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(71) Applicant: **Mitsubishi Shipbuilding Co., Ltd.**
Yokohama-shi
Kanagawa 220-8401 (JP)

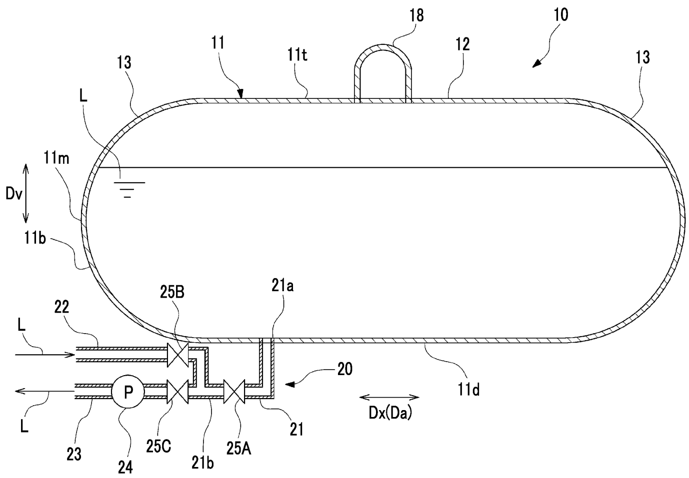
(72) Inventors:
- **ABE, Kazuya**
Yokohama-shi, Kanagawa 220-8401 (JP)
- **MORIMOTO, Shinsuke**
Yokohama-shi, Kanagawa 220-8401 (JP)

(74) Representative: **Studio Torta S.p.A.**
Via Viotti, 9
10121 Torino (IT)

(54) FLOATING BODY

(57) A floating structure comprising: a floating structure main body; a tank which is disposed on the floating structure main body and is capable of storing liquefied carbon dioxide; a loading pipe which is connected to the lower part of the tank and loads liquefied carbon dioxide supplied from outside of the floating structure main body into the tank; an unloading pipe connected to the lower part of the tank; and a pump which is disposed on the unloading pipe outside of the tank and feeds the liquefied carbon dioxide in the tank to the outside of the floating structure main body.

FIG. 2



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Description

Technical Field

[0001] The present disclosure relates to a floating structure.

[0002] Priority is claimed on Japanese Patent Application No. 2020-180558, filed October 28, 2020, the content of which is incorporated herein by reference.

Background Art

[0003] For example, the fuel tank disclosed in PTL 1 includes a loading pipe (pipeline) for loading a liquefied gas (liquefied natural gas (LNG)) into the fuel tank, and an unloading pipe (pipeline) for taking the liquefied gas from the fuel tank. The loading pipe and the unloading pipe are guided from the vicinity of the top to the vicinity of the bottom portion of the tank, in the tank.

Citation List

Patent Literature

[0004] [PTL 1] PCT Japanese Translation Patent Publication No. 2018-528119

Summary of Invention

Technical Problem

[0005] Incidentally, when the liquefied carbon dioxide is accommodated in the tank, there is a possibility that the liquefied carbon dioxide solidifies to form dry ice for the following reasons. That is, the pressure of the liquefied carbon dioxide at the lower end of the loading pipe or the unloading pipe that opens in the tank corresponds to the tank operating pressure. In the configuration as disclosed in PTL 1, the pipe top at the highest position in the loading pipe or the unloading pipe is positioned above the top of the tank. The pressure of the liquefied carbon dioxide at the pipe top is lower than the pressure of the liquefied carbon dioxide at the lower end of the pipe by the amount corresponding to the head pressure due to the height difference between the liquid surface of the liquefied carbon dioxide in the tank and the pipe top. That is, in the loading pipe or the unloading pipe, the pressure of the liquefied carbon dioxide at the pipe top is lower than the pressure of the liquefied carbon dioxide in the tank.

[0006] In the case of liquefied carbon dioxide, the pressure at the triple point where the gas phase, the liquid phase, and the solid phase coexist (triple point pressure) is higher than the triple point pressure of LNG or LPG, and the difference from the tank operating pressure during operation is small. As a result, depending on the tank operating pressure (tank design pressure), the pressure of the liquefied carbon dioxide may become equal to or less than the triple point pressure at the pipe top where the pressure of the liquefied carbon dioxide is the lowest, and the flash evaporation of the liquefied carbon dioxide may occur. Then, due to the latent heat of evaporation of the flash evaporation of the liquefied carbon dioxide, a decrease in temperature of the liquefied carbon dioxide remaining without evaporation occurs, and the liquefied carbon dioxide solidifies at the pipe top to form dry ice. When dry ice is formed in the loading pipe or the unloading pipe, the flow of the liquefied carbon dioxide in the pipe is obstructed, which may affect the loading and unloading work of the liquefied carbon dioxide.

[0007] Further, in the configuration as disclosed in PTL 1, a dome structure is disposed at the top of the tank to cover a joint part between the loading pipe or the unloading pipe penetrating the tank and the tank. In addition to the loading pipe and the unloading pipe, the dome structure includes a pipe (pipeline) for taking in and out carbon dioxide gas, an instrumentation pipe, and other equipment. When the tank operating pressure is increased according to the triple point pressure of the liquefied carbon dioxide, the pressure acting on the dome structure is also increased. Accordingly, in order to secure the strength of the dome structure, it is desired to make the dome structure as small as possible.

[0008] In addition, when the pipe is guided from the top to the bottom portion of the tank in the tank, a support structure for holding the pipe at a position away from the inner wall surface of the tank is required.

[0009] Further, in the configuration as disclosed in PTL 1, a pump (deep well pump) is disposed in the unloading pipe. The pump is disposed at a position where the liquefied carbon dioxide is submerged in the liquid. Therefore, when performing maintenance of the pump, it is necessary to take out all the liquid in the tank and then perform temperature control and oxygen supply to establish an environment in which the pump can be accessed, which takes a lot of trouble.

[0010] The present disclosure has been made to solve the above problems, and an object thereof is to provide a floating structure capable of suppressing the formation of dry ice in the loading pipe, and achieving the reduction of the size of the dome structure, the simplification of the pipe structure, and the facilitation of maintenance.

Solution to Problem

[0011] In order to solve the above problems, the floating structure according to the present disclosure includes a floating main structure, a tank, a loading pipe, an unloading pipe, and a pump. The tank is disposed in the floating main structure. The tank is capable of storing liquefied carbon dioxide. The loading pipe is connected to a lower portion of the tank. The loading pipe loads liquefied carbon dioxide supplied from an outside of the floating main structure into the tank. The unloading pipe is connected to the lower portion of the tank. The pump is disposed in the unloading pipe outside the tank. The pump delivers liquefied carbon dioxide in the tank to the outside of the floating main structure.

Advantageous Effects of Invention

[0012] According to the floating structure of the present disclosure, it is possible to suppress the formation of dry ice in the loading pipe and the unloading pipe, and to achieve the reduction of the size of the dome structure, the simplification of the pipe structure, and the facilitation of maintenance.

Brief Description of Drawings

[0013]

Fig. 1 is a plan view showing a schematic configuration of a ship as a floating structure according to an embodiment of the present disclosure.

Fig. 2 is a view showing a tank, a loading pipe, and an unloading pipe provided in a ship according to the embodiment of the present disclosure, and is a sectional view taken along line II-II of Fig. 1.

Fig. 3 is a sectional view showing a state where liquefied carbon dioxide is loaded into the tank from the loading pipe in the ship according to the embodiment of the present disclosure.

Fig. 4 is a sectional view showing a state where liquefied carbon dioxide in the tank is discharged by the unloading pipe in the ship according to the embodiment of the present disclosure.

Fig. 5 is a sectional view showing a tank, a loading pipe, and an unloading pipe according to a modification example of the embodiment of the present disclosure. Description of Embodiments

[0014] Hereinafter, a tank and a ship according to an embodiment of the present disclosure will be described with reference to Figs. 1 to 5.

(Configuration of Ship)

[0015] As shown in Fig. 1, in the embodiment of the present disclosure, a ship 1 which is a floating structure carries liquefied carbon dioxide. The ship 1 includes at least a hull 2 as a floating main structure and a tank facility 10.

(Configuration of Hull)

[0016] The hull 2 has a pair of sides 3A and 3B, a bottom (not shown), and an upper deck 5, which form an outer shell thereof. The sides 3A and 3B each have a pair of side shell platings which form the left and right sides. The bottom (not shown) has a bottom shell plating connecting the sides 3A and 3B to each other. Due to the pair of sides 3A and 3B and the bottom (not shown), the outer shell of the hull 2 has a U-shape in a cross section orthogonal to a stem-stern direction Da. The upper deck 5 shown in this embodiment is a continuous deck exposed to the outside. In the hull 2, a superstructure 7 having an accommodation space is formed on the upper deck 5 on a stern 2b side.

[0017] Inside the hull 2, a cargo tank storage compartment (hold) 8 is formed on a stem 2a side of the superstructure 7. The cargo tank storage compartment 8 is recessed toward the bottom below the upper deck 5, and is open upward.

(Configuration of Tank Facility)

[0018] A plurality of tank facilities 10 are disposed in the cargo tank storage compartment 8 along the stem-stern direction Da. In the embodiment of the present disclosure, two tank facilities 10 are disposed at intervals in the stem-stern direction Da.

[0019] As shown in Fig. 2, the tank facility 10 includes at least a tank 11 and a lower pipe portion 20 connected to a lower portion 11b of the tank 11.

[0020] In this embodiment, the tank 11 is disposed on the hull 2. The tank 11 has, for example, a cylindrical shape extending in the horizontal direction. The tank 11 accommodates a liquefied carbon dioxide L inside thereof. The tank main body includes a tubular portion 12 and an end spherical portion 13. The tubular portion 12 extends in the horizontal direction as a longitudinal direction Dx. In this embodiment, the tubular portion 12 is formed in a cylindrical shape having a circular cross-sectional shape orthogonal to the longitudinal direction Dx. The end spherical portions 13 are respectively disposed at both end portions of the tubular portion 12 in the longitudinal direction Dx. Each of the end spherical portions 13 has a hemispherical shape and blocks the openings at both ends of the tubular portion 12 in the longitudinal direction Dx. The tank 11 is not limited to a cylindrical shape, and the tank 11 may have a spherical shape, a square shape, or the like.

[0021] The lower pipe portion 20 includes a connection pipe 21, a loading pipe 22, an unloading pipe 23, a pump 24, and switching valves 25A, 25B, and 25C.

[0022] The connection pipe 21 connects the tank 11, and the loading pipe 22 and the unloading pipe 23 to each other. One end 21a of the connection pipe 21 is connected to the lower portion 11b of the tank 11. Here, the lower portion 11b of the tank 11 means a side lower than an intermediate position 11m in a vertical direction Dv of the tank 11. In this embodiment, the one end 21a of the connection pipe 21 is connected to a bottom portion 11d including the lowermost portion of the tank 11. The one end 21a of the connection pipe 21 is connected to the bottom portion 11d of the tank 11 from below, which is the outside of the tank 11. The one end 21a of the connection pipe 21 is open in the tank 11 upward in the vertical direction Dv. The connection pipe 21 extends downward from the one end 21a connected to the bottom portion 11d of the tank 11.

[0023] It is preferable that the position where the one end 21a of the connection pipe 21 is connected to the tank 11 is set at the lower portion 11b of the tank 11 and within a range that satisfies the following equation (1).

$$h < (Pt - TP) \cdot 1000/\rho g \;...\; (1)$$

[0024] Here,

h: Height from the lowermost portion of the tank 11 to the connection position of the connection pipe 21 (m)
Pt: Normal minimum pressure of the tank 11 (kPaG)
TP: Triple point pressure of the liquefied carbon dioxide L accommodated in the tank 11 (kPaG)
ρ: Liquid density of the liquefied carbon dioxide L (kg/m^3)
g: Gravitational acceleration (m/s^2)

[0025] In Fig. 2, since the one end 21a of the connection pipe 21 is connected to the bottom portion 11d (lowermost portion) of the tank 11, h = 0, and the above equation (1) is satisfied.

[0026] The other end 21b of the connection pipe 21 is branched and connected to the loading pipe 22 and the unloading pipe 23.

[0027] The loading pipe 22 is connected to a bottom portion 11d (lower portion 11b) of the tank 11 via the connection pipe 21. The loading pipe 22 loads the liquefied carbon dioxide L supplied from the outside of the hull 2 into the tank 11.

[0028] The unloading pipe 23 is connected to the bottom portion 11d (lower portion 11b) of the tank 11 via the connection pipe 21. The unloading pipe 23 delivers the liquefied carbon dioxide L in the tank 11 to the outside of the hull 2, thereby unloading the liquefied carbon dioxide L in the tank 11.

[0029] The pump 24 is disposed in the unloading pipe 23 outside the tank 11. The pump 24 sucks out the liquefied carbon dioxide L in the tank 11 through the unloading pipe 23 and the connection pipe 21, and delivers the liquefied carbon dioxide L to the outside of the hull 2.

[0030] The piping layout of the connection pipe 21, the loading pipe 22, and the unloading pipe 23, which forms the lower pipe portion 20, is not limited at all, but when the pipe top at the highest position in the middle of the connection pipe 21, the loading pipe 22, and the unloading pipe 23 is disposed at the highest position in the vertical direction Dv, the pressure of the liquefied carbon dioxide L at the pipe top becomes lower than the pressure of the liquefied carbon dioxide in the tank 11. Therefore, it is preferable that the entire connection pipe 21, the loading pipe 22, and the unloading pipe 23 be laid out at a position lower than the bottom portion 11d of the tank 11 as much as possible.

[0031] The switching valve 25A is disposed in the connection pipe 21. The switching valve 25B is disposed in the loading pipe 22. The switching valve 25C is disposed in the unloading pipe 23. The switching valves 25A, 25B, and 25C selectively switch the connection destination of the connection pipe 21 to either the loading pipe 22 or the unloading pipe 23. Specifically, as shown in Fig. 3, the loading pipe 22 is connected to the connection pipe 21 by opening the switching valve 25A and the switching valve 25B and closing the switching valve 25C. As shown in Fig. 4, the unloading pipe 23 is connected to the connection pipe 21 by opening the switching valve 25A and the switching valve 25C and closing the switching valve 25B.

[0032] In addition, a dome structure 18 is disposed at a top 11t of the tank 11. The dome structure 18 is disposed with a pipe (pipeline) for taking in and out carbon dioxide gas, a connecting portion of an instrumentation pipe (not shown) to the tank 11, and other equipment. Examples of various types of instrumentation include a gas component detection sensor in the tank 11.

[0033] Here, in the case of a tank on which an LNG or the like is mounted, according to the International Gas Carrier Code (IGC Code: international regulation on ship structure and facility for bulk transport of liquefied gas), the loading pipe and the unloading pipe are required to be connected to the top of the tank. On the other hand, in the tank 11 accommodating the liquefied carbon dioxide L, the connection position between the loading pipe 22 and the unloading pipe 23 is not limited to the top 11t of the tank 11. Therefore, the above configuration is feasible.

[0034] In the tank facility 10, when the liquefied carbon dioxide L is loaded into the tank 11, as shown in Fig. 3, the switching valve 25A and the switching valve 25B are opened and the switching valve 25C is closed. As a result, the loading pipe 22 communicates with the inside of the tank 11 via the connection pipe 21. In this state, the liquefied carbon dioxide L is loaded into the tank 11 from the outside of the ship through the loading pipe 22 and the connection pipe 21.

[0035] Further, in the tank facility 10, when the liquefied carbon dioxide L in the tank 11 is unloaded, as shown in Fig. 4, the switching valve 25A and the switching valve 25C are opened and the switching valve 25B is closed. As a result, the unloading pipe 23 communicates with the inside of the tank 11 via the connection pipe 21. In this state, the pump 24 is operated to suck the liquefied carbon dioxide L in the tank 11 and delivers the liquefied carbon dioxide L to the outside of the ship.

(Effects)

[0036] According to the ship 1 as described above, the loading pipe 22 and the unloading pipe 23 are connected to the lower portion 11b of the tank 11. Accordingly, compared to a case where the loading pipe 22 and the unloading pipe 23 are connected to the top 11t of the tank 11, the height of the highest position of the loading pipe 22 and the unloading pipe 23 can be suppressed. The pressure of the liquefied carbon dioxide L at the highest position of the loading pipe 22 and the unloading pipe 23 is higher than the pressure of the liquefied carbon dioxide L stored in the tank 11. Therefore, the pressure drop of the liquefied carbon dioxide L at the highest position of the loading pipe 22 and the unloading pipe 23 is suppressed. As a result, the approach of the pressure of the liquefied carbon dioxide L at the highest position of the loading pipe 22 and the unloading pipe 23 to the triple point pressure is suppressed. Accordingly, the solidification of the liquefied carbon dioxide L and the formation of dry ice in the loading pipe 22 and the unloading pipe 23 are suppressed.

[0037] Further, since the loading pipe 22 and the unloading pipe 23 are connected to the lower portion 11b of the tank 11, it is not necessary to connect the loading pipe 22 and the unloading pipe 23 to the dome structure 18 disposed at the top 11t of the tank 11. Accordingly, in order to increase the operating pressure of the tank 11, the size of the dome structure 18 can be reduced and the strength of the tank 11 structure can be increased. Further, it is not necessary to dispose the loading pipe 22 and the unloading pipe 23 in the tank 11 from the top 11t to the bottom portion 11d. Therefore, it is not necessary to provide the support structure for supporting the loading pipe 22 and the unloading pipe 23 in the tank 11. In addition, the pump 24 can be provided in the middle of a pipe disposed outside the tank 11. Therefore, maintenance of the pump 24 can be performed outside the tank 11. Therefore, the maintainability of the pump 24 is improved.

[0038] As a result, it is possible to suppress the formation of dry ice in the loading pipe 22, and to achieve the reduction of the size of the dome structure 18, the simplification of the pipe structure, and the facilitation of maintenance.

[0039] Further, the loading pipe 22 and the unloading pipe 23 are connected to the lower portion 11b of the tank 11 through the connection pipe 21. Therefore, compared to a configuration in which both the loading pipe 22 and the unloading pipe 23 are directly connected to the lower portion 11b of the tank 11, only one connection pipe 21 may be connected to the lower portion 11b of the tank 11, and the pipe connection work can be easily performed. The work of connecting the loading pipe 22 and the unloading pipe 23 to the connection pipe 21 can be performed outside the tank 11. Also in this respect, the pipe connection work can be easily performed.

[0040] Further, the one end 21a of the connection pipe 21 is connected to the bottom portion 11d of the tank 11 from the outside of the tank 11 and is open upward in the tank 11. As a result, the liquefied carbon dioxide L in the tank 11 flows into the unloading pipe 23 from the opening of the one end 21a of the connection pipe 21 through the connection pipe 21 due to its own weight. Therefore, the liquefied carbon dioxide L in the tank 11 can be efficiently discharged.

(Other Embodiments)

[0041] Above, the embodiments of the present disclosure have been described in detail with reference to the drawings, but the specific configuration is not limited to the embodiments, and includes design changes and the like within a scope not departing from the gist of the present disclosure.

[0042] In the above embodiment, the one end 21a of the connection pipe 21 is connected to the bottom portion 11d of the tank 11, but the present disclosure is not limited thereto. When the one end 21a of the connection pipe 21 is the lower portion 11b of the tank 11, the one end 21a may be disposed at a position above the bottom portion 11d. Also in this case, it is preferable to set the connection position of the connection pipe 21 such that the above equation (1) is satisfied.

[0043] Further, as shown in Fig. 5, the connection position of the connection pipe 21B to the tank 11 may be the lower portion 11b of the tank 11 and may be above the bottom portion 11d. In this case, the height h of the connection position of the connection pipe 21B to the tank 11 satisfies the above equation (1). In such a configuration, the connection pipe 21B may be extended downward in the tank 11 and a tip portion 21s may be disposed in the vicinity of the bottom portion 11d in the tank 11. Accordingly, when the liquefied carbon dioxide L in the tank 11 is unloaded through the unloading pipe 23, the amount of the liquefied carbon dioxide L remaining in the tank 11 after the unloading is completed is suppressed.

[0044] Further, in the above-described embodiment, the loading pipe 22 and the unloading pipe 23 are connected to the lower portion 11b (bottom portion 11d) of the tank 11 through the connection pipe 21, but the present disclosure is not limited thereto. The loading pipe 22 and the unloading pipe 23 may be directly connected to the tank 11, respectively. Further, in the above-described embodiment, for convenience of illustration, a case where the loading pipe 22 is disposed above the unloading pipe 23 is shown in Fig. 2, but the positional relationship between the loading pipe 22 and the unloading pipe 23 in the vertical direction is not limited to such a positional relationship. Regarding the positional relationship between the loading pipe 22 and the unloading pipe 23, for example, the loading pipe 22 may be disposed below the unloading pipe 23, or the loading pipe 22 and the unloading pipe 23 may be disposed to overlap each other when viewed from the horizontal direction.

[0045] Furthermore, the number and arrangement of the tank facilities 10 are not limited to the number and arrangement shown in the above embodiment. For example, only one tank facility 10 may be provided, or three or more tank facilities 10 may be provided. Further, in the above embodiment, a case where the plurality of tank facilities 10 are disposed side by side in the stem-stern direction Da has been shown. However, the tank facilities 10 may be disposed side by side in the ship width direction (in other words, the left-right side direction).

[0046] In addition, in the above embodiment, the ship 1 is exemplified as the floating structure, but the present disclosure is not limited thereto. The floating structure may be an offshore floating structure facility that does not include a propulsion mechanism.

<Additional Note>

[0047] The floating structure 1 described in the embodiment is ascertained as follows, for example.

(1) According to a first aspect, there is provided the floating structure 1 including: the floating main structure 2; the tank 11 disposed in the floating main structure 2 and capable of storing liquefied carbon dioxide L; the loading pipe 22 connected to the lower portion 11b of the tank 11 for loading the liquefied carbon dioxide L supplied from the outside of the floating main structure 2 into the tank 11; the unloading pipe 23 connected to the lower portion 11b of the tank 11; and the pump 24 disposed in the unloading pipe 23 outside the tank 11.

[0048] Examples of the floating structure 1 include a ship and an offshore floating structure facility. Examples of the floating main structure 2 include a floating main structure of a hull or an offshore floating structure facility.

[0049] In the floating structure 1, the loading pipe 22 and the unloading pipe 23 are connected to the lower portion 11b of the tank 11. Accordingly, compared to a case where the loading pipe 22 and the unloading pipe 23 are connected to the inside of the tank 11 from the upper portion of the tank 11, the height of the highest position of the loading pipe 22 and the unloading pipe 23 can be suppressed. Therefore, the approach of the pressure of the liquefied carbon dioxide L at the highest position of the loading pipe 22 and the unloading pipe 23 to the triple point pressure is suppressed. Accordingly, the solidification of the liquefied carbon dioxide L and the formation of dry ice in the loading pipe 22 and the unloading pipe 23 are suppressed.

[0050] Further, since the loading pipe 22 and the unloading pipe 23 are connected to the lower portion 11b of the tank 11, it is not necessary to dispose the loading pipe 22 and the unloading pipe 23 in the dome structure 18 disposed at the top 11t of the tank 11. Accordingly, in order to increase the operating pressure of the tank 11, the size of the dome structure 18 can be reduced and the strength of the tank 11 structure can be increased. Further, it is not necessary to dispose the loading pipe 22 and the unloading pipe 23 in the tank 11 from the top 11t to the bottom portion 11d. Therefore, the necessity of providing a support member or the like for supporting the loading pipe 22 and the unloading pipe 23 in the tank 11 is suppressed. In addition, the pump 24 is disposed outside the tank 11. Therefore, maintenance of the pump 24 can be performed outside the tank 11. Therefore, the maintainability of the pump 24 is improved.

[0051] As a result, it is possible to suppress the formation of dry ice in the loading pipe 22 and the unloading pipe 23, and to achieve the reduction of the size of the dome structure 18, the simplification of the pipe structure, and the facilitation of maintenance.

[0052] Further, as the pump 24, a pump generally applied in an on-land liquefied carbon dioxide facility, such as a centrifugal pump or a reciprocating pump, which is cheaper than a deep well pump installed in the tank 11, can be used. Therefore, there is an advantage that the choice of the type of pump is increased and the degree of design freedom can be improved.

[0053] (2) In the floating structure 1 according to a second aspect, which is the floating structure 1 of (1) further including: the connection pipe 21 having one end 21a connected to the lower portion 11b of the tank 11 and the other end 21b connected to the loading pipe 22 and the unloading pipe 23; and the switching valves 25A, 25B, and 25C that selectively switches a connection destination of the connection pipe 21 to any one of the loading pipe 22 and the unloading pipe 23, the loading pipe 22 and the unloading pipe 23 are connected to the lower portion 11b of the tank 11 via the connection pipe 21.

[0054] Further, the loading pipe 22 and the unloading pipe 23 are connected to the lower portion 11b of the tank 11 through the connection pipe 21. Therefore, compared to a configuration in which both the loading pipe 22 and the unloading pipe 23 are directly connected to the lower portion 11b of the tank 11, only the connection pipe 21 may be connected to the lower portion 11b of the tank 11, and the pipe connection work can be easily performed. The work of connecting the loading pipe 22 and the unloading pipe 23 to the connection pipe 21 can be performed outside the tank 11. Also in this respect, the pipe connection work can be easily performed.

[0055] (3) In the floating structure 1 according to a third aspect, which is the floating structure 1 of (2), the one end 21a of the connection pipe 21 is connected to the bottom portion 11d of the tank 11 from the outside of the tank 11 and is open upward in the tank 11.

[0056] As a result, the liquefied carbon dioxide L in the tank 11 flows into the unloading pipe 23 from the opening of the one end 21a of the connection pipe 21 through the connection pipe 21 due to its own weight. Accordingly, the liquefied carbon dioxide L in the tank 11 can be efficiently discharged.

Industrial Applicability

[0057] According to the floating structure of the present disclosure, it is possible to suppress the formation of dry ice in the loading pipe and the unloading pipe, and to achieve the reduction of the size of the dome structure, the simplification of the pipe structure, and the facilitation of maintenance.

Reference Signs List

[0058]

1: Ship (floating structure)
2: Hull (floating main structure)
2a: Stem
2b: Stern
3A: Side
3B: Side
4: Bottom
5: Upper deck
7: Superstructure
8: Cargo tank storage compartment
10: Tank facility
11: Tank
11b: Lower portion
11d: Bottom portion
11m: Intermediate position
11t: Top
18: Dome structure
20: Lower pipe portion
21, 21B: Connection pipe
21a: One end
21b: Other end
21s: Tip portion
22: Loading pipe
23: Unloading pipe
24: Pump
25A, 25B, 25C: Switching valve
Da: Stem-stern direction
Dv: Vertical direction
L: Liquefied carbon dioxide

Claims

1. A floating structure comprising:

a floating main structure;
a tank disposed in the floating main structure and capable of storing liquefied carbon dioxide;
a loading pipe connected to a lower portion of the tank for loading liquefied carbon dioxide supplied from an outside of the floating main structure into the tank;
an unloading pipe connected to the lower portion of the tank; and
a pump disposed in the unloading pipe outside the tank for delivering liquefied carbon dioxide in the tank to the outside of the floating main structure.

2. The floating structure according to Claim 1, further comprising:

a connection pipe having one end connected to the lower portion of the tank and the other end connected to the loading pipe and the unloading pipe; and
a switching valve that selectively switches a connection destination of the connection pipe to any one of the loading pipe and the unloading pipe, wherein
the loading pipe and the unloading pipe are connected to the lower portion of the tank via the connection pipe.

3. The floating structure according to Claim 2, wherein one end of the connection pipe is connected to a bottom portion of the tank from the outside of the tank and is open upward in the tank.

FIG. 1

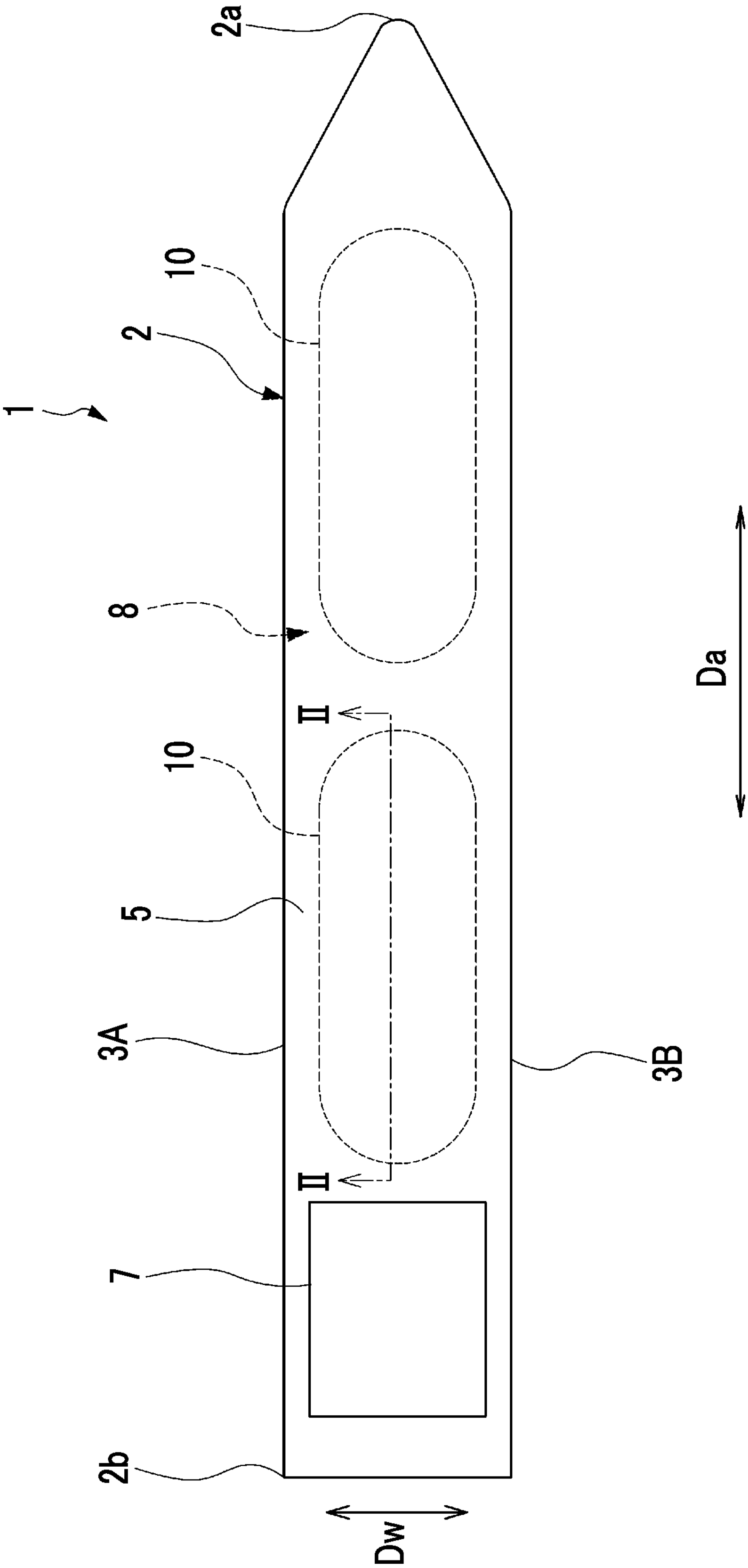

FIG. 2

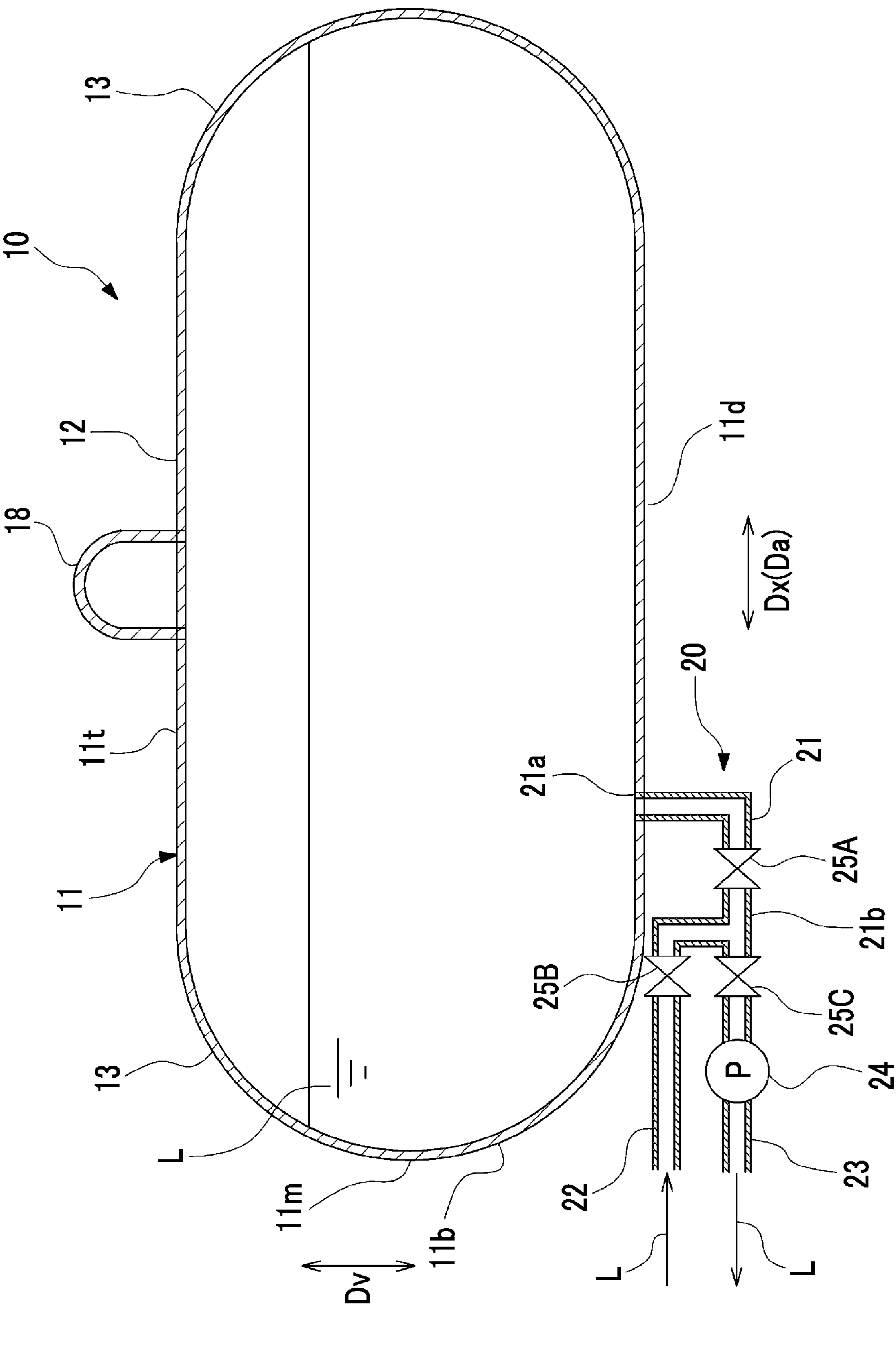
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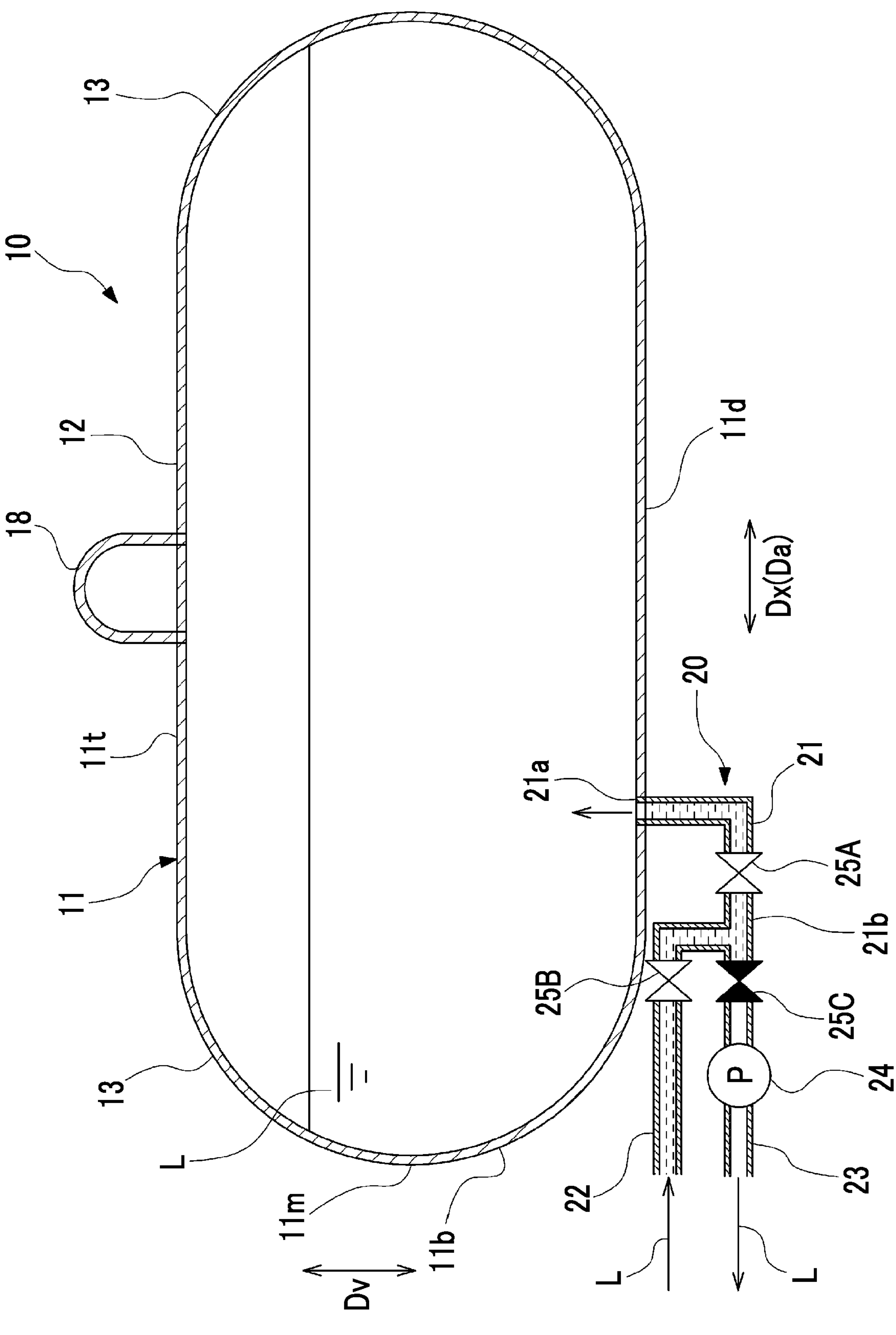
FIG. 3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Dv
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25B
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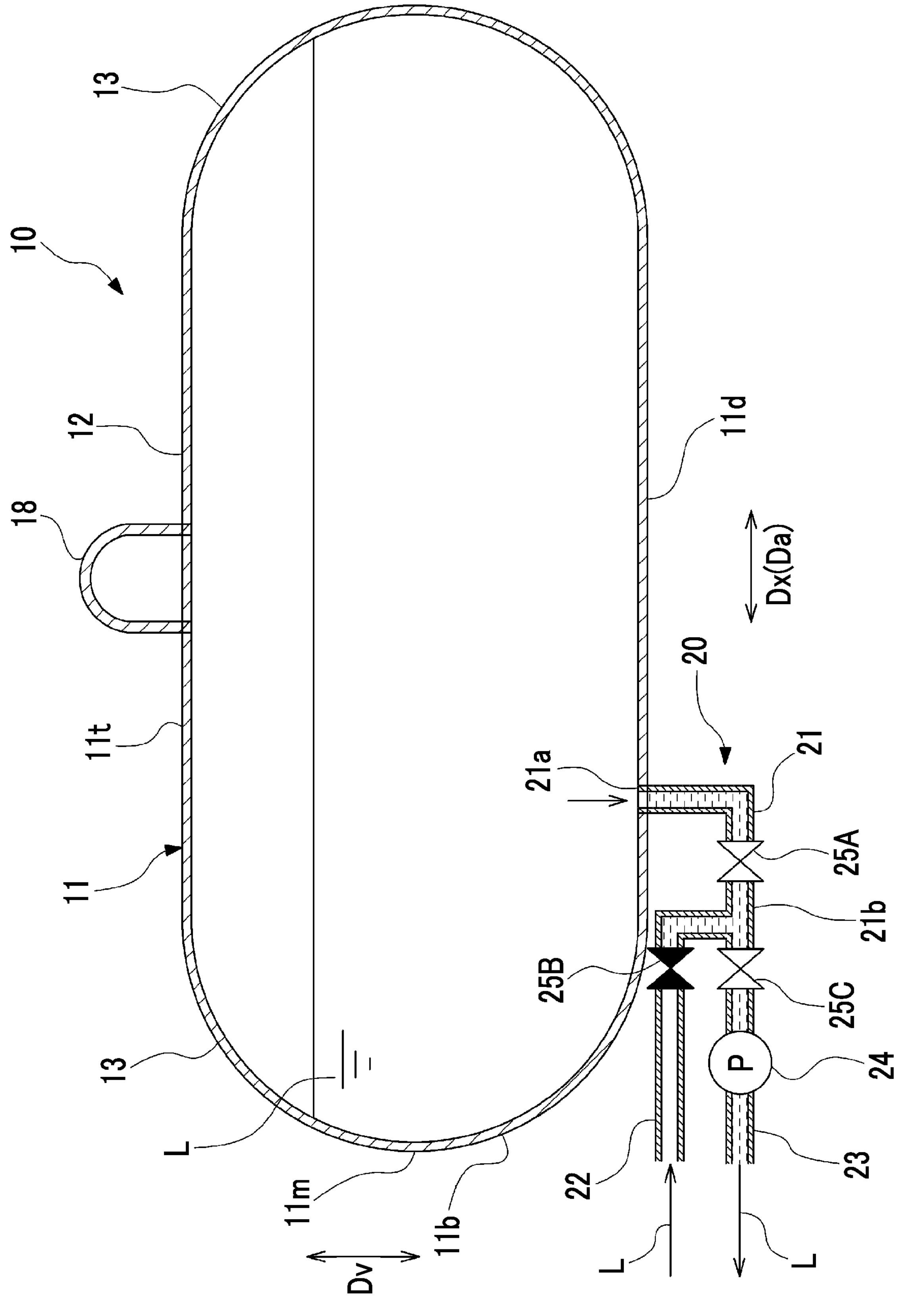
11d
Dx(Da)

FIG. 4



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11m
11b
Dv
11d
Dx(Da)
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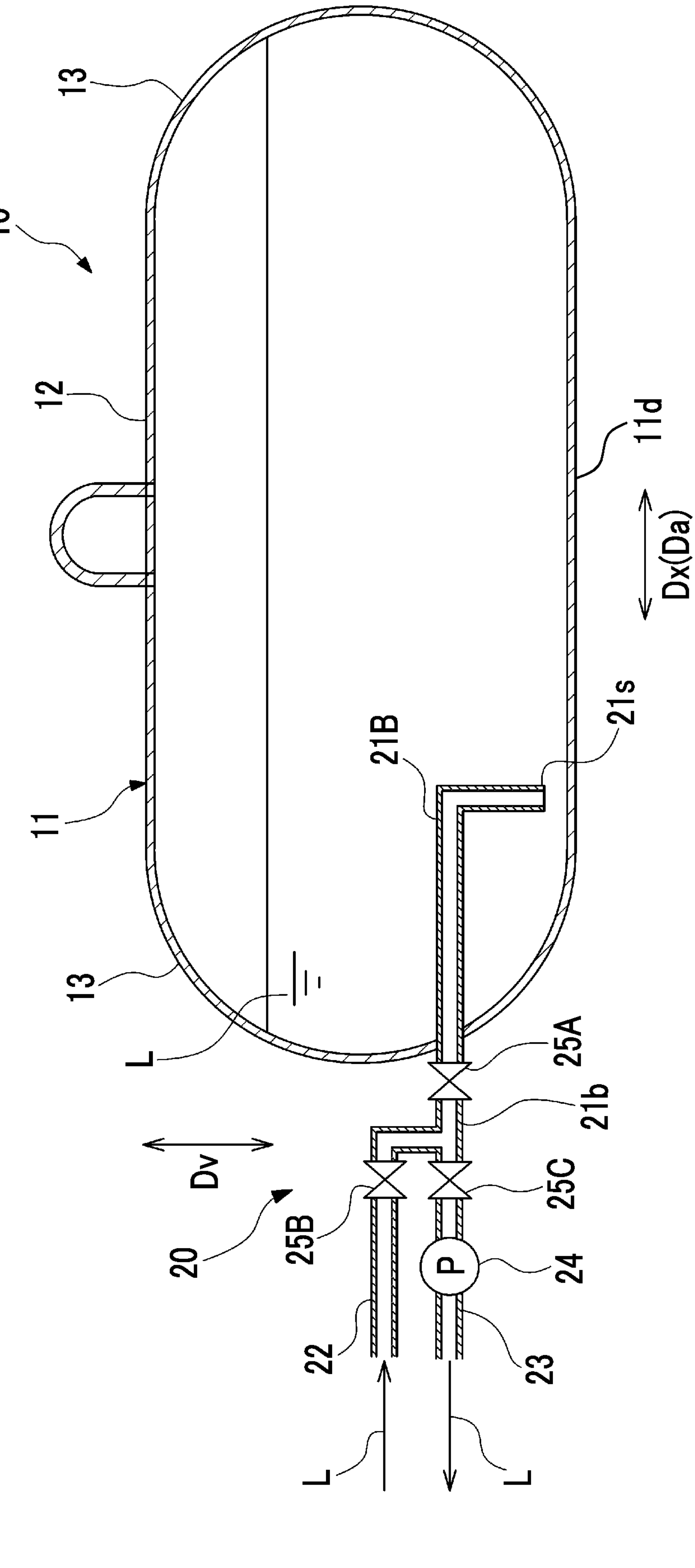
21b
25A
25B
25C
24
P
22
23
L
L

FIG. 5



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2021/039905

A. CLASSIFICATION OF SUBJECT MATTER

B63B 25/08(2006.01)i; ***B63B 25/16***(2006.01)i; ***B63B 27/24***(2006.01)i; ***F17C 13/00***(2006.01)i
FI: B63B25/08 B; B63B25/16 F; B63B27/24 E; B63B27/24 F; F17C13/00 302D

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B63B25/08; B63B25/16; B63B27/24; F17C13/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2021
Registered utility model specifications of Japan 1996-2021
Published registered utility model applications of Japan 1994-2021

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 10-2011-0126773 A (DAEWOO SHIPBUILDING & MARINE ENGINEERING CO., LTD.) 24 November 2011 (2011-11-24) paragraphs [0014]-[0027], fig. 2-3	1-3
Y	JP 2008-239097 A (MITSUI ENG & SHIPBUILD CO LTD) 09 October 2008 (2008-10-09) paragraphs [0018]-[0032], fig. 1-4	1-3
A	JP 2005-21814 A (SASAKURA ENGINEERING CO LTD) 27 January 2005 (2005-01-27)	1-3
A	JP 2003-285791 A (MITSUI ENG & SHIPBUILD CO LTD) 07 October 2003 (2003-10-07)	1-3

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
01 December 2021	**14 December 2021**

Name and mailing address of the ISA/JP	Authorized officer
Japan Patent Office (ISA/JP) **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2021/039905

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
KR 10-2011-0126773 A	24 November 2011	(Family: none)	
JP 2008-239097 A	09 October 2008	(Family: none)	
JP 2005-21814 A	27 January 2005	(Family: none)	
JP 2003-285791 A	07 October 2003	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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- JP 2020180558 A **[0002]**
- JP 2018528119 W **[0004]**