United States Patent [19]

Hnot

[11] **3,833,032**

[45] **Sept. 3, 1974**

[54] **TANDEM MOORING-LOADING SYSTEM**

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[73] Assignee: **Esso Research and Engineering Company,** Linden, N.J.

[22] Filed: **Oct. 31, 1972**

[21] Appl. No.: **302,528**

[52] **U.S. Cl.**..... **141/232,** 141/279, 141/387

[51] **Int. Cl.**..... **B65b 3/04,** B65b 39/02

[58] **Field of Search** 141/279, 284, 231, 232, 141/382–387, 388, 233

[56] **References Cited**

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3,727,650 4/1973 Ingram et al..... 141/279

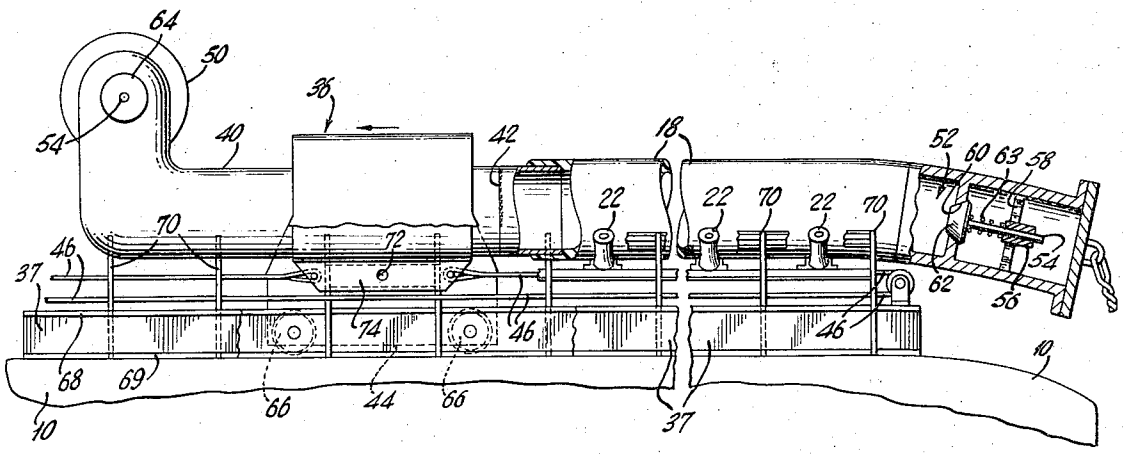
Primary Examiner—Houston S. Bell, Jr.

Attorney, Agent, or Firm—F. Donald Paris

[57] **ABSTRACT**

A combined mooring and loading system for the transfer of cargo (e.g., oil) from a floating offshore storage terminal (e.g., a vessel or other suitable floating member) to a shuttle tanker moored in tandem. The system includes a floating hose between the storage terminal and the shuttle tanker, which when not in use is stored on the storage terminal. A trolley is provided for retraction and paying out of the hose; and the hose is equipped with check valves at both ends to trap cargo within the hose when it is disconnected.

15 Claims, 12 Drawing Figures



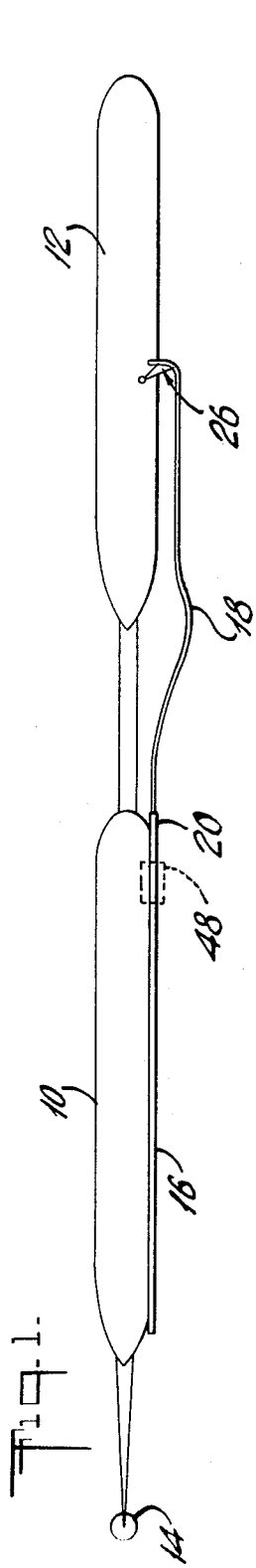


FIG. 1.

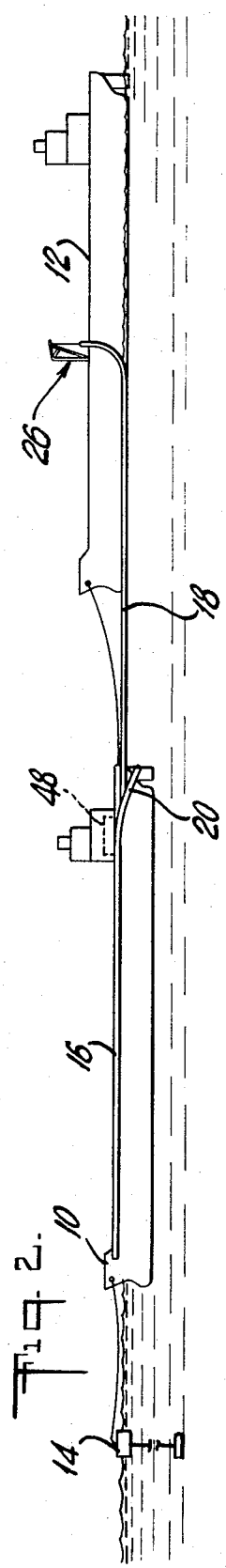


FIG. 2.

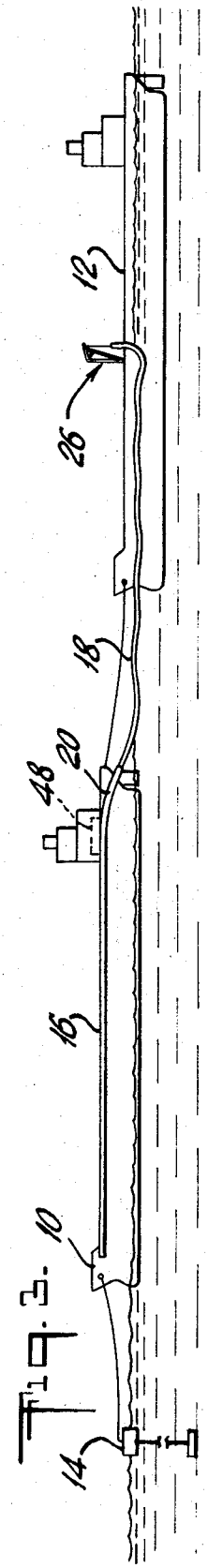


FIG. 3.

FIG. 4.

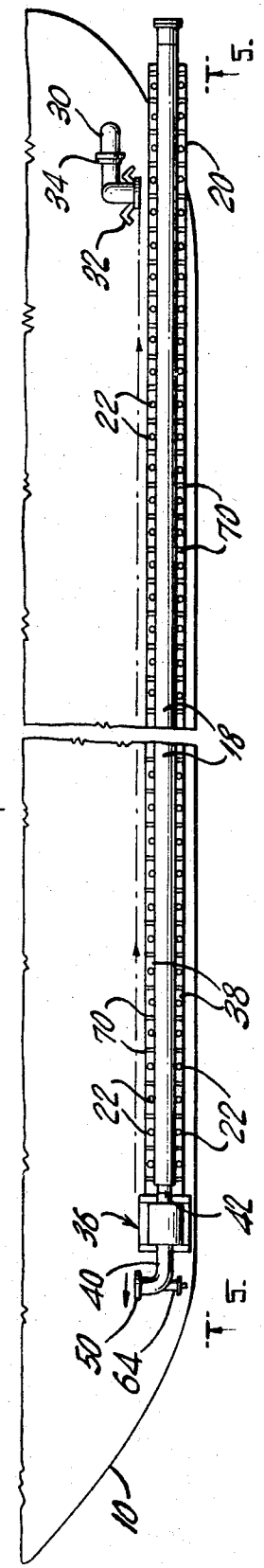


FIG. 5.

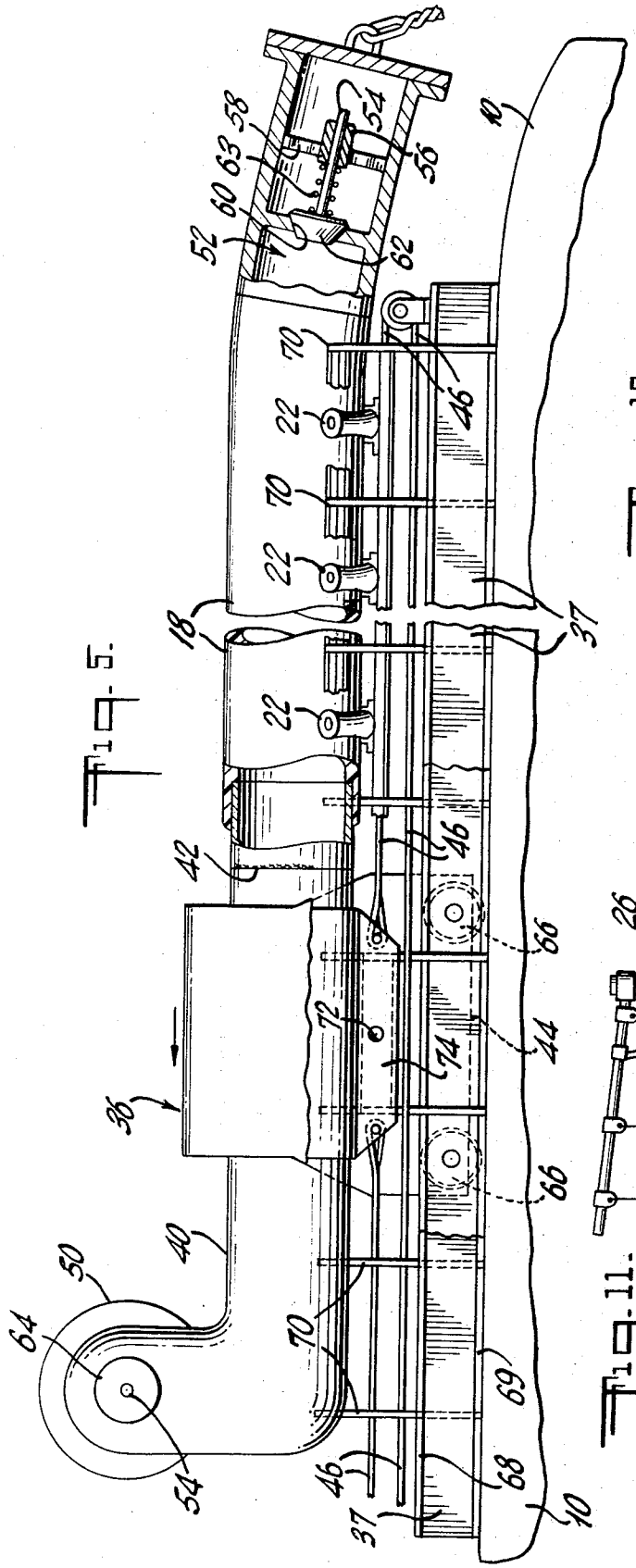


FIG. 5.

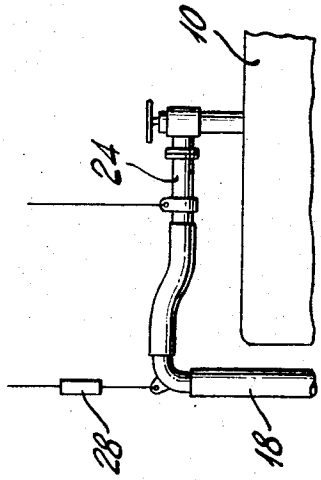


FIG. 12.

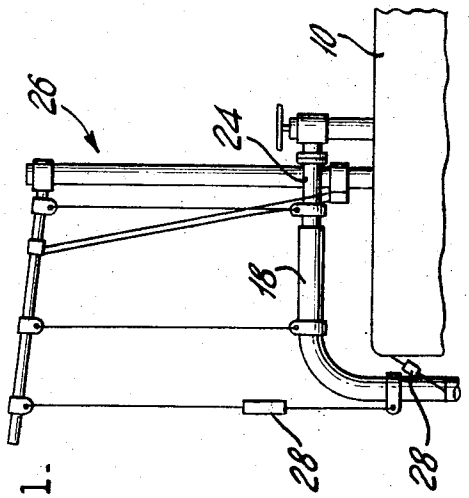


FIG. 11.

FIG. 6.

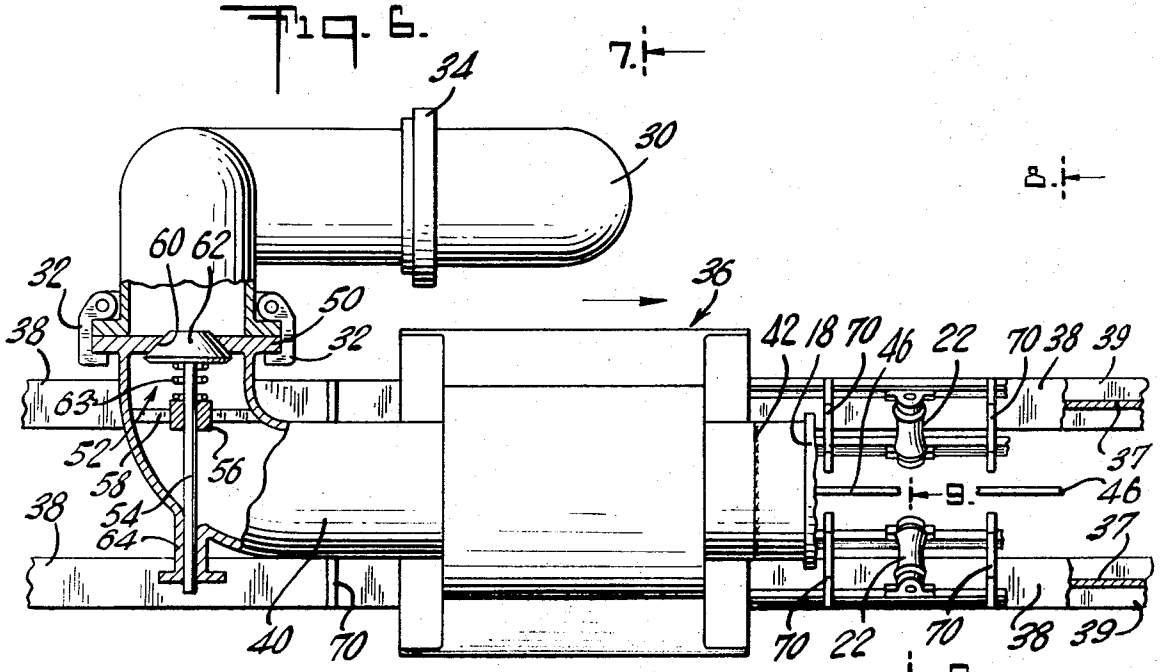


FIG. 9.

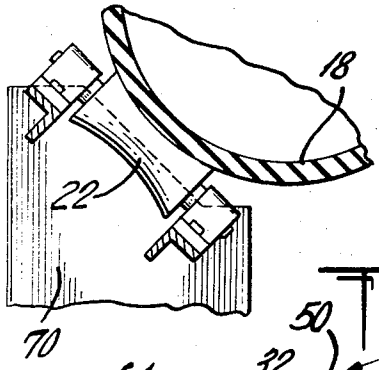


FIG. 10.

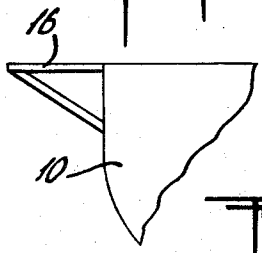


FIG. 7.

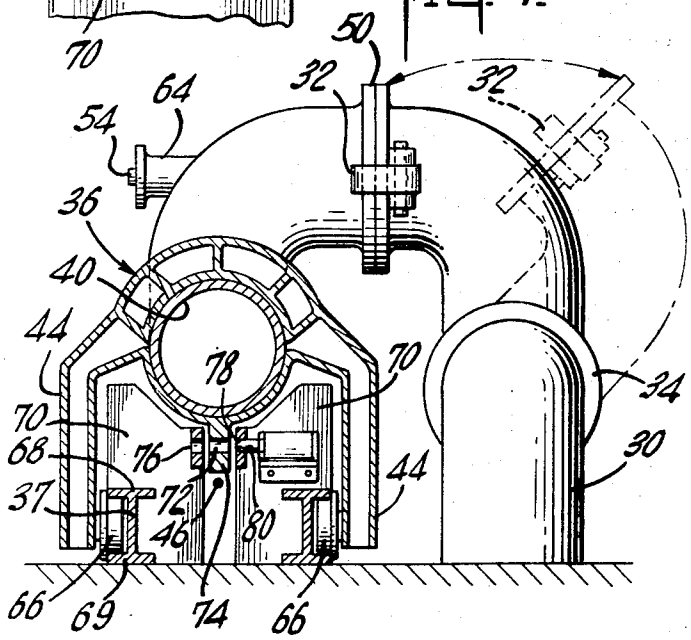
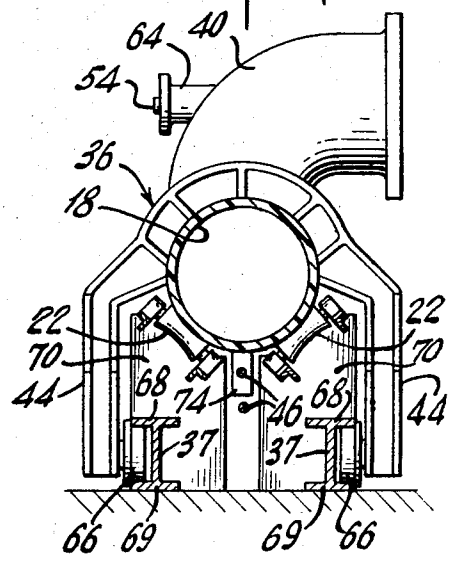


FIG. 8.



TANDEM MOORING-LOADING SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

This application comprises specific details of the basic cargo transfer system disclosed in copending U.S. Pat. application Ser. No. 220,838, filed Jan. 26, 1972, assigned to the same assignee as the present case.

BACKGROUND OF THE INVENTION

Heretofore the transfer of liquid cargo such as oil from a floating offshore terminal, which may comprise a tanker, or some other suitable cargo storage vessel, to another tanker generally has been accomplished by mooring the two tankers in side-by-side relationship and transferring the cargo between the tankers over the rail. It has been found that such operations are only practical in seas of less than 10-foot significant wave height and where the seas are greater than 10-foot significant wave height, the relative motions between the two vessels and the mooring and fendering forces are so large as to make such operations impractical. Thus, there clearly exists a need for an efficient method of transferring cargo from vessel to vessel as an integral part of a floating offshore attended terminal.

As a result of various test programs, it has been determined that tandem mooring of vessels is feasible in seas of at least 20-foot significant wave height, which is considered to be a relatively severe environment. Basically, a tandem mooring system utilizes a permanently moored storage member or float, such as a tanker, to load a smaller shuttle tanker or offtaker. The use of separate moorings for both the float and the offtaker, while shown to be possible in seas greater than 15-foot significant wave height, is considered uneconomical. Alongside mooring has been found to be economical in seas up to only 10-foot significant wave height.

DESCRIPTION OF PRIOR ART

In addition to the previously discussed prior art systems employed in the transfer of liquid cargo between two floating members such as a float and an offtaker, the prior art deemed closest to the present invention is in a nonanalogous area essentially relating to the fueling of ships at sea. Typical of this prior art is the Miller U.S. Pat. No. 1,685,927 which discloses a system for fueling ships at sea while the ships are traveling at a considerable speed. The hawsers and fuel hoses employed in the fuel transfer system are suspended from fixed supports and are tensioned by means of engines. Messenger lines are utilized in conjunction with the hawsers. Other ship fueling disclosures include the Silveston U.S. Pat. No. 3,154,118 which discloses a pier supported tower for use in transferring fuel between tankers moored at opposite sides of a pier, and the Garrett, et al, U.S. Pat. No. 3,199,553 which discloses a ship-to-ship refueling system which employs a nozzle movable along a ship spanning cable by means of a trolley. Another disclosure is the Manning U.S. Pat. No. 3,535,883, assigned to the assignee of the present invention, which discloses a floating terminal characterized by a pivotally mounted loading boom for transferring oil from a submerged storage tank to the floating terminal and thence to a tanker.

SUMMARY OF THE INVENTION

The present invention relates to a novel and improved cargo transfer system employing tandem mooring and more particularly relates to a tandem mooring-/loading system including means for storage, retraction and paying out of a floating hose for connection between two vessels. The invention includes a permanently moored floating storage member (e.g., tanker), which is referred to throughout this disclosure as the float, for loading a smaller shuttle tanker which is referred to throughout this disclosure as the offtaker. A system constructed and arranged according to the present invention includes a rack for storing and paying out the hose used in the transfer of the liquid cargo between the float and the offtaker and a trolley or carriage for retraction and paying out of the hose. Suitable means for mooring the offtaker and a manifold for connecting the cargo hose at each end are also provided. The hose includes check valves at each end thereof for trapping cargo therein when the hose is disconnected. The float has associated therewith the hose storage rack and the trolley. While the hose usually must be stored during severe sea conditions, it may be possible to leave it floating behind the float between offtaker loadings. This will depend on time intervals between offtaker loadings and the amount of interference with the offtaker during berthing. In order to minimize the amount of pull necessary to retract the hose from the water surface and for support, the storage rack is provided along its entire length with a plurality of preferably rubber covered rollers. The float vessel end of the hose, in addition to being connected to the float vessel piping, is mounted on the trolley which rides on tracks extending the full length of the hose storage rack. The mooring of the offtaker and connection of the hose may be accomplished by shooting a messenger line to the offtaker, which then can take on the mooring line which is connected to the messenger line. Likewise, a messenger line attached to the hose can be delivered to the offtaker as the float pays out the hose, whereupon the offtaker raises the hose over the rail and attaches it to its manifold. Thereafter, the cargo transfer operation may begin.

Accordingly, it is a primary object of the present invention to provide a novel and improved cargo transfer system for a float and offtaker moored in tandem.

It is a further object of the present invention to provide a cargo transfer system between a float and an offtaker, which includes means for storage, retraction and paying out of the hose used for transfer of the cargo.

Having in mind the above and other objects and advantages that will be apparent from an understanding of this disclosure, the present invention comprises the combinations and arrangements as illustrated in the presently preferred embodiments of this invention, which is hereinafter set forth in such detail as to enable those skilled in the art readily to understand the function, operation, construction and advantages of it when read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic plan view of a preferred embodiment of a cargo transfer system for tandem moored vessels in accordance with the present invention;

FIG. 2 illustrates an elevation view of the system of FIG. 1 with the float tanker full and the offtaker empty;

FIG. 3 illustrates an elevation view of the system of FIG. 1 with the float tanker empty and the offtaker full;

FIG. 4 is a partial plan view of the hose storage system on the float with the hose in stored position;

FIG. 5 is an enlarged cross-sectioned view taken substantially along the line 5—5 of FIG. 4, illustrating details of the hose storage system;

FIG. 6 shows details of the hose carriage when located at the stern of the float with the hose connected at its opposite end to the offtaker;

FIG. 7 is a cross-sectional view taken substantially along the line 7—7 of FIG. 6;

FIG. 8 is a cross-sectional view taken substantially along the line 8—8 of FIG. 6;

FIG. 9 is an enlarged cross-sectional view of the roller support taken substantially along the line 9—9 of FIG. 6;

FIG. 10 is an alternate embodiment to FIG. 5 with the storage system mounted in cantilevered relation to the float deck;

FIG. 11 is a partial cross-sectional view illustrating the hook up arrangement for the hose at the offtaker; and

FIG. 12 is an alternate embodiment of the hook up arrangement of FIG. 11.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Having reference to the drawings wherein like parts are designated by the same reference numerals throughout the several views, the present invention is illustrated in FIG. 1 wherein the float or permanently moored storage member 10 comprises a tanker moored in tandem with a shuttle tanker or offtaker 12. The float is moored by means of a standard bow mooring such as a single point mooring generally designated 14. It should be clearly understood that while throughout the disclosure and in the accompanying drawings the float comprises a tanker, other suitable floating members such as permanently attached floating storage tanks and the like may be employed. It is necessary that only one of the members be a floating offshore attended terminal, which for convenience is referred to as the float. As illustrated, the float 10 has secured thereto a rack or ramp generally designated 16 for use in the storage, retraction and paying out of a floating cargo transfer hose 18. FIGS. 2 and 3 show that the rack includes an outboard end in the form of a stinger ramp 20 having a generally downward curvature to facilitate movement of the hose toward and from the ramp. As illustrated in the preferred embodiment of FIGS. 1–3 the storage ramp 16 is built onto the deck of the float 10. A variation of the ramp location is shown in FIG. 10 where the ramp 16 is cantilevered off the deck. The configuration of the stinger at the outboard end of the rack prevents the hose from being bent or curved beyond its minimum bend radius. A suitable framework (not shown) may be provided to support this portion of the ramp. To facilitate storage, retraction and paying out of the hose 18 and to minimize the pull necessary during these operations, the rack 16 is provided along its entire length with a plurality of journaled rubber-covered rollers 22. In FIG. 1 the hose 18 is shown in its extended position connected to the shuttle tanker or offtaker 12. The hose extends from the stern of the float 10 and can be connected to the offtaker by any one of the several means previously discussed. As shown in FIG. 11, the hose is connected in a generally conventional manner to a schematically illustrated manifold 24 on the offtaker. A hoist mechanism generally designated 26 suspends the hose therefrom and may be connected to the hose through shock absorbers 28 or similar cushioning devices to minimize the impact stresses imposed by the hose during operations conducted in high seas.

An alternate arrangement to that illustrated in FIG. 11 for connecting the hose to the offtaker is shown in FIG. 12. As shown in FIG. 4 the float vessel end of the hose 18 is adapted to be connected to float vessel piping 30 by means of a standard quick-disconnect coupling 32. The float piping 30 is connected to the coupling via a standard fluid swivel point and pipe 34 which permits the coupling to be swung out of the way when it is desired to move the hose. This end of the hose also is fitted on a trolley or carriage 36 which rides on tracks 38 extending the full length of the ramp 16. The steel ripple of the float hose end is connected to a steel pipe 40 at the weld line 42. An anchor frame 44 is secured to the steel pipe 40 in straddled relation, thus providing for catenary pull of the hose. The free end of this steel pipe is provided with a flange 50 for faciliating connection of the pipe to the quick disconnect coupling 32. The carriage may be moved forward or backward by mechanical means such as winches with endless cables or chain 46 connected at each end at opposite ends of the carriage (see FIG. 5). When the carriage is moved forward the floating hose 18 is pulled onboard and when moved backward the carriage unloads the hose into the water. FIG. 6 shows the pipe connected for cargo transfer with the carriage located at its extreme stern position. A protective cage, as shown by the dotted lines 48 in FIGS. 1–3, may be provided at the stinger 20 for protecting the carriage against the environment of the sea when it is located at the stern of the float with the hose in its extended position. This case may be made from steel. While a prefered arrangement has been shown for movement of the hose it is within the scope of this invention to employ various other suitable means.

The hose 18 is provided with check valves 52 at both ends. These valves are normally spring-loaded in a closed position for trapping the oil or other cargo within the pipe and hose when disconnected from the float and offtaker. The valves are maintained open either by pumping pressure or by external activation. Alternatively, bolted blind flanges (not shown) may be used alone or in addition to these valves. The valves as shown in FIGS. 5 and 6 comprise a stem 54 slidably mounted in a bearing block 56 which is carried by an annular internal rib 58 formed at the free ends of the pipe 40 and hose 18. At the end of the pipe and hose there is provided an opening 60 in the form of a truncated cone. The adjacent end of the valve stem 54 carries a valve seat 62 having a shape complementary to the opening 60. A spring 62 disposed between the bearing block 56 and the underside of the valve seat 62 causes the valve to be normally disposed in a closed position. As shown in FIG. 6 at the pipe end the stem 54 is mounted for sliding movement in a bore 64 integral with the bottom of the steel pipe. At the opposite or

offtaker end of the hose, the opening **60** is spaced inwardly from the hose extremity. Obviously, the valve arrangement at the offtaker end of the hose may be reversed.

As mentioned heretofore, movement of the hose **18** along the track **36** is facilitated by means of the rollers **22.** As illustrated in FIGS. **5, 7** and **8,** the wheels **66** of the carriage are captured between the top and bottom guides **68** and **70** of the track **36.** As illustrated, the tracks typically comprise steel I-beams. These rollers may be powered by a suitable drive to facilitate movement of the carriage. As best shown in FIGS. **4, 6** and **9,** opposed pairs of the rollers **22** are spaced along the full length of the track **36** on support frames **70.** The frames may be constructed so that track is formed as an integral part thereof. Each of the opposed rollers are disposed at an appropriate angle relative to a vertical plane passing through the longitudinal axis of the hose such that the concave portion of the rollers provide a seat for the hose on either side of its longitudinal axis at the bottom thereof.

To hold the carriage **34** in its desired position either when the hose is fully retracted or fully extended from the float **10,** a transverse opening **72** (see FIGS. **5** and **7**) is provided in a lower downwardly extending plate **74** connected to the carriage. As shown in FIG. **5** this plate **74** also serves for securing the ends of the endless cable **42** to the carriage to accomplish the desired movement thereof. Each of the roller support frames **70,** as best shown in FIG. **7,** are provided with aligned opposing slots or openings **76** and **78.** A locking or anchor pin **80** for locking the carriage in place is aligned with these slots. This carriage locking arrangement is provided at extreme ends of the ramp and also may be provided at other suitable locations along the ramp. Thus, when the carriage is located so that the transverse opening **72** is aligned with the opposed openings **76** and **78** provided in the roller support frame **70,** the locking pin **80** (shown in its retracted position in FIG. **7**) is urged through the three openings thus holding the carriage in place. Although not shown, it is within the scope of this invention for the locking pin to be operated by suitable hydraulic or pneumatic cylinder means, instead of manually. With this arrangement, the carriage may be locked in any one of a plurality of positions along the ramp depending upon the desired amount of hose to be payed out. Also, as shown in FIG. **7,** the dot-dash position illustrates the swivel pipe swung out of the way and disconnected from the carriage steel pipe so that the carriage can be moved in the desired direction.

In operation the offtaker approaches the stern end of the float vessel. A messenger line is shot across and the mooring lines are winched over and made fast to the offtaker. The light messenger lines, in addition to pulling over the heavy mooring lines, are also connected to the end of the floating hose which is stored on the float vessel. After the offtaker mooring lines have been made fast, the line hooked to the end of the floating hose is winched in. This operation coincides with the float vessel lowering the hose. On the offtaker the hose end is lifted over-the-rail and connected to the manifold by means of a quick connect coupling. When this is done, oil transfer operations may begin. When pumping is completed, the check valves at the connected hose ends are closed by dropping the pressure. The spaces between the check valves are flushed and the connection released. The offtaker may then release the moorings and leave. The hose is retracted and stored onboard the float vessel after the offtaker has left the mooring.

It will be appreciated from the foregoing description that there has been provided a novel and improved cargo transfer system for a tandem moored float and offtaker. It should be understood, however, that the constructions and arrangements herein illustrated and described are intended to be representative only of preferred embodiments and that certain changes readily may be made therein without departing from the clear teachings and scope of the present invention. Accordingly, reference should be made to the following appended claims in determining the full scope of the invention.

What is claimed is:

1. A cargo transfer system for transferring cargo between floating members having cargo storage facilities thereon, wherein one of said members comprises a floating terminal and a second of said members comprises a tanker, comprising, said floating terminal and said tanker moored in tandem relation, ramp means operably associated with said floating terminal for the storage, retraction and paying out of a cargo transfer hose means adapted to be connected between said floating terminal and said tanker, said ramp means including a track extending substantially the full length of said floating terminal, and carriage means mounted for movement between the extremities of said track and connected to said hose means for facilitating movement thereof along said track on said floating terminal.

2. A cargo transfer system according to claim **1** wherein said hose means includes normally closed valve means at both ends for trapping cargo therein when said hose means is inoperative for transferring cargo between said floating terminal and said tanker.

3. A cargo transfer system according to claim **1** wherein track includes rollers for facilitating movement of the hose means.

4. A cargo transfer system according to claim **1** wherein carriage includes a frame disposed in straddling relation to said hose means.

5. A cargo transfer system according to claim **1** wherein ramp means is cantilevered relative to said floating terminal.

6. A cargo transfer system according to claim **1,** including means for releasably securing said carriage in place at least at two predetermined locations on said track, wherein one of said locations is proximate the end of said ramp means closest to said tanker.

7. A cargo transfer system according to claim **6** wherein said carriage is adapted to be releasably secured on said track at positions intermediate the extremities thereof.

8. A cargo transfer system according to claim **6** wherein said means comprises a locking pin for operably engaging said carriage to hold it in place.

9. A cargo transfer system according to claim **8** wherein said means comprises a locking plate secured to said carriage and having a transverse opening therein and adapted to be aligned with a pair of opposed slots on either side thereof, whereby said locking pin will releasably secure said carriage in place when it slidingly engages said slots and said opening.

10. A cargo transfer system according to claim 1, wherein said hose means comprises a steel pipe portion at one end thereof secured for movement with said carriage, one of said valve means being located at one end of said steel pipe and the other end of said steel pipe being secured to an end of said hose.

11. A cargo transfer system according to claim 1 wherein said floating terminal is elongated in the direction in which said floating terminal and said tanker are moored, and said ramp means extends in the direction of elongation of said floating terminal.

12. A cargo transfer system according to claim 1 wherein said floating terminal comprises a vessel having an elongated hull configuration.

13. A cargo transfer system according to claim 1 wherein said floating terminal includes a main deck and said ramp is located on said deck of said floating terminal.

14. A cargo transfer system according to claim 1 wherein each of said floating members is elongated and has a main longitudinal axis, said axes being located in tandem relation one behind the other and said ramp means including said track extending in the same axial longitudinal direction as said members.

15. A cargo transfer system for transferring cargo between two floating vessels each of which has cargo storage facilities associated therewith, comprising one of said vessels being permanently moored and the second of said vessels moored in tandem lengthwise behind said one vessel, ramp means located on a main deck of said one vessel for the storage, retraction and paying out of cargo transfer hose means adapted to be connected between said vessels for transferring cargo therebetween, said ramp means extending in longitudinal direction of said one vessel and including a track, carriage means mounted for movement along said track and connected to said cargo transfer hose means for moving said hose means along said track on said floating terminal, said carriage means being limited for movement only on said ramp means on said floating terminal.

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