DESCRIPTION

TITLE: TOWER FOR LOADING AND UNLOADING A LIQUEFIED GAS STORAGE TANK

[0001] The invention relates to the field of the storage and/or transport of a cargo of liquefied gas, such as liquefied natural gas, liquid ammonia as well as liquefied petroleum gas. More particularly, the invention relates to an assembly for loading and unloading a liquefied gas storage tank.

[0002] Liquefied natural gas, commonly known by the acronym "LNG," for "Liquefied Natural Gas," is an important source of energy and is composed of approximately 95% methane. More particularly, LNG is stored in the liquid state in a thermally insulated tank at a temperature near -160°C, at which LNG occupies 1/600 of the volume that it would occupy in the gaseous state, thus making it possible to facilitate transport from one site to another.

[0003] Conventionally, the tank comprises a loading and unloading tower that is suspended from a cover that enables the tank to be closed. The loading and unloading tower can comprise a tripod type structure, that is, comprising three vertical poles connected to one another by cross members forming a lattice structure, said tower being guided by a support of the tank emerging from a bottom wall. The loading and unloading tower then comprises at least one unloading pipe and a suction member, the function of which is to unload the cargo from the tank, said suction member being connected to a drive device arranged outside the tank. Furthermore, in order to allow optimal suction of the cargo, usually the suction member is arranged at least in part in a sump formed in the bottom wall of the tank which makes it possible to increase the amount of the cargo extracted by the unloading pipe while ensuring the immersion of the suction member in said cargo, thus preserving its integrity

[0004] It is then known to place the unloading pipe in one of the poles of the structure of the loading and unloading tower. One of the drawbacks of such an arrangement of the loading and unloading tower then lies in the proximity between the support guiding the structure of the tower and the sump formed opposite the unloading pipe. Such a proximity indeed limits the deformation property of the tank wall during storage of the cargo and when the tank is cooled down prior to filling it with the liquefied gas, this deformation property being necessary to limit the deterioration of the tank. Furthermore, such an arrangement of the unloading pipe in one of the poles of the structure of the tower complicates its accessibility for an operator. It is thus understood that such a configuration of the tank and more particularly of the loading and unloading tower reduces the strength of said tank, necessary for the storage of liquefied gas, while limiting the accessibility of the unloading pipe.

[0005] The invention therefore relates to an assembly for loading and unloading a liquefied gas storage tank, the loading and unloading assembly comprising at least one loading tower, an unloading device and at least one cover intended to close a storage volume of the tank and which is at least partially traversed by the loading tower and by the unloading device, the loading tower comprising a structure comprising at least three poles and a loading pipe, the unloading device comprising at least one unloading pipe, a suction member arranged at a first end of the unloading pipe and a drive assembly arranged at a second end of the unloading pipe, the cover being arranged between the suction member and the drive assembly, the loading and unloading assembly being characterized in that the unloading pipe of the unloading device is separate from the poles of the structure of the loading tower and is arranged outside a perimeter delimited by said structure of the loading tower.

[0006] The storage tank may be arranged on a floating structure and comprises at least a top wall and a bottom wall connected together by side walls. The walls of the tank in particular comprise at least one thermal insulation layer

covered by an undulating sealed membrane, capable of deforming according to the thermal variations of the tank. An opening is then formed in the top wall so as to accommodate the loading and unloading assembly. It is understood in particular that the cover of the loading and unloading assembly closes the opening of the top wall in a sealed manner. Furthermore, the loading tower is guided by a support, at least a portion of which passes through the bottom wall in order to anchor said loading tower in the tank.

[0007] The perimeter delimited by the structure of the loading tower corresponds to an axial projection of the structure of the loading tower onto the bottom wall of the tank. In addition, the perimeter is delimited by the outer edges of each of the poles, that is, by circular portions of the poles that are positioned outermost of the structure.

[0008] Thus, there is an advantage in the arrangement of the unloading pipe outside the perimeter delimited by the structure in that it makes it possible to separate the unloading pipe and therefore a sump associated with this unloading pipe from the support of the loading tower. The undulating sealed membrane arranged at the loading and unloading assembly is thus allowed to retain its deformation property.

[0009] According to one aspect of the invention, the unloading pipe that extends between the suction member and the drive assembly is separate from the pole of the structure, between these two components. In other words, the unloading pipe from one end thereof to the other is outside the pole.

[0010] According to a feature of the invention, two of the poles of the structure of the loading tower form two rear poles and a third pole of the structure forms a front pole, the unloading pipe extending opposite either one of the two rear poles relative to the front pole of the structure. It is understood here that the unloading pipe is in front of the front pole of the structure.

[0011] According to a feature of the invention, at least one holding device extends between the unloading pipe and one of the poles of the structure.

[0012] According to a feature of the invention, the structure delimits a substantially triangular perimeter comprising at least one base defined by a straight line joining the two rear poles and a front vertex defined by the front pole, the holding device extending between the unloading pipe and the front pole of the structure forming the front vertex of the perimeter of said structure.

[0013] More specifically, the substantially triangular perimeter delimited by the structure of the loading tower comprises three vertices each corresponding to one of the poles of said structure, the two vertices corresponding to the two rear poles then participating in defining the base, the vertex corresponding to the front pole participating in defining the front vertex.

[0014] According to a feature of the invention, the vertex of the perimeter of the structure and the unloading pipe are aligned along a height of the substantially triangular perimeter of the structure. Such a height is a straight line perpendicular to the base and which passes through the front vertex.

[0015] The invention also relates to a liquefied gas storage and/or transport tank comprising at least one loading and unloading assembly according to any one of the preceding features, said tank comprising a bottom wall, a top wall and side walls connecting the bottom wall to the top wall, said walls delimiting the storage volume of the liquefied gas.

[0016] According to a feature of the invention, the loading pipe extends between one of the side walls of the tank and the unloading pipe.

[0017] According to a feature of the invention, the drive assembly of the unloading device is arranged outside the storage volume of said tank and the

suction member of the unloading device is arranged inside the storage volume of the tank.

[0018] More specifically, a drive shaft connects the suction member to the drive assembly. It is understood in particular that the drive assembly allows the suction member to be activated by means of the drive shaft.

[0019] According to a feature of the invention, the unloading pipe is arranged opposite the side wall closest to the structure, relative to said structure. The closest wall may for example be a front side wall and a rear side wall of the tank.

[0020] More particularly, a front and a rear of the floating structure bearing the tank are defined, the front and the rear being defined relative to a standard direction of travel of said floating structure. Thus, in the tank, the unloading pipe corresponds to the forward-most pipe relative to the structure and the loading pipe.

[0021] Likewise, at least one front side wall and a rear side wall of the tank are defined, according to the standard direction of travel of the floating structure, the unloading pipe being arranged opposite the rear side wall of the tank, relative to the structure. This is in particular the case when the structure is closer to the rear wall.

[0022] Alternatively, the unloading pipe is arranged opposite the front side wall of the tank, relative to the structure. This is in particular the case when the structure is closer to the front wall.

[0023] According to a feature of the invention, the tank comprises at least one sump formed in the bottom wall of the tank, the suction member extending at least in part into the sump.

[0024] The sump corresponds in particular to a recess formed in the volume of the bottom wall of the tank, delimited by a sump wall and making it possible to optimize the unloading of the liquid cargo. More particularly, the sump makes it possible to facilitate the suction of the liquid cargo by the suction member by collecting and concentrating the liquid cargo in a reduced volume relative to the storage volume of the tank.

[0025] According to a feature of the invention, the tank comprises a support for the loading tower which passes through the bottom wall, the sump being formed such that a center of the latter is at a distance at least greater than 2.04 m from a center of said support of the loading tower.

[0026] The distance is taken along a straight line perpendicular to a main extension direction of the loading tower, which connects the center of the loading tower support and the center of the sump.

[0027] According to a feature of the invention, a center of the unloading pipe is positioned on any point of a semi-circle centered on the center of the support.

[0028] It is understood that the center of the support corresponds to a point arranged substantially equidistantly from a center of the three poles of the structure of the loading pipe.

[0029] According to a feature of the invention, the top wall comprises an opening wherein the cover is arranged so as to close the storage volume of the tank.

[0030] Other features, details and advantages of the invention will emerge more clearly on reading the description given below for information only, in relation to the drawings, in which:

[Fig. 1] is a schematic view of a vessel comprising a tank that houses a loading and/or unloading tower according to the invention;

[Fig. 2] is a general perspective view of the loading and unloading assembly of Figure 1;

[Fig 3] is a close-up top view of part of the loading and unloading assembly of Figure 1;

[Fig. 4] is a close-up side view of a part of the loading and unloading assembly of Figure 1.

[0031] It should first of all be noted that while the figures set out the invention in detail for its implementation, these figures can of course be used to better define the invention where appropriate. It should also be noted that these figures only show exemplary embodiments of the invention.

[0032] Figure 1 shows a floating structure 1 corresponding here to a liquefied gas transport ship 1. In order to transport the liquefied gas, the ship 1 comprises at least one tank 2 for storing and/or transporting liquefied gas comprising at least one bottom wall and a top wall, in this case not visible, and opposite one another in a vertical direction of the tank 2, said walls being connected to one another by side walls 4. The bottom wall, the top wall and the side walls 4 participate, inter alia, in delimiting a storage volume 6 of the liquefied gas.

[0033] In order to guarantee optimal transport and preservation of the liquefied gas in the tank 2, the walls 4 of the of said tank comprise at least one thermal insulation layer, not visible, covered by an undulating sealed membrane 8, visible in figures 3 and 4, and intended to be in contact with the liquefied gas. The undulating sealed membrane 8 in particular comprises a plurality of undulations 8a allowing it to withstand the deformations generated by thermal variations in the tank 2, for example when the tank 2 is cooled down prior to filling it with the liquefied gas.

[0034] The storage and/or transport tank 2 comprises at least one loading and unloading assembly 10 according to the invention making it possible to introduce or remove the liquefied gas into or out of the tank 2. The loading and unloading assembly 10, visible in Figures 1 and 2, comprises at least one loading tower 12, an unloading device 14 and at least one cover 16 intended to close the storage volume 6. More particularly, the top wall comprises an opening in which the cover 16 is arranged so as to close the storage volume 6 of the tank 2 in a sealed manner. As can be seen in Figure 2, the cover 16 is at least in part traversed by the loading tower 12 and by the unloading device 14.

[0035] The loading tower 12, particularly visible in Figure 2, comprises a structure 18 which extends in a main direction P of vertical extension V, comprising at least three poles 20, otherwise called a tripod, and a loading pipe 22. More specifically, the structure 18 of the loading tower 12 comprises the at least three poles 20 secured to one another by means of a lattice structure 24, each of the three poles 20 passing through the cover 16 of the tank 2. A front pole 20a of the structure 18 and two rear poles 20b of the structure 18 are then defined, defined according to a direction of travel A of the ship 1, visible in figure 1, under normal navigation conditions, the front pole 20a being the pole 20 of the forward-most structure 18 in the tank 2.

[0036] Furthermore, and as is particularly visible in Figures 3 and 4, the structure 18 of the loading tower 12 is supported by a support 26 which at least partially passes through the bottom wall 28 of the tank 2. More specifically, the support 26 comprises at least one platform 30 secured to each of the poles 20 of the structure 18 of the loading tower 12 and a foot 32 which extends from an external structure of the tank 2, not visible, and to the platform 30, by passing through the bottom wall 28 of said tank 2.

[0037] The loading pipe 22 of the loading tower 12, visible in figures 1 to 4, is distinct from the poles 20 of the structure 18 and extends through the cover 16 to the vicinity of the bottom wall 28, such that a free end 34 of said loading pipe

22, shown in dotted lines in Figure 4 because it is behind the front pole 20a in this view, is at a non-zero distance from said bottom wall 28 in the vertical direction V of the tank 2. It is understood that such a distance between the free end 34 of the loading pipe 22 which extends into the storage volume 6 and the bottom wall 28 allows the liquefied gas to flow through said free end 34.

[0038] The unloading device 14 according to the invention comprises at least one unloading pipe 36, a suction member 38 arranged at a first end 40 of the unloading pipe 36, visible in figures 3 and 4, and a drive assembly 42 arranged at a second end 44 of the unloading pipe 36, visible in Figure 2. According to one feature of the invention, the cover 16 is arranged between the suction member 38 and the drive assembly 42. More specifically, the suction member 38 is arranged in the storage volume 6 of the tank 2 while the drive assembly 42 is arranged outside the storage volume 6 of the tank 2. At least one drive shaft 46, partially visible in Figure 4, connects the suction member 38 to the drive assembly 42. More particularly, the drive shaft 46 extends into an internal volume of the unloading pipe 36 and allows the suction member 38 to be actuated under the effect of the drive element 42.

[0039] According to the invention and as particularly visible in Figures 2 to 4, the unloading pipe 36 of the unloading device 14 is separate from the poles 20 of the structure 18 of the loading tower 12. More particularly, and as visible in figure 3, a perimeter S is defined, shown schematically, delimited by the structure 18 of the loading tower 12, and corresponding to an axial, or vertical V, projection of the structure 18 of the loading tower 12 onto the bottom wall 28 of the tank 2. More particularly, the perimeter S of the structure 18 is delimited by each of the poles 20 of the structure 18. The perimeter S delimited by the structure 18 in particular passes through outer edges of each of the poles 20 of the structure 18, that is, by circular portions of the poles 20 positioned furthest to the outside of said structure 18. Thus, according to the invention, the unloading pipe 36 extends outside the perimeter S delimited by the structure 18 of the loading tower 12.

[0040] As can be seen in Figure 3, the perimeter S delimited by the structure 18 has a substantially triangular shape, each of the poles 20 forming one of the vertices of the perimeter S of the structure 18. Thus, the perimeter S comprises at least one base 48 defined by a straight line passing through the two rear poles 20b of the structure 18 defined previously and a vertex 50 defined by the front pole 20a of said structure 18, otherwise called the front vertex.

[0041] A front side wall 4a and a rear side wall 4b of the tank 2 are defined, defined according to the direction of travel A of the ship 1, visible in figure 1, under normal navigation conditions, the front side wall 4a being the forward-most side wall 4 in the tank 2, the rear side wall 4b being the rearmost side wall 4 in the tank 2. Thus, according to the example of the invention, the base 48 of the perimeter S projected onto the bottom wall 28 and delimited by the structure 18 is substantially parallel to one of the side walls of the tank 2 which extends closest to said structure 18, here the rear side wall 4b. Thus, and as can be seen in Figure 1, the unloading pipe 36 extends opposite the rear side wall 4b relative to the structure 18.

[0042] Furthermore, according to one example of the invention, a center C of the unloading pipe 36 is positioned on any point of a semi-circle 52, visible in Figure 1, centered on a center F of the support 26 of the structure 18. More specifically, the center F of the support 26 corresponds to a point located equidistant, or substantially equidistant, from a center of each of the poles 20 of said structure 18.

[0043] According to an alternative of the invention visible in Figure 1, the front vertex 50 of the perimeter S, that is, the front pole 20a, and the unloading pipe 36 are aligned along a height I of the substantially triangular perimeter S. Height I is understood to be a straight line passing through the vertex 50 defined by the front pole 20a and perpendicularly cutting the base 48 of said perimeter S.

[0044] According to the invention and visible in figure 3, at least one holding device 54 extends between the unloading pipe 36 and one of the poles 20 of the structure 18. The holding device 54 makes it possible to hold the unloading pipe 36 in the vertical direction V and ensures that it is held in particular during the loading of the tank 2 as well as during the transportation of the liquefied gas. According to the example of the invention, a plurality of holding devices 54 extends between one of the poles 20 of the structure 18 and the unloading pipe 36, along the latter, that is, between its first end 40 and the cover. According to the illustrated example, the at least one holding device 54 extends between the unloading pipe 36 and the front pole 20a of the structure 18, that is, the pole 20 forming the front vertex 50 of the perimeter S of the structure 18.

[0045] In order to improve the suction of the liquefied gas during its unloading from the tank 2, the latter comprises at least one sump 56 formed in its bottom wall 28 and particularly visible in Figures 3 and 4. The sump 56 corresponds to a volume which extends in the bottom wall 28 of the tank 2 and which is delimited by a sump wall 56a, here cylindrical around an axis of revolution X. The sump 56 in particular makes it possible to form a reduced volume in order to facilitate the collection of the liquefied gas by the suction member 38 by concentrating said liquefied gas in this reduced volume relative to the storage volume 6 of the tank 2. It is then understood that the suction member 38 of the unloading device 14 extends at least in part in the volume of the sump 56.

[0046] According to a feature of the invention, particularly visible in Figure 4, the sump 56 is formed in the bottom wall 28 of the tank 2 such that a center X of the tank, here positioned on its axis of revolution X, is at a distance D, at least more than 2.04 m from the center F of said support 26 of the loading tower 12. It is understood that the distance is taken along a straight line perpendicular to the axis of revolution X, between said axis of revolution X and the center F of the support 26 of the loading tower 12, taken on a central axis

F thereof. It is understood that such a distance d between the sump 56 and the support 26 makes it possible to retain flexibility to the undulating sealed membrane 8 which extends in the vicinity, said undulating sealed membrane 8 thus retaining its deformation properties limiting at least the risks of premature wear thereof.

[0047] It is also understood that the center C of the unloading pipe mentioned above is positioned on any point of the semi-circle 52, visible in Figure 1, centered on the center F of the support 26 of the structure 18, and such that the semi-circle 52 has a radius corresponding to the distance D, visible in figure 3, this distance being equal to or greater than 2.04 m.

[0048] It is also understood from the description that has been made of the loading and unloading assembly 10, that in a direction of travel A of the ship 1, visible in Figure 1, under normal navigation conditions, the unloading pipe 36 is the element of said loading and unloading assembly 10 furthest forward in the tank 2.

[0049] The invention as it has just been described cannot, however, be limited to the means and configurations exclusively described and illustrated, and also applies to all equivalent means or configurations and to any combination of such means or configurations.

Claims

1. A loading and unloading assembly (10) of a liquefied gas storage tank (2), the loading and unloading assembly (10) comprising at least one loading tower (12), an unloading device (14) and at least one cover (16) intended to close a storage volume (6) of the tank (2) and traversed by the loading tower (12), at least in part, and by the unloading device (14), the loading tower (12) comprising a structure (18) comprising at least three poles (20) and a loading pipe (22), the unloading device (14) comprising at least one unloading pipe (36), a suction member (38) arranged at a first end (40) of the unloading pipe (36) and a drive assembly (42) arranged at a second end (44) of the unloading pipe (36), the cover (16) being arranged between the suction member (38) and the drive assembly (42), the loading and unloading assembly (10) being characterized in that the unloading pipe (36) is arranged between the suction member (38) and the drive assembly (42), the loading and unloading assembly (10) being characterized in that the unloading pipe (36) of the unloading device (14) is separate from the poles (20) of the structure (18) of the loading tower (12) and is arranged outside a perimeter (S) delimited by said structure (18) of the loading tower (12).

2. The loading and unloading assembly (10) according to the preceding claim, wherein two of the poles (20) of the structure (18) of the loading tower (22) form two rear poles (20b) and a third pole (20) of the structure (18) forms a front pole (20a), the unloading pipe (36) extending opposite to either of the two rear poles (20b) relative to the front pole (20a) of the structure (18).

3. The loading and unloading assembly (10) according to any one of the preceding claims, wherein at least one holding device (54) extends between the unloading pipe (36) and one of the poles (20) of the structure (18).

4. The loading and unloading assembly (10) according to a combination of claims 2 and 3, wherein the structure (18) delimits a substantially triangular

perimeter (S) comprising at least one base (48) defined by a straight line joining the two rear poles (20b) and a front vertex (50) defined by the front pole (20a), the holding device (54) extending between the unloading pipe (36) and the front pole (20a) of the structure (18) forming the front vertex (50) of the perimeter (S) of said structure (18).

5. The loading and unloading assembly (10) according to the preceding claim, wherein the front vertex (50) of the perimeter (S) of the structure (18) and the unloading pipe (36) are aligned along a height (l) of the substantially triangular perimeter (S) of the structure (18).

6. A tank (2) for storing and/or transporting a liquefied gas comprising at least one loading and unloading assembly (10) according to any one of the preceding claims, said tank (2) comprising a bottom wall (28), a top wall and side walls (4) connecting the bottom wall (28) to the top wall, said walls (4, 28) delimiting the storage volume (6) of the liquefied gas.

7. The storage and/or transport tank (2) according to the preceding claim, wherein the drive assembly (42) of the unloading device (14) is arranged outside the storage volume (6) of said tank (2) and the suction member (38) of the unloading device (14) is arranged in the storage volume (6) of the tank (2).

8. The storage and/or transport tank (2) according to either one of claims 6 or 7, wherein the unloading pipe (36) is arranged opposite the side wall (4) closest to the structure (18), relative to said structure (18).

9. The storage and/or transport tank (2) according to any one of claims 6 to 8, comprising at least one sump (56) formed in the bottom wall (28) of the tank (2), the suction member (38) extending at least in part into the sump (56).

10. The storage and/or transport tank (2) according to the preceding claim, comprising a support (26) of the loading tower (12) which passes through the

bottom wall (28), the sump (56) being formed such that a center (X) of the said pump is at a distance (D) at least greater than 2.04 m from a center (F) of said support (26) of the loading tower (12).

11. The storage and/or transport tank (2) according to claim 10, wherein a center (C) of the unloading pipe (36) is positioned on any point of a semi-circle (52) centered on the center (F) of the support (26).

12. The storage and/or transport tank (2) according to any one of claims 6 to 11, wherein the top wall comprises an opening wherein the cover (16) is arranged so as to close the storage volume (6) of the tank (2).