

1030196600



INSTRUCTION MANUAL



HYDROGEN GENERATOR

OPGU-2100/2200

STEC INC.

■ PREFACE

Thank you very much for having HYDROGEN GENERATOR OPGU-2100/2200 purchased at this time truly.

This instruction manual is edited for users to operate this equipment.

For safety operation, read and understand this instruction manual thoroughly.

Please keep this manual importantly to refer at any time when it is necessary.

In this instruction manual, pressure is expressed with "kPa" unit. And these pressures are indicating gauge pressure.

■ Range of guarantee and responsibility

· Period of guarantee

The period of guarantee is one year. Any troubles or failures that occurs during this period will be repaired free of charge by our company upon notification.

· Range of guarantee

Range of guarantee is limited to this equipment. For instance, loss originated due to not being able to obtain test data because of equipment failure will not be compensated. Safety control of this equipment and its peripheral devices is the responsibility of the user.

· Exemption from responsibility.

In the following cases, no guarantee will be made regardless of the period of guarantee being valid.

- (1) Inevitable accidents such as natural calamity.
- (2) Breakdown caused by mistake of handling or neglecting necessary attention in handling.
- (3) When using or keeping the equipment in an inadequate environment.
- (4) Exceeding the rated specifications in using, or when the equipment is used for purpose other than specified or remodeling is added to the equipment.
- (5) When it is judged that the responsibility does not lie with company or when other provisions are made.

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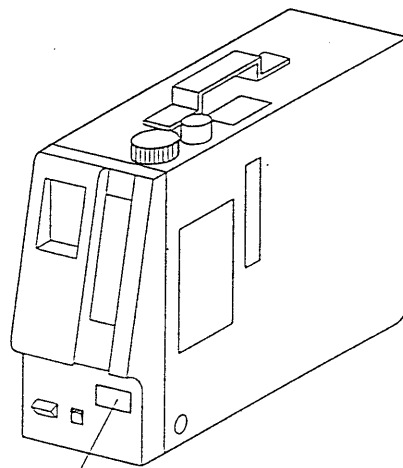
Warning Label on the Unit

WARNING

Risk in handling hydrogen gas

If a large amount of hydrogen gas leaks in an insufficiently ventilated room, an explosion might occur.

1. Be careful with fire.
Use the unit in a place free from fire.
2. Use the unit in a well ventilated place.



Warning label



Caution on Safety and Usage

CAUTION

- Check that the power source used meets the relevant specifications for the OPGU.
- Before turning ON the OPGU, be sure to apply protective grounding so that electric shocks can be prevented.
- Do not block the fan ventilation slots on the OPGU.
- Exhaust the H₂ gas to a safe place.
- Do not use the OPGU with its case cover removed.
- If you remove the case cover for maintenance or any other purpose, be sure to unplug the power cord.
- Do not disassemble or modify the OPGU.
- To replace silica gel, previously turn OFF the POWER switch and reduce the internal pressure with the relief valve.
- If you use the relief valve to replace silica gel, check that there is no leak from that valve when using it again.
- If H₂ gas is not used for 16 hours or more, turn OFF the POWER switch and reduce the internal pressure to atmospheric pressure with the relief valve..
- If the OPGU is not used for one month or longer, remove silica gel (inner cylinder).
- Flush the deionized water tank every three months.
- Use deionized water whose resistivity is 5 MΩ.cm minimum (electric conductivity: 0.2 μS/cm max.).
- Ensure that the cap is always put on the deionized water tank except when deionized water is replenished.

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1. OVERVIEW

1.1 Introduction

The OPGU-2100 /2200 is a hydrogen generator which uses electrolysis of water to ensure easy operations and high safety. This document uses "kPa" as the pressure unit and assumes that all the pressure values are those from the gauge.

1.2 Configuration

The OPGU-2100S/2200S consists of an electrolytic cell using solid polymer electrolyte (SPE) (hereinafter abbreviated as "electrolytic cell"); a deionized water tank; a water separation trap; a dryer; a pressure sensor; a solenoid valve; and a power source for the electrolytic cell. In the electrolysis of water using the electrolytic cell, the SPE membrane works as an electrolyte. This makes it unnecessary to use such a difficult-to-use electrolyte as sodium hydroxide and enables the electrolysis to be performed with deionized water only.

Once the electrolytic cell is turned ON, H₂ gas is generated and simultaneously water on the anode side moves to the cathode side. The moved water and the H₂ gas are separated into gas and liquid with the water separation trap. When the water caught by the water separation trap reaches a specified level, the internal float valve is opened and the internal pressure of the trap brings the water back to the deionized water tank. On the other hand, the H₂ gas is dehumidified with the dryer and supplied from the H₂ generation port. The generation pressure of the dehumidified H₂ gas is monitored with the pressure sensor. Thus, the water electrolysis current to the electrolytic cell is controlled by turning ON or OFF, so that a specified pressure can be attained.

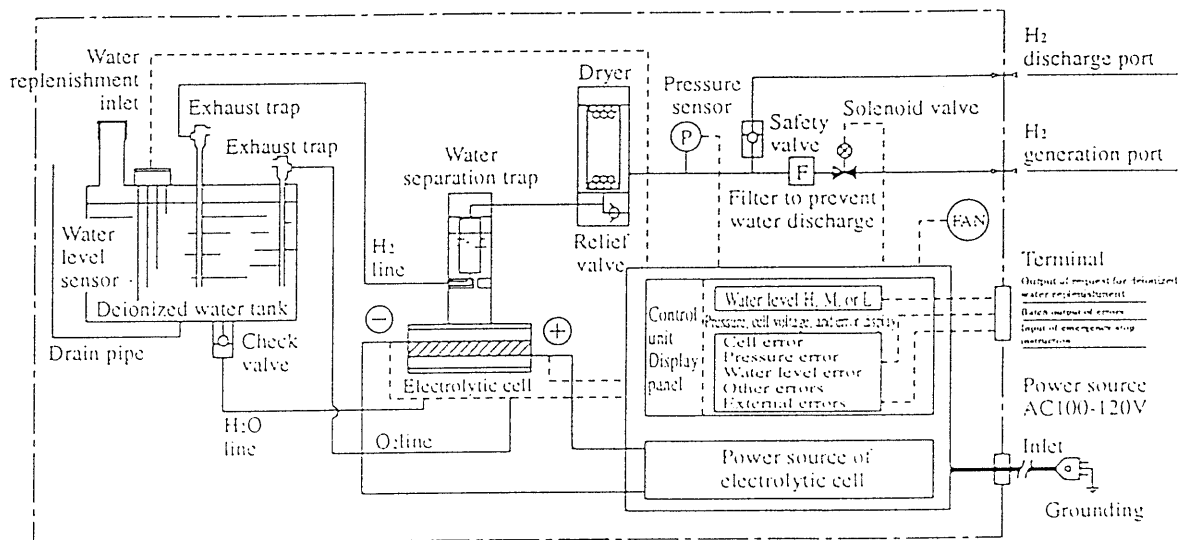


Fig. 1 Configuration

1.3 Specifications

Name	Hydrogen generator	
Model	OPGU-2100	OPGU-2200
Generating principle	Water electrolysis method using solid polymer electrolyte (SPE)	
Concentration of generated	H ₂ 99.99% min. (excluding moisture content)	
Max. generated flow rate	100ml/min (at 25°C, 1013.3hPa)	225ml/min (at 25°C, 1013.3hPa)
Generated pressure	20~400 kPa on gauge (variable)	
Capacity of deionized water tank	2l	
Applicable deionized water	5 MΩ cm min. in resistivity (electric conductivity: 0.2 μS/cm max.)	
Consumption of deionized water	Approx. 5.5 ml/h (when 100 ml/min is generated)	Approx. 12 ml/h (when 225 ml/min is generated)
Hydrogen gas outlet	Rc 1/8 (φ 3mm/φ 2mm Pipe Connector)	
Operating temperature	5 ~ 40°C	
Display	Generated pressure, cell voltage, and error messages can be selected to display (7-segment LED display; 2-digit digital)	
	Water level of deionized water tank (LED display; H, M, or L)	
	Kind of generated error (LED display)	
	Water electrolysis ON/OFF (LED display)	
	Whether shut-off valve at oxygen gas outlet is open or closed (LED display)	
External input/output	Input/output for interlocking with external units ① Input of emergency stop instruction (closing/opening is selectable) ② Output of request for filling water (common closing/opening) ③ Output of notification of generated errors: In batch (common closing/opening)	
Power source	100~120 VAC; 50/60 Hz	100~120 VAC; 50/60 Hz
	100 VA (20 VA when water electrolysis is OFF) Rush current: 1.4 A max. (0.5 sec.)	200 VA (20 VA when water electrolysis is OFF) Rush current: 2.6 A max. (0.5 sec.)
Weight	10 kg (dry)	11 kg (dry)
External dimensions	150 W × 300 H × 430 D (mm) excluding any protruding part	

2. DETAILS OF PARTS

2.1 Details of Parts

The following parts come as standard with the OPGU-2100S/2200S. If any of them is found missing or damaged when the shipment is unpacked, immediately contact us or our dealer:

Table. 1 Standard parts included with the OPGU

Name	Q'ty
Instruction manual	1
Flushing bottle for 1l	1
500 grams of silica gel	1
Filter element	10
Slow-blow fuse ϕ 5X20mm	1
2100Type:1.6A, 2200Type:3.15A	
Cylindrical cartridge for silica gel	2
ϕ 3mm/ ϕ 2mm Pipe connector	1
Power cord	1

3. DESCRIPTION OF THE OPGU

3.1 External View

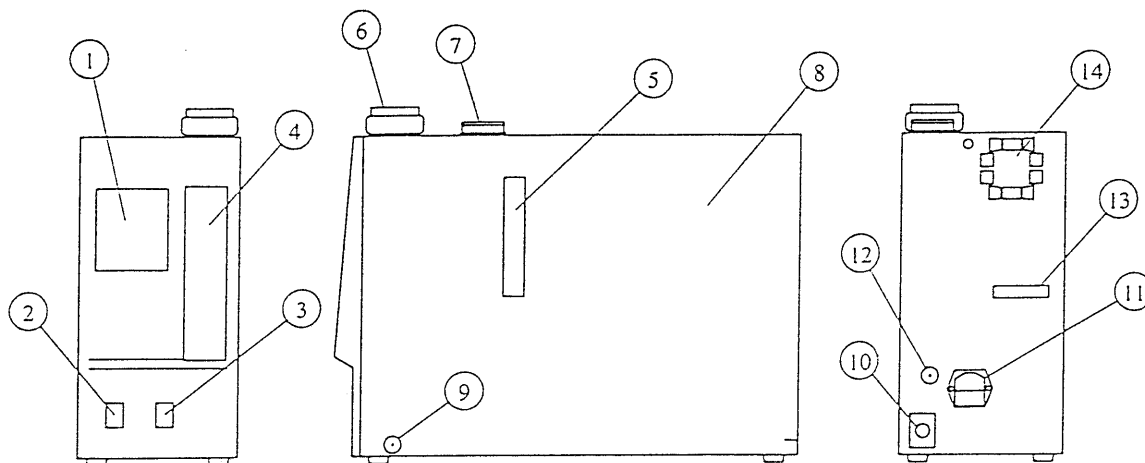


Fig. 2 Outer view of the OPGU

No.	Name	Description
①	Display panel	For details, see "3.2 Display Panel."
②	POWER switch	Switch for turning ON/OFF the power (the display panel is illuminated when this switch is ON.)
③	H ₂ VALVE switch	Switch for shutting off H ₂ (the indicator is lit when this switch is ON)
④	Dryer viewing window	Window through which to view the color of silica gel in the dryer.
⑤	Viewing window on deionized water tank	Window through which to view the water level in the deionized water tank
⑥	Dryer cap	Cap on the port through which to replace the cylindrical cartridge for silica gel in the dryer.
⑦	Cap on deionized water inlet	Cap on the port through which to fill the deionized water tank
⑧	Case cover	Case cover with grips
⑨	Relief valve	H ₂ relief valve inside the OPGU
⑩	H ₂ OUTLET	Outlet of generated H ₂ gas
⑪	Power inlet (with fuses)	Power source of 100~120 V.A.C; 50/60 Hz Incorporated fuse (2100 type: 1.6A; 2200 type: 3.15A)
⑫	H ₂ RELIEF	H ₂ gas release port in case of excessive pressure error in H ₂ line
⑬	Signal terminal bracket	For details, see "3.3 Signal Terminal Bracket."
⑭	Fan ventilation vents	Exhaust vents for air from inside the OPGU

3.2 Display Panel

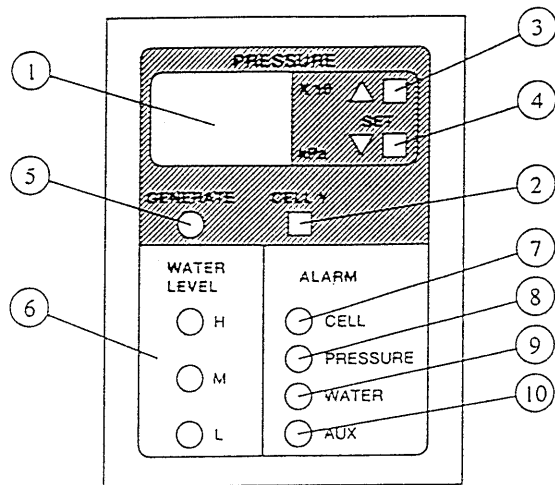


Fig. 3 Display panel

No.	Name	Description
①	PRESSURE display part	<ul style="list-style-type: none"> Shows the pressure of generated H₂ gas (0~40 × 10 kPa from gauge) Voltage across electrolytic cell (hereinafter called “electrolytic cell voltage”) can be alternatively selected to display (water electrolysis ON: 2.0 V or more displayed; water electrolysis OFF: 0.0~1.9 V displayed) If an error occurs, the details of its cause and the pressure of generated H₂ gas are displayed alternately.
②	CELL.V switch	Switch for displaying electrolytic cell voltage (when ON, electrolytic cell voltage is displayed in the PRESSURE display part)
③	SET Δ Switch	Switch for increasing the set pressure of generated H ₂ gas (400 kPa max.)
④	SET ∇ Switch	Switch for decreasing the set pressure of generated H ₂ gas (20 kPa max.)
⑤	GENERATE indicator	<p>Water electrolysis ON/OFF indicator</p> <p>Lights up when water electrolysis is turned ON (electrolytic cell voltage is more than 2.0 V min.)</p> <p>Lights out when water electrolysis is turned OFF (electrolytic cell voltage is less than 2.0 V)</p>
⑥	H, M, and L indicators	<p>WATER LEVEL (water level in deionized water tank) indicators</p> <p>The H, M, and L indicators light up in the descending order of water levels.</p>

No.	Name	Description
⑦	CELL indicator	<p>Electrolytic cell error (ALARM_CELL) indicator (If this indicator lights up, the following details are shown in the PRESSURE display part and water electrolysis is stopped.)</p> <p>C. 1: Overvoltage (2.8 V min.) at SPE electrolytic cell C. 2: Insulation failure or the like at SPE electrolytic cell C. 3: Failure in power supply system for SPE electrolytic cell</p>
⑧	PRESSURE indicator	<p>Generated H₂ gas pressure error (ALARM_PRESSURE) indicator (If this indicator lights up, the following details are shown in the PRESSURE display part and water electrolysis is stopped.)</p> <p>P. 1: Excessive gas pressure (470 kPa min.) in H₂ line P. 2: Leak from H₂ line</p>
⑨	WATER indicator	<p>Low water level error (ALARM_WATER) indicator for deionized water tank (If this indicator lights up, water electrolysis is stopped.)</p>
⑩	AUX indicator	<p>Indicator for any other error (ALARM_AUX) (If this indicator lights up, the following details are shown in the PRESSURE display part and water electrolysis is stopped.)</p> <p>A. 1: Failure in power source for ventilation fan inside the OPGU A. 2: Emergency stop instruction from an external system A. 3: Slanting of or impact to the OPGU</p>

3.3 Signal terminal bracket

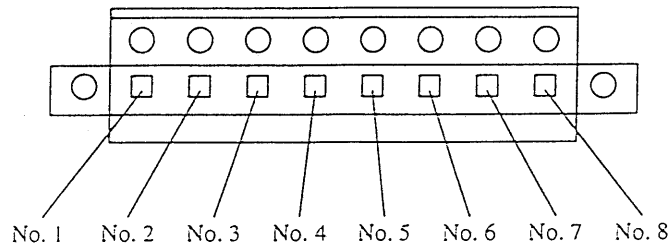


Fig. 4 Signal terminal bracket

- No. 1: Output of request for filling deionized water tank (NO terminal)
- No. 2: Output of request for filling deionized water tank (NC terminal)
- No. 3: Output of request for filling deionized water tank (common terminal)

Output specification: Contact capacity 30 VDC; 200 mA max.
 Output occurs while deionized water is being requested
 (For details of output timings, see "9.3.1 Replenishing deionized water.")

- No. 4: Output of notification of generated error (NO terminal)
- No. 5: Output of notification of generated error (NC terminal)
- No. 6: Output of notification of generated error (common terminal)

Output specification: Contact capacity 30 VDC; 200 mA max.
 Output occurs while any error is existing.

- No. 7: Input of emergency stop instruction (positive signal terminal)
- No. 8: Input of emergency stop instruction (negative common terminal)

Input specification: When short-circuited 1.5 VDC max.; less than 5 mA
 When opened 4~5 VDC
 Emergency stop occurs when Nos. 7 and 8 are short-circuited!
 Logic switching is possible to make emergency stop with this circuit opened! (For logic switching, see "5.3 Initial Mode 3.")

3.4 Inside of the OPGU

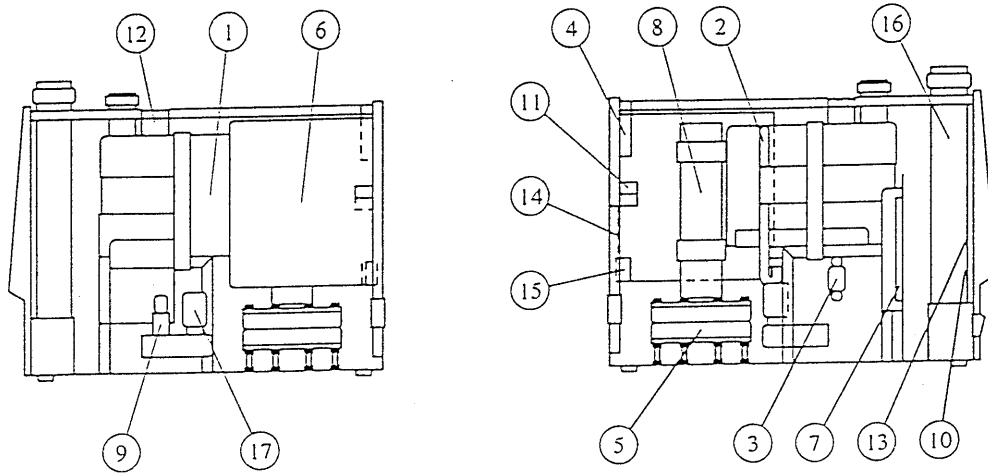


Fig. 5 Inside of the OPGU

No.	Name	Description
①	Deionized water tank	Container (2l) for deionized water being used for water electrolysis
②	Drain tube	Tube for draining deionized water tank
③	Check valve	Check valve for preventing reverse flow from occurring in deionized water circulation line
④	Fan	For ventilating the inside of the OPGU
⑤	Electrolytic cell	Electrolytic cell using solid polymer electrolyte (SPE)
⑥	Cell power source	Switching power source for electrolytic cell
⑦	System power source	Switching power source for system
⑧	Water separation trap	For separating H ₂ gas from water which has passed through electrolytic cell.
⑨	Safety valve	Valve for releasing H ₂ gas if internal pressure has abnormally increased
⑩	Pressure sensor	Sensor for monitoring the pressure of generated H ₂ gas
⑪	Vibration sensor	Sensor for detecting any slanting, vibration, or impact throughout the OPGU
⑫	Water level sensor	Titanium electrode sensor for detecting the level of deionized water
⑬	Control/display circuit board	For controlling the OPGU and displaying data
⑭	Interfacing board	For signal connections with external devices
⑮	Noise filter	Filter for eliminating noise from power source
⑯	Dryer	Cylinder for drying silica gel
⑰	Solenoid valve	Valve for opening/closing the line for generated H ₂ gas

4. INSTALLATION

4.1 Installation Environment

Warning

Risk in handling hydrogen gas:

If a large amount of hydrogen gas leaks in an insufficiently ventilated room, explosion might occur.

Be careful with fire:

Use the unit in a place free from fire.

Use the unit in a well ventilated place.

1. Room temperature Use the OPGU at an ambient temperature in the range from 5°C to 40°C without no sudden fluctuation. If the electrolytic cell is frozen, it can be no longer used as its inside is broken.
2. Installation base Use the OPGU in a flat place without any vibration.
3. Corrosive gas and dust Avoid installing the OPGU in a place where metal, salt, or any other kind of particle is generated or a large amount of organic solvent, corrosive gas, or dust exists.
4. Electromagnetic waves and power source noises Do not install the OPGU in a place where it is exposed to strong electromagnetic waves or strong noises from the power source. It may cause a malfunction of the OPGU or a failure in obtaining data to the specification.

4.2 Removing stoppers

Caution

Take off the case cover and remove two rubber stopper on the exhaust trap. These stoppers are used to protect the OPGU during its transportation. Be sure to remove them; or a failure or a safety risk can occur.

- 1) Remove six setscrews for the case cover, which can be found on the lateral sides of the OPGU. Remove the cap on the deionized water inlet and then take off the case cover upward.
- 2) Remove rubber stoppers A and B on the exhaust trap located on the top of the deionized water tank (Fig. 6).
- 3) Put the case cover back in place.
- 4) Put the cap back on the deionized water inlet.

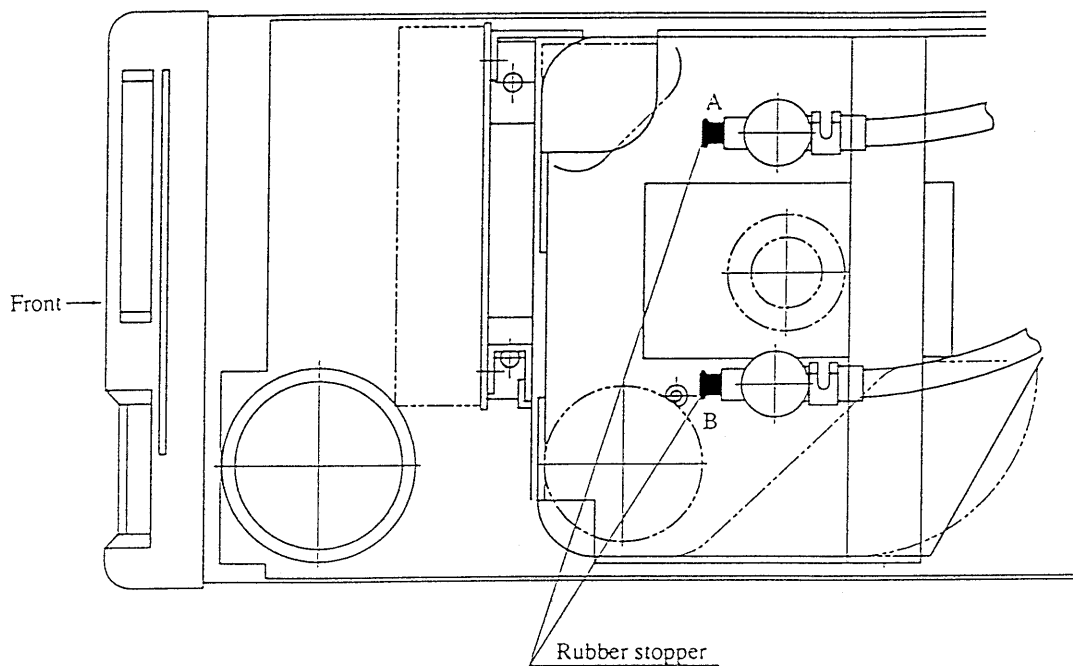


Fig. 6 Rubber stoppers on exhaust trap

4.3 Charging Silica Gel

The dryer was not filled with silica gel at the factory so that the electrolytic cell would not be dried. Charge silica gel as described in "9.3.2 Replacing silica gel."

4.4 Supplying deionized water

The deionized water tank was supplied with deionized water at the factory up to only the minimum level required to prevent the electrolytic cell from being dried. Replenish deionized water as described in "9.3.1 Replenishing deionized water."

4.5 Piping

. Connection of piping

(1) Piping of H₂ OUTLET

A blind plug is fitted at H₂ OUTLET on delivery. Detach the plug, and connect the OD 3 mm stainless pipe with attached fitting.

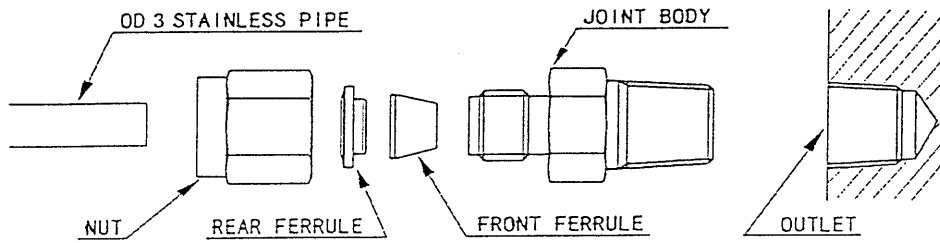


Fig. 5 JOINT

RELIEF (H₂): Rear of the OPGU

Caution

If the pressure of generated H₂ gas rises abnormally due to a failure in the pressure sensor or any other reason, the safety valve is actuated to release the H₂ gas from this exhaust port.

Connect a PVC tube of 9 mm o.d./5 mm i.d. to exhaust the generated H₂ gas to a safe place.

4.6 Connecting the power source

Caution

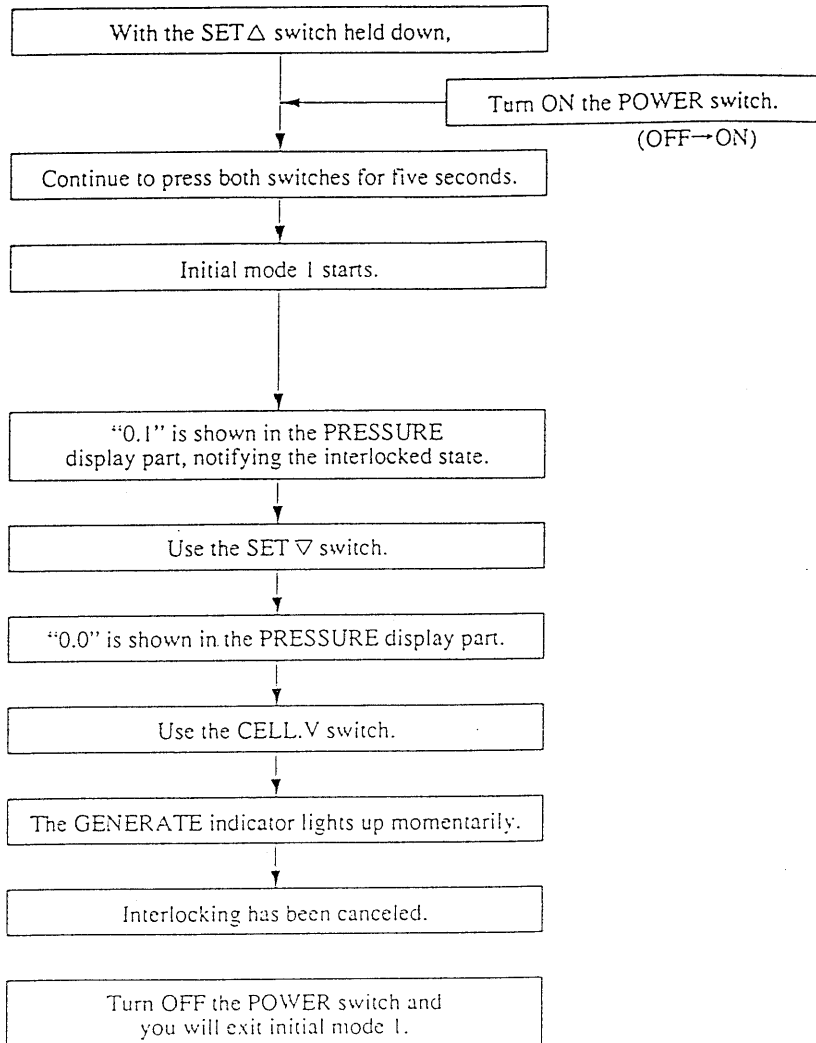
- Check that the power source used is compatible with the specification of the power source for the OPGU. At least the capacity shown in the specification is required for 100-120 VAC \pm 10%, 50 or 60 Hz (single phase).
- Connect the grounding wire to the grounding terminal on the plug socket. If the grounding wire is not connected or improperly connected, you might get an electric shock.

5. INITIAL SETTING

5.1 Initial Mode 1

- Description of mode: This mode is used to cancel interlocking resulting from an error.

- ◇ Starting the mode:

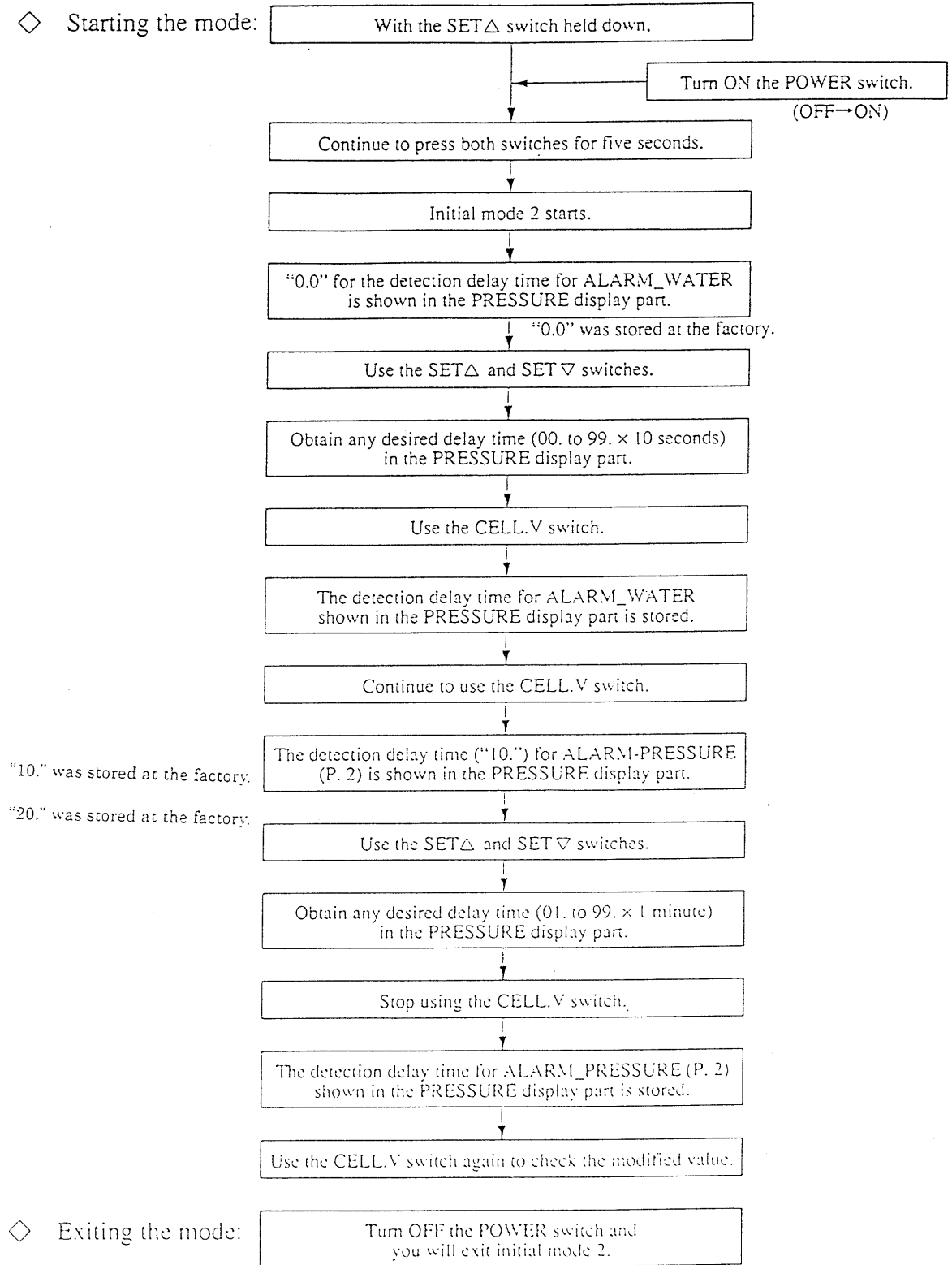


- ◇ Exiting the mode:

5.2 Initial mode 2

- Description of mode: This mode is used to set the detection delay time for ALARM_WATER and that for ALARM_PRESSURE (P. 2).

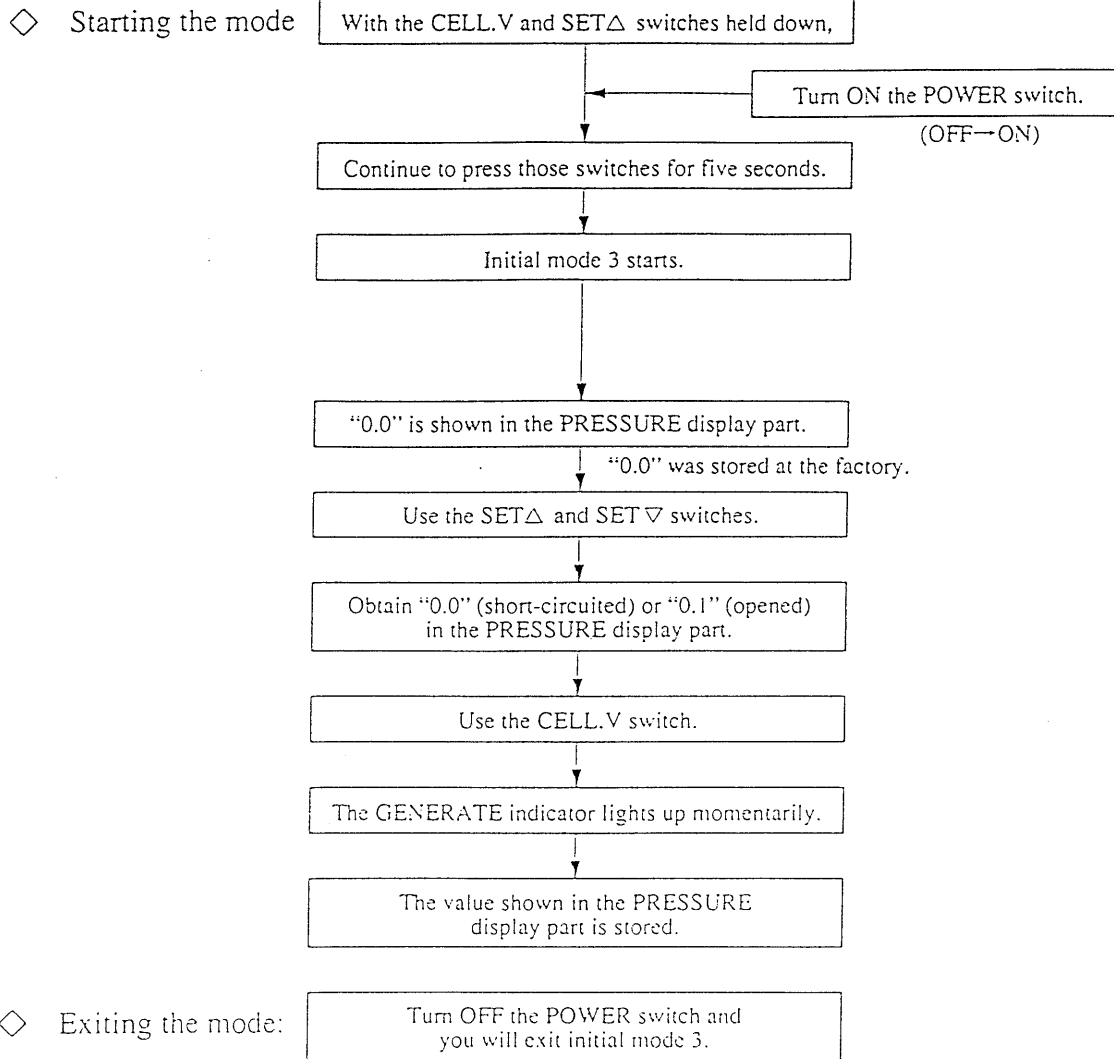
- ◇ Starting the mode:



- ◇ Exiting the mode:

5.3 Initial Mode 3

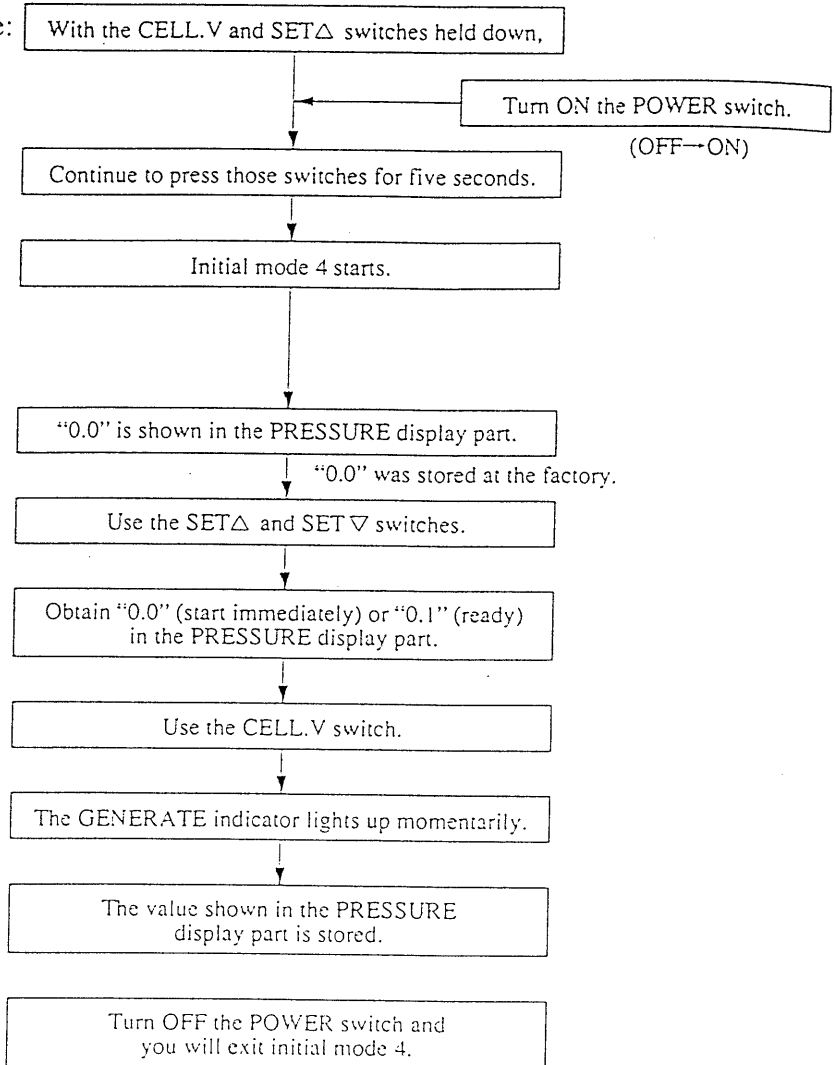
- Description of mode: This mode is used to select a state (short-circuited or opened) in which to accept the input of emergency stop instruction for ALARM_AUX (A.2).



5.4 Initial Mode 4

- Description of mode: This mode is used to select a method (immediate start or stand-by) to start water electrolysis when the power is turned ON in the normal mode.

- ◇ Starting the mode:



- ◇ Exiting the mode:

Turn OFF the POWER switch and you will exit initial mode 4.

6. BASIC OPERATIONS

6.1 Starting water electrolysis

Caution

For the safety purpose, be sure to put the case cover in place when operating the OPGU. Otherwise, you might get an electric shock.

- 1) Turn ON the POWER switch and check:
 - The PRESSURE display part is illuminated.
 - The GENERATE indicator lights up (It comes out if the pressure of generated H₂ gas is the same as the set pressure in the stand-by mode for water electrolysis).
 - The CELL indicator comes out.
 - The PRESSURE indicator comes out.
 - The AUX indicator comes out.
 - The WATER indicator comes out.
 - The H, M, or L indicator lights up. (The M indicator lights up if the water level in the deionized water tank is positioned at the center of the viewing window for the deionized water tank.)
- 2) Turn OFF the H₂ VALVE switch (whose indicator lights out) to shut off the line for generated H₂ gas.
- 3) When the POWER switch is turned ON in step 1, you are given two options; the mode of immediately starting water electrolysis and that of standing by for it. Select the desired mode (see "5.4 Initial mode 4").

[In the case of selecting the mode of standing by for water electrolysis], If you use the SET Δ or SET ∇ switch, water electrolysis starts. During this mode, the pressure in the line for generated H₂ gas is displayed with two decimal points blinking in the PRESSURE display part. When the OPGU is recovered from a power failure (approx. 0.2 seconds min.), the use of the stand-by mode enables you to suspend the start of water electrolysis until the SET Δ or SET ∇ switch is used.

6.2 Starting H₂ Generation

- 1) Once water electrolysis is started, use the SET ∇ switch to set the pressure to 20 kPa. During the setting mode, the current set pressure value is displayed with two decimal points blinking in the PRESSURE display part. Several seconds after the pressure has been set, the mode is changed to the pressure display mode.

- 2) In order to purge the air in the line for generated H₂ gas with H₂ gas, turn ON the H₂ VALVE switch (whose indicator lights up) to send H₂ gas at atmospheric pressure for 5 to 10 minutes.

Caution

The H₂ gas used to purge the air must be released to a safe place, e.g., outside the room. The OPGU must not be operated for more than 10 minutes while generated H₂ gas is being released to ambient air. The continuous operation mode in that state is not available. The factory setting causes the ALARM PRESSURE indicator to light up with the "P.2" message displayed, if such operation has continued for 10 minutes.

- 3) After purging the air with H₂ gas, turn OFF the H₂ VALVE switch (whose indicator comes out) to shut off the line for generated H₂ gas.
- 4) Using the SET Δ and SET ∇ switches, set the pressure to the desired value within the range from 20 to 400 kPa.
- 5) Perform the piping for the devices being connected.
- 6) When the pressure shown in the PRESSURE display part has reached the set value, turn ON the H₂ VALVE switch (whose indicator lights up) to start sending H₂ gas.
- 7) If you wish to modify the set pressure, use the SET Δ and SET ∇ switches to obtain the desired value within the range from 20 to 400 kPa. The set value is stored and even if the POWER switch is turned OFF and then ON, the pressure is controlled at that value.

Caution

Check the piping joints for any leak by using leak detection liquid or the like.

Note

After H₂ gas starts being generated, its pressure may temporarily decrease depending on the piping capacity. However, the pressure is immediately controlled at the set value so far as the flow rate for consumption is appropriate.

6.3 Stopping H₂ gas from being generated

- 1) To temporarily stop H₂ gas from being generated, turn OFF the H₂ VALVE switch (whose indicator comes out).
- 2) To restart generating H₂ gas, turn ON the H₂ VALVE switch (whose indicator lights up).

Caution

If H₂ gas is not used for more than 16 hours, turn OFF the POWER switch to release H₂ gas with the relief valve so that the internal pressure is reduced to an atmospheric pressure. If the OPGU is used for more than this time period while H₂ gas remains pressurized, the electrolytic cell can deteriorate. Press the relief valve at its center to release H₂ gas (several thousand ml) from inside the OPGU to a safe place free from fire. In addition to H₂ gas, a small amount of water comes out. Use rags or the like to soak it. If the relief valve cannot be used for safety or any other reason, perform the following steps:

1. Use the SET ▽ switch to set the pressure to 20 kPa.
2. Release H₂ gas from the H₂ gas outlet until 20 kPa is shown in the PRESSURE display part, and then turn OFF the POWER switch.
3. Turn OFF the H₂ VALVE switch.

6.4 Finishing Operation

- 1) To finish the operation, turn OFF the H₂ VALVE switch (whose indicator goes off).
- 2) Turn OFF the POWER switch.
- 3) Release H₂ gas with the relief valve so that the internal pressure is reduced to an atmospheric pressure.

6.5 Absence of Use for a Long Period

If the OPGU is not used for more than one months, take the steps described in "6.4 Finishing Operation" and then store the OPGU.

- 1) Make sure that deionized water remains up to 1/4 minimum the length of the viewing window on the deionized water tank (or in the state that the L indicator is lit).
- 2) Remove the cylindrical cartridge for silica gel for the dryer and store it separately.
- 3) Disconnect the piping for the H₂ gas outlet and put the appropriate cap on it.
- 4) Store the OPGU while keeping it away from dust.

Caution

The cylindrical cartridge for silica gel for the dryer must be removed. If it is left in the dryer, changes in the internal pressure can cause water to enter the H₂ line, so that the electrolytic cell may be dried and then deteriorate.

7. TROUBLESHOOTING

If any failure should occur, check the following items and contact us or our dealer to ask for inspections and services by a service person.

7.1 If Display Panel Is Not Illuminated

1) Check the following items starting with step 2).

2) Checking the power supply

Is the power cable which is included as standard, connected to the power inlet?

Does the supply voltage meet the specification?

3) Checking the fuse

Is the built-in fuse at the power inlet blown? If yes, replace it with a new fuse which is supplied as standard. If that fuse is also blown immediately, the wiring or a part may be short-circuited. Never use any fuse other than those supplied as standard.

4) Turning ON the POWER switch

If the indicator does not light up and no H₂ gas is generated, ask for the periodical inspection and maintenance services (see "9.4 Periodical Inspection and Maintenance Services").

The POWER switch is in failure (replace it).
The cell power source is in failure (replace it).
The system power source is in failure (replace it).
The control or display board is not powered; or a comprehensive failure exists (replace the relevant parts)

7.2 If the Pressure Cannot Be Controlled at a Given Value

1) Check the following items starting with step 2).

2) Is the GENERATE indicator lit? If this error indicator is lit, take the appropriate action (see "8. ACTIONS TO BE TAKEN IF AN ERROR INDICATOR LIGHTS UP").

3) Is the pressure set to a value within the specified range?

4) Turn OFF the H₂ VALVE switch (whose indicator comes out) to shut off the line for generated H₂ gas.

5) If the pressure still cannot be controlled at the set value after steps 2), 3), and 4) are performed, there is a leak from the piping inside the OPGU. Ask for periodical inspection and maintenance services (see "9.4 Periodical Inspection and Maintenance Services").

- 6) If the pressure can be controlled at the set value in step 5), turn ON the H₂ VALVE switch (whose indicator lights up). If the pressure becomes uncontrollable at the set value by turning ON the H₂ VALVE switch, check to see whether there is a leak from the piping between the OPGU and the device to which H₂ gas is sent. If there is no leak, check to see whether the consumed flow rate of H₂ gas exceeds the maximum generated flow rate.

7.3 If GENERATE Indicator Remains Lit

- 1) Turn OFF the H₂ VALVE switch (whose indicator goes off) to shut off the line for generated H₂ gas.
- 2) If the GENERATE indicator still remains lit after the above step 1), there is a leak from the piping inside the OPGU. Ask for the periodical inspection and maintenance services (see "9.4 Periodical Inspection and Maintenance Services").
- 3) If the GENERATE indicator comes out in step 2), turn ON the H₂ VALVE switch (whose indicator lights up) to open the line for generated H₂ gas. If the GENERATE indicator comes to remain lit again after this action, check to see whether there is a leak from the piping between the OPGU and the device to which H₂ gas is sent. If there is no leak, check to see whether the consumed flow rate of H₂ gas exceeds the maximum generated flow rate.

7.4 If Purity of H₂ Gas Is Too Low

- 1) The concentration of moisture content is high. Check the silica gel used for the dryer. If the silica gel is defective, replace it (see "9.3.2 Replacing silica gel").
- 2) Other gases are detected as impurities. Purge the piping and other similar parts and then try to detect those gases. If silica gel to which impurities have been adsorbed is used, those impurities are subsequently separated and then detected. If this is the case, replace the silica gel (see "9.3.2 Replacing silica gel").

7.5 If Water Comes to Dryer

- 1) If the OPGU never be used for a long period, the omission of the required actions is suspected (see "6.5 Absence of Use for a Long Period").
- 2) Check to see whether the pressure is 20 kPa min. at the H₂ outlet.
- 3) Has silica gel been replaced? If water comes to the dryer, the inside of the dryer and the H₂ gas line must be purged and silica gel must be replaced (see "9.3.2 Replacing silica gel").

- 4) If no problem has been found in steps 2) and 3), the float valve on the water separation trap malfunctions or is clogged. Ask for the periodical inspection and maintenance services for the above purge and replacement (see "9.4 Periodical Inspection and Maintenance Services").

7.6 If Consumption of Deionized Water Become Too Large

- 1) Check the water tank and the deionized water line for any leak of water (see "9.4 Periodical Inspection and Maintenance Services").
- 2) It is recommended that you check the piping inside and outside the OPGU for any leak of gas (see "9.4 Periodical Inspection and Maintenance Services").

8. ACTIONS TO BE TAKEN IF AN ERROR INDICATOR LIGHTS UP

8.1 Error Hold Function

8.1.1 Checking the history of generated errors

If a certain existing error is followed by the occurrence of other errors, the message for the last generated error and the pressure of generated H₂ gas are alternately shown in the PRESSURE display part. If you wish to check other generated errors, use the following actions:

With the **CELL.V switch** held down, press the **SET Δ switch** once (approx. 0.5 seconds) The error directly after the currently displayed one is shown.

With the **CELL.V switch** held down, press the **SET ∇ switch** once (approx. 0.5 seconds) The error directly before the currently displayed one is shown.

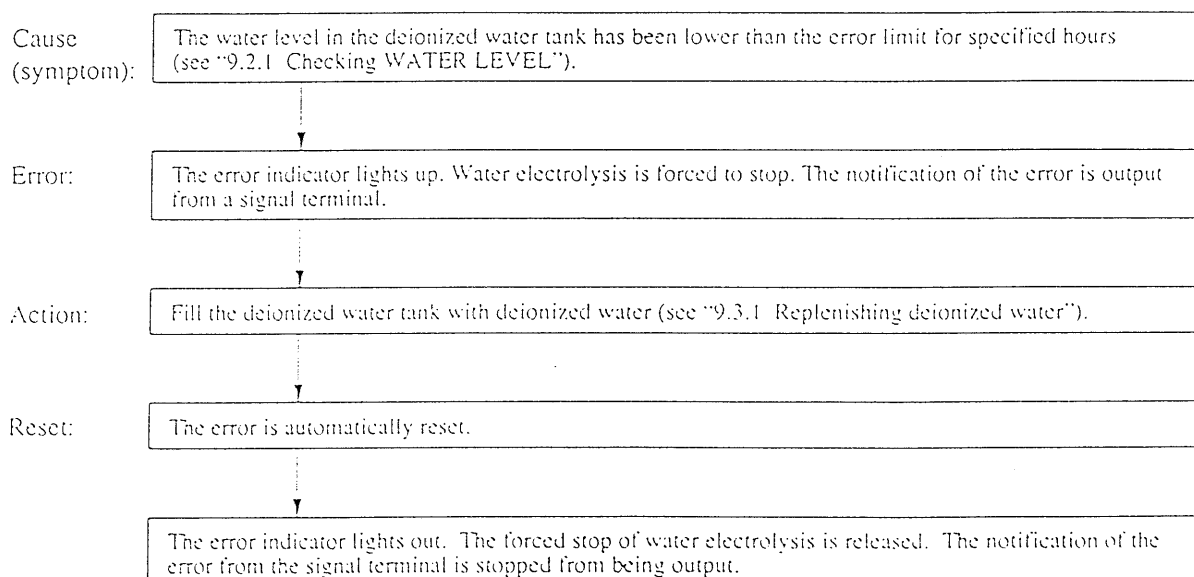
8.1.2 Resetting an error

Once an error has occurred, except for the WATER error, it is retained and cannot be reset by turning the POWER switch ON and then OFF. To reset the error, see the paragraph describing how to reset that error.

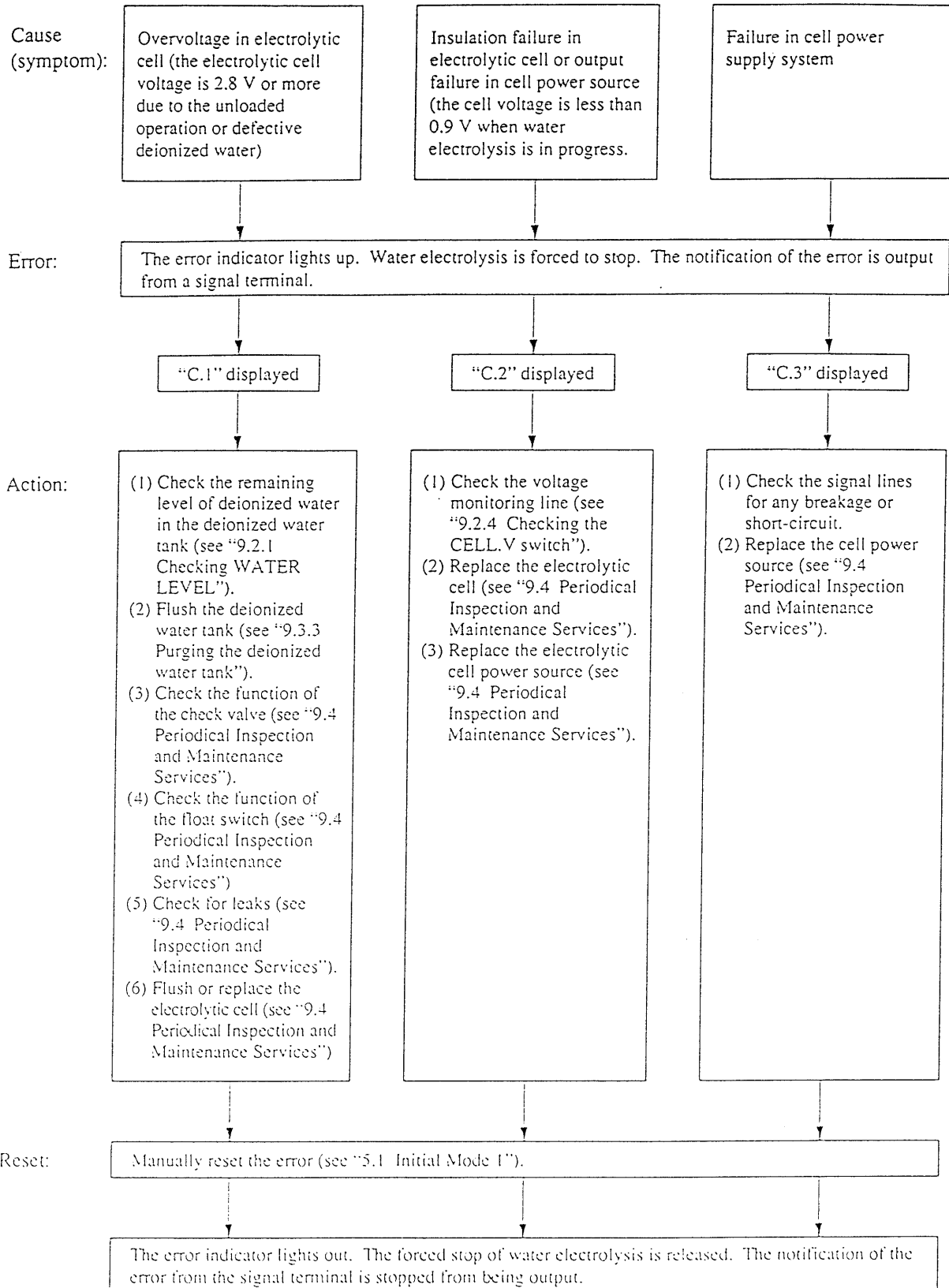
8.1.3 Action to be taken if an error continues

If an error continues after the appropriate action is taken for it, there is a failure. Contact us or our dealer to ask for inspection and maintenance services by a service person.

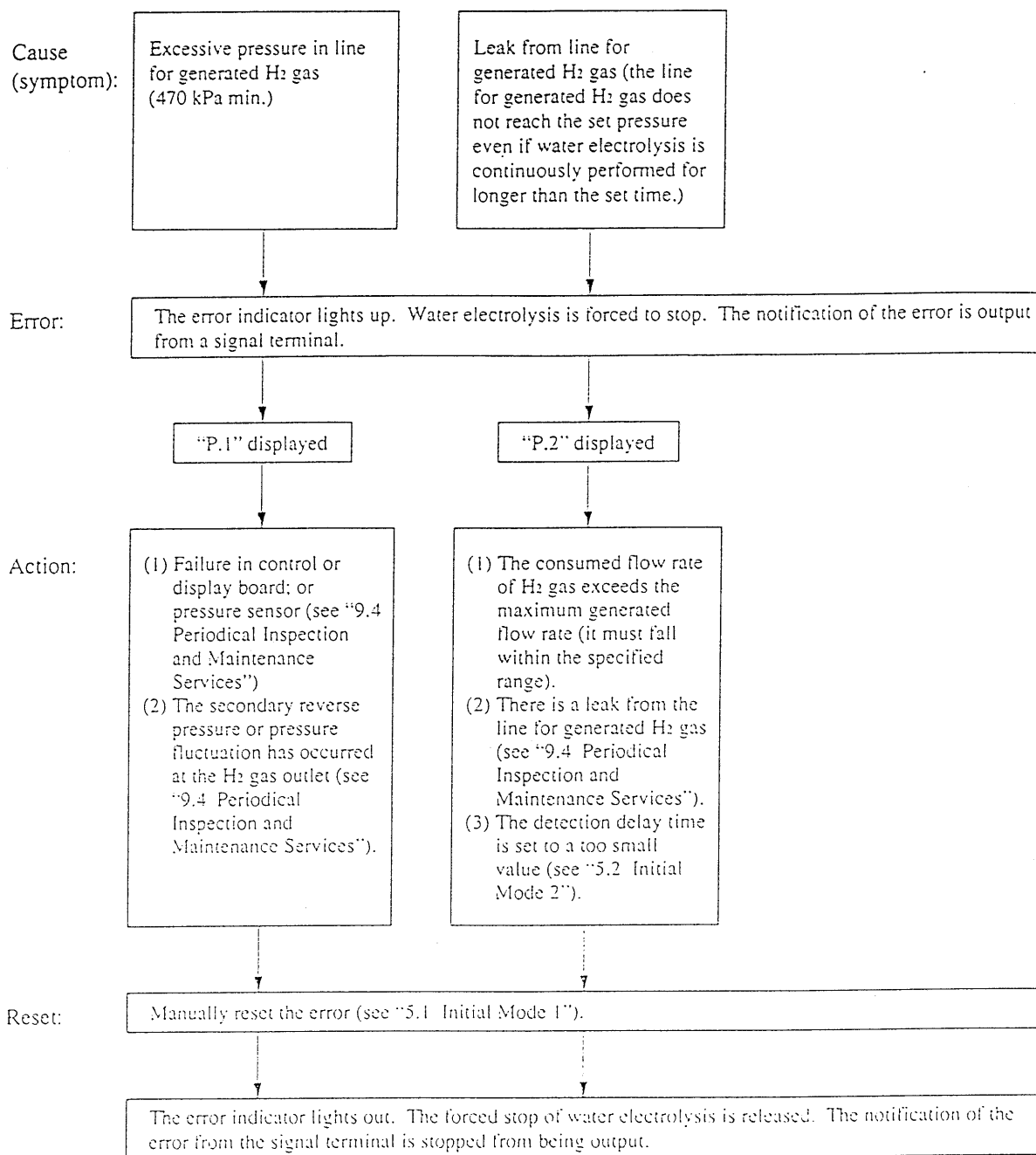
8.2 The WATER Indicator Lights Up



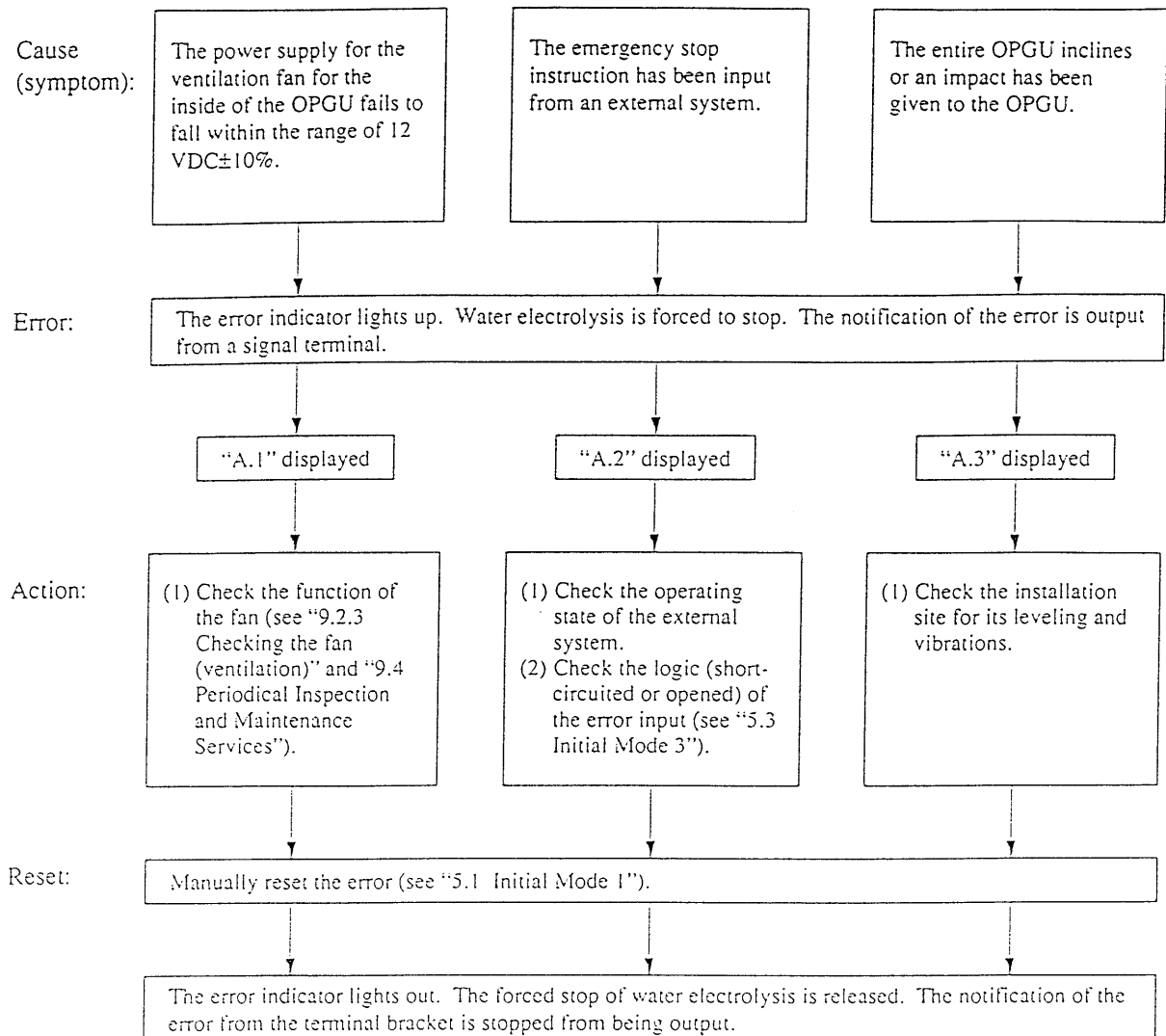
8.3 The CELL Indicator Lights Up



8.4 The PRESSURE indicator lights up



8.5 The AUX Indicator Lights Up



9. MAINTENANCE

9.1 Inspection and Maintenance Items

Periodically check the items listed in Table 2.

Table 2 Inspection and maintenance items

	Item	Daily	Weekly	Monthly	Every 2 years	Remarks
Daily inspection	Check WATER LEVEL	○				See 9.2.1.
	Check dryer	○				See 9.2.2.
	Check fan (ventilation)	○				See 9.2.3.
	Check CELL.V switch	○				See 9.2.4.
	GENERATE ON/OFF time		○			See 9.2.5.
Daily maintenance	Replenish deionized water		○			See 9.3.1.
	Replace silica gel		○			See 9.3.2.
	Flush deionized water tank			○		See 9.3.3.
Periodical inspection and maintenance services				○	See 9.4.	

9.2 Daily Inspections

9.2.1 Check WATER LEVEL

- 1) The indicator H, M, or L lights up in the descending order of water levels in the deionized water tank. If the water level becomes below "L", the WATER error indicator lights up.
- 2) The WATER error indicator lights up when the set detection delay times has elapsed after the water level becomes below the L level (error limit). This indicator blinks during the detection delay time. For setting the detection delay time, see "5.2 Initial Mode 2."
- 3) If the operation is still continued, the deionized water decreases. If you find that the L indicator lights up, replenish deionized water without delay by seeing "9.3.1 Replenishing deionized water."

In principle, check the water level in the deionized water tank every five to seven days, though this interval varies depends upon the consumption of H₂ gas and the ambient temperature. This check can also be made through a viewing window on either side of the OPGU.

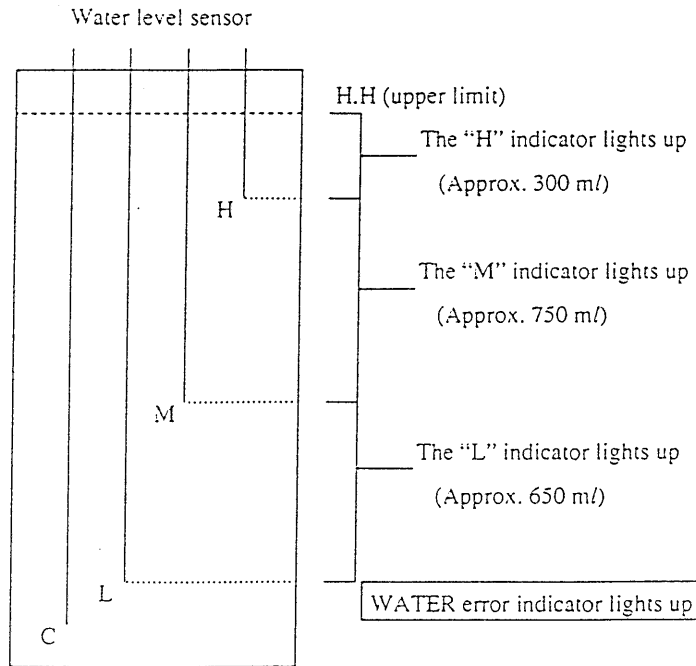


Fig. 8 Water level in deionized water tank

9.2.2 Checking the dryer

- 1) The humidity absorbing performance of silica gel deteriorates as the operation is carried out. Check the color of silica gel through the dryer viewing window located on the control panel. If approximately one third the lower part of the window becomes pink, replace silica gel. The silica gel generated for 200 ml/min is available for approximately one week, but this length varies depending on the consumption of H₂ gas and the ambient temperature. Frequently replace silica gel with dry one (blue-colored) by seeing "9.3.2 Replacing silica gel."

9.2.3 Checking the fan (ventilation)

- 1) Check to see whether wind is blown from the vents of the ventilation fan located on the rear. If the inside of the OPGU is not ventilated due to a failure in the fan, the OPGU must be stopped and then the fan must be checked and replaced, if necessary (see "9.4 Periodical Inspection and Maintenance Services").

9.2.4 Checking the CELL.V switch

In order to ensure the maximum life of the OPGU, the electrolytic cell must be kept in the normal state. The state of the electrolytic cell can be identified, in principle, by checking its voltage. In stead of a pressure value, the cell voltage

is shown in the PRESSURE display part while the CELL.V switch is being held down. Read the initial voltage when the GENERATE indicator is lit.

Normal value for cell voltage: 2.1~2.6 (V)

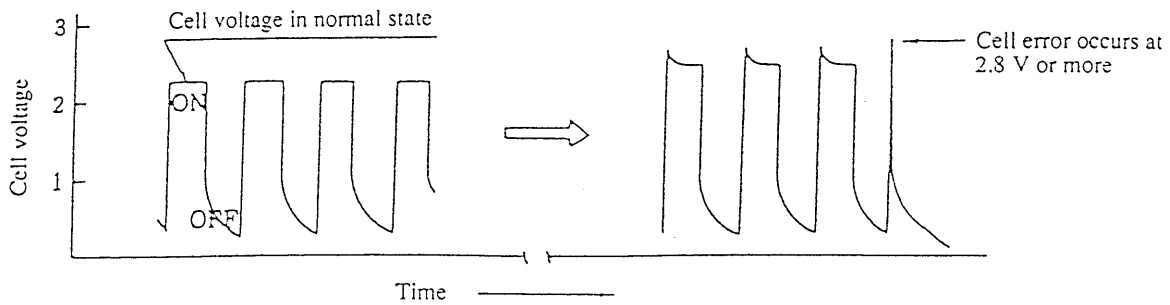


Fig. 9 Cell voltage diagram

If the cell voltage becomes 2.8 V or more, the cell error occurs and water electrolysis is stopped. The possible causes for an increase in the cell voltage are listed below. Take the appropriate action without delay.

- 1) Defective deionized water..... See "9.3.3 Purging the deionized water tank" to flush the deionized water tank and replenish deionized water.
- 2) Unloaded electrolytic cell..... See "9.4 Periodical Inspection and Maintenance Services."
 - A failure in the check valve (deionized water is not circulated through the electrolytic cell)
 - A failure in the float switch inside the water separation trap
 - A water leak
- 3) Deterioration of the electrolytic cell See "9.4 Periodical Inspection and Maintenance Services".

9.2.5 ON/OFF duration of the GENERATE indicator

If the OPGU is used for generating a given amount of H₂ gas, check the ON/OFF duration of the GENERATE indicator. This enables you to find the occurrence of any anomaly earlier (though the ON/OFF duration slightly varies depending on the ambient temperature and other factors).

If the ON duration becomes longer:

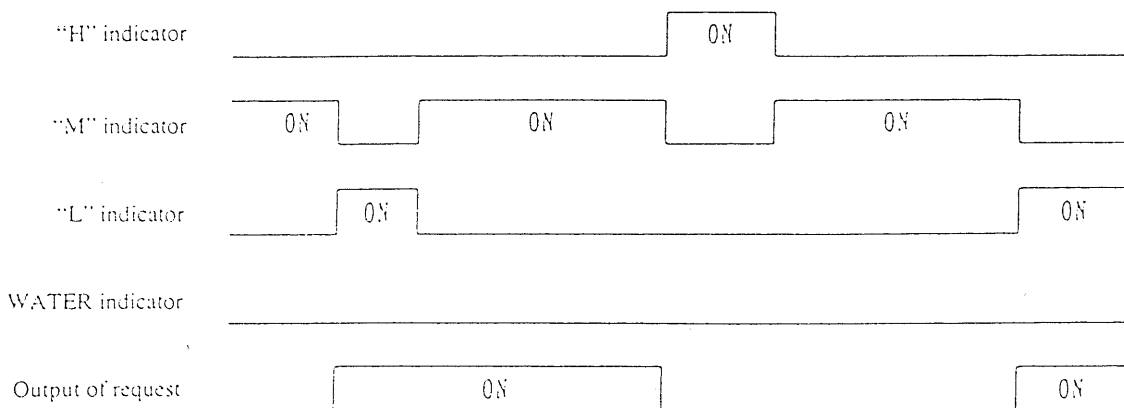
A leak from the H₂ gas line inside or outside the OPGU or deterioration of the electrolytic cell is suspected to cause a decrease in the amount of generated H₂ gas. Perform the periodical inspection and maintenance service earlier (see “9.4 Periodical Inspection and Maintenance Services”).

9.3 Daily Maintenance

9.3.1 Replenishing deionized water

- 1) Using deionized water, clean the flushing bottle which comes with the OPGU.
- 2) Remove the cap from the deionized water inlet and replenish deionized water from the flushing bottle through the deionized water inlet until the “H” indicator lights up. Do not replenish deionized water exceeding the H.H level of the viewing window located on the deionized water tank. Take care not to splash deionized water to any part other.
- 3) Put the cap back to the deionized water inlet.
- 4) Steps 1), 2), and 3) are required for the manual check and operation to replenish deionized water through the deionized water inlet. In order to configure a system to carry out this process automatically, the output of a request for filling the deionized water tank is available as standard. The output timing of a request for filling the deionized water tank is shown in the diagram below. Use this diagram as necessary. For the signal connections, see the paragraph for the signal terminal bracket.

If detection delay time is 0 second:



If detection delay time is 10~990 seconds:

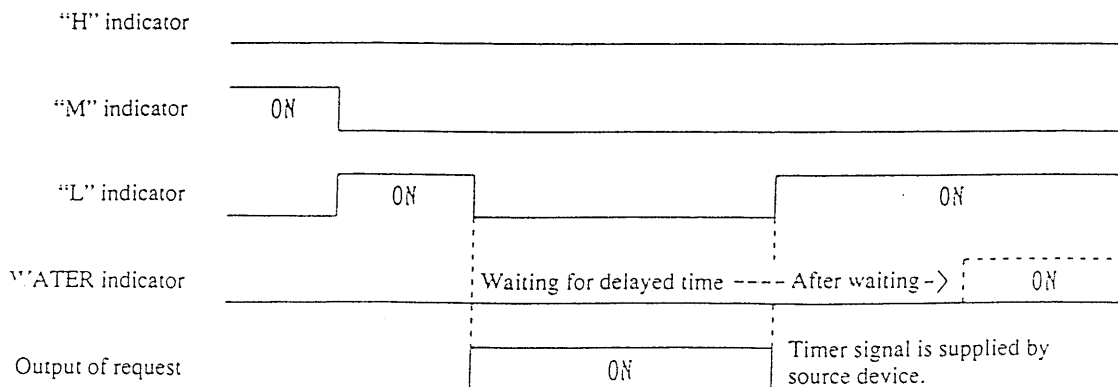


Fig. 10 Output timing of a request for filling the deionized water tank

When handling deionized water being supplied, observe the following instructions:

Caution

- Use deionized water whose resistivity is 5 MΩ.cm minimum (electric conductivity: 0.2 μS/cm max. as measured when deionized water is sampled). Never use any other water (e.g., tap water) because the electric cell is damaged or deteriorates.
- Do not use any metallic or PVC container. Use a polyethylene or Teflon container. The container must be used exclusively for the OPGU. The container must be stored by putting it in a polyethylene bag to keep the container away from dust.
- When you use the device of making deionized water, periodically check the sensitivity of the built-in meter for electric conductivity in accordance with its manufacturer's instructions.
- Be sure to make the cap put on the deionized water inlet except when deionized water is replenished, so that deionized water is prevented from being contaminated with dust or any other foreign matter.

9.3.2 Replacing silica gel

- 1) For the initial filling, start with step 7); for the replacement during maintenance, start with step 2).
- 2) Check that the H₂ VALVE switch is OFF (its indicator is not illuminated).
- 3) Check that the POWER switch is OFF.
- 4) Before removing the dryer cap, press the relief valve at its center to release the H₂ gas pressure inside the dryer (see "6.4 Finishing the Operation"). It is recommend to use rag or the like on your fingers when using the relief valve. Although a little amount of water may come out, the water accumulated in the bottom of the dryer can be drained.

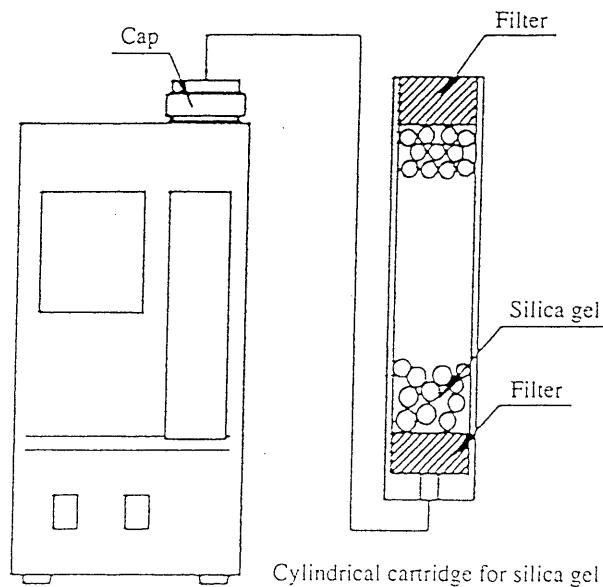


Fig. 11 Replacing the cylindrical cartridge for silica gel

- 5) Remove the dryer cap by turning it counterclockwise. Take out the cylindrical cartridge for silica gel from the cartridge replacement port.
- 6) Replace the upper and lower silica gel filters in the cartridge.
- 7) Set the new upper and lower filters which come as standard with the OPGU, in the supplied standard cartridge or the one removed from the dryer (Fig. 11). Then fill the cartridge with blue-colored, round, dry grains of silica gel (do not fill it with powdered silica gel).
- 8) For the initial filling, remove the dryer cap by turning it counterclockwise. Put the cartridge back in the dryer through the cartridge replacement port while taking care for the orientation of the cartridge filled with silica gel.

- 9) Tightly close the dryer cap to ensure that there is no leak of H₂ gas.
- 10) To restart the OPGU after this replacement, purge with H₂ gas for approximately 10 minutes. (See “6.1 Starting Water Electrolysis” and “6.2 Starting H₂ Generation”).

9.3.3 Flushing the deionized water tank

Since deionized water is used, the wetted parts may gather algae. The gathered algae can clog the water piping or cause a malfunction of the check valve. In addition, since dirty impurities are condensed in the tank, the electrolytic cell is adversely affected. Periodically flush the deionized water tank to ensure that the OPGU is always operated in a clean state.


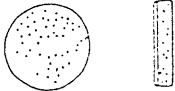
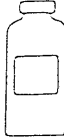
- 1) Prepare 5-6 lit of deionized water and a drain container (approx. 10l).
- 2) Turn OFF the POWER switch and then unplug the power cord.
- 3) Remove six set screws on the case cover, which can be found on the lateral sides of the OPGU. Remove the cap from the deionized water inlet and take off the cover upward.
- 4) Lower the leading end of the drain tube from the deionized water tank into the drain container and then remove the rubber cap on that leading end. The deionized water in the tank will be drained. Make sure that the deionized water is drained completely.
- 5) Put the drain tube back in place and supply deionized water through the deionized water inlet until the tank is filled up to approximately its seven tenth.
- 6) Repeat the flushing operation described in steps 4) and 5) at least three times.
- 7) After flushing the tank, put the rubber cap back in place on the drain tube.
- 8) Set the case cover in place.
- 9) Put the cap back to the deionized water inlet.
- 10) Turn ON the POWER switch and check the operation of the OPGU.

9.4 Periodical Inspection and Maintenance Services

Ask for the general inspections every two years. The general inspections include the following check items. For further details, contact us or our dealer. If your checks with a failure show that inspections and services are required, e.g., for replacing or flushing any part and checking for leaks of H₂ gas or water, then contact us or our dealer to ask for inspections and services by a service person.

- 1) General operation checks
- 2) Check for leaks of H₂ gas
- 3) Check for leaks of water
- 4) Checks of parts related to water piping (replacement and flushing)
 - Water piping
 - Water level sensor
 - Deionized water tank
 - Check valve
 - Water separation trap
 - Electrolytic cell *
 - * The estimated life time of electrolytic cell is 2 years, although it depends on the purity of water.
 - Replacement at every 2 years is recommended.
- 5) Checks of other parts (replacement)
 - POWER switch
 - Cell power source
 - System power source
 - Control and display boards
 - Interface board
 - Solenoid valve
 - Fan
 - Others

Parts for Maintenance

Part No.	Part name	Illustration
221-45130-01	Inner cylinder of dryer	
221-45130-02	Filter element (for inner cylinder of dryer; 10 pcs. included)	
221-45130-03	Silica gel	 Contents: 500 g