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The present invention relates to an articulated device for transferring fluids from a first location to a second location, for example from an offshore petroleum installation to a tanker or other ship.

Fluid transfer devices of the accordion or deformable rhombus type are known.

In one of these devices, which is described in the Patent Application FR-A-2,367,700, a single broken line (11) is used for transferring a liquid and is composed of articulated hollow elements, while the other broken line (12) is composed of articulated connecting elements of any kind. The whole arrangement is articulated respectively to a carrier arm (8) and to a connector (c). The articulation (10) to the carrier arm may be a cardan joint, while the connector (c) is a funnel or bell type device adapted to fit onto a hollow nozzle head disposed on a ship. The articulated arrangement is operated with the aid of a cable (32). The arrangement is completed by a hawser (26) which is fastened to the connector (c).

It is desirable for it to be possible to use both broken line routes for the transfer of a fluid or of two different fluids, and a transfer device is known, which is described in the Patent Application FR-A-2,373.009 and is also of the accordion or deformable rhombus type, and in which two broken line routes (10) and (14) are used for the fluid transfer. The whole arrangement is articulated to two coaxial

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terminals (T5) and (T6). Coaxial composite rotary joints (132) make the connection to these terminals with the aid of bolts (136), so that the connection is difficult to release and constitutes a disadvantage when the terminal at the first location and/or the terminal at the second location of the articulated device are movable because of the actual or relative mobility of these locations.

The present invention overcomes this major inconvenience in an advantageous manner, and relates to a fluid transfer device comprising in particular an arm composed of multiple articulated fluid conduit segments of the accordion or deformable rhombus type, this arm being provided with an upper universal connection means connecting it to a carrier means, a lower disconnectable connection means, and an actuating means such as a cable, this device permitting transfer of fluids from the carrier means, such as a boom comprising at least two fluid pipes and situated at one location, to a coupling means situated at a second location and connected to the articulated arm by the lower connection means, characterised in that the coupling means situated at the second location comprises two lines or legs each comprising a coupling means, three rotary joints and in addition two other rotational means having different horizontal axes, and in that a bend connects the coupler to the rotational means of each leg and is mounted pivotably on the same centre axis at the end of a bracket carried by a

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sleeve sliding on a central mast, the combination of the five rotations permitting a vertical movement of the couplers and a final connection of the end of the arm at the second location.

Other characteristics and advantages of the invention will emerge more clearly from the following description relating to one particular embodiment of the invention, which is illustrated in the accompanying drawings, in which:

Figure 1 is a front view of part of the transfer device according to the invention, showing the connection means of the arm which connect the latter on the one hand to the boom and on the other hand to the tanker;

Figure 2 is a side view of the device shown in Figure 1, wherein the connection means situated on the tanker are not shown;

Figure 3 is a diagrammatical view, in section on the line III-III in Figure 2, of the lower connection means of the arm articulated to the coupling means of the tanker;

Figure 4 is a view in elevation of the coupling and transfer means situated at the second location or tanker.

An articulated arm 1 according to the invention comprises two upper pipes 11, 12, the top end of which is pivotally connected to the end of a boom 2 (outlined only in broken lines in Figures 1 and 2) or more accurately to respective pipes 21, 22 carried by

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the boom, with the aid of connection means 3; two lower pipes 13, 14 whose bottom end is connected to a tanker 4, of which only a top wall is shown in broken lines in Figure 1, with the aid of a connection means 5 of the articulated arm and of the coupling means 6, forming part of the deformable transfer device, and two intermediate pipes 15, 16 inserted respectively between the bottom end of each upper pipe and the top end of the corresponding lower pipe. Each of the two assemblies consisting of an upper pipe 11, 12, an intermediate pipe 15, 16, and a lower pipe 13, 14 and connecting a pipe 21, 22 on the boom to the boat - one assembly being for the transfer of liquefied natural gas and the other for vapour return - is constructed in the form of an articulated broken line disposed facing the other assembly, as shown in Figure 1; these two assemblies are not in the same plane, but in planes lying parallel, and are so disposed as to constitute, in front view, two articulated rhombuses, in which two respective corners lie opposite one another at the apex, which is in the middle of the intermediate pipes 15, 16 which are fastened together at that point by an articulation, for example a ball joint; in this way the two rhombuses formed, disposed one above the other, remain equal to one another in all positions of the articulated arm 1. The tower or the vertical carrier device which is mounted by its base on a platform forming part of the offshore installation is not shown in the drawings, and it has been seen that

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the same applies to the greater part of the boom, particularly its end fixed pivotally to the apex of the carrier device; a cable type support and operating device is also supplied, which cooperates with a tensioning device whose characteristics will be described further on; a stowing device serves to stow the arformable articulated transfer arm 1 on the boom 2.

Each intermediate pipe is connected by its respective ends on the one hand to an upper pipe and on the other hand to a lower pipe, with the aid of articulations 18, which may be of the single knee type, each being provided with a rotary joint and at least one fastening means comprising fixed flanges whose respective axes are perpendicular or orthogonal, or, as shown in the drawings, of the "double knee" type, each provided with a pair of rotary joints 181, whose respective axes form extensions of one another and with fastening means comprising fixed flanges 182, whose respective axes likewise form extensions of one another and are parallel to those first-mentioned; whereas with single knee type articulations it is easier to form each of the two assemblies composed of an upper pipe, an intermediate pipe, and a lower pipe, in the form of a broken line whose three segments are in two (or three) parallel planes, with double knee type articulations it is easy to form a broken line whose three segments are in the same plane.

The means 3 connecting the articulated arm 1 to the pipes 21, 22 of the boom comprise, on each

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line, a single knee 31 permitting the extensions and retractions of the arm, with a pair of cryogenic rotary joints 311, 312 whose axes are at right angles in such a manner as to form a coupling of the cardan type.

The means 5 connecting the deformable transfer device to the ship may be of the axial rotary joint type; however, this is not indispensable and it comprises here two independent lines, each provided with a knee 51 to permit the extensions and retractions of the arm, with rotary joints 511, 512 whose axes are at right angles so as to form similarly a coupling of the cardan type, a safety valve 513, a hemispherical plug valve 514, and locking means 515; the connection means 5 also comprises a central locking head 516, which is here connected to the two lines by flanges; the safety valves 513 and the locking head 516 are provided on the one hand with closure means and on the other hand with quick disconnection means 517, shown symbolically, so that in the case of emergency disconnection the lower part of these valves and of the locking head remains on the ship, the flow being in addition blocked by its own weight or, if necessary, by spring devices provided respectively on the two parts of these valves and of the locking head which are to be disconnected, in such a manner that the closure means are then automatically pushed into their closure position.

The support and operating device comprises

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two cables 71 remaining permanently on the structure; these two cables, which are connected to the tensioning device 72 after passing over pulleys 72A disposed on the boom 2 above the arm, are attached to the bottom part of the deformable transfer device.

The tensioning device is so designed that on the one hand the arm has a position of equilibrium just above the zone of maximum movements occurring during loading, and that on the other hand it will rise to its position of equilibrium without oscillation when it is disconnected at the end of the loading, and also that in all cases of normal or emergency disconnection its upward acceleration will be greater than the acceleration of the ship; the folded position of the articulated arm is shown in long dash lines in Figure 1.

The stowing device is so designed that, from its position of equilibrium, the articulated arm will be stowed on the boom by means of grippers which raise it and support it in the stowed position.

The articulated transfer device according to the invention, which can be equipped with means for cryogenic type operation, particularly with cryogenic rotary joints, permits rapid connection and disconnection to and from the tanker under good conditions of equilibrium and safety as the result of its double rhombus pantograph arrangement operated by cables connected to a tensioning device designed to comply with extremely severe requirements, a certain number of

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members situated on the bottom part of the device being adapted to remain fastened to the tanker in the event of emergency disconnection.

The coupling means (6) on the ship, connected to the articulated arm (1) with the aid of the lower connection means (5), is formed by means of two transfer lines or doglegs (62, 63); these two doglegs (62, 63), each comprising three rotations, such as the rotary joints (621, 622, 623) of the leg (62), each form a transfer line articulated about a central mast (M), couplers (C) at the ends of the doglegs being coupled to the ends of the lower connection means (5) of the articulated arm (1). Each transfer line or dogleg giving three rotations of these coupling and transfer means comprises in addition two other rotations on a horizontal axis, the combination of the five rotations permitting a vertical movement of the couplers and a final connection at the ends of the arm. Each dogleg (62 or 63) therefore shows two other means of rotation (A and B) in addition to the three rotations (621 - 622 - 623) for the leg (62) and (631 - 632 - 633) for the leg (63).

The rotating means (A) is disposed between the coupler (C) and the rotation (621) or (631) and the rotation (621) or (631), depending on whether the leg (62) or the leg (63) is concerned.

The rotating means (B) is disposed between the rotations (622 and 623) for the leg (62) and between the rotations (632 and 633) for the leg (63).

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The bend (8) connecting the coupler (C) to the rotation (A) is mounted pivotally at the end of a bracket (82) carried by a sleeve (821) in the case of the leg (62) and at the end of a bracket (83) carried by another sleeve (831) in the case of the leg (63).

The sleeves (821) and (831) are disposed one above the other and are adapted to slide on the mast (M).

Pivoting is effected on a general axis (X - X) passing through the centre of the rotations or rotary joints (A) and with the aid of jacks (V1) which advantageously bear on the rotations (621) and (631).

Other jacks (V2) are provided for effecting a vertical translation of the sleeves (821) and (831) along the mast (M).

Another jack (V3) is provided for effecting a rotation about itself of the mast (M) about the axis (Z - Z).

The rotation (A) having a horizontal axis (X - X) provides the means of rocking the coupler during the connection phase, thus making it possible to avoid possible shocks.

The rotation (B), which likewise has a horizontal axis (Y - Y), in conjunction with the rotation (A) and the three rotations forming the dogleg, brings about a vertical movement of the coupler. This permits more reasonable manufacturing tolerances, since the arrangement has no hyperstatic redundancy. In addition, the doglegs are not subject to mechanical

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loads due to differential contraction between the doglegs and the locking mast (M), the latter remaining at ambient temperature when the doglegs are cooled.

The combination of the five rotations of each dogleg permits the following operation:

- the arm is positioned and locked relative to the ship by means of the beam (T) and mast (M). The couplers (C) are in the lower position;
- the doglegs are pivoted with the aid of the jack (V3) about the axis (Z - Z) of the beam, so as to bring the couplers (C) opposite the ends (E) of the arm;
- the couplers (C) are brought into the upper position by the rotation (A) with the aid of the jacks (V1);
- the couplers (C) are brought into the final connection position by vertical translation, effected with the aid of the jacks (V2) and made possible by the combination of the five rotations of each dogleg.

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Revendications (as printed)

1. Dispositif de transfert de fluides comprenant notamment un bras (1) composé de segments multiples articulés de conduite de fluide, du type accordéon ou à losanges déformables, ce bras étant muni d'un moyen de connexion supérieur universel (3) le reliant à un moyen porteur (4), d'un moyen de connexion inférieur (5) dissociable et d'un moyen d'actionnement tel un câble (71), lequel dispositif permet un transfert de fluides du moyen porteur, tel une flèche (2) comportant au moins deux conduites (21, 22) de fluide situé à un emplacement, à un moyen de couplage (6) situé à un second emplacement (4), et relié au bras articulé (1) par le moyen de connexion inférieur (5), caractérisé en ce que le moyen de couplage (6) situé au second emplacement (4) comprend deux lignes ou jambes (62) et (63) comportant chacune un moyen coupleur (C), trois joints tournants (621) (622) (623) et en plus, deux autres moyens de rotations (A et B) à axes horizontaux différents (XX et YY) et en ce qu'un coude (8) relie le coupleur (C) au moyen de rotation (A) de chaque jambe et est monté à pivot sur le même axe central (XX) à l'extrémité d'une console (82, 83) portée par un manchon coulissant (821, 831) sur un mât central (M), la combinaison des cinq rotations permettant un mouvement vertical des coupleurs et une connexion finale de l'extrémité de bras (1) au second emplacement.

2. Dispositif de transfert selon la revendication 1, caractérisé en ce que les manchons (821, 831) sont disposés l'un au-dessus de l'autre.

3. Dispositif de transfert selon l'une quelconque des revendications 1 et 2, caractérisé en ce que des vérins (V') produisent le pivotement des coudes (8) par l'intermédiaire des moyens de rotation (A).

4. Dispositif de transfert selon la revendication 3, caractérisé en ce que chacun desdits vérins (V1) prend appui sur le joint tournant (621, 631) qui suit immédiatement le moyen de rotation (A) de chaque jambe (62, 63).

5. Dispositif de transfert selon l'une quelconque des revendications 1 à 3, caractérisé en ce que des vérins (V2) sont

prévus pour obtenir une translation verticale des manchons (821, 831) le long du mât (M).

6. Dispositif de transfert selon l'une quelconque des revendications 1 à 5, caractérisé en ce que le bras articulé (1) comprend un dispositif de tensionnement (72) lui permettant de posséder une position d'équilibre juste au-dessus de la zone des mouvements maxima rencontrés pendant le chargement, et en ce qu'il remonte à sa position d'équilibre sans oscillation lorsqu'il est déconnecté en fin de chargement.

7. Dispositif de transfert selon l'une quelconque des revendications 1 à 6, caractérisé en ce que le moyen de connexion (5) dudit bras articulé 1 avec ledit moyen de couplage 6 situé au second emplacement comporte des joints tournants (511—512) ayant leurs axes perpendiculaires de façon à réaliser un accouplement du genre cardan et des organes de verrouillage (515) sur les coupleurs (C).



Patentansprüche (as printed)

1. Vorrichtung zum Übertragen von Fluiden mit insbesondere einem aus mehrfach gelenkigen Segmenten von Fluidleitungen zusammengesetzten Arm (1) von Ziehharmonika-Typ oder mit verformbaren Rhomben, wobei der Arm mit einem oberen Universal-Verbindungsmittel (3) versehen ist, das sich mit einem Trägermittel (4) verbunden ist, mit einem unteren lösbaren Verbindungsmittel (5) und einem Betätigungsmittel wie einem Seil (71), wobei die Vorrichtung eine Übertragung von Fluiden durch das Trägermittel erlaubt, z. Bsp. einen mindestens zwei Fluidleitungen (21, 22) tragenden Flansch (2), an einer Stelle liegend, mit einem Kupplungsmittel (6), an einer zweiten Stelle (4) liegend und durch das untere Verbindungsmittel (5) mit dem gelenkigen Arm (1) verbunden, dadurch gekennzeichnet, daß das an der zweiten Stelle (4) gelegene Kupplungsmittel (6) zwei Leitungen oder Schenkel (62 u. 63) mit jeweils einem Kuppel-mittel (C) enthält, drei Drehgelenke (621, 622, 623) und darüberhinaus zwei andere Drehmittel (A, u. B) mit unterschiedlichen Horizontalachsen (XX u. YY) und daß ein Kniestück (8) das Kuppel-mittel (C) mit dem Drehmittel (A) bei jedem Schenkel verbindet und an einem Drehzapfen an der gleichen Mittelachse (XX) am Ende einer Konsole (82, 83) befestigt ist, welche an einer Gleithülse (821, 831) an einem zentralen Mast (M) gehalten ist, wobei die Kombination der fünf Drehungen eine Vertikalbewegung der Kuppler und eine endgültige Verbindung des Endes des Armes (1) an der zweiten Stelle gestattet.

2. Vorrichtung zum Übertragen nach Anspruch 1, dadurch gekennzeichnet, daß die Hülsen (821, 831) untereinander angeordnet sind.

3. Vorrichtung zum Übertragen nach einem

der Ansprüche 1 oder 2, dadurch gekennzeichnet, daß Zylinder (V1) das Schwenken der Kniestücke (8) durch Vermittlung der Drehmittel (A) erzeugen.

4. Vorrichtung zum Übertragen nach Anspruch 3, dadurch gekennzeichnet, daß jeder Zylinder (V1) sich an dem Drehgelenk (621, 631) abstützt, das sich zunächst dem Drehmittel (A) jedes Schenkels (62, 63) befindet.

5. Vorrichtung zum Übertragen nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß Zylinder (V2) vorgesehen sind, um eine Vertikalverschiebung der Hülsen (821, 831) längs des Mastes (M) zu erreichen.

6. Vorrichtung zum Übertragen nach einem der Ansprüche 1 bis 5, dadurch gekennzeichnet, daß der gelenkig aufgebaute Arm (1) eine Spannvorrichtung (72) enthält, die ihm eine Gleichgewichtsstellung einzunehmen gestattet gerade unterhalb des maximalen Bewegungsbereichs, der beim Laden auftritt, und daß er seine Gleichgewichtsstellung ohne Überschwingen wieder einnimmt, sobald er beim Ende der Beladung abgetrennt ist.

7. Vorrichtung zum Übertragen nach einem der Ansprüche 1 bis 6, dadurch gekennzeichnet, daß das Verbindungsmittel (5) des gelenkig ausgebildeten Armes (1) mit dem an der zweiten Stelle gelegenen Kupplungsmittel (6) Drehverbindungen (511—512) enthält, deren Achsen senkrecht aufeinanderstehen nach Art einer Ausführung einer kardanischen Aufhängung und daß Verriegelungsorgane (515) an den Kupplern (C) vorgesehen sind.



Claims (as printed)

1. A fluid transfer device comprising in particular an arm (1) composed of multiple, articulated, fluid conduit segments of the accordion or deformable lozenge type, such arm being provided with a universal, upper, connection means (3) connecting the arm to a carrier means (4) of a lower dissociable connection means (5) and of an actuating means such as a cable (71), such device permitting transfer of fluids from the carrier means, such as a boom (2), comprising at least two fluid conduits (21, 22), disposed at one location, to a coupling means (6) disposed at a second location (4) and connected to the articulated arm (1) through the lower connecting means (5), characterized in that the coupling means (6) disposed at the second location (4) comprises two lines or legs (62 and 63), each comprising a coupling means (C), three rotary joints (621, 622, 633) and moreover, two other rotating means (A and B) with different horizontal axes (XX and YY), and in that a bent section (8) connects the coupling means (C) to the rotating means (A) of each leg and is pivotably mounted on the same central axis (XX) at the end of a console (82, 83) carried by a slidable sleeve (821, 831) on a central mast (M), the combination of the five rotations permitting vertical motion of the couplers and final connection of the end of arm (1) at the second location.

2. A transfer device according to claim 1, characterized in that the sleeves (821, 831) are disposed one above the other.

3. A transfer device according to any one of claims 1 and 2, characterized in that jacks (V1) produce the pivoting motion of the bent sections (8) through the rotating means (A).

4. A transfer device according to claim 3, characterized in that each of said jacks (V1) is supported on the rotary joint (621, 631) which immediately follows the rotating means (A) of each leg (62, 63).

5. A transfer device according to any one of claims 1 to 3, characterized in that jacks (V2) are provided to produce vertical translation of

the sleeves (821, 831) along the mast (M).

6. A transfer device according to any one of claims 1 to 5, characterized in that the articulated arm (1) comprises a tensioning means (72) permitting it to be in a balanced position precisely above the zone of the maximum motions encountered during the loading, and in that it moves up again to its balanced position without oscillation when it is disconnected at the end of the loading.

7. A transfer device according to any one of claims 1 to 6, characterized in that the connection means (5) of said articulated arm (1) with said coupling means (6) disposed at the second location comprises rotary joints (511—512) having perpendicular axes so as to realize a coupling of the cardanic type and locking members (515) on the couplers (C).



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