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Description

The invention relates to articulated fluid product transfer arms (for example for the loading or unloading of a ship), of the general type comprising a base, an inner tube and an outer tube hingedly connected to one another, and a system of counterweights, the inner tube pivoting on the base and the outer tube carrying an arrangement comprising elbows and an emergency disconnection device, a part of this arrangement remaining attached to the ship on emergency disconnection.

A problem encountered in this field consists of the difficulty of connecting marine loading arms to the ship when they are out of balance during normal operation, and of the danger occurring when the hydraulic system serving to operate them breaks down. Another problem is that of marine loading arms which, when they are overbalanced on the articulated arrangement or underbalanced (the filled or empty arm having undergone emergency disconnection), may tend to move closer to the ship, with a risk of impact, particularly in cases where the disconnection is effected with the inner tube situated to the rear of the vertical axis of the base of the arm. Another problem is that of the curve described by the end of that part of the arrangement comprising elbows and an emergency disconnection device which remains attached to the outer tube when the inner tube rises, particularly in cases where the angle between the outer tube and the

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inner tube remains constant or varies very slowly.

Several families of petroleum product loading arms comprising a counterweight system having two counterweights are known,

A family of arms is in particular known which is illustrated by the document DE-A-2,526,330, which corresponds to the preamble of the claim and which describes a deformable parallelogram comprising an inner tube and a rear extension of this inner tube. The parallelogram supports two counterweights, one on the rear extension and the other near the articulation of a shorter side and a longer side of the deformable parallelogram. The other shorter side of the parallelogram is fastened to and rearwardly extends the outer tube of the loading arm. The deformation of the parallelogram can be locked with the aid of a jack bearing against and articulated on the base.

For a given fixed position of the inner tube any oscillatory movement of the outer tube results in a corresponding oscillation in the opposite direction of the parallelogram counterweight.

An oscillatory movement of the outer tube results in a deformation of the parallelogram, making it possible for the outer arm to retain a position parallel to itself and at a constant angle, the parallelogram counterweight in this case likewise retaining a position parallel to itself and to that of the outer tube.

There is therefore interdependence between

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the inner tube and the shorter side of the parallelogram carrying the counterweight (9a).

The outer tube is not provided with an actuating jack.

The present invention overcomes the problems described above and relates to a mechanical arrangement having two counterweights, which is different from the foregoing families and which in particular permits emergency disconnection release of an articulated arm, characterised in that it comprises a conventional counterweight and an additional counterweight disposed for free pivoting rearwardly of the inner tube and carried by a subsidiary beam fixed on a pulley movable about a shaft carried by a rear beam extending the inner tube, this movable pulley being connected by a cable to a pulley mounted loose on the base but adapted to be locked to the base, the articulated assembly consisting of the additional counterweight and its beam being so designed and its position so selected as to achieve equilibrium of the arm in normal operation and overbalance or underbalance of the arm on emergency disconnection, depending on the position of the inner tube.

The invention provides in particular the following advantages:

- the inner tube moves backwards on disconnection either in the filled or in the empty state, whatever the position of the arm;
- the arrangement is mechanical;

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- it requires no detection of the absence or presence of products in the arm.

Other characteristics and advantages of the present invention will emerge from the following description, which is given with reference to the accompanying drawings, in which:

Figure 1 is a view in side elevation of a possible form of construction of a fluid product transfer arm equipped in accordance with the invention;

Figure 2 is a partial rear end view thereof;

Figure 3 is a diagram explaining the process according to the invention;

Figures 4 and 5 are diagrams showing the operation of said arm in normal service, in two possible cases;

Figures 6 and 7 are diagrams showing the operation of said arm on emergency disconnection, in the two cases illustrated in Figures 4 and 5;

Figure 8 is a diagram illustrating the operation of the arm on emergency disconnection with the inner tube situated to the rear of the vertical line of the base, and

Figures 9 and 10 are diagrams showing different locations of the device controlling the outer tube of the arm.

In the embodiment illustrated in Figures 1 to 3 in particular, the invention is applied to an articulated arm for the transfer of fluid products, par-

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ticularly petroleum products, between a quayside installation (Q) and a ship (N) for example. In this embodiment, which is selected solely as an example to illustrate the application of the invention, the articulated arm comprises a base (1) and an inner tube (6) which is mounted for pivoting on this base with the aid of two elbows (2) and (3) and of two bearings (4) and (5) and on one end of which is articulated an outer tube (7). In this arrangement a first pivoting is effected about a vertical axis Z-Z of the base and a second pivoting is effected about a horizontal axis X-X. On a beam (8) rearwardly extending the inner tube (6) is disposed the wheel (9) of the counterweight system (10), this wheel being connected by a cable (11) to the other wheel (12) of the system. The outer tube (7) carries at its end an assembly (13) comprising elbows (14) and an emergency disconnection device (15) for connection to the ship. It should be observed that a part of this assembly remains on the ship on emergency disconnection.

According to the invention, in order to overcome the problems explained above at least one additional counterweight (16) is provided on the rearward extension of the inner tube (6), that is to say the beam (8). More precisely, the additional counterweight (16) is mounted on a subsidiary beam (17) fixed on a pulley (18) movable about a shaft (19) carried by the beam (8). This movable pulley (18) is connected by a cable (20) to a pulley (21) mounted loose

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on the base but adapted to be locked to the base with the aid of a jack (22) mounted for oscillation on a fork (23) which is fastened to the base and the operating rod of which is articulated at (24) on the pulley (21). A jack (25) which is fixed to the beam (8) and the piston of which is connected to the cable (20) constitutes the actuating device of the inner tube (6). Another jack (26), wherever located, permits control of the outer tube (7). Various locations of this outer tube control device will be described further on.

The operation of an articulated fluid transfer arm equipped in accordance with the invention is as follows:

In normal operation the outer tube is balanced "empty" by its own counterweights provided for this purpose.

The loose pulley (21) is locked hydraulically to the base with the aid of the jack (22). Consequently, the moment $P \times l$ produced by the system of additional counterweights and its subsidiary beam (17) is transmitted to the base, passing in succession through the cable (20), the pulley (21) and the jack (22) in the form of forces and lever arm. Only the weight P is to be considered at the centre of the pulley (18) on the rear beam (8) of the inner tube for the balancing of the articulated arm.

During the operation of the inner tube, whatever its position, the additional counterweight does

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not change its inclination relative to the fixed axes of the base.

The jack (25) makes it possible to operate the inner tube (6) by transmitting the pressure into one or the other chamber of the jack in order to control downward or upward movement.

The jack (26) permits operation of the outer tube (7).

With the arm connected to the ship, users have two options:

Case I. Leave the jack (22) locked hydraulically and free the inner tube control jack (25) and the outer tube control jack (26) (Figure 4).

Case II. Unlock the jack (22) to leave the pulley (21) loose, and lock the jack (25), which transmits the moment ($P \times l$) to the inner tube but leaves it free for any movement. Free the jack (26) controlling the outer tube. The connected arm is thus again underbalanced or overbalanced, depending on the position of the inner tube at the time of the connection (Figure 5).

In case I the additional counterweight retains the same inclination relative to the fixed axes of the base, whatever the movements of the arm brought about by the displacement of the ship, whereas in case II the additional counterweight retains a constant angle to the inner tube. In other words, in case I the angle (α) of the additional counterweight to the horizontal remains constant (Figure 4), whereas in

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case II the angle (α) of the additional counterweight to the horizontal is variable and the angle (β) formed by the additional counterweight with the beam of the inner tube is constant (Figure 5).

In both Figures 4 and 5 the references A and B represent the possible vertical and horizontal displacements of the ship N during the time when the arm situated on the quay Q is connected.

On emergency disconnection of the arm, depending on the two possible cases explained above:

Case I. On commencement of the emergency disconnection sequence it is possible to lock the jack (25) and free the jack (22) in order to make the pulley (21) loose, so that the moment ($P \times l$) will be transmitted to the inner tube by the jack (25). It is possible to lock the jack (26) or to leave it free, depending on the solution adopted for its location, so that the inclination of the outer tube (7), defined by the angle (β) relative to the horizontal can remain constant relative to the base (Figure 6). Thus, the inner tube (6) turns to the rear (arrow F1, angle (δ) about the horizontal axis XX) until the piston of the jack (22) reaches its mechanical stop (the stroke (C1) of the jack (22) governs the angle of upward movement (δ) of the inner tube).

Case II. On emergency disconnection, with the arm already overbalanced or underbalanced, the inner tube (6) moves backwards (arrow F1, Figure 7). All that is then required is to lock the jack (26),

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if necessary, in order to retain a constant inclination of the outer tube (angle β relative to the horizontal).

The difference between the two options concerns the angular distance travelled by the inner tube after the disconnection. This travel is constant in case I, but variable in case II, depending on the distance already travelled between the moment of connection (N1) and the moment of disconnection (N2) because of the displacement of the ship (N). At the moment of connection (N1) the outer tube forms any angle with the horizon.

In Figure 7 (case II) the reference (C2) represents the travel necessary for permitting free displacement of the ship during disconnection and for raising the inner tube sufficiently after the disconnection.

In both Figures 6 and 7 the reference (E1) represents the curve travelled over by the point (O) if the position of the outer tube remained fixed in relation to the position of the inner tube. The reference (E2) represents the curve obtained in accordance with the invention and in particular making it possible to avoid collisions with the ship.

It should be observed that on emergency disconnection, even if the inner tube is situated to the rear of the vertical line Z-Z at that moment, it will continue to move back (arrow F2, Figure 8).

In Figure 3 the location of the device or

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jack (26) controlling the outer tube (7) lies between said outer tube and a loose pulley (27) disposed at the articulation of the inner tube to the outer tube and connected by a cable (28) to a pulley (29) fixed to the base. The body of the jack (26) is mounted for oscillation on the outer arm (7), while the end of its rod is articulated at (30) to the loose pulley (27).

Other locations of the jack (26) are shown in Figures 9 and 10 of the drawings, without these choices of location being limitative.

In Figure 9 two jacks (26) controlling the inner tube (7) are disposed on each of the sides of a cable (31) connecting a pulley fixed to the outer tube (7) and a pulley (33) fixed to the base.

In Figure 10 the body of the jack (26) controlling the outer tube (7) is mounted for oscillation on the base (1), while the end of its rod is articulated to a pulley (35) mounted loose on the base. The pulley (35) is connected by a cable (36) to a pulley (37) fixed to the outer tube.

**Revendications** (as printed)

1. Agencement mécanique à deux contrepoids permettant notamment le dégagement en déconnexion d'urgence, qu'il soit plein ou vide et quelle que soit sa position, d'un bras articulé de transfert de produits fluides du type général comportant une embase, un tube interne à prolongement arrière de ce tube et un tube externe articulés entre eux, et un système de contrepoids, à deux contrepoids, le tube interne pivotant sur l'embase et le tube externe portant un ensemble à coudes et dispositif de déconnexion d'urgence, caractérisé en ce qu'il comprend un contrepoids classique et un contrepoids additionnel (16) placé à pivotement libre à l'arrière du tube interne, étant porté par une poutre annexe (17) fixée sur une poulie (18) mobile autour d'un axe (19) porté par une poutre arrière (8) prolongeant le tube interne, ladite poulie mobile étant reliée par un câble (20) à une poulie (21) montée folle sur l'embase mais susceptible d'être verrouillée à l'embase, l'ensemble articulé constitué par le contrepoids additionnel et sa poutre étant calculé et sa position choisie pour obtenir l'équilibre du bras en manœuvre normale et son sur-équilibre ou sous-équilibre au moment de la déconnexion d'urgence en fonction de la position du tube interne.

2. Agencement selon la revendication 1, caractérisé en ce que le verrouillage de la poulie folle (21) est obtenu à l'aide d'un vérin (22) monté oscillant sur l'embase et dont la tige de commande est articulée sur la poulie folle.

3. Agencement selon l'une quelconque des revendications 1 et 2, caractérisé en ce qu'un vérin (25) fixé à la poutre (8) de prolongement arrière et dont le piston est relié au câble (20) constitue le dispositif de commande du tube interne.

4. Agencement selon l'une quelconque des revendications 1 à 3, caractérisé en ce qu'un autre vérin (26), quel que soit son emplacement, permet la commande du tube externe (7).

5. Agencement selon l'une quelconque des revendications 1 à 4, caractérisé en ce que l'emplacement du dispositif ou vérin (26) de commande du tube externe (7) est prévu entre ledit tube externe et une poulie folle (27) disposée à l'articulation du tube interne avec le tube externe, et reliée par un câble (28) à une poulie (29) fixée à l'embase.

6. Agencement selon l'une quelconque des revendications 1 à 4, caractérisé en ce que le dispositif ou vérin (26) de commande du tube externe (7) est disposé sur un câble (31) reliant une poulie (32) fixée au tube externe (7) et une poulie (33) fixée à l'embase.

7. Agencement selon l'une quelconque des revendications 1 à 4, caractérisé en ce que le dispositif de commande ou vérin (26) du tube externe (7) est monté oscillant sur l'embase (1) alors que sa tige est articulée à une poulie (35) montée folle sur l'embase, un câble (36) reliant la poulie (35) à une poulie (37) fixée au tube externe.

**Claims** (as printed)

1. A mechanical arrangement with two counterweights to permit, in particular, emergency disconnection release of an articulated fluid product transfer arm, whether it be filled or empty and whatever be its position, of the general type comprising a base, an inner tube with rearward extension thereof, and an outer tube hingedly connected to one another, and a counterweight system with two counterweights, with the inner tube being pivotable to the base and the outer tube carrying an elbow means and emergency disconnection device assembly, characterized in that it comprises a conventional counterweight and an additional counter weight (16), disposed so as to be freely pivotable rearwardly of the inner tube, being carried by subsidiary beam (17) secured to a pulley (18) movable about an axis (19) carried by a rearward beam (8) extending the inner tube, said movable pulley being connected through a cable (20) to a pulley (21) mounted idle to the base, but lockable to the base, the articulated assembly consisting of the additional counterweight and the beam thereof being designed and its position selected to obtain balance of the arm in normal operation and overbalance or underbalance thereof upon emergency disconnection, depending on the position of the inner tube.

2. An arrangement according to claim 1, characterized in that the locking of the idle pulley (21) is obtained by means of a jack (22) pivotably mounted to the base and having a control rod hingedly connected to the idle pulley.

3. An arrangement according to any one of claims 1 and 2, characterized in that a jack (25) secured to the rearward extension beam (8) and having a piston connected to the cable (20) constitutes the control device for the inner tube.

4. An arrangement according to any one of claims 1 to 3, characterized in that another jack (26), whatever be its location, permits control of the outer tube (7).

5. An arrangement according to any one of claims 1 to 4, characterized in that the location of the device or jack (26) for controlling the outer tube (7) is provided between said outer tube and an idle pulley (27) disposed at the joint of the inner tube with the outer tube, and connected through a cable (28) to a pulley (29) fixed to the base.

6. An arrangement according to any one of claims 1 to 4, characterized in that the device or jack (26) for controlling the outer tube (7) is disposed on a cable (31) connecting a pulley (32) secured to the outer tube (7) and a pulley (33) secured to the base.

7. An arrangement according to any one of claims 1 to 4, characterized in that the control device or jack (26) for the outer tube (7) is oscillatingly mounted to the base (1), whereas the rod thereof is hingedly connected to a pulley (35) mounted idle to the base, a cable (36) connecting the pulley (35) to a pulley (37) secured to the outer tube.



Ansprüche (as printed)

1. Mechanische Vorrichtung mit zwei Gegengewichten, die insbesondere das Entkoppeln bei einer Nottrennung im gefüllten oder leeren Zustand und unabhängig von der Lage eines gelenkigen Armes zur Übertragung von fluiden Erzeugnissen erlaubt, der allgemeinen Art, die aus einem Grundteil, einem inneren Rohr mit einer hinteren Verlängerung des Rohres, und einem äußeren Rohr, welche miteinander gelenkig verbunden sind, und einem Gegengewichtssystem mit zwei Gegengewichten besteht, wobei das innere Rohr um das Grundteil schwenkbar ist und das äußere Rohr eine Anordnung von Krümmern und die Nottrenneinrichtung trägt, dadurch gekennzeichnet, daß sie umfaßt ein klassisches Gegengewicht und ein zusätzliches Gegengewicht (16), welches frei schwenkbar hinter dem inneren Rohr angeordnet ist und gehalten von einem Zusatzträger (17), der an einer um eine von einem hinteren Träger (8) in Verlängerung des inneren Rohres getragenen Achse (19) bewegbaren Seilscheibe (18) befestigt ist, wobei die besagte bewegbare Seilscheibe über ein Seil (20) mit einer Seilscheibe (21) verbunden ist, die mitlaufend an dem Grundteil angebracht, jedoch mit dem Grundteil verriegelbar ist, wobei die durch das zusätzliche Gegengewicht und seinen Träger gebildete Anordnung berechnet und ihre Stellung gewählt ist zum Erreichen des Gleichgewichtes des Armes bei normaler Betätigung und seines Über- oder Untergleichgewichtes im Moment der Nottrennung in Abhängigkeit von der Lage des inneren Rohres.

2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Verriegelung der Mitlauf-Seilscheibe (21) mit Hilfe einer schwenkbar an dem Grundteil angebrachten Zylinder-Kolben-Anordnung (22) erreicht ist, und daß dessen Betätigungsstange an der Mitlauf-Seilscheibe angelenkt ist.

3. Vorrichtung nach einem der Ansprüche 1 und 2, dadurch gekennzeichnet, daß eine an dem hinteren Verlängerungsträger (8) befestigte Zylinder-Kolben-Anordnung (25), deren Kolben mit dem Seil (20) verbunden ist, die Steuereinrichtung für das innere Rohr bildet.

4. Vorrichtung nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß eine andere Zylinder-Kolben-Anordnung (26), unabhängig von ihrer Lage, die Steuerung des äußeren Rohres (7) erlaubt.

5. Vorrichtung nach einem der Ansprüche 1 bis 4, dadurch gekennzeichnet, daß die Vorrichtung oder die Zylinder-Kolben-Anordnung (26) zur Steuerung des äußeren Rohres (7) zwischen dem äußeren Rohr und einer an der Gelenkverbindung des inneren Rohres mit dem äußeren Rohr angebrachten Mitlauf-Seilscheibe (27) vorgesehen ist und über ein Seil (28) mit einer an dem Grundteil befestigten Seilscheibe (29) verbunden ist.

6. Vorrichtung nach einem der Ansprüche 1 bis 4, dadurch gekennzeichnet, daß die Vorrichtung oder die Zylinder-Kolben-Anordnung (26) zur Steuerung des äußeren Rohres (7) an einem Seil (31) vorgesehen ist, das eine an dem äußeren Rohr (7) befestigte Seilscheibe (32) mit einer an dem Grundteil befestigten Seilscheibe (33) verbindet.

7. Vorrichtung nach einem der Ansprüche 1 bis 4, dadurch gekennzeichnet, daß die Steuervorrichtung oder die Zylinder-Kolben-Anordnung (26) für das äußere Rohr (7) an dem Grundteil (1) schwenkend befestigt ist, während ihre Kolbenstange an einer an dem Grundteil mitlaufend angebrachten Seilscheibe (35) angelenkt ist, wobei ein Seil (36) die Seilscheibe (35) mit einer am äußeren Rohr befestigten Seilscheibe (37) verbindet.