June 2, 1970 W. H. VAN EEK 3,515,179

OFFSHORE LOADING/UNLOADING OF TANKERS

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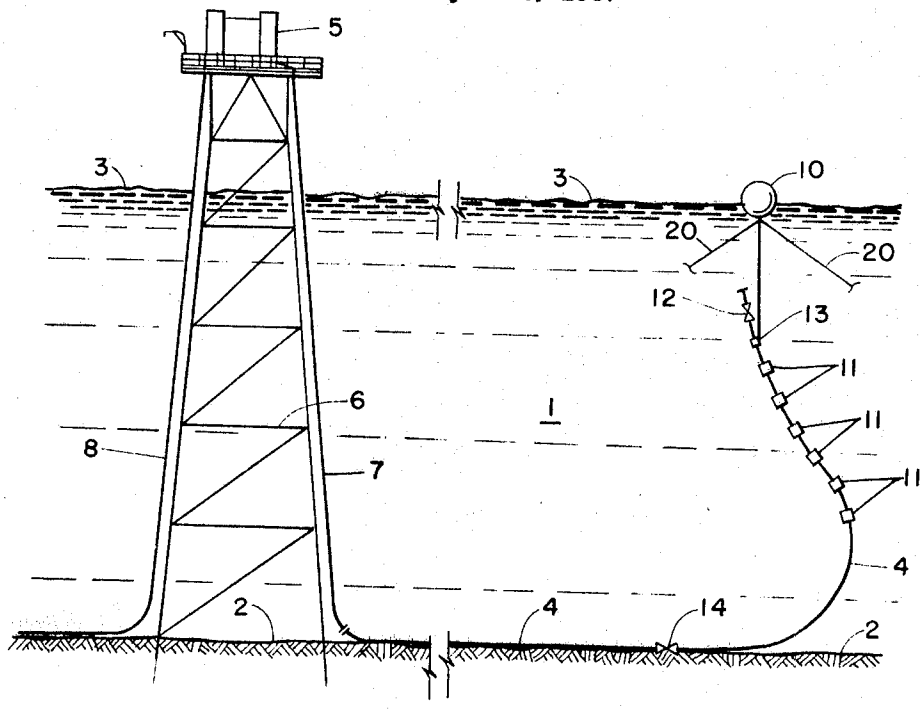

FIG. 1

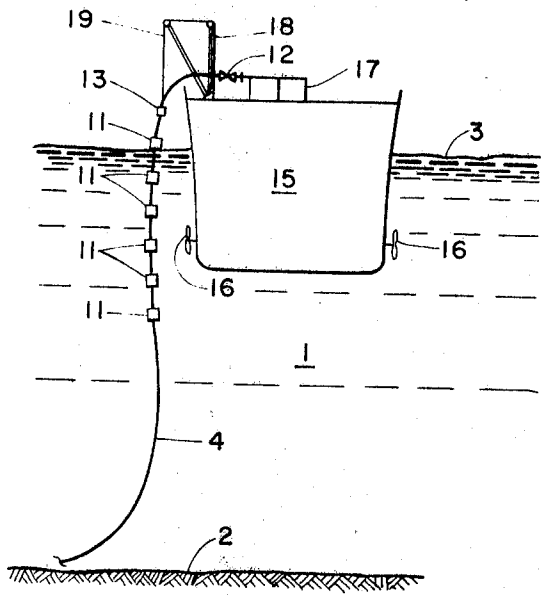

FIG. 2

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OFFSHORE LOADING/UNLOADING OF TANKERS

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U.S. Cl. 141—1 7 Claims

ABSTRACT OF THE DISCLOSURE

Offshore loading/unloading of tankers in which an end of a submerged fluid line is attached to a cable, suspended from a buoy. A tanker arriving at the buoy picks up the end of the line, whereafter said end is secured to the loading/unloading lines of the tanker and loading/unloading takes place. The tanker may be provided with dynamic positioning means so that use of mooring lines or anchors is not necessary.

The invention relates to a method of loading or unloading a fluid cargo ship or "tanker" at sea or on a body of water by means of a flowline, one end of which is provided with, or is secured to, at least one float or at least one buoy.

It is known to load or unload ships at sea or on a body of water in such a manner. In known methods, use is made of a single mooring buoy constructed in such a way that the ship can be made fast to the buoy by means of a cable so that the ship invariably has its bow pointing to the buoy and thus comes to lie parallel to, or substantially parallel to, the current and/or wind forces. A buoy of this type is described, inter alia, U.S. Pat. 3,187,555.

With expensive tankers such as large tankers of convention design, or tankers of very special and thus costly design, such as tankers for the transportation of liquefied gases or tankers for the transportation of gases at high pressure, the saving of time during mooring for loading or unloading is economically of great value.

One object of the convention is to provide a method of the above type in which delays awaiting weather or sea conditions in which a ship can be secured to a buoy or buoys are reduced or avoided. A further object of the invention is to eliminate the need for small boats to assist in the berthing operation or in the connection of the cargo flowline of the berth to the ship's own cargo piping.

For this purpose the method according to the invention is characterized in that a ship is used which is provided with means for automatically positioning the ship without the use of anchors, i.e., a ship having a so-called "dynamic positioning system." When the ship approaches the buoy, it is automatically positioned close to the end of the line with the aid of the positioning means and the end of the line is subsequently picked up by the ship and secured to the loading or unloading line of the ship, whereupon the loading or unloading of the ship begins.

In addition to this method, the invention also relates to a tanker for use with the said method, which tanker is provided with means for automatically positioning the tanker without the use of anchors.

The positioning means comprise, for example, a system consisting of one or more extra propellers and an automatic control device for operating the extra propellers in such a way that the ship is held in the desired position. It is to be noted that it is also possible to use special propellers which are used for propelling the ship as well as for holding it automatically in the desired position. Furthermore, instead of propellers, reaction engines of the jet type can be used for stationing purposes.

The invention will now be further elucidated with reference to the drawing in which:

FIG. 1 is an elevational view of the flowline and the buoy plug appurtenances in the rest position; and

FIG. 2 is an elevational view of a tanker being loaded or unloaded.

With reference to the drawing, the sea or body of water is designated by the numeral **1**, the floor of the sea or body of water by the numeral **2** and the surface of the sea or water by the numeral **3**. A line **4** for the supply or offtake of the fluid to be loaded or unloaded lies on the bed **2**. The line **4** may, for example, be connected to short storage tanks (not shown) for the fluid. Alternatively, it is also possible for the line **4** to be connected to reservoirs or container vessels in which oil or gas produced from the rock formations under the bed of the sea or body of water is collected. These reservoirs or vessels may be situated beneath the sea bed, above the sea bed and below the water surface, or above the water surface. In the drawing by way of example, the line **4** is connected via a line **7** to a separator **5** which is arranged on a steel or concrete offshore structure **6** supported by the floor **2**. It is to be noted that the reservoirs or vessels can also be secured to ships or other floating structures. In the separator **5**, for example, water is separated from petroleum, produced from the bed **2** or the separator **5** may serve to separate water or condensed hydrocarbons from natural gas produced from the bed **2**. The oil or gas produced is passed to the separator **5** via a flowline **8**. The free end of the line **4**, which end is preferably flexible, is provided with, or secured to, at least one float or buoy. In the embodiment shown in the drawing, the end of the line **4** is suspended below a buoy **10** by means of a cable **9**, the latter being connected at the point **13** to the line **4**. If desired, the line **4** can be provided close to the said end with floats **11**. A valve **12** is arranged near the end of the line **4**. In addition, a second valve **14** is arranged in the line **4**. The ship, for example a tanker, is designated in FIG. 2 by the numeral **15**. In addition to the conventional propeller(s) at the stern of the ship, the ship is also provided with one or more extra propellers **16**, which can be turned in all directions lying in a horizontal plane. The propeller(s) can be placed, for example, in the bow or in the stern of the ship. If desired, it is possible to secure these propellers to the ship in such a way that they can be raised out of the water, so that the resistance of the ship during the normal progress is not adversely affected. In the drawing the extra propellers are only shown diagrammatically.

On the ship **15** are loading or unloading lines **17** and a derrick **18**, provided with a cable **19**.

If desired, the connection between the line **4** and the ship can be designed in such a way that the ship can rotate freely round the line **4**; in such a case, use is made of a rotatable swivel.

The ship **15** is, as already stated, provided with means for automatically positioning the ship **15** without the use of anchors. These means comprise a system consisting of extra propellers **16** and an automatic control device for operating the extra propellers **16** in such a way that the ship **15** is held in the desired position. The control device and equipment are not shown in the drawing. Means for the automatic positioning without the use of anchors, of a floating structure, such as a floating drilling platform for instance, have already been described, for example, in U.S. Pat. 3,211,121. However, attention is drawn to the fact that the invention is not restricted to the automatic positioning means according to this patent,

other known suitable automatic positioning means can be used as well, if desired.

When use is made of the above devices for the automatic positioning of a tanker without the use of anchors, a relatively large amount of power is needed to drive the extra propellers. Depending on the prevalent wind and current forces, this power can amount to a substantial proportion of the power needed for the normal propulsion of the ship.

The method of the invention proceeds as follows. Let it be assumed that a tanker has to be loaded, for example, with natural gas. The tanker **15** approaches the buoy **10**. Once the tanker **15** has come close to the buoy **10** it is stopped or almost stopped, whereupon the system for positioning the tanker **15** automatically without the use of anchors is put into operation. The degree of deviation of the tanker **15** from a given desired location is determined in this system by a taut line method, by transponders or the like. The end of the line **4** is subsequently hoisted aboard the tanker **15** with the aid of the derrick **18** and cable **19** whereupon the end of the line **4** is connected to the loading line **17** of the tanker. The valve **12** and the valve **14** are then opened. The valve **14** can, for instance, be opened by generating a pressure impulse in the line **4**. The natural gas now flows via the line **4** to the tanks of the tanker **15**, in which it is stored, for example, under high pressure. After completion of the loading the valves **12** and **14** are closed and the end of the line **4** is uncoupled from the loading line **17**, whereupon the end is again suspended on or under the buoy **10** with the aid of the tackle **18**. The system for automatically positioning the tanker **15** without the use of anchors, and the extra propellers **16**, are then put out of action, whereupon the normal propulsion screw is put into operation and the tanker **15** proceeds to its destination. Instead of putting all the extra propellers out of action, it is then, if desired, possible to use the extra propellers for normal propulsion, provided their design is suitable for the purpose. It will be obvious that the unloading of the tanker **15** will take place in essentially the same manner as above described. The buoy **10** is preferably, although not necessarily, anchored to the water floor **2** by means of anchor lines **20**.

It will be clear that instead of natural gas other gases can be loaded or unloaded in the manner described, such as methane, propane, ethane, ethylene, butane and oxygen, can be loaded or unloaded in the manner described.

Alternatively, gases can also be loaded or unloaded in the manner described above in the so-called dense phase, i.e., at high pressure and low temperature.

Moreover, liquid oil products, such as, for example, crude petroleum, gasoline, fuel oil, and gas oil, can also be loaded or unloaded in the manner described above.

It is to be noted that it is not strictly necessary for the buoy, to which the end of the line is secured or suspended, to float on the surface of the water. It is instead also possible to make use of a buoy which is situated below the surface of the water.

It is noted that the means for automatically positioning the ship can be of any suitable known type. The special propellers for this purpose can, for example, be so arranged that they can be raised out of the water when not required, in order to improve propulsive efficiency. Propellers can, for example, be used which are so arranged that they can be retracted into the hull, namely, vertically through the bottom of the hull or horizontally through the sides of the hull.

I claim as my invention:

1. A method of loading or unloading a fluid-cargo ship at sea, said method comprising:

positioning a fluid-handling flowline on the floor of a body of water;

connecting one end portion of said flowline to a fluid-handling facility;

buoying up the other end portion of said flowline at spaced intervals along said flowline for maintaining said other end of said flowline intermediate the floor of said body of water and the water surface;

manuevering said ship to a position near said other end of said flowline;

maintaining the position of said ship;

hoisting said other end of said flowline aboard said ship;

connecting said flowline to said ship; and

establishing fluid communication between said fluid-handling facility and said ship by means of said flowline.

2. A method as defined in claim **1** including the steps of:

discontinuing fluid communication between said fluid-handling facility and said ship;

disconnecting said flowline from said ship; and

lowering said other end of said flowline into said water.

3. A method as defined in claim **2** wherein the position of said ship is maintained dynamically.

4. A method as defined in claim **3** wherein the step of providing said other end of said flowline with buoyancy means comprises attaching at least one float to said other end.

5. A method as defined in claim **3** wherein the step of providing said other end of said flowline with buoyancy means comprises attaching a buoy to said other end.

6. A method as defined in claim **5** wherein the step of providing said other end of said flowline with buoyancy means comprises:

suspending said other end under said buoy by means of a cable; and

anchoring said buoy on the floor of said body of water.

7. A method as defined in claim **6** wherein the step of connecting one end of said flowline to a fluid-handling facility comprises connecting said end to a separator positioned on an offshore platform.

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