

DESCRIPTION

TITLE OF INVENTION: LIQUEFIED GAS VAPORIZER UNIT

TECHNICAL FIELD

5 [0001]

The present disclosure relates to a liquefied gas vaporizer unit.

Priority is claimed on Japanese Patent Application No. 2024-002040, filed January 10, 2024, the content of which is incorporated herein by reference.

BACKGROUND ART

10 [0002]

For example, Patent Document 1 discloses a low-temperature liquefied gas vaporizer that vaporizes a liquefied gas containing a main component and a high-boiling-point component having a boiling point higher than a boiling point of the main component. The low-temperature liquefied gas vaporizer disclosed in Patent Document 1 includes a shell that is long in a horizontal direction, and vaporizes a liquefied gas by exchanging heat between the liquefied gas and a heating fluid inside the shell.

Citation List

Patent Document

[0003]

20 Patent Document 1: Japanese Unexamined Patent Application, First Publication No. 2022-6152

SUMMARY OF INVENTION

Technical Problem

[0004]

A liquefied gas in which a high-boiling-point component is mixed with a main component has a higher boiling point, and it is difficult to completely vaporize the liquefied gas with a heat source at a temperature on the low-boiling-point side. For

example, in the case of a liquefied gas in which liquefied ammonia is used as a main
5 component and water is mixed as a high-boiling-point component, a boiling point of the liquefied gas approaches a temperature of a heating fluid such as seawater, and the liquefied gas that cannot be vaporized accumulates in a lower portion of a container, causing a liquid level of the liquefied gas to rise. Therefore, the low-temperature liquefied gas vaporizer disclosed in Patent Document 1 includes a pump, and the
10 liquefied gas accumulated in the lower portion of the container is drawn out to the outside of the container using the pump. However, the pump provided in the low-temperature liquefied gas vaporizer disclosed in Patent Document 1 is rotating equipment. Therefore, a backup pump is required as a failure countermeasure, or power for driving is required.

15 [0005]

The present disclosure has been made in view of the above-described problems, and an object of the present disclosure is to suppress a rise in a liquid level of a liquefied gas accumulated in a lower portion of a container in a case where the liquefied gas is vaporized, and to enable the liquefied gas inside the container to be discharged without
20 using a pump even in a case where the liquid level rises.

Solution to Problem

[0006]

As a means for solving the above-described problem, the present disclosure adopts the following configurations.

25 [0007]

A first aspect of the present disclosure is a liquefied gas vaporizer unit that is configured to vaporize a liquefied gas, the liquefied gas vaporizer unit including: a vertical container having an internal space into which the liquefied gas is supplied, a horizontal cross-sectional area of the internal space being smaller than a vertical cross-sectional area of the internal space; a liquefied gas supply section configured to supply the liquefied gas into the internal space of the vertical container; a heating fluid guide pipe extending through the internal space of the vertical container; a heating fluid supply section configured to supply a heating fluid into the heating fluid guide pipe; a superheater configured to superheat a vaporized gas discharged from the vertical container; and a stagnant liquefied gas discharge section configured to discharge the liquefied gas accumulated in the internal space of the vertical container from the vertical container, by using a differential pressure between the internal space of the vertical container and a discharge destination.

Advantageous Effects of Invention

[0008]

In the present disclosure, the vertical container has a horizontal cross-sectional area smaller than a vertical cross-sectional area of the internal space. Therefore, a flow path area in a case where the vaporized gas vaporized in the internal space of the vertical container rises is smaller than that of a horizontally elongated container, and an average flow velocity of the vaporized gas increases. Therefore, the mist-like liquefied gas in the internal space can be discharged to the outside of the vertical container together with the vaporized gas, and can be vaporized by the superheater. Therefore, according to the present disclosure, the amount of the liquefied gas accumulated inside the container (vertical container) can be reduced, and a rise in the liquid level of the liquefied gas accumulated in the lower portion of the container can be suppressed. In addition, in the

present disclosure, the stagnant liquefied gas discharge section discharges the liquefied gas accumulated in the internal space of the vertical container from the vertical container by using the differential pressure between the internal space of the vertical container and the discharge destination. Therefore, the liquefied gas accumulated in the internal space of the vertical container can be discharged from the vertical container without using a pump. Therefore, according to the present disclosure, in a case where the liquefied gas is vaporized, a rise in the liquid level of the liquefied gas accumulated in the lower portion of the container can be suppressed, and the liquefied gas inside the container can be discharged without using a pump even in a case where the liquid level rises.

10 BRIEF DESCRIPTION OF DRAWINGS

[0009]

[FIG. 1] A schematic configuration diagram of a liquefied ammonia vaporizer unit according to a first embodiment of the present disclosure.

[FIG. 2] A schematic configuration diagram of a liquefied ammonia vaporizer unit according to a second embodiment of the present disclosure.

DESCRIPTION OF EMBODIMENTS

[0010]

Hereinafter, an embodiment of a liquefied gas vaporizer unit according to the present disclosure will be described with reference to the drawings.

20 [0011]

(First embodiment)

In the present embodiment, an example in which the liquefied gas vaporizer unit of the present disclosure is applied to a liquefied ammonia vaporizer unit will be described. However, the liquefied gas vaporizer unit of the present disclosure is not limited to being applied to the liquefied ammonia vaporizer unit, and can also be applied

to a facility that handles a liquefied gas different from liquefied ammonia, such as liquefied petroleum gas (LPG).

[0012]

FIG. 1 is a schematic configuration diagram of a liquefied ammonia vaporizer unit 1 of the present embodiment. The liquefied ammonia vaporizer unit 1 of the present embodiment vaporizes liquefied ammonia X (liquefied gas) by exchanging heat with seawater Y (heating fluid). It is noted that the liquefied ammonia X is, for example, a mixture of a high-boiling-point liquid (water or the like) with pure liquefied ammonia X. However, in the present embodiment, it is simply referred to as liquefied ammonia X. In addition, the heating fluid that exchanges heat with the liquefied ammonia X may not be the seawater Y. For example, the heating fluid may be fresh water, or river water or lake water may be used.

[0013]

In the liquefied ammonia vaporizer unit 1 of the present embodiment, as shown in FIG. 1, the liquefied ammonia vaporizer unit 1 of the present embodiment includes a vaporizer main body 2, a liquefied ammonia supply section 3 (liquefied gas supply section), a seawater supply section 4 (heating fluid supply section), a delivery section 5, a stagnant liquefied ammonia discharge section 6 (stagnant liquefied gas discharge section), and a drainage pipe 7.

[0014]

The vaporizer main body 2 exchanges heat between the liquefied ammonia X and the seawater Y in a heat exchange space K (internal space) to vaporize the liquefied ammonia X. As shown in FIG. 1, the vaporizer main body 2 includes a vertical container 2a, an upper partition wall 2b, a lower partition wall 2c, a heating fluid guide pipe 2d, and a plurality of baffle plates 2e.

[0015]

The vertical container 2a is a container in which a length dimension in a vertical direction is larger than a length dimension in a horizontal direction. In the present embodiment, the vertical container 2a is a cylindrical container having a circular cross-sectional shape in a horizontal plane.

[0016]

The heat exchange space K, an upper space KU, and a lower space KD are provided inside the vertical container 2a. The heat exchange space K, the upper space KU, and the lower space KD are arranged in an up-down direction, and are disposed to be arranged in the order of the upper space KU, the heat exchange space K, and the lower space KD from above.

[0017]

The heat exchange space K is a space in which the liquefied ammonia X is supplied and the liquefied ammonia X and the seawater Y exchange heat. In the present embodiment, the heat exchange space K is formed in a vertically elongated shape in which a length dimension in the up-down direction is larger than a diameter dimension in the horizontal direction. In the heat exchange space K, a horizontal cross-sectional area (a cross-sectional area in the case of being cut along a horizontal plane) is smaller than a vertical cross-sectional area (a cross-sectional area in the case of being cut along a vertical plane). The vaporized gas generated inside the heat exchange space K flows from below to above. In this case, since the horizontal cross-sectional area of the heat exchange space K is smaller than the vertical cross-sectional area, an average flow velocity of the vaporized gas in the heat exchange space K is higher than in a case where the horizontal cross-sectional area is larger than the vertical cross-sectional area.

[0018]

The upper space KU is a space located above the heat exchange space K, and is a space in which the seawater Y that exchanges heat with the liquefied ammonia X is supplied from the outside of the vertical container 2a. The lower space KD is a space located below the heat exchange space K, and is a space in which the seawater Y that exchanges heat with the liquefied ammonia X and is discharged to the outside of the vertical container 2a is temporarily retained.

[0019]

In addition, as shown in FIG. 1, the vertical container 2a includes a liquefied ammonia supply port 2a1, a vaporized gas discharge port 2a2, a liquefied ammonia discharge port 2a3, a seawater supply port 2a4, and a seawater discharge port 2a5.

[0020]

The liquefied ammonia supply port 2a1 is a supply port connected to a bottom portion of the heat exchange space K, and is connected to the liquefied ammonia supply section 3. The vaporized gas discharge port 2a2 is a discharge port connected to an upper portion of the heat exchange space K, and is connected to the delivery section 5.

[0021]

The liquefied ammonia discharge port 2a3 is a discharge port connected to the bottom portion of the heat exchange space K, similarly to the liquefied ammonia supply port 2a1. For example, the liquefied ammonia discharge port 2a3 is provided at a position facing the liquefied ammonia supply port 2a1 with the heat exchange space K interposed therebetween. The liquefied ammonia discharge port 2a3 is connected to the stagnant liquefied ammonia discharge section 6.

[0022]

The seawater supply port 2a4 is a supply port connected to an upper portion of the upper space KU, and is provided at an upper end of the vertical container 2a. The

seawater supply port 2a4 is connected to the seawater supply section 4. The seawater discharge port 2a5 is a discharge port connected to a lower portion of the lower space KD, and is provided at a lower end of the vertical container 2a. The seawater discharge port 2a5 is connected to the drainage pipe 7.

5 [0023]

The upper partition wall 2b is a separation wall provided in an upper portion inside the vertical container 2a, and separates the inside of the vertical container 2a into the heat exchange space K and the upper space KU. That is, the upper partition wall 2b is provided at a boundary between the heat exchange space K and the upper space KU.

10 [0024]

The lower partition wall 2c is a separation wall provided in a lower portion inside the vertical container 2a, and separates the inside of the vertical container 2a into the heat exchange space K and the lower space KD. That is, the lower partition wall 2c is provided at a boundary between the heat exchange space K and the lower space KD.

15 [0025]

The heating fluid guide pipe 2d is inserted through the heat exchange space K, and guides the seawater Y. As shown in FIG. 1, a plurality of the heating fluid guide pipes 2d are provided. An upper end of each heating fluid guide pipe 2d is connected to the upper partition wall 2b, and a lower end of each heating fluid guide pipe 2d is connected to the lower partition wall 2c. The heating fluid guide pipes 2d guide the seawater Y supplied to the upper space KU to the lower space KD.

[0026]

A plurality of the baffle plates 2e are provided in the heat exchange space K of the vertical container 2a. The baffle plates 2e are plate-shaped members of which a base is fixed to an inner wall surface of the vertical container 2a and a tip is disposed to

25

be separated from the inner wall surface of the vertical container 2a. The front and back surfaces of each baffle plate 2e are disposed to face the up-down direction. The heating fluid guide pipe 2d penetrates each baffle plate 2e in the up-down direction.

[0027]

5 As shown in FIG. 1, the plurality of baffle plates 2e are arranged in the up-down direction. In the baffle plates 2e arranged up and down in this way, the positions of the bases are alternately changed in the left-right direction. That is, the baffle plate 2e adjacent in the up-down direction to the baffle plate 2e of which the left side is the base in FIG. 1 and which is fixed to the inner wall surface of the vertical container 2a, is fixed
10 to the inner wall surface of the vertical container 2a with the right side being the base in FIG. 1.

[0028]

In addition, the baffle plate 2e located at the lowermost position is located above the liquefied ammonia supply port 2a1, and is disposed such that the base is fixed to the
15 inner wall surface of the vertical container 2a directly above the liquefied ammonia supply port 2a1. In addition, the baffle plate 2e located at the uppermost position is located below the vaporized gas discharge port 2a2, and is disposed such that the base is fixed to the inner wall surface of the vertical container 2a directly below the vaporized gas discharge port 2a2.

20 [0029]

The baffle plates 2e cause the flow path of the vaporized gas to meander in the heat exchange space K, and narrow the flow path cross-sectional area of the vaporized gas. In this way, by causing the flow path of the vaporized gas to meander with the baffle plates 2e, it is possible to further increase the average flow velocity of the
25 vaporized gas.

[0030]

The liquefied ammonia supply section 3 supplies the liquefied ammonia X to the heat exchange space K of the vertical container 2a. In the present embodiment, the liquefied ammonia supply section 3 is connected to the liquefied ammonia supply port 2a1. For example, as shown in FIG. 1, the liquefied ammonia supply section 3 includes a liquefied ammonia supply pipe 3a and a liquefied ammonia supply pump 3b.

[0031]

The liquefied ammonia supply pipe 3a is, for example, a pipe that connects the storage tank T that stores the liquefied ammonia X to the liquefied ammonia supply port 2a1. The liquefied ammonia supply pump 3b is installed at an intermediate position of the liquefied ammonia supply pipe 3a. The liquefied ammonia supply pump 3b pressurizes the liquefied ammonia X and discharges the pressurized liquefied ammonia X toward the liquefied ammonia supply port 2a1.

[0032]

Since the liquefied ammonia X pressurized by the liquefied ammonia supply pump 3b is supplied to the heat exchange space K of the vertical container 2a in this way, the pressure of the heat exchange space K becomes higher than atmospheric pressure. It is noted that, in a case where the pressurized liquefied ammonia X is supplied to the liquefied ammonia supply section 3, the liquefied ammonia supply section 3 can also be configured not to include the liquefied ammonia supply pump 3b.

[0033]

The seawater supply section 4 supplies the seawater Y to the upper space KU of the vertical container 2a. In the present embodiment, the seawater supply section 4 is connected to the seawater supply port 2a4. For example, as shown in FIG. 1, the

seawater supply section 4 includes a seawater supply pipe 4a and a seawater supply pump 4b.

[0034]

5 The seawater supply pipe 4a is, for example, a pipe that connects the ocean and the seawater supply port 2a4. The seawater supply pump 4b is installed at an intermediate position of the seawater supply pipe 4a. The seawater supply pump 4b pressurizes the seawater Y and discharges the pressurized seawater Y toward the seawater supply port 2a4.

[0035]

10 Since the seawater Y pressurized by the seawater supply pump 4b is supplied to the upper space KU of the vertical container 2a in this way, the pressure of the upper space KU becomes higher than the pressure of the lower space KD. Therefore, the seawater Y supplied to the upper space KU flows through the heating fluid guide pipe 2d toward the lower space KD. In a case where the pressurized seawater Y is supplied to
15 the seawater supply section 4, the seawater supply section 4 can also be configured not to include the seawater supply pump 4b.

[0036]

The delivery section 5 delivers the vaporized gas to the outside. In the present embodiment, the delivery section 5 is connected to the vaporized gas discharge port 2a2.
20 For example, as shown in FIG. 1, the delivery section 5 includes a delivery pipe 5a and a superheater 5b.

[0037]

The delivery pipe 5a is a pipe that connects the delivery destination and the vaporized gas discharge port 2a2. The superheater 5b is provided at an intermediate
25 position of the delivery pipe 5a, and superheats the vaporized gas to vaporize the mist

contained in the vaporized gas. By superheating the vaporized gas with the superheater 5b, the vaporized gas from which the mist is removed can be supplied to the supply destination.

[0038]

5 The stagnant liquefied ammonia discharge section 6 is capable of discharging the liquefied ammonia X accumulated in the heat exchange space K of the vertical container 2a from the vertical container 2a by using a differential pressure between the heat exchange space K of the vertical container 2a and the discharge destination. In the present embodiment, the discharge destination to which the stagnant liquefied ammonia
10 discharge section 6 discharges the liquefied ammonia X is the storage tank T. The storage tank T stores the liquefied ammonia X in a cooled state, but the internal pressure is close to atmospheric pressure. On the other hand, as described above, since the heat exchange space K of the vertical container 2a is supplied with the pressurized liquefied ammonia X, the internal pressure is higher than atmospheric pressure. The stagnant
15 liquefied ammonia discharge section 6 discharges the liquefied ammonia X from the heat exchange space K to the storage tank T by using the differential pressure between the storage tank T and the heat exchange space K.

[0039]

 In the present embodiment, as shown in FIG. 1, the stagnant liquefied ammonia
20 discharge section 6 includes a discharge pipe 6a, an opening/closing valve 6b, a liquid level detection section 6c, and a valve control section 6d. The discharge pipe 6a is a pipe that connects the storage tank T and the liquefied ammonia discharge port 2a3.
The discharge pipe 6a is connected to the bottom portion of the heat exchange space K of the vertical container 2a via the liquefied ammonia discharge port 2a3. In a case where
25 the liquefied ammonia X is accumulated in the bottom portion of the heat exchange space

K and the discharge pipe 6a is open, the liquefied ammonia X flows into the storage tank T through the discharge pipe 6a.

[0040]

The opening/closing valve 6b is installed at an intermediate position of the
5 discharge pipe 6a. The opening/closing valve 6b is capable of changing the open/closed state of the discharge pipe 6a under the control of the valve control section 6d. The liquid level detection section 6c is a sensor that detects the liquid level of the liquefied ammonia X accumulated in the heat exchange space K of the vertical container 2a. The liquid level detection section 6c is not particularly limited, and for example, a differential
10 pressure level sensor can be used.

[0041]

The valve control section 6d is connected to the liquid level detection section 6c and the opening/closing valve 6b. The valve control section 6d controls the opening/closing valve 6b based on the liquid level detected by the liquid level detection
15 section 6c. Specifically, in a case where the liquid level of the liquefied ammonia X in the heat exchange space K rises and exceeds a predetermined open liquid level, the valve control section 6d controls the opening/closing valve 6b such that the discharge pipe 6a is opened. In addition, in a case where the liquid level of the liquefied ammonia X in the heat exchange space K decreases and falls below a predetermined closed liquid level, the
20 valve control section 6d controls the opening/closing valve 6b such that the discharge pipe 6a is closed.

[0042]

The drainage pipe 7 is a pipe for discharging the seawater Y from the lower space KD of the vertical container 2a to the outside of the vertical container 2a. In the

present embodiment, the drainage pipe 7 is connected to the seawater discharge port 2a5 and guides the seawater Y discharged from the seawater discharge port 2a5.

[0043]

In the liquefied ammonia vaporizer unit 1 of the present embodiment, for
5 example, the liquefied ammonia X stored in the storage tank T is supplied to the heat exchange space K by the liquefied ammonia supply section 3. On the other hand, the seawater Y is supplied from the ocean to the upper space KU of the vertical container 2a by the seawater supply section 4. In addition, the seawater Y supplied to the upper
10 space KU flows through the heating fluid guide pipe 2d and is discharged to the lower space KD.

[0044]

The liquefied ammonia X supplied to the liquefied ammonia supply section 3 is vaporized by exchanging heat with the seawater Y flowing through the heating fluid guide pipe 2d. The vaporized gas generated by this is supplied to the supply destination
15 via the delivery section 5. Here, in the present embodiment, since the horizontal cross-sectional area of the heat exchange space K is smaller than the vertical cross-sectional area thereof, the average flow velocity of the vaporized gas is high. Therefore, the mist present in the heat exchange space K is delivered to the delivery section 5 together with the vaporized gas. The mist delivered to the delivery section 5 is vaporized by the
20 superheater 5b and supplied to the supply destination.

[0045]

However, for example, in a case where the vaporized gas required by the supply destination is smaller than usual, the flow rate of the liquefied ammonia X supplied to the heat exchange space K by the liquefied ammonia supply section 3 is small. Therefore,
25 the average flow velocity of the vaporized gas in the heat exchange space K becomes

slow, and the mist becomes difficult to discharge. As a result, the liquid level of the liquefied ammonia X accumulated in the heat exchange space K may rise.

[0046]

When the liquid level of the liquefied ammonia X accumulated in the heat
5 exchange space K rises, the opening/closing valve 6b of the stagnant liquefied ammonia
discharge section 6 is opened, and the accumulated liquefied ammonia X is discharged to
the storage tank T via the discharge pipe 6a. As a result, when the liquid level of the
liquefied ammonia X accumulated in the heat exchange space K is lowered, the
opening/closing valve 6b is closed.

10 [0047]

The liquefied ammonia vaporizer unit 1 of the present embodiment as described
above vaporizes the liquefied ammonia X. In addition, the liquefied ammonia vaporizer
unit 1 of the present embodiment includes the vertical container 2a, the liquefied
ammonia supply section 3, the heating fluid guide pipe 2d, the seawater supply section 4,
15 the superheater 5b, and the stagnant liquefied ammonia discharge section 6. In addition,
the vertical container 2a has a horizontal cross-sectional area smaller than the vertical
cross-sectional area of the heat exchange space K to which the liquefied ammonia X is
supplied. The liquefied ammonia supply section 3 supplies the liquefied ammonia X to
the heat exchange space K of the vertical container 2a. The heating fluid guide pipe 2d
20 is inserted into the heat exchange space K of the vertical container 2a. The seawater
supply section 4 supplies the seawater Y to the heating fluid guide pipe 2d. The
superheater 5b superheats the vaporized gas discharged from the vertical container 2a.
The stagnant liquefied ammonia discharge section 6 discharges the liquefied ammonia X
accumulated in the heat exchange space K of the vertical container 2a from the vertical

container 2a by using a differential pressure between the heat exchange space K of the vertical container 2a and the discharge destination.

[0048]

In the liquefied ammonia vaporizer unit 1 of the present embodiment, the vertical container 2a has a horizontal cross-sectional area smaller than the vertical cross-sectional area of the heat exchange space K. Therefore, the flow path area when the vaporized gas vaporized in the heat exchange space K of the vertical container 2a rises becomes smaller as compared with a horizontally elongated container, and the average flow velocity of the vaporized gas increases. Therefore, the mist-like liquefied ammonia X in the heat exchange space K can be discharged to the outside of the vertical container 2a together with the vaporized gas, and can be vaporized by the superheater 5b. Therefore, according to the liquefied ammonia vaporizer unit 1 of the present embodiment, the amount of the liquefied ammonia X accumulated inside the container (vertical container 2a) can be reduced, and the rise in the liquid level of the liquefied ammonia X accumulated in the heat exchange space K can be suppressed.

[0049]

In addition, in the liquefied ammonia vaporizer unit 1 of the present embodiment, the stagnant liquefied ammonia discharge section 6 discharges the liquefied ammonia X accumulated in the heat exchange space K of the vertical container 2a from the vertical container 2a by using a differential pressure between the heat exchange space K of the vertical container 2a and a discharge destination. Therefore, the liquefied ammonia X accumulated in the heat exchange space K of the vertical container 2a can be discharged from the vertical container 2a without using a pump.

[0050]

Therefore, according to the liquefied ammonia vaporizer unit 1 of the present embodiment, in a case where the liquefied ammonia X is vaporized, the rise in the liquid level of the liquefied ammonia X accumulated in the lower portion of the container is suppressed, and the liquefied ammonia X inside the vertical container 2a can be
5 discharged without using a pump even in a case where the liquid level rises.
[0051]

In addition, the liquefied ammonia vaporizer unit 1 of the present embodiment includes a plurality of baffle plates 2e. The baffle plates 2e are provided in the heat exchange space K of the vertical container 2a and cause the flow path of the vaporized
10 gas to meander.
[0052]

According to the liquefied ammonia vaporizer unit 1 of the present embodiment, the flow path of the vaporized gas in the heat exchange space K is caused to meander by the baffle plate 2e, and the flow path cross-sectional area of the vaporized gas is
15 narrowed. In this way, by causing the flow path of the vaporized gas to meander with the baffle plates 2e, it is possible to further increase the average flow velocity of the vaporized gas. Therefore, according to the liquefied ammonia vaporizer unit 1 of the present embodiment, the average flow velocity of the vaporized gas can be further increased, and a larger amount of the mist-like liquefied ammonia X can be discharged to
20 the outside of the vertical container 2a together with the vaporized gas.
[0053]

In addition, in the liquefied ammonia vaporizer unit 1 of the present embodiment, the stagnant liquefied ammonia discharge section 6 includes a liquid level detection section 6c. The liquid level detection section 6c detects the liquid level of the

liquefied ammonia X accumulated in the heat exchange space K of the vertical container 2a.

[0054]

According to the liquefied ammonia vaporizer unit 1 of the present embodiment,
5 it is possible to determine whether or not to discharge the liquefied ammonia X by the stagnant liquefied ammonia discharge section 6 according to the amount of the liquefied ammonia X accumulated in the heat exchange space K. However, without providing the liquid level detection section 6c, it may be determined whether or not to discharge the liquefied ammonia X by the stagnant liquefied ammonia discharge section 6 according to
10 the time or the operation mode.

[0055]

In addition, in the liquefied ammonia vaporizer unit 1 of the present embodiment, the stagnant liquefied ammonia discharge section 6 includes a discharge pipe 6a, an opening/closing valve 6b, and a valve control section 6d. The discharge
15 pipe 6a is connected to the bottom portion of the heat exchange space K of the vertical container 2a. The opening/closing valve 6b is installed at an intermediate position of the discharge pipe 6a. The valve control section 6d controls the opening/closing valve 6b based on the detection result of the liquid level detection section 6c.

[0056]

20 According to the liquefied ammonia vaporizer unit 1 of the present embodiment, it is possible to automatically control the opening and closing of the opening/closing valve 6b according to the detection result of the liquid level detection section 6c.

Therefore, according to the liquefied ammonia vaporizer unit 1 of the present embodiment, in a case where the amount of the liquefied ammonia X accumulated in the

heat exchange space K is increased, the liquefied ammonia X accumulated in the heat exchange space K can be automatically discharged.

[0057]

In addition, in the liquefied ammonia vaporizer unit 1 of the present
5 embodiment, the discharge destination of the liquefied ammonia X of the stagnant liquefied ammonia discharge section 6 is the storage tank T that stores the liquefied ammonia X.

[0058]

According to the liquefied ammonia vaporizer unit 1 of the present embodiment,
10 the liquefied ammonia X accumulated in the heat exchange space K can be stored again in the storage tank T. Therefore, the liquefied ammonia X accumulated in the heat exchange space K can be effectively used.

[0059]

(Second embodiment)

15 Next, a second embodiment of the present disclosure will be described with reference to FIG. 2. In the description of the present embodiment, the description of the same parts as in the first embodiment will be omitted or simplified.

[0060]

FIG. 2 is a schematic configuration diagram of a liquefied ammonia vaporizer
20 unit 1A of the present embodiment. In FIG. 2, the baffle plate 2e, the liquefied ammonia supply section 3, the delivery section 5, and the stagnant liquefied ammonia discharge section 6 are omitted. As shown in this figure, in the liquefied ammonia vaporizer unit 1A of the present embodiment, a plurality of heating fluid guide pipes 2d are inserted into the heat exchange space K in the horizontal direction.

25 [0061]

For example, as shown in FIG. 2, an inlet end of each of the heating fluid guide pipes 2d may be connected to the supply header pipe 2f. In such a case, the seawater supply section 4 distributes and supplies the seawater Y to each of the heating fluid guide pipes 2d via the supply header pipe 2f.

5 [0062]

In addition, an outlet end of each of the heating fluid guide pipes 2d may be connected to the discharge header pipe 2g. In such a case, the drainage pipe 7 receives the seawater Y discharged from each of the heating fluid guide pipes 2d via the discharge header pipe 2g.

10 [0063]

Even in the liquefied ammonia vaporizer unit 1A of the present embodiment having such a configuration, the vertical container 2a has a horizontal cross-sectional area smaller than the vertical cross-sectional area of the heat exchange space K.

Therefore, it is possible to suppress a rise in the liquid level of the liquefied ammonia X accumulated in the heat exchange space K by increasing the average flow velocity of the vaporized gas. In addition, even in the liquefied ammonia vaporizer unit 1A of the present embodiment, the liquefied ammonia X accumulated in the heat exchange space K of the vertical container 2a can be discharged from the vertical container 2a without using a pump by using a differential pressure between the heat exchange space K of the vertical container 2a and the discharge destination.

20 [0064]

Although the preferred embodiments of the present disclosure have been described above with reference to the accompanying drawings, it goes without saying that the present disclosure is not limited to the above-described embodiments. The various shapes, combinations, and the like of each constituent member shown in the

embodiments described above are merely examples, and can be variously changed on the basis of design requirements and the like without departing from the gist of the present disclosure.

[0065]

5 For example, in the above-described embodiment, an example in which the liquefied ammonia X discharged from the vertical container 2a by the stagnant liquefied ammonia discharge section 6 is supplied to the storage tank T has been described.

However, the present disclosure is not limited thereto. For example, a configuration in which the liquefied ammonia X discharged from the vertical container 2a is supplied to a
10 dedicated tank can also be adopted. In addition, the liquefied ammonia X discharged from the vertical container 2a can also be supplied to abatement equipment such as a flare stack.

[0066]

It is noted that the embodiments described above can also be described as, for
15 example, the following supplementary notes.

[0067]

(Supplementary Note 1)

A liquefied gas vaporizer unit that is configured to vaporize a liquefied gas, the liquefied gas vaporizer unit comprising:

20 a vertical container having an internal space into which the liquefied gas is supplied, a horizontal cross-sectional area of the internal space being smaller than a vertical cross-sectional area of the internal space;

 a liquefied gas supply section configured to supply the liquefied gas into the internal space of the vertical container;

a heating fluid guide pipe extending through the internal space of the vertical container;

a heating fluid supply section configured to supply a heating fluid into the heating fluid guide pipe;

5 a superheater configured to superheat a vaporized gas discharged from the vertical container; and

a stagnant liquefied gas discharge section configured to discharge, from the vertical container, the liquefied gas accumulated in the internal space of the vertical container by using a differential pressure between the internal space of the vertical

10 container and a discharge destination.

[0068]

(Supplementary Note 2)

The liquefied gas vaporizer unit according to Supplementary Note 1, further comprising: a plurality of baffle plates provided in the internal space of the vertical container and configured to cause a flow path of the vaporized gas to meander.

15

[0069]

(Supplementary Note 3)

The liquefied gas vaporizer unit according to Supplementary Note 1 or 2, in which the stagnant liquefied gas discharge section includes a liquid level detection

20 section configured to detect a liquid level of the liquefied gas accumulated in the internal space of the vertical container.

[0070]

(Supplementary Note 4)

The liquefied gas vaporizer unit according to Supplementary Note 3, in which the stagnant liquefied gas discharge section includes

25

a discharge pipe connected to a bottom portion of the internal space of the vertical container,

an opening/closing valve installed at an intermediate position of the discharge pipe, and

5 a valve control section configured to control the opening/closing valve based on a detection result of the liquid level detection section.

[0071]

(Supplementary Note 5)

The liquefied gas vaporizer unit according to any one of Supplementary Notes 1
10 to 4, in which the discharge destination of the liquefied gas of the stagnant liquefied gas discharge section is a storage tank configured to store the liquefied gas.

INDUSTRIAL APPLICABILITY

[0072]

In the present disclosure, the vertical container has a horizontal cross-sectional
15 area smaller than a vertical cross-sectional area of the internal space. Therefore, a flow path area in a case where the vaporized gas vaporized in the internal space of the vertical container rises is smaller than that of a horizontally elongated container, and an average flow velocity of the vaporized gas increases. Therefore, the mist-like liquefied gas in the internal space can be discharged to the outside of the vertical container together with
20 the vaporized gas, and can be vaporized by the superheater. Therefore, according to the present disclosure, the amount of the liquefied gas accumulated inside the container (vertical container) can be reduced, and a rise in the liquid level of the liquefied gas accumulated in the lower portion of the container can be suppressed. In addition, in the present disclosure, the stagnant liquefied gas discharge section discharges the liquefied
25 gas accumulated in the internal space of the vertical container from the vertical container

by using the differential pressure between the internal space of the vertical container and the discharge destination. Therefore, the liquefied gas accumulated in the internal space of the vertical container can be discharged from the vertical container without using a pump. Therefore, according to the present disclosure, in a case where the liquefied gas is vaporized, a rise in the liquid level of the liquefied gas accumulated in the lower portion of the container can be suppressed, and the liquefied gas inside the container can be discharged without using a pump even in a case where the liquid level rises.

REFERENCE SIGNS LIST

[0073]

- | | |
|----|--|
| 10 | 1 Liquefied ammonia vaporizer unit (liquefied gas vaporizer unit) |
| | 1A Liquefied ammonia vaporizer unit (liquefied gas vaporizer unit) |
| | 2 Vaporizer main body |
| | 2a Vertical container |
| | 2d Heating fluid guide pipe |
| 15 | 2e Baffle plate |
| | 3 Liquefied ammonia supply section (liquefied gas supply section) |
| | 4 Seawater supply section (heating fluid supply section) |
| | 5 Delivery section |
| | 5b Superheater |
| 20 | 6 Stagnant liquefied ammonia discharge section |
| | 6a Discharge pipe |
| | 6b Opening/closing valve |
| | 6c Liquid level detection section |
| | 6d Valve control section |
| 25 | 7 Drainage pipe |

K Heat exchange space (internal space)

T Storage tank (discharge destination)

X Liquefied ammonia (liquefied gas)

Y Seawater (heating fluid)

CLAIMS

[Claim 1] A liquefied gas vaporizer unit that is configured to vaporize a liquefied gas, the liquefied gas vaporizer unit comprising:

5 a vertical container having an internal space into which the liquefied gas is supplied, a horizontal cross-sectional area of the internal space being smaller than a vertical cross-sectional area of the internal space;

a liquefied gas supply section configured to supply the liquefied gas into the internal space of the vertical container;

10 a heating fluid guide pipe extending through the internal space of the vertical container;

a heating fluid supply section configured to supply a heating fluid into the heating fluid guide pipe;

a superheater configured to superheat a vaporized gas discharged from the vertical container; and

15 a stagnant liquefied gas discharge section configured to discharge the liquefied gas accumulated in the internal space of the vertical container from the vertical container, by using a differential pressure between the internal space of the vertical container and a discharge destination.

[Claim 2] The liquefied gas vaporizer unit according to Claim 1, further comprising:

20 a plurality of baffle plates provided in the internal space of the vertical container and configured to cause a flow path of the vaporized gas to meander.

[Claim 3] The liquefied gas vaporizer unit according to Claim 1 or 2,

wherein the stagnant liquefied gas discharge section includes a liquid level detection section configured to detect a liquid level of the liquefied gas accumulated in
25 the internal space of the vertical container.

[Claim 4] The liquefied gas vaporizer unit according to Claim 3,

wherein the stagnant liquefied gas discharge section includes

a discharge pipe connected to a bottom portion of the internal space of the vertical container,

5 an opening/closing valve installed at an intermediate position of the discharge pipe, and

a valve control section configured to control the opening/closing valve based on a detection result of the liquid level detection section.

[Claim 5] The liquefied gas vaporizer unit according to Claim 1 or 2,

10 wherein the discharge destination of the liquefied gas of the stagnant liquefied gas discharge section is a storage tank configured to store the liquefied gas.