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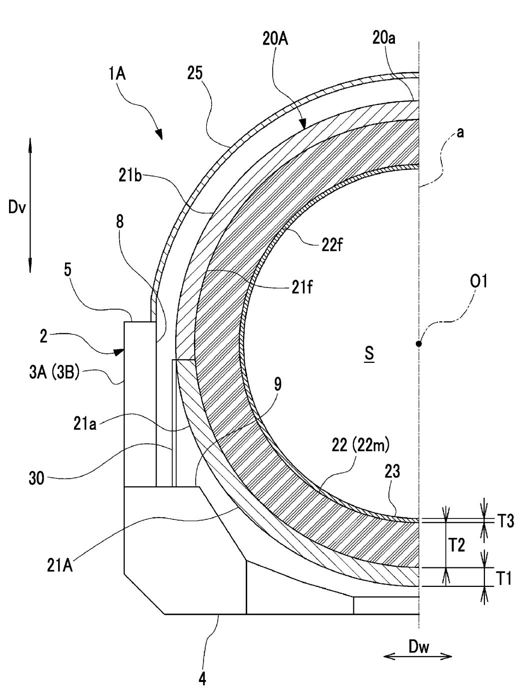
(54) LIQUEFIED GAS TANK AND SHIP

(57) A liquefied gas tank comprises: a tank body in the interior of which an accommodation space is formed; an intermediate layer that covers the inner surface of the tank body, the intermediate layer being formed from a heat-blocking material having lower heat conductivity than the tank body; and a thin film layer that covers the inner surface of the intermediate layer, the liquefied gas being capable of being accommodated in a liquid-tight manner on the inner side of the thin film layer.

FIG. 2



EP 4 089 313 A1

Description

Technical Field

[0001] The present disclosure relates to a liquefied gas tank and a ship.

[0002] This application claims the right of priority based on Japanese Patent Application No. 2020-027061 filed with the Japan Patent Office on February 20, 2020, the content of which is incorporated herein by reference.

Background Art

[0003] PTL 1 discloses a ship that carries liquefied gas such as liquefied natural gas and includes a cargo tank for liquefied gas, which is provided with a tank body for storing the liquefied gas and a heat insulating material provided so as to cover the outer peripheral surface of the tank body.

Citation List

Patent Literature

[0004] [PTL 1] Japanese Patent No. 6364694

Summary of Invention

Technical Problem

[0005] In the cargo tank stated in PTL 1, since low-temperature and high-pressure liquefied gas comes into contact with the inner surface of the tank body, the tank needs to have both strength against the pressure of the high-pressure liquefied gas and toughness (low-temperature toughness) against the low-temperature liquefied gas. In such a tank, for example, if an attempt is made to increase the diameter of the tank in order to increase the volume of the tank, there is a case where it is necessary to increase the wall thickness of the tank body. However, an increase in the wall thickness of the tank body leads to an increase in material cost. Further, if an attempt is made to secure strength while suppressing an increase in the wall thickness of the tank body, a higher-strength material is used, which also leads to an increase in material cost.

[0006] The present disclosure has been made to solve the above problems, and has an object to provide a liquefied gas tank and a ship, in which it is possible to increase the capacity of a tank while suppressing an increase in cost.

Solution to Problem

[0007] In order to solve the above problems, a liquefied gas tank according to the present disclosure includes a tank body, an intermediate layer, and a thin film layer. The tank body has an accommodation space formed in an interior thereof. The intermediate layer covers the inner surface of the tank body. The intermediate layer is formed of a heat-blocking material having thermal conductivity smaller than that of the tank body. The thin film layer covers the inner surface of the intermediate layer. The thin film layer is capable of accommodating liquefied gas in a liquid-tight manner on the inside thereof.

[0008] A ship according to the present disclosure includes a hull, and the liquefied gas tank as described above, which is provided in the hull.

Advantageous Effects of Invention

[0009] According to the liquefied gas tank and the ship of the present disclosure, it is possible to increase the capacity of the tank while suppressing an increase in cost.

Brief Description of Drawings

[0010]

Fig. 1 is a plan view showing an overall configuration of a ship according to an embodiment of the present disclosure.

Fig. 2 is a semi-cross-sectional view of a liquefied gas tank provided in the ship according to the embodiment of the present disclosure as viewed from a bow-stern direction.

Fig. 3 is a cross-sectional view showing a displacement absorbing portion formed in a thin film layer of the liquefied gas tank according to the embodiment of the present disclosure.

Fig. 4 is a plan view showing an overall configuration of a ship according to a modification example of the embodiment of the present disclosure.

Description of Embodiments

[0011] Fig. 1 is a plan view showing an overall configuration of a ship according to an embodiment of the present disclosure. Fig. 2 is a semi-cross-sectional view of a liquefied gas provided in the ship as viewed from a bow-stern direction.

[0012] As shown in Figs. 1 and 2, a ship 1A of the embodiment of the present disclosure carries liquefied gas such as liquefied natural gas, liquefied petroleum gas, liquid carbon dioxide, or liquid ammonia. The ship 1A includes at least a hull 2 and a liquefied gas tank 20A.

[0013] The hull 2 has a pair of broadsides 3A and 3B, a ship bottom 4, and an upper deck 5, which form an outer shell thereof. The broadsides 3A and 3B are provided with a pair of broadside outer plates forming the left and right broadsides, respectively. The ship bottom 4 is provided with a ship bottom outer plate connecting the broadsides 3A and 3B. Due to the pair of broadsides 3A and 3B and the ship bottom 4, the outer shell of the hull 2 has a U-shape in a cross section orthogonal to a bow-stern direction Da. The upper deck 5 is an all-deck that is exposed to the outside. A superstructure 7 having an accommodation space is formed on the upper deck 5 on the stern 2b side in the hull 2.

[0014] A cargo tank storage compartment (a hold) 8 is formed on the bow 2a side with respect to the superstructure 7 in the hull 2. The cargo tank storage compartment 8 is recessed toward the ship bottom 4 below the upper deck 5 and is open upward.

[0015] A plurality of liquefied gas tanks 20A are provided in the cargo tank storage compartment 8. The plurality of liquefied gas tanks 20A are disposed side by side in the bow-stern direction Da. An upper portion 20a of each of the liquefied gas tanks 20A protrudes to the upper side than the upper deck 5 of the hull 2. The upper portion 20a of each of the plurality of liquefied gas tanks 20A is covered with a tank cover 25 provided on the upper deck 5. An external heat insulating material (not shown) that suppresses heat input from the outside may be provided between the inner surface of the tank cover 25 and the outer surface of the liquefied gas tank 20A.

[0016] The liquefied gas tank 20A is supported by a skirt 30. The skirt 30 has a cylindrical shape extending in an up-down direction Dv, and a lower end portion thereof is fixed to a foundation deck portion 9 provided at a bottom portion of the cargo tank storage compartment 8.

[0017] The liquefied gas tank 20A accommodates the liquefied gas in an accommodation space S in the interior thereof. When the temperature and pressure of the liquefied gas in a state of being accommodated in the accommodation space S are exemplified, in the case of liquefied natural gas, a temperature of -163°C and pressure of 4 bar, in the case of liquefied petroleum gas, a temperature of -50°C and pressure of 18 bar, in the case of liquid carbon dioxide, a temperature of -35°C and pressure of 19 bar, and in the case of liquid ammonia, a temperature of -50°C and pressure of 5 bar can be given as examples.

[0018] As shown in Fig. 2, the liquefied gas tank 20A includes a tank body 21A, an intermediate layer 22, and a thin film layer 23.

[0019] The tank body 21A forms the outer shell of the liquefied gas tank 20A. The tank body 21A has the accommodation space S formed in the interior thereof. In this embodiment, the tank body 21A has a spherical shape. The tank body 21A includes a lower half portion 21a and an upper half portion 21b.

[0020] The lower half portion 21a has a hemispherical shape at a lower portion of the tank body 21A. In the lower half portion 21a, the diameter dimension centered on an axis a gradually increases from the lower side toward the upper side. The lower half portion 21a has a semi-spherical shape having a constant radius of curvature. Here, the axis a is a virtual line extending in the up-down direction Dv through the center of the tank body 21A and eventually the liquefied gas tank 20A.

[0021] In the present example, the axis a of the tank body 21A is disposed so as to be located at the center in the bow-stern direction Da of the hull 2 and the center in a ship width direction Dw (refer to Fig. 1). However, in the present invention, the disposition of the liquefied gas tank 20A in the hull 2 is not limited to this case.

[0022] The upper half portion 21b is provided on the upper side of the lower half portion 21a. The upper half portion 21b has a hemispherical shape at an upper portion of the tank body 21A. The diameter dimension of the upper half portion 21b gradually decreases from the lower side toward the upper side. In this embodiment, the upper half portion 21b may have a semi-spherical shape having a constant radius of curvature, or may be formed such that the radius of curvature gradually increases from the lower side toward the upper side.

[0023] The tank body 21A is not limited to the shape shown above. The tank body 21A may be configured to include a cylindrical portion (not shown) or the like between the upper half portion 21b and the lower half portion 21a.

[0024] The tank body 21A has a thickness T1 in a range of 10 to 70 mm, and preferably 40 to 60 mm, for example. As a material for forming the tank body 21A, for example, carbon manganese steel is used. In addition, an aluminum alloy, stainless steel, nickel steel, or the like can be used as the material for forming the tank body 21A.

[0025] The intermediate layer 22 is provided in the tank body 21A. The intermediate layer 22 is provided so as to cover the entire inner surface 21f of the tank body 21A. The intermediate layer 22 is formed of a heat-blocking material 22m having thermal conductivity smaller than that of the tank body 21A. The heat-blocking material 22m in this embodiment is concrete. As the heat-blocking material 22m forming the intermediate layer 22, in addition to concrete, for example, pearlite, wood, phenol resin, or the like can be exemplified. Further, the intermediate layer may be formed by combining a plurality of materials. Further, in a case where pearlite or the like is used for the intermediate layer 22, or the like, pearlite or the like may be enclosed in a wooden box or the like in order to maintain the shape of the intermediate layer 22.

[0026] A thickness T2 of the intermediate layer 22 is larger than, for example, the thickness T1 of the tank body 21A. The preferred range of the thickness T2 of the intermediate layer 22 is, for example, 100 to 500 mm, and preferably 150 to 250 mm.

[0027] The thin film layer 23 is formed, for example, in the shape of a spherical bag as a whole so as to cover an inner surface 22f of the intermediate layer 22. The thin film layer 23 is capable of accommodating the liquefied gas in a liquid-tight manner on the inside thereof. A thickness T3 of the thin film layer 23 is thinner than the thickness T1 of the tank body 21A.

[0028] As a material for forming the thin film layer 23, for example, stainless steel is used. As the material for forming the thin film layer 23, in addition, an Invar material (nickel steel) or the like can be given as an example. The material for forming the thin film layer 23 is selected according to the type of the liquefied gas that is accommodated in the accommodation space S of the liquefied gas tank 20A. For example, in a case where liquid ammonia is accommodated in the accommodation space S, as the material for forming the thin film layer 23, stainless steel is used so as to suppress a chemical reaction due to the contact between the liquid ammonia and the thin film layer 23.

[0029] The thickness T3 of the thin film layer 23 is smaller than the thickness T1 of the tank body 21A. The thickness T3 of the thin film layer 23 is preferably in a range of 0.5 mm to 2 mm, and more preferably in a range of about 0.7 to 1.2 mm, for example.

[0030] Fig. 3 is a cross-sectional view showing a displacement absorbing portion formed in the thin film layer of the liquefied gas tank.

[0031] As shown in Fig. 3, the thin film layer 23 is not bonded to the inner surface 22f of the intermediate layer 22, and can be independently displaced with respect to the intermediate layer 22 at the time of thermal deformation or the like. The thin film layer 23 is provided with a deformation absorbing portion 27 that absorbs the thermal deformation. The deformation absorbing portion 27 is provided, for example, in a part in a circumferential direction Dc of the thin film layer 23 in the cross section shown in Fig. 3. The deformation absorbing portion 27 is formed by bending a part in the circumferential direction Dc of the thin film layer 23 in a bellows shape alternately to the outer side and the inner side in a radial direction Dr of the liquefied gas tank 20A. The deformation absorbing portion 27 is formed, for example, in a ring shape around a center O1 of the liquefied gas tank 20A, and absorbs thermal contraction that occurs in the thin film layer 23 in a case where the liquefied gas is accommodated in the liquefied gas tank 20A. More specifically, when the thin film layer 23 thermally contracts in the circumferential direction Dc, the bellows-shaped deformation absorbing portion 27 is deformed so as to expand. The deformation absorbing portion 27 absorbs the thermal contraction of the thin film layer 23, so that excessive thermal stress is not generated in the thin film layer 23. The deformation absorbing portions 27 may be provided at a plurality of locations of one thin film layer 23.

[0032] An opening portion (not shown) formed to penetrate the tank body 21A, the intermediate layer 22, and the thin film layer 23 is formed in the liquefied gas tank 20A as described above. The liquefied gas is taken in and out through the opening portion (not shown).

[0033] In the liquefied gas tank 20A of the above embodiment, the liquefied gas tank 20A includes the tank body 21A, the intermediate layer 22, and the thin film layer 23. The tank body 21A has the accommodation space S formed in an interior thereof. The intermediate layer 22 is formed of the heat-blocking material 22m having small thermal conductivity. The intermediate layer 22 covers the inner surface 21f of the tank body 21A and forms the accommodation space in the interior thereof. The thin film layer 23 covers the inner surface 22f of the intermediate layer 22 and has the thickness T3 thinner than the thickness of the tank body 21A. The thin film layer 23 is capable of accommodating the liquefied gas in a liquid-tight manner on an inside thereof.

[0034] According to the liquefied gas tank 20A of the above embodiment, due to the thin film layer 23, it is possible to secure liquid-tightness with respect to the liquefied gas accommodated on the inside thereof. The pressure due to the liquefied gas accommodated on the inside of the thin film layer 23 is received by the intermediate layer 22 and the tank body 21A through the thin film layer 23. The tank body 21A functions as a strength member of the liquefied gas tank 20A that receives the internal pressure due to the liquefied gas. In this way, the out-of-plane deformation of the thin film layer 23 can be suppressed.

[0035] Further, the heat transfer from the low-temperature liquefied gas to the tank body 21A can be suppressed by the heat-blocking material 22m, and thus a decrease in the temperature of the tank body 21A can be suppressed. In this way, the requirement for low-temperature toughness for the tank body 21A is alleviated. In addition, since the requirement relating to the low-temperature toughness of the tank body 21A is alleviated, it becomes possible to use a cheaper material for the tank body 21A. Therefore, even in a case where the thickness of the tank body 21A is increased, it is possible to suppress an increase in cost as compared with the case of using a material having low-temperature toughness, and therefore, the tank body 21A can be increased in size at a lower cost.

[0036] Further, due to the heat-blocking material 22m having thermal conductivity smaller than that of the tank body 21A, the infiltration of heat from the outside of the liquefied gas tank 20A can be suppressed, and thus a temperature rise of the liquefied gas can be suppressed. In this way, the amount of an external heat-blocking material (not shown) that is installed outside the liquefied gas tank 20A can be reduced or canceled, and thus it becomes possible to suppress a manufacturing cost.

[0037] The intermediate layer 22 of the liquefied gas tank 20A of the above embodiment is formed of concrete.

[0038] In this manner, the intermediate layer 22 is formed of concrete, so that in a case where the pressure due to the liquefied gas acts on the intermediate layer 22 through the thin film layer 23, the pressure can be firmly received.

[0039] In the liquefied gas tank 20A of the above embodiment, the thin film layer 23 is independently displaceable with respect to the intermediate layer 22 at the time of thermal deformation.

[0040] Therefore, in a case where thermal contraction occurs in the thin film layer 23 according to a temperature change due to the liquefied gas, the thin film layer 23 is not constrained by the intermediate layer 22, and displacement due to the thermal contraction can be allowed. In this way, it is possible to suppress the occurrence of stress in the thin film layer 23 due to the thermal contraction.

[0041] In the liquefied gas tank 20A of the above embodiment, the thin film layer 23 is provided with the deformation absorbing portion 27 that absorbs thermal deformation.

[0042] Therefore, in a case where thermal contraction occurs in the thin film layer 23 according to a temperature change due to the liquefied gas, the thermal deformation of the thin film layer 23 can be absorbed by the deformation absorbing portion 27.

[0043] In the liquefied gas tank 20A of the above embodiment, the thin film layer 23 is formed of stainless steel or an Invar material.

[0044] In this manner, stainless steel or an invar material is used for the thin film layer 23, so that, for example, even in a case where, as the liquefied gas, liquid ammonia or the like is accommodated in the liquefied gas tank 20A, it is possible to suppress the occurrence of a chemical reaction due to the contact between the liquefied gas and the thin film layer 23.

[0045] The ship 1A of the above embodiment includes the hull 2 and the liquefied gas tank 20A provided in the hull 2.

[0046] According to the ship 1A, since the capacity of the liquefied gas tank 20A can be increased, the number of liquefied gas tanks 20A to be mounted can be reduced. Therefore, it becomes possible to suppress an increase in the cost of the ship 1A.

[0047] In the above embodiment, the liquefied gas tank 20A has a spherical shape. However, there is no limitation thereto. For example, as in a modification example shown in Fig. 4, a liquefied gas tank 20B of a ship 1B can also be formed in a cylindrical shape. The liquefied gas tank 20B in this modification example illustrates a case where it has a cylindrical shape extending in the horizontal direction. The liquefied gas tank 20B includes a tank body 21B, the intermediate layer 22, and the thin film layer 23, similarly to the liquefied gas tank 20A of the above embodiment. The tank body 21B integrally has a tubular portion 21d and two hemispherical portions 21e. The tubular portion 21d extends in the horizontal direction and has a constant diameter dimension. The tubular portion 21d is formed in an intermediate portion in the axial direction of the tank body 21B. The hemispherical portions 21e are provided at both ends in a center axis direction of the tubular portion 21d. Each of the hemispherical portions 21e is provided at each of both ends in the center axis direction of the tubular portion 21d, and closes each of openings at both ends of the tubular portion 21d.

[0048] Although the embodiment of the present disclosure has been described in detail above with reference to the drawings, the specific configuration is not limited to this embodiment and also includes design changes or the like within a scope which does not deviate from the gist of the present disclosure.

[0049] In the above embodiment and the above modification example, a configuration is adopted in which each of the liquefied gas tanks 20A and 20B is provided in the cargo tank storage compartment 8 formed in the hull 2. However, there is no limitation thereto, and for example, the whole or a part of each of the liquefied gas tanks 20A and 20B may be provided on the upper deck 5 or may be provided below the upper deck 5.

[0050] In the above embodiment, the liquefied gas tank 20A or 20B is provided in the ship 1A or 1B. However, there is no limitation thereto. For example, the liquefied gas tank 20A or 20B may be installed in a place other than a ship, such as an offshore floating body.

<Additional Remark>

[0051] The liquefied gas tank 20A or 20B and the ship 1A or 1B described in each embodiment are grasped as follows, for example.

(1) The liquefied gas tank 20A or 20B according to a first aspect includes the tank body 21A or 21B having the accommodation space S formed in the interior thereof, the intermediate layer 22 that covers the inner surface 21f of the tank body 21A or 21B and is formed of the heat-blocking material 22m having thermal conductivity smaller than that of the tank body 21A or 21B, and the thin film layer 23 that covers the inner surface 22f of the intermediate layer 22, has the thickness T3 thinner than the thickness of the tank body 21A or 21B, and is capable of accommodating liquefied gas in a liquid-tight manner on the inside thereof.

[0052] In the liquefied gas tank 20A or 20B, due to the thin film layer 23, liquid-tightness with respect to the liquefied gas that is accommodated on the inside thereof is secured. The pressure due to the liquefied gas accommodated on the inside of the thin film layer 23 is received by the intermediate layer 22 and the tank body 21A or 21B through the thin film layer 23. The tank body 21A or 21B is formed of a metal material and has the thickness T1 larger than the thickness of the thin film layer 23, and therefore, the tank body 21A or 21B functions as a strength member of the liquefied gas tank 20A or 20B that receives the internal pressure due to the liquefied gas. In this way, the out-of-plane deformation of the thin film layer 23 can be suppressed.

[0053] Further, the heat transfer from the low-temperature liquefied gas to the tank body 21A or 21B is suppressed by the heat-blocking material 22m, and thus a decrease in the temperature of the tank body 21A or 21B is suppressed. In this way, the requirement for low-temperature toughness for the tank body 21A or 21B is alleviated. In addition, since the requirement relating to the low-temperature toughness is alleviated, the thickness limitation of the tank body 21A or 21B is released, and thus it becomes possible to increase the thickness T1 of the tank body 21A or 21B. As a result, it becomes possible to use a cheaper material for the tank body 21A or 21B. Further, by increasing the thickness T1 of the tank body 21A or 21B, it also becomes possible to increase the size of the tank body 21A or 21B.

[0054] Further, due to the heat-blocking material 22m having thermal conductivity smaller than that of the tank body 21A or 21B, the infiltration of heat from the outside of the liquefied gas tank 20A or 20B can be suppressed, and thus a temperature rise of the low-temperature liquefied gas can also be suppressed. In this way, the amount of an external heat-blocking material (not shown) that is installed outside the liquefied gas tank 20A or 20B can be reduced, and thus it becomes possible to suppress a manufacturing cost.

[0055] In this way, it becomes possible to increase the capacity of the tank while suppressing an increase in cost.

[0056] (2) In the liquefied gas tank 20A or 20B according to a second aspect, in the liquefied gas tank 20A or 20B of the above (1), the intermediate layer 22 is made of concrete.

[0057] In this way, the intermediate layer 22 is formed of concrete, so that in a case where the pressure due to the liquefied gas acts on the intermediate layer 22 through the thin film layer 23, the pressure can be firmly received.

[0058] (3) In the liquefied gas tank 20A or 20B according to a third aspect, in the liquefied gas tank 20A or 20B of the above (1) or (2), the thin film layer 23 is capable of being independently displaced with respect to the intermediate layer 22 at the time of thermal deformation.

[0059] In this way, in a case where thermal contraction occurs in the thin film layer 23 according to a temperature change due to the liquefied gas, the thin film layer 23 is not constrained by the intermediate layer 22, and displacement due to the thermal contraction can be allowed. In this way, it is possible to suppress the occurrence of stress in the thin film layer 23 due to the thermal contraction.

[0060] (4) In the liquefied gas tank 20A or 20B according to a fourth aspect, in the liquefied gas tank 20A or 20B of the above (3), the thin film layer 23 includes the deformation absorbing portion 27 that absorbs the thermal deformation.

[0061] In this way, in a case where thermal contraction occurs in the thin film layer 23 according to a temperature change due to the liquefied gas, the thermal deformation of the thin film layer 23 can be absorbed by the deformation absorbing portion 27.

[0062] (5) In the liquefied gas tank 20A or 20B according to a fifth aspect, in the liquefied gas tank 20A or 20B of any one of the above (1) to (4), the thin film layer 23 is made of stainless steel or an Invar material...

[0063] In this way, when stainless steel or an invar material is used for the thin film layer 23, for example, even in a case where, as the liquefied gas, liquid ammonia or the like is accommodated in the liquefied gas tank 20A or 20B, it is possible to suppress the occurrence of a chemical reaction due to the contact between the liquefied gas and the thin film layer 23.

[0064] (6) The ship 1A or 1B according to a sixth aspect includes the hull 2, and the liquefied gas tank 20A or 20B of any one of the above (1) to (5), which is provided in the hull 2.

[0065] In this way, it becomes possible to provide the ship 1A or 1B provided with the liquefied gas tank 20A or 20B in which it is possible to increase the capacity of the tank while suppressing an increase in cost.

Industrial Applicability

[0066] According to the liquefied gas tank and the ship of the present disclosure, it is possible to increase the capacity of the tank while suppressing an increase in cost.

Reference Signs List

[0067]

1A, 1B:	ship
2:	hull
2a:	bow
2b:	stern
3A, 3B:	broadside
4:	ship bottom
5:	upper deck
7:	superstructure
8:	cargo tank storage compartment
9:	foundation deck portion
20A, 20B:	liquefied gas tank
20a:	upper portion
21A, 21B:	tank body
21a:	lower half portion
21b:	upper half portion
21d:	tubular portion
21e:	hemispherical portion
21f:	inner surface
22:	intermediate layer
22f:	inner surface
22m:	heat-blocking material
23:	thin film layer
25:	tank cover
27:	deformation absorbing portion
30:	skirt
S:	accommodation space

Claims

1. A liquefied gas tank comprising:

a tank body having an accommodation space formed in an interior thereof;
an intermediate layer that covers an inner surface of the tank body and is formed of a heat-blocking material having thermal conductivity smaller than thermal conductivity of the tank body; and

a thin film layer that covers an inner surface of the intermediate layer and is capable of accommodating liquefied gas in a liquid-tight manner on an inside thereof.

2. The liquefied gas tank according to claim 1, wherein the intermediate layer is made of concrete.

3. The liquefied gas tank according to claim 1 or 2, wherein the thin film layer is capable of being independently displaced with respect to the intermediate layer at the time of thermal deformation.

4. The liquefied gas tank according to claim 3, wherein the thin film layer includes a deformation absorbing portion that absorbs the thermal deformation.

5. The liquefied gas tank according to any one of claims 1 to 4, wherein the thin film layer is made of stainless steel or an Invar material.

6. A ship comprising:

a hull; and
the liquefied gas tank according to any one of claims 1 to 5, which is provided in the hull.

FIG. 1

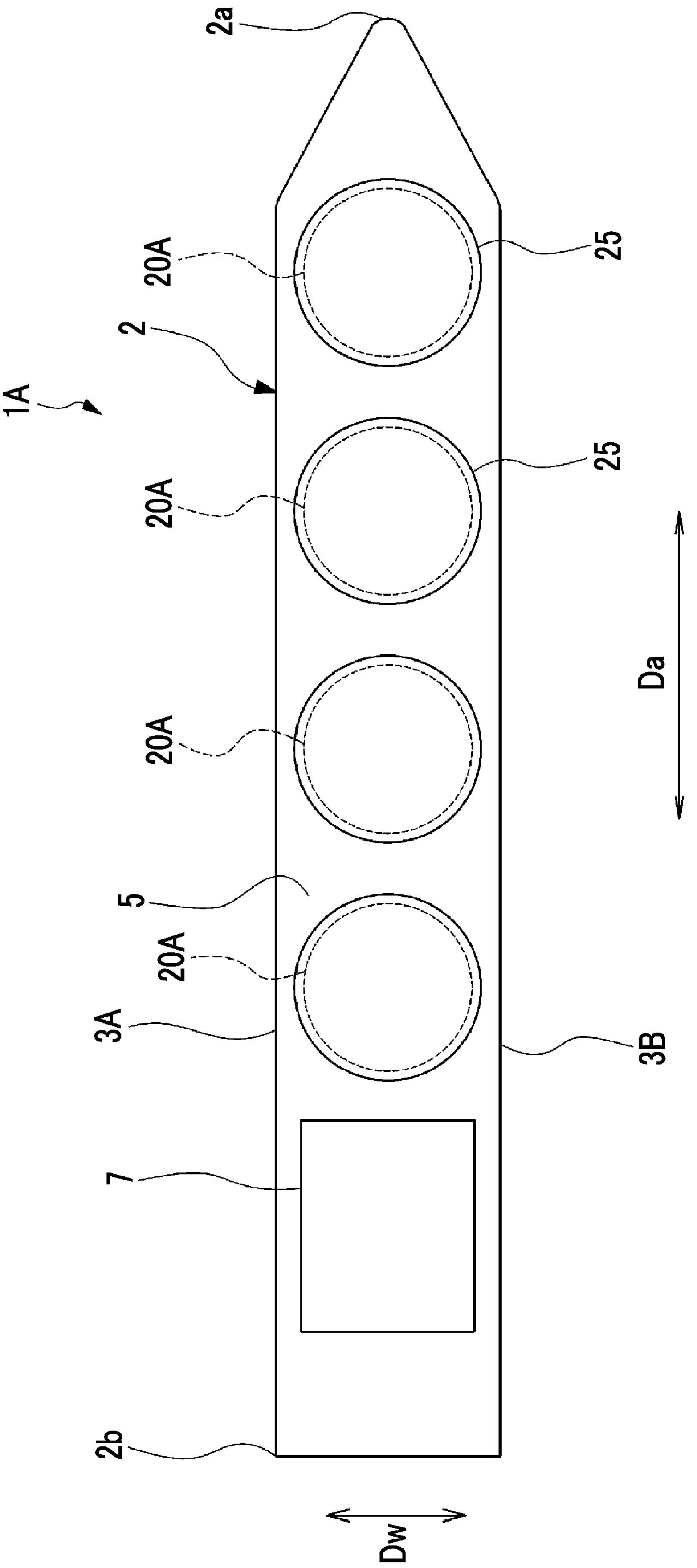
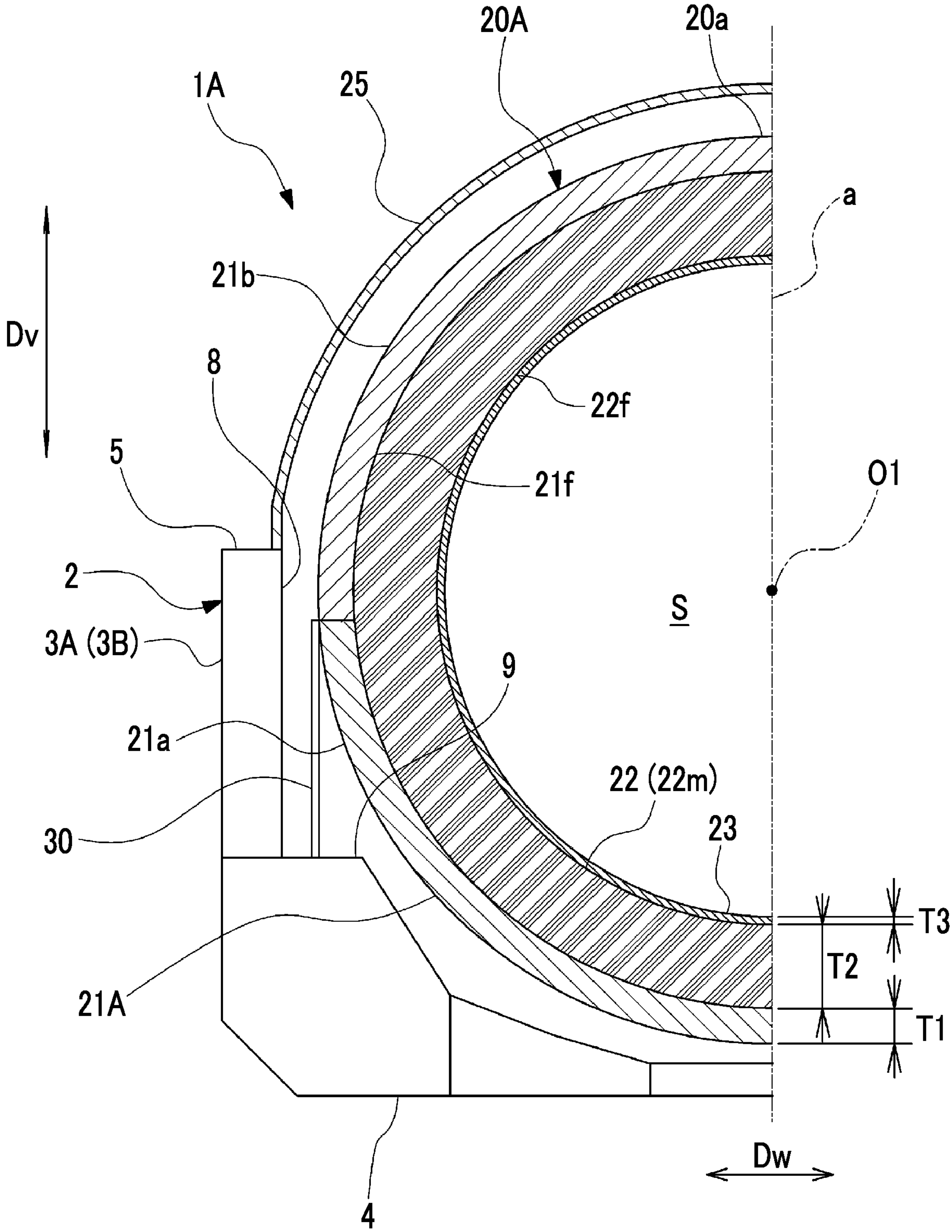


FIG. 2



20A
20a
1A
25
a
Dv
21b
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22f
5
21f
O1
2
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23
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T2
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T1
Dw
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FIG. 3

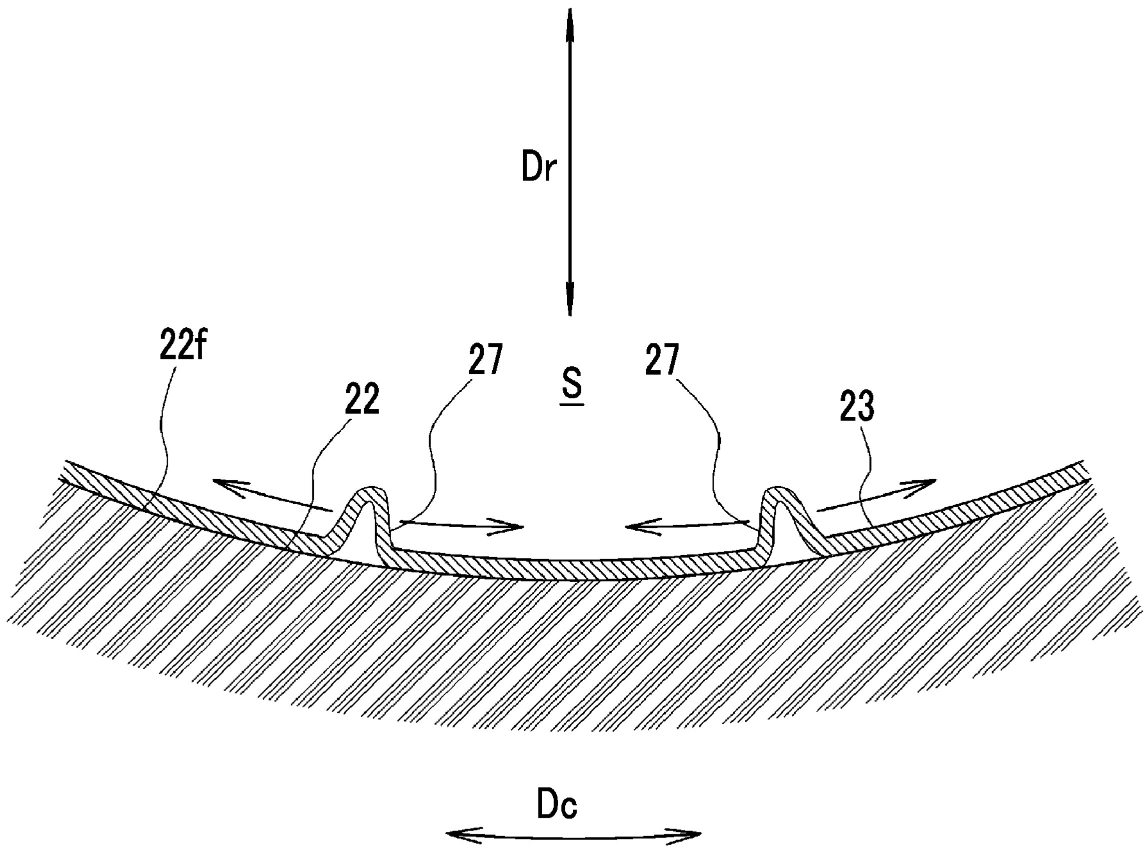
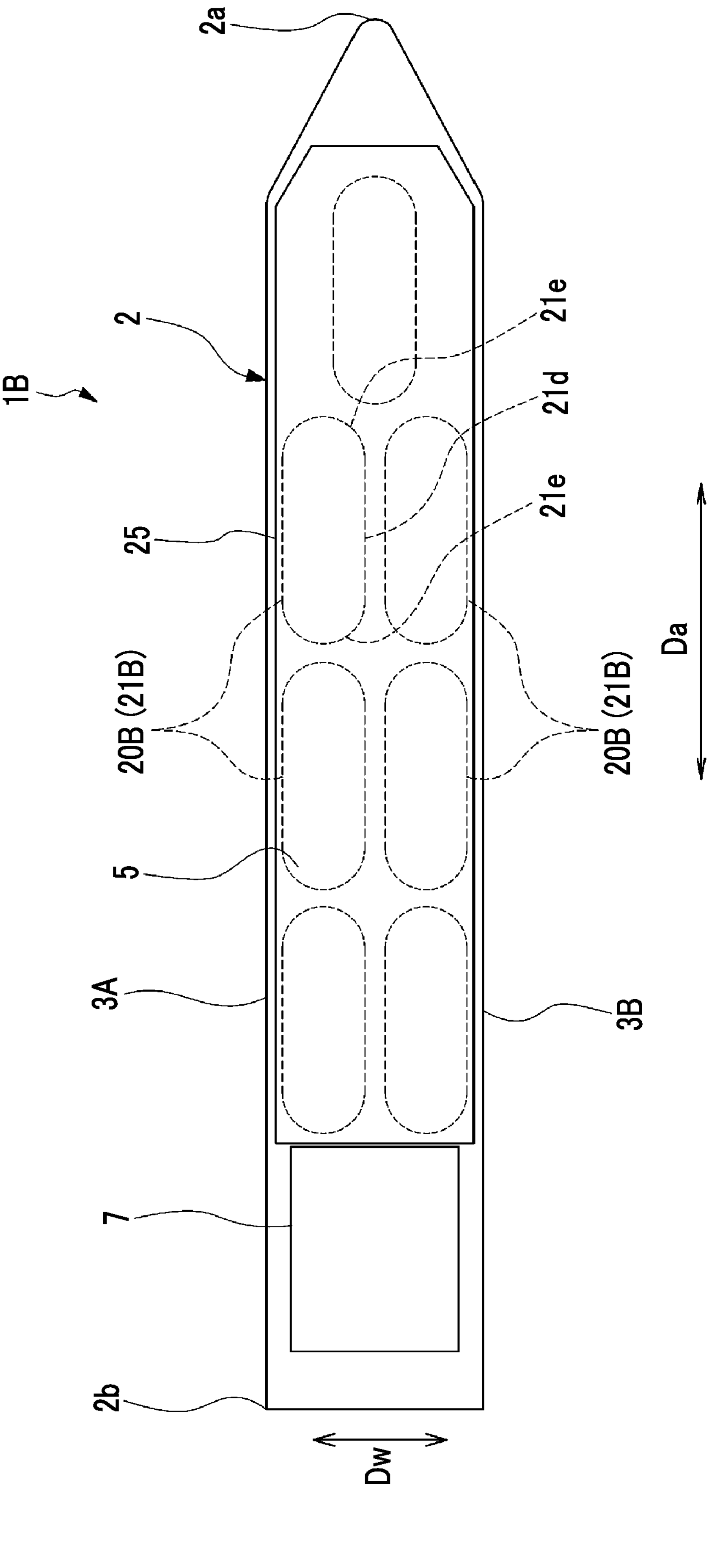


FIG. 4



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2020/048243

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. F17C3/04(2006.01)i, B65D90/02(2019.01)i, B65D90/04(2006.01)i
FI: B65D90/02B, F17C3/04A, B65D90/04A

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)
Int.Cl. F17C3/04, B65D90/02, B65D90/04

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.
X Y	KR 10-2015-0093329 A (HYUNDAI HEAVY INDUSTRIES CO., LTD.) 18 August 2015 (2015-08-18), paragraphs [0019]-[0048], fig. 1-6	1, 3-6 2
Y	JP 2019-90507 A (IHI CORPORATION) 13 June 2019 (2019-06-13), paragraph [0020]	2
Y	JP 2013-32170 A (TAISEI CORPORATION) 14 February 2013 (2013-02-14), paragraph [0063]	2

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

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Date of the actual completion of the international search	Date of mailing of the international search report
03 February 2021	16 February 2021

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

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2020/048243

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 10-2019-0100016 A (GAZTRANSPORT ET TECHNIGAZ) 28 August 2019 (2019-08-28), paragraphs [0048]-[0107], fig. 1-11	1-6
A	JP 2015-512819 A (LNG NEW TECHNOLOGIES AS) 30 April 2015 (2015-04-30), paragraphs [0028]-[0041], fig. 1, 2	1-6

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
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REFERENCES CITED IN THE DESCRIPTION

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- JP 2020027061 A **[0002]**
- JP 6364694 B **[0004]**