Description

The invention relates to a mooring system for mooring a vessel on the surface of a body of water, comprising a mooring point and a rigid arm structure connected at one end to said mooring point and at the other end to the respective, ballasted, ends of two tension members one on each side of the vessel hull.

Such a mooring system is known from French —A—2.420.475, Fig. 7 and 8. In this known mooring system the mooring point supports by means of a horizontal pivot axis two rigid arms which are at their respective other ends via respective horizontal pivot axes connected to the vertical tension members of which the other ends are at the bow of the vessel interconnected by a further horizontal axis.

Such a mooring system allows a limited movement in the longitudinal direction of the vessel and provides a restoring force when the vessel moves towards the mooring point and away from it. However, for rolling movements of the vessel this mooring system is in fact a rigid structure so that rolling movements of the moored vessel impart very severe bending moments on the entire structure resulting in a heavy loading of the various parts and pivots and a rapid wear thereof, the more so because they are constantly subjected to the corrosive influence of the seawater.

The invention aims to provide an improved mooring system of the abovementioned kind which allows considerable rolling movements of the vessel without loading of the mooring point which can either be a mooring tower or a mooring buoy.

To this end according to the invention said tension members are independently pivotable with respect to the hull and the rigid arm structure comprises two parts to which the respective tension members are attached and the two parts can move independently of each other in a vertical direction.

This results into a mooring system which has, as far as the counteracting of movements towards and away from the mooring point is concerned, the same advantages as the prior art mooring system but of which the structure is subjected to much smaller forces and loadings than in the prior art mooring system. Rolling movements of the vessel do not result into heavy loading and the resultant wear and tear of the structure, and are smoothed out by the up and down movements of the arms of the Y-shaped structure.

It is observed that a mooring system with a rigid Y-shaped arm, connected to a floating buoy and of which the vessel ends are connected via pivotable tension members to the hull of the moored vessel is subject of EP—A—0.079.404 filed in the name of applicant and published on 25.03.83. In the mooring system described in this application rolling movements of the vessel do not result into a heavy loading of the mooring point due to the fact that the mooring system allows rotational movement along the longitudinal axis of the rigid arm.

Further advantageous embodiments of the invention are described in the subclaims.

Further and additional objects and advantages of the present invention will become apparent to those skilled in the art when considering the following detailed description and accompanying drawings, wherein like element have been given like numbers, in which is shown in

Fig. 1 a perspective view of an embodiment of the rigid arm of the invention, made in the form of a Y, in Fig. 1A a detail thereof;

Fig. 2 a schematic view of another embodiment of the rigid arm formed as a polygon and in which the SPM is formed as a tower;

Fig. 3 another embodiment of a tower used as SPM.

As may be seen from Fig. 1, the vessel 1 is moored to the floor of a body of water 2 by means of two tension members 6, 7, a rigid arm 15, a standard type of single point mooring constituted by a buoy 3, and one or more anchor chains 5. The single point mooring buoy 3 is of a type known to those skilled in the art, and consists of a buoy body 4 on which the turntable 8 is free to rotate about the vertical axis A—A of the buoy body 4. The buoy body 4 is attached to the floor of the body of water 2 by means of one or more anchor chains 5. The rigid arm 15 is attached to the single point mooring buoy 3 by means of the hinges 9. These hinges 9 allow relative movement between the buoy 3 and the rigid arm 15 about the horizontal axis B—B.

In Fig. 1 a first embodiment of the rigid arm 15 according to the invention is shown, which serves as buffer or distance holder between a single point mooring buoy 3 and a tanker 1, for example a storage tanker. The rigid arm has here the shape of a Y and has at two locations a hinge, viz. a first hinge 10 in the middle leg 19 of the Y near the buoy 3, and a second hinge 21 at the other end of the middle leg 19 where the fork begins, consisting of two side-legs 11, 12. By the positioning of these two hinges 10, 21 when seen in the drawing, the right hand side leg 11 and middle leg 19 are pivotable with respect to the left hand side leg 12. Both side-legs carry ballasts 13 and 14 at their extremities coupled to tension chains 6, 7 running upwards to the vessel 1.

The second hinge 21 consists of a disc 22 and a centring pin 23, which is located in a bore 24 in the middle leg 19 of the Y. The left hand side arm 12 on the Y is connected to the hinge 21 via an extension 26 connected to the disc 22; vide Fig. 1A.

As may be seen from Fig. 2 the vessel 34 is moored to the floor of a body of water by means of two anchor chains 37, a rigid arm 36, a rotational table 38 and a structure ("tower") 31 rigidly attached to the seabed 33.

The rotating table 38 permits the vessel to swing freely around the tower 31 to take up the position of the least resistance to wind and weather. The rigid arm pivots in relation to this rotating table around an axis x—x, through hinges 41, thereby allowing independent pitch motions of the vessel relative to the tower.

Hinges at the rigid arm end 42 and at the vessel

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connection point 43 allow for excursions of the vessel due to surge and sway. Roll motions of the vessel relative to the tower are allowed by two basically triangular frames 44 and 45, which are coupled together at their base and hence form the rigid arm 36. The hinges 47 and 48 allow the rigid arm to be "folded" in itself, around axis Y—Y and thus allow independent roll between the tower side end of the rigid arm and the vessel side.

The restoring forces required to balance environmental forces acting on the tanker is generated by a weight 49 which forms a part of the rigid arm. This weight can be permanent or mobile, depending on the application of the mooring system.

The product is carried up the tower through rigid piping 50 to the top of the tower, where a fluid swivel mounted on a second rotating table 40 allows for orientation of the piping towards the vessel. The piping continues to the vessel in a manner described in published patent application No. EP—A—0079404.

In Fig. 3 is shown another embodiment of the tower or pile system 31 of Fig. 2.

The tower 60 consists of a number of piles 61, which are slanting and which are united in the upper part or top 62 of the tower, but spread out in the lower region near the sea bottom 63. Around the upper part of the tower is mounted the rotatory part or rotor 64 of the SPM. This rotor 64 is connected to the rigid arm 66, the latter being connected with its other end via chains 67 to the vessel 68.

The product is carried up the tower through rigid piping (not shown) to the top 62 of the tower 60, where a fluid swivel 69 mounted on a second rotating table 71 allows for orientation of the piping 72 towards the vessel 68. The piping 72 continues via sections 73—80 to the vessel 68.

Claims

1. Mooring system for mooring a vessel (1) on the surface of a body of water (2), comprising a mooring point (3, 31, 60) and a rigid arm structure (15, 36, 66) connected at one end to said mooring point and at the other end to the respective, ballasted, ends of two tension members (6, 7; 37, 67) one on each side of the vessel hull, characterized in that said tension members (6, 7; 37; 67) are independently pivotable with respect to the hull and that the rigid arm structure (15, 36, 66) comprises two parts (11, 19; 12—14, 15) to which the respective tension members (6, 7; 37; 67) are attached and that the two parts can move independently of each other in a vertical direction.

2. A mooring system according to claim 1, characterized in that the rigid arm structure (15) is Y-shaped of which the middle part (19) is provided at the vessel end with an axial rotational connection (21) between said part (19) and one of the outer legs (12).

3. A mooring system according to claim 1 or 2, characterized in that the rigid arm structure (36) comprises two triangular frames (44, 45) connected by hinges (47, 48) allowing an independent movement of the two frames (44, 45) with respect to each other.

4. Mooring system according to claim 3, characterized in that the two frames (44, 45) are both hingedly connected by their respective basis to the mooring point (31).

5. Mooring system according to claim 3, characterized in that the first frame (44) is hingedly connected to the mooring point (31) and the second frame (45) is hingedly connected to the first frame (44).

6. Mooring system according to claim 1—5, characterized in that the tension members consist of chains or cables (37) suspending from the vessel.

Patentansprüche

1. Festmachsystem zum Festmachen eines Schiffes (1) eines stehenden Gewässers (2), enthaltend einen Festmachpunkt (3, 31, 60) und eine steife Armkonstruktion (15, 36, 66), die an einem Ende mit dem Festmachpunkt und am anderen Ende mit den entsprechenden belasteten Enden von zwei Spanngliedern (6, 7; 37, 67), eines zu jeder Seite des Schiffskörpers, verbunden ist, dadurch gekennzeichnet, daß die Spannglieder (6, 7; 37; 67) unabhängig gegenüber dem Schiffskörper schwenkbar sind und daß die steife Armkonstruktion (15, 36, 66) zwei Teile (11, 19; 12—14, 15) enthält, an denen die entsprechenden Spannglieder (6, 7; 37; 67) befestigt sind und daß die zwei Teile sich unabhängig voneinander in einer vertikalen Richtung bewegen können.

2. Festmachsystem nach Anspruch 1, dadurch gekennzeichnet, daß die steife Armkonstruktion (15) Y-förmig ist, von dem der mittlere Teil an dem Schiffsende mit einer axialen Drehverbindung (21) zwischen dem Teil (19) und einem der äußeren Schenkel (12) versehen ist.

3. Festmachsystem nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die steife Armkonstruktion (36) zwei dreieckige Rahmen (44, 45) aufweist, die durch Gelenke (47, 48) miteinander verbunden sind, die eine unabhängige Bewegung der zwei Rahmen (44, 45) gegeneinander erlauben.

4. Festmachsystem nach Anspruch 3, dadurch gekennzeichnet, daß die zwei Rahmen (44, 45) beide gelenkig durch ihre entsprechenden Basen mit dem Festmachpunkt (31) verbunden sind.

5. Festmachsystem nach Anspruch 3, dadurch gekennzeichnet, daß der erste Rahmen (44) gelenkig mit dem Festmachpunkt (31) verbunden ist und der zweite Rahmen (45) gelenkig mit dem ersten Rahmen (44) verbunden ist.

6. Festmachsystem nach den Ansprüchen 1 bis 5, dadurch gekennzeichnet, daß die Spannglieder aus Ketten oder Kabeln (37) bestehen, die vom Schiff herabhängen.

Revendications

1. Système d'amarrage pour amarrer un navire

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2. A mooring system according to claim 1, characterized in that the rigid arm structure (15) is Y-shaped of which the middle part (19) is provided at the vessel end with an axial rotational connection (21) between said part (19) and one of the outer legs (12).

3. A mooring system according to claim 1 or 2, characterized in that the rigid arm structure (36) comprises two triangular frames (44, 45) connected by hinges (47, 48) allowing an independent movement of the two frames (44, 45) with respect to each other.

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5. Mooring system according to claim 3, characterized in that the first frame (44) is hingedly connected to the mooring point (31) and the second frame (45) is hingedly connected to the first frame (44).

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6. Festmachsystem nach den Ansprüchen 1 bis 5, dadurch gekennzeichnet, daß die Spannglieder aus Ketten oder Kabeln (37) bestehen, die vom Schiff herabhängen.

Revendications

1. Système d'amarrage pour amarrer un navire

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(1) sur un site marin (2), comprenant une tête d'amarrage (3, 31, 60) et une structure de bras rigide (15, 36, 66) reliée, par une extrémité, à ladite tête d'amarrage et, par l'autre extrémité, aux extrémités, lestées respectives de deux éléments de tension (6, 7; 37; 67) se trouvant de chaque côté de la coque du navire, caractérisé en ce que lesdits éléments de tension (6, 7; 37; 67) peuvent pivoter indépendamment par rapport à la coque, en ce que la structure de bras rigide (15, 36, 66) comprend deux parties (11, 19; 12—14, 15) auxquelles les éléments de tension respectifs (6, 7; 37; 67) sont reliés, et en ce que les deux parties peuvent se déplacer indépendamment l'une de l'autre dans une direction verticale.

2. Système d'amarrage selon la revendication 1, caractérisé en ce que la structure de bras rigide (15) a une forme de Y dont la partie médiane (19) comporte, à son extrémité côté navire, une liaison libre de tourner axialement (21) entre elle et une des branches latérales (12).

3. Système d'amarrage selon la revendication 1 ou 2, caractérisé en ce que la structure de bras rigide (36) comprend deux cadres triangulaires (44, 45) reliés par des articulations (47, 48) permettant aux deux cadres (44, 45) de bouger indépendamment l'un de l'autre.

4. Système d'amarrage selon la revendication 3, caractérisé en ce que les deux cadres (44, 45) sont tous les deux articulés par leurs bases respectives sur la tête d'amarrage (31).

5. Système d'amarrage selon la revendication 3, caractérisé en ce que le premier cadre (44) est articulé sur la tête d'amarrage (31) et en ce que le second cadre (45) est articulée sur le premier cadre (44).

6. Système d'amarrage selon l'une des revendications 1 à 5, caractérisé en ce que les éléments de tension sont des chaînes ou des câbles (37) pendant du navire.

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