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(54) **HEATING TYPE VAPORIZING DEVICE**

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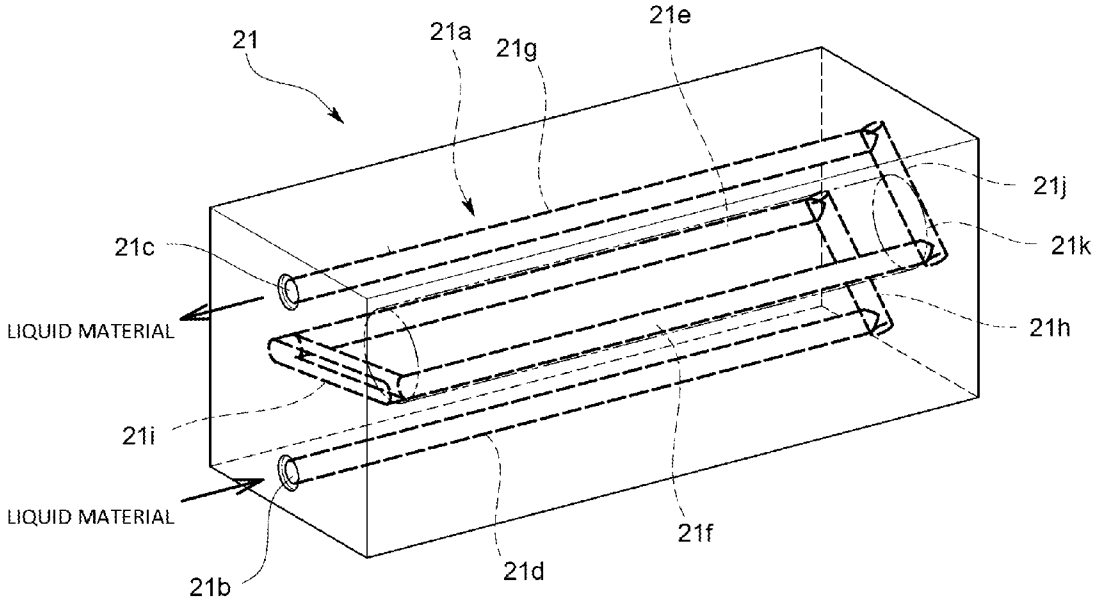
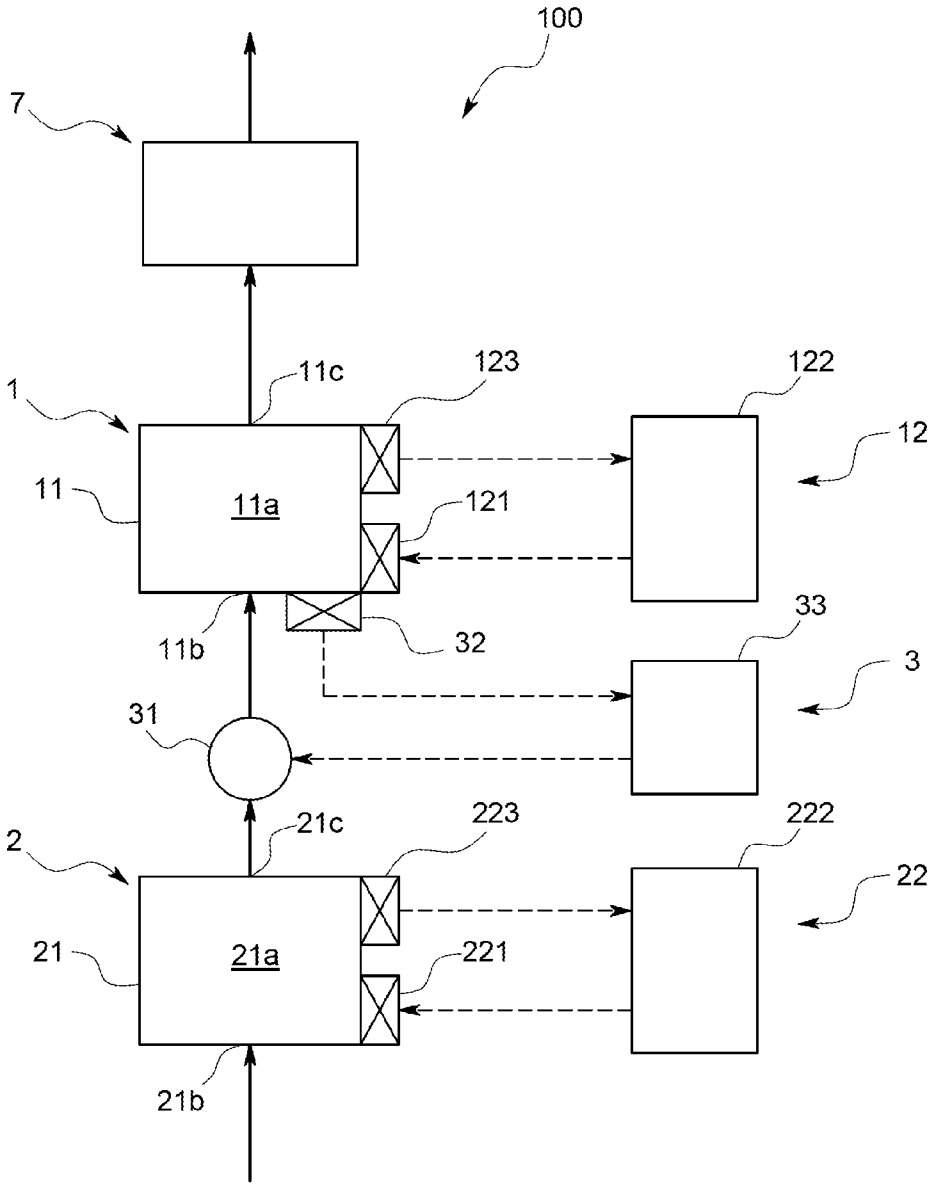
(57) **ABSTRACT**

This invention is a continuous type vaporizing device that makes it possible to output a large flow rate of the material gas stably while the vaporizing device is downsized. The vaporizing device comprises a vaporizing tank that has a vaporizing chamber and that outputs a material gas that is produced by vaporizing the liquid material that is introduced into the vaporizing chamber, a heater that promotes vaporization of the liquid material in the vaporizing chamber by heating the vaporization tank, and a partition wall that partitions a lower space of the vaporizing chamber into a first lower space into which the liquid material is introduced first and a second lower space into which the liquid material that overflows from the first lower space is introduced.

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7
1
11c
123
122
12
11
11a
121
11b
32
33
3
31
2
21c
223
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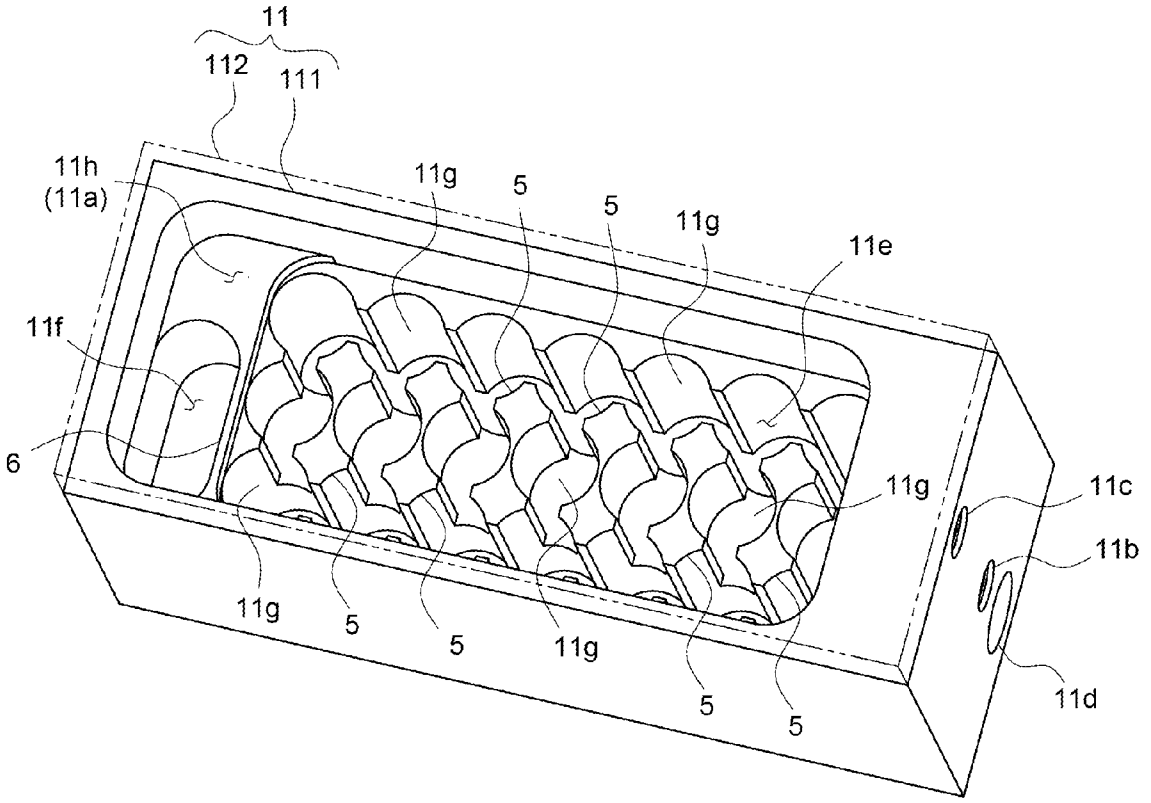
21
21a
221
21b

FIG.1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112
111
11h
(11a)
11g
5
5
11g
11e
11f
6
11g
11c
11b
11g
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5
11g
5
5
11d

FIG.2

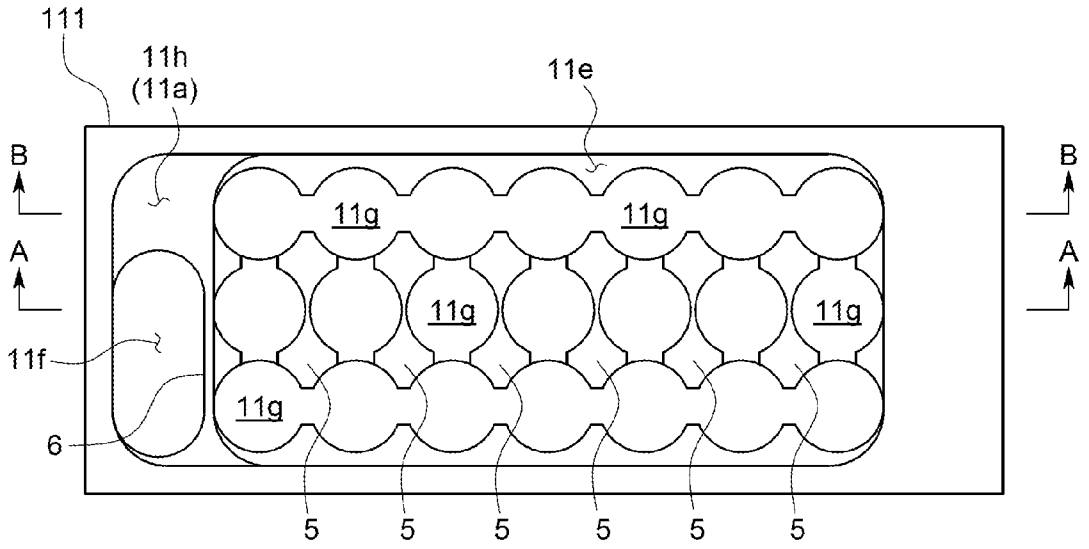

FIG.3

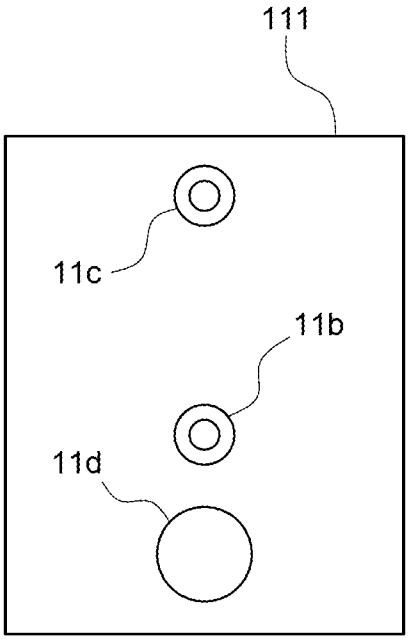

FIG.4

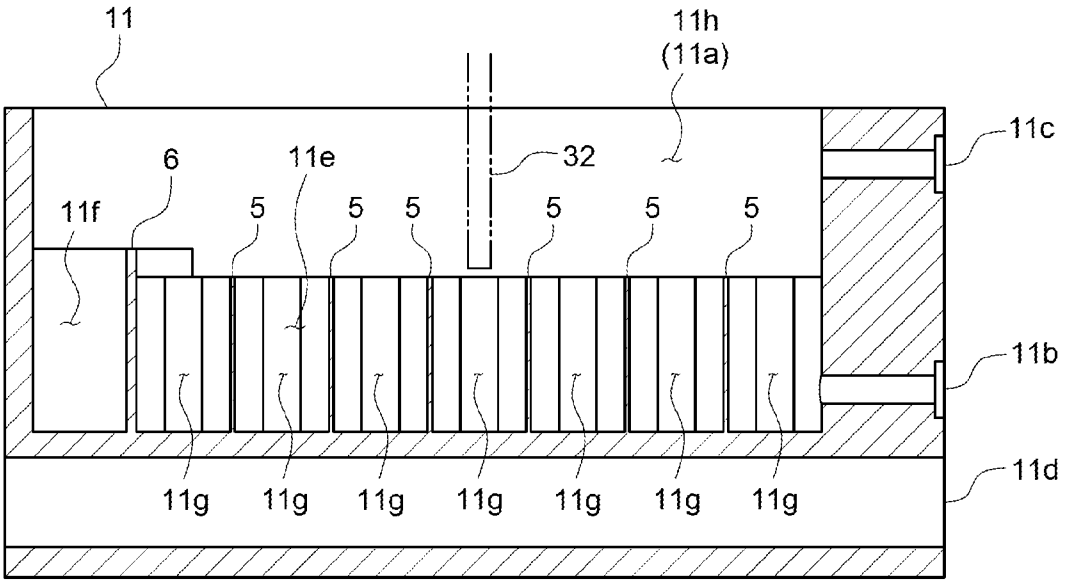
11
11h
(11a)
11c
6
11e
32
11f
5
5
5
5
5
5
11b
11g
11g
11g
11g
11g
11g
11g
11d

FIG.5

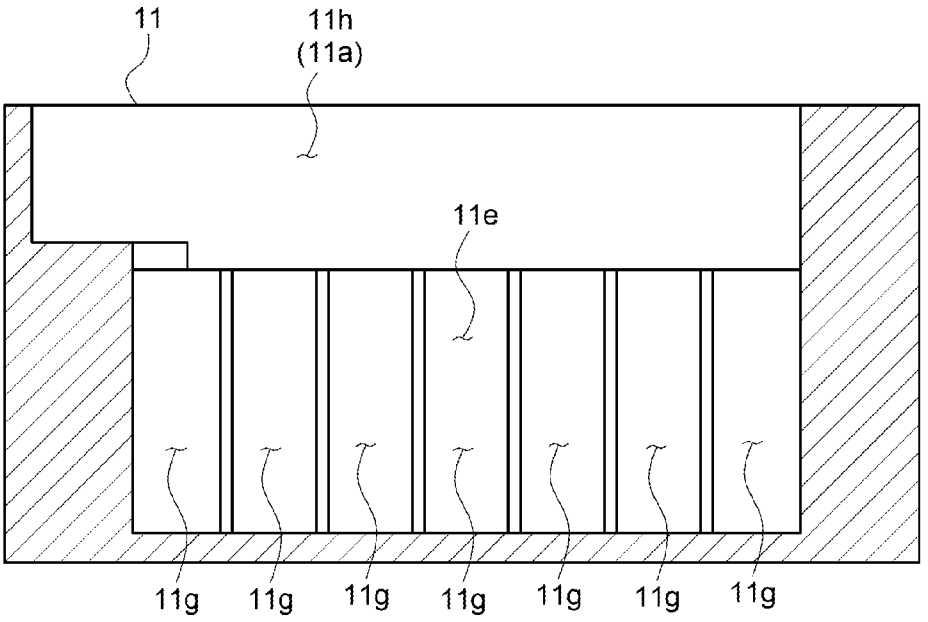

FIG.6

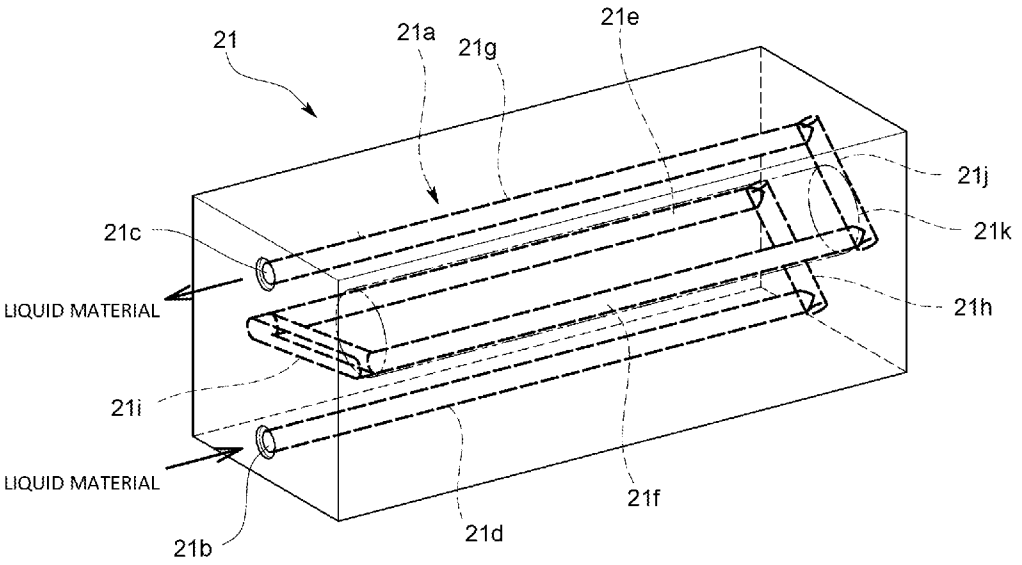
21
21a
21g
21e
21j
21k
21c
LIQUID MATERIAL
21h
21i
LIQUID MATERIAL
21f
21b
21d

FIG.7

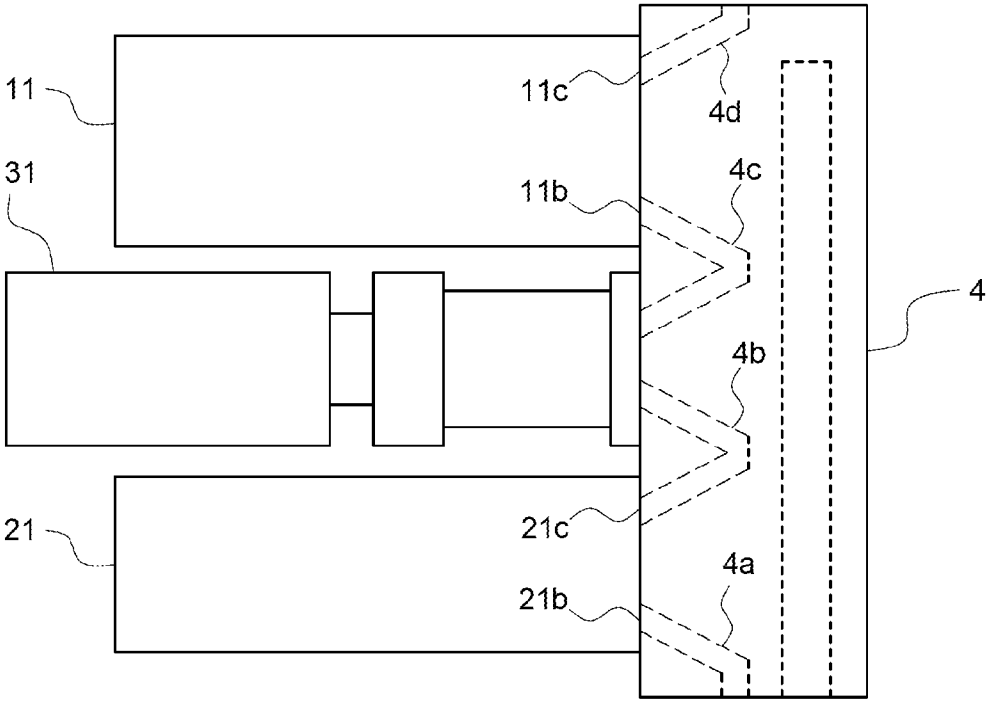

FIG.8

HEATING TYPE VAPORIZING DEVICE

FIELD OF THE ART

[0001] This invention relates to a heating type vaporizing device that gasifies a liquid semiconductor material.

BACKGROUND ART

[0002] Some semiconductor materials are liquid at a normal temperature such as a material containing no fluorocarbon. For a semiconductor manufacturing system, in case of using the liquid semiconductor material that is liquid at a normal temperature, a heating type vaporizing device that gasifies the liquid by applying heat to the liquid may be utilized.

[0003] A store type vaporizing device wherein a liquid material that is sufficiently required for a predetermined process is stored in a vaporizing tank, the liquid material is vaporized and the vaporized material gas is output, or a continuously introducing type vaporizing device wherein a liquid material is continuously or intermittently introduced into the vaporizing tank, the liquid material is vaporized and the vaporized gas is output as the material gas can be represented as a typical vaporizing device for this purpose.

[0004] Since the store type vaporizing device only requires sufficient amount of the liquid material stored in the vaporizing tank, there is no need of a complicated flow rate structure or a valve control to introduce the liquid material. In addition, with regard to controlling the temperature to heat the vaporizing tank, so much fast response is not required. As a result of this, the store type vaporizing device has a merit that it is easy to output a large flow rate of the material gas stably. On the other hand, the vaporizing tank of this type is prone to be enlarged so that there is a demerit that it is difficult to downsize the vaporizing device.

[0005] Whereas, although the continuously introducing type vaporizing device has a merit that the vaporizing tank can be downsized, it has a demerit that it is difficult to output a large flow rate of the material gas stably. The reason is that it is necessary to introduce a new liquid material one after another continuously by an amount that is vaporized in the vaporizing tank and output from the vaporizing tank so that a controlled responsiveness of the liquid material introducing amount is required. For example, if it takes too much time to control the responsiveness, too much liquid material is introduced into the vaporizing tank and the liquid material that fails to vaporize overflows from the vaporizing tank and is output from the output port of the material gas. As a result of this, there might be a risk that an unexpected failure occurs.

[0006] On the other hand, if an emergency output halt mechanism is added in order to prevent the liquid material from overflowing due to an excessive input of the liquid material, the state of halting the output occurs frequently and a harmful influence is exerted on the semiconductor process itself. Then this arrangement can not be a fundamental solution.

[0007] In addition, these problems will occur not a little also for the store type vaporizing device.

PRIOR ART DOCUMENTS

Patent Document

[0008] Patent document 1: Japanese Unexamined Patent Application Publication No. 2004-157719

DISCLOSURE OF THE INVENTION

Problems to be Solved by the Invention

[0009] The present claimed invention intends to solve all of the problems and a main object of this invention is to make it possible to provide a vaporizing device used for semiconductor manufacturing system that is downsized and that can output a large flow rate of a material gas stably.

Means to Solve the Problems

[0010] More specifically, a vaporizing tank in accordance with this invention has a vaporizing chamber heated by a heater and outputs a material gas that is vaporized by heating a liquid material that is introduced into the vaporizing chamber, and is characterized by comprising a partition wall that partitions a lower space of the vaporizing chamber into a first lower space into which the liquid material is introduced first and a second lower space into which the liquid material that overflows from the first lower space is introduced.

[0011] In accordance with this arrangement, since the liquid surface height is kept generally constant for a little while after the liquid material that first flows in the first lower space starts overflowing from the partition wall into the second lower space, it is possible to control the liquid surface height by making use of this time. As a result of this, it is possible to keep the liquid material amount (the liquid surface height) in the vaporizing chamber within an appropriate range without making use of an expensive and highly responsive mechanism to control the liquid surface height so that it is possible to attain an object of this invention that downsizing the device while increasing the flow rate of the liquid material.

[0012] If a liquid surface height at which the liquid material starts overflowing into the second lower space is set within a target liquid surface height range or at a height higher than the target liquid surface height range, it becomes easy to control the liquid surface height so that the above-mentioned effect becomes conspicuous.

[0013] In order to stably supply the large flow rate of the material gas in a compact vaporizing chamber, it is preferable that not only the liquid surface height is controlled in order to introduce the liquid material into the vaporizing chamber accurately whose amount meets an amount that is output as the material gas but also the temperature of the liquid material in the vaporizing chamber is kept at a vaporization promoting temperature at which the liquid material is securely vaporized.

[0014] In order to attain the object, it is more preferable to comprise a plurality of thermal conductors that project from an internal wall surface of the vaporizing chamber. The reason is since the heat from the heater is efficiently transmitted to the liquid material by means of multiple thermal conductors, even though the liquid material is introduced into the compact vaporizing chamber one after another so as to increase the flow rate of the liquid material by speeding up the velocity of replacing the liquid material, it is possible to keep the temperature to promote the vaporization by heating the liquid material quickly so as to offset the temperature drop due to the increased flow rate.

[0015] In order to facilitate the manufacture of the vaporizing tank, it is preferable to comprise a block shaped body where a bottomed hole that opens in a predetermined surface is formed and a cap body that forms the vaporizing chamber by closing the opening of the bottomed hole, and the bot-

tomed hole is formed by boring multiple portions of the predetermined surface of the body, and a remaining wall portion formed between the bottomed holes is so configured to perform a function as the thermal conductor.

[0016] In order to effectively transmit the heat from the heater to the liquid material, it is preferable that a wall body that forms the vaporizing chamber is so configured that the heater to apply heat to the liquid material can be buried.

[0017] In addition, the vaporizer in accordance with this invention is characterized by comprising a vaporizing tank that has a vaporizing chamber and that outputs a material gas produced by vaporizing a liquid material introduced into the vaporizing tank, a heater that applies heat to the vaporizing tank so as to promote vaporization of the liquid material in the vaporizing tank, and a partition wall that partitions a lower space of the vaporizing chamber into a first lower space into which the liquid material is introduced first and a second lower space into which the liquid material that overflows from the first lower space is introduced.

[0018] Furthermore, the vaporizing device in accordance with this invention comprises the vaporizer, a liquid surface sensor that detects a liquid surface height of a liquid material stored in a vaporizing chamber, a flow rate adjusting valve that is arranged on a liquid material introducing flow channel that communicates with the vaporizing chamber, and a control mechanism that controls the flow rate adjusting valve so as to make the liquid surface height detected by the liquid surface sensor within a predetermined target liquid surface height range, and is characterized by that the liquid surface height at which the liquid material overflows into the second lower space is set within or above the predetermined target liquid surface height range.

Effect of the Invention

[0019] In accordance with the present claimed invention having the above-mentioned arrangement, since the liquid surface height is kept generally constant for a little while after the liquid material that first flows in the first lower space overflows from the partition wall into the second lower space, it is possible to control the liquid surface height by making use of this time. As a result of this, it is possible for the continuously introducing type evaporation device to be downsized while increasing the flow rate of the liquid material stably.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] FIG. **1** is a pattern diagram showing an overall configuration of a vaporizing device in accordance with one embodiment of this invention.

[0021] FIG. **2** is a perspective view showing a vaporizing tank of this embodiment.

[0022] FIG. **3** is a plane view showing a body of the vaporizing tank of this embodiment.

[0023] FIG. **4** is a right side view showing a body of the vaporizing tank of this embodiment.

[0024] FIG. **5** is a cross-sectional view taken along A-A line in FIG. **3**.

[0025] FIG. **6** is a cross-sectional view taken along B-B line in FIG. **3**.

[0026] FIG. **7** is a perspective view showing a preheating tank in this embodiment.

[0027] FIG. **8** is a front view showing an arrangement configuration of the vaporizer, a preheater, and a flow rate control valve of the vaporizer in this embodiment.

BEST MODES OF EMBODYING THE INVENTION

[0028] One embodiment of this invention will be explained with reference to drawings.

(1) Summary of a Vaporizing Device **100** in Accordance with this Embodiment

[0029] The vaporizing device **100** of this embodiment is incorporated into, for example, a semiconductor manufacturing system, and to supply a material gas of a predetermined flow rate to a process chamber of the semiconductor manufacturing system.

[0030] As shown in FIG. **1**, the vaporizing device **100** comprises a vaporizer **1** that vaporizes the introduced liquid material and outputs the material gas, a preheater **2** that preheats the liquid material in advance and that introduces the preheated liquid material to the vaporizer **1**, an introducing amount control mechanism **3** that controls a flow rate of the liquid material that is introduced from the preheater **2** into the vaporizer **1** and a mass flow controller **7** that is connected to an output port of the vaporizer **1** and that controls a mass flow rate of the material gas.

[0031] Next, each component of this vaporizing device **100** will be explained.

(2) Configuration of the Vaporizer **1**

[0032] The vaporizer **1** comprises, as shown in FIG. **1**, a vaporizing tank **11** inside of which a vaporizing chamber **11***a* is provided, and a vaporizing chamber temperature control mechanism **12** that controls the temperature of the liquid material in the vaporizing chamber **11***a* so as to keep it at a predetermined vaporization promoting temperature at which vaporization is promoted.

[0033] As shown in FIG. **2**~FIG. **5**, the vaporizing tank **11** has the vaporizing chamber **11***a* that is provided inside of an elongated block shape metal body (more concretely, a rectangular parallelepiped), and an introducing port **11***b* for introducing the liquid material into the vaporizing chamber **11***a* and an output port **11***c* for outputting the material gas from the vaporizing chamber **11***a* are open on one end surface that is orthogonal to a longitudinal direction of the elongated block shape metal body. The vaporizing tank **11** is arranged with its longitudinal direction set as a horizontal direction in a posture wherein the output port **11***c* is located at an upper part of the introducing port **11***b*. The liquid material that is introduced from the introducing port **11***b* is stored in a lower space of the vaporizing chamber **11***a*, and the material gas that is made by vaporizing the liquid material is filled into an upper space of the vaporizing chamber **11***a* and then is output from the output port **11***c*.

[0034] The vaporizing chamber temperature control mechanism **12** comprises, as shown in FIG. **1**, a heater **121** that is mounted on the vaporizing chamber **11***a*, a temperature sensor **123** that directly or indirectly measures a temperature of the liquid material in the vaporizing chamber **11***a* and a heater control circuit **122** that controls the heater **121** so as to make the temperature measured by the temperature sensor **123** at the vaporization promoting temperature. The heater **121** is rod-shaped, and is inserted into a bore **11***d* for heater

that opens on the one end surface of the vaporizing tank **11** and that extends in the longitudinal direction.

(3) Configuration of the Preheater **2**

[0035] The preheater **2** comprises, as shown in FIG. **1** and FIG. **7**, a preheating tank **21** inside of which a preheating chamber **21***a* is provided, and a preheating chamber temperature control mechanism **22** that controls the temperature of the liquid material in the preheating chamber **21***a* to be kept at a predetermined preheating temperature that is lower than the vaporization promoting temperature. The preheater **2** outputs the preheated liquid material to the vaporizer **1**.

[0036] Similar to the vaporizing tank **11**, the preheating tank **21** has the preheating chamber **21***a* that is provided inside of an elongated block shape metal body (more concretely, a rectangular parallelepiped), and an introducing port **21***b* for introducing the liquid material into the preheating chamber **21***a* and an output port **21***c* for outputting the preheated material gas from the preheating chamber **21***a* are open on one end surface that is orthogonal to a longitudinal direction of the elongated block shape metal body.

[0037] As shown in FIG. **7**, the preheating tank **21** is arranged with its longitudinal direction set as a horizontal direction and the output port **21***c* is arranged to be located at an upper part of the introducing port **21***b*. In addition, the preheating chamber **21***a* comprises multiple (four, in this embodiment) extending flow channels **21***d*, **21***e*, **21***f*, **21***g* that extend in the longitudinal direction and connecting channels **21***h*, **21***i*, **21***j* each of which connects an end part of each of the extending flow channels **21***d*, **21***e*, **21***f*, **21***g* so as to connect the extending flow channels **21***d*, **21***e*, **21***f*, **21***g* in serial. A starting end of the extending flow channel **21***d* located in the most upstream side becomes the introducing port **21***b* and an ending end of the extending flow channel **21***g* located in the most downstream side becomes the output port **21***c*. These extending flow channels **21***d*, **21***e*, **21***f*, **21***g* are so arranged that the extending flow channels **21***d*, **21***e*, **21***f*, **21***g* in the more upstream side is located at the upper part than the extending flow channels **21***d*, **21***e*, **21***f*, **21***g* in the more downstream side. This is to make the material gas naturally go toward the output port **21***c* in order to avoid the material gas from remaining in the preheating chamber **21***a*, even though the liquid material is vaporized and becomes the material gas in the preheating chamber **21***a*.

[0038] The preheating chamber temperature control mechanism **22** comprises, as shown in FIG. **1**, a second heater **221** that is mounted on the preheating chamber **21***a*, a temperature sensor **223** that directly or indirectly measures a temperature of the liquid material in the preheating chamber **21***a* and a second heater control circuit **222** that controls the second heater **221** so as to make a temperature measured by the temperature sensor **223** at the preheating temperature. The second heater **221** is rod-shaped, and as shown in FIG. **7**, is inserted into a bore **21***k* for second heater that opens in a center of the other end surface of the preheating tank **21** and that extends in the longitudinal direction. The extending flow channels **21***d*, **21***e*, **21***f*, **21***g* are arranged to surround the bore **21***k* for second heater viewed from the end surface. This is to transmit the heat generated by the second heater **221** extremely efficiently to the liquid material in the preheating chamber **21***a*. Furthermore, in this embodiment, the extending flow channel **21***g* located in the most downstream side and the extending flow channel **21***d* located in the most upstream side are arranged to face across the bore **21***k* for second heater. This is to prevent the temperature drop as much as possible because the liquid material, whose temperature becomes the highest, in the extending flow channel **21***g* located in the most downstream side is influenced by the liquid material, whose temperature becomes the lowest, in the extending flow channel **21***d* located in the most upstream side.

(4) Configuration of the Introducing Amount Control Mechanism **3**

[0039] The introducing amount control mechanism **3** comprises, as shown in FIG. **1**, a flow rate adjusting valve **31** that is arranged on a connecting flow channel between the preheating tank **21** and the vaporizing tank **11**, a liquid surface sensor **32** as being a liquid material detecting device that detects an amount of the liquid material stored in the vaporization chamber **11***a*, and a valve control circuit **33** that controls the flow rate of the liquid material that is introduced into the vaporizing tank **11** by driving the flow rate adjusting valve **31** in order to make the flow rate of the liquid material detected by the liquid surface sensor **32** within a predetermined target range.

[0040] The flow rate adjusting valve **31** is in a cylindrical shape comprising a laminated piezoelectric element, not shown in drawings, and a valve body that is driven by the laminated piezoelectric element, and is of an ON/OFF open close valve type that takes only a full open state and a full close state. In this embodiment, as shown in FIG. **8**, the flow rate adjusting valve **31**, the vaporizing tank **11** and the preheating tank **21** are arranged vertically in a posture of its longitudinal direction being horizontal on one side surface of an upstanding plate shape block body **4**. The plate shape block body **4** is so called a manifold block wherein forming a first flow channel **4***a* for supplying the liquid material to the introducing port **21***b* of the preheating tank **21**, a second flow channel **4***b* for communicating the output port **21***c* of the preheating tank **21** with the flow rate adjusting valve **31**, a third flow channel **4***c* for communicating the flow rate adjusting valve **31** with the introducing port **11***b* of the vaporizing tank **11** and a forth flow channel **4***d* for outputting the vaporized material gas from the output port **11***c* of the vaporizing tank **11**. As mentioned above, the plate shape block body **4** where the internal flow channel **4***a*~**4***d* are formed is arranged to be upright. The preheating tank **21**, the flow rate adjusting valve **31** and vaporizing tank **11** each of which is placed in a horizontal posture are mounted in this order from the bottom on the upright block body **4** so as to downsize the vaporizing device **100**.

[0041] The liquid surface sensor **32** is of a float type that detects a liquid surface height of the liquid material stored in a first lower space **11***e*, and as shown in FIG. **5**, a probe of the liquid surface sensor **32** is mounted on the vaporizing tank **11** by being inserted from an upper wall surface of the vaporizing tank **11** to downward.

[0042] More concretely, the valve control circuit **33** receives an output from the liquid surface sensor **32**. In case that the liquid surface height detected by the liquid surface sensor **32** exceeds a predetermined target liquid surface height range, the valve control circuit **33** closes the flow rate adjusting valve **31**, and in case that the detected liquid surface height is lower than the predetermined target liquid surface height range, the valve control circuit **33** opens the flow rate adjusting valve **31**. The predetermined target liquid surface height range may have a width, or may be a point.

[0043] As shown in FIG. **1**, the valve control circuit **33** is formed as a physically integrated electric circuit together with the heater control circuit **112** and the second heater control circuit **22**. The electric circuit has, for example, a digital electronic circuit comprising a CPU, a memory, and a communication port, and an analog electronic circuit comprising an ADC, DAC, an amplifier and a buffer. The electric circuit produces functions as the valve control circuit **33**, the heater control circuit **122** and the second heater control circuit **222** by operating the peripheral circuits according to the predetermined programs stored in the memory.

(5) Configuration of the Mass Flow Controller **7**

[0044] The mass flow controller **7**, although its detail is not shown in drawings, is of, for example, a differential pressure type connected to the output port **11***c* of the vaporizer **1**, and controls a mass flow rate of the material gas output by the vaporizer **1** by controlling the flow rate adjusting valve arranged inside so as to make a difference between before and after a flow resistance element, not shown in drawings, at the target value, more specifically, the target mass flow rate.

(6) Characteristic Configuration of the Vaporizing Device **100**

[0045] Then, in this embodiment, the vaporizing tank **11** has the following characteristic configuration.

[0046] More specifically, as shown in FIG. **2**, FIG. **3** and FIG. **5**, provided is a partition wall **6** that partitions the lower space of the vaporizing chamber **11***a* into the first lower space **11***e* as being a space located in one end surface side where the introducing port **11***b* opens and a second lower space **11***f* as being a space located in the other end surface side. A volume of the first lower space **11***e* is set to be more than 8 to 10 times of the volume of the second lower space **11***f*. The upper space of the vaporizing chamber **11***a* is not divided and is continuous. In addition, the liquid surface sensor **32** is arranged just above the first lower space **11***e* so as to make it possible to detect the liquid surface height of the first lower space **11***e*.

[0047] Next, these characteristic points will be described.

[0048] The vaporizing tank **11** in this embodiment comprises a block shape body **111** wherein a bottomed hole **11***h* is formed on a predetermined surface (upper surface, in this embodiment) along a longitudinal direction and a plate shape cap body **112** that forms the vaporizing chamber **11***a* by closing the bottomed hole **11***h*.

[0049] The first lower space **11***e* of the bottomed hole **11***h* and its above space are formed by cutting (drilling) a top surface of, for example, a metal block material at multiple portions in a matrix shape. Each of the bores **11***g* has the same diameter and a pitch to punch the bores **11***g* is made a little larger than the diameter of the bore **11***g*. As a result of this, in case of punching the bores **11***g* by means of a drill, no punched portion remains between the bores **11***g*. However, in accordance with this embodiment, multiple remaining wall portions **5** that are lined at even intervals in the longitudinal direction and that extends in a width direction (orthogonal to the longitudinal direction) viewed from the top are formed by punching a part of the no punched portion.

[0050] The remaining wall portions **5** produce a function as a thermal conductor **5**. A top end height of the thermal conductor **5** as being the remaining wall portion is made to be lower than the opening surface of the bottomed hole **11***h* so that the thermal conductor **5** does not extend to the upper space of the vaporizing chamber **11***a*. This arrangement secures a gas circulation in the upper space. In addition, each of the thermal conductors **5** is arranged to be separated from an inner side surface of the bottomed hole **11***h* so as to store the liquid material in whole of the first lower space **11***e* smoothly.

[0051] In this embodiment, a number of the bores **11***g* arranged in the width direction is three, and a depth of the bore **11***g* located in the center is made shallower than the depth of the bores **11***g* located in both ends. This is because that the bore **11***d* for the heater into which the heater **121** is inserted is formed in the lower area of the bore **11***g* located in the center.

[0052] Meanwhile, the partition wall **6** extends in the width direction and each end of the partition wall **6** is continuous to the inner side surface of the bottomed hole **11***h*, and the top end height of the partition wall **6** is set to be near or over the upper limit of the target liquid surface height range by the introducing amount control mechanism **3**.

[0053] The top end height of the remaining wall portion **5** is set to be generally the same as or a little lower than the top end height of the partition wall **6**. In addition, the introducing port **11***b* is set to be lower than the top end height of the partition wall **6**, and the output port **11***c* is set to be both higher than the top end height of the partition wall **6** and higher than the upper limit of the target liquid surface height range.

(7) Operation Explanation of the Vaporizing Device **100**

[0054] Next, an operation of the vaporizing device **100** will be explained.

[0055] The liquid material introduced into the preheating tank **21** is preheated, and then the preheated liquid material is introduced into the vaporizing tank **11** and stored. The stored liquid material in the vaporizing tank **11** is heated and vaporized so as to be the material gas. The material gas is continuously output from the output port **11***c* of the vaporizing tank **11** while the flow rate of the material gas is controlled by the mass flow controller located in the downstream of the output port **11***c*.

[0056] Meanwhile, the liquid material in the vaporizing tank **11***a* gradually decreases because the material gas is output from the vaporizing tank **11***a*, and the liquid surface height is lowered. When the liquid surface height becomes below the target liquid surface height range, the introducing amount control mechanism **3** detects that the liquid surface height is below the predetermined target liquid surface height range and opens the flow rate adjusting valve **31**. Then, the liquid material enters the vaporizing chamber **11***a* so that the liquid surface height rises. When the liquid surface height becomes over the target liquid surface height range, the introducing amount control mechanism **3** detects that the liquid surface height exceeds the predetermined target liquid surface height range and closes the flow rate adjusting valve **31**.

[0057] As mentioned above, the material gas is continuously output from the vaporizing chamber **11***a* while the liquid material is intermittently introduced into the vaporizing chamber **11***a*. In addition, during this period, the liquid material temperature in the vaporizing chamber **11***a* is controlled to be at the predetermined vaporization promoting temperature at which the vaporization of the liquid material is promoted by the vaporizing chamber temperature control mechanism **12**.

(8) Effect by the Vaporizing Device **100**

[0058] Usually, in order to output a large flow rate of the material gas stably while downsizing the vaporizing chamber **11***a*, it is necessary to introduce a large flow rate of the liquid material into the vaporizing chamber **11***a* so that a fast response is required for controlling the flow rate. More specifically, since fluctuation velocity of the liquid surface height of the liquid material in the vaporizing chamber **11***a* becomes big, unless the response speed of the introducing amount control mechanism **3** comprising the liquid surface sensor **32**, the control circuit **33** and the flow rate adjusting valve **31** is increased, the introducing amount control mechanism **3** fails to catch the fluctuation velocity of the liquid surface height, resulting in a problem that the liquid material that is not vaporized overflows from the output port **11***c*. Especially, since the velocity of rising the liquid surface becomes considerably fast, it is important to control the fast response tailored to this.

[0059] Contrarily, in accordance with this vaporizing device **100**, the liquid material first flowing into the first lower space **11***e* of the vaporizing chamber **11***a* overflows from the partition wall **6** and flows into the second lower space **11***f* so that the liquid surface height is kept constant for a while after the liquid material overflows. In addition, since the liquid surface height is set at a height that is a little higher than the upper limit of the target liquid surface height range, it is possible to sufficiently control the amount of the liquid material (the liquid surface height) in the vaporizing chamber **11***a* at the appropriate value by making use of the time while the liquid surface height is kept generally constant without forcibly improving the responsiveness of the introducing amount control mechanism **3**.

[0060] Accordingly, there is no need of using the liquid surface sensor **32** whose response velocity and the sensing performance are high and that is expensive, and it is possible to use an inexpensive ON/OFF open/close valve as the flow rate adjusting valve **31** so that it is possible to produce an expected performance such as enlarging the flow rate with a downsized vaporizing device **3** at low cost.

[0061] In addition, every time the liquid material is filled, the liquid material overflows to the second lower space **11***f* and the overflown liquid material remains and is stored in the second lower space **11***f* and finally the second lower space **11***f* is filled with the liquid material. Once it reaches this situation, the effect cannot be expected that the liquid material overflows the partition wall **6** from the first lower space **11***e* and flows into the second lower space **11***f*. As a result of this, it can be conceived to fail to produce the effect of gaining the time to control the flow rate adjusting valve **31** by keeping the liquid surface height constant due to the liquid material that overflows to the second lower space **11***f*.

[0062] However, since the liquid material vaporizes, the liquid material that overflows into the second lower space **11***f* in a previous cycle vaporizes and almost disappears until the liquid material overflows into the second lower space **11***f* again, the above-mentioned problem will not be generated. Conversely, it is necessary to set the introducing amount of the liquid material and the liquid area of the second lower space **11***f* in order to make the liquid material that overflows into the second lower space **11***f* in the previous cycle vaporize and disappear until the liquid material is filled again and climbs over the partition wall **6** and overflows into the second lower space **11***f* again.

[0063] Meanwhile, in accordance with the vaporizing device **100** of this embodiment, since multiple thermal conductors **5** that integrally project from the inner wall of the vaporizing chamber **11***a* are provided inside of the vaporizing chamber **11***a* so that the heat from the heater **121** can be transmitted to the liquid material efficiently, even though a large flow rate of the liquid material is introduced one after another into a compact vaporizing chamber **11***a* and a speed of exchanging the liquid material is increased, it is possible to keep the temperature of the liquid material at the vaporization promoting temperature by quickly applying the heat to the liquid material so as to offset the temperature drop. As a result of this, it is possible to output a large flow rate of the material gas stably. Especially, in this embodiment, since the thermal conductor **5** makes use of the remaining wall part formed by being drilled and the cross-sectional shape of the thermal conductor **5** is a variant shape having concave parts and convex parts, a surface area of the thermal conductor **5** is considerably big, which enables an extremely effective thermal conductivity.

[0064] In addition, since the heater **121** is embedded inside of the metal wall that forms the vaporizing tank **11** (inserted into the bore **11***d* for the heater **121**), the above-mentioned effect is promoted in a point that the heat from the heater **121** can be effectively transmitted. In addition, a point that the preheating device **2** is provided in the previous stage of the vaporizing device **1** also contributes to a stable output of the large flow rate of the material gas. The reason is that the temperature fluctuation becomes small at a time when the liquid material flows in the vaporizing chamber **11***a* so that it becomes easy to keep the temperature of the liquid material in the vaporizing chamber **11***a*.

(9) Modified Embodiment

[0065] The present claimed invention is not limited to the above-mentioned embodiment.

[0066] For example, an elongated portion that elongates further upward may be provided at the top end of the partition wall. In this case, a bore may be provided for the elongated portion so that the liquid material overflows from the first lower space to the second lower space at the same height as that of the above-mentioned embodiment.

[0067] In addition, the float type of the liquid surface sensor is used in the above-mentioned embodiment, however, various types of the liquid surface sensor may be used such as a thermal capacity type, (for example, A resistive element where a certain electric current flows becomes a sensor body. The resistive element is made to generate the heat at a temperature higher than that of the ambient environment. The temperature of the resistive element changes due to a difference of the specific heat between a case wherein the resistive element is in a gas and a case wherein the resistive element is in a liquid. The liquid surface height is detected based on the change of the resistance value resulting from the change of the temperature of the resistive element.) an ultrasonic wave type, an electrostatic capacity type, a pressure type, an oscillating type or the like.

[0068] A platinum resistive element for temperature measurement (Pt sensor) may be conceived as the thermal capacity type liquid surface sensor.

[0069] In addition, as the thermal capacity type liquid surface sensor conceived is a liquid surface sensor comprising a thermocouple temperature sensor and a heating body that makes a temperature measuring junction of the thermal

capacity type liquid surface sensor higher than that of a reference junction of the thermal capacity type liquid surface sensor. The heating body is, for example, a Pt sensor that is arranged around or near the temperature measuring junction, and is to apply heat in advance to the temperature measuring junction in order to make the temperature of the temperature measuring junction higher than that of the reference junction. The reference junction is arranged at a position where no heat is applied by the heating body. With this arrangement, it is possible to increase an output at a time when the liquid material makes contact with the temperature measuring junction (temperature of the temperature measuring junction-temperature of the reference junction) so that the liquid surface height of the liquid material can be detected with high accuracy. Meanwhile, in case that no heat is applied to the temperature measuring junction by the heating body, an output at a time when the liquid material makes contact with the temperature measuring junction (temperature of the temperature measuring junction-temperature of the reference junction) is small so that it is difficult to detect the liquid surface height of the liquid material accurately. The reason is that the temperature of a liquid phase (the liquid material) in the vaporizing chamber is generally the same as that of a gaseous phase (vaporized material) in the vaporizing chamber and it is difficult to generate the temperature difference between the temperature measuring junction and the reference junction even though the liquid material makes contact with the temperature measuring junction.

[0070] From a point of downsizing the sensor and a point of responsiveness, it is preferable that the above-mentioned two thermal capacity type liquid surface sensors comprise a platinum resistive element for temperature measurement (Pt sensor). Meanwhile, from a point of measurement error reduction due to fluctuation of the ambient temperature, it is preferable to comprise a temperature sensor and a heating body.

[0071] Furthermore, a second liquid surface sensor may be provided and detect that the liquid surface in the vaporizing chamber exceeds the target liquid surface height range and the upper end height of the partition wall and approaches near the output port. In case that the liquid surface detected by the second liquid surface sensor approaches near the output port, the flow rate adjusting valve to introduce the liquid material into the vaporizing chamber is closed and an emergency halt mechanism to inform the emergency halt may be provided. In accordance with this arrangement, it is possible to securely prevent overflow of the liquid material that fails to vaporize in case of contingency (for example, a failure of the liquid surface sensor).

[0072] The thermal conductor may project from any arbitrary portion of the vaporizing tank. Similar to the above-mentioned embodiment, the thermal conductor may project integrally from a back surface of the cap body in consideration of facilitation of manufacturing.

[0073] In the above-mentioned embodiment, the remaining wall portion by boring the bore **11***g* is the thermal conductor **5**, however, a shape of the thermal conductor **5** is not limited to this, and the vaporizing tank and the thermal conductor may be integrally formed by the use of a metal mold. In addition, every diameter of the bore is set to be the same, however, it may differ each other.

[0074] The heater may be a type of surrounding the vaporizing tank without being embedded into the vaporizing tank.

[0075] The flow rate adjusting valve is not limited to the ON/OFF open/close valve, and may be a type wherein an opening degree continuously changes.

[0076] In addition, it is a matter of course that the present claimed invention is not limited to the above-mentioned embodiment and may be variously modified without departing from a spirit of the invention.

EXPLANATION OF CODES

[0077] **100** . . . vaporizing device
[0078] **1** . . . vaporizer
[0079] **11** . . . vaporizing tank
[0080] **111** . . . body
[0081] **112** . . . cap body
[0082] **121** . . . heater
[0083] **11***a* . . . vaporizing chamber
[0084] **11***e* . . . first lower space
[0085] **11***g* . . . bore
[0086] **11***f* . . . second lower space
[0087] **11***h* . . . bottomed hole
[0088] **3** . . . control mechanism (introducing amount control mechanism)
[0089] **31** . . . flow rate adjusting valve
[0090] **32** . . . liquid surface sensor
[0091] **5** . . . thermal conductor

1. A vaporizing tank that has a vaporizing chamber heated by a heater and that outputs a material gas that is vaporized by heating a liquid material that is introduced into the vaporizing chamber, wherein

comprising a partition wall that partitions a lower space of the vaporizing chamber into a first lower space into which the liquid material is introduced first and a second lower space into which the liquid material that overflows from the first lower space is introduced.

2. The vaporizing tank described in claim **1**, wherein

a liquid surface height at which the liquid material starts overflowing into the second lower space is set within a target liquid surface height range or at a height higher than the target liquid surface height range.

3. The vaporizing tank described in claim **1**, wherein

comprising a plurality of thermal conductors that project from an internal wall surface of the vaporizing chamber.

4. The vaporizing tank described in claim **3**, comprising a block shaped body where a bottomed hole that opens in a predetermined surface is formed and a cap body that forms the vaporizing chamber by closing the opening of the bottomed hole, wherein

the bottomed hole is formed by boring multiple portions of the predetermined surface of the body, and

a remaining wall portion formed between the bottomed holes is so configured to perform a function as the thermal conductor.

5. The vaporizing tank described in claim **1**, wherein

a wall body that forms the vaporizing chamber is so configured that the heater to apply the heat to the liquid material can be buried.

6. A vaporizer comprising

a vaporizing tank that has a vaporizing chamber and that outputs a material gas produced by vaporizing a liquid material introduced into the vaporizing tank,

a heater that applies heat to the vaporizing tank so as to promote vaporization of the liquid material in the vaporizing tank, and

a partition wall that partitions a lower space of the vaporizing chamber into a first lower space into which the liquid material is introduced first and a second lower space into which the liquid material that overflows from the first lower space is introduced.

7. A vaporizing device comprising

the vaporizer described in claim **6**,

a liquid surface sensor that detects a liquid surface height of a liquid material stored in a vaporizing chamber,

a flow rate adjusting valve that is arranged on a liquid material introducing flow channel that communicates with the vaporizing chamber, and

a control mechanism that controls the flow rate adjusting valve so as to make the liquid surface height detected by the liquid surface sensor within a predetermined target liquid surface height range, wherein

the liquid surface height at which the liquid material overflows into the second lower space is set within or above the predetermined target liquid surface height range.

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