

【DESCRIPTION】

【Invention Title】

FLOATING STRUCTURE WITH A FUEL GAS TANK

【Technical Field】

The present invention relates to a floating structure with a fuel gas tank, and more particularly, to a floating structure with a fuel gas tank for storing a gaseous fuel fed to a dual fuel propulsion system disposed under a cargo space.

【Background Art】

Generally, various ships such as a bulk carrier, a container ship, a passenger ship, or the like, have employed a fuel supply system using heavy oil (HFO or MDO) such as a bunker C oil, that is a liquid fuel, as propulsion fuel.

In the existing fuel supply system, if heavy oil, or the like, used as fuel combust, it causes serious environmental pollution due to harmful substances included in exhaust gas. Since a demand for preventing environmental pollution is increasingly regulated throughout the whole world, regulations for a propulsion system using heavy oil as fuel oil have also been

reinforced. As a result, costs have been continuously increased in order to meet these regulations.

In addition, when oil prices increase due to factors such as depletion of fossil fuel, localized insecurity, or the like, several operational problems such as the rapid increase of fuel expenses of a ship using heavy oil as fuel, etc., are caused.

Therefore, research into a fuel supply system, etc., using clean fuel such as LNG (or, LPG, CNG, DME, etc.), that is a liquefied or gaseous fuel without using heavy oil (or, MDO) or instead of using a minimum amount of heavy oil, as fuel oil of various ships, mainly using LNG (or, LPG, CNG, DME, etc.) as fuel when heavy oil (or MDO) is expensive or standards required for environmental protection are increased, and mainly using heavy oil (or, MDO) when heavy oil (or MDO) is cheap or environmental standards are weak has been continuously conducted.

【Disclosure】

【Technical Problem】

The present has been made in an effort to provide a floating structure with a fuel gas tank having advantages of efficiently using a space by disposing a fuel gas tank for storing a gaseous fuel fed to a dual fuel propulsion

system disposed under a cargo space.

【Advantageous Effects】

According to the present invention, the floating structure with the fuel gas tank for storing a gaseous fuel supplied to the dual fuel propulsion system disposed under the cargo space is provided.

As a result, according to the floating structure according to the present invention, it is possible to efficiently use the space in the hull and over the upper deck.

【Description of Drawings】

FIG. 1 is a side cross-sectional view schematically showing a floating structure with a dual fuel propulsion system according to an exemplary embodiment of the present invention;

FIG. 2 is a side cross-sectional view schematically showing a floating structure with a dual fuel propulsion system according to another exemplary embodiment of the present invention;

FIG. 3 is a diagram for explaining a method for additionally mounting another type of fuel tank in a floating structure designed and built to have only one type

of fuel tank;

FIG. 4 is a side cross-sectional view schematically showing a floating structure with a dual fuel propulsion system according to another exemplary embodiment of the present invention;

FIG. 5 is a diagram for explaining a concept selectively receiving different types of fuel in the same space according to the present invention;

FIG. 6 is a side view schematically showing a floating structure when a fuel gas tank is disposed under an accommodation space;

FIG. 7 is a magnified view of a major part of FIG. 6;

FIG. 8 is a side view schematically showing a floating structure when a fuel gas tank is disposed under a cargo space; and

FIG. 9 is a magnified view of major parts of FIG. 8.

<DESCRIPTION OF THE SYMBOLS IN MAIN PORTIONS OF THE DRAWINGS>

1:hull	1a:bow portion
1b:stern portion	1c:additional hull portion
1d:opening	3:fuel tank for liquid fuel
4:fuel gas tank	5:propulsion system
7:storage tank	9:removable fuel tank

101a:upper deck	102:accommodation space
104:fuel tank	105:propulsion system
106:engine room	108:machinery space
114:cargo space	115:freight
116:coffer dam	118:A-60 bulkhead

【Best Mode】

According to an aspect of the present invention, there is provided a floating structure with a fuel gas tank storing a gaseous fuel used as fuel while floating at sea. The floating structure with the fuel gas tank includes: a fuel gas tank disposed in the hull of the floating structure; and a cargo space disposed on the top of the fuel gas tank on the upper deck of the floating structure.

The floating structure may further include a blocking member disposed between the cargo space and the fuel gas tank to secure the safety of the freight loaded in the cargo space.

The blocking member may be a coffer dam formed to have a void space between a pair of bulk heads.

The blocking member may be a bulkhead capable of blocking heat and gas generated during a fire.

The bulkhead capable of blocking heat and gas generated during a fire may be disposed between the coffer

dam and the cargo space.

A machinery space for treating fuel stored in the fuel gas tank may be disposed over the fuel gas tank and the blocking member may be disposed between the machinery space and the cargo space.

The fuel stored in the fuel gas tank may be a liquefied gas and the machinery space may include at least one of a re-condenser, a pump, a cooler, a vaporizer, and a boil off gas compressor for treating the liquefied gas to be used in a propulsion system or a power generation apparatus.

The floating structure may further include a propulsion system using a gaseous fuel stored in the fuel gas tank as fuel.

The propulsion system may be a high pressure gas injection engine or a low pressure gas injection engine capable of generating power using dual fuel. In addition, the propulsion system may be a gas turbine.

The fuel gas tank may be removed from the hull. The floating structure may further include the fuel tank for liquid fuel stored to use at least one of heavy oil and diesel oil as fuel.

The fuel gas tank may be an independent tank capable of storing a liquefied gas.

The floating structure may be a ship that can be voyaged under one's own power by the propulsion system, wherein the ship may be a container ship.

According to another aspect of the present invention, there is provided a floating structure with a fuel gas tank storing a gaseous fuel used as fuel and used while floating at sea. The floating structure with the fuel gas tank includes: a fuel gas tank disposed in the hull of the floating structure; a cargo space disposed on the top of the fuel gas tank on the upper deck of the floating structure; and a coffer dam disposed between the cargo space and the fuel gas tank to secure the safety of the freight loaded in the cargo space; and a bulkhead capable of blocking heat and gas generated during a fire.

According to another aspect of the present invention, there is provided a ship with a fuel gas tank storing a gaseous fuel used as fuel and used while floating at sea. The ship with the fuel gas tank includes: a fuel gas tank disposed in the hull of the ship; a cargo space disposed on the top portion of the fuel gas tank on the upper deck of the ship; a blocking member disposed between the accommodation space and the fuel gas tank to secure the safety of the freight loaded in the cargo space; and a propulsion system generating propulsion power using a

gaseous fuel stored in the fuel gas tank as fuel.

【Mode for Invention】

Hereinafter, a floating structure having a dual fuel propulsion system according to an exemplary embodiment of the present invention will be described in detail with reference to the accompanying drawings.

FIGS. 1 to 4 are schematic side views of a floating structure with a dual fuel propulsion system according to various exemplary embodiments.

As shown in FIG. 1, a floating structure having a dual fuel propulsion system includes a plurality of fuel tanks 3 and 4 for storing fuel in a hull 1 and a propulsion system 5 generating propulsion power by fuel fed from the fuel tanks 3 and 4.

The dual fuel propulsion system may be configured to include the above-mentioned plurality of fuel tanks 3 and 4 and propulsion system 5 and a pipe capable of feeding fuel received in each of the fuel tanks 3 and 4 to the propulsion system 5.

The floating structure used herein implies a offshore plant such as an oil FPSO used while floating anywhere at sea at normal times, in addition to various ships such as a bulk carrier, a container ship, a passenger ship, or the

like.

As shown in FIG. 1, when the floating structure is a bulk carrier, a liquid cargo carrier, etc., it may include at least one storage tank 7 capable of storing freights in addition to the fuel tanks 3 and 4. The storage tanks 7 may also receive freights usable as fuel. In this case, it is to be noted that it is different from fuel stored in the fuel tank in the specification since it is handled as freights, not fuel.

According to the exemplary embodiment, a liquefied fuel such as heavy oil (HFO) or diesel oil (MDO), etc., generally widely used as fuel for the propulsion system may be stored in a part of the fuel tanks 3 and 4 (i.e., a fuel tank 3 for liquid fuel) and any one of the gaseous fuels such as LPG, LNG, DME, CNG, or the like, may be stored in the remaining fuel tank (i.e., a fuel tank 4 for fuel gas).

The liquid fuel and gaseous fuel used herein are determined according to whether fuel fed to the propulsion system, that is, the engine is liquid or gas. That is, fuel such as heavy oil, diesel oil, etc., maintaining a liquid state when being fed to the propulsion system is referred to as a liquid fuel and fuel such as LNG, LPG, DME, CNG, or the like, fed as a gas state when being fed to the propulsion system even though a liquid state or a gas state

is present when being stored in the fuel tank is referred to as gas fuel.

Generally, as fuel other than heavy oil, it is preferable to use fuel gas containing hydrocarbon component, such as LNG, LPG, CNG, or the like.

LNG, i.e., liquefied natural gas is generated by liquefying natural gas collected from a gas field, wherein the main component of the liquefied natural gas is methane. LNG is advantageous in respects to space efficiency by reducing its volume to approximately 1/600 when being liquefied by lowering the temperature or applying pressure, but should be charged in a specifically insulated tank or container to keep temperature at a boiling point or less during transportation and storage, since it has a low boiling point of approximately -162°C .

LPG, i.e., liquefied petroleum gas is generated by cooling and liquefying heavy hydrocarbon (two or more carbon atoms) component generated at the time of collecting crude oil from an oil field or purifying crude oil or heavy hydrocarbon component collected together at the time of collecting natural gas at a relatively low pressure ($6 \sim 7 \text{ kg/cm}^2$). LNG is advantageous in terms of storage and transportation since the volume thereof is reduced to approximately 1/250 at the time of liquefying, wherein the

main component thereof is propane and butane and may include a small amount of ethane, propylene, butylene, or the like.

CNG, i.e., compressed natural gas is generated by compressing natural gas at approximately 20 MPa to use the natural gas as fuel.

DME, i.e., dimethyl ether is a kind of ether and has lower flammability than the LPG and low toxicity and has a small environmental effect since a small amount of exhaust fume is generated during combustion due to high oxygen concentration.

Each of the fuel tanks 3 and 4 includes an appropriate insulation system and sealing system according to a type of fuel to be received. In particular, an example of the fuel tank receiving liquefying gas such as LNG, LPG, or the like, may include a membrane type tank or an independent type tank that has been used in the liquefying gas storage tank field.

Although FIG. 1 shows that both the fuel tank 3 for liquid fuel and the fuel gas tank 4 (for example, LNG, LPG, DME, CNG, or the like) are mounted in the hull 1 of the floating structure, the fuel tank 3 for liquefied fuel may be modified to be mounted in the hull 1 of the floating structure and the fuel gas tank 4 may be modified to be

mounted on the deck of the floating structure. In addition, the fuel gas tank 4 may be modified to be mounted in the hull 1 of the floating structure and the fuel tank 3 for liquid fuel may be modified to be mounted on the deck of the floating structure.

Meanwhile, an example of the propulsion system 5 may include a low pressure gas injection engine such as, for example, dual fuel diesel electric (DFDE), a high pressure gas injection engine such as, for example, ME-GI (Gas Injection Engine available from Man B&W Co.), and a gas turbine, or the like. If the propulsion system uses at least two types of fuels as fuel, any propulsion system may be used.

In the specification, the meanings "capable of using at least two types of fuels" include a concept of using a mixture of at least two types of fuels while using at least two types of fuels and a concept of selectively using at least one of two or more fuels, if necessary, while using at least two types of fuels.

FIG. 3 shows a diagram for explaining a method for additionally mounting the fuel gas tank 4 such as, another kind, for example, LNG, etc., in the floating structure designed and built to have one type, for example, only the fuel tank 3 for liquid fuel.

According to the method shown in FIG. 3, the hull of the floating structure is separated into two portions, that is, a bow portion 1a and a stern portion 1b by being divided at any position. An additional hull portion 1c having the fuel tank 4 embedded therein is inserted between the bow portion 1a and the stern portion 1b and is integrated into one hull by welding.

According to the present invention, a method for additionally mounting the fuel tank in the hull as shown in FIG. 3 as well as a method for additionally mounting the fuel tank on the deck on the floating structure as shown in FIG. 2 may be used.

When the plurality of fuel tanks 3 and 4 capable of storing two or more kinds of fuels from the initial design are mounted in the hull 1 as shown in FIG. 1 or when the fuel tank 4 capable of storing another kind of fuel is added to the hull 1 as shown in FIG. 3, these fuel tanks 3 and 4 may be configured to permanently attach to the hull 1 and may be configured to be removed, if necessary, as shown in FIG. 4.

As shown in FIG. 4, when the removable fuel tank 9 is provided, the fuel tank capable of storing fuel, that is larger amount used, may be selectively mounted in consideration of the usage of fuel. As factors for

determining the usage of fuel, there may be a kind of propulsion system, the price of fuel, season, and environmental factor, or the like.

For example, the fuel tank 3 for liquefied fuel such as heavy oil and the fuel gas tank 4 such as LNG, etc., are each installed in the hull of the floating structure and the removable fuel tank 9 as the fuel tank for liquid fuel is additionally mounted in the hull of the floating structure if it is expected that the usage of liquid fuel among these fuels will be increased and the removable fuel tank 9 as the fuel gas tank may be additionally mounted if it is expected that the usage of the gas fuel will be increased.

In addition, when the amount of fuel is small, the removable fuel tank 9 is removed and the empty space in the hull formed thereby may be used as a space for loading freight.

For example, since the gaseous fuel such as LNG, or the like, has density lower than the liquid fuel such as HFO, etc., the removable fuel tank 9 is removed when the only the liquid fuel having relatively higher density is used and the space in the hull formed thereby is used as a cargo space, etc., and then, when the gaseous fuel is mainly used, the fuel gas tank as the removable fuel tank 9

may be used by being mounted therein.

In addition, according to the present invention, it may be configured to store different kinds of fuel in one space, for example, one fuel tank 3 or 4, if necessary, as shown in FIG. 5. For example, LNG or LPG may be selectively stored in the same space, if necessary, and heavy oil or diesel oil may be selectively stored in the same space, if necessary.

As such, according to the present invention, different kinds of fuel tanks may be selectively received in one space as shown in FIG. 4 and different kinds of fuel may be selectively received in the same space as shown in FIG. 5.

Hereinafter, an example of when the dual fuel propulsion system is mounted as the propulsion system and the present invention is applied to a container ship having the fuel gas tank for storing gaseous fuel to be fed to the dual fuel propulsion system will be described with reference to FIGS. 6 to 9.

FIG. 6 is a side view for schematically showing the floating structure, i.e., the container ship when the fuel gas tank is mounted under the accommodation space and FIG. 7 is a magnified view of main parts of FIG. 6. FIG. 8 is a side view for schematically showing the floating structure,

i.e., the container ship when the fuel gas tank is mounted under the cargo space and FIG. 9 is a magnified view of the main parts of FIG. 8.

In the container ship, a plurality of containers are loaded in the hull and on a upper deck 101a other than an accommodation space 102 in which crewmen reside, an engine room 106 in which the propulsion system 105 is mounted, a space in which the LNG fuel tank 104 is mounted, a machinery space 108, or the like. When the size of the container ship is large, it is preferable to move from the stern of the accommodation space 102 to the central portion of the hull to secure the field of view. As a result, the lower space of the accommodation space 102 which is difficult to load containers is used as a space in which the LNG fuel tank 104 is disposed, in order to efficiently use the space. In the specification, the central part of the hull implies a portion in front of the bow of the hull in which the propulsion system 105 is mounted and does not necessarily imply the central portion of the length direction of the hull.

The inventors propose a method for using liquefied gas such as LNG (or LPG, DME), etc., as fuel of the propulsion system for propelling a cargo ship such as a container ship, in order to meet the price increase of

liquid fuel, such as heavy oil or diesel oil, etc., while avoiding the increasingly reinforced environmental regulations. To this end, the dual fuel propulsion system, such as the high pressure gas injection engine such as ME-GI and the low pressure gas injection engine such as DFDE capable of using the dual fuel as fuel, etc., is used.

FIGS. 6 and 7 show that the ME-GI is used as the propulsion system 105 and the LNG fuel tank 104 as the fuel gas tank is mounted under the accommodation space 102 and FIGS. 8 and 9 show that the ME-GI is used as the propulsion system 105 and the LNG fuel tank 104 as the fuel gas tank is installed under the cargo space 114, but the present invention is not limited thereto. The heavy oil fuel tank as the fuel tank for liquid fuel for storing heavy oil to be used as fuel together with LNG in the propulsion system 105 may be mounted under the accommodation space 102, together with the LNG fuel tank 104 and may also be mounted in the hull.

According to the present invention, at least one of the LNG fuel tank and the heavy oil fuel tank may be removed from the hull and may be replaced with other kinds of fuel tank. In addition, according to the present invention, the number of LNG fuel tanks and the number of heavy oil fuel tanks mounted in the hull may be controlled

according to the usage of fuel.

The membrane type tank or the independent type tank may be used as the LNG fuel tank 104, in particular, an IMO type B tank may be used. That is, in order for the LNG fuel tank 104 to be removed from the inside of the hull, it is preferable to use the independent type tank. Among various kinds of independent tanks, the IMO type B tank where the hull protecting member is mounted below the tank (between the tank and the floor inside the hull) as a secondary barrier is preferably used.

Various apparatuses for feeding fuel to the dual fuel propulsion system (gas injection engine) as the propulsion system 105 are preferably disposed in the machinery space 108 disposed over the LNG fuel tank 104. As the fuel supply system for supplying LNG to the engine as fuel, there are the re-condenser, the high pressure pump, the cooler, the high pressure vaporizer, the boil off gas compressor, or the like.

When the liquefied gas in the extremely low temperature state is used as fuel, the proper insulation is required for the fuel supply system, such that it is preferable that the LNG fuel tank 104 as the fuel tank and the machinery space 108 is maximally close to each other. The increased distance between the LNG fuel tank 104 and

the machinery space 108 is not preferable, since heat loss is increased in view of the insulation aspect for the transferring pipe for transferring LNG.

In addition, as shown in FIG. 7, when the LNG fuel tank 104 is disposed under the accommodation space 102, it is preferable that the machinery space 108 is disposed between the LNG fuel tank 104 and the accommodation space 102. As described above, since it is difficult to load freights 115 such as container, etc., under the accommodation space 102, it is preferable to use this space as a space where the LNG fuel tank 104 will be disposed. Further, since it is preferable that the machinery space 108 is close to the LNG fuel tank 104, it is preferable to dispose the machinery space 108 over the LNG fuel tank 104 while being disposed under the accommodation space 102.

Further, it is preferable in terms of maintenance to dispose the machinery space 108 between the accommodation space 102 and the LNG fuel tank 104.

In order to feed the LNG as fuel stored in the LNG fuel tank to the ME-GI engine as the propulsion system 105, the LNG is fed to the propulsion system 105 through the machinery space 108. In this case, in order to feed the LNG as fuel from the machinery space 108 to the propulsion system 105, a fuel feeding pipe may be mounted under the

hull or at the side thereof.

The LNG fuel tank 104 and the machinery space 108 are classified as a gas dangerous space and the accommodation space 102 disposed on the upper deck 101a is classified as a gas safe space. Therefore, when fire or the leakage of fuel, i.e., LNG occurs in the LNG fuel tank 104 or the machinery space 108 that is a gas dangerous space, there is a need to secure the safety of crewmen, passengers, or freight by blocking the gas safe space from the gas dangerous space.

To this end, according to the present invention, a coffer dam 116 is formed over the machinery space 108 and the deck between the coffer dam 116 and the accommodation space 102 is formed of bulkhead capable of blocking heat and gas, such as, for example, an A-60 bulkhead 118, etc., when fire occurs. The coffer dam 116 and the bulkhead 118 may serve as a blocking member for safety.

FIGS. 7 and 9 shows the A-60 bulkhead 118 as a bulkhead capable of blocking heat and gas, but the present invention is not limited thereto. Any bulkhead may be used if it can block heat and gas when fire occurs.

Meanwhile, the bottom of the LNG fuel tank 104, i.e., the floor of the hull is formed of a duplication floor.

The coffer dam 116 implies a structure where an empty

space between a pair of bulk heads, that is, a void space is formed. In addition, the A-60 bulkhead 118 implies a bulkhead (formed by single gas tight bulkhead of all-welld construction) securing insulation and gas cutoff for 60 minutes when fire occurs.

The coffer dam 116 and the A-60 bulkhead 118 may be used to partition between the cargo space 114 and the LNG fuel tank 104 as shown in FIGS. 8 and 9. Although FIG. 9 shows that the machinery space 108 is omitted and the coffer dam 116 is disposed over the LNG fuel tank 104, the machinery space 108 may be disposed between the LNG fuel tank 104 and the coffer dam 116 as shown in FIG. 7.

At least two types of fuel tanks 104 may be disposed in parallel according to a width direction of the hull and the length of the LNG fuel tank 104 may have a dimension approximately corresponding to a container of a length of 40ft as shown in FIG. 9.

According to the present invention, the removable LNG fuel tank 104 may be mounted from the hull and may store the gaseous fuel such as LPG, CNG, DME, etc., in addition to LNG. In addition, the fuel tank for liquid fuel storing liquid fuel such as heavy oil or diesel oil, etc., is mounted in parallel with the LNG fuel tank 104 in left or right or front and back directions and may be installed in

a separate place in the hull.

Although the example where the fuel tank for two different fuels is mounted in the floating structure is described above, the present invention may mount the fuel tank for at least three different fuels.

Although the price and efficiency for each fuel may be changed according to times and several factors, the present invention may be used for propulsion by selectively employing the most efficient fuel at the present time. In addition, when the development of an electric propulsion system or a solar power generation or a wind power generation system having excellent efficiency is completed in a short period of time, the present invention may configure a multi fuel propulsion system using the system.

In addition, although the example where the fuel from the fuel tank is fed to the propulsion system configured of the gas injection engine such as the ME-GI engine or the DFDE engine, or the like, is described, the fuel may be fed to the gas turbine, etc., in addition to the above-mentioned engines for power generation.

As described above, although the floating structure with the fuel gas tank according to the present invention is described with reference to the accompanying drawings, the present invention is not limited to the above exemplary

embodiments and drawings and thus, may be variously modified and changed by those skilled in the art to which the present invention pertains.

【CLAIMS】

【Claim 1】

A floating structure with a fuel gas tank storing a gaseous fuel used as fuel while floating at sea, comprising:

a fuel gas tank disposed in the hull of the floating structure;

a cargo space disposed on the top of the fuel gas tank on the upper deck of the floating structure; and

a blocking member disposed between the cargo space and the fuel gas tank to secure the safety of the freight loaded in the cargo space.

【Claim 2】

The floating structure with a fuel gas tank of claim 1, wherein the blocking member is a coffer dam configured by forming a void space between a pair of bulkheads.

【Claim 3】

The floating structure with a fuel gas tank of claim 1, wherein the blocking member is a bulkhead blocking heat and gas generated during fire.

【Claim 4】

The floating structure with a fuel gas tank of claim 2, wherein the bulkhead blocking heat and gas generated during fire is disposed between the coffer dam and the cargo space.

【Claim 5】

The floating structure with a fuel gas tank of claim 1, wherein a machinery space for treating fuel stored in the fuel gas tank is disposed over the fuel gas tank and the blocking member is disposed between the machinery space and the cargo space.

【Claim 6】

The floating structure with a fuel gas tank of claim 5, wherein the fuel stored in the fuel gas tank is a liquefied gas, and

the machinery space is provided with at least one of a re-condenser, a pump, a cooler, a vaporizer, and a boil off gas compressor to use the liquefied gas in a propulsion system or a power generation apparatus.

【Claim 7】

The floating structure with a fuel gas tank of claim 1, further comprising a propulsion system using the gaseous

fuel stored in the fuel gas tank as fuel.

【Claim 8】

The floating structure with a fuel gas tank of claim 7, wherein the propulsion system is a high pressure gas injection engine or a low pressure gas injection engine generating power by using dual fuel.

【Claim 9】

The floating structure with a fuel gas tank of claim 7, wherein the propulsion system is a gas turbine.

【Claim 10】

The floating structure with a fuel gas tank of claim 1, wherein the fuel gas tank is removable from the hull.

【Claim 11】

The floating structure with a fuel gas tank of claim 8, further comprising a fuel tank for liquid fuel storing at least one of heavy oil and diesel oil as fuel.

【Claim 12】

The floating structure with a fuel gas tank of claim 1, wherein the fuel gas tank is an independent type tank

storing liquefied gas.정

【Claim 13】

The floating structure with a fuel gas tank of claim 1, wherein the floating structure is a ship voyaged under one's own power by the propulsion system.

【Claim 14】

The floating structure with a fuel gas tank of claim 13, wherein the ship is a container ship.