June 2, 1970

A. F. DICKSON ET AL

3,515,182

ONE-POINT MOORING SYSTEM FOR LOADING OR UNLOADING A FLUID INTO OR FROM A SHIP

Filed May 5, 1967

2 Sheets-Sheet 1

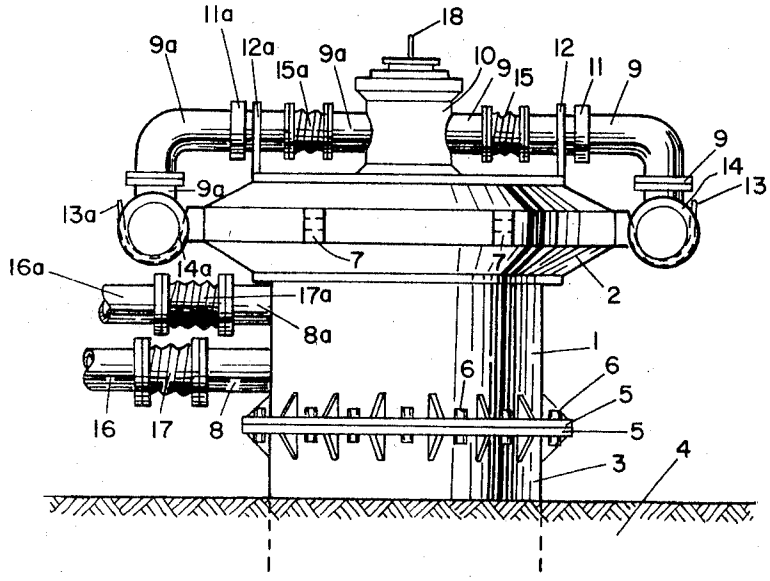



FIG. 1

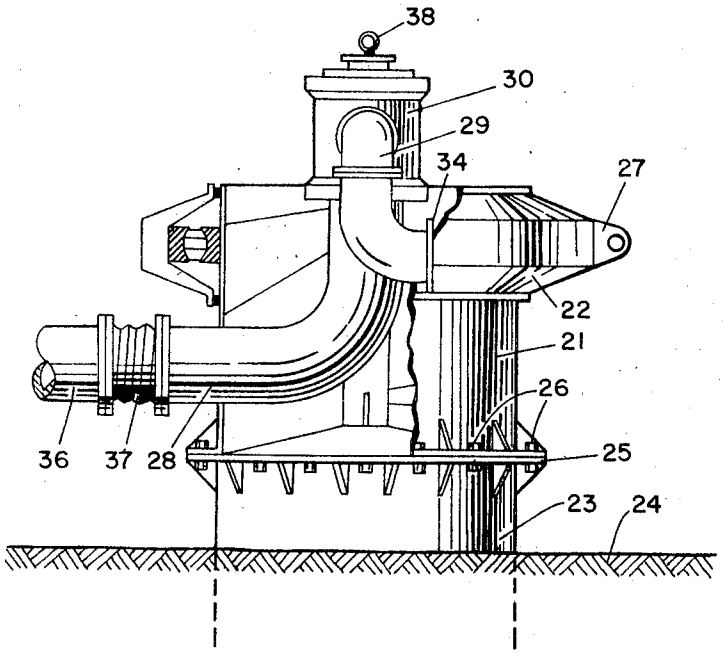



FIG. 2


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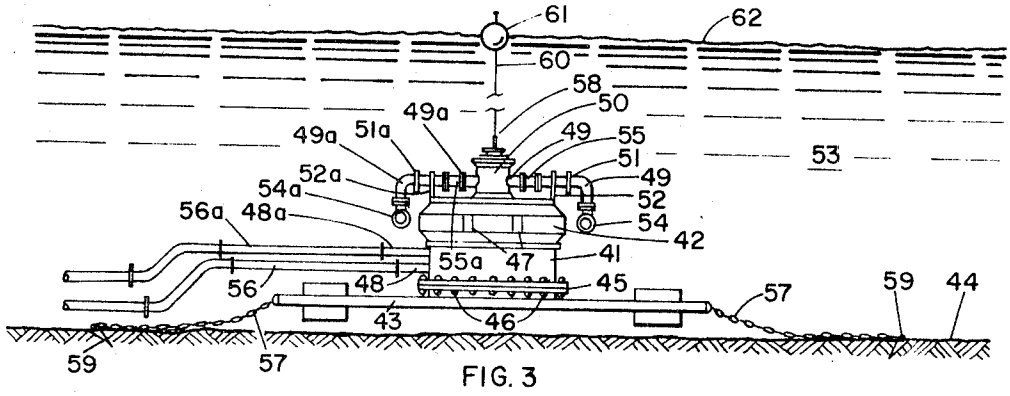



FIG. 3

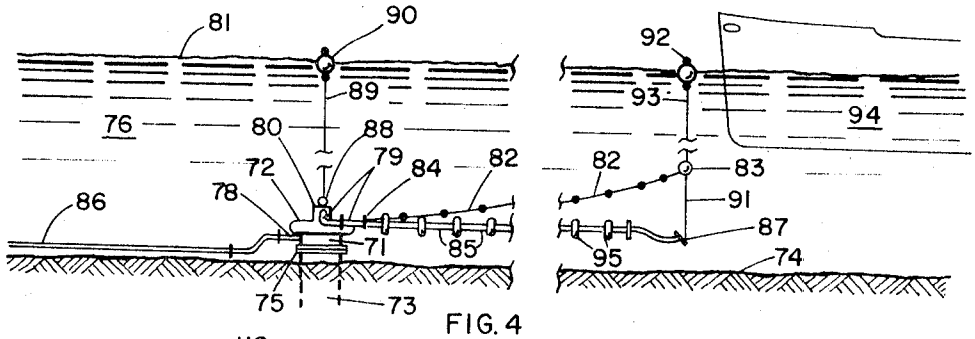



FIG. 4

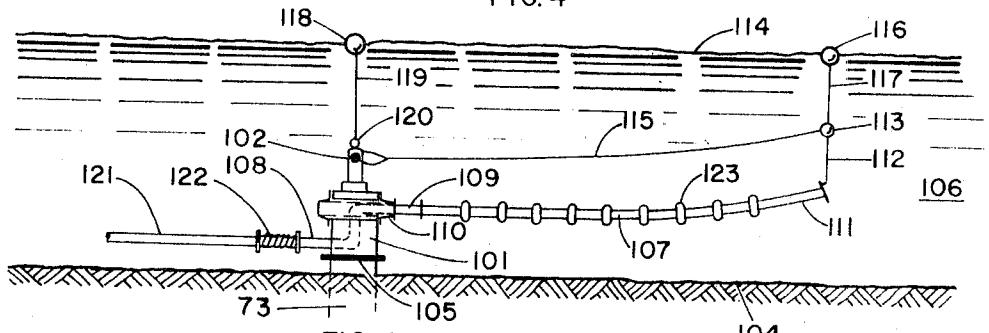



FIG. 5

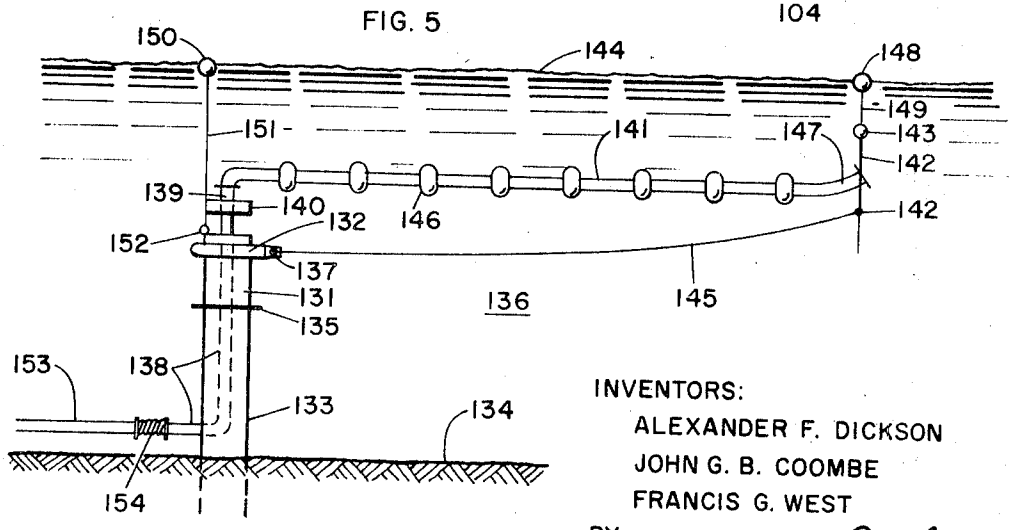



FIG. 6

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United States Patent Office 3,515,182 Patented June 2, 1970



3,515,182

# ONE-POINT MOORING SYSTEM FOR LOADING OR UNLOADING A FLUID INTO OR FROM A SHIP

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Filed May 5, 1967, Ser. No. 636,466
Claims priority, application Great Britain, May 6, 1966, 20,159/66
Int. Cl. B65b 1/04
U.S. Cl. 141—387 8 Claims

## ABSTRACT OF THE DISCLOSURE

A one-point mooring system arranged for loading or unloading fluid-cargo ships. The system includes a fixed member anchored to the water floor which carries a rotatable member having a mooring line connected thereto. The fixed member carries a first fluid line which is rotatably connected in fluid communication with a second fluid line carried by the rotatable member. The second fluid line is provided with a swivel to permit swivelling of the second line along a horizontal axis and is attached to a hose connectable to a ship for completing a flow path between the ship and the first fluid line. When the system is not accommodating a ship, the free ends of the hose and mooring line may be attached by means of a cable to a surface buoy to facilitate recovery of the mooring line and hose when the ship approaches.

The invention relates to a one-point mooring system for loading or unloading fluids into or from a ship.

In recent years loading and unloading systems of this kind have been developed comprising a floating buoy to which a ship can be moored in such a way that it can rotate freely around the buoy. Such mooring systems are described, for example, in the U.S. patent to Wassenaar 3,187,355 and U.S. patent to Koppenol 3,261,039 which issued on June 8, 1965 and July 19, 1966, respectively. These known mooring systems, which are being successfully used, are often provided with hoses for loading and unloading which are floating on the surface of the water. A difficulty of these known systems is that when using these systems, a small launch is often needed in order to fasten the mooring cable of the ship and in order to fasten the hose to the ship, which is of course a complication. Furthermore, in calm weather (no wind, waves or currents) the ship tends to bump against the buoy to which it is moored.

The object of the invention is to provide a one-point mooring system for loading and unloading fluids into or from a ship without the above disadvantages.

The system according to the invention therefore comprises a first part and a second part rotatable relative to the first part, the second part being provided with a device for securing a mooring cable of a ship thereto, a first fluid line secured to the first part and a second fluid line rotatably connected to the first fluid line, the system being adapted to be arranged below the surface of a body of water.

Furthermore, the invention comprises a mooring system as mentioned, secured to the bottom of a body of water by anchoring means, the first fluid line being connected to a fluid discharge or supply line arranged in or adjacent to the bottom of a body of water.

The invention will be further explained with reference to the drawings in which:

FIG. 1 is a schematic side veiw of a first embodiment of a mooring system according to the invention, arranged adjacent to and fixedly secured to the bottom of a body of water;



FIG. 2 is a schematic side view, partially in section, of another embodiment of a mooring system according to the invention, also arranged adjacent to and fixedly secured to the bottom of a body of water;

FIG. 3 is a schematic side view of a third embodiment of the invention which is arranged adjacent to and flexibly secured to the bottom of a body of water;

FIG. 4 is a schematic side view of the general arrangement in the water of the system according to the invention, and in particular the manner in which the mooring line and the loading or unloading hose are suspended;

FIG. 5 is a schematic side view of a further embodiment of the invention as arranged underwater; and,

FIG. 6 is a schematic side view of a sixth embodiment of the invention again as arranged under water, fixedly secured to the bottom of a body of water but at a substantial distance above said bottom.

In FIG. 1, a first part **1** is provided with a second part **2**, which is rotatable relative to the part **1**. Part **1** is fixedly secured by means of flanges **5** and bolts and nuts **6** to a tube pile base **3**, which has been drive into the bottom **4** of a body of water. Devices for securing mooring cables of a ship thereto are indicated by **7** and are fixedly secured to the part **2**. In the embodiment shown there are two first fluid lines **8** and **8***a* which pass through and are secured to the first part **1**. Second fluid lines **9** and **9***a* are rotatably connected respectively to the first fluid lines **8** and **8***a* by a main pipe swivel **10** of the multiple type. The second fluid lines **9** and **9***a* are each provided with an auxiliary pipe swivel **11** and **11***a* allowing rotation of part of the second fluid lines **9** and **9***a* around their longitudinal axes.

The second fluid lines **9** and **9***a* are supported by the rotatable part **2** by brackets **12** and **12***a*, which are secured to the part **2**, and by hooks **13** and **13***a*, which are also secured to part **2**. The ends of the second fluid lines **9** and **9***a* are provided with flanges **14** and **14***a* for connecting hoses thereto, which hoses and their function will be described later. The second fluid lines **9** and **9***a* are preferably provided with a flexible part, for example, bellows **15** and **15***a*. To the first fluid lines **8** and **8***a* are secured fluid discharge and supply lines **16** and **16***a*, preferably in a flexible manner, for example, by bellows **17** and **17***a*. On top of the main pipe swivel **10** an eye hook **18** is present for securing the cable of a marking buoy (which will be described later) thereto. The one point mooring system of FIG. 1 is suitable for loading or unloading two different fluids at the same time, namely, the lines **16**, **8** and **9** for one fluid and the lines **16***a*, **8***a* and **9***a* for another fluid.

The embodiment according to FIG. 2 comprises a first part **21** and a second part **22** which is rotatable relative to the first part **21**. The second part **22** is provided with a device **27** for securing a mooring cable of a ship thereto. The first part **21** is fixedly secured by means of flanges **25** and bolts and nuts **26** to a tube pile base **23**, which has been driven into the bottom **24** of a body of water. A first fluid line **28** is secured to the first part **21**. A second fluid line **29** is rotatably secured to the first fluid line **28** by means of a main pipe swivel **30**. The end of the second fluid line **29** is provided with a flange **34** for connecting a hose, the purpose of which will be described later, thereto. The second fluid line **29** is preferably provided with a flexible element, for example, a bellows (not shown). A fluid supply and discharge line **36** is secured to the first fluid line **28** by means of a bellows **37**. On top of the main pipe swivel **30** an eye hook **38** is provided for securing the cable of a marker buoy (which will be described later) thereto. The basic difference of the embodiment of

FIG. 2 with respect to the embodiment of FIG. 1 is that it is suitable only for loading or unloading one fluid.

In FIG. 3, a first part **41** carries a second part **42**. The second part **42**, which is rotatable relative to the first part **41**, is provided with devices **47** for securing a mooring cable of a ship thereto. The first part **41** is fixedly secured, by means of flanges **45** and bolts and nuts **46**, to a base **43**, which is floating adjacent to the bottom **44** of a body of water **53**. The base **43** has the shape of a plate or box and is anchored by means of cables or chains **57** and anchors **59** to the bottom **44**. To the first part **41** first fluid lines **48** and **48***a* are secured. Second fluid lines **49** and **49***a* are connected to the first fluid lines **48** and **48***a* by means of a main pipe swivel **50**, allowing rotation of these fluid lines relative to each other. The second fluid lines **49** and **49***a* are each provided with auxiliary pipe swivels **51** and **51***a*. Furthermore, the second fluid lines **49** and **49***a* are supported on the second part **42** by brackets **52** and **52***a*. The ends of the fluid lines **49** and **49***a* are provided with flanges **54** and **54***a* for securing a hose (which will be described later) thereto. Preferably each fluid line **49** and **49***a* is provided with a flexible part, for example, bellows **55** and **55***a*. Fluid supply and discharge lines **56** and **56***a* are connected to the first fluid lines **48** and **48***a*, respectively. On top of the main pipe swivel **50** an eye hook **58** is present to which is secured a cable **60** which is connected to a marker buoy **61** floating on the surface **62** of the body of water **53**.

In FIG. 4 the general arrangement in the water of the embodiments according to FIGS. 1, 2 and 3 is schematically shown. Although in FIG. 4 the mooring system shown is secured to a tube pile base, this general arrangement is also applicable to the mooring system according to FIG. 3, which floats adjacent to the bottom of a body of water. Furthermore, although the mooring system as shown in FIG. 4 is one for loading or unloading one fluid only, the general arrangement is equally well applicable to mooring systems for loading or unloading two or more different fluids. In FIG. 4 a first part **71** is fixedly secured by flanges **75** and bolts and nuts (not shown) to a tube pile base **73**, which has been driven into the bottom **74** of a body of water **76**. A second part **72** rotatable relative to the first part **71** is secured on the first part **71**. A first fluid line **78** is secured to the first part **71**, said first fluid line **78** being connected in a rotatable manner to a second fluid line **79** by means of a main pipe swivel **80**. A fluid supply and discharge line **86**, which is arranged adjacent to or in the bottom **74**, is connected to the first fluid line **78**. The end of the second fluid line **79** is provided with a flange **84** to which is connected a fluid conduit or hose **85**. On top of the main pipe swivel **80** an eye hook **88** is arranged, to which is connected a cable **89**. To the end of the cable **89** is connected a marker buoy **90**, floating on the water surface **81**. The second part **72** is provided with a device (not shown) for securing a mooring cable **82** of a ship thereto. The free end of the mooring cable **82** is secured to a buoy **83**, floating relatively deep under the water surface **81**. The free end **87** of the hose **85** is also secured to the buoy **83**, for example, by means of a cable **91**. To the buoy **83** a marker buoy **92**, floating on the water surface **81**, is connected by means of a cable **93**. A ship arriving at the mooring system is indicated by the reference numeral **94**. The hose **85** is preferably of about neutral buoyancy and is, for example, provided with annular floats **95**.

The use of the mooring arrangement as shown in FIG. 4, which applies to all the embodiments according to FIGS. 1, 2, 3, and also of FIGS. 5 and 6, is as follows.

Assume that a ship **94** arrives at the mooring system, in order to load or unload fluid. As soon as the ship **94** has arrived close to the marker buoy **92** it picks up this buoy **92**, together with the cable **93**, the buoy **83**, the cable **91** and the ends of the mooring cable **82** and of the hose **85**. In this respect it is remarked that, in order to make the picking up of the buoy **92** easy, this buoy can be provided with a line or rod floating on the water surface, so that the ship can first pick up the said floating rod or line and finally the buoy **92** which is secured to said floating line or rod. The floating rod may be made of fiber glass or of any other suitable material. The end of the mooring cable **82** is then secured to the ship **94** so that the ship **94** is moored. Further, the free end **87** of the hose **85** is connected to the fluid loading or unloading pipelines (not shown) on the ship, in any suitable manner. Now loading or unloading of fluid can begin. Assume that it is intended to load the ship **94**, which is, for example, a tanker, with oil or natural gas. The fluid to be loaded will then be passed through the fluid supply line **86**, the line **78**, the main pipe swivel **80**, the line **79**, the hose **85**, the loading lines of the ship **94** into the tanks (not shown) of the ship **94**. If it is desired to unload a fluid cargo from the ship **94**, the fluid is pumped out of the tanks of the ship through the unloading lines of the ship, the hose **85**, the line **79**, the main pipe swivel **80**, the line **78** and the fluid discharge line **86**.

During this loading or unloading of the ship **94**, the ship **94** will be free to rotate around, and will always point its bow to the mooring system, since the mooring cable **82** is secured to the second part **72**, which is rotatable relative to the fixed part **71** and since the fluid line **79** is free to follow this rotation, because of the main pipe swivel **80** allowing the fluid line **79** to rotate relative to the fixed fluid line **78**.

In FIG. 5 a further embodiment of the mooring system according to the invention comprises a first part **101** and a second part **102**, rotatable relative to the first part **101**. The second part **102** is in the shape of a device, for example, an eye hook, for securing a mooring cable thereto. The first part **101** is fixedly secured to a tube pile base **103** by means of flanges **105** and bolts and nuts (not shown). The tube pile base **103** has been driven into the bottom **104** of a body of water **106**. The first part **101** is provided with a first fluid line **108** which is rotatably connected to a second fluid line **109** by means of a main pipe swivel **110**. This main pipe swivel **110** is in the shape of an annular chamber rotatably mounted on the first part **101**, the first fluid line **108** passing through the wall of part **101** and debouching into the annular chamber. To the line **109** a hose **107** is secured, the free end **111** of the hose **107** being secured by a cable **112** to a buoy **113**, which is floating relatively deep below the surface **114** of the water. A cable **115** for mooring a ship is secured with one end to the second part **102**, the other end of cable **115** being secured to the buoy **113**. A marker buoy **116** is connected to buoy **113** by a cable **117**. Furthermore, a marker buoy **118** is connected to part **102** by a cable **119** and an eye hook **120**. A fluid supply and discharge line **121** is connected to line **108** by means of a bellows **122**. The hose **107** is provided with floats **123** so that it will have substantially neutral buoyancy.

In FIG. 6, the mooring system comprises a first part **131**, fixedly secured to a tube pile base **133** by means of flanges **135** and bolts and nuts (not shown). The tube pile base **133** has been driven into the bottom **134** of a body of water **136**. A second part **132**, in the shape of an annular ring, is rotatably secured on the first part **131**. On the part **132** a device **137** for securing one end of a mooring cable **145** of a ship thereto is present. The other end of the mooring cable **145** is secured to a buoy **143**, floating relatively deep under the water surface **144**, by means of a cable **142**. A first fluid line **138** is secured to the first part **131**. This fluid line **138** is rotatably connected to a second fluid line **139** by means of a main pipe swivel **140**. To the fluid line **139** is secured with one end a hose **141**, which is provided with floats **146**, so that it has substantially neutral buoyancy. The other end **147** of the hose **141** is secured to cable **142**. A marker buoy **148**, floating on the water surface **144**, is secured by a cable **149** to buoy **143**. Another marker buoy **150**, floating on the water surface **144**, is secured to part **131** by a cable **151**

and eye **152**. A liquid supply and discharge line **153** is connected to the first fluid line **138** by means of a bellows **154**. The line **153** is arranged adjacent to or in the bottom **134**.

The use of the arrangements of FIGS. 5 and 6 is basically the same as the use of the arrangement of FIG. 4, so that further explanation thereof is not considered to be necessary.

The hose (**85**, **107**, **141**) can be in the shape of a tube of fiber glass material. Instead, the said hose can also be in the shape of a large number of sections of pipe which are interconnected by universal joints. The said hose has preferably a small negative buoyancy. Furthermore, it is remarked that the said hose can be provided with annular floats in order to give it the desired buoyancy. Instead, it is, however, possible to use a hose which itself is provided with buoyancy cells.

The marker buoy secured to the mooring system by means of a cable and floating above the mooring system can be replaced, if desired, by a mast secured to the mooring system and extending above the water surface.

The one point mooring system according to the invention is suitable for fueling ships with fuel oil or for loading or unloading tankers. All kinds of fluids can be loaded into or unloaded from tankers, by means of the system as described, for example, crude oil, refined products, natural gas, methane, propane or other fluids.

The main pipe swivel can be of the universal type, which means that it allows movement in all directions. Furthermore, all cables used can be replaced by ropes or chains, if desired. The cables can be provided with floats, for example, annular floats.

The system according to the invention can be arranged close to the bottom of the body of water. Instead, it can, however, be arranged at a substantial distance above said bottom (see, for example, FIG. 6).

We claim as our invention:

**1**. An underwater one point mooring system for loading and unloading fluid-cargo ships, said system comprising:

a first part secured to the floor of a body of water and positioned beneath the surface of said body of water;

a second part rotatably carried underwater by said first part for rotation about a substantially vertical axis;

a first fluid line secured to said first part;

a second fluid line carried by said second part and having one end rotatably connected in fluid communication with said first fluid line for rotation about said vertical axis;

a pipe swivel connected in said second fluid line to permit swivelling of said second fluid line about a substantially horizontal axis;



flexible fluid conduit means having one end connected to the other end of said second fluid line and having a free end adapted to be connected to a fluid-cargo ship,

buoyant means carried by said fluid conduit means for supporting said fluid conduit means off the floor of the body of water,

buoy means on the surface of said body of water and connected to the free end of said fluid conduit means outboard of said first and second parts whereby said buoy means and said fluid conduit means are free to move in the direction dictated by wind and water forces, and,

at least one mooring line connected to one of said parts and having a free end for mooring said ship to said system.

**2**. A mooring system as defined in claim **1** wherein said parts are provided with third and fourth fluid lines, respectively, connected in fluid communication with one another and arranged in a manner similar to the connection of said first and second fluid lines.

**3**. A mooring system as defined in claim **1** wherein said first part is secured to the floor of the body of water by means of anchors.

**4**. A mooring system as defined in claim **1** wherein said first part is driven into the floor of said body of water.

**5**. A mooring system as defined in claim **1** wherein said fluid conduit comprises a hose.

**6**. A mooring system as defined in claim **1** wherein said system is arranged adjacent the floor of said body of water.

**7**. A mooring system as defined in claim **1** wherein said buoy means comprise at least one surface buoy connected to said free end of said fluid conduit means by cable means.

**8**. A mooring system as defined in claim **7** wherein said free end of said mooring line is also connected to said buoy means.


**References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 3,452,787 | 7/1969 | Bily | 141—388 |
| 2,894,268 | 7/1959 | Griebe | 137—236 |
| 3,236,266 | 2/1966 | Bily | 137—236 X |
| 3,311,142 | 3/1967 | Bergstrom | 141—388 |
| 3,372,409 | 3/1968 | Manning | 137—236 X |



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U.S. Cl. X.R.

137—236