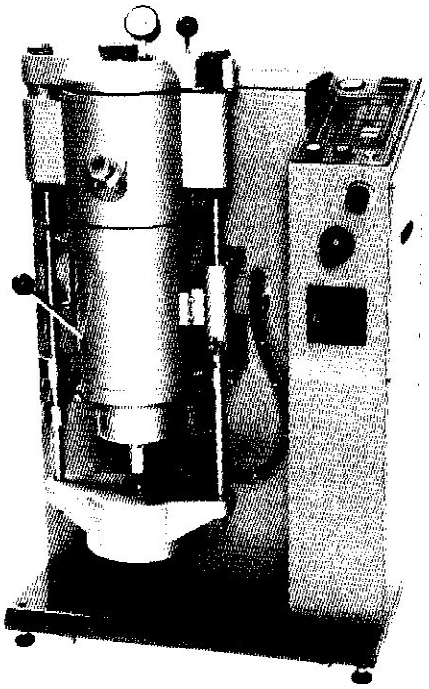
Yasui®

# VACUUM PRESSURE CASTING MACHINE *VPC*

# *K2E*

INSTRUCTIONS

This instructions manual is for Production Serial No. E241-E245, E251 and later.



Patent China ZL98803885.4,
U.S. 6,253,828 B1
Patent pending in other countries under
International No. PCT/CH98/00103
Int. Publication No. WO 98/45071

Patent U.S. 5,948,351
Utility Model China 97231790.2,
Germany 297 22 779 U1

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Keep this manual for your future reference.

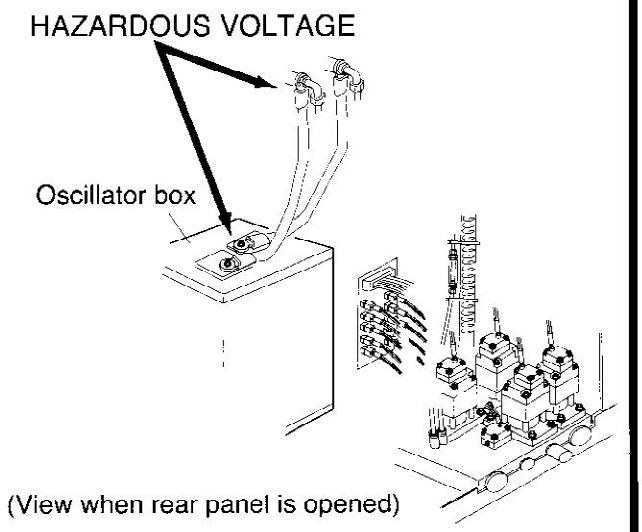
# CONTENTS

# 1. INTRODUCTION

## 1-1. SAFETY INSTRUCTIONS

### ⚠⚠ DANGER

Do not open the panel unless instructed in this manual, because hazardous voltage is flowing inside the machine. When it is necessary to open the panel, always turn power off before opening the panel for safety, otherwise hazardous voltage can cause an electrical shock, burn or death.

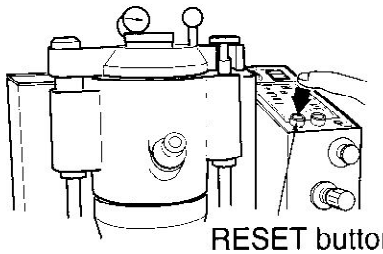


(View when rear panel is opened)

### ⚠ WARNING

1. Do not place fingers, hands, a part of body, or an article between the bottom of the lid and the top of the melting chamber or between the bottom of the melting chamber and the top of the mold chamber. When you press the START button, the lid will move downwards and the mold chamber will move upwards to close with pressure. As their pressing force to close is very strong, careless positioning of your fingers, hands, or any other part of body can cause severe injury.
Particular care should be taken so that any other person, standing close to you, should not place fingers, hands, any other part of body, or an article between the above-mentioned parts of chambers.

When you need to release the lid or the chambers, press the RESET button immediately.


RESET button

If you release the START button while the lid is lowering, the lid moves upward to its original position. If you release the START button in one second after the lid starts to close, the lid moves upward to its original position.

IMPORTANT:
The lid or the chamber does not open by pressing the EMERGENCY STOP button.

2. When you check, replace, or clean the crucible, the heating coil and the mold chamber and their surrounding area, where heating has been applied, allow them to cool enough beforehand.

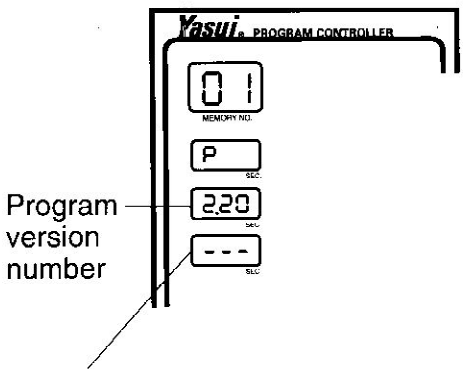
3. Do not place any material or tool on the operation panel or on the top cover of the machine. Particularly, never place anything on the operation panel because malfunction may be caused.

## CAUTION

1. Do not look into the molten metal continuously for a long time. Wear protection glasses.
2. Check that no crack or breakage is observed on the crucible, outer crucible, before their setting. Do not push the crucible body, or metal in the crucible, strongly. When the crucible has a crack, molten metal may leak through it, resulting damage of the machine.
3. Crucibles have their casting lives. Do not use a deteriorated crucible. Check condition of the crucible before use.
4. Do not leave the working room, while the machine is being operated.

- THE MANUFACTURER SHALL IN NO EVENT BE LIABLE FOR ANY DAMAGE RESULTING FROM IMPROPER USE, NEGLIGENCE TO FOLLOW THE WARNINGS AND CAUTIONS IN THE INSTRUCTIONS MANUAL OR THE LABELS ON THE MACHINE, UNSKILLFULNESS, USE OF NON-ORIGINAL OPTIONAL/CONSUMABLE ACCESSORIES/ SPARE PARTS, NON-AUTHORIZED MODIFICATION.
- THE MANUFACTURER SHALL IN NO EVENT BE LIABLE FOR ANY CONSEQUENTIAL OR INDIRECT DAMAGES INCLUDING, BUT NOT LIMITED TO, LOSS OF PRODUCTION OR LOSS OF PROFIT OR DAMAGES DUE TO MACHINE DOWNTIME.
- DAMAGES TO THE INSTRUMENT AND/OR HUMAN BODIES RESULTING FROM A CRUCIBLE BREAKAGE OR CONTACTING WITH HIGH TEMPERATURE PARTS ARE NOT COMPENSATED BY THE MANUFACTURER.
- DAMAGES RESULTING FROM DELAY OF REACTION AT EMERGENCY AND MISTAKEN OPERATION ARE NOT COMPENSATED BY THE MANUFACTURER.
- DAMAGES BY ELECTRICAL NOISE, OVER VOLTAGE, OR WIRING ERROR CAUSED FROM AN EXTERNAL VACUUM PUMP ARE NOT COMPENSATED BY THE MANUFACTURER.
- CASTING RESULTS BY THE MACHINE OR BY THIS MANUAL ARE NOT COMPENSATED BY THE MANUFACTURER.
- NO PART OF THIS DOCUMENT MAY BE COPIED OR IN ANY WAY REPRODUCED WITHOUT THE EXPRESSED WRITTEN CONSENT OF THE MANUFACTURER.

This manual is for the machine whose program version number is 2.20 or later. The program version number is displayed at the operation panel as the figure just after power is turned ON.




(If monthly update password mode (P.7-8) is set, HH is displayed here for about one second)

# 1-2. PASSWORD

## 1-2-1. KIND OF PASSWORD

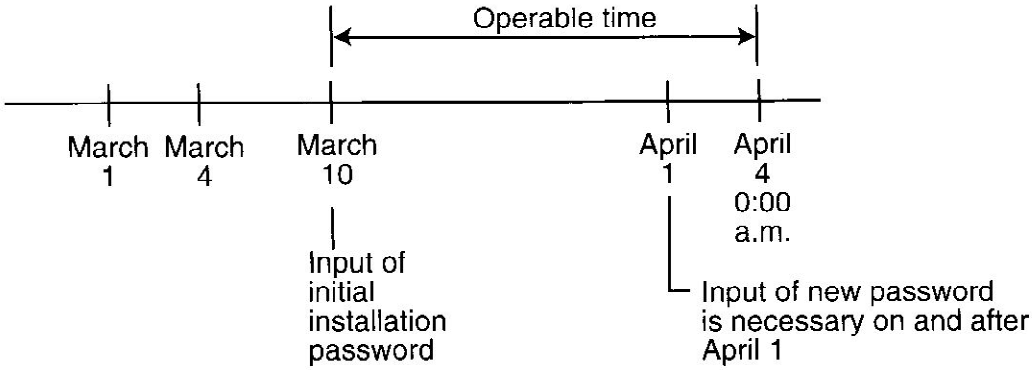
Three kinds of password are prepared for the machine as follows. Refer P.70-74 for input procedures.

### 1. Initial installation password

Initial installation password is necessary to release operation-lock of the machine at the time of installation of the machine.

0:00 a.m. of fourth day of the next month (Japan time) is expiration date of this password. Unless final password (Item 3. of P.8) is input, input of new update password (Item 2. of P.7) is necessary monthly to use the machine on and after this day. Without the new password, operation becomes impossible.

Example of initial installation password:

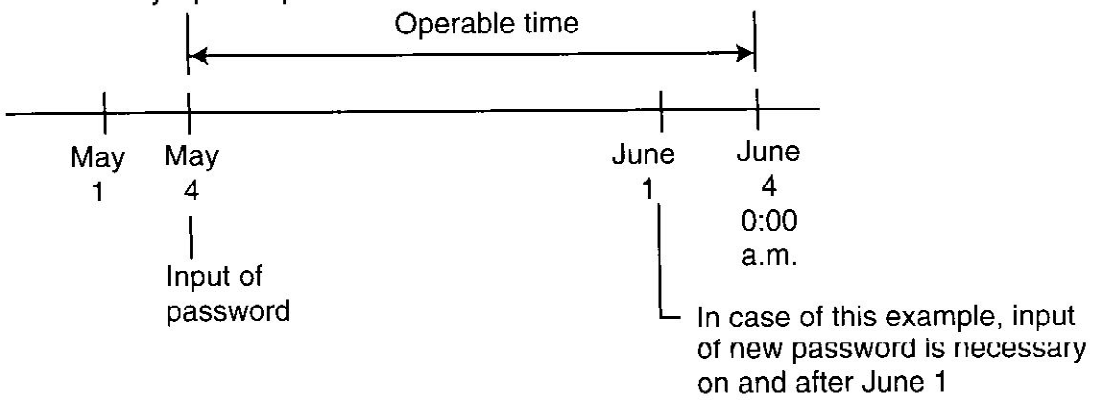



### 2. Monthly update password

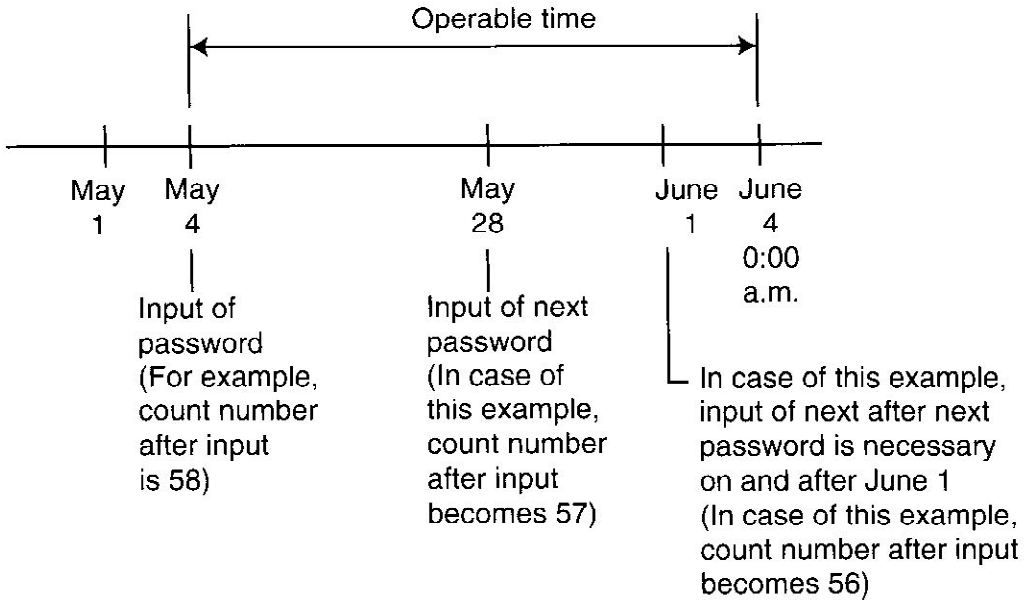
In case this machine is used by monthly use conditions, input of this kind of password is necessary on or after the first day of the month to which the next monthly calculation starting time belongs. Monthly calculation starting time is 0:00 a.m. of the fourth day of every month by Japan Time.

> IMPORTANT:
> Consider the world time-zone differences, and prepare password beforehand.
> Each machine has different password associated with the serial number of the machine and month, so password should be placed under control by the appropriate supervisor of your company.

Example of monthly update password:



IMPORTANT: If input is done before the first day of the month to which next monthly calculation starting time belongs, monthly update subtraction counter is decreased by extra one month.
Input should be done on or after the first day of the month to which calculation starting day belongs.




### 3. Final password

When this password is input and is verified by the machine normally, the machine can be operated without time-limit.

IMPORTANT: Once this final password has been verified by the machine, the machine can not be reset to the monthly update password mode.

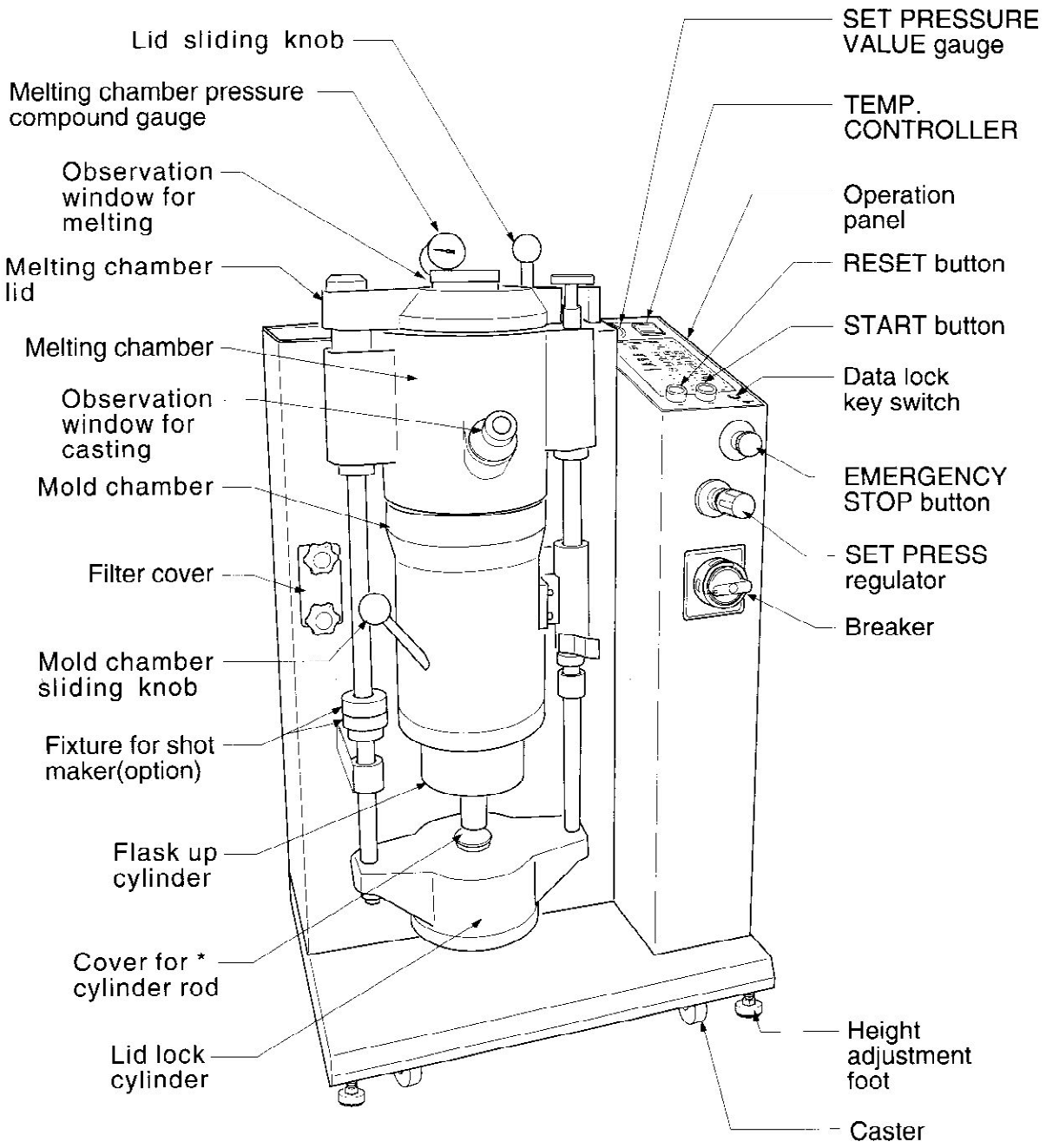
## 1-2-2. ISSUE OF PASSWORD

To issue next password in the case of use by monthly update password mode, the following information is necessary.

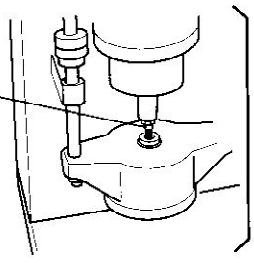
Model name : *K2*
Production Serial No. : xxx (See P.70)
Current monthly update history count : xx (See P.70)

# 2. NOMENCLATURE

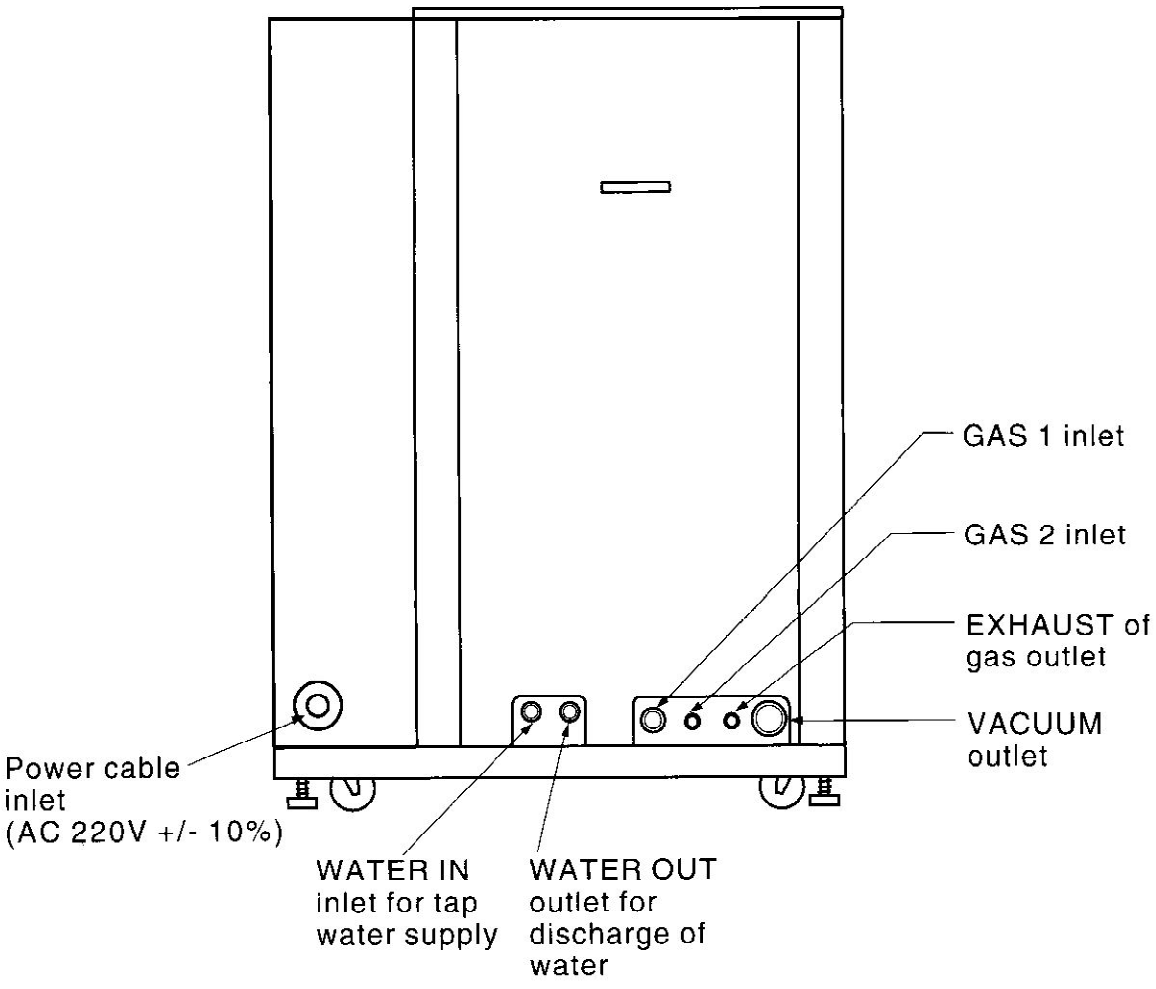
## (1) MAIN BODY



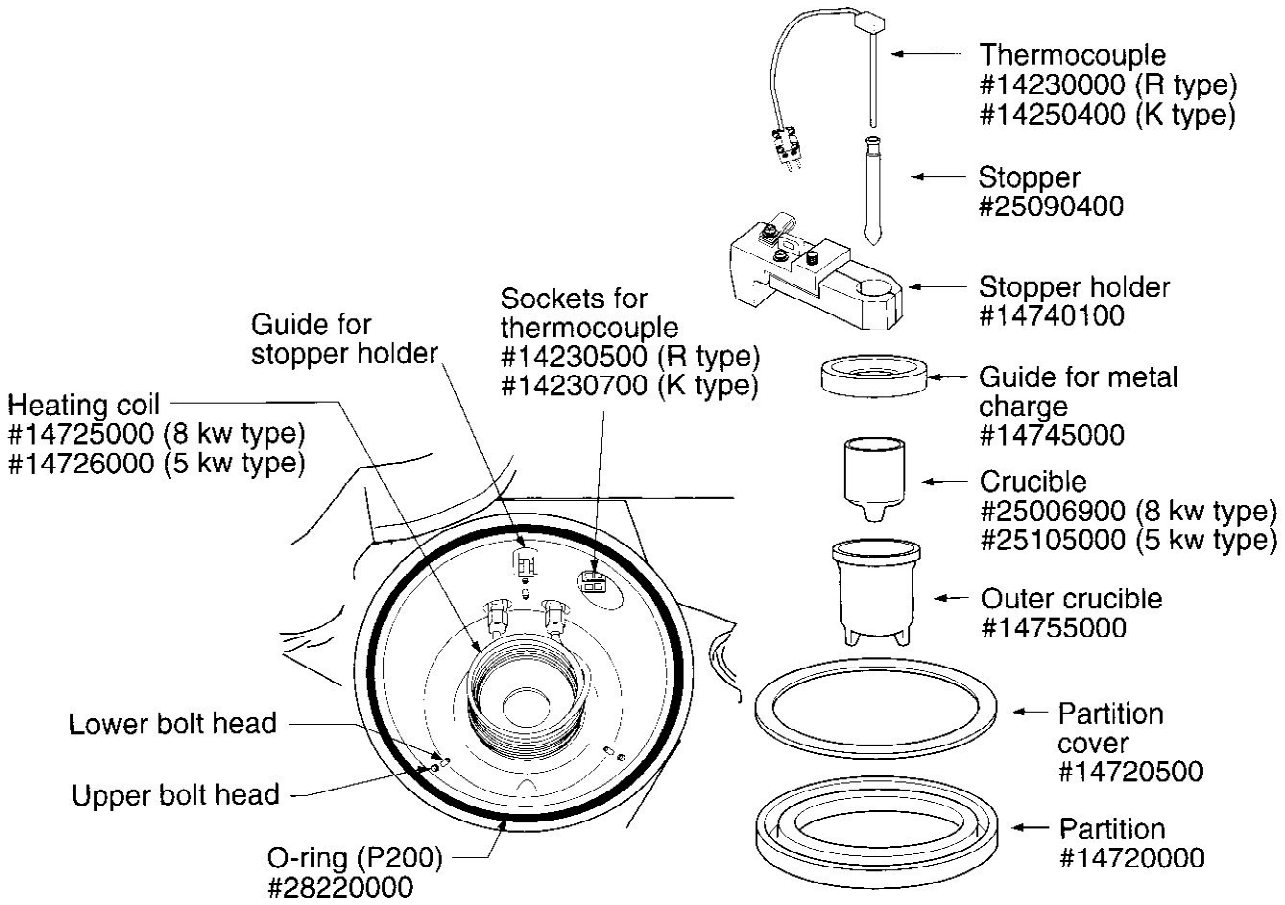

*
When installing the machine Production Serial No. E241-E245, E251 and later,
1) remove the fixation bolt for transportation
2) then, place the cover for cylinder rod.
See page 85 for details.



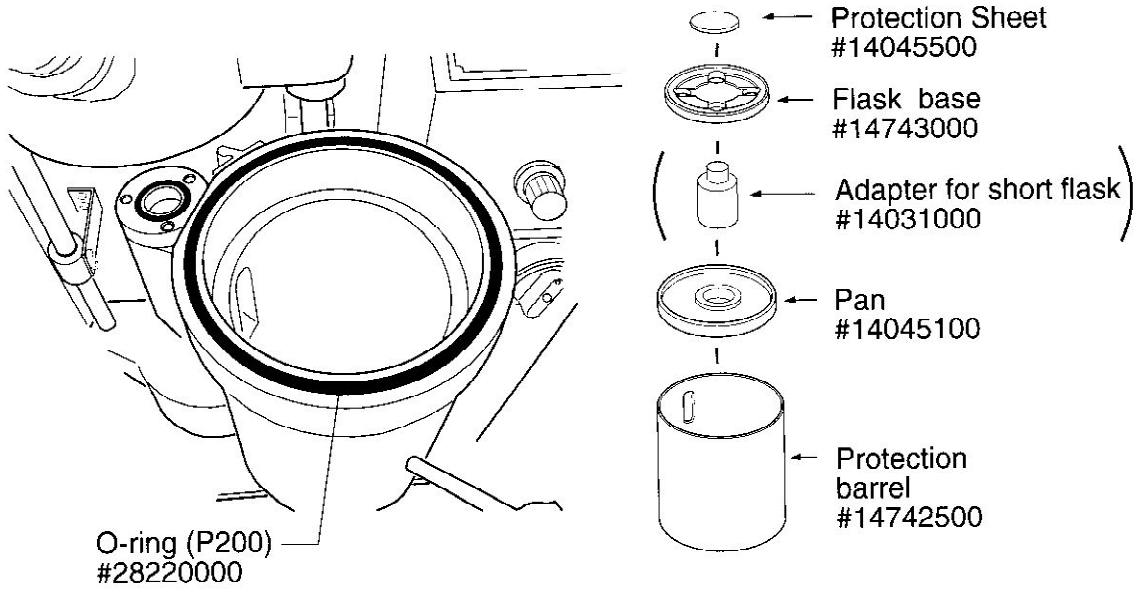
(2) REAR PANEL


GAS 1 inlet
GAS 2 inlet
EXHAUST of gas outlet
VACUUM outlet
Power cable inlet (AC 220V +/- 10%)
WATER IN inlet for tap water supply
WATER OUT outlet for discharge of water

## (3) MELTING CHAMBER




## (4) MOLD CHAMBER



# 3. PREPARATION BEFORE CASTING

## 3-1. CHECKING POINTS BEFORE POWER ON

Check the below points prior to power ON.

1) Connection of vacuum pump and its rotation direction
2) Pressure of supply inert gas
3) Connection of hose to WATER IN

> ⚠CAUTION
>
> Make sure before starting heating the coil that the faucet of water is turned on and the tap water is running inside machine.

4) Connection of hose to WATER OUT

## 3-2. SETTING CRUCIBLE AND OTHER PARTS

Set up the below items.

Melting chamber

1) Outer crucible, crucible (P.11)
2) Partition (P.11, 86)
3) Stopper holder, stopper (P.11, 87-88)
4) Thermocouple (P.11, 87-88)

Below melting chamber

1) Metal sealing disk and O-ring (P.29-31)

Mold chamber

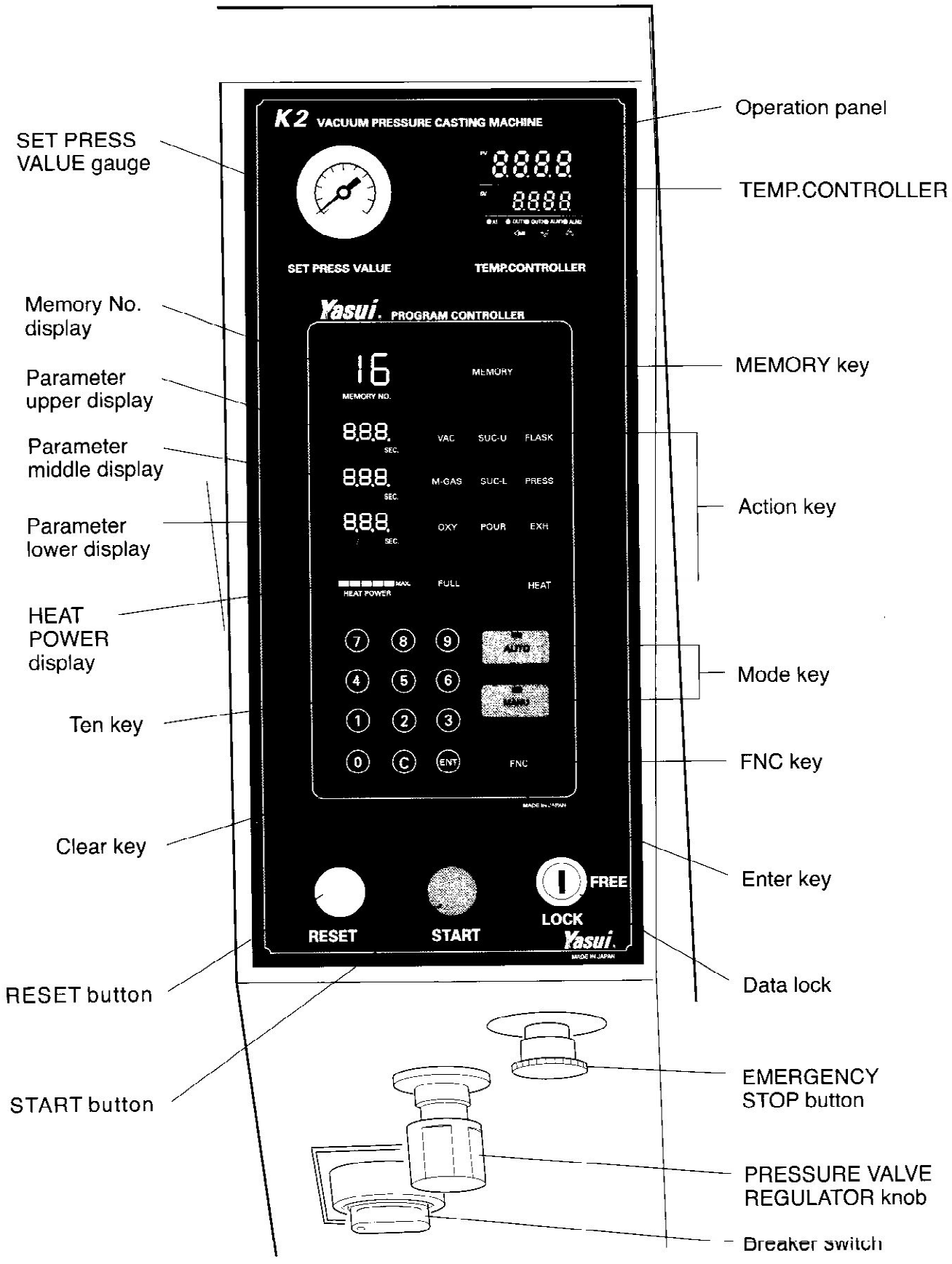
1) Protection barrel, pan and flask base (P.11, 27-28)

Below mold chamber

1) Cover for cylinder rod (P.85)

# 4. OPERATION-1 (BASIC OPERATION)

## 4-1. OPERATION PANEL



## (1) START button

If you press and hold the START button for more than one second during the AUTO mode, the lid moves downward and is locked, then casting process is started automatically.
If you press and hold the START button for more than one second during the MANUAL mode, the lid moves downward and is locked.

## (2) RESET button

By pressing the RESET button, you can stop operation. After pressure in the melting chamber has returned to one atmospheric pressure, the lid opens. This button is used to stop casting operation. This button can also be used to open the lid in emergency.

## (3) EMERGENCY STOP button

In the case of emergency, press the EMERGENCY STOP button to stop all of the functions. To recover, turn it clockwise and press the RESET button.

## (4) TEMP. CONTROLLER

The TEMP. CONTROLLER receives the signal from the temperature sensor and displays the measured temperature as PV. The TEMP. CONTROLLER also displays the target temperature of each Memory No. which is registered as parameter. When one Memory No. is selected, target temperature of the same Memory No. is recalled to the TEMP. CONTROLLER and displayed as SV.

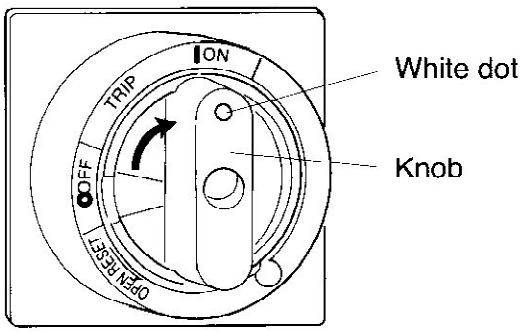
## (5) SET PRESS Regulator and SET PRESS VALUE Gauge

Turn the SET PRESS regulator knob to set the final pressurization value of the internal pressurization tank. Set value is indicated by the SET PRESS VALUE gauge on the operation panel.
Maximum pressure value of this machine is 0.3 MPa (300 kPa). When you finish turning the knob, push the knob in for locking.

# 4-2. POWER ON

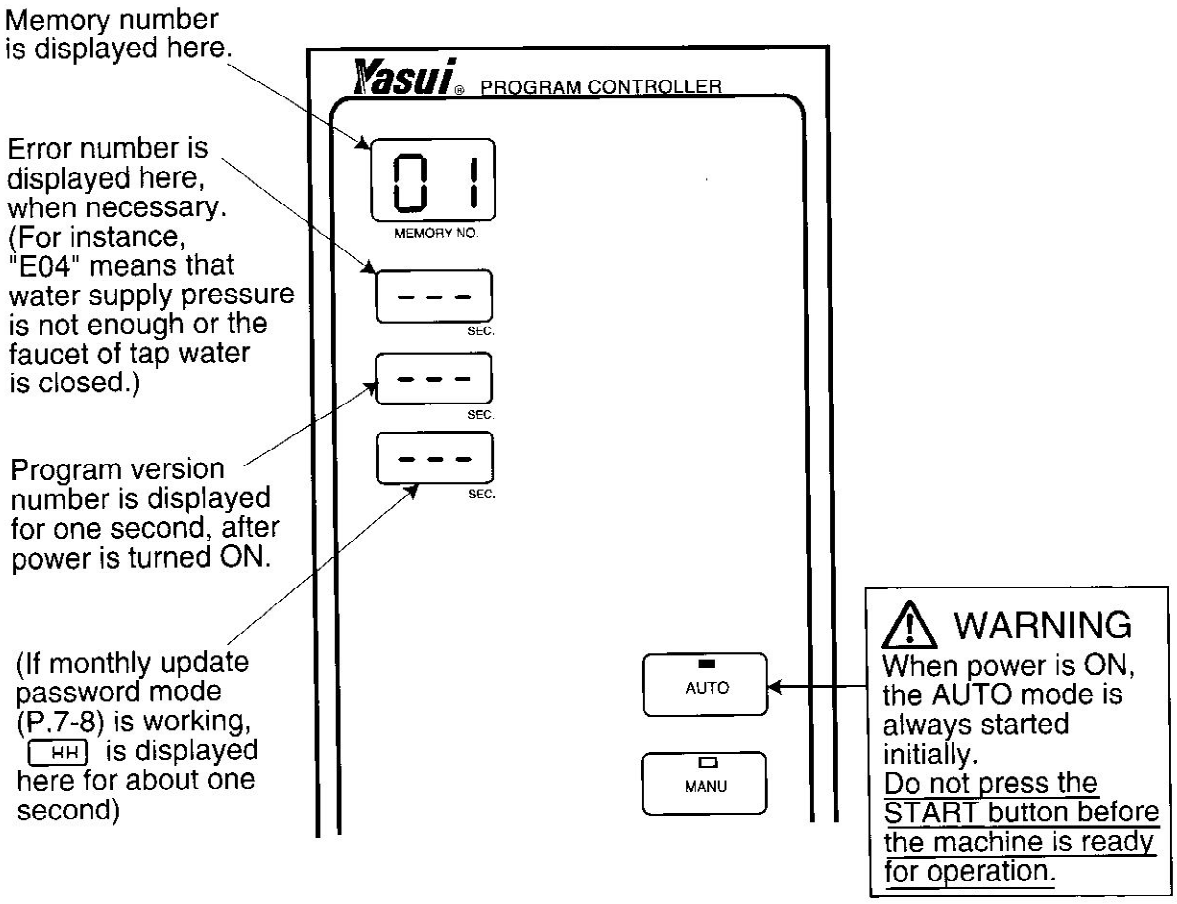
Turn the knob of the BREAKER switch until its white dot is set to ON position. Power is supplied to all necessary parts.

IMPORTANT : Turn the knob securely until it clicks into place.




IMPORTANT : When the white dot of the BREAKER switch moved to TRIPPED position during use of the machine, overcurrent has flown inside the machine (the machine became TRIPPED condition by overcurrent). In this case, check the cause and take necessary action. Then, turn the knob to RESET position. Next, turn the knob to ON.

Program version number of the machine is displayed on the operation panel for one second, and then the display changes as the below figure.



# 4-3. MODE SELECTION

There are three main modes;

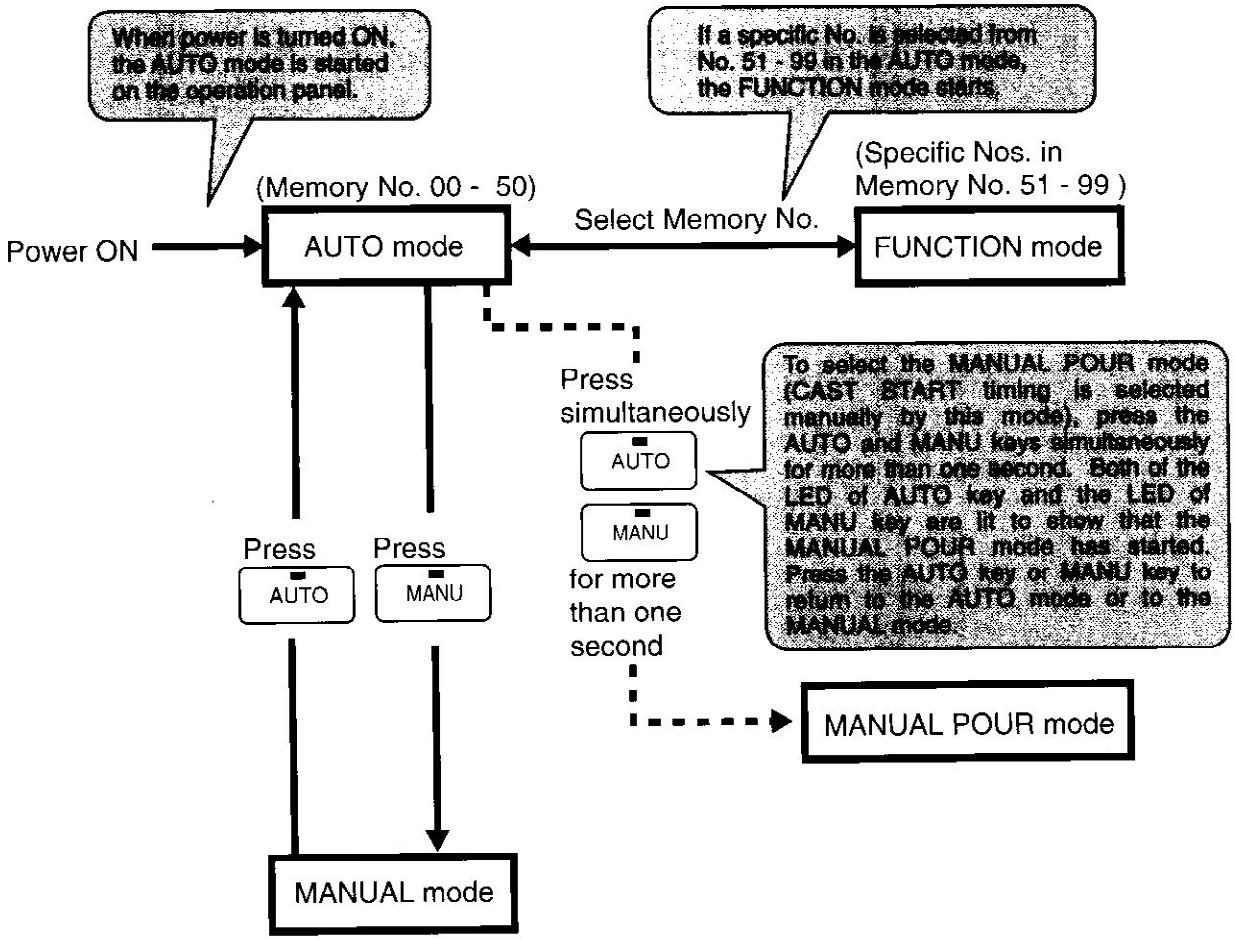
- AUTO mode
- MANUAL mode
- FUNCTION mode

There is one sub mode which belongs to the AUTO mode.

- MANUAL POUR mode

  (During casting under the AUTO mode, timing of starting metal pouring can be decided by pressing the START button manually)

Those modes can be selected as the below chart.




The memory numbers from 0 to 50 are for operation by the AUTO mode.

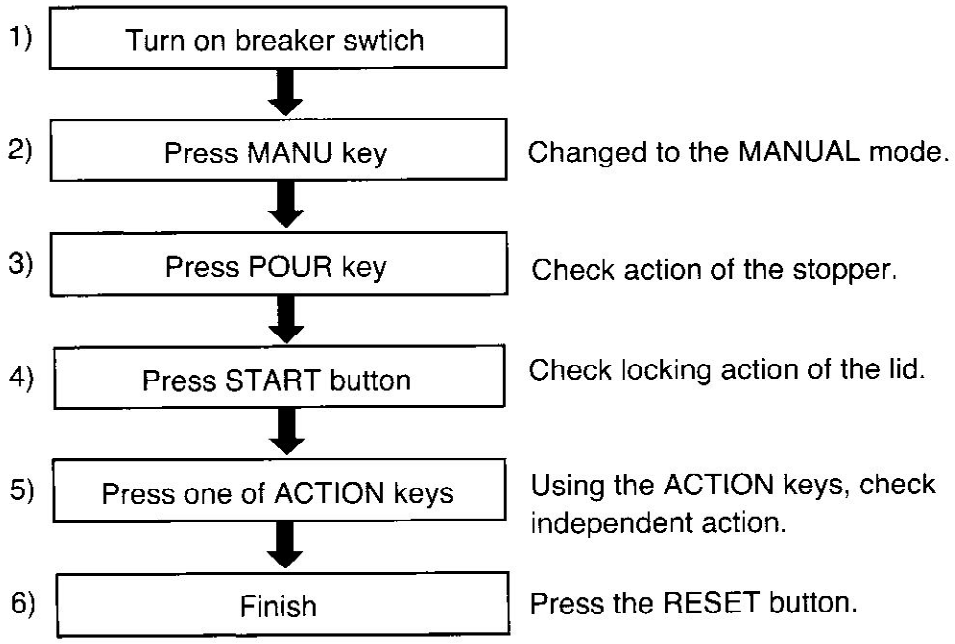
You can change memory number as below.

Press [MEMORY] ---> LED of MEMORY key flashes ---> Input desired value by the ten key (0) - (9) ---> Press (ENT) key.

# 4-4. BASIC OPERATION (QUICK REFERENCE)

## 4-4-1. MANUAL MODE

### 4-4-1-1. SEQUENCE OF MANUAL MODE




### 4-4-1-2. OPERATION TEST OF MANUAL MODE

1) Turn the BREAKER switch to turn power ON. LED of [AUTO] key is lit.

2) Press [MANU] key.

3) While the lid is opened, press [POUR] key to check upward movement of the stopper.

Press the [POUR] key again to check downward movement of the stopper, and also check that the LED of [POUR] key is turned off.

Check at this time that the lower end of the stopper is pressed fittingly against the inside bottom of the crucible.

4) Slide the lid to the position just above the melting chamber, and then press the START button to lock the lid.

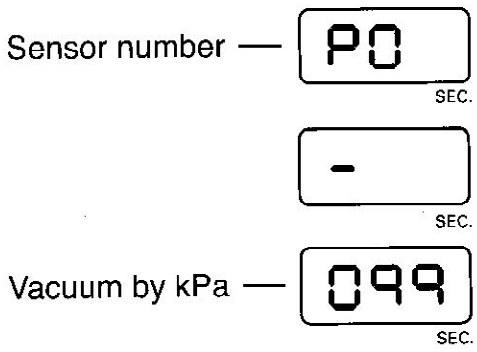
- Actions of [VAC] [M-GAS] [OXY] are possible during the lid-lock state only.

- To open the lid, press the RESET button.

5) Press and hold [VAC] key. While pressing and holding this key, the chambers are evacuated.

If you wish to continue evacuation for a long time, first press (FNC) key, and second press [VAC] key.

6) Suspend evacuation when vacuum level becomes 98 to 100 kPa. Vacuum level is shown at the parameter lower display.




- Vacuum level can also be shown at the gauge on the lid.

- If you press the RESET button, air is introduced into the chamber and the lid is opened.

7) Under vacuum, check the below functions.

i) When you press and hold [M-GAS] key, inert gas is introduced into the chambers.

Gas introduction will stop when you release the key.

ii) When you press and hold [OXY] key, air is introduced into the chambers.

(When the pressure inside the chambers is above one atmospheric pressure, gas inside goes out.)

iii) When you press and hold [EXH] key, air is introduced into the chambers.

iv) Press [HEAT] key to start heating. At trial heating, it is better to set the SV of the TEMP. CONTROLLER lower than 400 degrees centigrade to protect crucible and other surrounding parts. The PV window of the TEMP. CONTROLLER displays the present process temperature value of the thermocouple (thermo sensor). Check that PV value in the window shows increase. The HEAT POWER display on the operation panel indicates the output power status of the built-in oscillator.

v) Press [FLASK] key to move the flask jack-up shaft upward. The flask jack-up shaft moves downwards when you press [FLASK] key again.

vi) Press [SUC-U] key and [SUC-L] key to confirm by sound that the built-in electromagnetic valves are activated.

vii) Press [PRESS] key and check pressurization function.

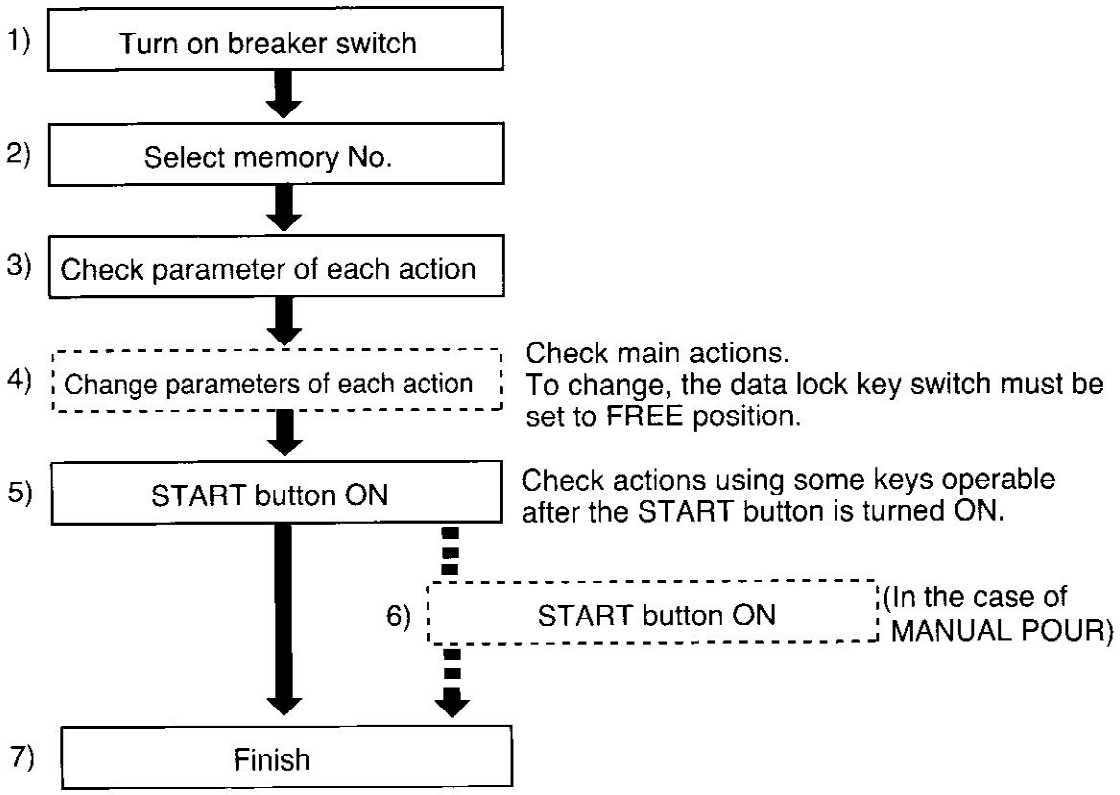
This checking should be done after checking that exhaust action is normal.
Check that pressure value is set to normal level by the SET PRESS regulator.

viii) Press [EXH] key to check that pressure inside the chamber becomes atmospheric value.

8) Press the RESET button to finish the operation test of the MANUAL MODE.

# 4-4-2. AUTO MODE

## 4-4-2-1. SEQUENCE OF AUTO MODE




## 4-4-2-2. OPERATION TEST OF AUTO MODE

1) Turn the BREAKER switch to turn power ON. LED of [AUTO] key is lit.

2) Select Memory No.

Example: to select Memory No. 01

Press [MEMORY] key ---> LED of MEMORY key flashes ---> Press (1) key

---> Press (ENT) key

Note: Factory preset value is registered in Memory No. 01.

3) Checking parameters

Check parameters of principal actions.

i) Press [VAC] key. (LED of [VAC] key flashes to show the key is in input-standby state, but for the purpose of checking of its parameter only it is possible to move to

other parameters by pressing another key.)

ii) Parameter of [VAC] key is shown in the upper parameter display.

At the same time, parameters of [M-GAS] and [OXY] keys located in the same column are shown in the middle and lower displays respectively as well.

iii) Then, press [SUC-U] key to check parameters of the keys in the column located second from the left.

iv) Furthermore, press [FLASK] key to check parameters of the keys in the column located third from the left.

v) Parameter of [HEAT] key is shown in the lower display. This parameter is the Set Temperature (SV value). When (ENT) key is pressed, this parameter is written in the TEMP. CONTROLLER as the SV value.

4) Changing parameters

If LED of an action key is flashing, parameter of that key can be changed by input of value.

Example:

Press [VAC] key ---> Press (0) - (9) ---> Press (ENT) key

IMPORTANT: Set the data lock key switch to FREE position in order to change parameters.

- Each function has a limit of input value.
- Decimal point is automatically inserted, so you need to press the numerical keys only to enter parameters.

Example: To input "5.5" for M-GAS

Press (5), and once again (5) ---> Press (ENT) key

5) Checking actions after pressing START button

Check the action process after pressing the START button.

When the START button is pressed, the lid automatically moves down and is locked, then evacuation process is started first.

Note: If LED of action key is flashing at the time of pressing the START button, the action process can not be started.

- Parameter value, which corresponds to a process just in action, is displayed on either of the upper, middle and lower parameter displays.

Parameters corresponding to [VAC] and [EXH] keys are displayed by countdown.

See the flow chart in P.56 for details of actions.

- SV value of the TEMP. CONTROLLER is overwritten by parameter which is already set by [HEAT] key, but it is possible to change this value by the TEMP. CONTROLLER before CAST START (C) (P.56) is started. (However this change will not be stored into the parameter memory. )

## ⚠CAUTION

During sequence of action process, you can break the sequence by pressing the RESET button. Then, the lid opens and the sequence will return to the initial condition.

(By pressing the EMERGENCY STOP button, process is suspended, however the lid does not open. Use the EMERGENCY STOP button in the case of emergency only.)

6) Selecting MANUAL POUR MODE (P.59 )

**The "MANUAL POUR" in this instructions manual is to finish preparation for metal pouring by changing set temperature or by checking melting state of the metal after turning the START button ON first, and to determine timing of starting metal-pour by turning the START button ON second.**

Press [AUTO] and [MANU] keys simultaneously for more than one second.

Both of the LEDs are on to show that the MANUAL POUR MODE is activated.

To return to the AUTO MODE, press [AUTO] key only. LED of [MANU] key goes off, and LED of [AUTO] key only is kept ON, to show that the AUTO MODE is operating.

7) Finish of Operation Test of AUTO MODE

When time corresponding to the [EXH] key is counted up, the exhaust valve opens to equalize the pressure in the chamber to one atmospheric pressure, and the lid opens automatically to finish the automatic sequence.

Before starting next casting, be sure to perform the stopper action to check that the lower end of the stopper makes contact with the inside bottom of crucible. Refer "7-3. CRUCIBLE AND STOPPER" (P.33-34) and take care that slag does not remain on the surface of crucible and stopper.

- POUR action is possible independent of open-close action of the lid.

Press (FNC) key ---> Press [POUR] key

## 4-4-2-3. MOLD-IN AFTER PREHEATING MODE (P.63)

**To melt the metal temporarily before setting the mold in the mold chamber for casting under the AUTO MODE is called "mold-in after preheating" in this instructions manual.**

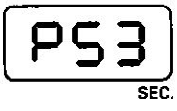
1) Select Memory No.53 with [AUTO] key .

2) Set parameter value (Recommended value: 30) other than "0" with [VAC] key in Memory No.53.

Set parameter value (Recommended value: factory preset value) with [M-GAS] key in Memory No.53. Further, set parameter value (Recommended value: factory preset value) with [HEAT] key in Memory No.53.

3) Select a Memory No. from Nos.01 to 50.
4) Press the START button. Primary process (preheating) of Memory No. 53 starts as follows.
Lid-lock ---> VAC ---> M-GAS ---> HEAT ---> Lid-open
5) When the lid is opened, set the flask.
6) Press the START button once again.
Secondary process of the Memory No. selected by the above 3) starts.

NOTE:

[1] When the START button is pressed first time as the above 4), 

is shown at the parameter upper display to indicate the "mold-in after preheating" is started.
[2] When the START button is pressed second time as the above 6) , Memory No. of normal AUTO MODE casting, selected at the above 3), is shown at the parameter upper display.

Factory preset values are registered in Memory Nos. 00, 01, 02 and 03.
The below parameters are for standard casting process. It is necessary to modify the parameters, depending upon kind, shape, size and amount of metal.

Parameters in No. 00 can not be changed, however it is possible to copy another Memory No.

Parameters of *K2* Preset at Factory

| MEMORY NO. | 00 | | 01 | | 02 | | 03 | |
|---|---|---|---|---|---|---|---|---|
| VAC | 60 | sec | 30 | sec | 30 | sec | 10 | sec |
| M-GAS | 4 | sec | 8 | sec | 0 | sec | 4 | sec |
| OXY | 0 | sec | 0 | sec | 3 | sec | 0 | sec |
| SUC-U | 0 | sec | 2 | sec | 0 | sec | 0 | sec |
| SUC-L | 10 | sec | 10 | sec | 10 | sec | 10 | sec |
| POUR | 1 | sec | 1 | sec | 1 | sec | 1 | sec |
| FLASK | -10 | deg.C | -10 | deg.C | -10 | deg.C | -10 | deg.C |
| PRESS | 1 | sec | 1 | sec | 1 | sec | 1 | sec |
| EXH | 180 | sec | 180 | sec | 180 | sec | 180 | sec |
| HEAT | 1000 | deg.C | 1000 | deg.C | 1000 | deg.C | 1000 | deg.C |
| Method | General casting | | Casting for metal which contains much amount of zinc | | Casting for metal which contains anti-oxidation agent | | Casting by "mold-in after preheating mode" | |

IMPORTANT

[1] VAC parameter is for use of vacuum pump whose capability is about 300 liters per minute.

[2] Adjust the flowing speed of M-GAS properly.

[3] Increase the PRESS parameter value as metal amount becomes larger.
For example, in the case of 14 K gold, "400 grams 1 second" or "800 grams 2 seconds" is standard.

[4] If longer EXH value is set, oxidation of the crucible will be smaller, which will result in extended life of the crucible.

[5] Adjust the HEAT parameter depending upon metal.

[6] Set the pressure of the internal pressure tank by adjusting the SET PRESS regulator so that pressure inside the melting chamber after metal pouring will be within from 0.1 to 0.2 MPa.

[7] When using metal containing large amounts of high evaporation rate materials such as zinc etc. and pouring it in high vacuum condition, vapor of zinc etc. is easily generated. As a result, dust of zinc etc. will be accumulated inside the chamber and further dust of zinc etc. will flow in and affect pipe components inside the machine.
When using such metal, evacuation time should be shorter (refer to the above table MEMORY NO. 01) than standard and finish gas substitution, and then melt the metal.

## 4-4-3. FUNCTION MODE

The FUNCTION mode uses the allocated numbers in Nos. 51 - 99.
Action parameters commonly used by all Memory Nos. for the AUTO mode are set in the FUNCTION mode. See P.60 - 75 for details.

## 4-4-4. OTHER FUNCTIONS

### 4-4-4-1. DATA LOCK KEY SWITCH

- When the key is set to the FREE position, parameters can be changed. However, parameters of Memory No. 00 and Memory Nos. whose parameters are locked can not be changed.
- When the key is set to the LOCK position, no parameters can be changed.

### 4-4-4-2. COPY OF PARAMETERS

1) Input Memory No. from which copy is taken.

Press [MEMORY] key ---> Press ten Key (0) - (9) ---> Press (ENT) key

2) Input (FNC) key and Memory No. to which copy is sent.

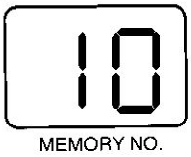
Example: To copy parameters from Memory No. 01 to Memory No. 10

Press [MEMORY] key ---> Press (1) key ---> Press (ENT) key

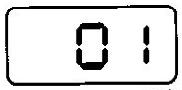
Press (FNC) key ---> Press [MEMORY] key ---> Press (1) and (0) keys --->

Press (ENT) key

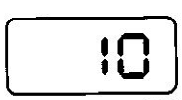
Parameter display will be as follows.



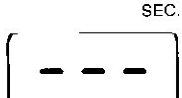
MEMORY NO.



SEC.



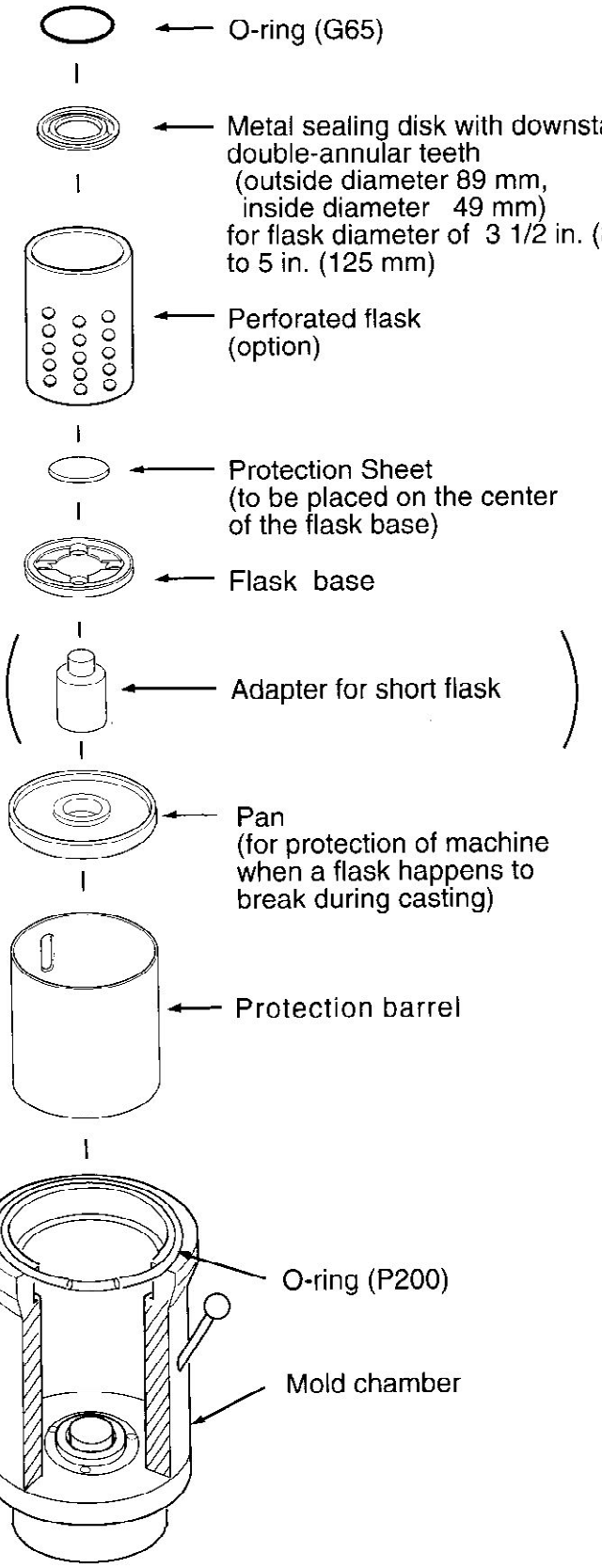
SEC.

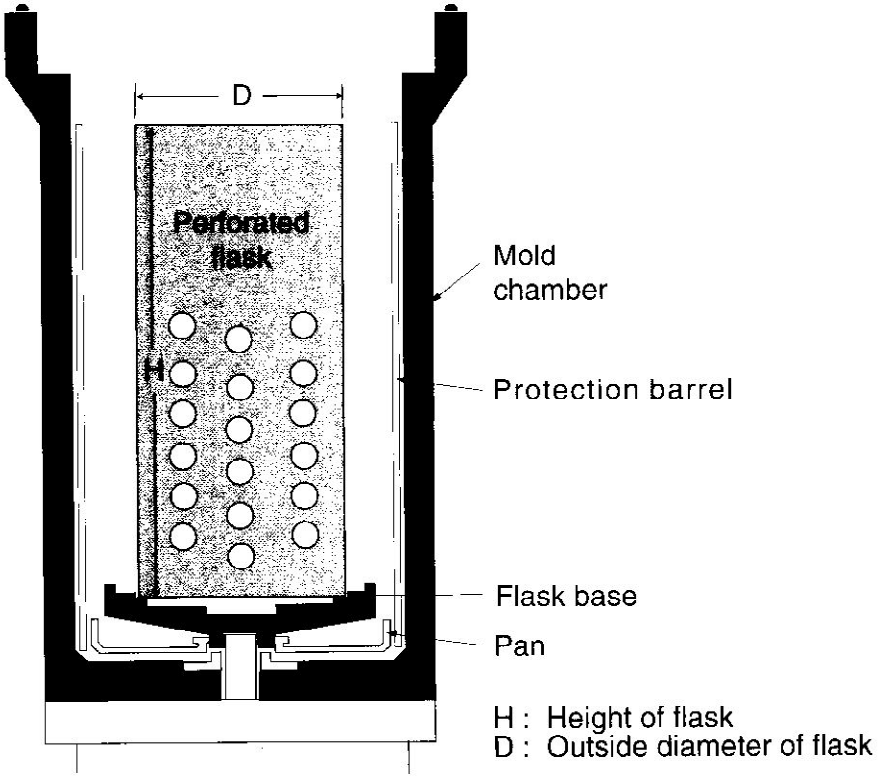


# 5. FLASK

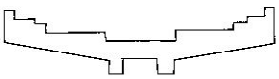
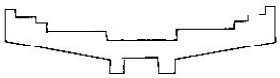
## 5-1. FLASK COMBINATION

Use of a perforated flask is recommended. Position the flask and other accessories in order as the below figure.



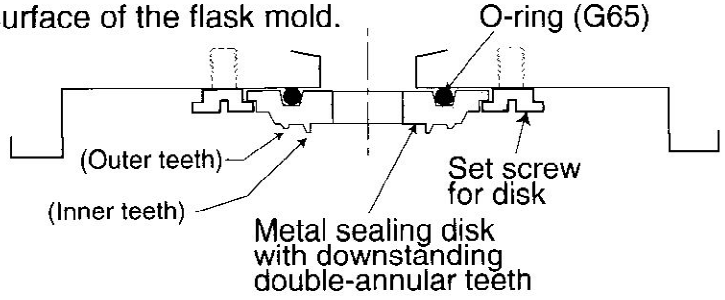



The below flasks can be used.

| Flask base | Size of flask to be used | |
|---|---|---|
| | Height (H) | Outside diameter (D) |
| Flask base  | 190 mm to 230 mm (7 1/2" to 9") | 89 mm (3 1/2") to 125 mm (5")(when flask is not deformed) |
| Flask base  to be used together with the Adapter for short flask (H=40 mm)  | 150 mm to 190 mm (6" to 7 1/2") | |

# 5-2. METAL SEALING DISK

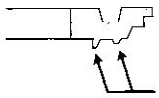
Top of the flask is pressed against the bottom of the melting chamber. Then, pressurization and suction are actuated. Gas passes from the upper surface of the flask mold through inside the mold, then is disperses through side walls and bottom of the mold to outside. Use the metal sealing disk with downstanding double-annular teeth to seal the upper surface of the flask mold.




(Section view of the bottom of the melting chamber)

IMPORTANT : Wrong fixation of the metal sealing disk with downstanding double-annular teeth may greatly affect casting results. Check the below [1] to [4].

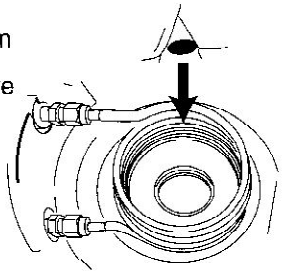
[1] Check periodically the conditions of the metal sealing disk and the O-ring. The O-ring used for this sealing is consumable. So, replace into a new one before sealing effect is weakened.

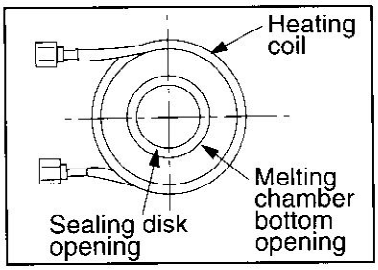


When a part of these teeth is broken, a good casting result may not be expected. Check them periodically.

[2] Adjust the horizontal location so that the disk is exactly centered, and then tighten the three screws evenly. If the disk is not set properly, results of casting will be greatly affected.

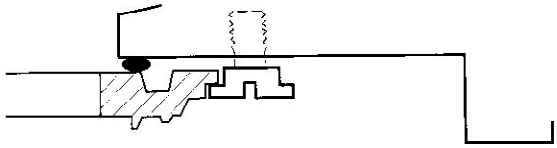
Look into the bottom opening of melting chamber from above





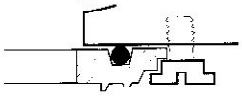

[3] Take care that the O-ring will not go off the groove of the disk and will not be flattened.

⊘ O-ring location not good

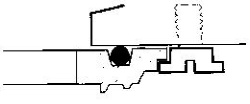


[4] Wrong positioning of the set screw and the disk will disturb tightening of the screw to its end.

⊘ Disk location not good



○ Good



## 5-3. O-RING CONDITIONS

As the O-ring is used for times, its sealing capability may be weakened, and casting result may be affected. When deterioration of the O-ring is found, replace into a new one. The O-ring has their lives. It is recommended to keep its spares in stock.

NOTE :

In one of the below cases, it is possible that the investment mold inside the flask may be cracked.

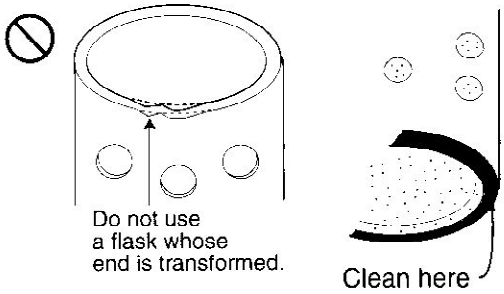
[1] Pressure of melting chamber indicates rapid decrease suddenly.

[2] Pressure increase is slower than usual at the time of pressurization.

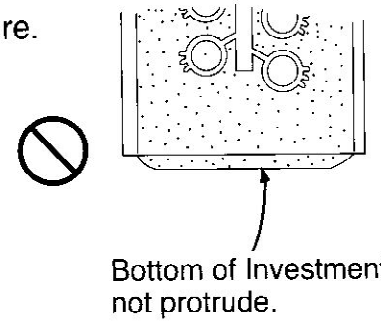
[3] Suction speed (after cast start) is slower than usual.

## 5-4. CORRECT PLACEMENT OF FLASK

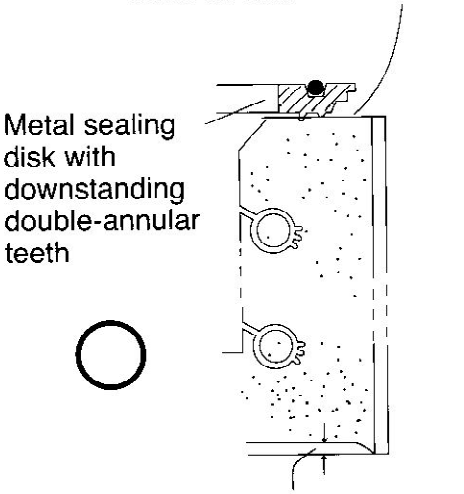
1) Buildup of investment powder on either top edge or bottom edge of the flask may result in failure of casting. Before placing the flask into the burnout furnace, scrape spilled investment on both edges of the flask completely.



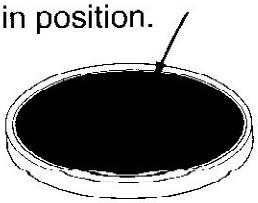

2) Check to see that investment surface is not protruding over the upper side edge or the lower side edge of the flask, so that sealing will be secured. Make space as required referring to the below figure.

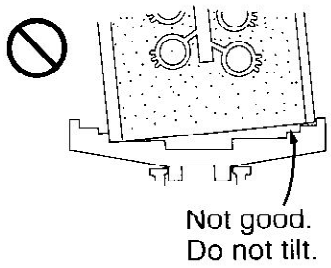



When you use the metal sealing disk with downstanding double-annular teeth, the upper surface of investment must be flat.



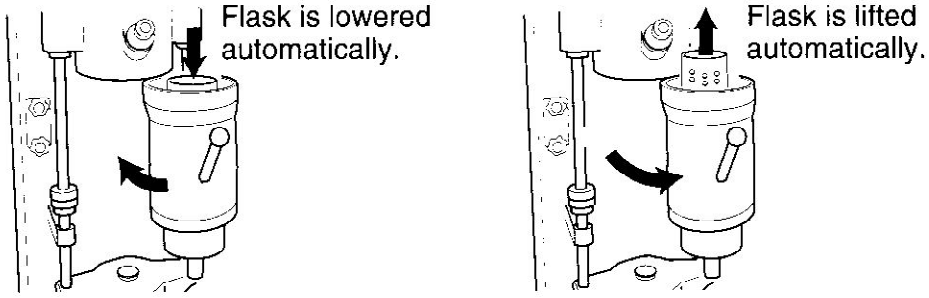

Remove a lump of investment powder residue from this area if there remains any, so that the flask will not tilt when it is set in position.





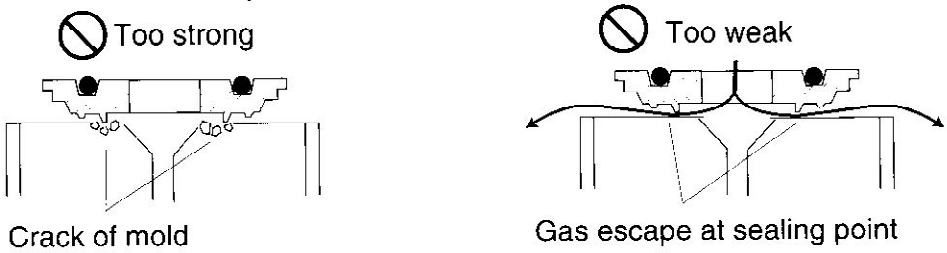
3) Slide the mold chamber in and out for trial to check that the flask automatically moves up and down.

> **⚠CAUTION**
>
> Do not slide the mold chamber toward the machine body too fast.




## 5-5. ADJUSTING FLASK-UP PRESSURE

When the mold cracks or gas leaks through the sealing point of the sealing disk, flask-up pressure is either too strong or too weak.



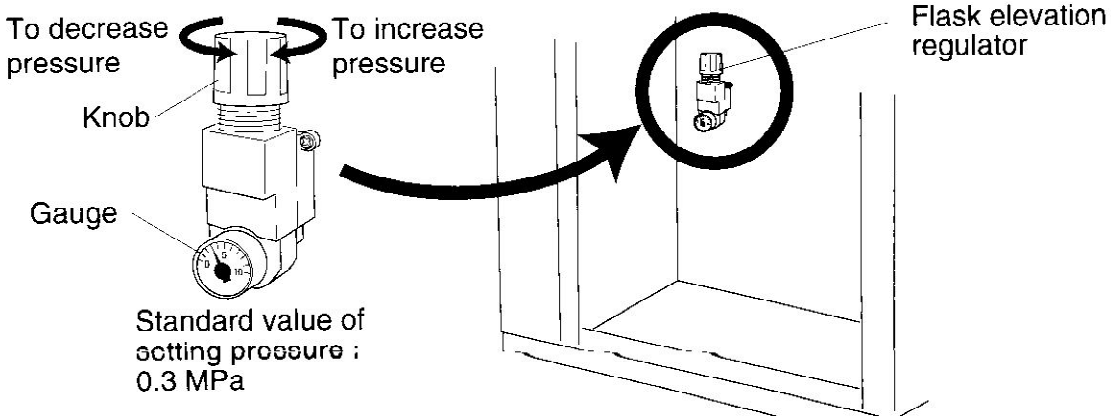

In such a case, turn power off and open the rear panel, and you will find the flask-up regulator at the upper part of the inside panel as the below figure. Turn its knob to adjust pressure.

> **⚠⚠ DANGER**
>
> HAZARDOUS VOLTAGE inside. See page 4.

Standard value: 0.3 MPa

---- The needle of the gauge indicates "3"

- Turn the knob clockwise to increase pressure.
- Turn the knob counterclockwise to decrease pressure.



# 6. PRESSURE DISPLAY

The pressure gauge of the machine is indicated by "Gauge Pressure".

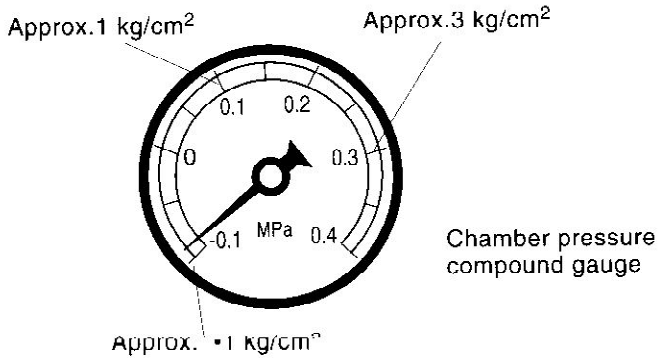
"Gauge Pressure display" is preset on the assumption that ambient atmospheric pressure at the factory is "0".

Therefore, when starting to use the machine just after its installation, pressure display value may become lower than zero depending upon ambient air atmosphere where the machine is installed, at highland for example. In this case, the below zero-adjustment is necessary before starting to use the machine.

AUTO MODE ---> Press the START button ---> Immediately press the RESET button.

The machine automatically performs zero-adjustment at the time of starting casting by the AUTO MODE, so it is not necessary to do zero-adjustment, except zero-adjustment for the first time use just after installation at highland place.

| | Kg/cm$^2$ | MPa | kPa |
|---|---|---|---|
| ↑ | 2.03944 Kg/cm$^2$ | 0.2 MPa | 200 KPa |
| | 2 Kg/cm$^2$ | 0.196 MPa | 196 KPa |
| | 1.0197 Kg/cm$^2$ | 0.1 MPa | 100 KPa |
| | 1 Kg/cm$^2$ | 0.098 MPa | 98 KPa |
| | | | |
| | Atmospheric pressure | 0 MPa | 0 KPa |
| | | | |
| Vacuum ↓ | -1 Kg/cm$^2$ | -0.098 MPa | -98 KPa |
| | -1.0197 Kg/cm$^2$ | -0.1 MPa | -100 KPa |



# 7. MAINTENANCE

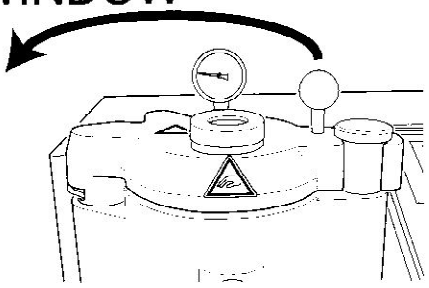
## ⚠WARNING

[1] Before starting maintenance or checking, be sure to turn the BREAKER switch OFF for safety. Be careful that electric current continues flowing in some part of the machine even when the BREAKER switch was turned OFF, unless the power supply cord is unplugged from the power outlet.

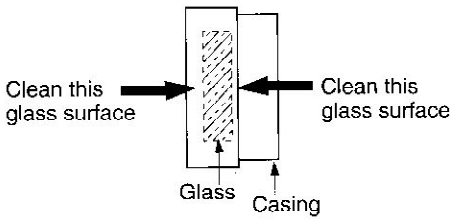
[2] Care should be taken so that the skin is protected from direct contact with heated parts after heating is applied, because it requires some time for each part to cool down.

## 7-1. CLEANING OBSERVATION WINDOW

1) When the inside surface of observation window for melting became dirty, rotate the lid to left side as the figure, and then clean the surface of the lens from beneath.



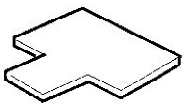
2) When the observation window for casting is to be cleaned, rotate the casing counterclockwise to loosen and remove. Then clean the internal lens.




IMPORTANT :

[1] Tighten the casing of the lens securely after cleaning. When tightening is insufficient, vacuum leakage may be caused. To remove the internal lens from its casing, use the special tool provided.

[2] However, it might be better not to remove the lens from the casing except for replacement of lens.



Special tool for glass replacement

## 7-2. GAS CYLINDER

Replace a gas cylinder for GAS 1 or GAS 2 early when remaining amount in the cylinder became small. Take enough care during replacement of gas cylinder, so that any dust will not enter the inside of gas tube.

## 7-3. CRUCIBLE AND STOPPER

1) After casting, slag sticks on the surface of crucible and stopper. Always clean it with a hard brass-wire brush or the like before next casting.

> **⚠CAUTION**
>
> When those parts are not cleaned, leakage of molten metal may be caused, resulting inferior casting. Further, a trouble which hinders normal operation of the machine may be caused, so take deliberate care about leakage of molten metal.

2) Shape of the crucible and the stopper will transform after long time use. That's why you need to check every time before casting to see whether the lower end of the stopper and the inside bottom opening of the crucible are securely fitted for perfect sealing.

# 7-4. FILTERS FOR CHAMBERS

## 7-4-1. CLEANING

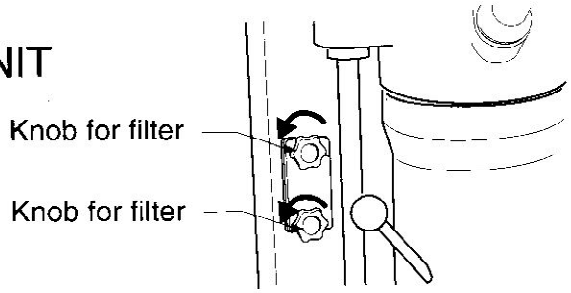
Condition of the filter is likely to affect casting results. Check the filters after every daily work and clean them as follows.

- Cleaning of the filter for melting chamber depends on amount of zinc contained in the molten metal you use, however, it is better to clean that filter frequently.
- Clean the filter for mold chamber after every daily work.

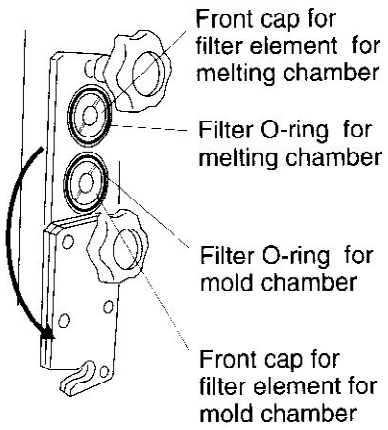
When clogging of the filter element can not be improved after cleaning, replace the element with a new one (filter element 10 micron --- #14769801).

## 7-4-2. DISASSEMBLING FILTER UNIT

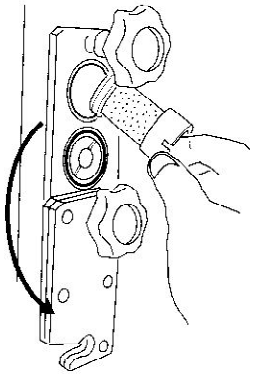
1) Rotate the knob for filter counterclockwise.

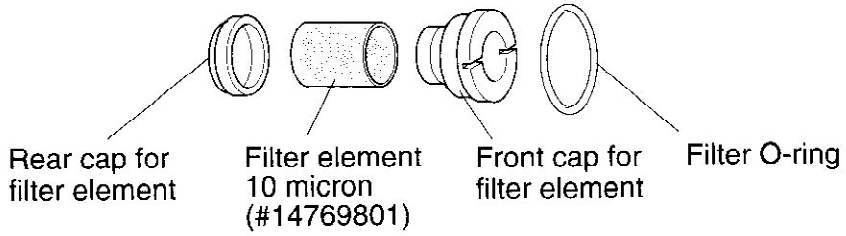



2) Slide the cover plate to left.

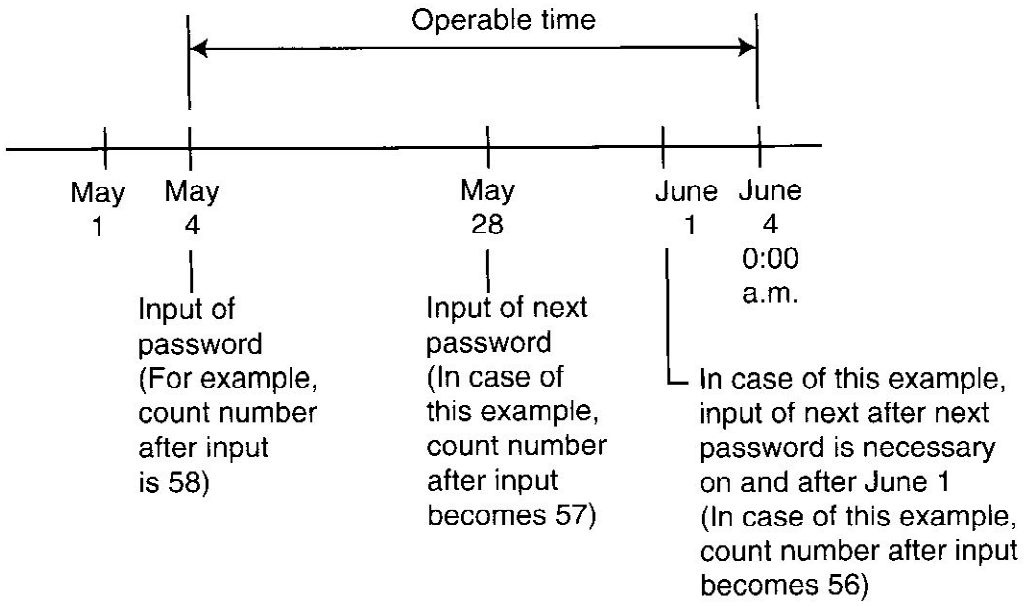



3) Withdraw the filter parts.





IMPORTANT: If input is done before the first day of the month to which next monthly calculation starting time belongs, monthly update subtraction counter is decreased by extra one month.
Input should be done on or after the first day of the month to which calculation starting day belongs.




### 3. Final password

When this password is input and is verified by the machine normally, the machine can be operated without time-limit.

IMPORTANT: Once this final password has been verified by the machine, the machine can not be reset to the monthly update password mode.

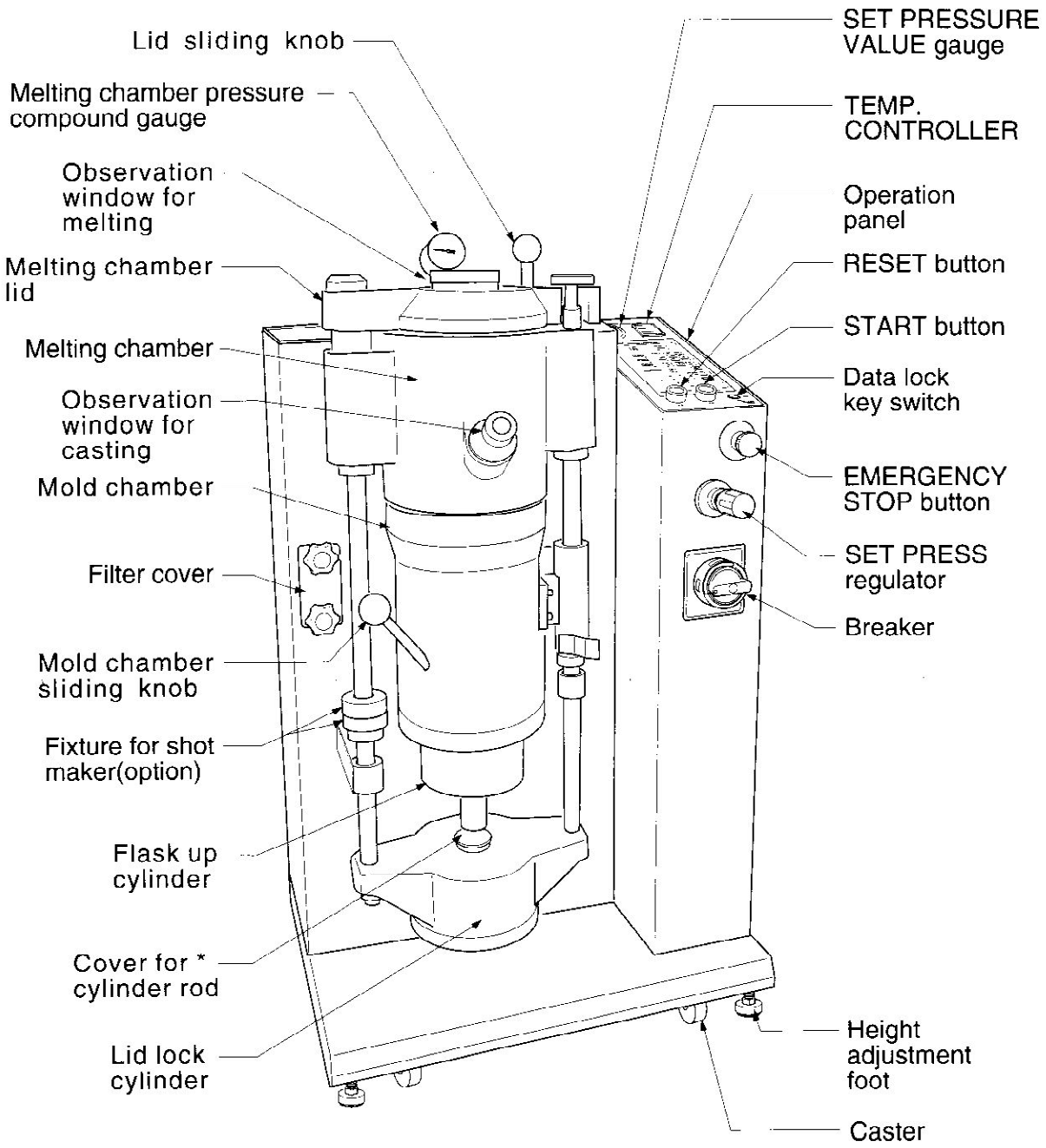
## 1-2-2. ISSUE OF PASSWORD

To issue next password in the case of use by monthly update password mode, the following information is necessary.

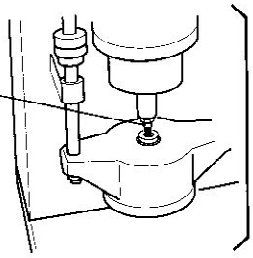
Model name : *K2*
Production Serial No. : xxx (See P.70)
Current monthly update history count : xx (See P.70)

# 2. NOMENCLATURE

## (1) MAIN BODY




*
When installing the machine Production Serial No. E241-E245, E251 and later,
1) remove the fixation bolt for transportation
2) then, place the cover for cylinder rod.
See page 85 for details.



## (2) E02 Lid/mold chamber open

CAUSE: This number is displayed if lid-lock is activated when the lid is not slid in position just above the melting chamber or when the mold chamber is not slid in position securely or the sensor is not positioned correctly.
SOLUTION: Press the RESET button once, so that the error number will be turned off. Then, close the lid or mold chamber securely, and then activate locking of the lid. Try this a few times, and if the same error number appears, it becomes necessary to check the action of the sensor. If the same error number appears, contact with the distributor at your place.

## (3) E03 EMERGENCY STOP button

CAUSE: The EMERGENCY STOP button is pressed in.
SOLUTION: Turn the knob of the EMERGENCY STOP button clockwise, and then press the RESET button. If the same error number appears, turn the BREAKER switch OFF once, and then turn it ON again.

## (4) E04 Water supply abnormality

CAUSE:
1) The valve of tap water supply is not opened.
2) Flowing water amount or water pressure is not enough.
3) The strainer is clogged.
SOLUTION:
1) Open the valve of tap water supply.
2) Amount of water supply should be more than 3 liters per minute. Water pressure should be over 1.5 $kg/cm^2$ .
3) The strainer is clogged. Remove its nut and rinse the internal filter (metal mesh) with water.

## (5) E06 Communication error of TEMP. CONTROLLER

CAUSE: Communication was suspended momentarily between the control unit board and the TEMP. CONTROLLER.
SOLUTION: Press the RESET button once, so that the error number will be turned off. Then, operation can be continued. However, it may be possible that HEAT parameter can not be used. After casting is finished, it will be necessary to check wire connection of communication line. Contact with the distributor at your place.

(6) E07 Measurement temperature error

CAUSE: During casting process by the AUTO MODE, temperature at the time of pouring is automatically checked by the machine. If the temperature exceeds the specified limit (K type 1250 degrees C, R type 1500 degrees C), this error number is indicated.

SOLUTION:

Automatic process after the POUR action continues normally, however;

1) In the case of FULL heating, stop FULL heating immediately.
2) Check that the cable of the thermocouple does not have breaks.
3) Check that selection of the type of the thermocouple (K or R) is correct.
4) Replace the thermocouple into a new one.
5) Check that the cable between the thermocouple and the TEMP. CONTROLLER is not disconnected.
6) Check the TEMP. CONTROLLER (P. 92 - 95).

(7) E 10 Parameter over limit

CAUSE: Entered parameter was over limit.

SOLUTION: Check input range and enter parameter again.

(8) E 12 Process time over

CAUSE: When it took more than 999 sec. from start to finish of casting, this error number is displayed. When speed of temperature rise is abnormally slow, this error number is displayed as well.

SOLUTION: Check entered parameter value. Also, remove any other causes.

(9) E 14 Voltage alarm

CAUSE: When power supply voltage exceeded the range of 195 V - 245 V, this error number is displayed.

SOLUTION: Press the RESET button once, so that the error number will be turned off. Then, operation can be continued. However, there is possibility of malfunctioning of the internal electrical parts, so make power supply voltage value closer to standard value.

(10) E 15 Voltage abnormality

CAUSE: When power supply voltage exceeded the range of 180 V - 260 V, this error number is displayed.

SOLUTION: The machine automatically stops heating at once. Press the RESET button, then turn the BREAKER switch off. After improving power supply voltage to standard value (220 V), turn the BREAKER switch on again.

### (11) E16 Power failure record

CAUSE: When power was suspended during the AUTO MODE process, this error number is displayed at the time of power recovery.
SOLUTION: Press the RESET button once, so that the error number will be turned off. Then, operation can be continued.

### (12) E20 Operation panel contact abnormality

CAUSE: When power is turned ON, contact points are automatically inspected. If there is any short-circuited switch or button, this error number is displayed.
SOLUTION: It is necessary to check whether wiring is normally connected, and the key panel board is normally working. Contact with the distributer at your place.

### (13) E21 High temperature of drain water

CAUSE: Water supplied to the machine is discharged outside after cooling inside of the machine, and when temperature of discharge water is abnormally high, this error number is displayed.
SOLUTION: Check that water supply temperature is less than 25 degrees centigrade, water supply amount is more than 3 liters/minute and water supply pressure is more than 1.5 kg/cm$^2$.

### (14) E22 Evacuation abnormality

CAUSE: During the AUTO MODE, when vacuum degree at the time of vacuum action finish is near to atmospheric pressure (smaller than - 20 kPa), this error number is displayed.
SOLUTION: Check the below 1) to 4).

1) Parameter of [VAC] is extremely short ( 0 to 2 seconds).

2) The vacuum pump is disconnected.
3) The filter cover of the machine is not set in place.
4) O-ring of the melting chamber or mold chamber is not set securely.

If problem can not be solved after checking above, the knob of SET PRESS regulator may be malfunction. Contact with the distributer at your place.

(15)  Grounding line overcurrent

CAUSE: There is an electrical short between the heating coil in the chamber and the inner wall of the chamber.

SOLUTION:

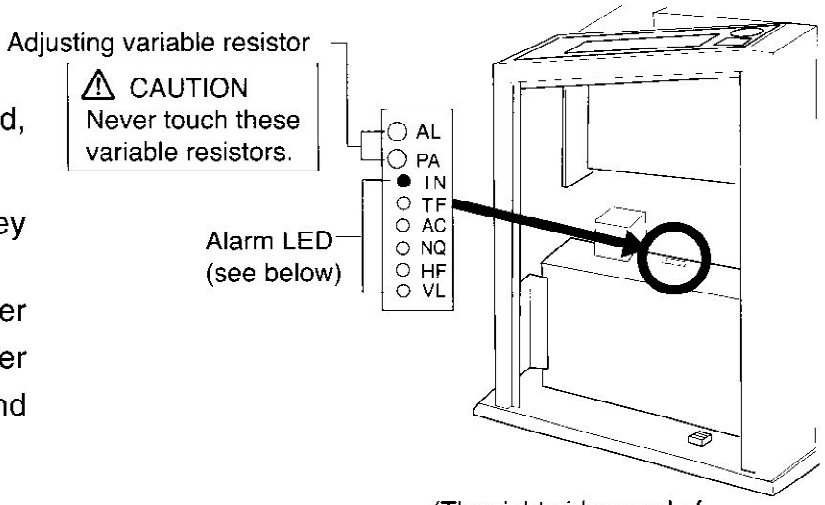
1) Check that there is no foreign materials left at the surrounding area of the heating coil.

2) Remove adherents on the connectors of the heating coil.

# 8-2. ALARM LED ON OSCILLATOR UNIT

When the error number E01 is shown on the operation panel, open the right-side panel of the machine, and check the LEDs on the cover box of oscillator unit. Please note that some of the below LEDs show alarm without display of the error number on the operation panel.

LEDs of AC, NQ, HF are lighted, when you touch the HEAT key and there is malfunction. Other LEDs show alarm, when power is supplied to the machine and there is malfunction.



(The right side panel of the machine is opened)

IN (Color : green, Power supply)

This LED is lit when power is supplied to the power supply unit of the oscillator unit. When the LED is OFF, it means that the machine is in trouble. The fuse for internal control power supply may be broken. When power supply voltage is abnormally high, it is possible that the internal fuse has blown.

TF (Color : yellow, Inside temperature)

Temperature inside the oscillator unit has become high, so the sensor is ON to light the LED. --- Check the water supply system.

AC (Color : red, Input overcurrent )

- The heating coil is short-circuited.
- Other internal element may be broken.

NQ (Color : yellow, Resonance circuit)

- Internal fuse has blown.
- The heating coil is short-circuited.
- There is wire disconnection between the power transformer and the coil.
- Other internal element may be broken.

HF (Color : red, Output overcurrent )

- The heating coil is short-circuited.
- Other internal element such as the power transformer etc. may be broken.

VL (Color : yellow, Input voltage )

The LED is lit, when voltage of power supply to the machine is abnormally low.

- Check the voltage of power supply, and raise it to normal voltage.

# 8-3. TROUBLES NOT INDICATED IN SCREEN

## 8-3-1. MOLD CHAMBER DOES NOT MOVE DOWNWARD

If the mold chamber does not move downward (the lid has moved upward), even when the lid-lock was released, the below causes are possible.

1) There is a trouble in the inert gas supply system.
   .... Check that the hose is securely connected.
2) Dirty grease on the shaft support is preventing the mold chamber from moving downward.
   .... Wipe off the dirty grease and apply new grease.
3) The shaft support has run out of grease.
   .... Apply grease.

## 8-3-2. IRREGULARITY OF DISPLAYED TEMPERATURE

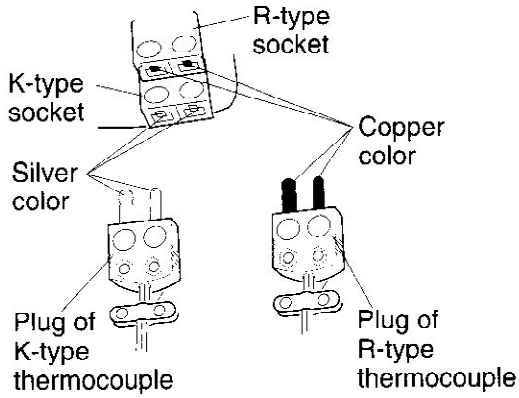
If the displayed temperature largely differs from the actual metal temperature you estimate from visual observation, type selection of thermocouple (K or R) may not be correct, or the thermocouple may be short-circuited, or the thermocouple is deteriorated, or parameters of the TEMP. CONTROLLER may be incorrectly set, or the lower end of the thermocouple may not reach the inside bottom of stopper. Check if two lead wires of the thermocouple are short-circuited or not (particularly check the upper part of the thermocouple), and replace it into a new one. If the error can not be solved after checking, contact with the distributor at your place.

**⚠CAUTION**

If heating is continued in spite of too much rise of actual metal temperature, carbon powders splashed around the crucible may be burned instantaneously when you open the lid. Also, the thermocouple, outer crucible, coil etc. may be damaged.

**⚠CAUTION**

In the case of the K-type machine, if the "R-type thermocouple" is connected to the "K-type socket" by mistake, display temperature will be lower, and actual temperature of metal will become too high. Such mistake at type selection may cause hazardous results, so always check that the type of thermocouple is correct.




You can identify K and R as above

## 8-3-3. LID DOES NOT OPEN OR OPENS UNNECESSARILY

- Gas is still remaining in the chamber.
  Check the exhaust valve and check clogging of the orifice of the exhaust port.

## 8-3-4. LID DOES NOT CLOSE OR DOES NOT OPEN FULLY

- The O-ring of the melting chamber or the O-ring of the mold chamber is not set properly.
  Set the O-ring securely.
- The cylinder head cover is not set.
- Malfunction of the lid lock cylinder.
  The internal axis of the cylinder is not moving properly.
  There is gas leakage in the cylinder.
- Malfunction of the lid-lock valve.

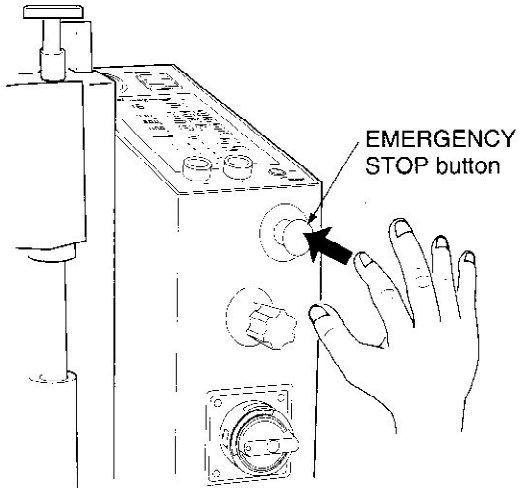
## 8-3-5. POWER FAILURE DURING ACTION

When power failure happened during operation, pressure in the chamber is released while suspending actions. When power is recovered, error number E-16 is displayed. Press the RESET button.

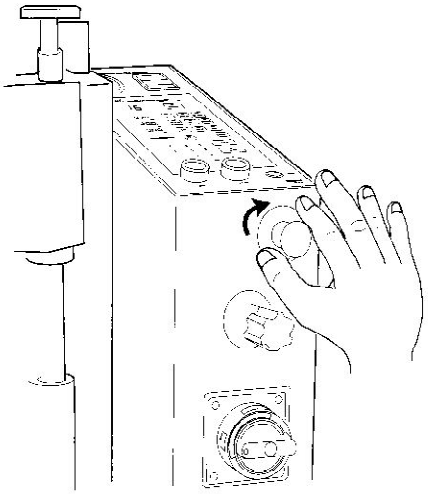
## 8-3-6. EMERGENCY STOP BUTTON

When the EMERGENCY STOP button is pressed, all actions are suspended.

-Do not use this button except in the case of emergency.
-In the case of operation mistake, use the RESET button.




To release the EMERGENCY STOP button, just turn it clockwise. Then internal power will be ON and all the buttons and keys will be effective.



## 8-3-7. WIRE-BREAKING OF THERMOCOUPLE

Wire-breaking of thermocouple is indicated by the message on the PV display of the TEMP. CONTROLLER as the figure.


The below causes are possible.

a) Wire-breaking of thermocouple
b) Wire-breaking in the socket for thermocouple
c) Wire-breaking in the connector outside of the melting chamber.

## 8-3-8. SETTING OF TEMP. CONTROLLER

Temperature is controlled by PID in the TEMP. CONTROLLER. Effectiveness of PID to stable temperature control varies depending upon conditions such as kind of gas, amount and kind of metal in the chamber at heating. However, PID is preset at the factory to the values (P = 120, i = 48, d = 12) such that the machine can widely correspond to those various conditions and can perform casting fast. So, usually it is not necessary to change the preset values. You can check that those values are correctly set by the procedure in Page 91 and 94. For further information, contact with the distributor at your place.

IMPORTANT: Do not operate the SET key unnecessarily. Protection will be released, and the TEMP. CONTROLLER is set into complicated modes.

## 8-3-9. DIGITAL READOUT DIFFERS FROM GAUGE

When digital readout shows difference from indication of melting chamber pressure compound gauge, it is possible that the filter for the sensor is clogged, although occurrence of clogging of the filter is only probable after several years of use.

Cleaning procedure is as follows.

1) Turn power off.
2) Turn off gas supply.
3) Open the rear panel.
4) Turn the nut for tube fixation at the lower part of sensor unit to remove.
5) Turn the cap for filter element at the lower part of sensor unit to remove.

# MORE DETAILED INSTRUCTIONS

Following pages are more
detailed instructions about
change of setting, checking etc.

# 9. OPERATION -2 (ADVANCED OPERATION)

## 9-1. MANUAL MODE

The action keys in the MANUAL MODE are used for checking of action.
Most of action keys work during the lid lock state only action for safety purposes.

(1) START button (for lid lock)
- When the START button is pressed, the lid moves downward and the lid is locked.
- To release the lid lock (to open the lid), press the RESET button.

(2) POUR key (for stopper elevation)

- When LED of POUR key is turned off, the stopper is lowered.

- When LED of POUR key is turned on, the stopper is lifted.

(3) HEAT key (for heating)

- When HEAT key is pressed to ON (LED of the key is turned on), heating action is started.
- When the key is pressed once again to OFF (LED of the key is turned off), heating action is stopped.
- Heating is possible when the lid is lifted. When the lid is slid outside and the limit sensor switch of the lid is off, heating is impossible.
- When the mold chamber is slid outside, heating is possible.
- Heating output is indicated by the HEAT POWER display.
- Heating is done by PID control to SV value of the TEMP. CONTROLLER.

(4) [VAC] key (for vacuuming)

- [VAC] key is pressed to ON during the lid lock state, the melting chamber and mold chamber are evacuated.
- While the key is pressed and held, action is ON. When the key is released, action is OFF (momentary switch action).

- (FNC) key and [VAC] key are pressed simultaneously to ON, evacuation is carried out continuously.

Then, either (FNC) key or [VAC] key is pressed once again to OFF, evacuation is stopped.

(5) [M-GAS] key (for charging inert gas)

- When [M-GAS] key is pressed to ON during the lid lock state, GAS2 is charged in the melting chamber and mold chamber (momentary switch). Maximum is 0.1 MPa.

NOTE: If gas supplied to GAS2 is same to gas supplied to GAS1, same gas as supplied to GAS1 is charged into the chamber through GAS2.

(6) [OXY] key (for air introduction)

- When [OXY] key is pressed to ON, air is drawn into the chamber through the EXHAUST port (momentary switch).

NOTE: If inside of the chamber is not vacuumed condition, air introduction is not carried out. In turn, if inside of the chamber is more than atmospheric pressure, gas in the chamber is released to outside.

(7) FLASK key (for lifting of mold flask)

- When FLASK key is pressed to ON during the lid lock state, the flask elevation shaft in the mold chamber is lifted.

- Press FLASK key once again to OFF (LED of the key is turned off), the flask elevation shaft moves downward.

- Even if the lid is opened, when the mold chamber is opened to the position where the limit switch for lifting is turned ON, the flask jack-up shaft is automatically lifted.

NOTE: For safety, when pressure inside chamber is not near atmospheric pressure, lifting is possible, but lowering is not possible.

(8) PRESS key (for pressurization)

- When PRESS key is pressed to ON during the lid lock state, gas connected to GAS1 is introduced in the melting chamber.

- It is possible to operate pressurization action once only for safety.

- It is necessary to adjust pressure in the melting chamber (final pressure) with the knob of SET PRESS REGULATOR beforehand. It is possible to set pressure in the melting chamber to maximum 0.3 MPa.

(9) EXH key (for exhaust, air introduction)

- When EXH key is pressed to ON, chamber and outside air are communicated.

At this time;

If gas remains in the chamber over atmospheric level ---> to be exhausted.

If inside of the chamber is vacuumed condition ---> air is to be introduced.

- When the key is pressed once again to OFF (LED of the key is turned off), the valve is closed.

(10) SUC-U key (for chambers communication)

- While SUC-U key is pressed and held, its LED is lit and the melting chamber and mold chamber are communicated.

(11) SUC-L key (for suction of mold chamber)

- While SUC-L key is pressed and held, its LED is ON and the mold chamber only is evacuated.

NOTE: When it is necessary to evacuate both the melting chamber and mold chamber simultaneously, use VAC key.

Time period from expiration of the time preset by "SUC-U" to lifting of the graphite stopper is set. When the timer is in action, it is counted down.

- During waiting time in the AUTO MODE, LED of [POUR] key flashes. During POUR time (stopper is lifted), LED of [POUR] key is lit.

IMPORTANT:
Before start of casting, always check stopper action to be sure that the lower end of the stopper is correctly fitted with the inside bottom opening of the crucible.
It is possible to carry out POUR action, whether the lid is opened or not.

Press (FNC) key ---> Press [POUR] key

(7) [PRESS] key (To set waiting time for starting pressurization)

Available range: 0 - 99.9 seconds)
Waiting time from start of POUR to action start of PRESS is set.

During waiting time in the AUTO MODE, LED of [PRESS] key flashes. During pressurization, LED of [PRESS] key is lit.

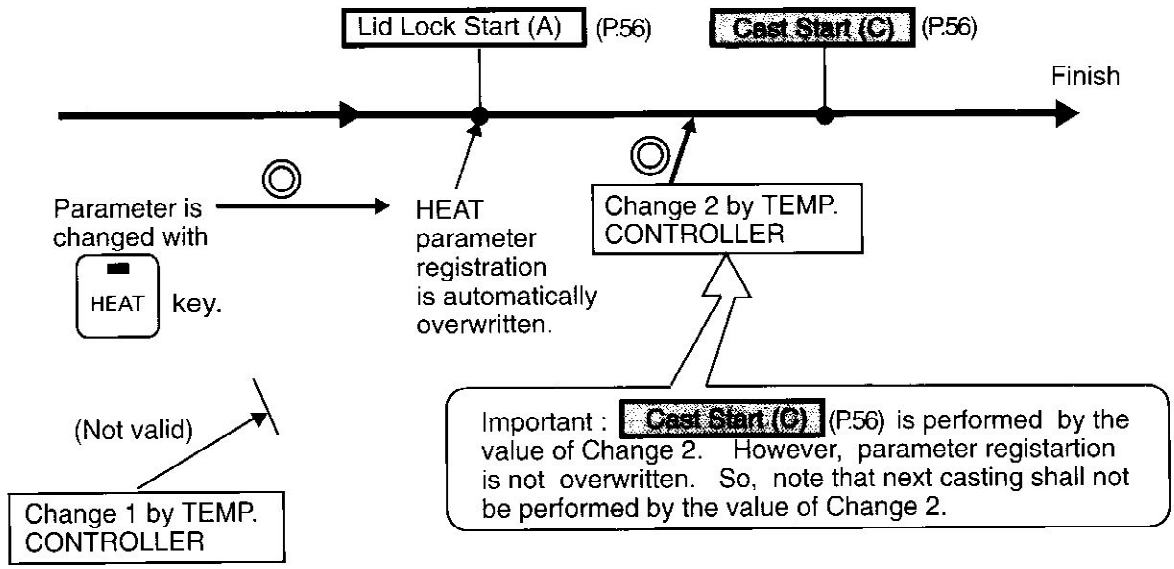
(8) [FLASK] key (To set timing of mold flask jack-up )

Available range: - 3 to - 99 degrees Celsius
Temperature to determine timing of flask up is set.
NOTE: Input value is automatically handled as "negative" value, so input value only.

The mold flask is lifted at " 'Set temperature (SV) of the TEMP. CONTROLLER' - (minus) 'set value by [FLASK] key' "

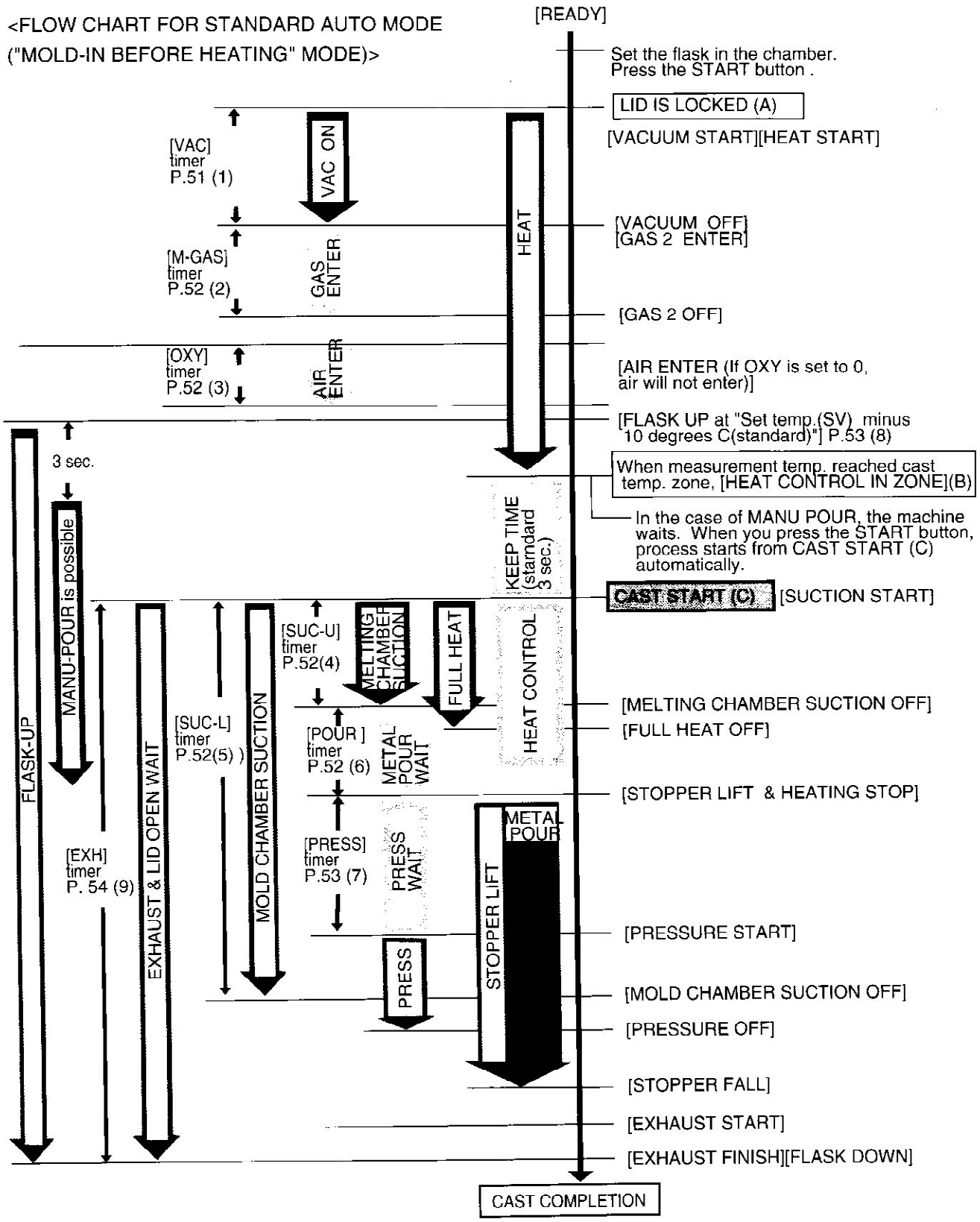
Example: Suppose that input value is "10" and that SV value of the TEMP. CONTROLLER is 1000 degrees centigrade. Then, the mold flask will be lifted at 990 degrees centigrade.

IMPORTANT: It is possible to change SV value by the TEMP. CONTROLLER as well, but in this case it is not possible to replace registered parameter with the changed SV value. Note that when SV value was set by the TEMP. CONTROLLER before Lid Lock Start (A) (P.56) , that SV value will be replaced by the registered temperature parameter at the time of Lid Lock Start (A) (P.56).



## 9-2-3. FLOW CHART OF CASTING

If you press the START button in the AUTO MODE, casting is automatically started. Check safety and understand this manual before starting actual process.



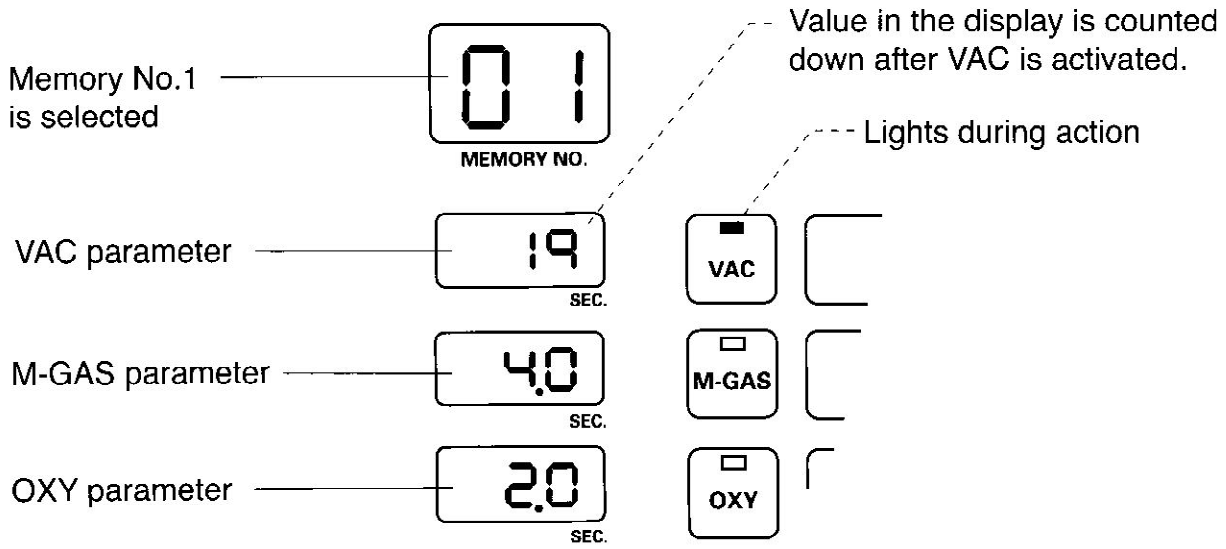

In the case of MANUAL POUR mode, you have to press the START button once again to activate **CAST START (C)**.

## 9-2-4. ACTION AFTER STARTING AUTO MODE

### (1) PARAMETER DISPLAY

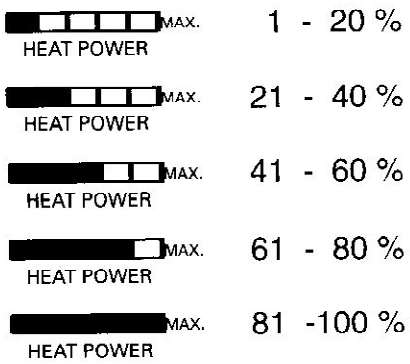
- As process starts, LEDs of action keys which are operating are lit. Further, parameter value of operating actions are indicated in the upper, middle and lower parameter displays.
- Set values of vacuum action and exhaust actions are displayed in the corresponding parameter display at the time of their starting, but as their actions proceed their display parameters will be changed into count down display.

Display example just after starting:




### (2) HEAT POWER DISPLAY

-During heating, LED of [HEAT] key is lit. At the same time, output is indicated in the HEAT POWER display as the below figures depending upon output amount.



## (3) TEMPERATURE AND CAST START

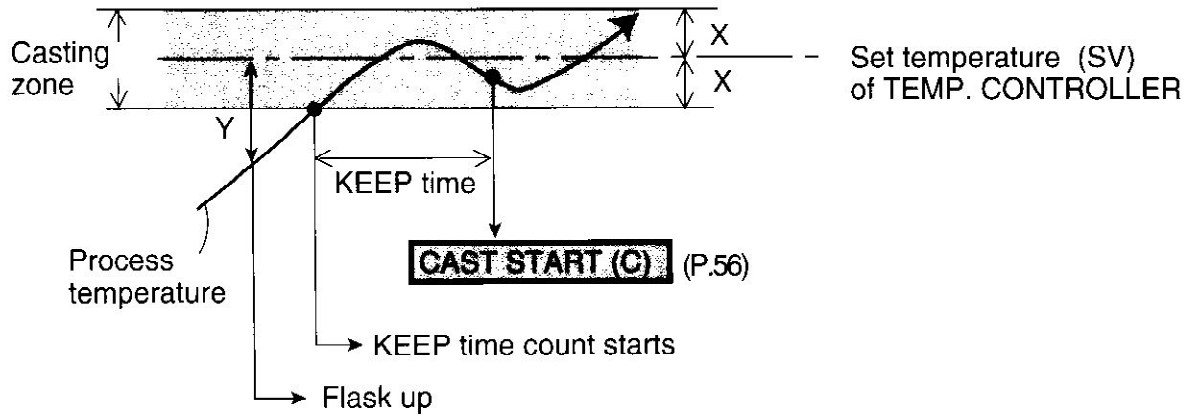
When temperature enters into the Casting Zone by heating, casting is started on specified conditions.

" Casting Zone =

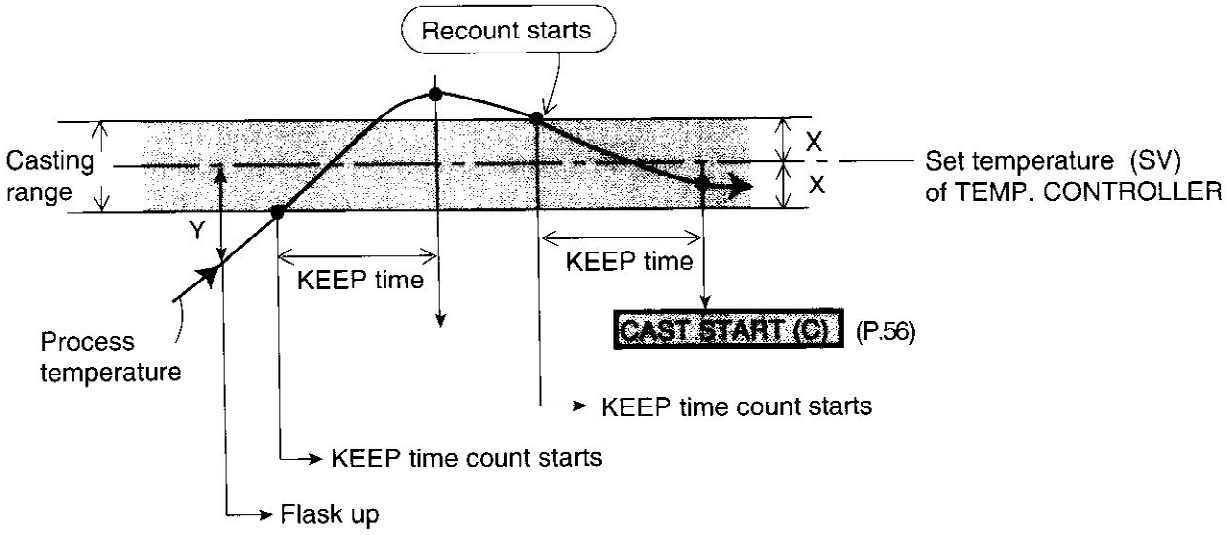
Temperature SV of the TEMP. CONTROLLER +/- X degrees centigrade "

(Standard of X : 3 degrees centigrade)

It is possible to change the Casting Zone by the TEMP. CONTROLLER.




- KEEP time is set by Memory No.80 (Standard: 3 sec.). Y degrees centigrade for activating flask up is set with FLASK key (Standard: set temperature (SV) - 10 degrees centigrade)




When measured present temperature goes out of the Casting Zone during the KEEP time, counting of time starts again when temperature again enters into the Casting Zone.

## 9-2-5. OTHER USES OF AUTO MODE

### (1) MANUAL POUR (P.23)

**To determine manually timing of CAST START (C) (P.56) during casting process by the AUTO MODE is called "MANUAL POUR" in this instructions manual. All actions except timing of CAST START (C) (P.56) are carried out in the same way as the standard process of AUTO MODE casting.**

- Starting MANUAL POUR

Press and hold MANU and AUTO keys simultaneously for about one second before pressing the START button, so that the MANUAL POUR mode is effective. (LEDs of both keys are lit at this time.)

- Timing of CAST START (C) (P.56)

When three seconds have elapsed after the flask is moved upward, CAST START (C) (P.56) can be started any time by pressing the START button.

### (2) MOLD-IN AFTER PREHEATING (P.24)

**To melt the metal temporarily before setting the mold in the mold chamber for casting under the AUTO MODE is called "mold-in after preheating" in this instructions manual.**

- How to preset mold-in after preheating by AUTO MODE

By Memory No.53, set the parameter values of pre-process action (preheating) for "mold-in after preheating" casting (P.63)

IMPORTANT: When the "mold-in after preheating" mode is selected, it is necessary to input parameter value other than "0" with VAC key in Memory No.53.

If parameter value of "0" is input with VAC key in Memory No.53, the "mold-in after preheating" mode becomes ineffective and the standard mode starts.

When "mold-in after preheating" mode is selected, process of Memory No.53 is added to pre-heating process of all memory Nos.

- Action of mold-in after preheating

When a Memory No. is selected from 00 to 50 and the START button is pressed, preheating of the "mold-in after preheating" mode is started. When temperature has reached the specified level, the lid is opened automatically, and the machine is ready for setting the mold. Set the mold withdrawn from the furnace into the mold chamber. When the START button is pressed once again, usual automatic action of the selected Memory No. is started.

# 9-3. FUNCTION MODE

## 9-3-1. MEMORY NOS. AND PRESET VALUES

By selecting Memory No. of more than 51 in the below table, special casting action or specific setting of parameter will be possible. (Other Nos. of more than 51 not listed in the below table are not used.)

FUNCTION MODE and FACTORY PRESET VALUES

| Memory No. | Function name | Key | Factory Preset | Description |
|---|---|---|---|---|
| 51 | Shot maker (Thermocouple used) | Upper parameter display | Pid | See following page. |
| | | Middle parameter display | - - | |
| | | Lower parameter display | - - | |
| 52 | Shot maker (Thermocouple not used) | Upper parameter display | HEA | See following page. |
| | | Middle parameter display | - - | |
| | | Lower parameter display | 50 | |
| 53 | Mold-in after preheating mode | VAC | 0 | Evacuation time |
| | | MGAS | 10 | Gas injection time |
| | | HEAT | 600 | Preheat temperature |
| 80 | Basic parameter 1 for casting | VAC | 10 | Stopper lift time |
| | | MGAS | 60 | Gas injection time |
| | | POUR | 3.0 | Temperature KEEP time |
| | | PRESS | 1.0 | Pressure valve open time |
| | | FULL | 3.0 | Full heat time |
| 81 | Basic parameter 2 for casting | HEAT POWER LED 1 | OFF | Select thermocouple |
| | | HEAT POWER LED 2 | OFF | Select auto mixing |
| | | HEAT POWER LED 3 | ON | Select OXY timing |
| | | HEAT POWER LED 4 | OFF | Protection Gas |
| | | HEAT POWER LED 5 | OFF | Printout |
| 85 | Printout | VAC | 0 | Cast counter |
| | | MGAS | 0 | Printout range (memory) |
| | | OXY | 1 | Printout range (parameter) |
| 98 | Password | See following page. | | |
| 99 | Data lock | VAC | 54 | Locking data |

## 9-3-2. DETAILS OF FUNCTION MODE

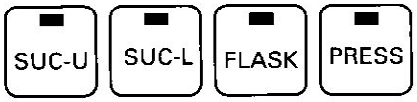
### (1) No.51, 52 --- for Shot Maker (option)

When the "Shot Maker" (option) is installed in the machine, the Shot Maker can be used more safely, if the machine is operated by this Memory No.
Select either No.51 or 52 in the AUTO MODE, and then operate in the MANUAL MODE.
See the instructions manual provided with the Shot Maker for how to use the Shot Maker.

1) No.51 for Shot Maker (option) (thermocouple type)

In the case of Memory No.51, 

(Pid) is displayed in the upper parameter display.
Heating is regulated by PID control of the TEMP. CONTROLLER.
The below four action keys can not be used because of safety purpose.




Heat action by 

key can be activated if the lid sensor is ON, even when the lid is opened.

The keys except 

key are activated, when the lid is closed.

2) No.52 for Shot Maker (option) (no-thermocouple type)

In the case of Memory No.52, 

(HEA) is displayed in the upper parameter display.

Heating is applied by manual operation of 

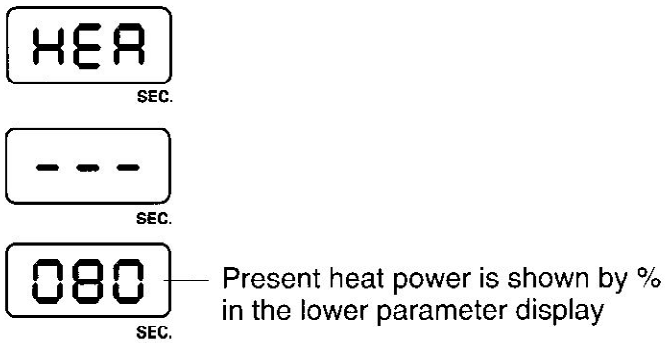
key.

In the case of Memory No.52, the TEMP. CONTROLLER and stopper are not used. Remove the stopper. However, plug the thermocouple into the socket of the machine and lay the thermocouple body down in the melting chamber. See instructions manual of Shot Maker.

**⚠ DANGER**

During heating by this No.52, temperature in the crucible (metal) can be checked by visual observation only. Always take care to avoid overheating.

Display example:




NOTE: If the thermocouple is unplugged and removed, 

(thermocouple short-circuit) is displayed on the PV of the TEMP. CONTROLLER. However, there is no problem for use because the TEMP. CONTROLLER is not used.

- The below five action keys can not be used.


- In the case of 

key, heating is carried out by preset output power value.

However, 

key is 100% output only.

- Setting of output by 

key can be done by the below procedure.

Press 

key ---> Press 

key ---> Press ten key 

to 

--->

Press 

key

## (2) No.53 --- for "mold-in after preheating" mode

Parameter for "mold-in after preheating" can be changed as the below procedure.
(The parameters are separated from VAC and M-GAS of the AUTO MODE.)

1) Evacuation time (Factory preset value: 0)

Evacuation time is set with [VAC] key by the below procedure.

Press [VAC] key ---> Press ten key (0) to (9) ---> Press (ENT) key

(Setting range: 0 to 999)

Recommended VAC value for the mold-in after preheating mode is "30".

> IMPORTANT: If "0" is input by [VAC] key, the mode is changed into the normal "mold-in before heating" mode.

2) Gas introduction time (Factory preset value: 10)

Inert gas introduction time is set by the below procedure.

Press [M-GAS] key ---> Press ten key (0) to (9) ---> Press (ENT) key

(Setting range: 0 to 99.9)

3) Temperature of pre-heating process finish (Factory preset value: 600
.... "600" means 600 degrees centigrade)

When pre-heating process is finished, the lid is opened once. Timing of this pre-heating process finish is determined by temperature. When process value (PV) temperature reached set temperature value, pre-heating process is finished.

Setting is done by the below procedure.

Press [HEAT] key ---> Press ten key (0) to (9) --->Press (ENT) key

During this process, [053 SEC.] is indicated in the upper parameter display.

## (3) No. 80---for casting action parameter 1

Parameters of the AUTO MODE can be changed by Memory No. 80.

NOTE: Memory No. 80 is locked at the factory. In order to change its parameters, it is necessary to release data lock (P.75).

NOTE: [AUTO] must be selected.

1) Stopper lifting time (Factory preset value: 10 )

Time of the pouring valve ON (stopper is lifted and held) is set.

Setting is carried out by the below procedure.

Press [VAC] key ---> Press ten key (0) to (9) ---> Press (ENT) key

(Setting range: 3 to 99.9)

2) Gas introduction time (Factory preset value: 60)

Inert gas introduction time is set by the below procedure.

Press [M-GAS] key ---> Press ten key (0) to (9) ---> Press (ENT) key

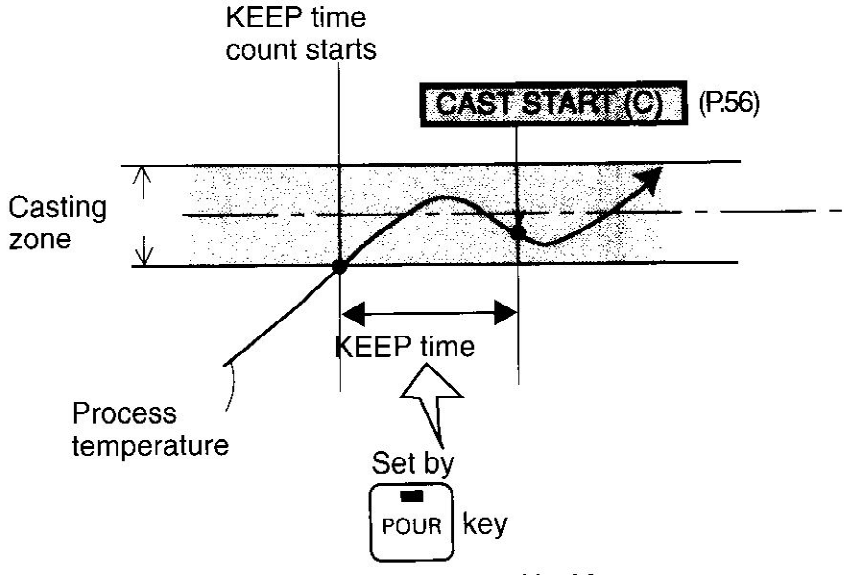
(Setting range: 0 to 99.9)

3) KEEP TIME (Factory preset value: 3.0)

KEEP time from reaching the Casting Zone to **CAST START (C)** (P.56) is set.

Press [POUR] key ---> Press ten key (0) to (9) ---> Press (ENT) key

(Setting range: 0 to 99.9)



4) Press time (Factory preset value: 1.0 )

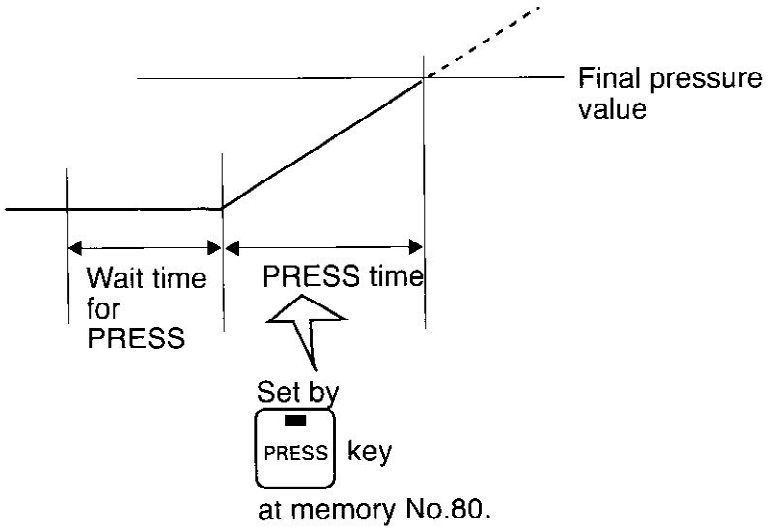
Time from starting of press to press valve OFF can be set.

Setting is carried out by the below procedure.

Press [PRESS] key ---> Press (0) to (9) ---> Press (ENT) key

(Setting range: 0.1 to 99.9)

Relation between press time and final press value varies depending upon outside piping or setting of the SET PRESS regulator. Therefore, timer setting should be determined by trial operation by the MANUAL MODE. For safety, final pressurization in the chamber is stopped by maximum 0.3 MPa.




5) Full heating time (Factory preset value: 3.0 )

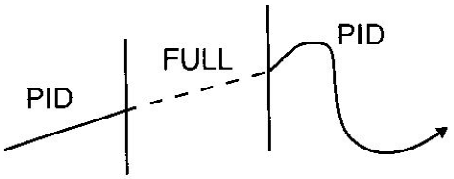
Full heating (100% output) takes preference to PID control heating by the TEMP. CONTROLLER. Timing of full heating is activating time of CAST START (C) (P.56).

Setting is carried out by the below procedure.

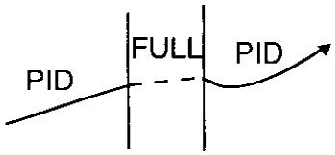
Press (FULL) key ---> Press (0) to (9) ---> Press (ENT) key

(Setting range: 0 to 9.9)

It is possible to activate full heating independently even during the AUTO MODE process. However, if full heating is done too long, control is disordered largely for a moment. Full heating should be done within short time (about 3 to 4 seconds).




Disordered

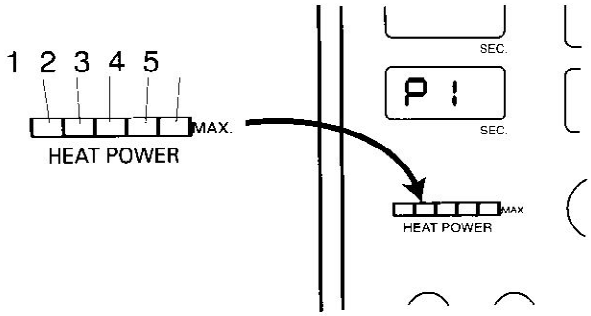



Proper example of short-time full heating

Manual use of full heating is possible from M-GAS, OXY finish to the time of reaching the Casting Zone.

## (4) No.81---for casting action parameter 2

Basic action of this machine is selected. Setting can be checked by LED of the HEAT POWER display.




| LED | Description | OFF | ON |
|---|---|---|---|
| 1 | Thermocouple | K type | R type |
| 2 | Auto mixing (full heatiing) | Not possible | Possible |
| 3 | Timing of activating OXY | Set temperature of flask-up | M-GAS finish |
| 4 | Protection Gas | Not possible | Possible |
| 5 | Printout | Possible | |

Standard presetting at the factory is 

.

When you need to change setting, follow the below procedure.

IMPORTANT:

[1] It is recommended to examine ON/OFF status of each LED, before pressing (ENT) key. (When LED is flashing, it is not possible to check its former LED status.)

[2] Do not press ten key (6) and after, because P2 is indicated in the lower parameter display, and this P2 mode is used for maintenance purpose only.

Press ten key ((1) to (5)) corresponding to LED number to be changed ---> P 1 is indicated in the lower parameter display, and LED of the selected number flashes---> Press (ENT) key (Every press of (ENT) key alternates "changed" and "not changed".)

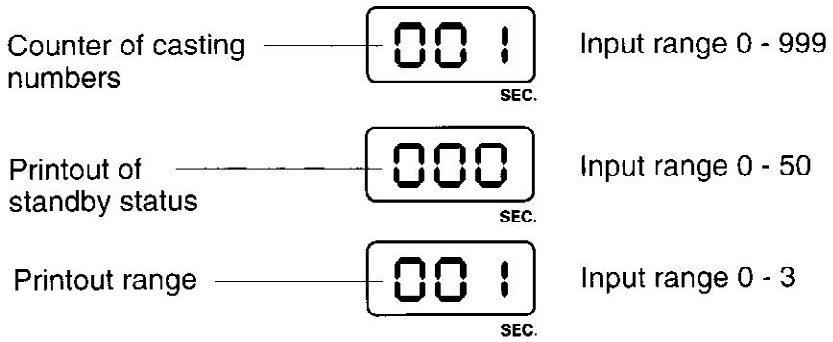
## (5) No.85 --- Printout

(Printer, printer cable etc. are optional accessories)

If printer (option) is connected to the machine and No.81 (P.66) is set to "printout possible", printout is carried out in accordance with setting by this No.85.

NOTE: No.85 is preset at the factory to be data lock. In order to change parameters, it is necessary to release data lock (P.75).

Each parameter display is used for setting.




1) In the upper parameter display, present casting counter value is displayed.
---maximum 999
- This counter value can be printed out as data.
- This counter value is incremented each time casting process by the AUTO MODE is finished normally.
(If casting process was suspended by pressing the RESET button, the counter is not incremented.)
- To change counter value,

Press [VAC] key ---> Press ten keys (0) to (9) (0 - 999) ---> LED of selected key flashes ---> Press (ENT) key

At next finish of casting, increment starts from this input value.

2) The middle parameter display is used for determining the printout Memory Nos. at the time of standby. ---maximum 50
- Data of PARA-1, PARA-2 and Memory No. which was input and the following 4 Memory Nos. are printed out.

Press [M-GAS] ---> Press ten key (0) to (9) (0 - 50) ---> Press (ENT) key (for input value) ---> Press (ENT) key (for starting printout)

NOTE: If (ENT) key is pressed once only, printout is not possible. If you want printout, press (ENT) key twice.

Example:

If [003] SEC. is input, five action parameters of Memory Nos.3,4,5,6 and 7, PARA-1(No.80 parameters) and PARA-2 (No.81 parameters) are printed out simultaneously.

NOTE: In the case of printout of standby status, POUR-TEMP, PRESS-OFF and TIME are deleted from printout example of P.69.

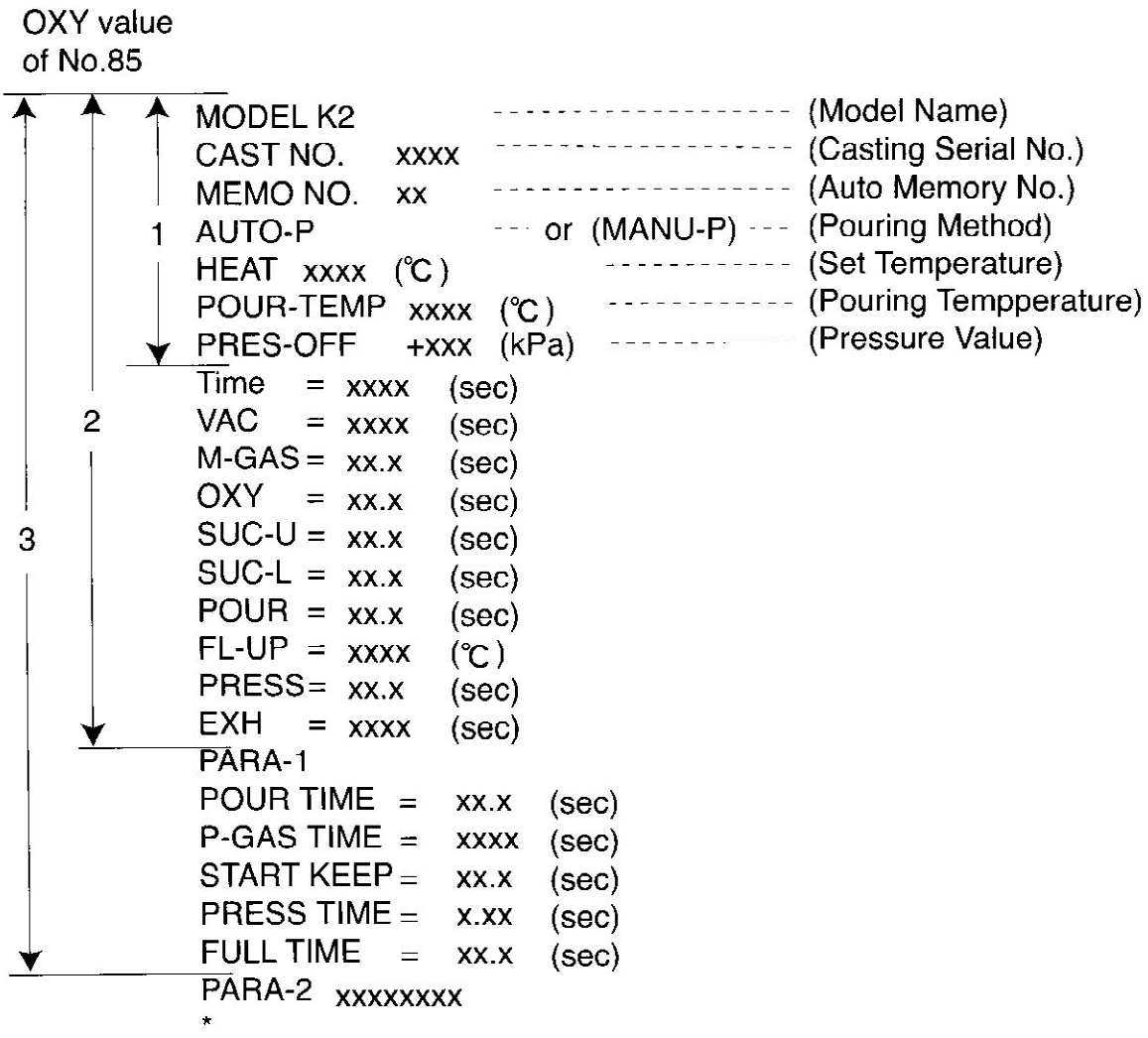
If [000] SEC. is input in the middle parameter display, a range set in the lower parameter display is carried out, each time one process of the AUTO MODE casting is finished.

3) Printout range is set by input of value in the lower parameter display. ---maximum 3

If [000] SEC. is input in the middle parameter display, and the lower parameter display is set to either value from 1 to 3, the items in P.69 are printed out automatically each time the AUTO MODE casting action is finished.

- If the lower parameter display is set to 0, printout is not carried out.

Press [OXY] ---> Press ten key (0) to (3) (0 - 3) ---> Press (ENT) key


OXY value
of No.85
MODEL K2 (Model Name)
CAST NO. xxxx (Casting Serial No.)
MEMO NO. xx (Auto Memory No.)
1
AUTO-P or (MANU-P) (Pouring Method)
HEAT xxxx (℃) (Set Temperature)
POUR-TEMP xxxx (℃) (Pouring Tempperature)
PRES-OFF +xxx (kPa) (Pressure Value)
Time = xxxx (sec)
2
VAC = xxxx (sec)
M-GAS = xx.x (sec)
OXY = xx.x (sec)
3
SUC-U = xx.x (sec)
SUC-L = xx.x (sec)
POUR = xx.x (sec)
FL-UP = xxxx (℃)
PRESS = xx.x (sec)
EXH = xxxx (sec)
PARA-1
POUR TIME = xx.x (sec)
P-GAS TIME = xxxx (sec)
START KEEP = xx.x (sec)
PRESS TIME = x.xx (sec)
FULL TIME = xx.x (sec)
PARA-2 xxxxxxxx
*

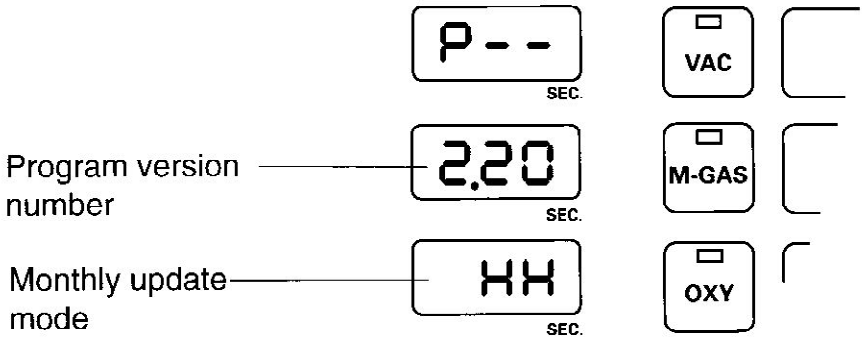
## (6) No.98 --- for password

(6-1) Checking current count No. and serial No.

1) Connect water supply etc. to the machine.

2) Turn the breaker switch on.

In case the monthly update password mode is working, program version number and [ HH ] (this HH means monthly update password mode is set) are shown and then turned off within one second as follows.



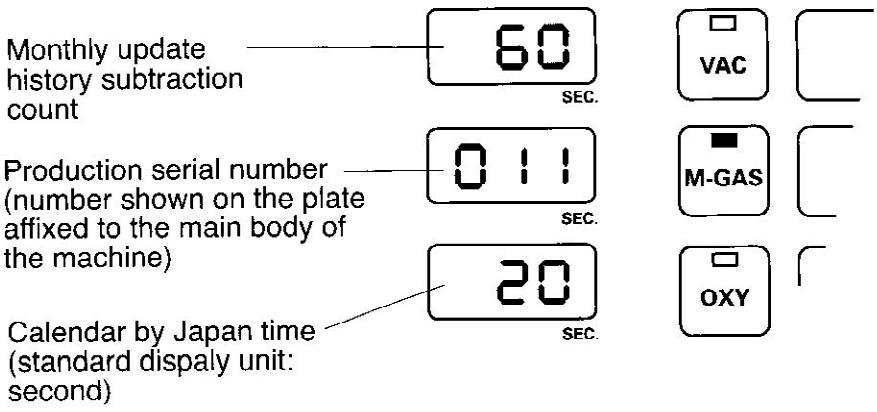

3) Select Memory No. 98

Press [ MEMORY ] key ---> Press (9) key ---> Press (8) key ---> Press (ENT) key.

All the parameter display windows show [ - - - ].

4) Press [ M-GAS ] key.

Numbers are shown on the parameter display windows as the below example.



Monthly update history subtraction count

Monthly update number of password is displayed by subtraction.

This number does not mean remaining months in the case of installment payment plan.

The count display number varies depending upon production number of each machine.

Production serial number

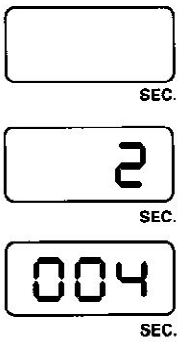
Production serial number of this machine is displayed.

Calendar by Japan time

Normally, current time is displayed by second.

When (FULL) key is pressed, current year is displayed.

Example of year display:




When [OXY] key is pressed, current month is displayed.

When [POUR] key is pressed, current date is displayed.

When [EXH] key is pressed, current hour is displayed.

When [HEAT] key is pressed, current minute is displayed.

IMPORTANT:
Calculation starting time is Japan time.
Calculation starting time is 0:00 a.m. of the fourth day of every month (Japan time).

(6-2) Input of password

- In case of use by monthly update password mode, input password on or after the first day of the month to which the calculation starting day belongs (for example, if the calculation starting day is May 4, input the password on or after May 1).

- In case of use by monthly update password mode, and when the calculation starting day has passed, display of [HH] in the lower parameter display window keeps on flickering at the time of pressing the START button, the machine is locked, and casting is not operable.

- If display of [HH] on the lower parameter display window is shown and then is turned out within one second at the time of power on, the monthly update password mode is working.

- Do not input password in the month before the month to which the next calculation starting day belongs. Monthly update subtraction counter is decreased by one and the machine is locked on the calculation starting day.

- In case of use by monthly update mode, do not input a password for trial purpose. Monthly update subtraction counter is decreased by one and the machine is locked on the calculation starting day.

- After the final password (P.8) is input, the machine is not locked at all on the calculation starting day, and input of password is no more necessary.

Input procedures are common to initial installation password (P.7), monthly update password (P.7), and final password (P.8) as follows.

1) Connect water supply etc. to the machine.
2) Turn the breaker switch on.
3) Rotate the lock key to FREE.
4) Select Memory No. 99.

Press [MEMORY] key ---> Press (9) key ---> Press (9) key ---> Press (ENT) key

5) Press [VAC] key and check the current data protection range is shown by Memory No. on the left side parameter display window.

Example of data lock after Memory No. 51:


6) Press [VAC] key ---> Press (9) key ---> Press (9) key ---> Press (ENT) key.

By this, data protection range was set to 99.

7) Press [MEMORY] key ---> Press (9) key ---> Press (8) key ---> Press (ENT) key

By this, Memory No.98 (password input screen) was selected, then all the parameter display windows show [- - -].

8) Press [VAC] key .

Then the figures on the parameter display on the left of [VAC] key flashes in a standby state for input of password.

The flashing figure is monthly update subtraction count value. When input of password is completed by the next step, the display value decreases by 1.

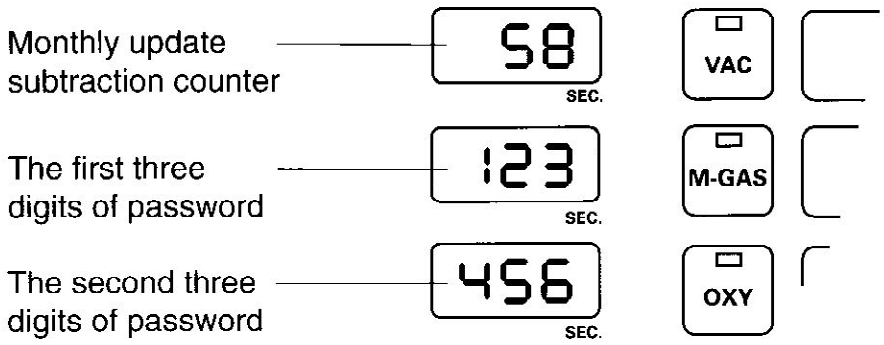
(If you want to cancel input and return to the previous step, press [VAC] key once again.)

9) Input a 6-digit password.

If password is "123456" for example:

Press (1) ---> (2) ---> (3) ---> (4) ---> (5) ---> (6) ---> (ENT) key

6 3 7 6 1 0




If the password is verified by the machine, the monthly update subtraction counter decreases by 1.

10) Check that input of password was finished normally. Input 1 (another Memory No. is also acceptable) to Memory No.

Press [MEMORY] key ---> Press (1) key ---> Press (ENT) key

If [HH] is not displayed, it shows that update work was finished successfully.

11) Set the data lock range to the former one.

Press [MEMORY] key ---> Press (9) key ---> Press (9) key ---> Press (ENT) key

(By this, Memory No. 99 is selected.)

For example, former data lock range is Memory No. 54:

---> Press [VAC] key ---> Press (5) key ---> Press (4) key ---> Press (ENT) key.

12) Rotate the lock key from FREE to LOCK.

## (7) No.99 --- for data lock

(Factory preset value: 54)

Parameter change range, when the data lock key switch is set to "FREE" position, can be set in No.99.

By input of Memory No. in the upper parameter display, parameters of later Memory Nos. can not be changed

Press [VAC] key ---> Press ten key (0) to (9) ---> Press (ENT) key

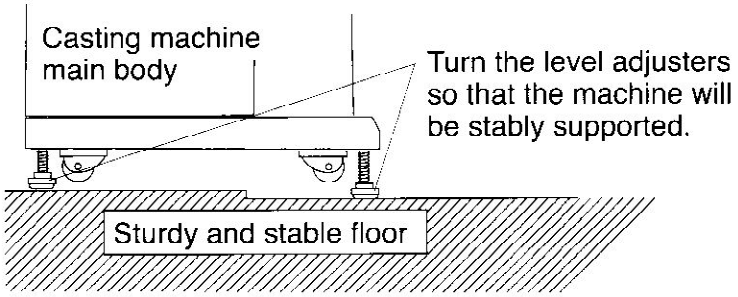
For example, if "2" is input, parameters of from No.02 to No.98 can not be changed.

# 10. INSTALLATION

## 10-1. PLACE

1) Floor must be sturdy and stable. The machine must be free from vibrations.

2) The machine must be levelled. (When the floor is not flat, adjust the level adjuster, so that the machine should be levelled.)



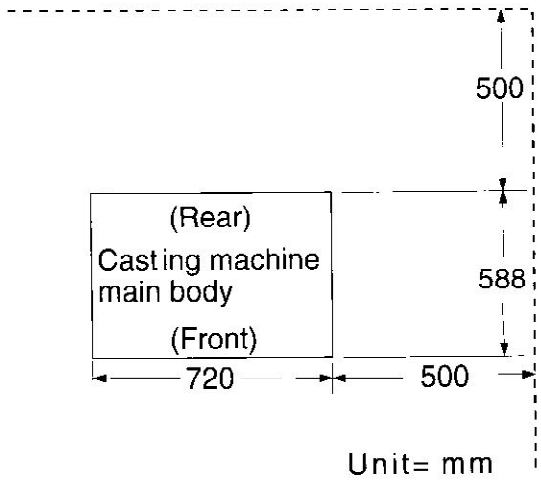

3) Do not install the machine at the place where material such as gas, that may affect casting and operation of the machine, is produced.

4) The machine must be installed at a dustless place.

5) Electrical noise should not be produced nearby.

6) Proper power supply is necessary.

7) Save enough space around the machine for daily maintenance.



# 10-2. POWER SOURCE

Use the power source of AC 220 V +/- 10%, three phase, 30 A, Approx. 9.5 KVA(8 KW model) or 6.5 KVA (5 KW model), 50/60 Hz, only for the machine.

**⚠WARNING**

[1] The machine must be earthed effectively.

[2] This machine is not equipped with a ground-fault circuit interrupter. Connect to the ground-fault circuit interrupter on the power switch board in your factory. If the grounding wire is not earthed correctly, the ground-fault circuit interrupter may not work normally. Connect the grounding wire correctly.

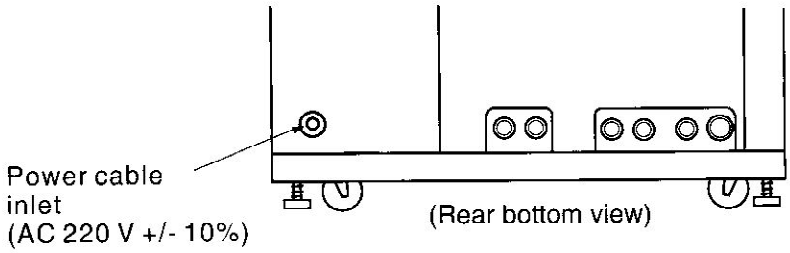
[3] Connection of the power supply cord should be made by a specialized electric technician only.

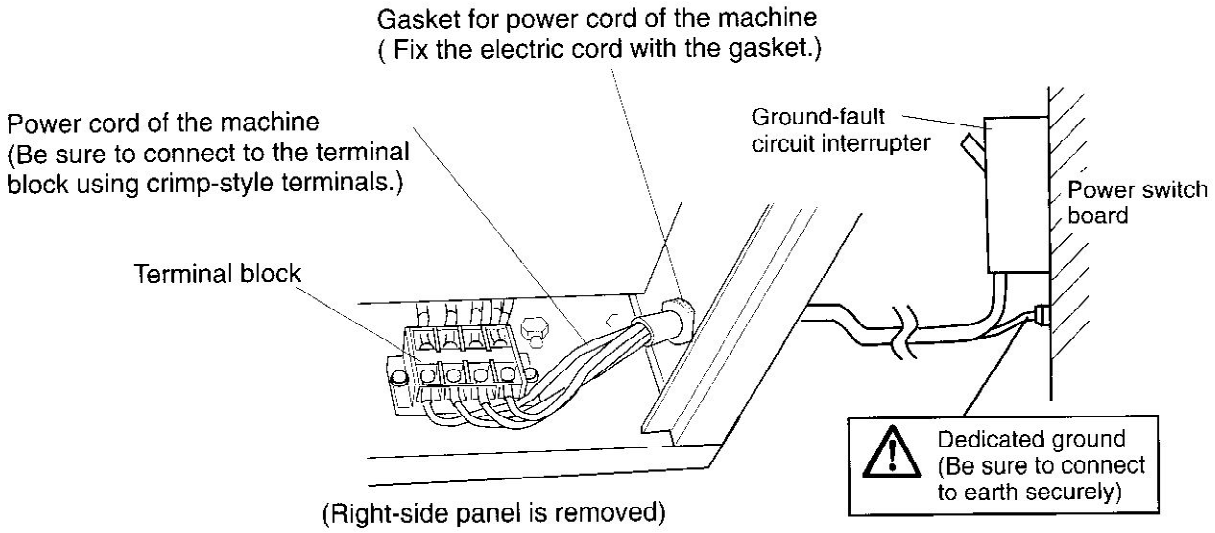
[4] Do not connect the vacuum pump to the *K2* machine body. Use another exclusive power supply line for the vacuum pump.

1) Open the right-side cover.

2) The terminal block for power source is located at the bottom. Connect the power cord for the machine to the terminal block.

IMPORTANT: Three-phase current is used for power supply in this machine. Therefore, correct connection of the power cord for the machine body is important.



# 10-3. CONNECTING WATER HOSE

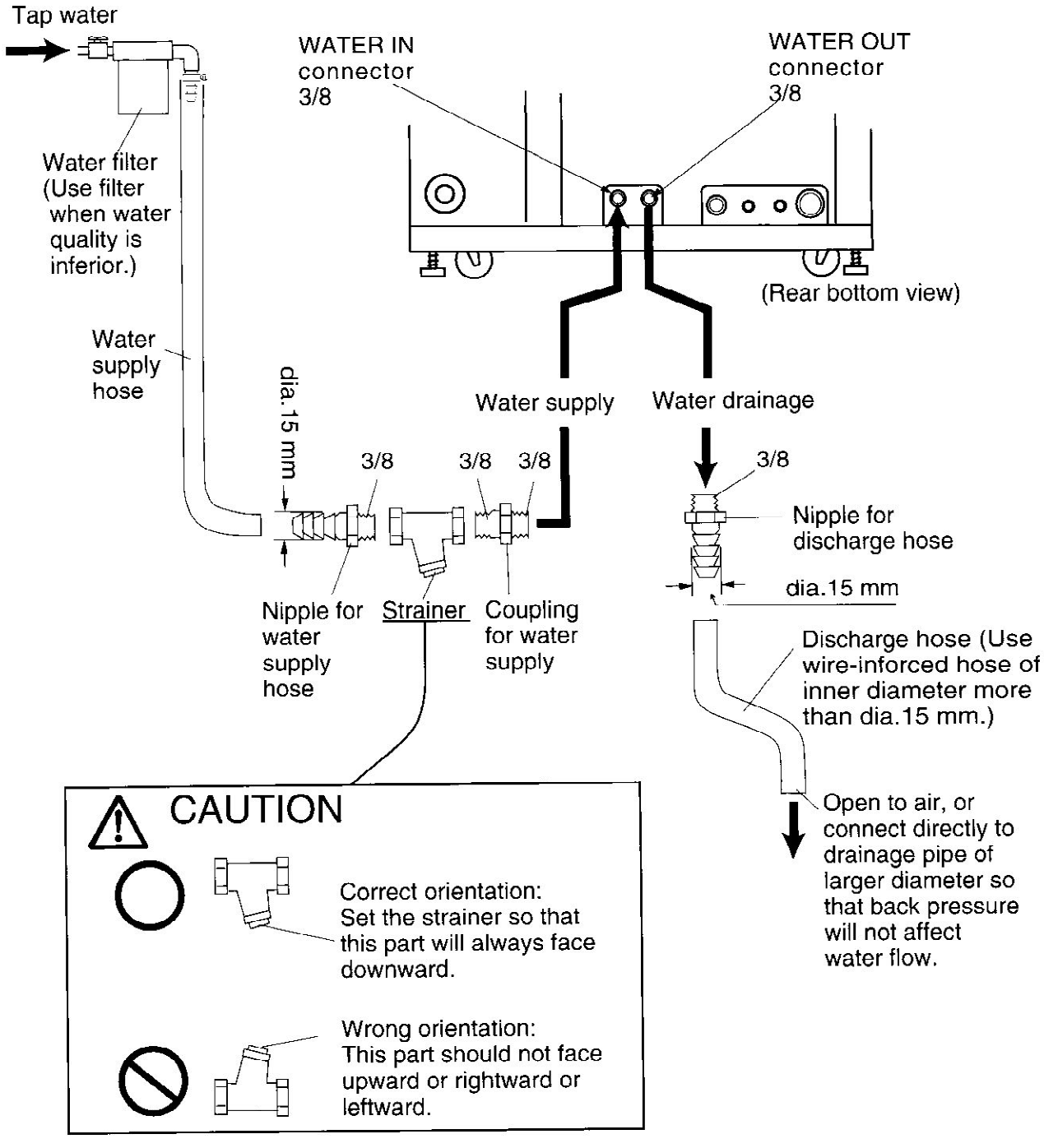
This machine needs internal circulation of tap water for cooling . Connect to water supply of sufficient water pressure (over 1.5 Kg/cm$^2$ in average).

**⚠CAUTION**

[1] In case water from the tap is not clean, water should be supplied through water filter available in the market. (Water filter and hose are not provided with the *K2.*) Select water filter of adequate size so that water flow should not be decreased.

[2] Be sure to complete water supply correctly before start heating.

Connect a water supply hose and an water discharge hose as below figure.



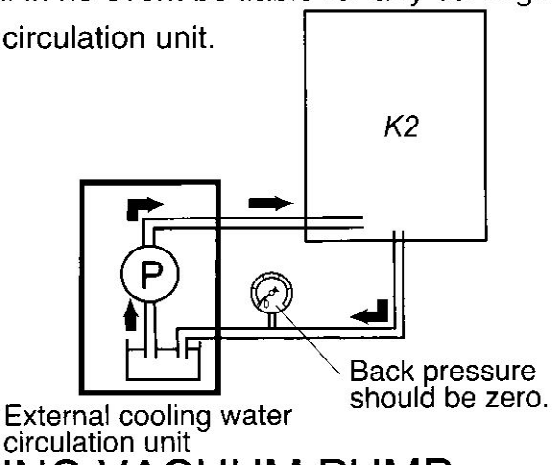
<When using external cooling water circulation unit>

When using external cooling water circulation unit available in the market, arrange it so that back pressure should 0 (zero). (External cooling water circulation unit is not provided with the *K2*.)

IMPORTANT:

1. Boost pressure of its pump should be high enough.
2. Consult with a qualified technician for arrangement of circulation unit.

The manufacturer shall in no event be liable for any damage resulting from use of external cooling water circulation unit.



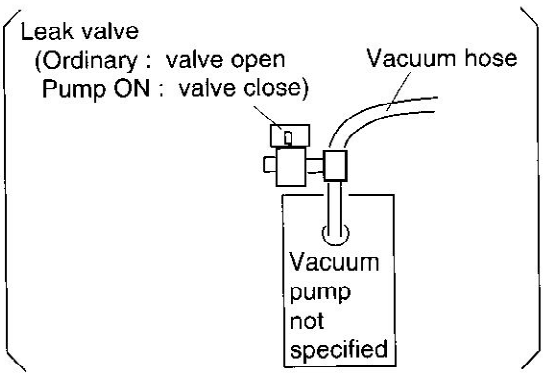

## 10-4. CONNECTING VACUUM PUMP

Connect the vacuum pump specified by the manufacturer to the machine as follows. (Vacuum pump is not included in the *K2*.)

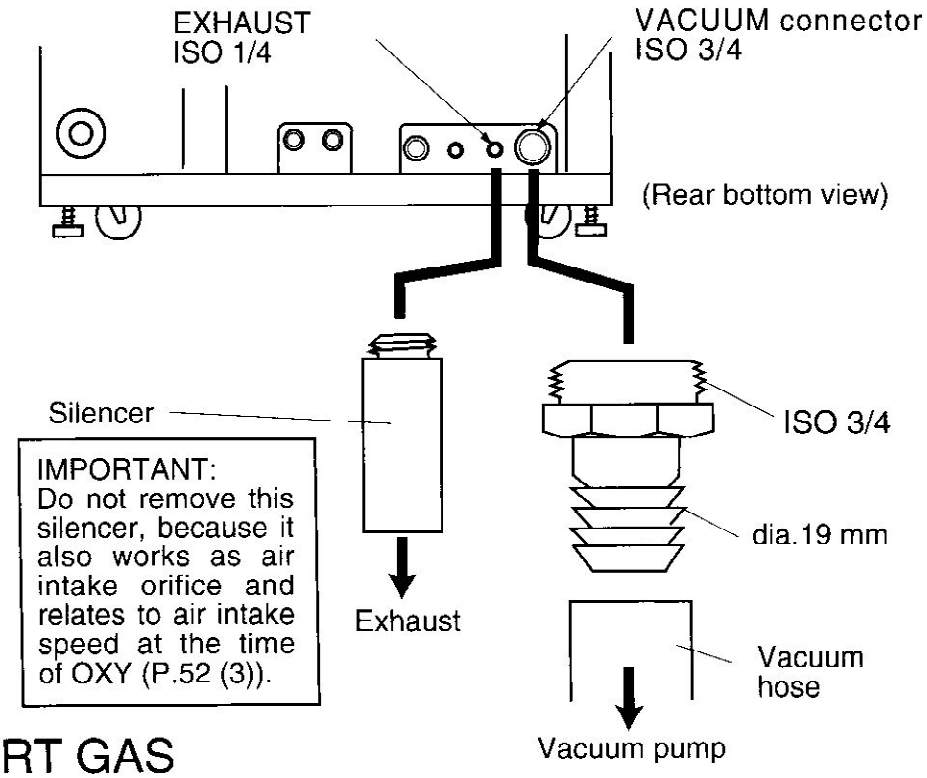
### ⚠CAUTION

[1] Use a pump of 300 liters per minute.

[2] Connect the power cable of the vacuum pump to wall power outlet separately from the casting machine, so that the pump will operate alone independently. Be sure to set a 'leak valve' to the vacuum pump so that the inside of the hose will become exhaust condition at the moment when the pump is turned OFF. That leak valve should synchronize with power ON-OFF in such a manner that when the pump is ON, the leak valve should be OFF and when the pump is OFF, the leak valve should be ON.




[3] After checking of cord connection, check also that rotating direction of the motor of vacuum pump is correct. Particular care should be taken at cable connection to avoid reverse rotation by phase difference.




## 10-5. INERT GAS

**⚠WARNING**

[1] Never use inflammable gas (such as hydrogen gas, etc.).

[2] Never replace the gas cylinder while the machine is in operation.

### 10-5-1. FUNCTION OF GAS

Tubing method depends on the casting program to be used. Consult the distributor at your place.

GAS 1 (for driving the lid lock cylinder etc.)

Supply of gas for driving the lid lock cylinder (including pressurization gas) is necessary to the inlet of GAS 1.

GAS 2 (for gas substitution)

Supply of gas for substitution is necessary to the inlet of GAS 2.

1. When Argon gas is to be supplied to GAS 2, it is necessary to replace the built-in valve "YV2 CN02" for GAS 2 as Pages 81 and 82.
2. When Helium gas is to be supplied to GAS 2, there is not need to replace the built-in valve "YV2 CN02" for GAS 2.

### 10-5-2. GAS SUPPLY PRESSURE

Ar gas is used for both GAS 1 and GAS 2 :

GAS 1 Ar ____ Supply pressure 0.7 MPa

GAS 2 Ar ____ Supply pressure 0.7 MPa

Ar gas is used for GAS 1 and He gas is used for GAS 2 :

GAS 1 Ar ____ Supply pressure 0.7 MPa

GAS 2 He ____ Supply pressure 0.1 MPa to 0.3 MPa

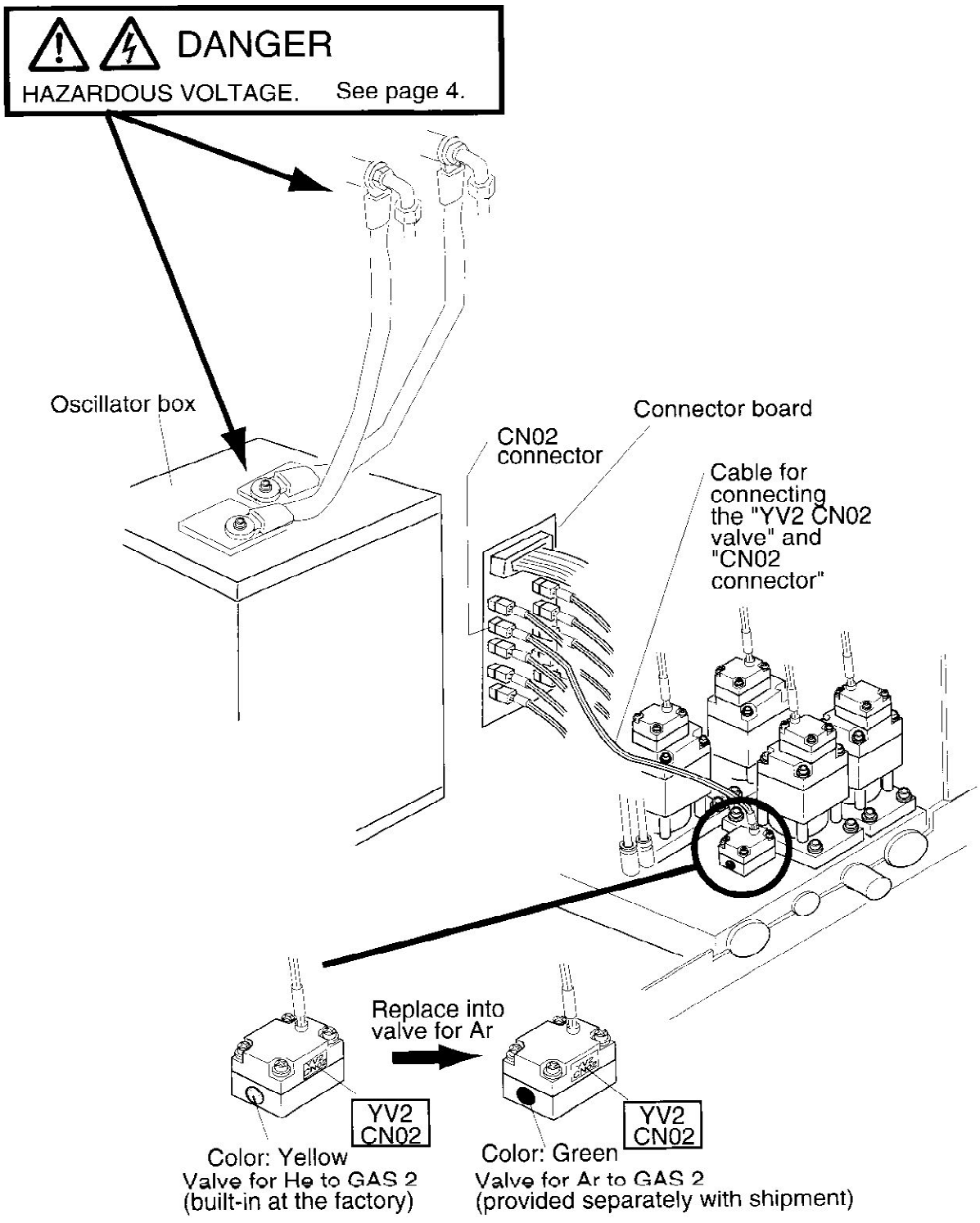
## 10-5-3. WHEN Ar GAS IS USED FOR BOTH GAS 1 and 2

### 10-5-3-1. REPLACEMENT OF INTERNAL VALVE FOR GAS 2

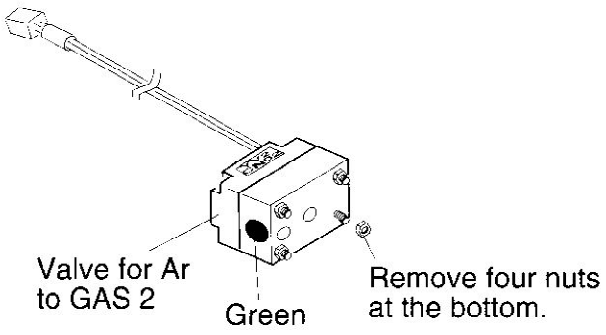
The internal valve for He gas with "YV2 CN02" and Yellow Mark labels is built in the body at the time of shipment from the factory. If Ar is to be supplied to GAS 2, it is first necessary to replace the internal valve into the valve for Ar gas with "YV2 CN02" and Green Mark labels.

1) Turn power off.

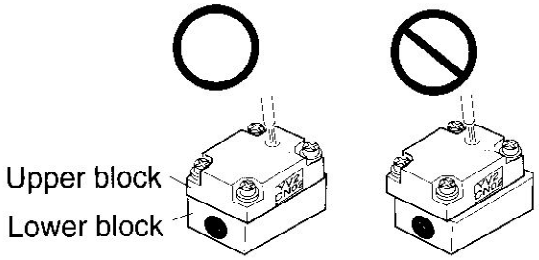
2) Open the rear panel. You will find the valve "YV2 CN02" the right bottom as the below figure. Never touch the oscillator box.



3) Remove the four nuts at the bottom of the valve for Ar to GAS 2.

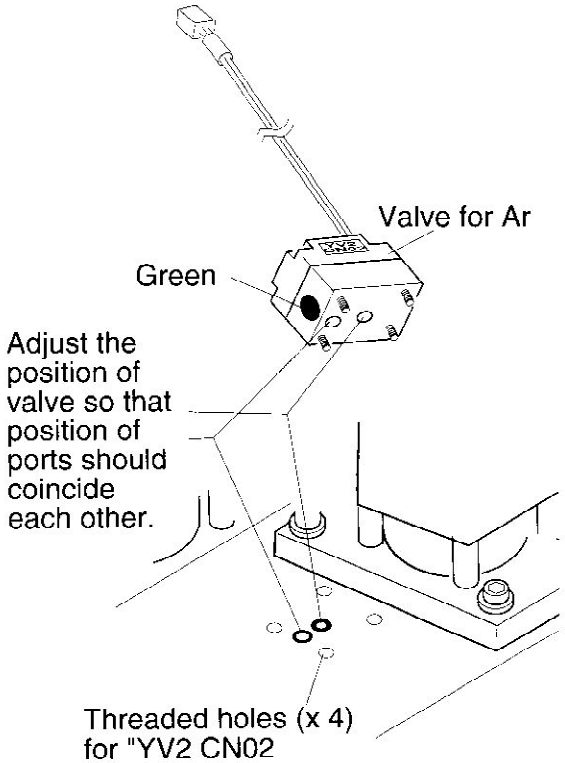



4) Taking care the position of the valve, fix it using a Phillips screwdriver. Do not tighten bolts too much. Tighten the four bolts evenly.

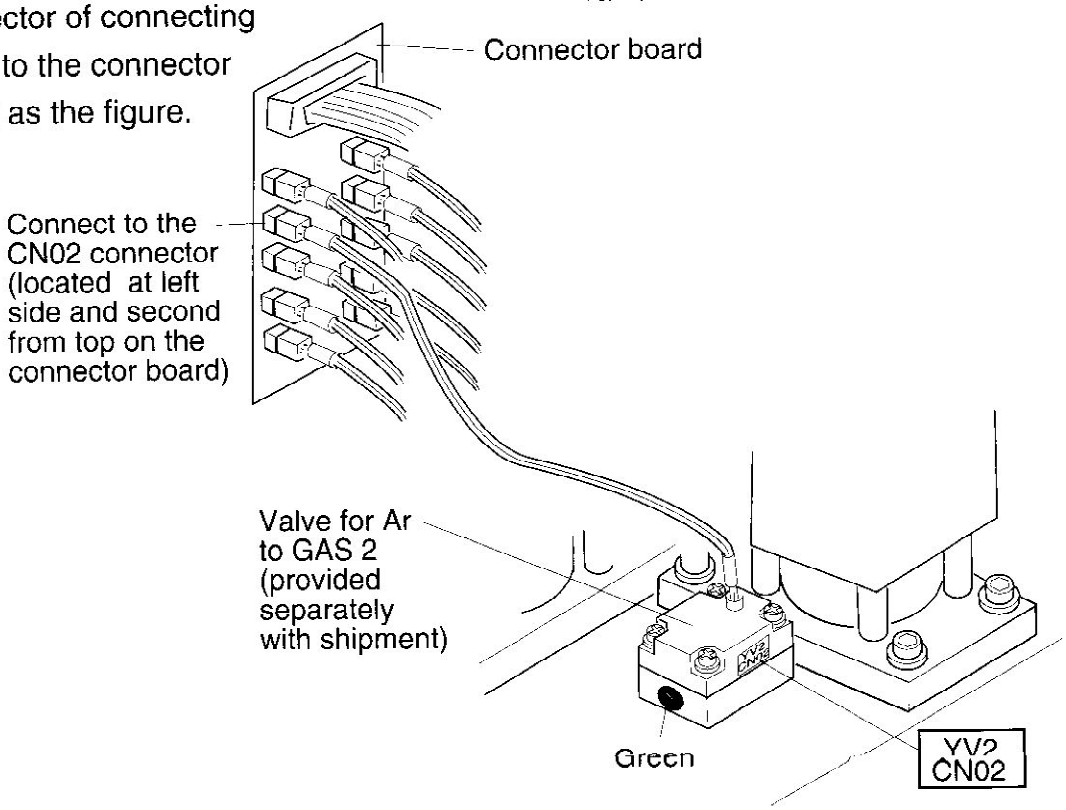


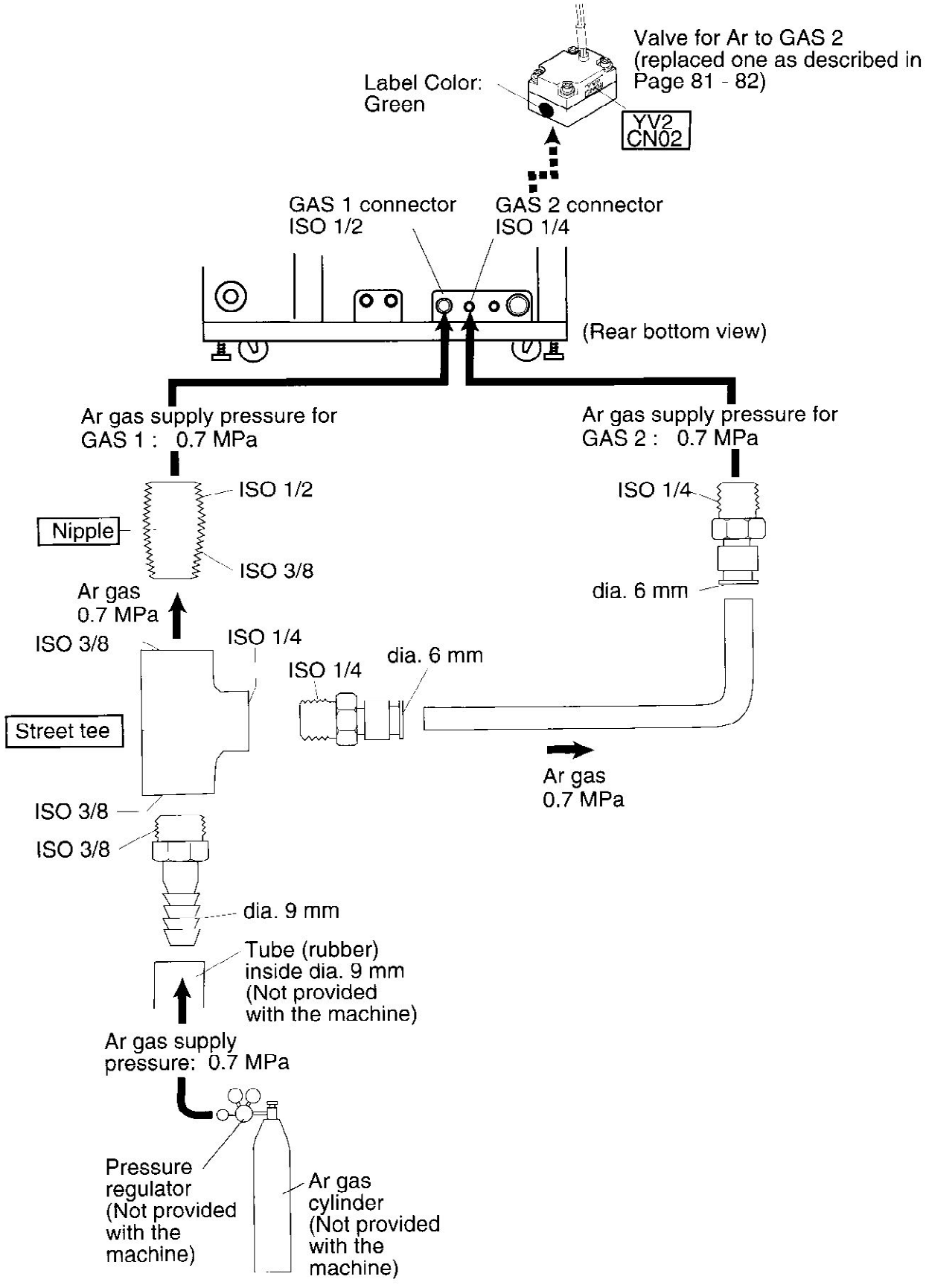

Good.
The upper block sides should be flush with the lower block sides.

Not good.



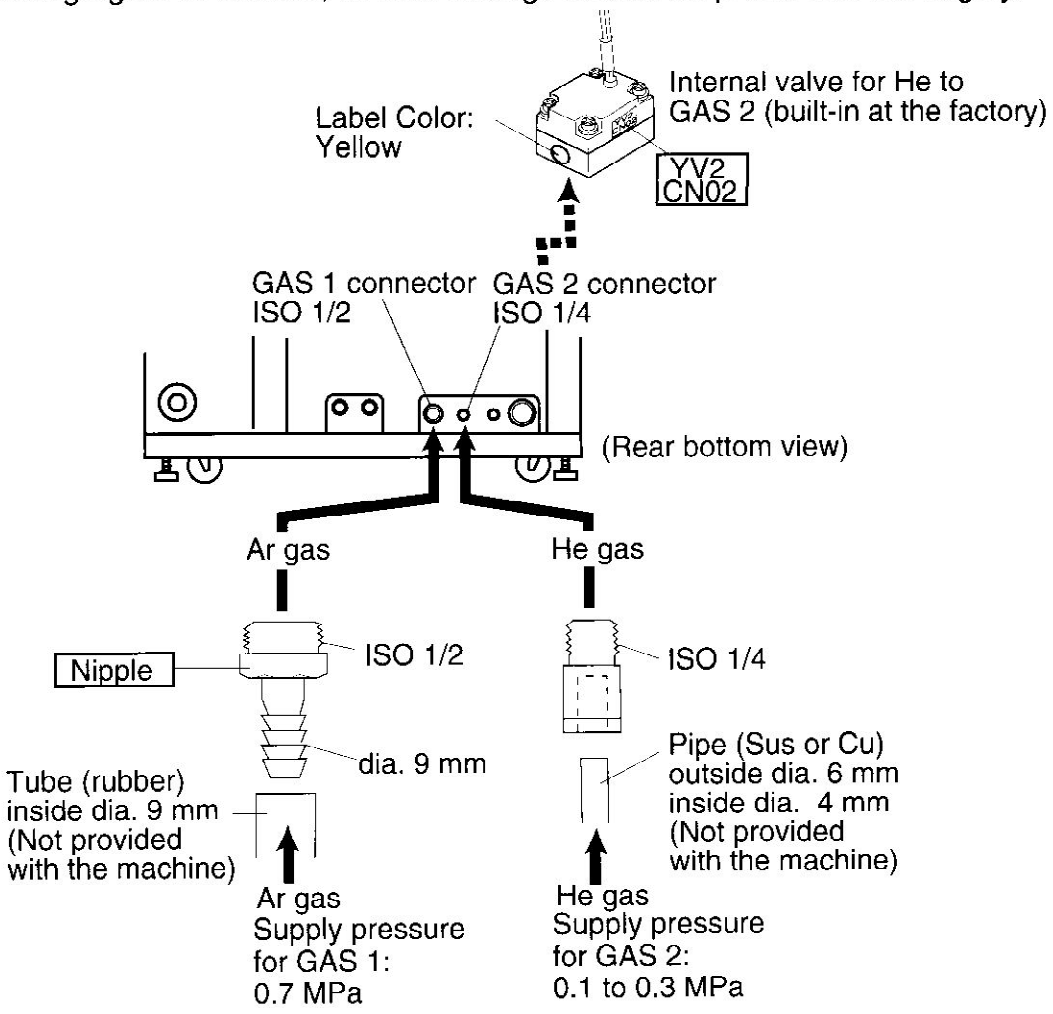

5) Taking care of the direction of the connector, push in the connector of connecting cable to the connector board as the figure.




Valve for Ar to GAS 2
(replaced one as described in
Page 81 - 82)
Label Color:
Green
YV2
CN02
GAS 1 connector
ISO 1/2
GAS 2 connector
ISO 1/4
(Rear bottom view)
Ar gas supply pressure for
GAS 1 : 0.7 MPa
Ar gas supply pressure for
GAS 2 : 0.7 MPa
ISO 1/2
Nipple
ISO 3/8
ISO 1/4
dia. 6 mm
Ar gas
0.7 MPa
ISO 3/8
ISO 1/4
ISO 1/4
dia. 6 mm
Street tee
Ar gas
0.7 MPa
ISO 3/8
ISO 3/8
dia. 9 mm
Tube (rubber)
inside dia. 9 mm
(Not provided
with the machine)
Ar gas supply
pressure: 0.7 MPa
Pressure
regulator
(Not provided
with the
machine)
Ar gas
cylinder
(Not provided
with the
machine)

## 10-5-4. TUBING FOR Ar TO GAS 1, AND He TO GAS 2

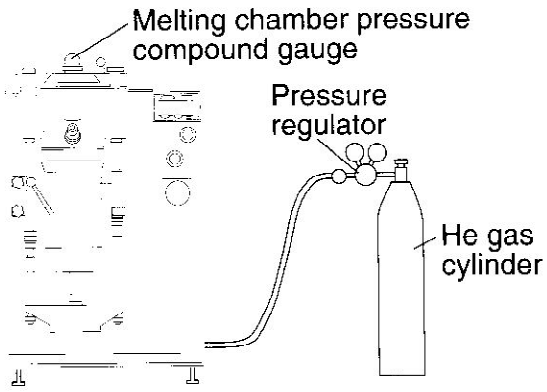
Apply sealing agent to threads, so that leakage should be prevented thoroughly.




IMPORTANT : He gas pressure has an effect on gas substitution level. Therefore, set He gas pressure at same value every day. To make fine adjustments of He gas pressure, activate the machine and check actual gas injection speed as follows:

Procedure:

1) Set the machine to the MANUAL MODE.
2) Lock the lid of melting chamber.
(Do not jack-up.)
3) Evacuate the inside of chamber.
4) Activate M-GAS injection.

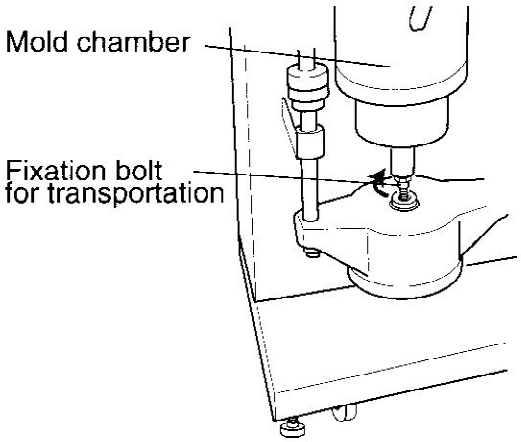



At this time, watching the needle movement of display value of melting chamber pressure compound gauge, adjust the pressure regulator of the gas cylinder, so that time period from vacuum (about -0.1 Mpa) to atmospheric pressure (0) should be within about 10 to 12 seconds.

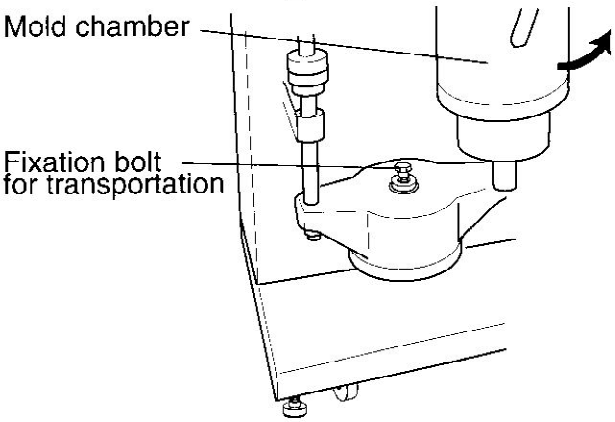
# 10-6. MOLD CHAMBER

## 10-6-1. REMOVING FIXATION BOLT FOR TRANSPORTATION

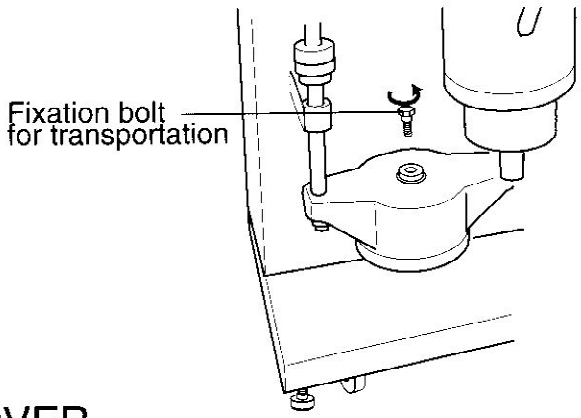
1) Turn the fixation bolt for transportation (Hexagonal head bolt, Size: ISO M12 L=45 mm) clockwise, so that the mold chamber can be moved back and forth freely.




2) Slide the mold chamber to front side.



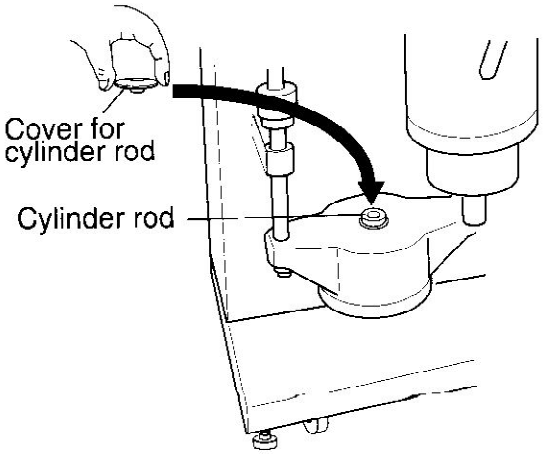

3) Remove the fixation bolt for mold chamber turning it counterclockwise.




## 10-6-2. CYLINDER ROD HEAD COVER

Place the cover for cylinder rod on the top of the cylinder rod for protection.

IMPORTANT: If the cylinder rod head cover is forgotten, the lid lock action can not be performed properly. At the time of installing the machine, be sure to check it is set in place.



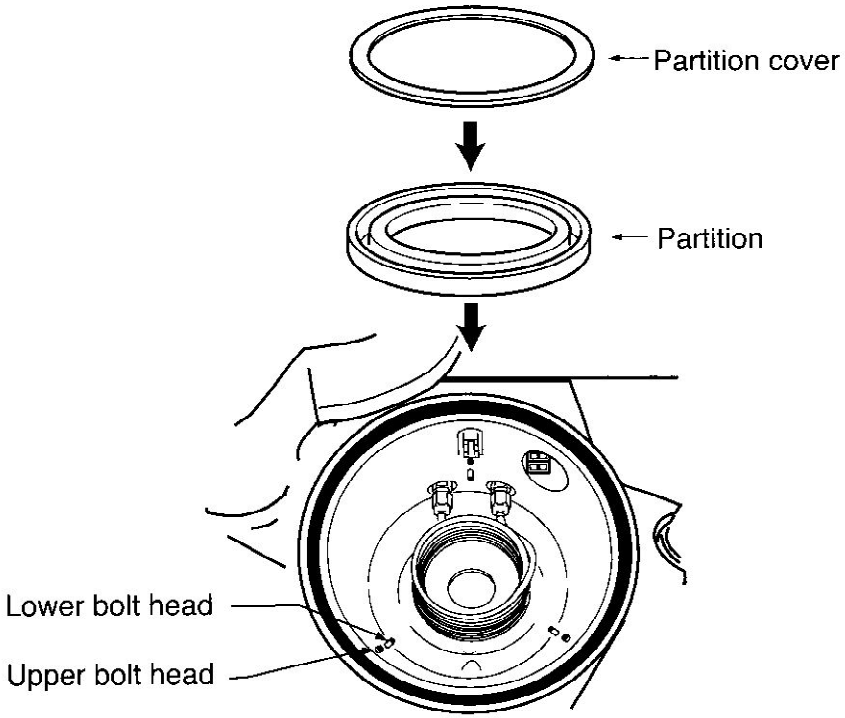
# 10-7. MELTING CHAMBER

## 10-7-1. HEATING COIL

Position of the heating coil is already adjusted at the factory, but it is possible that its position is offset especially in vertical direction due to vibration during transportation. Normal position of the coil is such that the outer crucible can be placed in position smoothly after the partition is set to its place.

## 10-7-2. PARTITION

Set the partition down in place.



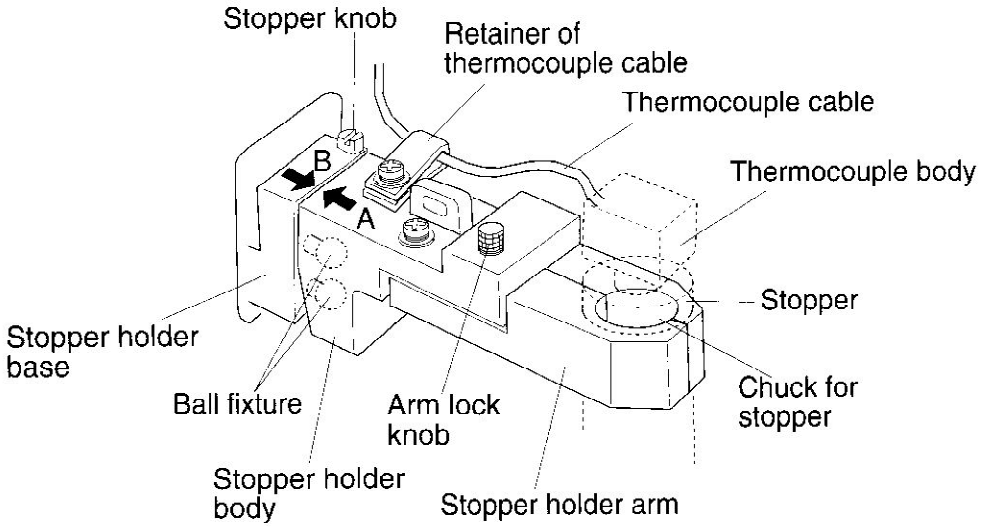
## 10-7-3. THERMOCOUPLE

### ⚠CAUTION

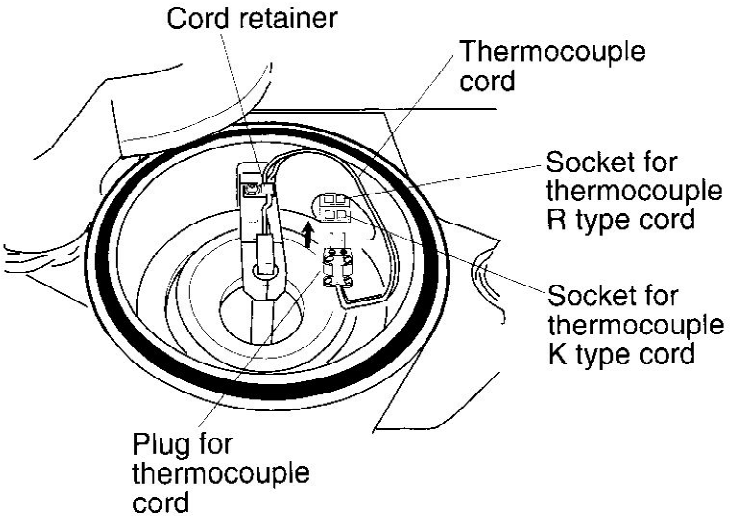
(See also P.42)

In the case of the K-type machine, if the "R-type thermocouple" is connected to the "K-type socket" by mistake, display temperature will be lower, and actual temperature of metal will become too high. Such mistake at type selection may cause hazardous results, so always check that the type of thermocouple is correct.

In the case of the R-type machine, if the "K-type thermocouple" is connected to the "R-type socket" by mistake, display temperature will be abnormally higher than actual metal temperature.




1) Lift the arm lock knob, so that the stopper holder arm will be released.
2) Plug the thermocouple into the socket of the machine. (It is not possible to connect the plug in reverse direction.)
3) Secure the electrical cord with the cord retainer on the stopper holder bracket using a Phillips screwdriver.




### ⚠CAUTION

[1] Carefully route its electrical cord so that the cord should not be caught by other parts.
[2] Do not kink the electrical cord.

4) Put the tube of thermocouple body into the hole of stopper hole.

> ⚠CAUTION
>
> The thermocouple must be set in place until its lower end makes contact with the bottom of the stopper hole.

5) Chuck the stopper with the stopper holder arm. Lower the arm lock knob.
6) Lift the stopper holder base.
7) Set the stopper holder in place, making alignment with the ball fixture.

> IMPORTANT:
> Check that the level of stopper holder (A) and that of stopper holder base (B) will be same as shown in the figure of P.87.

8) Turn the stopper knob for safety.

> IMPORTANT :
> It is possible that a large amount of moisture is contained in protection tube of a new thermocouple. Carry out preheating up to around 200 degrees C before actual casting.

# 11. CHECKING ON OPERATION PANEL

Action of sensors, and switches can be checked on the operation panel.

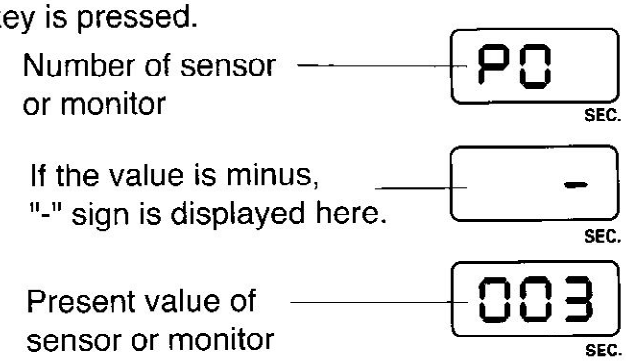
## 11-1. MONITORING PRESSURE SENSOR, POWER SUPPLY etc.

Press [MANU] key to enter into the MANUAL MODE, then press one of the ten keys from (0) to (4). Then, present value is displayed on the lower parameter display.

Check to compare with the below standard value.

Display example:

When (0) key is pressed.




(0) key

Mold chamber inside pressure (Unit: kPa)

Standard value: In air atmosphere 000 +/- 2 kPa

Monitoring range: -110 to 500 kPa

(1) key

Control output of TEMP. CONTROLLER (Unit: %)

Monitoring range: -10 to 110 %

- Even during standby time ([HEAT] key OFF), output is carried out as long as SV is larger than PV. However, heating is not carried out at this time, if [HEAT] or (FULL) key is not turned ON.
- Output value is not constant because output is controlled by PID.

(2) key

High frequency power supply output (Unit: %)

Monitoring range: -10 to 110%

- Check that output is correct by activating (FULL) key.

(3) key

Power supply voltage (Unit: V)

- Power supply voltage is displayed. Check whether power supply is within the permissible limits.
- Permissible limits: AC 220 V +/- 10%

If power supply is over the limits, error number (P.38 - 39) is displayed.

(4) key

Water temperature (Unit: degrees centigrade)

Monitoring range: 0 to 100 degrees centigrade

- Temperature of water drained from the machine to outside is monitored.
- If this temperature exceeds set temperature, the internal valve is opened automatically, so water supply amount is increased. If this temperature exceeds 60 degrees centigrade, error number (P.39) is displayed.

## 11-2. MONITORING TEMP. CONTROLLER OUTPUT etc.

Press [MANU] key to enter the MANUAL MODE, then press (FNC) key and (8) key. ON/OFF state is displayed on the HEAT POWER display.


Output (ALM2) is sent from the TEMP. CONTROLLER.


Output (ALM1) is sent from the TEMP. CONTROLLER.


The lid position sensor is ON.


The mold chamber position sensor is ON.

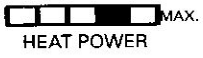

The flask elevation shaft sensor is ON.

# 11-3. MONITORING SWITCH CONDITIONS

After pressing [MANU] key to enter into the MANUAL MODE, press (FNC) key and (9) key. ON/OFF status of switches is displayed on the HEAT POWER display.


The START button is ON.


The RESET button is ON.




The data lock key switch is set to LOCK.


The water pressure sensor for water supply is ON.
(The machine can be used when it is ON)

# 12. TEMP. CONTROLLER

IMPORTANT:

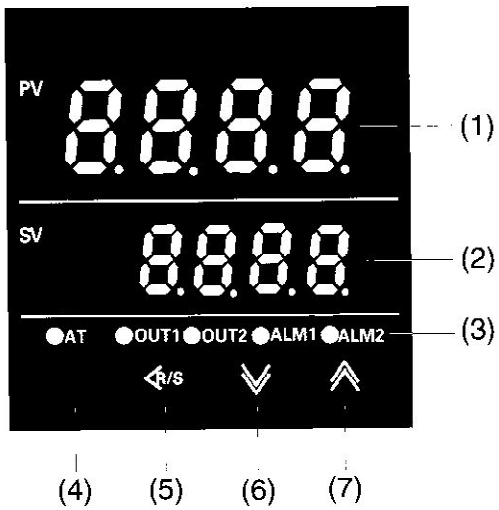
[1] Parameters etc. are preset at the factory. For usual casting, keys of the TEMP. CONTROLLER should not be operated. Protected parts at the factory presetting will be released and sequence action will not operate normally. If you need to change parameter values, do it with good understanding.

[2] Operation of the TEMP. CONTROLLER is limited to display of Process Value (PV).

Setting of Set Value (SV) is carried out by the HEAT key on the operation panel.

However, it is possible to modify Set Value (SV) of the TEMP. CONTROLLER after the AUTO MODE has started.

## 12-1. NOMENCLATURE OF TEMP. CONTROLLER




(1) PV (Process Value) display (green)--- Process value is displayed.

(2) SV (Setting Value) display (orange)---Set value is displayed.

(3) Display LED --- Signal output status is displayed.

(4) Set key --- Used to register and recall parameters for the TEMP. CONTROLLER.

(5) R/S key --- Used to select digit to be changed.
Further, used to select RUN/STOP function.

(6) Down key --- Used to decrease value.

(7) Up key --- Used to increase value.

# 13. SPECIFICATIONS

| | |
|---|---|
| POWER SOURCE | 3 Phase, 220 +/- 10%, 50/60 Hz,<br>Approx. 9.5 KVA (8 KW Model) / 6.5 KVA (5 KW Model) |
| OUTPUT | Max. 8 KW / 5 KW |
| WEIGHT | Approx. 185 Kg |
| DIMENSIONS | 720 (W) x 588 (D) x 1,219 (H) mm |
| MAXIMUM FLASK SIZE | 125 dia. x 230 mm (perforated straight flask)<br>(when flask is not deformed) |
| CRUCIBLE | Graphite Crucible |
| CRUCIBLE VOLUME | 242 cc (8 KW Model) / 158 cc (5 KW Model) |
| MOLTEN METAL | Gold Alloy, Silver Alloy, Copper Alloy |
| MAXIMUM CAST AMOUNT VOLUME | 150 cc (8 KW Model) / 100 cc (5 KW Model) |
| MAXIMUM WORKING TEMPERATURE | Standard : 1200 degrees C<br>(Option : 1450 degrees C (8 KW Model)<br>1300 degrees C (5 KW Model) ) |
| TEMP. SENSOR | K Type Thermocouple up to 1200 degrees C,<br>or<br>R Type Thermocouple (option)<br>up to 1450 degrees C (8 KW Model)<br>up to 1300 degrees C (5 KW Model) |
| MAXIMUM PRESSURIZATION POWER | 0.3 MPa |
| GAS | Inert gas (Helium, Argon) |
| MEMORY FOR CASTING PROGRAM | 50 |
| COOLING | Tap Water Direct Supply System |
| CASTING | Gravitational Casting with<br>Vacuum/Pressure/Suction |
| ALARM | Self Detection and Error Number Display |
| VACUUM | External Vacuum Pump (option) |
| AMBIENT TEMP. | 5 to 30 degrees C |
| AMBIENT HUMIDITY | Less than 80 % |
| WATER SUPPLY | 10 to 30 centigrade,<br>more than 3 litters/min.,<br>water pressure more than 1.5 kg/cm$^2$ |