Feb. 19, 1963 A. J. SCHULTZ 3,077,615

FLOATING OFF-SHORE TERMINAL

Filed Oct. 5, 1961 4 Sheets-Sheet 1

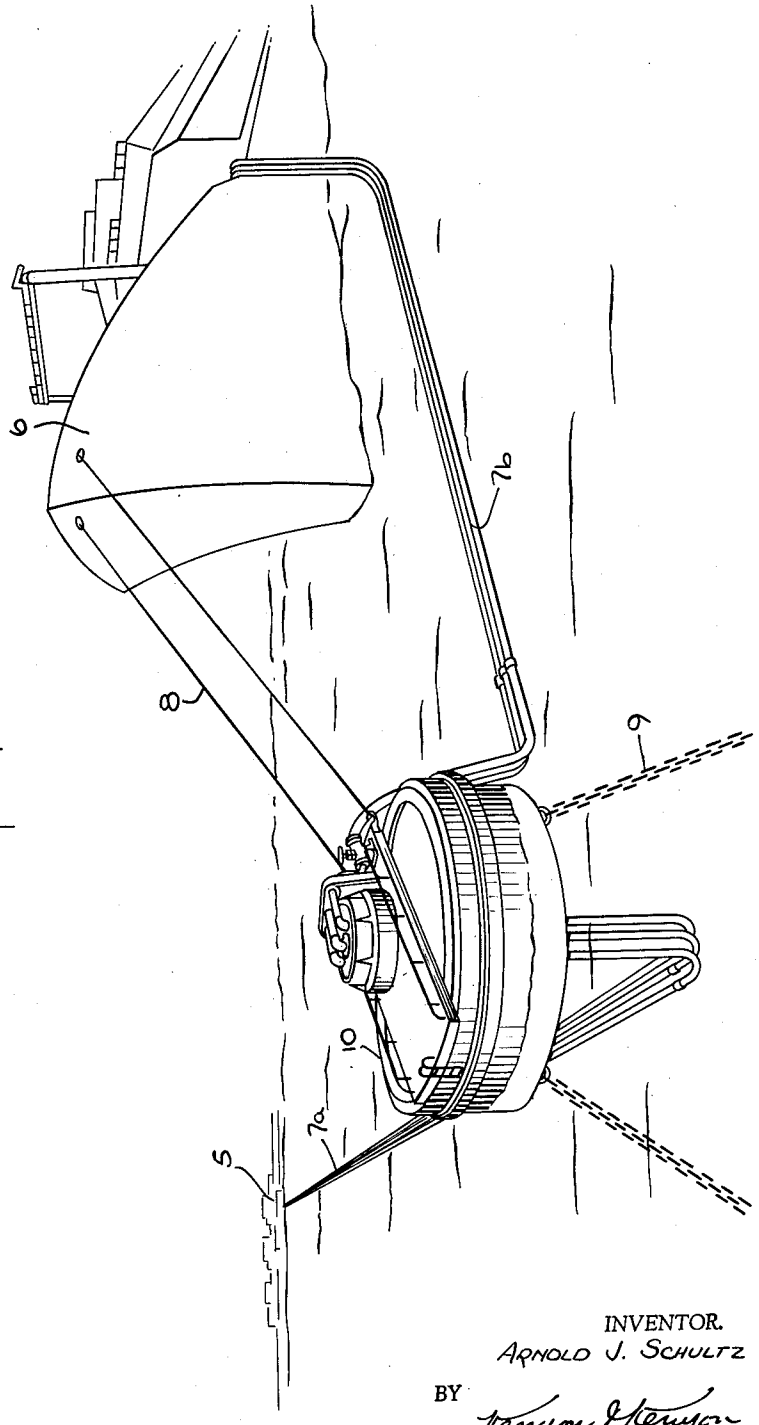


Fig. 1.

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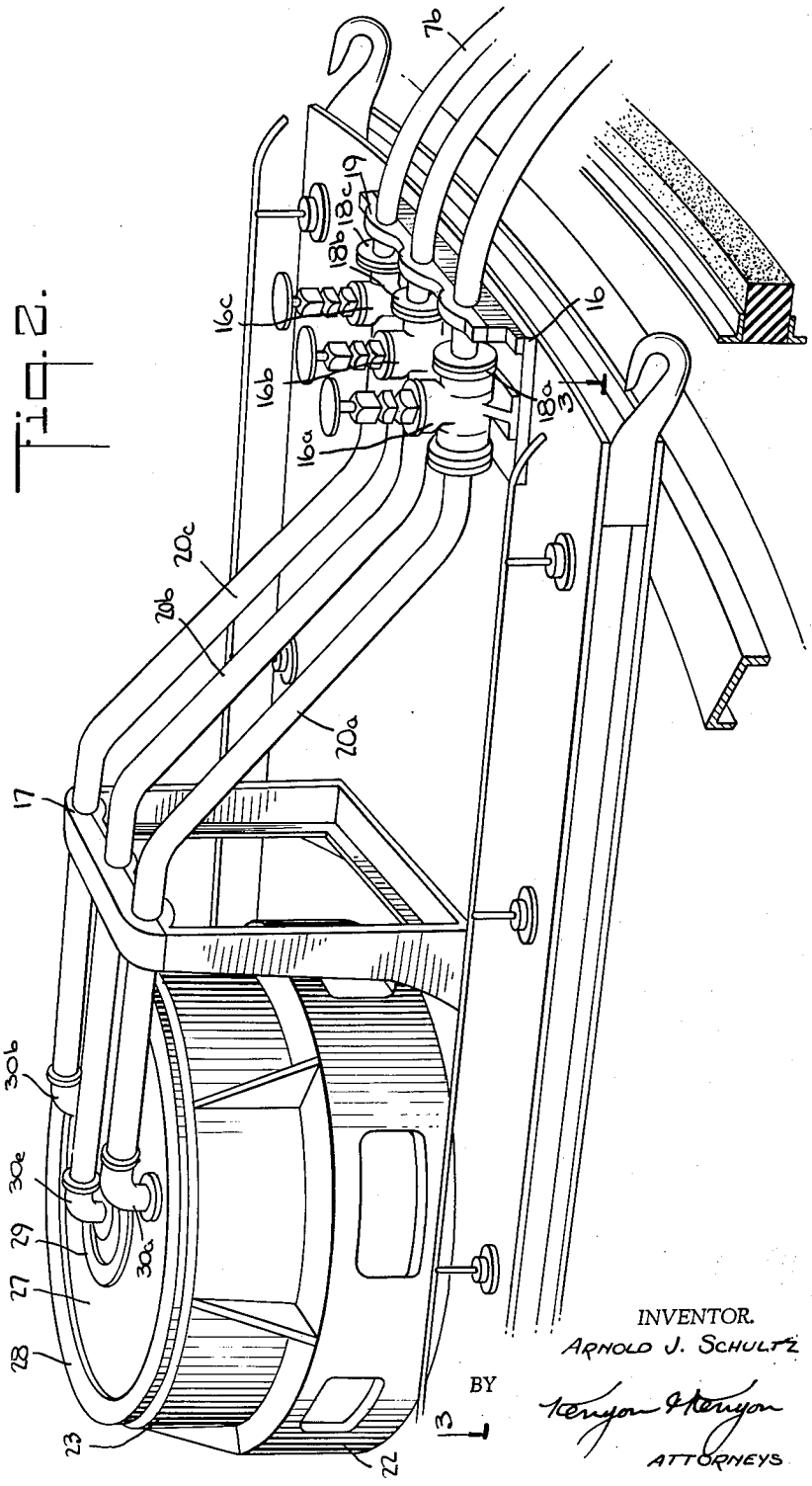
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Fig. 2.



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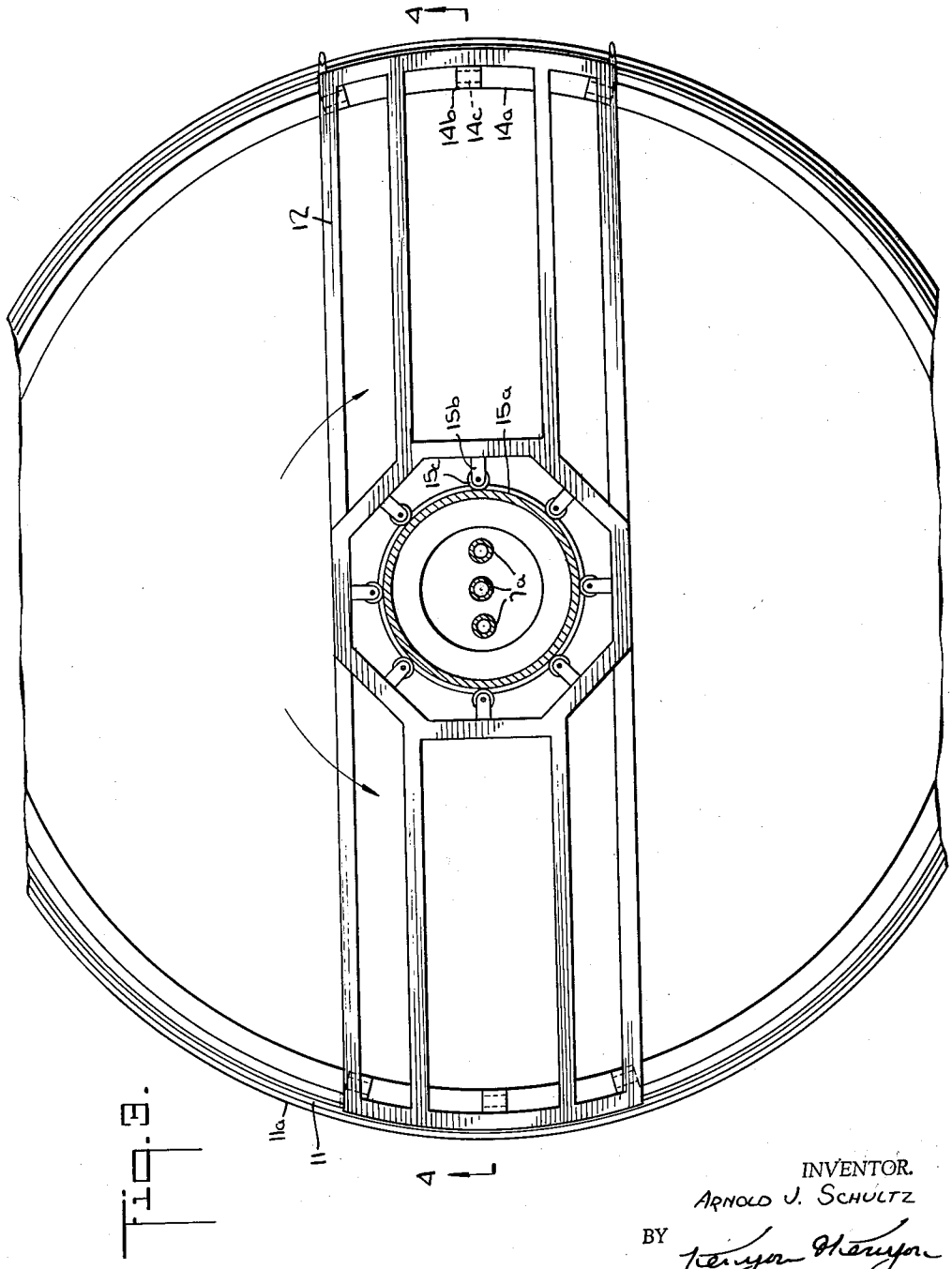


Fig. 1

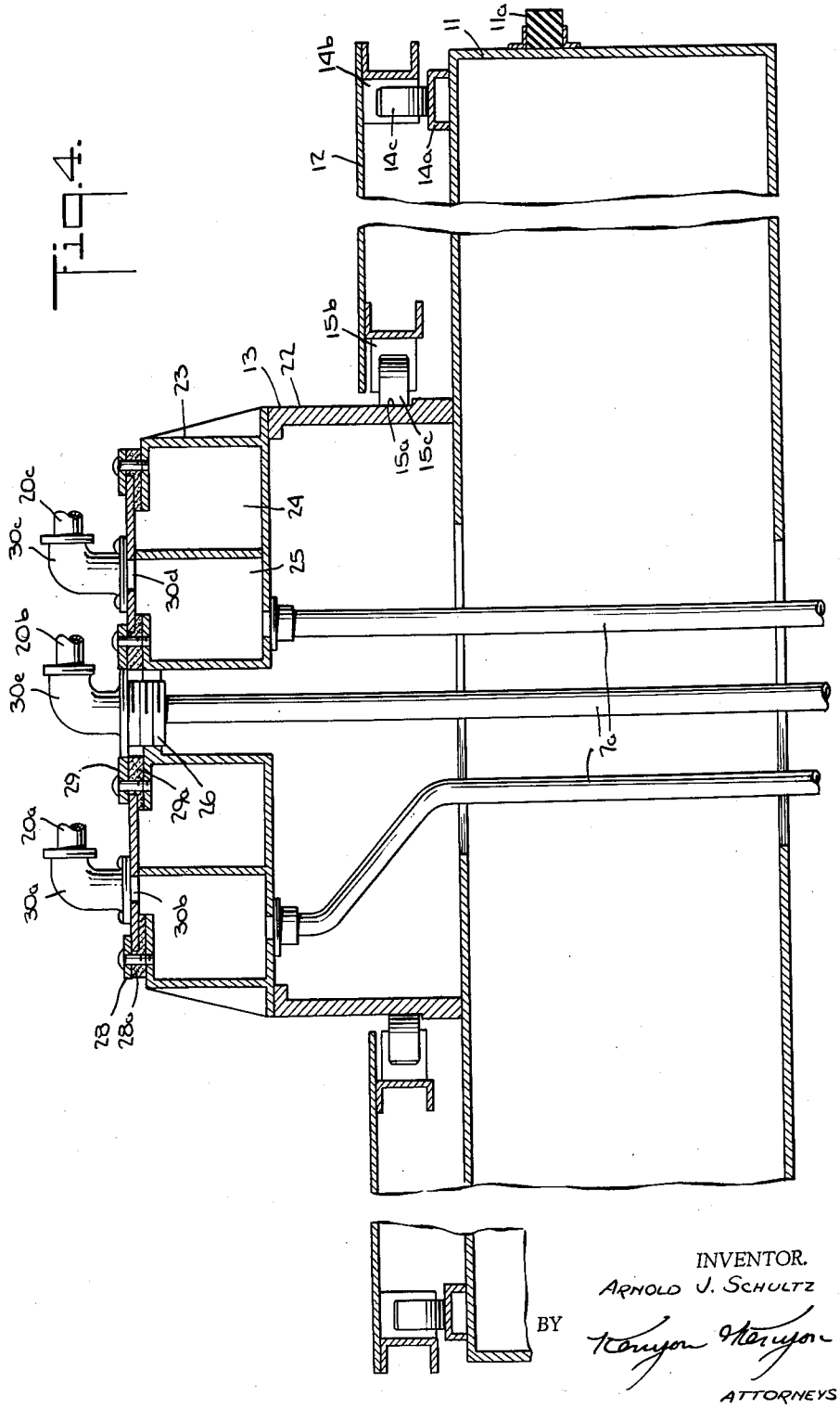
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Fig. 4.



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FLOATING OFF-SHORE TERMINAL

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4 Claims. (Cl. 9—8)

This invention relates to floating off-shore terminals, and more particularly to such terminals as are adapted to both load and unload a plurality of separate fluids from an off-shore tanker.

Modern harbours are extremely crowded, and considerable advantage resides in the ability to load and unload off-shore. Moreover, aside from the commercial advantages inherent in off-shore loading, considerable military advantages are also involved. The major commercial advantages reside in the avoidance of harbour piloting and tugging fees, as well as the expenses of renting or otherwise controlling a land-side pier facility. Also ships using off-shore facilities need not wait for high tide to enter a harbour, and for all the reasons which make harbour operations risky, are better insurance subjects.

These advantages are particularly accentuated where tanker vessels are concerned, because there the danger of fire is greatest while the necessity for actual handling of the cargo in unloading is smallest.

One particularly desirable form of off-shore terminal would be one which requires little maintenance, is easily adaptable to any depth of water, allows tethering of the moored vessel, and is adaptable to handling more than one liquid at one time in either the loading or unloading directions or in combinations thereof.

It is accordingly a principal object of the present invention to provide an off-shore terminal facility for loading and/or unloading tankers.

Another object of the invention is to provide a floating off-shore terminal facility adaptable to use in any depth of water and further adapted to moor and tether a tanker loading and/or unloading tanker.

Another object of the invention is to provide a floating off-shore terminal facility adaptable to use in any depth of water and further adapted to moor and tether a tanker loading and/or unloading therefrom.

Another object of the invention is to provide such a facility having a relatively low profile on the waters surface so as to resist windy seas without excessive pitching thus providing superior mooring and connecting characteristics.

Still another object of the invention is to provide such a facility having improved means for avoiding leakage cargoes, and having easy maintenance characteristics for ports most affected by a sea environment.

These and further objects and advantages of the invention will become more apparent to those skilled in the art upon examination of the hereinbelow detailed description of what is at present one excellent embodiment for practicing the invention, when taken with the claims and the drawings wherein:

FIGURE 1 is a perspective view of a vessel moored and connected to the floating off-shore terminal of the present invention;

FIGURE 2 is a detailed perspective view of a portion of the terminal of FIGURE 1;

FIGURE 3 is a sectional view along the line 3—3 of FIGURE 2;

FIGURE 4 is a broken sectional view of the terminal of FIGURE 3 taken along line 4—4 therein and showing internal details of construction.

Referring now to the drawings wherein like characters identify like parts in all views thereof, and particularly to FIGURE 1, the floating off-shore terminal of the present invention, indicated generally at **10**, is moored to the bottom of the harbour by chains **9** or similar devices in any suitable number, three being contemplated in the present device for stability. A vessel **6** is shown moored by lines **8** to the terminal **10**, and is thus free to tether thereon with the winds and tides, as will hereinafter be more fully described.

The terminal **10** is interconnected with the shore **5** and the ship **6** so as to allow passage of one or more fluids therebetween. Specifically, a plurality of relatively permanently connected conduit **7***a* connect the terminal **10** with the shore **5**, while a plurality of temporarily connected conduit **7***b* connect the terminal **10** with the vessel **6**. As will be hereinafter explained, the advantages of the present invention reside in the nature of the interconnections between the conduit **7***a* and the conduit **7***b* within the terminal **10**, as well as in the overall terminal structure itself.

In one form of the invention particularly adaptable to military purposes, ballast tanks (not shown) or the float chamber **11** best shown in FIGURE 4 may be interconnected with one of conduit **7***a* directly which would terminate therein so that either water or air could be pumped into the chamber or tanks on order to raise the terminal **10** to the surface for use or to submerge it below the surface for concealment.

Such an embodiment would also have application in crowded harbours where floating terminals would not be desirable full time. However, in general, most installations will require only full time floating terminals not having the aforesaid provisions. Referring now particularly to FIGURES 2, 3 and 4, such a terminal **10** comprises the aforesaid float chamber **11** having a platform **12** rotatably mounted thereon, and further having a fixed tower **13** mounted on said float chamber **11**.

The arrangement of the parts, is such, as will be hereinafter described in detail, that the float chamber is relatively fixed or free from rotation because of the constraint of chains **9**. The tower **13** is also fixed or free from rotation because of its rigid mounting upon the float chamber **11**. All tethering necessary to allow the vessel **6** to follow the wind and tide directions is accomplished by rotation of only two assemblies, the platform **12** and gasket assemblies atop the tower **13**. This arrangement is responsible for several of the advantages of the invention as will become apparent hereinafter.

The float chamber **11** is surrounded by a bumper **11***a* of any suitably salt sea resistant resilient material. As best shown in FIGURES 3 and 4, an annular track **14***a* follows the outer perimeter of float chamber **11** at its upper face, and a peripheral track **15***a* is notched into the outer vertical face of tower **13**. Platform **12** is generally rectilinear and is at least somewhat wider than tower **13** and bears a plurality of wheel assemblies **14***b* along each end thereof above track **14***a*. Contained within each wheel assembly **14***b*, three of which are shown at each end in FIGURE 3, is a horizontal axis wheel **14***c*. These wheels **14***c* bear the vertical load of the platform **12** and its equipment and transmit it to track **14***a*.

The area of platform **12** immediately adjacent tower **13** is open and bears a plurality of eight wheel assemblies **15***b* each containing a wheel **15***c* having a vertical axis so as to support horizontal loads on platform **12**. These wheels **15***c* serve to retain platform **12** axially about tower **13**, while all wheels **15***c* and **14***c* serve to mount platform **12** in freely rotatable fashion upon float chamber **11**.

As best shown in FIGURE 2, mounted upon platform **12** is a valve assembly **16** and a brace assembly **17**. Valve assembly **16** has mounted thereon plurality of valves **16***a*, **16***b*, and **16***c*, one for each of conduit **7***b*. Threaded means **18***a*, **18***b* and **18***c* are adapted to connect conduit **7***b* to said valves in a manner adaptable to disconnection with facility. Such means are well known to the art.

Clamp means **19**, also well known, is adapted to secure said connections against undue strain due to tossing of the terminal **10** and snapping of the conduit **7***b* in the seas. Brace **17** is adapted to rigidly support each of conduit **20***a*, **20***b* and **20***c* which permanently interconnect valves **16***a*, **16***b* and **16***c* with the tower **13**. Affixed to platform **12** are hooks **21** for securing the mooring lines **8** for the vessel **6**.

The construction and arrangement of tower **13** is extremely important and is largely responsible for the advantages of the invention. As best shown in FIGURES 2 and 4, tower **13** comprises an outer structural shell **22** surmounted by a fluid chamber assembly **23**. The various fluid chambers are **24** and **25**, but any number may be employed sufficient to accommodate the plurality of conduit being utilized, subject to the fact that one such conduit is centrally disposed without a chamber, as will be hereinafter described. Thus in FIGURE 4, a plurality of annular chambers **24** and **25**, arranged horizontally of each other, surround a centrally located swivel joint **26**, of well known construction.

An annular plate **27** mutually surmounts and closes the open upper faces of the chambers **24** and **25**. An annular ring **28** surrounds the outer perimeter of plate **27** while an annular ring **29** surrounds the inner perimeter of plate **27**. Clamped by ring **28** is a gasket **28***a*, and clamped by ring **29** is a gasket **29***a*. These gaskets serve to completely seal plate **27** between rings **28** and **29** and chambers **24** and **25** respectively against leakage but allowing rotation of plate **27**.

Conduit **20***a* terminates at fixture **30***a* on plate **27** which communicates via aperture **30***b* therein with chamber **24**. Conduit **20***c* similarly terminates at fixture **30***c* which communicates via aperture **30***d* with chamber **25**. Conduit **20***b* communicates directly with swivel joint **26**, as aforesaid. Communicating directly with the underside of chambers **24** and **25** and swivel **26** are three conduit **7***a*, one each respectively.

It is a feature of the invention that the horizontal chambers **24** and **25** may be multiplied indefinitely without adding to the height of the overall assembly. Height is disadvantageous because of possible pitching due to wind resistance. Moreover, the horizontal disposition of the chambers means that the conduit **7***a* are connected directly thereto, and need not pass through a lower chamber to an upper chamber as is the case in vertically arranged chambers. This latter removes a great deal of the possibility of interleakage among the chambers, and makes the entire conduit available for repairing if necessary.

Moreover, the gasketing at the top of the mutually horizontal chambers present less gasket area for leakage than other approaches to that problem, and also prevents interleakage between the various cargoes. Interleakage is to be avoided, since some chambers may be for example for oil while others are for fuel or for gasoline or even for fresh water. Another advantage of this arrangement of solid topped float chamber **11** and horizontally disposed fluid chambers **24** and **25** is that a protected repair and repair supplies storage area is thereby provided.

While there is a practical limit to the number of vertical or pyramided chambers that may be employed, the horizontal arrangement is very little restricted. Thus several of the aforesaid mentioned fluids may be handled simultaneously with less likelihood of interleakage.

In operation, a terminal **10** will be moored as aforesaid, and connected with the shore by conduit **7***a*. If the provisions mentioned above are made, the terminal may normally float or may normally be submerged and may only float when about to be used. A vessel **6** may approach the terminal and put off a small launch (not shown). The occupants thereof, after reaching the terminal, may secure the lines **8** to the hooks **21**. The conduit **7***b* will preferably be stored in the protected portion of tower **13** mentioned above, and suitably lashed down.

In this case the conduit **7***b* will be unrolled and fastened to valves **16***a*, **16***b* and **16***c* and clamp **19**.

The conduit **7***b* may also be carried by each vessel **6**, although this is not preferred. In either event, after affixing the conduit **7***b* to the terminal **10** as aforesaid, the launch will proceed back to the vessel **6**, paying out the floatable air-laden circuit **7***b* as it goes. The conduit will then be secured to the vessel and interconnected with its cargo and other storage receptacles.

Upon suitable communications with the shore installations **5**, unloading of cargo through any or all of conduit **7***b* to terminal **10** including the appropriate chambers and interconnections therein and thence to conduit **7***a* and the shore will be made. Unused conduit may simultaneously be employed to carry fresh water or fuel to the vessel **6**, or any other fluid.

As will be appreciated by those skilled in the art, the vessel **6** will constantly change its direction to head into the wind and tide. This occurs naturally from the effect of those elements, and while the terminal float **11** with the tower **13** remains fixed at the center of any such rotation, the platform **12** with all the appurtenant equipment and the gasket plate **27** with its appurtenant equipment will rotate with the vessel **6**.

Full 360° rotation is thus allowed with a minimum degree of leakage and interleakage danger, and a low profile so as to avoid wind pitching. These crucial advantages are a direct result of the horizontally arranged fluid chambers and the top side gasketing arrangement thereon. Furthermore, these characteristics are not compromised by addition of even more chambers for more simultaneous cargoes, which was not the case with the prior art attempts in this art.

What has been described is one embodiment, at present believed to be the best, of the invention claimed hereinafter. Those skilled in the art may modify this embodiment in many ways apparent to them but still within the scope of the invention as hereinafter claimed.

What is claimed is:

1. A floating off-shore terminal for loading and unloading liquids between a shore facility and a vessel moored to said terminal comprising a buoyant float chamber, a tower structure fixedly mounted thereon, a rotatable platform mounted upon said float chamber coaxially with said tower structure, a fluid chamber assembly comprising a horizontally disposed plurality of concentric coterminous annular chambers within said tower, a plate covering the top-side of said annular chambers and rotatably gasketed thereto at the outer perimeter thereof, a first plurality of conduits communicating with the underside of said fluid chamber assembly one each with each of said annular chambers, and a second plurality of conduits mounted on said rotatable platform and communicating through said rotatable plate one each with each of said underlying annular chambers.

2. A floating off-shore terminal for loading and unloading liquids between a shore facility and a vessel moored to said terminal comprising a buoyant float chamber, a tower structure fixedly mounted thereon, a rotatable platform mounted upon said float chamber coaxially with said tower structure, said platform being essentially long enough to span said float chamber but appreciably less in width so as to leave nonrotatable standing and repair and storage space on said float chamber, a fluid chamber assembly comprising a horizontally disposed plurality of concentric coterminous annular chambers within said tower, a plate covering the top-side of said annular chambers, and rotatably gasketed thereto at the outer perimeter thereof, a first plurality of conduits communicating with the underside of said fluid chamber assembly one each with each of said annular chambers, and a second plurality of conduits mounted on said rotatable platform and communicating through said rotatable plate one each with each of said underlying chambers.

3. A floating off-shore terminal for loading and un-

loading liquids between a shore facility and a vessel moored to said terminal comprising a buoyant float chamber, a tower structure fixedly thereon, a rotatable platform mounted upon said float chamber coaxially with said tower structure, a fluid chamber assembly within said tower comprising a fluid swivel joint disposed at the center of rotation of said platform and a plurality of concentric coterminous annular chambers each of said chambers being horizontally arranged coaxially with said swivel joint, a plate covering the top-side of said annular chambers and rotatably gasketed thereto at the outer perimeter thereof, a first plurality of conduits one of which communicates with the underside of said swivel joint and the remaining of which communicates with the underside of said fluid chamber assembly one each with each of said annular chambers, and a second plurality of conduits mounted on said rotatable platform one of which communicates with the upperside of said swivel joint and the remaining of which communicate through said rotatable plate one each with each of said underlying annular chambers.

4. A floating off-shore terminal for loading and unloading liquids between a shore facility and a vessel moored to said terminal comprising a buoyant float chamber, a tower structure fixedly mounted thereon, a rotatable platform mounted upon said float chamber coaxially with said tower structure, said platform being essentially long enough to span said float chamber but appreciably

less in width so as to leave nonrotatable standing and repair and storage space on said float chamber, a fluid chamber assembly within said tower comprising a fluid swivel joint disposed at the center of rotation of said platform and a plurality of concentric coterminous annular chambers each of said chambers being horizontally arranged coaxially with said swivel joint, an annular plate covering the top-side of said annular chambers and rotatably gasketed thereto at the outer perimeter thereof and at the inner perimeter thereof, a first plurality of conduits one of which communicates with the underside of said swivel joint and the remaining of which communicate with the underside of said fluid chamber assembly one each with each of said annular chambers, and a second plurality of conduits mounted on said rotatable platform one of which communicates with the upperside of said swivel joint and the remaining of which communicates through said rotatable plate one each with each of said underlying annular chambers.

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