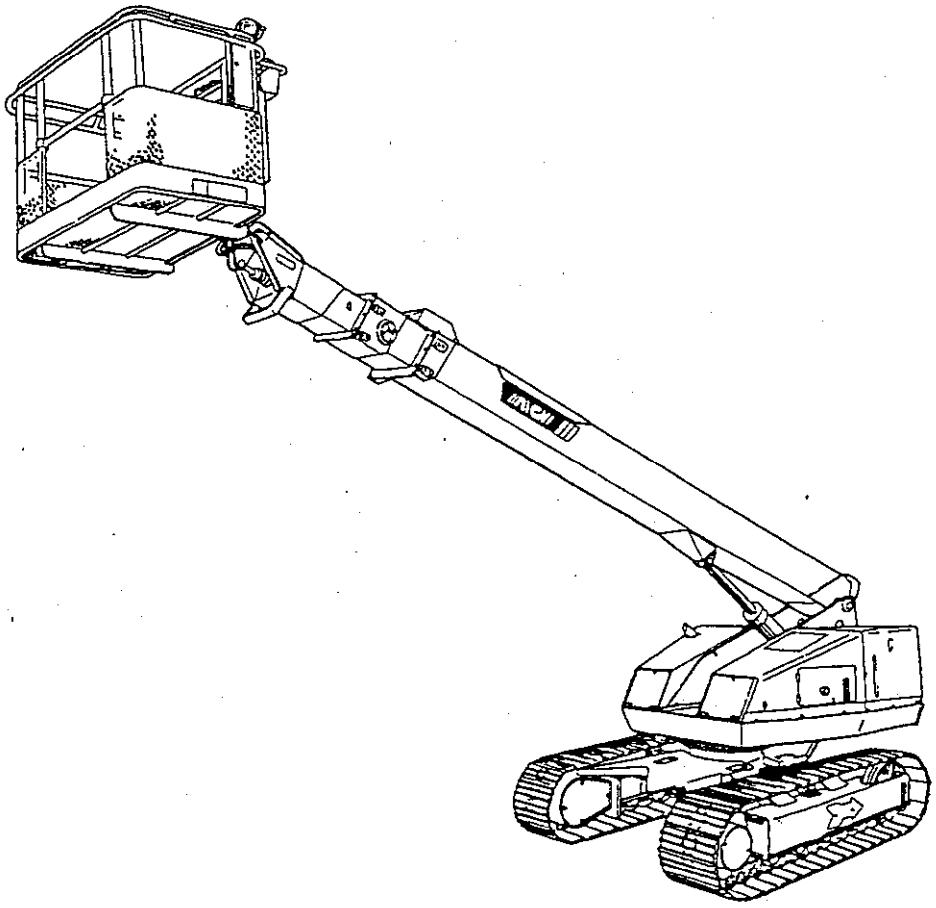
SME-114B

SERVICE MANUAL

SELF PROPELLED AERIAL PLATFORM

SR-123/ISR403



Applied to Specification A6 , A8 , 20 , BD

MICHI
CORPORATION

1152, RYOKE, AGEO, SAITAMA, JAPAN.

INTRODUCTION

This manual describes the correct adjustment and maintenance procedures for SR-123 self propelled aerial platform.
These procedures will ensure the most effective use of the operation features, and will ensure satisfaction through excellent performance.
Read this manual carefully, and ensure you understand each descriptions correctly.
When carrying out any maintenance or repair work, please cafully note the following.

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

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

Customer Service Division
Aichi Corporation

I N D E X

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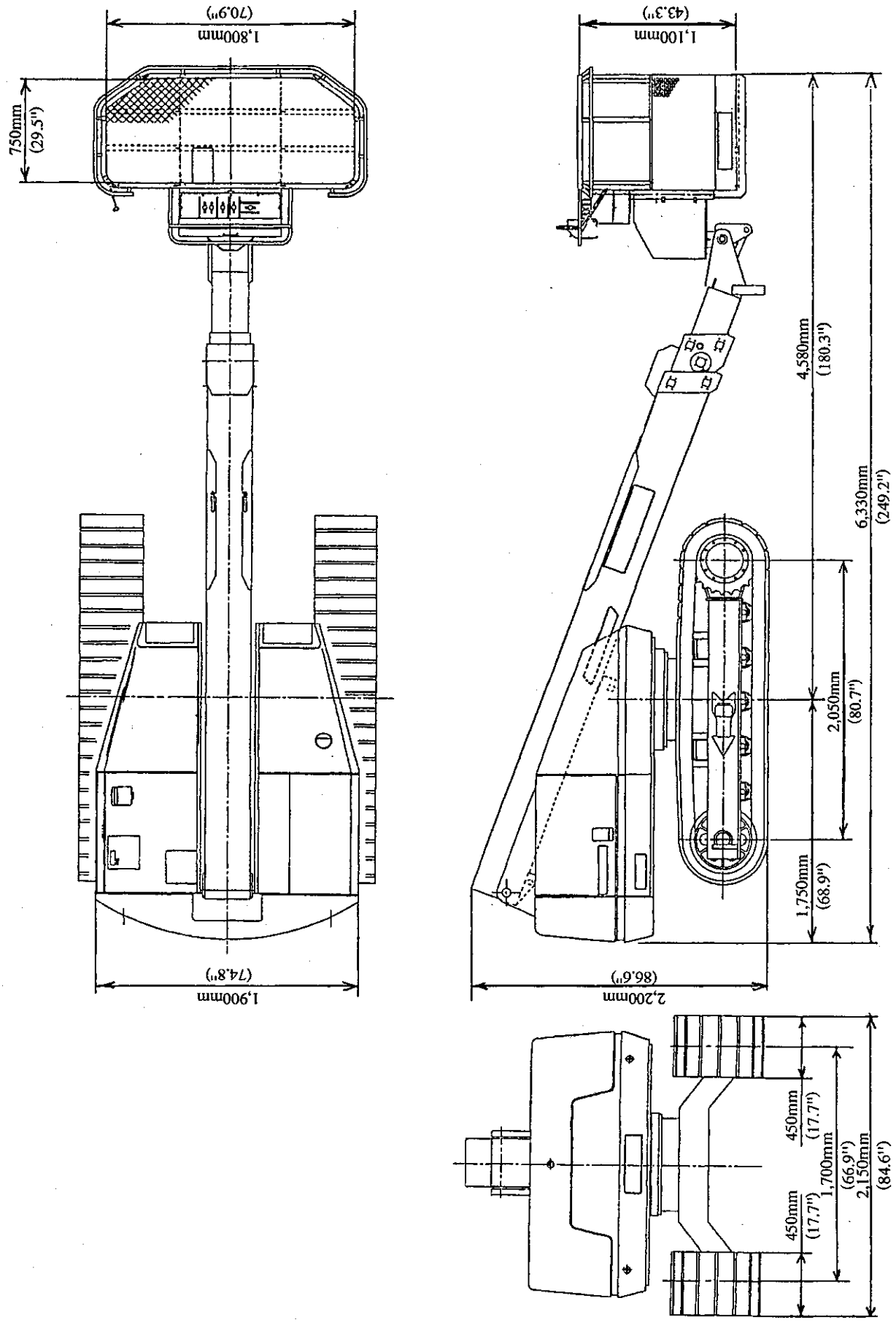
1
GENERAL INFORMATION

OVERALL DIMENSION

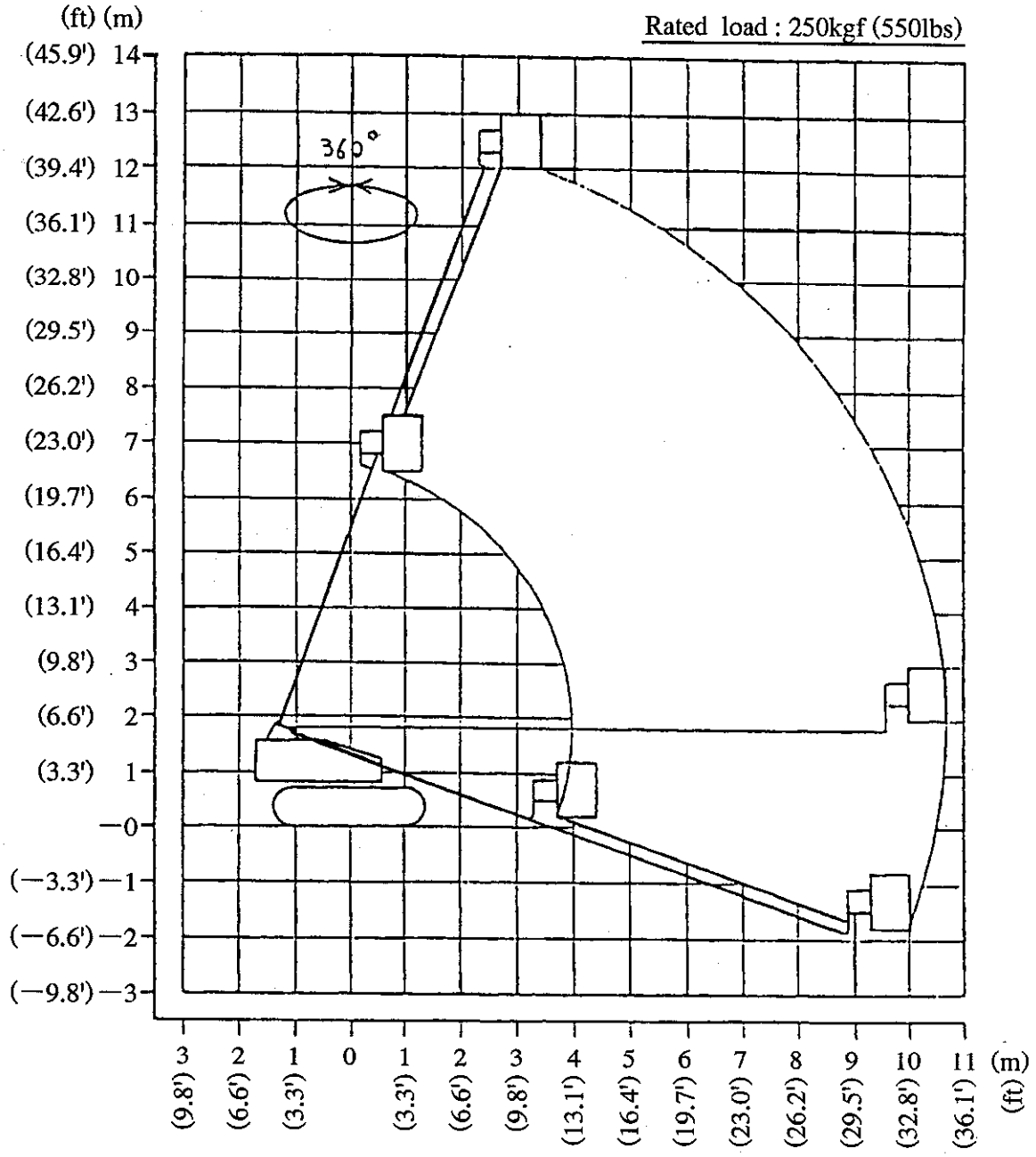


SPECIFICATIONS

Model				SR-123	ISR-403
Weight	Overall weight			7,650 kgf	16,865 lbs
	Max. ground contact pressure			0.66 kgf / cm^2	9.4 PSI
Engine	Model			ISUZU 4JB1-PA14	←
	(Since Nov. 1998, Serial. No. 661034 ~)			ISUZU A-4JB1-PAA17	
	Total displacement			2,771 cc	169 in^3
	Output power			55 ps / 2,200 rpm	40.5 kw / 2,200 rpm
	Output torque			18.0 kgf-m /1,800 rpm	130 ft-lb /1,800 rpm
	Engine oil capacity			6.6 liters	1.74 gals
	Cooling water capacity			11.0 liters	2.91 gals
	Fuel tank capacity			108 liters	28.5 gals
	Engine speed			1,200~2,300 rpm	←
	Battery			DC 12 v / 70 AH×2	←
Platform	Rated load			250 kgf or 2 persons + Tools (90 kgf)	550 lbs or 2 persons + Tools (200 lbs)
	Max. allowable side force			41 kgf (400N)	90 lbs
	Inner dimensions			1,800×750×1,100 mm	5.9×2.46×3.6 ft
	Rotation angle			180°	←
	Maximum floor height			12.0 meters	39 ft 4 in
	Maximum working radius			10.6 meters	34 ft 8 in
Boom	Boom length			5.0~10.9 meters	16.4 ~ 35.8 ft
	Boom angle			-20~70 degrees	←
	Rotation angle			360° continuously	←
Operational Speed	Elevation	UP		55±10 seconds/stroke	←
		DOWN		55±10 seconds/stroke	←
	Extension	OUT		25±5 seconds / stroke	←
		IN		25±5 seconds / stroke	←
	Rotation	C.W.		110±15 seconds / 1 turn	←
		C.C.W.		110±15 seconds / 1 turn	←
	Travelling	High speed	Forward	24±2 seconds / 10 m	22±2 seconds / 10 yards
			Reverse	24±2 seconds / 10 m	22±2 seconds / 10 yards
		Low speed	Forward	51±8 seconds / 10m	47±7 seconds / 10 yards
			Reverse	51±8 seconds / 10m	47±7 seconds / 10 yards
	Platform rotation	Right		20±4 seconds / stroke	←
		Left		20±4 seconds / stroke	←

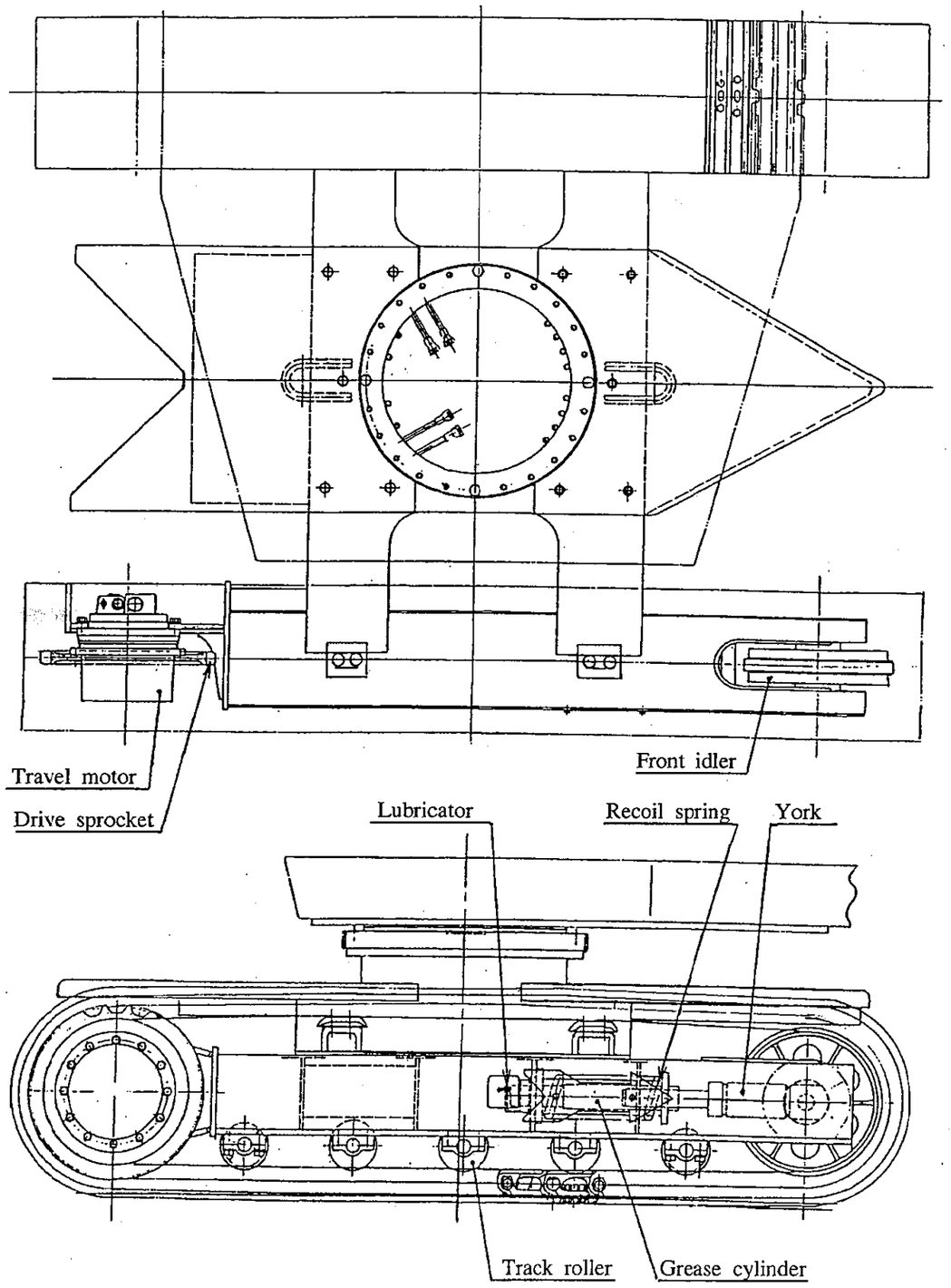
Maximum allowable slope			5 degrees	←
Gradeability			24 degrees	←
Hydraulic system	Hydraulic oil	Tank capacity	170 liters	45 gals
		Recommended oil	Shell Tellus oil 32	←
	Hydraulic pump	Type	Gear pump (Double)	←
		Discharge volume	24.5+24.5 cc / rev.	1.49+1.49 in^3/rev
		Pump speed	1,200~2,300 rpm	←
	Rated pressure	Main system (Elevation, Extension Rotation & Travelling)	210 $^{+5}_{-0}$ kgf /cm^2	3,000 $^{+70}_{-0}$ PSI
		Sub system (Platform rotation & Fly jib)	140 $^{+5}_{-0}$ kgf /cm^2	2,000 $^{+70}_{-0}$ PSI

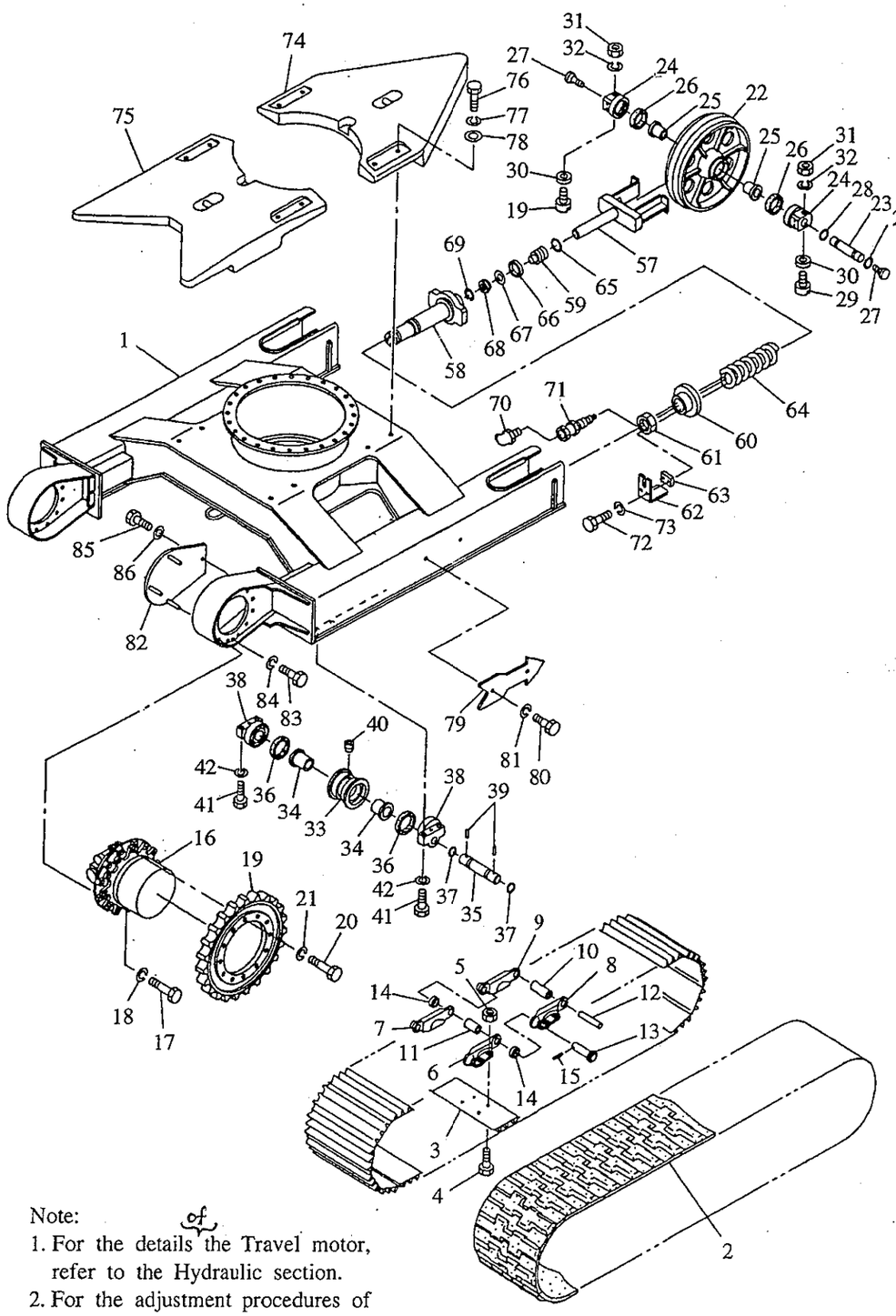
WORKING RANGE CHART



2
MECHANICAL SECTION

CRAWLER



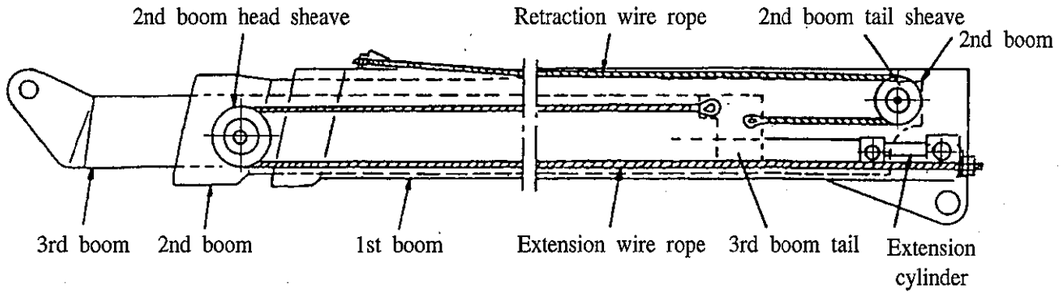


Note:
1. For the details of the Travel motor, refer to the Hydraulic section.
2. For the adjustment procedures of the Track tension, refer to the Adjustment section.

BOOM

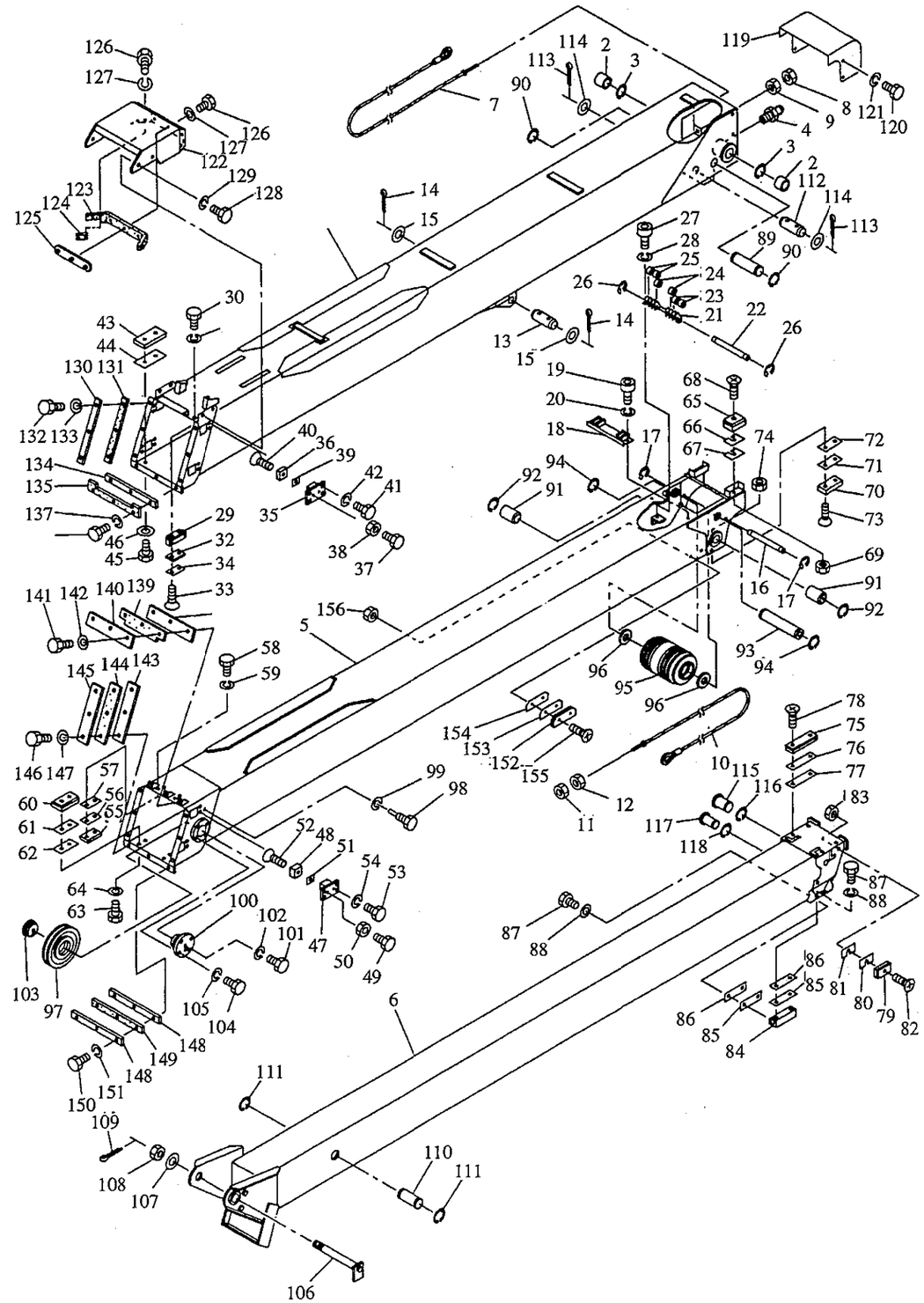
The boom Assy consists of 1st boom, 2nd boom, 3rd boom, extension cylinder, extension/retraction wire ropes, hydraulic plumbings, electric cables and their sheaves.
The 2nd boom is extended or retracted directly by the Extension cylinder. However, the 3rd boom is telescoped by the movement of 2nd boom through extension/retraction wire ropes.

1. Note on function

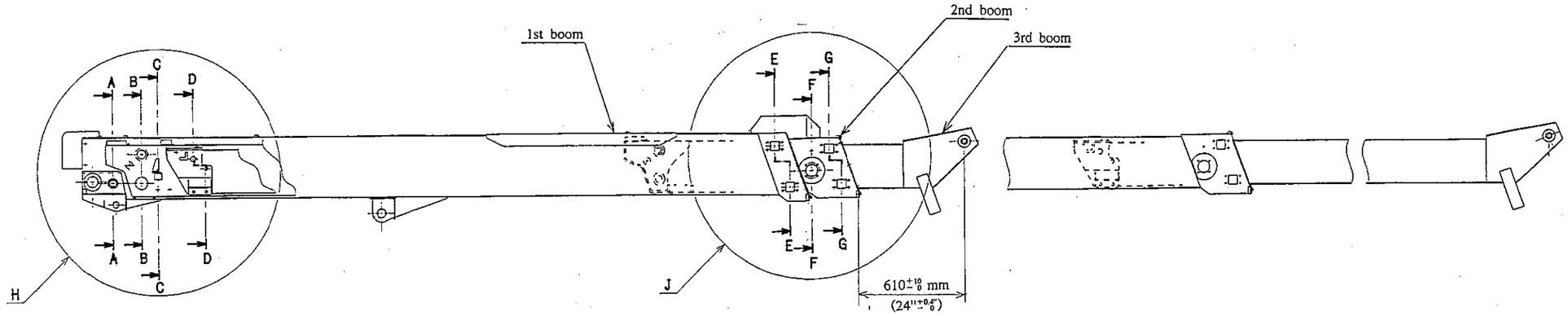


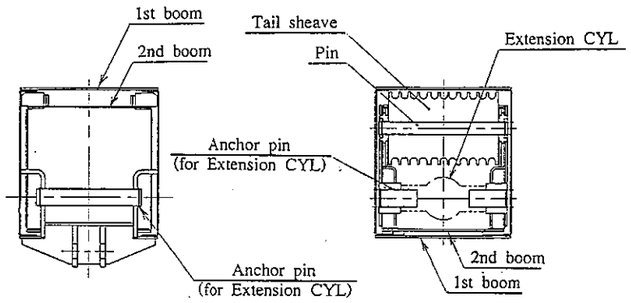
The first and second booms are connected by the "extension cylinder" which directry extends and retracts the second boom.
The third boom is connected by two pairs of wire ropes, one is the "retraction wire rope". This is connected to the tail of the third boom through the tail sheave installed on the tail of the second boom. The other is the "extension wire rope" this is also connected to the tail of the third boom through the head sheave which is installed on the head of the second boom.
During the extension of the boom, the second boom is extended by the extension cylinder together with the head sheave. As a result, the third boom is pulled by the "extension wire rope" and accordingly goes out of the second boom.
When retracting the boom, the second boom is retracted by the "extension cylinder" together with the tail sheave. As a result, the third boom is pulled by the "retraction wire rope" and accordingly goes into the second boom.

2. Illustration



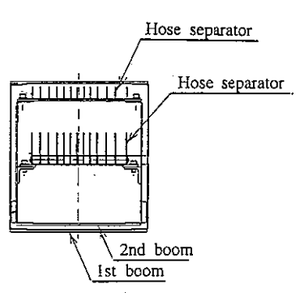
3. Sectional drawings



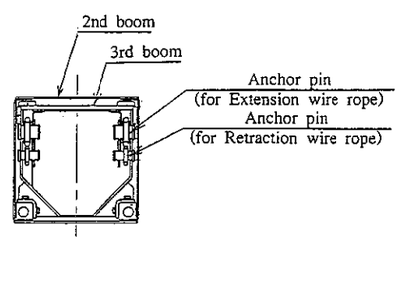


A-A section

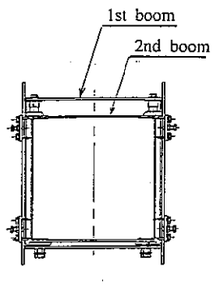
B-B section



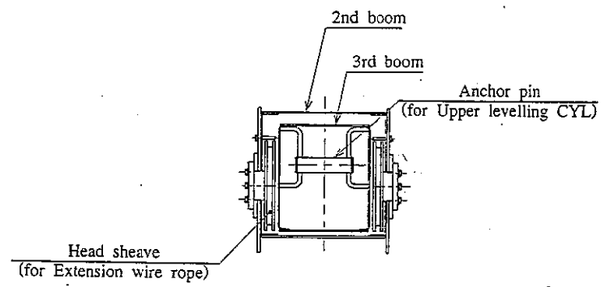
C-C section



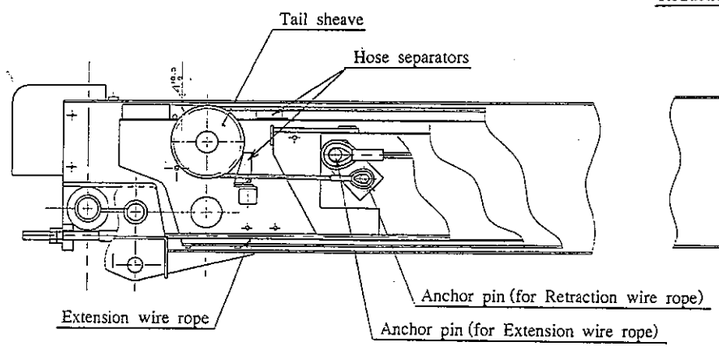
D-D section



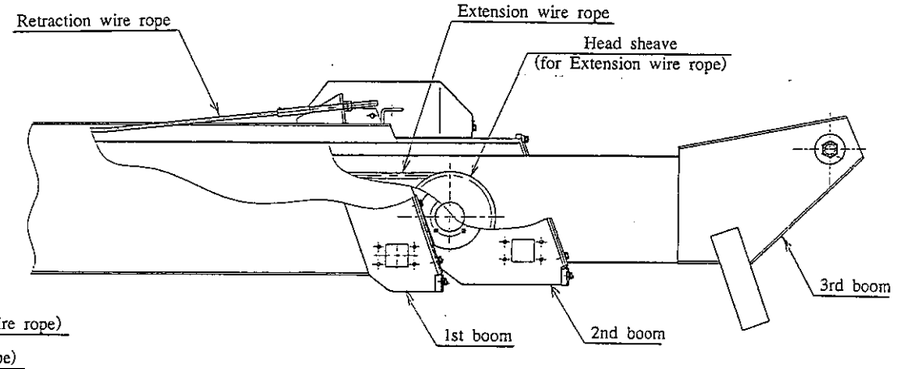
E-E section



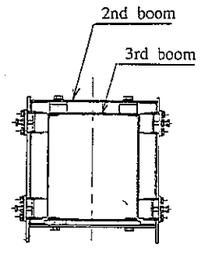
F-F section



H-Detail



J-Detail



G-G section

4. 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 slider and boom section.
      * Specific clearance : 2.0mm or less. (0.08" or less)
   2) If the clearance is not adequate, adjust the clearance by adding or reducing the spacers installed under the each slider or by adjusting the screws.

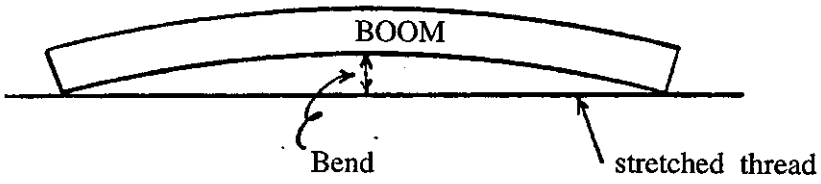
NOTE:

* Check each slider for wear, and replace if necessary.
* Apply a thread lock agent to the thread of each set screw for sliders before setting.
  Recommended thread lock agent : 3 Bond. 1374.

2. Bend of boom
   1) Set the boom horizontally and extend it fully.
   2) Visually check the bend of each boom.
   3) If the bend seems to be excessive, stretch a thread over the boom and measure the bend accurately as shown in the figure below.

NOTE: If the bend measured exceeds the serviceable limit (6.0mm), replace the boom. (0.24")

Fig:2



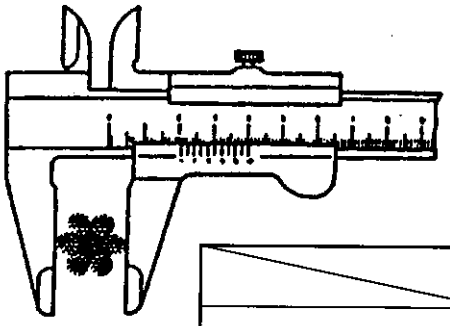
3. Dents, scratches.
   Check the each boom for both dents and scratches thoroughly.
   If any dent or scratch which exceeds the serviceable limit
   (Length : 50mm or more, Depth : 2mm or more) exsists, replace the boom.
   (1.97") (0.08")
4. Cracks.
   Check each boom thoroughly for cracks.
   For fine cracks, use "COLOR CHECK" or penetrant check.
   * Pay special attention, when checking each pin boss and welded part.

5. Extension/Retraction wire ropes.

After disassembling the boom, inspect 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.

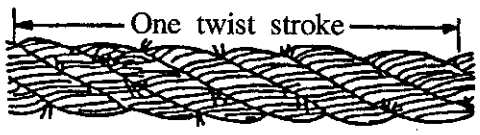
Fig:3



	Nominal diameter	Serviceable limit
Retraction wire rope	ϕ 8mm (0.315")	ϕ 7.76mm (0.306") or less
Extension wire rope	ϕ 12mm (0.472")	ϕ 11.64mm (0.458") or less

2) Check for broken wires.
If 3 or more wires of a wire rope are broken in a twist stroke, replace the wire rope.

Fig:4

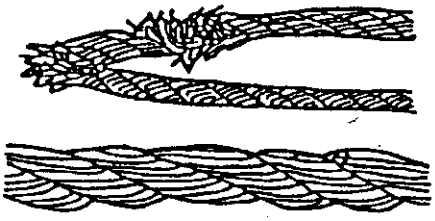


3) Check wire ropes for rust.
If rust is evident around the inside of the wire rope, replace it.

Fig:5

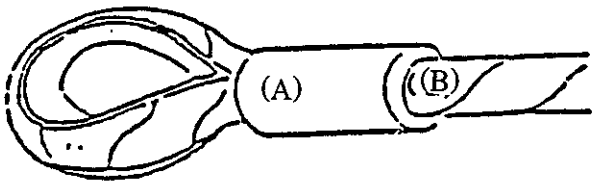
4) If any kinks are observed, replace the wire rope.
Also, an extremely deformed wire rope requires replacement.

Fig:6



5) Carefully check the end sections of a wire rope, especially sections A and B. Replace the wire rope if any defects are found.

Fig:7

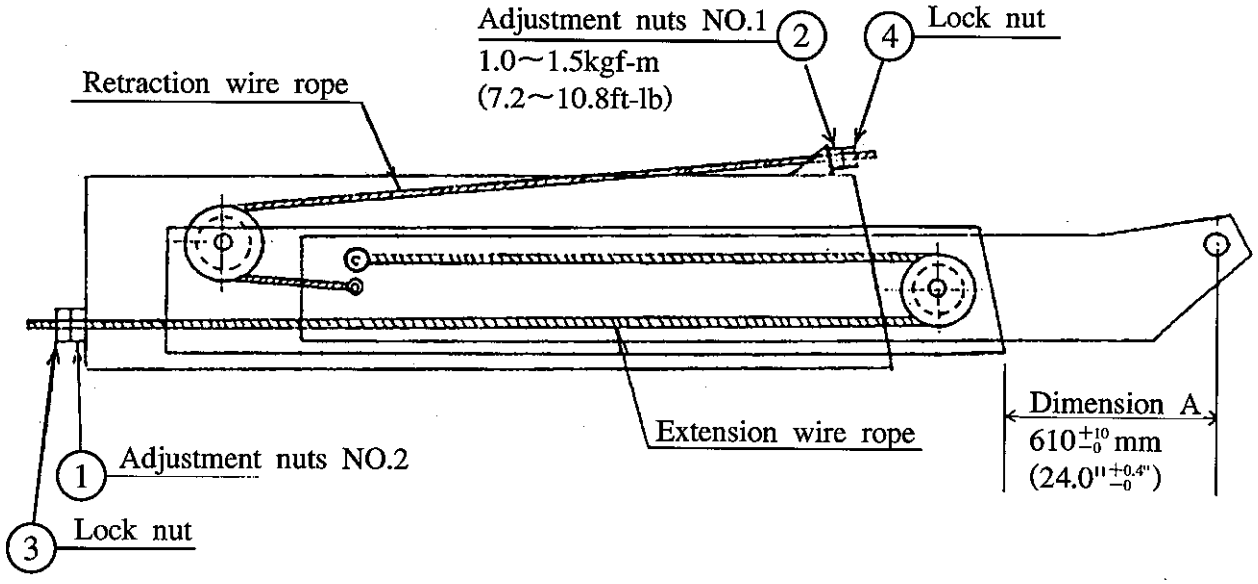


6. Tension of extension/retraction wire ropes

Extend/retract the boom for a full stroke, check for any jerky movements caused by loose or stretched extension/retraction wire ropes.
If the wire ropes are loose, adjust their tensions as follows.

1) Retract boom fully and set it horizontally.
2) Loosen both the lock-nuts and the Adjustment nuts NO.1②, which are located on both sides of the top part of the 1st boom.
3) Lubricate the Adjustment nuts NO.1 with machine oil, and make sure that the nuts turn smoothly on the threads.
4) Tighten both of the Adjustment nuts NO.1. Do this alternatly using a torque wrench, until the specified tightening torque is reached.
   Specified tightening torque of Adjustment nuts NO.1:1.0~1.5kgf-m(7.2~10.8ft-1b)
5) Check dimension A shown in the figure below, and make sure that it is 610^{+10}_{0}mm. ($24.0''^{+0.4''}_{-0}$)
   If the mesurement of dimension A is less than 610mm (24.0''):
   - Screw out Adjustment nuts NO.1 ② and screw in Adjustment nuts NO.2 ① until the specified dimension A is obtained.

   If the mesurement of dimension A is more than 620mm (24.4''):
   - Screw out Adjustment nuts NO.2 ① and screw in Adjustment nuts NO.1 ② until the specified dimension A is obtained.
6) Extend/retract boom several times for a full stroke, and recheck the tightening torque of Adjustment nuts NO.1, and dimension A, then secure the Adjustment nuts with lock-nuts.

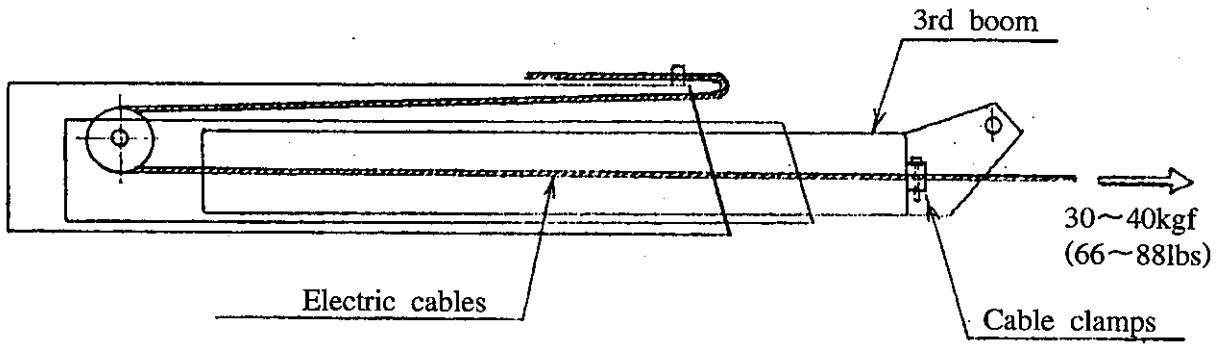


Note : Adjust the tension of wire ropes every 6 months.

7. Tension of Electric cable

Apply tension on the each electric cable after adjusting the tension of "Extension/Retraction wire ropes as follows.
It is advisable to apply the tension on each electric cable every 6 months or 600 working hours.

1) Position the boom horizontally, retract it fully, and check the tension of the "Extension/Retraction wire ropes."
   (Adjust the tension if necessary.)
2) Loosen the cable clamps at the top of the 3rd boom.
3) Pull each electric cable by applying 30~40kgf, and lock the cable with the cable clamp. (66~88lbs)

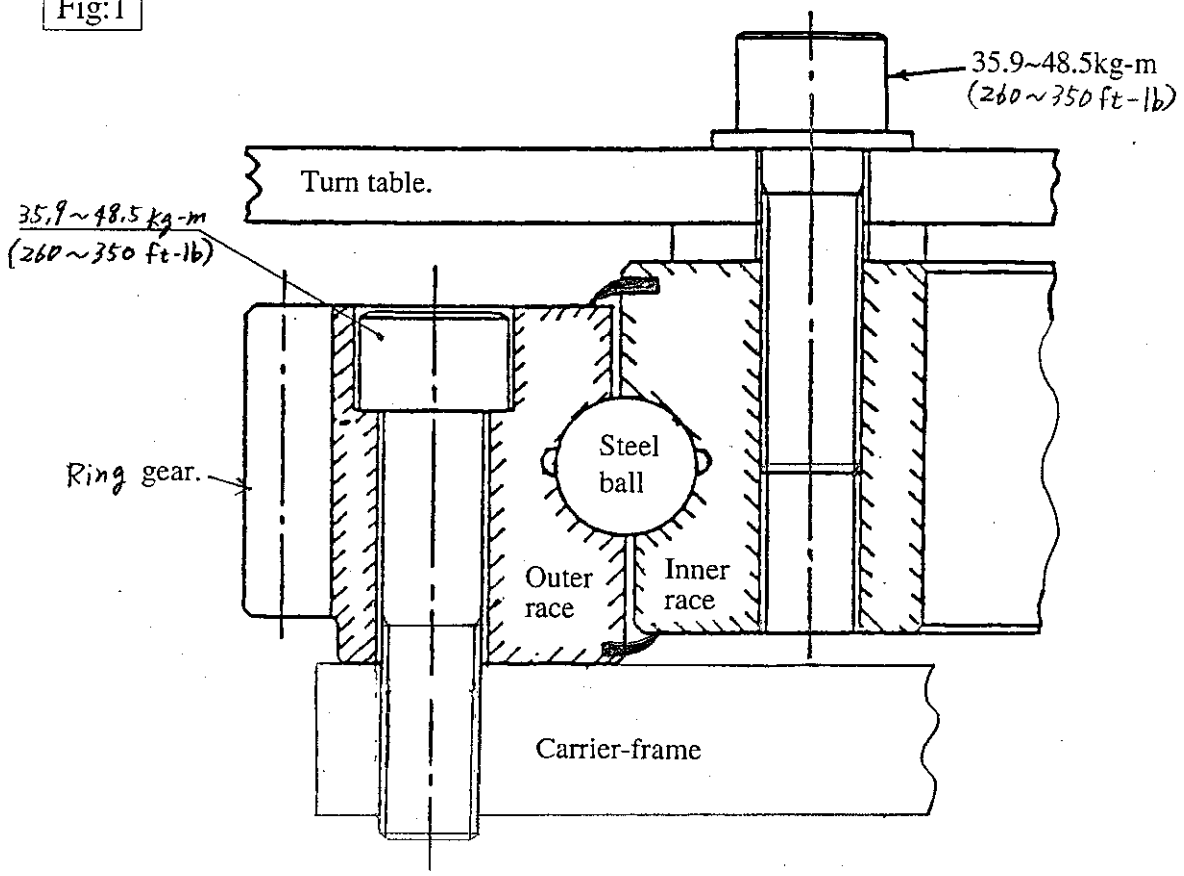


Note : Apply tension to the cables every 6 months.

T.T.B. (Turn Table Bearing)

The T.T.B. is mounted between the carrier-frame and the turn-table, it enables the turn-table to rotate freely over the carrier-frame.

Fig:1



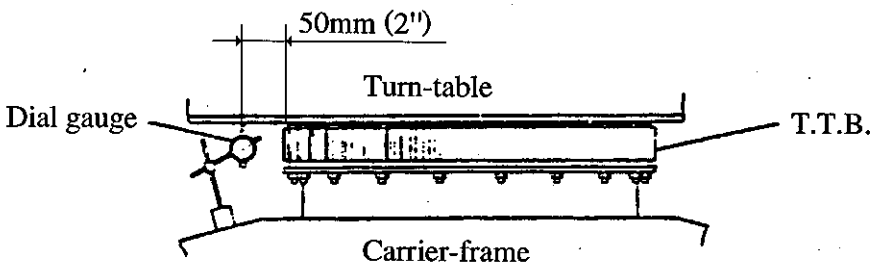
1. Inspection procedures.

1. Check anchor bolts and nuts for any looseness, omissions or any other damage.
   a. Loose bolts should be removed and checked for damaged threads and deformation.
   b. When resetting anchor bolts or nuts, apply thread lock agent to the threads.
   -Recommended thread lock agent : 3 Bond 1374.
   c. Tighten anchor bolts and nuts to the specified tightening torque.
   -Specified tightening torque : 35.9-48.5 kg-m (260~350 ft-lb).

NOTE : Before removing anchor bolts or nuts, use a gas bunner to heat them until they are red hot. This will remove the thread lock agent applied on the thread of each bolt and nut.

2. Check ring gear for cracks, scorings and any other damage.
   For any fine cracks, use a penetrant check such as a color check.
3. Check the back-lash between ring gear of T.T.B. and the drive pinion of Rotation gear box.
   -Standerd back-lash : 0.6mm (0.024") or less.
   NOTE : To measure the value of back-lash, rotate turn-table and crush a lead-wire between the ring gear and the drive pinion, then measure the thickness of the crushed lead-wire.
   When the back-lash is not within the the tolerance, adjust it by moving the position of rotation gear box.
4. Check the free-play between inner and outer races of T.T.B..
   To check the free-play, use the following steps.

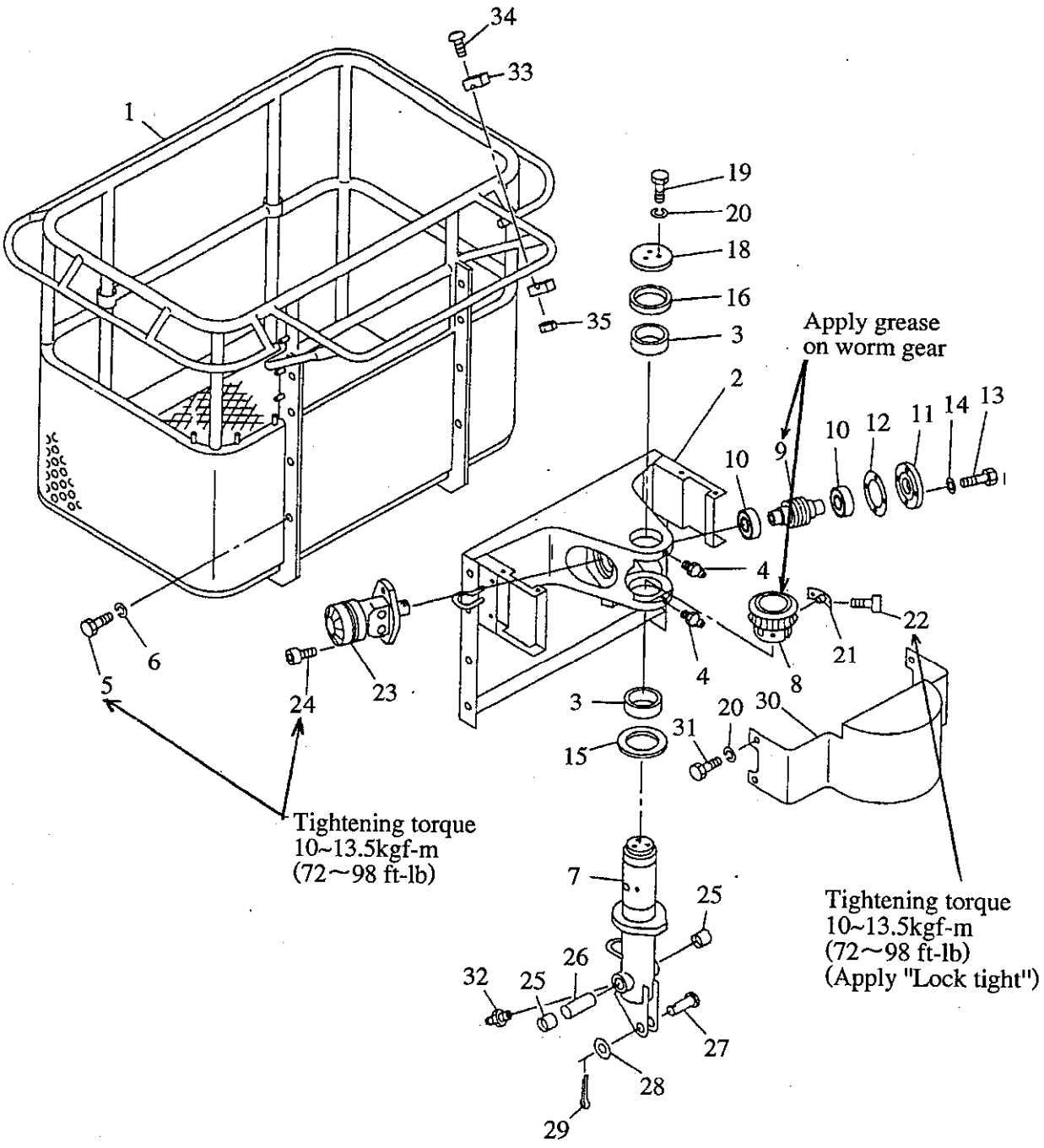
Fig:2



a. Set a dial gauge between the turn-table and the carrier-frame, as shown in Fig : 2.
b. Retract and raise the boom fully (with minimum boom length and maximum boom angle), and set the pointer of the dial gauge at "ZERO".
c. Lower the boom, set it horizontally and extend it fully, then re-check the dial gauge.
   The reading of the dial gauge is the value of free-play.
   -Standard free-play : 0.9mm (0.035").
   -Limit of free-play : 3.0mm (0.118").

NOTE :
The T.T.B. with free-play in excess of the limit 3.0mm (0.118") should be replaced.

PLATFORM SWING MECHANISM



3
HYDRAULIC SECTION

NOTE ON OVERHAULING THE HYDRAULIC SYSTEM

When repairing, servcing or overhauling the hydraulic system, take the following into consideration.

1. When disconnecting plumbing.
   a. Prepare a suitable container to catch the draining oil.
   b. Put "MATCH MARKS" on each part before disconnecting. This will make recoginition on the time of reconnection easier.
   c. Use double spanners as not to damage the plumbing and components.
   d. Clean the plumbing or components out before disconnection, to prevent foreign particles from entering into the hydraulic system.
   e. Install proper plugs to the disconnected plumbing or components, to prevent foreign particles from entering into the hydraulic system.
2. When connecting the plumbing.
   a. Check the "MATCH MARKS" made on disconnection to avoid incorrect connections.
   b. Clean the connecting plumbing, to prevent foreign particles from entering into the hydraulic system.
   c. When connecting the TP adaptors, wind seal-tape at least one and a half times around the threads.
   d. Use double spanners when tightening the connectors.
3. When assembling or disassembling hydraulic components.
   a. Put proper plugs onto the openings of oil passages to prevent foreign particles entering into the components.
   b. Before disassembling, clean the component thoroughly with a solvent and compressed air.
   c. Clean each disassembled part with solvent thoroughly. This will ensure easier check-up procedures, and prevent the introduction of foreign particles.
   d. When assembling 0 rings or packings, apply a little grease or lubricate them with hydraulic oil.
   e. When installing taper plugs, wind seal-tape at least one and a half times around the threads.

HYDRAULIC OIL

It should be noted that hydraulic system failures are often caused by defective hydraulic oil which in turn is caused by improper maintenance.

To insure maximum utilization, the followings should be observed.

1) Oil temperature should be below 70°c and ideally below 60°c (140°F), as heat causes earlier oxidation.
   On the other hand when the oil is very cold, a warm-up period is recommended before operation.
2) Regularly check for contaminants in the hydraulic oil.
   Contaminants in the oil may speed up the oxidation process.
3) Avoid introduction of water into the hydraulic system, as water will cause additives to deteriorate and if the amount of water is sufficiently large, it will cause the oil to emulsify.
4) As a rule, do not mix oils from different maufacturers.
   Furthermore, do not mix oils of the same make if they have different product names or viscosity differences.
   Improper mixing will cause the additives to deteriorate.
5) Eliminate oil leakage as much as possible from the hydraulic component and its plumbings.
6) Make it a habit to check the oil regularly.

Guidelines for oil change.

An oil change should be carried out every 1,200 working hours or on an annual basis.
(For new Machine : After 300 working hours or 3 months use.)
In the meantime, take a small amount of oil from the oil reservoir, and conduct the following inspections and tests.

1) Visually compare the sample taken from the oil reservoir, and a fresh, unused sample.
   - Color -
   As the oil deteriorates, the color becomes darker and less clear.
   If the oil is milky, let it settle for about 10 hours, then observe.
   a) If there is little or no change to the milky oil, the cause is water mixed into the oil.
      In this case a complete oil-change is necessary.

b) If the oil and water seperate, this indicates that the water has been introduced to the hydraulic system a short time ago. It can be reused after taking out water.

c) If the oil becomes clear with no water at the bottom of the container, it is an indication that air has been mixed into the oil.
- Access the cause of the air.

- Smell -

If the oil has a strong pungent odor, it is an indication that the deterioration has progressed to a point where an oil-change is needed.

- Contaminants -

If suspended contaminants are introduced to the hydraulic oil, leave the sample for 1 to 2 days and gather sediments for further tests of the development of contaminants.

2) Analytical tests.

Test the hydraulic oil for viscosity, water content, oxidation, contaminants, etc.

Test for	Shell Tellus 32	Shell Tellus T15
Contamination	Within NAS Class 12.	
Water content (%)	Less than 0.5%.	
Oxidation (mgKOH/g)	0.4mgKOH/g.	
Viscosity (cst) (at 40°c)	32 cst.	15 cst.

Suction strainer.

Be sure to clean suction strainer at the time of an oil change.

Wash and clean the strainer in kerosene or a similar solvent, then air-blast it from the inside.

Oil filters.

Regulary replace the filter element. If the machine is new, replace the element after 300 working hours or 3 months use.

Thereafter, replace it every 1,200 working hours or on an annual basis.

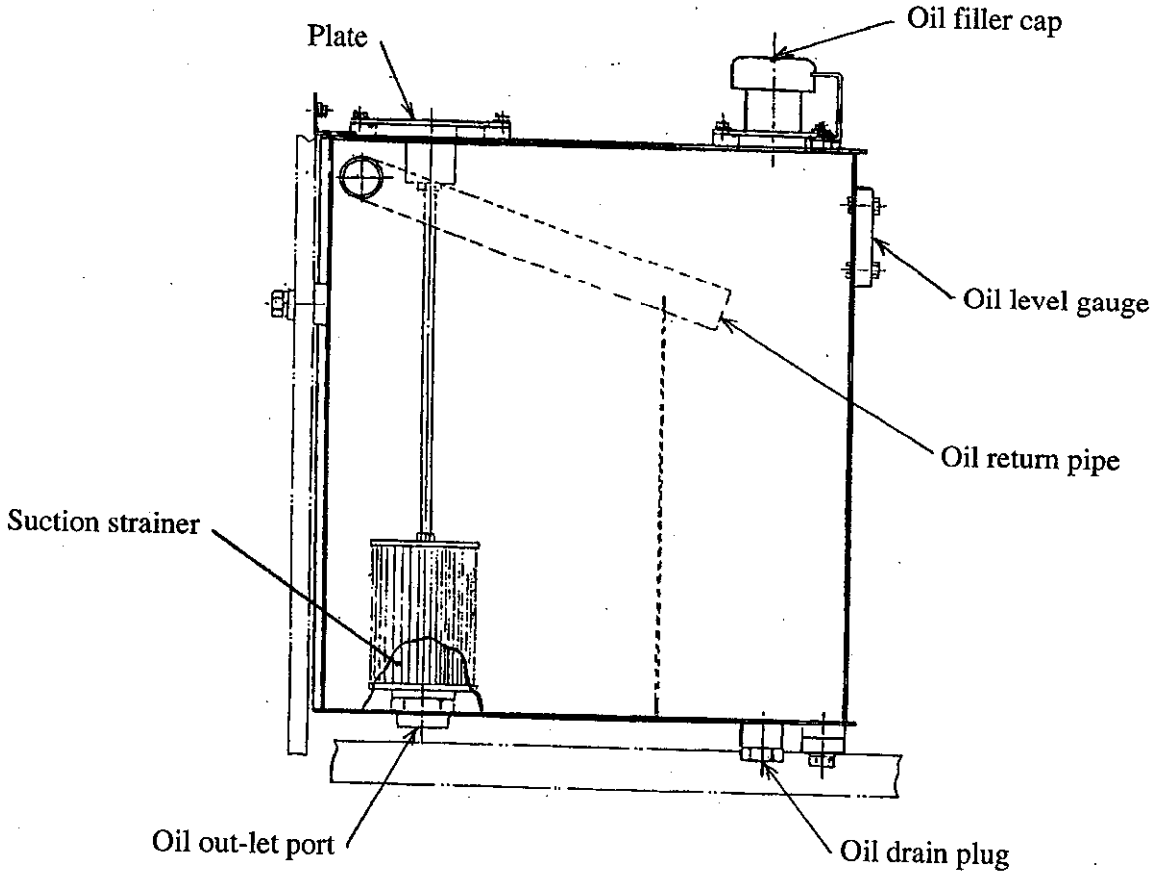
(The element should also be replaced at the time of an oil change.)

OIL RESERVOIR

The oil reservoir consists of such components as shown in the figure below, and supplies hydraulic oil to the whole hydraulic system.

Capacity ..... 170 liters (45 gals)

Recommended oil ..... Shell Tellus oil 32



Oil change interval

- Every 1,200 hours or annually
- For a new machine the first oil change should be carried out after 300 hours or 3 months use.

Note

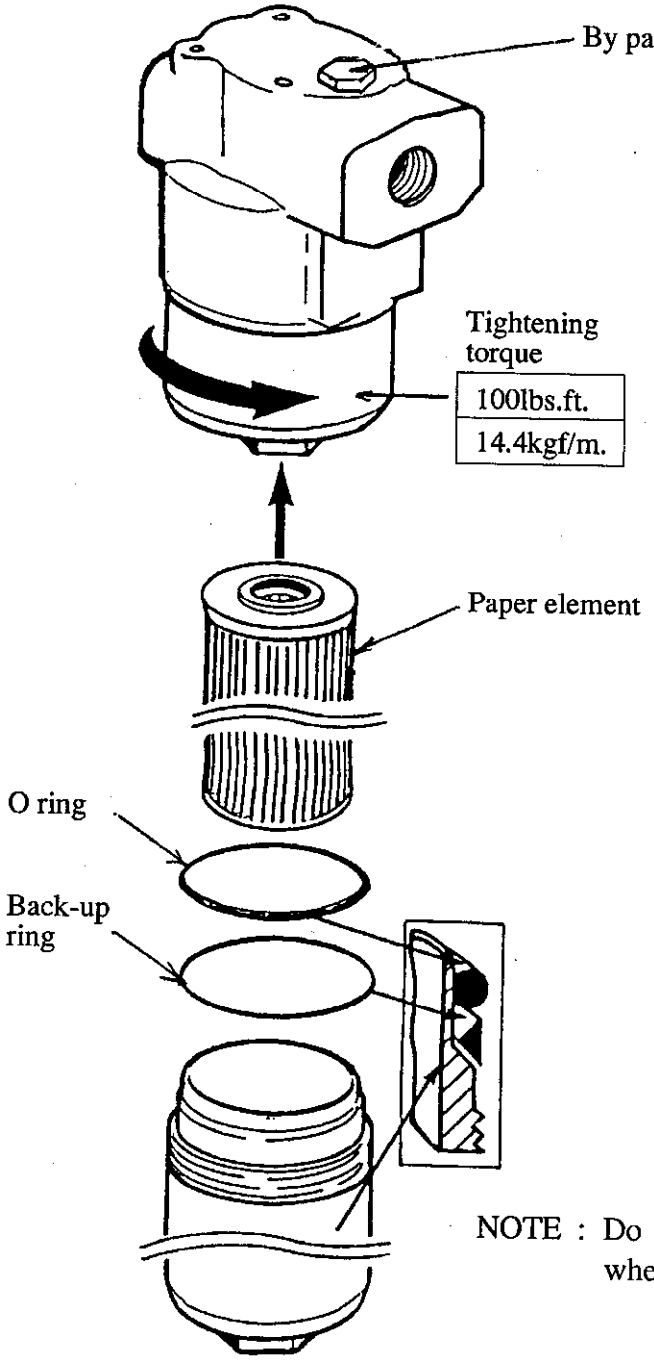
- When checking oil level, retract and lower the boom fully.
- Clean "Suction strainer" and replace "In-line filter", when changing the hydraulic oil.

IN-LINE FILTER

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

Replacement interval : Every 1,200 working hours or annually.
(of filter element)

NOTE : The first replacement of the filter element for new machine should be carried out after 300 working hours or 3 months use.

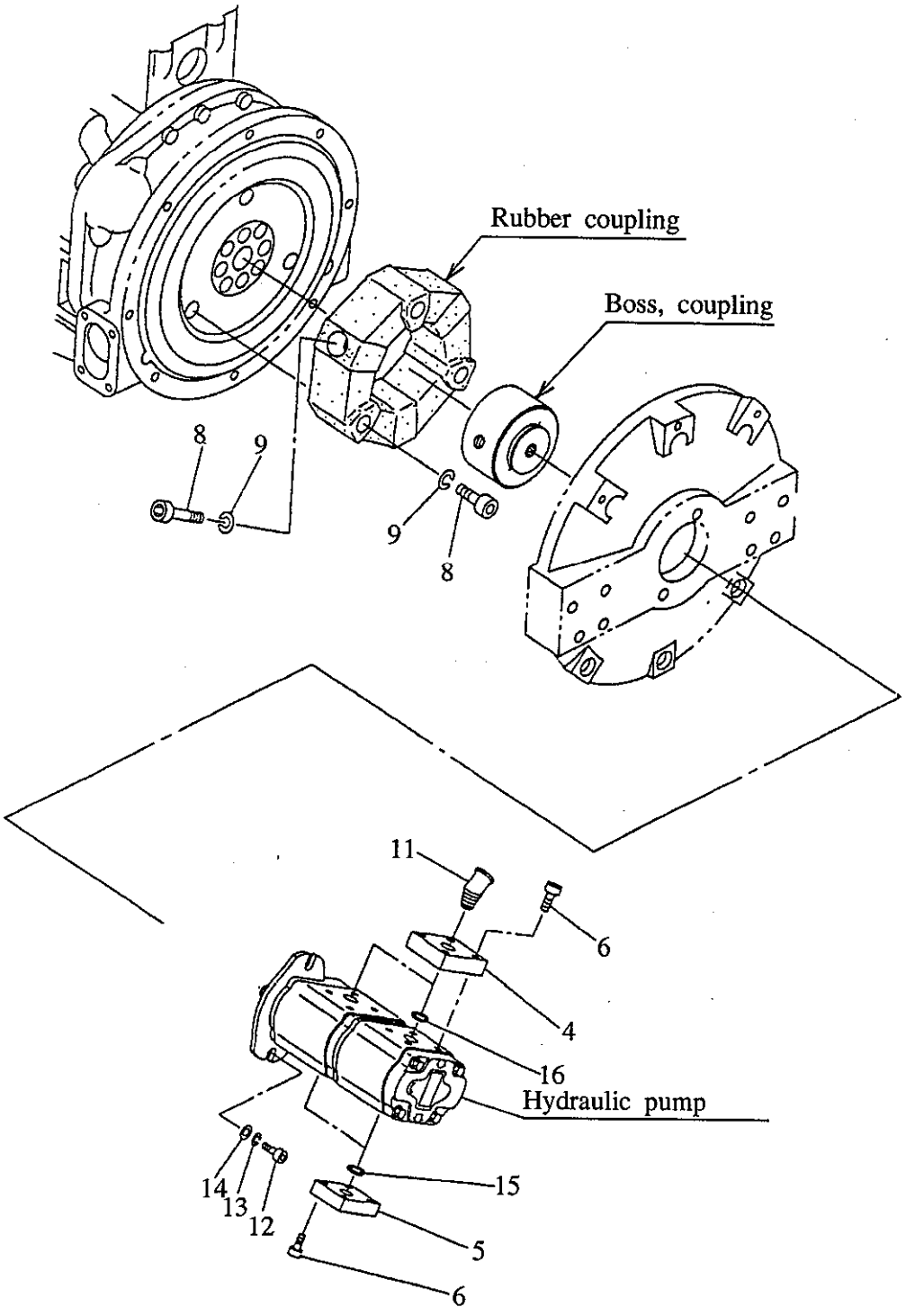


NOTE : Do not reuse "Oring" and "Back up ring", when removed once.

HYDRAULIC PUMP

The pump is driven directly by the engine, and supplies pressurized oil to hydraulic system.

Type ..... Gear pump (Double)
Discharge volume ..... 24.5 + 24.5cc/rev (1.49+1.49 in^3/rev)
Rated pressure ..... 210kgf/cm^2 (3,000 PSI)
Rotating direction ..... Clock wise



MAIN CONTROL VALVE NO.1 and NO.2

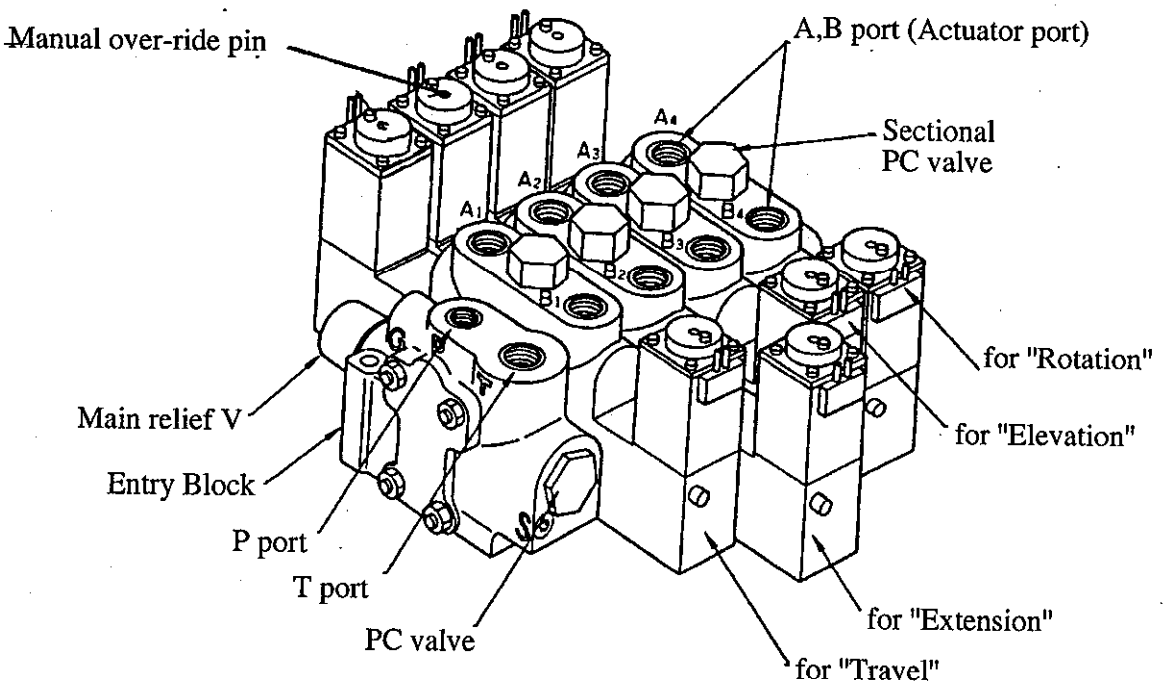
The main control valve is a "Soleniod Operated Proportional Type" and controls the following hydraulic systems.

1. Elevation system.
2. Extension system.
3. Rotation system.
4. Travel system.

When the main control valve is operated by the control levers (or Potentio meters) located at upper control box, the main spools of the valve are shifted proportionally in accordance with the operated value of the control levers.
Thus, the flow which is supplied to the each hydraulic actuator is controlled proportionally.

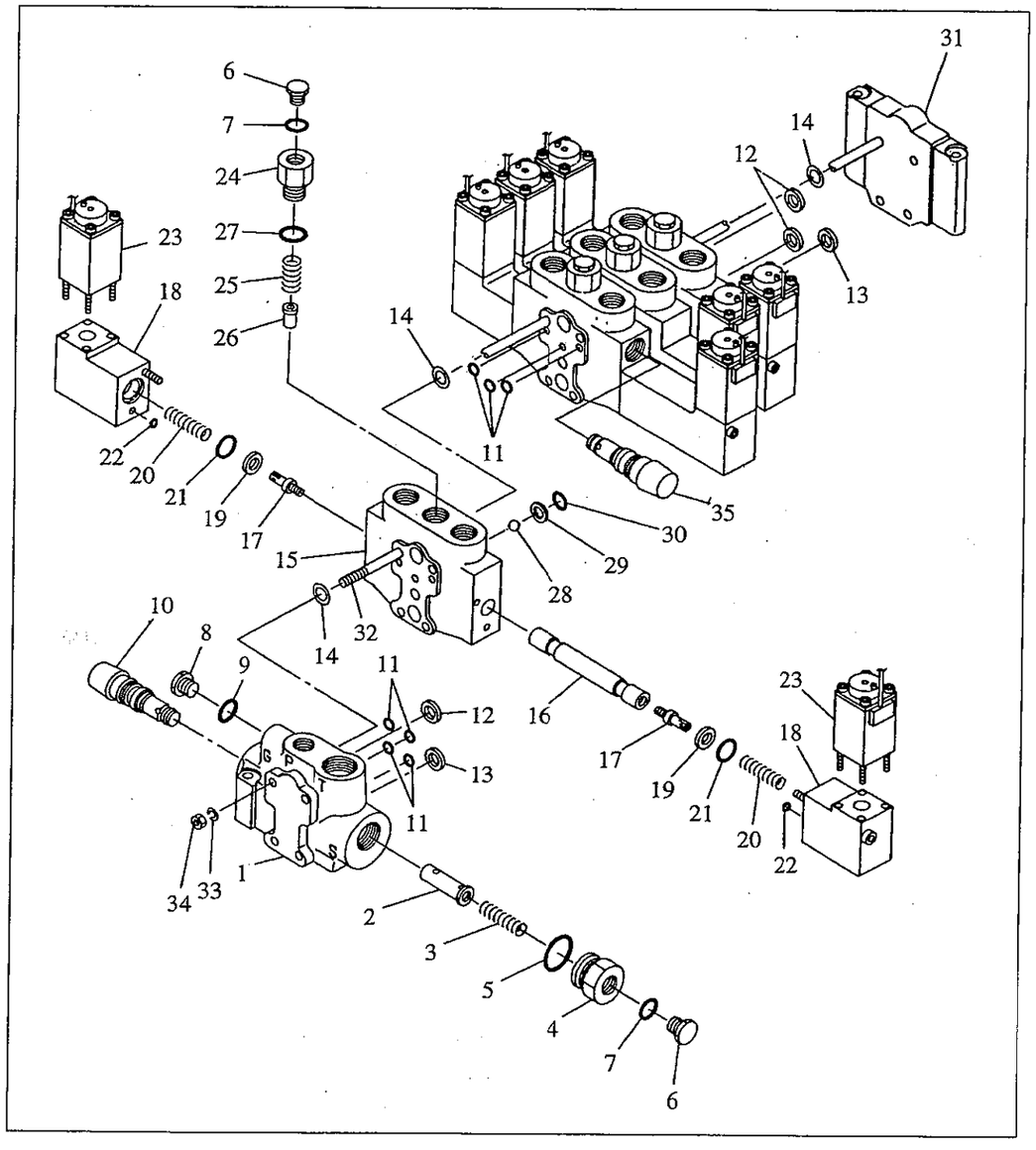
On the other hand, when the main control valve is operated by the control switches located at the lower control box, the valve is operated as a conventional solenoid valve.

* Rated pressure.
  - at P, A, B ports : 250 kg/cm². (3,555 PSI)
  - at T port : 10 kg/cm². (140 PSI)
* Solenoid.
  - Rated voltage : DC 24 V
  - Rated current : 650 mA
  - Resistance : 30 Ω

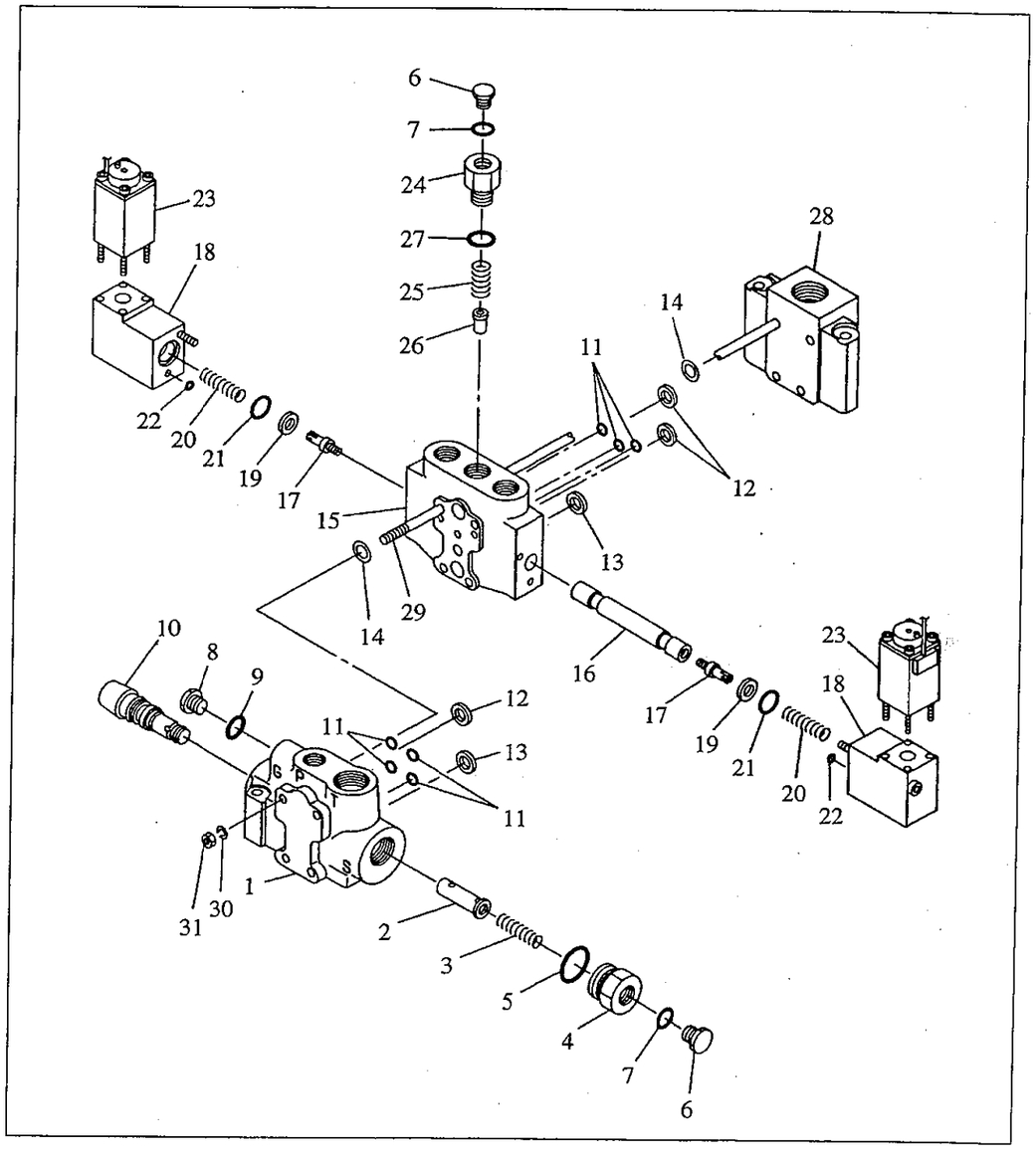


1. Illustrations

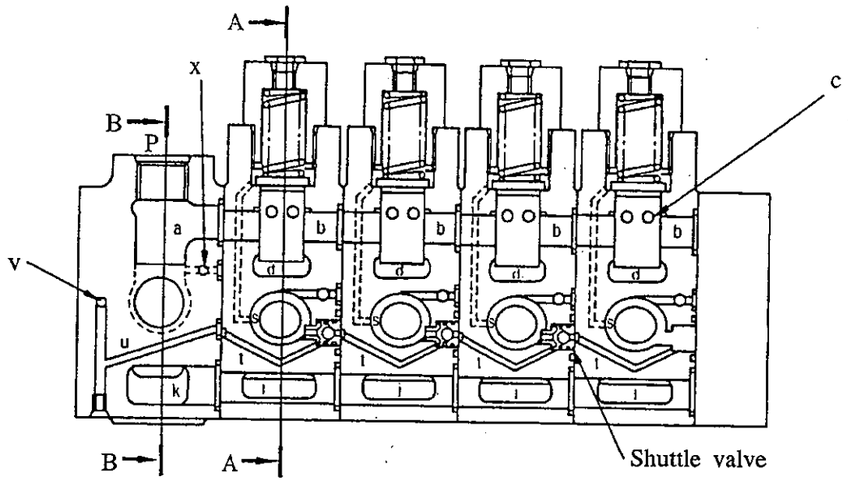
Main control valve NO.1 (R12-R2035)

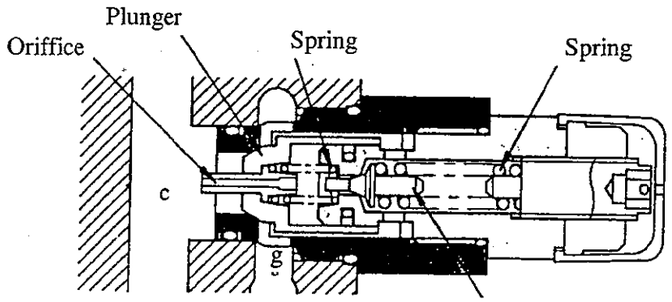


Main control valve NO.2 (R12-R2036)

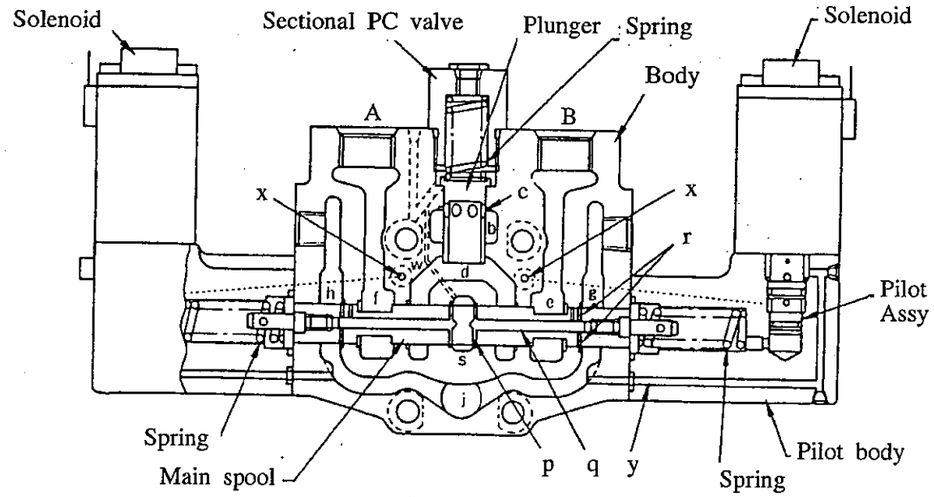


2. Sectional drawings

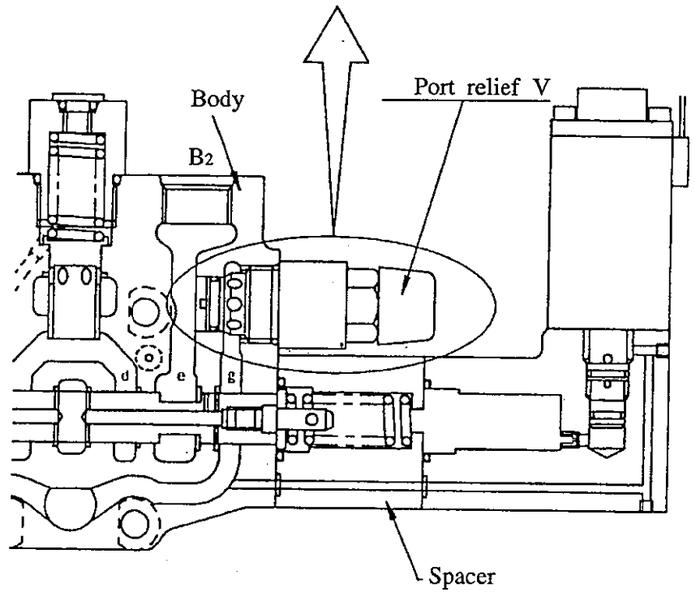


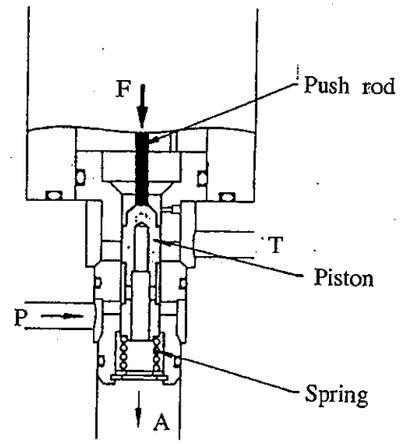


Detail of port relief V

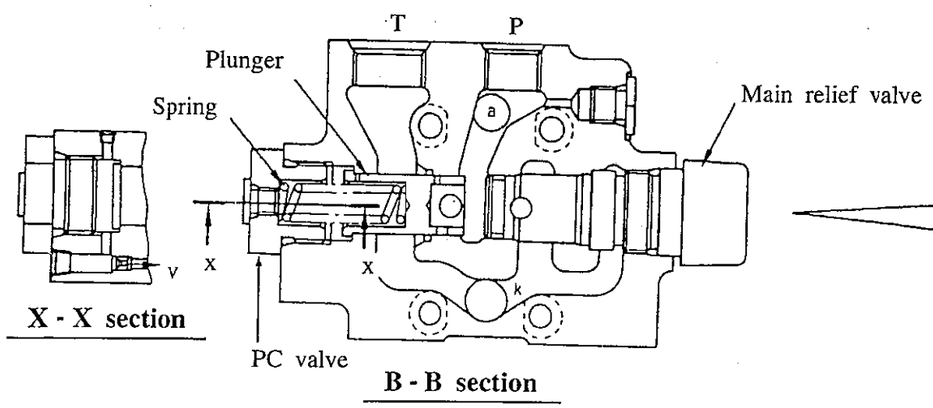


A - A section



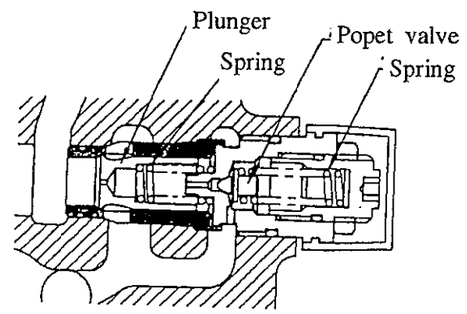


Detail of pilot valve



X - X section

B - B section



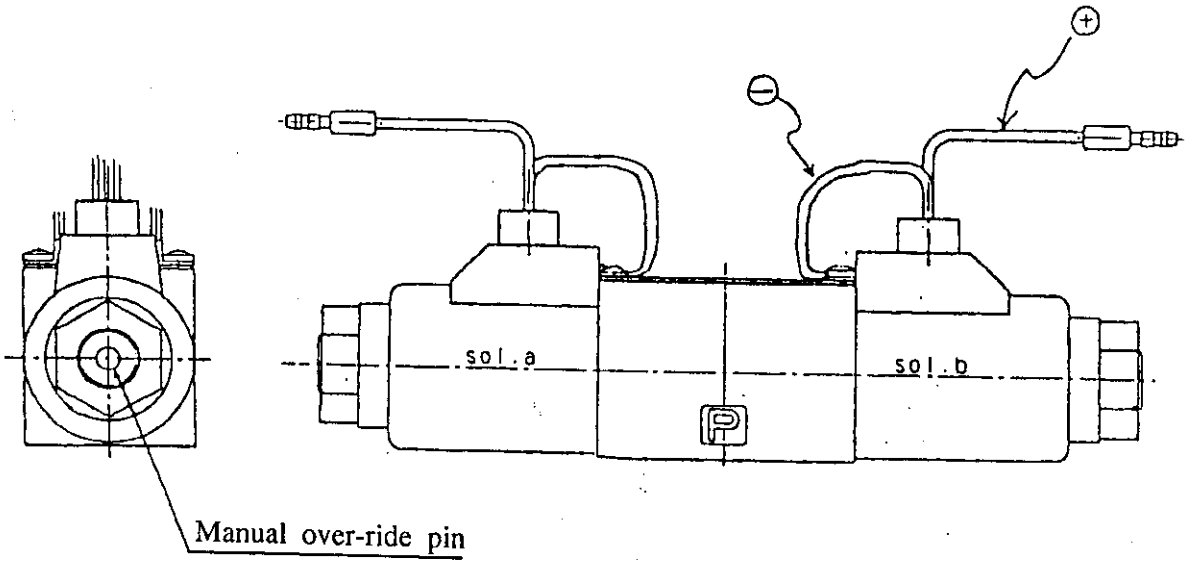
Detail of Main relief V

3. Trouble shooting

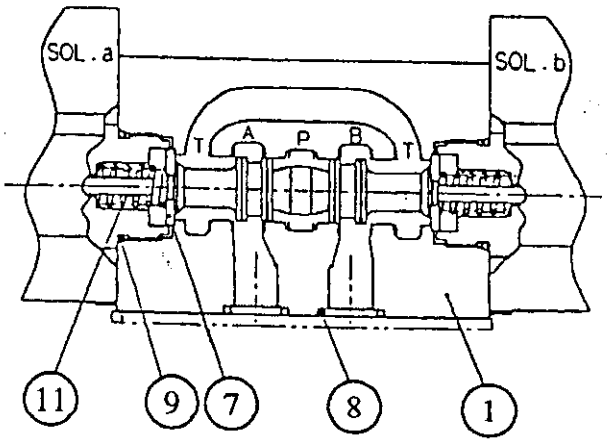
Trouble	Check point	Result	Cause	Remedy
Inoperative actuator or Operational speed of the actuator is too slow.	Check the "GAIN voltage" at "Valve control unit".	No "GAIN voltage" is obtained.	Defective "Potentio meter" or "Control switch".	Replace the "Potenio meter" or "Control switch".
			Inadequate adjustment of "GAIN voltage".	Readjust the "GAIN voltage" at the "Valve control unit".
			Defective "Valve control unit".	Replace the "Valve control unit".
			Defective electric wirings.	Repair the electric wirings.
		"GAIN voltage" is too low.	Battery voltage is too low.	Charge or replace the battery.
			Inadequate adjustment of "GAIN voltage".	Readjust the "GAIN voltage" at the "Valve control unit".
	In case the "GAIN voltage" is normal, press the "Manual over-ride pin" installed on "Solenoid".	Actuator is operative.	Defective solenoid.	Replace the solenoid.
			Sticked "Piston" in "Pilot valve" installed under the "Solenoid".	Clean or replace the "Pilot valve".
		Actuator is not operative.	Sticked "Main spool" or "Valves" caused by contaminated hydraulic oil.	Clean the hydraulic system, and replace the hydraulic oil.
			"PC valve" is sticked and the unloading pressure is not obtained.	Clean or replace the "PC valve".
			Sticked "Pilot valve" installed under the "Solenoid".	Clean or replace the "Pilot valve".
			Sticked "Main spool".	Clean or replace the "Main control valve Assy".
			Sticked "Sectional PC valve".	Clean or replace the "Sectional PC valve".
			Defective "Springs".	Replace the "Springs".
			Clogged "Orifice".	Clean or replace the "Orifice".
			Distorted "Valve body" caused by improper mounting.	Remount or replace the "Main control valve".
Operational speed is too fast, when operating control lever slightly.	Check the "NULL voltage" at "Valve control unit".	"NULL voltage" is too high.	Inadequate adjustment of "NULL voltage".	Readjust the "NULL voltage" at the "Valve control unit".
Actuator haunts, after overhauling hydraulic system.			Air is in the hydraulic system.	Bleed air by operating actuator several times".
				Loosen the "Air bleed screw" installed on "Solenoid", and bleed air.
Actuator is powerless.	Check the "MAX. pressure".	"MAX. pressure" is too low.	Improper adjustment of "Relief valve".	Readjust the "Relief valve".
			"PC valve" is loose.	Tighten the "PC valve".
Erratic hydraulic pressure, or higher pressure is not achieved.	Disassemble the "Relief & PC valves".		Defective spring.	Replace the spring.
			Worn out "Poppet" or "Poppet seat".	Replace the "Relief" or "PC valve".
			Sticked "Plunger".	Clean or replace the "Relief" or "PC valve".

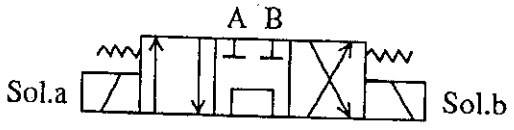
PLATFORM ROTATION SOLENOID VALVE

This valve is controlled electrically by the platform rotation switch located at the upper control box.



①	Body
⑦	Spring seat
⑧	O−ring
⑨	O−ring
⑪	Spring



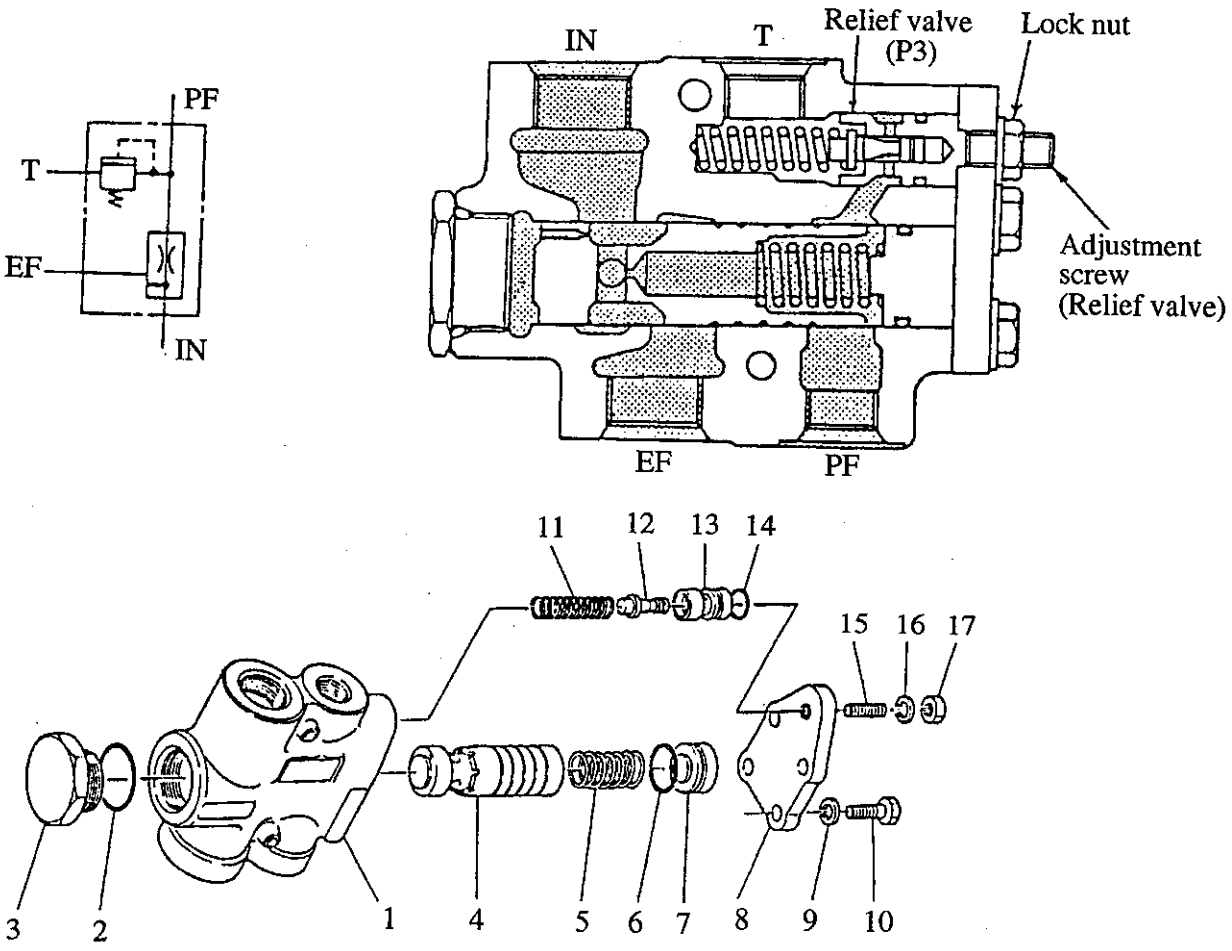


PRIORITY VALVE

The priority valve maintains the flow which comes out of the "PF port" at the constant level, regardless of any variation to the volume of pump discharge. While the rest of the pump discharge volume is by-passed through the "EF port". The relief valve incorporated in the valve is for limiting the maximum hydraulic pressure for the "PF port".

For SR-182, the flow and the maximum hydraulic pressure of the Platform swing system are both limited by the priority valve. This is because the system is supplied with hydraulic power through the "PF port".

* Rated pressure : 140 kg/㎠. (2,000 PSI)
* Constant flow : 8 liters/min. (2.1 gals/min)
  (at PF port)
* Relief valves (P3)
  Adjustable pressure range : 90~140 kg/㎠. (1,280~2,000 PSI)
  Pre-set pressure : 140 kg/㎠. (2,000 PSI)

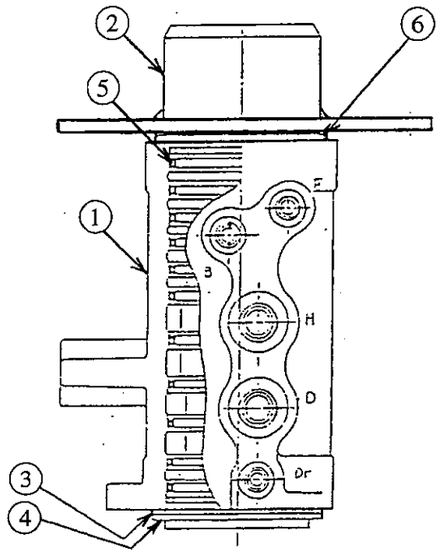


NOTE : Refer to ADJUSTMENT SECTION to adjust the Relief valve.

SWIVEL JOINT

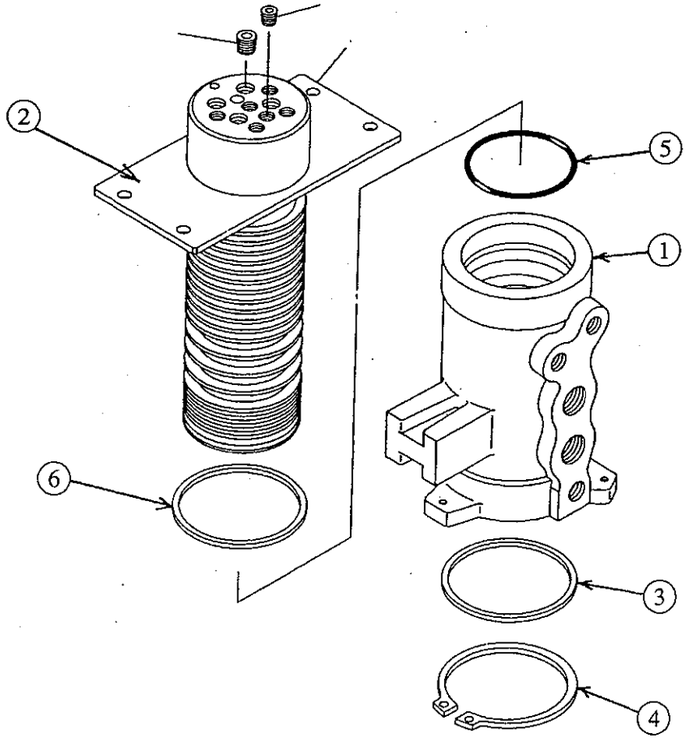
The swivel joint is installed at the rotation center of the turntable to supply pressurized oil to the "Travel motors".

Fig:1



1	Case
2	Shaft
3	Spacer
4	Snap ring
5	O ring
6	Spacer

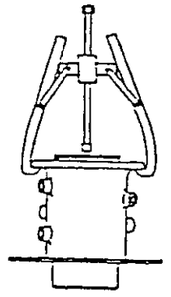
Fig:2



Disassembly

1. Remove snap ring ④ and spacer ③.
2. Press out the shaft ② from the case ① using a hydraulic press.
   (or pull the shaft ② out of the case ① using gear puller as shown in Fig:3.)

Fig:3



3. Remove the spacer ⑥ from the shaft.
4. Remove all of the O rings from the shaft.

Inspection

1. Check case ① and shaft ② for excessive wear, cracks, scorings, and any other damage.
2. Check the clearance between case ① and shaft ②.
   -If the clearance exceeds the limit, replace the shaft or the case.
   Limit of clearance : 0.4mm (0.016").
3. Check each groove on case ① and shaft ② for ridges, and sharp edges.
   -Ridges and sharp edges should be removed before installing O rings, as such faults may cause damage to the O rings.

Assembly

Assemble in the reverse order of disassembly, paying particular attention to the following points.

-Do not reuse O rings.

-Apply a slight amount of grease to O rings before installation.

ROTATION MOTOR UNIT (for Spec. A8)

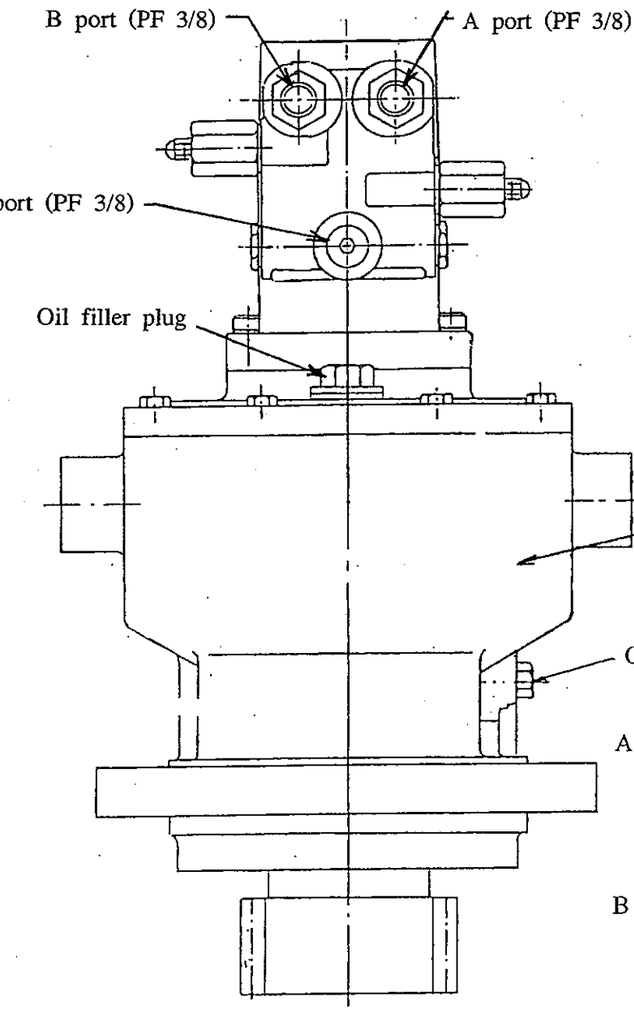
Applied to the machines prior to Ser. No. 665013

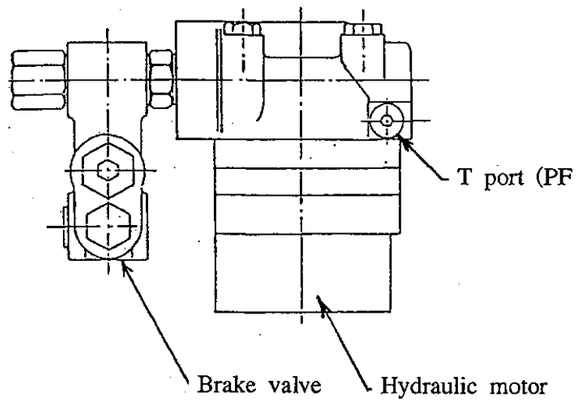
The unit consists of such major components as the Hydraulic motor the Brake valve and the Reduction gear box as shown in the figure below.

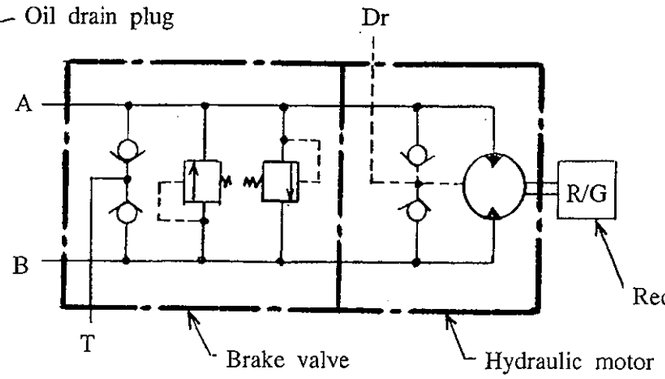
Hydraulic pump
- Type ---------- Orbit type
- Discharge volume -------- 195cc/rev (11.9 in^3/rev)

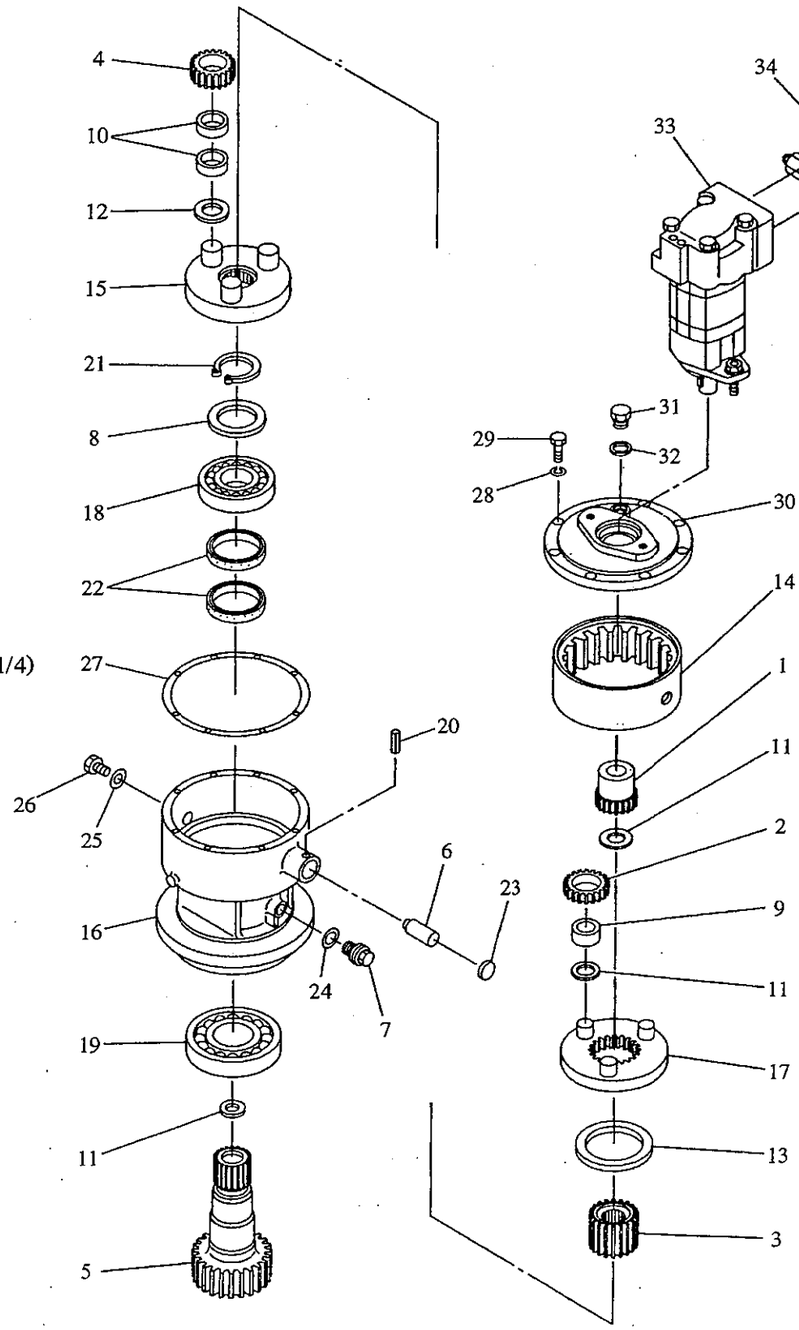
Brake valve
- Preset pressure ---------- 60kgf/cm^2 (850 PSI)

Reduction gear box
- Type ---------- Planetary gear
- Reduction ratio ---------- 1/16.6
- Gear oil ---------- Shell Omala oil 460 (1.1 liters, 0.3 gals)







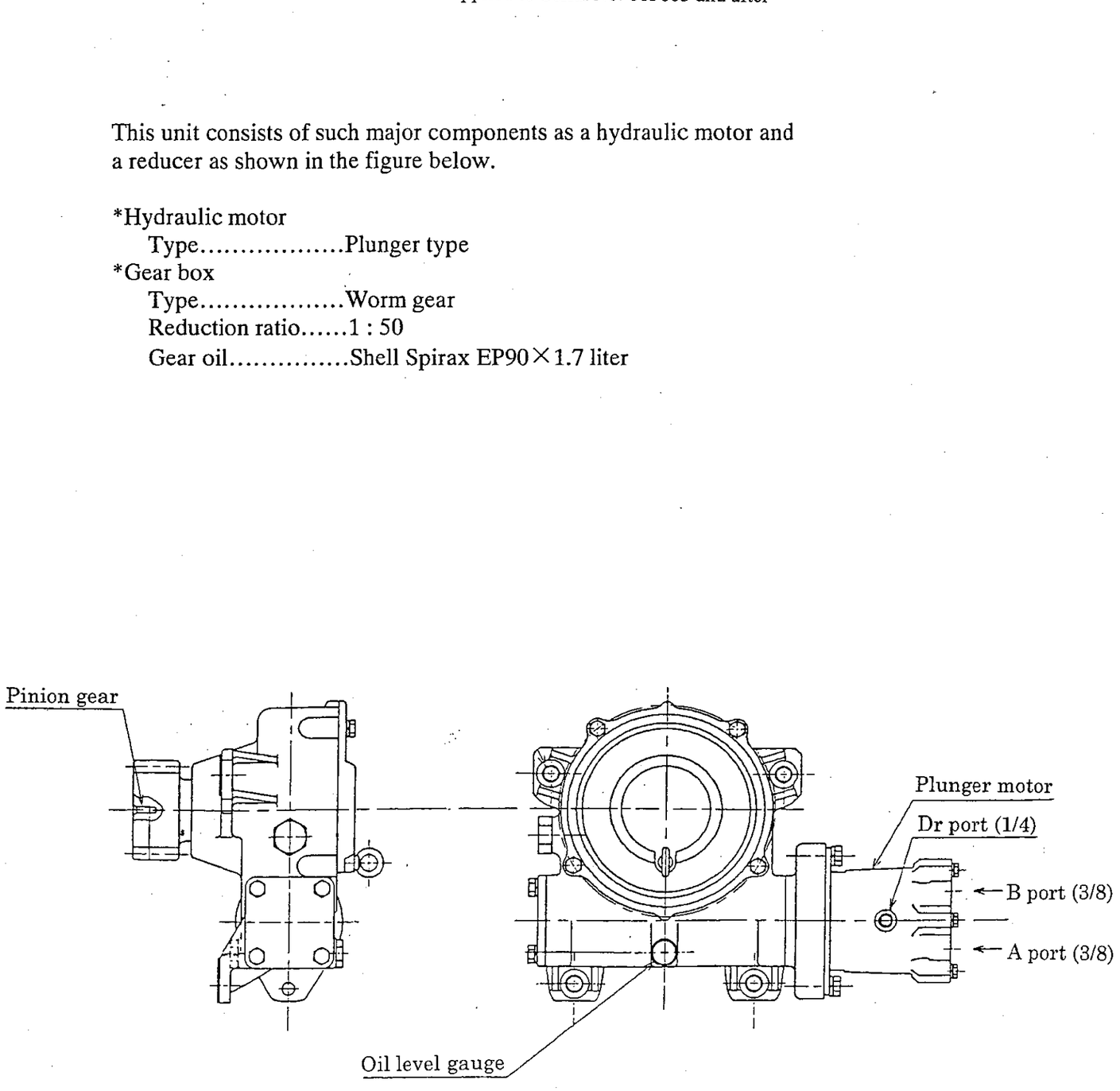


ROTATION MOTOR UNIT (for Spec. 20)

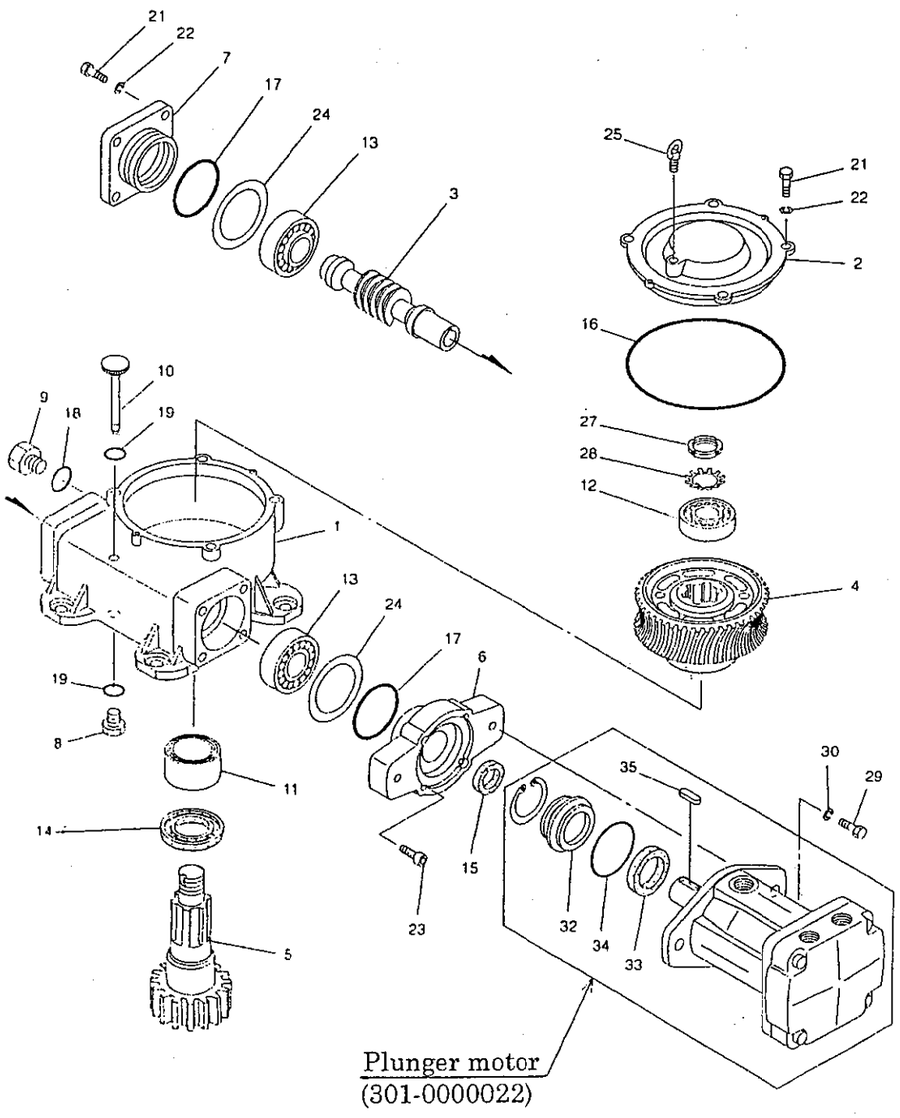
Applied to Serial No. 665663 and after

This unit consists of such major components as a hydraulic motor and a reducer as shown in the figure below.

*Hydraulic motor
Type.....Plunger type
*Gear box
Type.....Worm gear
Reduction ratio.....1 : 50
Gear oil.....Shell Spirax EP90×1.7 liter



Plan view



3-D view

TRAVEL MOTOR UNIT (for Spec. A8)

Applied to the machines prior to Ser. No. 665013

This unit consists of such major components as the Hydraulic motor, the Counter balance valve, the Parking brake and the Reduction gear box as shown in the figures.

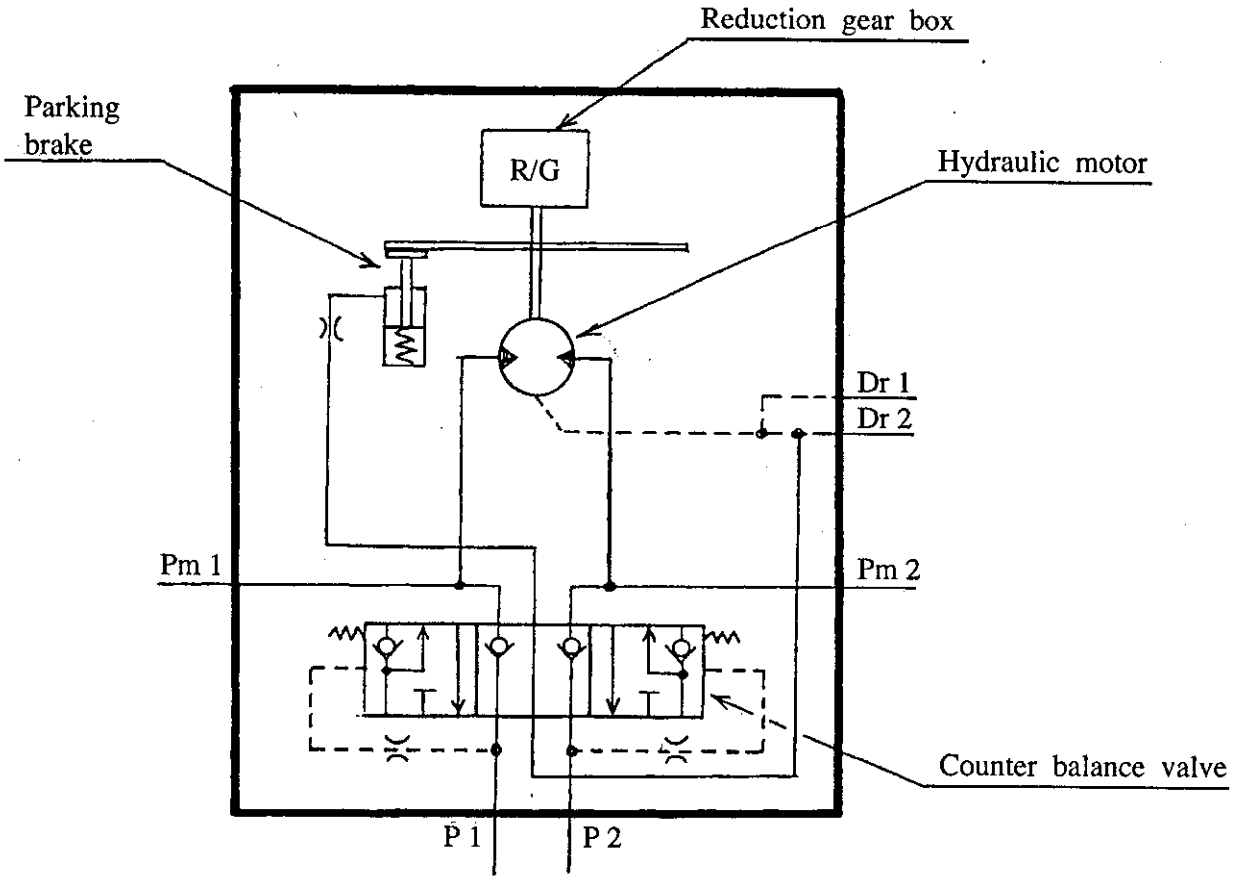
Hydraulic motor

- Type·····Axial plunger type
- Rated pressure·····210kgf/cm² (3,000PSI)
- Discharge volume·····62.9cc/rev (3.84in³/rev)
- Allowable drain pressure·····2kgf/cm² (28PSI)

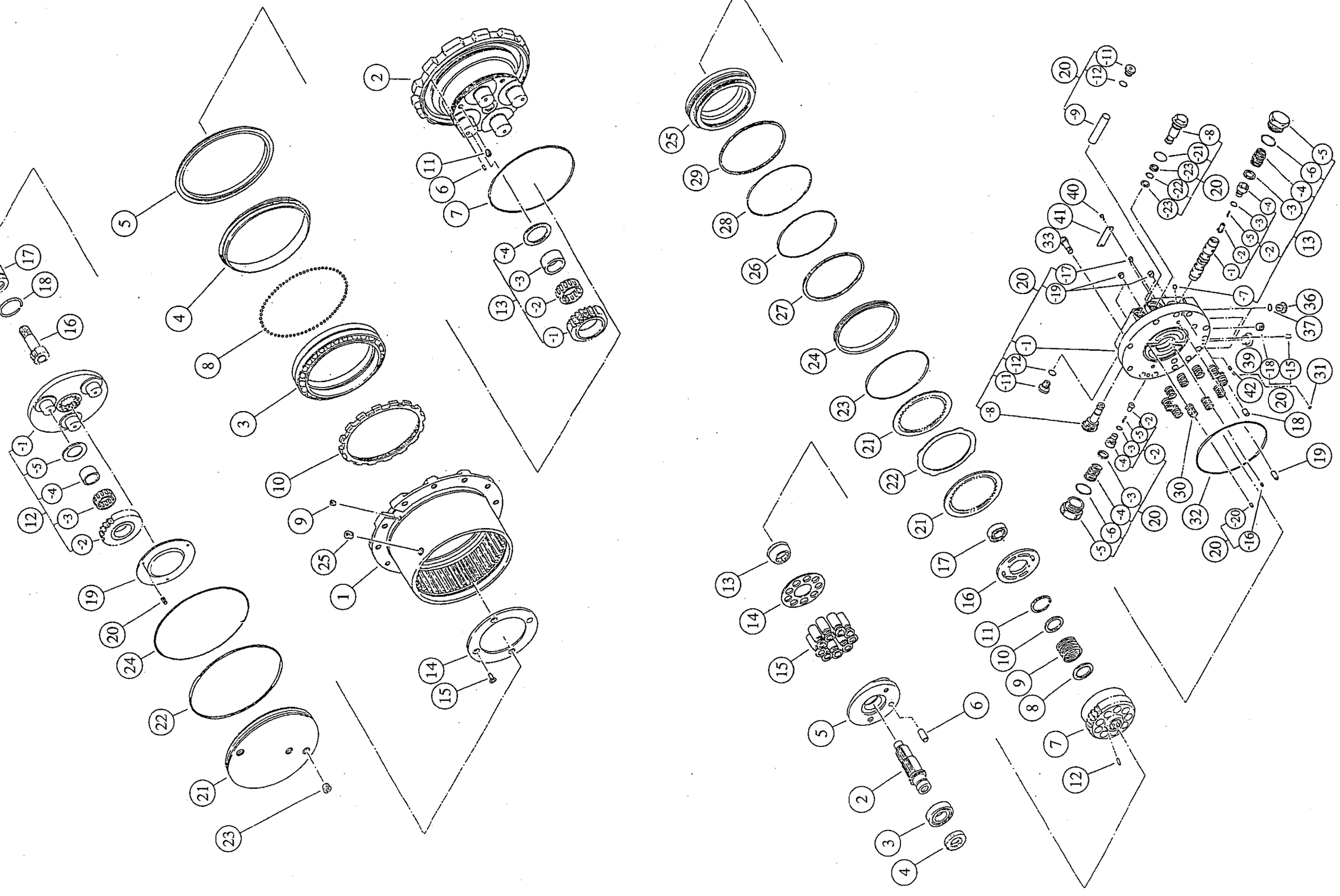
Reduction gear box

- Type·····Planetary gear
- Reduction ratio·····1/50.579
- Gear oil·····SAE 90 (1.7liters)(0.45gals)

1. Hydraulic circuit



2. Illustrations



TRAVEL MOTOR UNIT (for Spec. 20)

Applied to Serial No. 665663 and after

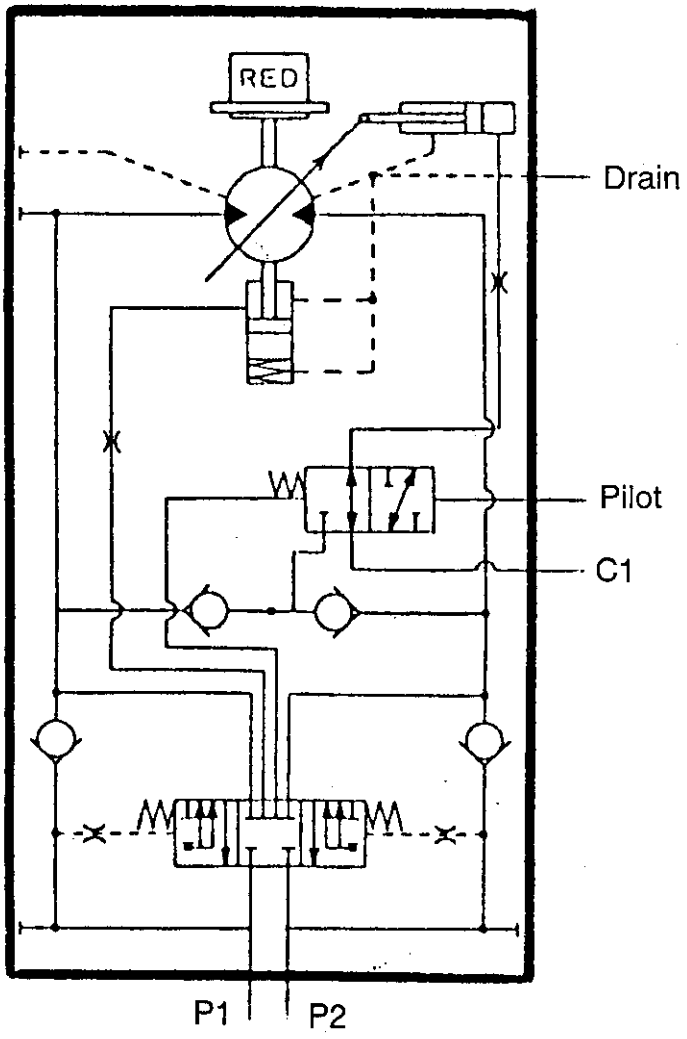
This unit consists of such major components as a hydraulic motor, a parking brake and a reduction gear box as shown in the figure.

*Hydraulic motor
- Type.....Axial plunger type
- Rated pressure.....210 kgf /cm² (3,000 PSI)
- Discharge volume....51.1 cm³ /rev. (3.12in³ / rev.)

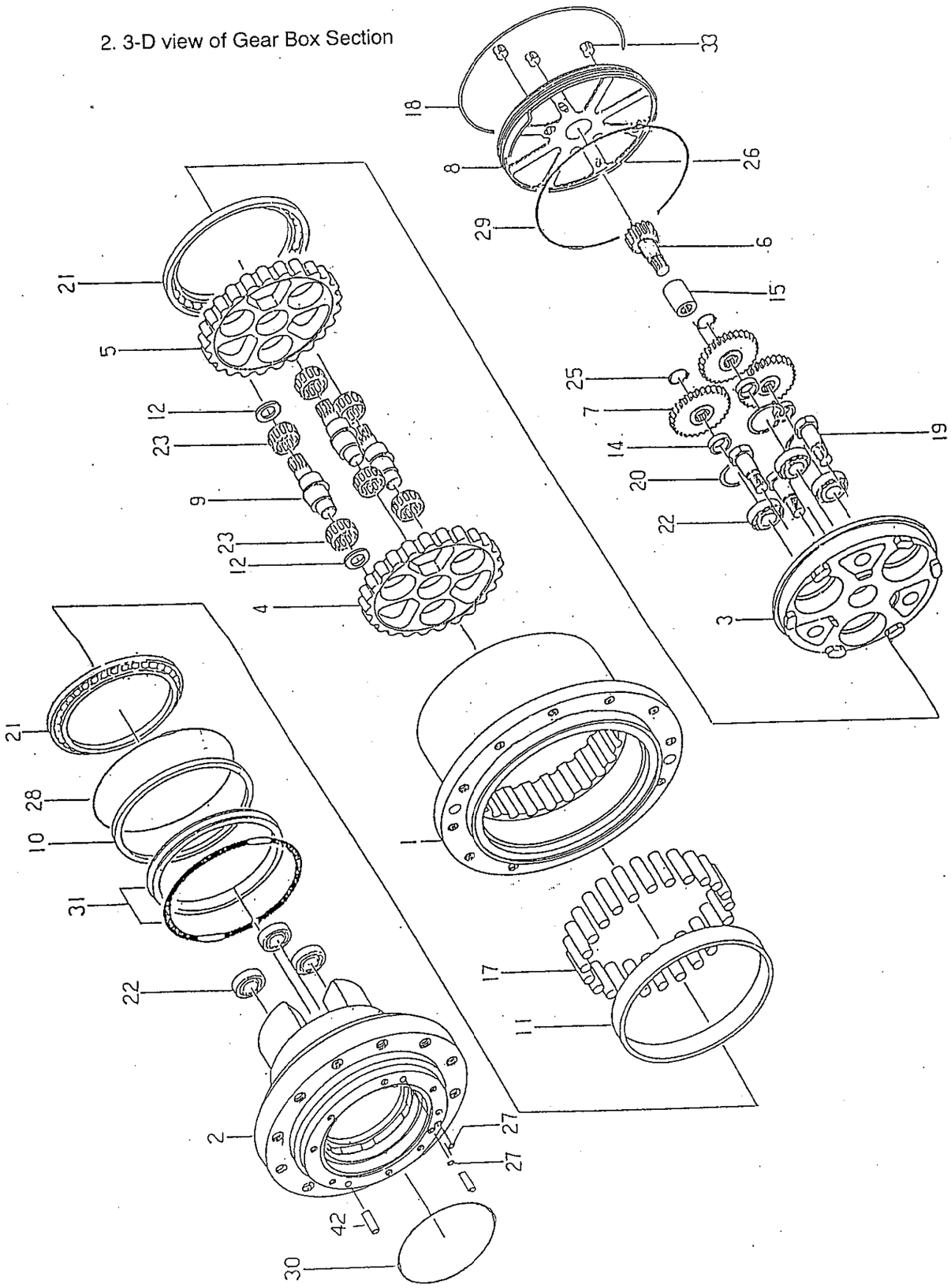
*Gear box
- Type.....Planetary gear
- Reduction ratio.....1 : 62.4
- Gear oil.....SAE #90×1.7 liter (0.45 gallon)

*Parking brake
- Brake torque.....14.8 kgf-m (107 ft-lb)
- Release pressure.....6.94 kgf /cm² (98.7 PSI)

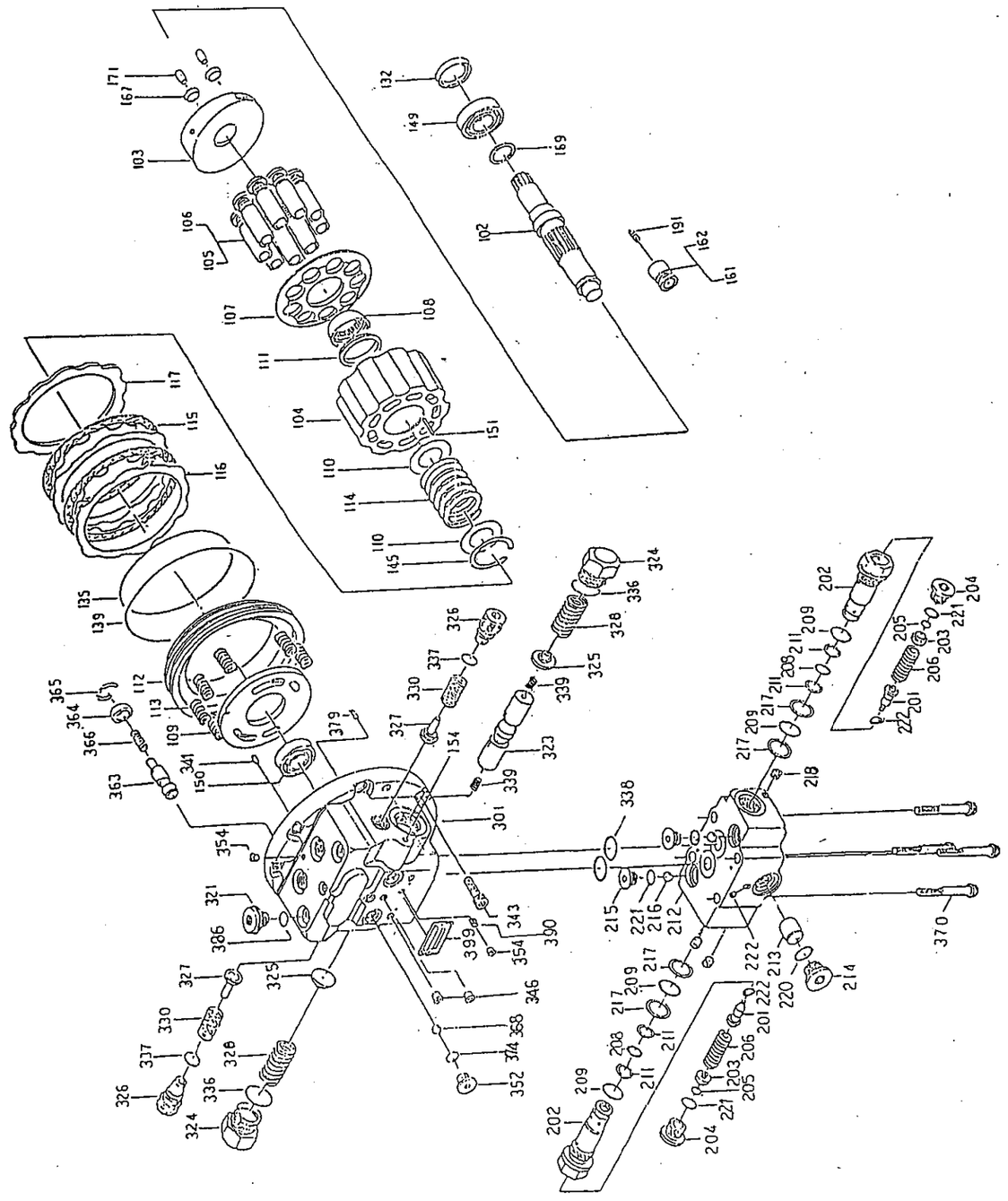
1. Hydraulic circuit



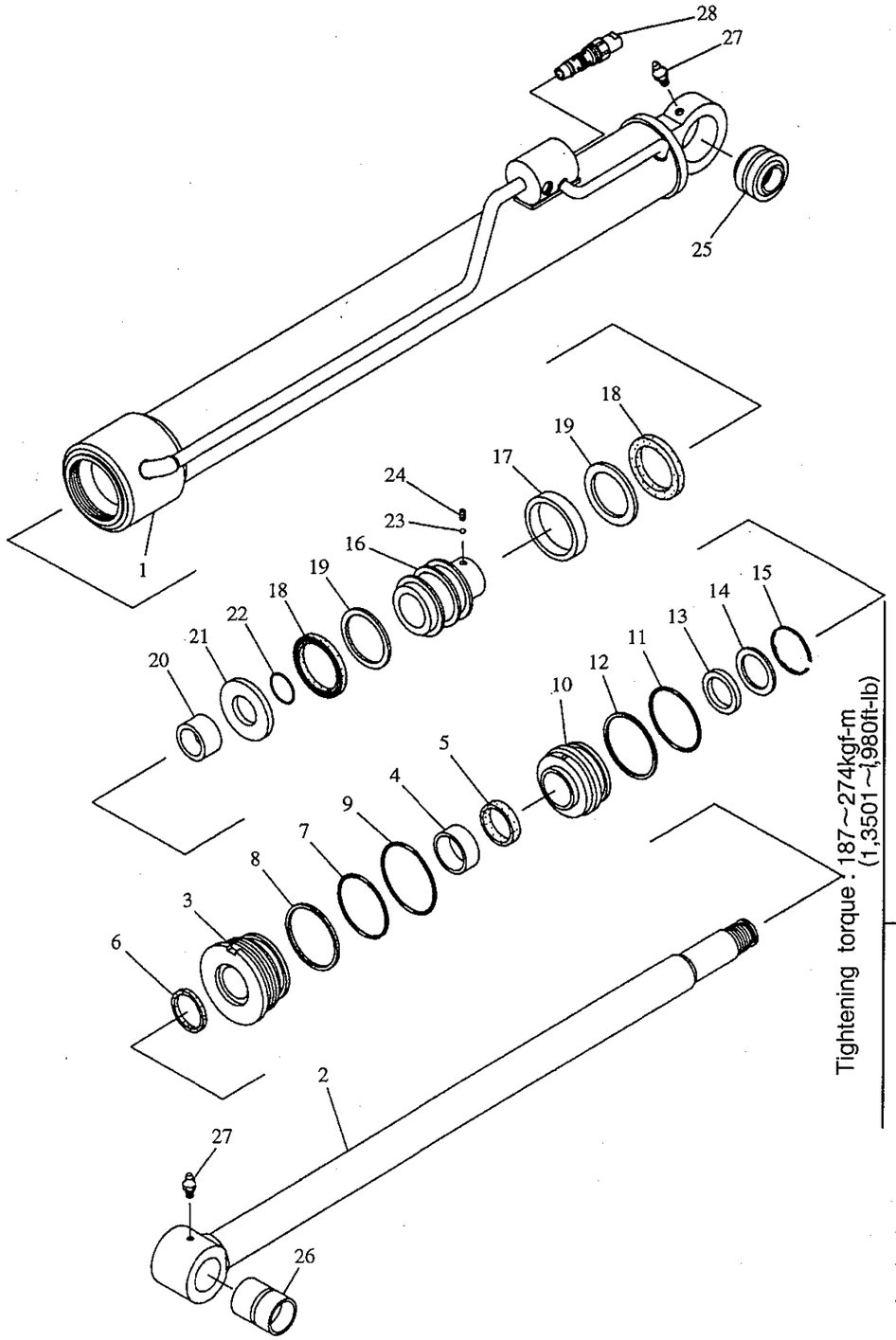
2. 3-D view of Gear Box Section

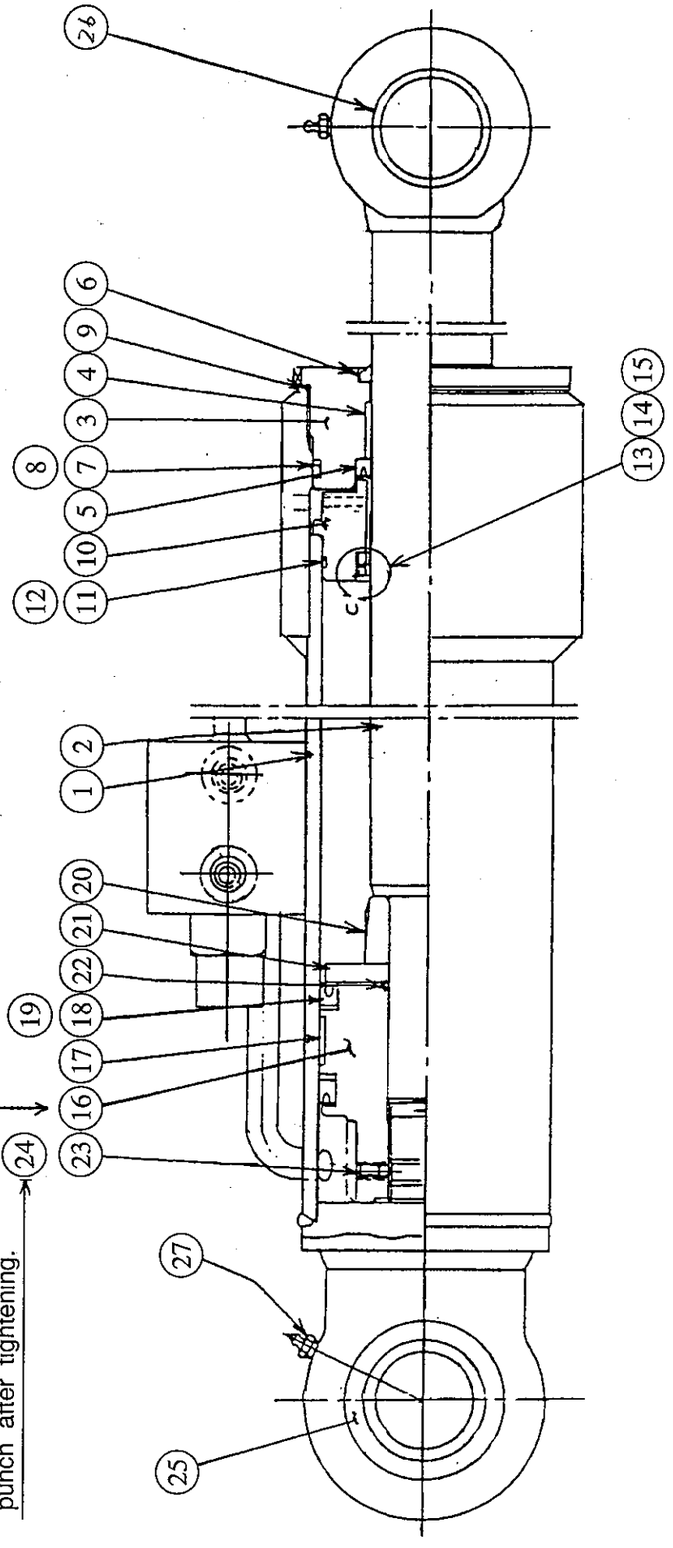


3. 3-D view of Motor Section



ELEVATION CYLINDER

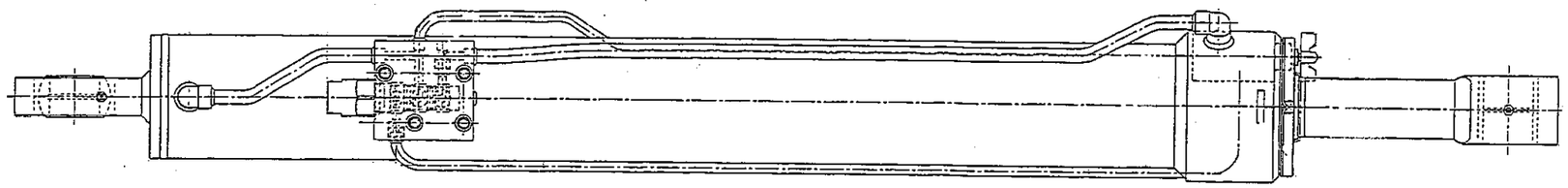


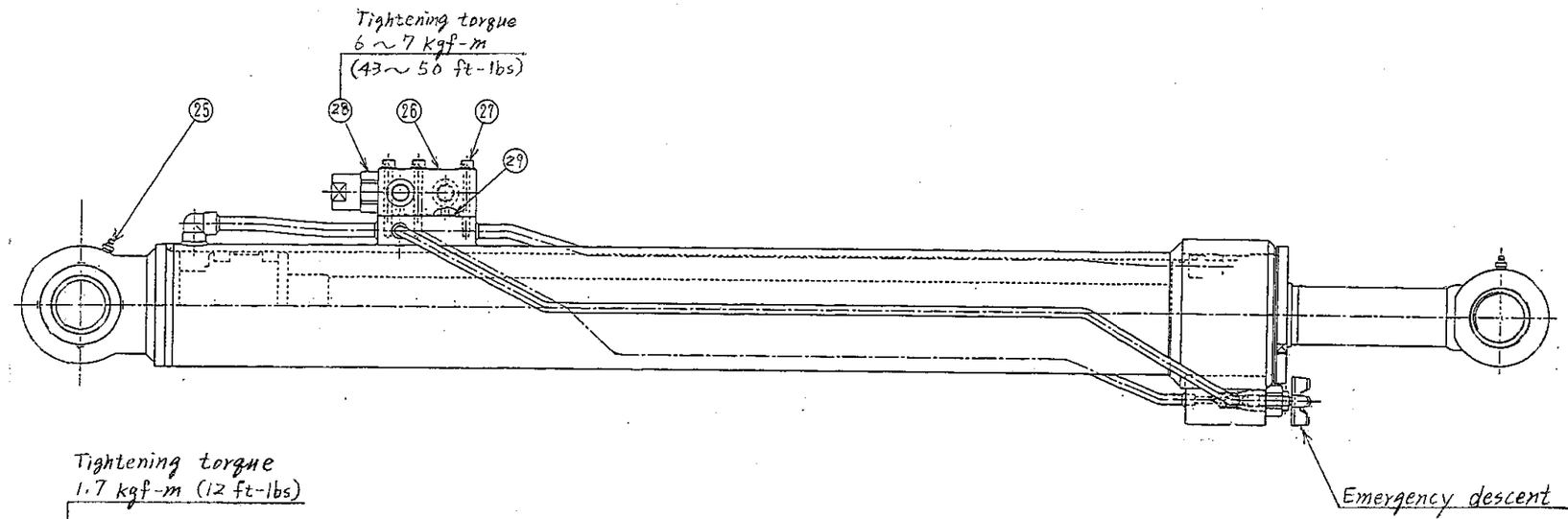


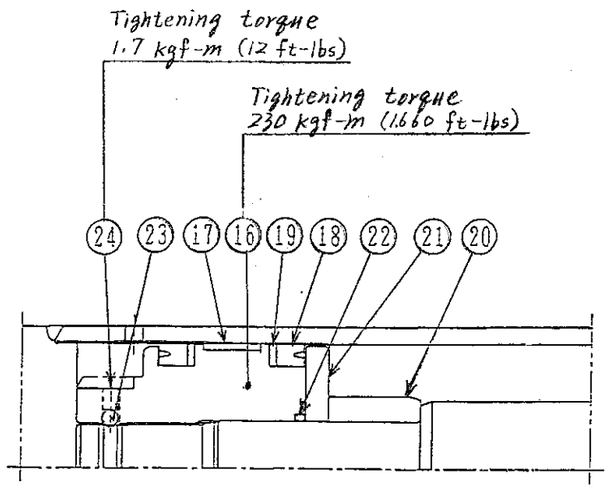
1	Cylinder tube	10	Cushion ring retainer	19	Back-up ring
2	Piston rod	11	O ring	20	Cushion collar
3	Cylinder head	12	Back-up ring	21	U ring holder
4	Bushing	13	Cushion ring	22	O ring
5	U ring	14	Spacer	23	Steel ball
6	Dust seal	15	Stopper	24	Set screw
7	O ring	16	Piston	25	Spherical bearing
8	Back-up ring	17	Wear ring	26	Bushing
9	O ring	18	U ring	27	Grease fitting

ELEVATION CYLINDER

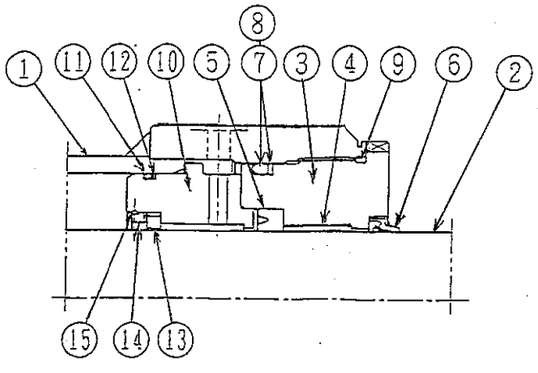
With Emergency descent valve



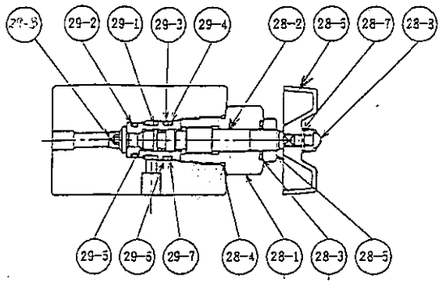




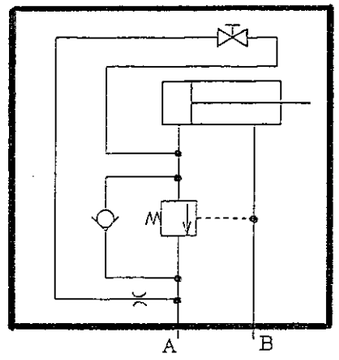
Piston Detail



Cylinder head Detail



Emergency descent valve Detail



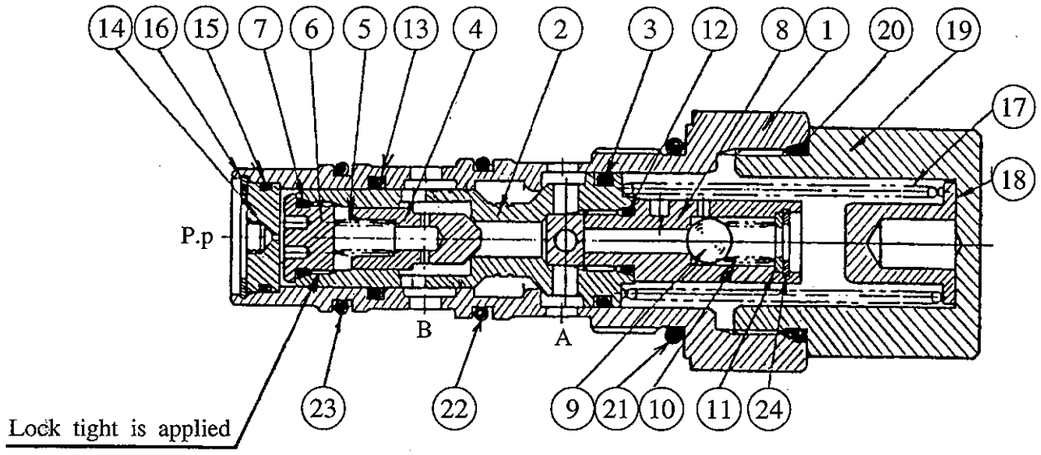
1	Cylinder tube
2	Piston rod
3	Cylinder head A
4	Bushing
5	U-ring
6	Dust seal
7	O-ring
8	Back-up ring
9	O-ring
10	Cylinder head B
11	O-ring
12	Back-up ring
13	Cushion ring
14	Stopper
15	Snap ring
16	Piston
17	Wear ring
18	U-ring
19	Back-up ring
20	Cushion collar
21	U-ring holder
22	O-ring
23	Steel ball
24	Set screw
25	Grease fitting
26	Manifold
27	Bolt
28	Cartridge, Holding valve
29	O-ring

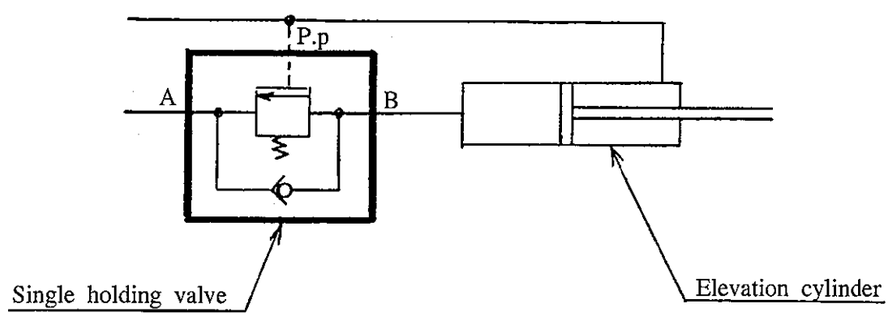
SINGLE HOLDING VALVE (for Elevation cylinder)

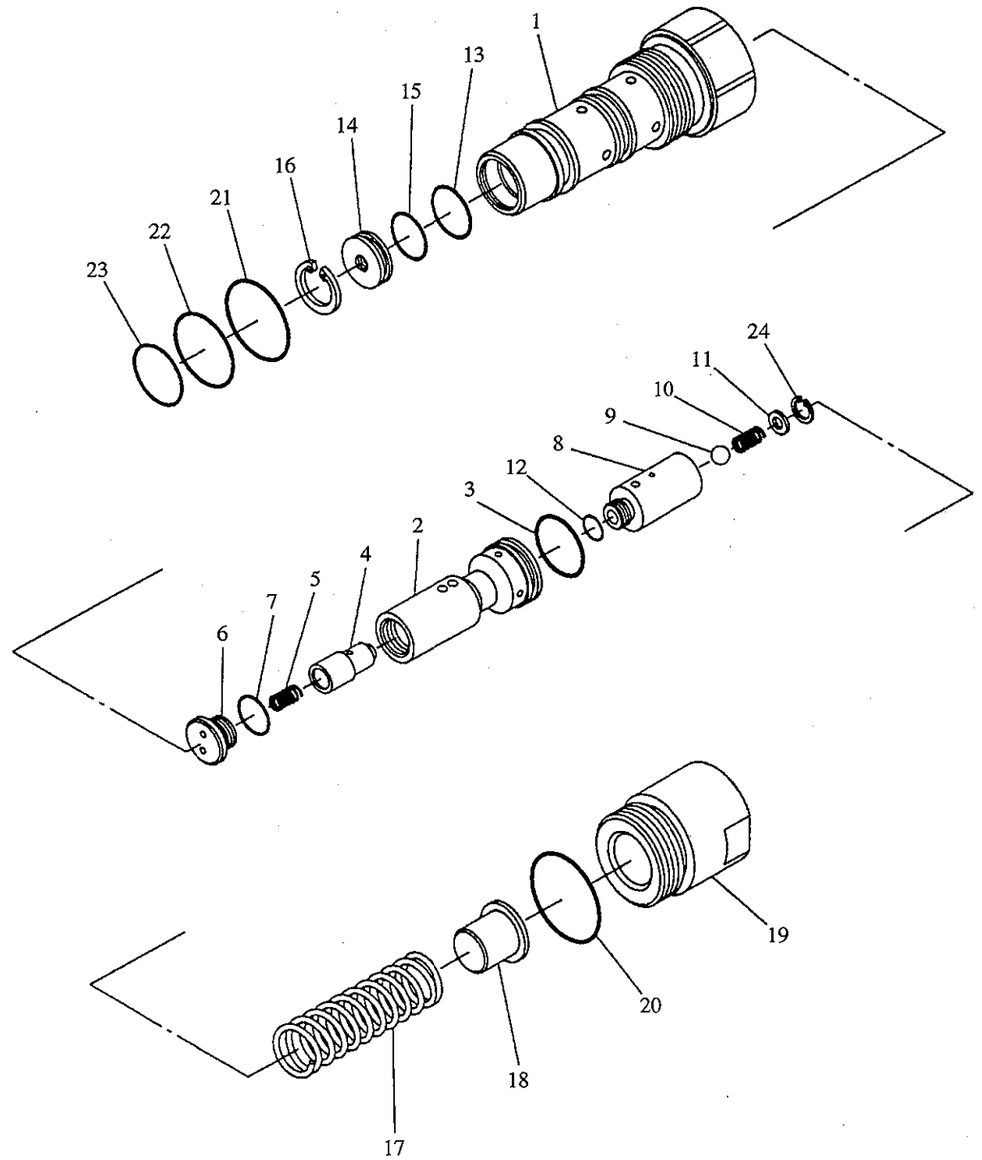
The Single holding valve is mounted on the Elevation cylinder to prevent any "Natural descent" of the cylinder caused by the gravities of the boom and the platform.

NOTE : Natural descent

This phenomenon causes the hydraulic cylinder to be extended or retracted due to external forces.





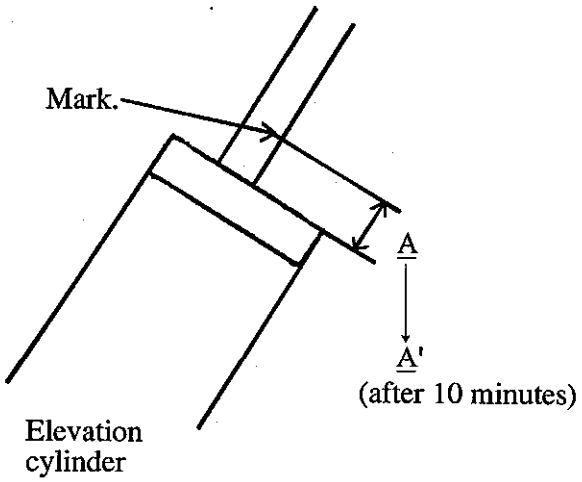


Inspection procedures

1. Check the external oil leakage thoroughly.
2. Check the internal oil leakage, using the following steps.
   (Internal oil leakage can be inspected by checking the "Natural descent" of the elevation cylinder.)
   1) Park the machine on an area of firm level ground.
   2) Start the machine, and position the boom, so that the boom angle is set at around 45degrees.
   3) Stop the engine, then put a mark on the piston rod of elevation cylinder as shown in Fig : 2.

Caution : Take care when marking the piston rod so as not to damage it.

Fig:2



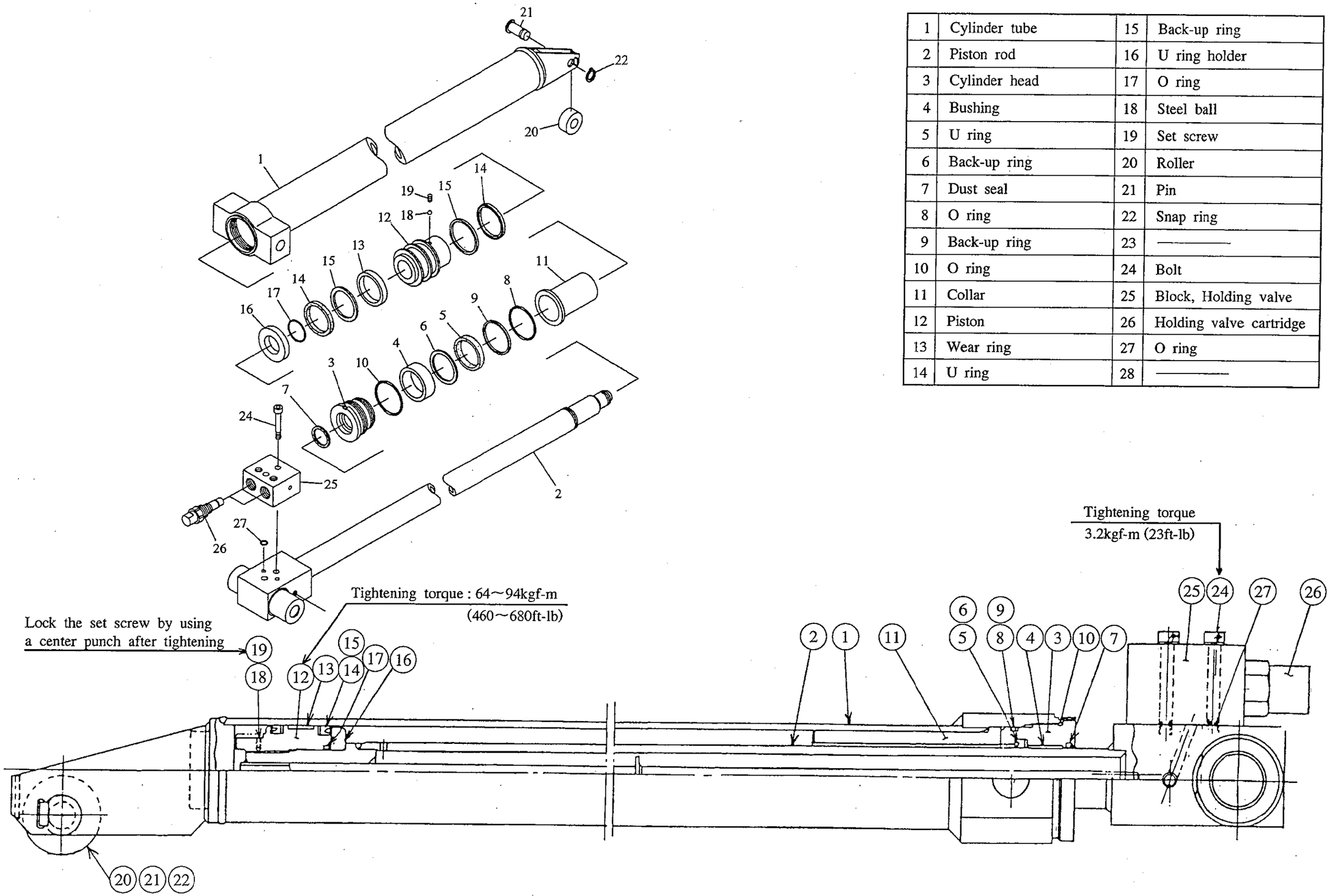
   4) After marking the rod, measure the dimension A (as shown in Fig : 2), then leave it for 10 minutes.
   5) After 10 minutes, measure the dimension A' between the mark made in step 3 and the edge of cylinder tube as shown in Fig : 2.
      A—A'=Natural descent of elevation cylinder.
      Serviceable limit·····2mm/10minutes. (0.08"/10min)
   6) If the "Natural descent" exceeds the limit (2mm/10min), check the single holding valve and the elevation cylinder for internal oil leakage.

NOTE : To indentify which has internal oil leakage (the single holding valve or the elevation cylinder), reter to the following steps.

1) Under the condition that the elevation cylinder is loaded with the gravities of boom and platform, disconnect the hydraulic hose connected to port—A at the single holding valve.
2) If hydraulic oil drips continuously from port—A of the single holding valve, this indicates internal oil leakage from the single holding valve.
However, if the oil-drips stop after a while, this indicates that elevation cylinder has internal oil leakage.

Caution : Before disconnecting the hydraulic hose, make sure to support the boom using such a crane to prevent the boom from unexpected descent.

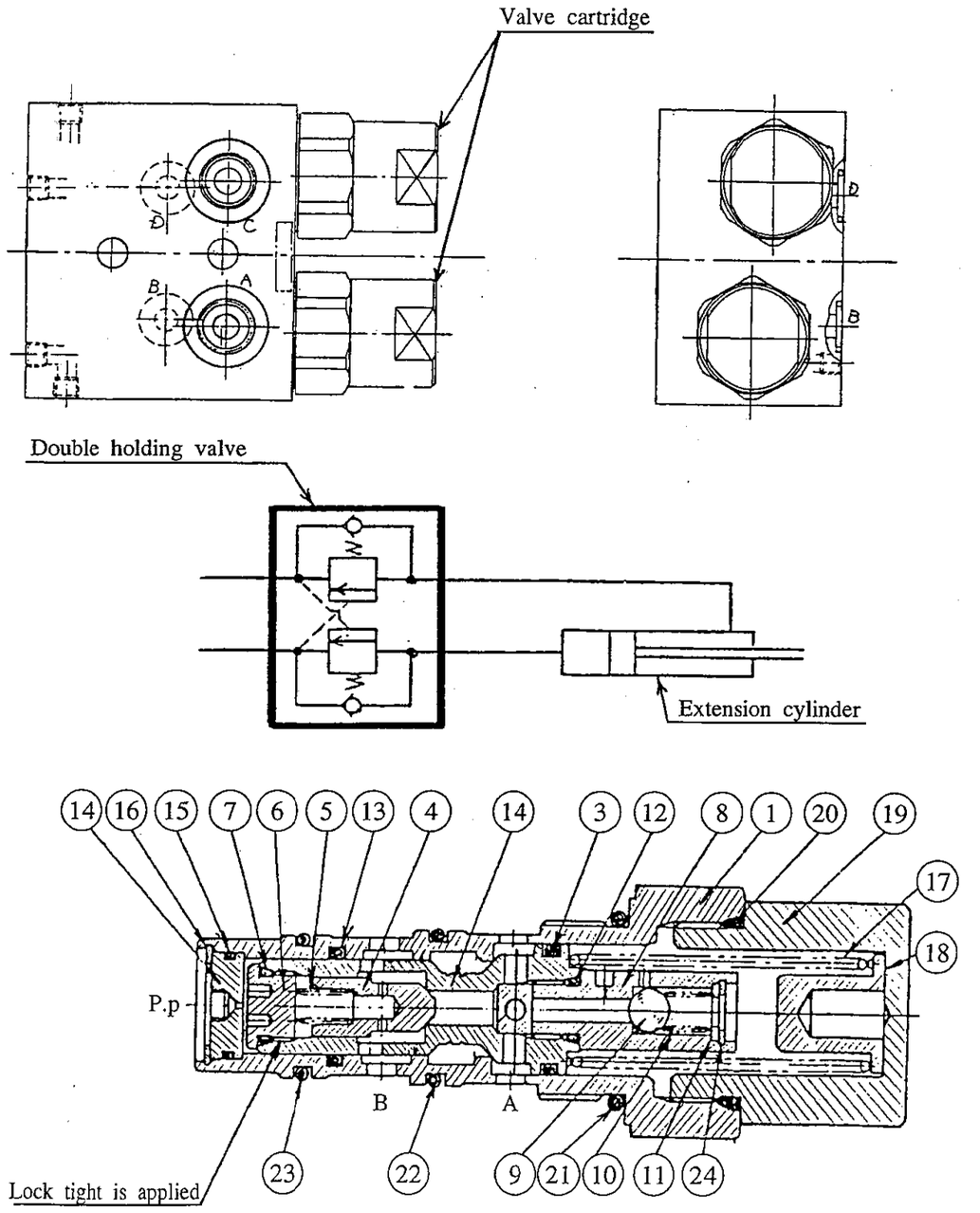
EXTENSION CYLINDER



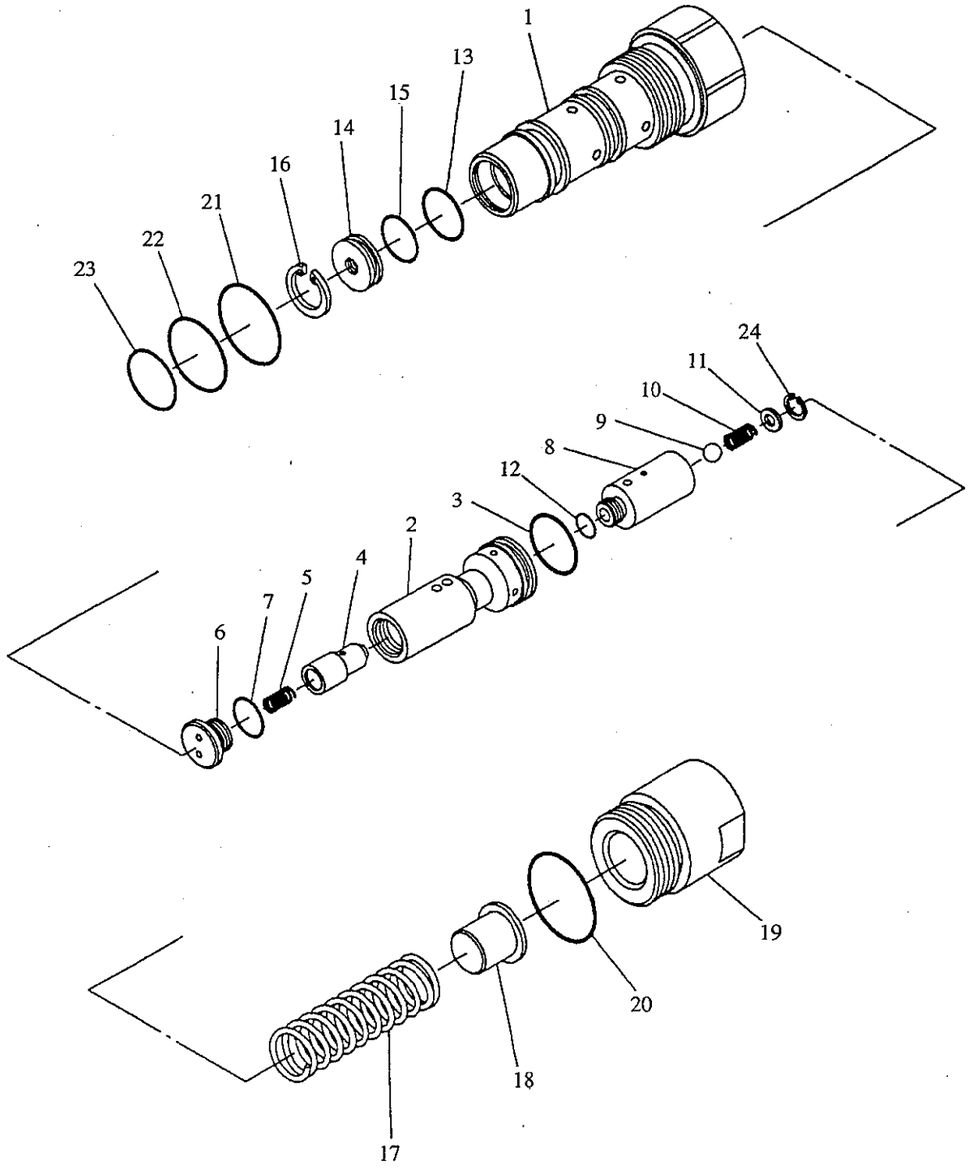
1	Cylinder tube	15	Back-up ring
2	Piston rod	16	U ring holder
3	Cylinder head	17	O ring
4	Bushing	18	Steel ball
5	U ring	19	Set screw
6	Back-up ring	20	Roller
7	Dust seal	21	Pin
8	O ring	22	Snap ring
9	Back-up ring	23	————
10	O ring	24	Bolt
11	Collar	25	Block, Holding valve
12	Piston	26	Holding valve cartridge
13	Wear ring	27	O ring
14	U ring	28	————

DOUBLE HOLDING VALVE (for Extension cylinder)

The "Double holding valve" is mounted on the extension cylinder to prevent "Natural descent" of the cylinder caused by the gravites of the boom and the platform.



Details of the valve cartridge

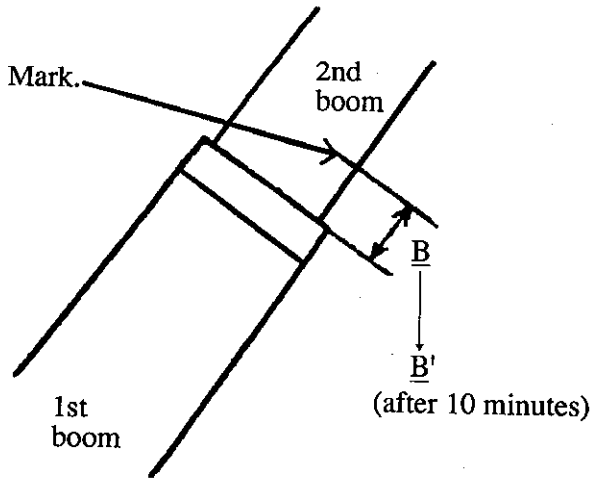


Details of the valve cartridge

Inspection procedures

1. Check the external oil leakage thoroughly.
2. Check the internal oil leakage, using the following steps.
   (Internal oil leakage is inspected by checking the "Natural descent" of the Extension cylinder.)
   1) Park the machine on an area of firm level ground.
   2) Extend the boom by about 1 meter, and raise it fully.
   3) Stop the engine, and put a mark on the 2nd boom as shown in Fig : 2 below.

Fig:2

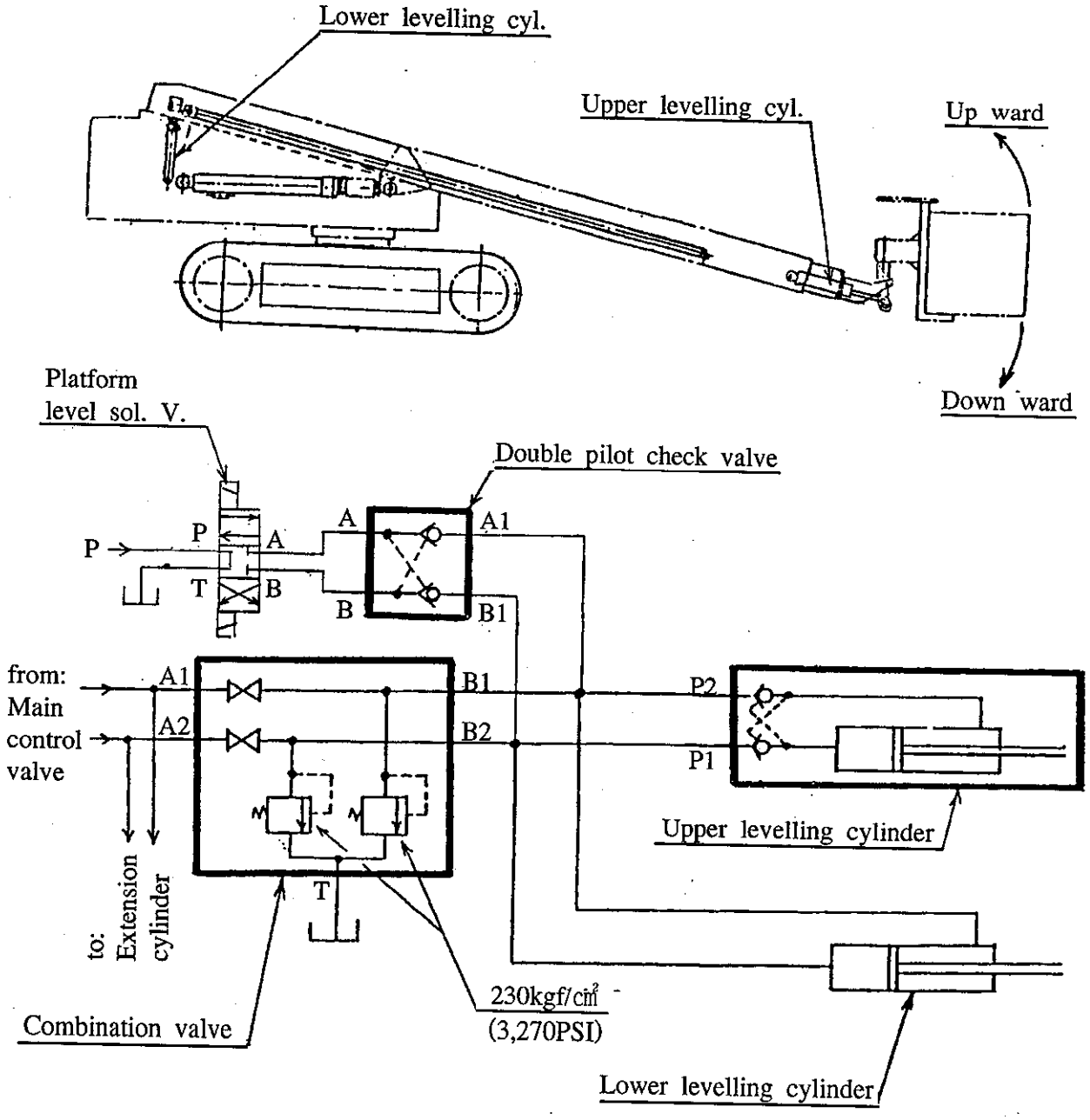


   4) Measure the Dimension B as shown in Fig : 2 above.
   then, leave it for 10 minutes.
   5) After 10 minutes, measure the Dimension B' as shown in Fig : 2.
      * B—B'=Natural descent of extension cylinder.
      * Serviceable limit·····2mm/10min. (0.08"/10min)
   6) If the "Natural descent" exceeds the Serviceable limit, further check the internal oil leakage of the Double holding valve or Extension cylinder by referring to the clause of SINGLE HOLDING VALVE. (for Elevation cylinder)

PLATFORM LEVELLING SYSTEM

The system maintains the platform at its level position automatically, regardless of boom's vertical movements.
It consists of Upper, and lower levelling cylinders, Double pilot check valve, Platform level solenoid valve, and Combination valve as shown in the figure below.

Fig:1



1. Note on function

Two levelling cylinders are in place, as shown in Fig : 1.
When the boom is lowered, the Lower levelling cylinder is retracted and the hydraulic oil in the bottom room of the cylinder flows into the bottom room of Upper levelling cylinder.
The sizes of the both levelling cylinders are exactly same.
Therefore, the Upper levelling cylinder extends simultaneously with the retraction of the Lower levelling cylinder.
Thus, the platform is balanced by the "Levelling cylinders" to maintain its level, as the boom is lowered.
When the boom is raised, the levelling cylinders work in an exactly opposite fashion to that described above.

2. Inspection procedures

1. Tilt of platform.
   Perform elevation and extension operations several times, and check that the platform always stays level.
   If the platform does not stay level, check the levelling system as follows.
   1) Thoroughly check the system for external oil leakage.
   2) Bleed air from the platform levelling system. (refer to the "Air bleeding procedures" on the next page.)
   3) Check the internal oil leakage of the "Combination valve".
      Make sure the two stop valves on the combination valve are closed firmly.
   4) Check the internal oil leakage of the "Double pilot check valve".
   5) Check the internal oil leakage of the "Upper and Lower levelling cylinders."

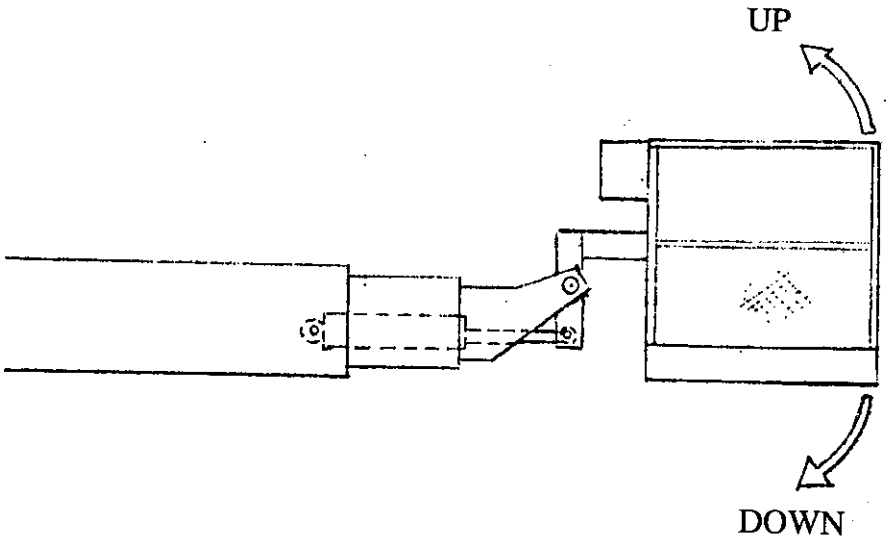
2. Natural descent.
   Load the platform with its maximum load (250kg), then visually check for any sign of the platform tilting downward. (550lbs)
   If the platform descends naturally, thoroughly check the levelling system for external oil leakage, Then check for internal oil leakage in the components listed below.
   - Double pilot check valve.
   - Combination valve.
   - Upper and lower levelling cylinders.

3. Air bleeding procedures

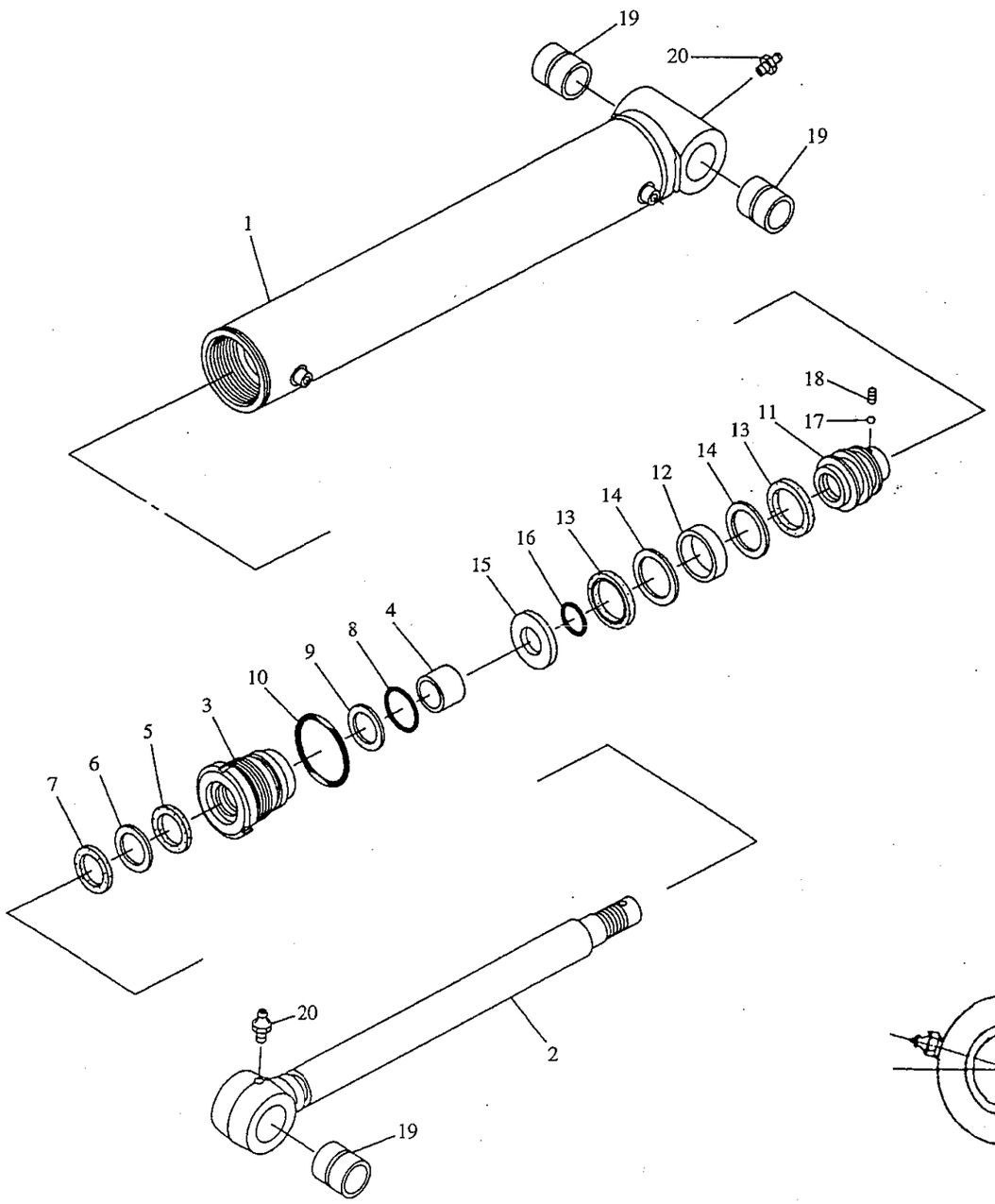
Caution:

* When bleeding air always operate the machine from the lower control panel.
* Always unload the platform completely, before carrying out these procedures.

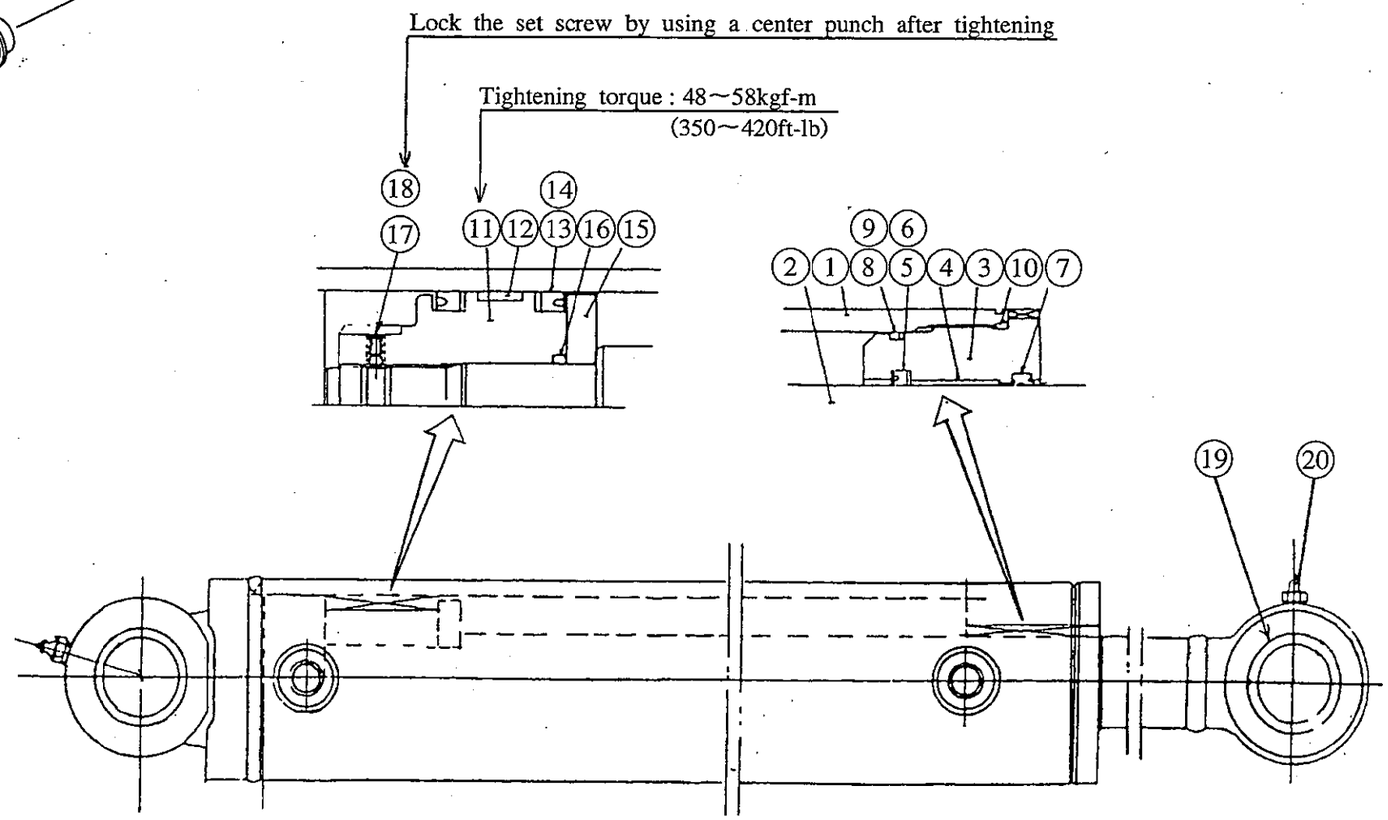
1. Retract the boom fully and position it horizontally.
2. Fully open the two stop valves installed on the combination valve.
3. Switch the "Extension switch" to "IN" and tilt the platform fully upward.
4. Now switch the "Extension switch" to "OUT" and tilt the platform fully downward.
5. Perform the above steps 3 and 4 several times (3~4times).
6. Return the platform to its level position, and firmly close the two stop valves.



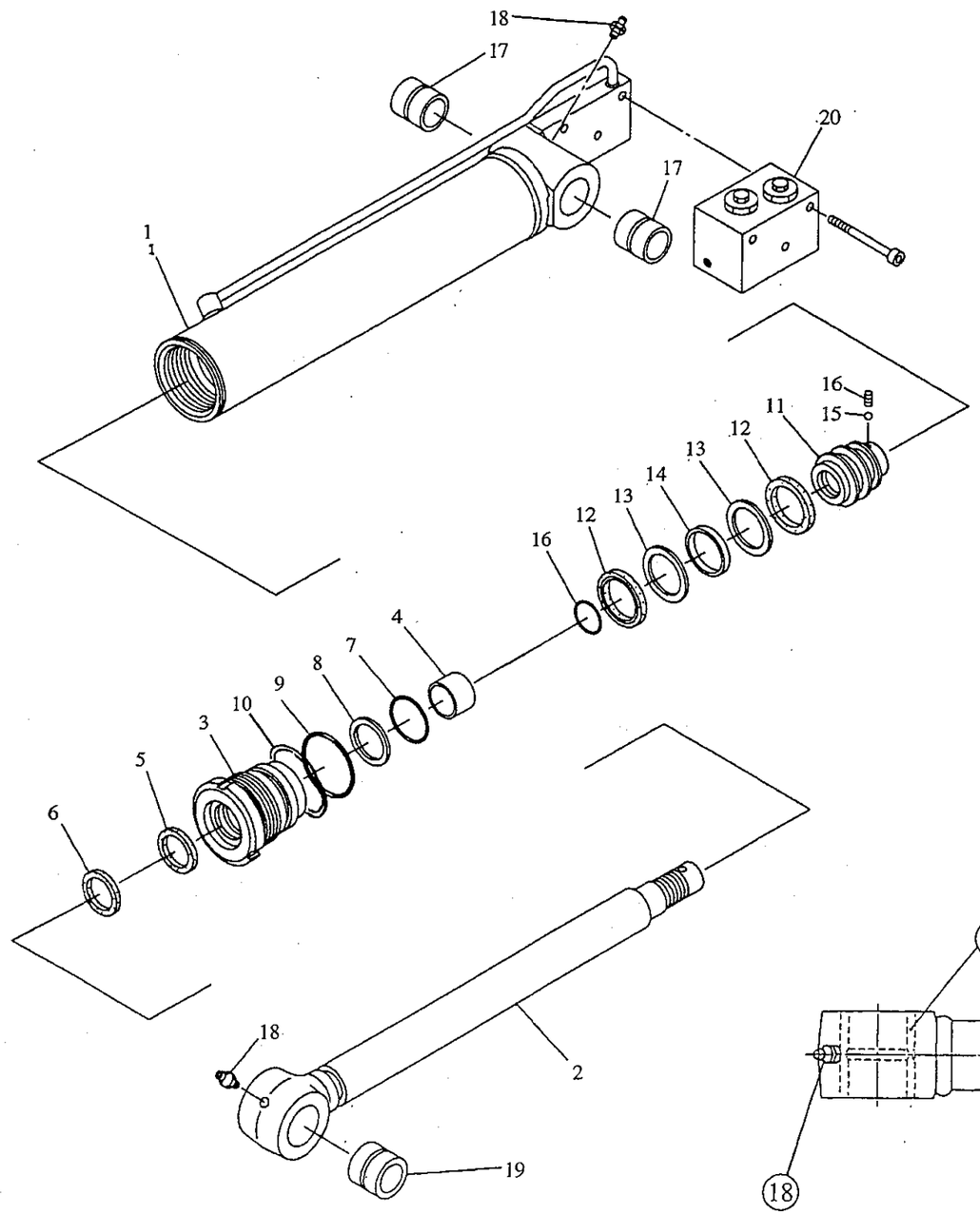
LOWER LEVELLING CYLINDER



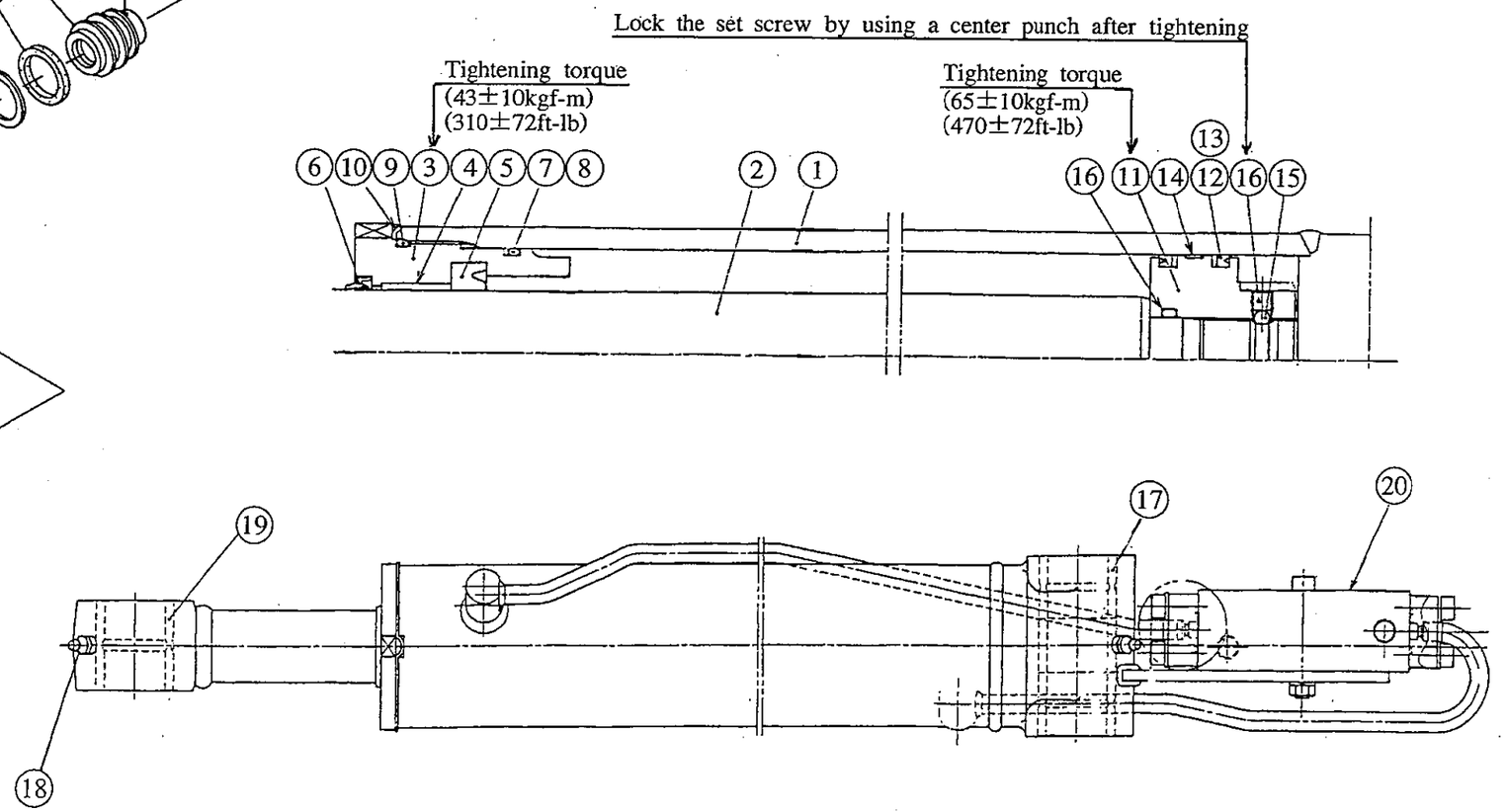
1	Cylinder tube	11	Piston
2	Piston rod	12	Wear ring
3	Cylinder head	13	U ring
4	Bushing	14	Back-up ring
5	U ring	15	U ring holder
6	Back-up ring	16	O ring
7	Dust seal	17	Steel ball
8	O ring	18	Set screw
9	Back-up ring	19	Bushing
10	O ring	20	Grease fitting



UPPER LEVELLING CYLINDER

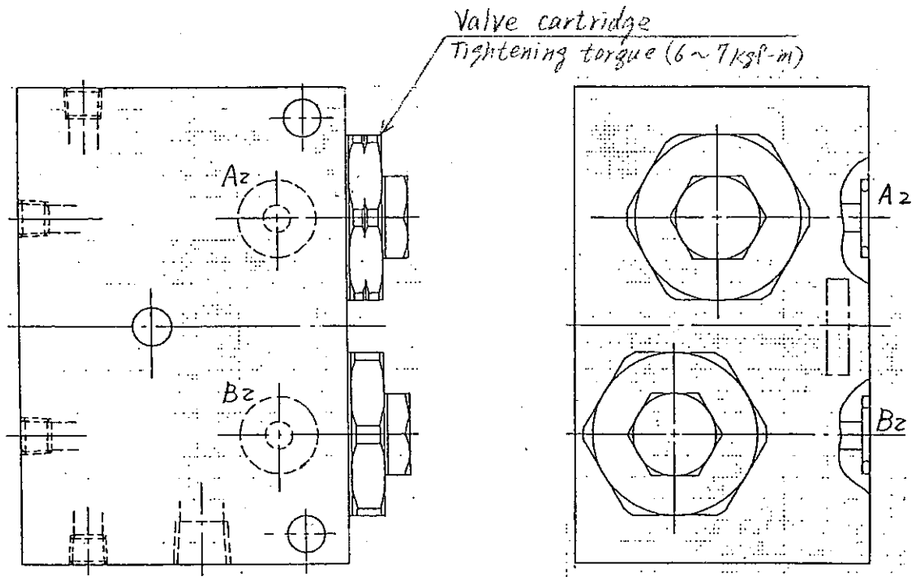


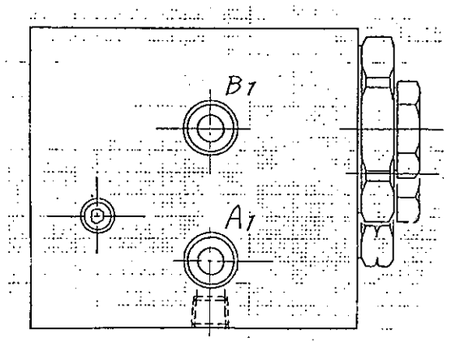
1	Cylinder tube	11	Piston
2	Piston rod	12	U ring
3	Cylinder head	13	Back-up ring
4	Bushing	14	Wear ring
5	U ring	15	Steel ball
6	Dust seal	16	Set screw
7	O ring	17	Bushing
8	Back-up ring	18	Grease fitting
9	O ring	19	Bushing
10	Lock plate	20	Double pilot check valve

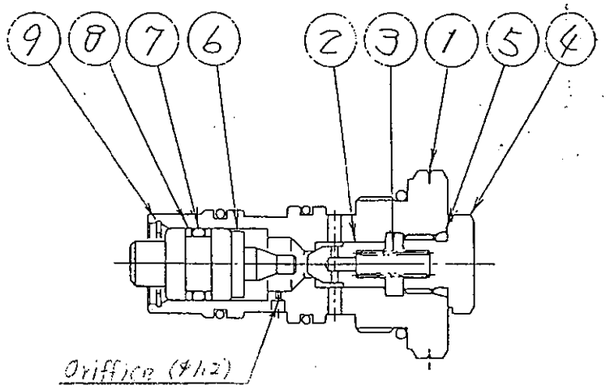


DOUBLE PILOT CHECK VALVE (for Upper levelling cylinder)

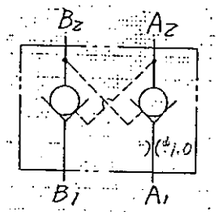
This valve is mounted on the Upper levelling cylinder.
It confines the hydraulic oil into the Upper levelling cylinder to keep the platform level in an emergency situation such as hydraulic line failure.

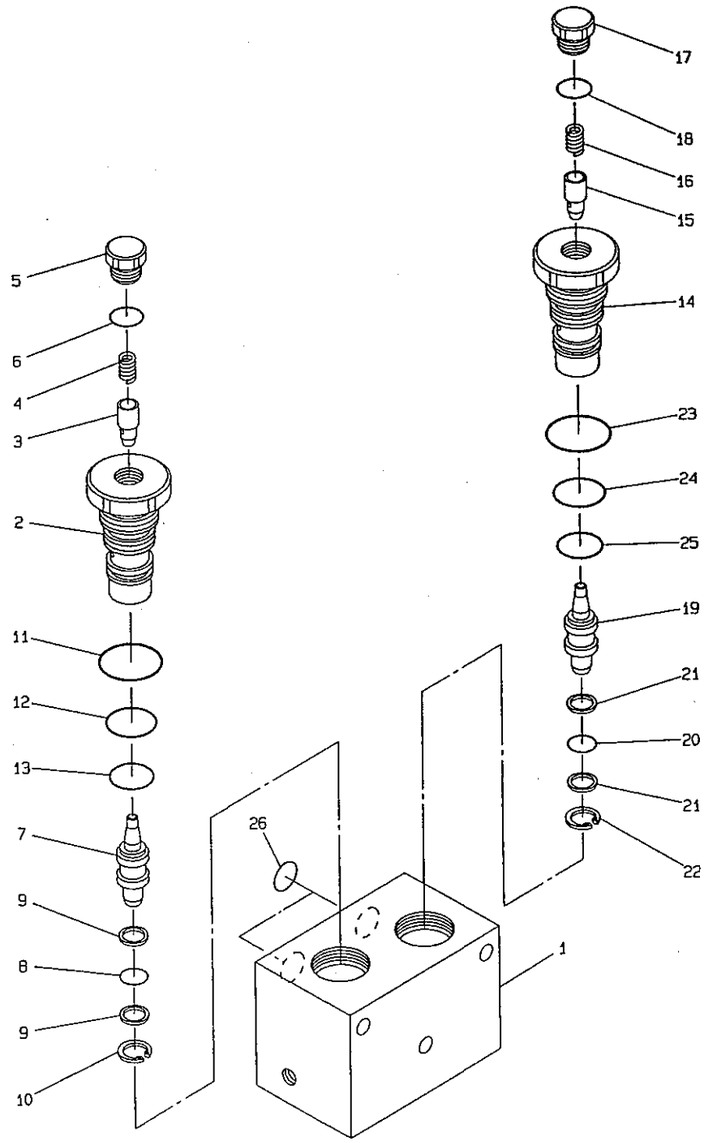






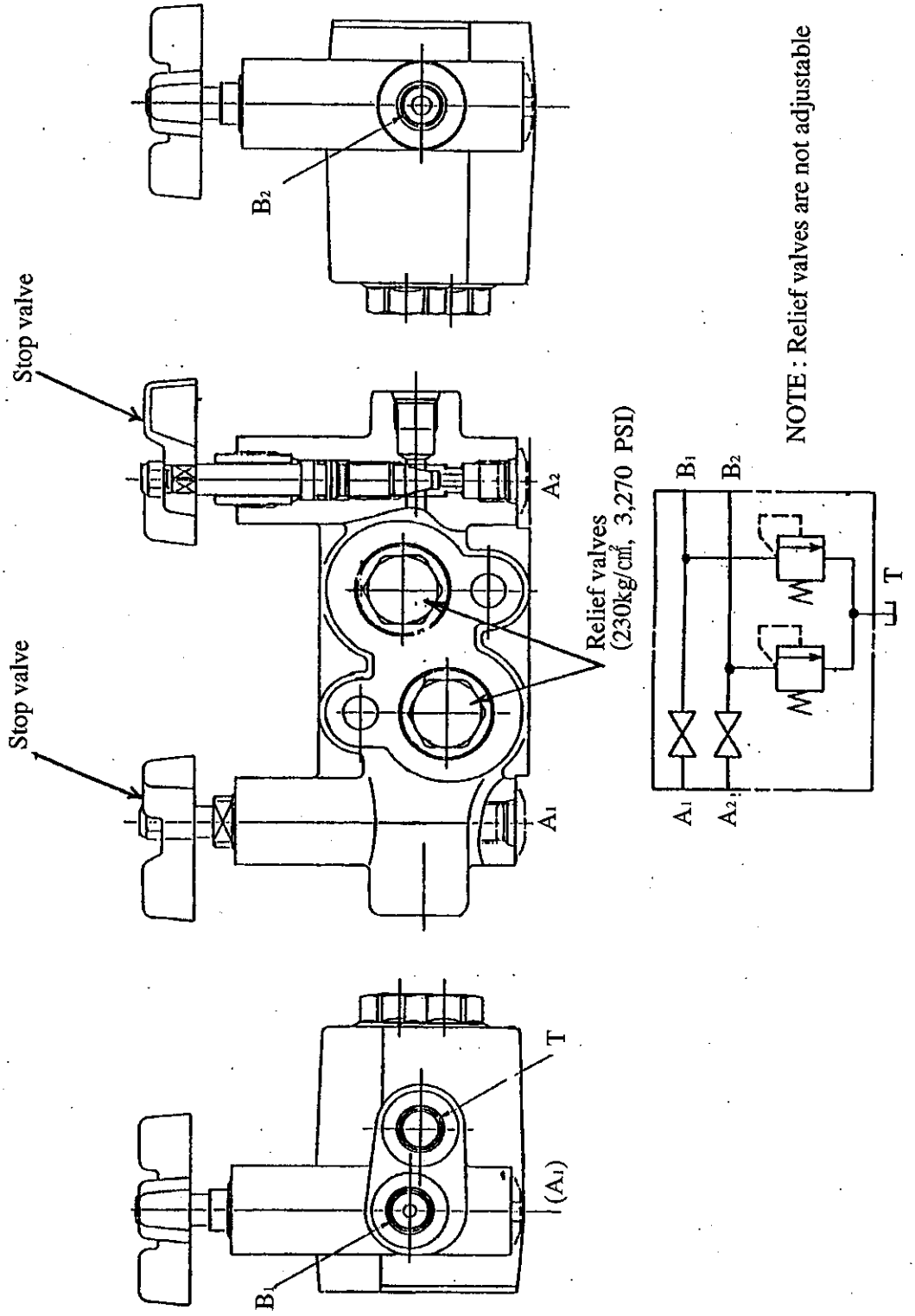
Valve cartridge - Detail





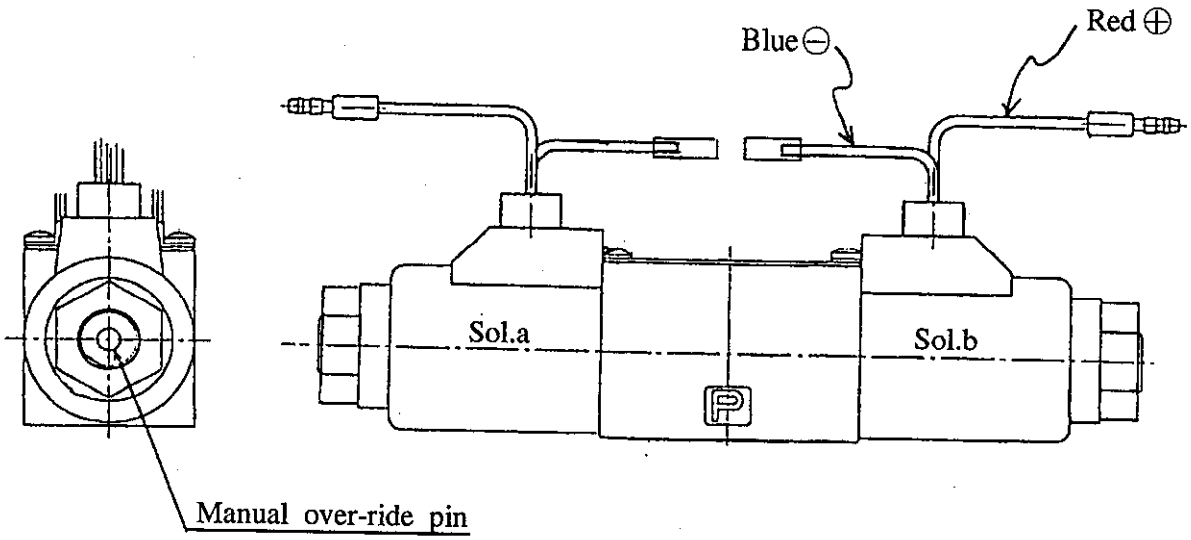
CONBINATION VALVE (for platform levelling system)

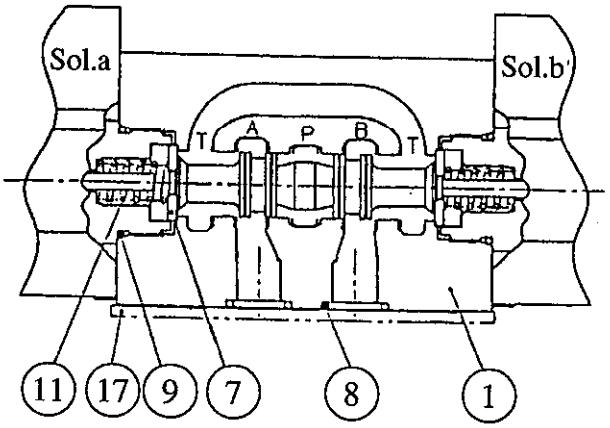
This valve consists of two Stop valves used for adjusting platform level, and two Relief valves which release excessively high pressure built up in the hydraulic circuit of the levelling system.

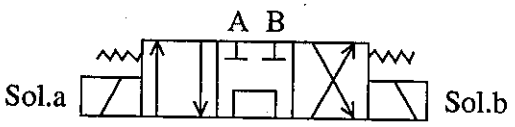


PLATFORM LEVEL SOLENOID VALVE

This valve is operated by the platform level switch to adjust the level of the platform.

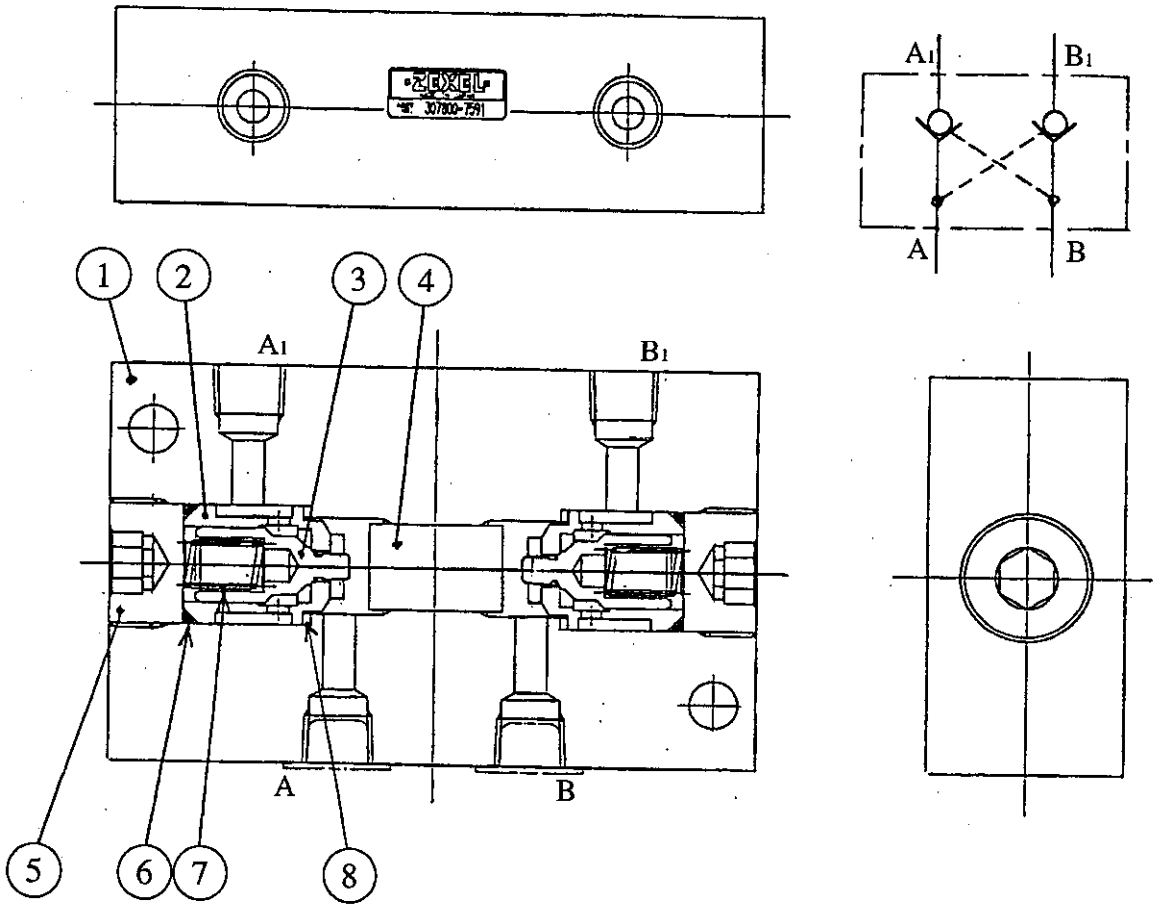






DOUBLE PILOT CHECK VALVE (for platform levelling system)

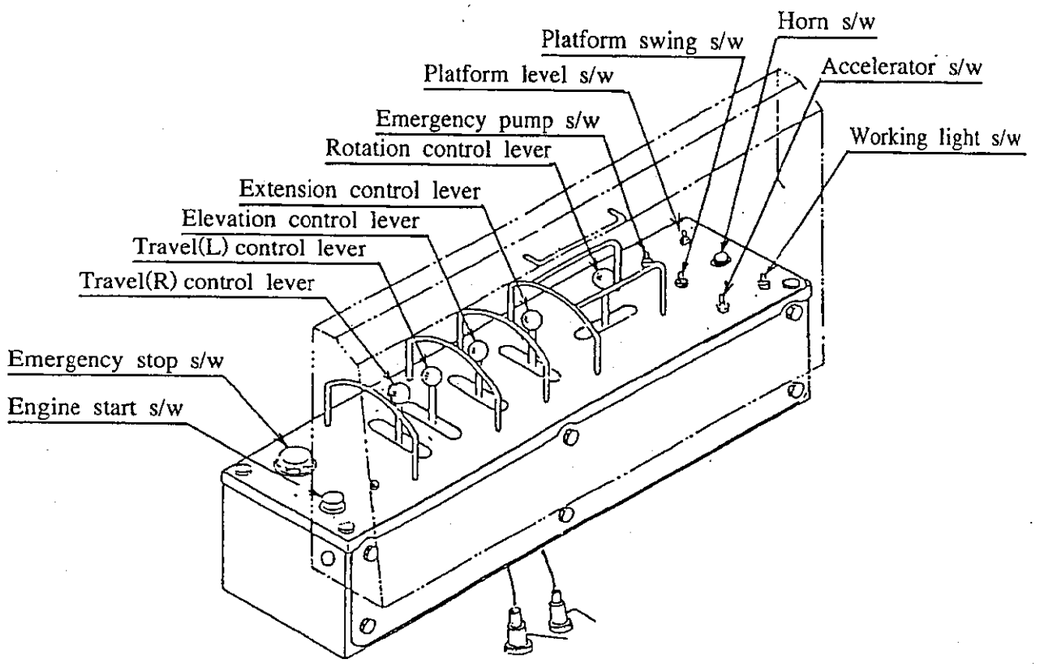
This valve confines the hydraulic oil to the platform levelling system to maintain the level of platform.

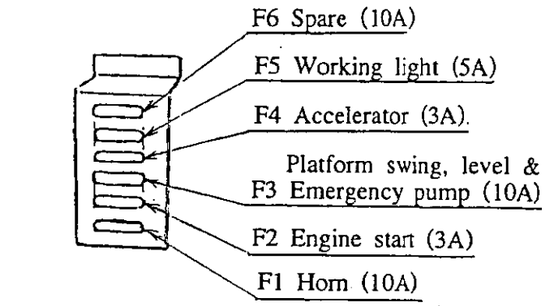


1	Valve housing
2	Valve seat
3	Check valve
4	Piston
5	Plug
6	O ring
7	Spring
8	Gasket

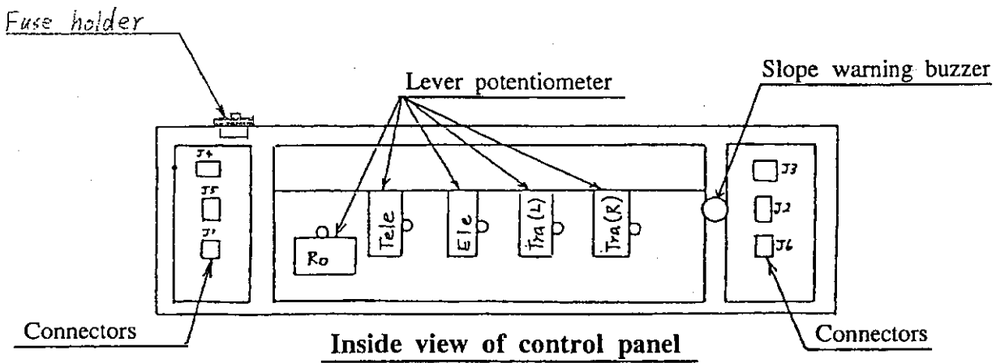
4
ELECTRIC SECTION

UPPER CONTROL BOX

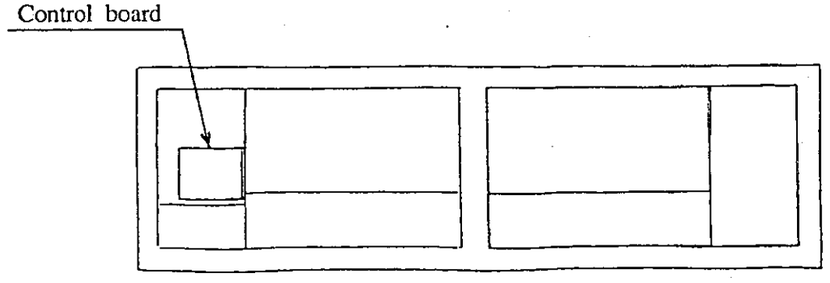




Fuse holder Detail

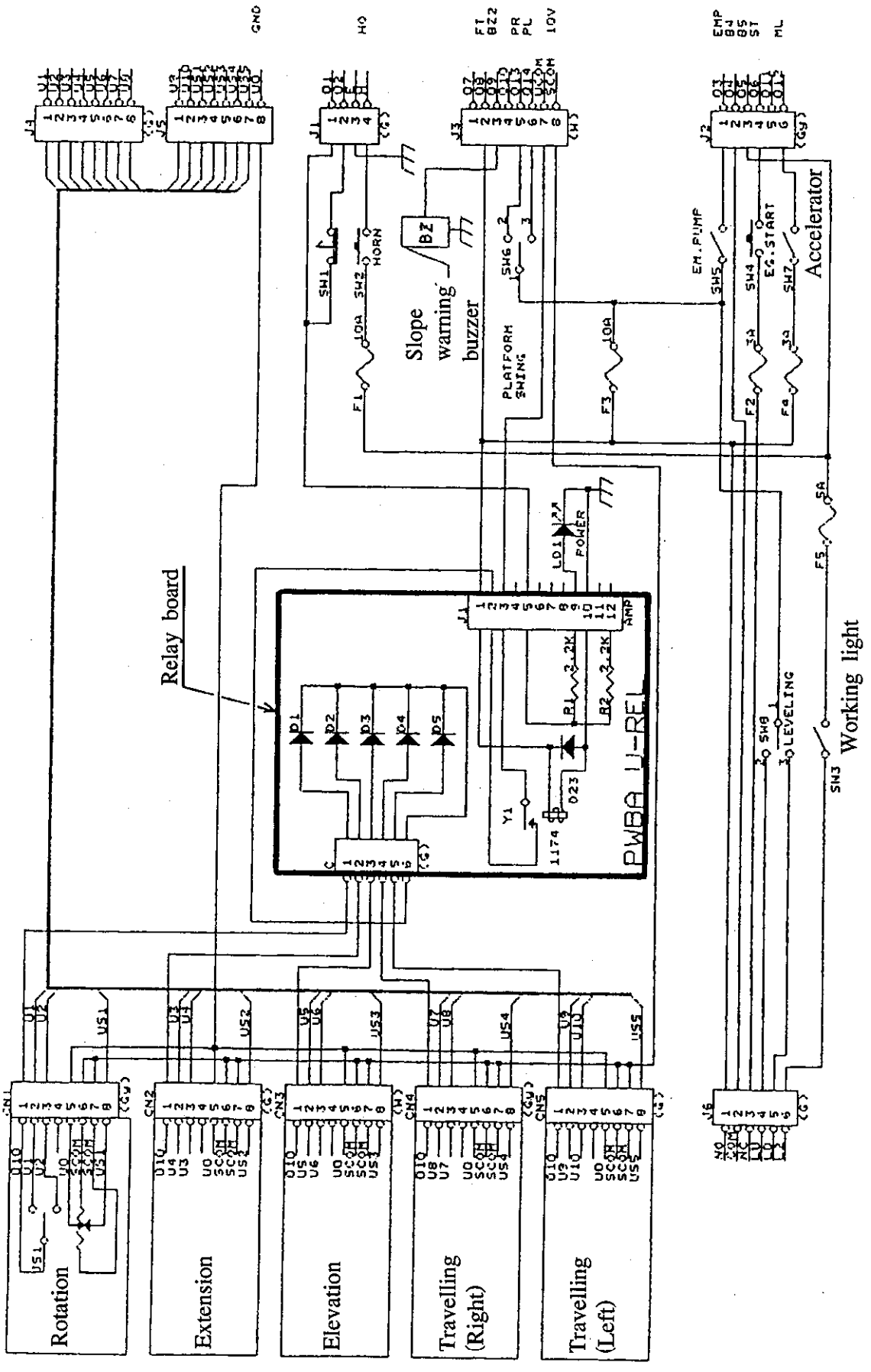


Inside view of control panel



Inside view of back panel

1. Electric circuit

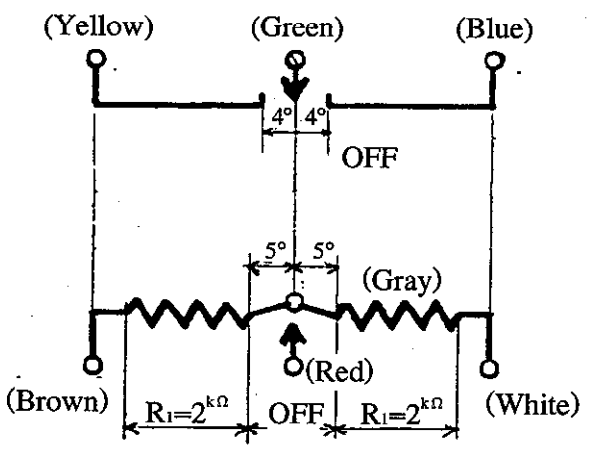


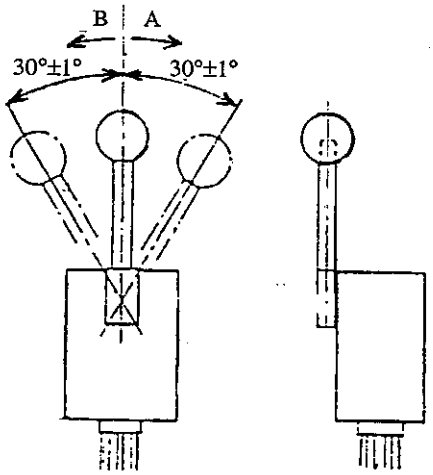
LEVER POTENTIOMETER

The lever potentiometer consists of two parts. One which functions as a switch and one which controls variations of resistance. These two parts are operated simultaneously by the control lever.

The "OFF" section of the switch extends 4° to either side of the lever's central position. The switch will be turned "ON" when the lever is inclined in excess of 4° to either side.

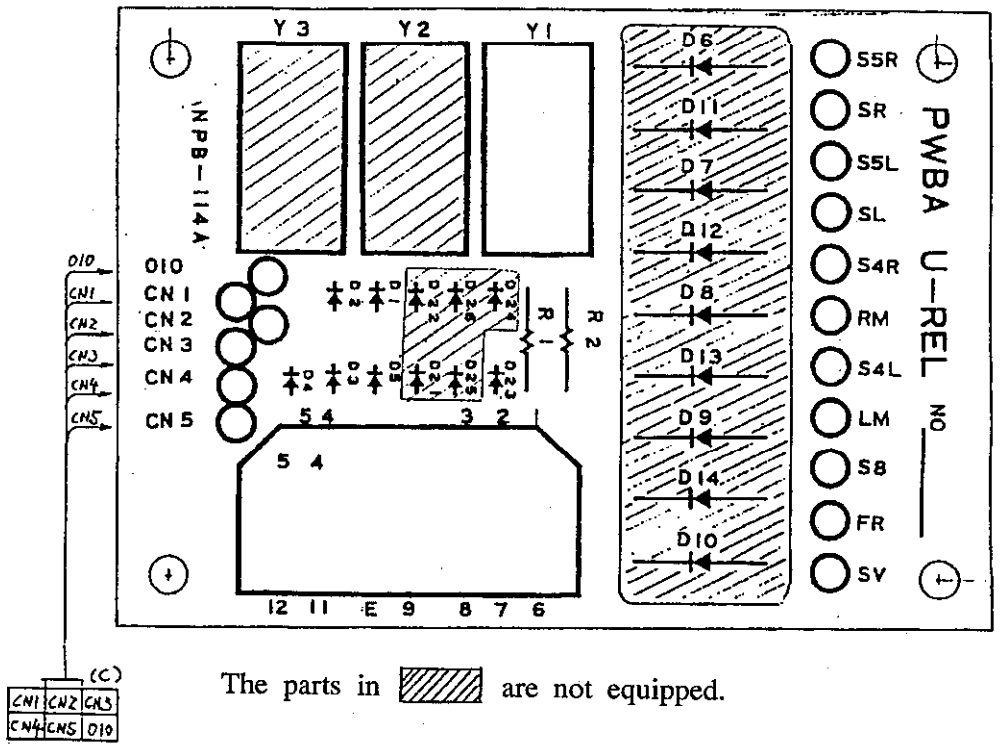
The "OFF" section of the resistance control extends 5° to either side, and from there the resistance (2kΩ) is varied as the control lever is inclined.



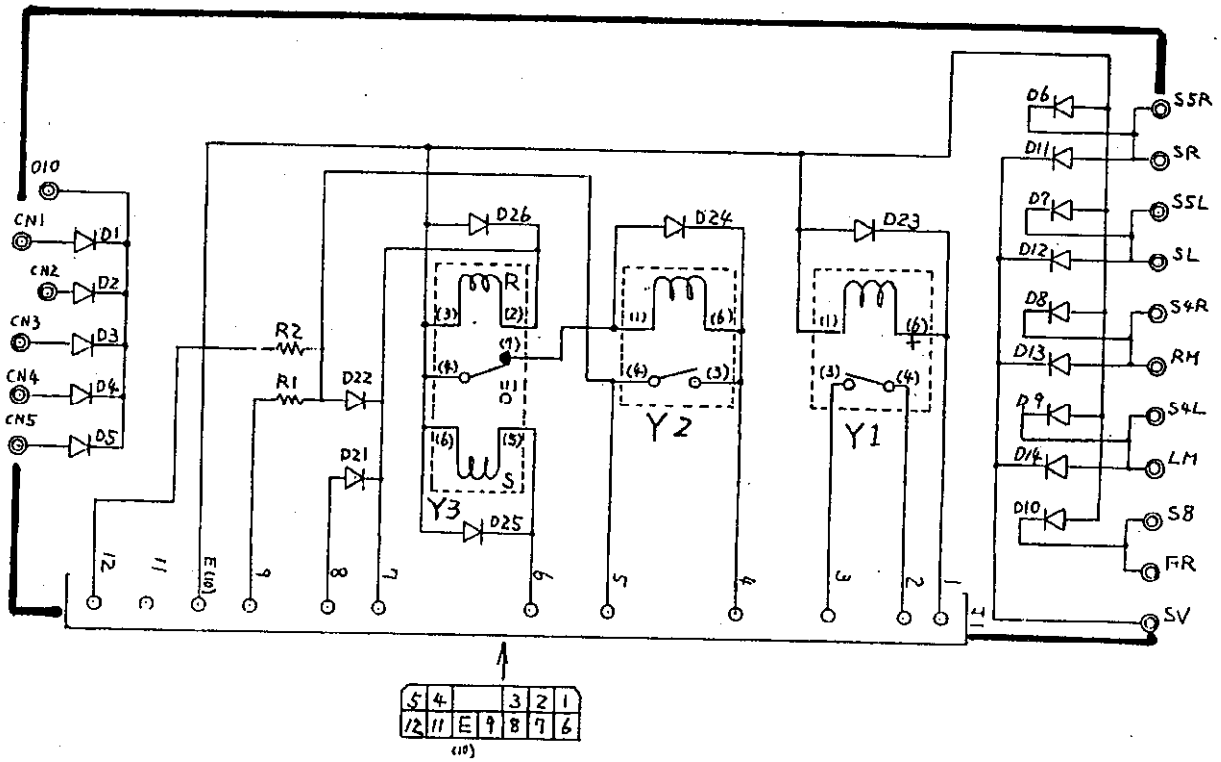


CONTROL BOARD

The board is installed in the "Upper control box".



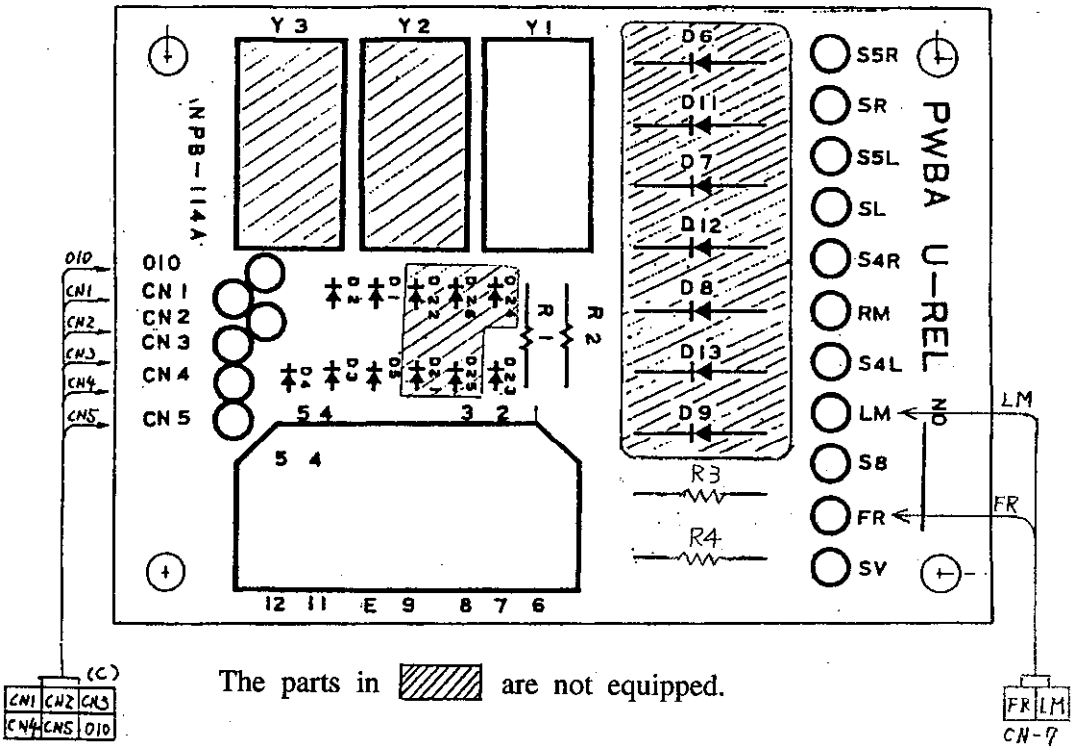
The parts in ▨ are not equipped.



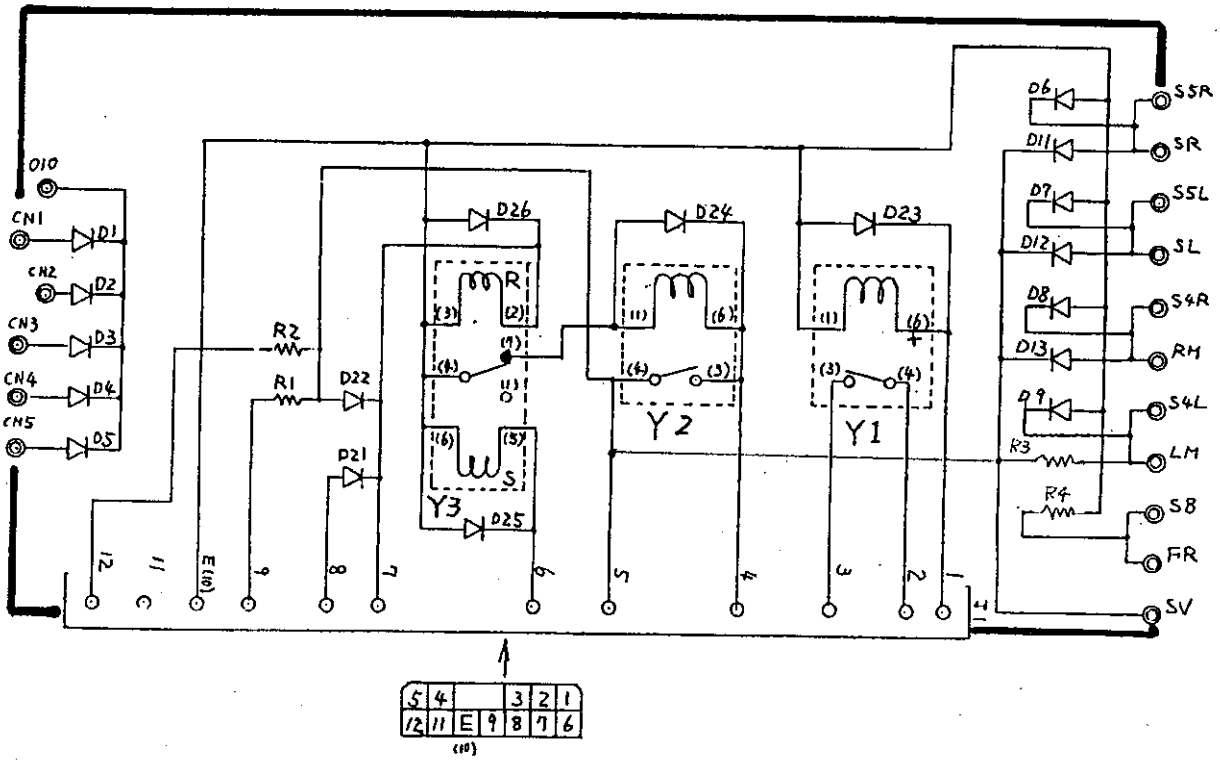
CONTROL BOARD

With resistance R3 and R4

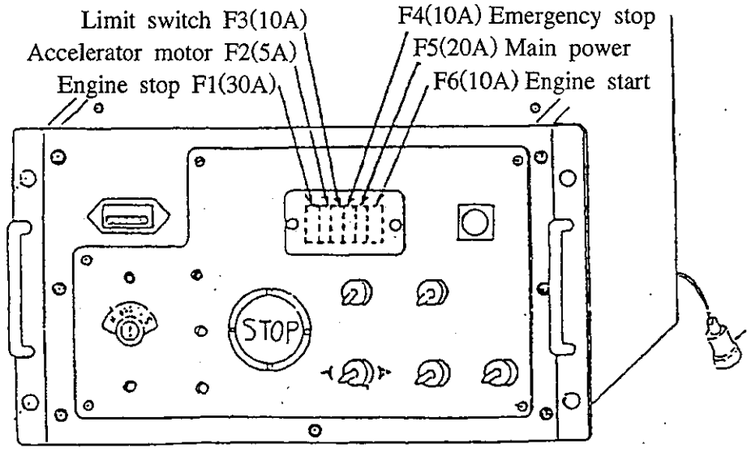
The board is installed in the "Upper control box".

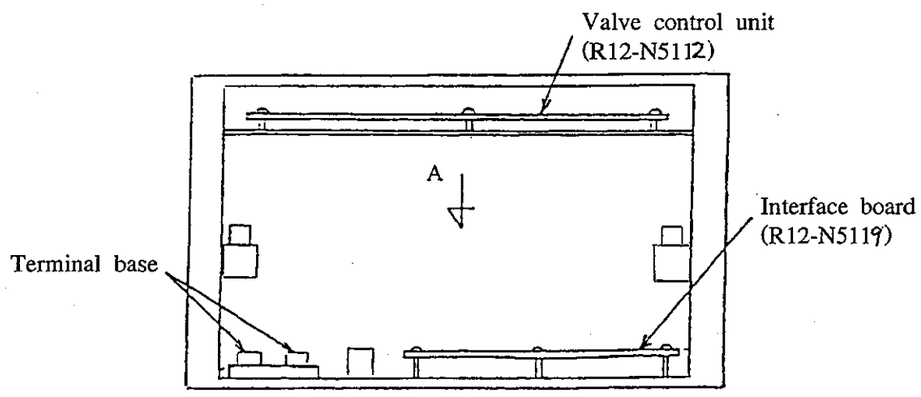


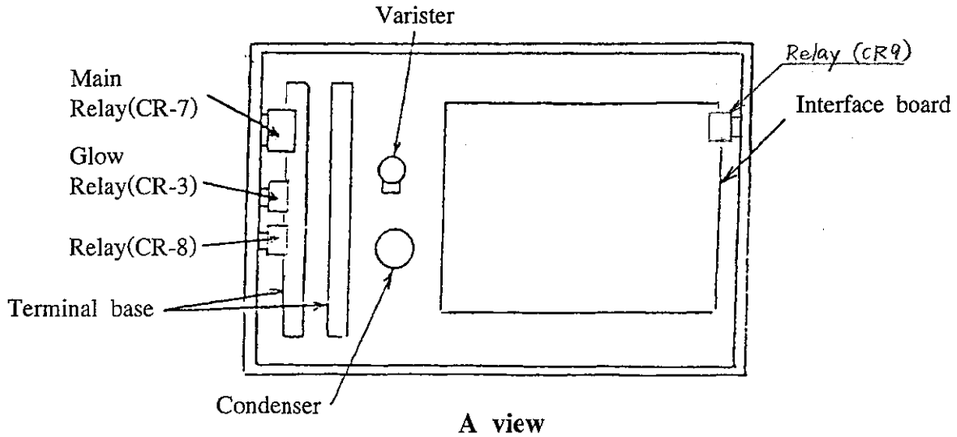
The parts in ▨ are not equipped.



LOWER CONTROL BOX







A view

UJ5

U9	U10	US1	US2
US3	US4	US5	U0

Gray

UJ4

U1	U2	U3	U4
U5	U6	U7	U8

Green

UJ3

07	08	O9	010
O13	O14	U COM	S COM

White

UJ2

O3	O4	O5
O6	011	O12

Gray

UJ1

O1	O2
E	H

Green

LJ10

F3		VL
VR	LS1	LS2

Gray

LJ11

B	G	LS
BZ	G	HO

Green

EJ6

1	E	E
9	LM	RM

White

EJ8

L	L	7	
5	5	8	

Green

VJ12

V1	V2
V3	V4

White

VJ13

V5	V6	V7	V8
V9	V10	V11	V12

Green

VJ14

V13	V14	V15	V16
V17	V18	V19	V20

Gray

EJ7

B	B
B1	B1

Gray

EJ9

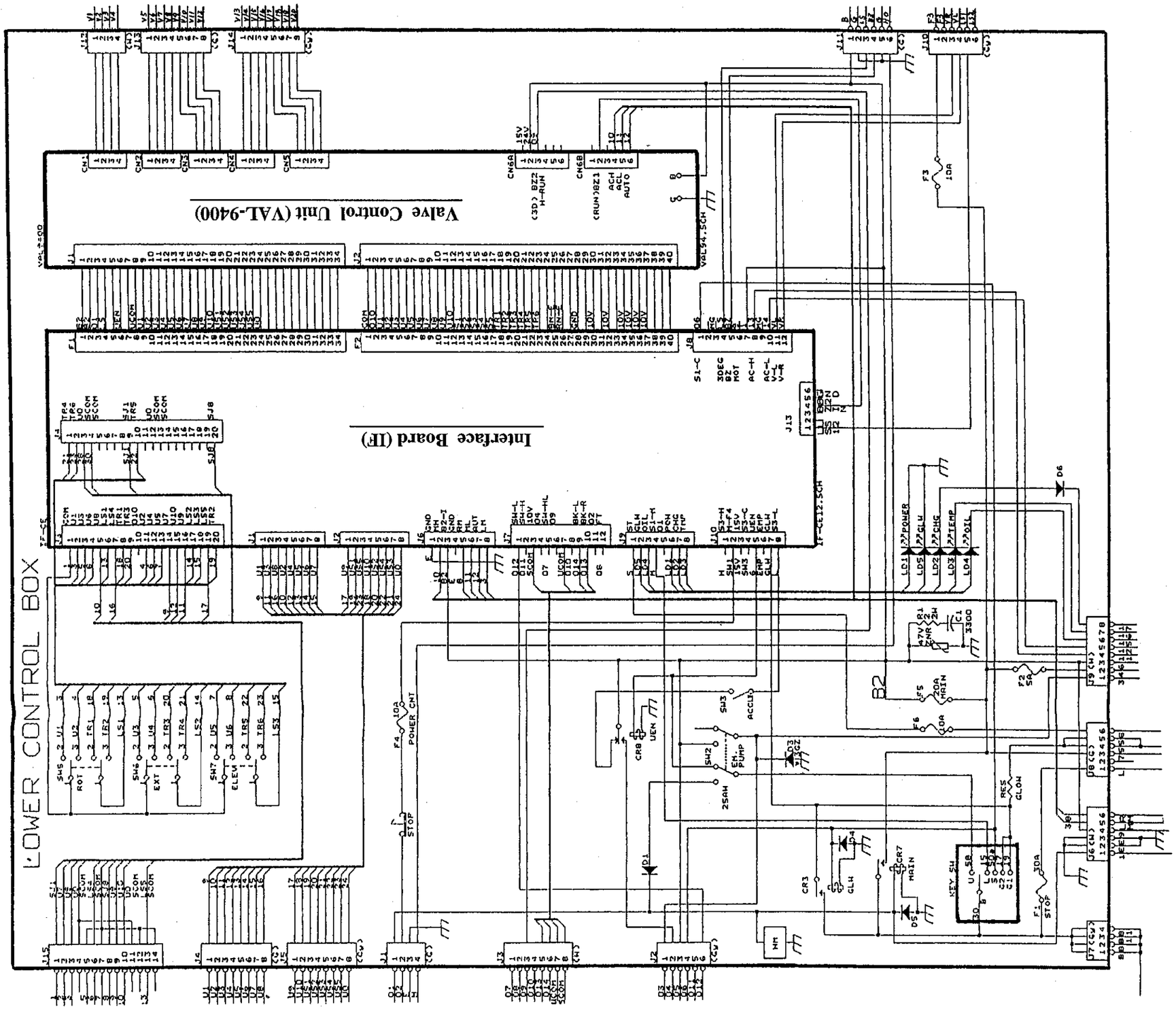
3	4	6	11
12	15	16	17

White

Identifications of Connectors

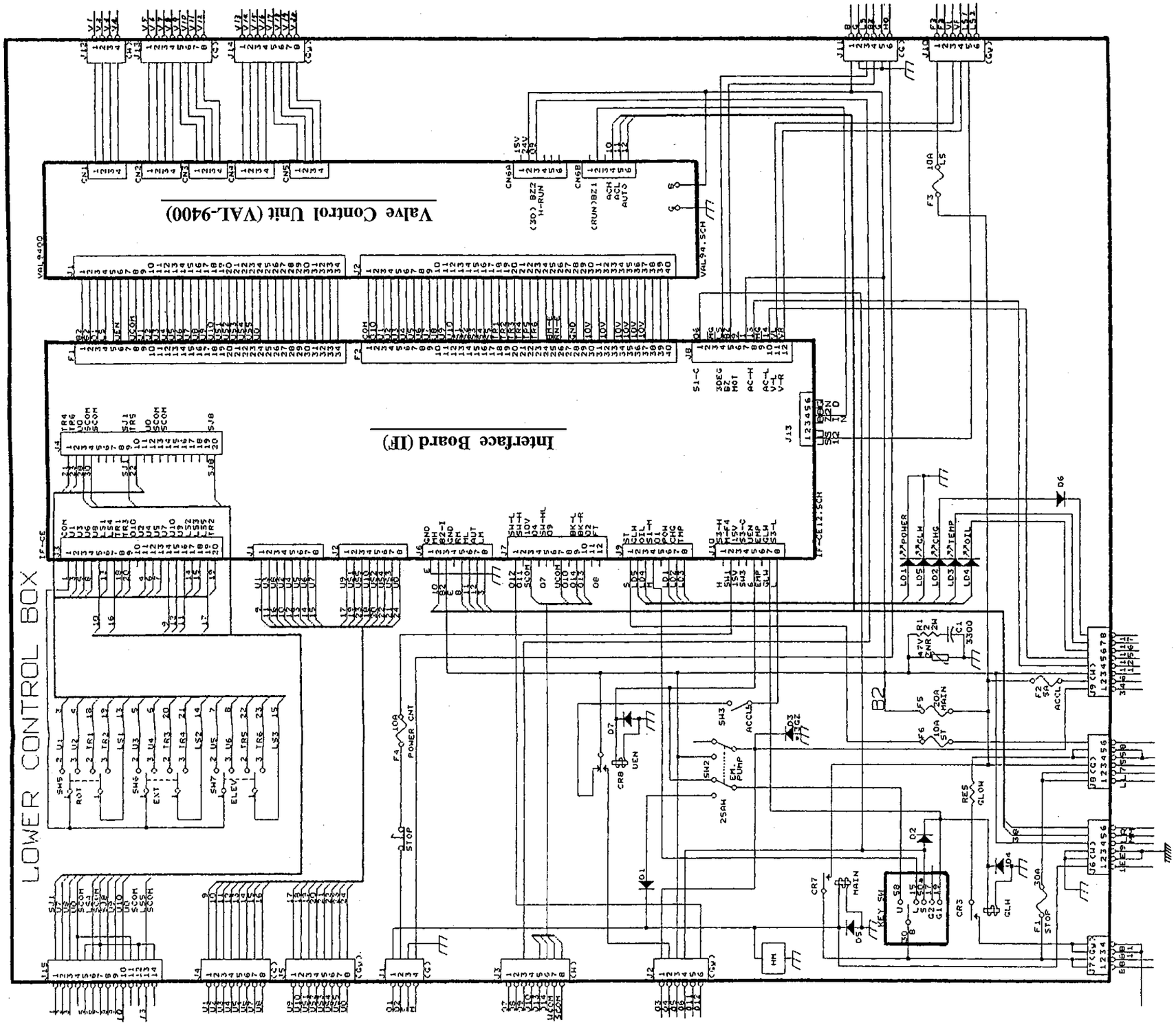
1. Electric circuit

for Spec: A6 (S/N. 652319 ~ 652348)



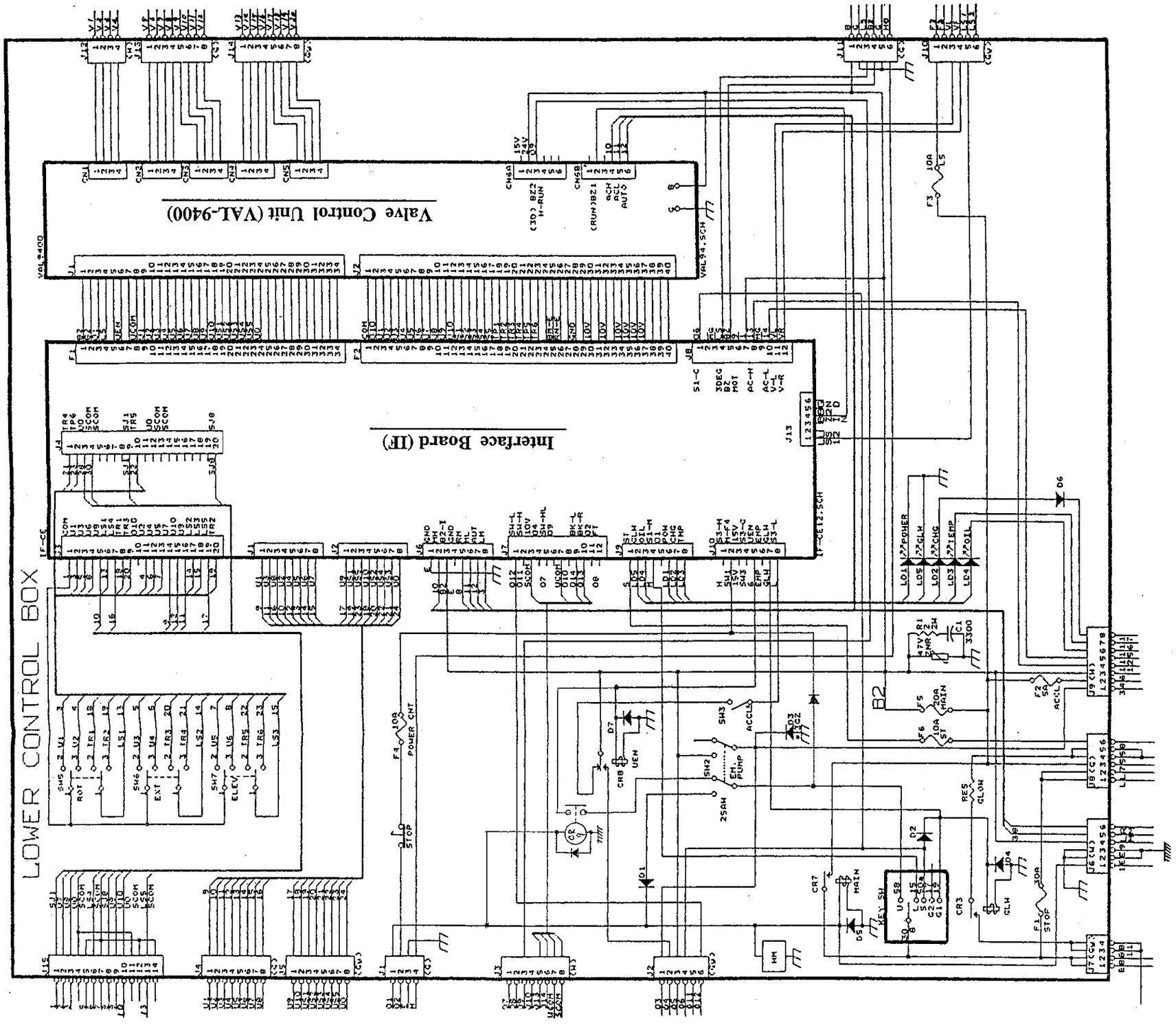
1. Electric circuit

for Spec : A6 (S/N. 652349 ~ 655351)

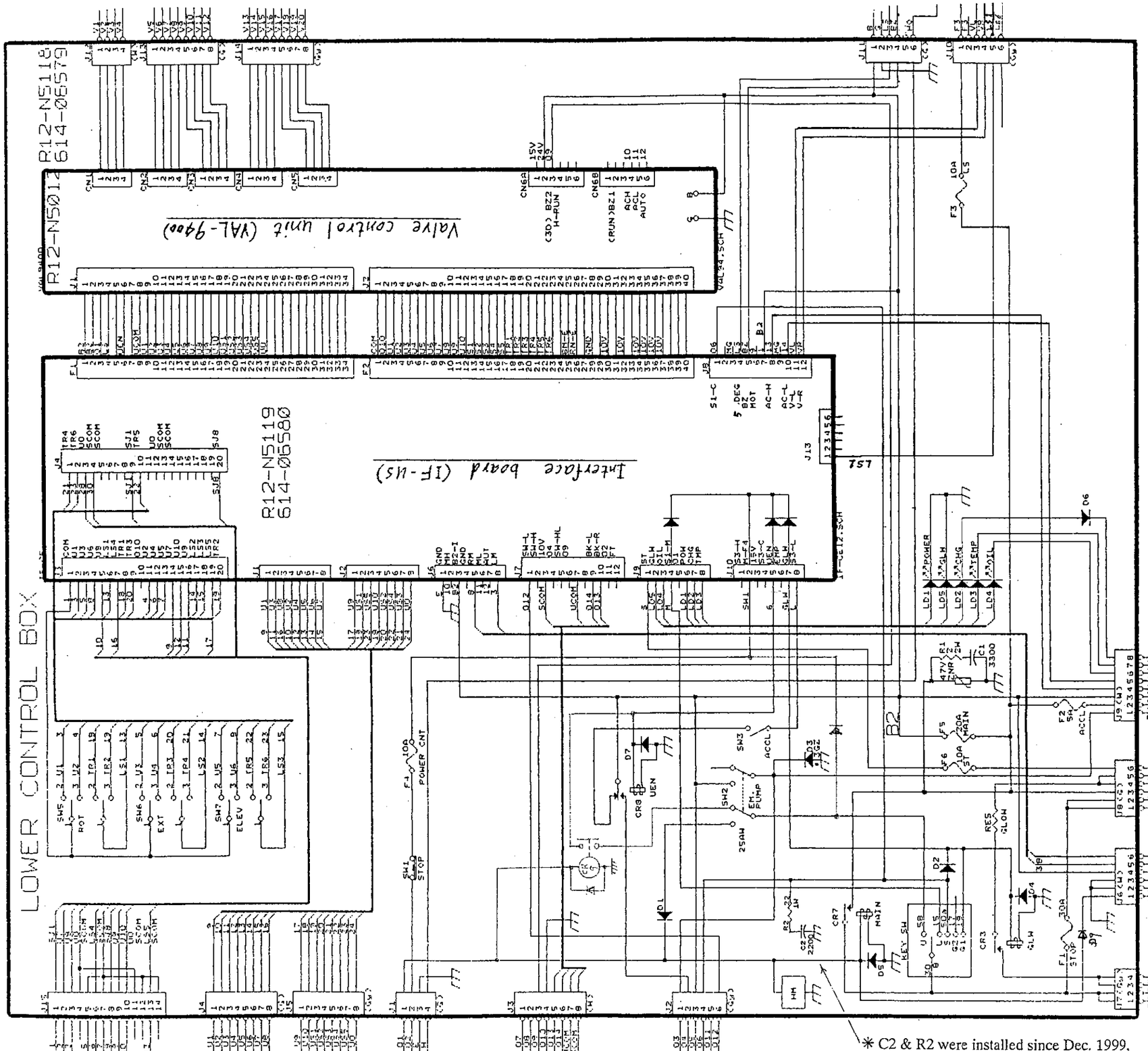


1. Electric circuit

for Spec: A6 (S/N. 655352~)

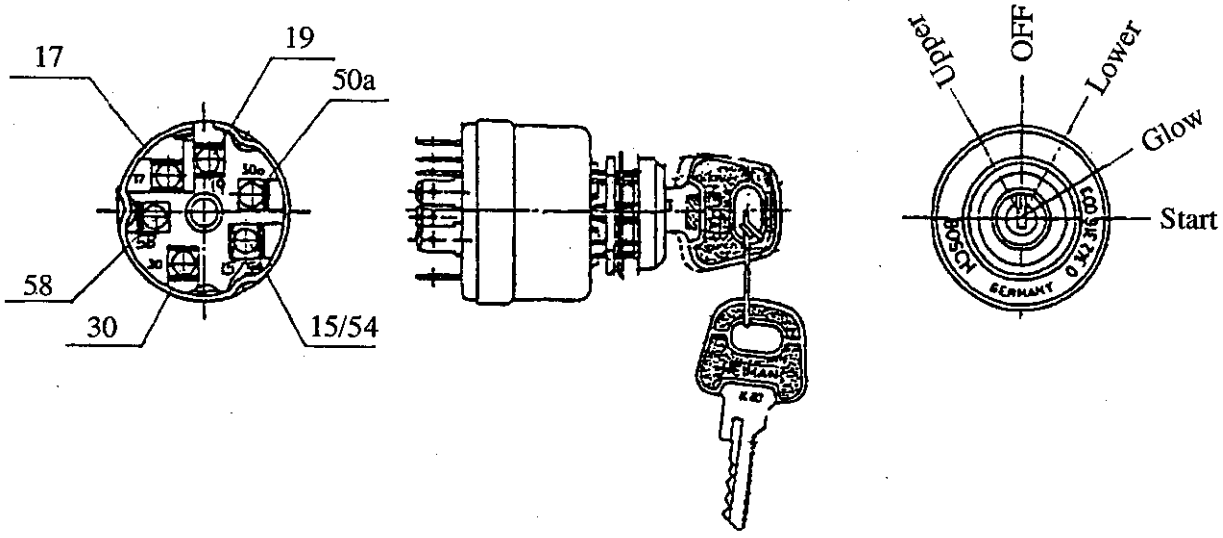


1. Electric circuit (for Spec : A8)



MAIN KEY SWITCH

The main key switch is located on the Lower control box.
This supplies power to the "Upper" or "Lower" control.



Key position and ON/OFF conditions of each terminal

		Terminal NO.					
		30	15/54	58	19	17	50a
Key position	OFF	○					
	Upper	○		○			
	Lower	○	○				
	Glow	○			○		
	Start	○				○	○

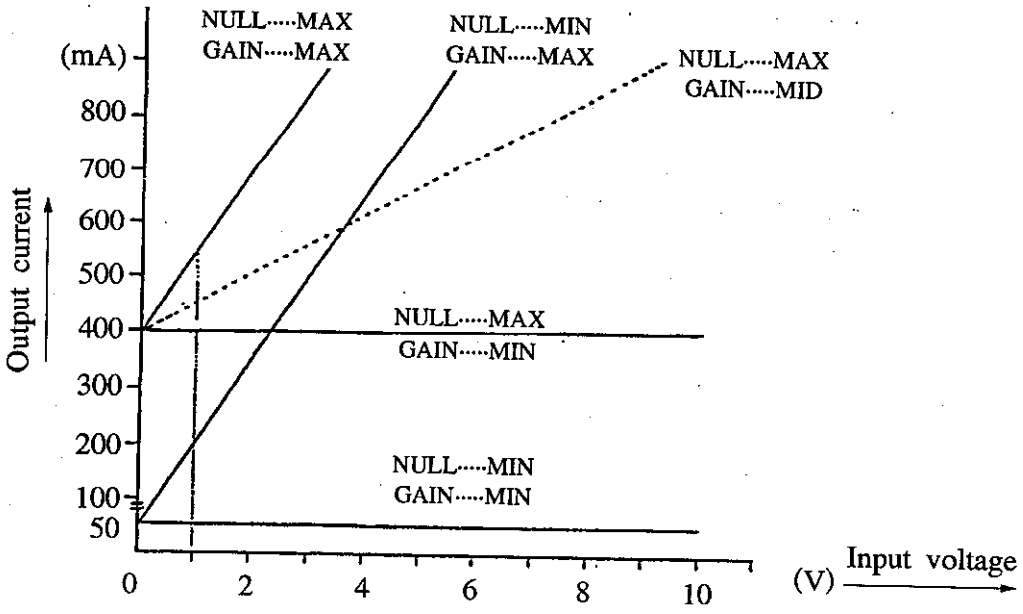
VALVE CONTROL UNIT

The Valve control unit is installed within the electric circuit between the "Potentio meters" (or control switches) and the "Solenoids" of the main control valve.
When the Valve control unit inputs "Voltage variation" (sent from Potentiometer), it converts this "Voltage variation" into the "Ampare variation", and outputs it to the "Solenoids" of the main control valve.
Thus, the proportional operation of main control valve is achieved, when the potentio meter is operated at the upper control.
However, in case the "Control switch" is operated at the lower control, the main control valve is actuated as a conventional solenoid valve, since the control switch does not output "Voltage variation", which is necessary for proportional operation.

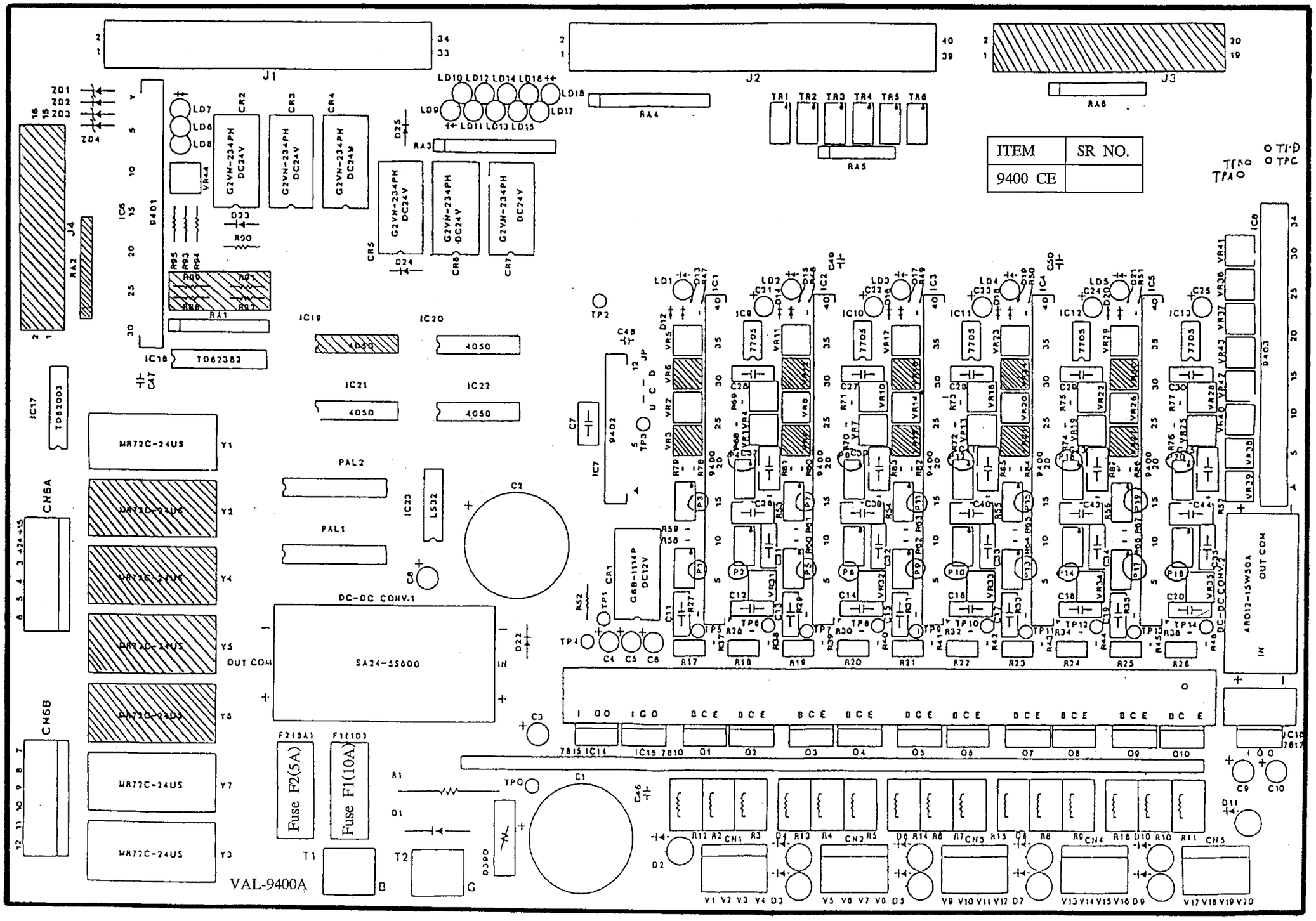
1.Specifications

Rated voltage	DC-24V
Input voltage	DC0~10V
Output current	0~800mA
Delay(Ramp)	0~7seconds(when input voltage is 10V)
Dither	50Hz

2.Input/output characteristic



1. External view



2. Trimmers and their functions

Operation \ Trimmer		NULL	GAIN	DELAY		DITHER	Tr
				UP	DOWN		
Rotation	C.W	P1	P2	VR-1	VR-2	VR-31	Tr-1
	C.C.W	P3	P4	VR-4	VR-5		Tr-2
Extension	OUT	P5	P6	VR-7	VR-8	VR-32	Tr-3
	IN	P7	P8	VR-10	VR-11		Tr-4
Elevation	UP	P9	P10	VR-13	VR-14	VR-33	Tr-5
	DOWN	P11	P12	VR-16	VR-17		Tr-6
Travelling (Right)	FWD	P13	P14	VR-19	VR-20	VR-34	
	REV	P15	P16	VR-22	VR-23		
Travelling (Left)	FWD	P17	P18	VR-25	VR-26	VR-35	
	REV	P19	P20	VR-28	VR-29		

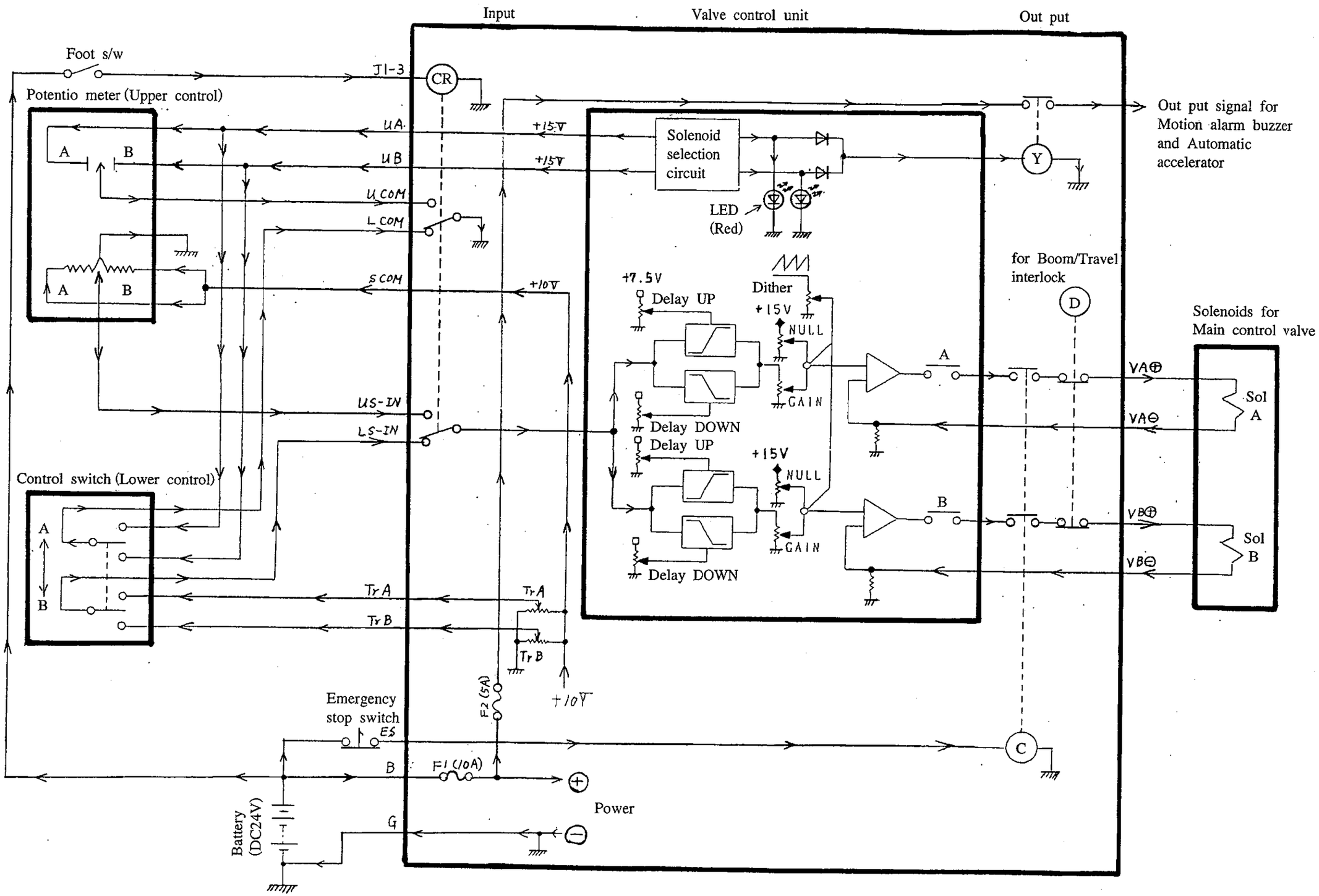
		Travelling (Right)	Travelling (Left)
Trimmer for adjusting "Input voltage" to Valve control unit, when conducting "Pivot turn".		VR-36	VR-37
Trimmer for adjusting "Input voltage" to Valve control unit, when conducting "Spin turn".	MIN	VR-38	VR-40
	MAX	VR-39	VR-41

3. LEDs and their functions

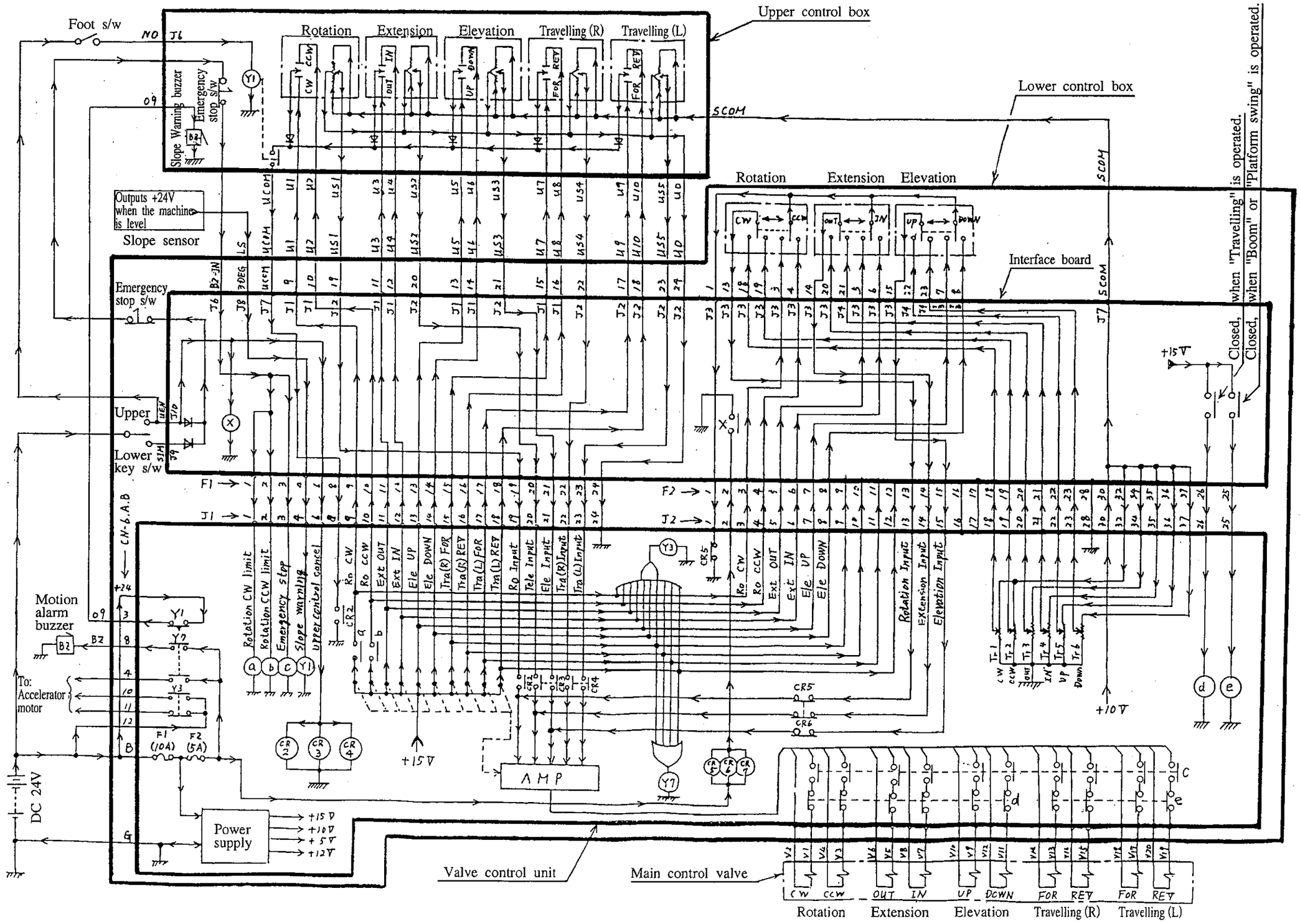
The LEDs and their functions installed on the Valve control unit are as shown in the table below.

	LED.NO.	Color	ON/OFF conditions & functions	Remarks
LEDs for Output	LD 1	Yellow	Output lines to Rotation solenoids } are { Normal → ON / Faulty → OFF	LEDs are turned off, in case the solenoids or electric lines to solenoids get short circuit.
	LD 2	Yellow	Output lines to Extension solenoids } are { Normal → ON / Faulty → OFF	
	LD 3	Yellow	Output lines to Elevation solenoids } are { Normal → ON / Faulty → OFF	
	LD 4	Yellow	Output lines to Travelling(Right) solenoids } are { Normal → ON / Faulty → OFF	
	LD 5	Yellow	Output lines to Travelling(Left) solenoids } are { Normal → ON / Faulty → OFF	
LEDs for Limitatin	LD 6	Yellow	OFF, when Emergency stop is operated.	
	LD 7	Green	OFF, when Rotation C.W. limitation is applied.	
	LD 8	Green	OFF, when Rotation C.C.W. limitation is applied.	
LEDs for "selector input signals"	LD 9	Red	ON, when Rotation C.W. selector input signal exists.	
	LD10	Red	ON, when Rotation C.C.W. selector input signal exists.	
	LD11	Red	ON, when Extension OUT selector input signal exists.	
	LD12	Red	ON, when Extension IN selector input signal exists.	
	LD13	Red	ON, when Elevation UP selector input signal exists.	
	LD14	Red	ON, when Elevation DOWN selector input signal exists.	
	LD15	Red	ON, when Travelling(Right) FWD selector input signal exists.	
	LD16	Red	ON, when Travelling(Right) REV selector input signal exists.	
	LD17	Red	ON, when Travelling(Left) FWD selector input signal exists.	
	LD18	Red	ON, when Travelling(Left) REV selector input signal exists.	

4. Note on function (NO.1)



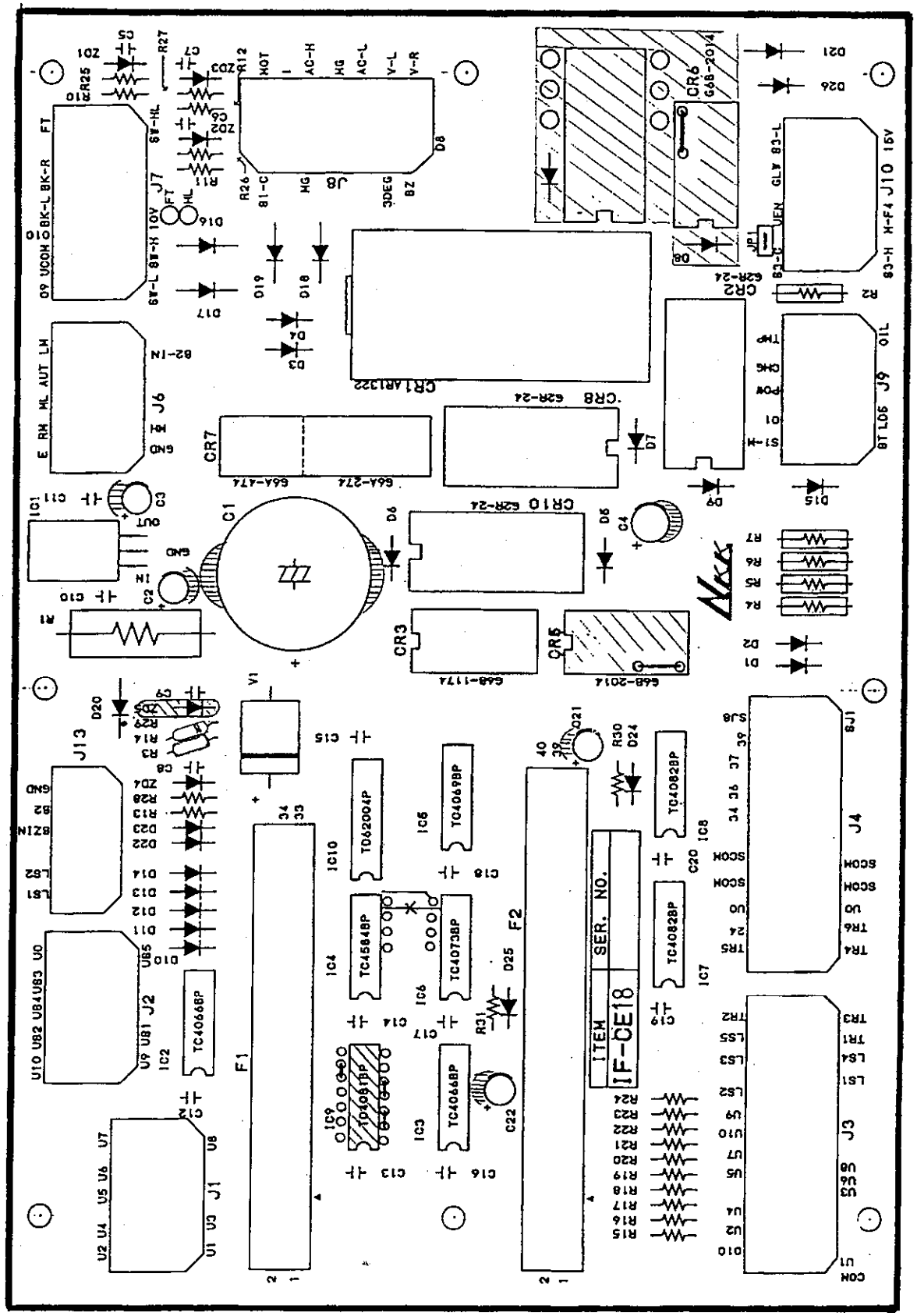
5. Note on function (NO.2)



INTERFACE BOARD

(witout CE/us selector switch)

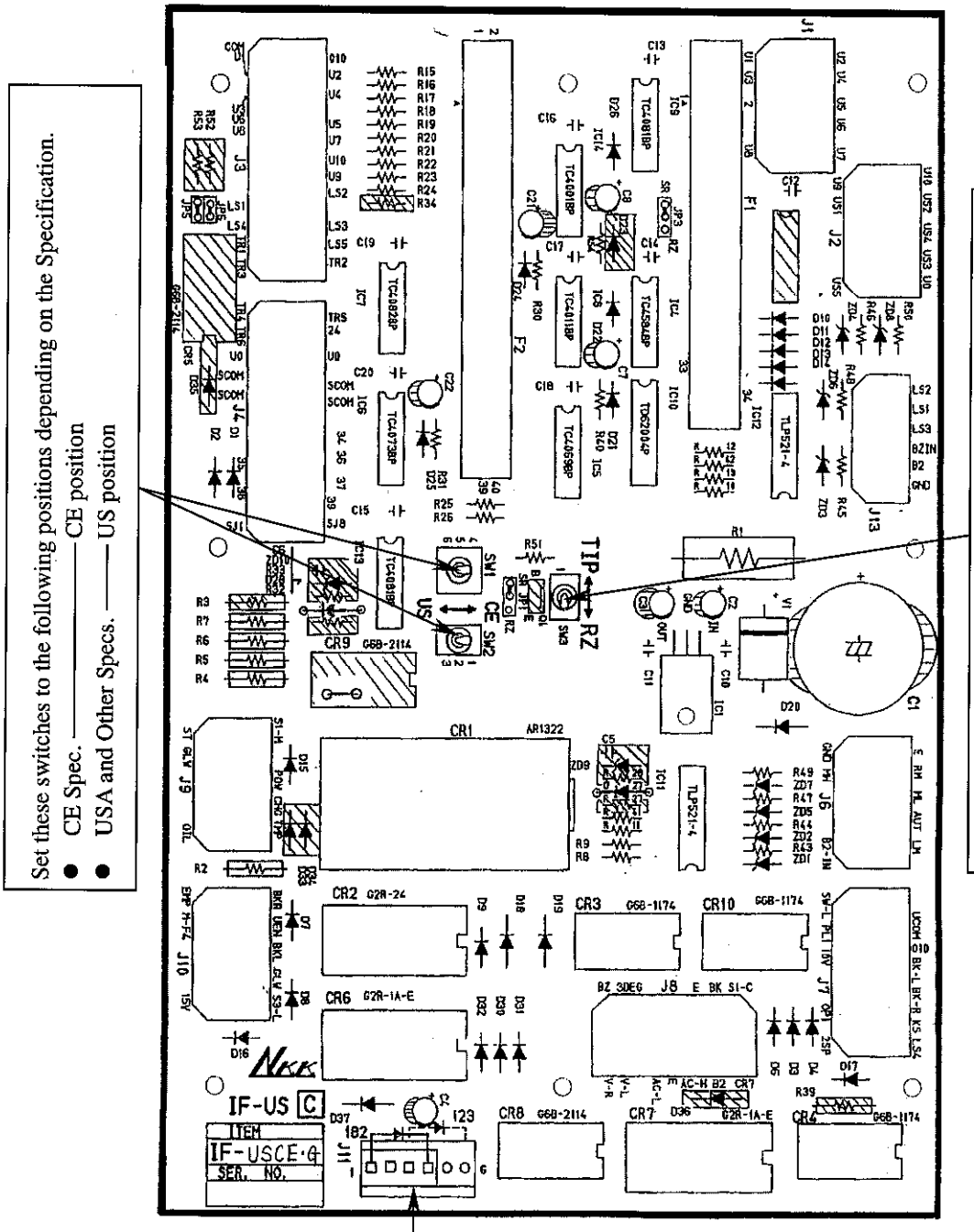
The interface board is located in the lower control box to control the electric system.



Interface Board

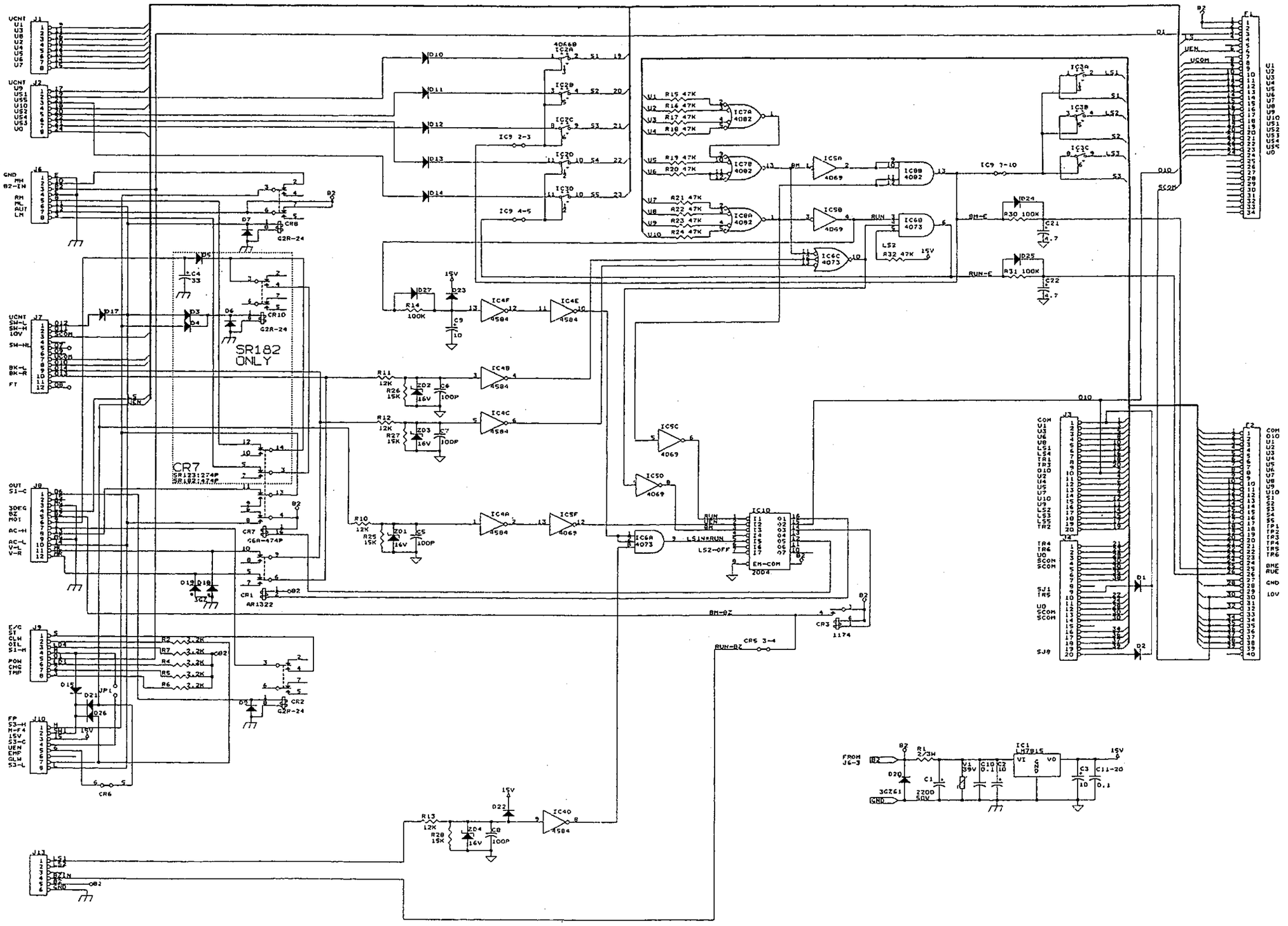
(with CE/US selector switches)

Set each switch and connector equipped on the board as shown in the figure below depending on the specifications of the machine.



1. Electric circuit (for R12-N5113)

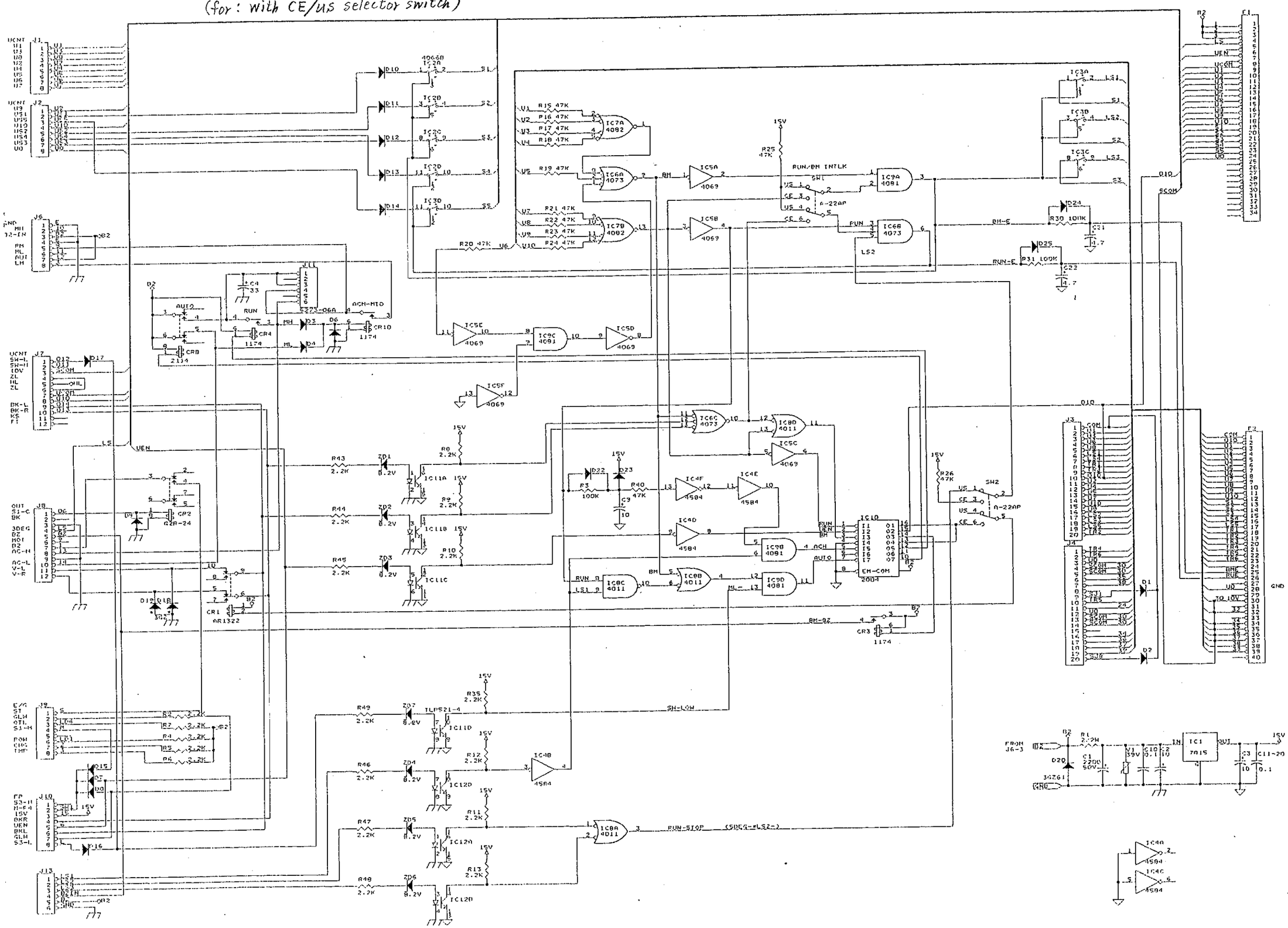
(for: witout CE/US selector switch)



614-06580

1. Electric circuit (for R12-N5119)

(for: with CE/us selector switch)



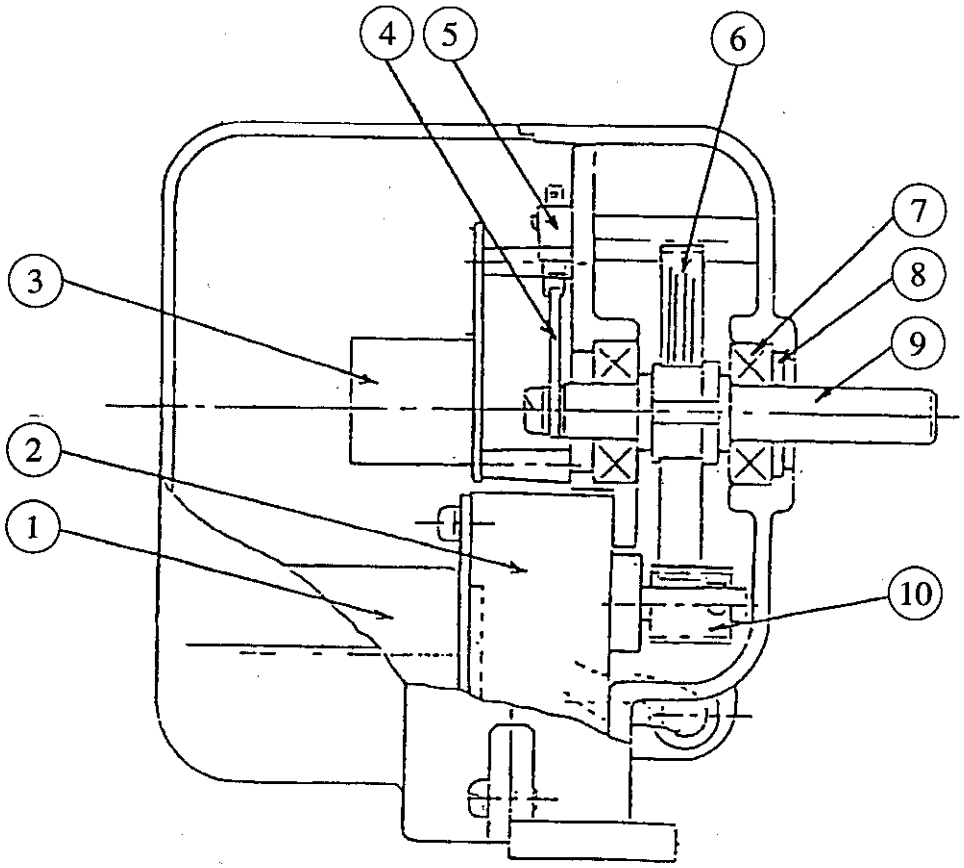
4-17-2

ACCELERATOR MOTOR

The Accelerator motor is installed on the turn table.
It is used to increase or decrease the engine speed.

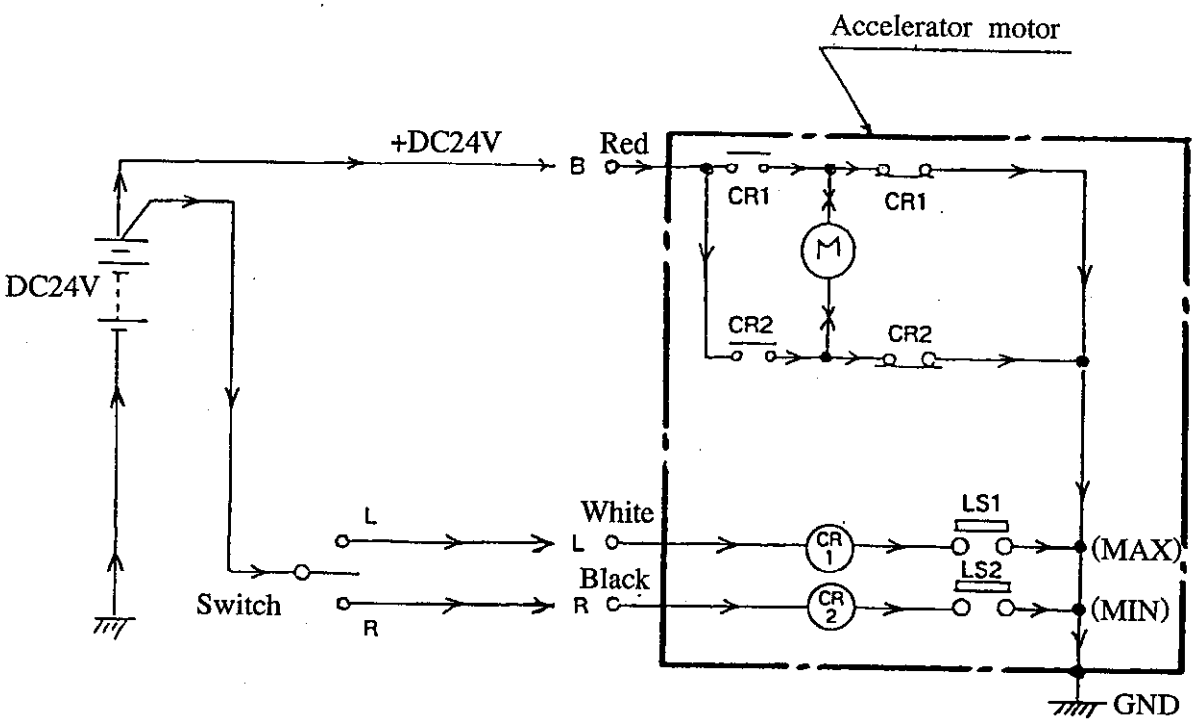
Rated voltage.....DC24V (DC20~30V)
Out-put torque.....80kgf-cm
Rated current.....250mA

Structure



1	DC motor	6	Gear
2	Speed reducer	7	Bearing
3	Relays	8	Dust seal
4	Cam plate	9	Output shaft
5	Limit switch	10	Gear

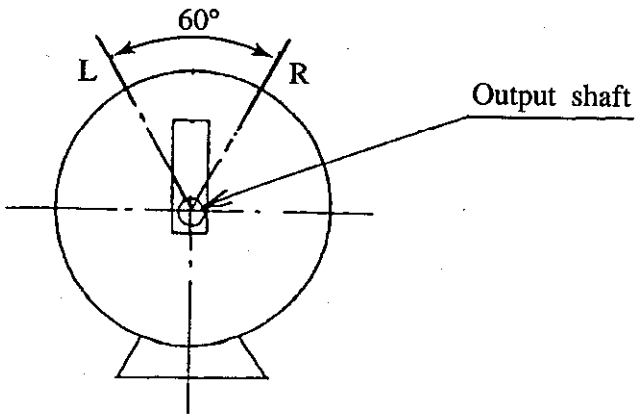
1. Electric circuit



2. Inspection procedures

Follow the steps listed below to check that the accelerator motor is functioning correctly.

1. Connect battery & switch as shown in the electric circuit above.
2. Operate the switch to "L" side, and ensure the output shaft rotates counter clock-wise, then stops at "L" position.
3. Operate the switch to "R" side, and ensure the output shaft rotates clock-wise, then stops at "R" position.



SLOPE SENSOR

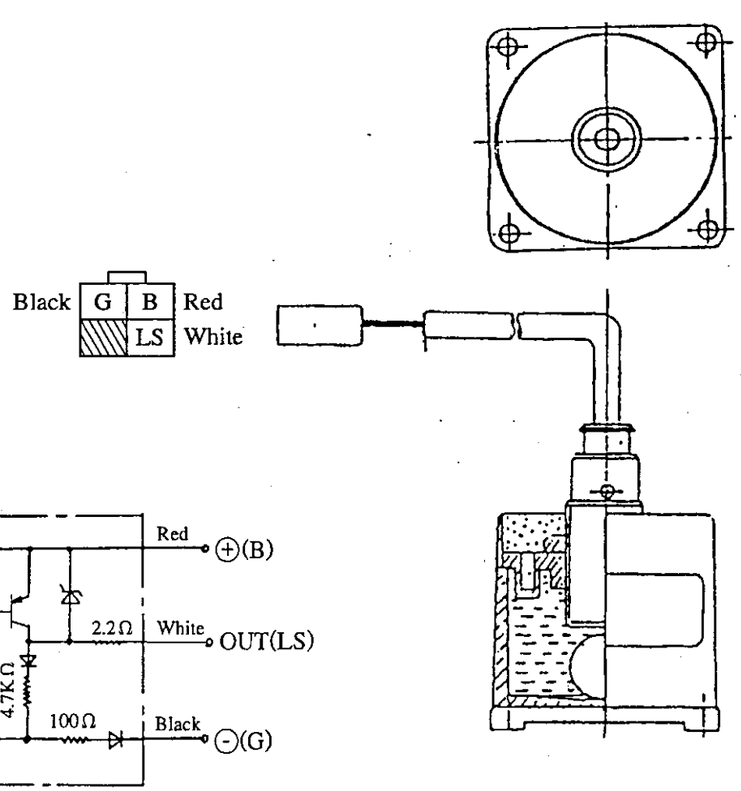
The sensor (installed on the turntable) detects the tilt angle of the machine caused by a slope.

(for Spec.: A6)

3 degree sensor

The sensor stops its out-put power (DC24V), and activates the slope warning buzzer, in case the machine is inclined 3° or more.

Rated voltage	DC24V(DC10~32V)
Preset angle	3°(2.5°~3.5°)
Output current	200mA



NOTE: The wire color of the slope sensor may be changed as follows.

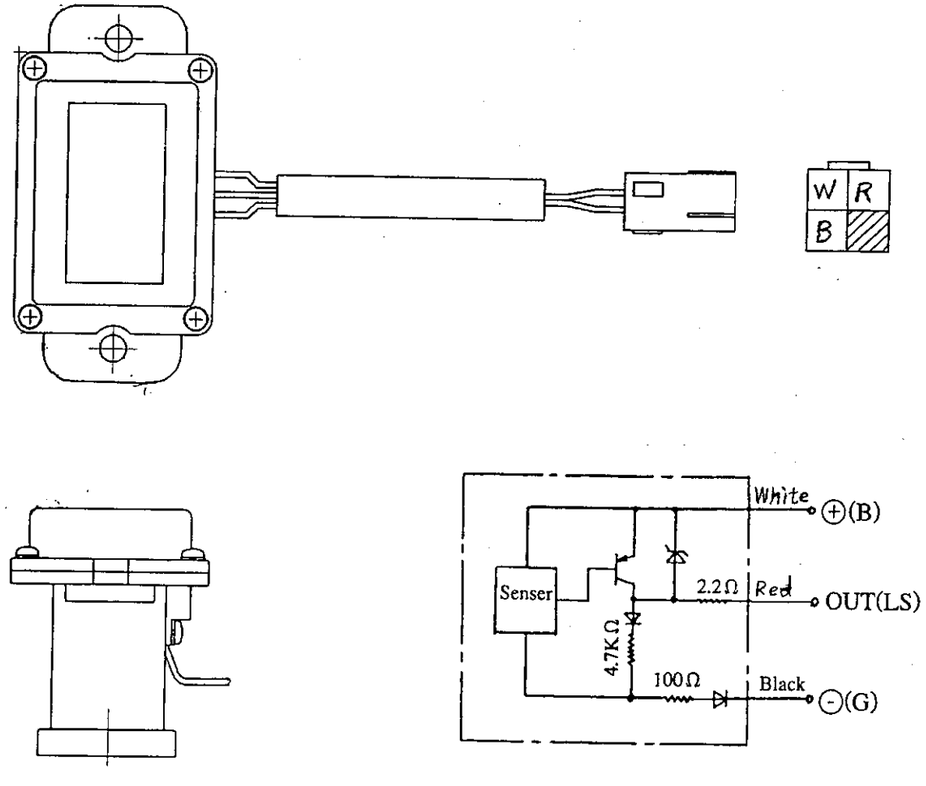
Red ⟶ Brown, White ⟶ Black, Black ⟶ Blue

(for Spec.: A8)

5 degree sensor

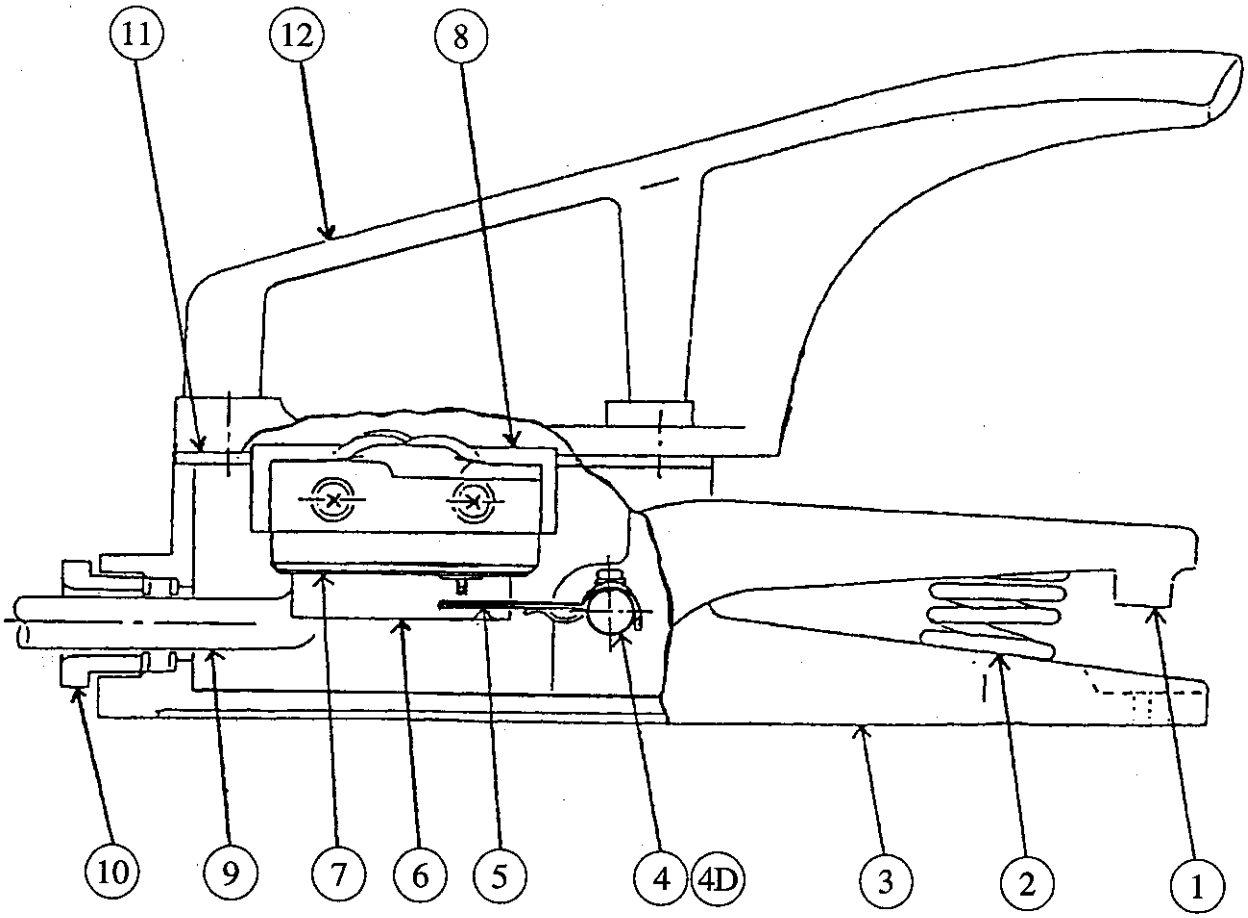
The sensor stops its out-put power (DC24V), and activates the slope warning buzzer, in case the machine is inclined 5° or more.

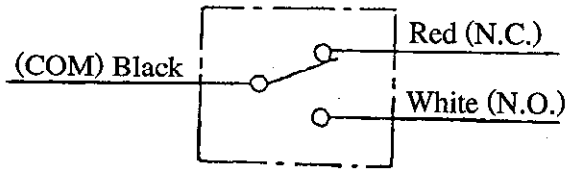
Rated voltage	DC24V(DC10~32V)
Preset angle	5.5°(5° ~ 6°)
Output current	100mA



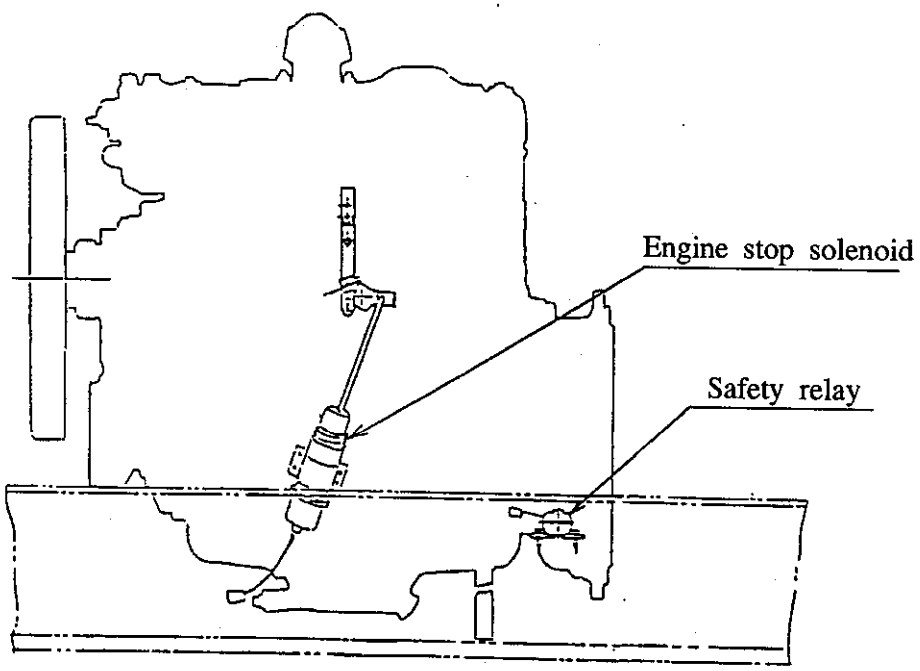
FOOT SWITCH

The foot switch is installed on the platform floor to stop the functions of Upper control levers and switches.
This will happen when the switch is not pressed down.





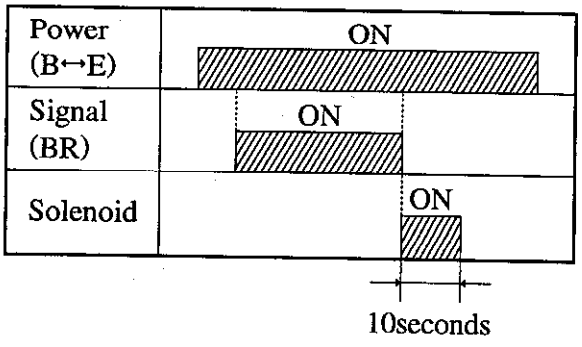
The Engine stop solenoid, Safety relay, etc. are installed as shown in the figure below.



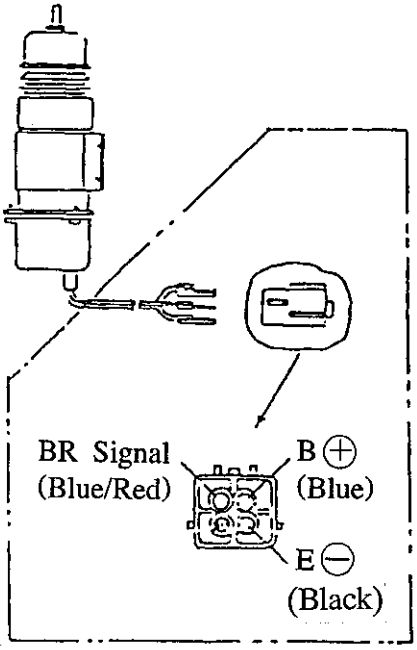
1. Engine stop solenoid

Rated voltage	DC24V
Rated current	10A or less
Actuating time	10seconds after switching off

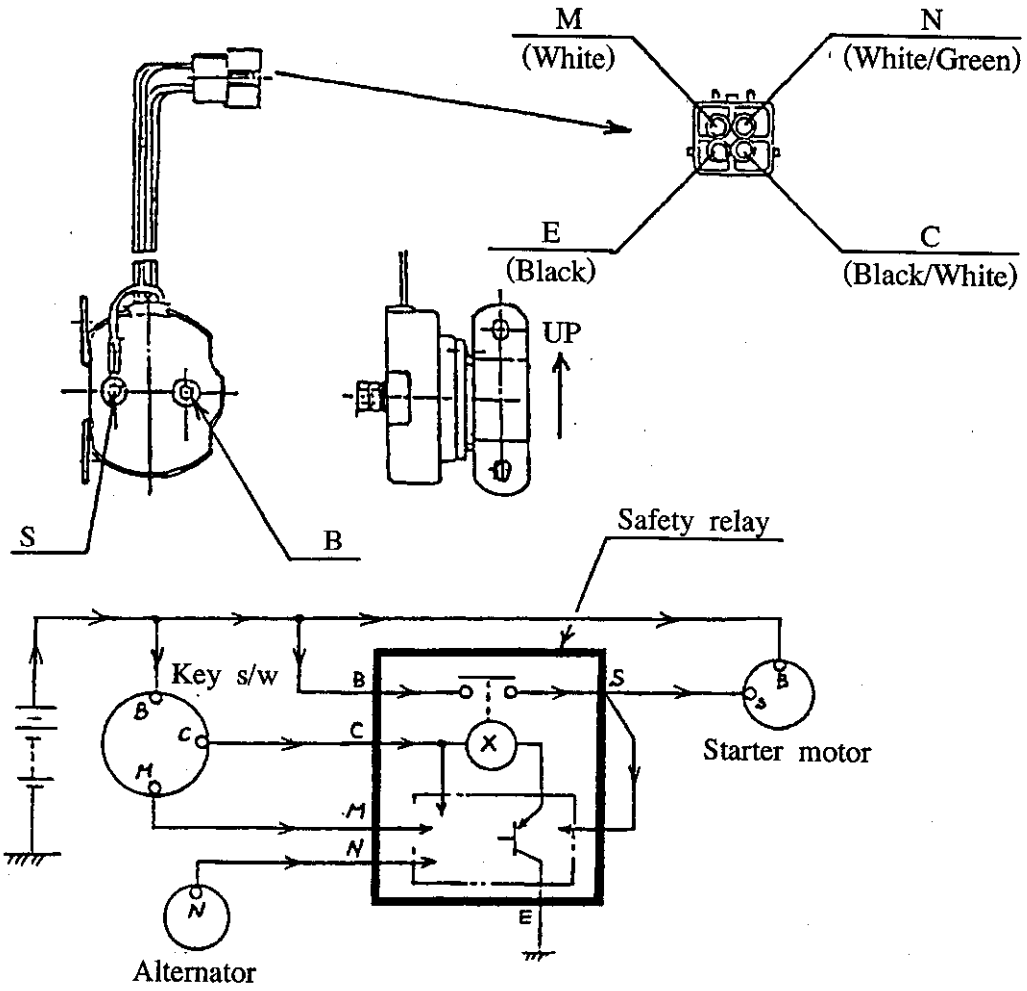
Function chart



The solenoid is switched on for about 10 seconds, when the power (+24V) applied on "Signal line" is turned off, and will switch off automatically after 10 seconds.

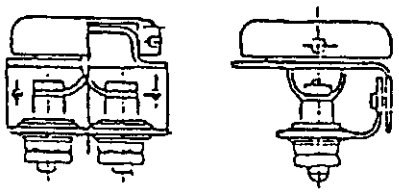


2. Safety relay



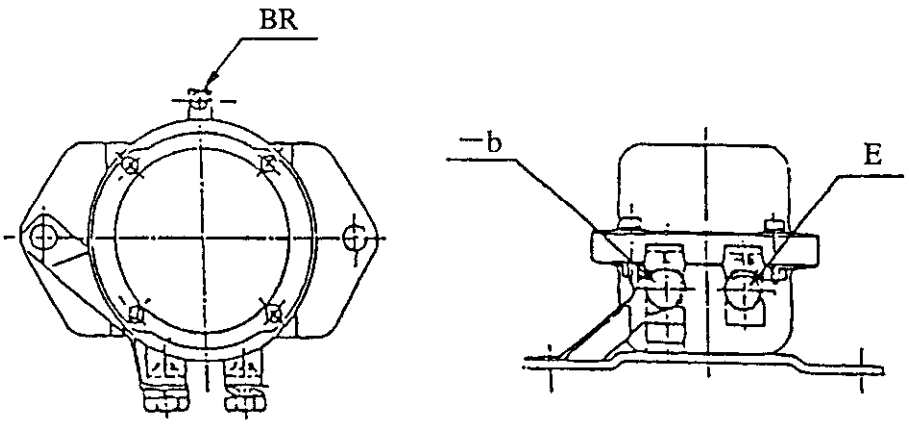
3. Glow indicator

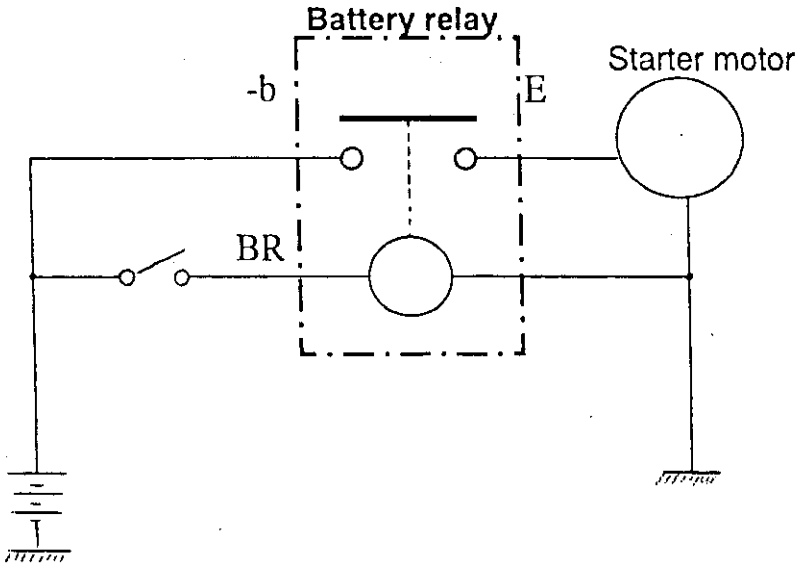
Rated voltage	DC24V
Rated current	16.4A
Resistance	0.054Ω
Time reaches to 800℃	20~25seconds



4. Battery relay

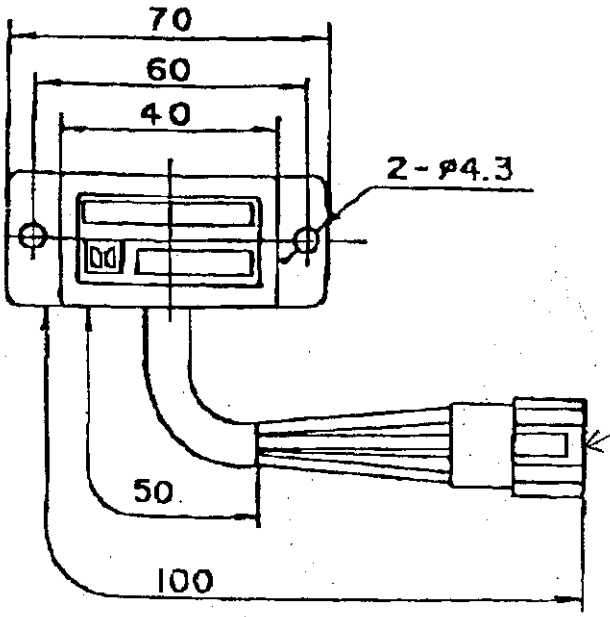
Rated voltage	DC24V
Rated current	100A (continuously), 1,000A (30seconds)



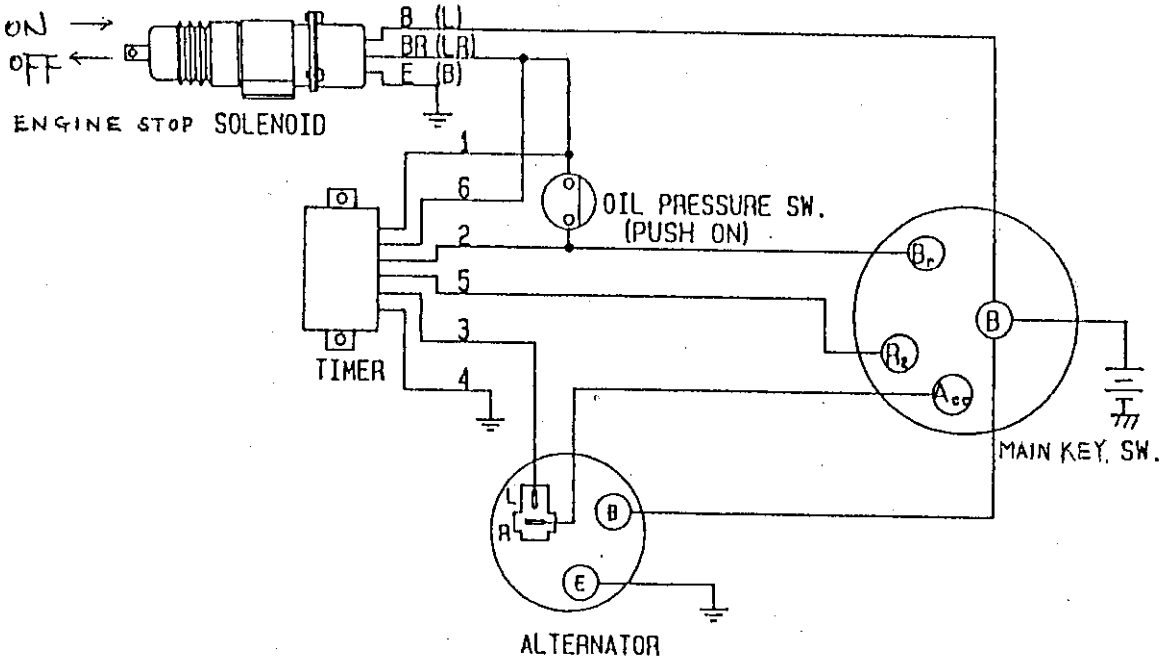


5. Timer

Rated voltage	DC 24 v
Delayed time	5±2 sec (The relay contact opens in 5± 2 sec after 24± 1 v are applied to the terminal No.3.)
Contact load	0.5 Ampere
Weight	80 gram



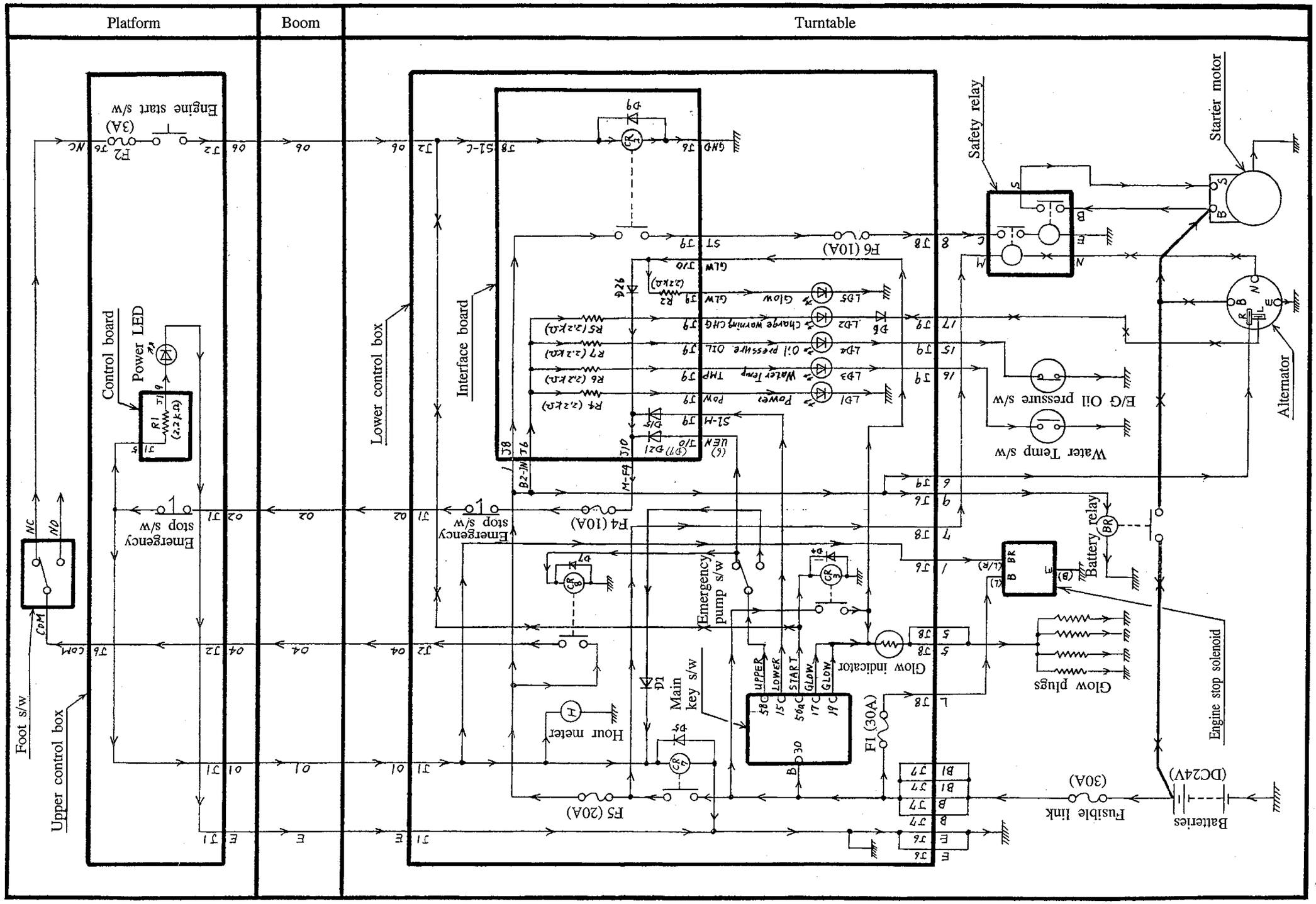
No.	Color code
1	Blue/red
2	Blue/yellow
3	White/red
4	Black
5	Black/yellow
6	Yellow



5
ELECTRIC CIRCUIT for INDIVIDUAL SYSTEM

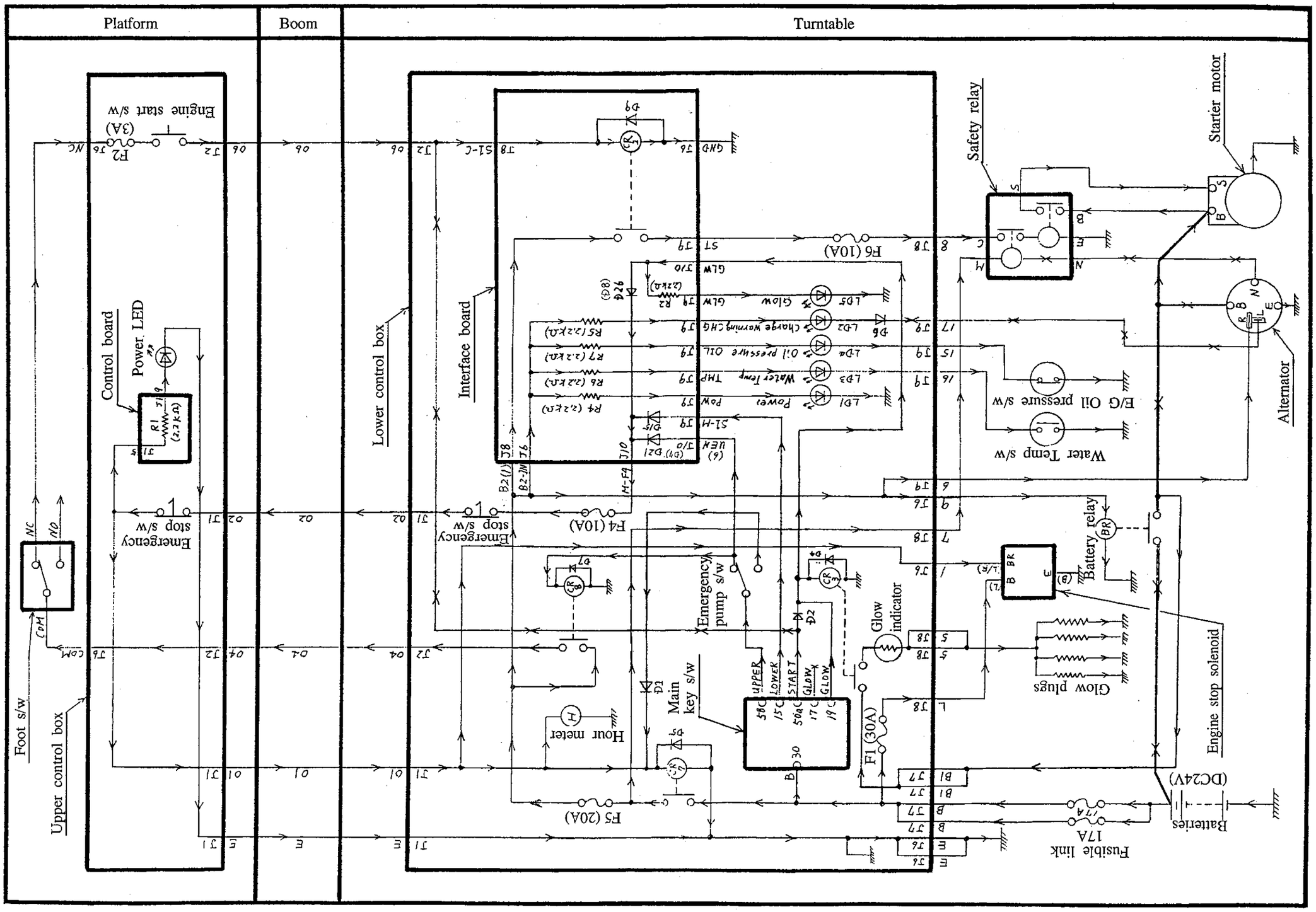
ENGINE CONTROL SYSTEM

for Spec : A6 (S/N 652319~652348)



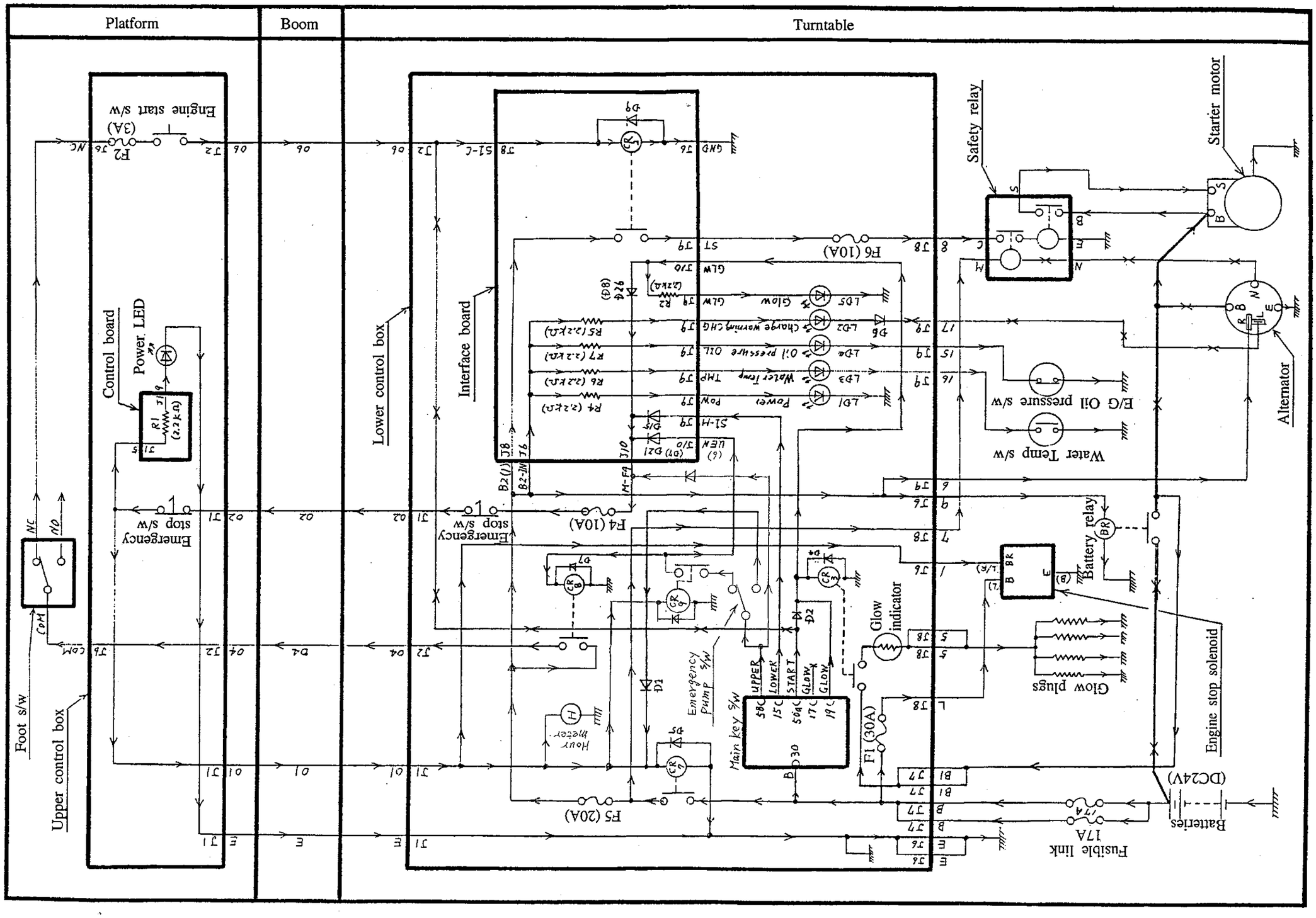
ENGINE CONTROL SYSTEM

for Spec : A6 (S/N 652349 ~ 655351)

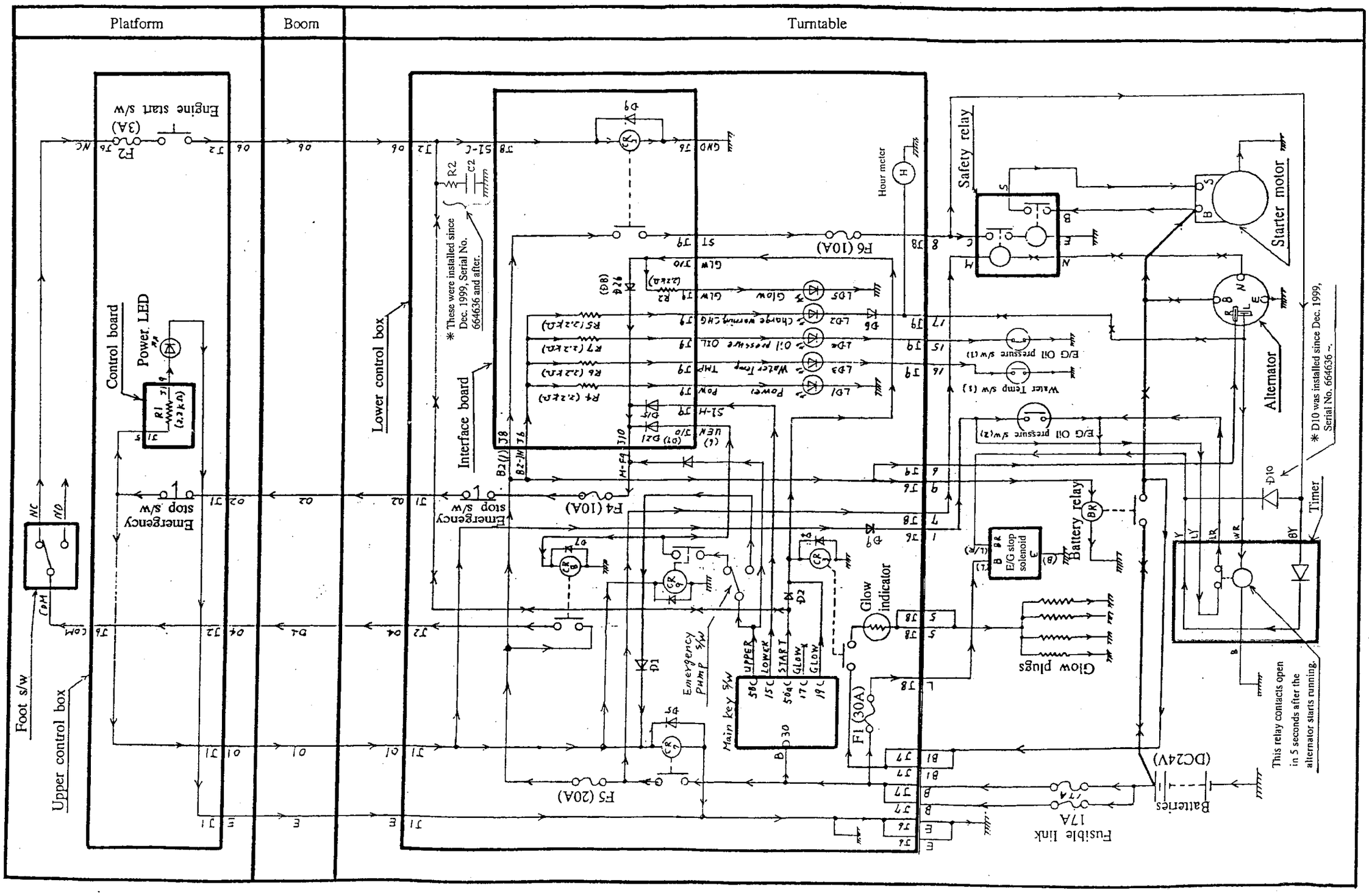


ENGINE CONTROL SYSTEM

for Spec : A6 (S/N 652352~)



ENGINE CONTROL SYSTEM (for Spec. A8 & 20)



ROTATION SYSTEM

for Spec: A6 (S/N 6523219 ~ 655351)

Turntable

Platform

Boom

Valve control unit

Main control valve No.1 (Rotation)

C.W. C.C.W.

V1 V2 V3 V4

Batteries (DC 24V)

Fusible links (17A x 2)

B E J7 J6

Main key S/W

B 30 50a START 15 LOWER 58 UPPER 19 Glow 17 Glow 19 Glow

Emergency pump S/W

Interface board

Voltage regulator +15V +10V +5V +12V

A M P

10A 5A

P C

+15V +10V

CR1 CR2 CR3 CR4 CR5 CR6 CR7

TR1 TR2

D1 D2 D3 D4 D5 D6 D7 D8 D9 D10 D11 D12

F1 F2 F3 F4 (10A) F5 (20A)

M-F4 GND

IC regulator IN GND OUT +15V

Emergency stop S/W

Rotation S/W

C.W. C.C.W.

Lever potentiometer (Rotation)

Upper control box

Relay board

Foot S/W

This relay is switched on when the boom is operated, and stays off when the travelling is operated

J1 J2 J3 J4 J5 J6 J7

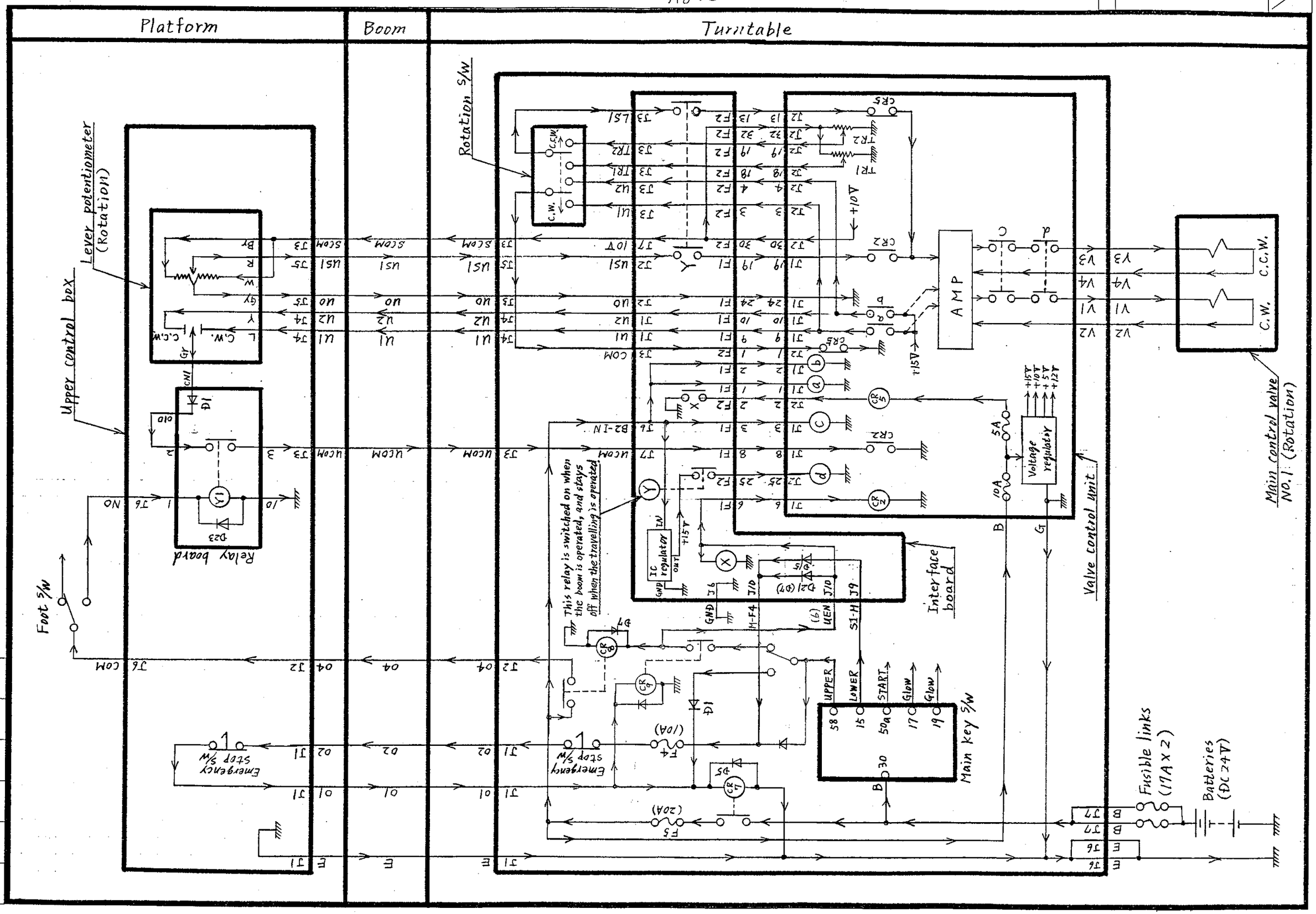
US1 U0 U1 U2 SCOM UCOM COM B2-IN

Br R W Y L G C.W. C.C.W.

CN1 CN2 CN3 CN4 CN5 CN6 CN7

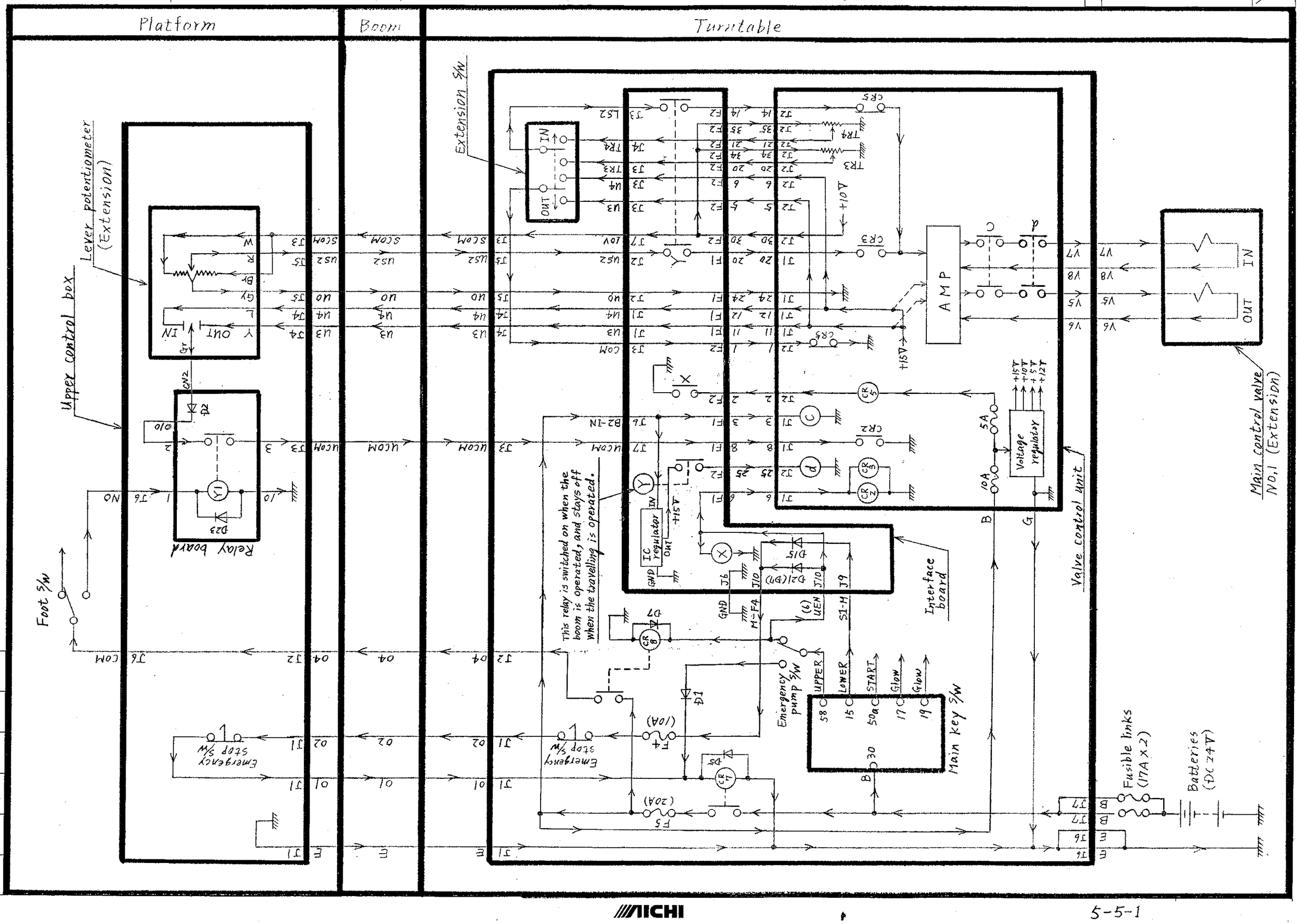
ROTATION SYSTEM

for Spec: A6 (S/N 655352 ~)
A8 ~



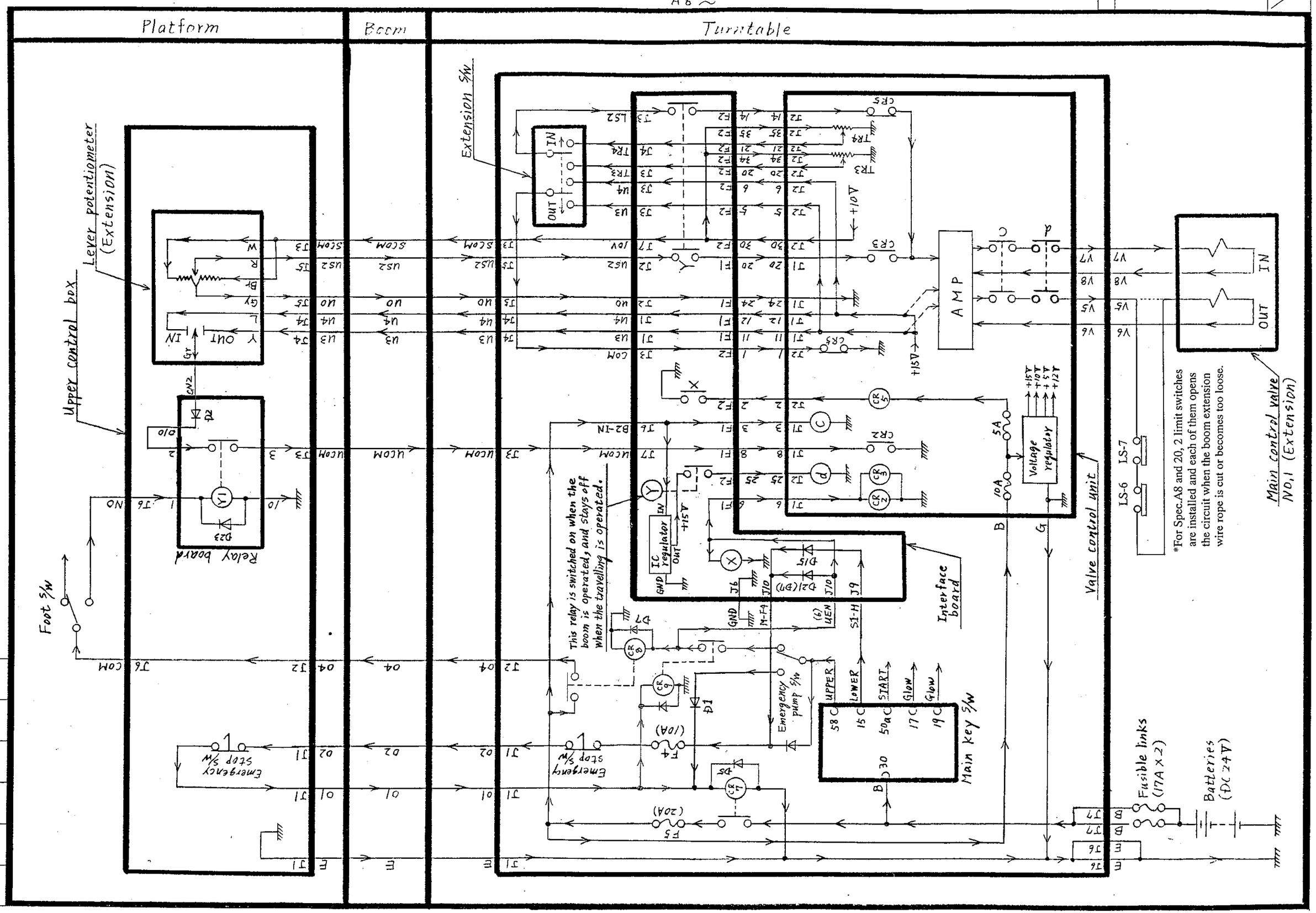
EXTENSION SYSTEM

for Spec : A6 (S/N 652319～655351)



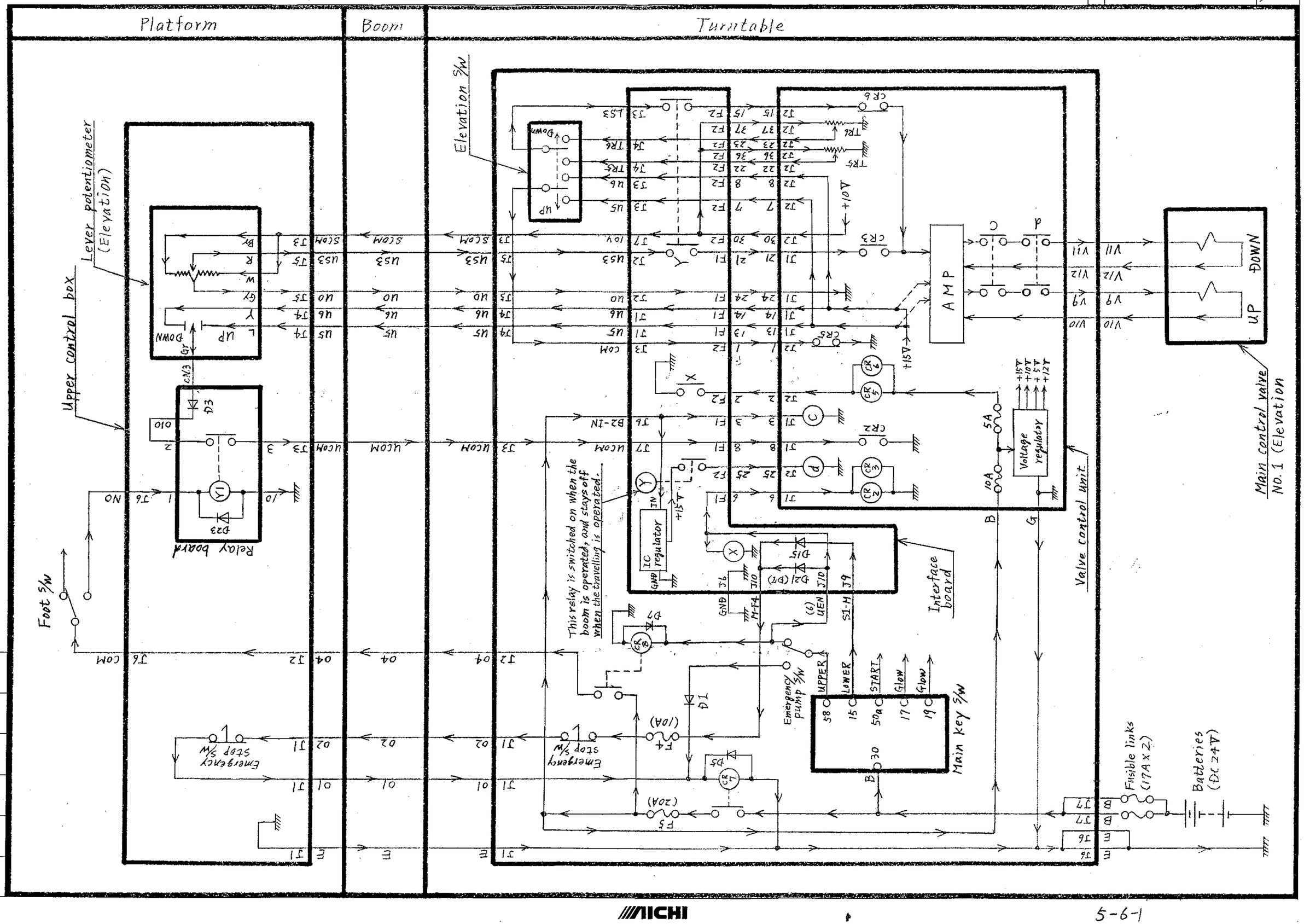
EXTENSION SYSTEM

for Spec : A6 (S/N 655352 ~)
A8 ~



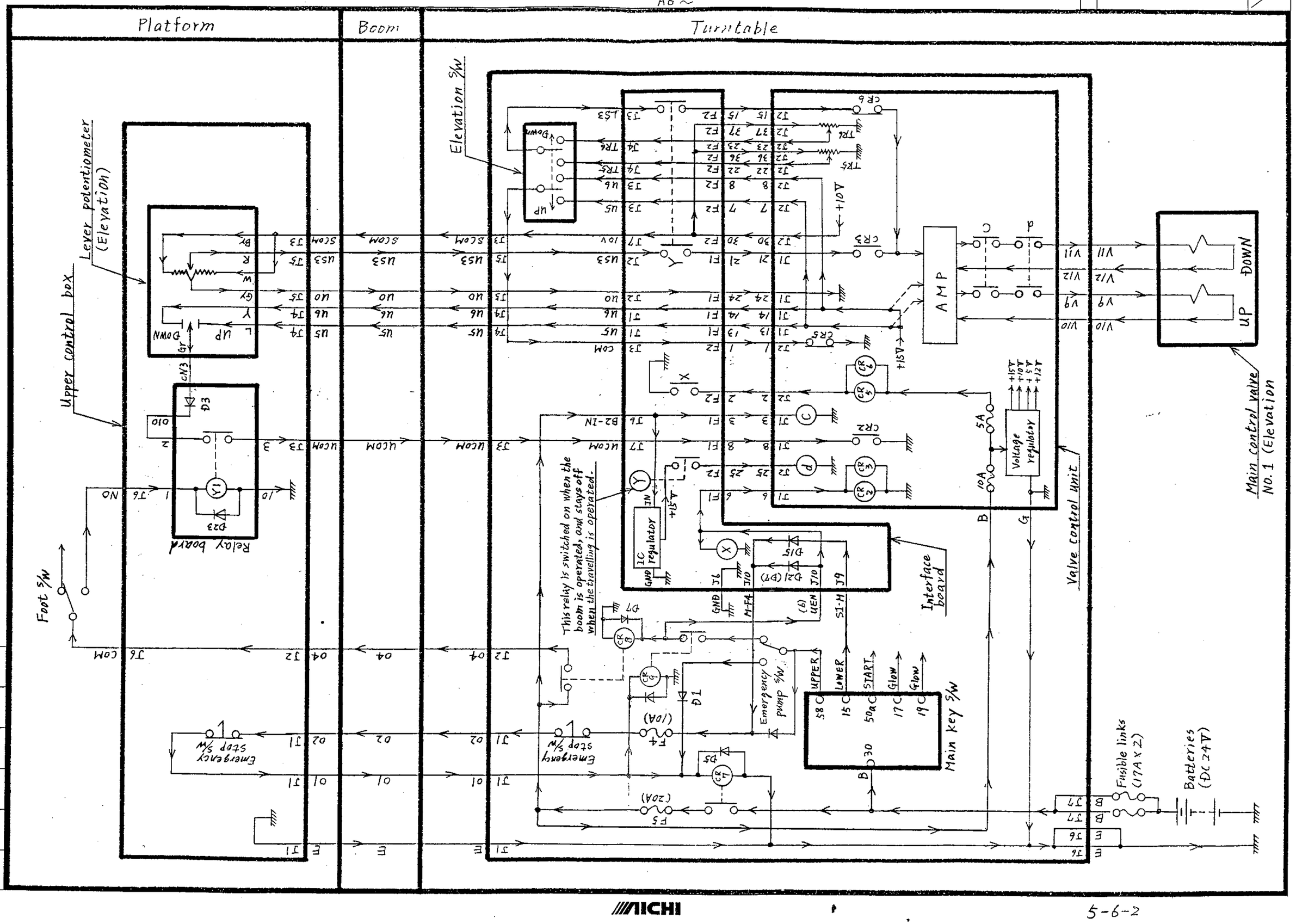
ELEVATION SYSTEM

for Spec : A6 (S/N 652319 ~ 655351)



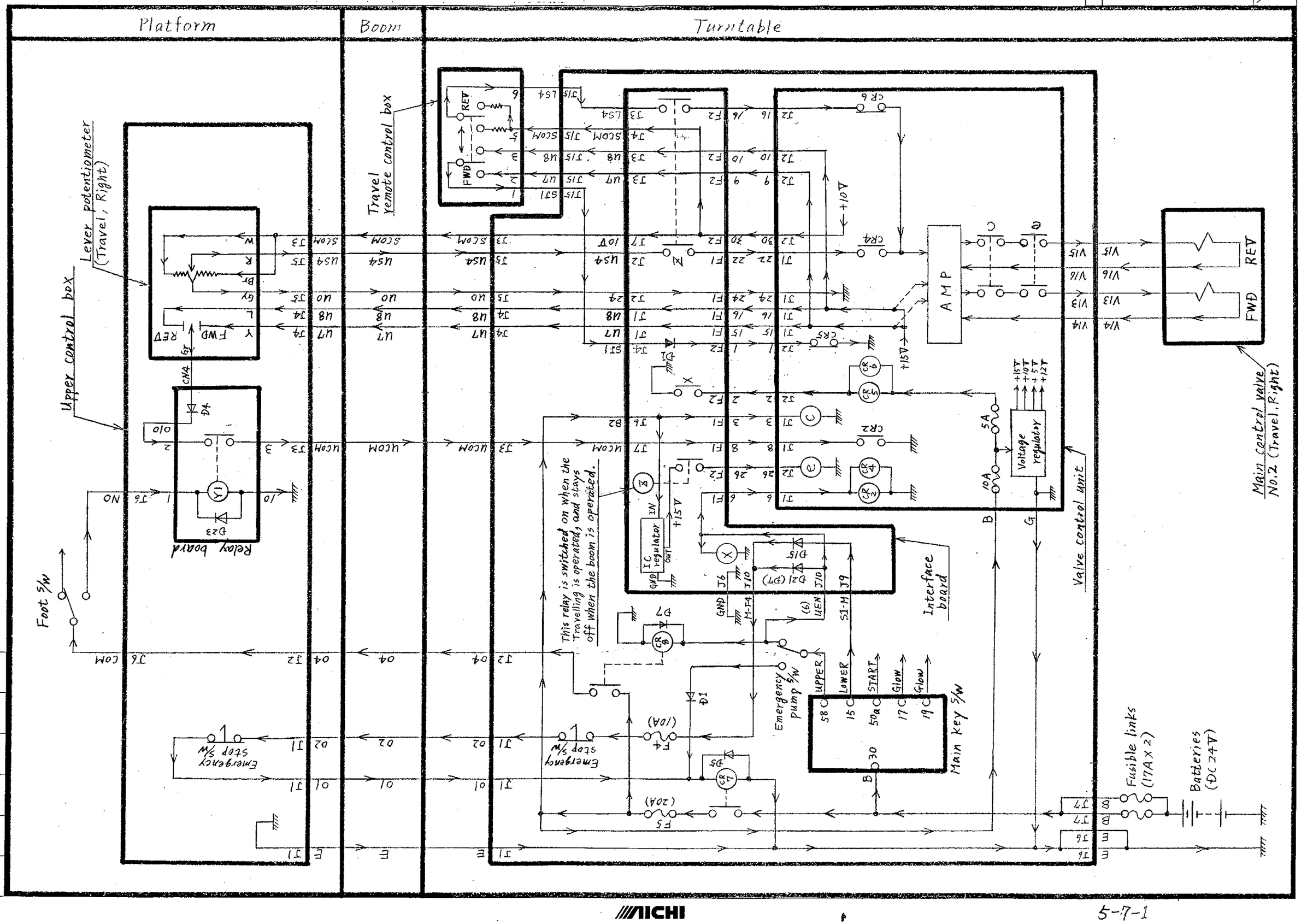
ELEVATION SYSTEM

for Spec : A6 (S/N 655352 ~)
A8 ~



TRAVEL (RIGHT) SYSTEM

for Spec: A6 (652319～655351)



TRAVEL (RIGHT) SYSTEM

for Spec: A6 (655352 ~)
A8 ~

Platform | Boom | Turntable

Upper control box
Lever potentiometer (Travel, Right)
Travel remote control box
Relay board
Foot S/W
Emergency stop S/W
Emergency stop S/W
This relay is switched on when the Travelling is operated, and stays off when the boom is operated.
Interface board
Emergency Pump S/W
Main key S/W
AMP
Voltage regulator
Valve control unit
Main control valve No.2 (Travel, Right)
Fusible links (17A x 2)
Batteries (DC 24V)
FWD
REV

TRAVEL (LEFT) SYSTEM

for Spec : A6 (652319 ~ 655351)

Platform

Boom

Turntable

Lever potentiometer (Travel, Left)

Upper control box

Relay board

Travel remote control box

Foot S/W

Emergency stop S/W

Emergency stop S/W

This relay is switched on when the travelling is operated, and stays off when the boom is operated.

IC regulator

Interface board

Emergency Pump S/W

Main key S/W

AMP

Voltage regulator

Valve control unit

Main control valve No.1 (Travel, Left)

Fusible links (17A x 2)

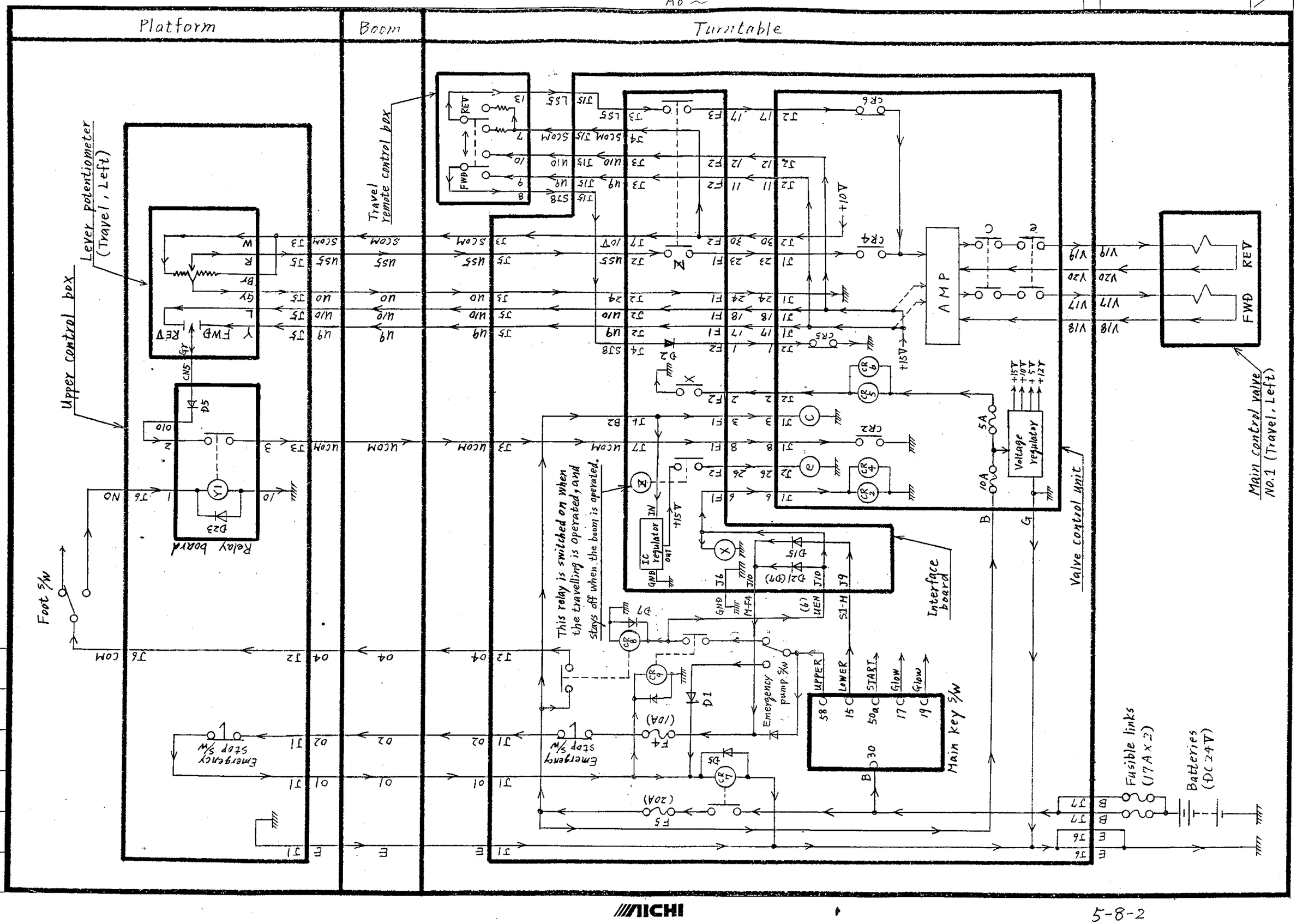
Batteries (DC 24V)

FWD

REV

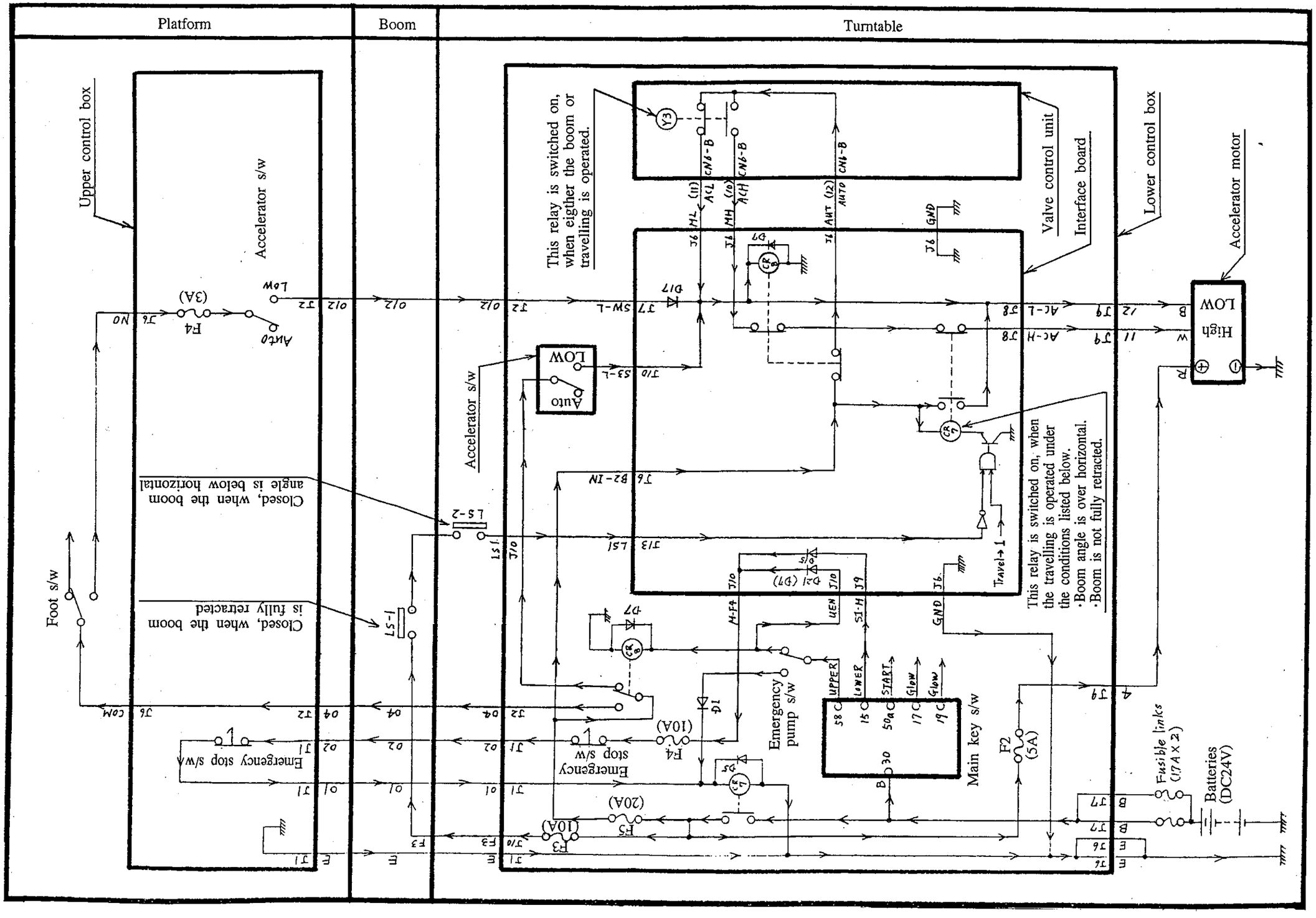
TRAVEL (LEFT) SYSTEM

for Spec : A6 (655352 ~)
A8 ~



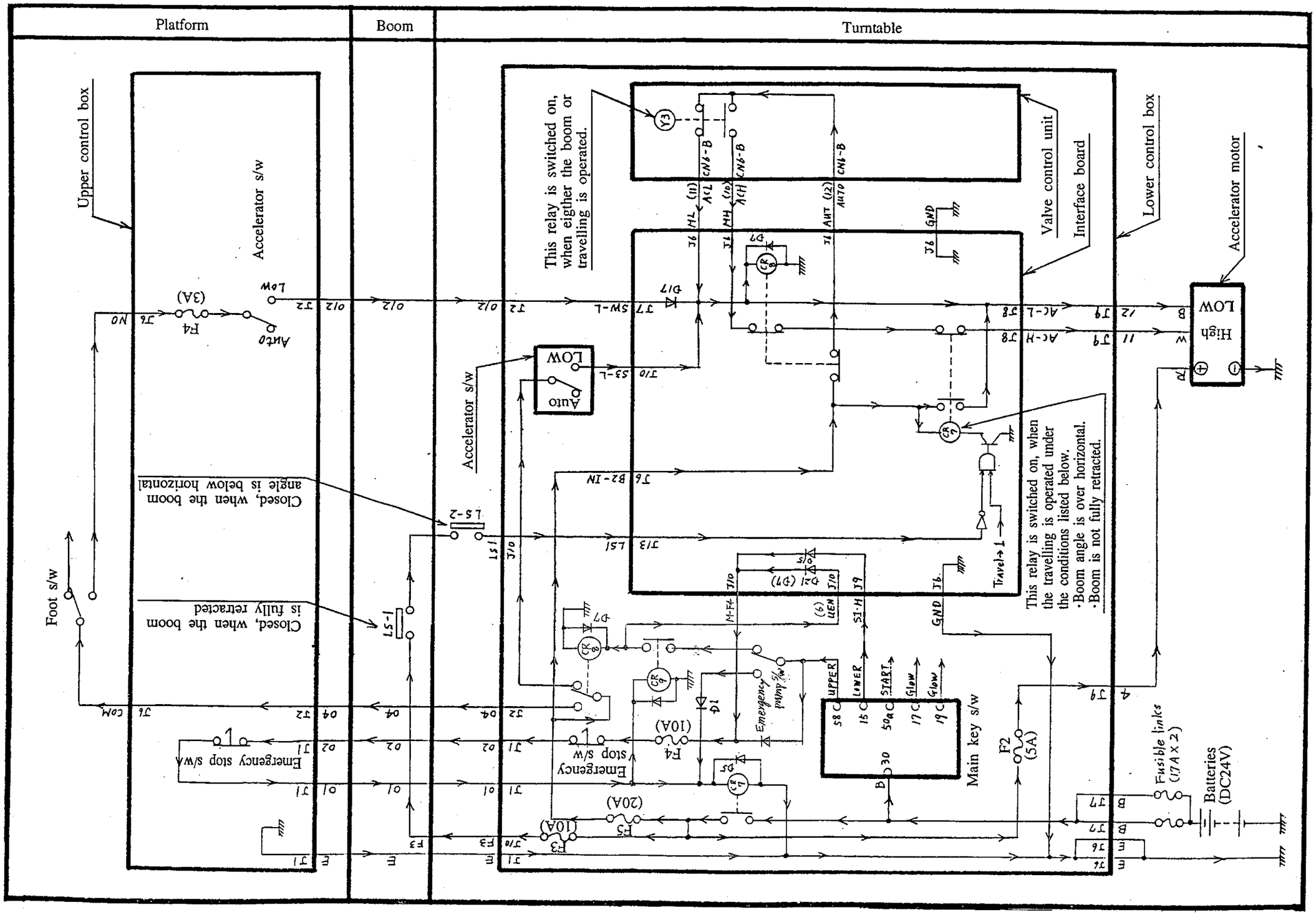
ACCELERATOR SYSTEM

for Spec: A6 (S/N 652319 ~ 655351)



ACCELERATOR SYSTEM

for Spec : A6 (S/N 655352 ~)



ACCELERATOR SYSTEM

for Spec : A8

Platform | Boom | Turntable

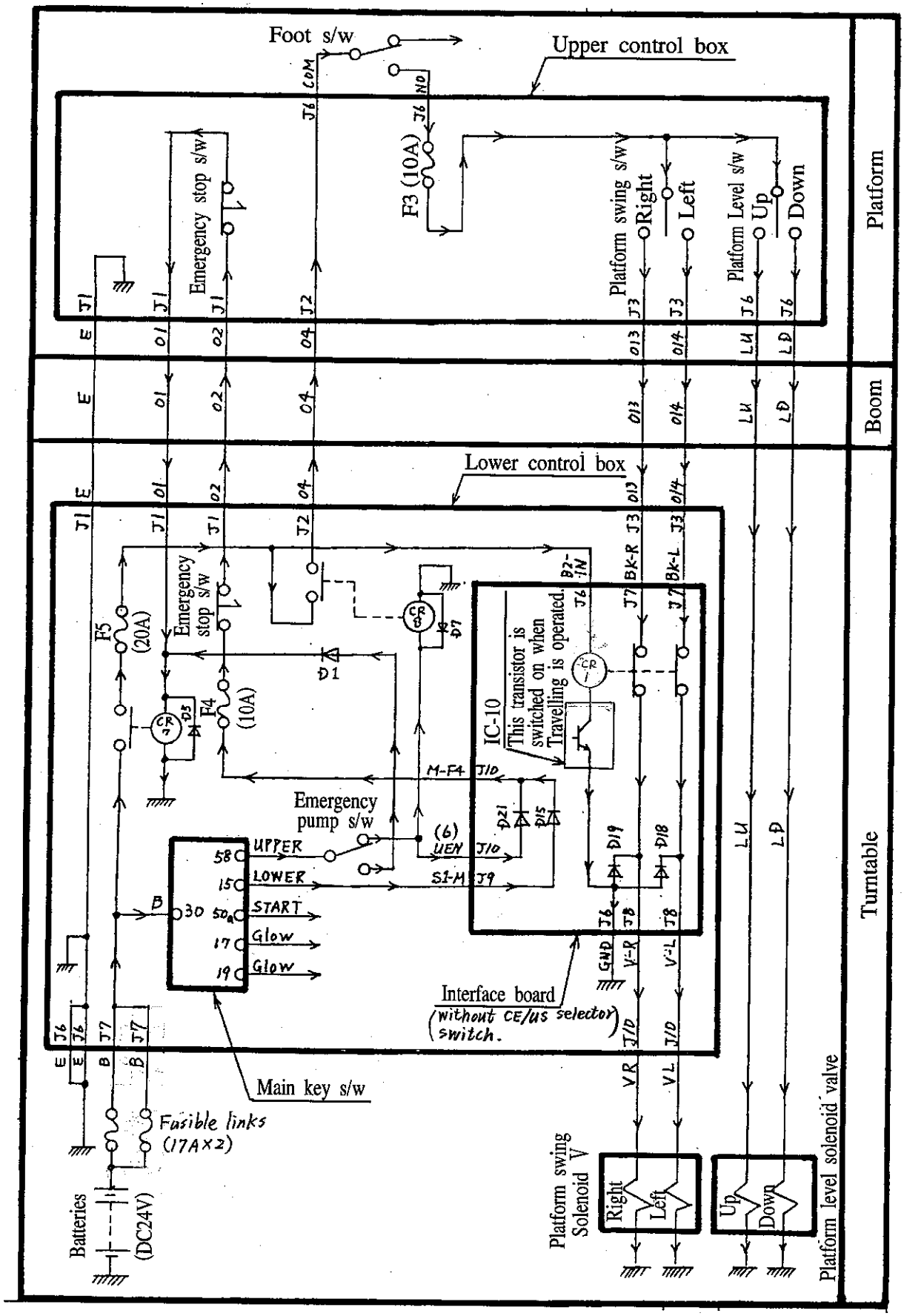
The Tr1 and Tr2 on ICs are switched on/off according to the various conditions as shown in the table below to control the engine speed (High or Low).

Position of Accelerator S/W	Status of boom	Operation performed	Tr1	Tr2	Engine speed
LOW	Any status	Boom / Travel	OFF / ON	OFF	LOW
AUTO	Any status	Boom	OFF	ON	HIGH
	Boom angle : Under the horizontal. (and) Boom length : Fully retracted.	Travel	ON	ON	HIGH
	Boom angle : Over the horizontal. (or) Boom length : Extended.	Travel	ON	OFF	LOW

Upper control box
Lower control box
Accelerator S/W
Accelerator motor
Interface board
Foot S/W
Opened, when the boom is extended.
Opened, when the boom angle is over horizontal.
Emergency stop S/W
Emergency pump S/W
Main key S/W
Boom operation signal
Travel operation signal
Fusible links (17A x 2)
Batteries (DC 24V)
ICs
Tr1
Tr2
LS1
LS2
F1 (10A)
F2 (5A)
F3 (10A)
F4 (3A)
F5 (20A)
D1
D7
D16
D17
CR1
CR4
CR6
CR7
SW-L
AC-L
AC-H
S3-L
B2-IN
M-F4
S1-H
GND
UPPER
LOWER
START
Glow
Glow
Auto
Low
High
Black
White
Red
COM
NO
NC

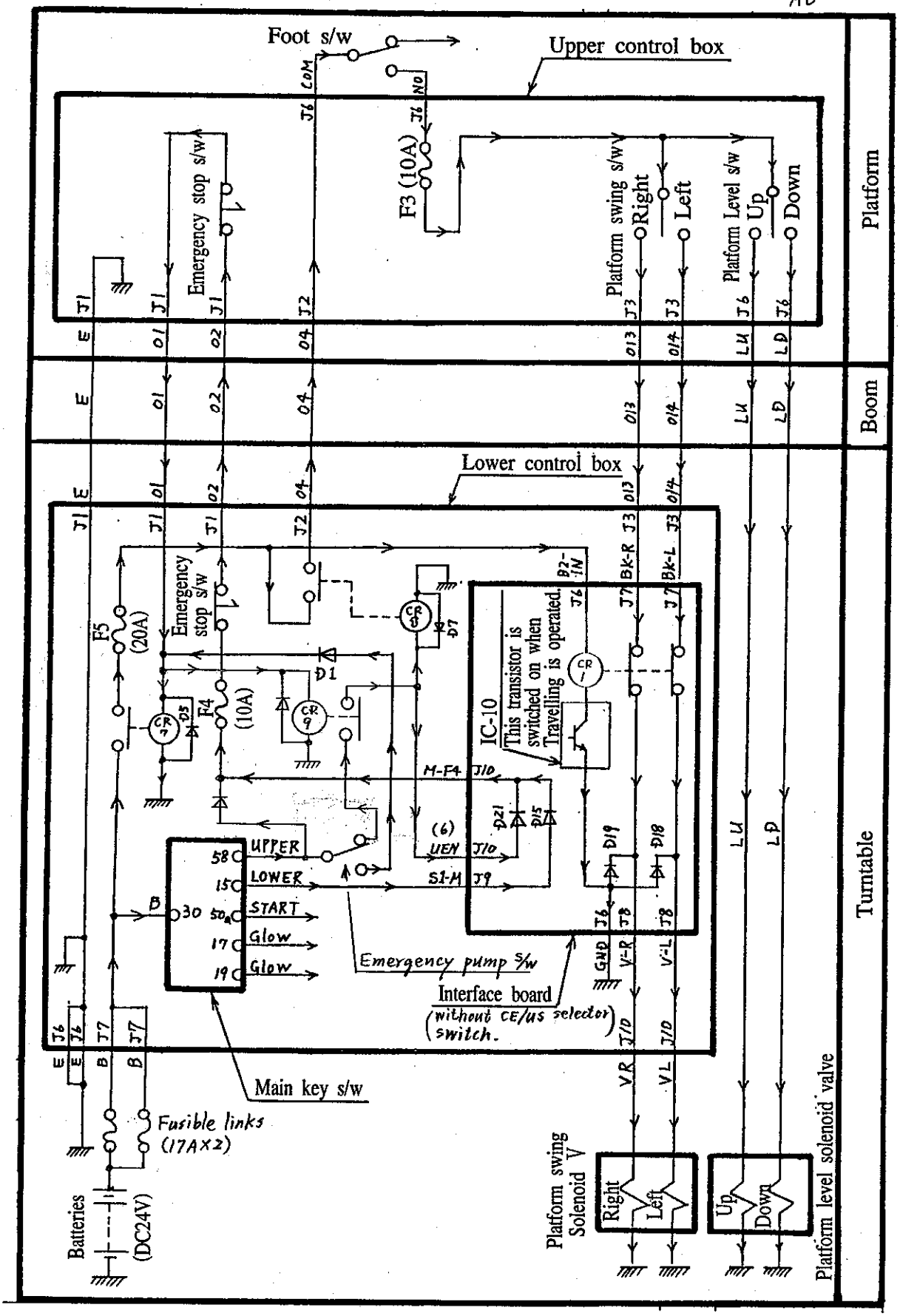
PLATFORM SWING, PLATFORM LEVEL SYSTEM

(for : Interface board without CE/us selector switch) for Spec:A6 (S/N 652319~655351)



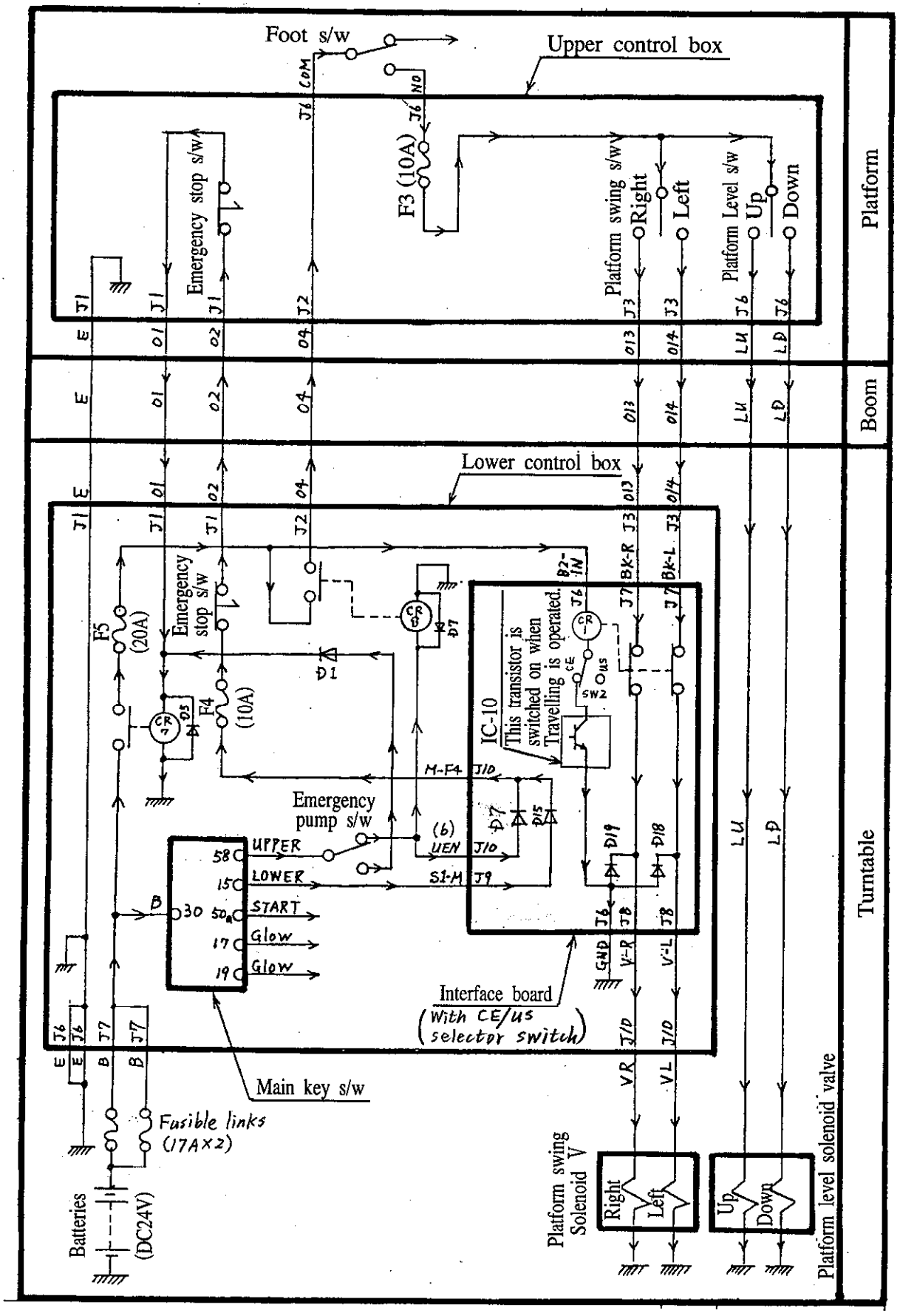
PLATFORM SWING, PLATFORM LEVEL SYSTEM

(for : Interface board without CE/us selector switch) for Spec : A6 (S/N 655352~) A8



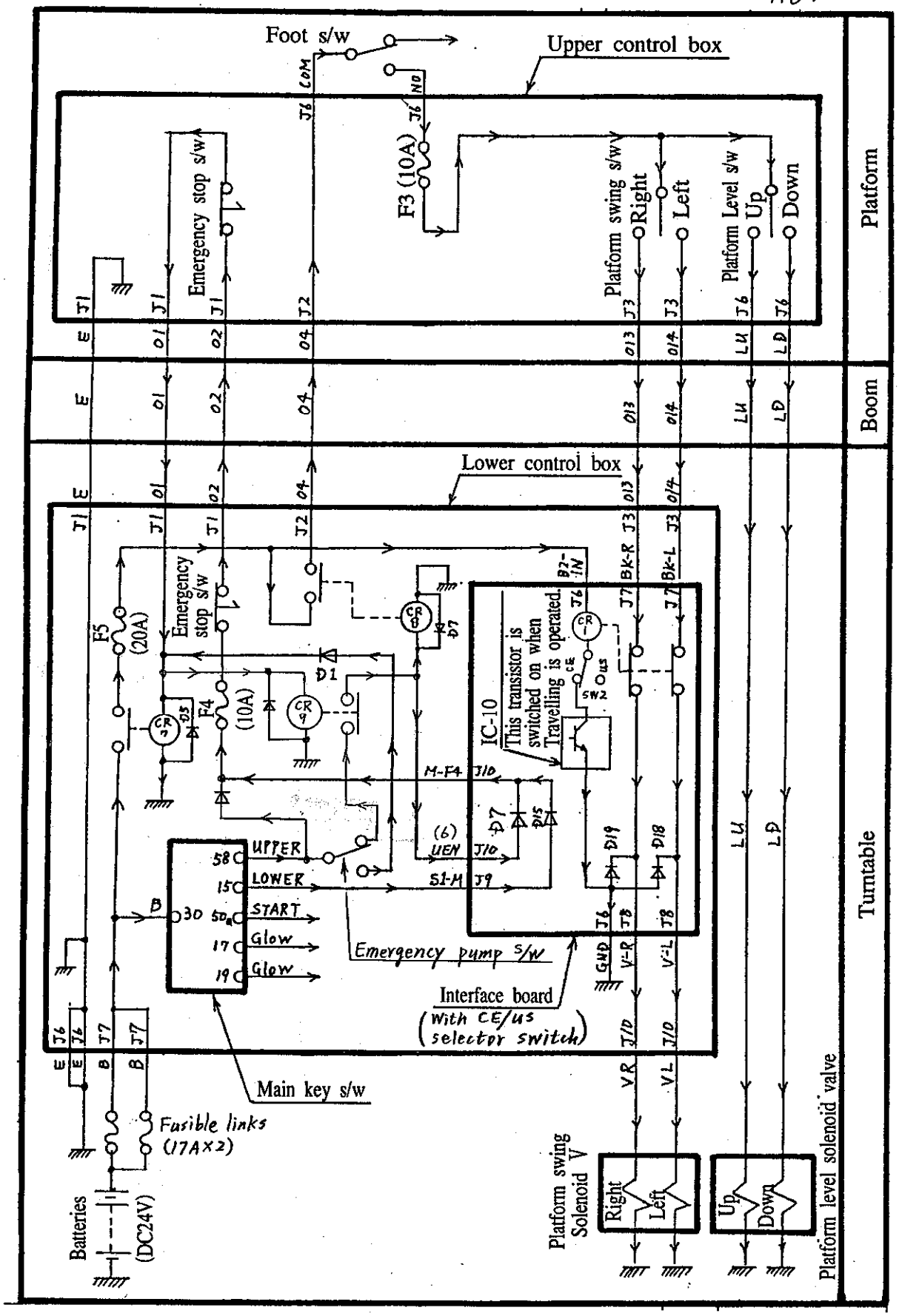
PLATFORM SWING, PLATFORM LEVEL SYSTEM

(for: Interface board with CE/US selector switch) for Spec:A6(S/N652319~655351)



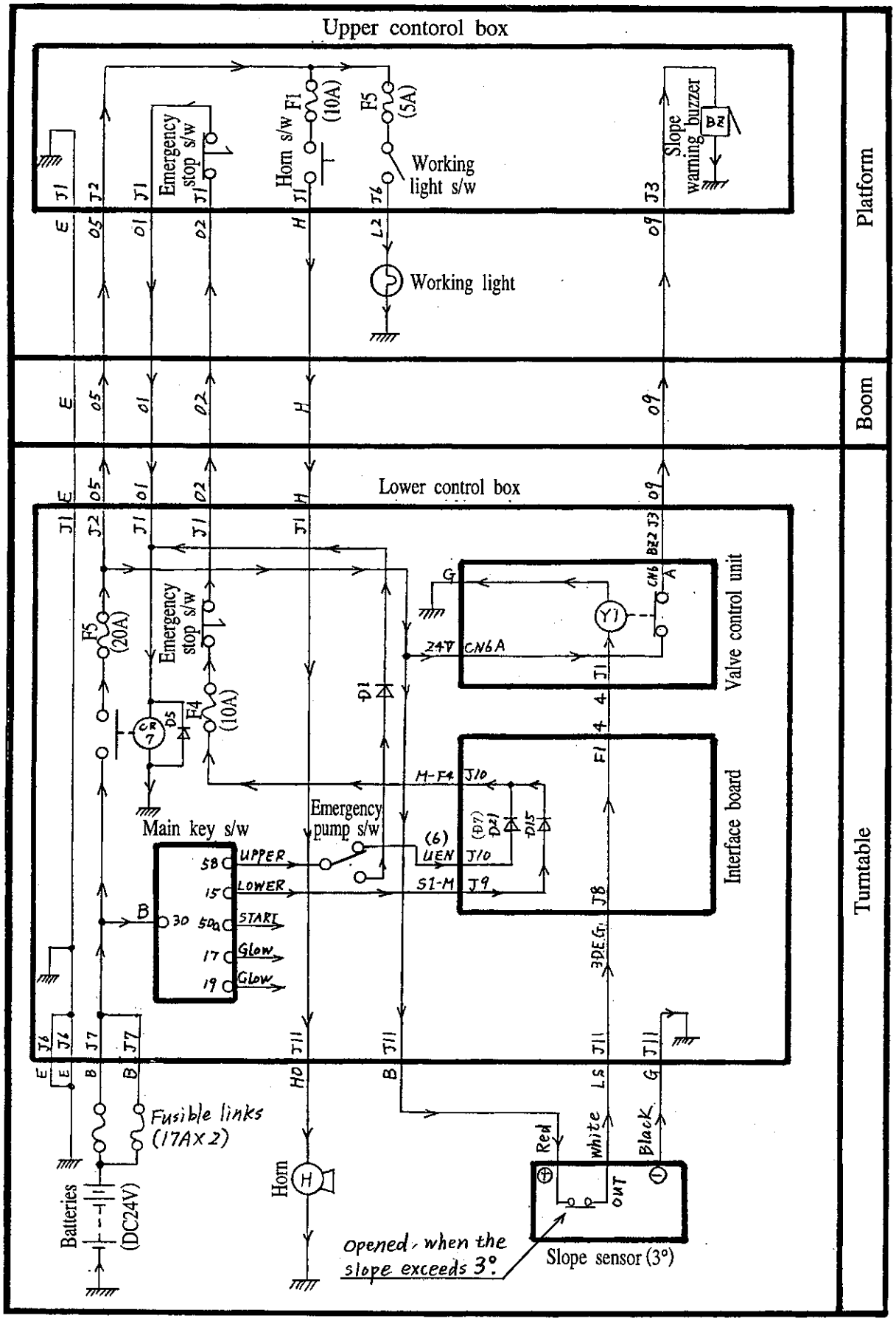
PLATFORM SWING, PLATFORM LEVEL SYSTEM

(for: Interface board with CE/US selector switch) for Spec: A6 (S/N 655352 ~)
A8 ~



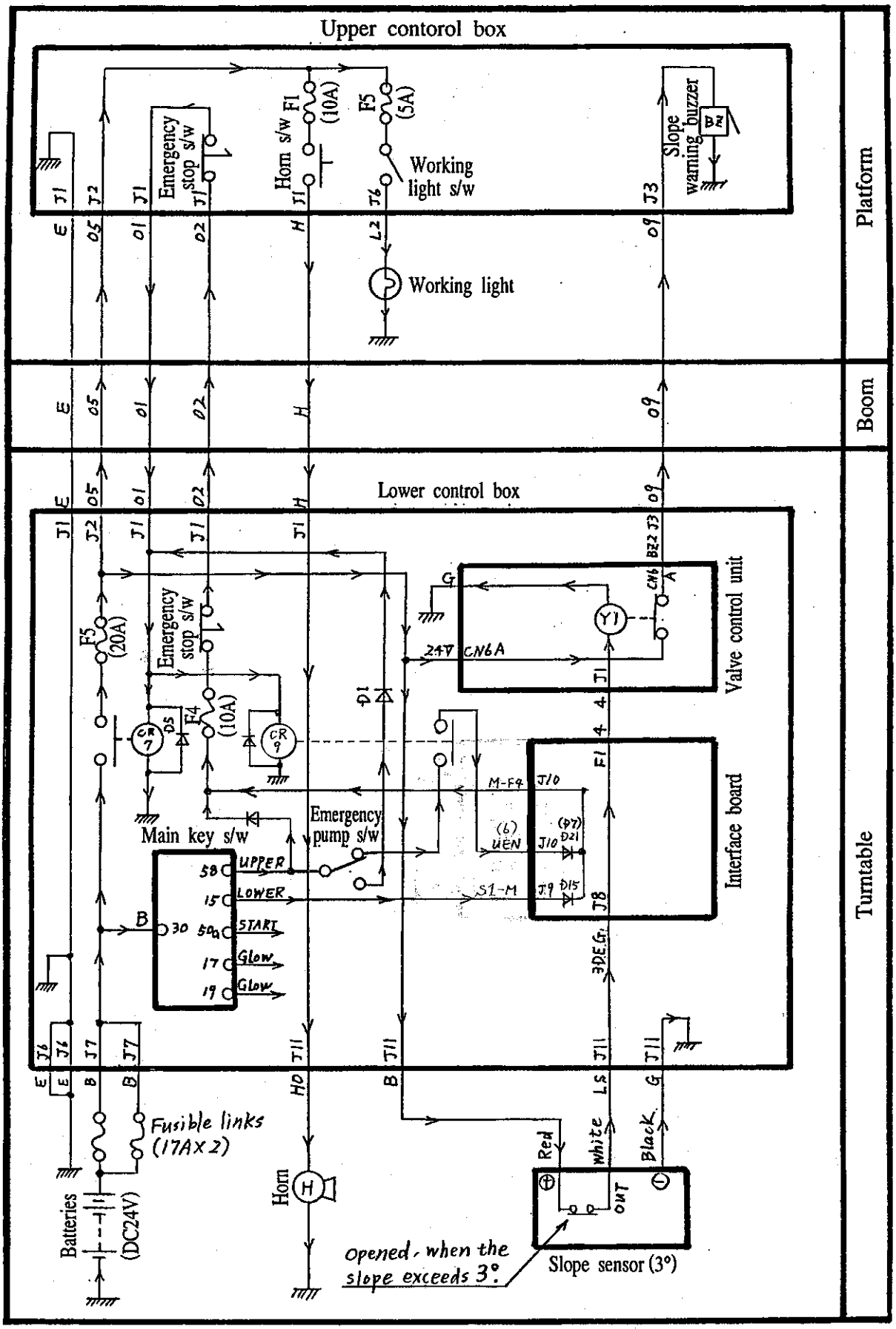
SLOPE WARNING, HORN and WORKING LIGHT SYSTEM

for Spec : A6 (S/N 652319 ~ 655351)



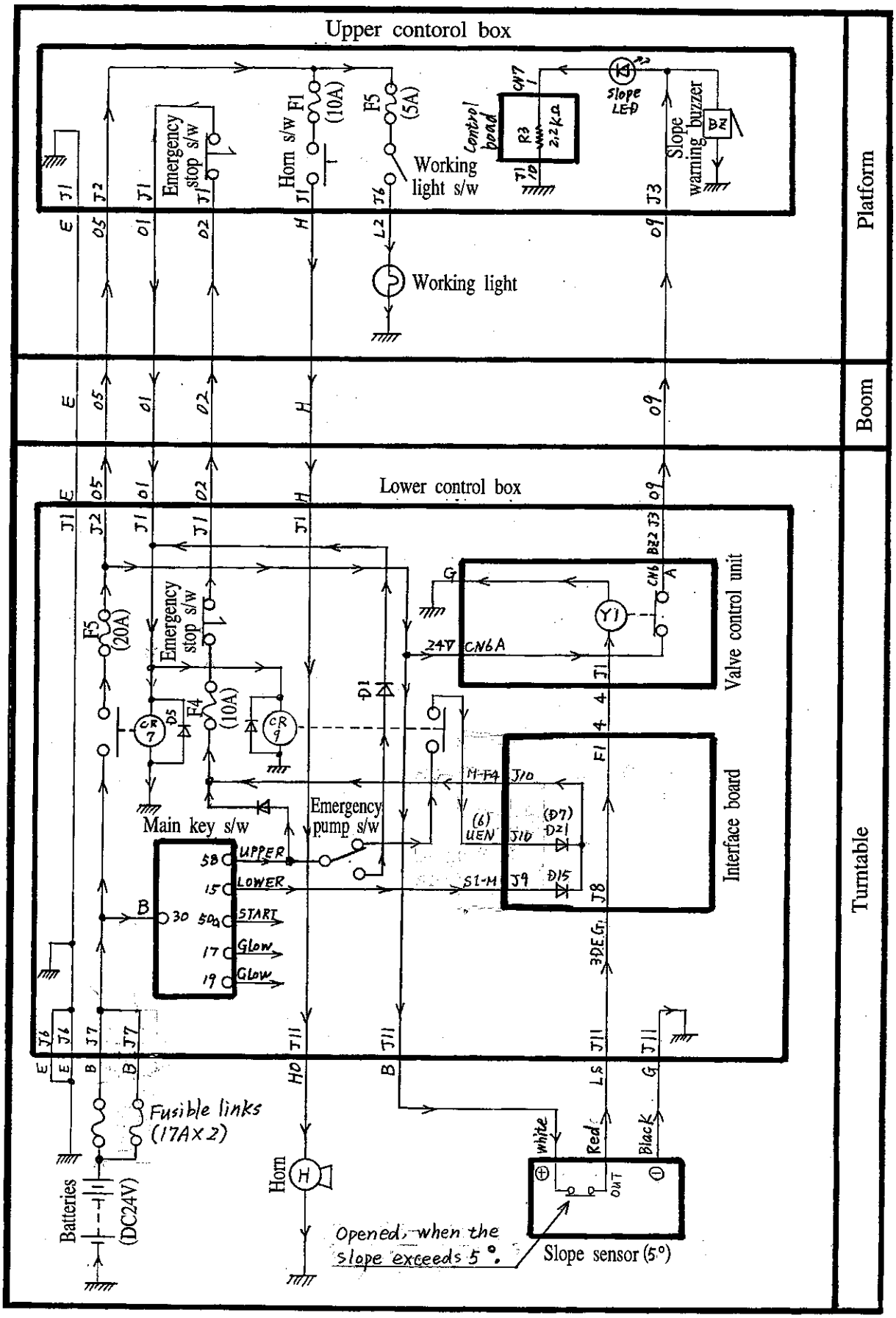
SLOPE WARNING, HORN and WORKING LIGHT SYSTEM

for Spec: A6 (S/N 655352 ~)



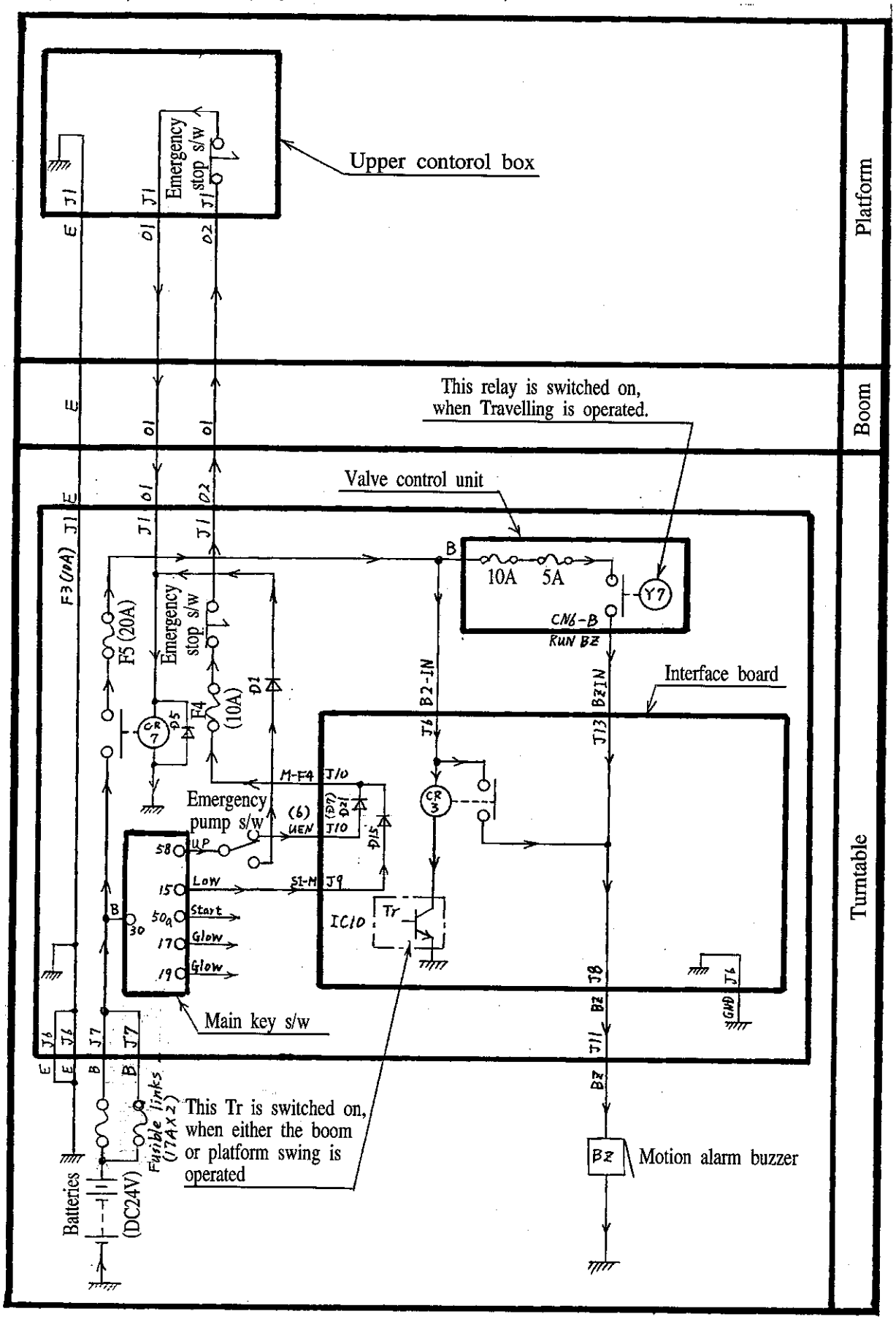
SLOPE WARNING, HORN and WORKING LIGHT SYSTEM

for Spec : A8 ~



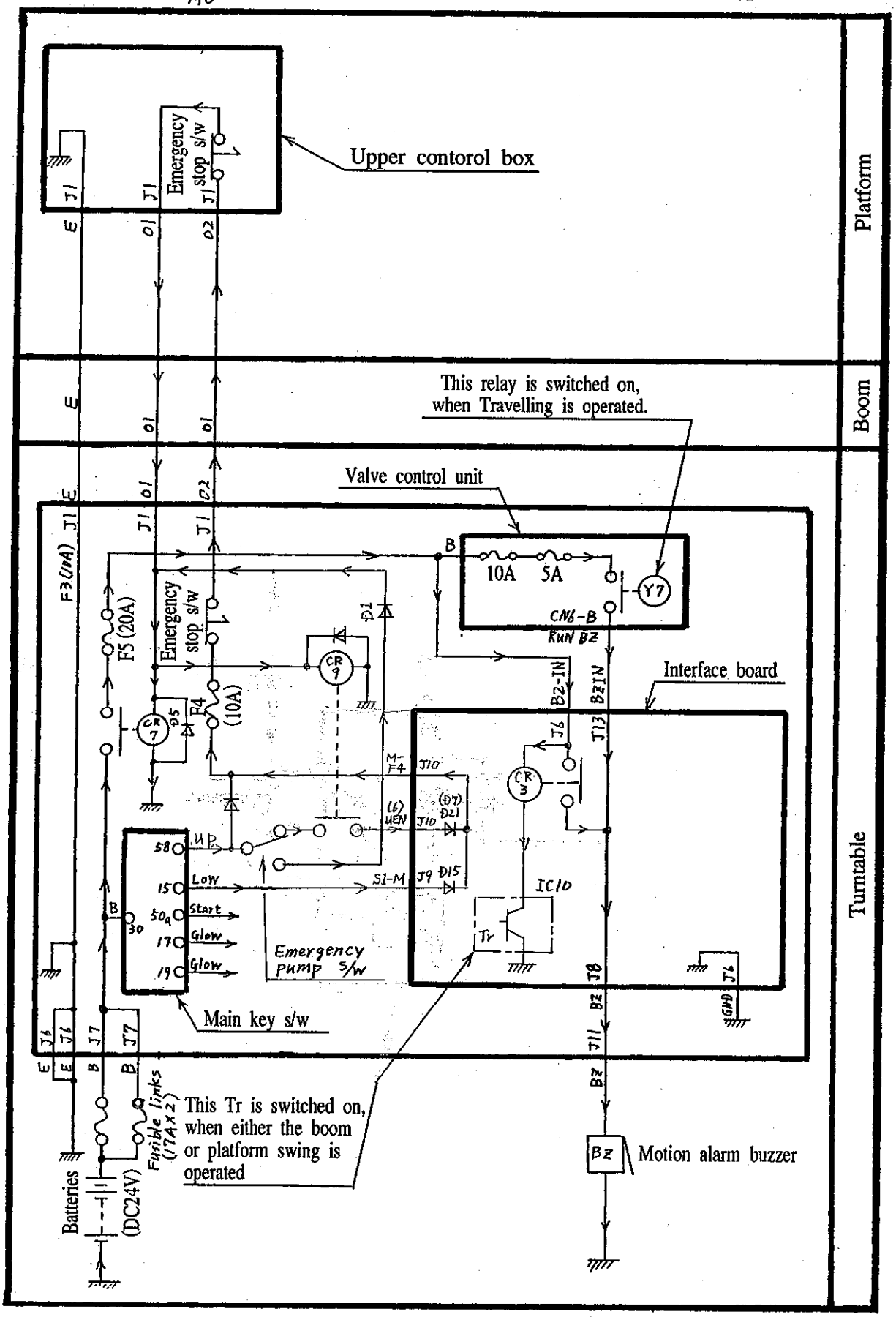
MOTION ALARM SYSTEM

for Spec : A6. (S/N 652319 ~ 655351)



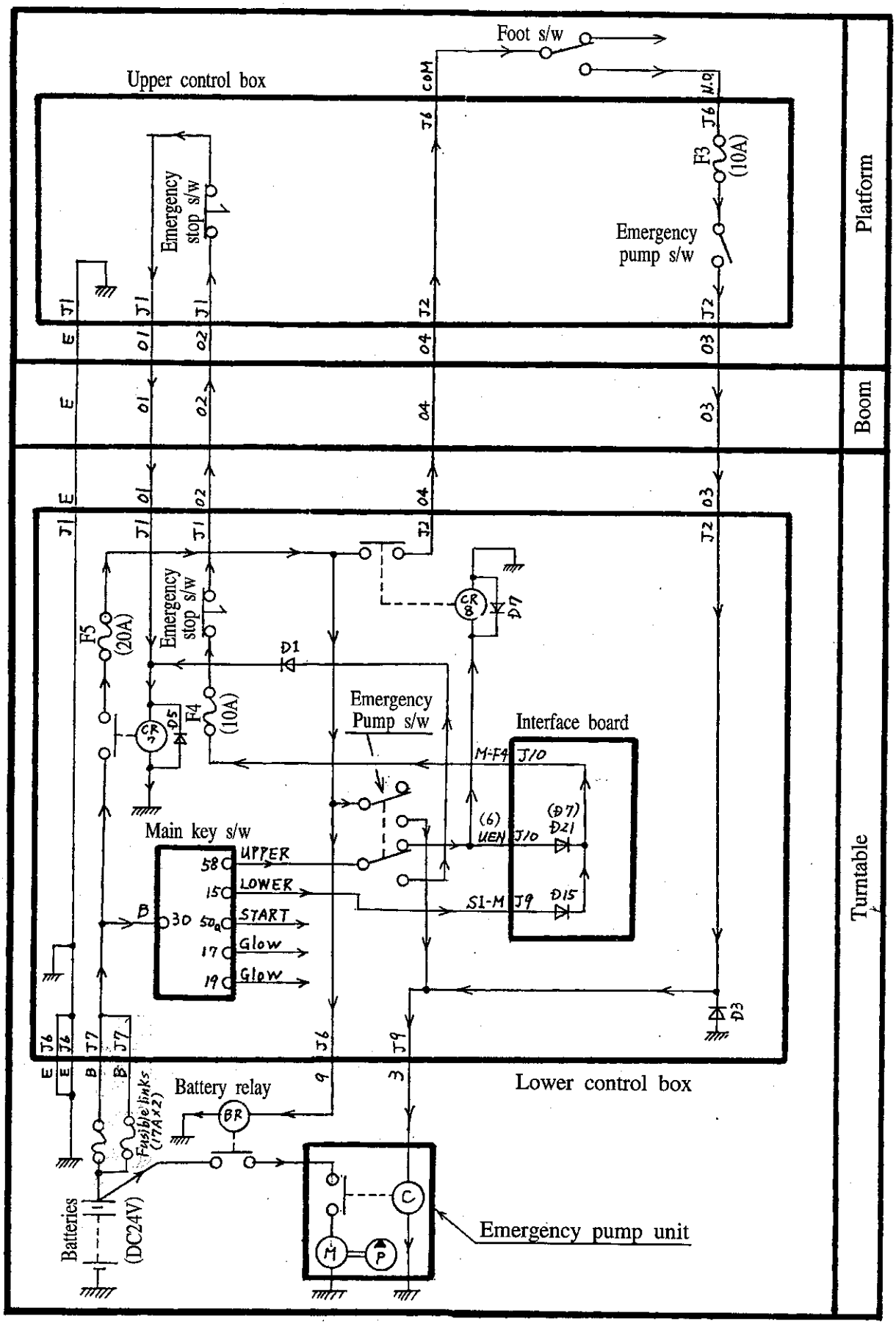
MOTION ALARM SYSTEM

for Spec : A6 (S/N 655352 ~)
A8



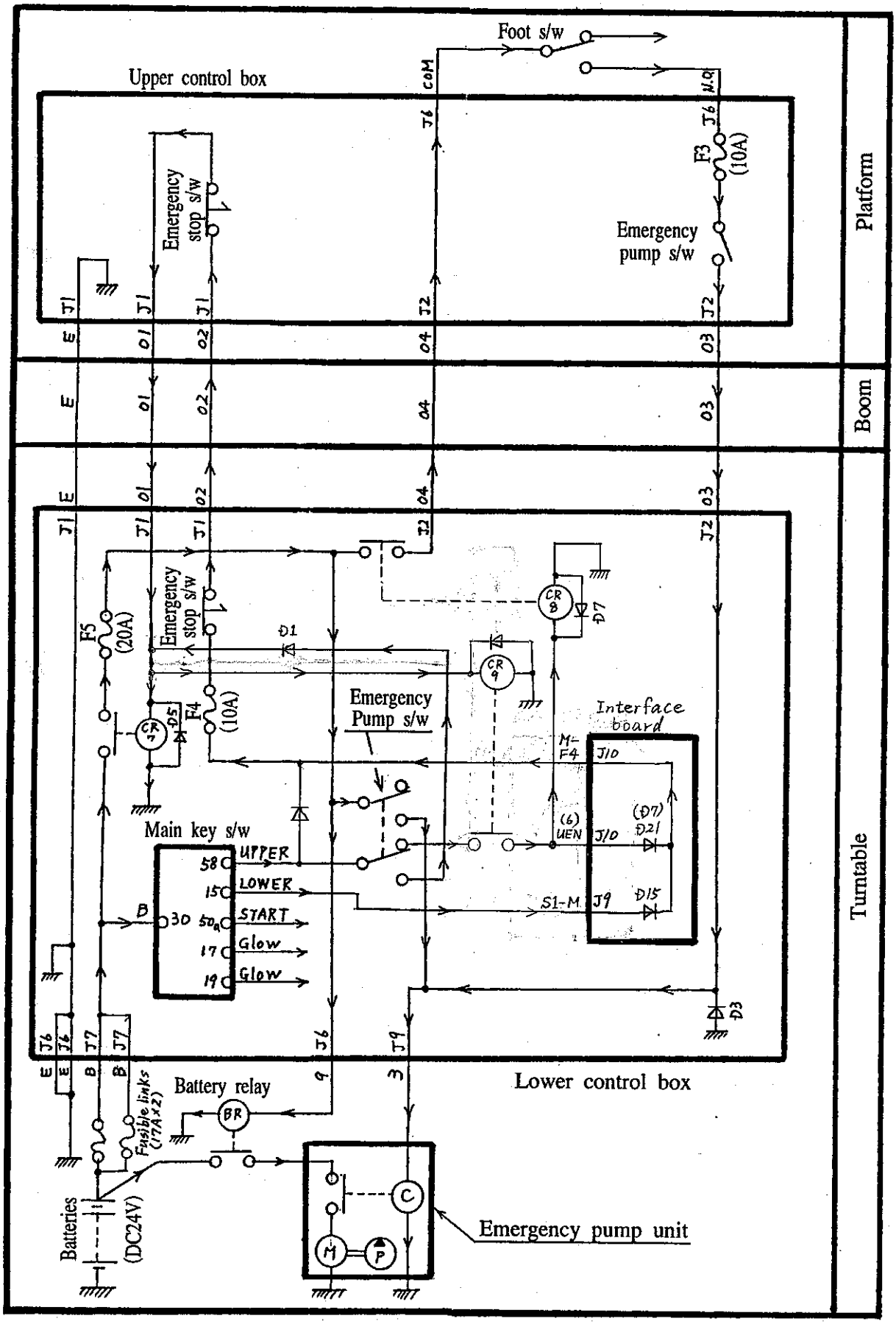
EMERGENCY PUMP SYSTEM

for Spec : A6 (S/N 652319 ~ 655351)



EMERGENCY PUMP SYSTEM

for Spec : A6 (S/N 655352 ~)
A8

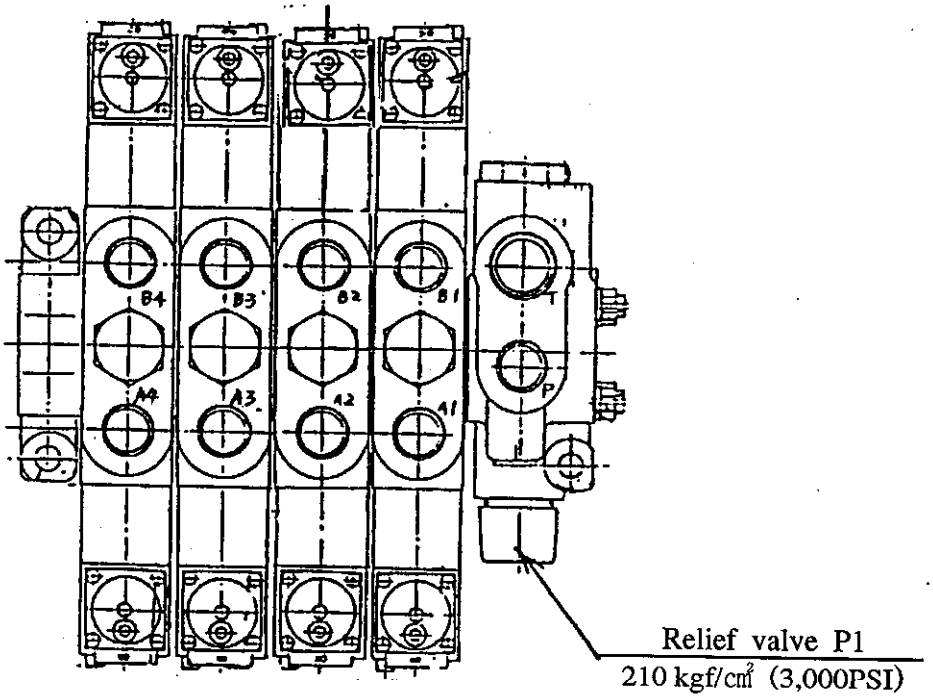


6
ADJUSTMENT SECTION

RELIEF VALVE P1

To adjust the preset pressure of the relief valve P1 which is installed on the main control valve No.1, take the following steps.

Preset pressure·····210$^{+5}_{0}$kgf/cm^2 (3,000$^{+70}_{0}$PSI)



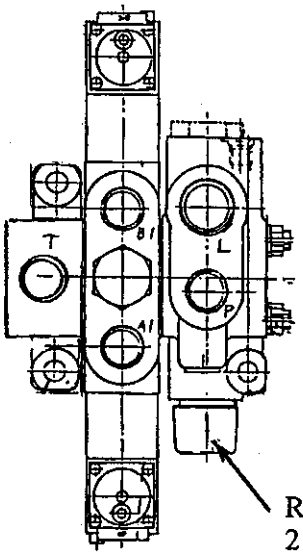
Main control valve NO.1

1. Remove the plug from the "Pressure test port" installed on the out-let line of Pump NO.1, and set a Pressure gauge onto the pressure test port.
2. Start engine, retract boom fully, and hold the Extension switch on "IN" to actuate the Relief valve P1.
3. Read the pressure gauge while the Relief valve P1 is active, and adjust the pressure to 210$^{+5}_{0}$kgf/cm^2 (3,000$^{+70}_{0}$PSI) by turning the Adjustment screw of relief valve P1.

RELIEF VALVE P2

To adjust the "Preset pressure" of Relief valve P2 installed on the Main control valve No.2, take the following steps.

Preset pressure·····210$^{+5}_{0}$kgf/㎠ (3,000$^{+70}_{0}$PSI)



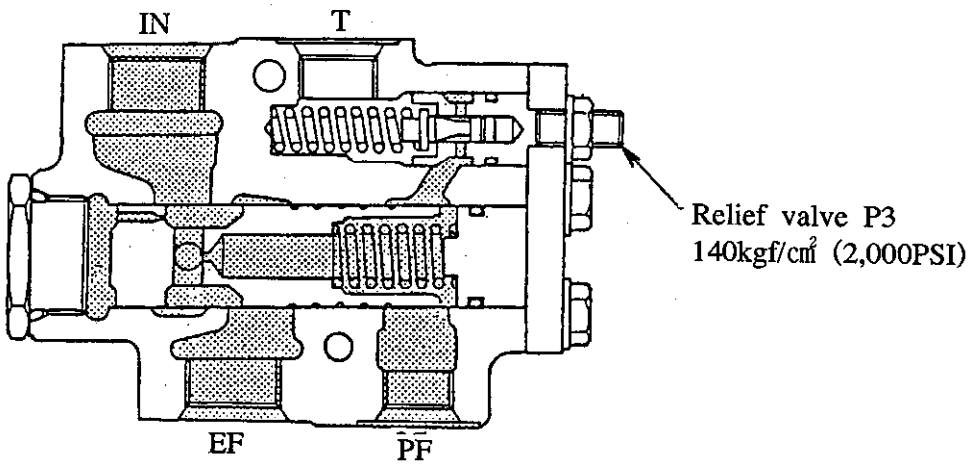
Main control valve NO.2

1. Remove the plug from the Pressure test port installed on the out - let line of Pump NO.2, and set a Pressure gauge onto the pressure test port.
2. Start engine, and insert something such as a Steel shaft between Drive sproket and the Track links on the right side travel motor to stop the rotation of travel motor.
3. Perform Travelling (Right) operation and actuate the Relief valve P2.
4. Read the pressure gauge while the Relief valve P2 is active, and adjust the pressure to 210$^{+5}_{0}$kgf/㎠ (3,000$^{+70}_{0}$PSI) by turning the adjustment screw of Relief valve P2.

RELIEF VALVE P3

To adjust the Preset pressure of Relief valve P3 installed on the Priority valve, take the following steps.

Preset pressure·····140^{+5}_{0} kgf/cm² ($2,000^{+70}_{0}$ PSI)



Priority valve

1. Remove the plug from the Pressure test port installed on the out - let line of Pump NO.2, and set a Pressure gauge onto the pressure test port.
2. Start engine, swing the Platform fully to the "Right", and hold the Platform swing switch at "Right" to actuate the Relief valve P3.
3. Read the Pressure gauge while Relief valve P3 is active, and adjust the pressure to 140^{+5}_{0} kgf/cm² ($2,000^{+70}_{0}$ PSI) by turning the Adjustment screw of Relief valve P3.

OPERATIONAL SPEED

The following conditions must be strictly kept, when measuring or adjusting the operational speed.

* Hydraulic pump speed :	2,300 rpm. (Without load)
* Maximum hydraulic pressure.	
for Main control system :	210 kg/㎠. (3,000 PSI)
for Sub control system :	140 kg/㎠. (2,000 PSI)
* Pump discharge volume :	More than 18 liters/min(4.76gals/min). (At pump speed : 1,000 rpm)
* Hydraulic oil temperature :	40°~ 60°C.
* Platform	No load condition.

1. Measurement procedures of "Maximum operational speed"

Take the following items into consideration, when measuring each Maximum operational speed.

*Measure each operational speed at least 3 times for the purpose of obtaining accurate data.

*Operate the control levers fully up to the stroke ends, when measuring the operational speed by functioning the upper control.

1. Elevation. (Boom raising "Up"/ lowering "DOWN" speed)
   Raise / lower the boom to its full stroke with the minimum boom length, and measure the boom raising "UP" and lowering "DOWN" speeds (seconds / stroke).
2. Extension (Boom extending "OUT" / retracting "IN" speed)
   Extend / retract the boom to its full stroke with the maximum boom angle, and measure the the boom extention "OUT" and retraction "IN" speeds (seconds / stroke).
3. Rotation. (Turn-table rotation speed)
   Rotate the Turn-table with the "minimum boom length" and the "maximum boom angle", and measure the turn-table rotation speed (seconds / rev).
4. Travelling. (Travelling speed straight)
   Travel the machine exactly 10 meters (10 yards) "Forward" and "REVERSE" on firm level ground, and measure the travelling speed (seconds / 10 meters, seconds / 10yards).
   NOTE : Travel the machine with the minimum boom length and with a boom angle which is less than horizontal.

5. Travelling Pivot turn speed.
   Perform "Pivot turn" to both Right and Left, and measure the "Pivot turn speed" (seconds/90°)
6. Travelling Spin turn speed.
   Perform "Spin turn" operation C.W. and C.C.W, and measure the "Spin turn speed" (seconds/90°)

2. Specific "Maximum operational speed"

Function		Direction	Upper control	Lower control
Elevation		UP	55 ± 7 sec/stroke	55 ± 7 sec/stroke
		DOWN	55 ± 7 sec/stroke	55 ± 7 sec/stroke
Extension		OUT	25 ± 5 sec/stroke	25 ± 5 sec/stroke
		IN	25 ± 5 sec/stroke	25 ± 5 sec/stroke
Rotation		C.W.	110 ± 5 sec/rev.	110 ± 15 sec/rev.
		C.C.W.	110 ± 5 sec/rev.	110 ± 15 sec/rev.
Travelling	Straight	FWD	24 ± 3 sec/10 meters (22 ± 3 sec/10 yards)	
		REV	24 ± 3 sec/10 meters (22 ± 3 sec/10 yards)	
	Pivot turn	Right	12 ± 3 sec/ 90°	
		Left	12 ± 3 sec/ 90°	
	Spin turn	C.W.	12 ± 3 sec/ 90°	
		C.C.W.	12 ± 3 sec/ 90°	

3. Adjustment procedures of Operational speed

Each operational speed for "Elevation", "Extension", "Rotation" and "Travelling" is adjusted by each "Trimmer" on the Valve control unit as follows.

NOTE : The locations of each "Trimmer" on the Valve control unit is shown in the clause of : Trimmer identification on valve control unit.

Adjustment is to be carried out in the following order

1. Minimum Operational speed.
2. Maximum Operational speed.
3. Adjustment of "Tr" trimmers
4. Adjustment of "Delay" trimmers
5. Adjustment of "Pivot" turn speed
6. Adjustment of "Spin" turn speed

1. Minimum operational speed

NOTE : The "Minimum" operational speed is obtained, when each Control lever is actuated slightly at the Upper control.

1. Start the machine and lower the platform close to the ground.
2. Stop engine and open the Lower control box.
   Then, set the Main key switch to the "UPPER" position.
3. Set a "Digital voltmeter" between each "PIN"⊕ on Valve control unit (listed below) and "Body earth" ⊖.

Function	Direction	Pin NO.
Elevation	UP	V10
	DOWN	V12
Extension	OUT	V6
	IN	V8
Rotation	C.W.	V2
	C.C.W.	V4
Travelling (Left)	FWD	V18
	REV	V20
Travelling (Right)	FWD	V14
	REV	V16

4. Move the Control lever slightly untill the "LED" indicator (Red) (on Valve control unit) turns on, and take the reading from the voltmeter.

NOTE : *The reading on the Digital voltmeter is the "NULL" voltage.
*Higher "NULL" voltage causes increased Minimum operational speed.
*The reference value for each "NULL" voltage is as shwon in the table below.

Function	Direction	NULL trimmer	"NULL voltage"
Elevation	UP	P9	0.32V
	DOWN	P11	0.32V
Extension	OUT	P5	0.32V
	IN	P7	0.32V
Rotation	C.W.	P1	0.32V
	C.C.W.	P3	0.32V
Travelling (Left)	FWD	P17	0.32V
	REV	P19	0.32V
Travelling (Right)	FWD	P13	0.32V
	REV	P15	0.32V

Caution : When checking or adjusting "NULL" voltage for Travelling, operate both of the Travel control levers "Right" and "Left" slightly in the same direction.

5. Adjust each "NULL" trimmer (listed above), so that each hydraulic actuator is about to move, when each Control lever is actuated slightly.
   NOTE : To increase the "NULL" voltage or "Minimum" operational speed, turn each "NULL" trimmer clockwise.

2. Maximum operational speed

NOTE : The "Maximum" operational speed is obtained, when each Control lever is actuated fully at the Upper control.

1. Start the machine and lower the platform close to the ground.
2. Stop the engine, and open the Lower control box.
   Then, set the Main key switch to the "UPPER" position.
3. Set a "Digital voltmeter" between each "PIN"⊕ on Valve control unit (listed below) and "Body earth"⊖.

Function	Direction	"Pin" NO.
Elevation	UP	V10
	DOWN	V12
Extension	OUT	V6
	IN	V8
Rotation	C.W.	V2
	C.C.W.	V4
Travelling (Left)	FWD	V18
	REV	V20
Travelling (Right)	FWD	V14
	REV	V16

4. Operate the Control lever fully and take the reading from the voltmeter.
   NOTE : * The reading on the Digital voltmeter is the "GAIN" voltage.
   * Higher "GAIN voltage" causes increased Maximum operational speed.
   * The reference value for each "GAIN" voltage is as shown in the table below.

Function	Direction	GAIN trimmer	GAIN voltage
Elevation	**UP**	P10	0.53v
	DOWN	P12	0.55v
Extension	**OUT**	P6	0.49v
	IN	P8	0.50v
Rotation	**C.W**	P2	0.47v
	C.C.W	P4	0.47v
Travelling (Right)	**FWD**	P14	0.56v
	REV.	P16	0.56v
Travelling (Left)	**FWD**	P18	0.56v
	REV.	P20	0.56v

   Caution : When checking or adjusting "NULL" voltage for Travelling, operate both of the Travel control levers fully in the same direction.

5. Adjust each "GAIN" trimmer (listed in the table above), so that the each "Maximum" operational speed becomes a Specific value.
   NOTE : * To increase the "GAIN" voltage or "Maximum" operational speed, turn each "GAIN" trimmer clockwise.

3. Adjustment of "Tr trimmers"

The "Tr" trimmers are adjusted to vary the "Maximum" operational speed which is obtained by actuating the "Control switches" at Lower control. Follow the descriptions below to adjust the speed.

1. Stop engine, and open the Lower control box.
   Then, set the Main key switch to the "LOWER" position.
2. Set a "Digital voltmeter" between each "Pin⊕" on valve control unit (listed below) and Body earth ⊖.

Function	Direction	"Pin" NO.
Elevation	UP	V10
	DOWN	V12
Extension	OUT	V6
	IN	V8
Rotation	C.W.	V2
	C.C.W.	V4

3. Operate the each Control switch at Lower control box, and take the reading from the voltmeter.
   NOTE : The reading on the Digital voltmeter is the "Out put" voltage of valve control unit.
4. Turn the each "Tr" trimmer (listed in the table below) to adjust the speed.
   NOTE : *An increase to the output voltage causes an increase to the speed.
   *To increase the Out put voltage, turn each "Tr" trimmer clockwise.

Function	**Direction**	**Tr trimmer No.**	**Output voltage**
Elevation	**UP**	Tr 5	0.53 v
	DOWN	Tr 6	0.55 v
Extension	**OUT**	Tr 3	0.49 v
	IN	Tr 4	0.50 v
Rotation	**C.W**	Tr 1	0.47 v
	C.C.W	Tr 2	0.47 v

4. Adjustment of "DELAY trimmers".

The "DELAY" trimmers can be adjusted to start or stop each operation more gradually, or quickly.

Function		Delay trimmer	
Elevation	UP	UP	VR 13
		DOWN	VR 14
	DOWN	UP	VR 16
		DOWN	VR 17
Extension	OUT	UP	VR 7
		DOWN	VR 8
	IN	UP	VR 10
		DOWN	VR 11
Rotation	C.W.	UP	VR 1
		DOWN	VR 2
	C.C.W.	UP	VR 4
		DOWN	VR 5
Travelling (Left)	FWD	UP	VR 25
		DOWN	VR 26
	REV	UP	VR 28
		DOWN	VR 29
Travelling (Right)	FWD	UP	VR 19
		DOWN	VR 20
	REV	UP	VR 22
		DOWN	VR 23

NOTE :

* To start each function more gradually, turn the each Delay trimmer "UP" clockwise.

* To stop each function more gradually, turn the each Delay trimmer "DOWN" clockwise.

Adjustment of DITHER trimmers.

The "DITHER" trimmers are adjusted to give the correct "Vibration" to the "Output power" of Valve control unit.

NOTE : Do not adjust the "Dither" trimmers, as they have been precisely adjusted by the manufacturer.

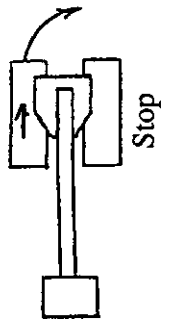
Function	Dither trimmer
Elevation	VR - 33
Extension	VR - 32
Rotation	VR - 31
Travelling (Left)	VR - 35
Travelling (Right)	VR - 34

5. Adjustment of "Pivot turn" speed

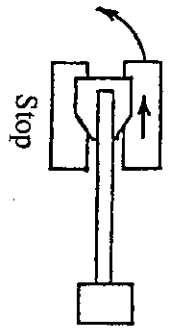
The "Pivot turn" speed is adjusted by the trimmers installed on the Valve control unit as follows.

Caution : The Pivot turn speed should be adjusted after having adjusted "Straight travelling speed".
The main key switch is to be set at its "UPPER" position, when adjusting the pivot turn speed.

1. Pivot Turn (Right)

NO.	Adjustment procedures	Remarks
1.	Set a Digital volt-meter between the "Check pin (TP - D)"⊕ on Valve control unit and "GND"⊖.	 Pivot turn (Right)
2.	Operate the "Travel lever (Left)" fully to "FWD", and read the voltmeter. Voltage (reference) 6.2V	
3.	Adjust the voltage by Trimmer (VR37). (The higher voltage causes the faster pivot turn speed.) Specific pivot turn speed ..... 12 ± 3 sec/90°	

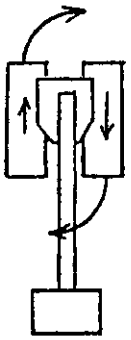
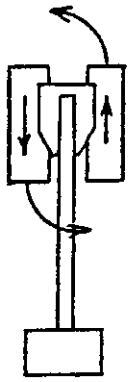
2. Pivot Turn (Left)

NO.	Adjustment procedures	Remarks
1.	Set a Digital volt-meter between the "Check pin (TP - C)"⊕ on Valve control unit and "GND"⊖.	 Pivot turn (Left)
2.	Operate the "Travel lever (Right)" fully to "FWD", and read the voltmeter. Voltage (reference) 6.2V	
3.	Adjust the voltage by Trimmer (VR36). (The higher voltage causes the faster pivot turn speed.) Specific pivot turn speed ..... 12 ± 3 sec/90°	

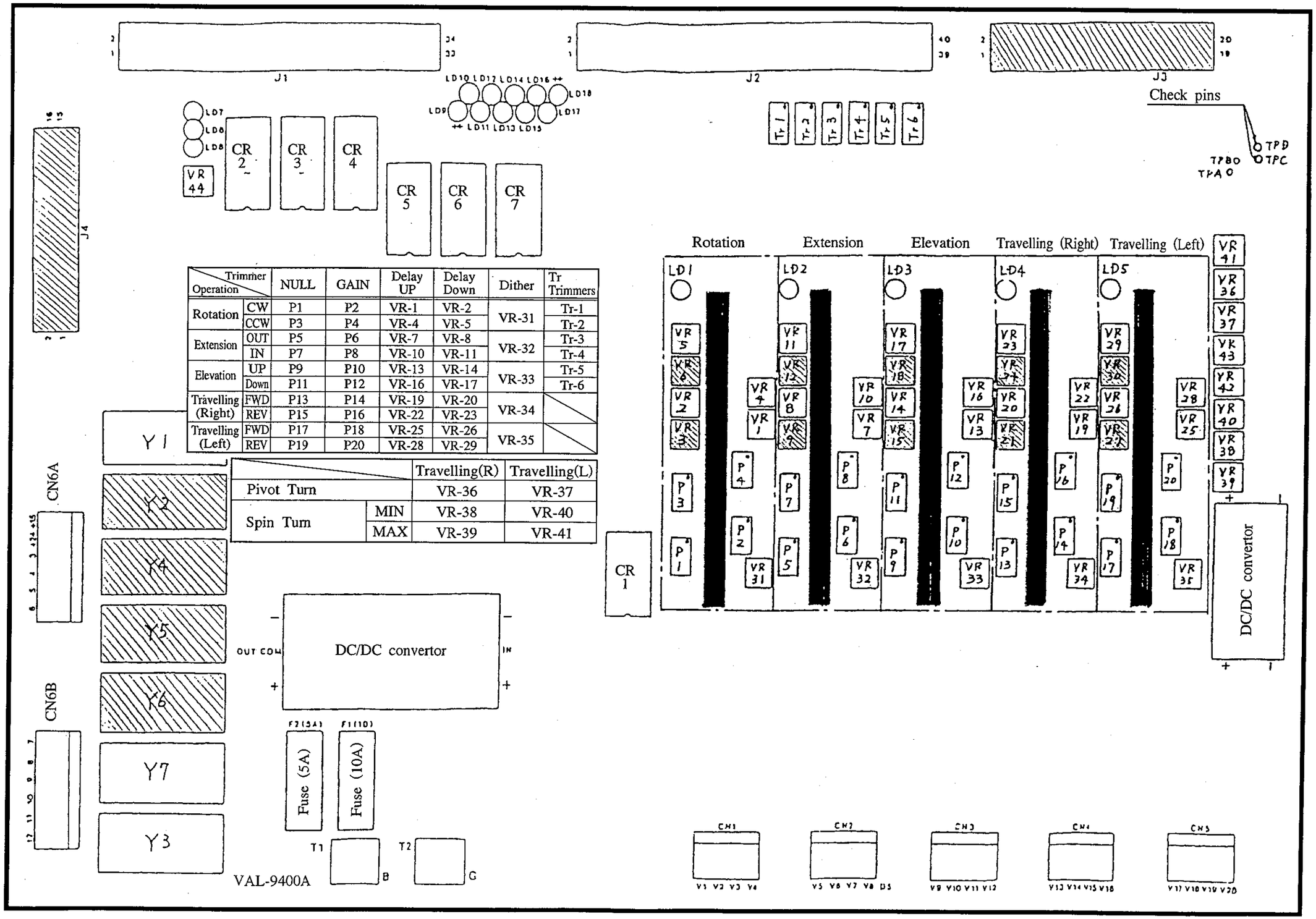
6. Adjustment of "Spin turn" speed.

The "Spin turn" speed is adjusted by the trimmers installed on the Valve control unit as follows.

Caution : The Spin turn speed should be adjusted after having adjusted "Straight travelling speed".
The main key switch is to be set at its "UPPER" position, when adjusting the spin turn speed.

NO.	Adjustment procedures	Remarks
1.	Set a Digital volt meter between the "Check pin (TP - C)"⊕ on Valve control unit and "GND"⊖.	
2.	Operate "Travel (Left) lever" to "REV" slightly, and "Travel (Right) lever" to "FWD" fully.	
3.	Hold the Travel levers at the above positions, and adjust the voltage (V_1) to 6.2V by Trimmer (VR - 38).	
4.	Operate "Travel (Left) lever" to "REV" fully, and "Travel (Right) lever" to "FWD" fully.	
5.	Hold the Travel levers at the above positions, and adjust the voltage (V_2) to 3.8V by Trimmer (VR - 39).	 Spin turn (C.W.)
6.	Set a Digital voltmeter between the "Check pin (TP - D)"⊕ on Valve control unit and "GND"⊖.	
7.	Operate "Travel (Right) lever" to "REV" slightly, and "Travel (Left) lever" to "FWD" fully.	
8.	Hold the Travel levers at the above positions, and adjust the voltage (V_3) to 6.2V by Trimmer (VR - 40).	
9.	Operate "Travel (Right) lever" to "REV" fully, and "Travel (Left) lever" to "FWD" fully.	 Spin turn (C.C.W.)
10.	Hold the Travel levers at the above positions, and adjust the voltage (V_4) to 3.8V by Trimmer (VR - 41).	
11.	Adjust the Spin turn speed CW & CCW, by varing the voltage (V_2 & V_4). The higher voltage causes the faster Spin turn speed.	Specific spin turn speed: C.W.···12±3sec/90° C.C.W.···12±3sec/90°

4. Trimmer's Identification on "Valve control unit"



Operation \ Trimmer		NULL	GAIN	Delay UP	Delay Down	Dither	Tr Trimmers
Rotation	CW	P1	P2	VR-1	VR-2	VR-31	Tr-1
	CCW	P3	P4	VR-4	VR-5		Tr-2
Extension	OUT	P5	P6	VR-7	VR-8	VR-32	Tr-3
	IN	P7	P8	VR-10	VR-11		Tr-4
Elevation	UP	P9	P10	VR-13	VR-14	VR-33	Tr-5
	Down	P11	P12	VR-16	VR-17		Tr-6
Travelling (Right)	FWD	P13	P14	VR-19	VR-20	VR-34	
	REV	P15	P16	VR-22	VR-23		
Travelling (Left)	FWD	P17	P18	VR-25	VR-26	VR-35	
	REV	P19	P20	VR-28	VR-29		

		Travelling(R)	Travelling(L)
Pivot Turn		VR-36	VR-37
Spin Turn	MIN	VR-38	VR-40
	MAX	VR-39	VR-41

ADJUSTMENT DATA SHEET

Serial No. _____ Date : _____

Function		Elevation		Extension		Rotation		Travel (R)		Travel (L)	
Direction		Up	Down	Out	In	CW	CCW	For.	Rev.	For.	Rev.
Pin No.		V10	V12	V6	V8	V2	V4	V14	V16	V18	V20
Null trimmer		P9	P11	P5	P7	P1	P3	P13	P15	P17	P19
Null voltage	Before adjustment	0.32V	0.32V	0.32V	0.32V	0.32V	0.32V	0.32V	0.32V	0.32V	0.32V
	After adjustment										
Gain trimmer		P10	P12	P6	P8	P2	P4	P14	P16	P18	P20
Gain voltage	Before Adjustment	0.50v	0.51v	0.50v	0.47v	0.47v	0.47v	0.56v	0.56v	0.56v	0.56v
	After adjustment										
Delay trimmer	Up	VR13	VR16	VR7	VR10	VR1	VR4	VR19	VR22	VR25	VR28
	Down	VR14	VR17	VR8	VR11	VR2	VR5	VR20	VR23	VR26	VR29
Tr trimmer		Tr5	Tr6	Tr3	Tr4	Tr1	Tr2				
Specific speed (second/stroke)	Upper control	55±10	55±10	25±5	25±5	110±15sec. / 1 turn	110±15sec. / 1 turn	24±2 sec. / 10 meters	24±2 sec. / 10 meters	24±2 sec. / 10 meters	24±2 sec. / 10 meters
	Lower control	55±10	55±10	25±5	25±5	110±15sec. / 1 turn	110±15sec. / 1 turn				
Dither trimmer		VR33		VR32		VR31		VR34		VR35	

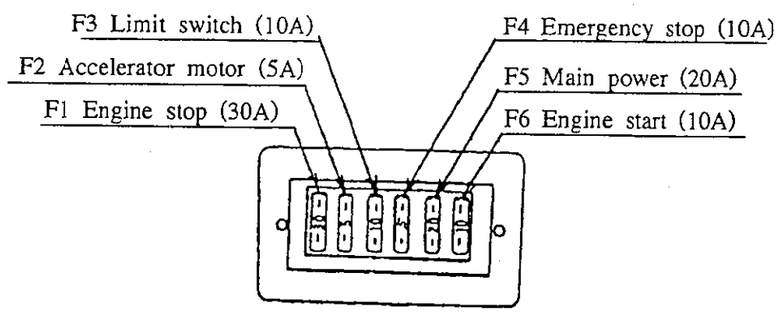
7
APPENDIX

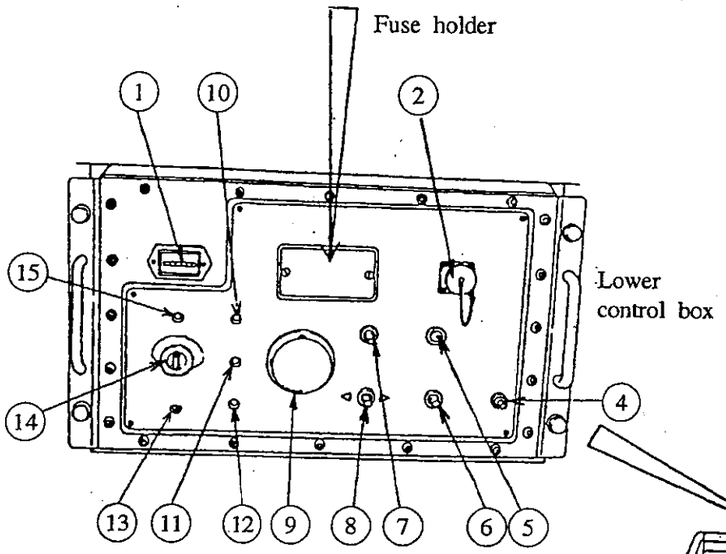
TROUBLE SHOOTING

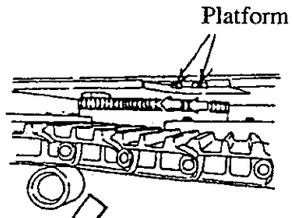
NO.	Problem	Cause	Remedy
1.	"Starter motor" does not run on either Upper or Lower control.	1)"Emergency stop s/w" on Lower or Upper control box is pressed. (Both Power lamps on "Lower" and "Upper" controls turn off.)	Pull the Emergency stop s/w to turn on Power lamps.
		2)"Emergency stop fuse F4 (10A) " in Lower contorol box has blown. (Power lamps turn off.)	Replace the fuse.
		3)"Main fuse F5 (20A) " in Lower contorol box has blown. (Power lamps turn off.)	Replace the fuse.
		4)"Engine start fuse F6 (10A) " in Lower contorol box has blown. (Power lamps turn on.)	Replace the fuse.
		5)"Fusible link" (30A) has blown.	Release the fusible link.
2.	"Starter motor" does not run at Upper control.	1)"Foot S/W" is pressed.	Release the foot switch and press the "Engine start switch".
		2)"Engine start fuse F2 (3A)" in Upper control box has blown.	Replace the fuse.
3.	"Starter motor" runs, but engine does not start.	1) Fuel tank is empty.	Fill fuel, bleed air, and start engine.
		2) Engine is cool.	Preheat "Glow plugs", and start engine.
4.	Engine does not stop.	1)"Engine stop fuse F1 (30A)" in Lower control box has blown.	Replace the fuse.
5.	Engine stopped naturally, and does not start again.	2) Fuel tank is empty.	Fill fuel, bleed air, and start engine.

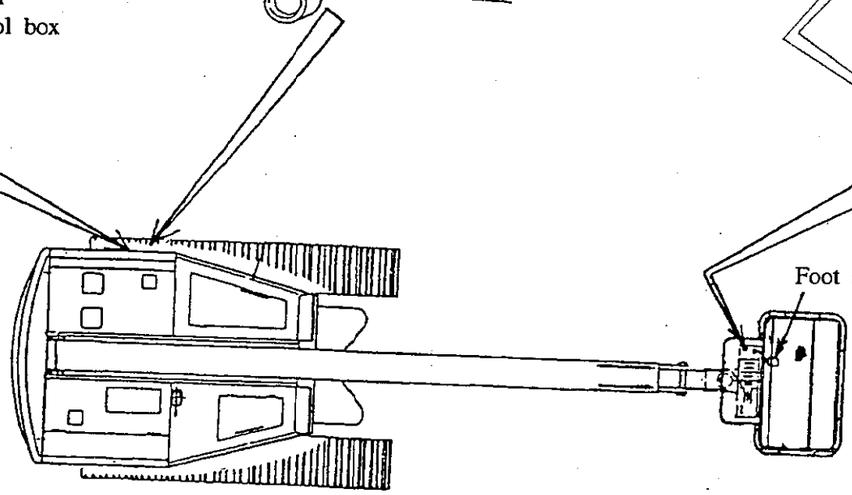
NO.	Problem	Cause	Remedy
6.	The upper control is non-operational, except for the "Horn" and "Working light".	1)"Foot switch" is not pressed.	Press Foot switch, and operate.
		2)"Main key switch" is set at "Lower" position.	Set the key switch to the "Upper" position.
7.	"Elevation", "Extension", "Rotation" and "Travel" operations are not functioning either "Lower" or "Upper" control.	"Fuse" on Valve control unit installed in Lower control box has blown.	Replace the fuse.
8.	Platform swing, level, and Emergency pump operation on Upper control are not functioning.	"Platform swing, level, & Emergency pump fuse F3 (10A)" in Upper control box has blown.	Replace the fuse.
9.	"Accelerator motor" does not work from either the "Upper" or "Lower" control.	"Accelerator motor Fuse F2 (5A)" in Lower control box has blown.	Replace the fuse.
10.	"Accelerator s/w" on Upper control does not work.	"Accelerator fuse F4 (3A)" in Upper control box has blown.	Replace the fuse.
11.	"Horn" does not work.	"Horn fuse F1 (10A)" has blown in Upper control box.	Replace the fuse.
11.	"Working light" does not work.	"Working light fuse F5 (5A)" in Upper control box has blow.	Replace the fuse.
12.	"Buzzer" sounds at Upper control.	Machine is inclined 3° or more due to slope.	Lower the platform, and set the machine on level ground.
13.	Platform loses level quite often.	"Platform level adjustment valves" are not closed firmly.	Close the valves firmly.

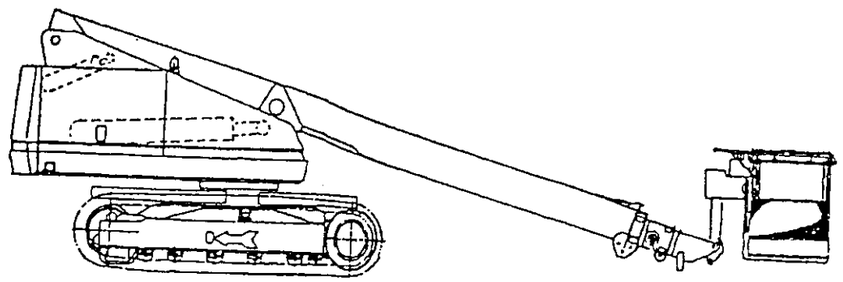
Identifications of "Control devices" and "Fuses"

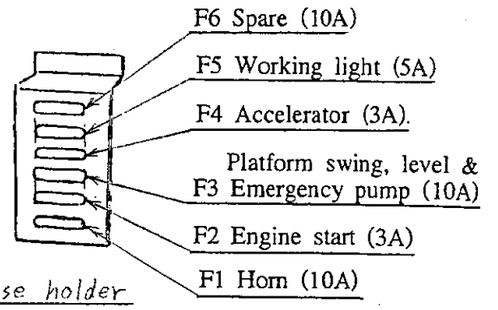


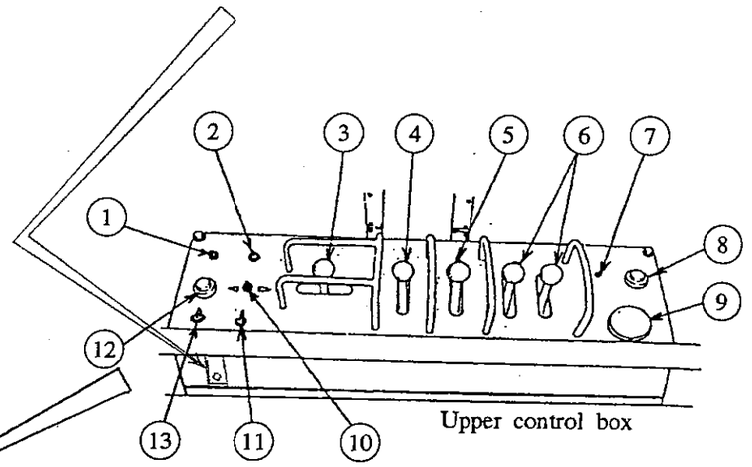








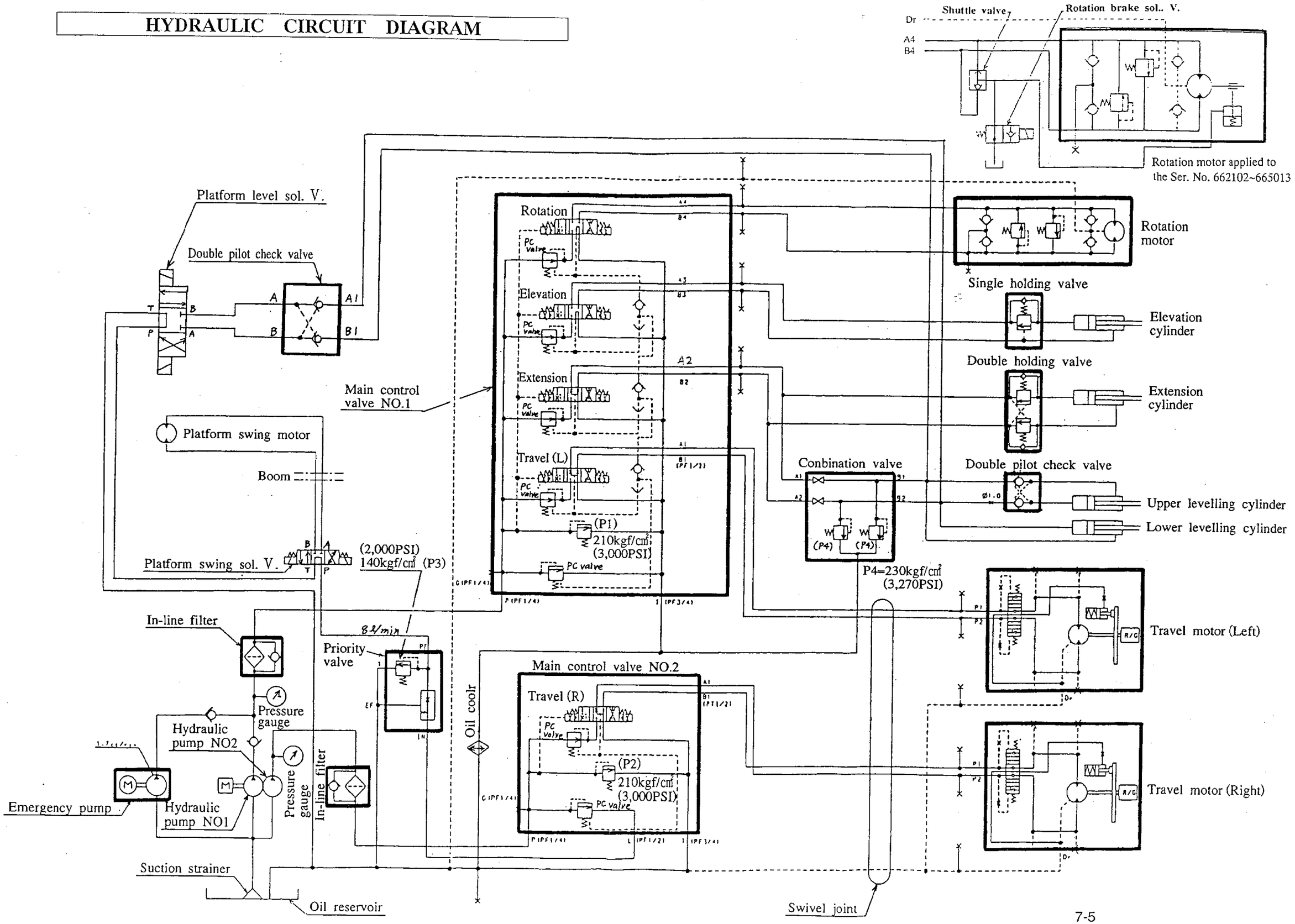




1	Hour meter
2	Metal connector(for Optional Remote control)
3	————
4	Elevation switch
5	Emergency pump switch
6	Extension switch
7	Accelerator switch
8	Rotation switch
9	Emergency stop switch
10	Charge warning lamp
11	Engine water temp lamp
12	Engine oil pressure lamp
13	Glow indicator lamp
14	Main key switch
15	Power lamp

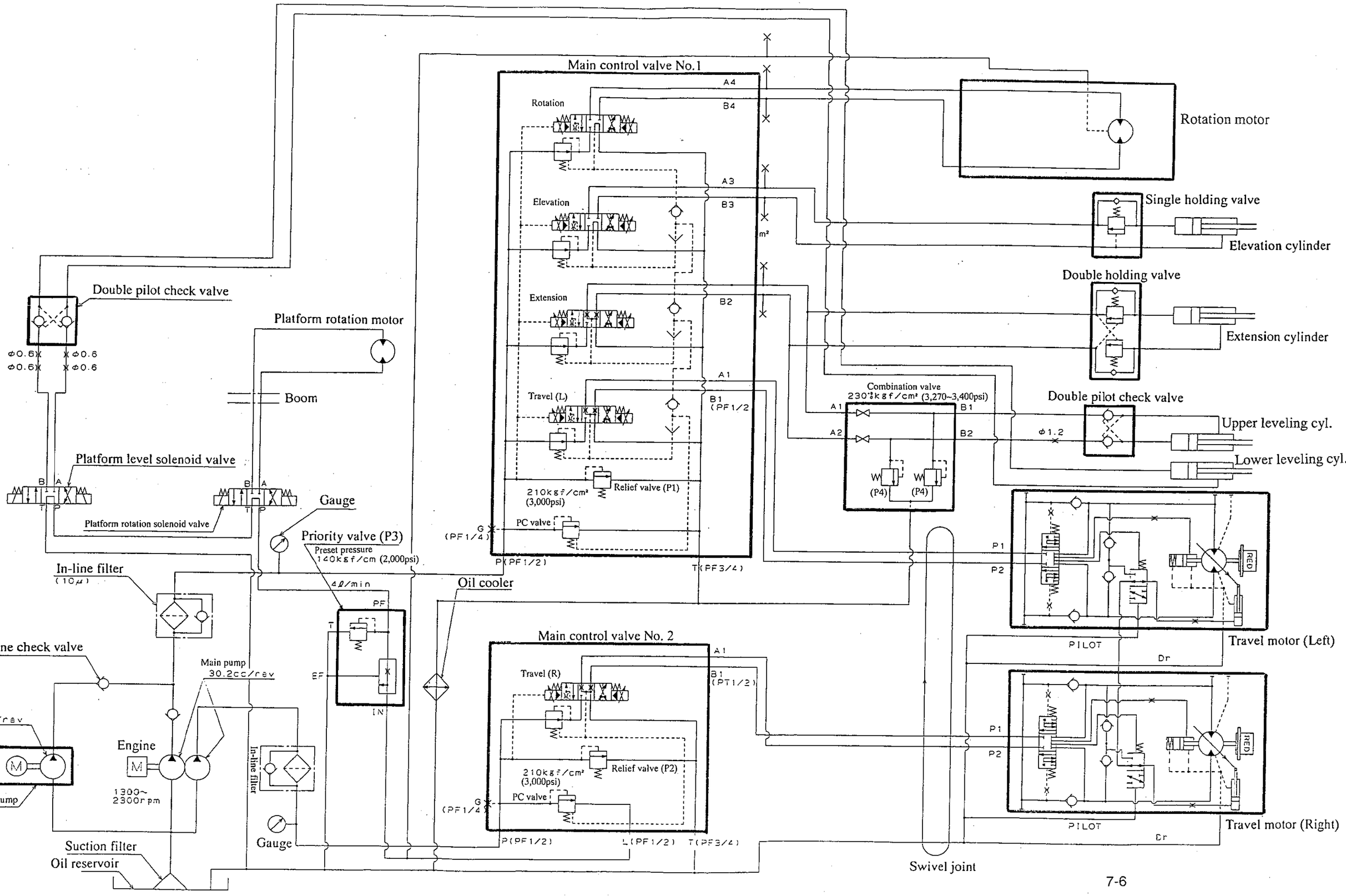
1	Working light switch
2	Accelerator switch
3	Rotation control lever
4	Extension control lever
5	Elevation control lever
6	Travel control lever
7	Power lamp
8	Engine start switch
9	Emergency stop switch
10	Platform swing switch
11	Emergency pump switch
12	Horn switch
13	Platform level switch

HYDRAULIC CIRCUIT DIAGRAM

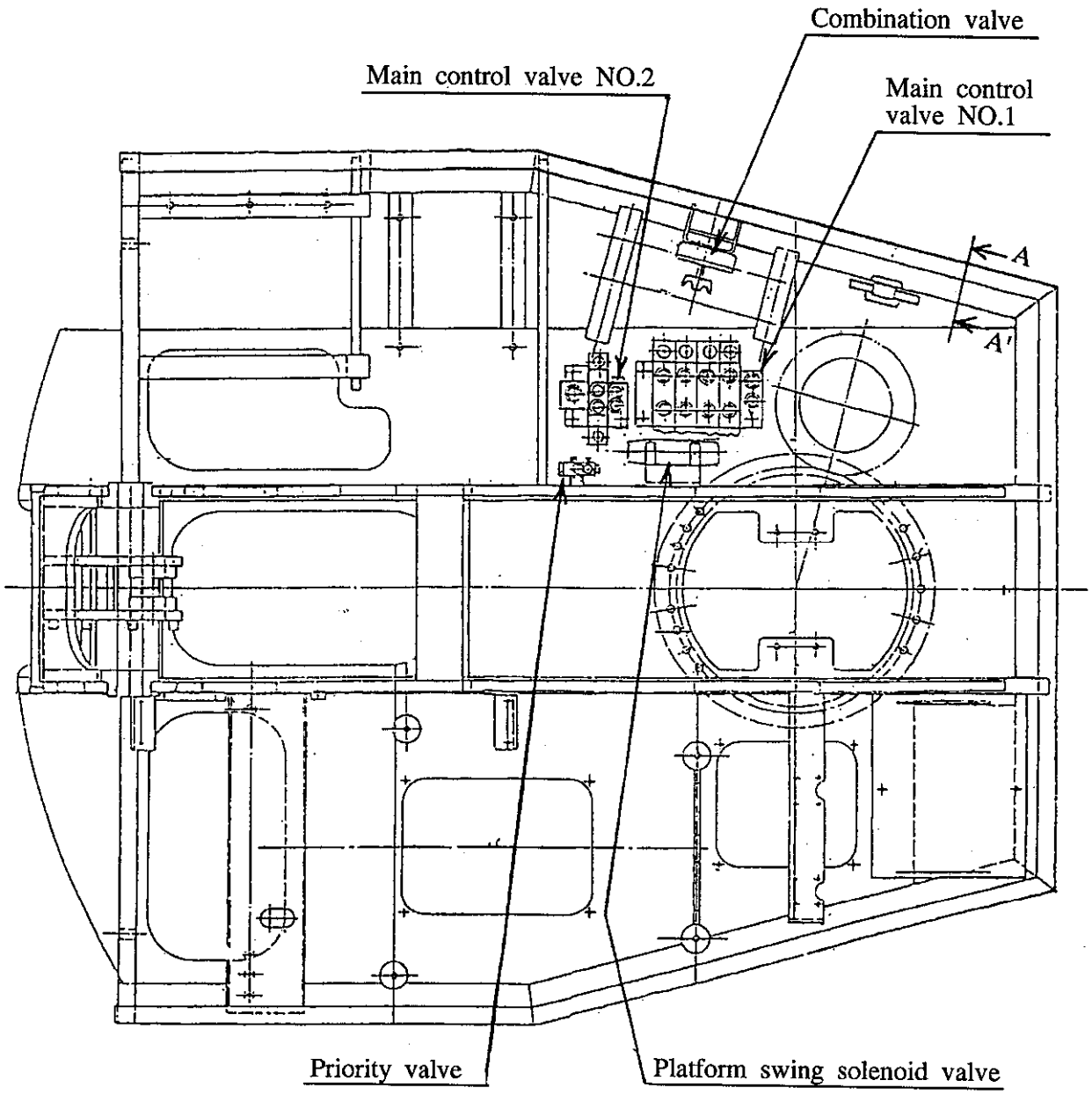


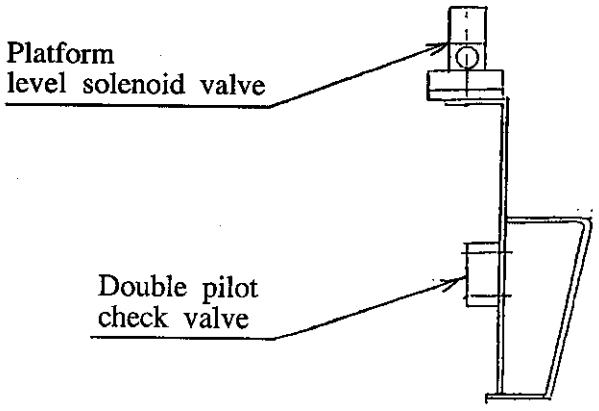
HYDRAULIC CIRCUIT DIAGRAM (for Spec. 20)

Applied to the Serial No. 665663 and after



IDENTIFICATIONS OF HYDRAULIC VALVES





View A-A'

ELECTRIC CIRCUIT DIAGRAM

for Spec : A6 (S/N 652319~652348)

Remote control box (for Travel)

UPPER CONTROL BOX

Rotation

Extension

Elevation

Travel (Right)

Travel (Left)

Relay board

U-REL

LOWER CONTROL BOX

Interface board (1F)

Valve control unit (VAL-9400)

Main control valve NO.1

C.C.W. Travel L. Rev DOWN IN

C.C.W. Travel L. For UP OUT

Travel R. Rev

Travel R. For

Main control valve NO.2

Slope warning buzzer

Mission alarm buzzer

HORN

PLATFORM SWING SOL

ACCELERATOR MOTOR

PLATFORM LEVEL SOL

FOOT SWITCH

WORKING LIGHT

LS1 Boom length

LS2 Boom angle

SLOPE SENSOR 3°

ENGINE

GLOW TEMP OIL

STOP SOLE.

ALTER-NATOR

STARTER

SAFETY RELAY

EMG.PUMP

BAT REL.

BT12

BT1 BATTERY

FUSIBLE LINK FL1 17A*2

SR123

KEY SWITCH

	45A 30	13A 15/54	33A 19	33A 17	9A 50a	9A 58
UP	C					O
OFF						
LOW	C	O				
GLW	C		O			
STR	C			C	O	

ELECTRIC CIRCUIT DIAGRAM

for Spec : A6 (652349 ~ 655351)

Remote control box (for Travel)

UPPER CONTROL BOX

LOWER CONTROL BOX

Interface board (IF)

Valve control unit (VAL-9400)

Main control valve NO.1

Main control valve NO.2

C.C.W. Travel L. Rev DOWN IN

C.C.W. Travel L. For UP OUT

Travel R. Rev Travel R. For

Rotation

Extension

Elevation

Travel (Right)

Travel (Left)

Relay board

U-REL

Slop warning buzzer

FOOT SWITCH

WORKING LIGHT

LS1 Boom length

LS2 Boom angle

SLOPE SENSOR

ENGINE

STOP SOLE.

ALTER-NATOR

STARTER

SAFETY RELAY

SR123

EMG. PUMP

BAT REL.

FL1 FUSIBLE LINK 50A

BT1 BATTERY (DC24V)

MOTION ALARM BUZZER

HORN

PLATFORM SWING SOL

ACCELERATOR MOTOR

PLATFORM LEVEL SOL

KEY SWITCH

	45A 30	13A 15/54	33A 19	33A 17	9A 50a	9A 58
UP	C					O
OFF						
LOW	C	O				
GLW	C		O			
STR	C			C	O	

ELECTRIC CIRCUIT DIAGRAM

for Spec : A6 (655352 ~)

Remote control box (for Travel)

UPPER CONTROL BOX

Rotation

Extension

Elevation

Travel (Right)

Travel (Left)

Relay board

U-REL

LOWER CONTROL BOX

Interface board (IF)

Valve control unit (VAL-9400)

Main control valve NO.1

C.C.W. Travel L. Rev DOWN IN

C.C.W. Travel L. For UP OUT

Travel R. Rev

Travel R. For

Main control valve NO.2

FOOT SWITCH

WORKING LIGHT

LS1 Boom length

LS2 Boom angle

SLOPE SENSOR

ENGINE

STOP SOLE.

ALTER-NATOR

STARTER

SAFETY RELAY

SR123

EMG. PUMP

BAT REL.

FL1 FUSIBLE LINK 30A

BT12 (DC24T)

BT1: BATTERY

MOTION ALARM BUZZER

HORN

PLATFORM SWING SOL

ACCLERATER MOTOR

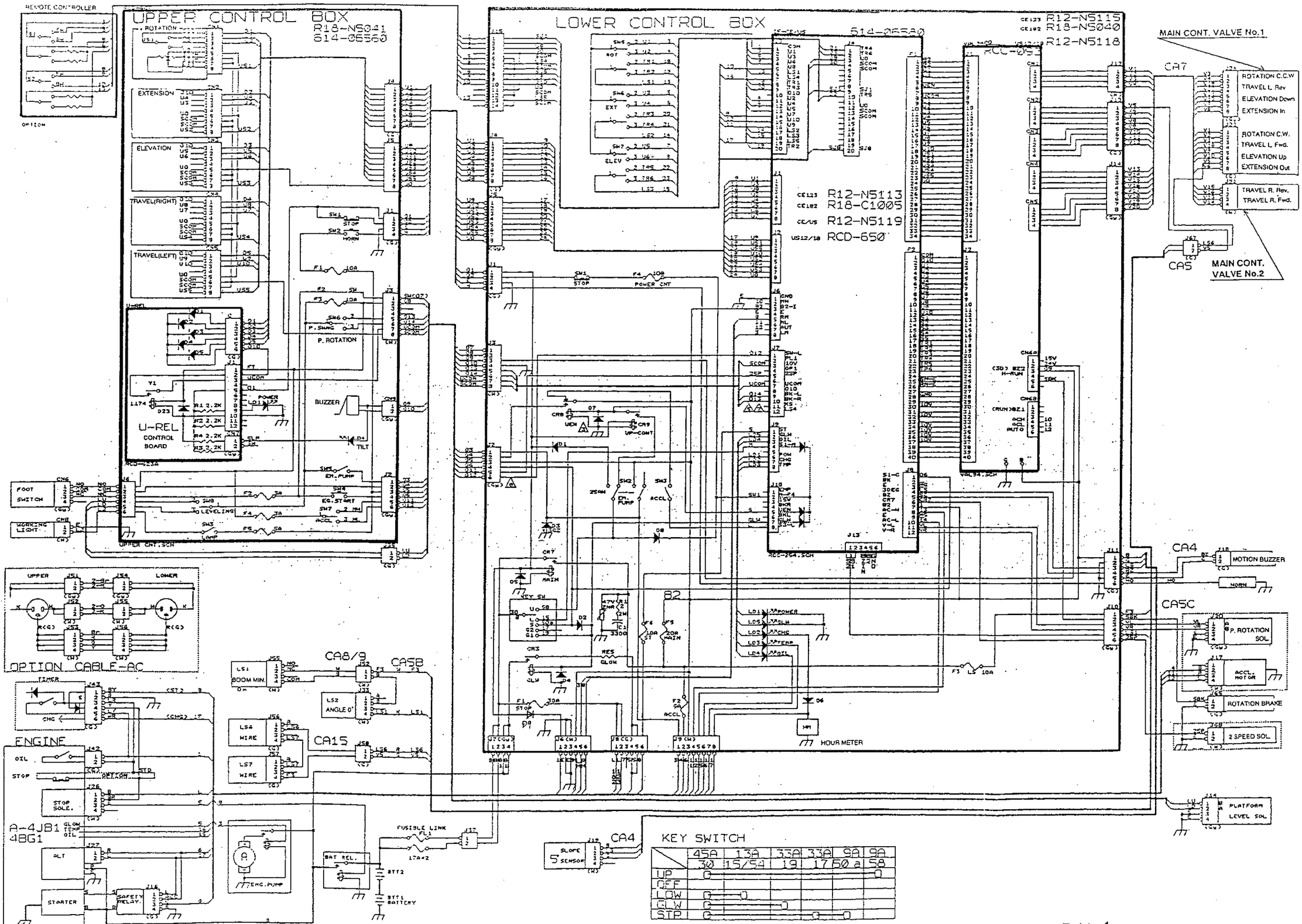
PLATFORM LEVEL SOL

KEY SWITCH

	45A 30	13A 15/54	33A 19	33A 17	9A 50 a	9A 58
UP	C					O
OFF						
LOW	C	O				
GLW	C		O			
STR	C			C	O	

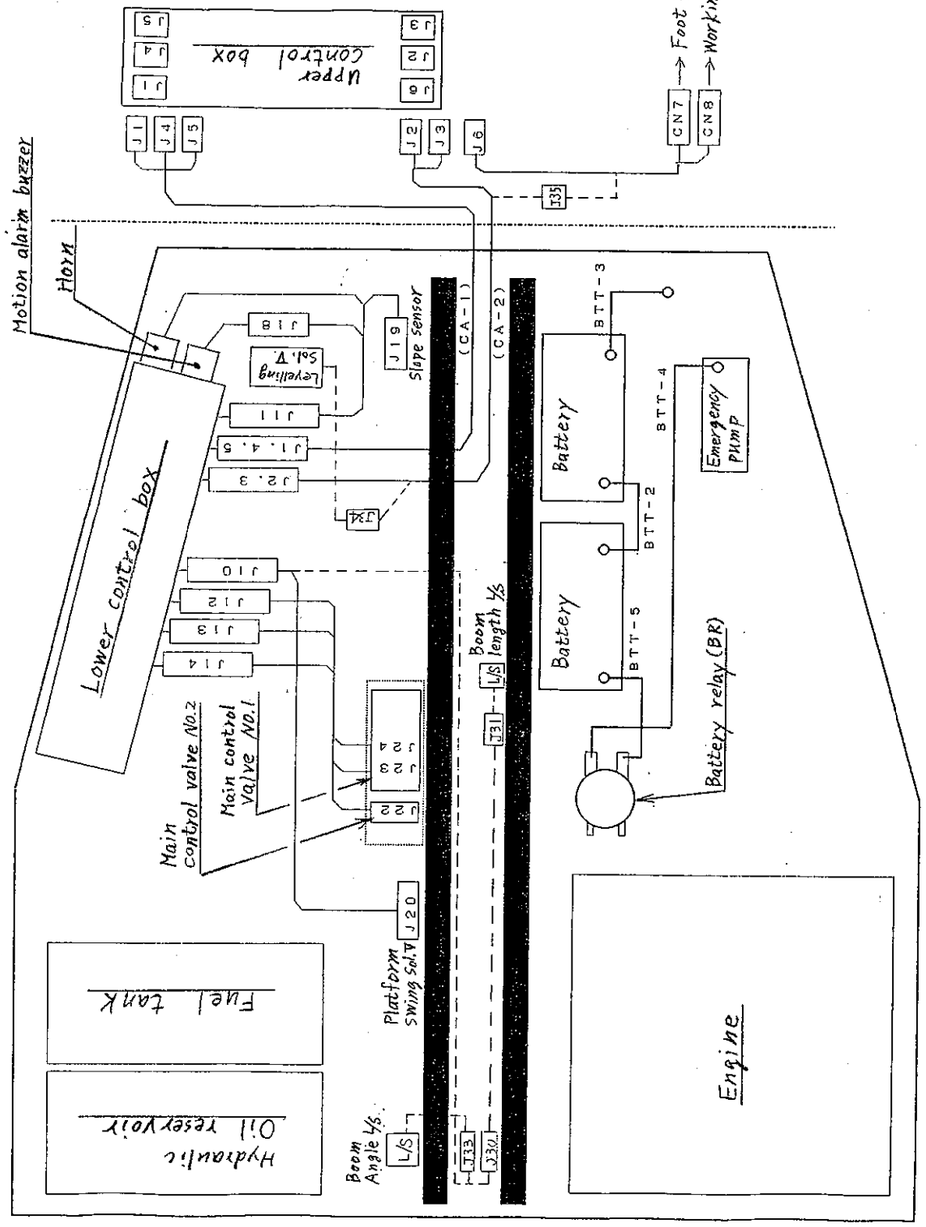
ELECTRIC CIRCUIT DIAGRAM (for Spec. A8)

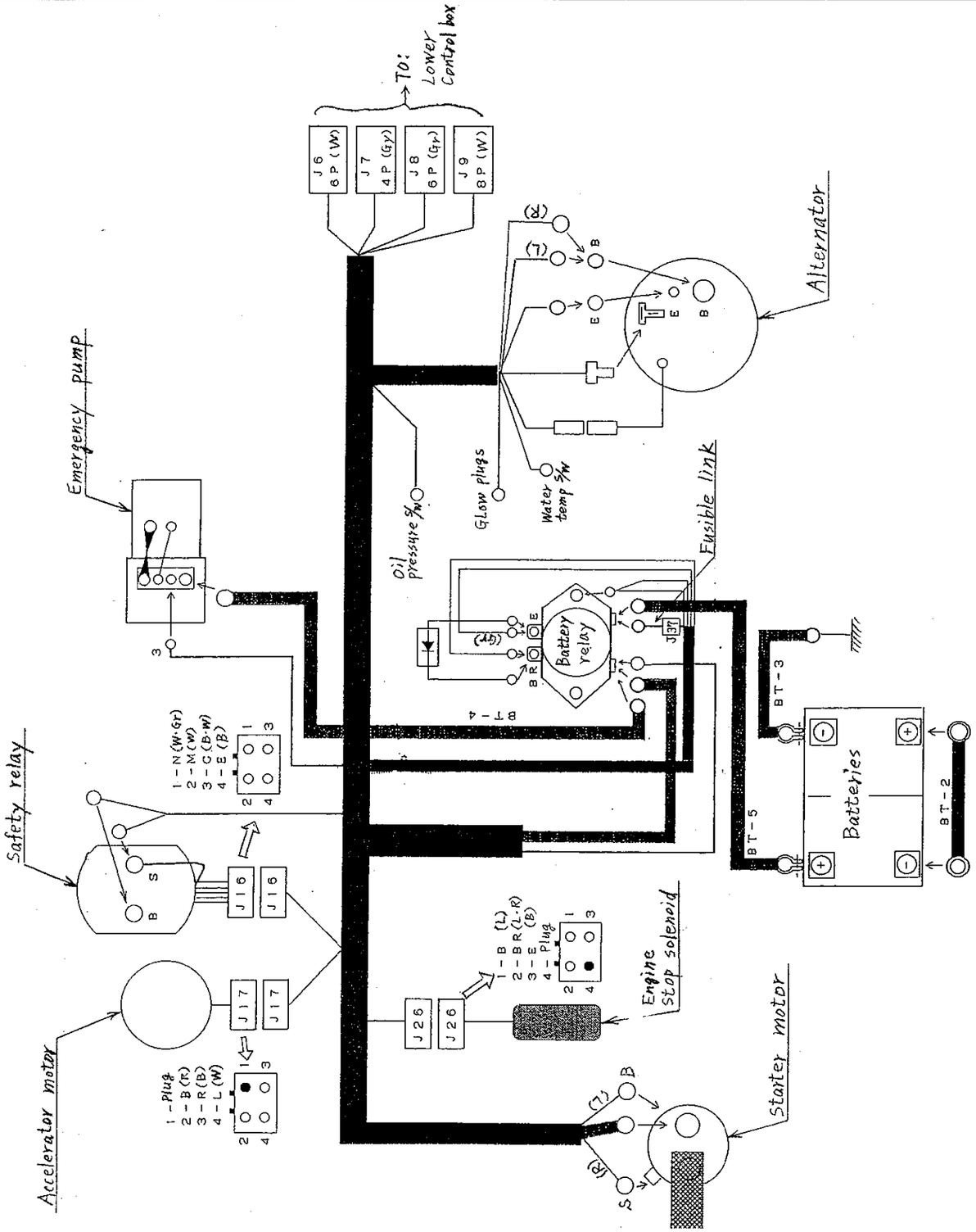
602-14372



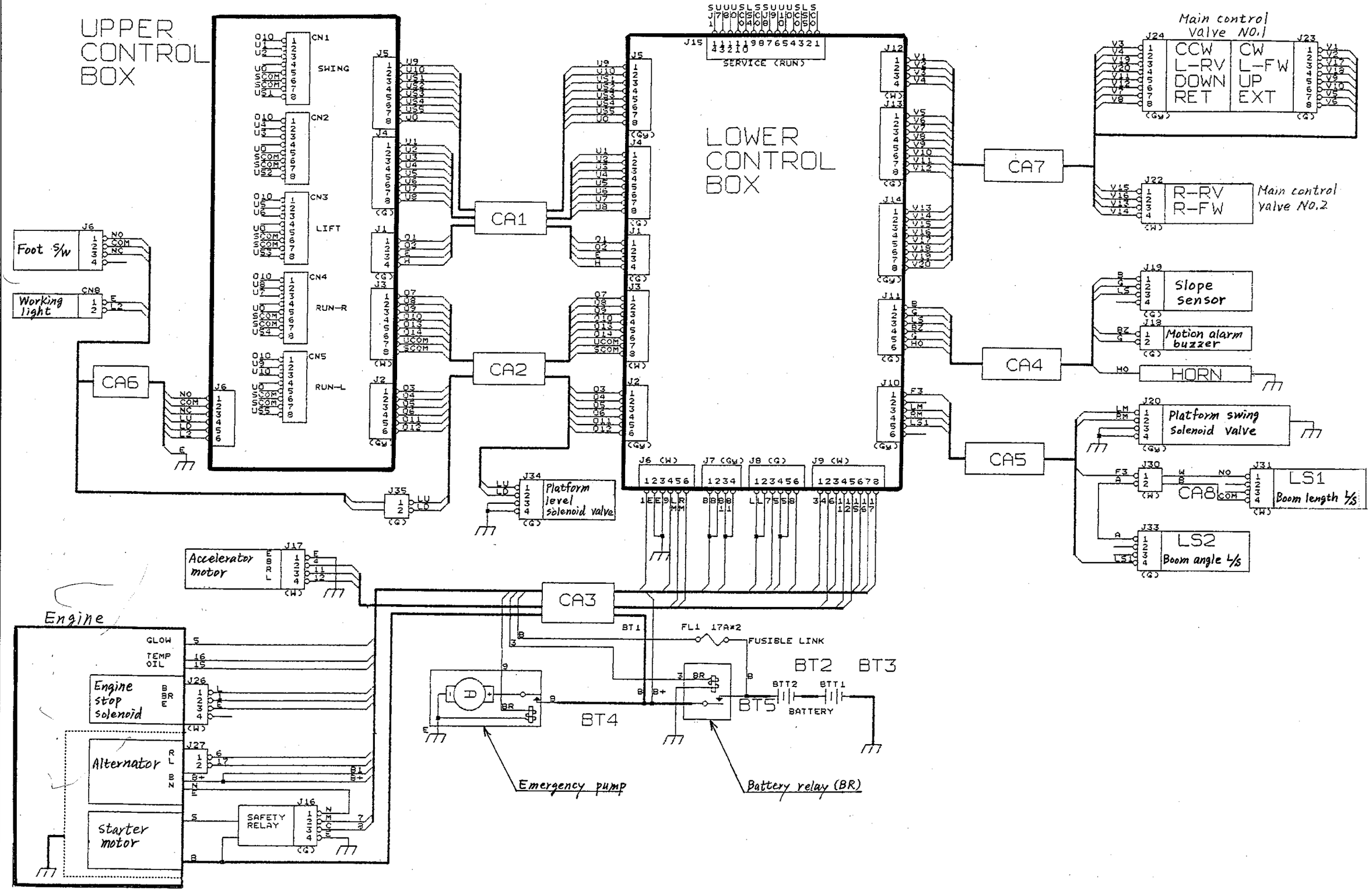
7-11-1

ELECTRIC WIRE HARNESS

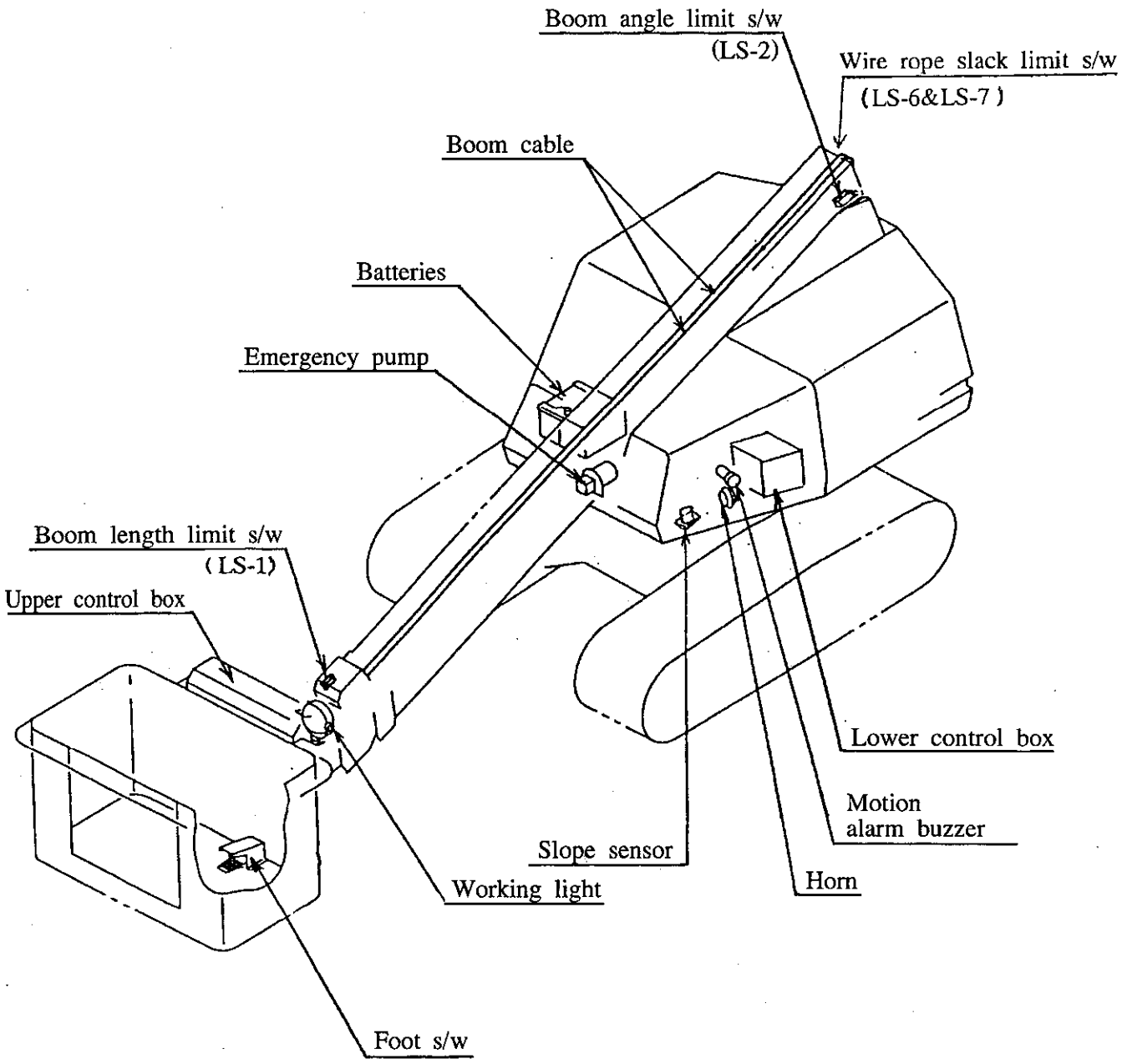




ELECTRIC WIRING CHART



IDENTIFICATIONS OF ELECTRIC COMPONENTS



TIGHTENING TORQUE STANDARD

1) Hexagon Bolts and Nuts (8.8T)
Material : S45C

Tensile strength : 80 kgf/㎟
Yield point : 64 kgf/㎟
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/㎟
Yield point : 90 kgf/㎟
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

SME-906

INSPECTION MANUAL

SELF PROPELLED AERIAL PLATFORM

SP,SR SERIES

MICHI
CORPORATION
1152, RYOKE, AGEO, SAITAMA, JAPAN.

I N D E X

DAILY INSPECTION PROCEDURES

The inspection is to be carried out on firm level ground.

POWER UNIT

UNIT	ITEM	DESCRIPTION
Radiater.	Cooling water level.	Remove radiator cap and check the cooling water level.
Battery.	Electrolyte level.	Remove filler cap and check the electrolyte level.
Oil pan.	Engine oil level.	Check oil level.
Fuel tank.	Fuel level.	Check fuel level.
Hydraulic oil reservoir.	Hydraulic oil level.	Lower platform to its lowest position, retract jacks fully, and check oil level.

CARRIER

Tyre.	Excessive wear, cuts	Check tyres for excessive wear and cuts.
Wheel nuts.	Looseness.	Check wheel nuts for looseness.
Steering linkages.	Deformation, cracks.	Check steering linkages for deformation and cracks.
Travel motor unit.	Oil leakage.	Check the unit for oil leakage.
Carrier frame.	Deformation, cracks.	Check carrier frame for deformation and cracks.
Crawler.	Track link, shoes. (Excessive wear, tension.)	Check track link and shoes for excessive wear and abnormal tension.

OUTRIGGERS

Outrigger arm jack post.	Cracks, deformation.	Extend all of the outriggers and jacks fully, and check for cracks, deformation.
Jack cylinder.	Oil leakage.	Check each jack cylinder for oil leakage.
	Natural descent.	1. Extend all jacks and ground them. 2. Check each jack cylinder if it is retracted due to the weight of machine.

CONTROL SYSTEM

Control levers, switches.	Function.	Operate all of the control levers, switches and check that their functions are operating correctly.
	Excessive free play.	Operate all of the control levers, switches and check for excessive free play.

PLATFORM

UNIT	ITEM	DESCRIPTION
Platform leveling system.	Function.	Operate the boom by the lower control, and check that the platform always keeps its level position.
Platform Swing device	Deformation, cracks, wear.	Check platform swing device for deformation, cracks, and wear.

SAFETY DEVICE

Engine start stop system.	Function.	Test the engine start/stop switches at upper control and check they function correctly.
Emergency pump.	Function.	Stop engine, operate boom by emergency pump and check it functions correctly.
Foot switch.	Function.	Operate the machine using the upper control, release foot switch, and check if all of the function stops immediately.
Slope warning buzzer.	Function.	Turn on main key switch and make sure the slope warning buzzer sounds for a second just after turning on.
Alarm horn.	Function.	Press horn switch at upper control, and check it functions correctly.
Motion alarm buzzer	Function.	Operate the control levers, and switches then check that the motion alarm buzzer sounds.
Safety switch	Function.	Operate the safety switch, and check that the engine stops and that the power lamps turn off.
Working range controller. Moment limitter.	Function.	Operate the boom using the lower control, and check that it functions correctly.

DAILY INSPECTION CHECK SHEET

POWER UNIT

UNIT	ITEM	RESULTS
(DATE) ⟶		
Radiater.	Cooling water level.	
Battery.	Electrolyte level.	
Oil pan.	Engine oil level.	
Fuel tank.	Fuel level.	
Hydraulic oil reservoir.	Hydraulic oil level.	

CARRIER

Tyre.	Excessive wear, cuts	
Wheel nuts.	Looseness.	
Steering linkages.	Deformation, cracks.	
Travel motor unit.	Oil leakage.	
Carrier frame.	Deformation, cracks.	
Crawler.	Track link, shoes. (Wear, tension.)	

TURNTABLE

Rotation gear box.	Function.	

CONTROL SYSTEM

Control levers, switches.	Function.	
	Free play.	

BOOM

Boom.	Deformation, cracks.	
Boom pivot pin.	Any damage.	
Extension, Elevation cylinder.	Oil leakage.	
	Natural descent.	

PLATFORM

Platform leveling system.	Function.	
Platform & swing device.	Deformation, cracks, wear.	

SAFETY DEVICE

UNIT	ITEM	RESULTS
(DATE) ⟶		
Engine start, stop system.	Function.	
Emergency pump.	Function.	
Foot switch.	Function.	
Slope warning buzzer.	Function.	
Alarm horn.	Function.	
Motion alarm buzzer.	Function.	
Safety switch.	Function.	
Working range controller, Moment limitter.	Function.	

PERIODICAL INSPECTION PROCEDURES

Carry out both of the descriptions for Monthly and Annual inspections when conducting Annual inspection.

		DESCRIPTION	
UNIT	ITEM	MONTHLY INSPECTION	ANNUAL INSPECTION
Engine	Water, oil leakage.	Check for water and oil leakage thoroughly.	←
	Radiator.	Check for water level, contamination and replenish or change the water if necessary.	←
		Check the function of radiator cap and for any damage to the radiator thoroughly.	
	Air filter.	Check air filter and clean or replace the element, if necessary.	←
	Water separator.	Drain water from water separator.	Disassemble and clean thoroughly. (Cleaning interval ; Every 6 months.)
	Fuel filter.	Check filter for fuel leakage.	Replace the element. (Replacement interval ; Every 600 hours.)
	Battery.	Check for the electrolyte level and clean battery terminals.	←
	Fan belt.	Check for wear and tension.	←
	Alternator, starter.	Check the function.	←
	Valve clearance.		Remove tappet cover and adjust valve clearance. (Adjustment interval ; Every 1,200 hours.)
	Engine oil.	Check oil level and contamination.	Change engine oil. (Replacement interval ; Every 200 hours.)
	Oil filter.	Check filter for oil leakage.	Replace the element. (Replacement interval ; Every 400 hours.)
	Fuel tank.	Check filter for oil leakage.	Drain fuel and clean the tank.
Hydraulic oil reservoir	Oil leakage.	Check for oil leakage.	←
	Anchor bolts.	Check the bolts for looseness.	←
	Stop valve.	Check stop valves for oil leakage and any other damage.	←
	Oil level, contamination, viscosity, water content, oxidation.	Check oil level.	Stir oil in the reservoir, take out sample(60cc) and check the following items.

UNIT	ITEM	MONTHLY INSPECTION	ANNUAL INSPECTION
Hydraulic oil reservoir			-Contamination ; Within NAS class 12. -Viscosity ; Within 10% ± Standard. -Water content ; Less than 0.5%. -Oxidation ; Less than 0.4mgKOR/g. (Oil change interval ; 1,200 hours orAnnually)
Hydraulic filter.	Oil leakage, any other damage.	Check filters for oil leakage.	←
	Replacement of filter element.		Replace the element. (Replacement interval ; 1200 hours or Annualy)
Hydraulic pump.	Abnormal noise, excessive heat.	Run the pump and check for the items.	←
	Oil leakage.	Run the pump with maximum pressure and check for oil leakage.	←
	Pump bracket, anchor bolts.	Check pump bracket for cracks, deformation, and anchor bolts for looseness.	
Wheels (SP series)	Tyre.	Check for excessive wear and cuts.	←
	Wheel nuts.	Check for looseness. Tightening torque ; 25-30kg-m.(180~220ft-lb)	←
Crawler. (SR series)	Track shoe, link.	Check for tension, and wear.	←
	Drive sprocket, Idle wheel.	Check for excessive wear and cracks.	←
	Track roller, carrier roller.	Check for wear and oil leakage.	←
Travel motor unit	Oil leakage, external damages.	Check for the items.	←
	Gear oil.	Check oil level.	Change gear oil. (Oil change interval; 1,200 hours or Annualy)
	Abnormal noise, excessive heat.	Run the motor and check the motor, gear box for the items.	←
	Bolts, nuts.	Check for looseness.	←

UNIT	ITEM	MONTHLY INSPECTION	ANNUAL INSPECTION
Steering mechanism. (SP serise)	Linkages.	Check for deformation, cracks.	←
	Wheel bearings.		Jack up the machine and check the wheel bearings for excessive free play and any other damage.
	Steering cylinder.	Operate the cylinder and check for oil leakage, abnormal function.	←
	Lubrication.	Supply grease to each grease fitting.	←
Travel speed limit system.	Travel speed.	Perform travelling operation with extended boom or setting boom over the horizontal and make sure the travelling speed is LOW.	←
	Flow divider valve.	Check the valves for oil leakage.	←
	Travel speed select solenoid valve.	Check the solenoid valve for oil leakage.	←
	Limit switch.	Check the limit switches for any damage.	←
Carrier, frame	Deformation, cracks.	Check the frame for the items.	←
Turntable.	Deformation, cracks.	Check turntable for the items.	←
	Anchor bolts.		Check anchor bolts for looseness.
T.T.B. (Turn Table Bearing)	Ring gear.	Check ring gear for excessive wear, cracks.	←
	Bearings.	Rotate T.T.B. and check for abnormal noise and any other fault.	Check the T.T.B. for free play. serviceable limit ; 3 mm(0.12 in)
	Anchor bolts.	Check bolts for looseness.	←
	Lubrication.	Supply grease to each grease fitting.	←
Rotation motor, gear box.	Oil leakage.	Check gear box and motor for oil leakage.	←
	Abnormal noise, excessive heat.	Run the motor and check for the items.	←
	Bolts, nuts.	Check bolts, and nuts for looseness.	←

UNIT	ITEM	MONTHLY INSPECTION	ANNUAL INSPECTION
Rotation motor, gear box.	Pinion gear.	Check pinion gear for wear, and cracks.	←
	Back-lash between pinion & T.T.B.		Check the back-lash between the pinion and ring gear of T.T.B. (Standard back-lash ; 0.6 mm (0.02in) or less)
	Gear oil.	Check oil level.	Change gear oil. (Oil change interval ; 1,200 hours or Annually)
Swivel joint.	Oil leakage.	Apply the maximum pressure, and check for oil leakage.	←
	Anchor bolts, stopper.	Check for looseness.	←
	Slip rings, carbon brushes.		Remove the cover or carbon brush holder and check for excessive wear, corrosion.
	Lubrication.	Supply grease to grease fitting.	←
Control system.	Control levers, switches, cables, linkages.	Test all of the control levers, switches and check the correct function, and any excessive free play.	←
	Instruments.	Check for the function.	←
	Relief valve.	Actuate relief valve, and check for abnormal noise, oil leakage.	Set a pressure gauge, measure the preset pressure of relief valve.
	Control valves.	Operate control valves, and check for oil leakage, any other fault.	←
	Name plates, Decals.	Check for legibility and any damage.	←
	Accelerator.	Operate accelerator switch either at lower or upper control and check for the function.	Check accelerator motor, limit switches, cams, wires for any damage.
Boom.	Bend, distortion, dent, crack, scratch.	Extend boom fully and check for the items. (The limit of bend ; —Vertically— 0.15% of the boom length. —Horizontally— 0.1% of the boom length.)	←
	Pivot pin.	Check boom pivot pin for excessive wear and any other damage. (The limit of clearance between pin and bushing ; 0.6 mm (0.024in))	←

UNIT	ITEM	MONTHLY INSPECTION	ANNUAL INSPECTION
Boom.	Wear pads, rollers.	Check each wear pad and roller for wear, cracks.	Check the clearance between each boom section and wear pad.
	Telescoping function.	Extend/retract the boom several times, and check for any abnormal function.	←
	Wire ropes.	Check wire ropes for excessive wear, breakage, corrosion.	Wire ropes should be checked in detail, when boom is disassembled for inspection every 4 years.
		Check turn buckles and wire end fittings for any damage.	
		Check the tension of wire rope.	
	Hydraulic hoses.	Check hydraulic hoses for oil leakage and any damage.	←
	Sheaves.	Check sheaves for excessive wear, free play.	←
	Lubrication.	Lubricate the sliding parts with grease.	←
Extension, Elevation, Platform swing cylinders.	Piston rod, cylinder tube.	Check for cracks, deformations, scratches.	←
	Oil leakage, faulty function.	Extend/retract the cylinders, and check for oil leakage, any faulty function.	←
	Anchor pins.	Check anchor pins for wear.	←
	Lubrication.	Supply grease to each grease fitting.	←
Platform leveling system.	Function.	Operate the boom thoroughly and ensure the platform keeps its level position.	←
	Levelling cylinder.	Check for oil leakage.	←
	Relief valve.	Check for oil leakage.	←
	Stop valve.	Check for oil leakage.	←
Platform.	Cracks, deformations.	Check for the items.	←
	Platform anchor bolts.	Check for looseness.	←
	Hook for safety belt.	Check for cracks, deformations.	←
Hydraulic plumbings.	Oil leakage, any damage.	Check hydraulic hoses, pipes for oil leakage and any other damage.	←

UNIT	ITEM	MONTHLY INSPECTION	ANNUAL INSPECTION
Auxiliary devices.	Engine start, stop system.	Check the function at both upper and lower controls.	Check the solenoid and linkages for any damage.
	Emergency pump.	Stop engine, operate the boom using the pump and check that it functions correctly.	Check the pump for oil leakage.
	Emergency stop.	Check for the function.	←
	Slope warning buzzer.	Turn on main key switch and make sure the warning buzzer sounds for a second just after turning on the switch.	Remove slope sensor, incline it about 3°, and check if the warning buzzer sounds.
			Check slope sensor and buzzer for any damage.
	Hydraulic outlets.	Check the self-seal couplings for oil leakage.	Using a pressure gauge, check the preset pressure.
	Receptacles. (AC 100 volts.)	Check for any damage.	←
	Alarm horn.	Check for function.	Check the switch and horn for any damage.
	Working range controller, Moment limitter.	Check for the function.	Check each sensor for any damage.
			Check each limited working radius.
			Check that the speed control system is functioning correctly.
	Motion alarm buzzer.	Check for function.	←
	Safety switch.	Check for function.	←
	Foot switch.	Check for function.	←

PROCEDURES OF FUNCTION TEST

–The following tests are to be conducted annually.
–All of the tests are to be carried out on firm level ground.

<table>
<tr><th>TEST</th><th>ITEM</th><th>DESCRIPTION</th></tr>
<tr><td>Load test.</td><td>Function.</td><td>1. Load platform with the rated load.
2. Operate the machine using the lower controls and check that the function is correct.</td></tr>
<tr><td>Natural descent test.</td><td>Extension, Elevation cylinders.</td><td>1. Set boom as listed below to check the natural descent of each cylinder.
<table>
<tr><th></th><th>Boom angle</th><th>Boom length</th></tr>
<tr><td>Extension cylinder</td><td>MAX.</td><td>Extend 1 meter</td></tr>
<tr><td>Elevation cylinder</td><td>45°</td><td>MIN</td></tr>
</table>
2. Stop engine and leave it for ten minutes.
3. Check the elevation, and extension cylinders for Natural descent.
–The limit of Natural descent; 2 mm (0.08in)/10 minutes.</td></tr>
<tr><td rowspan="4">Operational speed test.</td><td>Elevation speed. (UP, DOWN)</td><td>Raise/lower boom to its full stroke with the minimum boom length, and measure the UP and DOWN speed (seconds/stroke).</td></tr>
<tr><td>Extension speed. (IN, OUT)</td><td>Extend/retract boom to its full stroke with the maximum boom angle, and measure the OUT and IN speed (seconds/stroke).</td></tr>
<tr><td>Rotation speed. (C.W., C.C.W.)</td><td>Rotate turntable 360° with the maximum boom angle and minimum boom length, and measure the C.W. and C.C.W. speed (seconds/360°).</td></tr>
<tr><td>Travel speed. (FOR., REV.)</td><td>Retract boom fully, set it at an angle less than horizontal, perform travel operation and measure the FWD and REV speed (seconds/10 meter).</td></tr>
<tr><td>Platform swing speed. (RIGHT, LEFT)</td><td>Swing platform to its full stroke, and measure the RIGHT and LEFT motion speed (seconds/stroke).</td></tr>
</table>

PERIODICAL INSPECTION CHECK SHEET

		DATE	
CUSTMER		PHONE NO.	
ADDRESS			
MODEL		SERIAL NO.	
HOUR METER		INSPECTOR	

The marks (*) are the items to be inspected only on the annual inspection.

UNIT	ITEM	CHECK MARKS	REMARKS
Engine.	Water, oil leakage.		
	Radiator. (Water level, contamination, any damage.)		
	Air filter. (Cleaning.)		
	Water separator. (Draining water.)		Cleaning interval; Every 6 months.
	(*)(Cleaning.)		
	Fuel filter. (Oil leakage)		Replacement interval; Every 600 hours.
	(*)(Replacement.)		
	Battery. (Electrolyte level, Battery terminals.)		
	Fan belt. (Tension, wear)		
	Alternator, starter. (Function.)		
	Valve clearance.		Adjuatment interval; Every 1,200 hours.
	(*)(Adjustment.)		
	Engine oil (Oil level, contamination.)		Oil change interval; Every 200 hours.
	(*)(Oil change.)		
	Oil filter. (Oil leakage.)		Replacement interval; Every 400 hours.
	(*)(Replacement.)		
	Fuel tank. (Cracks, deformation.)		
	(*)(Cleaning.)		
Hydraulic oil reservoir.	Oil leakage.		
	Anchor bolts. (Looseness.)		
	Stop valve. (Oil leakage.)		
	Oil level, contamination,		Oil change interval;
	(*)water content, oxidation.		(1,200 hours or Annually)

UNIT	ITEM	CHECK MARKS	REMARKS
Hydraulic fillter.	Oil leakage.		
	(*)Repllacement of filter element.		Replacement interval; 1,200 hours or Annually.
Hydraulic pump.	Abnormal noise, excessive heat.		
	Oil leakage.		
	Pump bracket, anchor bolts. (Cracks, deformation, looseness.)		
Wheels. (SP series.)	Tyre. (Wear, cuts)		
	Wheel nuts. (Looseness.)		
Crawler. (SR series.)	Track shoe, link. (Tension, wear.)		
	Drive sprocket, idle wheel. (Wear, Cracks.)		
	Track roller, carrier roller. (Wear, Oil leakage.)		
Travel motor unit	Oil leakage, Oil level.		
	(*)Change gear oil.		Oil change interval; 1,200 hours or Annually.
	Abnormal noise, excessive heat.		
	Bolts, nuts. (Looseness.)		
Steering mechanism. (SP series.)	Linkages. (Deformation, Cracks.)		
	(*)Wheel bearing. (Excessive free play, any damage.)		
	Steering cylinder. (Oil leakage, abnormal function.)		
	Lubrication.		
Travel speed limit system.	Travel speed limit system. (Function.)		
	Flow divider valve. (Oil leakage.)		
	Travel speed select solenoid valve. (Oil leakage.)		
	Limit switch. (Any damage.)		
Carrier frame.	Deformation, cracks.		

UNIT	ITEM	CHECK MARKS	REMARKS
Turn table.	Deformation, cracks.		
	Anchor bolts. (Looseness.)		
T.T.B. (Turn Table Bearing.)	Ring gear. (Excessive wear, cracks.)		
	Bearings. (Abnormal noise.)		
	(*)(Free play.)		
	Anchor bolts. (Loosensee.)		
	Lubrication.		
Rotation motor, gear box.	Oil leakage.		
	Abnormal noise, excessive heat.		
	Bolts nuts. (Looseness.)		
	Pinion gear. (Excessive wear, cracks.)		
	Back-lash between pinion and ring gear.		
	Gear oil. (Oil level.)		Oil change interval; 1,200 hours or Annually.
	(*)(Oil change.)		
Swivel joint.	Oil leakage.		
	Anchor bolts, stopper. (Looseness.)		
	(*)Slip rings, carbon brushes. (Excessive wear, corrosion.)		
	Lubrication.		
Control system.	Control lever, switch, cable, linkage. (Function, excessive free play.)		
	Instruments. (Function.)		
	Relief valves. (Noise, Oil leakage.)		
	(*)(Pre-set pressure.)		
	Control valves. (Oil leakage.)		
	Name plates, Decals. (Legibility, any damage.)		
	Accelerator. (Function.)		
	(*)(Any damage of the components.)		

UNIT	ITEM	CHECK MARKS	REMARKS
Boom.	Bend, distortion, dent, cracks.		
	Anchor pins. (Excessive wear.)		
	(*)Wear pads, rollers. (Excessive wear, cracks.)		
	Telescoping function.		
	Wire ropes. (Excessive wear, corrosion, tension.)		Wire ropes should be inspected in detail, when boom is disassembled for inspection every 4 years.
	Hydraulic hoses. (Oil leakage, any damage.)		
	Sheaves. (Excessive wear, free play.)		
	Lubrication.		
Extension, Elevation, cylinders.	Piston rod, cylinder tube. (Cracks, deformation, scratches.)		
	Oil leakage, faulty function.		
	Anchor pins. (Wear.)		
	Lubrication.		
Platform leveling system.	Function.		
	Levelling cylinders. (Oil leakage.)		
	Relief valves. (Oil leakage.)		
	Stop valves. (Oil leakage.)		
Platform.	Cracks, deformation.		
	Anchor bolts. (Looseness.)		
	Hook for safety belt. (Cracks, deformation.)		
Hydraulic plumbings.	Oil leakage, any damage.		
Auxiliary devices.	Engine start stop system. (Function.)		
	(*)(Any damage of the components.)		

UNIT	ITEM	CHECK MARKS	REMARKS
Auxiliary devices.	Emergency pump. (Function.)		
	(*)(Any damage of the components.)		
	Emergency stop. (Function.)		
	Hydraulic out-lets. (Oil leakage.)		
	(*)(Pre-set pressure.)		
	Receptacles. (Any damage.)		
	Alarm horn. (Function.)		
	(*)(Any damage of the components.)		
	Working range controller. Moment limitter. (Function.)		
	(*)(Sensors for any damage, Limited working radius, Controlled speed.)		
	Motion alarm buzzer. (Function.)		
	Safety switch. (Function.)		

The following tests are to be carried out annually.

Function test.

TEST	ITEM	CHECK MARKS	REMARKS
Load test.	Function.		
Natural descent test.	Extension cylinder.		Sevviceable limit; 2 mm (0.08in)/10 minutes.
	Elevation cylinder.		
Operational speed test.	Elevation speed.		
	Extension speed.		
	Rotation speed.		
	Travel speed.		
	Platform swing speed.		

REMARKS