



For sales and service please call:

PTB Sales
Ph. (626) 334-0500
Fax (626) 334-2151
Toll Free 866-332-0500

www.ptb-sales.com

STP-2001/2001C

TURBO MOLECULAR PUMP INSTRUCTION MANUAL

MT-20E-002-0

- The second edition -

Can be used in the vertical only.

SEIKO SEIKI CO.,LTD.

Copyright © Seiko Seiki Co., LTD, 1995. All right reserved. Printed in Japan.

Dear Customer!

Thank you very much for purchasing our STP-2001/2001C turbo molecular pump.

We are sorry to inform you that this Manual may include inaccuracies in technical terms, or grammatical, typographical errors. If you find them, please advise us. Thank you in advance.

The information herein is subject to change without notice due to product improvement.

TABLE OF CONTENTS

	Page
WARRANTY	1
1. INSTALLATION OF THE STP PUMP	2
1-1 Unpacking the package	2
1-2 Name of each part	3
1-3 Getting started the STP pump	4
1-4 Installation conditions	5
1-4-1 Installation position	5
1-4-2 Fixture of the pump	5
1-4-3 Vacuum piping on the absorption port side	7
1-4-4 Vacuum piping on the exhaust port side.	7
1-4-5 Connection of the emergency electromagnetic valve	10
1-4-6 Connection of a purge port	11
1-4-7 Grounding the STP pump	11
1-4-8 Environmental conditions	11
1-5 Storage	13
1-5-1 Storage of the STP pump unit	13
1-5-2 Storage of the STP control unit	13
1-5-3 Notabilia on restarting after storage	14

2.	INSTALLATION OF THE STP CONTROL UNIT	15
2-1	Name and function of each part	15
2-1-1	Front panel	15
2-1-2	Rear panel	17
2-1-3	Control unit inside	19
2-2	Installation conditions on the rack	21
2-2-1	Environmental conditions	21
2-2-2	Conditions of fitting on the rack	21
2-2-3	Connection of the cables	22
3.	START / STOP	23
3-1	Check before START	23
3-2	START / STOP time	24
3-3	Manual operation	24
3-3-1	Rotor floating operation	24
3-3-2	Rotor rotating operation	24
3-3-3	Rotor STOP operation	24
3-3-4	Rotating operation after the rotor STOP operation	25
3-3-5	Rotor lowering down (levitating) operation	25
3-4	Remote operation	25
3-4-1	Rotor floating operation	26
3-4-2	Rotor rotating and STOP operations	26
3-4-3	Rotating operation after the rotor STOP operation	27
3-4-4	Rotor lowering down (levitating) operation	27
3-5	STOP operation	28

4.	SAFETY FUNCTIONS IN CASE OF ABNORMALITIES	28
4-1	Safety functions	28
4-1-1	Power failure	28
4-1-2	Abnormality of the magnetic bearing	32
4-1-3	Excessive vibration	32
4-1-4	Overload of the inverter	32
4-1-5	Overheating in the pump	32
4-1-6	Overheating in the control unit	32
4-1-7	Excessive speed of the rotor	32
4-1-8	Abnormal battery voltage	33
4-1-9	Trouble of the electromagnetic brake	33
4-2	Restarting after safety functions operate	33
4-3	Notabilia on operating the emergency electromagnetic valve	33
	Safety functions (Tables)	35
5.	BAKING, LOAD GAS INTRODUCTION AND COOLING	37
5-1	Baking	37
5-1-1	Mounting the baking heater	37
5-1-2	Notabilia on baking	37
5-2	Load gas introduction	37
5-3	Cooling	37
5-3-1	Connection of an air cooling unit	38
5-3-2	Connection of piping for coolant	39
6.	REMOTE I/O SIGNAL TERMINAL TABLE	40

6-1 I/O TB2 Terminal table	40
6-2 DC I/O TB3 Terminal table	44
6-3 START/STOP TB5 Terminal table	47
6-4 START/STOP TB6 Terminal table	48
7. INTERNAL BATTERY	51
7-1 Recharging method	51
7-2 Service life	51
7-3 Allowable leaving period	51
7-4 Battery replacement	54
8. EXTERNAL BATTERY	56
8-1 Specifications	56
8-2 Connecting method	56
8-3 Recharging method	57
8-4 Notabilia on usage	57
9. OPERATION PRINCIPLE OF THE STP PUMP	58
10. SPECIFICATIONS AND ACCESSORIES	60
11. TROUBLESHOOTING	65
12. MAINTENANCE	70
12-1 Replace the internal battery	70
12-2 Inspect the cooling fan	70
12-3 Transport the pump for repair or overhaul	70
13. CARRYING THE PUMP AND CONTROL UNIT	71
13-1 Carrying the pump	71
13-2 Carrying the control unit	71
TRUBLE CHECK SHEET FOR STP	72

FIGURES

Fig. 1	Structure of the STP pump	3
Fig. 2	Installation of the pump into the vacuum system	4
Fig. 4	Installation method of the pump	8
Fig. 5	Connection of the purge port and emergency electromagnetic valve	12
Fig. 6	Front panel of the control unit	17
Fig. 7	Rear panel of the control unit	20
Fig. 8	Control unit inside	20
Fig. 9	Fixing positions of the control unit	22
Fig. 10	Operating timing of emergency electromagnetic valve	34
Fig. 11	Baking and cooling	38
Fig. 12	I/O TB2 Terminal table for remote output signal	42
Fig. 13	Connecting method of R.PUMP terminal of I/O TB2	43
Fig. 14	Terminal table for remote input signal (DC I/O TB3)	46
Fig. 15	Terminal table for remote input signal (START/STOP TB5)	49
Fig. 16	Terminal table for remote input signal (START/STOP TB6)	49
Fig. 17	Battery service life	53
Fig. 18	The allowable leaving period of battery	53
Fig. 19	Replacement of the internal battery	55
Fig. 20	Cross sectional view of the STP pump	59
Fig. 21	Carrying the pump	71
Fig. 22	Dimensions of the control unit	73
Fig. 23	External view of the STP-2001/2001C (VG250 Flange)	74

Fig. 24	Position of the control unit name plate	75
Fig. 25	Position of the STP-2001/2001C name plate	76
Fig. 26	Position of the special accessories name plates	77

TABLES

Table 1	Connection of the power cable (primary side)	23
Table 2	Rotating and stop operations of the rotor in remote operation	27
Table 3	Operation at the time of the power recovery (manual operation)	30
Table 4	Operation at the time of the power recovery (remote operation)	31
Table 5	Safety functions	35
Table 6	I/O TB2 Terminal table	40
Table 7	Rating of G2R-117P-V, G6c-1117P-US	43
Table 8	Rating of the contacts of G2R-117P-V, G6c-1117P-US	43
Table 9	DC I/O TB3 Terminal table	44
Table 10	START/ STOP TB5 Terminal table	47
Table 11	START /STOP TB6 Terminal table	48
Table 12	The rating for G2VN-237PL	50
Table 13	The rating for the contacts of G2VN-237PL	50
Table 14	Specifications for the external battery	56
Table 15	Specifications for the STP pump (STP-2001/2001C)	60
Table 16	Specifications for the STP control unit	62
Table 17	Accessories	64
Table 18	Troubleshooting (1)	65
Table 19	Troubleshooting (2)	68
Table 20	Troubleshooting (3)	69

WARRANTY

The STP pump and the STP control unit are unconditionally warranted to be free of defects for a period of one year from the date of delivery. This warranty does not apply to any unit or component which has been subjected to misuse or alteration specified below:

- (1) The pump or the control unit has been used in violation of operation or maintenance instructions described in this Manual.
- (2) The pump or the control unit has been disassembled, repaired or remodeled without our authorization.
- (3) The pump or the control unit has been used under operating conditions not specified in this Manual without our approval.

CAUTIONS

- Apply voltage specified on the plate to the primary side of the control unit and connect properly.
- Always use its auxiliary pump, while you are operating the STP pump.
- DO NOT use gas, whose use is not allowed in this Manual.
- Be sure to fix the STP pump according to instructions.

Please read through this Instruction Manual carefully before operating the STP pump.

1. INSTALLATION OF THE STP PUMP

1-1 Unpacking the package

- 1) Check the contents of the package, referring to the accessory list of this Manual (Table 17).
- 2) Ensure that the package is free from any physical defect (deformation, depression, stains, water, etc.). If any defect is found and also the package must be recovered, please contact us.
- 3) We recommend the user to store the package material, such as corrugated cardboard boxes and styrofoam for recycle.
- 4) Take care not to scratch the flange. Ensure that there is no scratch before installing the pump into the system.

1-2 Name of each part

The structure of the STP pump is shown in Fig.1.

- 1) Absorption port flange (ICF, VG, ASA, ISO, etc.).
- 2) Exhaust port flange (KF40).
- 3) MB connector (connected to the control unit).
- 4) Motor connector (connected to the control unit).
- 5) Emergency electromagnetic valve installation port (connected to KF10 and the emergency electromagnetic valve).
- 6) Emergency electromagnetic valve (connected to KF10 and N₂ gas, etc.). The cable is connected to the control unit.
- 7) Purge port (KF10)

*Special accessory only for the STP-2001C (Chemical type).

Note : A protective wire net is fitted to the absorption port flange to prevent foreign matter from entering.

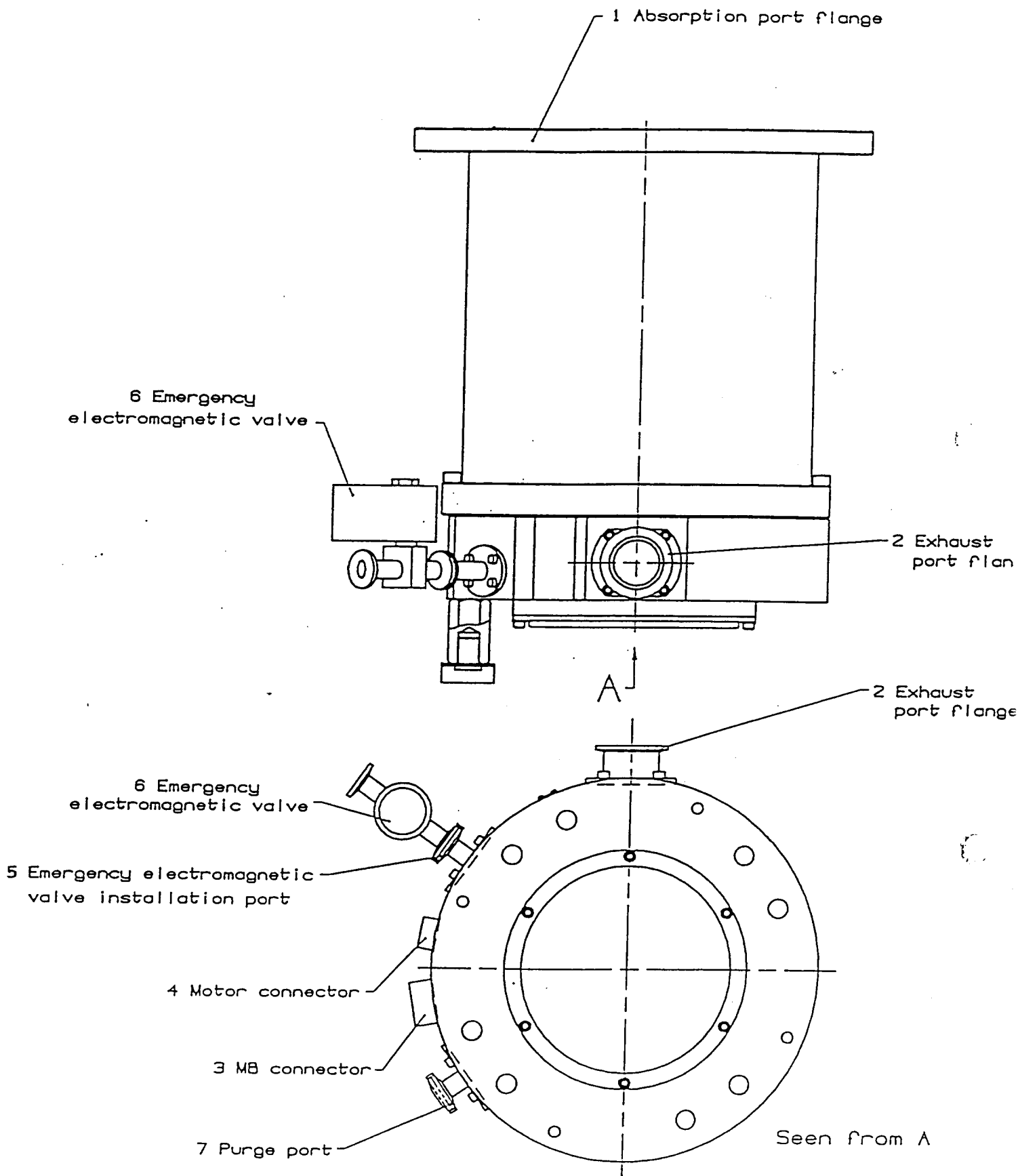


Fig. 1 Structure of the STP pump

1-3 Getting started the STP pump

The STP pump is installed into the vacuum system as shown in the figure below.

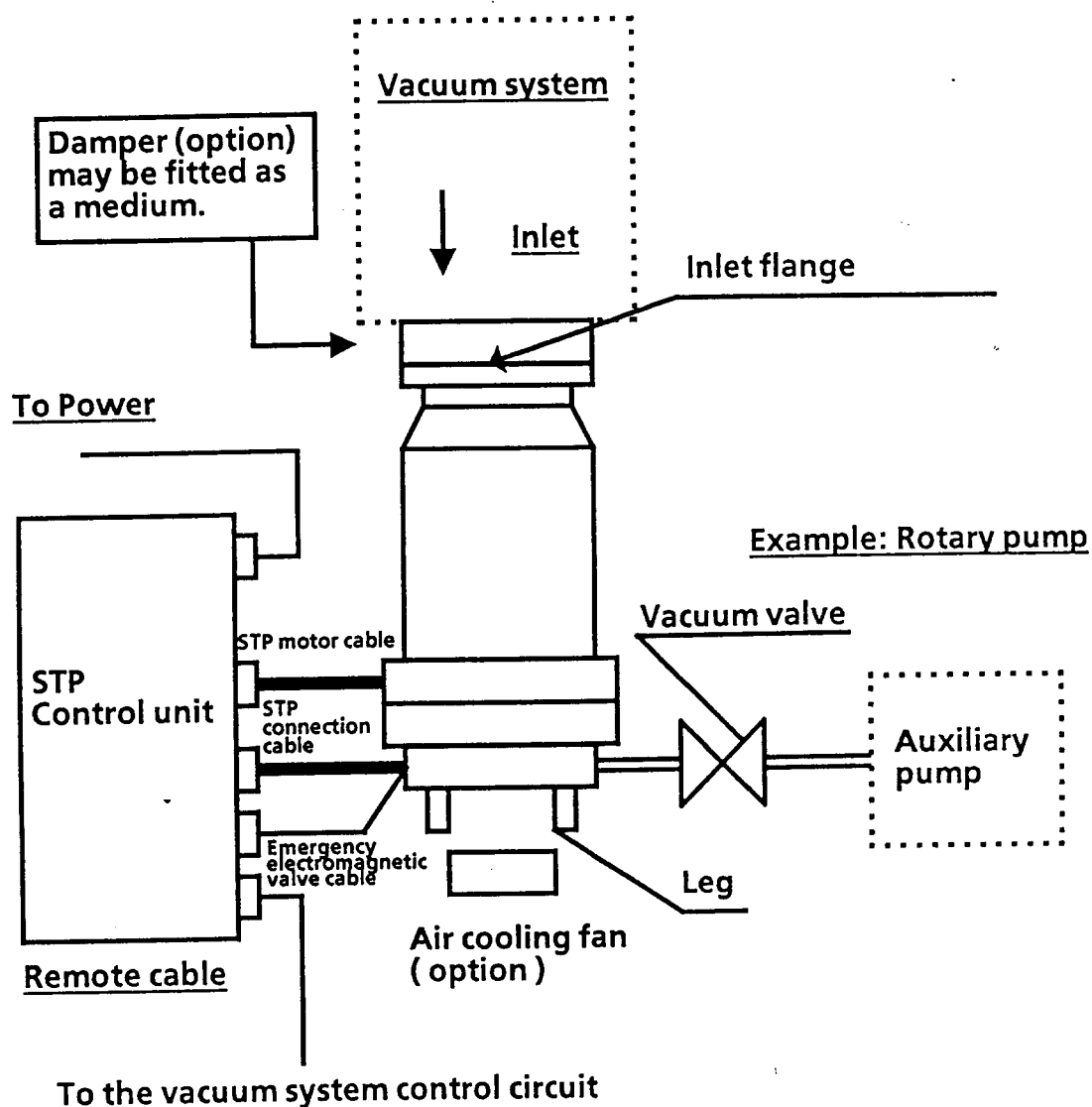


Fig. 2 Installation of the pump into the vacuum system

In the STP pump, the exhaust port cannot be used at atmospheric pressure. Use an auxiliary pump whose exhaust speed is more than 540 l/min . It is recommendable to use a vacuum valve between the STP pump and its auxiliary pump. Do not introduce corrosive gas into the STP-2001 (standard type). Though any chlorine gas can be used in the STP-2001C (chemical type), contact us if you plan to use any other kinds of gases (Ga or HBr). Also contact us if you plan to use the STP-2001/2001C for receiving radioactive rays.

1-4 Installation conditions

Check dust and oil stain on the sealing surface of the absorption/exhaust port flange before installing the STP pump into the system.

The following methods are recommended for cleaning the sealing surface.

- 1) Wiping with a solvent such as acetone, and alcohol. A protective wire net is fitted to the absorption port side to prevent foreign matter from entering.

Note : ① The wire net cannot prevent foreign matter from entering. Foreign matter entered through the wire may cause troubles.
② Refer to "13 TRANSPORTING THE PUMP AND CONTROL UNIT" for information about transporting the pump and the control unit.

1-4-1 Installation position

This pump can be mounted in vertical position.

1-4-2 Fixture of the pump

The STP pump weighs 63kg. If any trouble occurs in the rotating portion, the system may be affected. Fix the absorption port flange of the STP pump and the base firmly according to the fixing method and the mounting example shown in Fig. 5.

1) Fixing method of the absorption port flange

① Flange with bolts (ICF.VG, etc.)

Use a bolt whose size is specified by the flange standard, and fix the flange by all the bolts.

② Flange fixed by clampers (ISO)

Find the appropriate number of clampers in the table below according to the size of the flange. Fasten the clampers uniformly on the periphery of a circle.

Flange size	The number of clampers
ISO160 or less	4 or more
ISO200~250	6 or more
ISO320 or less	8 or more

2) Fixing of the base portion

- a. Fix the base portion with attached legs or over 4 screws M16 for legs.
- b. If the base is not fixed in the manner "a," fix the pump as shown in Fig.4B.

3) Fixing with a damper

Fix the absorption port flange and the base by both of the above 1) and 2) - a (see Fig. 4 D).

Use over 8 screws M16 for legs.

Note : DO NOT remove the bolt and the nut for reinforcement which are fitted to the damper.

4) Fixing method in case that cooling fan is used.

Fix the absorption port flange and the base by both of the above 1) and "a" or "b of 2) (see Fig. 4 A B).

1-4-3 Vacuum piping on the absorption port side

Fit the absorption port on the high vacuum side.

Allowable absorption port pressure..... 1×10^{-4} [Torr]

Use pipes made of stainless steel or aluminum between the system and the STP pump.

Make leakage as little as possible. Clean and remove grease of the inner wall of the pipe to minimize outgas amount.

Note: When the absorption port pressure becomes higher, you hear the sound of rotation of the dry bearings. This is not a problem.

1-4-4 Piping on the exhaust port side

Fit the exhaust port on the side of the auxiliary pump (the pump on the primary side).

Allowable absorption port pressure.....0.1 [Torr]

Note : Make the pressure on the exhaust port side under 10^{-2} Torr to obtain the attainable pressure 10^{-9} .

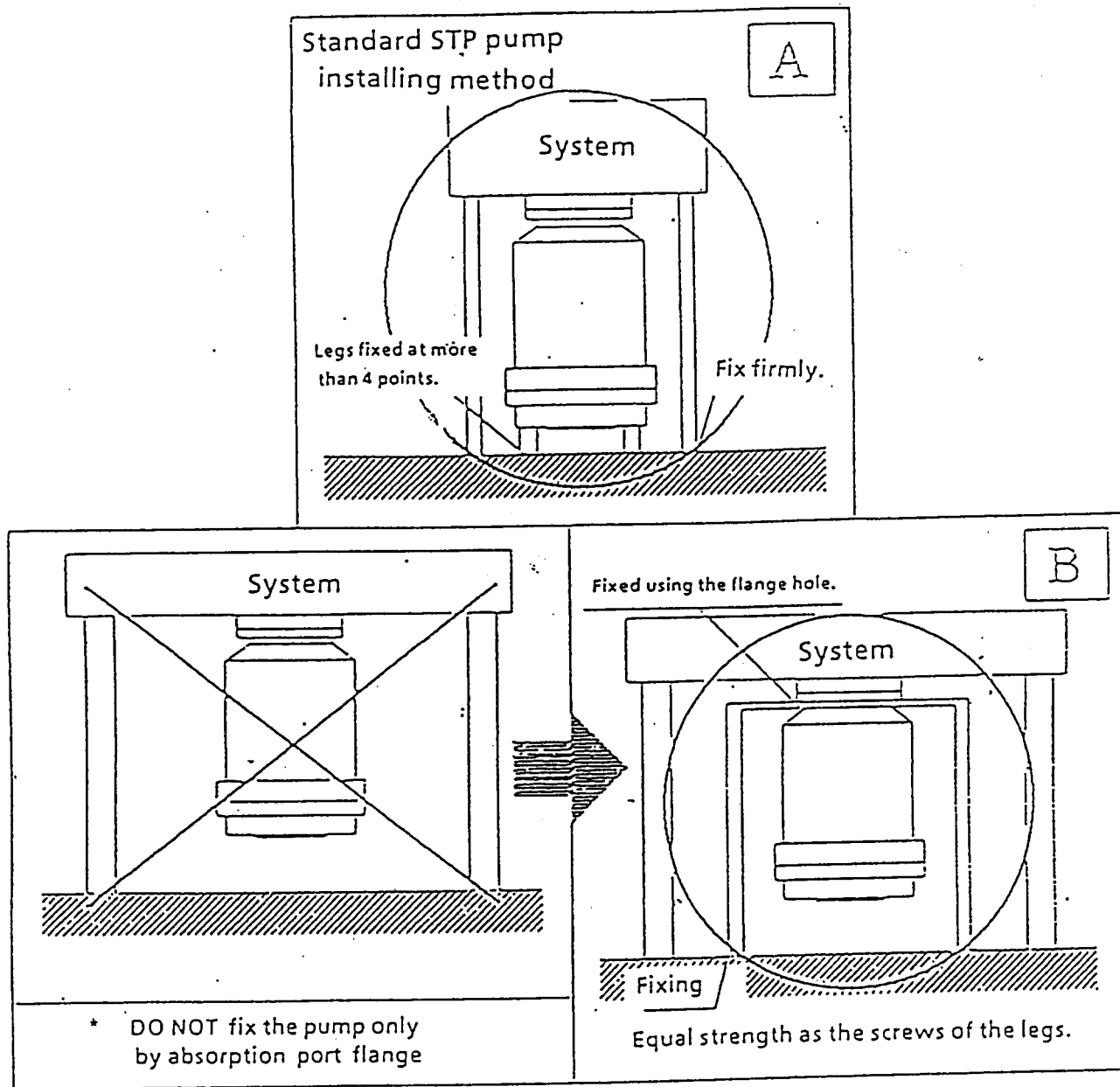
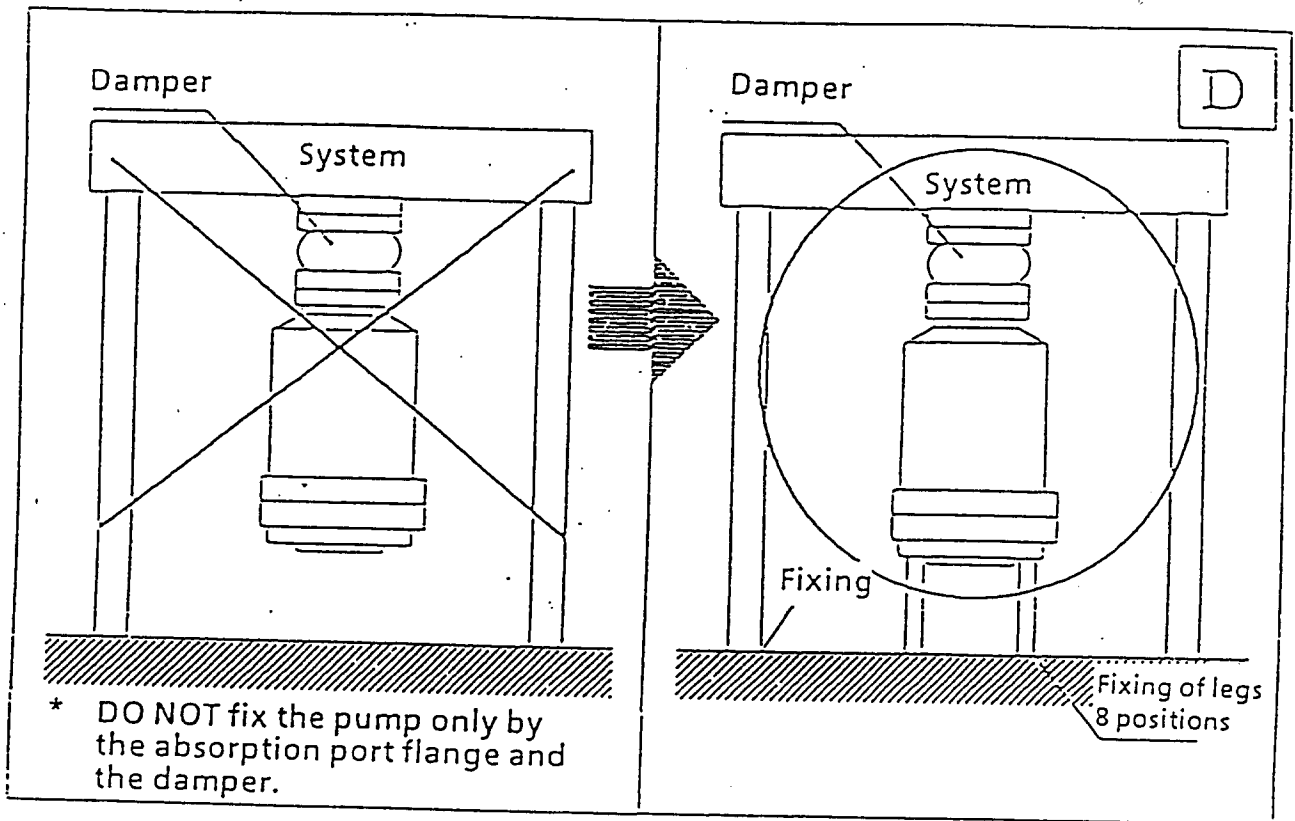


Fig.4 Installation method of the pump



- 1) An auxiliary pump whose capacity is more than 540 ℓ/min. is recommended. However, the pressures between absorption and exhaust port and outlet sides change depending upon the chamber capacity, the pipe length and material. Select the pump capacity and the starting method (simultaneous getting started, and getting started after rough vacuuming) according to the system being used.
- 2) Connect the STP pump and its auxiliary pump using a tube or a flexible tube made of vacuum rubber, stainless steel and aluminum alloy.
The following methods are considered, so as not to apply vibration of the auxiliary pump to the STP pump or to the system.
 - a Put the auxiliary pump on another floor.
 - b Put the auxiliary pump on a vibration proof table. Make the specific vibration number when putting the auxiliary pump on the vibration proof table one third of the rotation number of the auxiliary pump.
 - c Fit a weight to the pipe from the auxiliary pump or fix the pipe to a solid and heavy body which does not vibrate.
 - d Use a high flexibility tube.
- 3) Oil steam for an auxiliary pump might have possibility to enter into the STP pump and pollute the rotor and stator of the STP pump depending on the kind of the auxiliary pump. Or strong counter flow of oil stream may disturb the normal rotation of the rotor because of the viscosity of oil.
To prevent counter flow of oil steam, the following methods are recommended.
 - a Mount a vacuum valve between the absorption port of STP pump and its auxiliary pump.
 - b Mount an absorption trap near the valve described above.

1-4-5 Connection of an emergency electromagnetic valve

This valve introduces gas and stops the rotating body in case that same abnormality might occur in the STP pump. Fit an electromagnetic valve (a standard accessory, KF10) to the emergency electromagnetic valve fitting port as shown in Fig. 5. Fit the side on which the filter is not set to the port. Connect the cable fitted to the emergency electromagnetic valve to the LEAK VALVE portion of the control unit.

- Note :
1. DO NOT fail to fit the emergency electromagnetic valve.
 2. Make gas pressure under + 0.5 atmospheric pressure

1-4-6 Connection of a purge port (In case of the STP-2001C [Chemical type])

Never fail to introduce dry N₂, purge gas to protect the STP-pump inside, if you use active or corrosive gas.

From the purge port through the electromagnetic valve and a needle valve as shown in Fig. 5.

The gas purge amount of about 20 SCCM is an appropriate one.

1-4-7 Grounding the STP pump

As the STP pump is not grounded between the pump unit and the control unit, please ground on the system side.

Note : DO NOT apply voltage exceeding 500V to the STP pump.

1-4-8 Environmental conditions

- 1) Use the pump at the temperature ranging from 0°C to 40°C.
- 2) DO NOT apply acceleration over 1G to the STP pump and the system.
- 3) Keep the STP pump away from a heating source or set a heat sealed board to prevent over heating of the pump.
- 4) DO NOT use the pump where it is exposed to a strong magnetic field, an electric field or radiation (150 Gauss in vertical direction and 30 Gauss in horizontal direction to the STP pump at maximum).
- 5) Take care of the direction of the STP pump, considering foreign matter penetrated into the pump when fitting the pump to the system (example : Si wafer or samples above the pump), or set a sealed board above the pump.
When setting a sealed board, make the conductance large enough.
- 6) DO NOT introduce corrosive gas into the STP-2001 (standard). Though any chlorine gas can be used in the STP-2001C, contact us if you plan to use any other kinds of gases (Ga or HBr). Also contact us if you plan to use the STP-2001/2001C for receiving radioactive rays.

Note : There is no mechanical contact between the rotor and the protective dry bearing in normal state. However, vibration from outside (by movements of people, earthquakes etc.) may come into contact. Contact noise will stop some seconds later. There is no problem.

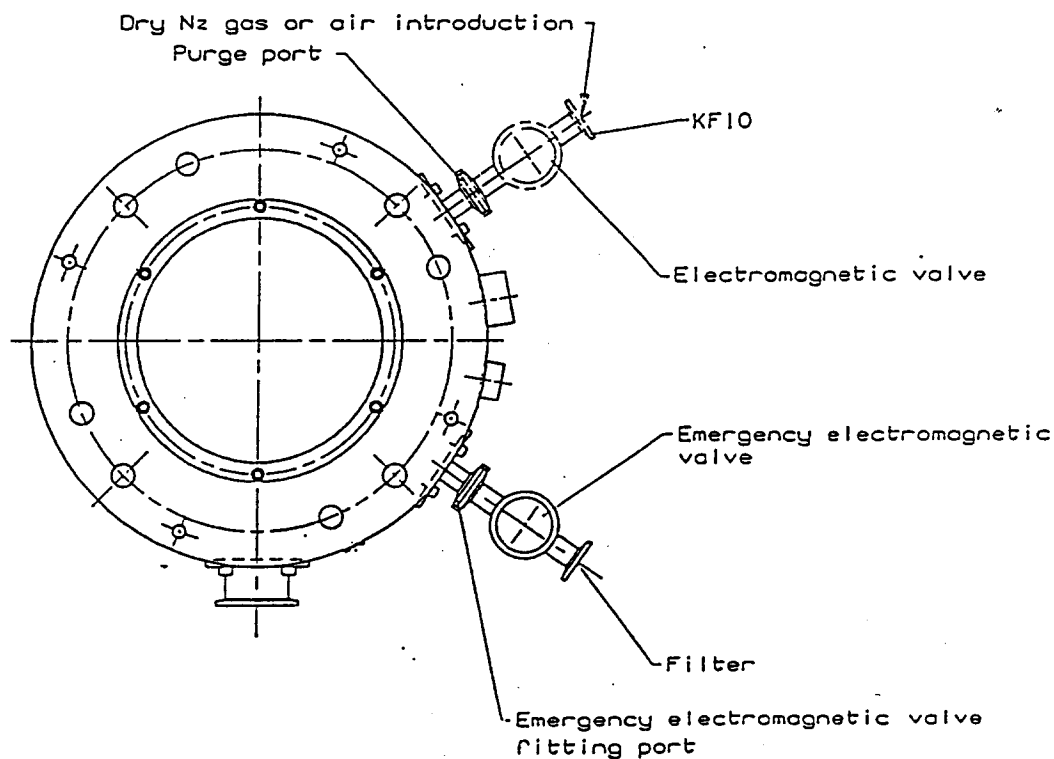


Fig. 5. Connection of the purge port and emergency electromagnetic valve

1-5 Storage

1-5-1 Storage of the STP pump unit

When stopping operation of the STP pump for a long time (more than several months), follow the instructions described below:

- 1) Close the absorption port flange of STP pump, and vacuum the pump by using its auxiliary pump.
- 2) Purge dry N₂ or dry air from the purge port.
- 3) Close the exhaust port flange and the purge port.
- 4) Stand the STP pump vertically.
- 5) DO NOT keep the STP pump in the places as described below:
 - Place where humidity is high. If the STP is stored in humid air, cut off air with a desiccant.
 - Place where corrosive gas exists.
 - Place where water splashes.
 - Place where the pump is exposed to dust.
 - Place where ventilation is no good.
 - Place where the pump is exposed to a strong magnetic field, electric field or radiation.

1-5-2 Storage of the STP control unit

When stopping operation of the STP control unit (including a cable) for a long time (more than several months), follow the instructions described below.

- 1) Remove the battery. For its method, see Section 7, "Internal Battery."
- 2) DO NOT keep the control unit in the places as described below:
 - Place where temperature is high.
 - Place where the control unit is exposed to direct sunlight, strong magnetic field, electric field, radiation, dust, a salt air, noise or vibration.
 - Place where corrosive gas exists.
 - Place where water splashes.
 - Place where ventilation is no good.

1-5-3 Notabilia on restarting after storage

- 1) In case that the STP pump is left for more than 4 months, recharge the batteries, with the rotor floated (Power ON condition) for one and half hour before operating the STP pump.
- 2) In case that the STP pump is left for more than 1 year, replace batteries before operating the STP pump.

2. INSTALLATION OF THE STP CONTROL UNIT

2-1 Name and function of each part

2-1-1 Front panel

- 1) Power ON/OFF switch (Illuminative push button switch/Lock-type/
Green LED)
 - When pressing the switch, the rotor floats.
 - At the same time, the lamp inside the button comes on.
 - In remote mode, rotor levitates if you push "MAIN POWER" switch ON without pushing this switch.

- 2) MOTOR START switch (Push button switch /Non-lock type/Black LED)
 - When pressing the switch, the rotor starts rotating only in manual mode.
 - At the same time, "ACCELERATION" lamp comes on.

- 3) MOTOR STOP switch (Push button switch / Non-lock type / Red LED)
 - When pressing the switch, the rotor begins to reduce the speed only in manual mode.
 - At the same time, "NORMAL OPERATION" lamp or "ACCELERATION" lamp goes out and "BRAKE" lamp comes on.
 - In case that the rotation speed does not attain 2000r.p.m. (When stopped immediately after starting, etc.), "BRAKE" lamp does not come on when "MOTOR STOP" switch is pressed.

- 4) HEATING ON/OFF switch (Illuminative push button switch / Lock type / Green LED)
 - When pressing the switch, the power is supplied to the baking heater, and baking of the pump unit is executed.
 - At the same time, the lamp installed inside the button comes on.
 - This switch operates only in "NORMAL OPERATION" state (See Section 6, "Remote I/O Signal Terminal Table" for details).

- 5) NORMAL OPERATION lamp (Green LED)
 - This lamp comes on during the rated rotation ("NORMAL OPERATION" state).

6) **ACCELERATION lamp (Green LED)**

- This lamp comes on during the acceleration operation.

7) **BRAKE lamp (Yellow LED)**

- This lamp comes on when the rotation speed is reducing.

8) **OVER TEMPERATURE lamp (Red LED)**

- This lamp comes on in case of the following abnormalities:
 - a. Overheating of the motor and the electromagnet (more than 115°C)
 - b. Failure in connection of STP cable

9) **BATTERY OPERATION lamp (Red LED)**

This lamp is come on when the power is supplied from the battery at the time of power stoppage.

10) **FAILURE lamp (Red LED)**

- This lamp comes on in case of the following abnormalities:
 - a. Overheating of the control unit more than 90°C at heat sink portion.
 - b. Overheating of the motor and the electromagnet more than 115°C.
 - c. Overload of the inverter.
 - d. Deterioration of the battery.
 - e. Power failure.
 - f. Failure in connection of STP cable.

11) **EMERGENCY OPERATION lamp (Red LED)**

- This lamp comes on in case of the following emergencies:
 - a. Power failure.
 - b. Successive vibrations or impact which bring the rotor into contact with the protective dry bearing.
 - c. Failure in connection of STP cable.

12) ROTATION meter (meter for the number of rotations)

- The indicator moves to the black side as the temperature rises.
- In rated rotation, the indicator is positioned on the black side.

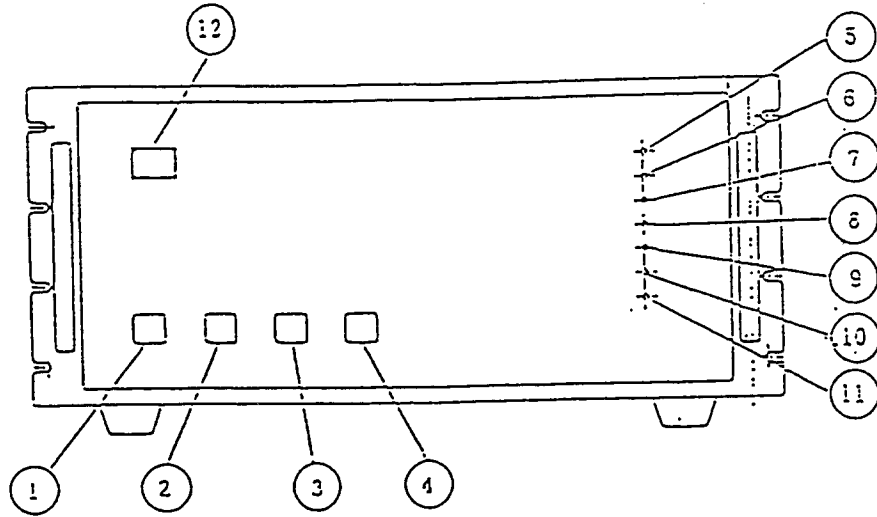


Fig. 6 Front panel of the control unit

2-1-2 Rear panel

13) AC POWER terminal table

- This table is used for the power (primary side).

Note : DO NOT cut the power (primary side) during the rotation of the rotor except for power failure.

14) P.CONNECTOR

- This connector is used for the STP connecting cable.

15) Emergency electromagnetic valve switch

- This switch opens and closes the emergency electromagnetic valve in manual operation.
- When pressing the button in case that the number of rotations of the rotor is more than 1000 r.p.m., the valve opens, and when releasing the button, the valve closes.

Note : In case that the pressure of the STP pump inside is sharply increased, the rotor may vibrate and contact the protective dry bearing. NEVER use this emergency electromagnetic valve switch except emergency use.

16) LEAK VALVE connector

- This connector is used for the cable of the emergency electromagnetic valve.

17) DC I/O TB3

18) I/O TB2,

21) START/STOP TB5,

23) START/STOP TB6 terminal table

They are for the remote operation.

19) INVERTER OUTPUT connector

- This connector is used for the motor connection cable.

20) MAIN POWER switch

- This switch turns ON/OFF the power.

Note : DO NOT turn OFF the main power while the rotor is rotating.

22) MANUAL/REMOTE switch

- START/STOP is possible only by the START switch on the front panel while this switch is turned MANUAL.
- START/STOP is possible only by the remote signal while this switch is turned REMOTE.

24) EXT. BATTERY connector

- This connector is used for the external battery.
- Connect (+) to pin 1 of the attached plug and (-) to pin 2.

2-1-3 Control unit inside

25) Inverter

- This is a 3-phase transistor inverter to rotate and stop the rotor.

26) Fuses F3~9, 11 and 12

- F3, F4 ... 250V, 5A
- F5, F6, F7, F8, F9 ... 250V 10A
- F11, F12 ... 250V, 0.1A

27) Control board

- This board controls the magnetic bearing, the motor and the safety functions.

28) Battery

- This battery supplies the power to the magnetic bearing in case of power failure.

29) Cooling fan

- This fan cools the control unit inside.

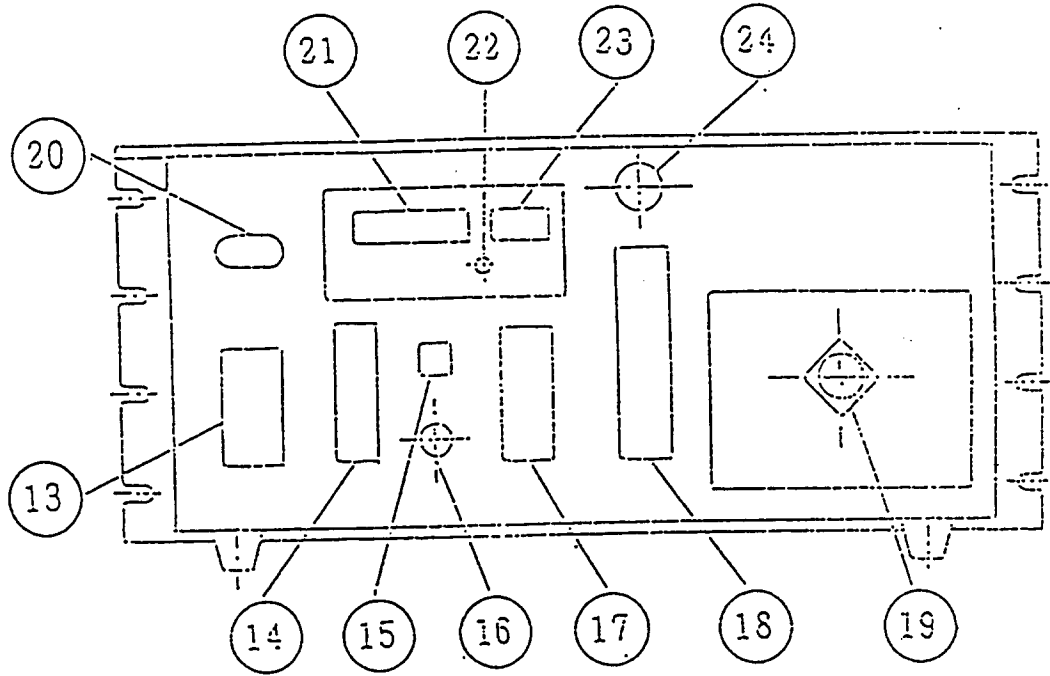


Fig. 7 Rear panel of the control unit

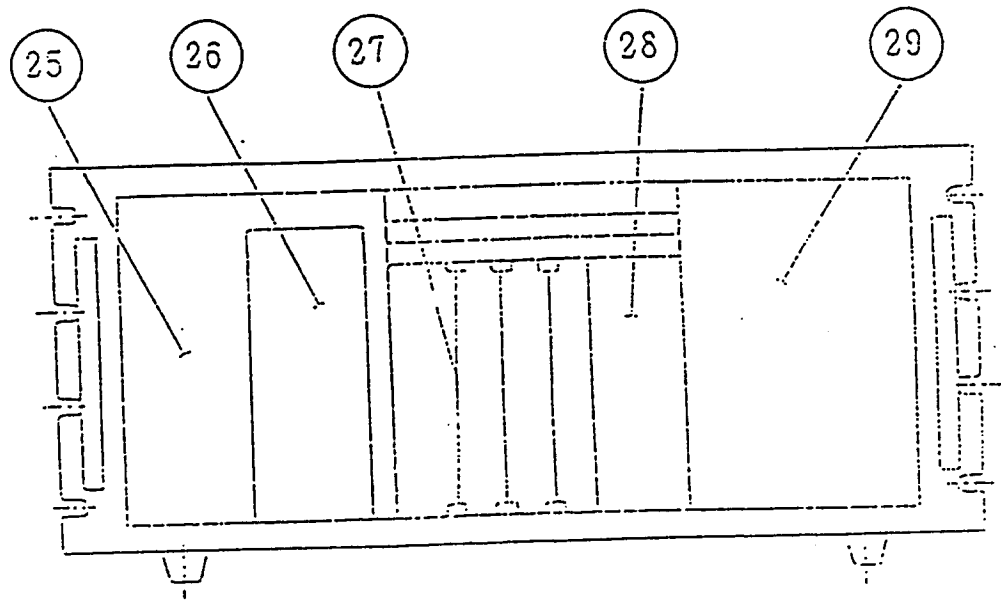


Fig. 8 Control unit inside

2-2 INSTALLATION CONDITIONS ON RACK

2-2-1 Environmental conditions

- (1) DO NOT put the control unit in the conditions as described below:
 - a. High temperature.
 - b. The unit is exposed to direct sunlight.
 - c. High humidity.
 - d. Explosive gas or inflammable gas exists.
 - e. The unit is exposed to a strong magnetic field or electric field.
 - f. Ill-ventilation
 - g. Salt air blows.
 - h. The unit is exposed to dust.
 - i. Water drops.
 - j. Noisy or vibration is severe.
 - k. The unit is exposed to radiation.
- (2) Set up the control unit horizontally (within $\pm 10^\circ$)

2-2-2 Installation conditions

The front panel of the STP control unit can be installed on the commercially -available rack whose size conforms to JIS. Follow the instructions below when installing the control unit on the rack:

- (1) Whole weight of the unit cannot be supported by the installing screws. Support the unit also by the portion of rubber legs.
- (2) Remove the rubber leg on the bottom surface and install it on the rack using the screw hole for installing the rubber legs. Refer to Fig. 21 for the position of the screw hole.
- (3) Screw the front panel on the rack. Protect the control unit and the rack from damage by pushing them from left and right sides as shown in Fig. 9.

- (4) The control unit inhales and exhales cooling air from the upper, lower and side faces. **DO NOT** prevent air flow taking a space of more than 2cm between each face and the wall, etc.
- (5) **DO NOT** bend the cables taking the space of more than 15cm between the rear face of the control unit and the wall.

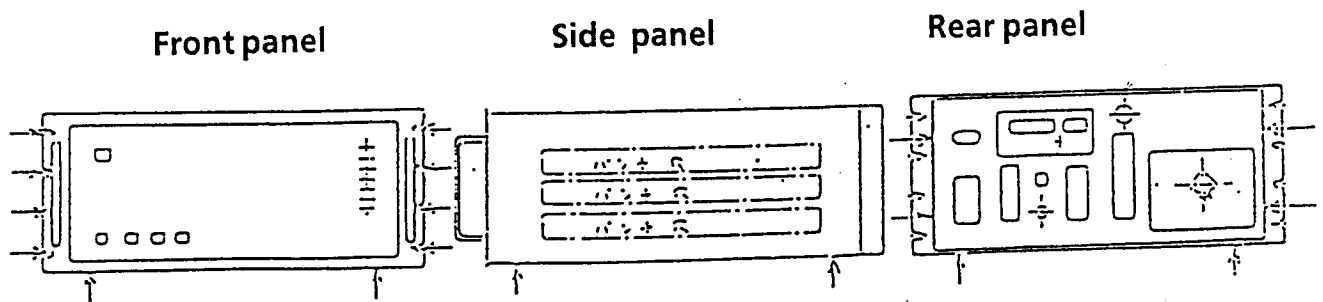


Fig. 9 Fixing positions of the control unit

2-2-3 Connection of the cables

Identify the number on the name plate of the STP pump with that on the plate of the control unit.

(1) Connection of the connecting cable

Connect the connecting cable to the MB connector of the STP pump and to "P CONNECTOR" portion on the rear panel of the control unit.

(2) Connection of the motor connecting cable

Connect the motor connecting cable to the motor connector of the STP pump and to "INVERTER OUTPUT" portion on the rear panel of the control unit. Ensure that each connector is locked firmly.

- Notes:
1. **DO NOT** apply voltage to the connector or shortcircuit it.
 2. **DO NOT** pull off the cable connectors during the rotation of the pump or when the control unit is turned ON.

(3) Connection of the power (primary side) cable

Connect the power cable to "AC POWER" of the rear panel as the table on the next page

Table 1 Connection of the power cable (primary side)

Pin No.	Color of the cable	Application
1	Black	200 to 240V \pm 10% 50 / 60Hz
2	White	200 to 240V \pm 10% 50 / 60Hz
3	Green	Grounding

- Notes:
1. DO NOT apply a surge voltage exceeding 1kV to the power cable line.
 2. When the ground line of the power cable is not used, connect one of the ground terminals on the rear panel of the control unit to the ground terminal in the building for safety. When using both of a ground line of the power cable and a ground terminal in the building, external noises are apt to be picked up. Connect only one of them.

3. START/STOP

3-1 Check before START

When installation of the STP pump, piping, leakage test and installation of the control unit are completed, the STP pump starts its operation. Check the following points before starting the pump:

- (1) Nos. on the name plates of the STP pump and the control unit are identified.
- (2) The power cable is connected to the power.

- (3) The connection cable, the motor connecting cable are securely connected and the connector is securely locked.
- (4) Selection of the power voltage is proper.

Note: If the variation of the voltage exceeds the allowable value, use a stable power source.

3-2 START/STOP time

START time: About 7 minutes after the rotor starting operation.

STOP time: About 7 minutes after the rotor stopping operation.

If the rated number of rotations is not attained within about 30 minutes, "FAILURE" lamp comes on. Start again after checking leakage from the piping and the chamber, the capacity of the auxiliary pump, etc.

3-3 Manual operation

Turn MANUAL/REMOTE switch on the rear panel "MANUAL."

3-3-1 Rotor floating operation

- (1) Turn two brakers on the rear panel ON.
- (2) When pressing the POWER switch, the magnetic bearing operates and the rotor floats.
- (3) The light built in the POWER switch comes on.

3-3-2 Rotor rotating operation

- (1) When pressing the MOTOR START switch after the rotor floats, the rotor starts rotating.
- (2) At the same time, "ACCELERATION" lamp comes on.
- (3) When the rotor attains the rated rotation, "ACCELERATION" lamp goes out and "NORMAL OPERATION" lamp comes on.

3-3-3 Rotor STOP operation

- (1) When pressing MOTOR STOP switch during acceleration of the rotor or the rated rotation, the rotor begins to reduce its speed by the electromagnetic brake.

Note: In case that the number of rotations is less than 2000 r. p. m. during acceleration, "BRAKE" lamp does not come on when pressing MOTOR STOP switch.

3-3-4 Rotating operation after the rotor STOP operation

During deceleration, the rotor can be accelerated again (see the procedures described in Section 3-3-2 "Rotor Rotating Operation").

3-3-5 Rotor lowering down operation

(1) *In case that "BRAKE" lamp comes on:*

a. Turn the power switch OFF by pressing and releasing it. The operation of the magnetic bearing stops and the rotor lowers down onto the protective bearing.

b. At the same time, the lamp built in the POWER switch goes out.

(2) *In case that one of "ACCELERATION" lamp, "NORMAL OPERATION" lamp and "BRAKE" lamp comes on:*

a. The rotor does not lower down and continues to rotate even when turning OFF the POWER switch by pressing and releasing it.

b. The lamp built in POWER switch does not go out.

c. When executing the rotor STOP operation in the state above, the rotor lowers down automatically when "BRAKE" lamp goes out.

Note: The brake stops at the number of rotations of 100 r. p. m. and "BRAKE" lamp goes out. After that, the rotor continues to rotate by inertia moment. When executing the rotor lowering down operation immediately after "BRAKE" lamp goes out, you hear the sound that the rotor and the protective bearing come into contact each other. This is not a problem. Repetition of such usage, however, causes wear of the protective bearing. Preferably, lower down the rotor after the rotor completely stops.

3-4 Remote operation

(Please execute remote operation after reading Section 6 "Remote I/O Signal Terminal Table").

(1) Turn MANUAL/REMOTE switch on the rear panel "REMOTE."

- (2) If a thermal switch connection terminal (R. P. THER.) for the protection of a rotary pump is not used, shortcircuit between terminals 3 and 1 of I/O TB3 terminal table.
- (3) If a rotation inhibit signal input terminal is not used, shortcircuit between terminals 7 and 5.

3-4-1 Rotor floating operation

When turning two brakers on the real panel ON, the magnetic bearing operates and the rotor floats.

3-4-2 Rotor rotating and stop operations

The rotor rotates and stops according to the following 3 kinds of rotor rotating and stop methods . Select one of them.

Table 2 Rotating and stop operations of the rotor in remote operation

	Terminal table	Rotation of the rotor	Stop of the rotor operation
Method 1	START/STOP TB5 terminal table	Shortcircuit between STOP signals (STOP IN) 3 and 2. Then shortcircuit between START signal terminals (START IN) 2 and 1 for 0.3 seconds. When you input this signal just after turning ON the braker on the rear panel, shortcircuit more than 5 seconds.	Open between the STOP signal terminals (STOP IN) 3 and 2.
Method 2	START/STOP TB5 terminal table	Shortcircuit between 3 and 1.	Open between 3 and 1.
Method 3	START/STOP TB6 terminal table	Apply AC 25V to AC250V or DC24V to 48V between START/STOP signal terminals 2 and 1.	Open between 2 and 1.

3-4-3 Rotating operation after the rotor STOP operation

The rotor can be accelerated again even during deceleration for the rotor by the rotor rotating method described above.

3-4-4 Rotor lowering down operation

- (1) When turning the braker on the rear panel OFF with the "BRAKE" lamp on the front panel OFF, operation of the magnetic bearing stops and the rotor lowers down onto the protective bearing.
- (2) When turning the braker on the rear panel OFF with "BRAKE" lamp on the front panel ON, the rotor operates by the batteries in "BATTERY OPERATION" state.

- Notes:
1. Refer to Section 4-1 "Power failure."
 2. The brake is released at the number of rotations of 1000 r. p. m. and "BRAKE" lamp goes out. Thereafter, the rotor continues to rotate for some time by inertia moment. When executing the rotor lowering down operation immediately after "BRAKE" lamp goes out, the rotor and the protective bearing come into contact each other due to noise. This is not a problem. Repetition of such usage, however, causes wear of the protective bearing. Preferably, lower down the rotor after it stops completely.

3-5 STOP operation

Close the vacuum valve immediately after STOP operation of the rotor. When closing the valve, the auxiliary pump can stop at will.

DO NOT stop the auxiliary pump first because the counter current of oil from the auxiliary pump may generate.

Note: DO NOT execute connection/disconnection of the connection cable, the motor connection cable or the power cable on the primary side and stop operation of the power source on the primary side during the rotation of the rotor.

4. SAFETY FUNCTIONS IN CASE OF ABNORMALITIES

The STP-2001/2001C is provided with various safety functions for emergencies (refer to Table 5, page 35 "Safety Functions")

4-1 Safety functions

4-1-1 Power failure

In case that the power voltage falls under 170V due to power failure, etc. the power is supplied from the batteries built in the control unit and the magnetic bearing continues to operate.

- (1) When the power failure time exceeds 2 seconds, "BATTERY OPERATION" state is entered and the speed of the rotor is reduced by the electromagnetic brake. At the speed of about 4000 r. p. m., gas is introduced from the emergency electromagnetic valve, and at 2000r. p. m., it lowers above the protective bearing and the rotor stops.
- (2) When the power failure time does not exceed 2 seconds, "BATTERY OPERATION" state is not entered and the rotor floats and continues

to rotate. In "BATTERY OPERATION " state, "BATTERY OPERATION" lamp, "FAILURE" lamp, "EMERGENCY OPERATION" lamp come on in both MANUAL and REMOTE operations. 10 to 9 of " ALARM" of I/O TB2 terminal table is electrically conducted and 10 to 11 is shut. Refer to Table 3 in case of manual operation and Table 4 in case of remote operation for the relationship among the power failure time, the power recovery time and the operation state of the STP pump after the power failure.

(1) In case of manual operation:

Table 3 Operation at the time of the power recovery

Power failure time	At power recovery		After power recovery		State of "BATTERY OPERATION", "FAILURE" AND "EMERGENCY OPERATION"
	Rotation of the rotor	"POWER" switch position	Floating of the rotor	Acceleration / deceleration of rotor	
More than 2 seconds	Lowers down after deceleration and stops Deceleration	"ON"	Refloating	Remains stop	Comes on in case of power failure, and goes out in case of rotor lowering down.
		"OFF"	Does not refloat	Remains stop	
		"ON"	Continues floating	Deceleration and stop	
		"OFF"	Lowers down at about 2000 r. p. m.	Deceleration and stop	
Less than 2 seconds	Floating and rotation	"ON"	Continues floating	Continues rotation	Does not come in

(2) In case of remote operation:

Table 4 Operation at the time of the power recovery

Power failure time	At power recovery		After power recovery		"ALARM" remote signal (I/O TB2 terminal table)
	Rotation of the rotor	"MOTOR START" remote signal	Floating of the rotor	Acceleration / deceleration of the rotor	
More than 2 seconds	Lowers down after deceleration and stops	Generates Does not generate	Refloating Does not refloat	Remains stop Remains stop	From power failure through power recovery 10 to 9: conducted, 10 to 11: interrupted
	Deceleration	Generates Does not generate	Continues floating Lowers down at about 2000 r. p. m.	Deceleration and stop Deceleration and stop	From power failure through power recovery 10 to 9: conducted, 10 to 11: interrupted
Less than 2 seconds	Floating and rotation	Generates	Continues floating	Continues rotation	- ditto -

4-1-2 Abnormality of the magnetic bearing

When the magnetic bearing malfunctions due to disconnection of the STP connection cable, disconnection of the connector or abnormality in the control circuit, the rotor lowers down and is supported by the protective bearing. Next, the emergency electromagnetic valve opens, gas is introduced, the rotor speed decelerates and the rotor stops. At the same time, "EMERGENCY OPERATION" lamp comes on.

Note: In case of the above abnormality, contact us for the check of the STP pump and the STP control unit.

4-1-3 Excessive vibrations

When the rotor vibrates so hard by external vibration, shock, air blown into the STP pump that the rotor comes into contact with the protective bearing, gas is introduced from the emergency electromagnetic valve, the rotor speed decelerates and the rotor stops. At the same time, "EMERGENCY OPERATION" lamp comes on.

4-1-4 Overload of the inverter

The inverter stops its operation and then continues rotating by inertia moment in case that the number of rotations is not attained within 30 minutes after getting started or in case that 30 minutes passed in the "ACCELERATION" state during the rotation. "FAILURE" lamp comes on. Leakage from the system or the piping and pressure failure in absorption and exhaust port sides cause such a trouble. Eliminate the cause and start the inverter again.

4-1-5 Overheating of the pump

In case that the temperature of the pump inside exceeds 115°C due to an abnormal baking temperature or an excessive load operation, the rotor speed is reduced and the rotor stops its operation by the electromagnetic brake. "OVER TEMPERATURE" and "FAILURE" lamps come on.

4-1-6 Overheating of the control unit

In case that the temperature of the heat sink in the control unit exceeds 90°C due to a trouble of the cooling fan or an external heating source, the rotor speed is reduced and the rotor stops its operation by the electromagnetic brake. "FAILURE" lamp comes on.

4-1-7 Excessive speed of the rotor

In case that the number of rotations of the rotor exceeds 29,000 r. p. m. due to a trouble of the inverter, the rotor speed is reduced and the rotor stops by the electromagnetic brake. "FAILURE" lamp comes on.

4-1-8 Abnormal battery voltage

In case that the battery voltage is less than 42V due to deterioration of the battery or connection failure when the power is turned ON, the rotor does not rotate by pressing the MOTOR START switch. "FAILURE" lamp comes on. In this case, "EMERGENCY OPERATION" lamp may come on.

Note: If the battery connection connector is pulled off after getting started, the failure in the battery voltage is not detected. DO NOT pull off the connection connector of the connection cable after getting started.

4-1-9 Trouble of the electromagnetic brake

In case that power failure occurs during the operation of the STP pump, "BATTERY OPERATION" state is entered and the electromagnetic brake operates. If the brake is defective, the emergency electromagnetic valve opens and the rotor is forced to stop.

4-2 Restarting after safety functions operate

- (1) *In case that "EMERGENCY OPERATION" lamp comes on when power failure does not occur:*

Go out "FAILURE" lamp by turning the power OFF by pressing the OFF button. The rotor continues rotating by inertia moment. Press the MOTOR STOP button after pressing the MOTOR START button. Then the rotor stops. Eliminate the cause of the failure and press the MOTOR STOP button. The rotor starts again.

4-3 Notabilia on operation of the emergency electromagnetic valve

- (1) The emergency electromagnetic valve opens about 1 second after failure in the magnetic bearing or excessive vibration occurs.
- (2) It is recommended to introduce N₂ gas for preventing pollution of the STP pump and the system. Set gas pressure to less than atmospheric pressure + (plus) 0.5 atmospheric pressure.
- (3) When the rotor rotates, with the emergency electromagnetic valve open for a long time, the rotor in high speed rotation comes into contact with dry bearing. Both of them may be broken. The rotor stops within a short time, and breakage is prevented by using a

vacuum exhaust system which stops the rough pump when the emergency electromagnetic valve opens.

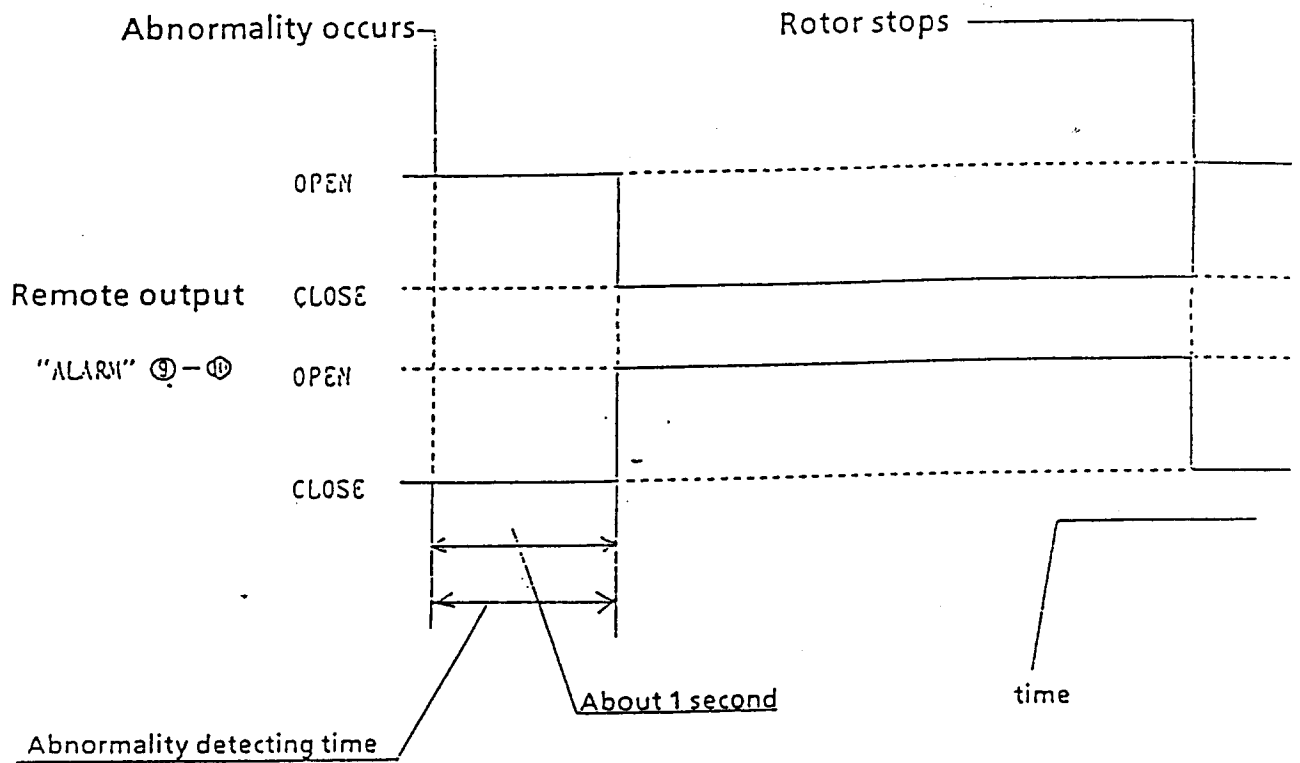


Fig. 10 Operating timing of emergency electromagnetic valve

Table 5 Safety Functions

Note 1: Refer to the Tables 2, 3 for the details in case of power failure.

Item	Operating conditions	Lamp display	Remote output signal	Pump condition	Cause
Power failure Note 1	* Power failure for more than 2 seconds	"BATTERY OPERATION" "EMERGENCY OPERATION"	"ALARM"	* Continues floating by battery * Deceleration by the electromagnetic brake * Lowers down onto the protection bearing at 2000r.p.m. and stops	* Power failure * Disconnection or dislocation of the power cable.
Abnormality in the magnetic bearing	* The rotor lowers down onto the protection dry bearing	"EMERGENCY OPERATION"	"ALARM"	* Deceleration and stop due to opening of the emergency electromagnetic valve	* Disconnection or dislocation of the cable * Abnormality in the control circuit
Excessive vibration	* The rotor continues vibration of more than 100 μ m for more than 1 second	"EMERGENCY OPERATION"	"ALARM"	* Deceleration and stop due to opening of the emergency electromagnetic valve	* External vibration or shock. * Air or foreign matter into the pump.
Overload of the inverter	* Inverter current exceeds 40A for an instant or 11.5A for more than 100 minutes	"FAILURE"	"ALARM"	* Stop of the inverter rotation by inertia moment	* Leakage of the vacuum piping * Failure in selecting an auxiliary pump

Item	Operating conditions	Lamp display	Remote output signal	Pump conditions	Cause
Overheating of the pump	* Motor more than 115°C	"OVER TEMPERATURE" "FAILURE"	"ALARM"	* Deceleration and stop by the electromagnetic brake	* Overbaking temperature * Insufficient cooling * Leakage of the vacuum piping * Repetition of START/STOP
Overheating of the control unit	* Heat sink of the controller : more than 90°C	"FAILURE"	"ALARM"	* Deceleration and stop by the electromagnetic brake	* Breakdown of the cooling fan * Close of in- and outlet for cooling
Excessive speed of the rotor	* The number of rotations : more than 29000r.p.m.	"FAILURE"	"ALARM"	* Deceleration and stop by the electromagnetic brake	* Breakdown of the inverter
Abnormal battery terminal voltage	* HBattery terminal voltage : less than 42V	"FAILURE"	"ALARM"	* The motor does not rotate	* Deterioration or failure in connecting the battery

5. BAKING, LOAD GAS INTRODUCTION AND COOLING

5-1 Baking

Baking of the equipment and the STP pump is required to attain a lower pressure or to shorten the exhaust time.

5-1-1 Mounting the baking heater

Mount the baking heater near the absorption port flange.
Refer to Fig. 11 for the mounting position.

5-1-2 Notabilia on baking

Take note of the following:

- (1) Be sure to cool the STP pump to prevent it from overheating by baking.
- (2) Start the baking after the cooling of the STP pump has started. Set the temperature of the baking heater at below 120°C.
(The baking heater, a special accessory, is set to below 120°C.)
- (3) To exhaust the gas emitted from the equipment and the inner wall of the STP pump, the STP pump should be operated during the baking.
- (4) Because the surfaces of the heater and the outer casing are extremely hot, do not touch them with bare hands when you use them.

5-2 Load gas introduction

Take note of the following:

- (1) Never fail to cool down the STP-pump, if you introduce load gas. Cooling is necessary when baking the STP-pump.
 - (2) The gas of chloride system is available, but when using the other gases (such as gallium or HBr), please contact us.
 - (3) When a corrosive gas flows, purge the gas with dried N₂ gas or the like after stopping the STP pump (20sccm).
- * Note : Any noise may generate from protection dry bearing when the pressure of the absorption port is high. However, this is no problem.

5-3 Cooling

The STP pump should be cooled in case of baking or introducing a load.

5-3-1 Connection of an air-cooling unit for cooling (a special accessory)

Connect an air-cooling unit as shown in Fig. 11.
Remove the rubber covers and screw the bolt into the screw hole of the legs.

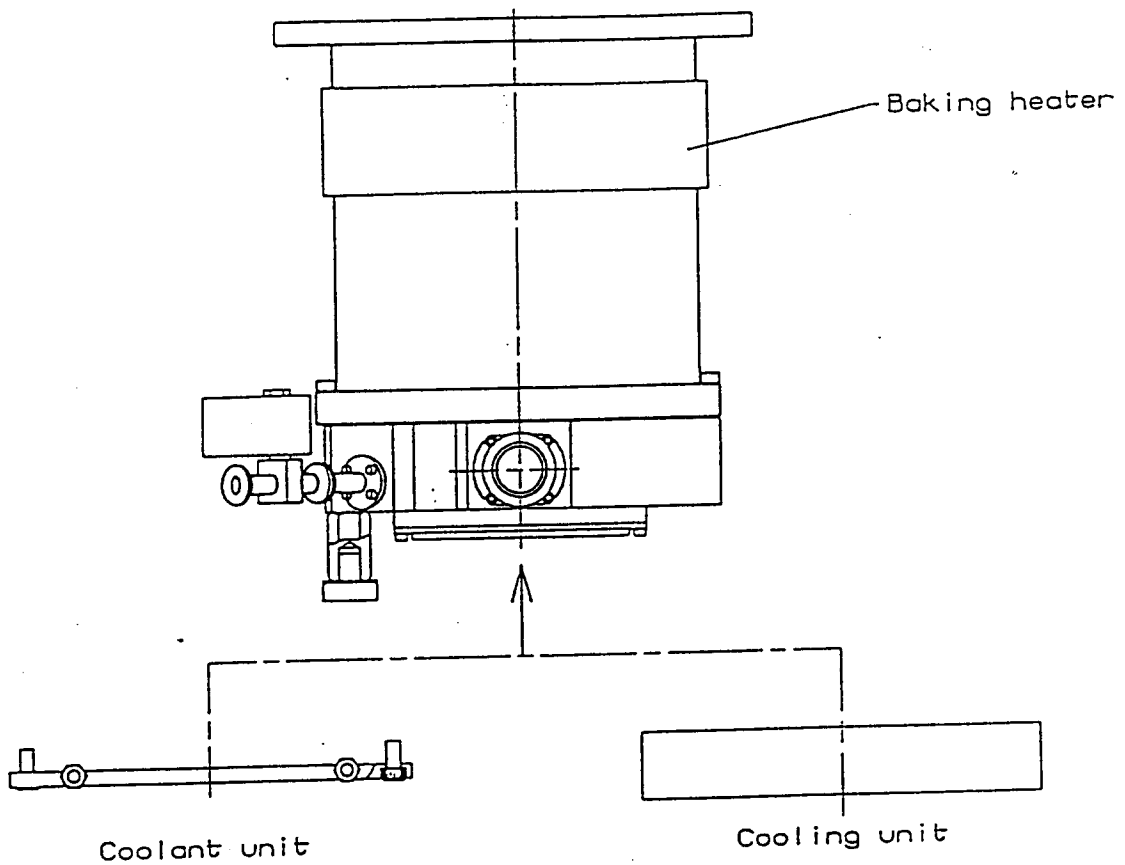


Fig. 11 Baking and cooling

5-3-2 Connection of piping for coolant

Connect a piping for coolant, referring to Fig. 11.

Amount of water: 2ℓ/min.

Temperature: 5 to 25°C

Water pressure : Below 3kg/cm²

* Notes :

- (1) Use the connection hose whose inner diameter is 8mm and fix it securely to prevent a water leak.
- (2) When the hose nipple (body side) is removed, PT1/4 female screw appears.
- (3) Use water as clean as possible for coolant.

If coolant system is clogged with foreign substances and does not flow, bottom up the water port. It may be occasionally recovered.

- (4) If the STP pump is heated due to lack of flow rate or suspension of water supply, the rotation is stopped by the protective function of the STP pump. For safety, however, set a flow switch on the way to coolant outlet and stop the rotation of the STP pump when something is wrong with coolant. (Flow switch is commercially available).
- (5) If the pump is not used for a long time or is moved after the use, introduce the compressed air or the like from coolant in- or outlet port to empty the water inside of the pump.

6. REMOTE I/O SIGNAL TERMINAL TABLE

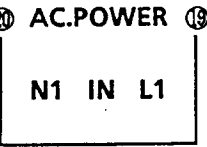
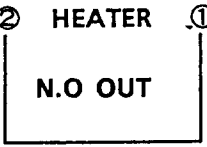
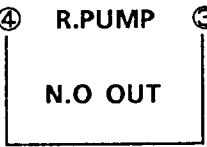
6-1 I/O TB2 Terminal table

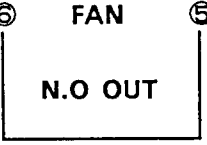
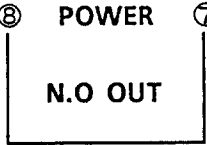
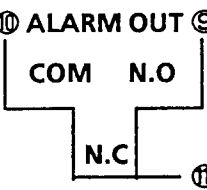
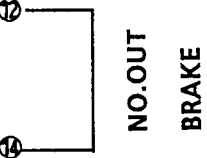
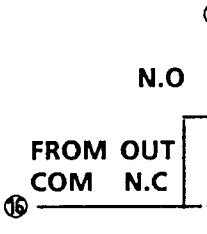
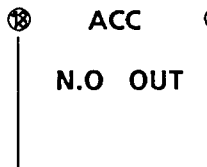
A terminal table for remote output signal. Use the table, referring to Table 6 and Fig. 12.

The terminal table operates both in manual and remote operations.

In the Table, N.O. denotes normal open, N.C.: normal close, COM: common, IN: input terminal, and OUT: output terminal.

Table 6 I/O TB2 Terminal Table

Terminal	Application
	<p>A power source input terminal for a baking heater, rotary pump and air-cooling fan.</p> <p>The voltage supplied to the terminal is output to a given terminal table by operating the STP pump.</p>
	<p>A terminal for connecting the baking heater.</p> <p>The voltage input to the AC. POWER terminal (20 - 19) is output at this terminal by the following two operations in the NORMAL OPERATION state:</p> <ol style="list-style-type: none"> (1) Turn ON the HEATING switch at the front panel by manual operation. (2) Shortcircuit the DC I/O TB3 HEATING terminal (2 - 4) by remote operation. <p>* Note: (1) or (2) is selected by MANUAL/REMOTE change-over switch.</p>
	<p>A rotary pump starting terminal for rough vacuuming.</p> <p>The voltage input to the AC POWER terminal (20 - 19) is output at this terminal by rotor rotating operation.</p> <p>When the rotary pump is used, DO NOT directly connect to this terminal but use another power source and relay. Refer to Fig. 13.</p> <p>* Note: When DC I/OTB3 THER terminal (1 - 3) is opened, the judgement that any defect by the rotary pump is found. As a result, FAILURE lamp comes on and the output from this terminal is interrupted.</p>

Terminal	Application
	<p>A terminal for connecting the air-cooling fan.</p> <p>The voltage input to the AC. POWER terminal (20 - 19) is output at this terminal by rotor rotating operation.</p> <p>The terminal is interrupted when the rotor stops.</p>
	<p>An output terminal of the POWER ON state signal.</p> <p>This terminal is electrically conducted in the POWER ON state (the state POWER switch is pressed in).</p>
	<p>An output signal for the abnormal state signal.</p> <p>When any abnormality is detected in the POWER ON state, the terminal between 10 and 9 is electrically conducted and the terminal between 10 and 11 is interrupted</p>
	<p>An output terminal for the STP pump braking state.</p> <p>This terminal is electrically conducted when the STP pump is in the BRAKE state.</p>
	<p>An output terminal for the STP pump NORMAL OPERATION state.</p> <p>When the STP pump is in the NORMAL OPERATION state, the terminal between 16 and 13 is electrically conducted and the terminal between 16 and 15 is interrupted.</p>
	<p>An output signal for the STP pump ACCELERATION state signal.</p> <p>When the STP pump is in the ACCELERATION state, this terminal is electrically conducted.</p>

I/O TB2 : Terminal table for the remote output signal

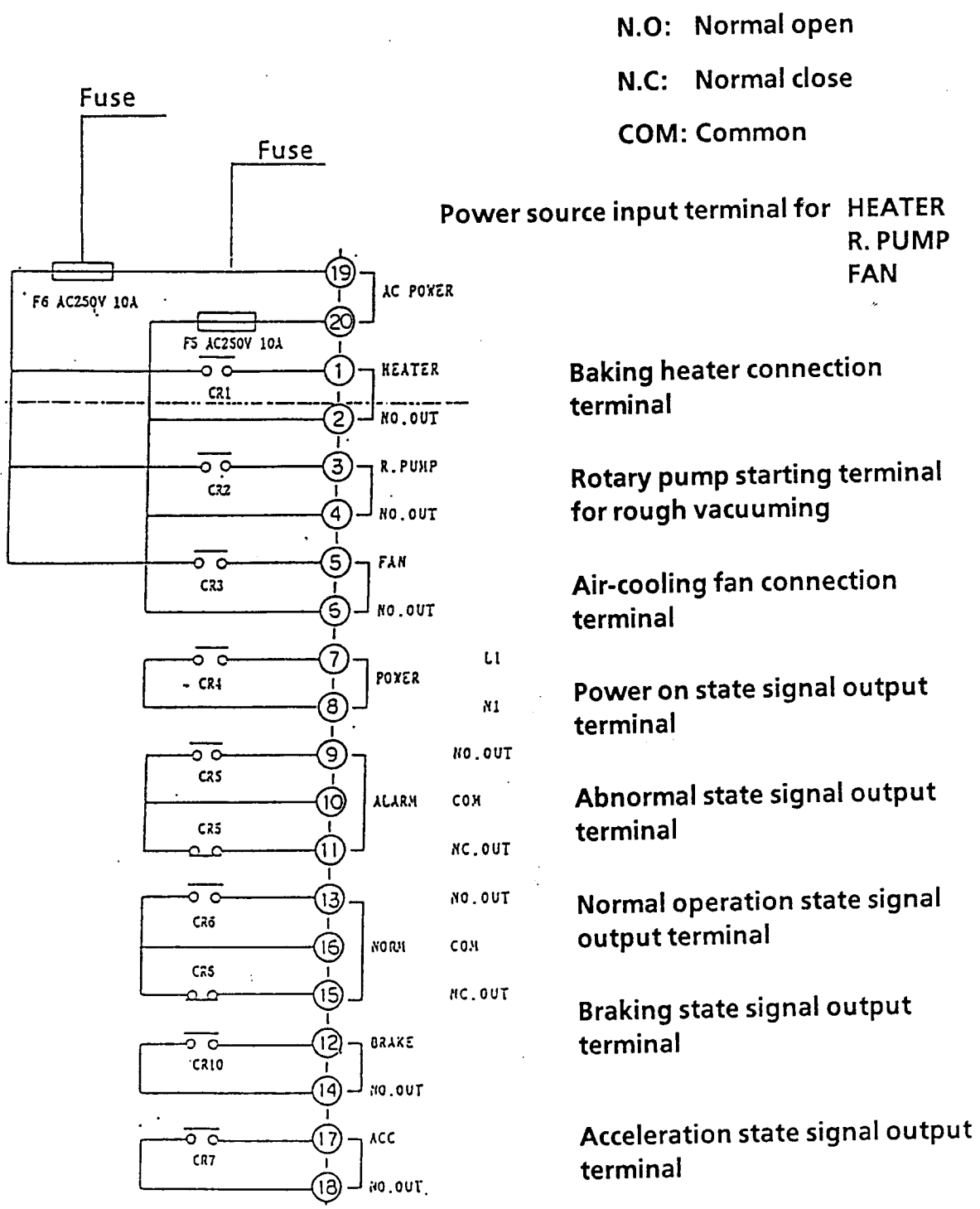


Fig. 12 I/O TB2 Terminal table for remote output signal

- Relays CR1 to CR4, CR7 and CR10 in Fig. 12 are G6C-1117P-US DC12V (manufactured by Tateishi Electric Co.). Relays CR5, CR6 are G2R-117P-V (DC12V)

Table 7 Rating of G2R-117P-V, G6C-1117P-US

Rated voltage	Rated current
DC12V	16.7mA

Table 8 Rating of the contact of G2R-117P-V, G6C-1117P-US

Rated load	Resistance load ($\cos \phi = 0.4$) ($\cos \phi = 1$)	Induced load (L/R = 7ms)
	AC250V 10A DC 30V 10A	AC250V 5A DC 30V 5A
Rated current	10A	
Maximum contact voltage	AC380V, DC125V	
Maximum contact current	10A	
Maximum switching capacity	2,500VA 300W	1,250VA 150W
Minimum available load (reference value of the P standard)	DC5V 10mA	

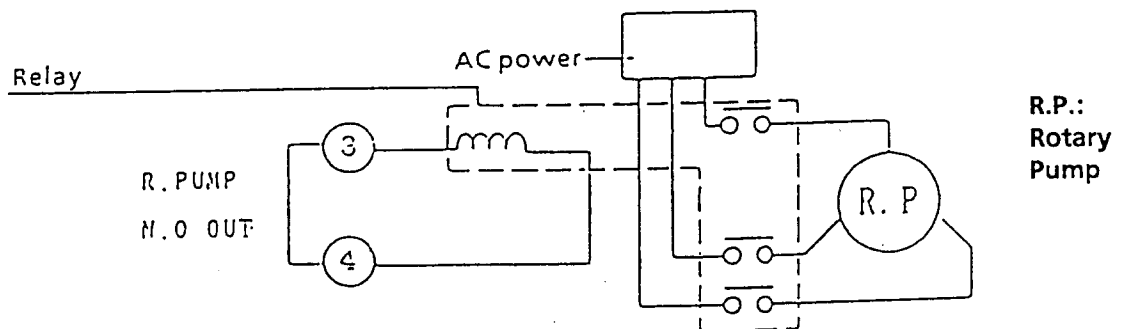


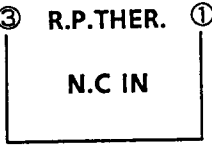
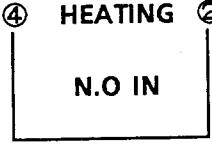
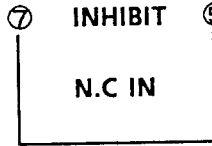
Fig. 13 Connecting method of R. PUMP terminal of I/O TB2

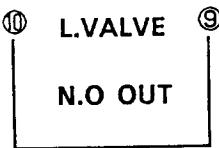
6-2 DC I/O TB3 Terminal table

A terminal table for remote in-and output signals. Use it, referring to the Table 9 and Fig. 14.

The terminals except for the HEATING terminal operate both in manual and remote operations.

Table 9 DC I/O TB3 Terminal table

Terminal	Application
	<p>A thermal switch connection terminal for protecting the rough vacuuming rotary pump.</p> <p>When the <i>normal close</i> type rotary pump protection thermal switch is connected between the terminals,</p> <p>(1) "Failure" lamp comes on when the thermal switch operates.</p> <p>(2) The output voltage of the I/O TB2 R. PUMP terminal (4 - 3) is interrupted to stop the rotor.</p> <p>When this function is not used, shortcircuit the terminal between 3 and 1.</p>
	<p>A remote control terminal for the baking heater.</p> <p>The voltage for baking heater is output to the I/O TB2 HEATER terminal (2 - 1) in the following states:</p> <p>(1) MANUAL/REMOTE change-over switch of the rear panel to the remote side</p> <p>(2) Shortcircuiting of the terminal between 4 and 2</p> <p>(3) NORMAL OPERATION state.</p>
	<p>An input terminal for rotation inhibit signal.</p> <p>When this terminal is opened, the STP pump does not rotate even by the rotor rotating operation, and only the rotary pump starting voltage is output at the I/O TB2 R. PUMP terminal (4 - 3).</p> <p>When this function is not used, shortcircuit the terminal between 7 and 5.</p>

Terminal	Application
 <p>⑩ L.VALVE ⑨ N.O OUT</p>	<p>An output terminal for emergency electromagnetic valve open signal.</p> <p>This terminal is electrically conducted when the emergency electromagnetic valve is operating.</p>
<p>⑥</p>	<p>A grounding terminal.</p>

DC I/O TB3 : Terminal table for remote input signal

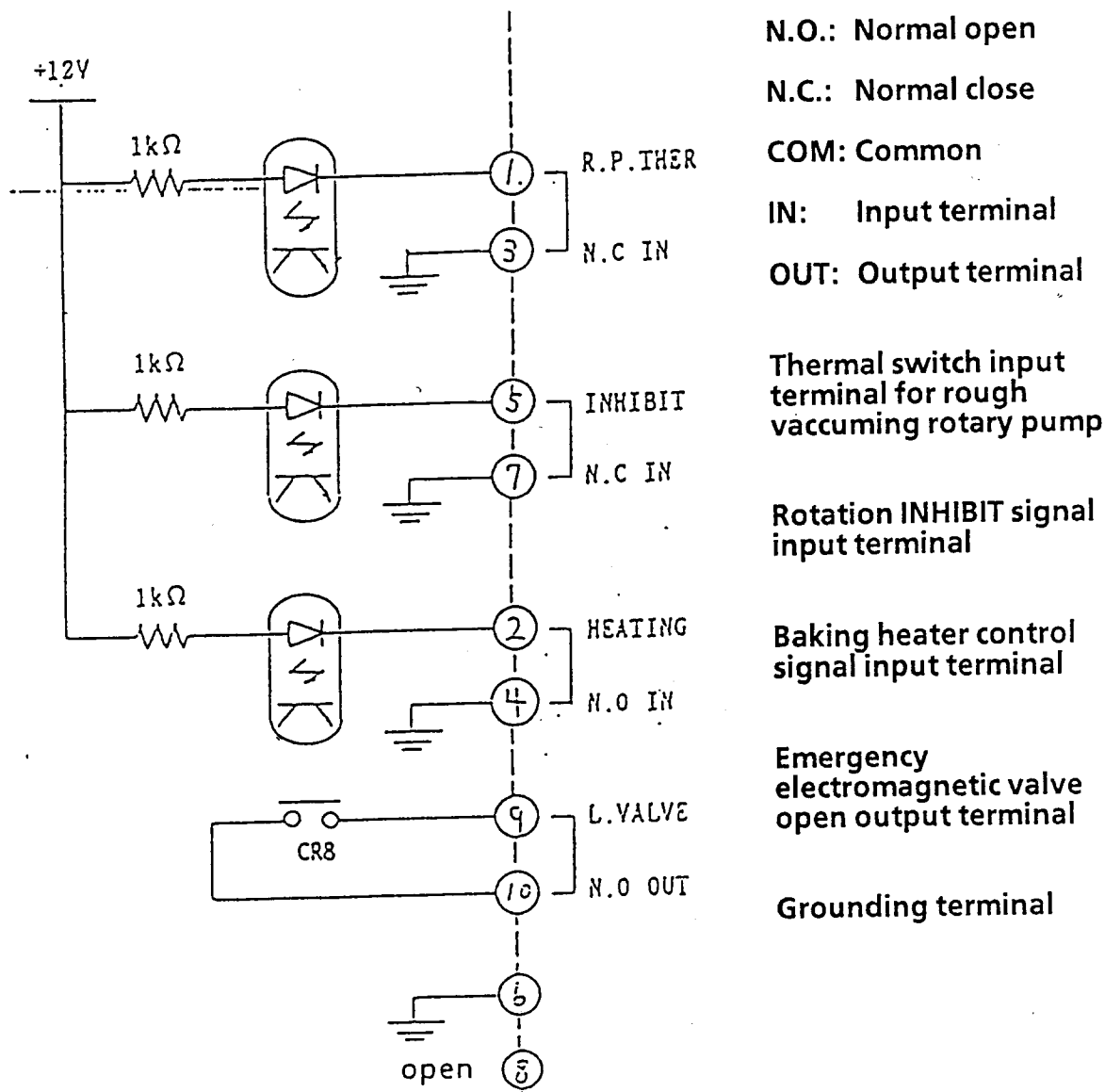


Fig. 14 Terminal table for remote input signal (DC I/O TB3)

* Notes:

- (1) Shortcircuit the terminal between 1 and 3 when R.P. THER terminal is not used.
- (2) Shortcircuit the terminal between 5 and 7 when INHIBIT terminal is not used.

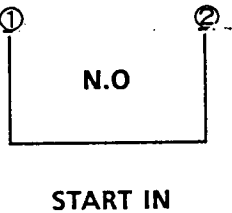
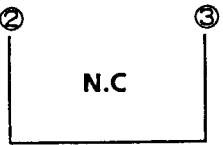
G2R-117P-V DC12V (manufactured by Tateishi Electric Co.) is used for relay CR8. Refer to Tables 7 and 8 for ratings.

6-3 START / STOP TB5 TERMINAL TABLE

The terminal table for a contact type remote input signal. Use it according to Table 10 and Fig. 15.

This terminal operates only by remote operation.

Table 10 START / STOP TB5 Terminal table

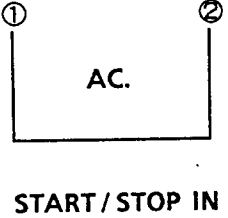
Terminal	Application
	<p>A terminal for a contact type START signal. There are the following two methods:</p> <p>(1) The STP pump rotates by shortcircuiting between terminal (2 and 3) for STOP signal and between terminal (1 and 2) for over 0.3 seconds. However, if the signal is input simultaneously with the braker on the rear panel turned ON, shortcircuit the terminal for over 5 seconds.</p> <p>(2) Shortcircuit between 1-3. 2 is not used here.</p>
	<p>A terminal for a contact type STOP signal.</p> <p>(1) In the above (1) case, the rotation stops if the terminal between 2 and 3 opens.</p> <p>(2) In the above (2) case, open the terminal between 1 and 3.</p> <p>The STOP signal has priority to the START signal. However, the STP pump does not stop when the START signal is input from the terminal between 1 and 2 of the START/STOP TB6 terminal table.</p>

6-4 START/STOP TB6 TERMINAL TABLE

A terminal table for a voltage type remote input signal. Use it according to Table 11 and Fig. 16.

The terminal table operates only by remote operation.

Table 11 START / STOP TB6 Terminal table

Terminal	Application
 <p>START/STOP IN</p>	<p>A terminal for a voltage START/STOP signal. The STP pump rotates when AC25-250V is input between terminals (1 - 2), and it stops when the terminal is opened. It can be used with DC24 to 48V. The + side can be connected to either 1 and 2. However, the STP pump does not stop even if the terminal between 1 and 2 of the START/STOP TB5 terminal table is opened since the starting operation is executed at the terminal.</p>

START/STOP TB5 : Terminal table for remote input signal

Contact type START/STOP input terminal

N.O.: Normal open
 N.C.: Normal close
 IN : Input terminal

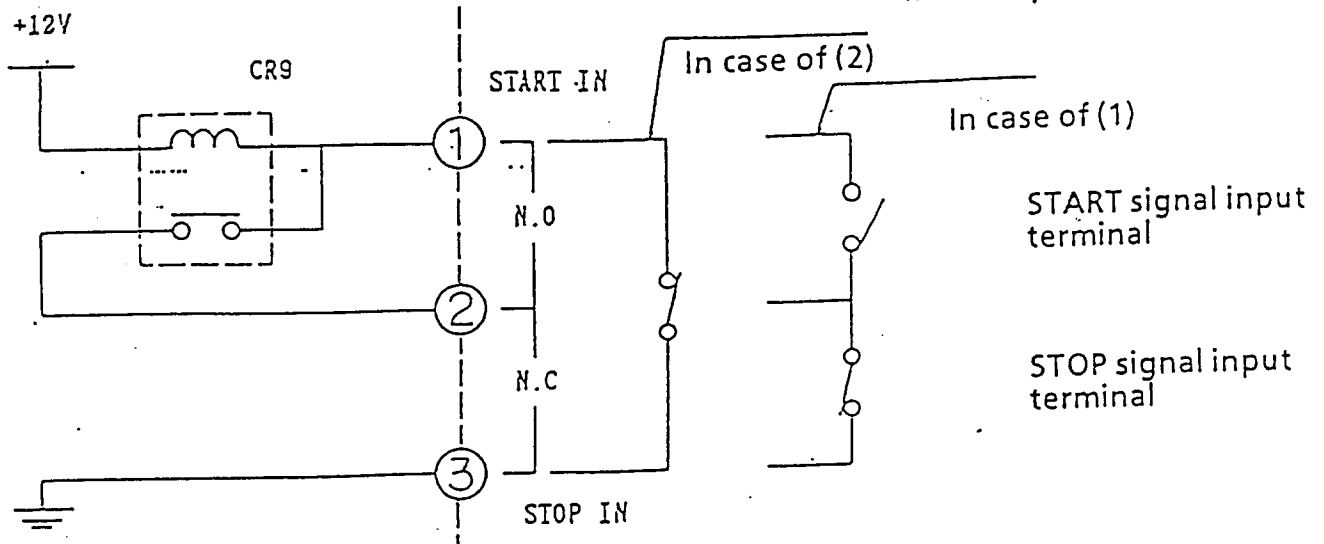


Fig. 15 Terminal table for remote input signal (START / STOP TB5)

START/STOP TB5 : Terminal table for remote input signal

Voltage type START/STOP input terminal

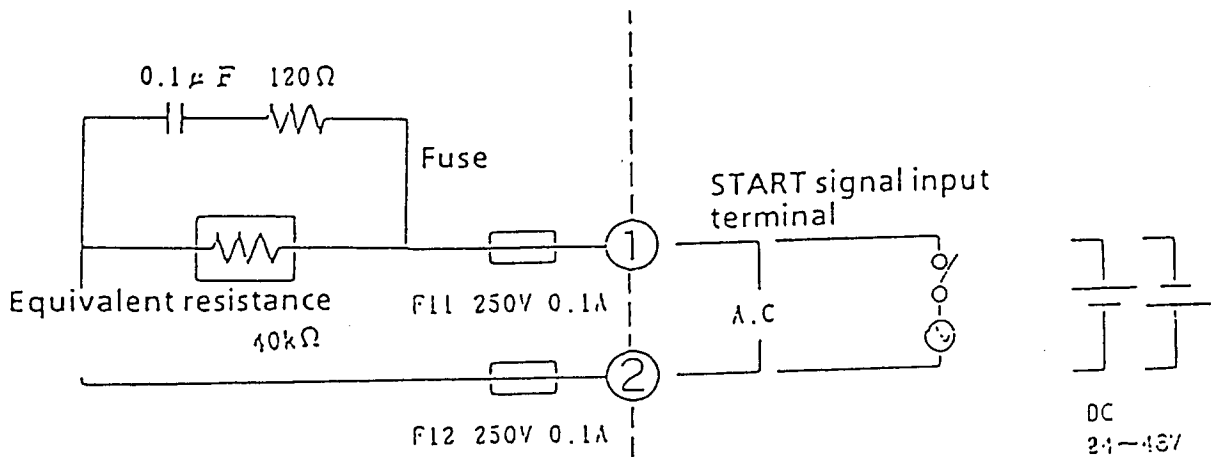


Fig. 16 Terminal table for remote input signal (START/STOP TB6)

- In Fig. 15, G2VN-237PL DC12V (manufactured by Tateishi Electric Co.) is used for relay CR9.

Table 12 The rating for G2VN-237PL

Rated voltage	Rated current
DC12V	30mA

Table 13 The rating for the contact of G2VN-237PL

Rated load	Resistance load ($\cos \phi = 1$)	Induced load ($\cos \phi = 0.4$) (L/R = 7ms)
		AC110V 0.3A DC 24V 1A
Rated energizing current	2A	
Maximum contact voltage	AC125V, DC125V	
Maximum contract current	2A	
Maximum switching capacity	60VA 30W	22VA 10W
Mimimum available load (P standard value)	DC100V 10mA	

7. INTERNAL BATTERY

The STP pump is provided with a rechargeable battery inside of the control unit as a memory backup for power failure. The power is supplied from the battery in case of power failure, and a floating state of the pump is kept for about 6 minutes by the magnetic bearing until the rotor decelerates and lowers down by the safety function.

The backup operation of the battery can be executed twice successively in a full recharging state.

For the battery, four 12V, 1.8Ah batteries (miniature sealed lead storage battery, *PORTALAC Series PE12V 1.8*, manufactured by Nippon Denchi) are used.

7-1 Recharging method

The battery is always recharged in the POWER ON state regardless of acceleration or deceleration of the rotor.

After the power failure, recharge the battery for about 12 times of the BATTERY OPERATION period.

When the BATTERY OPERATION period is 6 minutes, for example, recharging for about 75 minutes is required. If the power supply is interrupted twice in 90 minutes, recharge the battery for over 90 minutes before the rotor rotating operation.

7-2 Service life

The service life of the battery is affected by ambient temperature.

Since the life varies as typically shown in Fig. 17, take full note of the storage temperature.

- * Note : Replace a worn battery by a new one before its service life expires. It is advised to replace the battery every one year. Since the replacement time of the battery is specified at the rear side of the front panel, take note of the replacement time.

7-3 The allowable leaving period

If the battery is left uncharged, the capacity will be reduced due to its self-discharging.

Since the allowable leaving period of the battery varies as typically shown in Fig. 18, take full note of the storage temperature. Take note as well in case the STP pump is used again after being left.

- * Note : If the battery has been left for more than the allowable leaving period, recharge the battery for over 90 minutes

before the rotor rotating operation, or replace it by a new one.

Battery life

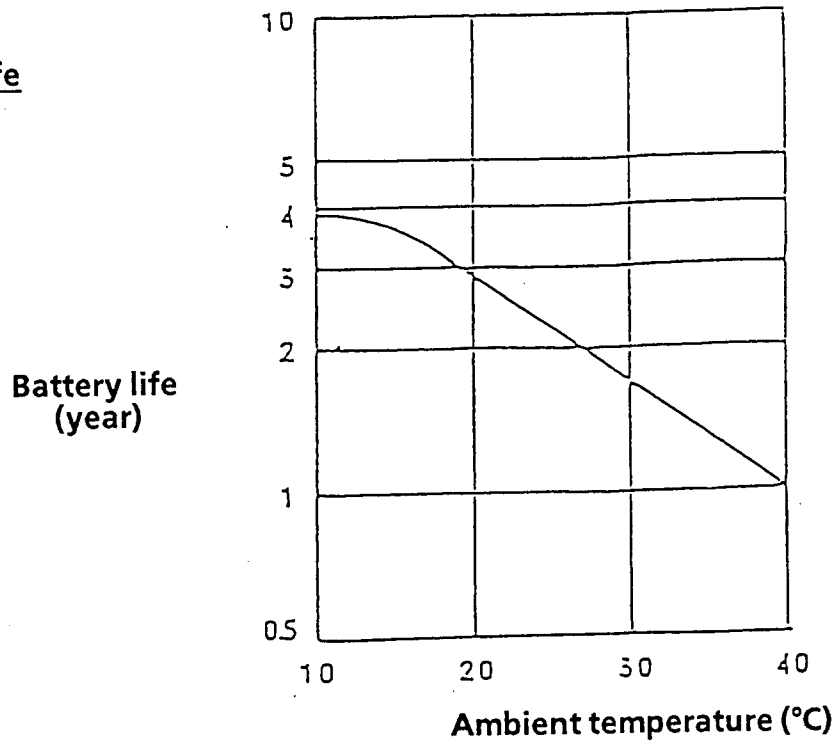


Fig. 17 Battery service life

Allowable leaving period of battery

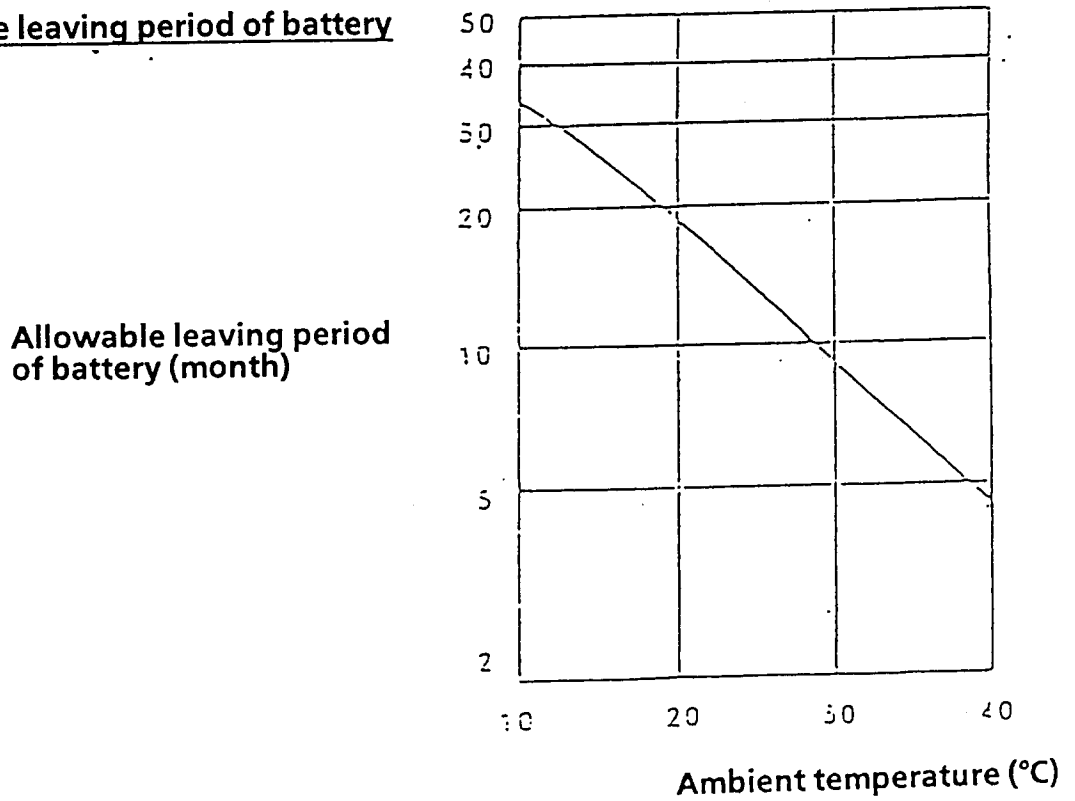


Fig. 18 The allowable leaving period of battery

7-4 Battery replacement

Replace the battery according to the following procedures, referring to Fig. 19:

- (1) Stop the rotation of the STP pump and turn OFF the power (primary side).
- (2) Unfasten 4 screws at the four portions of the front panel of the control unit, and tilt the front panel toward you.
- (3) Remove the battery connecting connector (CN12) inside of the control unit.
- (4) Unfasten the battery case mounting screw, and take off the battery case from the control unit.
- (5) Remove the front plate of the battery case.
- (6) Remove the internal terminal of the battery and slide the batteries out of the case.
- (7) Replace the used battery by a new battery (four batteries) with the code extending sides upward. At that time, take care not to mistake " + " polarity for " - " polarity and vice versa.
- (8) Connect the internal terminal of the battery and attach the front plate of the battery case.
- (9) Assemble the battery case in the control unit.
- (10) Fasten the battery case mounting screws.
- (11) Connect the battery connecting connector (CN12).
- (12) Attach the front panel of the control unit.

* Note : We will supply the battery case with newly replaced batteries if you contact us.

1	Front panel for control unit
2	Connector for battery connection
3	Battery case mounting screw
4	Battery case
5	Front plate of battery case
6	Internal terminal of battery
7	Battery record label

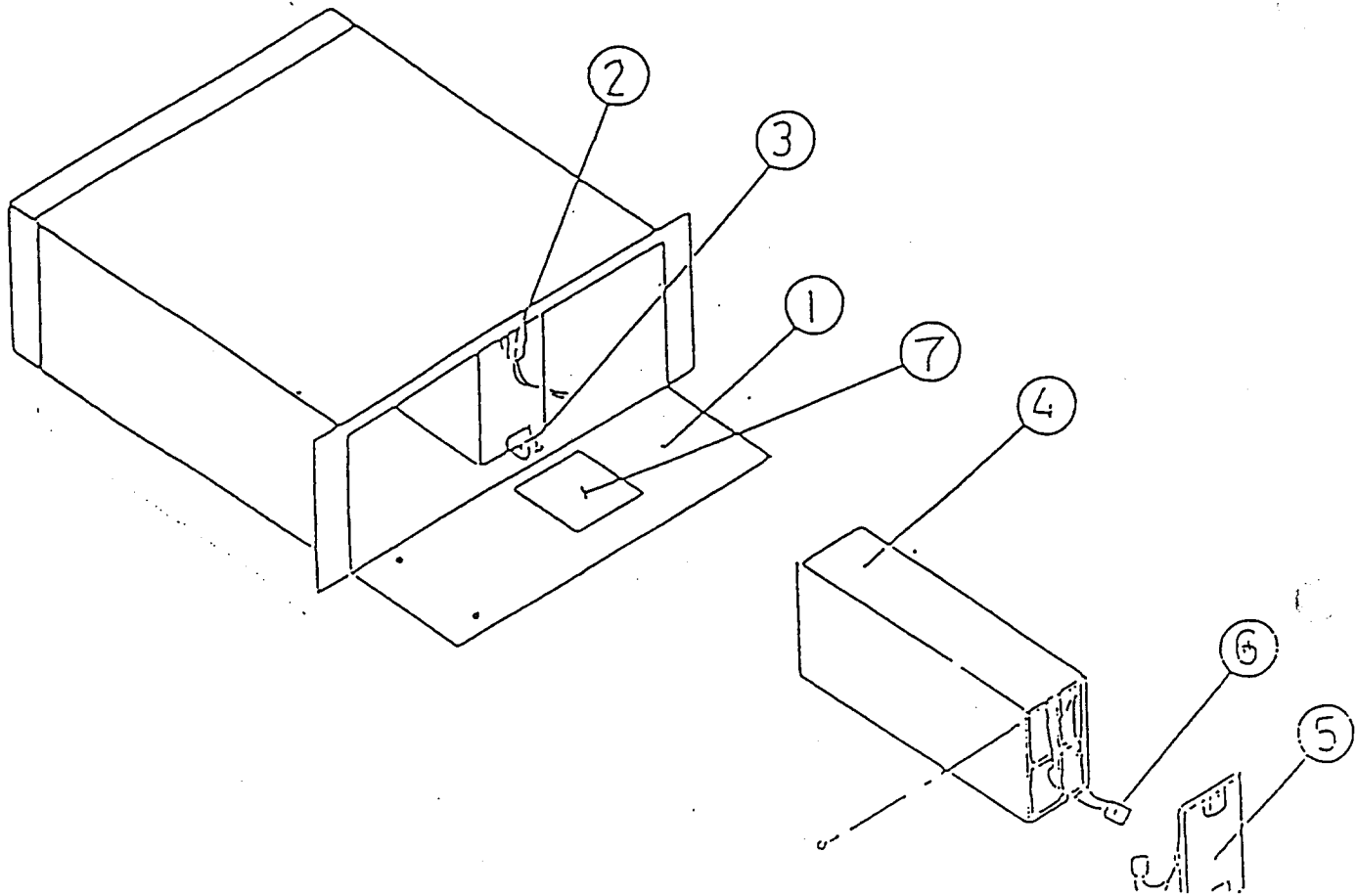


Fig. 19 Replacement of the internal battery

8. EXTERNAL BATTERY

8-1 Specifications

When the external battery is used, select the battery according to the specifications of Table 14.

Table 14 Specifications of the external battery

Item	Specifications
Capacity	Over 1.8Ah
Voltage	48V
Current	2.3A
Operating time	About 6 minutes
The number of operating times	Over 2 times succesively
Recharging voltage	55V

A miniature sealed lead battery (*PORTALAC Series* manufactured by Nippon denchi) is recommended.

8-2 Connecting method

Connect the external battery according to the following procedures:

- (1) Stop the STP pump and turn OFF the power (primary side).
- (2) Remove the front panel of the control unit.
- (3) Take off the battery in the same way as "7-4 Replacing method of the internal battery." Fix the internal battery connection connector (CN12) taking care not to shortcircuit with the other parts.
- (4) Attach the front panel.
- (5) Connect the external battery taking care not to mistake "+" polarity for "-" polarity and vice versa. The number of pins at "+" side of the external battery connection connector (CN9) is 1 and "-" side of the same is 2.

* Notes:

- (1) DO NOT use the external battery while internal batteries are being mounted.
- (2) If the battery connection is incomplete, the protective function of the battery may sometimes not work at the time of power failure.

8-3 Recharging method

External battery is always recharged in the POWER ON state with a constant voltage (55V) constant current (0.3A) circuit for recharging equipped in the control unit.

After the power failure, recharge for about 12 times as long as the BATTERY OPERATION time.

If BATTERY OPERATION time is 6 minutes, for example, its recharging time is about 75 minutes.

8-4 Notabilia on usage

Take note of the following:

- (1) DO NOT use the external battery with the internal battery being mounted.
- (2) DO NOT use the battery connected in parallel.
- (3) Be sure to replace the batteries with new ones before the service life expires.
- (4) If the batteries are left for over an allowable leaving period, recharge them for over 90 minutes or replace them by new ones.
- (5) The service life, allowable leaving time, operating time, etc. differ depending upon the battery employed and ambient temperatures. So, refer to the technical data or the like published by the battery manufacturer for details.

9. OPERATION PRINCIPLE OF THE STP PUMP (Refer to Fig. 20.)

The STP-2001/2001C turbo molecular pump incorporating magnetic bearings has excellent features of (1) complete oil-free, (2) ultra low vibration, and (3) high reliability.

The STP pump has the structure to arrange rotor blade 1 and stator blade 2 alternately in the axial direction. Thanks to high speed rotation of the rotor blade, gas molecules are transported from the absorption port to the exhaust port to execute the pumping action.

Since rotor blade 1 is supported by the magnetic bearing without mechanical contact, lubrication oil is not necessary as a turbo molecule pump using ball bearing. The magnetic bearing is made up of five pairs of active type magnetic bearings.

The rotor is supported in the radial direction by four pairs of radial direction active type magnetic bearings consisting of radial direction sensor 3 and radial direction electromagnet 4. The rotor is supported by a pair of axial direction active type magnetic bearings consisting of axial direction sensor 5 and axial direction electromagnet 6.

The rotor, being supported by the magnetic bearing of the above construction without mechanical contact, rotates with extremely low vibration.

The magnetic bearing, without mechanical friction, generates small heat and does not require the STP pump to be cooled except such cases as baking and load introduction. However, the STP pump must be cooled with water or air in cases of baking or load introduction.

To provide against a trouble in the magnetic bearing, protective dry bearings 7 and 8 coated with solid lubrication material are provided. They will not come into contact with the rotor in normal operation.

The states of the magnetic bearing and the rotor rotation are always monitored by the radial direction sensor, the rotation number sensor and the temperature sensor. If any abnormality occurs, therefore, the rotor stops.

THE STP PUMP

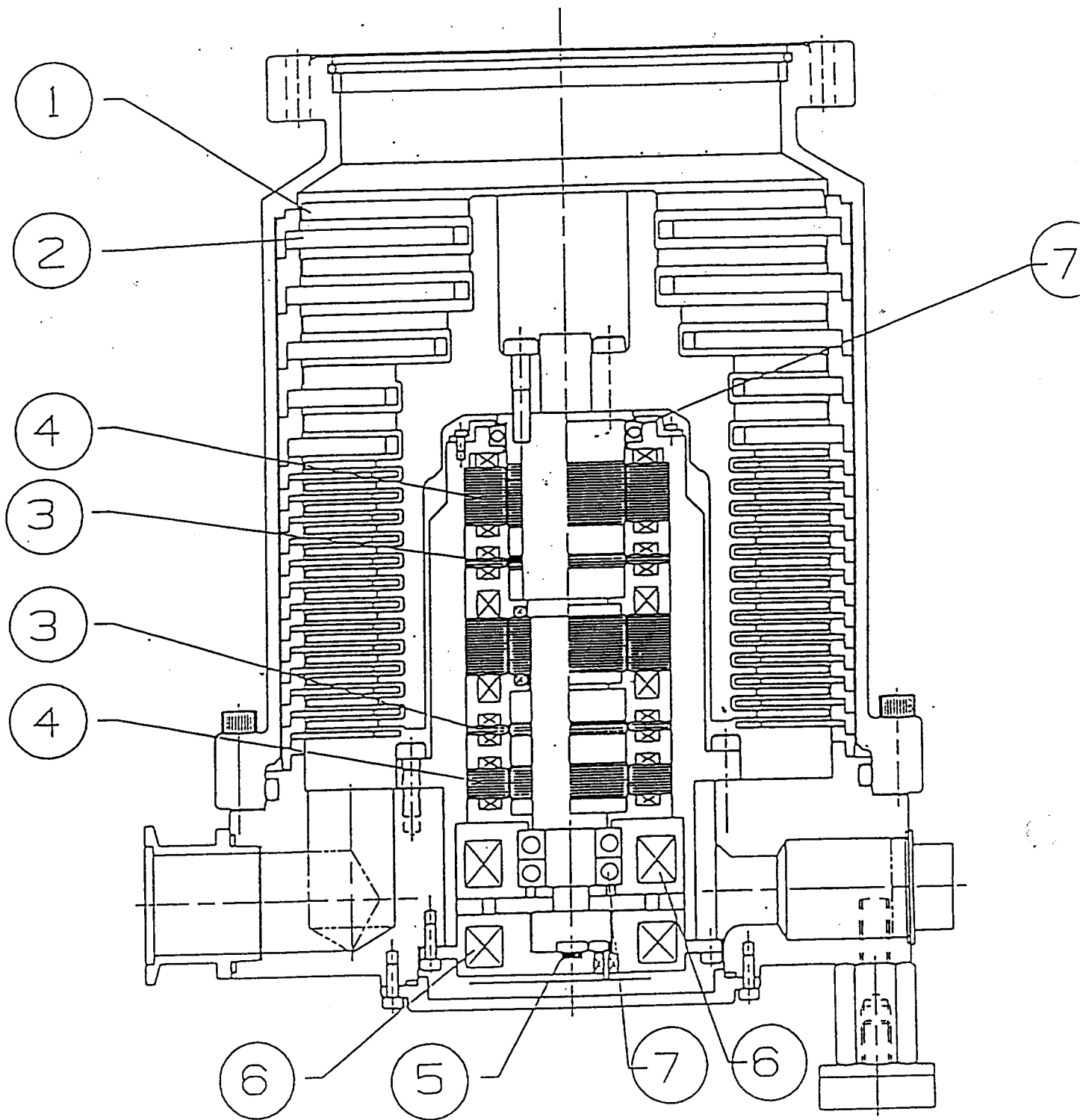


Fig. 20 Cross sectional view of the STP pump

10. SPECIFICATIONS AND ACCESSORIES

Table 15 Specifications for the STP pump (STP-2001/2001C)

Items		Specifications
Flange type	Absorption port	VG250, ICF305, ISO250, etc.
	Exhaust port	KF40
Exhaust gas speed	N ₂ l/s	2000
	He l/s	1800
	H ₂ l/s	1600
Compression ratio	N ₂	>10 ⁸
	He	10 ⁷
	H ₂	10 ⁵
Attainable pressure Torr (Pa)		After baking, the order of 10 ⁻¹⁰ (10 ⁻⁸) Note 1
Allowable absorption port pressure Torr		1 x 10 ⁻⁴
Allowable exhaust port pressure Torr		0.1
The number of rotations r.p.m.		27,000
Starting time min.		7
Stop time min.		7
Vibration μm(0-P)		<0.01 (At 27,000 r.p.m.)
Noise dB		<50 (At 27,000 r.p.m.)
Baking temperature °C		<120
Lubrication oil		Not necessary

Note1: 10⁻⁹ (10⁻⁷) ORDER in case of the STP-2001C (Chemical type)

Items		Specifications
Mounting position		Vertical
Cooling method		Spontaneous cooling (Water or air-cooling when baking)
Standard auxiliary pump /min.		540
Weight	Pump kg	63
	Control unit kg	40
Input power	Starting KVA	2.6
	Regular KVA	1.0

Table 16 Specifications for the STP Control Unit (STP-2001/2001C)

Items	Specifications
Input voltage ACV	200 to 240 \pm 10%
Input frequency Hz	50 / 60 \pm 2
Input phase	Single
Motor driving method	Transistor three-phase inverter
Regular output voltage(3-phase type)ACV	85
Regular output frequency Hz	450
Allowable ambient temperature $^{\circ}$ C	0 to 40
Storage temperature $^{\circ}$ C	-20 to 40
Available battery	12V 1.8Ahx4 (Miniature seal lead storage battery PORTALAC Series PE12V 1.8 manufactured by JAPAN STORAGE BATTERY CO., LTD)
Operation switch	<ul style="list-style-type: none"> • POWER ON/OFF (green illumination push button) • MOTOR START (push button) • MOTOR STOP (push button) HEATING ON/OFF (green illumination push button) • MANUAL/REMOTE change-over (toggle switch) • EMERGENCY (push button) (E. VALVE ON/OFF)
Panel display lamp	<ul style="list-style-type: none"> • EMERGENCY OPERATION (red LED) • FAILURE (red LED) • OVER TEMPERATURE (red LED) • BATTERY OPERATION (red LED) • BRAKE (yellow LED) • ACCELERATION (green LED) • NORMAL OPERATION (green LED) • HEATING (green illumination push button) • POWER (green illumination push button)

Item	Specifications
In- and Output terminal	<ul style="list-style-type: none"> • AC POWER (3 pins) • P. CONNECTOR (45 pins) • INVERTER OUTPUT (4 pins) • LEAK VALVE (4 pins) • I / O TB2 (20 pins) • DC I / O TB3 (10 pins) • START / STOP TB5 (3 pins) • START / STOP TB6 (2 pins) • EXT. BATTERY (2 pins)
In- and Output cable	<ul style="list-style-type: none"> • Power source cable (primary side) • STP connection cable • Motor connection cable • Cable for emergency electromagnetic valve
Safety functions	<ul style="list-style-type: none"> • Detection of abnormality in magnetic bearing (rotor vibration at 100 μm for over 1 sec.) • Detection of overheating of the STP pump (motor temperature is over 115°C) • Detection of overload of interter (over 40A momentary, over 11.5A for 100 minutes) • Detection of abnormality in batteries (Battery terminal voltage: less than 42V) • Detection of power failure (power failure of over 2 seconds \pm 70% is detected) • Detection of overspeed of rotor (over 29,000 r.p.m.) • Detection of overheating in control unit heat sink (over 90°C) • Breakdown of electromagnetic brake (in case of power failure, emergency electromagnetic valve functions if the
<p>Note :</p> <ol style="list-style-type: none"> 1. Replace the batteries by new ones after one year use. 2. If the control unit is left for over 4 months, the motor must be recharged by turning the power ON before getting started operation. 	

Table 17 Accessories

	Names	Qty.	Remarks
Standard Accessories	STP control unit	1	Remote control terminal and external battery connector attached
	Power source cable (primary side) (5m)	1	A both-end welding terminal attached
	STP connection cable (5m)	1	A both-end connector attached
	Motor connection cable (5m)	1	A both-end connector attached
	Protective wire net	1	
	Absorption port cover	1	
	Exhaust port cover	1	
	Connector cover	2	
	Operation manual	1	
	Plug for external battery	1	
	Spare fuses (3 types)	2 each	F3, 4 (250V, 5A) F5, 6, 7, 8, 9, (250V, 10A) F11, 12 (250V, 0.1A)
	Emergency electromagnetic valve	1	A single side connector cable attached
	Clamper for emergency electromagnetic valve	1	KF10 (with O-ring washer)
STP-2001C includes the following accessories.			
	Blanck flange for purge port	1	KF10
	Clamper for purge port	1	KF10 (with O-ring washer)

11. TROUBLESHOOTING

*If something unusual is found during operation, check and troubleshoot according to the following procedures:
Please contact us if no case is applicable to the trouble, or a normal operation does not start after the troubleshooting.*

Table 18 Troubleshooting (1)

No.	Trouble	Check points	Corretive action
1	A lamp does not come on even after turning ON the power	Power cable	Connect the cable as shown in Table 1.
		Select the MANUAL/REMOTE changeover switch.	Check the switch on the rear panel of the control unit
		Fuses F3,F4	Replace the disconnected fuse by new ones.
		Power voltage	Set at 200 to 240V \pm 10%
2	A troble diasplay lamp lights when "POEWR ON"	Connection of the STP connection cable	Connect it correctly. Check whether it is locked or not.
		Insufficient rechaging, deterioration of the battery	Check the battery connection connector inside of the control unit. Check whether a battery deteriorates or not.
		Coicidence of the plate No.	Check whether the pump number and the rear panel number of the control unit mate each other or not.
		fuses F8, F9	Replace the disconnected fuse by new one.
3	<u>ACCELERATION</u> lamp does not come on after starting.	Connection of the motor connection cable	Connect the cable correctly. Check whether it is lockd or not
		Fuses F11and F12(only remote operation)	Replace the disconnected fuse by new one.

No.	Trouble	Check points	Corrective action
4	<u>NORMAL OPERATION</u> lamp does not come on even about 100 minutes after starting	Pressure at the absorption port.	Use at below 1×10^{-4} Torr.
		Pressure at the exhaust port	Use at below 0.1 Torr.
		Leakage	Check the piping system.
		Auxiliary pump	Check the capacity and the starting state. (Use the pump with the capacity of over 540ℓ / min.)
		Power failure	Check whether there is any power failure or not.
5	The rotor stops during the baking operation.	Baking temperature	Set at below 120°C.
		Cooling	The pump needs to be cooled (water cooling, air cooling)
		Power failure	Check whether there is any power failure or not.
6	The rotor stops during regular operation.	Pressure at the absorption port	Use it at below 1×10^{-4} Torr.
		Pressure at the exhaust port	Use it at below 0.1 Torr.
		Excessive vibration	Remove the source of vibration.
		Overheating inside of the control unit	Remove any obstacle against the energy source and ventilating passage.
		Power failure	Check whether there is any power failure or not

No.	Trouble	Check points	Corretive action
7	Lowering down of the rotor during operation	Connection of the STP connection cable	Please contact us for inspection.
		Insufficient recharging or deterioration of the battery.	
8	Poor attainable pressure at normal operation.	Auxiliary pump	Check the capacity and the starting state (use the pump of over 540ℓ/min)
		Leakage	Check the piping system.
		Component of remaining gas	Clean the inside of the chamber if main component is other than H ₂ and H ₂ O (If gas remains inside of the pump, we will repair).

Table 19 Troubleshooting (2)

	Lamp display			
	"FAILURE"	"EMERGENCY"	"OVER TEMPERATURE"	"BATTERY OPERATION"
Defective connection of the connection cable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Deterioration of battery	<input type="radio"/>	Sometimes it comes on		
Defective connection of battery	<input type="radio"/>	Sometimes it comes on		
Power failure, drop in power voltage		<input type="radio"/>		<input type="radio"/>
Incoincidence of pump No. and control unit No.		<input type="radio"/>		
Excessive baking temperature.	<input type="radio"/>		<input type="radio"/>	
Lack of cooling	<input type="radio"/>		<input type="radio"/>	
Excessive ambient temperature during operation	<input type="radio"/>		<input type="radio"/>	
TR3 R.P. THER 3 - 1 open	<input type="radio"/>			

Check items

Table 20 Troubleshooting (3)

Defective connection of the connection cable	Check whether it is connected correctly or not.
Deterioration of battery	Replace it by new one.
Defective connection of battery	Check whether it is connected correctly or not.
Power failure, drop in power voltage	Check whether it is power failure and power voltage of AC input.
Incoincidence of pump No. and control unit No.	Use the pump and the control unit with the same No.
Excessive baking temperature	Set the baking temperature at below 120°C.
Lack of cooling	Be sure to cool in cases of baking and introduction of the load.
Excessive ambient temperature during operation	Set the ambient temperature at below 40°C.
TR3 R.P. THER 3 - 1 open	If you do not use this function, shortcircuit 1 - 3.

12. MAINTENANCE

12-1 Replace the internal battery

The STP pump is equipped with a rechargeable battery as a backup in case of a power failure inside the control unit.

In order to ensure safe switch over during a power failure, keep the internal battery in good condition by always replacing it before the end of its life (about once a year). Refer to "7-4 Battery replacement" for procedures on replacing the battery.

12-2 Inspect the cooling fan

Confirm that the cooling fan inside the control unit (see Fig. 8) is operating when you replace the internal battery. If the cooling fan has stopped, contact us.

Inspection procedures: After replacing the internal battery by following the steps in "7-4 Battery replacement", inspect whether the cooling fan is operating by the powering on (primary side) the unit before the closing the front panel.

12-3 Transport the pump for repair or overhaul

The pump needs to be overhauled in the following cases:

- There is a buildup of the reaction product inside the pump (The gas that deposits the product, has expired, inspect the pump every three to six months.)
- The protective bearing is worn (If the pump is damaged as much as ten or more times air inrush).
- When the water flow is interrupted due to deposited product in the water-cooled jacket.

Always contact Seiko Seiki before returning the pump for repairs, overhaul, etc. To avoid secondary accidents and corrosion of the pump, especially when poisonous or reactive gases have been used, evacuate and seal the pump before shipping. Shipping specifications will be sent after Seiko Seiki is contacted.

Note:

- 1) A fee will be charged for cleaning and overhauling the pump.
- 2) Seiko Seiki takes no responsibility for problems occurring during shipping if the shipping specifications have not been strictly followed.
- 3) When you return pump for repair, please write down every information in "TROUBLE CHECK SHEET" in next page and fax it to local services.

13. CARRYING THE PUMP AND CONTROL UNIT

The STP pump weighs approximately 63 kg.
The control unit weighs approximately 40 kg.
Take care when you carry them.

13-1 Carrying the pump

If the pump has a hole for a suction flange, place an eye-bolt into the hole and carry the pump. If it doesn't have a hole, carry it with by the feet with some kind of wire carrying apparatus.

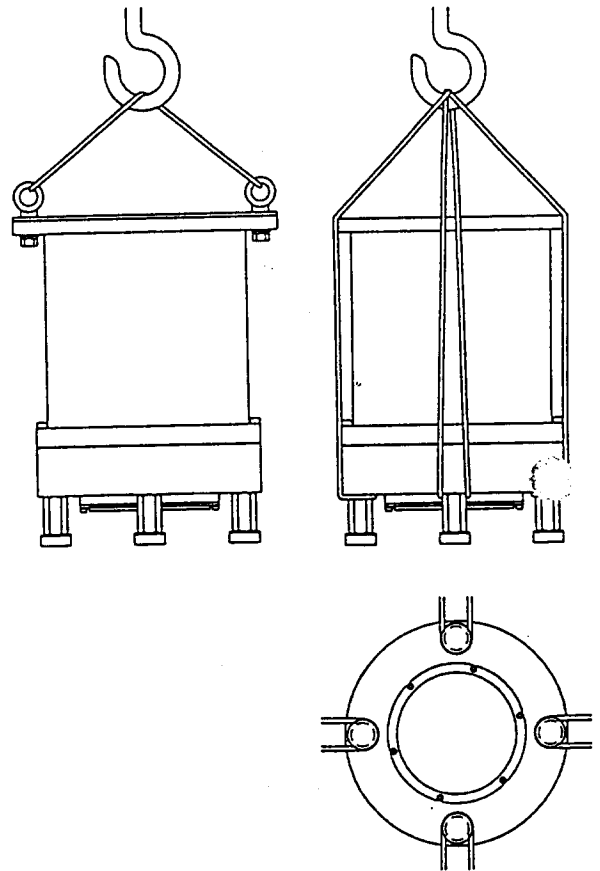


Fig. 21 Carrying up the Pump

13-2 Carrying the control unit

Lift up the control unit by the two handles on the front panel.

CAUTION:

- 1) Use a crane having enough lifting load to lift the weight of the control unit.
- 2) Keep the pump or the control unit vertically stable when lifting and carrying them to avoid any accident with them dropping.

TROUBLE CHECK SHEET FOR STP

MODEL	M/C No.	DATE	SUCTION PORT FLANGE	INPUT VOLTAGE	CABLE LENGTH	OTHER
STP-				V	M	

INFORMATION FROM CUSTOMER	CUSTOMER ()
----------------------------------	--------------------

CONFIRMATION ITEMS	RESULTS	SITUATION OF TROUBLE
ERROR MESSAGE		
SOUND		
VIBRATION		
HEAT		
CHOKER WATER		
DEPOSITION		
POWER FAILURE		
FUSES		
USED GAS		
MOUNTING POSITION		
LEAK		

CORRECTIVE ACTION

- RETURN TO LOCAL SERVICE
- RETURN TO SEIKO SEIKI JAPAN
- REPLACE TO M/C No. ()
- OTHER

SEIKO SEIKI CO., LTD

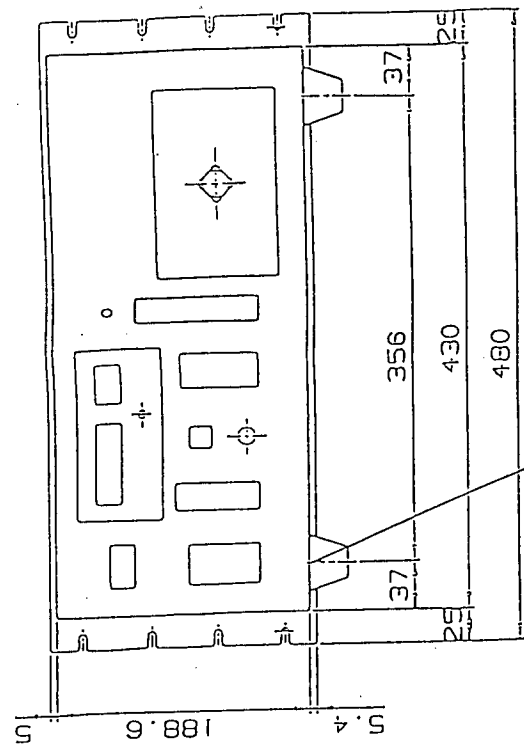
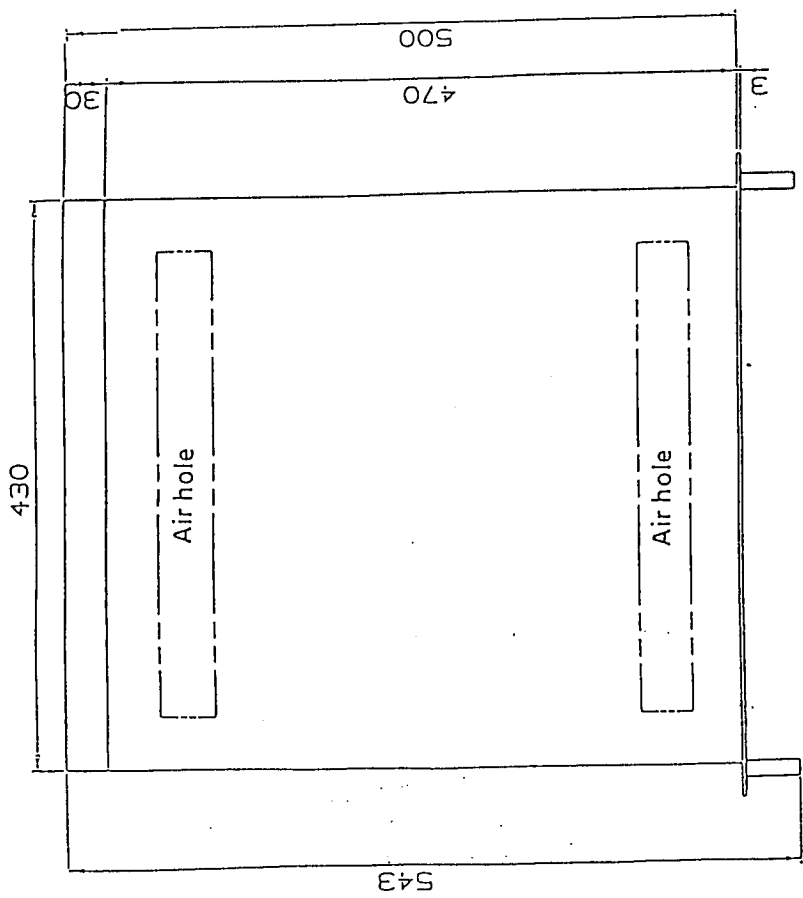
4-3-1 Yashiki Narashino-shi, Chiba 275 JAPAN
Telephone: 81-474-75-3111
Facsimile: 81-474-71-1544

SEIKO SEIKI Rep. Office(San Jose)

c/o Seiko Instruments USA Inc.
1130 Ringwood Court
San Jose, CA 95131
Telephone: 1-408-922-5932
Facsimile: 1-408-922-1959

SEIKO SEIKI BELGIUM S.A.

Av. De Messidor 198 1180 Bruxelles, Belgium
Telephone: 32-2-346-62-74
Facsimile: 32-2-347-52-68



Screw hole for rubber legs 4-M3

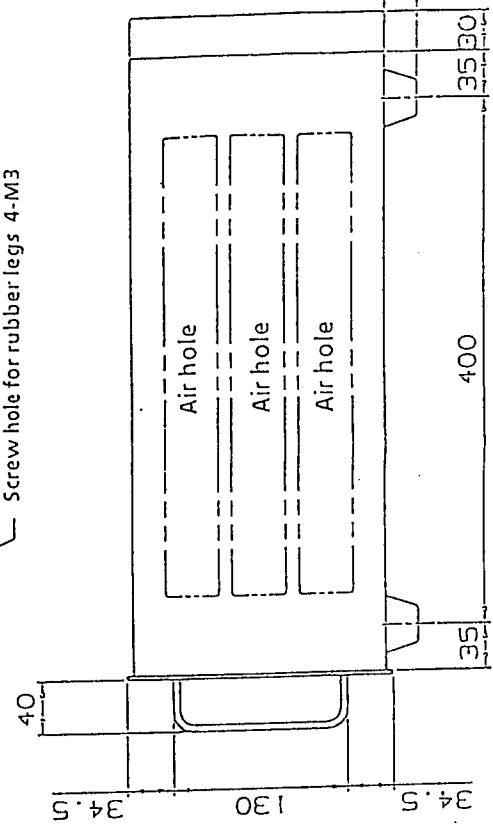
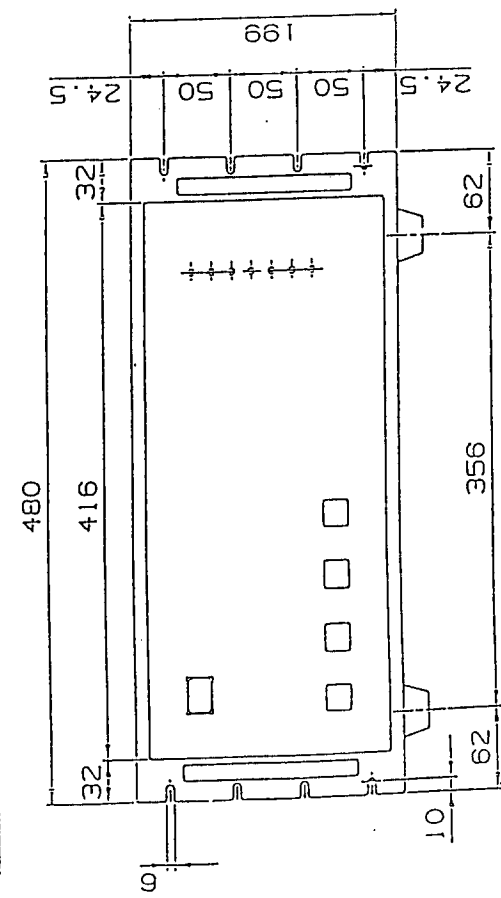
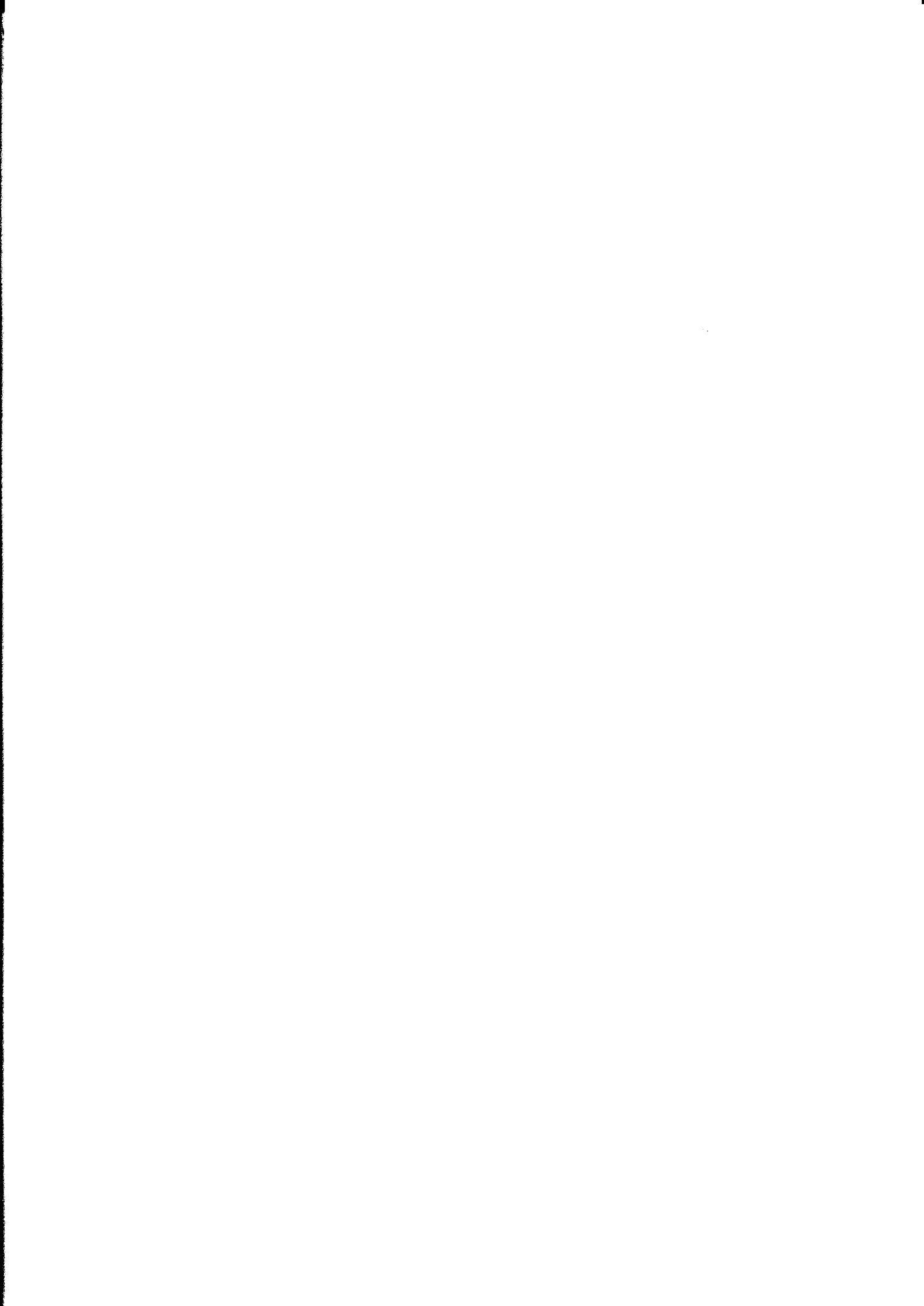
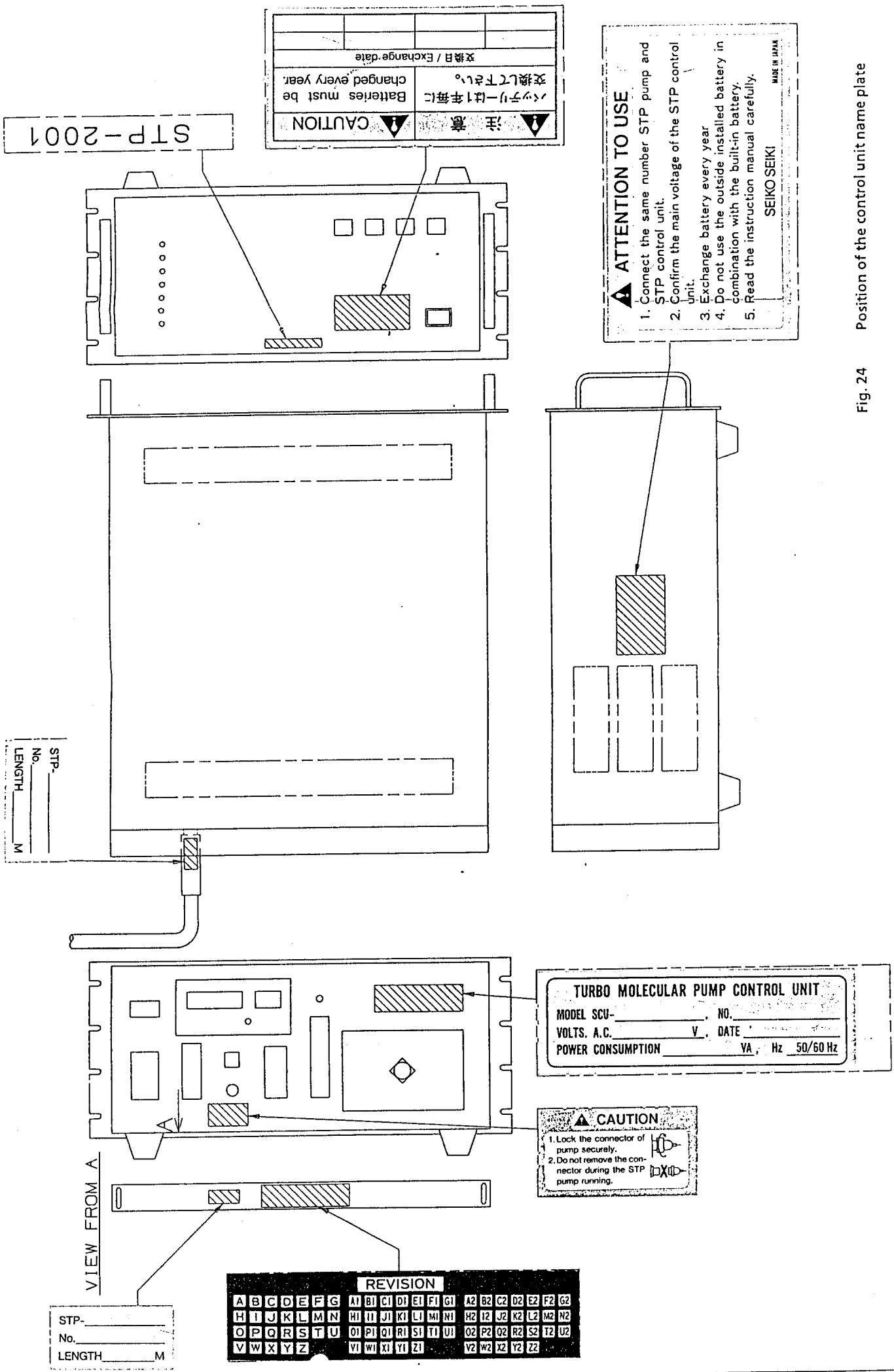


Fig. 22 Dimensions of the control unit







STP-2001

注意
 バッテリーは1年毎に交換して下さい。
 Batteries must be changed every year.
 交換日 / Exchange date

ATTENTION TO USE

1. Connect the same number STP pump and STP control unit.
2. Confirm the main voltage of the STP control unit.
3. Exchange battery every year.
4. Do not use the outside installed battery in combination with the built-in battery.
5. Read the instruction manual carefully.

SEIKO SEIKI
 MADE IN JAPAN

STP-
 No. _____
 LENGTH _____ M

TURBO MOLECULAR PUMP CONTROL UNIT

MODEL SCU- _____, NO. _____
 VOLTS. A.C. _____ V, DATE _____
 POWER CONSUMPTION _____ VA, Hz 50/60 Hz

CAUTION

1. Lock the connector of pump securely.
2. Do not remove the connector during the STP pump running.

VIEW FROM A

STP-
 No. _____
 LENGTH _____ M

REVISION																											
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z		
AI	BI	CI	DI	EI	FI	GI	A2	B2	C2	D2	E2	F2	G2	H1	I1	J1	K1	L1	M1	N1	O1	P1	Q1	R1	S1	T1	U1
							H2	I2	J2	K2	L2	M2	N2	O2	P2	Q2	R2	S2	T2	U2	V2	W2	X2	Y2	Z2		

Fig. 24 Position of the control unit name plate



SEIKO SEIKI

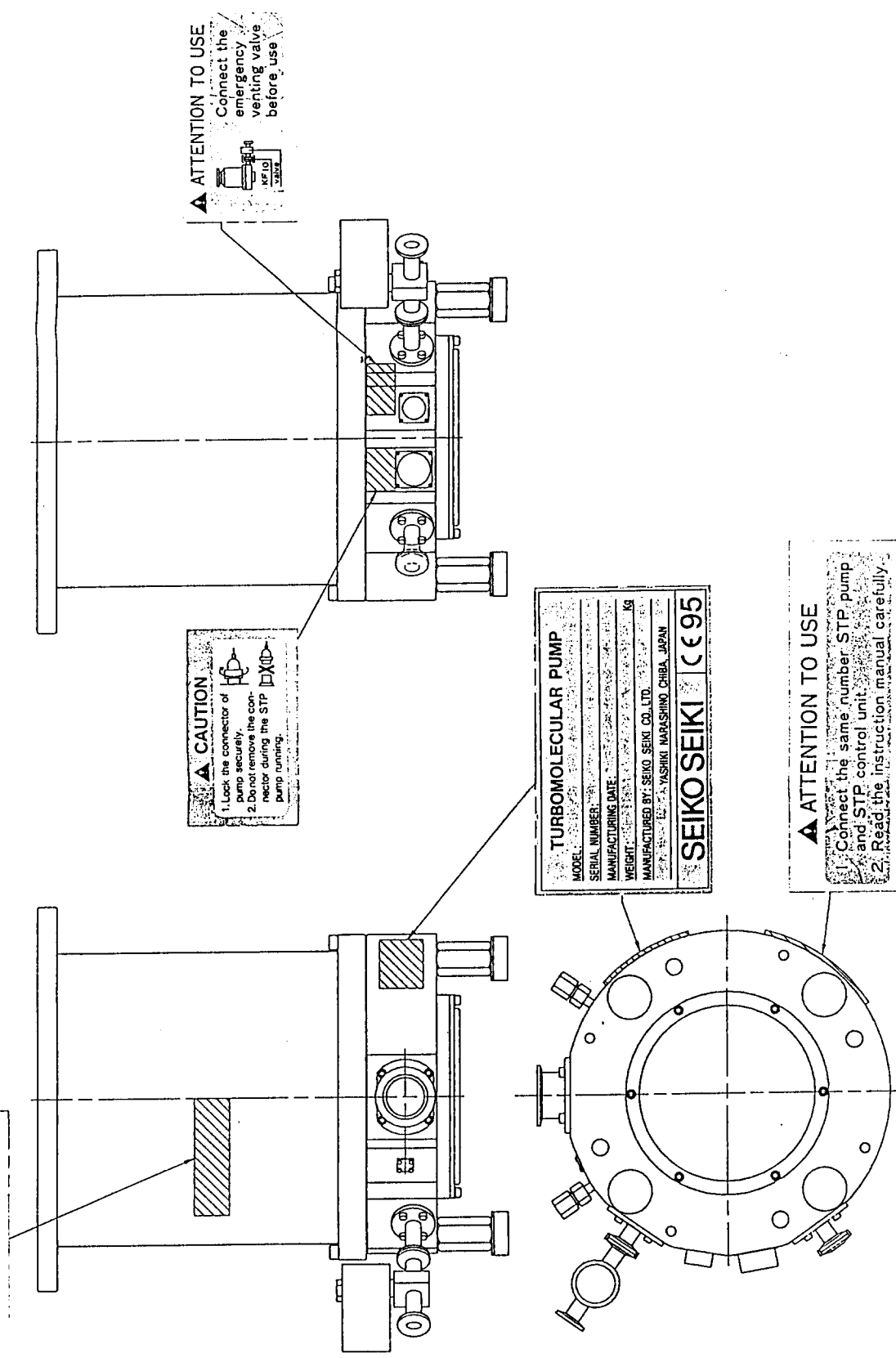
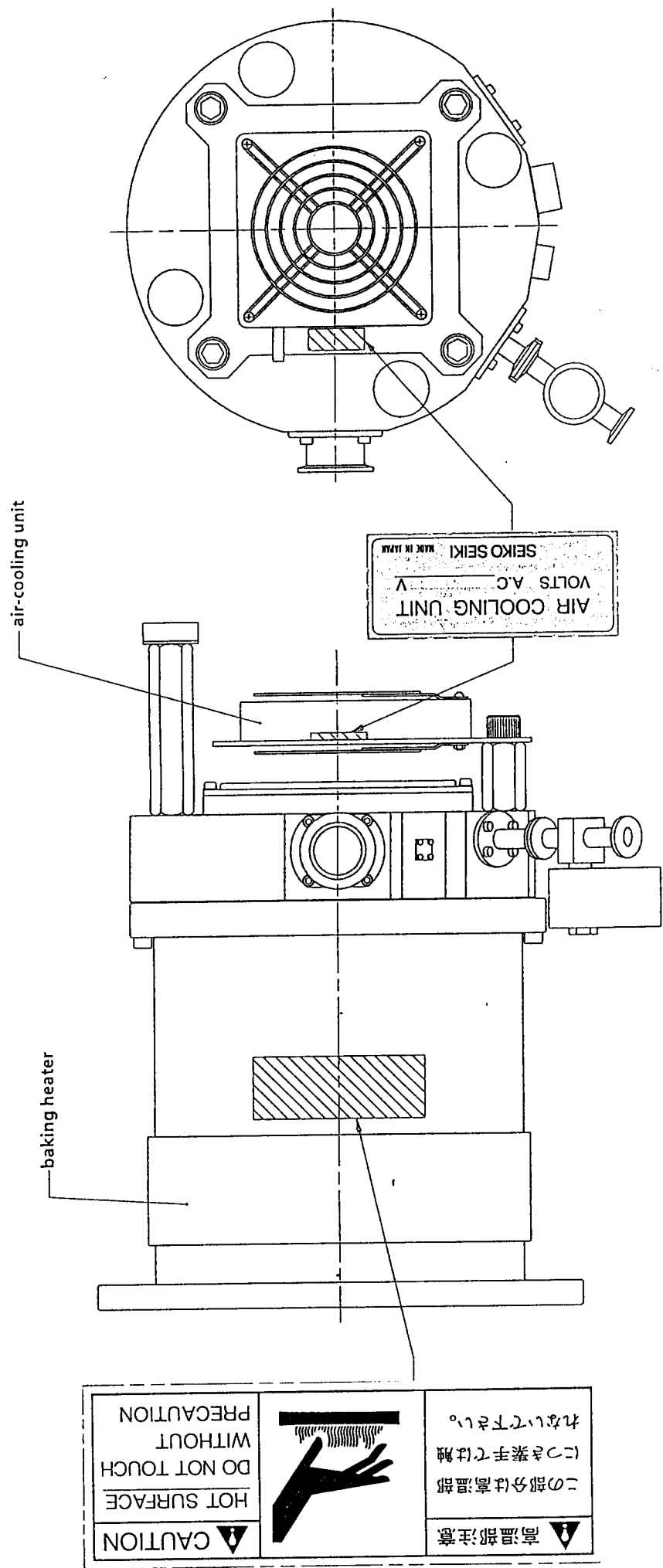


Fig. 25 Position of the STP-2001/2001C name plate





AIR COOLING UNIT
 VOLTS A.C. _____ V
 SEIKO SEIKI MADE IN JAPAN

<p>▲ CAUTION</p> <p>HOT SURFACE DO NOT TOUCH WITHOUT PRECAUTION</p>		<p>▲ 高温部注意</p> <p>この部分は高温部 につき素手では触 れないで下さい。</p>
--	--	--

Fig. 26 Position of the special accessories name plates

