

1030219100



**INSTRUCTION MANUAL**



**HYDROGEN GENERATOR**

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**OPGU—7100 / 7200**

**STEC. INC**

## ■ PREFACE

Thank you very much for purchasing HYDROGEN GENERATOR OPGU-7100/7200.

This instruction manual is edited for users operate this equipment.

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

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

In this instruction manual, pressure is expressed with "kPa" unit. And these pressures indicate 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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# ◆ INSTRUCTIONS FOR SAFETY OPERATION

For safety operation, warning marking is made on the equipment as follows.  
Warning messages are also described in this instruction manual.  
Read and understand these messages thoroughly before operating the equipment.  
Concerning the warning on the equipment, see also next page.



## WARNING

Failure to abide by the information in a **WARNING** may result in serious injury and can be life threatening.



## CAUTION

Failure to abide by the information in a **CAUTION** may result in moderate injury and/or property or product damage.



## WARNING

- BE CAREFUL WITH FIRE  
USE THE UNIT IN A PLACE FREE FROM FIRE.

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



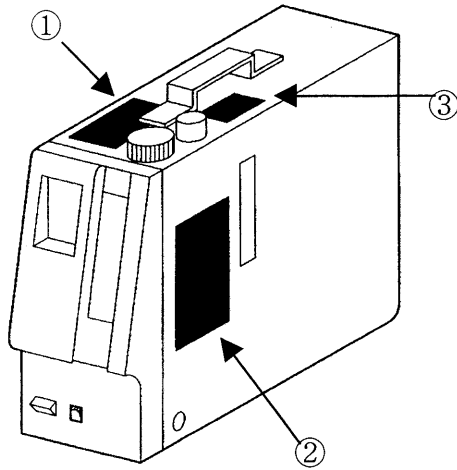
## CAUTION

- LEAD H<sub>2</sub> GAS IN SAFE PLACE
  - DO NOT BLOCK THE VENTILATION SLOTS
  - DO NOT DISMANTLE THE CASE COVER
  - DO NOT TOUCH THE PLUG WITH WET HANDS
  - USE THE CORRECT VOLTAGE
  - DO NOT DISSOLVE NOR ALTERATE THE EQUIPMENT
  - USE AN EXCLUSIVE POWER CORD TO CONNECT THE EARTH LEAD
  - OPERATION AND MAINTENANCE ARE TO BE IN ACCORDANCE WITH THE INSTRUCTION MANUAL
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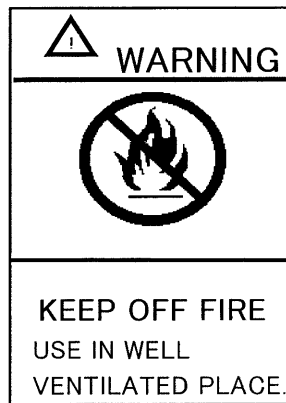
# ◆ INSTRUCTIONS FOR SAFETY OPERATION

## ● WARNING LABEL

The location of warning labels on this equipment are as follows.



Label 1



# ◆ INSTRUCTIONS FOR SAFETY OPERATION

Label 2

<b>SAFETY INSTRUCTIONS</b>
<ul style="list-style-type: none"><li>• LEAD H<sub>2</sub> GAS IN SAFE PLACE</li><li>• DO NOT BLOCK THE VENTILATION SLOTS</li><li>• DO NOT DISMANTLE THE CASE COVER</li><li>• DO NOT TOUCH THE PLUG WITH WET HANDS</li><li>• USE THE CORRECT VOLTAGE</li><li>• DO NOT DISSOLVE NOR ALTERATE THE EQUIPMENT</li><li>• USE AN EXCLUSIVE POWER CORD TO CONNECT THE EARTH LEAD</li><li>• OPERATION AND MAINTENANCE ARE TO BE IN ACCORDANCE WITH THE INSTRUCTION MANUAL</li></ul>

Label 3

<b><u>CAUTION</u></b>
<ul style="list-style-type: none"><li>• USE ION EXCHANGED WATER: CONDUCTIVITY <math>\leq 0.2 \mu\text{S/cm}</math></li><li>• FASTEN THE CAP OF THE WATER TANK EXCEPT FOR THE TIME TO POUR PURE WATER</li></ul>

## ◆ INSTRUCTIONS FOR SAFETY OPERATION

- Use ion exchange water which conductivity is 0.01-0.02 mS/m{0.1-0.2  $\mu$ S/cm} at 25 degree. (This value shows the conductivity at the time of extraction. Specific resistance: 0.5~1.0 $\times 10^2$  k $\Omega \cdot$ m{5~10M $\Omega \cdot$ cm})
- When distilled water is used, please use the water distilled from ion exchange water. A lot of cathode ion (such as zinc Zn<sup>2+</sup>) and anode ion (such as chloride ion Cl<sup>-</sup>) are contained in the distilled water refined from raw water. Please do not use it, because these ion carries out precipitation on the SPE film of the electrolytic cell and reduces the life of the cell.
- In the case that the equipment is suspended for a long time (more than 1 week), if it stops after replacing the water in tank with new pure water and operating about 10 minutes, precipitation of metal ion can be prevented and the life of the electrolytic cell can be prolonged.
- When pure water is supplied, please use the bottle of accessory or container of polyethylene or PTFE (brand name Teflon). If a metal container and vinyl chloride container are used, it will lead to contamination of pure water. Please do not use them by any means.  
And please store the container in a polyethylene bag to keep away from dust.
- If you use the water purification system, please check the conductivity of pure water after checking the sensitivity of the electric conductivity meter. Please extract pure water from the nearest purification system. When you cannot extract it from the nearest purification system, please extract it after checking the conductivity by a commercial electric conductivity meter.
- To prevent the pure water being polluted with dust etc., be sure to fasten the cap of water tank.

《Reference》 The example of purified water quality analysis

Kinds of water	conductivity $\mu$ S/cm	zinc $\mu$ gZn/L	Chloride ion $\mu$ gCl <sup>-</sup> /L	PH
Distilled water	2.9	1	1	-
Ion exchange water	0.1	0.04	<0.4	7.0
Tap water	261	<50	19,696	7.2

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# 1 GENERAL

## 1.1 Principle

Since the solid high polymer electrolyte (S.P.E.) film acts as an electrolyte for electrolyzing water by the ELECTROLYTIC CELL, the electrolyte (sodium hydroxide) which had been used in the past is no longer required and electrolysis is available with pure water only. When the ELECTROLYTIC CELL is energized,  $H_2$  gas is generated and simultaneously, the water on the anode side moves to the cathode sides. The  $H_2$  gas and water is separated by the WATER SEPARATION TRAP. The  $H_2$  gas is dehumidified through the DRYER and supplied from the  $H_2$  OUTLET. When the pressure is reached to the set value the power supply of the electrolytic cell is cut and when the pressure drops below the set value, the power supply is restored.

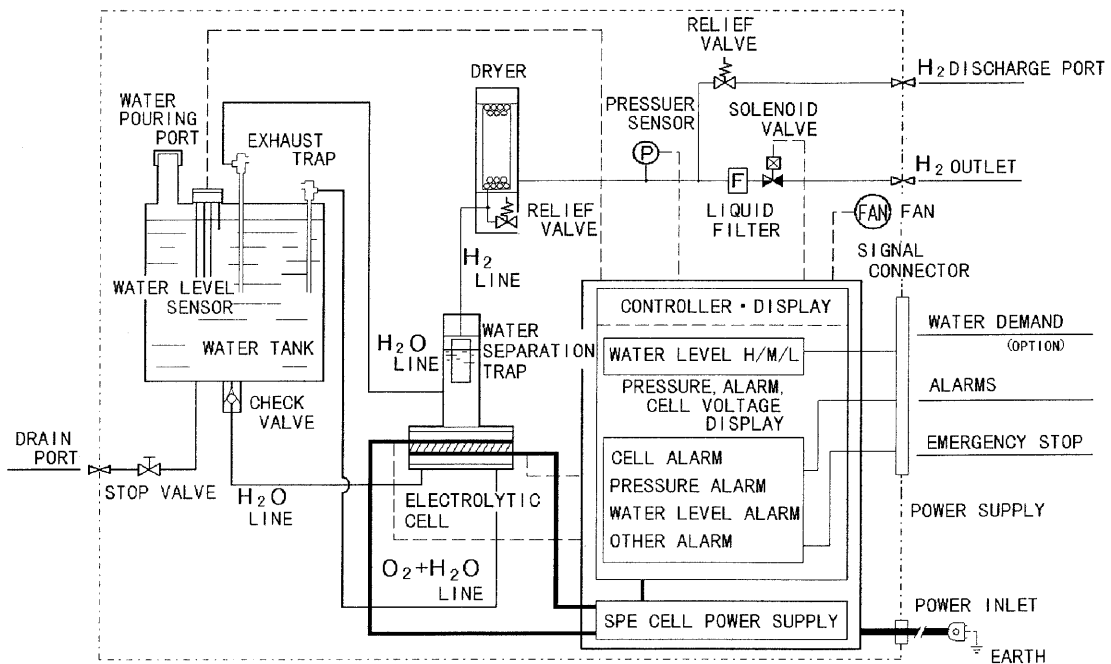


Fig. 1 Construction of the equipment

## 1.2 Specification

Name	HYDROGEN GENERATOR	
Type	OPGU-7100	OPGU-7200
Generating Principle	S. P. E. (Solid high polymer electrolytic film) water electrolysis	
Concentration of gas	More than 99.999% H <sub>2</sub> (excluding nitrogen and oxygen)	
Max. generated flow rate	100ml/min. (at 25°C 1,013 hPa)	225 ml/min. (at 25°C 1,013 hPa)
Generated pressure	20-400 kPa on gauge (variable)	
Water tank capacity	2 L	
Applicable pure water	Ion exchanged water Conductivity: 0.1-0.2 μS/cm	
Pure water consumption	Approximately 5.5 ml/h (at max. generation)	Approximately 12 ml/h (at max. generation)
Hydrogen gas outlet	Rc 1/8	
Operating temperature	5-40 degree	
Display	Generated pressure, cell voltage, and error messages can be selected to display (7-segment LED display; 2-digit digital)	
	Water level of pure water tank (LED display; H, M, or L)	
	Kind of generated error (LED display)	
	Water electrolysis ON/OFF (LED display)	
External input/output	Whether shut-off valve at oxygen gas outlet is open or closed (LED display)	
	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	100-120V AC; 50/60Hz 100VA (20VA when water electrolysis is OFF) Rush current: 1.4A max. (0.5sec.)	100-120V AC; 50/60Hz 100VA (20VA when water electrolysis is OFF) Rush current: 2.6A max. (0.5sec.)
Weight	about 10 kg (dry)	about 10 kg (dry)
External dimension	W150mm x H300mm x D430mm excluding any protruding part	

## 2 UNPACKING AND INSTALLATION

### 2.1 Unpacking

The followings are standard accessories of this equipment.  
When unpacking, confirm that there is no lack of accessories.

Table 1 Standard accessories

Description	Quantity
Inspection Sheet	1
Instruction Manual	1
Flushing bottle for 1L	1
Adsorbent:500g	1
Filter elements	1 0
Slow-blow fuse 7100 Type:1.6A 7200 Type:3.15A	1
Cylindrical cartridge for adsorbent	2
Joint for pipe( $\phi 3/\phi 2$ )	1
Power cord	1

### 2.2 Installation

Install the equipment at a location close to a power source and apparatus to be connected. Conform to the following conditions.



## WARNING

- 
- KEEP OFF FIRE
- 



## CAUTION

- 
- USE IN WELL VENTILATED PLACE
  - DO NOT TOUCH THE PLUG WITH WET HANDS
  - LEAD H<sub>2</sub> GAS IN SAFE PLACE

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

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### 3 DESCRIPTION OF THE OPGU

#### 3.1 External view

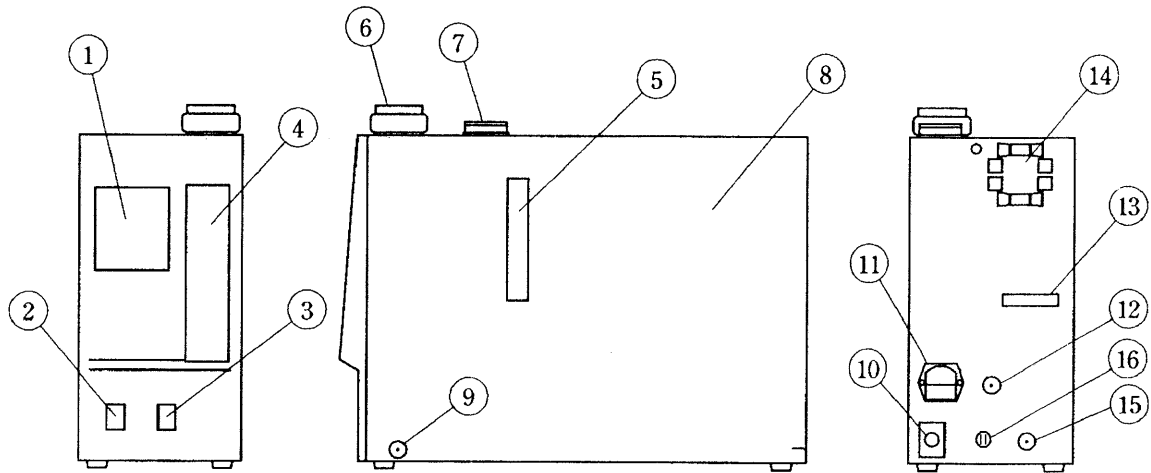


Fig. 2 Outer view of the equipment

NO.	Name	Description
①	Display panel	Refer to 3. 2.
②	Power switch	Switch for turning ON/OFF the power (the display panel is illuminated when this switch is ON.)
③	H <sub>2</sub> VALVE switch	Switch for shutting off H <sub>2</sub> (the indicator is lit when this switch is ON.)
④	Dryer viewing window	Window through which to view the color of adsorbent in the dryer.
⑤	Viewing window on pure water tank	Window through which to view the water level in the pure water.
⑥	Dryer cap	Cap on the port through which to replace the cylindrical cartridge for adsorbent in the dryer.
⑦	Cap on pure water inlet	Cap on the port through which to fill the pure water tank
⑧	Case cover	Case cover with a grip
⑨	Relief valve	H <sub>2</sub> relief valve inside the OPGU
⑩	H <sub>2</sub> outlet	Outlet of the generated H <sub>2</sub> gas
⑪	Power inlet(with fuses)	Power source of 100-120V AC; 50/60Hz Incorporated fuses(7100 Type:1. 6A/7200 Type:3. 15A)
⑫	H <sub>2</sub> relief	H <sub>2</sub> gas release port in case of excessive pressure error in H <sub>2</sub> line
⑬	Signal connector	Refer to 3. 3.
⑭	Fan vents	Exhaust vents for air from inside the OPGU
⑮	Drain port	Port for drainage of pure water in the water tank
⑯	Drain cock	Drain cock for drainage of pure water in the water

### 3.2 Display Panel

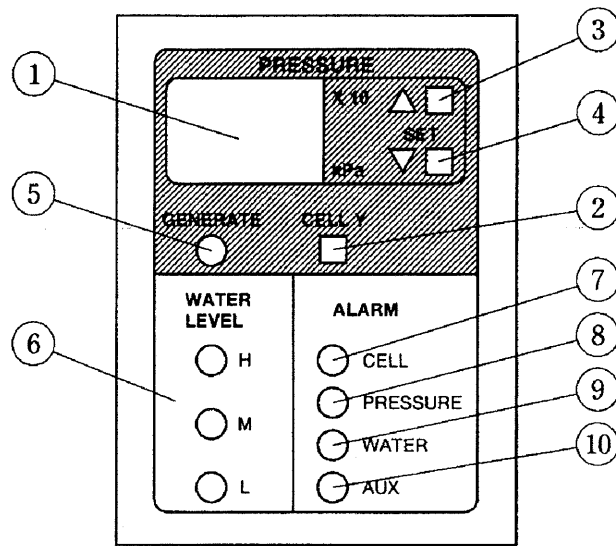


Fig. 3 DISPLAY PANEL

NO.	Name	Description
①	Pressure display part	<ul style="list-style-type: none"> <li>● Shows the pressure of generated H<sub>2</sub> gas (0-40 ×10 kPa from gauge)</li> <li>● Voltage across electrolytic cell (hereinafter called 'electrolytic cell voltage') can be alternatively selected to display (water electrolysis ON: 2.0V-2.8V displayed; water electrolysis OFF: 0.0-1.9V displayed)</li> <li>● If an error occurs, the details of its cause and the pressure of generated H<sub>2</sub> gas are displayed alternately.</li> </ul>
②	CELL. V button	Button for displaying electrolytic cell voltage (when ON, electrolytic cell voltage is displayed in the Pressure display part ①.)
③	SET △ button	Button for increasing the set pressure of generated H <sub>2</sub> gas (400 kPa max.)
④	SET ▽ button	Button for decreasing the set pressure of generated H <sub>2</sub> gas (20 kPa max.)
⑤	GENERATE indicator	Water electrolysis ON/OFF indicator Lights up when water electrolysis is turned ON (electrolytic cell voltage is more than 2.0V min.) Lights out when water electrolysis is turned OFF (electrolytic cell voltage is less than 2.0V min.)
⑥	H, M and L indicator	WATER LEVEL (water level in pure water tank) indicators The H, M and L indicators light up in the descending order of water levels.

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: Over-voltage (2.8V 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 H<sub>2</sub> gas pressure error (ALARM_WATER) 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 H<sub>2</sub> line  P. 2: Leak from H<sub>2</sub> line</p>
⑨	WATER indicator	<p>Low water level error (ALARM_WATER) indicator for pure 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 (OPTION)</p>

### 3.2 Signal connector

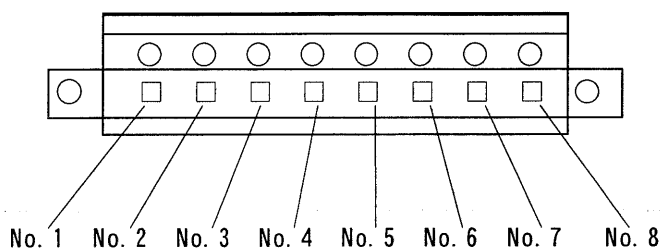


Fig. 4 SIGNAL CONNECTOR

- |   |   |   |
|---|---|---|
| <p>No. 1: Output of request for filling pure water tank<br/>(NO terminal)</p> <p>No. 2: Output of request for filling pure water tank<br/>(NO terminal)</p> <p>No. 3: Output of request for filling pure water tank<br/>(NO terminal)</p> | } | <p>Output specification: Contact capacity 30 VDC; 200mA max.<br/>Output occurs while pure water is being requested<br/>(For details of output timings, refer to 7.3.1.)</p> |
| <p>No. 4: Output of notification of generated error<br/>(NO terminal)</p> <p>No. 5: Output of notification of generated error<br/>(NC terminal)</p> <p>No. 6: Output of notification of generated error<br/>(Common terminal)</p>         | } | <p>Output specification:<br/>Contact capacity 30 VDC; 20mA max.<br/>Output occurs while any error is existing.</p>  |
| <p>No. 7: Input of emergency stop instruction<br/>(Positive signal terminal)</p> <p>No. 8: Input of emergency stop instruction<br/>(Negative common terminal)</p>   | } | <p>Input specification<br/>:When short-circuited<br/>1.5 VDC max. ;less than 5mA<br/>When opened DC4-5 V</p>  |

Emergency stop occurs when No. 7 and 8 are short-circuited.  
Logic switching is possible to make emergency stop with this circuit opened.  
(For logic switching, refer to 4.2.3.)

### 3.4 Inside of the OPGU

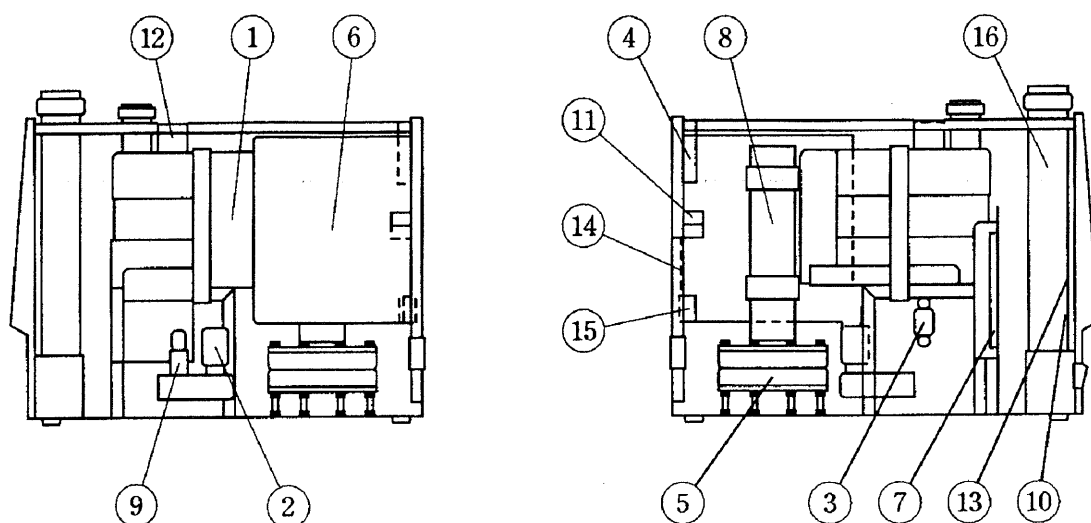


Fig. 5 INSIDE OF THE OPGU

NO.	Name	Description
①	Pure water tank	Container for pure water being used for water electrolysis
②	Solenoid valve	Valve for opening/closing the line for generated H <sub>2</sub> gas
③	Check valve	Check valve for preventing reverse flow from occurring in pure 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 <sub>2</sub> gas from water which has passed through electrolytic cell
⑨	Safety valve	Valve for releasing H <sub>2</sub> gas if internal pressure has abnormally increased
⑩	Pressure sensor	Sensor for monitoring the pressure of generated H <sub>2</sub> gas
⑪	Vibration sensor	Sensor for detecting any slanting, vibration or impact throughout the OPGU (OPTION)
⑫	Water level sensor	Titanium electrode sensor for detecting the level of pure water
⑬	Control/display 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	Adsorbent vessel



## 4 OPERATION

### 4.1 Preparation

#### 4.1.1 Filling adsorbent

The DRYER was not filled with adsorbent at the factory.  
Fill the adsorbent as described in 7.3.2.

#### 4.1.2 Pouring pure water

The pure water tank was supplied with pure water at the factory up to only the minimum level required to prevent the electrolytic cell from being dried.  
Pour the pure water as described in 7.3.1.

#### 4.1.3 Connection of piping

##### ● H<sub>2</sub> OUTLET

H<sub>2</sub> gas OUTLET is Rc1/8 female tapered pipe thread. As standard accessories with the OPGU, the joint is supplied for the metal pipe whose outside diameter is 3mm.

If you use this, connect it the following ways.

- 1) Wrap a thread sealant around the male tapered pipe thread of the joint.
- 2) Screw the joint into H<sub>2</sub> OUTLET then be tighten the body nut with a spanner.
- 3) Insert the NUT and FERRULR (FRONT - BACK) into the pipe as (Fig. 6) then be tighten the cap nut with a spanner.

### ⚠ CAUTION

When H<sub>2</sub> generates, check the piping joints for any leak by using a liquid leak detector.

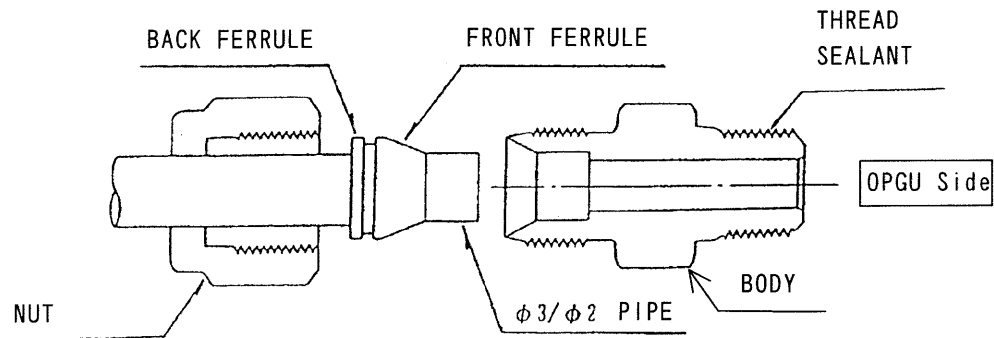


Fig. 6 JOINT

● H<sub>2</sub> RELIEF

Connect H<sub>2</sub> relief with  $\phi 9/\phi 5$  vinyl tube and discharged H<sub>2</sub> gas to a safe place.

 **CAUTION**

- When the generating pressure of H<sub>2</sub> gas abnormally rises due to trouble of pressure sensor, eg., the safety valve is actuated, and H<sub>2</sub> gas is discharged through this port.

4.1.4 Connection of power source

Connect the OPGU with the power supply by the power supply code with the earth line of the accessory. Follow the followings.

 **CAUTION**

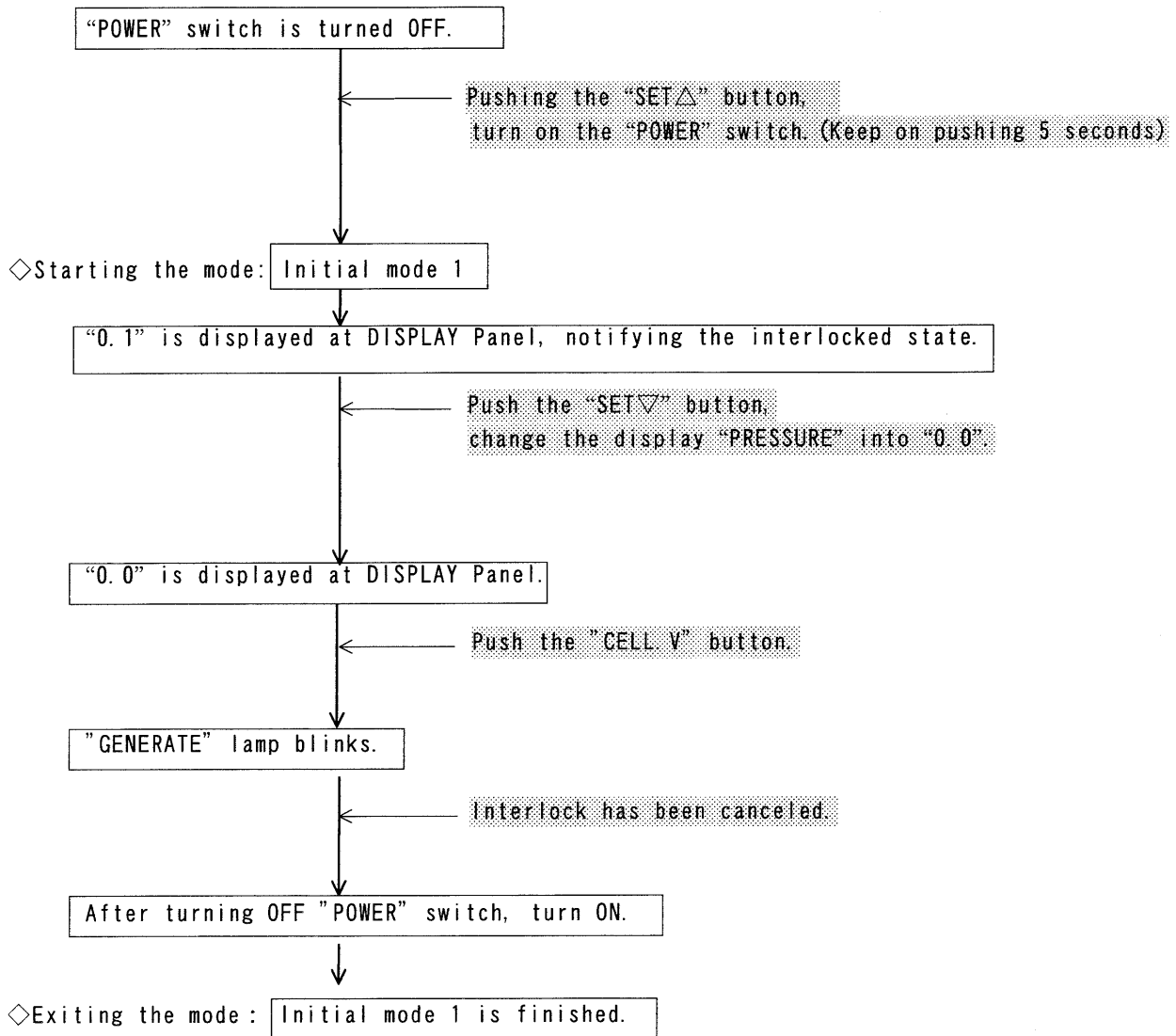
- Check that the power source used is compatible with the specification of the power Source for the OPGU.  
At least the capacity shown in the specification is required for 100-120 VAC $\pm$ 10%, 50 or 60 Hz (single phase).
- Connect the earth wire to the earth terminal on the plug socket.  
If the earth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

4.2 Initial setting

Mode No.	Function	Initial value
Initial mode 1	ALARM cancel function	—
Initial mode 2	The delay time for detecting of "ALARM_WATER" The delay time for detecting of "ALARM_PRESSURE"	0.0 (sec) 7200TYPE 10.0 (min) 7100TYPE 20.0 (min)
Initial mode 3	Accepting state of "ALARM_AUX" "A. 2" (short-circuit, open)	0.0 (short-circuit)
Initial mode 4	Selecting a method to start water electrolysis when the power is turned on. (immediate start, stand-by)	0.0 (immediate start)

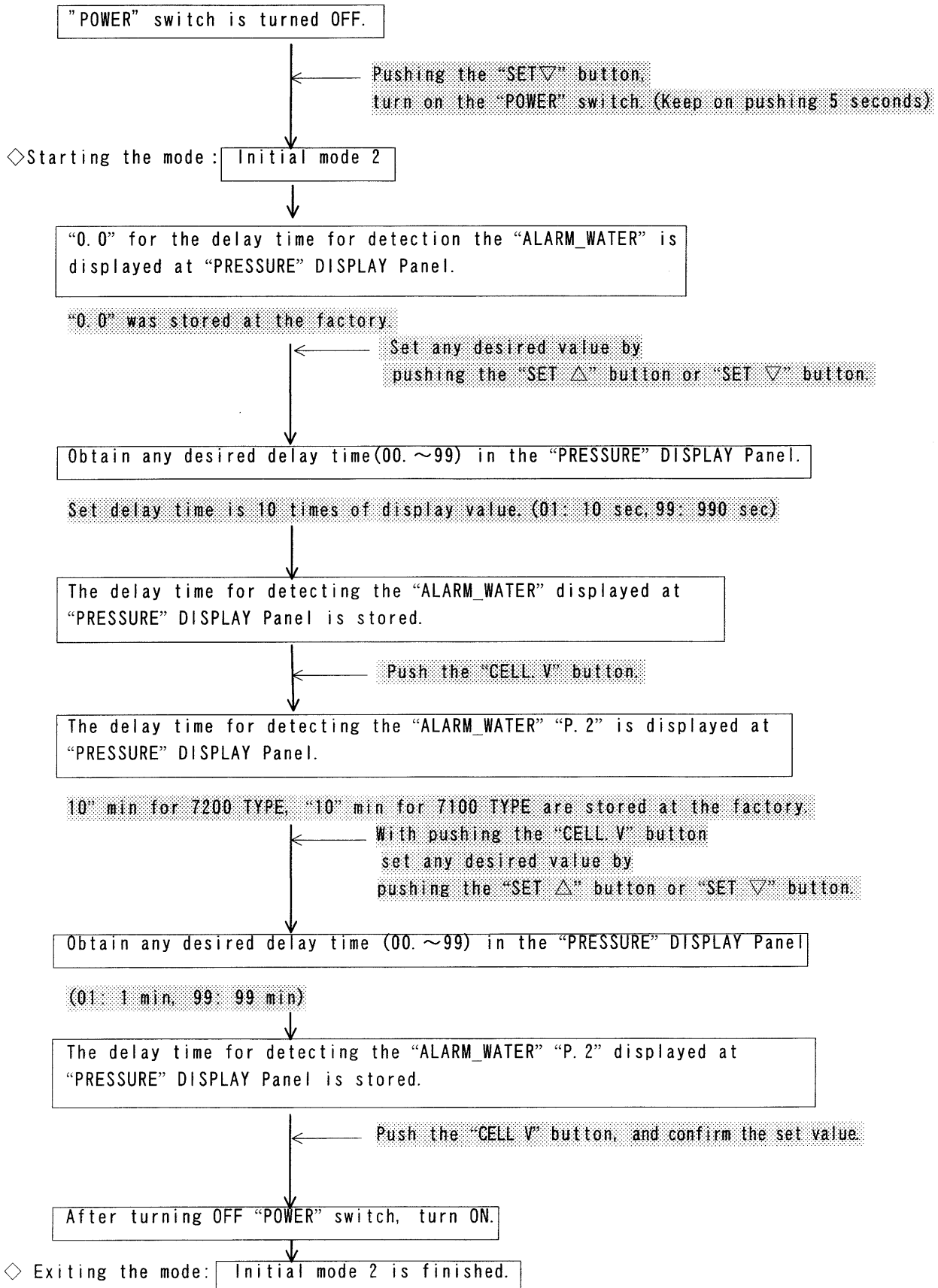
#### 4.2.1 Initial mode 1

○Description of mode: This mode is used to cancel interlocking resulting from an error.  
(refer to 6.1)



#### 4.2.2 Initial mode 2

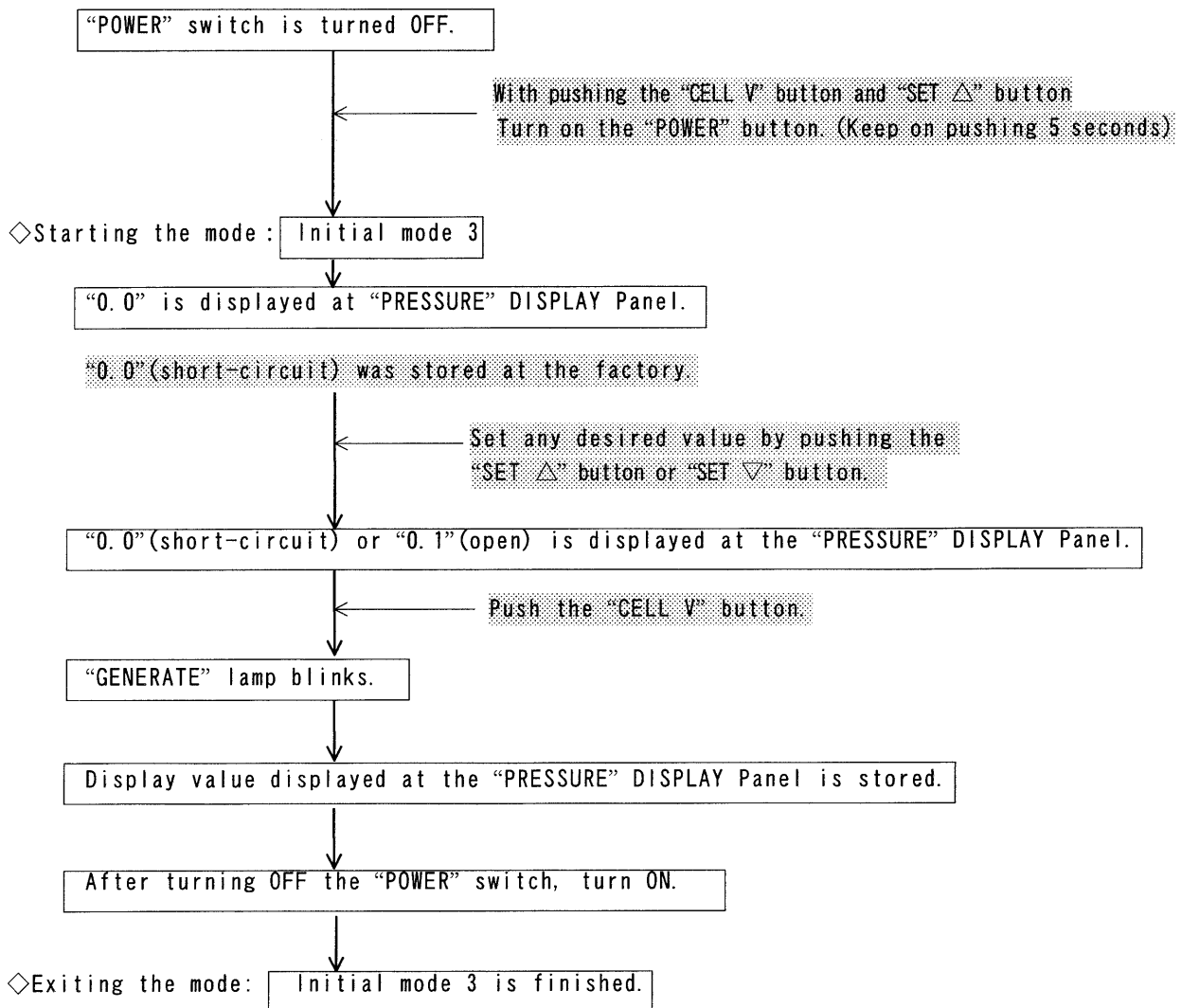
○ Description of mode : When pure water is supplied automatically, this mode is used to set the detection delay time for "ALARM\_WATER" (refer to 7.3.1.) and that for "ALARM\_PRESSURE" and "P.2"(refer to 6.4).



#### 4.2.3 Initial mode 3

○Description of mode: This mode is used to select a state in which to accept the input of emergency stop instruction for "ALARM\_AUX" "A. 2".

("00": short-circuit, "01": open)

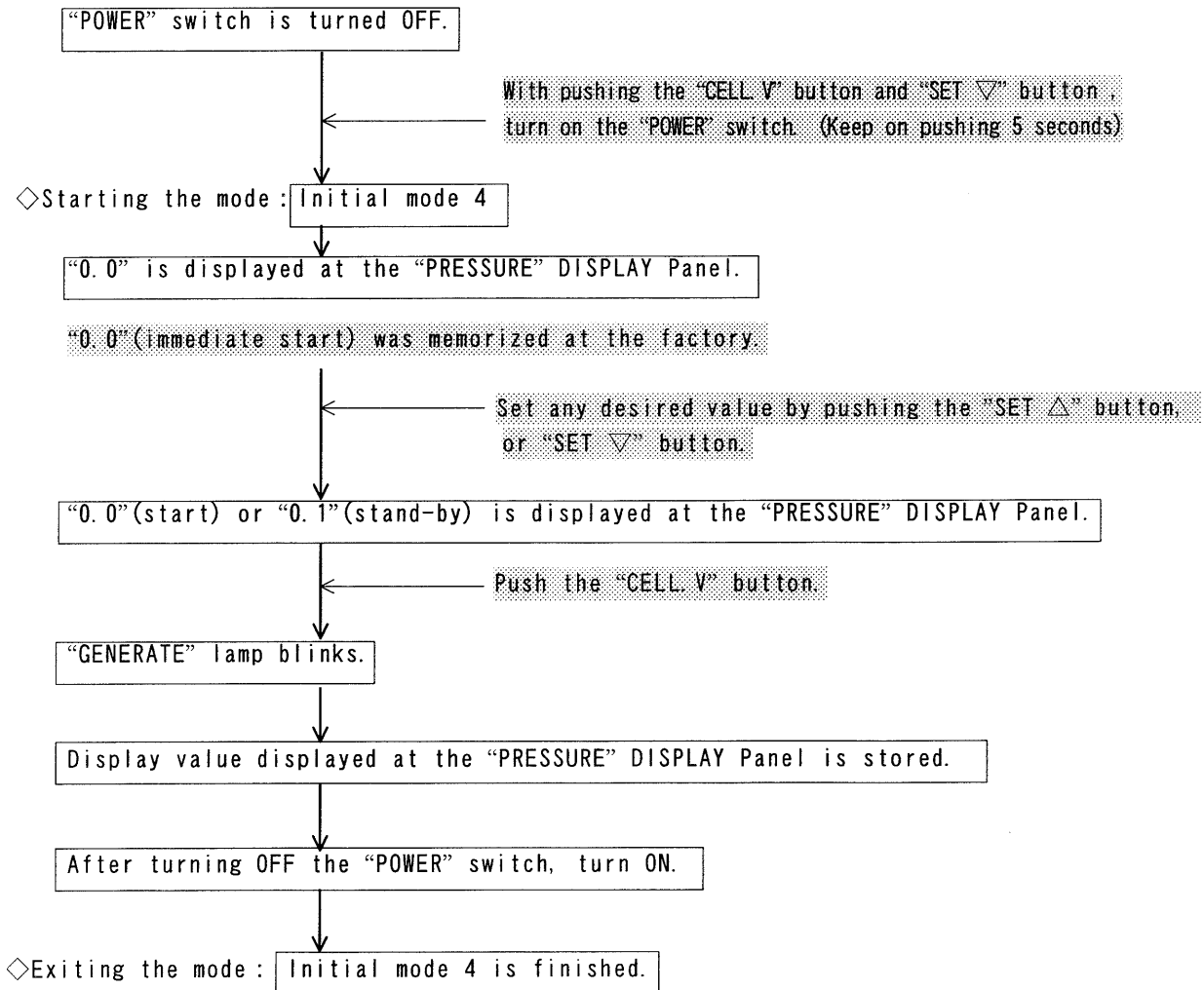


#### 4. 2. 4 Initial mode4

○ Description the 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. ("00": immediate start, "01": stand-by)

In case of making OPGU recover automatically from a power failure, set the immediate start.

In case of preventing OPGU from recovering automatically from a power failure, set the stand-by (refer to 4. 3. 1-3).



### 4.3 Operation

#### 4.3.1 Starting water electrolysis



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

1) Turn ON the "POWER" switch and check:

- The "PRESSURE" display part is illuminated.
- The "GENERATE" indicator lights up. (It goes out if pressure of generated H<sub>2</sub> gas is the same as the set pressure in the stand-by mode.)
- The "CELL" indicator goes out.
- The "PRESSURE" indicator goes out.
- The "AUX" indicator goes out.
- The "WATER" indicator goes out.
- The "H", "M", or "L" indicator lights up. (The "M" indicator lights up if the water level in the pure water tank is positioned at the center of the viewing window for the pure water tank.)

2) Turn OFF the "H<sub>2</sub> VALVE" switch (whose indicator lights out) to shut off the line for generated H<sub>2</sub> 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. (refer to 4.2.4 Initial mode 4)

**【In the case of selecting the mode of standing by for water electrolysis】**

By pressing the "SET △" or "SET ▽" button, water electrolysis start. During this mode, The pressure in the line for generated H<sub>2</sub> 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 to you to Suspend the start of water electrolysis until the "SET △" or "SET ▽" button is pressed.

#### 4.3.2 Starting H<sub>2</sub> gas generation

1) Once water electrolysis is started, press the "SET ▽" button 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) There are two ways to purge the gas in the generated H<sub>2</sub> gas line with H<sub>2</sub> gas

- Turn ON the "H<sub>2</sub> VALVE" switch (whose indicator lights up), to exhaust the gas in the generated H<sub>2</sub> gas line for 3 to 5 minutes.
- When H<sub>2</sub> gas reaches to the set pressure, turn ON the "H<sub>2</sub> VALVE". Turn OFF the H<sub>2</sub> VALVE after the pressure became low. Then please repeat this operation a few times.

 **CAUTION**

- The H<sub>2</sub> 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 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 with H<sub>2</sub> gas, turn OFF the “H<sub>2</sub> VALVE” switch (whose indicator goes out) to shut off the line for generated H<sub>2</sub> gas.
  - 4) Pressing the “SET △” and “SET ▽” buttons, set the pressure to the desired value within the range from 20 to 400 kPa.
  - 5) Connect the piping to the devices you use (Check the joints for any leak.).
  - 6) When the pressure shown in the “PRESSURE” display” part has reached to the set value, turn On the “H<sub>2</sub> VALVE” switch (whose indicator lights up) to start providing H<sub>2</sub> gas.
  - 7) If you want to change the set pressure, press the “SET △” and “SET ▽” buttons to obtain the desired value within the range from 20 to 400 kPa. The set value is stored, even if the “POWER” switch is turned OFF.

 **CAUTION**

- Check the piping joints for any leak by using leak detection liquid or the like.
- After H<sub>2</sub> 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.

4.3.3 Stopping H<sub>2</sub> gas from being generated

- 1) To temporarily stop H<sub>2</sub> gas from being generated, turn OFF the “H<sub>2</sub> VALVE” switch (whose indicator comes out).
- 2) To reset generating H<sub>2</sub> gas, turn ON the “H<sub>2</sub> VALVE” switch (whose indicator lights up).

 **CAUTION**

- If H<sub>2</sub> gas is not used for more than 16 hours, turn OFF the “POWER” switch to release H<sub>2</sub> 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 H<sub>2</sub> gas remains pressurized, the electrolytic cell can deteriorate. Press the relief valve at its center to release H<sub>2</sub> gas (several thousand ml) from inside the OPGU to a safe place free from fire.
- In addition to H<sub>2</sub> 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) Press the “SET ▽” button to set the pressure to 20 kPa.
  - 2) Release H<sub>2</sub> gas from the H<sub>2</sub> gas outlet until 20 kPa is shown in the “PRESSURE” display part, and then turn OFF the “POWER” switch.
  - 3) Turn OFF the “H<sub>2</sub> VALVE” switch.



#### 4.3.4 Finishing Operation

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

#### 4.3.5 Absence of use for a long period

If the OPGU is not used for more than one month, take the steps described in "4.3.4 finishing Operation" and then store the OPGU.

- 1) Replace the water in the pure water tank.
- 2) After the water is poured at the "M" level, operate for about 10 minutes. Then, stop the operation.
- 3) Release the H<sub>2</sub> gas from the relief valve at the safety place (no fire place).
- 4) Remove the cylindrical cartridge for the dryer and store it separately.
- 5) Disconnect the piping for the H<sub>2</sub> gas outlet and put the appropriate cap on it.
- 6) Store the OPGU while keeping it away from dust.

### CAUTION

- The cylindrical cartridge for the dryer must be removed. If it is left in the dryer, changes in the internal pressure can cause water to permeate the H<sub>2</sub> line, so that the electrolytic cell may be dried and then deteriorate.

#### 4.4 Instruction for safety operation

- Keep OFF fire. Do not use the OPGU near fires.
- Use in well ventilated place.
- Use the OPGU at an ambient temperature in the range from 5 degree to 40 degree without no sudden fluctuation.
- If the electrolytic cell is frozen, it can be no longer used as its inside is broken.
- Use the OPGU in flat place without any vibration.
- Avoid installing the OPGU in a place where metal, salt, any other kind of particle or dust is generated or a large amount of organic solvent etc.,  
The electrolytic cell can be deteriorated in these conditions.
- Use pure water whose conductivity of ion exchange water is (0.1-0.2  $\mu$ S/cm).
- Ensure that the cap is always put on the pure water tank except when pure water is poured.
- When the joint is connected check the joints for any leak by using a liquid leak detector or the like while generating H<sub>2</sub>.
- When the generating pressure of H<sub>2</sub> gas abnormally rises due to trouble of pressure sensor, e. g., the safety valve actuates, and H<sub>2</sub> gas is discharged this port.
- Do not use the OPGU with its case cover removed.
- The H<sub>2</sub> gas used to purge the line must be released to a safe place.
- The OPGU must not be operated for more than 10 minutes while generated H<sub>2</sub> 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.
- If H<sub>2</sub> gas is not used for 16 hours or more, turn OFF the "POWER" switch and release the H<sub>2</sub> gas with the relief valve and reduce the internal pressure to atmospheric pressure. If the OPGU is used for more than this time period while H<sub>2</sub> gas remains pressurized, the electrolytic cell can deteriorate.
- If the OPGU is used for more than this time period while H<sub>2</sub> gas remains pressurized, the electrolytic cell can be deteriorated. Press the relief valve at its center to release  
H<sub>2</sub> gas (several thousand ml) from inside the OPGU to a safe place free from fire. In addition to H<sub>2</sub> gas, A small amount of water comes out. Use rags or the like to soak.
- If the OPGU is not used for one month or longer, remove adsorbent (inner cylinder). If it is left in the dryer, fluctuation of the internal pressure can cause water to enter the H<sub>2</sub> line, so that the electrolytic cell may be dried and then deteriorate.

## 5 TROUBLE SHOOTING

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

### 5.1 If Display panel is not illuminated:

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

(2) Check the power supply

Is the power cable the one supplied as accessory? Is it connected to the power inlet?  
Does the supply voltage meet the specification?

(3) Check the fuse

Is the built-in fuse at the power inlet brown? If yes, replace it with a new fuse which is supplied as accessory.

If that fuse is also brown immediately, the wiring or a part may be short-circuited.

Never use any fuse other than those supplied accessories.

(4) Turn On the power switch

If the indicator does not light up and no H<sub>2</sub> gas is generated, ask for the periodical inspection and maintenance services. (refer to 7.4)

— 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)

### 5.2 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. (refer to 6)

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

(4) Turn OFF the H<sub>2</sub> VALVE switch (whose indicator comes out) to shut off the line for generated H<sub>2</sub> 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 (refer to 7.4).

(6) If the pressure can be controlled at the set value in step 5), turn ON the H<sub>2</sub> VALVE switch (whose indicator lights up). If the pressure becomes uncontrollable at the set value by turning ON the H<sub>2</sub> VALVE switch, check whether there is a leak from the piping between the OPGU and the device to which H<sub>2</sub> gas sent. If there is no leak, check whether the consumed flow rate of H<sub>2</sub> gas exceeds the maximum generated flow rate.

5.3 If GENERATE indicator remains lit:

- (1) Turn OFF the H<sub>2</sub> VALVE switch (whose indicator goes out) to shut off the line for generated H<sub>2</sub> 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 (refer to 7.4).
- (3) If the GENERATE indicator goes out in step 2), turn ON the H<sub>2</sub> VALVE switch (whose indicator lights up) to open the line for generated H<sub>2</sub> gas. If the GENERATE indicator comes to remain lit again after this action, check whether there is a leak from the piping between the OPGU and the device to which H<sub>2</sub> gas exceeds the maximum generated flow rate.

5.4 If purity of H<sub>2</sub> gas is too low:

- (1) The concentration of moisture content is high. Check the adsorbent for the dryer. If the adsorbent is defective, replace it (refer to 7.3.2).
- (2) Other gases are detected as impurities. Purge the piping, and then check the purity of H<sub>2</sub> gas again. If adsorbent which impurities have been adsorbed is used, those impurities are subsequently separated and then detected, If this is the case, replace the adsorbent (refer to 7.3.2).

5.5 If water comes to dryer:

- (1) If the OPGU never be used for a long period, the omission of the required actions is suspected (refer to 4.3.5).
- (2) Check whether the pressure is 20 kPa min. at the H<sub>2</sub> outlet.
- (3) Has adsorbent been replaced? If water comes to the dryer, the inside of the dryer and the H<sub>2</sub> gas line must be purged and adsorbent must be replaced (refer to 7.3.2).
- (4) If nothing has been improved by step 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 (refer to 7.4).

5.6 If consumption of pure water become too large:

- (1) Check the water tank and the pure water line for any leak of water (refer to 7.4).
- (2) It is recommended that you check the piping inside and outside of the OPGU for any leak of gas (refer to 7.4).

## 6. ACTION TO BE TAKEN IF AN ERROR INDICATR LIGHTS UP

### 6.1 Error hold function

#### 6.1.1 Checking the history of generated errors

If a certain existing error is followed by the occurrence of other errors, the message the last generated error and the pressure of generated H<sub>2</sub> 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" button held down, The error directly after the currently displayed one is shown.  
+  
press the "SET Δ" button once (approx. 0.5 seconds)

With the "CELL V" button held down, The error directly after the currently displayed one is shown.  
+  
press the "SET ∇" button once (approx. 0.5 seconds)

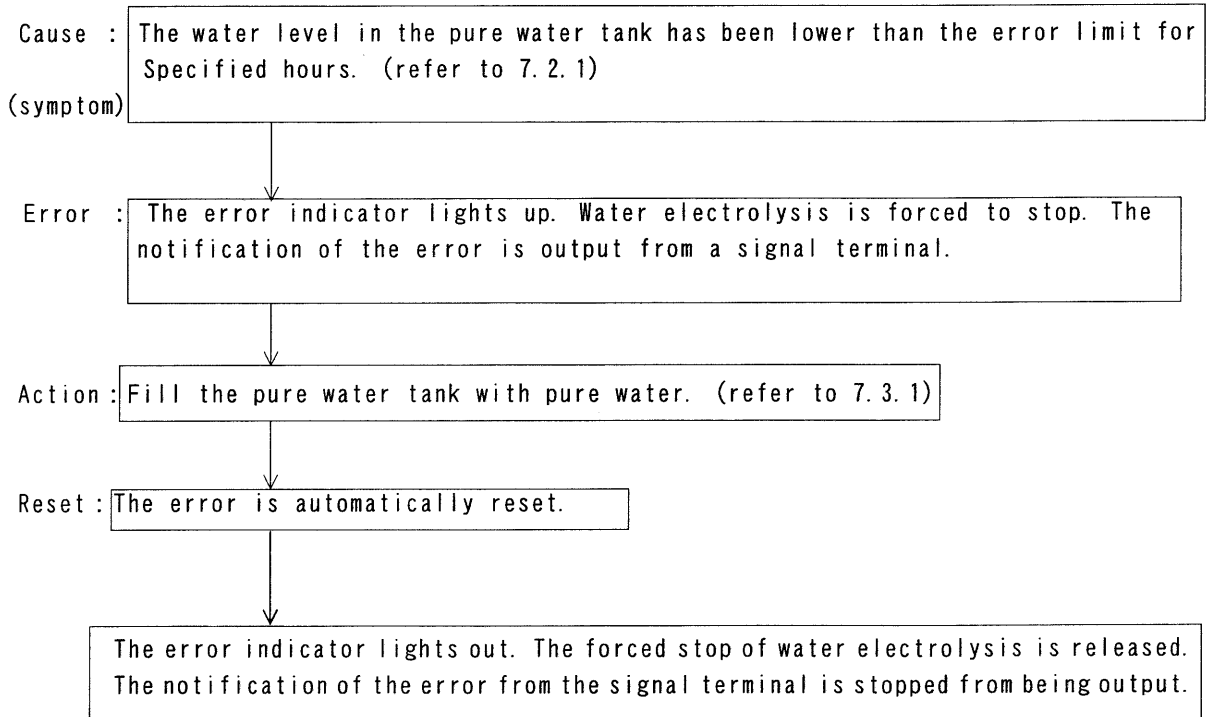
#### 6.1.2 Resetting an error

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 6.2 - 6.2 - 6.3 - 6.4 describing how to reset that error.

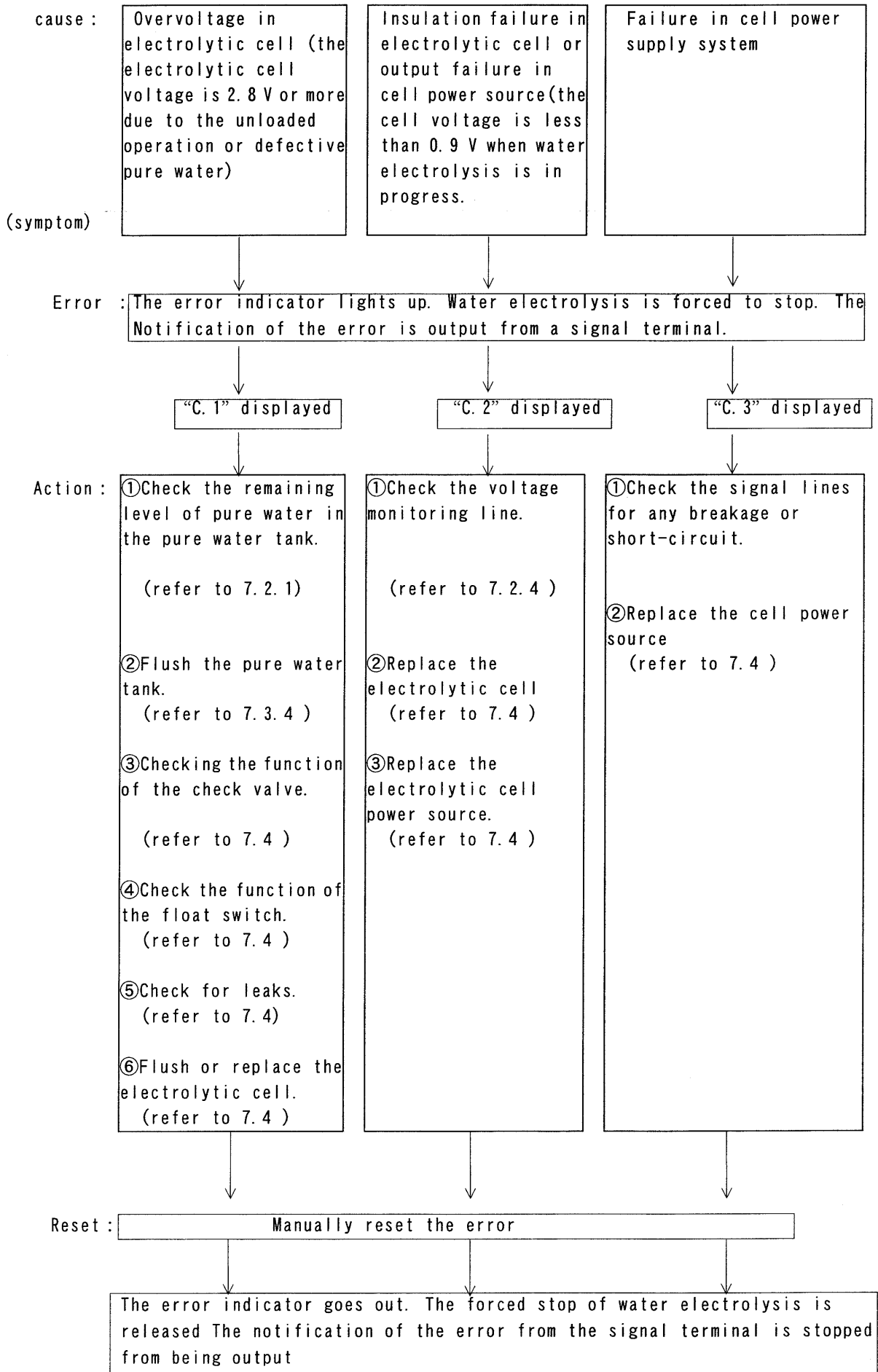
#### 6.1.3 Action to be taken if an error continues

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 man.

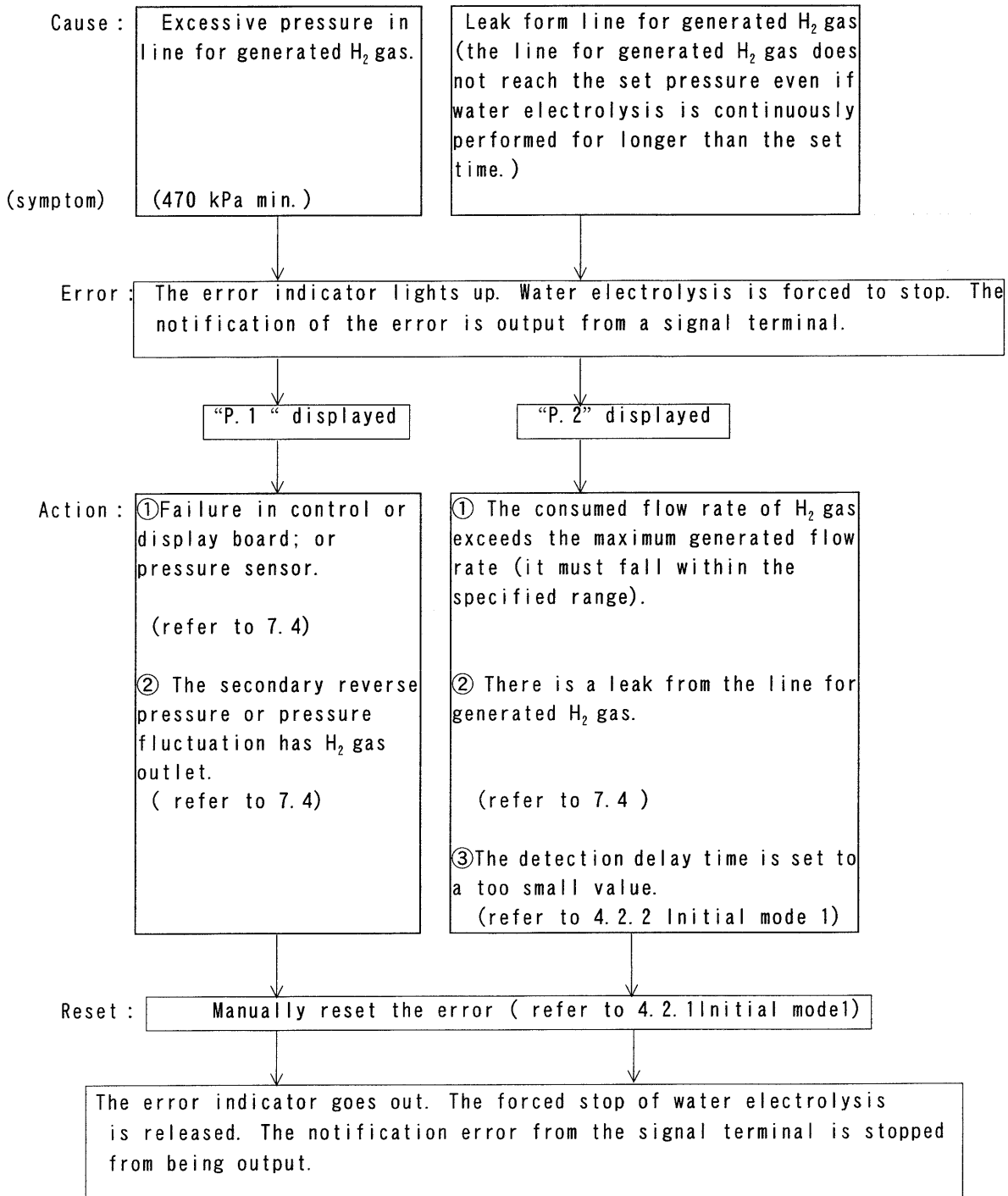
### 6.2 "WATER" ALARM



### 6.3 "CELL" ALARM



## 6. 4 "PRESSURE" ALARM

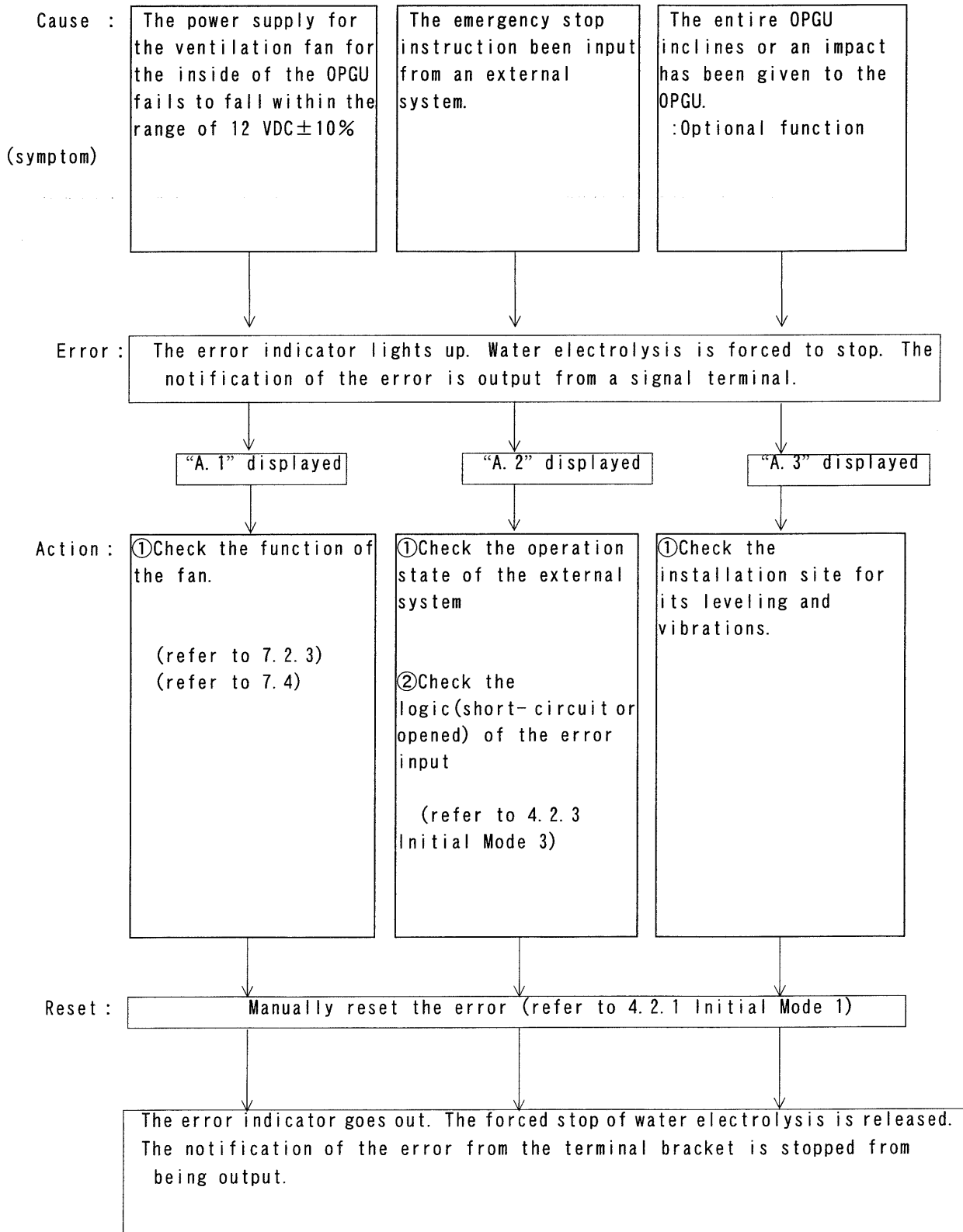


### CAUTION

When you set the detection delay time of "P. 2" "error messages display", set the time or operate the OPGU considering the following things. It causes to generating the error.

- The time to pressurize internal gas from atmospheric pressure to the present value, when you go into operation.
- The time to pressurize internal gas to changed setting value, if you change the setting.

## 6.5 "AUX" ALARM





## 7 MAINTENANCE

### 7.1 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	Reference
Daily inspection	Check WATER LEVEL	○				Refer to 7.2.1
	Check dryer	○				Refer to 7.2.2
	Check fan (ventilation)	○				Refer to 7.2.3
	Check CELL. V button	○				Refer to 7.2.4
	GENERATE ON/OFF time		○			Refer to 7.2.5
Daily maintenance	Replenish pure water		○			Refer to 7.3.1
	Replacing adsorbent		○			Refer to 7.3.2
	Cleaning the WATER TANK			○		Refer to 7.3.3
Periodical inspection and maintenance services	Periodical inspection and maintenance services				○	Refer to 7.4

### 7.2 Daily Inspection

#### 7.2.1 Check WATER LEVEL

- (1) The indicator H, M or L lights up in the descending order of water levels in the 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, refer to 4.2.2 initial mode 2.
- (3) If the operation is still continued, the pure water decreases. If you find that the L indicator lights up, replenish pure water without delay refer to 7.3.1. In principal, check the water level in the pure water tank upon the consumption of H<sub>2</sub> gas and the ambient temperature. This check can also be made through a viewing window on either side of the OPGU.

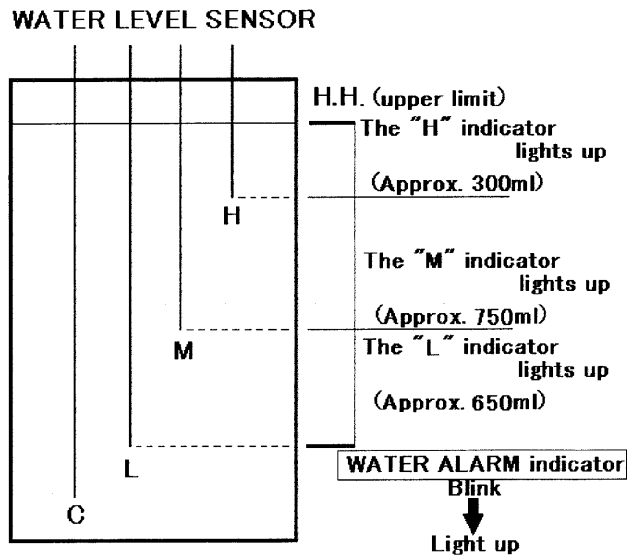


Fig. 8 Water level in pure water tank

**7. 2. 2 Checking the dryer**

The humidity adsorbing performance of adsorbent deteriorates as the operation is carried out. Check the color of adsorbent through the dryer viewing window located on the control panel. If approximately one third the lower part of the window becomes brown, replace adsorbent (refer to 7. 3. 2). The adsorbent generated for 200 ml/min is available for approximately one week, but this length varies depending on the consumption of H<sub>2</sub> gas and the ambient temperature.

**7. 2. 3 Checking the fan (ventilation)**

Check 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 (refer to 7. 4).

**7. 2. 4 CELL. V button**

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 principal, by checking its voltage. In stead of a pressure value, the cell voltage is shown in the PRESSURE display part while the CELL. V button is being held down. Read the initial voltage when the GENERATE indicator is lit.

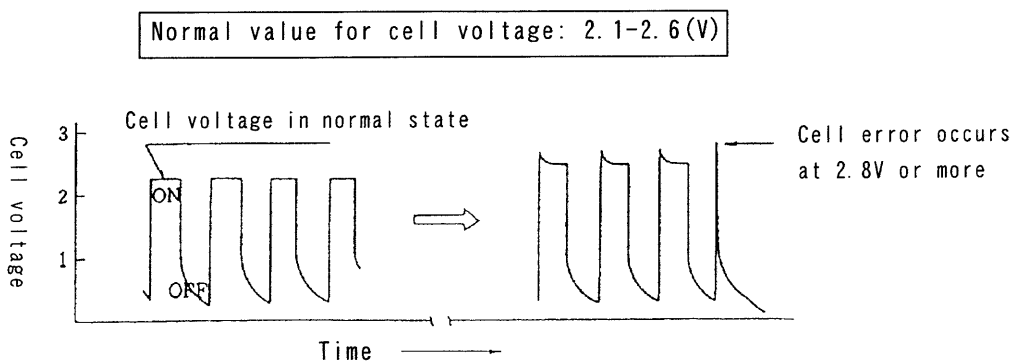


Fig. 9 Cell voltage diagram

If the cell voltage becomes 2.8V 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 pure water ----- refer to 7.3.3
- 2) Unloaded electrolytic cell ----- refer to 7.4.
  - A failure in the check valve (pure 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 ----- refer to 7.4.

#### 7.2.5 ON/OFF duration of the GENERATION indicator

If the OPGU is used for generating a given amount of H<sub>2</sub> 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 H<sub>2</sub> gas line inside or outside the OPGU or deterioration of the electrolytic cell is suspected to cause a decrease in the amount of generated H<sub>2</sub> gas. Perform the periodical inspection and maintenance service earlier (refer to 7.4).

### 7.3 Daily Maintenance

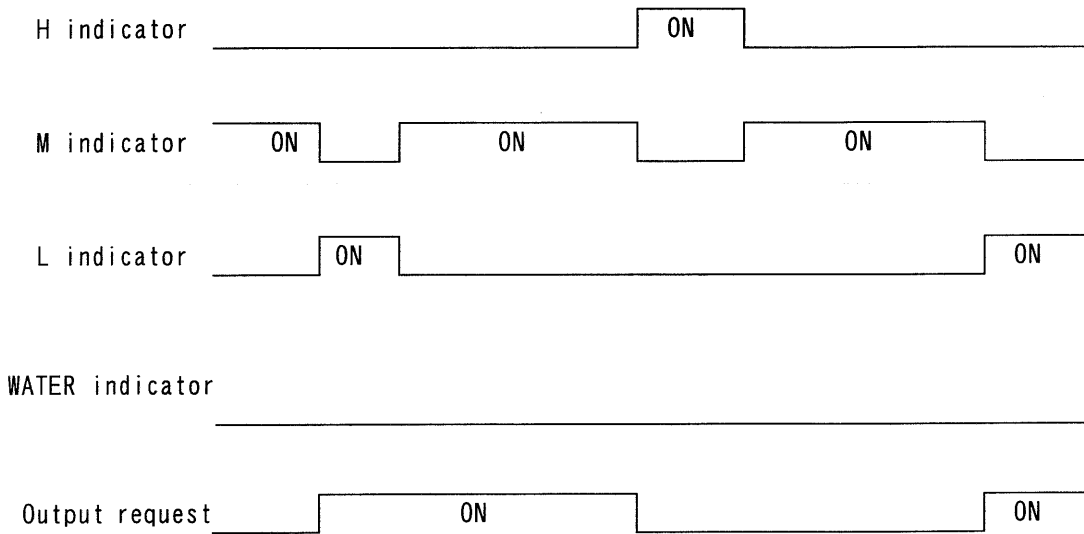
#### 7.3.1 Replenishing pure water

Please follow the undermentioned matter about the handling of the supplied pure water.

- Use pure water whose conductivity is 0.1-0.2  $\mu$ S/cm. 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 this equipment and stored by putting it in a polyethylene bag to keep away from dust.
- If you use the water purification system, periodically check the sensitivity of the electric conductivity in accordance with its manufacture's instructions.
- To prevent pure water being polluted with dust etc., be sure to fasten the cap of WATER TANK

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

If detection delay time is 0 second:



If detection delay time is 10-990 seconds:

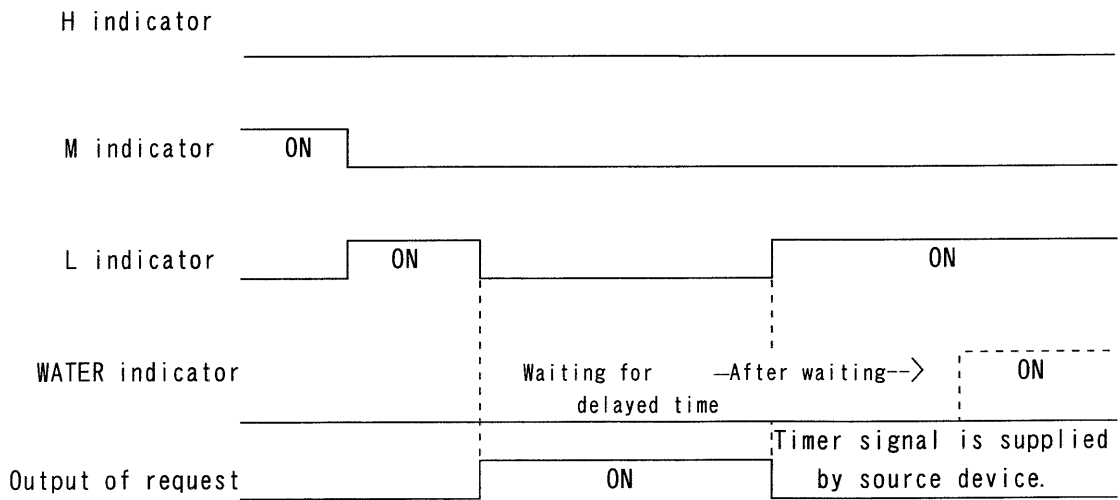


Fig. 10 Output timing of a request for filling the pure water tank

### 7.3.2 Replacing adsorbent

- 1) For the initial filling, start with step 7); for the replacement during maintenance, start with step 2).
- 2) Check that the H<sub>2</sub> 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 relieve the H<sub>2</sub> gas pressure inside the dryer. 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.

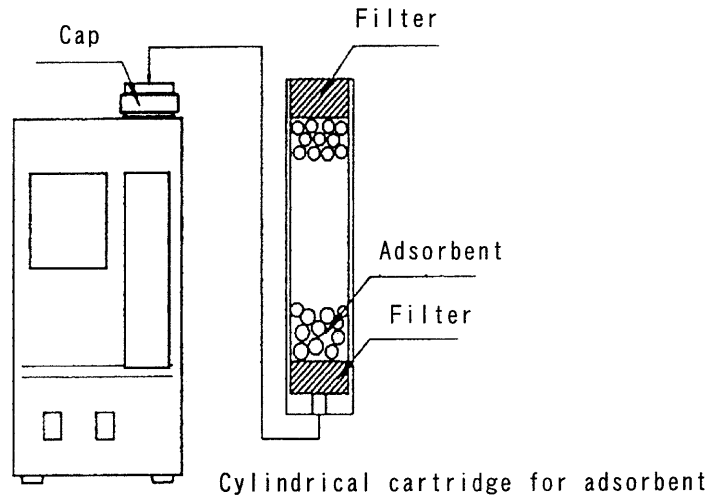


Fig.11 Replacing the cylindrical cartridge for adsorbent

- 5) Remove the dryer cap by turning it counterclockwise. Take out the cylindrical cartridge for adsorbent from the cartridge replacement port.
- 6) Replace the upper and lower adsorbent filters in the cartridge.
- 7) Set the new upper and lower filters which come as standard accessory with the OPGU, in the supplied standard accessory cartridge or the one removed from the dryer (Fig. 11). Then fill the cartridge with round, dry gains of adsorbent (do not fill it with powdered adsorbent).
- 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 adsorbent.
- 9) Tightly close the dryer cap to ensure that there is no leak of H<sub>2</sub> gas.
- 10) To restart the OPGU after this replacement, purge with H<sub>2</sub> gas for approximately 10 minutes (refer to 4.3.1 and 4.3.2).

### 7.3.3 Cleaning the WATER TANK

Since pure 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 pure water tank to ensure that the OPGU is always operated in a clean state.

- 1) Prepare 5-6 liter of pure water and a drain container (approx. 10 liter).
- 2) Turn OFF the POWER switch and then unplug the power cord.

- 3) Remove the cap of the water tank inlet and open the manual valve on rear panel. The pure water in the tank will be drained. And waste water in the water tank completely.
- 4) Put the manual valve back in place and supply pure water and through the pure water inlet until the tank is filled up to approximately its seven tenth.
- 5) Repeat flushing operation described in steps 3) and 4) at least three times.
- 6) After flushing the tank, put the manual valve back in place.
- 7) Put the cap back to the pure water inlet.
- 8) Turn ON the POWER switch and check the operation of the OPGU.

#### 7.4 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 H<sub>2</sub> gas or water, then contact us or our dealer to ask for inspections and services by a service man.

##### 1) General operation checks

2) Check for leaks of H<sub>2</sub> gas

3) Check for leaks of water

4) Checks of parts related to water piping(replacement and flushing)

- Water piping
- Water level sensor
- Pure water tank
- Check valve
- Water separation trap
- Electrolytic cell

5) Checks of other parts(replacement)

- POWER switch
- Cell power source
- System power source
- Control and display boards
- Interface board
- Solenoid valve
- Fan
- Others