

Line for transfer of fluid with clamping modules

WO 2009/071591 describes a line for transfer of fluid between two structures, one of which is a ship, comprising
5 catenary overhead cryogenic flexible piping with two joining pieces. The two joining pieces are connected by a single connector-disconnector on the line, which groups together into a single interface the service connection-disconnection and emergency disconnection devices, which
10 therefore have a single surface or plane of separation. The system for connection-disconnection of the two joining pieces is a clamping collar, the kinematics of which permit controlled opening in order to permit subsequent closure without manual reassembly, but which has the
15 disadvantage that it does not have a substantial spring cartridge, which provides a large clamping force to make it possible to absorb the forces which are transmitted, in particular by off-shore transfer lines, since it would be very difficult to rearm this spring cartridge
20 automatically before further closure of the collar takes place. An isolation valve with a spherical casing is fitted at the end of each joining piece. This type of valve constitutes a substantial weight at the end of the transfer line, while its form involves a relatively large
25 volume between the two of them, corresponding to a loss of fluid when an emergency disconnection takes place.

The invention eliminates these disadvantages by means of a line for transfer of fluid between two structures, of the
30 above-described type, characterised in that:

- the valves are butterfly valves, which are fitted respectively at the opposite free ends of the joining

pieces, and the manoeuvring shafts of which are driven by actuators;

- the connector-disconnector comprises a flange on one of the joining pieces, and at least three clamping modules which are fitted on the other joining piece, such as to be able to be attached to the flange and detached from it; and
- the manoeuvring shafts of the butterfly valves pass radially between two clamping modules.

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According to the invention, it is now possible to use butterfly valves with double offsetting which are fitted very close to one another, their manoeuvring shafts being disposed such as to leave only an extremely small volume between the butterfly valves, as previously designed by the companies Eurodim and KSB (W003/004925).

Since the distance between the necks of the valves is too small to place a collar there for controlled opening and closure, the service connection-disconnection and emergency disconnection manoeuvres are carried out by efficient clamping modules, the clamping forces being able to be very substantial, therefore making it possible to have no interaction with the necks of the valves, and with the modules extending substantially parallel to the axis of the joining pieces.

The number of clamping modules should be at least three, and should constitute a good compromise between the need to assure a clamping force which is distributed as well as possible in relation to the flange of the opposite joining piece, and the need to have enough space between two

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modules to permit the passage of the two necks of the valves which incorporate the manoeuvring shafts. Good results have been obtained with three to six clamping modules, which are preferably distributed angularly
5 equidistantly around the axis of the piping.

The two joining pieces are provided with means for approach and guiding, with male elements and female elements positioned on the two joining pieces, such that
10 they co-operate between one another in order to ensure that there is good positioning of one joining piece relative to the other before connection takes place.

In the attached drawings, which are provided purely by way
15 of example:

- figure 1 is a schematic view of an installation for transfer of fluid, according to the invention;
- 20 - figure 2 is a partial view where the connector-disconnector is in the connected position;
- figure 3 is a partial view where the connector-disconnector is in the disconnected position; and
- 25 - figures 4, 5 and 6 are cross-sectional views of a clamping module.

The installation for transfer of liquefied natural gas
30 between a liquefied gas tanker 1 and a floating terminal 2, which can be a discharge unit or a filling unit, which itself is connected to the gas network by pipes which are

situated undersea, comprises cryogenic flexible piping 3 for communication between the tanks of the two ships 1, 2. The catenary overhead cryogenic flexible piping 3 is deployed and rewound by means of a wheel 7 and a
5 connection-disconnection winch 6 which is positioned, for example, on the liquefied gas tanker 1, which winch, by means of its connection-disconnection cable 5, allows it to be brought closer to, or taken further away from the liquefied gas tanker 1. Figure 1 shows the transfer
10 system, with a connector-disconnector 4 providing the connection between the tanks of the two ships 1, 2.

In figure 2, the piping consists of two rigid pipe joining pieces, with the joining piece 4.1 connected to the
15 manifold of the liquefied gas tanker 1 by means of an adaptation part, and with the joining piece 4.2 having a flange 20 at its end, and being positioned at the end of the flexible cryogenic piping. The clamping modules 14 which can be seen in this view (at least three of them),
20 and are positioned for example on the joining piece 4.1, make possible the connection and disconnection of the transfer system in service and in emergency operation by locking and unlocking relative to one another the joining pieces 4.1 and 4.2, which bear respectively a guide bore
25 16 and a guide roller 18 by means of a support 10, and a guide shaft 15 which acts as a male element, as well as a guide fork 17 which acts as a female element by means of a support 11. Butterfly valves 13.1, 13.2, which are positioned respectively on the joining pieces 4.1, 4.2,
30 and are represented here in the open position, permit isolation of these two joining pieces after service or emergency disconnection, with the offsetting of the

manoeuvring shafts 12.1, 12.2 relative to the axis of the flow filaments allowing the butterfly valves to overlap one another when they are being manoeuvred, and therefore making it possible to limit as far as possible the volume between the two of them in the closed position. The manoeuvring shafts 12.1, 12.2 which are contained in collars, pass radially to the joining pieces between two clamping modules 14. A third butterfly valve 19, which is also represented in the open position, makes it possible to provide a double sealing barrier at the end of the overhead cryogenic flexible piping 3, further to disconnection of the transfer system, in particular in an emergency. The power and delivery of the hydraulic supply allocated to the clamping modules 14 are great enough to assure respectively the absorption of the forces caused by the formation of a layer of frost on the mechanical elements, and the implementation of rapid emergency disconnection, even though the response time for implementation of the emergency disconnection of a transfer system with catenary flexible piping need not necessarily be as short as with a loading arm, for example. The said clamping modules are positioned such as to permit the passage of the manoeuvring shafts 12.1, 12.2 from the respective joining pieces 4.1, 4.2 towards the hydraulic actuation, and are designed with kinematics which carry out mechanical blocking by means of a buttress system, which makes it possible to accept any loss of hydraulic energy without this disturbing the connection, and therefore the transfer.

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The clamping modules 14, like the butterfly valves 13.1, 13.2, have two distinct hydraulic control lines, one of

which is connected to the service automaton for the service functions, and the other one of which is connected to the safety automaton for the emergency functions (ESD).

5 Figure 3 shows the transfer line in the stage of connection (or disconnection), and the butterfly valves 13.1, 13.2. 19 are therefore represented in the closed position. During a disconnection, the joining piece 4.2 secured to the flexible cryogenic unit 3 comes into
10 contact with the joining piece 4.1 connected to the manifold of the liquefied gas tanker by means of an adaptation part 9, via the cable 5 of the connection-disconnection winch 6 which is guided by the pulley 8, and is attached to the end of the guide shaft 15 forming an
15 integral part of the guide system which is also constituted by the guide bore 16, the guide fork 17, and the guide roller 18, which make it possible to obtain good positioning before a service connection takes place between the two joining pieces 4.1, 4.2. Further to an
20 emergency disconnection, the connection-disconnection winch 6 also provides the habitual function of a drop brake, since in terms of manoeuvring, this emergency operation is assimilated to a service disconnection by the group of the corresponding devices on the connector-
25 disconnecter 4. In the case of an emergency disconnection procedure which requires a substantial distance between the two ships, the cable 5 of the connection-disconnection winch 6 is released after being completely unwound, so as to prevent any risk of the cable being torn away at the
30 level of the transfer system.

Figures 4, 5 and 6 show the view in cross-section of a clamping module according to its plane of symmetry. A jack 21, which is in pivot connection around its journals 41 on the support 23 which is secured to the body of the joining piece 4.1, has a fork joint 24 which is secured to the end of its rod 22. A shaft 25 positioned at the end of the fork joint 24 makes it possible to form a pivot connection with the connecting rod 28, which is also in pivot connection at its other end relative to the body of the joining piece 4.1 around the shaft 26 and the connecting rod 29, which is also in pivot connection at its other end with the thruster 30, around the shaft 27. This thruster 30, which is limited in its displacement downwards by support of the lower part of its large shoulder 42 in the inner bore in the jaw 33, is guided on its upper part by the small shoulder in translation, relative to the upper part of the cover 31, which itself is secured in the bore in the jaw 33, and protects the spring cartridge 32 which is supported on the large bore of the thruster 30. A connecting rod 35, which is in pivot connection at one end with the jaw 33, around the shaft 34, and at the other end around the shaft 26, has a lateral stop (not represented) which can come into contact with the upper part of the fin 37 of the joining piece 4.1, as well as a central stop 38 which can come into contact with the jaw 33, which has blocks 36 at its end. The shaft 25 is provided with two rollers (not represented) at each of its ends, with a small roller coming into contact with the slopes 39, 40 of the support guide 23, and a large roller which can come into contact with the upper part of the connecting rod 35.

Figure 4 shows the clamping module in the open position, where the rod 22 of the jack 21 is in the recessed position, whereas the central stop 38 is in contact with the jaw 33 which is thus retained in the raised position, making it possible to bring the joining piece 4.2 towards the joining piece 4.1 by means of the guide system of the connector-disconnector, thus assuring the coaxiality and plane-on-plane contact between the two joining pieces.

The closure of the module is initiated by extension of the rod 22 of the jack 21, which gives rise to the displacement of the shaft 25, such that the latter tends to be interposed between the shafts 26, 27, by means of the retention in the high position of the shaft 27, which is made possible by the contact between the large roller secured to its end, and the upper part of the lateral connecting rod 35, which also gives rise to the displacement upwards of the thruster 30 inside the bore in the jaw 33, thus giving rise to the compression of the spring cartridge 32, with the inclination of the slopes 39, 40 of the support guide 23, combined with the contact of the lateral stop of the connecting rod 35 with the upper part of the fin 37 of the joining piece 4.1, tending to close the jaw 33 on the flange 20 of the joining piece 4.2.

Figure 5 shows the position of the different elements of the module when the jaw 33 comes into contact by means of its blocks 36 with the flange 20 of the joining piece 4.2, which is thus clamped against the joining piece 4.1. In this position, the small roller at the end of the shaft 27

is situated at the level of the slope 40 of the support guide 23, whereas the spring cartridge 32 is compressed.

As shown in figure 6, an additional extension displacement
5 of the rod 22 of the jack 21, until its fork joint 24 comes into contact with the central stop 38, allows the shaft 25 to go in line with the plane which passes via the shafts 26, 27. Since the spring cartridge 32 is still compressed, the force which it exerts downwards according
10 to its central axis makes it possible to block the kinematics mechanically by buttressing, since the shaft 25 can no longer be displaced out of line with the plane which passes via the shafts 26, 27 without the action of the jack 21, irrespective of the forces which are absorbed
15 by the jaw 33. During a transfer, the blocked position of the jaw is thus assured, even in the event of a hydraulic supply fault, in particular at the level of the jack 21.

The reopening is thus initiated by the retraction of the
20 rod 22 of the jack 21, which gives rise to the release from buttressing of the kinematics of the system, by displacement of the shaft 25 out of line with the plane which passes via the shafts 26, 27, made possible by means of the retention in position of the shaft 27 by the
25 contact of the small roller which is secured to its end, against the slope 40 of the support guide 23. The continuation of the retraction of the rod 22 of the jack 21 gives rise, in particular by means of the connecting rod 29, to the displacement of the shaft 27 which is
30 guided by the contact of the small roller which is secured to its end, with the slope 39 of the support guide 23, thus making it possible to raise the jaw 33. Any influence

of gravity according to the position of the jaw 33 on the joining piece 4.1 is controlled by the contact of the small roller with the slopes 29, 30 of the support guide 23.

CLAIM

1. Line for transfer of fluid between two structures,
one of which is a ship, comprising catenary overhead
5 flexible piping (3) with two joining pieces (4.1,
4.2) with free ends and connected by a single
connector-disconnector (4) on the line, which groups
together into a single interface, such that the
joining pieces have the same surface of separation,
10 the service connection-disconnection and emergency
disconnection devices, a stop valve being fitted in
each joining piece, characterised in that:
- the valves are butterfly valves(13.1, 13.2) with
manoeuvring shafts (12.1, 12.2), which are
15 fitted respectively at the opposite free ends of
the joining pieces (4.1, 4.2), and the
manoeuvring shafts (12.1, 12.2) are driven by
actuators;
 - the connector-disconnector comprises a flange
20 (20) on one of the joining pieces (4.1, 4.2),
and at least three clamping modules (14) which
are fitted on the other joining piece, such as
to be able to be attached to the flange and
detached from it; and
 - 25 the manoeuvring shafts (12.1, 12.2) of the
butterfly valves(13.1, 13.2) pass radially
between two clamping modules (14).