

## [54] FLOATING MOORING ARRANGEMENT

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61/46.5, 46

## [56] References Cited

## UNITED STATES PATENTS

3,366,982	2/1968	Sutton	9/8 P
3,595,196	7/1971	Riffeser	9/8 P
3,668,875	6/1972	Sander et al.	114/230

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## [57] ABSTRACT

A floating mooring arrangement, for example for transferring liquified natural gas between the sea bottom and a ship, comprises a tower resting on the sea bottom, and a pair of concentric annular members surrounding the tower and floating on the surface of the water. The outer of these has a buoyant arm rigidly connected thereto, to which the ship is connected. The inner of these is secured by anchors and anchor chains. Conduits extend from the sea bottom up through the tower and from a swivel at the top of the tower to pipes on the outer annular member, and thence to the ship. Clearance between the tower and the annular members is such that the latter cannot touch the tower within the range of movement afforded by the anchor chains.

## 2 Claims, 2 Drawing Figures

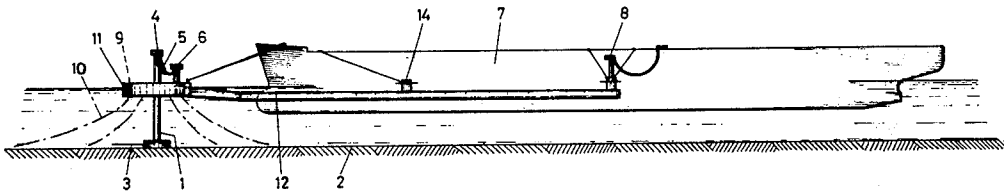


FIG. 1

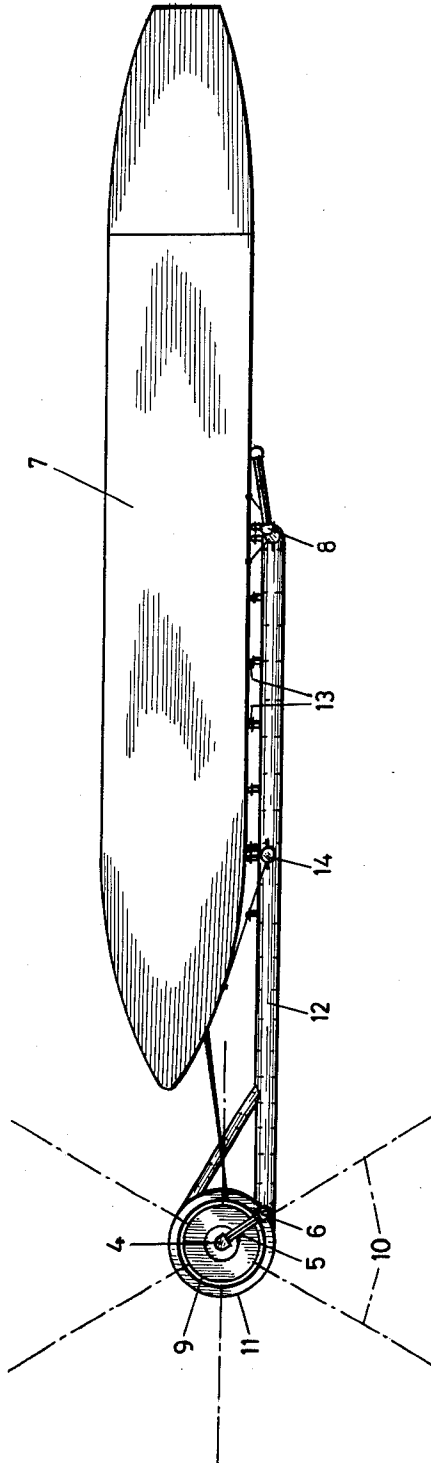
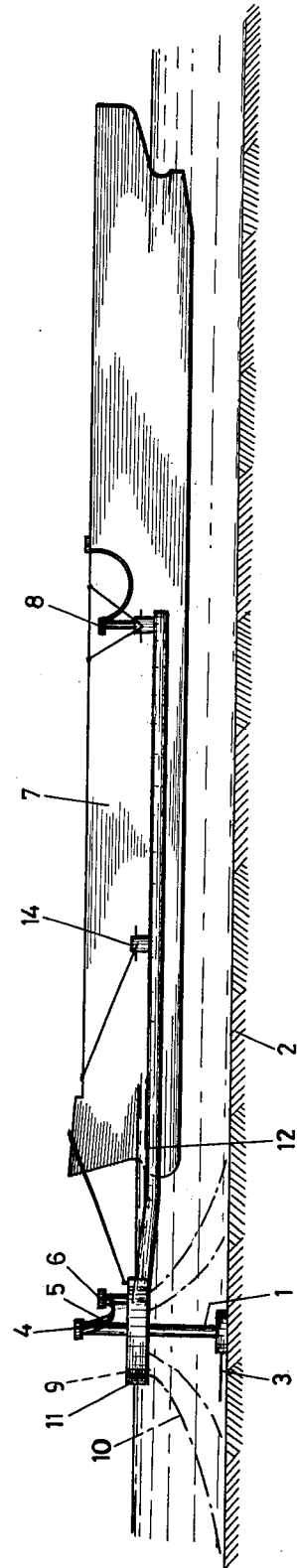


FIG. 2



## FLOATING MOORING ARRANGEMENT

This invention relates to a floating mooring arrangement comprising a first part which by means of anchors is held in place and a second part which is rotatable relative to the first part about an essentially vertical shaft and which comprises means for securing a ship thereto, and furthermore one or more conduits extending from the seabottom upwards to a rotatable connection and from there to the rotatable part of the arrangement. Mooring arrangements of this kind are generally known in many embodiments. The anchored arrangement is movable to a certain extent and the rotatable part can be rotated through an angle of 360° in order to afford the ship that has made fast to the arrangement the opportunity to adapt itself to the wash of the waves, the current and the direction of the wind.

In case a liquefied natural gas must be conveyed via such a mooring arrangement the known mooring arrangement is generally not serviceable anymore. The conduits extending from the arrangement to the bottom should be capable of adapting themselves to the movements of the arrangement. However, these conduits become rigid on account of deposition of ice because the liquified gas is sub-cooled ( $-160^{\circ}\text{C}.$ )

The invention aims at providing a mooring arrangement with which it is possible to handle sub-cooled media. This object is arrived at according to the invention in that the arrangement comprises a ring, that the conduits extend upwards via a tower placed on the seabottom and from the tower to the rotatable part of the ring in the form of hoses or articulated pipe connections and that the ring has so much interior space relative to the tower that said ring will not touch the tower within the range of movement offered by the anchor chains.

The submerged conduit section on which deposition of ice may take place is now arranged in or at the stationary tower which is located within the annular part of the arrangement, does not take up anchor forces and also does not come into contact with the arrangement. The only connection between tower and arrangement is constituted by the hoses or articulated pipe connections extending from the rotatable tower top to the rotatable part of the arrangement. These connections are visible and deposition of ice can therefore be ascertained and combatted, for instance by heating the outside of this comparatively short stretch. With a simple heating coil laid along the hose or wrapped around it it is possible to counteract a deposition of ice thus maintaining the movability of said connection.

According to the invention the rotatable part of the arrangement may furthermore comprise a ring and to this ring an arm having buoyancy may be tangentially connected so that a ship to be handled may make fast to said arm. As a result the movements of the arrangement are determined to a considerable extent by the movements of the ship, the more so because the arrangement and the mooring arm itself have only a small surface at the water level. The movements of the arrangement relative to the tower are therefore more limited than would be the case if the arm did not form one rigid unit with the rotatable ring of the buoy. Naturally the rotatable ring is completely supported both axially and radially.

The annular shape protects the tower against the action of the waves.

It is to be noted that the application of a tower is known in itself from the U.S. Pat. No. 2,699,321 which shows a mooring arrangement mounted to swing about the tower.

The invention will now be further elucidated with reference to the drawings.

FIG. 1 shows a top plan view of the mooring arrangement, and

FIG. 2 a side view of the same arrangement.

The arrangement shown in the drawings comprises a tower 1 which has been placed on the seabottom 2 and to which conduits 3 are connected which extend on the seabottom 2. Said conduits extend upwards through the tower (not shown). In the top of the tower there is fitted a rotatable head 4 to which hoses 5 are connected. Said hoses are connected to a connecting head 6 from which conduits extend, in a manner not shown, to connecting points for the ship to be handled as shown for instance at reference numeral 8.

The buoy comprises an annular body 9 which is secured with anchor cables or chains 10 and about which a ring 11 is rotatably arranged, on which the aforementioned connecting head 6 is fitted and to which furthermore an arm 12 is rigidly fastened. Conduits extend through said arm to the connecting point 8 which is provided with the necessary means such as fenders 13 and bollards 14 for anchoring a ship 7.

The space within the body 9 around the tower is so large that the movements which the body 9 may carry out under the influence of prevailing conditions do not result in a load on the tower. This tower may stand on the seabottom so that in the event of a collision, for example in the event of an anchor chain being ruptured, damage between buoy and tower need not always be serious.

In the case of sub-cooled media being pumped deposition of ice will take place mainly in that part of the conduit that is below the water level. In the part above the water checking and removal is easily carried out.

It is to be noted that the mooring arrangement may also be designed such that the part to which the anchor chains are fastened has no buoyancy of its own and is mounted in the rotatable part which does have buoyancy. The non-floating part may then be a frame supported in a bearing collar of the floating part.

I claim:

1. Floating mooring arrangement comprising a first annular part held in place by anchors and anchor chains, a second annular part which is rotatable relative to the first part about a vertical axis and which has means thereon for mooring a ship thereto and further comprising a tower placed on the sea bottom and extending upward through said first annular part, conduits extending from the sea bottom upward via the tower, the upper end of said conduits through a swivel and flexible conduits being connected to pipes on the second annular part, said annular parts having inner diameters such that within the range of movability allowed by the anchor chains to the first annular part, said parts cannot touch the tower, said first and second annular parts riding on the surface of the water and being vertically movable relative to the tower.

2. An arrangement as claimed in claim 1, said second annular part comprising a ring with an arm having buoyancy tangentially connected thereto.

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