pneumatic cylinders. The first linear actuator 13 has a first end mounted articulated on the first proximal part 6 and a second end mounted articulated on the second median part 7 and thus makes it possible to control the rotation of the second median part 7 relative to the first proximal part 6. The second linear actuator 14 has a first end mounted articulated on the second median part 7 and a second end mounted articulated on the third distal part 8 and thus makes it possible to control the rotation of the third distal part 8 relative to the second median part 7.

As shown in figure 1, when the articulated arm 2 is in its rest position, the second median part 7 and the third distal part 8 extend continuing on from each other, substantially horizontally. In this rest position, the first linear actuator 13 is in a retracted position while the second linear actuator 14 is in an extended position. In order to move the articulated arm 2 from its rest position, illustrated in figure 1, to an extended position, as shown in figures 5 and 6, the first actuator 13 is capable of extending so that it pivots the second median part 7 relative to the first proximal part 6 in a first rotation direction so as to raise the front end 10 of the second median part 7. Furthermore, the second actuator 14 is capable of retracting so that it pivots the third distal portion 8 relative to the second median part 7 in a second rotation direction opposite to the first rotation direction.

Such a three-part articulated arm 2 thus makes it possible for the transfer system 1 to adapt to a wide variety of different configurations.

Furthermore, each of the three transfer lines 3, 4, 5 includes in succession a flexible first proximal portion 15, a rigid second median portion 16, which is fastened to the second median part 7 of the articulated arm 2, and a flexible third distal portion 17.

The flexible portions, namely the first proximal portion 15 and the third distal portion 17, consist of cryogenic hoses, such as composite hoses or corrugated double-walled hoses, for example made from stainless steel, the intermediate space of which is lined with an insulating material.

As the first proximal portions 15 of the transfer lines 3, 4, 5 are flexible, they permit the rotation of the first proximal part 6 relative to the deck 30 of the supplier

vessel 31 about the vertical axis A and the rotation of the second median part 7 of the articulated arm 2 relative to the first proximal part 6 about the horizontal axis B.

The first proximal portions 15 of the transfer lines 3, 4, 5 are distributed on either side of the first proximal part 6 of the articulated arm 2. In particular, as shown in figure 3, the first proximal portion 15 of the first and second transfer lines 3, 4, and the first proximal portion of the third transfer line 5, are arranged diametrically on either side of the first proximal part 6 of the articulated arm 2.

The transfer system 1 includes two planar supports 18, 19 that are respectively arranged to support the first proximal portion 15 of the first and second transfer lines 3, 4 and the first proximal portion of the third transfer line 5. Advantageously, the supports 18, 19 are covered with a non-stick coating, which makes it possible to reduce the friction that might occur between said supports 18, 19 and the first proximal portions 15 of the transfer lines 3, 4, 5 when the articulated arm 2 is moved, and particularly when the first proximal part 6 of the articulated arm 2 pivots about its vertical pivot axis A. This makes it possible to limit the frictional wear of the first proximal portions 15 and to limit the forces necessary to pivot the first proximal part 6 of the articulated arm 2. The non-stick coating is for example polytetrafluoroethylene (PTFE).

Furthermore, advantageously, the first proximal part 6 includes, at least in a lower portion that might come into contact with the first proximal portions 15 during the movement of the first proximal part 6 about the vertical axis A, a protective cylindrical skirt 20. The protective cylindrical skirt 20 includes a non-stick coating, such as polytetrafluoroethylene (PTFE). This makes it possible to limit the friction that might occur between the first proximal part 6 of the articulated arm 2 and the first proximal portions 15 of the transfer lines 3, 4, 5.

Advantageously, as shown in figure 1, in order to limit the stresses acting on the first proximal portions 15 when the articulated arm 2 is in the rest position, the first proximal portions 15 are, in said rest position, substantially arranged in the same vertical plane as the second median portion 16 of their respective transfer line 3, 4, 5.

The second median portion 16 of the transfer lines 3, 4, 5 is rigid and consists of a cryogenic hose, such as a double-walled hose, for example made from stainless steel, the intermediate space of which is lined with an insulating material.

The second median portions 16 extend along the second median part 7 of the articulated arm 2, parallel to the longitudinal direction thereof. The second median portions 16 are arranged on one side or the other of the second median part 7 of the articulated arm 2. Thus, as shown in figure 3, the second median portion 16 of the first and second transfer lines 3, 4, and the second median portion of the third transfer line 5, are arranged laterally on either side of the second median part 7 of the articulated arm 2.

The second median portions 16 are fastened to the articulated arm 2 by means of support members 21 that are evenly distributed along said second median portions 16. According to one embodiment, the support members 21 include cross members that are welded to the second median part 7 of the articulated arm 2 and a clamping collar that is fastened to said cross members and through which the second median portion 16 passes. Advantageously, the support members 21 also include an insulating sleeve interposed radially between the clamping collar and the second median portion 16.

The second median portions 16 are also provided with cryogenic valves 22. The valves 22 are advantageously arranged near the front end of the second median portion 16, i.e., the end of the second median portion 16 that is connected to the third distal portion 17. This makes it possible to limit the quantity of liquefied gas downstream of said valves 22 when the transfer lines 3, 4, 5 are disconnected from the receiving manifold on the client vessel. The valves 22 are also advantageously arranged closer to the front end 24 of the second median portion 16 than to the rear end 23.

It will further be noted that, as shown for example in figure 4, the valves 22 have a significant height. As a result of this, in order to allow easy incorporation of said valves 22, the second median portions 16 are laterally offset relative to the second median part 7 of the articulated arm 2.

Furthermore, the second ends 23, 24 of each second median portion 16 are bent, for example at 90°, and are oriented downwards. This makes it possible to avoid the radius of curvature of the first proximal portions 15 and the third distal portions 17 being too small at the end thereof connected to the second median portion 16. The stresses that might be exerted on the first proximal portions 15 and the third distal portions 17 are thus limited.

Advantageously, the rear end 23 of each second median portion 16 is aligned or substantially aligned with the axis of articulation B of the second median part 7 relative to the first proximal part 6 of the articulated arm 2. Likewise, the front end 24 of each second median portion 16 is advantageously aligned or substantially aligned with the axis of articulation C of the third distal part 8 relative to the second median part 7 of the articulated arm 2. This makes it possible to limit the length of the first proximal portion 15 and the third distal portion 8 of the transfer lines 3, 4, 5 and to limit the fatigue wear thereof.

Moreover, according to an advantageous embodiment, as shown schematically in figure 1, the transfer system 1 includes protective sleeves 32, 33 that are fastened to the rear end 23 and the front end 24 of each median portion 16. The front end of the first proximal portion 15 is accommodated in the protective sleeve 32 and the rear end of the third distal portion 17 is accommodated in the protective sleeve 33. The protective sleeves 32, 33 have an arc-shaped inner surface that flares towards the bottom and is thus tulip-shaped. The radius of curvature of the arc-shaped inner surface is greater than the minimum permissible radius of curvature of the first proximal portion 15 and the third distal portion 17. The protective sleeves 32, 33 thus make it possible to further protect the first proximal portion 15 and the third distal portion 17.

Furthermore, the third distal portion 8 of each transfer line 3, 4, 5 includes, at its free end, a coupling 25 suitable for being connected to a manifold on the client vessel, during a transfer operation.

According to one embodiment, the coupling 25 is an emergency release coupling, also known as an ERC. The emergency release coupling includes an upstream element and a downstream element that are connected to each other in a

sealed manner in an operating position and are capable of separating from each other in an emergency. Advantageously, each of the upstream and downstream elements is provided with a check valve that makes it possible to prevent the flow of the fluid through said upstream or downstream element when the upstream and downstream elements are disconnected from each other. According to one embodiment, the release of the emergency release coupling is controlled by means of a hydraulic or pneumatic circuit capable of being remotely controlled. According to one embodiment, the upstream and downstream elements are secured to each other by means of a fastening member designed to fail when a separating force greater than a given threshold is exerted on the emergency release coupling.

According to another embodiment, not shown, the transfer system 1 includes in addition to the coupling 25 arranged at the free end of each of the three distal portions 17, an emergency release coupling that is positioned at the rear end of the third distal portion 17, i.e., at the end that is connected to the second median portion 16.

Furthermore, the third distal portion 17 of each transfer line 3, 4, 5 is suspended at the front end 12 of the third distal part 8 of the articulated arm 2. To this end, each of the couplings 25 is fastened to a lifting device. Each lifting device includes a drum 26 that is fastened to the third distal part 8 of the articulated arm 2 and interacts with a motor that makes it possible to rotate said drum 26 and a cable 27 that is wound around said drum 26 and fastened to one of the couplings 25. In the embodiment shown, each cable 27 interacts with a pulley 28, shown in figure 3, arranged at the front end 12 of the third distal part 8 so that the third distal portion 17 of the transfer lines 3, 4, 5 is suspended at the front end 12 of the third distal part 8 even though the drum 26 of the lifting device is arranged at a distance from said front end 12. The drums 26 and the associated motors are thus advantageously arranged near the rear end 11 of the third distal part 8, which makes it possible to limit the moment generated by the weight of the drums 26 and the motors and thus makes it possible to limit the forces exerted on the second linear actuator 14.

In the advantageous embodiment shown, the cable 27 of each lifting device is connected to the respective coupling 25 by means of a load balancing spreader 29,

CLAIMS

1. A system (1) for transferring liquefied gas between a first facility and a second facility, said transfer system (1) including:

- an articulated arm (2) including a first proximal part (6) suitable for being mounted so that it can rotate on the first facility about a first vertical axis (A), a second median part (7) that is mounted pivoting on the first proximal part (6) about a second axis (B) and a third distal part (8) that is mounted pivoting on the second median part (7) about a third axis (C); and

- at least one transfer line (3, 4, 5), suitable for transferring liquefied gas between the first facility and the second facility, and including a flexible first proximal portion (15) suitable for being connected to a liquefied gas storage tank of the first facility; a rigid second median portion (16) that is fastened to the second median part (7) of the articulated arm (2) and a third distal portion (17) that is suspended on the third distal part (8) of the articulated arm (2) and has an end suitable for being connected to a manifold of the second facility, the second median portion (16) being provided with a valve (22).

2. The transfer system (1) as claimed in claim 1, in which the second median portion (16) extends along the second median part (7) of the articulated arm (2) and has two bent ends (23, 24) oriented downwards and connected respectively to the first proximal portion (15) and the third distal portion (17).

3. The transfer system (1) as claimed in claim 1 or 2, in which the two ends of the second median portion (16) are respectively aligned with the second axis of articulation (B) and the third axis of articulation (C).

4. The transfer system (1) as claimed in any one of claims 1 to 3, in which the second median portion (16) is laterally offset relative to the second median part (7) of the articulated arm (2).

5. The transfer system (1) as claimed in any one of claims 1 to 4, in which the second median portion (16) is fastened to the second median part (7) of the articulated arm (2) by means of support members (21) that are distributed along the second median part (7), the support members (21) including cross members fastened

to the second median part (7) and a clamping collar fastened to said cross members and through which the second median portion (16) passes.

6. The transfer system (1) as claimed in any one of claims 1 to 5, in which the first proximal portion (15) rests on a support (18, 19) covered with a non-stick coating.

7. The transfer system (1) as claimed in any one of claims 1 to 6, in which the first proximal part (6) of the articulated arm (2) includes a protective cylindrical skirt (20) including a non-stick coating.

8. The transfer system (1) as claimed in any one of claims 1 to 7, in which the third distal portion (17) is suspended on the third distal part (8) of the articulated arm (2) by means of a lifting device, the lifting device including a drum (26) that is fastened to the third distal part (8) of the articulated arm (2) and is associated with a motor and a cable (27) that is wound around said drum (26) and fastened to the third distal portion (17).

9. The transfer system (1) as claimed in claim 8, in which the cable (27) is fastened to the third distal portion (17) by means of a load distributing spreader (29).

10. The transfer system (1) as claimed in any one of claims 1 to 9, in which the third distal portion (17) is provided with an emergency release coupling (25).

11. The transfer system (1) as claimed in claims 9 and 10 in combination, in which the emergency release coupling (25) is hung on the load balancing spreader (29).

12. The transfer system (1) as claimed in claim 10, in which the emergency release coupling is arranged at the junction between the third distal portion (17) and the second median portion (16).

13. The transfer system (1) as claimed in any one of claims 1 to 12, including at least two transfer lines (3, 4, 5), the first proximal portions (15) of each of the two transfer lines (3, 4, 5) being respectively arranged laterally on either side of the first proximal part (6) of the articulated arm (2) and the second median portions

(16) of each of the two transfer lines (3, 4, 5) being respectively arranged laterally on either side of the second median part (7) of the articulated arm (2).

14. The transfer system (1) as claimed in any one of claims 1 to 13, in which the second median portion (16) includes a double-walled hose having an intermediate space that is lined with an insulating material.

15. The transfer system (1) as claimed in any one of claims 1 to 14, in which the first proximal portion (15) and the third distal portion (17) each include a composite hose or a corrugated double-walled hose that includes an intermediate space lined with an insulating material.

16. The transfer system (1) as claimed in any one of claims 1 to 15, including a protective sleeve (32) that is fastened to one end (23) of the second median portion (16), which is connected to the first proximal portion (15), the protective sleeve (32) accommodating one end of the first proximal portion (15) and having a flared inner surface so that it ensures a minimum radius of curvature for said end of the first proximal portion (15).

17. The transfer system (1) as claimed in any one of claims 1 to 16, including a protective sleeve (33) that is fastened to one end (24) of the second median portion (16), which is connected to the third distal portion (17), the protective sleeve (33) accommodating one end of the first proximal portion (15) and having a flared inner surface so that it ensures a minimum radius of curvature for said end of the third distal portion (17).

18. The transfer system (1) as claimed in any one of claims 1 to 17, including at least two transfer lines (3, 4, 5) and a bypass device (34) that connects the median portion (16) of the two transfer lines (3, 4, 5) upstream of the valve (22) provided on each of the median portions (16).

19. A vessel (30) provided with a transfer system as claimed in any one of claims 1 to 18.