

## DESCRIPTION

TITLE OF THE INVENTION: SHIP-SHAPED STRUCTURE

## 5 TECHNICAL FIELD

[0001]

The present invention relates to a ship-shaped structure that can be applied to either an FPSO (i.e., Floating Production Storage and Offloading unit) or a tanker.

## 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. Recently, there has been an increase in the number  
15 of FPSOs, which are typically positioned several hundred kilo-meters offshore, and an FPSO having a ship-shaped structure similar to a tanker has been proposed (e.g., PATENT DOCUMENT 1).

PRIOR ART DOCUMENT

## 20 PATENT DOCUMENT

[0003]

PATENT DOCUMENT 1: Japanese Unexamined Patent Publication No.  
2000-025690

SUMMARY OF THE INVENTION

## 25 PROBLEM TO BE SOLVED BY THE INVENTION

[0004]

The offshore oil and gas production business is vulnerable to rapidly changing market conditions that can cause an offshore oil production project to be altered or  
5 suspended in the middle of the planning stage, which is risky. Thus, when building an FPSO inventors have become focused on the importance of reducing construction time while monitoring rapidly changing market conditions.

[0005]

10 An object of the present invention is to provide a ship-shaped structure, which can be configured as either an FPSO or a tanker in the middle of construction.

MEANS FOR SOLVING THE PROBLEMS

[0006]

15 A ship-shaped structure according to the present invention comprises a cargo tank for reserving cargo oil, and a common space that is a compartment provided independently from the cargo tank and can be provided with either mooring equipment for a floating production storage and offloading  
20 unit or a reinforcing member for mooring equipment.

[0007]

The ship-shaped structure may be configured such that a parallel part structure and an intermediate structure, which is obtained by joining together a bow structure and a stern  
25 structure that are formed by removing the parallel part

structure from the ship-shaped structure, are built independently from each other. In this case, the ship-shaped structure is built by dividing the intermediate structure into the bow structure and the stern structure, positioning  
5 the parallel part structure between the bow structure and the stern structure, joining the front end of the parallel part structure to the rear end of the bow structure, and joining the rear end of the parallel part structure to the front end of the stern structure. It is preferable that the breadth of  
10 the intermediate structure is less than or equal to 49m, and is capable of self-propelling.

[0008]

The common space may be positioned closer to the bow than the mid-ship point on the center line, and may be used  
15 as cargo tanks or trimming tanks. In this case, it is preferable that the common space is a centrally located tank obtained by dividing the fore peak tank into three parts with bulkheads that are substantially parallel to the center line, and the mooring equipment is an external turret. Or, it is  
20 preferable that the cargo tank comprises a center cargo tank disposed on the center line and wing cargo tanks provided on both sides of the center cargo tank, the common space is adjacent to one of the center cargo tanks, and the mooring equipment is an internal turret. When the cargo tanks are  
25 positioned on the starboard and portside of the center line,

it is preferable that the common space is provided on the center line, and the mooring equipment is an internal turret.

[0009]

When the mooring equipment includes spread mooring with  
5 a fairleader, through which a chain of the spread mooring passes, the common space is a ballast tank provided inside a side wall of the ship body, and the ballast tank is provided with a reinforcing member for the mooring equipment.

[0010]

10 In a structure in which the cargo tank comprises a center cargo tank disposed on the center line and wing cargo tanks provided on both sides of the center cargo tank, it is preferable that the number of ballast tanks provided in the longitudinal direction of the ship body on the outer sides of  
15 the wing cargo tanks is double the number of the center cargo tanks in the longitudinal direction, or the length of the aftermost- and foremost-positioned wing cargo tanks is 7% to 12% of the length between perpendiculars. When the cargo tanks are provided along the center line, it is preferable  
20 that the number of ballast tanks provided outside the cargo tanks in the longitudinal direction of the ship body is double the number of the cargo tanks in the longitudinal direction, except for the aftermost- and foremost-positioned two cargo tanks arranged along the longitudinal direction of  
25 the ship body, or the length of each of the aftermost- and

foremost-positioned cargo tanks is 6% to 11% of the length between perpendiculars.

[0011]

A cargo oil pump can be independently disposed close to  
5 a rear bulkhead in each of the cargo tanks.

[0012]

The breadth of the rear end of the upper deck close to the stern may be 0.6-1.0 time the breadth of the ship-shaped structure, or the upper deck of the bow may have an extension  
10 part with a tip that projects forward from the fore perpendicular by 1-3% of the length between perpendiculars and the breadth of the tip is 0.4-1.0 time the breadth of the ship-shaped structure. In this case, an accommodation space for 150 or more persons may be provided on the upper deck  
15 close to the stern.

#### EFFECT OF THE INVENTION

[0013]

According to the present invention, a ship-shaped structure can be reconfigured as either an FPSO or a tanker  
20 in the middle of the construction.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

Fig. 1 is a schematic view showing a structure of an FPSO, in which a first embodiment of the present invention is  
25 applied.

Fig. 2 is a schematic view showing a structure of a tanker, in which the first embodiment of the present invention is applied.

Fig. 3 is an arrangement plan showing a structure of  
5 cargo tanks and so on, provided in the ship-shaped structure of the first embodiment of the present invention.

Fig. 4 is an arrangement plan showing a structure of cargo tanks and so on of an intermediate structure.

Fig. 5 is an arrangement plan showing a structure of  
10 cargo tanks and so on, provided in a ship-shaped structure of a second embodiment of the present invention.

#### EMBODIMENT OF THE INVENTION

[0015]

In the following, a ship-shaped structure, which is a  
15 first embodiment of the present invention, will be described with reference to the drawings.

Fig. 1 roughly shows a structure of an FPSO, in which the embodiment of the present invention is applied. The structure of a ship body 10 of an FPSO is basically common to  
20 a tanker in the mid-ship part, while partially common to a tanker in the bow and the stern. Therefore, in this embodiment, the ship body 10 of an FPSO is designed to share as much as possible of its structure with a tanker.

[0016]

25 An upper deck of the bow is provided with an external

turret 21, which is connected to mooring lines and a riser pipe (not shown). A production plant 22 provided on the upper deck of the mid-ship part contains an oil treatment plant, a gas treatment plant, a water treatment plant, an electric power plant, and so on. Associated gas flare system 23 is disposed in front of the production plant 22, and cranes 24 are provided for the production plant 22. An accommodation space 25 provided on the upper deck of the stern is designed to house crews larger than the size usually required to operate a tanker (150 or more persons, for example). A propeller 26 and a rudder 27 are provided under the water line at the stern, similar to a tanker. Note that reference R will be described later.

[0017]

Fig. 2 schematically shows a structure of a tanker, in which the embodiment of the present invention is applied. The structure of a mid-ship part of a ship body 30 of a tanker is basically common to the FPSO as described above. Conversely, the bow is different from the FPSO, and is not provided with mooring equipment. Further, facilities provided on the upper deck are different from those of the FPSO, which have been omitted in Fig. 2. An accommodation space 31 provided on the upper deck of the stern is smaller than that of the FPSO. The propeller 26 and the rudder 27 have the same structures as those of the FPSO.

[0018]

With reference to Fig. 3, a ship-shaped structure 40, which is the embodiment, will be described below. The ship-shaped structure 40 is a part of a ship body, in which a  
5 topside structure (or superstructure) has been removed from each of the FPSO and the tanker, and is a structure in the middle of construction of either an FPSO or tanker.

[0019]

A number of cargo tanks for reserving cargo oil are  
10 provided in the ship-shaped structure 40. On the center line, which is in the longitudinal direction of the ship body, a first center cargo tank 41, a first common space 51, and second through fifth center cargo tanks 42-45 are disposed in order from the bow to the stern. First and second wing cargo  
15 tanks 61 and 62 are provided on both sides of the first center cargo tank 41. Third wing cargo tanks 63 are provided on both sides of the first common space 51 and the second center cargo tank 42. Fourth wing cargo tanks 64 are provided on both sides of the third center cargo tank 43, and  
20 fifth wing cargo tanks 65 are provided on both sides of the fourth center cargo tank 44. Sixth and seventh wing cargo tanks 71 and 72, and slop tanks 73 are provided on both sides of the fifth center cargo tank 45.

[0020]

25 Ballast tanks are provided outside of each of the wing

cargo tanks. A single ballast tank 81 is provided on each outer side of the first and second wing cargo tanks 61 and 62, and two ballast tanks 81 are provided on each outer side of the third wing cargo tank 63. Regarding the fourth and fifth wing cargo tanks 64 and 65, two ballast tanks 81 are similarly provided on each outer side of each respective wing cargo tank. Two ballast tanks 81 are also provided on outer side of a section of tanks consisting of the sixth and seventh wing cargo tanks 71 and 72, and the slop tank 73.

10 [0021]

Thus, the constructions of the cargo tanks and the ballast tanks of the ship-shaped structure 40 are different from those of a usual tanker, and they are divided by a relatively large number of bulkheads in the front-to-back direction of the ship body. For example, the number of ballast tanks 81 in the longitudinal direction of the ship body is ten, which is double the number (5) of center cargo tanks 41-45 in the longitudinal direction. The length X1 of the first wing cargo tank 61 positioned foremost among the wing cargo tanks is 7% to 12% of the length between perpendiculars (Lpp), and the length X2 of the wing cargo tanks (i.e., the seventh wing cargo tank 72 and the slop tank 73) positioned aftermost is 7% to 12% of the length between perpendiculars.

25 [0022]

The reason for the increased numbers of cargo tanks and ballast tanks is to improve stability in the event of damage. That is, in an FPSO, since the size of a topside structure is relatively large and the height from the keel to the center  
5 of gravity (KG) is high, the stability is relatively low. Thus, the ship-shaped structure 40 is designed such that by increasing the number of the tanks positioned on the outer side of the ship body, there is a reduced probability of damage to each of the tanks, and the amount of water  
10 immersion when damage does occur is small.

[0023]

A cargo oil pump 82 is disposed close to a rear bulkhead in each of the center cargo tanks 41-45, each of the wing cargo tanks 61-65, 71, and 72, and the slop tank 73.  
15 Although only part of the pumps 82 are indicated in Fig. 3, the cargo oil pumps 82 are provided in all the cargo tanks, and are independently controlled. Due to this, by exchanging cargo oil between the tanks 41-45, 61-65 and 71-73, or independently adjusting the amount of the cargo oil in each  
20 tank, trim and heel control of the ship body is easily performed.

[0024]

The ship-shaped structure 40 is designed such that various kinds of mooring equipment can be mounted in order to  
25 be used as an FPSO. Generally, for the mooring equipment of

an FPSO, an internal turret, an external turret, or spread mooring are selected based on the severity of the winds and waves where the FPSO will operate. The former two devices are used when the wind is relatively strong and a weather  
5 vane mechanism is required, in which the bow of the FPSO is always oriented windward like a weathercock so that excessive force is not exerted on the mooring equipment.

[0025]

A fore peak tank (FPT) formed in front of the bulkhead  
10 11 of the bow part is divided into three parts by bulkheads 12, which are substantially parallel to the center line, i.e., a second common space 13 is positioned at the center with tanks 14 positioned on both sides thereof. In the common space 13, the external turret 21 (see Fig. 1), which is  
15 mooring equipment, can be installed when the ship-shaped structure 40 is configured as the ship body 10 of an FPSO. Conversely, when the ship-shaped structure 40 is configured as the ship body 30 of a tanker, the second common space 13 can be used as trimming tanks.

20 [0026]

On the other hand, in the first common space 51 adjacent to the second center cargo tank 42, an internal turret, which is mooring equipment, can be installed when the ship-shaped structure 40 is configured as the ship body 10 of an FPSO.

25 Thus, the first common space 51 should be positioned closer

to the bow than the mid-ship point on the center line, taking account of the mooring equipment. Further, the first common space 51 is used as cargo tanks for reserving cargo oil when the ship-shaped structure 40 is configured as the ship body 30 of a tanker.

[0027]

When spread mooring is adopted as the mooring equipment for an FPSO, it is necessary to provide on a side wall of the ship body 10 fairleaders through which chains of the spread mooring pass; therefore, the side wall of the ship body is reinforced with a reinforcing member, which is provided in a ballast tank 81 formed inside the side wall, where the position of the ballast tank 81 is indicated by reference R in Fig. 1. The ballast tank 81, in which the reinforcing member is provided, is a common space normally used for ballast tanks when the ship-shaped structure 40 is configured as the ship body 30 of a tanker.

[0028]

In order to install an offloading facility for an FPSO, an upper deck of the bow part is extended forward to form an extension part 15. The breadth Y1 of the tip of the extension part 15 is greater than 0.4 time the breadth B of the ship body, and less than or equal to the breadth B of the ship body. The tip of the extension part 15 is positioned forward of the fore perpendicular (FP) by 1-3% of the length

between perpendiculars ( $L_{pp}$ ). The breadth  $Y_2$  of the rear end of the upper deck 83 closest to the stern is greater than 0.6 time the breadth  $B$  of the ship body, and less than or equal to the breadth  $B$  of the ship body. Thus, for enlarging the  
5 breadth  $Y_2$  of the rear end of the upper deck 83 of the stern, a knuckle may be formed at a proper height under the upper deck on a side wall, in a cross section of the ship body.

[0029]

Fig. 4 shows an intermediate structure 90, which is  
10 formed by joining together the bow part and the stern part, which are contained in the ship-shaped structure 40 (Fig. 3). The breadth of the center part of the ship-shaped structure 40, in which the third, fourth, and fifth wing cargo tanks 63, 64, and 65 are provided, is uniform, and the center part is a  
15 parallel part structure. The intermediate structure 90 is constructed by joining together at joining point "A" a bow structure 91 and a stern structure 92, which are formed by removing the parallel part structure from the ship-shaped structure 90. The intermediate structure is capable of self-  
20 propelling.

[0030]

The parallel part structure is a portion that extends from the middle of the third wing cargo tank 63 to the middle of the fifth wing cargo tank 65, and has a simpler structure  
25 in comparison with the intermediate structure 90. Since the

intermediate structure 90 and the parallel part structure can be built independently of each other, the intermediate structure 90 may be built in a first country having a higher technological capability, and the parallel part structure may  
5 be built in a second country having a lower technological capability. As an example, it is possible that the intermediate structure 90 is built in Japan, and the parallel part structure is built in a Central or South America. In such a case, taking into account that the intermediate  
10 structure 90 must move by itself from a shipyard in Japan to a shipyard in Central or South American country, it is preferable that the breadth of the intermediate structure 90 is less than or equal to 49m to fit in the breadth of Panama Canal after its expansion construction.

15 [0031]

In the shipyard of the second country where the parallel part structure is built, the intermediate structure 90 is first divided into the bow structure 91 and the stern structure 92. The parallel part structure is then positioned  
20 between these structures 91 and 92 with the front end of the parallel part structure joined to the rear end of the bow structure 91, and the rear end of the parallel part structure joined to the front end of the stern structure 92, so that the ship-shaped structure 40 is built. After that, topside  
25 structures (or superstructures) corresponding to the final

structure are mounted on the upper deck of the ship-shaped structure 40.

[0032]

As described above, the ship-shaped structure 40 of the  
5 embodiment has a common space that is a compartment provided independently from the center cargo tanks 41-45 and the wing cargo tanks 61-65, and can be provided with either mooring equipment for an FPSO or a reinforcing member for the mooring equipment. Namely, the common space is used for providing  
10 either mooring equipment or a reinforcing member when the ship-shaped structure 40 becomes a part of the ship body 10 of an FPSO, and is used as a cargo tank or ballast tank when the ship-shaped structure 40 becomes a part of the ship body 30 of a tanker. Therefore, during the construction of the  
15 ship-shaped structure, even if the plan of the final structure changes from an FPSO to a tanker, basically only the topside structure needs to be changed, and thus the ship-shaped structure can flexibly respond to the scheduled change. Further, since the design and manufacture of the ship-shaped  
20 structure 40 can be started before the final structure has been settled, the construction period can be shortened.

[0033]

Fig. 5 schematically shows a structure of cargo tanks and so on, of a ship-shaped structure of a second embodiment  
25 of the present invention. The second embodiment is a ship-

shaped structure 100, in which it is assumed that the breadth of the parallel part structure is relatively small (e.g., approximately 42m). Namely, since the ship-shaped structure 100 is relatively small in breadth, the ship body is not  
5 divided into three parts in the longitudinal direction to provide for center cargo tanks and wing cargo tanks as in the first embodiment, but each of the cargo tanks is divided into two parts by the center line.

[0034]

10 The ship-shaped structure 100 has eight cargo tanks 101 disposed on the starboard and portside of the center line, respectively. Slop tanks 102 are provided behind cargo tanks 101 positioned nearest to the stern. The length X1 of each foremost-positioned cargo tanks 101 is 6% to 11% of the  
15 length between perpendiculars (Lpp), and the total combined length X2 of each aftermost-positioned cargo tank 101 and slop tank 102 is 6% to 11% of the length between perpendiculars. In the cargo tank 101, which is third-nearest to the bow side, a first common space 103 is formed.  
20 The first common space 103 is provided on the center line, in which an internal turret can be installed. The other constructions are basically the same as those of the first embodiment, as described below.

[0035]

25 Namely, except for two cargo tanks, which are arranged

furthest aftermost and foremost along the longitudinal direction of the ship body, ballast tanks 104, which are provided on the outer side of each of the cargo tanks 101, are divided in the middle, and thus, the number of ballast  
5 tanks 104 in the longitudinal direction of the ship body is double the number of cargo tanks 101 in the longitudinal direction. In the bow part, a forepeak tank 105 is divided into three sections by bulkheads (not shown) substantially parallel to the center line to form a central common space  
10 with tanks positioned on both sides. An external turret can be installed in the common space, which can be used as trimming tanks for a tanker. In predetermined ballast tanks 104, reinforcing members are provided, assuming the adoption of spread mooring. Further, on an upper deck of the bow, an  
15 extension part is provided for installation of an offloading facility, and the breadth of the upper deck of the stern is enlarged to provide an offloading facility and an accommodation space, which is large enough to accommodate more persons than usually required on a tanker.

20 [0036]

Note that, in the first and second embodiments, although a plurality of common spaces are provided in the ship-shaped structure, the number of common spaces can be reduced in accordance with the purpose of the application, and for  
25 example, the first common space can be omitted.

## EXPLANATION OF REFERENCES

[0037]

13 second common space

21 external turret

5 40, 100 ship-shaped structure

41-45 center cargo tank

51, 103 first common space

61-65, 71, 72 wing cargo tank

90 intermediate structure

10 91 bow structure

92 stern structure

## CLAIMS

## [CLAIM 1]

A ship-shaped structure, comprising:

5 a cargo tank for reserving cargo oil; and

a common space that is a compartment provided independently from the cargo tank and can be provided with mooring equipment for a floating production storage and offloading unit or a reinforcing member for the mooring  
10 equipment.

## [CLAIM 2]

The ship-shaped structure according to claim 1, wherein a parallel part structure and an intermediate structure, which is obtained by joining together a bow structure and a  
15 stern structure that are formed by removing the parallel part structure from the ship-shaped structure, are built independently from each other.

## [CLAIM 3]

The ship-shaped structure according to claim 2, wherein  
20 the ship-shaped structure is built by dividing the intermediate structure into the bow structure and the stern structure, positioning the parallel part structure between the bow structure and the stern structure, joining the front end of the parallel part structure to the rear end of the bow  
25 structure, and joining the rear end of the parallel part

structure to the front end of the stern structure.

[CLAIM 4]

The ship-shaped structure according to claim 2 or 3,  
wherein the breadth of the intermediate structure is less  
5 than or equal to 49m.

[CLAIM 5]

The ship-shaped structure according to any one of claims  
2-4, wherein the intermediate structure is capable of self-  
propelling.

10 [CLAIM 6]

The ship-shaped structure according to any one of claims  
1-5, wherein the common space is positioned closer to the bow  
than the mid-ship point on the center line, and can be used  
as a cargo tank or a trimming tank.

15 [CLAIM 7]

The ship-shaped structure according to claim 6, wherein  
the common space is a centrally located compartment obtained  
by dividing the fore peak tank into three parts with  
bulkheads that are substantially parallel to the center line,  
20 and the mooring equipment is an external turret.

[CLAIM 8]

The ship-shaped structure according to claim 6, wherein  
the cargo tank comprises a center cargo tank disposed on the  
center line and wing cargo tanks provided on both sides of  
25 the center cargo tank, the common space is adjacent to one of

the center cargo tanks, and the mooring equipment is an internal turret.

[CLAIM 9]

5 The ship-shaped structure according to claim 6, wherein the cargo tanks are disposed on the starboard and portside of the center line, the common space is provided on the center line, and the mooring equipment is an internal turret.

[CLAIM 10]

10 The ship-shaped structure according to any one of claims 1-5, wherein the common space is a ballast tank provided inside a side wall of the ship body, and the mooring equipment includes a fairleader through which a spread mooring chain passes.

[CLAIM 11]

15 The ship-shaped structure according to any one of claims 1-8 and 10, wherein the cargo tank comprises a center cargo tank disposed on the center line and wing cargo tanks provided on both sides of the center cargo tank, and the number of ballast tanks provided in the longitudinal  
20 direction of the ship body on the outer sides of the wing cargo tanks is double the number of the center cargo tanks in the longitudinal direction, or the length of the aftermost- and foremost-positioned wing cargo tanks is 7% to 12% of the length between perpendiculars.

25 [CLAIM 12]

The ship-shaped structure according to any one of claims 1-7, 9 and 10, wherein the cargo tanks are provided along the center line, the number of ballast tanks provided outside the cargo tanks in the longitudinal direction of the ship body is  
5 double the number of the cargo tanks in the longitudinal direction, except for the aftermost- and foremost-positioned two cargo tanks arranged along the longitudinal direction of the ship body, or the length of each of the aftermost- and foremost-positioned cargo tanks is 6% to 11% of the length  
10 between perpendiculars.

[CLAIM 13]

The ship-shaped structure according to any one of claims 1-12, wherein a cargo oil pump is independently disposed close to a rear bulkhead in each of the cargo tanks.  
15 [CLAIM 14]

The ship-shaped structure according to any one of claims 1-13, wherein the breadth of the rear end of the upper deck close to the stern is 0.6-1.0 time the breadth of the ship-shaped structure, or the upper deck of the bow has an  
20 extension part with a tip that projects forward from the fore perpendicular by 1-3% of the length between perpendiculars and the breadth of the tip is 0.4-1.0 time the breadth of the ship-shaped structure.

[CLAIM 15]

25 The ship-shaped structure according to claim 14, wherein

an accommodation space for 150 or more persons is provided on the upper deck close to the stern.