United States Patent [19]

Mott et al.

[11] **3,894,567**

[45] **July 15, 1975**

[54] **OFFSHORE VESSEL MOORING**

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[22] Filed: **Sept. 8, 1971**

[21] Appl. No.: **178,831**

Related U.S. Application Data

[63] Continuation of Ser. No. 886,140, Dec. 18, 1969, abandoned.

[52] **U.S. Cl.** ..... **141/388**; 9/8 P; 137/236

[51] **Int. Cl.** **B65b 3/04**

[58] **Field of Search** ..... 9/8 P; 61/46, 46.5; 114/230; 137/236, 236.5; 141/279, 284, 387, 388; 166/.5, .6; 285/114, 226, 229, 236

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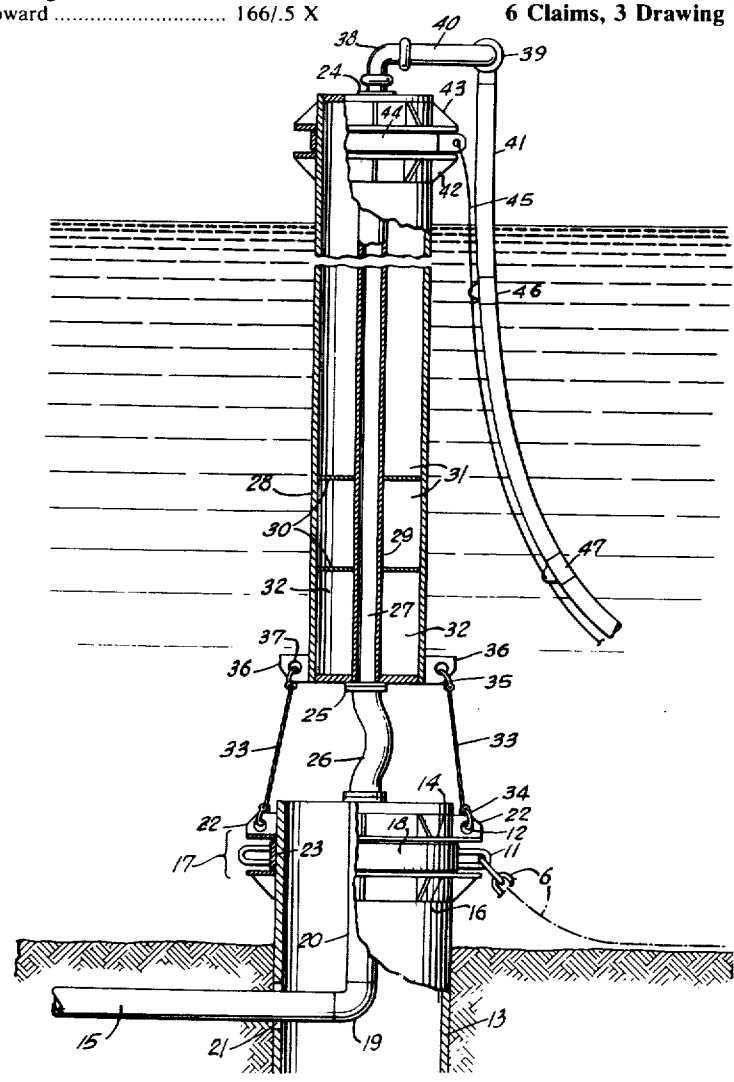
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[57] **ABSTRACT**

The invention relates to a ship's mooring of the single point type for an offshore location, including a liquid cargo loading facility. The mooring comprises a foundation member such as a pile or the like which is imbedded in the offshore substratum with a portion projecting thereabove. A buoyant casing extending to the water's surface is operably engaged at its lower end with the foundation member to enclose and protect a liquid carrying conduit. Said conduit is communicated either with a shore based source of liquid to be transferred to a transport vessel, or is coupled with a floating storage vessel such as a tanker or barge. In the latter instance, the storage or transport vessel is positioned by a rotatable connection at the foundation member whereby to limit movement of the vessel during a liquid transfer operation.

6 Claims, 3 Drawing Figures



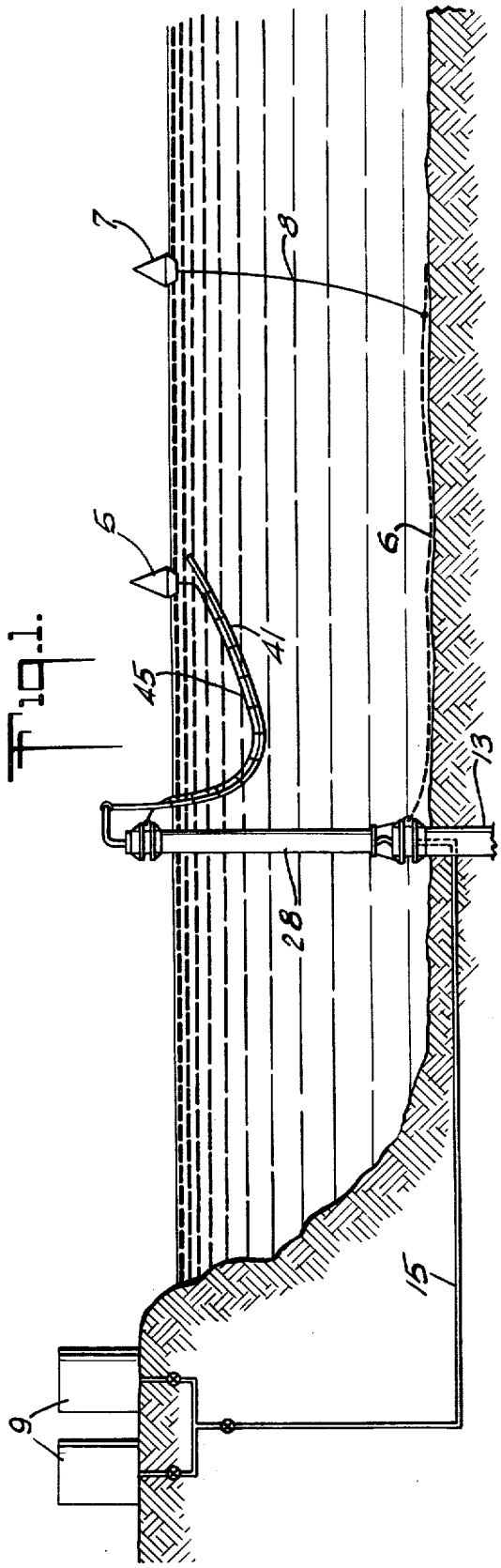


Fig. 1.

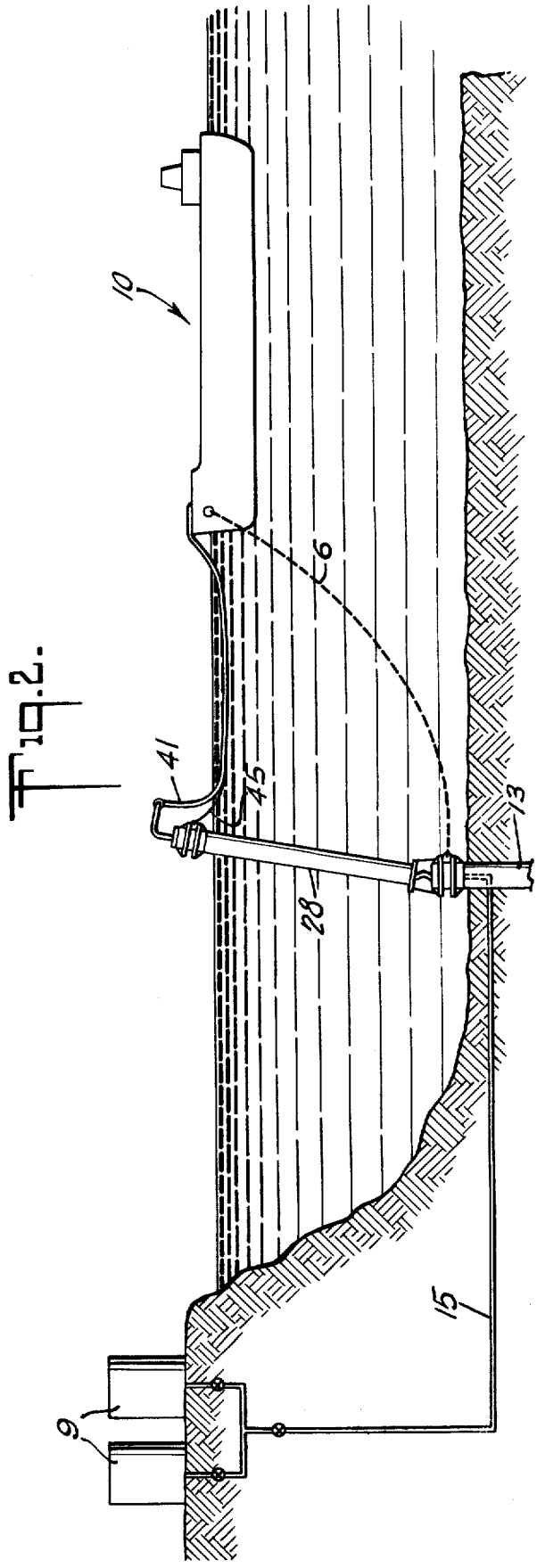
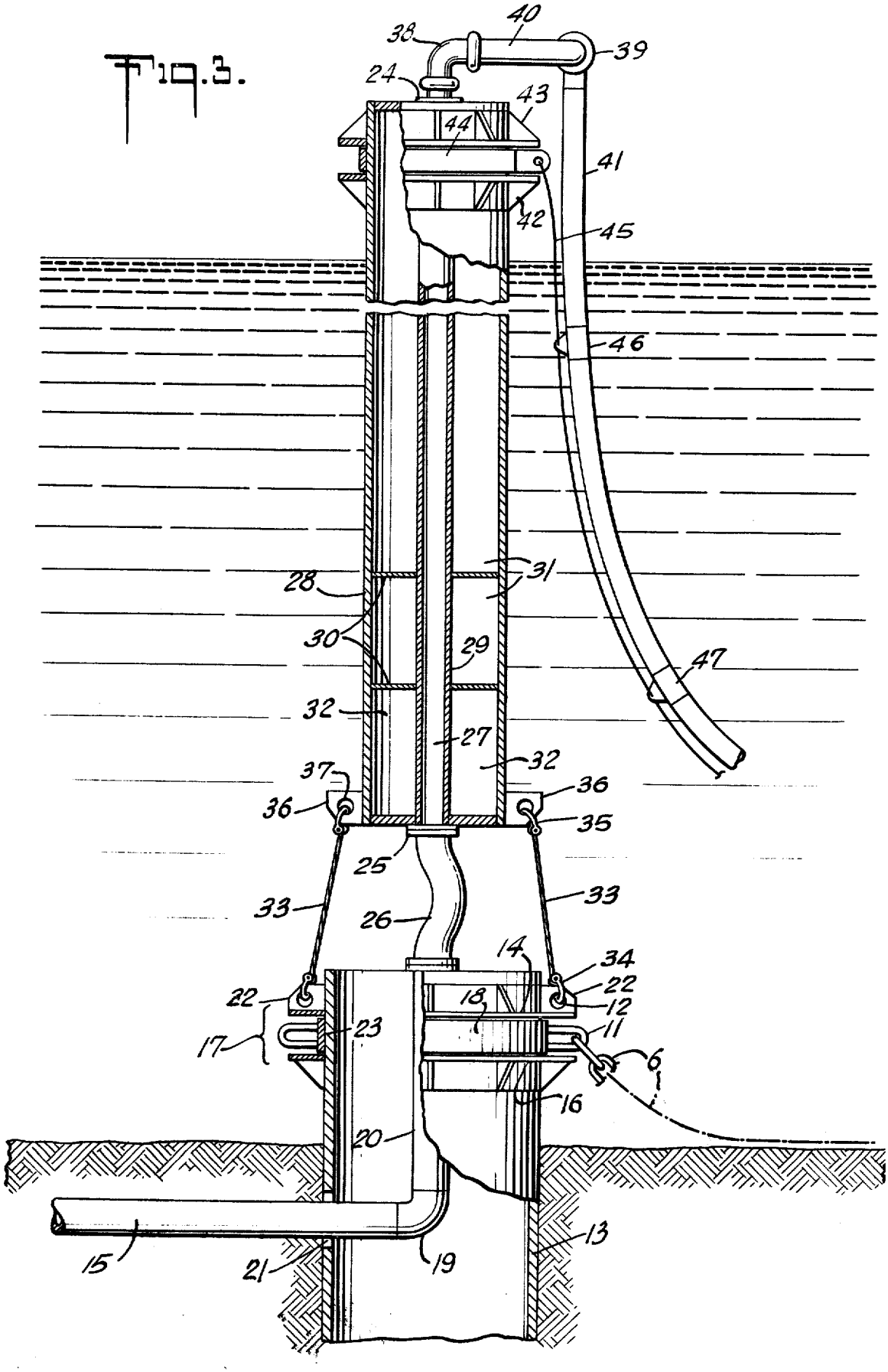


Fig. 2.

Fig. 3.


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OFFSHORE VESSEL MOORING

This is a continuation. Ser. No. 886,140, filed Dec. 18, 1969, now abandoned.

BACKGROUND OF THE INVENTION

The use of offshore moorings for positioning large vessels such as barges, tankers, super-tankers and the like, is becoming more necessary as the size and capacity of the vessels becomes greater. The floatable mooring is normally positioned in a water depth sufficient to accommodate a tanker and yet permit a degree of movement to the latter in response to varying wind and wave conditions. As a matter of practicality, the float is often provided not only with a ship mooring facility, but also with means for transferring a liquid cargo such as crude or refined petroleum products between the vessel and a land based source.

To function properly under all conditions, the offshore mooring must be adequate to permit uninterrupted flow or transfer of the liquid between the storage area and the tanker over an extended period of time. However, it must also be sufficiently massive to maintain the floating position of the tanker with a reasonable degree of immobility. Due to the uncertainty of weather conditions and to the certainty of tidal changes, there is a constant tendency for the moored vessel to be pivotally swung around its mooring point. Preferably, this swinging motion is about the ship's bow which is normally tethered in a relatively fixed position in order that the liquid cargo carrying lines may be maintained between the mooring and the ship without damage in spite of movement of the vessel.

It is therefore one of the objectives of the invention to provide an improved, ship's mooring for an offshore location. A further object is to provide a tanker anchoring and cargo transfer facility adapted to effectively receive and hold a tanker without entangling cargo transfer conduits. A still further object is to provide a single point mooring for securely holding a floating vessel whereby to transfer a liquid cargo to or from the latter.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation view illustrating the presently disclosed offshore facility when unoccupied by a floating vessel.

FIG. 2 is similar to FIG. 1 showing the disposition of the mooring means as related to a tanker.

FIG. 3 is an enlarged view in cross section of the disclosed mooring device.

In achieving the foregoing objectives, there is presently provided a single point mooring for use at an offshore location. The mooring includes a foundation member or anchor pile which is fixedly imbedded in the underwater substrate. The foundation member is in the form of an elongated, open ended pile which is usually buried in the substratum by driving, jetting or other appropriate means, with the upper end protruding upwardly from the substrate.

A buoyant casing, which maintains a normally upright position in the water, is operably engaged to the foundation member upper end to permit restrained movement of the casing. Said casing surrounds and protects one or more conduits, carrying liquid cargo to be transferred between the floating vessel and the shore facility.

Fastening collars capable of 360° rotation are secured to the buoyant casing and the foundation member respectively, to permit the floating vessel to rotate around the buoyant casing and foundation member. Two or more pipe swivels disposed 90° apart are mounted in the cargo carrying conduit near the top of the buoyant casing to permit the cargo loading hose to also rotate 360° around the buoyant casing. A series of flexible connections secures the buoyant casing to the fixed foundation member, whereby the former is free to oscillate in the water independently of the foundation member.

A mooring of the type contemplated is shown in FIG. 2 wherein a floating tanker **10** is tethered by mooring line **6** to the protruding upper end of an imbedded foundation member **13.** It is appreciated that in the following description the term tanker will be used to illustrate the invention. In actuality, any floating vessel such as a ship, barge or similar water borne unit would apply as well to function as a cargo transfer vehicle. Further, the present mooring is usually anchored immediately offshore in a bay or adjacent to a refinery, or tank field but could be used near a producing offshore field with an oil storage vessel. However, the terminology ocean and ocean floor will be used to illustrate any underwater section wherein the facility is disposed.

FIG. 2 illustrates an embodiment of the instant mooring means wherein a shore based source of liquid **9** is communicated with the offshore positioned vessel **10.** The means of communication usually consists of a plurality of rigid conduits **15** preferably imbedded beneath the substratum to avoid damage or breakage. The cargo transfer system is provided with necessary valve and manifold means normally used to controllably direct a variety of liquids between tanker **10** and the storage facility **9.** The shore based facility may as mentioned be a refinery, a tank farm or merely the gathering point of a number of dispersed well heads which deliver streams of crude liquid product thereto.

The mooring facility is positioned in a body of water a sufficient distance from the shore to permit the mooring to be safely approached by a tanker without fear of grounding or other damage. The tanker is preferably secured to the mooring by a bow line **6** extending from the tanker forward end to the ocean floor, and thence to permanently imbedded foundation member **13.** The latter for convenience is provided with a buoy or float **7** connected to the anchor line **6** by pendant line **8** to locate the latter prior to its being connected to the tanker and while lying at the ocean floor. In a similar manner, hose **41** is secured to line **45** which is fixedly connected to float **5** so that tanker **10** may easily locate and connect to hose **41.**

Foundation member **13** is formed preferably of an elongated metallic cylindrical piling imbedded a predetermined depth into the substratum. The actual depth of imbedment will be determined in advance of the imbedding operation by coring or other means to determine the consistency of the substratum. Foundation pile **13** can be installed in any of the usual ways and may be made of concrete, steel or other material of the necessary strength to accommodate the proposed mooring loads.

Pile **13** is imbedded in a substratum to a depth which permits the upper portion to extend above the floor of the ocean. Said upper portion is provided with a pair of circular thrust rings **14** and **16** spaced a determined distance apart to define an annular channel or track **17** therebetween. Rings **14** and **16** are preferably welded

to the exterior of the pile when the latter is metallic, but can be bolted or otherwise positioned. Lower ring **16** is fixedly welded in place, whereas upper ring **14** may be split and assembled to the pile by bolting thereby facilitating replacement. Collar **18** is disposed in track **17** between the respective rings **14** and **16** and can thus be readily assembled within the channel or track **17.**

Upper ring **14** includes two or more pad eyes or rings **22** spaced about the ring edge, having openings **12** adapted to receive fastening shackles **34** or the like. Similarly the outer surface of collar **18** is provided with one or more pad eyes or staples **11** adapted to hold the end of anchoring chain **6.**

Collar **18** may be provided with peripheral rubbing surfaces along the upper, lower, as well as inner faces. Said surfaces are relatively smooth and adapted to position the collar by sliding contact with the adjacent retaining rings **14** and **16.** The rubbing faces may be equipped with non-corrosive bearing inserts to prevent the collar from binding. The inner opening **23** of collar **18,** and the external surface of pile **13** define sufficiently wide spacing therebetween to allow the collar to be rotatably moved about the pile within the confines of rings **14** and **16.** In that the entire unit will be submerged beneath the sea, a degree of lubrication is provided by the watery environment. However, since movement of collar **18** is very slow additional lubrication although not essential, can be utilized.

The upper end of pile **13** is further provided with an elongated aperture **21** which allows one or more cargo carrying conduits **15** access to the pile interior. The conduits **15** may be imbedded beneath the surface of the ocean and terminate within the pile hollow interior. While the present illustration describes but a single cargo carrying conduit for the purpose of disclosing the invention, it is appreciated that a plurality of such conduits **15** may terminate within the confines of the pile and thereafter be directed upwardly by vertical risers to connect with swivels above the water's surface. If more than one conduit is utilized, a multi-product type swivel is utilized.

Conduit **15** comprises in effect an articulated cargo carrying member. Said conduit is communicated by elbow **19** to a short riser **20.** A flexible connection **26** further communicates riser **20** to an elongated riser **27** disposed within casing **28** and which extends to and beyond the upper end of the latter.

Casing **28** comprises an elongated hollow member preferably formed in a cylindrical configuration. A cylindrical housing **29** depends from the inner wall of casing **28,** being spaced from the latter to form an elongated passage extending substantially the length of casing **28.** A plurality of longitudinally spaced, fluid tight transverse panels **30** proportion said annular passage into discrete fluid tight chambers **31.**

To balance the floatable casing **28** against the buoying effect of said chambers **31** during installation, the lower chamber or chambers **32** can be flooded or provided with a ballasting means accessible from the surface. The unit is thus caused by the weight at the lower end to submerge to the desired depth for making the underwater connections. Subsequently, the ballast water may be removed by pumping or air pressure thereby permitting a constant buoyancy to be applied to casing **28.**

Riser **27** may further include upper and lower stop blocks **24** and **25** secured to the end walls of riser **27** to prevent said riser from moving up or down beyond desired limits.

Casing **28** as noted, operably engages the foundation pile **13** in such manner that the lower end of the casing is secured through flexible lines **33** to the upper end of the foundation pile. One embodiment of a connection means which provides the desired flexibility, yet restrained movement, comprises a plurality of lines or cables **33** extending between and connected to the respective casing **28** and foundation pile **13.** Each line **33** is provided terminally with connecting shackles **34** and **35** or similar connections which removably although flexibly retain the movable casing with respect to the fixed foundation member.

Lines **33** are connected at their lower ends to mooring staple **22** by shackles **34.** Similarly, the upper ends of lines **33** are operably engaged to the lower end of casing **28** by way of radially projecting brackets **36** having openings **37** in which shackles **35** are received.

As the collar **18** is caused to rotate within its confining channel **17** by a displacing movement of the moored vessel at a water's surface, the buoyant casing **28** will remain fixed to pile **13** and will therefore be restrained from rotating.

The upper end of liquid carrying riser **27** is provided with a universal joint consisting of two swivels disposed at right angles to each other to assure continuous liquid cargo flow without interruption in spite of movement of vessel **10.** Representative of such pipe swivels are the elbows **38** and **39** connected through a nipple **40.** Said connection represents any of a number of couplings suitable to the application which are available commercially. However, the said coupling is communicated to a flexible hose or similar member **41** which extends to a moored tanker, and is adapted to removably couple to pumps or other fluid conducting manifolds. Hose **41** is supportably retained by the casing **28** to permit freedom of movement of the hose **41** as the tanker **10** is swung about its moored forward end.

Thus, the upper end of casing **28** is provided with a pair of spaced thrust rings **42** and **43** together with a rotatable collar **44** disposed therebetween. The general disposition and structure of the respective ring and collar are similar to the description of the rings and collar previously described with respect to the anchoring pile **13.** The function of said collar **44** however, is to supportably position hose **41** by way of flexible connecting means such as cable or other line **45** which depends from collar **44,** and connects to bands **46** and **47** deposed along hose **41.**

Obviously, many modifications and variations of the invention, as hereinafter set forth, may be made without departing from the spirit and scope thereof, and therefore, only such limitations should be imposed as are indicated in the appended claims.

We claim:

1. A vessel mooring and liquid transfer apparatus for an offshore body of water being adapted to moor and communicate a floating vessel with a submerged source of liquid cargo, which transfer apparatus includes;

an elongated column disposed normally in a substantially upright disposition with said body of water and having an upper buoyant portion and a lower anchoring section, the latter being embedded into the floor beneath said body of water,

flexible coupling means operably connecting said respective lower section and upper buoyant portions,

to permit limited pivotal movement of the latter about said anchoring section,

an articulated conduit disposed within said elongated column having a pivotal segment extending beyond the upper end of said column and having means on said the ends of conduit to engage said floating vessel for transferring liquid cargo between said vessel and said liquid cargo source, said conduit including a flexible connection therein to permit pivotal movement of the conduit in response to pivotal movement of said column buoyant portion,

and vessel mooring means depending from said anchoring section at a point adjacent to the floor of said body of water, and spaced vertically downwardly from said conduit end, being rotatably carried on said anchoring section operable to removably engage a mooring line extending to said vessel whereby to permit limited movement of the latter about said transfer apparatus during a cargo transfer operation.

2. In an apparatus as defined in claim **1**, wherein said flexible coupling means includes; a plurality of flexible lines interconnecting the respective upper portion and lower anchoring sections to permit said limited pivotal movement therebetween.

3. In an apparatus as defined in claim **1**, wherein said lower anchoring section includes; at least one elongated foundation member substantially embedded along its length into the substrate beneath said body of water, the upper end thereof being disposed above the surface of said floor, said vessel mooring means including a collar rotatably carried on said anchoring section at the end thereof extending above the ocean floor.

4. In an apparatus as defined in claim **3**, wherein said lower anchoring section includes; at least one elongated cylindrical pile having the lower end thereof embedded in the substrate, and the pile upper end extending beyond the floor of said body of water, and means forming a circumferential track about said pile extending upper end, said collar being guidably received within said track to permit circumferential movement of the collar about said pile when the collar is connected to said vessel.

5. In an apparatus as defined in claim **4**, wherein said pile upper end projecting above the substrate includes a pair of longitudinally spaced circumferential rings defining a channel therebetween, said collar being slidably received within said channel to permit circumferential movement of the collar about the pile outer surface when said collar is connected to a floating vessel.

6. In an apparatus as defined in claim **1**, wherein said lower anchoring section includes; at least one elongated cylindrical pile embedded into the substrate beneath said body of water in a substantially upright position.

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