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RIGID ARM MOORING MEANS

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FIG. 1

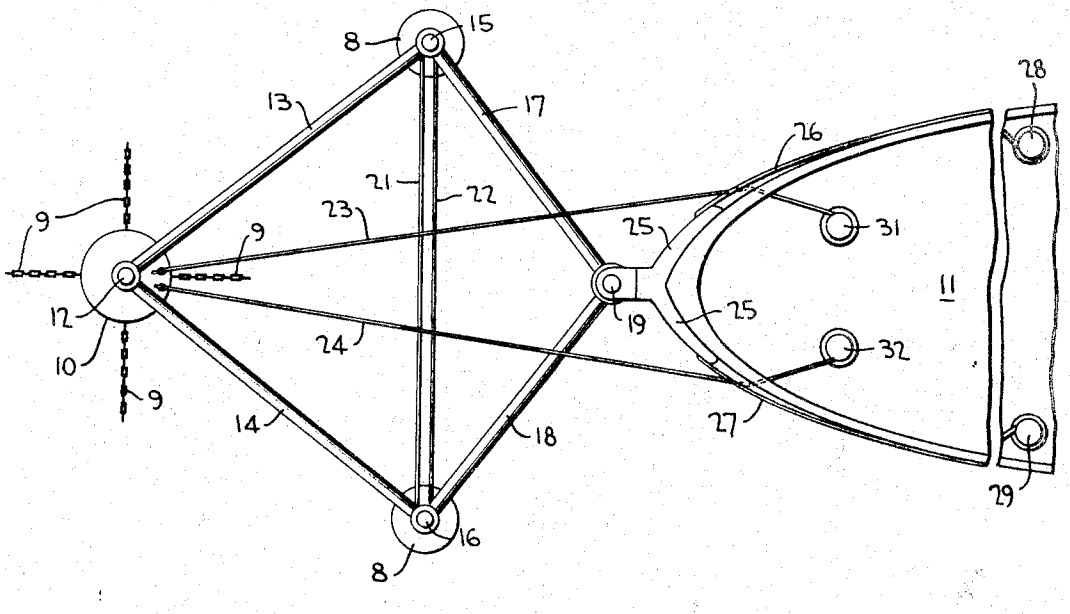
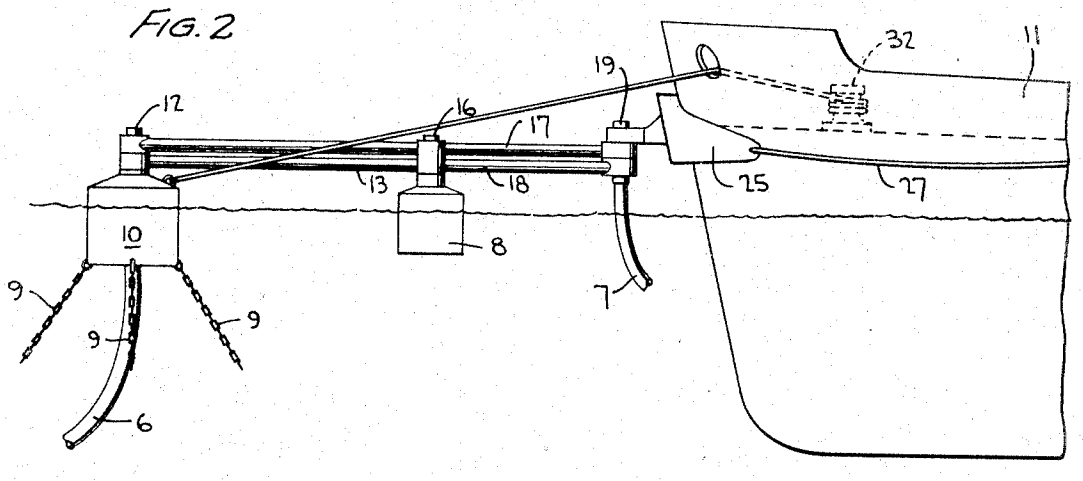


FIG. 2



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RIGID ARM MOORING MEANS

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ABSTRACT OF THE DISCLOSURE

This invention relates to a single buoy mooring system (SBM) and, more particularly, to a monomooring means wherein the structure that rigidly moors a tanker also provides for the delivery of fluids between the tanker and a land based source or storage facility. The rigid arm mooring means of this invention can be made up of four rigid fluid transporting pipes which are pivoted end to end in the form of a rectangle. One such pivot is connected to a mooring buoy and is capable of pivoting therearound. The diagonally opposite pivot is connected to a saddle which is secured to a tanker. The remaining pivots are mounted on fender buoys and are limited in their separation by nylon ropes. The distance between the tanker and the mooring buoy is limited by the length of mooring ropes. When loading onto a tanker, the fluid passes through a submarine pipeline into a swivel mounted centrally on a buoy on through the rigid pipes and the pivots to the saddle where a flexible pipe delivers fluid to the tanker manifold, usually at midship.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment to us of any royalties thereon.

Field of the invention

This invention is in the class of mooring buoy for floating vessels whereby fluids are passed through the mooring means.

Description of the prior art

In the art of monomooring, there is a need for a rigid mooring device which will prevent the moored vessel from damaging the buoy and floating hoses. No prior art is known to solve these problems in the manner set forth in this application.

Summary

The invention of this disclosure is a device for mooring tankers of any size for loading or discharging fluids. A tanker is maneuvered into a saddle which is pivoted onto the rectangular rigid pipes. Mooring ropes are connected from a mooring buoy to a forward mooring point on the tanker. The maximum distance between the mooring buoy and the tanker is determined by the length of these mooring ropes. Four rigid pipes, or metal frames, are pivoted at each end to form a rectangle with one pivot being at the saddle, one pivot being at the mooring buoy, and the other two pivots being on fender buoys which make up the other two opposite corners of a rectangle. The combined length of the two pipes pivoted at the saddle is greater than the length of nylon ropes which are connected between the two pivots on the fender buoys. The combined length of the rigid pipes pivoted on the mooring buoy is also longer than the nylon ropes connecting the pivots on the fender buoys.

This device is added to a single buoy mooring system (SBM) to overcome some of the operation problems now

being encountered. The present SBM consists of a mooring buoy secured in place by a plurality of anchors and anchor chains. The ship is secured to the buoy by means of mooring lines, such as nylon rope, for example. The liquid cargo from ship to shore or from shore to ship travels, in the case of off loading, from the tanker manifold into flexible pipes, such as rubber hoses, to floating hoses, to the pipes at the buoy, into a swivel mounted centrally on the buoy, through the submarine or under buoy hoses, into the submarine pipe lines and on to shore. With such prior device, in calm weather the ship will ride up on the buoy and endanger it as well as the floating hoses. Further, during rotation of the ship around the buoy, such as occurs when tide current changes direction, the ship often strikes the buoy as well as damages the floating hoses. Another difficulty encountered in the prior device occurs during periods of high loading. The ship can surge in a forward direction because of lack of restraint causing sharp increases in mooring forces.

The rigid arm mooring means of this invention will greatly reduce the above said problems or eliminate some of them completely. Further, this invention permits replacement of the expensive floating hose by cheaper, wider diameter steel pipe. This has the bonus of reducing the amount of pressure loss while permitting higher flow rates.

These advantages result in a monomooring system that is not only free of the troubles of damaged buoys, cables and pipelines, but is capable of better flow of liquid to and from the vessel.

It is, therefore, an object of this invention to provide a monomooring system which makes use of a tension member connected across a diagonal of rigid rectangular structure to limit the approach of a vessel to a mooring buoy.

Another object of this invention is to provide a monomooring system which is constructed in such a manner as to prevent damage of the fluid carrying lines by any movement of the vessel while it is moored at the buoy.

Still another object of this invention is to provide a monomooring system which utilized less expensive fluid handling materials to provide more efficient delivery of fluids to and from a vessel.

The exact nature of this invention as well as other objects and advantages thereof will be readily apparent from consideration of the following specification relating to the annexed drawings in which:

Brief description of the drawings

FIGURE 1 shows the monomooring system from above, and

FIGURE 2 shows the monomooring system in plan view.

Description of a preferred embodiment

Turning now to the drawings, a monomooring buoy **10** is anchored by cables or chains **9** connected to embedded anchors or dead weights not shown. A vessel **11**, such as a tanker, is connected to buoy **10** through a structure made up of pivot means **12** on buoy **10** to which are connected pipe or frame members **13** and **14**. Two other pipe or frame members **17** and **18** are provided. Pipe **17** is connected to pipe **13** by a pivot means **15** and pipe **18** is connected to pipe **14** by a pivot means **16**. Pipes **17** and **18** are connected to each other by pivot means **19**. Pivot means **15** and **16** are each mounted on one of a pair of fender buoys **8** which not only support the pipes but provide for limiting the amount that the vessel **11** pivots about pivot **19**.

Connected to pivots **15** and **16** across a diagonal of the rectangular structure formed by the four pipes are rope means, such as nylon rope, to prevent the buoys **8** from separating far enough to permit pivot **19** to ap-

proach the buoy **10**. Mooring lines **23** and **24** are connected from buoy **10** to cable securing means **31** and **32**, respectively, aboard the vessel **11** to limit the distance that the vessel **11** can move away from buoy **10** while being moored thereto.

Pivot **19** can be a universal joint connected to a saddle **25** which surrounds the bow of the vessel to assure the correct positioning of the vessel with respect to the pviot **19**. The saddle **26** is secured to the vessel by lines connected to cable securing means **28** and **29** on the deck of the vessel.

FIGURE 2 shows the arrangement of the pipes **13**, **14**, **17** and **18** so that fluids such as fuel or lubricants, can flow through submerged line **6** from a shore installation through buoy **10**, pivot **12**, and through either pipe **13**, pivot **15**, pipe **17** or arm **14**, pivot **16**, arm **18** to pivot **19** and out pipeline **7** which goes back to the manifold on the vessel. It is understood that pipeline **6** could extend through either fender buoy **8** instead of through mooring buoy **10**. In cases where rigid frames are used instead of pipes, a flexible pipe can be secured to the frame to accomplish the same purpose as using pipes. Obviously, the fluid would be equally readily transmitted from the manifold to the shore installation.

The flow system is through one side of the rectangular frame from the mooring buoy to emerge at the saddle into a floating or submerged steel pipe which runs backward to the area of the manifold. Rubber or other flexible hose is then used to connect the steel pipe to the manifold.

When the tanker is connected into the saddle, a set of wire ropes **26** and **27** is connected from the saddle to securing points a substantial distance rearward aboard the tanker. As the tanker rises or settles in response to being emptied or filled, respectively, the saddle remains at one level with respect to the water surface and ropes **26** and **27** maintain the tanker secured thereto.

The rectangular rigid pipe structure is free to move and follow the tanker away from the buoy until such rearward motion is stopped by the mooring ropes secured to the buoy. The top of buoy **10** to which ropes **23** and **24** are connected rotates with the pipe structure. Should the tanker move toward the buoy, the nylon ropes connecting the two pivots on the fender buoys are loaded sufficiently to limit the movement toward the buoy. This is because the ropes **21** and **22** are diagonal tension braces for a rectangular structure. The length of the nylon ropes determines the closeness that the tanker approaches the buoy.

The tanker may also pivot with the saddle until a side of the tanker is against one of the fender buoys. At this point the rectangular structure of pipes will rotate about the mooring buoy to protect the buoy and hoses. A fourth buol can be connected under saddle **19** to give support thereto.

The flow system of this invention is along one rigid pipe and enters a hose that enters the water at the end of the saddle at one end through the bottom of a fender buoy at the other end. Alternately, two pipes, such as **14** and **18** can be utilized for the flow to be through both of them to enter the hoses **6** and **7** beneath the mooring buoy **10** and the saddle pivot **19**, respectively. It is seen

that the ship can never damage the hoses nor the mooring buoy. The flow system from either end of the rigid pipe means can be through flexible hoses or through a submerged steel pipe and floating hose combination.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood, that the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. In a mooring system:
a mooring buoy;
a first, second, third and fourth rigid means, each having a first and a second end;
a first, second, third and fourth pivot means;
a first and a second fender buoy;
a saddle means having means for connecting to said fourth pivot means and means for connecting to a vessel;
said first pivot means mounted on said mooring buoy;
said first ends of said first and second rigid means connected to said first pivot means;
said first ends of said third and fourth rigid means and said saddle means connected to said fourth pivot means;
said second ends of said first and third rigid means connected to said second pivot means on said first fender buoy;
said second ends of said second and fourth rigid means connected to said third pivot means on said second fender buoy;
tensioning means connected between said first and second fender buoys of shorter length than the combined length of said second and fourth rigid means;
and mooring lines one end of each is connected to said mooring buoy and the other end of each is available to be connected to a vessel.

2. The mooring system of claim **1**:
and means for forming a fuel passage means through said fourth rigid means.

3. The mooring system of claim **1**:
and means for forming a continuous fuel passage means through said mooring buoy, said second rigid means, said third pivot means, said fourth rigid means, and said fourth pivot means.

4. The mooring system of claim **1**:
and means for forming a continuous fuel passage means through said mooring buoy, said first rigid means, said second pivot means, said third rigid means and said fourth pivot means.

5. In the mooring system of claim **1**:
said tensioning means comrising nylon ropes.

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TRYGVE M. BLIX, *Primary Examiner.*

U.S. Cl. X.R.

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