April 12, 1966 G. A. McCAMMON 3,245,438

SHIP MOORING DEVICE

Original Filed Aug. 2, 1960

FIG. 1

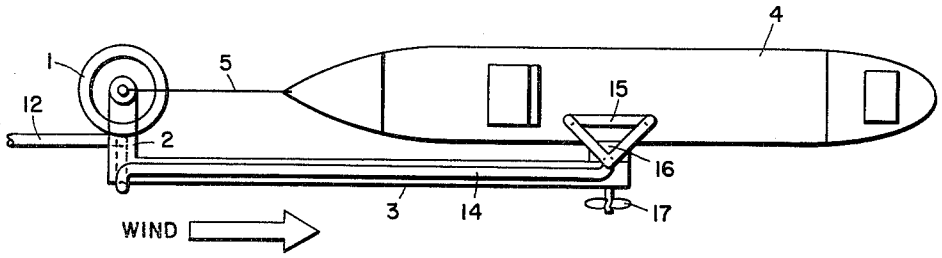


FIG. 2

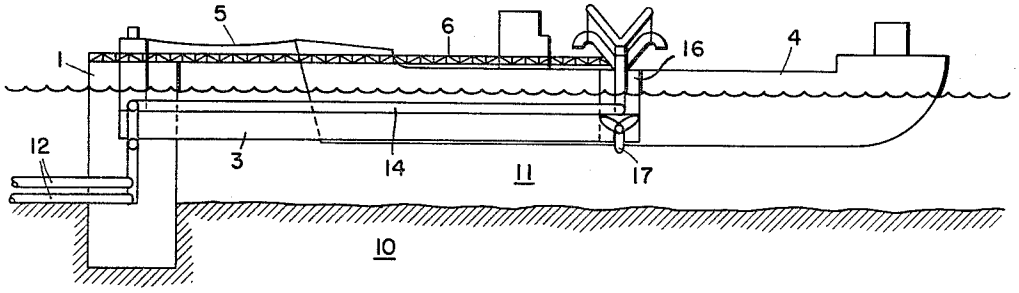
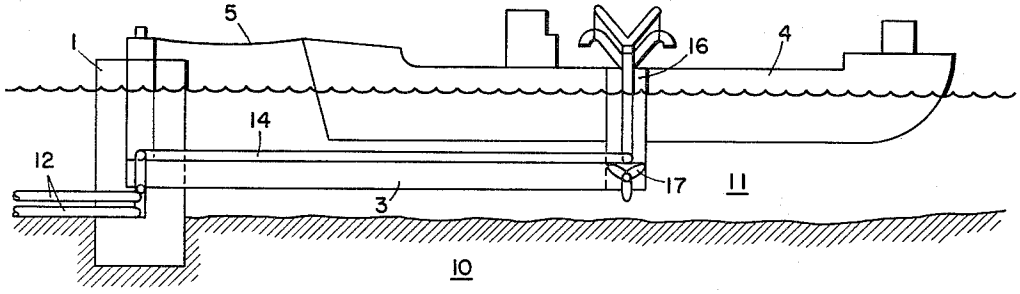


FIG. 3



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SHIP MOORING DEVICE

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Continuation of application Ser. No. 46,990, Aug. 2, 1960. This application Dec. 4, 1964, Ser. No. 418,585
12 Claims. (Cl. 141—387)

This application is a continuation of applicant's prior copending application Serial No. 46,990 filed August 2, 1960. The present invention is concerned with an improved ship mooring device whereby ships and other vessels can be more effectively loaded and unloaded, particularly, with fluids and the like. In accordance with the present invention, a rock-filled structure or caisson or equivalent structure is positioned offshore and utilized in conjunction with a submerged boom to more effectively moor ships for the purpose of loading and unloading them. In accordance with the preferred adaptation, the boom is free to rotate about the structure or caisson and a preferred application of the structure is for the loading and unloading of tankers which will be bow moored to the caisson. Liquids, such as crude oil, are then delivered or unloaded to the amidship's manifold of the vessel by pipelines or other conduits positioned inside the boom.

The rapid loading of marine equipment with liquid products as, for example, hydrocarbons and the like, has always presented a problem due to the continuous shifting of the marine equipment being loaded. This shifting of marine equipment is due to tidal variations, changes in the ship's draft during the loading operations and also wave and wind action. Thus there exists the problem of continually adjusting the position of the loading arm to compensate for these changes. Any appreciable change in the relative position of the loading arm, unless corrected, will cause a severe strain on the tanker connections, and in many instances, cause them to break, thereby putting the tanker out of operation until repairs are effected. This is a very expensive operation. Other difficulties are encountered when attempting to moor ships in various areas due to wave, current and ocean bottom conditions. In order to overcome many of these difficulties, it is known in the art to load ships, such as oil tankers and the like, at piers in protected waters or at marine anchorages or at nose moorings in the open sea.

In the case of tankers at piers, the manifolds of tankers are connected to the pier piping by multiple hoses or flexible arms. In the case of marine anchorages, the tanker manifolds are connected to hoses attached to submarine lines. The number of hoses is limited by the necessity of laying them out on the ocean bottom so that they are not tangled. The hoses must be long, usually 200 feet or more, and the weight, and hence the diameter is limited by the capacity of the ship's gear. Marine anchorages are generally limited to one or two hose connections of 12" diameter or smaller.

Tankers are sometimes moored by the bow with hoses extending from the mooring to the bow. However, few tankers have bow connections. On most other tankers, it is necessary either to lay a hose from the bow to the amidship's manifold connections or use a floating hose alongside the vessel. The latter is subject to adverse wave and current actions. The present invention provides a unique and effective means for unloading and loading tankers at offshore moorings. The invention may be readily understood by reference to the drawing wherein:

FIG. 1 is a top view of the ship and the mooring of the present invention;

FIG. 2 is a side view of the mooring apparatus of the present invention;

FIG. 3 is a view similar to FIG. 2 showing the mooring boom in a preferred submerged condition below the bottom of the loaded ship.

Referring specifically to FIG. 1 and FIG. 2, a rock-filled structure or caisson **1**, or equivalent means, is securely positioned to the bottom at the desired offshore position on the ocean floor **10** below the bottom of the sea. Suitable conduits **12** extend from shore tankage along the bottom of the sea to a universal manifold on the pylon. This conventional manifold permits feeding over 360° rotation. Attached to pylon **1** is an L shaped beam which comprises an inleg element **2**, which extends outwardly from the pylon and an outboard leg **3**, preferably at right angle to the inleg element, which extends along the side of the vessel being moored. The length of inboard leg **2** is sufficient so as to extend abeam of the ship or vessels to be handled. It is generally preferred that the length of this inleg element be such that approximately 1 to 6 feet distance exist between the ship's side and the lengthwise extending outboard leg **3**.

The length of outboard leg **3** is sufficient to extend from the end of the inboard leg to at least amidship of the vessel and to preferably extend somewhat beyond. In operation, tanker **4** is moored to caisson **1** by means of a bow line **5** or other similar equipment. Thus, as the wind blows in the direction, as shown, the L shaped structure will follow along with the ship in a manner that the bow of the ship is always pointing upwind. Pipelines **14**, or equivalent conduits, are positioned along the boom so as to be connected with the manifold **15** amidship, thereby permitting efficient loading and unloading of the vessel. Reference is particularly made to FIG. 2 wherein similar units of FIG. 1 are designated with the same numerals. A particular feature of the present invention comprises the fact that the main boom **3** is submerged below the surface of the water, thereby overcoming or avoiding any stresses or strains due to wave and wind action.

In accordance with the present invention, shore conduits lead up to caisson **1** and then are connected by means of universal connections to conduits which are positioned within or along boom **3** which, in turn, is connected to the manifolding amidships. It is within the concept of the present invention to provide passageways for ship personnel within loading boom **3**, and thereby increase the safety of the personnel boarding and debarking from the ship. Under certain circumstances, it is desirable to provide a super-structure walkway **6** extending along the submerged boom and above the surface of the water, which can be utilized in fair weather and in non-rough water. In essence, this apparatus of the present invention eliminates the disadvantages of present loading and unloading methods and consists of a structure strong enough to withstand the stresses from a ship mooring to it by the bow and casting off from it, a submerged arm which is free to revolve around the structure, the arm to carry personnel and materials from the mooring structure to a point or points on the ship.

One type of mooring structure is a gravity concrete unit, either monolithic or hollow or filled with rock, sand, concrete or similar material. One preferred form of the unit is a concrete cylinder which may be constructed in a dry dock, floated to the desired site and sunk by flooding. The cylinder may be jetted into the sea bottom or excavated by well known processes and may be filled with rock, sand or concrete to give the desired stability. The pylon structure must be stable to withstand wind, wave and current on itself and on the vessel moored to it. It is also properly fendered to protect it if the ship strikes it while maneuvering.

As pointed out heretofore, one application of the assembly is liquid handling to or from tankers. For this use the fixed structure is preferably connected to the shore liquid supply source by a submarine line. The ships may be fastened to the fixed structure by one or more mooring lines or by a strut. The lines may lead from the center or may converge from the sides of the structure to restrain side motion of the ship bow. Mooring lines may be manipulated by a winch assembly on the shore. A platform on the fixed structure may revolve to follow the motion of a ship as the forces of nature dictate. The platform may have living quarters and protected storage or working areas.

The boom or arm is pivoted from the center of the fixed structure. The boom may be revolved to any desired position by a propeller, paddle wheel or other mechanical device **17**. This device may also hold the boom away from or against the ship, and may swing the boom and ship about the pivot. When desired it may swing freely.

The normal position of the boom is submerged for protection from wave action; it may also be submerged below the bottom of the ship as shown in FIG. 3. The boom is preferably held in its submerged state by the pivot attachment to the fixed structure and by adjusting the buoyancy of one or more floatation chambers **16** which may extend above the water surface. In this way, as the ship's position relative to the caisson **1** varies as a function of cargo load and wave action, the outboard end of the boom is free to travel with the ship movements to minimize strain on the flexible loading hoses. The boom may be of steel, concrete or other suitable material. It is generally hollow to accommodate pipelines, material conveyors or personnel. Alternately, the boom may support a walkway or material conveyor above the water surface.

Also a boom floatation chamber **16** affixed at its outboard end may also be attached to the ship by lines or other suitable connections (not shown) to limit the movements of the ship with respect to the boom or to limit the movement of the boom with respect to the ship. The floatation chamber may carry devices such as hoses or flexible connections to transfer material or liquid between the boom and the ship. The chamber has flexible fenders to protect it and the ship. This floatation chamber is preferably attached to the boom and extends above the surface of the water. Connections with the ship are made here.

A normal operation, for example, when this device is used to load tankers with oil is, first, the boom swings to one side; then the ship approaches from a clear side and connects or moors to the fixed structure; then the boom swings around until it connects with the ship; then the ship moves fore or aft by its bow connection to line up the connections or the floatation chamber on the boom with the ship's manifold; oil arrives at the fixed structure by submarine pipelines, thence through a swivel or flexible joint to the boom pipelines, thence to the ship's tank via the flexible connections on the floatation chamber; and personnel may move through the boom between the fixed structure and the ship.

In FIG. 3, the invention is shown as it would be designed and proportioned to permit the passage of the loaded ship above the submerged boom **3**. In this form of the invention during conditions of tide, wind and wave action where the longitudinal axis of the ship is moved out of parallel to the axis of boom **3**, the ship may readily pass over the boom without interference.

The structure of the present invention may be utilized in: loading or unloading of marine tankers; loading or unloading of marine bulk carries; in port operations where waves or currents preclude the use of piers; and in port operations where bottom or other physical conditions preclude the use of marine anchorages.

The present invention permits the loading and unloading of ships under sea conditions which make the use of conventional equipment dangerous or impractical. It also permits ships to moor without the utilization of tugs. Also by utilization of the present invention, ships can moor and transfer cargo without the necessity of line handling launches normally necessary for marine anchorages. The device also permits vessels to readily change position so as to lie in the most favorable direction while loading or unloading cargo. The apparatus of the present invention permits the handling of fluids to or from vessels without the limitations of long hoses and floating hoses. Also the number of hoses to and from the ship, as well as the size of these hoses, can be increased. A very important advantage is that it permits the use of the cargo manifolds of the ships and fully utilizes the ship's cargo piping, and thus can deliver a fluid to any point on the ship.

What is claimed is:

1. Improved apparatus for loading and unloading a vessel at offshore sites which comprises in combination a pylon securely positioned on the sea bottom, means for mooring the bow of a vessel to said pylon, a structure extending substantially horizontal therefrom, said structure being characterized by consisting of an inboard leg element which extends outwardly from said pylon and an outboard leg element substantially perpendicular to said inboard leg element, said outboard leg element being positioned below the surface of the water and being adapted to extend along the side of said vessel moored to said pylon, conduits which extend the length of said structure with inboard ends having connections to conduits on said pylon and outboard ends having connections on the vessel.

2. Apparatus as defined by claim **1** wherein said structure contains a walkway extending above the surface of the water.

3. Apparatus as defined by claim **2** wherein said structure contains a sealed passageway in said outboard leg element permitting personnel to move from said pylon underneath the water to said vessel.

4. Improved apparatus for loading and unloading a vessel at offshore sites which comprises in combination a pylon securely positioned on the sea bottom, means for mooring the bow of a vessel to said pylon, a structure extending substantially horizontal therefrom, said structure being characterized by consisting of an inboard leg element which extends outwardly from said pylon and an outboard leg element substantially perpendicular to said inboard leg element, said outboard leg element being positioned below the surface of the water and being adapted to extend along the side of said vessel moored to said pylon, conduits which extend the length of said structure with inboard ends having connections to conduits on said pylon and outboard ends having connections on the vessel, a floatation chamber positioned on said outboard leg element, which chamber extends above the surface of the water at amidship of the moored vessel.

5. An improved apparatus for loading and unloading a vessel at offshort sites comprising in combination a pylon securely positioned on the sea bottom, means for mooring the bow of a vessel to said pylon, an elongated rigid boom structure extending in a submerged condition substantially horizontal therefrom, said boom structure having an inboard end rotatably connected to said pylon and an outboard end arranged to be connected to an amidship portion of the vessel to be loaded, and conduit means carried by said boom structure for conveying a fluid to and from said vessel, said conduit means including an inboard portion arranged to be connected to conduit means on said pylon and an outboard portion arranged to be connected to said vessel.

6. The combination of claim **5** including floatation chamber means connected to said boom structure for limiting vertical movements of the ship relative to said boom.

7. The combination of claim 6 including means located upon said boom for rotating said boom about said pylon.

8. An improved apparatus for loading and unloading a vessel at offshore sites which comprises in combination a pylon securely positioned on the sea bottom and means for mounting the bow of a vessel in spaced relation relative to said pylon; said means comprising cable means for limiting the maximum distance between the bow of the vessel and the pylon, and rigid boom means extending substantially parallel to said cable means for limiting the minimum predetermined distance between the bow of the vessel and said pylon; said rigid boom means including an inboard portion rotatably connected to said pylon and an outboard portion positioned substantially below the surface of the water and arranged to be connected to an amidship portion of the vessel to be loaded; and conduit means carried by said boom means for conveying a fluid to and from said vessel, said conduit means having end portions arranged respectively to be connected to conduit means on said pylon and upon said vessel.

9. Apparatus in accordance with claim 8 wherein said rigid boom means is submerged yet buoyant so that it is substantially immune from wave action.

10. Apparatus in accordance with claim 9 including means located upon said boom means for rotating said boom means about said pylon.

11. An improved apparatus for loading and unloading a vessel at offshore sites comprising in combination a pylon securely positioned on the sea bottom, means for mooring the bow of a vessel to said pylon, a structure rotatably connected to said pylon extending substantially horizontal therefrom, said structure having an inboard leg element and an outboard leg element, said outboard leg element being positioned below the surface of the water and being adapted to extend along the side of the vessel moored to said pylon, and conduit means carried by said structure for conveying a fluid to and from said vessel, said conduit means including an inboard portion connected to conduit means on said pylon and an outboard portion connected to said vessel.

12. The combination of claim 11 wherein said outboard leg element is positioned a sufficient distance below the surface of the water to permit the bottom of the vessel to pass thereover.

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ISADOR WEIL, *Primary Examiner.*