

SEALED AND THERMALLY INSULATING TANK

Technical field

The invention relates to the field of sealed and thermally insulating tanks which have membranes for storing and/or transporting fluid, such as a liquefied gas.

5 Sealed and thermally insulating tanks with membranes are used in particular for the storage of liquefied natural gas (LNG), which is stored at atmospheric pressure at approximately -163°C . These tanks may be installed onshore or on a floating structure. In the case of a floating structure, the tank may be intended for the transport of liquefied natural gas or to receive liquefied natural
10 gas which is used as fuel for propelling the floating structure.

Technical background

The application WO2014/170588 discloses a sealed and thermally insulating tank for the storage of liquefied natural gas which is integrated in the double hull of a ship. Each tank wall comprises a multi-layer structure and
15 successively has, in the direction of the thickness, from the outer side to the inner side of the tank, a secondary thermally insulating barrier which is retained on a carrier structure, a secondary sealing membrane which rests against the secondary thermally insulating barrier, a primary thermally insulating barrier which rests against the secondary sealing membrane and a primary sealing membrane which is
20 intended to be in contact with the liquefied natural gas contained in the tank and which rests against the primary thermally insulating barrier.

In the above-mentioned document, the thermally insulating barrier comprises a plurality of primary insulating panels which are anchored on secondary insulating panels of the secondary thermally insulating barrier, using anchoring
25 devices. All the anchoring devices are provided with a stack of resilient washers which enables resilient anchoring of the primary insulating panels on the secondary insulating panels to be ensured. Such a resilient anchoring enables the primary insulating panels to be held against the secondary insulating panels whilst permitting slight relative movements of the primary insulating panels relative to the secondary
30 insulating panels. This enables the stresses which may be applied to the primary insulating panels and the secondary insulating panels in the anchoring zones to be limited. However, such a sealed tank is not completely satisfactory. In particular,

such anchoring devices require a large number of stacks of Belleville washers which increases the cost of the tank equipped with such anchoring devices and the complexity of the production thereof.

Summary

5 A notion on which the invention is based involves providing a sealed and thermally insulating tank in which the anchoring of the insulating panels is carried out in a simpler and more economic manner.

 According to an embodiment, the invention provides a sealed and thermally insulating tank for storing a fluid, comprising a tank wall which successively has in a
10 direction of the thickness of the tank wall, from the outer side to the inner side of the tank, a thermally insulating barrier which is intended to be anchored to a carrier structure and a sealing membrane which rests against the thermally insulating barrier,

 wherein the thermally insulating barrier comprises insulating panels of
15 parallelepipedal form which are juxtaposed and intended to be anchored to the carrier structure, the insulating panels having a base plate and an insulating packing, the base plate defining a support surface which protrudes laterally from the insulating packing, the support surface being turned toward the inner side of the tank, a wedge being arranged on the support surface, the wedge having an inner
20 surface which is turned toward the inner side of the tank,

 wherein anchoring devices which are intended to be fixed to the carrier structure between the insulating panels cooperate with the insulating panels, the anchoring devices being intended to retain the insulating panels against the carrier structure;

25 wherein at least one of the anchoring devices comprises a support member which has an outer face which is turned toward the wedge, the support member being configured so that the outer face applies support to the inner face of the wedge in the direction of the support surface;

 and wherein one from the wedge and the base plate has a thermal
30 contraction coefficient in the thickness direction of the tank wall greater than the thermal contraction coefficient of the anchoring device in the thickness direction and the other from the wedge and the base plate has a thermal contraction coefficient in

the thickness direction less than the thermal contraction coefficient of the anchoring device in the thickness direction.

As a result of these features, the assembly formed by the base panel and the wedge has a behavior in terms of thermal contraction close to that of the anchoring device. More specifically, the behavior in terms of thermal contraction of this assembly enables the cooperation between the wedge and the support member to be maintained in spite of the variations in temperature. In other words, this assembly is prevented from contracting more than the anchoring member in order to maintain the support of the anchoring device on the wedge. In this manner, the cooperation between the support member and the wedge is maintained in order to maintain the anchoring of the insulating panels on the carrier structure in a simple and reliable manner. In particular, the anchoring devices does not require the use of numerous resilient washers in order to maintain the anchoring of the insulating panels in spite of the deformations linked with the thermal contraction in the tank or the deformations of the carrier structure.

A thermal contraction coefficient of the anchoring device is intended to be understood to be the behavior in terms of thermal contraction of all of the constituent elements of the anchoring device in the region of the base plate and the wedge. In other words, this thermal contraction coefficient defines the thermal contraction behavior of the assembly formed by the constituent element(s) of the anchoring device over a portion of the anchoring device located substantially in the same thickness section of the tank wall as the base plate and the wedge. This thermal contraction coefficient of the anchoring device may be measured experimentally or calculated from the knowledge of the different constituent materials of all the elements which form the anchoring device.

According to other advantageous embodiments, such a tank may have one or more of the following features.

According to an embodiment, the thermal contraction coefficient of the wedge is less than the thermal contraction coefficient of the base plate.

According to an embodiment, the wedge and the base plate have a respective dimension in the thickness direction which is configured so that the support member applies, preferably continuously, the support to the inner face of the

wedge in the direction of the support surface in the event of a decrease of the temperature from the ambient temperature.

According to an embodiment, the dimensional variation of the anchoring device in the thickness direction of the tank wall is greater than the dimensional variation in the thickness direction of the assembly formed by the base plate and the wedge in the event of a change of temperature from 20°C to -163°C.

In other words, the outer face of the support member moves in the thickness direction of the tank wall more than the movement of the inner face of the wedge in the event of a temperature change in the tank. In this manner, the support of the support member on the wedge is maintained in spite of the temperature changes in the tank.

According to an embodiment, at ambient temperature the support member applies a support to the wedge in the direction of the support zone.

According to an embodiment, the difference in size variation difference in the thickness direction of the tank wall during a change of temperature from 20°C to -163°C between the anchoring member and the assembly formed by the base plate and the wedge is between 5.50E-05 mm and 9.69E-02 mm. Conventionally, "E-N" signifies 10^{-N} in this description.

In other words, the movement of the outer face of the support member is greater than a value of from 5.50E-05 mm to 9.69E-02 mm compared with the movement of the inner face of the wedge in the event of a temperature change in the tank from 20°C to -163°C.

According to an embodiment, the wedge is made of plywood. According to an embodiment, such a plywood wedge is arranged so as to have fibers which are orientated in a plane parallel with the thickness direction of the tank wall.

According to an embodiment, the base plate is made of plywood. According to an embodiment, the base plate of plywood is arranged so as to have fibers which are orientated in a plane perpendicular to the thickness direction of the tank wall.

According to an embodiment, the wedge has a thermal contraction coefficient in the thickness direction of the tank wall between $4\text{E-}06\text{K}^{-1}$ and $8\text{E-}06\text{K}^{-1}$, for example $5.50\text{E-}06\text{K}^{-1}$.

According to an embodiment, the base plate has a thermal contraction coefficient in the thickness direction of the tank wall between $3\text{E-}05\text{K}^{-1}$ and $4\text{E-}05\text{K}^{-1}$, for example $3.65\text{E-}05\text{K}^{-1}$.

According to an embodiment, the anchoring device has a thermal contraction coefficient in the thickness direction of the tank wall between $1.4\text{E-}05\text{K}^{-1}$ and $1.8\text{E-}05\text{K}^{-1}$, for example $1.6\text{E-}05\text{K}^{-1}$.

According to an embodiment, in a thickness direction of the tank wall, the base plate has a thickness of 9 mm and the wedge has a thickness between 17.6 mm and 68 mm.

10 According to an embodiment, the wedge has a constant cross-section in the direction of the thickness of the tank. According to an embodiment, the wedge rests on at least 50% of the support surface of the insulating panel.

According to an embodiment, the wedge is arranged on the support surface of two adjacent insulating panels so that the support member applies a support to the wedge in the direction of the support surfaces of the two adjacent insulating panels.

According to an embodiment, the thermally insulating barrier is a primary thermally insulating barrier, the insulating panels are primary insulating panels, the sealing membrane is a primary sealing membrane and the support member is a primary support member, the tank wall further comprising a secondary thermally insulating barrier and a secondary sealing membrane which are intended to be interposed between the primary thermally insulating barrier and the carrier structure.

According to another embodiment, at least one of the insulating panels comprises a cover plate and carrier webs which extend in the thickness direction of the tank wall between the base plate and the cover plate and which delimit a plurality of compartments which are filled with an insulating packing, such as perlite.

According to an embodiment, at least one of the insulating panels comprises a cover plate, the insulating packing being interposed between the base plate and the cover plate, the insulating panel further comprising an intermediate plate which is arranged between the base plate and the cover plate, the insulating packing comprising a first layer of insulating polymer foam which is sandwiched between the base plate and the intermediate plate and a second layer of insulating

polymer foam which is sandwiched between the intermediate plate and the cover plate.

According to an embodiment, recesses are provided in the layers of insulating polymer foam and in the intermediate plate and the cover plate so that the
5 base plate projects relative to the layers of insulating polymer foam and the intermediate plate and base plate, thus providing the support surface on the base plate.

According to an embodiment, the secondary thermally insulating barrier comprises a plurality of secondary insulating panels which are juxtaposed on the
10 carrier structure, the tank further comprising a plurality of anchoring members which are intended to anchor the secondary insulating panels on the carrier structure.

According to an embodiment, the primary insulating panels rest on the secondary sealing membrane, the anchoring device developing from the secondary sealing membrane. According to an embodiment, the anchoring device is fixed to an
15 anchoring member in the region of the secondary sealed membrane. In other words, the anchoring device and the base plate both develop, in the thickness direction of the tank wall, from the secondary sealing membrane.

According to an embodiment, the first layer of insulating polymer foam has, in each of the corner zones of the insulating panel, a cut-out which accommodates a
20 pillar which extends between the base plate and the intermediate plate. This enables the flattening and the creep of the foam to be limited.

According to an embodiment, the fluid is a liquefied gas, such as natural liquefied gas.

Such a tank may be part of a ground storage installation, for example, for
25 storing liquefied natural gas, or may be installed in a floating structure, which is coastal or in deep water, in particular a liquid natural gas tanker, a floating storage and regasification unit (FSRU), a floating production, storage and offloading installation (FPSO) and the like.

According to an embodiment, the invention also provides a tanker for
30 transporting a cryogenic fluid comprising a double hull and an above-mentioned tank arranged in the double hull.

According to an embodiment, the double hull comprises an internal hull which forms the carrier structure of the tank.

According to an embodiment, the invention also provides a method for loading or unloading such a tanker, in which a fluid is conveyed through insulated
5 pipes from or to a floating or ground-based storage installation to or from the tank of the tanker.

According to an embodiment, the invention also provides a transfer system for a fluid, the system comprising the above-mentioned tanker, insulated pipes which are arranged in order to connect the tank installed in the hull of the tank to a
10 floating or ground-based storage installation and a pump for impelling a fluid through the insulated pipes to or from the floating or ground-based storage installation to or from the tank of the tanker.

Brief description of the Figures

The invention will be better understood and other objectives, details,
15 features and advantages thereof will be appreciated more clearly from the following description of a number of specific embodiments of the invention, given purely by way of non-limiting example, with reference to the appended drawings, in which:

- **Figure 1** is a cut-away perspective view of a tank wall;
- **Figure 2** is a perspective view of a secondary insulating panel;
- 20 - **Figure 3** is a partial perspective view of a primary insulating panel;
- **Figure 4** is a perspective view of an anchoring device for the primary insulating panels and secondary insulating panels;
- **Figure 5** is a partial exploded view of the anchoring device of Figure 4 integrated in the tank wall of Figure 1;
- 25 - **Figure 6** is a schematic, perspective view of the detail of Figure 5 illustrating a first embodiment of the anchoring wedge of the primary panel;
- **Figure 7** is a plan view of Figure 5;
- **Figures 8 and 9** are schematic perspective and plan views of
30 details of a second embodiment of the anchoring wedge, respectively;

- **Figures 10 and 11** are schematic perspective and plan views of details of a third embodiment of the anchoring wedge respectively;
- **Figure 12** is a cut-away schematic illustration of a tank of a liquid natural gas tanker and a loading/unloading terminal of this tank;
- 5 - **Figure 13** is a cut-away, perspective view of a tank wall according to another embodiment;
- **Figure 14** is an enlarged view of the zone XIII of Figure 13, further showing a primary anchoring member according to an embodiment.

Detailed description of embodiments

10 Conventionally, the terms "external" and "internal" are used to define the relative position of one element relative to another, with reference to the inner side and the outer side of the tank.

Figure 1 illustrates the multi-layer structure of a wall 1 of a sealed and thermally insulating tank for storing a liquefied fluid, such as liquefied natural gas (LNG). Each wall 1 of the tank successively comprises, in the direction of the thickness, from the outer side to the inner side of the tank, a secondary thermally insulating barrier 2 which is retained on a carrier structure 3, a secondary sealing membrane 4 which rests against the secondary thermally insulating barrier 2, a primary thermally insulating barrier 5 which rests against the secondary sealing membrane 4 and a primary sealing membrane 6 which is intended to be in contact with the liquefied natural gas contained in the tank.

The carrier structure 3 may in particular be formed by the hull or the double hull of a tanker. The carrier structure 3 comprises a plurality of walls which define the general shape of the tank, generally of polyhedral form.

25 The secondary thermally insulating barrier 2 comprises a plurality of secondary insulating panels 7 which are anchored to the carrier structure 3 using anchoring devices 8 which will be described in detail below. The secondary insulating panels 7 are generally parallelepipedal and are arranged in parallel rows.

In relation to Figure 2, the structure of a secondary insulating panel 7 according to an embodiment can be seen. The secondary insulating panel 7 comprises in this instance three plates, that is to say, a base plate 9, an intermediate plate 10 and a cover plate 11. The base plate 9, intermediate plate 10

and cover plate 11 are, for example, produced from plywood. The secondary insulating panel 7 also comprises a first layer of insulating polymer foam 12 which is sandwiched between the base plate 9 and the intermediate plate 10 and a second layer of insulating polymer foam 13 which is sandwiched between the intermediate plate 10 and the cover plate 11. The first and the second layers of insulating polymer foam 12, 13 are adhesively bonded to the base plate 9 and intermediate plate 10 and to the intermediate plate 10 and cover plate 11, respectively. The insulating polymer foam may in particular be a foam based on polyurethane, optionally reinforced with fibers.

10 The first layer of insulating polymer foam 12 has, in the corner zones, cut-outs in order to allow the passage of corner pillars 14. The corner pillars 14 extend, in the region of the four corner zones of the secondary insulating panel 7, between the base plate 9 and the intermediate plate 10. The corner pillars 14 are fixed, for example, using staples or screws or adhesively bonded, to the base plate 9 and the intermediate plate 10 and optionally to the insulating polymer foam 12. The corner pillars 14 are, for example, made of plywood or of plastics material. The corner pillars 14 enable a portion of the compression load during service to be absorbed and enable the flattening and the creep of the foam to be limited. Such corner pillars 14 have a thermal contraction coefficient which is different from that of the first layer of insulating polymer foam 12. Therefore, when the tank is cooled, the deflection of the secondary insulating panel 7 is lower in the region of the corner pillars 14 than in the other zones. This further increases the effects of changes in level or steps in the region of the corner zones of the secondary insulating panels 7.

25 Furthermore, the secondary insulating panel 7 comprises recesses 15, 16 in the region of the corner zones thereof in order to receive anchoring devices 8 which will be set out in detail below. The secondary insulating panel 7 comprises, from the base plate 9 to the intermediate plate 10, a first recess 15 which is intended to enable the passage of a rod 17 of the anchoring device 8. Above the intermediate plate 10, the secondary insulating panel 7 comprises a second recess 16. The second recess 16 has dimensions greater than those of the first recess 15 so that the intermediate plate 10 extends beyond the second layer of insulating polymer foam 13 and the cover plate 11. In this manner, the intermediate plate 10 forms in the region of the corner zones of the secondary insulating panel 7 a support zone 18

which is intended to cooperate with a secondary support plate 19 of the anchoring device 8.

Furthermore, the cover plate 11 has a counterbore 20 in the region of these four corner zones. Each counterbore 20 is intended to receive a force distribution plate 21 of the anchoring device 8, described below. The counterbores 20 have a thickness which is substantially similar to that of the force distribution plate 21 so that the force distribution plate 21 is flush with the upper surface of the cover plate 11. The cover plate 11 also comprises grooves 22 for receiving the weld supports.

The structure of the secondary insulating panel 7 is described above by way of example. In another embodiment, therefore, the secondary insulating panels 7 are capable of having another general structure, for example, the one described in the document WO2012/127141. The secondary insulating panels 7 are thus produced in the form of a casing which comprises a base plate, a cover plate and carrier webs which extend, in the thickness direction of the tank wall 1, between the base plate and the cover plate and which delimit a plurality of compartments filled with an insulating packing, such as perlite, glass wool or rock wool.

In another embodiment, the secondary thermally insulating barrier comprises secondary insulating panels 7 which have at least two types of different structures, for example, the two structures mentioned above in accordance with their fitting zone in the tank. In this manner, in some zones of the tank wall 1, the adjacent secondary insulating panels 7 are likely to have different behaviors when they are subjected to thermal gradients, which is likely to amplify the phenomena of changes in level between the adjacent corners of the secondary insulating panels 7.

Returning to Figure 1, it can be seen that the secondary sealing membrane 4 comprises a continuous sheet of metal strakes 23 with raised edges. The strakes 23 are welded via their raised edges to parallel weld supports which are fixed in the grooves 22 provided in the cover plates 11 of the secondary insulating panels 7. The strakes 23 are, for example, produced from Invar®: that is to say, an alloy of iron and nickel whose expansion coefficient is typically between 1.2×10^{-6} and $2 \times 10^{-6} \text{ K}^{-1}$.

The primary thermally insulating barrier 5 comprises a plurality of primary insulating panels 24 which are anchored to the carrier structure 3 using the above-mentioned anchoring devices 8. The primary insulating panels 24 have a generally parallelepipedal shape. Furthermore, they have dimensions identical to those of the

secondary insulating panels 7 with the exception of their thickness in the thickness direction of the tank wall 1 which may be different, and in particular lower. Each of the primary insulating panels 24 is positioned in line with one of the secondary insulating panels 7, in alignment therewith in the thickness direction of the tank wall

5 1.

In relation to Figure 3, the structure of a primary insulating panel 24 according to an embodiment can be seen. The primary insulating panel 24 has a multi-layer structure similar to that of the secondary insulating panel 7 of Figure 2. Therefore, the primary insulating panel 24 successively comprises a base plate 25,

10 a first layer of insulating polymer foam 26, an intermediate plate 27, a second layer of insulating polymer foam 28 and a cover plate 29. The insulating polymer foam may in particular be a foam based on polyurethane, optionally reinforced with fibers.

The primary insulating panel 24 comprises recesses 30 in the region of the corner zones thereof so that the base plate 25 extends beyond the first layer of

15 insulating polymer foam 26, the intermediate plate 27, the second layer of insulating polymer foam 28 and the cover plate 29. In this manner, the base plate 25 forms a support zone 31 in the region of the corner zones of the primary insulating panel 24. This support zone 31 receives a wedge 32 which is described in greater detail below. In the embodiment illustrated in Figure 3, the wedge 32 has a similar shape

20 to that of the support zone 31. This wedge 32 is intended to cooperate with a primary support plate 33 of the anchoring device 8.

The base plate 25 comprises grooves 34 which are intended to receive the raised edges of the strakes 23 of the secondary sealing membrane 4. In the embodiment illustrated in Figures 1 and 3, the cover plate 29 also comprises

25 grooves 35 for receiving weld supports (not illustrated).

The structure of the primary insulating panel 24 is described above by way of example. In another embodiment, therefore, the primary insulating panels 24 are capable of having a different general structure, for example, that described in document WO2012/127141.

30 In another embodiment, the primary thermally insulating barrier 5 comprises primary insulating panels 24 which have at least two types of different structures, for example, the two above-mentioned structures, in accordance with their fitting zone in the tank.

Returning to Figure 1, it can be seen that the primary sealing membrane 6 comprises a continuous sheet of metal strakes 36 with raised edges. The strakes 33 are welded via their raised edges to parallel weld supports which are fixed in the grooves provided on the cover plates 29 of the primary insulating panels 24.

5 Although the description is carried out in the context of a primary sealing membrane 6 which is produced using metal strakes 36, the primary sealing membrane could be produced in accordance with other techniques. For example, the primary sealing membrane could be produced using undulating metal plates, as described, for example, in the document FR2691520.

10 As illustrated in Figure 1, the anchoring devices 8 are positioned in the region of the four corners of the primary insulating panels 24 and secondary insulating panels 7. Each stack of a secondary insulating panel 7 and a primary insulating panel 24 is anchored to the carrier structure 3 using four anchoring devices 8. Furthermore, each anchoring device 8 cooperates with the corners of four

15 adjacent secondary insulating panels 7 and the corners of four adjacent primary insulating panels 24.

In relation to Figures 4 and 5, the structure of an anchoring device 8 can be seen.

The anchoring device 8 comprises a socket 37 whose base is welded to the

20 carrier structure 3 in a position which corresponds to an undercut in the region of the corner zones of four adjacent secondary insulating panels 7. The socket 37 accommodates a nut (not illustrated) in which the lower end of a rod 17 is screwed. The rod 17 extends between the adjacent secondary insulating panels 7.

The rod 17 extends through a bore which is provided in an insulating

25 stopper 38 which is intended to ensure a continuity of the secondary thermal insulation in the region of the anchoring device 8. The insulating stopper 38 has, along a plane orthogonal to the thickness direction of the tank wall 1, a cross-shaped cross-section which is defined by four branches. Each of the four branches is inserted into a gap which is provided between two of the four adjacent secondary

30 insulating panels 7.

The anchoring device 8 further comprises a secondary support plate 19 which is supported in the direction of the carrier structure 3 against the support zone 18 provided in each of the four adjacent secondary insulating panels 7 in order to

retain them against the carrier structure 3. In the embodiment illustrated, the secondary support plate 19 is accommodated in the second recess 16 provided in the second layer of insulating polymer foam 13 of each of the secondary insulating panels 7 and is supported against a zone of the intermediate plate 10 which forms the support zone 18.

A nut 39 cooperates with a thread which is provided in the region of the upper end of the rod 17 in order to ensure retention of the secondary support plate 19 on the rod 17.

In the embodiment illustrated, the anchoring device 8 further comprises one or more resilient washers 40, of the Belleville type. The resilient washers 40 are fitted onto the rod 17 between the nut 39 and the secondary support plate 19 which enables resilient anchoring of the secondary insulating panels 7 on the carrier structure 3. Furthermore, a locking member 41 is advantageously welded locally to the upper end of the rod 17 in order to fix the nut 39 in position on the rod 17.

The anchoring device 8 further comprises a force distribution plate 21, an upper plate 42 and a spacer 43 which are fixed to the secondary support plate 19.

The force distribution plate 21 is accommodated in each of the counterbores 20 provided in the cover plates 11 of the four adjacent secondary insulating panels 7. The force distribution plate 21 is therefore positioned between the cover plates 11 of each of the four secondary insulating panels 7 and the secondary sealing membrane 4. The force distribution plate 21 is intended to attenuate the phenomena of changes in level between the corners of the adjacent secondary insulating panels 7. Therefore, the force distribution plate 21 enables the stresses which may be applied to the secondary sealing membrane 4 and the primary insulating panels 24 to be distributed in line with the corner zones of the secondary insulating panels 7. Consequently, the force distribution plate 21 enables the phenomena of punching of the base plates 25 of the primary insulating panels 24 and punching and settlement of the layers of insulating polymer foam 26, 28 of the primary insulating panels 24 in line with the corner zones of the secondary insulating panels 7 to be limited.

The force distribution plate 21 is advantageously produced from a metal selected from stainless steel, alloys of iron and nickel, such as invar, whose expansion coefficient is typically between 1.2×10^{-6} and $2 \times 10^{-6} \text{ K}^{-1}$ and the alloys of

iron and manganese whose expansion coefficient is less than $2 \times 10^{-5} \text{ K}^{-1}$, typically in the order of $7 \times 10^{-6} \text{ K}^{-1}$. The force distribution plate 21 has a thickness between 1 and 7 mm, preferably between 2 and 4 mm, for example, in the order of 3 mm. The force distribution plate 21 advantageously has a square shape whose dimension for one side is between 100 and 250 mm, for example, in the order of 150 mm.

The upper plate 42 is arranged below the force distribution plate 21 and has dimensions smaller than those of the force distribution plate 21 so that the force distribution plate 21 completely covers the upper plate 42. The upper plate 42 is accommodated in the recesses 16 provided in the corner zones of the secondary insulating panels 7, in line with the support zones 17, that is to say, in the embodiment illustrated in Figure 5, in the recesses 16 provided in the second layer of insulating polymer foam 13 of the secondary insulating panels 7.

The upper plate 42 has a threaded bore 44 in which a threaded base of a pin 45 which is intended to anchor the primary insulating panels 24 is mounted. In order to enable the pin 45 to be fixed to the upper plate 42, the force distribution plate 21 also comprises a bore, provided opposite the threaded bore of the upper plate 42, and thus enabling the pin 45 to extend through the force distribution plate 21.

The upper plate 42 has a generally rectangular parallelepipedal shape which comprises two large opposing faces which are parallel with the carrier structure 3 of the wall 1 and four faces which connect the two large faces and which extend parallel with the thickness direction of the tank wall 1. In the embodiment illustrated in Figure 4, the four faces which extend parallel with the thickness direction of the tank wall 1 are connected by means of fillets 46. This enables the presence of an acute angle to be avoided and contributes to further limiting the phenomena of punching of the base plates 25 of the primary insulating panels 25 while limiting the concentrations of stresses.

In an embodiment, the upper plate 42 and the force distribution plate 21 are formed in a single integral component.

The spacer 43 is arranged between the secondary support plate 19 and the upper plate 42 and thus serves to maintain a spacing between the secondary support plate 19 and the upper plate 42. In the embodiment illustrated in Figure 4, the spacer 43 has chamfers 47 in order to be within the spatial requirement, when

viewed in the thickness direction of the tank wall 1, of the upper plate 42. In other words, the upper plate 42 completely covers the spacer 43.

In the embodiment illustrated in Figure 5, the anchoring device 8 differs from the anchoring device 8 illustrated in Figure 4 in that the spacer 43 has a cross-section, in a plane orthogonal relative to the thickness direction of the tank wall 1, without any chamfers, which enables the production thereof to be facilitated. In a similar manner (not illustrated), the upper plate 2 could not have any fillets.

The spacer 43 is advantageously made of wood which enables the thermal bridge toward the carrier structure 3 to be limited in the region of the anchoring device 8. The spacer 43 is in the form of an inverted U in order to define a central housing 48 between the two branches of the U. The central housing 48 receives the upper end of the rod 17, the locking member 41, the nut 39 and the resilient washers 40. The spacer 43 is also accommodated in the recess 16 provided, in line with the support surface 18.

The locking member 41 has a square or rectangular shape whose diagonal has a dimension greater than the dimension of the central housing 48 between the two branches of the U, which enables the rod 17 to be blocked in terms of rotation relative to the spacer 43 and thus prevents the rod 17 from becoming disengaged from the nut 39.

In order to fix the force distribution plate 21, the upper plate 42, the spacer 43 and the secondary support plate 19 to each other, the above-mentioned elements are each provided with two bores through each of which a screw 49, 50 extends. The bores provided in the secondary support plate 19 each have a thread which cooperates with one of the screws 49, 50 in order to ensure the fixing of the above-mentioned elements to each other.

Furthermore, the pin 45 extends through a drill hole which is provided through a strake 23 of the secondary sealing membrane 4. The pin 45 has a collar 51 which is welded at the periphery thereof, around the drill hole, in order to ensure the sealing of the secondary sealing membrane 4. The secondary sealing membrane is therefore sandwiched between the collar 51 of the pin 45 and the force distribution plate 21.

The anchoring device 8 also comprises a primary support plate 33 which is supported in the direction of the carrier structure 3 on the wedge 32. In the

embodiment illustrated in Figures 3 and 5, the corners of each primary insulating panel 24 comprise a respective wedge 32, the wedge 32 covering the support zone 31 formed by the base plate 25. In this manner, the primary support plate 33 presses on the wedges 32 of four adjacent primary panels 24, the wedge 32 being supported against the support zones 31 provided in the corresponding corners of the four adjacent primary insulating panels 24 in order to retain the primary insulating panels 24 against the carrier structure 3. In the embodiment illustrated, each support zone 31 is formed by a protruding portion of the base plate 25 of one of the primary insulating panels 24. The primary support plate 33 is accommodated in the recesses 30 provided in the corner zones of the primary insulating panels 24, in line with the support zones 31.

A nut 52 cooperates with a thread provided in the region of the upper end of the pin 45 in order to ensure the fixing of the primary support plate 33 to the pin 45. In the embodiment illustrated, the anchoring device 8 further comprises a single resilient washer 53, of the Belleville type, which is fitted on the pin 45 between the nut 52 and the primary support plate 33.

Furthermore, an insulating stopper 54, illustrated in Figure 5, is inserted above the anchoring device 8 in the recesses 30 provided in the region of the corner zones of four adjacent primary insulating panels 24 in order to ensure a continuity of the primary thermally insulating barrier 5 in the region of the anchoring device 8. Furthermore, a closure plate (not illustrated) of wood enables a flatness of the support surface of the primary sealing membrane 6 to be ensured. The closure plate is received in counterbores provided in the region of the corner zones of the primary insulating panels 24.

In order to maintain an anchoring of the primary insulating panels 24 on the carrier structure 3, it is necessary to maintain the support of the primary support plate 33 on the wedges 32 in spite of the behavior differences of the anchoring device 8 and the primary insulating panels 24. In particular, it is necessary to maintain this support in spite of the behavior differences in terms of thermal contraction of the anchoring device 8 and the primary insulating panels 24.

In order to maintain the support of the primary support plate 33 on the wedges 32, the embodiment illustrated in Figure 5 makes provision for the use of a wedge 32 and a base plate 25 which are selected to have a thermal contraction

coefficient in the thickness direction of the tank wall and which are adapted so that the assembly formed by the base plate 25 and the wedge 32 has an overall thermal contraction coefficient which is less than that of the anchoring device 8. In the remainder of the description, the references to the thermal contraction coefficient
5 are made for a thermal contraction coefficient in a thickness direction of the tank wall.

In the context of a base plate 25 which is produced from a material which has a thermal contraction coefficient greater than the thermal contraction coefficient of the pin 45 and the primary support plate 33, the wedge 32 is selected in order to
10 have a thermal contraction coefficient less than the thermal contraction coefficient of the pin 45 and the primary support plate 33. Furthermore, the base plate 25 and the wedge 32 are sized so that the assembly formed by the base plate 25 and the wedge 32 has an overall thermal contraction coefficient which is less than, preferably slightly less than, and ideally equal to the overall thermal contraction
15 coefficient of the pin 45 and the primary support plate 33. In this manner, an outer surface of the primary support plate 33 is kept supported on an inner surface of the wedge 32 in the event of a temperature change in the tank.

This is because, under the action of this temperature change, the movement of the outer surface of the primary support plate 33 is slightly greater
20 than, ideally substantially identical to the movement of the outer surface of the wedge 32 as a result of the fact that the assembly formed by the base plate 25 and the wedge 32 has an overall thermal contraction coefficient less than the thermal contraction coefficient of the pin 45 and the primary support plate 33.

This thermal contraction behavior therefore enables the support of the
25 primary support plate 33 on the wedge 32 to be maintained in a reliable and stable manner in spite of the absence or limited number of Belleville washers 50 on the pin 45.

In an example, the base plate 25 of the primary insulating panels 24 is produced from plywood with fibers which are orientated in a plane parallel with the
30 carrier structure 3 and a thickness of 9 mm. Such a base plate 25 thus has a thermal contraction coefficient in the order of $3.65\text{E-}05$. In the context of a pin 45 which has a thermal contraction coefficient in the order of $1.60\text{E-}05$, the wedge 32

can be produced so as to have a thermal contraction coefficient in the order of $5.50\text{E-}06$.

Such a wedge 32 is, for example, produced from plywood but, in contrast to the base plate 25, has an orientation of fibers of the plywood perpendicular to the porous structure, that is to say, in a plane parallel with the thickness direction of the tank wall.

In this instance, the wedge 32 thus has a thickness greater than 17.6 mm, and the pin 45 and the primary support plate 33 are sized so that the outer surface of the primary support plate 33 is positioned at 26.6 mm from the outer face of the base plate. This is because, in such an example, a temperature variation of 90°C , the movement difference between the outer surface of the primary support plate 33 and the inner surface of the wedge 32 is in the order of $2.70\text{E-}05$, the outer surface of the primary support plate 33 moving slightly more than the inner surface of the wedge 32 so that the support of the primary support plate 33 on the wedge 32 is maintained in spite of the temperature change. In the same manner, for a temperature variation of 183°C , the movement difference between the outer surface of the primary support plate 33 and the inner surface of the wedge 32 is in the order of $5.49\text{E-}05$, the outer surface of the primary support plate 33 moving slightly more than the inner surface of the wedge 32 so that the support of the primary support plate 33 on the wedge 32 is maintained in spite of the temperature change.

Thicknesses of the wedge 32 of 18, 19 or 20 mm, and a pin 45 and a primary support plate 33 which are sized so that the outer surface of the primary support plate is at a distance of 27, 28 or 29 mm, respectively, would also enable the locking of the primary support plate 33 on the wedge 32 to be maintained.

In order not to damage the wedge 32 and/or the base plate 25, however, the assembly formed by the base plate 25 and the wedge 32 must not have an overall contraction coefficient too far away from the thermal contraction coefficient of the assembly formed by the pin 45 and the primary support plate 33. This is because an excessively large difference of thermal contraction coefficient could bring about a movement and therefore an excessively high support of the primary support plate 33 on the wedge 32.

In this manner, in the example, given above by way of example, of a base plate 25 of plywood of 9 mm thickness with a thermal contraction coefficient of

3.65E-05 and a pin 45 with a thermal contraction coefficient of 1.60E-05, the wedge 32 with a thermal contraction coefficient of 5.50E-05 must not have a thickness greater than 68 mm at the risk of the primary support plate 33 applying an excessively powerful support. In other words, in this embodiment the wedge 32 must
 5 have a thickness between 17.6 mm and 68 mm in order to maintain the support of the primary support plate 33 without damaging the base plate 25.

In this manner, the wedge 32 is made from a material which is selected and/or arranged in order to obtain a wedge 32 which has a thermal contraction coefficient in the thickness direction of the tank wall less than that of the base plate
 10 25 on which it rests. Furthermore, this wedge 32 is sized in the thickness direction of the tank wall so that the assembly formed by the base plate 25 and the wedge 32 has a thermal contraction behavior close to that of the anchoring device 8. More specifically, the thermal contraction behavior of this assembly enables the cooperation between the wedge 32 and the primary support plate 33 to be
 15 maintained in spite of the temperature variations, that is to say, preventing this assembly from contracting more than the anchoring device 8.

Figure 6 shows a production variant of the wedge 32 in which the wedge 32 is sized so as to cover collectively two support zones 31 of two adjacent primary insulating panels 24. Such a wedge 32 enables assembly operations to be limited in
 20 the tank and therefore facilitates the production of the tank. This wedge 32 has a central recess 55 which enables the passage of the pin 45.

Furthermore, as illustrated in Figure 7, this wedge 32 is sized so as to preserve a space between the first layer of insulating polymer foam 26 and the wedge 32, enabling the circulation of gas in the primary thermally insulating barrier.
 25 In other words, the wedge 32 has such dimensions that it does not completely cover the support zones 31 of the adjacent primary insulating panels 24 in order to preserve a space which enables the circulation of gas, such as an inert gas in the primary thermally insulating barrier whilst ensuring adequate cooperation with the primary support plate 33 and with the support zones 31 in order to enable the
 30 anchoring of the primary insulating panels 24.

Figures 8 to 11 show other embodiments of the wedge 32 which also enable the circulation of gas in the primary thermally insulating barrier by providing spaces between the wedge 32 and the first layer of insulating polymer foam 26.

Figure 13 illustrates a tank wall 101 according to a second embodiment. The elements which are identical or similar to the elements of Figures 1 to 11 have the same reference numeral as these increased by 100 and will be described only if they are different.

5 The embodiment illustrated in Figures 13 and 14 differs from the embodiment illustrated in Figures 1 to 5 in that the primary insulating panels 124 are superimposed in an offset manner relative to the secondary insulating panels 107. In this manner, the corner zones of the primary insulating panels 124 are not located in line with the corner zones of the secondary insulating panels 107 but instead in line
10 with a central portion of the cover plate 111 of corresponding secondary insulating panels 107.

In the embodiment illustrated, the primary insulating panels 124 are offset with respect to the secondary insulating panels 107 in the two directions of the plane by half of the length of a secondary insulating panel 107. The amplitude of the offset
15 could be different and the corner zones of the primary insulating panels 124 could be elsewhere on the cover plate 111 of a secondary insulating panel 107 but preferably remote from the raised edges of the strakes 123 so as not to interfere with them. The amplitude of the offset may be different in the two directions of the plane.

20 Furthermore, in the embodiment illustrated in Figures 13 and 14, the secondary insulating panels 107 and primary insulating panels 124 differ from the secondary insulating panels 7 and primary insulating panels 24 described above in that they do not comprise an intermediate plate 10, 27. In this manner, a secondary insulating panel 107 comprises a base plate 109, a secondary layer of insulating
25 polymer foam 156 and a cover plate 111. In the same manner, a primary insulating panel 124 comprises a base plate 125, a primary layer of insulating polymer foam 157 and a cover plate 129. Furthermore, the base plate 109 extends beyond the secondary layer of insulating polymer foam 156 and the cover plate 111 at the sides of the secondary insulating panels 107.

30 In this second embodiment, the anchoring devices 8 are separated into two separate portions, a first portion which forms a secondary retention member 158 which cooperates with secondary insulating panels 107 and a second portion which forms a primary retention member 159 which cooperates with primary insulating

panels 124. As a result of the offset of the corner zones of the primary insulating panels 124 relative to the corner zones of the secondary insulating panels 107, the secondary retention members 158 are separated and offset from the primary retention members 159.

5 The secondary retention member 158 may be produced in different manners. For example, the secondary retention member 158 may comprise a threaded pin which is anchored to the carrier structure on which a secondary support plate is mounted and is retained on the pin by a nut. This secondary support plate is then supported on the base plate 109 of the secondary insulating panel 107,
10 directly or via a wedge which rests on the protruding portion of the base plate 109. An insulating stopper in order to ensure the continuity of the thermal insulation can be inserted into the vent formed by the recesses of the adjacent secondary insulating panels 107. In the same manner, a closure plate, for example, of plywood, may be accommodated in a counterbore of the cover plate 111 of the adjacent
15 secondary insulating panels 107 in order to ensure the continuity of the support surface formed by the cover plates 111.

In a production variant which is not illustrated, the secondary insulating panels 107 are identical to the secondary insulating panels 7 described above. In this variant, the secondary retention member 158 may have a similar structure to
20 that described above for the anchoring device 8 from which all the elements arranged above the force distribution plate 21 have been removed. In this instance, the force distribution plate 21 and the counterbore 20 intended to receive it may also be eliminated.

There may be various numbers of secondary retention members 158
25 ranging, for example, from 2 to 5 per secondary insulating panel 107 and placed, for example, at the corners of the secondary insulating panels 107 and/or in a gap between two secondary insulating panels 107 either in the first direction or in the second direction. Other embodiments of the secondary retention member are described in WO-A-2013093262.

30 In Figure 14, the primary retention member 159 comprises an anchoring plate 160, for example, having a square or circular contour, which is fixed in a counterbore provided in the surface of the cover plate 111 which is turned toward the secondary layer of insulating polymer foam 156, for example, by means of

adhesive bonding. The anchoring plate 160 has a tapped hole which opens at the upper surface of the cover plate 111, that is to say, on the surface of the cover plate 11 turned toward the inner side of the tank. A pin 145 which is identical to the pin 45 described above is screwed into the tapped hole of the plate 160.

5 Furthermore, the primary retention member 159 has features similar to those described above with reference to Figures 1 to 5 for the portions of the anchoring device 8 which cooperate with the pin 45. In this manner, the primary retention member 159 comprises a primary support plate which is retained on the pin 145 by a nut and, optionally, a resilient washer. This primary retention member
10 159 cooperates with the base plate 125 and a wedge in a similar manner to that described above between, on the one hand, the anchoring device 8 and, on the other hand, the base plate 25 and the wedge 32. In other words, the primary retention member 159, on the one hand, and the base plate 125 and the wedge, on the other hand, have selected thermal contraction coefficients and are sized in order
15 to maintain the support of the primary support plate of the primary retention member 159 on the wedge under the action of the temperature changes in the tank.

With reference to Figure 12, a cut-away view of a liquid natural gas tanker 70 shows a sealed and insulated tank 71 which is of generally prismatic form and which is mounted in the double hull 72 of the tanker. The tank wall 71 comprises a
20 primary sealed barrier which is intended to be in contact with the liquid natural gas contained in the tank, a secondary sealed barrier which is arranged between the primary sealed barrier and the double hull 72 of the tanker and two insulating barriers which are arranged between the primary sealed barrier and the secondary sealed barrier and between the secondary sealed barrier and the double hull 72,
25 respectively.

In a manner known per se, charging/discharging pipes 73 arranged on the upper bridge of the tanker can be connected, using appropriate connectors, to a sea or port terminal in order to transfer a load of LNG to or from the tank 71.

Figure 12 shows an example, of a sea terminal comprising a loading and
30 unloading station 75, an underwater pipe 76 and a ground-based installation 77. The loading and unloading station 75 is a fixed off-shore installation comprising a movable arm 74 and a tower 78 which supports the movable arm 74. The movable arm 74 carries a bundle of insulated flexible pipes 79 which can be connected to the

loading/unloading pipes 73. The orientable movable arm 74 adapts to all the gauges of tankers. A connection pipe which is not illustrated extends inside the tower 78. The loading and unloading station 75 enables the liquid natural gas tanker 70 to be loaded and unloaded from/to the ground-based installation 77. This installation
5 comprises liquefied gas storage tanks 80 and connection pipes 81 which are connected via the underwater pipe 76 to the loading or unloading station 75. The underwater pipe 76 enables the liquefied gas to be transferred between the loading or unloading station 75 and the ground-based installation 77 over a large distance, for example, 5 km, which enables the liquid natural gas tanker 70 to be kept at a
10 great distance from the coast during the loading and unloading operations.

In order to produce the pressure required to transfer the liquefied gas, on-board pumps are used in the tanker 70 and/or pumps with which the ground-based installation 77 is equipped and/or pumps with which the loading and unloading station 75 is equipped.

15 Although the invention has been described in connection with several specific embodiments, it is self-evident that it is by no means limited thereto and that it comprises all the technical equivalents of the means described and the combinations thereof if they fall within the scope of the invention.

The use of the verb "have", "comprise" or "include" and the conjugated
20 forms thereof does not exclude the presence of elements or steps other than those set out in a claim.

In the claims, any reference numeral in brackets should not be interpreted to be a limitation of the claim.

CLAIMS

1. A sealed and thermally insulating tank for storing a fluid, comprising a tank wall (1, 101) which successively has in a direction of the thickness of the tank wall, from the outer side to the inner side of the tank, a thermally
5 insulating barrier (5, 105) which is intended to be anchored to a carrier structure (3, 103) and a sealing membrane (6, 106) which rests against the thermally insulating barrier (5, 105),
 wherein the thermally insulating barrier (5, 105) comprises insulating panels (24, 124) of parallelepipedal form which are juxtaposed and intended to be anchored to
10 the carrier structure (3, 103), the insulating panels (24, 124) having a base plate (25, 125) and an insulating packing (26, 28, 157), the base plate (25, 125) defining a support surface (31) which protrudes laterally from the insulating packing (26, 28, 157), the support surface (31) being turned toward the inner side of the tank, a wedge (32) being arranged on the support surface (31), the wedge (32) having an
15 inner surface which is turned toward the inner side of the tank,
 wherein anchoring devices which are intended to be fixed to the carrier structure (3, 103) between the insulating panels (24, 124) cooperate with the insulating panels (24, 104), the anchoring devices being intended to retain the insulating panels (24, 124) against the carrier structure (3, 103);
20 wherein at least one of the anchoring devices (45, 145, 159) comprises a support member (33) which has an outer face which is turned toward the wedge (32), the support member (33) being configured so that the outer face applies support to the inner face of the wedge (32) in the direction of the support surface (31),
 and wherein one from the wedge (32) and the base plate (25) has a thermal
25 contraction coefficient in the thickness direction of the tank wall greater than the thermal contraction coefficient of the anchoring device (45, 145, 159) in the thickness direction and the other from the wedge (32) and the base plate (25) has a thermal contraction coefficient in the thickness direction less than the thermal
30 direction.

2. The tank as claimed in claim 1, wherein the thermal contraction coefficient of the wedge (32) is less than the thermal contraction coefficient of the base plate (25, 125).

3. The tank as claimed in one of claims 1 to 2, wherein the wedge
5 (32) and the base plate (25, 125) have a respective dimension in the thickness direction which is configured so that the support member (33) applies the support to the inner face of the wedge (32) in the direction of the support surface (31) in the event of a decrease of the temperature from the ambient temperature.

4. The tank as claimed in one of claims 1 to 3, wherein the
10 dimensional variation of the anchoring device (45, 145, 159) in the thickness direction of the tank wall is greater than the dimensional variation in the thickness direction of the assembly formed by the base plate (25, 125) and the wedge (32) in the event of a change of temperature from 20°C to -163°C.

5. The tank as claimed in one of claims 1 to 4, wherein the difference
15 in size variation difference in the thickness direction of the tank wall during a change of temperature from 20°C to -163°C between the anchoring member (45, 145, 159) and the assembly formed by the base plate (25, 125) and the wedge (32) is between 5.50E-05 mm and 9.69E-02 mm.

6. The tank as claimed in one of claims 1 to 5, wherein the wedge
20 (32) is made of plywood and is arranged so as to have fibers which are orientated in a plane parallel with the thickness direction of the tank wall,
and wherein the base plate (25, 125) is made of plywood and is arranged so as to have fibers which are orientated in a plane perpendicular to the thickness direction of the tank wall.

25 7. The tank as claimed in one of claims 1 to 6, wherein the wedge (32) has a thermal contraction coefficient in the thickness direction of the tank wall between $4\text{E-}06\text{K}^{-1}$ and $8\text{E-}06\text{K}^{-1}$.

8. The tank as claimed in one of claims 1 to 7, wherein the base plate
30 (25, 125) has a thermal contraction coefficient in the thickness direction of the tank wall between $3\text{E-}05\text{K}^{-1}$ and $4\text{E-}05\text{K}^{-1}$.

9. The tank as claimed in one of claims 1 to 8, wherein the anchoring device (45, 145, 145) has a thermal contraction coefficient in the thickness direction of the tank wall between $1.4\text{E-}05\text{ K}^{-1}$ and $1.8\text{E-}05\text{ K}^{-1}$.

10. The tank as claimed in one of claims 1 to 9, wherein, in a thickness
5 direction of the tank wall, the base plate (25, 125) has a thickness of 9 mm and the wedge has a thickness between 17.6 mm and 68 mm.

11. The tank as claimed in one of claims 1 to 10, wherein the wedge (32) rests on at least 50% of the support surface (31) of the insulating panel (24, 124).

10 12. The tank as claimed in one of claims 1 to 11, wherein the wedge (32) is arranged on the support surface (31) of two adjacent insulating panels (24, 124) so that the support member (33) applies a support to the wedge (32) in the direction of the support surfaces (31) of the two adjacent insulating panels (24, 124).

13. The tank as claimed in one of claims 1 to 12, wherein the thermally
15 insulating barrier is a primary thermally insulating barrier, the insulating panels are primary insulating panels, the sealing membrane is a primary sealing membrane and the support member (33) is a primary support member, the tank wall further comprising a secondary thermally insulating barrier and a secondary sealing membrane which are intended to be interposed between the primary thermally
20 insulating barrier and the carrier structure.

14. The tank as claimed in one of claims 1 to 13, wherein at least one of the insulating panels comprises a cover plate, the insulating packing being interposed between the base plate and the cover plate, the insulating panel further comprising an intermediate plate which is arranged between the base plate and the
25 cover plate, the insulating packing comprising a first layer of insulating polymer foam which is sandwiched between the base plate and the intermediate plate and a second layer of insulating polymer foam which is sandwiched between the intermediate plate and the cover plate,

and wherein recesses are provided in the layers of insulating polymer foam
30 and in the intermediate plate and the cover plate so that the base plate projects relative to the layers of insulating polymer foam and the intermediate plate and base plate, thus providing the support surface on the base plate.

15. A tanker (70) for transporting a fluid, the tanker comprising a double hull (72) and a tank (71) as claimed in one of claims 1 to 14 arranged in the double hull (72).

16. A method for loading or unloading a tanker (70) as claimed in
5 claim 15, wherein a fluid is conveyed through insulated pipes (73, 79, 76, 81) from or to a floating or ground-based storage installation (77) to or from the tank of the tanker (71).

17. A transfer system for a fluid, the system comprising a tanker (70)
as claimed in claim 15, insulated pipes (73, 79, 76, 81) which are arranged in order
10 to connect the tank (71) installed in the hull of the tank to a floating or ground-based storage installation (77) and a pump for impelling a fluid through the insulated pipes to or from the floating or ground-based storage installation to or from the tank of the tanker.