SME-111-B

SERVICE MANUAL

CRAWLER TYPE AERIAL PLATFORM

SR181

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

INTRODUCTION

This manual describes correct adjustment and servicing procedures for CRAWLER TYPE AERIAL PLATFORM **SR 181** in order to ensure the most effective use of the superb performance and excellent operation features for your satisfaction.

Read this manual carefully and understand the descriptions correctly.
We sincerely hope that this manual assists you in your servicing work.

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

Service Department.

Aichi Sharyo Co., Ltd.

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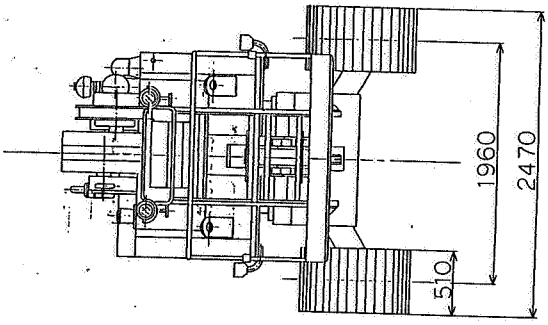
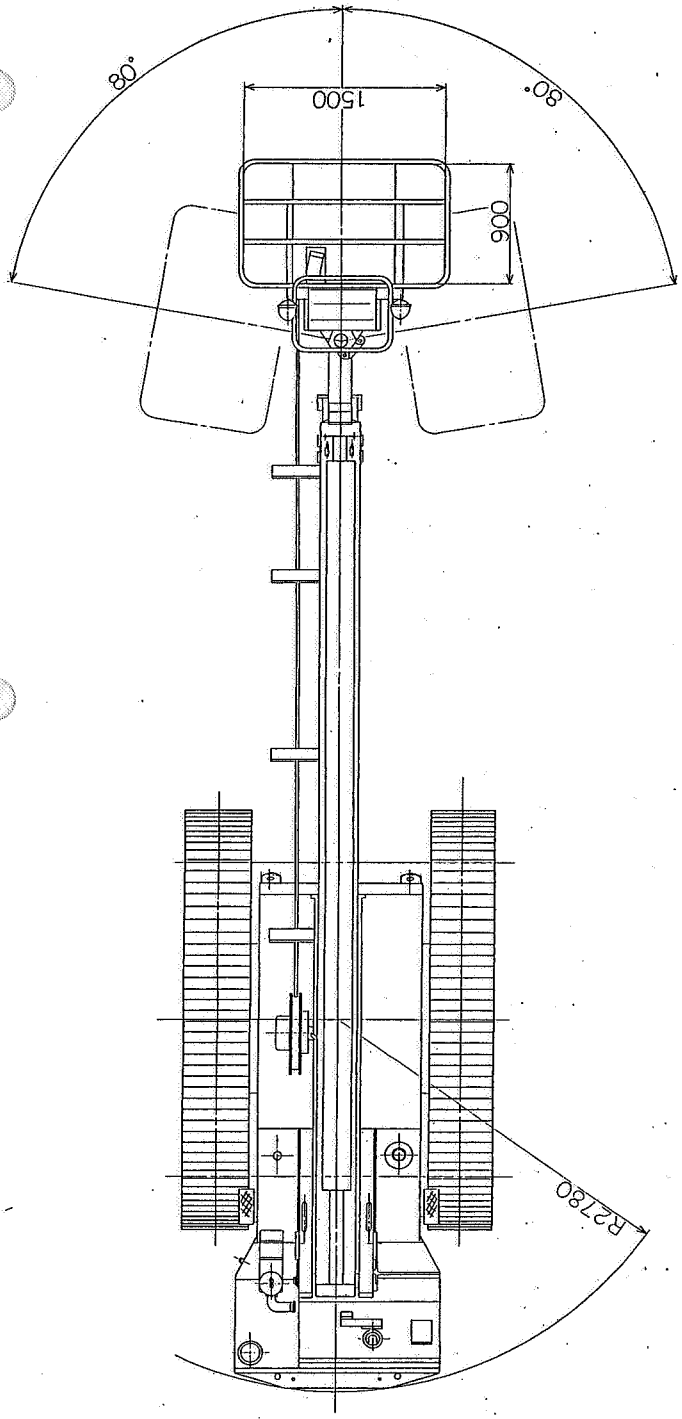
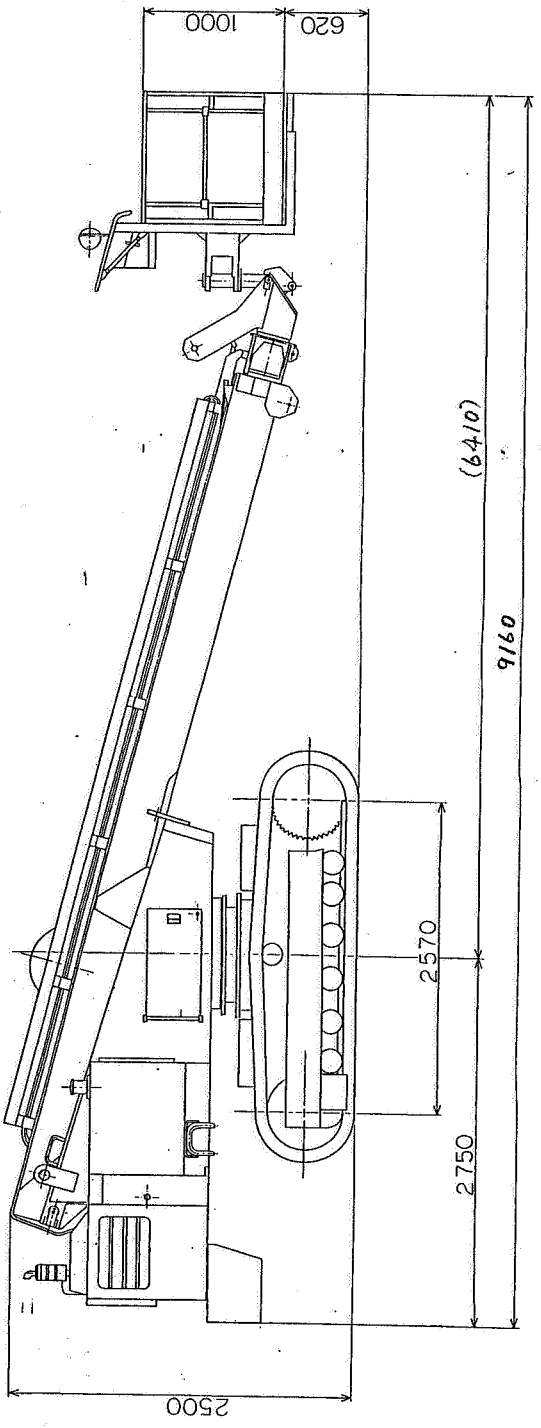
OVERALL DIMENSIONS





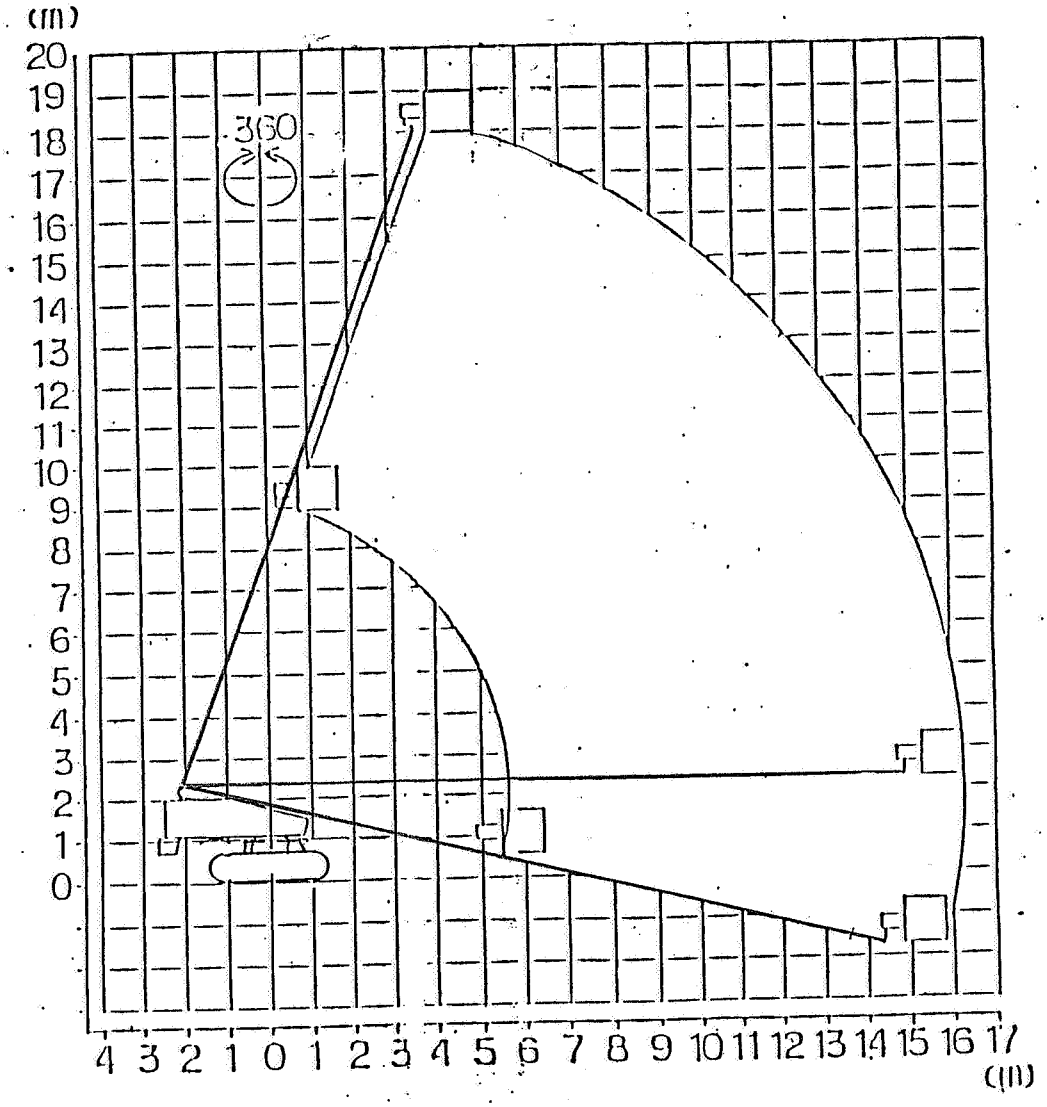


Major specifications

Model	SR 181
Platform	
Rated load	250 kg.
Max. platform floor height	18.1 meters.
Max working radius	16.0 meters.
Slew angle	45° (Right & Left)
Boom	
Elevation angle	−14° ~ 71°.
Boom length	7.17 ~ 16.84 meters.
Slew angle	360°. (continuously)
Power unit	
Model	Mitsubishi S4E-2.
Total displacement	2,957 cc.
Max. power	52 PS/2,300 rpm.
Max. torque	18.0 kg m/1,600 rpm.
Fuel tank capacity	165 liters.
Hydraulic system	
Oil reservoir capacity	150 liters
Recommended oil	Shell tellus T-15.
Max. hydraulic pressure	
for Elevation, Telescoping Slew systems	175 kg/cm^2.
for Travel system	210 kg/cm^2.
for Platform slew system	140 kg/cm^2.
Hydraulic pump	
Type	Tandem gear type.
Rated discharge volume	
Pump NO. 1	40 cc/rev.
Pump NO. 2	10 cc/rev.
Operational speed	1,000 ~ 2,450 rpm.

WORKING LOAD RATING CHART

Rating load : 250 Kg



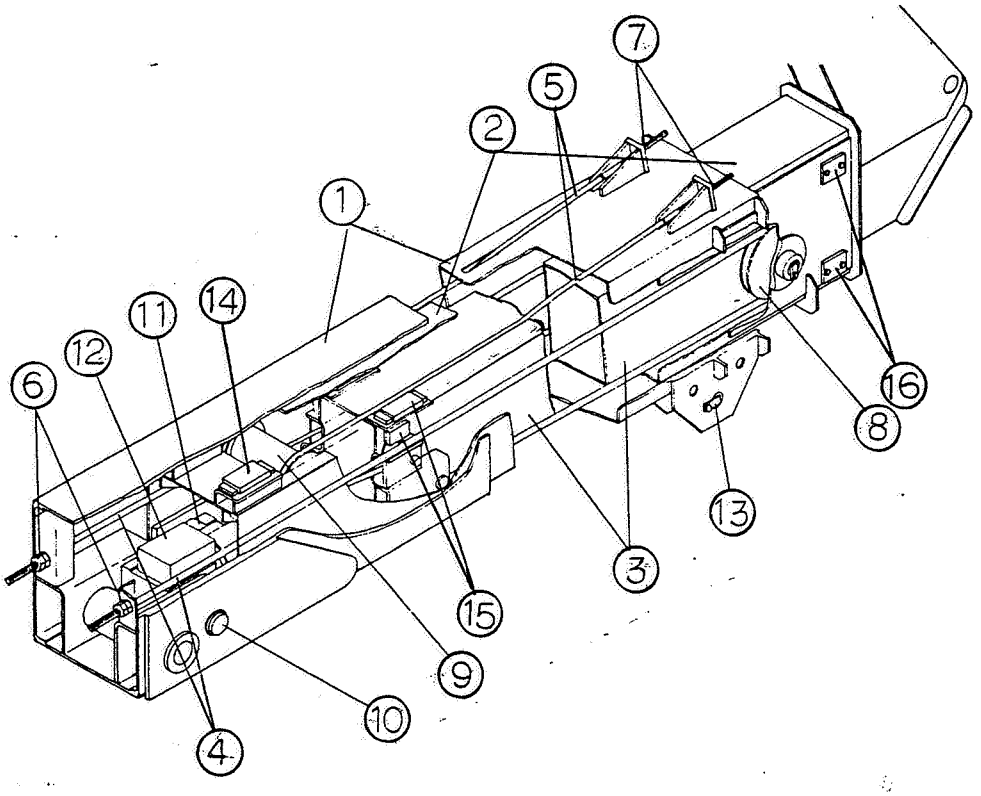
* The deflection of boom is not considered on the working load rating chart.
* The boom is capable of being slewed through 360°.
* The working load rating chart is calculated, assuming that the equipment is sited on a firm, level ground, and wind velocity is below 10 meters per second.
* The counter weight must be installed at the specified position.

AMECHANICAL SECTION

BOOM

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

Fig: 1



1. Base boom.
2. 1st boom section.
3. 2nd boom section.
4. Extension wire rope.
5. Retraction wire rope.
6. Lock-nut & Adjust-nut NO. 1.
7. Lock-nut & Adjust-nut NO. 2.
8. Sheave A.
9. Sheave B.
10. Set pin A. (for Telescoping cylinder)
11. Set pin B. (for Telescoping cylinder)
12. Telescoping cylinder.
13. Set pin. (for Roller)
14. Slider.
15. Slider.
16. Slider.

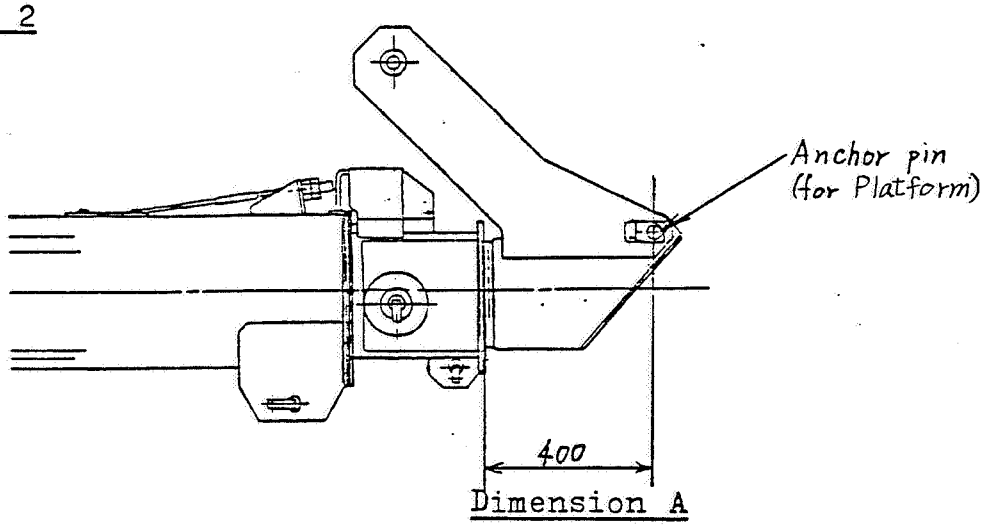
Inspection procedures.

1. Tension of extension/retraction wire ropes.

Extend/retract boom sections to their full stroke, and check for jerky movement caused by loose or stretched extension/retraction wire ropes.
In case the wire ropes are loose, adjust their tensions as follows.

1) Retract boom fully and set it horizontally.
2) Loosen lock-nuts and adjust-nuts NO. 1 ⑥, which are located at the both sides of base boom tail part. (Refer to Fig: 1.)
3) Lubricate the adjust nuts NO. 1 with machine oil, and make certain that the nuts turn smoothly on the threads.
4) Tighten both of the adjust-nuts NO. 1 alternately up to the specified tightening torque, using torque wrench.
   - Tightening torque of Adjust-nut NO.1: 3.0 - 4.0 kg-m.
5) Check the dimension A shown in Fig: 2, and make certain that it is approximately 400 mm.

Fig: 2



In case the dimension A is more than 400 mm:
- Screw out adjust-nuts NO. 1 ⑥ and screw in adjust-nuts NO. 2 ⑦ till the specified dimension A is obtained.

In case the dimension A is less than 400 mm:
- Screw out adjust-nuts NO. 2 ⑦ and screw in adjust-nuts NO. 1 ⑥ till the specified dimension A is obtained.

6) Extend/retract boom several times to its full stroke, and recheck the tightening torque of adjust-nuts NO. 1, and the dimension A, then lock the adjust-nuts with lock-nuts.

2. Clearances between boom sections.

1) Check the clearances between each slider and boom section.
   - Standard clearance; 0 - 2 mm.

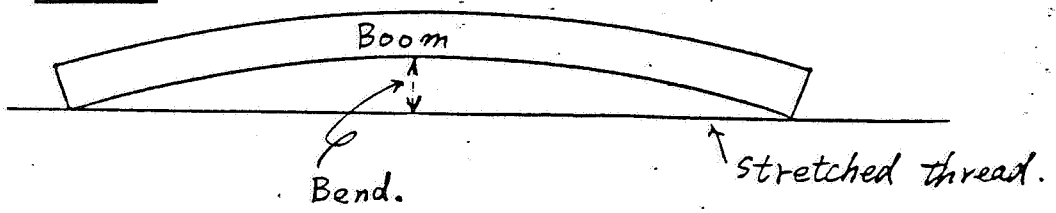
2) If the clearance is not within the standard, adjust the clearance by adding or reducing the spacers installed under the each slider.

NOTE; - Do not reuse the sliders worn to less than 6 mm in thickness
- Apply thread lock agent such as "3-BOND, TB-1303-B" on the thread of the set screws of each slider, before screwed in.

3. Bend of boom section.

1) Set the boom horizontally and extend it fully.
2) Visually check the each boom section for bend.
3) If the bend checked visually is seemed to be excessive, stretch a thread over the boom section and measure the bend accurately.

Fig: 3



- The limit of bend; 3 mm.
- If the bend measured above exceeds the limit (3 mm), replace the boom section.

4. Dents scratches.

Check the boom section thoroughly and replace, if excessive dents or scratches are observed.
- The boom section with dent or scratch (length: more than 50mm and Depth; more than 2mm) should be replaced.

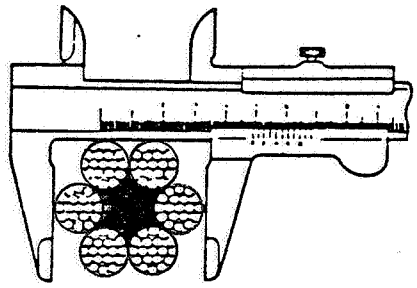
5. Cracks at the weldment.

Check the welded parts of the boom thoroughly for cracks. For fine cracks, use "COLOR CHECK" or penetrant check.

6. Extension/retraction wire ropes.

1) Identify the sections most subject to abrasion and wear. Measure the rope diameter by a vernier caliper as shown in the figure below.

Fig: 4



	Standard diameter	serviceable limit
Extension wire rope	12.0 mm.	11.2 mm.
Retraction wire rope	8.0 mm.	7.4 mm.

2) Check and count the broken wires.
Replace the wire rope, if 10% or more wires are broken within one twist.

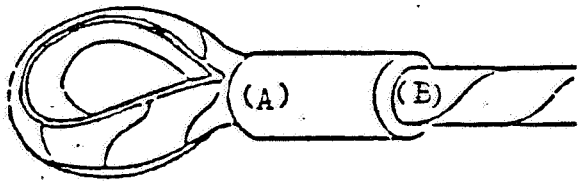
3) Examine degree of corrosion.
- Check if the corrosion is only the surface or deep into the wire rope.
- Replace the wire rope with internal corrosion.

4) Check for deformations.
Replace the wire rope, if kinks, crashes, fraying, soft-twisted or untwisted strands are found out.

5) Check the terminal fittings for the following items.

a) Replace the wire rope, if the swaged ferrule is expanded at (A) in the figure below.

Fig: 5



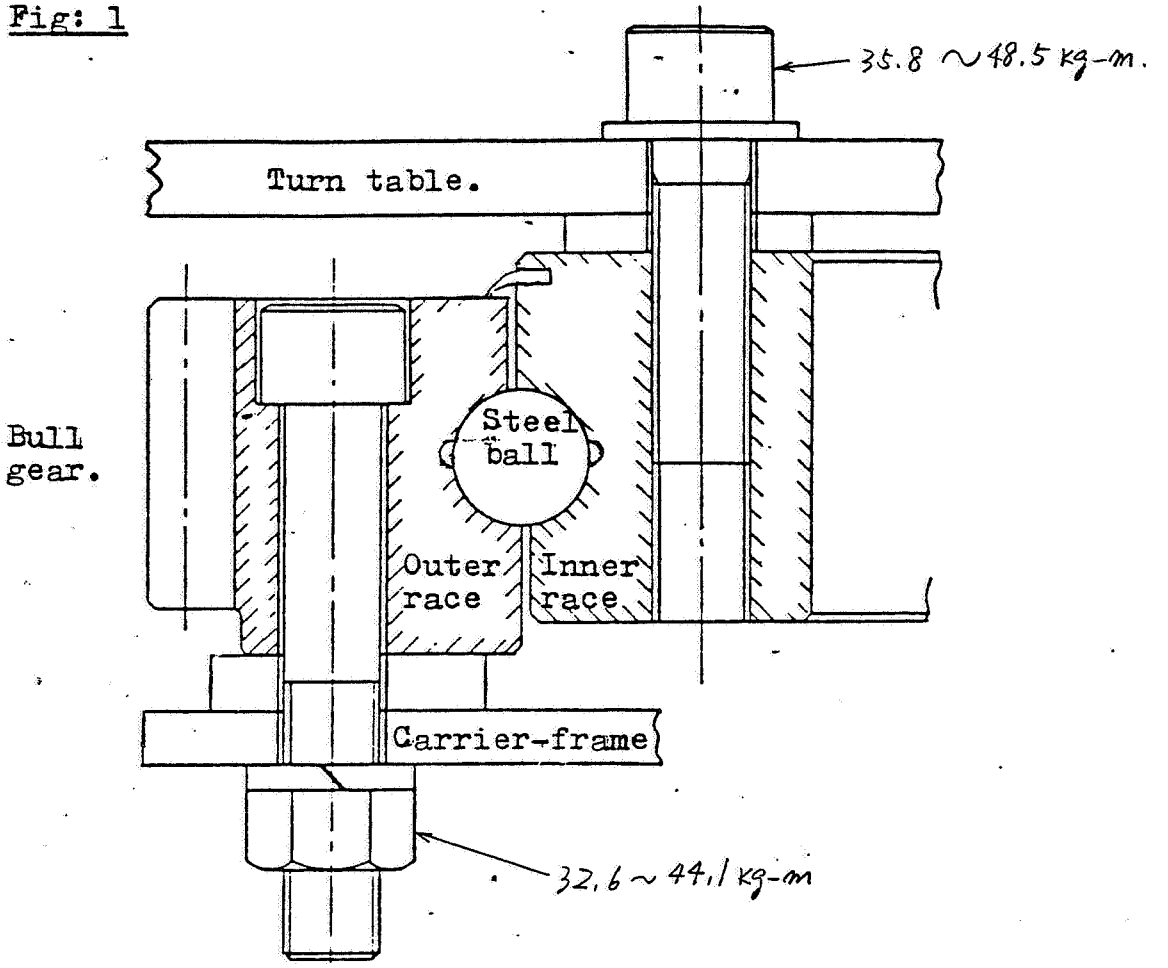
b) Replace the wire rope, if recognizable depression is found out at (B) in the figure above.

c) Replace the wire rope, if broken wires are observed at (B) in the figure above.

T.T.B. (Turn Table Bearing)

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

Fig: 1



Inspection procedures.

1. Check anchor bolts and nuts for looseness, omissions and any other damages.
   a. Loose bolts should be removed and checked for damaged threads and disfigurements.
   b. When resetting anchor bolts or nuts, apply thread lock agent to the threads.
      - Recommended thread lock agent: 3 Bond Loctite TB-1303-B.
   c. Tighten anchor bolts and nuts to the specified tightening torque.
      - Standard tightening torque: (Bolt): 35.8 - 48.5 kg-m.
        (Nut) : 32.6 - 44.1 kg-m.

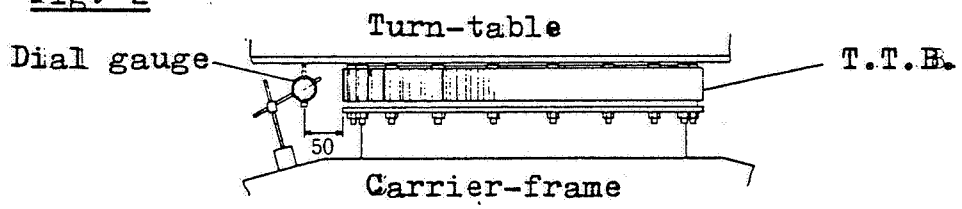
NOTE: Before removing anchor bolts or nuts, use gas bunner and heat them red hot to remove thread lock agent applied on the thread of each bolt and nut.

2. Check bull gears for cracks, scorings and any other damages. For fine cracks, use penetrant check such as color check.
3. Check the back-lash between bull gears of T.T.B. and the drive pinion of slewing mechanism reducer.
   - Standard back-lash: 0.6 mm or less.

   NOTE: To measure the value of back-lash, rotate turn table and crush a lead-wire between bull gears and drive pinion, then measure the thickness of crushed lead-wire.

   When the back-lash is not within the tolerance, adjust it, moving the position of slewing mechanism reducer.
4. Check the free-play between inner and outer races of T.T.B.. To check the free-play, follow the next steps.

Fig: 2



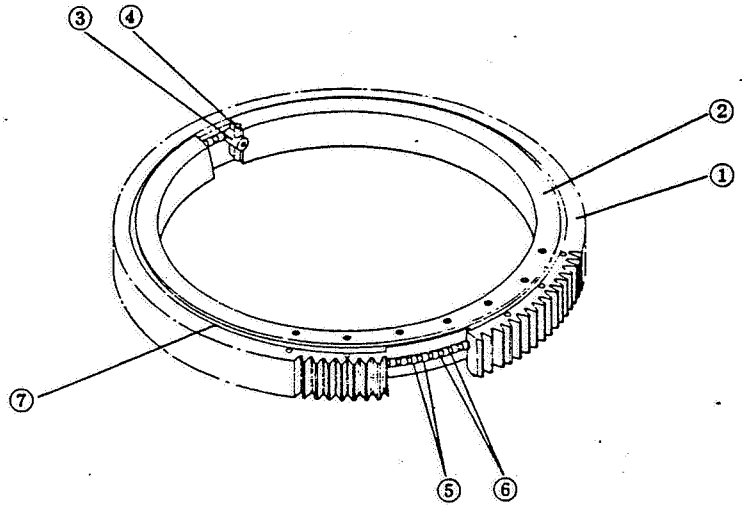
a. Set a dial gauge between turn-table and carrier-frame as shown in Fig: 2.
b. Retract and raise booms fully (with minimum boom length and maximum elevation angle), and set the pointer of the dial gauge at "ZERO".
c. Lower booms, set them horizontally and extend them fully, then read the dial gauge.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

NOTE:

The T.T.B. with free-play in excess of the limit (3.0 mm) should be overhauled or replaced.

Disassembly.

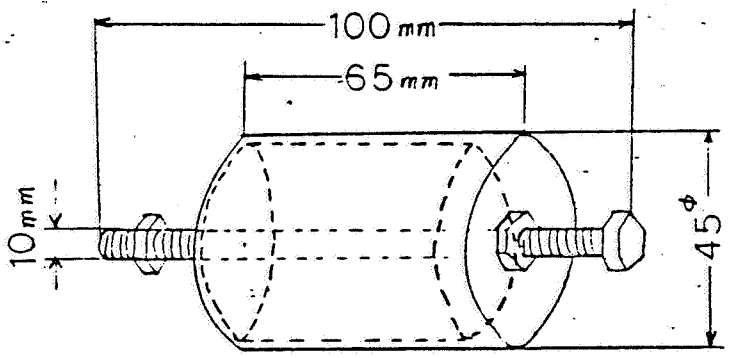
Fig: 3



1. Outer race. 3. Blank cap. 5. Steel ball. 7. Seal.
2. Inner race. 4. Lock pin. 6. Separator.

1. Place T.T.B. on a work-bench, so that inner race ② contacts on the bench and outer race ① rotates smoothly.
2. Tap lock pin ④ using a hammer and a proper metal rod, and remove the lock pin.
3. Remove blank cap ③, using special tool which is shown in Fig: 4.

Fig: 4



T.T.B. blank plug remover.

4. Insert a magnetic rod through the hole where blank cap ③ was removed, atract one of steel balls, and remove it through the hole.
5. Remove all of the steel balls and separators through the hole, as rotating outer race ①.
6. Lift up outer race ①, and remove it from inner race ②.
7. Remove seal ⑦ from inner race ②.

Inspection.

1. Wash and clean all of the disassembled parts in a solvent. Pay special attention to the grease fitting holes, and remove such as sticked grease and any other foreign particles.
2. Check inner and outer races for the following items.
   a. Bull gears for wear, cracks, scorings, etc.
   b. Steel balls contact surfaces for wear, scorings, etc.
   c. Bolt holes for any damages.
3. Check steel balls and separators for cracks, scorings, wear and any other damages.

NOTE: Steel balls of oversize are provided in case of over worn inner and outer races.

4. Check seal (7) for any damages.

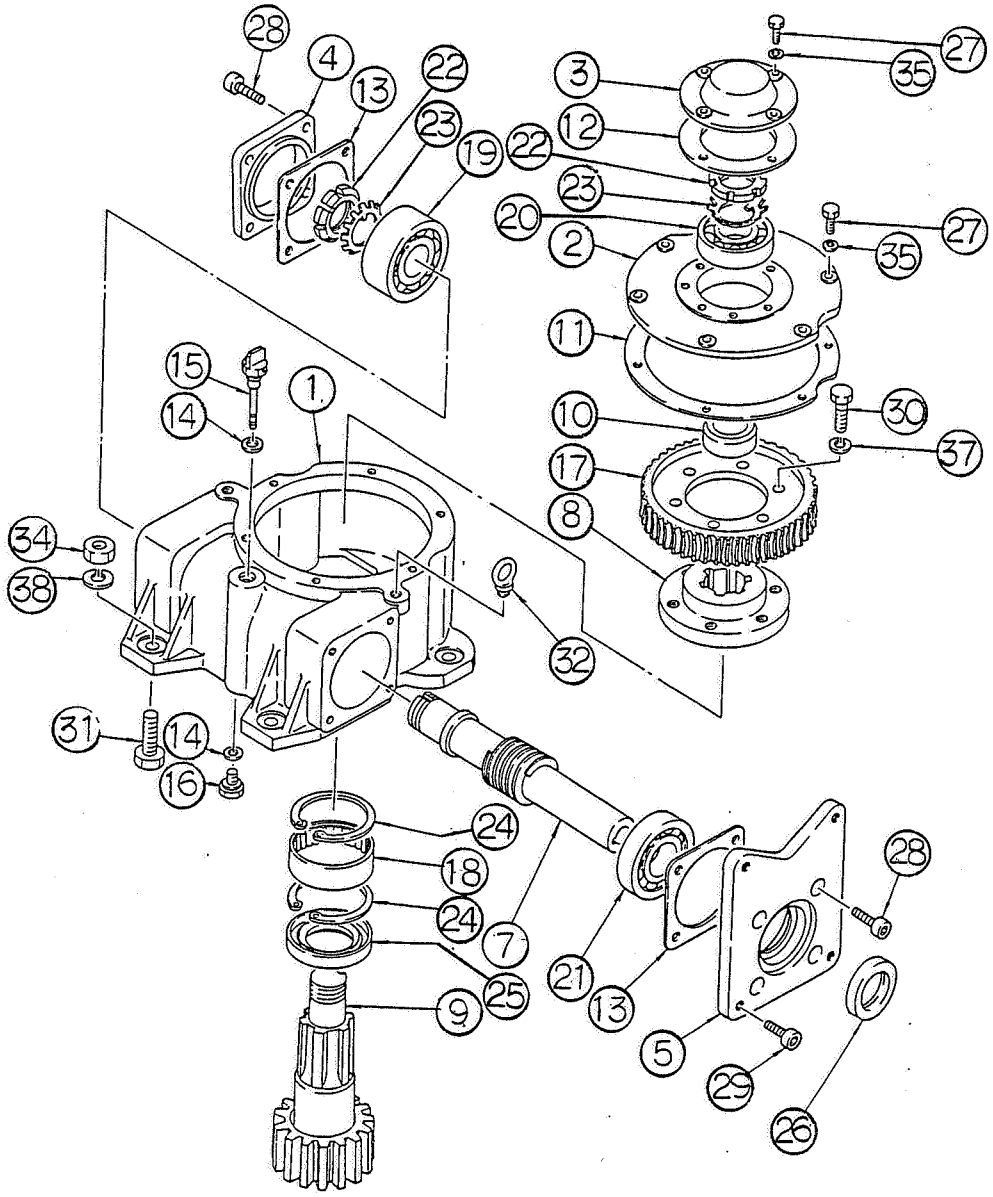
Assembly.

1. Assemble in the reverse order of disassembly.
2. Supply grease to T.T.B.
   - Recommended grease: Shell Alvania grease EP-2.
3. Make certain that the assembled T.T.B. rotates soomthly with out excessive free play between inner and outer races.

SLEWING MECHANISM REDUCER

Slewing mechanism reducer reduces the rotation speed of hydraulic motor and increases the torque to rotate turn table through turn table bearing.

Fig: 1



1. Case.
2. Cover.
3. Cover.
4. Cover.
5. Cover.
6. ---------
7. Worm shaft.
8. Boss.
9. Pinion Shaft.
10. Collar.
11. Gasket.
12. Gasket.
13. Gasket.
14. Gasket.
15. Oil level gauge.
16. Drain plug.
17. Worm wheel.
18. Needle bearing.
19. Ball bearing.
20. Ball bearing.
21. Ball bearing.
22. Lock nut.
23. Lock washer.
24. Snap ring.
25. Oil seal.
26. Oil seal.
27. Bolt.
28. Bolt.
29. Bolt
30. Bolt.
31. Bolt.
32. Eye bolt.
33. ---------
34. Nut.
35. Spring washer.
37. Spring washer.

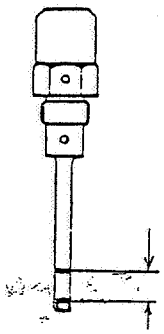
Inspection procedures

1. Check the amount of gear oil. Also check for oil contamination.

   NOTE: To check the level of gear oil, keep the vehicle in its level position and screw oil level gauge (15) fully into the case.

   a. Oil level is indicated by oil level gauge.
   The proper level is between the two lines on the level gauge.

Fig: 2



Proper oil level.

   b. If metallic particles are found in the gear oil, examine irregularities of gears and bearings.

- Recommended gear oil: Shell Omala 460.
- Oil change interval: Every 1,200 working hours or annually.

2. Run the slewing mechanism reducer, and check for abnormal noise, oil leakage and overall performance.
3. Check the teeth on pinion shaft (9) for excessive wear, scorings, cracks and any other damages.
4. Check the back-lash between the pinion gear and the bull gear of T.T.B.

   - Standard back-lash: 0.6 mm or less.

   To check the back-lash, follow the next steps.

   a. Place a lead wire between pinion gear and bull gear of T.T.B.
   b. Rotate the gears slowly and crush the lead wire.
   c. Measure the thickness of crushed lead wire by a vernier caliper to dertermine the back-lash.
   d. If the back-lash is not adequate, loosen the anchor bolts of slewing mechanism reducer and adjust the position of the reducer.

Disassembly

1. Remove oil level gauge (15) and drain plug (16), and drain gear oil.
2. Remove cover (4) from case (1).
3. Unlock lock washer (23) and loosen lock nut (22).
4. Remove cover (5) from case (1) and remove oil seal (26).
5. Pull out worm shaft (7) toward cover (5), then remove ball bearing (21) from the worm shaft.
6. Remove ball bearing (19) from case (1).
7. Remove cover (3).
8. Unlock lock washer (23) and loosen lock nut (22).
9. Remove cover (2) from case (1).
10. Remove ball bearing (20) from the cover (2).
11. Remove collar (10) and worm wheel (17) with boss (8) from pinion shaft (9).
12. Pull out pinion shaft (9) from case (1).
13. Remove oil seal (25) from case (1).
14. Remove snap ring (24), then remove needle bearing (18).

Inspection

1. Check bearings for excessive free play and any other damages.
2. Check worm wheel (17) and worm shaft (7) for wear, cracks, scorings, and any other damages.
3. Check the oil seal contact surface of each shaft for wear, and any other damages,
4. Check pinion gear for wear, cracks and any other damages.
5. Check the splined part of pinion shaft (9) and boss (8) for wear, cracks, deformations and any other damages.
   Also check the free-play between the pinion shaft and boss. If excessive free-play (More than 0.2 mm) is found, replace either the shaft or boss.

Assembly

- Do not reuse oil seals and gasket.
- Apply sealant when installing gaskets.
- Apply clean gear oil to the rotating parts (eg., bearings, gears), when installation.

- Apply grease slightly to the lips of oil seals before installation.

1. Install needle bearing (18) and oil seal (25) onto case (1).
2. Install worm wheel (17) onto boss (8).
   - Tightening torque. (Bolt 30): 350 - 530 kg-cm.
3. Install pinion shaft (9) in case (1).
4. Install worm wheel (17) and collar (10) on pinion shaft (9).
5. Install cover (2) onto case (1) with gasket (11) between the case and the cover.
6. Install bearing (20) onto cover (2), and install them onto the case.
7. Tighten lock nut (22) and lock with lock washer (23).
8. Install cover (3) onto cover (2) with gasket between the covers.
9. Install bearing (19) onto worm shaft (7) and tighten lock nut (22), then lock the nut with lock washer.
10. Press oil seal (26) onto cover (5).
11. Insert worm shaft (7) from cover (4) side into the case.
12. Press bearing (21) into case (1).
13. Install cover (4) onto the case with gasket (13) between the case and cover.
14. Install cover (5) onto the case with gasket between the cover and case.
15. Install drain plug (16), and refill with gear oil up to the specified level.
    - Recommended gear oil: Shell Omala 460.
16. Install oil level gauge (15).

HYDRAULIC SECTION

Note on overhauling hydraulic system.

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

1. When disconnecting plumbings.
   a. Prepare proper container to recieve draining oil.
   b. Put "MATCH MARKS" on each plumbing before disconnection for easier recoginition on connection.
   c. Use double spanners as not to damage plumbings or components.
   d. Clean the disconnecting plumbings or components before disconnection, as not to permit foreign particles into the hydraulic system.
   e. Install proper plugs to the disconnected plumbings or components, as not to permit foreign particles into the hydraulic system.

2. When connecting plumbings.
   a. Confirm the "MATCH MARKS" marked on disconnection to avoid wrong connections.
   b. Clean the connecting plumbings, as not to permit foreign particles into the hydraulic system.
   c. When connecting TP adaptors, wind seal-tape at least one and a half times aroung the threads.
   d. Use double spanners, when tightening the connections.

3. When assembling or disassembling hydraulic components.
   a. Put proper plugs onto the openings of oil passages as not to permit foreign particles into the components.
   b. Before disassembling, clean the component thoroughly with a solvent and compressed air.
   c. Clean each disassembled part with solvent thoroughly for easier check-up and prevention of foreign particle introduction.
   d. When assembling O rings or packings, apply grease slightly 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) Operational temperature should be below 70° C and ideally below 60° C, as heat causes early oxidation.
   On the other hand when the oil is very cold, a warm-up period is recommended before operation.
2) Regularly check for pollutants in the hydraulic oil.
   Contaminants in the oil may be catalysts to quicken 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 of 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 equipment and its plumbings.
6) Make it a habit to check the oil regularly.

Guidelines for oil change.

Oil change should be carried out every 1,200 working hours or annually. (For new equipment: After one month use.)
In the meantime, take a small amount of oil from 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 becomes 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 oil.
      - A complete oil-change is necessary.

b) If the oil and water separates, it is an indication 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 on the bottom of container, it is an indecation that air had been mixed into the oil.
- Check for the cause of air mixture and rectify.

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

2) Analytical tests.
Test the hydraulic oil for viscosity, water content, oxidation, contaminants, etc.

Test for	Shell Tellus 46	Shell Tellus T15
Contamination	Within NAS Class 12.	
Water content	Less than 0.5 %.	
Oxidation	0.4 mgKOH/g.	
Viscosity (at 40°C)	46 cst.	15 cst.

Suction strainer.

Be sure to clean suction strainer at the time of oil change. Wash and clean the strainer in kerosene or similar solvent, then air-blast from inside.

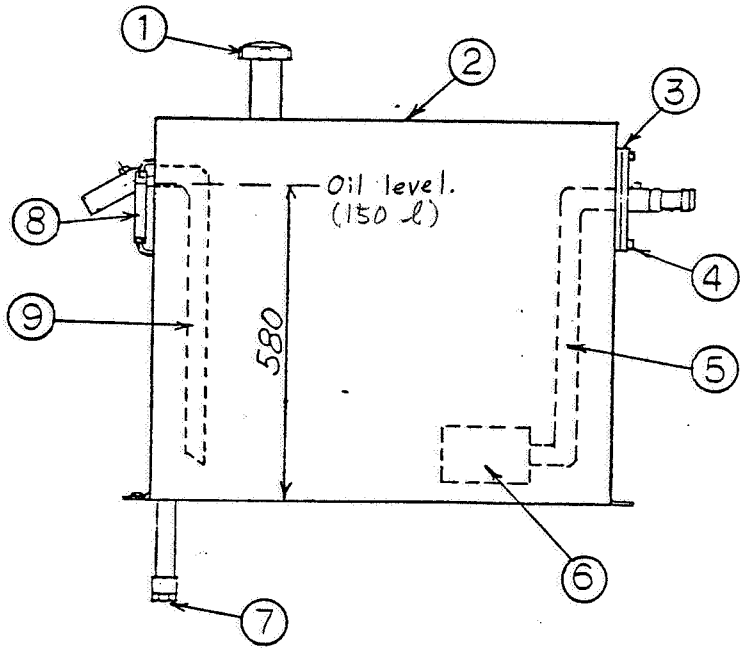
Oil filters.

Regulary change filter element. If the equipment is new, change it after one month use. Thereafter, change it annually at the time of oil change.

HYDRAULIC OIL RESERVOIR

Hydraulic oil reservoir consits of oil reservoir, suction strainer, suction pipe, return pipe, oil level gauge, etc.

Fig: 1



1. Oil filler cap.
2. Oil reservoir.
3. Gasket.
4. Bolt.
5. Suction pipe.
6. Suction strainer.
7. Drain plug.
8. Oil level gauge.
9. Return pipe.

Oil capacity:	150 liters.
Recommended oil:	Shell Tellus T-15.

Inspection procedures.

1. Check the anchor bolts and nuts for looseness, omissions.
2. Check for oil leakage thoroughly.
3. Check for deformations, cracks and any other damages.
   - Pay special attention to pipe flanges and welded parts.
4. Check oil level under the following conditions, and add up to the specified level, if necessary.
   - Booms: Fully retracted and stowed on the boom rest (ladder rest) properly.
   - Engine: Stoped.
   - Oil temperature: Less than 40°C.
5. Check the oil for contamination, water content, etc., as refering the clause of "HYDRAULIC OIL" and change, if necessary.

Oil change procedures.

1. Park the vehicle on a level ground.
2. Make certain all of the hydraulic components are at their stowed positions (eg, Booms are fully retracted and stowed on boom rest. ~~Stabilizers are properly stowed.~~), and stop the engine.
3. Remove filler cap ①, then drain plug ⑦ and drain oil completely.
   (Prepare proper container to catch oil.)
4. Clean inside of oil reservoir and suction strainer, following the next steps.
   1) Screw out bolts ④ and remove suction pipe ⑤ and suction strainer ⑥.
   2) Clean inside of oil reservoir thoroughly, using a solvent and compressed air.
      - If the sediment is sticked firmly on the bottom of oil reservoir, dismount the oil reservoir Assy and remove sticked sediment using proper wire brushes, etc.
   3) Remove suction strainer from suction pipe, wash suction strainer in a solvent and air-blast from inside.
   4) Install suction strainer onto suction pipe, and assemble them onto oil reservoir.
      - Replace gasket ③, if necessary.
5. Install drain plug ⑦ onto oil reservoir.
6. Replace in-line filters, as following the clause of IN-LINE FILTER.
7. Fill the specified hydraulic oil up to the specified level. and install filler cap ①.
8. Operate the equipment thoroughly and recheck the oil level.

NOTE:

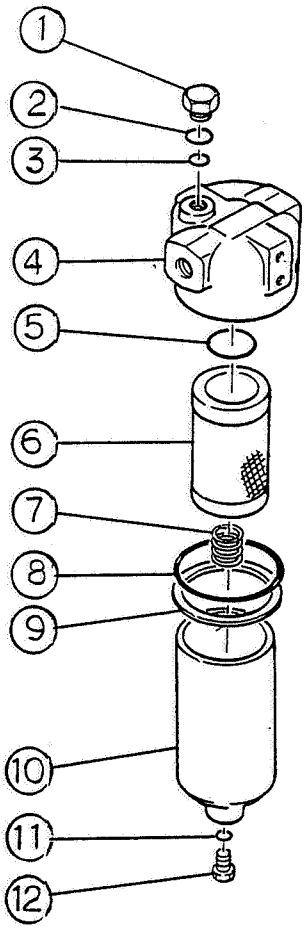
- Hydraulic oil change interval:
  Every 1,200 woring hours or annually.

IN-LINE FILTER

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

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

NOTE: The first replacement of filter element for new equipment is carried out after 100 working hours or one month use.



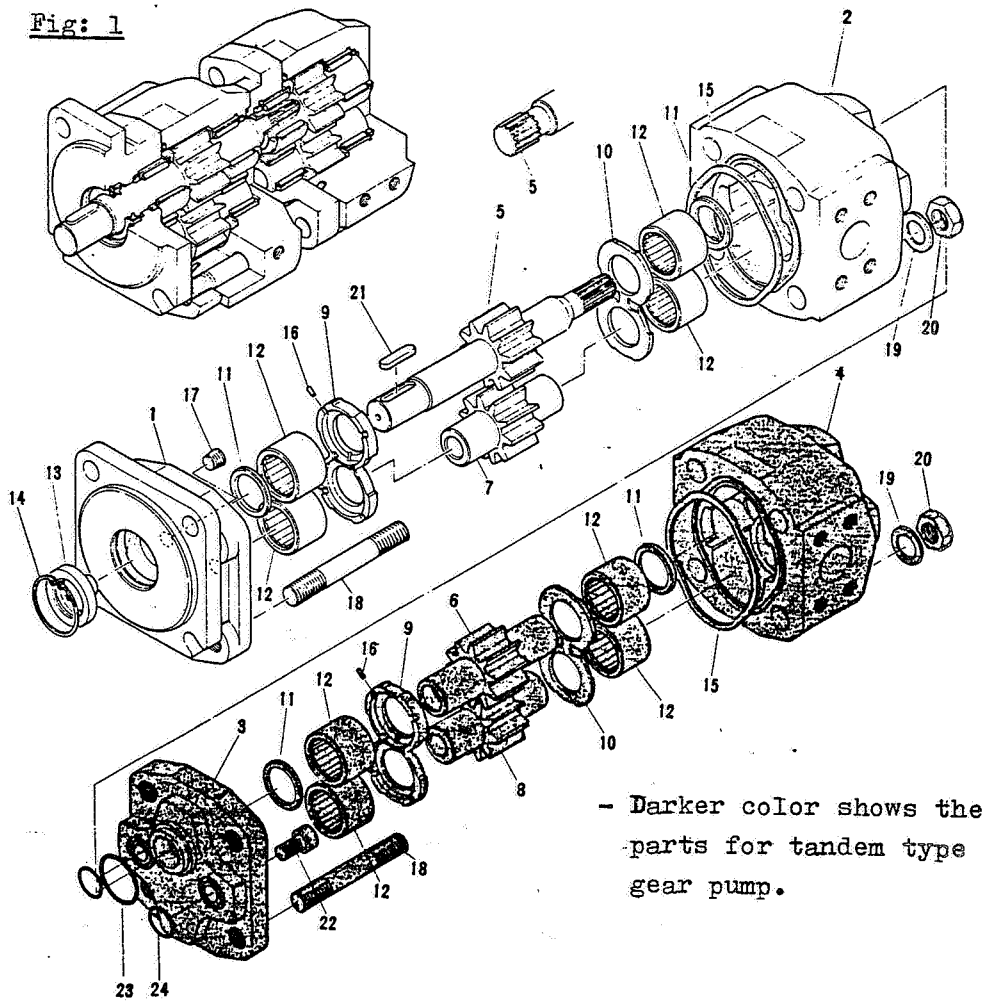
1. Plug.
2. O ring.
3. O ring.
4. Head.
5. O ring.
6. Filter element.
7. Spring.
8. O ring.
9. Back up ring.
10. Case.
11. O ring.
12. Drain plug.

CAUTION: Do not reuse the O rings and back up ring, when removed once.

HYDRAULIC PUMP

Hydraulic pump delivers hydraulic oil to each actuator at the specific hydraulic pressure.

Fig: 1



- Darker color shows the parts for tandem type gear pump.

1. Front frame.
2. Pump housing A.
3. Intermediate frame.
4. Pump housing B.
5. Drive shaft.
6. Drive gear.
7. Idle gear A.
8. Idle gear B.
9. Side plate A.
10. Side plate B.
11. Shaft seal.
12. Needle bearing.
13. Oil seal.
14. Snap ring.
15. O ring.
16. Pocket seal.
17. Plug.
18. Stud bolt.
19. Washer.
20. Nut.
21. Key.
22. Bolt.
23. O ring.
24. O ring.

Type	Tandem gear type.
Rated operational speed	1,000 ~ 2,450 rpm.
Rated discharge volume	
Pump NO. 1:	40 cc/rev. (40 liters/ 1,000 rpm)
Pump NO. 2:	10 cc/rev. (10 liters/ 1,000 rpm)
Max. hydraulic pressure	
Pump NO. 1:	210 kg/cm^2.
Pump NO. 2:	140 kg/cm^2.

Inspection procedures

Inspection is to be conducted under the following conditions.

- Hydraulic oil temperature: 40° - 60°C.
- Hydraulic pump speed: At 1,000 ~ 2,000 rpm.

1. Check for oil leakage visually and by running fingers over the critical areas which include various machined fittings of pump housing, hydraulic plumbing connections, oil seal, etc.

   Caution: Since the cavitation caused by sucked air into the pump results in excessive noise and serious damage, carefully check the inlet line of the pump.
2. Check for abnormal noise and vibration, and if they exist, inspect the probable causes which may include defects in the pump, excessively high maximum pressure, loose anchor bolts, improper connections of pump couplings, etc.
3. Check the temperature on the surface of hydraulic pump. If a 5° to 10°C higher reading is observed as compared with oil reservoir, it may be indicative of a defective pump.
4. Check the maximum hydraulic pressure to determine the pump performance roughly.

   To check the pump performance precisely, measure the discharge volume of hydraulic pump.

   Note: To measure the maximum hydraulic pressure and discharge volume of hydraulic pump, refer to "Measurement method of Max. hydraulic pressure" and "Measurement method of discharge volume" respectively.

Measurement method of Max. hydraulic pressure.

The following conditions should be strictly kept, when measuring Max. hydraulic pressure.

- Hydraulic oil temperature: 40° - 60°C.
- Hydraulic pump speed: At 2,000 rpm.

Note: - When the oil temperature is lower, operate the equipment and raise the temperature.

1. Remove the plug (for pressure test port) at the out-let plumbing of hydraulic pump or at the plumbing between the pump and main relief valve, and set a pressure gauge onto the test port.

2. Start engine and run hydraulic pump at 1,000 rpm.
3. Operate one of the actuators and force it to stop (eg., retract one of the cylinders, and continue to send hydraulic pressure to the rod side of the cylinder.) to activate the main relief valve.
4. Read the pressure gauge, while the main relief valve is active and take the Max. hydraulic pressure.
5. In case that the Max. hydraulic pressure taken in step 4 is higher or lower than the specific Max. hydraulic pressure, adjust the main relief valve to attain the specific Max. hydraulic pressure.

   NOTE: Refer to SPECIFICATION to know the specific Max. hydraulic pressure.

NOTE: In case of tandem or triple pump, measure the Max. hydraulic pressure for each pump, following the steps 1 to 5.

Measurement method of discharge volume.

The following conditions should be strictly kept, when measuring discharge volume of hydraulic pump.

- Hydraulic oil temperature: 40° - 60° C.
- Hydraulic pump speed: At 1,000 rpm.

Note: - When the oil temperature is lower, operate the equipment and raise the temperature.

1. Disconnect the hydraulic hose at the outlet port of the pump.
2. Set a "OIL FLOW GAUGE" between the outlet port and the disconnected hydraulic hose serially.
3. Start engine and run the pump at 1,000 rpm.
4. Close the throttle valve of the "OIL FLOW GAUGE" untill the specific Max. hydraulic pressure is obtained.
5. Under the condition in step 4, read the oil flow gauge.
6. In case that the discharge volume taken in step 5 is less than 70% of the rated discharge volume, the pump should be replaced.

   NOTE: Refer to SPECIFICATION to know the rated discharge volume.

   In case of tandem or triple pump, measure the dischage volume of each pump following steps 1 to 5, and determine if the pump is still serviceable or not, as refering step 6.

SWIVEL JOINT

Swivel joint is installed between turn table and carrier frame to carry hydraulic oil and electric current to the Lower stage of equipment.

It consists of swivel joint itself, which carries hydraulic oil, and slip ring Assy, which carries electric current.

Fig: 1

(Swivel joint Assy)

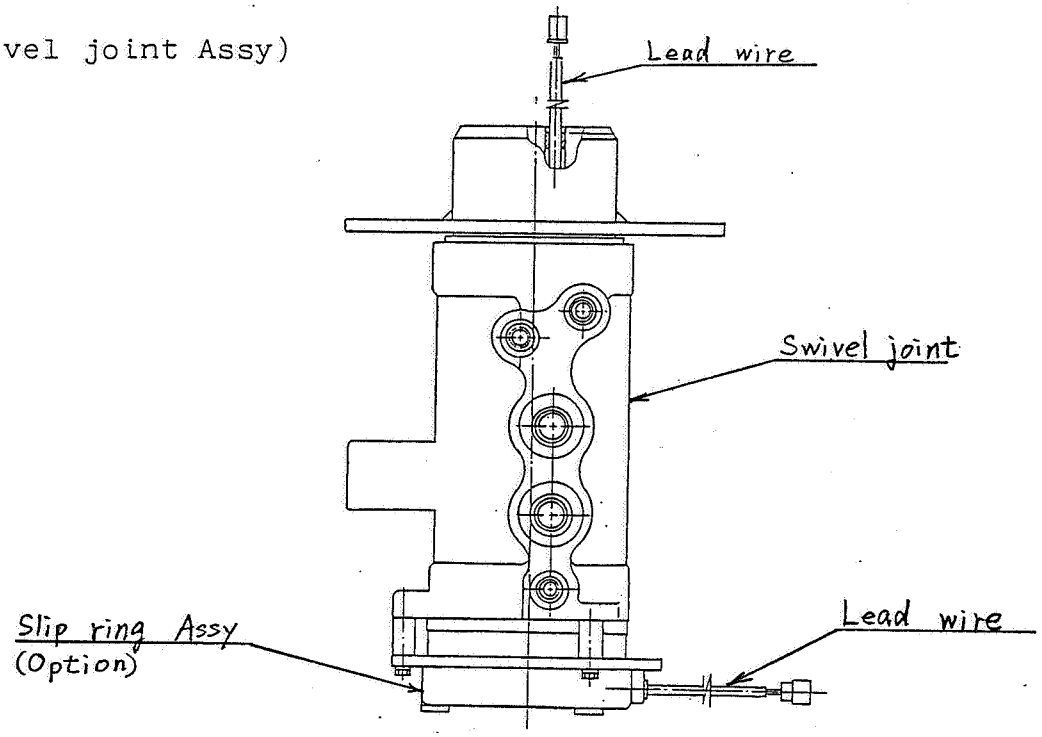
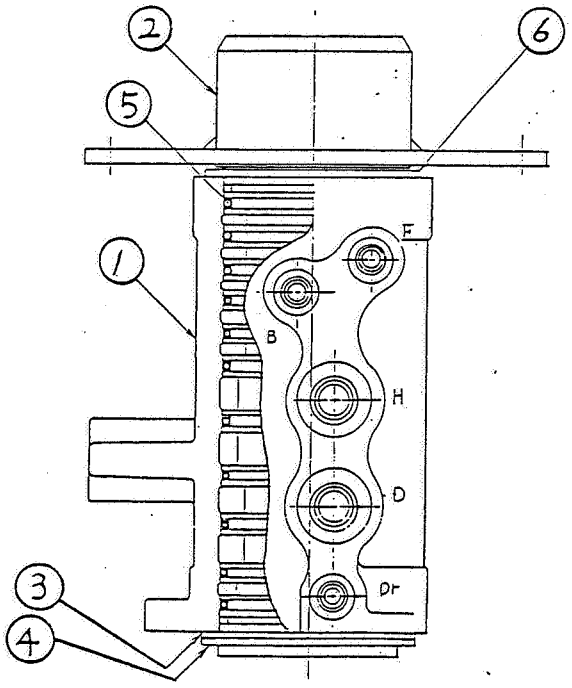
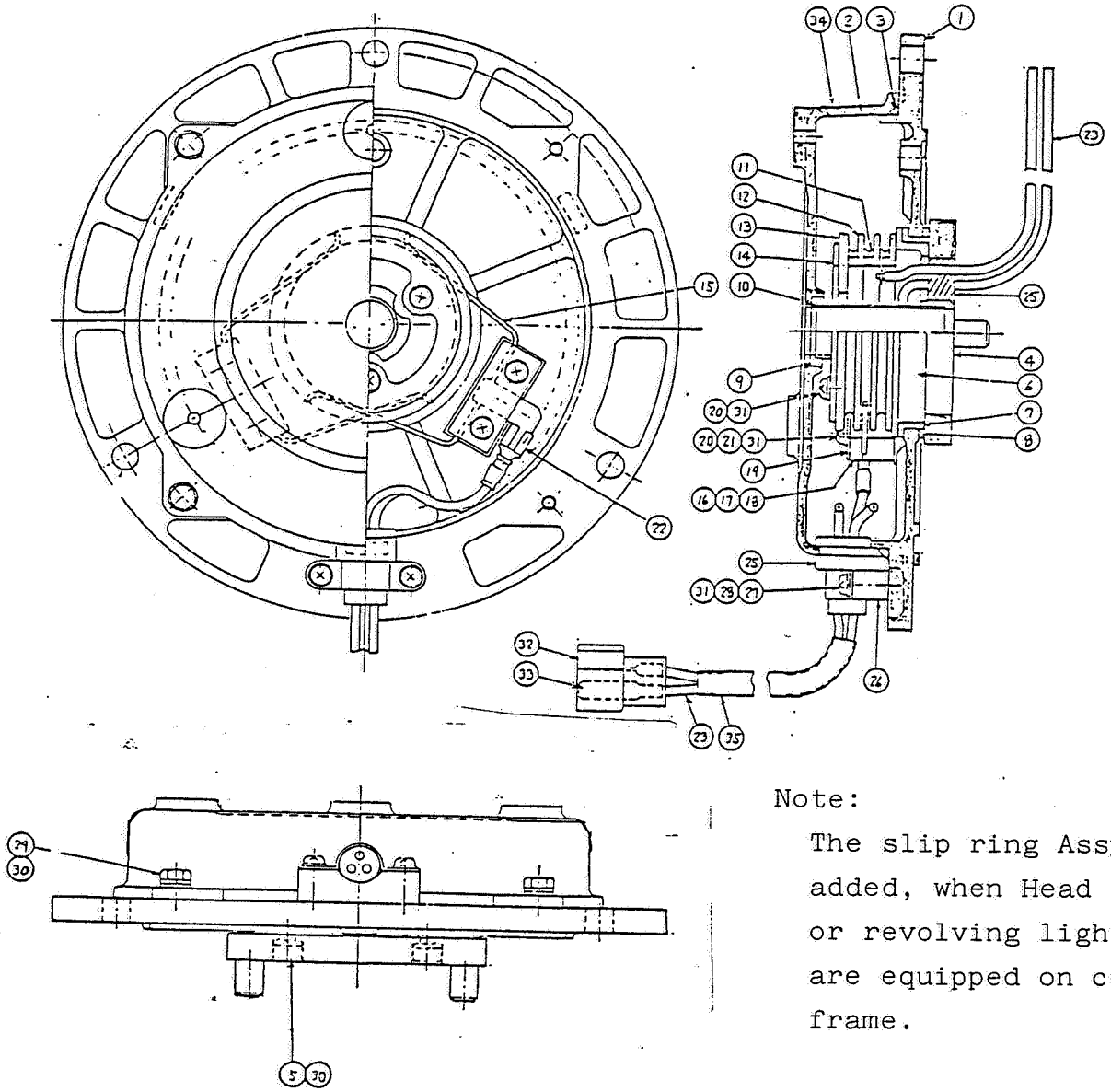


Fig: 2 (Swivel joint)



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

Fig: 3 Slip ring Assy (Option)



Note:

The slip ring Assy is added, when Head lights or revolving lights are equipped on carrier frame.

Inspection procedures.

1. Check anchor bolts and nuts for looseness, omissions.
2. Check for external and internal oil leakage.
   - To check external oil leakage, apply hydraulic pressure to the swivel joint by means of operating travel motors.

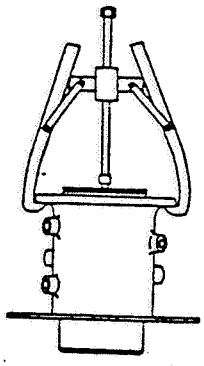
NOTE:

In case internal oil leakage exsists, the operational speed, and out-pur power of the travel motor becomes lower.

Disassembly (Refer to Fig: 1 and Fig: 2.)

1. Remove slip ring Assy from swivel joint, as refering Fig: 1.
2. Remove snap ring ④ and spacer ③.
3. Press out shaft ② from case ① using hydraulic press.
   (or pull out shaft ② from case ① using gear puller as shown in Fig: 4.)

Fig: 4



4. Remove spacer ⑥ from the shaft.
5. 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 damages.
2. Check the clearance between case ① and shaft ②.
   - In case that the clearance exceeds the limit, replace the shaft or case.
     Limit of clearance: 0.4 mm.
3. Check each groove on case ① and shaft ② for ridges, sharp edges.
   - Ridges, sharp edges should be removed before installing O rings, as they may damage O rings.
4. Check slip ring Assy and brush Assy for excessive wear, and any other damages.

Assembly.

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

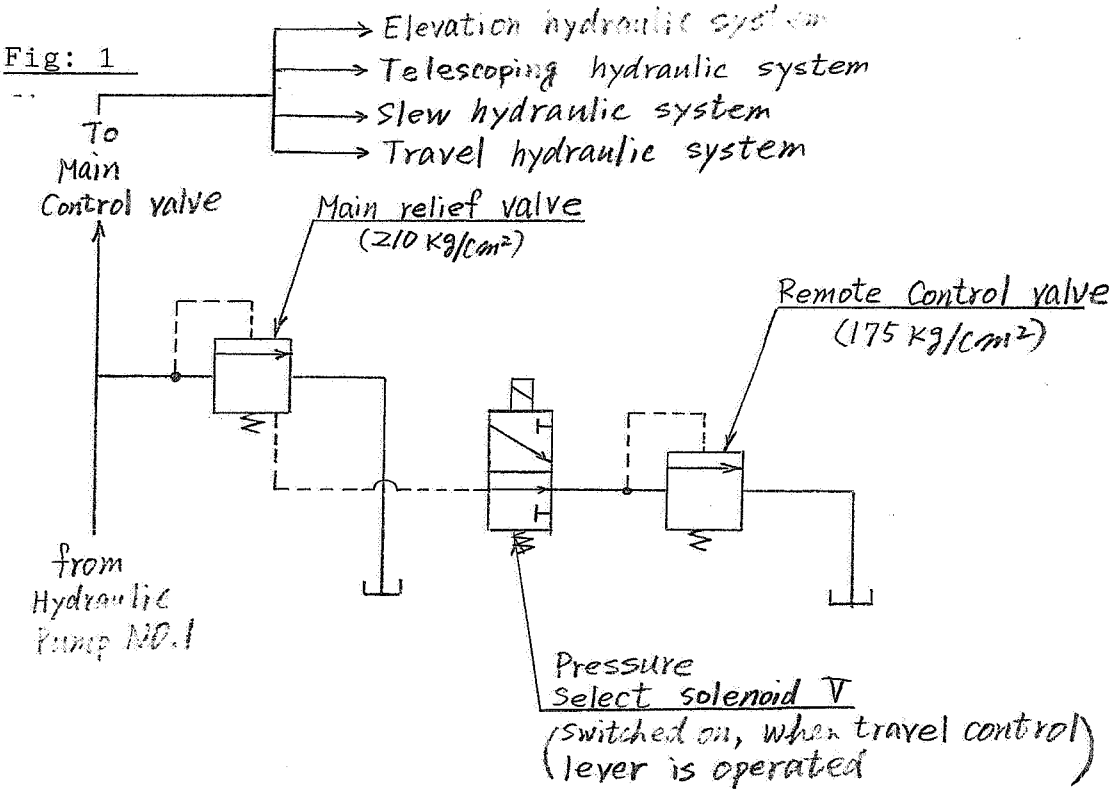
- Do not reuse O rings.
- Apply grease to O rings slightly before installation.
- Clean the surfaces of slip rings and brushes to attain good electrical contact.

MAX. HYDRAULIC PRESSURE CONTROL SYSTEM

The system controls the Max. hydraulic pressure, which is produced by the hydraulic pump NO. 1, and consists of the following hydraulic components.

1. Pressure select (Solenoid) valve.
2. Main relief valve.
3. Remote control valve.

Fig: 1



Note on function

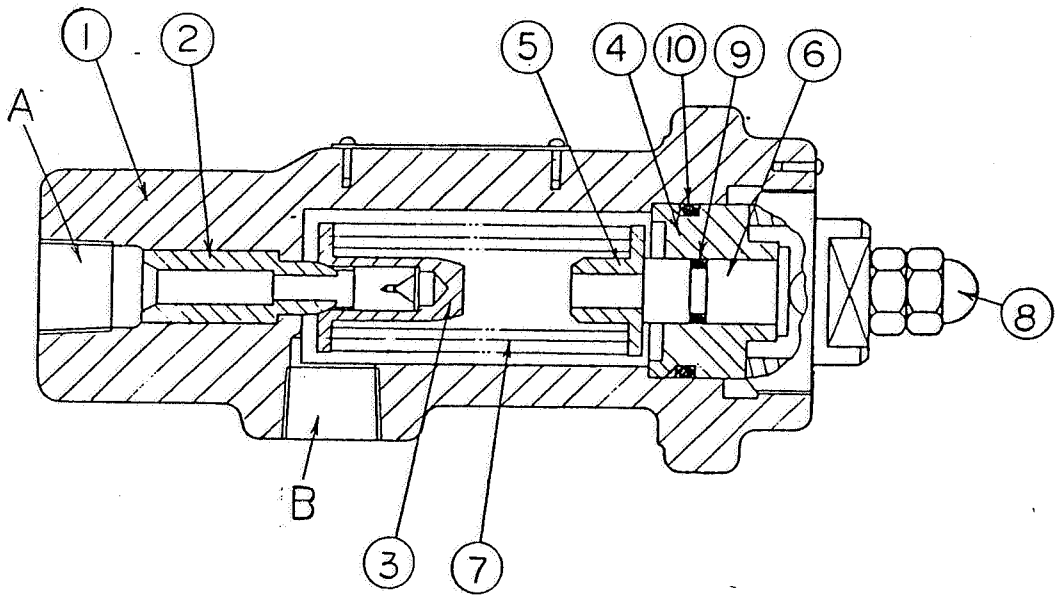
The "Pressure select (Solenoid) valve" is automatically switched ON/OFF by the electric control system, so that the valve is switched on, only when the travel control levers (located at upper control box) is operated.

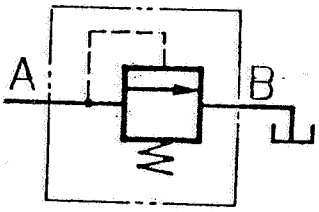
Since, when the "Pressure select (Solenoid) valve" is switched on, the "Max. hydraulic pressure" supplied to the "Main control valve" is limited by the "Main relief valve" at 210 kg/cm^2, the "Travel hydraulic system" (Travel motors) is operated by the hydraulic pressure of 210 kg/cm^2.

While, in case the "Pressure select (Solenoid) valve" is switched off, the "MAX. hydraulic pressure" supplied to the "Main control valve" is limited by the "Remote control valve" at 175 kg/cm^2, "Elevation", "Telescoping" and "Slew" hydraulic systems are operated by the hydraulic pressure of 175 kg/cm^2.

Remote control valve

Type:	Direct piston type.
Rated hydraulic pressure:	350 kg/cm^2.
Pressure setting range:	10 ~ 210 kg/cm^2.
Max. flow volume:	6 liters/min.



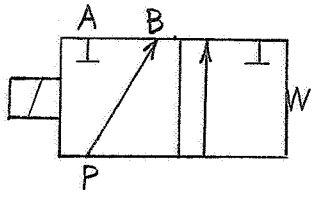


1. Valve housing.
2. Valve seat.
3. Poppet.
4. Guide.
5. Spring seat.
6. Push rod.
7. Spring.
8. Cap nut. (for Adjust screw)
9. O ring.
10. O ring.

Solenoid Pressure select valve

Type: Solenoid operated directional control valve.
Rated hydraulic pressure (P, A, B) : 315 kg/cm^2.
Operational voltage: DC 24 V.

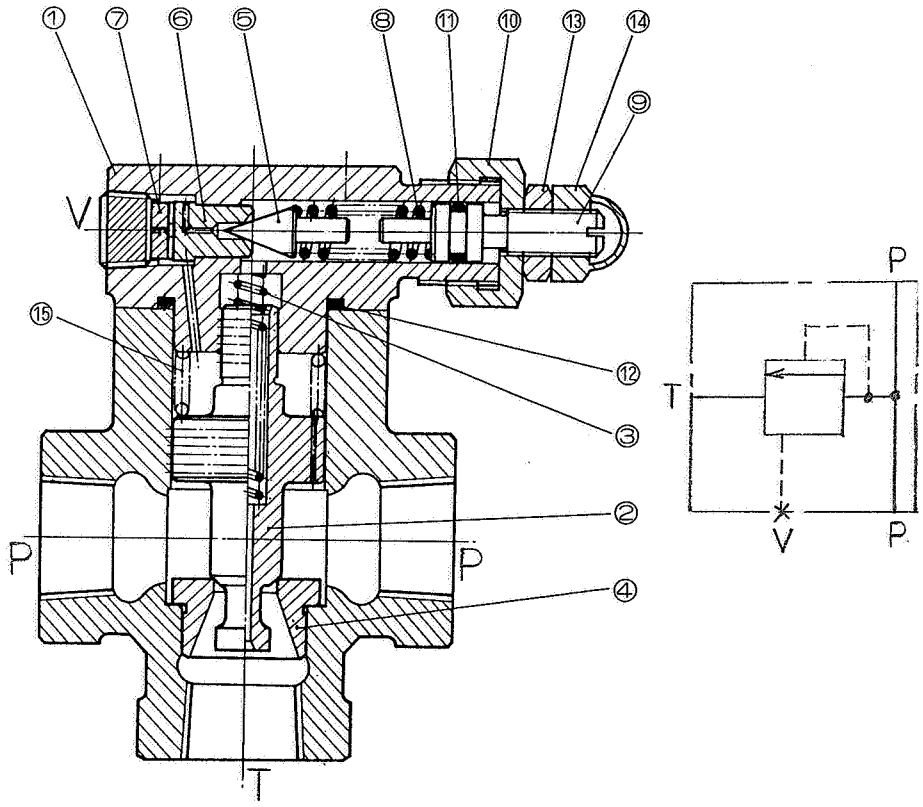
Fig: 2



Main relief valve

Type:	Balance piston type.
Rated hydraulic pressure:	210 kg/cm^2.
Pressure setting range:	10 ~ 210 kg/cm^2.
Max. flow volume:	60 liters/min.

Fig: 3



1. Pilot housing.
2. Piston.
3. Spring.
4. Valve seat.
5. Needle valve.
6. Needle valve seat.
7. Bushing.
8. Spring.
9. Adjust screw.
10. Guide.
11. O ring.
12. O ring.
13. Lock nut.
14. Cap nut.
15. Spring.

Adjustment of MAIN RELIEF VALVE

The following conditions should be strictly kept, when measuring and adjusting setting pressure.

- Hydraulic oil temperature: 40° - 60° C.
- Hydraulic pump speed: 2,000 rpm.

1. Remove the plug (for pressure test port) at the out-let pipe of hydraulic pump NO. 1, and set a oil pressure gauge onto the pressure test port.
2. Start engine and run the hydraulic pump at 2,000 rpm.
3. Disconnect the electric lead wire of "Pressure select valve" (solenoid), and supply DC 24V to the valve directly. (for the purpose of switching on the "Pressure select valve")
4. Operate the elevation control switch to "UP" position at lower control station, raise boom fully up to the stroke end of elevation cylinder, and keep the control switch at "UP" position to activate main relief valve.
5. Read the oil pressure gauge, while the main relief valve is active and take the setting pressure.
   - Rated setting pressure: 210 kg/cm^2.

   NOTE: Take the setting pressure at least 3 times for accuracy.
6. In case that the setting pressure taken in step 4 is higher or lower than the rated setting pressure (210 kg/cm^2), adjust the main relief valve, following the next steps.
   a) Remove cap-nut, and loosen lock-nut.
   b) In case that the setting pressure taken in step 4 is lower than the rated setting pressure, turn the adjust-screw clockwise untill the rated setting pressure is obtained. If the setting pressure is higher, turn the adjust-screw counter-clockwise and obtain the rated setting pressure.
   c) Lock the adjust-screw by lock-nut and recheck the setting pressure.

      NOTE: Recheck the pressure at least 3 times for accuracy.
   d) Install cap-nut and disconnect the oil pressure gauge, then install the plug onto the pressure test port.

      NOTE: Wind seal-tape at least one and a half times around the thread of the plug (for pressure test port), before installation.
7. Restore the electric lead wire, which is disconnected in step 3.

Adjustment of REMOTE CONTROL VALVE

The following conditions should be strictly kept, when measuring and adjusting setting pressure.

- Hydraulic oil temperature: 40° - 60° C.
- Hydraulic pump speed: 2,000 rpm.

1. Remove the plug (for pressure test port) at the out-let pipe of hydraulic pump NO. 1, and set a oil pressure gauge onto the pressure test port.
2. Start engine and run the hydraulic pump at 2,000 rpm.
3. Operate the elevation control switch to "UP" position at lower control station, raise boom fully up to the stroke end of elevation cylinder, and keep the control switch at "UP" position to activate "Remote control valve".
4. Read the oil pressure gauge, while the "Remote control valve" is active and take the setting pressure.
   - Rated setting pressure: 175 kg/cm^2.

   NOTE: Take the setting pressure at least 3 times for accuracy.
5. In case that the setting pressure taken in step 4 is higher or lower than the rated setting pressure (175 kg/cm^2), adjust the "Remote control valve", following the next steps.

   a) Remove cap-nut, and loosen lock-nut.
   b) In case that the setting pressure taken in step 4 is lower than the rated setting pressure, turn the adjust-screw clockwise untill the rated setting pressure is obtained. If the setting pressure is higher, turn the adjust-screw counter-clockwise and obtain the rated setting pressure.
   c) Lock the adjust-screw by lock-nut and recheck the setting pressure.

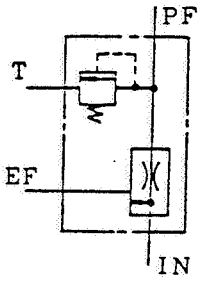
      NOTE: Recheck the pressure at least 3 times for accuracy.
   d) Install cap-nut and disconnect the oil pressure gauge, then install the plug onto the pressure test port.

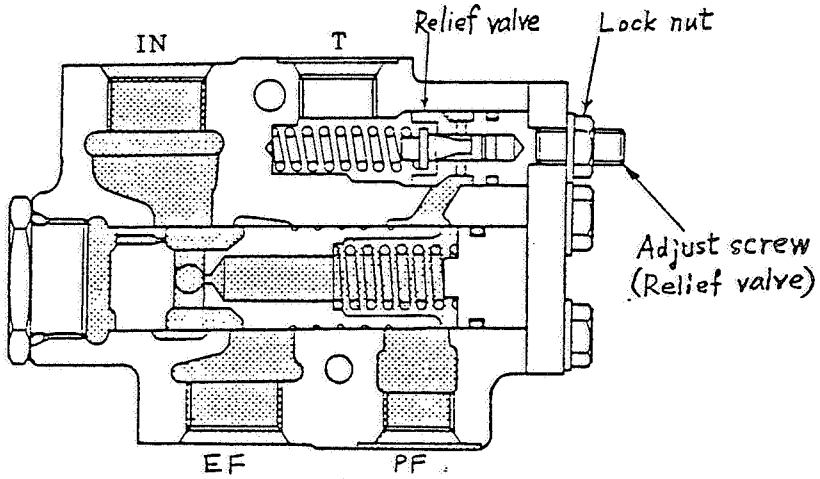
      NOTE: Wind seal-tape at least one and a half times around the thread of the plug (for pressure test port), before installation.

PRIORITY VALVE

The valve is incorporated in the hydraulic circuit of hydraulic pump NO. 2 to regulate the flow volume in the circuit at the constant level (15 liters/min), regardless of pump's discharge volume. Moreover, the relief valve built in the priority valve controls the maximum hydraulic pressure produced by hydraulic pump NO. 2.

Setting pressure. (for Relief valve): 140 kg/cm^2.
Regulated flow volume: 15 liters/min.





Adjustment procedures of relief valve.

The following conditions should be strictly kept, when measuring and adjusting setting pressure.

- Hydraulic oil temperature: 40° - 60° C,
- Hydraulic pump speed: 2,000 rpm.

1. Remove the plug (for pressure test port) at the out-let pipe of hydraulic pump NO. 2, and set a oil pressure gauge onto the pressure test port.
2. Start engine and run the hydraulic pump at 2,000 rpm.
3. Operate the platform slew switch either to "RIGHT" or "LEFT" direction, till the platform slew cylinder's function stops at its stroke end, and keep the switch at the position to activate the relief valve.
4. Read the oil pressure gauge, while the relief valve is active and take the setting pressure.
   - Rated setting pressure: 140 kg/cm^2.

   NOTE: Take the setting pressure at least 3 times for accuracy.

5. In case that the setting pressure taken in step 4 is higher or lower than the rated setting pressure (140 kg/cm^2), adjust the relief valve, following the next steps.

   a) Loosen lock-nut.

   b) In case that the setting pressure taken in step 4 is lower than the rated setting pressure, turn the adjust-screw clockwise untill the rated setting pressure is obtained. If the setting pressure is higher, turn the adjust-screw counter-clockwise and obtain the rated setting pressure.

   c) Lock the adjust-screw by lock-nut and recheck the setting pressure.

      NOTE: Recheck the pressure at least 3 times for accuracy.

   d) Disconnect the oil pressure gauge, then install the plug onto the pressure test port.

      NOTE: Wind seal-tape at least one and a half times around the thread of the plug (for pressure test port), before installation.

MAIN CONTROL VALVE (KL valve) (302 02632)

The "KL valve" (KL solenoid operated proportional valve) is used as a "Main control valve" to control the "Elevation", "Telescoping", "Slew" and "Travel" hydraulic systems.
The valve is actuated electrically by the "Potentio meters" or "Contro switches" (installed on Upper and Lower control boxes) through the "KL valve controllers" and "Main control unit" (contained in Lower control box).

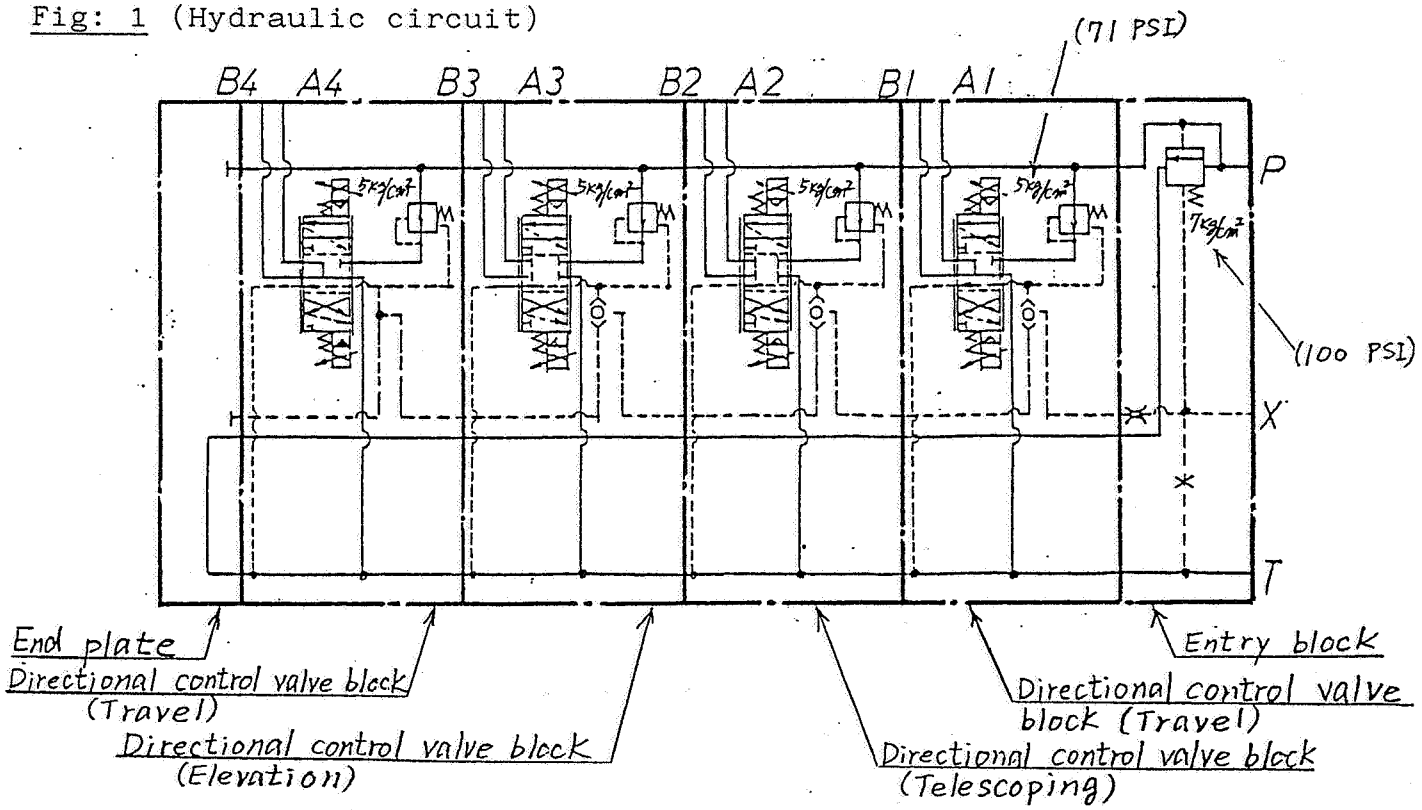
Hydraulic data.

Rated pressure:	P port:	210 kg/cm^2. (2990 PSI)
	A, B port:	240 kg/cm^2. (3410 PSI)
	T port:	10 kg/cm^2. (142 PSI) (Max. 30 kg/cm^2.) (427 PSI)
Flow volume:	(at Hydraulic pressure:	175 kg/cm^2.) (2,500 PSI)
A 1, B 1 port:		80 liters/min. (21.1 gals/min)
A 2, B 2 port:		80 liters/min. (21.1 gals/min)
A 3, B 3 port:		50 liters/min. (13.2 gals/min)
A 4, B 4 port:		25 liters/min. (6.6 gals/min)

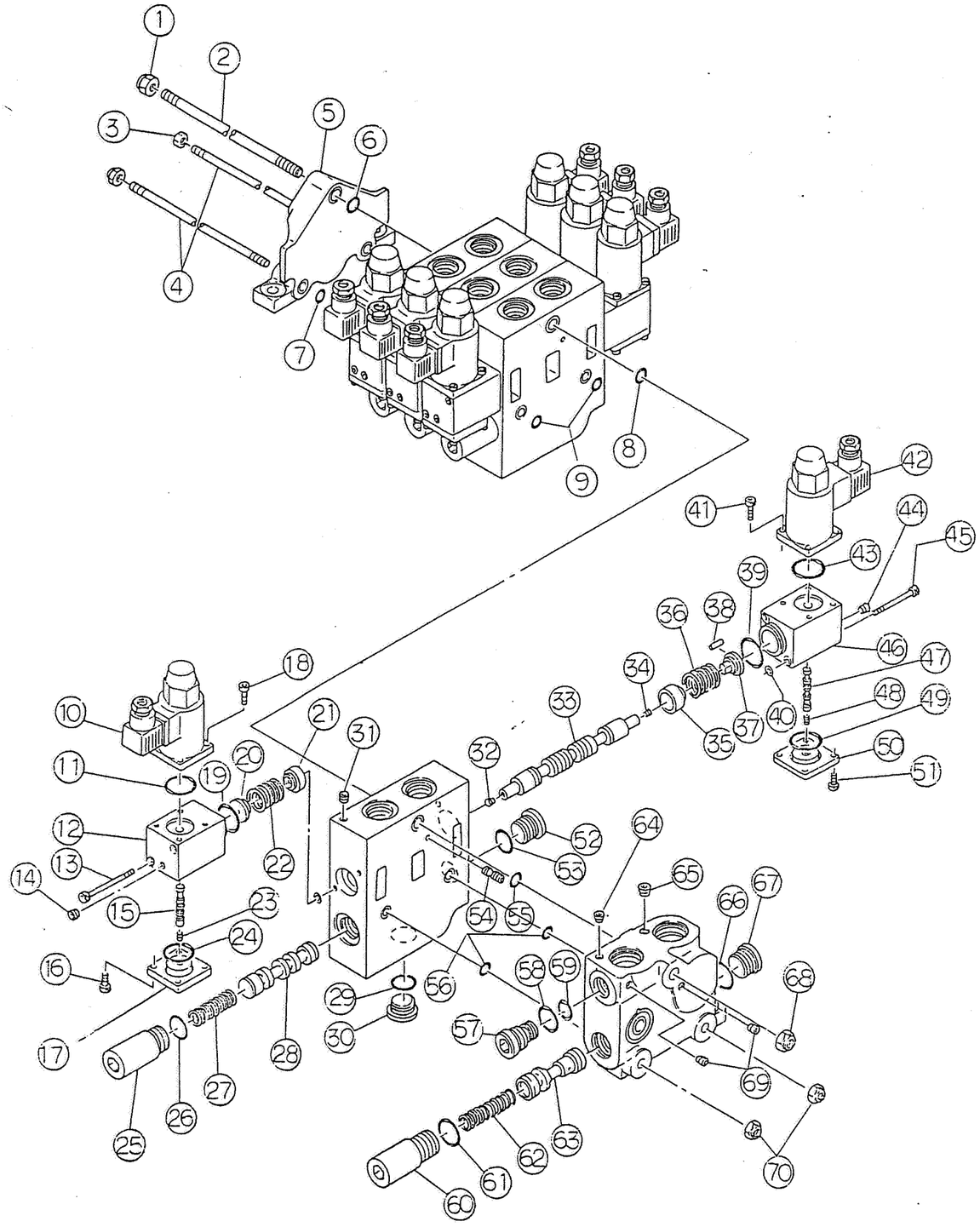
Electrical data.

Nominal solenoid voltage:	DC 12V.
Current at starting flow:	600 mmA.
Current at Max. flow:	1,400 mmA.
Coil resistance:	6.5Ω. (at 20°C) (at 68°F)

Fig: 1 (Hydraulic circuit)



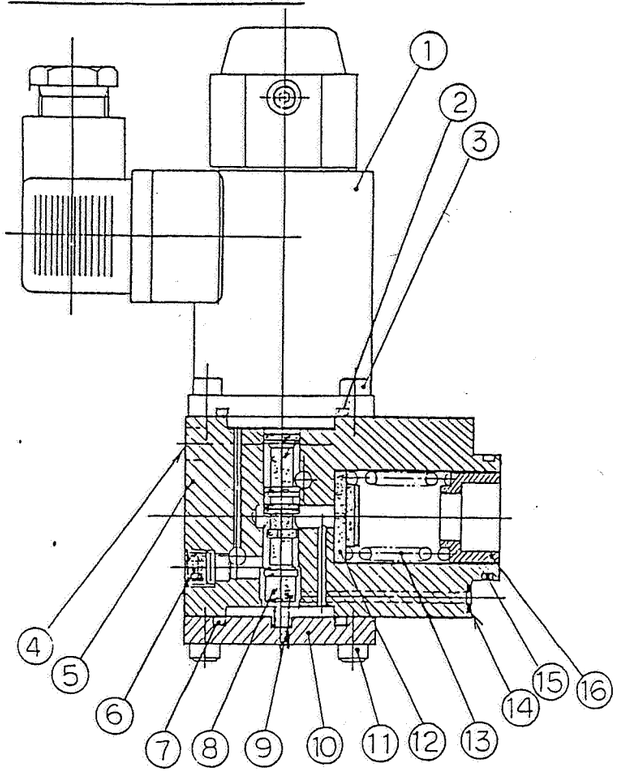
Illustration



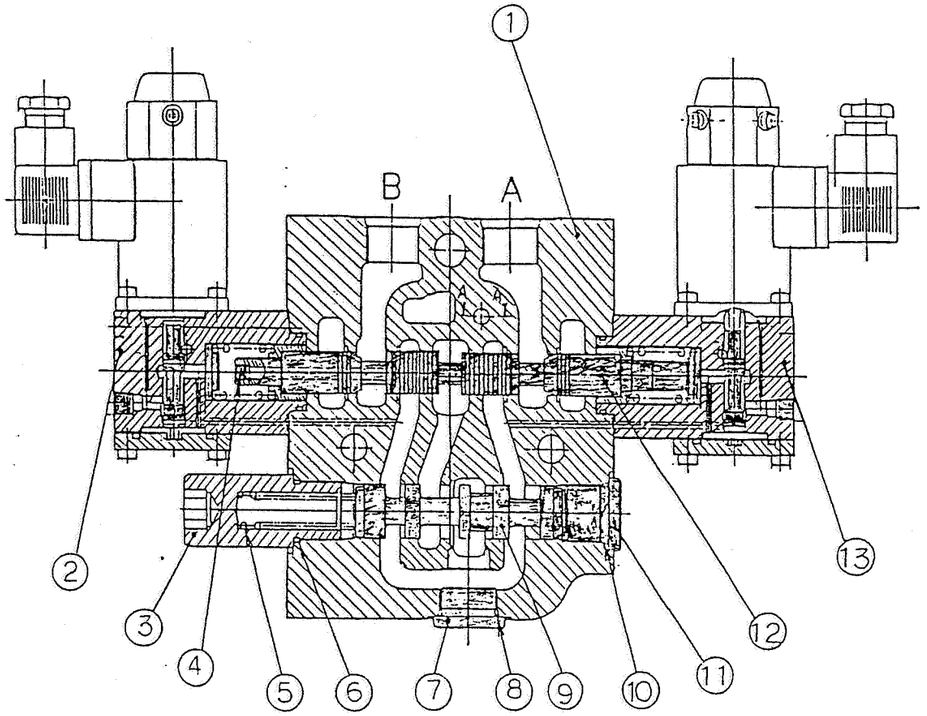
1. U nut.
2. Tie rod.
3. U nut.
4. Tie rod.
5. End plate.
6. O ring.
7. o ring.
8. O ring.
9. O ring.
10. Solenoid.
11. O ring.
12. Valve housing.
13. Cap screw.
14. Plug.
15. Pilot spool.
16. Cap screw.
17. Cover.
18. Cap screw.
19. O ring.
20. Spool stopper.
21. Spring retainer.
22. Spring.
23. Spring.
24. O ring.
25. Cap.
26. o ring.
27. Spring.
28. PC spool NO. 2.
29. O ring.
30. Plug.
31. Plug.
32. Plug.
33. Main spool.
34. Plug.
35. Spring retainer.
36. Spring.
37. Spool stopper.
38. Pin.
39. O ring.
40. o ring.
41. Cap screw.
42. Solenoid.
43. O ring.
44. Plug.
45. Cap screw.
46. Valve housing.
47. Pilot spool.
48. Spring.
49. O ring.
50. Cover.
51. Cap screw.
52. Plug.
53. O ring.
54. Shuttle valve.
55. O ring.
56. O ring.
57. Plug.
58. O ring.
59. o ring.
60. Cap.
61. O ring.
62. Spring.
63. PC spool NO. 1.
64. Plug.
65. Plug.
66. O ring.
67. Plug.
68. U nut.
69. U nut.
70. U nut.

37

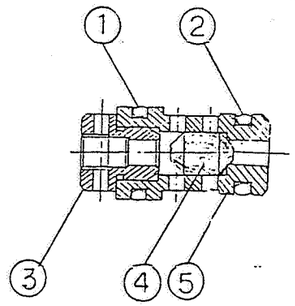
Sectional drawings



Solenoid & Pilot valve block (L/H)

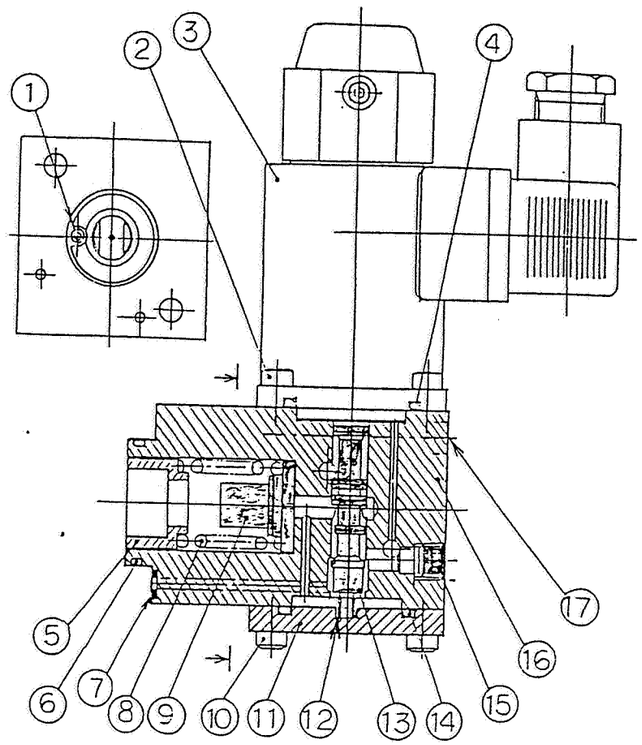


Directional control valve block

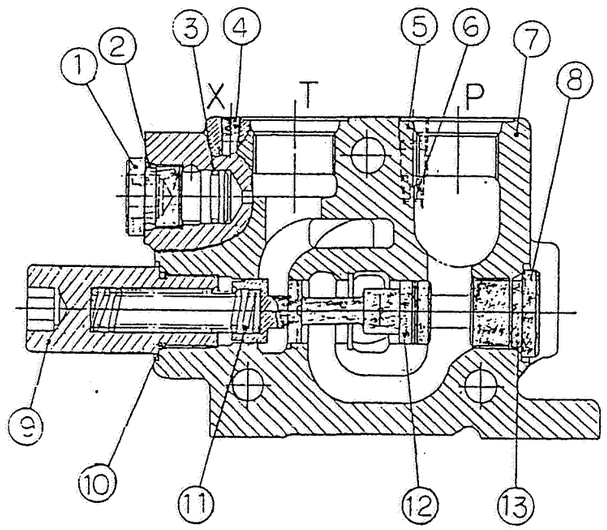


Shuttle valve

(A A section)



Solenoid & Pilot valve block (R/H)



Entry block

Solenoid & Pilot valve block (L/H)

1. solenoid.
2. O ring.
3. Cap screw.
4. Cap screw.
5. Valve housing.
6. Plug.
7. O ring.
15. O ring.
8. Pilot spool.
9. Spring.
10. Cover.
11. Cap screw.
12. Spool stopper.
13. Spring.
14. O ring.
16. Spring retainer.

Directional control valve block

1. Valve housing.
2. Pilot valve block (L/H).
3. Cap.
4. Plug.
5. Spring.
6. O ring.
7. Plug.
8. O ring.
9. PC spool NO. 2.
10. O ring.
11. Plug.
12. Main spool.
13. Pilot valve block (R/H).

Solenoid & Pilot valve block (R/H)

1. Pin.
2. Cap screw.
3. Solenoid.
4. O ring.
5. Spring retainer.
6. O ring.
7. O ring.
8. Spring.
9. Spool stopper.
10. Cap screw.
11. Cover.
12. Spring.
13. Pilot spool.
14. O ring.
15. Plug.
16. Valve housing.
17. Cap screw.

Entry block

1. Plug.
2. O ring.
3. O ring.
4. Plug.
5. Plug.
6. Orifice.
7. Valve housing.
8. plug.
9. Cap.
10. O ring.
11. Spring.
12. PC spool NO. 1.
13. O ring.

Shuttle valve

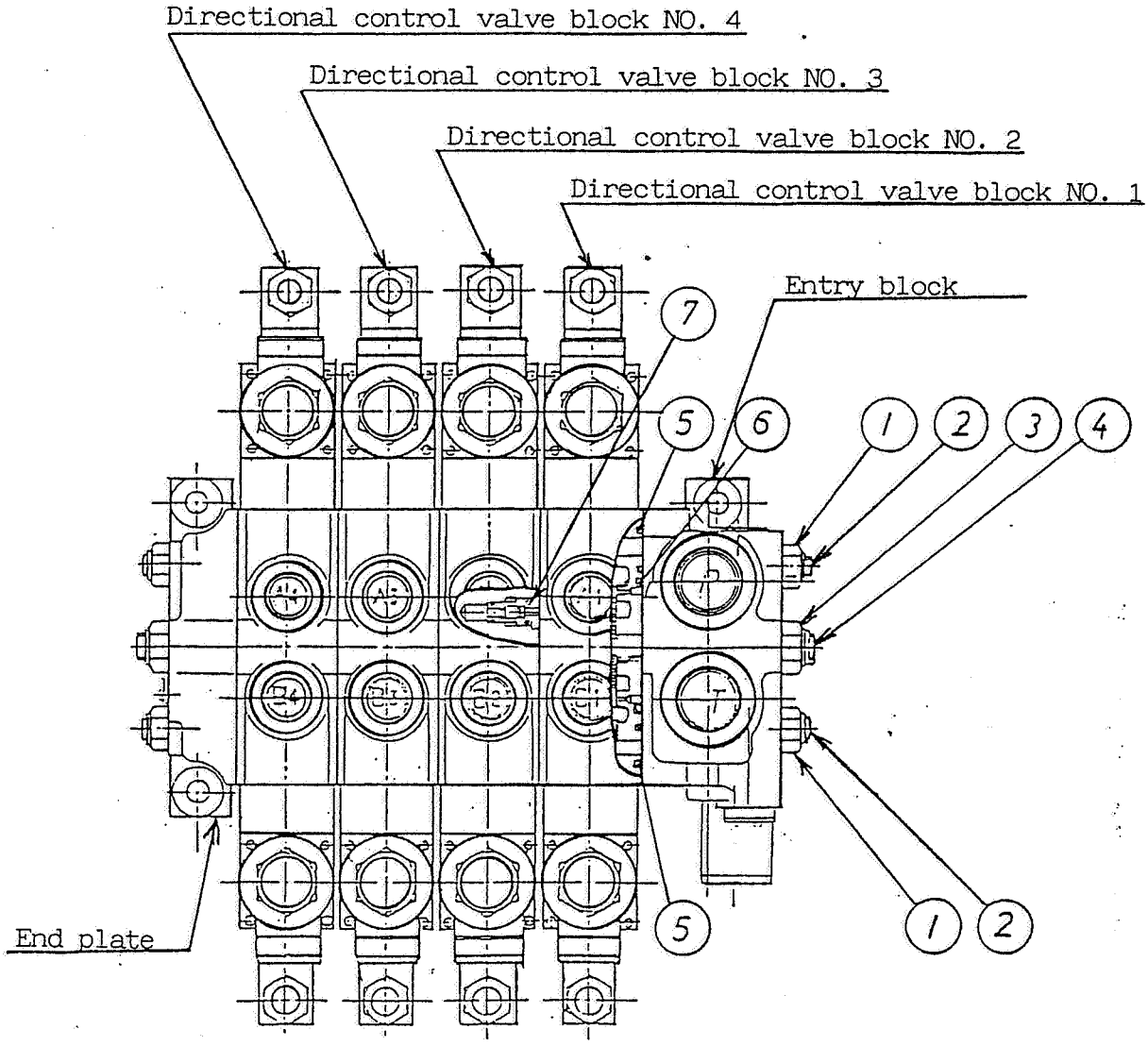
1. O ring.
2. O ring.
3. Valve seat.
4. Valve.
5. Valve housing.

Disassembly and Reassembly

* Control valve Assy (Disassembly)

1. Set a "Control valve Assy" on a work bench, and put "Match marks" on each valve block.
2. Loosen "U nuts (1), (3)" alternately, and screw them out.
3. Remove all of the "Valve blocks" from "Tie rods (2), (4)".
   NOTE: Do not insert such as a "Screw driver" between each "Valve block", as it may damage the mating surfaces.
4. Remove "O ring (5), (6)" from each "Valve block".
5. Screw in a "Bolt (M4)" into "Shuttle valve (7)", and pull it out from each "Directional control valve block".
   NOTE: The "Shuttle valve" is not attached on the "Directional control valve block NO. 4 ".

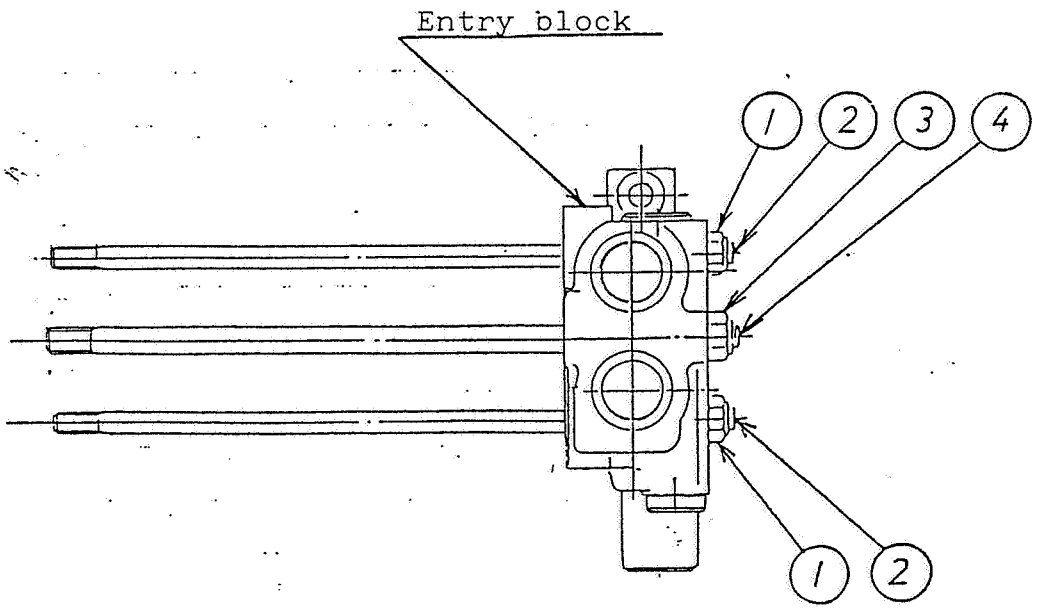
Fig: 4



* Control valve Assy (Reassembly)

1. Install "Shuttle valve" into each "Directional control valve block", using a "Screw driver" or a "Bolt (M 4)".
2. Set "O rings" between each mating surface of "Valve blocks".
   NOTE: Make certain that each mating surface is free from foreign particles.
3. Set "U nuts ①, ③" onto "Tie rods ②, ④".
   Then, insert them into "Entry block" as shown in the figure below.
4. Assemble all of the "Valve blocks" onto the "Tie rods" as confirming the "Match marks".
5. Press the assembled "Valve blocks" from both sides, and install "U nuts" on the other ends of "Tie rods".
   NOTE: Make certain that all of the "O rings" are settled properly.
6. Tighten "U nuts" alternately.
   * Specific tightening torque.
   U nut ①: 600 kg-cm. (43 ft·lb)
   U nut ③: 1,000 kg-cm. (72 ft·lb)

Fig: 5



CAUTION: Replace all of the O rings, before reassembly.

* Entry block (Disassembly)

1. Remove "Cap (5)", and pull out "Spring (4)".
2. Remove "Plug (2)". Then, push "PC spool NO. 1 (3)" to and fro several times, and make certain it moves smoothly in the "Entry block (1)".

   NOTE: In case sticky movement exsists on "PC spool NO. 1", do not remove it by force, since it may be caused by the lodged foreign particles between "PC spool NO. 1" and "Entry block".

4. Press the "PC spool NO. 1" and remove it from the "Entry blocK"

* Entry block (Re-assembly)

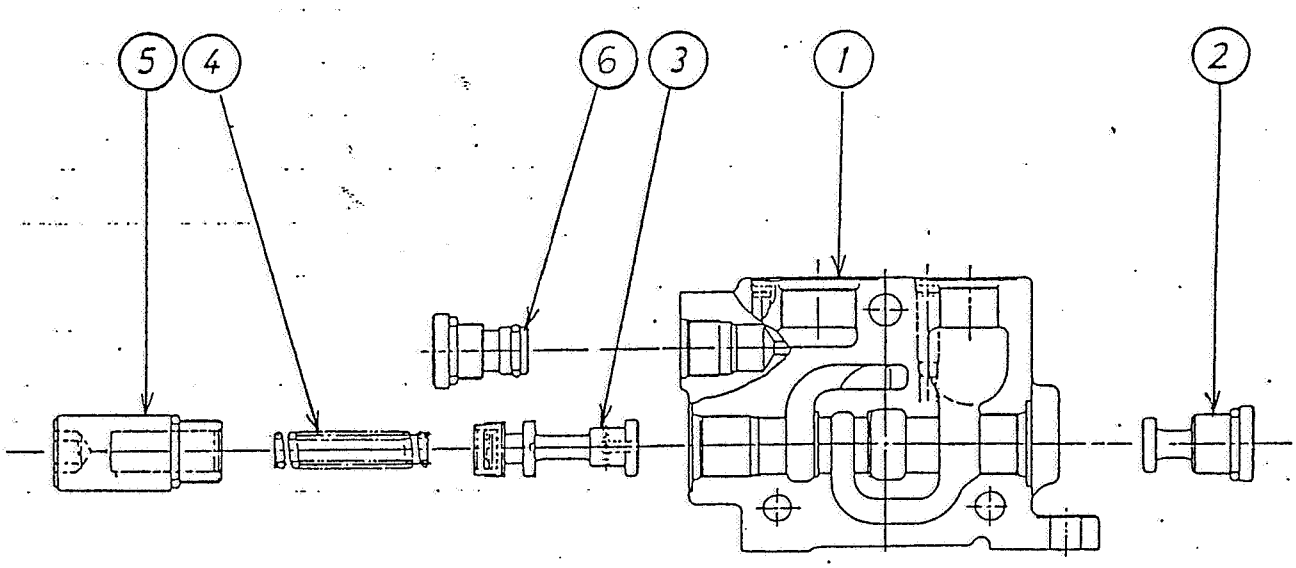
1. Install "Plug (2)" onto "Entry block (1)".

   Specific tightening torque of "Plug (2)" : 700 ~ 900 kg-cm. (51 ~ 65 ft·lb)
2. Insert "PC spool (3)", and "Spring (4)" into the "Entry block" in the order listed.
3. Install "Cap (5)" onto the "Entry block".

   Specific tightening torque of "Cap (5)" : 700 ~ 900 kg-cm. (51 ~ 65 ft·lb)
4. Install "Plug (6)" onto the "Entry block".

   Specific tightening torque of "Plug (6)" : 600 ~ 800 kg-cm. (43 ~ 58 ft·lb)

Fig: 6



CAUTION: Replace all of the O rings, before reassembly.

* Directional control valve block (Disassembly)

(Refer to Fig: 9 .)

1. Roosen "Cap screws (4)", and remove both of the "Pilot valve blocks R/H & L/H (2), (3)" with the "Solenoids".

   NOTE: Take care to keep the "Springs" and "Spring retainers" attached in the "Pilot valve blocks" in sight. Since, they may fall off, when removeing the "Pilot valve blocks".

2. Push the "Main spool (5)" to and fro, several times, and make certain it moves smoothly in the "Directionl control valve block (1)".

   NOTE: In case sticky movement exsists on the "Main spool", do not remove it by force, since it may be caused by the lodged foreign particles between the "Main spool" and "Valve block".

3. Press the "Main spool (5)", and remove it from the "valve block"
4. Remove "Cap (8)", and pull out "Spring (7)".
5. Remove "plug (9)". Then, press "PC spool NO. 2 (6)" out of the "Valve block".

   NOTE: Remove "PC spool NO. 2", after confirming smooth movement as metioned in "Step 2" above.

6. Remove "plug (10)".

* Directional control valve block (Reassembly)

(Refer to Fig: 9 .)

1. Install "Plug (9) and (10)" onto the "Directional control valve block (1)".

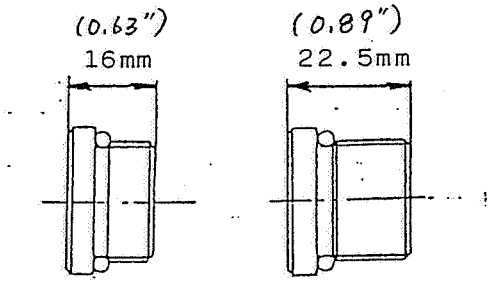
   * Specific tightening torque of "Plug (9) and (10)":

   700 ~ 900 kg-cm.
   (51 ~ 65 ft·lb)

   CAUTION:

   Do not mix the "Plug (9)" and "Plug (10)", since they are different in length as shown in the figure below.

Fig: 7



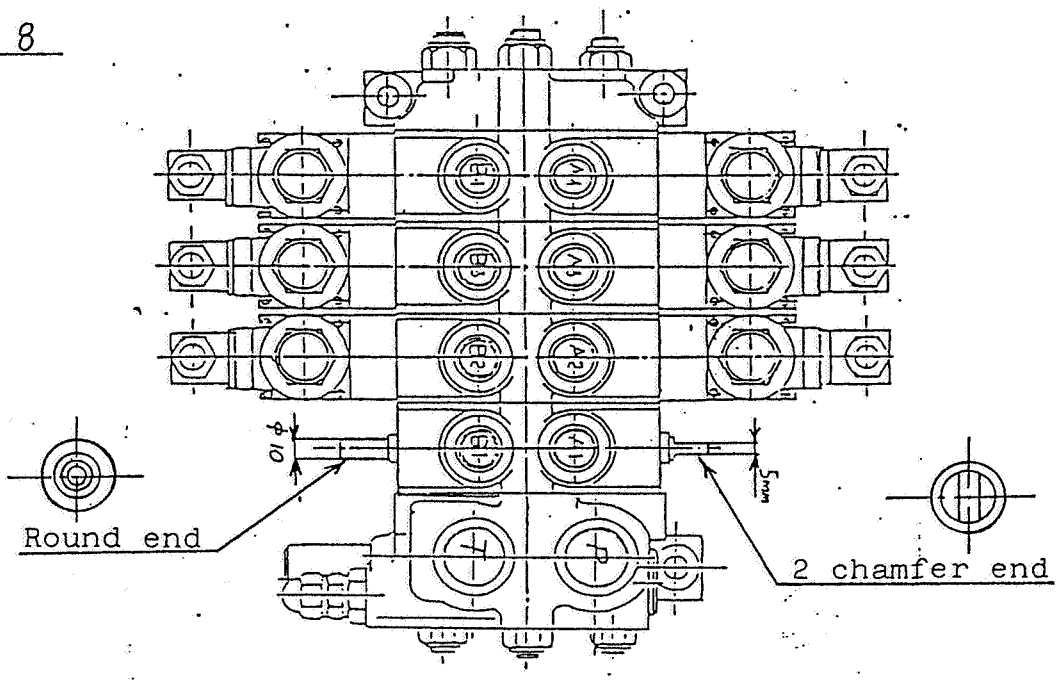
Plug 10 plug 9

2. Insert "PC spool NO. 2 (6)", "Spring (7)" into the "Valve block". Then, tighten "Cap (8)".

   * specific tightening torque of "Cap (8)": 700 ~ 900 kg-cm. (51 ~ 65 ft·lb)

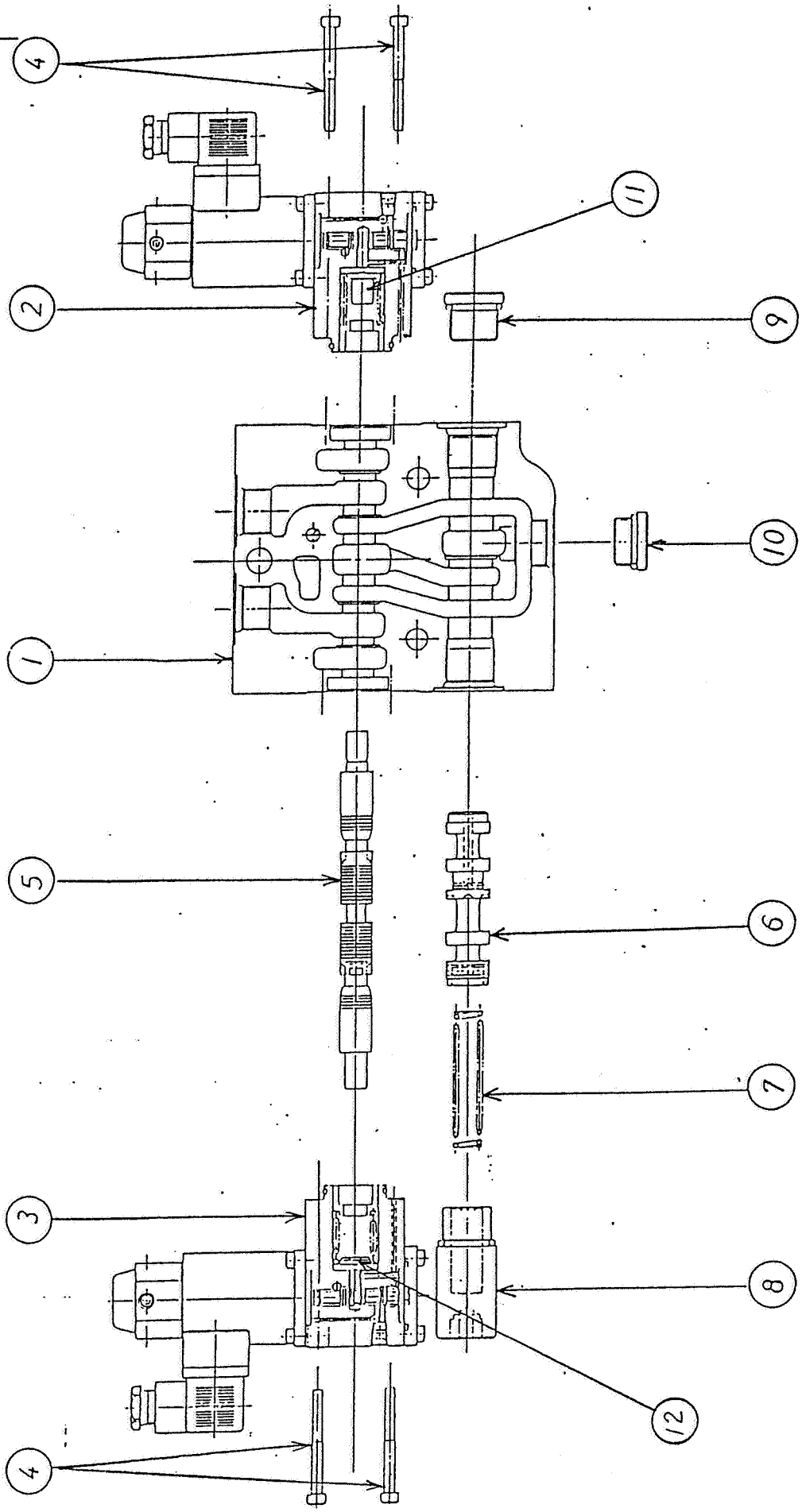
3. Insert "Main spool (5)" into the "Valve block".
   The "Main spool" shall be inserted as shown in the figure below, in such way that the "2-chamfer end" comes to the right side, and the "Round end" to the left side.
   Moreover, rotate the "Main spool" so that the "2-chamfer end" is set perpendicularly.

Fig: 8



4. Install "Pilot valve block R/H (2)" and "Pilot valve block L/H (3)" onto the "Directional control valve block (1)", and tighten "Cap screws (4)" alternately.
   * Specific tightening torque of "Cap screw (4)": 70 ~ 90 kg-cm. (5,0 ~ 6,5 ft·lb)
   CAUTION:
   Do not mix the "Pilot valve block R/H" and "L/H".
   Since, the "Spool stoppers (11) and (12)" (contained in the "Pilot valve blocks") are different in shape.
   Moreover, rotate the "Spool stopper (11)" (contained in the "Pilot valve block R/H" and set it at the position, where the "2-chamfer end" of the "Main spool" is inserted properly.

Fig: 9



* **Pilot valve block and Solenoid.** (Disassembly)
(Refer to Fig: // .)

1. loosen "Cap screws (7)", and remove "Pilot valve block (1)" with "Solenoid (12)" from the "Directional control valve block".
2. In case "Pilot valve R/H"
   * Remove "Spring retainer (6)", "Spring (5)", "Spool stopper (3)" and "Pin (2)" from the "Pilot valve block R/H (1)" in the order listed.

   In case "Pilot valve L/H".
   * Remove "Spring retainer (6)", "Spring (5)" and "Spool stoppe (4)" from the "Pilot valve block L/H (1)" in the order liste
3. Loosen "Cap screws (11)" and remove "Solenoid (12)".
4. Loosen "Cap screws (13)" and remove "Cover (10)".
5. Remove "Spring (9)", and press "Pilot spool (8)" out of the "Pilot valve block (1)".

* **pilot valve block and Solenoid.** (Reassembly)
(Refer to Fig: // .)

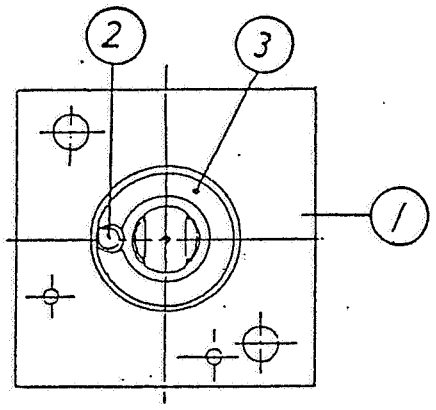
1. Insert "Pilot spool (8)" into the "Pilot valve block (1)". Then, make sure that the "Pilot spool" moves smoothly in the "Valve block".
2. Insert "Spring (9)",set "Cover (10)", and tighten "Cap screws (13)".
   * Specific tightening torque of "Cap screw (13)": 30~40 kg-cm. (2.2 ~ 2.9 ft-lb)
3. Install "Solenoid (12)", and tighten "Cap screws (11)".
   * specific tightening torque of "Cap screw (11)": 30~40 kg-cm. (2.2 ~ 2.9 ft-lb)
4. In case "Pilot valve R/H".
   * Install "Pin (2)", "Spool stopper (3)", "Spring (5)" and "Spring retainer (6)" into "Pilot valve block (1)" in the order listed.

   In case "Pilot valve L/H".
   * Install "Spool stopper (4)", "Spring (5)" and "Spring retainer (6)" into "Pilot valve block L/H (1)" in the order listed.
5. Install the "Pilot valve Assy" assembled above onto the "Directional control valve block".

   NOTE:

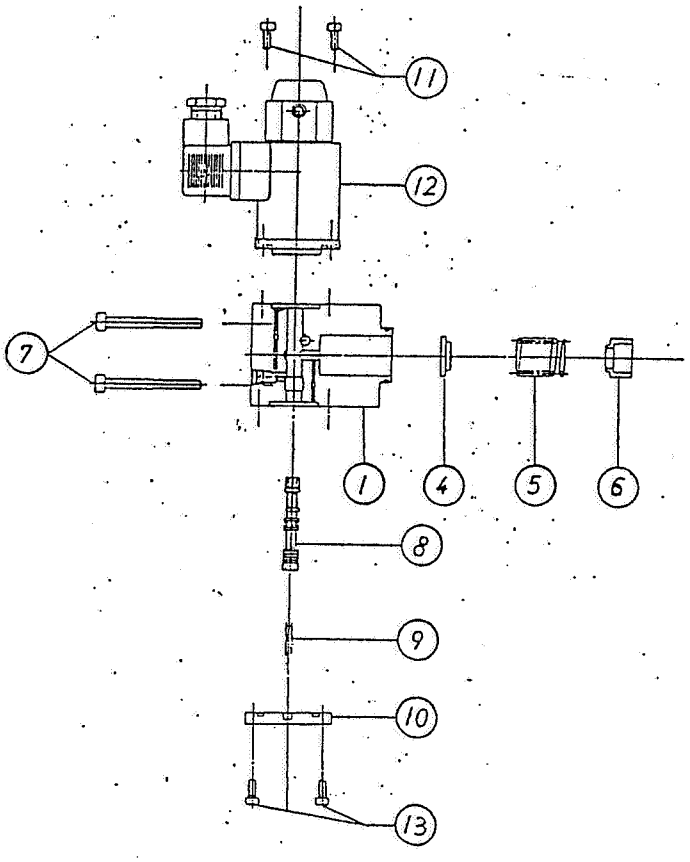
   The "Pilot valve R/H (1)" has been designed to prevent the "Main spool" (inserted in the "Directional control valve block") from being rotated.
   Therefore, the "Pin (2)" and "Spool stopper (3)" must be set in the "Pilot valve block R/H (1)" as shown in Fig: 10 .

Fig: 10

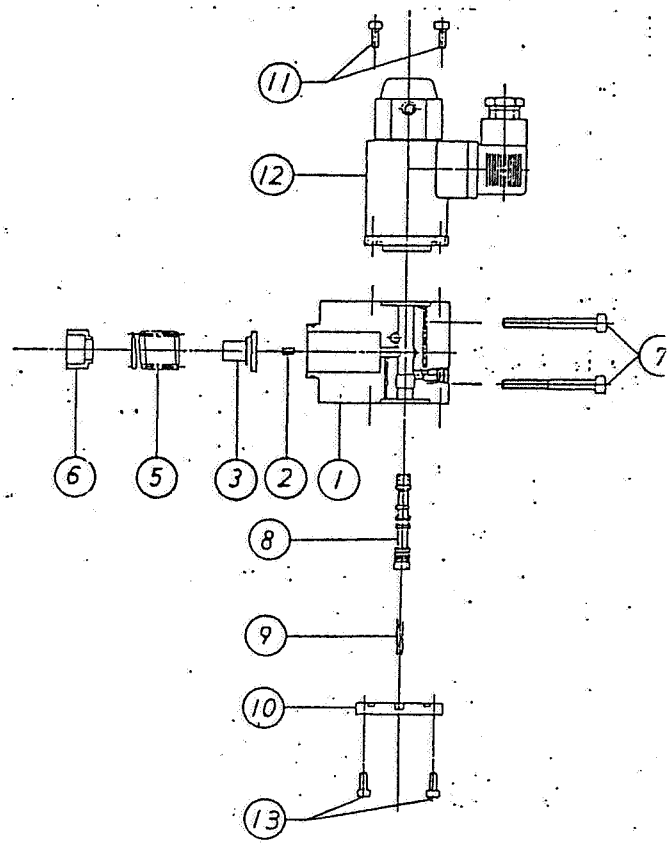


Pilot valve block R/H

Fig: 11



Pilot valve L/H



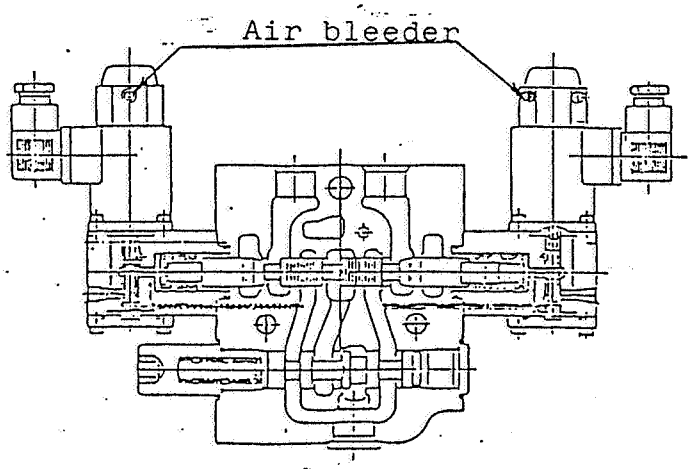
Pilot valve R/H

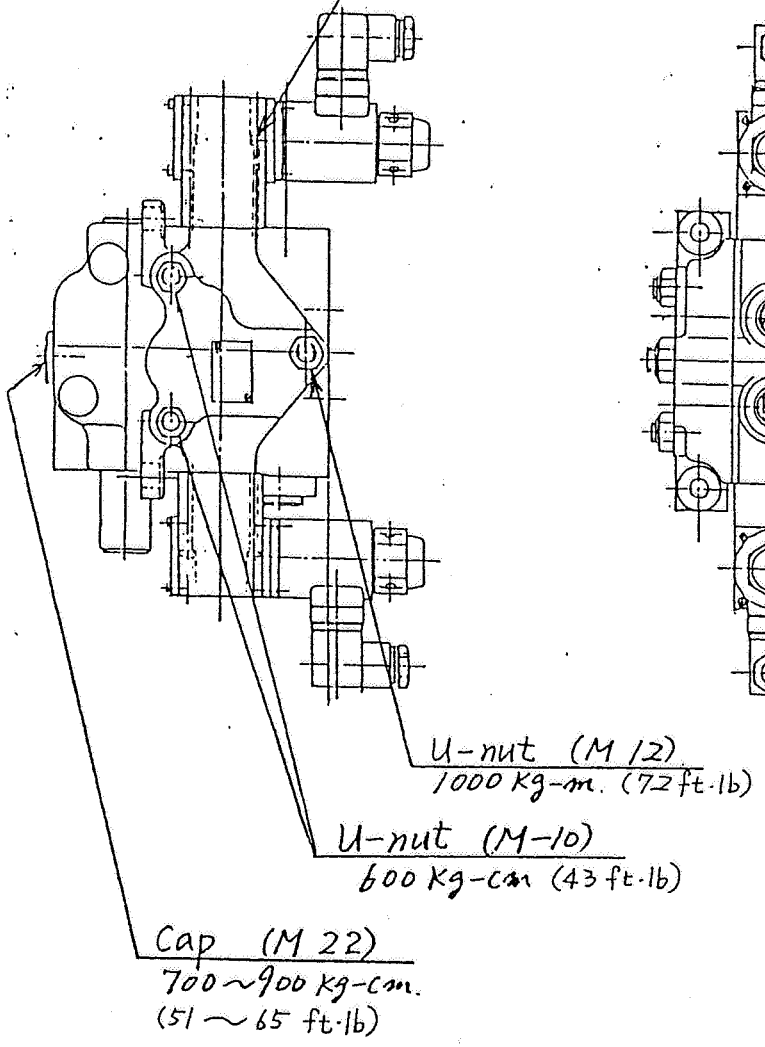
Air bleeding

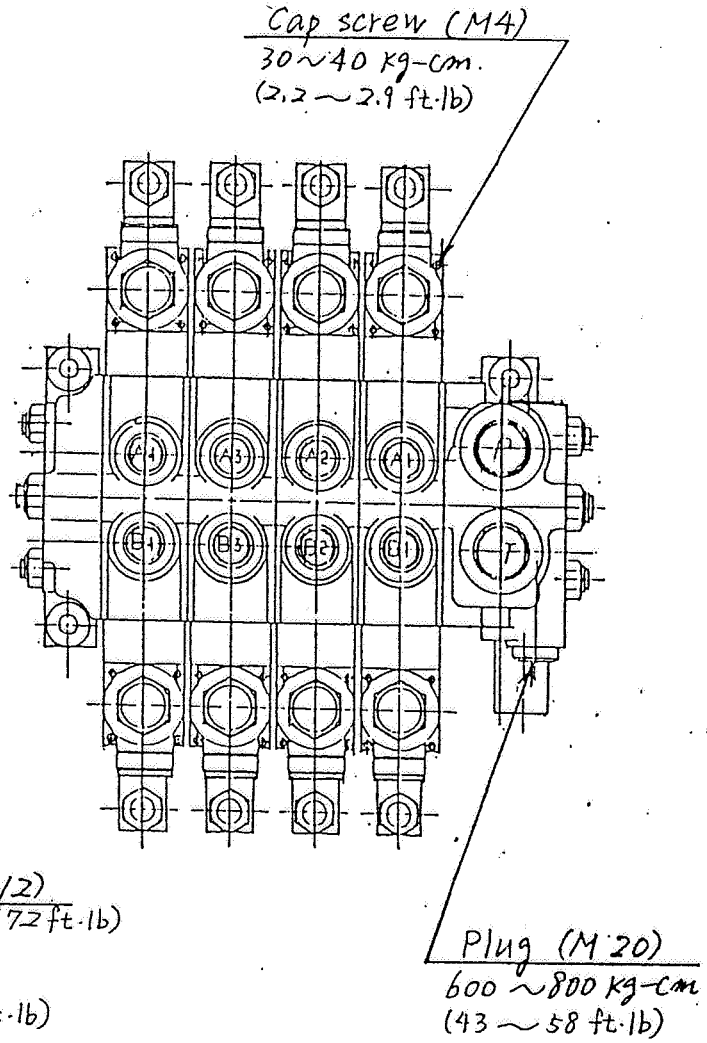
In case the "Main control valve (KL valve)" is disassembled or replaced, operate the control valve thoroughly, and check if the functions of "Hydraulic actuators" are smooth without "Vibration" or "Poor response".

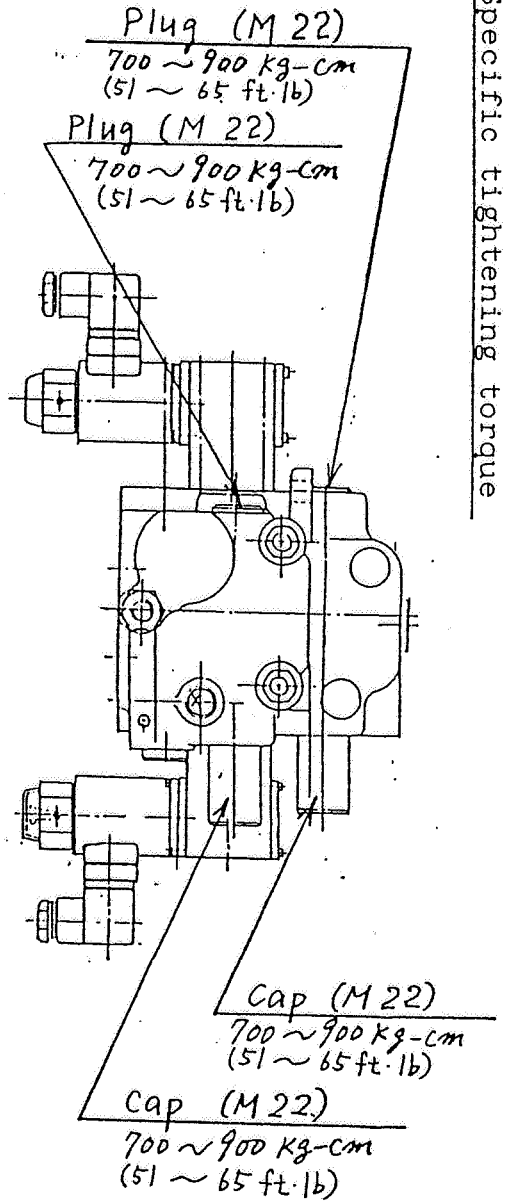
If any "Vibration" or "Poor response" is observed, loosen the "Air bleeders" (installed on each "Solenoid"), while operating the "Main control valve" several times, and bleed air.

Fig: 12




Cap screw (M5)
70 ~ 90 kg-cm
(5.0 ~ 6.5 ft·lb)
U-nut (M 12)
1000 kg-m. (7.2 ft·lb)
U-nut (M-10)
600 kg-cm (43 ft·lb)
Cap (M 22)
700 ~ 900 kg-cm.
(51 ~ 65 ft·lb)


Cap screw (M4)
30 ~ 40 kg-cm.
(2.2 ~ 2.9 ft·lb)
Plug (M 20)
600 ~ 800 kg-cm
(43 ~ 58 ft·lb)


Plug (M 22)
700 ~ 900 kg-cm
(51 ~ 65 ft·lb)
Plug (M 22)
700 ~ 900 kg-cm
(51 ~ 65 ft·lb)
Cap (M 22)
700 ~ 900 kg-cm
(51 ~ 65 ft·lb)
Cap (M 22)
700 ~ 900 kg-cm
(51 ~ 65 ft·lb)

Trouble shooting

TROUBLE	CAUSE	REMEDY	REMARKS
"Pump pressure is not unloaded, and causes the pressure to raise just after running the pump. (Actuator is moved, in spite of "Electric control system" not being actuated.)	"Pilot spool" or "Main spool is sticked at the actuated position.	Clean or replace the "Pilot valve block" or "Directional control valve block".	The "KL valve" unloads the pump pressure at (7 kg/cm^2 + Back pressure of tank line), when all of the "directional control valve blocks" are at their neutral positions.
	The "Solenoid" is excited, in spite of the "potentio meter" or "Control switch" not being actuated.	Check the "Electric control system", and rectify the cause.	
"Unload pressure" is erratic, when all of the "Directional control valve blocks" are at their neutral positions. (Movement of the actuator is erratic.)	Cavitation in "Hydraulic pump". 1. Excessively low oil level in the oil reservoir. 2. Clogged "Suction strainer". 3. Air is sucked in the "Inlet line" of hydraulic pump.	Check the items listed, and rectify the cause.	
	Air is confined in "Entry block".	Bleed air.	
"KL valve" is not actuated by the "Electric control system". However, it is actuated by the "Manual over ride pin" (on "Solenoid").	No "Exciting current" is supplied to the "Solenoid".	Repair or readjust the "Electric control system".	The "KL valve" is actuated manually by pressing the "Manual over ride pin" (installed on each "Solenoid"), in such case as electric failure.
	Burnt or damaged "Solenoid".	Replace the "Solenoid".	
"KL valve" is not actuated by the "Manual over ride pin" (on "Solenoid").	"PC spool NO. 1" is sticked and being opened in the "Entry block". (Unload pressure: 7 kg/cm is not obtained, when the valve is at neutral.)	Clean or replace the "Entry block".	
	"Main spool" is sticked at its neutral position.	Clean or replace the "Directional control valve block".	
	"Pilot spool" is sticked in the "Pilot valve block".	Clean or replace the "Pilot valve block".	
	"Shuttle valve" is sticked.	Clean or replace the "Shuttle valve".	
	Distorted "valve blocks" due to improper mounting, or excessively high oil temperature.	Remount the valve properly, or lower the oil temperature.	
"operational speed" of the actuator is too slow.	"MAX voltage" at the "KL valve controller" is too low.	Readjust the "MAX voltage" at the "KL valve controller" and "Main control unit".	
"operational speed" of the actuator is too "HIGH".	"MAX voltage" at the "KL valve controller" is too high.	Readjust the "MAX voltage" at the "KL valve controller" and "Main control unit".	
Poor "Proportional" operation.	Adjustment of "Electric control system is inadequate.	Readjust the Electric control system.	Readjsut the "MIN voltage" at the KL valve controller properly.
	Defective "Potentio meter".	Replace the "Potentio meter".	
	Defective "KL valve controller".	Replace the "KL valve controller".	
	Sticky movement of "Valve spools" due to contaminated hydraulic oil.	Clean the "KL valve" thoroughly, and replace the hydraulic oil.	
Response is too slow.	The adjustment of "Trimmers TM-U & TM-D" (on "KL valve controller") is inadequate.	Readjust the "Trimmers TM-U & TM-D" at the "KL valve controller".	
	Oil viscosity is too heavy.	Use proper hydraulic oil.	
Response is too swift, and excessive shock exsists, when starting or stopping the operation.	The adjustment of "Trimmers TM-U & TM-D" (on "KL valve controller") is inadequate.	Readjust the "Trimmers TM-U & TM-D" at the "KL valve controller".	
	Oil viscosity is too light.	Use proper hydraulic oil.	
Oil temperature raises excessively, in spite of "KL valve" not being actuated.	The "PC spool NO. 1" (in "Entry block") is sticked, and being closed.	Clean or replace the "Entry block".	

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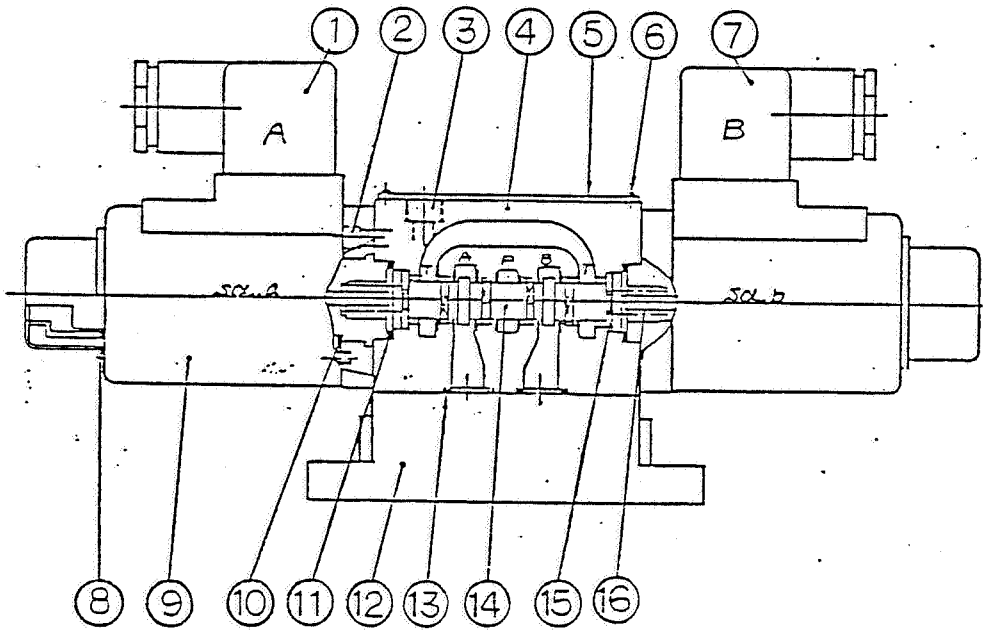
SWING SOLENOID VALVE
PLATFORM ~~SLEW CONTROL VALVE~~

The valve is a solenoid type.
It is controlled by the platform slew switch located at the upper control box electrically, and operates the platform slew cylinder.

Max. operational pressure:	160 kg/cm^2.
Rated flow volume:	15 liters/min.
Operational voltage:	DC 24 Volts.

Fig: 1

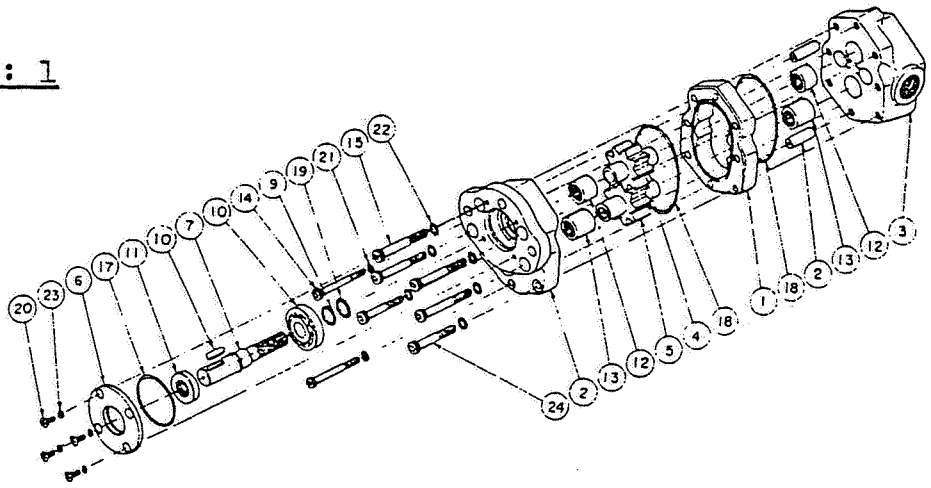


1. Connector A.
2. Bolt.
3. Bolt.
4. Valve housing.
5. Name plate.
6. Screw.
7. Connector B.
8. O ring.
9. Solenoid.
10. O ring.
11. O ring.
12. Sub-plate.
13. O ring.
14. Valve spool.
15. Retainer.
16. Spring.

HYDRAULIC MOTOR (for ~~Slewing~~ Rotation mechanism)

The motor drives ~~slewing~~ Rotation mechanism reducer to rotate turn table through T.T.B. (Turn Table Bearing).

Fig: 1



1. Gear plate.
2. Front frame.
3. Rear frame.
4. Drive gear.
5. Idler gear.
6. Oil seal case.
7. Drive shaft.
8. Knock pin.
9. Washer.
10. Bearing.
11. Oil seal.
12. Needle bearing.
13. Needle bearing.
14. Bolt.
15. Bolt.
16. Key.
17. O ring.
18. O ring.
19. Stop ring.
20. Screw.
21. Spring washer.
22. Spring washer.
23. Washer.
24. Bolt.

Inspection procedures.

1. Check the hydraulic lines for deformation, oil leakage and any other damages.
   - Crashed or deformed hydraulic lines results in lack of out-put power of the motor, as it causes lower oil flow volume or higher back pressure.
2. Check the anchor bolts or nuts for looseness, omissions.
3. Run the motor and check the following items.
   a) Oil leakage.
   b) Abnormal noise.
   c) Excessive heat at the surface of motor.
      - If a 5° to 10° C higher temperature exsists compared with oil reservoir, it is indicative of defective motor.
   d) Out-put power.
      - Powerless motor due to excessive internal oil leakage should be replaced.

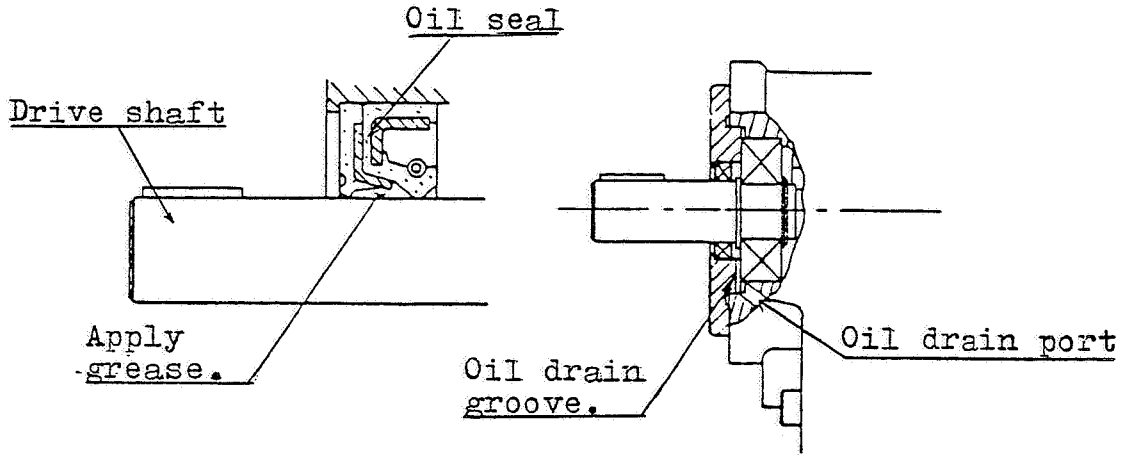
Oil seal replacement procedures.

In case that oil leakage from oil seal exists, replace the oil seal, following the next steps.
It is not advisable to overhaul the motor, as it is assembled very precisely by manufacturer. When the motor is powerless due to its internal oil leakage, just replace the motor Assy.

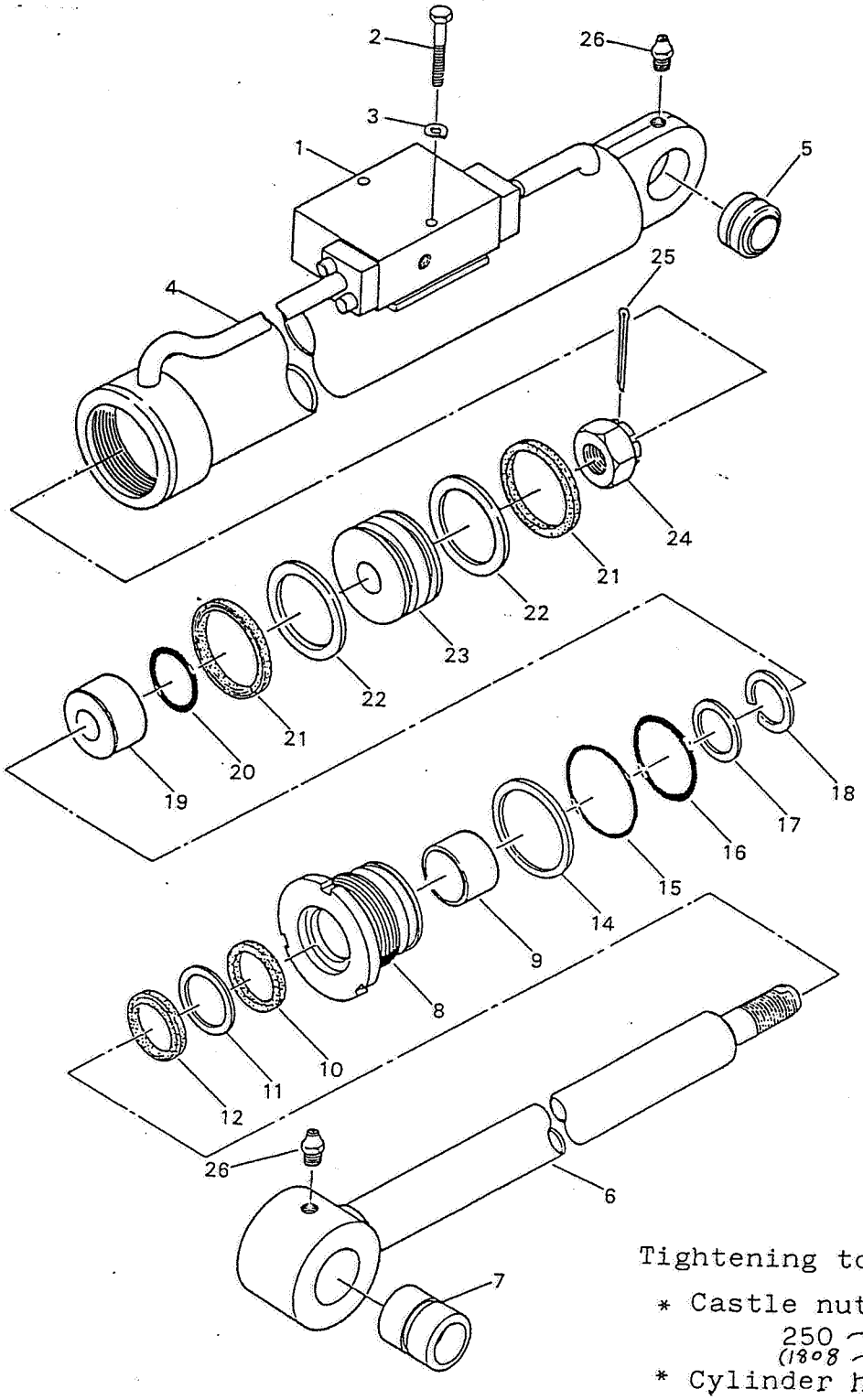
- When replacing oil seal, investigate the reason for damages to oil seal and rectify the cause.

1. Plug all of the ports of motor, as not to permit foreign particles, and clean the motor with a solvent and compressed air thoroughly.
2. Screw out screws (20) and remove oil seal case (6).
3. Remove oil seal (11) from oil seal case (6).
4. Check the following items before installing oil seal.
   a) Check drive shaft (7) for excessive wear and any other damages at the oil seal contact surface.
   b) Check oil seal case (6) and front frame (2) for ridge and any other damages at their contact surfaces.
5. Install a new oil seal onto oil seal case (6).
   - Apply grease slightly to the lip of oil seal.
6. Set O ring (17) at its position, and install oil seal case (6) onto front frame (2).
   - Use a new O ring (17).
   - Align the oil drain groove of oil seal case and the oil drain port of front frame as shown in Fig: 2.

Fig: 2



ELEVATION CYLINDER (303-03498 B)

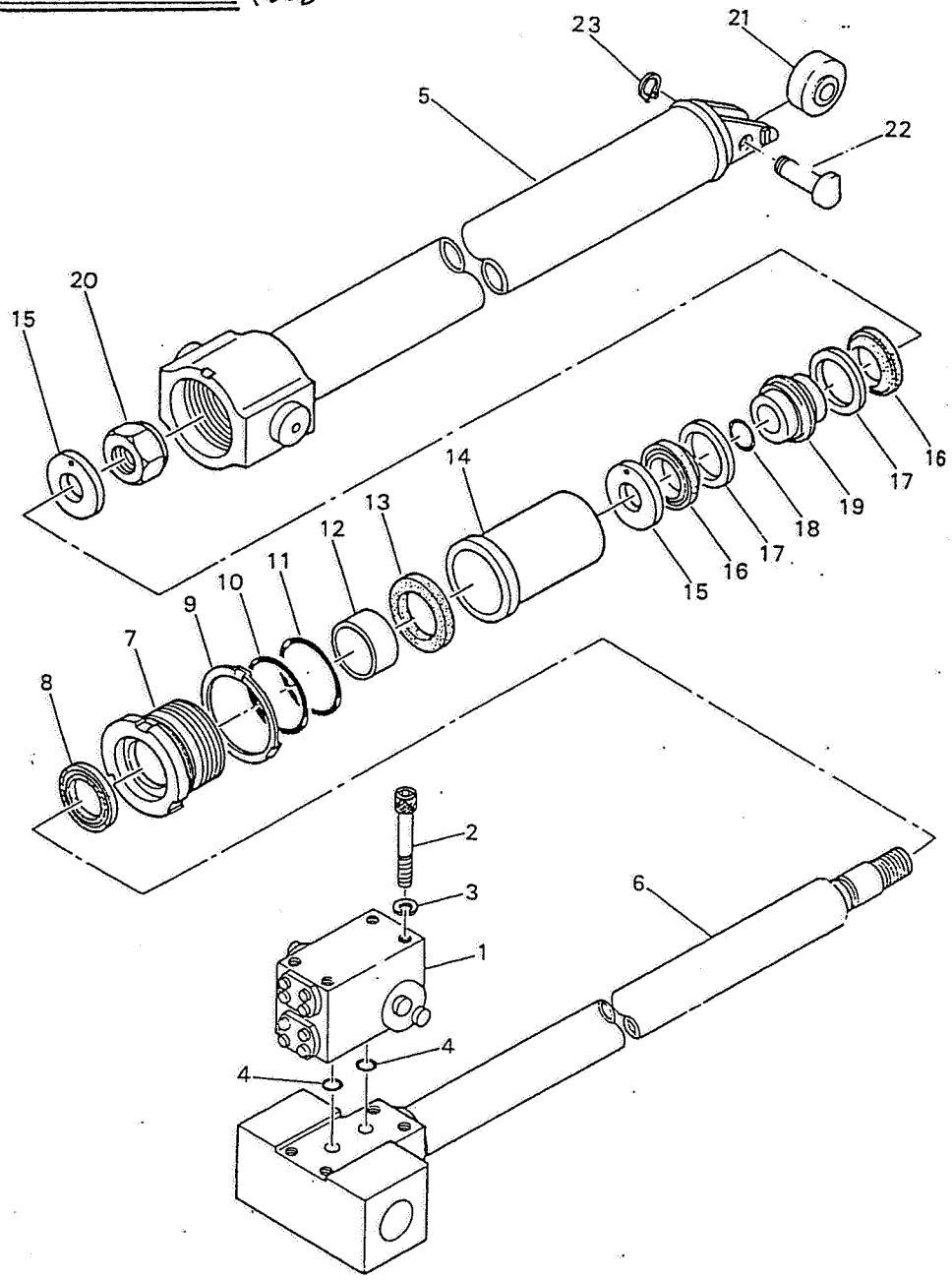


Tightening torque.

* Castle nut 24:
  250 ~ 270 kg-m.
  (1808 ~ 1953 ft-lb)
* Cylinder head 8:
  72 ~ 88 kg-m.
  (520 ~ 637 ft-lb)

1. Single holding valve.
2. Bolt.
3. Spring washer.
4. Cylinder tube.
5. Spherical bushing
6. Piston rod.
7. Bushing.
8. Cylinder head.
9. Bushing.
10. Packing.
11. Back up ring.
12. Dust seal.
13. ————
14. Lock plate.
15. O ring.
16. O ring.
17. Packing header.
18. Snap ring.
19. collar.
20. O ring.
21. Packing.
22. Back up ring.
23. Piston.
24. Castle nut.
25. Cotter pin.
26. Grease fitting.

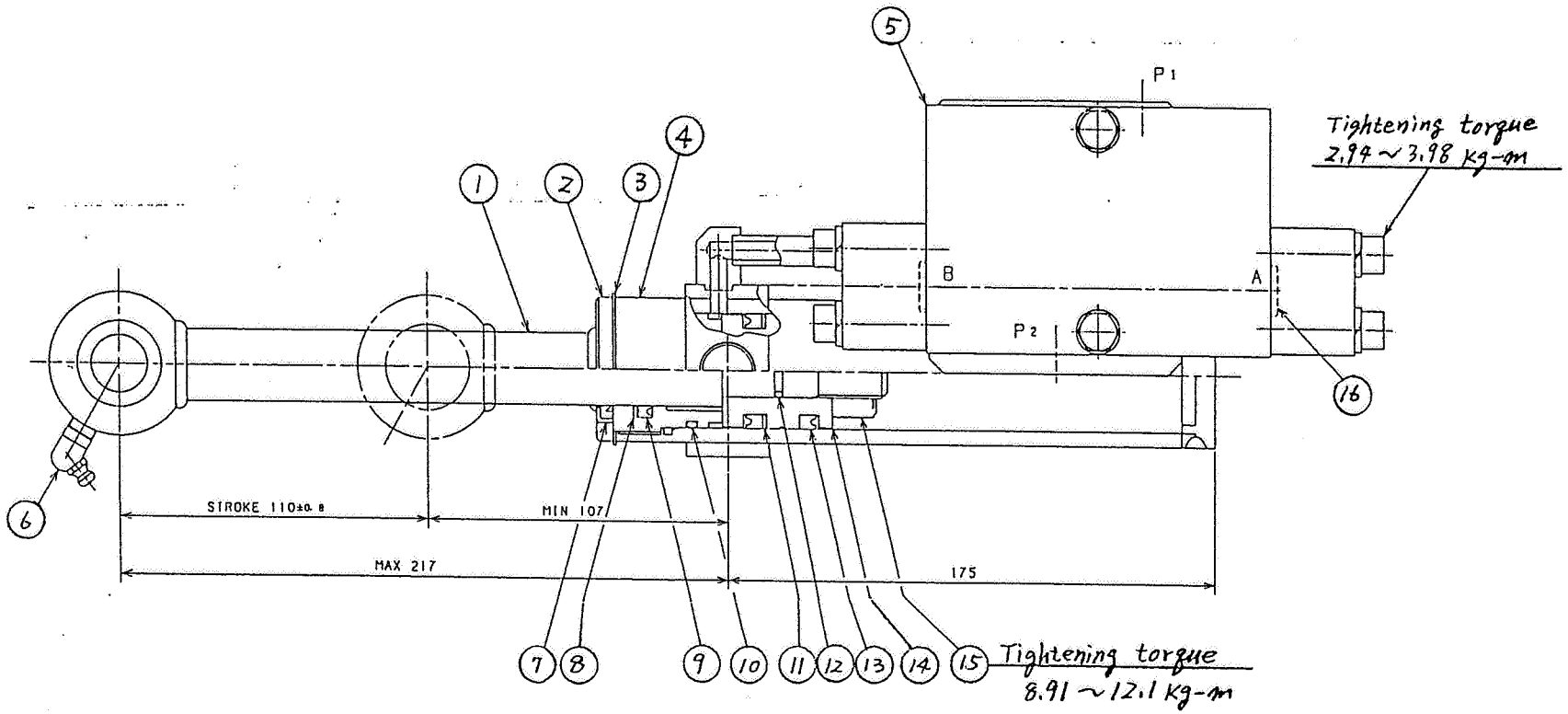
TELESCOPING CYLINDER (303-



Tightening torque. U nut 20: 135 ~ 185 kg-m. (976 ~ 1338 ft-lb)

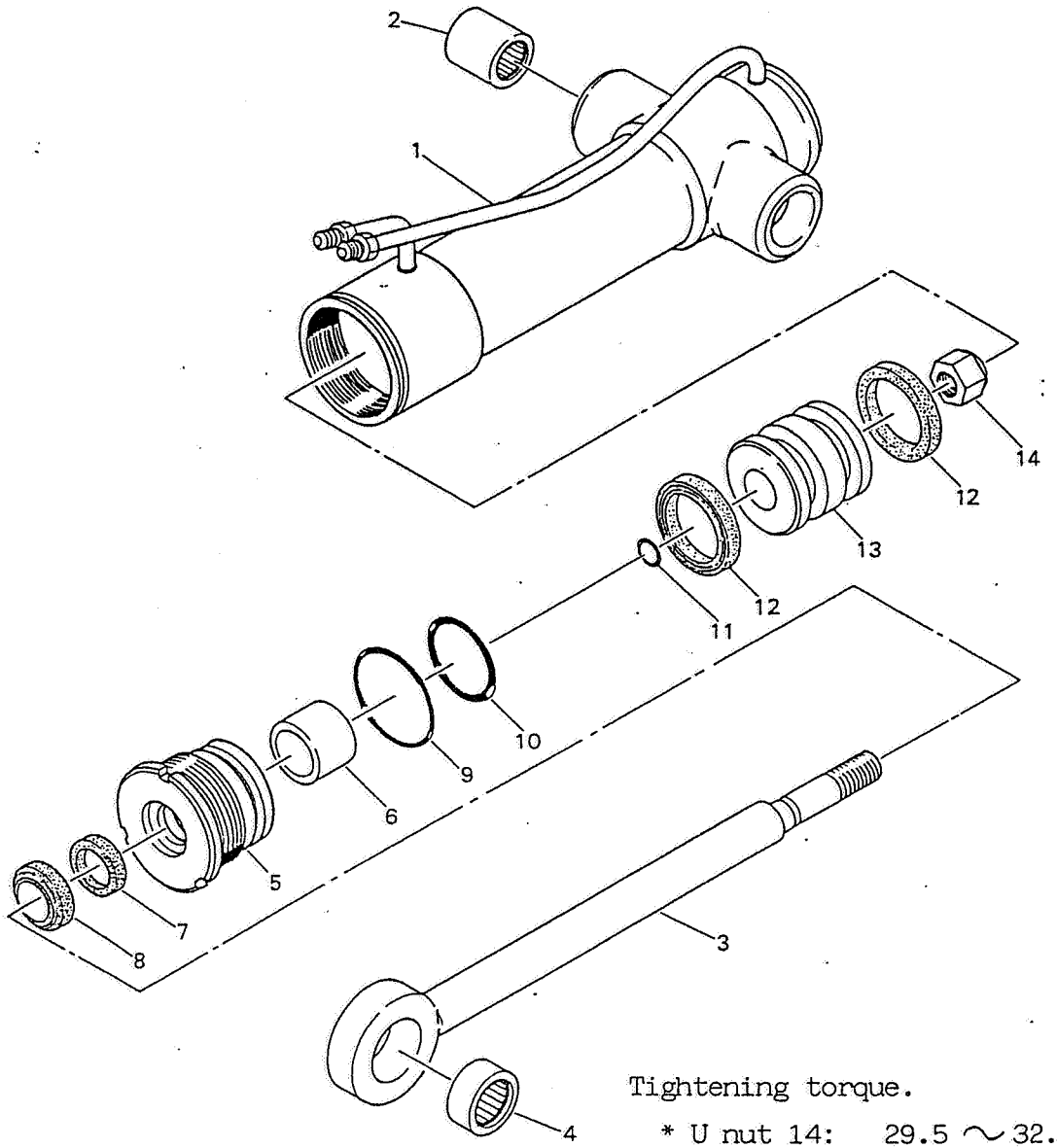
1. Double holding valve.
2. Cap screw.
3. Spring washer.
4. O ring.
5. Cylinder tube.
6. Piston rod.
7. cylinder head.
8. Dust seal.
9. Lock washer.
10. O ring.
11. O ring.
12. Bushing.
13. packing.
14. collar.
15. packing holder.
16. packing.
17. piston ring.
18. O ring.
19. piston.
20. u nut.
21. Roller.
22. pin.
23. Snap ring.

PLATFORM SWING CYLINDER (for 45°) (403-02395)



1	Piston rod	7	Dust seal	13	Packing
2	cylinder head	8	Back-up ring	14	Piston
3	Lock washer	9	Packing	15	U nut
4	Cylinder tube	10	O ring	16	O ring
5	Double pilot check. V	11	Back-up ring		
6	Grease fitting	12	O ring		

PLATFORM SWIG CYLINDER (for 80°) (303-03447)

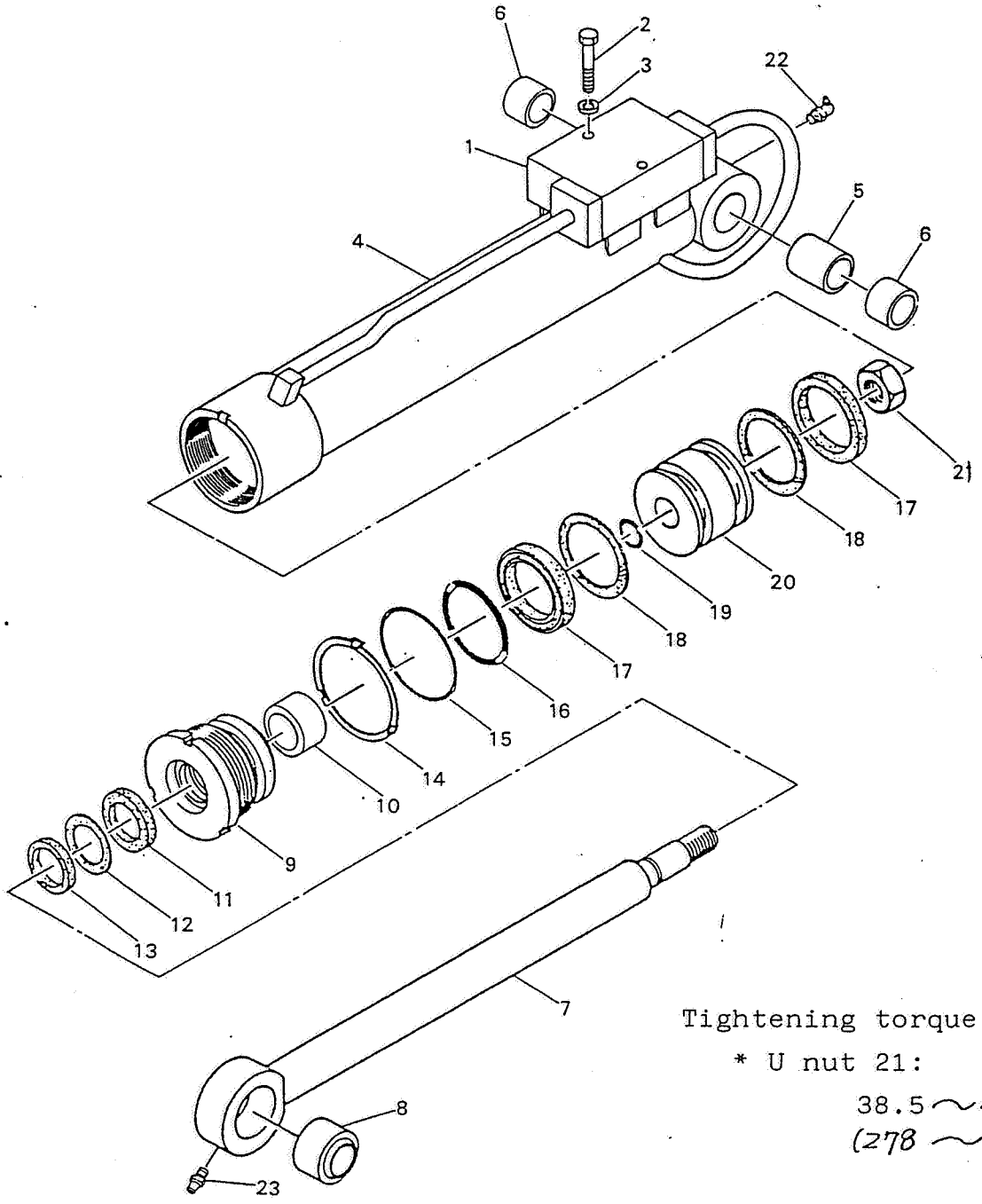


Tightening torque.

* U nut 14: 29.5 ~ 32.5 kg-m (213 ~ 235 ft-lb)
* Cylinder head 5: 29 ~ 35 kg-m. (209 ~ 253 ft-lb)

1. Cylinder tube.
2. Needle bearing.
3. Piston rod.
4. Needle bearing.
5. Cylinder head.
6. Bushing.
7. Packing.
8. Dust seal.
9. O ring.
10. O ring.
11. O ring.
12. packing.
13. piston.
14. U nut.

UPPER LEVELLING CYLINDER (403-02118 C)



Tightening torque.

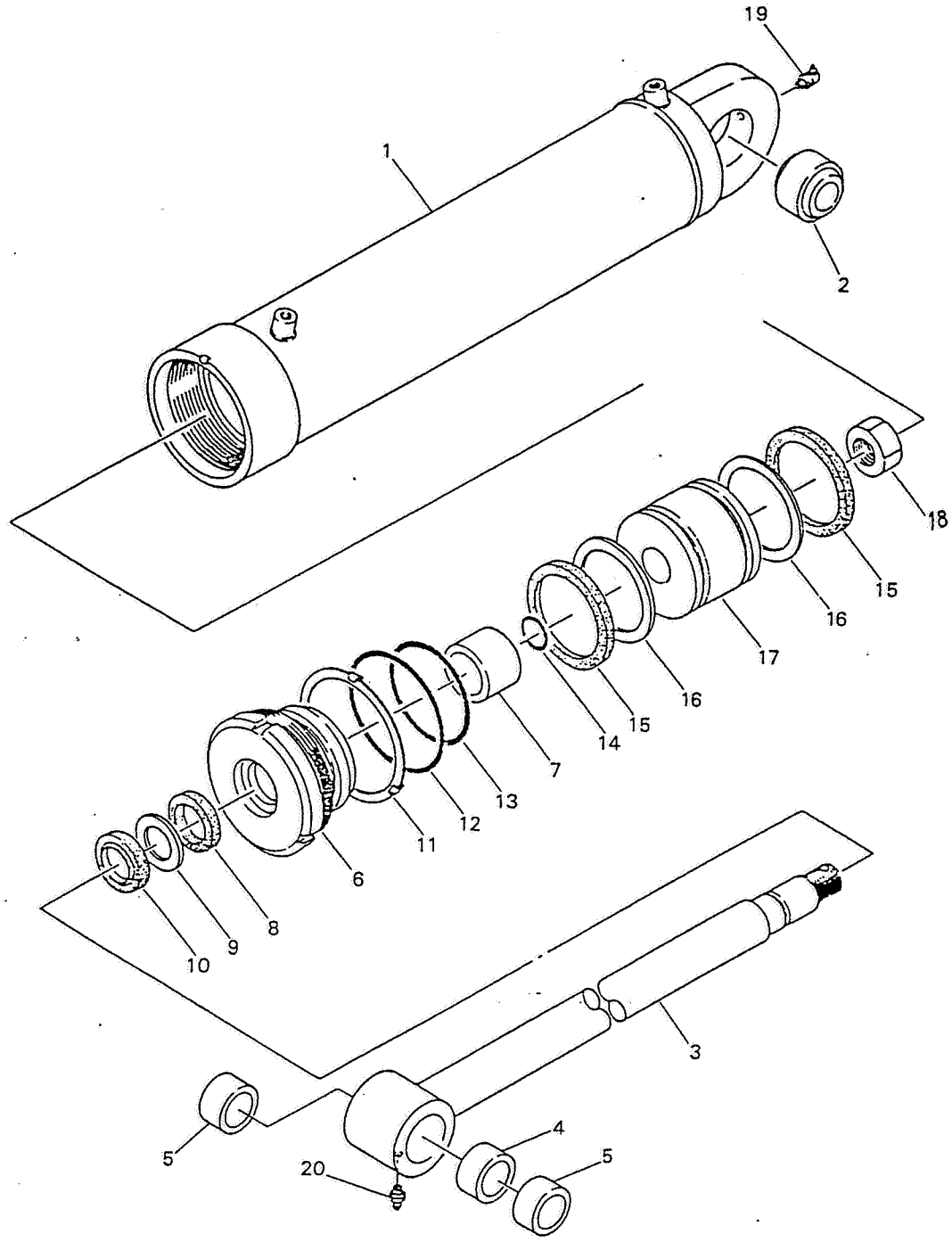
* U nut 21:

38.5 ~ 48.0 kg-m

(278 ~ 347 ft-lb)

1. Double pilot check valve.
2. Bolt.
3. Spring washer.
4. Cylinder tube.
5. Collar.
6. Bushing.
7. piston rod.
8. Spherical bushing.
9. Cylinder head.
10. Bushing.
11. packing.
12. Back up ring.
13. Dust seal.
14. Lock plate.
15. O ring.
16. O ring.
17. Packing.
18. Back up ring.
19. O ring.
20. piston.
21. U nut.
22. Grease fitting.
23. Grease fitting.

LOWER LEVELLING CYLINDER (403-02113B)



Tightening torque.

* U nut 18: 38.5 ～ 48.0 kg-m. (278～347 ft-lb)

1. Cylinder tube.
2. Spherical bushing.
3. Piston rod.
4. Collar.
5. Bushing.
6. Cylinder head.
7. Bushing.
8. Packing.
9. Back up ring.
10. Dust seal.
11. Lock plate.
12. o ring.
13. O ring.
14. O ring.
15. Packing.
16. Back up ring.
17. piston.
18. U nut.
19. Grease fitting.
20. Grease fitting.

SINGLE HOLDING VALVE (for Elevation cylinder) (302 03248)

The "Single holding valve" is mounted on "Elevation cylinder" to prevent "Free-fall" of the cylinder caused by the gravities of boom and platform.

The "Manual over-ride screw" installed on the valve is screwed in fully to open the passage "Port IN" to "Port OUT", in case the "Manual bleed down descent system" is actuated.

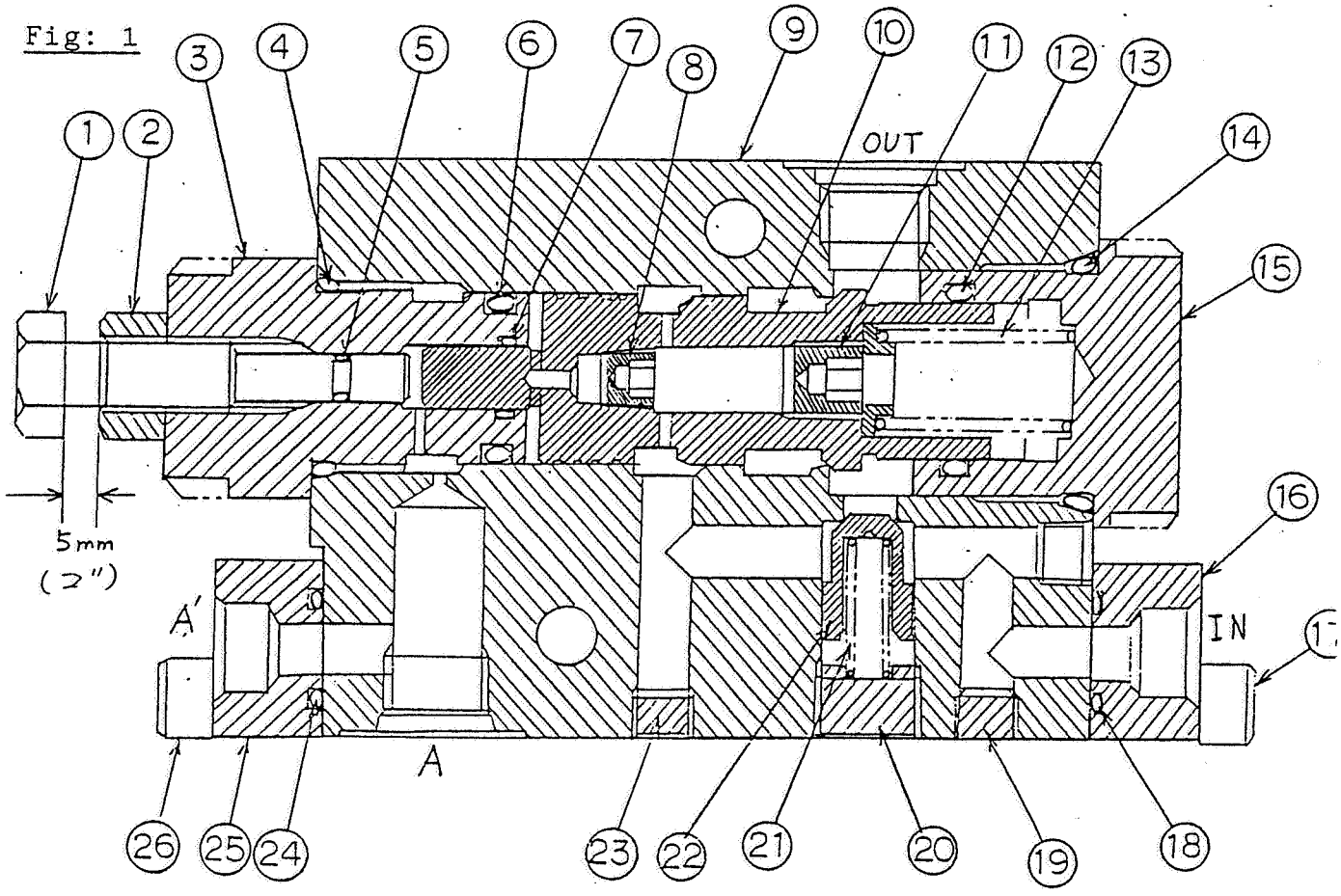
NOTE: "Free-fall" of cylinder.

The phenomenon that the hydraulic cylinder is extended or retracted due to the external force excerted.

Max. allowable pressure: 210 kg/cm^2. (≥990 PSI)

Max. flow volume: 80 liters/min. (21.1 gals/min)

Fig: 1

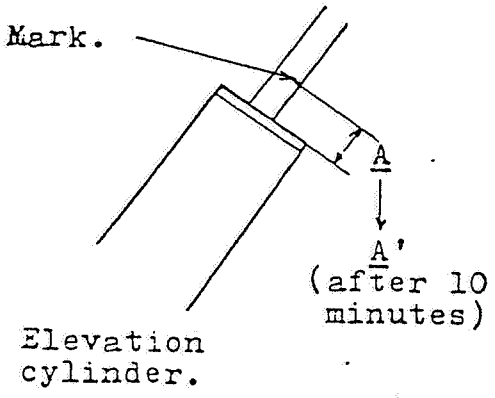


1. Manual over ride screw.
2. Lock nut.
3. Guide.
4. O ring.
5. O ring.
6. O ring.
7. O ring.
8. Orifice.
9. Valve housing.
10. Valve spool.
11. Orifice.
12. O ring.
13. Spring.
14. O ring.
15. Cap.
16. Flange.
17. Cap screw.
18. o ring.
19. Plug.
20. plug.
21. Spring.
22. Check valve.
23. Plug.
24. o ring.
25. Flange.
26. Cap screw.

Inspection procedures.

1. Check the external oil leakage thoroughly.
2. Check the internal oil leakage, following the next steps. (Internal oil leakage is inspected by checking the free-fall of elevation cylinder.)
   1) Park the equipment on a firm level ground.
   2) Operate the aerial equipment, and position the boom, so that the elevation angle becomes about 45 degrees.
   3) Stop engine, put mark on the piston rod of elevation cylinder as shown in Fig: 2.
      CAUTION: Do not damage the piston rod, when putting mark.

Fig: 2



   4) Take the dimension A as shown in Fig: 2., and leave it for 10 minutes.
   5) After 10 minutes, take the dimension A' between the mark put in step 3 and the edge of cylinder tube as shown in Fig: 2.
      A - A' = Free-fall of elevation cylinder.
      Limit of free-fall: 2mm/10minutes. (0.08"/10min)
   6) If the value of free-fall exceeds the limit (2mm/10min.), check the single holding valve and the elevation cylinder for internal oil leakage.

NOTE: To identify which has internal oil leakage (the single holding valve or the elevation cylinder), follow the next steps.

1) Under the condition that the elevation cylinder is loaded with the gravities of booms and platform, disconnect the hydraulic hose connected to port OUT at the single holding valve.
2) In case that hydraulic oil drips continuously from port OUT of single holding valve, it is indicative of internal oil leakage of single holding valve.
In case the oil-drips stop after a while, it indicates that elevation cylinder has internal oil leakage.

CAUTION:

After actuating "Manual bleed down descent system" or repairing "Single holding valve", make sure to set the "Dimension" between "Manual over ride screw (1)" and "Lock nut (2)" at 5 mm (2 ") as shown in Fig: 1.

Operating procedures of "Manual bleed down descent system"

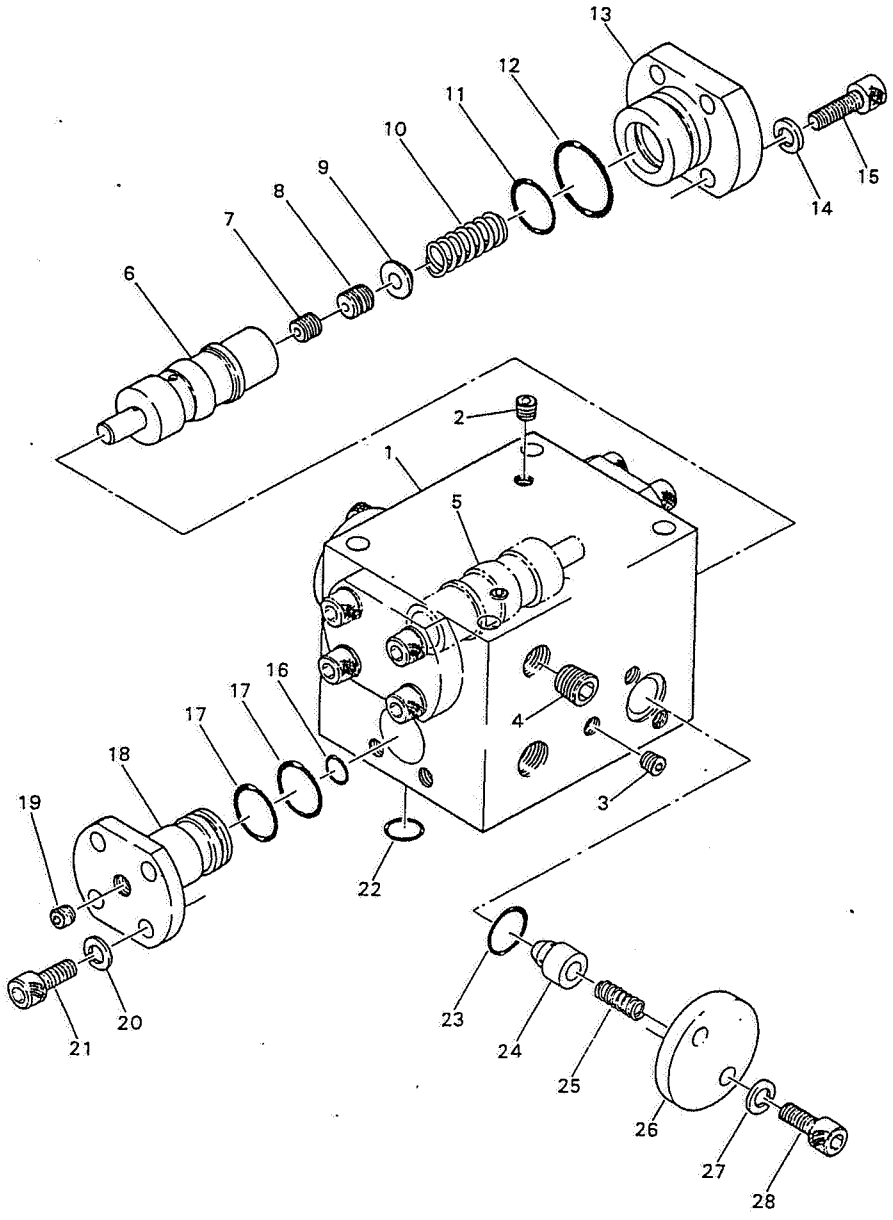
* To lower the platform.
  1. Screw in the "Manual over ride screw" (installed on "Single holding valve") fully.
  2. Open the "Stop valve" (for Manual bleed down descent system) gradually, and lower the platform.

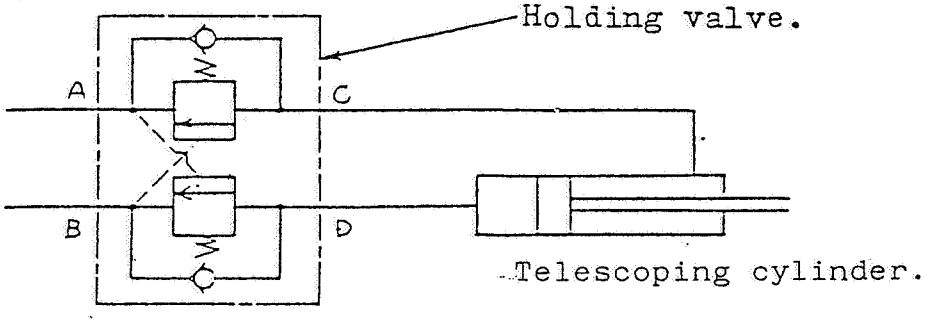
* To reset "Manual bleed down descent system".
  1. Close the "Stop valve" (for Manual bleed down descent system) securely.
  2. Start engine, perform "Elevation UP" operation at "Lower control", and raise the boom.
  3. Screw out the "Manual over ride screw" (installed on "Single holding valve as refering the "CAUTION" above.
  4. Perform "Elevation UP/DOWN" operation several times to bleed air in the "Elevation hydraulic system".
  5. Check the "Free fall" of "Elevation cylinder" as refering "Inspection procedures".

DOUBLE HOLDING VALVE (for Telescoping cylinder)(302-03231)

Double holding valve is mounted on telescoping cylinder, since the cylinder tends to extend or retract due to the gravities of boom (or ladders) and platform.

Fig: I

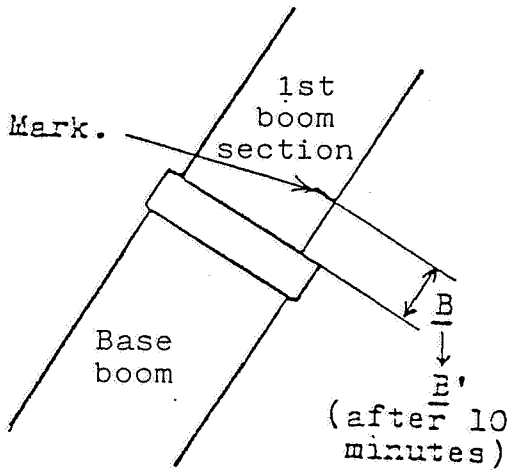




Inspection procedures

1. Check the external oil leakage thoroughly.
2. Check the internal oil leakage, following the next steps.
   (Internal oil leakage is inspected by checking the "Free-fall" of "Telescoping cylinder".)
   1) Park the equipment on a firm level ground.
   2) Extend boom about 1 meter, and raise it fully up to the stroke end of elevation cylinder.
   3) Stop the engine, and put a "Mark" on the "1st boom section" as shown in the figure below.

Fig: 2

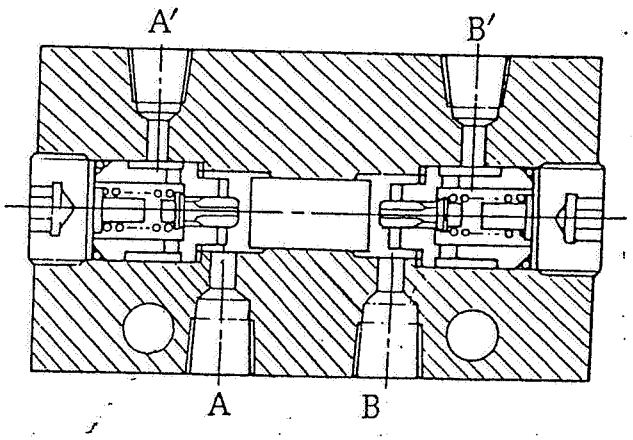


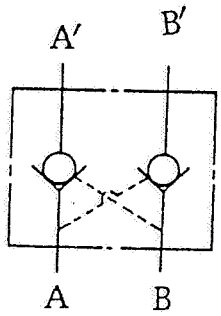
   4) Measure the "Dimension B" as shown in Fig: 2 above. Then, leave it for 10 minutes.
   5) After 10 minutes, measure the "Dimension B'" as shown in Fig: 2.
      * B — B = "Free-fall" of Telescoping cylinder.
      * Serviceable limit of "Free-fall": 2 mm/10 min. (0.08"/10n
   5) In case the value of the "Free-fall" exceeds the "Serviceable limit", further check the internal oil leakage of the "Double holding valve" or "Telescoping cylinder" as refering the clause of "SINGLE HOLDING VALVE" (for Elevation cylinder).

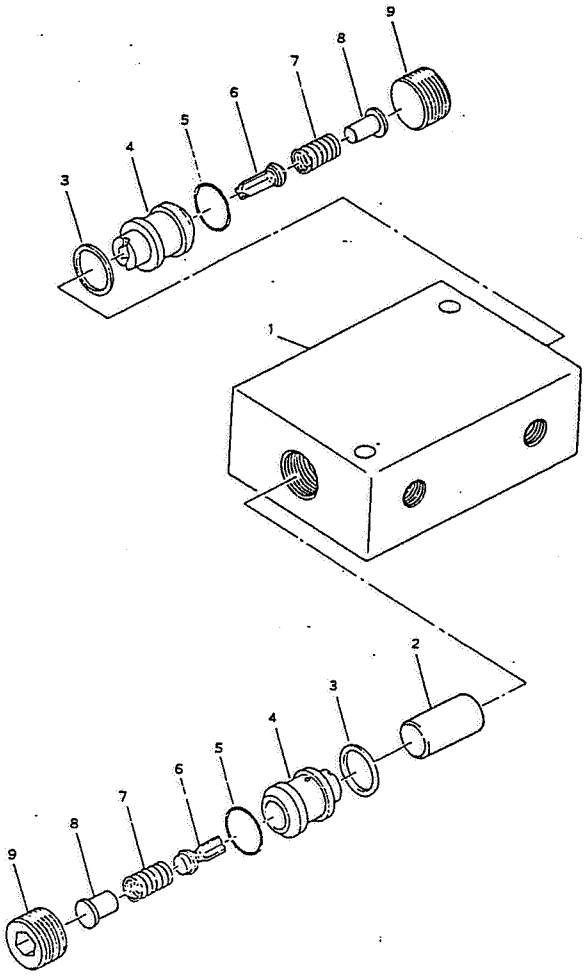
DOUBLE PILOT CHECK VALVE (for Platform swing ~~circuit~~ Cylinder) (302 02909)

Double pilot check valve for platform swing circuit is installed in the hydraulic lines between the platform swing solenoid valve and platform swing cylinder.
It confines hydraulic oil into both bottom and rod rooms of the platform swing cylinder to keep the current position of platform in such emergency case as hydraulic line failure.

Rated pressure:	210 kg/cm^2. (2990 PSI)
Max. allowable back pressure: (for check valve)	350 kg/cm^2. (4980 PSI)
Cracking pressure:	20 kg/cm^2. (284 PSI)
Pilot pressure rate:	7 : 1



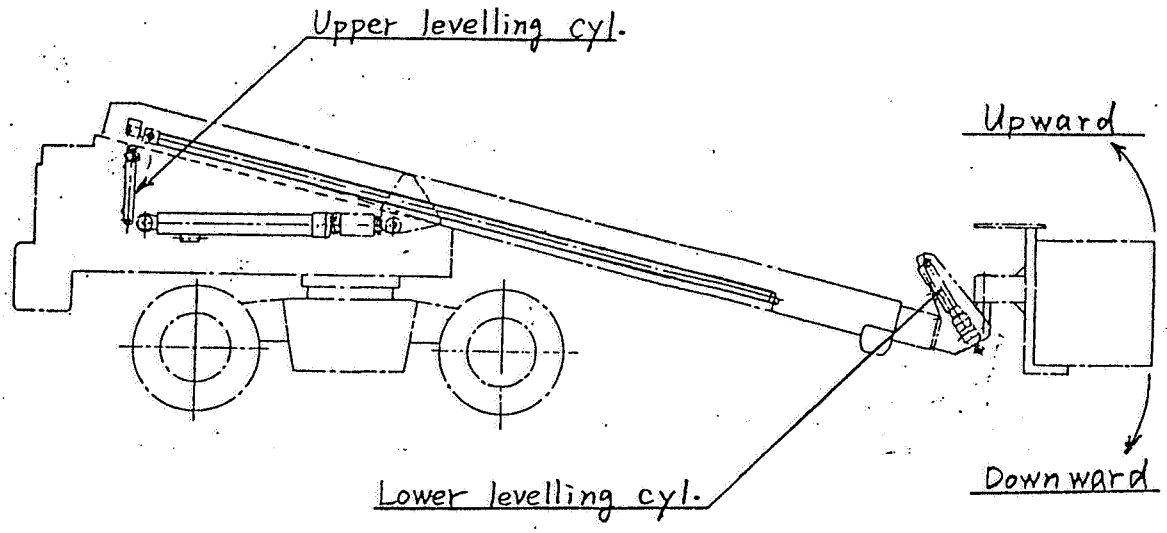


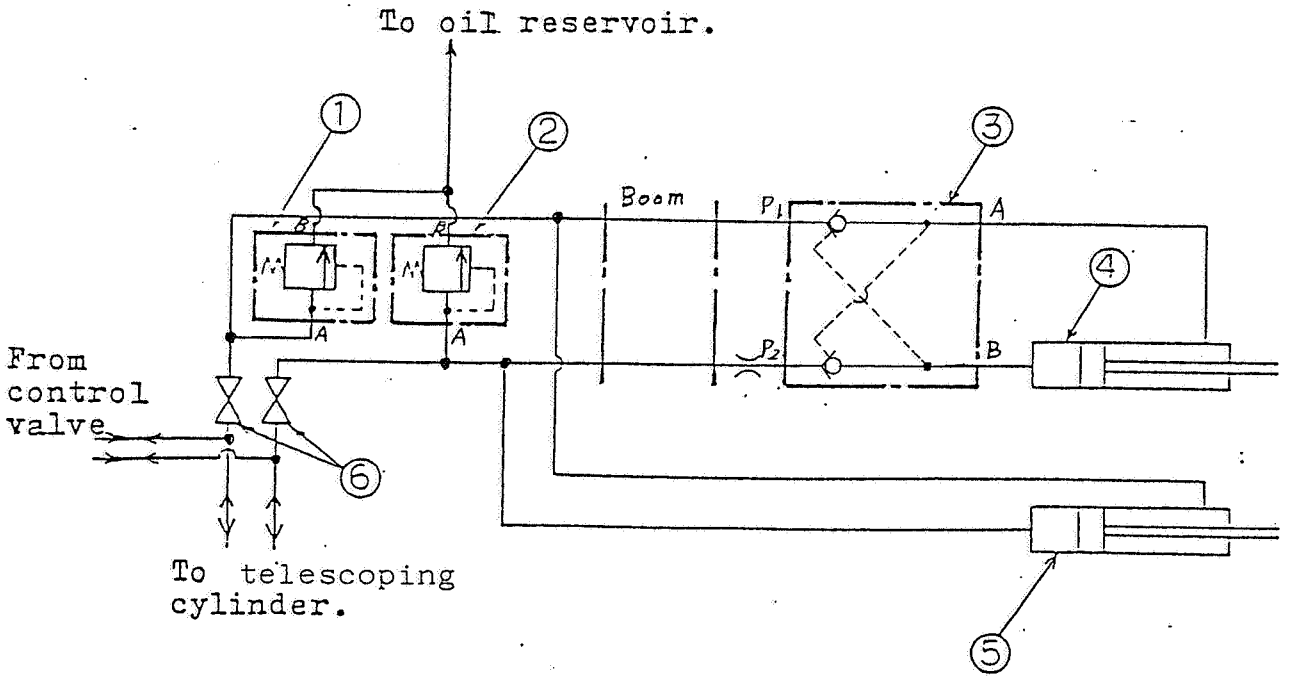


PLATFORM LEVELLING SYSTEM

The system maintains the level of platform automatically, regardless of boom's up/down movements.
It consists of "Upper & Lower levelling cylinders", "Double pilot check valve"(mounted on Upper levelling cylinder), Two "Overload relief valves" and two "Stop valves".

Fig: 1





1. Overload relief valve A.
2. Overload relief valve B.
3. Double pilot check valve.
4. Upper levelling cylinder.
5. Lower levelling cylinder.
6. Stop valve.

Note on functions

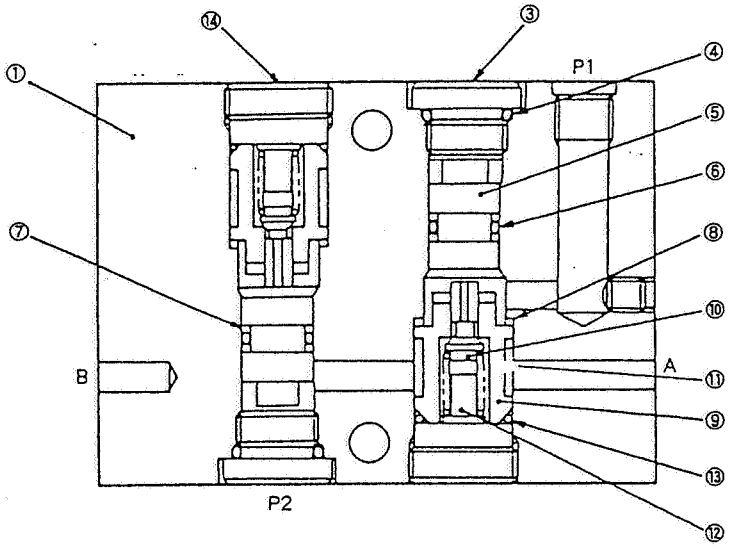
Two levelling cylinders are mounted as shown in Fig: 1.
When the boom is lowered, the "Lower levelling cylinder" is retracted and the hydraulic oil in the bottom room of the cylinder flows into the bottom room of "Upper levelling cylinder".
Since, the sizes of the both levelling cylinders are exactly same, the "Upper levelling cylinder" extends by the same stroke as the "Lower levelling cylinder" retracts.
Thus, the platform is moved by the "Levelling cylinders" to maintain its level, as the boom is lowered.

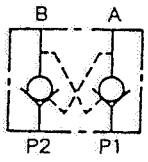
When the boom is raised, the exactly opposite function occurs in the system to maintain the level of "Platform".

Double pilot check valve (302 0

The valve is mounted on the "Upper levelling cylinder".
It confines the hydraulic oil into the "Upper levelling cylinder" to keep the level of platform, in such emergency case as hydraulic line failure.

Rated pressure ..... 210 kg/cm²
Rated flow volume ..... 30 ℓ/min
Cracking pressure ..... 6.5 kg/cm²
Pilot rate ..... 7 : 1





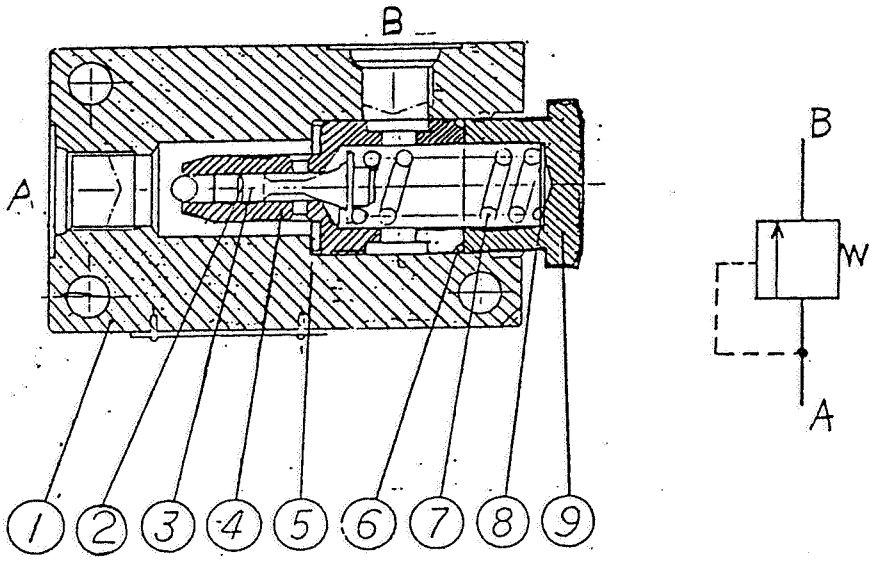
1	Valve housing	6	O ring	11	Spring
2	———	7	Back-up ring	12	Spring guide
3	Plug	8	Gasket	13	O ring
4	O ring	9	Valve seat	14	Plug
5	Piston	10	check valve		

Overload relief valve (302 02223)

Two "Overload relief valves" are incoporated with the system to protect the hydraulic components from excessively high pressure produced by inadequate adjustment of the system.

Rated pressure:	300 kg/cm^2. (4270 PSI)
Rated flow volume:	15 liters/min. (4 gals/min)
Specific setting pressure:	175 kg/cm^2. (2500 PSI)

Fig: 3



1. Valve body.
2. O ring.
3. Valve.
4. Valve seat.
5. Gasket.
6. O ring.
7. Spring.
8. Plate.
9. Plug.

a. In case the system is not adjusted properly and the platform is tilted downward.
   - The upper levelling cylinder reaches to its stroke end before the lower levelling cylinder, when the boom is raised. If the boom is raised more from this point, the hydraulic oil in the rod room of lower levelling cylinder is compressed and produces excessively high pressure in the system.
     To release this excessively high pressure, the relief valve (A) works and protects the hydraulic components.

b. In case the platform is tilted upward.
   - The system follows the opposite procedures "a" above, and the relief valve (B) works to protect the hydraulic components from excessively high pressure.

NOTE:

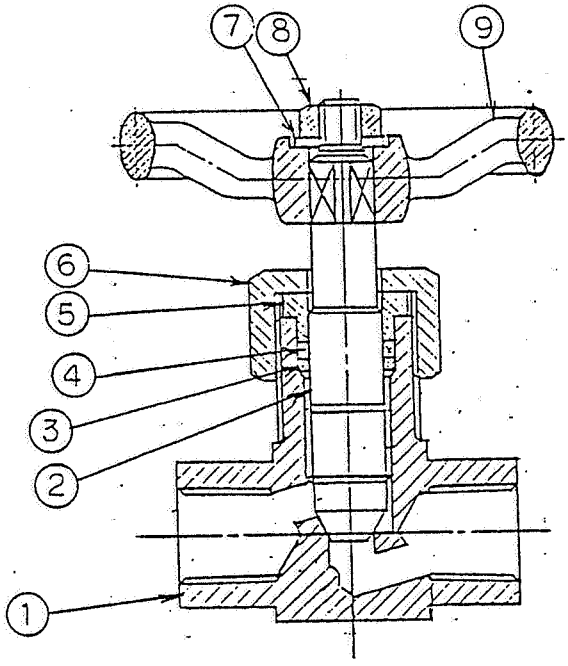
* Air bleeding and adjustment is required, when the "Overload relief valve" is actuated as described above.

Stop valve (302 02861A)

· Two "Stop valves" are installed at the "Lower control" to give a "Closed hydraulic circuit" in the "Platform levelling system". Both of the "Stop valves" are opened, only when performing the adjustment of "Platform's level".

* Rated pressure: 210 kg/cm^2. (≥990 PSI)

Fig: 4

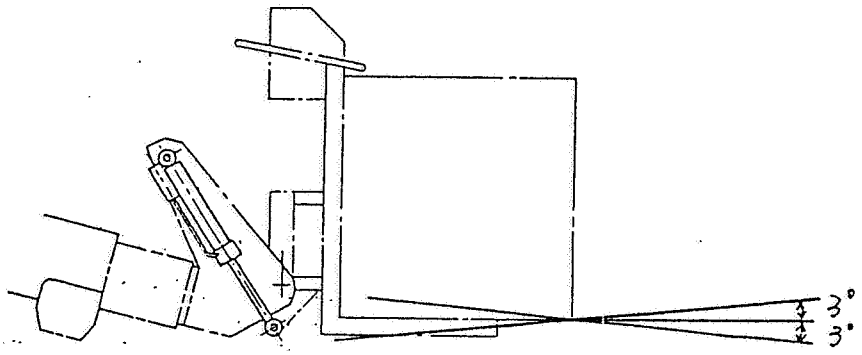


1. Valve body.
2. Shaft.
3. Plate.
4. O ring & Back up ring.
5. O ring holder.
6. Nut.
7. Washer.
8. Nut.
9. handle.

Inspection procedures

1. Tilt of platform.
   Perform "Elevation UP/DOWN" and "Telescoping IN/OUT" operations several times, and make certain that the platform always stays level.
   Then, if the platform is tilted in excess of "Serviceable limit 3° " as shown in the figure below, adjust the "Level of platform" as refering the clause of "Adjustment method of platform level".

Fig: 5



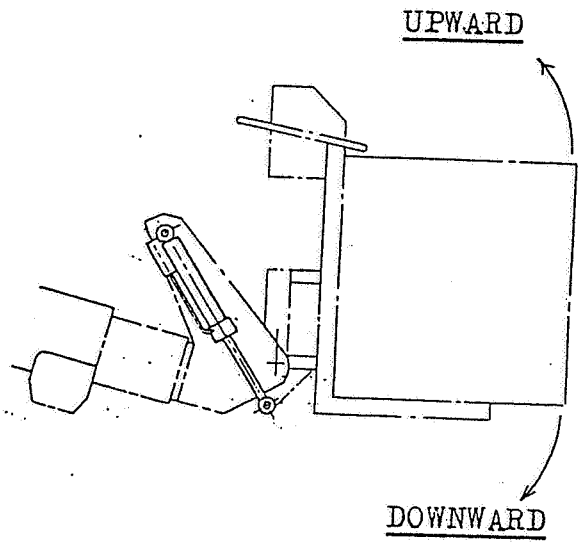
2. Free fall.
   Load the platform with its maximum load (250 kg), (550 lbs) and visually check if the platform tilts downward.
   If the platform tilts excessively, check the internal oil leakage of "Upper levelling cylinder" and "Double pilot check valve".

Adjustment method of platform level

CAUTION:

* Do not attempt the following procedures, when the platform is loaded.
* Operated the equipment at the "Lower control", when carrying out the adjustment.

Fig: 6



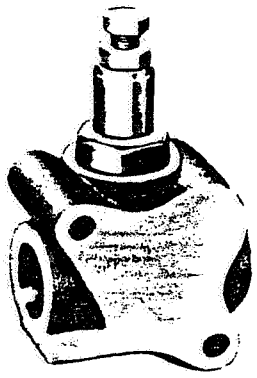
1. If the platform is tilted downward.
   1) Retract boom fully, and set it horizontally.
   2) Open the two "Stop valves" located at "Lower control".
   3) Operate the "Telescoping switch" to "IN".
      The platform moves upward.
   4) When the platform gets its level, return the control switch to its neutral, and close the "Stop valves" firmly.
   5) Operate the equipment thoroughly at the "Lower control", and make certain that the platform always stays level.

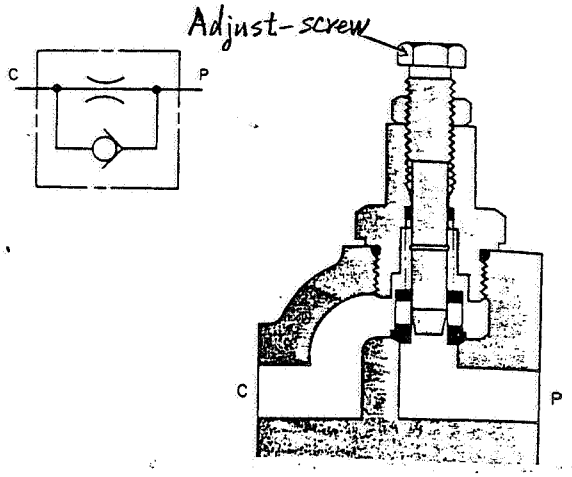
2. If the platform is tilted upward.
   1) Extend boom fully, and set it horizontally.
   2) Open the two "Stop valves" located at "Lower control".
   3) Operate the "Telescoping switch" to "OUT".
      The platform moves downward.
   4) When the platform gets its level, return the control switch to its neutral, and close the "Stop valves" firmly.
   5) operate the equipment thoroughly at the "Lower control", and make certain that the platform always stays level.

THROTTLE CHECK VALVE (for Elevation cylinder)

The valve is installed on the hydraulic line between main control valve and the bottom room of elevation cylinder for the purpose of controlling the retracting speed of elevation cylinder.
The adjust screw of the valve is screwed in to lower the speed, and screwed out to higher it.

- Maximum flow volume: 60 liters/min.
- Operational pressure: 175 kg/cm^2.
- Cracking pressure: (for check valve) 0.3 kg/cm^2.





Adjustment procedures.

The following conditions should be strictly kept, when measuring and adjusting operational speed.

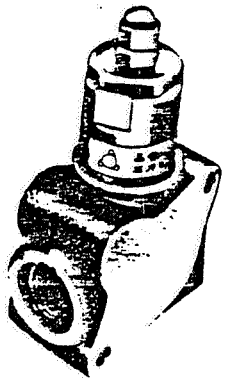
- Hydraulic oil temperature: 40° - 60° C.
- Hydraulic pump speed: 2,000 rpm.

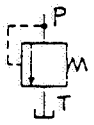
1. Adjust the KL valve controller for elevation, as refering "ADJUSTMENT SECTION".
2. Measure the boom lowering speed following the next steps
   a) Retract booms fully.
   b) Raise/lower boom by the full stroke of elevation cylinder, using upper control station, and measure the boom lowering speed by a stop watch.
      - Rated boom lowering speed: 5±5 seconds/stroke.
3. In case the boom lowering speed measured in step 2 is higher or lower than the rated speed, adjust the throttle check valve as follows.
   - To higher the speed, turn the adjust screw counter-clockwise. and to lower it, turn the adjust-screw clockwise.

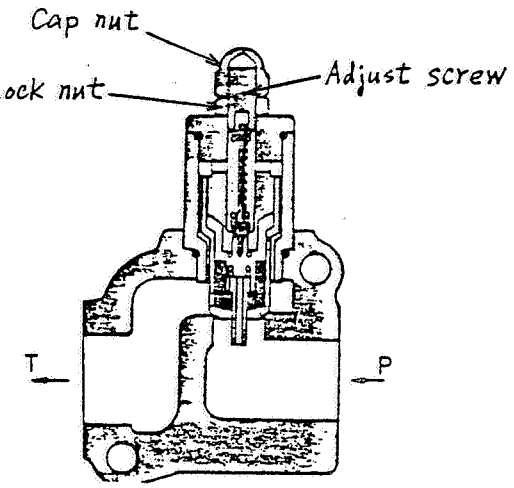
OVER-LOAD RELIEF VALVE (for Telescoping cylinder)

The valve is installed on the hydraulic line between main control valve and bottom room of telescoping cylinder.
It reduces the maximum hydraulic pressure exerted in the bottom room of telescoping cylinder from 175 kg/cm^2 to 90 kg/cm^2.

- Maximum flow volume: 65 liters/minute.
- Adjustable pressure range: 70 - 120 kg/cm^2.
- Setting pressure: 90 kg/cm^2.







Adjustment procedures.

The following conditions should be strictly kept, when measuring and adjusting setting pressure.

- Hydraulic oil temperature: 40° - 60° C.
- Hydraulic pump speed: 2,000 rpm.

1. Remove the plug (for pressure test port) at the out let line of hydraulic pump NO. 1, and set a "Pressure gauge" onto the pressure test port.
2. Start engine and run the hydraulic pump at 2,000 rpm.
3. Operate the "Telescoping switch" to "OUT" position at lower control station, extend boom fully up to the stroke end of telescoping cylinder, and keep the switch at "OUT" position to activate over-load relief valve.
4. Read the oil pressure gauge, while the over-load relief valve is active and take the setting pressure.
   - Rated setting pressure: 90 kg/cm^2.

   NOTE: Take the setting pressure at least 3 times for accuracy.
5. In case that the setting pressure taken in step 4 is higher or lower than the rated setting pressure (90 kg/cm^2), adjust the over-load relief valve following the next steps.

a) Remove cap-nut, and loosen lock-nut for adjust-screw.
b) In case that the setting pressure taken in step 4 is lower than the rated setting pressure, turn the adjust-screw clockwise untill the rated setting pressure is obtained. If the setting pressure is higher, turn the adjust-screw counter-clockwise and obtain the rated setting pressure.
c) Lock the adjust-screw by lock-nut and recheck the setting pressure.

NOTE: Recheck the pressure at least 3 times for accuracy.

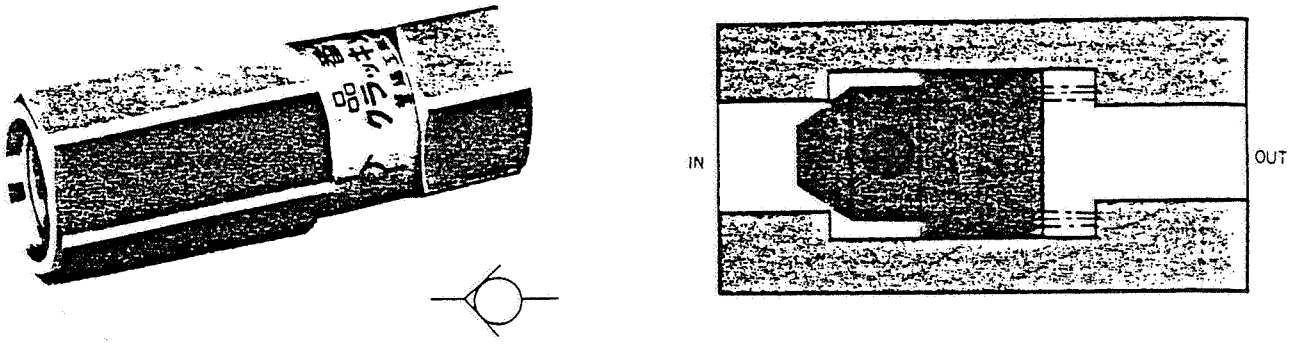
d) Install cap-nut and disconnect the oil pressure gauge, then install the plug onto the pressure test port.

NOTE: Wind seal-tape at least one and a half times around the thread of the plug (for pressure test port), before installation.

IN-LINE CHECK VALVE

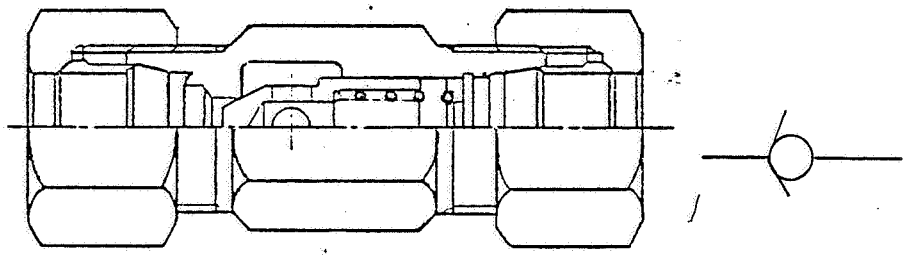
In-line check valve NO. 1 is installed on the out-let line of hydraulic pump NO. 1, and in-line check valve NO. 2 on the out-let line of emergency pump.

Fig: 1 In-line check valve NO. 1.



- Rated flow volume: 75 liters/min.
- Operational pressure: 175 kg/cm^2.
- Cracking pressure: 0.4 kgf/cm^2.

Fig: 2 In-line check valve NO. 2



- Rated flow volume: 18 liters/min.
- Operational pressure: 175 kg/cm^2.
- Cracking pressure: 0.5 kgf/cm^2.

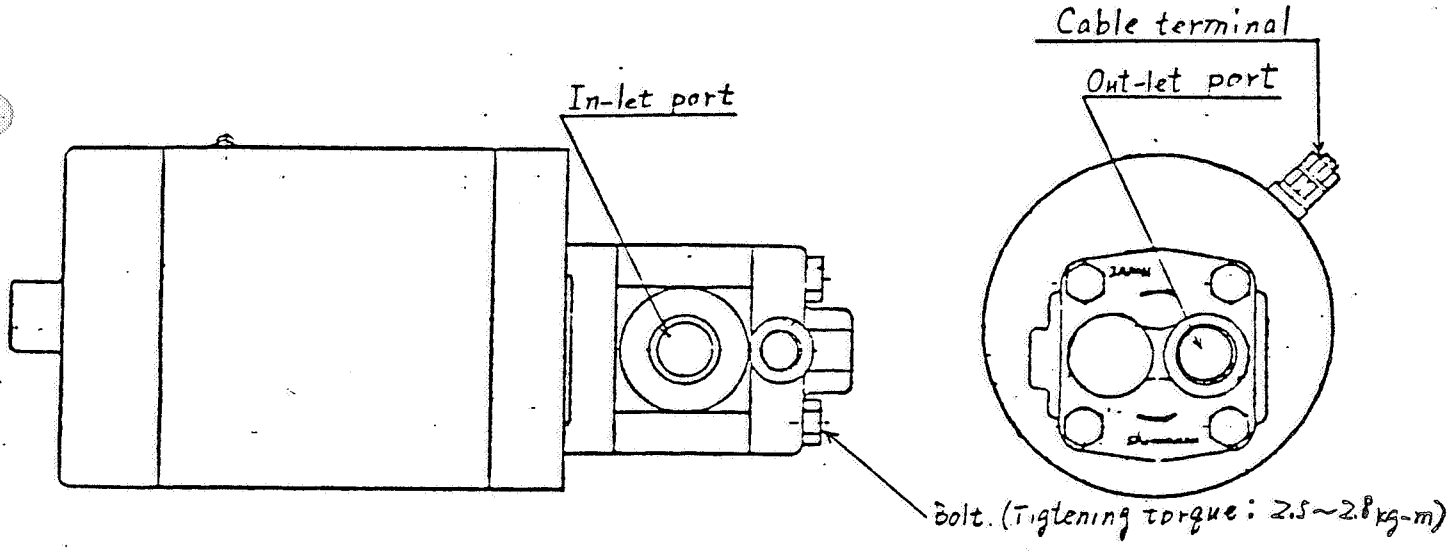
Note on function (Refer to hydraulic circuit diagram.)

In-line check valve NO. 1 is closed, in case the emergency pump is driven, and prevents the hydraulic oil discharged by emergency pump from flowing into hydraulic pump NO. 1.
On the contrary, in-line check valve NO. 2 prevents the hydraulic oil discharged by hydraulic pump NO. 1 from flowing into emergency pump.

EMERGENCY PUMP

The emergency pump supplies hydraulic pressure to each hydraulic component, in case of emergency (eg, engine trouble). The pump is driven by the DC motor which is powered by the battery (24 volts).

Model;	SP10-0.8
Discharge volume;	0.77 cc/rev.
Maximum hydraulic pressure;	175 kg/cm^2.
Operational speed;	800 rpm.



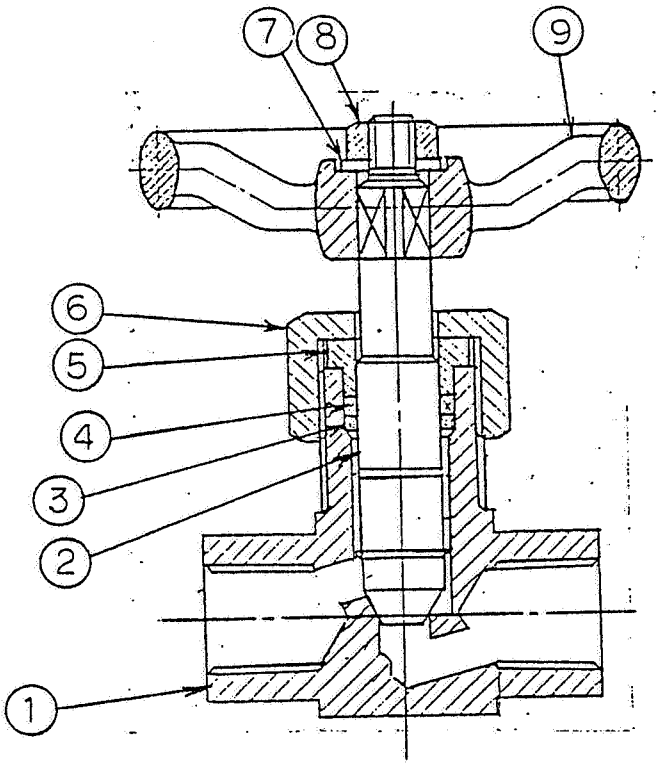
Caution on operation.

The emergency pump is not supposed to be run for more than 30 seconds continuously.
The continuous operation of the pump which is more than 30 seconds causes the overheated and burnt out DC motor.
Moreover, to cool down the DC motor, give interval of more than 30 seconds between the each operation.

STOP VALVE (for Manual bleed down descent system) (302 02861A) (option)

The valve is opened and releases the hydraulic oil confined in the bottom room of "Elevation cylinder" to descent the "Platform", in case the "Manual bleed down desent system" is actuated.
Note that the "Manual over ride screw" for "Single holding valve on Elevation cylinder" is also screwed in to actuate the "Manual bleed down descent system".

Rated pressure: 210 kg/cm^2. (≥990 PSI)

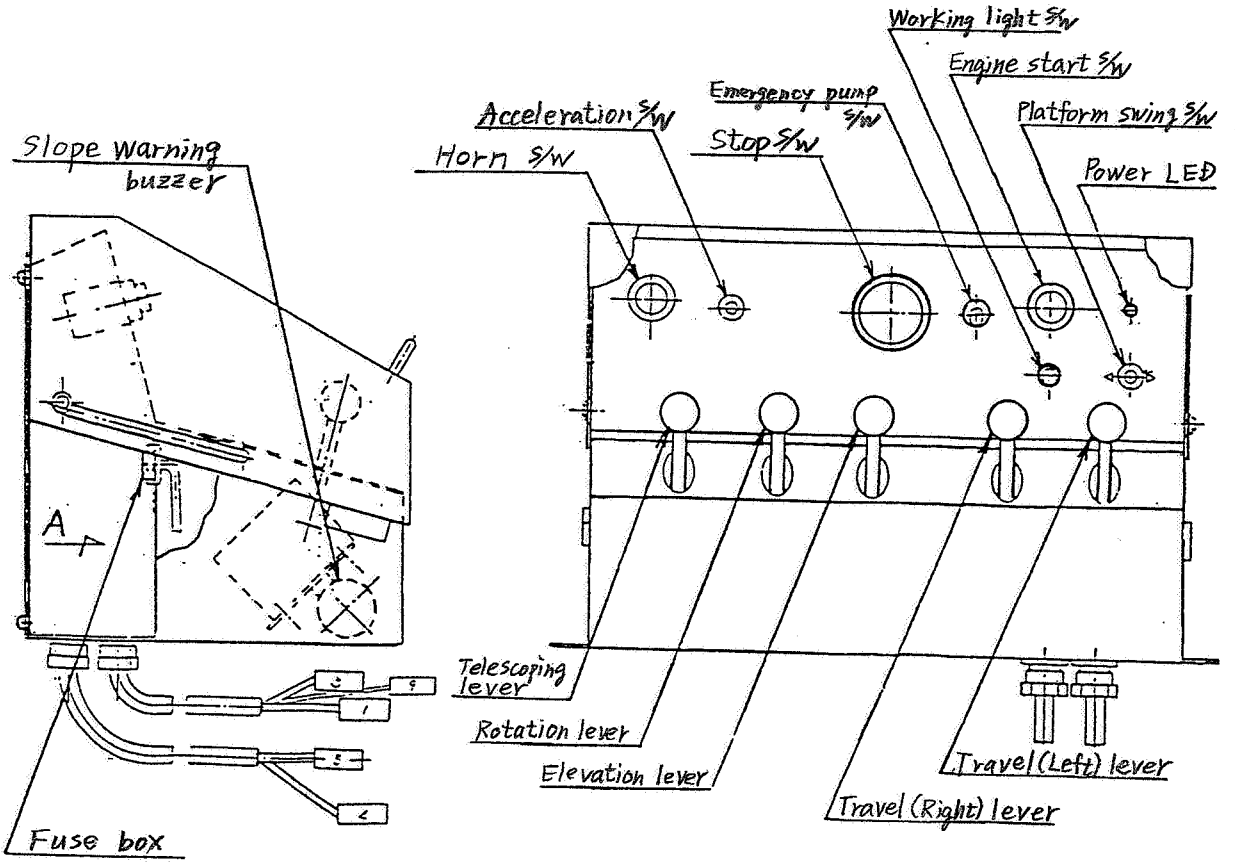


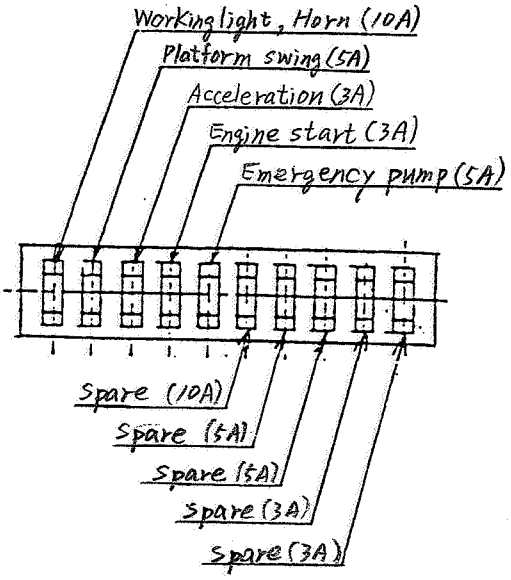
1. Valve body.
2. Shaft.
3. Plate.
4. O ring & Back up ring.
5. O ring holder.
6. Nut.
7. Washer.
8. Nut.
9. handle.

NOTE:
To lower the platform by "Manual bleed down descent system" or reset the system, refer to the clause of "SINGLE HOLDING VALVE" (for Elevation cylinder).

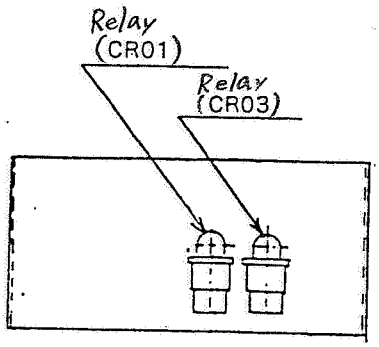
ELECTRIC SECTION

Upper Control Box (R18-N5031C)



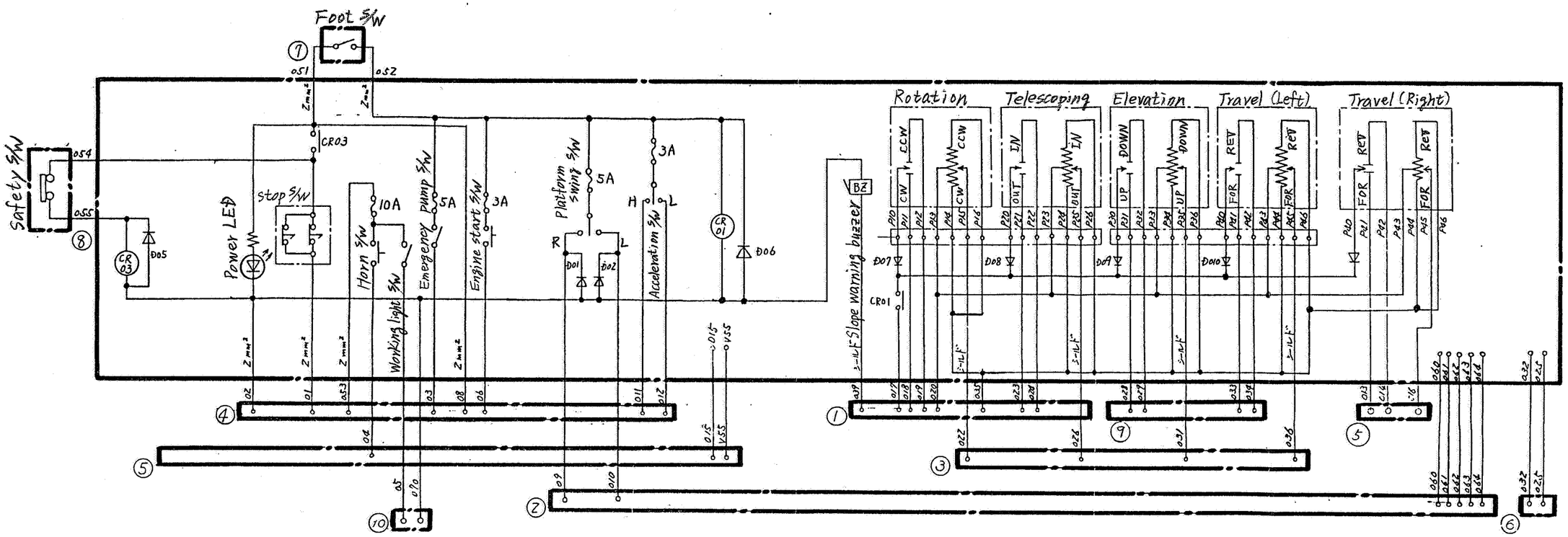


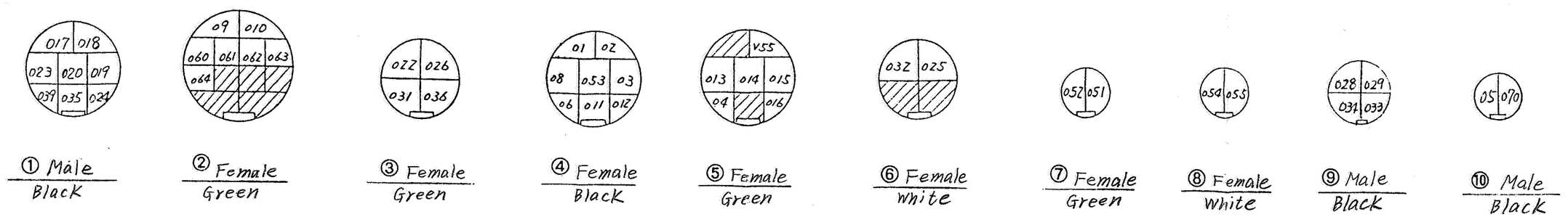
Fuse box Detail



A view

Electric Circuit for "Upper control box"





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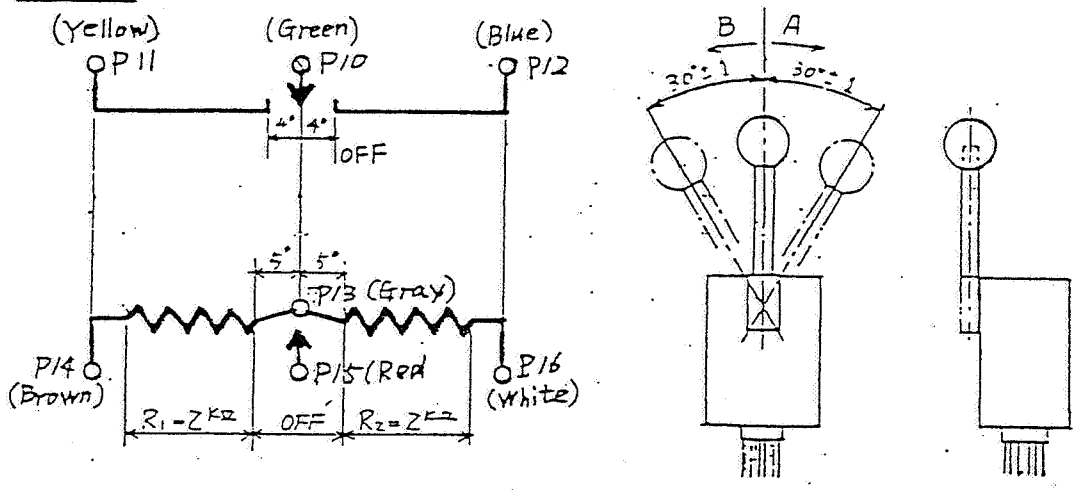
Potentio meter (324-01615)

The potentio meter consists of a part which functions as a switch and a part which causes a variations of resistance, and those two parts are operated simultaneously by the control lever.

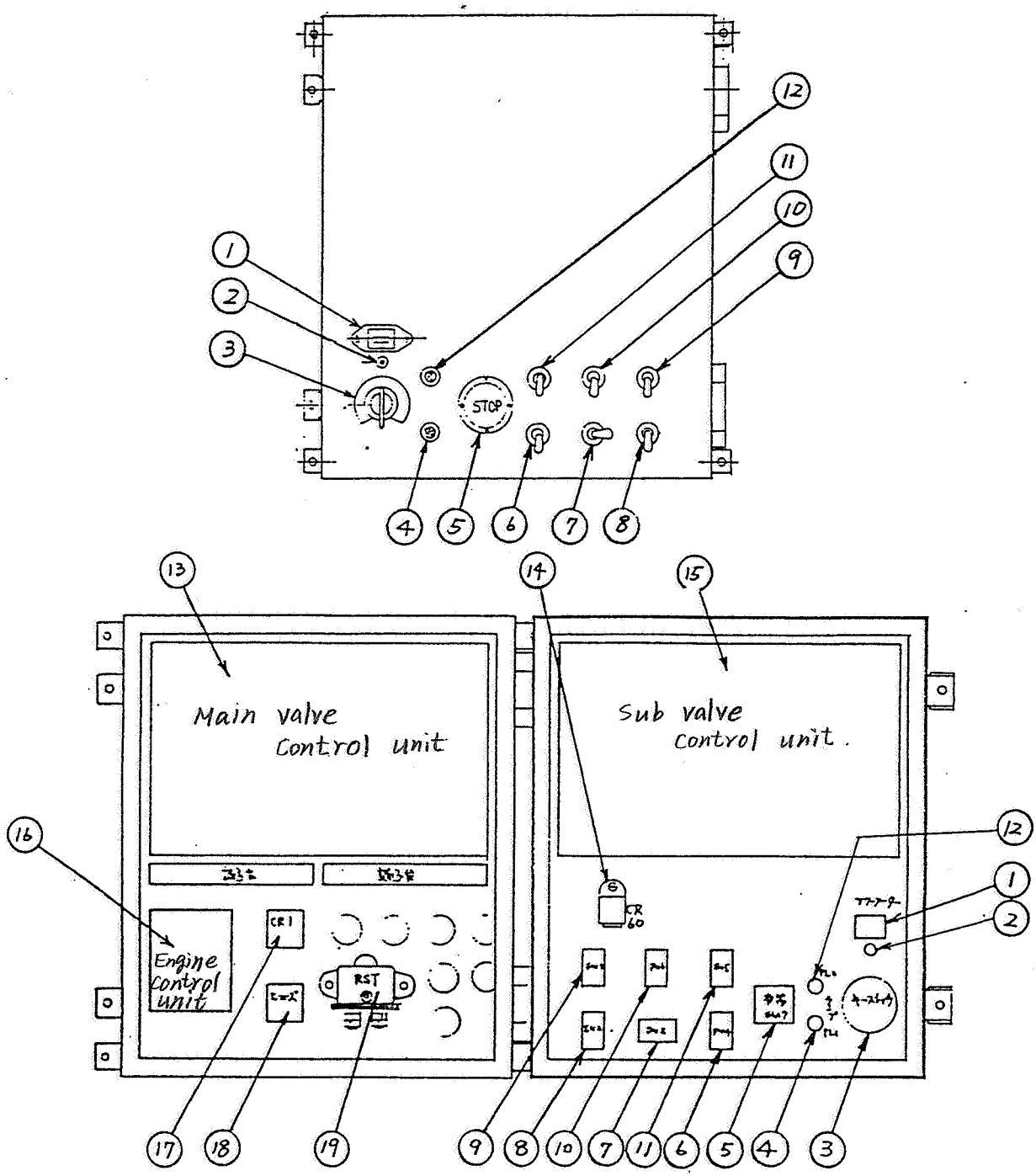
The "OFF" section of the switch extends 4° to the either side from the central position of control lever, and it is turned on, when the control lever is inclined in excess of 4°.

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

Fig: 2

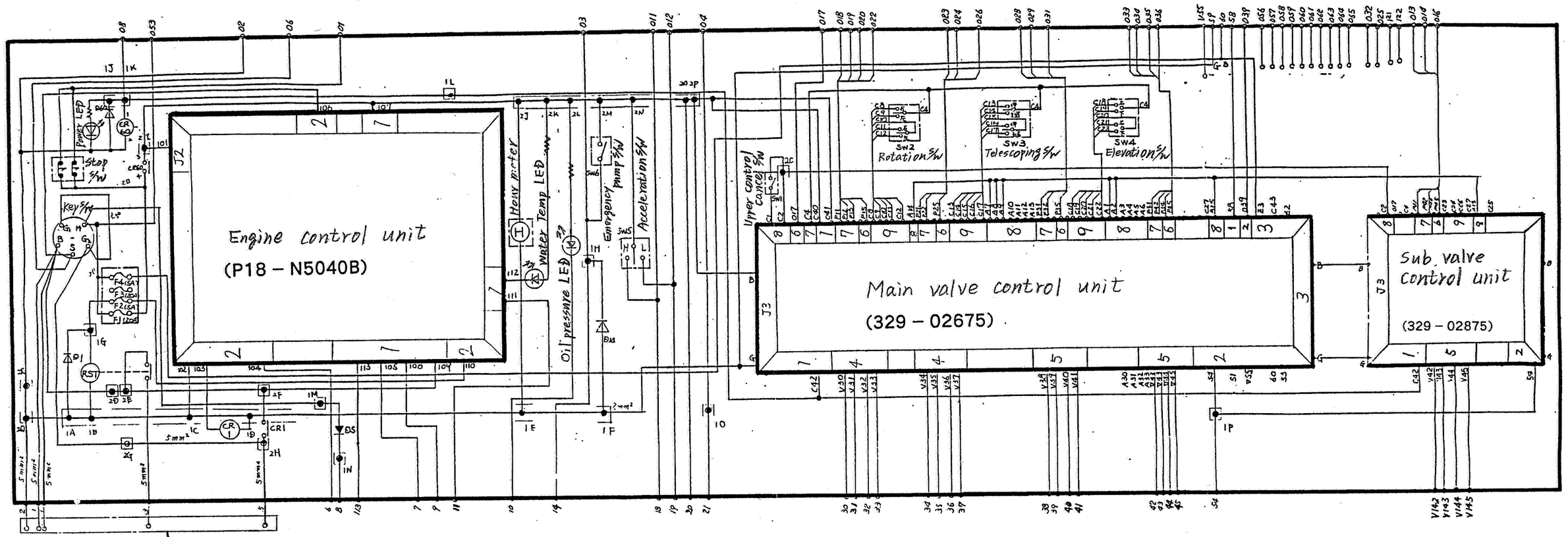


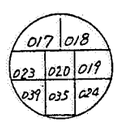
Lower control Box (329-02876B)



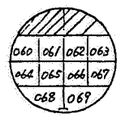
1	Hour meter	6	Elevation S/W	11	Acceleration S/W	16	Engine control unit
2	Power LED	7	Rotation S/W	12	E/G water Temp LED	17	Relay (CR-1)
3	Key S/W	8	Telescoping S/W	13	Main valve control unit	18	Fuse box
4	E/G oil pressure LED	9	Upper control cancel S/W	14	Relay (CR-60)	19	starter relay (RST)
5	Stop S/W	10	Emergency pump S/W	15	Sub valve control unit		

Electric circuit for "Lower control box"



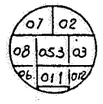


① Male
Black

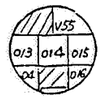


② Female
Green

③ Female
Green

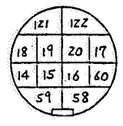


④ Female
Black



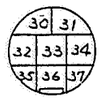
⑤ Female
Green

⑥ Female
White

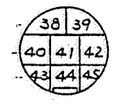


⑦ Male
Black

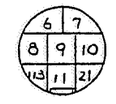
⑧ Female
White



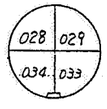
⑨ Female
white



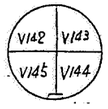
⑩ Female
Black



⑪ Female
White



⑫ Male
Black



⑬ Female
Black.

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Valve Control Unit (329-02675)

The "valve control unit" is installed in the electric circuit between "Potentio meters" (or "Control switches) and "Solenoids of Main control valve".

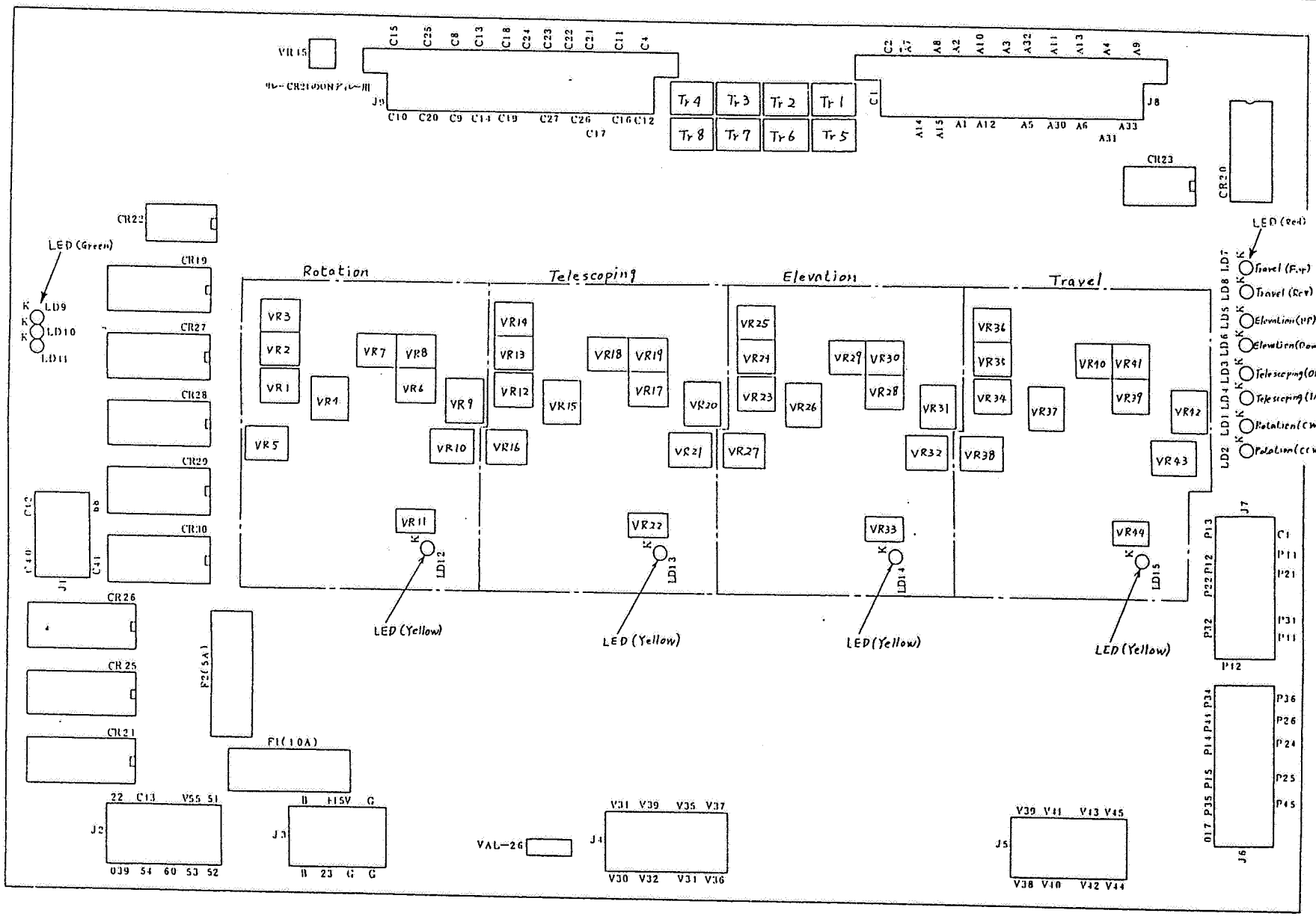
When the "Valve control unit" inputs "Voltage variation" (sent from "Potentio meter"), it converts this "Voltage variation" into "Ampare variation", and outputs it to the "Solenoid of Main control valve".

Thus, the proportional operation of "Main control valve" is achieved, when the "Potentio meter" is actuated at "Upper control".

However, in case the "Control switch" is operated at "Lower control", the "Main control valve" is actuated as a conventional solenoid valve, since the "Control switch" does not outputs "Voltage variation", which is necessary for proportional operation.

- Power source : DC 24V
- Input voltage : 0 ~ 10 V
- Output current : 0 ~ 1800 mA (12V)

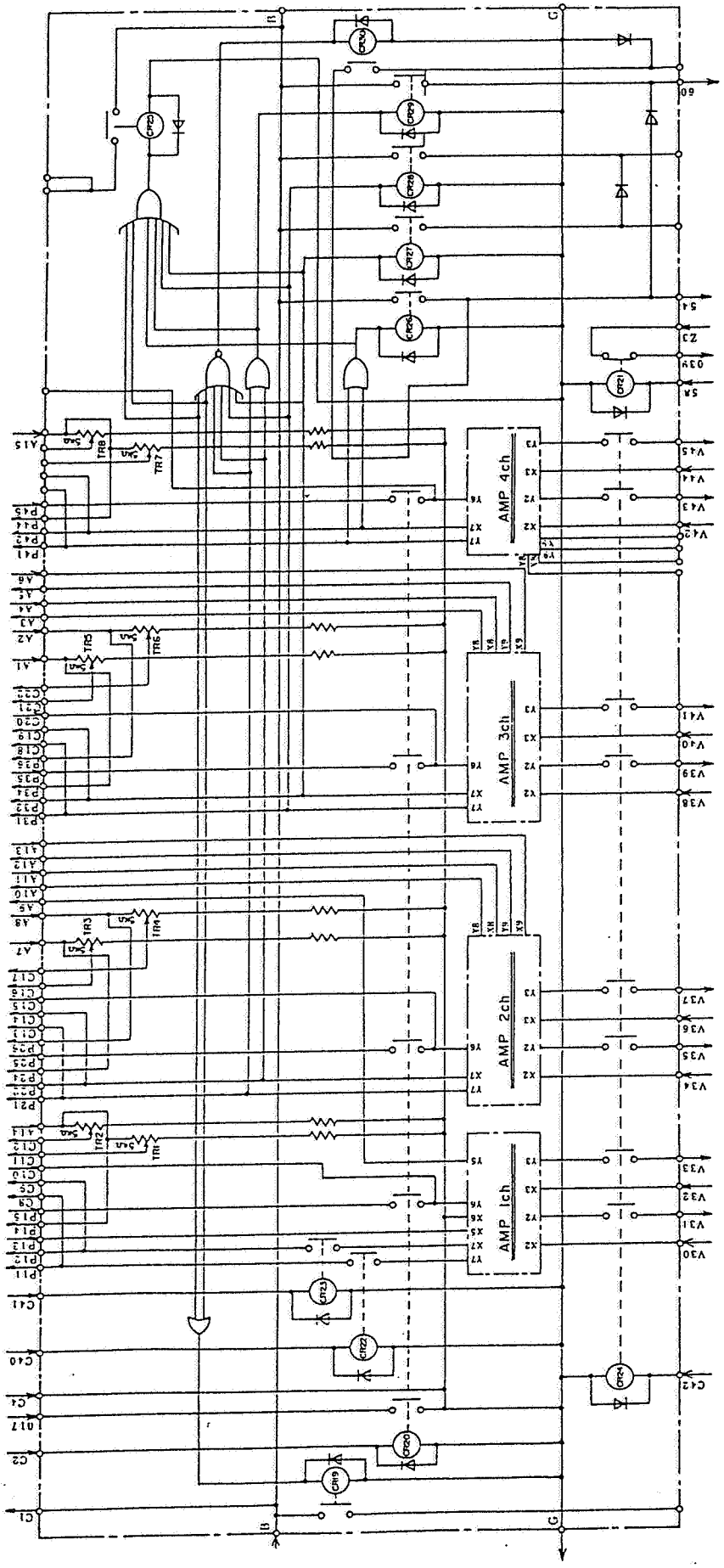
1. External view



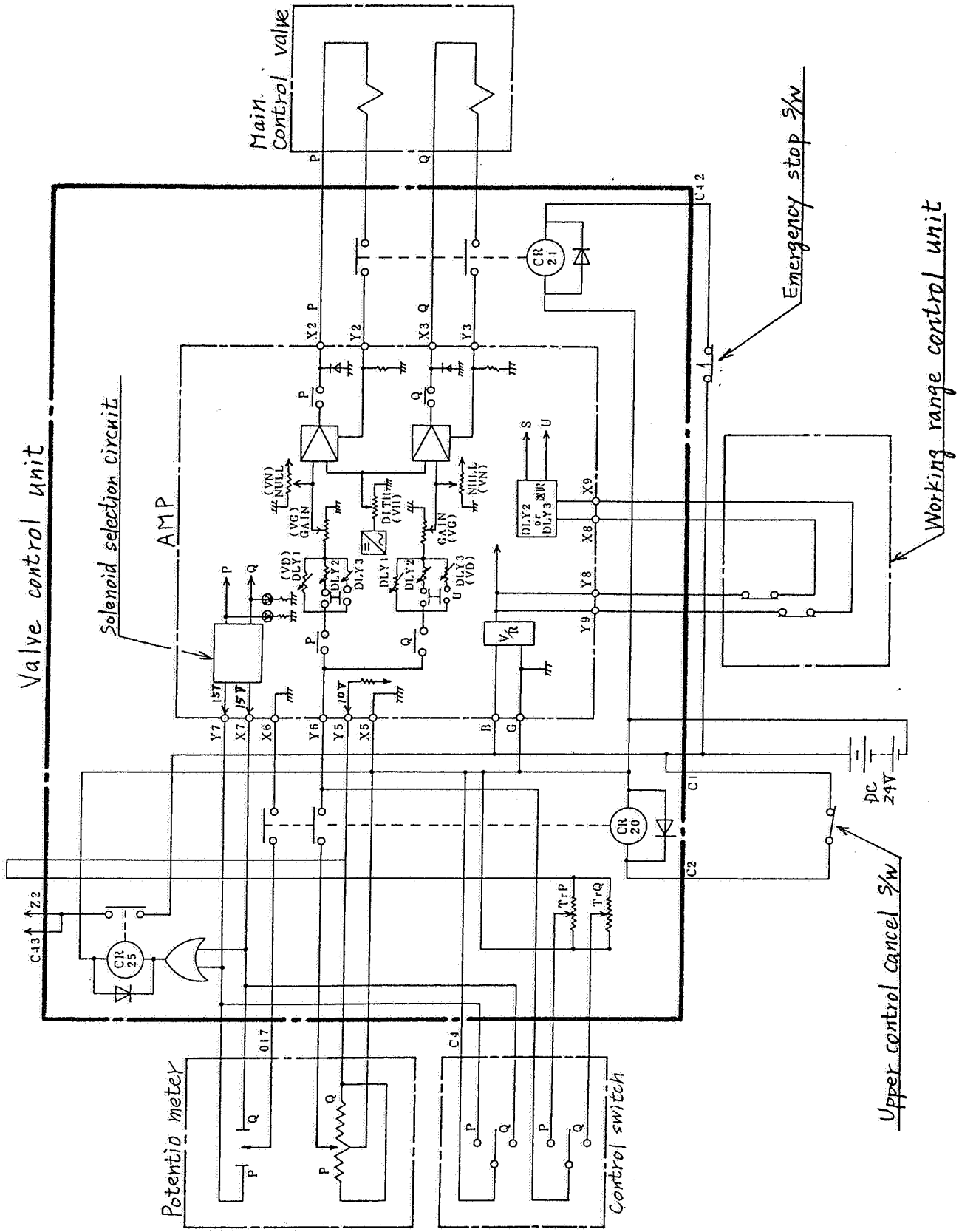
作成 年 月 日

備考

2. Electric Circuit



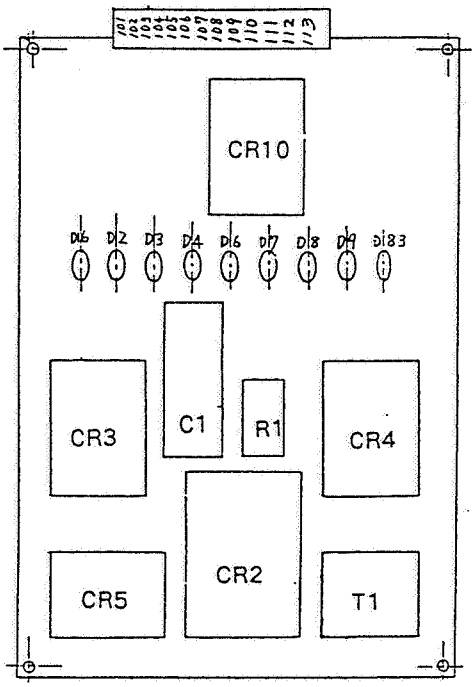
3. Note on function

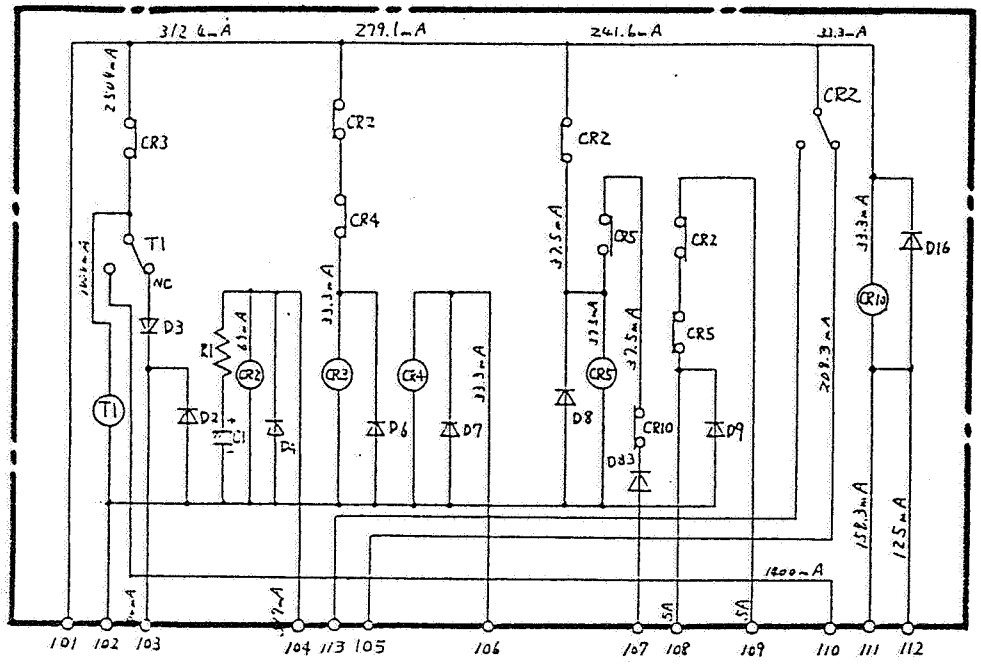


作成 年 月 日

Engine Control Unit (P18-N5040B)

The unit is installed in "Lower control box" and control engine starting or stopping operation.

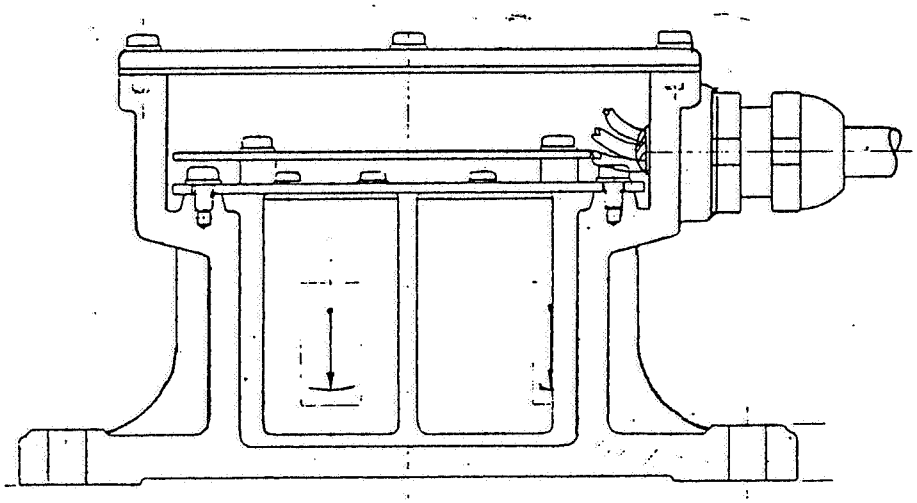


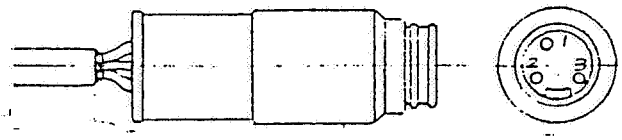


SLOPE SENSOR (324-01651)

The "Slope sensor" (installed on turn talbe) detects the inclination angle of the equipment.
The sensor stops sending its "Out-put power" (DC 24V), when the equipment is inclined 5° or more to sound the "Slope warning buzzer"

Fig: 1





1. (+) DC 24 V. (W)
2. (-) (B)
3. Out-put. (R)

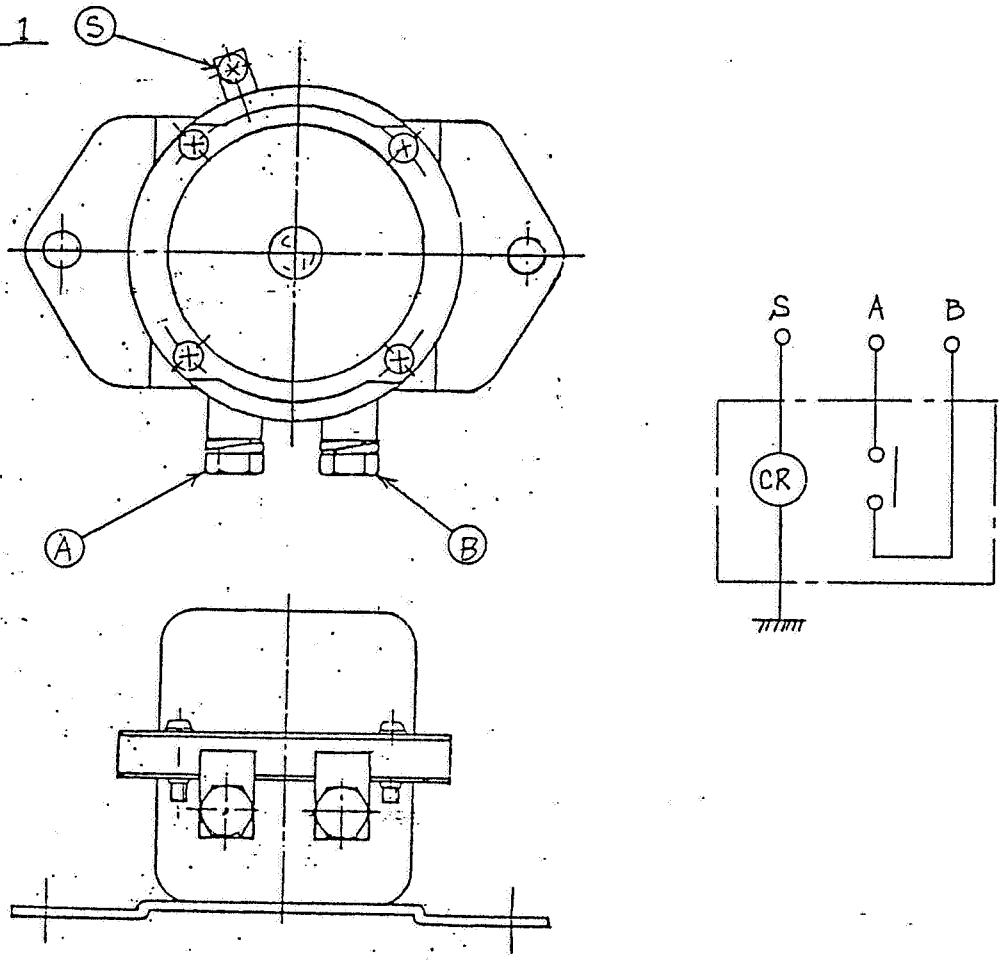
Connector detail

NOTE: Do not disassemble the "Slope sensor", since it is adjusted precisely by the manufacturer.

CONTACTOR (CR 36) (for Engine stop solenoid) (327 00201)

The contactor supplies the power (DC 24V) to the engine stop solenoid, when the engine is stopped.

Fig: 1



CONTACTOR (CRC) (for Emergency pump) (327 00201)

The same type of contactor as CR 36 (for Engine stop solenoid) is used to supply the power (DC 24V) to the emergency pump unit.

CONTACTOR (CR 60) (for Head light) (327 00201)

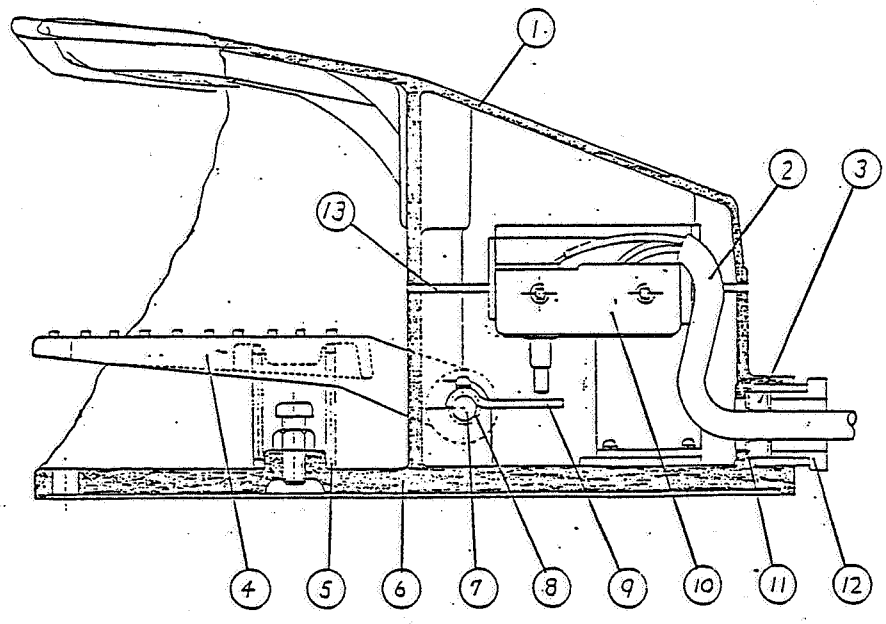
In case the optional head lights are equipped, the same type of contactor shown above (Contactor for engine stop solenoid) is added.

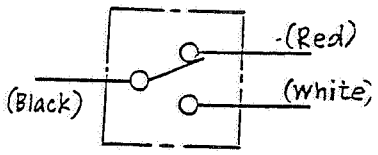
Foot ~~Dead man~~ switch (Option)

The Foot ~~dead man~~ switch is provided as an optional device. When the switch is released, it stops supplying the power (DC 24V) to the following electric components installed on upper control box, and cancels their functions.

1. Engine start switch.
2. Platform slew switch.
3. Acceleration switch.
4. Potentio meter. (Elevation)
5. Potentio meter. (Telescoping)
6. Potentio meter. (Slew)
7. Potentio meter. (Travel R/H)
8. Potentio meter. (Travel L/H)

Fig: 4





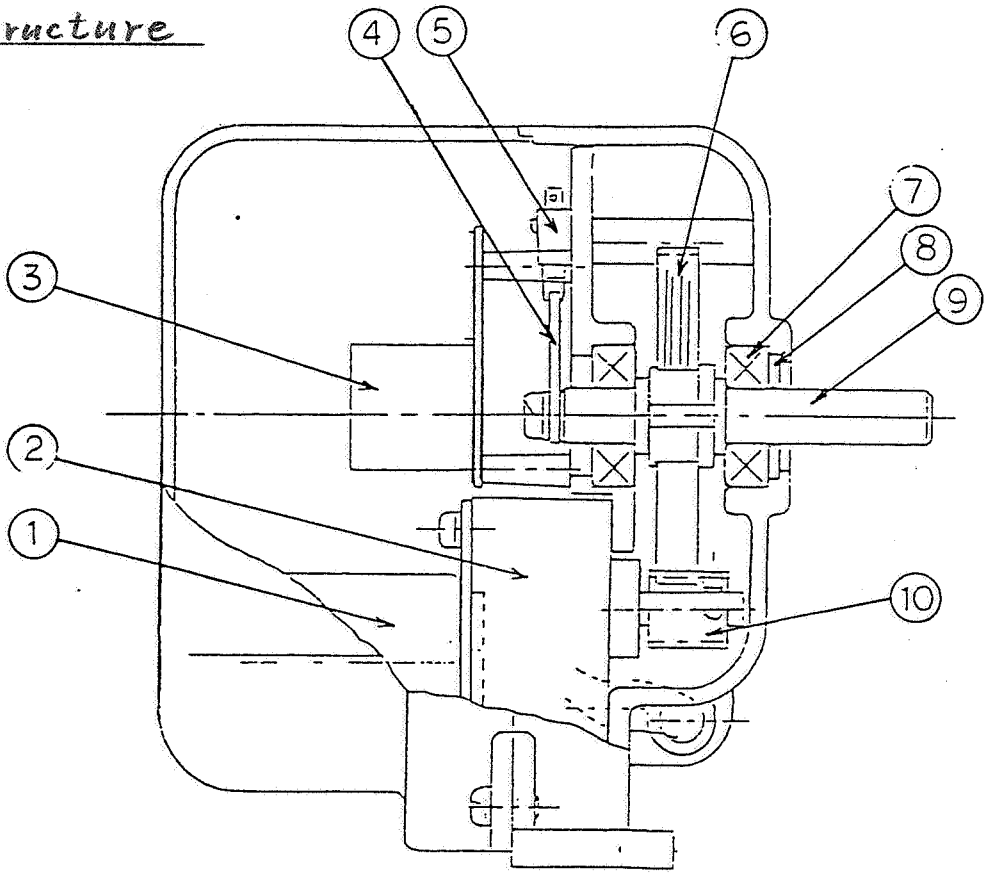
1. Cover.
2. Lead wire.
3. Seal rubber.
4. Pedal.
5. Return spring.
6. Body.
7. Pin.
8. O ring.
9. Plate.
10. Micro switch.
11. Washer.
12. Seal nut.
13. Packing.

Acceleration motor (322-00913)

The motor is installed on "Turn table" to increase or decrease "Engine speed".

Rated voltage ----- DC 24V (DC20~30V)
Out-put torque ---- 80 kgf-cm
Rated current ---- 250 mA

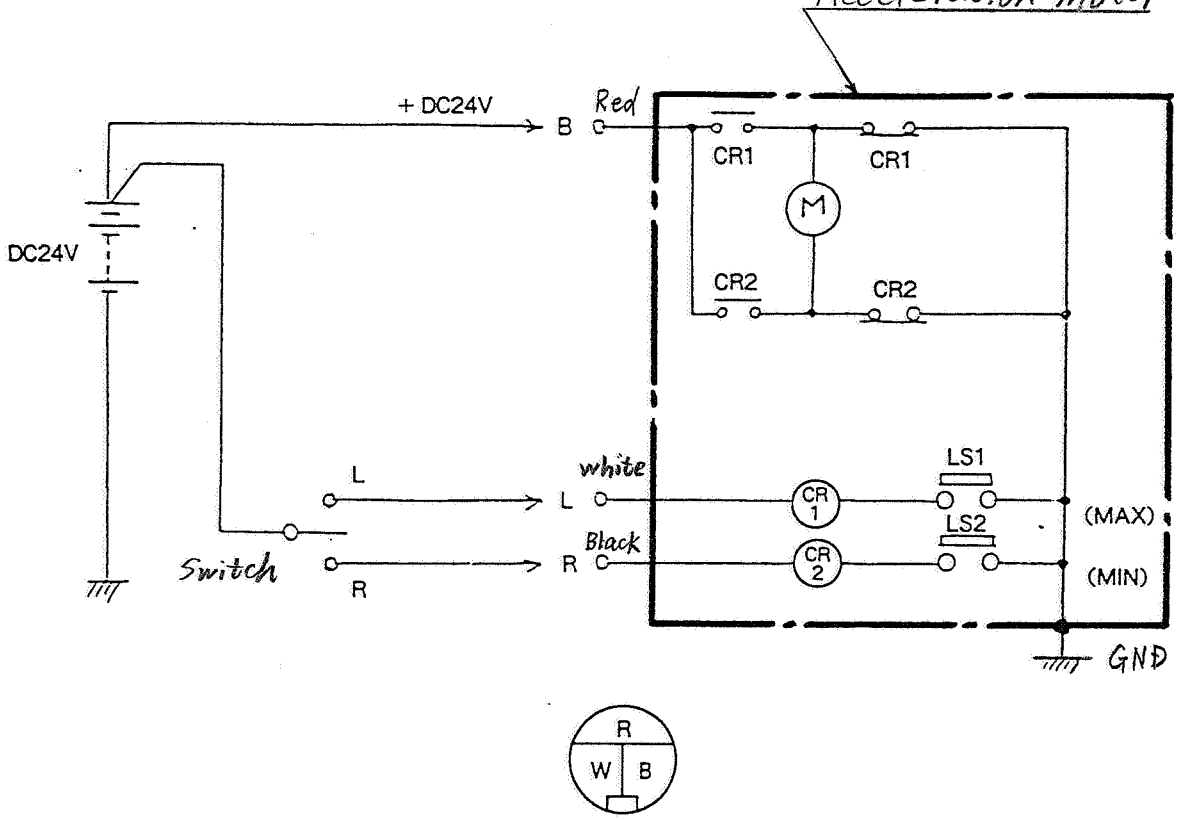
Structure



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

作成 年 月 日

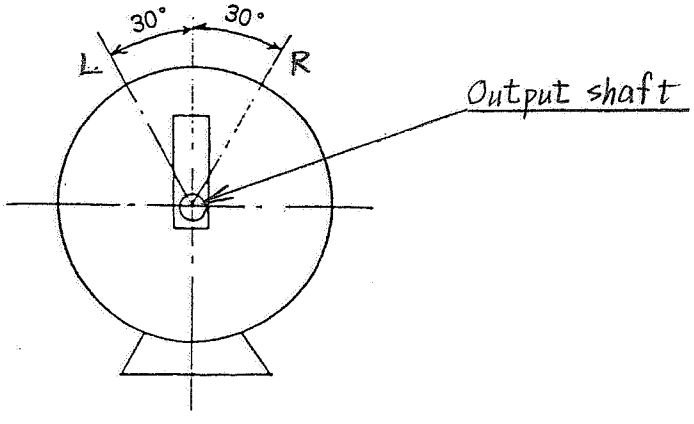
Electric Circuit



Inspection procedures

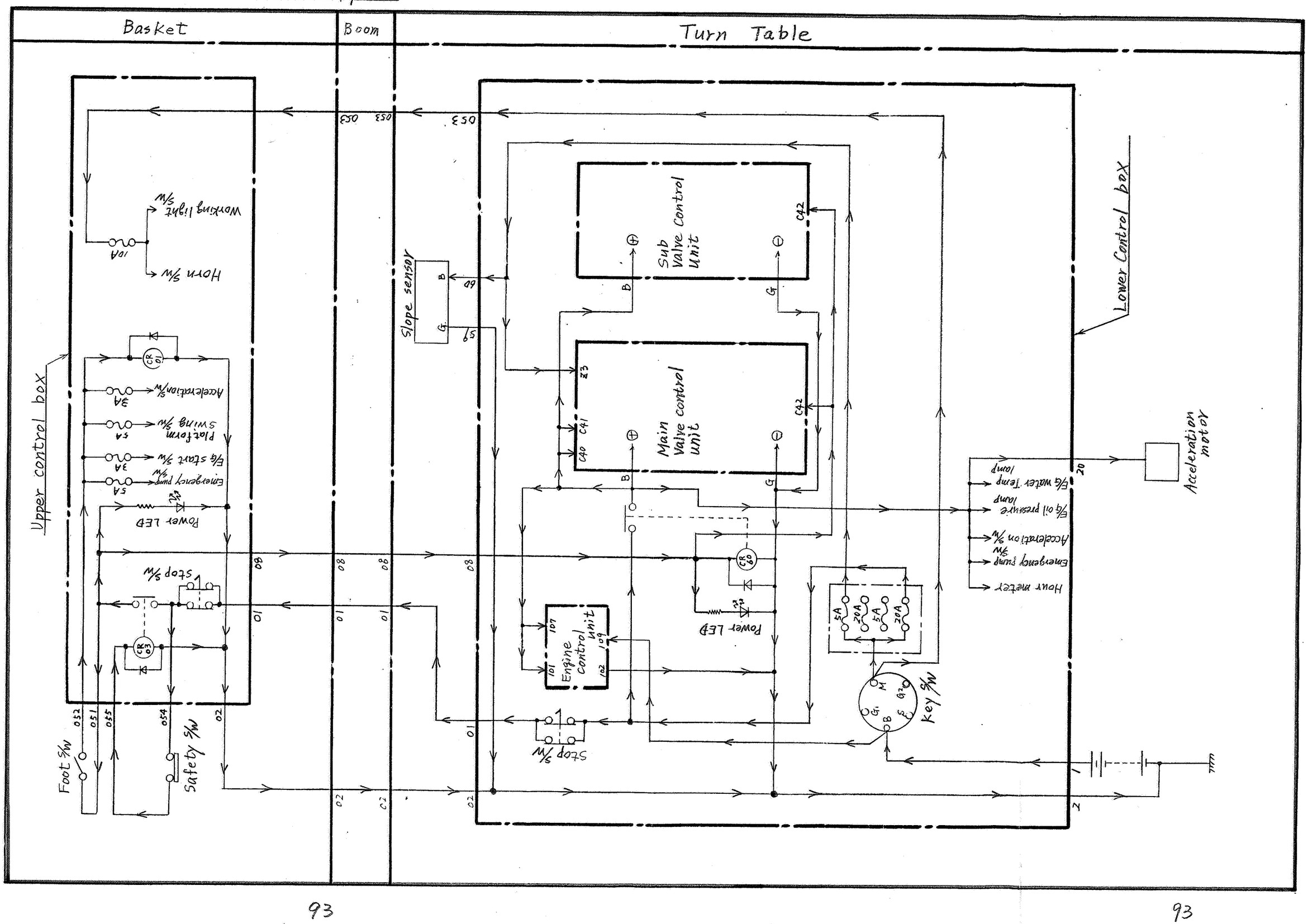
Follow the steps listed below to check the function of Acceleration motor.

1. Connect "Battery" & "Switch" as shown in the "Electric circuit" above.
2. Operate the switch to "L" side, and make sure the "Output shaft" rotates counter-clockwise.
3. Operate the switch to "R" side, and make sure the "Output shaft" rotates clock-wise.



作成	年	月	日

Electric Circuit for "Power Supply"



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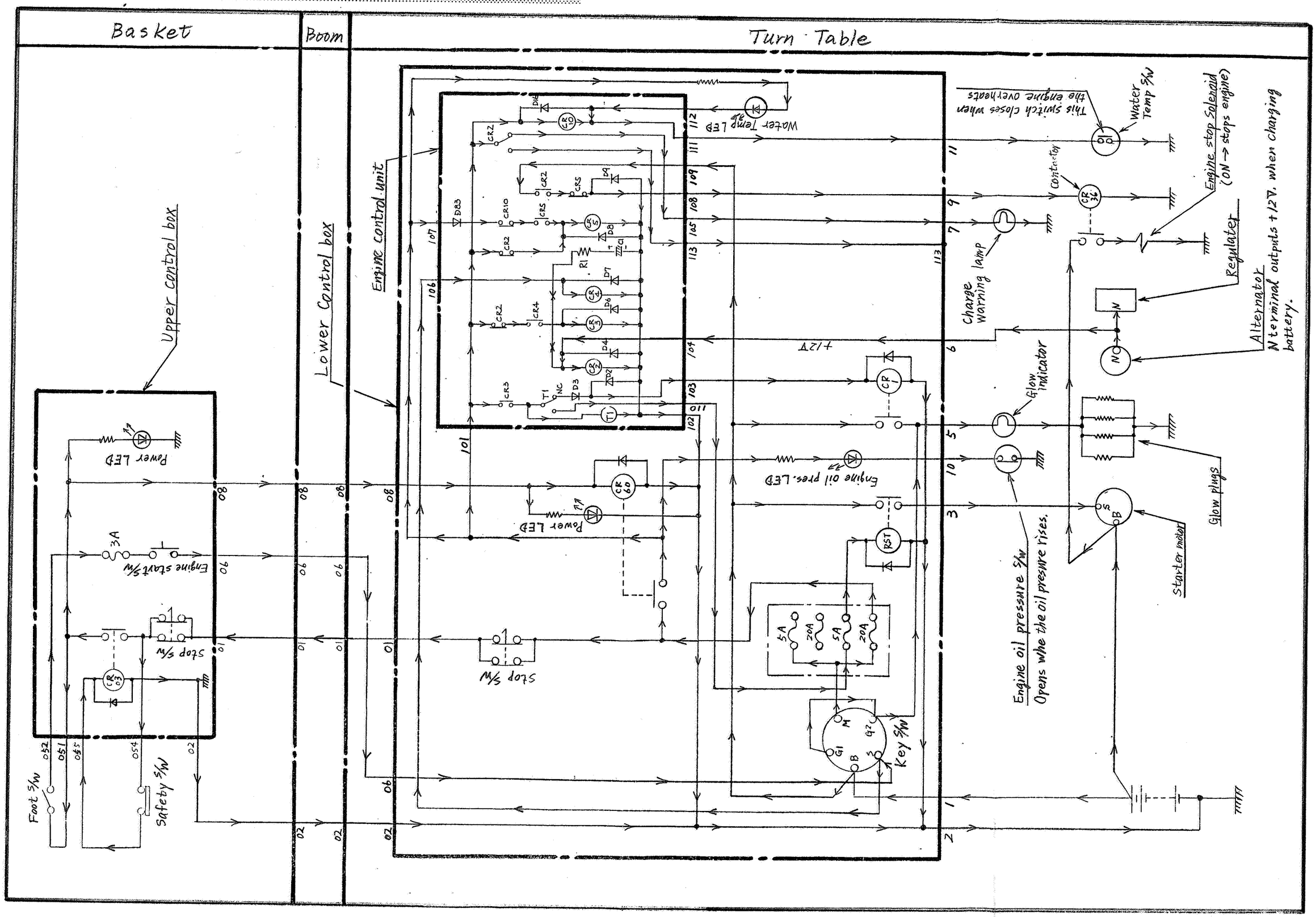
Electric Circuit for "Engine control system"

ESS系電気回路図



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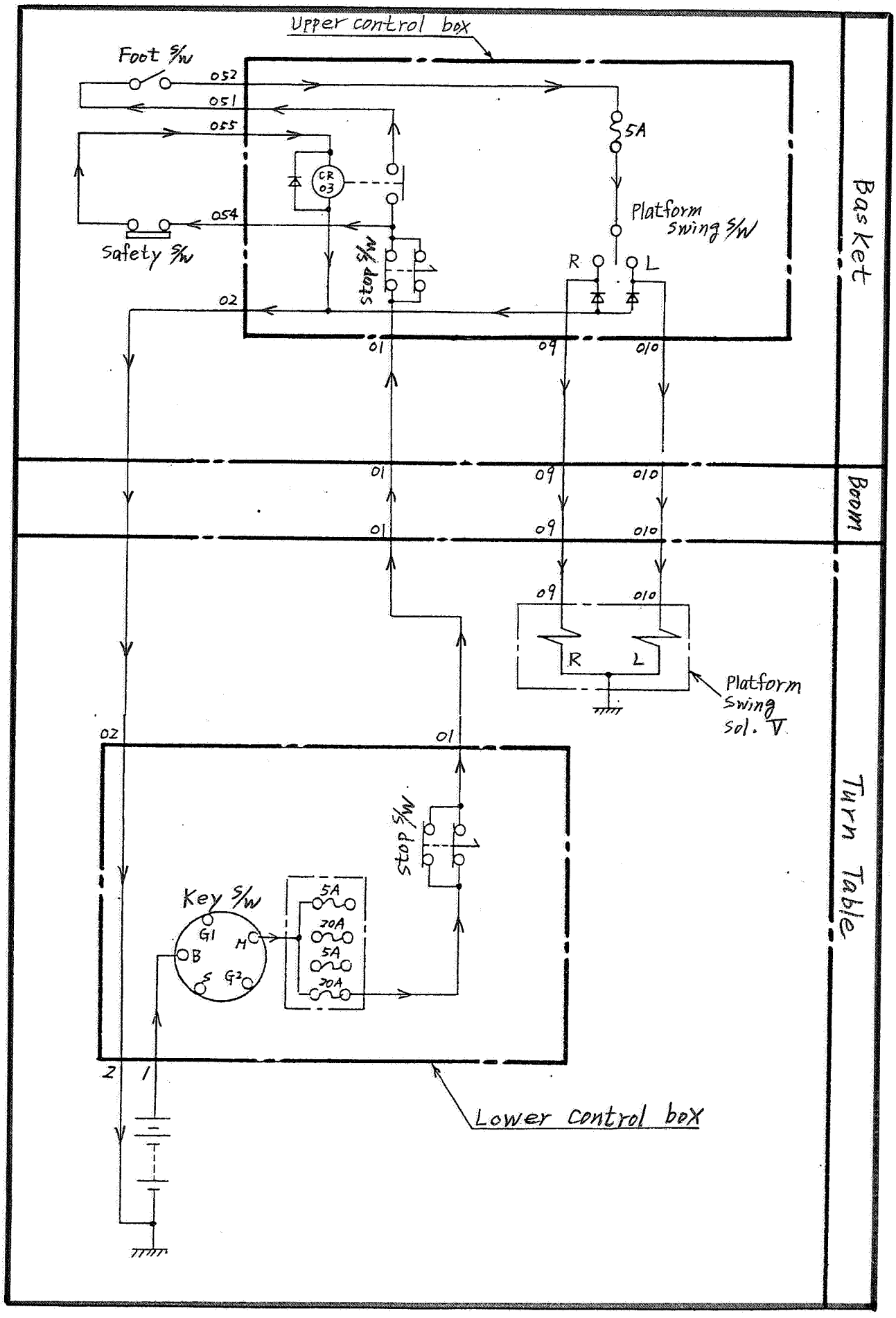
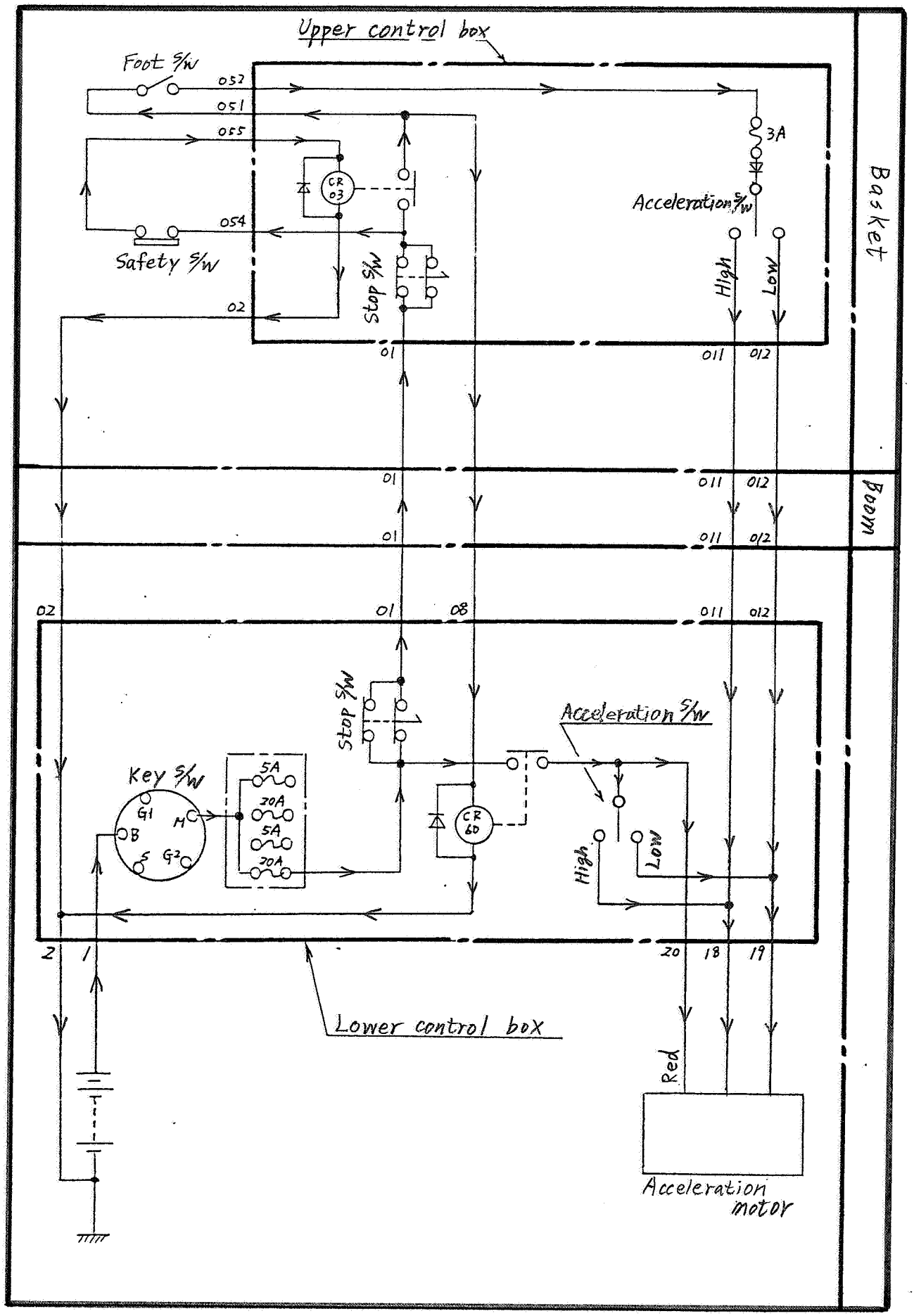
Electric Circuit for "Platform swing system"

首振系電気回路図



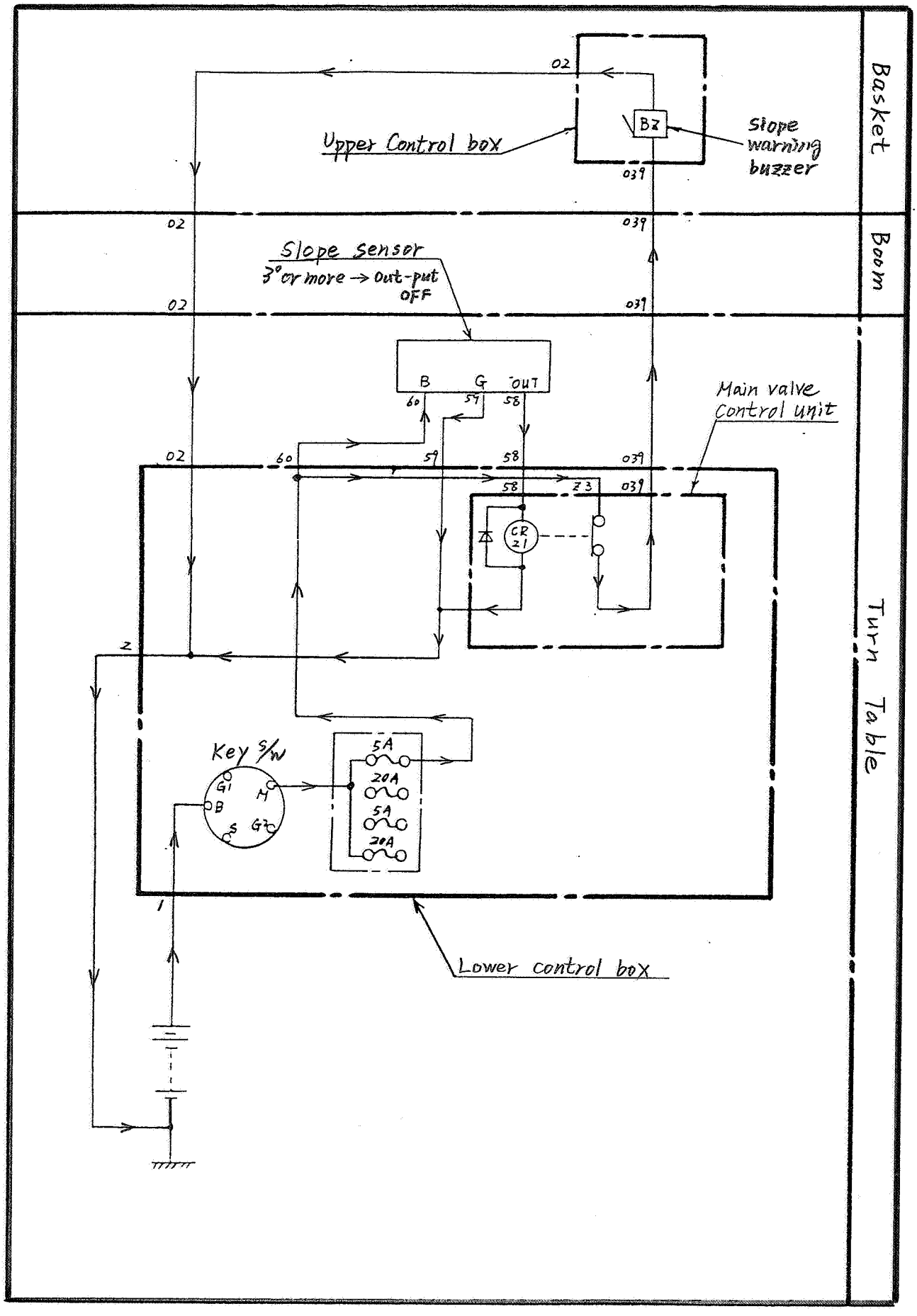
Electric Circuit for "Acceleration system"

アクセル系電気回路図



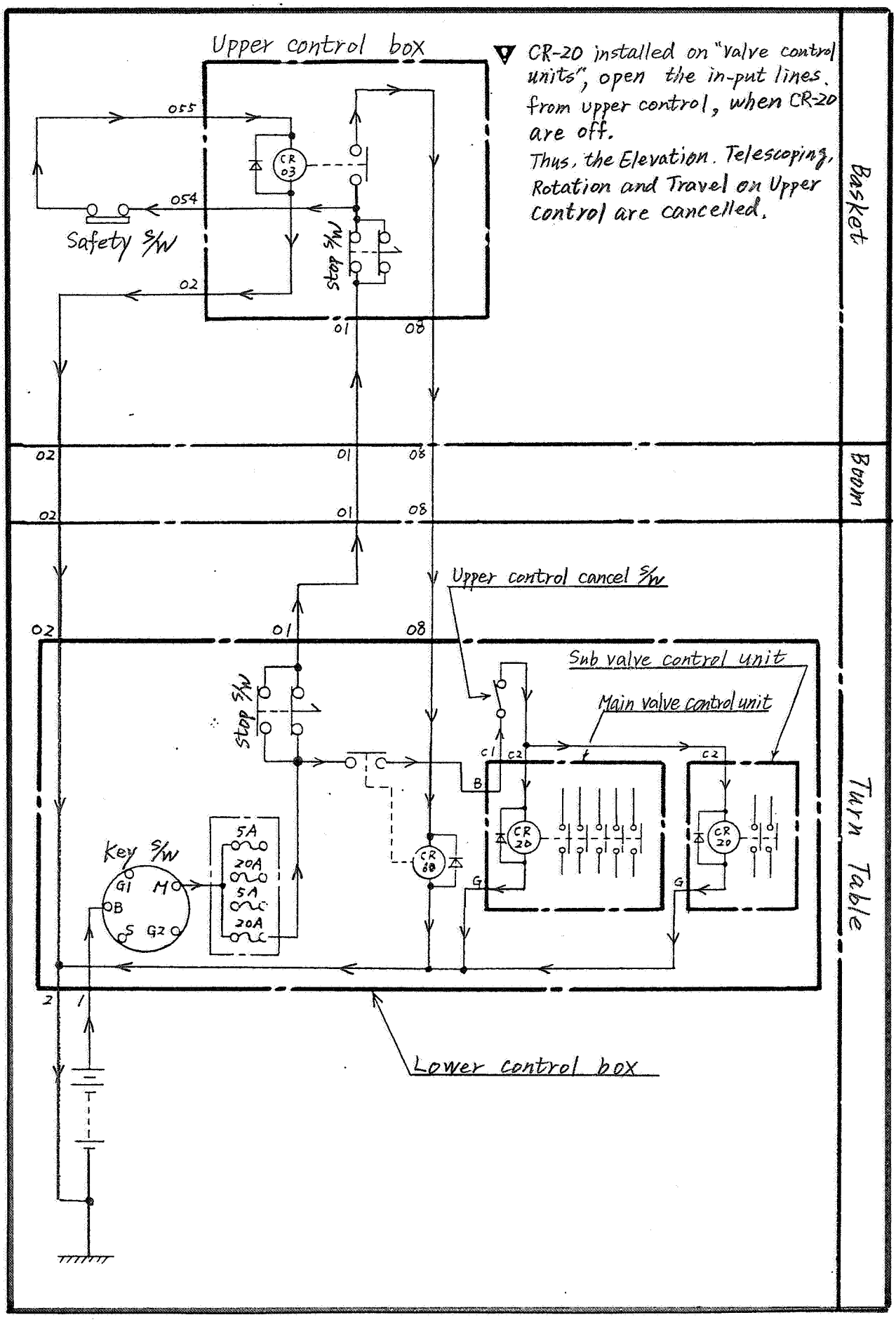
Electric Circuit for "Slope warning system".

傾斜警報系電気回路図



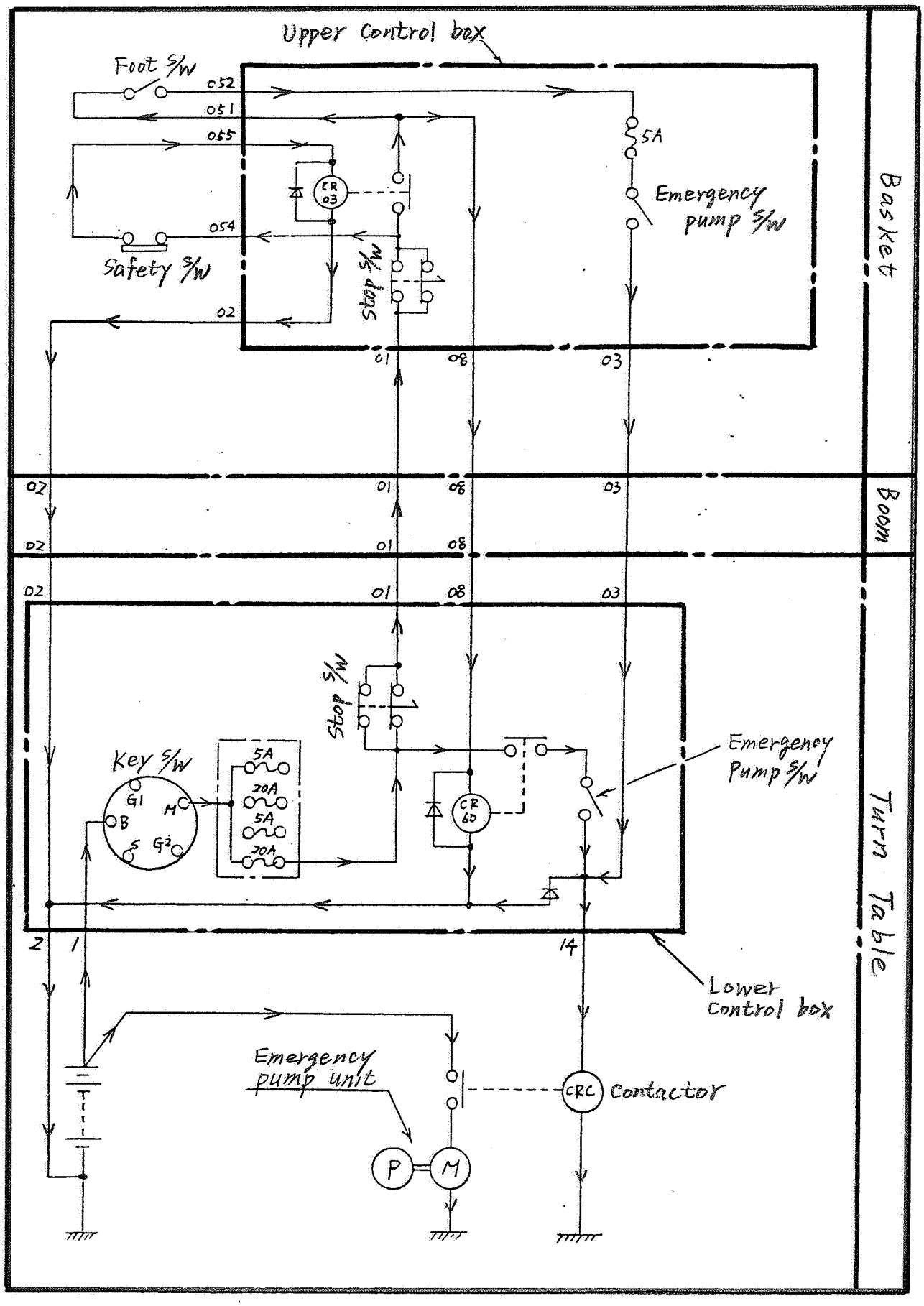
Electric Circuit for "Upper control cancel system"

上部キャンセル系電気回路図



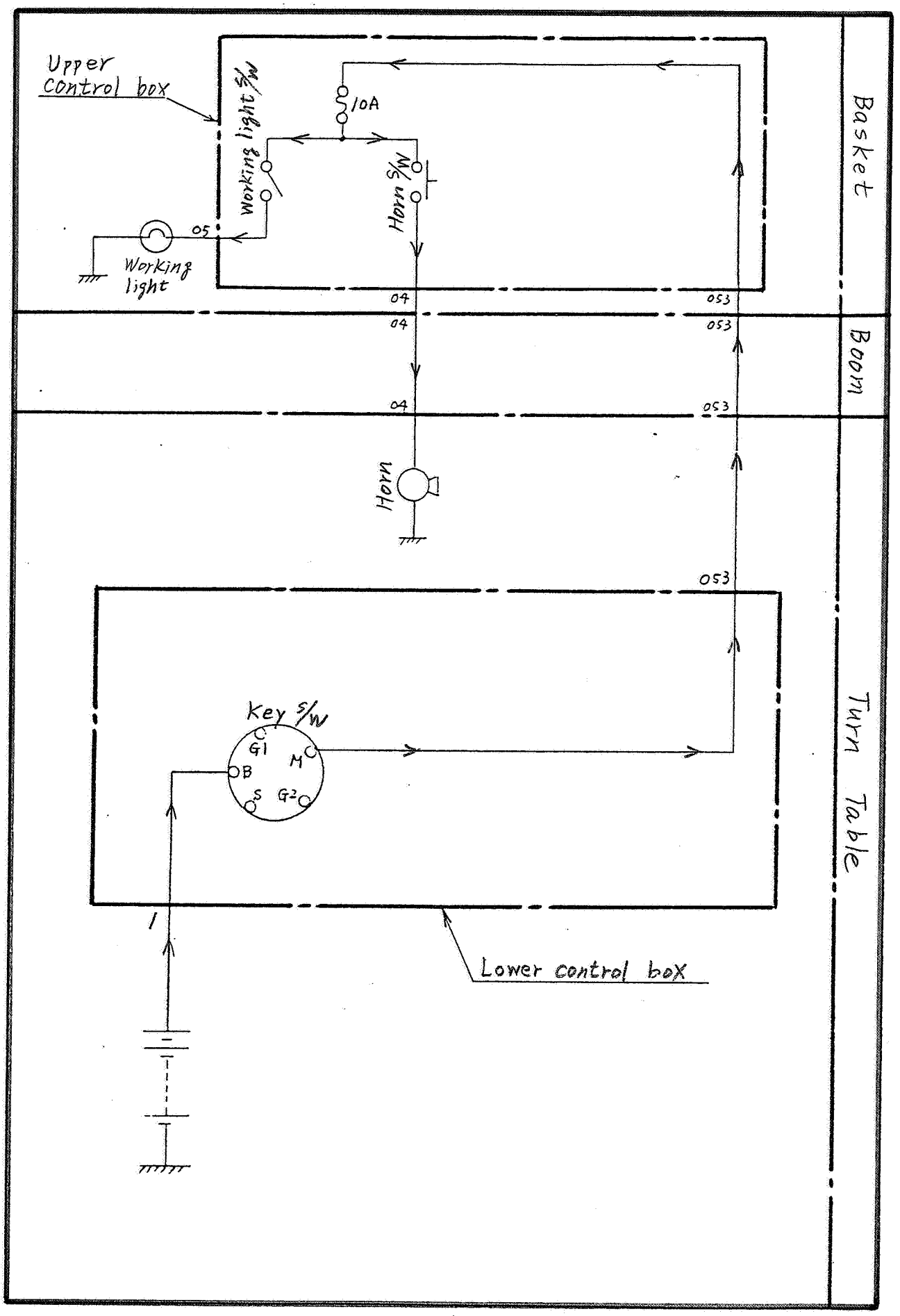
Electric Circuit for "Emergency Pump system"

非常用ポンプ系電気回路図



Electric Circuit for "Working light & Horn"

作業灯・ホーン系電気回路図



Upper control box

Foot S/W
053
051
055
054
02
Safety S/W
CR 03
Stop S/W
CR 01
POT for Rotation
CCW
CW
P10 P11 P12 P13 P14 P15 P16
01 08
017 018 019 020 022 035

Basket

Boom

Turn Table

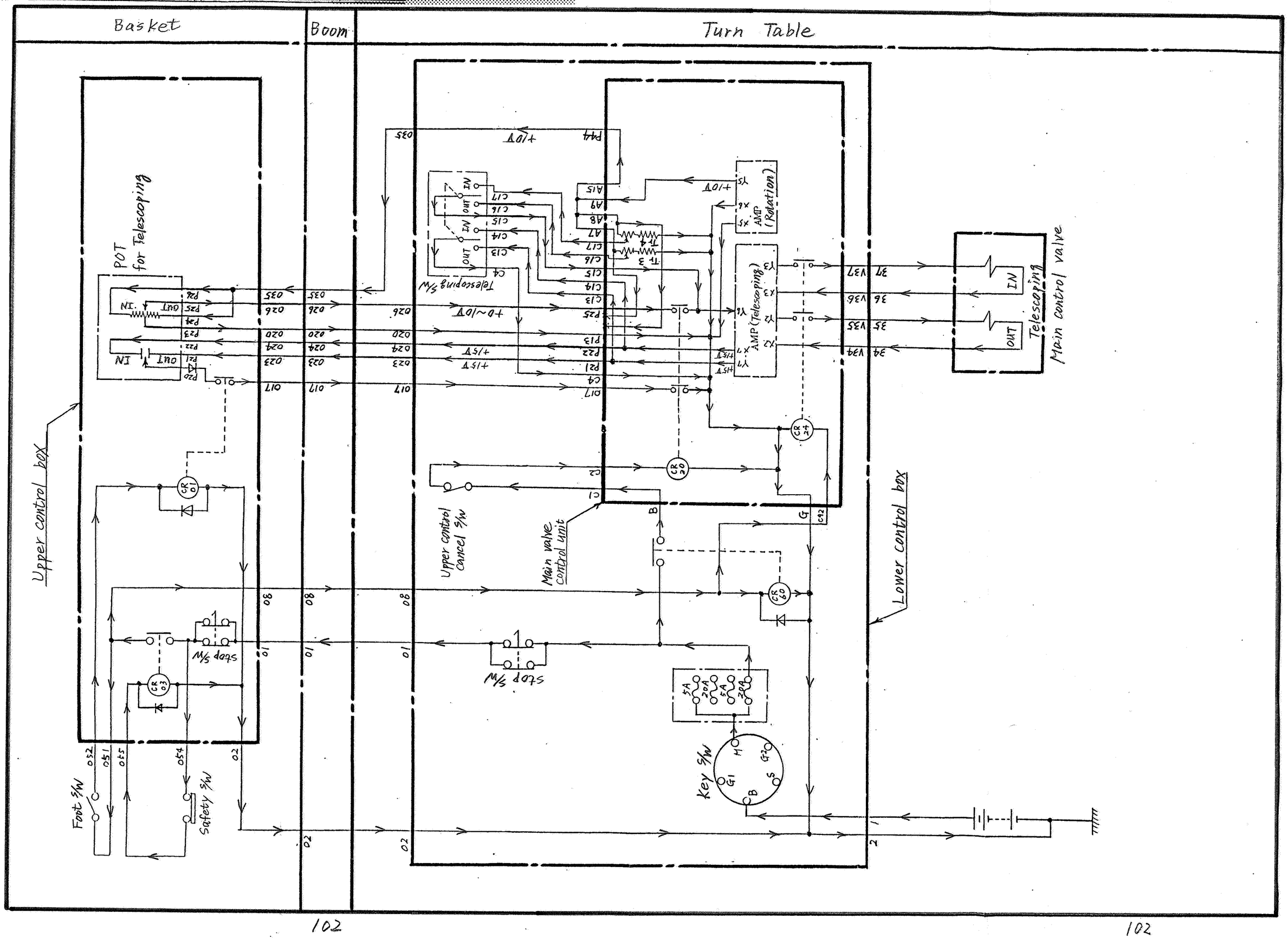
Upper control cancel S/W
Stop S/W
Main valve control unit
C1 C2 C40 C41
B
CR 22
CR 23
CR 20
CR 60
G
C42
CR 24
+15V
+0~10V
+10V
Rotation S/W
CW CCW CW CCW
C4 C8 C9 C10 C11 C12
D17 C4 P11 P12 P13 P15 C8 C9 C10 C11 C12 A14 A9 A15 P44
Tr1 Tr2
Y7 X7 X5 X6 Y6 Y5
AMP
X2 Y2 X3 Y3
V30 V31 V32 V33
30 31 32 33
CW CCW
Rotation
Main control valve

Key S/W
G1 M B S G2
5A 20A 5A 20A
2 1
Lower control box

101

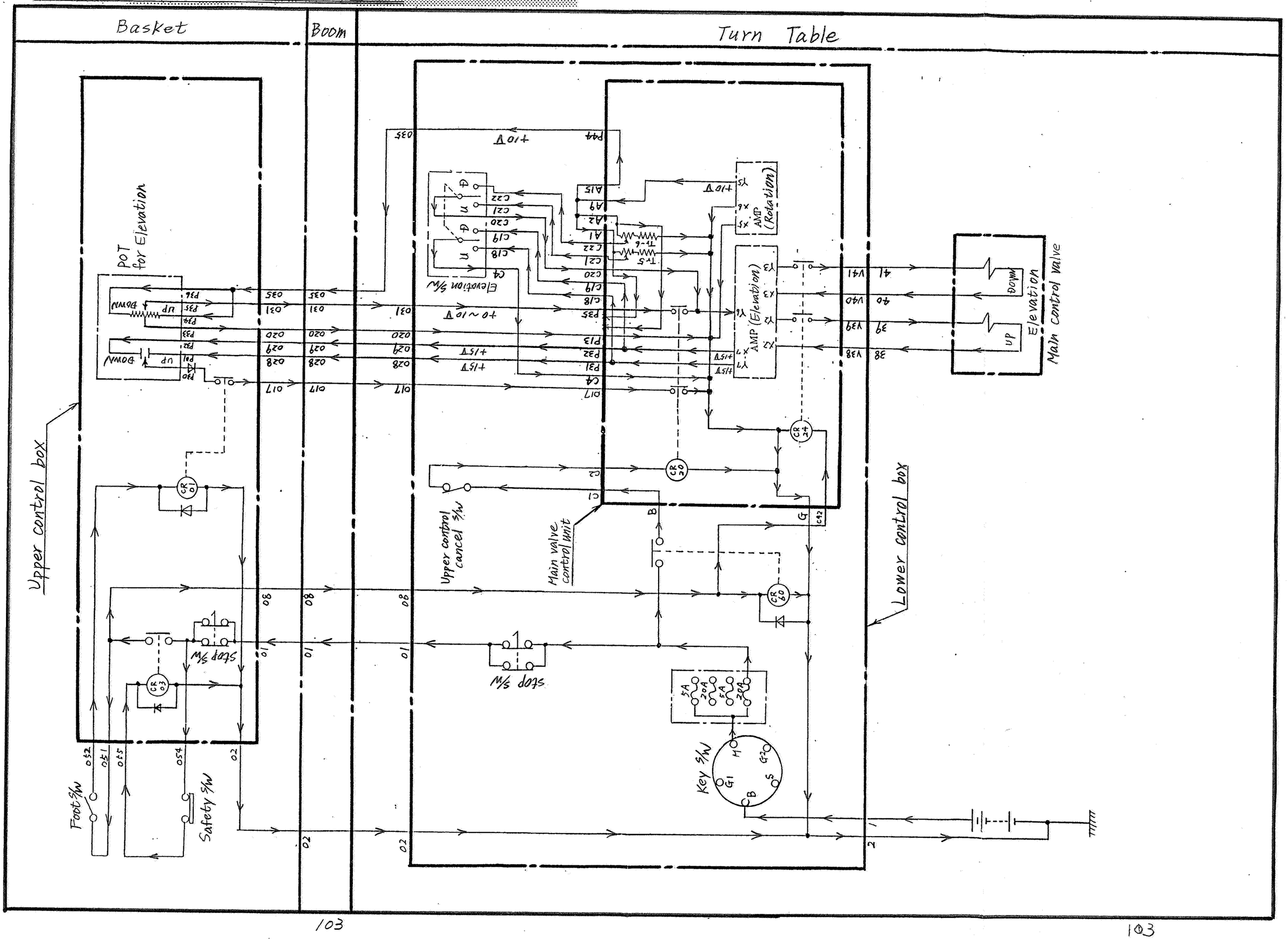
101

Electric Circuit for "Telescoping system"



102

Electric Circuit for "Elevation system"



103

Electric Circuit for "Travel (Left) system"

Upper control box

Foot S/W

052
051
055
054
02

Safety S/W

CR 03

Stop S/W

CR 01

POT for Travel (Left)

Rev
For
Rev
For

P40 P41 P42 P43 P44 P45 P46

01 08

017 033 034 020 036 035

Basket

Boom

Turn Table

02 01 08

017 033 034 020 036 035

02 01 08

017 033 034 020 036 035

Upper control cancel S/W

Stop S/W

Main valve control unit

C1 C2

+15V +15V +0~10V +10V

017 C4 P41 P42 P13 P45 C23 C24 C25 C26 C27 A15 A9 P44

Tr.7 Tr.8

B

CR 30

+10V

+15V +15V

CR 26 (ON, when Travelling)

Key S/W

G1 M B S G2

5A 20A 5A 20A

CR 60

CR 24

AMP (Travel)

Y7 Y6 Y5

X7 X6 X5

X2 Y2 X3 Y3

AMP (Rotation)

G

C42

Y42 Y43 Y44 Y45 54

2 1

42 43 44 45 54

Lower control box

For Rev

Travel (Left)

Main control valve

BZ

Pressure select Sol. V

Travel Warning buzzer

104

104

Electric Circuit for "Travel (Right) system"

Upper control box

Foot S/W

052
051
055
054

Safety S/W

Stop S/W

CR 03

CR 01

POT for Travel (Right)

P140 P141 FOR P142 P143 REV P144 P145 FOR P146 REV

01 08 02

017 013 014 020 016 035

Basket

Boom

Turn Table

Upper control cancel S/W

+10V

+15V

+0~10V

Sub valve Control unit

Main valve control unit

C1 P13 A9 A15 P44

C2 017 C4 P41 P42 P45 C23 C24 C25 C26 C27 A15

T7 T8

CR 20

CR 24

CR 60

Key S/W

G1 M B S G2

5A 20A 5A 20A

X5 Y5 AMP(Rotation)

X7 Y7 AMP (Travel) X2 Y2 X3 Y3 Y6

CN26 (ON, when travelling)

G

B

C42

T142 T143 T144 T145 54

Lower control box

FOR REV Travel (Right)

Main control valve

Bz Travel warning buzzer

Pressure select Sol. V.

2 1

105

ADJUSTMENT SECTION

OPERATIONAL SPEED ADJUSTMENT

The following conditions must be strictly kept, when measuring and adjusting operational speeds.

a) Hydraulic pump speed: 2,000 rpm.
b) Maximum hydraulic pressure:
   - Pump NO. 1: 175 kg/cm^2.
   - Pump NO. 2: 140 kg/cm^2.
c) Pump discharge volume. (At pump speed: 1,000 rpm.)
   Pump NO. 1: More than 28 liters.
   Pump NO. 2: More than 7 liters.
d) Hydraulic oil temperature: 40° - 60° C.
e) Platform : With no load condition.

Measurement procedures of operational speeds.

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

a) Take the each operational speed at least 3 times for the purpose of obtaining accurate data.
b) Incline the control levers fully up to the stroke ends, when measuring the operational speeds by functioning the upper control.

1. Elevation. (Boom raising "UP"/lowering "DOWN" speeds.)
   Raise/lower the boom to its full stroke with the minimum boom length, and take the boom raising "UP" and lowering "DOWN" speeds (seconds/stroke).

2. Telescoping. (Boom extending "OUT"/retracting "IN" speeds.)
   Extend/retract the boom to its full stroke with the maximum elevation angle, and take the boom extending "OUT" and retracting "IN" speeds (seconds/stroke).

3. Rotation (Turntable rotation speed)
   Rotate the turn table with the minimum boom length and maximum elevation angle, and take the turn table rotation speed (seconds/rev.).

4. Travel. (Traveling speed)
   Travel the equipment exactly 5 meters on a firm level ground and take the traveling speeds (seconds/5 meters).
   NOTE: Travel the equipment with minimum boom length and at the elevation angle: 0 degree.

Standard operational speed

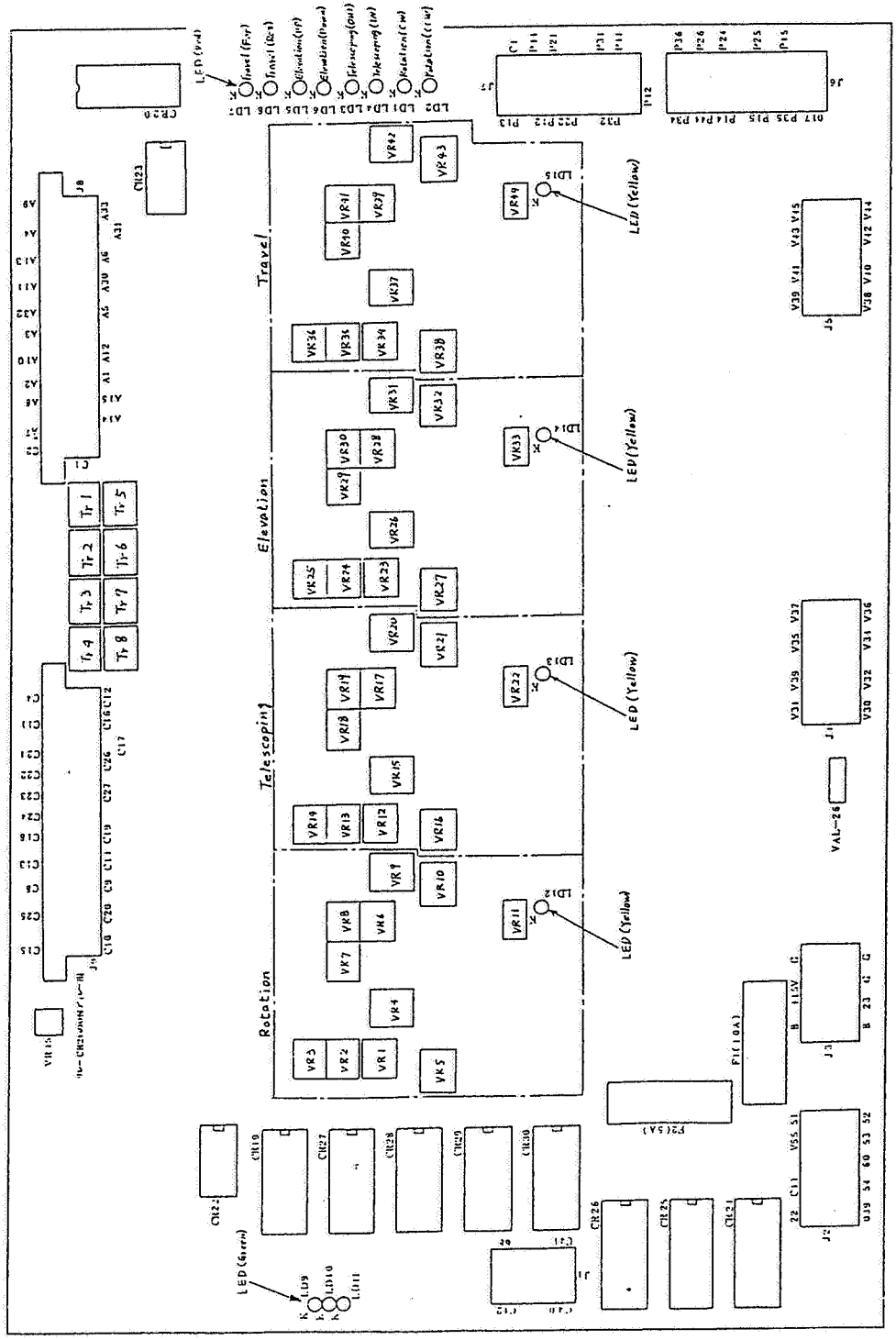
Function	Direction (Range)	Upper control	Lower control
ELevation	"UP"	50 ± 5 sec/stroke	85 ± 20 sec/stroke
	"DOWN"	55 ± 5 sec/stroke	65 ± 5 sec/stroke
Telescoping	"IN"	30 ± 5 sec/stroke	30 ± 5 sec/stroke
	"OUT"	30 ± 5 sec/stroke	30 ± 5 sec/stroke
Rotation	"RIGHT"	70 ± 5 sec/rev	70 ± 20 sec/rev
	"LEFT"	70 ± 5 sec/rev	70 ± 20 sec/rev
Travel		19 sec/ 5 meters	

Adjustment procedures of "Operational speed"

The each operational speed for "Elevation, Telescoping, Rotation, and Travel" is adjusted by the each "Trimmer" on "Valve control unit" as follows.

NOTE: The locations of each "Trimmer" on "Valve control unit" is as shown in Fig: 1

Fig: 1



1. Minimum operational speed

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

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

Function	Direction	Pin NO.	Remarks
Elevation	UP	V 38	Use the pins on "Main valve control unit."
	DOWN	V 40	
Telescoping	OUT	V 34	
	IN	V 36	
ROTATION	C.W.	V 30	
	C.C.W.	V 32	
Travel (Left)	FOR	V 42	
	REV	V 44	
Travel (Right)	FOR	▽42	"Sub valve control unit"
	REV	▽44	

4. Operate the "Control lever" slightly untill the "LED indicator" (on "Valve control unit") turns on, and read the "Digital voltmeter".

NOTE:

* The reading of "Digital voltmeter" is the "NULL voltage".
* The higher "NULL voltage" causes the increased "Mimimum operational speed,
* The reference value for each "NULL voltage is as shwon in the table below,

Elevation	0.30 V
Telescoping	↑
Rotation	↑
Travel (Left)	↑
Travel (Right)	↑

5. Adjust the each "NULL trimmer" (listed below), so that the each hydraulic actuator is about to move, when the each "Control lever" is actuated slightly.

NOTE: To higher the "NULL voltage" or "Minimum operational speed", turn the each "NULL trimmer" clockwise.

Function	Direction	"NULL trimmer NO.	Remarks
Elevation	UP	▽R27	Use the trimmrs on "Main valve control unit."
	DOWN	▽R32	
Telescoping	OUT	▽R16	
	IN	▽R21	
Rotation	C.W.	▽R5	
	C.C.W.	▽R10	
Travel (Left)	FOR	▽R38	
	REV	▽R43	
Travel (Right)	FOR	▽R38	"Sub valve control unit"
	REV	▽R43	

2. Maximum operational speed

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

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

Function	Direction	"PIN" NO.	Remarks
Elevation	UP	V 38	Use the pins on "Main valve control unit".
	DOWN	V 40	
Telesco ping	OUT	V 34	
	IN	V 36	
Rotation	C.W.	V 30	
	C.C.W.	V 32	
Travel (Left)	FOR	V 42	
	REV	V 44	
Travel (Right)	FOR	V 42	"Sub valve control unit"
	REV	V 43	

4. Operate the "Control lever" fully up to the stroke end, and read the "Digital voltmeter".

   NOTE: * The reading of "Digital voltmeter" is the "GAIN voltage".
   * The higher "GAIN voltage" causes the increased "Maximum operational speed".
   * The reference value for each "GAIN voltage" is as shown in the table below.

Function	Direction	"GAIN trimmer"	"GAIN voltage"	Remarks
Elevation	UP	VR 26	0,55V	Use the trimmers on "Main valve control unit"
	DOWN	VR 31	0,50V	
Telesco ping	OUT	VR 15	0,60V	
	IN	VR 20	0,55V	
Rotation	C.W.	VR 4	0,59V	
	C.C.W.	VR 9	0,59V	
Travel (Left)	FOR	VR 37	0,60V	
	REV	VR 42	0,60V	
Travel (Right	FOR	VR 37	0,60V	"Sub valve control unit"
	REV	VR 42	0,60V	

5. Adjust the each "GAIN trimmer" (listed in the table above), so that the each "Maximum operational speed" becomes "Specific value".

   NOTE: * To higher the "GAIN voltage" or "Maximum operational speed", turn the each "GAIN trimmer" clockwise.

3. Adjustment of "DELAY trimmers".

The "DELAY trimmers" are adjusted to start or stop the each operation more gradually (shocklessly), or promptly (precisely).

* Turn the each "DELAY trimmer", and set it at the central position of its adjustable range.

Function		Delay Trimmer		
Elevation	UP	UP	VR23	Use the trimmers on "Main valve control unit"
		Down	VR24	
	Down	UP	VR28	
		Down	VR29	
Telescoping	OUT	UP	VR12	
		Down	VR13	
	IN	UP	VR17	
		Down	VR18	
Rotation	CW	UP	VR1	
		Down	VR2	
	CCW	UP	VR6	
		Down	VR7	
Travel (Left)	FOR	UP	VR34	
		Down	VR35	
	REV	UP	VR39	
		Down	VR40	
Travel (Right	FOR	UP	VR34	Use the trimmers on "Sub valve control unit"
		Down	VR35	
	REV	UP	VR39	
		Down	VR40	

NOTE:

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

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

4. Adjustment of "DITHER trimmers".

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

* Turn the each "DITHER trimmer" listed in the table below, and set it at the central position of its adjustable range.

Function	"DITHER trimmer" NO.	Remarks
Elevation	VR33	Use the trimmers on "Main valve control unit".
Telescoping	VR22	
Rotation	VR11	
Travel (Left)	VR44	
Travel (Right)	VR44	"Sub valve control unit"

Note: It is not necessary to adjust the "Dither trimmer".

5. 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" at ON position
2. Set a "Digital voltmeter" between the each "Pin ⊕ on valve control unit" (listed below) and Body earth ⊖

Function	Direction	"PIN" NO.
Elevation	UP	V 38
	DOWN	V 40
Telesco-ping	OUT	V 34
	IN	V 36
Rotation	C.W.	V 30
	C.C.W.	V 32

3. Operate the each "Control switch" at Lower control box, and read the "Digital voltmeter".
   Note: The reading of "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: * The higher "Out put voltage" causes the increased speed.
   * To increase the "Out put voltage", turn the each "Tr trimmer clockwise.

Function	Direction	Tr trimmer NO.
Elevation	UP	Tr 5
	DOWN	Tr 6
Telesco-ping	OUT	Tr 3
	IN	Tr 4
Rotation	C.W.	Tr 1
	C.C.W.	Tr 2

SR-181 ADJUSTMENT SHEET

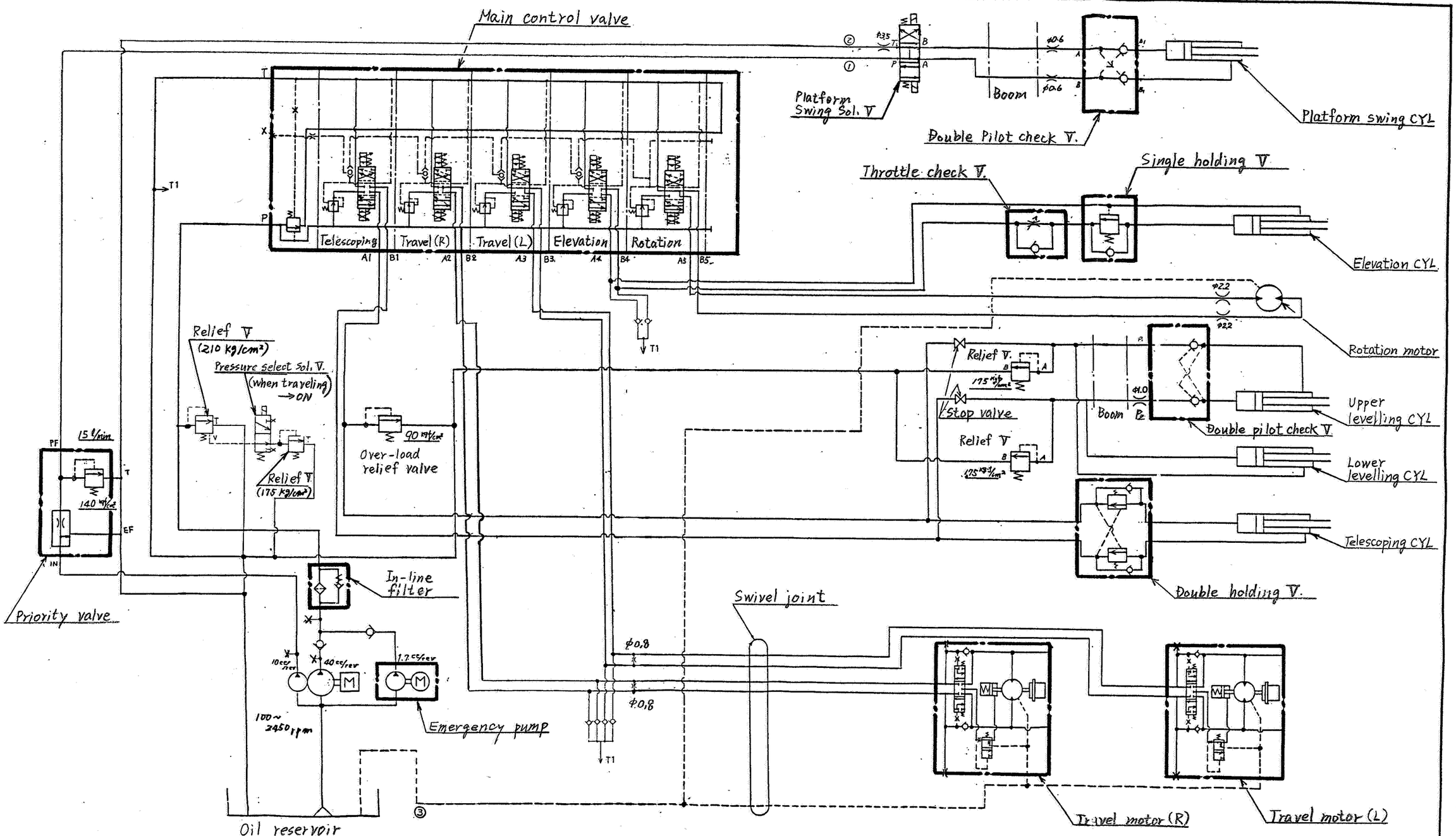
Date:

Serial NO:

FUNCTION		ELEVATION		TELESCOPING		ROTATION		TRAVEL (Left)		TRAVEL (Right)	
DIRECTION		UP	DOWN	OUT	IN	CW	CCW	FOR	REV	FOR	REV
PIN NO.		V 38	V 40	V 34	V 36	V 30	V 32	V 42	V 44	V42	V44
NULL trimmer		VR 27	VR 32	VR 16	VR 21	VR 5	VR 10	VR 38	VR43	VR38	VR43
NULL voltage	Before adjustment										
	After adjustment										
GAIN trimmer		VR 26	VR 31	VR 15	VR 20	VR4	VR9	VR37	VR42	VR37	VR42
GAIN voltage	Before adjustment										
	After adjustment										
DELAY trimmer	Up	VR23	VR28	VR12	VR17	VR1	VR6	VR34	VR39	VR34	VR39
	Down	VR24	VR29	VR13	VR18	VR2	VR7	VR35	VR40	VR35	VR40
Tr trimmer		Tr 5	Tr 6	Tr 3	Tr 4	Tr 1	Tr 2				
DITHER trimmer		VR 33		VR 22		VR 11		VR 44		VR44	
Spec., speed	Upper control	50±5 sec	55±5 sec	30±5 sec	30±5 sec	70±5 sec	70±5 sec	19 sec/5 m	19 sec/5 m	19 sec/5 m	19 sec/5 m
	Lower control	85±20 sec	65±5 sec	30±5 sec	30±5 sec	70±20 sec	70±20 sec				

APPENDIX

Hydraulic Circuit Diagram (601-04925C)



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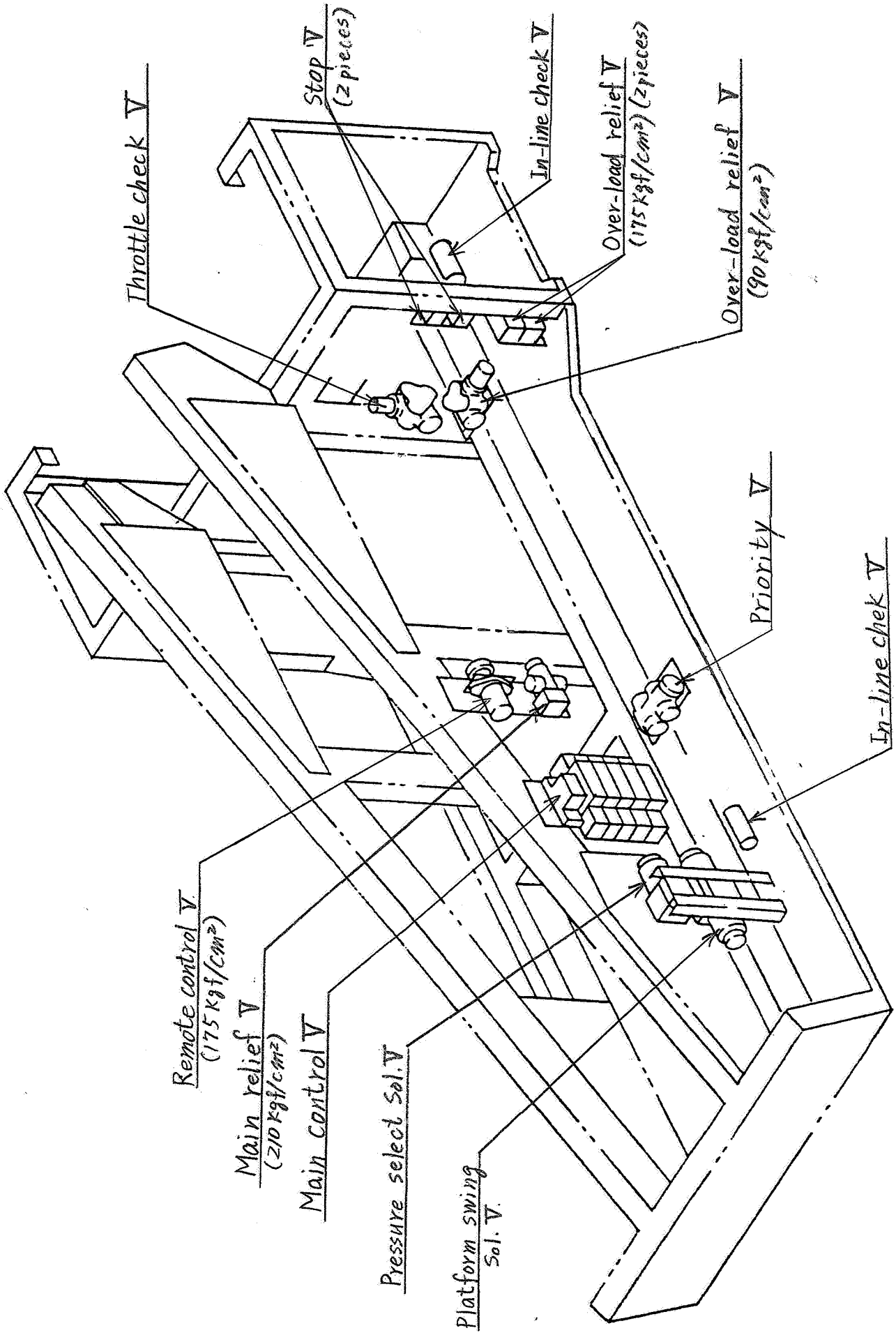
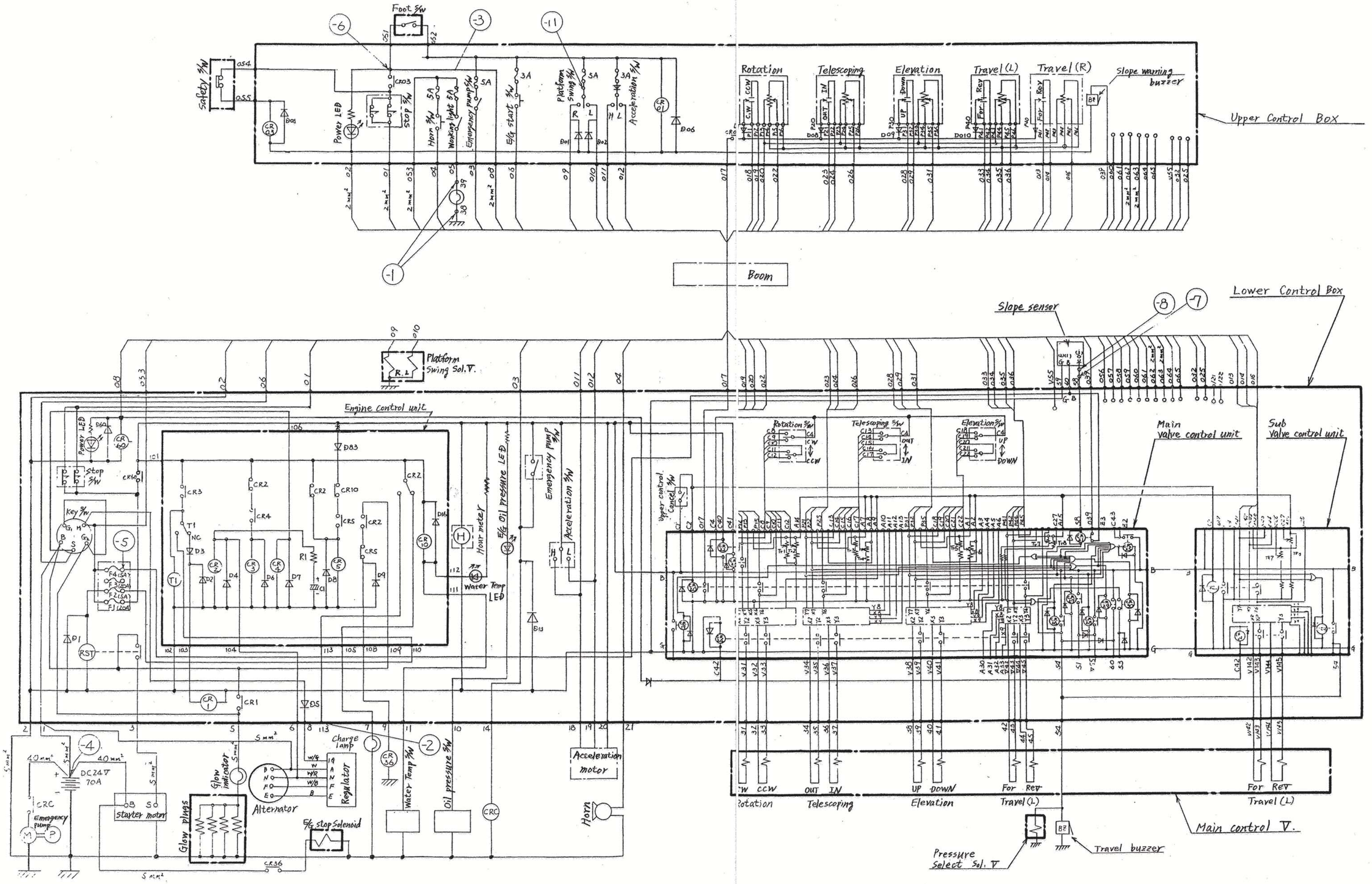
Locations of Hydraulic valves (7R2-01391)



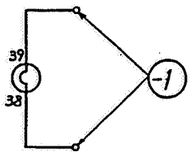
Electric Circuit Diagram (602-04284C)



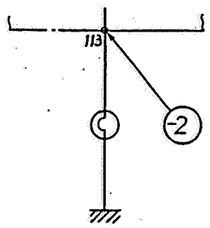
Electric Circuit Diagram (3/2) (602-04284C)

OPTIONAL DEVICES

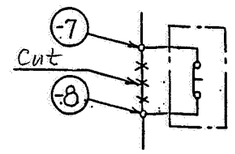
Ⓐ Extra Working light



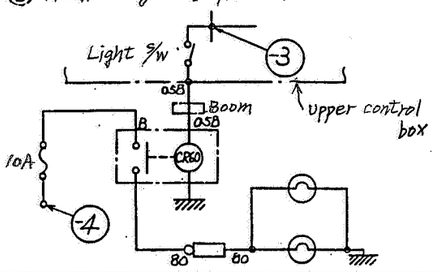
Ⓑ Revolving light



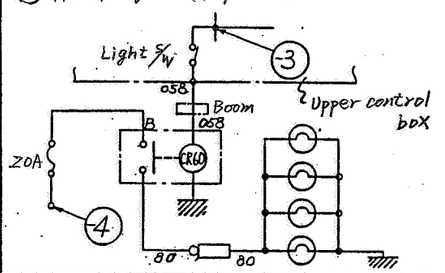
Ⓙ Warning buzzer switch



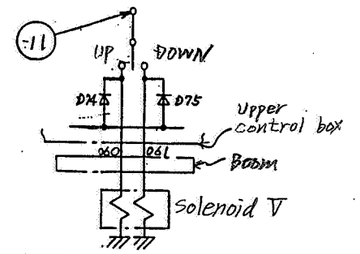
Ⓒ Head Light (2 pieces)



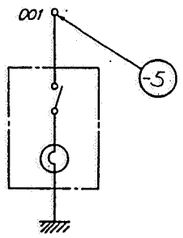
Ⓓ Head light (4 pieces)



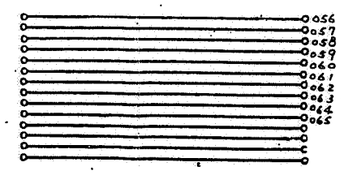
Ⓛ Platform levelling switch



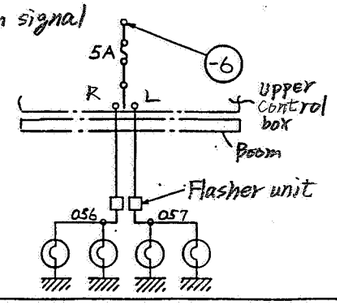
Ⓕ Lower control illumination lamp



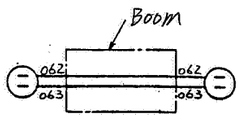
Ⓩ Extra wires in boom cable.



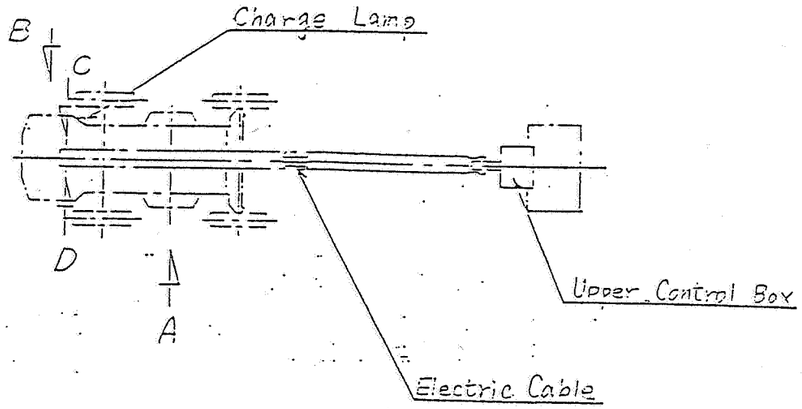
Ⓖ Turn signal

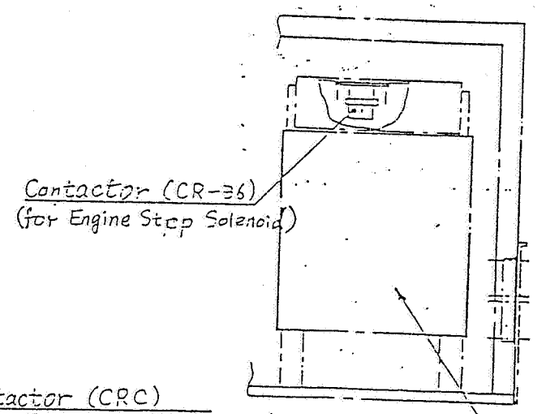


Ⓗ AC100V out-lets

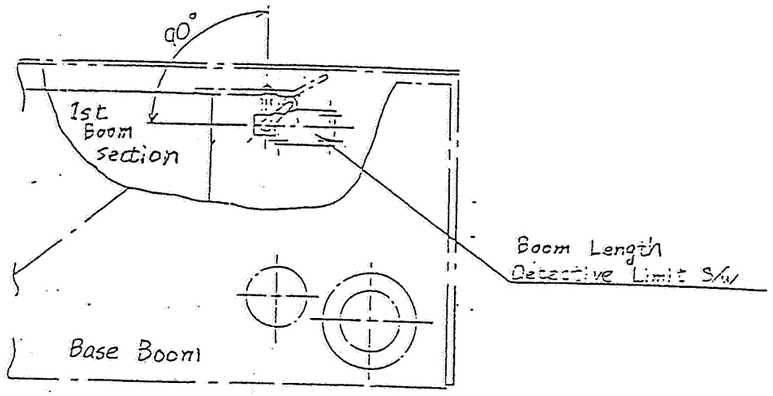


LOCATIONS OF ELECTRIC COMPONENTS

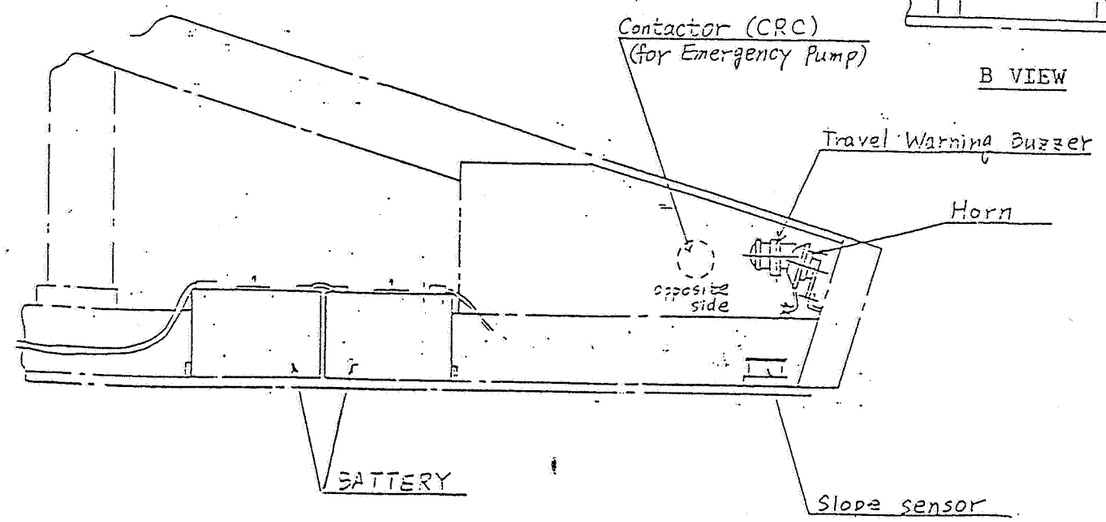




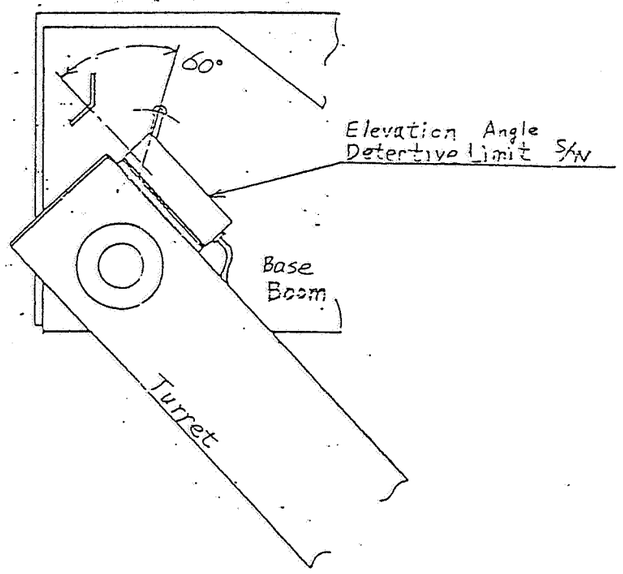
B VIEW



C VIEW



A VIEW



D VIEW

Lower Control Box

TIGHTENING TORQUE STANDARD

"Hexagon bolt for Grade 10.9" and "Cap screw" (S45C)

Size mm.	Pich mm.	Tightening torque kg-m.	Tightening torque ft-lb.
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	235 ~ 319
20	2.5	45.6 ~ 61.6	330 ~ 446
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 ~ 1117
30	3.5	155.4 ~ 210.2	1124 ~ 1519

"Hexagon bolt for Grade 8.8" (SCM 435)

Size mm.	Pich mm.	Tightening torque kg-m.	Tightening torque ft-lb.
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

Trouble shooting (SR-181, SP-150, SP-181, SP-210)

NO.	Trouble	Cause	Remedy
1.	"Starter motor" does not run. on both "Upper" and "Lower" controls.	1) "Emergency stop S/W" on "Lower" or "Upper" control is pressed, or both of the switches are pressed. (Both "Power lamps" on "Lower" and "Upper control boxes turn off.	Press the "Emergency stop S/W" again, and turn on "Power lamps".
		2) "Main fuse (20A)" in "Lower control box" blows off. (Both "Power lamps" on "Lower" and "Upper" control boxes turns off.	Replace the fuse.
		3) "Engine start fuse (5A)" in "Lower control box" blows off.	Replace the fuse.
		4) "Safety S/W" (Touch S/W) on "Upper control" is pressed. (Both "Power lamps" on "Lower" and "Upper control boxes turn off.	Release the switch.
		5) Battery is flat.	Charge battery.
2.	"Starter motor" does not run at "Upper control".	1) "Foot switch" is not pressed.	Press "Foot switch", and operate "Engine start S/W".
		2) "Engine start fuse (3A)" in "Upper control box" blows off.	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.
		3) Engine is overheated. ("Water Temp lamp" on "Lower control box" turns on.)	Check "Engine cooling system", cool down engine, and start.

作成 年 月 日

備考

NO.	Trouble	Cause	Remedy
4.	Engine does not stop.	"Charging system" (Alternator) is not charging battery. ("Charge warning lamp" turns on.)	Repair the "Charging system".
5.	Engine stopped naturally, and does not start again.	1) Fuel tank is empty.	Fill fuel, bleed air, and start engine.
		2) Engine is overheated. ("Water Temp lamp" on "Lower control box" turns on.)	Check "Engine cooling system", cool down, and start engine.
6.	No operation is available at "Upper control", except for "Horn" and "Working light".	1) "Foot switch" is not pressed. ("Power lamp on "Upper control box" turns on.)	Press "Foot switch", and operate.
7.	"Elevation", "Telescoping", "Rotation" and "Travel" are not available at "Upper control".	"Upper control cancel switch" on "Lower control box" is on.	Turn off "Upper control cancel switch".
8.	"Elevation", "Telesoping", "Rotation" and "Travel" are not available on both "Upper" and "Lower" controls	"Fuse" on "Valve control units" installed in "Lower control box" blows off.	Replace the fuses,
9.	"Platform swing" is not available at "Upper control".	"Platform swing fuse (5A)" in "Upper control box" blows off.	Replace the fuse,
10.	"Acceleration" is not available at "Upper control".	"Acceleration fuse (3A)" in "Upper control box" blows off.	Replace the fuse.
11.	"Emergency pump" is not available at "Upper control".	"Emergency pump fuse (5A) in "Upper control box." blows off.	Replace the fuse.
12.	"Horn" and "Working light" are not available at "Upper control".	"Horn, Working light fuse (10A) in "Upper control box" blows off.	Replace the fuse.
13	"Buzzer" sounds at "Upper control".	Machine is inclined 3° or more due to slope.	Lower the platform, and set the machine on level ground.

作成 年 月 日

備考

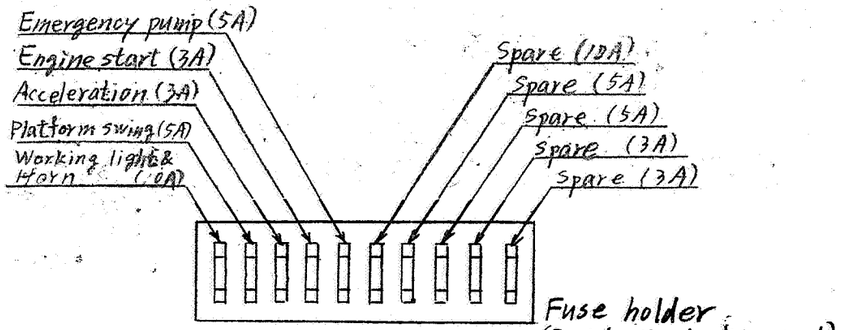
NO.	Trouble	Cause	Remedy
14	"High speed travelling" is not available in spite of "Travel speed select switch" being positioned at "High speed" (SP-150, 181, 210 only)	1) Boom is extended or elevated more than horizontal level.	Retract boom fully, and bring down lower than horizontal level.
		2) "Travel speed select fuse (3A)" in "Upper control box" blows off.	Replace the fuse.
15	"Steering" is not available. (SP-150, 181, 210 only)	"Steering fuse (5A) blows off in "Upper control box".	Replace the fuse.
16	Abnormal noise comes out from "Travel motor" and "Travelling" operation stops, when "steering" is operated. (SP-150, 181, 210 only)	"Travel speed select switch" is positioned at "High speed".	Set the switch at "Low speed" side.
17	Platform loses level quite often.	"Platform level adjust valves" are not closed firmly.	Closed the valves firmly.

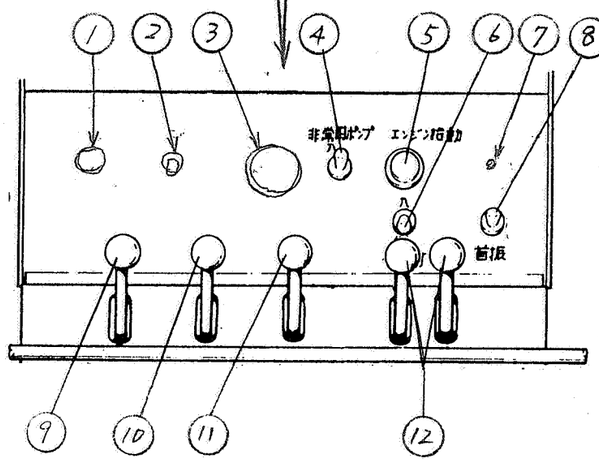
作成 年 月 日

整理

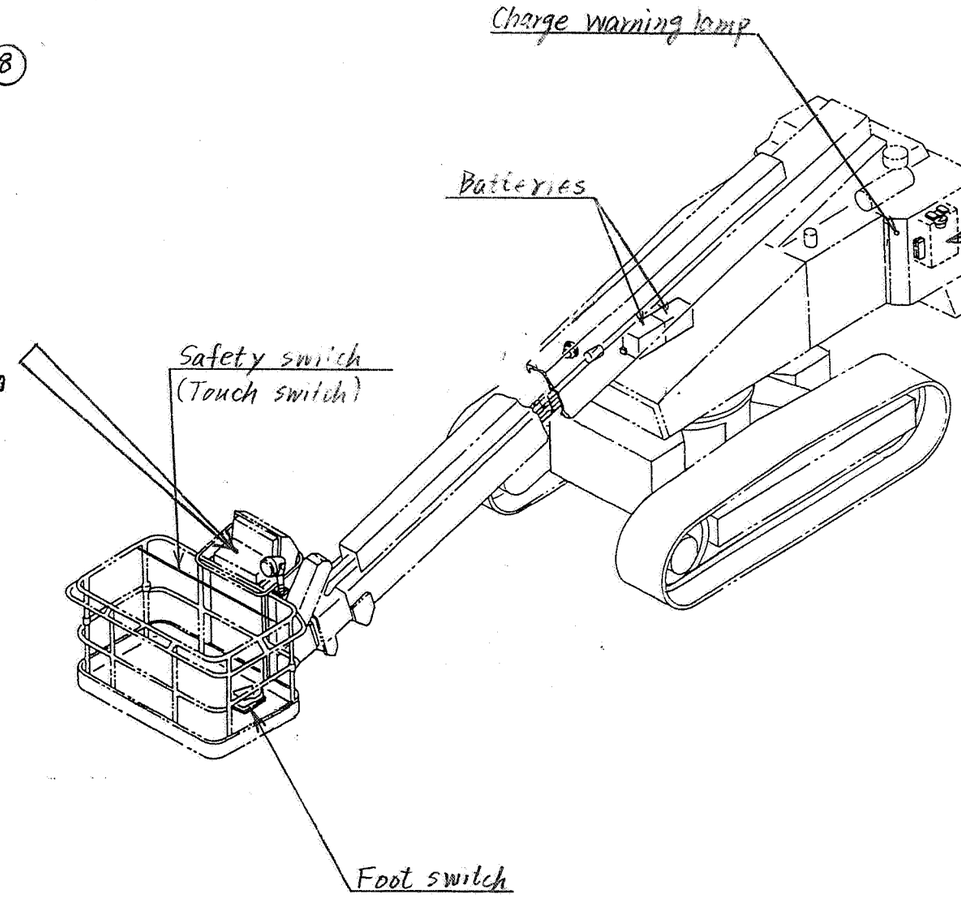
配布先

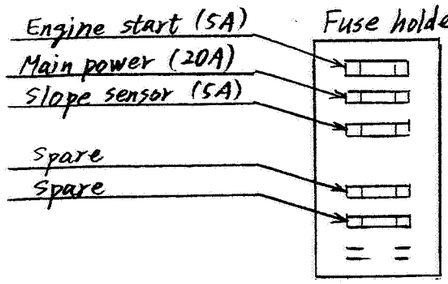
Identification of "Control devices" and "Fuses" (SR-181)

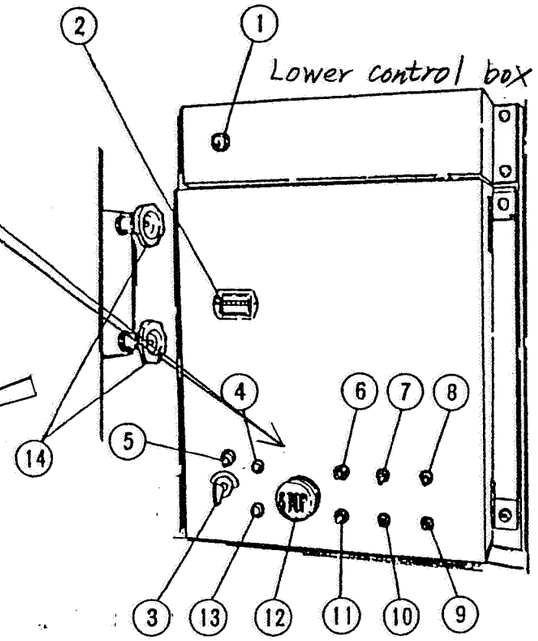




1	Horn switch
2	Acceleration switch
3	Emergency stop switch
4	Emergency pump switch
5	Engine start switch
6	Working light switch
7	Power LED
8	Platform swing switch
9	Extension (Telescoping) control lever
10	Rotation control lever
11	Elevation control lever







1	Glow indicator
2	Hour meter
3	Main key switch
4	Engine water Temp. LED
5	Power LED
6	Acceleration switch
7	Emergency pump switch
8	Upper control cancel switch
9	Extension (Telescoping) switch
10	Rotation switch
11	Elevation switch
12	Emergency stop switch
13	Engine oil pressure LED
14	Platform level adjust valves