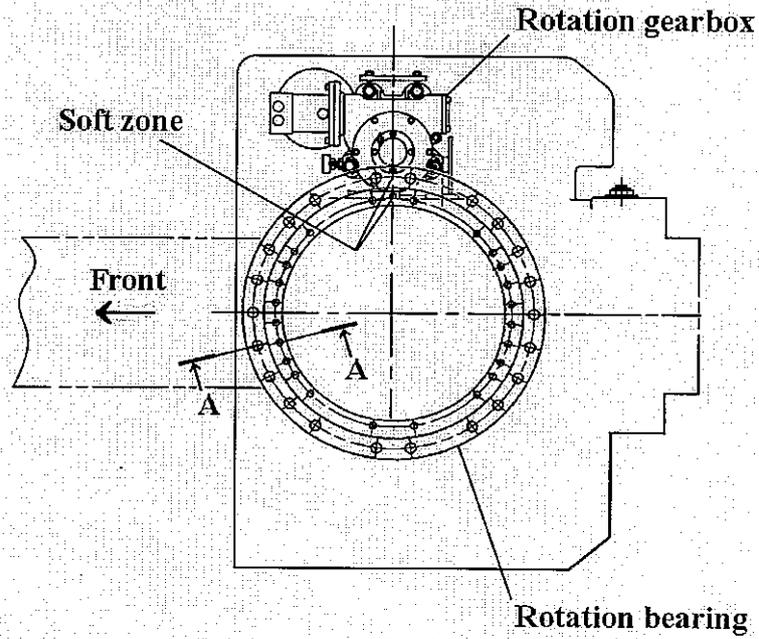
2. Mechanical section

Boom rotation bearing

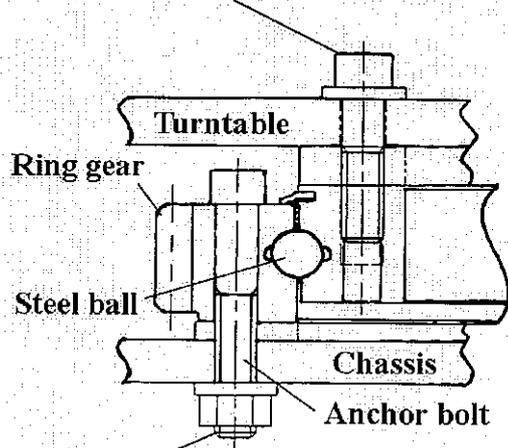
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The boom rotation bearing is mounted between the sub-frame and the turntable, and enables the turntable to rotate.

* Set the Soft zone at the positions shown in the figure below when installing the rotation bearing.



Tightening torque : 35 kg-m (255 ft-lbs)



Tightening torque : 40 kg-m (290 ft-lbs)

A-A section

1. Inspection

1. Check the anchor bolts and nuts for looseness.

- Loose bolts and nuts should be removed and be checked for any damage.
- Before removing the bolts and nuts, use a gas burner and heat the bolts and nuts red hot to burn out the lock tight.
- Do not reuse the removed or heated bolts and nuts.
- Apply a lock tight (Loctite 262 or equivalent) to the thread of each bolt before installing the bolts.
- Tighten the anchor bolts and nuts by the specific tightening torque.

Specific tightening torque (for Chassis) ----- 40 kg-m (290 ft-lbs)
(for Turntable) ----- 35 kg-m (255 ft-lbs)

2. Check the ring gear for cracks and scorings.

3. Check the back-lash between the ring gear and the pinion of the rotation gear box, then adjust the back-lash by shifting the position of the rotation gear box.

Standard back-lash ----- 0.6 mm (0.024 in) or less.

Follow the next procedures to check the back-lash.

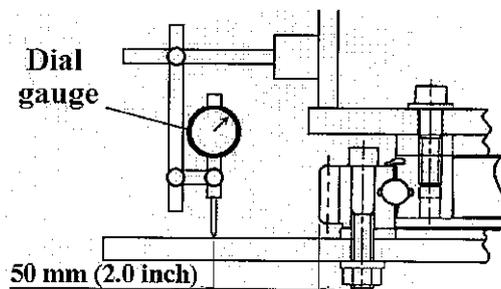
- 1) Place a lead wire between the pinion and the ring gear.
- 2) Rotate the turntable slowly and crush the lead wire.
- 3) Measure the thickness of the crushed lead wire. The thickness is the back-lash.

4. Check the free-play between the inner and outer races of the rotation bearing and replace the rotation bearing, if the free-play exceeds the serviceable limit.

Free-play serviceable limit ----- 3.0 mm (0.118 in)

Follow the next procedures to check the free-play.

- 1) Stow the boom on the boom rest properly.
- 2) Set a dial gauge between the sub-frame and the turntable as shown in the figure below.



3) Raise the boom till the boom leaves the boom rest, then set the pointer of the dial gauge at "ZERO".

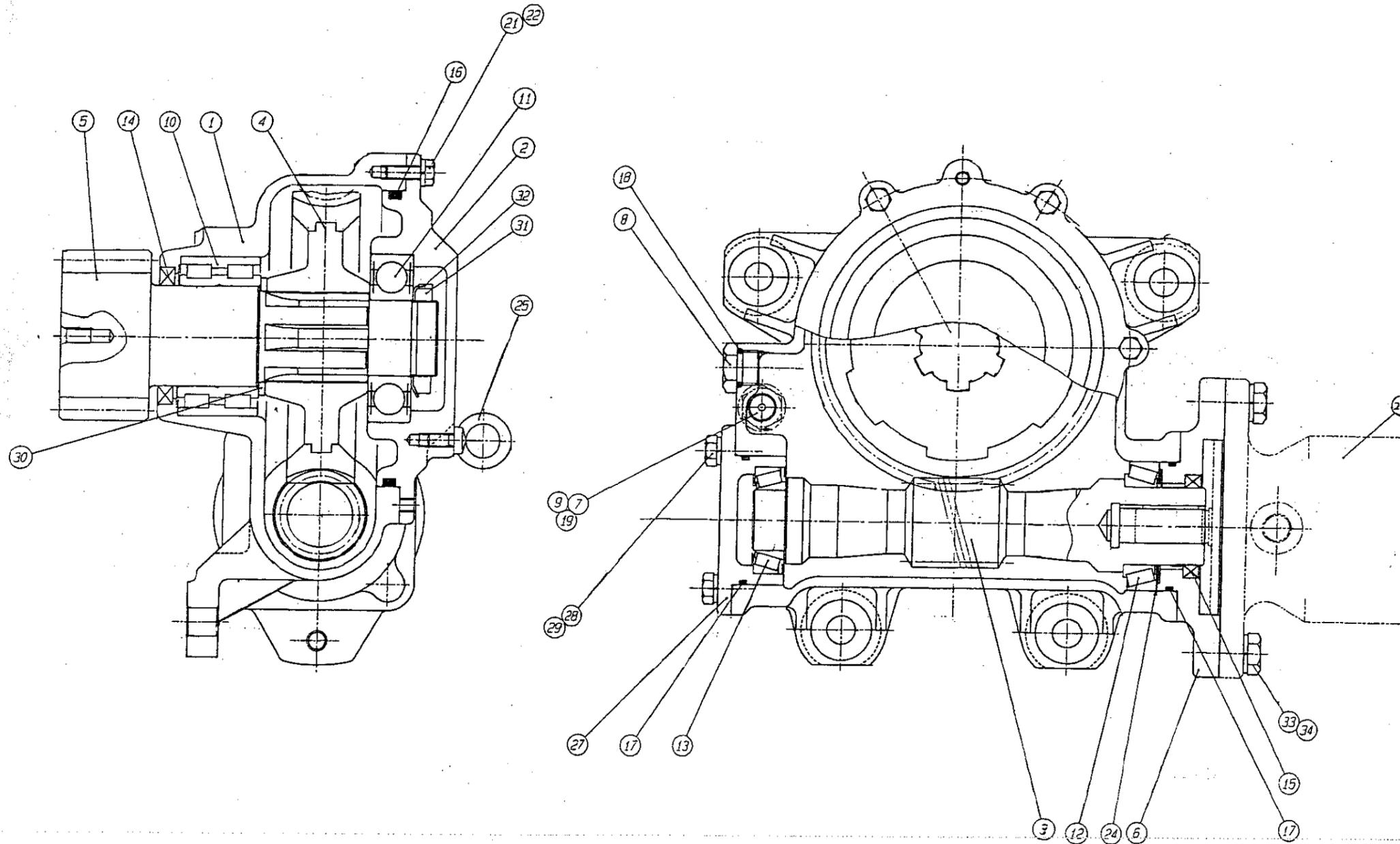
4) Press the boom against the boom rest by lowering the boom, then read the dial gauge.
The reading of the dial gauge is the free play.

Boom rotation gear box

Type ----- Worm gear

Reduction ratio ----- 1/50

Gear oil ----- Shell Omala oil 460 (1 liter, 0.26 gallons)



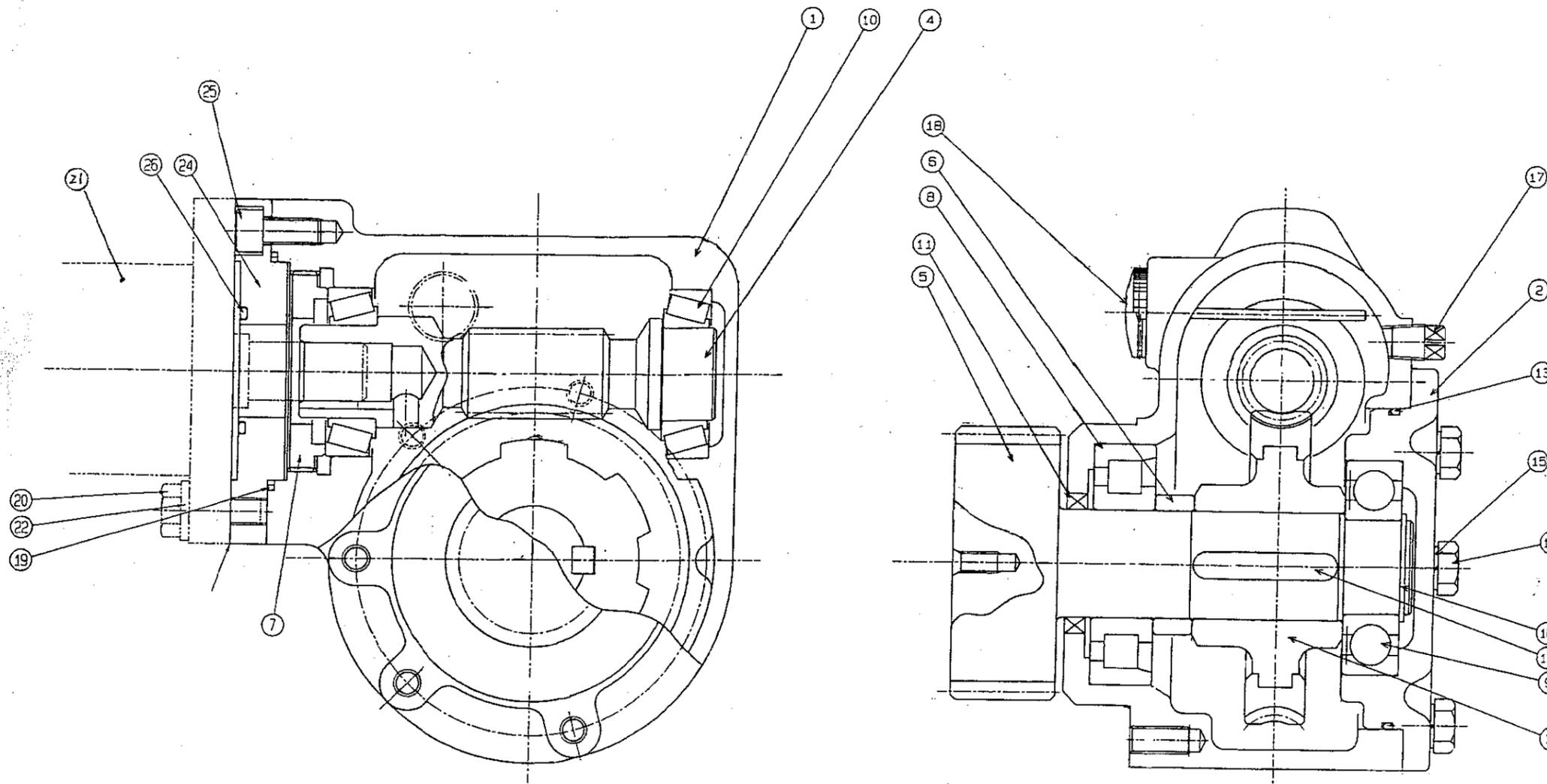
1	Case
2	Cover
3	Worm shaft
4	Worm wheel
5	Out-put shaft
6	Flange
7	Plug
8	Plug
9	Oil filler cap with dip stick
10	Needle roller bearing
11	Ball bearing
12	Taper roller bearing
13	Taper roller bearing
14	Oil seal
15	Oil seal
16	O ring
17	O ring
18	O ring
19	O ring
20	Hydraulic motor
21	Bolt
22	Spring washer
23	-----
24	Shim
25	Hook
26	-----
27	Cap
28	Bolt
29	Spring washer
30	Collar
31	Bearing nut
32	Lock washer
33	Bolt
34	Spring washer

Platform rotation gear box

Type ----- Worm gear

Reduction ratio ----- 1/49

Gear oil ----- Shell Spirax EP90 (0.6 liters, 0.16 gallons)



1	Case
2	Cover
3	Worm wheel
4	Worm shaft
5	Out-put shaft
6	Collar
7	Screw ring
8	Roller bearing
9	Ball bearing
10	Taper roller bearing
11	Oil seal
12	Parallel key
13	O ring
14	Bolt
15	Spring washer
16	Snap ring
17	Plug
18	Oil filler cap with dip stick
19	O ring
20	Bolt
21	Hydraulic motor
22	Flat washer
23	-----
24	Flange-----
25	Bolt
26	O ring

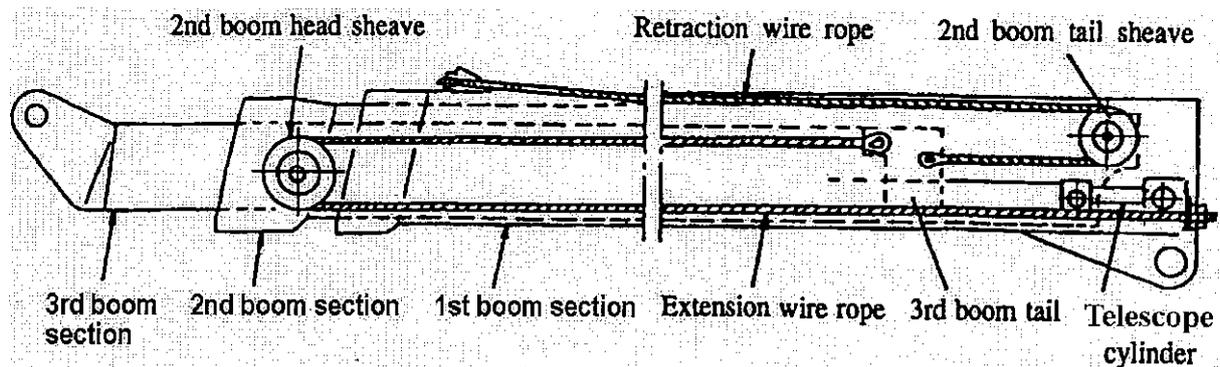
Boom

The boom consists of 1st boom section, 2nd boom section, 3rd boom section, Telescope cylinder, Extension / Retraction wire ropes, Hydraulic plumbing, Electric cables and their sheaves.

The 2nd boom section is extended or retracted directly by the telescope cylinder.

However, the 3rd boom section is telescoped by the movement of 2nd boom section through extension / retraction wire ropes.

1. Note on function



The 1st and 2nd boom sections are connected by the **telescope cylinder** which directly extends and retracts the second boom section.

The 3rd boom section is connected by two pairs of wire ropes, one is the **retraction wire rope**.

This is connected to the tail of the 3rd boom section through the tail sheave installed on the tail of the 2nd boom section. The other is the **extension wire rope**. This is also connected to the tail of the 3rd boom section through the head sheave which is installed on the head of the 2nd boom section.

The 2nd boom section is extended by the **telescope cylinder** together with the head sheave.

As a result, the 3rd boom section is pulled by the **extension wire rope** and accordingly goes out of the 2nd boom section.

When retracting the boom, the 2nd boom section is retracted by the **telescope cylinder** together with the tail sheave. As a result, the 3rd boom section is pulled by the **retraction wire rope** and accordingly goes into the 2nd boom section.

2. Inspection procedures

The boom is to be disassembled for a detailed inspection every 4 years.

1. Clearance between each boom section.

1) Check the clearance between each wear pad and boom section.

* Specific clearance : Upper ----- 3.0 mm or less. (0.12 in or less)

Side ----- 2.0 mm or less. (0.08 in or less)

2) If the clearance is not adequate, adjust the clearance by adding or reducing the spacers installed under the each wear pad or by turning the adjust screws.

NOTE :

* Check each wear pad for wear, and replace if necessary.

* Apply a thread lock agent to the thread of each set screw for wear pad before setting.

Recommended thread lock agent : Loctite 262.

2. Bend of boom.

1) Set the boom horizontally and extend it fully.

2) Visually check the bend of each boom section and replace the boom section, if the excessive bend is observed.

3. Dents, scratches.

Check the each boom section for both dents and scratches thoroughly.

If any dent or scratch which exceeds the serviceable limit {Length : 50 mm (1.97 in) or more, Depth : 2 mm (0.08 in) or more} is observed, replace the boom section.

4. Cracks.

Check each boom section thoroughly for cracks.

For fine cracks, use **COLOR CHECK** or penetrant check.

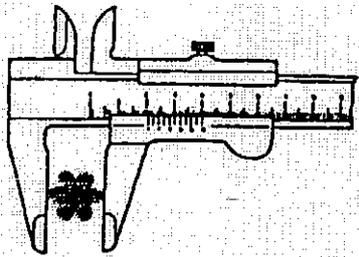
* Pay special attention, when checking each pin boss and welded section.

3. Extension / Retraction wire ropes

After disassembling the boom, inspect the extension and retraction wire ropes as follows.

1. Measure the diameter of both the extension and retraction wire ropes with slide calipers.

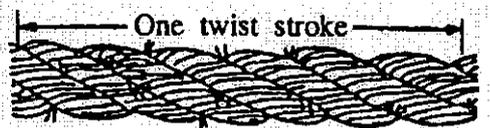
Replace the rope, if the decrease in the diameter is more than 3 % of the nominal diameter.



	Nominal diameter	Serviceable limit
Retraction wire rope	ϕ 8.0 mm (0.32 in)	ϕ 7.8 mm (0.31 in) or less
Extension wire rope	ϕ 14.0 mm (0.55 in)	ϕ 13.6 mm (0.54 in) or less

2. Check for broken wires.

If 3 or more wires of the wire rope are broken in one twist stroke, replace the wire rope.



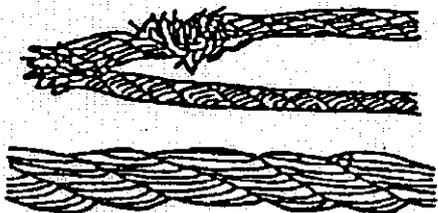
3. Check wire ropes for rust.

If rust is evident around the inside of the wire rope, replace it.



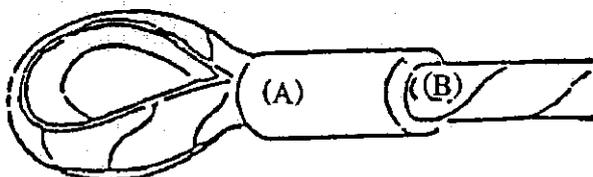
4. If any kinks are observed, replace the wire rope.

Also, an extremely deformed wire rope requires replacement.

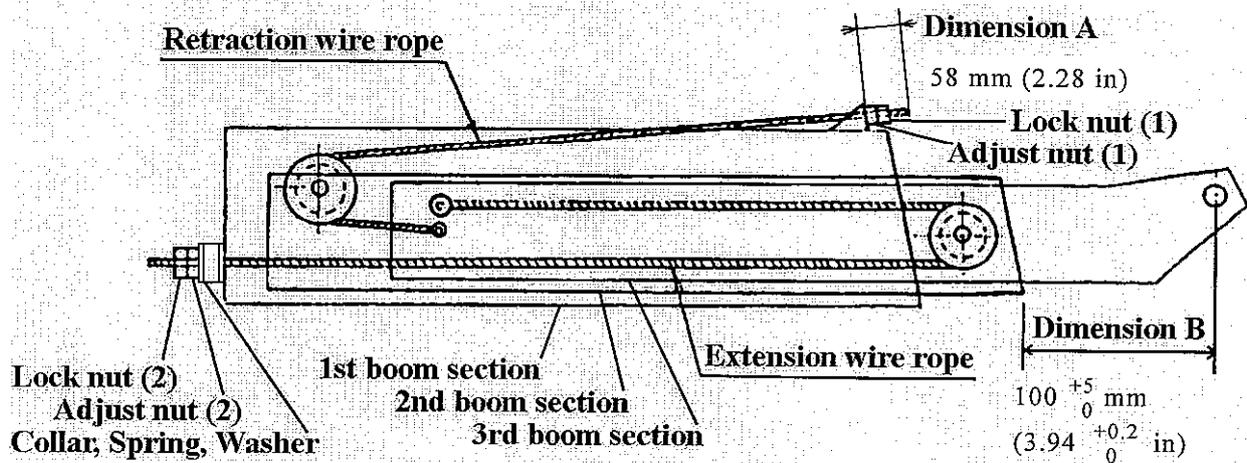


5. Carefully check the end sections of the wire rope, especially sections A and B.

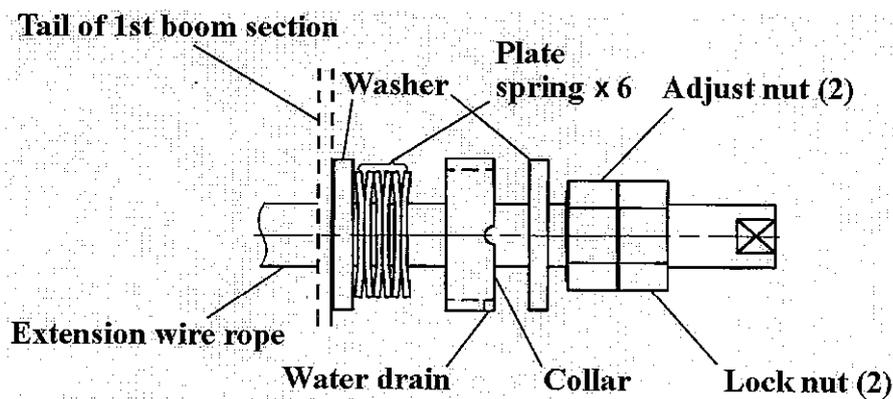
Replace the wire rope, if any defects are found.



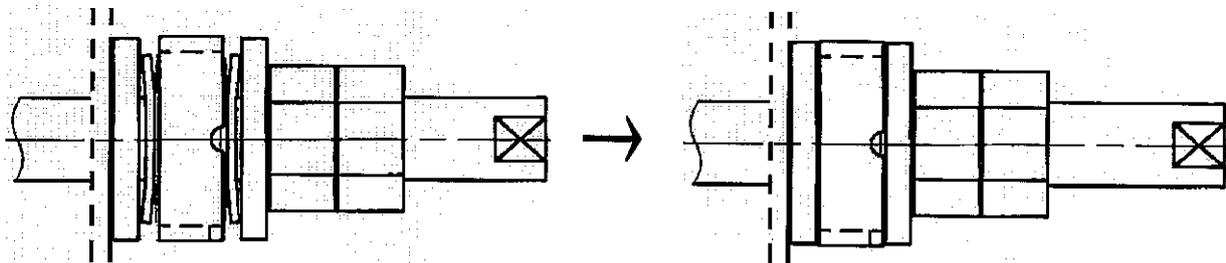
4. Adjustment of Extension / Retraction wire ropes



1. Set the boom horizontally and retract fully.
2. Adjust the dimension A to 58 mm (2.28 in) by turning the adjust nut (1).
3. Assemble the 6 plate springs, washers and collar to the end of the extension wire rope as shown in the figure below.



4. Tighten both of the adjust nut (2) (Right and Left) alternately till the washers touch the collar as shown in the figure below.



5. Extend and retract the boom several times, then make sure that the dimension B is 100^{+5}_0 mm ($3.94^{+0.2}_0$ in) when the boom is retracted fully.

If the dimension B exceeds the specified dimension, loosen the adjust nut (2) and tighten the adjust nut (1) till it comes to the specified dimension.

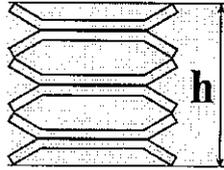
6. Tighten the lock nut (1) and (2).

Tightening torque ----- Lock nut (1) : 2.57 ~ 3.48 kg-m (18.6 ~ 25.1 ft-lbs)

----- Lock nut (2) : 11.7 ~ 15.8 kg-m (85 ~ 114 ft-lbs)

- * Do not twist the wires when tightening the lock nuts.
- * When replacing the plate springs, make sure to use the correct collar by following the next instructions.

1. Pile up the 6 plate springs on the level surface, and then measure the overall height (h) of the plate springs.



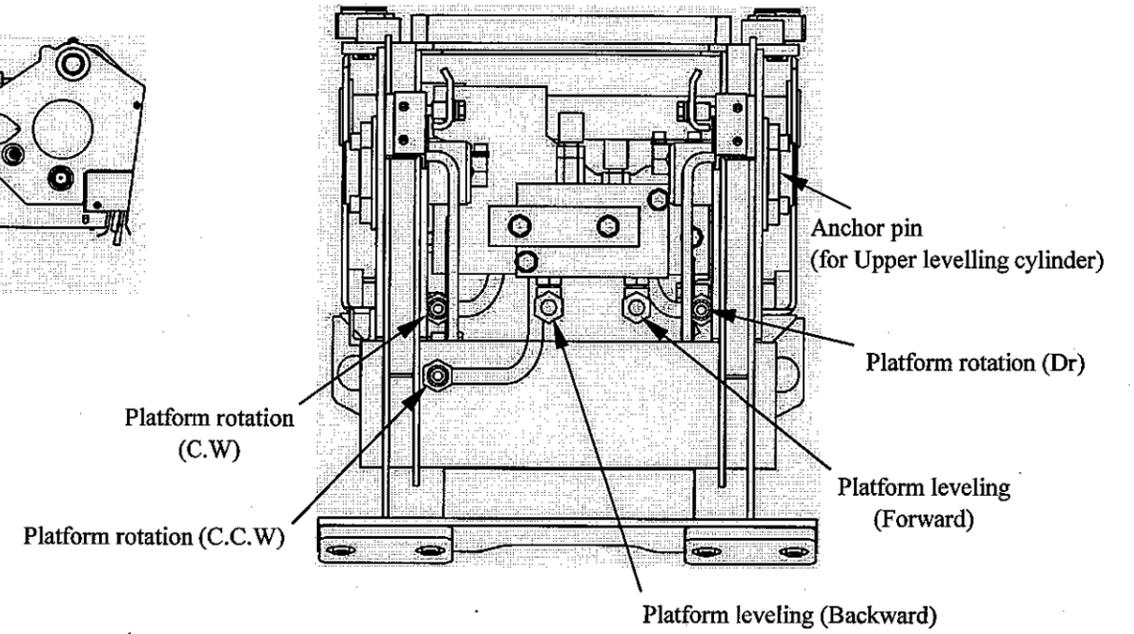
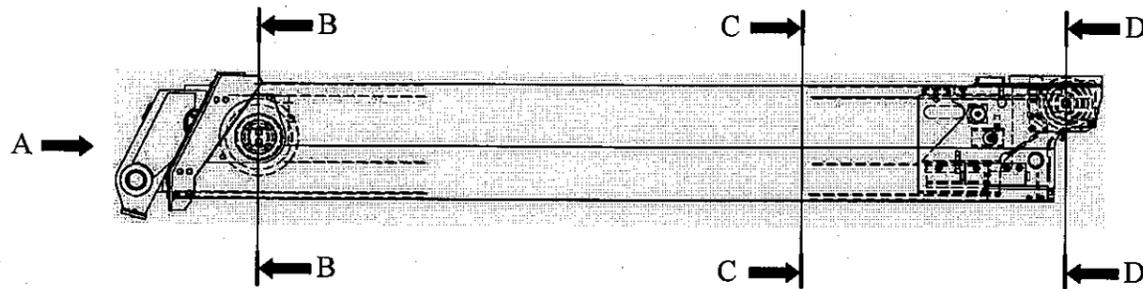
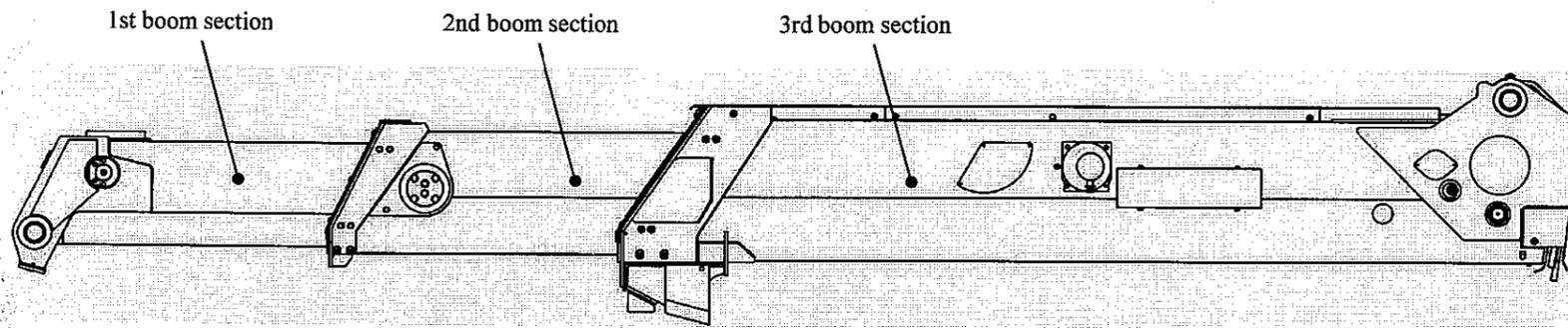
2. See the table below and measure the heights of the collars to select the correct collar corresponding to the overall height (h) of the 8 plate springs.

Total height of 6 springs (h)	(mm)	18.8 ~ 19.2	18.3 ~ 18.8	17.9 ~ 18.3	17.4 ~ 17.9	17.0 ~ 17.4	16.5 ~ 17.0
	(in)	0.74 ~ 0.76	0.72 ~ 0.74	0.70 ~ 0.72	0.69 ~ 0.70	0.67 ~ 0.69	0.65 ~ 0.67
Height of collar	(mm)	15.2	14.7	14.1	13.6	13.1	12.6
	(in)	0.60	0.58	0.56	0.54	0.52	0.50
Parts number of collar		S44340-01	S44340-02	S44340-03	S44340-04	S44340-05	S44340-06

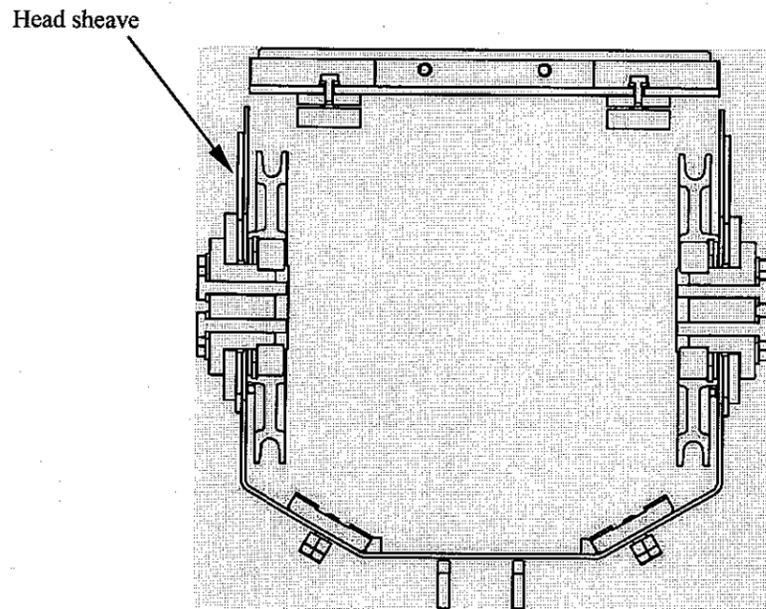
5. Sectional drawings

Detail of electric cables

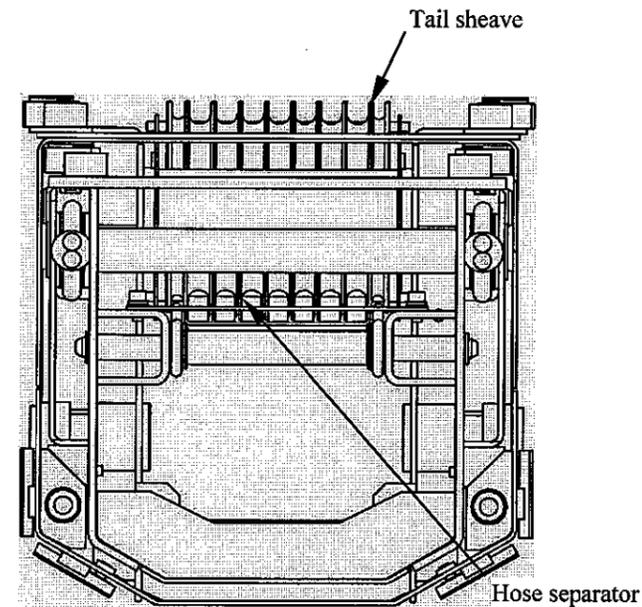
	Parts number	Constructions	Length
Electric cable A	5C1-01181-00	2.0 mm ² × 4, 1.25 mm ² × 6,	10,230 mm (33 ft 6.8 in)
Electric cable B	5C1-01182-00	0.5 mm ² × 4 (with shield wires)	10,230 mm (33 ft 6.8 in)



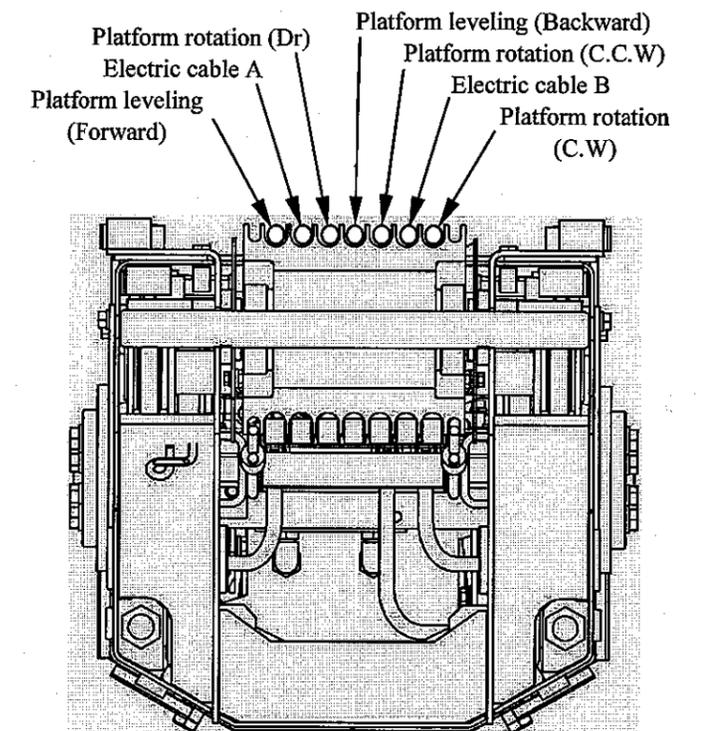
A view



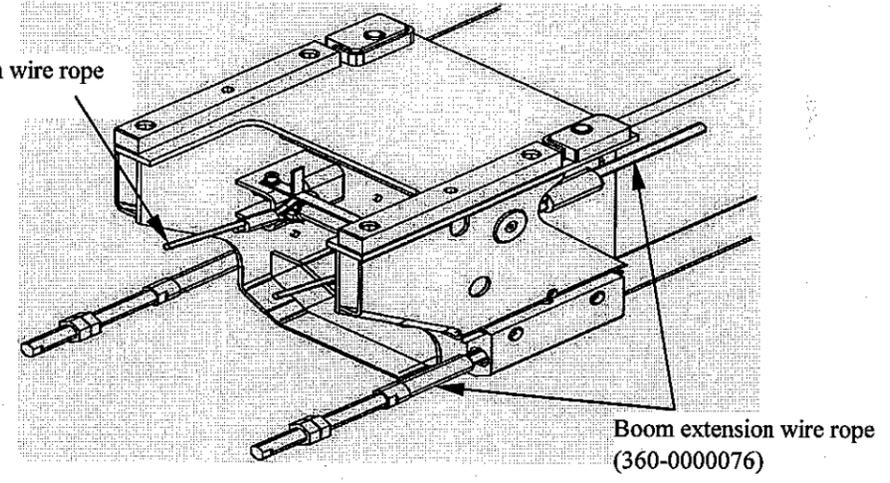
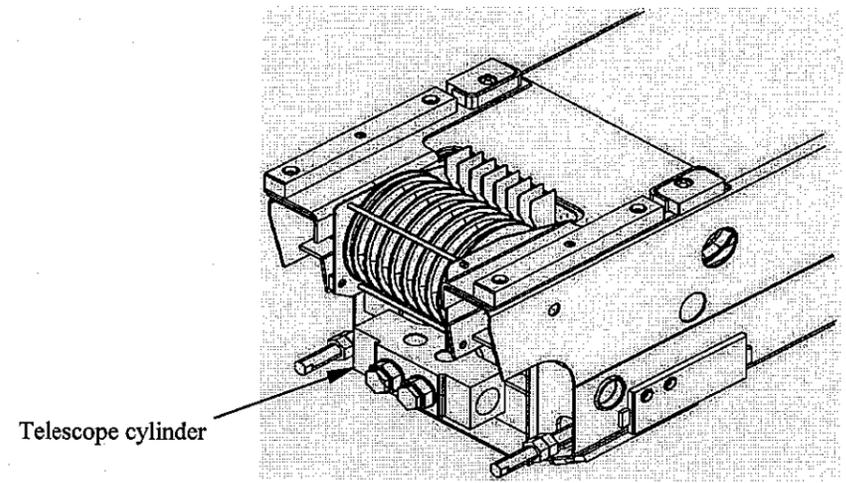
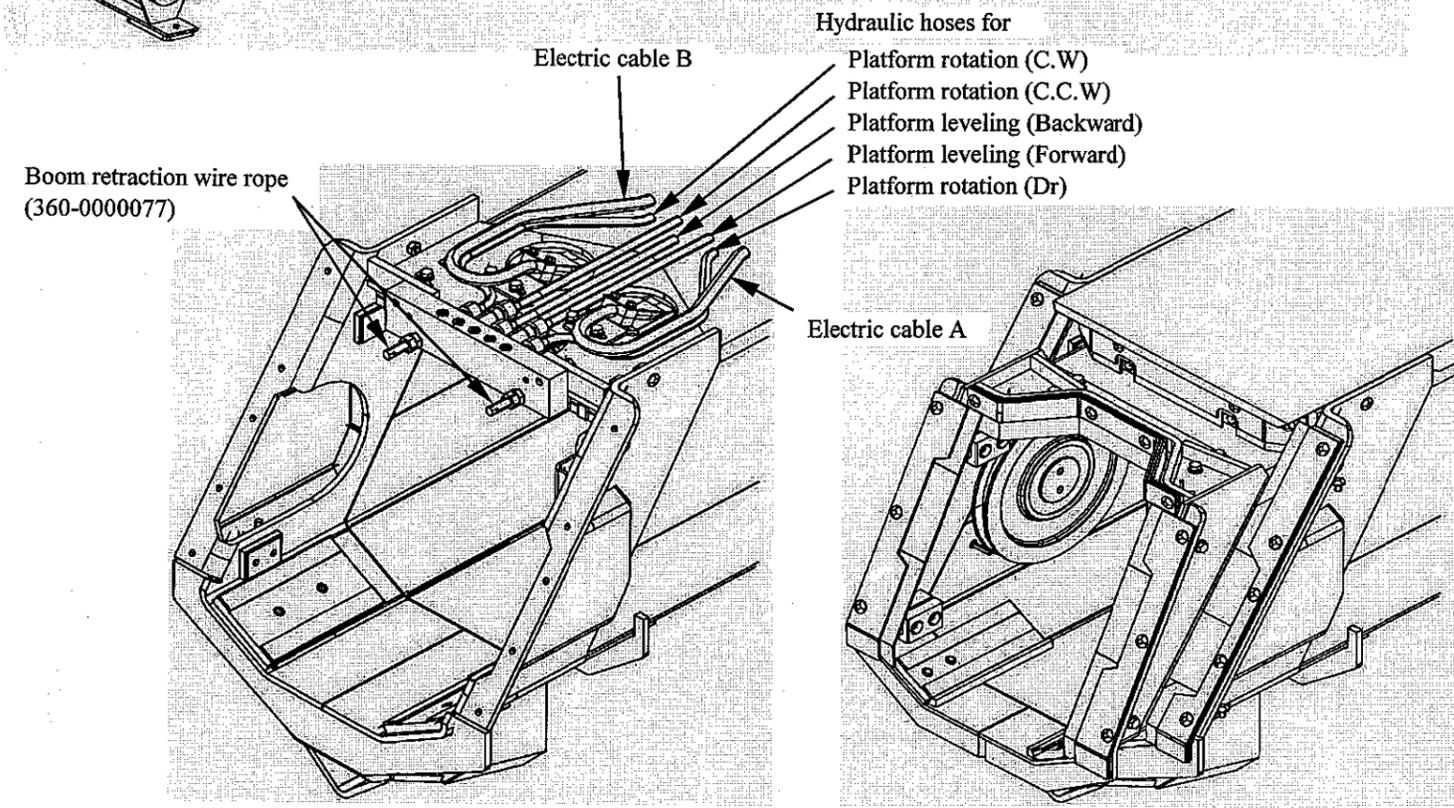
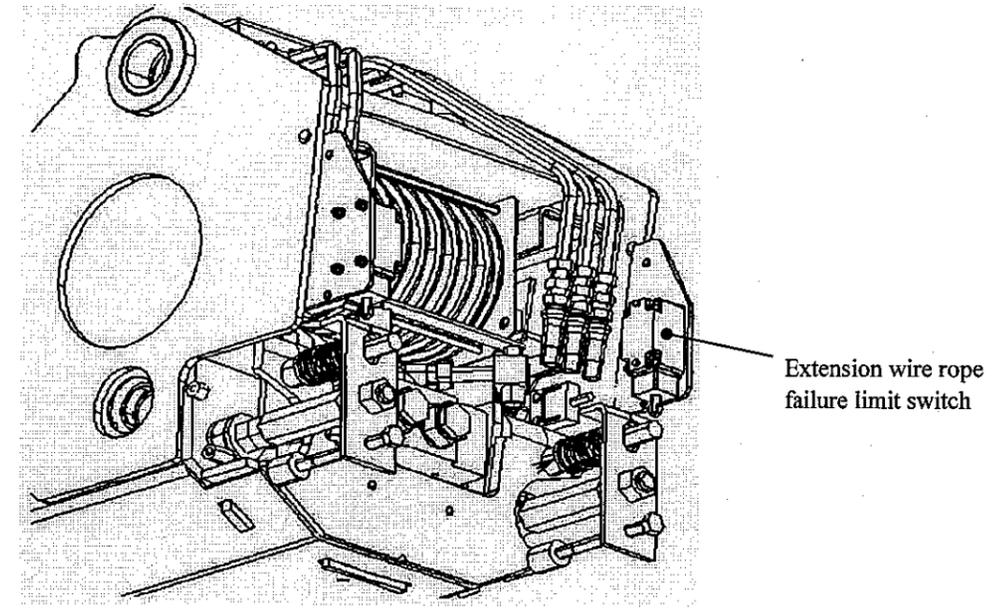
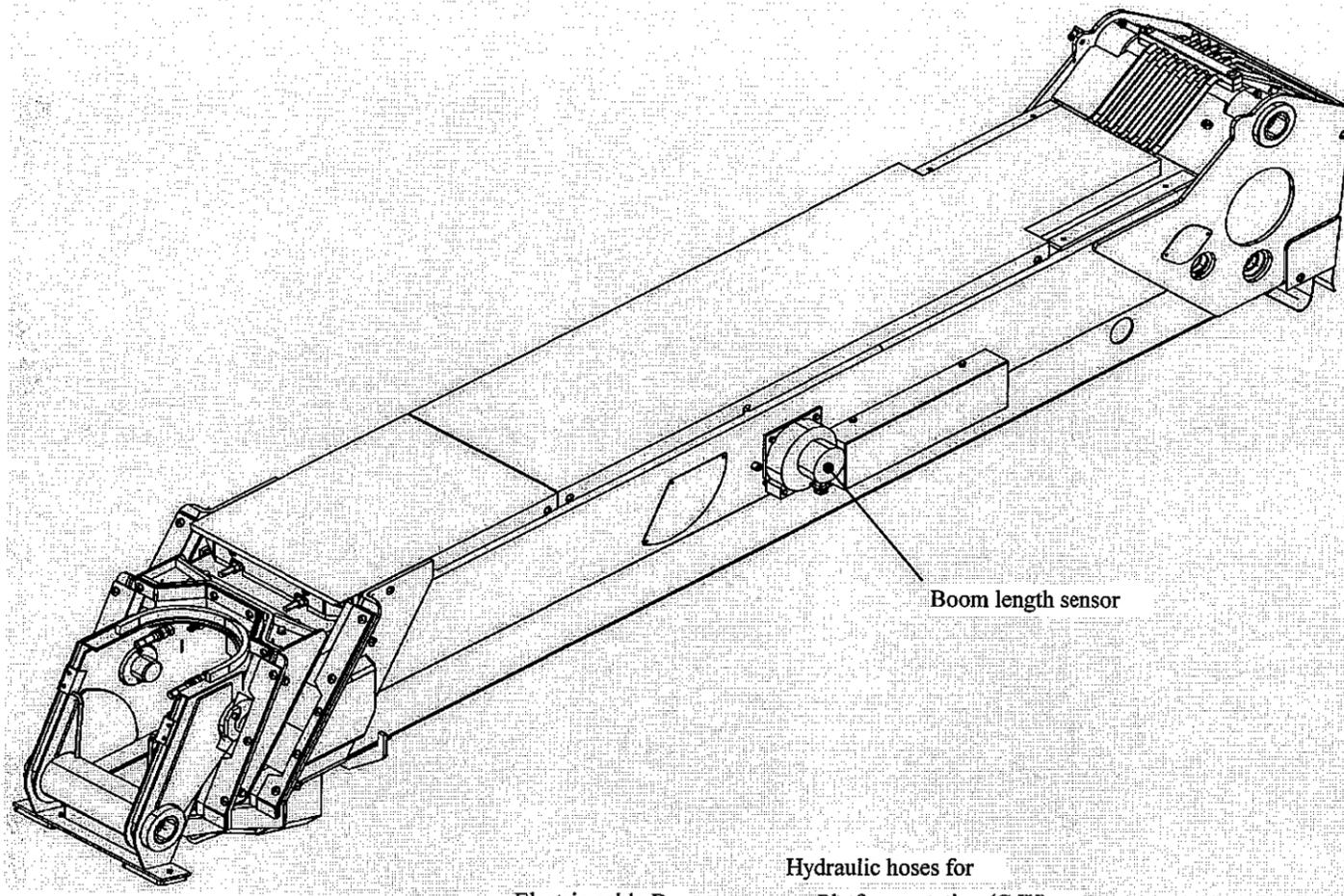
B-B section



C-C section



D-D section



1st boom section (Front)

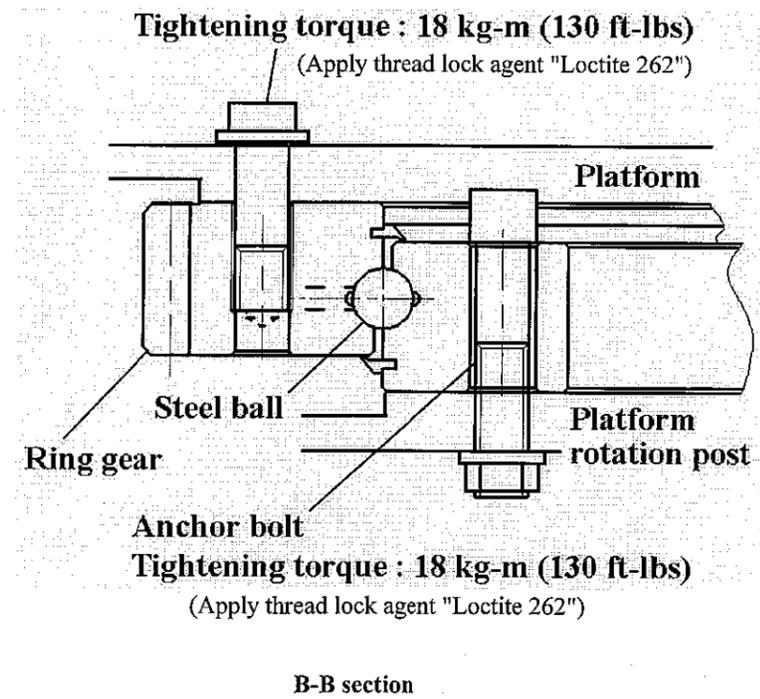
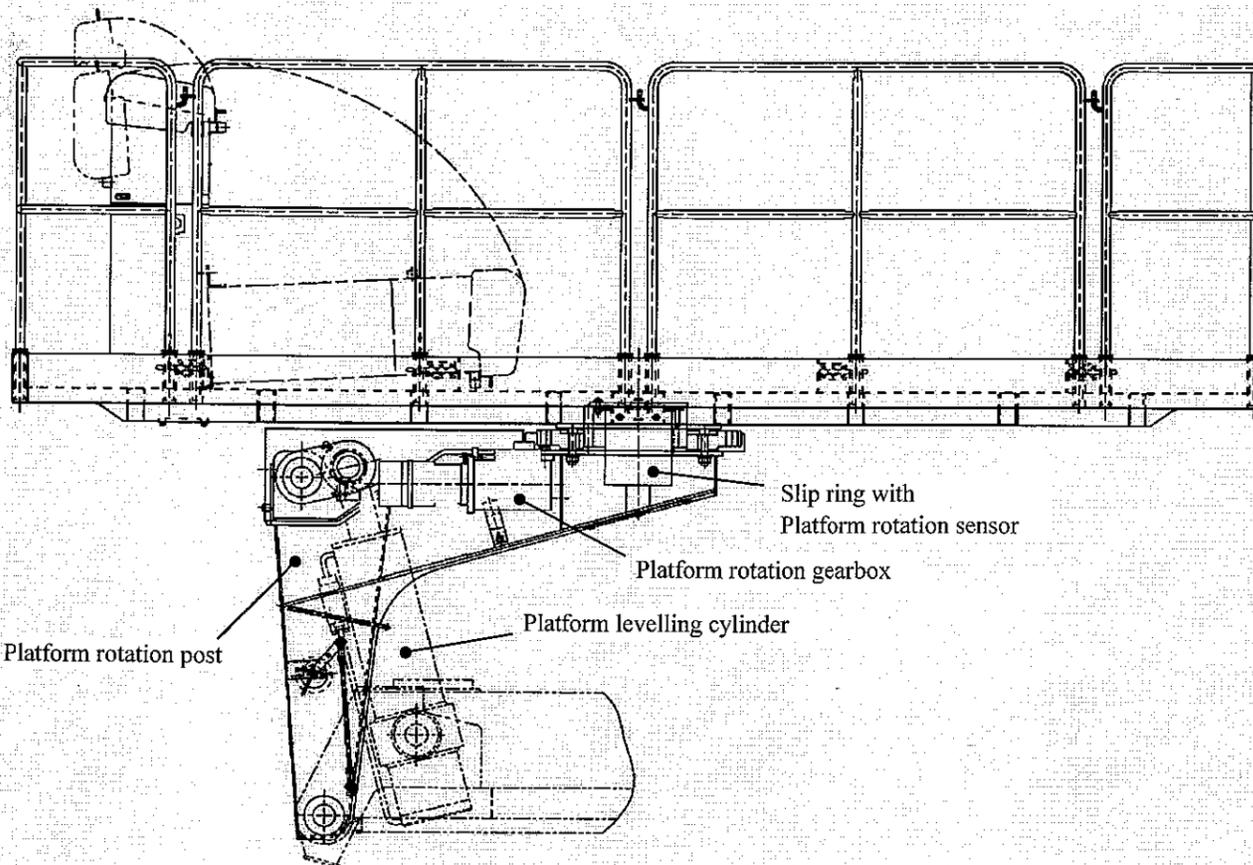
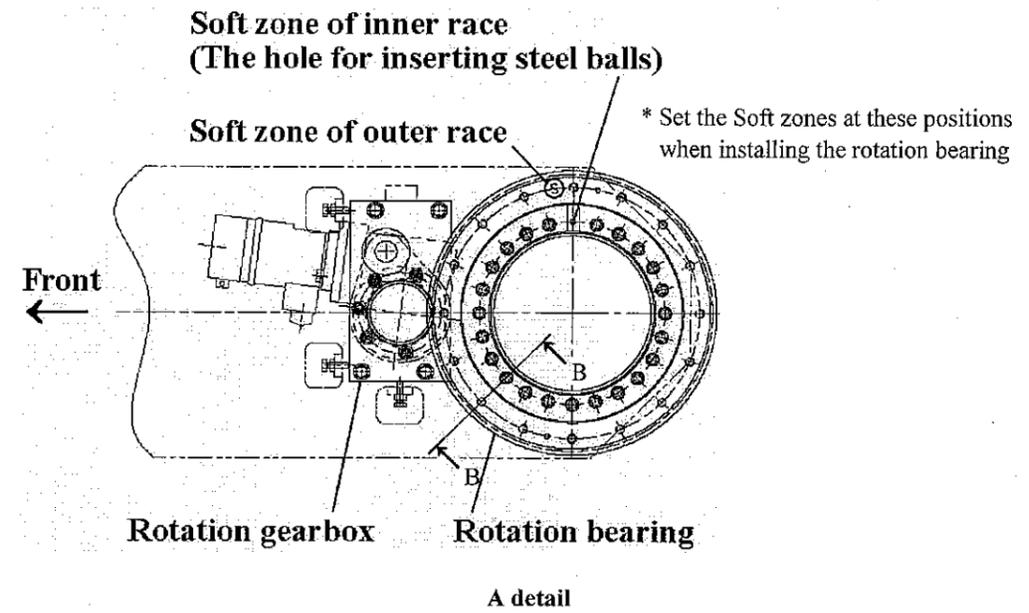
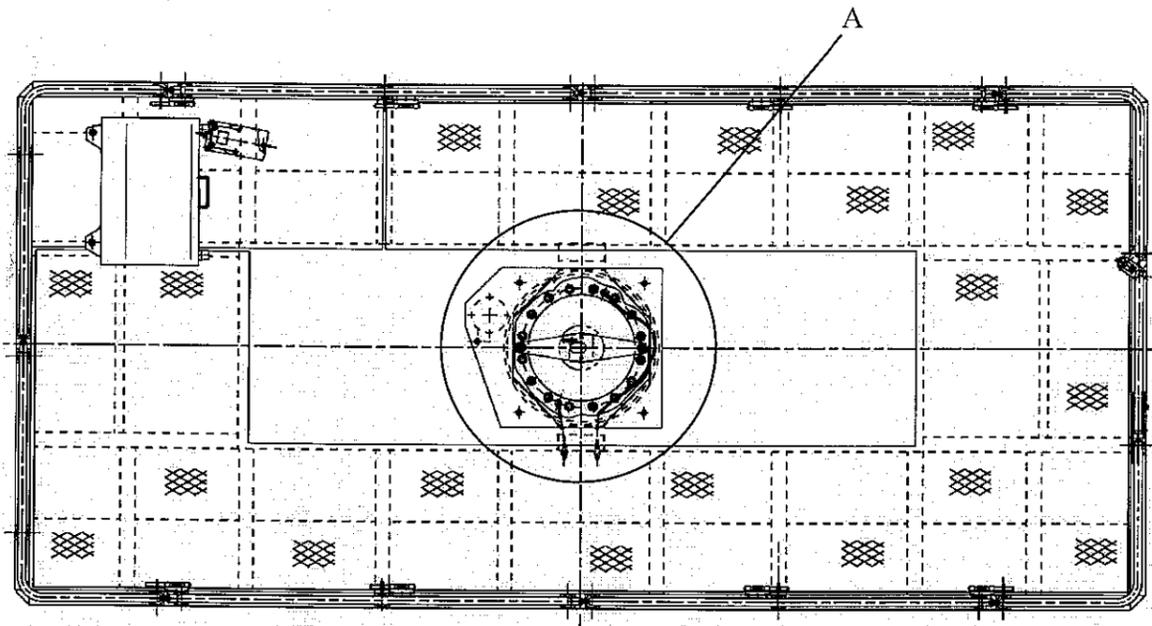
2nd boom section (Front)

1st boom section (Rear)

2nd boom section (Rear)

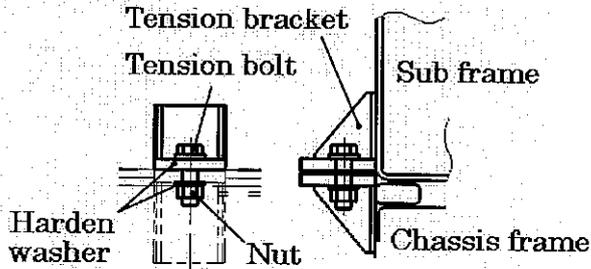
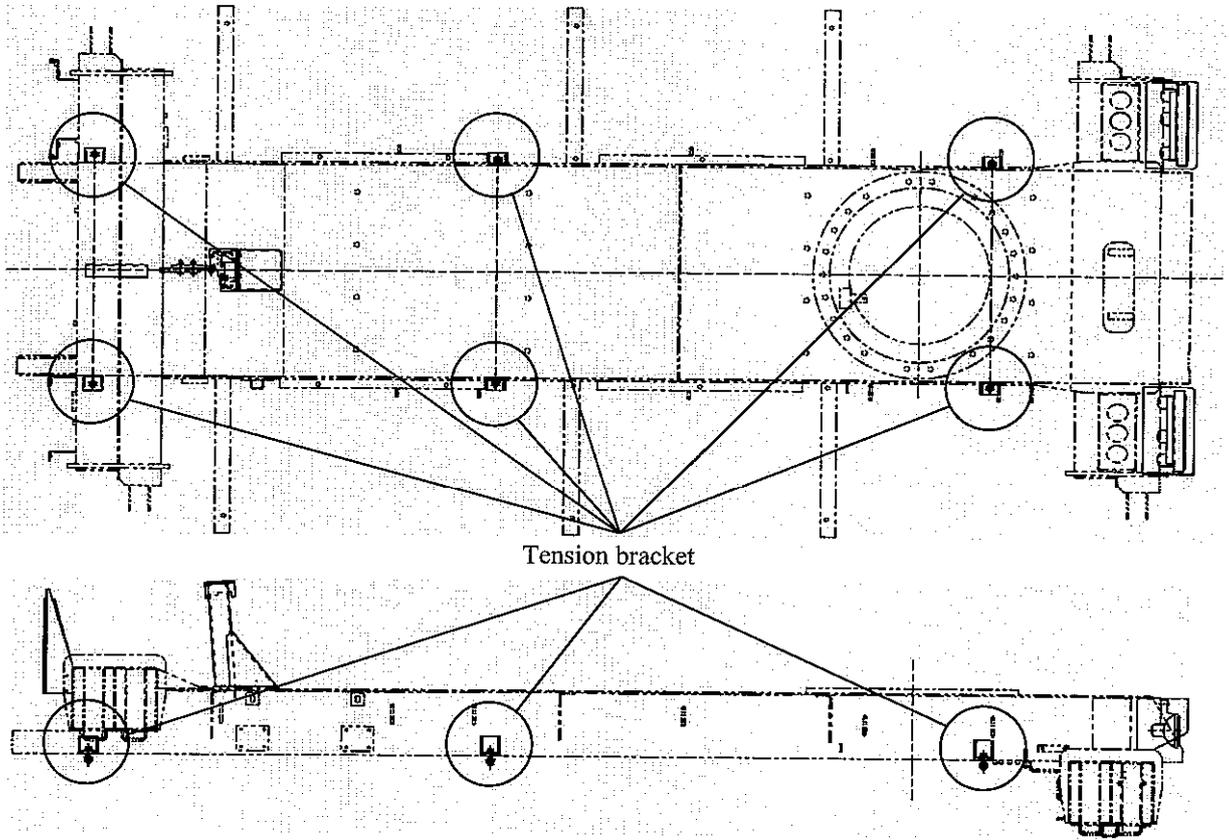
3rd boom section (Rear)

Platform



Sub frame

The sub frame is mounted on the chassis and fixed by the 6 tension bolts.



Detail of Tension bracket

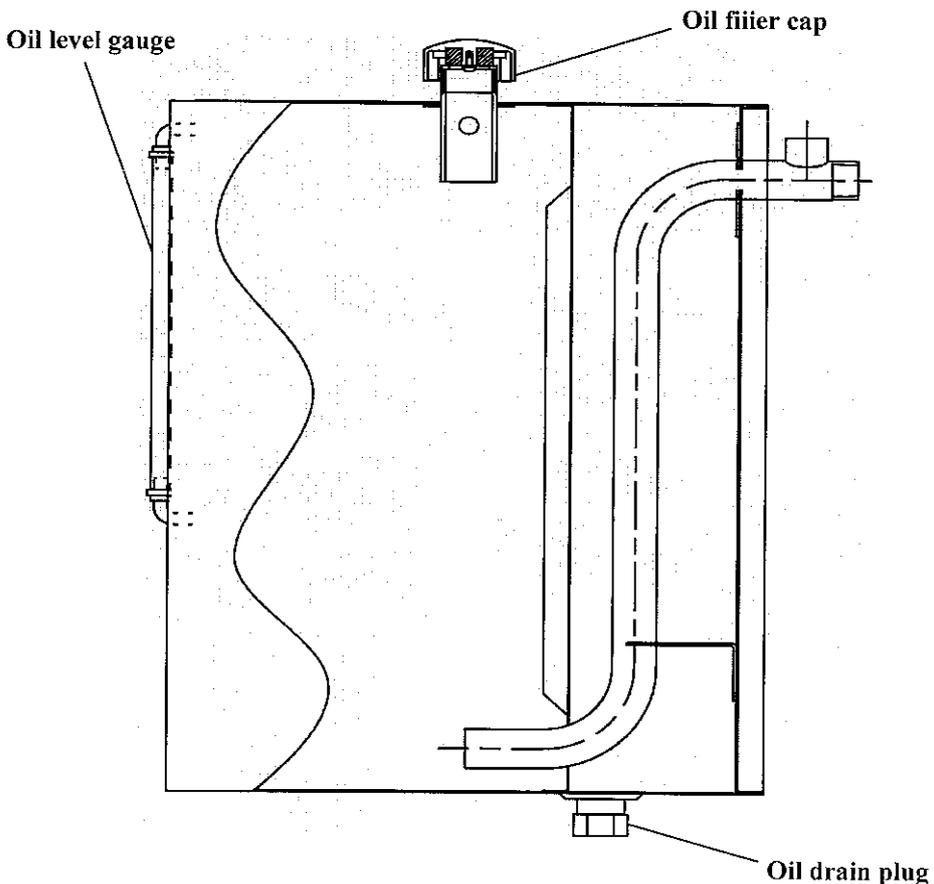
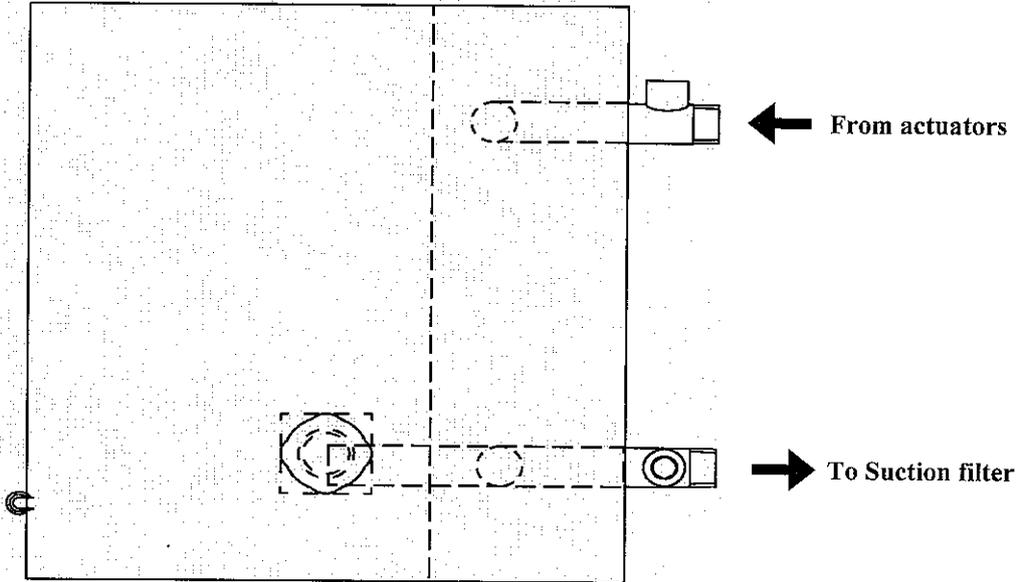
Check the tension bolts for looseness, omissions and any other damages.
Loose bolts should be removed and checked for elongation, bend, and any other damages.
* Tightening torque of Tension bolts: 17.1 ~ 20.9 kg-m (124 ~ 151 ft-lbs).

3. Hydraulic section

Hydraulic oil reservoir

3780000338A

- Oil capacity ----- 100 liters (26.5 gallons)
 - Hydraulic oil ----- Shell tellus oil T22
 - Oil change interval ----- Every 1,200 hours or annually
- For new machine, the first oil change should be conducted after 300 hours or 3 months use.



Note:

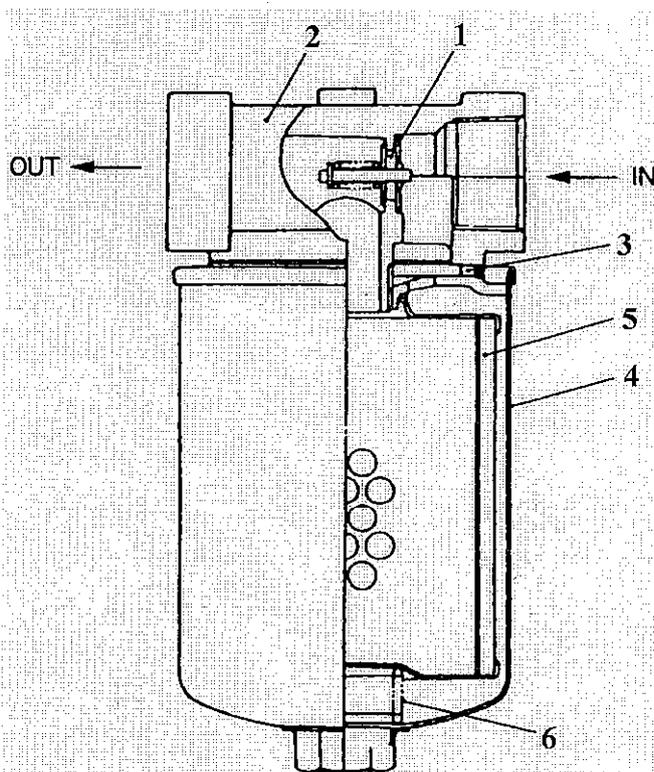
- Check the oil level with setting the machine on level ground and with the boom and the outriggers stowed.
- Replace the suction filter and the in-line filter when changing the hydraulic oil.

Suction filter

305-03660

The suction filter is installed on the pump suction line to eliminate contaminants contained in the hydraulic oil.

Type ----- Cartridge type
Rated flow ----- 35 liters / min (9.2 gallons /min)
Filtration accuracy ----- 105 micron
By-pass valve cracking pressure ----- 0.35 kg / cm² (5.0 PSI)
Cartridge element replacement interval ----- Every 1,200 hours or annually.



No.	Description
1	By-pass valve
2	Base
3	O-ring
4	Cartridge element
5	Paper element
6	Spring

High pressure filter

The in-line filter is installed in the outlet line of the hydraulic pump to eliminate contaminants contained in the hydraulic oil.

Rated pressure ----- 175 kg/cm² (2500 PSI)

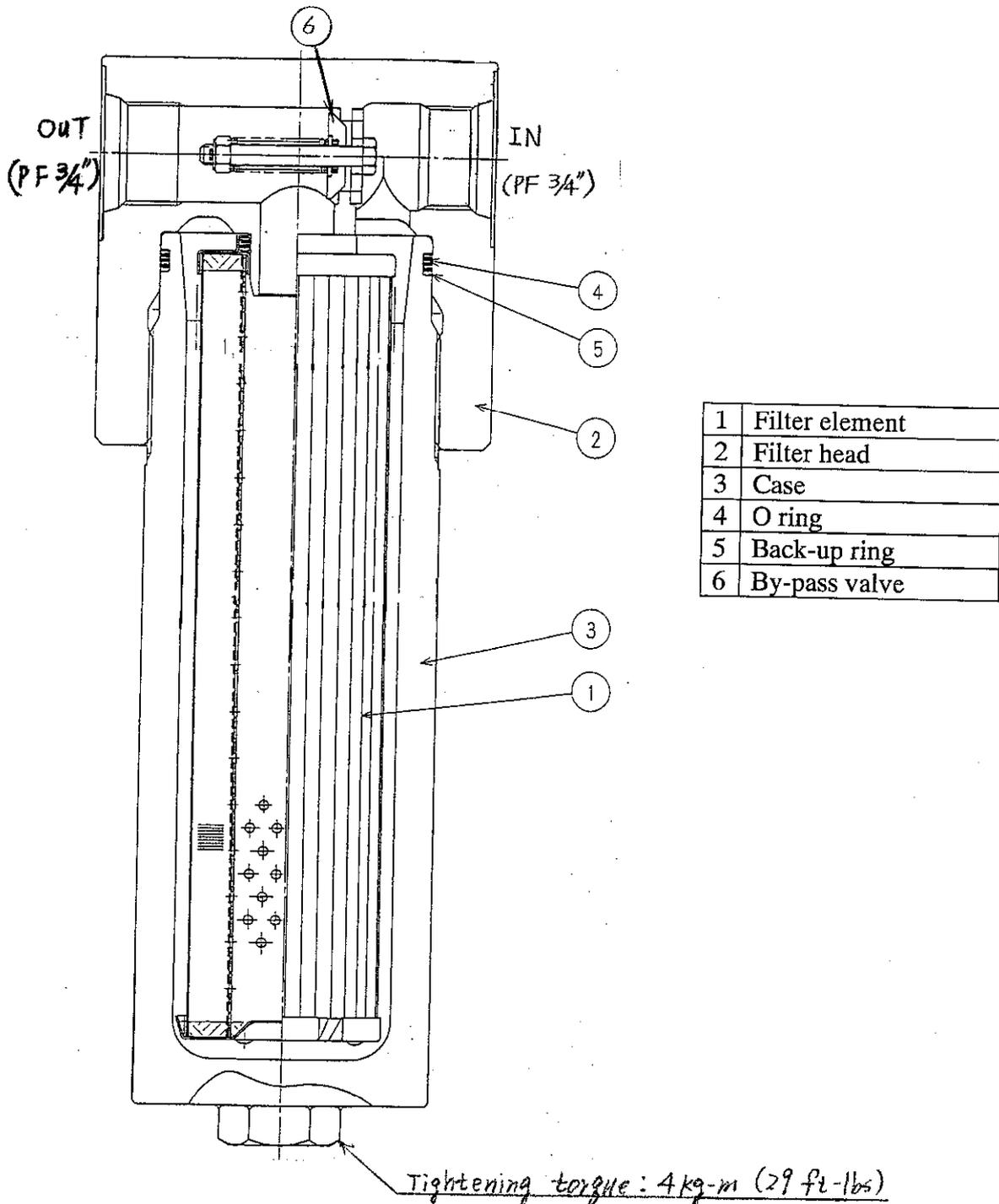
Proof pressure ----- 315 kg/cm² (4480 PSI)

Rated flow ----- 100 liters/min (26.4 GPM)

Filtration accuracy ----- 10 μ

Replacement intervals of the filter element ----- Every 1200 hours or one year

For new machine, the first replacement of the filter element should be conducted after 300 hours or 3 months use.

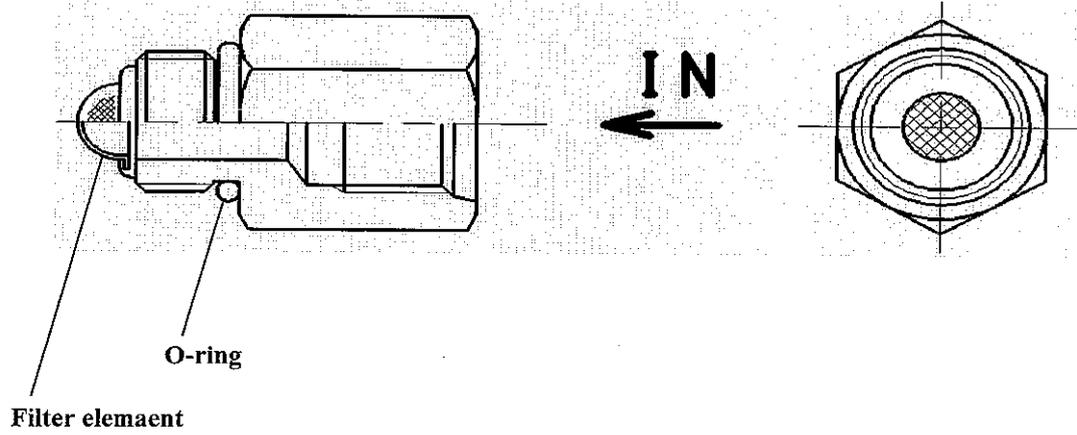


Adaptor filter

305-000003

The adaptor filter is installed on the P port (In-let port) of the main control valve to filter the hydraulic oil.

Rated pressure -----	175 kg / cm ² (2,500 PSI)
Rated flow -----	50 liters / min (13.2 gal / min)
Filtration accuracy -----	100 mesh

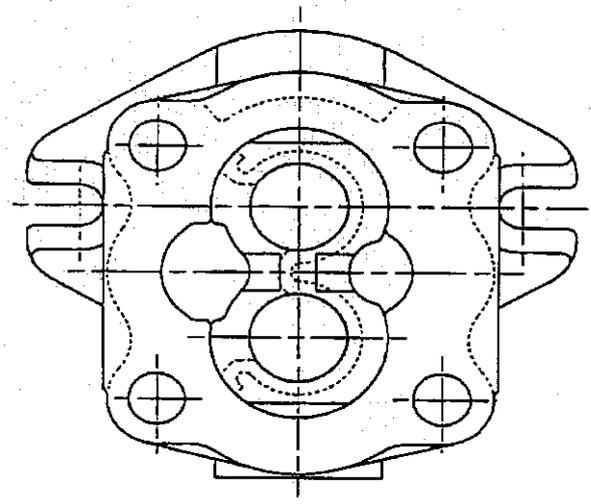
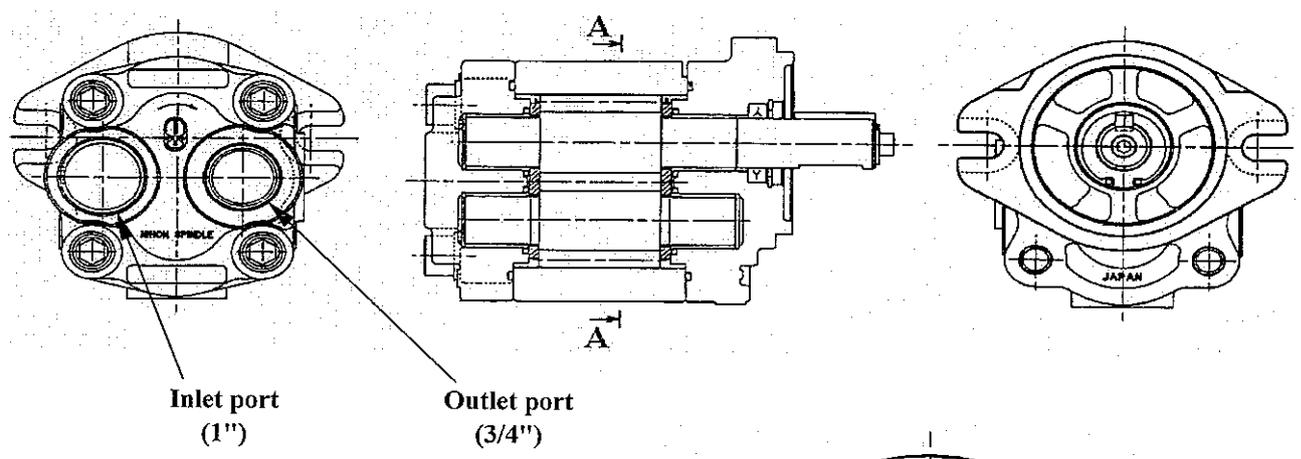
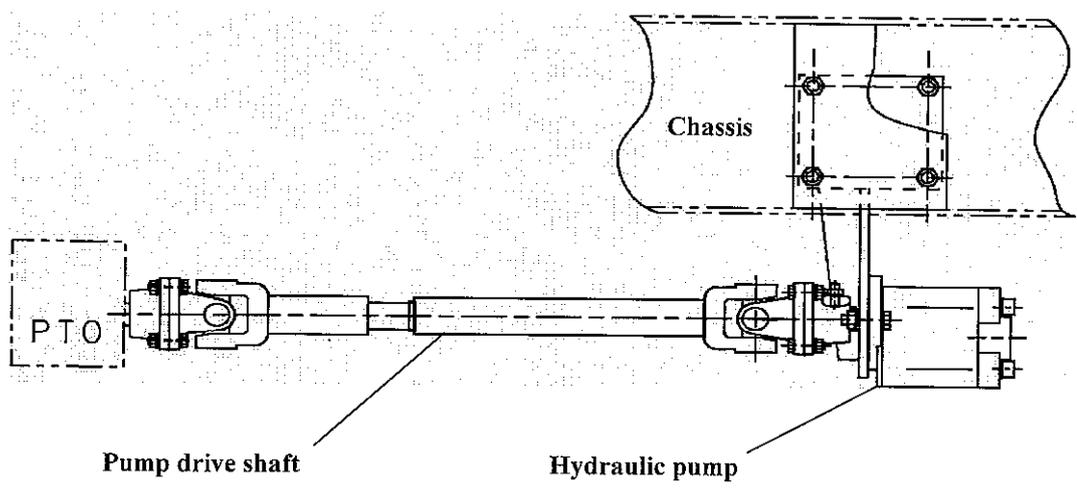


Hydraulic pump

300000029A

The hydraulic pump is driven by the PTO through the pump drive shaft as shown in the figure below.

Type -----	Gear type
Rated pressure -----	175 kg / cm ² (2,500 PSI)
Displacement -----	40 cc / rev (2.4 in ³ / rev)
Rotation speed -----	350 ~ 1,000 rpm



A-A section

Emergency pump unit

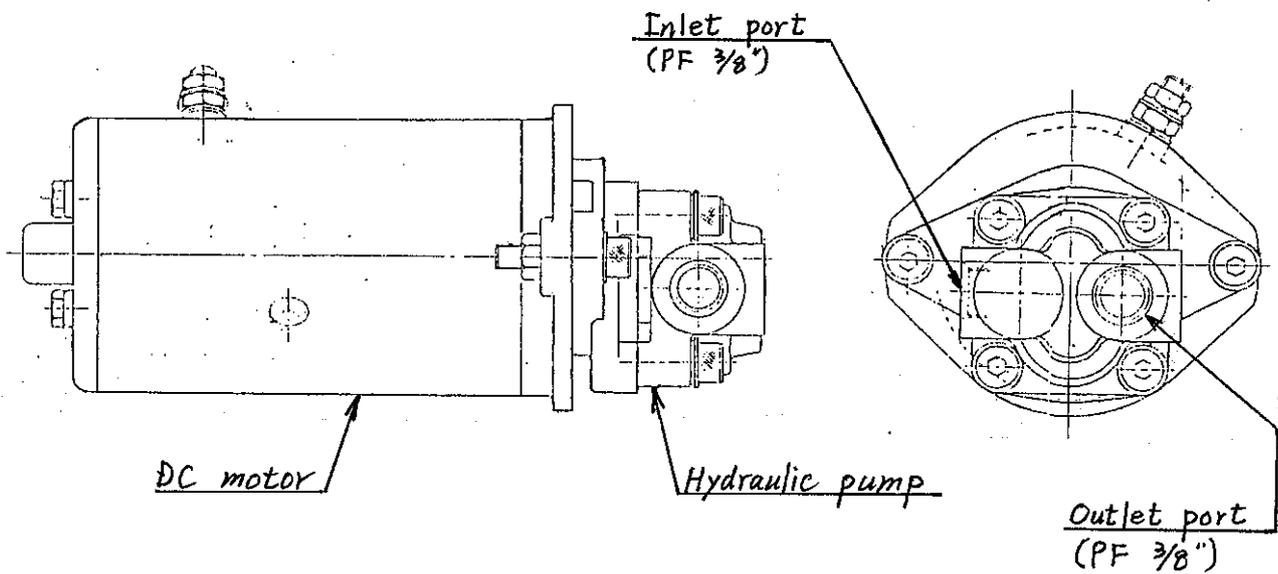
The emergency pump unit consists of the DC motor and the hydraulic pump, and is driven by the batteries (DC 24 V).

DC motor ----- DC 24 V, 1 kw

Hydraulic pump

Rated pressure ----- 175 kg/cm² (2500 PSI)

Displacement ----- 1.7 cc/rev (0.1 in³/rev)



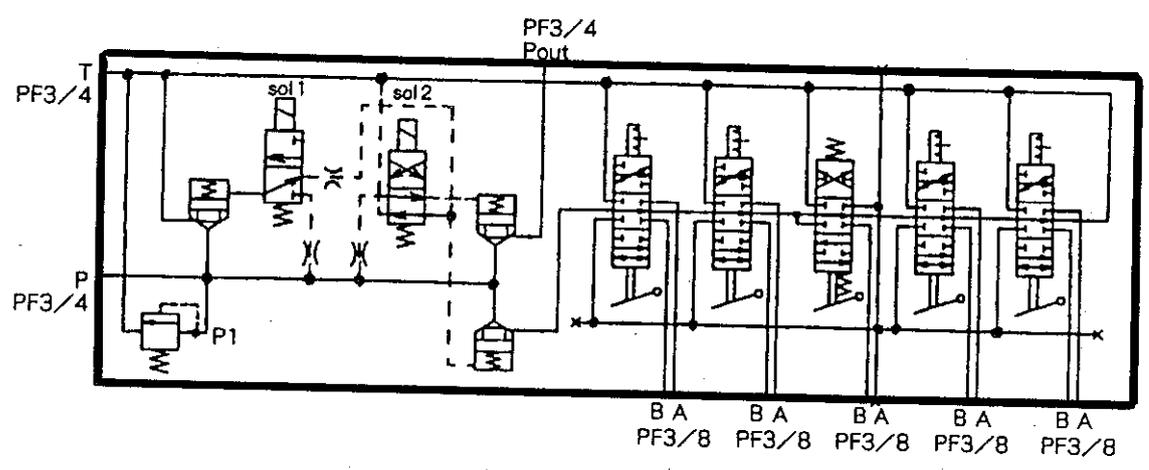
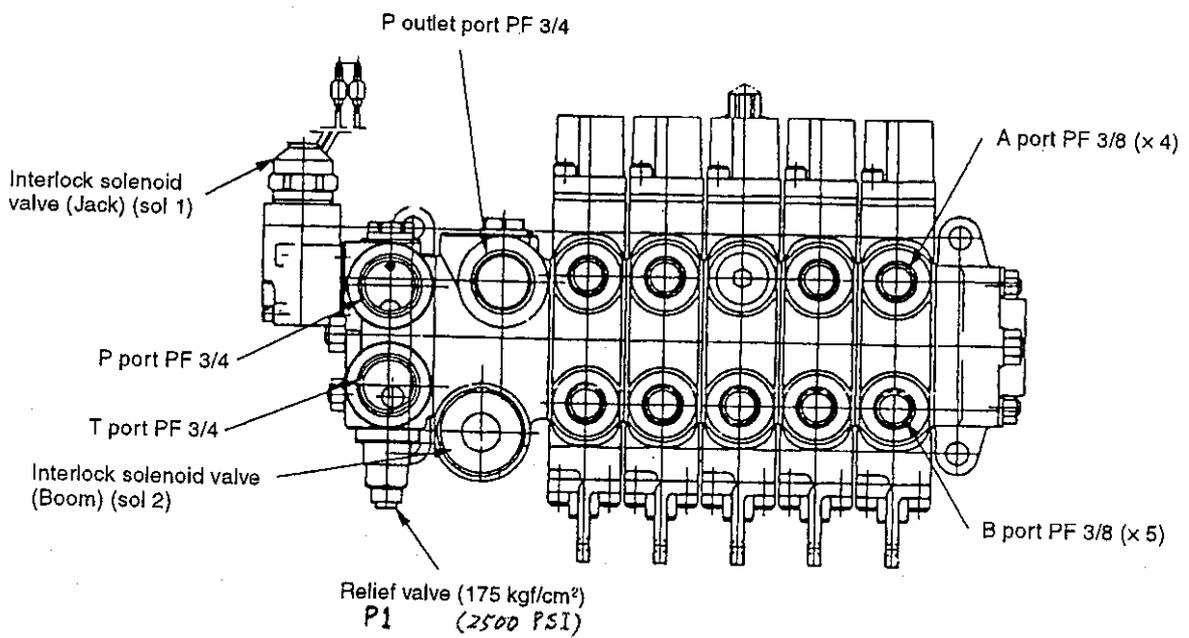
Caution: Do not drive the emergency pump for more than 30 seconds continuously.

The continuous operation may cause the burnt-out DC motor.

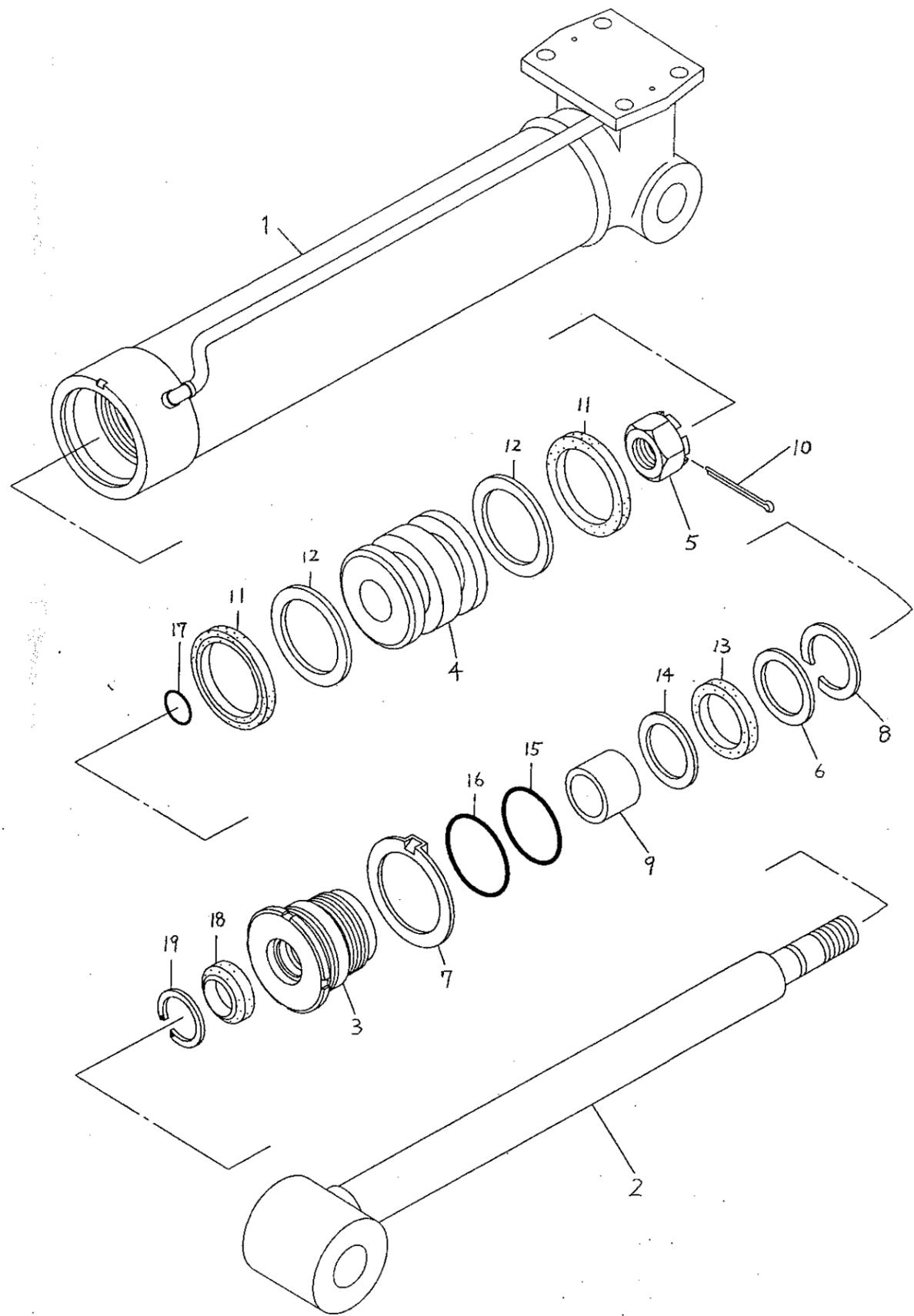
Outrigger control valve

The jack control valve is equipped with the main relief valve (P1) and the two interlock solenoid valves as shown in the figure below.

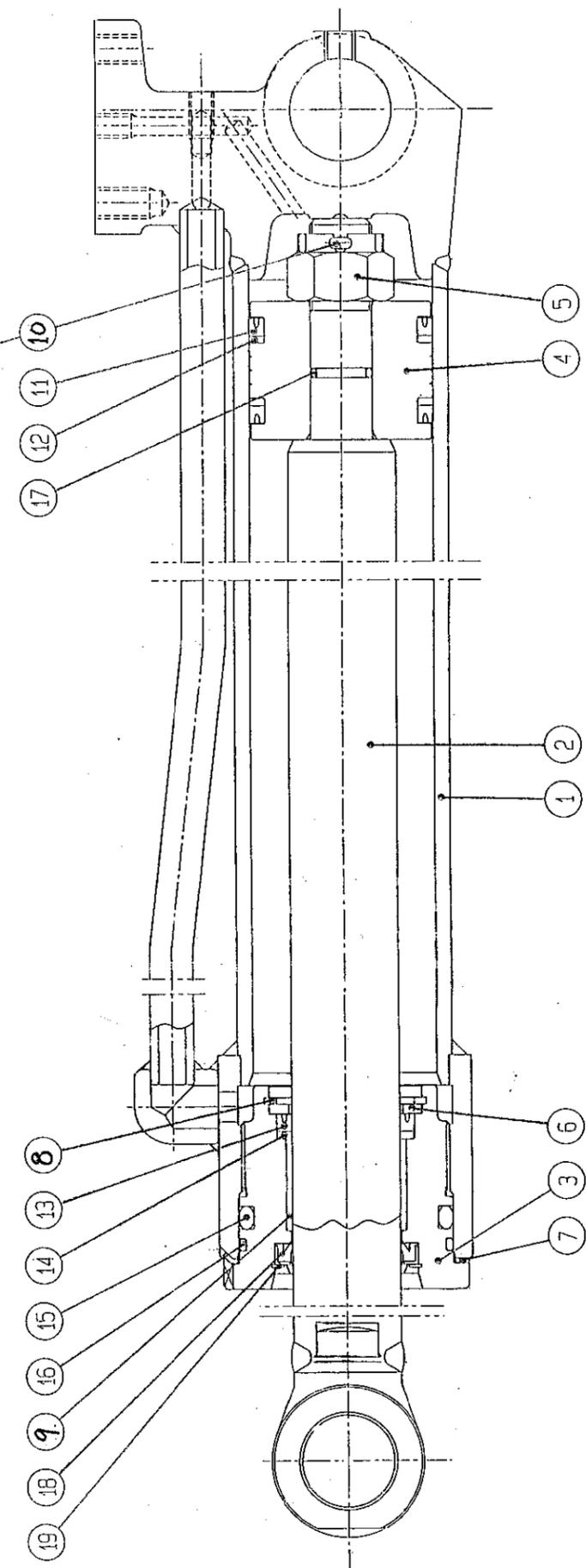
- Rated flow pressure ----- 175 kg/cm² (2500 PSI)
- Rated flow ----- 60 liters/min. (15.9 GPM)
- Pre-set pressure of main relief valve (P1) ----175 kg/cm² (2500 PSI)
- Rated voltage of solenoids ----- DC 24 V (DC 18 ~ 30 V)



Jack cylinder

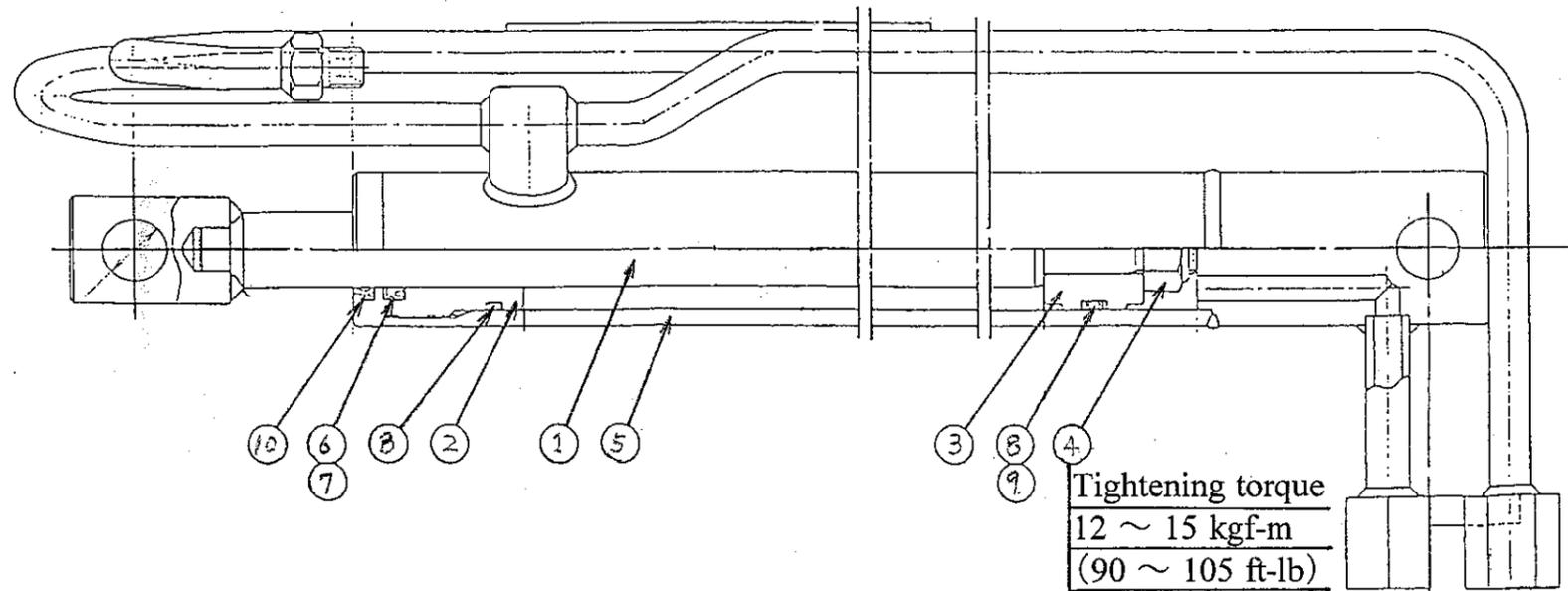
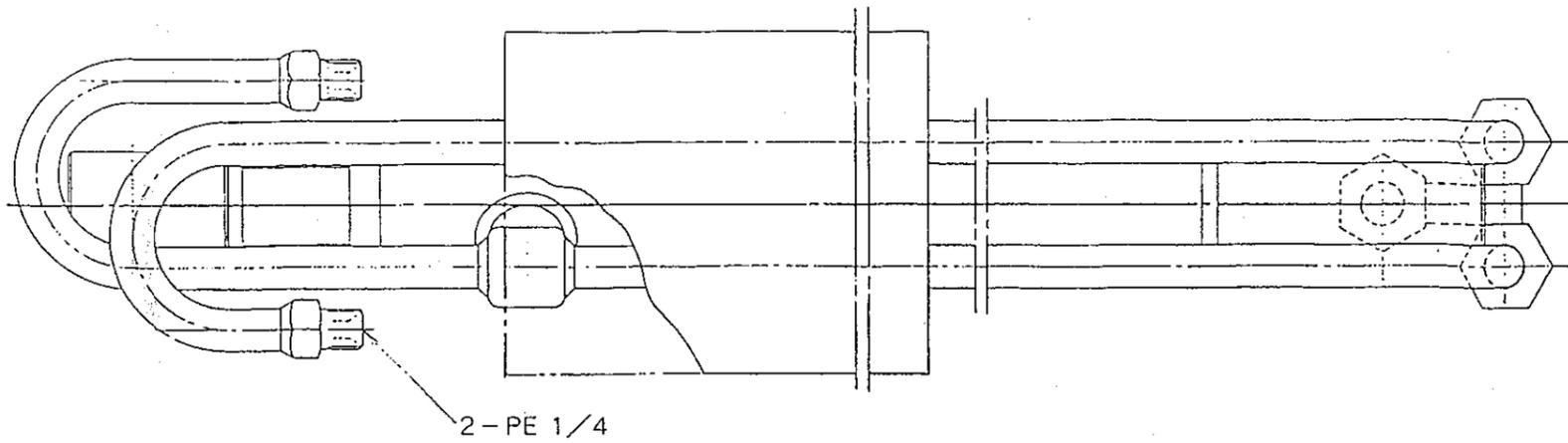


Tightening torque:
24 ~ 28 kg-m (175 ~ 200 ft-lbs)



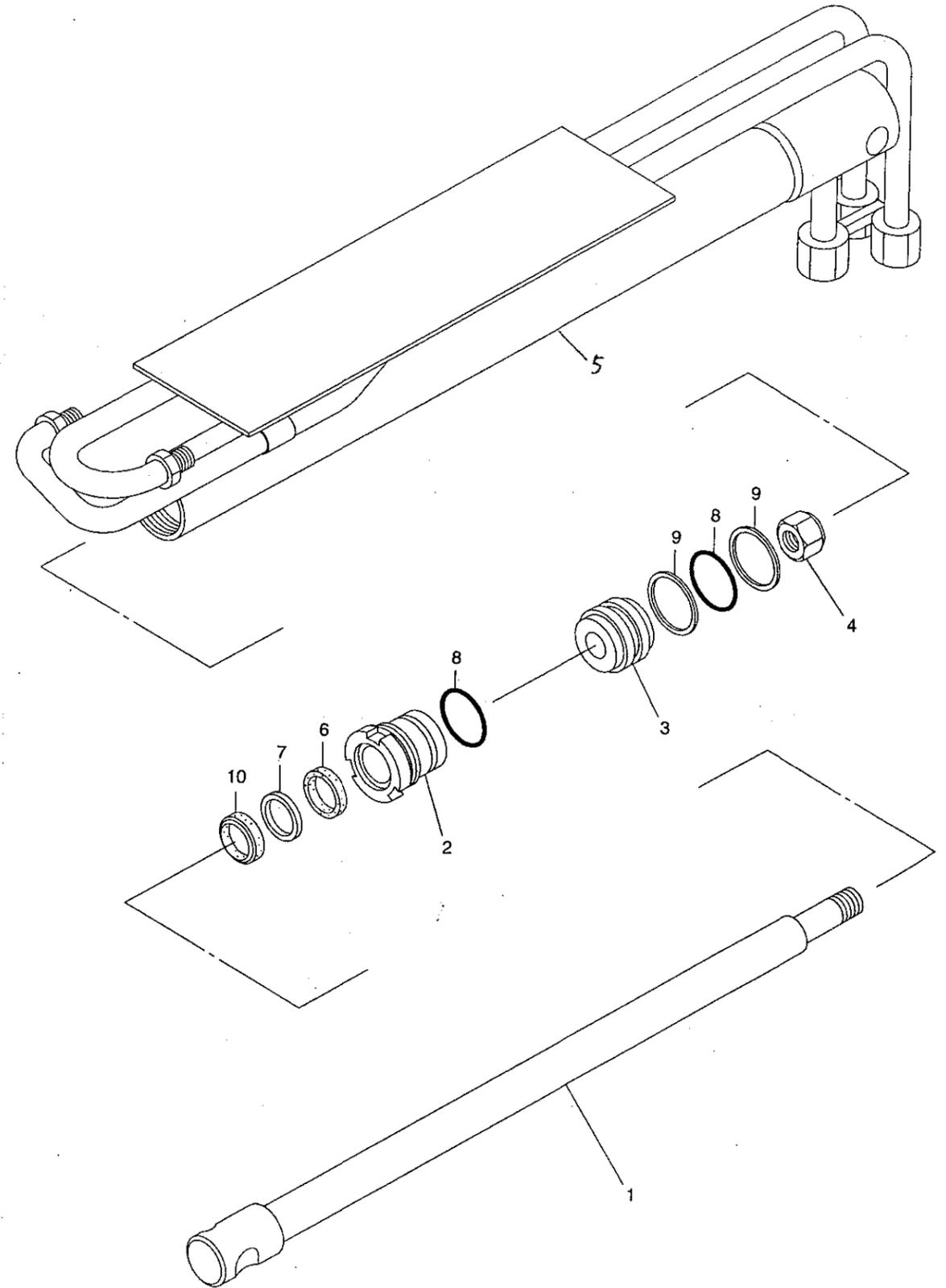
1	Cylinder tube	6	U ring holder	11	U ring	16	O ring
2	Piston rod	7	Lock plate	12	Back-up ring	17	O ring
3	Cylinder head	8	Snap ring	13	U ring	18	Dust seal
4	Piston	9	Bushing	14	Back-up ring	19	Snap ring
5	Castle nut	10	Split pin	15	O ring		

Outrigger cylinder



Tightening torque
 12 ~ 15 kgf-m
 (90 ~ 105 ft-lb)

1	Piston rod	6	U ring
2	Cylinder head	7	Back-up ring
3	Piston	8	O ring
4	Self-lock nut	9	Back-up ring
5	Cylinder tube	10	Dust seal



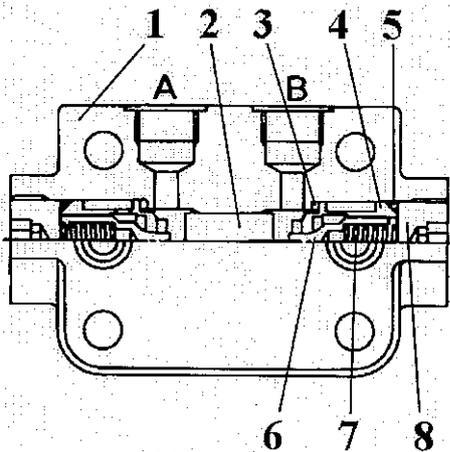
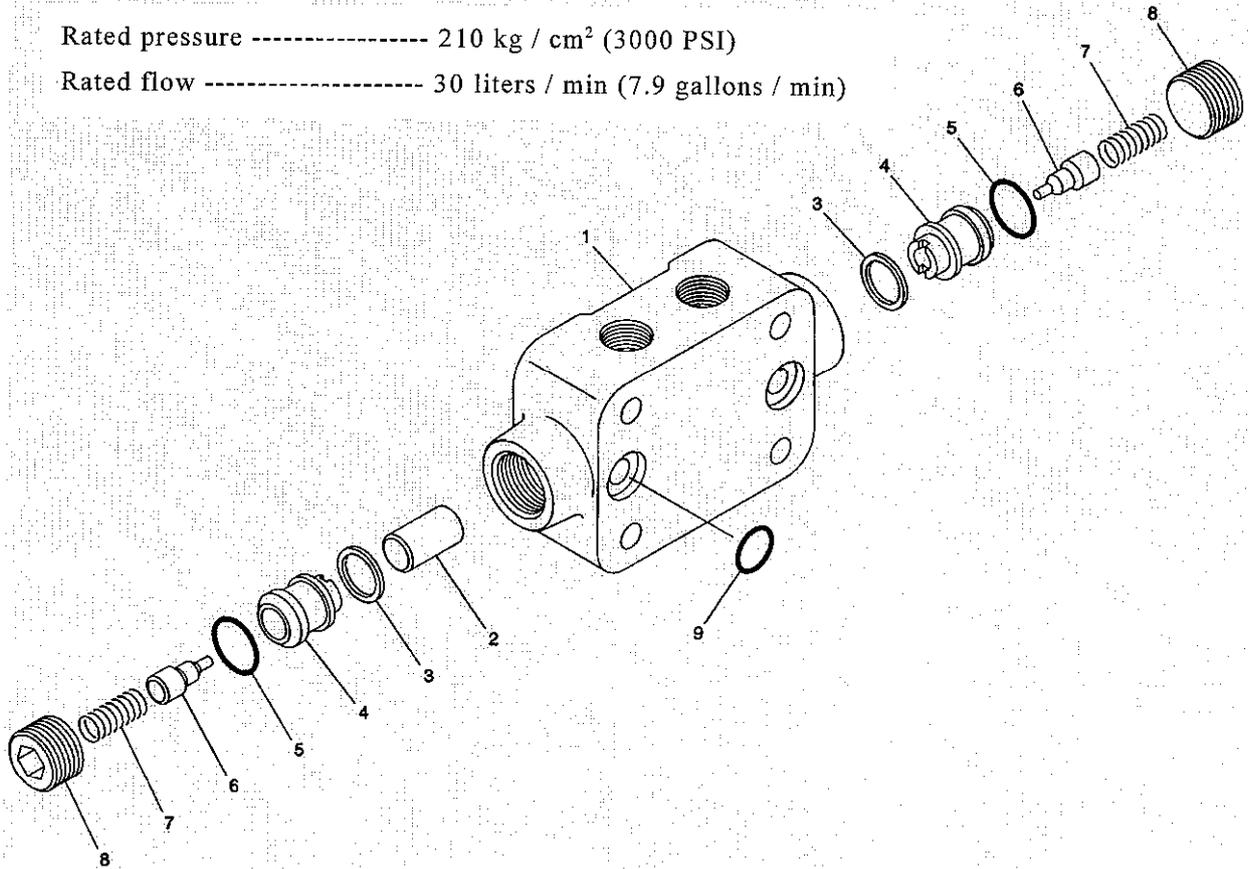
Double pilot check valve

302-02845

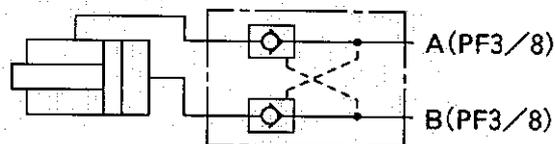
The double pilot check valve is mounted on each jack cylinder to prevent the jack cylinder from natural descent.

Rated pressure ----- 210 kg / cm² (3000 PSI)

Rated flow ----- 30 liters / min (7.9 gallons / min)



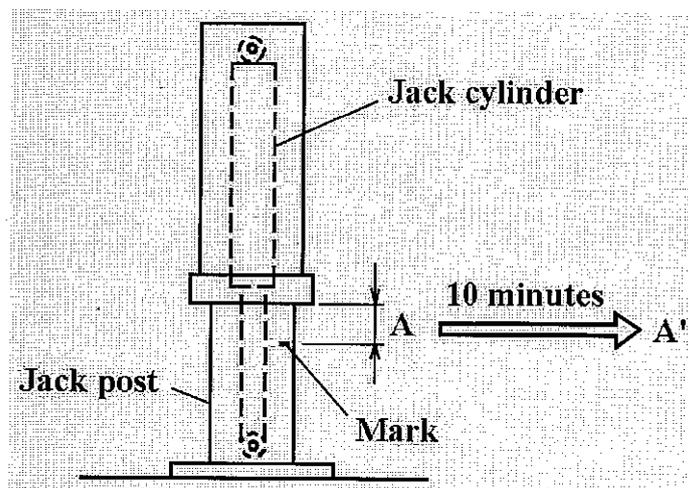
1	Housing
2	Piston
3	Gasket
4	Seat
5	O-ring
6	Check valve
7	Spring
8	Plug
9	O-ring



1. Inspection

Check the internal oil leakage of the double pilot check valve by measuring the natural descent of the jack cylinder as follows.

1. Set up the machine on firm and level ground with the boom stowed on the boom rest.
2. Extend all of the jacks till all of the tires leave the ground, make sure that all of the jacks have made firm contact with the ground, then stop the engine.
(Load all of the jack cylinders with the gravity of the machine.)
3. Apply the mark on each jack post, then measure the dimension A as shown in the figure below.



4. Leave the machine for 10 minutes, then measure the dimension A'.

$$A - A' = \text{Natural descent}$$

Serviceable limit of natural descent ----- 1 mm (0.04 in) / 10 minutes.

5. If the natural descent exceeds the serviceable limit, check the double pilot check valve and the jack cylinder for internal oil leakage.

Follow the next procedures to identify which has internal oil leakage (the double pilot check valve or the jack cylinder.)

- 1) Make sure that the boom is stowed on the boom rest properly and that the jack is loaded with the gravity of the machine.
- 2) Disconnect both of the hydraulic hoses from the double pilot check valve.

Caution : Do not disconnect the hydraulic hoses unless the boom is stowed on the boom rest properly.

- 3) Check if the hydraulic oil leaks from the double pilot check valve.

If the hydraulic oil leaks from the pilot check valve, it indicates that the internal oil leakage is in the double pilot check valve.

No oil leakage indicates that the internal oil leakage is in the jack cylinder.

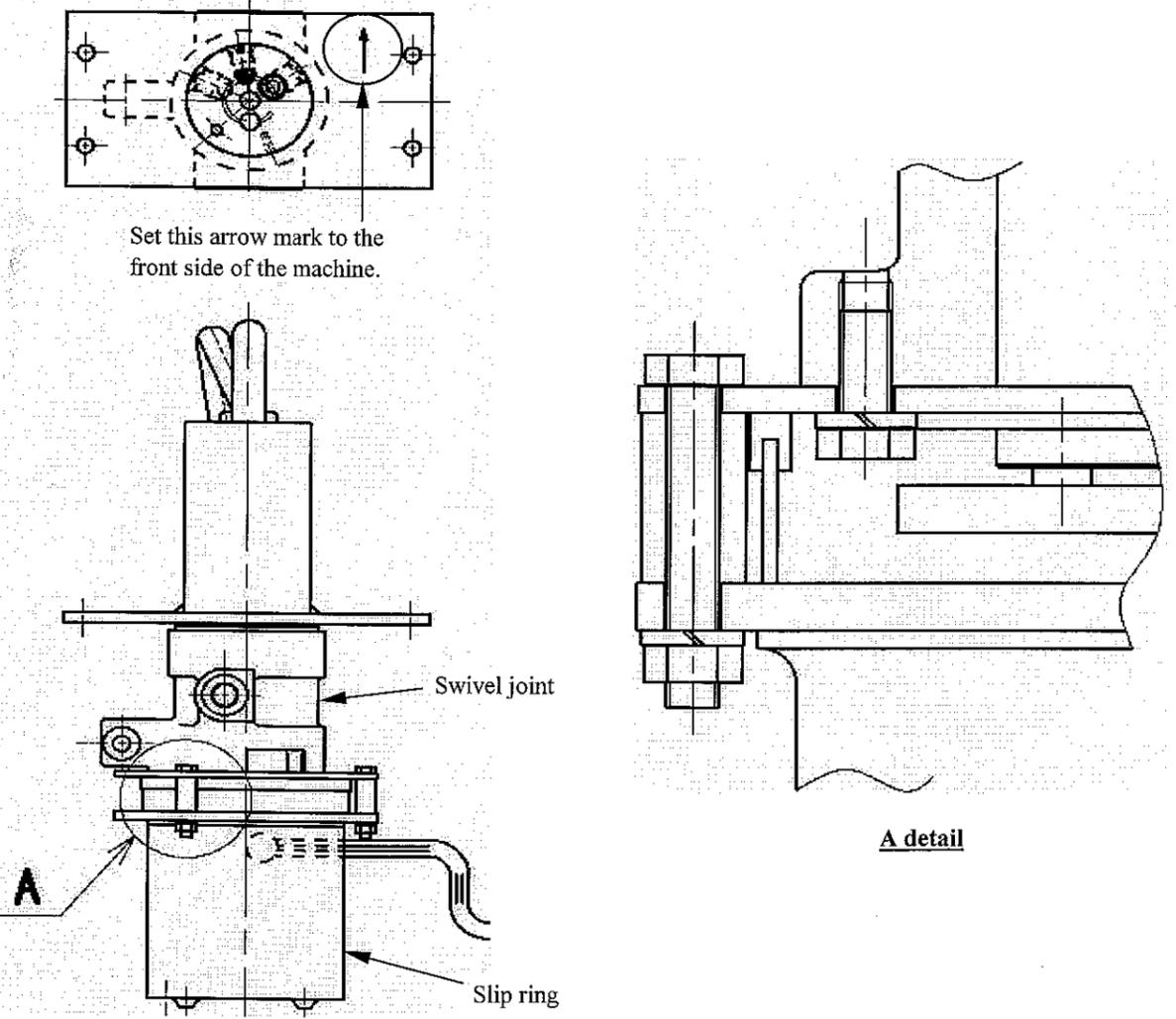
Swivel joint

The swivel joint is installed in the rotation center of the turntable to make the hydraulic oil passage between the chassis and the turntable.

Rated pressure :	A port ----- 30 kg / cm ² (425 PSI)	used for drain line.
	B port ----- 210 kg / cm ² (3,000 PSI)	used for pressure line.
	C port ----- 210 kg / cm ² (3,000 PSI)	used for return line.
Rated flow :	A port ----- 9 liters / min (2.4 gal / min)	
	B, C ports ----- 50 liters / min (13.2 gal / min)	

1. Structure

The swivel joint complete consists of the swivel joint and the slip ring as shown in the figure below. See the "Electric section" for the detail of the "Slip ring".

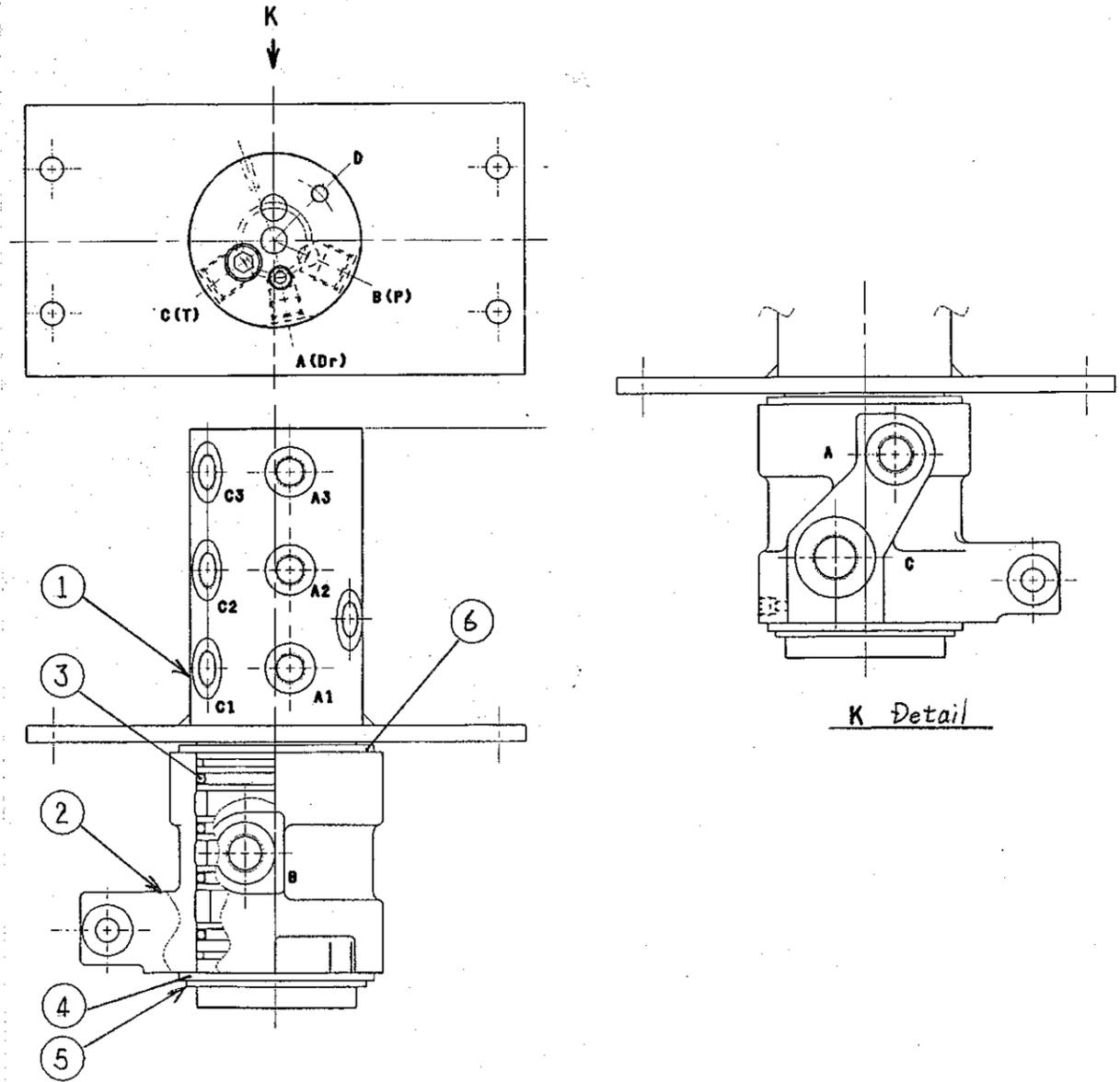


2. Disassembly and Re-assembly

1. Remove the slip ring from the swivel joint.
2. Remove the snap ring ⑤ and the plate ④.
3. Remove the case ② from the shaft ① using a "Hydraulic press".
4. Remove all of the O rings ③, then plate ⑥.
5. Re-assemble the swivel joint by following the reverse order above.

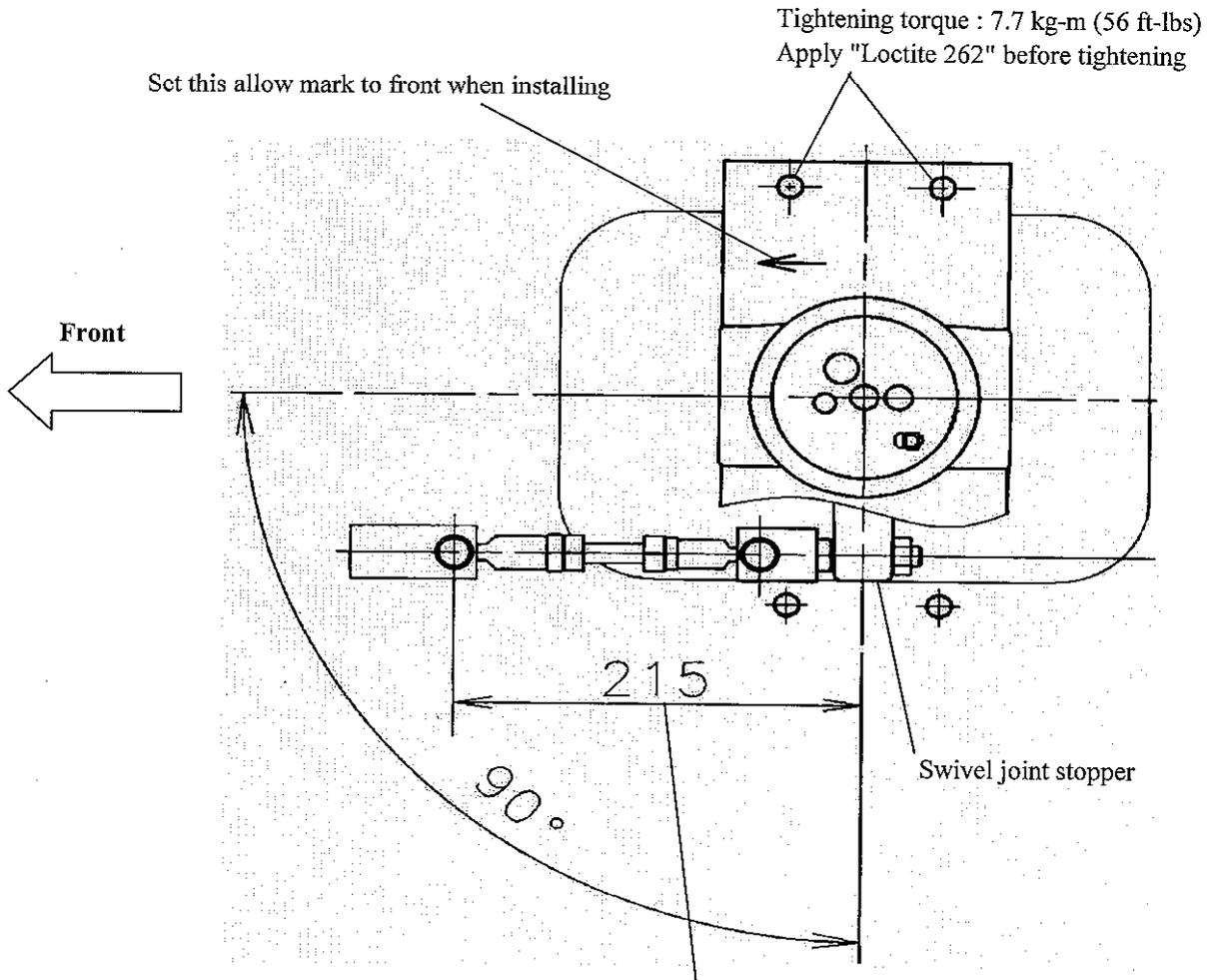
Caution on re-assembly.

1. Apply grease to the O rings ③ and the plates ④, ⑥ before installing.
2. See the "Electric section" for installing the "Slip ring" to the "Swivel joint".

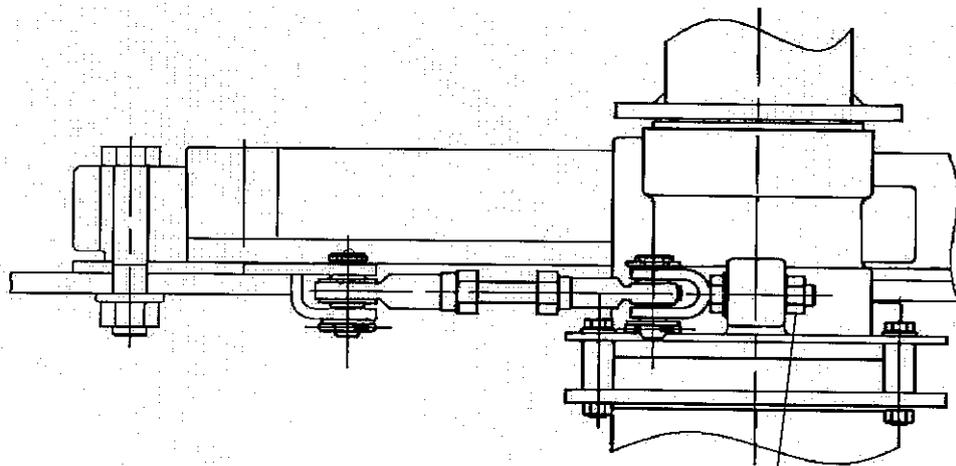


3. Installation

Install the swivel joint complete to the machine as shown in the figure below.



Adjust this length to 215 mm (8.45 in)
and make sure that the swivel joint stopper
faces exactly left side of the machine.



Apply "Loctite 262" before tightening.

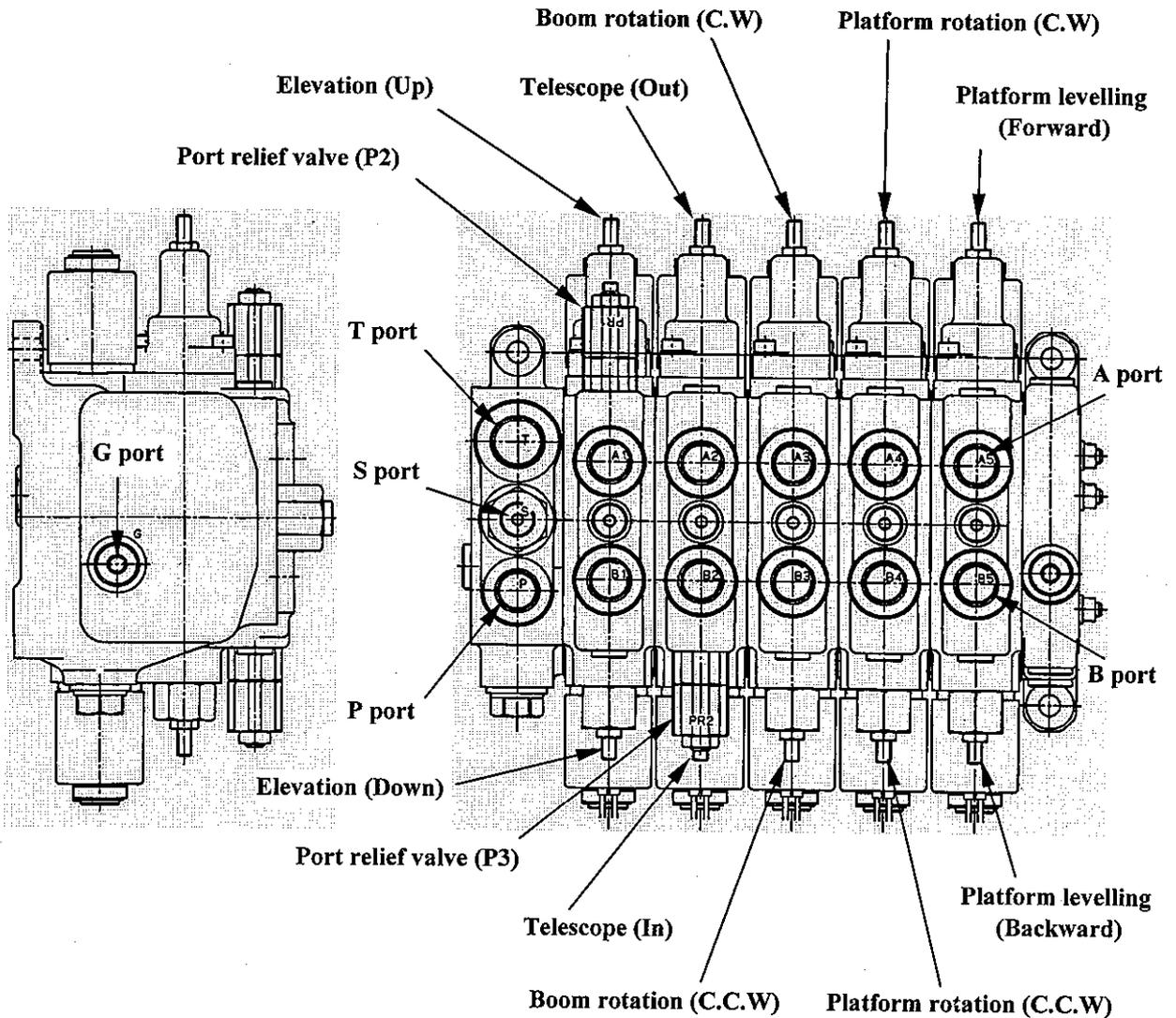
Main control valve

3020004700A

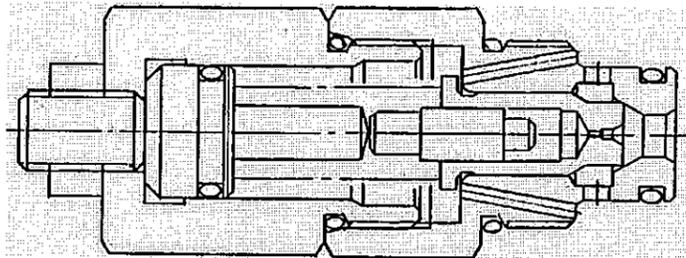
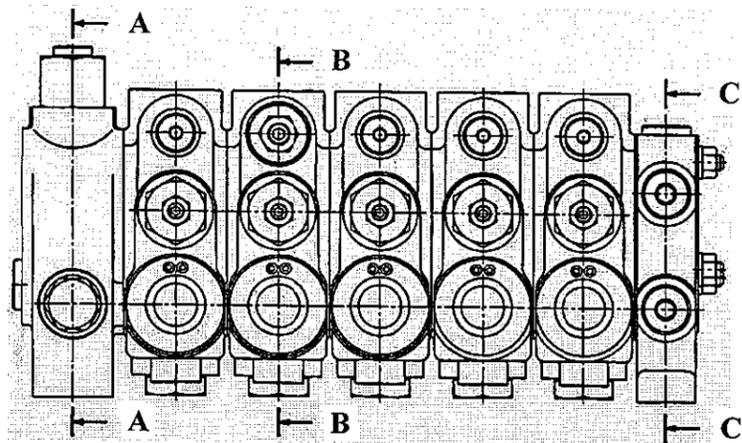
The main control valve controls the "Boom telescope", "Boom elevation", "Boom rotation", "Platform rotation" and "Platform levelling" functions proportionally.

Type -----	Solenoid operated proportional control valve
Rated pressure	P, A, B, S, G ports ----- 175 kg / cm ² (2,500 PSI)
	T port ----- 10 kg / cm ² (140 PSI)
Rated flow -----	40 liters / min (10.5 gal / min)
Solenoid	Rated voltage ----- DC 24 volts
	Rated current ----- 800 mA
	Resistance ----- 15.6 Ω (at 20°C)

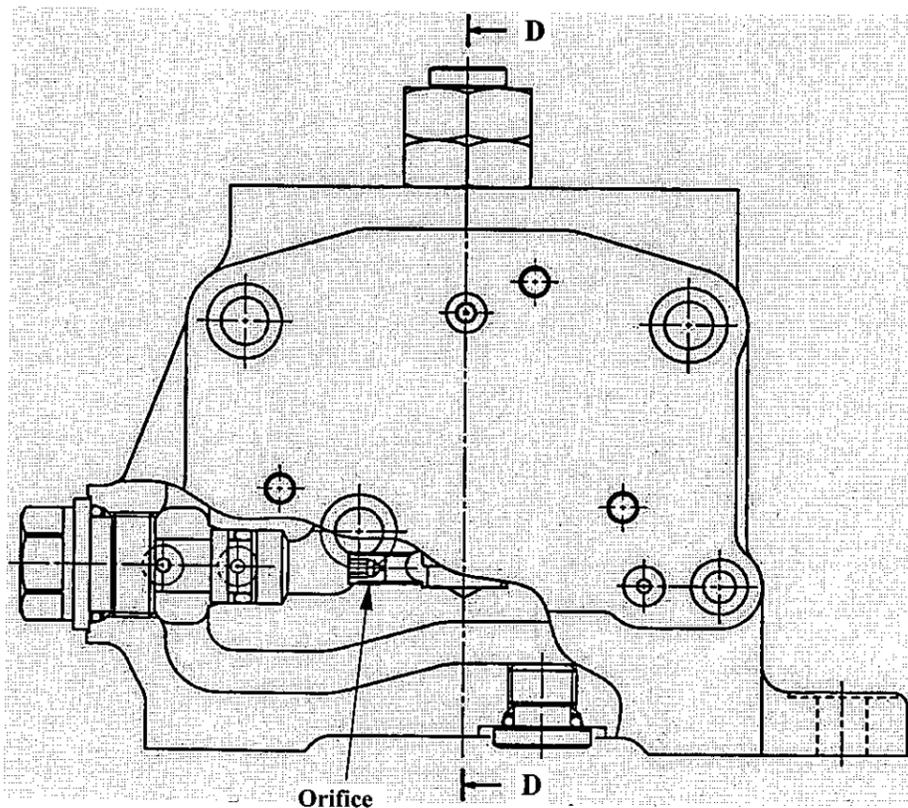
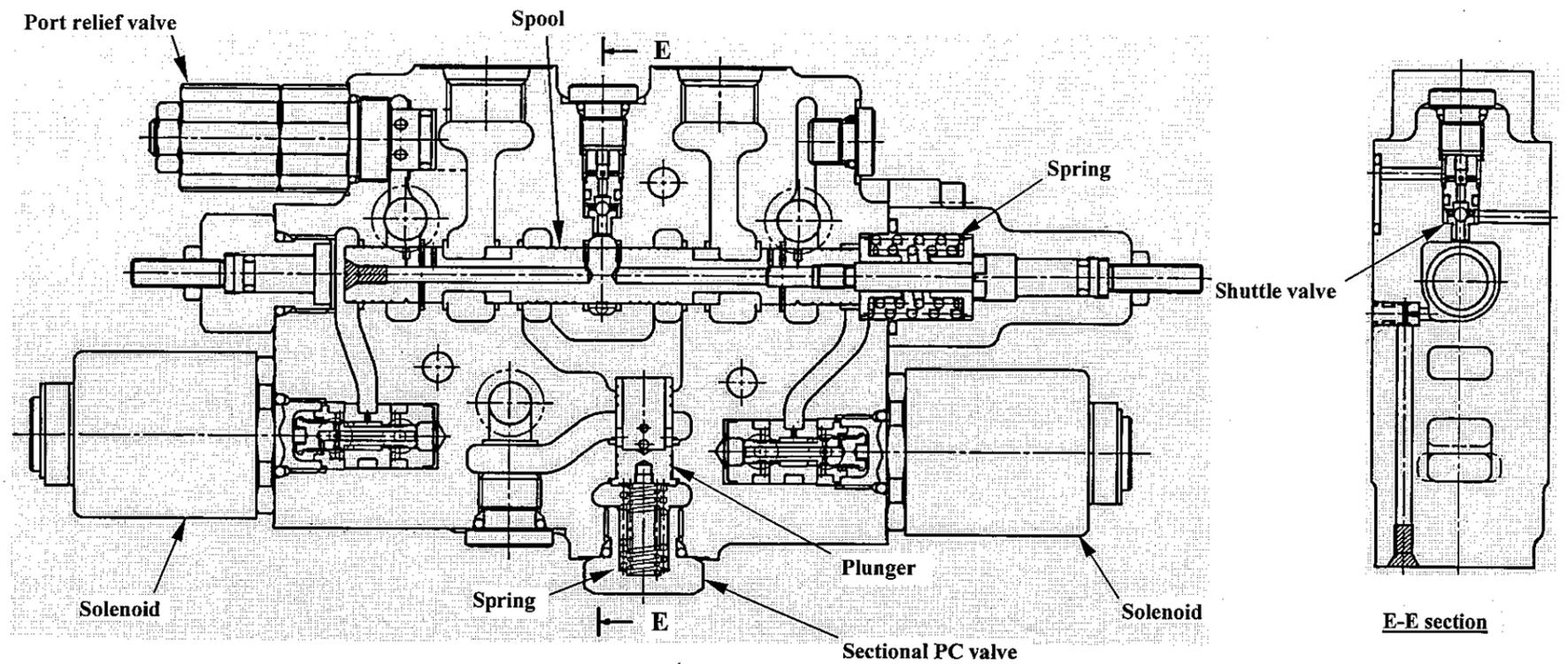
1. Structure



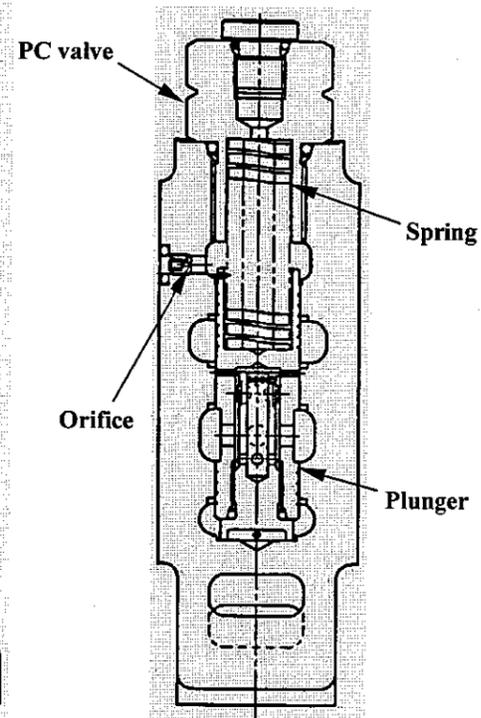
2. Section drawings



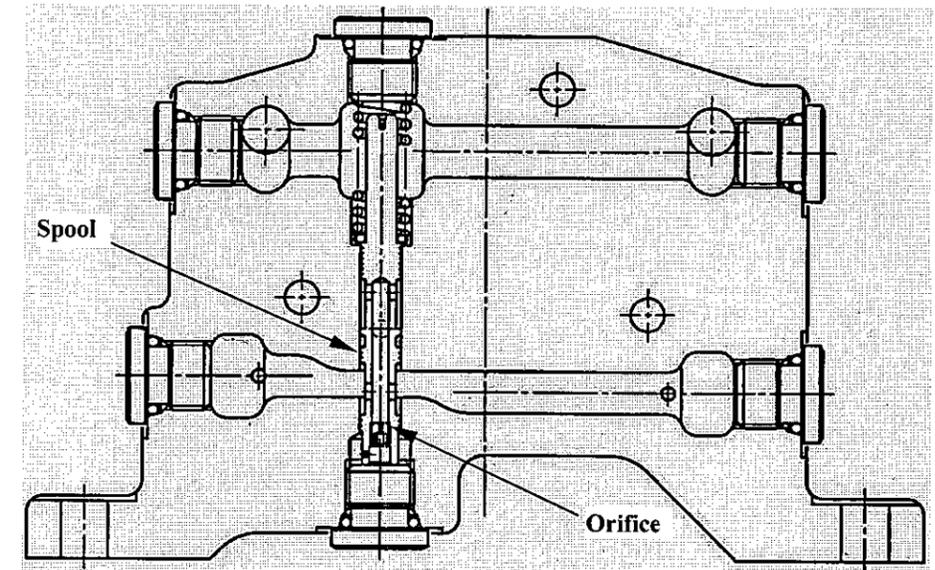
Detail of port relief valve



A-A section

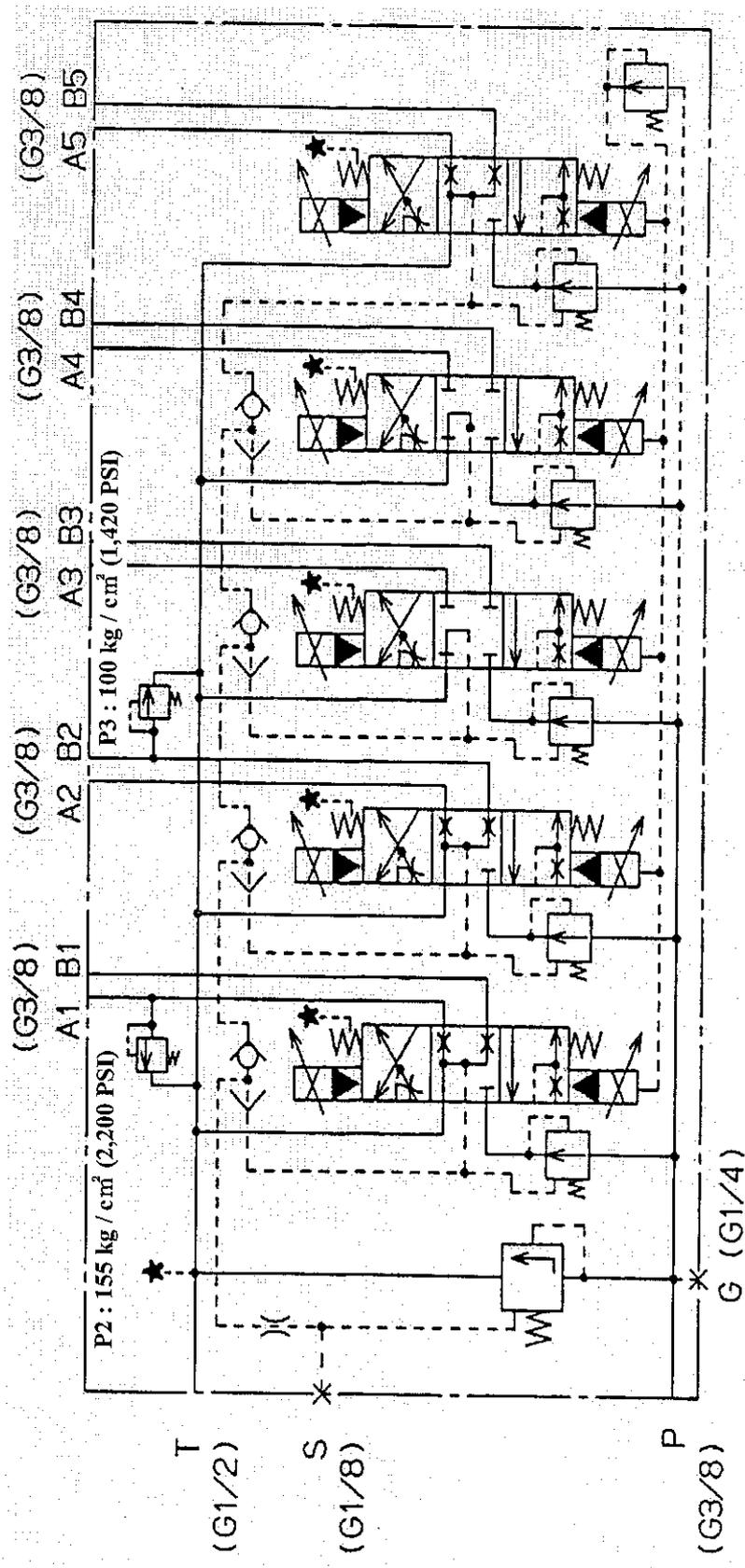


D-D section

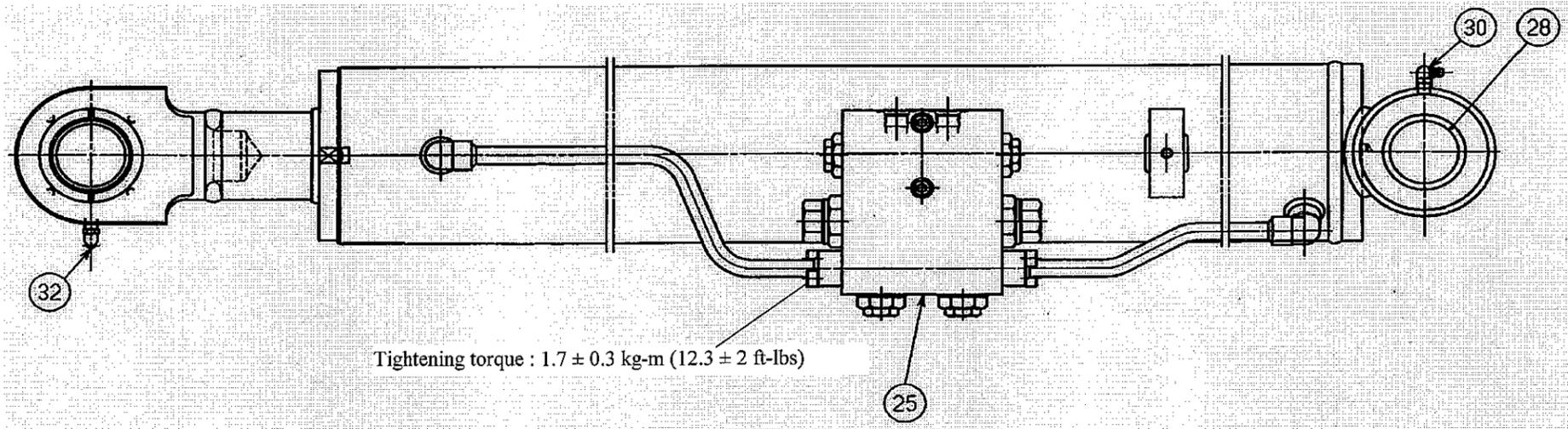
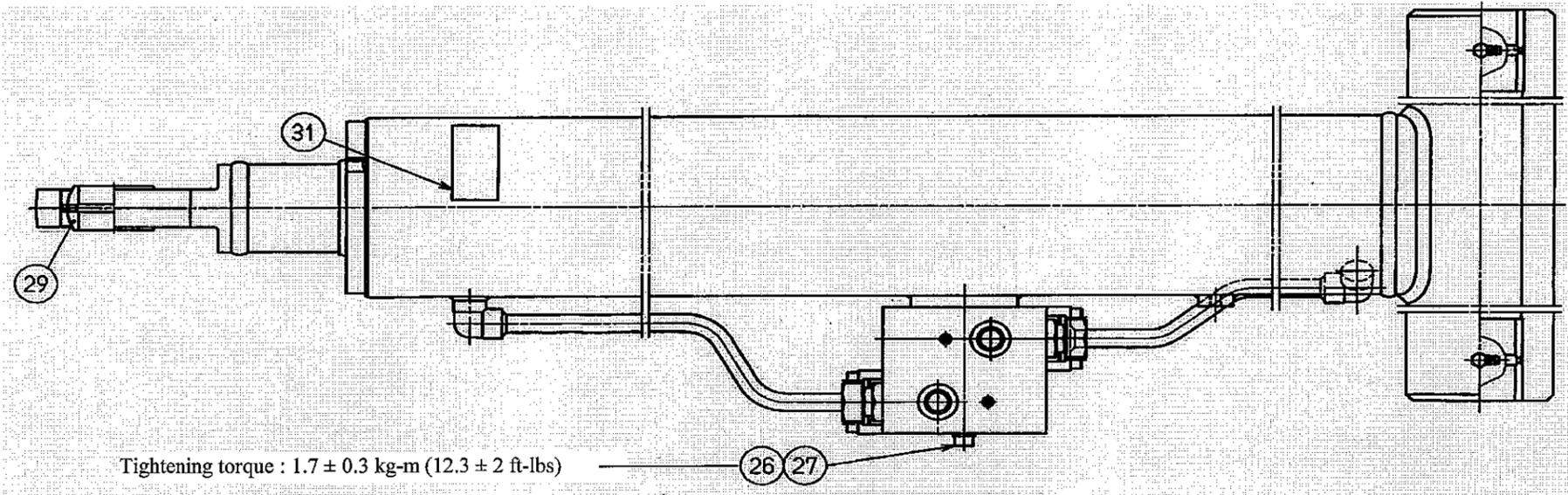
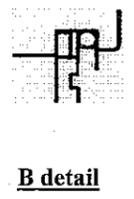
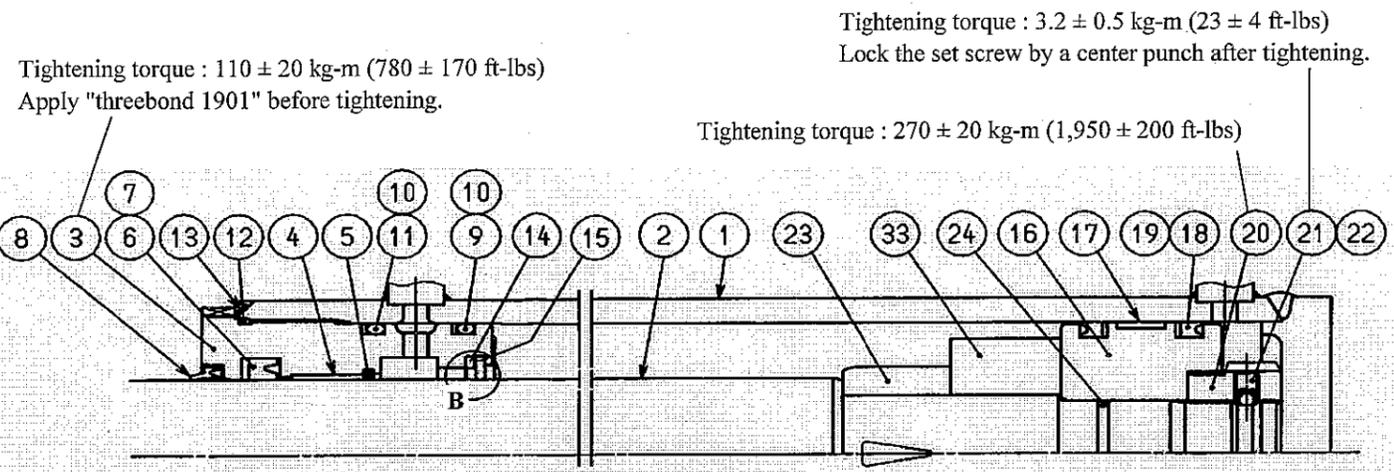


C-C section

3. Hydraulic schematic



Elevation cylinder



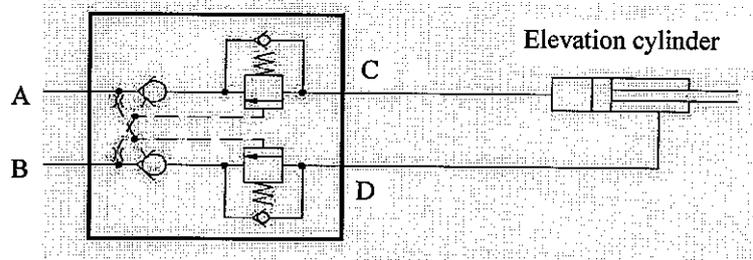
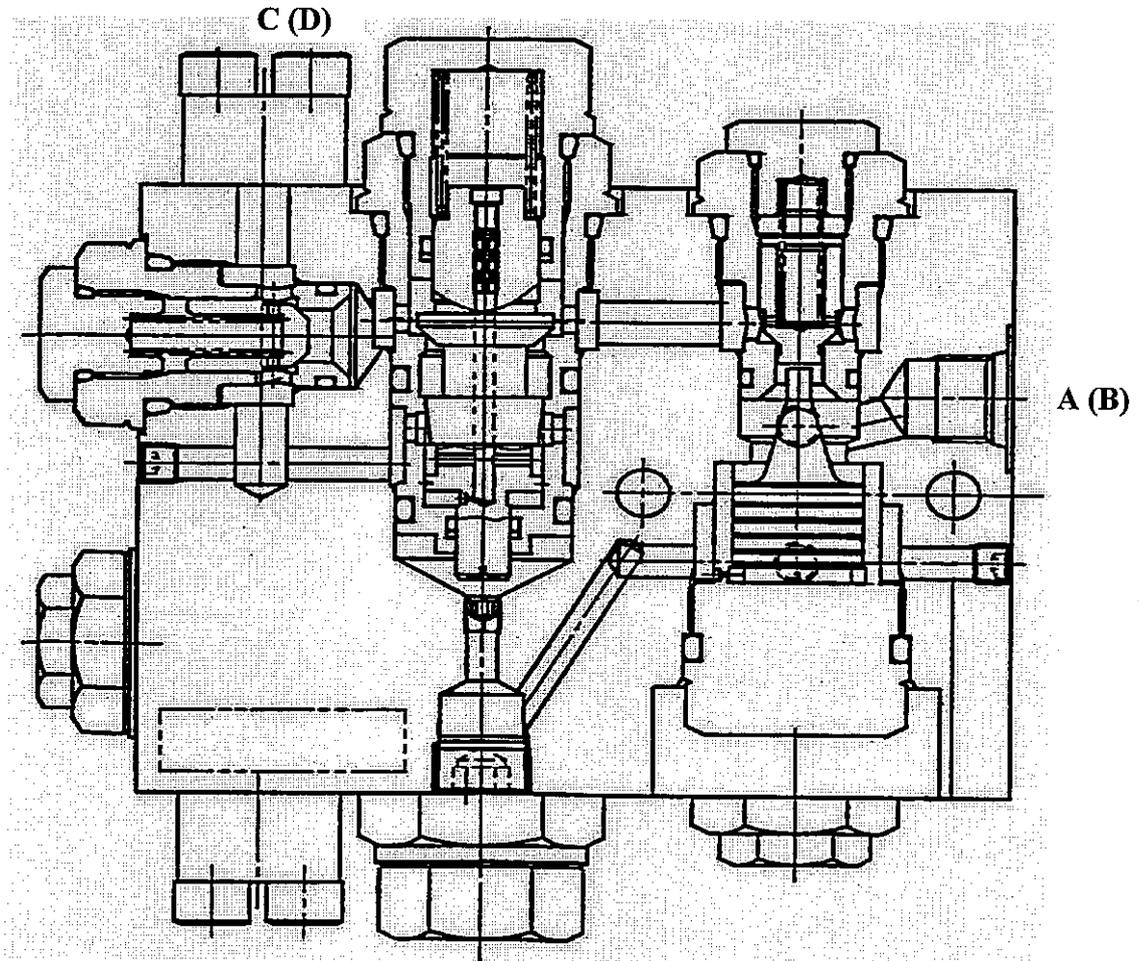
1	Cylinder tube
2	Piston rod
3	Cylinder head
4	Bushing
5	Retaining ring
6	U ring
7	Back-up ring
8	Wiper ring
9	O ring
10	Back-up ring
11	O ring
12	O ring
13	Lock washer
14	Cushion ring
15	Retaining ring
16	Piston
17	Wear ring
18	U ring
19	Back-up ring
20	Nut
21	Set screw
22	Steel ball
23	Cushion bearing
24	O ring
25	Double holding valve
26	Bolt
27	Spring washer
28	Pin bushing
29	Spherical bearing
30	Grease fitting
31	Name plate
32	Grease fitting
33	Spacer

Double holding valve (for Elevation cylinder)

302-000030

The double holding valve is mounted on the elevation cylinder to prevent the cylinder from natural descent.

Rated pressure ----- 210 kg/cm² (3,000 PSI)
 Rated flow ----- 30 liters / min (7.9 gal / min)

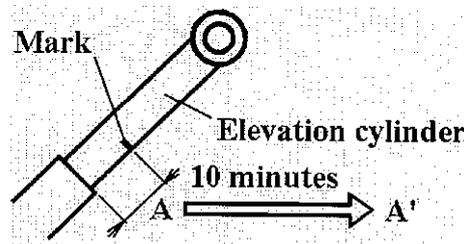


1. Inspection

Check the internal oil leakage of the holding valve by measuring the natural descent of the boom elevation cylinder as follows.

1. Set up the machine on firm and level ground.
2. Raise the boom and set the boom at the boom angle of 45 degrees, then stop the engine.
3. Apply the mark on the piston rod of the boom elevation cylinder, then measure the dimension A as shown in the figure below.

CAUTION : Do not damage the piston rod by applying the mark.



4. Leave the machine for 10 minutes, then measure the dimension A'.

$$A - A' = \text{Natural descent}$$

Serviceable limit of natural descent ----- 2 mm (0.08 in) / 10 minutes.

5. If the natural descent exceeds the serviceable limit, check the holding valve and the boom elevation cylinder for internal oil leakage.

Follow the next procedures to identify which has internal oil leakage (the holding valve or the boom elevation cylinder).

- 1) Hold the boom by crane to prevent the boom from sudden descent.
- 2) Disconnect the hydraulic hose which is connected to the "A port" of the holding valve.

CAUTION : Loosen the hydraulic hose fitting slowly when disconnecting the hydraulic hose.

- 3) Lower the hoisting hook of the crane to load the boom elevation cylinder with the gravity of the boom, then check if the hydraulic oil leaks from the holding valve.

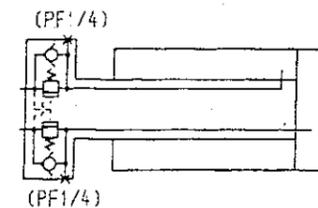
If the hydraulic oil leaks from the holding valve, it indicates that the internal oil leakage is in the holding valve.

No oil leakage indicates that the internal oil leakage is in the boom elevation cylinder.

DANGER : Do not remove the holding valve without supporting the boom.

If the holding valve is removed or loosened, the boom will fall, resulting in serious injury or death.

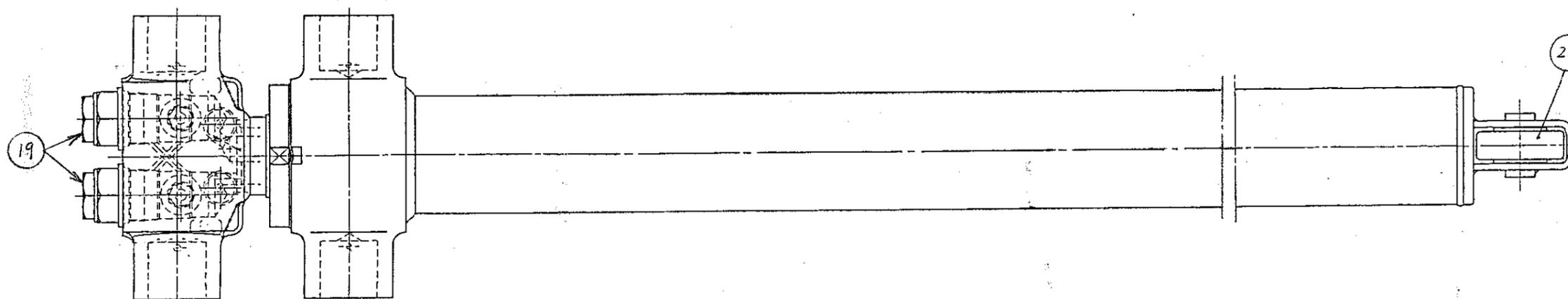
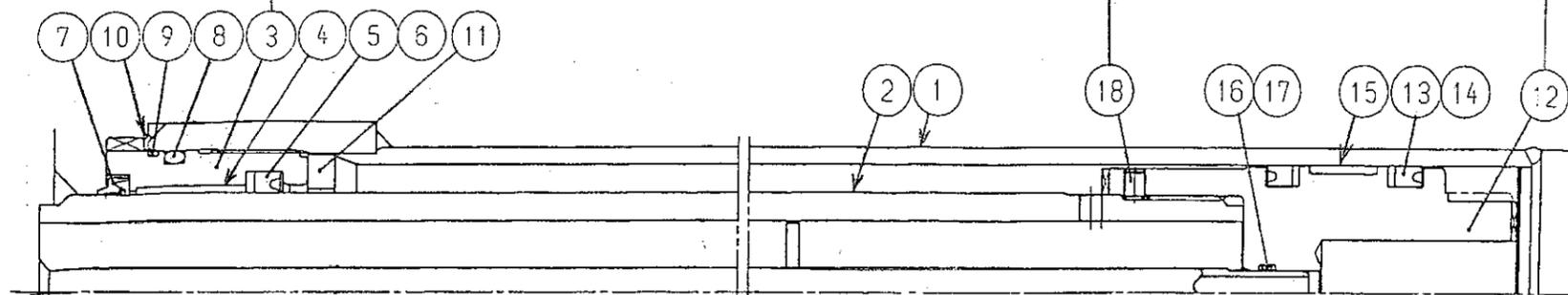
Telescope cylinder



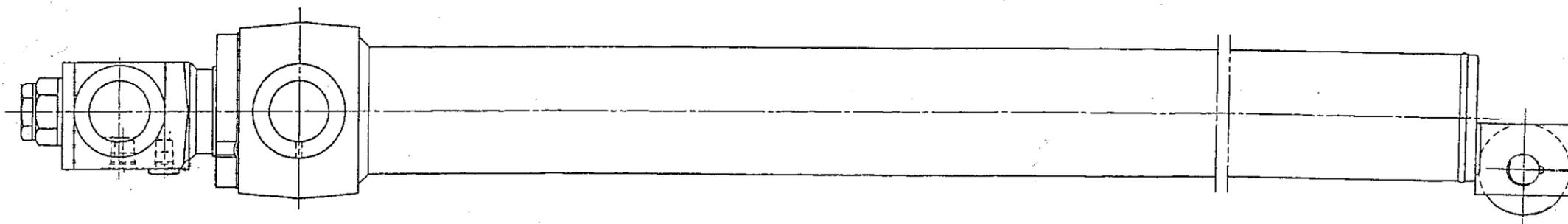
Tightening torque
 $50 \pm 11 \text{ kg-m}$
 $(360 \pm 80 \text{ ft-lbs})$

Lock the set screw by
 "Center punch" after tightening

Tightening torque
 $100 \pm 10 \text{ kg-m}$
 $(720 \pm 72 \text{ ft-lbs})$

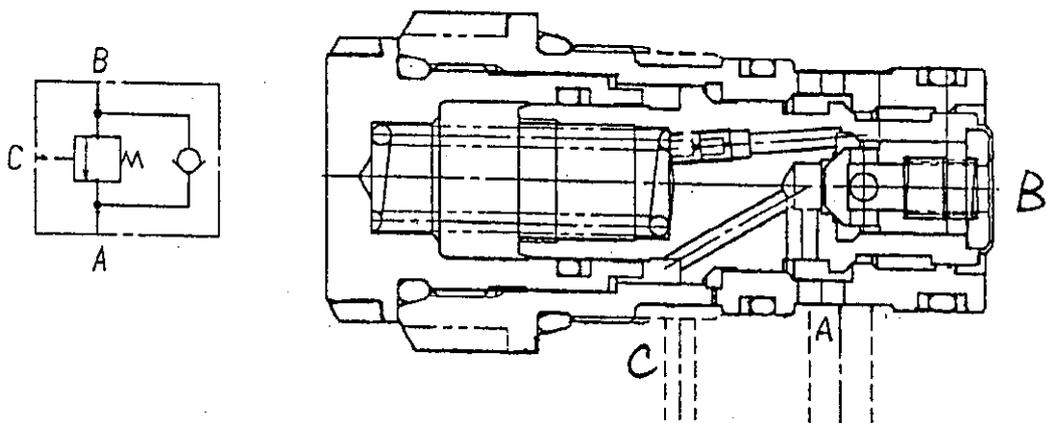
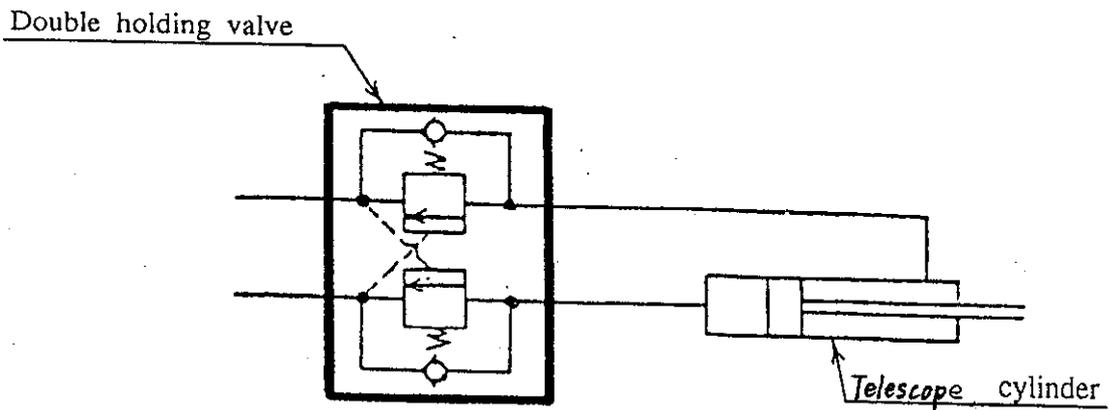
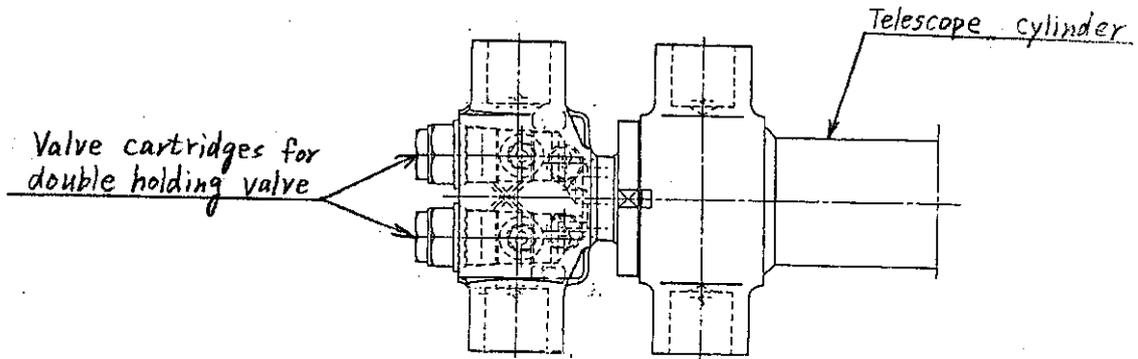


1	Cylinder tube
2	Piston rod
3	Cylinder head
4	Bushing
5	U ring
6	Back-up ring
7	Dust seal
8	O ring
9	O ring
10	Lock plate
11	Spacer
12	Piston
13	U ring
14	Back-up ring
15	Wear ring
16	O ring
17	Back-up ring
18	Set screw
19	Double holding valve
20	Roller



Double holding valve (for Telescope cylinder)

The double holding valve is mounted on the telescope cylinder to prevent the cylinder from natural descent.

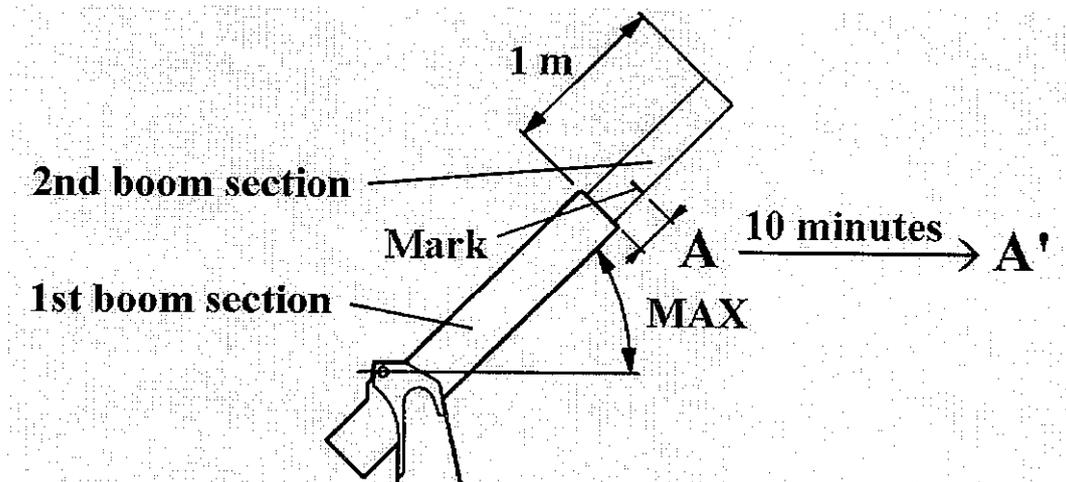


Details of the valve cartridge

1. Inspection

Check the internal oil leakage of the holding valve by measuring the natural descent of the boom telescope cylinder as follows.

1. Set up the machine on firm and level ground.
2. Raise the boom fully and extend the boom about 1 meter (3 feet), then stop the engine.
3. Apply the mark on the 2nd boom section, then measure the dimension A as shown in the figure below.



4. Leave the machine for 10 minutes, then measure the dimension A'.

$$A - A' = \text{Natural descent}$$

Serviceable limit of natural descent ----- 2 mm (0.08 in) / 10 minutes.

5. If the natural descent exceeds the serviceable limit, check the holding valve and the boom telescope cylinder for internal oil leakage.

Follow the next procedures to identify which has internal oil leakage (the holding valve or the boom telescope cylinder).

- 1) Raise the boom fully and extend the boom about 1 meter (3 feet).
- 2) Disconnect the hydraulic hose which is connected to the "A port" of the holding valve, then check if the hydraulic oil leaks from the holding valve.

CAUTION : Loosen the hydraulic hose fittings slowly when disconnecting the hydraulic hose.

If the hydraulic oil leaks from the holding valve, it indicates that the internal oil leakage is in the holding valve.

No oil leakage indicates that the internal oil leakage is in the boom telescope cylinder.

CAUTION : The boom should be fully retracted when removing the holding valve.

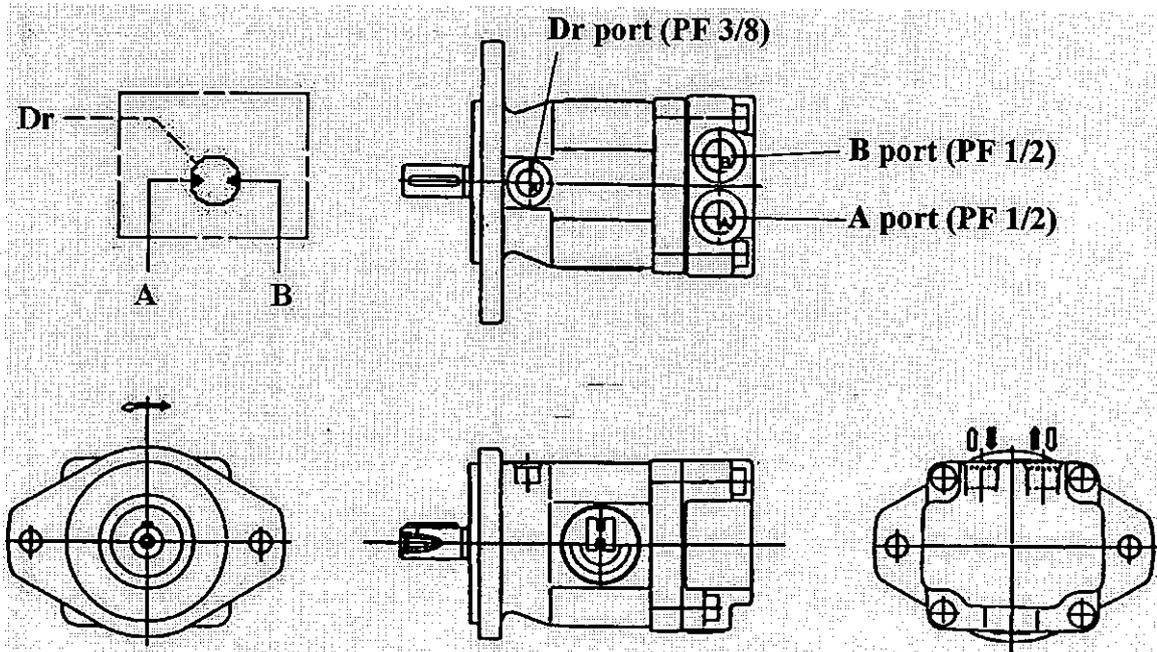
If the holding valve is removed or loosened while the boom is extended, the 2nd boom section will retract suddenly, resulting in the damage to the machine.

Boom rotation motor

301-03806

The boom rotation motor is installed on the rotation gearbox to rotate the turntable.

Type ----- Plunger type
Rated pressure ----- 210 kg / cm² (3000 PSI)
Displacement ----- 28 cc / rev (1.7 in³)

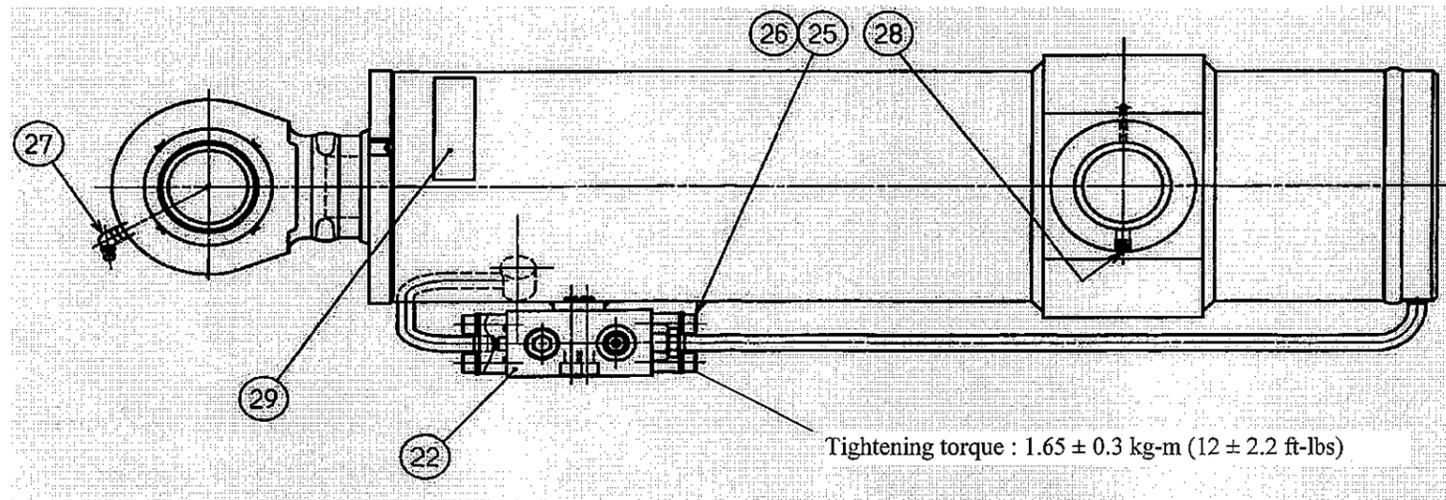
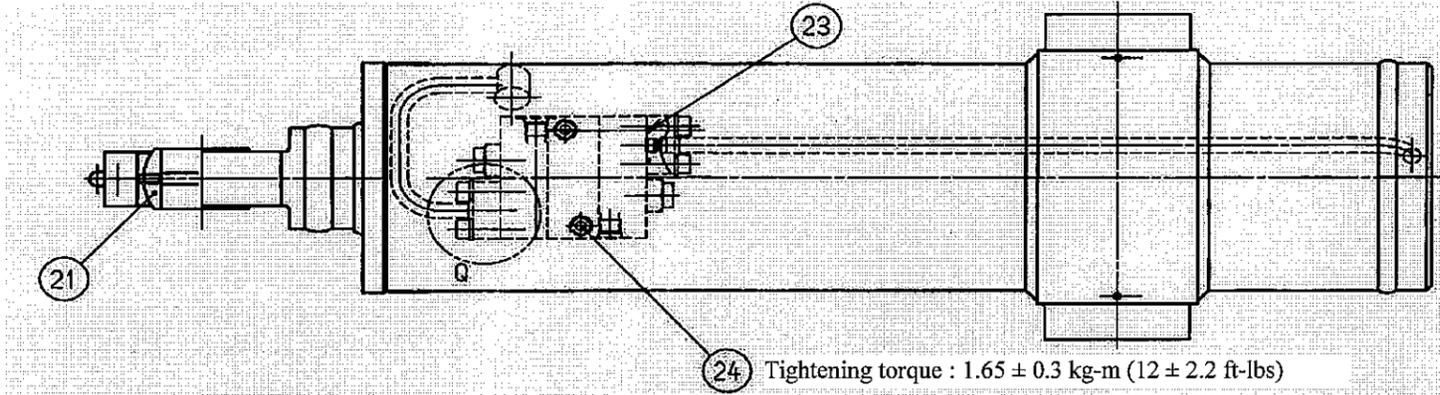
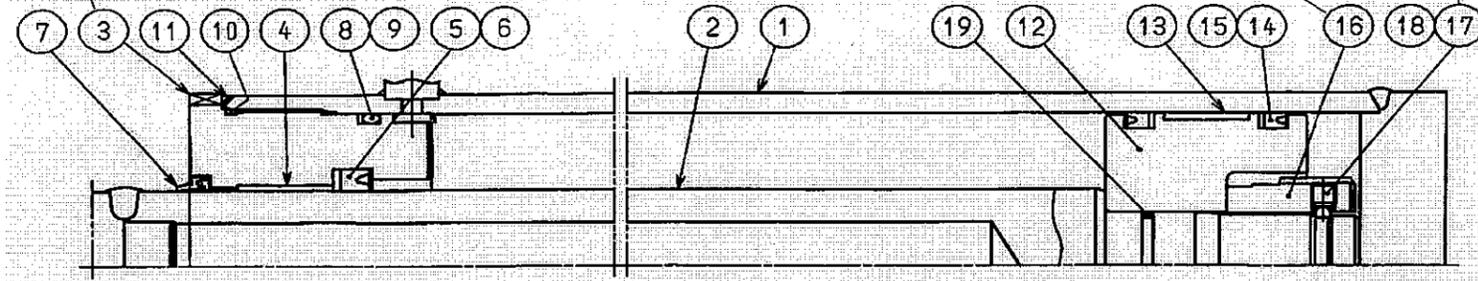


Platform levelling cylinder

Tightening torque : 185 ± 40 kg-m ($1,330 \pm 300$ ft-lbs)
Apply "Three bond 1901" before tightening.

Tightening torque : 400 ± 80 kg-m ($2,900 \pm 550$ ft-lbs)

Tightening torque : 3.2 ± 0.5 kg-m (23 ± 4 ft-lbs)
Lock the set screw by a center punch after tightening.



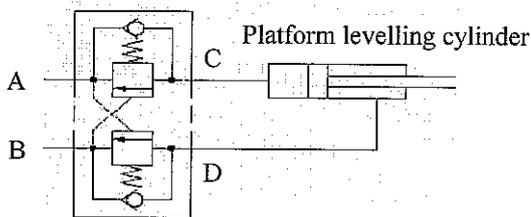
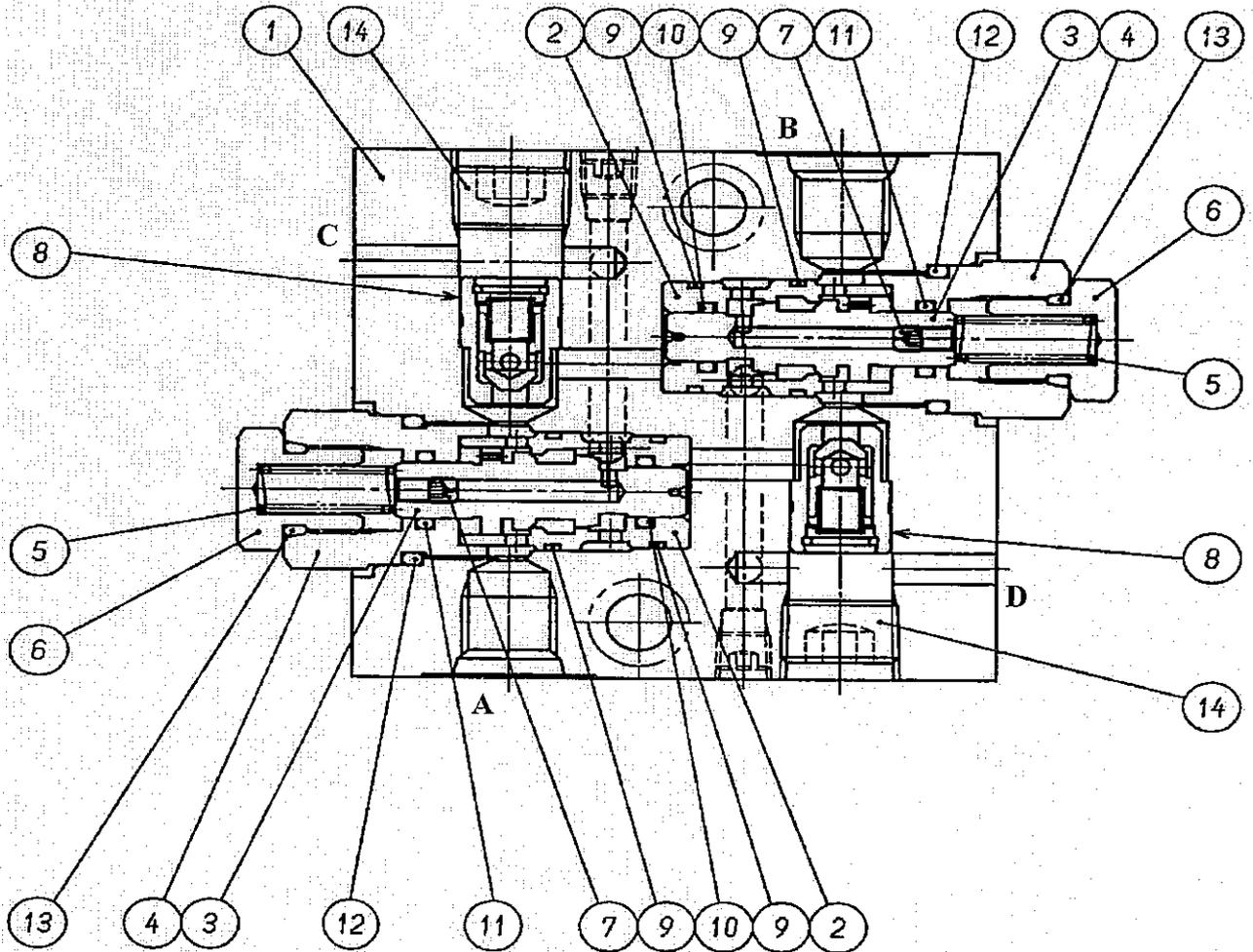
1	Cylinder tube
2	Piston rod
3	Cylinder head
4	Bushing
5	U ring
6	Back-up ring
7	Wiper ring
8	O ring
9	Back-up ring
10	O ring
11	Lock washer
12	Piston
13	Wear ring
14	U ring
15	Back-up ring
16	Nut
17	Set screw
18	Steel ball
19	O ring
20	Pin bushing
21	Spherical bearing
22	Double holding valve
23	O ring
24	Bolt
25	Bolt
26	Spring washer
27	Grease fitting
28	Plug
29	Serial number plate

Double holding valve (for Platform levelling cylinder)

302-05847

The double holding valve is mounted on the platform levelling cylinder to confine the hydraulic oil into the cylinder and maintain the platform level in the event of hydraulic hose breakage.

Rated pressure ----- 230 kg/cm² (3,270 PSI)
 Rated flow ----- 10 liters / min (2.64 gal / min)



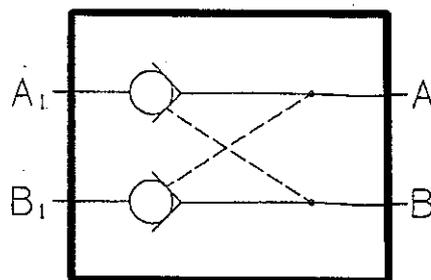
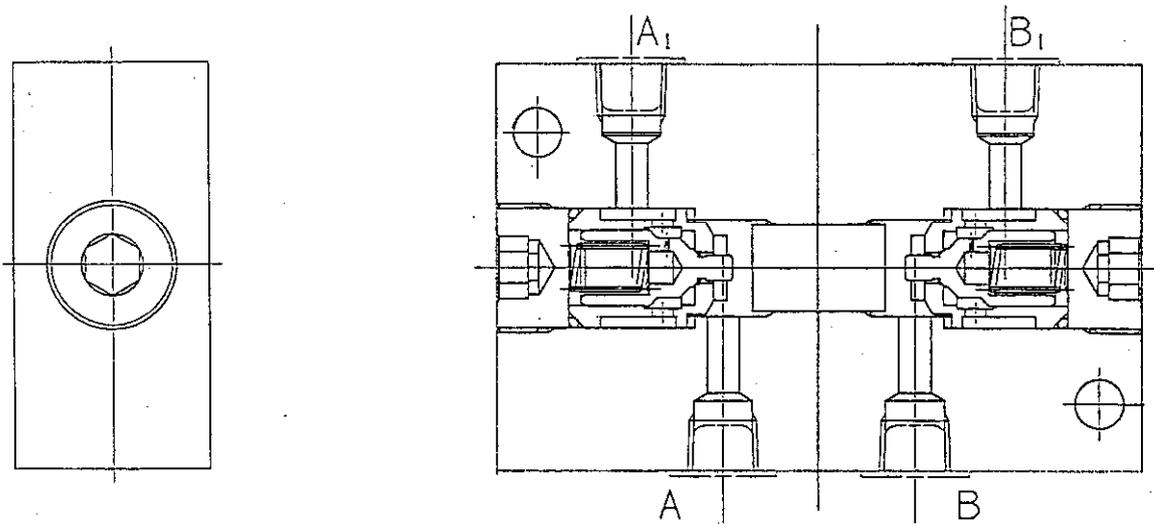
1	Body
2	Valve seat
3	Spool
4	Cap
5	Spring
6	Cap
7	Orifice
8	Check valve
9	O ring
10	O ring
11	O ring
12	O ring
13	O ring
14	Plug

Double pilot check valve (for Platform levelling system)

This valve confines the hydraulic oil into the closed hydraulic circuit of the platform levelling system.

Rated pressure ----- 210 kg/cm² (3000 PSI)

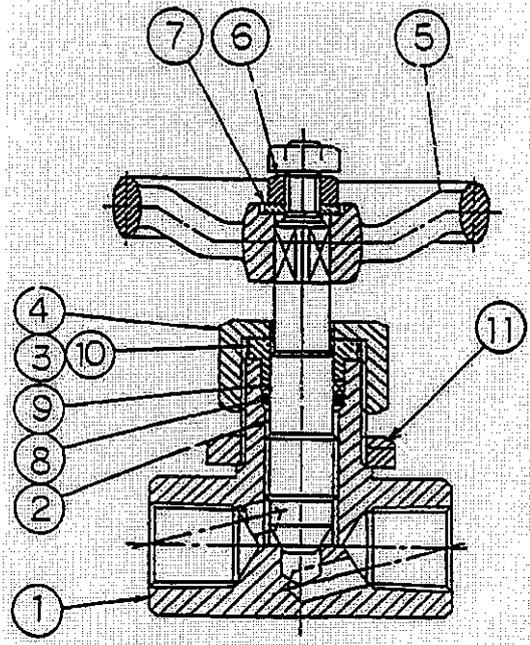
Rated flow ----- 30 liters/min (7.9 GPM)



Stop valve

302-05835

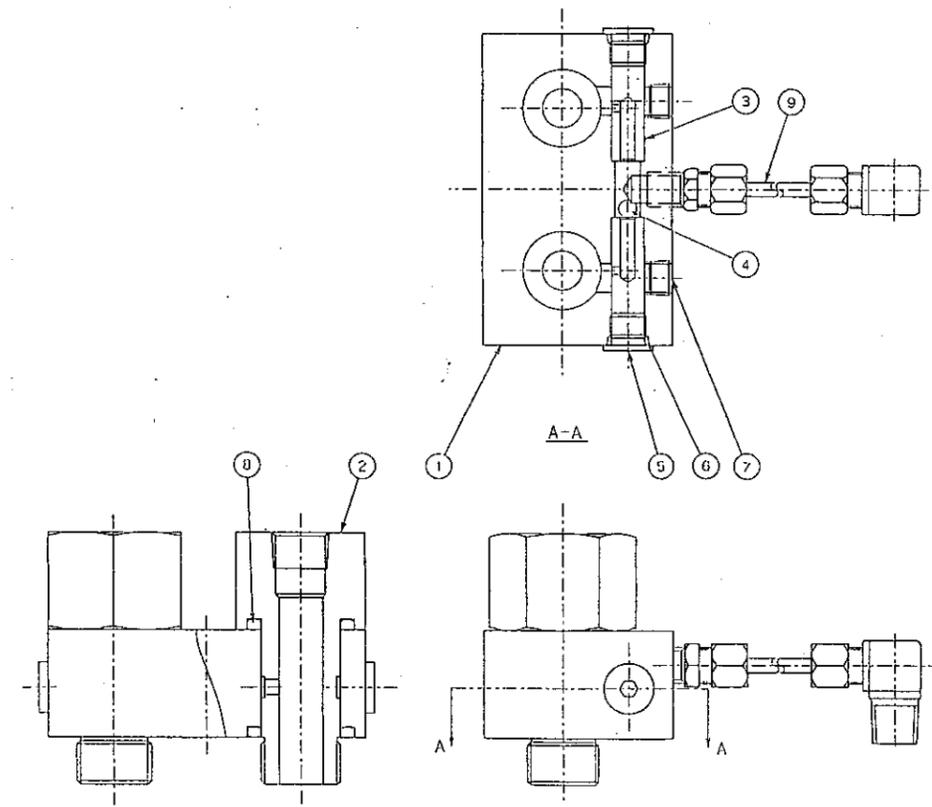
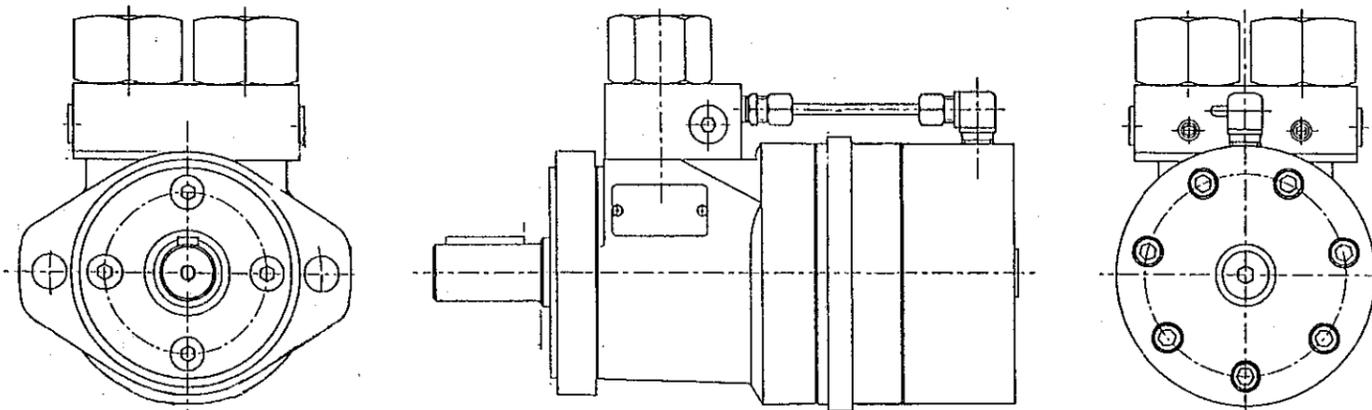
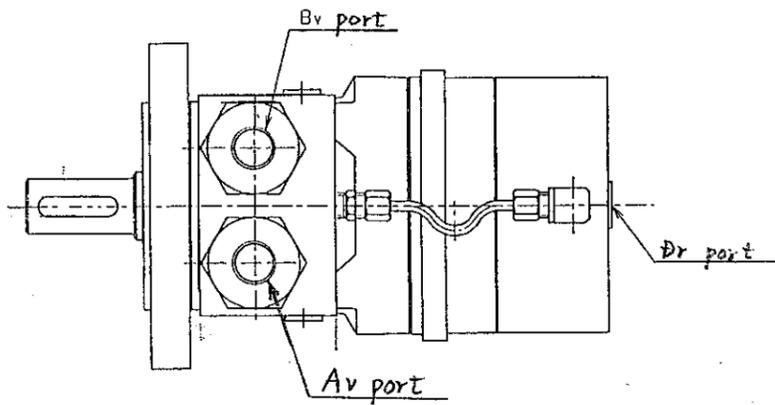
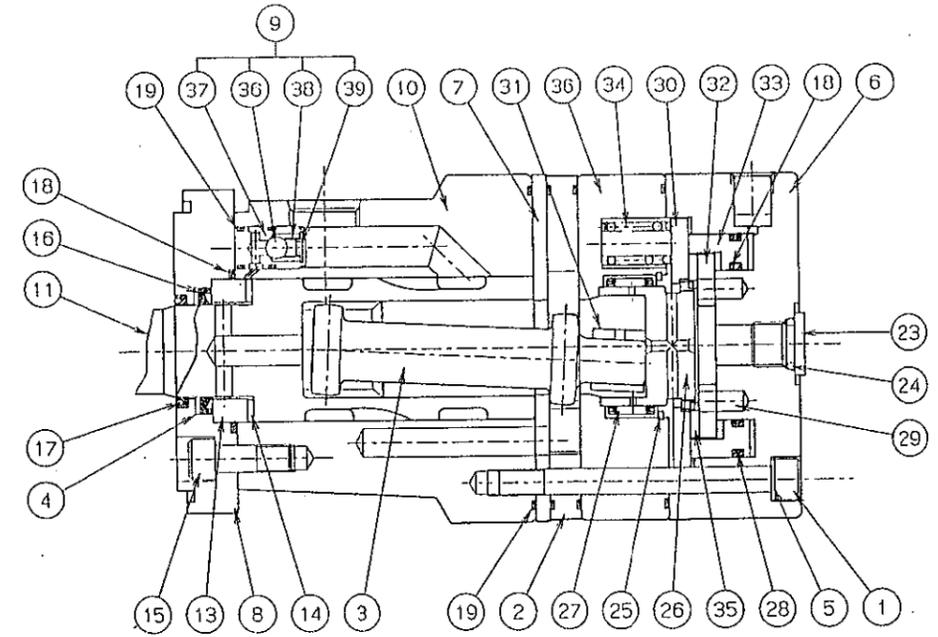
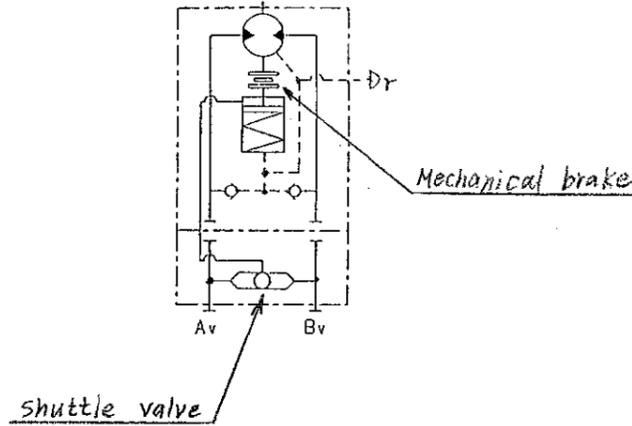
Two stop valves are installed in the platform levelling circuit to disable the functions of the platform levelling system, in the event of any failure occurred in the control system.



Platform rotation motor

This hydraulic motor rotates the platform and incorporates the mechanical brake.
 The mechanical brake locks the output shaft when no pressure is applied to the motor and is released automatically when pressure is applied.

- Type ----- Orbit motor
- Rated pressure ----- 175 kg/cm² (2500 PSI)
- Displacement ----- 54 cc/rev (3.3 in³/rev)
- Mechanical brake release pressure ----- 4 kg/cm² (57 PSI)



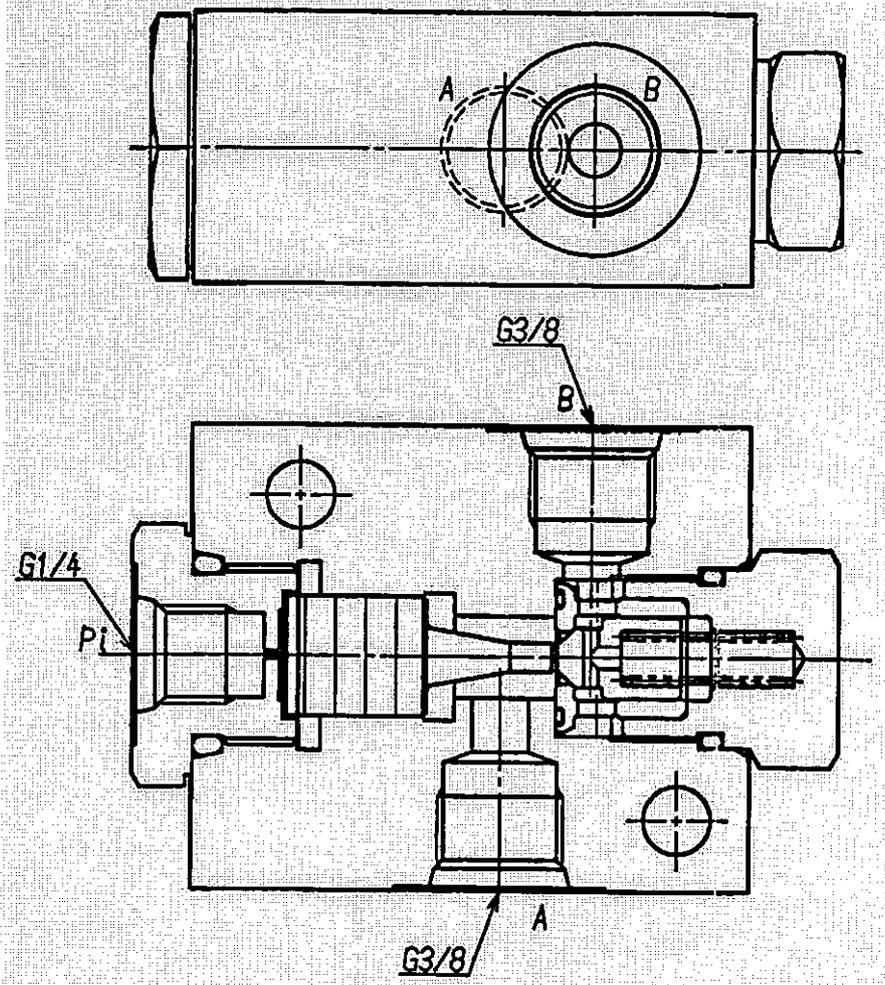
Shuttle valve detail

Pilot check valve (for Outrigger cylinder)

302-06428

The pilot check valve is located behind the outrigger control valve to prevent the outrigger cylinders from natural extension.

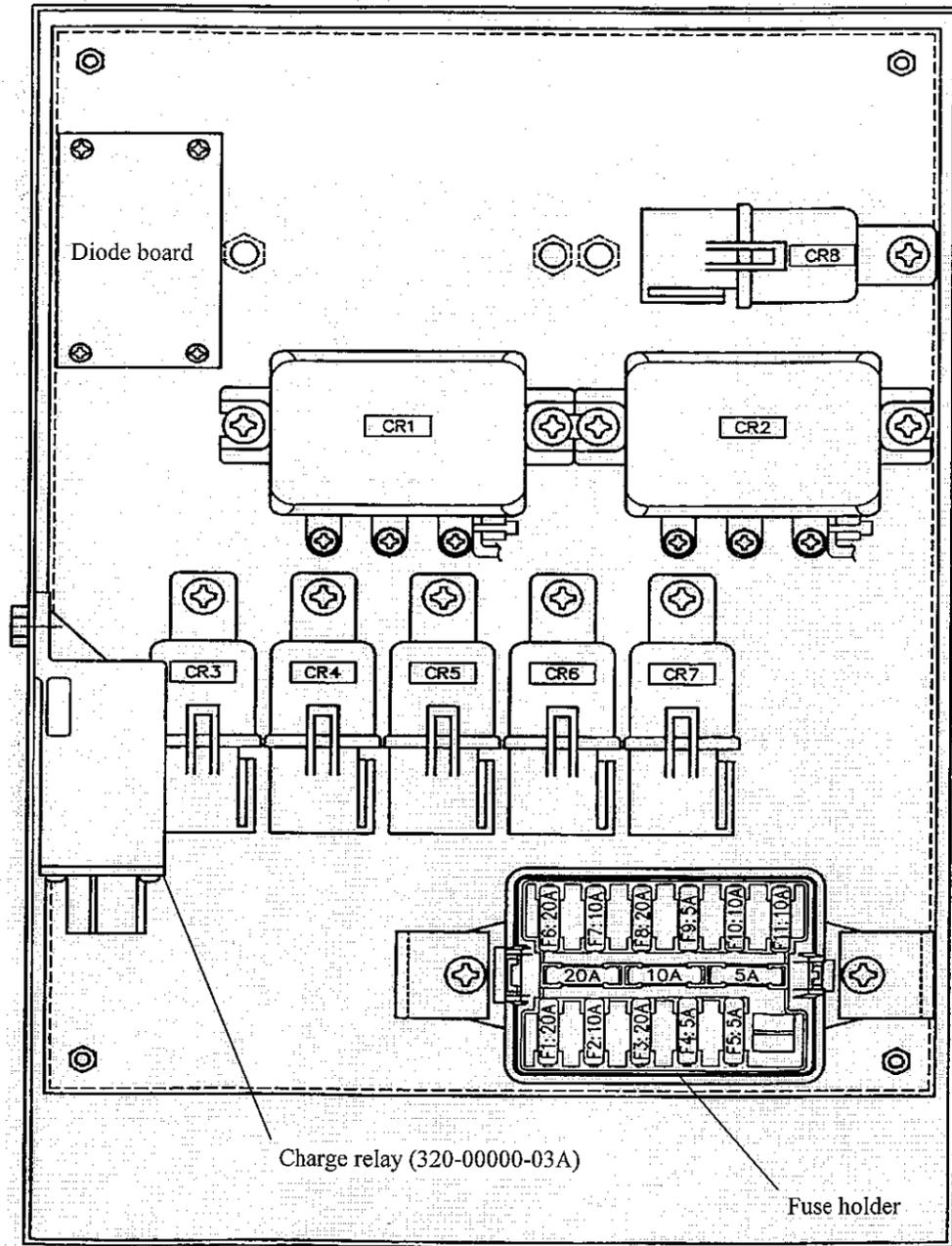
Rated pressure ----- 210 kg / cm² (3000 PSI)
Rated flow ----- 30 liters / min (7.9 gallons / min)



4. Electrical section

Main power box

The main power box is located at the left front corner of the sub-frame to supply the main power (DC24V) to the machine.



RY (1.25)	YR (1.25)	Y (1.25)	P
GR	GW	G (1.25)	L
WR	WB	WL	W

Connector No.201

BY	GY	RW	RB
WR	Br (1.25)	Br	WR
Gy	Lg (1.25)	O (1.25)	RG (2.0)

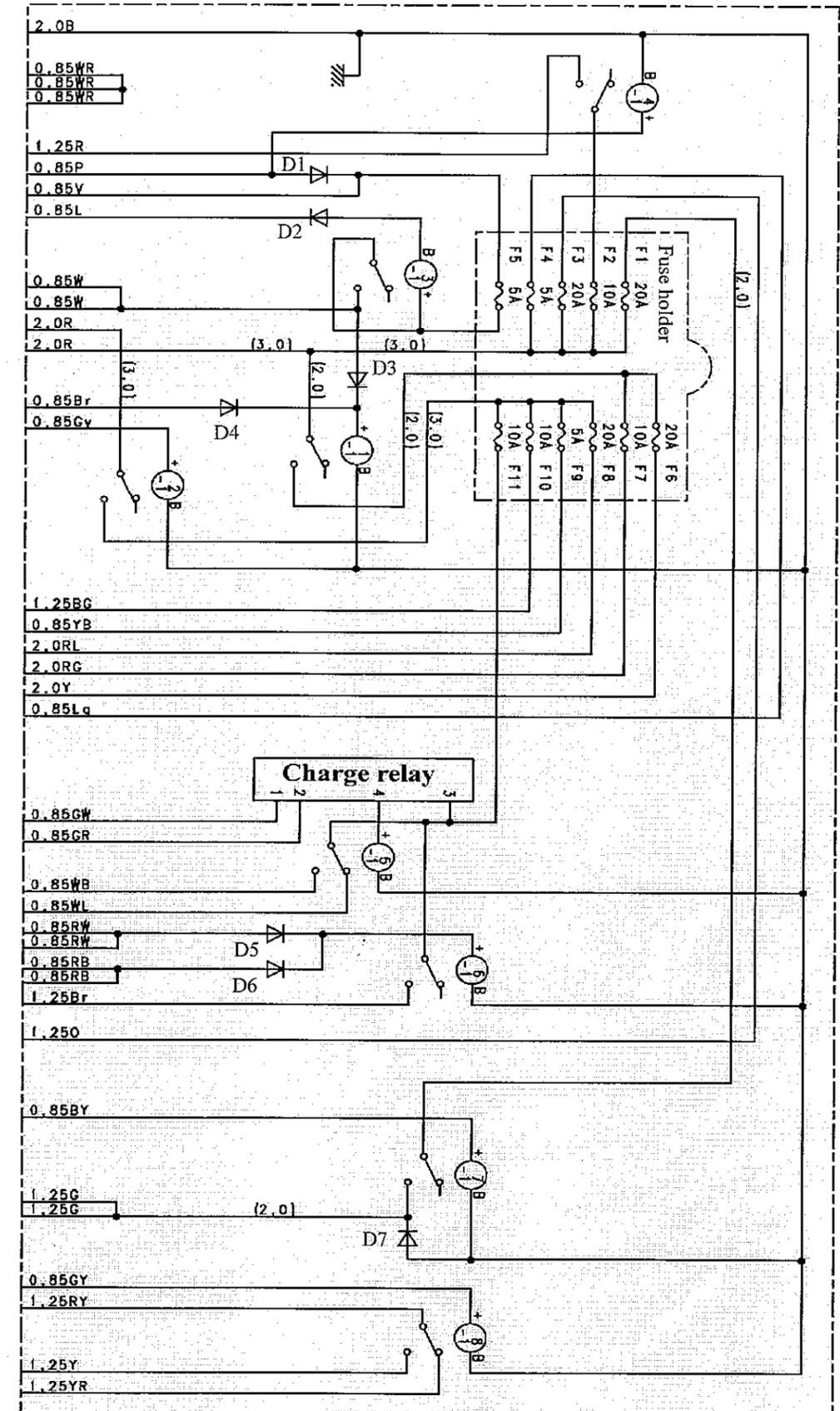
Connector No.202

		RL (2.0)	Y (2.0)
BG (1.25)	R (1.25)		YB

Connector No.203

R (2.0)	R (2.0)	RW	B (2.0)
V	W	RB	G (1.25)

Connector No.204



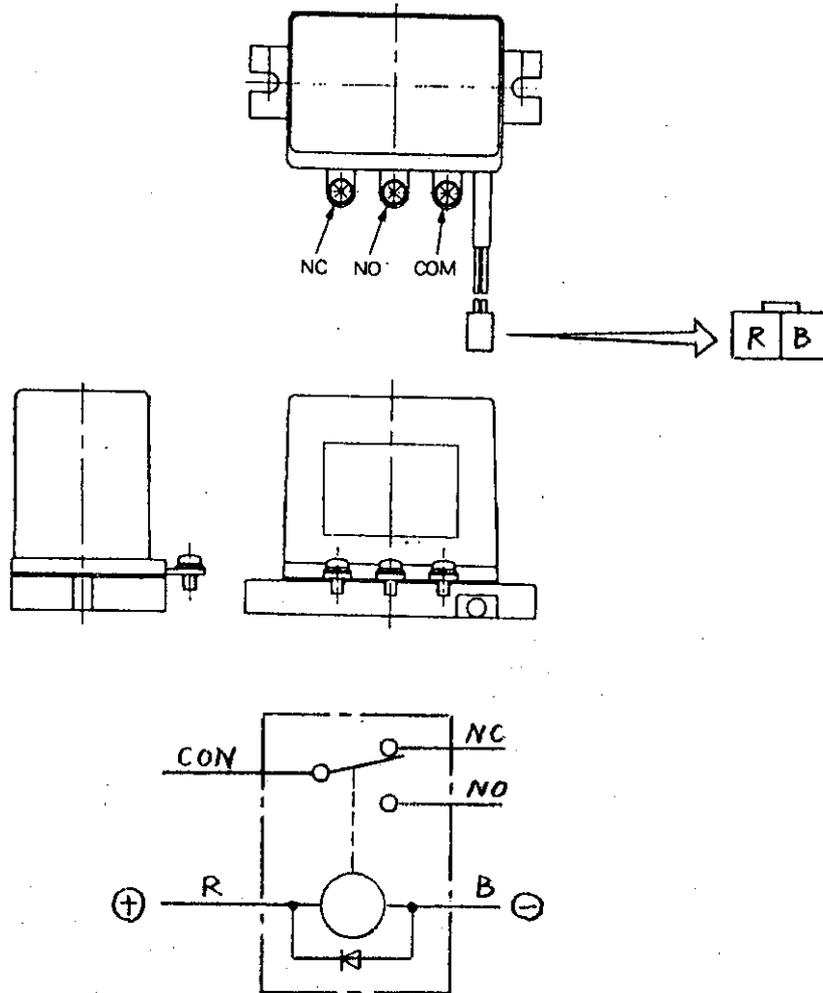
CR1	Main power 1	320-05778
CR2	Main power 2	320-05778
CR3	PTO	320-05792
CR4	Accelerator	320-05792
CR5	Stand-by 1	320-05792
CR6	Stand-by 2	320-05792
CR7	Engine start	320-05792
CR8	Engine stop	320-05792

F1 (20A)	Engine start	F6 (20A)	Power, Turntable, Platform
F2 (10A)	Accelerator motor	F7 (10A)	Power, Sub frame
F3 (20A)	Option	F8 (20A)	Option
F4 (5A)	Back-up memory	F9 (5A)	Hour meter
F5 (5A)	Main power switch	F10 (10A)	CPU output
Fuse removing tool		F11 (10A)	Stand-by

1. Relay (CR-1 and CR-2)

The relays CR-1 and CR-2 supplies the main power to the machine.

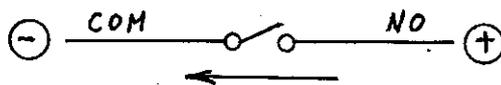
Rated voltage ----- DC24 V.
 Coil resistance ----- 130 ohms.



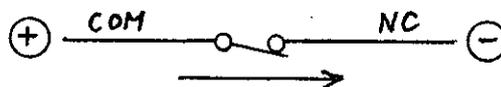
Caution:

Connect the wires to the contacts of this relay as shown in below.

- When using the "Normally open contact".



- When using the "Normally closed contact".



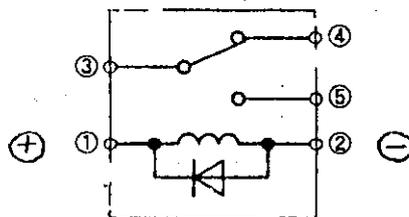
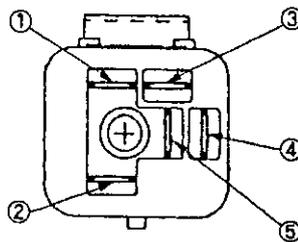
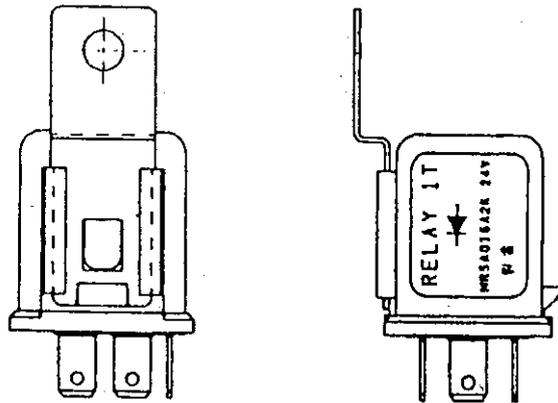
2. Relay (CR-3 ~ CR-8)

The relays CR-3 ~ CR-8 are used for actuating the following systems.

- CR-3 ----- PTO
- CR-4 ----- Accelerator
- CR-5 ----- Stand-by (1)
- CR-6 ----- Stand-by (2)
- CR-7 ----- Engine start
- CR-8 ----- Engine stop

Rated voltage-----DC-24V

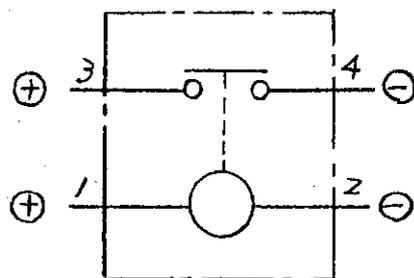
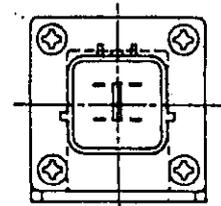
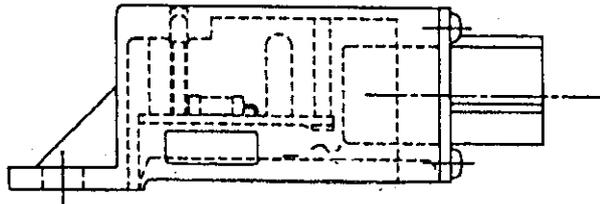
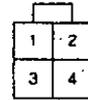
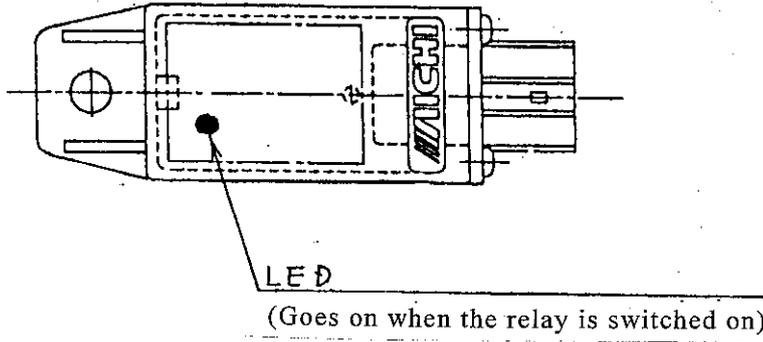
Coil resistance-----290 Ω



3. Charge relay

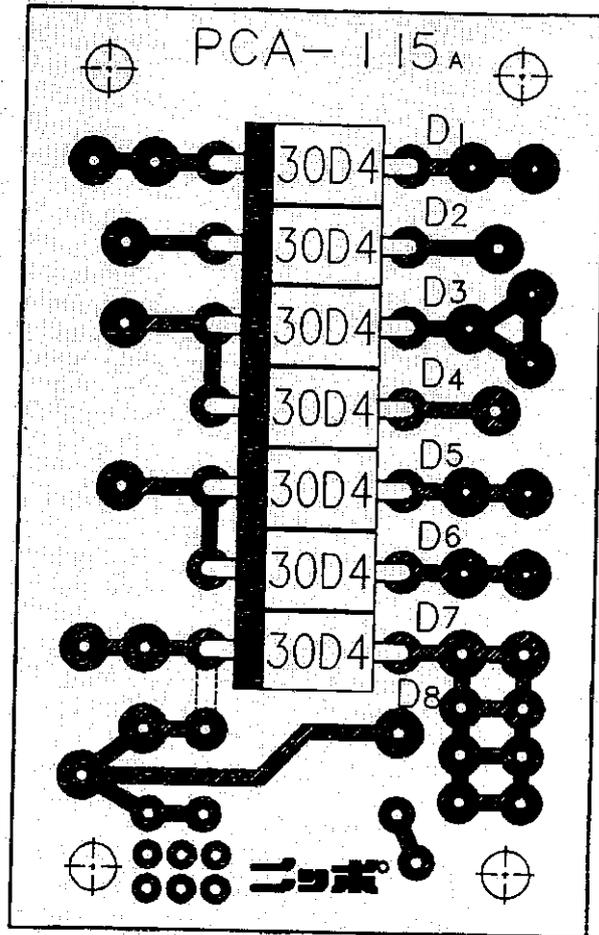
The charge relay is switched on when the alternator charges the batteries.

- Rated voltage -----DC24V
- Switching on voltage -----DC18V or higher
- Switching off voltage ----- DC10V or lower

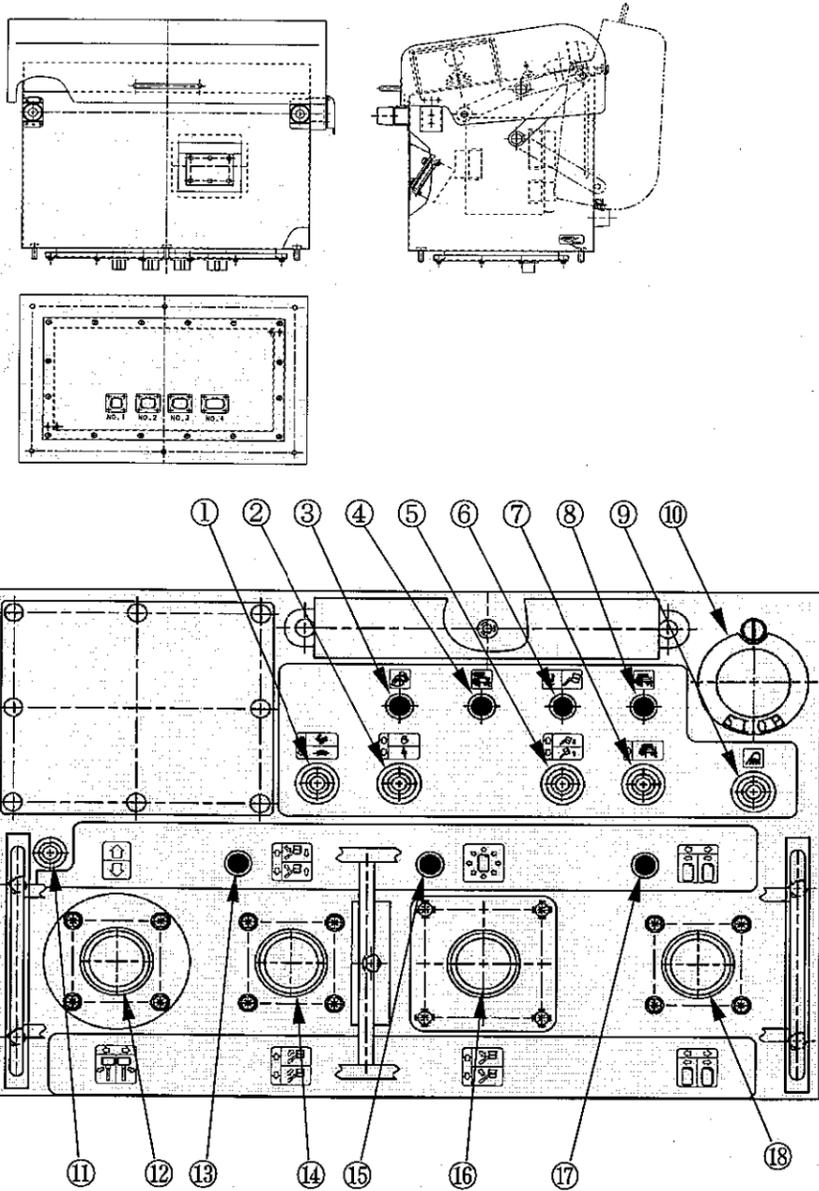


4. Diode board

All of the diodes (D1 ~ D8) located in the main power box are installed on this diode board.



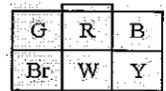
Upper control box



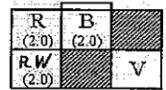
- 1 Accelerator switch
- 2 Engine start / Emergency pump switch
- 3 Load moment limiter LED
- 4 Interference LED
- 5 Platform level adjust switch
- 6 Platform tilt LED
- 7 Boom auto-storage switch
- 8 Boom auto-storage LED
- 9 Control panel light switch
- 10 Emergency stop switch
- 11 Horizontal / Vertical select switch
- 12 Joy-stick controller for Boom rotation
- 13 Horizontal / Vertical LED (Telescope)
- 14 Joy-stick controller for Boom telescope
- 15 Horizontal / Vertical LED (Elevation)
- 16 Joy-stick controller for Boom elevation
- 17 Horizontal / Vertical LED (Platform rotation)
- 18 Joy-stick controller for Platform rotation



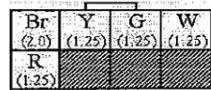
Connector No.1



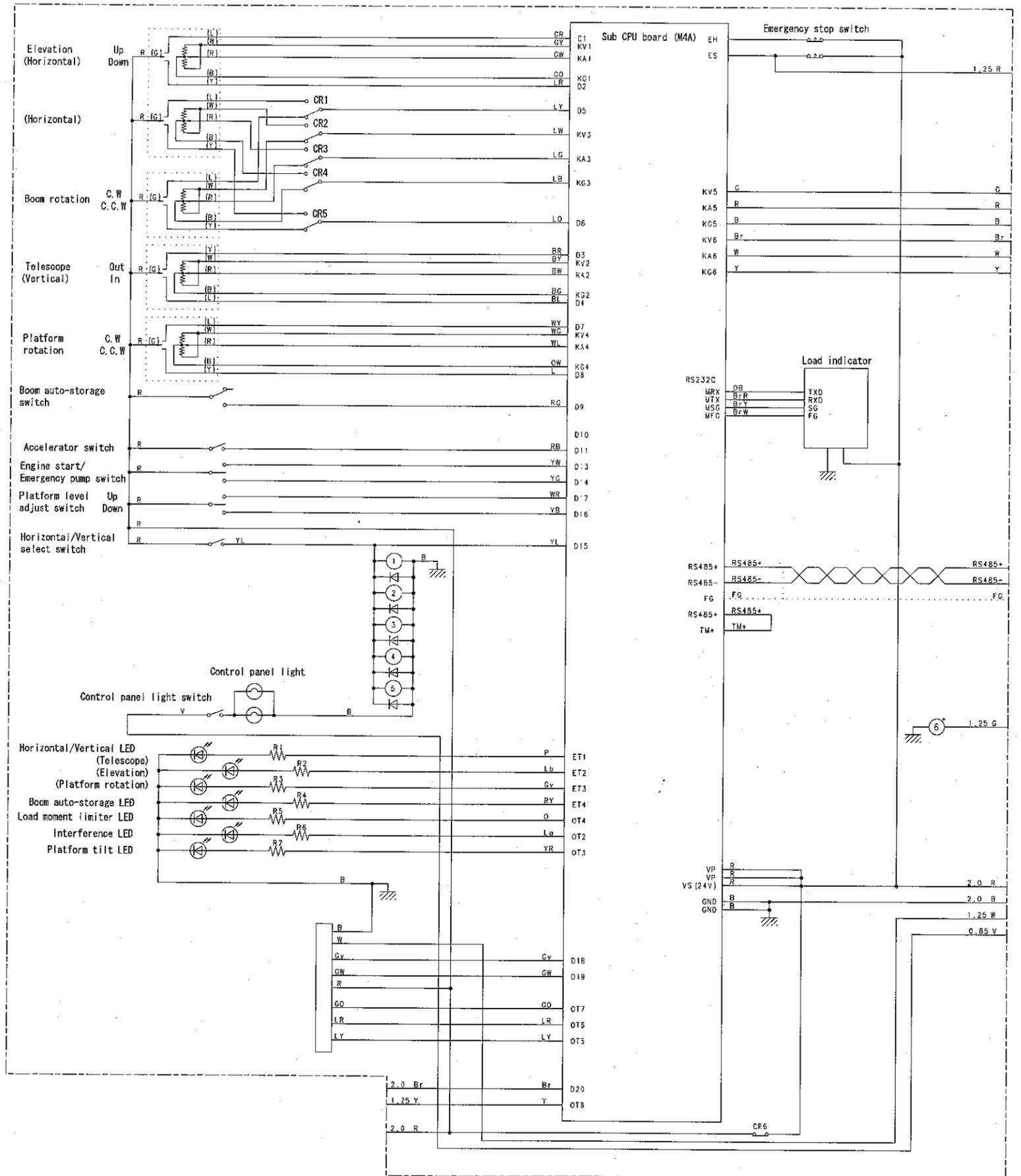
Connector No.2



Connector No.3



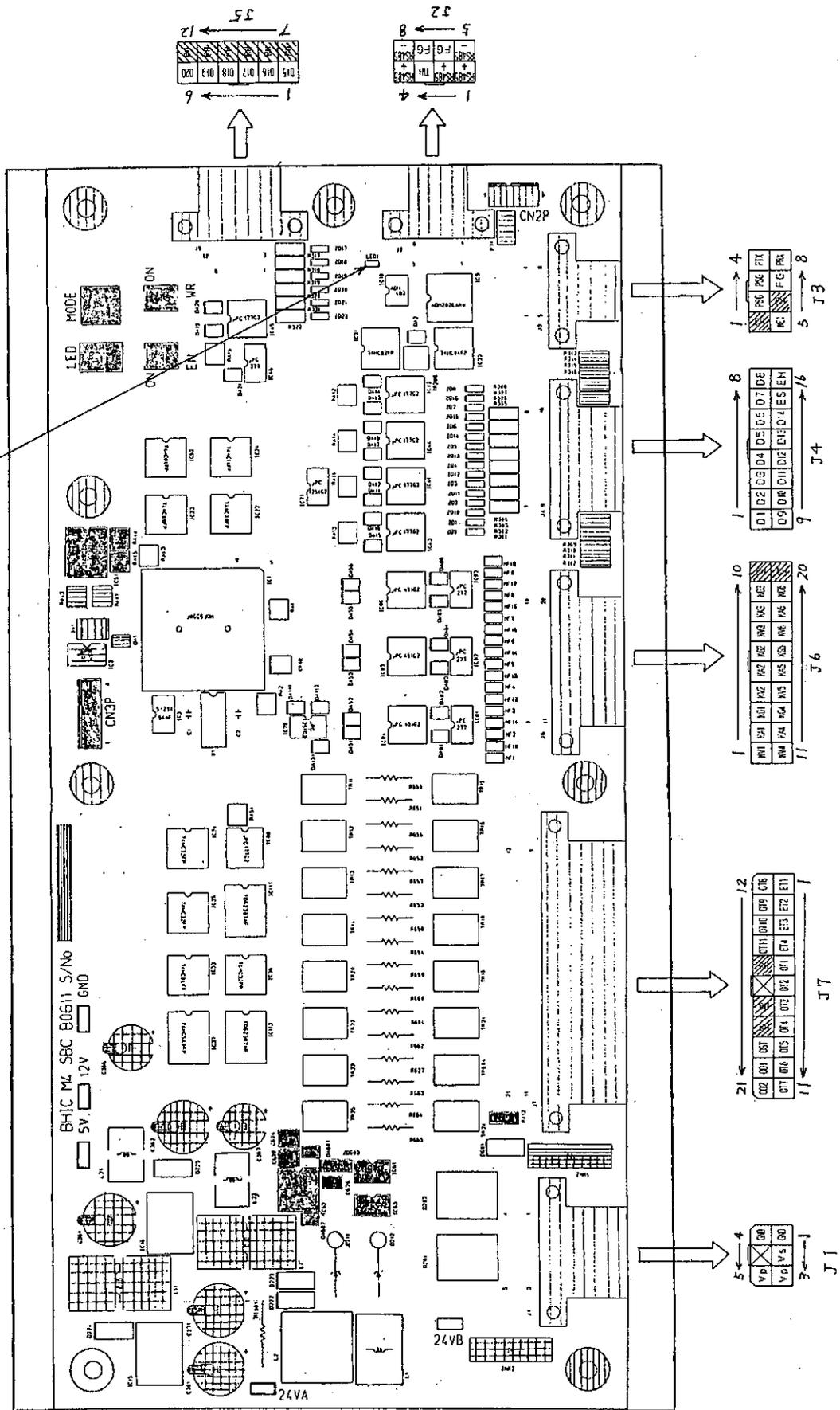
Connector No.4



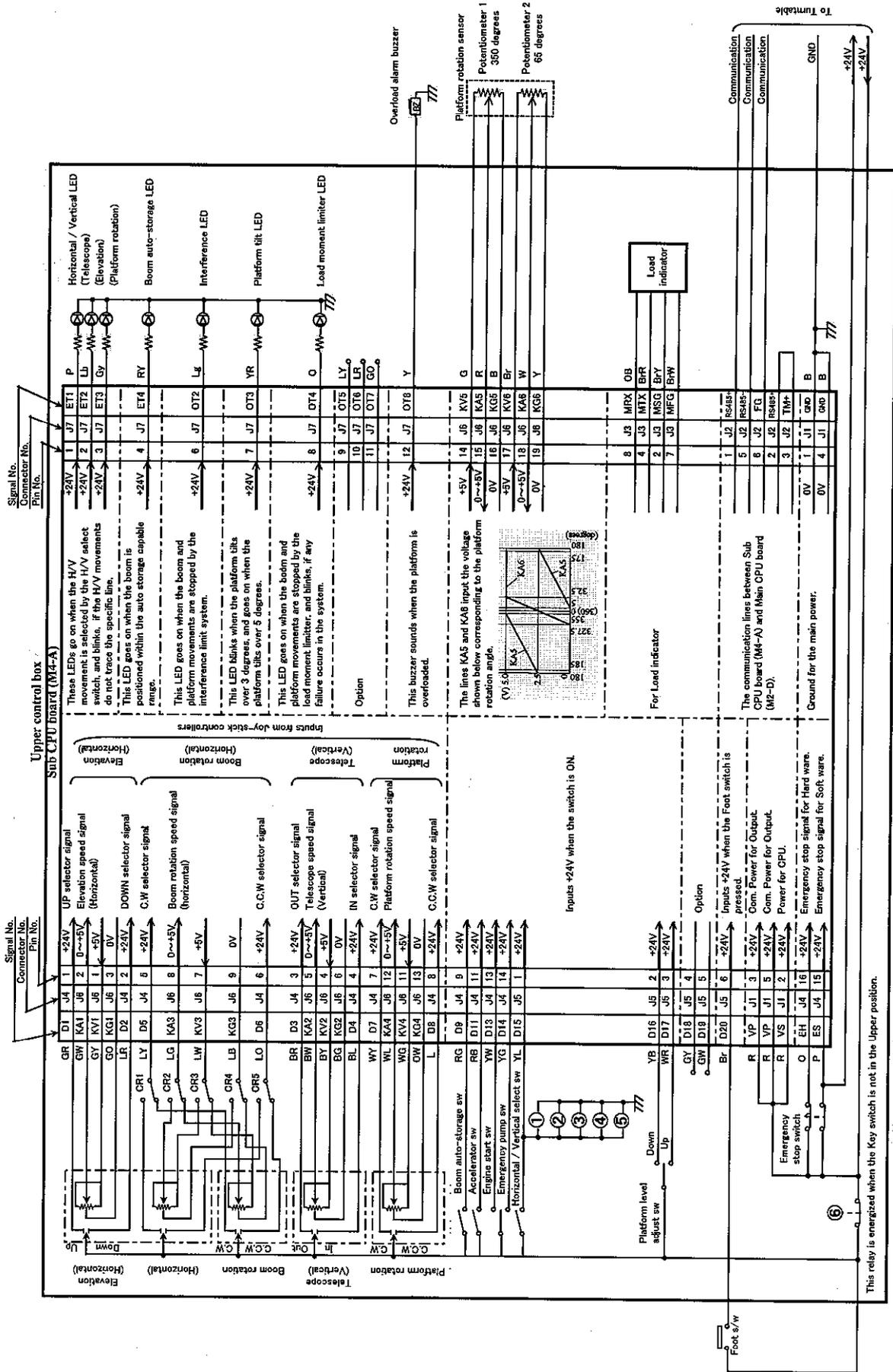
Sub-CPU board (M4-A)

This board is installed in the upper control box to control the machine together with the Main CPU box (M1-C, M2-D) located on the turntable and the Sub CPU box (M2-E) located on the sub frame. **LED1**

This LED blinks when the CPU is working properly and goes off, if the CPU fails.



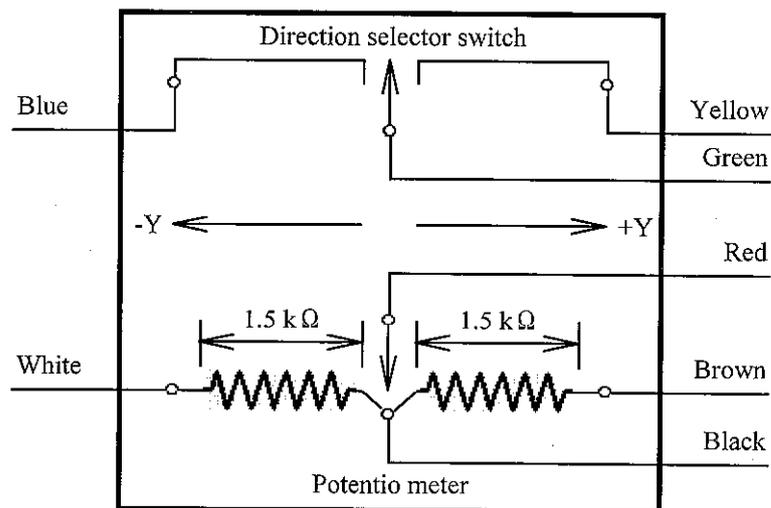
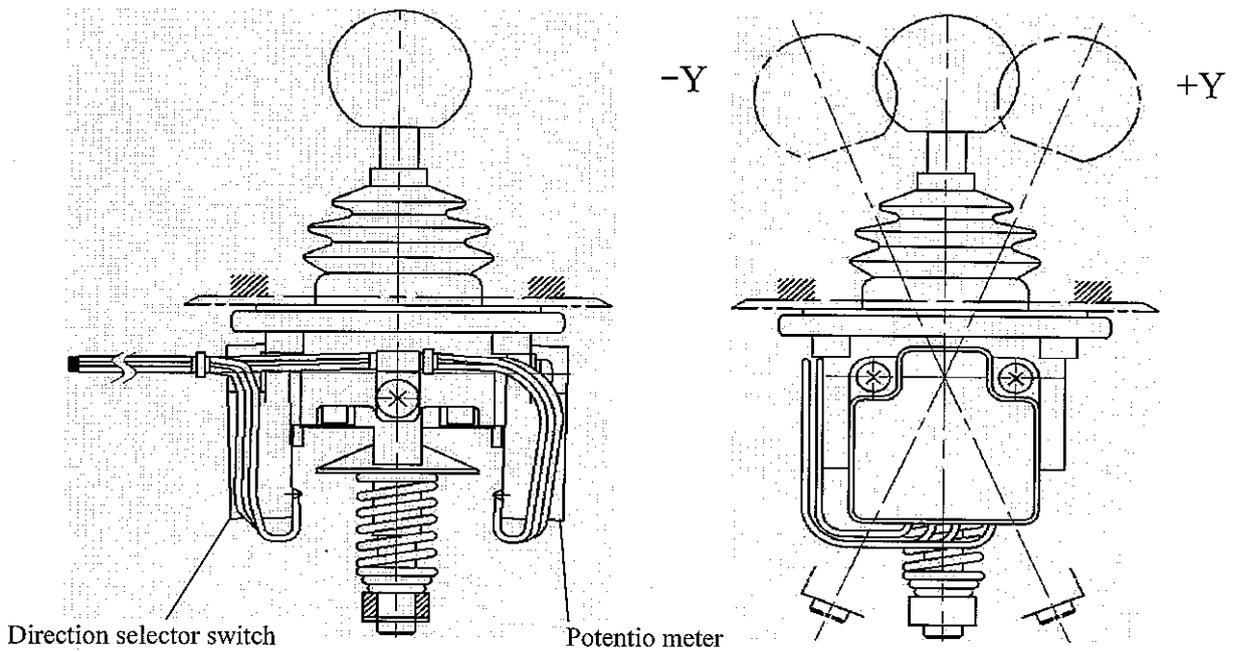
1. Input / Output characteristics



Joy stick controller (for Telescope, Boom rotation, Platform rotation and Vertical)

324-00000-12C

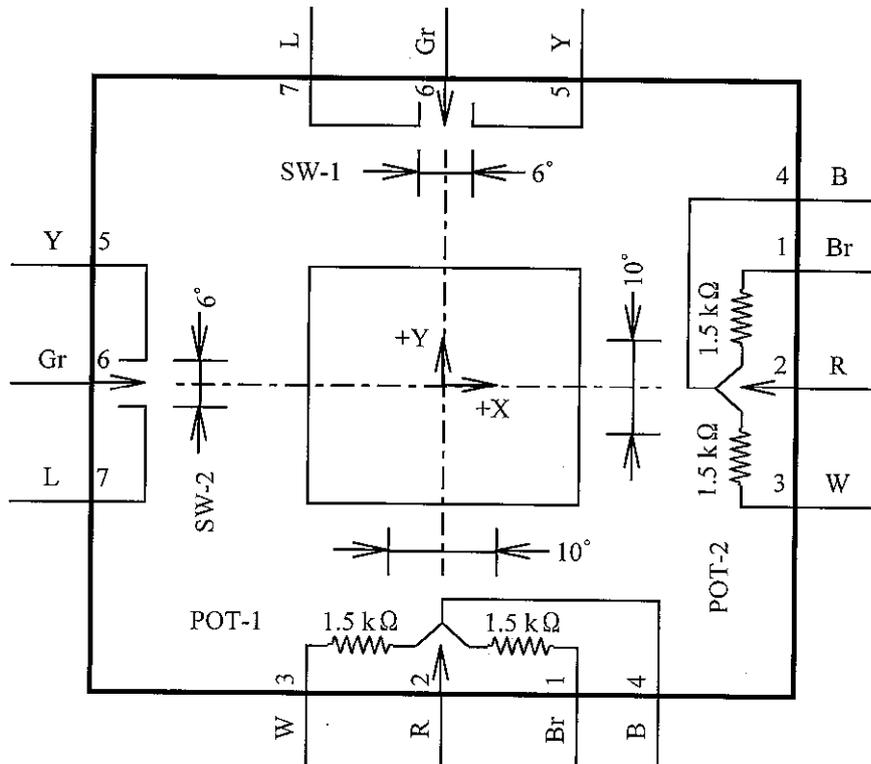
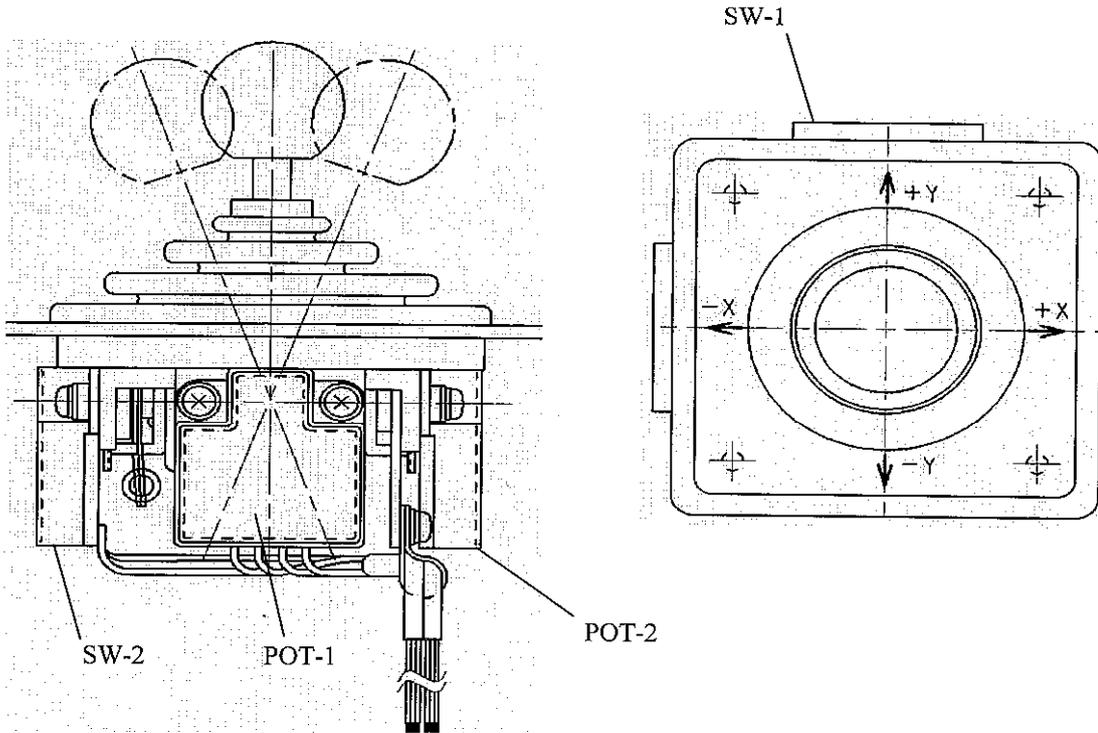
This joy stick controller is installed on the upper control box to control the Telescope, Boom rotation, Platform rotation and Vertical movement.



Joy stick controller (for Elevation and Horizontal)

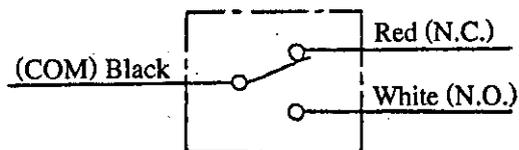
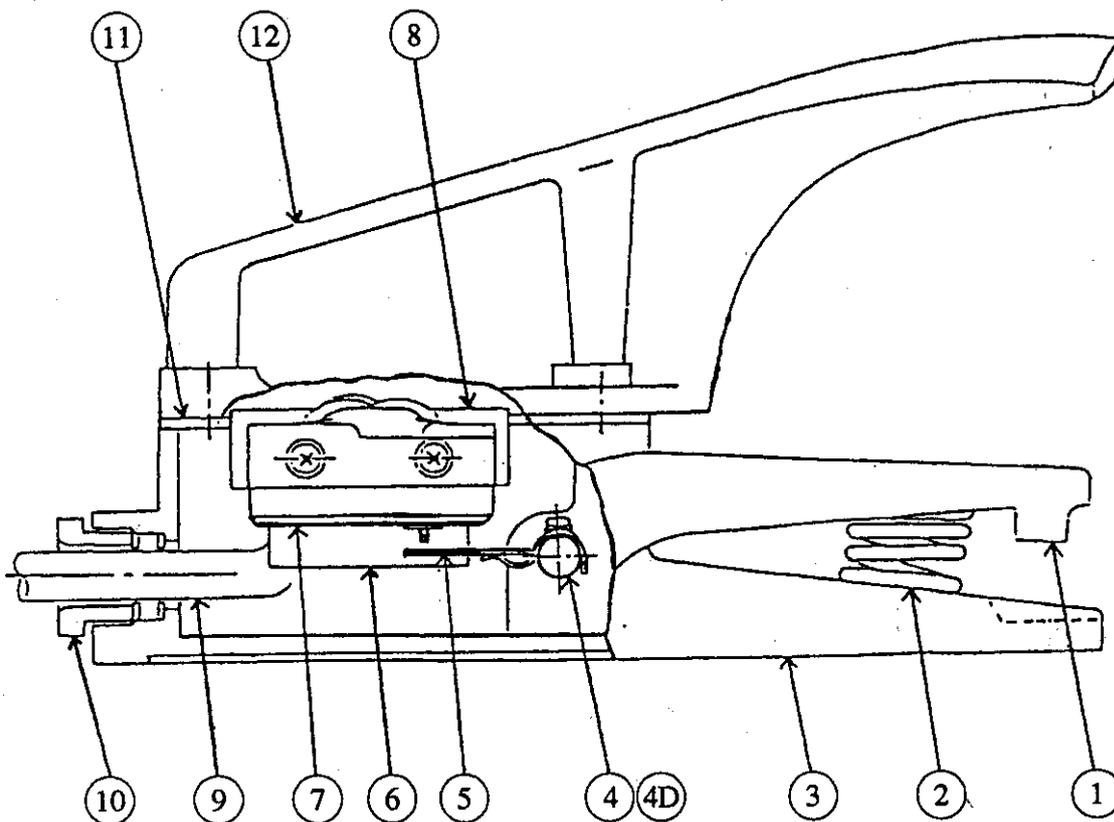
324-00027-00

This joy stick controller is installed on the upper control box to control the Elevation and Horizontal movement.



Foot switch

The foot switch is installed on the platform floor to disable the functions from the platform, unless the foot switch is pressed down.

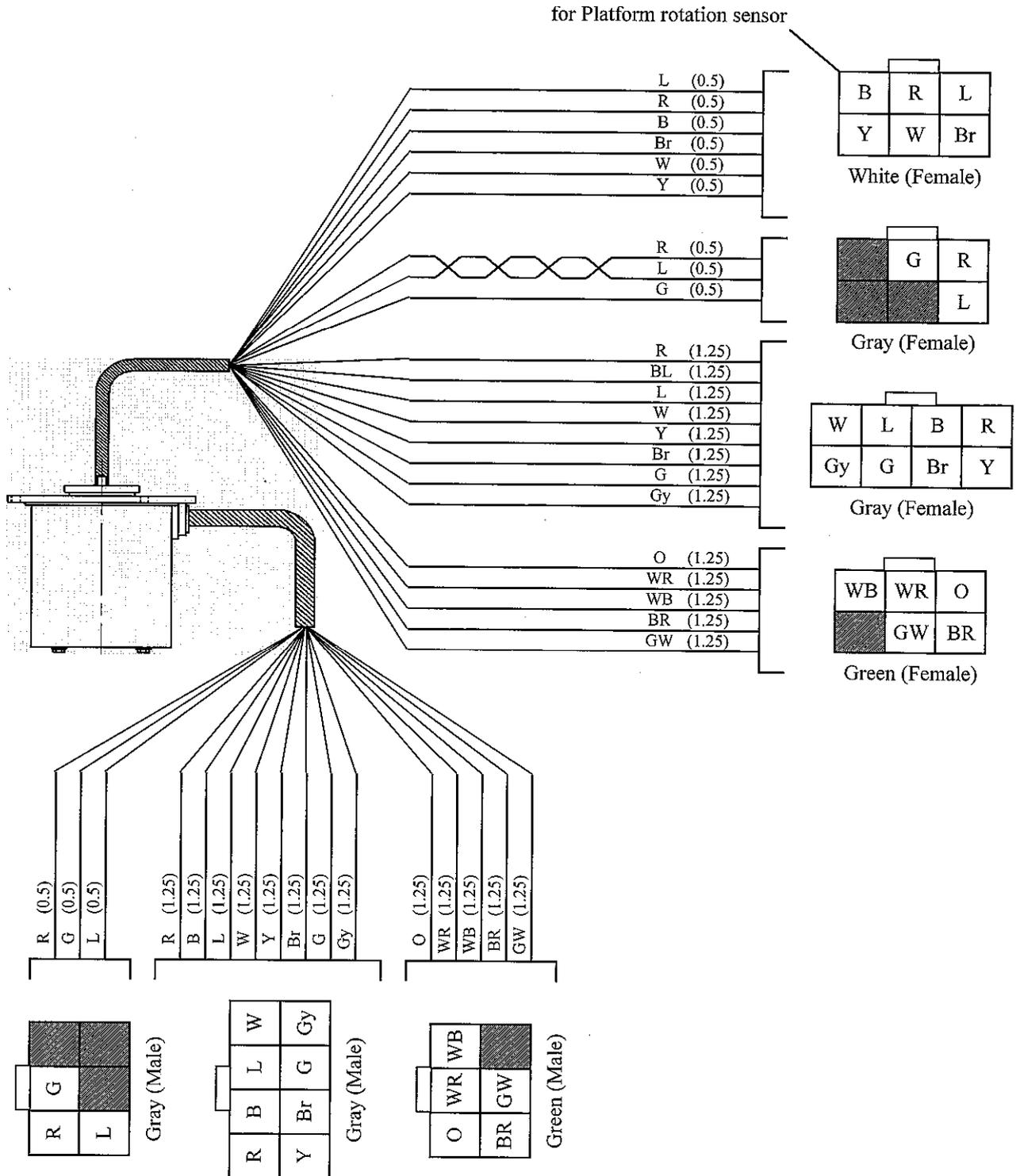


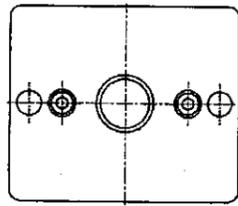
No.	Name	Q'ty
1	Pedal	1
2	Spring	1
3	Body	1
4	Shaft	1
4D	O ring	2
5	Lever	1
6	Switch holder	1
7	Micro S/W	1
8	Insulator	1
9	Cable	1
10	Connector	1
11	Rubber seal	1
12	Cover	1

Slip ring and Platform rotation sensor

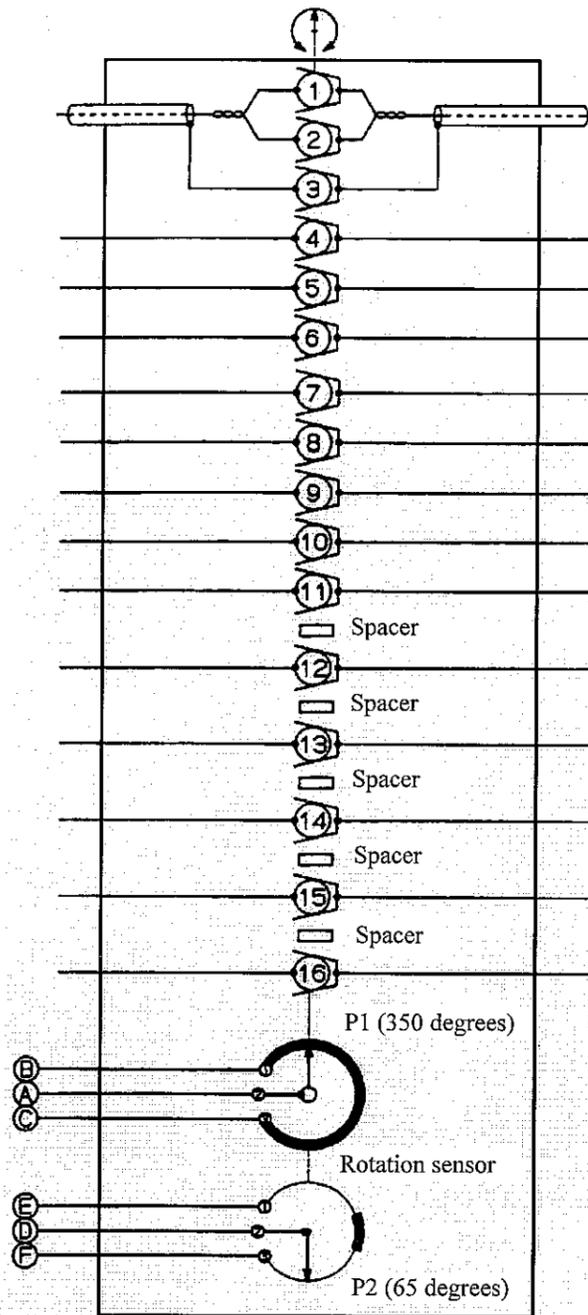
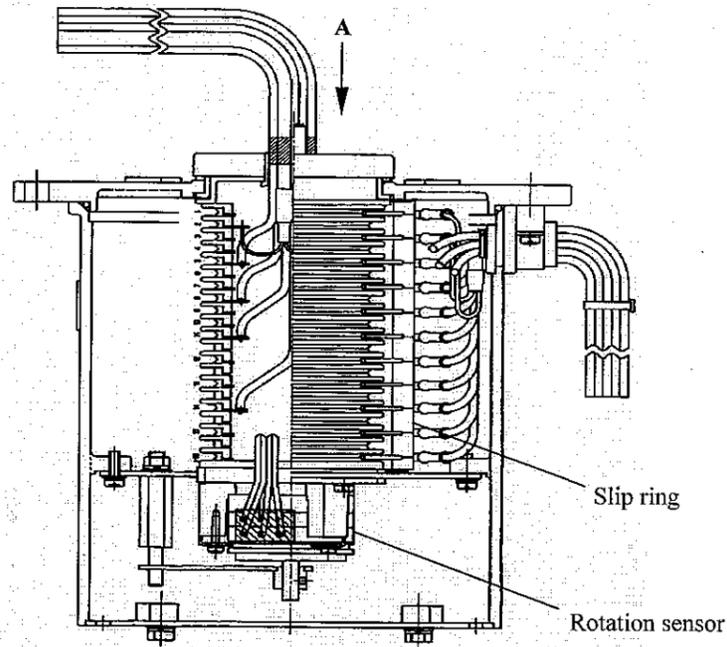
The slip ring is installed at the rotation center of the platform to make electric lines between the boom and the platform.

The platform rotation sensor incorporated in the slip ring detects the rotation angle of the platform.





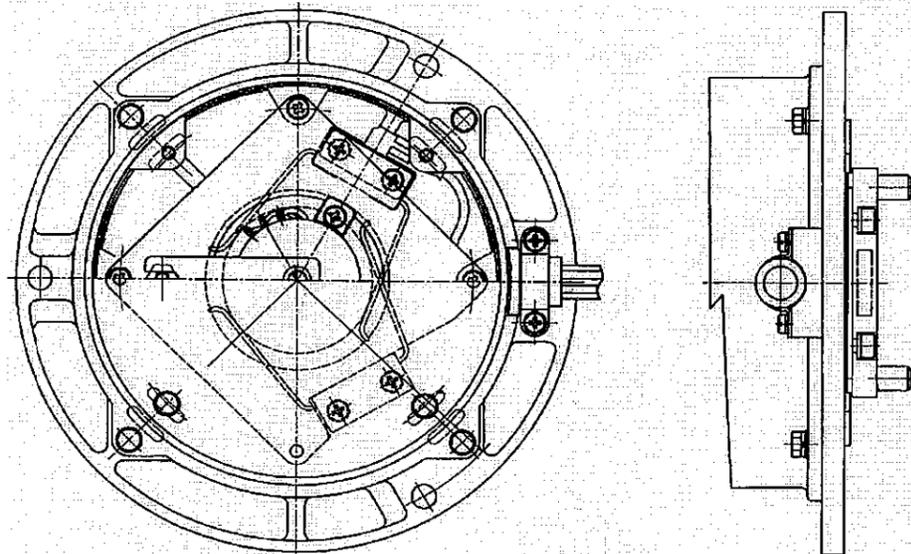
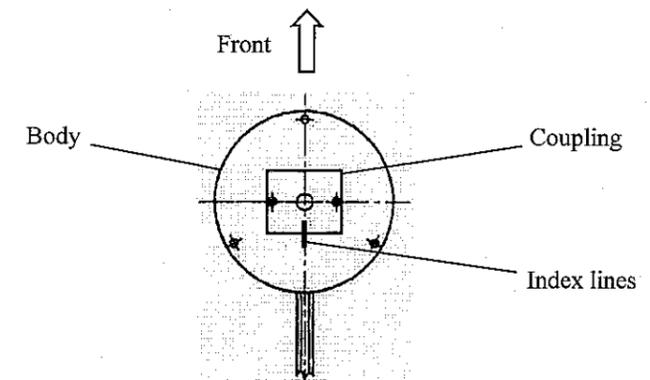
A view



No.	Color of lead wires	Size of lead wires	Remarks
1	Red	0.5 mm ² (Twisted pair)	Multiplex transmission lines between Main CPU box (M2-D) and Sub CPU board (M4-A).
2	Blue		
3	Green	0.5 mm ²	DC power lines
4	Red	1.25 mm ²	
5	Black		
6	Blue		
7	White		
8	Yellow		
9	Brown		
10	Green		
11	Gray	1.25 mm ²	
12	Orange		
13	White / Red		
14	White / Black		
15	Black / Red	0.5 mm ²	Rotation sensor lead wires
16	Black / White		
A	Red	0.5 mm ²	
B	Black		
C	Blue		
D	White		
E	Yellow		
F	Brown		

Installation of Slip ring complete

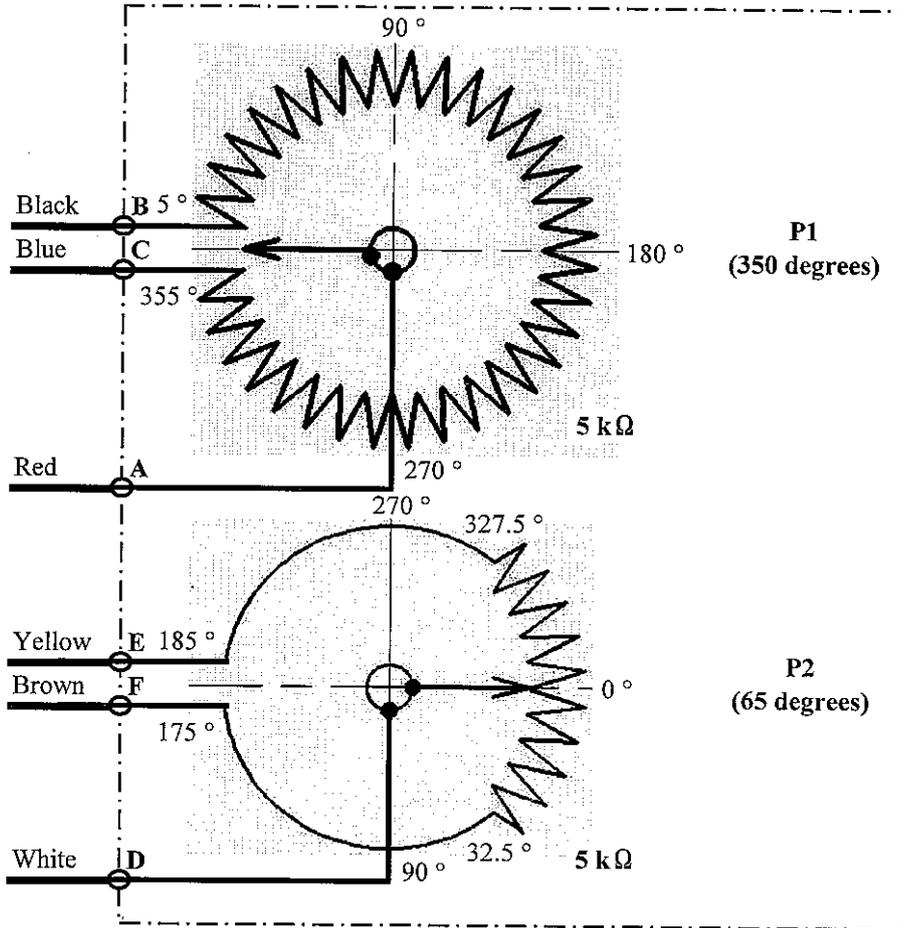
Before installing the slip ring complete to the swivel joint, rotate the platform to the central position exactly, then align the "Index lines" on the coupling and the body as shown in the figure below.



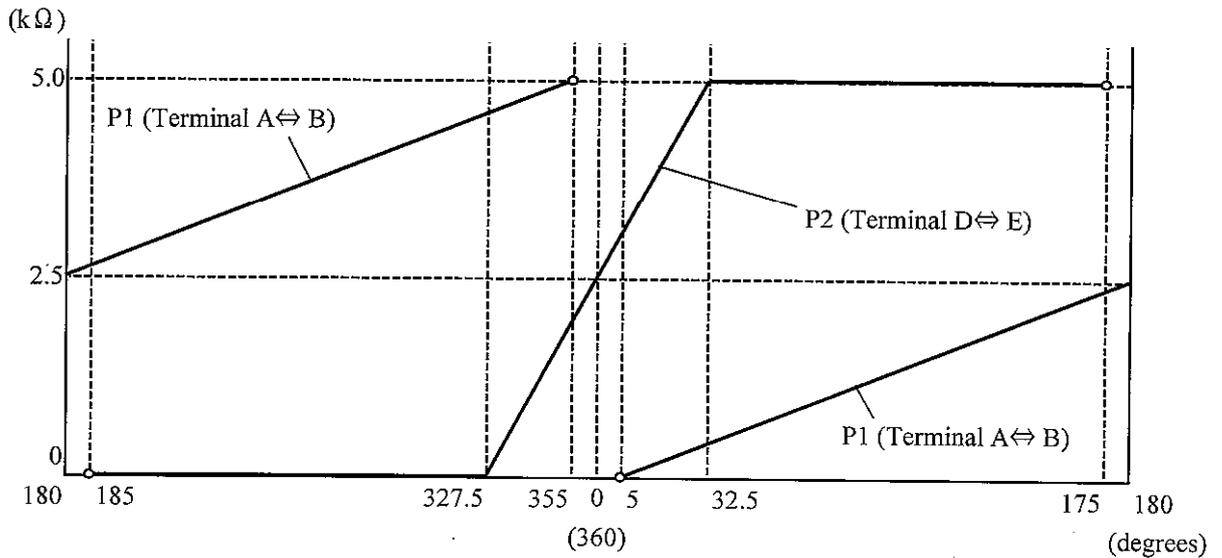
Platform rotation sensor

The platform rotation sensor is installed under the slip ring to detect the platform rotation angle.

1. Characteristics



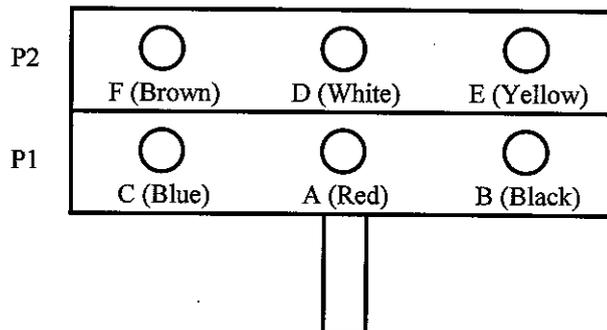
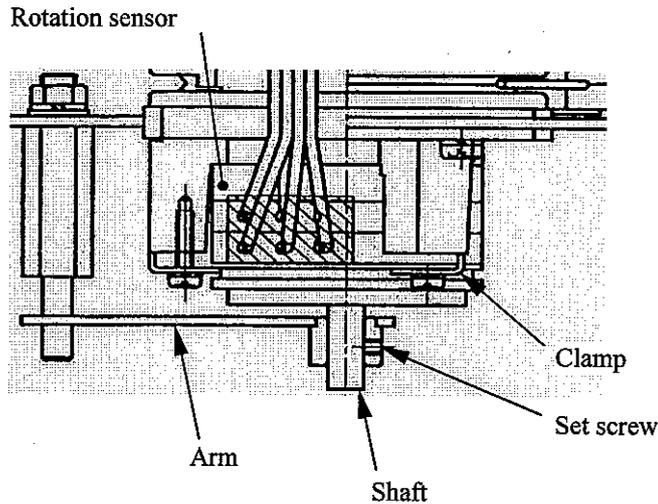
Rotation angle and resistance



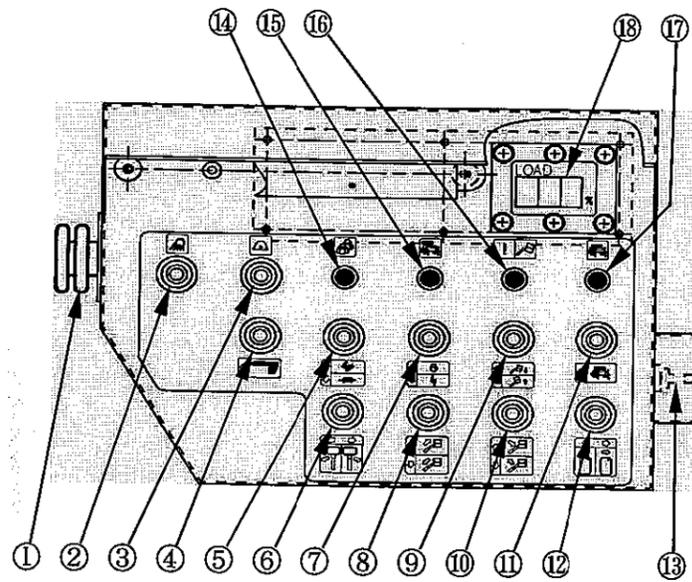
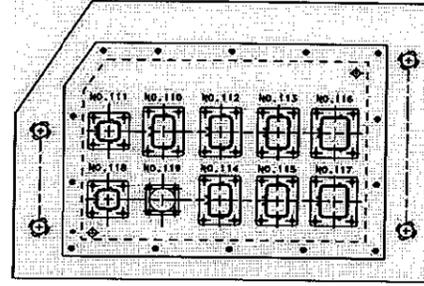
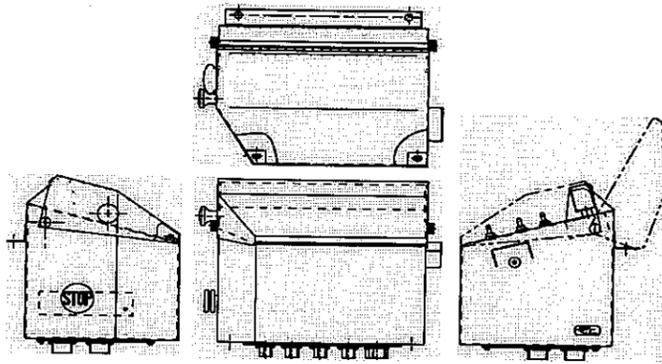
2. Replacement procedures

Replace the platform rotation sensor as follows.

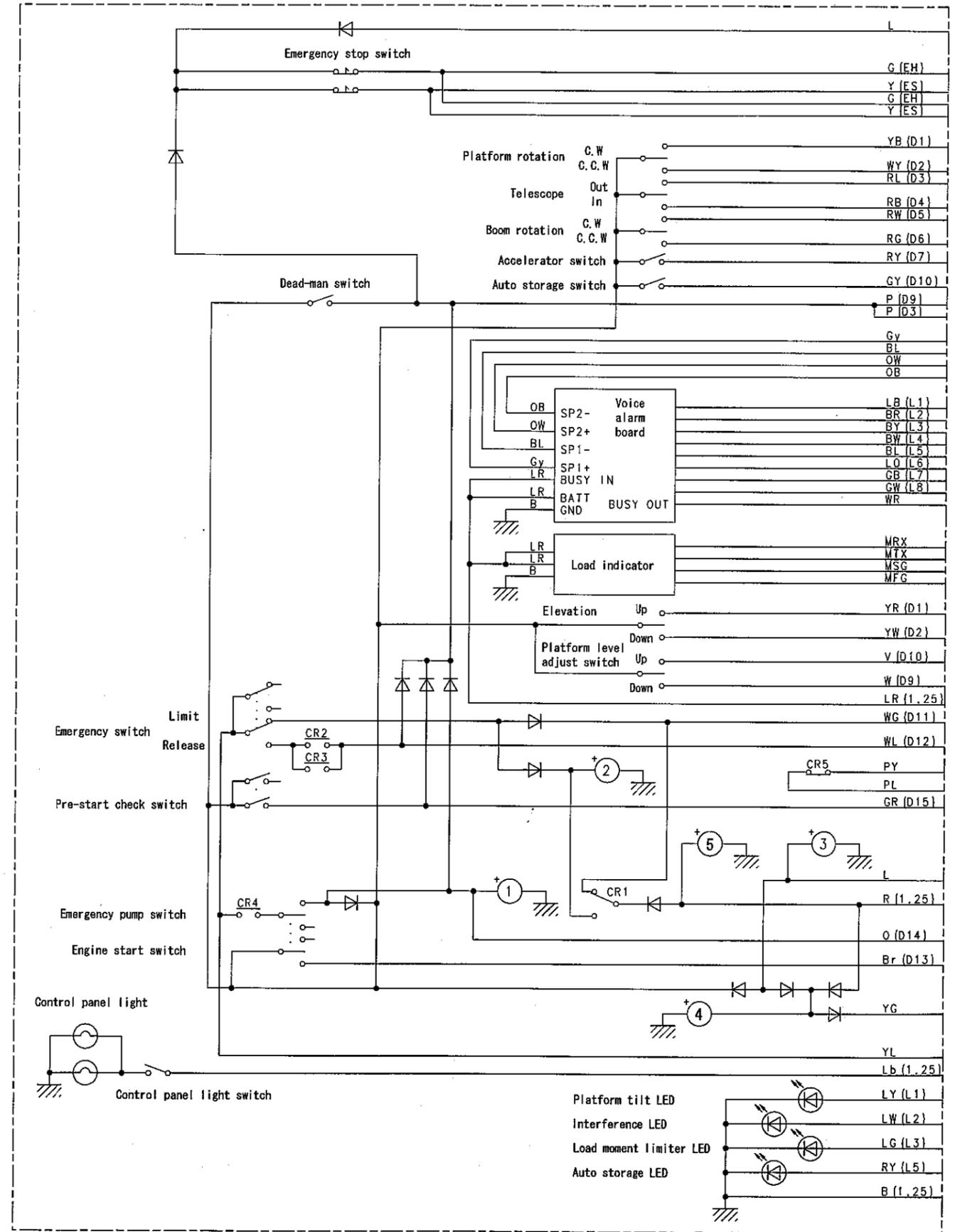
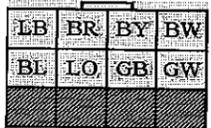
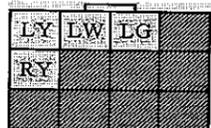
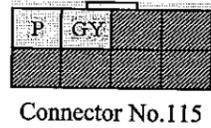
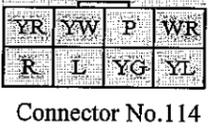
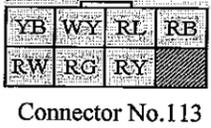
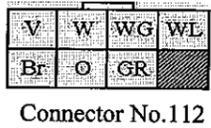
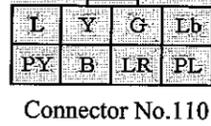
1. Set up the machine on firm level ground and extend all of the outriggers and the jack fully.
2. Rotate both the boom and the platform to the front center of the vehicle exactly.
3. Disengage the PTO and turn off the engine key switch.
4. Remove the slip ring complete from the platform.
5. Remove the cover from the slip ring, then remove the arm and the clamps from the platform rotation sensor.
6. Remove the platform rotation sensor by cutting the six wires connected to the sensor.
7. Connect the six wires to the new rotation sensor by soldering.
See the previous page when connecting each wire.
8. Install the rotation sensor under the slip ring.
9. Rotate the coupling and align the index lines marked on the coupling and the body.
See the previous page to align the index lines.
10. Set a ohmmeter between D (White) and E (Yellow) wires, turn the shaft of the rotation sensor slowly and adjust the resistance at $2.5\text{ k}\Omega$.
11. Install the arm onto the shaft of the rotation sensor, then reinstall the cover.
Caution : Do not turn the shaft of the rotation sensor when installing the arm.
12. Reinstall the reassembled slip ring complete onto the platform, then conduct the AD turning of the platform rotation sensor by connecting the lap top computer.



Lower control box



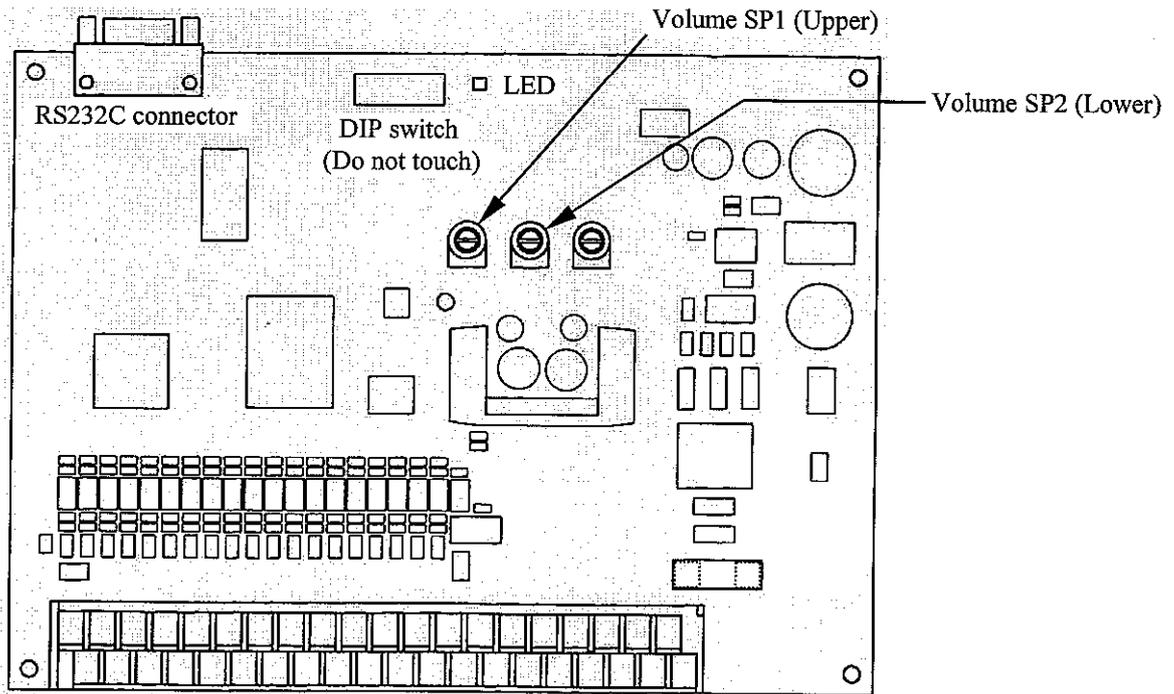
1	Emergency stop switch
2	Control panel light switch
3	Pre-start check switch
4	Dead-man switch
5	Accelerator switch
6	Boom rotation switch
7	Engine start / Emergency pump switch
8	Boom telescope switch
9	Platform level adjust switch
10	Boom elevation switch
11	Boom auto-storage switch
12	Platform rotation switch
13	Emergency switch
14	Load moment limiter LED
15	Interference LED
16	Platform tilt LED
17	Boom auto-storage LED
18	Load indicator



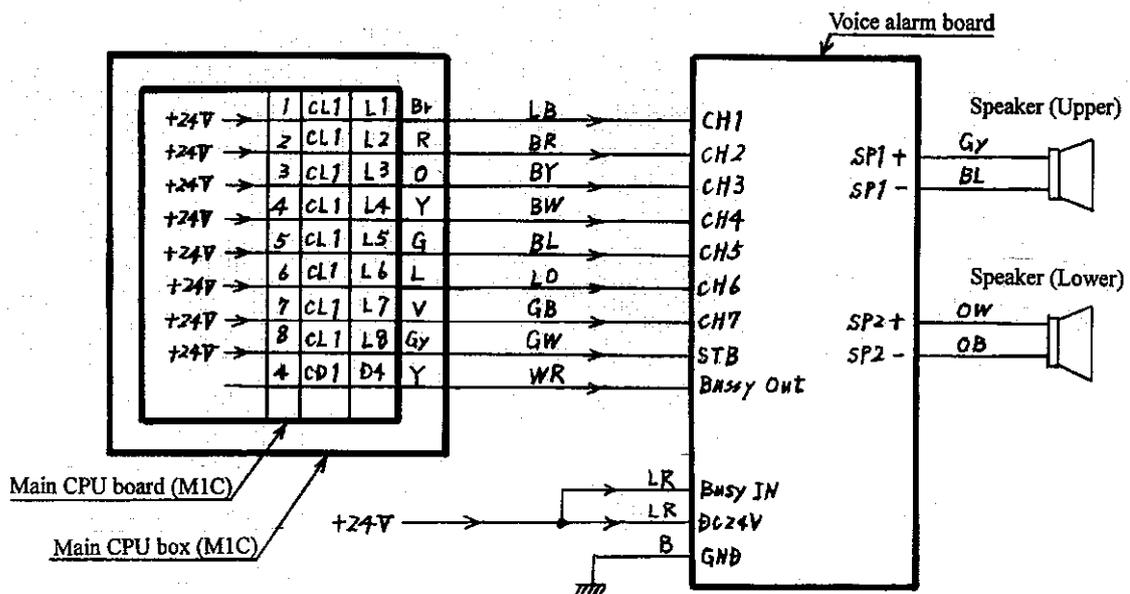
Voice alarm board

English 329-00119-01
 German 329-00119-02

This board is installed in the lower control box to sound the voice messages corresponding to the machine status as listed on the next page.



20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
	OUT											GND			SP1 (-)	SP1 (+)		DC 0V	DC 24V
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	CH1	CH2	CH3	CH4	CH5	CH6	CH7		STB		GND	BUSY IN	BUSY OUT	SP2 (-)	SP2 (+)				



Terminals (CH1 ~ CH7) input +24V corresponding to the machine status to select the voice message.
 (See the next page for the input status of each terminal.)
 Terminal "STB" inputs +24V to start the voice message.
 (Any voice messages do not start, unless the terminal "STB" inputs +24V.)

Voice alarm message list

No.	Voice message	Machine status	Opera- tions	Input terminal						
				CH7	CH6	CH5	CH4	CH3	CH2	CH1
1	The safety system has failed. Stop using the machine immediately. Stow the machine carefully by following the operation manual.	When any failure is in the CPU control and safety systems.	☆	0	0	0	0	0	0	1
2	The jack boom interlock system has been canceled by the interlock release switch.	When the interlock release switch is operated.	×	0	0	0	0	0	1	0
3	Hold the dead-man switch to on position and operate the control switch.	When the control switches are operated without the dead-man switch held in its ON position.	×	0	0	0	0	0	1	1
4	The interference protection system has stopped the movement.	When the interference protection system has disabled the functions to prevent the boom and the platform from interfering with the chassis cabin and the outriggers.	×	0	0	0	0	1	0	0
5	Rotate the platform till the interference lamp turns off, then lower the boom further.	When the interference protection system has disabled the boom lowering function to prevent the boom from interfering with the platform.	×	0	0	0	0	1	0	1
6	Raise the boom till the interference lamp turns off, then rotate the platform further.	When the interference protection system has disabled the platform rotating functions to prevent the platform from interfering with the boom.	×	0	0	0	0	1	1	0
7	The interference protection system has been cancelled by the interference release switch.	When the emergency switch is operated at the lower control to cancel the functions of interference protection system.	×	0	0	0	0	1	1	1
8	The boom will be lowered to stow the boom.	When the boom automatic storage system starts lowering the boom.	×	0	0	0	1	0	0	0
10	The outreach of the platform has reached the specific limit.	When the load moment limiter has disabled boom lowering, extending or rotating functions to limit the work range of the platform.	☆	0	0	0	1	0	1	0
11	The hydraulic oil temperature is too high. The engine rpm stays low.	When the hydraulic oil thermo sensor (Option) is switched on.	×	0	0	0	1	0	1	1
12	The jacks are not set up properly.	When trying to raise the boom from the boom rest when the jacks do not make firm contact with the ground.	×	0	0	0	1	1	0	0
13	The horizontal vertical movement has been stopped. The hydraulic cylinder has come to the stroke end.	When the hydraulic cylinder has come to the stroke end while conducting the horizontal or vertical movements.	×	0	0	0	1	1	0	1
14	The boom will be stowed onto the boom rest automatically.	When the auto-storage switch is operated to automatically stow the boom onto the boom rest.	×	0	0	0	1	1	1	0
15	Rotate the boom, then operate the boom automatic storage switch.	When the auto-storage switch is operated while the boom is rotated to hysteresis range of the boom rotation sensor.	×	0	0	0	1	1	1	1
16	Raise the boom, then operate the boom automatic storage switch.	When the auto-storage switch is operated to stow the boom with the boom being lowered under the horizontal.	×	0	0	1	0	0	0	0
17	Rotate the platform, then operate the boom automatic storage switch.	When the auto-storage switch is operated while the platform is rotated to hysteresis range of the platform rotation sensor.	×	0	0	1	0	0	0	1
18	The engine has been stoped, because the boom or the platform is out of the specified position for pre-start check.	When the pre-start check switch is operated with the boom and the platform being positioned out of the specified pre-start check range.	×	0	0	1	0	0	1	0
19	Failure has been detected. Inspect the machine.	When the CPU control system has detected any error during the pre-start checks.	×	0	0	1	0	0	1	1
20	The platform movement tracing system has been cancelled.	When the CPU control system has detected any faults during the platform movement tracing function is in operation. (For the machine equipped with optional platform movement tracing system.)	×	0	0	1	0	1	0	0
21	The horizontal or vertical movement has deviated from the specific range.	When the horizontal or vertical movement function has been stopped, because the movement excessively deviated from the specific allowable line.	×	0	0	1	0	1	0	1
22	The platform is overloaded. Reduce the load.	When the platform is overloaded.	●	0	0	1	0	1	1	0
23	The platform movement tracing system can not be started.	When starting platform movement tracing function with the platform overloaded.(For the machine equipped with optional platform movement tracing system.)	☆	0	0	1	0	1	1	1
25	The safety system is not working. Operate the machine carefully.	When the emergency switch located on the lower control is operated to cancel the functions of the safety system in the event of a CPU control system failure.	☆	0	0	1	1	0	0	1
26	The control levers or switches are not in the neutral position. Return them to the neutral position.	When the main power switch is turned on in the chassis cabin while the control levers or switches are not in their neutral positions.	●	0	0	1	1	0	1	0
27	The current platform position has been memorized.	When the platform position memorize switch is operated while the platform movement-tracing switch is on. (For the machine equipped with optional platform movement tracing system.)	×	0	0	1	1	0	1	1
29	The platform movement tracing system is in operation.	When the platform movement tracing function is in operation.(For the machine equipped with optional platform movement tracing system.)	☆	0	0	1	1	1	0	1
30	The platform movement tracing system will be in operation.	When starting the platform movement tracing functions.(For the machine equipped with optional platform movement tracing system.)	×	0	0	1	1	1	1	0
31	The platform has reached the memorized position.	When the platform reaches near the memorized position and the platform movement tracing system stops the movements. (For the machine equipped with optional platform movement tracing system.)	×	0	0	1	1	1	1	1

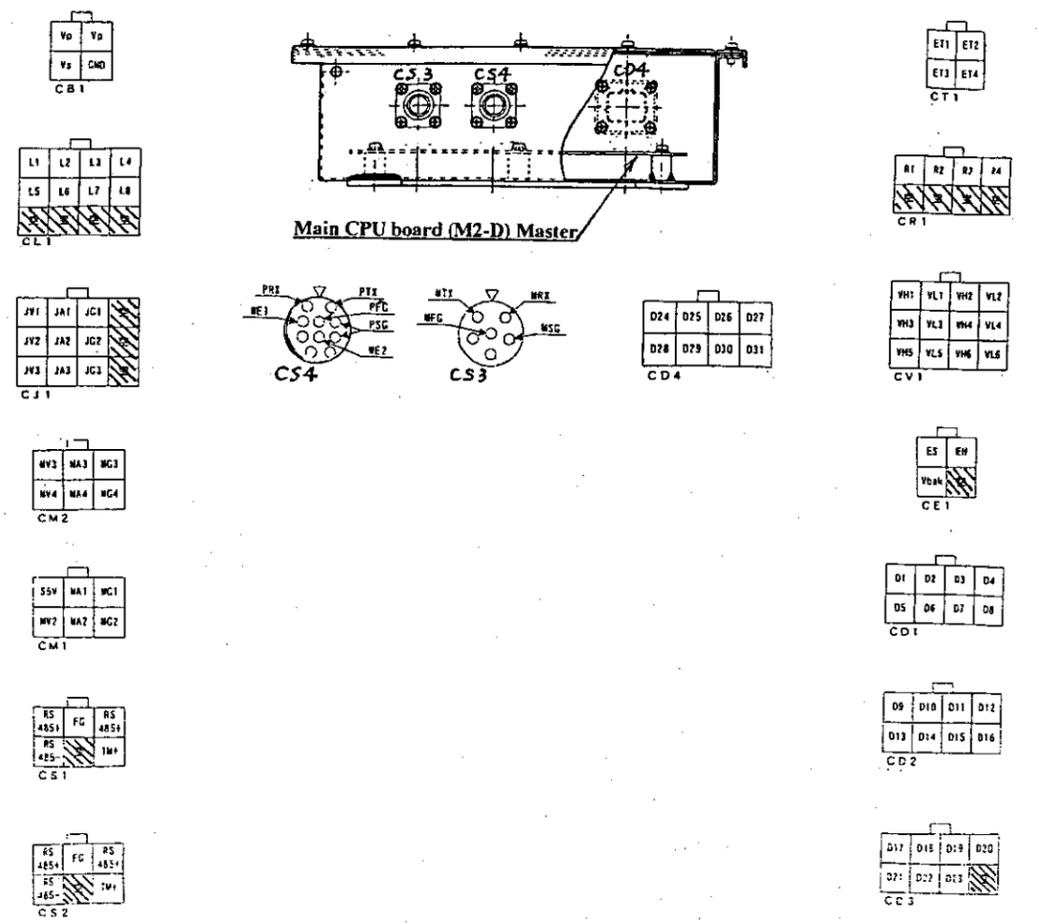
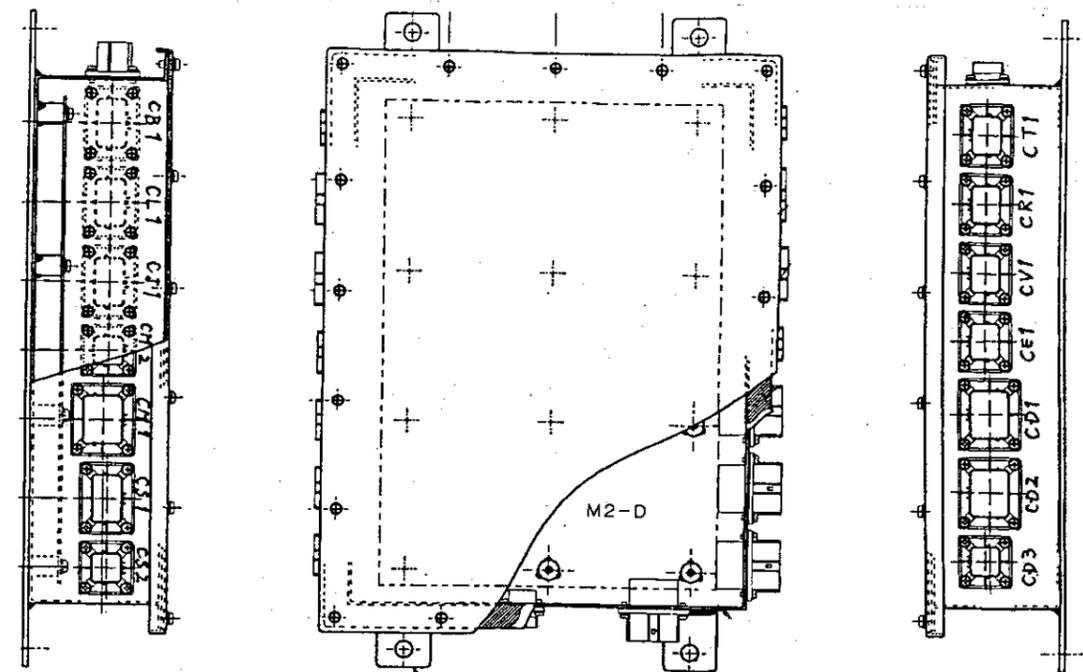
No.	Voice message	Machine status	Opera- tions	Input status						
				CH7	CH6	CH5	CH4	CH3	CH2	CH1
32	Make sure that no obstacle is under the boom and the platform.	When the boom angle has reached the specified value while lowering the boom.	☆	0	1	0	0	0	0	0
33	The boom is not stowed on the boom rest properly.	When the jacks or the outriggers are operated while the boom is not on the boom rest.	×	0	1	0	0	0	0	1
34	The platform is not in the storage position. Rotate the platform to the storage position.	When the jacks or the outriggers are operated while the platform is not in its storage position.	×	0	1	0	0	0	1	0
35	Press down the foot switch and operate the control lever or switch.	When the control lever or switch is operated with the foot switch not being depressed.	×	0	1	0	0	0	1	1
36	The boom will be retracted.	When the boom automatic storage system starts retracting the boom.	×	0	1	0	0	1	0	0
37	The boom will be rotated clockwise.	When the boom automatic storage system starts rotating the boom clockwise.	×	0	1	0	0	1	0	1
38	The boom will be rotated counter-clockwise.	When the boom automatic storage system starts rotating the boom counter-clockwise.	×	0	1	0	0	1	1	0
39	The boom has been stowed on the boom rest.	When the boom has been stowed on the boom rest by the functions of the boom automatic storage system.	×	0	1	0	0	1	1	1
40	The platform will be rotated clockwise.	When the boom automatic storage system starts rotating the platform clockwise.	×	0	1	0	1	0	0	0
41	The platform will be rotated counter-clockwise.	When the boom automatic storage system starts rotating the platform counter-clockwise.	×	0	1	0	1	0	0	1
42	This function is not available while the boom is on the boom rest.	When the boom rotation, extension or lowering operation is attempted while the boom is on the boom rest.	×	0	1	0	1	0	1	0
43	The boom is pressed against obstacles excessively. Raise the boom.	When the boom is excessively pressed against any obstacles.	☆	0	1	0	1	0	1	1
44	The platform is tilted. Adjust the platform level.	When the main power switch is turned on while the platform is out of level.	●	0	1	0	1	1	0	0
50	Conduct the pre-start check by following the instructions on the decal.	When the pre-start check switch is turned on while the machine is in the specified pre-start check starting status.	×	0	1	1	0	0	1	0
60	The boom rising and lowering speed has been slowed down, because the platform is out of level.	When the platform became out of level by 5 degrees while raising or lowering the boom.	☆	0	1	1	1	1	0	0
61	The boom rising and lowering movement has been stopped, because the platform is out of level.	When the platform became out of level by more than 5 degrees while raising or lowering the boom.	☆	0	1	1	1	1	0	1
62	The platform levelling system has failed. Stop using the machine.	When any failure occurred in the platform leveling system.	☆	0	1	1	1	1	1	0
63	The outreach of the platform has been limited.	When the load moment limiter has disabled the boom lowering and extending functions.	×	0	1	1	1	1	1	1
64	The platform is tilted. Stow the boom by using the boom automatic storage switch.	When the platform has approached quite near the chassis cabin with the platform tilted while attempting to stow the boom onto the boom rest without using the boom auto-storage switch.	☆	1	0	0	0	0	0	0
65	The platform will be made parallel to the chassis automatically.	When the platform has approached quite near the chassis cabin with the platform tilted while attempting to stow the boom onto the boom rest, using the boom auto-storage switch.	☆	1	0	0	0	0	0	1
66	The platform position has not been memorized.	When the platform movement tracing start switch is turned on before making the system to memorize the platform position.(For the machine equipped with optional platform movement tracing system.)	×	1	0	0	0	0	1	0
67	Raise the boom before rotating the platform.	When the interference protection system has disabled the platform rotating functions.	×	1	0	0	0	0	1	1
68	Rotate the platform.	Not in use	×	1	0	0	0	1	0	0
69	Allow more clearance between the boom and the chassis.	Not in use	×	1	0	0	0	1	0	1
70	The dead-man switch on the lower control is in on position. Turn off the switch to operate from the upper control.	When operating control levers or switches at upper control box during the dead-man switch, emergency switch or emergency pump switch is operated.	×	1	0	0	0	1	1	0
71	Allow more clearance between the boom and the chassis, then operate the boom automatic storage switch.	When the boom auto-storage switch is operated while the interference protection system is in operation.	×	1	0	0	0	1	1	1
72	Rotate the boom to the other direction.	When attempting to rotate the boom to the direction which has been disabled by the interference protection system.	×	1	0	0	1	0	0	0

☆ : This voice message sounds repetitiously while operating control levers or switches.
 ● : This voice message sounds repetitiously regardless of control lever or switch operations.
 × : This voice message sounds only when operating control levers or switches.

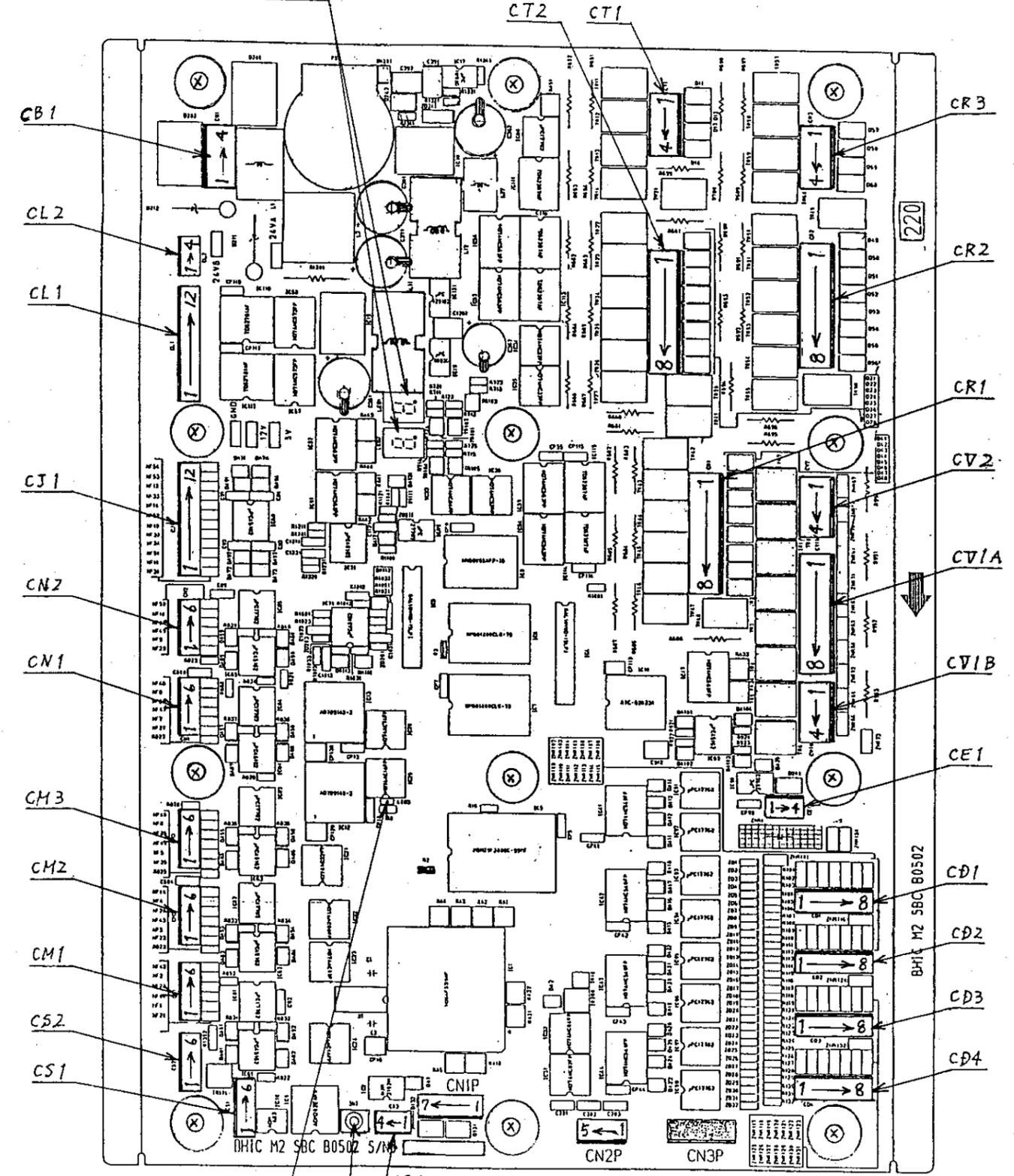
1 : Input +24V
 0 : No input

Main CPU box (M2-D)

This box is installed on the turntable to control the machine together with the Main CPU box (M1-C), installed just behind this box, Sub CPU box (M2-E) located on the sub frame and the sub CPU board (M4-A) installed in the upper control box.



7 segment diode (Manufacturers use only.)

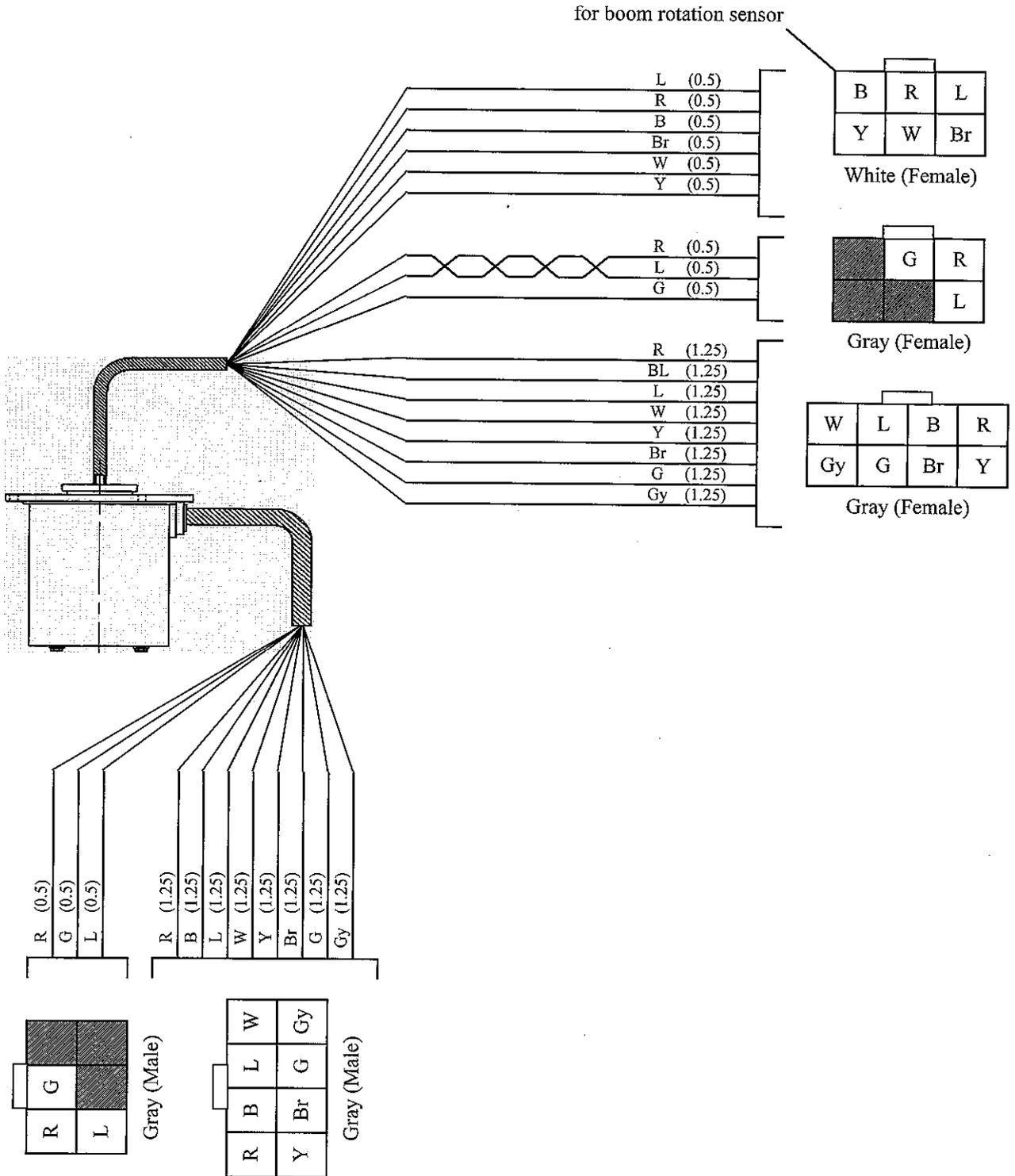


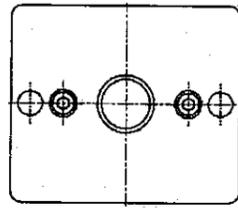
LED3
This LED blinks when the CPU is working properly and goes off, if the CPU fails.

Slip ring and Boom rotation sensor

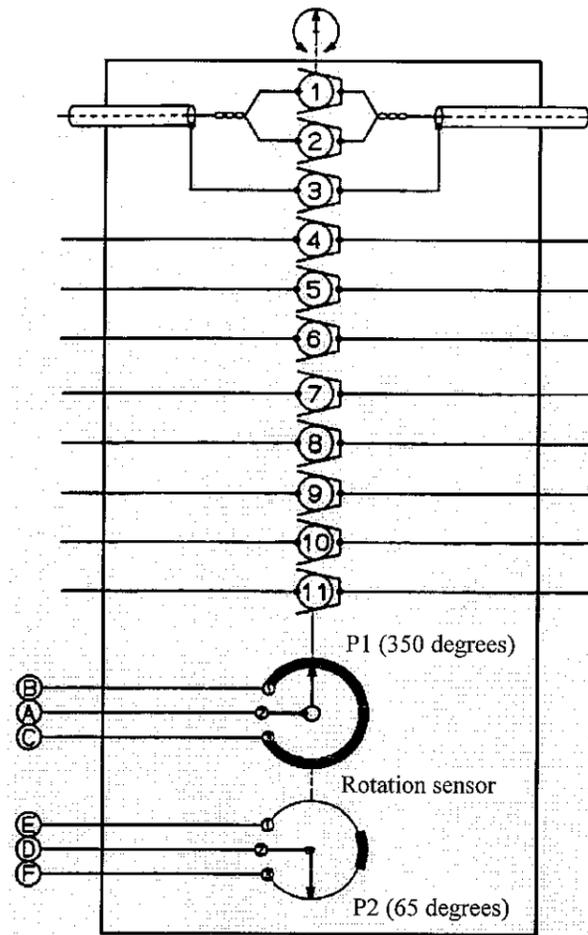
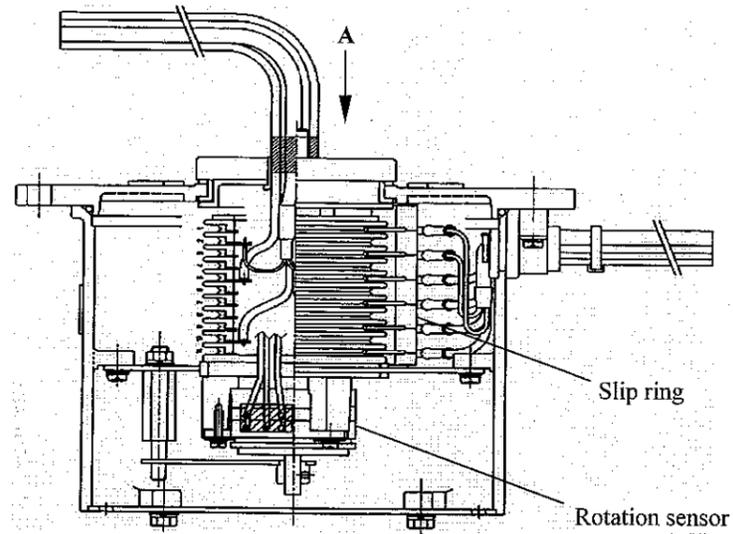
The slip ring is installed under the Swivel joint located at the rotation center of the turntable to make electric lines between the sub frame and the turntable.

The boom rotation sensor incorporated in the slip ring detects the rotation angle of the boom.





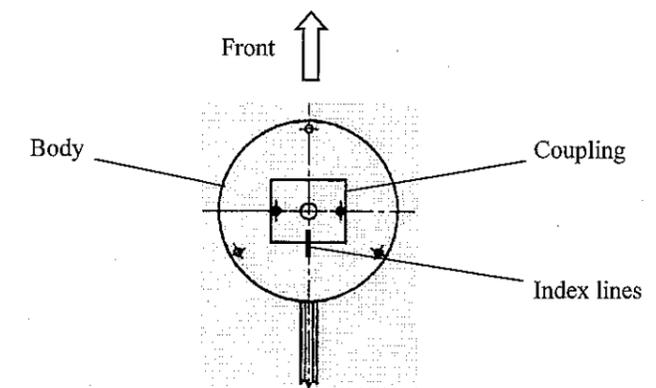
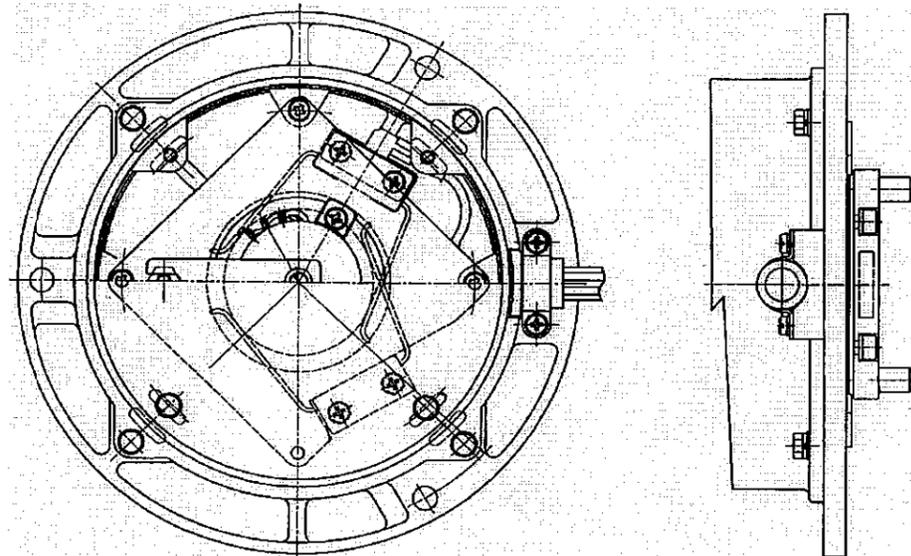
A view



No.	Color of lead wires	Size of lead wires	Remarks		
1	Red	0.5 mm ² (Twisted pair)	Multiplex transmission lines between Main CPU box (M1-C) and Sub CPU box (M2-E).		
2	Blue				
3	Green	1.25 mm ²	DC power lines		
4	Red				
5	Black				
6	Blue				
7	White				
8	Yellow				
9	Brown				
10	Green				
11	Gray				
A	Red			0.5 mm ²	Rotation sensor lead wires
B	Black				
C	Blue				
D	White				
E	Yellow				
F	Brown				

Installation of Slip ring complete

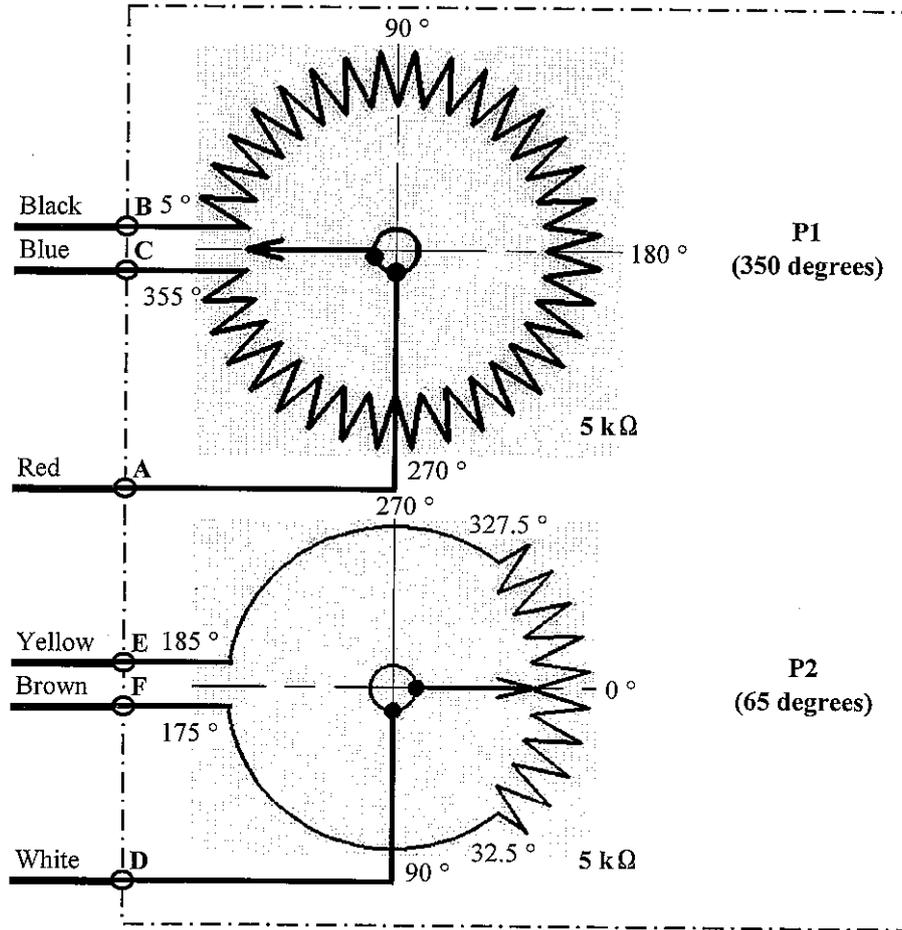
Before installing the slip ring complete to the swivel joint, rotate the boom to the front side of the vehicle exactly, then align the "Index lines" on the coupling and the body as shown in the figure below.



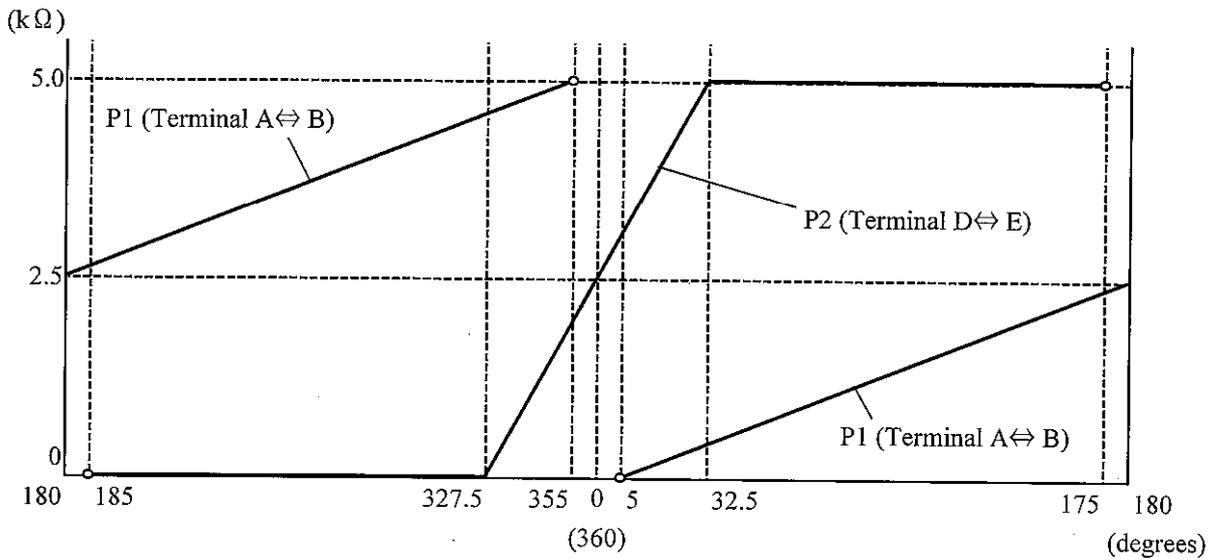
Boom rotation sensor

The boom rotation sensor is installed under the slip ring to detect the boom rotation angle.

1. Characteristics



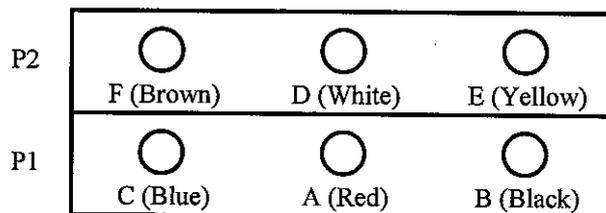
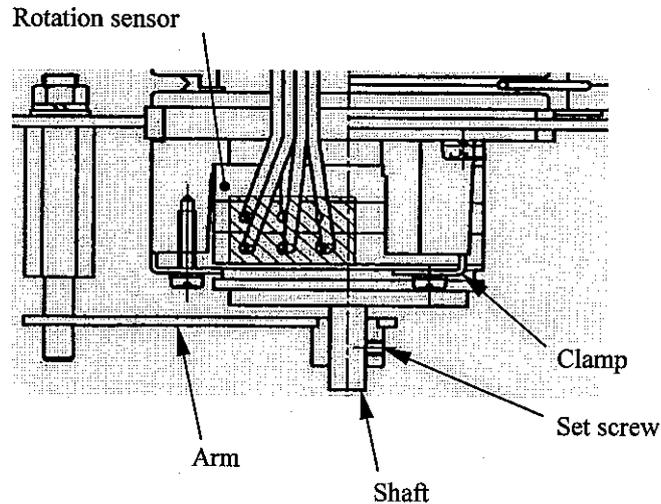
Rotation angle and resistance



2. Replacement procedures

Replace the boom rotation sensor as follows.

1. Set up the machine on firm level ground and extend all of the outriggers and the jack fully.
2. Rotate the boom to the front center of the vehicle exactly.
3. Disengage the PTO and turn off the engine key switch.
4. Remove the slip ring complete from the swivel joint.
5. Remove the cover from the slip ring, then remove the arm and the clamps from the boom rotation sensor.
6. Remove the boom rotation sensor by cutting the six wires connected to the sensor.
7. Connect the six wires to the new rotation sensor by soldering.
See the previous page when connecting each wire.
8. Install the rotation sensor under the slip ring.
9. Rotate the coupling and align the index lines marked on the coupling and the body.
See the previous page to align the index lines.
10. Set a ohmmeter between D (White) and E (Yellow) wires, turn the shaft of the rotation sensor slowly and adjust the resistance at 2.5 k Ω .
11. Install the arm onto the shaft of the rotation sensor, then reinstall the cover.
Caution : Do not turn the shaft of the rotation sensor when installing the arm.
12. Reinstall the reassembled slip ring complete onto the boom, then conduct the AD turning of the boom rotation sensor by connecting the lap top computer.

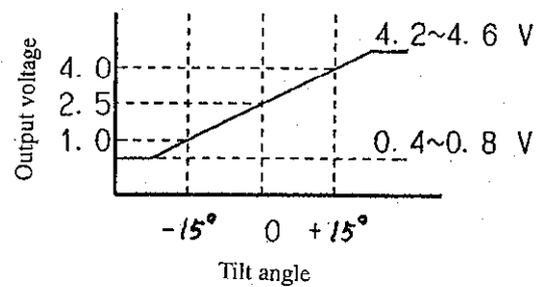
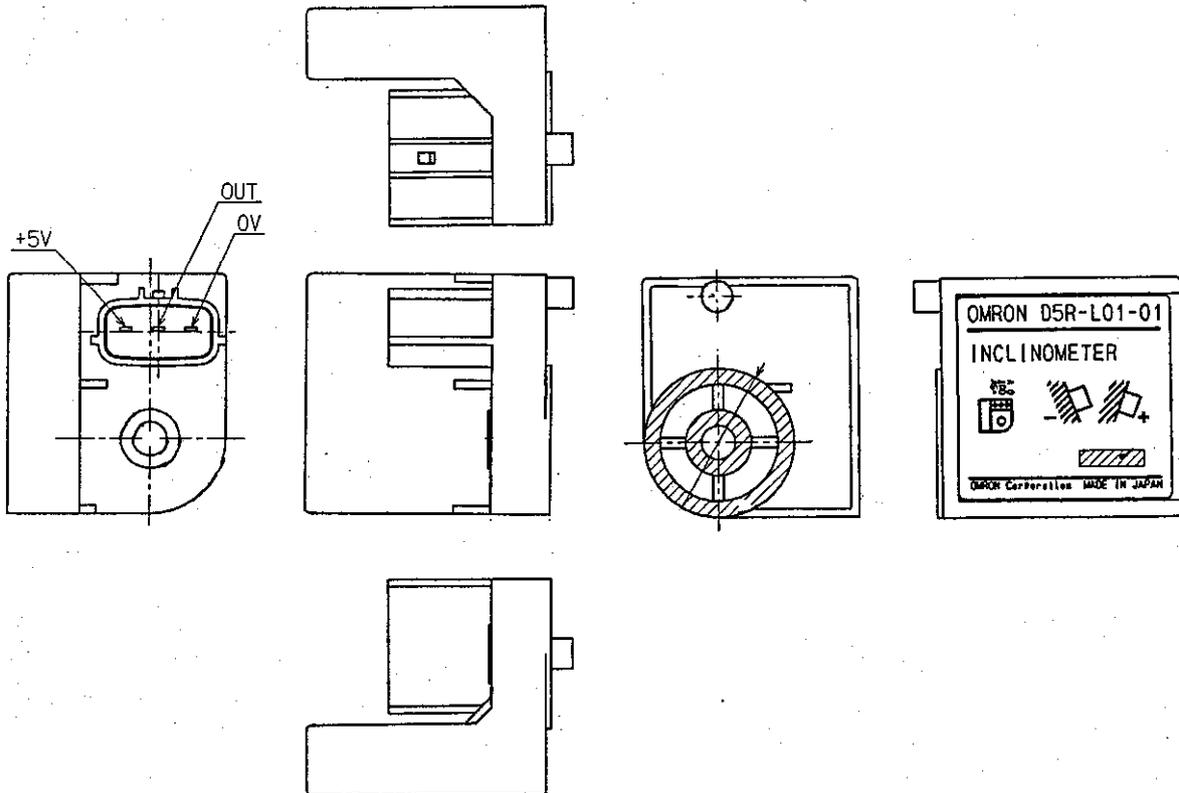


Platform tilt sensor

The platform tilt sensor is installed on the platform rotation post to detect the tilt angle of the platform.

Power voltage ----- DC5 \pm 0.5 V

Output voltage ----- 100 mV / 1 degree (2.5 ± 0.05 volts when horizontal)

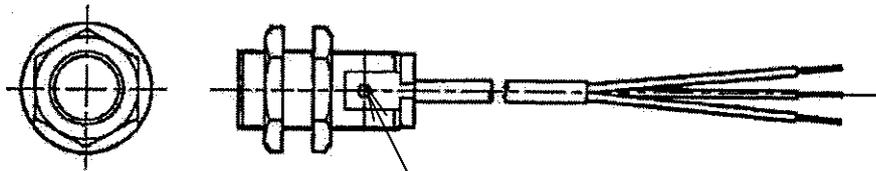


Output characteristics

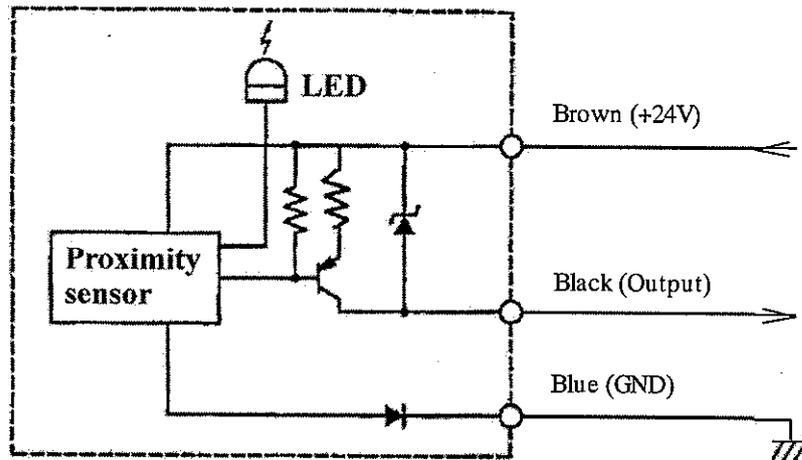
Platform storage position proximity switch

This proximity switch installed on the platform rotation post is used for the boom auto-storage system and switches on to stop the platform rotation when the platform is rotated to the central position.

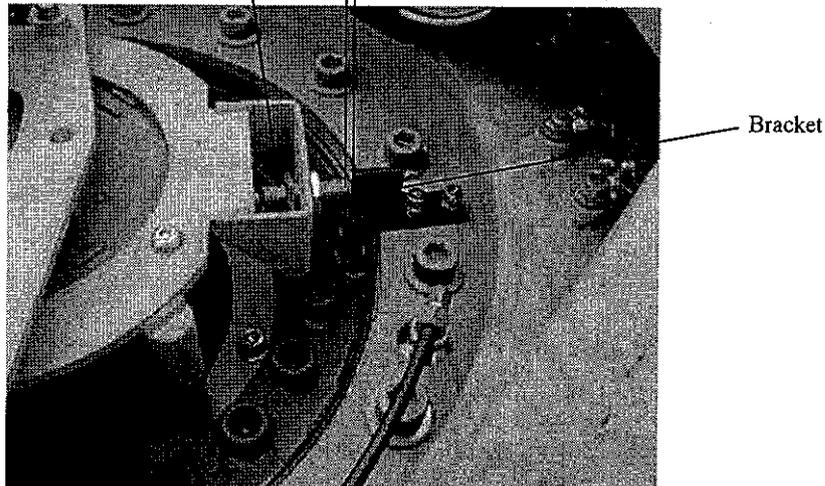
- Rated voltage ----- DC 24 V
- Rated current ----- 100 mA or less
- Switching distance ----- 5 mm (0.2 in)



The LED goes on when the switch is ON.



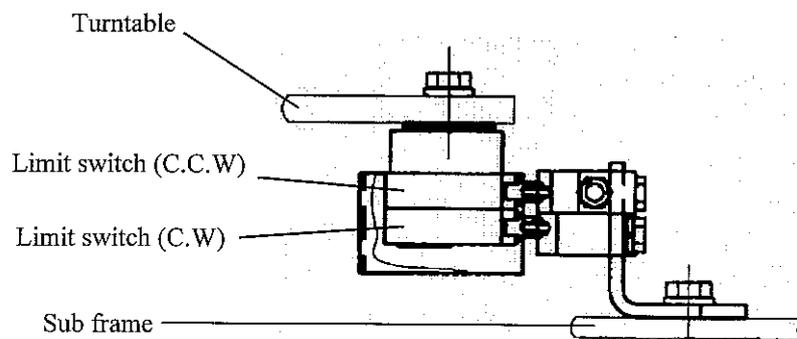
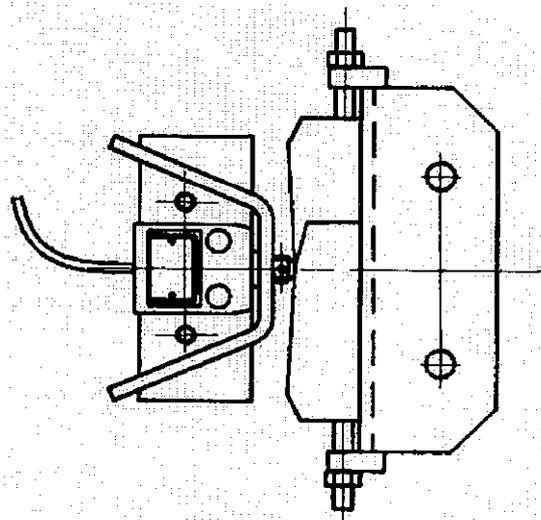
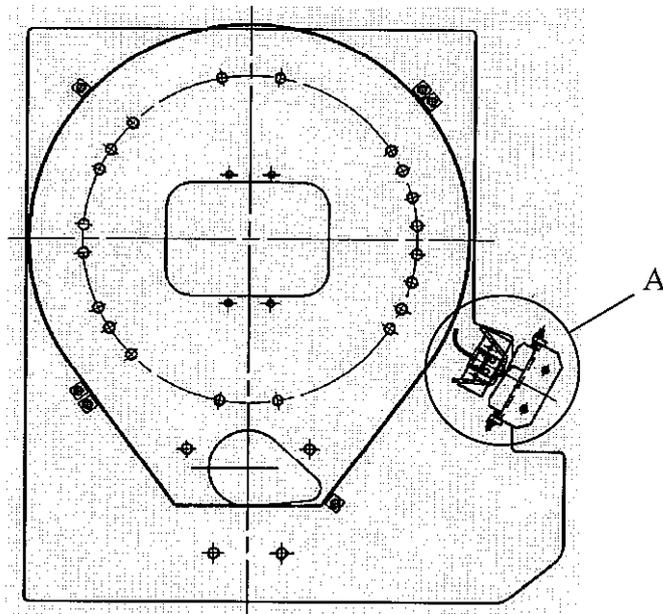
Proximity switch Specified gap: 3.5~3.7 mm (0.138"~0.146")



Boom storage position limit switches

171-20000

Two limit switches installed beside the turntable are used for the boom auto-storage system to automatically stop the boom rotation when the boom is rotated exactly above the boom rest.



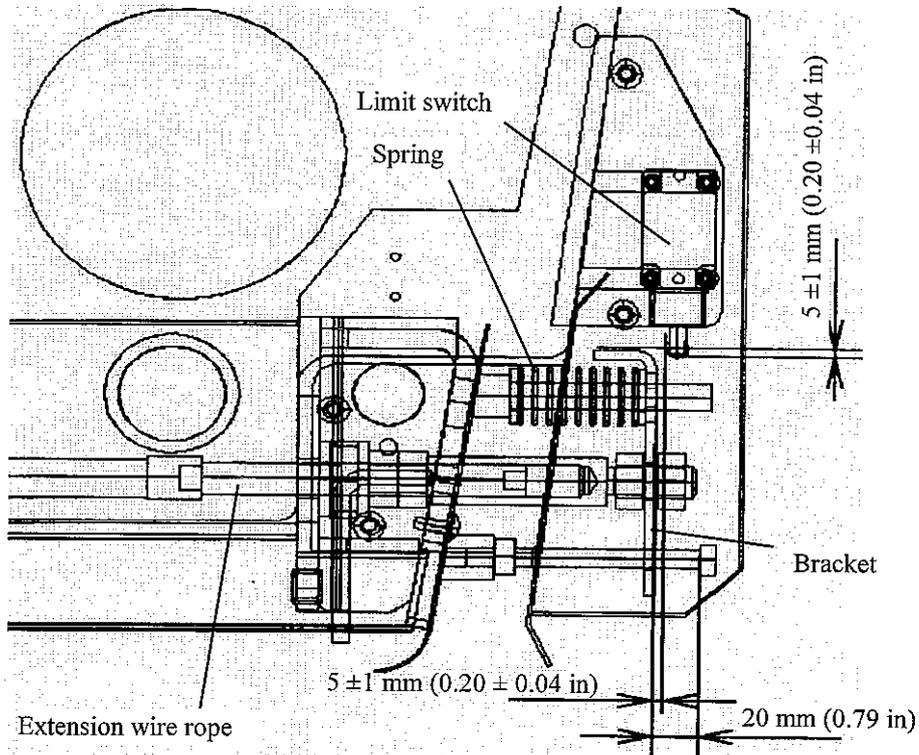
A detail

Extension wire rope failure limit switch

320-00026-00

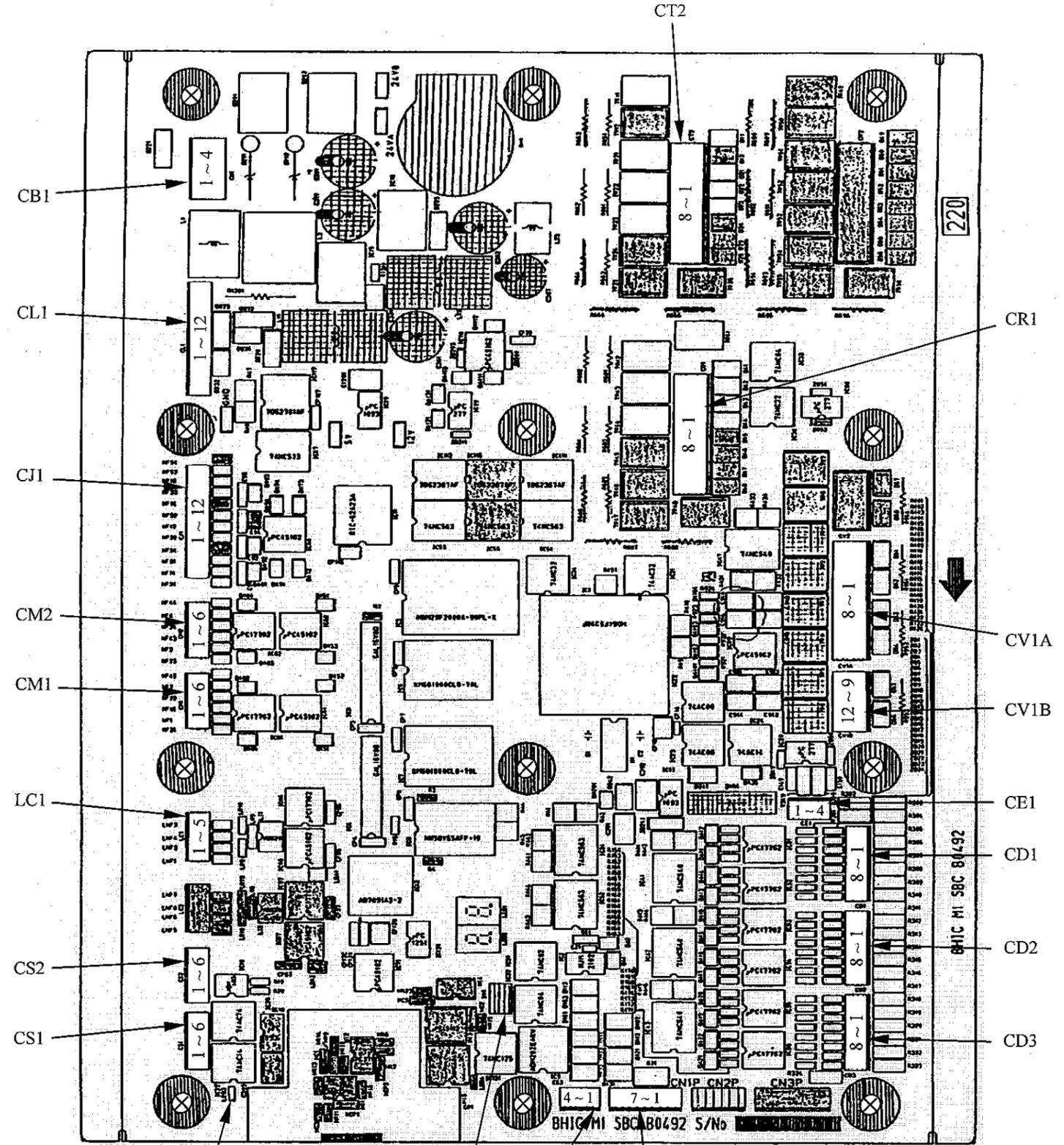
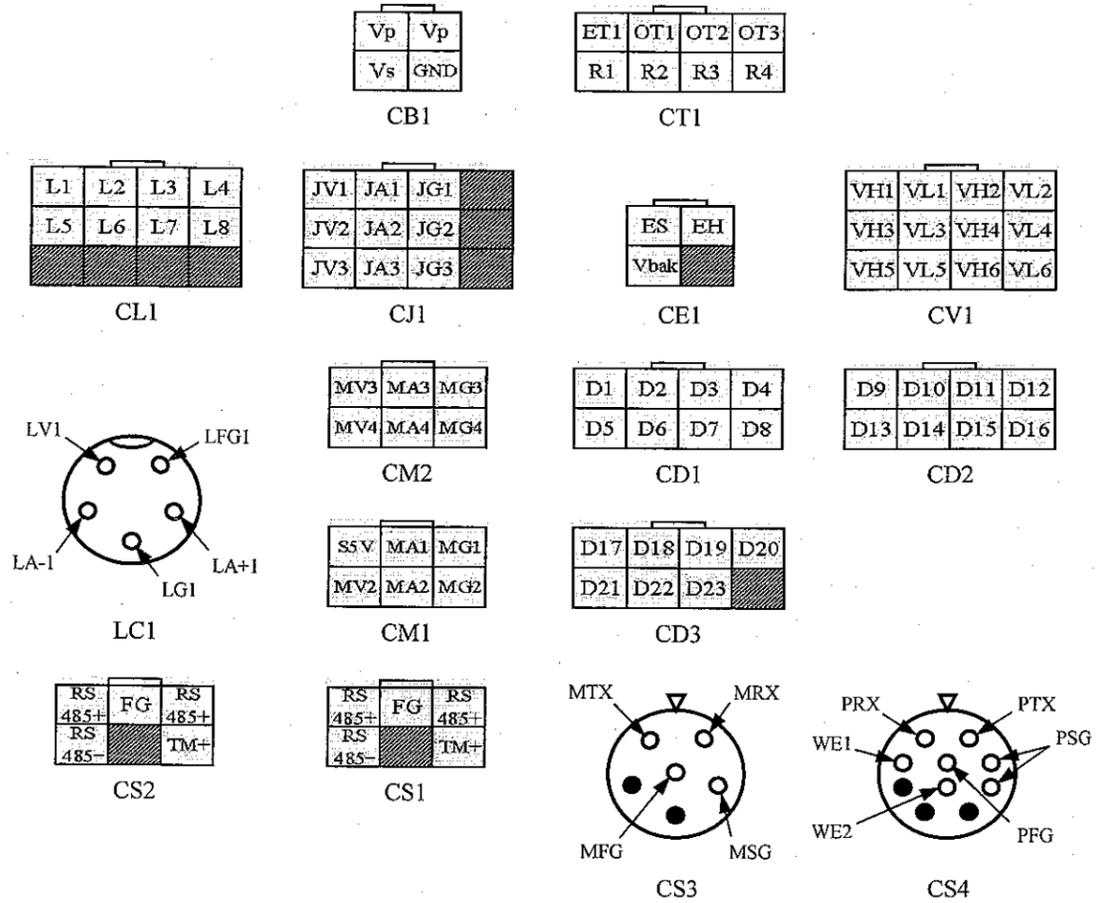
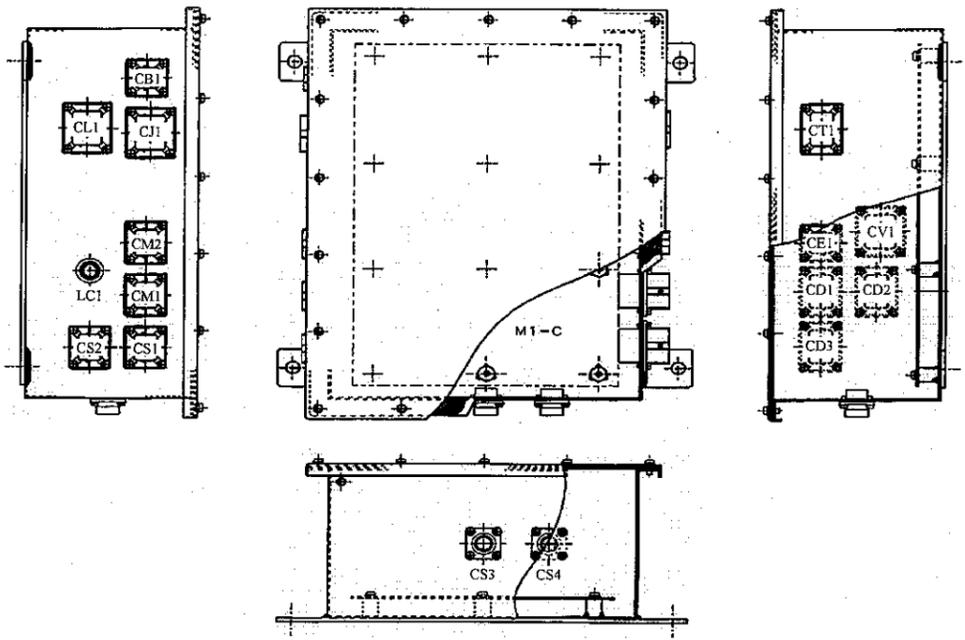
Two extension wire rope failure limit switches are installed on the tail of the 1st boom section to detect the wire rope failure.

These limit switches disable the boom extending function in the event of a wire rope failure.



Main CPU box (M1-C)

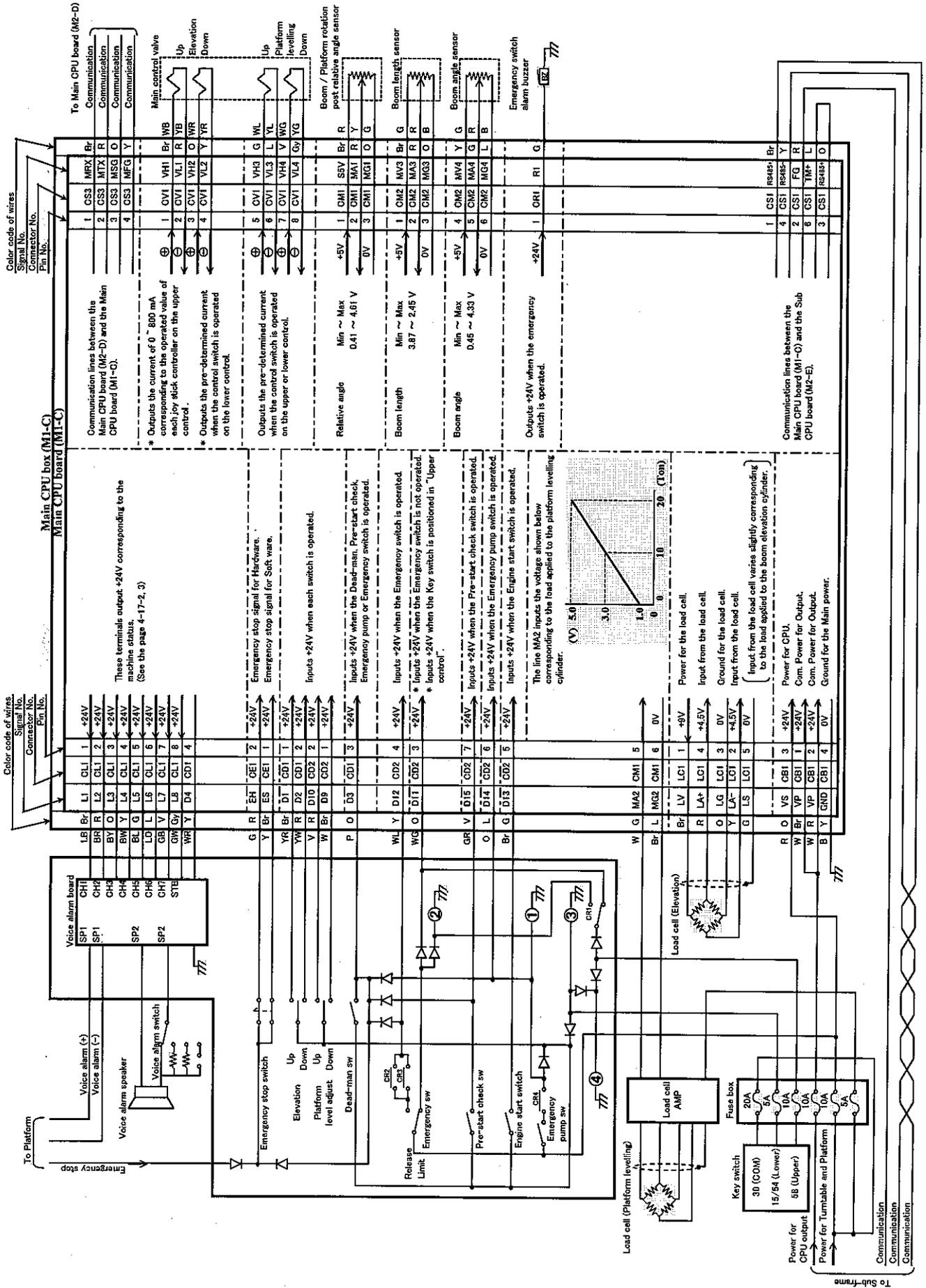
This box is installed on the turntable behind the Main CPU box (M2-D) to control the machine together with the M2-D, Sub CPU box (M2-E) located on the sub frame and the Sub CPU board (M4-A) installed in the upper control box.



LED3
This LED blinks when the CPU is working properly and goes off, if the CPU fails.

Switch (SW1) CPU reset switch (Manufacturers use only)

1. Input / Output characteristics

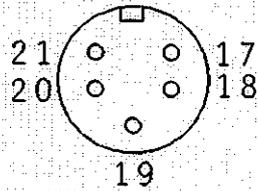
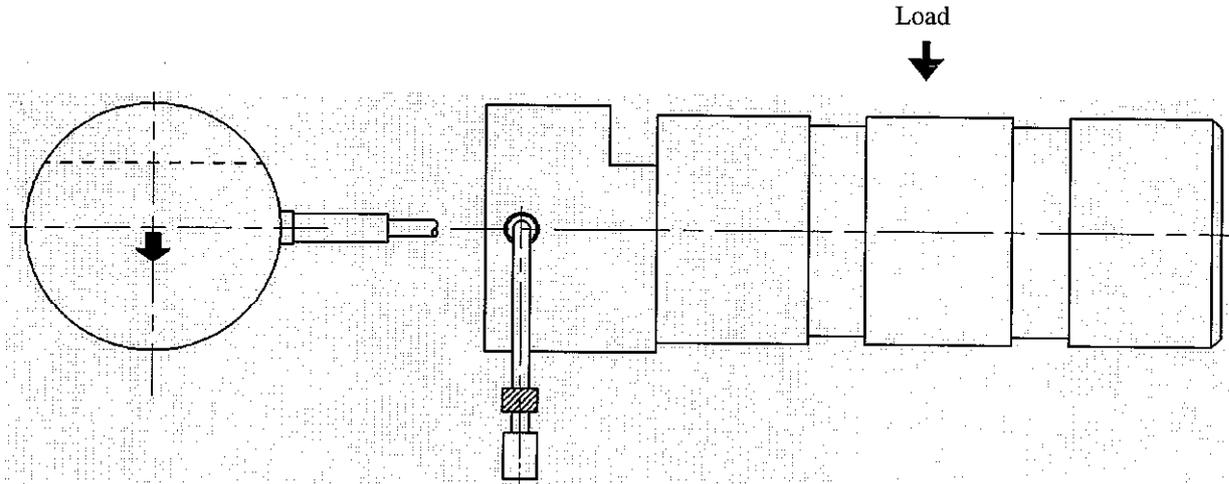


Load cell (for Elevation cylinder)

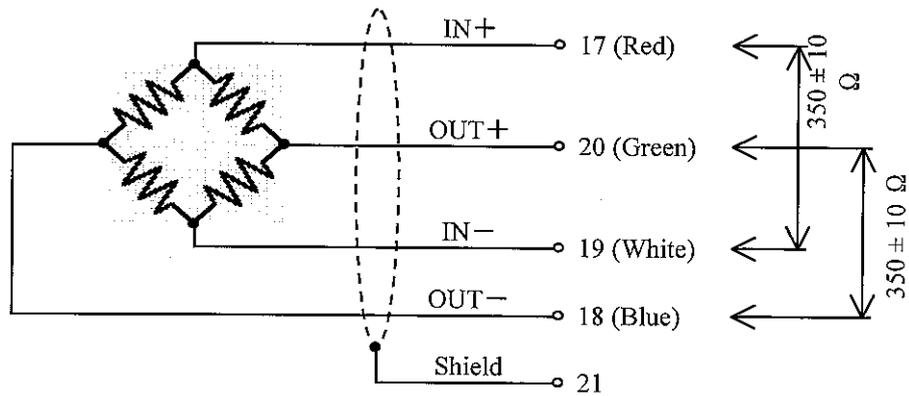
382-000003 or 382-000005

The load cell detects the load applied to the elevation cylinder.

Rated load -----	20 tons
Rated output -----	1.5 mV / 10V
Applied voltage -----	DC10V (DC9 ~ 12V)
Resistance	
Between input terminals -----	350 ± 10 Ω
Between output terminals -----	350 ± 10 Ω



	17	19	18	20	21
Connection	Input		Output		Shield
	+	-	+	-	

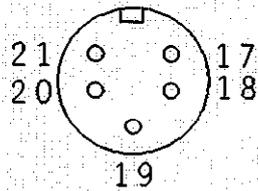
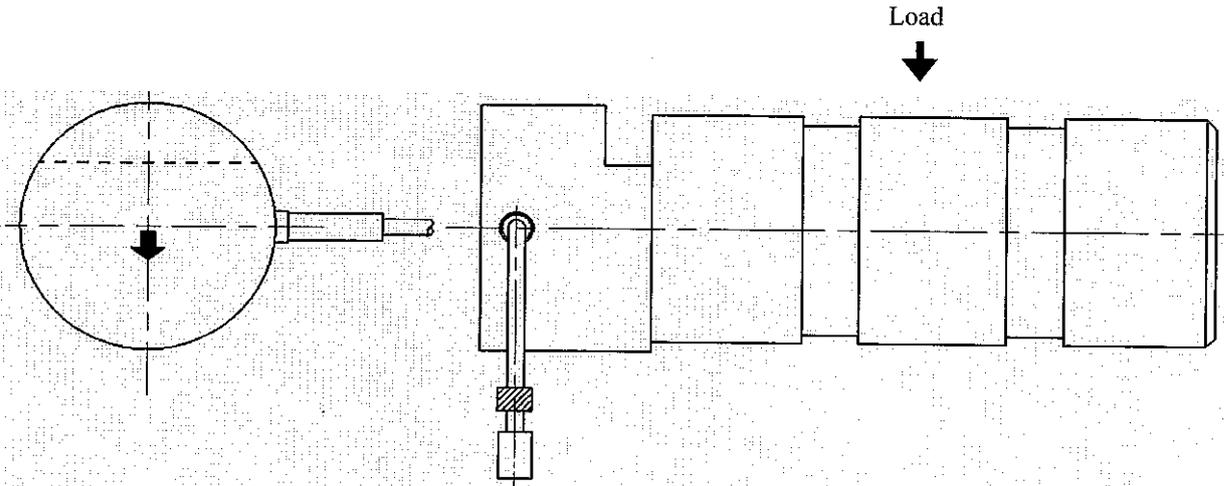


Load cell and Load cell AMP (for Platform levelling cylinder)

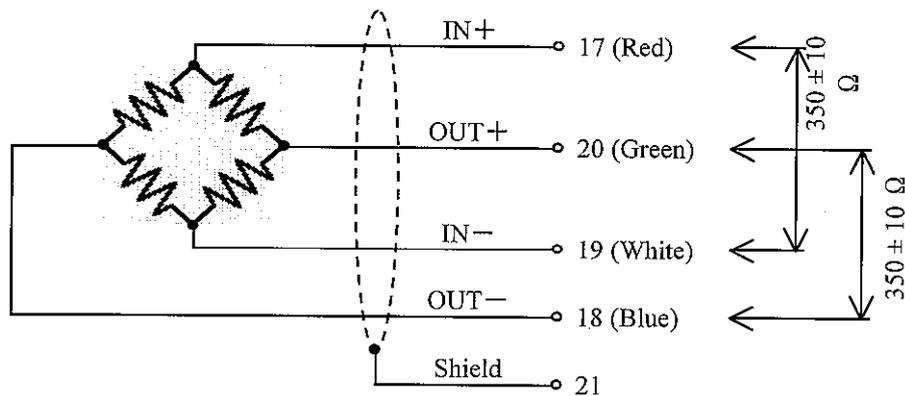
1. Load cell (382-0000003 or 382-0000005)

The load cell detects the load applied to the platform levelling cylinder.

Rated load -----	20 tons
Rated output -----	1.5 mV / 10V
Applied voltage -----	DC10V (DC9 ~ 12V)
Resistance	
Between input terminals -----	350 ± 10 Ω
Between output terminals -----	350 ± 10 Ω



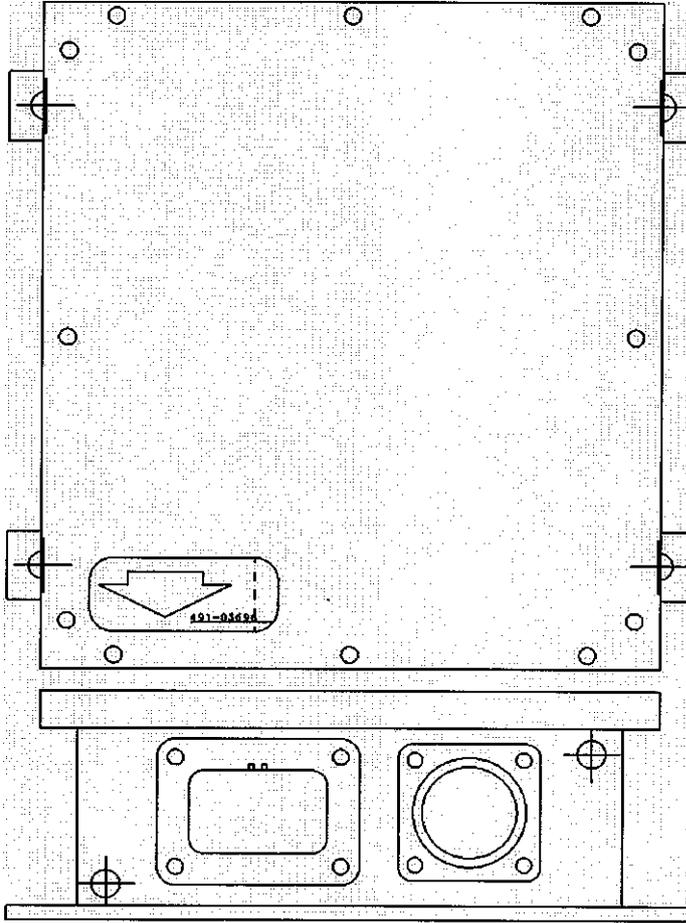
	17	19	18	20	21
Connection	Input		Output		Shield
	+	-	+	-	



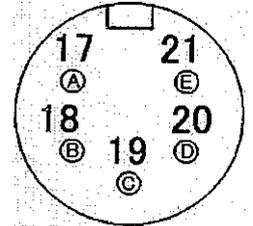
2. Load cell AMP (382-00784)

The load cell AMP amplifies the load signal sent from the load cell, then outputs the amplified load signal to the main CPU box (M1-C).

Rated voltage ----- DC24V (DC18 ~ 30V)
 Output voltage ----- DC1 ~ 5V / 0 ~ +20 tons

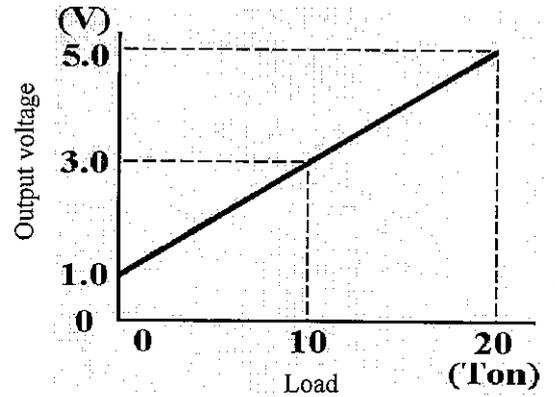


1	30	32	33
2	31		34

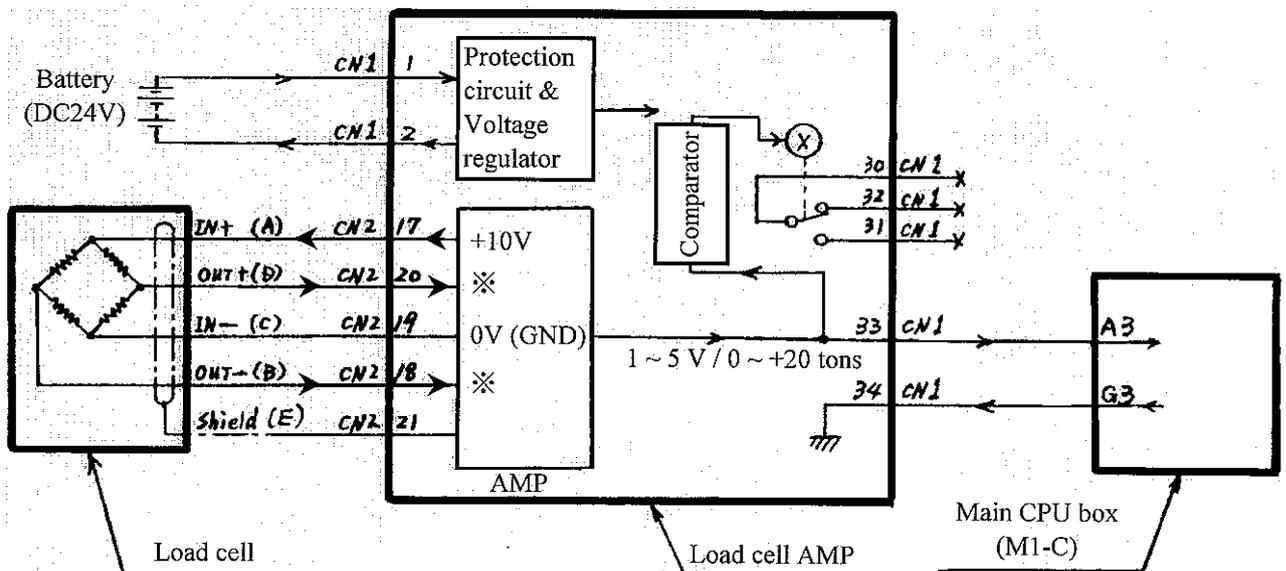


CN1

CN2



Output characteristics

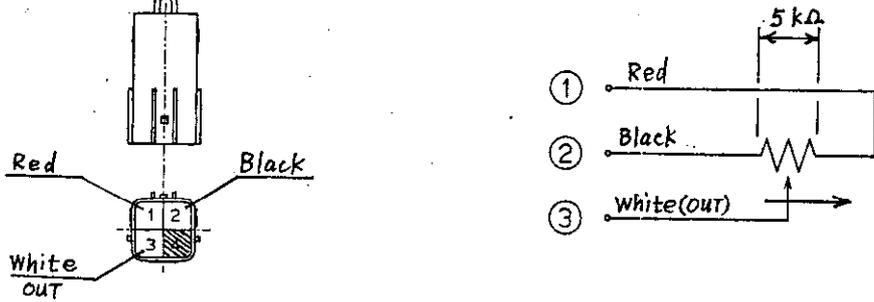
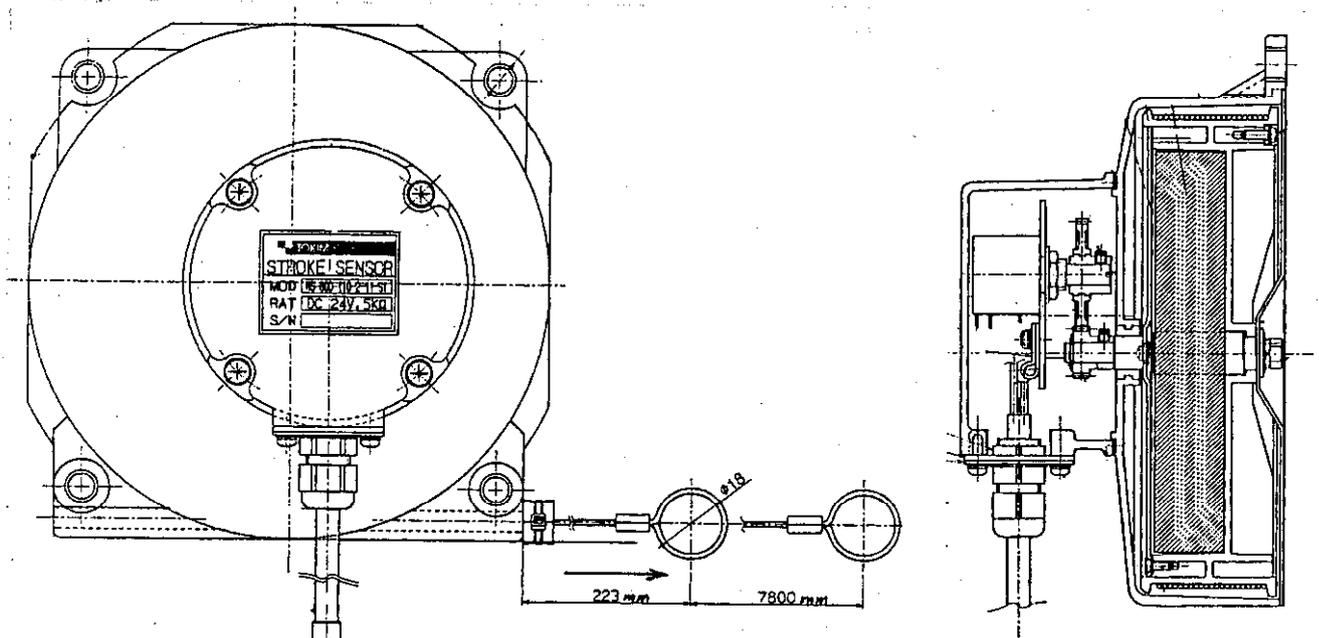


※ Input from the load cell varies slightly corresponding to the load applied to the platform levelling cylinder.

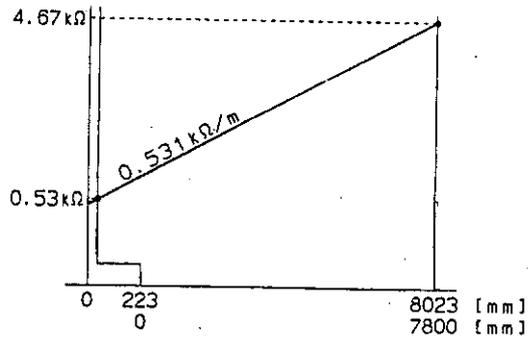
Boom length sensor

382-00005-00

The boom length sensor is installed on the side of the 1st boom section to detect the boom length.



Resistance between White and Black wires

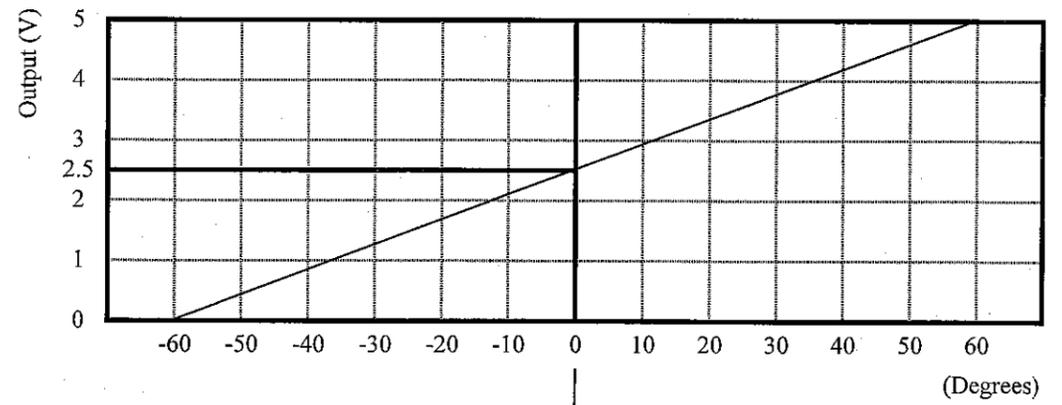
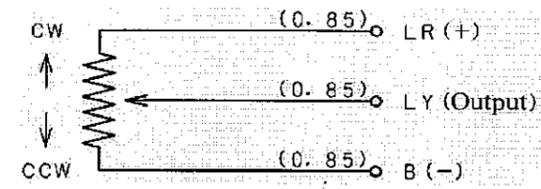
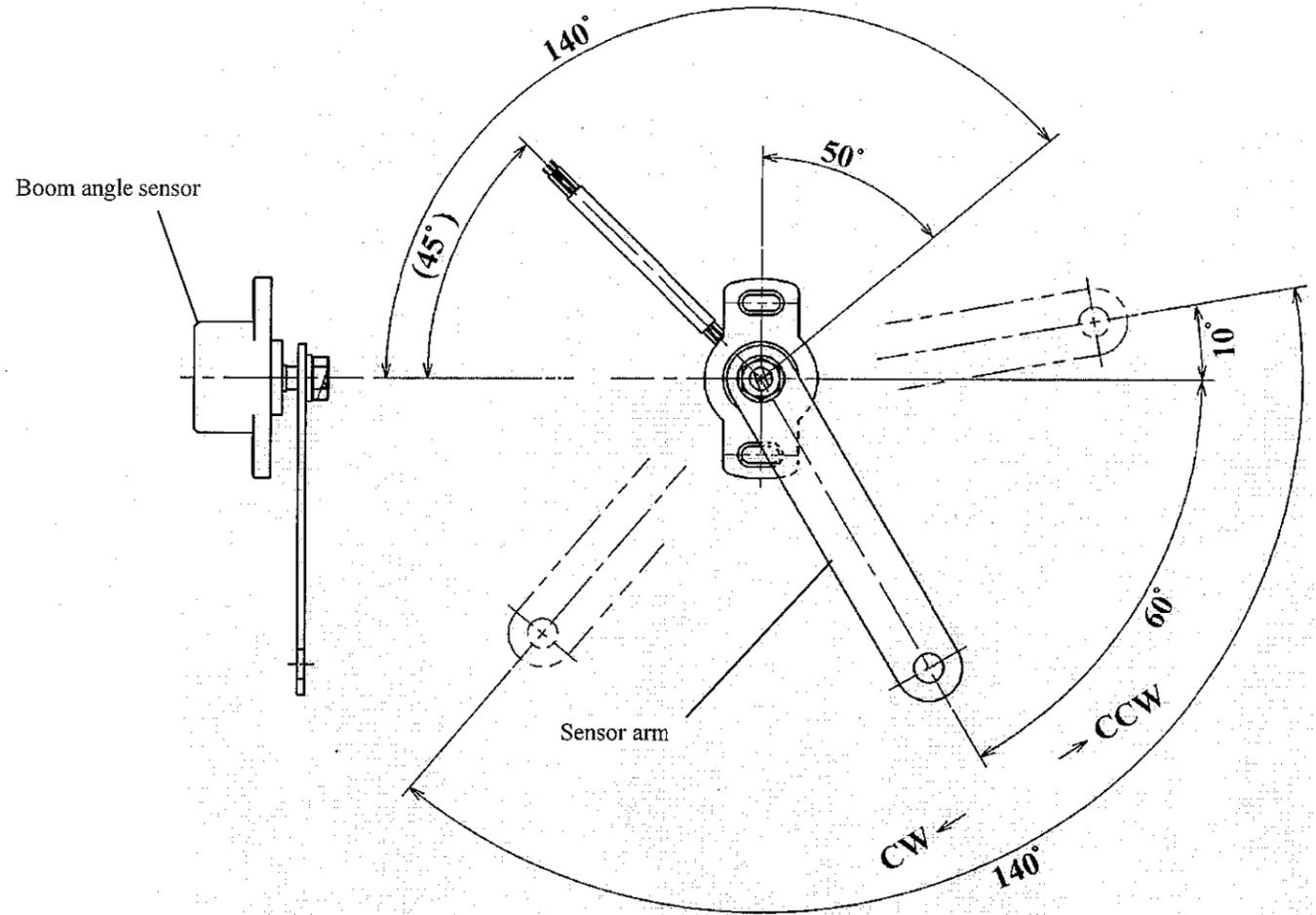
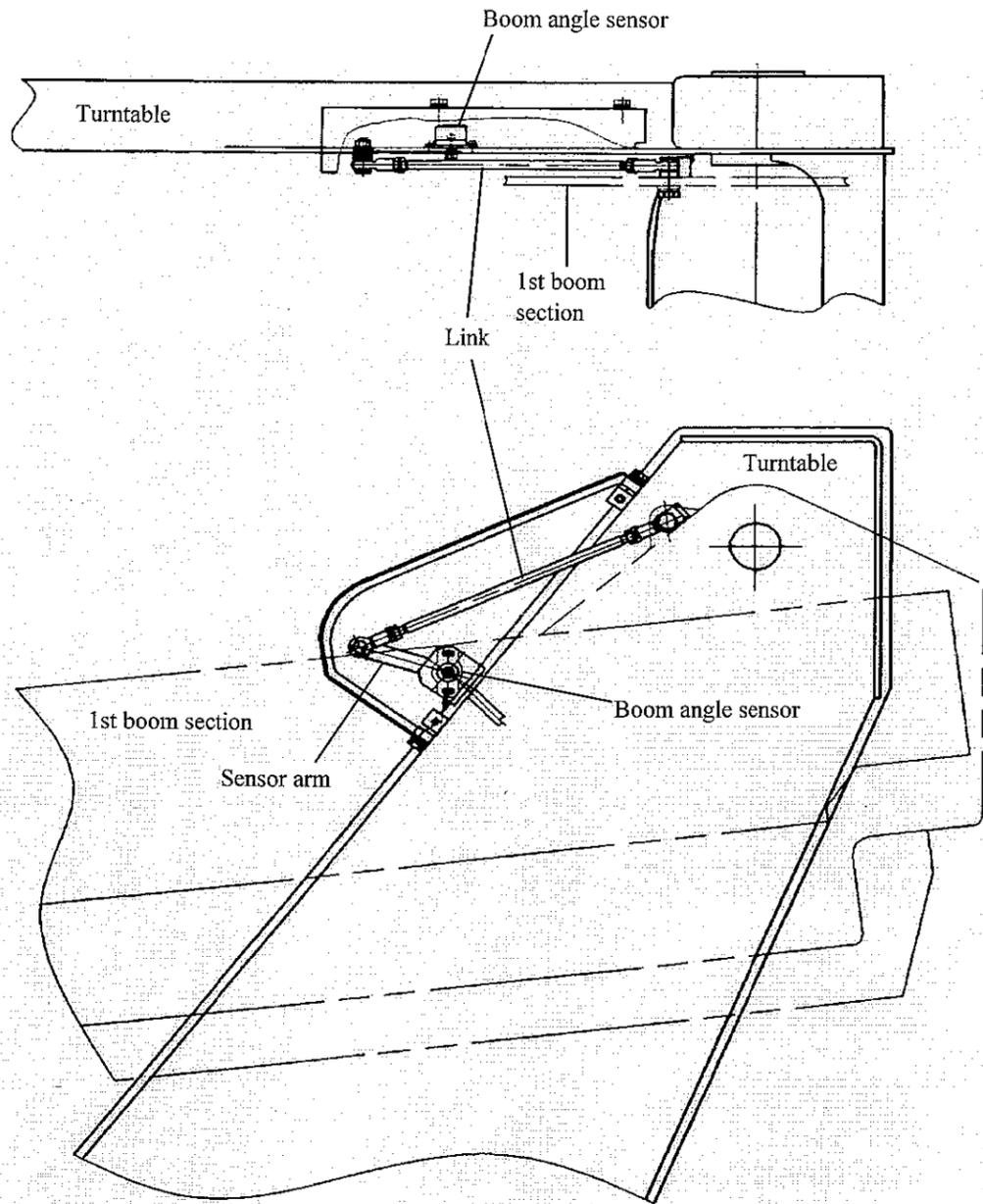


Resistance characteristics

Boom angle sensor

The boom angle sensor is installed on the turntable and actuated by the link connected between the sensor arm and the 1st boom section.

Rated voltage ----- DC 5 V
Resistance ----- 5 kΩ



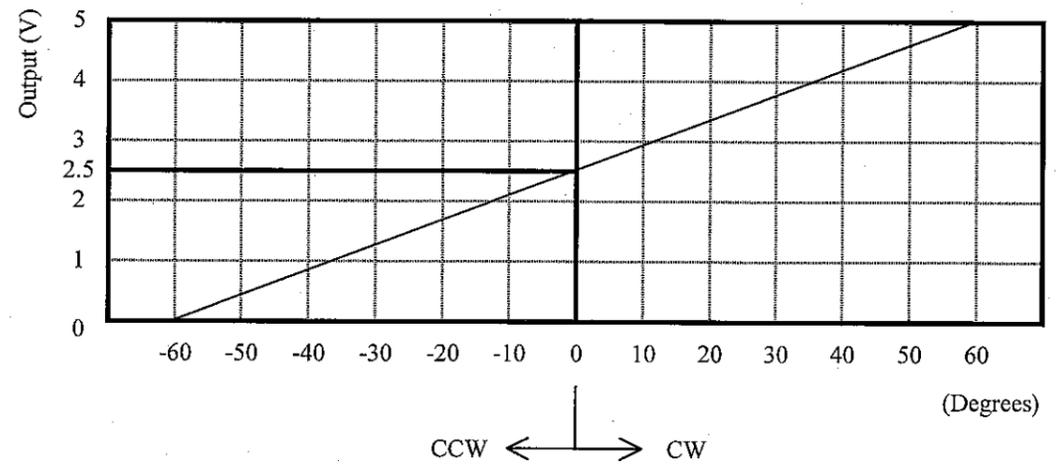
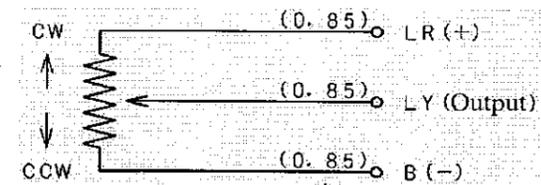
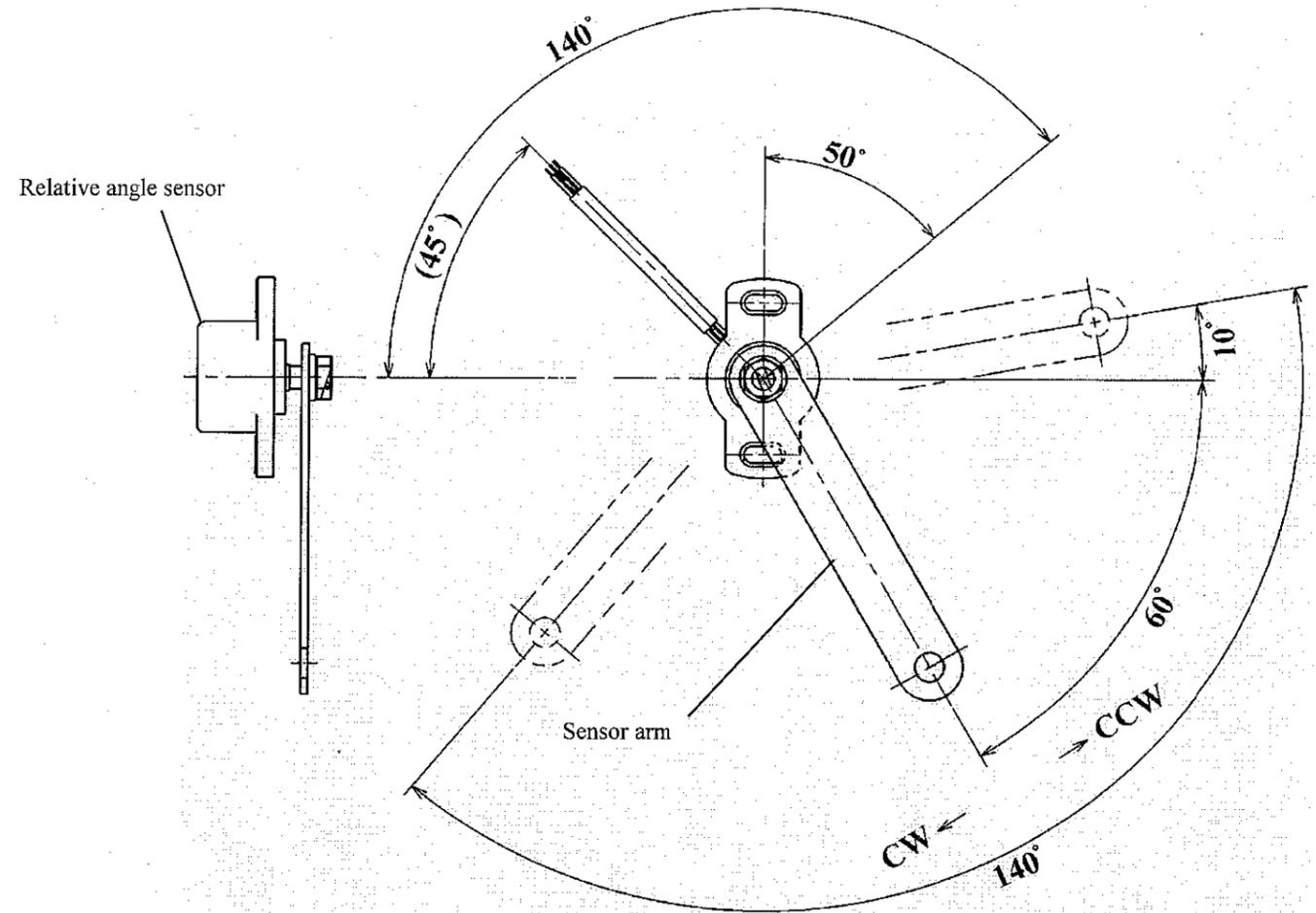
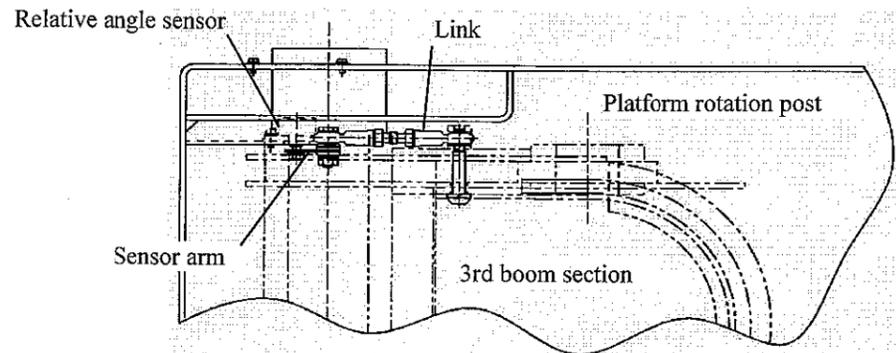
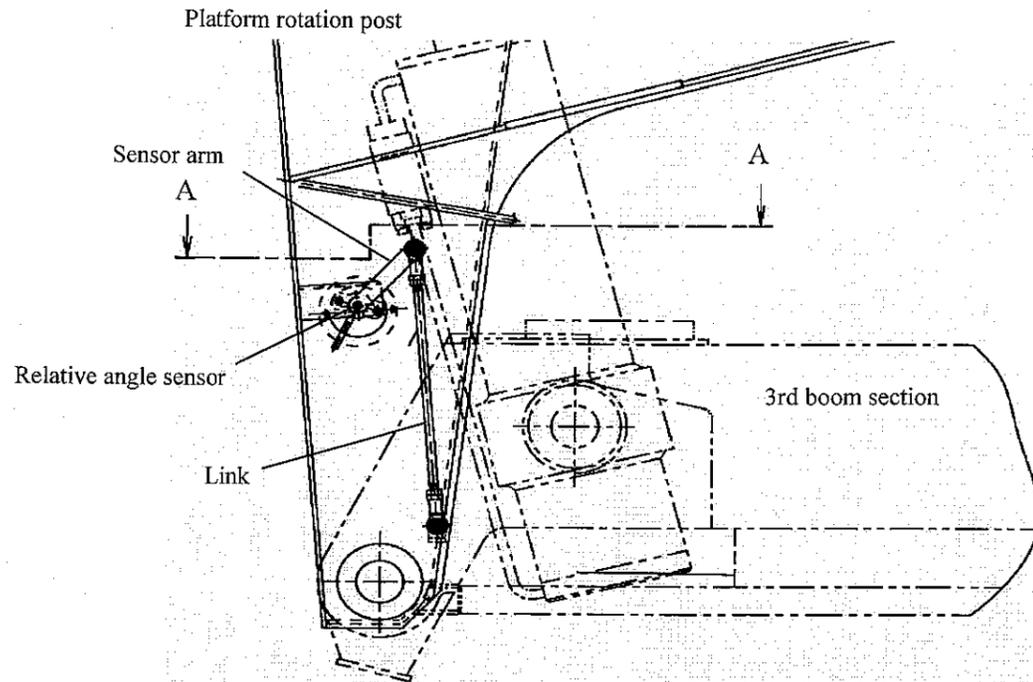
CCW ← → CW

Output characteristics

Boom / Platform rotation post relative angle sensor

The boom / Platform rotation post relative angle sensor is installed on the platform rotation post and actuated by the link connected between the sensor arm and the 3rd boom section.

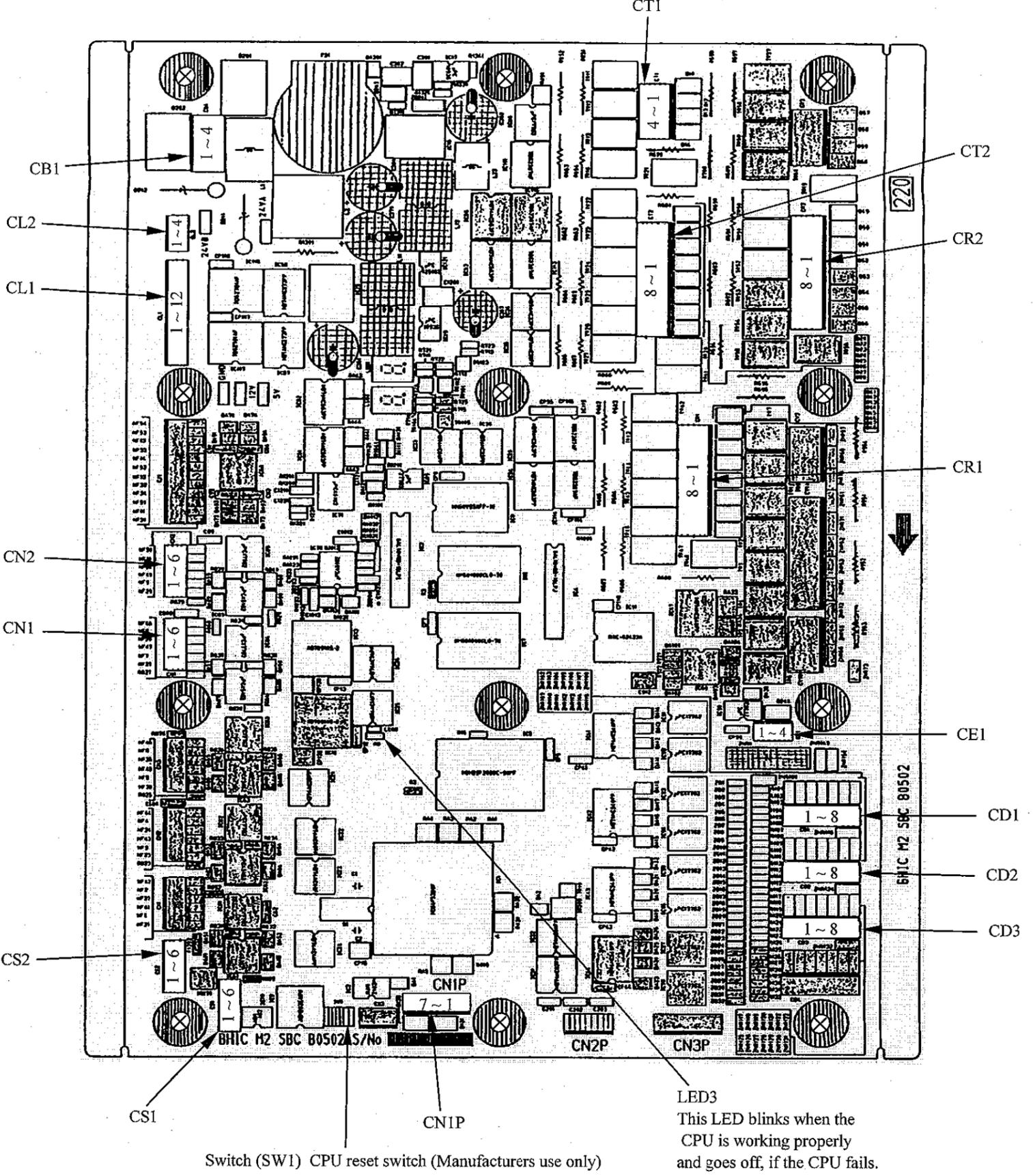
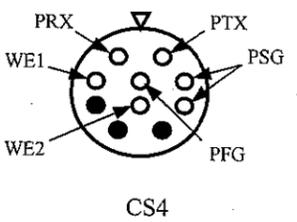
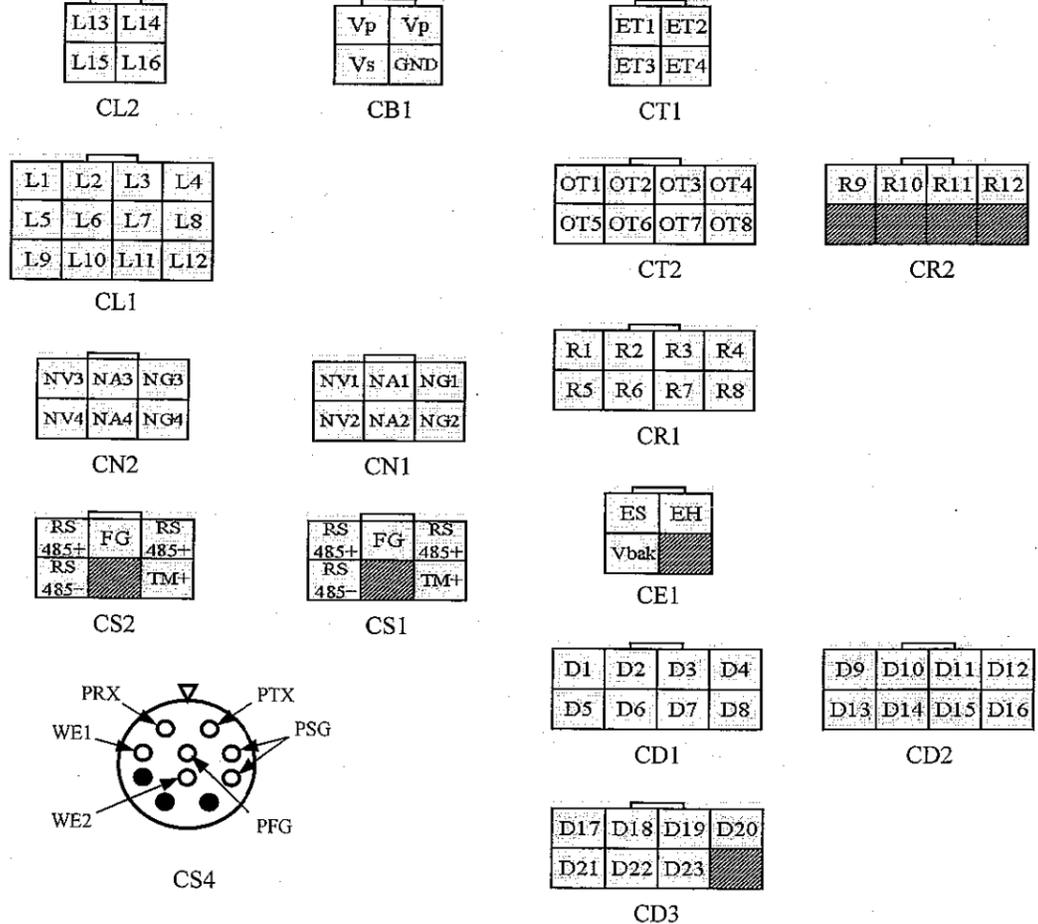
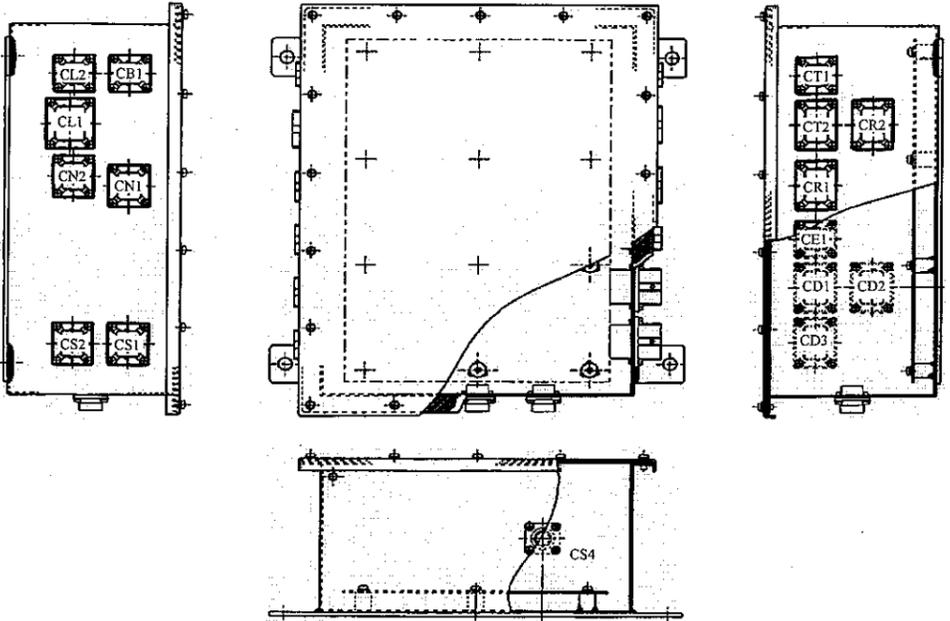
Rated voltage ----- DC 5 V
Resistance ----- 5 kΩ



Output characteristics

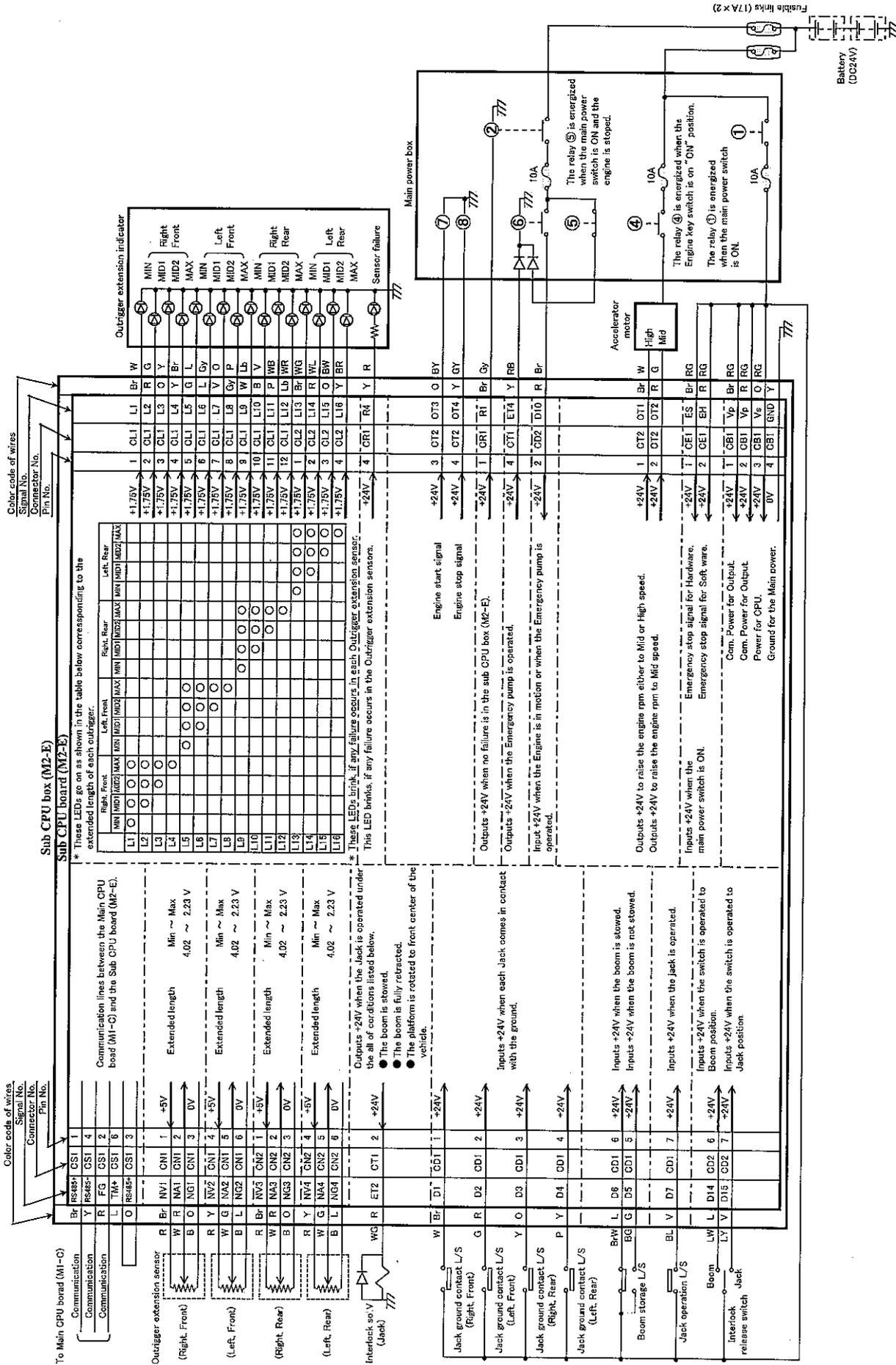
Sub CPU box (M2-E)

This box is installed on the sub frame to control the machine together with the main CPU box (M1-C, M2-D) located on the turntable and the Sub CPU board (M4-A) installed in the upper control box.



Switch (SW1) CPU reset switch (Manufacturers use only)

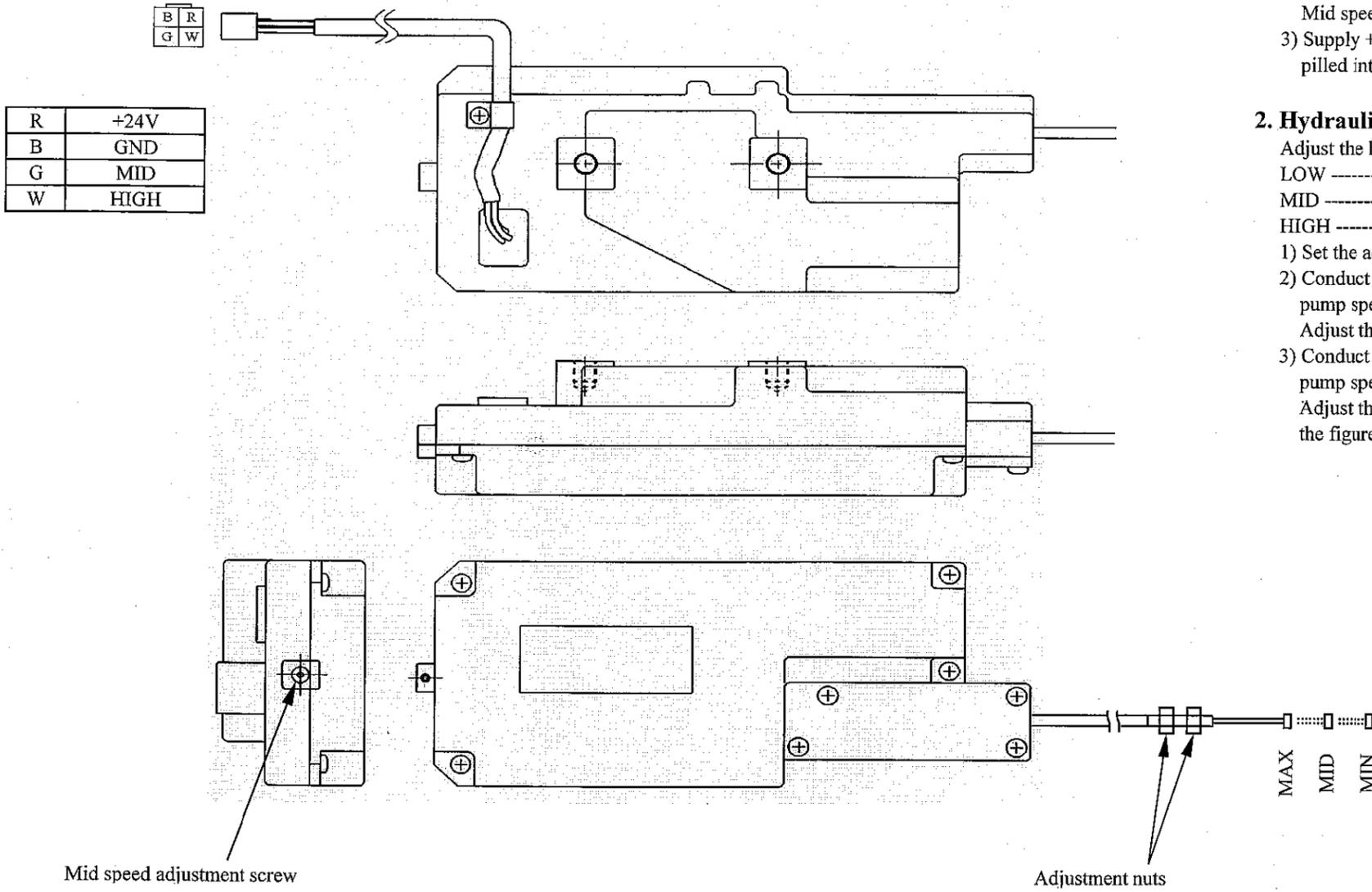
1. Input / Output characteristics



Accelerator motor

The accelerator motor is actuated by the sub CPU box (M2-E) and controls the engine rpm (Hydraulic pump rpm) into 3 speeds (LOW, MID and HIGH).

Rated voltage ----- DC24V



1. Inspection

Check the functions of the accelerator motor as follows.

- 1) Connect the battery (DC24V) between Red and Black wires.
- 2) Supply +24V to the Green wire and make sure that the control cable is pulled into Mid speed position.
- 3) Supply +24V to both Green and White wires and make sure that the control cable is pulled into the High speed position.

2. Hydraulic pump speed adjustment procedures

Adjust the hydraulic pump speed as follows.

- LOW ----- Engine idling speed
- MID ----- 800 rpm
- HIGH ----- 900 rpm

- 1) Set the accelerator switch on the lower control panel to "Auto" position.
- 2) Conduct the boom raising operation from the lower control and adjust the High pump speed to 900 rpm.
Adjust the High pump speed by turning the "Adjustment nuts" shown in the figure.
- 3) Conduct the boom lowering operation from the lower control and adjust the Mid pump speed to 800 rpm.
Adjust the Mid pump speed by turning the "Mid speed adjustment screw" shown in the figure.

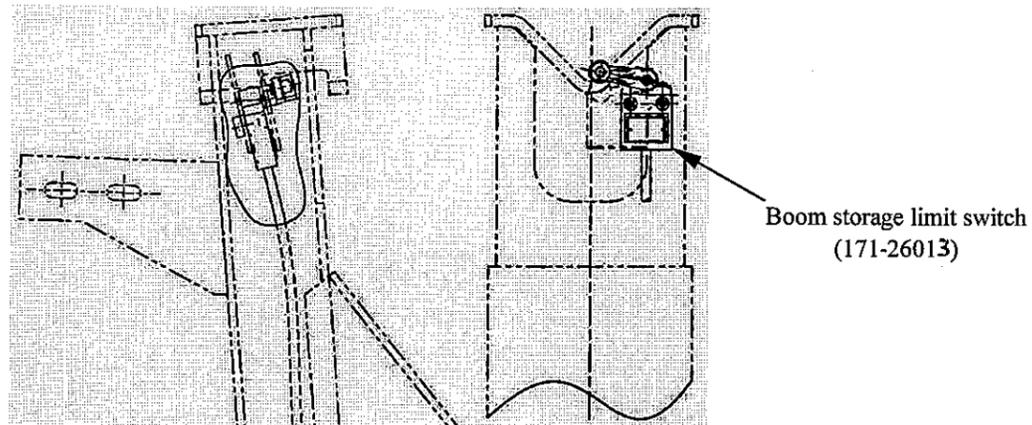
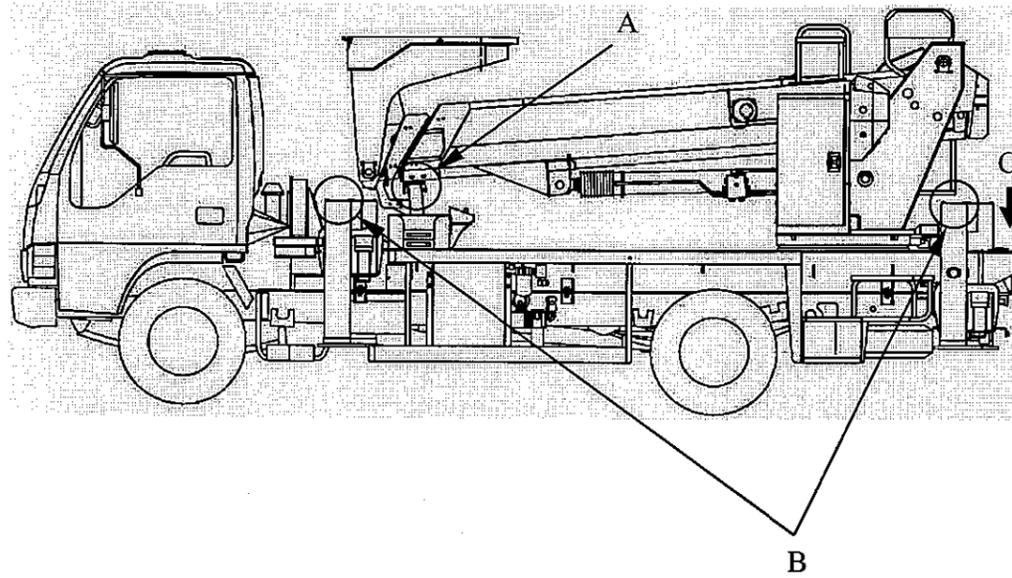
Interlock system

The interlock system consists of the components shown in the figure below and functions as follows.

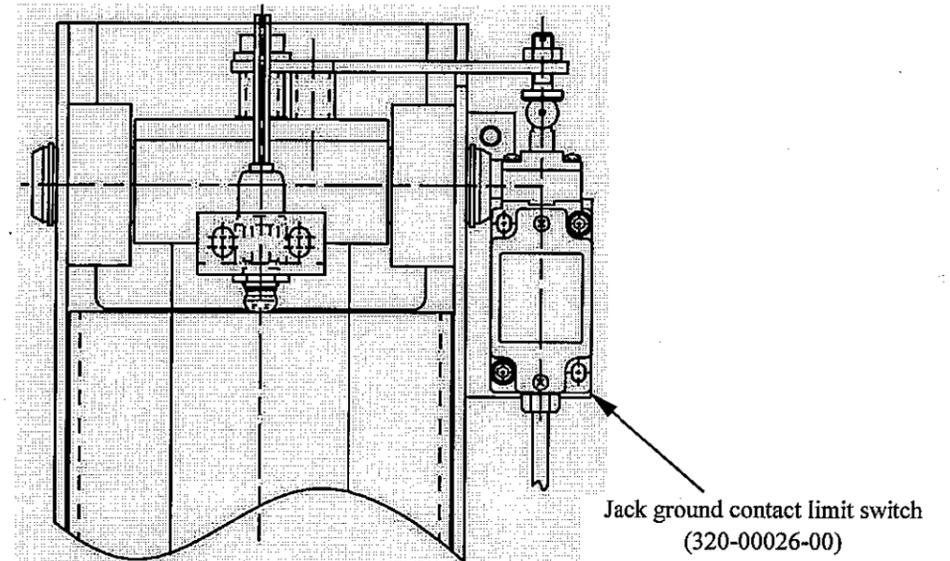
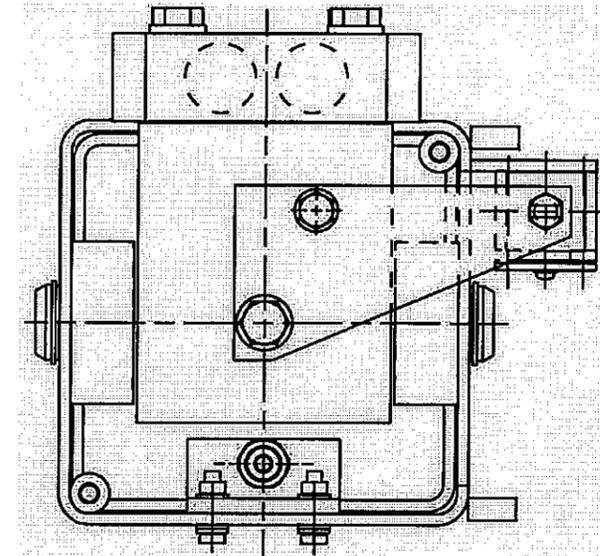
The interlock system disables the boom functions unless all of the jacks make firm contact with the ground.

The interlock system disables the jack and outrigger functions unless all of the following conditions apply.

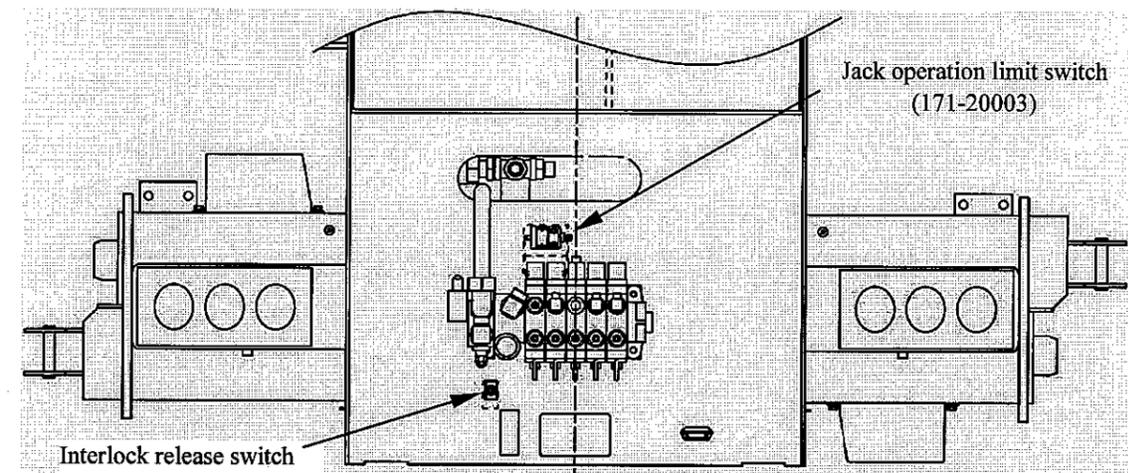
- * The boom is stowed on the boom rest.
- * The boom is fully retracted.
- * The platform is rotated to the central position.



A detail



B detail



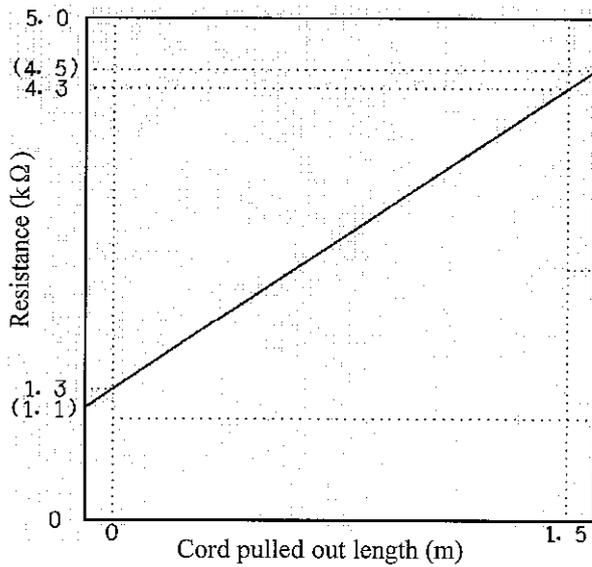
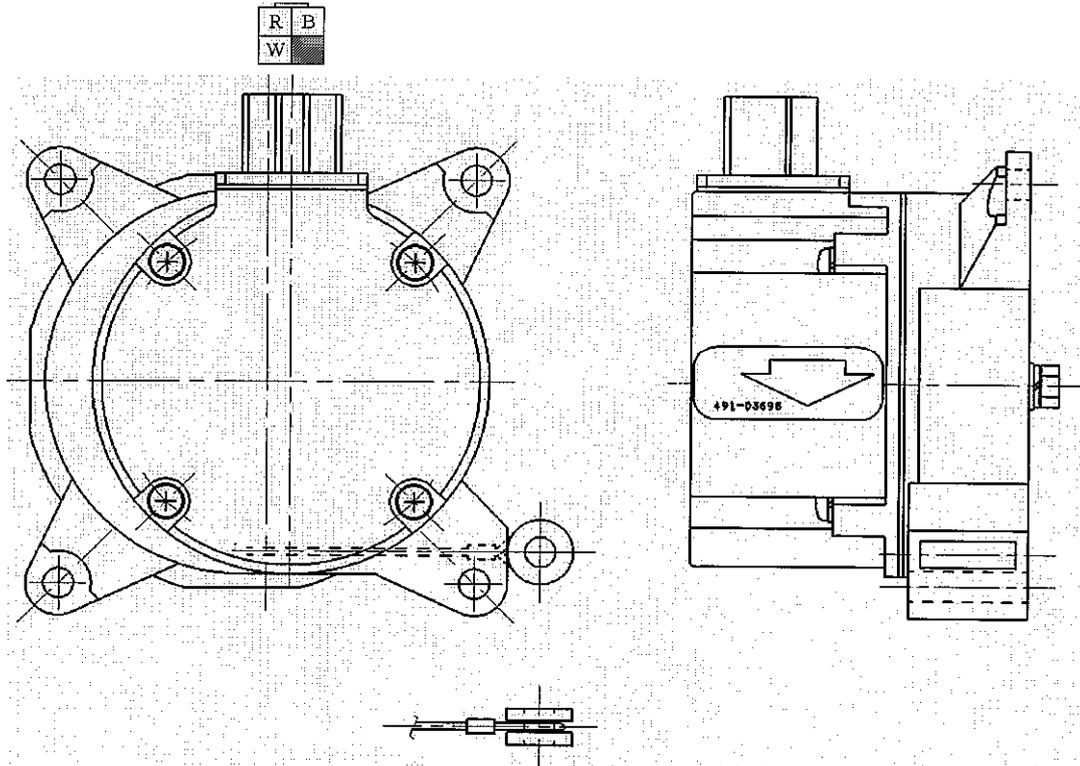
C view

Outrigger extension sensor

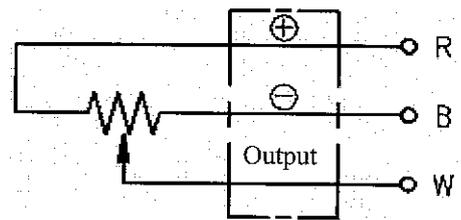
382-000006

The outrigger extension sensors are installed on each outrigger housing to detect the outrigger extension length.

Applied voltage -----	DC5V
Resistance -----	5 k Ω
Cord stroke -----	1.5 m



Output characteristics

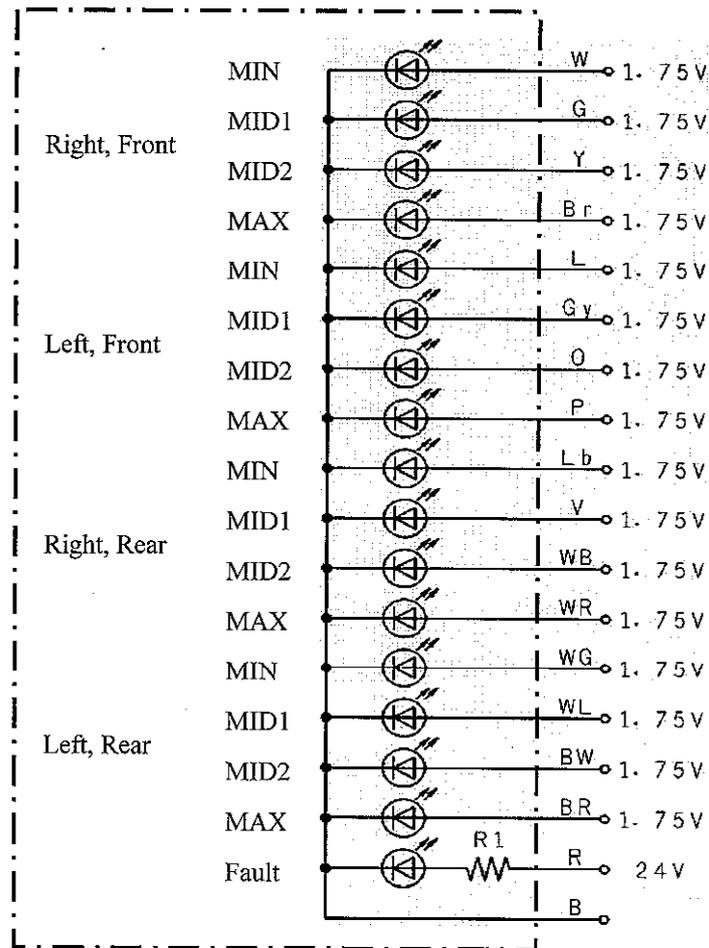
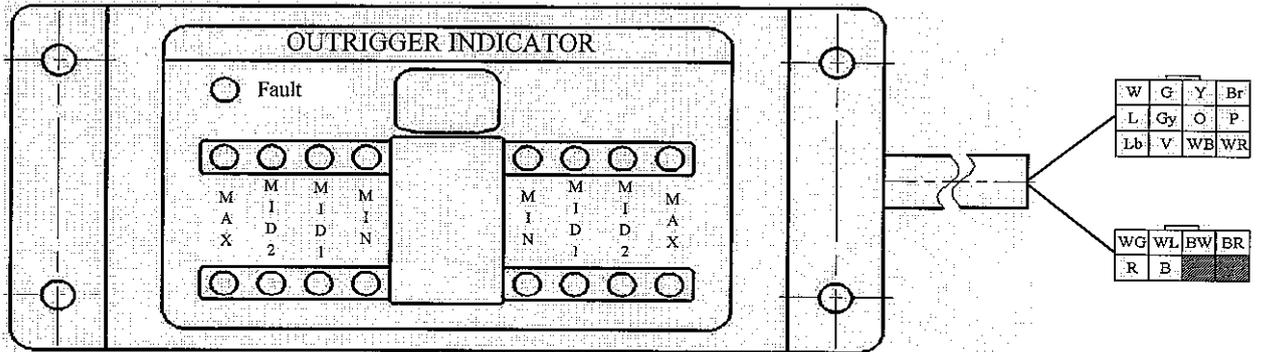


Outrigger extension indicator

329-000005

The outrigger extension indicator is located at the outrigger control station to indicate the current outrigger extension length.

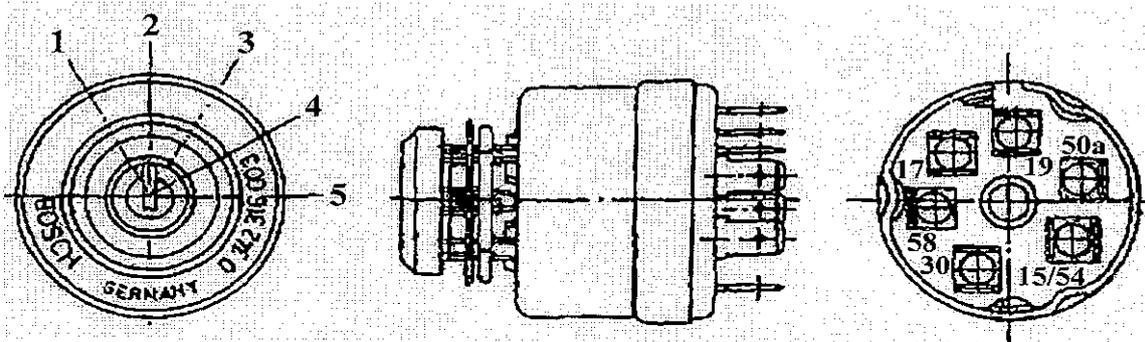
Rated voltage Outrigger extension length LED ----- DC1.75V
 Sensor failure LED (Fault) ----- DC24V



Control select key switch

This key switch is installed in the box located on the left side of the turntable to select the operating position from the platform (Upper) or the turntable(Lower).

Rated voltage ----- DC24V



	30	15 / 54	58	19	17	50a
2 (OFF)	○					
1 (UPPER)	○	—	○			
3 (LOWER)	○	○				
4 (GLOW)	○	—		○		
5 (START)	○	—	—	—	○	○

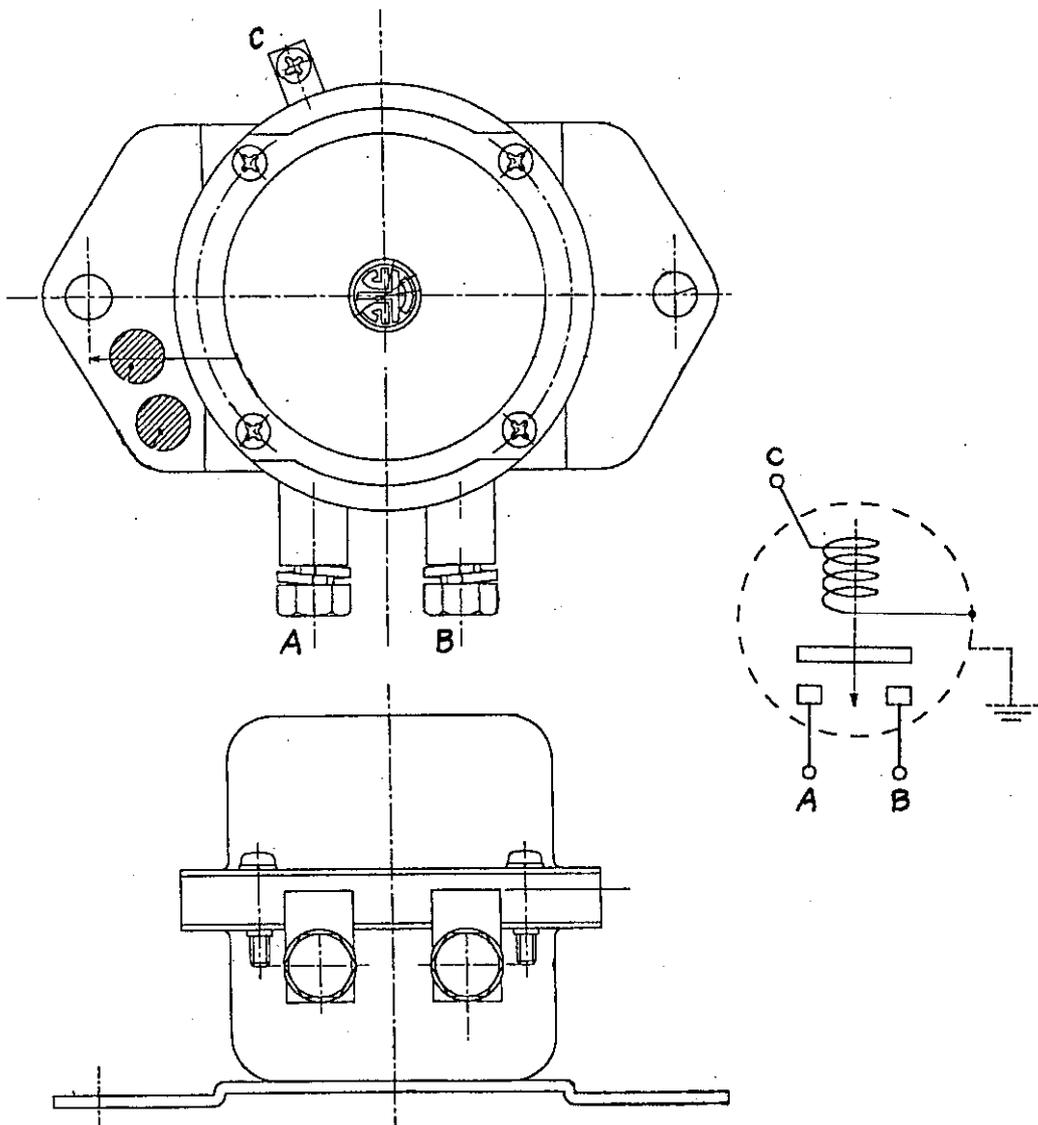
※4 (GLOW) and 5 (START) are not in use.

Contactor for Emergency pump

This contactor is installed on left side of the sub frame to supply the power to the emergency pump.

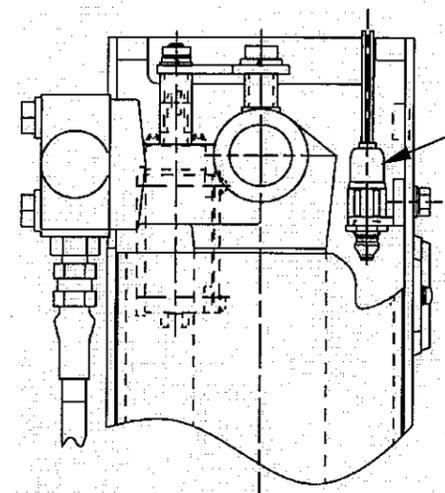
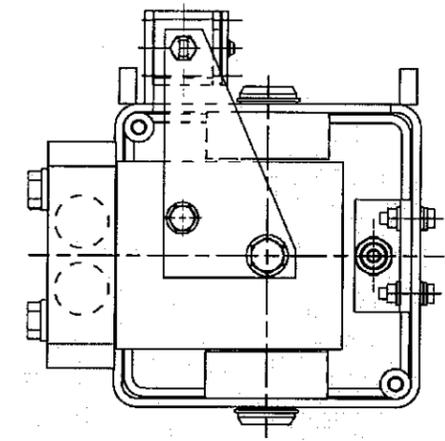
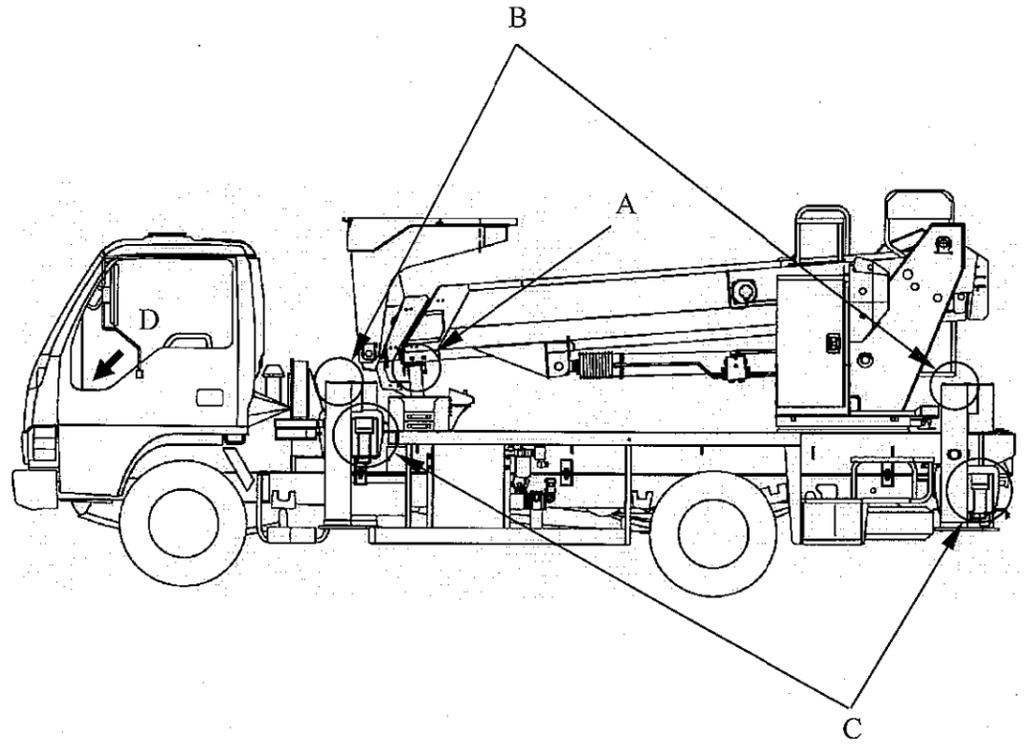
Rated voltage ----- DC 24 V.

Rated current ----- 200 A (Continuously), 700 A (2 minutes)



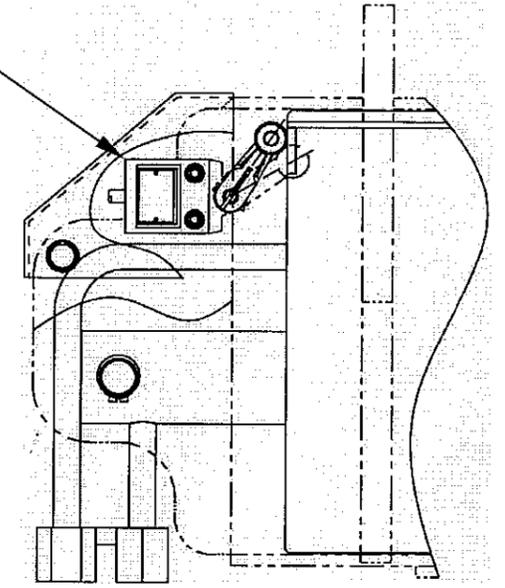
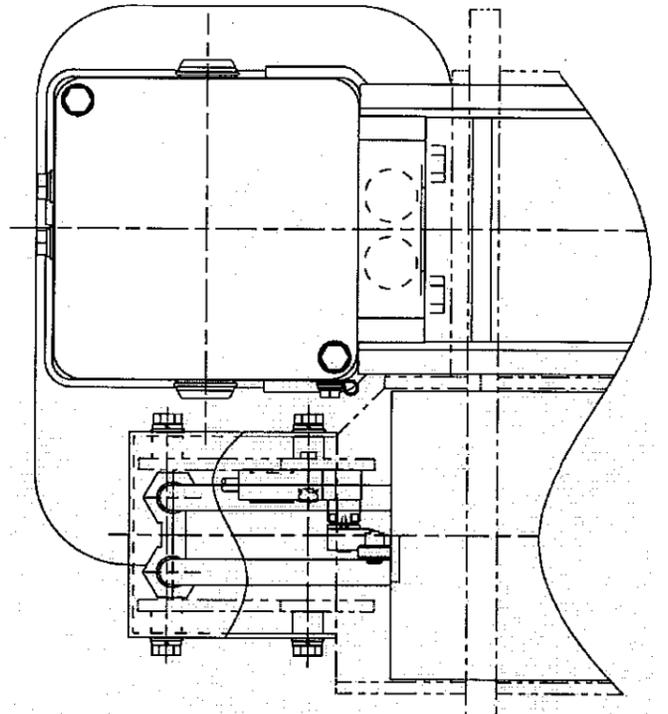
Storage confirmation system

The storage confirmation system consists of the components shown in the figure below to confirm that all of the outriggers, jacks and the boom are stowed.



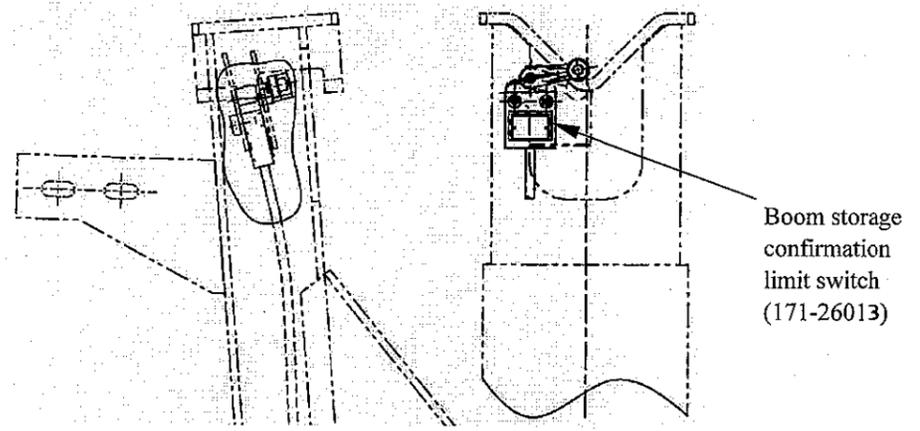
Jack storage confirmation limit switch (320-00013-00)

Outrigger storage confirmation limit switch (171-26000)



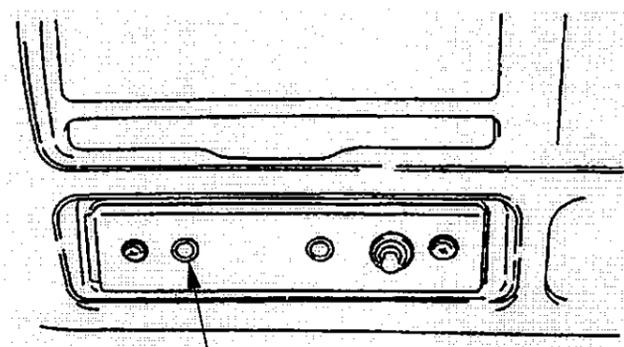
B detail

C detail



Boom storage confirmation limit switch (171-26013)

A detail

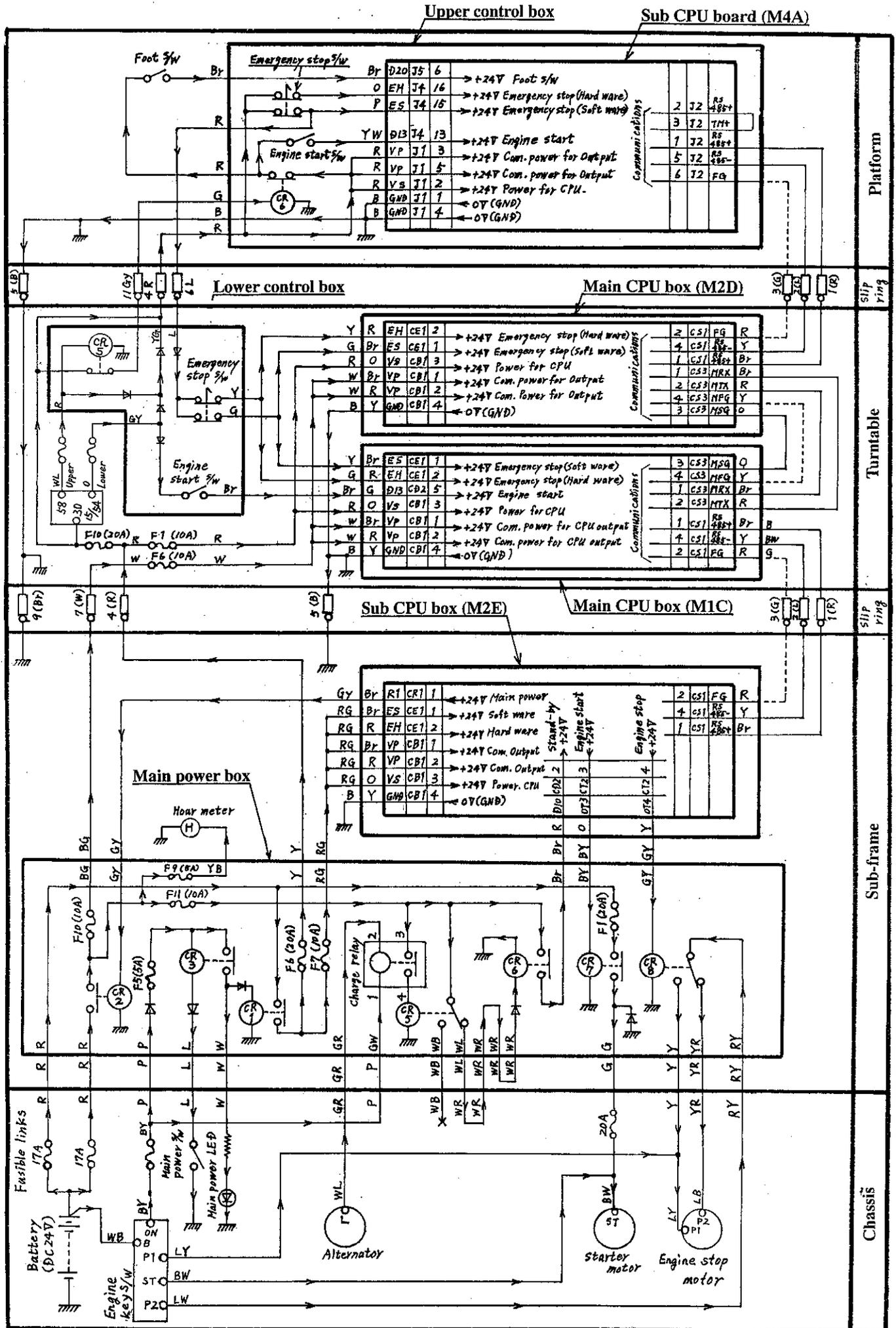


Storage LED

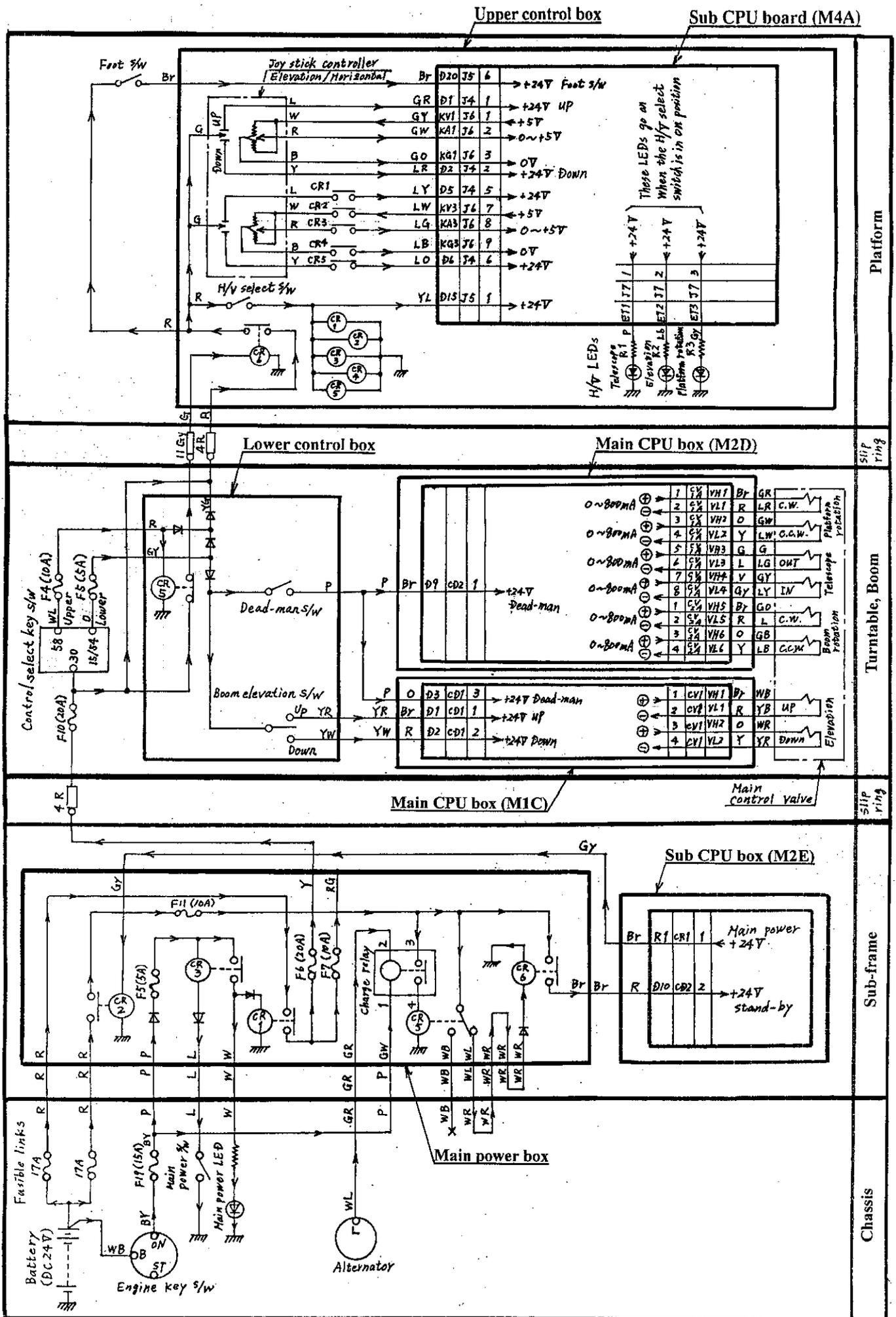
D view

5. Electrical circuit for individual system

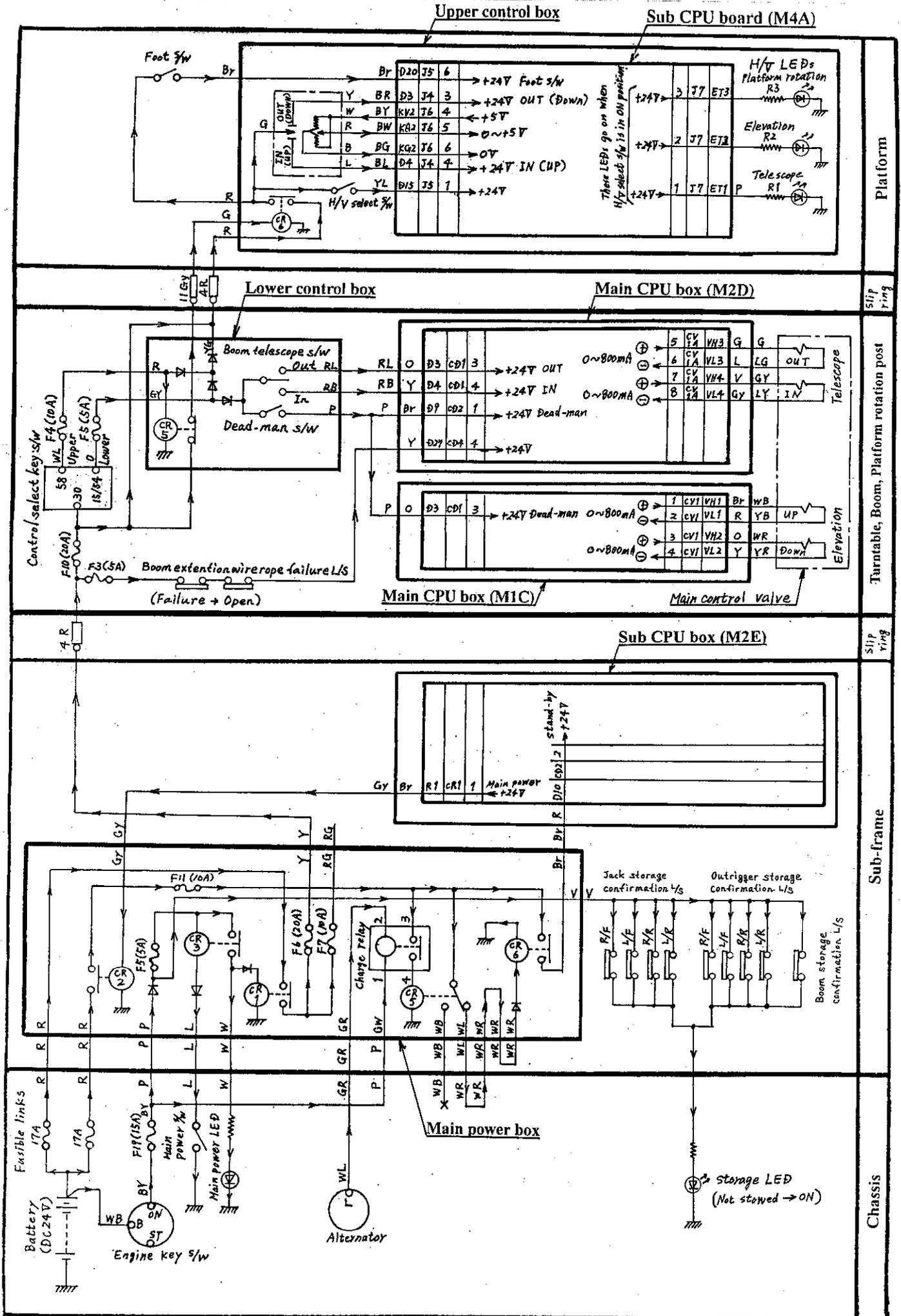
Engine control system



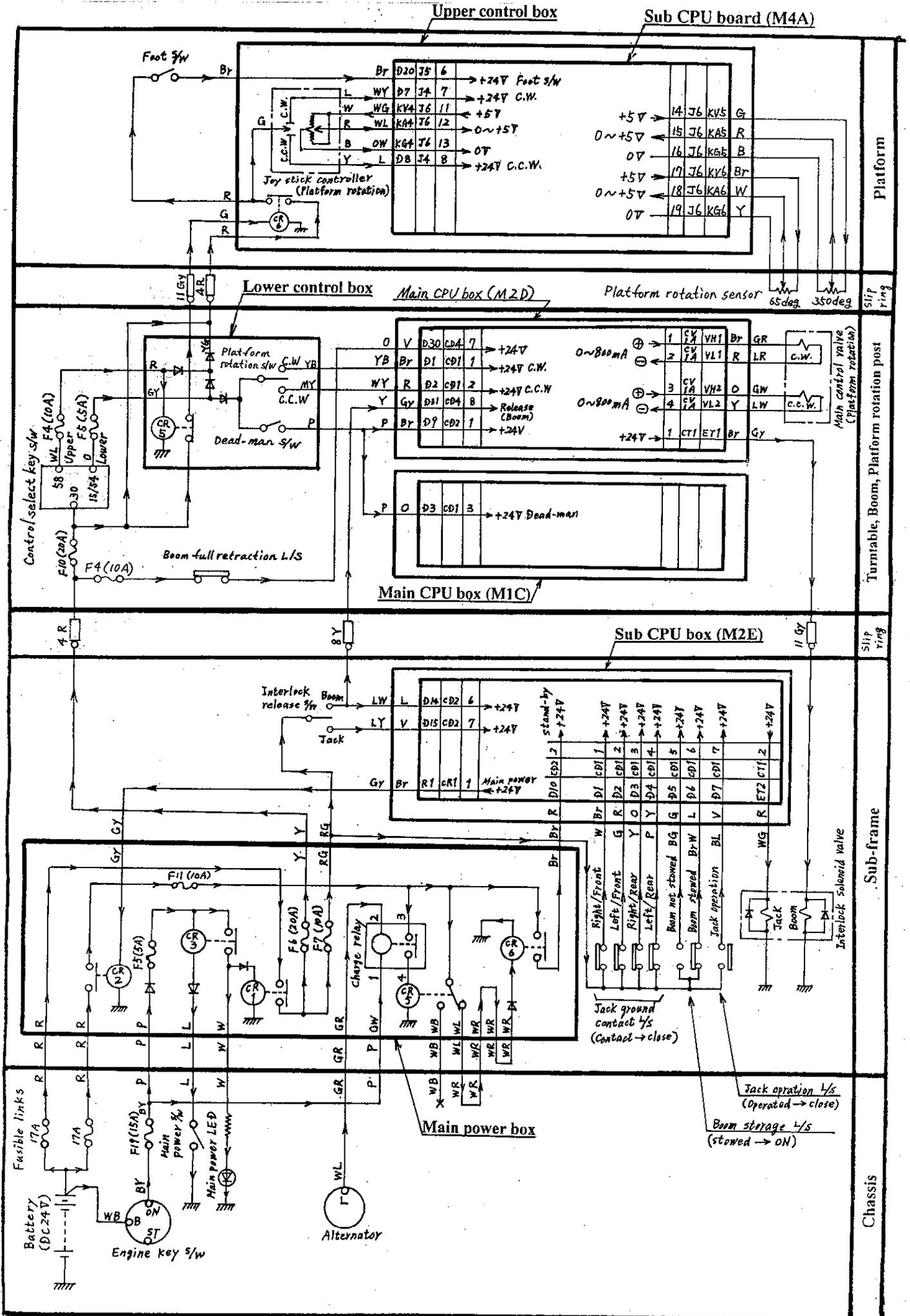
Boom elevation / Horizontal movement system



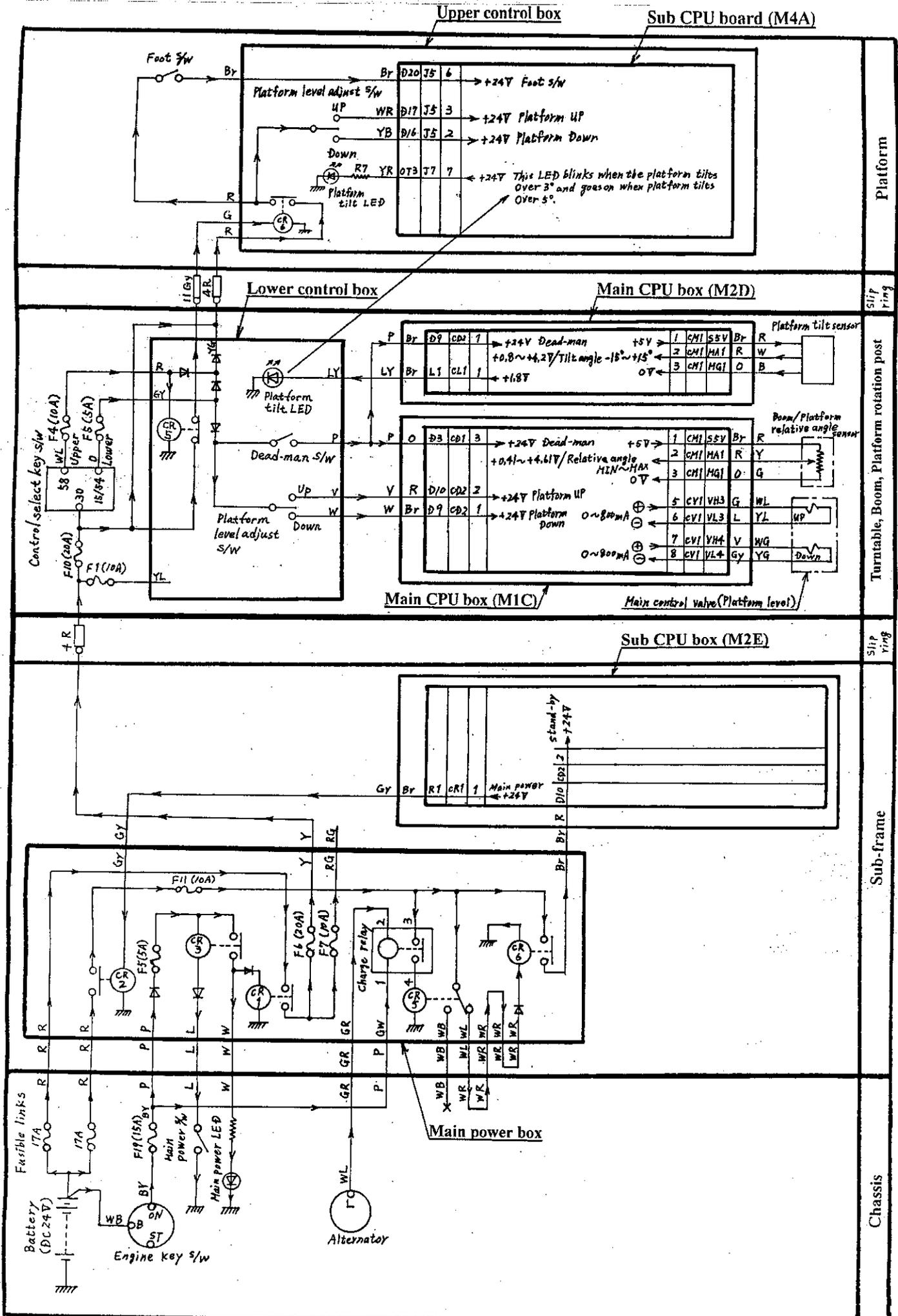
Boom telescope / Vertical movement and Storage confirmation system



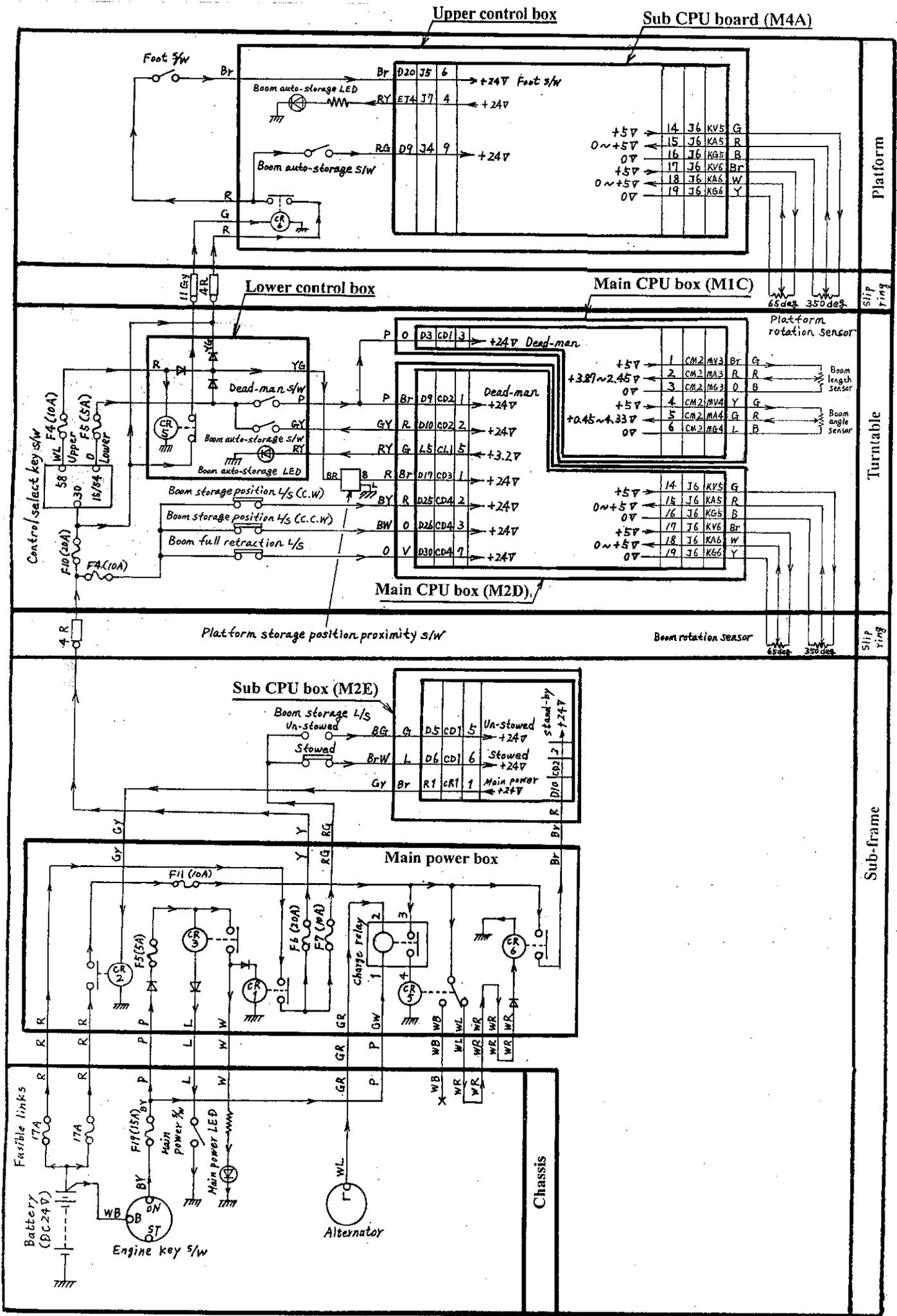
Platform rotation and Interlock system



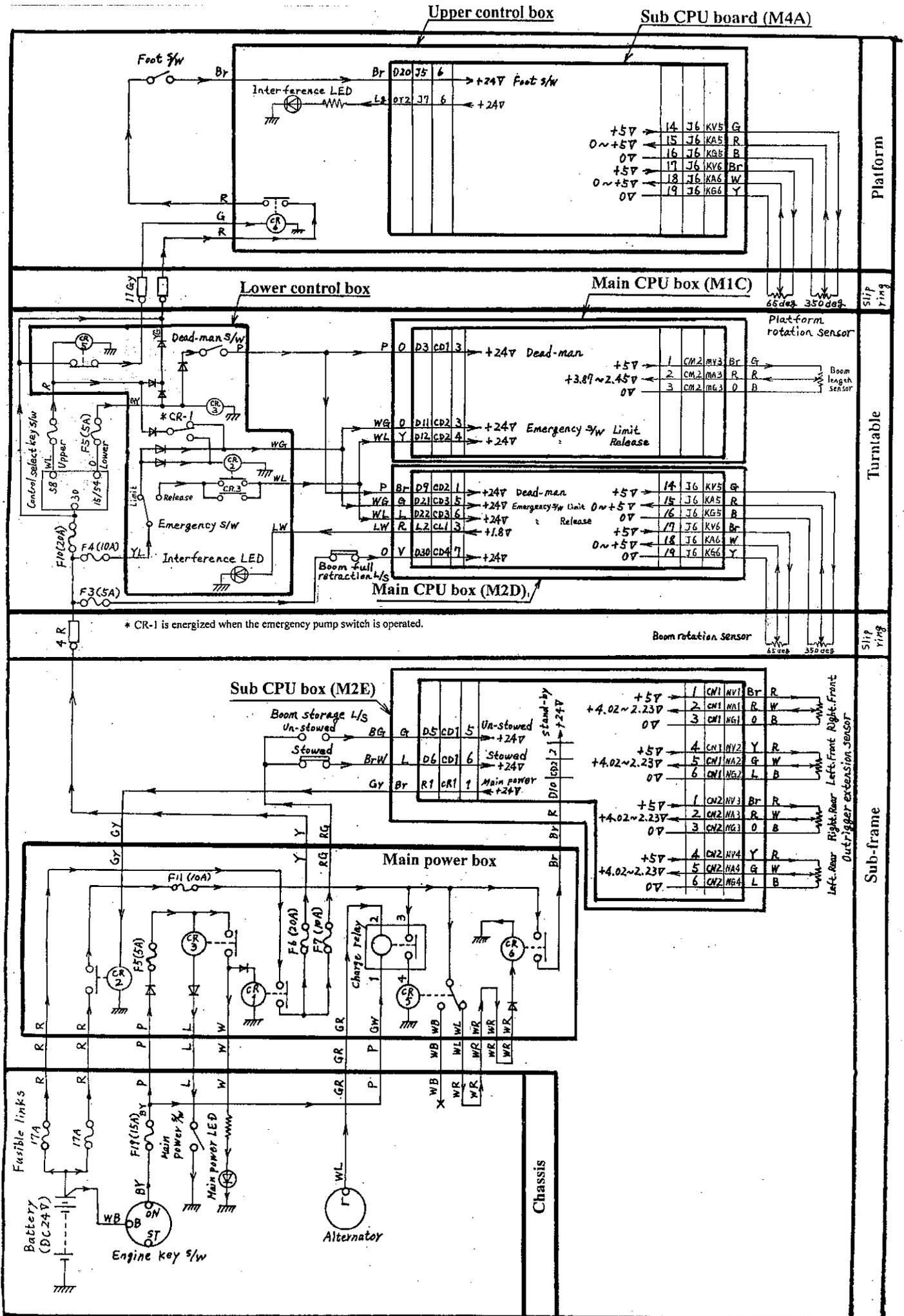
Platform levelling and Platform level adjust system



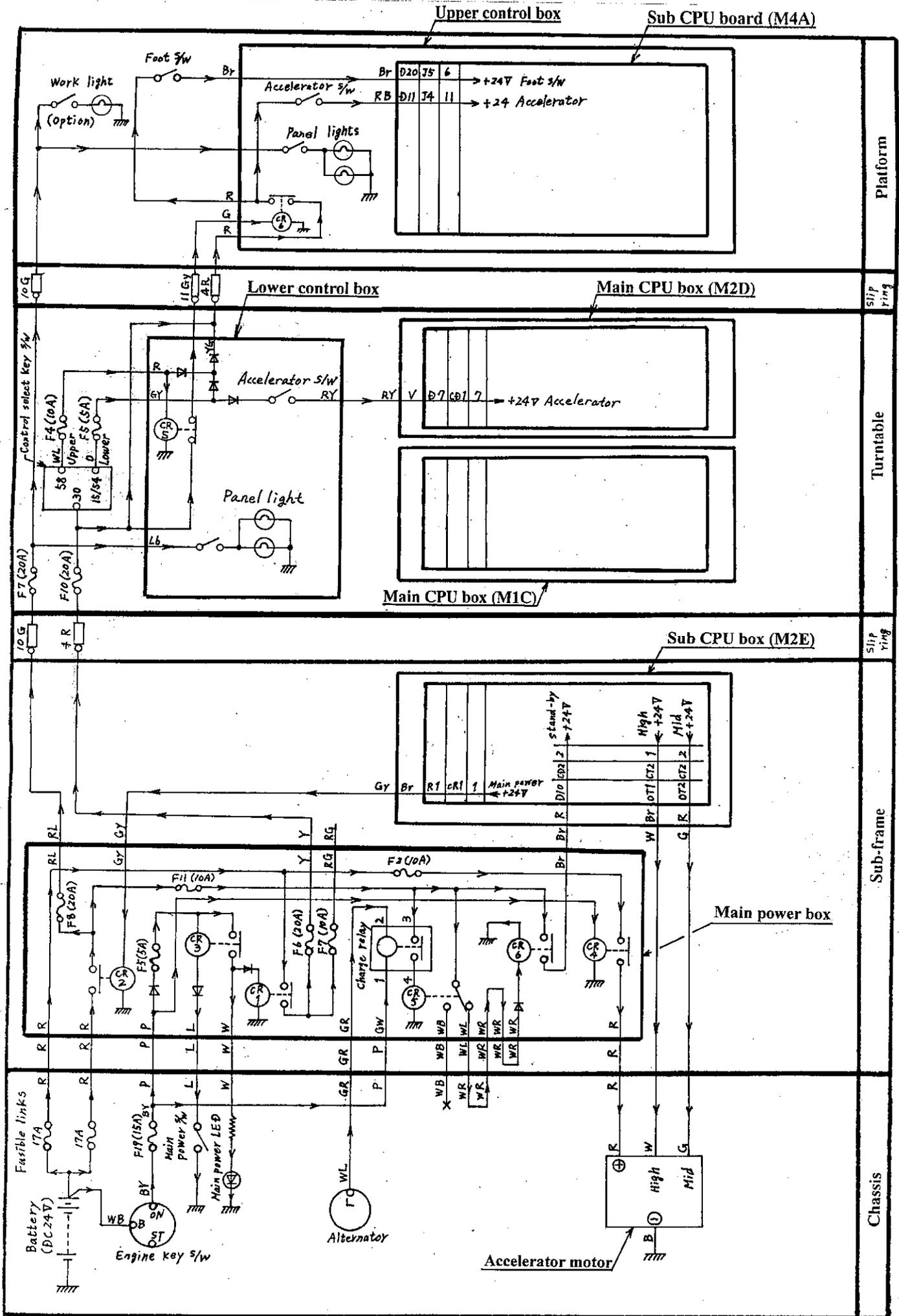
Boom auto-storage system



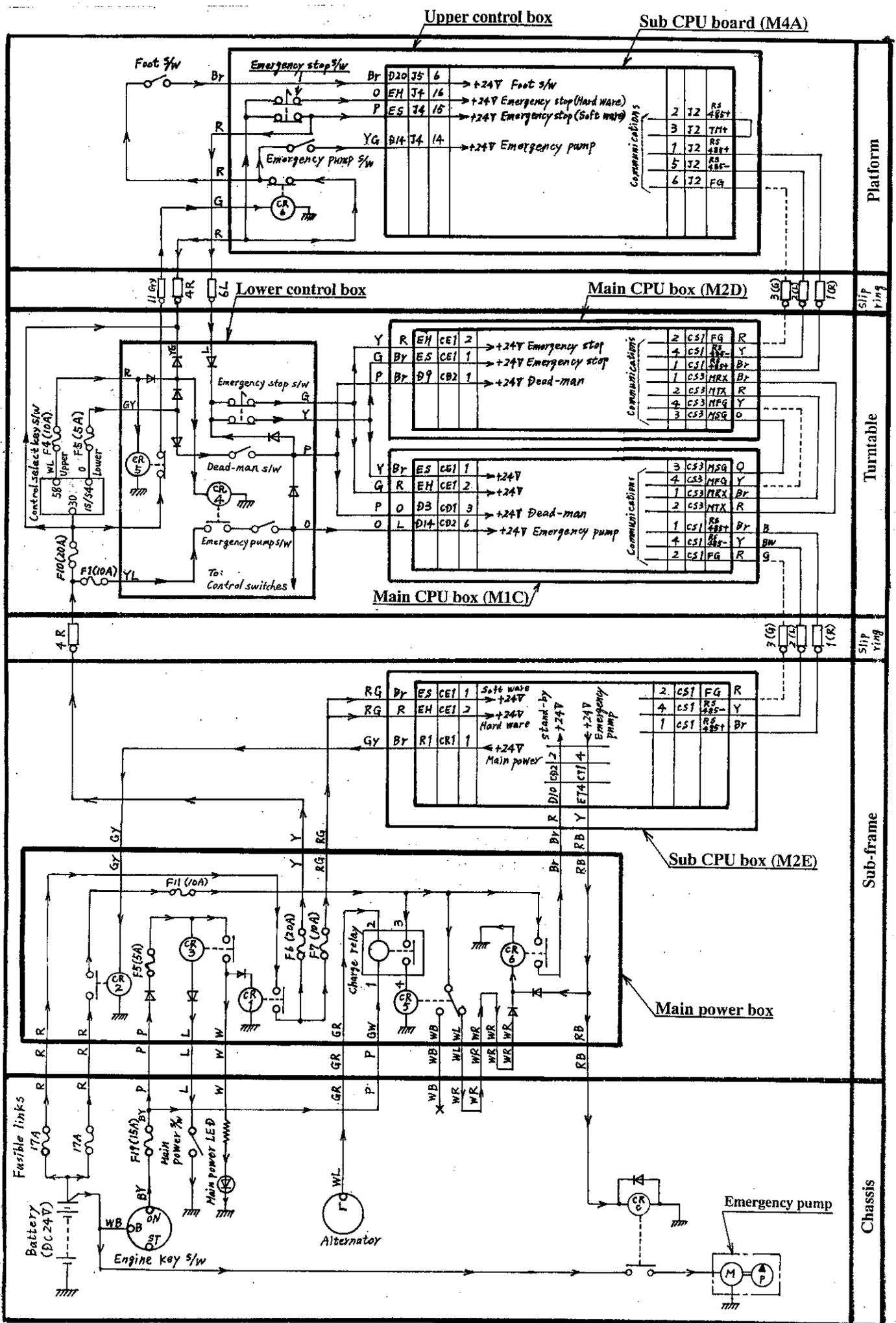
Interference limit system



Accelerator, Panel light and optional work light system



Emergency pump system



6. Inspections and Adjustments

Inspection procedures of Load moment limiter

The inspections of the load moment limiter should be conducted in the sequence listed below.

1. Inspection of Outrigger extension indicator.
2. Inspection of Work radius.
3. Inspection of Boom rotation limit angle.

For the detail of each inspection procedures, see the following pages.

Caution:

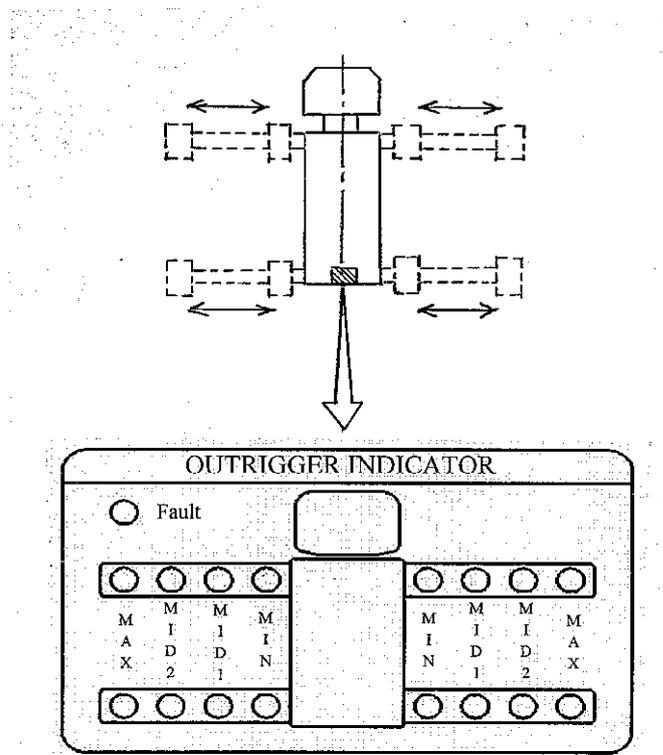
The following items should be strictly obeyed when conducting the inspections.

1. Set up the machine on firm and level surface.
2. Operate the boom from the lower control with the accelerator switch set to LOW position when checking the work radius and the boom rotation limit angle.
3. Do not allow any person on the platform when conducting these inspections.
4. Stop the inspections immediately and conduct adequate adjustments and repairs, if any fault is found out during the inspections.

1. Inspection of Outrigger extension indicator

This inspection should be conducted at the outrigger control station as follows with the boom stowed on the boom rest.

NO.	Inspection procedures	Remarks
1.	Start the engine, engage the PTO, and then turn on the main power switch.	
2.	Extend and retract each outrigger to its full stroke, and make sure that the LEDs (MIN, MID-1, MID-2 and MAX) turn on and off corresponding to the extended length of each outrigger.	



2. Inspection of work radius

Check the work radius of the platform following the procedures below as well as referring to the figures on the following page.

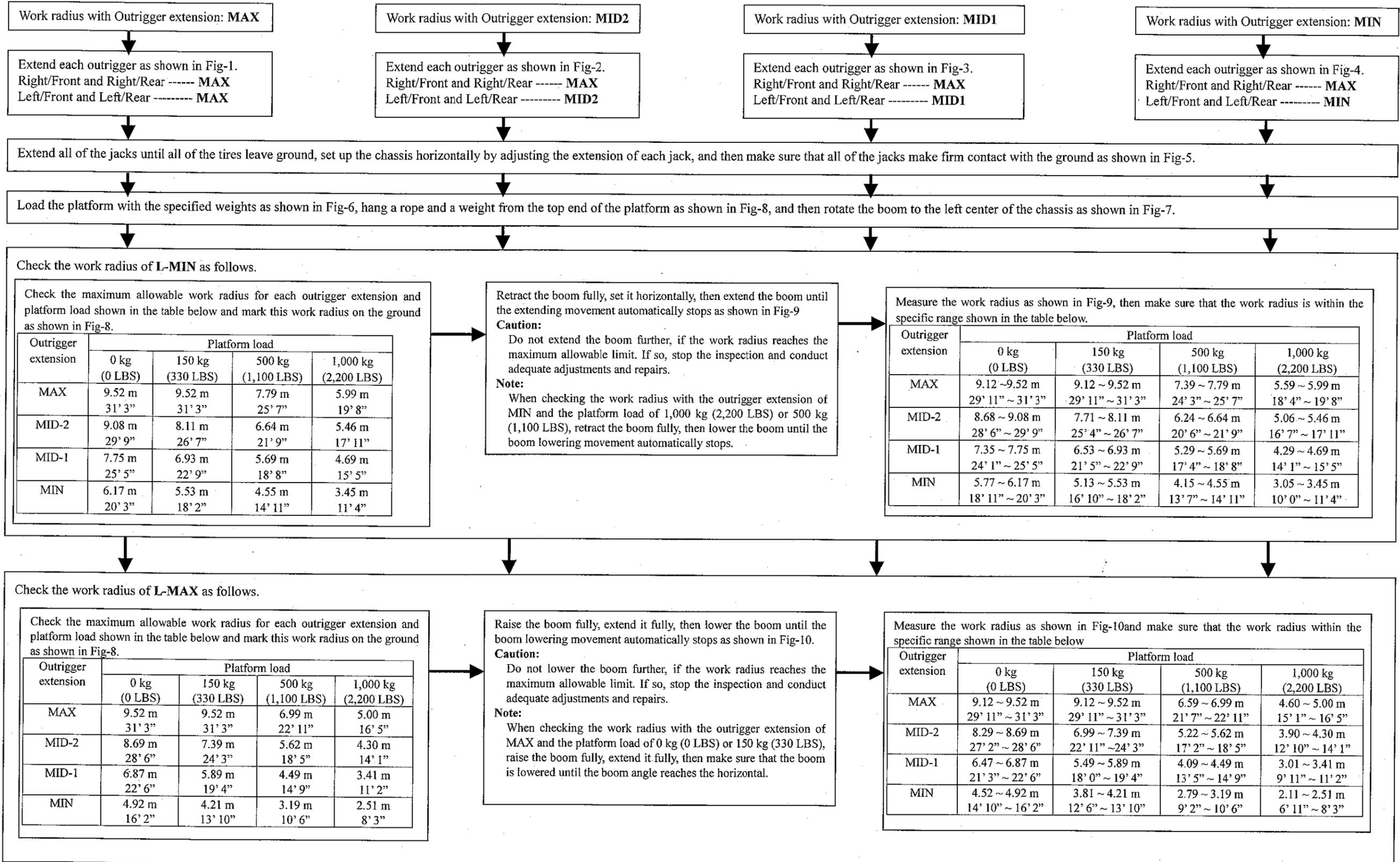


Fig - 1

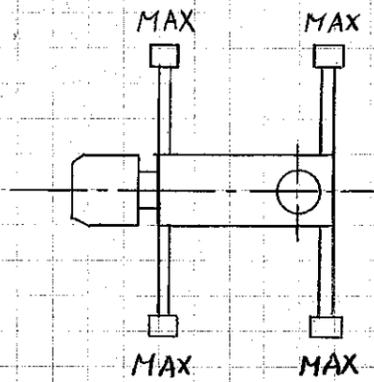


Fig - 2

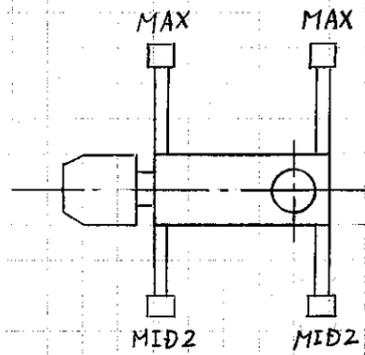


Fig - 3

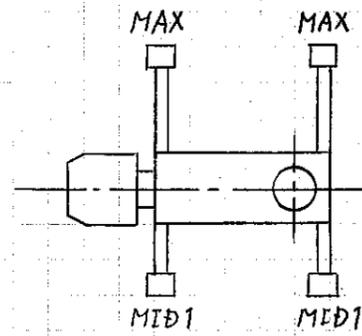


Fig - 4

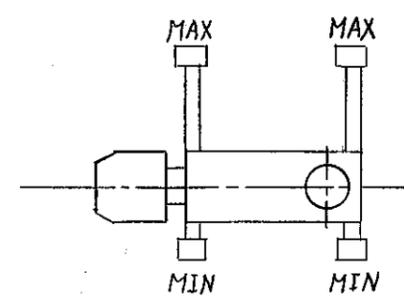


Fig - 5

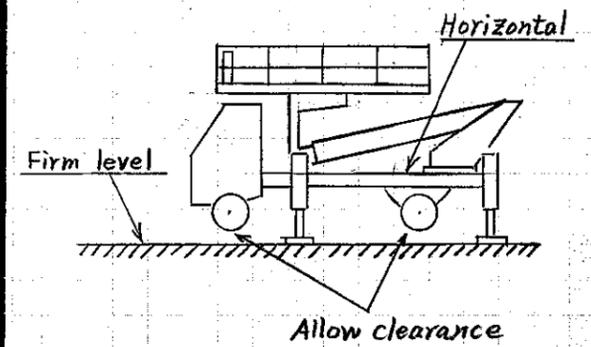


Fig - 6

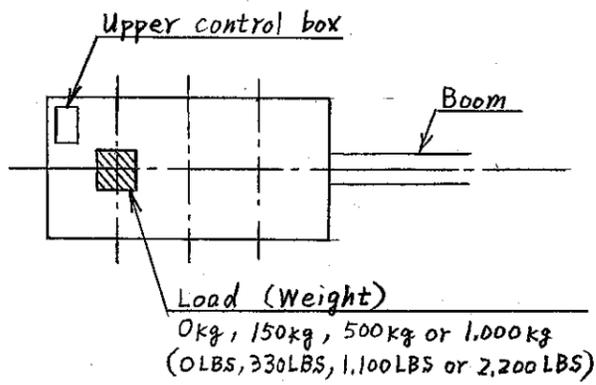


Fig - 7

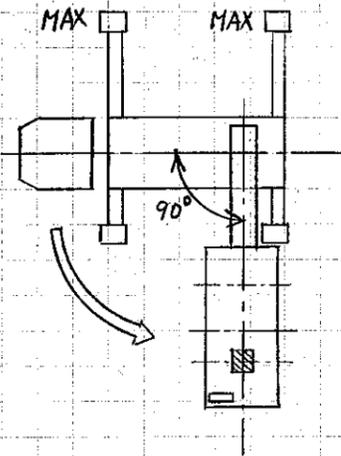


Fig - 8

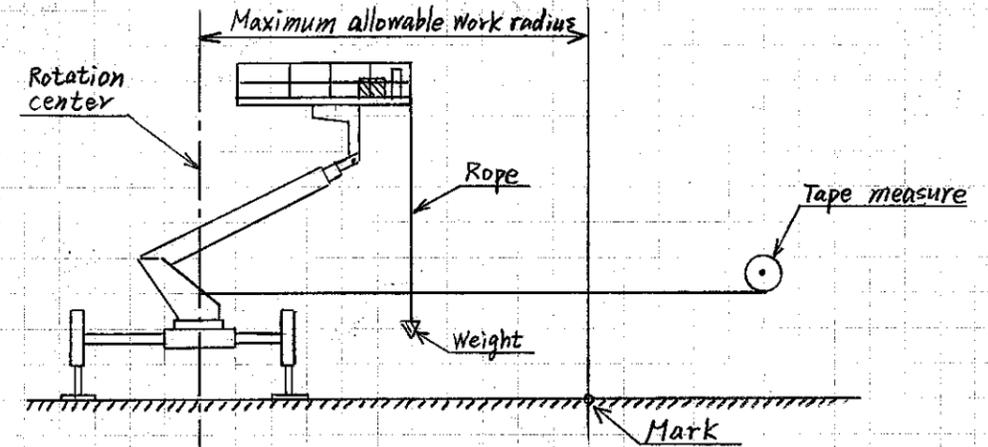


Fig - 9

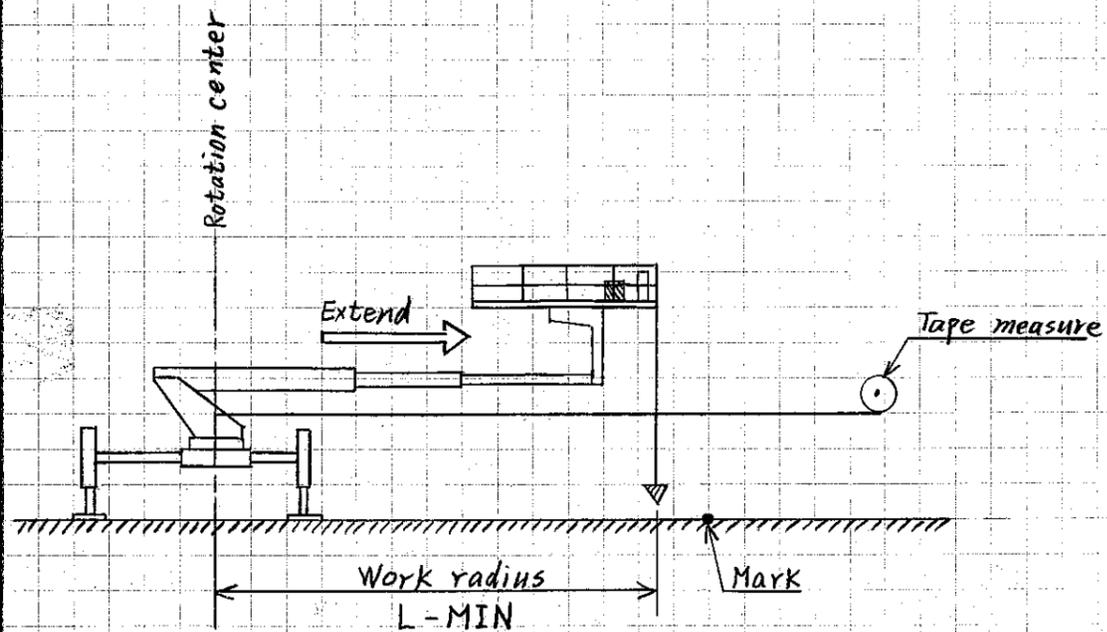
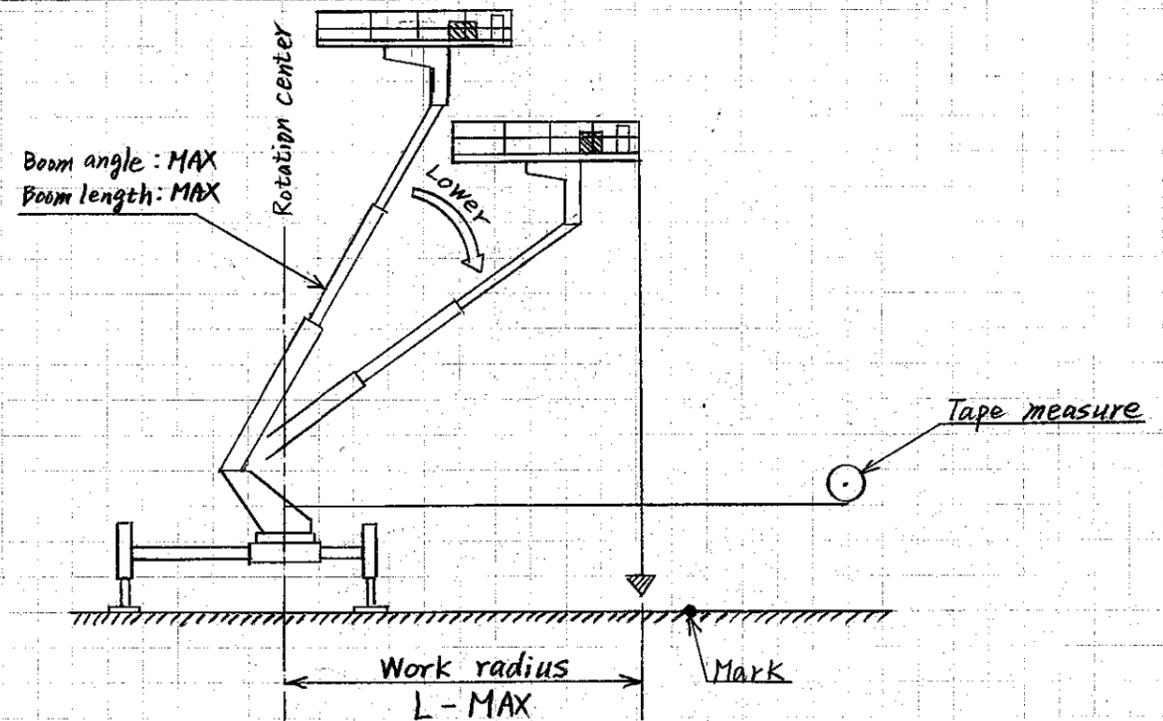


Fig - 10

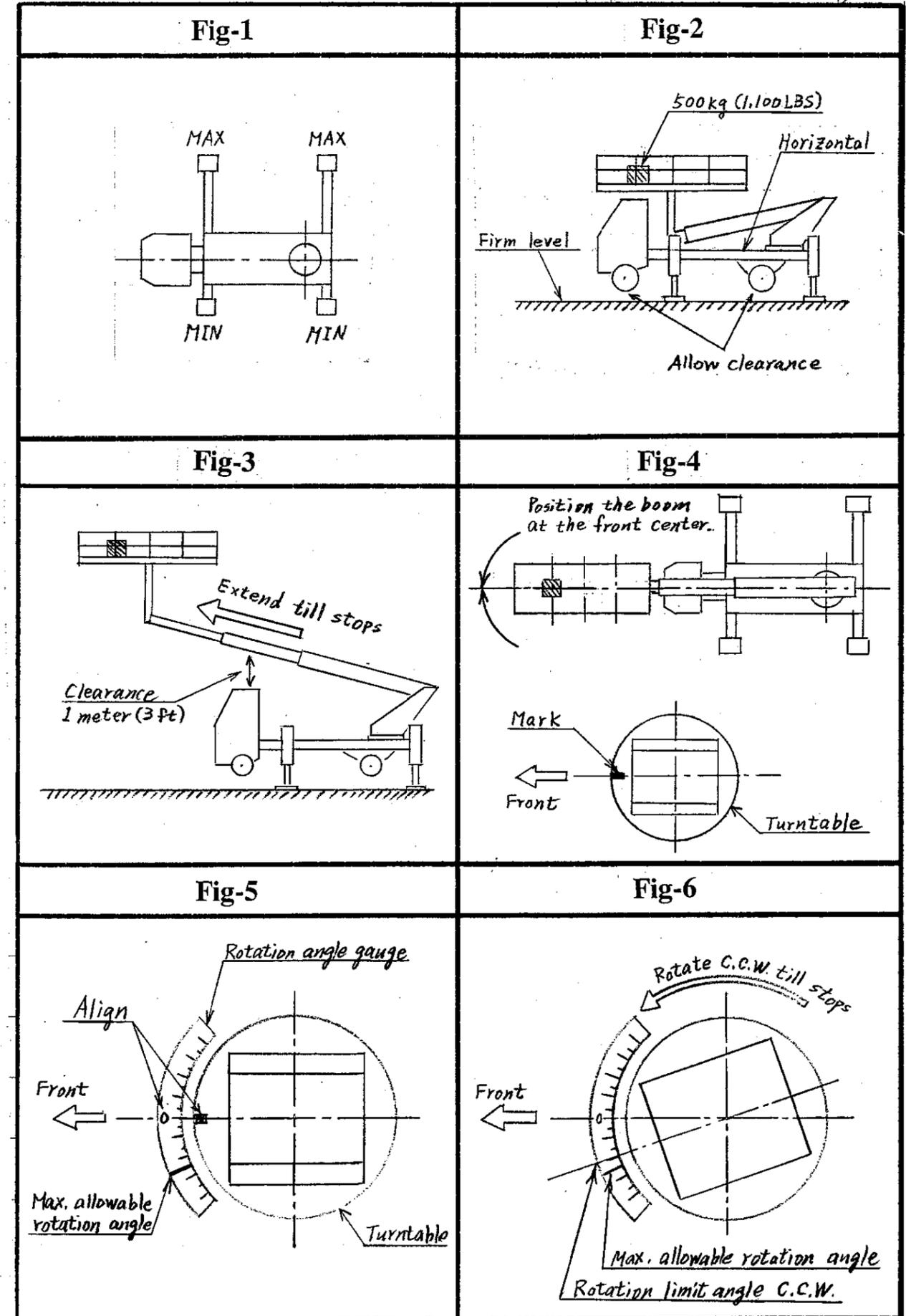


3. Inspection of Boom rotation limit angle

Check the boom rotation limit angle as follows

1. Extend each outrigger as shown in Fig-1 and allow "MIN" work radius to the left side of the vehicle.
2. Extend all of the jacks until all of the tires leave the ground, set up the machine horizontally by adjusting each jack, make sure all of the jacks make firm contact with the ground, then load the platform with 500 kg (1,100 LBS) as shown in Fig-2.
3. Raise the boom to allow the clearance of about 1 meter (3 ft) between the boom and the cabin, and then extend the boom till the extending movement automatically stops as shown in Fig-3.
4. Make sure that the boom is positioned at the front center of the vehicle, and then mark the front center of the turntable as shown in Fig-4.
5. Set the "Rotation angle gauge" (MZ99-9290) in front of the turntable and align the 0 degree of the gauge to the mark applied on the turntable as shown in Fig-5.
6. Check the maximum allowable rotation limit angle, and mark the angle onto the rotation angle gauge as shown in Fig-5.
 - Maximum allowable rotation limit angle ----- 25 degrees.
7. Rotate the turntable in C.C.W. direction until it automatically stops as shown in Fig-6.

Caution: Do not rotate the turntable beyond the maximum allowable rotation limit angle. If the turntable rotates beyond the maximum limit, stop the inspection and conduct adequate adjustments or repairs.
8. Check the rotation angle and make sure that the angle is within the specific range.
 - Specific rotation limit angle C.C.W. ----- 20 ~ 25 degrees. (See Fig-6)
9. Stow the boom on the boom rest, extend the left side outriggers to MAX and the right side outriggers to MIN, then check the rotation C.W. limit angle as following the above procedures.
 - Specific rotation limit angle C.W. ----- 20 ~ 25 degrees.



Inspection data sheet

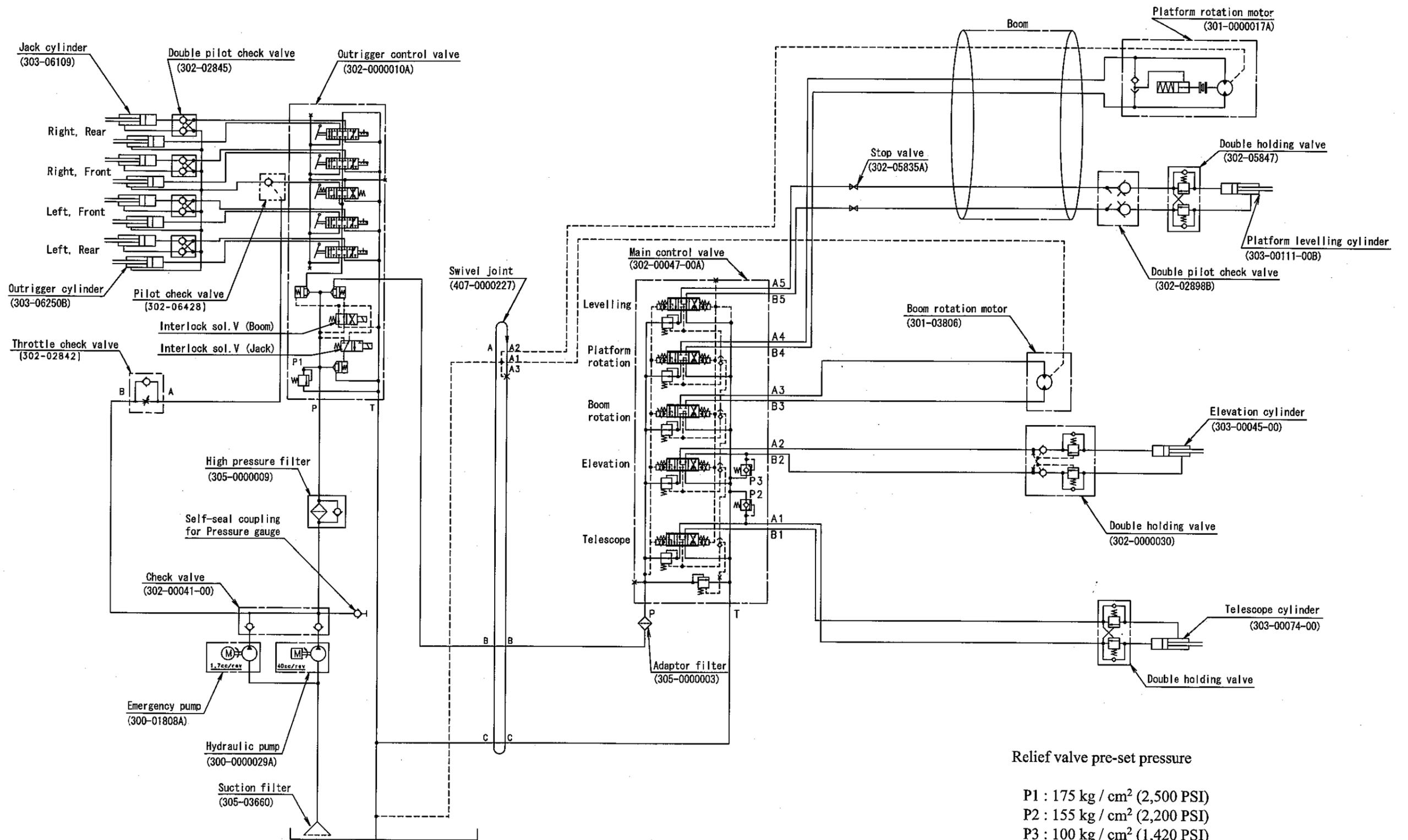
Model	Spec. No.	Serial No.	Hour meter	Date	Inspector		
Hydraulic pump rpm	Specific rpm		Results		Remarks		
	LOW	Engine idling	rpm				
	MID	800 ~ 850 rpm	rpm				
	HIGH	900 ~ 950 rpm	rpm				
Relief valve	Relief valve No.		Specific pressure		Remarks		
	P1 (Main)		175 ~ 180 kg/cm ² (2500 ~ 2560 PSI)				
	P2 (Telescope OUT)		155 ~ 160 kg/cm ² (2200 ~ 2275 PSI)				
Actuating speed	Item		Specific speed		Results	Remarks	
	Elevation	UP	40 ± 10 sec.				sec.
		DOWN	45 ± 10 sec.		sec.		
	Telescope	OUT	30 ± 10 sec.		sec.	Boom angle: Max.	
		IN	30 ± 10 sec.		sec.		
	Boom rotation	CW	60 ± 10 sec./360degrees		sec.	Boom angle: Max. Boom length: Min.	
		CCW	60 ± 10sec./360degrees		sec.		
	Platform rotation	CW	60 ± 10 sec./360degrees		sec.	Boom angle: Max. Boom length: Min.	
CCW		60 ± 10 sec./360degrees		sec.			
Limited actuating speed	Elevation	UP	90 ± 10 sec. (Boom angle: 0 degree ~ Max.)		sec.	Boom length: Max.	
		DOWN	90 ± 10 sec. (Boom angle: Max. ~ 0 degree.)		sec.		
	Boom rotation	CW	45 ± 4 sec./45degrees.		sec.	Boom angle: 0 degree. Boom length: Max.	
		CCW	45 ± 4 sec./45degrees.		sec.		
Hydraulic cylinder natural descent	Item		Serviceable limit		Results	Remarks	
	Jack cylinder	Right/Front	1 mm (0.04 in)/10 min.				
		Left/Front	1 mm (0.04 in)/10 min.				
		Right/Rear	1 mm (0.04 in)/10 min.				
		Left/Rear	1 mm (0.06 in)/10 min.				
	Elevation cylinder		2 mm (0.08 in)/10 min.				
Telescoping cylinder		2 mm (0.08 in)/10 min.					
Outtrigger extension indicator	Outriggers	Results (LED ON/OFF conditions)				Remarks	
		MIN	MID-1	MID-2	MAX		
	Right/Front						
	Left/Front						
	Right/Rear						
Left/Rear							
Work radius	Outtrigger extension	Load on platform	Item	Specific work radius		Results	Remarks
	MAX	0 kg (0 LBS)	L-MIN	9.12 ~ 9.52 m (29' 11" ~ 31' 3")			
			L-MAX	9.12 ~ 9.52 m (29' 11" ~ 31' 3")			
		150 kg (330 LBS)	L-MIN	9.12 ~ 9.52 m (29' 11" ~ 31' 3")			
			L-MAX	9.12 ~ 9.52 m (29' 11" ~ 31' 3")			
		500 kg (1,100 LBS)	L-MIN	7.39 ~ 7.79 m (24' 3" ~ 25' 7")			
			L-MAX	6.59 ~ 6.99 m (21' 7" ~ 22' 11")			
		1,000 kg (2,200 LBS)	L-MIN	5.59 ~ 5.99 m (18' 4" ~ 19' 8")			
L-MAX			4.60 ~ 5.00 m (15' 1" ~ 16' 5")				

Work radius	Outrigger extension	Platform load	Item	Specific work radius		Result	Remarks
	MID-2	0 kg (0 LBS)	L-MIN	8.68 ~ 9.08 m (28' 6" ~ 29' 9")			
			L-MAX	8.29 ~ 8.69 m (27' 2" ~ 28' 6")			
		150 kg (330 LBS)	L-MIN	7.71 ~ 8.11 m (25' 4" ~ 26' 7")			
			L-MAX	6.99 ~ 7.39 m (22' 11" ~ 24' 3")			
		500 kg (1,100 LBS)	L-MIN	6.24 ~ 6.64 m (20' 6" ~ 21' 9")			
			L-MAX	5.22 ~ 5.62 m (17' 2" ~ 18' 5")			
	1,000 kg (2,200 LBS)	L-MIN	5.06 ~ 5.46 m (16' 7" ~ 17' 11")				
		L-MAX	3.90 ~ 4.30 m (12' 10" ~ 14' 1")				
	MID-1	0 kg (0 LBS)	L-MIN	7.35 ~ 7.75 m (24' 1" ~ 25' 5")			
			L-MAX	6.47 ~ 6.87 m (21' 3" ~ 22' 6")			
		150 kg (330 LBS)	L-MIN	6.53 ~ 6.93 m (21' 5" ~ 22' 9")			
			L-MAX	5.49 ~ 5.89 m (18' 0" ~ 19' 4")			
		500 kg (1,100 LBS)	L-MIN	5.29 ~ 5.69 m (17' 4" ~ 18' 8")			
			L-MAX	4.09 ~ 4.49 m (13' 5" ~ 14' 9")			
	1,000 kg (2,200 LBS)	L-MIN	4.29 ~ 4.69 m (14' 1" ~ 15' 5")				
		L-MAX	3.01 ~ 3.41 m (9' 11" ~ 11' 2")				
	MIN	0 kg (0 LBS)	L-MIN	5.77 ~ 6.17 m (18' 11" ~ 20' 3")			
			L-MAX	4.52 ~ 4.92 m (14' 10" ~ 16' 2")			
150 kg (330 LBS)		L-MIN	5.13 ~ 5.53 m (16' 10" ~ 18' 2")				
		L-MAX	3.81 ~ 4.21 m (12' 6" ~ 13' 10")				
500 kg (1,100 LBS)		L-MIN	4.15 ~ 4.55 m (13' 7" ~ 14' 11")				
		L-MAX	2.79 ~ 3.19 m (9' 2" ~ 10' 6")				
1,000 kg (2,200 LBS)	L-MIN	3.05 ~ 3.45 m (10' 0" ~ 11' 4")					
	L-MAX	2.11 ~ 2.51 m (6' 11" ~ 8' 3")					
Rotation limit angle	Outrigger extension	Rotating direction		Specific limit angle	Results	Remarks	
	MIN	C. W.		20 ~ 25 degrees		Platform load: 500 kg (1,100 LBS)	
Other systems	Item	Inspection procedures					Results
	Interlock system	Stow the jacks and make sure that the boom does not rise from the boom rest.					
		Raise the boom and make sure that the jack and outrigger functions are disabled.					
	Boom automatic storage system	Set the boom and the platform at the automatic storage-able positions, operate the "Auto storage switch" and make sure the boom is stowed onto the boom rest properly.					
	Pre-start check system	Conduct the pre-start check by operating the pre-start check switch and make sure the boom movements stop at the specified positions.					
	Interference limit system	Operate the boom and the platform near the cabin and the jacks and make sure that the boom and the platform movements stop before interfering with the cabin and the jacks.					
		Lower the boom fully with the platform rotated 90 degrees from the central position, rotate the platform and make sure that the platform rotation stops before the platform interferes with the boom.					
Lower the boom with the platform rotated to the central position and make sure that the boom lowering movement stops before the boom interferes with the platform.							
Emergency stop system	Press the emergency stop switch and make sure that engine stops and all of the functions are disabled.						
Emergency pump system	Operate the boom and the platform using the emergency pump and make sure they move.						

7. Appendix

Hydraulic circuit diagram

(601-00077-00A)



Relief valve pre-set pressure

P1 : 175 kg / cm² (2,500 PSI)

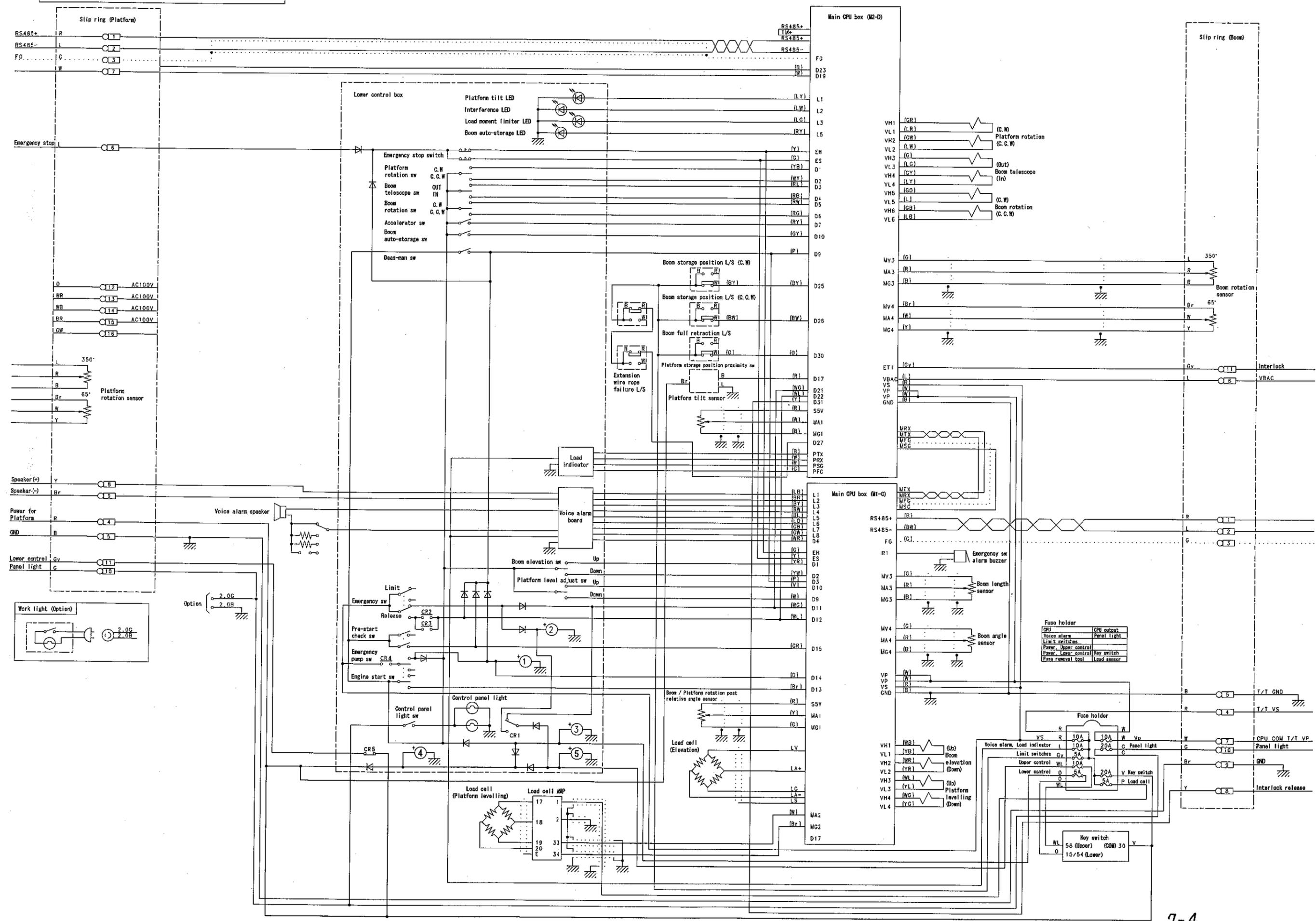
P2 : 155 kg / cm² (2,200 PSI)

P3 : 100 kg / cm² (1,420 PSI)

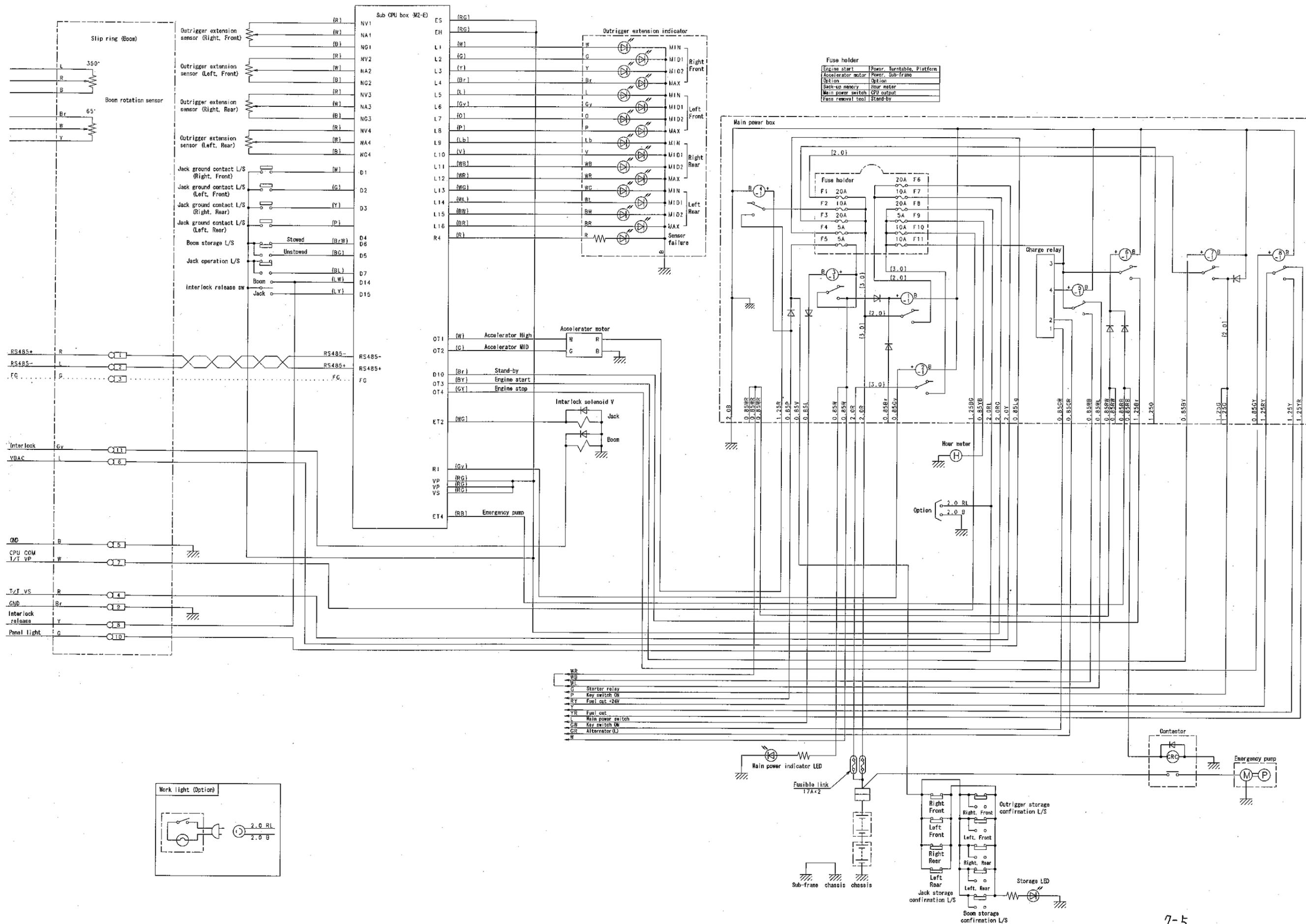
* at Pump speed : 900 ⁺⁵⁰/₀ rpm

Electric circuit diagram (Turntable)

(602-00369-00A)

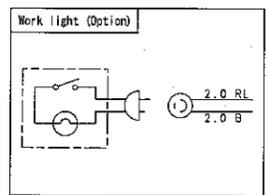


Electric circuit diagram (Subframe)



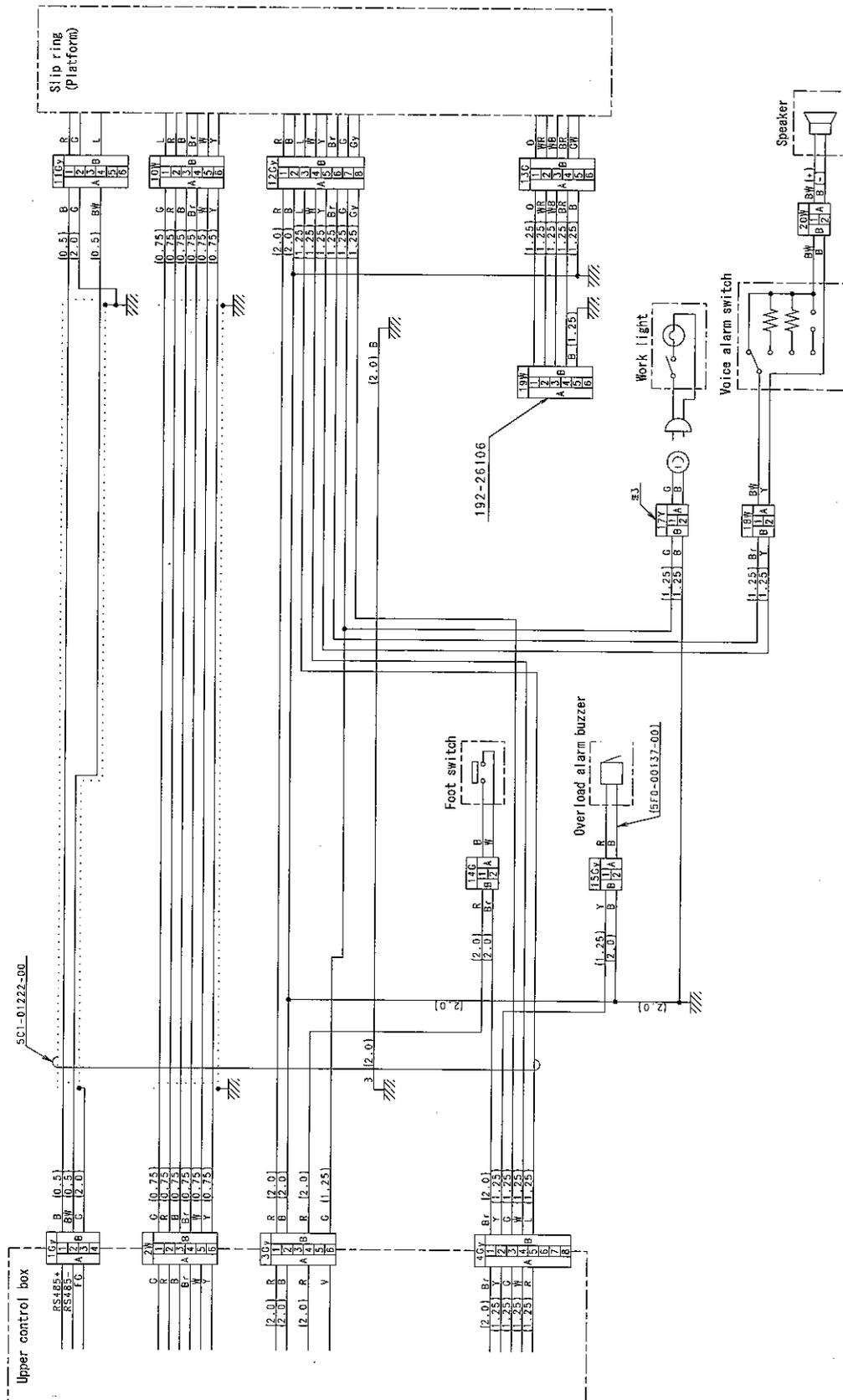
Fuse holder

Engine start	Power, Turntable, Platform
Accelerator motor	Power, Sub-frame
Option	Option
Back-up memory	Hour meter
Main power switch	GPU output
Fuse removal tool	Stand-by



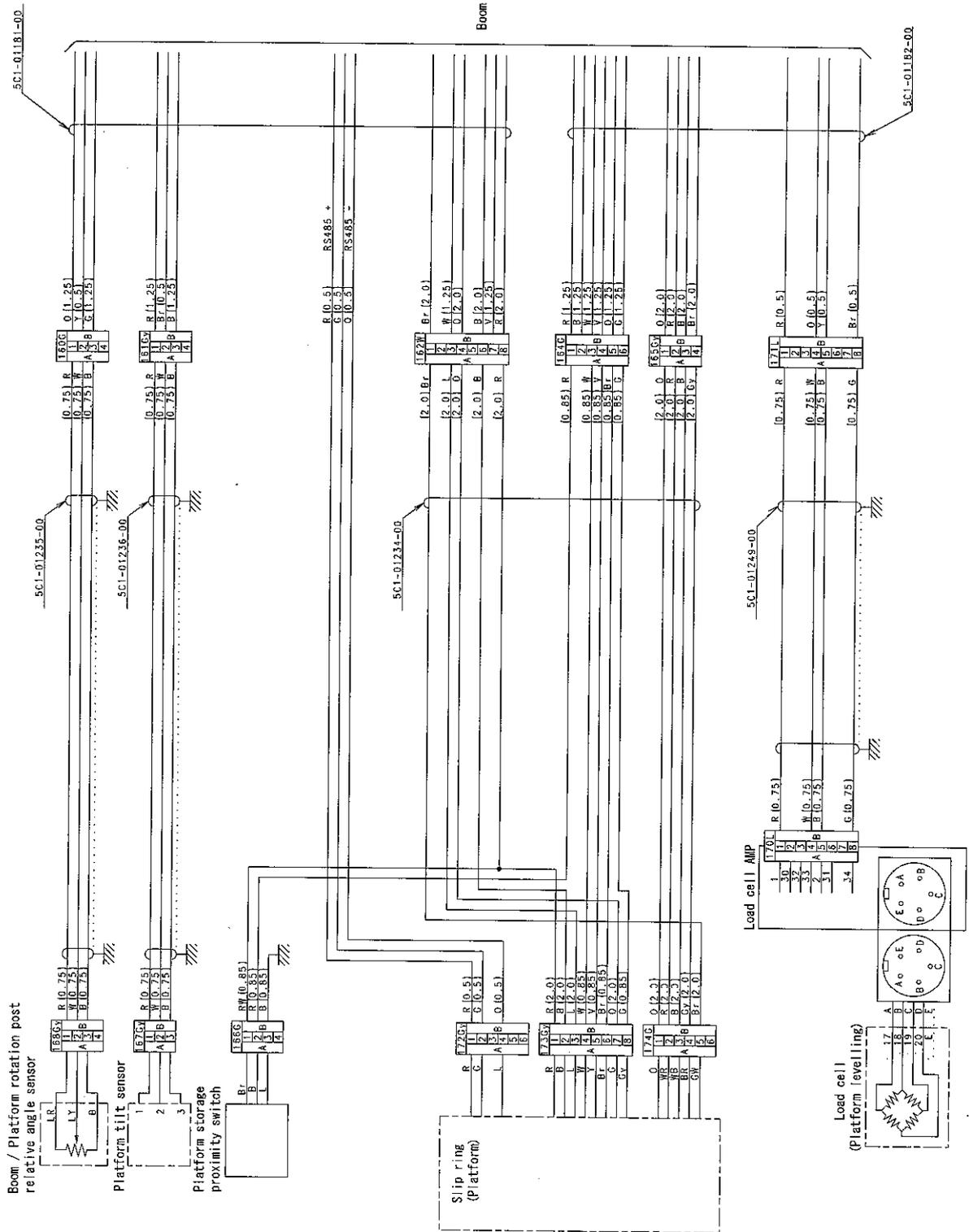
Electric wiring chart (Platform)

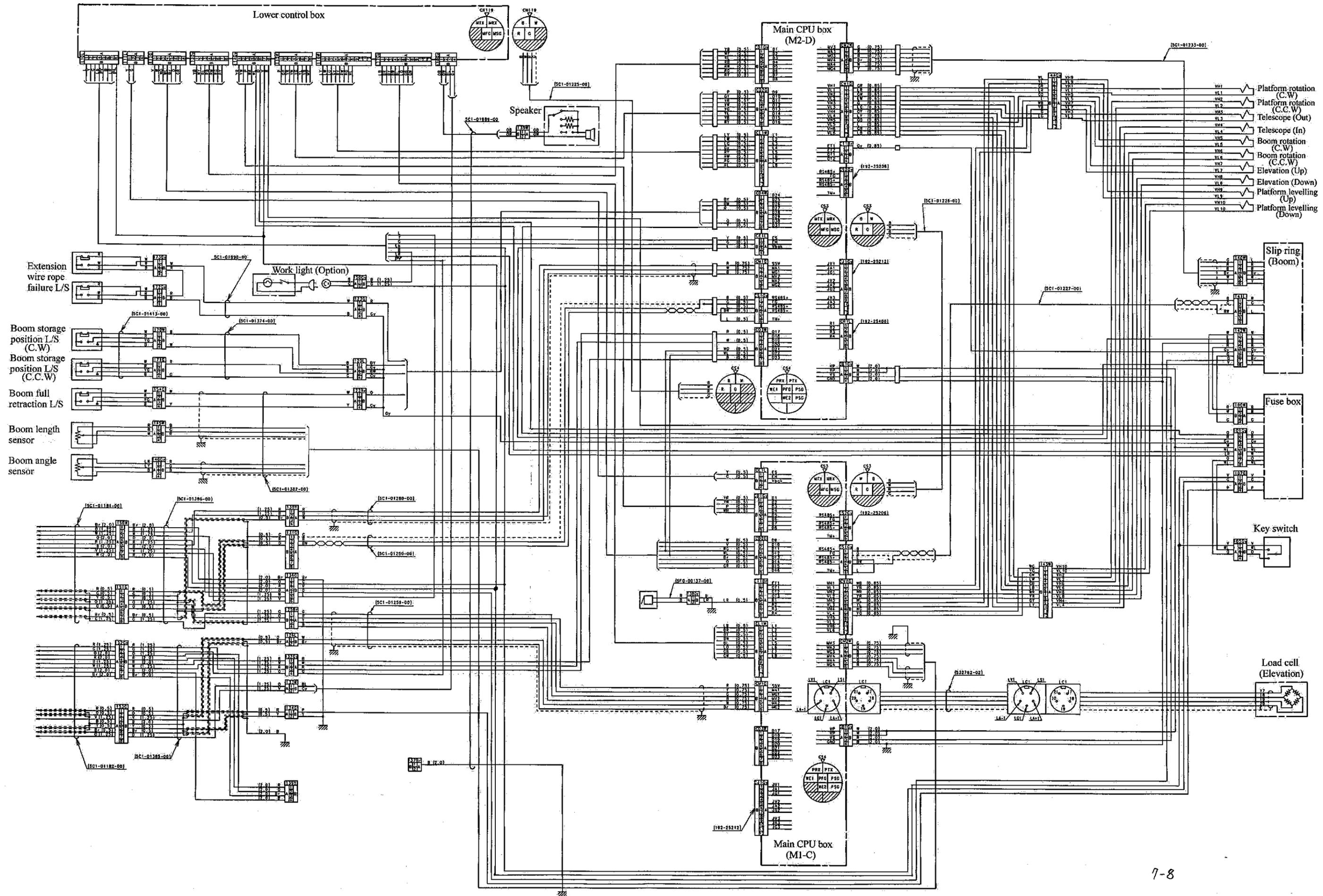
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Electric wiring chart (Platform rotation post)

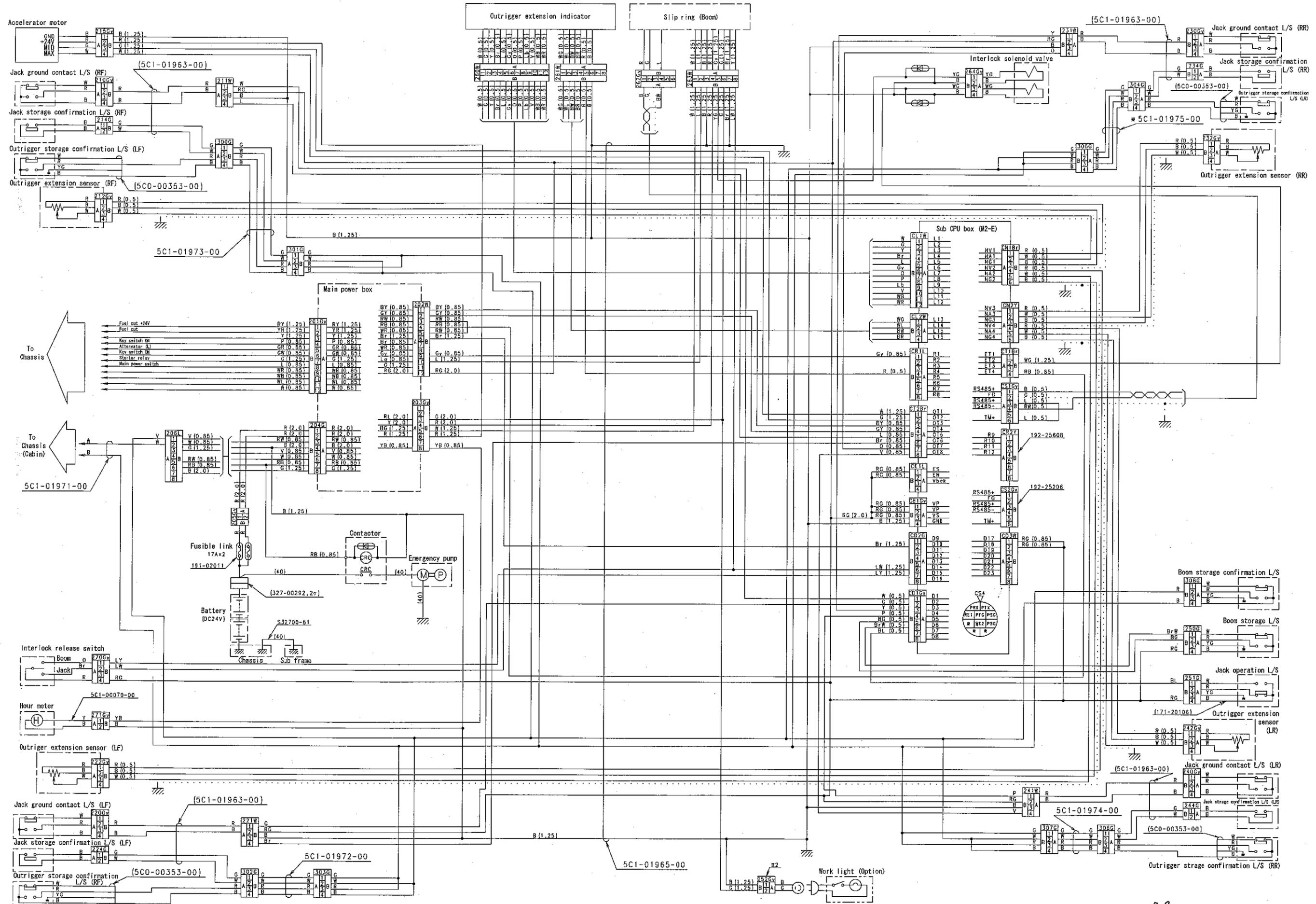
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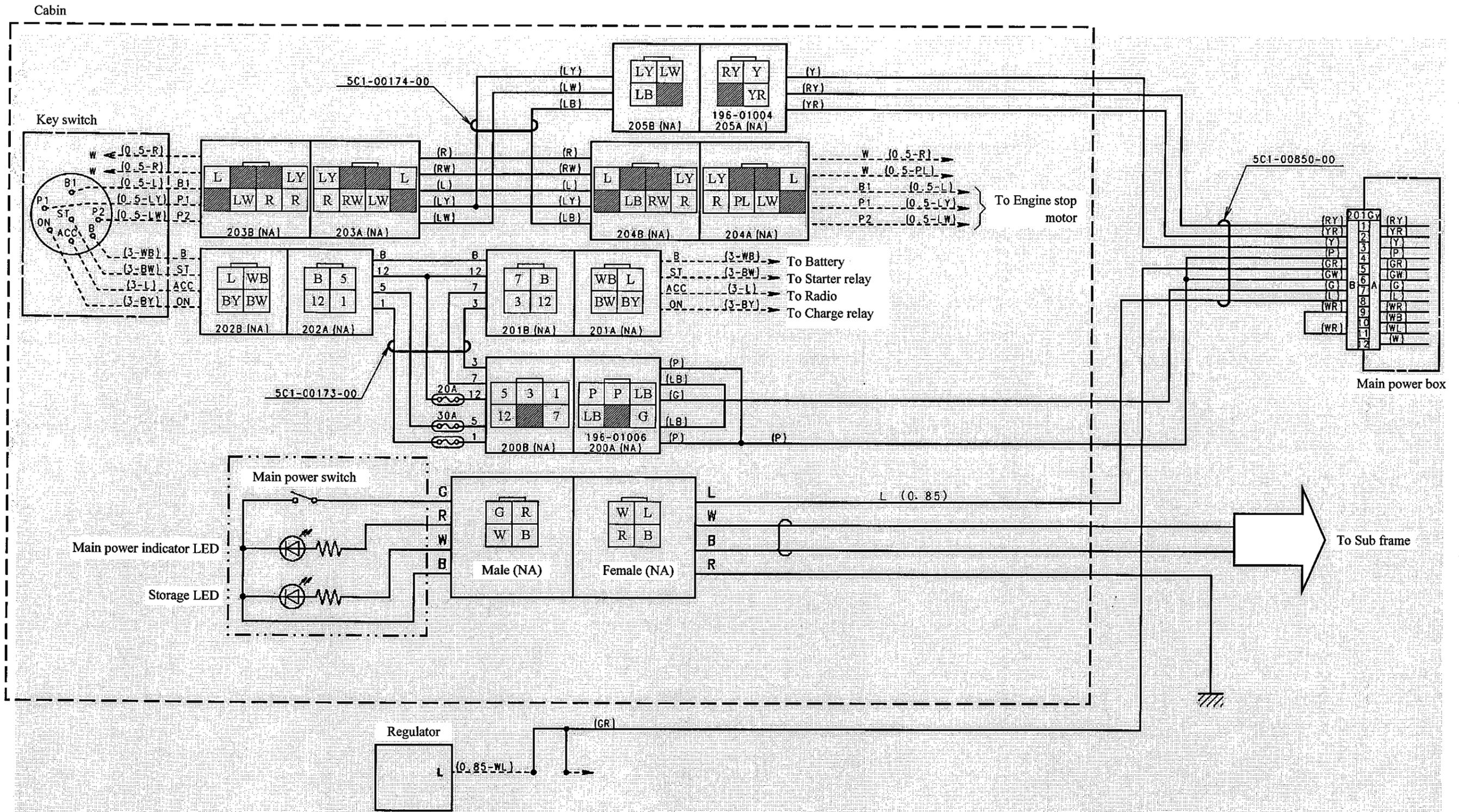
Electric wiring chart (Sub frame)

7E0-00433-00

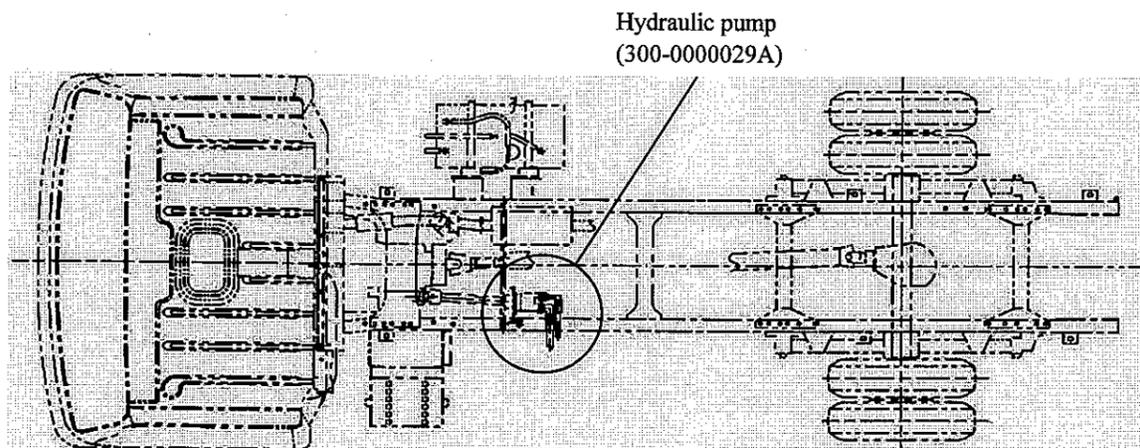
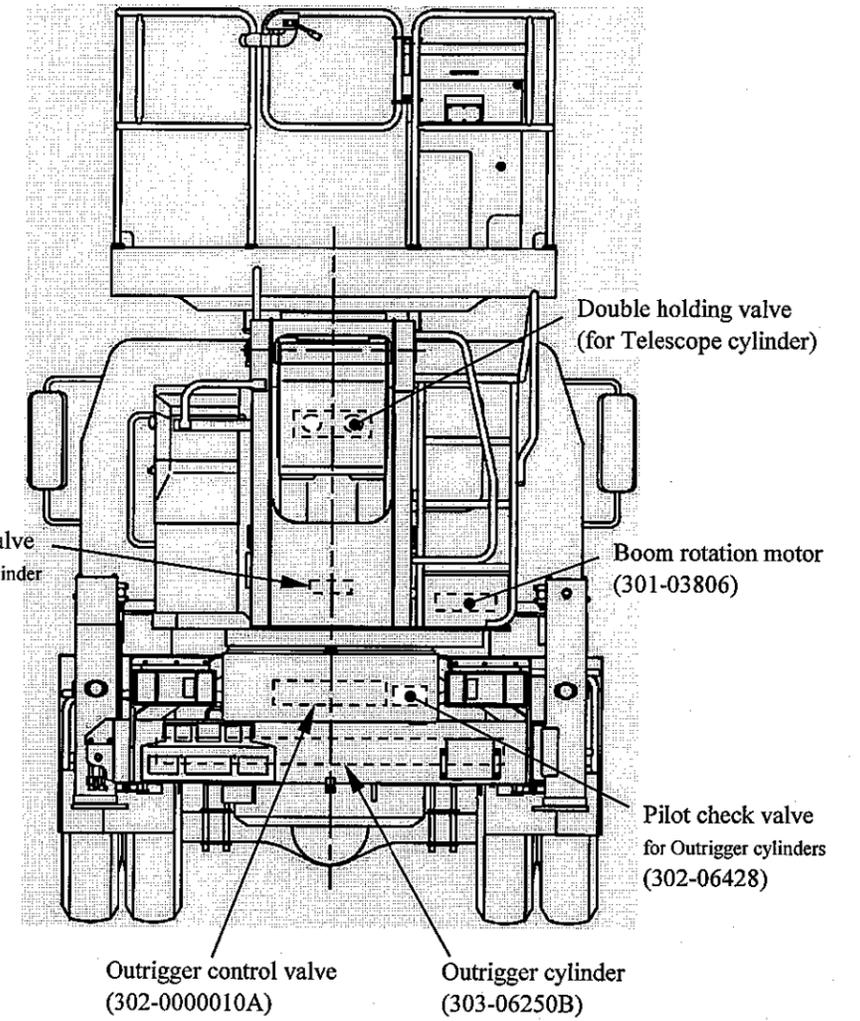
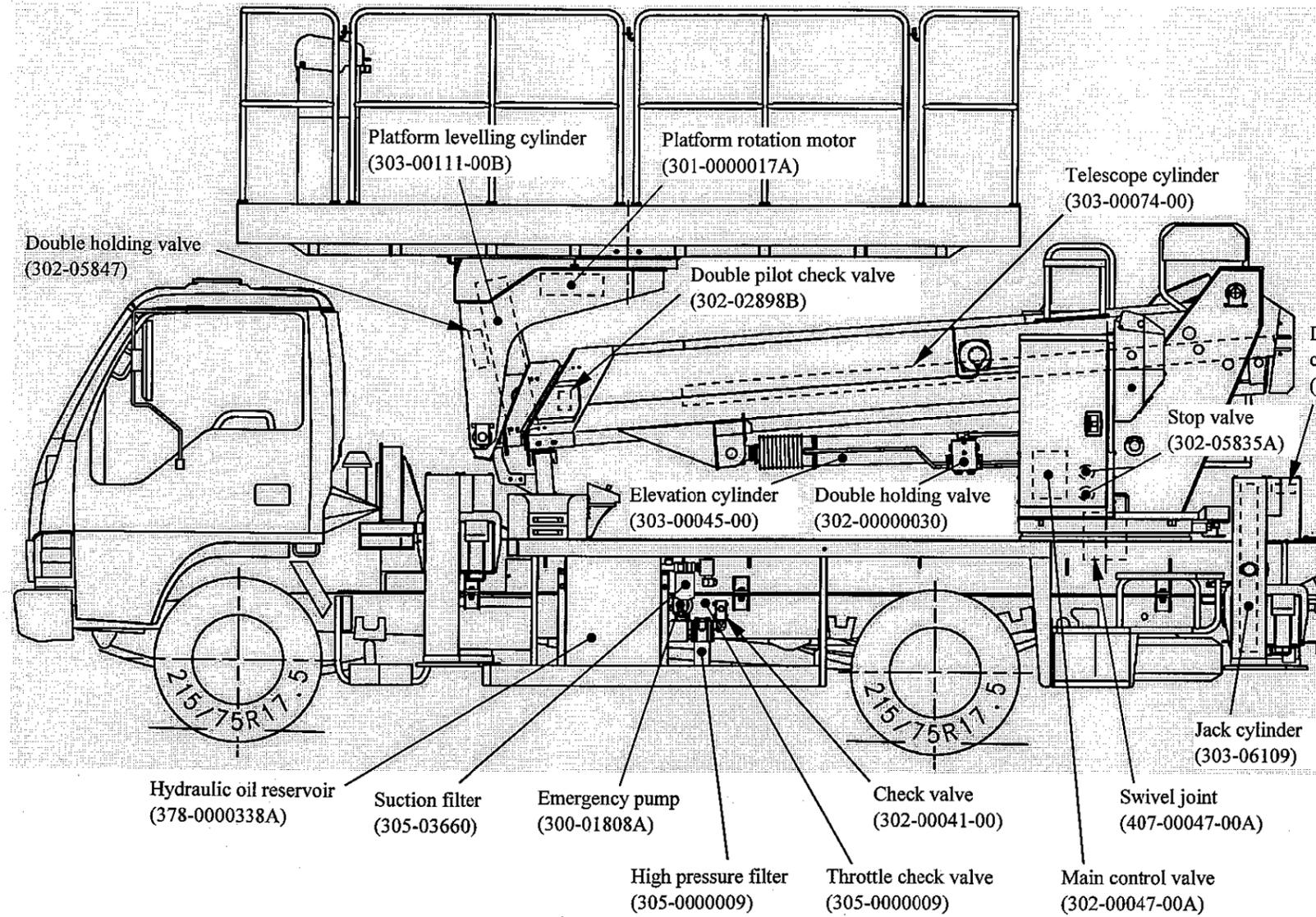


Electric wiring chart (Chassis)

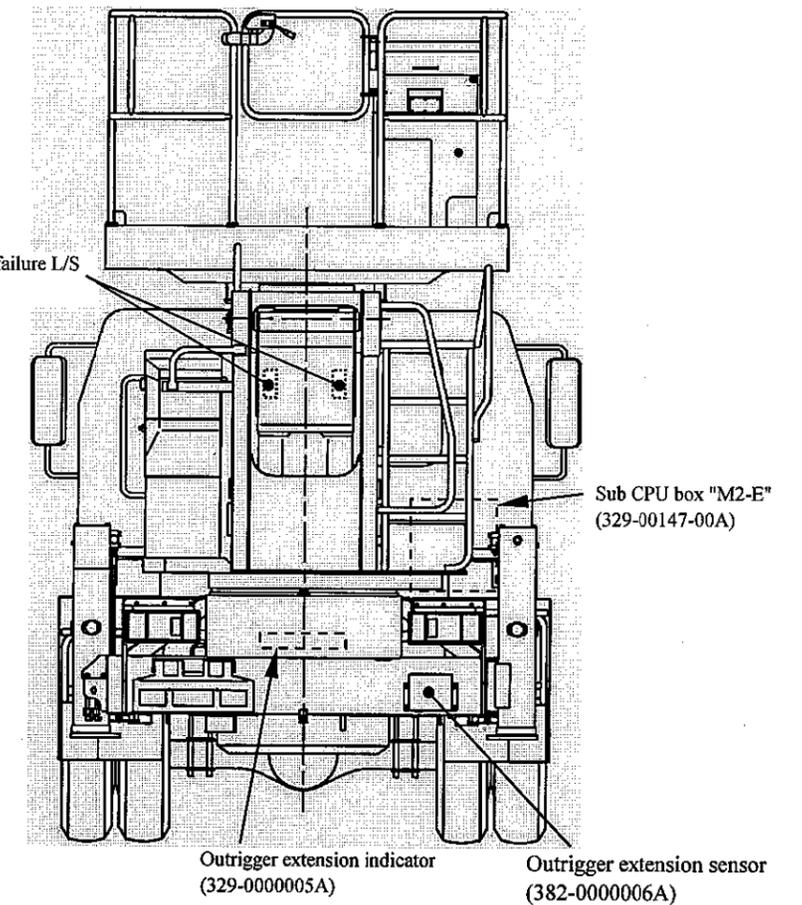
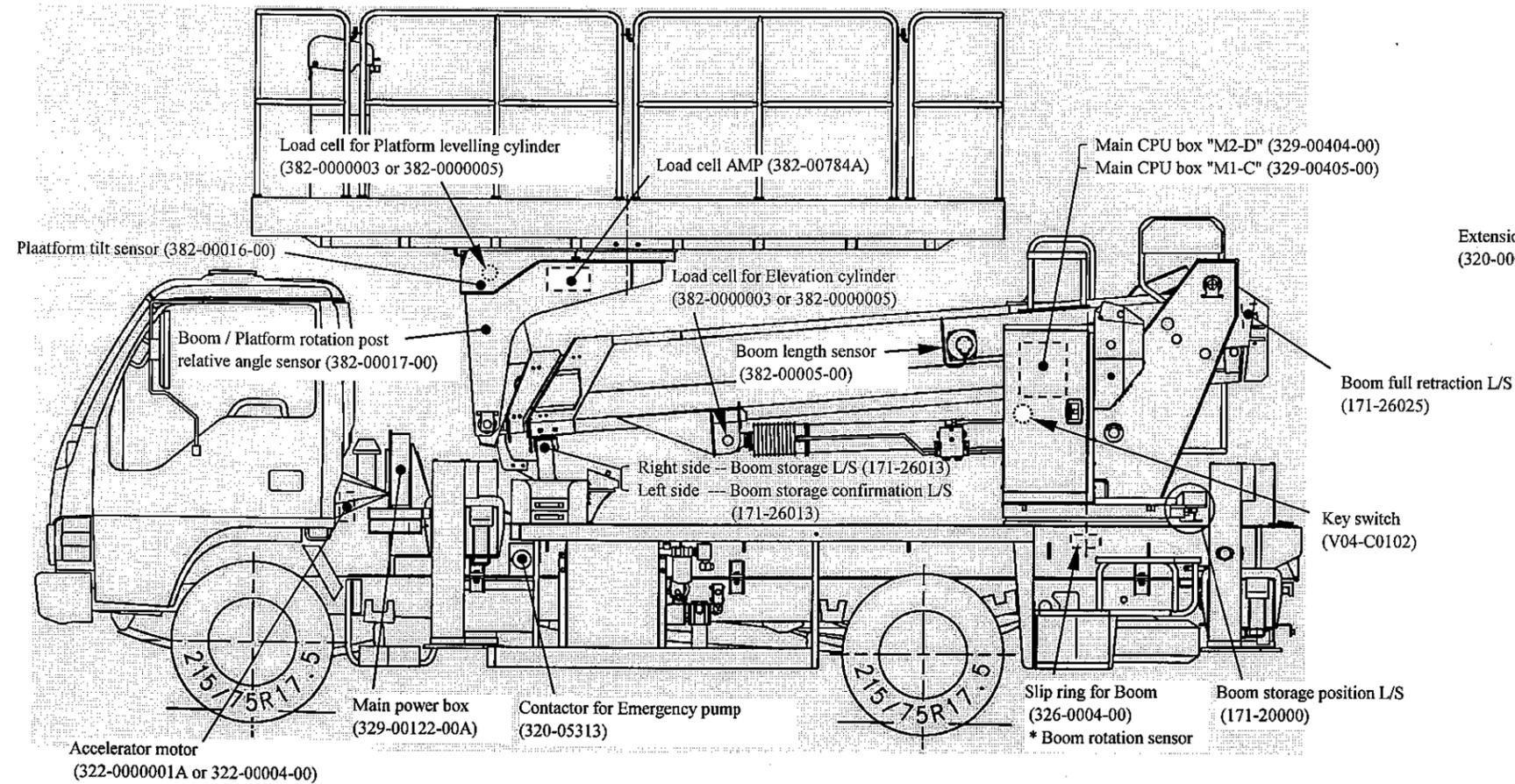
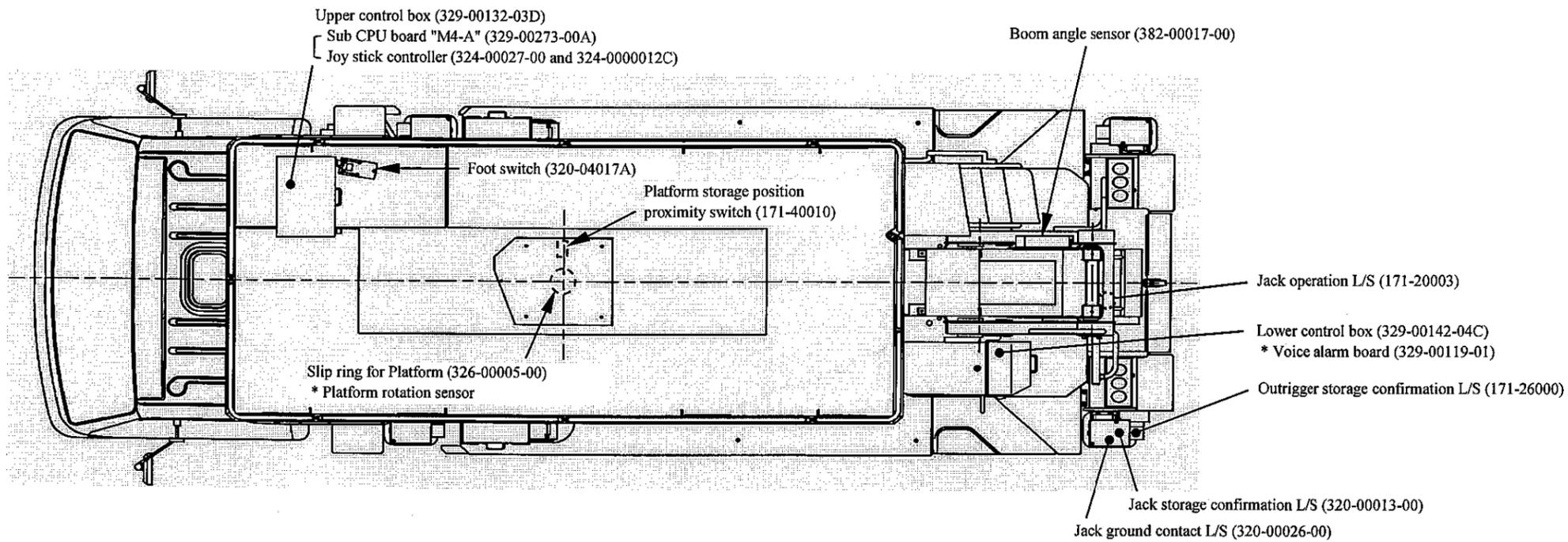
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Locations of Hydraulic components



Locations of Electric components



TIGHTENING TORQUE STANDARD

1) Hexagon Bolts and Nuts (8.8T)

Material : S45C

Tensile strength : 80 kgf/mm²

Yield point : 64 kgf/mm²

Brinell hardness : 225 ~ 300

Size mm	Pitch mm	Tightening torque	
		kgf - m	lb - ft
6	1.0	0.68 ~ 0.92	5 ~ 7
8	1.25	1.63 ~ 2.21	12 ~ 16
10	1.5	3.22 ~ 4.36	23 ~ 32
12	1.75	5.60 ~ 7.57	41 ~ 55
14	2.0	8.92 ~ 12.1	65 ~ 88
16	2.0	13.7 ~ 18.5	99 ~ 134
18	2.5	18.1 ~ 24.5	131 ~ 177
20	2.5	25.3 ~ 34.2	183 ~ 247
22	2.5	34.2 ~ 46.2	247 ~ 334
24	3.0	43.7 ~ 59.2	316 ~ 428
27	3.0	63.4 ~ 85.8	459 ~ 621
30	3.5	86.3 ~ 116.8	624 ~ 845
33	3.5	116.5 ~ 157.6	843 ~ 1140
36	4.0	150.2 ~ 203.3	1086 ~ 1471
39	4.0	193.1 ~ 261.2	1397 ~ 1889
42	4.5	214.5 ~ 290.2	1552 ~ 2099
45	4.5	266.2 ~ 360.2	1926 ~ 2605
48	5.0	321.4 ~ 434.8	2325 ~ 3145
52	5.0	412.7 ~ 558.4	2985 ~ 4039

2) Hexagon Socket Head Cap Screws (10.9T)

Material : SCM435

Tensile strength : 100 kgf/mm²

Yield point : 90 kgf/mm²

Brinell hardness : 280 ~ 365

Color : Black

Size mm	Pitch mm	Tightening torque	
		kgf - m	lb - ft
6	1.0	1.22 ~ 1.65	9 ~ 12
8	1.25	2.94 ~ 3.98	21 ~ 29
10	1.5	5.80 ~ 7.84	42 ~ 57
12	1.75	10.1 ~ 13.6	73 ~ 98
14	2.0	16.1 ~ 21.7	116 ~ 157
16	2.0	24.6 ~ 33.2	178 ~ 240
18	2.5	32.6 ~ 44.1	236 ~ 319
20	2.5	45.6 ~ 61.6	330 ~ 445
22	2.5	61.5 ~ 83.2	445 ~ 602
24	3.0	78.7 ~ 106.5	569 ~ 770
27	3.0	114.1 ~ 154.4	825 ~ 1116
30	3.5	155.4 ~ 210.2	1124 ~ 1570
33	3.5	209.6 ~ 283.6	1515 ~ 2050
36	4.0	270.4 ~ 365.9	1955 ~ 2645
39	4.0	347.5 ~ 470.2	2512 ~ 3340
42	4.5	386.1 ~ 522.4	2792 ~ 3777
45	4.5	479.2 ~ 648.3	3465 ~ 4687
48	5.0	578.5 ~ 782.7	4183 ~ 5659
52	5.0	742.6 ~ 1011	5369 ~ 7310

Error code and their countermeasures

The Load indicators on the Lower and Upper control boxes indicate the Error code listed in the table below when the system fails.

Error code	Descriptions	Cause	Countermeasures
E06	Boom angle sensor error	<p>* Abnormally high or low AD value has been input from the <i>Boom angle sensor</i>.</p> <ol style="list-style-type: none"> 1. Incorrect <i>Boom angle sensor calibrations</i>. 2. Faulty <i>Boom angle sensor</i>. 3. Faulty electrical lines between the <i>Boom angle sensor</i> and the <i>Main CPU box (MIC)</i>. 4. Faulty <i>Main CPU box (MIC)</i>. 	<ol style="list-style-type: none"> 1. Perform the <i>Boom angle sensor calibrations</i>, using the Laptop computer. 2. Replace the <i>Boom angle sensor</i>. 3. Rectify the faulty electrical lines. 4. Replace the <i>Main CPU box (MIC)</i>.
E07	Boom / Platform relative angle sensor error	<p>* Abnormally high or low AD value has been input from the <i>Boom / Platform relative angle sensor</i>.</p> <ol style="list-style-type: none"> 1. Incorrect <i>Boom / Platform relative angle sensor calibrations</i>. 2. Faulty <i>Boom / Platform relative angle sensor</i>. 3. Faulty electrical lines between the <i>Boom / Platform relative angle sensor</i> and the <i>Main CPU box (MIC)</i>. 4. Faulty <i>Main CPU box (MIC)</i>. 	<ol style="list-style-type: none"> 1. Perform the <i>Boom / Platform relative angle sensor calibrations</i>, using the Laptop computer. 2. Replace the <i>Boom / Platform relative angle sensor</i>. 3. Rectify the faulty electrical lines. 4. Replace the <i>Main CPU box (MIC)</i>.
E08	Boom length sensor error	<p>* Abnormally high or low AD value has been input from the <i>Boom length sensor</i>.</p> <ol style="list-style-type: none"> 1. Incorrect <i>Boom length sensor calibrations</i>. 2. Faulty <i>Boom length sensor</i>. 3. Faulty electrical lines between the <i>Boom length sensor</i> and the <i>Main CPU box (MIC)</i>. 4. Faulty <i>Main CPU box (MIC)</i>. 	<ol style="list-style-type: none"> 1. Perform the <i>Boom length sensor calibrations</i>, using the Laptop computer. 2. Replace the <i>Boom length sensor</i>. 3. Rectify the faulty electrical lines. 4. Replace the <i>Main CPU box (MIC)</i>.
E09	Platform tilt sensor error	<p>* Abnormally high or low AD value has been input from the <i>Platform tilt sensor</i>.</p> <ol style="list-style-type: none"> 1. Incorrect <i>Platform tilt sensor calibrations</i>. 2. Faulty <i>Platform tilt sensor</i>. 3. Faulty electrical lines between the <i>Platform tilt sensor</i> and the <i>Sub CPU board (M4A)</i>. 4. Faulty <i>Sub CPU board (M4A)</i>. 	<ol style="list-style-type: none"> 1. Perform the <i>Platform tilt sensor calibrations</i>, using the Laptop computer. 2. Replace the <i>Platform tilt sensor</i>. 3. Rectify the faulty electrical lines. 4. Replace the <i>Sub CPU board (M4A)</i>.
E10	Load cell (Elevation cylinder) error	<p>* Abnormally high or low AD value has been input from the <i>Load cell (Elevation cylinder)</i>.</p> <ol style="list-style-type: none"> 1. Incorrect <i>Load cell (Elevation cylinder) calibrations</i>. 2. Faulty <i>Load cell (Elevation cylinder)</i>. 3. Faulty electrical lines between the <i>Load cell (Elevation cylinder)</i> and the <i>Main CPU box (MIC)</i>. 4. Faulty <i>Main CPU box (MIC)</i>. 	<ol style="list-style-type: none"> 1. Perform the <i>Load cell (Elevation cylinder) calibrations</i>, using the Laptop computer. 2. Replace the <i>Load cell (Elevation cylinder)</i>. 3. Rectify the faulty electrical lines. 4. Replace the <i>Main CPU box (MIC)</i>.
E13	Boom rotation sensor error	<p>* Abnormally high or low AD value has been input from the <i>Boom rotation sensor</i>.</p> <ol style="list-style-type: none"> 1. Incorrect <i>Boom rotation sensor calibrations</i>. 2. Faulty <i>Boom rotation sensor</i>. 3. Faulty electrical lines between the <i>Boom rotation sensor</i> and the <i>Main CPU box (M2D)</i>. 4. Faulty <i>Main CPU box (M2D)</i>. 	<ol style="list-style-type: none"> 1. Perform the <i>Boom rotation sensor calibrations</i>, using the Laptop computer. 2. Replace the <i>Boom rotation sensor</i>. 3. Rectify the faulty electrical lines. 4. Replace the <i>Main CPU box (M2D)</i>.

Error code	Descriptions	Cause	Countermeasures
E17	Load cell (Platform leveling cylinder) error	<p>* Abnormally high or low AD value has been input from the <i>Load cell (Platform leveling cylinder)</i>.</p> <ol style="list-style-type: none"> 1. Incorrect <i>Load cell (Platform leveling cylinder)</i> calibrations. 2. Faulty <i>Load cell (Platform leveling cylinder)</i>. 3. Faulty <i>Load cell AMP</i>. 4. Faulty electrical lines between the <i>Load cell AMP</i> and the <i>Load cell (Platform leveling cylinder)</i> or the <i>Main CPU box (MIC)</i>. 5. Faulty <i>Main CPU box (MIC)</i>. 	<ol style="list-style-type: none"> 1. Perform the <i>Load cell (Platform leveling cylinder)</i> calibrations, using the Laptop computer. 2. Replace the <i>Load cell (Platform leveling cylinder)</i>. 3. Replace the <i>Load cell AMP</i>. 4. Rectify the faulty electrical lines. 5. Replace the <i>Main CPU box (MIC)</i>.
E23	M2D E2PROM error	1. Faulty E2PROM in the <i>Main CPU box (M2D)</i> .	1. Replace the <i>Main CPU box (M2D)</i> .
E24	M1C E2PROM error	1. Faulty E2PROM in the <i>Main CPU box (MIC)</i> .	1. Replace the <i>Main CPU box (MIC)</i> .
E30	M2D, Divided by zero or Exceptional error	1. Incorrect or damaged parameters are memorized in the <i>Main CPU box (M2D)</i> .	<ol style="list-style-type: none"> 1. Write the correct parameters into the <i>Main CPU box (M2D)</i>, using the Laptop computer. 2. Replace the <i>Main CPU box (M2D)</i>. 1. Replace the <i>Sub CPU board (M4A)</i>.
E31	M4A, Divided by zero or Exceptional error	1. Incorrect or damaged parameters are memorized in the <i>Sub CPU board (M4A)</i> .	1. Replace the <i>Sub CPU board (M4A)</i> .
E33	M1C, Divided by zero or Exceptional error	1. Incorrect or damaged parameters are memorized in the <i>Main CPU box (MIC)</i> .	<ol style="list-style-type: none"> 1. Write the correct parameters into the <i>Main CPU box (MIC)</i>, using the Laptop computer. 2. Replace the <i>Main CPU box (MIC)</i>. 1. Replace the <i>Sub CPU box (M2E)</i>.
E34	M2E, Divided by zero or Exceptional error	1. Incorrect or damaged parameters are memorized in the <i>Sub CPU box (M2E)</i> .	1. Replace the <i>Sub CPU box (M2E)</i> .
E40	Outrigger extension sensor (Right, Front) error	* Abnormally high or low AD value has been input from the <i>Outrigger extension sensors</i> .	1. Perform the <i>Outrigger extension sensor calibrations</i> , using the Laptop computer.
E43	Outrigger extension sensor (Left, Front) error	1. Incorrect <i>Outrigger extension sensor calibrations</i> .	2. Replace the <i>Outrigger extension sensor</i> .
E46	Outrigger extension sensor (Right, Rear) error	2. Faulty <i>Outrigger extension sensor</i> .	3. Rectify the faulty electrical lines.
E49	Outrigger extension sensor (Left, Rear) error	3. Faulty electrical lines between the <i>Outrigger extension sensor</i> and the <i>Sub CPU box (M2E)</i> .	4. Replace the <i>Main CPU box (M2E)</i> .
E53	Platform rotation sensor error	4. Faulty <i>Sub CPU box (M2E)</i> .	1. Perform the <i>Platform rotation sensor calibrations</i> , using the Laptop computer.
E60	Limit cancel switch error	* Abnormally high or low AD value has been input from the <i>Platform rotation sensor</i> .	1. Perform the <i>Platform rotation sensor calibrations</i> , using the Laptop computer.
		1. Incorrect <i>Platform rotation sensor calibrations</i> .	2. Replace the <i>Platform rotation sensor</i> .
		2. Faulty <i>Platform rotation sensor</i> .	3. Rectify the faulty electrical lines.
		3. Faulty electrical lines between the <i>Platform rotation sensor</i> and the <i>Sub CPU board (M4A)</i> .	4. Replace the <i>Main CPU board (M4A)</i> .
		4. Faulty <i>Sub CPU board (M4A)</i> .	1. Rectify the electrical lines between the <i>Emergency switch</i> and the <i>Main CPU box (M2D)</i> or <i>(MIC)</i> .
		1. Open or short circuit on the lines between the <i>Emergency switch</i> and the <i>Main CPU box (M2D)</i> or <i>(MIC)</i> .	2. Replace the <i>Emergency switch</i> .
		2. Faulty <i>Emergency switch</i> .	

Error code	Descriptions	Cause	Countermeasures
E61	Pre-start check error	1. <i>Pre-start check switch</i> was operated while the platform is positioned out of the specific range for Pre-start check.	
E62	M2D ET1 error Boom extension wire rope failure limit switch error	* The <i>Main CPU box (M2D)</i> has output to the <i>Interlock solenoid (Boom)</i> in spite of no command. 1. Short circuit is in the output lines to the <i>Interlock solenoid (Boom)</i> . 2. Faulty <i>Interlock solenoid (Boom)</i> . 3. Faulty <i>Main CPU box (M2D)</i> . * No input from the <i>Boom extension wire rope failure limit switches</i> . 1. <i>Boom extension wire rope</i> has loosened or been cut. 2. Faulty electric lines between the <i>Boom extension wire rope failure limit switches</i> and the <i>Main CPU box (M2D)</i> .	1. Rectify the output lines to the <i>Interlock solenoid (Boom)</i> . 2. Replace the <i>Interlock solenoid (Boom)</i> . 3. Replace the <i>Main CPU box (M2D)</i> . 1. Adjust the tension of the <i>Boom extension wire rope</i> , or replace the <i>Boom extension wire rope</i> . 2. Rectify the electric lines between the <i>Boom extension wire rope failure limit switches</i> and the <i>Main CPU box (M2D)</i> .
E67	M2E ET2 error	* The <i>Sub CPU box (M2E)</i> has output to the <i>Interlock solenoid (Jack)</i> in spite of no command. 1. Short circuit is in the output lines to the <i>Interlock solenoid (Jack)</i> . 2. Faulty <i>Interlock solenoid (Jack)</i> . 3. Faulty <i>Sub CPU box (M2E)</i> .	1. Rectify the output lines to the <i>Interlock solenoid (Jack)</i> . 2. Replace the <i>Interlock solenoid (Jack)</i> . 3. Replace the <i>Main CPU box (M2E)</i> .
E69	M2E ET4 error	* The <i>Sub CPU box (M2E)</i> has output to the <i>Relay CR6 (for Emergency pump)</i> in the <i>Main power box</i> in spite of no command. 1. Short circuit is in the output lines to the <i>Relay CR6</i> . 2. Faulty <i>Relay CR6</i> . 3. Faulty <i>Sub CPU box (M2E)</i> .	1. Rectify the output lines to the <i>Relay CR6</i> in the <i>Main power box</i> . 2. Replace the <i>Relay CR6</i> . 3. Replace the <i>Main CPU box (M2E)</i> .
E70	M2D, AD timeout, converter, power source voltage (DC 5 volts) error	1. Faulty <i>Main CPU box (M2D)</i> .	1. Replace the <i>Main CPU box (M2D)</i> .
E71	M4A, AD timeout, converter, power source voltage (DC 5 volts) error	1. Faulty <i>Sub CPU board (M4A)</i> .	1. Replace the <i>Main CPU box (M4A)</i> .
E72	M1C, AD timeout, converter, power source voltage (DC 5 volts) error	1. Faulty <i>Main CPU box (M1C)</i> .	1. Replace the <i>Main CPU box (M1C)</i> .
E80	M1C, RS232 communication error (M1C ↔ M2D)	* The <i>Main CPU box (M1C)</i> and the <i>Main CPU box (M2D)</i> have failed to communicate each other. 1. Faulty communication lines between the <i>Main CPU box (M1C)</i> and the <i>Main CPU box (M2D)</i> . 2. Faulty <i>Main CPU box (M1C)</i> or <i>Main CPU box (M2D)</i> .	1. Rectify the communication lines. 2. Replace the <i>Main CPU box (M1C)</i> or the <i>Main CPU box (M2D)</i> .
E82	M2E, RS485 communication error (M1C ↔ M2E)	* The <i>Main CPU box (M1C)</i> and the <i>Sub CPU box (M2E)</i> have failed to communicate each other. 1. Faulty communication lines between the <i>Main CPU box (M1C)</i> and the <i>Sub CPU box (M2E)</i> . 2. Faulty <i>Main CPU box (M1C)</i> or <i>Sub CPU box (M2E)</i> .	1. Rectify the communication lines. 2. Replace the <i>Main CPU box (M1C)</i> or the <i>Sub CPU box (M2E)</i> .

Error code	Descriptions	Cause	Countermeasures
E84	M4A, RS485 communication error (M2D) ↔ M4A)	<p>* The Main CPU box (M2D) and the Sub CPU board (M4A) have failed to communicate each other.</p> <ol style="list-style-type: none"> 1. Faulty communication lines between the Main CPU box (M2D) and the Sub CPU board (M4A). 2. Faulty Main CPU box (M2D) or Sub CPU board (M4A). 	<ol style="list-style-type: none"> 1. Rectify the communication lines. 2. Replace the Main CPU box (M2D) or the Sub CPU board (M4A).
E85	M4A, RS485 communication error (M2D) ↔ M4A)	<p>* The Main CPU box (M2D) and the Sub CPU board (M4A) have failed to communicate each other.</p> <ol style="list-style-type: none"> 1. Faulty communication lines between the Main CPU box (M2D) and the Sub CPU board (M4A). 2. Faulty Main CPU box (M2D) or Sub CPU board (M4A). 	<ol style="list-style-type: none"> 1. Rectify the communication lines. 2. Replace the Main CPU box (M2D) or the Sub CPU board (M4A).
E90	M2D PWM ch1/ch2 error	<p>* The Main CPU box (M2D) has output to the Platform rotation (C.W or C.C.W) solenoid in spite of no command.</p> <ol style="list-style-type: none"> 1. Short circuit is in the output lines to the Platform rotation (C.W or C.C.W) solenoid. 2. Faulty Platform rotation (C.W or C.C.W) solenoid. 3. Faulty Main CPU box (M2D). 	<ol style="list-style-type: none"> 1. Rectify the output lines to the Platform rotation (C.W or C.C.W) solenoid. 2. Replace the Platform rotation (C.W or C.C.W) solenoid. 3. Replace the Main CPU box (M2D).
E91	M2D PWM ch3/ch4 error	<p>* The Main CPU box (M2D) has output to the Boom telescope (Out or In) solenoid in spite of no command.</p> <ol style="list-style-type: none"> 1. Short circuit is in the output lines to the Boom telescope (Out or In) solenoid. 2. Faulty Boom telescope (Out or In) solenoid. 3. Faulty Main CPU box (M2D). 	<ol style="list-style-type: none"> 1. Rectify the output lines to the Boom telescope (Out or In) solenoid. 2. Replace the Boom telescope (Out or In) solenoid. 3. Replace the Main CPU box (M2D).
E92	M2D PWM ch5/ch6 error	<p>* The Main CPU box (M2D) has output to the Boom rotation (C.W or C.C.W) solenoid in spite of no command.</p> <ol style="list-style-type: none"> 1. Short circuit is in the output lines to the Boom rotation (C.W or C.C.W) solenoid. 2. Faulty Boom rotation (C.W or C.C.W) solenoid. 3. Faulty Main CPU box (M2D). 	<ol style="list-style-type: none"> 1. Rectify the output lines to the Boom rotation (C.W or C.C.W) solenoid. 2. Replace the Boom rotation (C.W or C.C.W) solenoid. 3. Replace the Main CPU box (M2D).
E93	MIC PWM ch1/ch2 error	<p>* The Main CPU box (MIC) has output to the Boom elevation (Up or Down) solenoid in spite of no command.</p> <ol style="list-style-type: none"> 1. Short circuit is in the output lines to the Boom elevation (Up or Down) solenoid. 2. Faulty Boom elevation (Up or Down) solenoid. 3. Faulty Main CPU box (MIC). 	<ol style="list-style-type: none"> 1. Rectify the output lines to the Boom elevation (Up or Down) solenoid. 2. Replace the Boom elevation (Up or Down) solenoid. 3. Replace the Main CPU box (MIC).
E94	MIC PWM ch3/ch4 error	<p>* The Main CPU box (MIC) has output to the Platform leveling (Up or Down) solenoid in spite of no command.</p> <ol style="list-style-type: none"> 1. Short circuit is in the output lines to the Platform leveling (Up or Down) solenoid. 2. Faulty Platform leveling (Up or Down) solenoid. 3. Faulty Main CPU box (MIC). 	<ol style="list-style-type: none"> 1. Rectify the output lines to the Platform leveling (Up or Down) solenoid. 2. Replace the Platform leveling (Up or Down) solenoid. 3. Replace the Main CPU box (MIC).

8. Inspection manual

All of the inspection and test results should be recorded in the inspection check sheets and kept for three years.

The inspections and the function tests should be conducted by the qualified personnel.

Procedures of Daily inspection

The daily inspection should be conducted with the machine being set on firm level ground.

Use the chassis manufacturer's manual for checking the chassis.

<i>Unit</i>	<i>Item</i>	<i>Description</i>
PTO	Abnormal noise	Start the engine, engage the PTO, and then check for any abnormal noise.
	Oil leakage	Check for oil leakage.
	Indicator lamp	Engage and disengage the PTO and check if the PTO indicator lamp turns on and off properly.
Hydraulic oil reservoir	Oil level, Oil leakage	Stow the outriggers and the boom, then check for hydraulic oil level and oil leakage.
Outriggers	Crack, deformation	Extend all of the outriggers and check for any cracks and deformations.
	Abnormal noise, movements	Operate the outriggers and the jacks and check for any abnormal noise and movements.
	Oil leakage	Check the outrigger control valve, outrigger cylinders, and jack cylinders for oil leakage.
	Natural descent	Extend all of the jacks, support the machine by the jacks, then check if the jack cylinders retract naturally.
Turntable	Crack, deformation	Check the turntable thoroughly for any cracks and deformations.
	Abnormal noise, movements	Rotate the turntable, and check for any abnormal noise and movements.
Boom	Crack, deformation	Extend the boom fully and check for any cracks and deformations.
	Boom pivot pin	Check the boom pivot pin for any damage.
	Abnormal noise, movements	Raise, lower, telescope the boom and check for any abnormal noise and movements.
	Oil leakage	Check the hydraulic cylinders for oil leakage.
	Natural descent	Elevate the platform and check if the elevation and the telescoping cylinders retract naturally.
Platform	Crack, deformation	Check the platform and the platform rotation device for any cracks and deformations.
	Abnormal noise, movements	Rotate the platform and check for any abnormal noise and movements.
	Oil leakage	Check the platform levelling cylinders and the platform rotation motor for oil leakage.
	Platform levelling system	Raise and lower the boom several times and check if the platform stays level.
Crane (Option)	Winch rope and hook	Check the winch rope and hook for any damage.
	Sub-boom	Check the sub-boom for any damage.
	Abnormal noise, movements	Operate the winch and check for any abnormal noise and movements.
	Oil leakage	Check the winch motor and hydraulic hoses for oil leakage.
Engine power unit (Option)	Cooling system	Check the cooling water level.
		Check the cooling system for water leakage.
		Check the fan belt for tension and any damage.
	Lubrication system	Check the engine oil level.
		Check the engine for oil leakage.
Battery power unit. (Option)	Battery	Check the electrolyte level.
		Check if the batteries are fully charged.
		Check the battery terminals for any damages.
		Check the batteries for electrolyte leakage.

<i>Unit</i>	<i>Item</i>	<i>Descriptions</i>
Safety devices.	Interlock system	Check the jack and the boom interlock systems for any abnormal functions.
	Emergency stop system	Operate the emergency stop switches or levers and check if all of the movements are disabled.
	Emergency pump	Operate the machine by the emergency pump and check if the machine moves properly.
	Moment limiter,	Operate the boom and check if the moment limiter works properly.
	Work range limit system	Operate the boom and check if the work range limit system works properly.
	Pre-start check system	Conduct the pre-start check by using the pre-start check switch and check for any abnormalities.
	Other safety devices	Check the functions of other safety devices, if any.
Other devices.	Engine start/stop system	Operate the engine start and stop switches and check if the engine starts and stops properly.
	Accelerator	Operate the accelerator switch or knob and check for the functions.
	Outrigger indicator	Extend and retract the outriggers and check if the outrigger indicator lamps turn on and off corresponding to the extended length of each outrigger.
	Boom automatic storage system	Operate the boom automatic storage switch and check if the boom is stowed on the boom rest properly.
	Boom interference limit system	Operate the boom near the cabin or outriggers and check if the boom movement stops before hitting the cabin or outriggers.
	Jack automatic setting system	Operate the jack automatic setting switch and check if all of the jacks are set up or stowed properly.
	Auxiliary battery	Check if the auxiliary battery located at the platform is fully charged.
		Check if the spare battery is fully charged.
	Horizontal and vertical movements	Operate the boom with selecting the horizontal and vertical movement mode and check if the platform moves horizontally and vertically.
Other devices	Check the functions of other devices, if any.	
Decals	Readability	Check the decals for readability.

Daily inspection check sheet

Unit	Item	Results										
(Date)												
PTO	Abnormal noise											
	Oil leakage											
	Indicator lamp	Function Damage										
Hydraulic oil reservoir	Oil level, Oil leakage											
Outriggers	Crack, deformation											
	Abnormal noise, movements											
	Oil leakage											
	Jack cylinder	Natural descent										
Turntable	Crack, deformation											
	Abnormal noise, movements											
Boom	Crack, deformation											
	Boom pivot pin	Damage										
	Abnormal noise, movements											
	Oil leakage											
	Elevation cylinder	Natural descent										
	Telescoping cylinder	Natural descent										
Platform	Crack, deformation											
	Abnormal noise, movements											
	Oil leakage											
	Platform levelling system	Function										
Crane (Option)	Winch rope	Damage										
	Hook	Damage										
	Sub-boom	Damage										
	Abnormal noise, movements											
	Oil leakage											
Engine power unit (Option)	Cooling system	Water level										
		Water leakage										
		Fan belt	Tension Damage									
	Lubrication system	Oil level										
Oil leakage												
Battery power unit (option)	Battery	Electrolyte level										
		Charged level										
		Damage on terminals										
		Electrolyte leakage										

<i>Unit</i>	<i>Item</i>		<i>Results</i>																
	<i>(Date)</i>																		
Safety devices	Interlock	Function																	
	Emergency stop	Function																	
	Emergency pump	Function																	
	Moment limiter	Function																	
	Work range limit	Function																	
	Pre-start check	Function																	
	Others	Function																	
Other devices	Engine start/stop	Function																	
	Accelerator	Function																	
	Outrigger indicator	Function																	
	Boom automatic storage	Function																	
	Boom interference limit	Function																	
	Jack automatic setting	Function																	
	Auxiliary battery	Charged level																	
	Horizontal vertical movements	Function																	
	Others	Function																	
Decals	Readability																		

Remarks

Procedures of Periodical inspection

Conduct the periodical inspection with the machine being set on firm level ground.

Carry out the both descriptions of monthly and annual inspections when conducting annual inspections.

Use the chassis manufacturer's manual for checking the chassis.

<i>Unit</i>	<i>Item</i>	<i>Monthly inspections</i>	<i>Annual inspections</i>
PTO	Oil level, contamination.	Check the oil level, contamination and replenish or change oil, if necessary.	
	Oil leakage.	Check for oil leakage thoroughly.	
	Abnormal noise.	Start the engine, engage the PTO and check for abnormal noise.	
	Loose bolts and nuts		Check each bolt and nut for looseness.
	Indicator lamp.	Engage and disengage the PTO, and check if the PTO indicator lamp turns on and off properly.	
Hydraulic oil reservoir	Oil level, contamination.	Check the oil level and replenish, if necessary.	Check the oil for contamination and change the oil, if necessary. Oil change interval: Every 1,200 hours or one year.
	Oil leakage.	Check for oil leakage thoroughly.	
Hydraulic filters	Oil leakage.	Check for oil leakage thoroughly.	
	Replacement		Replace the filter element. Replacement interval: Every 1,200 hours or one year.
Pump drive shaft and coupling	Loose bolts and nuts	Check each bolt and nut for looseness.	
	Wear, deformation	Check the drive shaft and the coupling for wear and deformation.	
	Lubrication	Check for lubrication.	
Hydraulic pump	Loose bolts and nuts	Check the pump mounting bolts and nuts for looseness.	
	Abnormal noise	Start the engine, engage the PTO and check for abnormal noise.	
	Oil leakage	Check for oil leakage.	
Chassis frame, Sub-frame	Cracks, deformation	Check the chassis frame and the sub-frame for cracks and deformations.	
	Sub-frame mounting bracket	Check each bracket for cracks and deformation.	
	Sub-frame mounting bolts and nuts	Check each bolt and nut for looseness.	
	Counter weight	Check the counter weight mounting brackets, bolts, nuts for any damage.	
Outriggers, Jacks	Cracks, deformation, wear	Extend all of the outriggers and the jacks and check for cracks, deformation and wear.	
	Lubrication	Check the outrigger arms and the jack posts for lubrication.	
	Oil leakage	Check for oil leakage.	

<i>Unit</i>	<i>Item</i>	<i>Monthly inspections</i>	<i>Annual inspections</i>
Outriggers, jacks	Natural descent	Extend all of the jacks, support the machine by the jacks, and then check the jack cylinders for natural descent. Serviceable limit: 1 mm (0.04 in)/10 min.	
Rotation bearing	Loose bolts and nuts	Check each mounting bolt and nut for looseness.	
	Wear, cracks	Check the rotation bearing for excessive wear and cracks.	
	Lubrication	Check for lubrication.	
Rotation gearbox	Loose bolts and nuts	Check each mounting bolt and nut for looseness.	
	Oil leakage	Check for oil leakage.	
	Lubrication	Check the gear oil level and replenish, if necessary.	Change gear oil. Oil change interval: Every 1,200 hours or one year.
	Backlash		Check the backlash between the pinion of the rotation gearbox and the ring gear of the rotation bearing. Standard backlash: 0.6 mm (0.024 in)
	Abnormal noise, movements	Rotate the turntable and check for abnormal noise and movements.	
Turntable	Cracks, deformation	Check the turntable for cracks and deformations.	
	Loose bolts and nuts	Check each bolt and nut for looseness.	
Swivel joint	Loose bolts and nuts	Check each bolt and nut for looseness.	
	Oil leakage	Check for oil leakage.	
	Lubrication	Check for lubrication.	
Boom	Cracks, deformation	Extend the boom and check for cracks and deformations.	
	Loose bolts and nuts	Check each bolt and nut for looseness.	
	Oil leakage	Check for oil leakage.	
	Lubrication	Check for lubrication and lubricate, if necessary.	
	Extension/retraction wire ropes	Check each wire rope for any damage.	Check each wire rope if proper tension is applied to.
	Electric cables, Photo fiber cable		Check each electric cable and photo fiber cable if proper tension is applied to.
	Wear pads		Check each wear pad for wear.
	Abnormal noise, movement	Raise, lower, telescope the boom and check for abnormal noise and movements.	
	Natural descent	Check the elevation and telescope cylinders for natural descent. Serviceable limit: 2 mm (0.08 in)/10 min.	
Platform	Cracks, deformation	Check the platform and its mounting bracket for cracks and deformations.	
	Loose bolts and nuts	Check each bolt and nut for looseness.	
	Oil leakage	Check for oil leakage.	

<i>Unit</i>	<i>Item</i>	<i>Monthly inspections</i>	<i>Annual inspections</i>
Platform	Abnormal noise, movement	Rotate the platform and check for abnormal noise and movements.	
	Platform levelling system	Raise and lower the boom and check if the platform stays level.	
Crane	Winch rope	Check the winch rope for any damage.	
	Hook	Check the hook for cracks and deformation.	
	Loose bolts and nuts	Check each bolt and nut for looseness.	
	Winch gearbox	Check the gear oil level, and replenish, if necessary.	Change gear oil. Oil change interval: Every 1,200 hours or one year.
	Sub boom	Check the sub boom for cracks and deformations.	
	Oil leakage	Check for oil leakage.	
	Abnormal noise, movements	Operate the crane and check for abnormal noise and movements.	
Engine power unit (Option)	Engine oil	Check the engine oil and replenish or change, if necessary.	
	Oil filter	Check the oil filter and replace, if necessary.	
	Oil leakage	Check for oil leakage.	
	Cooling water	Check the cooling water and replenish or change, if necessary.	
	Water leakage	Check for water leakage.	
	Fan belt	Check the fan belt for wear and tension.	
	Radiator hose	Check each radiator hose for any damage.	
	Air cleaner	Check the air cleaner and clean or replace, if necessary.	
	Fuel filter	Check the fuel filter and replace, if necessary.	
	Loose bolts and nuts	Check each bolt and nut for looseness.	
	Hydraulic pump	Check for oil leakage.	
	Abnormal noise, functions	Operate the machine by the engine power unit and check for any abnormal noise and functions.	
	Battery power unit (Option)	Battery	Check electrolyte level and replenish, if necessary.
Check the battery for cracks and electrolyte leakage.			
Check each battery terminal for any damage.			
Check the battery tie-down bolts and nuts for looseness.			
Battery charger.		Charge the battery and check for any abnormal functions.	
DC motor			Check the brushes for wear.
Hydraulic pump		Check for oil leakage.	
Loose bolts and nuts		Check each bolt and nut for looseness.	

<i>Unit</i>	<i>Item</i>	<i>Monthly inspections</i>	<i>Annual inspections</i>
Battery power unit	Abnormal noise, functions	Operate the machine by the battery power unit and check for any abnormal noise and functions.	
Relief valves	Pre-set pressure		Check each relief valve setting pressure and make sure that the pressure is within the specific range.
Control panels	Control switches, levers, Joy stick controllers	Check each control switch, lever and joystick controller for any damage.	
		Operate each control switch, lever and joy stick controller and make sure that it works properly.	
	Indicator lamps	Check each indicator lamp for any damage.	
		Check if each indicator lamp turns on and off properly.	
Safety devices	Jack interlock system	<ol style="list-style-type: none"> 1. Stow the boom on the boom rest. 2. Extend the jacks, make all of the jacks contact with ground, then make sure that the jack interlock lamp turns on. 3. Retract one of the jacks till the jack interlock lamp turns off, then make sure the boom does not rise from the boom rest. 	
	Boom interlock system	<ol style="list-style-type: none"> 1. Raise the boom from the boom rest. 2. Operate the jacks and make sure that the jacks do not move. 	
	Emergency stop system	Operate the emergency stop switches or levers and make sure that all of the operations are disabled.	
	Emergency pump	Operate the machine by the emergency pump and make sure that the machine moves properly.	
	Moment limiter	Operate the boom and make sure that the moment limiter works properly.	Measure each work radius of the platform and make sure that the work radius is within the specific range.
	Work range limit system	Operate the boom and make sure that the work range limit system works properly.	Measure each work radius of the platform and make sure that the work radius is within the specific range.
	Pre-start check system	Conduct the pre-start check by using the pre-start check switch and check for any abnormalities.	
	Other safety devices	Check the functions of other safety devices and make sure that they work properly.	
Other devices	Engine start/stop system	Operate the engine start and stop switches on the upper and the lower control panels and make sure that the engine starts and stops properly.	
	Accelerator	Operate the accelerator switch or knob and make sure that the accelerator works properly.	
	Outrigger indicator	Extend and retract each outrigger and make sure that the outrigger indicator lamps turn on and off properly corresponding to the extended length of each outrigger.	

<i>Unit</i>	<i>Item</i>	<i>Monthly inspections</i>	<i>Annual inspections</i>
Other devices	Boom automatic storage system	Operate the boom automatic storage switch and make sure that the boom is stowed on the boom rest properly.	
	Boom interference limit system	Operate the boom near the cabin or the outriggers and make sure that the boom movement stops before hitting the cabin or outriggers.	
	Jack automatic setting system	Operate the jack automatic setting switch and make sure that all of the jacks are set up or stowed properly.	
	Auxiliary battery	Check the auxiliary batteries for any damage.	
		Check the auxiliary battery charging system and make sure the system works properly.	
	Hydraulic out-lets	Check the hydraulic out-lets for oil leakage and any damage.	Check the Max. pressure of the hydraulic out-lets and make sure that the pressure is within the specific range.
	AC power out-let	Check the AC power out-let for any damage.	
	Hydraulic booster	Check the ultra-high pressure hose for any damage.	
Operate the hydraulic booster and check for oil leakage and the functions.			
Other devices	Check the other devices for damages and functions		
Decals	Readability	Check all of the decals for readability and any damage.	

Withstand voltage tests

Conduct the withstand voltage tests on the insulated buckets and bucket liners.

For the test methods and the test interval, check the national or local regulations.

If no national or local regulation is available, conduct the withstand voltage tests every 6 months by applying the specific withstand voltage to the bucket and the bucket liner for 10 minutes.

Function tests

Conduct the function tests annually with the machine being set on firm level ground.

<i>Test</i>	<i>Item</i>	<i>Descriptions</i>
Load test	Damage, function, Abnormal noise	<ol style="list-style-type: none"> 1. Extend all of the outriggers fully, extend the jacks and make sure that all of the jacks have made firm contact with the ground. 2. Load the platform with the rated load, operate the boom thoroughly from the lower control and make sure that the boom moves smoothly without any abnormal noise. Caution: Do not allow any person on the platform. 3. Check the machine thoroughly and make sure that no damage is on the machine.
Load test on optional crane	Damage, function, abnormal noise, natural descent	<ol style="list-style-type: none"> 1. Extend all of the outriggers fully, extend the jacks and make sure that all of the jacks have made firm contact with the ground. 2. Set up the crane, load the crane with the rated lifting weight, raise and lower the load several times and make sure the crane works smoothly without any abnormal noise. 3. Leave the crane with the rated weight loaded, and make sure that the load does not descend.
Speed test	Boom elevation speed	<ol style="list-style-type: none"> 1. Step on the platform and retract the boom fully. (Only one person on the platform.) 2. Raise and lower the boom to its full stroke, measure the boom rising and the lowering speed (seconds/stroke) and make sure that the speed is within the specific range.
	Boom telescope speed	<ol style="list-style-type: none"> 1. Step on the platform and raise the boom fully. (Only one person on the platform.) 2. Extend and retract the boom to its full stroke, measure the boom extending and the retracting speed (seconds/stroke) and make sure that the speed is within the specific range.
	Boom rotation speed	<ol style="list-style-type: none"> 1. Step on the platform, retract the boom fully, then raise it fully. (Only one person on the platform.) 2. Rotate the turntable 360 degrees CW and CCW, measure the rotation speed (seconds/stroke) and make sure that the speed is within the specific range.
	Platform rotation speed	Step on the platform, rotate the platform CW and CCW, measure the platform rotation speed (seconds/stroke), then make sure that the speed is within the specific range. (Only one person on the platform.)

Periodical inspection check sheet

Model	Spec No.	Serial No.	Hour meter	Date	Inspector

The items marked (*) should be inspected only on the annual inspections.

Unit	Item	Results	Remarks
PTO	Oil level, contamination		
	Oil leakage		
	Abnormal noise		
	Loose bolts and Nuts		
	Indicator lamp		
Hydraulic oil reservoir	Oil level, contamination		Oil change interval: Every 1,200 hours or one year.
	Oil leakage		
Hydraulic filters	Oil leakage		Replacement interval: Every 1,200 hours or one year.
	Replacement		
Pump drive shaft and coupling	Loose bolts and nuts		
	Wear, deformation		
	Lubrication		
Hydraulic pump	Loose bolts and nuts		
	Abnormal noise		
	Oil leakage		
Chassis frame, Sub-frame	Cracks, deformation		
	Sub-frame mounting Bracket	Cracks, deformations	
	Sub-frame mounting bolts, nuts	Looseness	
	Counter weights mounting bracket, bolts, nuts	Cracks, deformation, looseness	
Outriggers, Jacks	Cracks, deformations		
	Lubrication		
	Oil leakage		
	Jack cylinder	Natural descent	
Rotation bearing	Loose bolts and nuts		
	Wear, cracks		
	Lubrication		
Rotation gearbox	Loose bolts and nuts		Gear oil change interval: Every 1,200 hours or one year.
	Oil leakage		
	Lubrication		
	(*) Back-lash between pinion and ring gear (Back-lush: 0.6 mm, 0.024 in)		
	Abnormal noise, movements		
Turntable	Cracks, deformations		
	Loose bolts and nuts		
Swivel joint	Loose bolts and nuts		
	Oil leakage		
	Lubrication		
Boom	Cracks, deformations		
	Loose bolts and nuts		
	Oil leakage		
	Lubrication		
	Extension/retraction wire rope	Damage (*) Tension	
	Electric cables, Photo fiber cable	(*) Tension	
	Wear pads	(*) Wear	
	Abnormal noise, movements		

<i>Unit</i>	<i>Item</i>		<i>Results</i>	<i>Remarks</i>
Boom	Elevation cylinder	Natural descent		Serviceable limit of natural descent: 2 mm (0.08 in)/10 min.
	Telescope cylinder	Natural descent		
Platform	Cracks, deformations			
	Loose bolts and nuts			
	Oil leakage			
	Abnormal noise, movements			
	Platform levelling system	Function		
Crane	Winch rope	Damage		Gear oil change interval: Every 1,200 hours or one year.
	Hook	Cracks, deformations		
	Winch gear box	Oil level		
	Sub boom	Cracks deformations		
	Loose bolts and nuts			
	Oil leakage			
	Abnormal noise, movements			
Engine power unit (Option)	Engine oil level, contamination			
	Replacement of oil filter			
	Oil leakage			
	Cooling water level, contamination			
	Water leakage			
	Fan belt	Wear, tension		
	Radiator hoses	Damage		
	Air cleaner	Blockage		
	Fuel filter	Replacement		
	Hydraulic pump	Oil leakage		
	Loose bolts and nuts			
Abnormal noise, function				
Battery power unit (Option)	Batteries	Electrolyte	Level	Specific gravity of electrolyte: 1.26 ~ 1.28 (at 20°C)
			Leakage	
			(*) Specific gravity	
		Damage on terminals		
		Looseness of tie-down bolts and nuts		
	Battery charger	Function		
	DC motor	(*) Wear of brushes		
	Hydraulic pump	Oil leakage		
	Loose bolts and nuts			
	Abnormal noise, functions			
Relief valves	(*) Pre-set pressure			
Control panels	Control switches, levers, Joy stick controllers	Damage		
		Functions		
	Indicator lamps	Damage		
		ON/OFF conditions		
Safety devices	Jack interlock system		Function	
	Boom interlock system		Function	
	Emergency stop system		Function	
	Emergency pump		Function	
	Moment limiter	Function		
		(*) Work radius		
	Work range limit system	Function		
		(*) Work radius		
	Pre-start check system		Function	
Other safety devices		Function		

<i>Unit</i>	<i>Item</i>		<i>Results</i>	<i>Remarks</i>
Other devices	Engine start/stop system	Function		
	Accelerator	Function		
	Outrigger indicator	ON/OFF conditions		
	Boom automatic storage system	Function		
	Boom interference limit system	Function		
	Jack automatic setting System	Function		
	Auxiliary battery	Damage		
		Functions of battery charging system		
	Hydraulic out-lets	Oil leakage, damage		
		(*) Pre-set pressure		
	AC power out-let	Damage		
	Hydraulic booster	Damage on ultra high pressure hose		
		(*) Pre-set pressure		
Other devices	Damage, function			
Decals	Readability			

Withstand voltage tests check sheet

Function tests check sheet

<i>Test</i>	<i>Item</i>		<i>Results</i>	<i>Remarks</i>
Load test	Function			
	Abnormal noise			
	Damage			
Load test on optional crane	Function			
	Abnormal noise			
	Natural descent			
	Damage			
Speed test	Boom elevation	Up		
		Down		
	Boom telescope	Out		
		In		
	Boom rotation	CW		
		CCW		
Platform rotation	CW			
	CCW			

