FLOATING OFFSHORE BUNKER SUPPLY BASE

Abstract: A floating offshore bunker supply base comprising at least one floating storage module for storing a liquid and at least one floating berth coupled to the floating storage module such that a ship can berth at the floating berth and receive or discharge said liquid. The base may also include a mooring system coupled to the at least one floating berth, the mooring system including one or more mooring devices capable of mooring a ship to the berth without using mooring cables or a tugboat.
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Published: with international search report
FIELD OF INVENTION

Embodiments of the present invention relate to floating offshore bunker supply bases capable of quickly and efficiently refuelling bunker vessels from an offshore refuelling facility.

BACKGROUND

A bunker vessel is a ship or barge that operates within or out of a port to supply fuel (bunker) to ships that are anchored offshore. Bunker vessels have to collect the fuel from a near shore fuel depot and travel to ships moored at pre-assigned anchorage spaces, which may be a considerable distance away. These ships are generally moored to the seabed using an anchor and anchor chain, which requires a sea space circular area with a radius equal to the sum of the length of the mooring chain and the length of the ship. This requires a large amount of surface area to anchor large ships. For large or very busy harbours, there must be a large number of anchorage points. The more anchorage points there are, the farther the bunker vessel must travel to refuel the ships.

The bunker vessel may need to wait for the jetty at the near shore fuel depot to be free in order to take on the fuel. The wait for jetty space and the sometimes long trip out to the anchored ships result in lost time, which equates to lost revenue.

The fuel used to fill the bunker vessel at a shore facility must be stored in large tanks located near the port. These tanks consume large tracts of land that could be used more
productively. Additionally, there is an inherent risk of fire when storing large volumes of petrochemicals.

It would therefore be advantageous to provide a system and method to overcome one or more of the above disadvantages.

SUMMARY

One aspect of the present invention provides a floating offshore bunker supply base (FOBSB) comprising at least one floating storage module for storing a liquid and at least one floating berth coupled to said floating storage module such that a ship can berth at said floating berth and receive or discharge said liquid.

The floating storage modules and floating berths may be attached to a plurality of mooring dolphins, said mooring dolphins being attached to a seabed such that said floating storage modules and said floating berths remain in a fixed lateral position with respect to each other.

The FOBSB may also include a mooring system coupled to said at least one floating berth, said mooring system capable of mooring a ship to said berth without using mooring cables. The mooring system may allow the ship to moored to the berth without the use of a tugboat to position the ship. The mooring system may include one or more vacuum mooring devices.

The FOBSB may also include a plurality of floating fenders attached to the floating berth.

The floating storage module may comprise an outer pre-stressed concrete hull, an inner pre-stressed concrete hull, at least one steel tank within said inner hull, and a plurality of bulkheads defining a plurality of compartments for storing the liquid.
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within said tank. The floating storage module may also include a plurality of concrete beam grids disposed between said outer hull and said inner hull. The compartments can be arranged in a concentric configuration so that said floating storage module can remain uniformly loaded while charging and discharging fuel. The bulkhead may comprise a material selected from a group consisting of steel, concrete, and a steel-concrete composite.

The FOBSB may also include a plurality of floating storage modules and a plurality of floating berths, wherein said berths are located towards an outside of said FOBSB, and said storage modules are located between said berths on an inside of said FOBSB. The FOBSB may also include at least one floating collision barrier positioned to cushion the collision of the ship into the FOBSB. The floating collision barrier can be positioned to protect said floating storage module from collision.

The FOBSB may also include a plurality of facilities for the operation of said FOBSB. The facilities may be selected from a group consisting of a control station, an incinerator plant, a desalination plant, a power generation plant, a slop and wastewater treatment plant, a gas processing plant, an inert gas supply point, a warehouse, a pump room, a central monitoring system office, a plurality of living quarters, and a recreational facility.

The liquid may be selected from a group consisting of bunker fuel, diesel fuel, gasoline, petrochemicals, fresh water, and seawater.

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Another aspect of the present invention provides a method for transferring fuel between a ship and an offshore refueling facility, the method comprising the steps of:
providing at least one floating storage module for storing a liquid, and at least one floating berth coupled to said floating storage module;

mooring said ship to the berth; and

providing fuel to the ship from said floating storage module, said fuel being at least part of said liquid.

The facility may further comprise a mooring system coupled to said at least one floating berth and capable of mooring said ship to said berth without using mooring cables, and said mooring step further comprises mooring said ship to said berth using said mooring system.

In another aspect of the present invention, the ship delivers the liquid to the module.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will be better understood and readily apparent to one of ordinary skill in the art from the following written description, by way of example only, and in conjunction with the drawings, in which:

Figure 1 is a perspective view of one embodiment of a floating offshore bunker supply base (FOBSB) according to the present invention;

Figure 2 is a top plan view of the FOBSB of Figure 1;

Figure 3 is a cross-sectional side view of the FOBSB of Figure 2 along the line 3-3; and

Figure 4 is an exploded view of one embodiment of a floating storage module forming a portion of the FOBSB of Figures 1-3.
Figures 1 through 3 provide different views of one embodiment of a floating offshore bunker supply base (FOBSB), designated generally with reference numeral 100, according to the present invention. The FOBSB 100 can include one or more floating berths 110, one or more floating storage modules 150, and one or more mooring dolphins 101 to secure the FOBSB 100 to the seabed 102 (Figure 3). In some embodiments, the FOBSB can also include one or more floating collision barriers 104, one or more bilge keels 106, one or more flexible hose towers 108, one or more fire fighting foam guns 109 (Figure 3), and a plurality of facilities and equipment, designated generally as reference numeral 120. In some embodiments, the facilities and equipment 120 can be located on one or more floating facilities platforms 121. These will be discussed in more detail below.

The floating berths 110, floating storage modules 150, and facilities platforms 121 are held laterally in place with respect to each other using mooring dolphins 101. However, these floating structures can move freely in a vertical direction with respect to each other due to tidal variations and different floating heights based on the weight of the stored product.

Personnel can navigate between the floating berths 110 and floating storage modules 150 using drawbridges 115 and between the floating facilities platforms 121 and floating berths 110 using linkways 117. The drawbridges 115 are needed between the floating storage modules and the floating berths, as the differential heights of these structures can be large due to the loading and unloading of fuel. The linkways are used for gentler slopes between the floating facilities platforms 121 and floating berths 110.
The floating berths 110 provide mooring space for one or more ships 112. The floating berths 110 can be hollow or contain large air cavities in order to stay afloat. To secure the ships 112 to the berth 110, a mooring system that includes one or more mooring devices 114 can be located on the water side of the berths 110. To protect the mooring berths 110 from accidental collision, one or more floating fenders 116 can be placed in the water adjacent the floating berths 110. The floating berths 110 themselves, also serve to protect the floating fuel storage modules 150 from direct ship collision.

The mooring devices 114 allow the ships 112 to be moored to the floating berth 110 without the need for guide ropes or tugboats. In some embodiments, the mooring devices 114 can be vacuum mooring devices. This saves time in mooring the ships 112, as well as berth space. Since the ships 112 can be directly secured to the berths 110, the need to provide additional sea space in a circular area with a radius equal to the sum of the length of the mooring chain and the length of the ship is eliminated. Therefore, two or more ships 112 can be berthed at the floating berth 110 using the same amount of space required for a single ship secured with mooring chains.

In the embodiment of the FOBSB 100 illustrated in Figures 1-3, the floating berths 110 can be about 300 meters long and about 30 meters wide. It is understood that these dimensions are provided by way of example only. The floating berths 110 can be constructed using any dimensions, larger and smaller, depending on specific needs, desires or design considerations.

The floating collision barriers 104 can be secured, for example, between spaced apart floating berths 110 to help protect the floating storage modules 150 from accidental (or intentional) ship collisions. The collision barriers 104 also serve to
provide some protection to the facilities and equipment 120 on the floating facilities platform 121.

The facilities and equipment 120 can be located at various points around or in between the floating berths 110. The facilities and equipment can include, by way of example and not limitation, a control station 122, an incinerator plant 124, a desalination plant 126, a power generation plant 128, a slop and wastewater treatment plant 130, a gas processing plant 132, an inert gas supply point 134, one or more warehouses, pump rooms and a central monitoring system, designated generally as reference numeral 136, and one or more Offices, living quarters and recreational facilities, designated generally as reference numeral 138. The facilities and equipment 120 can allow the FOBSB 100 to be self-sufficient.

It is understood that the specific examples of facilities and equipment 120 discussed above are provided for the purpose of illustration only. Additional facilities and equipment 120 can be incorporated without departing from the scope of the embodiments. Likewise, the locations of the illustrated facilities and equipment 120 are illustrative only. It is understood that individual facilities can be located anywhere on the platform 121. In alternate embodiments, one or more of the facilities 120 can be located on the floating berths 110.

In the embodiment of the FOBSB 100 illustrated in Figures 1-3, the facilities and equipment 120, and specifically the facilities platform 121, can be about 175 meters long and about 40 meters wide. It is understood that these dimensions are provided by way of example only. The facilities platform 121 can be constructed using any dimensions, larger and smaller, depending on specific needs, desires or design considerations.
The mooring dolphins 101 can be secured to the sea floor 102 using, by way of example and not limitation, one or more support towers 103. These support towers 103 prevent the floating platforms 121 and berths 110 from moving horizontally, but do not offer any restraint in the vertical direction. In other words, the floating berths 110 are able to move freely in the vertical direction due to wave action and weight variances. The specific techniques for constructing and securing mooring dolphins 101 are known to those of skill in the art. It is understood that the term seabed 102 can include any underwater surface that can support the mooring dolphins 101. Therefore, the FOBSB 100 can be used as a floating platform at any fresh water or salt water location.

Figure 4 is an exploded view of one embodiment of the floating storage module 150 that forms a portion of the FOBSB 100 of Figures 1-3. While only one floating storage module 150 is illustrated in Figure 4, it is understood that many floating storage modules 150 could be incorporated in the FOBSB 100. In one embodiment, the floating storage module 150 can include an outer pre-stressed concrete hull 152 and a plurality of concrete beam grids 154 located within the outer hull 152. An inner pre-stressed concrete hull 156 can then be formed on top of the beam grids 154 within the outer hull 152. The beam grids 154 stiffen and integrate the inner hull 156 and outer hull 152 of the floating storage modules 150. In alternate embodiments, the concrete beam grids 154 can be replaced with concrete honeycomb. One or more steel tanks 158 can be incorporated into the inner hull 156. A plurality of bulkheads 160 can be incorporated into the steel tanks 158 to define a plurality of storage compartments 162. In some embodiments, the bulkheads 160 can be steel, concrete, a steel-concrete composite or any other material that provides sufficient structural rigidity to contain a variety of liquids.
The storage compartments 162 are designed to store a variety of liquids (not shown), such that the liquid in one compartment 162 is isolated from the liquid in adjacent compartments 162. These liquids can include, by way of example and not limitation, bunker fuel, diesel fuel, gasoline, various feedstock petrochemicals such as benzene and ethylene, fresh water, seawater, and the like. Any type of petroleum, petrochemical, or fuel product can be stored within the compartments 162, depending on the specific needs of the operators of the FOBSB 100. Seawater or fresh water can be stored in one or more of the compartments 162 to provide ballast to the floating storage module 150.

The specific design of the compartments 162 illustrated in Figure 4 is provided by way of example only. The compartments 162 in the tank 158 can be configured and arranged in a variety of ways to provide the storage capability required. In some embodiments, the storage compartments 162 can be arranged in a concentric configuration so that the floating storage module 150 remains uniformly loaded while charging and discharging the compartments 162.

The concrete hulls 152, 156 have several advantages over steel hulls. Concrete structures can be built at a lower cost. They are fire resistant and exhibit good fatigue resistance. Concrete is non-corrosive. The concrete hulls 152, 156 provide greater inertia against wave motion and vibration produced by equipment. They are longer lasting than steel and have lower maintenance costs.

In the embodiment of the floating storage module 150 illustrated in Figure 4, the floating storage module 150 can be about 180 meters long and about 80 meter wide with a depth of about 14 meters. It is understood that these dimensions are provided by
way of example only. The floating storage modules 150 can be constructed using any dimensions, both larger and smaller, depending on specific needs, desires or design considerations.

The embodiment of the FOBSB 100 shown in Figures 1-3 illustrates two floating berths 110, two floating storage modules 150, two facilities platforms 121, and two floating collision barriers 104. This arrangement is provided for the sake of illustration only. The FOBSB 100 is a highly scalable system that can be designed and constructed depending on the specific needs of an organization and the specific geographic considerations involved in placement of the FOBSB 100 at a particular location. A single or multiple floating berths 110, storage modules 150, facilities platforms 121, and collision barriers 104 can be incorporated into a specific design for the FOBSB 100 as required. The illustrated embodiment of the FOBSB 100 has a storage capacity of 300,000 cubic meters of liquid product, and can accommodate a Suez-max type tanker. As discussed above, this storage capacity can be easily expanded if needed.

Likewise, floating berths 110 can be provided that can accommodate the largest supertankers.

The FOBSB 100 provides many advantages over the prior art. The FOBSB 100 overcomes the anchorage and storage space limitations in ports/harbours. Ships 112 moored at the floating berth 110 take up less space than those moored at a single buoy mooring point at anchorage. By using FOBSB 100, the anchorage space available in ports may be better utilized.

The FOBSB 100 frees up fuel storage space on land for more value-added developments, as the number of land based fuel storage tanks can be reduced. Likewise, the bunker suppliers can realize a greater profit margin from the presence of an FOBSB 100. By locating an FOBSB 100 at an appropriate place, say near
the anchorage space, bunker vessels need not wait for free jetties at the near shore fuel depot. The travel time between the fuel facility and the ship 112 at anchor is considerably shortened. This results in a faster turnover for bunker suppliers and thus a greater return of investment. The FOBSB 100 can also provide direct fuel supply to ships 112 berthing at its floating berth 110. The number of bunker vessels can thus be reduced.

The FOBSB 100 is scalable and can be configured in various layouts depending on the operational needs and/or on the business climate. This flexibility makes it attractive for investors. The FOBSB 100 saves precious anchorage space as ships berthed at its floating berths 110 are held in place, whereas using an anchor and anchor chain, the sea space required is considerable due to the allowance for ships to turn around the anchor point. The FOBSB 100 can function as a relief base in case of an emergency, such as an oil spill.

The FOBSB 100 facilitates easy mooring and refuelling operations. Ships can dock at the berths without using mooring cables. Additionally, ships docking at the berths do not require tugboat assistance. Since the base can be located away from busy port facilities, manoeuvring the ships to the berths is much easier.

It will be appreciated by a person skilled in the art that numerous variations and/or modifications may be made to the present invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects to be illustrative and not restrictive.
We Claim:

1. A floating offshore bunker supply base comprising:
   at least one floating storage module for storing a liquid;
   and
   at least one floating berth coupled to said floating storage module such that a ship can berth at said floating berth and receive or discharge said liquid.

2. The floating offshore bunker supply base of claim 1, wherein each of said floating storage modules and floating berths is attached to a plurality of mooring dolphins, said mooring dolphins being attached to a seabed such that said floating storage modules and said floating berths remain in a fixed lateral position with respect to each other.

3. The floating offshore bunker supply base of claim 1, further comprising a mooring system coupled to said at least one floating berth, said mooring system capable of mooring a ship to said berth without using mooring cables.

4. The floating offshore bunker supply base of claim 3, wherein said mooring system comprises one or more vacuum mooring devices.

5. The floating offshore bunker supply base of any of the preceding claims, further comprising a plurality of floating fenders attached to the floating berth.

6. The floating offshore bunker supply base of any of the preceding claims, wherein the floating storage module comprises an outer pre-stressed concrete hull, an inner pre-stressed concrete hull, at least one steel tank within said inner hull,
and a plurality of bulkheads defining a plurality of compartments for storing the liquid within said tank.

7. The floating offshore bunker supply base of claim 6, wherein the floating storage module further comprises a plurality of concrete beam grids disposed between said outer hull and said inner hull.

8. The floating offshore bunker supply base of claims 6 or 7, wherein said compartments are arranged in a concentric configuration so that said floating storage module can remain uniformly loaded while charging and discharging fuel.

9. The FOBSB of any one of claims 6-8, wherein said bulkhead comprises a material selected from a group consisting of steel, concrete, and a steel-concrete composite.

10. The floating offshore bunker supply base of any of the preceding claims, further comprising a plurality of floating storage modules and a plurality of floating berths, wherein said berths are located towards an outside of said FOBSB, and said storage modules are located between said berths on an inside of said FOBSB.

11. The floating offshore bunker supply base of any of the preceding claims, further comprising at least one floating collision barrier positioned to cushion the collision of the ship into the floating offshore bunker supply base.

12. The floating offshore bunker supply base of claim 11, wherein said at least one floating collision barrier is positioned to protect said floating storage module from collision.
13. The floating offshore bunker supply base of any of the preceding claims, wherein each of said floating storage modules and floating berths is coupled to a plurality of mooring dolphins, said mooring dolphins being attached to a seabed such that said floating storage modules and said floating berths remain in a fixed lateral position with respect to each other.

14. The floating offshore bunker supply base of any of the preceding claims, further comprising a plurality of facilities for the operation of said floating offshore bunker supply base.

15. The floating offshore bunker supply base of claim 14, wherein said facilities are selected from a group consisting of a control station, an incinerator plant, a desalination plant, a power generation plant, a slop and wastewater treatment plant, a gas processing plant, an inert gas supply point, a warehouse, a pump room, a central monitoring system office, a plurality of living quarters, and a recreational facility.

16. The floating offshore bunker supply base of any one of claims 14 and 15, wherein said facilities are located on at least one facilities platform coupled to a plurality of mooring dolphins, said mooring dolphins being attached to a seabed such that said facilities platform remains in a fixed lateral position with respect to each of said floating storage modules and said floating berths.

17. The floating offshore bunker supply base of claim 16, further comprising one or more linkways between said platform and said berth.

18. The floating offshore bunker supply base of any of the preceding claims, wherein said liquid is selected from a group
consisting of bunker fuel, diesel fuel, gasoline, petrochemicals, fresh water, and seawater.

19. The floating offshore bunker supply base of any one of the previous claims, further comprising one or more drawbridges coupled between said floating storage module and said floating berth.

20. A method for transferring fuel between a ship and an offshore refueling facility, the method comprising the steps of:
   providing at least one floating storage module for storing a liquid, and at least one floating berth coupled to said floating storage module;
   mooring said ship to the berth; and
   providing fuel to the ship from said floating storage module, said fuel being at least part of said liquid.

21. The method of claim 20, wherein the floating storage module comprises an outer pre-stressed concrete hull, an inner pre-stressed concrete hull, at least one steel tank within said inner hull, and a plurality of bulkheads defining a plurality of compartments for storing the liquid within said tank.

22. The method of any one of claims 20-21, wherein, in said providing step, said ship delivers said liquid to said module.

23. The method of any one of claims 20-22, wherein said facility further comprises a mooring system coupled to said at least one floating berth and capable of mooring said ship to said berth without using mooring cables, and said mooring step further comprises mooring said ship to said berth using said mooring system.
A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

B63B 35/44 (2006.0 1)  B63B 21/00 (2006.0 1)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B63B 35/44, E02B 3/20, 3/24

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DWPI, B63B 35/44, E02B 3/20, 3/24 +KW(MOOR+, BERTH+, SHIP+, BOAT+)and like terms

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>US 1547092 (SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B.V.) 6 June 1979</td>
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* Further documents are listed in the continuation of Box C

X See patent family annex

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Date of the actual completion of the international search

23 August 2007

Date of mailing of the international search report

31 AUG 2007

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