

DESCRIPTION

SHIP-TYPE STRUCTURE AND METHOD FOR DESIGNING SHIP-TYPE STRUCTURE

Technical Field

[0001]

The present invention relates to a ship-type structure and a method for designing a ship-type structure having a tank constitution shared between a tanker and a floating offshore storage structure.

Background Art

[0002]

Recently, a floating ocean petroleum/gas production, storage and offloading system called FPSO and a floating ocean petroleum/gas storage offloading system called FSO are used for development and use of submarine energy resources.

[0003]

This FPSO is a facility for producing petroleum/gas on the ocean, storing a product in a tank in the facility and directly offloading it on a tanker, and the FSO is a facility not having a facility of producing petroleum/gas but dedicated for storage and offloading on the ocean and a facility for receiving a crude oil produced in a fixed producing facility, a floating producing facility not having a storage facility such

as a TLP (tension leg platform) or an onshore producing facility or the like and storing it in a tank in the facility and offloading it to a transport tanker. Here, they are collectively referred to as a floating offshore storage structure.

[0004]

As illustrated in Figs. 7 and 8, the floating offshore storage structure for storing petroleum, a liquefied natural gas and the like on the ocean has a structure for storage extremely similar to a hull structure of a tanker for transporting petroleum or petroleum products as illustrated in Figs. 9 and 10 in an aspect that a liquid cargo is stored in a structure floating on the ocean.

[0005]

The "floating offshore storage structure" here means a structure floating on the ocean not having a propelling device for self-navigation, such as a tanker is provided, but having a cargo tank for storing a liquid cargo such as petroleum, a liquefied natural gas and the like as FPSO and FSO.

[0006]

Then, as illustrated in Fig. 7, in a floating offshore storage structure 1X, in addition to a superstructure 30 for an accommodation section, an associated gas combusting device 31, a producing facility (process, topside) 32 such as an oil treatment facility, a gas treatment facility, a water treatment facility, a power generation facility, a crane 33, a mooring facility (turret) 34 to which a mooring rope connected to an

anchor on a tip end side and a riser pipe (flow line) are connected, a heliport (not shown) and the like are provided, while as illustrated in Fig. 9, a tanker 1Y is provided with an engine room 20 on a rear part of a hull 10 and a superstructure 30 having a bridge and an accommodation space and is also provided with a propeller 41, a rudder 42 and the like for navigation.

[0007]

On the other hand, as illustrated in Figs. 8 and 10, if the floating offshore storage structure 1X and the tanker 1Y are large-sized, both are constituted by including a center cargo tank 11, a wing cargo tank 12, a ship-side-and-bottom compartment 13 used for a ballast tank or a void space, and a slop tank 14, in the hull 10. In a small-sized tanker, its structure does not have the center cargo tank 11 in many cases.

[0008]

In building of these tankers and floating offshore storage structures, each is made by a custom-made built-to-order manufacturing method, in which a navigation function and a loading function are given importance for the tankers, while a production function, a storage function, and the loading function are given importance for the floating offshore storage structures, and the tankers or floating offshore storage structures each having a structure with individually optimized a deadweight, a voyage speed, a propelling performance, a stability performance, seaworthy performance and the like are provided in accordance with the

respective applications.

[0009]

In building of the floating offshore storage structure moored on the ocean and not intended for navigation, ship classification (NK, ABS and the like) rules different from that for the navigating tankers are applied to hull structures, and a rule for a floating offshore storage structure is applied instead of the rule for a tanker applied to a tanker.

[0010]

On the other hand, the tankers and floating offshore storage structures are both manufactured by the built-to-order manufacturing method, but commercial customs are different, and the tanker has a period of two to several years from order receipt to delivery, while the period from the order receipt to the delivery of the floating offshore storage structure is as extremely short as one to less than two years.

[0011]

Since the delivery period of this floating offshore storage structure is extremely short, in order to reduce a design period, there can be a measure of making the structures of the tanker and the floating offshore storage structure common in advance so that a structural design for a tanker can be used for the floating offshore storage structure or to the contrary, the structural design for the floating offshore storage structure can be used for the tanker.

[0012]

However, if the structural design for the floating

offshore storage structure not navigating on the ocean is to be used for a tanker, since it is different from the structure of the tanker with the most importance given to transportation efficiency, there is a problem that it cannot be used as it is. Particularly, unlike the tankers, in the floating offshore storage structure or particularly in the floating offshore storage structure performing production, since a large-sized structure such as a refining facility (plant) and the like is mounted on an upper deck, the center of gravity is raised and stability (performance to endure without turning over and to restore to an original attitude when the hull is inclined) deteriorates, and a drastic design change is required for ensuring stability when the hull is damaged.

[0013]

Regarding the problem of stability when the hull is damaged, in the floating offshore storage structure on the premise of not navigating on the ocean with no need to consider the damage on the hull from a lower side, that is, on the ship-bottom section much but the damage on the ship-side section is given importance, while in the tanker on the premise of navigating on the ocean, due to a risk of stranding, the damage on the ship-bottom section is given importance in addition to the damage on the ship-side section.

[0014]

Thus, if a second-hand tanker is to be converted into a floating offshore storage structure or particularly an FPSO provided with a production facility, since a gigantic

production structure is mounted on an upper deck, drastic conversion is needed in some cases such as meeting an applied rule for the floating offshore storage structure by increasing a compartment for a tank and the like.

[0015]

On the other hand, if the structural design for a floating offshore storage structure not navigating on the ocean and the structural design for a tanker are made different in advance and designs and building methods are made different from each other, two designs and building methods need to be prepared for a similar hull structure, whereby a large number of processes and costs are required.

[0016]

Examples of this compartment in a tanker include a hull structure of an oil tanker as described in Japanese Patent Laid-Open No. 7-2165 and a hull structure of oil and fresh water tankers as described in Japanese Patent Laid-Open No. 2003-81177, for example. Moreover, as described in Japanese Patent Laid-Open No. 11-115875, for example, an oil carrier in which a hull is made a double shell structure formed of an outer shell member and an inner shell member in order to suppress an apparent rise of a position of the center of gravity caused by an influence of a free water surface of ballast water and to ensure stability of the hull, a U-shaped ballast tank is defined and formed on an outer side of a cargo oil tank, and the ballast tank portions juxtaposed in a longitudinal direction are partitioned by a partition member extending in the longitudinal

direction alternately at a position on a port side and a position on a starboard side so that movement of the ballast water in the divided ballast tanks located on a side opposite to a inclining side is prevented by the partition member when the hull is inclined, is proposed.

Citation List

Patent Literature

[0017]

PTL 1: Japanese Patent Laid-Open No. 7-2165

PTL 2: Japanese Patent Laid-Open No. 2003-81177

PTL 3: Japanese Patent Laid-Open No. 11-115875

Summary of Invention

Technical Problem

[0018]

In view of the aforementioned circumstances, the inventors had a finding that, in order to prepare a ship-type structure having a structure shared between a tanker and a floating offshore storage structure, compartmentation of a tank for a cargo, a ballast tank, a void space and the like in a hull is important, and in order to satisfy the classification rules for both the tanker and the floating offshore storage structure and to enable sharing by the both at the same time, it is important to arrange a bulkhead so that a capacity of a compartment in an expected damage range is minimized by making the number of wing cargo tanks on one side larger than the number

of center cargo tanks for segmentation more than the prior-art tanker structure and by reducing the capacity per wing cargo tank susceptible to damage caused by an accident such as a collision of a ship to this ship-type structure or the like.
[0019]

The present invention has been made in view of this finding and has an object to provide a ship-type structure and a method for designing a ship-type structure which has a structure with a compartment arrangement that can be also used for the floating offshore storage structure as it is while usability and cost competitiveness as a tanker are maintained and which can reduce a designing cost or shorten a lead time and can provide a floating offshore storage structure inexpensively and quickly, by planning the compartment arrangement particularly resistant to ship-side damage without increasing the number of tanks which results in the cost increase, that is, an area of a watertight bulkhead partitioning the tank as much as possible.

Solution to Problem

[0020]

A ship-type structure of the present invention in order to achieve the aforementioned object is a ship-type structure having a tank constitution provided with center cargo tanks and wing cargo tanks on both sides thereof symmetrically to the transverse direction, ship-side-and-bottom compartments used as a ballast tank or a void space are provided outside the wing cargo tanks, and in the number of tanks or compartments excluding the slop tanks, the number of the wing cargo tanks

on one side is made larger than the number of center cargo tanks.

[0021]

That is, the wing cargo tanks located inside the ship-side-and-bottom compartments are segmented and made smaller so as to reduce a total volume of the tank to be damaged so that excessive inclining or sinking is not caused in the ship-type structure but sufficient stability at damage can be maintained even if the ship-type structure is damaged in an accidental situation such as a collision of a ship or the like, and the center cargo tank which is hardly included in the damage range is made larger as much as possible so as to reduce the number and an area of a watertight bulkhead resulting in an increase of the number of processes or a cost.

[0022]

The slop tank is a tank for temporarily storing and leaving oil sewage having cleaned an inside of the cargo tank as it is and for separating oil and water and is a tank not used as a normal cargo tank.

[0023]

According to this constitution, even if the ship-side-and-bottom compartments of the ship-type structure are damaged across two compartments due to a collision of a ship or the like, and an outer longitudinal bulkhead of the wing cargo tank or a transverse bulkhead for wing cargo tank partitioning the wing cargo tank in the longitudinal direction is damaged, since the number of the wing cargo tanks is increased and a capacity per wing cargo tank is reduced, stability of the

ship-type structure when the ship-side is damaged can be increased, and outflow of the cargo in the wing cargo tank can be reduced.

[0024]

Moreover, since the number of center cargo tanks is made smaller than the number of wing cargo tanks on one side and kept to the number similar to that of a prior-art tanker, the number of transverse bulkheads for center cargo tanks dividing the center cargo tank in the longitudinal direction which results in an increase of the number of manufacturing processes and hull weight, that is, the number and an area of the watertight bulkheads are not increased, whereby a cost increase can be suppressed while usability as the tanker is maintained.

[0025]

That is, by keeping the number of center cargo tanks not in the damage range at damage on the hull as small as possible and by increasing the number of wing cargo tanks, the increase of the transverse bulkheads which increases a cost can be suppressed, and compartment arrangement resistant to the damage on the ship-side can be realized. As a result, when used as a tanker, the compartment arrangement that can be also used as it is for the floating offshore storage structure such as FPSO and FSO can be realized while usability and cost competitiveness as the tanker is maintained, a design cost or a lead time can be reduced and moreover, when used as the floating offshore storage structure, a floating offshore storage structure can be supplied inexpensively and quickly.

[0026]

As a result, the ship-type structure satisfying requests of both the tanker and the floating offshore storage structure or the ship-type structure that can be design-changed or converted from the tanker to the floating offshore storage structure easily or that can be design-changed or converted from the floating offshore storage structure to the tanker easily can be easily provided. That is, the ship-type structure having a tank constitution shared between the tanker and the floating offshore storage structure can be provided.

[0027]

In the aforementioned ship-type structure, a transverse bulkhead for side compartment partitioning the ship-side-and-bottom compartments with respect to a ship longitudinal direction is constituted to be provided by being shifted by a preset distance with respect to the transverse bulkhead for wing cargo tank partitioning the longitudinal direction of the wing cargo tank.

[0028]

According to this constitution, even if the ship-side-and-bottom compartments of the ship-type structure are damaged across two compartments due to a collision of a ship or the like, a possibility that the damage on the wing cargo tank adjacent to them remains in one compartment increases, and thus, stability at damage on the ship-side of the ship-type structure can be increased, and outflow of the cargo in the wing cargo tank can be reduced.

[0029]

As this preset distance, assuming that a freeboard length of the ship-type structure is L , if it is a length L_s or more of the smaller of " $L^{(2/3)}/3$ " or "14.5m" and also a half or less of the distance between the two transverse bulkheads for wing cargo tank, it is preferable since the damage is more likely to remain in the one wing cargo tank. That is because, if it is less than the aforementioned length L_s , when the damage portion becomes long, the possibility the damage reaches the two wing cargo tanks becomes larger.

[0030]

In the aforementioned ship-type structure, if the number of ship-side-and-bottom compartments on one side is made larger than the number of center cargo tanks, by this constitution, even if the ship-side-and-bottom compartments of the ship-type structure are damaged across two compartments by a collision of a ship or the like, since the number of ship-side-and-bottom compartments is increased and the capacity per ship-side-and-bottom compartment is reduced, stability at damage on the ship-side of the ship-type structure can be made larger.

[0031]

In the aforementioned ship-type structure, by setting the number of ship-side-and-bottom compartments on one side not less than the number of the wing cargo tanks on one side in the number of tanks or compartments excluding the slop tanks, by means of this constitution, even if the ship-side-and-bottom

compartments of the ship-type structure are damaged across two compartments by a collision of a ship or the like, since the number of ship-side-and-bottom compartments is increased and the capacity per ship-side-and-bottom compartment is reduced, stability at damage on the ship-side of the ship-type structure can be made larger.

[0032]

In the aforementioned ship-type structure, by setting the number of the wing cargo tanks on one side 1.5 times or more and twice or less of the number of the center cargo tanks in the number of tanks or compartments excluding the slop tank, a structural difference from the prior-art tanker is fewer, and most of the structural design of the prior-art tanker can be used, and design changes can be small.

[0033]

In the aforementioned ship-type structure, a position in the transverse direction of the longitudinal bulkhead between the center cargo tank and the wing cargo tank is set, assuming a ship width at the position in the ship longitudinal direction is B_s , within a range from more than "20% B_s " inside a side shell to "30% B_s " or less inside the side shell. According to this constitution, while stability at damage required as the tanker is sufficiently ensured, in a floating offshore storage structure on which a gigantic plant is mounted on an upper deck, a volume of the wing cargo tank susceptible to ship-side damage can be made smaller.

[0034]

If this position of the longitudinal bulkhead between the center cargo tank and the wing cargo tank is set to a position of "20% Bs" or less, a possibility of damage on this longitudinal bulkhead is caused by an accidental situation such as a collision of a ship or the like, which is not preferable, or if larger than "30% Bs", an effect to suppress reduction of stability obtained by reducing the capacity of the wing cargo tank and an effect of enlarging the center cargo tank are reduced, which is not preferable.

[0035]

In the prior-art technology, the position of the longitudinal bulkhead between the center cargo tank and the wing cargo tank is at a position "distance Bt of the longitudinal bulkhead from the ship-side = $(Bs - 2 \times B1) / 3 + B1$ " = " $(Bs + B1) / 3$ " obtained by dividing a sum of the widths of the center cargo tank and the wing cargo tank ($Bs - 2 \times B1$) in a ship width Bs excluding a width B1 of the ship-side-and-bottom compartment into substantially three equal parts with respect to the transverse direction and is constituted such that the capacities of the center cargo tank and the wing cargo tank are substantially equal. With respect to this prior-art constitution, the aforementioned constitution of the present invention can reduce an influence at damage by making the capacity of the wing cargo tank smaller.

[0036]

In the aforementioned ship-type structure, regarding the ship longitudinal direction, one of the ship-side-and-bottom

compartments adjacent to the transverse bulkhead for side compartment dividing the ship-side-and-bottom compartment is formed by a U-shaped compartment structure formed of a U-shaped compartment covering a lower side portion of the center cargo tank, and a lower side portion and an outer side portion of the wing cargo tank in communication, and the other side is formed by a J-shaped compartment structure formed of a pair of two J-shaped compartments, each covering the lower side portion of the center cargo tank, and the lower side portion and the outer side portion of the wing cargo tank in communication and having a ship-bottom longitudinal bulkhead on the lower side of the center tank, and regarding the ship longitudinal direction, the ship-side-and-bottom compartments are constituted by alternately arranging the U-shaped compartment structure and the J-shaped compartment structure.

[0037]

In this U-shaped compartment structure, since the ship-side-and-bottom compartment on the port side and the ship-side-and-bottom compartment on the starboard side communicate with each other in a ship-bottom portion, even if the ballast water in the ship-side-and-bottom compartment flows out due to damage on the one side, or even if seawater flows into the ship-side-and-bottom compartment, it reaches the both sides. Thus, an influence of the outflow of the ballast water or the inflow of the seawater on heeling of the hull can be reduced.

[0038]

On the other hand, in the J-shaped compartment structure, since the ship-side-and-bottom compartment on the port side and the ship-side-and-bottom compartment on the starboard side are partitioned in the ship-bottom portion and shut off, even if the ballast water in the ship-side-and-bottom compartment flows out due to damage on the one side, or even if seawater flows into the ship-side-and-bottom compartment, it remains only on one side, and though heeling of the hull occurs due to the outflow of the ballast water or the inflow of the seawater, an outflow amount of the ballast water and an inflow amount of the seawater remains only on the one side, and an influence on a sinking amount of the hull can be reduced.

[0039]

Thus, by arranging the U-shaped compartment structure and the J-shaped compartment structure alternately, the influence of damage on the two compartments by a collision of a ship or the like can be distributed with a good balance to an improvement effect of the influence on the sinking amount in the damages compartment and stability and an influence on a heeling amount, and comprehensive handling of the damage can be improved. When damage is not applied, heeling can be adjusted by pouring the ballast water only into one of the right and left J-shaped compartments, but if only the U-shaped compartments are provided, this adjustment of heeling cannot be made.

[0040]

In the aforementioned ship-type structure, in the ship-side-and-bottom compartment, a ship-bottom center

compartment is provided on the lower side of the center cargo tank and between the ship-bottom longitudinal bulkheads and if the structure is used as the tanker, the ship-bottom center compartment is used as a compartment with the ballast water, while if it is used as the floating offshore storage structure, the ship-bottom center compartment is used as a compartment without the ballast water.

[0041]

According to this constitution, when the structure is used as the floating offshore storage structure, by providing the ship-bottom center compartment without the ballast water, it can be kept almost in a maintenance-free state as compared with the case with the ballast water, and maintenance can be extremely simplified. Moreover, in the floating offshore storage structure not on the premise of navigation, there is no need to consider damage on the ship bottom unlike the tanker on the premise of navigation, and this portion can be also made a cargo tank, and by having this ship-bottom center compartment communicate with the center cargo tank in conversion, the capacity of the cargo tank can be increased extremely easily.

[0042]

The method for designing a ship-type structure of the present invention in order to achieve the aforementioned objects is a method for designing a ship-type structure having a tank constitution, in which the center cargo tank and the wing cargo tanks on the both sides thereof are provided symmetrically to the transverse direction, the ship-side-and-bottom

compartment used as the ballast tank or the void space is provided on the outer side of the wing cargo tank, and in the number of tanks or compartments excluding the slop tanks, the number of the wing cargo tanks on one side is made larger than the number of the center cargo tanks.

[0043]

According to this method, the ship-type structure which can exert the aforementioned effects can be easily designed.

[0043a]

In view of the above, according to a first aspect of the present disclosure, there is provided a ship-type structure having a tank constitution, comprising: center cargo tanks and wing cargo tanks on both sides thereof symmetrically to a transverse direction; and ship-side-and-bottom compartments used as a ballast tank or a void space on an outer side of the wing cargo tanks, wherein in the number of tanks or compartments excluding slop tanks, the number of the wing cargo tanks on one side is made larger than the number of the center cargo tanks, wherein regarding the ship longitudinal direction, one of the ship-side-and-bottom compartments adjacent to one side of one of a plurality of transverse bulkheads for side compartment dividing the ship-side-and-bottom compartment is formed by a U-shaped compartment structure formed of a U-shaped compartment covering a lower side portion of the center cargo tank, and a lower side portion and an outer side portion of the wing cargo tank in communication, and one of the ship-side-and-bottom compartments adjacent to another side of the one of the

plurality of transverse bulkheads for side compartment dividing the ship-side-and-bottom compartment is formed by a J-shaped compartment structure formed of a pair of two J-shaped compartments, each covering the lower side portion of the center cargo tank, and the lower side portion and the outer side portion of the wing cargo tank in communication and having a ship-bottom longitudinal bulkhead on the lower side of the center tank; and regarding the ship longitudinal direction, the ship-side-and-bottom compartments are constituted by alternately arranging the U-shaped compartment structure and the J-shaped compartment structure.

[0043b]

According to a second aspect of the present disclosure, there is provided a method for designing a ship-type structure having a tank constitution, wherein center cargo tanks and wing cargo tanks on the both sides thereof are provided symmetrically to the transverse direction, ship-side-and-bottom compartment used as a ballast tank or a void space is provided on an outer side of the wing cargo tank, wherein in the number of tanks or compartments excluding the slop tanks, the number of the wing cargo tanks on one side is made larger than the number of the center cargo tanks, and wherein regarding the ship longitudinal direction, one of the ship-side-and-bottom compartments adjacent to one side of one of a plurality of transverse bulkheads for side compartment dividing the ship-side-and-bottom compartment is formed by a U-shaped compartment structure formed of a U-shaped compartment covering

a lower side portion of the center cargo tank, and a lower side portion and an outer side portion of the wing cargo tank in communication, and one of the ship-side-and-bottom compartments adjacent to another side of the one of the plurality of transverse bulkheads for side compartment dividing the ship-side-and-bottom compartment is formed by a J-shaped compartment structure formed of a pair of two J-shaped compartments, each covering the lower side portion of the center cargo tank, and the lower side portion and the outer side portion of the wing cargo tank in communication and having a ship-bottom longitudinal bulkhead on the lower side of the center tank; and regarding the ship longitudinal direction, the ship-side-and-bottom compartments are constituted by alternately arranging the U-shaped compartment structure and the J-shaped compartment structure.

Advantageous Effects of Invention

[0044]

According to the ship-type structure and a method for designing a ship-type structure according to the present invention, a compartment arrangement particularly resistant to ship-side damage is planned with as little increase as possible in the number of tanks which results in a cost increase, that is, in the surface area of the watertight bulkheads for partitioning the tanks, the tanker remains easy to use, the cost is kept competitive, and the compartment arrangement can be used as it is in a floating offshore storage structure, whereby a floating offshore storage structure that has reduced design

costs and shortened lead time can be provided inexpensively and quickly.

Brief Description of Drawings

[0045]

[Fig. 1] Fig. 1 is a plan view schematically illustrating

compartmentation of cargo tanks of a ship-type structure of a first embodiment of the present invention.

[Fig. 2] Fig. 2 is a plan view schematically illustrating compartmentation of cargo tanks of a ship-type structure of a second embodiment of the present invention.

[Fig. 3] Fig. 3 is a plan view schematically illustrating compartmentation of cargo tanks of a ship-type structure of a third embodiment of the present invention.

[Fig. 4] Fig. 4 is a cross sectional view schematically illustrating a U-shaped compartment structure of a ship-type structure of a fourth embodiment of the present invention.

[Fig. 5] Fig. 5 is a cross sectional view schematically illustrating a J-shaped compartment structure of a ship-type structure of the fourth embodiment of the present invention.

[Fig. 6] Fig. 6 is a cross sectional view schematically illustrating a three-compartment structure of a ship-type structure of a fifth embodiment of the present invention.

[Fig. 7] Fig. 7 is a side sectional view schematically illustrating a structure of a prior-art floating offshore storage structure.

[Fig. 8] Fig. 8 is a plan view schematically illustrating compartmentation of cargo tanks of the prior-art floating offshore storage structure.

[Fig. 9] Fig. 9 is a side sectional view schematically illustrating a structure of a prior-art tanker.

[Fig. 10] Fig. 10 is a plan view schematically illustrating compartmentation of cargo tanks of the prior-art

tanker.

Description of Embodiments

[0046]

A ship-type structure and a method for designing a ship-type structure of embodiments according to the present invention will be described below by referring to the attached drawings.

[0047]

First, a ship-type structure of a first embodiment according to the present invention will be described by referring to Fig. 1. A ship-type structure 1A of the first embodiment according to the present invention is a ship-type structure having a tank constitution shared between a tanker and a floating offshore storage structure. The "floating offshore storage structure" here means a structure having a cargo tank for storing a liquid cargo such as petroleum, a liquefied gas or the like but not having a propelling device for self-navigation, such as a tanker is provided, and floating on the ocean such as FPSO and FS0.

[0048]

As illustrated in Fig. 1, this ship-type structure 1A is constituted to be provided with center cargo tanks 11 symmetrically to a transverse direction and wing cargo tanks 12 on both sides thereof and to be provided with ship-side-and-bottom compartments 13 used as a ballast tank or a void space on outer sides of the wing cargo tanks 12. Then,

rows of the ship-side-and-bottom compartments 13, the wing cargo tanks 12, the center cargo tanks 11, the wing cargo tanks 12, and the ship-side-and-bottom compartments 13 juxtaposed transversely are arranged in a ship longitudinal direction.
[0049]

Moreover, a transverse bulkhead 14a for a slop tank is provided and partitioned on a portion of a rear part of the last wing cargo tank 12, and a slop tank 14 (indicated by hatching) is provided. This slop tank 14 is a tank for temporarily storing and leaving oil sewage having cleaned insides of the cargo tanks 11 and 12 as it is and for separating it to oil and water.
[0050]

In this slop tank 14, water separated from oil is sent to a wastewater treatment facility, while oil is recovered to an oil recovery tank, respectively, and in a tanker, the oil sewage collected in the slop tank 14 is separated and water on a lower layer is subjected to wastewater treatment for lowering oil concentration as necessary and discharged to an outside of the ship, while a mixture of oil and water remaining in the end after oil and water cannot be completely separated is stored and unloaded when calling at a port.
[0051]

Moreover, in this ship-type structure 1A, in the number of tanks or compartments excluding the slop tanks 14, the number of the wing cargo tanks 12 on one side (six in the constitution in Fig. 1) N_w is constituted so as to be larger than the number of the center cargo tanks 11 (three in the constitution in Fig.

1) N_c . That is, it is set to $N_w > N_c$.

[0052]

More preferably, the number N_s of the ship-side-and-bottom compartments 13 on the one side is made larger than the number N_c of the center cargo tanks 11. That is, it is set to $N_s > N_c$. Alternatively, the number N_s of the ship-side-and-bottom compartments 13 on the one side is set equal to or larger than the number N_w of the wing cargo tanks on the one side in the number of tanks or compartments excluding the slop tanks 14. That is, it is set to $N_s \geq N_w$. By means of these constitution, even if the ship-side-and-bottom compartments 13 of the ship-type structure 1A are damaged across two compartments by a collision of a ship or the like, since the number of ship-side-and-bottom compartments 13 is increased, and the capacity per ship-side-and-bottom compartment 13 is decreased, a stability when the ship-side is damaged in the ship-type structure 1A can be made larger.

[0053]

As a result, a total volume of the ship-side-and-bottom compartments 13 and tanks of the wing cargo tank 12 located therein subjected to damage on the ship-side is reduced by segmenting, and the center cargo tanks 11 hardly included in the damage range is made as large as possible, whereby the number and an area of the watertight bulkheads resulting in the increase of the number of processes and costs are reduced.

[0054]

Moreover, in the number of the tanks or the number of the

compartments excluding the slop tanks 14, the number N_w of the wing cargo tanks 12 on the one side is set 1.5 times or more and twice or less ($1.5 \times N_c \leq N_w \leq 2 \times N_c$) of the number N_c of the center cargo tanks 11. As a result, many of the prior-art tanker structural designs can be used with fewer structural differences from the prior-art tankers, and design changes can be few.

[0055]

Subsequently, a ship-type structure of a second embodiment according to the present invention will be described by referring to Fig. 2. A ship-type structure 1B of the second embodiment according to the present invention is different from the ship-type structure 1A of the first embodiment in a point that a transverse bulkhead 13a for side compartment partitioning the ship-side-and-bottom compartment 13 is constituted to be provided by being shifted by preset distances L_{t1} and L_{t2} with respect to the transverse bulkhead 12a for wing cargo tank partitioning the wing cargo tank 12 in the longitudinal direction with respect to the ship longitudinal direction, but the other constitution are the same.

[0056]

As the preset distances L_{t1} and L_{t2} , assuming that a freeboard length of the ship-type structure is L , by setting it to the length L_s or more, which is the smaller of " $L^{(2/3)}/3$ " or "14.5 m" and a half or less of the distance L_t between the two transverse bulkheads 12a for wing cargo tank, it is preferable since a possibility that damage on the ship-side

remains in one wing cargo tank 12 becomes high. If the preset distances L_{t1} and L_{t2} are less than this length L_s , if the damage portion is long, possibility that the damage reaches two wing cargo tanks 12 becomes high.

[0057]

According to this constitution, even if the ship-side-and-bottom compartments 13 of the ship-type structure 1B are damaged across two compartments by a collision of a ship or the like, it is likely that submergence remains in one compartment of the adjacent wing cargo tanks 12, whereby stability at damage on the ship-side of the ship-type structure 1B can be increased, and the outflow of the cargo in the wing cargo tank 12 can be reduced.

[0058]

Subsequently, a ship-type structure of a third embodiment according to the present invention will be described by referring to Fig. 3. A ship-type structure 1C of the third embodiment according to the present invention is different from the ship-type structure 1A of the first embodiment only in the following points and the other constitution are the same.

[0059]

That is, a position in a transverse direction of a longitudinal bulkhead 11t between the center cargo tank 11 and the wing cargo tank 12 is set, assuming that a ship width at the position in its ship longitudinal direction is B_s , within a range from more than "20% B_s " inside a side shell 10a to "30% B_s " or less inside the side shell 10a. According to this

constitution, while stability at damage required as the tanker is sufficiently ensured, in a floating offshore storage structure on which a gigantic plant is mounted on an upper deck, a volume of the wing cargo tank 12 susceptible to ship-side damage can be made smaller.

[0060]

If the position of the longitudinal bulkhead between the center cargo tank 11 and the wing cargo tank 12 is set to a position at "20% Bs" or less, possibility occurs that this longitudinal bulkhead 11t is damaged by an accident such as a collision of a ship or the like, which is not preferable, while if it is set to larger than "30% Bs", the effect of suppressing reduction of stability at damage and the effect of enlarging the center cargo tank 11 obtained by reducing the capacity of the wing cargo tank 12 is made small, which are not preferable.

[0061]

By applying the constitution of the ship-type structure 1C of the third embodiment to the ship-type structure 1B of the second embodiment, too, the same effects can be obtained.

[0062]

Subsequently, a ship-type structure of a fourth embodiment according to the present invention will be described by referring to Figs. 1, 4, and 5. A ship-type structure 1D of the fourth embodiment according to the present invention is different from the ship-type structure 1A of the first embodiment only in the following points, and the other constitution are the same.

[0063]

That is, one of the ship-side-and-bottom compartments 13 (front one, for example) adjacent to the transverse bulkhead 13a for side compartment partitioning the ship-side-and-bottom compartment 13 with respect to the ship longitudinal direction is constituted by a U-shaped compartment structure formed by a U-shaped compartment 13A covering a lower side portion of the center cargo tank 11, and a lower side portion and an outer side portion of the wing cargo tank 12 in communication.

[0064]

Moreover, the other of the ship-side-and-bottom compartments 13 (rear one, for example) adjacent to the transverse bulkhead 13a for side compartment is formed by a J-shaped compartment structure formed of a pair of two J-shaped compartments 13B each covering the lower side portion of the center cargo tank 11, and the lower side portion and the outer side portion of the wing cargo tank 12 in communication and having a ship-bottom longitudinal bulkhead 13t on the lower side of the center tank 11.

[0065]

As a result, regarding the ship longitudinal direction, the ship-side-and-bottom compartments 13 are constituted by arranging the U-shaped compartment structure and the J-shaped compartment structure alternately.

[0066]

In this U-shaped compartment structure, since the ship-side-and-bottom compartment 13 on the port side and the

ship-side-and-bottom compartment 13 on the starboard side communicate with each other in a ship-bottom portion, even if the ballast water in the ship-side-and-bottom compartment 13 flows out due to damage on the one side, or even if seawater flows into the ship-side-and-bottom compartment 13, it reaches the both sides. Thus, the influence of the outflow of the ballast water or the inflow of the seawater on heeling of the hull can be reduced.

[0067]

On the other hand, in the J-shaped compartment structure, since the ship-side-and-bottom compartment 13 on the port side and the ship-side-and-bottom compartment 13 on the starboard side are partitioned in the ship-bottom portion and shut off, even if the ballast water in the ship-side-and-bottom compartment 13 flows out due to damage on the one side, or even if seawater flows into the ship-side-and-bottom compartment 13, it remains only on one side. Thus, though heeling of the hull occurs due to the outflow of the ballast water or the inflow of the seawater, the outflow amount of the ballast water and the inflow amount of the seawater remains only on the one side, and the influence on a sinking amount of the hull can be reduced.

[0068]

Thus, by arranging the U-shaped compartment structure and the J-shaped compartment structure alternately, the influence of damage on the two compartments by a collision of a ship or the like can be distributed with a good balance to the improvement effect of the influence on the sinking amount in

the damaged compartment and stability and the influence on the heeling amount, and comprehensive handling of the damage can be improved. When damage is not applied, heeling can be adjusted by pouring the ballast water only into one of the right and left J-shaped compartments 13B, but if only the U-shaped compartments 13A are provided, this adjustment of heeling cannot be made.

[0069]

If the constitution of the ship-type structure 1D of this fourth embodiment is applied to the ship-type structure 1B of the second embodiment and the ship-type structure 1C of the third embodiment, too, the same effects can be obtained.

[0070]

Subsequently, a ship-type structure of a fifth embodiment according to the present invention will be described by referring to Figs. 1 and 6. A ship-type structure 1E of the fifth embodiment according to the present invention is different from the ship-type structure 1A of the first embodiment only in the following points, and the other constitution are the same.

[0071]

That is, in the ship-side-and-bottom compartment 13, when a ship-bottom longitudinal bulkhead 13te partitioning the lower side of the center cargo tank 11 from the broadside compartment 13C is provided, and a ship-bottom center compartment 13D (cross hatched portion) is provided between the ship-bottom longitudinal bulkheads 13te of the both broadsides, and when

the structure is used as a tanker, this ship-bottom center compartment 13D is used as a compartment in which the ballast water is filled, while when this is used as a floating offshore storage structure, the compartment is used as a compartment in which the ballast water is not filled.

[0072]

According to this constitution, when the structure is used as the floating offshore storage structure, by providing the ship-bottom center compartment 13D without the ballast water, it can be kept almost in a maintenance-free state as compared with the case with the ballast water, and maintenance can be extremely simplified. Moreover, in the floating offshore storage structure not on the premise of navigation, there is no need to consider damage on the ship bottom unlike the tanker on the premise of navigation, and this portion can be also made a cargo tank, and by having this ship-bottom center compartment 13D communicate with the center cargo tank 11 in conversion, the capacity of the cargo tank can be increased extremely easily.

[0073]

If the constitution of the ship-type structure 1E of this fifth embodiment is applied to the ship-type structure 1B of the second embodiment and the ship-type structure 1C of the third embodiment, too, the same effects can be obtained.

[0074]

The method for designing a ship-type structure of the embodiments according to the present invention is a method used

in designing of the ship-type structures 1A, 1B, 1C, 1D, and 1E (hereinafter referred to as 1A to 1E) of the aforementioned first to fifth embodiments and is a method in which, when a ship-type structure having a tank constitution shared between the tanker and the floating offshore storage structure is to be designed, the center cargo tanks 11 and the wing cargo tanks 12 on the both sides thereof are provided symmetrically to the transverse direction, the ship-side-and-bottom compartments 13 used as the ballast tank or the void space are provided on the outer side of the wing cargo tanks 12, and in the number of tanks or the compartments excluding the slop tanks 14, the number N_w of the wing cargo tanks 12 on the one side is made larger than the number N_c of the center cargo tanks 11.

[0075]

According to the ship-type structures 1A to 1E of the first to fifth embodiments according to the present invention with the aforementioned constitution and the method for designing a ship-type structure according to the present invention, even if the ship-side-and-bottom compartments 13 of the ship-type structures 1A to 1E are damaged across two compartments and the longitudinal bulkhead 12t between the wing cargo tank 12 and the ship-side-and-bottom compartment 13 or the transverse bulkhead 12a for wing cargo tank for partitioning the wing cargo tank 12 in the longitudinal direction is damaged, the number of the wing cargo tanks 12 is increased, and the capacity per wing cargo tank 12 is decreased, and thus, stability at damage on the ship-side of the ship-type structures 1A to 1E can be

made larger, and the outflow of the cargo in the wing cargo tank 12 can be reduced.

[0076]

Moreover, since the number N_c of the center cargo tanks 11 is made smaller than the number N_w of the wing cargo tanks 12 on the one side and kept to the number similar to that of the prior-art tanker, the number of the transverse bulkheads 11a for center cargo tank partitioning the center cargo tank 11 in the longitudinal direction which results in the increase of the number of manufacturing processes and the hull weight, that is, the number and the area of the watertight bulkheads are not increased, whereby a cost increase can be suppressed while usability as a tanker is maintained.

[0077]

That is, by making the number N_c of the center cargo tanks 11 not within the damage range at damage on the ship-side as small as possible and by increasing the number of the wing cargo tanks 12 ($2 \times N_w$), an increase of the transverse bulkheads which results in the cost increase can be suppressed, and the compartment arrangement resistant to damage on the ship-side can be obtained. As a result, when used as a tanker, the compartment arrangement that can be also used as it is for the floating offshore storage structure such as FPSO and FSO can be realized while usability and cost competitiveness as the tanker is maintained, a design cost or a lead time can be reduced, and moreover, when used as the floating offshore storage structure, a floating offshore storage structure can be

supplied inexpensively and quickly.

[0078]

As a result, the ship-type structures 1A to 1E satisfying the both requests of the tanker and the floating offshore storage structure, the ship-type structures 1A to 1E that can be design-changed or converted easily from the tanker to the floating offshore storage structure, or the ship-type structures 1A to 1E that can be design-changed or converted easily from the floating offshore storage structure to the tanker can be easily provided.

Industrial Applicability

[0079]

According to the ship-type structure and the method for designing a ship-type structure of the present invention, the compartment arrangement can be provided that can be also used for the floating offshore storage structure as it is while usability and cost competitiveness as the tanker are maintained and which can reduce a designing cost or shorten a lead time and can provide a floating offshore storage structure inexpensively and quickly by planning the compartment arrangement particularly resistant to ship-side damage without increasing the number of tanks which results in a cost increase, that is, an area of watertight bulkheads partitioning the tank as much as possible, and thus, they can be applied to the ship-type structures and the methods for designing ship-type structures for many tankers and floating offshore storage

structures.

Reference Signs List

[0080]

1A, 1B, 1C, 1D, 1E ship-type structure

10 hull

10a side shell

11 center cargo tank

11a transverse bulkhead for center cargo tank

11t longitudinal bulkhead between center cargo tank and wing
cargo tank

12 wing cargo tank

12a transverse bulkhead for wing cargo tank

12t longitudinal bulkhead between wing cargo tank and
ship-side-and-bottom compartment

13 ship-side-and-bottom compartment

13A U-shaped compartment

13B J-shaped compartment

13C broadside compartment

13D ship-bottom center compartment

13a transverse bulkhead for side compartment

13t, 13te ship-bottom longitudinal bulkhead

14 slop tank

14a transverse bulkhead for slop tank

CLAIMS

1. A ship-type structure having a tank constitution, comprising:

center cargo tanks and wing cargo tanks on both sides thereof symmetrically to a transverse direction; and

ship-side-and-bottom compartments used as a ballast tank or a void space on an outer side of the wing cargo tanks, wherein

in the number of tanks or compartments excluding slop tanks, the number of the wing cargo tanks on one side is made larger than the number of the center cargo tanks,

wherein regarding the ship longitudinal direction, one of the ship-side-and-bottom compartments adjacent to one side of one of a plurality of transverse bulkheads for side compartment dividing the ship-side-and-bottom compartment is formed by a U-shaped compartment structure formed of a U-shaped compartment covering a lower side portion of the center cargo tank, and a lower side portion and an outer side portion of the wing cargo tank in communication, and one of the ship-side-and-bottom compartments adjacent to another side of the one of the plurality of transverse bulkheads for side compartment dividing the ship-side-and-bottom compartment is formed by a J-shaped compartment structure formed of a pair of two J-shaped compartments, each covering the lower side portion of the center cargo tank, and the lower side portion and the outer side portion of the wing cargo tank in communication and having a ship-bottom longitudinal bulkhead on the lower side of the center tank; and

regarding the ship longitudinal direction, the ship-side-and-bottom compartments are constituted by alternately arranging the U-shaped compartment structure and the J-shaped compartment structure.

2. The ship-type structure according to claim 1, wherein a transverse bulkhead for side compartment partitioning the ship-side-and-bottom compartments with respect to a ship longitudinal direction is provided by being shifted by a preset distance with respect to the transverse bulkhead for wing cargo tank partitioning the longitudinal direction of the wing cargo tank.

3. The ship-type structure according to claim 1 or 2, wherein the number of the ship-side-and-bottom compartments on one side is made larger than the number of the center cargo tanks.

4. The ship-type structure according to any one of claims 1 to 3, wherein

the number of the ship-side-and-bottom compartments on the one side is set to not less than the number of the wing cargo tanks on the one side in the number of the tanks or compartments excluding the slop tanks.

5. The ship-type structure according to any one of claims 1 to 4, wherein

the number of the wing cargo tanks on the one side is set to 1.5 times or more and 2 times or less of the number of the center cargo tanks in the number of the tanks or compartments excluding the slop tanks.

6. The ship-type structure according to any one of claims 1 to 5, wherein

a position in the transverse direction of a longitudinal bulkhead between the center cargo tank and the wing cargo tank is set, assuming a ship width at the position in a ship longitudinal direction thereof is B_s , within a range from "20% B_s " to "30% B_s " inside a side shell.

7. The ship-type structure according to any one of claims 1 to 6, wherein

in the ship-side-and-bottom compartment, a ship-bottom center compartment is provided on the lower side of the center cargo tank and between the ship-bottom longitudinal bulkheads and if the structure is used as the tanker, the ship-bottom center compartment is used as a compartment with the ballast water, while if the structure is used as the floating offshore storage structure, the ship-bottom center compartment is used as a compartment without the ballast water, wherein the ship-side-and-bottom compartment is the J-shaped compartment structure.

8. A method for designing a ship-type structure having a tank constitution, wherein

center cargo tanks and wing cargo tanks on the both sides thereof are provided symmetrically to the transverse direction, ship-side-and-bottom compartment used as a ballast tank or a void space is provided on an outer side of the wing cargo tank, wherein

in the number of tanks or compartments excluding the slop tanks, the number of the wing cargo tanks on one side is made larger than the number of the center cargo tanks, and

wherein regarding the ship longitudinal direction, one of the ship-side-and-bottom compartments adjacent to one side of one of a plurality of transverse bulkheads for side compartment dividing the ship-side-and-bottom compartment is formed by a U-shaped compartment structure formed of a U-shaped compartment covering a lower side portion of the center cargo tank, and a lower side portion and an outer side portion of the

wing cargo tank in communication, and one of the ship-side-and-bottom compartments adjacent to another side of the one of the plurality of transverse bulkheads for side compartment dividing the ship-side-and-bottom compartment is formed by a J-shaped compartment structure formed of a pair of two J-shaped compartments, each covering the lower side portion of the center cargo tank, and the lower side portion and the outer side portion of the wing cargo tank in communication and having a ship-bottom longitudinal bulkhead on the lower side of the center tank; and

regarding the ship longitudinal direction, the ship-side-and-bottom compartments are constituted by alternately arranging the U-shaped compartment structure and the J-shaped compartment structure.