

DESCRIPTION

TANK DOME STRUCTURE AND SHIP

Technical Field

[0001]

The present invention relates to a tank dome structure and a ship, and more particularly to a tank dome structure suitable for a ship provided with a tank for storing a liquefied gas, and a ship.

Background Art

[0002]

In recent years, liquefied gases such as a liquefied natural gas (LNG) and a liquefied petroleum gas (LPG) have attracted attention as alternative fuels for heavy oil from the viewpoint of environmental conservation. For example, Patent Literature 1 discloses a configuration in which a fuel tank is arranged in an upper structure arranged on an upper deck of a hull.

[0003]

In addition, a liquefied gas carrying ship is known as a ship including a tank for containing a liquefied gas. For example, a liquefied gas carrying ship described in Patent Literature 2 includes a tank hold compartment formed in a hull, and a tank arranged independently of the hull in the tank hold compartment. In this independent type tank,

a tank dome for connecting a pipe in the tank and a pipe on the hull side is regularly required.

[0004]

The tank dome is generally arranged in a state of protruding to another compartment such as an upper deck in many cases. In addition, the tank hold compartment needs to be regularly surrounded by an airtight partition wall. In addition, since the tank containing the liquefied gas contracts at a low temperature, it is necessary to absorb the displacement. Therefore, as described in Patent Literature 2, an expansion joint (bellows) is arranged at a mating portion between the tank dome and the hull side in many cases.

Citation List

Patent Literature

[0005]

Patent Literature 1: JP 2020-50135 A

Patent Literature 2: JP 2011-7320 A

Summary of Invention

Technical Problem

[0006]

As described in Patent Literature 1, there is also a method of arranging a fuel tank on an upper deck, but it

may be preferable to arrange the fuel tank in a hull from the viewpoint of an installation space problem and weather resistance. In addition, when such an independent system as described in Patent Literature 2 is adopted when a fuel tank is arranged in a hull, a tank dome is required.

[0007]

However, in the tank dome structure described in Patent Literature 2, since the expansion joint (bellows) is disposed at a portion where the tank dome protrudes to another compartment, there is a problem that the tank dome tends to be high.

[0008]

The present invention has been made in view of such problems, and an object of the present invention is to provide a tank dome structure and a ship that can reduce an amount of protrusion of a tank dome to another compartment.

Solution to Problem

[0009]

According to the present invention, there is provided a tank dome structure including a tank dome arranged in an upper portion of a tank that stores a liquefied gas, the tank dome structure including: a deck that forms a part of a tank hold compartment containing the tank and includes an opening portion formed at a position corresponding to the

tank dome; a flange portion extending from a peripheral surface portion of the tank dome so as to be arranged between the tank and the deck; and an expansion joint arranged to seal between the deck and the flange portion.

[0010]

The flange portion may be disposed so as to have a gap with the deck such that the expansion joint can be arranged in the gap between the flange portion and the deck in a normal temperature state of the tank.

[0011]

The deck may include a bracket arranged on a lower surface of a peripheral edge portion of the opening portion and connected to the expansion joint.

[0012]

The tank hold compartment may be formed in a hull, and the deck may be disposed at a position below an upper deck.

[0013]

The tank hold compartment may be formed below a living quarter, or may be formed in front of an engine room.

[0014]

The tank may be a fuel tank using the liquefied gas as a propellant.

[0015]

Further, according to the present invention, there is provided a ship including any of the tank dome structures

described above.

Advantageous Effects of Invention

[0016]

According to the tank dome structure and the ship according to the present invention described above, the flange portion is arranged between the tank and the deck, and the expansion joint is arranged between the deck and the flange portion. Therefore, the expansion joint can be arranged below the deck, and the amount of protrusion of the tank dome to another compartment can be reduced.

Brief Description of Drawings

[0017]

Fig. 1 is an overall configuration diagram illustrating a ship according to an embodiment of the present invention.

Fig. 2 is cross-sectional views of the ship illustrated in Fig. 1, in which (A) is an X-X cross-sectional view and (B) is a Z-Z cross-sectional view.

Fig. 3 is an enlarged view of a portion A of a tank dome structure in a normal temperature state.

Fig. 4 is an enlarged view of the portion A of the tank dome structure in a low temperature state.

Fig. 5 is an enlarged view of a portion A illustrating a modification of the tank dome structure illustrated in

Fig. 3.

Fig. 6 is an overall configuration diagram illustrating a modification of the ship illustrated in Fig. 1.

Description of Embodiments

[0018]

Hereinafter, an embodiment of the present invention will be described with reference to Figs. 1 to 6. Fig. 1 is an overall configuration diagram illustrating a ship according to the embodiment of the present invention. Fig. 2 is cross-sectional views of the ship illustrated in Fig. 1, in which (A) is an X-X cross-sectional view and (B) is a Z-Z cross-sectional view. Fig. 3 is an enlarged view of a portion A of a tank dome structure in a normal temperature state. Fig. 4 is an enlarged view of the portion A of the tank dome structure in a normal temperature state.

[0019]

As illustrated in Fig. 1, a ship 1 according to the embodiment of the present invention includes a tank dome structure 2 including a tank dome 12 arranged in an upper portion of a tank 11 that contains a liquefied gas. The tank dome structure 2 includes a deck 3 that forms a part of a tank hold compartment 13 surrounding the tank 11 and includes an opening portion 31 formed at a position corresponding to the tank dome 12, a flange portion 4

extending from a peripheral surface portion of the tank dome 12 so as to be disposed between the tank 11 and the deck 3, and an expansion joint 5 arranged to seal between the deck 3 and the flange portion 4.

[0020]

Fig. 1 is a side view of the ship 1, but illustrates, for convenience of description, a state in which a portion of a hull where the tank hold compartment 13 is arranged is cut out.

[0021]

The ship 1 is, for example, a container ship, but may be another cargo ship, a working ship, a fishing boat, a special service ship, a warship, or the like as long as it is a ship in which the tank hold compartment 13 can be formed. The ship 1 includes, for example, a living quarter 15 arranged on an upper deck 14. The tank hold compartment 13 is formed, for example, below the living quarter 15.

[0022]

When the ship 1 is a container ship, a space for loading a container cannot be formed below the living quarter 15. Therefore, by arranging the tank hold compartment 13 below the living quarter 15, the tank 11 can be arranged in the hull while suppressing a decrease in loading efficiency of cargo handling.

[0023]

The tank hold compartment 13 is formed in the hull of the ship 1, and includes four partition walls 16 that partition a hold in the front, rear, left, and right directions, a bottom plate 17 arranged in the bulkheads 16, and the deck 3 arranged below the upper deck 14.

[0024]

A tank connection space 18 for connecting a pipe of the tank 11 and a pipe on the hull side is formed above the tank hold compartment 13. A plurality of support blocks 11b that skid support the bottom surface of the tank 11 are arranged on the bottom plate 17.

[0025]

The tank 11 is, for example, an independent type tank separated from the hull. The tank 11 contains a liquefied gas such as a liquefied natural gas (LNG) or a liquefied petroleum gas (LPG). The tank 11 according to the present embodiment is a fuel tank using a liquefied gas as a propellant. The tank 11 is made of, for example, aluminum, and a heat insulating material (not illustrated) is arranged on the entire outer circumferential surface.

[0026]

The tank 11 has, for example, a substantially rectangular parallelepiped shape as a whole, but is not limited to such a shape. The tank 11 in the present embodiment has a shape that is long in the ship width

direction and short in the ship length direction. Although not illustrated, the tank 11 may have a shape that is long in the ship length direction and short in the ship width direction.

[0027]

The tank dome 12 is formed in a cylindrical shape on the upper surface 11a of the tank 11 so as to communicate with the tank 11. The tank dome 12 is a portion forming a space for connecting the pipe in the tank 11 and the pipe on the hull side. For example, as illustrated in Fig. 3, the tank dome 12 has a height h from the upper surface 11a of the tank 11 and is formed so as to protrude into the tank connection space 18 of the adjacent upper compartment.

[0028]

Since the tank 11 contracts in a low temperature state in which the liquefied gas is contained in the tank 11, the tank dome 12 is preferably formed on the center line of the tank 11 in the ship width direction. The position of the tank dome 12 is arbitrarily set according to the tank shape and the contraction amount.

[0029]

The deck 3 is a steel plate welded to the bulkheads 16. The deck 3 has the opening portion 31 formed at the position where the tank dome 12 is arranged. The opening portion 31 is formed in a shape into which the tank dome 12

can be inserted, and is formed such that, for example, an inner edge portion has a certain gap with a peripheral surface of the tank dome 12.

[0030]

In addition, the deck 3 has an annular bracket 32 disposed on the lower surface of the peripheral edge portion of the opening portion 31. For example, as illustrated in Fig. 3, the bracket 32 includes a cylindrical portion extending downward from the lower surface of the deck 3 and a flange portion horizontally expanded at the lower end of the cylindrical portion.

[0031]

The tank 11 is arranged in the tank hold compartment 13 so as to have a predetermined gap with the bulkheads 16 and the deck 3. For example, as illustrated in Fig. 3, a gap g is provided between the upper surface 11a of the tank 11 and the deck 3 in the normal temperature state. The flange portion 4 extending in the horizontal direction is disposed over the entire peripheral surface of the tank dome 12.

[0032]

For example, as illustrated in Fig. 3, the flange portion 4 is arranged so as to be positioned below the bracket 32 in the gap g between the deck 3 and the upper surface 11a of the tank 11. The flange portion of the bracket 32 and the flange portion 4 are arranged so as to

vertically wrap (overlap) each other.

[0033]

The expansion joint 5 is arranged between the flange portion of the bracket 32 and the flange portion 4. That is, the flange portion 4 is arranged so as to have a gap with the deck 3 such that the expansion joint 5 can be arranged in the gap between the deck 3 and the upper surface 11a of the tank 11 in the normal temperature state of the tank 11.

[0034]

The expansion joint 5 has, for example, a cylindrical shape having a circumferential surface having a bellows shape along the axial direction. The expansion joint 5 is, for example, a bellows formed of a thermosetting elastomer such as synthetic rubber or silicone rubber. By arranging the expansion joint 5 between the bracket 32 and the flange portion 4, it is possible to seal the gap g formed between the deck 3 and the upper surface 11a of the tank 11.

[0035]

Both end portions of the expansion joint 5 are fixed to the bracket 32 and the flange portion 4 by fasteners such as bolts and nuts. An adhesive, a sealing material, a heat insulating material, shaped steel, or the like may be interposed between the fastening portions. Note that the configuration related to the fastening portions of the

expansion joint 5 is not limited to the above-described configuration.

[0036]

When a cryogenic liquefied gas is put into the tank 11, the tank 11 contracts. For example, as illustrated in Fig. 4, the gap g' between the deck 3 and the upper surface 11a of the tank 11 in the low temperature state of the tank 11 is larger than the gap g in the normal temperature state. The expansion of the gap g' is absorbed by the expansion of the expansion joint 5.

[0037]

In the present embodiment, since the expansion joint 5 is arranged below the deck 3, a load is generated in the expansion joint 5 in the tensile direction when the tank 11 transitions from the normal temperature state to the low temperature state. In a tank dome arranged in a tank of a conventional liquefied gas carrying ship, since an expansion joint is arranged above a deck, a load is generated in the expansion joint in a compression direction when the tank transitions from a normal temperature state to a low temperature state.

[0038]

Therefore, in the conventional tank dome, it is necessary to secure a sufficient amount of compressive deformation for the expansion joint, and the expansion

joint tends to be long. On the other hand, in the present embodiment, since a load acts in the tensile direction at a low temperature, the expansion joint 5 can be set to a minimum necessary length.

[0039]

In addition, in the conventional tank dome, since the deck is arranged below a flange portion so that rainwater or sea water does not enter the flange portion, an opening portion cannot pass through the flange portion at the time of constructing the deck, and work of constructing the deck in a state where the outer edge of the flange portion is cut and then welding the outer edge of the flange portion has occurred.

[0040]

On the other hand, in the present embodiment, since the tank hold compartment 13 is arranged in the hull, the possibility that rainwater or sea water enters the flange portion 4 is low, and the deck 3 can be disposed above the flange portion 4. Therefore, the tank dome 12 can be inserted through the opening portion 31 of the deck 3 without cutting the outer edge of the flange portion 4, and the construction period can be shortened.

[0041]

Next, a modification of the tank dome structure 2 according to the present embodiment will be described with

reference to Fig. 5. Fig. 5 is an enlarged view of a portion A illustrating the modification of the tank dome structure illustrated in Fig. 3. The same components as those of the tank dome structure 2 illustrated in Fig. 3 are denoted by the same reference numerals, and redundant description is omitted.

[0042]

In the tank dome structure 2 illustrated in Fig. 3, a top portion of the tank dome 12 is higher than the deck 3, and the tank dome 12 is inserted through the opening portion 31. However, as illustrated in Fig. 5, the top portion of the tank dome 12 may be lower than the deck 3. In this case, the flange portion 4 may be configured to extend from the circumferential surface portion of the top portion of the tank dome 12 as illustrated in the drawing.

[0043]

Next, a modification of the ship 1 according to the present embodiment will be described with reference to Fig. 6. Fig. 6 is an overall configuration diagram illustrating the modification of the ship illustrated in Fig. 1. Note that the same components as those of the ship 1 illustrated in Fig. 1 are denoted by the same reference numerals, and redundant description will be omitted.

[0044]

In the ship 1 illustrated in Fig. 1, the tank hold

compartment 13 is arranged below the living quarter 15. However, as illustrated in Fig. 6, the tank hold compartment 13 may be arranged in front of an engine room 19.

[0045]

When the tank 11 is a fuel tank, the length of the pipe can be shortened and the space in the hull can be effectively used by forming the tank hold compartment 13 at a position adjacent to the engine room 19.

[0046]

The position of the tank hold compartment 13 is not limited to a position below the living quarter 15 or a position in front of the engine room 19, and may be another position as long as it is in the hull (position below the upper deck 14).

[0047]

According to the tank dome structure 2 according to the present embodiment described above, the flange portion 4 is arranged between the tank 11 and the deck 3, and the expansion joint 5 is arranged between the deck 3 and the flange portion 4. Therefore, the expansion joint 5 can be disposed below the deck 3, and the amount of protrusion of the tank dome 12 to another compartment (for example, the tank connection space 18) can be reduced.

[0048]

In the above-described embodiment (modifications are included), it is assumed that the tank 11 is a fuel tank, but the tank 11 may be a tank other than the fuel tank as long as it is a tank capable of containing a liquefied gas and capable of being arranged in the hull.

[0049]

The present invention is not limited to the above-described embodiment, and various modifications can be made without departing from the gist of the present invention.

Reference Signs List

[0050]

- 1 ship
- 2 tank dome structure
- 3 deck
- 4 flange portion
- 5 expansion joint
- 11 tank
- 11a upper surface
- 11b support block
- 12 tank dome
- 13 tank hold compartment
- 14 upper deck
- 15 living quarter
- 16 bulkhead

- 17 bottom plate
- 18 tank connection space
- 19 engine room
- 31 opening portion
- 32 bracket

CLAIMS

1. A tank dome structure including a tank dome arranged in an upper portion of a tank that contains a liquefied gas, the tank dome structure comprising:

a deck that forms a part of a tank hold compartment surrounding the tank and includes an opening portion formed at a position corresponding to the tank dome;

a flange portion extending from a peripheral surface portion of the tank dome so as to be arranged between the tank and the deck; and

an expansion joint arranged to seal between the deck and the flange portion.

2. The tank dome structure according to claim 1, wherein the flange portion is arranged so as to have a gap with the deck such that the expansion joint can be arranged in the gap between the flange portion and the deck in a normal temperature state of the tank.

3. The tank dome structure according to claim 1, wherein the deck includes a bracket arranged on a lower surface of a peripheral edge portion of the opening portion and connected to the expansion joint.

4. The tank dome structure according to claim 1, wherein the tank hold compartment is formed in a hull, and the deck is arranged at a position below an upper deck.

5. The tank dome structure according to claim 4, wherein

the tank hold compartment is formed below a living quarter or in front of an engine room.

6. The tank dome structure according to claim 1, wherein the tank is a fuel tank using the liquefied gas as a propellant.

7. A ship comprising the tank dome structure according to any one of claims 1 to 6.