

DESCRIPTION

LNG SHIP OR LPG SHIP

Technical Field

[0001]

The present invention relates to a liquefied natural gas (LNG) ship or a LPG ship.

Background Art

[0002]

It has been increasing LNG demand as clean energy every year since the amount of exhausted nitrogen oxides or sulfurous acid gas in combustion is small. The LNG is liquefaction material obtained by cooling a natural gas to about -162°C . Then, a tank of a LNG carrier transporting the LNG on the sea has a structure in which a cryogenic material is used so as to withstand a wide temperature change and thermal shrinkage and thermal stress caused by a temperature difference are taken into consideration. Further, since the LNG carrier is used to transport a large amount of LNG at a high speed, the LNG carrier generally has a speed of about 20 knots, and its capacity exceeding $200,000\text{ m}^3$ is now planned due to the tendency of an increase in size of a hull.

[0003]

In an existing LNG carrier, a LNG tank mounted thereon is generally divided into two types. One is a moss spherical tank type and the other is a membrane type (for example, see USPN 5697312 and USPN 7137345).

[0004]

In the moss spherical tank type, a spherical tank made of aluminum alloy is fixed into a hold through a skirt-shaped support structure extending downward from the equatorial portion thereof. In the tank, both the weight of the liquid cargo loaded therein and the dynamic force acting on the liquid cargo due to the rolling of ship are directly put on the tank itself, and are transmitted to the hull through the skirt. Of course, a heat insulating material of the tank is provided on the outer surface of the tank.

[0005]

Meanwhile, in the membrane type tank, a heat insulating material is provided inside a double hull structure of a hull and a top surface thereof is liquid-tightly covered by a membrane. In this type tank, the liquid pressure of LNG is transmitted to the hull structure through the heat insulating material. As the membrane, stainless steel or nickel alloy (invar) having a small thermal expansion coefficient is used.

[0006]

Incidentally, since the hold is formed in a substantially box shape, a useless space is inevitably formed around the spherical tank when the moss spherical tank is applied in the hold. For this reason, the moss spherical tank has a disadvantage in that the tank volume is small compared with the size of the hull of both types.

[0007]

Meanwhile, since the membrane type tank can be made in a shape along the hold, a large tank space is obtained, and hence volumetric efficiency is satisfactory. On the contrary, when the membrane type

tank encounters heavy weather in a half load condition, a sloshing phenomenon occurs in which a large pressure is applied (attacked) to the inner wall of the tank due to the harmony of the shaking of the hull and the shaking of the LNG liquid level. That is, the liquid cargo inside the tank is violently ruffled due to the shaking of the hull, and hence the membrane or the heat insulating material is damaged due to the impact. In the spherical tank, since the tank wall is curved, the impact can be smoothly disappeared. Further, since the heat insulating material is provided outside the tank, the sloshing substantially does not cause any problem. Accordingly, in the membrane type tank, there is always a need of full or almost full load condition so that the LNG in the cargo is not ruffled.

[0008]

The moss type and the membrane type are mainly used in the cargo tank of the LNG ship, but these types have merits and demerits as described above. For the use of the LNG ship, it is important to select the ship type based on the enough consideration of the advantages and disadvantages. Here, an independent prismatic tank is developed as an ideal LNG cargo tank in many ship builders in Japan based on the advantages and disadvantages. As an example thereof, a SPB tank manufactured by IHI Corporation is known.

Citation List

Patent Literatures

[0009]

Patent Literature 1: USPN 5697312

Patent Literature 2: USPN 7137365

Technical Problem

[0010]

Unlike the spherical tank, the independent prismatic tank is of an ideal type without any disadvantage in which the tank volume is small compared with the size of the hull of both types.

However, the material of the used plate is limited to a material in which a strength property is exhibited in a cryogenic region, and stainless steel and aluminum are mainly used as the material. For this reason, the independent prismatic tank is disadvantageous comparing with the moss type and the membrane type from an economical viewpoint of building cost, and hence only several ships are built.

[0011]

An object of the invention is to obtain an economical hull structure by employing an independent prismatic tank having a large tank volume with respect to a ship size and reducing material cost.

[0012]

Another object of the invention is to obtain an economical hull structure without a double bulkhead (partition wall) construction between tanks.

[0013]

The other objects will be proved by the following description.
Solution to Problem

[0014]

The invention solves the above-described problems as below.

[0015]

<Invention of claim 1>

ALNG ship having a structure in which a substantially prismatic tank is installed inside a hold while not being integrated with a hull structure material,

wherein the tank is a long tank, which has a larger dimension of a ship longitudinal direction than that of a ship width direction and is installed inside the hold along the ship longitudinal direction, and

the long tank is divided into two or more liquid cargo compartments in the ship longitudinal direction by one or more bulkhead plates, each of which is formed in the ship width direction as one plate.

[0016]

(Operation and Effect)

In the structure in which the tank is installed inside the hold while not being integrated with the hull structure (for example, the double hull structure) material (without any welding structure), there is an economical advantage in that a high-cost material is not needed.

Since a double hull block construction and a long tank production construction can be individually performed at the same time, construction cost is reduced, and the construction can be completed in a short time.

Further, since the tank has a substantially prismatic shape, the volumetric efficiency of the tank is larger than that of the spherical tank.

When a plurality of independent tanks is provided in the hull,

there is a need to construct a double bulkhead between independent tanks in order to prevent influence on other tanks or in order to prevent thermal deformation in the event of, for example, a collision. Such double bulkhead construction and the necessary material thereof cause an increase in cost.

Incidentally, according to the invention, the long tank is divided into two or more liquid cargo compartments in the ship longitudinal direction by one or more bulkhead plates, each of which is formed in the ship width direction as one plate. Thus, the double bulkhead construction between the adjacent liquid cargo compartments (tanks) and the material thereof can be replaced by the bulkhead plate formed as one plate, and hence there is an extremely economical advantage. That is, the double bulkhead plate as a hull major construction member is unnecessary, which means heat insulation construction therefor is also unnecessary.

[0017]

<Invention of claim 2>

The LNG ship according to claim 1, wherein a tank group is formed in the ship longitudinal direction so that tanks, each of which does not have bulkhead, are arranged at the front and rear sides of the long tank, and a space between the long tank and each tank adjacent to the long tank has a cofferdam structure.

[0018]

(Operation and Effect)

The space between the long tank and each tank adjacent to the long tank has the cofferdam structure. The "cofferdam structure"

used above indicates a structure in which a void space is formed between the bulkheads (the partition walls). Thus, heat/gas shielding effect can be ensured in case of fire.

[0019]

<Invention of claim 3>

The LNG ship according to claim 1, wherein the long tank is provided at the left and right sides of a center line direction of the ship as a boundary.

[0020]

(Operation and Effect)

Such configuration provides an advantage in volume when the hull has a large width.

[0021]

<Invention of claim 4>

The LNG ship according to claim 1, wherein a key portion is integrally formed with an upper portion of liquid cargo compartment, which is located at a center in the ship longitudinal direction of the long tank, in a protruding manner and anchor point chocks for thermal deformation are provided in the hull structure material so as to be located at front and rear sides in the center line direction of the ship corresponding to the key portion.

[0022]

(Operation and Effect)

When the anchor point chock for thermal deformation is provided in the key portion, the thermal deformation movement stop of the independent long tank in the ship longitudinal direction can be

prevented.

In order to set the center upper portion of the tank as a thermal deformation center of the tank in the front to back direction, the anchor point chock for thermal deformation having a width in the ship width direction is provided in the hull so as to suppress the movement of the tank in the front to back direction as small as possible, and this point is set as the thermal deformation center. Thus, it is possible to minimize stress in a LNG pipe connected between tanks and an expansion joint connected between a tank and a pipe outside of the tank.

[0023]

<Invention of claim 5>

The LNG ship according to claim 1, wherein the long tank includes two liquid cargo compartments in the ship longitudinal direction, a key portion is integrally formed with a substantially center upper portion of the long tank in the ship longitudinal direction, in a protruding manner and anchor point chocks for thermal deformation are provided in the hull structure material so as to be located at front and rear sides in the center line direction of the ship corresponding to the key portion.

[0024]

(Operation and Effect)

The same operation and effect as those of claim 4 are obtained.

[0025]

<Invention of claim 6>

The LNG ship according to claim 1, wherein an upper portion

of the bulkhead plate of the long tank is separated from a ceiling plate of the long tank so as to form a separation space and the adjacent liquid cargo compartments communicate with each other via the separation space.

[0026]

(Operation and Effect)

As illustrated in Fig. 3, the long tank can be divided into separate liquid cargo compartments by the bulkhead plate. However, in this case, there is a need to control and adjust the liquid level in each liquid cargo compartment. Then, a complicated mechanism of relation between the upper stopper and a vapor dome of the tank corresponding to each liquid cargo compartment is not solved.

On the contrary, as illustrated in Fig. 9, when the adjacent liquid cargo compartments communicate with each other via the separation space separated from the ceiling plate, pressure applied to the adjacent liquid cargo compartments each other is balanced, and hence the liquid level control/adjustment operation can be performed for the adjacent liquid cargo compartments in the same manner as for one liquid cargo compartment. Additionally, the mechanism of relation between the upper stopper and the vapor dome of the tank is simple. Thus, there is an economical advantage.

[0027]

<Invention of claim 7>

The LNG ship according to claim 1, wherein a lower portion of the bulkhead plate of the long tank is separated from a bottom plate of the long tank so as to form a separation space and the

adjacent liquid cargo compartments communicate with each other via the separation space.

[0028]

(Operation and Effect)

As illustrated in Fig. 10, when the adjacent liquid cargo compartments communicate with each other via the separation space separated from the bottom plate, pressure applied to the adjacent liquid cargo compartments each other is balanced, and hence the same effect can be obtained as in claim 6.

[0029]

<Invention of claim 8>

The LNG ship according to claim 1, wherein the LNG ship includes a LNG carrier, FLNG, FSRU, and SRV.

[0030]

(Operation and Effect)

The term of the "LNG ship" of the invention is widely used as a ship including a LNG carrier, FLNG, FSRU, and SRV.

[0031]

<Invention of claim 9>

The LPG ship according to claim 1, wherein LPG is transformed.
Advantageous Effects of Invention

[0032]

As described above, according to the invention, it is possible to obtain the economical hull structure by employing the independent prismatic tank having the large tank volume with respect to the ship size and reducing the material cost.

Further, since the long tank is used, there is an economical advantage since the double bulkhead (partition wall) construction is not needed unlike the conventional ship in which the double bulkhead (partition wall) construction is needed between the tanks.

Brief Description of Drawings

[0033]

Fig. 1 is a front view of a LNG ship.

Fig. 2 is a plane view of the LNG ship.

Fig. 3 is an outline perspective view of a long tank.

Fig. 4 is a cross-sectional view of the LNG ship.

Fig. 5 is a view taken along the line 5-5.

Fig. 6 is a cross-sectional view of another shape example of the long tank.

Fig. 7 is a cross-sectional view of still another shape example of the long tank.

Fig. 8 is a plane view of another example of the LNG ship.

Fig. 9 is an outline perspective view of another long tank example.

Fig. 10 is an outline perspective view of still another long tank example.

Description of Embodiments

[0034]

Hereinafter, an embodiment of the invention will be described with reference to the accompanying drawings.

[0035]

As illustrated in Figs. 1 and 2, a LNG tanker has a structure

in which a bow area 10, a tank space 12, an engine room 14, and a stern area 16 are connected in this order from the upper most front side, and an accommodation area 18 and a steering room 20 are provided above the engine room. The tank space 12 is divided into a plurality of compartments by transfer bulkheads 32.

[0036]

The invention relates to a LNG ship in which each independent tank 30 having a substantially prismatic shape is installed inside a hold while not being integrated with hull (double hull) structure materials 36 and 35.

Further, the bottom surface of the independent prismatic tank 30 is provided with pedestals 36, 36 ... integrated with the hull structure material 35, and the tank 30 is put on the pedestals 36, 36 ...

[0037]

In the invention, in a tank group, at least one tank is set as the independent prismatic long tank 30, which has a larger dimension of a ship longitudinal direction than that of a ship width direction and is installed inside the hold along the ship longitudinal direction,

The long tank 30 is installed inside the hold while not being integrated with the hull structures (for example, the double hull structures) 34 and 35 (without any welding structure), there is an economical advantage in that a high-cost material is not needed. Further, since the shape of long tank 30 cross section is substantially prismatic, the volumetric efficiency of the tank is

larger than that of the spherical tank.

[0038]

The long tank 30 is divided into two or more liquid cargo compartments in the ship longitudinal direction by one or more bulkhead plates 31, each of which is formed in the ship width direction as one plate. The example illustrated in the drawing is an example of three liquid cargo compartments 30-1, 30-2, and 30-3.

[0039]

The plane length and the width of each of the liquid cargo compartments 30-1, 30-2, and 30-3 can be appropriately selected. It is desirable to have the width of 18 to 35 m and to ensure two or three liquid cargo compartments in the ship longitudinal direction. Accordingly, it is desirable that the length in the ship longitudinal direction be 40 to 180 m.

[0040]

Meanwhile, it is desirable to employ a structure in which a key portion 40 is integrally formed with a center upper portion of the long tank 30 in a protruding manner and anchor point chocks for thermal deformation 41 are provided in the hull structure material so as to be located at the front and rear sides in the center line direction of the ship corresponding to the key portion 40. Thus, it is possible to restrict the thermal deformation movement caused by a change in amount of liquid cargo of the tank in the front to back direction.

[0041]

Although not illustrated in the drawings, a heat insulating

material can be provided on the outer surface of the long tank 30.
[0042]

A tank group can be formed in the ship longitudinal direction so that tanks 33, 33, each of which has a liquid cargo compartment and does not have bulkhead 31, are arranged at the front and rear sides of the long tank 30. In this case, it is desirable that a space between the long tank 30 and each tank 33 adjacent to the long tank 30 has a cofferdem structure 32 for insulation.
[0043]

As illustrated in Fig. 8, the long tank 30 can be provided at the left and right sides of a center line direction of the ship as a boundary. Reference sign 31 indicates a bulkhead plate formed in the ship width direction as one plate as in the example of Fig. 2, and reference sign 37 indicates a bulkhead plate formed in the center line direction as one plate. Such configuration provides an advantage in volume when the hull has a large width.
[0044]

The "substantially prismatic independent tank" of the invention may be a rectangular shape in the cross-section as a whole, and does not need to be a precise rectangular shape. For example, as illustrated in Fig. 6, a tank 30C may be provided so that a chamfered portion 30a and a round portion 30b are provided at the corner and an inclined surface 30c is provided in the top surface.
[0045]

Further, as illustrated in Fig. 7, it is possible that a tank 30D includes a small tank 30d at an upper portion and a main tank

30e at a lower portion.

[0046]

As a material of the tank 30, aluminum alloy, 9% nickel steel, stainless steel, or the like can be used.

[0047]

Meanwhile, as illustrated in Fig. 9, an upper portion of the bulkhead plate 31A of the long tank 30 is separated from a ceiling plate 30U of the long tank 30 so as to form a separation space 31U and there is another separation space like the separation space 31U, although the reference sign is not given. Then, the adjacent liquid cargo compartments 30-2, 30-3 communicate with each other via the other separation space in a same manner via the separation space 31U.

[0048]

Further, as illustrated in Fig. 10, a lower portion of the bulkhead plate 31A of the long tank 30 is separated from a ceiling plate 30D of the long tank 30 so as to form a separation space 31D and the adjacent liquid cargo compartments 30-1, 30-2 communicate with each other via the separation space 31D. There is another separation space like the separation space 31D, although the reference sign is not given. Then, the adjacent liquid cargo compartments 30-2 and 30-3 can also communicate with each other via the other separation space in a same manner via the separation space 31D. In the example illustrated in Fig. 10, in addition to the lower separation space 31D, an upper portion of the bulkhead plate 31A is also separated from the ceiling plate 30U of the long

tank 30.

[0049]

The communication may be performed at one of or both the upper and lower portions. Here, it is desirable that the height of the separation space 31U is within 10% of the bulkhead plate 31A and the height of the separation space 31D is within 5% of the bulkhead plate 31A so that the bulkhead plate 31A can prevent sloshing and maintain the mechanical strength of the long tank 30.

[0050]

The above-described embodiments can be used in combination.

Industrial Applicability

[0051]

The invention can be applied to a LNG carrier and in addition, the invention can be applied also to a FLNG (LNG-FPSO (Floating Production, Storage and Off-loading system)), FSRU, and SRV, which require handling of sloshing phenomenon in the same manner as the LNG carrier.

[0052]

In the FLNG (LNG-FPSO), impurities of natural gas from a marine gas field are removed and the natural gas is liquefied to produce LNG so that the LNG is stored on a ship or a barge having a LNG storage capacity. Then, the LNG is shipped off to a LNG ship for carrying the LNG. As compared with a case where a liquefied natural gas plant is constructed on the land, this system has the following advantages: a pipeline from the marine gas field to the land can be reduced; an environmental load can be reduced because development

on the coast is not required; and workers can be comparatively easily secured because the LNG-FPSO is constructed in a country or a region different from those in which a gas field is developed and is towed to the site.

[0053]

The LNG ship of the present invention includes a re-gasification unit and the examples of the re-gasification unit are an FSRU (Floating Storage and Re-gasification Unit) and SRV (Shuttle and Re-gasification Vessel). The FSRU is mounted with a re-gasification unit and fixes a ship having an LNG storage capacity on the sea and receives LNG from the other LNG ship. The natural gas re-gasified by the FSRU is sent out to a pipeline on the land. The SRV does not transfer LNG from the other LNG ship but transports LNG loaded in at a liquefaction base to a demand area, re-gasifies the LNG on the deck, and sends out the re-gasified natural gas to a pipeline on the land.

[0054]

Meanwhile, the structure of the ship according to the invention can be also applied to the transportation of LPG in addition to LNG. Accordingly, the invention covers LPG ship.

Reference Signs List

[0055]

10: bow part, 12: tank space, 14: engine room, 16: stern area, 18: accommodation area, 20: steering room, 30, 30A, 30B: independent prismatic tank, 31: bulkhead plate, 31D, 31U: separation space, 32: transfer bulkhead, 34, 35: hull structure material, 37: bulkhead

plate

CLAIMS

1. An LNG ship having a structure in which a substantially prismatic tank is installed inside a hold while not being integrated with a hull structure material;

wherein the tank is a long tank, which has a larger dimension of a ship longitudinal direction than that of a ship width direction and is installed inside the hold along the ship longitudinal direction, the long tank being divided into two or more liquid cargo compartments in the ship longitudinal direction by one or more bulkhead plates, each of which is formed in the ship width direction as one plate; and

a key portion is provided on the outer surface of the long tank and integrally formed with an upper portion of a liquid cargo compartment;

wherein the key portion is not a component of the long tank;

the liquid cargo compartment is located at a center of the ship in the longitudinal direction of the long tank; and

anchor point chocks for thermal deformation are provided in a protruding manner in the hull structure material and configured to be located above the long tank on a front side and a rear side of the key portion in the center line direction of the ship and facing the key portion.

2. The LNG ship according to claim 1, wherein a tank group is formed in the ship longitudinal direction so that a plurality of tanks, each of which does not have a bulkhead, are arranged at the front

and rear sides of the long tank, and a space between the long tank and each tank adjacent to the long tank has a cofferdam structure.

3. The LNG ship according to claim 1 or 2, wherein the long tank is provided at the left and right sides of a center line direction of the ship as a boundary.

4. The LNG ship according to any one of claims 1 to 3, wherein the long tank includes three liquid cargo compartments in the ship longitudinal direction.

5. The LNG ship according to any one of claims 1 to 4, wherein the long tank includes two liquid cargo compartments in the ship longitudinal direction.

6. The LNG ship according to any one of claims 1 to 5, wherein an upper border line of the bulkhead plate of the long tank is configured to be spaced apart from a ceiling plate of the long tank so as to form a separation space which is located between the upper border line of the bulkhead plate of the long tank and the ceiling plate of the long tank;

the adjacent liquid cargo compartments communicate with each other via the separation space; and

the height of the separation space is within 10% of the bulkhead plate.

7. The LNG ship according to any one of claims 1 to 6, wherein a lower border line of the bulkhead plate of the long tank is configured to be spaced apart from a bottom plate of the long tank so as to form a separation space which is located between the lower border line of the bulkhead plate of the long tank and the bottom plate of the long tank;

the adjacent liquid cargo compartments communicate with each other via the separation space; and

the height of the separation space is within 5% of the bulkhead plate.

8. The LNG ship according to any one of claims 1 to 7, wherein the LNG ship includes a LNG carrier, FLNG, FSRU, and SRV.

9. The LPG ship according to any one of claims 1 to 8, wherein LPG is transferable.