

DESCRIPTION

LIQUEFIED-GAS TRANSPORT VESSEL AND LIQUEFIED-GAS TRANSPORT VESSEL DESIGNING METHOD

Technical Field

[0001]

The present invention relates to a liquefied-gas transport vessel which is suitable for short-distance transport and coastal regional secondary transport, which has a medium-sized capacity of 60,000 m³ to 90,000 m³ and which corresponds to multiple gases, and to a liquefied-gas transport vessel designing method.

Background Art

[0002]

An LNG vessel which transports LNG (liquefied natural gas) is increasingly larger, and it is considered that the number of large LNG vessels will be increased in the future. In the transport of LNG, the main component of the LNG is methane (CH₄), the pressure of LNG in a liquid state at the time of transport is atmospheric pressure, the temperature is minus 162°C and the liquid specific gravity of methane that is a main component, is 0.43 but the liquid specific gravity is 0.43 to 0.48 in terms of the composition component ratio of LNG. Accordingly, a thermal insulation construction such as a

heat-insulating layer is provided in order to keep a tank at a low temperature. In addition, since the specific gravity of the liquefied natural gas is as very low as 0.5 or less, a tank structure whose volume is large with respect to a hull is provided.

[0003]

In recent years, as to the ship transport of LNG, it has been gradually necessary to perform short-distance transport and coastal regional secondary transport by using a vessel. In particular, large numbers of LNG-receiving land tanks in Japan have a size of 60,000 m³ to 90,000 m³, and in response to this, medium-sized LNG vessels of 60,000 m³ to 90,000 m³ are actually present but membrane-type LNG vessels are mainly in service.

[0004]

However, this membrane-type tank is vulnerable to sloshing, its navigation in a partial loading state in which generation of sloshing is concerned is not allowed, whether the tank is fully loaded or is empty is selected, and thus it is not possible to perform partial loading and unloading necessary for a voyage in which LNG is distributed to multiple ports, with the result that there is a problem that the membrane-type tank is not suitable for a liquefied-gas transport vessel which is used for short-distance transport such as regional secondary transport and which have a medium-sized capacity of 60,000 m³ to 90,000 m³.

[0005]

As measures for the sloshing as disclosed in, for example,

Japanese Patent Laid-Open No. 06-123569, the adoption of a MOSS-type low-temperature liquefied gas tank can be considered, and an LNG vessel having 3 to 5 MOSS-type low-temperature liquefied gas tanks is disclosed although the transport scale is not disclosed.

[0006]

On the other hand, with respect to medium-sized liquefied-gas transport, there are cases where transport is carried out exclusively for LNG, but in recent years, not only the transport of LNG but also the transport of ethane (C_2H_6) and ethylene (C_2H_4) also increases. Accordingly, from the viewpoint of the efficient utilization of a liquefied-gas transport vessel, it is necessary that the transport of ethane and ethylene can be performed in addition to the transport of LNG and LPG.

[0007]

However, with respect to LPG (liquefied petroleum gas), the similar medium-sized LPG vessel has been used, and with respect to ethylene, an ethylene vessel which has an ethylene loading weight of 3,500 tons has been in service, but there has not yet been manufactured a medium-sized liquefied-gas transport vessel which can be loaded with and can transport multiple gases such as LNG, LPG, ethane and ethylene by using the same liquefied-gas transport vessel depending on the situation and which has a capacity of 60,000 m³ to 90,000 m³.

[0008]

LPG is a liquefied gas which has propane, butane and the

like as main components and which is easily liquefied at a relatively high temperature even under atmospheric pressure, is heavier than LNG, and has a larger amount of heat per unit volume than LNG. For example, under atmospheric pressure (about 1.0 atmospheric pressure), butane is liquefied at minus 0.5°C to minus 11.7°C, and propane is liquefied at minus 42.1°C.

[0009]

In addition, ethane is a component which is second most contained in natural gas after methane, and can be obtained from a petroleum gas as a by-product at the time of refinement. The boiling point of ethane is minus 89°C at normal pressure, and the specific gravity of the liquid is 0.55. The boiling point of ethylene is minus 104°C at normal pressure, and the specific gravity at the time of transport is 0.57. The temperature and the pressure of ethylene in a liquid state at the time of transport are, respectively, minus 104°C and 0.1 MPa (about 1.0 atmospheric pressure).

[0010]

When an LNG vessel is loaded with ethylene as it is, in terms of thermal insulation, the temperature of ethylene at the time of transport is minus 104°C as compared with minus 162°C in a case of LNG, and since both the pressures of LNG and ethylene at the time of transport are normally atmospheric pressure, the temperature and the pressures at the time of transport are sufficient in terms of temperature management and pressure management. However, the liquid specific gravity of ethylene is 0.57 while the liquid specific gravity of LNG at the time

of transport is 0.50 or less, and thus the tank strength is insufficient, with the result that the LNG vessel cannot be loaded with and cannot transport ethylene.

[0011]

Furthermore, when the LNG vessel is loaded with ethylene as it is due to the difference in the liquid specific gravities, the center of gravity of the entire vessel at the time of transport is rised, and thus stability with respect to heel required for its navigation is not sufficient. Namely, a carrying vessel exclusively for LNG cannot transport ethylene and the like, and thus there is a problem that it is difficult to utilize the carrying vessel exclusively for LNG as a medium-sized liquefied-gas transport vessel which often transports a large number of types of multiple gases.

[0012]

Moreover, with respect to a liquefied-gas transport vessel designing method, when, for example, a MOSS-type liquefied-gas-carrying vessel exclusively for LNG is designed, it is planned that the breadth of a hull is constantly the same, and the diameter of a tank is determined such that the carrying vessel can be equipped with thermal insulation of the tank for LNG, whereas when a liquefied-gas transport vessel exclusively for ethane is designed, the diameter of a tank is increased along with the decrease in the thermal insulation thickness, and thus the capacity of the tank is maximized. For example, in order that the capacity of the tank may be maximized, the equator portion of a MOSS-type spherical tank is elongated as long as

the stability of the present vessel is allowed, and thus the capacity of the tank is maximized. That is, when there is designed a liquefied-gas transport vessel which transports a dedicated liquefied gas for each type, the designing is performed in accordance with a property of the dedicated liquefied gas, and thus a major challenge is determination to which of the liquefied gases an individual design item is made to correspond in the case of a multi-cargo of LNG, LPG, ethane, ethylene and the like.

Citation List

Patent Literature

[0013]

PTL 1: Japanese Patent Laid-Open No. 06-123569

Summary of Invention

Technical Problem

[0014]

The present invention has been made in view of the forgoing situation, and an object thereof is to provide a liquefied-gas transport vessel which can efficiently transport liquefied gas of not only LNG but also multiple gases such as LPG, ethane and ethylene for intraregional transport and short-distance transport and which has the function enabling loading and unloading at multiple ports and a liquefied-gas transport vessel designing method.

Solution to Problem

[0015]

A liquefied-gas transport vessel for achieving the object described above is a liquefied-gas transport vessel loaded with a MOSS-type low-temperature liquefied gas tank, wherein a total loading capacity of the low-temperature liquefied gas tank is equal to or more than 60,000 m³ but equal to or less than 90,000 m³, the low-temperature liquefied gas tank includes a thermal insulation construction for LNG, a structural strength of the low-temperature liquefied gas tank and a structural strength of a cargo hold loaded with the low-temperature liquefied gas tank are configured so as to allow loading of LNG, ethane, ethylene or LPG, and a hull structure is configured so as to include a sufficient freeboard and stability with respect to heel for the navigation when performing a navigation, in each of three cases, that is, a case where all the low-temperature liquefied gas tanks are loaded with LNG, a case where all the low-temperature liquefied gas tanks are loaded with ethane, ethylene or LPG and a case where the low-temperature liquefied gas tanks are mix-loaded with two or more of LNG, ethane, ethylene and LPG.

[0016]

In this configuration, the total loading capacity of the low-temperature liquefied gas tanks is equal to or more than 60,000 m³ but equal to or less than 90,000 m³, and thus with this medium-sized liquefied-gas transport vessel, it is possible to efficiently perform the medium-sized and

short-distance transport of the liquefied gas.

[0017]

Furthermore, since a MOSS-type low-temperature liquefied gas tank in which sloshing problem is unlikely to occur and which can perform transport in a partial loading state is mounted, it is possible to solve the sloshing problem caused by a liquefied gas liquid, by adoption of the MOSS-type low-temperature liquefied gas tank. As a result, it becomes possible to perform its navigation in a partial loading state of the tank which cannot be performed due to sloshing by the liquefied-gas transport vessel of a membrane-type tank having a conventional technology, with the result that it becomes possible to perform the unloading of a small amount at multiple ports.

[0018]

With respect to the thermal insulation construction of the low-temperature liquefied gas tank, the thermal insulation construction for LNG which can cope with a temperature of minus 162°C at the time of transport is provided, and thus the thermal insulation construction is also effective for ethylene whose temperature at time of transport is minus 104°C.

[0019]

Moreover, in particular, when mixed loading can be performed, the liquid specific gravity at the time of transport is a large factor for the structural strength of the MOSS-type low-temperature liquefied gas tank, and thus the tank is configured to so as have the structural strength for 0.55 which

is the liquid specific gravity of ethane or 0.57 which is the liquid specific gravity of ethylene, and which is a larger one of the liquid specific gravities of LNG, and ethane or ethylene at the time of transport. In addition, the tank is configured to so as have the strength which can also cope with the full-loading state and the partial loading state for LNG, and ethane or ethylene whose specific gravities are different from each other. Accordingly, the MOSS-type low-temperature liquefied gas tank can be loaded with LNG, and ethane or ethylene, and LPG in which the conditions of the pressure, the boiling point and the specific gravity at the time of transport are alleviated or are substantially equal thereto can also be loaded and transported through the use of the same method.

[0020]

Furthermore, the strength of the vessel hull which performs a voyage while supporting the MOSS-type low-temperature liquefied gas tanks is sufficient enough to cope with LNG in terms of temperature, and is also sufficient enough to be able to perform a voyage while supporting the MOSS-type low-temperature liquefied gas tanks even in a state where the MOSS-type low-temperature liquefied gas tanks are loaded with ethane, ethylene or LPG whose specific gravity is higher.

[0021]

In addition, with respect to the hull, even in a case where the MOSS-type low-temperature liquefied gas tanks are loaded with LNG whose specific gravity is relatively low, it is

possible to secure draft required for the navigation, even in a case where the MOSS-type low-temperature liquefied gas tanks are loaded with ethane, ethylene or LPG whose specific gravity is relatively high, it is possible to secure freeboard and stability required for the navigation, and even when the MOSS-type low-temperature liquefied gas tanks are mix-loaded with two or more of LNG, ethane, ethylene and LPG whose specific gravities are different from each other, it is possible to secure freeboard and stability and to acquire the trim (longitudinal inclination) of the vessel, appropriate for the navigation. These are sufficiently possible within the range of conventional technologies by securing the capacity of the ballast water tanks and setting the arrangement of the ballast water tanks and the shape of the hull.

[0022]

There is formed the medium-sized liquefied-gas transport vessel which has a total loading capacity of the low-temperature liquefied gas tanks that is equal to or more than 60,000 m³ but equal to or less than 90,000 m³ and which can be loaded with multiple gases, by the combination of the MOSS-type low-temperature liquefied gas tanks, the thermal insulation construction for LNG, the structural strength of the tank for LNG, ethane, ethylene or LPG, the structural strength of the cargo hold, and the hull structure that can cope with the mixed loading of two or more of LNG, ethane, ethylene and LPG.

[0023]

Namely, it becomes possible to provide the liquefied-gas

transport vessel which can efficiently transport a medium-sized liquefied gas, which can cope with loading and unloading at multiple ports and which can be engaged in medium-sized liquefied-gas transport so as to transport a liquefied gas having a capacity that is equal to or more than 60,000 m³ but equal to or less than 90,000 m³, by the combination of the transport scale, the MOSS-type low-temperature liquefied gas tank, the structural strength of the low-temperature liquefied gas tank that copes with multiple gases, the structural strength of the cargo hold, the structural strength of the hull structure that copes with multiple gases, and the securement of freeboard and stability at the time of voyage which cope with multiple gases.

[0024]

In other words, the configuration is such that the liquefied-gas transport vessel transports the low-temperature liquefied gases such as LNG, ethane, ethylene and LPG, and can be used as a dedicated vessel for each of the liquefied gases, and can cope with being used as a multiple-gas carrier that can change cargos in accordance with the application of liquefied gas, by permanent installation of or additional provision of a liquefying device and a gas processing device when needed.

[0025]

In the liquefied-gas transport vessel configured as described above, when the loading number of low-temperature liquefied gas tanks is three, the capacity of one tank is equal to or more than 20,000 m³ but equal to or less than 30,000 m³,

it is possible to perform its navigation while maintaining high transport efficiency through the use of the three tanks and efficiently performing a small amount of unloading at a terminal for gas consumer in medium-sized liquefied-gas transport.

[0026]

In the liquefied-gas transport vessel configured as described above, when a cargo machine room is arranged in front of the low-temperature liquefied gas tank in a forefront portion, and in one area, several areas or all areas between the low-temperature liquefied gas tanks, there is arranged a manifold for piping connection which connects piping on a cargo-handling facility on the land or on the sea, the following effects are produced.

[0027]

In the liquefied-gas transport vessel having the three MOSS-type tanks, when the cargo machine room is arranged between the tanks as in a conventional method, troubles are caused in the proper arrangement of the manifold compatible with the piping of a shore terminal on the land or on the sea, and thus in this configuration, the cargo machine room is arranged not between the low-temperature liquefied gas tanks but in front of the low-temperature liquefied gas tank (the first tank) in the forefront portion, and the manifold for piping connection is arranged in one area, several areas or all areas between the low-temperature liquefied gas tanks, with the result that it is possible to enhance compatibility with the cargo-handling facility on the land or on the sea.

[0028]

Furthermore, the cargo machine room is arranged in a narrow portion between the low-temperature liquefied gas tanks, and thus as compared with the conventional technology of adopting a three-story structure using the first floor portion of the cargo machine room as a passage space in a fore-aft direction, in this configuration, the cargo machine room is arranged in front of the low-temperature liquefied gas tank (the first tank) in the forefront portion, with result that it is possible to utilize the entire breadth of a deck. Accordingly, it is possible to suppress the installation height by providing a one-story or two-story structure while securing the passage space on both sides of port and starboard of the vessel, and thus it is possible to reduce the wind pressure resistance and lower the height of the center of gravity.

[0029]

A liquefied-gas transport vessel designing method for achieving the object described above is a liquefied-gas transport vessel designing method of a liquefied-gas transport vessel loaded with a MOSS-type low-temperature liquefied gas tank, the method including: a tank designing step of performing a design such that a total loading capacity of the low-temperature liquefied gas tank is equal to or more than $60,000 \text{ m}^3$ but equal to or less than $90,000 \text{ m}^3$, such that the low-temperature liquefied gas tank has a thermal insulation specification for LNG and such that a structural strength of the low-temperature liquefied gas tank and a structural

strength of a cargo hold loaded with the low-temperature liquefied gas tank are configured to be structural strengths for LNG, ethane, ethylene or LPG; and a hull designing step of designing a hull structure so as to allow a navigation, in each of three cases, that is, a case where all the low-temperature liquefied gas tanks are loaded with LNG, a case where all the low-temperature liquefied gas tanks are loaded with ethane, ethylene or LPG and a case where the low-temperature liquefied gas tanks are mix-loaded with two or more of LNG, ethane, ethylene and LPG.

[0030]

Namely, in particular, when mixed loading can be performed, the MOSS-type cargo tank is designed so as to be capable of coping with thermal contraction and a high load such that the requirement for the extremely low temperature of LNG is satisfied and such that the requirement for loading of the high specific gravity of ethane, ethylene or LPG is satisfied. The liquefied-gas transport vessel transports low-temperature liquefied gases such as LNG, ethane, ethylene and LPG and can also be used as a dedicated vessel for each of the liquefied gases, and the liquefied-gas transport vessel is configured so as to be able to cope with being used as a multiple-gas carrier that can change cargos in accordance with the type of liquefied gas, by additional provision of a liquefying device and a gas processing device when needed.

[0031]

In the liquefied-gas transport vessel designing method

configured described above, the tank designing step includes a tank capacity determination step of designing the low-temperature liquefied gas tank such that the loading number of the low-temperature liquefied gas tanks is three and such that a capacity of one tank is equal to or more than 20,000 m³ but equal to or less than 30,000 m³, and thus it is possible to efficiently design the liquefied-gas transport vessel which can perform its navigation while maintaining high transport efficiency through the use of the three tanks and efficiently performing a small amount of unloading at a terminal for gas consumer in medium-sized liquefied-gas transport.

[0032]

In the liquefied-gas transport vessel designing method described above, the hull designing step includes an existing tank utilization step in which, on an assumption that the low-temperature liquefied gas tank in an existing LNG vessel having a MOSS-type low-temperature liquefied gas tank whose capacity is equal to or more than 125,000 m³ but equal to or less than 135,000 m³ is removed and mounted, the hull structure is designed in accordance with the low-temperature liquefied gas tank in the existing LNG vessel, and thus it becomes unnecessary to redesign the MOSS-type low-temperature liquefied gas tank and it is possible to efficiently design the liquefied-gas transport vessel.

[0033]

In the liquefied-gas transport vessel designing method described above, the method further including: a tank periphery

designing step in which a cargo machine room is arranged in front of the low-temperature liquefied gas tank in a forefront portion, and in which in one area, several areas or all areas between the low-temperature liquefied gas tanks, there is arranged a manifold for piping connection that connects piping on the cargo-handling facility on land or on sea, and thus it is possible to efficiently design: the manifold for piping connection in which compatibility with the cargo-handling facility on the land or on the sea is enhanced; and the liquefied-gas transport vessel in which, while securing a passage space on both sides of port and starboard of the vessel, the installation height is suppressed by adoption of a one-story or two-story structure, the wind pressure resistance is reduced and the cargo machine room where the center of gravity is lowered is included.

Advantageous Effects of Invention

[0034]

According to the liquefied-gas transport vessel and the liquefied-gas transport vessel designing method in the present invention, it is possible to provide a liquefied-gas transport vessel which can efficiently transport liquefied gas of not only LNG but also multiple gases such as ethane and ethylene for intraregional transport and short-distance transport, and which has the function enabling loading and unloading at multiple ports.

Brief Description of Drawings

[0035]

[Fig. 1] Fig. 1 is a side view schematically showing the configuration of a liquefied-gas transport vessel in an embodiment according to the present invention.

[Fig. 2] Fig. 2 is a diagram schematically showing a liquefied-gas transport vessel designing method in the embodiment according to the present invention.

Description of Embodiments

[0036]

A liquefied-gas transport vessel and a liquefied-gas transport vessel designing method in an embodiment according to the present invention will be described below with reference to drawings. Note that, although the following description will be given using ethylene as a target, even when ethane is used as the target, the liquid specific gravity of ethylene which is 0.57 is replaced with the liquid specific gravity of ethane which is 0.55, and thus the present invention can be applied. Furthermore, the present invention can also be applied to LPG by appropriate correction of the boiling point and the specific gravity.

[0037]

First, the liquefied-gas transport vessel in the embodiment according to the present invention will be described. As shown in Fig. 1, in the liquefied-gas transport vessel 1, three MOSS-type low-temperature liquefied gas tanks 10 are

mounted in a cargo hold 4 having a double bottom in which a cargo hold bottom plate 3 is provided on a vessel bottom 2. It is assumed that the total loading capacity of the three low-temperature liquefied gas tanks is equal to or more than 60,000 m³ but equal to or less than 90,000 m³ and that the tank capacity of one low-temperature liquefied gas tank 10 is equal to or more than 20,000 m³ but equal to or less than 30,000 m³. Accordingly, while high transport efficiency is maintained by setting of the number of the tanks as three, the unloading of a small amount at a terminal for gas consumer in medium-sized liquefied-gas transport is efficiently performed, and its navigation can be performed.

[0038]

Furthermore, a propeller 5 and a rudder 6 for the navigation are provided at the stern of the vessel, an engine room 7 storing the main engine (not shown) which drive the propeller 5 and an auxiliary engine is further provided and a superstructure 8 where a accommodation space and a bridge are arranged is provided on the engine room 7. In front of the superstructure 8, the low-temperature liquefied gas tanks 10 are mounted in the cargo hold 4 in a state where the upper sides of the spherical low-temperature liquefied gas tanks 10 protrude above an upper deck 9.

[0039]

In the present invention, the total loading capacity of the low-temperature liquefied gas tanks is equal to or more than 60,000 m³ but equal to or less than 90,000 m³, and thus a

medium-sized liquefied-gas transport vessel can be provided to thereby give a liquefied-gas transport vessel that efficiently performs medium-sized and short-distance transport of the liquefied gas, with the result that it is possible to achieve the efficiency of medium-sized liquefied-gas transport.

[0040]

Since there is adopted, as the low-temperature liquefied gas tank 10, a MOSS-type liquefied-gas tank in which sloshing problem is unlikely to occur and which can perform transport in a partial loading state, it is possible to solve the sloshing problem caused by a liquefied gas liquid, and it becomes possible to perform its navigation in the partial loading state of the tank which cannot be performed by the liquefied-gas transport vessel of a membrane-type tank having a conventional technology due to sloshing, with the result that it becomes possible to perform the unloading of a small amount at multiple ports.

[0041]

Furthermore, in the low-temperature liquefied gas tank 10, a thermal insulation construction for LNG is provided. Namely, the thermal insulation construction for LNG which can cope with a temperature of minus 162°C at the time of transport is provided, and thus the thermal insulation construction is also effective for ethylene whose temperature at time of transport is minus 104°C.

[0042]

Along with that, in particular, in a case where mixed

loading can be performed, the structural strength of the low-temperature liquefied gas tank 10 is configured so as to allow the loading of ethylene. Namely, since the liquid specific gravity at the time of transport becomes a large factor for the structural strength of the MOSS-type low-temperature liquefied gas tank 10, the tank 10 is configured so as to have the structural strength for the liquid specific gravity of ethylene which is 0.57 (0.55 in a case of ethane) and which is a larger one of the liquid specific gravities of LNG and ethylene at the time of transport. In addition, there is set the strength that can cope with the full-loading state and the partial loading state for both LNG and ethylene whose specific gravities are different from each other. Accordingly, the MOSS-type low-temperature liquefied gas tank 10 can be loaded with both LNG and ethylene.

[0043]

Furthermore, the structural strength of the cargo hold 4 loaded with the low-temperature liquefied gas tank 10 is configured so as to allow the loading of ethylene. Accordingly, the structural strength of the cargo hold 4 is set to strength that can also cope with the full-loading state of ethylene.

[0044]

In addition, with respect to the hull structure, the structure of the hull is configured such that the strength of the hull that performs a voyage while supporting the MOSS-type low-temperature liquefied gas tank is sufficient enough to cope with LNG in terms of temperature, and such that the hull

structure is configured so as to have the whole strength which is sufficient enough to cope with ethylene in terms of load.
[0045]

Along with that, with respect to the hull, the hull is configured so as to include a sufficient freeboard and stability with respect to heel for the navigation when performing a navigation, in each of three cases, that is, a case where all the low-temperature liquefied gas tanks 10 are loaded with LNG whose specific gravity is relatively low, a case where all the low-temperature liquefied gas tanks 10 are loaded with ethylene whose specific gravity is relatively high and a case where the low-temperature liquefied gas tanks 10 are mix-loaded with LNG and ethylene.

[0046]

Accordingly, even in a case where the low-temperature liquefied gas tanks are loaded with LNG whose specific gravity is relatively low, it is possible to secure draft required for its navigation, even in a case where the low-temperature liquefied gas tanks are loaded with ethylene whose specific gravity is relatively high, it is possible to secure freeboard and stability required for its navigation, and even when the low-temperature liquefied gas tanks are mix-loaded with LNG and ethylene whose specific gravities are different from each other, the trim (longitudinal inclination) of the vessel, appropriate for its navigation, can be set. Namely, even in a case where the low-temperature liquefied gas tanks are loaded with only LNG whose specific gravity is relatively low, even in a state

where the low-temperature liquefied gas tanks are loaded with only ethylene whose specific gravity is relatively high or even in a case where the low-temperature liquefied gas tanks are mix-loaded with LNG and ethylene, the configuration is such that it is possible to secure sufficient stability and perform a safe voyage. These configurations can be sufficiently achieved with known conventional technologies by ensuring the capacity of ballast water tanks and setting the arrangement of the ballast water tanks and the shape of the hull.

[0047]

According to the liquefied-gas transport vessel 1 having the configuration as described above, the medium-sized liquefied-gas transport vessel in which the total loading capacity of the low-temperature liquefied gas tanks is equal to or more than 60,000 m³ but equal to or less than 90,000 m³ can be formed by the combination of the MOSS-type low-temperature liquefied gas tank 10, the thermal insulation construction for LNG in the low-temperature liquefied gas tank 10, the structural strength of the low-temperature liquefied gas tank 10 for ethylene, the structural strength of the cargo hold 4 for ethylene, the hull structure that can cope with both LNG and ethylene, the ballast water system and the shape of the hull, with the result that the liquefied-gas transport vessel is loaded with multiple gases and thereby can perform efficient distribution.

[0048]

Namely, it is possible to provide the liquefied-gas

transport vessel which can efficiently transport a medium-sized liquefied gas, which can cope with loading and unloading at multiple ports and which can be engaged in medium-sized liquefied-gas transport so as to transport a liquefied gas having a capacity that is equal to or more than 60,000 m³ but equal to or less than 90,000 m³, by the combination of the transport scale, the MOSS-type low-temperature liquefied gas tank, the structural strength of the tank capable of coping with multiple gases, the structural strength of the cargo hold, the structural strength of the hull structure, and the securement of draft, trim and stability at the time of voyage.

[0049]

In other words, the configuration is such that the liquefied-gas transport vessel transports the low-temperature liquefied gases such as LNG, ethane, ethylene and LPG, and can be used as a dedicated vessel for each of the liquefied gases, and can cope with being used as a multiple-gas carrier that can change cargos in accordance with the application of liquefied gas, by permanent installation of or additional provision of a liquefying device and a gas processing device when needed.

[0050]

Then, furthermore, as shown in Fig. 1, a cargo machine room (solidly painted portion) 11 is arranged in front of the low-temperature liquefied gas tank 10 in the forefront portion. Along with that, in one area, several areas, or all the areas between the low-temperature liquefied gas tanks 10 (in Fig. 1, all the areas therebetween, that is, two positions (four

positions including both sides of the vessel)), there is arranged a manifold for piping connection (cross-hatched portion) 12 which connects piping on the cargo-handling facility on the land or on the sea.

[0051]

Accordingly, in the liquefied-gas transport vessel having the three MOSS-type tanks, it is possible to solve a problem in which, when the cargo machine room is arranged between the tanks as in a conventional method, there are generated troubles in the proper arrangement of the manifold compatible with the piping of a shore terminal on the land or on the sea, with the result that it is possible to enhance compatibility with the cargo-handling facility on the land or on the sea.

[0052]

Furthermore, it is possible to solve a problem in which, in the conventional technology, the cargo machine room is arranged in a narrow portion between the low-temperature liquefied gas tanks and thereby, a three-story structure is compelled to be adopted through the use of the first floor portion of the cargo machine room as a passage space in a fore-aft direction, the wind pressure resistance of the cargo machine room is increased and the height of the center of gravity is rised, and it is possible to provide a one-story or two-story structure of the cargo machine room 11 while securing passage space on both sides of port and starboard of the vessel by utilization of the entire breadth of the upper deck 9, to thereby

suppress the installation height, with the result that it becomes possible to reduce the wind pressure resistance and lower the center of gravity.

[0053]

Next, a liquefied-gas transport vessel designing method in the embodiment according to the present invention will be described. The liquefied-gas transport vessel designing method is a method of designing the liquefied-gas transport vessel 1 loaded with the MOSS-type low-temperature liquefied gas tanks 10, and as shown in Fig. 2, a process in this designing method, that is, a process S1 of designing the liquefied-gas transport vessel includes a tank designing step S10, a tank periphery designing step S20, and a hull designing step S30.

[0054]

In the tank designing step S10, the total loading capacity of the low-temperature liquefied gas tanks 10 is equal to or more than $60,000 \text{ m}^3$ but equal to or less than $90,000 \text{ m}^3$, and the thermal insulation specifications of the low-temperature liquefied gas tank 10 are thermal insulation specifications for LNG. Along with that, in particular, when mixed loading can be performed, the structural strength of the low-temperature liquefied gas tank 10 and the structural strength of the cargo hold 4 loaded with the low-temperature liquefied gas tanks 10 are designed to be the structural strengths for ethylene.

[0055]

Namely, the MOSS-type low-temperature liquefied gas tank 10 is designed to be capable of coping with thermal contraction

and a high load such that the requirement for the extremely low temperature of LNG is satisfied and such that the requirement for loading of the high specific gravity of ethylene can be satisfied. The liquefied-gas transport vessel 1 transports liquefied gases such as LNG, LPG, ethane and ethylene, and can also be used as a dedicated vessel for each of the liquefied gases, and the configuration is such that the liquefied-gas transport vessel can also be used as a multiple-gas carrier that can change cargos in accordance with the type of liquefied gas, by additional provision of a liquefying device and a gas processing device when needed.

[0056]

In addition, the tank designing step S10 is preferably configured so as to include a tank capacity determination step S11 of designing the tank such that the loading number of low-temperature liquefied gas tanks 10 is three and such that the capacity of one tank is equal to or more than $20,000 \text{ m}^3$ but equal to or less than $30,000 \text{ m}^3$. Accordingly, it is possible to design the liquefied-gas transport vessel which maintains high transport efficiency through the use of the three tanks and which can perform its navigation while efficiently performing a small amount of unloading at a terminal for gas-consumer in medium-sized liquefied-gas transport.

[0057]

Then, furthermore, in the tank periphery designing step S20, the cargo machine room 11 is arranged in front of the low-temperature liquefied gas tank 10 in the forefront portion,

and moreover, in one area, several areas, or all the areas between the low-temperature liquefied gas tanks 10 (in Fig. 1, all the areas therebetween), there is designed to be arranged the manifold for piping connection 12 which connects piping on the cargo-handling facility on the land or on the sea.

[0058]

Accordingly, it is possible to efficiently design the liquefied-gas transport vessel that includes: the manifold for piping connection 12 in which compatibility with the cargo-handling facility on the land or on the sea is enhanced; and the cargo machine room 11 in which, while the passage space is secured on both sides of port and starboard of the vessel, the installation height is suppressed by adoption of a one-story or two-story structure, the wind pressure resistance is reduced and the center of gravity is lowered. Note that the tank periphery designing step S20 may be configured so as to be included in the tank designing step S10 or the hull designing step S30.

[0059]

In addition, in the hull designing step S30, the hull structure is designed so as to allow its navigation in each of the three cases, that is, the case where all the low-temperature liquefied gas tanks 10 are loaded with LNG, the case where all the low-temperature liquefied gas tanks 10 are loaded with ethylene and the case where the low-temperature liquefied gas tanks 10 are mix-loaded with LNG and ethylene.

[0060]

Furthermore, the hull designing step S30 is preferably configured so as to include an existing tank utilization step S31 in which, on the assumption that low-temperature liquefied gas tanks 10 in an existing LNG vessel having, for example, 4 or 5 MOSS-type low-temperature liquefied gas tanks 10 whose capacity is equal to or more than $125,000 \text{ m}^3$ but equal to or less than $135,000 \text{ m}^3$ are removed, recycled and mounted, the hull structure is designed in accordance with the low-temperature liquefied gas tank 10 in the existing LNG vessel. Accordingly, it becomes unnecessary to redesign the MOSS-type low-temperature liquefied gas tank 10, and thus it becomes possible to efficiently design the liquefied-gas transport vessel 1.

Industrial Applicability

[0061]

According to the liquefied-gas transport vessel and the liquefied-gas transport vessel designing method in the present invention, it is possible to provide the liquefied-gas transport vessel which efficiently can transport liquefied gas of not only LNG but also multiple gases such as, LPG, ethane and ethylene for intraregional transport or short-distance transport and which has the function enabling loading and unloading at multiple ports, and thus the present invention can be utilized for a large number of medium-sized liquefied-gas transport vessels.

Reference Signs List

[0062]

- 1 liquefied-gas transport vessel
- 2 vessel bottom
- 3 cargo hold bottom plate
- 4 cargo hold
- 5 propeller
- 6 rudder
- 7 engine room
- 8 superstructure
- 9 upper deck
- 10 low-temperature liquefied gas tank
- 11 cargo machine room
- 12 manifold for piping connection

CLAIMS

1. A liquefied-gas transport vessel loaded with a MOSS-type low-temperature liquefied gas tank,

wherein a total loading capacity of the low-temperature liquefied gas tank is equal to or more than 60,000 m³ but equal to or less than 90,000 m³,

the low-temperature liquefied gas tank includes a thermal insulation construction for LNG,

a structural strength of the low-temperature liquefied gas tank and a structural strength of a cargo hold loaded with the low-temperature liquefied gas tank are configured so as to allow loading of LNG, ethane, ethylene or LPG, and

a hull structure is configured so as to include a sufficient freeboard and stability with respect to heel for the navigation when performing a navigation, in each of three cases, that is, a case where all the low-temperature liquefied gas tanks are loaded with LNG, a case where all the low-temperature liquefied gas tanks are loaded with ethane, ethylene or LPG and a case where the low-temperature liquefied gas tanks are mix-loaded with two or more of LNG, ethane, ethylene and LPG.

2. The liquefied-gas transport vessel according to claim 1,

wherein a loading number of the low-temperature liquefied gas tanks is three, and a capacity of one tank is equal to or more than 20,000 m³ but equal to or less than 30,000 m³.

3. The liquefied-gas transport vessel according to claim 1 or 2,

wherein a cargo machine room is arranged in front of the low-temperature liquefied gas tank in a forefront portion, and in one area, several areas or all areas between the low-temperature liquefied gas tanks, a manifold for piping connection is arranged that connects piping on a cargo-handling facility on land or on sea.

4. A liquefied-gas transport vessel designing method of a liquefied-gas transport vessel loaded with a MOSS-type low-temperature liquefied gas tank, the method comprising:

a tank designing step of performing a design such that a total loading capacity of the low-temperature liquefied gas tank is equal to or more than 60,000 m³ but equal to or less than 90,000 m³, such that the low-temperature liquefied gas tank has a thermal insulation specification for LNG and such that a structural strength of the low-temperature liquefied gas tank and a structural strength of a cargo hold loaded with the low-temperature liquefied gas tank are configured to be structural strengths for LNG, ethane, ethylene or LPG; and

a hull designing step of designing a hull structure so as to allow a navigation, in each of three cases, that is, a case where all the low-temperature liquefied gas tanks are loaded with LNG, a case where all the low-temperature liquefied gas tanks are loaded with ethane, ethylene or LPG and a case where the low-temperature liquefied gas tanks are mix-loaded

with two or more of LNG, ethane, ethylene and LPG.

5. The liquefied-gas transport vessel designing method according to claim 4,

wherein the tank designing step includes a tank capacity determination step of designing the low-temperature liquefied gas tank such that a loading number of the low-temperature liquefied gas tanks is three and such that a capacity of one tank is equal to or more than 20,000 m³ but equal to or less than 30,000 m³.

6. The liquefied-gas transport vessel designing method according to claim 4 or 5,

wherein the hull designing step includes an existing tank utilization step in which, on an assumption that the low-temperature liquefied gas tank in an existing LNG vessel having a MOSS-type low-temperature liquefied gas tank whose capacity is equal to or more than 125,000 m³ but equal to or less than 135,000 m³ is removed and mounted, the hull structure is designed in accordance with the low-temperature liquefied gas tank in the existing LNG vessel.

7. The liquefied-gas transport vessel designing method according to any one of claims 4 to 6, the method further comprising:

a tank periphery designing step in which a cargo machine room is arranged in front of the low-temperature liquefied gas

tank in a forefront portion, and in which in one area, several areas or all areas between the low-temperature liquefied gas tanks, there is arranged a manifold for piping connection that connects piping on a cargo-handling facility on land or on sea.