

DESCRIPTION

TITLE OF THE INVENTION: OFFSHORE FLOATING STRUCTURE

5 TECHNICAL FIELD

[0001]

The present invention relates to an offshore floating structure, which is a ship body part for an FPSO (Floating Production, Storage and Offloading system).

10 BACKGROUND ART

[0002]

The FPSO is a facility which can produce petroleum and gas at sea, and store crude oil in a tank for delivery to a tanker. The FPSO is different from a tanker, and is not only
15 provided with a tank for holding crude oil, but also has a production facility on an upper deck. The production facility comprises various kinds of equipment, including a gas separation facility, a dewatering facility, a metering facility, an electric power facility, and so on. These
20 facilities are designed in accordance with characteristics of an oil well, and are mounted on the upper deck after construction of the ship body. Therefore, it often occurs that the detailed specifications of these facilities are not decided when designing the ship body. Thus, if the design of
25 the ship body is carried out after the requirement from the

production facility are decided for each of the projects, the construction of the ship body cannot be completed by the time the production facility is to be mounted. As a result, a problem occurs, in which a construction period of the FPSO as a whole becomes long.

[0003]

On the other hand, PATENT DOCUMENT 1 shows a construction method, in which a ship body is separately constructed as a bow part, a central part, and a stern part, and these parts are then connected together to complete the ship body. If this method is applied to the FPSO, the construction of the bow part and the stern part can proceed prior to the design and construction of the central part on which the production facilities are mounted. That is, by manufacturing the stern part, which has a complicated structure, in advance, prolonging the design and construction period of the FPSO as a whole can be prevented even if the manufacture of the central part is delayed. However, since facilities that can be mounted on the upper deck are limited by the area of the upper deck, if a change is made to the specifications that requires the production facilities to be enlarged in a middle design stage, it would be very difficult to meet this requirement.

PRIOR ART DOCUMENT

25 PATENT DOCUMENT

[0004]

PATENT DOCUMENT 1: Japanese Unexamined Patent Publication No.
2014-121920

SUMMARY OF THE INVENTION

5 PROBLEM TO BE SOLVED BY THE INVENTION

[0005]

An object of the present invention is to provide an
offshore floating structure that can shorten the construction
period including the design period, and enable design changes
10 to be easily carried out even at the middle design stage.

MEANS FOR SOLVING THE PROBLEMS

[0006]

The present invention is an offshore floating structure
comprising a bow module, a stern module, and a plurality of
15 tank modules provided between the bow module and the stern
module. A production facility can be mounted on the upper
decks of the tank modules. The breadths and the depths are
common among the bow module, the stern module, and the tank
modules, which are connected to each other to form the
20 offshore floating structure.

[0007]

It is preferable that the number of the plurality of
tank modules can be changed. The number of cargo tanks,
included in the bow module, the stern module, and the tank
25 modules, along the ship length direction is greater than or

equal to 4 and less than or equal to 8, for example. The length of the tank modules is preferably less than or equal to 87% of the breadth when the tank modules have four longitudinal bulkheads, and preferably less than or equal to 5 68% of the breadth when the tank modules have three longitudinal bulkheads. One of the plurality of tank modules may be configured such that a turret can be equipped. Note that it is not necessary to unify the length of each of the tank modules as far as the length of the tank modules are 10 within the range described above.

[0008]

An accommodation may be provided on an upper deck of the stern module.

The bow module may have a support structure for 15 supporting an external turret.

[0009]

It is preferable that a lower portion of the stern module, below the water line, has a streamlined shape that is tapered toward the stern. It is also preferable that an 20 outer surface of the stern module has an upper area connected to a side wall extending downward in a vertical direction from an edge of the upper deck, a lower area connected to the bottom, and an intermediate area formed between the upper area and the lower area, having an inclination angle smaller 25 than those of the upper and lower areas. The intermediate

area is composed of a ruled surface, for example. The intermediate area may be configured such that a portion close to the aft end is composed of a developable surface, and a portion close to the mid part is composed of a twisted surface. The upper area may have an inclined plane, the inclination angle of which decreases approaching the aft end. The upper area is composed of a ruled surface, for example.

The lower area may be composed of a ruled surface, except for a bilge portion.

10 EFFECT OF THE INVENTION

[0010]

According to the present invention, an offshore floating structure, which can shorten the overall construction period and enables design changes to be easily carried out even at the middle design stage, can be obtained.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

Fig. 1 is a side view showing an arrangement of each of the modules of an offshore floating structure, which is an embodiment of the present invention.

Fig. 2 is a plan view showing an arrangement of each of the modules of the offshore floating structure shown in Fig. 1.

Fig. 3 is a cross-sectional view of the tank module.

Fig. 4 is a view showing a longitudinal bending moment

diagram, which acts on the offshore floating structure when the number of cargo tanks along the ship length direction is seven.

Fig. 5 is a view showing a longitudinal bending moment
5 diagram, which acts on the offshore floating structure when the number of cargo tanks along the ship length direction is four.

Fig. 6 is a side view showing an example of the FPSO, to which the offshore floating structure of an embodiment of the
10 present invention is applied.

Fig. 7 is a plan view of the FPSO shown in Fig. 6.

Fig. 8 is a side view showing another example of the FPSO, to which the offshore floating structure of an embodiment of the present invention is applied.

15 Fig. 9 is a plan view of the FPSO shown in Fig. 8.

Fig. 10 is a perspective view, in which a fore part of the offshore floating structure is viewed from a diagonal lower part.

Fig. 11 is a body plan of the fore part of the offshore
20 floating structure.

Fig. 12 is a perspective view, in which an aft part of the offshore floating structure is viewed from a diagonal lower part.

Fig. 13 is a body plan of the aft part of the offshore
25 floating structure.

EMBODIMENT OF THE INVENTION

[0012]

In the following, with reference to an embodiment shown in the drawings, a construction of an offshore floating structure of the present invention will be described.

As shown in Figs. 1 and 2, the ship body of the offshore floating structure has a bow module 100, a plurality of tank modules 200, a stern module 300, and an accommodation 400. The tank modules 200 are provided between the bow module 100 and the stern module 300. The bow module 100, the stern module 300, and the tank modules 200 are connected to each other to form the offshore floating structure. The number of tank modules 200, which can be changed, is five in Fig. 1(a) and Fig. 2(a), is four in Fig. 1(b) and Fig. 2(b), is three in Fig. 1(c) and Fig. 2(c), and is two in Fig. 1(d) and Fig. 2(d). Note that the bow module 100, the stern module 300, and the tank modules 200 are separately designed. That is, for example, the designs of the bow module 100 and the stern module 300 may be carried out in advance, and the design of the tank modules 200 may not be completed until after construction has begun on the bow module 100 and the stern module 300.

[0013]

The bow module 100 has a bow part 110 and a bow tank 120, which are partitioned by a bulkhead 130. The bow tank 120 is

partitioned by four longitudinal bulkheads 121, which are extended in the ship length direction. That is, a center cargo tank 122 is formed at the center of the bow tank 120, and wing cargo tanks 123 are provided on both sides. These
5 cargo tanks 122 and 123 are provided for holding crude oil. Side tanks 124 are provided outside the wing cargo tanks 123.
[0014]

The stern module 300 has a stern part 310 and a stern tank 320, which are partitioned by a bulkhead 330. The stern
10 tank 320 is partitioned by longitudinal bulkheads 321, which are extended in the ship length direction. That is, a center cargo tank 322 is formed at the center of the stern tank 320, and wing cargo tanks 323 and slop tanks 324 are provided on both sides. The cargo tanks 322 and 323 are used for holding
15 not only crude oil, but also liquid discharged from a production facility module 500 described later. The slop tank 324 is provided for holding oil-contaminated water generated from the cleaning of a cargo tank, and drainage water coming from an upper deck and a top side area, and
20 bilge water. A pump room 340 is provided behind the center cargo tank 322 and the slop tanks 324. Side tanks 325 are provided outside the wing cargo tanks 323 and the slop tanks 324.

[0015]

25 The plurality of tank modules 200 are partitioned by

bulkheads 201. As shown in Fig. 3, each of the tank modules 200 is partitioned by four longitudinal bulkheads 202. That is, a center cargo tank 203 is provided at the center of the tank module 200, and wing cargo tanks 204 are provided on both sides thereof. These cargo tanks 203 and 204 are provided for storing crude oil. Side tanks 205 are provided outside the wing cargo tanks 204. Production facility modules 500 (see Figs. 6 and 7) can be mounted on the upper deck 206, as described later.

10 [0016]

The bow module 100, the tank modules 200, and the stern module 300 contain cargo tanks, and the number of cargo tanks along the ship length direction is less than or equal to 8. In the example shown in Fig. 1(a) and Fig. 2(a), the number of cargo tanks in the bow tank 120 is one, the number of cargo tanks in the tank module 200 is five, and the number of cargo tanks in the stern tank 320 is one. Therefore, the number of cargo tanks along the ship length direction is seven in all. The total number of cargo tanks along the ship length direction is six in the example of Fig. 1(b) and Fig. 2(b), five in the example of Fig. 1(c) and Fig. 2(c), and four in the example of Fig. 1(d) and Fig. 2(d).

[0017]

If the number of cargo tanks along the ship length direction is less than or equal to three, the number of cargo

tanks in the offshore floating structure as a whole is less than or equal to nine, and thus when one of the cargo tanks is damaged and oil flows out of the tank, the amount of oil outflow is over 10% of the cargo carrying capacity of the offshore floating structure as a whole, which is unacceptable for a countermeasure against oil spill risk. Accordingly, the number of cargo tanks along the ship length direction is preferably more than or equal to four. Further, in order to ensure the stability of the offshore floating structure when a cargo tank is damaged, it is preferable that the size of each of the cargo tanks is small, and in terms of this reason as well, the number of cargo tanks along the ship length direction is preferably more than or equal to four.

[0018]

The number of cargo tanks along the ship length direction, which is described in this specification, is obtained by counting the smallest number among wing cargo tanks and center cargo tanks for each tank module 200, the bow tank 120, and the stern tank 320, along the longitudinal direction of the offshore floating structure. For example, in the case of a tank module in which one of the wing cargo tanks 204 is provided with a partition wall (see Fig. 2) dividing the tank in the middle thereof in order to separately hold two different kinds of liquid, the number of cargo tanks along the ship length direction is regarded as

one.

[0019]

In the case of a structure having four longitudinal bulkheads as shown in Fig. 3, the length of the tank module 200 is preferably less than or equal to 87% of the breadth. For example, when the breadth is 58m, the length is preferably less than or equal to 50m. Due to such a configuration, while maintaining a predetermined capacity it is possible to ensure stability and limit the amount of oil that flows out when the cargo tank is damaged. Further, by making the length shorter, such as less than or equal to 78% or 70% of the breadth, stability is ensured and the risk of cargo oil flowing out is restrained even more, and thus a ship structure can be obtained, in which environmental protection and safety are improved. Furthermore, since the volume and the length of a single tank module 200 is small, the structure can more flexibly meet the demands of production facilities. Different from Fig. 3, the number of longitudinal bulkheads 202 in a single tank module 200 can be three, and in this case, the length of the tank module 200 is preferably less than or equal to 68% of the breadth. Further, when the length is shorter, such as less than or equal to 61% or 52% of the breadth, the effect described above can be obtained.

[0020]

On the other hand, the greater the number of cargo tanks, the more advantageous from the viewpoints of capacity, the quantity of production facilities which can be mounted, and the reduction in the risk of oil outflows. Due to such a case, however, since the offshore floating structure has a slender shape, the longitudinal bending moment becomes large, which is not preferable from the viewpoint of the strength performance. Thus, the number of cargo tanks along the ship length direction is preferably less than or equal to eight at most. Note that the number of cargo tanks is seven in the example of Fig. 1(a).

[0021]

The cross-sectional shapes of all of the tank modules 200 are common to one another, and the breadth, depth, and the cross-sectional shape are identical to the joint surfaces of the bow module 100 and the stern module 300. That is, the breadth, the depth, and the profile of the cross-sections are common for the joint surfaces between the bow module 100, the stern module 300, and the plurality of tank modules 200, and thus, each of the bow module 100 and the stern module 300 can be easily joined to the tank modules 200, and two of the tank modules 200 can be easily joined together. Note that the length of each of the tank modules 200 may be common, or may be different from each other depending upon the purpose.

[0022]

Since the propulsion performance is not emphasized in the offshore floating structure, it is not necessary to pursue a ship body shape that is optimal in terms of hydrodynamics even when the number of the tank modules is changed and the size of the ship body is changed. Further, the load conditions, such as longitudinal bending moments and shearing forces acting on the bow module 100 and the stern module 300, do not depend upon the production facilities and the cargo loading capacity of the offshore floating structure, and are approximately constant as described below with reference to Figs. 4 and 5. Therefore, the bow module 100 and the stern module 300 do not need to be designed specifically for each offshore floating structure, but can be commonly used. That is, the shapes and the principal hull structures of the bow module 100 and the stern module 300 can be standardized, respectively, and thus, the bow module 100 and the stern module 300 can be designed and constructed prior to the tank modules 200. Especially, the stern module 300 contains areas which are constructed more densely with fittings, such as an accommodation and an engine room that require a greater amount of time for manufacturing. Therefore, the fact that the construction of the stern module 300 can be started earlier is effective for shortening the construction period of the offshore floating structure. Further, it is possible to construct the bow module 100 and

the stern module 300 beforehand and keep them in stock, which makes it possible to further shorten the construction period.

[0023]

Note that the stern module 300 may be equipped with a self-propulsion system. Due to this construction, it is possible to ensure the safety and shorten the time required for transportation to the production site, and thus, the construction period required before production begins on the offshore floating structure can be shortened.

10 [0024]

Figs. 4 and 5 show longitudinal bending moments acting on the offshore floating structure in the case in which the number of cargo tanks along the ship length direction is seven (i.e., the number of tank modules 200 is five), and in the case in which the number of cargo tanks along the ship length direction is four (i.e., the number of tank modules 200 is two), respectively. The longitudinal bending moment (reference M1) acting on the tank modules 200 in the case in which the number of cargo tanks is seven, is clearly greater than the longitudinal bending moment (reference M2) acting on the tank modules 200 in the case in which the number of cargo tanks is four. Conversely, the longitudinal bending moment (reference M3) acting on the bow module 100 in the case in which the number of cargo tanks is seven, and the longitudinal bending moment (reference M4) acting on the bow

module 100 in the case in which the number of cargo tanks is four are approximately constant. Further, the longitudinal bending moment (reference M5) acting on the stern module 300 in the case in which the number of cargo tanks is seven, and
5 the longitudinal bending moment (reference M6) acting on the stern module 300 in the case in which the number of the cargo tanks is four are also approximately constant. Therefore, as described above, the principal hull structures of the bow module 100 and the stern module 300 can be standardized,
10 respectively.

[0025]

On the other hand, regarding the tank modules 200, the longitudinal bending moment varies depending upon the lengths thereof. Therefore, as an optimal design of the structure of
15 the tank modules 200, the tank modules 200 may be designed such that the tank positioned at the center along the ship length direction endures the longitudinal bending moment (see Fig. 4) under the condition that the maximum number of cargo tanks along the ship length direction is seven, for example.
20 Due to such a design, the tank modules 200 have a sufficient strength performance even when the number of tank modules 200 is decreased, and thus, a period of time required for designing the tank modules 200 can be minimized when the number of tanks along the ship length direction is less than
25 or equal to seven. Further, it is possible to construct the

tank modules 200 beforehand and keep them in stock, so that the construction period of the offshore floating structure can be shortened. In this case, regarding all of the tank modules 200, not only the breadth, the depth, and the cross-sectional shape are standardized, but also the principal hull structures are basically standardized. Therefore, by mass-producing the same modules, the manufacturing efficiency can be easily improved, and the usage of the modules can be easily diversified. Thus, the modules are kept in stock and are joined together when necessary, which can improve the manufacturing efficiency.

[0026]

As described above, by designing the tank modules 200 based on the seven-tank structure, the design time can be minimized. Preferably, however, depending upon the assumed number of the tank modules 200, the designs carried out in accordance with a plurality of bending moments are prepared in advance, obtaining the tank modules 200 by combining the prepared designs. Due to this method, a structure of sufficient strength can be obtained and the ship structure can be optimized.

[0027]

With reference to Figs. 6 and 7, an example of the construction of the FPSO, to which the embodiment is applied, will be described.

In the bow module 100, a flare tower 140 is mounted on an upper deck of the bow tank 120. A device for hooking up a mooring chain 150 of a spread mooring system is provided on each of both side walls of the bow tank 120. This device is
5 composed of a chain stopper 151 and a fairleader 152. The chain stopper 151 is positioned on an outer surface of the side wall and close to the upper deck, and the fairleader 152 is provided on a lower portion of the side wall. On the other hand, in the stern module 300, an accommodation 400 is
10 provided on the upper deck of the stern part 310. The accommodation 400 is constructed separately from the stern part 310, and mounted on the stern part 310. A chain stopper 351 and a fairleader 352 for hooking up a mooring chain 350 of a spread mooring system are provided on each of both side
15 walls of the stern tank 320, similar to the bow tank 120.

[0028]

A riser guide 230 for supporting a riser is provided on a side wall of the portside of each of the tank modules 200. In the tank module 200, the bow tank 120, and the stern tank
20 320, various kinds of production facility modules 500 are mounted on the upper decks of each one. As examples of the production facility modules 500, a gas separation plant, a dewatering facility, a metering facility, an electric power facility and so on can be considered. The constructions of
25 these production facility modules 500 are different from each

other, and an appropriate construction is selected in accordance with the characteristics of the oil well where the FPSO is operated. Although most production facility modules 500 are mounted on the tank modules 200, some of them may be
5 mounted on the bow tank 120 or the stern tank 320. A crane 600 may be provided on some of the tank modules 200.

[0029]

Each of the production facility modules 500 are placed on first and second support members 510 and 520 provided on
10 the upper decks. The first support member 510 has a construction fixedly supporting the production facility module 500, and an undersurface of the production facility module 500 is integrally connected to an upper surface of the first support member 510. Conversely, the second support
15 member 520 supports an undersurface of the production facility module 500 so that the module can be displaced in a lateral direction. That is, each of the production facility modules 500 is connected to the first support member 510 so not to displace relative to the first support member 510, but
20 to slidably move relative to the second support member 520. Therefore, even when sagging or hogging occurs in the offshore floating structure due to ocean waves or the storage condition of the cargo tanks, the deformation of the upper deck is barely transmitted to each of the production facility
25 modules 500, since each of the production facility modules

500 slides to the second support member 520. Note that, in Fig. 6, for convenience of explanation, some of the support members are indicated by triangles, and the first support members 510 are colored in black.

5 [0030]

Figs. 8 and 9 show the other example of a construction of the FPSO, to which the embodiment is applied.

In this example, in the tank module 200 adjacent to the bow tank 120, although a side tank 205 is provided, a cargo
10 tank is not provided, and a moon pool 210 is provided. The moon pool 210 is a through-hole provided for connecting a turret 213, which supports riser pipes 211 and mooring chains 212, and extends from the upper deck to the bottom of the tank module 200. In the tank module 200, a derrick 220 used
15 for pulling up the turret 213 is provided on the upper deck. Thus, one of the tank modules 200 can be configured such that a turret can be equipped.

[0031]

Note that an external turret can be provided to the end
20 of the bow module 100. In this case, a support structure may be provided to support the external turret on the line extending in the bow direction from the longitudinal bulkheads 121 of the bow tank 120. Due to such a construction, a design change of the bow module 100 caused by
25 a turret can be minimized.

[0032]

Thus, when the offshore floating structure is configured as an FPSO, oil is stored in the cargo tanks, and various kinds of production facility modules 500 (see Figs. 6 and 7) are mounted on the upper decks of the bow tank 120, each of the tank modules 200, and the stern tank 320. Although the storage capacity of cargo oil and the size and number of production facility modules 500 are often changed during the design stage, since the breadth, depth, and profile of the cross-section are constant or standardized, the number of tank modules 200 can be easily changed, and thus the design changes are easy. On the other hand, the ship body may be required to change depending upon the characteristics of an oil well when a production place is changed. At that time, since the designs of the tank modules 200 already exist, and the joint surfaces of the modules are the same, the required changes for the ship body can be easily applied. It is possible to change the number of tank modules 200 even after the FPSO is completed.

[0033]

As described above, it is not necessary for the offshore floating structure to have a hydrodynamically optimal construction. Therefore, the shapes of the bow module 100 and the stern module 300 can be as simple as possible, so that the offshore floating structure can be easily

manufactured to reduce the manufacturing cost. Next, with reference to Figs. 10-13, examples of the shapes of the bow module 100 and the stern module 300 will be described below. Note that, in the explanation described below, a fore part 11 corresponds to the bow module 100, a mid part 12 corresponds to the tank modules 200, and an aft part 13 corresponds to the stern module 300.

[0034]

Fig. 10 is a perspective view, in which the fore part 11 is viewed from a diagonal lower part, and Fig. 11 is a body plan of the fore part 11. The fore part 11 is connected to the mid part 12, and the outer surface is zoned into an upper area 31, a lower area 32, and a bottom 33. The upper area 31 is connected to the edge of the upper deck 25, and inclined so as to make an acute angle with the upper deck 25. The lower area 32 extends downward in a vertical direction from the upper area 31. The lower area 32 is formed only by line segments extending in the vertical direction, except for a bilge portion 34, as understood from Fig. 11, and the horizontal section has a curve in which the breadth tapers toward the fore end. That is, the lower area 32 is composed of a developable surface, which can be developed into a plane. The bottom 33 is a plane. Note that, in Figs. 10 and 11, references F1-F4 indicate sections at the corresponding positions.

[0035]

Fig. 12 is a perspective view, in which the aft part 13 is viewed from a diagonal lower part, and Fig. 13 is a body plan of the aft part 13. The aft part 13 is connected to the mid part 12, and the upper deck 25 has an equivalent breadth to that of the mid part 12, such that the upper deck 25 of the aft part 13 is ideally rectangular when viewed from above. In fact, however, the planar shape of the aft part 13 may be roughly rectangular with corners that are chamfered or rounded. Further, the aft part 13 is configured such that a lower portion of the aft part 13, below the water line L (see Fig. 1(a)) during transit, has a streamlined shape that is tapered toward the stern. An outer surface of the aft part 13 is segmented into a side wall 42, an upper area 43, an intermediate area 44, a lower area 45, and a bottom 46. Note that, in Figs. 12 and 13, references A0-A2 indicate sections at the corresponding positions.

[0036]

The side wall 42 extends downward in a vertical direction from the edge of the upper deck 25. The upper area 43, which is connected to the side wall 42, is a twisted surface that forms an inclined plane the inclination angle of which gets smaller approaching the aft end, as shown by sections A0-A2 of Fig. 13. That is, the upper area 43 is composed of a ruled surface (a developable surface or a

twisted surface, or a combination of these surfaces) that can be formed only by line segments. On the other hand, the lower area 45 is connected to the bottom 46, and a connecting portion to the bottom 46, i.e., the bilge portion 47, is a
5 three-dimensional curved surface close to an arc, but a portion other than the bilge portion 47 is composed of a ruled surface.

[0037]

The intermediate area 44 is formed between the upper
10 area 43 and the lower area 45. An upper edge of the intermediate area 44 is connected to the upper area 43, and a lower edge of the intermediate area 44 is connected to the lower area 45. The inclination angle of the intermediate area 44 is smaller than those of the upper area 43 and the
15 lower area 45. The intermediate area 44 is configured such that a portion close to the aft end (i.e., between reference A1 and reference A2, and a portion close to these references, in Fig. 13) is composed of a developable surface, and a portion close to the mid part 12 (i.e., located in front of
20 reference A2 in Fig. 13) is composed of a twisted surface. That is, the intermediate area 44 is expressed as a locus of line segments, and is composed of a ruled surface.

[0038]

A corner 51, which is a boundary between the upper area
25 43 and the intermediate area 44, is convexly bent as shown in

Fig. 13. Conversely, a corner 52, which is a boundary between the intermediate area 44 and the lower area 45, is concavely bent as shown in Fig. 13.

[0039]

5 As described above, in the present embodiment, the fore part 11 is configured such that the bottom 33 is composed of a plane except for the bilge portion 34, and the lower area 32 of the side wall is formed as a developable surface, in which the breadth is tapered toward the fore end. That is,
10 the shape of the fore part 11 is simple, so that the manufacturing cost can be reduced, and the resistance during transit can be lowered. Further, since the upper area 31 has a flared shape, the area of the upper deck 25 is enlarged so that not only space for installing a production facility, a
15 storage facility, mooring equipment and so on can be ensured, but also the seaworthiness during transit or operations can be improved.

[0040]

 In the aft part 13, a lower portion below the water line
20 L during transit has a shape similar to a hull form. Therefore, in comparison with an offshore floating structure having a box shape, the resistance during transit can be reduced. Due to the reduction of the resistance, the propulsion system can be downsized so that the engine room
25 can be made smaller, according to which the storage space can

be expanded. Further, since fuel consumption during transit can be suppressed, the environmental burden can be reduced, and the transportation cost can be decreased. Furthermore, according to the shape of the aft part 13, whether the
5 offshore floating structure is a towed type or a self-propelled type, the course-keeping performance can be improved.

[0041]

The upper deck 25 of the aft part 13 has an equivalent
10 breadth to that of the mid part 12, and compared to a conventional offshore floating structure, in which the breadth is tapered toward the aft end, the upper deck 25 is expanded to the maximum breadth. The production facility modules 500, the accommodation 400, the mooring equipment,
15 lifesaving equipment, a helicopter station and so on are provided on the upper deck 25, and among them, particularly the accommodation 400, the helicopter station, and the lifesaving equipment are isolated for safety reasons from the storage facility for crude oil and so on. Since the aft part
20 13, which is far away from the storage facility provided in the mid part 12, is located in a high-safety area, by making the area of the upper deck 25 of the aft part 13 large, it becomes easy to arrange the accommodation 400 (Fig. 1), the helicopter station, the lifesaving equipment and so on in the
25 aft part 13.

[0042]

In the upper area 43 of the aft part 13, the aft end is inclined as indicated by reference A0, and the inclination angle is greater toward the mid part 12. Due to such an inclination angle of the upper area 43, the seaworthiness related to ocean waves under mooring and fixed conditions is improved. That is, the water line during mooring (i.e., during operations) is higher than during transit, and is close to the lower end of the line segment indicated by reference A0, for example. Since the upper area 43 is inclined, even when the body of the offshore floating structure pitches or heaves, slamming can be reduced. Further, due to the inclination of the upper area 43, the area of the water plane during operation is enlarged, and thus, the offshore floating structure can be prevented from inclining to improve safety.

[0043]

As shown in Fig. 13, the corner 52 between the intermediate area 44 and the lower area 45 of the aft part 13 is closer to the water line L (see Fig. 1(a)) approaching the aft end. That is, a space below the intermediate area 44 is greater toward the aft end. Therefore, during transit, the attitude is set to trim by the stern, so that the submergence of the propeller can be sufficiently maintained.

[0044]

Furthermore, in the aft part 13, the upper area 43, the intermediate area 44, the lower area 45, and the bottom 46 are formed by ruled surfaces (a developable surface or a twisted surface, or a combination of these surfaces), except
5 for the bilge portions 47. Therefore, the shape of the aft part 13 is simple, and the manufacturing cost can be suppressed.

[0045]

According to the embodiment of the present invention as
10 described above, the bow module 100 and the stern module 300 are manufactured prior to the tank module 200, which can be designed and manufactured after the specification of the offshore floating structure is determined. The production facility modules 500, which are unitized, are mounted on the
15 upper deck of the offshore floating structure, and are required to correspond to the characteristics of the oil well. The storage capacity of the cargo tank is changed depending upon the object. Therefore, although it often takes a long time until the number and the length of the tank modules 200
20 are determined, the embodiment can flexibly respond to such a case even when the specification of the offshore floating structure is changed during the design procedure, since the number of tank modules 200 can be changed in the embodiment.

[0046]

25 Inspecting and repairing the FPSO by docking cannot be

carried out, but should be carried out at sea while the tanks are empty. By emptying only a part of tanks during inspection and repair situations, the stability of the offshore floating structure may be compromised and the load acting on the ship body may be increased. However, since each of the tanks is made as small as possible in the embodiment, such a problem can be restrained.

[0047]

In the embodiment described above, the bow module 100 has the bow part 110 and the bow tank 120, and the stern module 300 has the stern part 310 and the stern tank 320. However, the bow module 100 may be composed of the bow part 110 and not contain the bow tank 120, and the stern module 200 may be composed of the stern part 310 and not contain the stern tank 320. In other words, the bow tank 120 and the stern tank 320 may be contained in the tank module 200, and due to this it is possible that the bow part 110 and the stern part 310 are the only common parts of the offshore floating structure manufactured prior to the other parts.

EXPLANATION OF REFERENCES

[0048]

100 bow module

200 tank module

300 stern module

25 400 accommodation

500 production facility

CLAIMS

[CLAIM 1]

An offshore floating structure comprising:

5 a bow module;

a stern module; and

a plurality of tank modules provided between the bow module and the stern module, a production facility being able to be mounted on upper decks of the tank modules;

10 wherein the breadths and the depths are common to the bow module, the stern module, and the tank modules, which are connected to each other to form the offshore floating structure.

[CLAIM 2]

15 The offshore floating structure according to claim 1, wherein the number of the plurality of tank modules can be changed.

[CLAIM 3]

The offshore floating structure according to claim 1,
20 wherein the bow module, the stern module, and the tank modules contain cargo tanks, and the number of cargo tanks along the ship length direction is greater than or equal to 4 and less than or equal to 8.

[CLAIM 4]

25 The offshore floating structure according to claim 1,

wherein the tank modules have four longitudinal bulkheads,
and the length of the tank modules is less than or equal to
87% of the breadth.

[CLAIM 5]

5 The offshore floating structure according to claim 1,
wherein the tank modules have three longitudinal bulkheads,
and the length of the tank modules is less than or equal to
68% of the breadth.

[CLAIM 6]

10 The offshore floating structure according to claim 1,
wherein one of the plurality of tank modules is configured
such that a turret can be equipped.

[CLAIM 7]

15 The offshore floating structure according to claim 1,
wherein the bow module has a support structure for supporting
an external turret.

[CLAIM 8]

20 The offshore floating structure according to claim 1,
wherein an accommodation is provided on an upper deck of the
stern module.

[CLAIM 9]

25 The offshore floating structure according to claim 1,
wherein a lower portion of the stern module, below the water
line, has a streamlined shape that is tapered toward the
stern.

[CLAIM 10]

The offshore floating structure according to claim 9, wherein an outer surface of the stern module has an upper area connected to a side wall extending downward in a vertical direction from an edge of the upper deck, a lower area connected to the bottom, and an intermediate area formed between the upper area and the lower area, the intermediate area having an inclination angle smaller than those of the upper and lower areas.

10 [CLAIM 11]

The offshore floating structure according to claim 10, wherein the intermediate area is composed of a ruled surface.

[CLAIM 12]

The offshore floating structure according to claim 11, wherein the intermediate area is configured such that a portion close to the aft end is composed of a developable surface, and a portion close to the mid part is composed of a twisted surface.

[CLAIM 13]

20 The offshore floating structure according to claim 10, wherein the upper area has an inclined plane, the inclination angle of which decreases approaching the aft end.

[CLAIM 14]

The offshore floating structure according to claim 13, wherein the upper area is composed of a ruled surface.

[CLAIM 15]

The offshore floating structure according to claim 10, wherein the lower area is composed of a ruled surface, except for a bilge portion.